APPENDIX B

BIOASSAY BATCHING AND SAMPLE SELECTION MEMOS

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APPENDIX B1

MEMORANDUM TO EPA FROM TAI REGARDING SHORT-TERM BIOASSAY SAMPLE BINNING AND PROPOSED BATCHING (DECEMBER 11, 2013)

MEMORANDUM

TO:	KRIS MCCAIG TECK AMERICAN INCORPORATED	DATE:	DECEMBER 11, 2013
FROM:	MARK VELLEUX	RE:	PRELIMINARY UCR PHASE 2 SEDIMENT STUDY SHORT-TERM BIOASSAY SAMPLE BINNING AND PROPOSED BATCHING
CC:		FILE:	UCR TASK D-94

Preliminary chemistry data for recently completed Phase 2 sediment sampling efforts conducted by Teck American Incorporated (TAI) to support toxicity assessments (hereafter, "Teck 2013 SedTox study" or "Study") for the Upper Columbia River (UCR) site were evaluated to bin samples collected at planned bioassay stations (or associated reserve stations). Binning results were used to place samples into proposed batches for subsequent short-term bioassays. A brief summary of the binning and batching processes follows.

Sediment Sample Binning

As previously described in the March 2013 Final Phase 2 sediment study quality assurance project plan (QAPP), preliminary analytical chemistry results were used to place sediment samples into "high", "medium", and "low" bins based on three characteristics: (i) zinc-to-vanadium ratio (ZnV); (ii) total organic carbon content (TOC); and (iii) mean Probable Effects Concentration Quotient (mPECQ) as determined using four metals of primary interest (i.e., cadmium, copper, lead, and zinc) ("mPECQ4"). Thresholds between high, medium, and low bins for each of these three characteristics reflect the underlying probability distributions of the entire dataset for the UCR and are consistent with prior descriptions of the binning process. Bin thresholds are presented in Table 1. These thresholds define a total of 27 possible categories (i.e., three properties that have three bins each). Those 27 categories were combined into 10 distinct sediment groups as presented in Table 2. Sediments were successfully collected at 70 stations intended for bioassay analyses. Analytical results for stations where duplicate samples were collected were averaged prior to binning. For further reference during the sampling batching process, mPECQ8 values (i.e., mPECQ values calculated using all eight metals for which PECs exist) were also tabulated for each station.

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Table 1. Sediment characteristics and bin thresholds.

Characteristic	***Low***	***Medium***	***High***
ZnV	< 10	10 – 50	> 50
TOC (mg/kg)	< 5,000	5,000 – 10,000	> 10,000
mPECQ4	< 0.2 (very low < 0.1)	0.2 – 2	> 2 (very high > 5)

Notes: (1) mPECQ values were estimated based on concentrations of cadmium, copper, lead, and zinc; (2) for reference, the mPECQ4 attribute of sediments was further subdivided into very low (mPECQ4 < 0.1) and very high (mPECQ4 > 5) bins.

Table 2. Sediment binning, corresponding categories, and characteristic groups.

Category	***ZnV***	***TOC***	***mPECQ4***	***Group***	***Predominant mPECQ4***
1	High	High	High	1	High
2	High	High	Med		
3	High	High	Low		
4	High	Med	High	2	High
5	High	Med	Med		
6	High	Med	Low		
7	High	Low	High	3	High
8	High	Low	Med		
9	High	Low	Low		
10	Med	High	High	4	Med
11	Med	High	Med		
12	Med	High	Low		
13	Med	Med	High	5	Med
14	Med	Med	Med		
15	Med	Med	Low		
16	Med	Low	High	6	Med
17	Med	Low	Med		
18	Med	Low	Low		
19	Low	High	High	7	Med
20	Low	High	Med		
21	Low	High	Low	IR1	Low
22	Low	Med	High	8	Med
23	Low	Med	Med		
24	Low	Med	Low	IR2	Low
25	Low	Low	High	9	Med
26	Low	Low	Med		
27	Low	Low	Low	IR3	Low

Notes: (1) Predominant mPECQ indicates the mPECQ bin expected to occur most frequently within a sediment group, while the exact mPECQ bin of any sample will be indicated by its sediment category; (2) the IR1, IR2, and IR3 categories comprise a "reference group" and represent sediment categories with low ZnV, low or very low mPECQ4, and a range of TOC contents; reference stations typically fall into these categories; (3) color-coding used in this table is intended as a visual aid to help reviewers distinguish between groups.

Proposed Short-Term Bioassay Sample Batching

It is our understanding that the bioassay laboratory has the capacity to test sediments from up to 12 individual stations at one time. Given this constraint, samples will need to be processed in six (6) batches. Samples were placed into proposed batches in a randomized manner such that each batch would contain samples spanning the spectrum of characteristic ZnV, TOC, and mPECQ4 values. Thus, each batch contains samples that fall into each of sediment groups (and bin categories) in the dataset and those samples span the spectrum of metal concentrations and TOC values. Because there are 70 stations to batch and the bioassay laboratory can process a total of 72 samples across the six batches, the batching approach placed 11 samples into Batch 1, 12 samples each into Batches 2-5, and 11 samples into Batch 6 based on best professional judgment that each batch should also have the same number of samples to the greatest extent practical.

Breakdowns of sediment characteristics (ZnV, TOC, mPECQ4), associated bins, sediment category, and sediment group, along with mPECQ8 values, for each station are presented in the attached tables. The first table presents binning and proposed batches with samples sorted based on sediment group. This sorting is intended to facilitate understanding how samples within any sediment group would be processed. The second table uses the identical set of information to present binning and proposed batches with samples sorted based on proposed bioassay batch. This sorting is intended to facilitate understanding how each proposed batch reflects the overall spectrum of sediments to be processed within each batch.

Should you have any questions, please let me know.

Station Type	sum_sample_id	znv	toc (%)	toc (mg/kg)	mpecq4	mpecq8	ZnV Bin	TOC Bin	mPECQ4 Bin	Category	Group	Proposed Batch
Bioassay	SE-1B-R2	79	1.6	15900	1.92	1.08	High	High	Medium	2	1	6
Bioassay	SE-3-B3	69	1.4	13800	1.60	0.93	High	High	Medium	2	1	4
Bioassay	SE-3-R9	89	1.2	11600	2.25	1.27	High	High	High	1	1	5
Bioassay	SE-1-B5	161	1.0	9930	3.64	1.94	High	Medium	High	4	2	4
Bioassay	SE-3-R1	194	0.8	7820	3.65	1.95	High	Medium	High	4	2	3
Bioassay	SE-4-B4	302	0.8	8280	8.19	4.24	High	Medium	Very High	4	2	2
Bioassay	SE-1-R1	325	0.1	770	5.66	2.96	High	Low	Very High	7	3	1
Bioassay	SE-1-R2	397	0.3	2980	10.59	5.50	High	Low	Very High	7	3	6
Bioassay	SE-2-B2	242	0.3	2960	3.89	2.05	High	Low	High	7	3	5
Bioassay	SE-2-R1	314	0.4	4483	7.12	3.73	High	Low	Very High	7	3	2
Bioassay	SE-2-R3	85	0.4	3520	1.67	0.93	High	Low	Medium	8	3	3
Bioassay	SE-3-R8	494	0.1	840	19.39	10.05	High	Low	Very High	7	3	3
Bioassay	SE-4-B1	393	0.1	1420	14.03	7.26	High	Low	Very High	7	3	5
Bioassay	SE-4-B2	420	0.1	1430	12.82	6.61	High	Low	Very High	7	3	2
Bioassay	SE-4-B6	421	0.1	775	14.34	7.40	High	Low	Very High	7	3	1
Bioassay	SE-3-R7	430	0.2	2270	12.79	6.61	High	Low	Very High	7	3	4
Bioassay	SE-4-B5	382	0.2	1710	9.57	4.89	High	Low	Very High	7	3	6
Bioassay	SE-3-R2	39	1.6	16000	1.18	0.71	Medium	High	Medium	11	4	1
Bioassay	SE-4-B3	30	1.9	19400	1.49	0.91	Medium	High	Medium	11	4	6
Bioassay	SE-5-B2	19	1.6	15900	2.17	1.46	Medium	High	High	10	4	5
Bioassay	SE-5-B3	11	2.2	21800	0.96	0.67	Medium	High	Medium	11	4	2
Bioassay	SE-5-B4	12	2.3	22600	0.93	0.66	Medium	High	Medium	11	4	3
Bioassay	SE-5-B5	12	2.1	20800	1.25	0.87	Medium	High	Medium	11	4	4
Bioassay	SE-5-B6	15	1.7	17200	1.67	1.15	Medium	High	Medium	11	4	4
Bioassay	SE-6-B4	18	1.3	13200	1.43	0.94	Medium	High	Medium	11	4	3
Bioassay	SE-6-B5	22	1.2	12100	2.06	1.37	Medium	High	High	10	4	2
Bioassay	SE-8-B1	16	1.6	16000	1.27	0.89	Medium	High	Medium	11	4	5
Bioassay	SE-8-B2	15	1.6	16400	1.31	0.96	Medium	High	Medium	11	4	6
Bioassay	SE-8-B3	17	1.6	16300	1.57	1.12	Medium	High	Medium	11	4	1
Bioassay	SE-8-B4	19	1.5	15200	1.68	1.15	Medium	High	Medium	11	4	1
Bioassay	SE-8-B6	27	1.4	13600	2.23	1.45	Medium	High	High	10	4	6
Bioassay	SE-2-B1	28	0.6	6370	0.48	0.29	Medium	Medium	Medium	14	5	4
Bioassay	SE-REF-3	19	1.0	9610	1.47	0.96	Medium	Medium	Medium	14	5	3
Bioassay	SE-REF-8	11	0.9	8700	0.57	0.42	Medium	Medium	Medium	14	5	2
Bioassay	SE-6-B1	5	1.2	12300	0.29	0.25	Low	High	Medium	20	7	5
Bioassay	SE-6-B2	9	1.3	13000	0.87	0.65	Low	High	Medium	20	7	6
Bioassay	SE-6-B6	8	2.5	24500	0.69	0.55	Low	High	Medium	20	7	1
Bioassay	SE-6-R3	7	1.3	12800	0.64	0.51	Low	High	Medium	20	7	1
Bioassay	SE-REF-7	9	1.6	15900	0.75	0.58	Low	High	Medium	20	7	3
Bioassay	SE-7-B1	7	1.0	10300	0.63	0.54	Low	High	Medium	20	7	6
Bioassay	SE-7-B4	7	1.2	12000	0.63	0.53	Low	High	Medium	20	7	5
Bioassay	SE-7-B6	8	1.0	10300	0.84	0.66	Low	High	Medium	20	7	4
Bioassay	SE-5-B1	10	0.9	9400	0.67	0.51	Low	Medium	Medium	23	8	1
Bioassay	SE-8-B5	8	0.9	9210	0.38	0.29	Low	Medium	Medium	23	8	6
Bioassay	SE-REF-1	6	0.9	8820	0.29	0.23	Low	Medium	Medium	23	8	3

Bioassay	SE-REF-2	6	0.6	6490	0.30	0.22	Low	Medium	Medium	23	8	4
Bioassay	SE-REF-4	5	0.7	6660	0.40	0.32	Low	Medium	Medium	23	8	2
Bioassay	SE-7-B2	5	0.6	6060	0.30	0.26	Low	Medium	Medium	23	8	3
Bioassay	SE-7-B3	7	1.0	9590	0.65	0.55	Low	Medium	Medium	23	8	4
Bioassay	SE-7-B5	5	0.7	6610	0.37	0.32	Low	Medium	Medium	23	8	5
Bioassay	SE-REF-6	6	0.3	3300	0.25	0.21	Low	Low	Medium	26	9	1
Bioassay	SE-TRIB-6	4	1.3	13400	0.09	0.07	Low	High	Very Low	21	IR1	6
Bioassay	SE-LAL-1	2	2.6	26200	0.12	0.16	Low	High	Low	21	IR1	2
Bioassay	SE-LAL-2	2	2.7	26700	0.09	0.09	Low	High	Very Low	21	IR1	2
Bioassay	SE-LAL-5	2	1.7	17300	0.13	0.23	Low	High	Low	21	IR1	5
Bioassay	SE-LAL-4	4	0.9	9485	0.06	0.08	Low	Medium	Very Low	24	IR2	3
Bioassay	SE-LAL-6	3	0.5	5330	0.07	0.09	Low	Medium	Very Low	24	IR2	2
Bioassay	SE-TRIB-5	1	0.9	9420	0.10	0.15	Low	Medium	Low	24	IR2	4
Bioassay	SE-G-1	3	0.1	700	0.03	0.04	Low	Low	Very Low	27	IR3	1
Bioassay	SE-G-4	3	0.1	610	0.04	0.04	Low	Low	Very Low	27	IR3	4
Bioassay	SE-REF-10b	3	0.2	1950	0.09	0.11	Low	Low	Very Low	27	IR3	3
Bioassay	SE-REF-5	3	0.3	2670	0.10	0.11	Low	Low	Very Low	27	IR3	5
Bioassay	SE-TRIB-1	2	0.1	625	0.01	0.01	Low	Low	Very Low	27	IR3	5
Bioassay	SE-TRIB-2	2	0.3	2610	0.01	0.02	Low	Low	Very Low	27	IR3	4
Bioassay	SE-TRIB-3	2	0.3	3140	0.07	0.11	Low	Low	Very Low	27	IR3	3
Bioassay	SE-TRIB-4	1	0.3	2765	0.07	0.10	Low	Low	Very Low	27	IR3	1
Bioassay	SE-G-2	3	0.1	655	0.04	0.04	Low	Low	Very Low	27	IR3	5
Bioassay	SE-G-3	3	0.1	850	0.04	0.09	Low	Low	Very Low	27	IR3	6
Bioassay	SE-LAL-3	2	0.1	1355	0.04	0.05	Low	Low	Very Low	27	IR3	2
Bioassay	SE-REF-9	2	0.1	1080	0.03	0.03	Low	Low	Very Low	27	IR3	2

Station Type	sum_sample_id	znv	toc (%)	toc (mg/kg)	mpecq4	mpecq8	ZnV Bin	TOC Bin	mPECQ4 Bin	Category	Group	Proposed Batch
Bioassay	SE-1-R1	325	0.1	770	5.66	2.96	High	Low	Very High	7	3	1
Bioassay	SE-4-B6	421	0.1	775	14.34	7.40	High	Low	Very High	7	3	1
Bioassay	SE-3-R2	39	1.6	16000	1.18	0.71	Medium	High	Medium	11	4	1
Bioassay	SE-8-B3	17	1.6	16300	1.57	1.12	Medium	High	Medium	11	4	1
Bioassay	SE-8-B4	19	1.5	15200	1.68	1.15	Medium	High	Medium	11	4	1
Bioassay	SE-6-B6	8	2.5	24500	0.69	0.55	Low	High	Medium	20	7	1
Bioassay	SE-6-R3	7	1.3	12800	0.64	0.51	Low	High	Medium	20	7	1
Bioassay	SE-5-B1	10	0.9	9400	0.67	0.51	Low	Medium	Medium	23	8	1
Bioassay	SE-REF-6	6	0.3	3300	0.25	0.21	Low	Low	Medium	26	9	1
Bioassay	SE-G-1	3	0.1	700	0.03	0.04	Low	Low	Very Low	27	IR3	1
Bioassay	SE-TRIB-4	1	0.3	2765	0.07	0.10	Low	Low	Very Low	27	IR3	1
Bioassay	SE-4-B4	302	0.8	8280	8.19	4.24	High	Medium	Very High	4	2	2
Bioassay	SE-2-R1	314	0.4	4483	7.12	3.73	High	Low	Very High	7	3	2
Bioassay	SE-4-B2	420	0.1	1430	12.82	6.61	High	Low	Very High	7	3	2
Bioassay	SE-5-B3	11	2.2	21800	0.96	0.67	Medium	High	Medium	11	4	2
Bioassay	SE-6-B5	22	1.2	12100	2.06	1.37	Medium	High	High	10	4	2
Bioassay	SE-REF-8	11	0.9	8700	0.57	0.42	Medium	Medium	Medium	14	5	2
Bioassay	SE-REF-4	5	0.7	6660	0.40	0.32	Low	Medium	Medium	23	8	2
Bioassay	SE-LAL-1	2	2.6	26200	0.12	0.16	Low	High	Low	21	IR1	2
Bioassay	SE-LAL-2	2	2.7	26700	0.09	0.09	Low	High	Very Low	21	IR1	2
Bioassay	SE-LAL-6	3	0.5	5330	0.07	0.09	Low	Medium	Very Low	24	IR2	2
Bioassay	SE-LAL-3	2	0.1	1355	0.04	0.05	Low	Low	Very Low	27	IR3	2
Bioassay	SE-REF-9	2	0.1	1080	0.03	0.03	Low	Low	Very Low	27	IR3	2
Bioassay	SE-3-R1	194	0.8	7820	3.65	1.95	High	Medium	High	4	2	3
Bioassay	SE-2-R3	85	0.4	3520	1.67	0.93	High	Low	Medium	8	3	3
Bioassay	SE-3-R8	494	0.1	840	19.39	10.05	High	Low	Very High	7	3	3
Bioassay	SE-5-B4	12	2.3	22600	0.93	0.66	Medium	High	Medium	11	4	3
Bioassay	SE-6-B4	18	1.3	13200	1.43	0.94	Medium	High	Medium	11	4	3
Bioassay	SE-REF-3	19	1.0	9610	1.47	0.96	Medium	Medium	Medium	14	5	3
Bioassay	SE-REF-7	9	1.6	15900	0.75	0.58	Low	High	Medium	20	7	3
Bioassay	SE-REF-1	6	0.9	8820	0.29	0.23	Low	Medium	Medium	23	8	3
Bioassay	SE-7-B2	5	0.6	6060	0.30	0.26	Low	Medium	Medium	23	8	3
Bioassay	SE-LAL-4	4	0.9	9485	0.06	0.08	Low	Medium	Very Low	24	IR2	3
Bioassay	SE-REF-10b	3	0.2	1950	0.09	0.11	Low	Low	Very Low	27	IR3	3
Bioassay	SE-TRIB-3	2	0.3	3140	0.07	0.11	Low	Low	Very Low	27	IR3	3
Bioassay	SE-3-B3	69	1.4	13800	1.60	0.93	High	High	Medium	2	1	4
Bioassay	SE-1-B5	161	1.0	9930	3.64	1.94	High	Medium	High	4	2	4
Bioassay	SE-3-R7	430	0.2	2270	12.79	6.61	High	Low	Very High	7	3	4
Bioassay	SE-5-B5	12	2.1	20800	1.25	0.87	Medium	High	Medium	11	4	4
Bioassay	SE-5-B6	15	1.7	17200	1.67	1.15	Medium	High	Medium	11	4	4
Bioassay	SE-2-B1	28	0.6	6370	0.48	0.29	Medium	Medium	Medium	14	5	4
Bioassay	SE-7-B6	8	1.0	10300	0.84	0.66	Low	High	Medium	20	7	4
Bioassay	SE-REF-2	6	0.6	6490	0.30	0.22	Low	Medium	Medium	23	8	4

Bioassay	SE-TRIB-5	1	0.9	9420	0.10	0.15	Low	Medium	Low	24	IR2	4
Bioassay	SE-G-4	3	0.1	610	0.04	0.04	Low	Low	Very Low	27	IR3	4
Bioassay	SE-TRIB-2	2	0.3	2610	0.01	0.02	Low	Low	Very Low	27	IR3	4
Bioassay	SE-3-R9	89	1.2	11600	2.25	1.27	High	High	High	1	1	5
Bioassay	SE-2-B2	242	0.3	2960	3.89	2.05	High	Low	High	7	3	5
Bioassay	SE-4-B1	393	0.1	1420	14.03	7.26	High	Low	Very High	7	3	5
Bioassay	SE-5-B2	19	1.6	15900	2.17	1.46	Medium	High	High	10	4	5
Bioassay	SE-8-B1	16	1.6	16000	1.27	0.89	Medium	High	Medium	11	4	5
Bioassay	SE-6-B1	5	1.2	12300	0.29	0.25	Low	High	Medium	20	7	5
Bioassay	SE-7-B4	7	1.2	12000	0.63	0.53	Low	High	Medium	20	7	5
Bioassay	SE-7-B5	5	0.7	6610	0.37	0.32	Low	Medium	Medium	23	8	5
Bioassay	SE-LAL-5	2	1.7	17300	0.13	0.23	Low	High	Low	21	IR1	5
Bioassay	SE-REF-5	3	0.3	2670	0.10	0.11	Low	Low	Very Low	27	IR3	5
Bioassay	SE-TRIB-1	2	0.1	625	0.01	0.01	Low	Low	Very Low	27	IR3	5
Bioassay	SE-G-2	3	0.1	655	0.04	0.04	Low	Low	Very Low	27	IR3	5
Bioassay	SE-1B-R2	79	1.6	15900	1.92	1.08	High	High	Medium	2	1	6
Bioassay	SE-1-R2	397	0.3	2980	10.59	5.50	High	Low	Very High	7	3	6
Bioassay	SE-4-B5	382	0.2	1710	9.57	4.89	High	Low	Very High	7	3	6
Bioassay	SE-4-B3	30	1.9	19400	1.49	0.91	Medium	High	Medium	11	4	6
Bioassay	SE-8-B2	15	1.6	16400	1.31	0.96	Medium	High	Medium	11	4	6
Bioassay	SE-8-B6	27	1.4	13600	2.23	1.45	Medium	High	High	10	4	6
Bioassay	SE-6-B2	9	1.3	13000	0.87	0.65	Low	High	Medium	20	7	6
Bioassay	SE-7-B1	7	1.0	10300	0.63	0.54	Low	High	Medium	20	7	6
Bioassay	SE-8-B5	8	0.9	9210	0.38	0.29	Low	Medium	Medium	23	8	6
Bioassay	SE-TRIB-6	4	1.3	13400	0.09	0.07	Low	High	Very Low	21	IR1	6
Bioassay	SE-G-3	3	0.1	850	0.04	0.09	Low	Low	Very Low	27	IR3	6

APPENDIX B2

EMAIL TO TAI FROM EPA REGARDING PROPOSED BATCHING PLAN (DECEMBER 20, 2013)

McCaig Kris SPOK

From: Buelow, Laura <Buelow.Laura@epa.gov>
Sent: Friday, December 20, 2013 12:18 PM
To: McCaig Kris SPOK
Cc: Anne Fairbrother (afairbrother@exponent.com)

Kris,

EPA has reviewed Teck's proposed batches for the sediment toxicity tests. EPA expressed concerns about using this method for binning when it was first proposed by Teck in the Draft Phase II Sediment Quality Assurance Sampling Plan. EPA continues to have concerns with placing the highest emphasis on the zinc to vanadium ratio and the lowest emphasis on mPECQ. That being said, EPA did our own comparison of the batches based off of placing the highest emphasis on mPECQ and we concluded that the suggested batches from Teck are sufficiently random. Therefore, EPA agrees with the batches that Teck has proposed.

Please let me know if you have any questions.

Laura Buelow, Ph.D.
Project Manager
U.S. Environmental Protection Agency
Hanford Project Office
309 Bradley Blvd, Suite 115
Richland, WA 99352
Phone: 509 376-5466
Fax: 509 376-2396
E-mail: buelow.laura@epa.gov

APPENDIX B3

MEMORANDUM TO EPA FROM TAI ON PROPOSED LONG-TERM BIOASSAY SAMPLE SELECTION (JUNE 30, 2014)

MEMORANDUM

TO:	KRIS MCCAIG TECK AMERICAN INCORPORATED	DATE:	JUNE 30, 2014
FROM:	HDR EXPONENT, INC. CARDWELL CONSULTING, LLC	RE:	PROPOSED UCR PHASE 2 SEDIMENT STUDY LONG-TERM BIOASSAY SAMPLE SELECTION
CC:		FILE:	01-773180-000

Preliminary, un-validated analytical chemistry and biology data from short-term sediment bioassays generated as part of the Upper Columbia River (UCR) Phase 2 Sediment Study (hereafter, "Study") for the UCR site ("Site") were used to select samples for testing in long-term bioassays. Short-term bioassays with survival and growth endpoints for *Chironomus dilutus* and *Hyallela azteca* were completed on 69 sediment samples, including reference samples of varying types (i.e., tributary, presumptive internal reference, and external reference) and an additional set of control samples. The final Quality Assurance Project Plan (QAPP) for the Study (Exponent et al. March 2013) specifies that long-term bioassays will be conducted on 18 sediment samples on which short-term bioassays were performed.

Page B-5 of the QAPP specifies that sample selection for long-term bioassays will target sediment with:

(1) low to moderate toxicity response in short-term studies;
(2) high metal concentrations in porewater or bulk sediment; and/or
(3) a range of sediment and porewater characteristics.

The QAPP also specifies that preference will be given to samples from stations located within high-medium exposure gradients. A list of proposed samples for long-term bioassay analyses is presented below. A brief summary of the sample selection process also follows.

List of Proposed Samples for Long-Term Bioassay Analyses

The list of samples proposed for long-term bioassay analysis is presented in Table 1. The location of each proposed sample is presented Figure 1. A set of 18 site samples and 6 external reference samples are recommended for long-term bioassays.

Process Used to Group Biological and Chemical Results of Short-Term Bioassays

The Study data includes multiple measures of biological response and sediment chemistry (bulk sediment and porewater) for each sample. Composite biological and chemistry indexes were created to integrate results across the spectrum of measures. As a first step in the process to select samples for long-term bioassay analysis, preliminary biological response and analytical chemistry results were used to place sediment samples into "high", "medium" (i.e., "intermediate"), and "low" groups (hereafter referred to as "bins") based on the three indexes referred to on p. B-5 of the QAPP: (i) a composite biological response index; (ii) a composite sediment chemistry (bioavailability) index for porewater and bulk sediment; and (iii) mean Probable Effects Concentration Quotient (mPECQ) to represent the "exposure gradient." Thresholds (i.e., limits) between high, intermediate, and low bins for the composite biological response and sediment chemistry indexes are similar to those used to segment the probability distributions of historical Site sediment data used to select sample locations for the study. In this case, the limit between the high and intermediate bins was defined as the 80th percentile of the probability distribution for the index and the limit between the intermediate and low bins was defined as the 40th percentile of the distribution. Bin thresholds for mPECQ are consistent with those used in prior evaluations of Site data using mPECQ. Index descriptions and bin thresholds are presented in Table 2.

The composite biological response index was defined using 10-day *Chironomus dilutus* (CD10) and 28-day *Hyallela azteca* (HA28) survival and individual mean weight[1] values, with each value expressed as a fraction of control sample values for its given batch. This index provides an indication of biological responses across different organisms and endpoints. Each response was then divided by the maximum value that occurred for that response to yield a scaled metric that ranged from zero to 1. This scaling was performed so that each of the four metrics received equal weight when combined into the overall index. The four scaled metrics were then summed to obtain a composite index representing an overall biological response value. Higher composite biological response index values indicate samples associated with higher survival and greater weight and represent locations where the least response occurred.

The composite sediment chemistry index was defined using simultaneously extracted metals (SEM) in excess of acid volatile sulfide (i.e., SEM minus AVS) ("xSEM") and porewater toxic units calculated using the Biotic Ligand Model (BLM) (i.e., ratios of porewater metal concentrations to benchmarks determined using the BLM). This index provides an indication of bioavailability of metals in sediment samples. Chemistry measurements from CD10 and HA28 tests were included. Each chemistry measure was divided by the maximum value for that type of measurement to yield a metric that ranged from zero to 1. Because of factors such as non-detected concentrations, not all

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1 Individual mean weight is derived by dividing total biomass at the end of the test by the number of individuals alive at the end of the test.

samples have a value for all four metrics. Consequently, the average of the scaled chemical metrics was used to obtain an overall sediment chemistry index. Use of an average, rather than a sum, prevents samples with only one type of sediment chemistry measure from receiving less weight in the overall index than samples with more measures. Higher composite sediment chemistry index values indicate samples with higher potential metal bioavailability.

The "exposure gradient" across the site was represented by mPECQ values determined using four metals of primary interest (i.e., cadmium, copper, lead, and zinc) ("mPECQ4") and eight metals (i.e., arsenic, cadmium, chromium, copper, lead, nickel, mercury, and zinc) ("mPECQ8"). Higher mPECQ values indicate samples with metal concentrations that, on average, exceed Probable Effects Concentrations (PEC) values by a larger degree than samples with lower mPECQ values.

The biological response, sediment chemistry, and exposure gradient indices, and corresponding bins for each, for all 69 short-term bioassay samples are shown in Table 3. Calculations are presented in the spreadsheet file that accompanies this memorandum. Results for all 69 samples were then sorted by bin. Sorting occurred in the order of biological index (high to low), chemistry index (high to low), and mPECQ4 (high to low). This approach is consistent with requirements specified in the QAPP (see p. B-5) and is analogous to the binning approach developed at the outset of Phase 2 sediment sampling program design. It is also consistent with the process used in December 2013 to bin and sort short-term bioassay samples into test batches.

Additional Analyses Used to Divide Short-Term Chemistry Results into Groups

Because organisms may simultaneously respond to both chemical and physical attributes (e.g., grain size) of sediment, further statistical analyses were performed to determine whether sediments cluster into a small number of groups, including both attributes, from which representative samples could be chosen. Principal Component Analysis (PCA) and Hierarchical Cluster Analysis (HCA) were also performed to identify distinct groups of samples based on sediment composition. PCA is a multivariate data analysis method that evaluates correlations among variables in a data set, with the aim of reducing its dimensionality (Johnson et al. 2007). The reduction in dimensionality is accomplished by grouping highly correlated variables into a new set of uncorrelated reference variables, termed principal components (PCs), such that each successive PC accounts for a progressively smaller amount of variance in the original data. PCA and HCA can help distinguish among groups of samples that share similar characteristics (Johnson et al. 2007). In broad terms, PC1 characterizes the magnitude of metal concentrations in sediment; PC2 characterizes variations in sediment composition in terms of relative abundance of major elements. In this analysis, PC1 and PC2 account for approximately 86% of the variability in the original data. PCA and HCA analyses suggest that Site sediments cluster into four groups.

The results of these analyses are presented in Figures 2 and 3 and indicate that two major groups of UCR sediment groups can be distinguished based on metal composition, one mostly in the upper reaches of the UCR, and the other common to the lower UCR reaches and all reference locations. This group common to lower UCR reaches and reference locations is further subdivided into smaller subgroups representing a gradient of sediment chemistry, from low concentrations in reference samples to higher concentrations in samples from the middle and lower reaches of the Site (Table 3).

Process Used to Select Proposed Long-Term Bioassay Samples

The sample selection/identification process was based on application of the parameters specified in the QAPP (p. B-5). Applying these parameters, the set of 69 possible samples was reduced by filtering out sites that exhibited the highest survival and weight, to select samples from those that were the closest to showing "low to moderate toxicity response." The sample set was then further reduced by filtering out samples with low metal bioavailability based on the composite sediment chemistry index (which considers excess SEM and metal concentrations in porewater). The remaining samples vary over a range of mPECQ values, from very high to very low bins, expressing the "exposure gradient".

Sample selection also gave consideration to factors such as differences between endpoints for each test organism, the spatial distribution of samples, and proximity to locations considered more likely to have adverse chemical or physical characteristics (e.g., the toes of gravel bars). Differences ("discordance") in endpoints were considered to evaluate cases where one endpoint was low while others were high. This judgment was exercised to ensure that samples with toxicity in one organism (e.g., *Chironomus*) but not the other (e.g., *Hyalella*) would not be overlooked. PCA and HCA results were also used to help identify samples with a range of sediment characteristics. Sample selection for long term tests was balanced by choosing some samples from each of the groups identified using PCA and HCA results. The rationale for selecting Site samples proposed for long-term bioassay analysis is included in the rightmost column of Table 1.

In addition to Site samples, a selection of representative reference locations is necessary for accurate interpretation of long-term toxicity test results. For this purpose, three riverine (Genelle or "G") and three lacustrine (Lower Arrow Lake or "LAL") external reference locations were included in the list of proposed long-term bioassay samples. These external reference locations were selected to represent the range of ecological conditions, and physical settings encompassed by Site samples. Preference was given to these upstream external reference locations based on the following criteria described in the QAPP (Section B1.1):

- Upgradient in the same watershed as the study site;

- Comparable physical setting as the study site; and
- Similar water depth and flow as the study site.

In the selection of these six external reference samples, short-term bioassay results were used to screen out samples with lower performance, such as G-3 (lower biomass than other G samples), and LAL-4 and LAL-6 (lower growth than other LAL samples). Inclusion of reference locations with conditions less conducive to growth in the short-term bioassays could result in a larger reference envelope due to a larger range of possible responses. Therefore, only those reference locations with the most optimal conditions were selected for the long-term bioassays to provide a more conservative estimation of the reference envelope for subsequent comparison of site samples.

References

Johnson, G.W., R. Ehrlich, W. Full, and S. Ramos. 2007. Principal components analysis and receptor models in environmental forensics. In: B. Murphy and R.D. Morrison (Eds.). Introduction to Environmental Forensics, Second edition. Elsevier, San Diego, CA, 776 pp.

Exponent, HDR|HydroQual, Parametrix, Cardwell Consulting LLC, and Integral Consulting Inc. 2013. Final - Upper Columbia River Quality Assurance Project Plan for the Phase 2 Sediment Study. Spokane, WA, Prepared for Teck American, Incorporated: 943 pp. Appendices. Available online at: http://www.ucr-rifs.com/documents-plans.

Table 1. List of Proposed Samples for Long-Term Bioassay Analyses

Sample ID	x_UTM11N	y_UTM11N	Teck River Mile	mPECQ4 values	mPECQ8 values	CD10 Survival-Sum	CD10 Weight-IndMn	HA28 Survival-Juvenile	HA28 Weight-IndMn	Field Excess SEM	CD10 Excess SEM	CD10 BLM Sum TU (WQC)	HA28 Excess SEM	HA28 BLM Sum TU (WQC)	Recommendation and Rationale
SE-1-B5	446362.42	5421170.33	738.08	3.64	1.94	1.082	1.188	1.056	1.360	17.384	16.512	0.060	33.522	0.071	1-B5: High(est) BLM-TU; Toe of Dead Man's Eddy Island
SE-1B-R2	442818.00	5418846.00	735.16	1.92	1.08	0.957	0.711	0.996	1.261	14.868	17.005	4.623	15.746	2.890	1B-R2: Low wt of CD; High BLM-TU
SE-1-R2	452607.49	5424703.46	742.79	10.59	5.50	1.087	0.726	0.786	0.886	55.354	76.376	0.216	49.150	0.405	1-R2: Low wt of HA and CD, low survival of HA; high BLM-TU
SE-2-B1	441086.80	5417285.57	733.58	0.48	0.29	1.111	1.055	1.069	1.091	2.696	1.981	0.024	2.980	0.072	2-B1: Toe of gravel bar (moderate SEM and BLM-TU)
SE-2-R1	441059.98	5417084.55	733.48	7.12	3.73	1.039	1.009	1.017	1.053	27.296	21.070	0.105	14.759	0.247	2-R1: High mPECQ with intermediate bioavailability and responses, PCA/HCA Cluster 1
SE-3-B3	431659.35	5408578.95	725.06	1.60	0.93	1.067	0.864	0.736	0.848	6.350	9.689	0.092	14.089	0.161	3-B3: lower HA survival and weight with intermediate mPECQ, PCA/HCA Cluster
SE-3-R7	430299.33	5407152.19	723.60	12.79	6.61	1.010	1.020	1.083	0.738	41.908	32.181	0.445	49.143	0.578	3-R7: Low(ish) wt of HA and CD, greater variability in HA wt; high MPECQ
SE-3-R8	429441.87	5407276.90	723.00	19.39	10.05	0.855	0.522	0.978	0.815	77.702	109.456	1.680	96.062	0.888	3-R8: Low wt of HA and CD; high MPECQ; High SEM
SE-4-B1	424499.39	5393516.74	710.74	14.03	7.26	1.005	0.863	0.950	0.779	136.035	84.036		40.250		4-B1: Low(ish) wt of CD; high BLM-TU; thalweg in Marcus Flats
SE-4-B5	418622.79	5389013.18	705.45	9.57	4.89	1.058	0.937	0.943	1.058	84.856	26.027		29.588		4-B5: thalweg in Marcus Flats (moderate SEM)
SE-5-B2	413351.40	5354542.05	681.35	2.17	1.46	0.963	1.150	1.018	0.900	3.361	11.597	0.067	11.484	0.556	5-B2: Transect location in Reach 5 (moderate SEM and BLM-TU)
SE-5-B4	413420.50	5352206.64	679.93	0.93	0.66	0.370	1.669	1.044	1.182	2.600	3.587	0.096	6.270	0.263	5-B4: Low wt and survival of CD;
SE-6-B2	411272.52	5335725.11	668.34	0.87	0.65	0.957	0.508	0.956	1.207	-10.114	-12.488	0.029	-3.219	0.079	6-B2: Low wt of CD; medium MPECQ; low SEM; transect location in Reach
SE-6-B5	411006.27	5333732.12	667.08	2.06	1.37	0.618	1.263	0.991	1.131	10.971	14.142	0.509	12.900	3.161	6-B5: lower CD survival with high mPECQ, PCA/HCA Cluster 4
SE-7-B2	398078.45	5315204.09	648.04	0.30	0.26	0.472	1.711	1.017	1.220	1.262	1.022	0.026	0.940	0.086	7-B2: Transect location in Reach 7 (low'ish SEM and low BLM-TU)
SE-7-B5	398830.11	5310721.55	645.05	0.37	0.32	0.991	1.152	0.855	0.726	0.680	1.663	0.026	2.450	0.121	7-B5: Low wt of HA; medium MPECQ; above confluence w/ Spokane (low'ish SEM and low BLM-TU)
SE-8-B2	362206.87	5311914.93	606.74	1.31	0.96	1.116	0.653	0.956	1.163	3.193	3.588	0.044	4.911	0.147	8-B2: Low wt of CD (moderate SEM and low BLM-TU)
SE-8-B3	362315.44	5312466.90	606.64	1.57	1.12	0.878	1.067	1.267	1.036	1.872	5.529	0.064	5.680	0.593	8B-3: discordance (good survival but lower weights)
SE-G-1	448664.06	5450379.42		0.03	0.04	0.982	0.917	1.117	0.971	0.106	0.138		0.141		G-1
SE-G-2	448710.94	5450338.71		0.04	0.04	0.963	0.880	0.950	0.913	0.151	0.153	0.089	0.144	0.066	G-2
SE-G-4	448723.87	5450204.05		0.04	0.04	1.096	0.671	0.875	0.184	0.200	0.150	0.183	0.203	0.137	G-4
SE-LAL-1	418638.03	5492297.99		0.12	0.16	0.671	1.123	1.004	0.975	0.293	0.423	0.037	0.331	0.155	LAL-1
SE-LAL-3	418371.13	5493673.70		0.04	0.05	0.974	1.158	1.004	1.178	0.074	0.094	0.032	0.117	0.066	LAL-3
SE-LAL-5	435187.02	5466554.90		0.13	0.23	0.865	1.292	0.991	0.746	0.376	0.616	0.085	0.563	0.106	LAL-5

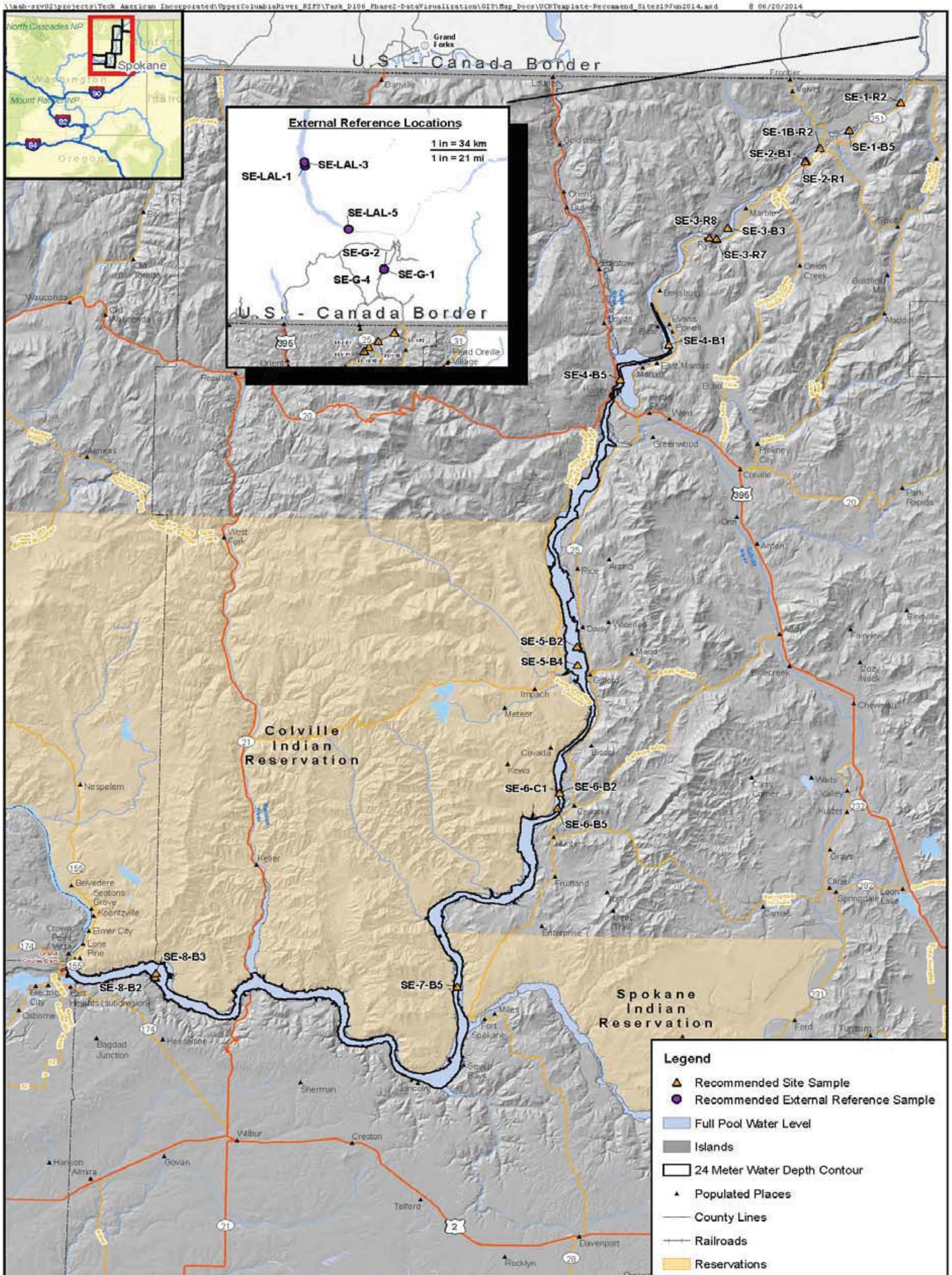
Table 2. Indexes and bin thresholds used to rank samples.

Index	***Description***	***Bin Thresholds***		
		Low	***Medium***	***High***
Biological Response	Composite index expressing relative response of survival and growth endpoints for each test organism. Higher index values indicate samples with higher survival and growth.	< 40^{th} Percentile	40^{th} – 80^{th} Percentile	> 80^{th} Percentile
Sediment Chemistry (Bioavailability)	Composite index expressing relative bioavailability of metals in samples. Includes excess SEM and BLM-calculated porewater toxic units in chambers for each test organism. Higher index values indicate samples with higher potential bioavailability.	< 40^{th} Percentile	40^{th} – 80^{th} Percentile	> 80^{th} Percentile
mPECQ4	Composite index expressing average degree to which metals in bulk sediment exceed probable effects concentration values.	< 0.2 (very low < 0.1)	0.2 – 2	> 2 (very high > 5)

Notes: (1) mPECQ4 values were estimated based on concentrations of four metals: cadmium, copper, lead, and zinc; (2) mPECQ4 bins were further subdivided into very low (mPECQ4 < 0.1) and very high (mPECQ4 > 5) bins to delimit the range of sediment conditions.

Table 3. Biological response, sediment chemistry and exposure gradient indices for 69 short-term bioassay samples.

Sample Information					Gradient		Bio Response (All responses are divided by average control value for the batch in which a sample was run) --> "%" of Control (fraction of control)									Sed Chem (field)	Sed Chem (lab)									PCA/HCA		Biological Response	Sediment Chemistry	Exposure Gradient	Recommendation and Rationale
Sample ID	x_UTM11N	y_UTM11N	loccode	Teck River Mile	mPECQ 4 values	mPECQ 8 values	CD10 Survival-Sum	CD10 Weight-IndMn	HA28 Survival-Juvenile	HA28 Weight-IndMn	Scaled CD10 Survival	Scaled CD10 Weight	Scaled HA10 Survival	Scaled HA10 Weight	Sum Bio Response Index	Field Excess SEM	CD10 Excess SEM	CD10 BLM Sum TU (WQC)	HA28 Excess SEM	HA28 BLM Sum TU (WQC)	Scaled CD10 Excess SEM	Scaled CD10 BLM Sum TU (~WQC)	Scaled HA28 Excess SEM	Scaled HA28 BLM Sum TU (~WQC)	Sed Chem Index (Average)	HCA Cluster	PC1 Score	Bio Response Index Bin	Sed Chem (Bioavailability) Index Bin	mPECQ4 bin	Recommendation and Rationale
SE-1-B5	446362.42	5421170.33	R1C_S	738.08	3.64	1.94	1.082	1.188	1.056	1.360	0.945	0.662	0.792	0.866	3.265	17.384	16.512	0.060	33.522	0.071	0.151	0.013	0.349	0.020	0.133	1	1.34	High (>80th percentile)	Higher (>80th percentile)	High	1-B5: High(est) BLM-TU; Toe of Dead Man's Eddy Island
SE-1B-R2	442818.00	5418846.00	R1C_S	735.16	1.92	1.08	0.957	0.711	0.996	1.261	0.835	0.396	0.747	0.804	2.782	14.868	17.005	4.623	15.746	2.890	0.155	1.000	0.164	0.830	0.537	4	-0.26	Lower (<40th pecertile)	Higher (>80th percentile)	Intermediate	1B-R2: Low wt of CD; High BLM-TU
SE-1-R1	453443.41	5427290.80	R1C_S	744.66	5.66	2.96	0.982	0.847	1.333	1.020	0.858	0.472	1.000	0.650	2.980	18.702	16.077	0.258	30.372	0.559	0.147	0.056	0.316	0.160	0.170	1	3.54	Intermediate (40th-80th percentile)	Higher (>80th percentile)	High (very high)	
SE-1-R2	452607.49	5424703.46	R1C_S	742.79	10.59	5.50	1.087	0.726	0.786	0.886	0.949	0.405	0.589	0.565	2.508	55.354	76.376	0.216	49.150	0.405	0.698	0.047	0.512	0.116	0.343	1	3.54	Lower (<40th pecertile)	Higher (>80th percentile)	High (very high)	1-R2: Low wt of HA and CD, low survival of HA; high BLM-TU
SE-2-B1	441086.80	5417285.57	R1C_S	733.58	0.48	0.29	1.111	1.055	1.069	1.091	0.970	0.588	0.802	0.695	3.055	2.696	1.981	0.024	2.980	0.072	0.018	0.005	0.031	0.021	0.019	4	-4.19	Intermediate (40th-80th percentile)	Intermediate (40th-80th percentile)	Intermediate	2-B1: Toe of gravel bar (moderate SEM and BLM-TU)
SE-2-B2	440369.25	5416812.82	R1C_S	733.08	3.89	2.05	1.033	0.996	1.113	1.171	0.902	0.555	0.835	0.746	3.038	23.144	24.721	0.058	17.176	0.498	0.226	0.013	0.179	0.143	0.140	1	0.49	Intermediate (40th-80th percentile)	Higher (>80th percentile)	High	
SE-2-R1	441059.98	5417084.55	R1C_S	733.48	7.12	3.73	1.039	1.009	1.017	1.053	0.908	0.563	0.763	0.671	2.904	27.296	21.070	0.105	14.759	0.247	0.192	0.023	0.154	0.071	0.110	1	3.12	Intermediate (40th-80th percentile)	Intermediate (40th-80th percentile)	High (very high)	2-R1: High mPECQ with intermediate bioavailability and responses, PCA/HCA Cluster 1
SE-2-R3	440006.66	5416667.25	R1C_S	732.83	1.67	0.93	0.957	1.504	1.017	1.270	0.836	0.839	0.763	0.809	3.247	12.439	12.942	0.322	17.626	0.387	0.118	0.070	0.183	0.111	0.121	4	-1.26	High (>80th percentile)	Intermediate (40th-80th percentile)	Intermediate	
SE-3-B3	431659.35	5408578.95	R2C_S	725.06	1.60	0.93	1.067	0.864	0.736	0.848	0.932	0.482	0.552	0.540	2.506	6.350	9.689	0.092	14.089	0.161	0.089	0.020	0.147	0.046	0.075	4	-0.57	Lower (<40th pecertile)	Intermediate (40th-80th percentile)	Intermediate	3-B3: lower HA survival and weight with intermediate mPECQ, PCA/HCA Cluster 3
SE-3-R1	432830.67	5411178.65	R2C_S	726.84	3.65	1.95	1.021	0.850	0.991	1.213	0.892	0.474	0.744	0.773	2.882	17.628	26.754	0.052	24.644	0.306	0.244	0.011	0.257	0.088	0.150	1	1.17	Intermediate (40th-80th percentile)	Higher (>80th percentile)	High	
SE-3-R2	431977.47	5409801.85	R2C_S	725.81	1.18	0.71	0.996	1.355	0.967	1.235	0.870	0.755	0.725	0.787	3.137	10.080	7.712	0.016	11.869	0.133	0.070	0.003	0.124	0.038	0.059	4	-0.89	Intermediate (40th-80th percentile)	Intermediate (40th-80th percentile)	Intermediate	
SE-3-R7	430299.33	5407152.19	R2C_S	723.60	12.79	6.61	1.010	1.020	1.083	0.738	0.882	0.569	0.813	0.470	2.733	41.908	32.181	0.445	49.143	0.578	0.294	0.096	0.512	0.166	0.267	1	4.47	Lower (<40th pecertile)	Higher (>80th percentile)	High (very high)	3-R7: Low(ish) wt of HA and CD, greater variability in HA wt; high MPECQ
SE-3-R8	429441.87	5407276.90	R2C_S	723.00	19.39	10.05	0.855	0.522	0.978	0.815	0.747	0.291	0.734	0.519	2.291	77.702	109.456	1.680	96.062	0.888	1.000	0.363	1.000	0.255	0.655	1	5.49	Lower (<40th pecertile)	Higher (>80th percentile)	High (very high)	3-R8: Low wt of HA and CD; high MPECQ; High SEM
SE-3-R9	428488.74	5407828.75	R2C_S	722.30	2.25	1.27	1.061	1.440	1.045	1.003	0.926	0.803	0.784	0.639	3.152	14.764	16.125	0.181	14.233	0.416	0.147	0.039	0.148	0.119	0.114	1	5.49	High (>80th percentile)	Intermediate (40th-80th percentile)	High	
SE-4-B1	424499.39	5393516.74	R3C_D	710.74	14.03	7.26	1.005	0.863	0.950	0.779	0.878	0.481	0.713	0.496	2.568	136.035	84.036		40.250		0.768		0.419		0.593	1	5.21	Lower (<40th pecertile)	Higher (>80th percentile)	High (very high)	4-B1: Low(ish) wt of CD; high BLM-TU; thalweg in Marcus Flats
SE-4-B2	422289.31	5391549.11	R3C_D	708.64	12.82	6.61	1.039	0.913	0.991	1.081	0.908	0.509	0.744	0.688	2.849	22.953	28.286	0.314	62.011	0.291	0.258	0.068	0.646	0.084	0.264	1	4.54	Intermediate (40th-80th percentile)	Higher (>80th percentile)	High (very high)	
SE-4-B3	420545.86	5391416.88	R3C_S	707.55	1.49	0.91	0.841	1.098	0.917	1.084	0.734	0.612	0.688	0.691	2.725	8.495	9.447	0.041	9.640	0.293	0.086	0.009	0.100	0.084	0.070	2	0.74	Lower (<40th pecertile)	Intermediate (40th-80th percentile)	Intermediate	
SE-4-B4	418964.49	5390736.08	R3C_D	706.48	8.19	4.24	1.013	0.739	0.966	0.939	0.885	0.412	0.724	0.598	2.619	6.973	4.049	0.022	13.679	0.092	0.037	0.005	0.142	0.026	0.053	1	3.18	Lower (<40th pecertile)	Intermediate (40th-80th percentile)	High (very high)	
SE-4-B5	418622.79	5389013.18	R3C_D	705.45	9.57	4.89	1.058	0.937	0.943	1.058	0.924	0.522	0.707	0.674	2.828	84.856	26.027		29.588		0.238		0.308		0.273	1	2.61	Intermediate (40th-80th percentile)	Higher (>80th percentile)	High (very high)	4-B5: thalweg in Marcus Flats (moderate SEM)
SE-4-B6	423102.47	5391739.07	R3C_D	709.16	14.34	7.40	0.943	0.930	1.300	1.223	0.824	0.518	0.975	0.779	3.096	46.109	41.607	1.069	54.426	0.959	0.380	0.231	0.567	0.276	0.363	1	4.98	Intermediate (40th-80th percentile)	Higher (>80th percentile)	High (very high)	
SE-5-B1	413953.15	5354594.26	R4C_S	681.32	0.67	0.51	0.812	1.419	1.233	1.143	0.709	0.791	0.925	0.728	3.154	1.170	2.596	0.057	3.801	0.495	0.024	0.012	0.040	0.142	0.054	4	-0.37	High (>80th percentile)	Intermediate (40th-80th percentile)	Intermediate	
SE-5-B2	413351.40	5354542.05	R4C_D	681.35	2.17	1.46	0.963	1.150	1.018	0.900	0.841	0.641	0.764	0.574	2.820	3.361	11.597	0.067	11.484	0.556	0.106	0.014	0.120	0.160	0.100	2	2.98	Lower (<40th pecertile)	Intermediate (40th-80th percentile)	High	5-B2: Transect location in Reach 5 (moderate SEM and BLM-TU)
SE-5-B3	412691.33	5354422.00	R4C_D	681.43	0.96	0.67	0.461	1.466	0.991	1.090	0.402	0.817	0.744	0.694	2.657	3.377	2.649	0.048	3.372	0.133	0.024	0.010	0.035	0.038	0.027	2	1.13	Lower (<40th pecertile)	Intermediate (40th-80th percentile)	Intermediate	
SE-5-B4	413420.50	5352206.64	R4C_D	679.93	0.93	0.66	0.370	1.669	1.044	1.182	0.323	0.931	0.783	0.753	2.790	2.600	3.587	0.096	6.270	0.263	0.033	0.021	0.065	0.076	0.049	2	0.80	Lower (<40th pecertile)	Intermediate (40th-80th percentile)	Intermediate	5-B4: Low wt and survival of CD;
SE-5-B5	413957.79	5351687.92	R4C_D	679.56	1.25	0.87	0.894	1.114	1.042	1.286	0.781	0.621	0.781	0.820	3.003	2.660	2.157	0.060	6.067	0.202	0.020	0.013	0.063	0.058	0.038	2	1.85	Intermediate (40th-80th percentile)	Intermediate (40th-80th percentile)	Intermediate	
SE-5-B6	414416.73	5351559.30	R4C_D	679.51	1.67	1.15	0.923	1.005	1.056	1.452	0.806	0.560	0.792	0.925	3.083	2.591	4.573	0.124	4.696	0.299	0.042	0.027	0.049	0.086	0.051	2	2.21	Intermediate (40th-80th percentile)	Intermediate (40th-80th percentile)	Intermediate	
SE-6-B1	410864.75	5335490.57	R4C_S	668.20	0.29	0.25	0.879	0.952	0.991	0.901	0.768	0.531	0.743	0.574	2.615	0.653	0.915	0.165	1.494	0.445	0.008	0.036	0.016	0.128	0.047	4	-2.55	Lower (<40th pecertile)	Intermediate (40th-80th percentile)	Intermediate	
SE-6-B2	411272.52	5335725.11	R4C_D	668.34	0.87	0.65	0.957	0.508	0.956	1.207	0.835	0.283	0.717	0.769	2.605	-10.114	-12.488	0.029	-3.219	0.079	0.000	0.006	0.000	0.023	0.007	2	0.80	Lower (<40th pecertile)	Lower (<40th percentile)	Intermediate	6-B2: Low wt of CD; medium MPECQ; low SEM; transect location in Reach
SE-6-B4	410686.36	5334129.15	R4C_S	667.23	1.43	0.94	0.357	1.781	1.017	1.180	0.312	0.993	0.763	0.752	2.820	3.144	4.942	0.543	5.966	3.481	0.045	0.118	0.062	1.000	0.306	2	0.29	Lower (<40th pecertile)	Higher (>80th percentile)	Intermediate	
SE-6-B5	411006.27	5333732.12	R4C_S	667.08	2.06	1.37	0.618	1.263	0.991	1.131	0.540	0.704	0.744	0.721	2.708	10.971	14.142	0.509	12.900	3.161	0.129	0.110	0.134	0.908	0.320	2	1.93	Lower (<40th pecertile)	Higher (>80th percentile)	High	6-B5: lower CD survival with high mPECQ, PCA/HCA Cluster 4
SE-6-B6	411292.89	5333335.66	R4C_D	666.93	0.69	0.55	0.786	1.282	1.283	1.261	0.687	0.715	0.963	0.803	3.167	1.380	1.747	0.044	2.613	0.313	0.016	0.010	0.027	0.090	0.036	2	0.75	High (>80th percentile)	Intermediate (40th-80th percentile)	Intermediate	
SE-6-R3	410903.28	5336565.65	R4C_D	668.87	0.64	0.51	0.838	1.128	1.283	1.193	0.732	0.629	0.963	0.760	3.084	1.518	2.561	0.081	3.343	0.686	0.023	0.018	0.035	0.197	0.068	2	1.17	Intermediate (40th-80th percentile)	Intermediate (40th-80th percentile)	Intermediate	
SE-7-B1	397451.91	5315603.05	R4C_D	648.48	0.63	0.54	0.768	1.128	1.035	1.268	0.671	0.629	0.776	0.808	2.884	2.436	2.368	0.038	2.964	0.145	0.022	0.008	0.031	0.042	0.026	2	0.78	Intermediate (40th-80th percentile)	Intermediate (40th-80th percentile)	Intermediate	
SE-7-B2	398078.45	5315204.09	R4C_D	648.04	0.30	0.26	0.472	1.711	1.017	1.220	0.413	0.954	0.763	0.777	2.907	1.262	1.022	0.026	0.940	0.086	0.009	0.006	0.010	0.025	0.012	4	-1.87	Intermediate (40th-80th percentile)	Lower (<40th percentile)	Intermediate	7-B2: Transect location in Reach 7 (low'ish SEM and low BLM-TU)
SE-7-B3	398694.12	5315138.98	R4C_D	647.73	0.65	0.55	1.024	0.980	1.083	1.405	0.894	0.546	0.813	0.895	3.149	0.823	1.618	0.062	2.079	0.166	0.015	0.013	0.022	0.048	0.024	2	0.92	High (>80th percentile)	Intermediate (40th-80th percentile)	Intermediate	
SE-7-B4	398629.95	5312042.66	R4C_D	645.90	0.63	0.53	0.684	1.563	1.059	1.166	0.597	0.872	0.794	0.743	3.006	1.338	1.258	0.041	1.841	0.156	0.011	0.009	0.019	0.045	0.021	2	1.26	Intermediate (40th-80th percentile)	Intermediate (40th-80th percentile)	Intermediate	
SE-7-B5	398830.11	5310721.55	R4C_D	645.05	0.37	0.32	0.991	1.152	0.855	0.726	0.865	0.642	0.641	0.463	2.612	0.680	1.663	0.026	2.450	0.121	0.015	0.006	0.026	0.035	0.020	4	-0.80	Lower (<40th pecertile)	Intermediate (40th-80th percentile)	Intermediate	7-B5: Low wt of HA; medium MPECQ; above confluence w/ Spokane (low'ish SEM and low BLM-TU)
SE-7-B6	398723.70	5311549.73	R4C_D	645.57	0.84	0.66	0.736	1.088	1.097	1.250	0.642	0.607	0.823	0.796	2.869	2.057	2.899	0.041	3.730	0.150	0.026	0.009	0.039	0.043	0.029	2	1.56	Intermediate (40th-80th percentile)	Intermediate (40th-80th percentile)	Intermediate	
SE-8-B1	363040.57	5310495.90	R6C_D	608.19	1.27	0.89	0.823	1.049	1.045	1.022	0.719	0.585	0.784	0.651	2.739	3.380	7.487	0.064	5.479	0.178	0.068	0.014	0.057	0.051	0.048	2	1.94	Lower (<40th pecertile)	Intermediate (40th-80th percentile)	Intermediate	
SE-8-B2	362206.87	5311914.93	R6C_D	606.74	1.31	0.96	1.116	0.653	0.956	1.163	0.975	0.364	0.717	0.741	2.797	3.193	3.588	0.044	4.911	0.147	0.033	0.010	0.051	0.042	0.034	2	2.44	Lower (<40th pecertile)	Intermediate (40th-80th percentile)	Intermediate	8-B2: Low wt of CD (moderate SEM and low BLM-TU)
SE-8-B3	362315.44	5312466.90	R6C_D	606.64	1.57	1.12	0.878	1.067	1.267	1.036	0.767	0.595	0.950	0.660	2.972	1.872	5.529	0.064	5.680	0.593	0.051	0.014	0.059	0.170	0.073	2	2.65	Intermediate (40th-80th percentile)	Intermediate (40th-80th percentile)	Intermediate	8B-3: discordance (good survival but lower weights)
SE-8-B4	362434.53	5313451.93	R6C_D	606.42	1.68	1.15	0.825	1.079	1.267	1.125	0.721	0.601	0.950	0.717	2.989	4.554	5.205	0.050	7.592	0.647	0.048	0.011	0.079	0.186	0.081	2	2.56	Intermediate (40th-80th percentile)	Intermediate (40th-80th percentile)	Intermediate	
SE-8-B5	364227.68	5309157.16	R6C_D	609.14	0.38	0.29	1.000	0.953	1.009	1.261	0.873	0.532	0.757	0.803	2.965	0.665	-0.085	0.018	1.205	0.106	0.000	0.004	0.013	0.031	0.012	4	-1.09	Intermediate (40th-80th percentile)	Lower (<40th percentile)	Intermediate	
SE-8-B6	364197.30	5309594.91	R6C_D	609.00	2.23	1.45	0.928	0.965	0.982	0.961	0.810	0.538	0.737	0.612	2.697	7.925	8.594	0.091	11.512	0.302	0.079	0.020	0.120	0.087	0.076	2	2.42	Lower (<40th pecertile)	Intermediate (40th-80th percentile)	High	
SE-G-1	448664.06	5450379.42		NA	0.03	0.04	0.982	0.917	1.117	0.971	0.858	0.511	0.838	0.618	2.825	0.106	0.138		0.141		0.001		0.001		0.001	3	-10.02	Intermediate (40th-80th percentile)	Lower (<40th percentile)	Low (very low)	G-1
SE-G-2	448710.94	5450338.71		NA	0.04	0.04	0.963	0.880	0.950	0.913	0.841	0.490	0.713	0.582	2.626	0.151	0.153	0.089	0.144	0.066	0.001	0.019	0.001	0.019	0.010	3	-9.67	Lower (<40th pecertile)	Lower (<40th percentile)	Low (very low)	G-2
SE-G-3	448596.95	5450270.32		NA	0.04	0.09	1.145	0.571	1.022	0.818	1.000	0.318	0.766	0.521	2.606	0.119	0.149	0.140	0.153	0.118	0.001	0.030	0.002	0.034	0.017	3	-9.38	Lower (<40th pecertile)	Lower (<40th percentile)	Low (very low)	
SE-G-4	448723.87	5450204.05		NA	0.04	0.04	1.096	0.671	0.875	0.184	0.957	0.374	0.656	0.117	2.105	0.200	0.150	0.183	0.203	0.137	0.001	0.040	0.002	0.039	0.021	3	-10.43	Lower (<40th pecertile)	Intermediate (40th-80th percentile)	Low (very low)	G-4
SE-LAL-1	418638.03	5492297.99		NA	0.12	0.16	0.671	1.123	1.004	0.975	0.586	0.626	0.753	0.621	2.587	0.293	0.423	0.037	0.331	0.155	0.004	0.008	0.003	0.045	0.015	4	-2.71	Lower (<40th pecertile)	Lower (<40th percentile)	Low	LAL-1
SE-LAL-2	418537.24	5492506.79		NA	0.09	0.09	1.000	0.929	1.017	1.170	0.873	0.518	0.763	0.746	2.900	0.241	-11.993	0.018	-14.189	0.072	0.000	0.004	0.000	0.021	0.006	4	-4.42	Intermediate (40th-80th percentile)	Lower (<40th percentile)	Low (very low)	
SE-LAL-3	418371.13	5493673.70		NA	0.04	0.05	0.974	1.158	1.004	1.178	0.850	0.646	0.753	0.751	3.000	0.074	0.094	0.032	0.117	0.066	0.001	0.007	0.001	0.019	0.007	3	-8.45	Intermediate (40th-80th percentile)	Lower (<40th percentile)	Low (very low)	LAL-3
SE-LAL-4	435078.03	5466832.23		NA	0.06	0.08	1.008	1.388	0.939	0.537	0.881	0.774	0.704	0.342	2.701	-0.389	-0.375	0.039	-0.376	0.173	0.000	0.008	0.000	0.050	0.015	3	-8.68	Lower (<40th pecertile)	Lower (<40th percentile)	Low (very low)	
SE-LAL-5	435187.02	5466554.90		NA	0.13	0.23	0.865	1.292	0.991	0.746	0.756	0.721	0.743	0.475	2.695	0.376	0.616	0.085	0.563	0.106	0.006	0.018	0.006	0.030	0.015	4	-2.48	Lower (<40th pecertile)	Lower (<40th percentile)	Low	LAL-5
SE-LAL-6	435335.92	5466507.16		NA	0.07	0.09	1.039	1.171	1.009	1.296	0.908	0.653	0.757	0.825	3.143	-0.471	-0.521	0.017	-0.364	0.059	0.000	0.004	0.000	0.017	0.005	3	-7.44	High (>80th percentile)	Lower (<40th percentile)	Low (very low)	
SE-REF-1	416076.91	5380829.30	R3C_S	699.22	0.29	0.23	0.626	1.793	1.044	1.279	0.546	1.000	0.783	0.815	3.144	0.691	0.441	0.014	0.893	0.068	0.004	0.003	0.009	0.019	0.009	4	-2.64	High (>80th percentile)	Lower (<40th percentile)	Intermediate	
SE-REF-10b	356558.31	5311243.78	R6C_S	602.67	0.09	0.11	0.970	1.266	1.044	1.154	0.847	0.706	0.783	0.736	3.072	0.382	0.411	0.030	0.501	0.082	0.004	0.006	0.005	0.024	0.010	4	-4.68	Intermediate (40th-80th percentile)	Lower (<40th percentile)	Low (very low)	
SE-REF-2	414938.47	5376760.49	R4C_S	696.61	0.30	0.22	0.923	1.202	1.069	1.151	0.806	0.670	0.802	0.733	3.012	1.170	1.076	0.011	1.468	0.108	0.010	0.002	0.015	0.031	0.015	4	-3.12	Intermediate (40th-80th percentile)	Lower (<40th percentile)	Intermediate	
SE-REF-3	412079.46	5370108.17	R4C_S	691.73	1.47	0.96	0.613	1.769	1.030	1.127	0.535	0.987	0.773	0.718	3.013	6.853	6.640	0.189	7.977	1.147	0.061	0.041	0.083	0.329	0.129	2	0.18	Intermediate (40th-80th percentile)	Higher (>80th percentile)	Intermediate	
SE-REF-4	411920.49	5356517.51	R4C_S	682.55	0.40	0.32	0.895	1.018	0.953	1.074	0.781	0.568	0.715	0.684	2.748	2.265	0.815	0.031	1.300	0.155	0.007	0.007	0.014	0.045	0.018	4	-1.40	Lower (<40th pecertile)	Intermediate (40th-80th percentile)	Intermediate	
SE-REF-5	414616.84	5352322.26	R4C_S	679.71	0.10	0.11	1.033	1.151	1.032	0.871	0.902	0.642	0.774	0.555	2.873	0.188	0.422	0.281	0.278	0.800	0.004	0.061	0.003	0.230	0.074	4	-5.60	Intermediate (40th-80th percentile)	Intermediate (40th-80th percentile)	Low (very low)	
SE-REF-6	400853.29	5322793.84	R4C_S	654.78	0.25	0.21	0.969	1.381	1.300	1.191	0.847	0.770	0.975	0.759	3.351	0.477	0.754	0.079	0.729	0.523	0.007	0.017	0.008	0.150	0.045	4	-3.81	High (>80th percentile)	Intermediate (40th-80th percentile)	Intermediate	
SE-REF-7	396873.55	5316361.88	R4C_D	649.04	0.75	0.58	0.702	1.593	1.030	1.238	0.613	0.888	0.773	0.789	3.063	2.353	2.117	0.122	3.636	0.309	0.019	0.026	0.038	0.089	0.043	2	0.60	Intermediate (40th-80th percentile)	Intermediate (40th-80th percentile)	Intermediate	
SE-REF-8	391932.39	5299477.84	R5C_S	634.02	0.57	0.42	0.789	1.009	0.991	1.017	0.690	0.563	0.744	0.648	2.644	1.284	2.977	0.641	3.883	1.947	0.027	0.139	0.040	0.559	0.191	4	-0.81	Lower (<40th pecertile)	Higher (>80th percentile)	Intermediate	
SE-TRIB-1	409564.60	5365249.90	R4R_S	688.48	0.01	0.01	0.991	0.873	1.072	1.569	0.865	0.487	0.804	1.000	3.156	0.019	0.024	0.041	0.017	0.051	0.000	0.009	0.000	0.015	0.006	3	-14.37	High (>80th percentile)	Lower (<40th percentile)	Low (very low)	
SE-TRIB-2	417919.40	5389775.80		705.89	0.01	0.02	1.096	1.080	1.000	1.150	0.957	0.602	0.750	0.733	3.042	0.025	0.031	0.022	0.036	0.047	0.000	0.005	0.000	0.013	0.005	3	-12.67	Intermediate (40th-80th percentile)	Lower (<40th percentile)	Low (very low)	
SE-TRIB-3	412684.00	5363469.00	R4L_S	687.15	0.07	0.11	1.034	1.374	1.044	1.119	0.903	0.766	0.783	0.713	3.164	0.168	0.195	0.012	0.120	0.046	0.002	0.003	0.001	0.013	0.005	4	-5.08	High (>80th percentile)	Lower (<40th percentile)	Low (very low)	
SE-TRIB-4	428199.07	5408255.78	R2R_S	722.16	0.07	0.10	0.930	1.220	1.283	1.090	0.812	0.680	0.963	0.694	3.149	0.166	0.133	0.020	0.169	0.046	0.001	0.004	0.002	0.013	0.005	4	-5.24	High (>80th percentile)	Lower (<40th percentile)	Low (very low)	
SE-TRIB-5	430695.50	5412505.20		726.51	0.10	0.15	1.125	0.909	1.111	1.311	0.983	0.507	0.833	0.835	3.158	0.135	0.118	0.019	0.171	0.022	0.001	0.004	0.002	0.006	0.003	4	-3.85	High (>80th percentile)	Lower (<40th percentile)	Low	
SE-TRIB-6	441373.76	5416578.37	R1L_S	733.41	0.09	0.07	0.986	0.609	1.022	1.371	0.861	0.340	0.766	0.874	2.840	0.417	0.214	0.009	0.117	0.048	0.002	0.002	0.001	0.014	0.005	3	-7.65	Intermediate (40th-80th percentile)	Lower (<40th percentile)	Low (very low)	



HDR

Figure 1. Recommended Long-Term Bioassay Samples

Upper Columbia River, WA

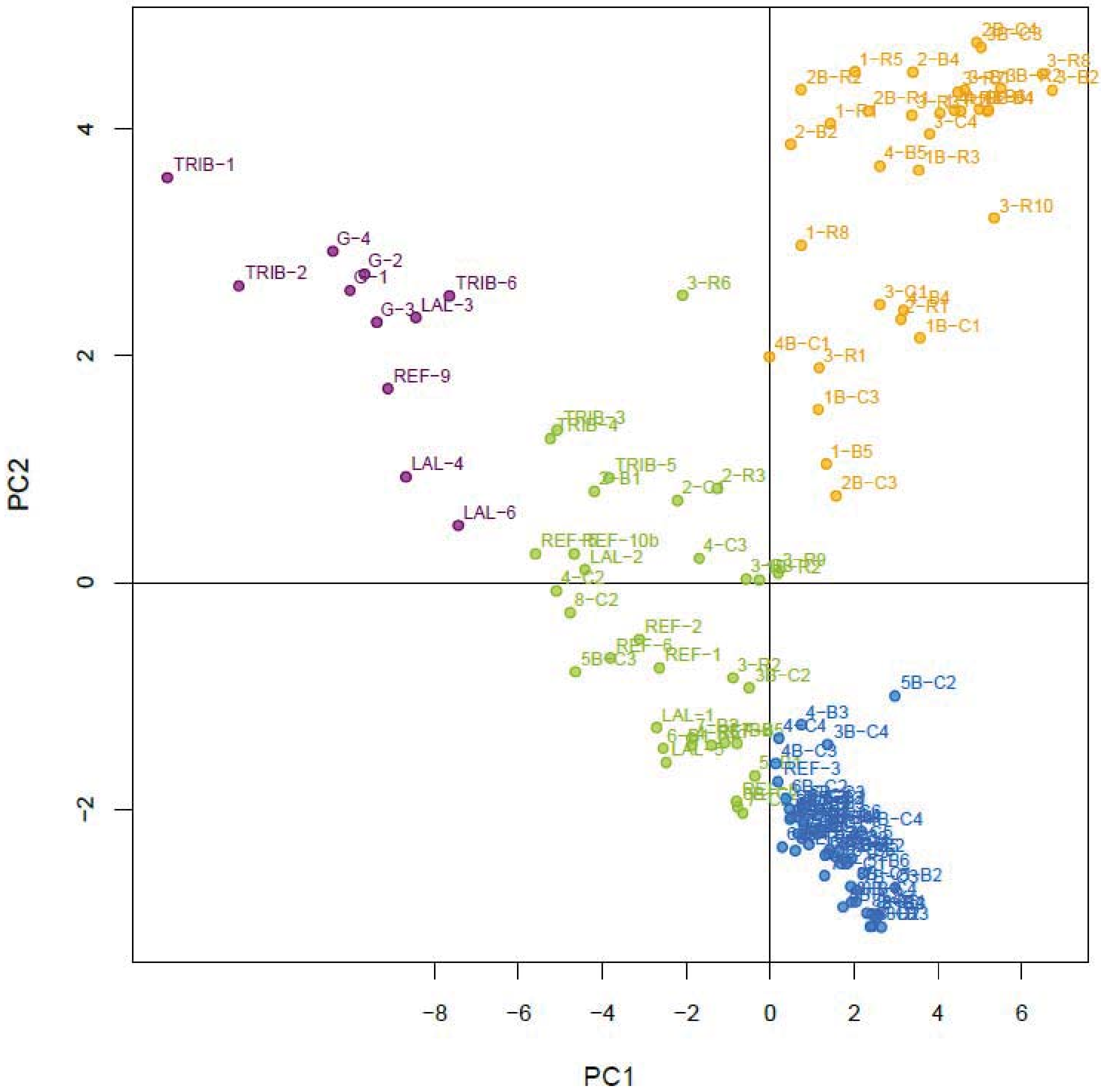


Figure 2. Results from PCA of field sediment chemistry. The first two PCs account for 86% of the variance in this data set. Symbol color represents the group membership of each location, as determined by the results of an HCA.

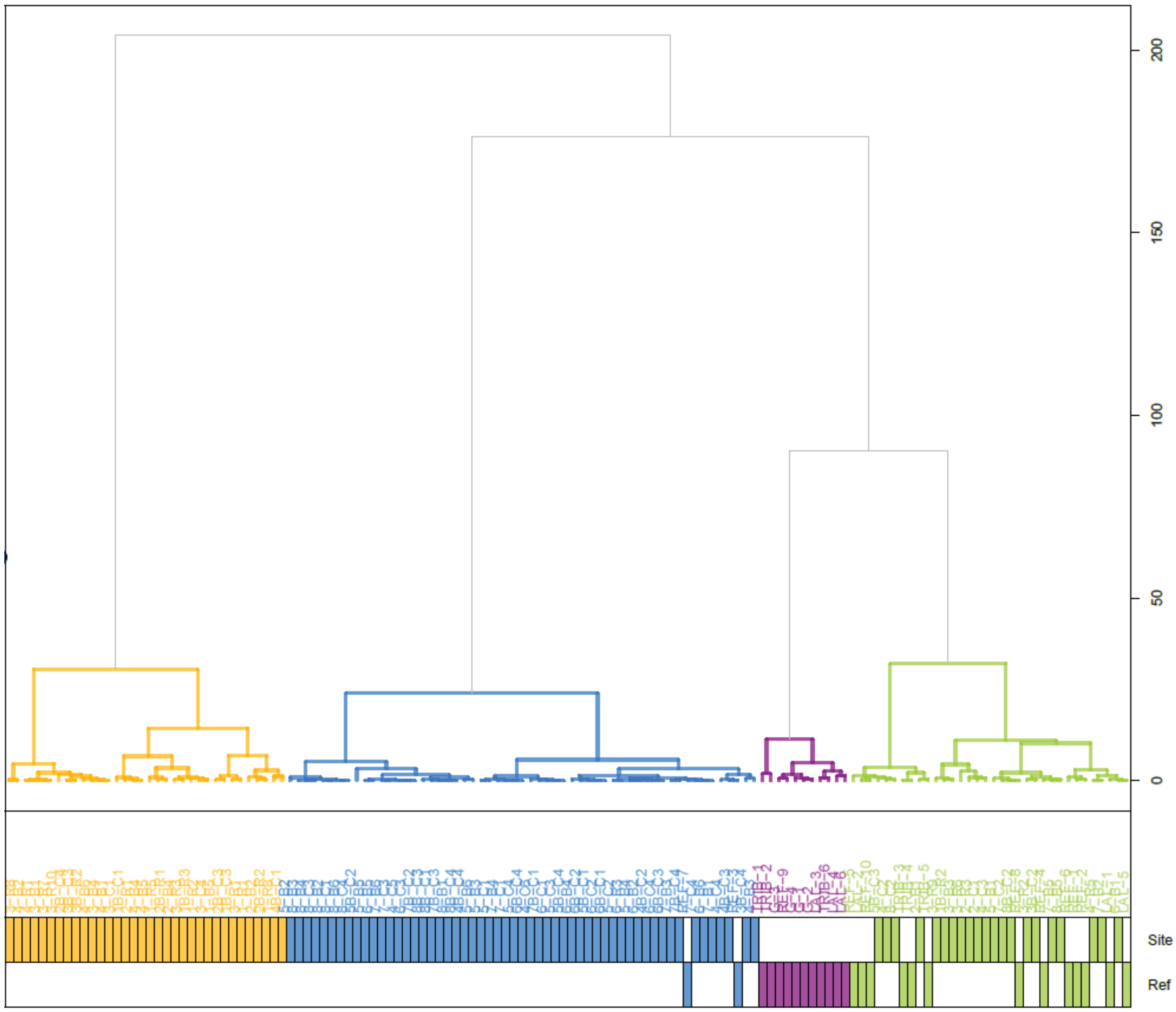


Figure 3. Tree diagram depicting results of the HCA for UCR sediment chemistry samples, based on principal components shown in Figure 2.

APPENDIX B4

LETTER TO TAI FROM EPA WITH COMMENTS ON PROPOSED LONG-TERM BIOASSAY SAMPLE SELECTION (OCTOBER 8, 2014)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
HANFORD/INL PROJECT OFFICE
309 Bradley Boulevard, Suite 115
Richland, Washington 99352

October 8, 2014

Kris McCaig
Project Manager
Teck American Incorporated
501 North Riverpoint Boulevard, Suite 300
Spokane, Washington 99202

Re: Long-Term Toxicity Test Sample Selection

VIA ELECTRONIC MAIL ONLY

Dear Ms. McCaig,

Enclosed is EPA's review of TAI's proposed sample selection for the long-term toxicity tests and our recommendations for changes.

Sincerely,

Laura C. Buelow
Project Manager

Enclosure (1)

cc: Dan Audet, U.S. Department of Interior (electronic)
Patti Bailey, Confederated Tribes of the Colville Reservation (electronic)
Randy Connolly, Spokane Tribe of Indians (electronic)
John Roland, Washington Department of Ecology (electronic)

EPA Comments on Long-Term Toxicity Test Sample Selection

Introduction

Sediment samples were collected from the Upper Columbia River (UCR), Washington, in the fall of 2013 to develop chemistry and benthic invertebrate toxicity data for use in a baseline ecological risk assessment (BERA). Initial shorter-term (i.e., 10 – 28 day) benthic invertebrate toxicity testing with larvae of the freshwater midge (*Chironomus dilutus)* and an amphipod (*Hyalella azteca*) was completed on 69 sediment samples (including 19 targeted reference sediments) to assess effects on survival and growth. These preliminary (i.e., draft and un-validated) data were evaluated to inform selection of site samples and reference samples for longer-term (L-T) reproductive sediment toxicity tests with both species as described in the Final Quality Assurance Project Plan (QAPP) for Phase 2 UCR Sediment Sampling (TAI, 2013). These draft data are considered sufficient for the purpose of selecting samples for L-T testing.

Proposed samples to be used for L-T toxicity tests and a rationale for their selection are described in a memorandum prepared by HDR et al. (2014) for Teck American Incorporated (TAI) and shared with the United States Environmental Protection Agency (EPA) on June 30th, 2014. Eighteen site sediments and 6 reference sediments were proposed. This memorandum describes EPA's initial review of the shorter-term toxicity test data and consideration of the samples proposed for L-T toxicity testing in the HDR memorandum and the rationale for EPA's recommended changes to the sample list.

EPA's recommendations for the reference and site samples to be evaluated using L-T sediment toxicity tests differ from those proposed by HDR et al. (2014) as follows:

Reference Samples G-1, ~~G-2,~~ G-3*, ~~G-4,~~ ~~LAL-1,~~ LAL-3, LAL-5, Trib-3*, Ref10-b*

Site Samples 1-B5, 1B-R2, 1-R2, 2-B1, 2-R1, 3-B3, 3-R7, 3-R8, 4-B1, 4-B5, 4-B6*, 5-B2, 5-B4, 6-B2, 6-B5, 7-B2, 7-B5, 8-B2, 8-B3

* EPA recommended alternative sample

EPA Review of Proposed Samples for Longer-Term Toxicity Tests

Approach

The QAPP (Page B-5) states that the L-T sample selection process will target samples according to the following:

(1) Low to moderate toxicity response in short-term studies;
(2) High metal concentrations in porewater or bulk sediment; and/or,
(3) A range of sediment and porewater characteristics.

The QAPP also specifies that preference will be given to samples from stations located within high-medium exposure gradients.

HDR et al. (2014) provides a detailed evaluation of the data and proposed samples for L-T toxicity testing that meets these QAPP goals. EPA independently evaluated the shorter-term toxicity test data, and considered the proposed samples for L-T testing through graphical analyses of these data with a goal of identifying potential bias or data gaps.

Initial Data Evaluation

Preliminary results from shorter-term sediment toxicty test data assessed to determine if they were usable for selecting samples for L-T testing and to identify any potential concerns or questions about the data that would affect or inform L-T sample selection. We did identify some minor data corrections and concerns over the variability in responses among the control sample results that led us to evaluate the data differently than HDR et al. (2014). Despite these data assessment differences we determined that they are usable for L-T toxicity test sample selection and we are working to address the questions that were raised.

A summary of test results (Table 1) was developed based on data downloaded from http://teck-ucr.exponent.com/ on 7/1/14. This summary differs slightly from the data summary presented in HDR et al. (2014) due to inconsistencies in the number of organisms seeded in each replicate. The mean percent control survival presented in HDR et al. (2014) was calculated based on a seeding density of 10 organisms per replicate (as described in the QAPP) but there were 10 replicates (of nearly 700 replicates) where more than 10 organisms were found at test termination. The survival summary results in Table 1 have been adjusted to account for replicates that were seeded with more than 10 organisms.

Toxicity tests were performed by Pacific EcoRisk (PER) over 6 batches due to the high number of samples that were tested. Each batch consisted of 11 or 12 site and reference sediments and 3 controls (PER control sediment, quartz sand, and a control sediment from the US Army Engineer Research and Development Center ERDC]). Organism responses (i.e., survival, growth, or biomass) in the toxicity tests were control-normalized to account for differences in organism sensitivity between batches and to establish an even footing for comparing results between batches. HDR et al. (2014) presents control-normalized organism responses that were calculated by dividing the mean organism response for each sample by the mean control response among the 3 controls tested in each batch (Figures 1a through 1f). This may not be appropriate because some of these controls did not meet Test Acceptability Criteria (TAC) for survival as described in the QAPP. Midge survival in the ERDC control sediment (batch 4) was only 66% and did not meet the 70% TAC. Likewise, *Hyalella* survival in the ERDC control sediment (batch 1) was 31% and did not meet the 80% TAC (Table 1).

Hyalella growth in ERDC control sediment (0.287 mg dry weight /organism; batch 5) was below the goal for control growth of 0.40 mg dry weight /organism. Poor *Hyalella* growth was not limited to ERDC control sediment as both the quartz sand and PER control sediment also did not meet this growth goal in one of the tested batches. Reasons for these poor control results are being discussed but for this evaluation it was not considered appropriate to include controls that did not meet TAC as part of the mean control response. All ERDC control results were therefore excluded from control normalization calculations until their inconsistent biological responses are better understood. Control-normalized data excluding the ERDC controls are presented in Table 2 and summary plots indicating sample selection for longer-term toxicity tests are shown in Figures 2 through 4.

This recalculation helps to address an apparent batch bias due to low control responses. For example, poor *Hyalella* survival in the batch 1 ERDC control sediment lowered the mean *Hyalella* control survival to 75% (Table 1). Most batch 1 samples outperformed this mean control result and therefore control normalized data were biased high when all controls were included in these calculations (see Figure 1d; note the data points with a 'halo' to identify batch 1). The batch 1 mean *Hyalella* control survival increases ~20% to 97% when ERDC controls are excluded from control normalization (see Figure 2d). Similarly, poor midge survival in ERDC control batches 4 (66%) and 6 (71%) suppressed control means (see Figures 1a and 2b) but these did not affect normalized data as much as for the *Hyalella*. Finally, poor *Hyalella* growth in batch 5 (ERDC and PER control sediments) suppressed control means but didn't cause a high bias in control normalized results (probably because all the *Hyalella* in the batch didn't grow well; see Figures 1e and 1f relative to Figures 2e and 2f).

Test acceptability criteria for midge growth described in the QAPP (TAI 2013) included mean midge weights of 0.48 mg ash free dry weight (AFDW)/organism at test termination and this was met in all controls (Table 1). Midge weights at test initiation were close to the goal of average starting weight of 0.12 mg AFDW/organism and only exceeded this weight in 4 of 48 replicates (all in batch 1). The mean midge weight in each of 8 replicates at the start of each batch are reported in the database and indicate an overall mean size of 0.074 mg AFDW/organism (± 0.031 [standard deviation]) with a minimum and maximum of 0.024 and 0.15 mg AFDW/organism, respectively.

Hyalella starting weights were below the goal of 0.02 – 0.035 mg/organism in 35 of 48 replicates reported, whereas only 3 replicates were above the goal. The overall mean *Hyalella* weights at test initiation were 0.017 mg (dry weight basis)/organism (± 0.009 [standard deviation]) with a minimum and maximum of 0.006 and 0.055 mg/organism, respectively. These relatively small starting organism sizes may have influence their ability to consistently meet the growth goal of 0.4 mg dry weight/organism. The impacts of relatively large midge and variable and/or relatively small *Hyalella* will be considered further as data analyses continue.

Recommended Changes to the Proposed Longer-Term Toxicity Test Sample List

Sample selection for L-T toxicity testing was evaluated based on control normalized shorter-term toxicity data calculated as described above.

Reference Samples

HDR et al. (2014) proposed L-T toxicity testing on 6 reference samples (3 riverine samples from Genelle and 3 lacustrine samples from Lower Arrow Lake). The rationale for selecting these samples was "*to represent a range of ecological conditions, and physical settings encompassed by Site samples.*" Stations with the lowest performance were also excluded to avoid a low bias for reference responses. HDR et al. (2014) also stated that "*Inclusion of reference locations with conditions less conducive to growth in the short-term bioassays could result in a larger reference envelope due to a larger range of possible responses. Therefore, only those reference locations with the most optimal conditions were selected for the long-term bioassays to provide a more conservative estimation of the reference envelope for subsequent comparison of site samples*." This is a reasonable rationale; however, we found that not all of the HDR et al. (2014) proposed reference samples reflected this goal. Shorter-term toxicity tests results from several of the proposed reference sediments had a lower mean response than that of the larger pool of 19 reference samples (excluding those that did not meet the minimum control TAC for survival), as shown in Table 3.

Reference conditions are not required to meet TAC, and should represent a range of reference conditions, but selecting too many poorly performing reference samples – which may have unmeasured properties affecting the test organisms – would not result in a conservative group of reference responses. ASTM (2010) defines reference sediment as"…*a whole sediment near an area of concern used to assess sediment conditions exclusive of material(s) of interest*".

Specific concerns are over sediment from LAL-1 which did not meet the control TAC for midge survival, G-4 which did not meet the control TAC for *Hyalella* survival, and LAL-5 which did not meet the QAPP defined goal for *Hyalella* growth. Poor survival could exclude samples from inclusion in reference envelopes where a minimum of 75% of control survival is required (CH2M HILL 2012; MacDonald et al., 2009). *Hyalella* growth less than the goal of 0.4 mg dry weight/organism in controls (TAI, 2013) was also a concern for samples G-4, G-2.

EPA recommends changes to the HDR et al. (2014) proposed reference samples to account for this apparent low bias in reference sample survival and growth. The recommended alternative reference samples more closely resemble the mean and range of conditions from reference samples, as well as continuing to target samples representing the "…*range of ecological conditions, and physical settings encompassed by Site samples*." Specifically, 2 samples from Genelle (G-1 and G-3), 2 samples from Lower Arrow Lake (LAL-3 and LAL-5), a tributary reference (Trib-3), and an internal (reservoir) reference (Ref 10b) are recommended as reference samples for L-T toxicity testing. These samples more closely reflect the distribution of riverine and lacustrine reference samples, represent a range of responses, and had survival results that met TAC (Figures 5 through 10). Data summary plots with the alternative reference samples are presented in Figures 11 through 13.

We recommend that G-3 be retained as a reference, even though HDR et al. (2014) excluded this sample as a potential reference for L-T testing due to relatively poor performance (i.e., midge weight was only 68% of controls). The sample should be retained because midge growth was still well above the goal of 0.48 mg AFDW/ organism and, unlike G-2 and G-4, the *Hyalella* met the growth goal of 0.4 mg (dry weight).

LAL-5 should also be retained even though it did not meet the growth goal for *Hyalella* controls because it did have good *Hyalella* survival (94% of controls), it represents the lower range of conditions observed in reference sites, and because it was part of batch 5 where the mean of *Hyalella* controls (0.355 mg dry weight /organism;

Table 1) did not meet the growth goal. It will be interesting to see if repeat testing with LAL-5 continues to show relatively low growth as it did when part of batch 5 and this information could be helpful in data interpretation.

Site Samples

The site samples proposed in HDR et al. (2014) for L-T toxicity tests cover the data distributions reasonably well when comparing organism responses to mean Probably Effect Concentration Quotients for cadmium, copper, lead, and zinc (mPECQ), pore water Toxic Units (TUs) , or excess Simultaneously Extracted Metals (SEM), as shown in Figures 2, 3, and 4, respectively. However, as shown in Figures 4d through 4f, two samples (4-B2 and 4-B6), from the Marcus Flat area have high excess SEM (ranging from 32 to 84 in midge exposures and from 40 to 49 in *Hyalella* exposures), but with marginal to no effects (i.e., midge responses were slightly lower than controls and *Hyalella* responses were on par with controls). This same trend is also apparent at relatively high mPECQs, ranging 13 to 14 in these samples (Figures 4d through 4f). Sample 4-B2 was collected from the main river channel at the upstream end of Marcus Flats and 4-B6 was collected from the flats near Welty Bay. EPA recommends adding Sample 4-B6 to fill this data gap.

Sample 4-B6 would be tested in addition to 2 other samples proposed by HDR et al (2014) from the Marcus Flat area. Both of the currently proposed Marcus Flat samples (4-B1 and 4-B5) were collected from the main river channel whereas 4-B6 was collected in the flat area near Welty Bay. The HDR et al. (2014) rationale for selecting 4-B5 was that it was in a location of interest (i.e., thalweg in Marcus Flats) and had moderate SEM (85, 26, and 30 in the field sediment, midge bioassays, and *Hyalella* bioassays, respectively). Similarly, 4-B1 was selected for a "Low(ish)" weight of midge, high BLM Toxic Units, and is found in the thalweg of Marcus Flats. Samples 4-B6 also has moderate SEM (46, 42, and 54 in the field sediment, midge bioassays, and *Hyalella* bioassays, respectively), as shown in Table 2. The elevated mPECQ (14) of 4-B6, low TOC (approximately 0.1%), and location in the flats rather than in the thalweg of Marcus Flats make this a potentially interesting samples for longer-term toxicity testing. Biologically, 4B-6 is located in a different habitat than are 4B-1 and 4B-5 (reservoir inundated near-shore location vs. original river mid-channel thalweg). Biological, physical and chemical properties of near-shore vs. thalweg sediments not measured during the fall 2013 sampling may be sufficiently different as to affect the toxicity of contaminants in these different habitats. Planned electron backscatter analyses for sediment from 4-B6 will provide further data on grain size distribution and metal concentrations to associate with biological responses. Data summary plots that highlight the recommended additional site sample are presented in Figures 11 through 13.

Demonstrating Success for Longer-Term Toxicity Test Controls

EPA has concerns over the inconsistency of control performance among shorter-term toxicity test batches performed by PER and how this inconsistency or failure to meet TAC for all controls in L-T tests could affect data quality and interpretation. Laboratory qualifications reported by TAI (2013) indicate that PER has not conducted L-T toxicity tests with midge since 2010 or with *Hyalella* since 2011. EPA encourages TAI to have PER perform initial L-T toxicity tests with midge and *Hyalella* in control sediments (i.e., PER's control sediment and quartz sand) to demonstrate that TAC can be met and to allow laboratory staff to become reacquainted with the test protocols. Less effort would be needed to conduct this demonstration and practice test protocols than to repeat testing of a batch with site sediments if TAC are not met. TAI has reported to EPA that there are sufficient sediment volumes (i.e., greater than 20 liters) to repeat L-T testing, if needed, for all proposed sediment samples except for one. Only 8 liters of sediment is available from station 3-R8. This should be sufficient for repeat testing (approximately 4 liters are required for L-T testing), if needed, but EPA recommends excluding this sample from the first batch to reduce the risk that any remaining sediment would be needed for repeat testing if controls do not meet TAC before PER becomes more experienced with the L-T testing procedures.

Conclusions and Summary of Recommendations

The conclusions and recommendations of our review are as follows:

- The UCR sediment samples proposed for longer-term toxicity tests (HDR et al., 2014) meet the QAPP direction to target 1) low to moderate toxicity responses in short-term studies; 2) high metal concentrations in porewater or bulk sediment; 3) a range of sediment and porewater characteristics; and to focus on samples with high-medium exposure gradients.
- Alternative reference samples G-3, Trib-3, and Ref-10b are recommended to more closely resemble the mean and range of conditions from reference samples, as well as continuing to target samples representing the "…*range of ecological conditions, and physical settings encompassed by Site samples*."
- One additional site sediment sample from station 4-B6 is recommended for L-T toxicity testing to fill a potential data gap in the dose-response distribution.
- EPA encourages TAIs toxicity testing lab to perform initial L-T toxicity tests with midge and *Hyalella* in control sediments (i.e., PER's control sediment and quartz sand) to demonstrate that TAC can be met.

References

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HDR, Exponent, Inc., and Cardwell Consulting, LLC. 2014. Proposed UCR Phase 2 sediment study long-term bioassay sample selection. Technical Memorandum to Kris McCaig, Teck American Inc., June 30.

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Teck American Inc. (TAI). 2013. Final Quality Assurance Project Plan (QAPP) for Phase 2 UCR Sediment Sampling.

Tables

Table 1. Summary of UCR Phase 2 (2013) Sediment Toxicity Tests by Pacific EcoRisk Lab (uncorrected

Upper Coumbia River Phase 2 Sediment Sampling

			C. dilutus (midge) 10-day bioassay			*H. azteca* 28-day bioassay		
			Survival	Biomass, total	Weight, individual	Survival	Biomass, total	Weight, individual mean
	Sample	Batch	percent	mg (AFDW)	mg (AFDW)	percent	mg (dry weight)	mg (dry weight)
Site Sediment								
* †	1-B5	Batch-4	94%	16.49	1.76	95%	7.84	0.825
*	1B-R2	Batch-6	83%	7.90	0.97	95%	7.08	0.743
†	1-R1	Batch-1	94%	12.00	1.30	100%	6.33	0.633
* †	1-R2	Batch-6	94%	10.85	1.16	75%	3.92	0.522
* †	2-B1	Batch-4	96%	13.70	1.45	96%	6.36	0.662
†	2-B2	Batch-5	93%	13.04	1.41	100% [a]	4.25	0.416
* †	2-R1	Batch-2	99%	16.11	1.64	99%	7.11	0.719
†	2-R3	Batch-3	94%	15.01	1.61	98%	8.03	0.824
*	3-B3	Batch-4	93%	12.21	1.33	66%	3.37	0.514
	3-R1	Batch-3	100%	10.86	1.09	95%	7.49	0.787
	3-R2	Batch-1	95%	17.00	1.85	73%	5.50	0.766
* †	3-R7	Batch-4	88%	14.80	1.70	98%	4.41	0.448
* †	3-R8	Batch-3	84%	6.42	0.75	94%	4.96	0.529
†	3-R9	Batch-5	95%	17.24	1.84	96%	3.41	0.356
* †	4-B1	Batch-5	90%	11.95	1.36	88%	2.45	0.277
†	4-B2	Batch-2	99%	14.89	1.51	96%	7.13	0.738
	4-B3	Batch-6	73%	10.33	1.42	88%	5.60	0.638
†	4-B4	Batch-2	96%	11.58	1.20	93% [a]	6.04	0.641
* †	4-B5	Batch-6	91%	10.79	1.19	90%	5.75	0.623
†	4-B6	Batch-1	90%	11.56	1.34	98%	7.38	0.758
	5-B1	Batch-1	78%	12.93	1.71	91% [a]	6.56	0.709
* †	5-B2	Batch-5	86%	12.77	1.50	94%	3.00	0.320
	5-B3	Batch-2	44%	10.52	2.50	96%	7.15	0.744
*	5-B4	Batch-3	36%	6.70	2.00	100%	7.67	0.767
	5-B5	Batch-4	78%	12.82	1.68	94%	7.39	0.781
	5-B6	Batch-4	80%	12.15	1.55	95%	8.35	0.881
	6-B1	Batch-5	79%	9.37	1.20	91%	2.89	0.320
*	6-B2	Batch-6	83%	5.75	0.70	91%	6.40	0.711
†	6-B4	Batch-3	35%	7.22	1.86	98%	7.52	0.766
*	6-B5	Batch-2	59%	10.86	2.06	96%	7.43	0.772
	6-B6	Batch-1	75%	12.06	1.70	96%	7.52	0.782
	6-R3	Batch-1	80%	12.35	1.55	96%	7.11	0.740
†	7-B1	Batch-6	66%	9.54	1.47	99%	7.37	0.747
*	7-B2	Batch-3	46%	7.93	1.88	98%	7.71	0.792
	7-B3	Batch-4	89%	11.96	1.35	98%	8.30	0.853
	7-B4	Batch-5	61%	11.82	1.94	96% [a]	4.09	0.414
*	7-B5	Batch-5	89%	12.95	1.47	79%	2.02	0.258
	7-B6	Batch-4	64%	9.75	1.59	99%	7.49	0.759
	8-B1	Batch-5	74%	10.80	1.48	96%	3.50	0.363
*	8-B2	Batch-6	96%	8.13	0.85	91%	6.25	0.685
* †	8-B3	Batch-1	84%	12.25	1.49	95%	6.09	0.643
	8-B4	Batch-1	79%	11.76	1.51	95%	6.62	0.697
	8-B5	Batch-6	86%	10.92	1.28	96%	7.13	0.743
	8-B6	Batch-6	80%	10.46	1.34	94%	5.32	0.566
Reference								
*	G-1	Batch-1	94%	13.95	1.49	84%	5.74	0.602
*	G-2	Batch-5	86%	11.83	1.37	88%	2.87	0.324
	G-3	Batch-6	99%	8.52	0.86	98%	4.72	0.482
*	G-4	Batch-4	95%	11.23	1.19	79%	0.94	0.112
*	LAL-1	Batch-2	64%	11.76	1.87	98%	6.47	0.666
	LAL-2	Batch-2	95%	16.51	1.74	99%	7.90	0.799
*	LAL-3	Batch-2	93%	15.33	1.66	98%	7.89	0.805
	LAL-4	Batch-3	99%	14.33	1.45	90%	3.17	0.348
* †	LAL-5	Batch-5	78%	13.04	1.75	89% [a]	2.43	0.265
	LAL-6	Batch-2	99%	15.79	1.60	96%	7.36	0.763
	REF-1	Batch-3	61%	11.64	1.94	100%	8.30	0.830
	REF-10b	Batch-3	95%	11.22	1.18	100%	7.49	0.749
	REF-2	Batch-4	80%	12.16	1.56	96%	6.72	0.699
†	REF-3	Batch-3	60%	10.51	1.86	99%	7.22	0.731

Table 1. Summary of UCR Phase 2 (2013) Sediment Toxicity Tests by Pacific EcoRisk Lab (uncorrected

Upper Coumbia River Phase 2 Sediment Sampling

		C. dilutus (midge) 10-day bioassay			*H. azteca* 28-day bioassay		
		Survival	Biomass, total	Weight, individual	Survival	Biomass, total	Weight, individual mean
Sample	Batch	percent	mg (AFDW)	mg (AFDW)	percent	mg (dry weight)	mg (dry weight)
REF-4	Batch-2	85%	11.78	1.40	93%	6.82	0.733
REF-5	Batch-5	93%	12.56	1.36	95%	2.92	0.309
REF-6	Batch-1	93%	15.88	1.72	98%	7.21	0.738
REF-7	Batch-3	69%	11.02	1.67	99%	7.94	0.804
REF-8	Batch-2	75%	11.37	1.56	96%	6.68	0.695
TRIB-1	Batch-5	89%	11.62	1.33	99%	5.51	0.557
TRIB-2	Batch-4	95%	15.46	1.72	88% [a]	6.47	0.698
TRIB-3	Batch-3	100% [a]	15.73	1.56	100%	7.26	0.726
TRIB-4	Batch-1	89%	15.43	1.81	96%	6.52	0.676
TRIB-5	Batch-4	98%	14.51	1.49	100%	7.96	0.796
TRIB-6	Batch-6	85%	7.37	0.87	98%	7.88	0.808
Controls							
CTL-ERDC-B1	Batch-1	95%	14.13	1.49	31%	1.64	0.542
CTL-ERDC-B2	Batch-2	94%	15.16	1.62	96%	6.78	0.706
CTL-ERDC-B3	Batch-3	99%	12.40	1.26	96%	7.18	0.748
CTL-ERDC-B4	Batch-4	66%	11.82	1.87	90%	5.39	0.595
CTL-ERDC-B5	Batch-5	84%	13.42	1.66	88%	2.51	0.287
CTL-ERDC-B6	Batch-6	71%	10.33	1.51	96%	7.18	0.747
CTL-QS-B1	Batch-1	96%	13.25	1.38	94%	5.28	0.554
CTL-QS-B2	Batch-2	98%	14.24	1.46	98%	5.85	0.603
CTL-QS-B3	Batch-3	98%	12.60	1.29	99%	5.62	0.570
CTL-QS-B4	Batch-4	95%	11.57	1.23	96%	5.98	0.622
CTL-QS-B5	Batch-5	96%	10.21	1.06	93%	3.75	0.401
CTL-QS-B6	Batch-6	100%	11.37	1.14	94%	3.42	0.363
CTL-SS-B1	Batch-1	95%	15.56	1.65	100%	7.65	0.765
CTL-SS-B2	Batch-2	94%	14.25	1.52	98%	7.25	0.741
CTL-SS-B3	Batch-3	98%	10.32	1.06	93%	5.85	0.628
CTL-SS-B4	Batch-4	99%	13.88	1.41	84%	5.07	0.603
CTL-SS-B5	Batch-5	89%	13.33	1.50	96%	3.67	0.376
CTL-SS-B6	Batch-6	88%	12.33	1.41	96%	6.29	0.658
Mean Control Response							
	batch 1	95%	14.31	1.51	75%	4.86	0.620
	batch 2	95%	14.55	1.53	97%	6.62	0.683
	batch 3	98%	11.77	1.20	96%	6.22	0.649
	batch 4	87%	12.42	1.50	90%	5.48	0.607
	batch 5	90%	12.32	1.41	92%	3.31	0.355
	batch 6	86%	11.34	1.35	95%	5.63	0.589
Mean Control Response (withouth the ERDC controls)							
	batch 1	96%	14.41	1.51	97%	6.47	0.659
	batch 2	96%	14.25	1.49	98%	6.55	0.672
	batch 3	98%	11.46	1.18	96%	5.74	0.599
	batch 4	97%	12.72	1.32	90%	5.53	0.613
	batch 5	93%	11.77	1.28	94%	3.71	0.388
	batch 6	94%	11.85	1.27	95%	4.86	0.510

Notes:

Results reflect raw data and are not control normalized as in the summary table provided by TAI as part of their longer-term toxicity test sample selection memo (TAI Memo to EPA on 6/60/14)

Batch 5 *Hyalella* toxicity tests are reported from a re-test

[a] Survival results included more than 10 individuals in at least one replicate; survial (%) results were manually corrected in this table. Number or organisms seeded must be updated in the database.

* Proposed by TAI (6/30/14 memo to EPA) for Longer-Term Toxicity Tests (n=24)

† Planned Backscatter (n=21)

Highlighted values did not meet the control test acceptability criteria

Table 2. Summary of Control Normalized UCR Phase 2 (2013) Sediment Toxicity Tests by Pacific EcoRisk Lab

Upper Coumbia River Phase 2 Sediment Sample Toxicity

		C. dilutus (midge) 10-day bioassay			H. azteca 28-day bioassay				Sediment and Pore Water Metal Summary Data from HDR et al., 2014 (Table 3 dated 6/30/14)									
			Growth			Growth												
Sample	**Batch**	Survival	Biomass, total (AFDW)	Weight, individual (AFDW)	Survival	Biomass, total DW	Weight, individual	MPECQ4	Field Excess SEM	CD10 Excess SEM	CD10 BLM Sum TU (WQC)	HA28 Excess SEM	HA28 BLM Sum TU (WQC)	Scaled CD10 Excess SEM	Scaled CD10 BLM Sum TU (~WQC)	Scaled HA28 Excess SEM	Scaled HA28 BLM Sum TU (~WQC)	Sed Chem Index (Average)
Site Sediment																		
* † 1-B5	Batch-4	97%	130%	134%	106%	142%	135%	3.64	17.384	16.512	0.060	33.522	0.071	0.151	0.013	0.349	0.020	0.133
* 1B-R2	Batch-6	88%	67%	76%	100%	146%	146%	1.92	14.868	17.005	4.623	15.746	2.890	0.155	1.000	0.164	0.830	0.537
† 1-R1	Batch-1	98%	83%	86%	103%	98%	96%	5.66	18.702	16.077	0.258	30.372	0.559	0.147	0.056	0.316	0.160	0.170
* † 1-R2	Batch-6	100%	92%	91%	79%	81%	102%	10.59	55.354	76.376	0.216	49.150	0.405	0.698	0.047	0.512	0.116	0.343
* † 2-B1	Batch-4	99%	108%	110%	107%	115%	108%	0.48	2.696	1.981	0.024	2.980	0.072	0.018	0.005	0.031	0.021	0.019
† 2-B2	Batch-5	100%	111%	110%	106%	115%	107%	3.89	23.144	24.721	0.058	17.176	0.498	0.226	0.013	0.179	0.143	0.140
* † 2-R1	Batch-2	103%	113%	110%	101%	109%	107%	7.12	27.296	21.070	0.105	14.759	0.247	0.192	0.023	0.154	0.071	0.110
† 2-R3	Batch-3	96%	131%	137%	102%	140%	138%	1.67	12.439	12.942	0.322	17.626	0.387	0.118	0.070	0.183	0.111	0.121
* 3-B3	Batch-4	95%	96%	101%	74%	61%	84%	1.60	6.350	9.689	0.092	14.089	0.161	0.089	0.020	0.147	0.046	0.075
3-R1	Batch-3	103%	95%	92%	99%	131%	131%	3.65	17.628	26.754	0.052	24.644	0.306	0.244	0.011	0.257	0.088	0.150
3-R2	Batch-1	99%	118%	122%	75%	85%	116%	1.18	10.080	7.712	0.016	11.869	0.133	0.070	0.003	0.124	0.038	0.059
* † 3-R7	Batch-4	90%	116%	129%	108%	80%	73%	12.79	41.908	32.181	0.445	49.143	0.578	0.294	0.096	0.512	0.166	0.267
* † 3-R8	Batch-3	86%	56%	64%	98%	86%	88%	19.39	77.702	109.456	1.680	96.062	0.888	1.000	0.363	1.000	0.255	0.655
† 3-R9	Batch-5	103%	146%	143%	102%	92%	92%	2.25	14.764	16.125	0.181	14.233	0.416	0.147	0.039	0.148	0.119	0.114
* † 4-B1	Batch-5	97%	102%	106%	93%	66%	71%	14.03	136.035	84.036	1.000	40.250	1.000	0.768		0.419		0.593
† 4-B2	Batch-2	103%	105%	101%	99%	109%	110%	12.82	22.953	28.286	0.314	62.011	0.291	0.258	0.068	0.646	0.084	0.264
4-B3	Batch-6	77%	87%	112%	92%	115%	125%	1.49	8.495	9.447	0.041	9.640	0.293	0.086	0.009	0.100	0.084	0.070
† 4-B4	Batch-2	101%	81%	81%	95%	92%	95%	8.19	6.973	4.049	0.022	13.679	0.092	0.037	0.005	0.142	0.026	0.053
* † 4-B5	Batch-6	97%	91%	93%	95%	118%	122%	9.57	84.856	26.027	1.000	29.588	1.000	0.238		0.308		0.273
† 4-B6	Batch-1	94%	80%	88%	101%	114%	115%	14.34	46.109	41.607	1.069	54.426	0.959	0.380	0.231	0.567	0.276	0.363
5-B1	Batch-1	81%	90%	113%	94%	101%	108%	0.67	1.170	2.596	0.057	3.801	0.495	0.024	0.012	0.040	0.142	0.054
* † 5-B2	Batch-5	93%	109%	117%	99%	81%	82%	2.17	3.361	11.597	0.067	11.484	0.556	0.106	0.014	0.120	0.160	0.100
5-B3	Batch-2	46%	74%	167%	99%	109%	111%	0.96	3.377	2.649	0.048	3.372	0.133	0.024	0.010	0.035	0.038	0.027
* 5-B4	Batch-3	37%	58%	170%	105%	134%	128%	0.93	2.600	3.587	0.096	6.270	0.263	0.033	0.021	0.065	0.076	0.049
5-B5	Batch-4	80%	101%	127%	104%	134%	127%	1.25	2.660	2.157	0.060	6.067	0.202	0.020	0.013	0.063	0.058	0.038
5-B6	Batch-4	83%	95%	117%	106%	151%	144%	1.67	2.591	4.573	0.124	4.696	0.299	0.042	0.027	0.049	0.086	0.051
6-B1	Batch-5	85%	80%	93%	97%	78%	82%	0.29	0.653	0.915	0.165	1.494	0.445	0.008	0.036	0.016	0.128	0.047
* 6-B2	Batch-6	88%	49%	55%	96%	132%	139%	0.87	-10.114	-12.488	0.029	-3.219	0.079	0.000	0.006	0.000	0.023	0.007
† 6-B4	Batch-3	36%	63%	158%	102%	131%	128%	1.43	3.144	4.942	0.543	5.966	3.481	0.045	0.118	0.062	1.000	0.306
* 6-B5	Batch-2	61%	76%	138%	99%	114%	115%	2.06	10.971	14.142	0.509	12.900	3.161	0.129	0.110	0.134	0.908	0.320
6-B6	Batch-1	78%	84%	113%	99%	116%	119%	0.69	1.380	1.747	0.044	2.613	0.313	0.016	0.010	0.027	0.090	0.036
6-R3	Batch-1	84%	86%	102%	99%	110%	112%	0.64	1.518	2.561	0.081	3.343	0.686	0.023	0.018	0.035	0.197	0.068
† 7-B1	Batch-6	71%	81%	115%	104%	152%	146%	0.63	2.436	2.368	0.038	2.964	0.145	0.022	0.008	0.031	0.042	0.026
* 7-B2	Batch-3	47%	69%	160%	102%	134%	132%	0.30	1.262	1.022	0.026	0.940	0.086	0.009	0.006	0.010	0.025	0.012
7-B3	Batch-4	92%	94%	103%	108%	150%	139%	0.65	0.823	1.618	0.062	2.079	0.166	0.015	0.013	0.022	0.048	0.024
7-B4	Batch-5	66%	100%	151%	102%	110%	107%	0.63	1.338	1.258	0.041	1.841	0.156	0.011	0.009	0.019	0.045	0.021
* 7-B5	Batch-5	96%	110%	115%	83%	54%	66%	0.37	0.680	1.663	0.026	2.450	0.121	0.015	0.006	0.026	0.035	0.020
7-B6	Batch-4	66%	77%	121%	110%	136%	124%	0.84	2.057	2.899	0.041	3.730	0.150	0.026	0.009	0.039	0.043	0.029
8-B1	Batch-5	80%	92%	116%	102%	94%	93%	1.27	3.380	7.487	0.064	5.479	0.178	0.068	0.014	0.057	0.051	0.048
* 8-B2	Batch-6	100%	69%	67%	96%	129%	134%	1.31	3.193	3.588	0.044	4.911	0.147	0.033	0.010	0.051	0.042	0.034
* † 8-B3	Batch-1	88%	85%	98%	98%	94%	97%	1.57	1.872	5.529	0.064	5.680	0.593	0.051	0.014	0.059	0.170	0.073

Table 2. Summary of Control Normalized UCR Phase 2 (2013) Sediment Toxicity Tests by Pacific EcoRisk Lab

Upper Coumbia River Phase 2 Sediment Sample Toxicity

		C. dilutus (midge) 10-day bioassay			H. azteca 28-day bioassay				Sediment and Pore Water Metal Summary Data from HDR et al., 2014 (Table 3 dated 6/30/14)									
			Growth			Growth												
Sample	**Batch**	Survival	Biomass, total (AFDW)	Weight, individual (AFDW)	Survival	Biomass, total DW	Weight, individual	MPECQ4	Field Excess SEM	CD10 Excess SEM	CD10 BLM Sum TU (WQC)	HA28 Excess SEM	HA28 BLM Sum TU (WQC)	Scaled CD10 Excess SEM	Scaled CD10 BLM Sum TU (~WQC)	Scaled HA28 Excess SEM	Scaled HA28 BLM Sum TU (~WQC)	Sed Chem Index (Average)
8-B4	Batch-1	82%	82%	100%	98%	102%	106%	1.68	4.554	5.205	0.050	7.592	0.647	0.048	0.011	0.079	0.186	0.081
8-B5	Batch-6	92%	92%	101%	101%	147%	146%	0.38	0.665	-0.085	0.018	1.205	0.106		0.004	0.013	0.031	0.012
8-B6	Batch-6	85%	88%	105%	99%	109%	111%	2.23	7.925	8.594	0.091	11.512	0.302	0.079	0.020	0.120	0.087	0.076
Reference																		
* G-1	Batch-1	98%	97%	99%	86%	89%	91%	0.03	0.106	0.138	0.000	0.141	0.000	0.001		0.001		0.001
* G-2	Batch-5	93%	101%	107%	93%	77%	83%	0.04	0.151	0.153	0.089	0.144	0.066	0.001	0.019	0.001	0.019	0.010
G-3	Batch-6	105%	72%	68%	103%	97%	94%	0.04	0.119	0.149	0.140	0.153	0.118	0.001	0.030	0.002	0.034	0.017
* G-4	Batch-4	98%	88%	90%	88%	17%	18%	0.04	0.200	0.150	0.183	0.203	0.137	0.001	0.040	0.002	0.039	0.021
* LAL-1	Batch-2	67%	83%	125%	100%	99%	99%	0.12	0.293	0.423	0.037	0.331	0.155	0.004	0.008	0.003	0.045	0.015
LAL-2	Batch-2	99%	116%	116%	101%	121%	119%	0.09	0.241	-11.993	0.018	-14.189	0.072		0.004	0.000	0.021	0.006
* LAL-3	Batch-2	97%	108%	111%	100%	120%	120%	0.04	0.074	0.094	0.032	0.117	0.066	0.001	0.007	0.001	0.019	0.007
LAL-4	Batch-3	101%	125%	123%	94%	55%	58%	0.06	-0.389	-0.375	0.039	-0.376	0.173		0.008	0.000	0.050	0.015
* † LAL-5	Batch-5	84%	111%	136%	94%	65%	68%	0.13	0.376	0.616	0.085	0.563	0.106	0.006	0.018	0.006	0.030	0.015
LAL-6	Batch-2	103%	111%	107%	99%	112%	114%	0.07	-0.471	-0.521	0.017	-0.364	0.059		0.004	0.000	0.017	0.005
REF-1	Batch-3	63%	102%	165%	105%	145%	139%	0.29	0.691	0.441	0.014	0.893	0.068	0.004	0.003	0.009	0.019	0.009
REF-10b	Batch-3	97%	98%	101%	105%	131%	125%	0.09	0.382	0.411	0.030	0.501	0.082	0.004	0.006	0.005	0.024	0.010
REF-2	Batch-4	83%	96%	119%	107%	122%	114%	0.30	1.170	1.076	0.011	1.468	0.108	0.010	0.002	0.015	0.031	0.015
† REF-3	Batch-3	62%	92%	158%	103%	126%	122%	1.47	6.853	6.640	0.189	7.977	1.147	0.061	0.041	0.083	0.329	0.129
REF-4	Batch-2	89%	83%	94%	95%	104%	109%	0.40	2.265	0.815	0.031	1.300	0.155	0.007	0.007	0.014	0.045	0.018
REF-5	Batch-5	100%	107%	106%	101%	79%	80%	0.10	0.188	0.422	0.281	0.278	0.800	0.004	0.061	0.003	0.230	0.074
REF-6	Batch-1	97%	110%	114%	101%	112%	112%	0.25	0.477	0.754	0.079	0.729	0.523	0.007	0.017	0.008	0.150	0.045
REF-7	Batch-3	71%	96%	142%	103%	138%	134%	0.75	2.353	2.117	0.122	3.636	0.309	0.019	0.026	0.038	0.089	0.043
REF-8	Batch-2	78%	80%	105%	99%	102%	103%	0.57	1.284	2.977	0.641	3.883	1.947	0.027	0.139	0.040	0.559	0.191
TRIB-1	Batch-5	96%	99%	104%	105%	148%	143%	0.01	0.019	0.024	0.041	0.017	0.051	0.000	0.009	0.000	0.015	0.006
TRIB-2	Batch-4	103%	131%	134%	93%	174%	180%	0.01	0.025	0.031	0.022	0.036	0.047	0.000	0.005	0.000	0.013	0.005
TRIB-3	Batch-3	99%	137%	133%	105%	127%	121%	0.07	0.168	0.195	0.012	0.120	0.046	0.002	0.003	0.001	0.013	0.005
TRIB-4	Batch-1	93%	107%	119%	99%	101%	102%	0.07	0.166	0.133	0.020	0.169	0.046	0.001	0.004	0.002	0.013	0.005
TRIB-5	Batch-4	105%	123%	116%	106%	214%	205%	0.10	0.135	0.118	0.019	0.171	0.022	0.001	0.004	0.002	0.006	0.003
TRIB-6	Batch-6	91%	62%	68%	103%	162%	158%	0.09	0.417	0.214	0.009	0.117	0.048	0.002	0.002	0.001	0.014	0.005

Notes:

Toxicity results are presented as a percent of the mean control response (i.e., divided by the mean control response for that batch); ERDC controls were excluded from the control normalization

Batch 5 *Hyalella* toxicity tests are reported from a re-test

* Proposed by TAI (6/30/14 memo to EPA) for Longer-Term Toxicity Tests (n=24)

† Planned Backscatter (n=21)

Table 3. Summary of Shorter-term Toxicity for Reference Samples Proposed for Longer-term Toxicity Tests
Upper Coumbia River Phase 2 Sediment Sample Toxicity

		Raw Data Summary								*Control Normalized[1] Data Summary*					
		Midge (10-day) bioassay				*H. azteca* (28-day) bioassay				Midge (10-day) bioassay			*H. azteca* (28-day) bioassay		
			Growth				Growth				Growth			Growth	
Sample	**Batch**	Survival (percent)	Biomass, individual mean mg (AFDW)	Biomass, total mg (AFDW)	Weight, individual mg (AFDW)	Survival percent	Biomass, individual mean mg (dry weight)	Biomass, total mg (dry weight)	Weight, individual mean mg (dry weight)	Survival percent	Biomass, total mg (AFDW)	Weight, individual mg (AFDW)	Survival percent	Biomass, total DW (% of controls)	Weight, individual (DW) % of controls
Teck Proposed Reference Samples for Longer-Term Toxicity Testing															
* G-1	Batch-1	94%	1.40	14.0	1.49	84%	0.574	5.74	0.602	98%	97%	99%	86%	89%	91%
* G-2	Batch-5	86%	1.18	11.8	1.37	88%	0.287	2.87	0.324	93%	101%	107%	93%	77%	83%
* G-4	Batch-4	95%	1.12	11.2	1.19	79%	0.094	0.94	0.112	98%	88%	90%	88%	17%	18%
* LAL-1	Batch-2	64%	1.18	11.8	1.87	98%	0.647	6.47	0.666	67%	83%	125%	100%	99%	99%
* LAL-3	Batch-2	93%	1.53	15.3	1.66	98%	0.789	7.89	0.805	97%	108%	111%	100%	120%	120%
* † LAL-5	Batch-5	78%	1.30	13.0	1.75	89%	0.243	2.43	0.265	84%	111%	136%	94%	65%	68%
Average Teck Proposed		***84.8%***	***1.29***	***12.9***	***1.56***	***89%***	***0.44***	***4.39***	***0.46***	***89%***	***98%***	***111%***	***93%***	***78%***	***80%***
DRAFT EPA Proposed Reference Samples for Longer-Term Toxicity Testing															
* G-1	Batch-1	94%	1.40	14.0	1.49	84%	0.574	5.74	0.602	98%	97%	99%	86%	89%	91%
G-3	Batch-6	99%	0.85	8.52	0.86	98%	0.472	4.72	0.482	105%	72%	68%	103%	97%	94%
REF-10b	Batch-3	95%	1.12	11.2	1.18	100%	0.749	7.49	0.749	97%	98%	101%	105%	131%	125%
TRIB-3	Batch-3	96%	1.57	15.7	1.56	100%	0.726	7.26	0.726	99%	137%	133%	105%	127%	121%
* LAL-3	Batch-2	93%	1.53	15.3	1.66	98%	0.789	7.89	0.805	97%	108%	111%	100%	120%	120%
* † LAL-5	Batch-5	78%	1.30	13.0	1.75	89%	0.243	2.43	0.265	84%	111%	136%	94%	65%	68%
Average EPA Propos		***92.3%***	***1.30***	***12.96***	***1.42***	***95%***	***0.59***	***5.92***	***0.60***	***97%***	***104%***	***108%***	***99%***	***105%***	***103%***
Average Reference[2]		***90.8%***	***1.31***	***13.12***	***1.46***	***96%***	***0.63***	***6.31***	***0.65***	***96%***	***103%***	***108%***	***100%***	***118%***	***116%***
Average Control3		***93%***	***1.28***	***12.84***	***1.39***	***94%***	***0.56***	***5.57***	***0.59***						

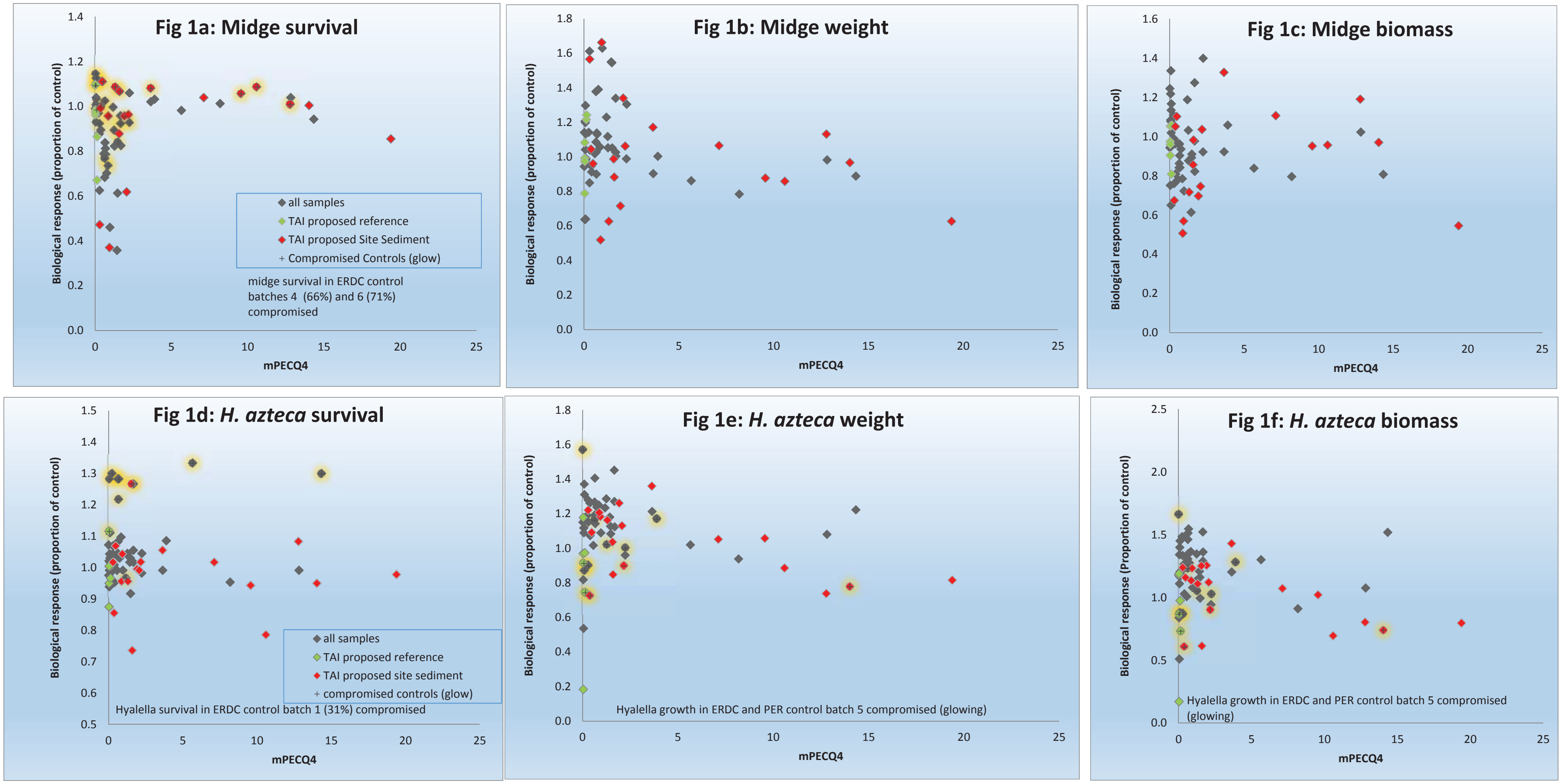
Notes

[1] Refrence sample responses relataive to the mean batch control result (excluding ERDC controls)

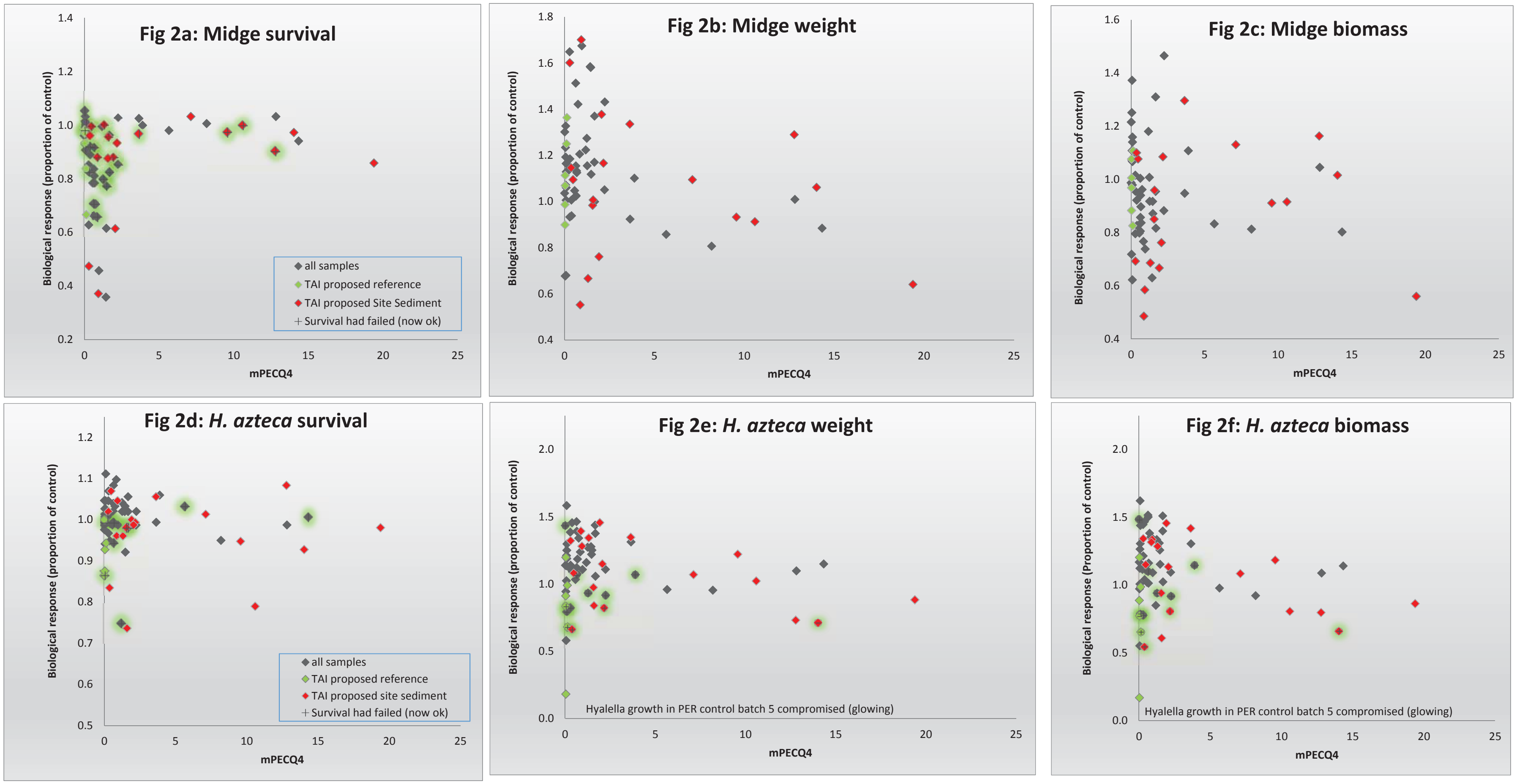
[2] Average reference results excludes samples that did not meet TAC (minimum survival): LAL-1, REF-1, REF-3, and REF-7 for midge and G-4 for *Hyalella*

[3] Average control results excludes samples that failed test acceptability criteria (TAC)

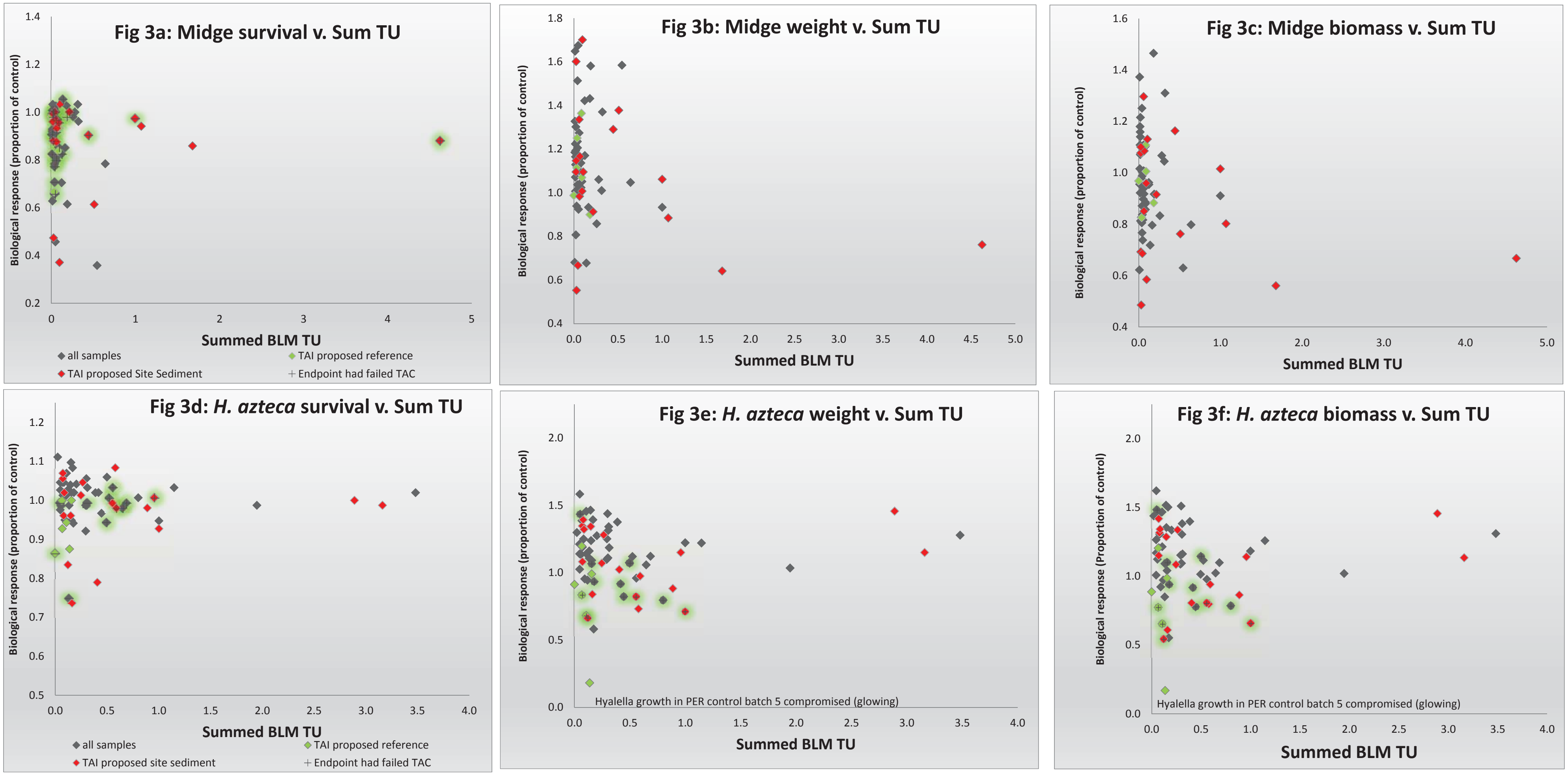
Figures



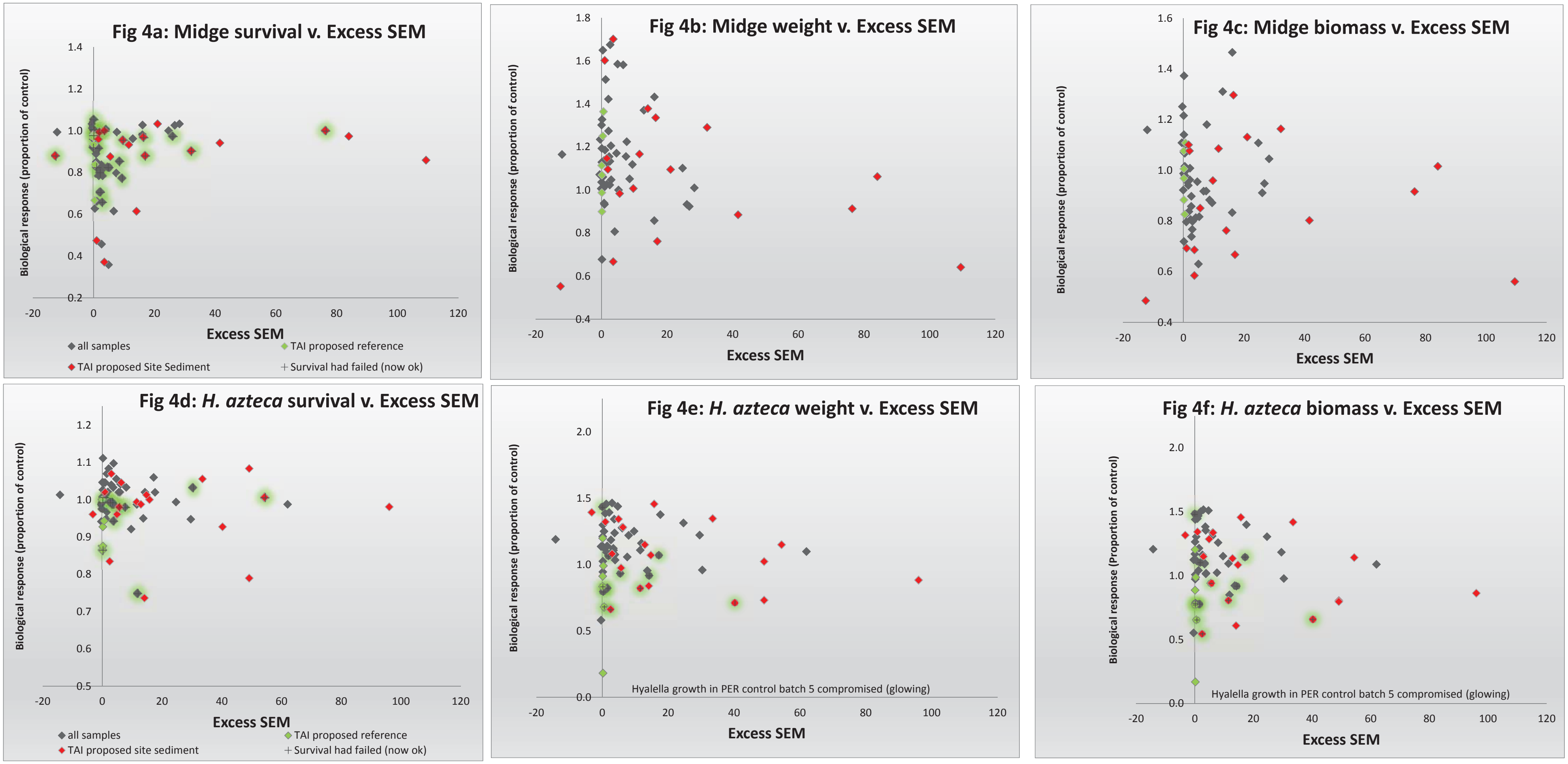
Figures 1a through 1f. UCR Phase 2 sediment toxicity results normalized for controls (average of toxicity endpoint from ERDC control sediment, PER control sediment, and quartz sand control)



Figures 2a through 2f. UCR Phase 2 sediment control normalized toxicity results relative to the mean Probable Effect Concentration Quotients for 4 metals (Cd, Cu, Pb, Zn). **Note that control normalization is based on the average toxicity endpoint from PER control sediment and the quartz sand control; excludes ERDC controls where results are suspected as compromised.**



Figures 3a through 3f - UCR Phase 2 sediment control normalized toxicity results relative to Pore Water Toxic Units - calculated using the Biotic Ligand Model (i.e., ratios of porewater metal concentrations to benchmarks determined using the BLM). **Note that control normalization is based on the average toxicity endpoint from PER control sediment and the quartz sand control; excludes ERDC controls where results are suspected to be compromised.**



Figures 4a through 4f - UCR Phase 2 sediment control normalized toxicity results relative to Excess SEM (Acid Volitile Sulfids - Simultaneously Extracted Metals). **Note that control normalization is based on the average toxicity endpoint from PER control sediment and the quartz sand control; excludes ERDC controls where results are susptected to be compromised.**

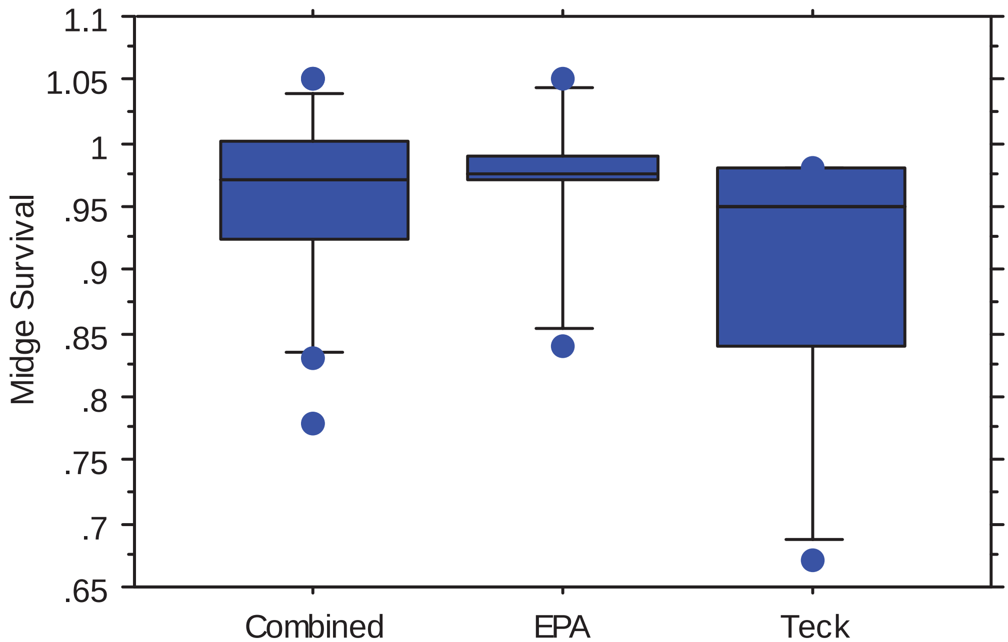


Figure 5. Midge survival (proportion of control response) in all reference samples that met test acceptability criteria for survival (combined), EPAs proposed reference samples for longer-term toxicity testing, and Teck's proposed reference samples for longer-term toxicity testing.

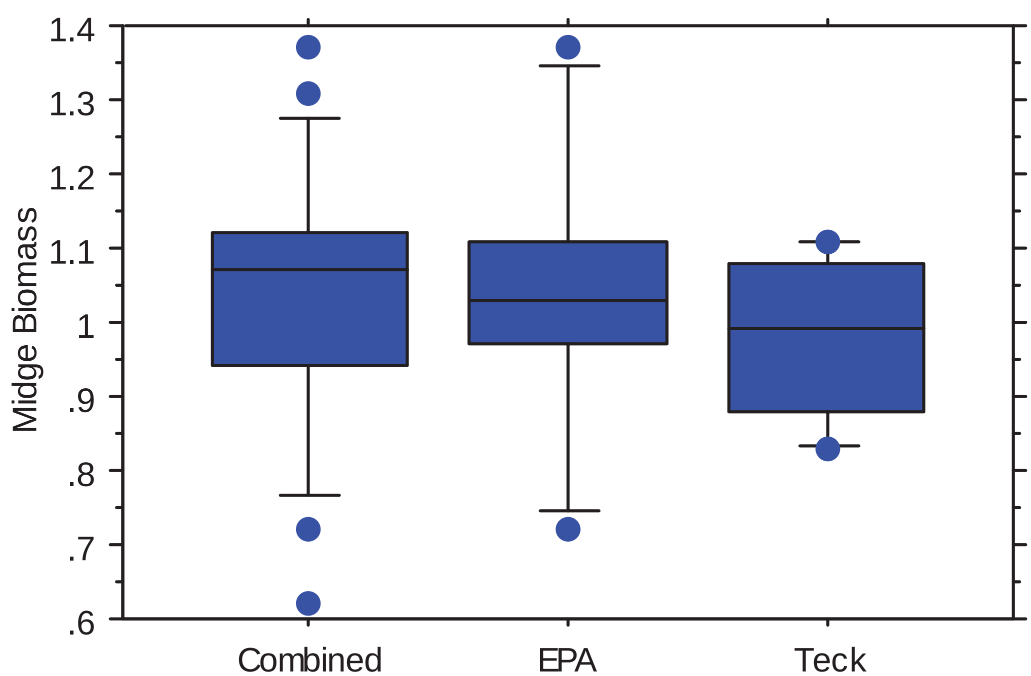


Figure 6. Midge biomass (proportion of control response) in all reference samples that met test acceptability criteria for survival (Combined), EPAs proposed reference samples for longer-term toxicity testing, and Teck's proposed reference samples for longer-term toxicity testing.

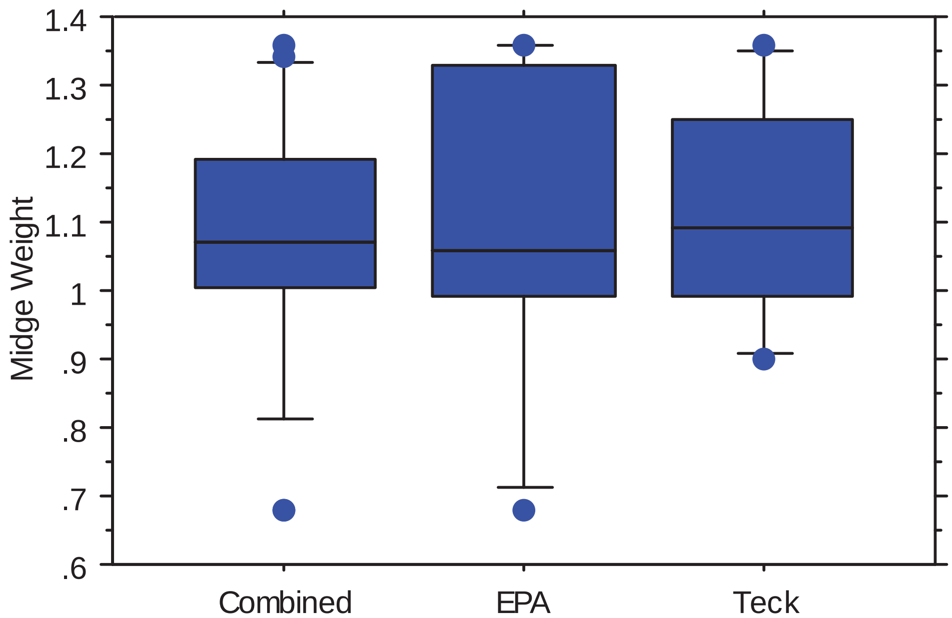


Figure 7. Midge weight (proportion of control response) in all reference samples that met test acceptability criteria for survival (Combined), EPAs proposed reference samples for longer-term toxicity testing, and Teck's proposed reference samples for longer-term toxicity testing.

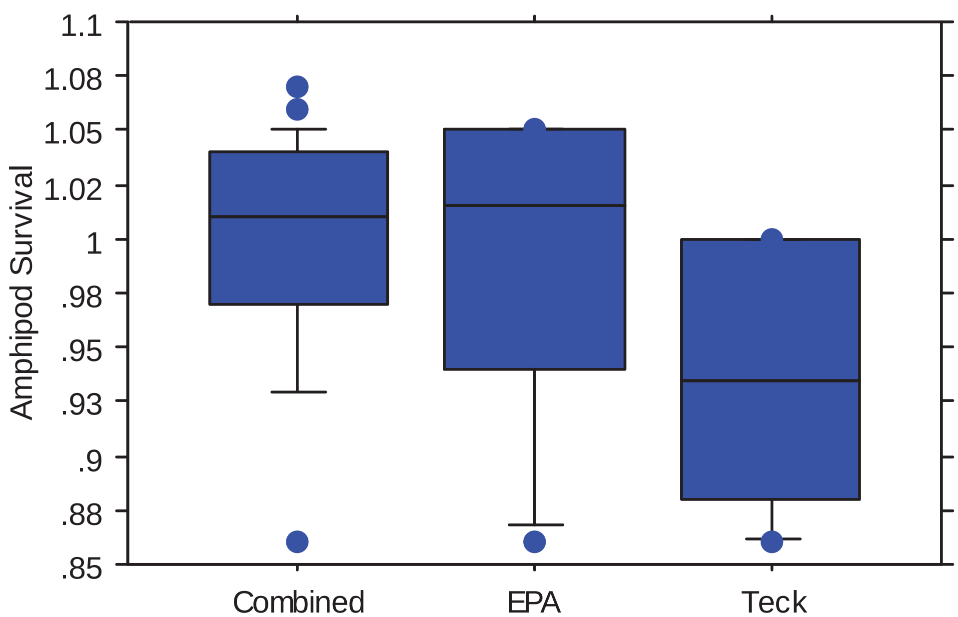


Figure 8. *Hyalella* survival (proportion of control response) in all reference samples that met test acceptability criteria for survival (Combined), EPAs proposed reference samples for longer-term toxicity testing, and Teck's proposed reference samples for longer-term toxicity testing.

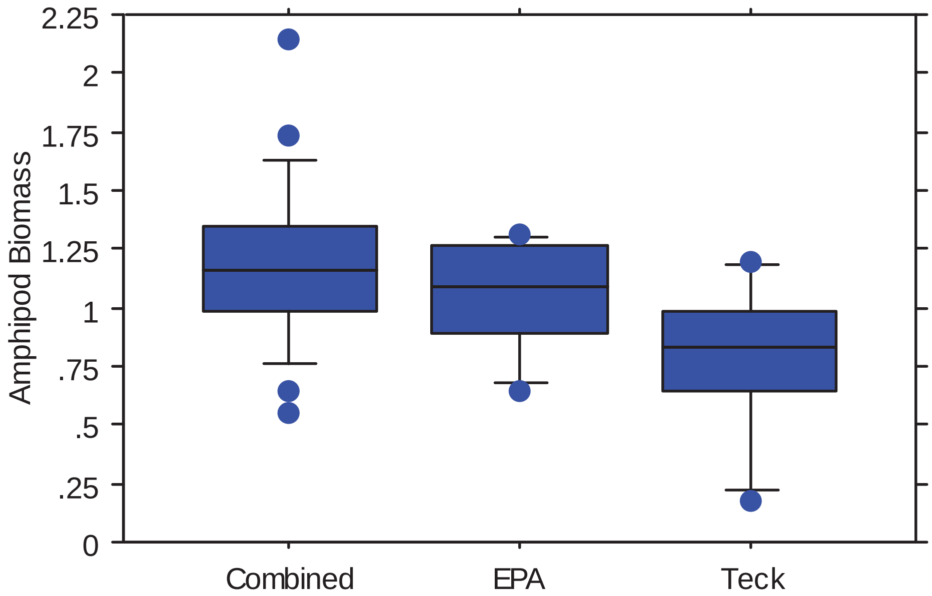


Figure 9. *Hyalella* biomass (proportion of control response) in all reference samples that met test acceptability criteria for survival (Combined), EPAs proposed reference samples for longer-term toxicity testing, and Teck's proposed reference samples for longer-term toxicity testing.

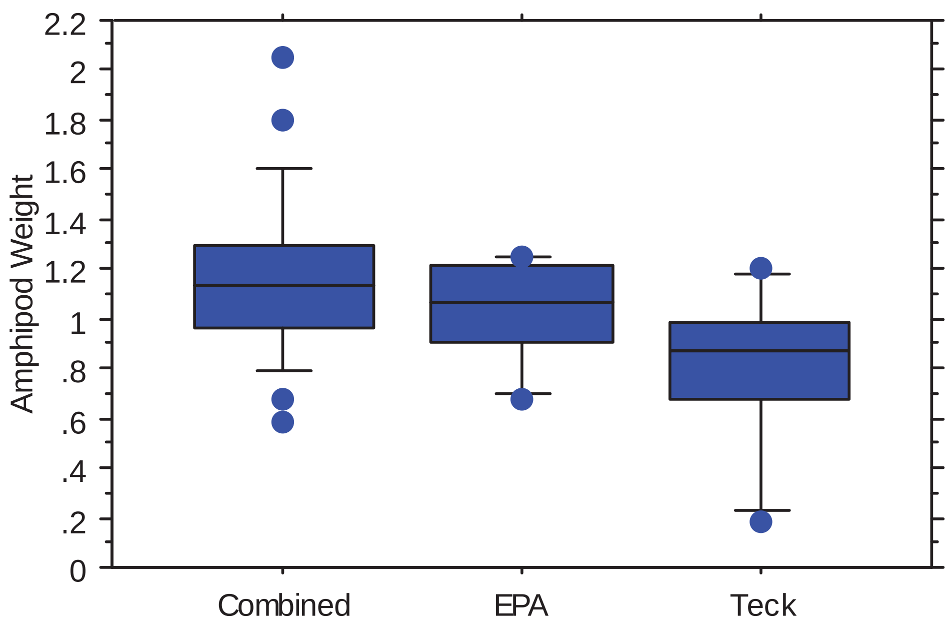
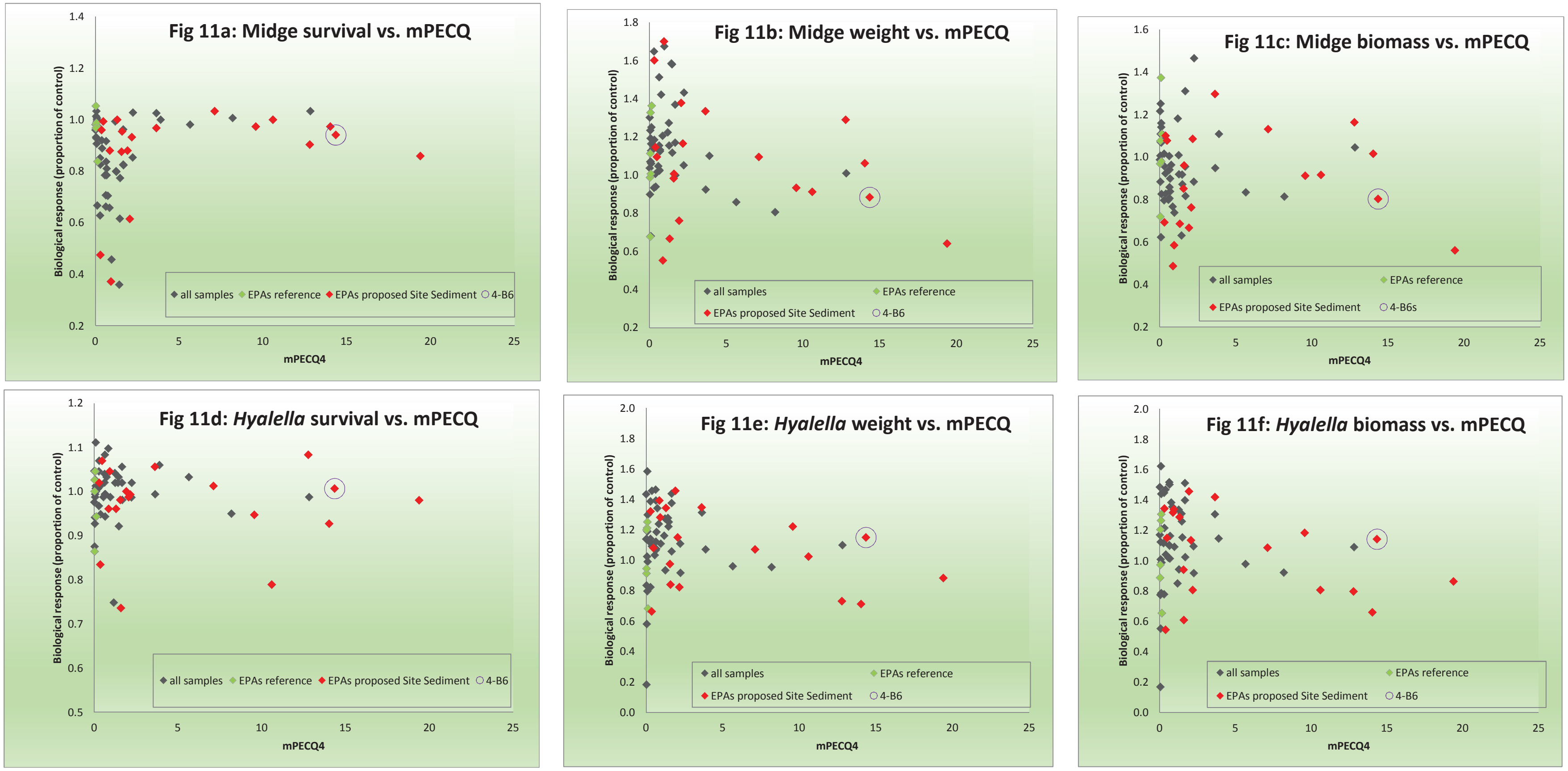
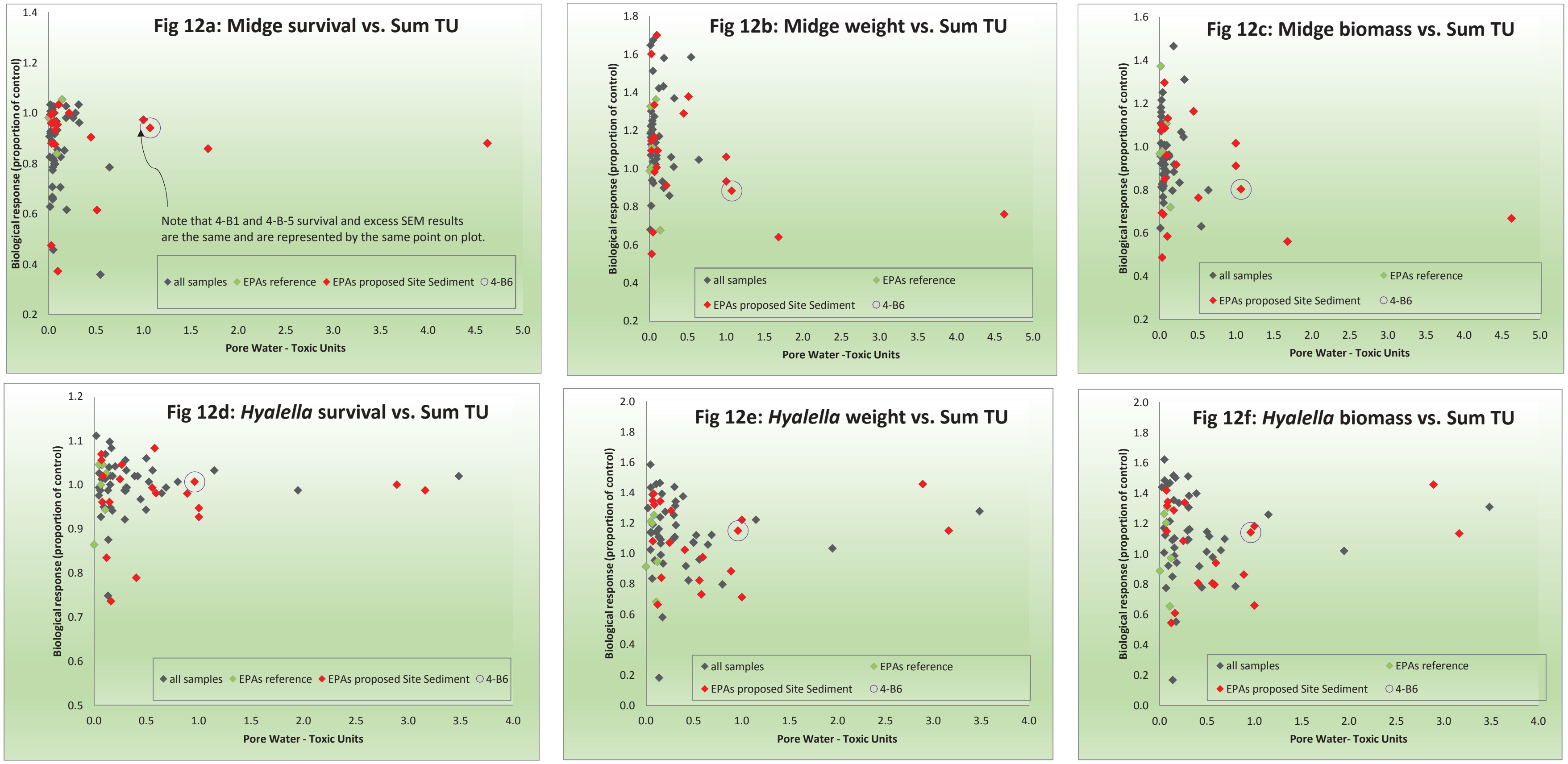


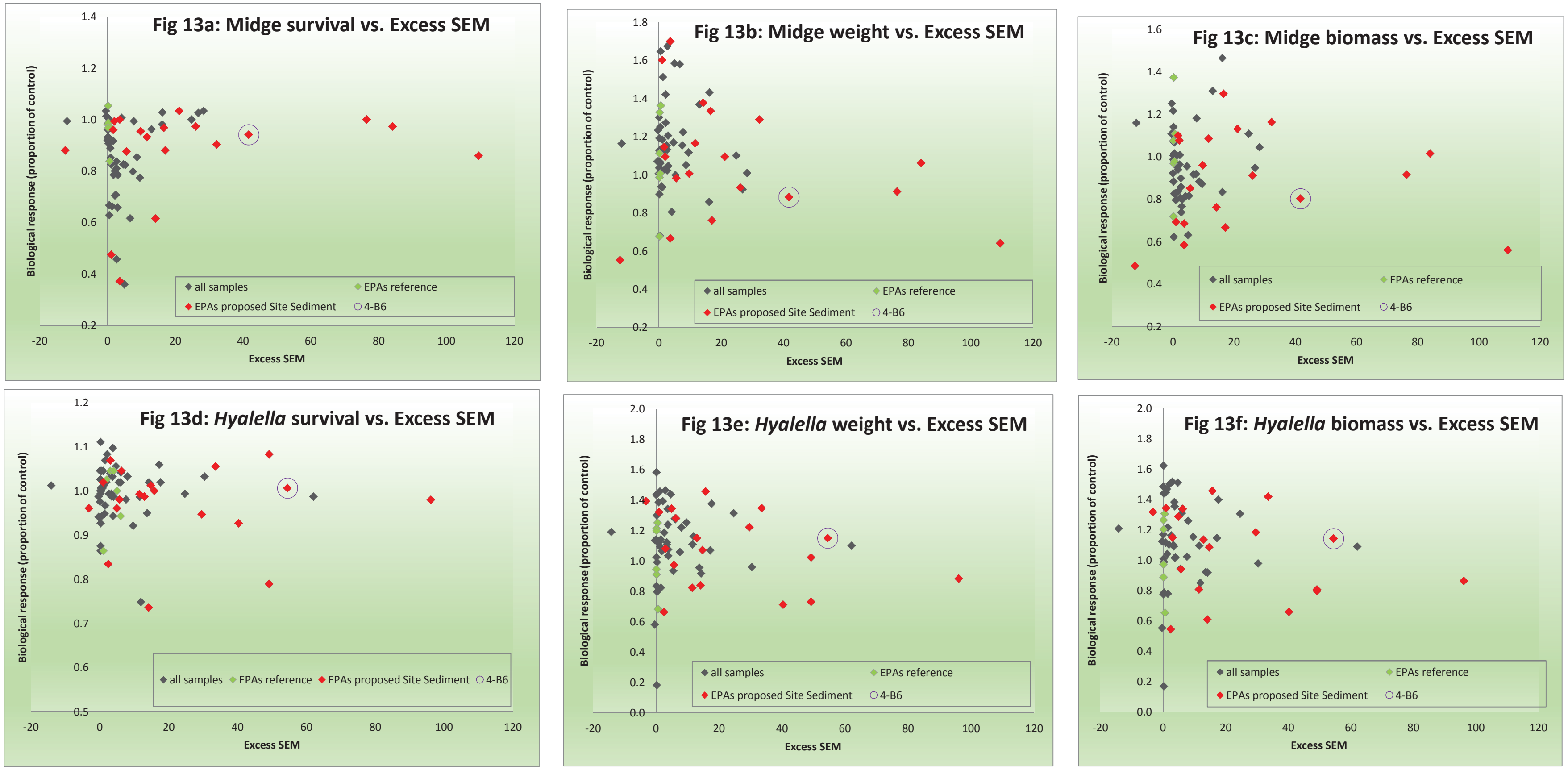
Figure 10. *Hyalella* weight (proportion of control response) in all reference samples that met test acceptability criteria for survival (Combined), EPAs proposed reference samples for longer-term toxicity testing, and Teck's proposed reference samples for longer-term toxicity testing.



Figures 11a through 11f. UCR Phase 2 sediment control normalized toxicity results relative to the mean Probable Effect Concentration Quotients for 4 metals (Cd, Cu, Pb, Zn) - EPAs longer-ter toxicity test sample recommendations. **Note that control normalization is based on the average toxicity endpoint from PER control sediment and the quartz sand control; excludes ERDC controls where results are suspected to be compromised. EPAs additional recommended site sample 4-B6 is circled.**



Figures 12a through 12f - UCR Phase 2 sediment control normalized toxicity results relative to pore water toxic units (i.e., ratios of porewater metal concentrations to benchmarks determined using the BLM) - EPAs longer-ter toxicity test sample recommendations. **Note that control normalization is based on the average toxicity endpoint from PER control sediment and the quartz sand control; excludes ERDC controls where results are suspected to be compromised.EPAs additional recommended site sample 4-B6 is circled.**



Figures 13a through 13f - UCR Phase 2 sediment control normalized toxicity results relative to excess SEM (Acid Volitile Sulfids - Simultaneously Extracted Metals) - EPAs longer-ter toxicity test sample recommendations. **Note that control normalization is based on the average toxicity endpoint from PER control sediment and the quartz sand control; excludes ERDC controls where results are susptected to be compromised. EPAs additional recommended site sample 4-B6 is circled.**

APPENDIX B5

MEMORANDUM TO EPA FROM TAI RESPONDING TO EPA'S COMMENTS ON PROPOSED LONG-TERM BIOASSAY SAMPLE SELECTION (DECEMBER 1, 2014)

Memo

Date:	Monday, December 01, 2014
Project:	Upper Columbia River RI/FS
To:	Kris McCaig
From:	Teck American Incorporated (TAI) Upper Columbia River (UCR) Project Technical Team
Subject:	Recommendations for Long-Term Bioassays

This memo addresses USEPA's October 8, 2014, comments on the samples selected for the long-term bioassays. The purpose of this memo is to clarify the context for long-term toxicity tests and to present the TAI technical team's response to USEPA's suggested changes to the samples selected for testing.

Based on discussions between USEPA and the TAI technical team, and as stated in the Level of Effort (LOE) document dated February 10, 2010 (USEPA, 2010), a sub-set of highly contaminated samples were selected for long-term testing to determine if short-term tests provide a reasonable basis for estimating reproductive effects in midge and/or amphipods in UCR sediment (i.e., results from long-term toxicity tests could help determine if survival and/or growth of midge in 10-d exposures and/or amphipods in 28-d exposures are sufficiently sensitive). The long-term bioassay data generated will be used primarily in a pair wise fashion, comparing the long-term and short-term test results for the same location. For the evaluation of site data compared with reference data, the short-term bioassay study (which includes many more samples than the long-term bioassay study) will provide the primary data set.

With this understanding about the objective of the long-term bioassay tests and how the data will be used to fulfill the study objectives, the TAI technical team agrees to accept most of the locations USEPA requested be used for the long-term bioassays.

Review of Reference Samples

The USEPA and TAI technical teams have agreed to use samples SE-G-1, SE-LAL-3, and SE-LAL-5 as external reference samples. However, the USEPA team proposed alternative samples for SE-G-2, SE-G-4, and SE-LAL-1; substituting SE-G-3, SE-TRIB-3, and SE-REF-10b.

A high TOC reference sample is needed to represent the high TOC end of the spectrum of site conditions. SE-LAL-2 has a TOC of 2.67% and is roughly is equivalent to SE-LAL-1 in terms of TOC. No reference samples other than SE-LAL-1 and SE-LAL-2 cover the high end of TOC. Therefore, the TAI technical team proposes that SE-LAL-2 be included along with SE-LAL-3 and SE-LAL-5 for the lacustrine external reference samples (and accepts removal of SE-LAL-1).

TAI's initial proposal recommended use of three riverine external reference samples (SE-G-1, SE-G-2, and SE-G-4). TAI's technical team accepts USEPA's recommendation to include sample SE-G-3 from this area and remove sample SE-G-4. The rationale provided by the USEPA team for excluding sample SE-G-2 is that *Hyalella* growth in the associated control was less than the goal of 0.4 mg dry weight/organism established for control organisms. USEPA has not established test acceptability criteria for 28-day *Hyalella* weight and although the weight goal was not reached by control organisms, survival was high (96%). Hyalella survival and weight in sample SE-G-2 relative to control results was 92% for survival and

86% for weight. Therefore, the TAI technical team recommends retaining SE-G-2 as a riverine external reference sample.

With USEPA team comments and this discussion in mind, the TAI technical team's recommended set of external reference samples for long-term bioassay analysis is SE-G-1, SE-G-2, SE-G-3, SE-LAL-2, SE-LAL-3, and SE-LAL-5. TAI agrees to include SE-TRIB-3 (tributary) and SE-REF-10b (internal reference) samples to obtain long-term bioassay data from these types of locations. Their inclusion is described below.

Expanded Experimental Design

The TAI technical team agrees to add sample SE-4-B6 as a site sample per USEPA's suggestion. SE-TRIB-3 and SE-REF10-b would be included in one of the batches (i.e., as two additional site samples rather than include them with each batch as will be done for the six external reference samples). The inclusion of samples SE-4-B6, SE-TRIB-3, and SE-REF-10b will be in addition to the 18 site samples originally proposed and accepted by USEPA. The TAI technical team proposes modifying the long-term bioassay study experimental design so that samples will be run in three (3) batches, with controls (PER control sediment and quartz sand), six (6) external reference samples, and seven (7) other samples in each batch. A summary of the proposed samples for inclusion is provided in the table below. *Sequencing of samples for long-term bioassays (i.e., identification of which samples would be processed in each batch) will be developed once the list of samples for analysis is approved.*

Proposed Samples

Test Samples	SE-1-B5, SE-1B-R2, SE-1-R2, SE-2-B1, SE-2-R1, SE-3-B3, SE-3-R7, SE-3-R8, SE-4-B1, SE-4-B5, SE-5-B2, SE-5-B4, SE-6-B2, SE-6-B5, SE-7-B2, SE-7-B5, SE-8-B2, SE-B-3, SE-4-B6, SE-TRIB-3, and SE-REF-10b.	Each sample run once in one of three batches
External Reference Samples	SE-G-1, SE-G-2, SE-G-3, SE-LAL-2, SE-LAL-3, and SE-LAL-5	Each sample run once in each batch of three batches

References

USEPA. 2010. EPA Technical Team Level of Effort (LOE) for Investigations Designed to Evaluate Risks of Contaminants to Benthic Invertebrate Communities in the Upper Columbia River (Sediment Toxicity LOE). U.S. Environmental Protection Agency, Region 10, Seattle, Washington. Dated: February 10, 2010.

APPENDIX B6

EMAIL TO EPA FROM TAI REGARDING PROPOSED LONG-TERM BIOASSAY SAMPLES (DECEMBER 12, 2014)

From: McCaig Kris SPOK [mailto:Kris.McCaig@teck.com]
Sent: Friday, December 12, 2014 2:30 PM
To: Buelow, Laura
Cc: Anne Fairbrother (afairbrother@exponent.com); Nicholas Gard - Exponent (gardn@exponent.com)
Subject: RE: Long term tox test

Laura,

With this email, Teck would like to propose going back to EPA's recommended list of reference samples (identified in EPA's October 2014 memo to Teck) and adding SE-G-2 and SE-LAL-2 to the list of test samples to be run in one of the batches. Please note that this means SE-TRIB-3 and SE-REF-10b will be run in every batch. See the attached spreadsheet for further clarification.

With regard to the "Proposed by Teck – December 12, 2014" columns in the attached spreadsheet, we would like to note that by putting SE-TRIB-3 and SE-REF-10b samples into the "Reference Samples" column, Teck is not admitting that they will be used as such during data analysis; similarly, although SE-G-2 and SE-LAL-2 samples are included in the list of "Test Samples", Teck recognizes that they are outside the Site and as such may be analyzed with reference samples.

Please let me know if you have questions or would like to discuss. We look forward to EPA's approval and to continuing work on the Phase 2 Sediment Study.

Thanks,

Kris

Kris McCaig
Manager, Environment & Public Affairs
Teck American Incorporated
Phone: +1.509.623.4501
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Mobile: +1.509.434.8542
eMail: Kris.McCaig@teck.com
www.teck.com

APPENDIX B7

EMAIL TO TAI FROM EPA WITH AGREEMENT ON SAMPLES FOR LONG-TERM BIOASSAYS
(DECEMBER 17, 2015)

From: Buelow, Laura [mailto:Buelow.Laura@epa.gov]
Sent: Wednesday, December 17, 2014 10:44 AM
To: McCaig Kris SPOK
Cc: Anne Fairbrother (afairbrother@exponent.com); Nicholas Gard - Exponent (gardn@exponent.com)
Subject: RE: Long term tox test

Kris,

In repose to your memo dated December 1, 2014, EPA has a few concerns worth noting.

The rationale given by TAI for excluding SE-TRIB-3 and SE-REF-10b as reference samples was that SE-LAL-2 was needed to provide a high total organic carbon (TOC) reference sample to represent the spectrum of site conditions. Sample SE-LAL-2 (2.67 percent TOC) is in the 98th percentile of TOC among all site samples (i.e., from the UCR downstream of the Canada-U.S. border and including internal reference samples), has a TOC greater than any site sample collected for bioassays, and is not representative of the majority of site conditions or bioassay samples. Only 2 site samples have TOC higher than SE-LAL-2 (SE-4B-C2 and SE-3B-C2) and neither of these are bioassay samples. The highest TOC among site samples used in bioassays is 2.45 percent (SE-6-B6). EPA contends that sample SE-LAL-5 (1.73 percent TOC; 88th percentile) adequately meets the objective of testing a higher TOC sample as 88 percent of sites samples have TOC at or below this concentration (93rd percentile among site bioassay samples). Moreover, we wound not anticipate a difference of about 0.5 to 1 percent TOC among samples would affect responses of midge or amphipods in bioassays.

In addition, It is premature to identify the short-term toxicity tests as the primary data set for use in the Remedial Investigation in advance of completing the long-term tests. The long-term tests are being conducted to determine if UCR sediments are more toxic to benthic invertebrates when long-term exposures and/or additional endpoints are considered. To make this determination in advance of conducting the long-term toxicity tests is inappropriate and inconsistent with the sediment LOE.

That being said, EPA agrees with Teck’s proposal as of December 12, 2014 for including SE-TRIB-3 and SE-REF-10b in the “Reference Samples.” We do not object to samples SE-G-2 and SE-LAL-2 being run in the “Test Samples.”

Laura

APPENDIX C

BACKSCATTERED SCANNING ELECTRON MICROSCOPY SAMPLE SELECTION

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Teck

August 15, 2014

File No.: 01-773180-000

Dr. Laura C. Buelow
Project Manager, Hanford/INL Project Office
U.S. Environmental Protection Agency, Region 10
309 Bradley Boulevard, Suite 115
Richland, WA 99352

Mr. Matt Wilkening
Project Manager, Idaho Office
U.S. Environmental Protection Agency, Region 10
950 W. Bannock Street, Suite 900
Boise, ID 83702

VIA ELECTRONIC MAIL ONLY

Subject: Upper Columbia River Remedial Investigation Feasibility Study - Phase 2 Sediment Study; Backscatter Electron Microscopy Technical Memorandum

Dear Dr. Buelow and Mr. Wilkening:

Consistent with the U.S. Environmental Protection Agency (EPA) approved Quality Assurance Project Plan (QAPP) for the above-referenced study; Teck American Incorporated (TAI) is pleased to submit for your review and approval the following technical memorandum outlining the proposed approach to conduct backscatter electron microscopy (BSEM) on archived sediments. The approach herein addresses Section A-9 of the QAPP in that samples be selected for this specialized work following a review of the preliminary chemistry data; and be documented in a technical memorandum, or QAPP addendum, for EPA's review and approval.

This technical memorandum summarizes the proposed samples selected for analysis; the methodology; and the selected laboratory including qualifications.

Sample Selection

Samples were selected on the basis of a range of predicted slag content as determined by metal ratios in accordance to Section A7.2 of the QAPP: "Can the nature and extent of unacceptable risk at the Site via spatial gradients and sediment bed properties such as slag content (e.g., Zn/V ratio[1]), TOC, mPECQ, and sediment texture be further refined[2]?" As noted on page A-9 of the QAPP, "Sediment samples will be archived and no fewer than 35 sediment samples will undergo backscatter electron microscopy following a review of the preliminary data." Accordingly, TAI proposed 38 samples for BSEM analysis in a letter to EPA dated February 25, 2014 (Attachment A). EPA responded via email on June 4, 2014 with a memorandum requesting an additional four samples be added to the 38 identified by TAI (Attachment A). Rational for selection of these samples is included in Attachment A. ALS Environmental (ALS) has confirmed that sample matrix exists for all 42 samples. A list of samples to be analyzed for BSEM is presented as Table 1.

Method Overview

TAI will evaluate elemental composition of the identified samples using scanning electron microscopy (SEM) with energy dispersive X-ray spectroscopy (EDS). The SEM analytical device, in backscattered imaging mode, directs a beam of electrons at a prepared sample. Between 20-30% of the beam electrons collide with atoms comprising the sample, and rebound elastically (with little energy loss) backscattering out of the specimen. These re-emergent beam electrons are known as backscattered electrons. The production of backscattered electrons is a function of the atomic number of the atoms comprising the sample specimen. Because of this relationship, phases differing by average atomic number can be distinguished and consequently imaged relative to the phase of the backscattered electron; e.g. brightness is proportional to the average atomic number. This image will be processed by computer (computer controlled scanning electron microscopy - CCSEM) and compiled into an electronic file summarizing each sample particle's elemental composition. From this data, particle phases can be inventoried and reported.

Specific Method

- A minimum of 200 grams of sample matrix archived at ALS will be transferred under chain of custody to the BSEM laboratory.

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[1] The basis and rationale of using a Zn/V ratio was detailed within Appendix D of the BERA work plan (TAI 2011). Other chemical ratios and/or methods (i.e., backscatter electron microscopy) may also be used to refine sediment bed properties and facilitate data interpretation.

[2] The sampling design is not intended to provide an assessment of spatial distribution of contaminants in the Site.

- Upon receipt, the BSEM laboratory will dry each sample in a low temperature oven.
- Samples will be weighed, and then sieved using a 2-millimeter screen. The coarse fraction will be visually observed for presence of black particles (e.g., slag), weighed, and retained. The finer fraction passing the 2-millimeter sieve will be weighed and retained for BSEM analysis.
- The retained sample will be split using rotary-split or other appropriate method. A sub-sample of one split will be collected and prepared into an epoxy grain mount and polished. The remainder will be archived.
- Based on Zn:V ratios, the BSEM laboratory will conduct initial analyses using low (LAL-5; Zn:V = 2.33) and high (SE-3-R8; Zn:V = 493.7) Zn:V ratio samples to identify optimal field-of-view, image enhancement, post-imaging processing, analysis stopping criterion (typically grain count), and other calibrations and thresholds.
- Once calibrations and thresholds are optimized, the prepared sample is inspected using the SEM in the backscattered electron imaging mode, where brightness is proportional to the average atomic number. In this mode, the particles are brighter than the epoxy and are detected by the CCSEM program.
- Starting with a field of view and with a suitable magnification to include many particles, a particle is detected, its periphery defined, and the size (various diameters, perimeter and area) measured. A microimage of the individual particle is acquired using SEM; and the elemental composition is acquired using energy dispersive spectroscopy (EDS). Electronically (and automatically) each particle is classified into a specific phase (mineral, slag, etc.). Analysis continues for all particles in the field, and additional fields are analyzed until the specified stopping criteria are met.

BSEM Reporting

Based on a random grain orientation in the plane of the polished section, the area assigned to each particle phase is proportional to the volume of that phase in the bulk sample, even though the plane of the section may not pass through a particle center. The BSEM laboratory will report, by sample, total area (and, by extension, volume) proportions of the sample by particle phase, the estimated mass proportions of the sample by particle phase, and the apparent size distributions by particle phase. Gray scale (256 shades) SEM images also will be reported. These data will be incorporated into the project database and linked to results for that sample.

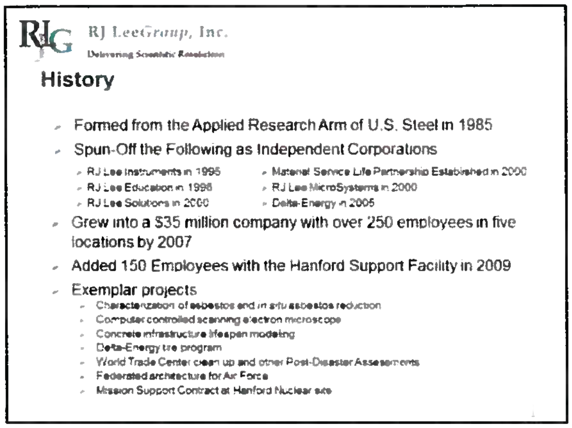
Quality Assurance/Quality Control

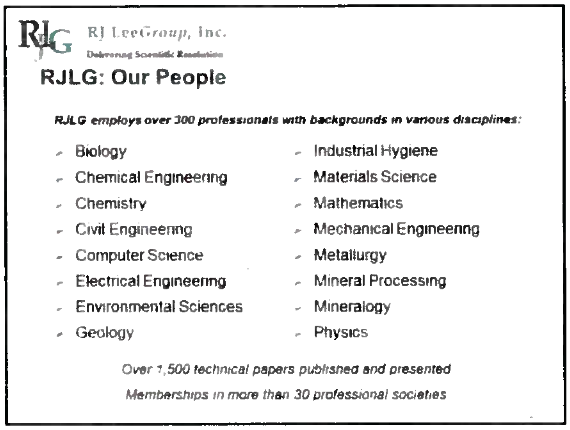
Duplicate epoxy grain mounts will be prepared for approximately 10% of the samples, which will be analyzed and reported separately. One laboratory-grade clean silica sand sample blank will be processed and analyzed for every 20 samples.

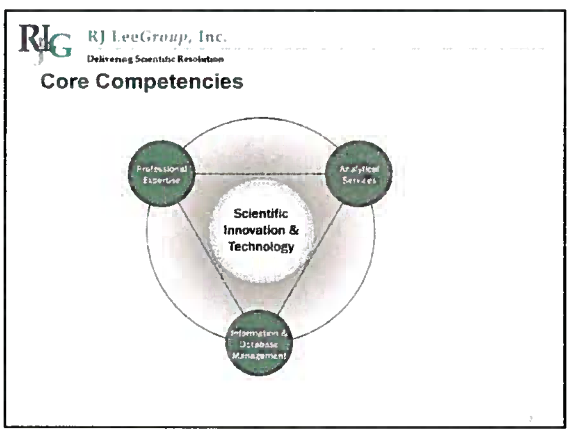
Laboratory

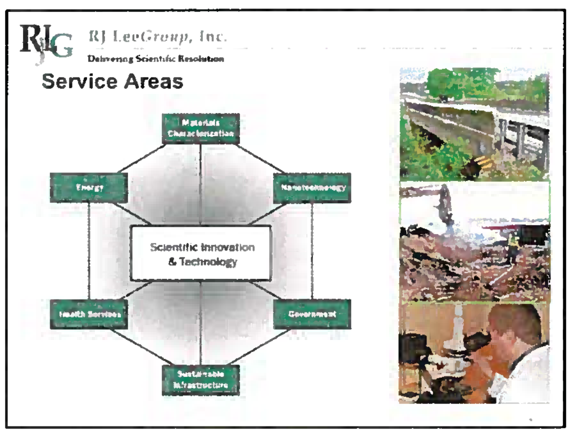
RJ LeeGroup, Inc., (RJLG) headquartered at 350 Hochberg Road, Monroeville, Pennsylvania, will conduct the BSEM analysis. RJLG is a private, nationally recognized, scanning electron microscopy (SEM) service provider.

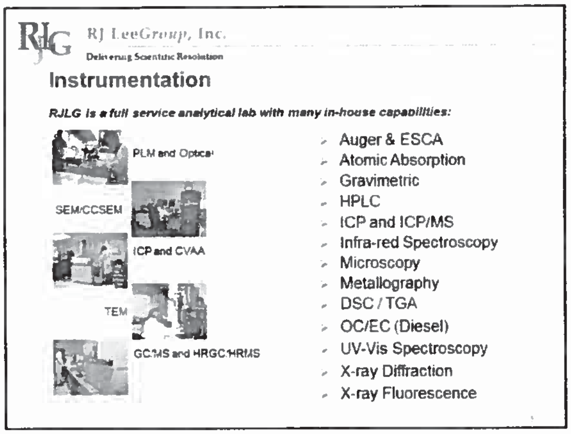
RJLG's company overview is summarized in the following six slides from a PowerPoint Presentation. Attachment B presents additional RJLG corporate information:

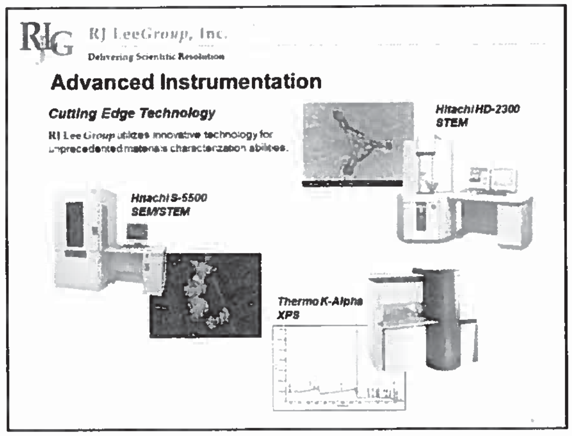












RJLG's Experience in Particle Analysis

Over its almost 30 years of operation, RJLG has had a significant portion of its work in the characterization of individual particles. Examples include:

- SEM evaluation of outdoor and indoor airborne particulate and dust, building materials (including asbestos), soil, and inclusions in metals. Representative project descriptions are presented in Attachment B.
- Beginning in 1991 under the direction of Dr. John Drexler and Region 8 EPA, RJLG characterized heavy metals (mostly lead) in soils in and around Leadville, Colorado. As part of this project hundreds of samples were analyzed. The project was managed by Dr. Stephen Kennedy, the proposed RJLG project manager for the UCR sediment BSEM analysis. Dr. Kennedy's *curriculum vita is* presented in Attachment B.
- Several published papers authored by Dr. Kennedy are included in Attachment B to demonstrate RJLG's and Dr. Kennedy's ability to conduct BSEM analysis.

RJLG's Instrumentation Relative to Project

- Sample preparation equipment includes particle mount (various), polished section, and thin section preparation tools.
- RJLG's scanning electron microscopy units, all with Secondary Electron Imaging (SEI) and Backscattered Electron Imaging (BEI) capabilities:

Instrument	Capabilities	Number of Units
ASPEX PSEM 75[1,2]	SEM-EDS, 3 VP	10
JEOL 6460	VP SEM-EDS	1
Tescan Vega[1]	SEM-EDS	2
Tescan Mira TC[1]	FESEM-EDS	1
Hitachi S5500	FESEM/STEM-EDS	1
Hitachi HD2300A	FESTEM-EDS	1

[1] These instruments are capable of CCSEM

[2] RJLG designed and manufactured the original PSEM 75 later acquired by ASPEX Instruments.

We would like to thank you in advance for your attention to this matter and look forward to receiving your approval in the very near future. Should you have any questions or require any additional information at this time, please call me at (509) 623-4501.

Sincerely,
Teck American Incorporated

Kris R. McCaig

Kris R. McCaig
Manager, Environment and Public Affairs

cc: Dr. Nicholas Gard – Exponent, Inc.; Bellevue, WA
Dave Enos – Teck American Incorporated, Spokane, WA

Table 1. Summary of Sediment Samples for Specialized Backscatter Electron Microscopy Analysis and Estimated Archived Mass

Sample Id	River Mile	Estimated Archived Mass (g)
LAL-5	Canada	2800
SE-1-R5	744	1575
SE-1-R1	744	1470
SE-1-R2	742	1470
SE-1-B5	737	1470
SE-1-R8	737	1470
SE-1B-R3	735	1470
SE-1B-C3	735	1470
SE-1B-C1	734	2870
SE-2-B1	733	1470
SE-2-B2	732	1470
SE-2-R1	732	2940
SE-2-R3	732	1470
SE-2B-R1	728	1470
SE-2B-C4	728	1470
SE-2B-C3	726	1470
SE-3-B1	725	893
SE-3-C1	724	1470
SE-3-B2	724	280
SE-3-B4	723	333
SE-3-R7	722	1470
SE-3-R8	722	1470
SE-3-R10	721	595
SE-3-R9	721	1470
SE-3-C4	721	1470
SE-3B-C3	715	1470
SE-4-R1	711	1470
SE-4-B1	710	1470
SE-4-B6	709	1470
SE-4-B2	708	1470
SE-4-B4	706	1470
SE-4-B5	705	1470
SE-4-C4	705	1470
SE-4B-C3	692	1470
REF-3	689	1300
SE-5-B2	678	2800
SE-5B-C1	674	1470
SE-6-B4	665	3500
SE-6B-C4	652	1470
SE-7-B1	646	1470
SE-8-B3	605	1470
SE-8B-C2	600	1470

McCaig Kris SPOK

From: Buelow, Laura <Buelow.Laura@epa.gov>
Sent: Wednesday, June 04, 2014 11:45 AM
To: McCaig Kris SPOK
Cc: Wilkening, Matt; Nicholas Gard (gardn@exponent.com)
Subject: BSEM Memo
Attachments: Backscatter memo to Teck FINAL..docx

Kris,

Please find attached a memo regarding the BSEM samples. Let me know if you have any questions/concerns regarding our request for 4 additional sampling in addition to the ones that Teck proposed.

I believe the next step is for you to provide EPA with a technical memo describing how the BSEM will be performed. Is that your understanding also?

Laura Buelow, Ph.D.
Project Manager
U.S. Environmental Protection Agency
Hanford Project Office
309 Bradley Blvd, Suite 115
Richland, WA 99352
Phone: 509 376-5466
Fax: 509 376-2396
E-mail: buelow.laura@epa.gov

MEMORANDUM

SUBJECT: Back-Scatter Electron Microscopy for Sediment Samples

FROM: Laura Buelow, EPA

TO: Kris McCaig, Teck American, Inc.

Summary

EPAs level of effort (LOE) for Phase 2 sediment sampling at the UCR included submitting samples for back-scatter electron microscopy (BSEM; a potential measure of slag content in sediment). Teck (TAI) proposed 38 samples for this analysis. EPA requests that 4 new samples be included in addition to those proposed by TAI. A brief discussion on the selection of these samples is shared below.

DQOs

- Data Quality Objectives (DQOs) for this analysis were to:

    1) Calibrate the metal ratio approach for slag characterization; and,
    2) As an explanatory variable for interpreting sediment tox results.

    "Can the nature and extent of unacceptable risk at the Site via spatial gradients and sediment bed properties such as slag content (e.g., Zn/V), TOC, mPECQ, and sediment texture be further refined?

    The adequacy of multiple metal ratio methods for describing sediment bed properties such as slag content will be evaluated by using field observations (e.g., presence/ absence and percent of visible black silica glass particles) in conjunction with sediment chemistry. Sediment samples will be archived and no fewer than 35 samples will undergo backscatter electron microscopy following a review of the preliminary data. Samples will be selected for this specialized work following a review of the preliminary chemistry data; and will be documented in a technical memorandum, or QAPP addendum, for EPA's review and approval."

- Samples were to be selected upon the basis of a range of predicted slag content as determined by metal ratios.

TAIs Proposed Samples

- Preliminary analytical data were evaluated in consideration of TAIs proposed samples for BSEM.
- TAI proposed 38 samples for BSEM of the 137 available samples (letter from K. McCaig to L. Buelow on 2/25/14). Most samples with field observations of visual slag were selected (29 of the 32). Most (32 of 38) samples were also from the riverine reaches (i.e., upstream of Kettle Falls).
- TAIs proposed samples are generally skewed for variables assessed (e.g., TOC, mPECQ, Zn/V, and Cu/Al, river mile). This is likely due to TAI selecting samples with visual slag - which are typically associated with the riverine reaches that were generally sandy.
- Including additional samples will improve our ability to meet DQOs.
    - Samples without visually observed slag will improve our understanding of how backscatter can identify slag characteristics when slag is not visible; and/or,
    - Samples that were also submitted for bioassays provide another variable to interpret dose-responses (dependent on toxicity data - currently unavailable).

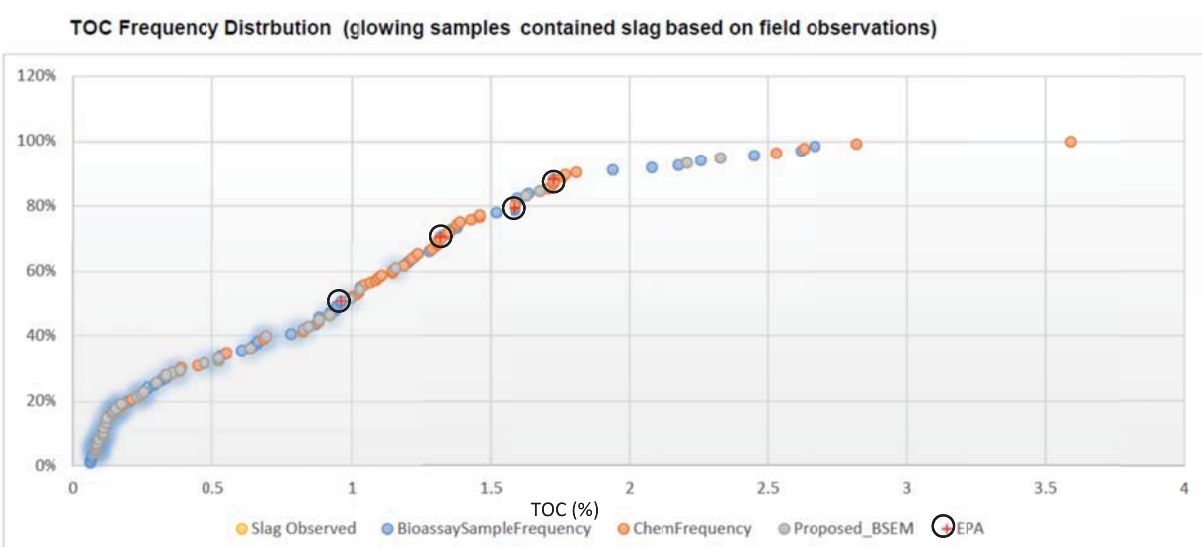
Requested Additional Analyses

EPA requests 4 additional samples be included with those proposed by TAI for BSEM analysis. LAL-5 represents a sample from an external reference site, sample 6-B4 represents a sample from Focus Area 6, and samples 5-B2 and REF-3 are samples from Focus Area 5.

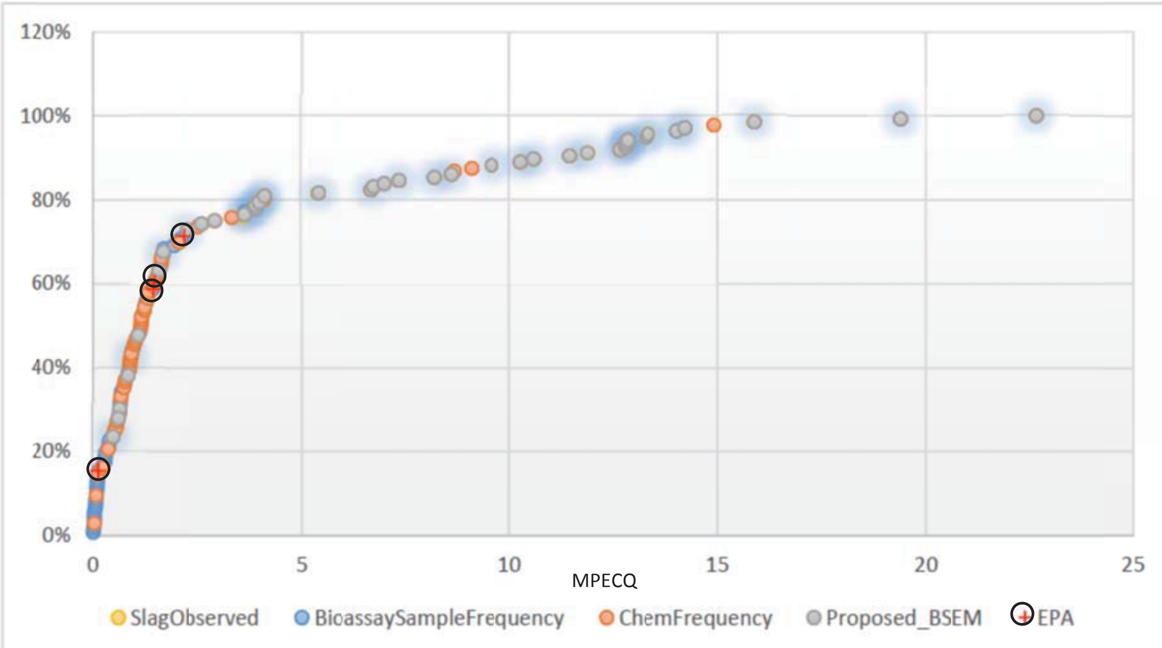
Sediment Characteristics of the 4 alternative samples for BSEM requested by EPA

Sample	*RM*	*Visual Slag (%)*	*TOC (%)*	*mPECQ4*	*Silt (%)*	*Clay (%)*	*Medium Sand (%)*	*Zn:V*	*Cu:Al*	*Notes*
6-B4	665	0	1.3	1.4	61	23	2.3	18	0.0025	From Focus Area 6.
LAL-5	Canada	0	1.7	0.14	19	19	1.3	2.3	0.00195	Canadian reference site
5-B2	678	0	1.59	2.2	57	39	1	18.7	0.0044	From Focus Area 5.
REF-3	689	0	0.961	1.5	40	12	8	19.0	0.0047	From Focus Area 5.

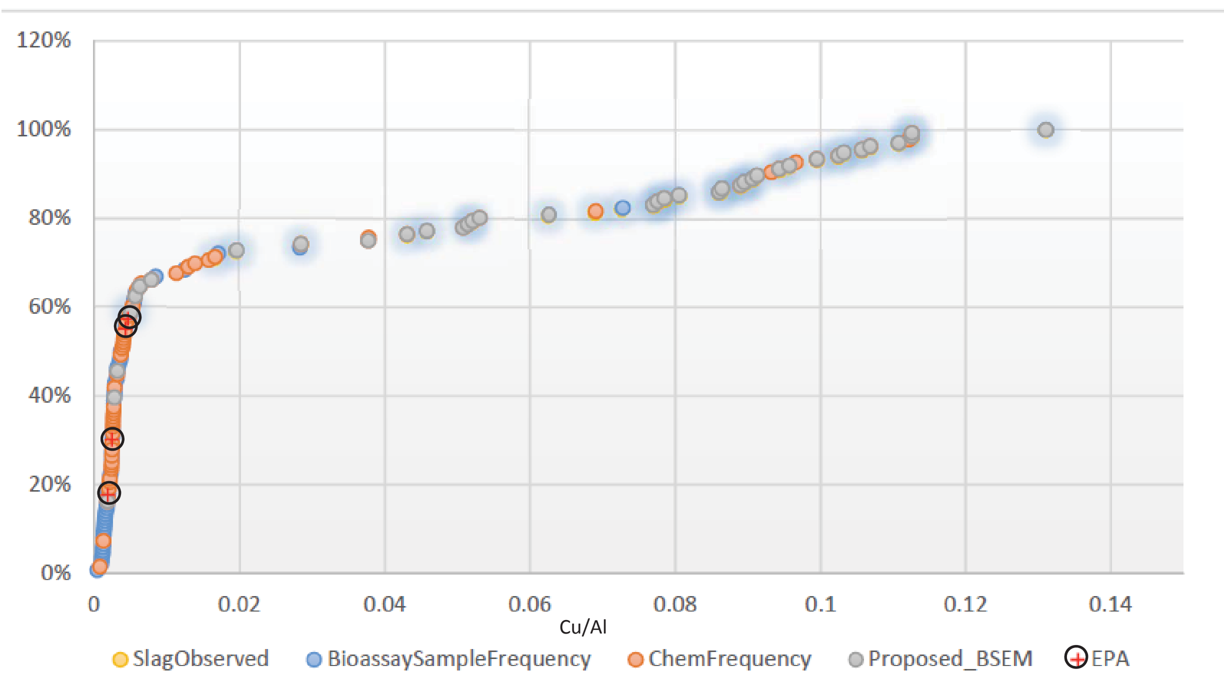
Together, these four additional samples will help meet the goal of validating visual and metal ratio methods for describing slag content as they do not have visible slag; they were sampled in reaches not described by other samples proposed for BSEM, and they cover a broader range of sediment characteristics than the TAI samples proposed for BSEM (e.g., where TOC was between 1-2.1 percent, or >2.5 percent; and, mPECQ ranged between 1-1.5 or was <0.25; see figures).



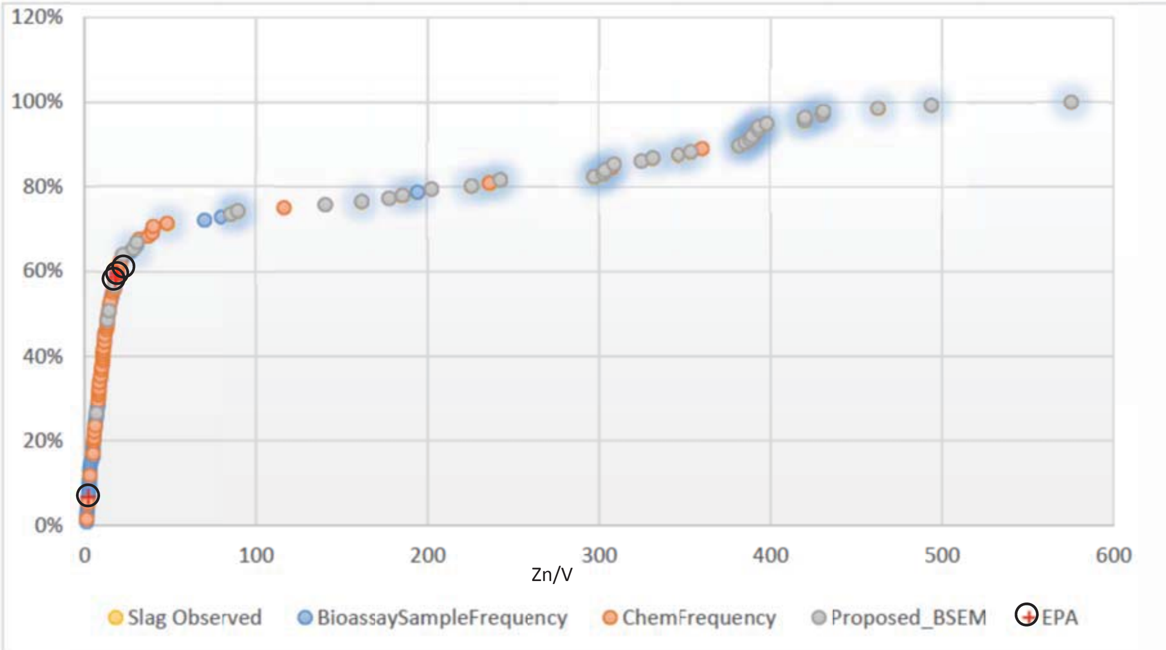
MPECQ4 Frequency Distrbution (glowing samples contained slag based on field observations)



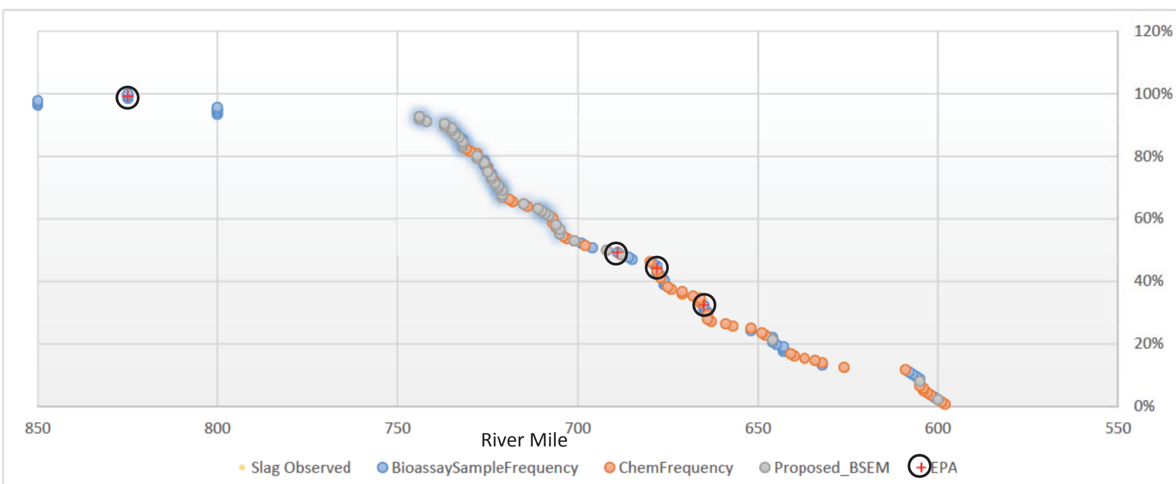
Cu/Al Frequency Distrbution (glowing samples contained slag based on field observations)

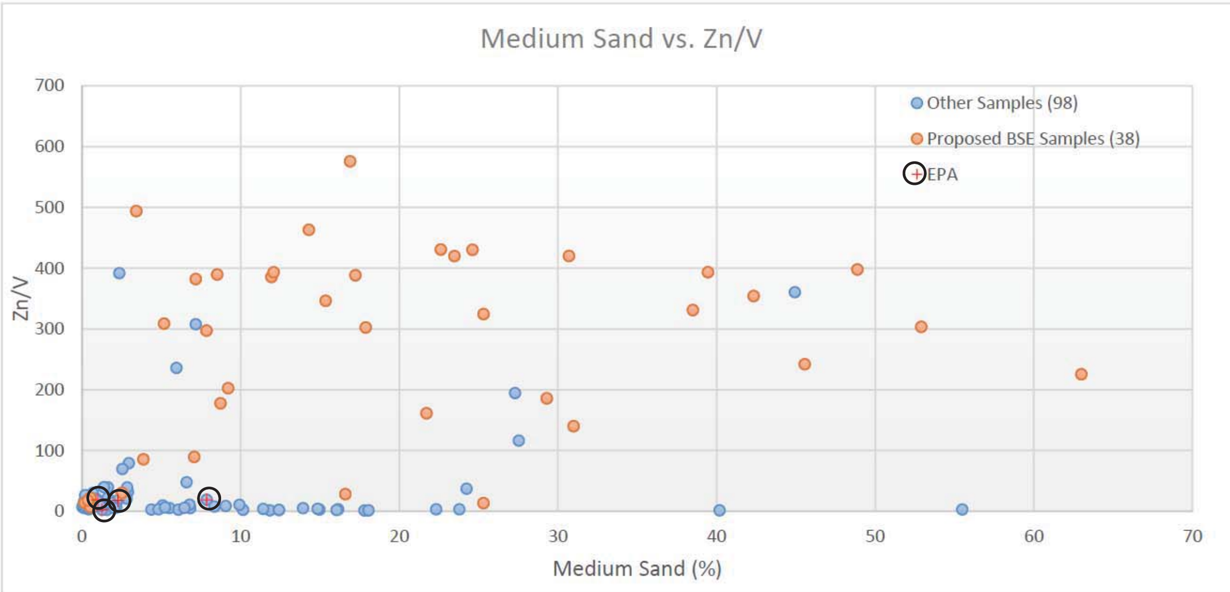


Zn/V Frequency Distrbution (glowing samples contained slag based on field observations)

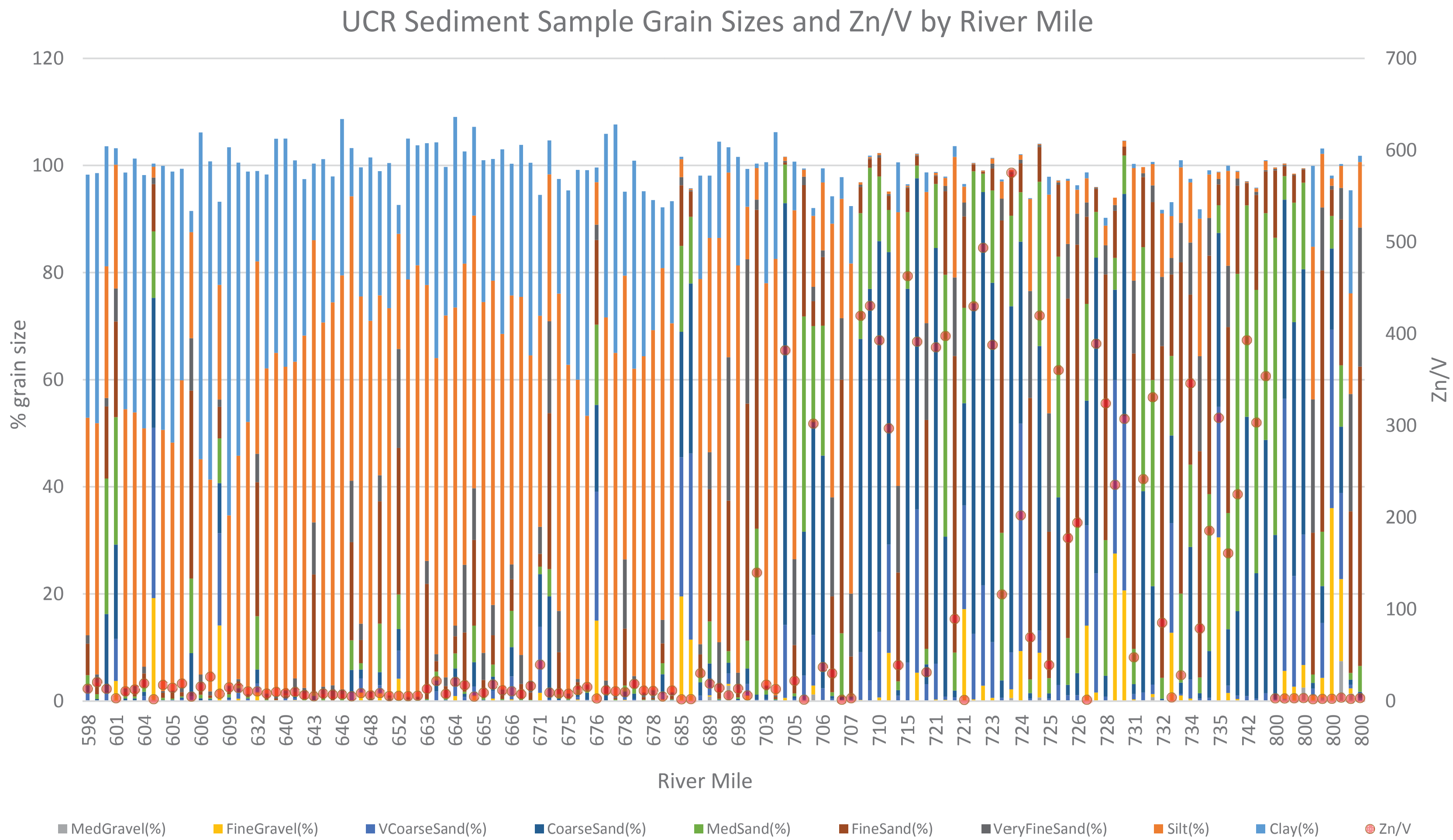


BSE Sampling Frequency Distrbution by River Mile (glowing samples contained slag based on field observations)





Medium Sand vs. Zn/V
700
600
500
400
300
200
100
0
Zn/V
0
10
20
30
40
50
60
70
Medium Sand (%)
Other Samples (98)
Proposed BSE Samples (38)
EPA


UCR Sediment Sample Grain Sizes and Zn/V by River Mile
% grain size
0
20
40
60
80
100
120
Zn/V
0
100
200
300
400
500
600
700
River Mile
598 601 604 605 606 609 632 640 643 646 648 652 663 664 665 666 671 675 676 678 678 685 689 698 703 705 706 707 710 715 721 721 723 724 725 726 728 731 732 734 735 742 800 800 800 800
MedGravel(%)
FineGravel(%)
VCoarseSand(%)
CoarseSand(%)
MedSand(%)
FineSand(%)
VeryFineSand(%)
Silt(%)
Clay(%)
Zn/V

McCaig Kris SPOK

From:	McCaig Kris SPOK
Sent:	Tuesday, March 11, 2014 4:40 PM
To:	'Buelow, Laura'
Cc:	Wilkening, Matt; Cameron Irvine (cameron.irvine@ch2m.com); Anne Fairbrother - Exponent, Inc. (afairbrother@exponent.com); Nicholas Gard - Exponent (gardn@exponent.com)
Subject:	RE: Backscatter samples
Attachments:	03-11-14_Table 1 Update_Backscatter Proposal_LBuelow.pdf; 03-11-14_Teck-2013-Sedtox-combined.xlsx

Laura,

Please see attached an updated Table 1 from the letter to EPA dated February 25, 2014. Thank you again for pointing out that we inadvertently entered the wrong data in the cells for mPECQ4, mPECQ8 and Zn:V ratio for the 38 samples identified in Table 1.

Also, per your request I have attached a spreadsheet containing calculated mPECQ4, mPECQ8, and Zn:V ratios, for all Phase 2 sediment samples.

Please let me know if you have any questions or need more information.

Thanks,

Kris

Kris McCaig
Manager, Environment & Public Affairs
Teck American Incorporated
Phone: +1.509.623.4501
Fax: +1.509.922.8767
Mobile: +1.509.434.8542
eMail: Kris.McCaig@teck.com
www.teck.com

From: Buelow, Laura [mailto:Buelow.Laura@epa.gov]
Sent: Thursday, March 06, 2014 2:17 PM
To: McCaig Kris SPOK
Cc: Wilkening, Matt; Cameron Irvine (cameron.irvine@ch2m.com)
Subject: Backscatter samples

Kris,

In order to assist EPA in determining if we agree with Teck's proposed samples for backscatter electron microscopy, we would like to request some additional information.

As offered in your letter, we would like all of the field sampling forms. I realize that the file is too large to email. If you are able, a secure file transfer would seem to be the easiest way for us to get the information. Please make sure Cameron Irvine is able to have access. If you would prefer to send the forms on a CD, please send them to myself, Matt Wilkening and Cameron Irvine.

It would make our review easier if you could send us a spreadsheet containing calculated mPECQ4, mPECQ8, Zn:V, for all samples.

Also, can you clarify if data have changed since preliminary sediment data were downloaded from the TAI-Exponent database for validation? It seems that there are inconsistent mPECQ values for the same samples reported in the memo proposing samples for BSE and in the files with proposed batching samples for sediment toxicity tests.

Thank you,

Laura Buelow, Ph.D.
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Table 1. Summary of Sediment Samples Proposed for Specialized Backscatter Electron Microscopy Analysis

Sample Id	River Mile	mPECQ8	mPECQ4	Zn:V Ratio
SE-1-R5	744	3.5	6.7	353.9
SE-1-R1	744	3.0	5.7	325.1
SE-1-R2	742	5.5	10.6	396.8
SE-1-B5	737	1.9	3.6	161.0
SE-1-R8	737	2.1	3.9	225.2
SE-1B-R3	735	4.9	9.4	306.7
SE-1B-C3	735	2.2	4.1	185.5
SE-1B-C1	734	4.2	8.1	327.3
SE-2-B1	733	0.3	0.5	28.1
SE-2-B2	732	2.1	3.9	241.8
SE-2-R1	732	3.7	7.1	314.4
SE-2-R3	732	0.9	1.7	85.4
SE-2B-R1	728	3.5	6.7	324.3
SE-2B-C4	728	6.6	12.7	389.3
SE-2B-C3	726	2.2	4.0	177.7
SE-3-B1	725	6.2	11.9	419.9
SE-3-C1	724	3.6	7.0	202.3
SE-3-B2	724	11.7	22.7	575.5
SE-3-B4	723	6.9	13.3	388.0
SE-3-R7	722	6.6	12.8	430.1
SE-3-R8	722	10.1	19.4	493.7
SE-3-R10	721	6.8	13.1	388.6
SE-3-R9	721	1.3	2.2	89.5
SE-3-C4	721	6.5	12.8	385.3
SE-3B-C3	715	8.2	15.9	463.0
SE-4-R1	711	5.9	11.4	297.1
SE-4-B1	710	7.3	14.0	392.9
SE-4-B6	709	7.4	14.3	421.3
SE-4-B2	708	6.6	12.8	419.8
SE-4-B4	706	4.2	8.2	302.3
SE-4-B5	705	4.9	9.6	381.9
SE-4-C4	705	0.7	1.1	22.0
SE-4B-C3	692	0.6	0.8	14.2
SE-5B-C1	674	0.6	0.7	8.4
SE-6B-C4	652	0.5	0.6	5.6
SE-7-B1	646	0.5	0.6	7.0
SE-8-B3	605	1.1	1.6	17.5
SE-8B-C2	600	0.5	0.6	12.6
Minimum =	600	0.3	0.5	5.6
Average =	N/A	4	8	263
Maximum =	744	12	23	576
Count =	38	38	38	38

N/A = not applicable

study_id	sum_sample_id	x_coord	y_coord	river_mile	mPECQ8	mPECQ4	ZnV
Teck_2013_SedTox	SE-1-B5	446362.4167	5421170.33	737	1.9	3.6	161.0
Teck_2013_SedTox	SE-1-R1	453443.405	5427290.8	744	3.0	5.7	325.1
Teck_2013_SedTox	SE-1-R2	452607.49	5424703.46	742	5.5	10.6	396.8
Teck_2013_SedTox	SE-1-R5	453605.67	5427595.55	744	3.5	6.7	353.9
Teck_2013_SedTox	SE-1-R8	446279.675	5421174.52	737	2.1	3.9	225.2
Teck_2013_SedTox	SE-1B-C1	442912	5418855	734	4.2	8.1	327.3
Teck_2013_SedTox	SE-1B-C3	443176.26	5418971.53	735	2.2	4.1	185.5
Teck_2013_SedTox	SE-1B-R2	442818	5418846	734	1.1	1.9	79.1
Teck_2013_SedTox	SE-1B-R3	443089.75	5418973.73	735	4.9	9.4	306.7
Teck_2013_SedTox	SE-2-B1	441086.8	5417285.565	733	0.3	0.5	28.1
Teck_2013_SedTox	SE-2-B2	440369.25	5416812.82	732	2.1	3.9	241.8
Teck_2013_SedTox	SE-2-B4	438170.2	5414292.74	730	4.5	8.7	307.5
Teck_2013_SedTox	SE-2-C1	439808.02	5415827.997	731	0.6	0.9	49.3
Teck_2013_SedTox	SE-2-R1	441059.98	5417084.545	732	3.7	7.1	314.4
Teck_2013_SedTox	SE-2-R3	440006.655	5416667.245	732	0.9	1.7	85.4
Teck_2013_SedTox	SE-2B-C3	433665.84	5411567.82	726	2.2	4.0	177.7
Teck_2013_SedTox	SE-2B-C4	435613	5413153.72	728	6.6	12.7	389.3
Teck_2013_SedTox	SE-2B-R1	435498.54	5412969.86	728	3.5	6.7	324.3
Teck_2013_SedTox	SE-2B-R2	435848.58	5413606.07	728	2.2	4.1	235.6
Teck_2013_SedTox	SE-3-B1	432375.225	5410510.34	725	6.2	11.9	419.9
Teck_2013_SedTox	SE-3-B2	432198.765	5408502.85	724	11.7	22.7	575.5
Teck_2013_SedTox	SE-3-B3	431659.35	5408578.953	724	0.9	1.6	69.4
Teck_2013_SedTox	SE-3-B4	431062.79	5407460.52	723	6.9	13.3	388.0
Teck_2013_SedTox	SE-3-C1	431411.37	5407940.87	724	3.6	7.0	202.3
Teck_2013_SedTox	SE-3-C4	428079.45	5407611.32	721	6.5	12.8	385.3
Teck_2013_SedTox	SE-3-R1	432830.665	5411178.65	726	2.0	3.6	194.3
Teck_2013_SedTox	SE-3-R10	427599.405	5407777.635	721	6.8	13.1	388.6
Teck_2013_SedTox	SE-3-R2	431977.4733	5409801.853	725	0.7	1.2	39.2
Teck_2013_SedTox	SE-3-R3	432257.13	5409127.39	725	4.6	8.9	356.9
Teck_2013_SedTox	SE-3-R6	430835.95	5407397.87	723	0.8	1.5	116.1
Teck_2013_SedTox	SE-3-R7	430299.33	5407152.19	722	6.6	12.8	430.1
Teck_2013_SedTox	SE-3-R8	429441.8667	5407276.903	722	10.1	19.4	493.7
Teck_2013_SedTox	SE-3-R9	428488.735	5407828.75	721	1.3	2.2	89.5
Teck_2013_SedTox	SE-3B-C2	426133.81	5404744.78	719	0.7	1.1	31.4
Teck_2013_SedTox	SE-3B-C3	422937.97	5401182.31	715	8.2	15.9	463.0
Teck_2013_SedTox	SE-3B-C4	422097.22	5398702.95	714	1.6	2.5	39.2
Teck_2013_SedTox	SE-3B-R2	425848.725	5403960.515	718	7.7	14.9	391.4
Teck_2013_SedTox	SE-4-B1	424499.39	5393516.74	710	7.3	14.0	392.9
Teck_2013_SedTox	SE-4-B2	422289.305	5391549.11	708	6.6	12.8	419.8
Teck_2013_SedTox	SE-4-B3	420545.856	5391416.884	707	0.9	1.5	30.1
Teck_2013_SedTox	SE-4-B4	418964.49	5390736.08	706	4.2	8.2	302.3
Teck_2013_SedTox	SE-4-B5	418622.79	5389013.18	705	4.9	9.6	381.9
Teck_2013_SedTox	SE-4-B6	423102.47	5391739.07	709	7.4	14.3	421.3
Teck_2013_SedTox	SE-4-C2	418306.16	5391991.23	707	0.1	0.1	1.4
Teck_2013_SedTox	SE-4-C3	419429.79	5390224.54	706	0.7	1.2	37.0
Teck_2013_SedTox	SE-4-C4	419067.85	5388803.8	705	0.7	1.1	22.0
Teck_2013_SedTox	SE-4-C5	420013.1	5387632.83	704	1.0	1.4	13.1
Teck_2013_SedTox	SE-4-C6	419943.5	5386149.313	703	1.1	1.6	17.6
Teck_2013_SedTox	SE-4-R1	424340.05	5394268.37	711	5.9	11.4	297.1
Teck_2013_SedTox	SE-4-R5	419267.52	5391735.7	707	0.2	0.2	3.1
Teck_2013_SedTox	SE-4B-C1	416961.07	5384343.21	701	1.5	2.9	142.0
Teck_2013_SedTox	SE-4B-C2	416724.72	5379563.31	698	0.7	0.9	13.4
Teck_2013_SedTox	SE-4B-C3	413004.16	5373263.99	692	0.6	0.8	14.2
Teck_2013_SedTox	SE-4B-C4	410842.42	5368239.76	688	1.7	2.6	30.3

Teck_2013_SedTox	SE-5-B1	413953.1525	5354594.26	678	0.5	0.7	9.8
Teck_2013_SedTox	SE-5-B2	413351.4	5354542.05	678	1.5	2.2	18.7
Teck_2013_SedTox	SE-5-B3	412691.33	5354422	678	0.7	1.0	11.3
Teck_2013_SedTox	SE-5-B4	413420.5	5352206.64	677	0.7	0.9	11.7
Teck_2013_SedTox	SE-5-B5	413957.79	5351687.92	676	0.9	1.2	12.0
Teck_2013_SedTox	SE-5-B6	414416.73	5351559.3	676	1.1	1.7	15.4
Teck_2013_SedTox	SE-5-C1	412642.82	5357585.94	680	0.7	1.0	11.4
Teck_2013_SedTox	SE-5-C2	412148.51	5354419.25	678	0.7	1.0	11.0
Teck_2013_SedTox	SE-5-C3	412739.47	5352655.47	677	0.8	1.1	10.7
Teck_2013_SedTox	SE-5-C4	413790.34	5350031.34	675	0.6	0.8	8.0
Teck_2013_SedTox	SE-5B-C1	414804.09	5347922.58	674	0.6	0.7	8.4
Teck_2013_SedTox	SE-5B-C2	414102.12	5343193.65	671	1.9	3.3	39.7
Teck_2013_SedTox	SE-5B-C3	413655.93	5343212.01	671	0.3	0.4	9.3
Teck_2013_SedTox	SE-5B-C4	410881.55	5339275.8	668	1.1	1.5	16.5
Teck_2013_SedTox	SE-6-B1	410864.75	5335490.568	665	0.2	0.3	4.9
Teck_2013_SedTox	SE-6-B2	411272.52	5335725.11	665	0.6	0.9	9.1
Teck_2013_SedTox	SE-6-B4	410686.355	5334129.15	665	0.9	1.4	18.0
Teck_2013_SedTox	SE-6-B5	411006.27	5333732.115	664	1.4	2.1	21.8
Teck_2013_SedTox	SE-6-B6	411292.89	5333335.66	664	0.5	0.7	7.7
Teck_2013_SedTox	SE-6-C1	411008.34	5336019.64	666	0.9	1.1	11.7
Teck_2013_SedTox	SE-6-C2	411236.31	5336306.01	666	0.7	0.9	10.5
Teck_2013_SedTox	SE-6-C3	410708.89	5333769.16	664	1.3	2.0	20.8
Teck_2013_SedTox	SE-6-C4	410959.35	5333350	664	0.9	1.3	17.4
Teck_2013_SedTox	SE-6-R3	410903.28	5336565.645	666	0.5	0.6	7.4
Teck_2013_SedTox	SE-6B-C1	409906.96	5332427.52	663	0.8	1.1	13.2
Teck_2013_SedTox	SE-6B-C2	407027.24	5328227.84	659	0.4	0.5	5.8
Teck_2013_SedTox	SE-6B-C3	407582.5	5324288.34	657	0.4	0.5	5.3
Teck_2013_SedTox	SE-6B-C4	400538.85	5322330.34	652	0.5	0.6	5.6
Teck_2013_SedTox	SE-7-B1	397451.91	5315603.05	646	0.5	0.6	7.0
Teck_2013_SedTox	SE-7-B2	398078.45	5315204.09	646	0.3	0.3	5.2
Teck_2013_SedTox	SE-7-B3	398694.1167	5315138.98	645	0.5	0.6	7.0
Teck_2013_SedTox	SE-7-B4	398629.945	5312042.66	643	0.5	0.6	6.6
Teck_2013_SedTox	SE-7-B5	398830.11	5310721.55	643	0.3	0.4	5.2
Teck_2013_SedTox	SE-7-B6	398723.7	5311549.73	643	0.7	0.8	8.2
Teck_2013_SedTox	SE-7-C1	396292.83	5319468.45	648	0.5	0.6	6.2
Teck_2013_SedTox	SE-7-C2	397270.49	5320065.49	649	0.4	0.6	8.7
Teck_2013_SedTox	SE-7-C3	399050.65	5306928.97	640	0.6	0.8	8.5
Teck_2013_SedTox	SE-7-C4	399383.17	5307268.96	641	0.5	0.7	9.9
Teck_2013_SedTox	SE-7B-C1	398693.71	5301339.09	637	0.7	0.9	10.0
Teck_2013_SedTox	SE-7B-C2	392535.06	5299892.81	632	0.6	0.8	10.6
Teck_2013_SedTox	SE-7B-C3	386078.7	5303882.69	626	0.8	1.1	14.3
Teck_2013_SedTox	SE-7B-C4	397022.96	5298004.92	634	0.5	0.7	8.3
Teck_2013_SedTox	SE-8-B1	363040.566	5310495.902	606	0.9	1.3	15.8
Teck_2013_SedTox	SE-8-B2	362206.87	5311914.925	605	1.0	1.3	14.5
Teck_2013_SedTox	SE-8-B3	362315.44	5312466.9	605	1.1	1.6	17.5
Teck_2013_SedTox	SE-8-B4	362434.53	5313451.93	605	1.2	1.7	19.0
Teck_2013_SedTox	SE-8-B5	364227.68	5309157.16	608	0.3	0.4	7.9
Teck_2013_SedTox	SE-8-B6	364197.3	5309594.91	607	1.4	2.2	26.5
Teck_2013_SedTox	SE-8-C1	366218.29	5308848.18	609	1.0	1.4	15.1
Teck_2013_SedTox	SE-8-C2	363848.56	5313282.12	605	0.1	0.1	5.0
Teck_2013_SedTox	SE-8-C3	360369.44	5313737.98	603	0.9	1.2	12.7
Teck_2013_SedTox	SE-8-C4	361822.12	5313107.9	604	1.1	1.6	19.2
Teck_2013_SedTox	SE-8B-C1	359196.83	5312370.95	602	0.7	0.9	10.7
Teck_2013_SedTox	SE-8B-C2	355225.31	5311303.61	600	0.5	0.6	12.6
Teck_2013_SedTox	SE-8B-C3	353797.33	5311826.83	599	1.1	1.5	20.5

Teck_2013_SedTox	SE-8B-C4	352174.41	5312039.31	598	0.8	1.2	13.6
Teck_2013_SedTox	SE-G-1	448664.06	5450379.42 NA		0.0	0.0	2.8
Teck_2013_SedTox	SE-G-2	448710.94	5450338.71 NA		0.0	0.0	2.8
Teck_2013_SedTox	SE-G-3	448596.95	5450270.32 NA		0.1	0.0	3.1
Teck_2013_SedTox	SE-G-4	448723.87	5450204.05 NA		0.0	0.0	3.3
Teck_2013_SedTox	SE-LAL-1	418638.03	549229.99 NA		0.2	0.1	2.0
Teck_2013_SedTox	SE-LAL-2	418537.24	5492506.79 NA		0.1	0.1	2.4
Teck_2013_SedTox	SE-LAL-3	418371.1275	5493673.7 NA		0.0	0.0	2.4
Teck_2013_SedTox	SE-LAL-4	435078.025	5466832.225 NA		0.1	0.1	3.7
Teck_2013_SedTox	SE-LAL-5	435187.02	5466554.9 NA		0.2	0.1	2.3
Teck_2013_SedTox	SE-LAL-6	435335.9233	5466507.157 NA		0.1	0.1	3.2
Teck_2013_SedTox	SE-REF-1	416076.91	5380829.295	699	0.2	0.3	6.1
Teck_2013_SedTox	SE-REF-10b	356558.31	5311243.78	601	0.1	0.1	3.1
Teck_2013_SedTox	SE-REF-2	414938.465	5376760.49	696	0.2	0.3	6.3
Teck_2013_SedTox	SE-REF-3	412079.4575	5370108.165	689	1.0	1.5	18.9
Teck_2013_SedTox	SE-REF-4	411920.4875	5356517.505	679	0.3	0.4	5.0
Teck_2013_SedTox	SE-REF-5	414616.84	5352322.257	676	0.1	0.1	2.8
Teck_2013_SedTox	SE-REF-6	400853.2933	5322793.837	652	0.2	0.2	5.7
Teck_2013_SedTox	SE-REF-7	396873.5475	5316361.883	646	0.6	0.8	8.6
Teck_2013_SedTox	SE-REF-8	391932.3875	5299477.838	632	0.4	0.6	10.5
Teck_2013_SedTox	SE-REF-9	360880.52	5313941.26	604	0.0	0.0	2.0
Teck_2013_SedTox	SE-TRIB-1	409564.6	5365249.9	686	0.0	0.0	2.0
Teck_2013_SedTox	SE-TRIB-2	417919.4	5389775.8	705	0.0	0.0	1.5
Teck_2013_SedTox	SE-TRIB-3	412684	5363469	685	0.1	0.1	1.8
Teck_2013_SedTox	SE-TRIB-4	428199.07	5408255.78	721	0.1	0.1	1.3
Teck_2013_SedTox	SE-TRIB-5	430695.5	5412505.2	726	0.2	0.1	1.4
Teck_2013_SedTox	SE-TRIB-6	441373.76	5416578.365	732	0.1	0.1	3.7

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Teck

February 25, 2014

File No.: 01-773180-000

Dr. Laura C. Buelow
Project Manager, Hanford/INL Project Office
U.S. Environmental Protection Agency, Region 10
309 Bradley Boulevard, Suite 115
Richland, WA 99352

Mr. Matt Wilkening
Project Manager, Idaho Office
U.S. Environmental Protection Agency, Region 10
950 W. Bannock Street, Suite 900
Boise, ID 83702

VIA ELECTRONIC MAIL ONLY

Subject: Upper Columbia River Remedial Investigation Feasibility Study - Phase 2 Sediment Study; Backscatter Electron Microscopy Proposal

Dear Dr. Buelow and Mr. Wilkening:

Consistent with the U.S. Environmental Protection Agency (EPA) approved Quality Assurance Project Plan (QAPP) for the above-referenced study; Teck American Incorporated (TAI) is pleased to submit for your review and approval a proposal to conduct backscatter electron microscopy on archived sediments. As noted on page A-9 of the QAPP, "Sediment samples will be archived and no fewer than 35 sediment samples will undergo backscatter electron microscopy following a review of the preliminary data."

The following proposal is intended to address the additional question outlined within Section A7.2 of the QAPP: "Can the nature and extent of unacceptable risk at the Site via spatial gradients and sediment bed properties such as slag content (e.g., Zn/V ratio[1]), TOC, mPECQ, and sediment texture be further refined[2]?"

To facilitate the identification of samples for consideration of backscatter electron microscopy, field observations as recorded on sampling forms (i.e., "Sediment/Porewater Sampling Form") were reviewed to identify if and what percentage of silica glass particles were observed. Copies of all field sampling forms can be made available; but simply due to file size (i.e., ~373 MB) were not included at this time. Following a review of all field sampling forms, 38 samples were identified as having a percentage of "silica glass" as determined by a qualified person in the field. As defined within the QAPP, "a qualified person is either a Washington State Licensed Geologist (LG) or an engineer/scientist who has received site-specific training in the following: 1) identification of sedimentary deposits of the UCR basin, 2) recognition of amorphous silica-rich glass, 3) particle size and percentage estimation, 4) soil/sediment classification systems, and 5) recording of observations."

Field observations in conjunction with preliminary sediment chemistry (e.g., zinc to vanadium ratio and mPECQ[3] calculations) were used to identify 38 samples for backscatter electron microscopy, see Table 1. We wish to confirm that upon receiving EPA's approval on the proposed samples TAI will take the necessary steps to secure a qualified contractor to perform this specialized work.

We would like to thank you in advance for your attention to this matter and look forward to receiving your approval on the proposal. Should you have any questions or require any additional information at this time, please call me at (509) 623-4501.

Sincerely,
Teck American Incorporated

Kris R. McCaig

Kris R. McCaig
Manager, Environment and Public Affairs

cc: Dr. Anne Fairbrother – Exponent, Inc.; Bellevue, WA

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[1] The basis and rationale of using a Zn/V ratio was detailed within Appendix D of the BERA work plan (TAI 2011). Other chemical ratios and/or methods (i.e., backscatter electron microscopy) may also be used to refine sediment bed properties and facilitate data interpretation.
[2] The sampling design is not intended to provide an assessment of spatial distribution of contaminants in the Site.
[3] mPECQ = mean Probable Effect Concentration Quotient.

Table 1. Summary of Sediment Samples Proposed for Specialized Backscatter Electron Microscopy Analysis

Sample Id	River Mile	mPECQ8	mPECQ4	Zn:V Ratio
SE-1-R5	744	3.6	6.9	357.6
SE-1-R1	744	3.0	5.6	319.5
SE-1-R2	742	5.4	10.1	382.8
SE-1-B5	737	2.3	4.6	175.4
SE-1-R8	737	2.4	4.6	233.4
SE-1B-R3	735	5.5	10.8	335.4
SE-1B-C3	735	3.2	6.4	237.1
SE-1B-C1	734	4.3	8.8	325.5
SE-2-B1	733	0.4	0.6	32.7
SE-2-B2	732	1.8	3.6	180.0
SE-2-R1	732	3.7	7.4	304.2
SE-2-R3	732	1.0	1.8	80.0
SE-2B-R1	728	3.6	7.0	274.9
SE-2B-C4	728	6.7	14.5	377.0
SE-2B-C3	726	2.7	5.0	186.5
SE-3-B1	725	5.6	10.7	381.0
SE-3-C1	724	3.6	6.9	208.0
SE-3-B2	724	9.9	19.0	479.5
SE-3-B4	723	6.4	12.4	363.9
SE-3-R7	722	3.7	6.5	212.0
SE-3-R8	722	11.7	25.6	489.9
SE-3-R10	721	6.2	11.4	333.2
SE-3-R9	721	1.3	2.3	81.3
SE-3-C4	721	5.5	10.2	296.2
SE-3B-C3	715	5.9	11.2	307.6
SE-4-R1	711	5.0	9.6	225.4
SE-4-B1	710	6.4	12.1	326.7
SE-4-B6	709	6.4	12.2	343.8
SE-4-B2	708	5.9	11.2	340.3
SE-4-B4	706	3.6	6.6	228.7
SE-4-B5	705	4.3	7.7	307.0
SE-4-C4	705	0.7	1.1	23.5
SE-4B-C3	692	0.5	0.8	11.9
SE-5B-C1	674	0.6	0.8	8.7
SE-6B-C4	652	0.4	0.5	5.4
SE-7-B1	646	0.5	0.6	6.9
SE-8-B3	605	1.1	1.5	17.3
SE-8B-C2	600	0.5	0.6	12.2
Minimum =	600	0.4	0.5	5
Average =	N/A	4	7	232
Maximum =	744	12	26	490
Count =	38	38	38	38

N/A = not applicable

APPENDIX D

CHANGE REQUEST FORMS

Change Request Form
Upper Columbia River Phase 2 Sediment Study

Page: 1 of 2 | Change No: 1

CHANGE REQUEST

Modify positions of sample locations LAL-4, LAL-5 and LAL-6

Applicable Reference:

FSP Map A-9. External Reference Locations in Canada

Description of Change:

Upstream relocation of sample locations LAL-4, LAL-5 and LAL-6 such that a 300 meter seperation is achieved between the original sample location cluster and the relocated sample location cluster, while remaining approximately 100 meters from the shoreline.

Reason for Change:

Relocation of samples will avoid impacts to previously documented archaeological sites. See attached Figure for revised locations.

Impact on Present and Completed Work:

No impact is anticipated.

Requested By: Michael Kelly (Scientist) Date: 8/28/2013

Acknowledged By: David Hose (Task Leader) Date: 8/28/2013

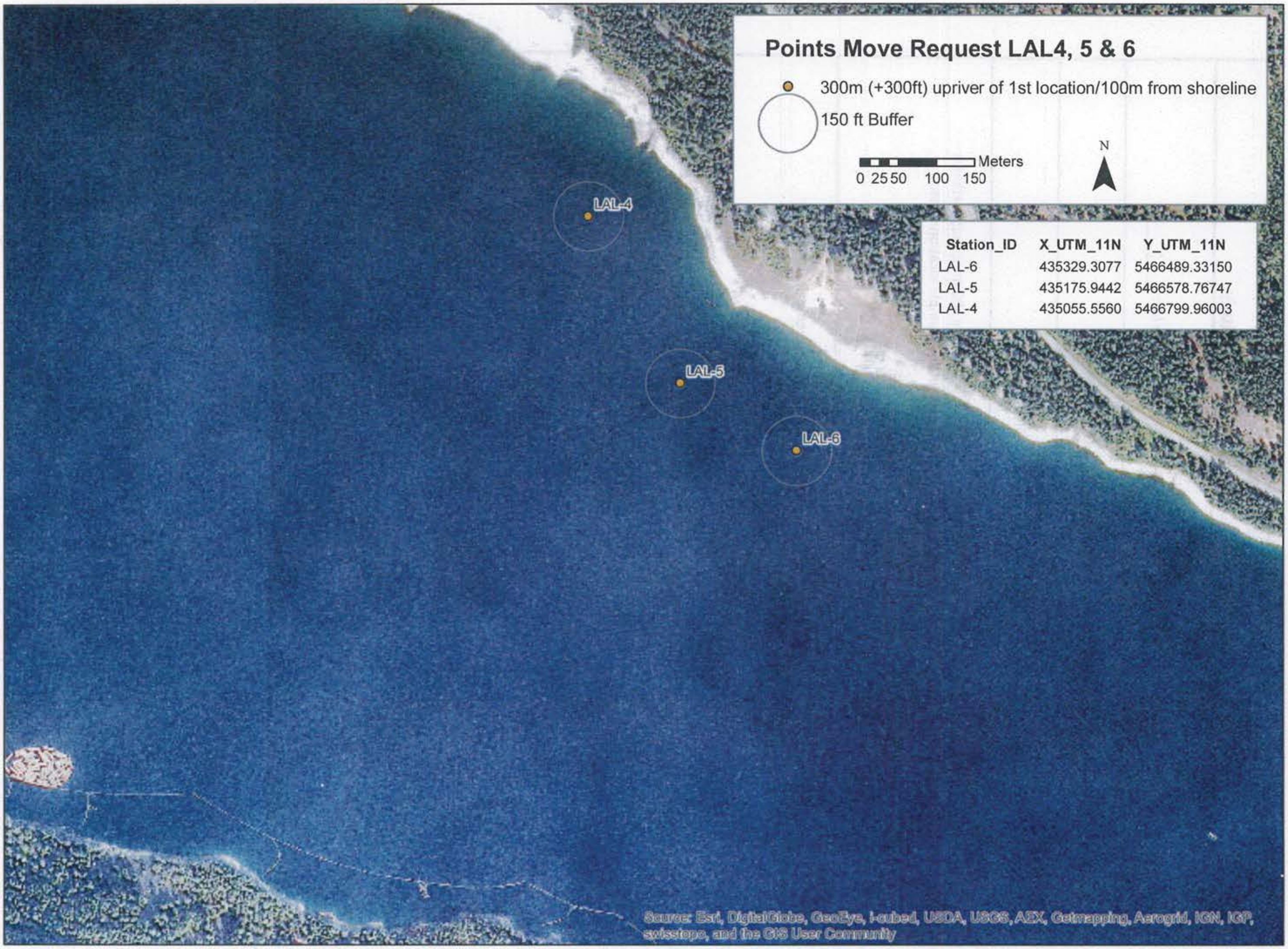
APPROVAL

URS Project Manager: Paul T. McCullough Date: 28 Aug 13

Teck Project Manager: [signature] Date: 08/29/13

EPA Project Manager: [signature] Date: 9/3/13

Points Move Request LAL4, 5 & 6



Station_ID	X_UTM_11N	Y_UTM_11N
LAL-6	435329.3077	5466489.33150
LAL-5	435175.9442	5466578.76747
LAL-4	435055.5560	5466799.96003

Document Path: J:\Projects\CADGIS\Teck\UCR\MXDs\MovingLALL456.mxd

Change Request Form
Upper Columbia River Phase 2 Sediment Study

Page: 1 of 8 Change No: 2

CHANGE REQUEST

Creation of SOP for Tributary Sediment Sampling

Applicable Reference:

SOPs section (Attachment A2) of the Field Samplin Plan

Description of Change:

A new SOP (3-A) was prepared that details the procedures to be followed during tributary sampling activities. SOP 3-A is attached.

Reason for Change:

No SOP specific to tributary sampling was provided in the Final QAPP, dated March 2013.

Impact on Present and Completed Work:

None

Requested By: J.R. Flanders (Scientist) Date: 9/23/2013

Acknowledged By: David Hose (Task Leader) Date: 9/23/2013

APPROVAL

URS Project Manager: Paul T. McCullough Date: 9/23/2013

Teck Project Manager: [signature] Date: 09/23/13

EPA Project Manager: [signature] Date: 9.23.13

STANDARD OPERATING PROCEDURE SOP-3A

TRIBUTARY SEDIMENT AND POREWATER SAMPLE COLLECTION

Scope and Applicability

The purpose of this standard operating procedure (SOP) is to describe the procedures used to collect surface sediment (i.e., 0-6 inches) and porewater from tributary reference locations that cannot be accessed using a boat-mounted sampler (e.g., refer to Photo 1).

Photo 1. Example of conditions associated with tributary reference sample locations encountered in 2005.

Procedures described in this SOP may be modified in the field by the Field Team Leader, sampling personnel, and the on-site EPA representative, based on site conditions. Any field modifications to this SOP will be documented in the field logbook.

Equipment and Materials

Representative samples should be collected with this procedure, which requires vigilant care and precision by each sample team member. Equipment required for tributary reference sampling includes the following:

- Decontaminated Ekman™ or Petite Ponar™ dredge
- Decontaminated stainless-steel shovel
- Decontaminated sampling tools (e.g., stainless-steel or Lexan scoops, trowels, or spoons)
- Laboratory pre-cleaned decontaminated ≤140 mL porewater extraction syringe, airstone, Tygon® or similar polyethylene tubing, and 0.45 µm hydrophilic filters
- Large Lexan tub
- Stainless steel paddle wheel mixer
- Stainless-steel ruler and/or tape measure
- Laboratory-supplied sample containers, insulated coolers, and wet ice
- Chain-of-custody forms, custody seals, sample labels
- Re-sealable plastic storage bags
- Digital camera
- Field logbook, sample collection forms, and pens
- Project-specific field sampling plan and health and safety plan
- Personal protective equipment (PPE) as specified within the health and safety plan

Procedures for Sediment Sample Collection and Processing

1. Locate the sample station using Map A8 in the Field Sampling Plan (FSP), and confirm the sample coordinates using a handheld GPS unit.

2. Assess substrate conditions at the sample location and determine if conditions are amenable to collection of fine-grained sediment (≤2 mm). A minimum area of fine-grained sediment 2-feet square and 6-inches deep is needed to provide sufficient volume of material for sampling purposes. If conditions are not amenable (e.g., the dominant substrate size is gravel and cobble, or the current prevents safely accessing the location), the Field Team Leader will discuss with the on-site EPA representative moving the sampling location to an area within the reference tributary that is amendable to sediment sampling. If accessing the sample location requires wading, ensure that the sampler has proper PPE (e.g., waders and flotation device).

3. Identify the final sample location on a site map, obtain location coordinates with the GPS unit, document site conditions, location coordinates, and digital site photos in the field logbook as described in SOP-5.
4. Label sediment and porewater sampling containers prior to filling in accordance with SOP-2.
5. All sampling activities will be conducted using the prescribed PPE including but not limited to nitrile gloves.
6. Assemble the porewater sampler by attaching the airstone to a ≤140 ml sampling syringe with tubing. All components of the porewater sampler that contact the sample will be precleaned by the analytical laboratory and stored in a re-sealable plastic storage bag until needed for sampling.
7. In order to provide the sampling team with a flexible approach in response to varied field conditions, porewater samples may be collected by one of two methods:

   i. Sample collection from a sediment grab sampling device

   ii. Direct porewater collection from accumulated sediment in the Lexan tub

   Detailed description of sampling methodologies for each of these scenarios is provided below.

   a. Samples will be collected from within the grab sampler. Sediment samples will be collected using either an Ekman dredge or Petite Ponar grab sampler. An Ekman dredge is a lightweight sediment-sampling device with spring-activated jaws used to collect soft, fine grained sediment. A Petite Ponar dredge is a midweight sediment-sampling device with lever-activated weighted jaws that is used to collect more consolidated fine to coarse grained sediment. The following steps will be followed to collect a sediment sample depending on the sampler type selected:

      i. **Ekman dredge**:

         1. Decontaminate the dredge prior to sampling following procedures described in SOP-4.
         2. Attach a nylon or wire rope and messenger line to the dredge. If the dredge is to be operated using a handle, attach the handle.
         3. Fix the jaws so that they are in the open position by placing trip cables over the release studs. Ensure that the hinged doors on the dredge top are free to open.

4. Lower the sampler through the water column to a point 4 to 6 inches above the sediment surface.
5. Drop the sampler sharply onto the sediment. If a handle is used apply sufficient force to insert the sampler approximately 6 inches into the sediment. Repeated use of the sampler may be necessary to achieve the required depth if a handle is not available.
6. If a handle is used, depress button to trigger the jaw release mechanism. If a handle is not available trigger the jaw release mechanism by lowering the messenger weight down the line.
7. Raise the dredge at a slow and steady rate to prevent the doors from opening.
8. Place the sample dredge into the Lexan tub. Open the doors on the top of the dredge, determine the sediment penetration depth achieved by the sampler and record this information on the field forms. The sampler should penetrate to between 4 and 6 inches below the sediment surface. However, penetration less than 4 inches can be retained and additional sediment collected until the sampler reaches the 6-inch depth.
9. Collect a porewater sample from the top of the grab following procedures described in SOP-3. If porewater volume obtained from individual grabs is insufficient to collect a porewater sample, then it is allowable to collect porewater from the accumulated sediment in the Lexan tub.
10. Repeat steps 3 – 8 to collect sediment volume sufficient for chemistry and bioassay analyses.

ii. **Petite Ponar Grab Sampler**:

1. Decontaminate the grab sampler prior to sampling following procedures described in SOP-4.
2. Attach a nylon or wire rope to the grab sampler.
3. Arrange the grab sampler with the jaws in the open position, setting the trip bar so the sampler remains open when lifted from the top. If the sampler is so equipped, place the spring-loaded pin into the aligned holes in the trip bar.
4. Lower the grab sampler slowly through the water column to a point 4 to 6 inches above the sediment surface.
5. Drop the sampler sharply onto the sediment.

6. Pull up sharply on the line, triggering the jaw release mechanism to close the sampler.
7. Raise the dredge at a slow and steady rate to prevent doors from opening.
8. Place the sample dredge into the Lexan tub. Open the doors on the top of the dredge, determine the sediment penetration depth achieved by the sampler and record this information on the field forms. The sampler should penetrate to between 4 and 6 inches below the sediment surface. However, penetration less than 4 inches can be retained and additional sediment collected until the sampler reaches the 6-inch depth.
9. Collect a porewater sample from the top of the grab following procedures described in SOP-3. If porewater volume obtained from individual grabs is insufficient to collect a porewater sample, then it is allowable to collect porewater from the accumulated sediment in the Lexan tub.
10. Repeat steps 3 – 8 to collect sediment volume sufficient for chemistry and bioassay analyses.

If substrate conditions limit sampling success using either the Eckman dredge or the petite ponar grab samplers described above, sediment samples may be obtained by extracting sediment using a stainless steel shovel (or equivalent hand held tool):

1. Decontaminate the shovel prior to sampling following procedures described in SOP-4.
2. Using the decontaminated stainless-steel shovel, excavate sediment from to a depth of 6-inches until adequate sediment volume is obtained for both chemistry and bioassay analyses.
3. Place all excavated sediment into the Lexan tub.
4. Collect porewater from the accumulated sediment in the Lexan tub following the procedure described in SOP-3.

8. Porewater will be expelled from the syringe into labeled, laboratory-provided sample containers (Table A-2 of the FSP). This water will be distributed unfiltered or filtered as specified by the analytical method. Porewater samples will be stored in a cooler with ice until they arrive at the analytical laboratory.
9. The cultural resource monitor will examine the sediment to determine if cultural resources are present. If cultural resources are present, the field crew will follow instructions from the cultural resources monitor regarding what to do with the

recovered sediment and cultural artifacts, as well as whether to abandon the sampling station.

10. Using a decontaminated stainless-steel paddle wheel mixer the sample will be homogenized in the Lexan tub until the texture and color of the sediment appears to be uniform.
11. A qualified person will characterize the sediment and visually estimate the percentage of the homogenized material that is ≤2 mm in size as described in SOP-3.
12. The sediment will be characterized as specified in the study design. Characteristics that will be recorded in the field logbook and/or data form include:
    a. Sediment type (e.g., silt, sand)
    b. Texture (e.g., fine-grain, coarse, poorly sorted sand)
    c. Color
    d. Presence/location/thickness of the redox potential boundaries (a visual indication of black is often adequate for documenting anoxia)
    e. Presence of biological structures (e.g., amphipods, macrophytes)
    f. Presence of debris (e.g., twigs, leaves)
    g. Presence of shells
    h. Stratification, if any
    i. Presence of a sheen
    j. Odor (e.g., hydrogen sulfide, oil, other).
13. The homogenized sediment will be photographed. The photograph ID will be documented in the field so that the photograph can be subsequently labeled with station location, date, and time of sample.
14. Once the cultural and geological evaluations are complete, rocks that are greater than or equal to ½-inch diameter (≥ ½-in.) may be discarded from the homogenized sample after their approximate percent contribution to the homogenized volume has been determined and noted on the field collection form.
15. The homogenized sediment will be placed into labeled, laboratory-provided, sample containers using a decontaminated stainless-steel or Lexan spoon/scoop. Sample containers for a field duplicate sample (if needed) will be filled from the same homogenized sediment as the primary sample.

16. The container for the acid volatile sulfides/simultaneously extracted metals (AVS/SEM) analysis should be filled first, as the results of this analysis are affected by excess oxygen exposure. The AVS/SEM container should be filled with sediment leaving no headspace, and the preservative should be distributed through the sample by inverting the container or by mixing.
17. Sediment samples designated for chemical analyses by the analytical laboratory will be placed directly in a cooler with wet ice. Bioassay samples will be stored in a chilled refrigerated truck until delivered to the analytical laboratory.
18. All pertinent field forms, chain of custody forms, quality assurance/quality control documentation, and logbooks entries will be completed before leaving the sample vicinity. Record any deviations from the specified sampling procedures in the field logbook.
19. All non-dedicated sampling equipment (e.g., dredge, Lexan tub, mixer and sampling scoops) will be decontaminated between sampling locations in accordance with decontamination procedures (see SOP-4).

Change Request Form
Upper Columbia River Phase 2 Sediment Study

Page 1 of 2 Change No. : 3

CHANGE REQUEST:

Applicable Reference: Quality Assurance Project Plan for the Phase 2 Sediment Study

Description of Change: The following changes will be made to the bioassay procedures in the QAPP Tables B1-3, B1-5, B1-6, and B1-10, (Please and in Appendix E, Standard Operating Procedures Nos. XYZ and General Activity Schedules Nos. XYZ. Specifically the following changes are requested:

1. Table B1-3 and Table B1-5 will be amended to indicate Feeding at a rate of 1 mL/day, increasing to 2 mL/day at day 14. This was the intended feeding rate and the original table entry of 1 mg/day to 2 mg/day was a typographical error. Updated Tables are attached.

2. General activity schedules (GAS) (in Appendix E) will be updated to be congruent with the test SOPs in Appendix E. The GAS for the long term Chironomus test will have the Days for isolating and checking egg masses revised from -3 and -2 to -7 and -6 which will allow larvae to be 4-day old at start of the test. All GASs were modified by adding the following on Day 0 (updated GASs are attached):
Renewal of the overlying water using the Zumwalt water delivery system is implemented immediately prior to the introduction of the test organisms into the test replicates.

3. SOP (in Appendix E) will be amended to indicate that the Chironomus life cycle test will begin with 4-day old larvae instead of <24-hr old larvae. This follows PER's SOP and provides better growth and biomass measurement endpoints. Amended SOP is attached (Rev 5; dated 9-11-13).

4. Hyalella and Chironomus SOPs (in Appendix E) will be updated to be consistent with the QAPP (attached; proposed updates are highlighted for easy reference):

- Hyalella test SOPs now reflect the QAPP-specified 0.4 mg/L Br in test water
- Hyalella long-term test SOP now states that Nitex mesh is used (consistent with the GAS).
- Chirionomus test SOPs now reflect the use of EPA moderately-hard water and use of 4-day old chironomids for the lifecycle test
- Biomass is now listed as an endpoint for all tests in addition to mean growth.

Reason for Change: These changes will be made to correct typographical errors and to bring the tables, SOPs, and GASs into alignment with each other and with the QAPP text. The only substantive change is starting the long-term Chironomus test with 4-day old larvae instead of <24 hr old larvae.

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Impact on Present and Completed Work: Starting the Chironomus test with older larvae brings the protocol into alignment with PER's current SOP; better growth and biomass endpoints are achieved. This is commensurate with discussions with other testing laboratories that have achieved similar benefits from the adjusted protocol. All other changes have no impact as there is no substantive change to the test protocols.

Requested By: [signature] (Scientist) Date: 10/16/13

Acknowledged By: [signature] Jeffrey Cotsifas (PER) Date: 10/16/13

APPROVAL

Task Manager: Anne Fairbrother Anne Fairbrother (Exponent) Date: 10/18/13

TAI Project Manager: [signature] for MEA Marko Adzic (TAI) Date: 11/26/13

EPA Project Manager: [signature] Laura Buelow (EPA) Date: 12/3/13

Table B1-3. Test Conditions for Conducting a 28-d Sediment Toxicity Test with *Hyalella azteca*

Parameter	Conditions
Test type	Whole-sediment toxicity test with renewal of overlying water
Temperature	23 ± 1°C
Light quality	Wide-spectrum fluorescent lights
Illuminance	About 500 lux
Photoperiod	16L:8D
Test chamber	300-mL high-form lipless beaker
Sediment volume	100 mL
Overlying water volume	175 mL
Renewal of overlying water	2 volume additions/d; continuous or intermittent (e.g., 1 volume addition every 12 h)
Age of organisms [a]	7- to 8-d old at the start of the test with a goal of achieving starting weights in the range of 0.02 to 0.035 mg/organism. The weight of a representative sample of organisms at the start of sediment exposures will be documented.
Number of organisms/chamber	10
Number of replicate chambers/treatment	14 replicates: 8 for biological endpoints and 6 for chemistry only
Feeding	YCT food: fed 1.0 mL YCT/day to each test chamber during Days 0 to 13, and 2 mL YCT/day to each test chamber during the remaining exposure (Days 14 to 27).
Aeration	None, unless DO in overlying water drops below 2.5 mg/L.
Overlying water [a]	Test water will consist of reconstituted water created using the methods specified in Borgmann (1996) but modified to contain 0.4 mg/L bromide.
Test chamber cleaning	If screens become clogged during a test, gently brush the *outside* of the screen.
Overlying water quality	Hardness, alkalinity, conductivity, pH, and ammonia at the beginning and end of a test. Temperature daily. Conductivity weekly. (DO and pH three times/week. Concentrations of DO should be measured more often if DO drops more than 1 mg/L since the previous measurement.
Test duration [a]	28 d
Endpoints	Survival, weight, and biomass
Test acceptability	Minimum mean control survival of 80% on Day 28.

Source: USEPA (2000)

Notes:

[a] Modified from EPA standard method as directed by EPA (letter from Shawn D. Blocker; June 21, 2012 and Dr. Laura Buelow on August 24, 2012)

DO = dissolved oxygen

Table B1-5. Test Conditions for Conducting a 42-d Sediment Toxicity Test with *Hyalella azteca*

Parameter	Conditions
Test type	Whole-sediment toxicity test with renewal of overlying water
Temperature	23 ± 1°C
Light quality	Wide-spectrum fluorescent lights
Illuminance	About 500 lux
Photoperiod	16L:8D
Test chamber	300-mL high-form lipless beaker
Sediment volume	100 mL
Overlying water volume	175 mL in the sediment exposure from Day 0 to Day 28 (175 to 275 mL in the water-only exposure from Day 28 to Day 42)
Renewal of overlying water	2 volume additions/d; continuous or intermittent (e.g., 1 volume addition every 12 h)
Age of organisms	7- to 8-d-old at the start of the test with a goal of achieving starting weights in the range of 0.02 to 0.035 mg/organism. The weight of a representative sample of organisms at the start of sediment exposures will be documented.
Number of organisms/chamber	10
Number of replicate chambers/treatment	18 replicates: 12 for biological endpoints and 6 for chemistry only. Of the 12 replicates for biological endpoints, 4 replicates are for 28-d survival and growth and 8 replicates are for 35- and 42-d survival, growth, and reproduction.
Feeding	YCT food: fed 1.0 mL YCT/day to each test chamber during Days 0 to 13, and 2 mL YCT/day to each test chamber during the remaining exposure (Days 14 to 42).
Aeration	None, unless DO in overlying water drops below 2.5 mg/L.
Overlying water [a]	Test water will consist of reconstituted water created using the methods specified in Borgmann (1996) but modified to contain 0.4 mg/L bromide.
Test chamber cleaning	If screens become clogged during a test, gently brush the *outside* of the screen.
Overlying water quality	Hardness, alkalinity, conductivity, and ammonia at the beginning and end of a sediment exposure (Day 0 and 28). Temperature daily. Conductivity weekly. DO and pH three times/week. Concentrations of DO should be measured more often if DO drops more than 1 mg/L since the previous measurement.
Test duration	42 d
Endpoints	28-d survival, weight, and biomass; 35-d survival and reproduction; and 42-d survival, weight, biomass reproduction, and number of adult males and females on Day 42.
Test acceptability	Minimum mean control survival of 80% on Day 28.

Source: USEPA (2000)

Notes:

[a] Modified from EPA standard method as directed by EPA (letter from Shawn D. Blocker; June 21, 2012) and Dr. Laura Buelow on August 24, 2012)

DO = dissolved oxygen

Table B1-6. Test Conditions for Conducting a Long-term Sediment Toxicity Test with *Chironomus dilutus*

Parameter	Conditions
Test type	Whole-sediment toxicity test with renewal of overlying water
Temperature	23 ± 1°C
Light quality	Wide-spectrum fluorescent lights
Illuminance	About 500 lux
Photoperiod	16L:8D
Test chamber	300-mL high-form lipless beaker
Sediment volume	100 mL
Overlying water volume	175 mL
Renewal of overlying water	2 volume additions/d; continuous or intermittent (e.g., 1 volume addition every 12 h)
Age of organisms	4-day-old larvae. The weight of a representative sample of organisms at the start of sediment exposures will be documented.
Number of organisms/chamber	12
Number of replicate chambers/treatment [a]	25 replicates: 16 for biological endpoints and 9 for chemistry only. Of the 16 replicates for biological endpoints, 4 replicates are created only to produce auxiliary males.
Feeding [a]	TetraMin® goldfish food, 6 mg of particles fed daily to each test chamber starting Day 1
Aeration	None, unless DO in overlying water drops below 2.5 mg/L.
Overlying water [a]	Reformulated moderately hard reconstituted water (as specified in USEPA [2000] page 25)
Test chamber cleaning	If screens become clogged during a test, gently brush the *outside* of the screen.
Overlying water quality	Hardness, alkalinity, conductivity, and ammonia at the beginning, on Day 20, and at the end of a test. Temperature daily (ideally continuously). DO and pH three times/week. Conductivity weekly. Concentrations of DO should be measured more often if DO has declined by more than 1 mg/L since the previous measurement.
Test duration	About 50 to 65 d; each treatment is ended separately when no additional emergence has been recorded for seven consecutive days. When no emergence is recorded from a treatment, termination of that treatment should be based on the control sediment using this 7-d criterion.
Endpoints	20-d survival, weight, and biomass; female and male emergence, adult mortality, the number of egg cases oviposited, the number of eggs produced, and the number of hatched eggs.
Test acceptability	Average size of *C. dilutus* in the control sediment at 20 d must be at least 0.6 mg/surviving organism as dry weight or 0.48 mg/surviving organism as AFDW. Emergence should be greater than or equal to 50%. Experience has shown that pupae survival is typically >83% and adult survival is >96%. Time to death after emergence is <6.5 d for males and <5.1 d for females. The mean number of eggs/egg case should be greater than or equal to 800 and the percent hatch should be greater than or equal to 80%.

Source: USEPA (2000)

Notes:

[a] Modified from EPA standard method as directed by EPA (letter from Shawn D. Blocker; June 21, 2012 and Dr. Laura Buelow on August 24, 2012)

AFDW = ash-free dry weight

DO = dissolved oxygen

Table B1-10. Test Acceptability Requirements for a Long-term Sediment Toxicity Test with *Chironomus dilutus*

A.	It is recommended for conducting a long-term test with *C. dilutus* that the following performance criteria be met	
	1.	Tests must be started with 4-day old larvae. Starting a test with substantially older organisms may compromise the emergence and reproductive endpoint.
	2.	Average survival of *C. dilutus* in the control sediment must be greater than or equal to 70% on Day 20 and greater than 65% at the end of the test.
	3.	Average size of *C. dilutus* in the control sediment at 20 d must be at least 0.6 mg/surviving organism as dry weight or 0.48 mg/surviving organism as AFDW. Emergence should be greater than or equal to 50%. Experience has shown that pupae survival is typically >83% and adult survival is >96%. Time to death after emergence is <6.5 d for males and <5.1 d for females. The mean number of eggs/egg case should be greater than or equal to 800 and the percent hatch should be greater than or equal to 80%.
	4.	Hardness, alkalinity, and ammonia in the overlying water typically should not vary by more than 50% during the test, and DO should be maintained above 2.5 mg/L in the overlying water.
B.	Performance-based criteria for culturing *C. dilutus* include the following	
	1.	It may be desirable for laboratories to periodically perform 96-h water-only reference-toxicity tests to assess the sensitivity of culture organisms. Data from these reference-toxicity tests could be used to assess genetic strain or life-stage sensitivity of test organisms to select chemicals.
	2.	Laboratories should keep a record of time to first emergence for each culture and record this information using control charts. Records should also be kept on the frequency of restarting cultures.
	3.	Laboratories should record the following water quality characteristics of the cultures at least quarterly: pH, hardness, alkalinity, and ammonia. DO in the cultures should be measured weekly. Temperature of the cultures should be recorded daily. If static cultures are used, it may be desirable to measure water quality more frequently.
	4.	Laboratories should characterize and monitor background contamination and nutrient quality of food if problems are observed in culturing or testing organisms.
	5.	Physiological measurements such as lipid content might provide useful information regarding the health of the cultures.
C.	Additional requirements	
	1.	All organisms in a test must be from the same source. If organisms are purchased, the vendor information must be reported.
	2.	All test chambers (and compartments) should be identical and should contain the same amount of sediment and overlying water.
	3.	Standard negative-control sediment, quartz sand negative control sediment, and appropriate solvent controls must be included in a test. The concentration of solvent used must not adversely affect test organisms.
	4.	Test organisms must be cultured and tested at 23°C (±1°C).
	5.	The daily mean test temperature must be within ±1°C of 23°C. The instantaneous temperature must always be within ±3°C of 23°C.
	6.	Natural physio-chemical characteristics of test sediment collected from the field should be within the tolerance limits of the test organisms. (see USEPA [2000] for standard tolerance limits).
	7.	Source of overlying water and control sediments must be documented and reported.

Source: USEPA (2000)

Notes:

AFDW = ash-free dry weight
DO = dissolved oxygen

General Activity Schedule for Conducting a Short-term Sediment Toxicity Test with the amphipod *Hyalella azteca* (adapted ASTM 2012 and USEPA 2000).	
Day	**Activity**
About -7	Inform organism supplier of the need to isolate <24-h old amphipods from mass culture, and to observe isolated amphipods daily to evaluate health.
-2 to -1	5-6 or 6-7 day old amphipods are received from the test organism supplier and maintained prior to testing. Amphipods are fed and observed daily to evaluate health.
-1	Sample sediments for physical and chemical characteristics and sample pore water by centrifugation for water quality analyses. Analytical program will follow approved UCR Phase II QAPP. Place sediments into exposure beakers and add overlying water for about a 24-h equilibration period at 23°C. Start delivery of overlying water to the exposure beakers.
0	Renewal of the overlying water using the Zumwalt water delivery system is implemented immediately prior to the introduction of the test organisms into the test replicates. Measure total water quality of overlying water (pH, temperature, dissolved oxygen, hardness, alkalinity, conductivity, ammonia). Transfer ten test organisms into each test chamber. Release organisms under the surface of the water. Add appropriate food to each test chamber. Isolate 80 amphipods for T0 weight measurement. Place first set of peepers in chemistry beakers on Day 0 and sample peepers from chemistry beakers 7 days later.
1–27	Feed test organisms. Perform AM and PM water changes (2 volume additions per day). Measure temperature and dissolved oxygen (DO) daily, pH three times a week, and conductivity weekly. Observe behavior of test organisms.
7	Sample peepers and sediment porewater from chemistry beakers that were loaded on Day 0. Analytical program will follow approved UCR Phase II QAPP
14	Increase YCT feeding rate from 1.0 ml/day to 2.0 ml/day (Mount 2011).
14–20	Place a second set of peepers in chemistry beakers on one of the days between Day 14-20 and sample peepers from chemistry beakers 7 days later.
21–27	Sample peepers and sediment porewater from chemistry beakers that were loaded on Day 14-20. Analytical program will follow approved UCR Phase II QAPP
28	Measure temperature, dissolved oxygen, pH, hardness, alkalinity, conductivity, and ammonia. End the sediment-exposure portion of the test by collecting the test organisms with a #40 mesh sieve (425-µm mesh; U.S. standard size sieve). Count survivors and weigh test organisms for biomass and mean dry weight test endpoints.

General Activity Schedule for Conducting a Long-term Sediment Toxicity Test with the amphipod *Hyalella azteca* (adapted ASTM 2012 and USEPA 2000).	
Day	**Activity**
About -8	Inform organism supplier of the need to isolate <24-h old amphipods from mass culture, and to observe isolated amphipods daily to evaluate health.
-2 to -1	5-6 or 6-7 day old amphipods are received from the test organism supplier and maintained prior to testing. Amphipods are fed and observed daily to evaluate health.
-1	Sample sediments for physical and chemical characteristics and sample pore water by centrifugation for water quality analyses. Analytical program will follow approved UCR Phase II QAPP. Place sediments into exposure beakers and add overlying water for about a 24-h equilibration period at 23°C. Start delivery of overlying water to the exposure beakers.
0	Renewal of the overlying water using the Zumwalt water delivery system is implemented immediately prior to the introduction of the test organisms into the test replicates. Measure total water quality of overlying water (pH, temperature, dissolved oxygen, hardness, alkalinity, conductivity, ammonia). Transfer ten test organisms into each test chamber. Release organisms under the surface of the water. Add appropriate food to each test chamber. Isolate 80 amphipods for T0 weight measurement. Place first set of peepers in chemistry beakers on Day 0 and sample peepers from chemistry beakers 7 days later.
1–27	Feed test organisms. Perform AM and PM water changes (2 volume additions per day). Measure temperature and dissolved oxygen (DO) daily, pH three times a week, and conductivity weekly. Observe behavior of test organisms.
7	Sample peepers and sediment porewater by centrifugation from chemistry beakers that were loaded on Day 0. Analytical program will follow approved UCR Phase II QAPP.
14	Increase YCT feeding rate from 1.0 ml/day to 2.0 ml/day (Mount 2011).
14–20	Place a second set of peepers in chemistry beakers on one of the days between Day 14-20 and sample peepers from chemistry beakers 7 days later.
21–27	Sample peepers and sediment porewater by centrifugation from chemistry beakers that were loaded on Day 14-20. Analytical program will follow approved UCR Phase II QAPP.
28	Measure temperature, dissolved oxygen, pH, hardness, alkalinity, conductivity, and ammonia. End the sediment-exposure portion of the test by collecting the test organisms with a #40 mesh sieve (425-µm mesh; U.S. standard size sieve). Count survivors and weigh test organisms for biomass and mean dry weight test endpoints. Prepare eight amphipod replicate beakers for reproduction measurements: Place survivors in individual replicate water-only beakers containing 2 inch squares of nitex mesh. Add food to each test beaker/d and 2 volume additions/d of overlying water.
29–35	Feed daily. Measure temperature and dissolved oxygen (DO) daily, pH three times a week, and conductivity weekly. Perform AM and PM water changes (2 volume additions per day).
35	Record the number of surviving adults and remove offspring. Return adults to their original individual beakers and add food.
36–41	Feed daily. Measure temperature and dissolved oxygen (DO) daily, pH three times a week, and conductivity weekly. Perform AM and PM water changes (2 volume additions per day).
42	Measure total water quality (pH, temperature, dissolved oxygen, hardness, alkalinity, conductivity, ammonia). Record the number of surviving adults and offspring. Surviving adult amphipods on Day 42 are observed for determination of the number of males and females in each replicate. This information is used to calculate the number of young produced per female per replicate from Day 28 to Day 42. Weigh adult test organisms for biomass and mean dry weight test endpoints.

General Activity Schedule for Conducting a Short-term Sediment Toxicity Test with *Chironomus dilutus* (adapted from ASTM 2012a and USEPA 2000).	
Day	**Activity**
About -9	Isolate egg mass from mass cultures for hatching on about Day -7. Feed and observe larvae daily to evaluate health.
-1	Sample sediments for physical and chemical characteristics and sample pore water by centrifugation for water quality analyses. Analytical program will follow approved UCR Phase II QAPP. Place sediments into exposure beakers and add overlying water for about a 24-h equilibration period at 23°C. Start delivery of overlying water to the exposure beakers.
0	1. Renewal of the overlying water using the Zumwalt water delivery system is implemented immediately prior to the introduction of the test organisms into the test replicates. 2. Measure temperature, pH, hardness, alkalinity, dissolved oxygen, conductivity, and ammonia at start of test. 3. Transfer larvae into exposure chambers. Add 1.5 ml food to each test beaker with sediment before the larvae are added. Add 10 larvae to each replicate beaker. 4. Isolate 80 larvae for T0 weight measurement. 5. Place first set of peepers in chemistry beakers on Day 0 and sample peepers from chemistry beakers 7 days later.
1–10	Perform AM and PM water changes (2 volume additions per day). On a daily basis, add 1.5 ml food to each beaker. Measure temperature and DO daily. Aerate if DO is less than 2.5 mg/L.
7	Sample peepers and sediment porewater by centrifugation from chemistry beakers that were loaded on Day 0. Analytical program will follow approved UCR Phase II QAPP
About 9	In preparation for weight determinations, ash weigh-pans at 550 °C for 2 h. Note that the weigh boats should be ashed before use to eliminate weighing errors due to the pan oxidizing during ashing of samples.
10	Recover larvae for growth, biomass, and survival determinations. Pool all living larvae per replicate and dry the sample to a constant weight (e.g., 60°C for 24 h). Measure overlying water quality (pH, ammonia, DO, conductivity, hardness, and alkalinity).
11	The sample with dried larvae is brought to room temperature in a desiccator and weighed to the nearest 0.01 mg. The dried larvae in the pan are then ashed at 550°C for 2 h. The pan with the ashed larvae is then re-weighed and the tissue mass of the larvae determined as the difference between the weight of the dried larvae plus pan and the weight of the ashed larvae plus pan.

General Activity Schedule for Conducting a Long-term Sediment Toxicity Test with *Chironomus dilutus* (adapted from ASTM 2012 and USEPA 2000 with 4-d-old larvae used to start the exposures).	
Day	**Activity**
About -7	Isolate egg mass from mass cultures for hatching on Day 0. Incubated at 23°C
About -6	Check egg cases for viability and development
-1	Sample sediments for physical and chemical characteristics and sample pore water by centrifugation for water quality analyses. Analytical program will follow approved UCR Phase II QAPP. Place sediments into exposure beakers and add overlying water for about a 24-h equilibration period at 23°C. Add 1.5 ml food to each test beaker after sediment has settled. Start delivery of overlying water to the exposure beakers. Check egg cases for hatch and development.
0	Renewal of the overlying water using the Zumwalt water delivery system is implemented immediately prior to the introduction of the test organisms into the test replicates. Measure temperature, pH, hardness, alkalinity, dissolved oxygen, conductivity, and ammonia at start of test. Transfer larvae into exposure chambers. Add 1.5 ml food to each test beaker with sediment before the larvae are added. Add 12 larvae to each replicate beaker. Place first set of peepers in chemistry beakers on Day 0 and sample peepers from chemistry beakers 7 days later.
1–End	Perform AM and PM water changes (2 volume additions per day). On a daily basis, add 1.5 ml food to each beaker. Measure temperature and DO daily. Aerate if DO is less than 2.5 mg/L. Measure the pH three times a week, and conductivity weekly.
7	Sample peepers and sediment porewater by centrifugation from chemistry beakers that were loaded on Day 0. Analytical program will follow approved UCR Phase II QAPP
7–10	Set up auxiliary male beakers (4 replicates/treatment) same as those described above for the beginning of the test.
14–20	Place a second set of peepers in chemistry beakers on one of the days between Day 14-20 and sample peepers from chemistry beakers 7 days later.
15	In preparation for weight determinations, ash weigh-pans at 550 °C for 2 h. Note that the weigh boats should be ashed before use to eliminate weighing errors due to the pan oxidizing during ashing of samples.
16	Sample four replicates from each treatment to recover larvae for growth, biomass, and survival determinations. Pool all living larvae per replicate and dry the sample to a constant weight (e.g., 60°C for 24 h). Install emergence traps on each reproductive replicate beaker. Measure overlying water quality (pH, ammonia, DO, conductivity, hardness, and alkalinity).
17	The sample with dried larvae is brought to room temperature in a desiccator and weighed to the nearest 0.01 mg. The dried larvae in the pan are then ashed at 550°C for 2 h. The pan with the ashed larvae is then re-weighed and the tissue mass of the larvae determined as the difference between the weight of the dried larvae plus pan and the weight of the ashed larvae plus pan.
21–27	Sample peepers and sediment porewater by centrifugation from chemistry beakers that were loaded on Day 14-20. Analytical program will follow approved UCR Phase II QAPP
17–End	On a daily basis, record emergence of males and females, pupal, and adult mortality, and time to death for previously collected adults. Each day, transfer adults from each replicate to a corresponding reproduction/oviposition (R/O) chamber. Transfer each primary egg case from the R/O chamber to a corresponding Petri dish to monitor incubation and hatch. Record each egg case oviposited, number of eggs produced (using either the ring or direct count methods), and number or hatched eggs. If it is difficult to estimate the number of eggs in an egg case, use a direct count to determine the number of eggs; however the hatchability data will not be obtained for this egg case.
17	Place emergence traps on auxiliary male replicate beakers.
17–End	Transfer males emerging from the auxiliary male replicates to individual reproduction/oviposition (R/O) chambers. The auxiliary males are used for mating with females from corresponding treatments from which most of the males had already emerged or in which no males emerged.

33–42	Place a second set of peepers in chemistry beakers on one of the days between Day 35-42 and sample peepers from chemistry beakers 7 days later.
42–49	Sample peepers and sediment porewater by centrifugation from chemistry beakers that were loaded on Day 35-42. Analytical program will follow approved UCR Phase II QAPP.
40–End	After 7 d of no recorded emergence in the control treatment, end the study by recovering larvae, pupae, or pupal exuviae. Measure overlying water quality (pH, ammonia, DO, conductivity, hardness, and alkalinity) at the end of the study.

Revision #9
Effective Date: September 11, 2013
Accepted:

Chironomus dilutus

(Formerly Classified as *C. tentans*)

UCR Acute (10-day) Survival & Growth Sediment Toxicity Test

Standard Operating Procedures

This SOP is based upon the U.S. EPA Test Method 100.2 Guidelines described in Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition (EPA/600/R-99/064). It is also in general accordance with ASTM Standard E1706-05 (2012), Test methods for measuring the toxicity of sediment-associated contaminants with freshwater invertebrates.

1.0 Introduction

This test is based on a 10-day static-renewal exposure of 2nd and 3rd *Chironomus dilutus* to sediments. The test endpoints are survival and growth (measured as ash-free dry weight [AFDW] and ash-free biomass).

2.0 Test preparation

2.1 Equipment and Supplies Needed

1. Sample containers may be necessary for the client's collection of sediment. Containers must be pre-cleaned consistent with EPA guidelines. A minimum volume of 2-L of sediment is necessary (4-L is preferred) to provide sediment for the bioassay and particularly if sediment porewater characterization is part of the study plan. Additional volume will be necessary for further characterization of sediment (e.g., grain size characteristics, total organic carbon, contaminant concentrations).
2. Stainless steel bowls and spatulas or spoons, to homogenize sediments prior to placement in replicate containers.
3. Test chambers, consisting of 300-mL tall-form glass beakers, modified as follows:
    a. The flared lip of the beakers should be cut off, and the upper rim flame-polished. Orca Glassworks in Benicia provides this service. The prepared beakers must be appropriately cleaned before further use.
    b. Cut a 2.5 cm-wide band of 120-μm Nitex®, approximately 25 cm in length. Using aquarium-safe silicon sealant, attach the band of Nitex around the upper lip of the beaker, such that ~two-thirds of the width of the Nitex band is above the glass. Make sure to completely seal the Nitex such that there are no openings or seams into which the test organisms might become entrapped. Allow the silicon sealant to cure for a minimum of 24 hrs. The resulting test containers must be

appropriately cleaned and rinsed, and then pre-soaked for 48 hrs in Type I lab water [reverse-osmosis, de-ionized (RO/DI) water], before use in testing.

4. Modified Zumwalt-type water delivery system, consisting of a lower plastic tub to hold replicate containers in position, and an upper plastic tub, plumbed with 60 mL syringes and attached flow restrictors for delivery of water to replicate containers.

5. Synthetic Test Water, consisting of reformulated moderately hard reconstituted water, prepared as per EPA guidelines (see Section 7.1.3.4 of guidelines):
   a. Transfer ~75 L of Type 1 [reverse-osmosis, de-ionized (RO/DI)] water into an appropriately-cleaned 120-L HDPE tank.
   b. Add 5 g of $CaSO_4$ and 5 g of $CaCl_2$ to a 2-L aliquot of Type 1 water and mix on magnetic stir plate for 30 min or until the salts completely dissolve.
   c. Add 3 g of $MgSO_4$, 9.6 g of $NaHCO_3$, and 0.4 g of KCl to a second 2-L aliquot of Type 1 water, and mix on a magnetic stir plate for 30 min.
   d. While vigorously stirring, pour each of the 2-L aliquots of salt solutions into the 75-L of Type 1 water, and fill to a total volume of 100-L with Type 1 water.
   e. Vigorously aerate the water for at least 24 hrs prior to use.
   f. The water quality should be:
      i. Hardness, 90-100 mg/L as $CaCO_3$
      ii. Alkalinity, 50-70 mg/L as $CaCO_3$
      iii. Conductivity, 330-360 μS/cm
      iv. pH, 7.8-8.2

6. Water quality (pH, DO, and conductivity/salinity) meters, calibrated and used as per the appropriate SOPs.

7. Type I lab water, for rinsing of probes, etc.

8. Wash bottles, for rinsing of probes, etc.

9. Glass or electronic thermometer, calibrated and used to measure temperature.

10. Disposable glass Pasteur pipets, for the collection and transfer of test organisms.

11. Fine-tip forceps, for use in collecting individual organisms from culture material at test termination.

12. Glass dishes, for the sorting and collection of test organisms at test initiation and at test termination.

13. Light boxes, for the sorting and collection of test organisms at test initiation and at test termination.

14. Aeration system, in case needed to aerate should D.O. drops below acceptable levels.

15. Test Food, consisting of TetraMin® flake fish food:

    a. Ground TetraMin® is fed to provide 6.0 mg of dry solids daily per test chamber

16. Sieves, #25 (700 μm), #40 (425 μm), and #50 (300 μm), for collection of organisms at test termination.
17. Aluminum foil weighing pans, for drying and weighing of test organisms at end of test. Pans must be dried in muffle furnace prior to taring.
18. Drying oven, at 60°C to 90°C for drying test organisms at test termination.
19. Desiccators, for holding dried organisms.
20. Balance, capable of weighing to 0.01 mg. Calibrate and use as per the appropriate SOP.
21. Reference weights, for calibration of balance.
22. Muffle furnace, at 550°C, for ashing of dried organisms.

2.2 Ordering and Holding of Test Organisms

2.2.1 Ordering and Holding of Test Organisms from Commercial Supplier

1. Test organisms should be ordered far enough in advance so as to ensure arrival of 2nd and 3rd instar animals 24 hrs prior to Day 0; third instar organisms are generally 8-12 days old. Approximately 25% more animals should be ordered than are actually needed for the test, so as to allow for some attrition of organisms that are stressed from the shipping, etc.
2. Order organisms from:
   a. Environmental Consulting and Testing - (800) 377-3657
   b. Aquatic Research Organisms - (800) 927-1650
3. Upon receipt, the test organism culture should be transferred into 4-L HDPE tanks containing test water at 23°C; the culture should be gently aerated, and should be fed ground flake fish food (TetraMin). For additional instruction on the receipt and handling of the test organisms, see the "Test Organism Receipt and Handling S.O.P."

2.2.2 Organisms from In-Lab Culture

Test organisms can be raised from eggs (obtained from in-lab cultures, or from commercial suppliers), as per the '*C. dilutus* Culture SOP'. Egg cases are incubated in test water at 23°C until hatching begins, as evidenced by apparent disintegration of the egg case coil. Larvae are also incubated in gently aerated test water and provided ground flake fish food for use as food and tube-building substrate. Typical growth and development at 23°C should result in organisms at the second to third instar stage about 8-12 days after hatching.

2.2.3 Organism Health

Test organisms must appear healthy, behave normally, feed well, and have low mortality in the cultures during holding. There should be <20% mortality in the cultures 48 hrs prior to test initiation.

2.3 Collection and Holding of Sediment Samples

Grab or composite samples should be collected into appropriately-cleaned glass or plastic container(s), and immediately placed on ice (or "blue ice" type product) to bring the temperature to 0-6°C. The sample should be shipped or transported to the testing laboratory ASAP. Upon receipt of the sample(s) in the laboratory, each sample should be logged in, and then placed in the sample refrigerator at 4°C. For instruction on the log-in of incoming samples, see the "**Test Sample(s) Log-In Procedures**". The test sample(s) used to start the test should be <14 days old, although samples <8 weeks old can be used. For each sample tested, a minimum of 2 L volume (4 L is preferred) of debris-free sediment will be needed for the sediment testing. Chemistry analyses will require additional sample.

3.0 TEST INITIATION

Before test initiation begins, be aware of any client-specific testing requirements and read the attached "**Summary of Test Conditions for *Chironomus dilutus* (formerly *C. tentans*).**"

3.1 On the Day Before Test Initiation (Day –1):

1. Remove the test replicate containers from soaking in the tank of Type I water and shake excess water off. Each test treatment, including each Control, will require 8 test chambers. Label the test containers with their treatment and replicate ID code (replicates "A" through "H") using an indelible black ink (Sharpie®) pen.
2. Remove the sediment from the sample storage refrigerator and allow thermal equilibration to room temperature. Using a stainless steel spoon and bowl, re-homogenize the sediment along with any overlying water that has developed.
3. For each sediment sample, use a stainless steel spoon or spatula to transfer approximately 100 mL of homogenized sediment into each of the 8 replicates, carefully "tamping" down the sediments. Carefully pour approximately 175 mL of control water into each beaker, taking care to minimize disturbance of the sediment.
4. Place the test replicates into the water bath or controlled temperature room, with the temperature set at 23°C, under cool-white fluorescent lighting on a 16L:8D photoperiod.

3.2 Pre-Test Sediment Porewater Characterization, if required (Day –1, or before):

1. Place approximately 500 mL of each homogenized sediment into a 750-mL centrifuge bottle, and centrifuge at 2500 g for 30 min.
2. Decant supernatant (= sediment porewater), and measure routine water quality characteristics of the porewater (pH, DO, conductivity, and total ammonia). Record the water quality data into the appropriate test data sheet.

3.3 Immediately Prior to Test Initiation (Day 0):

1. Renewal of the overlying water using the Zumwalt water delivery system is implemented immediately prior to the introduction of the test organisms into the test replicates. Using

the Zumwalt water delivery system, renew the overlying water in each of the replicate containers with 1replicate volume of water as described below:

To renew the overlying water, place the test chambers in the lower plastic tub to hold them in place. Place the tub with the test chambers directly under the syringes connected to the upper splitting chamber of the Zumwalt water delivery system and fill each syringe with reformulated moderately hard reconstituted water. Adjust the stopcocks so as to minimize any disturbance of the flow on the sediment. After the syringe has emptied, repeat twice with additional syringe volumes of water (for a total of 3 syringe volumes).

2. After the water is renewed, use a disposable 25 mL pipet to collect test water from 1-2 cm above the sediment for each replicate, compositing the replicate water samples for each test treatment to provide a total volume of '"200 mL. The pipet must be inspected to ensure no organisms were removed during sampling. Bring the volume of overlying water in each test chamber back to the appropriate level with fresh test water.
3. Measure the initial water quality conditions (temperature, pH, D.O., conductivity, hardness, alkalinity, and total ammonia). From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, D.O., and conductivity) in the remaining composited water. Record the water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
4. If the D.O. levels fall below 2.5 mg/L, implement gentle aeration at about I bubble/second in the overlying water of each test replicate.
5. Isolation and collection of individual test organisms:
    a. Immediately prior to test initiation, transfer a small portion of test organism culture and test water into a shallow glass dish placed on top of light box.
    b. Using a glass pipette, gently agitate the culture material. This disturbance will cause the larval chironomids to emerge from their tubes, facilitating their capture.

3.4 Initiate the Test (Day 0):

1. Gently draw individual 2nd and 3rd instar larvae into the pipette and transfer organisms into a small transfer dish (e.g., plastic weigh boats) containing small aliquot of test water (make sure that organisms are transferred below the water surface), continuing this process until there are 1O organisms in the transfer dish. Approximately 50% of the organisms at second instar and approximately 50% of the organisms at third instar with a goal of achieve a starting average weight of 0.12 mg/organism. Upon confirming the organisms' life stage and that they are all of good quality (active organisms with 'plump' segments and bright red pigmentation), the organisms within a dish can be poured into a test replicate, again making sure that organisms are below the water surface. Note – this process must take place quickly, as extended period in the transfer dish will stress the organisms.

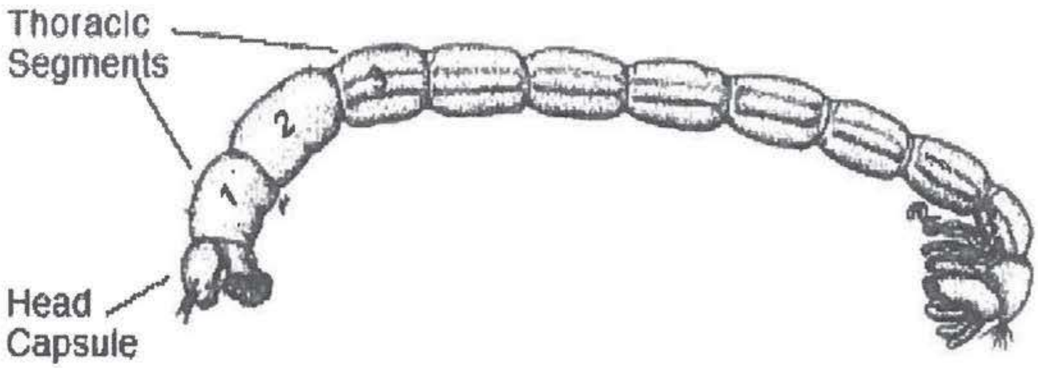

Figure 10.2. ***Chironomus tentans*** **larvae. Note thoracic segments which are used to measure instars. (Reprinted from Clifford, 1991 with kind permission from the University of Alberta Press.)**

2. Load test replicates following a randomized block approach. Load all "A" replicate containers first, with the order of test treatments being randomized. Repeat process for the "B" replicates, with the order of test treatments being re-randomized. Continue until all test replicates are loaded.
3. Immediately re-examine the replicates, replacing any dead or injured animals. Due to surface tension, some organisms may be "trapped" on the water surface. Examine each replicate to ensure that all test organisms are below the water surface. Using a plastic pipette, organisms that are at the water surface should be moved into the water by gently squirting the organisms with test water.
4. Following a randomization template, randomly place the replicate containers into the temperature-controlled water bath or test room at 23°C, under cool-white fluorescent lighting on a 16L:8D photoperiod.
5. Feed each replicate ground TetraMin® so as to provide 6.0 mg of dry solids daily per test chamber.
6. For an assessment of growth, at t=0, a minimum of 80 organisms should be dried as described below in Section 5, Steps 9-12. If length measurements are required, 20 chironomids should be archived in sugar formalin (as per EPA guidelines).

4.0 TEST MAINTENANCE (DAYS 1-9)

AM:

a. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet. Similarly, any observed pupae, pupal exuvia, and/or emerged adults should also be removed, and similarly recorded onto test data sheet.

b. Measure the temperature in the test water from one randomly-selected replicate for each treatment and record data onto test datasheet.

c. Using a disposable 25 mL pipet, collect "old" test water from 1-2 cm above the sediment for a test replicate chamber. The pipet must be inspected to ensure no organisms were removed during sampling. Measure the "old" pH and DO and record data onto the test data sheet. If the D.O. levels fall below 2.5 mg/L, implement gentle aeration of each test replicate.

d. Renew the overlying water using the Zumwalt water delivery system to deliver 1 replicate water volume to each replicate container as described above in Section 3.3, Step 1.

e. Using a disposable 25 mL pipet, collect "new" test water from 1-2 cm above the sediment for a test replicate chamber. The pipet must be inspected to ensure no organisms were removed during sampling. Measure the "new" pH and D.O. and record data onto the test data sheet.

f. Return the test replicates to the water bath or test room and record your initials in the "AM" maintenance check box on the data sheet.

PM:

a. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.

b. Renew the overlying water using the Zumwalt water delivery system to deliver 1 replicate water volumes to each replicate container as described above in Section 3.3, Step 1.

c. Return the test replicates to the test waterbath or constant temperature room, and feed each replicate ground TetraMin® so as to provide 6.0 mg of dry solids daily per test chamber.

d. Record your initials in the "PM" maintenance check box on the data sheet.

5.0 TEST TERMINANTION

Survival, mean dry weight, biomass, ash-free dry weight (AFDW), and ash-free biomass are assessed at Day 10. Remove the replicates for one treatment at a time and process as follows:

1. Measure the temperature in the test water in one randomly-selected replicate for each treatment and record data onto test data sheet.
2. Collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate using a disposable 25-mL glass pipette; composite the replicate water samples for each test treatment to provide a total volume of ~200 mL.

3. From the composite, collect sub-samples for analysis of alkalinity, hardness, and total ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, D.O., and conductivity) in the remaining composited water. Record the final water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.

4. Working one replicate at a time, examine each replicate, noting and recording the number of any larvae, pupae, adults and/or pupal exuvia, and record this data onto the test weight data sheet.

5. Label weight boats with the corresponding sediment test treatment and replicate identification for each test replicate and fill the weigh boats with a small volume of clean test water.

6. Using a pipette or a squirt bottle containing clean test water, vigorously squirt water onto the top of the sediment so as to disturb the surficial layer – this will often result in the emergence of many of the *Chironomus*, facilitating their collection. Using a pipette and/or forceps, collect and transfer any emerging larvae into a weigh boat. Using a squirt bottle, rinse the organisms with fresh 'test' water to remove any sediment or other clinging material. Using the forceps, transfer the individual larvae into a pre-labeled, -dried (via muffle furnace), and –weighed aluminum foil drying pan.

7. Carefully wash the sediment from the same replicate container through a #40 stainless steel sieve, washing the retained materials into a large glass tray. Using a pipette and/or forceps, collect and transfer any emerging larvae into the appropriately labeled weigh boat. Using a squirt bottle, rinse the organisms with clean test water to remove any sediment or other clinging material. Using the forceps, transfer the individual larvae into the same pre-labeled, -dried, and –weighed aluminum foil drying pan that was used for the organisms collected from that same replicate in the earlier Step 6, above.

8. Repeat Step 7 until no additional organisms have been found after three sediment washes. If there is any question as to whether or not all of the organisms have been accounted for, sieve the remaining sediment sequentially with #25, #40, and #50 sieves.

9. Record the total number of live larvae collected from that replicate onto the test weight data sheet.

10. Repeat steps 4 through 9 for each test replicate.

11. When all of the replicate organisms have been transferred into their respective drying pans, place the pans into the drying oven, and dry at 105°C for a minimum of 48 hrs.

12. After drying, place the aluminum pans into the desiccator and seal. Allow to cool at least 4 hrs, after which each pan must be weighed and the weight data recorded onto the test weight data sheet.

13. Place the pans of dried organisms into the muffle furnace at 550°C for 2 hrs to obtain the dry-ash weights.

14. After drying, place the aluminum pans into the desiccator and seal. Allow to cool at least 4 hrs, after which each pan must be weighed and the weight data recorded onto the test weight data sheet.

6.0 DATA ANALYSIS

1. For each sediment, sum up the total number of live organisms that were counted at test termination (number of live larvae, live pupae, and number of emerged adults [as evidenced by the number of exuvia]) and record total number of live organisms at test termination onto the toxicity test data sheet.
2. On the test weight data sheet, subtract the weight recorded for the 'pans + dried animals' minus the empty 'tare' pan weight = the pooled dry weight of the organisms for that replicate. Divide this number by the number of organisms in the replicate to obtain the mean dry weight for individual organisms in that replicate. Divide the pooled dry weight for each replicate by the corresponding number of initial organisms to obtain the biomass.
3. On the test weight data sheet, subtract the weight recorded for the 'pans + dry-ashed animals' minus the previous 'pans + dried animals' weight = the pooled ash-free dry weight of the organisms for that replicate. Divide this number by the number of organisms in the replicate to obtain the mean ash-free dry weight (AFDW) for individual organisms in that replicate. Divide the pooled ash-dry weight for each replicate by the corresponding number of initial organisms to obtain the biomass.
4. Using the CETIS® statistical software, input the survival and relevant weight data for the Control treatment and for a given test sediment into a linked-file specific for that test sediment.
5. Analyze the test data, as per the EPA guidelines statistical flowchart procedures, comparing the test responses of the test sediment against the Control treatment to determine whether the test sediment exposure resulted in statistically significant reductions in survival or growth (as AFDW) of the larval chironomids.

7.0 TEST ACCEPTABILITY CRITERIA

1. Tests must be started with 2nd to 3rd instar larvae (about 10-d-old larvae), and at least 50% of the organisms must be 3rd instar.
2. The mean percentage survival of *C. dilutus* in the control sediment must be greater than or equal to 70% at the end of the test.
3. The mean size (measured as weight) of *C. dilutus* in the control sediment must be at least 0.48 mg AFDW at the end of the test.
4. Hardness, alkalinity, and ammonia in the overlying water typically should not vary by more than 50% during the test, and D.O. should be maintained above 2.5 mg/L in the overlying water.

8.0 QUALITY CONTROL

1. To ensure that the organisms being used in the test are responding to test conditions in a "typical" manner, a lab reference or "Control" sediment of known quality is run side-by-side with the test sediment. In the absence of a reference site sediment, the lab "Control" sediment is used for comparison purposes.
2. Additional Control sediments may be tested (i.e., silica quartz sand), as appropriate to the study.
3. Reference sediment test set-up, maintenance, and termination are identical to those described above.
4. All measured water quality should be within the limits established by the EPA guidelines; any deviations must be noted in lab notebook and explained.
5. All equipment is calibrated and operated as described in each applicable equipment SOP.
6. All staff working independently on any test shall have previously demonstrated familiarity and competency with the test, analytical equipment used, and the corresponding SOPs.
7. A reference toxicant test can be performed, at the client's discretion, to validate the response of the test organisms.

9.0 TEST INTERFERENCES

Characteristics of a sediment, aside from sediment-associated chemical constituents of concern, that can potentially affect test organism survival and growth should be assessed prior to preparing data submittals to the client. Interferences for this test generally fall into the categories of contaminant and non-contaminant factors.

9.1 Contaminant Interferences

1. All efforts should be made to avoid contaminating any component of the test system or sediments used in testing so as to avoid both false positives and false negatives. Standard "clean techniques" should be used in the lab at all times.
2. Measurable concentrations of ammonia are common in the pore water of many sediments and have been found to be a common cause of toxicity in pore water. Total ammonia results should be generated to determine if the concentration exceeds the reported tolerance limit for this test species.

9.2 Non-contaminant Interferences

1. Natural geomorphological and physico-chemical characteristics, such as sediment texture, may influence the response of test organisms. A control sediment that includes characteristics (e.g., grain size, organic carbon) that are within the tolerance range of the

test organism should be included in the study design. This may best be accomplished by using a formulated sediment.

2. Morphologically similar indigenous organisms in a sediment sample may be confused with the test species during test termination, and result in overestimates in survival. In addition, indigenous organisms may also compete for food or prey with the test species. Should indigenous organisms be observed during test termination, the scientist should immediately notify the Project Manager, as it may be necessary to identify the indigenous organism, and determine the number or biomass in order to better interpret the growth data.

10.0 SAFETY

The 10-day *Chironomus dilutus* survival and growth toxicity test poses little risk to those performing it. Sediments can contain pathogenic organisms and appropriate precautions should be observed when handling this material. After the test is complete, the sediments should be disposed of in an appropriate fashion.

11.0 REPORTING

1. Following the completion of the statistical analyses and the QC review of the statistical analyses, the PER Project Lead is to summarize the results for an email submittal to the PER Project Manager for review. Following this review, either the Project Lead or Project Manager will submit the email summary to the client.
2. The Project Lead will generate a draft report and submit it to the Project Manager for review. The Project Manager reviews the draft report, makes any necessary revisions, and then submits a final report to administrative staff for preparation of the proper number of project-specific hard copies and electronic copies for posting to the client.
3. As per project-specific guidelines, any necessary electronic data deliverables will be generated under guidance by the Project Lead, and will be reviewed for accuracy by properly trained scientists.

12.0 REFERENCES

American Society for Testing and Materials (ASTM). 2012. Standard test method for measuring 1633 the toxicity of sediment-associated contaminants with freshwater invertebrates (ASTM 1634 E1706-05 (Reapproved 2010)). Annual Book of ASTM Standards Volume 11.06, West Conshohocken, PA.

USEPA. 2000. Method for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition. EPA-600/R-99-064, Duluth, MN

Summary of Test Conditions and Test Acceptability Criteria for Conducting the 10-Day ***Chironomus dilutus*** Survival and Growth Sediment Toxicity Test (Test Method 100.2)		
1.	Test type	Whole-sediment toxicity test with renewal of overlying water
2.	Test duration	10 days
3.	Temperature	23 ± 1°C
4.	Light quality	Wide-spectrum fluorescent lights
5.	Light intensity	About 100 to 1000 lux
6.	Photoperiod	16L:8D
7.	Test chamber size	300-mL high-form lipless beaker
8.	Test sediment volume	100 mL
9.	Overlying water	reformulated moderately hard reconstituted water
10.	Overlying water volume	175 mL
11.	Overlying water quality	Temperature and D.O. daily. Hardness, alkalinity, conductivity, pH, and ammonia at beginning and end of test.
12.	Overlying water renewal	2 volume additions/day via one volume addition twice per day
13.	Age of test organisms	2nd- to 3rd-instar larvae (about 10-d-old larvae; all organisms must be third instar or younger with at least 50% of the organisms at 3rd instar)
14.	Noumber of organisms per test chamber	10
15.	Number of replicates per concentration	8, but depends on the objective of the test
16.	Feeding regime	Ground TetraMin® so as to provide 6.0 mg of dry solids daily per test chamber
17.	Test chamber cleaning	If screens become clogged during the test, gently brush the *outside* of the screen to remove material
18.	Test solution aeration	None, unless DO in overlying water drops below 2.5 mg/L
19.	Endpoints	Survival and growth (ash-free dry weight, AFDW)
20.	Sample and sample holding requirements	Grab or composite samples should be stored at 0-6°C
21.	Sample volume required	2 Liter (minimum), 4 L preferred
22.	Test acceptability criteria	Minimum mean control survival must be 70%, with minimum mean weight/ surviving control organism of 0.48 mg AFDW

Supplemental SOP Language

Definitions:

ACS:	American Chemical Society
ASAP :	As soon as possible
ASTM :	American Society for Testing Materials
°C :	degrees Celsius
dH_2O :	distilled water
D.O.:	dissolved oxygen
ECx:	Effective concentration in X% of the population.
hrs :	hours
ICx:	Inhibitory concentration in X% of the population.
LCx:	Lethal concentration in X% of the population.
LOEC:	Lowest Observed Effect Concentration
mg :	milligram
mg/L :	milligram per liter
mL :	milliliter
NOEC:	No Observed Effect Concentration
NPDES :	National Pollutant Discharge Elimination System
S.O.P.:	Standard Operation Procedure
TIE:	Toxicity Identification Evaluation
U.S. EPA :	United States Environmental Protection Agency

Interferences:

In an effort to eliminate interferences, SOPs have been established for every procedure involved in conducting a successful bioassay test. Additionally, a rigorous daily QA/QC inspection is designed to identify potential sources of interference. Prior to the initiation of toxicity tests every effort is made to identify and eliminate potential sources of interference that could compromise test results. These can include but are not limited to the following: clean and functional facilities, equipment and test chambers; sample storage and handling; test organism and food quality; laboratory water quality.

Pollution Prevention

As a pollution prevention measure, wastes generates during toxicity testing must be properly handled and disposed of in an appropriate manner. Care should be taken not to generate excessive wastes when preparing solutions for testing. All materials identified as hazardous should be labeled and appropriately stored for hazardous waste disposal.

Data Assessment

Bioassay and water quality data are assessed each day during the course of testing for accuracy and compliance with established criteria. At test termination, the data for each replicate, which are recorded on the appropriate data sheets, are entered into a CETIS™ data file labeled for identification of the specific test. Statistical analyses are performed in accordance with EPA guidelines for statistical analysis. Control data for all endpoints are evaluated for compliance with established test acceptability criteria. Water Quality data are assessed for compliance with specifications outlined in the appropriate USEPA testing manuals.

Corrective Actions and Contingencies for Out-of-Control Data

If control performance is not met, a project manager should be notified immediately and, upon approval, the test is to be repeated. The potential cause(s) of poor control performance will be documented by scientific staff and evaluated and assessed by a project manager. Corrective actions will be determined on a case-by-case basis. The results of all tests will be summarized in reports for the regulatory authorities with an explanation of the results.

Revision #4
Effective Date: September 11, 2013
Accepted:

Hyalella azteca
UCR 28-Day Survival & Growth Sediment Toxicity Test
Standard Operating Procedures

This SOP is based upon a modification of the EPA Method 100.4 guidelines described in Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition (EPA/600/R-99/064). It is also in general accordance with ASTM Standard E1706-05 (2012), Test methods for measuring the toxicity of sediment-associated contaminants with freshwater invertebrates.

1.0 INTRODUCTION

This test is based on a 28-day static-renewal exposure of 7-8 day old ***Hyalella azteca*** to sediments. The final test endpoints include survival and growth. This method follows the guidelines for the 28-day sediment exposure period of the 42-day test (EPA Method 100.4).

H. azteca are often important components of the benthos in freshwater ecosystems and have been used in sediment toxicity testing and have shown to be a sensitive indicator of contaminants associated with sediments. They have a wide tolerance of sediment grain size with acceptable survival in sediments ranging from >90% fines to 100% sand (Ingersoll and Nelson, 1990).

2.0 TEST PREPARATION

2.1 Equipment and Supplies Needed

1. Sample containers may be necessary for the client's collection of sediment. Containers must be pre-cleaned consistent with EPA guidelines. A minimum volume of 2-L of sediment is necessary (4-L is preferred) to provide sediment for the bioassay and for the accompanying sediment porewater characterization. Additional volume will be necessary for further characterization of sediment (e.g., grain size characteristics, total organic carbon, contaminant concentrations).
2. Stainless steel bowls and spatulas or spoons, to homogenize sediments prior to placement in replicate containers.
3. Test chambers, consisting of 300-mL tall-form glass beakers, modified as follows:
    a. The flared lip of the beakers should be cut off, and the upper rim flame-polished. Orca Glassworks in Benicia provides this service. The prepared beakers must be appropriately cleaned before further use.
    b. Cut a 2.5 cm-wide band of 120-μm Nitex®, approximately 25 cm in length. Using aquarium-safe silicon sealant, attach the band of Nitex around the upper lip of the

beaker, such that ~two-thirds of the width of the Nitex band is above the glass. Make sure to completely seal the Nitex such that there are no openings or seams into which the test organisms might become entrapped. Allow the silicon sealant to cure for a minimum of 24 hrs. The resulting test containers must be appropriately cleaned and rinsed, and then pre-soaked for 48 hrs in Type I lab water [reverse-osmosis, de-ionized (RO/DI) water] before use in testing

4. Modified Zumwalt-type water delivery system, consisting of a lower plastic tub to hold replicate containers in position, and an upper plastic tub, plumbed with 60 mL syringes and attached flow restrictor for delivery of water to replicate containers.
5. Standard Artificial Medium (SAM-5S), consisting of synthetic freshwater (SAM-5S), prepared as per Borgman 1996:
   a. Transfer ~75 L of Type I water into an appropriately-cleaned 120-L HDPE tank.
   b. Add 14.7 g of $CaCl_2{\cdot}2H_2O$ to a 2-L aliquot of Type I water and mix on magnetic stir plate for 30 min or until the salts completely dissolve.
   c. Add 6.16 g of $MgSO_4{\cdot}7H_2O$, 8.4 g of $NaHCO_3$, 0.37 g of KCl, and 0.05 g of NaBr to a second 2-L aliquot of Type I water, and mix on a magnetic stir plate for 30 min or until the salts completely dissolve.
   d. While vigorously stirring, pour each of the 2-L aliquots of salt solutions into the 75-L of Type I water, and fill to a total volume of 100-L with Type I water.
   e. Vigorously aerate the water for at least 24 hrs prior to use.
   f. The water quality should be:
      i. Hardness, 120-140 mg/L as $CaCO_3$
      ii. Alkalinity, 43-53 mg/L as $CaCO_3$
      iii. Conductivity, 385-435 μS/cm
      iv. pH, 7.5-8.4
6. Water quality (pH, D.O., and conductivity/salinity) meters, calibrated and used as per the appropriate SOPs.
7. Type I lab water, for rinsing of probes, etc.
8. Wash bottles, for rinsing of probes, etc.
9. Glass or electronic thermometer, calibrated and used to measure temperature.
10. Disposable plastic Pasteur pipettes, for the collection and transfer of test organisms, and collection of water quality subsamples.
11. Fine-tip forceps, for use in collecting individual organisms from culture material at test termination.
12. Glass dishes, for the sorting and collection of test organisms at test initiation and at test initiation.

13. Light boxes, for the sorting and collection of test organisms at test initiation and at test termination.

14. Aeration system, in cases where the chambers need to be aerated when the D.O. drops below acceptable levels.

15. Test Food.
    a. YCT (yeast, Cerophyl®, trout chow) is prepared according to Appendix B, EPA 600/R-99/064.
    b. YCT is amended with powdered *Spirulina*, sieved at 250 µm, at a rate of 90 mg per 100 mL YCT.

16. Sieves, #25 (701 μm), #40 (425 μm), and #50 (300 μm), for collection of organisms at test termination.

17. Aluminum foil weighing pans, for drying and weighing of organisms at end of test.

18. Drying oven, at 60°C to 90°C for drying organisms at test termination.

19. Desiccators, for holding dried organisms.

20. Balance, capable of weighing to 0.01 mg. Calibrate and use as per the appropriate SOP.

21. Reference weights, for calibration of balance.

22. Microscope and calibrated software for performing length measurements (if length is measured rather than mean dry weight).

2.2 Ordering and Holding of Test Organisms

2.2.1 Ordering and Holding of Test Organisms from a Commercial Supplier

1. Test organisms should be ordered far enough in advance so as to ensure the arrival of 6-7 day old organisms at least 24 hrs prior to Day 0 (so that organism will be 7-8 days old at test initiation). Approximately 25% more animals should be ordered than are actually needed for the test, so as to allow for some attrition of organisms that are stressed from the shipping, etc.

2. Order organisms from:
    a. Aquatic Biosystems Inc. - (800) 331-5916
    b. Chesapeake Cultures - (803) 694-4046

Note: Aquatic BioSystems supplies known-age organisms, while Chesapeake Culture provides organisms aged by class size.

3. Upon receipt, the test organism culture should be transferred into 4-L HDPE tanks containing test water at 23°C; the culture should be gently aerated, and should be fed *Spirulina*-amended YCT. If the test is to be run at salinity >2‰ (up to 15‰), cultures must be salinity adjusted. Place them in control water at the receiving salinity and

immediately begin to adjust the holding salinity towards the test salinity. For additional instruction on the receipt and handling of the test organisms, see the "Test Organism Receipt and Handling S.O.P."

2.2.2 Organisms from In-Lab Culture

If the test organisms will be supplied from in-lab cultures, the organisms must be isolated from the in-lab culture 7-8 days before the test is to begin in order to have 7-8-day old organisms at the time of test initiation. Adults from each of the culture tanks should be collected and transferred to a #25 sieve resting in a collection bowl containing SAM-5S water and a few conditioned leaves, and provide gentle aeration. Allow the culture to sit undisturbed overnight.

The following day, carefully remove the leaves, shaking to dislodge any clinging adults. Gently shake the top sieve and lift out of the neonate collection bowl assembly, carefully transferring the retained adults into a temporary holding container (make sure the transferred adults are not trapped at the water surface). The remaining water in the collection bowl contains all of the neonates that were released overnight. These should be transferred into a new culture tank containing a few conditioned leaves, with the neonates being counted during this transfer. There should be at least 125% of the number needed for the test. If not, repeat this process with the retained adults and collect a second day's batch of neonates, which will be combined with the first days. After enough neonates are collected, the adults can be returned to their culture tanks.

The collected neonates should be fed *Spirulina*-amended YCT. Change the water every 3 days, inspecting the animals to ensure adequate abundance, health and quality.

2.2.3 Organism Health

Test organisms must appear healthy, behave normally, feed well, and have low mortality in the cultures during holding. There should be <20% mortality in the cultures 48 hrs prior to test initiation.

2.3 Collection and Holding of Sediment Samples

Grab or composite samples should be collected into appropriately-cleaned glass or plastic container(s), and immediately be placed on ice (or "blue ice" type product) to bring the temperature to 0-6°C. The sample should be shipped or transported to the testing laboratory ASAP. Upon receipt of the sample(s) in the laboratory, each sample should be logged in, and then placed in the sample refrigerator at 4°C. For instruction on the log-in of incoming samples, see the "**Test Sample(s) Log-In Procedures**". The test sample(s) used to start the test should be <14 days old, although samples <8 weeks old can be used. For each sample tested, a minimum of 2 L of debris-free sediment will be needed for the sediment testing (4 L is preferred). If needed, chemistry analyses will require additional samples.

3.0 TEST INITIATION

Before test initiation begins, be aware of any client-specific testing requirements and read the attached "**Summary of Test Conditions for the 28-Day *Hyalella azteca* Survival and Growth Sediment Toxicity Test.**"

3.1 On the Day Before the Test Initiation (Day -1):

1. Remove the test replicate containers from soaking in the tank of Type I water and shake excess water off. Each test treatment, including each Control, will require 8 test replicate containers. Label the test containers with their treatment and replicate ID code (Replicates "A" through "H") using an indelible black ink (Sharpie®) pen.
2. Remove the sediment from the sample storage refrigerator and allow thermal equilibration to room temperature. Using a stainless steel spoon and bowl, re-homogenize the sediment along with any overlying water that has developed.
3. For each sediment sample, use a stainless steel spoon or spatula to transfer approximately 100 mL of homogenized sediment into each of the 8 replicates, carefully "tamping" down the sediments. Carefully pour approximately 175 mL of SAM-5S water into each beaker, taking care to minimize disturbance of the sediment.
4. Place the test replicates into the water bath or test room, with the temperature controlled at 23°C, under cool-white fluorescent lighting on a 16L:8D photoperiod.

3.2 Pre-Test Sediment Porewater Characterization, if required (Day –1, or before):

1. Place approximately 500 mL of each homogenized sediment into a 750-mL centrifuge bottle, and centrifuge at 2500 g for 30 min.
2. Decant sediment porewater, and measure routine water quality characteristics of the porewater (pH, DO, conductivity, and total ammonia). Record the water quality data into the appropriate test data sheet.

3.3 Immediately Prior to Test Initiation (Day 0):

1. Renewal of the overlying water using the Zumwalt water delivery system is implemented immediately prior to the introduction of the test organisms into the test replicates. Using the Zumwalt water delivery system, renew the overlying water in each of the replicate containers with 1 replicate volume of water as described below:

   To renew the overlying water, place the test chambers in the lower plastic tub to hold them in place. Place the tub with the test chambers directly under the syringes connected to the upper splitting chamber of the Zumwalt water delivery system and add fill each syringe with SAM-5S water. Adjust the stopcocks so as to minimize any disturbance of the flow on the sediment. After the syringe has emptied, repeat twice with additional syringe volumes of water (for a total of 3 syringe volumes).

2. After the water is renewed, use a disposable 25-mL glass pipette to collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate; the pipet must be inspected

to ensure no organisms were removed during sampling. Composite the replicate water samples for each test treatment to provide a total volume of ~200 mL for each sediment.

3. From the composite, collect sub-samples for analysis of alkalinity, hardness, and total ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, D.O., and conductivity) in the remaining composited water. Record the water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
4. If the D.O. levels fall below 2.5 mg/L, implement gentle aeration at about 1 bubble/second in the overlying water of each test replicate.
5. Isolation and Collection of Individual Test Organisms:
    a. Immediately prior to test initiation, transfer small portion of test organism culture and test water into shallow glass dish placed on top of light box.
    b. Using plastic pipette, agitate the culture material. This disturbance will cause the larval *H. azteca* to swim up, facilitating their capture.

3.4 Initiate the Test (Day 0):

1. Transfer organisms into a small transfer dish (e.g., plastic weigh boats) containing a small aliquot of SAM-5S water, continuing this process until there are 10 organisms in the transfer dish (these counts must be confirmed by an independent Scientist); these can then be "poured" into the test replicates, making sure that organisms are below the water surface in the test replicate chambers. Note – this process must take place quickly, as extended period in the transfer dish will stress the organisms.
2. Allocate ten 7-8 day old organisms into each replicate beaker. Load all "A" replicate containers first, with the order of test treatments being randomized. Repeat process for the "B" replicates, with the order of test treatments being re-randomized. Continue until all test replicates are loaded.
3. Immediately re-examine each replicate, replacing any dead or injured animals. Examine each replicate to ensure that all test organisms are below the water surface, as some organisms may be "trapped" on the water surface due to surface tension. Using a plastic pipette, organisms that are at the water surface should be moved down into the water by gently squirting the organisms with test water.
4. Randomly place the test replicates into the water bath or test room, with the temperature controlled at 23°C, under cool-white fluorescent lighting on a 16L:8D photoperiod.
5. Feed each replicate 1.0 mL of Spirulina-amended YCT.
6. For an assessment of growth, at t=0, a minimum of 80 organisms should be dried as described below in Section 5, Step 10. If growth is to be determined using length measurements, 20 amphipods should be archived in sugar formalin (as per EPA guidelines).

4.0 TEST MAINTENANCE (DAYS 1-27)

Each day:

AM:

1. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.
2. Measure the temperature in the test water from one randomly-selected replicate for each treatment and record data onto test datasheet.
3. Using a disposable 25 mL pipet, collect "old" test water from 1-2 cm above the sediment for a test replicate chamber; the pipet must be inspected to ensure no organisms were removed during sampling. Measure the "old" D.O. and record data onto the test data sheet. If the D.O. levels fall below 2.5 mg/L, implement gentle aeration of each test replicate.
4. Renew the overlying water using the Zumwalt water delivery system to deliver 1 replicate water volume to each replicate container as described above in Section 3.3, Step 2.
5. Using a disposable 25 mL pipet, collect "new" test water from 1-2 cm above the sediment for a test replicate chamber. The pipet must be inspected to ensure no organisms were removed during sampling. Measure the "new" D.O. and record data onto the test data sheet. If the D.O. levels fall below 2.5 mg/L, implement gentle aeration of each test replicate.
6. Return the test replicates to the water bath or test room and record your initials in the "AM" maintenance check box on the data sheet.

PM:

1. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.
2. Renew the overlying water using the Zumwalt water delivery system to deliver 1 replicate water volume to each replicate container as described above in Section 3.3, Step 2.
3. Return the test replicates to the water bath or test room, and feed each replicate 1.0 mL of *Spirulina*-amended YCT on days 0-13. Feed each replicate 2.0 mL on days 14-27.
4. Initial "PM" maintenance on data sheet.

Three Days per Week (e.g., T, Th, Sat)
Measure pH three times per week.

Once per Week

Measure conductivity once per week.

5.0 TEST TERMINATION

Survival and growth at 28 days will be assessed. Remove one sediment test treatment at a time and process as follows:

1. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.
2. Measure the temperature in the test water in one randomly-selected replicate for each treatment and record data onto test data sheet.
3. Collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate using a disposable 25 ml glass pipet; composite the replicate water samples for each test treatment to provide a total volume of ~200 mL; the pipet must be inspected to ensure no organisms were removed during sampling.
4. From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, DO, and conductivity) in the remaining composited water. Record the final water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
5. Label plastic weigh boats with the corresponding sediment test treatment and replicate identification for each test replicate and fill each weigh boat about half-full with fresh test water.
6. Using a squirt bottle containing clean test water, vigorously squirt water onto the surface of the sediment so as to disturb the surficial layer – this will facilitate the collection of the test organisms. Swirl and pour the slurry of water and disturbed surficial sediment into a glass sorting dish atop a light box. Using a plastic Pasteur pipettes, carefully capture the individual organisms from the dish and transfer them into the weigh boat.
7. Repeat Step 6 with the remaining sediment from that replicate until no additional organisms have been found after three surficial sediment washes. If all of the organisms have not been accounted for, sieve the remaining sediment sequentially with #25, #40, and #50 sieves.
8. Using a squirt bottle, rinse the organisms with clean test water to remove any adhered sediment or other clinging material. Using the fine-tip forceps, transfer the cleaned individual amphipods into a pre-labeled, -dried, and –weighed aluminum foil drying pan.
9. Record the number of live amphipods recovered in each replicate onto the test data sheet.
10. Repeat steps 6 through 10 for each of the four test replicates.

11. **Growth Option 1** - Transfer the surviving amphipods from each of the 4 replicates onto separate labeled pre-dried and pre-weighed aluminum pan (the pans should be weighed as per the "Weighing of Test Organisms SOP."). When all of the replicates have been transferred into their respective drying pans, place the pans into the drying oven, and dry at 100°C for 24 hrs.

    or

12. **Growth Option 2 -** Place the surviving organisms from 4 replicates into pre-labeled 20 mL scintillation vials with 8% sugar formalin. The length of each organism is subsequently determined by measuring along the dorsal surface from the base of the first antenna to the tip of the third uropod along the curve of the dorsal surface using the microscope and measurement system

6.0 DATA ANALYSIS

Test endpoints include:

- Day 28 % survival,
- Day 28 growth (biomass and dry weight)

Using the CETIS® statistical software, input the survival and weight (or length) data for the Control treatment and for a given test sediment into a linked-file specific for that test sediment. Analyze the test data, as per the EPA guidelines statistical flowchart procedures, comparing the test responses of the test sediment against the Control treatment to determine whether the test sediment exposure resulted in statistically significant reductions in survival and weight (or length).

7.0 TEST ACCEPTABILITY CRITERIA

As per the EPA test guidelines, "It is recommended (for this test) that the following performance criteria be met":

1. Mean % survival should be ≥80% in the Control treatment on Day 28, and
2. Growth of test organisms should be measurable in the control sediment at the end of the 28-d test (i.e., relative to organisms at the start of the test). Typically, mean dry weight ≥0.15 mg/individual and mean length ≥3.2 mm/individual on Day 28.
3. Hardness, alkalinity, and total ammonia in the overlying water typically should not vary by more than 50% during the test, and dissolved oxygen should be maintained above 2.5 mg/L in the overlying water.

8.0 QUALITY CONTROL

1. All measured water quality should be within the limits established by the US EPA guidelines; any deviations must be noted in lab notebook and explained.
2. Control water, consisting of consisting of SAM-5S reconstituted water [Borgmann 1996, with bromide concentration modified as per Ivey et al. (2011)], should be used as the overlying water in this test. Use of the reconstituted water "*Hyalella*" Water (USEPA 2000) is NOT recommended.
3. To ensure that the organisms being used in the test are responding to test conditions in a "typical" manner, a lab reference or "Control" sediment of known quality is run concurrently with the test sediment. In the absence of a site reference sediment, the lab "Control" sediment is used for comparison purposes. Reference sediment test set-up, maintenance, and termination are identical to those described above.
4. All equipment is calibrated and operated as described in each applicable equipment SOP.
5. All staff working independently on any test shall have previously demonstrated familiarity and competency with the test, analytical equipment used, and the corresponding SOPs.
6. A reference toxicant test can be performed, at the client's discretion, to validate the response of the test organisms.

9.0 TEST INTERFERENCES

Characteristics of a sediment, aside from sediment-associated chemical constituents of concern, that can potentially affect test organism survival and growth should be assessed prior to preparing data submittals to the client. Interferences for this test generally fall into the categories of contaminant and non-contaminant factors.

9.1 Contaminant Interferences

1. All efforts should be made to avoid contaminating any component of the test system or sediments used in testing so as to avoid both false positives and false negatives. Standard "clean techniques" should be used in the lab at all times.
2. Measurable concentrations of total ammonia are common in the pore water of many types of sediment and have been found to be a common cause of toxicity in pore water. Total ammonia concentrations in the porewater should be determined to evaluate if the concentration exceeds the reported tolerance limit for this test species.

9.2 Non-contaminant Interferences

1. Natural geomorphological and physico-chemical characteristics, such as sediment texture, may influence the response of test organisms. A control sediment that includes characteristics (e.g., grain size, organic carbon) that are within the tolerance range of the

test organism should be included in the study design. This may best be accomplished by using a formulated sediment.

2. Morphologically similar indigenous organisms in a sediment sample may be confused with the test species during test termination, and result in overestimates in survival. In addition, indigenous organisms may also compete for food or prey on the test species. Should indigenous organisms be observed during test termination, the scientist should immediately notify the Project Manager, as it may be necessary to identify the indigenous organism, and determine the number or biomass in order to better interpret the growth data.

10.0 SAFETY

The 28-d *Hyalella azteca* toxicity test poses little risk to those performing it. Sediments can contain pathogenic organisms and appropriate precautions should be observed when handling this material. After the test is complete, the sediments should be disposed of in an appropriate fashion.

11.0 REPORTING

1. Following the completion of the statistical analyses and the QC review of the statistical analyses, the PER Project Lead is to summarize the results for an email submittal to the PER Project Manager for review. Following this review, either the Project Lead or Project Manager will submit the email summary to the client.
2. The Project Lead will generate a draft report and submit it to the Project Manager for review. The Project Manager reviews the draft report, makes any necessary revisions, and then submits a final report to administrative staff for preparation of the proper number of project-specific hard copies and electronic copies for posting to the client.
3. As per project-specific guidelines, any necessary electronic data deliverables will be generated under guidance by the Project Lead, and will be reviewed for accuracy by properly trained scientists.

12.0 REFERENCES

American Society for Testing and Materials (ASTM). 2012. Standard test method for measuring 1633 the toxicity of sediment-associated contaminants with freshwater invertebrates (ASTM 1634 E1706-05 (Reapproved 2010)). Annual Book of ASTM Standards Volume 11.06, West Conshohocken, PA.

Borgmann, U. 1996. Systematic analysis of aqueous ion requirements of *Hyalella azteca*: A standard artificial medium including the essential bromide ion. *Arch. Environ. Contam. Toxicol.* 30:356-363.

Ingersoll, C.G. and Nelson, M.K. 1990. Testing sediment toxicity with *Hyalella azteca* (Amphipoda) and *Chironomus riparius* (Diptera). In *Aquatic Toxicology and Risk Assessment*, 13th volume, eds. W.G. Landis and W.H. van der Schalie, 93-109. ASTM STP 1096. Philadelphia, PA

USEPA. 2000. Method for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition. EPA-600/R-99-064, Duluth, MN.

Summary of Test Conditions and Test Acceptability Criteria for Conducting the 28-Day *Hyalella azteca* Survival & Growth Sediment Toxicity Test (Modified from EPA Test Method 100.4)

1.	Test type	Whole-sediment toxicity test with renewal of overlying water
2.	Test duration	28 days
3.	Temperature	23 ± 1°C
4.	Light quality	Wide-spectrum fluorescent lights
5.	Light intensity	About 100 to 1000 lux
6.	Photoperiod	16L:8D
7.	Test chamber size	300-mL high-form lipless beaker
8.	Test sediment volume	lOO mL
9.	Overlying water	SAM-SS Reconstituted Water
1O.	Overlying water volume	175 mL
11.	Overlying water quality	Hardness, alkalinity, conductivity, and total ammonia are measured at Day 0 and Day 28. Temperature daily. pH and D.O. three times per week. Conductivity weekly.
12.	Overlying water renewal	2 volume additions/day via one volume addition twice per day
13.	Age of test organisms	7- to 8-d old at the start of the test
14.	No. of organisms per test chamber	10
15.	No. of rep. chambers/concentration	8, but depends on the test objective
16.	Feeding regime	*Spirulina-amended* YCT, fed 1.0 mL daily (days 1-13) or 2.0 mL daily (days 14-28) (1800 mg/L stock) to each test chamber
17.	Test chamber cleaning	If screens become clogged during the test, gently brush the *outside* of the screen
18.	Test solution aeration	None, unless D.O. in overlying water drops below 2.5 mg/L
19.	Endpoints	Survival and growth
20.	Sample and sample holding requirements	Grab or composite samples should be stored at 0-6°C
21.	Sample volume required	2 Liter (minimum), 4 L preferred
22.	Test acceptability criteria	Minimum mean control survival of 80%. Measurable growth in the control; ty pically, mean dry weight 0.15 mg/individual and average length is 3.2 mm/individual for test organisms in the control sediment.

Supplemental SOP Language

Definitions:

ACS:	American Chemical Society
ASAP :	As soon as possible
ASTM :	American Society for Testing Materials
°C :	degrees Celsius
dH_2O :	distilled water
D.O.:	dissolved oxygen
ECx:	Effective concentration in X% of the population.
hrs :	hours
ICx:	Inhibitory concentration in X% of the population.
LCx:	Lethal concentration in X% of the population.
LOEC:	Lowest Observed Effect Concentration
mg :	milligram
mg/L :	milligram per liter
mL :	milliliter
NOEC:	No Observed Effect Concentration
NPDES :	National Pollutant Discharge Elimination System
S.O.P.:	Standard Operation Procedure
TIE:	Toxicity Identification Evaluation
U.S. EPA :	United States Environmental Protection Agency

Interferences:

In an effort to eliminate interferences, SOPs have been established for every procedure involved in conducting a successful bioassay test. Additionally, a rigorous daily QA/QC inspection is designed to identify potential sources of interference. Prior to the initiation of toxicity tests every effort is made to identify and eliminate potential sources of interference that could compromise test results. These can include but are not limited to the following: clean and functional facilities, equipment and test chambers; sample storage and handling; test organism and food quality; laboratory water quality.

Pollution Prevention

As a pollution prevention measure, wastes generates during toxicity testing must be properly handled and disposed of in an appropriate manner. Care should be taken not to generate excessive wastes when preparing solutions for testing. All materials identified as hazardous should be labeled and appropriately stored for hazardous waste disposal.

Data Assessment

Bioassay and water quality data are assessed each day during the course of testing for accuracy and compliance with established criteria. At test termination, the data for each replicate, which are recorded on the appropriate data sheets, are entered into a CETIS™ data file labeled for identification of the specific test. Statistical analyses are performed in accordance with EPA guidelines for statistical analysis. Control data for all endpoints are evaluated for compliance with established test acceptability criteria. Water Quality data are assessed for compliance with specifications outlined in the appropriate USEPA testing manuals.

Corrective Actions and Contingencies for Out-of-Control Data

If control performance is not met, a project manager should be notified immediately and, upon approval, the test is to be repeated. The potential cause(s) of poor control performance will be documented by scientific staff and evaluated and assessed by a project manager. Corrective actions will be determined on a case-by-case basis. The results of all tests will be summarized in reports for the regulatory authorities with an explanation of the results.

Revision #6
Effective Date: September 11, 2013
Accepted:

Hyalella azteca
UCR 42-Day Survival, Growth & Reproduction
Sediment Toxicity Test
Standard Operating Procedures

This S.O.P. is based upon EPA Method 100.4 guidelines described in Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition (EPA/600/R-99/064). It is also in general accordance with ASTM Standard E1706-05 (2010), Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates.

1. INTRODUCTION

This test is based on a 28-day static-renewal exposure of 7-8 day old ***Hyalella azteca*** to sediments, followed by a 14-day exposure in "lab" water only during which reproduction is evaluated. The final test endpoints include survival, growth and reproduction (survival and growth on Day 28, survival and reproduction on Day 35, and survival, growth, and reproduction on Day 42).

Hyalella azteca are often an important component of the benthos in freshwater ecosystems, have been used in sediment toxicity testing, and have shown to be a sensitive indicator of contaminants associated with sediments. They have a wide tolerance of sediment grain size with acceptable survival in sediments ranging from >90% fines to 100% sand (Ingersoll and Nelson, 1990).

2. TEST PREPARATION

2.1 Equipment and Supplies Needed

1. Sample containers may be necessary for the client's collection of sediment. Containers must be pre-cleaned consistent with EPA guidelines. A minimum volume of 2-L of sediment is necessary (4-L is preferred) to provide sediment for the bioassay and for the accompanying sediment porewater characterization. Additional volume will be necessary for further characterization of sediment (e.g., grain size characteristics, contaminant concentrations).
2. Stainless steel bowls and spatulas (or spoons) to homogenize sediments prior to placement in replicate containers.

3. Test containers, consisting of 300-mL tall-form glass beakers, modified as follows:
   a. The flared lip of the beakers should be cut off, and the upper rim flame-polished. Orca Glassworks in Benicia can provide this service. The prepared beakers must be appropriately cleaned before further use.
   b. Cut a 2.5 cm-wide band of 425-μm Nitex®, approximately 25 cm in length. Using aquarium-safe silicon sealant, attach the band of Nitex around the upper lip of the beaker, such that ~two-thirds of the width of the Nitex band is above the glass. Make sure to completely seal the Nitex such that there are no openings or seams into which the test organisms might become entrapped. Allow the silicon sealant to cure for a minimum of 24 hrs. The resulting test containers must be appropriately cleaned and rinsed, and then pre-soaked for 48 hrs in Type 1 lab water (reverse-osmosis, de-ionized (RO/DI) water) before use in testing.
4. "Water Only" replicate containers, consisting of 400 mL glass beakers.
5. Modified Zumwalt-type water delivery system, consisting of lower plastic tub to hold replicate containers in position, and upper plastic tub, plumbed with 60 mL syringes and attached flow restrictors for delivery of water to replicate containers.
6. Standard Artificial Medium (SAM-5S), consisting of synthetic freshwater (SAM-5S), prepared as per Borgman 1996 guidelines:
   a. Transfer ~75 L of Type I water into an appropriately-cleaned 120-L HDPE tank.
   b. Add 14.7 g of $CaCl_2•2H_2O$ to a 2-L aliquot of Type I water and mix on magnetic stir plate for 30 min or until the salts completely dissolve.
   c. Add 6.16 g of $MgSO_4•7H_2O$, 8.4 g of $NaHCO_3$, 0.37 g of KCl, and 0.05 g of NaBr to a second 2-L aliquot of Type I water, and mix on a magnetic stir plate for 30 min or until the salts completely dissolve.
   d. While vigorously stirring, pour each of the 2-L aliquots of salt solutions into the 75-L of Type I water, and fill to a total volume of 100-L with Type I water.
   e. Vigorously aerate the water for at least 24 hrs prior to use.
   f. The water quality should be:
      i. Hardness, 120-140 mg/L as $CaCO_3$
      ii. Alkalinity, 43-53 mg/L as $CaCO_3$
      iii. Conductivity, 385-435 μS/cm
      iv. pH, 7.5-8.4
7. Water quality (pH, DO, and conductivity/salinity) meters, calibrated and used as per the appropriate SOPs.

8. Type 1 lab water (reverse-osmosis, de-ionized (RO/DI) water), for rinsing of probes, etc.
9. Wash bottles, for rinsing of probes, etc.
10. Glass or electronic thermometer calibrated and used to measure temperature.
11. Pipettes, disposable plastic Pasteur pipettes, for the collection and transfer of test organisms, and collection of water quality subsamples.
12. Fine-tip forceps, for use in collecting individual organisms from culture material at test termination.
13. Glass dishes, for the sorting and collection of test organisms at test initiation and at test initiation.
14. Light boxes, for the sorting and collection of test organisms at test initiation and at test termination.
15. Aeration system, in cases where the chambers need to be aerated when the D.O. drops below acceptable levels.
16. Test Food.
    a. YCT (yeast, Cerophyl®, trout chow) is prepared according to Appendix B, EPA 600/R-99/064.
    b. YCT is amended with powdered *Spirulina*, sieved at 250 µm, at a rate of 90 mg per 100 mL YCT.
17. Sieves, #25 (701 µm), #40 (425 µm), and #50 (300 µm), for collection of organisms at test termination.
18. Aluminum Foil Weighing Pans, for drying and weighing of organisms at end of test.
19. Drying Oven, at 60°C to 90°C for drying organisms at test termination.
20. Desiccators, for holding dried organisms.
21. Balance, capable of weighing to 0.01 mg. Calibrate and use as per the appropriate SOP.
22. Reference weights, for calibration of balance.
23. Microscope and calibrated software for performing length measurements (if length is measured rather than mean dry weight).

2.2 Ordering and Holding of Test Organisms

2.2.1 Ordering and Holding of Test Organisms from Commercial Supplier

1. Test organisms should be ordered far enough in advance so as to ensure the arrival of 6-7 day old organisms at least 24 hrs prior to Day 0 (so that organism will be 7-8 days old at test initiation). Approximately 25% more animals should be ordered than are actually

needed for the test, so as to allow for some attrition of organisms that are stressed from the shipping, etc.

2. Order organisms from:
   a. Aquatic Biosystems Inc. - (800) 331-5916
   b. Chesapeake Cultures - (803) 694-4046

Note: Aquatic BioSystems supplies known-age organisms while, Chesapeake Culture provides organisms aged by class size.

3. Upon receipt, the test organism culture should be transferred into 4-L HDPE tanks containing test water at 23°C; the culture should be gently aerated, and should be fed *Spirulina*-amended YCT. If the test is to be run at salinity >2 ‰ (up to 15‰), cultures must be salinity adjusted. Place them in control water at the receiving salinity and immediately begin to adjust the holding salinity towards the test salinity. For additional instruction on the receipt and handling of the test organisms, see the "Test Organism Receipt and Handling S.O.P."

2.2.2 Organisms from In-Lab Culture

If the test organisms will be supplied from in-lab cultures, the organisms must be isolated from the in-lab culture 7-8 days before the test is to begin in order to have 7-8-day old organisms at the time of test initiation. Adults from each of the culture tanks should be collected and transferred to a #25 sieve resting in a collection bowl containing SAM-5S water and a few conditioned leaves, and provide gentle aeration. Allow the culture to sit undisturbed overnight.

The following day, carefully remove the leaves, shaking to dislodge any clinging adults. Gently shake the top sieve and lift out of the neonate collection bowl assembly, carefully transferring the retained adults into a temporary holding container (make sure the transferred adults are not trapped at the water surface). The remaining water in the collection bowl contains all of the neonates that were released overnight. These should be transferred into a new culture tank containing a few conditioned leaves, with the neonates being counted during this transfer. There should be at least 125% of the number needed for the test. If not, repeat this process with the retained adults and collect a second day's batch of neonates, which will be combined with the first days. After enough neonates are collected, the adults can be returned to their culture tanks.

The collected neonates should be fed *Spirulina*-amended YCT. Change the water every 3 days, inspecting the animals to ensure adequate abundance, health and quality.

2.2.3 Organism Health

Test organisms must appear healthy, behave normally, feed well, and have low mortality in the cultures during holding. There should be <20% mortality in the cultures 48 hrs prior to test initiation.

2.3 Collection and Holding of Sediment Samples

Grab or composite samples should be collected into appropriately-cleaned glass or plastic container(s), and immediately be placed on ice (or "blue ice" type product) to bring the temperature to 0-6°C. The sample should be shipped or transported to the testing laboratory ASAP. Upon receipt of the sample(s) in the laboratory, each sample should be logged in, and then placed in the sample refrigerator at 0-6°C. For instruction on the log-in of incoming samples, see the "**Test Sample(s) Log-In Procedures.**" The test sample(s) used to start the test should be <14 days old, although samples <8 weeks old can be used. For each sample tested, a minimum of 2 L of **debris-free** sediment will be needed for the sediment testing. If needed, chemistry analyses will require additional samples.

3. TEST INITIATION

Before test initiation begins, be aware of any client-specific testing requirements and read the attached "**Summary of Test Conditions for the 42-Day *Hyalella azteca* Survival and Growth Sediment Toxicity Test.**"

3.1 On the Day Before Test Initiation (Day –1):

1. Remove the test replicate containers from soaking in the tank of Type 1 water and shake excess water off. Each test treatment, including each Control, will require 12 test replicate containers. Label the test containers with their treatment and replicate ID code (Replicates "A" through "L") using an indelible black ink (Sharpie®) pen.
2. Remove the sediment from the sample storage refrigerator and allow thermal equilibration to room temperature. Using a stainless steel spoon and bowl, re-homogenize the sediment along with any overlying water that has developed.
3. For each sediment sample, use a stainless steel spoon or spatula to transfer approximately 100 mL of homogenized sediment into each of the 12 replicates, carefully "tamping" down the sediments. Carefully pour approximately 175 mL of SAM-5S water into each beaker, taking care to minimize disturbance of the sediment.
4. Place the test replicates into the water bath or test room, with the temperature controlled at 23°C, under cool-white fluorescent lighting on a 16L:8D photoperiod.

3.2 Pre-Test Sediment Porewater Characterization, if required (Day –1, or before):

1. Place approximately 500 mL of each homogenized sediment into 750-mL centrifuge bottles, and centrifuge at 2500 g for 30 min.
2. Decant sediment porewater, and measure routine water quality characteristics of the porewater (pH, DO, conductivity, and total ammonia). Record the water quality data into the appropriate test data sheet.

3.3 Immediately Prior to Test Initiation (Day 0):

1. Renewal of the overlying water using the Zumwalt water delivery system is implemented immediately prior to the introduction of the test organisms into the test replicates Using the Zumwalt water delivery system, renew the overlying water in each of the replicate containers with 1 replicate volume of water as described below:
2. To renew the overlying water, place the test chambers in the lower plastic tub to hold them in place. Place the tub with the test chambers directly under the syringes connected to the upper splitting chamber of the Zumwalt water delivery system and add fill each syringe with EPAMH water. Adjust the stopcocks so as to minimize any disturbance of the flow on the sediment. After the syringe has emptied, repeat twice with additional syringe volumes of water (for a total of 3 syringe volumes).
3. After the water is renewed, use a disposable 25-mL glass pipette to collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate; the pipet must be inspected to ensure no organisms were removed during sampling. Composite the replicate water samples for each test treatment to provide a total volume of ~200 mL for each sediment. From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia.
4. Measure the initial water quality conditions (temperature, pH, D.O., conductivity, hardness, alkalinity, and total ammonia). From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, DO, and conductivity) in the remaining composited water. Record the water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
5. If the D.O. levels fall below 2.5 mg/L, implement gentle aeration of each test replicate.
6. Isolation and Collection of Individual Test Organisms:
   a. Immediately prior to test initiation, transfer small portion of test organism culture and test water into shallow glass dish placed on top of light box.
   b. Using a plastic pipette, gently agitate the culture material. This disturbance will cause the larval *H. azteca* to swim up, facilitating their capture.

3.4 Initiate the Test (Day 0):

1. Transfer organisms into a small transfer dish (e.g., plastic weigh boats) containing a small aliquot of SAM-5S water, continuing this process until there are 10 organisms in the transfer dish (these counts must be confirmed by an independent Scientist); these can then be "poured" into the test replicates, making sure that organisms are below the water surface in the test replicate chambers. Note – this process must take place quickly, as extended period in the transfer dish will stress the organisms.

2. Allocate ten 7-8 day old organisms into each replicate beaker. Load all "A" replicate containers first, with the order of test treatments being randomized. Repeat process for the "B" replicates, with the order of test treatments being re-randomized. Continue until all test replicates are loaded.
3. Immediately re-examine each replicate, replacing any dead or injured animals. Examine each replicate to ensure that all test organisms are below the water surface, as some organisms may be "trapped" on the water surface due to surface tension. Using a plastic pipette, organisms that are at the water surface should be moved down into the water by gently squirting the organisms with test water.
4. Randomly place the test replicates into the water bath or test room, with the temperature controlled at 23°C, under cool-white fluorescent lighting on a 16L:8D photoperiod.
5. Feed each replicate 1.0 mL of Spirulina-amended YCT.
6. For an assessment of growth, at t=0, a minimum of 80 organisms should be dried as described below in Section 5, Step 10. If growth is to be determined using length measurements, 20 amphipods should be archived in sugar formalin (as per EPA guidelines).

4. TEST MAINTENANCE (DAYS 1-27)

Each day:

AM:

1. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.
2. Measure the temperature in the test water from one randomly-selected replicate for each treatment and record data onto test datasheet.
3. Perform water quality analyses as required (see Section 4.0-2 and 4.0-3), collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate using a disposable 25 ml glass pipet; composite the replicate water samples for each test treatment to provide a total volume of ~50 mL; the pipet must be inspected to ensure no organisms were removed during sampling. Measure the "old" D.O. and record data onto the test data sheet. If the D.O. levels fall below 2.5 mg/L, implement gentle aeration of each test replicate.
4. Renew the overlying water using the Zumwalt water delivery system to deliver 1 replicate water volume to each replicate container as described above in Section 3.3, Step 2.
5. Collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate using a disposable 25 ml glass pipet; composite the replicate water samples for each test treatment to provide a total volume of ~50 mL; the pipet must be inspected to

ensure no organisms were removed during sampling. Measure the "new" D.O. and record data onto the test data sheet. If the DO levels fall below 2.5 mg/L, implement gentle aeration of each test replicate.

6. Return the test replicates to the water bath or test room and initial "AM" maintenance on data sheet.

PM:

1. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.
2. Renew the overlying water using the Zumwalt water delivery system to deliver 1 replicate water volume to each replicate container as described above in Section 3.3, Step 2.
3. Return the test replicates to the water bath or test room, and feed each replicate 1.0 mL of *Spirulina*-amended YCT on days 0-13. Feed each replicate 2.0 mL on days 14-27.
4. Initial "PM" maintenance on data sheet.

Three Days per Week (e.g., T, Th, Sat)
Measure pH three times per week.

Once per Week
Measure conductivity once per week.

5. DAY 28 TEST TERMINATION & INITIATION OF WATER-ONLY EXPOSURES

5.1 Day 28: Interim Assessment of Survival and Growth

Survival and growth at 28 days will be assessed in four of the original 12 replicates, as follows.

1. Examine each replicate container. Any dead organisms should be removed via pipette, and the number of mortalities recorded onto the test data sheet.
2. Measure the temperature in the test water in one randomly-selected replicate for each treatment and record data onto test data sheet.
3. Collect ~25 mL of test water from 1-2 cm above the sediment in each test replicate using a disposable 25 ml glass pipet; composite the replicate water samples for each test treatment to provide a total volume of ~200 mL; the pipet must be inspected to ensure no organisms were removed during sampling.
4. From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, DO, and conductivity) in the remaining composited water.

Record the final water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.

5. Label plastic weigh boats with the corresponding sediment test treatment and replicate identification for each test replicate and fill each weigh boat about half-full with fresh test water.
6. Using a squirt bottle containing clean test water, vigorously squirt water onto the surface of the sediment so as to disturb the surficial layer – this will facilitate the collection of the test organisms. Swirl and pour the slurry of water and disturbed surficial sediment into a glass sorting dish atop a light box. Using a plastic Pasteur pipettes, carefully capture the individual organisms from the dish and transfer them into the weigh boat.
7. Repeat Step 6 with the remaining sediment from that replicate until no additional organisms have been found after three surficial sediment washes. If all of the organisms have not been accounted for, sieve the remaining sediment sequentially with #25, #40, and #50 sieves.
8. Using a squirt bottle, rinse the organisms with clean test water to remove any adhered sediment or other clinging material. Using the fine-tip forceps, transfer the cleaned individual amphipods into a pre-labeled, -dried, and –weighed aluminum foil drying pan.
9. Record the number of live amphipods recovered in each replicate onto the test data sheet.
10. Repeat steps 6 through 10 for each of the four test replicates.
11. **Growth Option 1** - Transfer the surviving amphipods from each of the 4 replicates onto separate labeled pre-dried and pre-weighed aluminum pan (the pans should be weighed as per the "Weighing of Test Organisms SOP."). When all of the replicates have been transferred into their respective drying pans, place the pans into the drying oven, and dry at 100°C for 24 hrs.

    or

12. **Growth Option 2 -** Place the surviving organisms from 4 replicates into pre-labeled 20 mL scintillation vials with 8% sugar formalin. The length of each organism is subsequently determined by measuring along the dorsal surface from the base of the first antenna to the tip of the third uropod along the curve of the dorsal surface using the microscope and measurement system.

5.2 Day 28: Initiation of Water-Only Exposures for Survival, Reproduction, and Growth

1. For each of the remaining eight replicates, prepare a new 'water only' replicate (400 mL glass beaker that will contain water without any sediment); label each replicate appropriately, and fill with control water.
2. Add 2 1 cm^2 110 mesh, ~137 μm Nitex per replicate as an amphipod substrate.

3. Collect ,..,,25 mL of test water from 1-2 cm above the sediment in each of the remaining original 8 test replicates using a disposable 25 ml glass pi pet; composite the replicate water samples for each test treatment to provide a total volume of '"200 mL; the pi pet must be inspected to ensure no organisms were removed during sampling.
4. From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, DO, and conductivity) in the remaining composited water. Record the final water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
5. Process each test replicate as described above (Section 5.1, Steps 1-10). For each replicate, transfer the surviving organisms to the corresponding "water only" replicate chamber.
6. Return the "Water Only" replicates to the temperature-controlled room under the same test conditions used in the initial 28-days of testing.

6. TEST MAINTENANCE FOR WATER-ONLY EXPOSURE (DAY 28-42)

1. Renew the overlying water daily; ensure that no offspring are lost during renewal. Examine each replicate container and remove any dead organisms via pipet and record the number of mortalities on the test data sheet.
2. For each test treatment, collect a sub-sample of test solution from a random replicate and measure and record the "old" water quality parameters. After the solution renewal, collect a sub-sample of test solution from a random replicate and measure and record the "new" water quality parameters.
3. Feed each replicate 2.0 mL of *Spirulina-amended* YCT.
4. On Day 35, collect 25 mL of test water from each test replicate using a disposable 25 ml glass pi pet; composite the replicate water samples for each test treatment to provide a total volume of 200 mL; the pipet must be inspected to ensure no organisms were removed during sampling.
5. From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, DO, and conductivity) in the remaining composited water. Record the final water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
6. On day 35, remove and count the offspring in each replicate, and record on the test data sheet. Return the test replicates to the test room, and continue to maintain for the remaining six days.

7. TEST TERMINATION FOR WATER ONLY EXPOSURE (DAY 42)

5. On Day 42, Collect ~25 mL of test water from each test replicate using a disposable 25 ml glass pipet; composite the replicate water samples for each test treatment to provide a total volume of ~200 mL; **the pipet must be inspected to ensure no organisms were removed during sampling**.
6. From the composite, collect sub-samples for analysis of alkalinity, hardness, and ammonia, which are recorded in their respective logbooks. Then measure routine water quality parameters (pH, DO, and conductivity) in the remaining composited water. Record the final water quality data onto the Sediment Toxicity Test Water Quality Data Sheet.
7. Remove and count adults and young in each replicate, and record on test data sheet.
8. Determine and record the number of adult males and females for each replicate. Mature male amphipods are distinguished by the presence of an enlarged second gnathopod.
9. From the number of young produced from day 28-to-42 and the number of adult females [at Day 42], calculate and record the number of young produced per female for each replicate.
10. Measure the length or dry weight as described above in section 5.1.

8. DATA ANALYSIS

Test endpoints include:

- Day 28 % survival,
- Day 28 growth (biomass and dry weight)
- Day 35 % survival,
- Day 35 number of offspring,
- Day 42 % survival,
- Day 42 growth (biomass and dry weight),
- Day 42 number of males and females, and
- Day 42 reproduction (as number of young/female).

The survival, length or weight, and reproduction data for each replicate, which are recorded on the appropriate data sheets, are entered into the most current CETIS statistical software data file labeled for identification of the specific test. Statistical analyses are performed in accordance with EPA guidelines.

9. TEST ACCEPTABILITY CRITERIA

As per the EPA test guidelines, "It is recommended (for this test) that the following performance criteria be met":

1. Mean % survival should be ≥80% in the Control treatment on Day 28.
2. Mean dry weight ≥0.15 mg/individual on Day 28, or Mean length ≥3.2 mm/individual on Day 28.
3. Reproduction from Day 28 to Day 42 of ≧2 offspring/female.

10. QUALITY CONTROL

1. All measured water quality should be within the limits established by the US EPA guidelines; any deviations must be noted in lab notebook and explained.
2. Control water, consisting of consisting of SAM-5S reconstituted water (Borgmann 1996), culture water, well water, surface water, or site water should be used as the overlying water in this test. Use of the reconstituted water "Hyalella" Water (USEPA 2000) is NOT recommended.
3. To ensure that the organisms being used in the test are responding to test conditions in a "typical" manner, a lab reference or "Control" sediment of known quality is run side-by-side with the test sediment. In the absence of a site reference sediment, the lab "Control" sediment is used for comparison purposes. Reference test set-up, maintenance, and termination are identical to those described above.
4. Additional Control sediments may be tested (i.e., silica quartz sand), as appropriate to the study.
5. Reference sediment test set-up, maintenance, and termination are identical to those described above.
6. All measured water quality should be within the limits established by the EPA guidelines; any deviations must be noted in lab notebook and explained.
7. All equipment is calibrated and operated as described in each applicable equipment SOP.
8. All staff working independently on any test shall have previously demonstrated familiarity and competency with the test, analytical equipment used, and the corresponding SOPs.
9. A reference toxicant test can be performed, at the client's discretion, to validate the response of the test organisms.

11. TEST INTERFERENCES

Characteristics of a sediment, aside from sediment-associated chemical constituents of concern, that can potentially affect test organism survival and growth should be assessed prior to preparing data submittals to the client. Interferences for this test generally fall into the categories of contaminant and non-contaminant factors.

11.1 Contaminant Interferences

1. All efforts should be made to avoid contaminating any component of the test system or sediments used in testing so as to avoid both false positives and false negatives. Standard "clean techniques" should be used in the lab at all times.
2. Measurable concentrations of ammonia are common in the pore water of many sediments and have been found to be a common cause of toxicity in pore water. Total ammonia concentrations in the porewater should be determined to evaluate if the concentration exceeds the reported tolerance limit for this test species.

11.2 Non-contaminant Interferences

1. Natural geomorphological and physico-chemical characteristics, such as sediment texture, may influence the response of test organisms. A control sediment that includes characteristics (e.g., grain size, organic carbon) that are within the tolerance range of the test organism should be included in the study design. This may best be accomplished by using a formulated sediment.
2. Morphologically similar indigenous organisms in a sediment sample may be confused with the test species during test termination, and result in overestimates in survival. In addition, indigenous organisms may also compete for food or prey on the test species. Should indigenous organisms be observed during test termination, the scientist should immediately notify the Project Manager, as it may be necessary to identify the indigenous organism, and determine the number or biomass in order to better interpret the growth data.

13. SAFETY

This toxicity test poses little risk to those performing it. Sediments can contain pathogenic organisms and appropriate precautions should be observed when handling this material. After the test is complete, the sediments should be disposed of in an appropriate fashion.

14. REPORTING

1. Following the completion of the statistical analyses and the QC review of the statistical analyses, the PER Project Lead is to summarize the results for an email submittal to the PER Project Manager for review. Following this review, either the Project Lead or Project Manager will submit the email summary to the client.
2. The Project Lead will generate a draft report and submit it to the Project Manager for review. The Project Manager reviews the draft report, makes any necessary revisions, and then submits a final report to administrative staff for preparation of the proper number of project-specific hard copies and electronic copies for posting to the client.

3. As per project-specific guidelines, any necessary electronic data deliverables will be generated under guidance by the Project Lead, and will be reviewed for accuracy by properly trained scientists.

15. REFERENCES

American Society for Testing and Materials (ASTM). 2012. Standard test method for measuring 1633 the toxicity of sediment-associated contaminants with freshwater invertebrates (ASTM 1634 E1706-05 (Reapproved 2010)). Annual Book of ASTM Standards Volume 11.06, West Conshohocken, PA

Borgmann, U. 1996. Systematic analysis of aqueous ion requirements of *Hyalella azteca*: A standard artificial medium including the essential bromide ion. *Arch. Environ. Contam. Toxicol.* 30:356-363.

USEPA. 2000. Method for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates. EPA-600/R-99-064, Duluth, MN.

SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR CONDUCTING THE 42-DAY ***HYALELLA AZTECA*** SURVIVAL AND GROWTH SEDIMENT TOXICITY TEST (MODIFIED FROM TEST METHOD 100.4)		
1.	Test type	Whole-sediment toxicity test with renewal of overlying water
2.	Test duration	42 days
3.	Temperature	23 ± 1°C
4.	Light quality	Wide-spectrum fluorescent lights
5.	Light intensity	About 100 to 1000 lux
6.	Photoperiod	16L:8D
7.	Test chamber size	300-mL high-form lipless beaker
8.	Test sediment volume	100 mL
9.	Overlying water	SAM-5S reconstituted Water
10.	Overlying water volume	175 mL
11.	Overlying water quality	Hardness, alkalinity, conductivity and ammonia at beginning and end of sediment exposure. Temperature daily, pH and DO three times per week. Conductivity weekly.
12.	Overlying water renewal	2 volume additions/d @ one volume addition every 12 h
13.	Age of test organisms	7- to 8-d old at the start of the test
14.	No. of organisms per test chamber	10
15.	No. of rep. chambers/concentration	12, but depends on the objective of the test, 8 for 42 days, 4 for 28 growth
16.	Feeding regime	*Spirulina* amended YCT, fed 1.0 mL days 0-13, 2.0 mL days 14-41. (1800 mg/L stock) to each test chamber
17.	Test chamber cleaning	If screens become clogged during the test, gently brush the *outside* of the screen
18.	Test solution aeration	None, unless DO in overlying water drops below 2.5 mg/L
19.	Endpoints	Survival and growth
20.	Sample and sample holding requirements	Grab or composite samples should be stored at 0-6°C.
21.	Sample volume required	2 Liter, 4 L preferred
22.	Test acceptability criteria	Mean control survival of ≥80% and growth as mean dry weight ≥ 0.15 mg/individual or ≥ 3.2 mm/individual for test organisms in the control sediment at Day 28; reproduction from Day 28 to Day 42 of ≥2 offspring/female.

Supplemental SOP Language

Definitions:

ACS:	American Chemical Society
ASAP :	As soon as possible
ASTM :	American Society for Testing Materials
°C :	degrees Celsius
dH_2O :	distilled water
D.O.:	dissolved oxygen
ECx:	Effective concentration in X% of the population.
hrs :	hours
ICx:	Inhibitory concentration in X% of the population.
LCx:	Lethal concentration in X% of the population.
LOEC:	Lowest Observed Effect Concentration
mg :	milligram
mg/L :	milligram per liter
mL :	milliliter
NOEC:	No Observed Effect Concentration
NPDES :	National Pollutant Discharge Elimination System
S.O.P.:	Standard Operation Procedure
TIE:	Toxicity Identification Evaluation
U.S. EPA :	United States Environmental Protection Agency

Interferences:

In an effort to eliminate interferences, SOPs have been established for every procedure involved in conducting a successful bioassay test. Additionally, a rigorous daily QA/QC inspection is designed to identify potential sources of interference. Prior to the initiation of toxicity tests every effort is made to identify and eliminate potential sources of interference that could compromise test results. These can include but are not limited to the following: clean and functional facilities, equipment and test chambers; sample storage and handling; test organism and food quality; laboratory water quality.

Pollution Prevention

As a pollution prevention measure, wastes generates during toxicity testing must be properly handled and disposed of in an appropriate manner. Care should be taken not to generate excessive wastes when preparing solutions for testing. All materials identified as hazardous should be labeled and appropriately stored for hazardous waste disposal.

Data Assessment

Bioassay and water quality data are assessed each day during the course of testing for accuracy and compliance with established criteria. At test termination, the data for each replicate, which are recorded on the appropriate data sheets, are entered into a CETIS™ data file labeled for identification of the specific test. Statistical analyses are performed in accordance with EPA guidelines for statistical analysis. Control data for all endpoints are evaluated for compliance with established test acceptability criteria. Water Quality data are assessed for compliance with specifications outlined in the appropriate USEPA testing manuals.

Corrective Actions and Contingencies for Out-of-Control Data

If control performance is not met, a project manager should be notified immediately and, upon approval, the test is to be repeated. The potential cause(s) of poor control performance will be documented by scientific staff and evaluated and assessed by a project manager. Corrective actions will be determined on a case-by-case basis. The results of all tests will be summarized in reports for the regulatory authorities with an explanation of the results.

Change Request Form
Upper Columbia River Phase 2 Sediment Study

Page: 1 of 5 Change No: 4

CHANGE REQUEST

Creation of SOP for collecting EPA-chemistry only split samples from ALS Laboratory in Kelso, WA

Applicable Reference:

SOPs section (Attachment A2) of the Field Samplin Plan

Description of Change:

A new SOP (No. 10) was prepared that details the procedures to be followed for collecting EPA-chemistry only split samples from sediment samples located at ALS in Kelso, WA. SOP-10 is attached.

Reason for Change:

No SOP specific to collecting EPA-spilt samples from ALS was provided in the Final QAPP, dated March 2013.

Impact on Present and Completed Work:

None

Requested By: J.R. Sugalski (Scientist) Date: 11/12/2013

Acknowledged By: David Hose (Task Leader) Date: 11/12/2013

APPROVAL

URS Project Manager: [signature] Date: 11/12/2013

Teck Project Manager: [signature] Date: 11/12/13

EPA Project Manager: [signature] Date: 11/12/13

STANDARD OPERATING PROCEDURE SOP 10

PROCESSING OF EPA CHEMISTRY SPLIT SAMPLES IN THE ALS LABORATORY

Scope and Applicability

This standard operating procedure (SOP) describes the general procedures for collecting EPA-chemistry only split samples at the ALS Laboratory (ALS) in Kelso, WA. EPA split samples were obtained in accordance with the Final Quality Assurance Project Plan (QAPP) for the Phase 2 Sediment Study dated March 2013 and shipped to ALS for temporary storage pending re-packaging from 5-gallon buckets to smaller containers and shipment to an EPA selected laboratory. This SOP applies to only the EPA-chemistry only split samples that were collected during the Phase 2 Sediment Field Program conducted from September 5, 2013 through October 24, 2013. The locations and designations of the chemistry only split samples are identified in Table 2-5 of the Quality Assurance Project Plan, Upper, Columbia River, Phase 2 Sediment Study, Split Sample Metals Analysis prepared by CH2M Hill and dated September 2013.

Equipment and Materials

Specific equipment and materials required to collect EPA split samples at the laboratory include the following:

- One Lexan tub
- One electric drill (preferably 18 volts)
- One stainless steel mixer paddle
- Two plastic scoop (s)
- Labeled Sample Containers (assumed to be provided by USEPA or their designee)
- Rubber hammer to close lid
- Six 5-gallon buckets to collect decontamination rinse water
- Three Spray bottles (DI, liquinox, Acid)
- 1L. Nitric Acid (10%)
- Liquinox
- Scrub brush
- Health and safety equipment (safety glasses, nitrile gloves, and coveralls or apron)

Procedures

The steps listed below should be followed to collect EPA chemistry only split samples at the laboratory:

1. Identify and locate sediment samples listed in Table 1.
2. Don appropriate health and safety equipment
3. Identify a suitable decontamination area and containers used to collect the rinse waters.
4. Decontaminate the following in accordance with SOP 4 of the QAPP (TAI, 2013).
    a. Lexan tub
    b. Two plastic scoops
    c. One stainless steel homogenizer paddle
5. Each sample will be processed individually. Only one bucket should be open at a time.
6. Identify a sample to be processed and take the bucket to the processing area.
7. Remove bucket lid.
8. If sediment is primarily sand-sized particles the contents of the bucket may be emptied into a decontaminated Lexan tub for homogenization (**Proceed to step 10**). If sediment is primarily fine-grained particles and the bucket is approximately three quarters full, the material may be homogenized in the sample bucket (**Proceed to step 9**). If the bucket is more than three quarters full, the sediment may be emptied into a decontaminated Lexan tub for homogenization (**Proceed to Step 10**).
9. For material mixed in the sample bucket the following should occur:
    a. Insert homogenizer paddle attached to drill into bucket.
    b. Turn drill on and move paddle throughout the sample until the sample is satisfactorily mixed.
    c. Using a decontaminated plastic scoop, remove sediment from the bucket and place into sample container(s). Label the sample containers if necessary.
    d. Replace the lid on the bucket and return the bucket and remaining sediment to storage.
    e. Decontaminate the mixing paddle and scoops in accordance with SOP 4 and proceed to the next sample (**Step 6**) until all samples have been processed.
10. For material mixed in the decontaminated Lexan tub the following should occur:
    a. Place sediment into the decontaminated Lexan tub.
    b. Use scoops to homogenize the material if the material is primarily sand sized particles. Use the decontaminated mixing paddle to homogenize the material if the sediment is primarily fine grained particles.
    c. Mix the sample until it is satisfactorily mixed
    d. Using a decontaminated plastic scoop, remove sediment from the bucket and place into sample container(s). Label the sample containers if necessary.

e. Return the homogenized sediment to the bucket it originally came from.
f. Replace the lid on the bucket and return the bucket and sediment to storage.
g. Decontaminate the mixing paddle, Lexan tub and scoops in accordance with SOP 4 if used to mix the sample. Proceed to the next sample (**Step 6**) until all samples have been processed.

11. After all samples have been mixed and the necessary sample containers filled, ensure that the equipment used to homogenize the sample (tub, scoop and mixing paddle) have been decontaminated in accordance with SOP 4 of the QAPP. Using laboratory supplied Deionized (DI) water perform a final rinse of the equipment. After the final rinse is compete, pour additional DI water over the equipment and collect it in appropriate sample containers listed in the QAPP. Two containers will be filled for each piece of equipment and submitted for metals analysis by ALS in accordance with the QAPP. The equipment rinsate (ER) samples will have the following Sample IDs, where Station ID (Table 1) corresponds to the sample collected following the last decontamination of the sampling equipment:
    a. Lexan Tub – ER-Station ID-LAB-1
    b. Homogenizing paddle – ER-Station ID-LAB-2
    c. Scoop – ER-Station ID-LAB-3
12. Clean up area and ensure sample containers and buckets are stored properly.
13. Sign over custody of the sediment samples to the EPA or authorized representative.

Table 1: EPA Chemistry Only Split Sample Locations

Station ID	Location Priority	Proposed Analysis
8-C4	Primary	TAL Metals
Ref-4	Primary	TAL Metals
Ref-8	Primary	TAL Metals
6-R3	Reserve for 6-B3	TAL Metals
6B-C2	Primary	TAL Metals
7-B5	Primary	TAL Metals
5-B2	Primary	TAL Metals
5-B5	Primary	TAL Metals
5-B6	Primary	TAL Metals
5B-C3	Primary	TAL Metals
5-C3	Primary	TAL Metals
4-B3	Primary	TAL Metals
4-C6	Primary	TAL Metals
3-B3	Primary	TAL Metals
3-C4	Primary	TAL Metals
Trib-3	Primary	TAL Metals
2-B2	Primary	TAL Metals
1B-R2	Reserve for 1-B2	TAL Metals
1-R5	Reserve for 1-C1	TAL Metals
1-R8	Reserve for 1-C3	TAL Metals

References

CH2M Hill, 2013, Quality Assurance Project Plan, Upper, Columbia River, Phase 2 Sediment Study, Split Samples Metal Analysis. September 2013

TAI, 2013. Final Quality Assurance Project Plan for the Phase 2 Sediment Study. Prepared by Exponent and HDR HydroQual for Teck American Incorporated, Spokane, WA. March 2013.

Change Request Form
Upper Columbia River Phase 2 Sediment Study

Page 1 **of** 1 **Change No. :** 5

CHANGE REQUEST:

Applicable Reference:	Quality Assurance Project Plan for the Phase 2 Sediment Study
Description of Change:	The following changes will be made to the use of peepers in the sediment bioassays: 1. Peepers will be deployed on Day -1 instead of Day 0. 2. Peepers in the 21-day Hyalella test will all be deployed at Day -1, retieving a group from one set of beakers on Day 7 and another at approximately Day 21. Peepers will be examined during retrieval for indication of fouling of the membranes.
Reason for Change:	1. Early deployment will enable insertion of the peepers into the beakers as they are being filled with sediment, making deployment much more efficient. 2. The QAPP requires (Figure B4-1) deployment of the second set on Day 14, but this would necessarily disturbed any oxygen gradient that was setting up in the sediment. Deploying all peepers during test set up will eliminate this problem.
Impact on Present and Completed Work:	The data on porewater metals will be more accurate as a result of these changes in peeper deployment times.

Requested By: [signature] (Scientist) Date: 1/14/14

Acknowledged By: [signature] Jeffrey Colsifas (PER) Date: 1/14/2014

APPROVAL

Task Manager: afairbrother@exponent.com Digitally signed by afairbrother@exponent.com DN: cn=afairbrother@exponent.com Date: 2014.01.14 13:57:44 -07'00' Date:

Anne Fairbrother (Exponent)

TAI Project Manager: [signature] Kris McCaig (TAI) Date: 1/17/2014

EPA Project Manager: [signature] Laura Buelow (EPA) Date: 1/21/14

Change Request Form
Upper Columbia River Phase 2 Sediment Study

Page 1 **of** 1 **Change No. :** 6

CHANGE REQUEST:

Applicable Reference:	Quality Assurance Project Plan for the Phase 2 Sediment Study
Description of Change:	The SOPs for Hyalella and Chironomid bioassays will all be amended to state that *all organisms will be placed in a drying oven at 60 °C for 24 hours*, after which they will be weighed and their dry weight recorded. The Hyalella SOP currently calls for drying at 100 °C for 24 hours The Chironomid SOP currently calls for drying at 105 °C for 48 hours
Reason for Change:	This will standardize the test protocols between the two organisms and ensure that PER and the Army Corps ERDC laboratory are using the same temperature and time in the drying oven. The ERDC protocols already call for drying the organisms at 60 °C for 24 hours.
Impact on Present and Completed Work:	There should be no impact on the results as the organisms will be completely dry after 24 hours at any of these temperatures. The ASTM and EPA protocols simply state that the organisms should be dried at temperatures between 60 and 90 °C until they reach a constant weight; that time generally is significanly less than 24 hours.

Requested By: [signature] (Scientist) Date: 1/24/14

Acknowledged By: Jeffrey Cotsifas (PER) Date: 1/24/14

APPROVAL

Task Manager: Anne Fairbrother (Exponent) Date: 1/24/14

TAI Project Manager: Kris McCaig (TAI) Date: 1/24/14.

EPA Project Manager: Laura Buelow (EPA) Date: 1/27/14

Change Request Form Upper Columbia River Phase 2 Sediment Study	
Page 1 of 1	Change No. : 7 KM
CHANGE REQUEST:	
Applicable Reference:	Quality Assurance Project Plan for the Phase 2 Sediment Study
Description of Change:	The initiation of Batch 2 will be delayed by 1 week. This will necessarily push the initiation of Batch 3 back by 1 week as well. The revised schedule is attached and incorporated as part of this Change Request.
Reason for Change:	Pacific Ecorisk did not hatch out sufficient numbers of Chironomus to start the bioassay on the date planned, with 4-day-old organisms. Because of the necessity for sending samples to ALS for chemical analyses on certain days of the week, the test initiation day is constrained such that the simplist course of action is to just delay by 1 week.
Impact on Present and Completed Work:	There should be no impact on the results the tests will proceed as planned, just a week later. Site visits for oversight of the testing will need to be revised accordingly.

Requested By: [signature] (Scientist) Date: 2/18/15

Acknowledged By: [signature] Jeffrey Cotsifas (PER) Date: 2/18/15

APPROVAL

Task Manager: Anne Fairbrother Anne Fairbrother (Exponent) Date: 2/18/15

TAI Task Manager: [signature] Dave Enos (TAI) Date: 2/19/15

TAI Project Manager: Kris McCaig Kris McCaig (TAI) Date: 2/19/15

EPA Project Manager: [signature] Laura Buelow (EPA) Date: 2/27/15

APPENDIX E

BIOASSAY LABORATORY DATA REPORT

PACIFIC ECORISK | ENVIRONMENTAL CONSULTING & TESTING

Ms. Kris McCaig
Teck American, Incorporated
501 North Riverpoint Blvd, Suite 300
Spokane, WA 99202

March 28, 2017

Dear Ms. McCaig:

I have enclosed our revised draft report "An Evaluation of the Toxicity of Upper Columbia River Site Sediments to the Larval Insect *Chironomus dilutus* and the Amphipod *Hyalella azteca*" describing the toxicity testing of the 69 sediment samples that were collected on September 5 through October 24, 2013.

If you have any questions regarding these tests or this report, please give me a call at (707) 207-7761.

Sincerely,

Jeffrey Cotsifas
President

2250 Cordelia Road, Fairfield, CA 94534 *phone*: 707.207.7760 *fax*: 707.207.7916 *www.pacificecorisk.com*

An Evaluation of the Toxicity of Upper Columbia River Site Sediments to the Larval Insect *Chironomus dilutus* and the Amphipod *Hyalella azteca*

Samples collected September 5 through October 24, 2013

Prepared for

Teck American, Incorporated
501 North Riverpoint Blvd, Suite 300
Spokane, WA 99202

Prepared by

Pacific EcoRisk
2250 Cordelia Rd.
Fairfield, CA 94534

March 2017

PACIFIC ECORISK
ENVIRONMENTAL CONSULTING & TESTING

An Evaluation of the Toxicity of Upper Columbia River Site Sediments to the Larval Insect *Chironomus dilutus* and the Amphipod *Hyalella azteca*

Samples collected September 5 - October 24, 2013

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List of Acronyms

ALS	ALS Global
ASTM	American Society for Testing and Materials
AVS	Acid volatile sulfide
cm	centimeter
DO	Dissolved oxygen
EC	Effect Concentration
EDD	Electronic Data Deliverable
EPA	Environmental Protection Agency
ERDC	Engineer Research and Development Center
g/L	grams per liter
LC	Lethality Concentration
LDPE	Low-density polyethylene
mg/L	milligram per liter
mL	milliliter
PER	Pacific EcoRisk
QA/QC	Quality assurance and quality control
QAPP	Quality Assurance Project Plan
R/O	Reproduction/oviposition
RI/FS	Remedial Investigation and Feasibility Study
SAM-5S	Standard Artificial Medium
SD	Standard deviation
SEM	Simultaneously extracted metals
SOP	Standard Operating Procedure
TAC	Test acceptability criteria
TAI	Teck American, Incorporated
UCR	Upper Columbia River
URS	URS Corporation
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
wt	weight
YCT	Yeast-Cerophyll®-Trout
μm	micrometer

1. INTRODUCTION

Exponent, Inc. (Exponent) has contracted Pacific EcoRisk (PER) to perform evaluations of the toxicity of 69 ambient sediment samples collected from the Upper Columbia River (UCR). This testing was performed in support of the Remedial Investigation and Feasibility Study (RI/FS) of the UCR being performed by Teck American, Incorporated (TAI). These evaluations consisted of performing the following sediment toxicity tests:

- 10-day whole-sediment toxicity tests with the larval insect, *Chironomus dilutus* (test endpoints: survival, weight, and biomass [USEPA 2000; ASTM 2012]);
- Life-cycle (50- to 65-day) whole-sediment toxicity tests with *C. dilutus* (test endpoints: survival, weight, biomass, emergence, eggs/egg case, and egg hatchability) [USEPA 2000; ASTM 2012]);
- 28-day whole-sediment toxicity tests with the amphipod, *Hyalella azteca* (test endpoints: survival, weight, and biomass [USEPA 2000; ASTM 2012]); and
- 42-day whole-sediment toxicity tests with *H. azteca* (test endpoints: survival, weight, biomass, and neonates/surviving female [USEPA 2000; ASTM 2012]).

Due to the large number of sediment samples, this testing was split into multiple testing events, or batches, as per the Quality Assurance Project Plan (QAPP) (Exponent et al. 2013).

Two rounds of testing were performed:

- The first round of testing, which consisted of the 10-day *C. dilutus* and 28-day *H. azteca* toxicity tests, was initiated in January 2014, and was performed on all 69 samples, with the testing split into six test batches.
- The second round of testing, which consisted of the life-cycle *C. dilutus* and 42-day *H. azteca* toxicity tests, was initiated in February, 2015, and was performed on 27 samples, with the testing split into three test batches.

In order to assess the sensitivity of the test organisms to toxic stress, reference toxicant testing was also performed on each batch of organisms used in the testing.

This report describes the performance and results of these tests, and was prepared as a companion document to the Electronic Data Deliverable (EDD) to both provide the data needed to validate the EDD data, as well as provide an overview of the testing as it relates to compliance with the UCR QAPP (Exponent et al 2013).

2. MATERIALS AND METHODS

The methods used in conducting these tests followed:

- USEPA. 2000. US EPA guidelines, "Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates, Second Edition" (EPA/600/R-99/064);
- ASTM. 2012. Standard Test Method for Measuring the Toxicity of Sediment Associated Contaminant with Freshwater Invertebrates (ASTM 1706 05);
- Exponent et al. 2013. Upper Columbia River: Final Quality Assurance Project Plan for the Phase 2 Sediment Study;
- UCR QAPP Change Order Requests #3, #4, #5, #6, and #7 (Appendix A); and
- Brambaugh, Bill. 2014. USGS CERC Peeper Method for *In Situ* Sampling of Sediment Porewater. Revised January 8, 2014.

Photo documentation of various aspects of the study is provided in Appendix B.

2.1 Receipt and Handling of the Sediment Samples

Sediment samples used in this testing were collected from the UCR site on September 5 - October 24, 2013, and were stored unopened and refrigerated at ALS Global (ALS) in Kelso, WA. On December 16, 2013, URS Corporation (URS) staff transported 70 samples, using a refrigerated truck, to the PER laboratory facility in Fairfield, CA, where they were received on December 18. At the client's request, PER shipped sample SE-2B-R1 back to ALS on December 19, 2013 via overnight delivery; the replacement SE-2-R1 sample was received at the PER lab that same day. Due to an insufficient sediment volume provided for sample SE-3-R8 to accomplish the testing program, additional sediment volume for sample SE-3-R8 was shipped from ALS and received at PER on January 7, 2014; this supplemental sediment volume was composited with the initial sediment that had been received on December 18. Based on insufficient sediment volume and as per client instruction, sample SE-REF-9 was removed from the testing program. In addition to the site samples, U.S. Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC) staff provided a sample of their Control sediment (designated "ERDC Control") to PER for use in the short-term testing program; the ERDC Control sediment was received on January 14, 2014. The chain-of-custody records for the collection and delivery of these samples and sample log-in records are provided in Appendix C.

On December 18, 2014, additional sediment volume was shipped for select samples for use in the long-term testing program; these supplemental sediment samples were composited with the corresponding initial sediment samples that had been received in December 2013 and January 2014. The chain-of-custody records for the collection and delivery of these supplemental samples and sample log-in records are provided in Appendix D.

Upon receipt, the sediment samples were logged-in and were stored, with limited access, in a locked refrigerated room in the dark at 4±2°C, except when being used to prepare the sediment test replicates prior to testing. A record of sample IDs, sample collection dates, sample receipt dates, and test initiation dates is provided in Tables 2-1(a-b) below.

Table 2-1a. Sediment collection, receipt, and test initiation dates of UCR sediment samples: Short-term testing.

Batch	Sample ID	Date of Sample Collection	Date of Sample Receipt	Date of *C. dilutus* 10-day and *H. azteca* 28-day Test Initiations
1	SE-1-R1	10/21/13	12/18/13	1/22/14
	SE-3-R2	10/14/13	12/18/13	1/22/14[A]
	SE-4-B6	10/8/13	12/18/13	1/22/14
	SE-5-B1	9/28/13	12/18/13	1/22/14
	SE-6-B6	9/24/13	12/18/13	1/22/14
	SE-6-R3	9/25/13	12/18/13	1/22/14
	SE-8-B3	9/19/13	12/18/13	1/22/14
	SE-8-B4	9/19/13	12/18/13	1/22/14
	SE-G-1	9/5/13	12/18/13	1/22/14
	SE-REF-6	9/14/13	12/18/13	1/22/14
	SE-TRIB-4	10/9/13	12/18/13	1/22/14
2	SE-2-R1	10/23/13	12/19/13	1/23/14 [A]
	SE-4-B2	10/5/13	12/18/13	1/23/14
	SE-4-B4	10/5/13	12/18/13	1/23/14
	SE-5-B3	9/30/13	12/18/13	1/23/14
	SE-6-B5	9/24/13	12/18/13	1/23/14
	SE-LAL-1	9/8/13	12/18/13	1/23/14
	SE-LAL-2	9/8/13	12/18/13	1/23/14
	SE-LAL-3	9/8/13	12/18/13	1/23/14
	SE-LAL-6	9/7/13	12/18/13	1/23/14
	SE-REF-4	9/30/13	12/18/13	1/23/14
	SE-REF-8	9/16/13	12/18/13	1/23/14
3	SE-2-R3	10/18/13	12/18/13	1/24/14 [A]
	SE-3-R1	10/17/13	12/18/13	1/24/14
	SE-3-R8	10/24/13	12/18/13 and 1/7/14[B]	1/24/14
	SE-5-B4	9/27/13	12/18/13	1/24/14
	SE-6-B4	9/26/13	12/18/13	1/24/14
	SE-7-B2	9/13/13	12/18/13	1/24/14
	SE-LAL-4	9/7/13	12/18/13	1/24/14
	SE-REF-1	10/4/13	12/18/13	1/24/14
	SE-REF-10b	9/18/13	12/18/13	1/24/14
	SE-REF-3	10/1/13	12/18/13	1/24/14
	SE-REF-7	9/13/13	12/18/13	1/24/14
	SE-TRIB-3	10/1/13	12/18/13	1/24/14

Table 2-1a *(continued)*. Sediment collection, receipt, and test initiation dates of UCR sediment samples: Short-term testing.

Batch	Sample ID	Date of Sample Collection	Date of Sample Receipt	Date of *C. dilutus* 10-day and *H. azteca* 28-day Test Initiations
4	SE-1-B5	10/18/13	12/18/13	1/29/14 [A]
	SE-2-B1	10/23/13	12/18/13	1/29/14 [A]
	SE-3-B3	10/16/13	12/18/13	1/29/14 [A]
	SE-3-R7	10/15/13	12/18/13	1/29/14
	SE-5-B5	9/27/13	12/18/13	1/29/14
	SE-5-B6	9/27/13	12/18/13	1/29/14
	SE-7-B3	9/13/13	12/18/13	1/29/14
	SE-7-B6	9/13/13	12/18/13	1/29/14
	SE-G-4	9/6/13	12/18/13	1/29/14
	SE-REF-2	10/1/13	12/18/13	1/29/14
	SE-TRIB-2	10/7/13	12/18/13	1/29/14
	SE-TRIB-5	10/9/13	12/18/13	1/29/14
5	SE-2-B2	10/23/13	12/18/13	1/30/14[A] and 3/27/14[A,C]
	SE-3-R9	10/24/13	12/18/13	1/30/14 and 3/27/14[C]
	SE-4-B1	10/7/13	12/18/13	1/30/14 and 3/27/14[C]
	SE-5-B2	9/28/13	12/18/13	1/30/14 and 3/27/14[C]
	SE-6-B1	9/25/13	12/18/13	1/30/14 and 3/27/14[C]
	SE-7-B4	9/13/13	12/18/13	1/30/14 and 3/27/14[C]
	SE-7-B5	9/13/13	12/18/13	1/30/14 and 3/27/14[C]
	SE-8-B1	9/20/13	12/18/13	1/30/14 and 3/27/14[C]
	SE-G-2	9/5/13	12/18/13	1/30/14 and 3/27/14[C]
	SE-LAL-5	9/7/13	12/18/13	1/30/14 and 3/27/14[C]
	SE-REF-5	9/27/13	12/18/13	1/30/14 and 3/27/14[C]
	SE-TRIB-1	9/26/13	12/18/13	1/30/14 and 3/27/14[C]
6	SE-1B-R2	10/22/13	12/18/13	1/31/14
	SE-1-R2	10/21/13	12/18/13	1/31/14
	SE-4-B3	10/5/13	12/18/13	1/31/14
	SE-4-B5	10/5/13	12/18/13	1/31/14
	SE-6-B2	9/25/13	12/18/13	1/31/14
	SE-7-B1	9/13/13	12/18/13	1/31/14
	SE-8-B2	9/19/13	12/18/13	1/31/14
	SE-8-B5	9/20/13	12/18/13	1/31/14
	SE-8-B6	9/20/13	12/18/13	1/31/14
	SE-G-3	9/6/13	12/18/13	1/31/14
	SE-TRIB-6	10/10/13	12/18/13	1/31/14

A – Small aquatic snails were observed during sediment processing; as per client instruction, visible snails were removed by hand, euthanized, and discarded.

B – Supplemental sediment volume needed to complete the testing program and was received on 1/7/14.

C – The *H. azteca* and *C. dilutus* short-term tests were initiated on 1/30/14. As the Batch 5 *H. azteca* test Laboratory Control Sediment did not meet Test Acceptability Criteria, the Batch 5 samples were retested on 3/27/14.

Table 2-1b. Sediment collection, receipt, and test initiation dates of UCR sediment samples: Long-term testing.				
Batch	Sample ID	Date of Sample Collection	Date of Sample Receipt	Date of *C. dilutus* life-cycle and *H. azteca* 42-day Test Initiations
1	SE-1-B5	10/18/13	12/18/13	2/13/15
	SE-1B-R2	10/22/13	12/18/13	2/13/15
	SE-1-R2	10/21/13	12/18/13	2/13/15
	SE-4-B6	10/8/2013	12/18/13 and 12/19/14	2/13/15
	SE-6-B2	9/25/13	12/18/13	2/13/15
	SE-7-B5	9/13/13	12/18/13	2/13/15
	SE-8-B3	9/19/13	12/18/13 and 12/19/14	2/13/15
	SE-G-1	9/5/13	12/18/13 and 12/19/14	2/13/15
	SE-G-3	9/6/13	12/18/13 and 12/19/14	2/13/15
	SE-LAL-3	9/8/13	12/18/13 and 12/19/14	2/13/15
	SE-LAL-5	9/7/13	12/18/13 and 12/19/14	2/13/15
	SE-REF-10b	9/18/13	12/18/13 and 12/19/14	2/13/15
	SE-TRIB-3	10/1/13	12/18/13 and 12/19/14	2/13/15
2	SE-2-B1	10/23/13	12/18/13	2/25/15
	SE-2-R1	10/23/13	12/18/13 and 12/19/14	2/25/15
	SE-3-R7	10/15/13	12/18/13	2/25/15
	SE-4-B1	10/7/13	12/18/13	2/25/15
	SE-5-B2	9/28/13	12/18/13	2/25/15
	SE-8-B2	9/19/13	12/18/13	2/25/15
	SE-LAL-2	9/8/13	12/18/13 and 12/19/14	2/25/15
	SE-G-1	9/5/13	12/18/13 and 12/19/14	2/25/15
	SE-G-3	9/6/13	12/18/13 and 12/19/14	2/25/15
	SE-LAL-3	9/8/13	12/18/13 and 12/19/14	2/25/15
	SE-LAL-5	9/7/13	12/18/13 and 12/19/14	2/25/15
	SE-REF-10b	9/18/13	12/18/13 and 12/19/14	2/25/15
	SE-TRIB-3	10/1/13	12/18/13 and 12/19/14	2/25/15
3	SE-3-B3	10/16/13	12/18/13 and 12/19/14	3/5/15
	SE-3-R8	10/24/13	12/18/13	3/5/15
	SE-4-B5	10/5/13	12/18/13	3/5/15
	SE-5-B4	9/27/13	12/18/13	3/5/15
	SE-6-B5	9/24/13	12/18/13 and 12/19/14	3/5/15
	SE-7-B2	9/13/13	12/18/13	3/5/15
	SE-G-2	9/5/13	12/18/13	3/5/15
	SE-G-1	9/5/13	12/18/13 and 12/19/14	3/5/15
	SE-G-3	9/6/13	12/18/13 and 12/19/14	3/5/15
	SE-LAL-3	9/8/13	12/18/13 and 12/19/14	3/5/15
	SE-LAL-5	9/7/13	12/18/13 and 12/19/14	3/5/15
	SE-REF-10b	9/18/13	12/18/13 and 12/19/14	3/5/15
	SE-TRIB-3	10/1/13	12/18/13 and 12/19/14	3/5/15

2.2 Sediment Processing

Immediately prior to the preparation of each set of test replicates (i.e., immediately prior to the initiation of each batch of short- and long-term sediment tests), the sediments for each test batch were removed from refrigerated storage, and each sample was re-homogenized as per the UCR sediment homogenization Standard Operating Procedure (SOP-10 [Exponent et al. 2013] and Change Order #3 [Appendix A]). Any observed sticks, rocks, or debris were removed from the samples. It should be noted that small aquatic snails were observed in samples SE-3-R2, SE-2-R1, SE-2-R3, SE-1-B5, SE-2-B1, SE-3-B3, and SE-2-B2. As per client instruction, all visible snails were manually removed, euthanized, and discarded.

Immediately following sediment re-homogenization, sub-samples of the sediments were centrifuged at 4300 g for 30 minutes, and the resulting supernatant porewaters were carefully collected and placed into pre-cleaned and preserved sample containers provided by the analytical laboratory (ALS Global, Kelso, WA). These sediment porewater samples were submitted for chemical analysis as per the UCR QAPP (Exponent et al 2013). It should be noted that porewater could not be generated for the following samples for the short-term tests due to the samples consisting primarily of sand: SE-G-1, SE-4-B1, SE-4-B5; porewater could not be obtained from the following samples for the long-term tests due to the samples consisting primarily of sand: SE-TRIB-3, SE-4-B1, and SE-4-B5.

Prior to initiation of the long-term tests, a sub-sample of each homogenized sediment from each test batch was collected into sample containers supplied by ALS, and submitted to ALS for chemical analysis as per the UCR QAPP (Exponent et al 2013); sediment samples collected for acid volatile sulfide and simultaneously extracted metals (AVS and SEM) analysis were stored with nitrogen headspace and frozen. As per guidance from ALS, any AVS and SEM sample containers that broke during freezing were double-bagged under nitrogen and then placed inside another larger jar with nitrogen headspace prior to shipment. The following site samples: SE-1-B5-T0-B1, SE-1B-R2-T0-B1, SE-6-B2-T0-B1, SE-7-B5-T0-B1, and SE-8-B3-T0-B1 had containers that broke during freezing.

The remaining sediment was used to prepare the test replicates and ancillary supporting replicates (i.e., the peeper replicates); any remaining sediment was placed back into cold storage. All reusable sediment processing equipment (e.g., lexan tubs, spoons, stainless steel mixers, etc.) was decontaminated before each use; decontamination was performed following the procedures outlined in UCR SOP-4 (Exponent et al. 2013).

After the processing of an entire batch of sediment samples and after the last equipment decontamination was performed, equipment rinsate blanks for the lexan tub, homogenization paddle, and sediment scoop were collected into sample containers supplied by ALS and submitted to ALS for analysis as per the UCR QAPP (Exponent et al. 2013). The long-term testing sediment re-homogenization also included a centrifugation bottle blank.

2.3 *In Situ* Sampling of Toxicity Test Sediment Porewater Using Peepers and Collection of Test Sediment for AVS and SEM

2.3.1 Deployment and Collection of Porewater via Peepers

Peepers were utilized to sample sediment porewater from within the sediments within the test replicates for analysis of dissolved metals, as per the UCR QAPP (Exponent et al. 2013). Peeper construction, deployment, and retrieval followed methods presented in the UCR QAPP and UCR SOP-9 (Exponent et al. 2013), and updated guidance provided by U.S. Geological Survey (USGS) staff (Brambaugh 2014). A detailed description of peeper preparation, deployment, retrieval, and processing prior to shipment of peeper porewater to ALS is presented in Appendix E.

For each sediment, additional peeper replicates, identical to the test replicates, were established for peeper deployment and retrieval. For each test, enough peeper replicates were established to cover the desired number of monitoring intervals (e.g., $T_{Day\ 7}$, $T_{Day\ 21}$, etc.), with three peeper replicates being established for each interval; the number of additional treatment replicates established was dependent on test duration. At the time of test replicate set-up (the day prior to test initiation [Change Order #5 in Appendix A]), peepers were inserted into the peeper replicate sediments so that the top edge was between 0.5 and 1 cm below the sediment surface. Peeper retrieval was performed for each test on the schedules presented below in Tables 2-2 and 2-3. Peeper processing logs are presented in Appendices F and G, respectively.

2.3.2 Collection of Sediment for AVS and SEM

At the time of peeper retrieval, samples of the remaining sediment from the peeper replicates were collected for AVS and SEM analyses, as follows:

- at T_7 for the *C. dilutus* short-term (10-day) tests;
- at T_{21} and T_{42} for the *C. dilutus* long-term (life-cycle) tests;
- at T_{21} for the *H. azteca* short-term (28-day) tests; and
- at T_{21} for the *H. azteca* long-term (42-day) tests.

For each of these replicates, the overlying water was poured off and the sediments from the three peeper replicates were collected and composited into a single sample container and stored as described in Section 2.2.

Table 2-2. Peeper deployment, retrieval and AVS and SEM collection dates of UCR sediment samples: Short-term testing.					
Test Species	Batch	Number of Additional Peeper Replicates Established[A]	Date of Peeper Deployment (T_{-1})	Date of Peeper Retrieval and AVS and SEM Sample Collections (T_7)[B]	Date of Peeper Retrieval and AVS and SEM Sample Collections (T_{21})
10-day *C. dilutus*	1	3	1/21/14	1/29/14	n/a
	2	3	1/22/14	1/30/14	n/a
	3	3	1/23/14	1/31/14	n/a
	4	3	1/28/14	2/5/14	n/a
	5	3	1/29/14	2/6/14	n/a
	6	3	1/30/14	2/7/14	n/a
28-day *H. azteca*	1	6	1/21/14	1/29/14 [B]	2/12/14
	2	6	1/22/14	1/30/14 [B]	2/13/14
	3	6	1/23/14	1/31/14 [B]	2/14/14
	4	6	1/28/14	2/5/14 [B]	2/19/14
	5	6	1/29/14	2/6/14 [B]	2/20/14
	5RE	6	3/26/14	4/3/15 [B]	4/17/14
	6	6	1/30/14	2/7/14 [B]	2/21/14

A - Three replicates were included for each retrieval period.
B - AVS and SEM samples were not collected for *H. azteca* tests at T_7.

Table 2-3. Peeper deployment, retrieval and AVS and SEM collection dates of UCR sediment samples: Long-term testing.						
Test	Batch	Number of Additional Peeper Replicates Established[A]	Date of Peeper Deployment (T_{-1})	Date of Peeper Retrieval (T_7)	Date of Peeper Retrieval and AVS and SEM Sample Collections (T_{21})	Date of Peeper Retrieval and AVS and SEM Sample Collections (T_{42})[B]
Life-cycle *C. dilutus*	1	9	2/12/15	2/20/15	3/6/15	3/27/15
	2	9	2/24/15	3/4/15	3/18/15	4/8/15
	3	9	3/4/15	3/12/15	3/26/15	4/16/15
42-day *H. azteca*	1	6	2/12/15	2/20/15	3/6/15	-
	2	6	2/24/15	3/4/15	3/18/15	-
	3	6	3/4/15	3/12/15	3/26/15	-

A - Three replicates were included for each retrieval period.
B - For *C. dilutus* tests that terminated earlier than the nominal 42-day test duration, peeper retrieval was performed on the day of test termination.

The following short-term testing AVS and SEM site samples had containers that broke during freezing: SE-6-B5-HA28-T21, SE-3-R2-HA28-T21, SE-8-B4-HA28-T21, SE-LAL-5-CD10-T7 and SE-TRIB-6-CD10-T7.

The following long-term testing AVS and SEM site samples had containers that broke during freezing:

SE-1B-R2-HA42-T21-B1,
SE-1-R2-HA42-T21-B1,
SE-1-B5-HA42-T21-B1,
SE-7-B5-HA42-T21-B1,
SE-4-B6-HA42-T21-B1,
SE-1-R2-CD50-T42-B1,
SE-8-B3-CD50-T42-B1,
SE-LAL-5-CD50-T42-B1,
SE-LAL-5-CD50-T21-B1,
SE-G-1-CD50-T21-B1,
SE-8-B3-CD50-T21-B1,
SE-1B-R2-CD50-T21-B1,
SE-4-B6-CD50-T21-B1,
SE-7-B5-CD50-T42-B1,
SE-7-B5-CD50-T21-B1,
SE-LAL-5-CD50-T21-B2,
SE-LAL-5-CD50-T42-B2,
SE-CTL-QS-CD50-T21-B2,
SE-LAL-5-CD50-T21-B3,
SE-7-B2-CD50-T42-B3.

2.4 Sediment Testing

Due to the large number of sediment samples, the short-term and long-term testing were both split into multiple testing events or batches (Tables 2-1[a-b]), as per the QAPP (Exponent et al. 2013). The specific procedures used in these tests are described below.

2.4.1 Sediment Toxicity Testing with *Chironomus dilutus*

As stated above, two different sediment toxicity tests were performed using *C. dilutus*:

- short-term (10-day) whole-sediment toxicity tests with test endpoints of survival, weight, and biomass; and
- long-term (Life-cycle [50- to 65-day]) whole-sediment toxicity tests with test endpoints of survival, weight, biomass, emergence, eggs/egg case, and egg hatchability.

Detailed descriptions of each test method are provided below.

2.4.1.1 Test Organisms - *C. dilutus* egg cases were obtained from a commercial supplier (Environmental Consulting & Testing, Superior, WI) and the eggs and subsequent *C. dilutus* larvae were cultured in the PER lab for use in testing. These organisms were maintained in reformulated EPA synthetic moderately hard reconstituted water at 23˚C, and larvae were fed ground Tetramin® flake fish food, as per EPA guidelines. Immediately prior to the start of a given 'batch' of tests, healthy second-to-third-instar larvae were collected for use in the 10-day toxicity tests. The larvae used to start the Batch 1 tests were 9-10 days old; test organisms for Batches 2 and 4 were 8-9 days old; test organisms for Batches 3, 5, and 6 were 8 days old. As per Change Request #3 (Appendix A), 4-day old larvae were used to initiate the life-cycle tests.

2.4.1.2 Test Water Medium - The overlying water for the *C. dilutus* testing consisted of reformulated EPA synthetic moderately-hard water. This same water was also used in the reproduction/oviposition (R/O) chambers, described below.

2.4.1.3 Negative Lab Control Sediment Medium - The parent material for the Negative Lab Control medium was washed sediment collected from a reference site in SF Bay (this parent material is used to create a freshwater sediment by numerous washings in freshwater, followed by continuous culture under that same freshwater at the PER Lab for a minimum of at least one month prior to usage). This material was selected for this use as it has been documented to be free of contamination, and through performance evaluations, has demonstrated acceptable biological responses by the test organisms.

Chemical characterization of the Negative Lab Control sediment is provided in Appendix H.

2.4.1.4 Auxiliary Control Sediment Mediums - In addition to the Negative Lab Control sediment, two additional control sediment media were utilized:

- Quartz sand (purchased from New England Quartz, Inc., South Windsor, CT) was used to identify the possibility of physical effects of sediment on the test organisms; the Quartz characteristics are provided in Appendix H.
- The ERDC control sediment was used as an inter-laboratory comparison for the short-term test data; this control sediment was not used in the long-term testing program.

2.4.1.5 Short-Term (10-day) Sediment Toxicity Testing with *Chironomus dilutus* – This test consisted of exposing second-to-third instar *C. dilutus* larvae to the sediment for 10 days, after which effects on survival and growth were evaluated.

The site sediments, auxiliary Controls (Quartz sand and ERDC), and Negative Lab Control sediment were each tested at the 100% concentration only. Approximately 24 hrs prior to test initiation (T_{-1}), each of the sediment samples was re-homogenized and sub-samples collected for sediment and sediment porewater characterization (described in Section 2.2, above), after which the test replicates were prepared. A total of eight test replicates and three peeper replicates were established for each test treatment (i.e., each sediment). Each replicate container consisted of a 300-mL tall-form glass beaker with a 3-cm ribbon of 425-μm mesh NITEX® attached to the top of the beaker with silicone sealant. Approximately 100-mL of homogenized sediment was placed into each test replicate. The site sediments, Negative Lab Control sediment, and auxiliary Control sediments (Quartz sand and ERDC sediment) were each tested at the 100% concentration only. Each test replicate was then carefully filled with 175 mL of overlying water. The replicates, now containing sediments and clean overlying water, were maintained in a temperature-controlled room at 23°C under cool-white fluorescent lighting at ~500 lux on a 16:8 L:D photoperiod.

After this initial ~24 hr period, the overlying water in each replicate was flushed with approximately 200 mL of fresh overlying water using a calibrated Zumwalt water delivery system (see Section 5.1.1 and Change Order #3 [Appendix A]). Approximately 25 mL of the renewed overlying water was then collected from each of the test replicates and composited for measurement of initial water quality characteristics (pH, dissolved oxygen [DO], conductivity, alkalinity, hardness, and total ammonia); 25 mL of overlying water was then added back to each replicate prior to test initiation. The tests were then initiated with the random allocation of ten 2^{nd}-3^{rd} instar *C. dilutus*, still within their individual cases, into each replicate, followed by the addition of 1.0 mL of the ground Tetramin® flake fish food slurry, so as to provide 6.0 mg of dry solids. The test replicates were then returned to the temperature-controlled rooms; the position of all test replicate beakers relative to the other replicates were randomized throughout the test according to the short-term chironomid test randomization chart.

At the time of test initiation, eight replicates of 10 randomly-selected organisms were collected, dried, and weighed to determine the mean ash-free dry weight of the test organisms at test initiation (T_0).

Daily Test Maintenance – At the beginning of each day, for the following nine days, each test replicate was examined for the presence of any dead *C. dilutus* or the presence of pupal exuvia (which, if observed, were documented on the data sheets and then removed), after which 5 mL of the overlying water in each of the eight test replicates (per treatment) was collected and composited as before for measurement of old DO. Each replicate was then flushed with approximately 200 mL of fresh overlying water. Another 5 mL aliquot of the overlying water in each of the eight replicates was then collected and composited as before for measurement of new DO; 5 mL of overlying water was then added to each replicate, after which each replicate was fed 1.0 mL of the ground Tetramin® flake fish food slurry.

Each evening, each replicate was again flushed with approximately 200 mL of fresh overlying water. As a precautionary measure, and in order to catch any drops in DO that might be of concern, a P.M. DO check was performed for each treatment immediately prior to the overlying water renewal.

For any test treatment for which a test replicate overlying water DO level had decreased below 2.5 mg/L, all replicates for that treatment were aerated for the remaining duration of the testing, as per EPA guidance, and the date of aeration implementation was recorded.

Test Termination - After 10 days exposure, each replicate was again examined for the presence of any dead *C. dilutus* or the presence of pupal exuvia (which, if observed, were documented on the data sheets and then removed). A 25 mL aliquot of overlying water was collected from each of the eight test replicates at each treatment and composited for analysis of the test treatment final water quality characteristics. The surficial sediment from each replicate was rinsed into large glass dishes to recover the test organisms; the remaining sediment in each replicate was then sieved to recover any remaining surviving organisms. The numbers of larvae, pupae, and adults (retrieved pupal exuvia were counted as a surviving adult), were determined and recorded onto the test data sheets.

The surviving larval organisms from each replicate were then rinsed with de-ionized water, and transferred to a pre-dried (i.e., pre-ashed) and pre-tared weighing pan. These were then dried at 60°C for >24 hrs (Change Order #6 [Appendix A]), transferred into a desiccator to cool, after which they were re-weighed to determine the mean dry weight per individual organism. Each replicate pan was then placed into a muffle furnace and ashed at 550˚C for 2 hrs, after which the pans were cooled, and then re-weighed to determine the mean ashed weight per individual organism. The mean ash-free dry wt per individual was then calculated as the total final dry weight minus the total ashed weight, divided by the number of organisms in the pan. Biomass was calculated as the total final dry weight minus the total ashed weight, divided by the number of organisms loaded in the test replicate at test initiation minus any pupae or emerged adults, thus providing a combined measure of survival and growth.

2.4.1.6 Long-Term (Life-Cycle) Testing with *Chironomus dilutus* – Larval *C. dilutus* were exposed to the test sediments for 16 days, after which a sub-set of organisms were maintained through completion of one full life-cycle (from 4 days post-hatch through to completion of reproduction by the adult lifestage). Effects on larval survival and growth, as well as adult survival, emergence, and reproduction endpoints were assessed.

The site sediments, auxiliary Control (Quartz sand), and Negative Lab Control sediment were each tested at the 100% concentration only. Approximately 24 hrs prior to test initiation (T_{-1}), each of the sediment samples was re-homogenized and sub-samples collected for sediment and sediment porewater characterization (described in Section 2.2, above), after which the test replicates were prepared. A total of 12 test replicates and nine peeper replicates were established for each test treatment (i.e., each sediment). Each replicate container consisted of a 300-mL tall-form glass beaker with a 3-cm ribbon of 425-μm mesh NITEX® attached to the top of the beaker with silicone sealant. Approximately 100-mL of sediment was placed into each test replicate. The site sediments, Negative Lab Control sediment, and auxiliary Control (Quartz sand) were each tested at the 100% concentration only. Each test replicate was then carefully filled with 175 mL of overlying water. The replicates, now containing sediments and clean overlying water, were maintained in a temperature-controlled room at 23˚C under cool-white fluorescent lighting at ~500 lux on a 16:8 L:D photoperiod; the position of all test replicate beakers relative to the other replicates were randomized throughout the test according to the long-term chironomid test randomization chart.

Test Initiation – After this initial ~24 hr period, the overlying water in each replicate was flushed with approximately 200 mL of the overlying water using a calibrated Zumwalt water delivery system (see Section 5.2.1 and Change Order #3 [Appendix A]). A 25 mL aliquot of water from each test replicate was collected and composited for each test treatment for determination of routine water quality characteristics (e.g., pH, DO, conductivity, alkalinity, hardness, and total ammonia); 25 mL of control water was then added back to each replicate prior to test initiation. Immediately prior to test initiation, each test replicate received 1.0 mL of the ground Tetramin® flake fish food slurry. Each test was then initiated by the allocation of 12 randomly-selected 4-day old *C. dilutus* larvae, still within their individual 'cases', into each replicate.

On Day 7 of the test, an additional four test replicates were similarly established for each treatment to provide auxiliary males for use in evaluating the reproduction endpoints (auxiliary males were used to mate with females at the same test treatment when there were not enough males available from the original test replicates).

Daily Test Maintenance – Each day, a 25 mL sub-sample of test solution was collected from randomly-selected test replicates at each treatment, and the temperature, pH, DO, and conductivity were determined. Any observed mortalities were recorded and dead organisms removed. Each replicate was then flushed with approximately 200 mL of fresh overlying water, after which each replicate was fed 1.0 mL of the ground Tetramin® flake fish food slurry. Each evening, each replicate was again flushed with approximately 200 mL of fresh overlying water. As a precautionary measure, and in order to catch any drops in DO that might be of concern, a P.M. DO check was performed for each treatment immediately prior to the overlying water renewal.

For any test treatment for which a test replicate overlying water DO level had decreased below 2.5 mg/L, all replicates for that treatment were aerated for the remaining duration of the testing, as per EPA guidance, and the date of aeration implementation was recorded on the bench data sheet.

Day 16 Assessment of Larval Survival and Growth – To assess the effects of the test exposures on larval survival and growth, four of the initial 12 test replicates were selected and terminated on Day 16 of the test. A 25 mL water sample was collected from each replicate and composited for each treatment and analyzed for alkalinity, hardness, and ammonia. The surficial sediment from each replicate was rinsed into large glass dishes to recover the test organisms; the remaining sediment in each replicate was then sieved to recover any remaining surviving organisms. The number of larvae, pupae, and adults (pupal exuvia were counted as a surviving adult) were determined and recorded. The surviving larval *C. dilutus* from each replicate were then processed and dry weights and ash-free dry weights determined, as described above in Section 2.4.1.5. As before, the biomass was calculated as the total final dry weight minus the total ashed weight, divided by the number of organisms loaded in the test replicate at test initiation minus any pupae or emerged adults.

Determination of Reproduction Endpoints – On Day 14 of the test, a removable emergence trap was placed atop each test replicate to catch emerged flying adults. Emergence was recorded daily, and was categorized as either partial emergence (when an emerging adult failed to shed the pupal exuviae and died) or complete emergence (complete shedding of the pupal exuviae and escape from the surface tension of the water into the overlying airspace); when an emerging adult shed its pupal exuviae, but did not escape the surface tension of the water, it was recorded as an adult mortality and was not included in the in the % emergence calculation.

Emerged adults were carefully collected and transferred to that replicate's corresponding reproduction/oviposition (R/O) chamber to facilitate the production and isolation of egg cases; when necessary, auxiliary males (from the four additional replicates at that treatment that had been established on Day 7 of the test) were also transferred into the R/O chambers so as to ensure that any females had available males with which to mate. The R/O chambers consisted of wide-mouth 250-mL Erlenmeyer flasks containing ~50 mL of the overlying water medium and a 2 cm x 5 cm piece of 425-μm Nitex® mesh half-in and half-out of the water to facilitate the ability of the emergent adults to oviposit without becoming trapped by the water surface tension. The reproduction chambers were also maintained in the temperature-controlled room at 23±1°C.

Each day, the R/O chambers were checked for the presence of egg cases and/or dead adults. In situations where more than one male or female adult was contained in an R/O chamber, time-to-death was recorded for any observed dead adult, based upon the assumption that the order of occurrence of death (for that sex) corresponded to the order of introduction into the R/O chamber (EPA 2000). Similar assumptions were made for determining a particular female's egg case deposition date.

Female *C. dilutus* are capable of laying multiple egg cases: an initial primary egg case (typically large and banana-shaped) and potential secondary egg cases (which are typically much smaller). Each individual primary egg case was transferred from the R/O chamber to a corresponding plastic petri dish containing ~15 mL of the overlying water to monitor incubation and hatching. If there was more than one gravid female in the R/O chamber, more than one primary egg case may have been present. For each primary egg case that appeared normal (i.e., large and banana-shaped), an estimate of the number of eggs in the egg case was made using the ring method (the number of eggs in five rings from the middle of the egg case was counted, the mean count of the five rings was determined, and this mean was then multiplied by the number of rings in the egg case). When the integrity of the egg cases precluded use of the ring method (i.e., the egg case was convoluted or distorted), the eggs were enumerated using the direct count method (the egg case was placed in about 2-mL of 2 N sulfuric acid and left overnight; after digestion, the eggs were enumerated under a dissecting microscope). By definition, when the direct count method was used, hatchability data could not be determined for that egg case.

After six days of incubation, the number of unhatched eggs was determined for those primary egg cases where the ring method had been used to estimate the number of eggs in the egg case.

Egg cases oviposited by a female for which a male was not present in the oviposition chamber, or egg cases for which no hatching occurred and fertilization could not be verified, were noted in results tables.

Test Termination – Once seven days had passed without any observation of emergence in a given sediment's test replicates, the test of that sediment was terminated. Prior to test termination, a 25 mL aliquot of water from each remaining test replicate was composited for each test treatment; a sub-sample of each composite was used for determination of routine water quality characteristics (e.g., pH, DO, and conductivity, alkalinity, hardness, and ammonia). Then, each remaining replicate was terminated with the contents being poured into glass trays to recover and enumerate any larvae, pupae, or pupal exuviae.

2.4.1.7 Reference Toxicant Testing of the *Chironomus dilutus* – In order to assess the sensitivity of the test organisms to toxic stress, reference toxicant tests were performed for each batch of tests. The reference toxicant tests consisted of a 96-hr exposure to test water medium spiked with NaCl at concentrations of 0, 1.25, 2.5, 5, 10, and 20 g/L. There were 10 replicates at each treatment, each replicate consisting of a 30-mL plastic cup containing a mono-layer of Quartz sand and 20-mL of test solution. The tests were initiated by randomly allocating one 2^{nd}-3^{rd} instar larvae (8-11 days old for the 10-day tests and 9 days old for the life-cycle testing) into each of the replicate chambers, followed by the addition of 0.1 mL of ground Tetramin® flake fish food slurry. The beakers were placed in a temperature-controlled room at 23˚C under a 16:8 L:D photoperiod.

After ~48 hrs of exposure, each replicate was again fed 0.1 mL of ground Tetramin® flake fish food slurry. After 96-hrs (±2 hrs) exposure, the tests were terminated, and the number of surviving organisms in each replicate was determined. The resulting test response data were statistically analyzed to determine key concentration-response point estimates (e.g., EC_{50}); all statistical analyses were made using the CETIS® software (Tidepool Scientific, McKinleyville, CA). These response endpoints were then compared to the typical response range established by the mean ± 2 SD of the point estimates generated by the 20 most recent previous reference toxicant tests performed by this lab. The results of the reference toxicant tests for the short-term and long-term tests are presented in Appendices HH and LL, respectively.

2.4.2 Sediment Toxicity Testing with *Hyalella azteca*

As stated above, two different sediment toxicity tests were performed using *H. azteca*:

- the short-term (28-day) test (with survival and growth as test endpoints); and
- the long-term (42-day) test (with survival, growth, and reproduction as test endpoints).

Detailed descriptions of each test method are provided below.

2.4.2.1 Test Organisms – The *H. azteca* used in these tests were obtained from a commercial supplier (Aquatic BioSystems, Inc., Fort Collins, CO); upon receipt at the lab, the amphipods were held in tanks of Standard Artificial Medium (SAM-5S, a synthetic freshwater prepared as per Borgmann [1996] with the bromine concentration modified to 0.4 mg/L as per the UCR QAPP [Exponent et al. 2013] and Change Order #3 [Appendix A]) at 23˚C, and were fed Yeast-Cerophyll®-Trout Chow (YCT) food amended with powdered *Spirulina* (90 mg of 250-μm sieved powdered *Spirulina* per 100 mL YCT). The *H. azteca* used to start both short-term and long term tests were 8-days old.

2.4.2.2 Test Water Medium - The water used in the *H. azteca* tests consisted of SAM-5S, a synthetic freshwater prepared as per Borgmann (1996) with the bromine concentration modified to 0.4 mg/L as per the UCR QAPP (Exponent et al. 2013) and Change Order #3 (Appendix A).

2.4.2.3 Negative Lab Control Sediment Medium - The Negative Lab Control sediment medium for all *H. azteca* testing consisted of the same blend of ambient sediments used in the *C. dilutus* testing, as described above in Section 2.4.1.3.

2.4.2.4 Auxiliary Control Sediment Mediums - The auxiliary Control sediment mediums for all *H. azteca* testing consisted of the same sediment media used in the *C. dilutus* testing (described above in Section 2.4.1.4).

2.4.2.5 Short-Term (28-Day) Sediment Toxicity Testing with *Hyalella azteca* – This test consists of exposing 8-day old amphipods to the sediment for 28 days, after which effects on survival and growth are evaluated. The specific procedures used in this testing are described below.

The site sediments, auxiliary Controls (Quartz sand and ERDC), and Negative Lab Control sediment were each tested at the 100% concentration only. Approximately 24 hrs prior to test initiation (T_{-1}), each of the sediment samples was re-homogenized and sub-samples collected for sediment and sediment porewater characterization (described in Section 2.2, above), after which the test replicates were prepared. A total of eight test replicates and six peeper replicates were established for each test treatment (i.e., each sediment). Each replicate container consisted of a 300 mL tall-form glass beaker with a 3-cm ribbon of 425-μm mesh NITEX® attached to the top of the beaker with silicone sealant. Approximately 100-mL of sediment was placed into each test replicate. Each of the test replicates was then carefully filled with 175 mL of overlying water. The replicates, now containing sediments and clean overlying water, were maintained in a temperature-controlled room at 23˚C under cool-white fluorescent lighting at ~500 lux on a 16:8 L:D photoperiod; the position of all test replicate beakers relative to the other replicates were randomized throughout the test according to the short-term amphipod test randomization chart.

Test Initiation – After this initial ~24 hr period, the overlying water in each replicate was flushed with approximately 200 mL of the overlying water using a calibrated Zumwalt water delivery system (see Section 5.3.1 and Change Order #3 [Appendix A]). A 25 mL aliquot of the renewed overlying water in each of the eight test replicates per treatment was then collected and composited for measurement of initial water quality characteristics (pH, DO, conductivity, alkalinity, hardness, and total ammonia); 25 mL of overlying water was then added back to each replicate prior to test initiation. The tests were initiated with the random allocation of 10 eight-day old amphipods into each replicate (test organism receipt records are presented in Appendix C), followed by the addition of 1.0 mL of *Spirulina*-amended YCT food. The test replicates were then returned to the temperature-controlled room.

At the time of test initiation, eight replicates of 10 randomly-selected 8-day old organisms were collected, dried, and weighed to determine the mean dry weight of the test organisms at T_0.

Daily Test Maintenance - Each day, for the following 28 days, each replicate was examined and any dead organisms were recorded and removed. A 5 mL aliquot of the overlying water in each of the eight test replicates was then collected and composited as for measurement of old DO (pH was measured three times per week and conductivity was measured once per week), after which each replicate was flushed with approximately 200 mL of fresh water. A 5 mL aliquot of the overlying water in each of the eight test replicates was then collected and composited as before for measurement of new DO; 5 mL of overlying water was then added to each replicate, after which each replicate was fed 1.0 mL of *Spirulina*-amended YCT; on Day 14 of the test, the feeding rate was increased to 2.0 mL of *Spirulina*-amended YCT.

Each evening, each replicate was again flushed with approximately 200 mL of fresh overlying water. As a precautionary measure, and in order to catch any drops in DO that might be of concern, a P.M. DO check was performed for each treatment immediately prior to the overlying water renewal.

Test Termination – These tests were terminated after 28 days exposure. A 25 mL aliquot of overlying water was collected from each test replicate and composited for analysis of the final water quality characteristics. The surficial sediment from each replicate was rinsed into large glass dishes to recover the test organisms; the remaining sediment in each replicate was then sieved to recover any remaining surviving organisms. The surviving organisms were enumerated, euthanized with methanol, rinsed with de-ionized water, and then transferred to a pre-dried and pre-tared weighing pan. These were then dried at 60°C for ≥24 hrs (Change Order #6 [Appendix A]) and re-weighed to determine the mean dry weight per individual organism. Biomass was calculated as the total final dry weight, divided by the number of organisms loaded in the test replicate at test initiation.

2.4.2.6 Long-Term (42-Day) Sediment Toxicity Testing with *Hyalella azteca* – This test consists of exposing 8-day old amphipods to the sediments for 28 days, after which effects on survival and growth are evaluated. A sub-sample of the surviving amphipods is then transferred to clean water for an additional 14 days, and growth and reproduction are evaluated. The specific procedures used in this test are described below.

The site sediments, auxiliary Control (Quartz sand), and Negative Lab Control sediment were each tested at the 100% concentration only. Approximately 24 hrs prior to test initiation, each of the sediment samples was re-homogenized and sub-samples collected for sediment and sediment porewater characterization (described in Section 2.2, above), after which the test replicates were prepared. A total of 12 test replicates and six peeper replicates were established for each test treatment (i.e., each sediment). Each replicate container consisted of a 300-mL tall-form glass beaker with a 3-cm ribbon of 425-μm mesh NITEX® attached to the top of the beaker with silicone sealant. Approximately 100-mL of sediment was placed into each test replicate. Each test replicate was then carefully filled with 175 mL of overlying water. The replicates, now containing sediments and clean overlying water, were placed in a temperature-controlled room at 23˚C lighting at ~500 lux on a 16L:8D photoperiod; the position of all test replicate beakers relative to the other replicates were randomized throughout the test according to the long-term amphipod test randomization chart.

Test Initiation – After this initial ~24 hr period, the overlying water in each replicate was flushed with approximately 200 mL of the overlying water using a calibrated Zumwalt water delivery system (see Section 5.1.1 and Change Order #3 [Appendix A]). A 25 mL aliquot of the renewed overlying water in each of the test treatments was then collected and composited for measurement of initial water quality characteristics (pH, DO, conductivity, alkalinity, hardness, and total ammonia); 25 mL of overlying water was then added back to each replicate prior to test initiation. The tests were initiated with the allocation of 10 randomly-selected 8-day old *H. azteca* into each replicate (test organism receipt records are presented in Appendix D), followed by the addition of 1.0 mL of *Spirulina*-amended YCT food. The test replicates were then returned to the temperature-controlled room.

At the time of test initiation, eight replicates of 10 randomly-selected 8-day old organisms were collected, dried, and weighed to determine the mean dry weight of the test organisms at T_0.

Daily Test Maintenance - Each day, for the following 28 days, each replicate was examined for the presence of any dead amphipods, which were recorded and removed. Each day, a 25 mL sub-sample of test solution was collected from randomly-selected test replicates at each treatment for measurement of old DO (pH was measured three times per week and conductivity was measured once per week), after which each replicate was flushed with approximately 200 mL of fresh water. Another 25 mL aliquot of the overlying water from randomly-selected test replicates was then collected as before for measurement of new DO; 25 mL of overlying water was then added to each replicate, after which each replicate was fed 1.0 mL of *Spirulina* amended YCT; on Day 14 of the test, the feeding rate was increased to 2.0 mL of *Spirulina* amended YCT.

Each evening, each replicate was again flushed with approximately 200 mL of fresh overlying water. As a precautionary measure, and in order to catch any drops in DO that might be of concern, a P.M. DO check was performed for each treatment immediately prior to the overlying water renewal.

For any test treatment for which a test replicate overlying water DO level had decreased below 2.5 mg/L, all replicates for that treatment were aerated for the remaining duration of the testing, as per EPA guidance, and the date of aeration implementation was recorded.

28-Day Test Transition - After 28 days exposure, four of the 12 test replicates were removed from the temperature-controlled room, and a 25 mL aliquot of overlying water was collected from each replicate and composited for analysis of the Day 28 water quality characteristics. Then, the surficial sediment from each of the four replicates was rinsed into large glass dishes to recover the test organisms; the remaining sediment in each replicate was then sieved to recover any remaining surviving organisms. The surviving amphipods were euthanized with methanol, rinsed with de-ionized water, and then transferred to a pre-dried and pre-tared weighing pan. These were then dried at 60°C for 24 hrs (Change Order #6 [Appendix A]) and re-weighed to determine the mean dry weight per individual organism. Biomass was calculated as the total final dry weight, divided by the number of organisms loaded in the test replicate at test initiation.

Evaluation of *Hyalella azteca* Reproduction – On Day 28, the contents of the remaining eight test replicates for each sediment treatment were processed as described above and the surviving organisms were enumerated. The surviving organisms were then transferred to corresponding reproduction replicate containers, which consisted of 400-mL glass beakers containing 200 mL of Control water (no sediment) and two 2 cm-x-2 cm pieces of 425 μm Nitex mesh. The reproduction replicates were then placed into the same temperature-controlled room.

For the next six days, each replicate beaker was examined twice each day (in the morning and evening), at which time any dead organisms were enumerated and removed via pipette; after each examination, ~80% of the water in each replicate was replaced. As part of each morning inspection, a 25 mL sub-sample of test solution was collected from randomly-selected replicates at each treatment for measurement of old DO (pH was measured three times per week and conductivity was measured once per week). Another 25 mL aliquot of the overlying water was then collected from randomly-selected replicates at each treatment as before for measurement of new DO, after which each replicate was fed 2.0 mL of *Spirulina*-amended YCT.

After seven days (on Day 35 of the overall test), a 25 mL aliquot of water from each replicate was collected and composited for each test treatment for determination of routine water quality characteristics (e.g., pH, DO, and conductivity, alkalinity, hardness, and ammonia). The remaining contents of each replicate were then poured into glass dishes and carefully examined for the presence of neonate *H. azteca*, which were counted and removed. The surviving adult *H. azteca* were counted and returned to the reproduction replicates (now containing fresh water), which were then placed back into the temperature-control room.

For the next six days, the replicates were maintained as before, with daily examination of the replicates, determinations of water qualities for each treatment, and subsequent feeding of each replicate.

The test was terminated on Day 42 of the overall test. A 25 mL aliquot of water from each replicate was collected and composited for each test treatment for determination of routine water quality characteristics (e.g., pH, DO, and conductivity, alkalinity, hardness, and ammonia). The surviving adult *H. azteca* were then retrieved via pipette, enumerated, and then euthanized with methanol. The remaining contents of each test replicate were poured out into glass dishes and the number of neonate organisms determined.

The resulting total number of offspring produced in each replicate (the sum of the Day 35 and Day 42 neonate counts) was divided by the number of surviving females at Day 42 in that replicate to obtain a reproduction value of offspring per surviving female.

Evaluation of *Hyalella azteca* Sex – The adults euthanized at test termination were examined to determine the number of adult males and females in each replicate. Mature males were distinguished by the presence of an enlarged second gnathopod. Females were distinguished as those individuals lacking this enlarged gnathopod.

Evaluation of *Hyalella azteca* Growth – The euthanized adult amphipods from each replicate were then rinsed with de-ionized water, and transferred to a pre-dried and pre-tared weighing pan. These were then dried at 60°C for ≥24 hrs and re-weighed to determine the mean dry weight per individual organism.

2.4.2.7 Reference Toxicant Testing of the *Hyalella azteca* – In order to assess the sensitivity of the *H. azteca* test organisms to toxic stress, reference toxicant tests were performed. The reference toxicant tests consisted of 96-hr exposures to test water medium spiked with KCl at concentrations of 0.1, 0.2, 0.4, 0.8, and 1.6 g/L. For each test, there were 10 replicates at each treatment, each replicate consisting of a 30-mL plastic cup containing 20 mL of test media and a small piece of 425-mesh Nitex® screen. The tests were initiated by randomly allocating one 8-day old amphipod into each replicate followed by the addition of 0.1 mL of the *Spirulina*-amended YCT. The replicates were then placed in a temperature-controlled room at 23˚C under a 16:8 L:D photoperiod.
After ~48-hrs exposure, each of the replicate beakers was again fed 0.1 mL of *Spirulina*-amended YCT. The tests were terminated after 96-hrs (± 2-hrs). The resulting test response data

were statistically analyzed to determine key concentration-response point estimates (e.g., EC_{50}); all statistical analyses were made using the CETIS® software (Tidepool Scientific, McKinleyville, CA). These response endpoints were then compared to the typical response range established by the mean ± 2 SD of the point estimates generated by the most recent previous reference toxicant tests performed by this lab. The results of the reference toxicant tests for the short-term and long-term tests are presented in Appendices OO and SS, respectively.

3. EFFECTS OF UCR SITE SEDIMENTS ON *CHIRONOMUS DILUTUS*

The survival and growth results of the 10-day sediment toxicity tests with *C. dilutus* are presented in Section 3.1; the survival, growth, and reproduction results of the life-cycle tests are presented in Section 3.2.

3.1 Results of 10-Day Sediment Toxicity Testing with *Chironomus dilutus*

The results of these tests are presented below:

- ***Chironomus dilutus* Initial Weights at Test Initiation: 10-Day Tests**
  The initial T_0 weights of the *C. dilutus* for Batches 1-6 are summarized below in Table 3-1. The data for these test initiation weights are presented in Appendix I.

- **Results for *Chironomus dilutus* 10-Day Tests: Batch 1**
  The survival and growth results of the Batch 1 tests are summarized in Tables 3-2(a-c). The test data for these tests are presented in Appendix J.

- **Results for *Chironomus dilutus* 10-Day Tests: Batch 2**
  The survival and growth results of the Batch 2 tests are summarized in Tables 3-3(a-c). The test data for these tests are presented in Appendix K.

- **Results for *Chironomus dilutus* 10-Day Tests: Batch 3**
  The survival and growth results of the Batch 3 tests are summarized in Tables 3-4(a-c). The test data for these tests are presented in Appendix L.

- **Results for *Chironomus dilutus* 10-Day Tests: Batch 4**
  The survival and growth results of the Batch 4 tests are summarized in Tables 3-5(a-c). The test data for these tests are presented in Appendix M.

- **Results for *Chironomus dilutus* 10-Day Tests: Batch 5**
  The survival and growth results of the Batch 5 tests are summarized in Tables 3-6(a-c). The test data for these tests are presented in Appendix N.

- **Results for *Chironomus dilutus* 10-Day Tests: Batch 6**
  The survival and growth results of the Batch 6 tests are summarized in Tables 3-7(a-c). The test data for these tests are presented in Appendix O.

Table 3-1. Initial weights of the *Chironomus dilutus* at the time of test initiation.		
Batch	Test Initiation Date	Mean Dry Weight (mg)
1	1/22/14	0.120
2	1/23/14	0.077
3	1/24/14	0.069
4	1/29/14	0.087
5	1/30/14	0.065
6	1/31/14	0.027

Table 3-2a. Effects of UCR sediments on *Chironomus dilutus* survival in 10-day tests: Batch 1.

Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B1	10	9	10	10	8	9	10	10	**9.5**
CTL-QS-B1	10	10	10	10	10	8	9	10	**9.6**
CTL-ERDC-B1	9	8	9	10	10	10	10	10	**9.5**
SE-1-R1	9	9	10	9	9	10	10	9	**9.4**
SE-3-R2	8	10	10	10	10	10	9	9	**9.5**
SE-4-B6	9	9	8	8	9	10	9	10	**9.0**
SE-5-B1	9	5	5	10	9	9	6	9	**7.8**
SE-6-B6	9	9	7	6	10	8	6	5	**7.5**
SE-6-R3	7	8	7	9	8	8	8	9	**8.0**
SE-8-B3	9	9	9	10	6	10	7	7	**8.4**
SE-8-B4	7	10	7	10	7	7	8	7	**7.9**
SE-G-1	10	10	10	9	7	9	10	10	**9.4**
SE-REF-6	9	9	10	9	10	10	9	8	**9.3**
SE-TRIB-4	8	8	10	8	9	8	10	10	**8.9**

Table 3-2b. Effects of UCR sediments on *Chironomus dilutus* growth (ash-free dry weight [mg per individual]) in 10-day tests: Batch 1.									
Site ID	Mean Individual Ash-Free Dry Wt (mg) in Test Replicates								**Mean Ash-Free Dry Wt (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B1	1.499	1.637	1.556	1.682	2.001	1.887	1.471	1.469	**1.650**
CTL-QS-B1	1.342	1.329	1.486	1.461	1.324	1.370	1.383	1.318	**1.377**
CTL-ERDC-B1	1.534	1.758	1.274	1.458	1.591	1.428	1.295	1.594	**1.492**
SE-1-R1	1.640	1.589	1.315	1.143	1.201	1.182	1.228	1.087	**1.298**
SE-3-R2	2.270	1.888	1.563	1.755	1.792	1.759	2.002	1.789	**1.852**
SE-4-B6	1.236	1.652	1.523	1.168	1.449	1.123	1.206	1.352	**1.339**
SE-5-B1	1.702	1.546	2.290	1.483	1.419	1.669	2.052	1.557	**1.715**
SE-6-B6	1.699	1.459	1.719	2.032	1.381	1.454	1.722	2.162	**1.703**
SE-6-R3	1.583	1.491	1.579	1.378	1.581	1.656	1.661	1.461	**1.549**
SE-8-B3	1.541	1.248	1.524	1.424	1.798	1.190	1.499	1.684	**1.489**
SE-8-B4	1.544	1.368	1.557	1.299	1.594	1.696	1.388	1.657	**1.513**
SE-G-1	1.681	1.438	1.529	1.360	1.680	1.554	1.393	1.320	**1.494**
SE-REF-6	1.812	1.627	1.735	1.820	1.716	1.606	1.604	1.840	**1.720**
SE-TRIB-4	1.949	1.963	1.801	1.820	1.874	1.959	1.507	1.569	**1.805**

Table 3-2c. Effects of UCR sediments on *Chironomus dilutus* growth (ash-free biomass[A] [mg]) in 10-day tests: Batch 1.									
Site ID	Mean Ash-Free Biomass (mg) in Test Replicates								**Mean Ash-Free Biomass (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B1	1.499	1.473	1.556	1.682	1.601	1.698	1.471	1.469	**1.556**
CTL-QS-B1	1.342	1.329	1.486	1.461	1.324	1.096	1.245	1.318	**1.325**
CTL-ERDC-B1	1.381	1.406	1.147	1.458	1.591	1.428	1.295	1.594	**1.413**
SE-1-R1	1.476	1.430	1.315	1.029	1.068 [B]	1.182	1.228	0.978	**1.213**
SE-3-R2	1.766[B]	1.888	1.563 [B]	1.755	1.792	1.759	1.802	1.610	**1.742**
SE-4-B6	1.099 [B]	1.487	1.218	0.934	1.304	1.123 [B]	1.085	1.352 [B]	**1.200**
SE-5-B1	1.532	0.773	1.145	1.483	1.277	1.502	1.231	1.401	**1.293**
SE-6-B6	1.529	1.313	1.203	1.219	1.381 [C]	1.163	1.033	1.081	**1.240**
SE-6-R3	1.108	1.193	1.105	1.240	1.265	1.325	1.328	1.315	**1.235**
SE-8-B3	1.387	1.123	1.372	1.424	1.079	1.190	1.049	1.179	**1.225**
SE-8-B4	1.081	1.368	1.090	1.299	1.116	1.187	1.110	1.160	**1.176**
SE-G-1	1.681	1.438	1.529	1.224	1.176	1.399	1.393	1.320	**1.395**
SE-REF-6	1.631	1.464	1.735	1.638	1.716	1.606	1.444	1.472	**1.588**
SE-TRIB-4	1.559	1.570	1.801	1.456	1.640 [C]	1.567	1.507	1.569	**1.584**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.
B – 1 pupae observed at the end of the test; ash-free biomass is based on 9 instead of 10 initial larvae.
C – 2 pupae observed at the end of the test; ash-free biomass is based on 8 instead of 10 initial larvae.

Table 3-3a. Effects of UCR sediments on *Chironomus dilutus* survival in 10-day tests: Batch 2.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B2	9	8	9	9	10	10	10	10	**9.4**
CTL-QS-B2	9	10	10	10	10	10	9	10	**9.8**
CTL-ERDC-B2	10	9	9	9	10	10	9	9	**9.4**
SE-2-R1	10	10	10	10	10	10	10	9	**9.9**
SE-4-B2	10	10	10	10	10	10	10	9	**9.9**
SE-4-B4	9	10	9	9	10	10	10	10	**9.6**
SE-5-B3	4	5	3	3	6	5	6	3	**4.4**
SE-6-B5	5	7	7	8	8	7	2	3	**5.9**
SE-LAL-1	5	8	9	6	5	6	6	6	**6.4**
SE-LAL-2	10	10	9	9	10	10	9	9	**9.5**
SE-LAL-3	9	9	10	8	10	9	10	9	**9.3**
SE-LAL-6	10	10	9	10	10	10	10	10	**9.9**
SE-REF-4	6	10	9	7	9	9	10	8	**8.5**
SE-REF-8	10	6	7	7	5	9	9	7	**7.5**

Table 3-3b. Effects of UCR sediments on *Chironomus dilutus* growth (ash-free dry weight [mg per individual]) in 10-day tests: Batch 2.									
Site ID	Mean Individual Ash-Free Dry Wt (mg) in Test Replicates								**Mean Ash-Free Dry Wt (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B2	1.638	1.726	1.378	1.537	1.623	1.440	1.457	1.400	**1.525**
CTL-QS-B2	1.393	1.265	1.459	1.480	1.406	1.479	1.604	1.607	**1.462**
CTL-ERDC-B2	1.673	1.702	1.567	1.500	1.628	1.471	1.500	1.907	**1.618**
SE-2-R1	1.564	1.352	1.706	1.632	1.963	1.412	1.490	1.963	**1.635**
SE-4-B2	1.435	1.402	1.485	1.655	1.399	1.618	1.530	1.539	**1.508**
SE-4-B4	1.076	1.153	1.213	1.423	1.248	1.320	1.228	0.975	**1.205**
SE-5-B3	2.615	2.566	3.173	2.603	2.225	1.986	1.908	2.930	**2.501**
SE-6-B5	2.426	1.713	1.854	1.795	1.436	1.337	3.160	2.740	**2.058**
SE-LAL-1	2.142	1.584	1.598	2.168	1.344	1.910	2.118	2.075	**1.867**
SE-LAL-2	1.755	1.670	1.708	1.780	1.694	1.729	1.900	1.680	**1.739**
SE-LAL-3	1.701	1.722	1.387	1.814	1.645	1.826	1.644	1.569	**1.663**
SE-LAL-6	1.564	1.521	1.727	1.673	1.665	1.421	1.580	1.650	**1.600**
SE-REF-4	1.545	1.253	1.313	1.611	1.261	1.280	1.416	1.536	**1.402**
SE-REF-8	1.179	1.688	1.680	1.584	1.990	1.392	1.359	1.639	**1.564**

Site ID	Mean Ash-Free Biomass (mg) in Test Replicates								Mean Ash-Free Biomass (mg)
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B2	1.474	1.381	1.240	1.383	1.623	1.440	1.457	1.400	**1.425**
CTL-QS-B2	1.254	1.265	1.459	1.480	1.406	1.479	1.444	1.607	**1.424**
CTL-ERDC-B2	1.673	1.532	1.410	1.350	1.628	1.471	1.350	1.716	**1.516**
SE-2-R1	1.564	1.352	1.706	1.632	1.963	1.412	1.490	1.767	**1.611**
SE-4-B2	1.435	1.402	1.485	1.655	1.399	1.618	1.530	1.385	**1.489**
SE-4-B4	0.968	1.153	1.092	1.281	1.248	1.320	1.228	0.975	**1.158**
SE-5-B3	1.046	1.283	0.952	0.781	1.335	0.993	1.145	0.879	**1.052**
SE-6-B5	1.213	1.199	1.298	1.436	1.149	0.936	0.632	0.822	**1.086**
SE-LAL-1	1.071	1.267	1.438	1.301	0.672	1.146	1.271	1.245	**1.176**
SE-LAL-2	1.755	1.670	1.537	1.602	1.694	1.729	1.710	1.512	**1.651**
SE-LAL-3	1.531	1.550	1.387	1.451	1.645	1.643	1.644	1.412	**1.533**
SE-LAL-6	1.564	1.521	1.554	1.673	1.665	1.421	1.580	1.650	**1.579**
SE-REF-4	0.927	1.253	1.182	1.128	1.135	1.152	1.416	1.229	**1.178**
SE-REF-8	1.179	1.013	1.176	1.109	0.995	1.253	1.223	1.147	**1.137**

Table 3-3c. Effects of UCR sediments on *Chironomus dilutus* growth (ash-free biomass[A] [mg]) in 10-day tests: Batch 2.

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 3-4a. Effects of UCR sediments on *Chironomus dilutus* survival in 10-day tests: Batch 3.

Site ID	# of Surviving Organisms in Test Replicates								Mean Survival
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B3	9	10	10	10	10	9	10	10	**9.8**
CTL-QS-B3	10	9	10	10	10	10	10	9	**9.8**
CTL-ERDC-B3	10	10	10	10	10	9	10	10	**9.9**
SE-2-R3	9	10	9	9	10	10	10	8	**9.4**
SE-3-R1	10	10	10	10	10	10	10	10	**10.0**
SE-3-R8	7	9	8	6	9	10	8	10	**8.4**
SE-5-B4	2	1	6	7	2	2	4	5	**3.6**
SE-6-B4	5	5	5	3	3	3	0	4	**3.5**
SE-7-B2	6	5	1	3	6	8	4	4	**4.6**
SE-LAL-4	10	10	9	10	10	10	10	10	**9.9**
SE-REF-1	6	6	4	7	5	8	5	8	**6.1**
SE-REF-10b	10	9	10	10	9	9	9	10	**9.5**
SE-REF-3	7	4	6	9	4	5	5	8	**6.0**
SE-REF-7	10	6	6	8	6	6	8	5	**6.9**
SE-TRIB-3	11	10	10	9	13	9	9	10	**10.1**

Table 3-4b. Effects of UCR sediments on *Chironomus dilutus* growth (ash-free dry weight [mg per individual]) in 10-day tests: Batch 3.									
Site ID	Mean Individual Ash-Free Dry Wt (mg) in Test Replicates								**Mean Ash-Free Dry Wt (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B3	1.094	0.947	1.209	1.123	0.977	0.994	0.934	1.182	**1.058**
CTL-QS-B3	1.285	1.279	1.278	1.277	1.201	1.319	1.326	1.379	**1.293**
CTL-ERDC-B3	1.213	1.310	1.194	1.239	1.283	1.317	1.303	1.193	**1.256**
SE-2-R3	1.721	1.457	1.688	1.922	1.468	1.706	1.209	1.713	**1.610**
SE-3-R1	1.031	1.290	0.825	1.085	0.990	1.040	1.240	1.184	**1.086**
SE-3-R8	0.507	0.856	0.841	0.543	0.848	0.769	0.909	0.755	**0.753**
SE-5-B4	2.735	1.790	1.602	1.514	2.345	2.115	2.268	1.626	**1.999**
SE-6-B4	1.716	1.830	1.996	2.317	2.093	2.983	0.000	1.965	**1.863**
SE-7-B2	1.560	1.594	2.830	2.070	1.728	1.406	1.805	2.065	**1.882**
SE-LAL-4	1.436	1.462	1.431	1.503	1.443	1.453	1.470	1.411	**1.451**
SE-REF-1	1.927	1.942	2.255	2.017	2.182	1.748	1.880	1.555	**1.938**
SE-REF-10b	1.281	1.249	1.368	0.906	1.336	1.366	0.934	1.021	**1.183**
SE-REF-3	1.583	2.460	1.552	1.312	2.260	1.828	2.384	1.489	**1.858**
SE-REF-7	1.017	2.100	1.557	1.334	1.707	1.992	1.628	2.036	**1.671**
SE-TRIB-3	1.419	1.602	1.763	1.553	1.427	1.533	1.640	1.545	**1.560**

Table 3-4c. Effects of UCR sediments on *Chironomus dilutus* growth (ash-free biomass[A] [mg]) in 10-day tests: Batch 3.									
Site ID	Mean Ash-Free Biomass (mg)in Test Replicates								**Mean Ash-Free Biomass (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B3	0.985	0.947	1.209	1.123	0.977	0.895	0.934	1.182	**1.032**
CTL-QS-B3	1.285	1.151	1.278	1.277	1.201	1.319	1.326	1.241	**1.260**
CTL-ERDC-B3	1.213	1.310	1.194	1.239	1.283	1.185	1.303	1.193	**1.240**
SE-2-R3	1.549	1.457	1.519	1.730	1.468	1.706	1.209	1.370	**1.501**
SE-3-R1	1.031	1.290	0.825	1.085	0.990	1.040	1.240	1.184	**1.086**
SE-3-R8	0.355	0.770	0.673	0.326	0.763	0.769	0.727	0.755	**0.642**
SE-5-B4	0.547	0.179	0.961	1.060	0.469	0.423	0.907	0.813	**0.670**
SE-6-B4	0.858	0.915	0.998	0.695	0.628	0.895	0.000	0.786	**0.722**
SE-7-B2	0.936	0.797	0.283	0.621	1.037	1.125	0.722	0.826	**0.793**
SE-LAL-4	1.436	1.462	1.288	1.503	1.443	1.453	1.470	1.411	**1.433**
SE-REF-1	1.156	1.165	0.902	1.412	1.091	1.398	0.940	1.244	**1.164**
SE-REF-10b	1.281	1.124	1.368	0.906	1.202	1.229	0.841	1.021	**1.122**
SE-REF-3	1.108	0.984	0.931	1.181	0.904	0.914	1.192	1.191	**1.051**
SE-REF-7	1.017	1.260	0.934	1.067	1.024	1.195	1.302	1.018	**1.102**
SE-TRIB-3	1.419	1.602	1.763	1.398	1.427	1.380	1.476	1.545	**1.501**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 3-5a. Effects of UCR sediments on *Chironomus dilutus* survival in 10-day tests: Batch 4.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B4	10	10	10	10	10	10	10	9	**9.9**
CTL-QS-B4	10	9	10	10	10	10	7	10	**9.5**
CTL-ERDC-B4	6	10	7	6	7	8	6	3	**6.6**
SE-1-B5	9	9	9	9	10	9	10	10	**9.4**
SE-2-B1	10	10	9	10	10	10	9	9	**9.6**
SE-3-B3	10	8	10	9	7	10	10	10	**9.3**
SE-3-R7	9	9	8	10	6	9	9	10	**8.8**
SE-5-B5	9	7	9	9	6	8	7	7	**7.8**
SE-5-B6	6	8	7	9	8	7	9	10	**8.0**
SE-7-B3	10	10	8	9	9	8	9	8	**8.9**
SE-7-B6	8	5	8	7	6	4	5	8	**6.4**
SE-G-4	10	9	8	10	10	10	9	10	**9.5**
SE-REF-2	9	8	7	8	10	6	7	9	**8.0**
SE-TRIB-2	10	10	8	9	10	9	10	10	**9.5**
SE-TRIB-5	10	10	10	9	9	10	10	10	**9.8**

Table 3-5b. Effects of UCR sediments on *Chironomus dilutus* growth (ash-free dry weight [mg per individual]) in 10-day tests: Batch 4.									
Site ID	Mean Individual Ash-Free Dry Wt (mg) in Test Replicates								**Mean Ash-Free Dry Wt (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B4	1.378	1.429	1.339	1.472	1.423	1.467	1.246	1.497	**1.406**
CTL-QS-B4	1.192	1.328	1.212	1.121	1.221	1.101	1.610	1.086	**1.234**
CTL-ERDC-B4	1.793	1.429	1.743	1.950	1.893	1.618	1.908	2.663	**1.875**
SE-1-B5	2.013	1.782	1.807	1.794	1.779	1.720	1.754	1.456	**1.763**
SE-2-B1	1.444	1.379	1.533	1.437	1.447	1.292	1.629	1.407	**1.446**
SE-3-B3	1.338	1.328	1.263	1.381	1.559	1.151	1.305	1.311	**1.330**
SE-3-R7	1.706	1.528	1.821	1.446	1.903	1.678	1.709	1.835	**1.703**
SE-5-B5	1.474	1.694	1.573	1.438	2.187	1.596	1.836	1.659	**1.682**
SE-5-B6	1.938	1.568	1.653	1.449	1.339	1.691	1.403	1.320	**1.545**
SE-7-B3	1.306	1.185	1.305	1.338	1.286	1.481	1.442	1.489	**1.354**
SE-7-B6	1.249	1.640	1.453	1.413	1.572	2.275	1.748	1.383	**1.592**
SE-G-4	1.085	1.449	1.189	0.943	1.121	1.304	1.274	1.132	**1.187**
SE-REF-2	1.398	1.721	1.677	1.673	1.119	1.703	1.634	1.591	**1.565**
SE-TRIB-2	1.036	2.222	1.863	1.871	1.765	1.637	1.589	1.764	**1.718**
SE-TRIB-5	1.379	1.551	1.487	1.489	1.689	1.482	1.422	1.424	**1.490**

Table 3-5c. Effects of UCR sediments on *Chironomus dilutus* growth (ash-free biomass[A] [mg]) in 10-day tests: Batch 4.									
Site ID	Mean Ash-Free Biomass (mg) in Test Replicates								**Mean Ash-Free Biomass (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B4	1.378	1.429	1.339	1.472	1.423	1.467	1.246	1.347	**1.388**
CTL-QS-B4	1.192	1.195	1.212	1.121	1.221	1.101	1.127	1.086	**1.157**
CTL-ERDC-B4	1.076	1.429	1.220	1.170	1.325	1.294	1.145	0.799	**1.182**
SE-1-B5	1.812	1.604	1.626	1.615	1.779	1.548	1.754	1.456	**1.649**
SE-2-B1	1.444	1.379	1.362[B]	1.437	1.447	1.292	1.466	1.266	**1.387**
SE-3-B3	1.338	1.062	1.263	1.243	1.091	1.151	1.305	1.311	**1.221**
SE-3-R7	1.535	1.375	1.457	1.446	1.142	1.510	1.538	1.835	**1.480**
SE-5-B5	1.327	1.186	1.416	1.294	1.312	1.277	1.285	1.161	**1.282**
SE-5-B6	1.163	1.254	1.157	1.304	1.071	1.184	1.263	1.320	**1.215**
SE-7-B3	1.306	1.185	1.044	1.204	1.157	1.185	1.298	1.191	**1.196**
SE-7-B6	0.999	0.820	1.162	0.989	0.943	0.910	0.874	1.106	**0.975**
SE-G-4	1.085	1.304	0.951	0.943	1.121	1.304	1.147	1.132	**1.123**
SE-REF-2	1.242[B]	1.377	1.174	1.338	1.119	1.022	1.144	1.432	**1.231**
SE-TRIB-2	1.036[B]	2.222[B]	1.490	1.684	1.765	1.433[C]	1.589	1.764	**1.623**
SE-TRIB-5	1.379	1.551	1.487	1.340	1.520	1.482	1.422	1.424	**1.451**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.
B – 1 pupae observed at the end of the test; ash-free biomass is based on 9 instead of 10 initial larvae.
C – 2 pupae observed at the end of the test; ash-free biomass is based on 8 instead of 10 initial larvae.

Table 3-6a. Effects of UCR sediments on *Chironomus dilutus* survival in 10-day tests: Batch 5.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B5	9	8	9	9	9	9	9	9	**8.9**
CTL-QS-B5	9	10	10	10	10	9	10	9	**9.6**
CTL-ERDC-B5	10	6	10	9	10	9	7	6	**8.4**
SE-2-B2	9	10	9	9	9	9	10	9	**9.3**
SE-3-R9	10	7	10	10	10	10	10	9	**9.5**
SE-4-B1	9	10	9	10	9	6	10	9	**9.0**
SE-5-B2	9	8	9	10	9	8	6	10	**8.6**
SE-6-B1	8	6	8	10	6	8	8	9	**7.9**
SE-7-B4	6	6	6	6	5	7	7	6	**6.1**
SE-7-B5	9	10	7	9	9	8	9	10	**8.9**
SE-8-B1	7	9	7	8	7	8	6	7	**7.4**
SE-G-2	9	8	8	10	9	8	8	9	**8.6**
SE-LAL-5	4	8	9	7	7	10	9	8	**7.8**
SE-REF-5	9	10	9	10	8	9	9	10	**9.3**
SE-TRIB-1	6	9	10	10	10	9	8	9	**8.9**

Table 3-6b. Effects of UCR sediments on *Chironomus dilutus* growth (ash-free dry weight [mg per individual]) in 10-day tests: Batch 5.

Site ID	Mean Individual Ash-Free Dry Wt (mg) in Test Replicates								**Mean Ash-Free Dry Wt (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B5	1.443	1.545	1.426	1.331	1.712	1.451	1.500	1.613	**1.503**
CTL-QS-B5	1.137	1.053	1.032	0.976	1.040	1.102	1.082	1.076	**1.062**
CTL-ERDC-B5	1.283	2.155	1.338	1.662	1.503	1.482	1.823	2.022	**1.659**
SE-2-B2	1.479	1.331	1.507	1.301	1.327	1.478	1.307	1.569	**1.412**
SE-3-R9	1.721	2.353	1.795	1.694	1.839	1.651	1.708	1.930	**1.836**
SE-4-B1	1.312	1.059	1.333	1.241	1.322	1.997	1.269	1.360	**1.362**
SE-5-B2	1.491	1.640	1.436	1.342	1.384	1.546	1.702	1.425	**1.496**
SE-6-B1	1.305	1.362	0.993	1.037	1.103	1.209	1.356	1.209	**1.197**
SE-7-B4	2.135	2.013	2.130	1.758	1.982	1.856	1.519	2.132	**1.941**
SE-7-B5	1.479	1.484	1.771	1.282	1.566	1.468	1.477	1.239	**1.471**
SE-8-B1	1.671	1.267	1.361	1.466	1.489	1.303	1.878	1.421	**1.482**
SE-G-2	1.302	1.194	1.449	1.375	1.372	1.376	1.429	1.474	**1.371**
SE-LAL-5	2.588	1.545	1.284	1.876	1.777	1.682	1.733	1.508	**1.749**
SE-REF-5	1.357	1.347	1.344	1.322	1.450	1.279	1.444	1.335	**1.360**
SE-TRIB-1	1.672	1.412	1.256	1.232	1.089	1.376	1.321	1.276	**1.329**

Table 3-6c. Effects of UCR sediments on *Chironomus dilutus* growth (ash-free biomass[A] [mg]) in 10-day tests: Batch 5.

Site ID	Mean Ash-Free Biomass (mg) in Test Replicates								**Mean Ash-Free Biomass (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B5	1.299	1.236	1.283	1.198	1.541	1.306	1.350	1.452	**1.333**
CTL-QS-B5	1.023	1.053	1.032	0.976	1.040	0.992	1.082	0.968	**1.021**
CTL-ERDC-B5	1.283	1.293	1.338	1.496	1.503	1.334	1.276	1.213	**1.342**
SE-2-B2	1.331	1.331	1.356	1.171	1.194	1.330	1.307	1.412	**1.304**
SE-3-R9	1.721	1.647	1.795	1.694	1.839	1.651	1.708	1.737	**1.724**
SE-4-B1	1.181	1.059	1.200	1.241	1.190	1.198	1.269	1.224	**1.195**
SE-5-B2	1.342	1.312	1.292	1.342	1.246	1.237	1.021	1.425	**1.277**
SE-6-B1	1.044	0.817	0.794	1.037	0.662	0.967	1.085	1.088	**0.937**
SE-7-B4	1.281	1.208	1.278	1.055	0.991	1.299	1.063	1.279	**1.182**
SE-7-B5	1.331	1.484	1.240	1.154	1.409	1.174	1.329	1.239	**1.295**
SE-8-B1	1.170	1.140	0.953	1.173	1.042	1.042	1.127	0.995	**1.080**
SE-G-2	1.172	0.955	1.159	1.375	1.235	1.101	1.143	1.327	**1.183**
SE-LAL-5	1.035	1.236	1.156	1.313	1.244	1.682	1.560	1.206	**1.304**
SE-REF-5	1.221	1.347	1.210	1.322	1.160	1.151	1.300	1.335	**1.256**
SE-TRIB-1	1.003	1.271	1.256	1.232	1.089	1.238	1.057	1.148	**1.162**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 3-7a. Effects of UCR sediments on *Chironomus dilutus* survival in 10-day tests: Batch 6.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B6	8	9	7	10	9	9	9	9	**8.8**
CTL-QS-B6	10	10	10	10	10	10	10	10	**10.0**
CTL-ERDC-B6	4	7	10	7	6	8	6	9	**7.1**
SE-1B-R2	9	6	9	6	9	9	8	10	**8.3**
SE-1-R2	10	10	9	10	10	8	8	10	**9.4**
SE-4-B3	8	7	8	7	8	7	7	6	**7.3**
SE-4-B5	9	7	9	9	10	10	10	9	**9.1**
SE-6-B2	9	7	8	8	9	8	8	9	**8.3**
SE-7-B1	5	8	7	5	9	5	7	7	**6.6**
SE-8-B2	10	9	9	10	9	8	11	11	**9.6**
SE-8-B5	7	7	9	8	10	10	9	9	**8.6**
SE-8-B6	9	9	9	6	7	10	6	8	**8.0**
SE-G-3	10	10	10	10	10	10	10	9	**9.9**
SE-TRIB-6	7	9	8	9	7	9	9	10	**8.5**

Table 3-7b. Effects of UCR sediments on *Chironomus dilutus* growth (ash-free dry weight [mg per individual]) in 10-day tests: Batch 6.									
Site ID	Mean Individual Ash-Free Dry Wt (mg) in Test Replicates								**Mean Ash-Free Dry Wt (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B6	1.361	1.358	1.479	1.400	1.512	1.533	1.353	1.288	**1.411**
CTL-QS-B6	1.245	1.138	1.088	1.063	1.336	1.227	1.009	0.986	**1.137**
CTL-ERDC-B6	2.113	1.619	1.166	1.324	1.587	1.375	1.652	1.279	**1.514**
SE-1B-R2	0.929	1.242	1.080	1.020	0.826	1.069	0.696	0.896	**0.970**
SE-1-R2	1.105	1.174	1.021	1.157	1.176	1.318	1.276	1.073	**1.162**
SE-4-B3	1.486	1.170	1.266	1.460	1.666	1.639	1.121	1.587	**1.424**
SE-4-B5	1.206	1.284	1.229	1.067	1.214	0.997	1.161	1.346	**1.188**
SE-6-B2	0.743	1.010	0.540	0.545	0.650	0.653	0.866	0.620	**0.703**
SE-7-B1	1.302	1.488	1.511	1.916	1.158	1.684	1.223	1.481	**1.470**
SE-8-B2	0.932	0.942	0.742	0.844	1.047	0.828	0.731	0.729	**0.849**
SE-8-B5	1.539	1.430	1.060	1.396	1.101	1.314	1.251	1.162	**1.282**
SE-8-B6	1.348	1.118	1.273	1.628	1.540	1.076	1.557	1.170	**1.339**
SE-G-3	0.884	0.632	0.958	0.767	0.936	0.949	0.886	0.889	**0.863**
SE-TRIB-6	0.776	0.852	0.872	0.937	0.857	0.776	1.118	0.744	**0.866**

Table 3-7c. Effects of UCR sediments on *Chironomus dilutus* growth (ash-free biomass[A] [mg]) in 10-day tests: Batch 6.									
Site ID	Mean Ash-Free Biomass (mg) in Test Replicates								**Mean Ash-Free Biomass (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B6	1.089	1.222	1.035	1.400	1.361	1.380	1.218	1.159	**1.233**
CTL-QS-B6	1.245	1.138	1.088	1.063	1.336	1.227	1.009	0.986	**1.137**
CTL-ERDC-B6	0.845	1.133	1.166	0.927	0.952	1.100	0.991	1.151	**1.033**
SE-1B-R2	0.836	0.745	0.972	0.612	0.743	0.962	0.557	0.896	**0.790**
SE-1-R2	1.105	1.174	0.919	1.157	1.176	1.054	1.021	1.073	**1.085**
SE-4-B3	1.189	0.819	1.013	1.022	1.333	1.147	0.785	0.952	**1.033**
SE-4-B5	1.085	0.899	1.106	0.960	1.214	0.997	1.161	1.211	**1.079**
SE-6-B2	0.669	0.707	0.432	0.436	0.585	0.522	0.693	0.558	**0.575**
SE-7-B1	0.651	1.190	1.058	0.958	1.042	0.842	0.856	1.037	**0.954**
SE-8-B2	0.932	0.848	0.668	0.844	0.942	0.662	0.731	0.729	**0.795**
SE-8-B5	1.077	1.001	0.954	1.117	1.101	1.314	1.126	1.046	**1.092**
SE-8-B6	1.213	1.006	1.146	0.977	1.078	1.076	0.934	0.936	**1.046**
SE-G-3	0.884	0.632	0.958	0.767	0.936	0.949	0.886	0.800	**0.852**
SE-TRIB-6	0.543	0.767	0.698	0.843	0.600	0.698	1.006	0.744	**0.737**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

3.2 Results of the Long-Term (Life-Cycle) Toxicity Testing with *Chironomus dilutus*

The results of the long-term (life cycle) toxicity tests with *C. dilutus* are presented below:

- **Results for *Chironomus dilutus* Long-Term Toxicity Testing: Batch 1**
  The Day 16 survival and growth results for the Batch 1 tests are summarized in Table 3-8a; the reproduction results of the Batch 1 long-term toxicity tests are summarized in Tables 3-8b and 3-8c. The test data for these tests are presented in Appendix P.

- **Results for *Chironomus dilutus* Long-Term Toxicity Testing: Batch 2**
  The Day 16 survival and growth results for the Batch 2 tests are summarized in Table 3-9a; the reproduction results of the Batch 2 long-term toxicity tests are summarized in Tables 3-9b and 3-9c. The test data for these tests are presented in Appendix Q.

- **Results for *Chironomus dilutus* Long-Term Toxicity Testing: Batch 3**
  The Day 16 survival and growth results for the Batch 3 tests are summarized in Table 3-10a; the reproduction results of the Batch 3 long-term toxicity tests are summarized in Tables 3-10b and 3-10c. The test data for these tests are presented in Appendix R.

Table 3-8a. Effects of UCR sediments on *Chironomus dilutus* Day 16 survival and growth in long-term (life-cycle) tests: Batch 1.

Site ID	# of Surviving Organisms[A]					Mean Individual Ash-Free Dry Wt (mg per individual)					Mean Ash-Free Biomass[B] (mg)				
	Rep A	Rep B	Rep C	Rep D	**Mean**	Rep A	Rep B	Rep C	Rep D	**Mean**	Rep A	Rep B	Rep C	Rep D	**Mean**
CTL-SS-B1	12	10	11	12	**11.3**	1.388	1.717	1.535	1.580	**1.555**	1.388	1.431	1.407	1.580	**1.451**
CTL-QS-B1	12	12	11	12	**11.8**	1.906	1.749	1.986	1.451	**1.773**	1.906 [F]	1.749 [H]	1.655 [G]	1.451	**1.690**
SE-1-B5	12	9	8	9	**9.5**	1.270	2.182	1.260	1.560	**1.568**	1.270 [C]	1.637	0.756 [D]	1.092 [D]	**1.189**
SE-1B-R2	10	8	8	5	**7.8**	1.500	1.370	1.459	2.448	**1.694**	1.250	0.913	0.972	1.020	**1.039**
SE-1-R2	11	11	8	11	**10.3**	1.983	1.744	1.764	1.995	**1.871**	1.818	1.598	1.176	1.814 [E]	**1.601**
SE-4-B6	10	12	11	10	**10.8**	2.266	1.815	1.914	1.880	**1.969**	1.854 [E]	1.815 [E]	1.740 [E]	1.567	**1.744**
SE-6-B2	12	9	11	7	**9.8**	1.061	1.212	0.868	1.320	**1.115**	1.061	0.909	0.796	0.770	**0.884**
SE-7-B5	12	6	11	4	**8.3**	1.422	2.300	1.603	2.642	**1.992**	1.422	1.150	1.470	0.881	**1.231**
SE-8-B3	9	11	7	9	**9.0**	1.851	1.337	1.957	1.682	**1.707**	1.388	1.226	1.142	1.262	**1.254**
SE-G-1	12	12	12	12	**12**	1.283	1.335	1.173	1.064	**1.214**	1.283	1.335	1.173	1.064	**1.214**
SE-G-3	12	12	11	13	**12**	1.043	1.267	1.301	1.362	**1.243**	1.043	1.267	1.192	1.362	**1.216**
SE-LAL-3	7	6	5	9	**6.8**	1.985	2.383	2.662	1.549	**2.145**	1.083 [E]	1.192	1.109	1.126 [E]	**1.128**
SE-LAL-5	4	10	9	8	**7.8**	3.042	1.864	2.126	2.176	**2.302**	1.014	1.553	1.594	1.451	**1.403**
SE-REF-10b	11	11	9	11	**10.5**	1.323	1.767	1.706	1.582	**1.594**	1.212	1.620	1.279	1.424 [D]	**1.384**
SE-TRIB-3	10	9	8	10	**9.3**	1.283	1.481	1.186	1.102	**1.263**	1.069	1.111	0.791	0.918	**0.972**

A – Tests were initiated with 12 organisms in each replicate.
B – Biomass = total weight of organisms/number of organisms loaded at test initiation.
C – 2 pupae and 1 adult observed during the test; ash-free biomass is based on 9 instead of 12 initial larvae.
D – 2 pupae observed during the test; ash-free biomass is based on 10 instead of 12 initial larvae.
E – 1 pupae observed during the test; ash-free biomass is based on 11 instead of 12 initial larvae.
F – 2 pupae and 2 adults observed during the test; ash-free biomass is based on 8 instead of 12 initial larvae.
G – 4 pupae and 2 adults observed during the test; ash-free biomass is based on 6 instead of 12 initial larvae.
H – 1 adult observed during the test; ash-free biomass is based on 11 instead of 12 initial larvae.

Table 3-8b. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Batch 1.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
CTL-SS-B1	E	0	1	0	0	1	6	7	0	8	1
	F	1	0	0	0	2	9	11	0	12	2
	G	0	1	0	0	0	5	5	0	6	3
	H	0	0	0	0	0	3	3	0	3	2
	I	1	1	0	0	0	7	7	0	9	1
	J	0	0	0	0	2	7	9	0	9	1
	K	0	0	0	0	1	7	8	0	8	1
	L	0	0	0	0	1	7	8	0	8	0
CTL-QS-B1	E	0	1	0	1	3	7	11	0	12	5
	F	0	2	0	0	0	8	8	0	10	3
	G	0	3	0	0	0	7	7	0	10	0
	H	0	1	0	1	1	8	10	0	11	1
	I	0	0	1	0	0	9	9	0	10	2
	J	0	1	0	0	3	6	9	0	10	1
	K	0	0	0	0	1	9	10	0	10	2
	L	0	0	0	0	0	9	9	0	9	3

Table 3-8b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 1.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-1-B5	E	1	1	1	0	0	4	4	0	7	1
	F	1	0	1	0	0	6	6	0	8	0
	G	0	0	0	0	0	5	5	0	5	1
	H	1	0	0	0	0	8	8	0	9	1
	I	2	0	0	0	3	4	7	0	9	0
	J	0	0	0	0	1	6	7	0	7	4
	K	0	1	0	0	0	10	10	0	11	5
	L	0	0	0	0	0	8	8	0	8	5
SE-1B-R2	E	0	0	0	0	0	4	4	0	4	2
	F	0	1	0	0	1	4	5	0	6	1
	G	0	1	0	0	0	8	8	0	9	1
	H	2	0	0	0	0	6	6	0	8	1
	I	0	0	0	0	1	7	8	0	8	4
	J	0	0	0	0	2	6	8	0	8	2
	K	0	0	0	0	0	7	7	0	7	2
	L	0	0	0	0	1	8	9	0	9	2

Table 3-8b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 1.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Dead Larvae[A]				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-1-R2	E	0	0	2	0	2	4	6	0	8	1
	F	2	0	0	0	0	10	10	0	12	3
	G	0	0	0	0	1	9	10	0	10	1
	H	0	0	0	0	0	8	8	0	8	1
	I	0	0	0	0	0	12	12	0	12	1
	J	0	0	0	0	0	7	7	0	7	2
	K	1	0	0	0	0	10	10	0	11	2
	L	0	3	0	0	0	7	7	0	10	4
SE-4-B6	E	0	1	0	0	1	6	7	0	8	3
	F	0	1	0	1	0	10	11	0	12	1
	G	0	0	0	0	0	8	8	0	8	1
	H	1	1	0	0	2	8	10	0	12	4
	I	1	0	1	0	1	9	10	0	12	5
	J	1	0	0	0	3	8	11	0	12	3
	K	1	0	0	1	3	6	10	0	11	3
	L	0	0	0	0	1	11	12	0	12	3

Table 3-8b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life cycle) test: Batch 1.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-6-B2	E	1	0	0	0	0	2	2	2	5	0
	F	0	0	0	0	0	4	4	2	6	3
	G	0	0	2	0	0	2	2	0	4	0
	H	0	0	1	0	1	4	5	0	6	1
	I	0	0	0	0	0	10	10	0	10	4
	J	0	0	1	0	1	9	10	1	12	5
	K	0	0	0	0	0	6	6	0	6	3
	L	0	0	0	0	1	10	11	0	11	4
SE-7-B5	E	2	0	0	0	0	4	4	0	6	1
	F	0	1	0	0	0	4	4	1	6	0
	G	0	0	0	0	0	2	2	1	3	1
	H	1	0	0	0	0	5	5	0	6	4
	I	0	0	0	0	0	3	3	0	3	1
	J	1	1	0	0	0	3	3	0	5	1
	K	0	0	0	0	0	3	3	0	3	2
	L	0	0	0	0	0	2	2	0	2	1

Table 3-8b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 1.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[E]	Total Emerged Adults[F]			
SE-8-B3	E	0	0	0	0	1	8	9	0	9	2
	F	1	0	0	0	0	5	5	1	7	3
	G	0	0	0	0	0	4	4	0	4	0
	H	0	0	0	0	0	8	8	0	8	2
	I	0	0	0	0	1	7	8	0	8	1
	J	0	0	0	0	0	7	7	0	7	3
	K	0	0	0	0	0	6	6	0	6	3
	L	0	0	0	0	0	7	7	0	7	3
SE-G-1	E	0	0	0	0	0	8	8	0	8	4
	F	0	0	0	0	1	10	11	0	11	1
	G	0	0	0	1	0	9	10	0	10	3
	H	1	0	0	0	0	9	9	0	10	2
	I	1	1	0	0	1	8	9	0	11	1
	J	0	1	0	0	1	4	5	0	6	3
	K	0	0	0	0	1	7	8	0	8	3
	L	0	0	0	0	0	9	9	0	9	3

Table 3-8b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 1.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-G-3	E	0	0	0	0	0	11	11	0	11	5
	F	0	0	1	0	1	8	9	0	10	6
	G	0	1	0	0	0	11	11	0	12	4
	H	0	1	0	0	1	8	9	0	10	4
	I	1	2	0	0	1	6	7	0	10	1
	J	0	0	0	0	0	10	10	0	10	1
	K	0	1	1	1	0	8	9	0	11	0
	L	0	0	0	0	0	11	11	0	11	1
SE-LAL-3	E	1	1	1	0	0	3	3	0	6	2
	F	0	0	0	0	0	5	5	0	5	0
	G	0	0	0	0	0	2	2	0	2	0
	H	0	0	1	0	0	4	4	0	5	2
	I	0	0	0	0	1	6	7	0	7	2
	J	0	1	0	0	0	7	7	0	8	1
	K	0	0	0	0	0	5	5	0	5	1
	L	0	0	0	1	0	7	8	0	8	3

Table 3-8b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 1.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-LAL-5	E	1	0	0	0	0	8	8	0	9	3
	F	0	0	0	0	0	5	5	0	5	0
	G	0	0	0	0	0	5	5	0	5	0
	H	0	0	0	0	0	7	7	0	7	3
	I	2	0	0	0	0	3	3	0	5	0
	J	1	0	0	0	1	7	8	0	9	0
	K	0	0	1	0	0	9	9	0	10	2
	L	0	0	0	0	0	0	0	0	0	0
SE-REF-10b	E	0	0	0	0	0	7	7	0	7	3
	F	1	0	0	0	0	8	8	0	9	1
	G	0	0	0	0	0	8	8	0	8	2
	H	0	0	0	0	0	9	9	0	9	2
	I	0	2	0	0	0	6	6	0	8	0
	J	1	0	0	0	1	8	9	0	10	3
	K	0	1	0	1	1	4	6	0	7	0
	L	0	1	1	0	0	5	5	0	7	2

Table 3-8b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 1.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-TRIB-3	E	0	1	0	0	0	5	5	0	6	1
	F	0	1	0	0	0	4	4	0	5	2
	G	0	0	0	0	1	6	7	0	7	2
	H	1	0	0	0	0	6	6	0	7	2
	I	0	0	0	0	1	8	9	0	9	4
	J	2	0	0	0	1	6	7	0	9	1
	K	0	0	0	0	1	11	12	0	12	3
	L	1	0	0	0	1	3	4	0	5	1

A – Dead Larvae = dead organisms removed from replicate during or at test termination.
B – Dead Pupae = dead organisms that did not emerge or partially emerge.
C – Dead organisms that had partially emerged = organisms that began to emerge, but died during the process.
D – Dead adults = organism that died on the same day as emergence and did not have the opportunity to mate.
E – Escaped adults = organism that escaped during transfer to mating chambers.
F – Retained adults = sum of male and female adults retained in the test replicate after emergence and placed in reproduction chambers.
G – Total emerged adults = sum of male and female adults retained in the test replicate after emergence + number of escaped adults + number of dead adults.
H – Larvae recovered at the end of the test = organism that did not go through pupation.
I – Total organisms recovered = Dead Larvae + Dead Pupae + Partially-Emerged Dead Organisms + Successfully Emerged Adults + Larvae Recovered at Test Termination.
J – Total egg masses = total number of primary egg masses.

Table 3-8c. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 1.						
Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
CTL-SS-B1	E	#1	1316	-	-	-
	F	#1	-	810	0	810
		#2	-	1703	297	1406
	G	#1	510	-	-	-
		#2	516	-	-	-
		#3	-	630	45	585
	H	#1	-	1102	3	1099
		#2	-	1716	32	1684
	I	#1	-	771	243	528
	J	#1	-	1455	1455	0[a]
	K	#1	-	597	597	0[b]
	L	-	-	-	-	-
CTL-QS-B1	E	#1	-	1463	140	1323
		#2	-	1189	305	884
		#3	-	256	33	223
		#4	-	774	106	668
		#5	788	-	-	-
	F	#1	558	-	-	-
		#2	-	1470	27	1443
		#3	-	1064	160	904
	G	-	-	-	-	-
	H	#1	1170	-	-	-
	I	#1	-	1376	260	1116
		#2	-	1290	1290	0[b]
	J	#1	-	876	72	804
	K	#1	-	1755	1695	60
		#2	354	-	-	-
	L	#1	-	1484	135	1349
		#2	319	-	-	-
		#3	-	1391	5	1386

Table 3-8c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 1.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-1-B5	E	#1	1071	-	-	-
	F	-	-	-	-	-
	G	#1	-	1376	601	775
	H	#1	-	147	79	68
	I	-	-	-	-	-
	J	#1	-	1394	80	1314
		#2	-	594	89	505
		#3	-	1294	70	1224
		#4	2003	-	-	-
	K	#1	328	-	-	-
		#2	-	1584	19	1565
		#3	-	1929	24	1905
		#4	-	1638	327	1311
		#5	-	1548	200	1348
	L	#1	-	2069	2069	0[b]
		#2	-	1920	204	1716
		#3	-	1163	58	1105
		#4	-	1265	73	1192
		#5	-	2556	534	2022
SE-1B-R2	E	#1	-	839	839	0[b]
		#2	-	379	379	0[a]
	F	#1	-	141	141	0[b]
	G	#1	874	-	-	-
	H	#5	-	2160	281	1879
	I	#1	-	1720	181	1539
		#2	-	268	51	217
		#3	-	1008	3	1005
		#4	-	738	3	735
	J	#1	-	1676	107	1569
		#2	-	2448	2448	0[b]
	K	#1	1225	-	-	-
		#2	-	1263	1263	0[b]
	L	#1	-	1105	58	1047
		#2	882	-	-	-

Table 3-8c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 1.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-1-R2	E	#1	-	1725	55	1670
	F	#1	-	768	154	614
		#2	-	388	388	0[a]
		#3	-	1536	128	1408
	G	#1	-	1400	103	1297
	H	#1	196	-	-	-
	I	#1	-	1322	678	644
	J	#1	374	-	-	-
		#2	-	1624	79	1545
	K	#1	-	981	30	951
		#2	1195	-	-	-
	L	#1	-	918	918	0[b]
		#2	-	828	828	0[b]
		#3	-	627	627	0[b]
		#4	-	931	931	0[b]

Table 3-8c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 1.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-4-B6	E	#1	-	1565	1565	0[a]
		#2	-	945	173	772
		#3	-	378	0	378
	F	#1	-	1935	141	1794
	G	#1	-	844	32	812
	H	#1	-	2871	1020	1851
		#2	548	-	-	-
		#3	-	860	2	858
		#4	742	-	-	-
	I	#1	-	1105	15	1090
		#2	-	1136	5	1131
		#3	-	1482	40	1442
		#4	-	2209	207	2002
		#5	-	1421	1421	0[a]
	J	#1	-	1513	9	1504
		#2	-	1232	30	1202
		#3	1320	-	-	-
	K	#1	-	1407	102	1305
		#2	258	-	-	-
		#3	-	1558	18	1540
	L	#1	-	1037	50	987
		#2	-	2091	39	2052
		#3	-	1554	59	1495

Table 3-8c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching Batch 1.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-6-B2	E	-	-	-	-	-
	F	#1	-	903	7	896
		#2	-	1510	1213	297
		#3	-	1232	1206	26
	G	-	-	-	-	-
	H	#1	640	-	-	-
	I	#1	-	1293	61	1232
		#2	-	2401	284	2117
		#3	-	3183	117	3066
		#4	-	1248	858	390
	J	#1	1216	-	-	-
		#2	-	1846	192	1654
		#3	862	-	-	-
		#4	-	741	410	331
		#5	949	-	-	-
	K	#1	-	1364	127	1237
		#2	-	1172	1172	0[a]
		#3	-	997	997	0[a]
	L	#1	206	-	-	-
		#2	-	1700	352	1348
		#3	-	794	166	628
		#4	2720	-	-	-
SE-7-B5	E	#1	224	-	-	-
	F	-	-	-	-	-
	G	#1	-	1740	11	1729
	H	#1	-	1397	1397	0[b]
		#2	-	1649	883	766
		#3	-	1729	1729	0[a]
		#4	-	1748	1121	627
	I	#1	1085	-	-	-
	J	#1	-	1313	0	1313
	K	#1	654	-	-	-
		#2	-	2596	66	2530
	L	#1	-	795	6	789

Table 3-8c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 1.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-8-B3	E	#1	-	1139	322	817
		#2	902	-	-	-
	F	#1	1217	-	-	-
		#2	884	-	-	-
		#3	389	-	-	-
	G	-	-	-	-	-
	H	#1	-	2965	742	2223
		#2	294	-	-	-
	I	#1	-	1401	38	1363
	J	#1	-	2622	173	2449
		#2	-	836	171	665
		#3	1669	-	-	-
	K	#1	-	1343	24	1319
		#2	-	1680	21	1659
		#3	-	278	11	267
	L	#1	-	1461	58	1403
		#2	-	2968	128	2840
		#3	-	2720	66	2654

Table 3-8c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 1.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-G-1	E	#1	-	1778	865	913
		#2	-	946	946	0[a]
		#3	-	1031	4	1027
		#4	269	-	-	-
	F	#1	-	960	146	814
	G	#1	-	945	201	744
		#2	384	-	-	-
		#3	-	977	52	925
	H	#1	-	900	13	887
		#2	-	388	11	377
	I	#1	-	1634	104	1530
	J	#1	-	1345	43	1302
		#2	-	946	3	943
		#3	-	2197	2197	0[a]
	K	#1	-	1224	12	1212
		#2	-	700	65	635
		#3	1726	-	-	-
	L	#1	-	1098	5	1093
		#2	-	1003	98	905
		#3	674	-	-	-

Table 3-8c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 1.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-G-3	E	#1	-	1111	18	1093
		#2	168	-	-	-
		#3	-	1102	1102	0[a]
		#4	-	190	190	0[a]
		#5	-	2982	1683	1299
	F	#1	-	1323	866	457
		#2	-	1067	84	983
		#3	283	-	-	-
		#4	-	1273	1273	0[a]
		#5	-	2050	1954	96
		#6	-	229	225	4
	G	#1	-	1100	58	1042
		#2	-	1617	611	1006
		#3	-	1128	218	910
		#4	-	1517	0	1517
	H	#1	-	782	131	651
		#2	-	928	444	484
		#3	-	1110	102	1008
		#4	969	-	-	-
	I	#1	-	1072	49	1023
	J	#1	-	1638	152	1486
	K	-	-	-	-	-
	L	#1	-	1126	64	1062
SE-LAL-3	E	#1	-	1669	1669	0[b]
		#2	889	-	-	-
	F	-	-	-	-	-
	G	-	-	-	-	-
	H	#1	-	1680	912	768
		#2	-	1955	260	1695
	I	#1	-	1227	1	1226
		#2	-	1346	77	1269
	J	#1	-	950	10	940
	K	#1	-	1109	32	1077
	L	#1	-	2207	162	2045
		#2	206	-	-	-
		#3	-	388	388	0[a]

Table 3-8c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 1.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-LAL-5	E	#1	-	2018	120	1898
		#2	-	1240	226	1014
		#3	-	1180	1	1179
	F	-	-	-	-	-
	G	-	-	-	-	-
	H	#1	-	1402	831	571
		#2	-	1778	276	1502
		#3	364	-	-	-
	I	-	-	-	-	-
	J	-	-	-	-	-
	K	#1	-	1207	699	508
		#2	-	1576	87	1489
	L	-	-	-	-	-
SE-REF-10b	E	#1	1128	-	-	-
		#2	-	1183	14	1169
		#3	-	1584	114	1470
	F	#1	-	2600	310	2290
	G	#1	363	-	-	-
		#2	-	905	42	863
	H	#1	-	1632	467	1165
		#2	-	292	200	92
	I	-	-	-	-	-
	J	#1	-	1247	10	1237
		#2	-	2040	18	2022
		#3	-	1879	47	1832
	K	-	-	-	-	-
	L	#1	-	2230	440	1790
		#2	-	1879	55	1824

Table 3-8c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 1.						
Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-TRIB-3	E	#1	-	1688	21	1667
	F	#1	-	206	206	0[a]
		#2	870	-	-	-
	G	#1	-	539	539	0[a]
		#2	-	1350	10	1340
	H	#1	1864	-	-	-
		#2	-	1025	0	1025
	I	#1	-	1278	53	1225
		#2	-	1632	87	1545
		#3	-	666	17	649
		#4	-	2430	128	2302
	J	#1	-	1591	194	1397
	K	#1	-	1197	169	1028
		#2	-	1122	61	1061
		#3	-	2821	131	2690
	L	#1	-	1580	15	1565

a – No eggs hatched. A male was present at some point prior to the egg case being laid; as no eggs hatched, fertilization could not be confirmed.
b – No male in R/O flask to fertilize eggs. Egg case likely not fertilized.

Table 3-9a. Effects of UCR sediments on *Chironomus dilutus* Day 16 survival and growth in long-term (life-cycle) tests: Batch 2.

Site ID	# of Surviving Organisms[A]					Mean Individual Ash-Free Dry Wt (mg per individual)					Mean Ash-Free Biomass[B] (mg total dry weight)				
	Rep A	Rep B	Rep C	Rep D	**Mean**	Rep A	Rep B	Rep C	Rep D	**Mean**	Rep A	Rep B	Rep C	Rep D	**Mean**
CTL-SS-B2	12	11	11	12	**11.5**	1.603	1.475	1.495	1.680	**1.563**	1.603	1.353	1.370	1.680 [D]	**1.502**
CTL-QS-B2	12	10	11	12	**11.3**	1.549	1.946	1.625	1.400	**1.630**	1.549	1.592 [D]	1.490	1.400	**1.508**
SE-2-B1	11	12	10	11	**11.0**	1.765	1.274	1.496	2.284	**1.704**	1.618	1.274 [C]	1.224 [D]	2.030 [E]	**1.536**
SE-2-R1	10	12	12	11	**11.3**	1.503	1.350	1.301	1.628	**1.445**	1.202 [C]	1.350 [C]	1.301 [D]	1.480 [D]	**1.333**
SE-3-R7	12	11	12	10	**11.3**	1.756	1.569	1.486	1.863	**1.668**	1.756	1.438	1.486	1.553	**1.558**
SE-4-B1	11	12	11	11	**11.3**	1.568	1.320	1.545	1.482	**1.479**	1.438	1.320	1.416	1.358	**1.383**
SE-5-B2	13	9	12	12	**11.5**	0.962	1.414	1.012	1.149	**1.134**	0.962	1.061	1.012	1.149	**1.046**
SE-8-B2	9	12	9	12	**10.5**	2.006	1.408	2.293	1.858	**1.891**	1.504	1.408	1.720	1.858	**1.622**
SE-LAL-2	12	10	10	12	**11.0**	1.503	1.823	2.004	1.233	**1.641**	1.503	1.519	1.670	1.233	**1.481**
SE-G-1	11	13	11	12	**11.8**	1.294	1.438	1.196	1.333	**1.315**	1.186	1.438	1.097	1.333	**1.263**
SE-G-3	11	11	11	12	**11.3**	1.852	1.428	1.645	1.563	**1.622**	1.667 [F]	1.269 [G]	1.500 [H]	1.563	**1.500**
SE-LAL-3	12	11	12	12	**11.8**	1.638	1.910	1.798	1.838	**1.796**	1.638 [D]	1.751	1.798	1.838	**1.756**
SE-LAL-5	12	10	11	12	**11.3**	2.328	1.729	1.827	1.891	**1.944**	2.328	1.441	1.675	1.891	**1.834**
SE-REF-10b	12	11	12	12	**11.8**	1.425	1.313	1.310	1.694	**1.436**	1.425	1.182 [C]	1.310 [C]	1.694	**1.403**
SE-TRIB-3	10	12	12	12	**11.5**	1.565	1.049	1.591	1.240	**1.361**	1.304	1.049	1.591	1.240	**1.296**

A – Tests were initiated with 12 organisms in each replicate.
B – Biomass = total weight of organisms/number of organisms loaded at test initiation.
C – 2 pupae observed during the test; ash-free biomass is based on 10 instead of 12 initial larvae.
D – 1 pupae observed during the test; ash-free biomass is based on 11 instead of 12 initial larvae.
E – 2 pupae and 1 adult observed during the test; ash-free biomass is based on 9 instead of 12 initial larvae.
F – 1 pupae and 1 adult observed during the test; ash-free biomass is based on 10 instead of 12 initial larvae.
G – 3 pupae observed during the test; ash-free biomass is based on 9 instead of 12 initial larvae.
H – 1 adult observed during the test; ash-free biomass is based on 11 instead of 12 initial larvae.

Table 3-9b. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 2.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
CTL-SS-B2	E	0	0	1	0	1	6	7	0	8	3
	F	0	0	0	0	1	7	8	0	8	3
	G	0	1	0	0	0	6	6	0	7	2
	H	0	1	0	0	0	6	6	0	7	1
	I	0	0	1	0	0	6	6	0	7	1
	J	0	1	0	0	0	8	8	0	9	1
	K	0	0	0	0	0	5	5	0	5	0
	L	0	1	0	0	0	9	9	0	10	3
CTL-QS-B2	E	0	3	0	0	2	5	7	0	10	2
	F	0	0	0	0	0	11	11	0	11	2
	G	0	0	0	0	1	7	8	0	8	0
	H	0	0	0	1	1	10	12	1	13	1
	I	0	0	0	0	0	12	12	0	12	3
	J	0	0	0	0	1	8	9	0	9	1
	K	0	1	1	0	0	9	9	0	11	1
	L	0	0	0	0	1	11	12	0	12	2

Table 3-9b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 2.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-2-B1	E	1	0	0	0	1	9	10	0	11	4
	F	0	0	0	0	1	7	8	0	8	1
	G	0	0	0	0	0	3	3	0	3	0
	H	0	0	0	0	0	8	8	0	8	2
	I	0	1	0	0	0	7	7	0	8	2
	J	0	0	0	1	0	7	8	0	8	2
	K	1	0	0	0	0	8	8	0	9	4
	L	0	0	0	1	1	7	9	0	9	1
SE-2-R1	E	0	0	0	1	0	8	9	0	9	1
	F	1	0	1	0	0	10	10	0	12	2
	G	0	0	0	0	2	10	12	0	12	1
	H	0	0	0	0	0	9	9	0	9	2
	I	0	0	0	1	0	6	7	0	7	2
	J	0	0	0	0	0	11	11	0	11	4
	K	0	0	0	0	0	9	9	0	9	1
	L	0	0	0	1	1	7	9	0	9	1

Table 3-9b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 2.											
Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-3-R7	E	0	0	0	0	2	7	9	0	9	2
	F	0	0	0	0	0	8	8	0	8	3
	G	2	0	0	0	0	10	10	1	13	0
	H	1	1	0	0	2	7	9	0	11	1
	I	0	0	0	0	3	7	10	0	10	0
	J	0	0	0	0	2	6	8	0	8	2
	K	0	0	0	0	0	10	10	0	10	5
	L	0	0	0	0	0	7	7	0	7	2
SE-4-B1	E	0	0	0	0	1	9	10	0	10	4
	F	0	0	0	0	0	9	9	0	9	2
	G	0	1	1	0	0	8	8	0	10	3
	H	0	0	0	0	0	7	7	0	7	0
	I	2	0	0	0	0	7	7	0	9	1
	J	1	1	0	0	0	7	7	0	9	3
	K	0	0	1	0	0	9	9	0	10	2
	L	2	0	0	0	1	6	7	0	9	4

Table 3-9b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 2.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-5-B2	E	0	0	1	0	0	5	5	0	6	0
	F	0	0	0	1	1	7	9	0	9	5
	G	0	0	0	0	0	10	10	0	10	2
	H	0	0	1	0	0	11	11	0	12	2
	I	0	0	0	1	0	9	10	0	10	1
	J	0	0	1	1	0	9	10	0	11	5
	K	0	0	0	1	1	7	9	0	9	2
	L	0	0	0	0	0	8	8	0	8	2
SE-8-B2	E	0	0	0	2	0	9	11	0	11	1
	F	0	0	0	0	0	9	9	0	9	3
	G	0	1	2	1	0	7	8	0	11	2
	H	0	0	0	0	2	9	11	0	11	2
	I	0	0	0	0	0	5	5	0	5	3
	J	1	0	0	0	0	6	6	0	7	1
	K	0	0	0	3	0	6	9	0	9	3
	L	0	0	0	0	0	6	6	0	6	3

Table 3-9b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 2.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-LAL-2	E	0	0	0	0	0	7	7	0	7	2
	F	0	0	1	1	0	5	6	0	7	1
	G	0	0	0	0	0	11	11	0	11	2
	H	0	0	0	0	0	9	9	0	9	0
	I	0	0	1	0	0	10	10	0	11	5
	J	0	2	1	0	0	7	7	0	10	2
	K	0	0	1	0	0	8	8	0	9	3
	L	0	1	1	0	1	8	9	0	11	3
SE-G-1	E	0	1	0	0	0	11	11	0	12	3
	F	0	0	0	0	0	12	12	0	12	7
	G	0	1	0	0	1	7	8	0	9	3
	H	0	0	0	0	0	8	8	0	8	4
	I	0	1	0	0	0	9	9	0	10	2
	J	0	0	0	0	0	9	9	0	9	4
	K	0	1	1	0	0	7	7	0	9	1
	L	0	0	0	0	0	7	7	0	7	3

Table 3-9b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 2.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-G-3	E	0	2	0	0	1	6	7	0	9	0
	F	0	0	0	0	1	9	10	0	10	2
	G	0	0	1	0	0	8	8	0	9	1
	H	0	0	0	0	0	8	8	0	8	2
	I	0	0	0	0	3	9	12	0	12	3
	J	0	0	0	0	0	8	8	0	8	3
	K	0	2	1	0	0	5	5	0	8	4
	L	0	0	0	0	0	9	9	0	9	3
SE-LAL-3	E	0	0	1	0	0	8	8	0	9	2
	F	0	1	0	0	0	9	9	0	10	2
	G	0	0	0	0	1	7	8	0	8	5
	H	0	0	0	0	0	8	8	0	8	2
	I	0	0	0	0	0	11	11	0	11	2
	J	0	0	0	0	2	11	13	0	13	4
	K	0	0	0	0	0	9	9	0	9	2
	L	0	0	0	0	0	7	7	0	7	4

Table 3-9b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 2.											
Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-LAL-5	E	0	0	1	0	0	8	8	0	9	5
	F	0	0	0	0	1	5	6	0	6	2
	G	0	0	0	0	0	8	8	0	8	4
	H	0	0	0	0	1	8	9	0	9	4
	I	0	0	0	0	0	6	6	0	6	0
	J	0	0	0	0	0	7	7	0	7	1
	K	0	0	0	0	0	6	6	0	6	1
	L	0	0	0	0	0	6	6	0	6	1
SE-REF-10b	E	0	0	0	0	0	8	8	0	8	2
	F	0	0	0	0	0	11	11	0	11	3
	G	0	0	0	0	0	9	9	0	9	4
	H	0	0	0	0	0	8	8	1	9	3
	I	1	0	0	0	0	7	7	0	8	1
	J	0	0	0	0	0	10	10	0	10	3
	K	0	0	0	0	0	8	8	0	8	2
	L	0	0	0	0	1	8	9	0	9	4

Table 3-9b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 2.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-TRIB-3	E	0	1	0	1	1	6	8	0	9	2
	F	0	0	0	0	1	7	8	0	8	2
	G	0	2	0	0	0	9	9	0	11	3
	H	0	3	0	0	0	7	7	0	10	1
	I	0	1	0	0	0	6	6	0	7	1
	J	0	1	0	0	1	7	8	0	9	2
	K	0	1	0	0	0	9	9	0	10	0
	L	0	0	0	0	0	10	10	0	10	1

A – Dead Larvae = dead organisms removed from replicate during or at test termination.
B – Dead Pupae = dead organisms that did not emerge or partially emerge.
C – Dead organisms that had partially emerged = organisms that began to emerge, but died during the process.
D – Dead adults = organism that died on the same day as emergence and did not have the opportunity to mate.
E – Escaped adults = organism that escaped during transfer to mating chambers.
F – Retained adults = sum of male and female adults retained in the test replicate after emergence and placed in reproduction chambers.
G – Total emerged adults = sum of male and female adults retained in the test replicate after emergence + number of escaped adults + number of dead adults.
H – Larvae recovered at the end of the test = organism that did not go through pupation.
I – Total organisms recovered = Dead Larvae + Dead Pupae + Partially-Emerged Dead Organisms + Successfully Emerged Adults + Larvae Recovered at Test Termination.
J – Total egg masses = total number of primary egg masses.

Table 3-9c. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 2.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
CTL-SS-B2	E	#1	-	1323	67	1256
		#2	1265	-	-	-
		#3	-	1687	148	1539
	F	#1	-	1368	107	1261
		#2	-	735	145	590
		#3	656	-	-	-
	G	#1	-	1046	1046	0[a]
		#2	-	1546	473	1073
	H	#1	1042	-	-	-
	I	#1	-	988	112	876
	J	#1	-	950	105	845
	K	#1	-	-	-	-
	L	#1	-	1768	60	1708
		#2	-	1302	49	1253
		#3	1309	-	-	-
CTL-QS-B2	E	#1	286	-	-	-
		#2	-	278	9	269
	F	#1	841	-	-	-
		#2	-	1208	88	1120
	G	-	-	-	-	-
	H	#1	1043	-	-	-
	I	#1	-	1767	114	1653
		#2	-	1995	195	1800
		#3	1099	-	-	-
	J	#1	-	1188	45	1143
	K	#1	79	-	-	-
	L	#1	-	2112	66	2046
		#2	-	1610	270	1340

Table 3-9c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 2.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-2-B1	E	#1	-	1099	39	1060
		#2	-	1888	124	1764
		#3	-	406	3	403
		#4	-	1190	286	904
	F	#1	714	-	-	-
	G	-	-	-	-	-
	H	#1	-	1445	563	882
		#2	-	1944	621	1323
	I	#1	-	1104	66	1038
		#2	-	1546	121	1425
	J	#1	352	-	-	-
		#2	-	1930	1930	0[a]
	K	#1	-	1763	64	1699
		#2	-	216	0	216
		#3	-	1693	170	1523
		#4	338	-	-	-
	L	#1	-	1632	1632	0[a]
SE-2-R1	E	#1	-	1421	48	1373
	F	#1	-	1250	195	1055
		#2	570	-	-	-
	G	#1	-	2277	2277	0[b]
	H	#1	-	1215	1180	35
		#2	1130	-	-	-
	I	#1	-	1733	185	1548
		#2	-	1722	303	1419
	J	#1	-	1008	110	898
		#2	-	1318	4	1314
		#3	-	997	0	997
		#4	-	870	870	0[a]
	K	#1	-	2153	2153	0[a]
	L	#1	1259	-	-	-

Table 3-9c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 2.						
Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-3-R7	E	#1	-	1005	87	918
		#2	-	1363	172	1191
	F	#1	202	-	-	-
		#2	-	1910	1910	0[a]
		#3	-	1600	352	1248
	G	-	-	-	-	-
	H	#1	-	2115	133	1982
	I	-	-	-	-	-
	J	#1	1071	-	-	-
		#2	1723	-	-	-
	K	#1	-	1160	263	897
		#2	-	1091	70	1021
		#3	-	894	894	0[a]
		#4	804	-	-	-
		#5	-	1619	104	1515
	L	#1	1620	-	-	-
		#2	-	1498	1498	0[a]

Table 3-9c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 2.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-4-B1	E	#1	-	1430	119	1311
		#2	-	1374	352	1022
		#3	-	1845	292	1553
		#4	-	1938	147	1791
	F	#1	-	1628	35	1593
		#2	1026	-	-	-
	G	#1	-	1256	368	888
		#2	-	1017	1017	0[a]
		#3	-	1597	11	1586
	H	-	-	-	-	-
	I	#1	-	1786	314	1472
	J	#1	-	1044	130	914
		#2	-	718	33	685
		#3	-	1289	212	1077
	K	#1	-	963	93	870
		#2	-	1535	436	1099
	L	#1	-	1849	1849	0[b]
		#2	-	1602	296	1306
		#3	-	2179	101	2078
		#4	-	2208	124	2084

Table 3-9c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 2.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-5-B2	E	-	-	-	-	-
	F	#1	736	-	-	-
		#2	1841	-	-	-
		#3	-	1309	52	1257
		#4	-	1900	118	1782
		#5	-	1034	1034	0[a]
	G	#1	-	902	902	0[a]
		#2	-	2520	8	2512
	H	#1	-	2450	190	2260
		#2	-	2071	14	2057
	I	#1	1029	-	-	-
	J	#1	-	1794	53	1741
		#2	-	1184	45	1139
		#3	-	1297	258	1039
		#4	-	1746	294	1452
		#5		2093	706	1387
	K	#1	-	1190	49	1141
		#2	-	1888	50	1838
	L	#1	-	1798	10	1788
		#2	-	910	87	823

Table 3-9c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 2.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-8-R2	E	#1	214	-	-	-
	F	#1	-	568	43	525
		#2	680	-	-	-
		#3	-	2284	0	2284
	G	#1	1071	-	-	-
		#2	-	1892	1892	0[b]
	H	#1	-	2409	72	2337
		#2	1040	-	-	-
	I	#1	-	770	770	0[b]
		#2	-	1056	1056	0[b]
		#3	1083	-	-	-
	J	#1	-	2331	2331	0[b]
	K	#1	-	1298	589	709
		#2	-	1399	377	1022
		#3	-	1398	1398	0[b]
	L	#1	-	704	49	655
		#2	864	-	-	-
		#3	-	2184	71	2113

Table 3-9c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 2.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-LAL-2	E	#1	-	1469	1469	0[a]
		#2	-	619	277	342
	F	#1	-	1775	229	1546
	G	#1	-	1483	946	537
		#2	-	2068	216	1852
	H	-	-	-	-	-
	I	#1	-	834	834	0[a]
		#2	-	1434	1434	0[a]
		#3	-	2372	57	2315
		#4	-	3663	346	3317
		#5	328	-	-	-
	J	#1	-	1247	112	1135
		#2	-	877	220	657
	K	#1	1149	-	-	-
		#2	-	510	8	502
		#3	-	2108	30	2078
	L	#1	-	2016	140	1876
		#2	-	2307	97	2210
		#3	349	-	-	-

Table 3-9c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 2.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-G-1	E	#1	-	1312	18	1294
		#2	1388	-	-	-
		#3	-	2394	58	2336
	F	#1	-	1172	29	1143
		#2	-	1702	31	1671
		#3	-	1418	95	1323
		#4	-	2037	43	1994
		#5	-	800	0	800
		#6	-	1018	230	788
		#7	-	728	0	728
	G	#1	-	2070	76	1994
		#2	944	-	-	-
		#3	-	1008	74	934
	H	#1	-	1949	127	1822
		#2	-	1679	71	1608
		#3	-	1375	364	1011
		#4	-	2635	112	2523
	I	#1	-	2602	91	2511
		#2	334	-	-	-
	J	#1	-	946	946	0[b]
		#2	-	1804	114	1690
		#3	-	1344	54	1290
		#4	-	546	45	501
	K	#1	1792	-	-	-
	L	#1	602	-	-	-
		#2	-	925	176	749
		#3	2119	-	-	-

Table 3-9c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 2.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-G-3	E	-	-	-	-	-
	F	#1	-	924	71	853
		#2	-	1525	30	1495
	G	#1	-	274	2	272
	H	#1	940	-	-	-
		#2	-	1708	550	1158
	I	#1	-	1088	380	708
		#2	-	710	81	629
		#3	-	1054	108	946
	J	#1	-	940	214	726
		#2	-	602	4	598
		#3	-	1288	134	1154
	K	#1	-	889	79	810
		#2	-	1207	72	1135
		#3	-	1156	0	1156
		#4	-	749	300	449
	L	#1	-	1230	190	1040
		#2	-	1449	98	1351
		#3	-	1240	249	991

Table 3-9c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 2.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-LAL-3	E	#1	-	1105	604	501
		#2	-	1588	483	1105
	F	#1	438	-	-	-
		#2	-	1785	133	1652
	G	#1	-	2334	153	2181
		#2	-	1253	178	1075
		#3	-	2034	2034	0[b]
		#4	-	1484	392	1092
		#5	-	490	3	487
	H	#1	-	729	729	0[a]
		#2	-	740	2	738
	I	#1	529	-	-	-
		#2	1146	-	-	-
	J	#1	-	670	47	623
		#2	2346	-	-	-
		#3	1017	-	-	-
		#4	-	1620	0	1620
	K	#1	-	669	439	230
		#2	692	-	-	-
	L	#1	-	1129	19	1110
		#2	1309	-	-	-
		#3	-	2200	159	2041
		#4	-	1196	192	1004

Table 3-9c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 2.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-LAL-5	E	#1	-	1270	1270	0[a]
		#2	-	1862	1862	0[a]
		#3	1165	-	-	-
		#4	-	1476	247	1229
		#5	216	-	-	-
	F	#1	1072	-	-	-
		#2	-	1024	1024	0[b]
	G	#1	-	1339	78	1261
		#2	-	2094	291	1803
		#3	-	866	131	735
		#4	-	2365	129	2236
	H	#1	-	784	71	713
		#2	-	1358	464	894
		#3	-	1084	303	781
		#4	-	1571	334	1237
	I	-	-	-	-	-
	J	#1	2365	-	-	-
	K	#1	-	1778	124	1654
	L	#1	-	1312	423	889

Table 3-9c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 2.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-REF-10b	E	#1	-	819	28	791
		#2	-	1492	211	1281
	F	#1	-	1010	61	949
		#2	-	902	94	808
		#3	-	2469	668	1801
	G	#1	1659	-	-	-
		#2	-	2728	101	2627
		#3	-	866	110	756
		#4	1545	-	-	-
	H	#1	-	1045	294	751
		#2	-	1760	61	1699
		#3	-	1612	118	1494
	I	#1	-	1616	65	1551
	J	#1	-	1471	490	981
		#2	2108	-	-	-
		#3	-	2016	150	1866
	K	#1	-	1215	150	1065
		#2	832	-	-	-
	L	#1	-	1677	55	1622
		#2	-	1318	137	1181
		#3	-	1339	51	1288
		#4	-	1386	15	1371

Table 3-9c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 2.						
Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-TRIB-3	E	#1	-	2250	116	2134
		#2	-	1245	116	1129
	F	#1	1326	-	-	-
		#2	-	1883	457	1426
	G	#1	-	952	628	324
		#2	-	2442	2420	22
		#3	-	476	41	435
	H	#1	-	1008	104	904
	I	#1	-	1159	650	509
	J	#1	1020	-	-	-
		#2	-	2300	223	2077
	K	-	-	-	-	-
	L	#1	-	1346	74	1272

a – No eggs hatched. A male was present at some point prior to the egg case being laid; as no eggs hatched, fertilization could not be confirmed.
b – No male in R/O flask to fertilize eggs. Egg case likely not fertilized.

Table 3-10a. Effects of UCR sediments on *Chironomus dilutus* Day 16 survival and growth in long-term (life-cycle) tests: Batch 3.															
Site ID	# of Surviving Organisms[A]					Mean Individual Ash-Free Dry Wt (mg per individual)					Mean Ash-Free Biomass[B] (mg total dry weight)				
	Rep A	Rep B	Rep C	Rep D	**Mean**	Rep A	Rep B	Rep C	Rep D	**Mean**	Rep A	Rep B	Rep C	Rep D	**Mean**
CTL-SS-B3	12	13	11	12	**12.0**	1.564	1.463	1.802	1.603	**1.608**	1.564	1.463 [D]	1.652	1.603	**1.571**
CTL-QS-B3	12	11	7	11	**10.3**	0.984	1.066	0.920	1.218	**1.047**	0.984	0.978	0.537	1.117	**0.904**
SE-3-B3	11	8	7	10	**9.0**	1.182	0.888	0.940	1.773	**1.196**	1.083	0.592	0.548	1.478	**0.925**
SE-3-R8	9	8	6	7	**7.5**	0.861	0.769	1.273	0.619	**0.880**	0.646	0.512	0.637	0.361	**0.539**
SE-4-B5	12	10	11	10	**10.8**	1.259	1.471	1.503	1.551	**1.446**	1.259	1.226	1.378	1.293	**1.289**
SE-5-B4	10	10	9	9	**9.5**	1.674	1.615	1.978	1.631	**1.724**	1.395	1.346	1.483	1.223	**1.362**
SE-6-B5	15	12	9	8	**11.0**	1.008	0.919	1.482	1.340	**1.187**	1.008	0.919	1.112	0.893	**0.983**
SE-7-B2	11	9	6	10	**9.0**	1.275	1.234	1.573	1.429	**1.378**	1.168	0.926	0.787	1.191	**1.018**
SE-G-2	11	8	10	9	**9.5**	1.051	1.576	1.394	1.543	**1.391**	0.963	1.051	1.162	1.158	**1.083**
SE-G-1	12	12	12	12	**12.0**	1.311	1.126	1.110	1.438	**1.246**	1.311	1.126	1.110	1.438	**1.246**
SE-G-3	11	12	11	11	**11.3**	1.005	1.140	1.063	1.163	**1.093**	0.922	1.140	0.974	1.066	**1.025**
SE-LAL-3	10	8	7	8	**8.3**	1.227	1.655	1.751	1.541	**1.544**	1.023	1.103	1.022	1.028	**1.044**
SE-LAL-5	7	7	7	5	**6.5**	1.646	1.913	1.453	1.526	**1.634**	0.960	1.116	0.847	0.636	**0.890**
SE-REF-10b	12	12	12	12	**12.0**	1.478	1.548	1.560	1.668	**1.563**	1.478	1.548	1.560	1.668	**1.563**
SE-TRIB-3	12	12	11	10	**11.3**	1.541	1.456	1.615	1.486	**1.524**	1.541	1.456	1.468 [C]	1.238	**1.426**

A – Tests were initiated with 12 organisms in each replicate.
B – Biomass = total weight of organisms/number of organisms loaded at test initiation.
C – 1 pupae observed during the test; ash-free biomass is based on 11 instead of 12 initial larvae.
D – 1 pupae observed during the test; ash-free biomass is based on 12 instead of 13 initial larvae.

Table 3-10b. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 3.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
CTL-SS-B3	E	0	0	0	0	0	10	10	0	10	4
	F	0	0	0	0	1	8	9	0	9	3
	G	0	1	0	0	0	10	10	0	11	3
	H	0	0	0	0	1	8	9	0	9	2
	I	0	0	0	0	0	10	10	0	10	4
	J	0	0	0	0	1	7	8	0	8	1
	K	1	0	0	0	1	4	5	0	6	2
	L	0	0	0	0	0	7	7	0	7	4
CTL-QS-B3	E	0	0	0	0	1	7	8	0	8	4
	F	0	0	0	0	0	10	10	0	10	4
	G	0	1	0	0	1	8	9	0	10	2
	H	0	0	0	0	0	7	7	0	7	3
	I	0	0	0	0	1	5	6	0	6	1
	J	0	1	0	0	0	5	5	0	6	1
	K	0	2	0	0	0	6	6	0	8	0
	L	0	0	0	0	0	9	9	0	9	4

Table 3-10b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 3.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-3-B3	E	0	0	0	0	1	8	9	0	9	1
	F	0	0	0	0	1	6	7	0	7	2
	G	0	0	0	0	0	7	7	0	7	1
	H	0	0	0	0	0	7	7	0	7	3
	I	0	0	0	0	0	8	8	0	8	3
	J	0	0	0	0	1	10	11	0	11	6
	K	0	0	0	0	0	6	6	0	6	3
	L	0	0	0	0	1	11	12	0	12	5
SE-3-R8	E	0	0	0	0	0	8	8	0	8	1
	F	0	0	0	0	0	6	6	0	6	3
	G	0	0	0	0	0	7	7	0	7	2
	H	0	0	0	0	0	6	6	0	6	3
	I	0	0	0	0	0	8	8	0	8	2
	J	0	0	0	0	0	5	5	0	5	1
	K	0	0	0	0	2	4	6	0	6	2
	L	0	0	0	0	0	8	8	0	8	2

Table 3-10b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 3.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-4-B5	E	0	0	0	0	0	10	10	0	10	3
	F	1	0	0	0	0	8	8	0	9	2
	G	0	0	0	0	0	10	10	0	10	1
	H	0	1	0	0	1	6	7	0	8	1
	I	0	0	0	0	0	8	8	0	8	2
	J	0	0	0	0	0	8	8	0	8	3
	K	0	1	0	0	1	8	9	0	10	2
	L	0	0	0	0	0	9	9	0	9	6
SE-5-B4	E	0	0	0	0	0	5	5	0	5	0
	F	0	1	0	1	1	4	6	0	7	1
	G	0	0	1	0	0	2	2	0	3	0
	H	0	0	0	0	0	5	5	0	5	2
	I	0	1	0	0	1	3	4	0	5	0
	J	0	0	0	0	1	7	8	0	8	3
	K	0	0	0	0	0	2	2	0	2	1
	L	0	0	0	0	0	3	3	0	3	2

Table 3-10b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 3.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-6-B5	E	0	1	0	0	0	6	6	0	7	2
	F	0	2	0	0	1	4	5	0	7	1
	G	0	1	0	0	0	4	4	0	5	0
	H	0	0	0	0	0	7	7	0	7	3
	I	0	0	0	0	1	4	5	0	5	3
	J	0	0	1	0	2	6	8	0	9	3
	K	0	1	0	0	0	5	5	0	6	2
	L	0	1	1	0	0	3	3	0	5	1
SE-7-B2	E	0	0	0	0	0	7	7	0	7	2
	F	0	1	0	0	0	6	6	0	7	1
	G	0	0	0	0	0	7	7	0	7	2
	H	0	1	0	0	0	4	4	0	5	1
	I	0	1	0	0	0	6	6	0	7	3
	J	0	0	0	0	0	8	8	0	8	6
	K	0	0	0	0	0	9	9	0	9	3
	L	0	0	0	0	1	4	5	0	5	4

Table 3-10b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 3.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-G-2	E	0	0	1	0	0	6	6	0	7	4
	F	1	0	0	0	0	8	8	0	9	3
	G	0	1	0	0	0	7	7	0	8	2
	H	0	0	0	0	1	10	11	0	11	4
	I	0	0	0	0	0	9	9	0	9	3
	J	0	0	0	0	1	10	11	0	11	6
	K	0	2	0	0	1	9	10	0	12	3
	L	1	0	0	0	1	10	11	2	14	4
SE-G-1	E	0	0	1	0	1	10	11	0	12	5
	F	0	1	0	0	0	10	10	0	11	3
	G	0	1	0	0	1	10	11	0	12	4
	H	0	1	0	0	0	10	10	0	11	4
	I	0	0	0	0	2	9	11	0	11	2
	J	0	0	0	0	0	11	11	0	11	4
	K	2	0	0	0	1	9	10	1	13	3
	L	0	0	0	1	0	12	13	0	13	5

Table 3-10b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 3.											
		Emergence and Reproduction Summary									
					# of Successfully Emerged Adults						
Site ID	Replicate	# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]	# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
SE-G-3	E	0	0	0	0	1	8	9	0	9	2
	F	0	0	0	1	1	7	9	0	9	1
	G	0	0	0	0	2	7	9	0	9	3
	H	0	0	0	0	0	7	7	0	7	1
	I	0	0	0	0	1	8	9	0	9	3
	J	0	0	0	0	0	11	11	0	11	4
	K	0	0	0	0	1	9	10	0	10	2
	L	0	0	0	0	2	9	11	0	11	1
SE-LAL-3	E	0	1	0	0	0	7	7	0	8	2
	F	0	0	0	0	0	4	4	0	4	1
	G	0	0	0	0	0	3	3	0	3	0
	H	0	0	0	0	0	8	8	0	8	2
	I	1	0	0	0	0	8	8	0	9	1
	J	0	0	0	0	2	7	9	0	9	0
	K	0	0	0	0	0	5	5	0	5	0
	L	0	0	0	0	0	8	8	0	8	1

Table 3-10b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 3.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-LAL-5	E	1	0	0	0	0	5	5	0	6	1
	F	0	0	0	0	0	8	8	0	8	2
	G	0	0	0	1	1	4	6	0	6	1
	H	0	1	0	0	0	4	4	0	5	1
	I	0	0	0	0	1	4	5	0	5	2
	J	0	1	0	0	0	8	8	0	9	2
	K	0	0	0	0	0	6	6	0	6	3
	L	0	0	0	0	1	6	7	0	7	5
SE-REF-10b	E	0	0	0	0	0	5	5	0	5	2
	F	0	0	0	0	0	9	9	0	9	1
	G	0	1	0	0	0	8	8	0	9	3
	H	0	0	0	1	0	8	9	0	9	1
	I	2	0	0	0	0	0	0	0	2	0
	J	0	0	0	0	0	6	6	0	6	2
	K	0	0	0	1	0	4	5	0	5	1
	L	0	2	0	0	0	7	7	0	9	1

Table 3-10b *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in long-term (life-cycle) tests: Batch 3.

Site ID	Replicate	Emergence and Reproduction Summary									
		# of Dead Larvae[A]	# of Dead Pupae[B]	# of Dead Organisms that had Partially Emerged[C]	# of Successfully Emerged Adults				# of Larvae Recovered at the End of the Test[H]	Total # of Organisms Recovered[I]	Total # of Egg Masses[J]
					Dead Adults[D]	Escaped Adults[E]	Retained Adults[F]	Total Emerged Adults[G]			
SE-TRIB-3	E	0	0	1	0	2	9	11	0	12	3
	F	0	1	0	0	1	6	7	0	8	3
	G	0	0	0	0	0	10	10	0	10	3
	H	1	1	0	0	0	8	8	0	10	1
	I	0	1	0	0	0	7	7	0	8	2
	J	0	1	0	0	1	11	12	0	13	0
	K	0	0	0	0	2	9	11	0	11	7
	L	1	0	0	0	0	11	11	0	12	5

A – Dead Larvae = dead organisms removed from replicate during or at test termination.
B – Dead Pupae = dead organisms that did not emerge or partially emerge.
C – Dead organisms that had partially emerged = organisms that began to emerge, but died during the process.
D – Dead adults = organism that died on the same day as emergence and did not have the opportunity to mate.
E – Escaped adults = organism that escaped during transfer to mating chambers.
F – Retained adults = sum of male and female adults retained in the test replicate after emergence and placed in reproduction chambers.
G – Total emerged adults = sum of male and female adults retained in the test replicate after emergence + number of escaped adults + number of dead adults.
H – Larvae recovered at the end of the test = organism that did not go through pupation.
I – Total organisms recovered = Dead Larvae + Dead Pupae + Partially-Emerged Dead Organisms + Successfully Emerged Adults + Larvae Recovered at Test Termination.
J – Total egg masses = total number of primary egg masses.

Table 3-10c. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 3.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
CTL-SS-B3	E	#1	-	1901	240	1661
		#2	-	1463	10	1453
		#3	-	1893	NA	NA
		#4	-	3048	64	2984
	F	#1	-	1613	180	1433
		#2	-	1340	1340	0[a]
		#3	1799	-	-	-
	G	#1	-	2394	61	2333
		#2	596	-	-	-
		#3	1652	-	-	-
	H	#1	-	2009	27	1982
		#2	708	-	-	-
	I	#1	-	1642	51	1591
		#2	-	2145	61	2084
		#3	1306	-	-	-
		#4	-	1960	30	1930
	J	#1	-	2080	278	1802
	K	#1	1876	-	-	-
		#2	-	3074	936	2138
	L	#1	-	1073	1073	0[b]
		#2	-	1605	1605	0[b]
		#3	-	1159	120	1039
		#4	-	1891	198	1693

Table 3-10c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 3.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
CTL-QS-B3	E	#1	-	198	27	171
		#2	-	1919	393	1526
		#3	-	994	994	0[a]
		#4	-	1168	2	1166
	F	#1	-	1539	201	1338
		#2	-	1296	40	1256
		#3	918	-	-	-
		#4	-	1394	6	1388
	G	#1	-	2163	2018	145
		#2	-	2000	81	1919
	H	#1	-	1630	950	680
		#2	-	1836	1689	147
		#3	-	1166	208	958
	I	#1	-	1960	195	1765
	J	#1	-	147	147	0[b]
	K	-	-	-	-	-
	L	#1	1382	-	-	-
		#2	-	774	774	0[b]
		#3	-	1520	1520	0[b]
		#4	-	964	225	739

Table 3-10c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 3.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-3-B3	E	#1	-	1832	1566	266
	F	#1	-	1747	63	1684
		#2	676	-	-	-
	G	#1	-	1265	725	540
	H	#1	1026	-	-	-
		#2	-	874	874	0[a]
		#3	-	2234	114	2120
	I	#1	-	2002	111	1891
		#2	1632	-	-	-
		#3	1310	-	-	-
	J	#1	-	1345	1345	0[a]
		#2	1045	-	-	-
		#3	-	1609	204	1405
		#4	-	1877	506	1371
		#5	-	2010	462	1548
		#6	-	855	254	601
	K	#1	3328	-	-	-
		#2	-	1683	77	1606
		#3	-	480	468	12
	L	#1	-	1190	1190	0[a]
		#2	-	2163	93	2070
		#3	-	1602	329	1273
		#4	-	1777	30	1747
		#5	-	1407	14	1393

Table 3-10c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 3.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-3-R8	E	#1	-	1116	1116	0[b]
	F	#1	-	1188	713	475
		#2	-	864	60	804
		#3	-	1284	16	1268
	G	#1	-	1240	15	1225
		#2	-	1504	21	1483
	H	#1	-	1344	506	838
		#2	-	1228	75	1153
		#3	-	1900	1900	0[b]
	I	#1	-	1021	268	753
		#2	-	1415	362	1053
	J	#1	-	2196	108	2088
	K	#1	-	1181	162	1019
		#2	-	825	92	733
	L	#1	-	1742	106	1636
		#2	-	1691	125	1566

Table 3-10c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 3.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-4-B5	E	#1	-	1063	34	1029
		#2	776	-	-	-
		#3	-	1648	269	1379
	F	#1	-	986	18	968
		#2	-	1283	45	1238
	G	#1	-	1841	62	1779
	H	#1	-	1514	149	1365
	I	#1	-	510	12	498
		#2	1498	-	-	-
	J	#1	-	1008	28	980
		#2	-	1510	1510	0[a]
		#3	1309	-	-	-
	K	#1	-	919	60	859
		#2	-	2529	89	2440
	L	#1	745	-	-	-
		#2	-	1430	1430	0[b]
		#3	-	986	986	0[a]
		#4	-	661	13	648
		#5	852	-	-	-
		#6	-	1154	18	1136
SE-5-B4	E	-	-	-	-	-
	F	#1	-	1584	398	1186
	G	-	-	-	-	-
	H	#1	-	1494	401	1093
		#2	1966	-	-	-
	I	-	-	-	-	-
	J	#1	-	1087	170	917
		#2	-	983	2	981
		#3	472	-	-	-
	K	#1	1596	-	-	-
	L	#1	-	2632	128	2504
		#2	-	220	43	177

Table 3-10c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 3.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-6-B5	E	#1	-	1290	44	1246
		#2	-	1395	1395	0[a]
	F	#1	-	1209	1040	169
	G	-	-	-	-	-
	H	#1	-	1496	53	1443
		#2	-	1125	50	1075
		#3	-	1694	1694	0[b]
	I	#1	-	1658	428	1230
		#2	-	1975	1975	0[b]
		#3	-	1822	1822	0[b]
	J	#1	-	1230	53	1177
		#2	-	1310	170	1140
		#3	-	1690	390	1300
	K	#1	1545	-	-	-
		#2	-	2037	1596	441
	L	#1	1215	-	-	-

Table 3-10c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 3.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-7-B2	E	#1	-	734	734	0[a]
		#2	-	1203	374	829
	F	#1	1002	-	-	-
	G	#1	-	972	869	103
		#2	-	1904	22	1882
	H	#1	-	2714	87	2627
	I	#1	-	1135	810	325
		#2	-	1862	1281	581
		#3	1542	-	-	-
	J	#1	-	1444	40	1404
		#2	-	1380	119	1261
		#3	-	2048	28	2020
		#4	-	1858	59	1799
		#5	432	-	-	-
		#6	-	1874	1874	0[b]
	K	#1	-	1569	5	1564
		#2	-	1628	72	1556
		#3	-	1600	23	1577
	L	#1	-	1728	1728	0[b]
		#2	-	1172	1172	0[b]
		#3	1476	-	-	-
		#4	-	2199	2172	27

Table 3-10c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 3.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary: Egg Counts Ring Method	Egg Hatching Summary: # of Unhatched Eggs	Egg Hatching Summary: # of Hatched Eggs
SE-G-2	E	#1	-	1414	386	1028
		#2	-	1107[b]	1107[b]	0[b]
		#3	-	1958	12	1946
		#4	471	-	-	-
	F	#1	-	1449	1449	0[a]
		#2	-	1037	0	1037
		#3	-	1331	51	1280
	G	#1	-	1140	1140	0[b]
		#2	-	915	53	862
	H	#1	-	1969	336	1633
		#2	-	1638	268	1370
		#3	-	1310	55	1255
		#4	-	1008	16	992
	I	#1	-	1480	6	1474
		#2	-	2180	43	2137
		#3	-	2754	385	2369
	J	#1	-	720	141	579
		#2	-	748	9	739
		#3	-	1032	40	992
		#4	-	1967	0	1967
		#5	-	590	2	588
		#6	-	845	27	818
	K	#1	1270	-	-	-
		#2	-	1870	79	1791
		#3	812	-	-	-
	L	#1	-	781	13	768
		#2	-	2040	45	1995
		#3	-	1302	1302	0[b]
		#4	-	1240	238	1002

Table 3-10c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 3.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-G-1	E	#1	-	1758	24	1734
		#2	-	1790	16	1774
		#3	-	1245	7	1238
		#4	120	-	-	-
		#5	-	1342	0	1342
	F	#1	-	1446	54	1392
		#2	614	-	-	-
		#3	-	1591	85	1506
	G	#1	-	1188	57	1131
		#2	-	1710	96	1614
		#3	-	1612	37	1575
		#4	-	1379	1379	0[b]
	H	#1	-	1047	25	1022
		#2	-	1222	63	1159
		#3	-	653	653	0[a]
		#4	-	1242	151	1091
	I	#1	-	1311	14	1297
		#2	-	1187	99	1088
	J	#1	-	972	59	913
		#2	-	821	24	797
		#3	-	856	0	856
		#4	664	-	-	-
	K	#1	-	1311	38	1273
		#2	-	946	34	912
		#3	-	1222	60	1162
	L	#1	-	1348	210	1138
		#2	-	1126	12	1114
		#3	-	1026	1026	0[a]
		#4	1068	-	-	-
		#5	-	1367	25	1342

Table 3-10c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 3.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-G-3	E	#1	-	1458	1458	0[a]
		#2	-	1080	1080	0[b]
	F	#1	-	1501	18	1483
	G	#1	-	1479	320	1159
		#2	-	106	3	103
		#3	-	1775	8	1767
	H	#1	-	2430	261	2169
	I	#1	-	1210	81	1129
		#2	-	1525	20	1505
		#3	-	1600	4	1596
	J	#1	-	1440	20	1420
		#2	-	743	9	734
		#3	-	1258	1258	0[a]
		#4	-	2227	2106	121
	K	#1	-	429	429	0[b]
		#2	-	1228	185	1043
	L	#1	-	1980	53	1927
SE-LAL-3	E	#1	1604	-	-	-
		#2	-	1920	480	1440
	F	#1	1136	-	-	-
	G	-	-	-	-	-
	H	#1	1008	-	-	-
		#2	-	2613	386	2227
	I	#1	-	731	3	728
	J	-	-	-	-	-
	K	-	-	-	-	-
	L	#1	-	2156	125	2031

Table 3-10c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 3.

Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-LAL-5	E	#1	-	1842	40	1802
	F	#1	894	-	-	-
		#2	-	1306	1306	0[b]
	G	#1	-	2618	110	2508
	H	#1	-	2042	78	1964
	I	#1	-	1998	79	1919
		#2	1838	-	-	-
	J	#1	-	1042	196	846
		#2	-	1577	30	1547
	K	#1	-	1279	98	1181
		#2	-	1542	56	1486
		#3	-	2730	45	2685
	L	#1	-	1778	102	1676
		#2	-	1178	20	1158
		#3	-	1918	73	1845
		#4	-	2411	65	2346
		#5	-	2454	61	2393
SE-REF-10b	E	#1	-	1784	52	1732
		#2	1037	-	-	-
	F	#1	-	2081	385	1696
	G	#1	-	1121	201	920
		#2	-	1007	45	962
		#3	-	1098	224	874
	H	#1	-	2224	628	1596
	I	-	-	-	-	-
	J	#1	-	1596	1596	0[b]
		#2	534	-	-	-
	K	#1	1292	-	-	-
	L	#1	-	1360	79	1281

Table 3-10c *(continued)*. Effects of UCR sediments on *Chironomus dilutus* reproduction in the long-term (life cycle) tests: Egg counts and egg hatching: Batch 3.						
Site ID	Replicate	Egg Case	Egg Counts Acid Method	Egg Hatching Summary		
				Egg Counts Ring Method	# of Unhatched Eggs	# of Hatched Eggs
SE-TRIB-3	E	#1	-	1372	80	1292
		#2	-	1225	297	928
		#3	1703	-	-	-
	F	#1	-	1420	68	1352
		#2	-	1544	71	1473
		#3	-	377	377	0[b]
	G	#1	-	1142	14	1128
		#2	810	-	-	-
		#3	-	1105	102	1003
	H	#1	-	1166	165	1001
	I	#1	-	1345	11	1334
		#2	1928	-	-	-
	J	-	-	-	-	
	K	#1	-	1553	54	1499
		#2	-	1122	45	1077
		#3	-	1575	18	1557
		#4	-	1632	1632	0[a]
		#5	-	1042	32	1010
		#6	-	1982	236	1746
		#7	-	1700	231	1469
	L	#1	1366	-	-	-
		#2	-	1084	58	1026
		#3	-	2068	23	2045
		#4	-	1155	15	1140
		#5	1369	-	-	-

a – No eggs hatched. A male was present at some point prior to the egg case being laid; as no eggs hatched, fertilization could not be confirmed.
b – No male in R/O flask to fertilize eggs. Egg case likely not fertilized.
NA – Egg case not found 6 days post initial count. Number of Eggs Not Hatched count could not be performed.

4. EFFECTS OF UCR SITE SEDIMENTS ON *HYALELLA AZTECA*

The survival and growth results for the 28-day sediment toxicity tests with *H. azteca* are presented in Section 4.1; the survival, growth, and reproduction results for the 42-day sediment toxicity tests are presented in Section 4.2.

4.1 Results of 28-Day Sediment Toxicity Testing with *Hyalella azteca*

The results of these tests are presented below:

- ***Hyalella azteca* Initial Weights at Test Initiation**
  The initial weights of the *H. azteca* at test initiation for Batches 1-6, and the Batch 5 re-test are summarized below in Table 4-1. The data for these test initiation weights are presented in Appendix S.

- **Results for *Hyalella azteca* 28-Day Testing: Batch 1**
  The survival and growth results of the Batch 1 sediment toxicity tests are summarized in Tables 4-2(a-c). The test data for these tests are presented in Appendix T.

- **Results for *Hyalella azteca* 28-Day Testing: Batch 2**
  The survival and growth results of the Batch 2 sediment toxicity tests are summarized in Tables 4-3(a-c). The test data for these tests are presented in Appendix U.

- **Results for *Hyalella azteca* 28-Day Testing: Batch 3**
  The survival and growth results of the Batch 3 sediment toxicity tests are summarized in Tables 4-4(a-c). The test data for these tests are presented in Appendix V.

- **Results for *Hyalella azteca* 28-Day Testing: Batch 4**
  The survival and growth results of the Batch 4 sediment toxicity tests are summarized in Tables 4-5(a-c). The test data for these tests are presented in Appendix W.

- **Results for *Hyalella azteca* 28-Day Testing: Batch 5**
  The survival and growth results of the Batch 5 sediment toxicity tests are summarized in Tables 4-6(a-c). The test data for these tests are presented in Appendix X.

- **Results for *Hyalella azteca* 28-Day Testing: Batch 5 Re-Tests**
  The survival and growth results of the Batch 5 sediment toxicity re-tests are summarized in Tables 4-7(a-c). The test data for these tests are presented in Appendix Y.

- **Results for *Hyalella azteca* 28-Day Testing: Batch 6**
  The survival and growth results of the Batch 6 sediment toxicity tests are summarized in Tables 4-8(a-c). The test data for these tests are presented in Appendix Z.

Table 4-1. Initial weights of the *Hyalella azteca* at test initiation.

Batch	Test Initiation Date	Mean Biomass Dry Weight (mg)
1	1/22/14	0.013
2	1/23/14	0.011
3	1/24/14	0.016
4	1/29/14	0.012
5	1/30/14	0.011
5 re-test	3/27/14	0.025
6	1/31/14	0.026

Table 4-2a. Effects of UCR sediments on *Hyalella azteca* survival in 28-day tests: Batch 1.

Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B1	10	10	10	10	10	10	10	10	**10.0**
CTL-QS-B1	10	10	10	10	10	10	9	6	**9.4**
CTL-ERDC-B1	5	1	2	4	5	1	1	6	**3.1**
SE-1-R1	10	10	10	10	10	10	10	10	**10.0**
SE-3-R2	8	7	9	7	6	8	5	8	**7.3**
SE-4-B6	10	9	10	10	10	9	10	10	**9.8**
SE-5-B1	10	10	10	8	9	8	8	11	**9.3**
SE-6-B6	9	9	9	10	10	10	10	10	**9.6**
SE-6-R3	9	10	10	10	9	10	9	10	**9.6**
SE-8-B3	10	9	8	10	10	10	9	10	**9.5**
SE-8-B4	9	9	10	10	10	8	10	10	**9.5**
SE-G-1	8	10	0	10	10	10	9	10	**8.4**
SE-REF-6	9	10	10	9	10	8	9	10	**9.4**
SE-TRIB-4	9	9	10	10	10	10	10	9	**9.6**

Table 4-2b. Effects of UCR sediments on *Hyalella azteca* growth (mg dry weight per individual) in 28-day tests: Batch 1.									
Site ID	Mean Individual Dry Wt (mg) in Test Replicates								**Mean Dry Wt (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B1	0.774	0.703	0.827	0.833	0.814	0.699	0.759	0.712	**0.765**
CTL-QS-B1	0.492	0.554	0.618	0.586	0.531	0.698	0.580	0.370	**0.554**
CTL-ERDC-B1	0.562	0.870	0.375	0.265	0.672	0.610	0.440	0.542	**0.542**
SE-1-R1	0.589	0.687	0.871	0.098	0.691	0.738	0.668	0.718	**0.633**
SE-3-R2	0.929	0.819	0.752	0.910	0.835	0.445	0.790	0.645	**0.766**
SE-4-B6	0.744	0.864	0.703	0.733	0.793	0.736	0.764	0.729	**0.758**
SE-5-B1	0.703	0.684	0.750	0.733	0.726	0.628	0.748	0.701	**0.709**
SE-6-B6	0.787	0.776	0.830	0.839	0.775	0.716	0.709	0.822	**0.782**
SE-6-R3	0.759	0.669	0.759	0.731	0.781	0.806	0.776	0.638	**0.740**
SE-8-B3	0.707	0.591	0.784	0.645	0.607	0.642	0.571	0.594	**0.643**
SE-8-B4	0.620	0.728	0.688	0.751	0.693	0.744	0.622	0.734	**0.697**
SE-G-1	0.745	0.774	0.000	0.657	0.468	0.610	0.762	0.798	**0.602**
SE-REF-6	0.842	0.778	0.879	0.739	0.775	0.571	0.807	0.732	**0.765**
SE-TRIB-4	0.212	0.873	0.408	0.828	0.700	0.876	0.696	0.812	**0.676**

Table 4-2c. Effects of UCR sediments on *Hyalella azteca* growth (biomass[A], mg total dry weight) in 28-day tests: Batch 1.									
Site ID	Mean Biomass (mg) in Test Replicates								**Mean Biomass (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B1	0.774	0.703	0.827	0.833	0.814	0.699	0.759	0.712	**0.765**
CTL-QS-B1	0.492	0.554	0.618	0.586	0.531	0.698	0.522	0.222	**0.528**
CTL-ERDC-B1	0.281	0.087	0.075	0.106	0.336	0.061	0.044	0.325	**0.164**
SE-1-R1	0.589	0.687	0.871	0.098	0.691	0.738	0.668	0.718	**0.633**
SE-3-R2	0.743	0.573	0.677	0.637	0.501	0.356	0.395	0.516	**0.550**
SE-4-B6	0.744	0.778	0.703	0.733	0.793	0.662	0.764	0.729	**0.738**
SE-5-B1	0.703	0.684	0.750	0.586	0.653	0.502	0.598	0.701	**0.647**
SE-6-B6	0.708	0.698	0.747	0.839	0.775	0.716	0.709	0.822	**0.752**
SE-6-R3	0.683	0.669	0.759	0.731	0.703	0.806	0.698	0.638	**0.711**
SE-8-B3	0.707	0.532	0.627	0.645	0.607	0.642	0.514	0.594	**0.609**
SE-8-B4	0.558	0.655	0.688	0.751	0.693	0.595	0.622	0.734	**0.662**
SE-G-1	0.596	0.774	0.000	0.657	0.468	0.610	0.686	0.798	**0.574**
SE-REF-6	0.758	0.778	0.879	0.665	0.775	0.457	0.726	0.732	**0.721**
SE-TRIB-4	0.191	0.786	0.408	0.828	0.700	0.876	0.696	0.731	**0.652**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 4-3a. Effects of UCR sediments on *Hyalella azteca* survival in 28-day tests: Batch 2.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B2	10	10	10	9	9	10	10	10	**9.8**
CTL-QS-B2	10	10	10	8	10	10	10	10	**9.8**
CTL-ERDC-B2	10	9	10	9	10	10	10	9	**9.6**
SE-2-R1	10	10	10	10	9	10	10	10	**9.9**
SE-4-B2	9	10	10	10	8	10	10	10	**9.6**
SE-4-B4	10	9	9	9	10	11	7	10	**9.4**
SE-5-B3	9	9	10	9	10	10	10	10	**9.6**
SE-6-B5	10	10	10	9	10	10	9	9	**9.6**
SE-LAL-1	10	9	10	10	10	9	10	10	**9.8**
SE-LAL-2	10	10	9	10	10	10	10	10	**9.9**
SE-LAL-3	10	10	10	9	10	10	10	9	**9.8**
SE-REF-4	10	9	9	10	8	9	10	9	**9.3**
SE-REF-8	10	9	9	10	9	10	10	10	**9.6**

Table 4-3b. Effects of UCR sediments on *Hyalella azteca* growth (mg dry weight per individual) in 28-day tests: Batch 2.									
Site ID	Mean Individual Dry Wt (mg) in Test Replicates								**Mean Dry Wt (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B2	0.826	0.729	0.798	0.664	0.636	0.722	0.829	0.723	**0.741**
CTL-QS-B2	0.673	0.522	0.520	0.719	0.674	0.609	0.545	0.559	**0.603**
CTL-ERDC-B2	0.766	0.807	0.639	0.704	0.736	0.651	0.623	0.722	**0.706**
SE-2-R1	0.765	0.797	0.704	0.620	0.694	0.771	0.680	0.722	**0.719**
SE-4-B2	0.826	0.721	0.760	0.705	0.599	0.771	0.723	0.800	**0.738**
SE-4-B4	0.649	0.620	0.568	0.636	0.711	0.658	0.600	0.687	**0.641**
SE-5-B3	0.780	0.799	0.723	0.771	0.718	0.782	0.746	0.635	**0.744**
SE-6-B5	0.793	0.742	0.773	0.711	0.782	0.744	0.774	0.860	**0.772**
SE-LAL-1	0.723	0.762	0.811	0.736	0.182	0.771	0.642	0.698	**0.666**
SE-LAL-2	0.887	0.920	0.721	0.739	0.712	0.814	0.789	0.813	**0.799**
SE-LAL-3	0.832	0.987	0.929	0.743	0.625	0.949	0.816	0.558	**0.805**
SE-REF-4	0.829	0.659	0.906	0.712	0.603	0.597	0.779	0.783	**0.733**
SE-REF-8	0.649	0.762	0.527	0.754	0.867	0.618	0.652	0.729	**0.695**

Table 4-3c. Effects of UCR sediments on *Hyalella azteca* growth (biomass[A], mg total dry weight) in 28-day tests: Batch 2.									
Site ID	Mean Biomass (mg) in Test Replicates								**Mean Biomass (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B2	0.826	0.729	0.798	0.598	0.572	0.722	0.829	0.723	**0.725**
CTL-QS-B2	0.673	0.522	0.520	0.575	0.674	0.609	0.545	0.559	**0.585**
CTL-ERDC-B2	0.766	0.726	0.639	0.634	0.736	0.651	0.623	0.650	**0.678**
SE-2-R1	0.765	0.797	0.704	0.620	0.625	0.771	0.680	0.722	**0.711**
SE-4-B2	0.743	0.721	0.760	0.705	0.479	0.771	0.723	0.800	**0.713**
SE-4-B4	0.649	0.558	0.511	0.572	0.711	0.658	0.420	0.687	**0.596**
SE-5-B3	0.702	0.719	0.723	0.694	0.718	0.782	0.746	0.635	**0.715**
SE-6-B5	0.793	0.742	0.773	0.640	0.782	0.744	0.697	0.774	**0.743**
SE-LAL-1	0.723	0.686	0.811	0.736	0.182	0.694	0.642	0.698	**0.647**
SE-LAL-2	0.887	0.920	0.649	0.739	0.712	0.814	0.789	0.813	**0.790**
SE-LAL-3	0.832	0.987	0.929	0.669	0.625	0.949	0.816	0.502	**0.789**
SE-REF-4	0.829	0.593	0.815	0.712	0.482	0.537	0.779	0.705	**0.682**
SE-REF-8	0.649	0.686	0.474	0.754	0.780	0.618	0.652	0.729	**0.668**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 4-4a. Effects of UCR sediments on *Hyalella azteca* survival in 28-day tests: Batch 3.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B3	10	9	8	9	10	9	10	9	**9.3**
CTL-QS-B3	10	10	10	10	10	9	10	10	**9.9**
CTL-ERDC-B3	10	10	10	10	10	10	9	8	**9.6**
SE-2-R3	10	9	10	9	10	10	10	10	**9.8**
SE-3-R1	9	10	10	10	9	10	9	9	**9.5**
SE-3-R8	8	10	10	9	9	10	9	10	**9.4**
SE-5-B4	10	10	10	10	10	10	10	10	**10.0**
SE-6-B4	10	10	10	8	10	10	10	10	**9.8**
SE-7-B2	10	10	10	9	10	10	9	10	**9.8**
SE-LAL-4	10	7	10	10	10	10	7	8	**9.0**
SE-REF-1	10	10	10	10	10	10	10	10	**10.0**
SE-REF-10b	10	10	10	10	10	10	10	10	**10.0**
SE-REF-3	10	10	10	10	10	10	10	9	**9.9**
SE-REF-7	10	10	10	10	10	10	9	10	**9.9**
SE-TRIB-3	10	10	10	10	10	10	10	10	**10.0**

Table 4-4b. Effects of UCR sediments on *Hyalella azteca* growth (mg dry weight per individual) in 28-day tests: Batch 3.									
Site ID	Mean Individual Dry Wt (mg) in Test Replicates								**Mean Dry Wt (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B3	0.881	0.446	0.530	0.764	0.616	0.342	0.647	0.797	**0.628**
CTL-QS-B3	0.558	0.407	0.626	0.512	0.600	0.647	0.634	0.579	**0.570**
CTL-ERDC-B3	0.841	0.713	0.652	0.720	0.729	0.750	0.800	0.776	**0.748**
SE-2-R3	0.822	0.788	0.814	0.943	0.820	0.791	0.858	0.759	**0.824**
SE-3-R1	0.857	0.781	0.804	0.829	0.673	0.833	0.747	0.772	**0.787**
SE-3-R8	0.542	0.511	0.541	0.592	0.519	0.494	0.476	0.557	**0.529**
SE-5-B4	0.724	0.744	0.655	0.784	0.808	0.848	0.687	0.888	**0.767**
SE-6-B4	0.746	0.808	0.850	0.546	0.779	0.852	0.758	0.786	**0.766**
SE-7-B2	0.785	0.727	0.752	0.861	0.708	0.825	0.851	0.826	**0.792**
SE-LAL-4	0.293	0.254	0.312	0.295	0.589	0.322	0.296	0.425	**0.348**
SE-REF-1	0.863	0.808	0.768	0.915	0.769	0.753	0.949	0.817	**0.830**
SE-REF-10b	0.696	0.749	0.721	0.758	0.796	0.778	0.778	0.718	**0.749**
SE-REF-3	0.810	0.753	0.806	0.687	0.701	0.605	0.773	0.714	**0.731**
SE-REF-7	0.789	0.777	0.833	0.804	0.775	0.851	0.811	0.790	**0.804**
SE-TRIB-3	0.822	0.786	0.767	0.674	0.763	0.784	0.574	0.638	**0.726**

Table 4-4c. Effects of UCR sediments on *Hyalella azteca* growth (biomass[A], mg total dry weight) in 28-day tests: Batch 3.									
Site ID	Mean Biomass (mg) in Test Replicates								**Mean Biomass (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B3	0.881	0.401	0.424	0.688	0.616	0.308	0.647	0.717	**0.585**
CTL-QS-B3	0.558	0.407	0.626	0.512	0.600	0.582	0.634	0.579	**0.562**
CTL-ERDC-B3	0.841	0.713	0.652	0.720	0.729	0.750	0.720	0.621	**0.718**
SE-2-R3	0.822	0.709	0.814	0.849	0.820	0.791	0.858	0.759	**0.803**
SE-3-R1	0.771	0.781	0.804	0.829	0.606	0.833	0.672	0.695	**0.749**
SE-3-R8	0.434	0.511	0.541	0.533	0.467	0.494	0.428	0.557	**0.496**
SE-5-B4	0.724	0.744	0.655	0.784	0.808	0.848	0.687	0.888	**0.767**
SE-6-B4	0.746	0.808	0.850	0.437	0.779	0.852	0.758	0.786	**0.752**
SE-7-B2	0.785	0.727	0.752	0.775	0.708	0.825	0.766	0.826	**0.771**
SE-LAL-4	0.293	0.178	0.312	0.295	0.589	0.322	0.207	0.340	**0.317**
SE-REF-1	0.863	0.808	0.768	0.915	0.769	0.753	0.949	0.817	**0.830**
SE-REF-10b	0.696	0.749	0.721	0.758	0.796	0.778	0.778	0.718	**0.749**
SE-REF-3	0.810	0.753	0.806	0.687	0.701	0.605	0.773	0.643	**0.722**
SE-REF-7	0.789	0.777	0.833	0.804	0.775	0.851	0.730	0.790	**0.794**
SE-TRIB-3	0.822	0.786	0.767	0.674	0.763	0.784	0.574	0.638	**0.726**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 4-5a. Effects of UCR sediments on *Hyalella azteca* survival in 28-day tests: Batch 4.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B4	8	9	10	9	6	8	9	8	**8.4**
CTL-QS-B4	10	9	9	10	10	9	10	10	**9.6**
CTL-ERDC-B4	8	10	10	8	9	8	9	10	**9.0**
SE-1-B5	10	10	9	10	7	10	10	10	**9.5**
SE-2-B1	8	10	9	10	10	10	10	10	**9.6**
SE-3-B3	5	9	9	8	9	3	6	4	**6.6**
SE-3-R7	10	9	9	10	10	10	10	10	**9.8**
SE-5-B5	10	7	10	10	9	9	10	10	**9.4**
SE-5-B6	10	10	8	10	10	10	10	8	**9.5**
SE-7-B3	10	10	9	10	10	10	9	10	**9.8**
SE-7-B6	9	10	10	10	10	10	10	10	**9.9**
SE-G-4	8	8	9	10	7	10	4	7	**7.9**
SE-REF-2	10	10	10	8	10	9	10	10	**9.6**
SE-TRIB-2	10	7	10	12	10	8	6	9	**9.0**
SE-TRIB-5	10	10	10	10	10	10	10	10	**10.0**

Table 4-5b. Effects of UCR sediments on *Hyalella azteca* growth (mg dry weight per individual) in 28-day tests: Batch 4.									
Site ID	Mean Individual Dry Wt (mg) in Test Replicates								**Mean Dry Wt (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B4	0.596	0.622	0.546	0.624	0.528	0.560	0.670	0.677	**0.603**
CTL-QS-B4	0.651	0.682	0.721	0.603	0.533	0.526	0.669	0.593	**0.622**
CTL-ERDC-B4	0.509	0.674	0.609	0.553	0.552	0.570	0.631	0.662	**0.595**
SE-1-B5	0.869	0.861	0.814	0.785	0.829	0.850	0.785	0.810	**0.825**
SE-2-B1	0.715	0.610	0.707	0.805	0.671	0.573	0.668	0.550	**0.662**
SE-3-B3	0.378	0.548	0.532	0.483	0.501	0.663	0.468	0.543	**0.514**
SE-3-R7	0.678	0.332	0.271	0.611	0.201	0.546	0.313	0.633	**0.448**
SE-5-B5	0.770	0.607	0.797	0.893	0.733	0.824	0.865	0.756	**0.781**
SE-5-B6	0.911	0.875	0.979	0.806	0.842	0.863	0.894	0.879	**0.881**
SE-7-B3	0.838	0.783	0.896	0.866	0.870	0.861	0.943	0.768	**0.853**
SE-7-B6	0.804	0.844	0.601	0.744	0.788	0.775	0.825	0.689	**0.759**
SE-G-4	0.108	0.080	0.089	0.155	0.067	0.217	0.085	0.093	**0.112**
SE-REF-2	0.717	0.560	0.670	0.699	0.798	0.773	0.698	0.675	**0.699**
SE-TRIB-2	0.682	0.816	0.913	0.666	0.688	0.871	0.108	0.841	**0.698**
SE-TRIB-5	0.854	0.104	0.985	0.901	0.830	0.903	0.862	0.925	**0.796**

Table 4-5c. Effects of UCR sediments on *Hyalella azteca* growth (biomass[A], mg total dry weight) in 28-day tests: Batch 4.									
Site ID	Mean Biomass (mg) in Test Replicates								**Mean Biomass (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B4	0.477	0.560	0.546	0.562	0.317	0.448	0.603	0.542	**0.507**
CTL-QS-B4	0.651	0.614	0.649	0.603	0.533	0.473	0.669	0.593	**0.598**
CTL-ERDC-B4	0.407	0.674	0.609	0.442	0.497	0.456	0.568	0.662	**0.539**
SE-1-B5	0.869	0.861	0.733	0.785	0.580	0.850	0.785	0.810	**0.784**
SE-2-B1	0.572	0.610	0.636	0.805	0.671	0.573	0.668	0.550	**0.636**
SE-3-B3	0.189	0.493	0.479	0.386	0.451	0.199	0.281	0.217	**0.337**
SE-3-R7	0.678	0.299	0.244	0.611	0.201	0.546	0.313	0.633	**0.441**
SE-5-B5	0.770	0.425	0.797	0.893	0.660	0.742	0.865	0.756	**0.739**
SE-5-B6	0.911	0.875	0.783	0.806	0.842	0.863	0.894	0.703	**0.835**
SE-7-B3	0.838	0.783	0.806	0.866	0.870	0.861	0.849	0.768	**0.830**
SE-7-B6	0.724	0.844	0.601	0.744	0.788	0.775	0.825	0.689	**0.749**
SE-G-4	0.086	0.064	0.080	0.155	0.047	0.217	0.034	0.065	**0.094**
SE-REF-2	0.717	0.560	0.670	0.559	0.798	0.696	0.698	0.675	**0.672**
SE-TRIB-2	0.682	0.571	0.913	0.666	0.688	0.697	0.065	0.757	**0.630**
SE-TRIB-5	0.854	0.104	0.985	0.901	0.830	0.903	0.862	0.925	**0.796**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 4-6a. Effects of UCR sediments on *Hyalella azteca* survival in 28-day tests: Batch 5.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B5	4	10	10	8	5	9	4	8	**7.3**
CTL-QS-B5	10	10	10	10	9	10	10	10	**9.9**
CTL-ERDC-B5	7	10	10	8	4	7	9	10	**8.1**
SE-2-B2	10	10	10	10	10	10	10	10	**10.0**
SE-3-R9	10	10	10	10	9	10	10	9	**9.8**
SE-4-B1	9	10	10	10	9	7	9	10	**9.3**
SE-5-B2	10	10	9	10	10	10	9	10	**9.8**
SE-6-B1	9	10	9	10	10	10	10	8	**9.5**
SE-7-B4	10	10	10	10	10	10	10	10	**10.0**
SE-7-B5	10	10	10	10	9	10	8	9	**9.5**
SE-8-B1	10	9	9	10	10	9	9	10	**9.5**
SE-G-2	10	10	10	10	10	10	9	10	**9.9**
SE-LAL-5	10	10	10	10	10	10	10	10	**10.0**
SE-REF-5	10	10	9	1	9	10	10	10	**8.6**
SE-TRIB-1	9	10	10	10	10	10	9	10	**9.8**

Table 4-6b. Effects of UCR sediments on *Hyalella azteca* growth (mg dry weight per individual) in 28-day tests: Batch 5.									
Site ID	Mean Individual Dry Wt (mg) in Test Replicates								**Mean Dry Wt (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B5	0.780	0.465	0.534	0.620	0.436	0.693	0.755	0.718	**0.625**
CTL-QS-B5	0.576	0.542	0.623	0.641	0.488	0.560	0.543	0.598	**0.571**
CTL-ERDC-B5	0.526	0.803	0.797	0.696	0.443	0.399	0.642	0.700	**0.626**
SE-2-B2	0.732	0.792	0.738	0.919	0.817	0.801	0.902	0.698	**0.800**
SE-3-R9	0.612	0.673	0.631	0.596	0.653	0.692	0.581	0.618	**0.632**
SE-4-B1	0.687	0.739	0.581	0.596	0.587	0.667	0.568	0.549	**0.622**
SE-5-B2	0.716	0.653	0.808	0.780	0.673	0.751	0.720	0.709	**0.726**
SE-6-B1	0.729	0.503	0.759	0.777	0.738	0.722	0.745	0.203	**0.647**
SE-7-B4	0.898	0.871	0.908	0.888	0.721	0.829	0.832	0.683	**0.829**
SE-7-B5	0.702	0.783	0.781	0.807	0.818	0.776	0.863	0.731	**0.783**
SE-8-B1	0.669	0.777	0.709	0.670	0.799	0.522	0.813	0.743	**0.713**
SE-G-2	0.872	0.973	0.748	0.721	0.929	0.952	0.673	0.679	**0.818**
SE-LAL-5	0.857	0.727	0.789	0.864	0.770	0.847	0.856	0.768	**0.810**
SE-REF-5	0.779	0.852	0.492	0.750	0.750	0.820	0.813	0.822	**0.760**
SE-TRIB-1	0.582	0.494	0.303	0.638	0.125	0.567	0.077	0.074	**0.357**

Table 4-6c. Effects of UCR sediments on *Hyalella azteca* growth (biomass[A], mg total dry weight) in 28-day tests: Batch 5.									
Site ID	Mean Biomass (mg) in Test Replicates								**Mean Biomass (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B5	0.312	0.465	0.534	0.496	0.218	0.624	0.302	0.574	**0.441**
CTL-QS-B5	0.576	0.542	0.623	0.641	0.439	0.560	0.543	0.598	**0.565**
CTL-ERDC-B5	0.368	0.803	0.797	0.557	0.177	0.279	0.578	0.700	**0.532**
SE-2-B2	0.732	0.792	0.738	0.919	0.817	0.801	0.902	0.698	**0.800**
SE-3-R9	0.612	0.673	0.631	0.596	0.588	0.692	0.581	0.556	**0.616**
SE-4-B1	0.618	0.739	0.581	0.596	0.528	0.467	0.511	0.549	**0.574**
SE-5-B2	0.716	0.653	0.727	0.780	0.673	0.751	0.648	0.709	**0.707**
SE-6-B1	0.656	0.503	0.683	0.777	0.738	0.722	0.745	0.162	**0.623**
SE-7-B4	0.898	0.871	0.908	0.888	0.721	0.829	0.832	0.683	**0.829**
SE-7-B5	0.702	0.783	0.781	0.807	0.736	0.776	0.690	0.658	**0.742**
SE-8-B1	0.669	0.699	0.638	0.670	0.799	0.470	0.732	0.743	**0.678**
SE-G-2	0.872	0.973	0.748	0.721	0.929	0.952	0.606	0.679	**0.810**
SE-LAL-5	0.857	0.727	0.789	0.864	0.770	0.847	0.856	0.768	**0.810**
SE-REF-5	0.779	0.852	0.443	0.075	0.675	0.820	0.813	0.822	**0.660**
SE-TRIB-1	0.524	0.494	0.303	0.638	0.125	0.567	0.069	0.074	**0.349**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 4-7a. Effects of UCR sediments on *Hyalella azteca* survival in 28-day tests: Batch 5 re-tests.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B5-RE	9	10	10	8	10	10	10	10	**9.6**
CTL-QS-B5-RE	10	10	8	9	8	9	10	10	**9.3**
CTL-ERDC-B5-RE	9	8	10	9	10	8	8	8	**8.8**
SE-2-B2-RE	10	12	10	10	10	10	10	10	**10.3**
SE-3-R9-RE	9	10	10	10	8	10	10	10	**9.6**
SE-4-B1-RE	8	9	10	10	10	9	6	8	**8.8**
SE-5-B2-RE	9	10	10	10	9	10	10	7	**9.4**
SE-6-B1-RE	9	9	10	10	7	8	10	10	**9.1**
SE-7-B4-RE	10	10	10	11	8	10	10	9	**9.8**
SE-7-B5-RE	9	8	9	6	5	8	8	10	**7.9**
SE-8-B1-RE	10	10	9	10	10	10	9	9	**9.6**
SE-G-2-RE	10	5	8	9	8	10	10	10	**8.8**
SE-LAL-5-RE	6	9	12	8	10	9	10	9	**9.1**
SE-REF-5-RE	10	10	10	9	7	10	10	10	**9.5**
SE-TRIB-1-RE	10	9	10	10	10	10	10	10	**9.9**

Table 4-7b. Effects of UCR sediments on *Hyalella azteca* growth (mg dry weight per individual) in 28-day tests: Batch 5 re-tests.									
Site ID	Mean Individual Dry Wt (mg) in Test Replicates								**Mean Dry Wt (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B5-RE	0.431	0.347	0.445	0.140	0.346	0.428	0.432	0.438	**0.376**
CTL-QS-B5-RE	0.436	0.394	0.351	0.384	0.298	0.366	0.467	0.512	**0.401**
CTL-ERDC-B5-RE	0.347	0.303	0.326	0.192	0.270	0.329	0.303	0.229	**0.287**
SE-2-B2-RE	0.418	0.382	0.393	0.327	0.588	0.487	0.350	0.381	**0.416**
SE-3-R9-RE	0.361	0.391	0.286	0.288	0.428	0.282	0.459	0.355	**0.356**
SE-4-B1-RE	0.313	0.274	0.281	0.241	0.332	0.369	0.227	0.176	**0.277**
SE-5-B2-RE	0.344	0.460	0.290	0.250	0.190	0.267	0.397	0.359	**0.320**
SE-6-B1-RE	0.434	0.350	0.172	0.428	0.290	0.409	0.195	0.279	**0.320**
SE-7-B4-RE	0.457	0.408	0.405	0.578	0.278	0.470	0.306	0.411	**0.414**
SE-7-B5-RE	0.211	0.301	0.288	0.352	0.236	0.190	0.196	0.289	**0.258**
SE-8-B1-RE	0.389	0.321	0.402	0.307	0.386	0.439	0.267	0.391	**0.363**
SE-G-2-RE	0.400	0.284	0.301	0.328	0.297	0.300	0.300	0.383	**0.324**
SE-LAL-5-RE	0.265	0.336	0.260	0.215	0.346	0.194	0.257	0.246	**0.265**
SE-REF-5-RE	0.277	0.294	0.240	0.618	0.266	0.342	0.226	0.212	**0.309**
SE-TRIB-1-RE	0.594	0.483	0.536	0.491	0.630	0.641	0.472	0.610	**0.557**

Table 4-7c. Effects of UCR sediments on *Hyalella azteca* growth (biomass[A], mg total dry weight) in 28-day tests: Batch 5 re-tests.									
Site ID	Mean Biomass (mg) in Test Replicates								**Mean Biomass (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B5-RE	0.388	0.347	0.445	0.112	0.346	0.428	0.432	0.438	**0.367**
CTL-QS-B5-RE	0.436	0.394	0.281	0.346	0.238	0.329	0.467	0.512	**0.375**
CTL-ERDC-B5-RE	0.312	0.242	0.326	0.173	0.270	0.263	0.242	0.183	**0.251**
SE-2-B2-RE	0.418	0.382	0.393	0.327	0.588	0.487	0.350	0.381	**0.416**
SE-3-R9-RE	0.325	0.391	0.286	0.288	0.342	0.282	0.459	0.355	**0.341**
SE-4-B1-RE	0.250	0.247	0.281	0.241	0.332	0.332	0.136	0.141	**0.245**
SE-5-B2-RE	0.310	0.460	0.290	0.250	0.171	0.267	0.397	0.251	**0.300**
SE-6-B1-RE	0.391	0.315	0.172	0.428	0.203	0.327	0.195	0.279	**0.289**
SE-7-B4-RE	0.457	0.408	0.405	0.578	0.222	0.470	0.306	0.370	**0.402**
SE-7-B5-RE	0.190	0.241	0.259	0.211	0.118	0.152	0.157	0.289	**0.202**
SE-8-B1-RE	0.389	0.321	0.362	0.307	0.386	0.439	0.240	0.352	**0.350**
SE-G-2-RE	0.400	0.142	0.241	0.295	0.238	0.300	0.300	0.383	**0.287**
SE-LAL-5-RE	0.159	0.302	0.260	0.172	0.346	0.175	0.257	0.221	**0.237**
SE-REF-5-RE	0.277	0.294	0.240	0.556	0.186	0.342	0.226	0.212	**0.292**
SE-TRIB-1-RE	0.594	0.435	0.536	0.491	0.630	0.641	0.472	0.610	**0.551**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 4-8a. Effects of UCR sediments on *Hyalella azteca* survival in 28-day tests: Batch 6.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B6	9	10	8	10	10	10	10	10	**9.6**
CTL-QS-B6	10	10	9	10	9	8	10	9	**9.4**
CTL-ERDC-B6	10	9	10	10	10	9	9	10	**9.6**
SE-1B-R2	10	7	9	10	10	10	10	10	**9.5**
SE-1-R2	10	5	6	8	7	9	6	9	**7.5**
SE-4-B3	9	8	8	10	10	8	10	7	**8.8**
SE-4-B5	9	10	10	9	10	5	9	10	**9.0**
SE-6-B2	9	9	5	10	10	10	10	10	**9.1**
SE-7-B1	10	9	10	10	10	10	10	10	**9.9**
SE-8-B2	10	6	9	10	10	10	9	9	**9.1**
SE-8-B5	10	9	10	10	10	9	10	9	**9.6**
SE-8-B6	8	10	10	10	9	9	9	10	**9.4**
SE-LAL-6	10	9	10	9	10	9	10	10	**9.6**
SE-G-3	10	10	10	10	10	10	8	10	**9.8**
SE-TRIB-6	10	10	8	10	10	10	10	10	**9.8**

Table 4-8b. Effects of UCR sediments on *Hyalella azteca* growth (mg dry weight per individual) in 28-day tests: Batch 6.									
Site ID	Mean Individual Dry Wt (mg) in Test Replicates								**Mean Dry Wt (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B6	0.718	0.458	0.774	0.596	0.749	0.687	0.653	0.626	**0.658**
CTL-QS-B6	0.265	0.213	0.456	0.581	0.198	0.246	0.437	0.506	**0.363**
CTL-ERDC-B6	0.668	0.857	0.772	0.756	0.742	0.664	0.779	0.735	**0.747**
SE-1B-R2	0.683	0.719	0.678	0.813	0.816	0.752	0.770	0.713	**0.743**
SE-1-R2	0.517	0.514	0.547	0.539	0.579	0.462	0.460	0.559	**0.522**
SE-4-B3	0.617	0.569	0.623	0.745	0.719	0.615	0.542	0.679	**0.638**
SE-4-B5	0.659	0.625	0.718	0.661	0.695	0.372	0.678	0.579	**0.623**
SE-6-B2	0.682	0.704	0.858	0.742	0.525	0.746	0.724	0.704	**0.711**
SE-7-B1	0.922	0.798	0.704	0.763	0.704	0.721	0.776	0.586	**0.747**
SE-8-B2	0.621	0.690	0.664	0.728	0.647	0.740	0.670	0.720	**0.685**
SE-8-B5	0.681	0.727	0.707	0.830	0.693	0.841	0.654	0.809	**0.743**
SE-8-B6	0.475	0.667	0.527	0.552	0.689	0.584	0.522	0.510	**0.566**
SE-LAL-6	0.854	0.794	0.849	0.703	0.677	0.679	0.773	0.775	**0.763**
SE-G-3	0.382	0.598	0.799	0.162	0.582	0.500	0.384	0.449	**0.482**
SE-TRIB-6	0.842	0.760	0.786	0.916	0.773	0.669	0.912	0.802	**0.808**

Table 4-8c. Effects of UCR sediments on *Hyalella azteca* growth (biomass[A], mg total dry weight) in 28-day tests: Batch 6.									
Site ID	Mean Biomass (mg) in Test Replicates								**Mean Biomass (mg)**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	
CTL-SS-B6	0.646	0.458	0.619	0.596	0.749	0.687	0.653	0.626	**0.629**
CTL-QS-B6	0.265	0.213	0.410	0.581	0.178	0.197	0.437	0.455	**0.342**
CTL-ERDC-B6	0.668	0.771	0.772	0.756	0.742	0.598	0.701	0.735	**0.718**
SE-1B-R2	0.683	0.503	0.610	0.813	0.816	0.752	0.770	0.713	**0.708**
SE-1-R2	0.517	0.257	0.328	0.431	0.405	0.416	0.276	0.503	**0.392**
SE-4-B3	0.555	0.455	0.498	0.745	0.719	0.492	0.542	0.475	**0.560**
SE-4-B5	0.593	0.625	0.718	0.595	0.695	0.186	0.610	0.579	**0.575**
SE-6-B2	0.614	0.634	0.429	0.742	0.525	0.746	0.724	0.704	**0.640**
SE-7-B1	0.922	0.718	0.704	0.763	0.704	0.721	0.776	0.586	**0.737**
SE-8-B2	0.621	0.414	0.598	0.728	0.647	0.740	0.603	0.648	**0.625**
SE-8-B5	0.681	0.654	0.707	0.830	0.693	0.757	0.654	0.728	**0.713**
SE-8-B6	0.380	0.667	0.527	0.552	0.620	0.526	0.470	0.510	**0.532**
SE-LAL-6	0.854	0.715	0.849	0.633	0.677	0.611	0.773	0.775	**0.736**
SE-G-3	0.382	0.598	0.799	0.162	0.582	0.500	0.307	0.449	**0.472**
SE-TRIB-6	0.842	0.760	0.629	0.916	0.773	0.669	0.912	0.802	**0.788**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

4.2 Results of 42-Day Sediment Toxicity Testing with *Hyalella azteca*

The results of the 42-day sediment toxicity tests using *Hyalella azteca* are presented below:

- ***Hyalella azteca* Initial Weights at Test Initiation**
  The initial weights of the *Hyalella azteca* for Batches 1-3 are summarized below in Table 4-9. The data for the test initiation weight determinations are presented in Appendix AA.

Table 4-9. Initial weights of the *Hyalella azteca* at the time of test initiation.		
Batch	Test Initiation Date	Mean Biomass Dry Weight (mg)
1	2/13/15	0.017
2	2/24/15	0.011
3	3/5/15	0.010

- **Results for *Hyalella azteca* 42-Day Tests: Batch 1**
  The survival, growth, and reproduction results of the Batch 1 tests are summarized in Tables 4-10(a-j). The test data for these tests are presented in Appendix BB.

- **Results for *Hyalella azteca* 42-Day Tests: Batch 2**
  The survival, growth, and reproduction results of the Batch 2 tests are summarized in Tables 4-11(a-j). The test data for these tests are presented in Appendix CC.

- **Results for *Hyalella azteca* 42-Day Tests: Batch 3**
  The survival, growth, and reproduction results of the Batch 3 tests are summarized in Tables 4-12(a-j). The test data for these tests are presented in Appendix DD.

Table 4-10a. Effects of UCR sediments on *Hyalella azteca* 28-day survival in the 42-day tests: Batch 1.													
Site ID	# of Surviving Organisms in Test Replicates												**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B1	10	10	10	10	9	10	10	8	10	10	10	10	**9.8**
CTL-QS-B1	10	10	10	10	10	10	8	10	10	10	10	9	**9.8**
SE-1-B5	20	10	8	10	10	10	10	10	10	10	10	9	**10.6**
SE-1B-R2	8	10	9	9	10	10	10	8	9	6	9	7	**8.8**
SE-1-R2	1	9	8	9	6	7	6	7	8	8	9	9	**7.3**
SE-4-B6	9	10	10	10	10	10	10	10	10	10	10	10	**9.9**
SE-6-B2	10	10	9	10	9	9	10	10	10	10	10	10	**9.8**
SE-7-B5	10	8	9	10	8	10	9	10	10	10	10	9	**9.4**
SE-8-B3	8	10	9	9	6	9	9	10	10	10	10	9	**9.1**
SE-G-1	10	10	10	10	10	9	10	10	9	10	10	10	**9.8**
SE-G-3	10	10	10	10	6	10	10	10	10	9	10	8	**9.4**
SE-LAL-3	10	8	10	10	10	10	10	10	10	10	10	10	**9.8**
SE-LAL-5	10	10	10	10	9	10	10	10	10	9	10	10	**9.8**
SE-REF-10b	9	11	10	10	10	9	10	10	10	10	10	10	**9.9**
SE-TRIB-3	10	10	0	0	10	9	10	10	10	10	10	10	**8.3**

Table 4-10b. Effects of UCR sediments on *Hyalella azteca* 28-day growth in the 42-day tests: Batch 1.										
Site ID	Mean Individual Dry Wt (mg per individual)					Mean Biomass[A] (mg total dry weight)				
	Rep A	Rep B	Rep C	Rep D	**Mean**	Rep A	Rep B	Rep C	Rep D	**Mean**
CTL-SS-B1	0.497	0.531	0.378	0.326	**0.433**	0.497	0.531	0.378	0.326	**0.433**
CTL-QS-B1	0.215	0.226	0.257	0.279	**0.244**	0.215	0.226	0.257	0.279	**0.244**
SE-1-B5	0.435	0.608	0.688	0.581	**0.578**	0.435	0.608	0.550	0.581	**0.544**
SE-1B-R2	0.433	0.528	0.503	0.547	**0.503**	0.346	0.528	0.453	0.492	**0.455**
SE-1-R2	0.220	0.213	0.206	0.394	**0.259**	0.022	0.192	0.165	0.355	**0.184**
SE-4-B6	0.590	0.336	0.609	0.563	**0.525**	0.531	0.336	0.609	0.563	**0.510**
SE-6-B2	0.530	0.573	0.609	0.511	**0.556**	0.530	0.573	0.548	0.511	**0.541**
SE-7-B5	0.527	0.628	0.458	0.499	**0.528**	0.527	0.502	0.412	0.499	**0.485**
SE-8-B3	0.531	0.523	0.572	0.578	**0.551**	0.425	0.523	0.515	0.520	**0.496**
SE-G-1	0.475	0.525	0.548	0.473	**0.505**	0.475	0.525	0.548	0.473	**0.505**
SE-G-3	0.502	0.531	0.400	0.456	**0.472**	0.502	0.531	0.400	0.456	**0.472**
SE-LAL-3	0.673	0.387	0.439	0.705	**0.551**	0.673	0.310	0.439	0.705	**0.532**
SE-LAL-5	0.544	0.484	0.538	0.523	**0.522**	0.544	0.484	0.538	0.523	**0.522**
SE-REF-10b	0.517	0.591	0.608	0.481	**0.549**	0.465	0.591	0.608	0.481	**0.536**
SE-TRIB-3	0.470	0.543	-	-	**0.507**	0.470	0.543	0.000	0.000	**0.253**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 4-10c. Effects of UCR sediments on *Hyalella azteca* 35-day survival: Batch 1.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B1	9	10	10	8	10	10	10	10	**9.6**
CTL-QS-B1	10	10	8	10	10	10	10	9	**9.6**
SE-1-B5	10	10	10	9	10	10	9	9	**9.6**
SE-1B-R2	10	10	10	8	9	6	8	7	**8.5**
SE-1-R2	4	7	5	7	7	7	9	8	**6.8**
SE-4-B6	10	10	10	10	10	10	10	10	**10.0**
SE-6-B2	9	9	10	10	10	10	10	10	**9.8**
SE-7-B5	8	10	9	10	9	10	10	9	**9.4**
SE-8-B3	6	9	9	10	10	9	10	9	**9.0**
SE-G-1	10	9	10	10	9	10	10	10	**9.8**
SE-G-3	5	10	10	10	10	9	0	8	**7.8**
SE-LAL-3	10	10	10	10	10	10	10	10	**10.0**
SE-LAL-5	9	9	10	10	9	9	10	10	**9.5**
SE-REF-10b	10	9	10	10	10	10	10	9	**9.8**
SE-TRIB-3	9	5	10	10	10	10	10	10	**9.3**

Table 4-10d. Effects of UCR sediments on *Hyalella azteca* 42-day survival: Batch 1.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B1	9	10	10	7	10	10	10	10	**9.5**
CTL-QS-B1	10	10	8	9	10	10	10	9	**9.5**
SE-1-B5	10	10	10	9	10	10	9	8	**9.5**
SE-1B-R2	10	10	10	8	9	6	8	7	**8.5**
SE-1-R2	4	7	5	7	7	7	9	8	**6.8**
SE-4-B6	10	10	10	10	10	10	10	10	**10.0**
SE-6-B2	9	9	10	10	10	10	10	10	**9.8**
SE-7-B5	8	10	9	10	9	10	10	9	**9.4**
SE-8-B3	6	8	8	10	10	9	10	9	**8.8**
SE-G-1	10	9	10	10	9	10	10	10	**9.8**
SE-G-3	5	10	9	10	10	10	0	8	**7.8**
SE-LAL-3	10	10	8	10	10	10	10	10	**9.8**
SE-LAL-5	9	9	10	10	9	9	10	10	**9.5**
SE-REF-10b	10	9	10	10	10	10	10	9	**9.8**
SE-TRIB-3	9	0	10	10	10	10	10	10	**8.6**

Table 4-10e. Effects of UCR sediments on *Hyalella azteca* 42-day growth (mg dry weight per individual): Batch 1.									
Site ID	Mean Individual Dry Wt (mg) in Test Replicates								**Mean Dry Wt (mg)**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B1	0.509	0.790	0.644	0.704	0.448	0.672	0.720	0.665	**0.644**
CTL-QS-B1	0.517	0.485	0.509	0.430	0.486	0.496	0.539	0.507	**0.496**
SE-1-B5	0.884	1.001	0.965	0.933	0.942	0.999	0.861	1.065	**0.956**
SE-1B-R2	0.905	0.738	0.715	1.003	0.818	0.795	0.842	0.900	**0.839**
SE-1-R2	0.480	0.381	0.602	0.654	0.460	0.484	0.619	0.306	**0.498**
SE-4-B6	0.899	0.753	0.894	0.703	0.568	0.771	0.924	0.779	**0.786**
SE-6-B2	0.953	0.826	0.925	0.892	0.778	0.805	0.791	0.973	**0.868**
SE-7-B5	0.779	0.861	0.803	0.854	0.790	0.809	0.975	0.786	**0.832**
SE-8-B3	0.597	0.934	0.720	0.756	0.819	0.678	0.804	0.954	**0.783**
SE-G-1	0.746	0.819	0.787	0.728	0.944	0.530	0.594	0.617	**0.721**
SE-G-3	0.426	0.558	0.542	0.465	0.606	0.264	-	0.182	**0.435**
SE-LAL-3	0.839	0.621	0.709	0.867	0.845	0.847	0.700	1.010	**0.805**
SE-LAL-5	0.528	0.920	0.841	0.735	0.822	0.700	0.621	0.758	**0.741**
SE-REF-10b	0.779	0.874	0.713	0.662	0.995	0.964	0.675	0.770	**0.804**
SE-TRIB-3	0.388	-	0.843	0.777	0.969	0.495	0.528	0.662	**0.666**

Table 4-10f. Effects of UCR sediments on *Hyalella azteca* 42-day growth (biomass[A], mg total dry weight): Batch 1.									
Site ID	Mean Dry Wt Biomass (mg) in Test Replicates								**Mean Biomass (mg)**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B1	0.458	0.790	0.644	0.493	0.448	0.672	0.720	0.665	**0.611**
CTL-QS-B1	0.517	0.485	0.407	0.387	0.486	0.496	0.539	0.456	**0.472**
SE-1-B5	0.884	1.001	0.965	0.840	0.942	0.999	0.775	0.852	**0.907**
SE-1B-R2	0.905	0.738	0.715	0.802	0.736	0.477	0.674	0.630	**0.710**
SE-1-R2	0.192	0.267	0.301	0.458	0.322	0.339	0.557	0.245	**0.335**
SE-4-B6	0.899	0.753	0.894	0.703	0.568	0.771	0.924	0.779	**0.786**
SE-6-B2	0.858	0.743	0.925	0.892	0.778	0.805	0.791	0.973	**0.846**
SE-7-B5	0.623	0.861	0.723	0.854	0.711	0.809	0.975	0.707	**0.783**
SE-8-B3	0.358	0.747	0.576	0.756	0.819	0.610	0.804	0.859	**0.691**
SE-G-1	0.746	0.737	0.787	0.728	0.850	0.530	0.594	0.617	**0.699**
SE-G-3	0.213	0.558	0.488	0.465	0.606	0.264	0.000	0.146	**0.343**
SE-LAL-3	0.839	0.621	0.567	0.867	0.845	0.847	0.700	1.010	**0.787**
SE-LAL-5	0.475	0.828	0.841	0.735	0.740	0.630	0.621	0.758	**0.704**
SE-REF-10b	0.779	0.787	0.713	0.662	0.995	0.964	0.675	0.693	**0.784**
SE-TRIB-3	0.349	0.000	0.843	0.777	0.969	0.495	0.528	0.662	**0.578**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 4-10g. Effects of UCR sediments on *Hyalella azteca* Male 42-day survival: Batch 1.									
Site ID	Number of Surviving Males in Test Replicates								**Mean # Males**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B1	2	6	5	5	5	6	6	5	**5.0**
CTL-QS-B1	4	4	5	2	4	4	3	4	**3.8**
SE-1-B5	5	5	5	5	5	6	3	6	**5.0**
SE-1B-R2	5	6	4	7	3	3	1	2	**3.9**
SE-1-R2	2	3	3	4	4	2	4	5	**3.4**
SE-4-B6	6	5	5	4	3	5	8	5	**5.1**
SE-6-B2	6	3	6	4	5	6	5	7	**5.3**
SE-7-B5	4	4	5	7	4	4	8	5	**5.1**
SE-8-B3	3	5	3	3	6	4	4	6	**4.3**
SE-G-1	4	5	4	5	5	4	4	5	**4.5**
SE-G-3	3	8	6	3	7	1	0	0	**3.5**
SE-LAL-3	5	6	6	6	6	5	4	6	**5.5**
SE-LAL-5	4	5	7	3	5	5	4	6	**4.9**
SE-REF-10b	7	8	4	3	7	6	4	4	**5.4**
SE-TRIB-3	3	0	5	2	6	2	4	4	**3.3**

Table 4-10h. Effects of UCR sediments on *Hyalella azteca* Female 42-day survival: Batch 1.									
Site ID	Number of Surviving Females in Test Replicates								**Mean # Females**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B1	7	4	5	2	5	4	4	5	**4.5**
CTL-QS-B1	6	6	3	7	6	6	7	5	**5.8**
SE-1-B5	5	5	5	4	5	4	6	2	**4.5**
SE-1B-R2	5	4	6	1	5	3	7	5	**4.5**
SE-1-R2	2	4	2	3	3	5	5	3	**3.4**
SE-4-B6	4	5	5	6	7	5	2	5	**4.9**
SE-6-B2	3	6	4	6	5	4	5	3	**4.5**
SE-7-B5	4	6	4	3	5	6	2	4	**4.3**
SE-8-B3	3	3	5	7	4	5	6	3	**4.5**
SE-G-1	6	4	6	5	4	6	6	5	**5.3**
SE-G-3	2	2	3	7	3	9	0	8	**4.3**
SE-LAL-3	5	4	2	4	4	5	6	4	**4.3**
SE-LAL-5	5	4	3	7	4	4	6	4	**4.6**
SE-REF-10b	3	1	6	7	3	4	6	5	**4.4**
SE-TRIB-3	6	0	5	8	4	8	6	6	**5.4**

Table 4-10i. Effects of UCR sediments on *Hyalella azteca* reproduction (total number of offspring[A]) in 42-day test: Batch 1.									
Site ID	Number of Offspring in Test Replicates								**Mean # of Offspring**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B1	35	18	30	3	4	11	48	39	**23.5**
CTL-QS-B1	22	11	9	13	18	16	40	12	**17.6**
SE-1-B5	73	58	72	61	83	69	126	22	**70.5**
SE-1B-R2	25	10	27	5	37	11	32	27	**21.8**
SE-1-R2	3	2	0	0	0	5	17	4	**3.9**
SE-4-B6	55	83	59	57	45	56	14	49	**52.3**
SE-6-B2	24	73	20	78	68	46	66	30	**50.6**
SE-7-B5	41	42	35	13	58	65	31	48	**41.6**
SE-8-B3	22	39	53	94	49	46	30	27	**45.0**
SE-G-1	97	24	50	50	50	10	47	75	**50.4**
SE-G-3	9	4	39	52	17	2	0	0	**15.4**
SE-LAL-3	61	31	44	92	33	56	26	49	**49.0**
SE-LAL-5	26	31	35	62	47	33	42	40	**39.5**
SE-REF-10b	20	20	52	110	39	58	97	38	**54.3**
SE-TRIB-3	7	0	34	65	24	9	26	52	**27.1**

A – Sum of number of offspring on Day 35 and Day 42.

Table 4-10j. Effects of UCR sediments on *Hyalella azteca* reproduction (total number of offspring per female[A]) in 42-day test: Batch 1.									
Site ID	Number of Offspring per Female in Test Replicates								**Mean # of Offspring**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B1	5.0	4.5	6.0	1.5	0.8	2.8	12.0	7.8	**5.0**
CTL-QS-B1	3.7	1.8	3.0	1.9	3.0	2.7	5.7	2.4	**3.0**
SE-1-B5	14.6	11.6	14.4	15.3	16.6	17.3	21.0	11.0	**15.2**
SE-1B-R2	5.0	2.5	4.5	5.0	7.4	3.7	4.6	5.4	**4.8**
SE-1-R2	1.5	0.5	0.0	0.0	0.0	1.0	3.4	1.3	**1.0**
SE-4-B6	13.8	16.6	11.8	9.5	6.4	11.2	7.0	9.8	**10.8**
SE-6-B2	8.0	12.2	5.0	13.0	13.6	11.5	13.2	10.0	**10.8**
SE-7-B5	10.3	7.0	8.8	4.3	11.6	10.8	15.5	12.0	**10.0**
SE-8-B3	7.3	13.0	10.6	13.4	12.3	9.2	5.0	9.0	**10.0**
SE-G-1	16.2	6.0	8.3	10.0	12.5	1.7	7.8	15.0	**9.7**
SE-G-3	4.5	2.0	13.0	7.4	5.7	0.2	-[B]	0.0[C]	**5.5**
SE-LAL-3	12.2	7.8	22.0	23.0	8.3	11.2	4.3	12.3	**12.6**
SE-LAL-5	5.2	7.8	11.7	8.9	11.8	8.3	7.0	10.0	**8.8**
SE-REF-10b	6.7	20.0	8.7	15.7	13.0	14.5	16.2	7.6	**12.8**
SE-TRIB-3	1.2	-[B]	6.8	8.1	6.0	1.1	4.3	8.7	**5.2**

A - Sum of number of offspring on Day 35 and Day 42.

B - Complete mortality was observed prior to the Day 35 survival and reproduction assessment; replicate not included in calculation of mean # of offspring.

C - No males observed in the test replicate to reproduce with females; replicate is not included in calculation of mean # of offspring.

Table 4-11a. Toxicity of UCR sediments to *Hyalella azteca* 28-day survival: Batch 2.													
Site ID	# of Surviving Organisms in Test Replicates												**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B2	10	10	10	9	10	8	10	10	10	9	10	10	**9.7**
CTL-QS-B2	10	9	10	9	9	10	9	10	10	10	10	10	**9.7**
SE-2-B1	10	10	9	10	10	10	10	10	10	10	10	10	**9.9**
SE-2-R1	10	10	10	10	10	10	10	10	10	10	10	10	**10.0**
SE-3-R7	10	9	9	10	10	10	10	10	9	10	10	10	**9.8**
SE-4-B1	9	10	9	10	9	10	9	10	10	10	9	9	**9.5**
SE-5-B2	10	10	10	9	9	7	10	9	9	9	9	10	**9.3**
SE-8-B2	9	10	10	10	8	10	10	10	10	10	10	10	**9.8**
SE-LAL-2	7	10	10	4	10	10	9	10	10	8	10	7	**8.8**
SE-G-1	8	9	10	10	10	10	9	10	10	9	10	9	**9.5**
SE-G-3	10	10	10	10	10	10	10	10	10	10	10	10	**10.0**
SE-LAL-3	10	10	10	10	10	10	10	10	10	10	10	10	**10.0**
SE-LAL-5	10	10	9	10	10	10	10	10	10	10	10	9	**9.8**
SE-REF-10b	10	10	10	10	10	10	9	10	10	10	10	10	**9.9**
SE-TRIB-3	10	10	9	0	10	10	10	10	9	10	10	10	**9.0**

Table 4-11b. Toxicity of UCR sediments to *Hyalella azteca* 28-day growth: Batch 2.										
Site ID	Mean Individual Dry Wt (mg per individual)					Mean Biomass[A] (mg total dry weight)				
	Rep A	Rep B	Rep C	Rep D	**Mean**	Rep A	Rep B	Rep C	Rep D	**Mean**
CTL-SS-B2	0.448	0.537	0.629	0.556	**0.542**	0.448	0.537	0.629	0.500	**0.529**
CTL-QS-B2	0.363	0.270	0.153	0.429	**0.304**	0.363	0.243	0.153	0.386	**0.286**
SE-2-B1	0.577	0.642	0.328	0.602	**0.537**	0.577	0.642	0.295	0.602	**0.529**
SE-2-R1	0.482	0.554	0.604	0.501	**0.535**	0.482	0.554	0.604	0.501	**0.535**
SE-3-R7	0.489	0.479	0.461	0.507	**0.484**	0.489	0.431	0.415	0.507	**0.461**
SE-4-B1	0.403	0.549	0.504	0.496	**0.488**	0.363	0.549	0.454	0.496	**0.466**
SE-5-B2	0.375	0.483	0.481	0.516	**0.464**	0.375	0.483	0.481	0.464	**0.451**
SE-8-B2	0.523	0.275	0.552	0.546	**0.474**	0.471	0.275	0.552	0.546	**0.461**
SE-LAL-2	0.154	0.648	0.308	0.550	**0.415**	0.108	0.648	0.308	0.220	**0.321**
SE-G-1	0.559	0.451	0.573	0.452	**0.509**	0.447	0.406	0.573	0.452	**0.470**
SE-G-3	0.528	0.469	0.545	0.531	**0.518**	0.528	0.469	0.545	0.531	**0.518**
SE-LAL-3	0.467	0.627	0.431	0.501	**0.507**	0.467	0.627	0.431	0.501	**0.507**
SE-LAL-5	0.467	0.573	0.614	0.588	**0.561**	0.467	0.573	0.553	0.588	**0.545**
SE-REF-10b	0.517	0.535	0.458	0.604	**0.529**	0.517	0.535	0.458	0.604	**0.529**
SE-TRIB-3	0.485	0.448	0.203	-	**0.379**	0.485	0.448	0.183	0.000	**0.279**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 4-11c. Toxicity of UCR sediments to *Hyalella azteca* 35-day survival: Batch 2.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B2	10	8	10	10	10	9	10	10	**9.6**
CTL-QS-B2	9	10	9	10	10	10	10	10	**9.8**
SE-2-B1	10	10	10	10	10	10	10	10	**10.0**
SE-2-R1	10	10	10	10	10	10	9	10	**9.9**
SE-3-R7	10	9	10	10	9	9	10	10	**9.6**
SE-4-B1	9	10	10	10	10	10	9	8	**9.5**
SE-5-B2	9	7	10	9	9	9	9	10	**9.0**
SE-8-B2	8	10	10	10	10	10	10	10	**9.8**
SE-LAL-2	10	10	8	10	10	8	10	7	**9.1**
SE-G-1	10	10	9	10	10	9	10	8	**9.5**
SE-G-3	10	10	10	10	10	10	10	10	**10.0**
SE-LAL-3	10	10	10	10	10	10	10	10	**10.0**
SE-LAL-5	10	10	10	10	10	10	10	9	**9.9**
SE-REF-10b	10	10	9	10	10	10	10	9	**9.8**
SE-TRIB-3	10	10	10	10	9	10	10	10	**9.9**

Table 4-11d. Toxicity of UCR sediments to *Hyalella azteca* 42-day survival: Batch 2.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B2	10	8	10	10	10	8	9	10	**9.4**
CTL-QS-B2	9	10	9	10	10	10	10	10	**9.8**
SE-2-B1	10	10	10	10	10	10	10	10	**10.0**
SE-2-R1	10	10	10	10	10	10	9	10	**9.9**
SE-3-R7	10	8	10	10	9	8	9	10	**9.3**
SE-4-B1	9	10	10	9	10	10	9	8	**9.4**
SE-5-B2	9	7	10	9	9	9	9	10	**9.0**
SE-8-B2	8	10	10	10	10	10	10	10	**9.8**
SE-LAL-2	10	10	8	4	5	8	8	7	**7.5**
SE-G-1	10	10	9	10	10	9	10	8	**9.5**
SE-G-3	9	10	10	9	9	10	10	10	**9.6**
SE-LAL-3	9	9	10	10	10	10	10	10	**9.8**
SE-LAL-5	10	7	10	9	10	10	10	9	**9.4**
SE-REF-10b	10	10	8	10	10	10	10	8	**9.5**
SE-TRIB-3	10	10	10	10	9	10	10	10	**9.9**

Table 4-11e. Toxicity of UCR sediments to *Hyalella azteca* 42-day growth (dry weight per individual): Batch 2.									
Site ID	Mean Individual Dry Wt (mg) in Test Replicates								**Mean Dry Wt (mg)**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B2	0.606	0.634	0.625	0.587	0.760	0.731	0.754	0.893	**0.699**
CTL-QS-B2	0.661	0.625	0.566	0.696	0.596	0.581	0.623	0.664	**0.626**
SE-2-B1	0.769	0.820	0.596	0.760	0.842	0.778	0.872	0.874	**0.789**
SE-2-R1	0.676	0.885	0.842	0.847	0.803	0.768	0.916	0.870	**0.826**
SE-3-R7	0.766	0.746	0.806	0.740	0.676	0.816	0.823	0.614	**0.748**
SE-4-B1	0.514	0.748	0.777	0.726	0.603	0.812	0.827	0.856	**0.733**
SE-5-B2	0.858	0.683	0.660	0.834	0.759	0.536	0.527	0.821	**0.710**
SE-8-B2	0.631	0.733	0.732	0.926	0.780	0.830	0.877	0.761	**0.784**
SE-LAL-2	0.320	0.929	0.923	0.205	0.220	0.679	0.155	0.131	**0.445**
SE-G-1	0.702	0.749	0.753	0.608	0.503	0.713	0.582	0.644	**0.657**
SE-G-3	0.724	0.554	0.551	0.733	0.680	0.745	0.734	0.785	**0.688**
SE-LAL-3	0.499	0.490	0.744	0.813	0.863	0.814	0.906	0.878	**0.751**
SE-LAL-5	0.765	0.514	0.908	0.804	0.739	0.827	0.716	0.957	**0.779**
SE-REF-10b	0.657	0.889	0.999	0.678	0.963	0.882	0.843	0.974	**0.861**
SE-TRIB-3	0.819	0.882	0.783	0.697	0.819	0.790	0.769	0.892	**0.806**

Table 4-11f. Toxicity of UCR sediments to *Hyalella azteca* 42-day growth (biomass[A]): Batch 2.									
Site ID	Mean Dry Wt Biomass (mg) in Test Replicates								**Mean Biomass (mg)**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B2	0.606	0.507	0.625	0.587	0.760	0.585	0.679	0.893	**0.655**
CTL-QS-B2	0.595	0.625	0.509	0.696	0.596	0.581	0.623	0.664	**0.611**
SE-2-B1	0.769	0.820	0.596	0.760	0.842	0.778	0.872	0.874	**0.789**
SE-2-R1	0.676	0.885	0.842	0.847	0.803	0.768	0.824	0.870	**0.814**
SE-3-R7	0.766	0.597	0.806	0.740	0.608	0.653	0.741	0.614	**0.691**
SE-4-B1	0.463	0.748	0.777	0.653	0.603	0.812	0.744	0.685	**0.686**
SE-5-B2	0.772	0.478	0.660	0.751	0.683	0.482	0.474	0.821	**0.640**
SE-8-B2	0.505	0.733	0.732	0.926	0.780	0.830	0.877	0.761	**0.768**
SE-LAL-2	0.320	0.929	0.738	0.082	0.110	0.543	0.124	0.092	**0.367**
SE-G-1	0.702	0.749	0.678	0.608	0.503	0.642	0.582	0.515	**0.622**
SE-G-3	0.652	0.554	0.551	0.660	0.612	0.745	0.734	0.785	**0.662**
SE-LAL-3	0.449	0.441	0.744	0.813	0.863	0.814	0.906	0.878	**0.739**
SE-LAL-5	0.765	0.360	0.908	0.724	0.739	0.827	0.716	0.861	**0.738**
SE-REF-10b	0.657	0.889	0.799	0.678	0.963	0.882	0.843	0.779	**0.811**
SE-TRIB-3	0.819	0.882	0.783	0.697	0.737	0.790	0.769	0.892	**0.796**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 4-11g. Toxicity of UCR sediments to *Hyalella azteca* – Total number of surviving males on Day 42: Batch 2.									
Site ID	Number of Surviving Males in Test Replicates								**Mean # Males**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B2	6	4	5	5	5	5	5	4	**4.9**
CTL-QS-B2	5	3	4	4	1	5	4	3	**3.6**
SE-2-B1	6	3	3	6	3	5	4	7	**4.6**
SE-2-R1	4	7	7	3	8	6	4	6	**5.6**
SE-3-R7	4	5	4	3	5	5	5	3	**4.3**
SE-4-B1	6	3	8	7	3	4	6	7	**5.5**
SE-5-B2	4	2	4	5	2	3	5	1	**3.3**
SE-8-B2	2	6	6	7	6	5	6	4	**5.3**
SE-LAL-2	2	7	6	0	0	3	0	0	**2.3**
SE-G-1	6	6	5	5	3	3	4	3	**4.4**
SE-G-3	6	4	4	4	5	6	7	5	**5.1**
SE-LAL-3	3	6	4	6	6	4	6	5	**5.0**
SE-LAL-5	4	2	5	6	2	6	3	7	**4.4**
SE-REF-10b	3	4	6	3	6	4	4	7	**4.6**
SE-TRIB-3	3	7	4	6	5	3	6	5	**4.9**

Table 4-11h. Toxicity of UCR sediments to *Hyalella azteca* – Total number of surviving females on Day 42: Batch 2.									
Site ID	Number of Surviving Females in Test Replicates								**Mean # Females**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B2	4	4	5	5	5	3	4	6	**4.5**
CTL-QS-B2	4	7	5	6	9	5	6	7	**6.1**
SE-2-B1	4	7	7	4	7	5	6	3	**5.4**
SE-2-R1	6	3	3	7	2	4	5	4	**4.3**
SE-3-R7	6	3	6	7	4	3	4	7	**5.0**
SE-4-B1	3	7	2	2	7	6	3	1	**3.9**
SE-5-B2	5	5	6	4	7	6	4	9	**5.8**
SE-8-B2	6	4	4	3	4	5	4	6	**4.5**
SE-LAL-2	8	3	2	4	5	5	8	7	**5.3**
SE-G-1	4	4	4	5	7	6	6	5	**5.1**
SE-G-3	3	6	6	5	4	4	3	5	**4.5**
SE-LAL-3	6	3	6	4	4	6	4	5	**4.8**
SE-LAL-5	6	5	5	3	8	4	7	2	**5.0**
SE-REF-10b	7	6	2	7	4	6	6	1	**4.9**
SE-TRIB-3	7	3	6	4	4	7	4	5	**5.0**

Table 4-11i. Toxicity of UCR sediments to *Hyalella azteca* reproduction – Total number of offspring[A]: Batch 2.									
Site ID	Number of Offspring in Test Replicates								**Mean # of Offspring**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B2	6	26	11	60	65	11	30	113	**40.3**
CTL-QS-B2	15	32	17	28	28	4	43	28	**24.4**
SE-2-B1	26	64	80	59	88	67	101	47	**66.5**
SE-2-R1	12	31	17	51	9	23	26	31	**25.0**
SE-3-R7	67	7	34	24	16	33	13	42	**29.5**
SE-4-B1	9	48	17	8	49	23	19	0	**21.6**
SE-5-B2	37	27	58	60	58	24	20	103	**48.4**
SE-8-B2	35	18	8	12	32	33	27	76	**30.1**
SE-LAL-2	3	21	12	0	0	73	0	0	**13.6**
SE-G-1	40	28	60	44	37	74	42	37	**45.3**
SE-G-3	29	46	68	44	9	19	13	51	**34.9**
SE-LAL-3	22	26	64	35	43	47	45	68	**43.8**
SE-LAL-5	113	27	73	27	81	57	74	10	**57.8**
SE-REF-10b	72	67	31	82	31	66	70	6	**53.1**
SE-TRIB-3	56	25	48	26	29	52	35	34	**38.1**

A – Sum of number of offspring on Day 35 and Day 42.

Table 4-11j. Toxicity of UCR sediments to *Hyalella azteca* reproduction – Total number of offspring per female[A]: Batch 2.									
Site ID	Number of Offspring per Female in Test Replicates								**Mean # of Offspring**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B2	1.5	6.5	2.2	12.0	13.0	3.7	7.5	18.8	**8.2**
CTL-QS-B2	3.8	4.6	3.4	4.7	3.1	0.8	7.2	4.0	**3.9**
SE-2-B1	6.5	9.1	11.4	14.8	12.6	13.4	16.8	15.7	**12.5**
SE-2-R1	2.0	10.3	5.7	7.3	4.5	5.8	5.2	7.8	**6.1**
SE-3-R7	11.2	2.3	5.7	3.4	4.0	11.0	3.3	6.0	**5.9**
SE-4-B1	3.0	6.9	8.5	4.0	7.0	3.8	6.3	0.0	**4.9**
SE-5-B2	7.4	5.4	9.7	15.0	8.3	4.0	5.0	11.4	**8.3**
SE-8-B2	5.8	4.5	2.0	4.0	8.0	6.6	6.8	12.7	**6.3**
SE-LAL-2	0.4	7.0	6.0	0.0[B]	0.0[B]	14.6	0.0[B]	0.0[B]	**7.0**
SE-G-1	10.0	7.0	15.0	8.8	5.3	12.3	7.0	7.4	**9.1**
SE-G-3	9.7	7.7	11.3	8.8	2.3	4.8	4.3	10.2	**7.4**
SE-LAL-3	3.7	8.7	10.7	8.8	10.8	7.8	11.3	13.6	**9.4**
SE-LAL-5	18.8	5.4	14.6	9.0	10.1	14.3	10.6	5.0	**11.0**
SE-REF-10b	10.3	11.2	15.5	11.7	7.8	11.0	11.7	6.0	**10.6**
SE-TRIB-3	8.0	8.3	8.0	6.5	7.3	7.4	8.8	6.8	**7.6**

A - Sum of number of offspring on Day 35 and Day 42.
B - No males observed in the test replicate to reproduce with females; replicate is not included in calculation of mean # of offspring.

Table 4-12a. Toxicity of UCR sediments to *Hyalella azteca* 28-day survival: Batch 3.													
Site ID	# of Surviving Organisms in Test Replicates												**Mean Survival**
	Rep A	Rep B	Rep C	Rep D	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B3	10	10	10	10	10	10	10	10	10	10	10	10	**10.0**
CTL-QS-B3	10	10	10	10	9	10	10	10	10	10	10	9	**9.8**
SE-3-B3	9	10	10	10	10	10	9	10	10	10	10	10	**9.8**
SE-3-R8	5	6	3	5	7	7	5	2	6	6	7	4	**5.3**
SE-4-B5	7	4	7	8	8	1	10	6	10	10	9	9	**7.4**
SE-5-B4	10	10	10	10	10	9	10	10	10	10	10	9	**9.8**
SE-6-B5	10	10	10	10	9	10	9	9	10	9	9	10	**9.6**
SE-7-B2	10	10	10	10	10	10	10	9	10	10	10	10	**9.9**
SE-G-2	10	10	10	10	10	10	10	10	10	10	10	10	**10.0**
SE-G-1	10	10	10	9	10	10	10	10	10	10	10	10	**9.9**
SE-G-3	10	10	10	10	8	10	10	10	10	10	10	10	**9.8**
SE-LAL-3	10	10	10	10	10	10	10	10	10	10	8	9	**9.8**
SE-LAL-5	9	10	10	10	10	10	10	10	10	9	10	10	**9.8**
SE-REF-10b	10	10	10	10	10	10	10	10	10	10	10	10	**10.0**
SE-TRIB-3	10	10	10	10	10	0	10	10	9	5	10	10	**8.7**

Table 4-12b. Toxicity of UCR sediments to *Hyalella azteca* 28-day growth: Batch 3.										
Site ID	Mean Individual Dry Wt (mg per individual)					Mean Biomass[A] (mg total dry weight)				
	Rep A	Rep B	Rep C	Rep D	**Mean**	Rep A	Rep B	Rep C	Rep D	**Mean**
CTL-SS-B3	0.515	0.530	0.547	0.482	**0.519**	0.515	0.530	0.547	0.482	**0.519**
CTL-QS-B3	0.334	0.152	0.157	0.280	**0.231**	0.334	0.152	0.157	0.280	**0.231**
SE-3-B3	0.744	0.587	0.663	0.658	**0.663**	0.670	0.587	0.663	0.658	**0.645**
SE-3-R8	0.126	0.153	0.233	0.176	**0.172**	0.063	0.092	0.070	0.088	**0.078**
SE-4-B5	0.459	0.477	0.423	0.268	**0.407**	0.321	0.191	0.296	0.214	**0.256**
SE-5-B4	0.464	0.614	0.511	0.436	**0.506**	0.464	0.614	0.511	0.436	**0.506**
SE-6-B5	0.454	0.554	0.544	0.572	**0.531**	0.454	0.554	0.544	0.572	**0.531**
SE-7-B2	0.460	0.624	0.575	0.635	**0.574**	0.460	0.624	0.575	0.635	**0.574**
SE-G-2	0.571	0.600	0.608	0.435	**0.554**	0.571	0.600	0.608	0.435	**0.554**
SE-G-1	0.422	0.569	0.511	0.444	**0.487**	0.422	0.569	0.511	0.400	**0.476**
SE-G-3	0.339	0.476	0.494	0.345	**0.414**	0.339	0.476	0.494	0.345	**0.414**
SE-LAL-3	0.573	0.568	0.674	0.609	**0.606**	0.573	0.568	0.674	0.609	**0.606**
SE-LAL-5	0.568	0.605	0.618	0.514	**0.576**	0.511	0.605	0.618	0.514	**0.562**
SE-REF-10b	0.624	0.537	0.557	0.324	**0.511**	0.624	0.537	0.557	0.324	**0.511**
SE-TRIB-3	0.594	0.529	0.488	0.487	**0.525**	0.594	0.529	0.488	0.487	**0.525**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 4-12c. Toxicity of UCR sediments to *Hyalella azteca* 35-day survival: Batch 3.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B3	10	10	9	10	9	10	10	10	**9.8**
CTL-QS-B3	9	10	9	10	10	10	10	9	**9.6**
SE-3-B3	10	10	9	10	10	9	9	9	**9.5**
SE-3-R8	7	7	5	2	6	6	7	4	**5.5**
SE-4-B5	8	1	10	6	10	10	9	9	**7.9**
SE-5-B4	10	9	10	8	10	10	10	9	**9.5**
SE-6-B5	9	10	9	9	10	9	8	10	**9.3**
SE-7-B2	10	10	10	9	9	9	10	10	**9.6**
SE-G-2	10	10	10	10	10	10	10	10	**10.0**
SE-G-1	10	10	9	10	10	10	10	10	**9.9**
SE-G-3	7	10	10	10	10	10	10	10	**9.6**
SE-LAL-3	10	10	10	9	10	10	8	9	**9.5**
SE-LAL-5	9	10	10	10	9	9	10	10	**9.6**
SE-REF-10b	10	10	10	10	10	10	10	10	**10.0**
SE-TRIB-3	10	0	10	10	8	3	10	10	**7.6**

Table 4-12d. Toxicity of UCR sediments to *Hyalella azteca* 42-day survival: Batch 3.									
Site ID	# of Surviving Organisms in Test Replicates								**Mean Survival**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B3	9	10	8	10	9	10	10	10	**9.5**
CTL-QS-B3	9	10	9	10	10	10	10	9	**9.6**
SE-3-B3	10	10	9	10	9	10	9	10	**9.6**
SE-3-R8	7	6	5	2	6	5	7	4	**5.3**
SE-4-B5	8	1	10	6	10	10	9	9	**7.9**
SE-5-B4	10	9	10	8	10	10	10	9	**9.5**
SE-6-B5	9	10	9	9	10	9	8	10	**9.3**
SE-7-B2	10	10	10	9	9	9	10	10	**9.6**
SE-G-2	10	10	10	10	10	10	10	10	**10.0**
SE-G-1	10	10	9	10	10	10	10	10	**9.9**
SE-G-3	5	10	10	10	10	10	10	10	**9.4**
SE-LAL-3	10	10	10	9	10	10	8	9	**9.5**
SE-LAL-5	9	10	10	10	9	9	10	10	**9.6**
SE-REF-10b	10	10	10	6	10	9	10	10	**9.4**
SE-TRIB-3	10	0	10	10	8	1	10	10	**7.4**

Table 4-12e. Toxicity of UCR sediments to *Hyalella azteca* 42-day growth (dry weight per individual): Batch 3.									
Site ID	Mean Individual Dry Wt (mg) in Test Replicates								**Mean Dry Wt (mg)**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B3	0.648	0.563	0.871	0.656	0.578	0.691	0.729	0.543	**0.660**
CTL-QS-B3	0.646	0.643	0.667	0.655	0.770	0.424	0.518	0.286	**0.576**
SE-3-B3	0.960	0.981	1.039	1.033	1.000	0.992	1.026	0.881	**0.989**
SE-3-R8	0.600	0.392	0.534	0.640	0.900	0.310	0.613	0.425	**0.552**
SE-4-B5	0.685	1.130	0.850	0.698	0.829	0.939	0.890	0.871	**0.862**
SE-5-B4	0.704	0.837	0.791	0.550	0.835	0.721	0.782	0.950	**0.771**
SE-6-B5	0.870	0.844	0.797	0.846	0.882	0.919	1.033	0.702	**0.861**
SE-7-B2	0.842	0.898	0.851	0.952	0.904	0.811	0.697	0.935	**0.861**
SE-G-2	0.634	0.798	0.790	0.794	0.989	0.899	0.886	0.872	**0.833**
SE-G-1	0.758	0.852	0.794	0.876	0.688	0.827	0.596	0.677	**0.759**
SE-G-3	0.072	0.826	0.734	0.736	0.748	0.143	0.642	0.707	**0.576**
SE-LAL-3	0.911	0.896	0.946	0.946	0.950	0.916	0.955	0.872	**0.924**
SE-LAL-5	0.817	0.842	0.815	0.854	0.782	0.688	1.026	0.971	**0.849**
SE-REF-10b	0.807	0.573	0.876	0.152	0.634	0.699	1.013	0.939	**0.712**
SE-TRIB-3	0.901	-	0.399	0.900	0.121	0.090	0.413	0.805	**0.518**

Table 4-12f. Toxicity of UCR sediments to *Hyalella azteca* 42-day growth (biomass[A]): Batch 3.									
Site ID	Mean Dry Wt Biomass (mg) in Test Replicates								**Mean Biomass (mg)**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B3	0.583	0.563	0.697	0.656	0.520	0.691	0.729	0.543	**0.623**
CTL-QS-B3	0.581	0.643	0.600	0.655	0.770	0.424	0.518	0.257	**0.556**
SE-3-B3	0.960	0.981	0.935	1.033	0.900	0.992	0.923	0.881	**0.951**
SE-3-R8	0.420	0.235	0.267	0.128	0.540	0.155	0.429	0.170	**0.293**
SE-4-B5	0.548	0.113	0.850	0.419	0.829	0.939	0.801	0.784	**0.660**
SE-5-B4	0.704	0.753	0.791	0.440	0.835	0.721	0.782	0.855	**0.735**
SE-6-B5	0.783	0.844	0.717	0.761	0.882	0.827	0.826	0.702	**0.793**
SE-7-B2	0.842	0.898	0.851	0.857	0.814	0.730	0.697	0.935	**0.828**
SE-G-2	0.634	0.798	0.790	0.794	0.989	0.899	0.886	0.872	**0.833**
SE-G-1	0.758	0.852	0.715	0.876	0.688	0.827	0.596	0.677	**0.749**
SE-G-3	0.036	0.826	0.734	0.736	0.748	0.143	0.642	0.707	**0.572**
SE-LAL-3	0.911	0.896	0.946	0.851	0.950	0.916	0.764	0.785	**0.877**
SE-LAL-5	0.735	0.842	0.815	0.854	0.704	0.619	1.026	0.971	**0.821**
SE-REF-10b	0.807	0.573	0.876	0.091	0.634	0.629	1.013	0.939	**0.695**
SE-TRIB-3	0.901	-	0.399	0.900	0.097	0.009	0.413	0.805	**0.441**

A – Biomass = total weight of organisms/number of organisms loaded at test initiation.

Table 4-12g. Toxicity of UCR sediments to *Hyalella azteca* – Total number of surviving males on Day 42: Batch 3.									
Site ID	Number of Surviving Males in Test Replicates								**Mean # Males**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B3	2	5	7	2	3	4	6	1	**3.8**
CTL-QS-B3	4	5	3	6	6	4	4	2	**4.3**
SE-3-B3	6	5	5	5	1	5	6	5	**4.8**
SE-3-R8	3	1	2	1	4	1	2	2	**2.0**
SE-4-B5	1	1	5	3	5	5	2	3	**3.1**
SE-5-B4	4	6	5	7	6	3	6	5	**5.3**
SE-6-B5	4	2	2	5	6	6	5	3	**4.1**
SE-7-B2	3	6	3	6	5	3	1	7	**4.3**
SE-G-2	4	4	5	4	5	3	6	4	**4.4**
SE-G-1	5	5	5	5	2	5	7	4	**4.8**
SE-G-3	3	5	5	5	5	6	3	4	**4.5**
SE-LAL-3	4	5	5	6	4	5	4	4	**4.6**
SE-LAL-5	1	2	5	5	3	5	7	6	**4.3**
SE-REF-10b	2	5	4	0	3	4	7	6	**3.9**
SE-TRIB-3	7	-	2	5	0	0	4	3	**3.0**

Table 4-12h. Toxicity of UCR sediments to *Hyalella azteca* – Total number of surviving females on Day 42: Batch 3.									
Site ID	Number of Surviving Females in Test Replicates								**Mean # Females**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B3	7	5	1	8	6	6	4	9	**5.8**
CTL-QS-B3	5	5	6	4	4	6	6	7	**5.4**
SE-3-B3	4	5	4	5	9	5	3	5	**5.0**
SE-3-R8	4	5	3	1	2	4	5	2	**3.3**
SE-4-B5	7	0	5	3	5	5	7	6	**4.8**
SE-5-B4	6	3	5	1	4	7	4	4	**4.3**
SE-6-B5	5	8	7	4	4	3	3	7	**5.1**
SE-7-B2	7	4	7	3	4	6	9	3	**5.4**
SE-G-2	6	6	5	6	5	7	4	6	**5.6**
SE-G-1	5	5	4	5	8	5	3	6	**5.1**
SE-G-3	2	5	5	5	5	4	7	6	**4.9**
SE-LAL-3	6	5	5	3	6	5	4	5	**4.9**
SE-LAL-5	8	8	5	5	6	4	3	4	**5.4**
SE-REF-10b	8	5	6	6	7	5	3	4	**5.5**
SE-TRIB-3	3	-	8	5	8	1	6	7	**5.4**

Table 4-12i. Toxicity of UCR sediments to *Hyalella azteca* reproduction – Total number of offspring[A]: Batch 3.									
Site ID	Number of Offspring in Test Replicates								**Mean # of Offspring**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B3	86	30	8	79	53	40	59	39	**49.3**
CTL-QS-B3	18	13	33	10	12	12	1	3	**12.8**
SE-3-B3	38	97	64	93	103	78	29	76	**72.3**
SE-3-R8	17	0	11	0	6	0	11	0	**5.6**
SE-4-B5	31	0	39	6	39	41	46	48	**31.3**
SE-5-B4	62	21	42	6	21	64	45	70	**41.4**
SE-6-B5	56	19	70	35	48	34	20	42	**40.5**
SE-7-B2	130	44	48	60	38	81	54	41	**62.0**
SE-G-2	12	74	39	82	57	79	59	71	**59.1**
SE-G-1	43	42	26	56	60	32	15	53	**40.9**
SE-G-3	0	49	41	43	53	0	29	34	**31.1**
SE-LAL-3	63	76	35	43	108	92	31	80	**66.0**
SE-LAL-5	52	69	47	48	111	26	20	27	**50.0**
SE-REF-10b	122	46	60	0	43	43	21	34	**46.1**
SE-TRIB-3	33	-[B]	7	31	0	0	3	106	**25.7**

A – Sum of number of offspring on Day 35 and Day 42.
B – Complete mortality in this replicate at Day 28; replicate not included in calculation of mean # of offspring.

Table 4-12j. Toxicity of UCR sediments to *Hyalella azteca* reproduction – Total number of offspring per female[A]: Batch 3.

Site ID	Number of Offspring per Female in Test Replicates								**Mean # of Offspring**
	Rep E	Rep F	Rep G	Rep H	Rep I	Rep J	Rep K	Rep L	
CTL-SS-B3	12.3	6.0	8.0	9.9	8.8	6.7	14.8	4.3	**8.8**
CTL-QS-B3	3.6	2.6	5.5	2.5	3.0	2.0	0.2	0.4	**2.5**
SE-3-B3	9.5	19.4	16.0	18.6	11.4	15.6	9.7	15.2	**14.4**
SE-3-R8	4.3	0.0	3.7	0.0	3.0	0.0	2.2	0.0	**1.6**
SE-4-B5	4.4	- [B]	7.8	2.0	7.8	8.2	6.6	8.0	**6.4**
SE-5-B4	10.3	7.0	8.4	6.0	5.3	9.1	11.3	17.5	**9.4**
SE-6-B5	11.2	2.4	10.0	8.8	12.0	11.3	6.7	6.0	**8.5**
SE-7-B2	18.6	11.0	6.9	20.0	9.5	13.5	6.0	13.7	**12.4**
SE-G-2	2.0	12.3	7.8	13.7	11.4	11.3	14.8	11.8	**10.6**
SE-G-1	8.6	8.4	6.5	11.2	7.5	6.4	5.0	8.8	**7.8**
SE-G-3	0.0	9.8	8.2	8.6	10.6	0.0	4.1	5.7	**5.9**
SE-LAL-3	10.5	15.2	7.0	14.3	18.0	18.4	7.8	16.0	**13.4**
SE-LAL-5	6.5	8.6	9.4	9.6	18.5	6.5	6.7	6.8	**9.1**
SE-REF-10b	15.3	9.2	10.0	0.0[C]	6.1	8.6	7.0	8.5	**9.2**
SE-TRIB-3	11.0	- [B]	0.9	6.2	0.0[C]	0.0[C]	0.5	15.1	**6.7**

A - Sum of number of offspring on Day 35 and Day 42.
B - Complete mortality was observed prior to the Day 35 survival and reproduction assessment; replicate is not included in the calculation of mean # of offspring.
C - No males observed in the test replicate to reproduce with females; replicate is not included in the calculation of mean # of offspring.

5. QUALITY ASSURANCE AND QUALITY CONTROL

A QA/QC summary for toxicity testing of the UCR sediments with *Chironomus dilutus* and *Hyalella azteca* is provided below. Quality assurance procedures followed methods described in USEPA 2000, ASTM 2012, UCR QAPP (Exponent et al. 2013), and UCR QAPP Change Order Requests #3, #4, #5, #6, and #7.

The biological testing of the UCR sediment samples incorporated standard QA/QC procedures to ensure that the test results were valid, including the use of Negative Lab Controls, Positive Lab Controls, test replicates, and measurements of water quality during testing. Sediments used for the bioassay testing were stored at 4°C ± 2°C prior to use in testing. The QA/QC summaries for the *C. dilutus* 10-day tests and *C. dilutus* long-term (life-cycle) tests are presented below in Sections 5.1 and 5.2, respectively. QA/QC summaries for the *H. azteca* 28-day and *H. azteca* 42-day tests are presented below in Sections 5.3 and 5.4, respectively.

5.1 QA/QC Summary: *Chironomus dilutus* 10-day Toxicity Testing

5.1.1 Test Conditions

All test water quality conditions were within the appropriate limits (Tables 5-1a through 5-1f). Laboratory instruments were calibrated daily according to Lab standard operating procedures (SOPs), and calibration data were logged and initialed. Zumwalt water delivery systems were calibrated prior to test initiation and periodically throughout the testing; calibration logs are provided in Appendix EE. Lighting intensity was also confirmed at test initiation; light verification measurements are presented in Appendix FF. It should be noted that for test replicate overlying water DO levels that fell below the 2.5 mg/L aeration trigger level during the course of testing, aeration was initiated for these samples; the majority of the low DO levels were observed during the evening (P.M.) DO checks. When aeration was implemented, the aeration initiation date was recorded on the bench data sheet, along with the lowest replicate DO measurement for each treatment that fell below the aeration trigger. A summary of sediment samples that were aerated is provided in Appendix GG; any additional test treatment replicate DO measurements performed upon observation of a DO <2.5 mg/L are also provided in Appendix GG.

The lowest DO observed in the testing was 1.0 mg/L for treatment replicates CTL-QS-B3-E and SE-6-B2-B (Tables 5-1a through 5-1f, Appendix GG). With the exception of treatment replicate CTL-QS-B3-G, which had a DO level of 1.1 mg/L, all other DO measurements throughout the test were ≥1.2 mg/L. Studies have shown that DO levels of 1.2 mg/L during 10-day exposures of *C. dilutus* did not impair midge survival or growth (Irving et. al 2004). Based on this information and the very short duration (approximately <18 hrs) that test organisms were potentially exposed to low DO levels in the current testing, it is expected that data quality was not impacted.

Table 5-1a. Summary of water quality data for 10-day *Chironomus dilutus* UCR sediment tests: Batch 1.

Site ID	Temperature (°C)			AM DO (mg/L)			Aeration Trigger Exceedance DO Level (mg/L)[A]	pH			Conductivity (µS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-1-R1	22.0	23.4	22.8	4.7	8.9	6.9	1.9*	7.57	8.10	7.84	336	341	339	62	76	69	91	106	98.5	<1.00	<1.00	<1.00
SE-3-R2	22.0	23.4	22.8	4.6	8.5	7.0	2.5*	7.60	7.99	7.80	344	378	361	78	90	84	100	123	112	<1.00	1.35	0.68
SE-4-B6	22.1	23.4	22.9	4.4	8.8	6.9	2.5*	7.67	8.08	7.88	334	334	334	57	68	62.5	96	106	101	<1.00	<1.00	<1.00
SE-5-B1	22.0	23.4	22.8	4.7	8.6	7.0	2.4*	7.47	8.07	7.77	336	359	348	55	84	69.5	96	110	103	<1.00	<1.00	<1.00
SE-6-B6	22.0	23.7	22.9	4.1	8.6	6.8	2.3*	7.57	8.05	7.81	317	329	323	50	54	52	94	100	97	<1.00	<1.00	<1.00
SE-6-R3	22.2	23.7	23.0	4.2	8.7	6.5	NA	7.59	8.01	7.80	320	326	323	52	54	53	90	92	91	<1.00	<1.00	<1.00
SE-8-B3	22.0	23.3	22.8	4.2	8.7	6.9	2.4*	7.58	7.95	7.77	318	326	322	46	59	52.5	90	96	93	<1.00	<1.00	<1.00
SE-8-B4	22.0	23.6	22.9	4.5	8.5	6.6	2.1*	7.58	7.97	7.78	321	329	325	54	60	57	91	100	95.5	<1.00	<1.00	<1.00
SE-G-1	22.0	23.4	22.9	4.2	9.0	6.5	2.2*	7.58	8.01	7.80	331	334	333	59	68	63.5	91	92	91.5	<1.00	<1.00	<1.00
SE-REF-6	22.1	23.4	22.9	4.4	8.7	6.4	NA	7.50	7.97	7.74	329	332	331	58	76	67	96	102	99	<1.00	<1.00	<1.00
SE-TRIB-4	22.0	23.4	22.8	3.7	8.7	6.6	2.0*	7.47	8.02	7.75	350	381	366	62	98	80	106	142	124	<1.00	<1.00	<1.00
CTL-SS-B1	22.0	23.3	22.8	4.2	8.6	6.6	1.9*	7.61	8.03	7.82	352	360	356	67	76	71.5	92	110	101	<1.00	<1.00	<1.00
CTL-QS-B1	22.1	23.8	22.9	4.0	8.9	6.8	1.3*	7.70	7.99	7.85	327	332	330	60	78	69	90	98	94	<1.00	1.17	0.59
CTL-ERDC-B1	22.1	23.4	22.9	4.3	8.7	6.7	1.7*	7.58	7.81	7.70	290	336	313	58	69	63.5	82	88	85	2.51	2.74	2.63

A – The dissolved oxygen (DO) value reported here is the lowest replicate DO recorded for the treatment on the day that the aeration trigger level was exceeded and aeration was initiated. See Appendix GG for a summary of DO readings for each replicate.
* Aeration Trigger exceedance observed at the daily PM DO check.
NA – Observed DO never fell below 2.5 mg/L during the test.

Table 5-1b. Summary of water quality data for 10-day *Chironomus dilutus* UCR sediment tests: Batch 2.

Site ID	Temperature (°C)			AM DO (mg/L)			Aeration Trigger Exceedance DO Level (mg/L)[A]	pH			Conductivity (µS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-2-R1	22.4	23.7	23.2	4.4	8.7	7.1	1.6*	7.77	8.08	7.93	341	348	345	69	70	69.5	101	107	104	<1.00	<1.00	<1.00
SE-4-B2	22.6	23.5	23.1	4.5	8.8	7.1	1.6*	7.80	8.11	7.96	333	339	336	61	84	72.5	92	97.6	94.8	<1.00	<1.00	<1.00
SE-4-B4	22.6	23.4	23.0	4.0	8.6	6.5	NA	7.68	8.07	7.88	347	352	350	71	78	74.5	103	104	104	<1.00	1.00	0.50
SE-5-B3	22.0	23.5	23.0	4.1	8.5	6.6	2.2*	7.74	8.03	7.89	326	326	326	61	68	64.5	85.2	95	90.1	<1.00	1.36	0.68
SE-6-B5	22.4	23.5	23.1	4.7	8.5	6.7	1.8*	7.82	7.96	7.89	327	336	332	51	67.2	59.1	95	99.6	97.3	<1.00	<1.00	<1.00
SE-LAL-1	22.7	23.8	23.3	4.4	8.7	6.6	2.2*	7.73	7.95	7.84	326	334	330	58	68	63	98	100	99	<1.00	1.25	0.63
SE-LAL-2	22.0	23.9	23.1	3.7	8.6	7.0	2.3*	7.81	7.91	7.86	311	331	321	60	63	61.5	79.6	99	89.3	<1.00	<1.00	<1.00
SE-LAL-3	22.7	23.7	23.2	3.6	8.6	6.9	1.8*	7.82	7.90	7.86	338	341	340	69	100	84.5	97.2	101	99.1	<1.00	<1.00	<1.00
SE-LAL-6	22.5	23.3	23.0	3.7	8.7	7.1	1.4*	7.72	7.93	7.83	338	341	340	68	69	68.5	91.2	99	95.1	<1.00	<1.00	<1.00
SE-REF-4	22.5	23.3	23.0	4.1	8.6	7.0	1.7*	7.80	7.93	7.87	332	336	334	64	67.6	65.8	95.2	96	95.6	<1.00	<1.00	<1.00
SE-REF-8	22.7	23.8	23.2	3.8	8.6	6.2	NA	7.59	7.92	7.76	327	334	331	59	78	68.5	96	98	97	<1.00	<1.00	<1.00
CTL-SS-B2	22.7	23.4	23.1	4.7	8.6	7.1	2.3*	7.71	7.98	7.85	360	365	363	64	77.6	70.8	96	103	99.6	<1.00	<1.00	<1.00
CTL-QS-B2	22.6	23.9	23.2	4.2	8.8	6.9	1.9*	7.78	8.01	7.90	325	333	329	56	60	58	86	90.4	88.2	<1.00	1.01	0.51
CTL-ERDC-B2	22.4	23.9	23.2	3.5	8.8	7.0	1.3*	7.67	7.71	7.69	296	336	316	62	74	68	68	89	78.5	2.50	2.79	2.65

A – The dissolved oxygen (DO) value reported here is the lowest replicate DO recorded for the treatment on the day that the aeration trigger level was exceeded and aeration was initiated. See Appendix GG for a summary of DO readings for each replicate.
* Aeration Trigger exceedance observed at the daily PM DO check.
NA – Observed DO never fell below 2.5 mg/L during the test.

Table 5-1c. Summary of water quality data for 10-day *Chironomus dilutus* UCR sediment tests: Batch 3.

Site ID	Temperature (°C)			AM DO (mg/L)			Aeration Trigger Exceedance DO Level (mg/L)[A]	pH			Conductivity (μS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-2-R3	22.3	23.9	23.3	4.5	8.7	6.9	1.8*	7.86	8.17	8.02	364	365	365	72	79.2	75.6	102	106	104	<1.00	1.14	0.57
SE-3-R1	22.8	23.3	23.0	4.0	8.7	7.1	1.4*	7.87	8.23	8.05	337	354	346	69	86.4	77.7	95.6	103	99.4	<1.00	1.28	0.64
SE-3-R8	22.8	23.4	23.1	5.1	8.7	6.9	1.9*	7.88	8.29	8.09	325	344	335	76.8	80	78.4	94.4	99.2	96.8	<1.00	<1.00	<1.00
SE-5-B4	22.9	23.7	23.3	4.9	8.6	7.1	2.5*	7.90	8.17	8.04	318	319	319	57.6	80	68.8	88.4	90.4	89.4	<1.00	<1.00	<1.00
SE-6-B4	23.0	23.9	23.4	3.7	8.3	6.4	NA	7.65	8.15	7.90	321	336	329	65	69	67	90.4	103	96.6	<1.00	<1.00	<1.00
SE-7-B2	23.0	23.7	23.3	4.1	8.4	6.8	1.9*	7.71	8.11	7.91	324	326	325	61.2	70	65.6	90.4	104	97.2	<1.00	<1.00	<1.00
SE-LAL-4	23.0	23.7	23.3	4.7	8.6	7.2	2.2*	7.74	8.12	7.93	317	329	323	62	62	62	90	98	94	<1.00	<1.00	<1.00
SE-REF-1	23.0	23.9	23.4	4.7	8.6	6.9	2.2*	7.74	8.10	7.92	335	342	339	69.6	72	70.8	100	102	101	<1.00	<1.00	<1.00
SE-REF-10b	22.8	23.6	23.2	5.6	8.6	7.1	1.9*	7.77	8.32	8.05	332	342	337	72.8	74	73.4	86.4	97.2	91.8	<1.00	<1.00	<1.00
SE-REF-3	22.9	23.7	23.3	5.0	8.8	7.0	1.7*	7.77	8.16	7.97	326	340	333	68.4	72	70.2	94	104	98.8	<1.00	<1.00	<1.00
SE-REF-7	23.0	24.0	23.4	4.7	8.8	7.0	1.9*	7.78	8.13	7.96	320	322	321	55.2	96	75.6	87.6	96.8	92.2	<1.00	<1.00	<1.00
SE-TRIB-3	23.0	23.9	23.3	4.2	8.6	7.0	2.2*	7.77	8.12	7.95	344	390	367	81	94.4	87.7	107	128	118	<1.00	<1.00	<1.00
CTL-SS-B3	22.8	23.4	23.1	5.3	8.4	7.1	1.6*	7.85	8.19	8.02	356	365	361	82	94	88	92	105	98.6	<1.00	<1.00	<1.00
CTL-QS-B3	22.9	23.8	23.3	4.4	8.7	6.9	1.0*	7.85	8.21	8.03	319	332	326	60	63	61.5	86	94	90	<1.00	1.12	0.56
CTL-ERDC-B3	22.8	23.5	23.2	4.9	8.8	7.0	1.6*	7.78	8.00	7.89	291	318	305	44.8	58	51.4	83.2	92.4	87.8	2.12	2.74	2.43

A – The dissolved oxygen (DO) value reported here is the lowest replicate DO recorded for the treatment on the day that the aeration trigger level was exceeded and aeration was initiated. See Appendix GG for a summary of DO readings for each replicate.
* Aeration Trigger exceedance observed at the daily PM DO check.
NA – Observed DO never fell below 2.5 mg/L during the test.

Table 5-1d. Summary of water quality data for 10-day *Chironomus dilutus* UCR sediment tests: Batch 4.

Site ID	Temperature (°C)			AM DO (mg/L)			Aeration Trigger Exceedance DO Level (mg/L)[A]	pH			Conductivity (μS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-1-B5	23.0	23.8	23.3	4.9	8.4	7.4	1.5*	7.70	7.94	7.82	356	368	362	77.2	78.8	78	106	111	108	<1.00	1.01	0.51
SE-2-B1	22.9	23.9	23.3	3.8	8.6	7.3	2.2*	7.69	7.87	7.78	354	362	358	57.2	76.4	66.8	102	122	112	<1.00	<1.00	<1.00
SE-3-B3	22.6	23.5	23.1	4.0	8.3	7.0	1.6*	7.71	7.88	7.80	354	357	356	65.2	71.6	68.4	101	121	111	<1.00	1.21	0.61
SE-3-R7	22.9	23.8	23.2	4.5	8.7	7.4	2.1*	7.74	7.97	7.86	325	354	340	67.2	71.6	69.4	95.6	102	98.8	<1.00	<1.00	<1.00
SE-5-B5	22.9	23.8	23.2	4.4	8.6	6.9	1.5*	7.78	7.97	7.88	317	331	324	56	59.6	57.8	89.6	96.4	93	<1.00	1.30	0.65
SE-5-B6	23.1	23.9	23.3	4.2	8.4	7.3	2.5*	7.77	7.92	7.85	314	327	321	53.6	60.4	57	90.4	92	91.2	<1.00	<1.00	<1.00
SE-7-B3	22.6	23.5	23.2	5.2	8.6	7.3	1.8*	7.77	7.88	7.83	314	328	321	56	57.2	56.6	86.8	94.8	90.8	<1.00	<1.00	<1.00
SE-7-B6	23.0	23.5	23.3	3.9	8.4	6.5	NA	7.67	7.84	7.76	316	335	326	62	62.4	62.2	89.2	98.4	93.8	<1.00	<1.00	<1.00
SE-G-4	22.8	24.0	23.4	4.4	8.6	6.7	NA	7.57	7.84	7.71	315	345	330	62.4	63.6	63	91.2	92	91.6	<1.00	<1.00	<1.00
SE-REF-2	22.9	23.8	23.3	5.3	8.6	7.4	1.9*	7.62	7.83	7.73	320	343	332	63.2	63.6	63.4	93.6	97.2	95.4	<1.00	<1.00	<1.00
SE-TRIB-2	22.9	24.0	23.4	4.4	8.6	7.5	2.4*	7.66	7.80	7.73	325	347	336	66.4	69.6	68	96.4	99.2	97.8	<1.00	<1.00	<1.00
SE-TRIB-5	22.8	24.0	23.3	4.9	8.4	7.2	2.3*	7.64	7.76	7.70	349	396	373	82.8	93.6	88.2	106	120	113	<1.00	<1.00	<1.00
CTL-SS-B4	22.8	23.9	23.3	4.6	8.5	7.2	1.6*	7.74	7.87	7.81	348	370	359	67.6	75.2	71.4	93.6	108	101	<1.00	<1.00	<1.00
CTL-QS-B4	22.8	23.6	23.2	4.4	8.7	6.8	NA	7.74	7.88	7.81	315	343	329	57.2	69.6	63.4	91.6	102	97	<1.00	<1.00	<1.00
CTL-ERDC-B4	22.9	23.9	23.3	4.4	8.4	7.1	1.8*	7.75	7.75	7.75	304	309	307	42	56	49	66.8	88.8	77.8	1.51	1.76	1.64

A – The dissolved oxygen (DO) value reported here is the lowest replicate DO recorded for the treatment on the day that the aeration trigger level was exceeded and aeration was initiated. See Appendix GG for a summary of DO readings for each replicate.
* Aeration Trigger exceedance observed at the daily PM DO check.
NA – Observed DO never fell below 2.5 mg/L during the test.

Table 5-1e. Summary of water quality data for 10-day *Chironomus dilutus* UCR sediment tests: Batch 5.

Site ID	Temperature (°C)			AM DO (mg/L)			Aeration Trigger Exceedance DO Level (mg/L)[A]	pH			Conductivity (µS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-2-B2	23.1	23.8	23.4	4.6	8.9	7.4	2.1*	7.97	8.03	8.00	318	353	336	66.4	68	67.2	94.4	103	98.8	<1.00	<1.00	<1.00
SE-3-R9	23.1	23.9	23.5	3.9	8.9	7.1	1.3*	7.92	7.93	7.93	338	373	356	76.4	79.6	78	104	116	110	<1.00	<1.00	<1.00
SE-4-B1	23.1	23.5	23.3	4.0	8.4	6.9	1.9*	7.93	7.96	7.95	323	351	337	63.6	72.8	68.2	91.2	102	96.4	<1.00	<1.00	<1.00
SE-5-B2	23.0	23.7	23.4	4.0	8.6	7.0	1.2*	7.85	7.94	7.90	308	327	318	57.6	63.2	60.4	90	97.6	93.8	<1.00	1.12	0.56
SE-6-B1	23.0	23.6	23.3	4.1	8.2	6.4	NA	7.61	7.91	7.76	313	341	327	59.2	70.4	64.8	95.6	100	97.8	<1.00	<1.00	<1.00
SE-7-B4	23.2	23.6	23.4	4.7	9.0	7.2	1.6*	7.80	7.87	7.84	318	334	326	61.6	66.8	64.2	86.4	94.8	90.6	<1.00	<1.00	<1.00
SE-7-B5	22.9	23.6	23.2	5.1	8.9	7.3	1.9*	7.79	7.88	7.84	313	322	318	55.2	61.6	58.4	89.6	93.6	91.6	<1.00	<1.00	<1.00
SE-8-B1	22.7	23.5	23.2	4.3	8.3	6.6	NA	7.67	7.88	7.78	314	336	325	63.6	64	63.8	91.6	96.4	94	<1.00	<1.00	<1.00
SE-G-2	22.9	23.5	23.3	4.5	8.7	7.2	1.5*	7.87	7.89	7.88	316	341	329	66.4	67.6	67	90.8	92	91.4	<1.00	<1.00	<1.00
SE-LAL-5	22.9	23.6	23.3	4.4	8.9	7.2	1.5*	7.85	7.89	7.87	308	326	317	60.4	67.2	63.8	89.2	95.2	92.2	<1.00	1.29	0.65
SE-REF-5	23.0	23.7	23.4	3.8	8.9	7.0	2.5*	7.84	7.93	7.89	318	341	330	62.4	67.6	65	98	101	99.6	<1.00	<1.00	<1.00
SE-TRIB-1	23.2	23.5	23.4	4.2	8.5	7.0	NA	7.70	7.86	7.78	321	343	332	62.4	67.6	65	91.2	97.2	94.2	<1.00	<1.00	<1.00
CTL-SS-B5	23.0	23.7	23.4	4.3	8.9	7.2	1.6*	7.87	7.87	7.87	339	365	352	68.8	71.2	70	96	107	101	<1.00	<1.00	<1.00
CTL-QS-B5	23.1	23.6	23.4	4.6	9.0	6.8	NA	7.55	7.89	7.72	310	340	325	49.6	67.2	58.4	87.6	97.2	92.4	<1.00	<1.00	<1.00
CTL-ERDC-B5	23.1	23.5	23.4	4.5	9.0	7.2	2.2*	7.59	7.64	7.62	283	298	291	38	45.6	41.8	69.2	74	71.6	1.19	3.29	2.24

A – The dissolved oxygen (DO) value reported here is the lowest replicate DO recorded for the treatment on the day that the aeration trigger level was exceeded and aeration was initiated. See Appendix GG for a summary of DO readings for each replicate.
* Aeration Trigger exceedance observed at the daily PM DO check.
NA – Observed DO never fell below 2.5 mg/L during the test.

Table 5-1f. Summary of water quality data for 10-day *Chironomus dilutus* UCR sediment tests: Batch 6.

Site ID	Temperature (°C)			AM DO (mg/L)			Aeration Trigger Exceedance DO Level (mg/L)[A]	pH			Conductivity (µS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-1B-R2	22.9	23.9	23.3	4.0	9.2	6.9	1.3*	7.80	8.03	7.92	363	385	374	84	85.6	84.8	112	116	114	<1.00	1.23	0.62
SE-1-R2	23.0	23.8	23.4	3.8	8.6	6.8	2.0*	7.94	7.98	7.96	320	355	338	65.6	74.4	70	96.8	99.2	98	<1.00	1.13	0.57
SE-4-B3	22.9	23.8	23.4	4.6	9.0	7.4	1.5*	7.90	7.97	7.94	330	357	344	72.8	73.2	73	100	102	101	<1.00	<1.00	<1.00
SE-4-B5	23.0	23.9	23.4	4.0	9.0	7.0	2.3*	7.96	8.00	7.98	325	351	338	62.4	71.6	67	89.6	99.2	94.4	<1.00	<1.00	<1.00
SE-6-B2	22.8	23.9	23.3	4.0	8.7	6.8	1.0*	7.88	7.98	7.93	323	349	336	63.2	66.4	64.8	95.6	99.2	97.4	<1.00	1.04	0.52
SE-7-B1	23.0	23.9	23.4	4.5	8.6	7.0	1.7*	7.81	7.96	7.89	318	332	325	58.8	66.4	62.6	84.8	90.4	87.6	<1.00	1.05	0.53
SE-8-B2	22.8	23.6	23.3	3.8	8.7	7.1	1.3*	7.85	7.93	7.89	315	333	324	56.8	64.8	60.8	89.2	91.2	90.2	<1.00	<1.00	<1.00
SE-8-B5	22.9	23.6	23.3	3.9	9.1	7.3	2.4*	7.79	7.88	7.84	325	339	332	64.4	78	71.2	92.8	93.2	93.0	<1.00	<1.00	<1.00
SE-8-B6	22.8	23.8	23.3	4.1	8.5	7.1	2.2*	7.77	7.88	7.83	314	342	328	59.2	60.8	60.0	87.2	94	90.6	<1.00	1.02	0.51
SE-G-3	22.9	23.6	23.2	3.7	8.8	6.9	1.8*	7.87	7.91	7.89	320	345	333	65.6	66	65.8	93.6	96	94.8	<1.00	1.07	0.54
SE-TRIB-6	23.0	23.6	23.3	4.1	8.8	7.1	1.2*	7.85	8.05	7.95	350	412	381	88.8	106	97.6	93.2	119	106	<1.00	1.42	0.71
CTL-SS-B6	22.9	23.8	23.4	4.1	8.7	7.1	2.3*	7.80	8.01	7.91	348	370	359	69.6	74.8	72.2	93.2	103.2	98.2	<1.00	<1.00	<1.00
CTL-QS-B6	23.0	23.8	23.4	3.4	8.7	6.9	1.6*	7.94	7.97	7.96	319	344	332	61.2	64.8	63.0	92.4	97.2	94.8	<1.00	1.08	0.54
CTL-ERDC-B6	22.9	23.9	23.4	4.4	8.6	6.9	1.8*	7.63	7.96	7.80	296	307	302	40.8	50.8	45.8	68.4	74.8	71.6	2.05	2.06	2.06

A – The dissolved oxygen (DO) value reported here is the lowest replicate DO recorded for the treatment on the day that the aeration trigger level was exceeded and aeration was initiated. See Appendix GG for a summary of DO readings for each replicate.
* Aeration Trigger exceedance observed at the daily PM DO check.
NA – Observed DO never fell below 2.5 mg/L during the test.

5.1.2 Negative Lab Control

Test acceptability was based upon test organism response in the Negative Lab Control sediment. A summary of the organism performance in the Negative Lab Control sediment tested as part of the project is presented in Table 5-2, and discussed below.

The biological responses for the test organisms at the Negative Lab Control sediment treatments were within test acceptability criteria (TAC) limits (≥70% survival and ≥0.48 mg/individual ash-free dry weight at test termination) for each round of testing (i.e., each 'batch' of tests). The increases in growth from T_0 to T_{10} ranged from 14x to 52x.

Table 5-2. *Chironomus dilutus* test responses in Negative Lab Control sediment in short-term tests .

Batch	Sample ID	Mean % Survival	Mean Ash-Free Dry Wt (mg/individual)	Test Initiation Mean Weight (mg/individual)	Weight Increase at Test Termination
1	CTL-SS-B1	95.0	1.650	0.120	14x
2	CTL-SS-B2	93.8	1.525	0.077	20x
3	CTL-SS-B3	97.5	1.058	0.069	15x
4	CTL-SS-B4	98.8	1.406	0.087	16x
5	CTL-SS-B5	88.8	1.503	0.065	23x
6	CTL-SS-B6	87.5	1.411	0.027	52x

A - The survival response for this test did not meet the test acceptability criterion of ≥70% survival.

5.1.2.1 Auxiliary Controls - Additional auxiliary controls were also performed as part of the study and as per the QAPP (Exponent et al. 2013). The biological responses for the test organisms at the Auxiliary Quartz Control and Auxiliary_USACE ERDC Control Sediment treatments for each round of testing are presented below in Table 5-3.

Table 5-3. Chironomus dilutus test responses in Auxiliary Control media in short-term tests.

Batch	*Sample ID*	Mean % Survival	Mean Ash-Free Dry Wt (mg/individual)	Test Initiation Mean Weight (mg/individual)	Weight Increase at Test Termination
	Auxiliary Quartz Control				
1	CTL-QS-B1	96.3	1.377	0.120	11x
2	CTL-QS-B2	97.5	1.462	0.077	19x
3	CTL-QS-B3	97.5	1.293	0.069	19x
4	CTL-QS-B4	95.0	1.234	0.087	14x
5	CTL-QS-B5	96.3	1.062	0.065	16x
6	CTL-QS-B6	100	1.137	0.027	42x
	Auxiliary USACE ERDC Control				
1	CTL-ERDC-B1	95.0	1.492	0.120	12x
2	CTL-ERDC-B2	93.8	1.618	0.077	21x
3	CTL-ERDC-B3	98.8	1.256	0.069	18x
4	CTL-ERDC-B4	66.3[A]	1.875	0.087	22x
5	CTL-ERDC-B5	83.8	1.658	0.065	26x
6	CTL-ERDC-B6	71.3	1.514	0.027	56x

5.1.3 Positive Lab Controls

The sensitivity of the test organisms to toxic stress was evaluated using positive controls (i.e., reference toxicant testing); the results of the reference toxicant testing are presented in Table 5-4.

Table 5-4. Reference Toxicant Testing: Effects of NaCl on *Chironomus dilutus*.

Test Batch	Test Initiation Date	Control Treatment % Survival	Survival LC50 (g/L NaCl)	Control Chart Mean LC50 (g/L NaCl)	Typical Response Range (g/L NaCl)
1	1/22/14	70[A]	7.1	7.6	5.1 – 11.2
1 Re-test	1/23/14	100	11.5[B, C]	7.4 (8.4)[C]	5.1 – 10.7 (5.8 – 12.1)[C]
2	1/23/14	100	7.0	7.4	5.1 – 10.7
3	1/24/14	80[A]	7.1	7.4	5.1 – 10.9
3 Re-test	1/26/14	90	5.4	7.4	5.0 – 10.9
4	1/29/14	100	5.9	7.3	4.9 – 11.0
5	1/30/14	40[A]	7.1	7.1	4.9 – 10.2
5 Re-test	1/31/14	100	7.6	6.9	4.8 – 9.9
6	1/31/14	100	5.0	7.0	5.0 – 9.7

A - The Control treatment survival response for this test did not meet the test acceptability criterion of ≥90% survival; however, the LC50 point estimate was within the typical response ranges for this species. An immediate re-test of the same batch of test organisms was performed and met all TAC.

B - The LC point estimate for this test was outside the typical response range (i.e., the 20-test mean±2SD of the laboratory control chart). It should be noted that the control chart consists primarily of tests initiated with test organisms that are 8-10 days old. When our reference toxicant test control chart database is limited to reference toxicity tests that were initiated with 10-11 day organisms, the LC50 for this test falls within the age-specific typical response ranges for this species suggesting that the current results are not an indication of insensitivity, but rather a response to decreasing sensitivity to NaCl associated with slightly older organisms.

C - While the LC50 point estimate for this test was outside the QC chart typical response range, the LC50 was within the age-specific typical response range based upon previous tests using similarly-aged organisms.

It should be noted that the Control treatment survival responses for the initial Batch #1, #3, and #5 reference toxicant tests fell below acceptable limits (however, the key concentration-response LC point estimates were all within the respective typical response ranges for these tests, indicating that the test organisms were responding to toxic stress in a typical fashion). For each of these three reference toxicant tests, an immediate re-test was initiated using the same batch of test organisms that had been used to initiate the original reference toxicant tests and the corresponding Batch #1, #3, and #5 sediment tests; all of the re-tests were within acceptable control survival limits (i.e., >90% survival).

Note - the Batch #1 reference toxicant re-test LC50 fell slightly outside the typical response range established by the QC chart of the 20 previous test results. However, the Batch #1 re-test was initiated with test organisms that were 10-11 days old, whereas all other reference toxicant tests for this project used organisms 8-10 days old. When the reference toxicant test QC chart is revised to include only tests that were initiated with 10-12 day old organisms (as in the Batch #1 re-test), the Batch 1 re-test LC50 falls within the typical response range, suggesting that the Batch 1 re-test results are not an indication of atypical insensitivity, but are simply a result of slight changes in sensitivity corresponding to changes in organism size/age. Furthermore, it must also be noted that the EPA manual indicates that control limits of ±2 SD will be exceeded 5% of the time, regardless of how well a laboratory performs, so the observation of this slightly elevated LC_{50} for this one test should not be unexpected.

With respect to the low Control treatment survival responses observed for the initial Batch #1, #3, and #5 reference toxicant tests, these responses are not considered to be accurate measures of organism quality, as there was ≥90% survival in the adjacent next two lowest NaCl test treatments for each of these tests. Furthermore, there was ≥96.3% survival in the accompanying Quartz Control for each of the tests; the Quartz Control exposure is essentially the same as the reference toxicant test Control: a layer of Quartz sand with Control water as the overlying water in a glass beaker; the high survival responses in each of the Quartz Control tests in conjunction with the concomitantly high survival response at the two lowest reference toxicant test treatments serve to indicate that the test organisms used in each round of UCR sediment testing were of appropriate quality. *In toto*, the results of the reference toxicant testing indicated that the sensitivities of the test organisms used for these sediment toxicity tests were similar across batches of test organisms, and that these sensitivities fall within the typical response range for this species. Reference toxicant tests results for the *C. dilutus* 10-day testing are presented in Appendix HH.

5.1.4. Identification of Anomalous Deviations

A review of the test data indicated that >10 test organisms were recovered at test termination in four of the 696 overall total number of replicates (i.e., 0.6%): SE-TRIB-3-A, SE-TRIB-3-E, SE-8-B2-G, and SE-8-B2-H.

The EPA acknowledges that when loading midge larvae while still in their individual 'cases' (the method specified in the UCR QAPP [Exponent et al. 2013]), there is the possibility that there may be more than one organism in a case (EPA 2011). As this is a relatively new recommendation for performance of the test, the expected frequency has not been quantified in round-robin laboratory testing. However, one can speculate that since the EPA is recommending this as a procedural modification, the frequency is not expected to be of such extent that data quality is impacted.

Any reporting of test treatment mean survival or growth was performed as per guidance provided by the project team (personal communication Anne Fairbrother, 2014 [Appendix A]).

5.2 QA/QC Summary: *Chironomus dilutus* Long-Term Toxicity Testing

5.2.1 Test Conditions

All biological testing water quality conditions were within the appropriate limits (Tables 5-5a through 5-5c). All measurements of routine water quality characteristics were performed as described in the UCR QAPP (Exponent et al. 2013). Laboratory instruments were calibrated daily according to Lab standard operating procedures (SOPs), and calibration data were logged and initialed. Zumwalt water delivery systems were calibrated prior to test initiation and periodically throughout the testing; calibration logs are provided in Appendix II. Lighting intensity was confirmed at test initiations; light verification measurements are presented in Appendix JJ.

It should be noted that when the overlying water DO level fell below the 2.5 mg/L aeration trigger level in any replicate during the course of testing, aeration was initiated for each of the test replicates for these samples; the majority of the low DO levels were observed during the evening (P.M.) DO checks. When aeration was implemented, the aeration initiation date was recorded on the bench data sheet, along with the lowest replicate DO measurement for each treatment that fell below the aeration trigger. A summary of sediment samples that were aerated is provided in Appendix KK; any additional test treatment replicate DO measurements performed upon observation of a DO <2.5 mg/L are also provided in Appendix KK.

Studies have shown that DO levels of 1.2 mg/L during 10-day exposures of *C. dilutus* did not impair midge survival or growth (Irving et. al 2004). DO levels of less ≤ 1.2 mg/L were only observed in the following treatment replicates (Appendix KK):

Batch 1 - SE-1-B5-K (0.9 mg/L), SE-6-B2-L (1.1 mg/L), SE-8-B3-G (0.9 mg/L), SE-8-B3-I (0.8 mg/L), SE-8-B3-J (1.1 mg/L);

Batch 2 - SE-REF-10b-E (0.7 mg/L);

Batch 3 - SE-3-R8-G (0.5 mg/L), SE-3-R8-I (1.0 mg/L), SE-3-R8-J (0.7 mg/L), SE-3-R8-L (0.9 mg/L), SE-5-B4-I (0.7 mg/L), SE-6-B5-F (0.9 mg/L), SE-G-2-G (0.9 mg/L), SE-G-1-K (1.1 mg/L), SE-G-1-L (0.7 mg/L), SE-LAL-5-G (0.2 mg/L), SE-LAL-5-I (0.8 mg/L), SE-LAL-5-K (0.8 mg/L).

All other treatment replicate DO measurements throughout the test were ≥1.2 mg/L. Based on this information and the very short duration (no more than 18 hours) that test organisms were potentially exposed to low DO levels in the current testing, it is expected that data quality was not impacted.

Table 5-5a. Summary of water quality data for Life cycle *Chironomus dilutus* UCR sediment tests: Batch 1.

Site ID	Temperature (°C)			AM DO (mg/L)			Aeration Trigger Exceedance DO Level (mg/L)[A]	pH			Conductivity (µS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-1-B5	22.0	23.6	22.8	4.9	8.5	7.3	0.9*	7.31	8.00	7.68	343	440	371	72.4	77.6	75.6	106	115	112	<1.00	1.03	0.34
SE-1B-R2	22.0	23.8	22.8	4.8	8.6	7.5	2.0*	7.38	8.01	7.69	348	450	376	70.8	82.8	75.5	110	126	120	<1.00	<1.00	<1.00
SE-1-R2	22.1	23.6	22.7	5.1	8.6	7.2	2.4*	7.29	7.95	7.62	338	405	360	62	76.8	68.5	93.6	102	97.9	<1.00	1.40	0.47
SE-4-B6	22.1	23.6	22.6	4.2	8.6	7.3	2.2*	7.31	8.00	7.67	337	375	356	58.4	77.2	67.5	96	104	100	<1.00	1.58	0.53
SE-6-B2	22.0	23.6	22.7	3.6	8.6	7.1	1.1*	7.26	8.12	7.63	331	391	352	52.4	67.2	61.5	99.2	102	101	<1.00	<1.00	<1.00
SE-7-B5	22.0	23.6	22.8	4.5	8.6	7.4	2.7*	7.26	7.91	7.61	312	372	341	59.2	64	62.1	92.4	98	94.8	<1.00	<1.00	<1.00
SE-8-B3	22.0	23.6	22.8	0.8	8.5	7.1	0.8	7.24	7.98	7.59	317	382	342	55.6	64.8	58.9	93.2	100	96.1	<1.00	1.02	0.34
SE-G-1	22.1	23.6	22.7	3.3	8.5	7.0	1.4*	7.27	7.91	7.59	329	408	349	56.8	66.8	62.1	95.6	104	98.7	<1.00	1.12	0.37
SE-G-3	22.0	23.6	22.7	4.5	8.7	7.6	1.5*	7.10	8.34	7.69	327	398	347	60	65.2	61.9	92.8	96.4	64.9	<1.00	<1.00	<1.00
SE-LAL-3	22.0	23.7	22.9	4.9	8.7	7.6	2.1*	7.27	8.04	7.68	330	402	354	63.2	68.8	65.7	100	103	102	<1.00	<1.00	<1.00
SE-LAL-5	22.0	23.6	22.8	3.4	8.5	7.1	1.7*	7.22	7.91	7.59	322	385	342	54.8	65.2	58.7	86.8	126	104	<1.00	1.28	0.43
SE-REF-10b	22.1	23.6	22.8	4.2	8.5	7.4	2.4*	7.27	7.94	7.64	330	392	359	66.8	72.8	69.5	103	107	105	<1.00	<1.00	<1.00
SE-TRIB-3	22.1	23.6	22.7	3.8	8.7	7.2	1.6*	7.50	8.05	7.72	350	420	386	71.2	88.8	82.7	108	129	121	<1.00	<1.00	<1.00
CTL-SS-B1	22.0	23.6	22.8	3.9	8.6	7.0	1.7*	7.39	8.12	7.67	343	699	381	68	84.4	75.5	104	116	109	<1.00	1.22	0.41
CTL-QS-B1	22.0	23.6	22.8	4.3	8.8	7.5	2.2*	7.31	8.04	7.67	329	375	348	60	70	64.4	92	96.4	94.7	<1.00	1.74	0.58

A – The dissolved oxygen (DO) value reported here is the lowest replicate DO recorded for the treatment on the day that the aeration trigger level was exceeded and aeration was initiated. See Appendix KK for a summary of DO readings for each replicate.
* Aeration Trigger exceedance observed at the daily PM DO check.

Table 5-5b. Summary of water quality data for Life cycle *Chironomus dilutus* UCR sediment tests: Batch 2.

Site ID	Temperature (°C)			AM DO (mg/L)			Aeration Trigger Exceedance DO Level (mg/L)[A]	pH			Conductivity (µS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-2-B1	22.0	23.5	22.7	4.3	8.9	7.6	1.9*	7.28	8.13	7.71	337	421	363	68.4	98.4	79.2	103	123	113	<1.00	<1.00	<1.00
SE-2-R1	22.0	23.4	22.8	1.7	8.8	7.5	1.7	7.37	8.19	7.75	328	403	357	63.6	74.8	70.9	104	111	108	<1.00	1.03	0.34
SE-3-R7	22.1	23.3	22.7	3.2	8.7	7.3	1.3*	7.37	8.13	7.70	329	386	354	67.6	70.8	69.2	94	111	102	<1.00	<1.00	<1.00
SE-4-B1	22.0	23.5	22.8	3.3	8.7	7.5	1.5*	7.37	8.43	7.77	331	391	356	66.8	75.6	72.1	97.6	114	106	<1.00	<1.00	<1.00
SE-5-B2	22.0	23.4	22.8	1.4	8.7	7.3	1.4	7.34	8.18	7.71	313	465	346	57.2	62	59.3	85.2	110	98.7	<1.00	<1.00	<1.00
SE-8-B2	22.0	23.7	22.8	3.2	8.8	7.6	1.5*	7.25	8.14	7.66	309	406	336	51.6	62.4	57.7	92.4	102	96.4	<1.00	<1.00	<1.00
SE-LAL-2	22.0	23.5	22.8	3.9	8.8	7.7	1.3*	7.25	8.12	7.67	300	393	332	47.6	72.8	61.9	95.6	102	99.1	<1.00	<1.00	<1.00
SE-G-1	22.1	23.5	22.8	4.1	8.9	7.7	2.4*	7.22	8.12	7.73	327	389	345	58.8	71.2	66.0	97.2	110	102	<1.00	1.03	0.34
SE-G-3	22.1	23.8	22.8	5.0	8.8	7.7	1.8*	7.26	8.10	7.70	324	383	347	60.8	67.2	64.8	95.6	108	100	<1.00	<1.00	<1.00
SE-LAL-3	22.1	23.5	22.8	1.4	8.7	7.4	1.4	7.28	8.09	7.64	325	410	349	66.4	71.2	69.6	101	111	106	<1.00	<1.00	<1.00
SE-LAL-5	22.0	23.4	22.7	3.3	8.8	7.3	1.8*	7.04	8.18	7.57	314	399	342	54	76	62.7	90.4	102	97.1	<1.00	<1.00	<1.00
SE-REF-10b	22.0	23.6	22.7	3.3	8.7	7.3	0.7*	7.28	8.13	7.62	324	396	354	67.6	74.4	71.2	101	117	107	<1.00	<1.00	<1.00
SE-TRIB-3	22.0	23.5	22.8	1.3	8.8	7.2	1.3	7.42	8.23	7.77	343	449	381	75.2	87.6	80.7	104	139	119	<1.00	<1.00	<1.00
CTL-SS-B2	22.0	23.6	22.8	1.5	8.7	7.2	1.5	7.29	8.13	7.71	324	545	383	53.2	72.8	65.7	103	118	109	<1.00	<1.00	<1.00
CTL-QS-B2	22.0	23.6	22.8	1.4	8.7	7.5	1.4	7.20	8.17	7.70	327	376	348	62	71.6	65.5	97.6	107	102	<1.00	1.98	0.66

A – The dissolved oxygen (DO) value reported here is the lowest replicate DO recorded for the treatment on the day that the aeration trigger level was exceeded and aeration was initiated. See Appendix KK for a summary of DO readings for each replicate.
* Aeration Trigger exceedance observed at the daily PM DO check

Table 5-5c. Summary of water quality data for Life cycle *Chironomus dilutus* UCR sediment tests: Batch 3.

Site ID	Temperature (°C)			AM DO (mg/L)			Aeration Trigger Exceedance DO Level (mg/L)[A]	pH			Conductivity (µS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-3-B3	22.1	23.5	22.9	4.3	8.5	7.5	1.6*	7.03	8.45	7.72	335	421	357	62	97.6	76.1	102	142	116	<1.00	<1.00	<1.00
SE-3-R8	21.6	23.7	23.0	0.5	8.9	6.9	0.5	7.28	8.11	7.72	335	408	360	68.4	78.4	73.5	105	113	110	<1.00	1.21	0.40
SE-4-B5	22.1	23.7	23.1	3.0	8.6	7.1	2.2*	7.18	8.13	7.69	328	424	355	66	77.2	71.1	106	113	110	<1.00	<1.00	<1.00
SE-5-B4	22.0	23.6	23.0	0.7	8.8	7.2	0.7	7.09	8.16	7.62	313	392	338	51.6	65.6	60.3	93.6	106	101	<1.00	<1.00	<1.00
SE-6-B5	22.0	23.6	23.0	0.9	8.9	6.9	0.9	7.26	8.00	7.66	333	401	352	60	68.8	63.2	103	108	106	<1.00	<1.00	<1.00
SE-7-B2	22.0	23.5	22.9	3.3	8.5	7.1	1.2*	7.23	8.00	7.64	325	388	346	57.2	85.2	71.1	98.8	119	112	<1.00	<1.00	<1.00
SE-G-2	22.0	23.6	23.0	0.9	8.4	6.8	0.9	7.22	8.01	7.63	320	432	352	68.4	72	70.3	104	110	108	<1.00	<1.00	<1.00
SE-G-1	22.2	23.6	23.0	0.7	8.5	6.7	0.7	7.19	7.95	7.62	319	424	349	65.2	68.4	66.5	102	116	108	<1.00	<1.00	<1.00
SE-G-3	22.1	23.9	23.0	3.3	8.7	7.1	1.8*	7.20	8.08	7.65	322	405	352	62.4	73.2	67.1	102	114	108	<1.00	<1.00	<1.00
SE-LAL-3	22.0	23.7	22.9	3.6	8.6	7.2	1.2*	7.21	7.96	7.64	330	389	350	60.4	77.2	67.5	100	116	108	<1.00	1.45	0.48
SE-LAL-5	22.0	23.6	23.0	0.2	8.5	6.6	0.2	7.15	7.96	7.53	307	381	337	61.2	66.8	63.7	102.4	114	108	<1.00	1.13	0.38
SE-REF-10b	22.1	23.8	23.0	3.4	8.3	7.1	1.9*	7.18	8.04	7.65	327	412	356	66.4	73.2	70.5	104	122	113	<1.00	<1.00	<1.00
SE-TRIB-3	22.1	23.8	23.0	3.6	8.5	7.2	1.2*	7.32	8.80	7.78	344	455	394	67.6	94.4	83.2	110	128	119	<1.00	<1.00	<1.00
CTL-SS-B3	22.2	23.7	23.0	3.6	8.5	7.2	1.3*	7.36	8.03	7.74	341	542	378	72.4	79.2	76.7	109	124	116	<1.00	<1.00	<1.00
CTL-QS-B3	22.0	23.7	22.9	3.2	8.5	6.9	1.9*	7.19	8.07	7.67	327	590	357	66.4	68.8	67.2	101	109	105	<1.00	1.00	0.33

A – The dissolved oxygen (DO) value reported here is the lowest replicate DO recorded for the treatment on the day that the aeration trigger level was exceeded and aeration was initiated. See Appendix KK for a summary of DO readings for each replicate.
* Aeration Trigger exceedance observed at the daily PM DO check.

5.2.2 Negative Lab Control

Test acceptability was based upon test organism response in the Negative Lab Control sediment. A summary of the organism performance in the Negative Lab Control sediment tested as part of the project is presented in Table 5-6, and discussed below relative to the following endpoints:

- **16-day Survival** = # surviving larvae/# larvae loaded at test initiation,
- **16-day Mean Ash-Free Dry Weight/Larvae** = Ash-free dry weight of all larvae in replicate/# larvae surviving in replicate,
- **Pupae Survival - End of test** = # of emerged pupae (partial and complete adult)/# pupae observed,
- **Adult Survival - End of test** = # adults that escaped the water surface/# of pupae emerged (partial and complete),
- **Emergence** = # of pupae emerged (complete adult)/# larvae loaded at test initiation,
- **Time to death** = mean time to death for male and female organisms in a treatment,
- **Mean Number of Eggs/Egg Case** = mean number of eggs produced by females in a treatment, and
- **% hatch** = total # of hatched eggs/total # of eggs for a treatment x 100.

The test organism biological responses in the Negative Lab Control sediment treatments were within acceptable limits (≥0.48 mg/individual ash-free dry weight at 16-day test termination) for each round of testing (i.e., each 'batch' of tests). PER control sediment also met TAC performance goals for 16-day survival (≥70% survival), emergence (≥50%), mean number of eggs per egg case (≥800), and percent hatch (≥80%). PER Control sediment also was within the range of round-robin testing performance (USEPA 2000) for pupae survival (≥83%), adult survival (≥96%), and adult time to death (<6.5 days for males and <5.1 days for females).

5.2.2.1 Auxiliary Controls - An Auxiliary Quartz Control treatment was also performed as part of the study and as per the QAPP (Exponent et al. 2013). The biological responses for the test organisms at the Auxiliary Quartz Control treatment for each round of testing are presented below in Table 5-7.

Table 5-6. *Chironomus dilutus* test responses in Negative Lab Control sediment in long-term tests

Batch	Sample ID	16-day Mean % Survival	16-day Mean Ash-Free Dry Wt (mg)/individual	Pupae Survival	Adult Survival	% Emergence	Time to Death		Mean # of Eggs per Egg Case	% Hatch[A]
							Males	Females		
1	CTL-SS-B1	93.8	1.555	93.7	100	60.4	3.4	2.9	1051	87.9
2	CTL-SS-B2	95.8	1.563	93.8	96.7	57.3	3.4	1.9	1154	87.1
3	CTL-SS-B3	100	1.608	98.9	100	70.8	3.5	2.4	1789	90.4

A – Unfertilized egg cases not included in the % hatch calculation.

Table 5-7. *Chironomus dilutus* test responses in Auxiliary Quartz Control medium at in long-term tests

Batch	Sample ID	16-day Mean % Survival	16-day Mean Ash-Free Dry Wt (mg)/individual	Pupae Survival	Adult Survival	% Emergence	Time to Death		Mean # of Eggs per Egg Case	% Hatch[A]
							Males	Females		
1	CTL-QS-B1	97.9	1.773	90.3	96.4	76.0	4.1	2.8	1060	74.6
2	CTL-QS-B2	93.8	1.630	95.1	97.7	83.3	3.2	2.3	1013	93.5
3	CTL-QS-B3	85.4	1.047	93.5	100	62.5	3.5	2.9	1321	74.2

A – Unfertilized egg cases not included in the % hatch calculation.

5.2.3 Positive Lab Controls

The sensitivity of the test organisms to toxic stress was evaluated using positive controls (i.e., reference toxicant testing); the results of the reference toxicant testing for the *C. dilutus* long-term testing are summarized in Table 5-8. The key test concentration-response LC point estimates were all within the respective typical response ranges for this species, indicating that these test organisms were responding to toxic stress in a consistent and typical fashion. These results also indicated that the sensitivities of the test organisms were similar across batches. Reference toxicant tests results for the *C. dilutus* long-term testing are presented in Appendix LL.

Table 5-8. Reference Toxicant Testing: Effects of NaCl on *Chironomus dilutus*.

Test Batch	Test Initiation Date	Control Treatment % Survival	Survival LC50 (g/L NaCl)	Control Chart Mean LC50 (g/L NaCl)	Typical Response Range (g/L NaCl)
1	2/18/15	90	5.20	7.09	4.13-10.0
2	3/2/15	90	7.59	6.85	4.69-9.00
3	3/10/15	100	7.07	6.98	4.78-9.19

5.2.4. Identification of Anomalous Deviations

A review of the test data indicated that >12 test organisms were recovered at test termination in 12 of the 540 overall number of test treatment replicates (i.e., 2.2%):

Batch 1 - SE-G-3-D (at Day16);
Batch 2 - SE-5-B2-A (at Day16), SE-G-1-B (at Day16), CTL-QS-B2-H, SE-3-R7-G, SE-LAL-3-J; and
Batch 3 - CTL-SS-B3-B (at Day16), SE-6-B5-A (at Day16), SE-G2-L, SE-G1-K, SE-G1-L, and SE-TRIB-3-J.

The EPA acknowledges that when loading midge larvae while still in their individual 'cases' (the method specified in the UCR QAPP [Exponent et al. 2013]), there is the possibility that there may be more than one organism in a case (EPA 2011). As this is a relatively new recommendation for performance of the test, the expected frequency has not been quantified in round-robin laboratory testing. However, one can speculate that since the EPA is recommending this as a procedural modification, the frequency is not expected to be of such extent that data quality is impacted.

Any reporting of test treatment mean survival or growth was performed as per guidance provided by the project team (personal communication Anne Fairbrother, 2014 [Appendix A]).

5.3 QA/QC Summary: *Hyalella azteca* 28-day Toxicity Testing

5.3.1 Test Conditions

All biological testing water quality conditions were within the appropriate limits (Tables 5-9a through 5-9g). All measurements of routine water quality characteristics were performed as described in the UCR QAPP (Exponent *et al*. 2013). Laboratory instruments were calibrated daily according to Lab SOPs, and calibration data were logged and initialed. Zumwalt water delivery systems were calibrated prior to test initiation and periodically throughout the testing; calibration logs are provided in Appendix MM. Lighting intensity was also confirmed at test initiation; light verification measurements are presented on Appendix NN.

Table 5-9a. Summary of water quality data for 28-day *Hyalella azteca* UCR sediment tests: Batch 1.

Site ID	Temperature (°C)			DO (mg/L)			pH			Conductivity (µS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-1-R1	22.3	23.9	23.5	4.7	8.5	6.9	7.26	7.84	7.47	402	437	418	56	64.8	60.4	133	136	134	<1.00	<1.00	<1.00
SE-3-R2	22.5	23.8	23.3	4.9	8.5	7.0	7.25	7.74	7.52	412	449	433	66.4	78	72.2	135	152	143	<1.00	<1.00	<1.00
SE-4-B6	22.4	23.8	23.3	4.6	8.8	7.1	7.25	7.82	7.44	394	441	413	54	64.8	59.4	126	133	130	<1.00	<1.00	<1.00
SE-5-B1	22.3	23.8	23.3	4.5	8.9	7.2	7.30	7.85	7.56	406	442	426	57	64.4	60.7	131	134	133	<1.00	<1.00	<1.00
SE-6-B6	22.3	23.8	23.3	4.8	8.6	7.1	7.24	7.78	7.49	395	430	412	52	60	56	127	129	128	<1.00	<1.00	<1.00
SE-6-R3	22.3	23.9	23.4	4.7	8.6	6.9	7.27	7.81	7.46	392	429	409	52	56.4	54.2	124	126	125	<1.00	<1.00	<1.00
SE-8-B3	22.4	23.9	23.3	4.9	8.8	7.0	7.21	7.74	7.36	384	424	405	51	56.4	53.7	123	133	128	<1.00	<1.00	<1.00
SE-8-B4	22.4	23.9	23.5	4.6	8.5	6.9	7.24	7.74	7.44	393	428	409	56	58.4	57.2	128	124	126	<1.00	<1.00	<1.00
SE-G-1	22.3	23.7	23.3	4.8	9.0	7.1	7.29	7.78	7.43	396	427	411	52	57.2	54.6	125	128	126	<1.00	<1.00	<1.00
SE-REF-6	22.2	23.8	23.3	5.0	8.8	7.0	7.25	7.82	7.41	403	431	413	54	59.6	56.8	127	132	129	<1.00	<1.00	<1.00
SE-TRIB-4	22.2	24.0	23.4	5.7	8.6	7.3	7.34	7.90	7.54	419	458	439	68	72.8	70.4	137	141	139	<1.00	<1.00	<1.00
CTL-SS-B1	22.4	24.0	23.4	5.1	8.6	7.1	7.36	7.91	7.54	423	448	433	56	65.6	60.8	128	131	129	<1.00	<1.00	<1.00
CTL-QS-B1	22.5	23.8	23.4	4.4	8.8	7.0	7.29	7.88	7.47	392	433	412	51	60.8	55.9	125	129	127	<1.00	<1.00	<1.00
CTL-ERDC-B1	22.3	23.8	23.3	5.5	8.5	7.1	7.25	7.59	7.40	397	426	409	56	61.6	58.8	118	134	126	1.14	2.31	1.73

Table 5-9b. Summary of water quality data for 28-day *Hyalella azteca* UCR sediment tests: Batch 2.

Site ID	Temperature (°C)			DO (mg/L)			pH			Conductivity (µS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-2-R1	22.0	23.8	23.4	5.3	8.7	7.0	7.25	7.90	7.53	408	443	424	58	73.2	65.6	137	137	137	<1.00	<1.00	<1.00
SE-4-B2	23.0	23.8	23.4	4.5	8.8	6.9	7.29	7.91	7.44	402	438	416	56	63.6	59.8	131	132	132	<1.00	<1.00	<1.00
SE-4-B4	22.6	23.7	23.3	5.3	8.7	7.0	7.30	7.86	7.43	409	424	416	65	66	65.5	133	134	133	<1.00	<1.00	<1.00
SE-5-B3	23.0	23.9	23.5	5.2	8.6	6.9	7.17	7.82	7.38	393	417	404	50.8	54	52.4	125	127	126	<1.00	<1.00	<1.00
SE-6-B5	22.9	24.0	23.5	5.4	8.7	7.0	7.26	7.86	7.44	399	426	413	56	57.6	56.8	126	133	130	<1.00	<1.00	<1.00
SE-LAL-1	23.3	23.9	23.6	5.1	8.7	6.9	7.17	7.87	7.43	397	430	409	51	53.6	52.3	126	129	128	<1.00	<1.00	<1.00
SE-LAL-2	22.6	23.8	23.5	5.3	8.6	6.8	7.15	7.78	7.39	399	427	411	57.2	58	57.6	126	131	129	<1.00	<1.00	<1.00
SE-LAL-3	22.8	23.8	23.5	5.2	8.6	7.0	7.30	7.77	7.49	406	435	414	57.2	58	57.6	125	126	125	<1.00	<1.00	<1.00
SE-REF-4	22.9	23.8	23.5	5.4	8.6	7.1	7.28	7.76	7.49	403	431	415	56	58	57	126	128	127	<1.00	<1.00	<1.00
SE-REF-8	22.7	23.8	23.5	5.4	8.7	7.0	7.30	7.86	7.49	398	429	411	51	58.4	54.7	125	128	127	<1.00	<1.00	<1.00
CTL-SS-B2	22.9	23.9	23.5	4.9	8.6	7.1	7.33	7.87	7.51	423	444	435	60	64	62	127	128	128	<1.00	<1.00	<1.00
CTL-QS-B2	22.8	23.7	23.4	5.4	8.8	7.1	7.21	7.81	7.43	399	427	411	51	57.6	54.3	123	124	123	<1.00	<1.00	<1.00
CTL-ERDC-B2	23.0	23.8	23.5	5.4	8.7	7.0	7.07	7.55	7.35	390	420	404	56	56	56	115	116	116	<1.00	2.24	1.12

Table 5-9c. Summary of water quality data for 28-day *Hyalella azteca* UCR sediment tests: Batch 3.

Site ID	Temperature (°C)			DO (mg/L)			pH			Conductivity (µS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-2-R3	22.9	24.0	23.4	5.8	8.6	7.1	7.25	7.90	7.47	424	454	435	62	65.6	63.8	128	134	131	<1.00	<1.00	<1.00
SE-3-R1	23.1	23.8	23.5	4.9	8.5	7.0	7.30	7.87	7.47	405	453	431	66	69	67.5	130	134	132	<1.00	<1.00	<1.00
SE-3-R8	23.0	23.8	23.3	5.4	8.6	7.1	7.26	7.82	7.44	402	453	425	51	64.8	57.9	129	135	132	<1.00	<1.00	<1.00
SE-5-B4	23.1	23.8	23.4	5.2	8.6	7.1	7.09	7.90	7.42	390	434	414	54	58	56	122	150	136	<1.00	<1.00	<1.00
SE-6-B4	23.0	24.0	23.5	5.6	8.4	7.1	7.16	7.87	7.41	392	446	420	52	64	58	123	130	126	<1.00	<1.00	<1.00
SE-7-B2	23.1	23.8	23.4	5.0	8.6	7.0	7.21	7.87	7.42	394	437	415	54	56.4	55.2	124	128	126	<1.00	<1.00	<1.00
SE-LAL-4	22.9	23.8	23.3	4.5	8.4	7.0	7.21	7.67	7.37	389	439	416	42	62	52	118	127	122	<1.00	<1.00	<1.00
SE-REF-1	23.0	24.0	23.5	4.8	8.6	6.9	7.18	7.70	7.40	404	447	425	68	86	77	128	133	130	<1.00	<1.00	<1.00
SE-REF-10b	23.0	23.7	23.4	4.6	8.6	7.0	7.22	7.70	7.40	401	443	421	64.4	73	68.7	126	132	129	<1.00	<1.00	<1.00
SE-REF-3	22.9	23.8	23.4	4.9	8.6	7.2	7.24	7.68	7.41	393	445	421	56	64.8	60.4	124	132	128	<1.00	<1.00	<1.00
SE-REF-7	23.0	24.0	23.5	5.1	8.6	7.1	7.22	7.85	7.41	388	442	415	50	57.6	53.8	126	129	127	<1.00	<1.00	<1.00
SE-TRIB-3	23.1	24.0	23.5	5.2	8.6	7.1	7.31	7.80	7.50	416	459	444	69	76.8	72.9	140	148	144	<1.00	<1.00	<1.00
CTL-SS-B3	23.0	23.8	23.4	5.5	8.6	7.2	7.28	7.85	7.46	420	451	436	60	66.8	63.4	124	128	126	<1.00	<1.00	<1.00
CTL-QS-B3	23.0	23.7	23.4	5.2	8.7	7.1	7.25	7.71	7.41	396	444	418	51	62.8	56.9	112	126	119	<1.00	<1.00	<1.00
CTL-ERDC-B3	23.0	24.0	23.5	4.8	8.6	7.0	7.15	7.75	7.33	384	434	408	50	54.4	52.2	122	126	124	<1.00	1.82	0.91

Table 5-9d. Summary of water quality data for 28-day *Hyalella azteca* UCR sediment tests: Batch 4.

Site ID	Temperature (°C)			DO (mg/L)			pH			Conductivity (µS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-1-B5	22.8	24.0	23.5	4.7	8.5	7.0	7.24	7.76	7.49	431	446	441	63.2	70.4	66.8	135	140	138	<1.00	<1.00	<1.00
SE-2-B1	22.7	23.9	23.4	4.9	8.5	7.0	7.23	7.80	7.36	419	435	427	62	77.2	69.6	129	144	136	<1.00	<1.00	<1.00
SE-3-B3	22.8	23.7	23.4	4.9	8.3	7.0	7.19	7.79	7.36	423	440	430	64.4	74.4	69.4	124	143	133	<1.00	<1.00	<1.00
SE-3-R7	23.2	24.0	23.6	4.9	8.5	7.0	7.26	7.89	7.41	399	442	425	60.4	63.2	61.8	125	131	128	<1.00	<1.00	<1.00
SE-5-B5	23.1	24.0	23.5	5.0	8.5	7.0	7.23	7.86	7.37	389	425	410	52	58.8	55.4	117	121	119	<1.00	<1.00	<1.00
SE-5-B6	23.2	24.0	23.7	4.7	8.3	6.9	7.18	7.82	7.35	388	428	412	53.6	54	53.8	120	122	121	<1.00	<1.00	<1.00
SE-7-B3	23.3	24.0	23.7	5.0	8.4	6.9	7.15	7.79	7.33	387	426	410	51.6	58.8	55.2	118	124	121	<1.00	<1.00	<1.00
SE-7-B6	23.0	23.9	23.5	5.3	8.6	7.0	7.24	7.77	7.43	390	426	411	53.6	55.2	54.4	123	127	125	<1.00	<1.00	<1.00
SE-G-4	22.8	23.9	23.4	5.2	8.6	7.1	7.17	7.80	7.33	393	429	415	53.2	58.4	55.8	127	129	128	<1.00	<1.00	<1.00
SE-REF-2	23.1	23.8	23.5	5.0	8.7	6.9	7.17	7.78	7.38	397	430	416	58	59.6	58.8	126	135	130	<1.00	<1.00	<1.00
SE-TRIB-2	23.3	23.9	23.5	4.8	8.5	6.9	7.19	7.75	7.41	405	440	426	58.8	60	59.4	117	127	122	<1.00	<1.00	<1.00
SE-TRIB-5	23.1	23.9	23.6	5.1	8.5	7.1	7.40	7.73	7.57	414	479	450	76	82.8	79.4	148	149	148	<1.00	<1.00	<1.00
CTL-SS-B4	22.7	23.8	23.4	4.9	8.5	7.0	7.20	7.80	7.38	427	439	431	60	62.8	61.4	123	125	124	<1.00	<1.00	<1.00
CTL-QS-B4	23.0	23.9	23.6	4.7	8.7	7.0	7.22	7.80	7.38	400	430	417	51.6	57.6	54.6	124	126	125	<1.00	<1.00	<1.00
CTL-ERDC-B4	22.8	23.8	23.4	5.0	8.5	6.9	6.93	7.50	7.21	387	419	407	46.4	54	50.2	116	129	122	<1.00	<1.00	<1.00

Table 5-9e. Summary of water quality data for 28-day *Hyalella azteca* UCR sediment tests: Batch 5.

Site ID	Temperature (°C)			DO (mg/L)			pH			Conductivity (μS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-2-B2	23.0	23.9	23.4	5.0	8.5	6.9	7.27	7.92	7.47	393	434	419	59.2	63.2	61.2	129	130	129	<1.00	<1.00	<1.00
SE-3-R9	23.0	23.7	23.4	4.7	8.3	7.0	7.19	7.84	7.39	410	434	424	67.6	70	68.8	130	147	138	<1.00	<1.00	<1.00
SE-4-B1	23.0	23.8	23.4	4.5	8.3	6.9	7.19	7.90	7.41	396	439	423	60.4	60.4	60.4	134	139	137	<1.00	<1.00	<1.00
SE-5-B2	23.1	23.8	23.5	4.7	8.5	6.8	7.16	7.81	7.36	381	423	408	57.2	58.4	57.8	120	129	125	<1.00	<1.00	<1.00
SE-6-B1	23.1	24.0	23.4	4.7	8.6	6.9	7.16	7.77	7.35	384	428	413	54.8	58.8	56.8	119	130	125	<1.00	<1.00	<1.00
SE-7-B4	23.2	23.9	23.5	5.0	8.5	6.9	7.18	7.74	7.39	381	431	413	59.6	62	60.8	125	132	129	<1.00	<1.00	<1.00
SE-7-B5	23.2	23.8	23.5	4.2	8.4	6.8	7.16	7.74	7.37	386	420	408	54	56.4	55.2	122	126	124	<1.00	<1.00	<1.00
SE-8-B1	23.0	23.9	23.4	4.8	8.3	6.8	7.22	7.75	7.42	384	428	411	55.6	58.8	57.2	120	128	124	<1.00	<1.00	<1.00
SE-G-2	23.0	23.8	23.4	5.1	8.6	7.1	7.20	7.75	7.34	392	425	412	55.2	55.2	55.2	126	132	129	<1.00	<1.00	<1.00
SE-LAL-5	23.1	23.9	23.4	4.8	8.4	6.9	7.18	7.76	7.40	381	427	409	55.6	56.4	56	122	128	125	<1.00	<1.00	<1.00
SE-REF-5	22.4	23.9	23.4	4.6	8.5	6.9	7.21	7.74	7.41	390	434	418	57.6	63.2	60.4	131	134	132	<1.00	<1.00	<1.00
SE-TRIB-1	23.0	23.8	23.4	5.0	8.7	7.0	7.27	7.77	7.46	391	429	415	57.2	61.6	59.4	127	128	127	<1.00	<1.00	<1.00
CTL-SS-B5	23.0	23.7	23.4	4.5	8.3	7.0	7.19	7.82	7.40	413	436	427	56	63.6	59.8	127	132	130	<1.00	<1.00	<1.00
CTL-QS-B5	23.1	24.0	23.5	4.4	8.6	6.9	7.16	7.85	7.40	361	432	401	54	58	56	126	130	128	<1.00	<1.00	<1.00
CTL-ERDC-B5	22.9	23.7	23.4	5.2	8.4	7.0	7.19	7.83	7.33	386	415	403	51.6	56	53.8	106	126	116	<1.00	<1.00	<1.00

Table 5-9f. Summary of water quality data for 28-day *Hyalella azteca* UCR sediment tests: Batch 5 re-tests.

Site ID	Temperature (°C)			DO (mg/L)			pH			Conductivity (μS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-2-B2-RE	22.3	23.3	22.7	3.9	8.6	6.7	7.22	8.24	7.49	408	431	420	58	58.8	58.4	125	129	127	<1.00	<1.00	<1.00
SE-3-R9-RE	22.4	22.9	22.7	4.4	8.6	6.7	7.24	8.12	7.55	409	446	431	61.6	69.2	65.4	126	132	129	<1.00	<1.00	<1.00
SE-4-B1-RE	22.3	23.0	22.6	4.0	8.8	6.8	7.23	8.10	7.48	404	421	413	57.6	58	57.8	120	130	125	<1.00	<1.00	<1.00
SE-5-B2-RE	22.3	23.0	22.7	3.9	8.7	6.7	7.11	8.04	7.53	404	429	413	56.4	58	57.2	118	119	118	<1.00	<1.00	<1.00
SE-6-B1-RE	22.3	23.0	22.7	4.0	8.8	6.8	7.04	7.99	7.55	406	429	418	56.4	61.2	58.8	128	129	128	<1.00	<1.00	<1.00
SE-7-B4-RE	22.4	22.9	22.7	3.8	8.7	6.8	7.28	7.93	7.50	406	432	417	54.8	56.4	55.6	121	126	124	<1.00	<1.00	<1.00
SE-7-B5-RE	22.3	23.2	22.6	4.0	8.8	6.7	7.13	7.90	7.38	400	423	410	54.8	55.2	55.0	125	127	126	<1.00	<1.00	<1.00
SE-8-B1-RE	22.3	23.1	22.8	3.9	8.6	6.7	7.15	7.88	7.37	401	424	411	53.2	56.4	54.8	120	124	122	<1.00	<1.00	<1.00
SE-G-2-RE	22.4	23.2	22.6	4.2	9.0	6.8	7.16	7.89	7.45	401	422	413	56.8	62.4	59.6	124	125	124	<1.00	<1.00	<1.00
SE-LAL-5-RE	22.3	23.2	22.6	3.9	8.8	6.6	7.11	7.89	7.38	398	419	411	52	58	55	114	119	116	<1.00	<1.00	<1.00
SE-REF-5-RE	22.4	23.0	22.7	4.0	8.9	6.7	7.23	7.89	7.49	405	438	418	57.2	59.6	58.4	121	129	125	<1.00	<1.00	<1.00
SE-TRIB-1-RE	22.4	23.3	22.8	3.8	8.9	6.7	7.23	7.89	7.47	404	419	413	56.4	58	57.2	122	126	124	<1.00	<1.00	<1.00
CTL-SS-B5-RE	22.3	23.0	22.7	4.1	8.7	6.8	7.24	7.91	7.54	419	474	442	62.8	64.8	63.8	124	127	125	<1.00	<1.00	<1.00
CTL-QS-B5-RE	22.3	23.2	22.7	3.5	9.1	6.6	7.14	7.92	7.44	401	424	415	58	58	58	115	130	122	<1.00	<1.00	<1.00
CTL-ERDC-B5-RE	22.5	23.0	22.8	4.5	8.7	6.7	6.93	7.57	7.27	399	420	411	56.8	60	58.4	111	124	118	1.03	1.48	1.26

Table 5-9g. Summary of water quality data for 28-day *Hyalella azteca* UCR sediment tests: Batch 6.																					
Site ID	Temperature (°C)			DO (mg/L)			pH			Conductivity (μS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-1B-R2	22.8	23.6	23.3	4.9	8.6	7.2	7.28	7.79	7.49	445	463	450	62.4	80	71.2	139	151	145	<1.00	<1.00	<1.00
SE-1-R2	22.5	23.7	23.3	5.4	8.9	7.2	7.23	7.84	7.46	404	446	429	58.8	65.6	62.2	128	132	130	<1.00	<1.00	<1.00
SE-4-B3	22.7	23.7	23.3	5.1	8.5	7.2	7.22	7.83	7.45	409	445	426	57.2	68	62.6	129	131	130	<1.00	<1.00	<1.00
SE-4-B5	22.7	23.9	23.3	5.1	8.4	7.1	7.18	7.93	7.43	406	443	428	55.2	56.4	55.8	127	131	129	<1.00	<1.00	<1.00
SE-6-B2	22.7	23.7	23.3	5.0	8.5	7.1	7.17	7.91	7.42	372	435	415	58	63.2	60.6	119	132	125	<1.00	<1.00	<1.00
SE-7-B1	23.0	23.8	23.4	4.6	8.5	6.9	7.19	7.88	7.43	395	431	416	54.4	58.4	56.4	120	128	124	<1.00	<1.00	<1.00
SE-8-B2	22.7	23.7	23.4	5.2	8.5	7.1	7.16	7.83	7.38	390	427	414	55.2	55.6	55.4	122	132	127	<1.00	<1.00	<1.00
SE-8-B5	22.6	23.6	23.3	4.8	8.6	7.1	7.18	7.80	7.45	400	431	418	55.2	59.2	57.2	123	128	125	<1.00	<1.00	<1.00
SE-8-B6	22.4	23.8	23.3	5.2	8.6	7.2	7.19	7.80	7.41	392	434	417	56.8	57.2	57	124	128	126	<1.00	<1.00	<1.00
SE-LAL-6	22.7	23.7	23.3	5.2	8.4	7.0	7.20	7.66	7.42	410	437	423	58.4	67.6	63	125	135	130	<1.00	<1.00	<1.00
SE-G-3	22.8	23.5	23.2	5.4	8.6	7.1	7.27	7.81	7.47	394	438	421	59.2	74	66.6	123	126	125	<1.00	<1.00	<1.00
SE-TRIB-6	22.9	23.9	23.3	5.3	8.4	7.2	7.42	7.80	7.57	431	490	469	87.6	93.2	90.4	156	163	159	<1.00	<1.00	<1.00
CTL-SS-B6	22.8	23.7	23.3	5.0	8.7	7.1	7.36	7.91	7.53	427	470	448	63.6	65.6	64.6	131	131	131	<1.00	<1.00	<1.00
CTL-QS-B6	22.7	23.7	23.3	5.4	8.5	7.2	7.19	7.92	7.43	399	437	420	57.2	59.2	58.2	124	127	125	<1.00	<1.00	<1.00
CTL-ERDC-B6	22.7	23.8	23.4	4.9	8.4	7.0	7.17	7.69	7.34	363	419	403	43.6	51.6	47.6	104	126	115	<1.00	<1.00	<1.00

5.3.2 Negative Lab Control

Test acceptability was based upon test organism response in the Negative Lab Control sediment. A summary of the organism performance in the Negative Lab Control sediment tested as part of the project is presented in Table 5-10, and discussed below.

With the exception of the survival response in the Batch 5 Negative Lab Control sediment, the test organism responses at the remaining Negative Lab Control treatments were within acceptable limits (≥80% survival at test termination) for each round of testing (i.e., each batch of tests). In addition, the Negative Lab Control sediment dry weight per individual was well above the round-robin testing dry wt. of >0.15 mg/individual observed for laboratories performing this test (USEPA 2000) and the project goal dry wt. of 0.4 mg/individual. Furthermore, *H. azteca* growth in the Negative Lab Control sediment exceeded the EPA's recommended performance-based 12x growth increase (EPA 2011); the growth increases from test initiation ranged from 15x-67x for test Batches 1-6.

Table 5-10. *Hyalella azteca* test responses in the Negative Lab Control sediment at 28 days.

Batch	Treatment Sample ID	Mean % Survival	Mean Dry Weight (mg/individual)	Test Initiation Mean Weight (mg/individual)	Weight Increase at Test Termination
1	CTL-SS-B1	100	0.765	0.013	59x
2	CTL-SS-B2	97.5	0.741	0.011	67x
3	CTL-SS-B3	92.5	0.628	0.014	45x
4	CTL-SS-B4	83.8	0.603	0.012	50x
5	CTL-SS-B5	72.5	0.625	0.011	57x
5 re-test	CTL-SS-B5RE	96.3	0.376	0.025	15x
6	CTL-SS-B6	96.3	0.658	0.026	25x

5.3.2.1 Auxiliary Controls

Additional auxiliary controls were also performed as part of the study and as per the QAPP (Exponent et al. 2013). The biological responses for the test organisms at the Auxiliary Quartz Control and Auxiliary USACE ERDC Control Sediment treatments for each round of testing are presented below in Table 5-11.

Table 5-11. *Hyalella azteca* test responses test performance in the Auxiliary Control media at 28 days.					
Batch	Treatment Sample ID	Mean % Survival	Mean Dry Weight (mg/individual)	Test Initiation Mean Weight (mg/individual)	Weight Increase at Test Termination
	Quartz Control				
1	CTL-QS-B1	93.8	0.554	0.013	43x
2	CTL-QS-B2	97.5	0.603	0.011	55x
3	CTL-QS-B3	98.8	0.570	0.014	41x
4	CTL-QS-B4	96.3	0.622	0.012	52x
5	CTL-QS-B5	98.8	0.571	0.011	52x
5 re-test	CTL-QS-B5RE	92.5	0.401	0.025	16x
6	CTL-QS-B6	93.8	0.363	0.026	14x
	USACE ERDC Control				
1	CTL-ERDC-B1	31.3	0.542	0.013	42x
2	CTL-ERDC-B2	96.3	0.706	0.011	64x
3	CTL-ERDC-B3	96.3	0.748	0.014	53x
4	CTL-ERDC-B4	90.0	0.595	0.012	50x
5	CTL-ERDC-B5	81.3	0.626	0.011	57x
5 re-test	CTL-ERDC-B5RE	87.5	0.287	0.025	12x
6	CTL-ERDC-B6	96.3	0.747	0.026	29x

5.3.3 Positive Lab Controls

The sensitivity of the test organisms to toxic stress was evaluated using positive controls (i.e., reference toxicant testing); the results of the *H. azteca* reference toxicant test performed as part of the 28-day testing are presented in Table 5-12. The key test concentration-response LC point estimates were all within the typical response range for this species, indicating that these test organisms were responding to toxic stress in a consistent and typical fashion. These test results also indicated that the sensitivities of the test organisms were similar across batches. The results of these tests are summarized in Appendix OO.

Table 5-12. Reference Toxicant Testing: Effects of KCl on *Hyalella azteca*.					
Test Batch	Test Initiation Date	Control Treatment % Survival	Survival LC50 (g/L KCl)	Control Chart Mean LC50 (g/L KCl)	Typical Response Range (g/L KCl)
1	1/22/14	100	0.39	0.35	0.26 – 0.46
2	1/23/14	100	0.46	0.35	0.26 – 0.46
3	1/24/14	100	0.43	0.35	0.26 – 0.48
4	1/29/14	100	0.35	0.35	0.26 – 0.48
5	1/30/14	100	0.28	0.35	0.26 – 0.48
5 re-test	3/24/14	100	0.37	0.41	0.26 – 0.65
6	1/31/14	90	0.37	0.35	0.26 – 0.48

5.3.4. Identification of Anomalous Data

A review of the test data indicated that >10 test organisms were recovered at test termination in six of the 816 overall total number of replicates (i.e., 0.7%): SE-5-B1-H, SE-4-B4-F, and SE-TRIB-2-H; the Batch 5 retest data indicated that >10 test organisms were recovered at test termination in the following replicates: SE-2-B2-RE-B, SE-7-B4-RE-D, and SE-LAL-5RE-C.

Any reporting of test treatment mean survival or growth was performed as per guidance provided by the project team (personal communication Anne Fairbrother, 2014 [Appendix A]).

In addition, anomalously low survival responses were observed for the following replicates:

Batch 1 – SE-G1-C;
Batch 5 – SE-REF-5-D;
Batch 5 Re-test – SE-G-2RE-B; and
Batch 6 – SE-4-B5-F, and SE-6-B2-C.

The cause of the low survival in these replicates is unknown.

It should also be noted that during the Batch 3 old water quality measurements on 2/9/14, two *H. azteca* were observed in the wastewater cup. As it could not be determined which treatment replicates these organisms came from; they were discarded.

5.4 QA/QC Summary: *Hyalella azteca* 42-day Toxicity Testing

5.4.1 Test Conditions

All biological testing water quality conditions were within the appropriate limits (Tables 5-13a-5-13c). All measurements of routine water quality characteristics were performed as described in the UCR QAPP (Exponent et al. 2013). Laboratory instruments were calibrated daily according to Lab SOPs, and calibration data were logged and initialed. Zumwalt water delivery systems were calibrated prior to test initiation and periodically throughout the testing; calibration logs are provided in Appendix PP. Lighting intensity was also confirmed at test initiation; light verification measurements are presented on Appendix QQ. It should be noted that for some of the samples, the test replicate overlying water DO levels fell below the 2.5 mg/L aeration trigger level during the course of the test, and aeration was initiated for these samples. When aeration was implemented, the aeration initiation date was recorded on the bench data sheet, along with the lowest replicate DO measurement for each treatment that fell below the aeration trigger. A summary of sediment samples that were aerated is provided in Appendix RR; any additional test treatment replicate DO measurements performed upon observation of a DO <2.5 mg/L are also provided in Appendix RR.

Table 5-13a. Summary of water quality data for 42-day *Hyalella azteca* UCR sediment tests: Batch 1.

Site ID	Temperature (°C)			AM DO (mg/L)			Aeration Trigger Exceedance DO Level (mg/L)[A]	pH			Conductivity (μS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-1-B5	22.1	23.8	23.0	1.5	8.7	6.8	1.5	7.22	7.99	7.57	407	450	428	53.6	78.8	63.9	123	142	134	<1.00	<1.00	<1.00
SE-1B-R2	22.4	23.8	23.1	2.0	8.6	6.8	2.0	7.31	7.96	7.58	408	447	436	55.2	78.4	66.2	124	147	135	<1.00	<1.00	<1.00
SE-1-R2	22.1	24.0	23.1	2.4	8.6	6.9	2.4	7.16	7.98	7.52	393	427	416	58	62	59.8	116	133	126	<1.00	<1.00	<1.00
SE-4-B6	22.0	24.0	23.0	2.4	8.6	6.9	2.4	7.32	7.97	7.56	398	438	419	50.8	64.8	58.2	126	143	136	<1.00	<1.00	<1.00
SE-6-B2	22.0	23.9	23.1	2.4	8.7	7.1	2.4	7.33	7.97	7.57	392	434	419	55.6	66.4	60.7	119	149	131	<1.00	<1.00	<1.00
SE-7-B5	22.1	23.9	23.1	2.3	8.9	6.9	2.3	7.28	7.83	7.48	388	429	408	50.8	65.2	56.9	114	138	128	<1.00	<1.00	<1.00
SE-8-B3	22.2	24.0	23.2	1.9	9.0	6.7	1.9	7.07	7.93	7.46	389	425	408	49.2	60.8	55.4	112	134	126	<1.00	<1.00	<1.00
SE-G-1	22.1	24.0	23.1	2.1	8.9	7.1	2.1	7.27	7.94	7.52	398	429	413	54	63.6	58.3	113	143	129	<1.00	<1.00	<1.00
SE-G-3	22.3	23.8	23.1	2.3	8.8	7.2	2.3	7.32	7.92	7.53	405	427	413	53.2	62	57.4	113	133	126	<1.00	<1.00	<1.00
SE-LAL-3	22.2	23.9	23.1	2.3	8.6	6.9	2.3	7.29	8.02	7.50	399	434	419	56.8	63.6	59.6	122	139	130	<1.00	<1.00	<1.00
SE-LAL-5	22.2	23.9	23.1	2.4	8.8	6.8	2.4	7.21	7.92	7.43	389	427	406	49.2	58.8	52.7	110	130	122	<1.00	<1.00	<1.00
SE-REF-10b	22.2	23.9	23.1	1.9	8.7	7.1	1.9	7.28	7.98	7.57	401	431	418	55.6	63.2	58.7	121	143	130	<1.00	<1.00	<1.00
SE-TRIB-3	22.1	23.8	23.0	2.2	8.7	7.3	2.2	7.35	8.08	7.68	405	451	431	55.2	69.2	63	125	154	137	<1.00	<1.00	<1.00
CTL-SS-B1	22.0	23.9	23.0	3.7	8.6	7.0	NA	7.35	7.99	7.58	403	517	438	54.8	60.8	59.2	122	136	128	<1.00	<1.00	<1.00
CTL-QS-B1	22.1	24.0	23.1	2.8	8.6	6.9	NA	7.25	8.03	7.53	392	424	412	50.8	66.4	57.5	110	137	126	<1.00	<1.00	<1.00

A – The dissolved oxygen (DO) value reported here is the lowest replicate DO recorded for the treatment on the day that the aeration trigger level was exceeded and aeration was initiated. See Appendix RR for a summary of DO readings for each replicate.
NA – Observed DO never fell below 2.5 mg/L during the test.

Table 5-13b. Summary of water quality data for 42-day *Hyalella azteca* UCR sediment tests: Batch 2.

Site ID	Temperature (°C)			AM DO (mg/L)			Aeration Trigger Exceedance DO Level (mg/L)[A]	pH			Conductivity (µS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-2-B1	22.1	24.0	23.1	3.2	8.9	6.8	NA	7.22	7.87	7.48	405	446	426	59.6	78	66.5	127	147	136	<1.00	<1.00	<1.00
SE-2-R1	22.0	23.8	22.9	3.2	8.7	6.7	NA	7.15	7.98	7.48	400	433	414	57.2	61.6	59.4	118	134	128	<1.00	<1.00	<1.00
SE-3-R7	22.0	24.0	22.9	2.7	8.9	6.8	NA	7.29	7.91	7.51	399	424	413	56.8	62	60.1	120	137	132	<1.00	<1.00	<1.00
SE-4-B1	22.1	23.7	23.0	2.4	8.8	7.3	2.4	7.32	7.86	7.50	395	425	414	60.8	62.8	61.6	128	144	133	<1.00	<1.00	<1.00
SE-5-B2	22.0	24.0	23.0	3.0	9.0	6.9	NA	7.09	7.78	7.44	394	451	413	56.4	63.2	61.0	115	140	130	<1.00	<1.00	<1.00
SE-8-B2	22.0	24.0	23.0	3.4	8.9	6.8	NA	7.13	7.72	7.40	390	423	406	55.2	60	57.4	120	132	127	<1.00	<1.00	<1.00
SE-LAL-2	22.0	23.9	23.0	2.0	8.7	7.0	2.0	7.16	7.68	7.41	383	416	405	49.6	60.8	56.6	125	134	130	<1.00	<1.00	<1.00
SE-G-1	22.0	24.0	23.1	2.7	8.8	7.0	NA	7.14	7.80	7.43	395	444	413	55.6	63.2	58.4	123	136	130	<1.00	<1.00	<1.00
SE-G-3	22.0	23.8	22.9	3.0	8.8	6.8	NA	7.03	7.82	7.44	398	425	411	54	62.4	58.5	118	133	128	<1.00	<1.00	<1.00
SE-LAL-3	22.1	23.9	23.1	2.3	9.0	7.0	2.3	7.23	7.79	7.48	408	421	417	54.8	63.2	57.7	125	142	132	<1.00	<1.00	<1.00
SE-LAL-5	22.0	24.0	23.0	3.0	8.9	6.9	NA	7.13	7.77	7.40	389	420	404	54.8	62.4	58.6	113	137	126	<1.00	<1.00	<1.00
SE-REF-10b	22.2	24.0	23.2	2.8	9.2	6.9	NA	7.25	7.79	7.48	409	433	416	54.4	70.4	60.6	123	138	131	<1.00	<1.00	<1.00
SE-TRIB-3	22.0	23.9	23.0	2.4	9.0	7.0	2.4	7.31	7.84	7.56	413	453	428	51.6	80.4	63.7	132	145	138	<1.00	<1.00	<1.00
CTL-SS-B2	22.0	23.9	23.0	3.1	8.8	6.9	NA	7.20	7.90	7.50	404	516	438	58	62.8	60.3	122	136	130	<1.00	<1.00	<1.00
CTL-QS-B2	22.0	23.9	23.0	3.1	9.0	7.0	NA	7.10	7.91	7.46	395	420	407	40	58	51.5	117	131	124	<1.00	<1.00	<1.00

A – The dissolved oxygen (DO) value reported here is the lowest replicate DO recorded for the treatment on the day that the aeration trigger level was exceeded and aeration was initiated. See Appendix RR for a summary of DO readings for each replicate.
NA – Observed DO never fell below 2.5 mg/L during the test.

Table 5-13c. Summary of water quality data for 42-day *Hyalella azteca* UCR sediment tests: Batch 3.																									
Site ID	Temperature (°C)			AM DO (mg/L)			Aeration Trigger Exceedance DO Level (mg/L)[A]	pH			Conductivity (μS)			Alkalinity (mg/L CaCO3)			Hardness (mg/L CaCO3)			Ammonia (mg/L)		
	Min.	Max.	Mean	Min.	Max.	Mean		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
SE-3-B3	22.2	24.0	23.4	2.2	8.8	6.8	2.2	7.06	7.99	7.42	409	499	436	56.4	88	66.3	125	164	143	<1.00	<1.00	<1.00
SE-3-R8	22.2	23.7	23.1	3.1	8.9	7.0	NA	7.11	7.92	7.47	402	511	433	53.6	64.8	59.1	130	144	141	<1.00	<1.00	<1.00
SE-4-B5	22.2	23.6	23.0	3.7	8.9	7.0	NA	7.17	7.86	7.48	405	432	418	54.4	60.8	57.3	124	143	136	<1.00	<1.00	<1.00
SE-5-B4	22.1	23.7	23.1	1.7	8.8	6.7	1.7	7.20	7.84	7.42	388	431	409	49.6	58.8	55.8	130	142	136	<1.00	<1.00	<1.00
SE-6-B5	22.4	23.6	23.1	3.1	8.7	6.8	NA	7.23	7.78	7.41	399	442	420	55.2	62.4	58	129	147	139	<1.00	<1.00	<1.00
SE-7-B2	22.3	24.0	23.3	2.2	8.8	6.9	2.2	7.12	7.86	7.43	396	463	420	51.6	61.2	57.7	126	145	137	<1.00	<1.00	<1.00
SE-G-2	22.3	23.6	23.1	1.8	8.9	6.8	1.8	7.20	7.85	7.43	399	448	419	53.6	64.8	59.2	133	144	138	<1.00	<1.00	<1.00
SE-G-1	22.3	23.9	23.1	3.2	8.9	7.0	NA	7.19	7.82	7.46	398	432	415	52	61.6	57.3	129	147	139	<1.00	<1.00	<1.00
SE-G-3	22.3	23.7	23.1	3.0	8.9	7.0	NA	7.19	7.82	7.46	394	434	412	54.8	59.6	58.2	126	141	133	<1.00	<1.00	<1.00
SE-LAL-3	22.4	24.0	23.3	3.1	8.8	6.9	NA	6.89	7.78	7.42	406	470	426	58.4	71.2	61.9	134	155	143	<1.00	<1.00	<1.00
SE-LAL-5	22.4	23.6	23.0	3.4	8.9	6.9	NA	7.18	7.75	7.42	390	433	411	54.4	61.2	58	136	142	139	<1.00	<1.00	<1.00
SE-REF-10b	22.2	23.8	23.1	3.2	8.8	7.1	NA	7.16	7.76	7.47	404	468	423	54.8	68.8	60.5	134	148	143	<1.00	<1.00	<1.00
SE-TRIB-3	22.4	24.0	23.2	3.5	8.9	7.1	NA	7.42	7.79	7.58	420	556	452	54.4	83.2	65.6	137	158	149	<1.00	<1.00	<1.00
CTL-SS-B3	22.4	24.0	23.3	3.4	8.8	7.2	NA	7.20	8.21	7.58	419	515	456	54	65.2	60.1	132	148	140	<1.00	<1.00	<1.00
CTL-QS-B3	22.4	23.9	23.2	3.7	8.8	7.1	NA	7.26	8.09	7.54	401	432	418	56	59.2	57.3	135	147	140	<1.00	<1.00	<1.00

A – The dissolved oxygen (DO) value reported here is the lowest replicate DO recorded for the treatment on the day that the aeration trigger level was exceeded and aeration was initiated. See Appendix RR for a summary of DO readings for each replicate.
NA – Observed DO never fell below 2.5 mg/L during the test.

The lowest treatment replicate DO observed in the testing, 1.5 mg/L, was for treatment replicate SE-B1-R5-K (Appendix RR); there was 100 percent survival in this treatment replicate. Based on this information and the very short duration (no more than 18 hours) that test organisms were potentially exposed to low DO levels in the current testing, it is expected that data quality was not impacted.

5.4.2 Negative Lab Control

Test acceptability was based upon test organism response in the Negative Lab Control sediment. Summaries of the organism performance in the Negative Lab Control sediment tested as part of the *H. azteca* 42-day toxicity testing are presented in Tables 5-14(a-b), and discussed below.

The biological responses for the test organisms at the Negative Lab Control treatments were within acceptable limits (≥80% survival at test termination) for each round of testing (i.e., each 'batch' of tests). In addition, the Negative Lab Control sediment dry weight per individual and number of offspring/female were above the round-robin testing 28-day dry wt of >0.15 mg/individual and >2 young per female, respectively, observed for laboratories performing this test (USEPA 2000). The biological responses for the test organisms at the PER Lab Control treatments also met additional project goals of 28-day dry wt. of 0.4 mg/individual, and 42-day dry wt. of 0.5 mg/individual (Exponent 2013). Furthermore, *H. azteca* growth in the PER Control sediment exceeded the EPA's recommended performance-based 12x growth increase (EPA 2011) at 28-days, ranging from 26x-52x.

Table 5-14a. *Hyalella azteca* test responses in Negative Lab Control sediment at 28 days in long-term tests.

Batch	Treatment Sample ID	Mean % Survival	Mean Dry Weight (mg/individual)	Test Initiation Mean Dry Weight (mg/individual)	Weight Increase at Test Termination
1	CTL-SS-B1	97.5	0.433	0.017	26x
2	CTL-SS-B2	96.7	0.542	0.011	49x
3	CTL-SS-B3	100	0.519	0.010	52x

Table 5-14b. *Hyalella azteca* test responses in Negative Lab Control sediment at 42 days in long term tests.

Batch	Treatment Sample ID	Mean % Survival	Mean Dry Weight (mg/individual)	Number of Offspring/female
1	CTL-SS-B1	95.0	0.644	5.2
2	CTL-SS-B2	93.8	0.699	8.9
3	CTL-SS-B3	95.0	0.660	8.8

5.4.2.1 Auxiliary Controls - An Auxiliary Quartz Control treatment was also performed as part of the study and as per the QAPP (Exponent et al. 2013). The biological responses for the test organisms at the Auxiliary Quartz Control treatment for each round of testing are presented below in Tables 5-15(a-b), and discussed below.

Table 5-15a. *Hyalella azteca* test responses in Quartz Control medium at Day 28 in long-term tests.

Batch	Treatment Sample ID	Mean % Survival	Mean Dry Weight (mg/individual)	Test Initiation Mean Dry Weight (mg/individual)	Weight Increase at Test Termination
1	CTL-QS-B1	97.5	0.244	0.017	14x
2	CTL-QS-B2	96.7	0.304	0.011	28x
3	CTL-QS-B3	98.3	0.231	0.010	23x

Table 5-15b. *Hyalella azteca* test responses in Quartz Control medium at Day 42 in long-term tests.

Batch	Treatment Sample ID	Mean % Survival	Mean Dry Weight (mg/individual)	Number of Offspring/female
1	CTL-QS-B1	95.0	0.496	3.0
2	CTL-QS-B2	97.5	0.626	4.0
3	CTL-QS-B3	96.3	0.576	2.5

5.4.3 Positive Lab Controls

The sensitivity of the test organisms to toxic stress was evaluated using positive controls (i.e., reference toxicant testing); the results of the reference toxicant testing for the *H. azteca* long-term tests are presented in Table 5-16. The key test concentration-response LC point estimates were all within the typical response range for this species, indicating that these test organisms were responding to toxic stress in a consistent and typical fashion. These results also indicated that the sensitivities of the test organisms were similar across batches. These results also indicated that the sensitivities of the test organisms were similar across batches. Reference toxicant tests results for the *H. azteca* long-term testing are presented in Appendix SS.

Table 5-16. Reference Toxicant Testing: Effects of KCl on *Hyalella azteca*.

Test Batch	Test Initiation Date	Control Treatment % Survival	Survival LC50 (g/L KCl)	Control Chart Mean LC50 (g/L KCl)	Typical Response Range (g/L KCl)
1	2/13/15	100	0.40	0.37	0.25-0.48
2	2/25/15	100	0.42	0.38	0.22-0.54
3	3/5/15	100	0.35	0.37	0.25-0.54

5.4.4. Identification of Anomalous Data

A review of the test data indicated that >10 test organisms were recovered in two of the overall 540 test replicates (i.e., 0.4%): SE-1-B5-A and SE-REF-10b-B.

Any reporting of test treatment mean survival or growth was performed as per guidance provided by the project team (personal communication Anne Fairbrother, 2014 [Appendix A]).

In addition, anomalously low survival responses for the following replicates were identified:

- Batch 1 - SE-1-R2-A, SE-TRIB-3-C, SE-TRIB-3-D, SE-TRIB-3-F (Day 42), and SE-G-3-K (Day 42);
- Batch 2 - SE-TRIB-3-D; and
- Batch 3 - SE-TRIB-3-F and SE-TRIB-3-J.

The cause of the low survival in these replicates is unknown.

It should also be noted that during water renewal on March 10, 2015, site replicate SE-LAL-2-K knocked up against another beaker and a small piece of glass broke off of the bottom of the replicate. The piece of glass was placed back on the beaker and the bottom of the beaker was wrapped in polyvinyl film and securely taped; the replicate was retained and maintained throughout the duration of the test.

6. REFERENCES

American Society for Testing and Materials (ASTM) 2012. Standard test method for measuring the toxicity of sediment –associated contaminants with freshwater invertebrates (ASTM 1634 E1706-05) Annual Book of ASTM Standards Volume 11.06, West Conshohocken, PA.

Borgmann, U. 1996. Systematic analysis of aqueous ion requirements of *Hyalella azteca*: A standard artificial medium including the essential bromide ion. *Arch. Environ. Contam. Toxicol 30:356-363*.

Brambaugh, B. 2014. USGS CERC Peeper Method for *In Situ* Sampling of Sediment Porewater. Revised January 8, 2014.

Exponent and HDR-Hydroqual 2013. Upper Columbia River: Final Quality Assurance Project Plan for the Phase 2 Sediment Study. Prepared for Teck American Incorporated. Prepared by Exponent and HDR-Hydroqual in Association and Consultation with Parametrix Inc., Cardwell Consulting, LLC, and Integral Consulting Inc. March 2013.

Irving E.C., K. Leber, and J. Culp (2004) Lethal and Sublethal Effects of Low Dissolved Oxygen Condition on Two Aquatic Invertebrates, *Chironomus tentans* and *Hyalella azteca*. Environmental Toxicology and Chemistry 23(6):1561-1566.

USEPA 2000. Method for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates. EPA-600/R-99-064, Duluth, MN.

USEPA 2011. Memorandum: Suggested requirements and performance criteria for laboratories conducting sediment toxicity tests. Prepared by David R. Mount, United States Environmental Protection Agency National Health and Environmental Effects Research Laboratory, Duluth, Minnesota. Prepared for D. Scott Ireland Great Lakes National Program Office. November 23, 2011.

Appendix A

Upper Columbia River Quality Assurance Project Plan Change Order Requests #3, #4, #5, #6, #7, and Personal Communications

Change Request Form
Upper Columbia River Phase 2 Sediment Study

Page 1 of 2 Change No. : 3

CHANGE REQUEST:

Applicable Reference: Quality Assurance Project Plan for the Phase 2 Sediment Study

Description of Change: The following changes will be made to the bioassay procedures in the QAPP Tables B1-3, B1-5, B1-6, and B1-10, (Please and in Appendix E, Standard Operating Procedures Nos. XYZ and General Activity Schedules Nos. XYZ. Specifically the following changes are requested:

1. Table B1-3 and Table B1-5 will be amended to indicate Feeding at a rate of 1 mL/day, increasing to 2 mL/day at day 14. This was the intended feeding rate and the original table entry of 1 mg/day to 2 mg/day was a typographical error. Updated Tables are attached.

2. General activity schedules (GAS) (in Appendix E) will be updated to be congruent with the test SOPs in Appendix E. The GAS for the long term Chironomus test will have the Days for isolating and checking egg masses revised from -3 and -2 to -7 and -6 which will allow larvae to be 4-day old at start of the test. All GASs were modified by adding the following on Day 0 (updated GASs are attached):
Renewal of the overlying water using the Zumwalt water delivery system is implemented immediately prior to the introduction of the test organisms into the test replicates.

3. SOP (in Appendix E) will be amended to indicate that the Chironomus life cycle test will begin with 4-day old larvae instead of <24-hr old larvae. This follows PER's SOP and provides better growth and biomass measurement endpoints. Amended SOP is attached (Rev 5; dated 9-11-13).

4. Hyalella and Chironomus SOPs (in Appendix E) will be updated to be consistent with the QAPP (attached; proposed updates are highlighted for easy reference):
- Hyalella test SOPs now reflect the QAPP-specified 0.4 mg/L Br in test water
- Hyalella long-term test SOP now states that Nitex mesh is used (consistent with the GAS).
- Chironomus test SOPs now reflect the use of EPA moderately-hard water and use of 4-day old chironomids for the lifecycle test
- Biomass is now listed as an endpoint for all tests in addition to mean growth.

Reason for Change: These changes will be made to correct typographical errors and to bring the tables, SOPs, and GASs into alignment with each other and with the QAPP text. The only substantive change is starting the long-term Chironomus test with 4-day old larvae instead of <24 hr old larvae.

Change Request Form Upper Columbia River Phase 2 Sediment Study	
Page 1 of 2	Change No.: 3
Impact on Present and Completed Work:	Starting the Chironomus test with older larvae brings the protocol into alignment with PER's current SOP; better growth and biomass endpoints are achieved. This is commensurate with discussions with other testing laboratories that have achieved similar benefits from the adjusted protocol. All other changes have no impact as there is no substantive change to the test protocols.
Requested By: [signature] (Scientist)	Date: 10/16/13
Acknowledged By: [signature] Jeffrey Cotsifas (PER)	Date: 10/16/13
APPROVAL	
Task Manager: Anne Fairbrother — Anne Fairbrother (Exponent)	Date: 10/18/13
TAI Project Manager: Kris McCaig for MEA — Marko Adzic (TAI)	Date: 11/26/13
EPA Project Manager: [signature] Laura Buelow (EPA)	Date: 12/3/13

Change Request Form
Upper Columbia River Phase 2 Sediment Study

Page: 1 of 5 Change No: 4

CHANGE REQUEST

Creation of SOP for collecting EPA-chemistry only split samples from ALS Laboratory in Kelso, WA

Applicable Reference:

SOPs section (Attachment A2) of the Field Samplin Plan

Description of Change:

A new SOP (No. 10) was prepared that details the procedures to be followed for collecting EPA-chemistry only split samples from sediment samples located at ALS in Kelso, WA. SOP-10 is attached.

Reason for Change:

No SOP specific to collecting EPA-spilt samples from ALS was provided in the Final QAPP, dated March 2013.

Impact on Present and Completed Work:

None

Requested By: J.R. Sugalski (Scientist) Date: 11/12/2013

Acknowledged By: David Hose (Task Leader) Date: 11/12/2013

APPROVAL

URS Project Manager: [signature] Date: 11/12/2013

Teck Project Manager: [signature] Date: 11/12/13

EPA Project Manager: [signature] Date: 11/12/13

STANDARD OPERATING PROCEDURE SOP 10

PROCESSING OF EPA CHEMISTRY SPLIT SAMPLES IN THE ALS LABORATORY

Scope and Applicability

This standard operating procedure (SOP) describes the general procedures for collecting EPA-chemistry only split samples at the ALS Laboratory (ALS) in Kelso, WA. EPA split samples were obtained in accordance with the Final Quality Assurance Project Plan (QAPP) for the Phase 2 Sediment Study dated March 2013 and shipped to ALS for temporary storage pending re-packaging from 5-gallon buckets to smaller containers and shipment to an EPA selected laboratory. This SOP applies to only the EPA-chemistry only split samples that were collected during the Phase 2 Sediment Field Program conducted from September 5, 2013 through October 24, 2013. The locations and designations of the chemistry only split samples are identified in Table 2-5 of the Quality Assurance Project Plan, Upper, Columbia River, Phase 2 Sediment Study, Split Sample Metals Analysis prepared by CH2M Hill and dated September 2013.

Equipment and Materials

Specific equipment and materials required to collect EPA split samples at the laboratory include the following:

- One Lexan tub
- One electric drill (preferably 18 volts)
- One stainless steel mixer paddle
- Two plastic scoop (s)
- Labeled Sample Containers (assumed to be provided by USEPA or their designee)
- Rubber hammer to close lid
- Six 5-gallon buckets to collect decontamination rinse water
- Three Spray bottles (DI, liquinox, Acid)
- 1L. Nitric Acid (10%)
- Liquinox
- Scrub brush
- Health and safety equipment (safety glasses, nitrile gloves, and coveralls or apron)

Procedures

The steps listed below should be followed to collect EPA chemistry only split samples at the laboratory:

1. Identify and locate sediment samples listed in Table 1.
2. Don appropriate health and safety equipment
3. Identify a suitable decontamination area and containers used to collect the rinse waters.
4. Decontaminate the following in accordance with SOP 4 of the QAPP (TAI, 2013).
    a. Lexan tub
    b. Two plastic scoops
    c. One stainless steel homogenizer paddle
5. Each sample will be processed individually. Only one bucket should be open at a time.
6. Identify a sample to be processed and take the bucket to the processing area.
7. Remove bucket lid.
8. If sediment is primarily sand-sized particles the contents of the bucket may be emptied into a decontaminated Lexan tub for homogenization (**Proceed to step 10**). If sediment is primarily fine-grained particles and the bucket is approximately three quarters full, the material may be homogenized in the sample bucket (**Proceed to step 9**). If the bucket is more than three quarters full, the sediment may be emptied into a decontaminated Lexan tub for homogenization (**Proceed to Step 10**).
9. For material mixed in the sample bucket the following should occur:
    a. Insert homogenizer paddle attached to drill into bucket.
    b. Turn drill on and move paddle throughout the sample until the sample is satisfactorily mixed.
    c. Using a decontaminated plastic scoop, remove sediment from the bucket and place into sample container(s). Label the sample containers if necessary.
    d. Replace the lid on the bucket and return the bucket and remaining sediment to storage.
    e. Decontaminate the mixing paddle and scoops in accordance with SOP 4 and proceed to the next sample (**Step 6**) until all samples have been processed.
10. For material mixed in the decontaminated Lexan tub the following should occur:
    a. Place sediment into the decontaminated Lexan tub.
    b. Use scoops to homogenize the material if the material is primarily sand sized particles. Use the decontaminated mixing paddle to homogenize the material if the sediment is primarily fine grained particles.
    c. Mix the sample until it is satisfactorily mixed
    d. Using a decontaminated plastic scoop, remove sediment from the bucket and place into sample container(s). Label the sample containers if necessary.

   e. Return the homogenized sediment to the bucket it originally came from.
   f. Replace the lid on the bucket and return the bucket and sediment to storage.
   g. Decontaminate the mixing paddle, Lexan tub and scoops in accordance with SOP 4 if used to mix the sample. Proceed to the next sample (**Step 6**) until all samples have been processed.

11. After all samples have been mixed and the necessary sample containers filled, ensure that the equipment used to homogenize the sample (tub, scoop and mixing paddle) have been decontaminated in accordance with SOP 4 of the QAPP. Using laboratory supplied Deionized (DI) water perform a final rinse of the equipment. After the final rinse is compete, pour additional DI water over the equipment and collect it in appropriate sample containers listed in the QAPP. Two containers will be filled for each piece of equipment and submitted for metals analysis by ALS in accordance with the QAPP. The equipment rinsate (ER) samples will have the following Sample IDs, where Station ID (Table 1) corresponds to the sample collected following the last decontamination of the sampling equipment:
    a. Lexan Tub – ER-Station ID-LAB-1
    b. Homogenizing paddle – ER-Station ID-LAB-2
    c. Scoop – ER-Station ID-LAB-3
12. Clean up area and ensure sample containers and buckets are stored properly.
13. Sign over custody of the sediment samples to the EPA or authorized representative.

Table 1: EPA Chemistry Only Split Sample Locations

Station ID	Location Priority	Proposed Analysis
8-C4	Primary	TAL Metals
Ref-4	Primary	TAL Metals
Ref-8	Primary	TAL Metals
6-R3	Reserve for 6-B3	TAL Metals
6B-C2	Primary	TAL Metals
7-B5	Primary	TAL Metals
5-B2	Primary	TAL Metals
5-B5	Primary	TAL Metals
5-B6	Primary	TAL Metals
5B-C3	Primary	TAL Metals
5-C3	Primary	TAL Metals
4-B3	Primary	TAL Metals
4-C6	Primary	TAL Metals
3-B3	Primary	TAL Metals
3-C4	Primary	TAL Metals
Trib-3	Primary	TAL Metals
2-B2	Primary	TAL Metals
1B-R2	Reserve for 1-B2	TAL Metals
1-R5	Reserve for 1-C1	TAL Metals
1-R8	Reserve for 1-C3	TAL Metals

References

CH2M Hill, 2013, Quality Assurance Project Plan, Upper, Columbia River, Phase 2 Sediment Study, Split Samples Metal Analysis. September 2013

TAI, 2013. Final Quality Assurance Project Plan for the Phase 2 Sediment Study. Prepared by Exponent and HDR HydroQual for Teck American Incorporated, Spokane, WA. March 2013.

Change Request Form
Upper Columbia River Phase 2 Sediment Study

Page 1 of 1 Change No.: 5

CHANGE REQUEST:

Applicable Reference:	Quality Assurance Project Plan for the Phase 2 Sediment Study
Description of Change:	The following changes will be made to the use of peepers in the sediment bioassays: 1. Peepers will be deployed on Day -1 instead of Day 0. 2. Peepers in the 21-day Hyalella test will all be deployed at Day -1, retieving a group from one set of beakers on Day 7 and another at approximately Day 21. Peepers will be examined during retrieval for indication of fouling of the membranes.
Reason for Change:	1. Early deployment will enable insertion of the peepers into the beakers as they are being filled with sediment, making deployment much more efficient. 2. The QAPP requires (Figure B4-1) deployment of the second set on Day 14, but this would necessarily disturbed any oxygen gradient that was setting up in the sediment. Deploying all peepers during test set up will eliminate this problem.
Impact on Present and Completed Work:	The data on porewater metals will be more accurate as a result of these changes in peeper deployment times.

Requested By: [signature] (Scientist) Date: 1/14/14

Acknowledged By: [signature] Jeffrey Colsifas (PER) Date: 1/14/2014

APPROVAL

Task Manager: afairbrother@exponent.com Digitally signed by afairbrother@exponent.com DN: cn=afairbrother@exponent.com Date: 2014.01.14 13:57:44 -07'00' Anne Fairbrother (Exponent) Date:

TAI Project Manager: [signature] Kris McCaig (TAI) Date: 1/17/2014

EPA Project Manager: [signature] Laura Buelow (EPA) Date: 1/21/14

Change Request Form
Upper Columbia River Phase 2 Sediment Study

Page 1 of 1		Change No. : 6	

CHANGE REQUEST:

Applicable Reference:	Quality Assurance Project Plan for the Phase 2 Sediment Study
Description of Change:	The SOPs for Hyalella and Chironomid bioassays will all be amended to state that *all organisms will be placed in a drying oven at 60 °C for 24 hours*, after which they will be weighed and their dry weight recorded. The Hyalella SOP currently calls for drying at 100 °C for 24 hours The Chironomid SOP currently calls for drying at 105 °C for 48 hours
Reason for Change:	This will standardize the test protocols between the two organisms and ensure that PER and the Army Corps ERDC laboratory are using the same temperature and time in the drying oven. The ERDC protocols already call for drying the organisms at 60 °C for 24 hours.
Impact on Present and Completed Work:	There should be no impact on the results as the organisms will be completely dry after 24 hours at any of these temperatures. The ASTM and EPA protocols simply state that the organisms should be dried at temperatures between 60 and 90 °C until they reach a constant weight; that time generally is significanly less than 24 hours.

Requested By: [signature] (Scientist) Date: 1/24/14

Acknowledged By: [signature] Jeffrey Cotsifas (PER) Date: 1/24/14

APPROVAL

Task Manager: [signature] Anne Fairbrother (Exponent) Date: 1/24/14

TAI Project Manager: [signature] Kris McCaig (TAI) Date: 1/24/14.

EPA Project Manager: [signature] Laura Buelow (EPA) Date: 1/27/14

Change Request Form
Upper Columbia River Phase 2 Sediment Study

Page 1 of 1 Change No. : 7

CHANGE REQUEST:

Applicable Reference:	Quality Assurance Project Plan for the Phase 2 Sediment Study
Description of Change:	The initiation of Batch 2 will be delayed by 1 week. This will necessarily push the initiation of Batch 3 back by 1 week as well. The revised schedule is attached and incorporated as part of this Change Request.
Reason for Change:	Pacific Ecorisk did not hatch out sufficient numbers of Chironomus to start the bioassay on the date planned, with 4-day-old organisms. Because of the necessity for sending samples to ALS for chemical analyses on certain days of the week, the test initiation day is constrained such that the simplist course of action is to just delay by 1 week.
Impact on Present and Completed Work:	There should be no impact on the results the tests will proceed as planned, just a week later. Site visits for oversight of the testing will need to be revised accordingly.

Requested By: [signature] (Scientist) Date: 2/18/15

Acknowledged By: [signature] Jeffrey Cousifas (PER) Date: 2/18/15

APPROVAL

Task Manager: [signature] Anne Fairbrother (Exponent) Date: 2/18/15

TAI Task Manager: [signature] Dave Enos (TAI) Date: 2/19/15

TAI Project Manager: [signature] Kris McCaig (TAI) Date: 2/19/15

EPA Project Manager: [signature] Laura Buelow (EPA) Date: 2/27/15

From: **Jeffrey Cotsifas** cotsifas@pacificecorisk.com
Subject: Fwd: Excess organisms
Date: October 22, 2015 at 4:24 PM
To:

From: Anne Fairbrother <afairbrother@exponent.com>
Subject: Excess organisms
Date: February 26, 2014 at 5:34:01 AM PST
To: "'Jeffrey Cotsifas'" <cotsifas@pacificecorisk.com>
Cc: Kris McCaig <Kris.McCaig@teck.com>, Cristy Kessel <ckessel@exponent.com>

Jeff:

After another round of discussion, there is agreement among the technical team for you to use the replicates that have >10 organisms at the end of a test. Simply average them in with the others. So if you have 11 organisms, you will have 110% survival. The biomass is what it is, although the average per organism would be calculated with the appropriate denominator (e.g., 11). The team felt that there was no reason to throw out perfectly good data and that one needs to simply take what is there. Since there are only a few such replicates, the overall impact on the study will be small, regardless.

Please let me know if you have questions. Thanks!
Anne
++++++++++++++++++++++++++++

Anne Fairbrother, D.V.M., Ph.D.
Principal Scientist and Office Director

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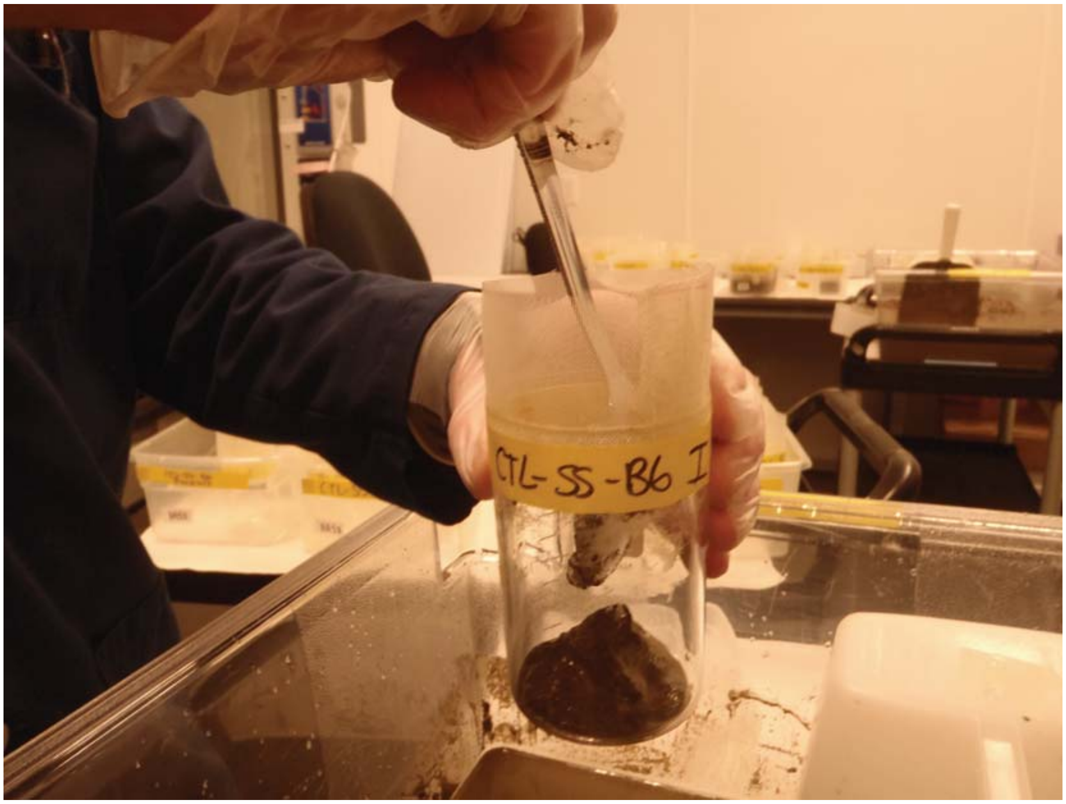
Appendix B

Study Photo Documentation

Homogenization of sediment consisting primarily of sand.

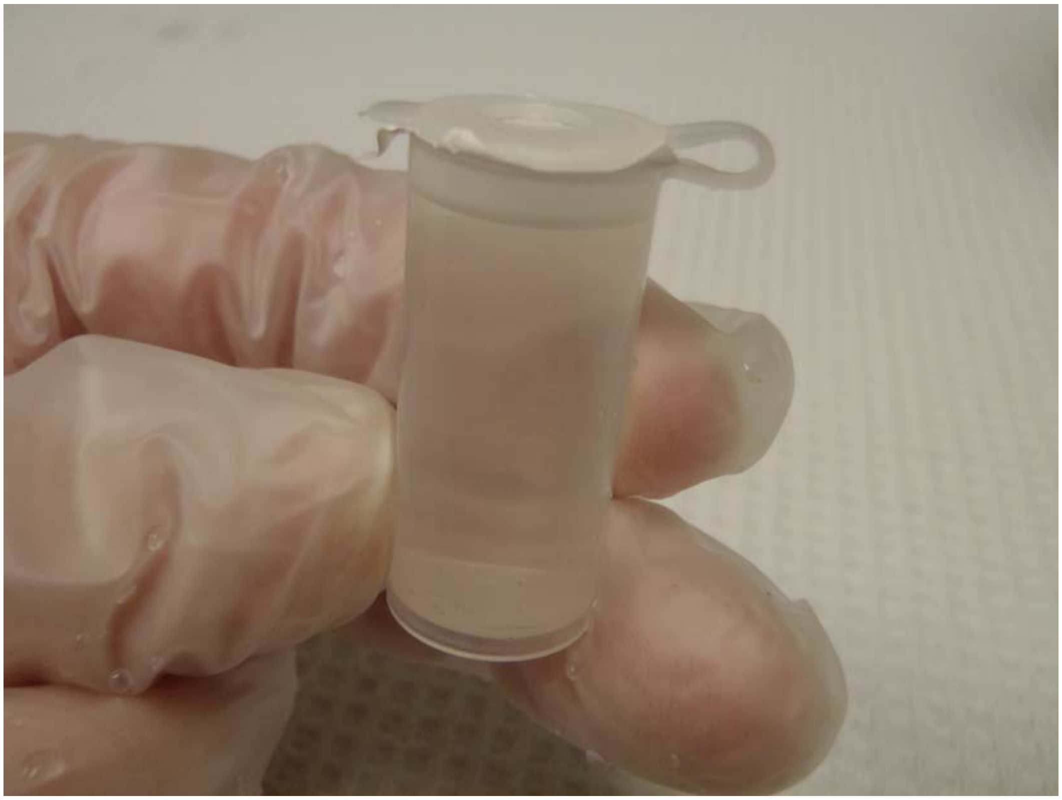

Homogenization of sediment consisting primarily of silt and clay.



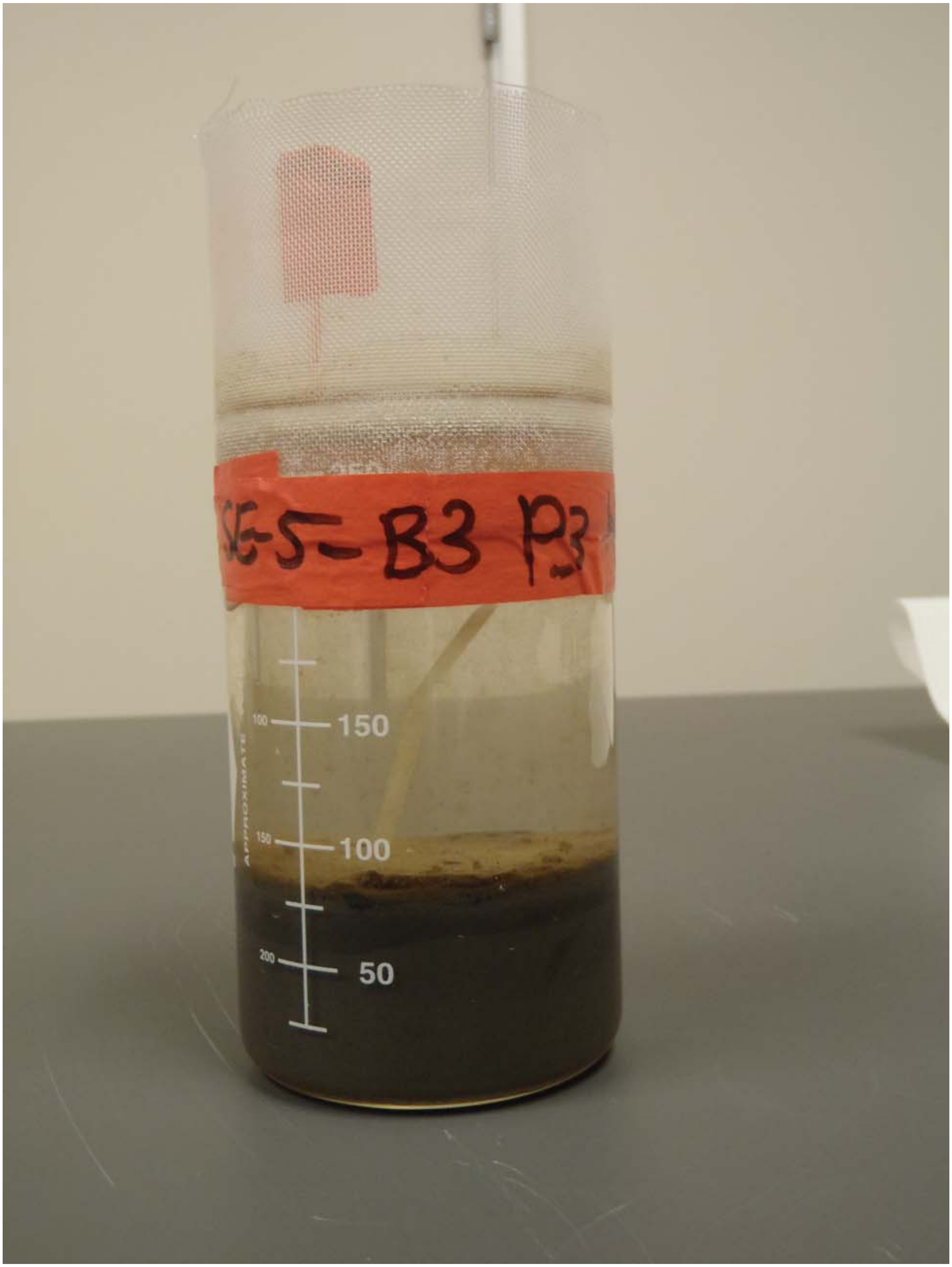
Loading "sand" sediment into test replicate.

Loading "silt and clay" sediment into test replicate.

Addition of overlying water to test replicates at Day -1.



Peeper

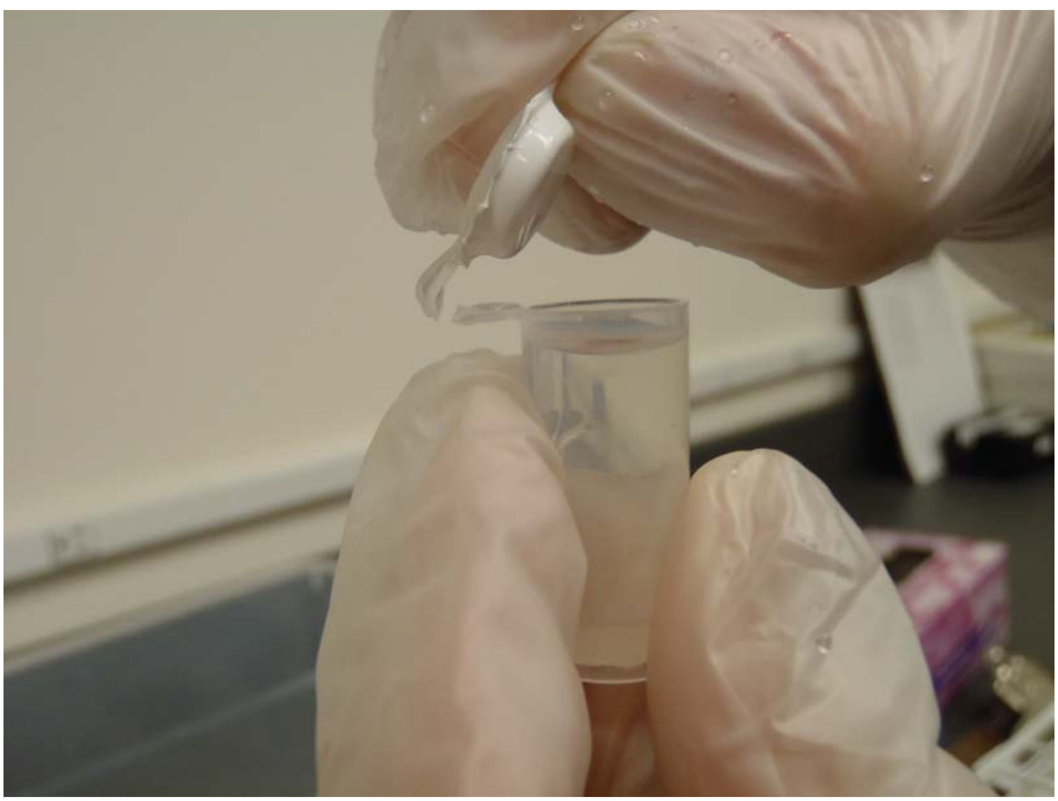


Peeper in test beaker.

Peeper retrieval

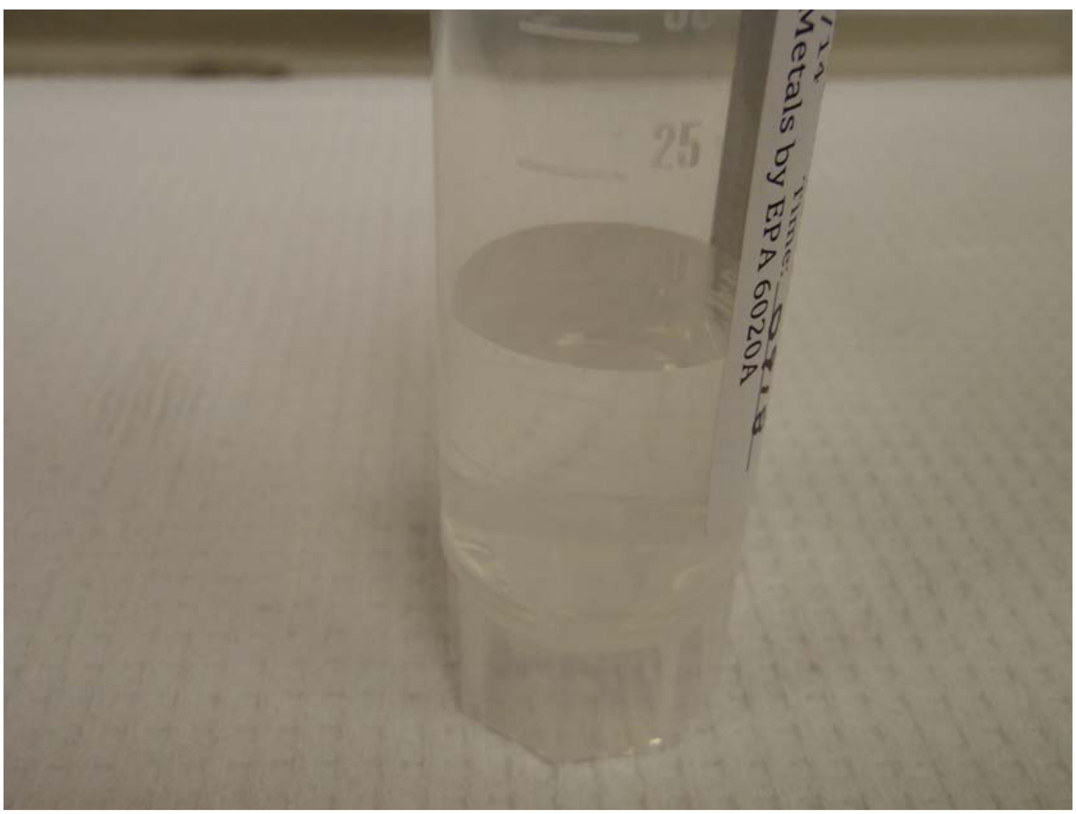

Peeper rinsing

Cleaned peeper



Removal of peeper top.

Collecting porewater sample from peeper.



Final peeper porewater sample.

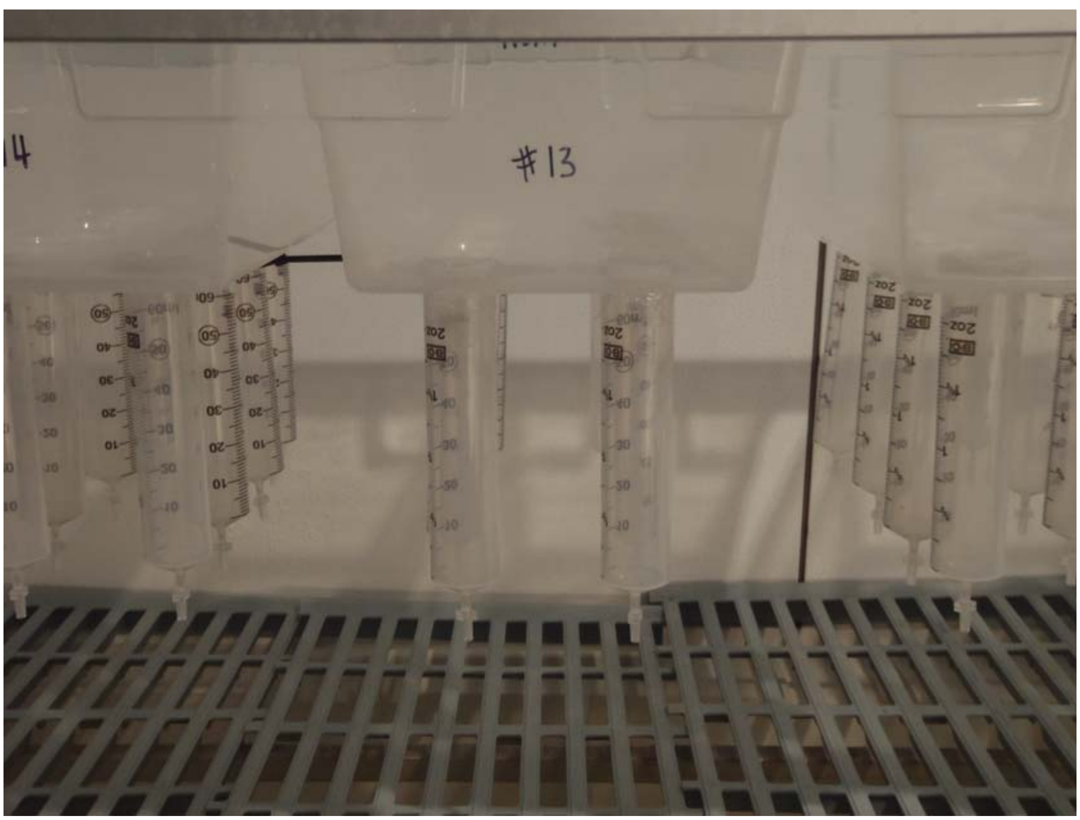
Example of AVS and SEM sample after addition of nitrogen gas.

Freezing AVS and SEM samples after collection.

Demonstration of shipping and handling of AVS and SEM sample jars that cracked during freezing -Step 1:
Jar placed in initial ziploc bag which is then purged with Nitrogen.

Demonstration of shipping and handling of AVS and SEM sample jars that cracked during freezing -Step 2:
Jar and initial Ziploc bag placed into second ziploc bag which is also purged with nitrogen.

Demonstration of shipping and handling of AVS and SEM sample jars that cracked during freezing -Step 3: Bagged sample placed into 2-L jar, which is purged with nitrogen.



Zumwalt diluter

Zumwalt diluter (overhead).

Zumwalt diluters in test room.

Larval stage *Chironomus dilutus*.
http://www.portlandharborcag.info/sites/default/files/Portland%20Harbor%20final%20BERA%20presentation%20to%20CAG%20short%20form%20070914s.pdf

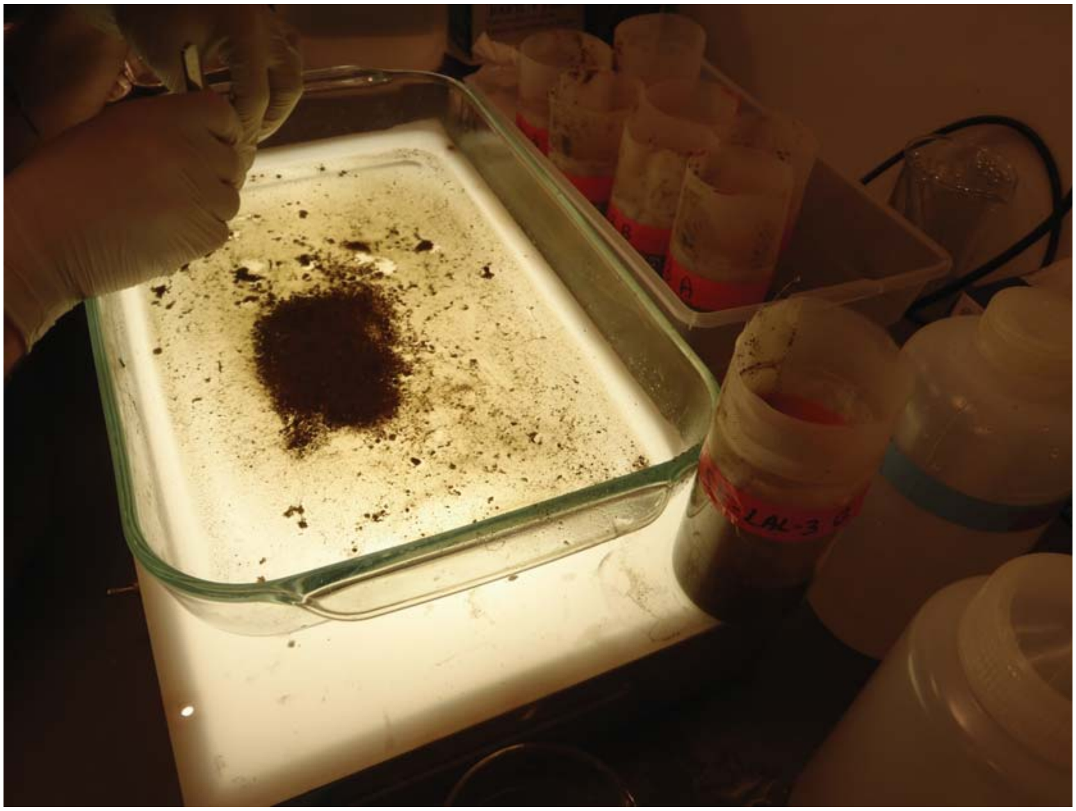
Pupal stage Chironomid.
http://midge.cfans.umn.edu/vsmivp/diptera/chironomidae/

Chironomid adults (male on left [note “fuzzy” antennae], female on right).
https://www2.uef.fi/documents/1054012/1063814/ristola.pdf/eba25905-bf42-4b30-843d-1e88b11ebc76

C. dilutus Reproduction/Oviposition (R/O) chamber.

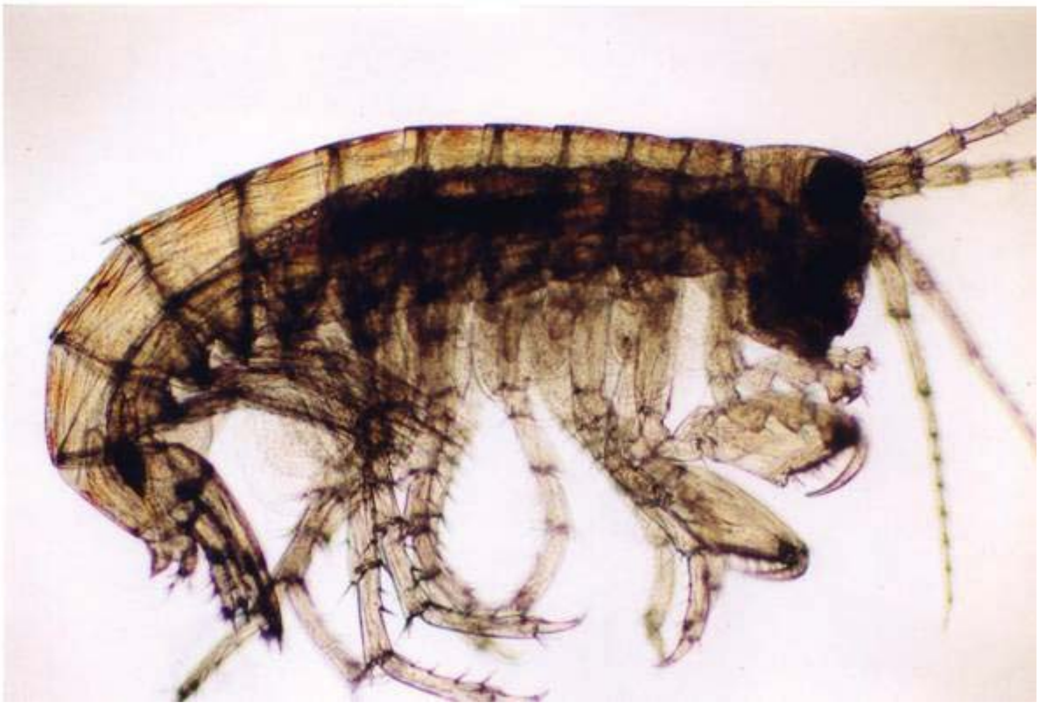
C. dilutus R/O chambers in test room.

Chironomid egg cases.
https://jeremybiggs.wordpress.com/2009/03/page/3/



Terminating *C. dilutus* Test (1 of 2).

Terminating *C. dilutus* Test (2 of 2).



Adult male *Hyallela azteca* showing enlarged gnathopod.
http://www.aslo.org/photopost/showphoto.php/photo/398/title/hyalella-azteca-amphipod/cat/518

Adult female *Hyallela azteca* – note absence of enlarged gnathopod.
http://www.aslo.org/photopost/showphoto.php/photo/399/title/hyalella-azteca-female-amphipod/cat/518

Terminating *H. azteca* Test (1 of 2).

Terminating *H. azteca* Test (2 of 2) – Transfer of organisms to weighing pans.

Appendix C

Chain-of-Custody Records and Sediment Log-in Sheets for the Upper Columbia River Site Sediment Samples Received on December 18 and 19, 2013, and January 7, 2014 and the U.S. Army Corps of Engineers Engineer and Research Development Center Control Sediment Received January 14, 2014, and Short-Term Test Organism Receipt Records

(1)

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534

(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

Results To:	Teck American Incorporated	**Invoice To:**	Exponent, Inc.
Address:	501 N. Riverpoint Blvd., Suite 300 Spokane, WA 99202	**Address:**	15375 SE 30th Place, Suite 250 Bellevue, WA 98007
Phone:	509-623-4501	**Phone:**	425-519-8716
Attn:	Kris McCaig	**Attn:**	Anne Fairbrother
E-mail:	kris.mccaig@teck.com	**E-mail:**	afairbrother@exponent.com
Project Name:	UCR Phase 2 Sediment Study		
P.O.#/Ref:			

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Grab/Comp	Container Number	Container Type	28-d Hyallela Bioassay	10-d Chronomus Bioassay								
1	✓ SE-REF-10b	9/18/2013	1507	SED		1	5 Gallon Bucket	X	X								
2	✓ SE-8-B6	9/20/2013	1003	SED		1	5 Gallon Bucket	X	X								
3	✓ SE-6-R3	9/25/2013	1744	SED		1	5 Gallon Bucket	X	X								
4	✓ SE-3-R2	10/14/2013	1258	SED		1	5 Gallon Bucket	X	X								
5	✓ SE-3-R7	10/15/2013	1705	SED		1	5 Gallon Bucket	X	X								
6	✓ SE-2B-R1	10/17/2013	1343	SED		1	5 Gallon Bucket	X	X								
7	✓ SE-3-R1	10/14/2013 ~~10/13/1002~~ TJC 12/18/13	1139	SED		1	5 Gallon Bucket	X	X								
8	✓ SE-2-R3	10/18/2013	1236	SED		1	5 Gallon Bucket	X	X								
9	✓ SE-1-R2	10/21/2013	1450	SED		1	5 Gallon Bucket	X	X								
10	✓ SE-1-R1	10/21/13	1140	SED		1	5 Gallon Bucket	X	X								

Samples collected by:

Comments/Special Instruction:

RELINQUISHED BY:	**RECEIVED BY:**
Signature: [signature]	**Signature:** gina franco
Print: Dustin Moore	**Print:** GINA FRANCO
Organization: ALS-Kelso	**Organization:** URS CORP
Date: 12/16/13 **Time:** 1000	**Date:** 12-16-13 **Time:** 1000
RELINQUISHED BY:	**RECEIVED BY:**
Signature: gina franco	**Signature:** [signature]
Print: GINA FRANCO	**Print:** M. M'Elroy
Organization: URS CORP	**Organization:** PER
12-18-13 11:17	12-18-13 1117

(2)

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2250 Cordelia Rd., Fairfield, CA 94534
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CHAIN-OF-CUSTODY RECORD

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Phone:	509-623-4501	**Phone:**	425-519-8716
Attn:	Kris McCaig	**Attn:**	Anne Fairbrother
E-mail:	kris.mccaig@teck.com	**E-mail:**	afairbrother@exponent.com
Project Name:	UCR Phase 2 Sediment Study		
P.O.#/Ref:			

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Grab/Comp	Container Number	Container Type	28-d Hyallela Bioassay	10-d Chronomus Bioassay								
1 ✓	SE-REF-2	10/1/2013	1400	SED		1	5 Gallon Bucket	X	X								
2 ✓	SE-REF-3	10/1/2013	1420	SED		1	5 Gallon Bucket	X	X								
3 ✓	SE-REF-1	10/4/2013	1246	SED		1	5 Gallon Bucket	X	X								
4 ✓	SE-4-B3	10/5/2013	1333	SED		1	5 Gallon Bucket	X	X								
5 ✓	~~SE-4B-5~~ SE-4-B5 gmf 12-16-13	10/5/2013	0915	SED		1	5 Gallon Bucket	X	X								
6 ✓	SE-4-B2	10/5/2013	1225	SED		1	5 Gallon Bucket	X	X								
7 ✓	SE-4-B4	10/5/2013	1451	SED		1	5 Gallon Bucket	X	X								
8 ✓	SE-TRIB-2	10/7/2013	1130	SED		1	5 Gallon Bucket	X	X								
9 ✓	SE-4-B1	10/7/2013	1440	SED		1	5 Gallon Bucket	X	X								
10 ✓	SE-4-B6	10/8/2013	1026	SED		1	5 Gallon Bucket	X	X								

Samples collected by:

Comments/Special Instruction:

RELINQUISHED BY:		**RECEIVED BY:**	
Signature:	[signature]	**Signature:**	gina franco
Print:	Dustin Moore	**Print:**	GINA FRANCO
Organization:	ALS-Kelso	**Organization:**	URS CORP
Date: 12/16/13	**Time:** 1000	**Date:** 12-16-13	**Time:** 1000

RELINQUISHED BY:		**RECEIVED BY:**	
Signature:	gina franco	**Signature:**	[signature]
Print:	GINA FRANCO	**Print:**	M. McElroy
Organization:	URS CORP	**Organization:**	PER
12-18-13	11:17	12-18-13	1117

(3)

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Attn:	Kris McCaig
E-mail:	kris.mccaig@teck.com
Invoice To:	Exponent, Inc.
Address:	15375 SE 30th Place, Suite 250 Bellevue, WA 98007
Phone:	425-519-8716
Attn:	Anne Fairbrother
E-mail:	afairbrother@exponent.com
Project Name:	UCR Phase 2 Sediment Study
P.O.#/Ref:	

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Grab/ Comp	Container Number	Container Type	28-d Hyallela Bioassay	10-d Chronomus Bioassay
1	✓ SE-6-B4	9/26/2013	1032	SED		1	5 Gallon Bucket	X	X
2	✓ SE-REF-5	9/27/2013	1655	SED		1	5 Gallon Bucket	X	X
3	✓ SE-5-B5	9/27/2013	1045	SED		1	5 Gallon Bucket	X	X
4	✓ SE-5-B6	9/27/2013	1233	SED		1	5 Gallon Bucket	X	X
5	✓ SE-5-B4	9/27/2013	1436	SED		1	5 Gallon Bucket	X	X
6	✓ SE-5-B1	9/28/2013	1011	SED		1	5 Gallon Bucket	X	X
7	✓ SE-5-B2	9/28/2013	1125	SED		1	5 Gallon Bucket	X	X
8	✓ SE-REF-4	9/30/2013	1430	SED		1	5 Gallon Bucket	X	X
9	✓ SE-5-B3	9/30/2013	1350	SED		1	5 Gallon Bucket	X	X
10	✓ SE-TRIB-3	10/1/13	1100	SED		1	5 Gallon Bucket	X	X

Samples collected by:

Comments/Special Instruction:

RELINQUISHED BY:		RECEIVED BY:	
Signature:	[signature]	Signature:	gina franco
Print:	Dustin Moore	Print:	GINA FRANCO
Organization:	ALS-Kelso	Organization:	URS CORP
Date: 12/16/13	Time: 1000	Date: 12-16-13	Time: 1000
RELINQUISHED BY:		RECEIVED BY:	[signature]
Signature:	gina franco	Signature:	[signature]
Print:	GINA FRANCO	Print:	M. McElroy
Organization:	URS CORP	Organization:	PER
12-18-13	11:17	12-18-13	11:17

(4)

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CHAIN-OF-CUSTODY RECORD

Results To:	Teck American Incorporated	**Invoice To:**	Exponent, Inc.
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	Spokane, WA 99202		Bellevue, WA 98007
Phone:	509-623-4501	**Phone:**	425-519-8716
Attn:	Kris McCaig	**Attn:**	Anne Fairbrother
E-mail:	kris.mccaig@teck.com	**E-mail:**	afairbrother@exponent.com
Project Name:	UCR Phase 2 Sediment Study		
P.O.#/Ref:			

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Grab/ Comp	Container Number	Container Type	28-d Hyalleia Bioassay	10-d Chronomus Bioassay								
1	√ SE-G-1	9/5/2013	1425	SED		1	5 Gallon Bucket	X	X								
2	√ SE-G-2	9/5/2013	1555	SED		1	5 Gallon Bucket	X	X								
3	√ SE-G-3	9/6/2013	0945	SED		1	5 Gallon Bucket	X	X								
4	√ SE-G-4	9/6/2013	1116	SED		1	5 Gallon Bucket	X	X								
5	√ SE-LAL-1	9/8/2013	1046	SED		1	5 Gallon Bucket	X	X								
6	√ SE-LAL-2	9/8/2013	1330	SED		1	5 Gallon Bucket	X	X								
7	√ SE-LAL-3	9/8/2013	1536	SED		1	5 Gallon Bucket	X	X								
8	√ SE-LAL-4	9/7/2013	1112	SED		1	5 Gallon Bucket	X	X								
9	√ SE-LAL-5	9/7/2013	1218	SED		1	5 Gallon Bucket	X	X								
10	√ SE-LAL-6	9/7/2013	1509	SED		1	5 Gallon Bucket	X	X								

Samples collected by:

Comments/Special Instruction:

RELINQUISHED BY:	**RECEIVED BY:**
Signature: [signature]	**Signature:** Gina Franco
Print: Dustin MoorE	**Print:** GINA FRANCO
Organization: ALS-Kelso	**Organization:** URS CORP
Date: 12/16/13 **Time** ### 1000	**Date:** 12-16-13 **Time:** 1000
RELINQUISHED BY:	**RECEIVED BY:**
Signature: Gina Franco	**Signature:** [signature]
Print: GINA FRANCO	**Print:** M. McElroy
Organization: URS CORP	**Organization:** PER
12-18-13 11:17	12-18-13 11:17

201/2084

(8)

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Results To:	Teck American Incorporated	**Invoice To:**	Exponent, Inc.
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E-mail:	kris.mccaig@teck.com	**E-mail:**	afairbrother@exponent.com
Project Name:	UCR Phase 2 Sediment Study		
P.O.#/Ref:			

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Grab/ Comp	Container Number	Container Type	28-d Hyallela Bioassay	10-d Chronomus Bioassay								
1	√ SE-8-B2	9/19/2013	1105	SED		1	5 Gallon Bucket	X	X								
2	√ SE-REF-9	9/19/2013	1525	SED		1	5 Gallon Bucket	X	X								
3	√ SE-8-B1	9/20/2013	1403	SED		1	5 Gallon Bucket	X	X								
4	√ SE-8-B4	9/19/2013	1249	SED		1	5 Gallon Bucket	X	X								
5	√ SE-8-B5	9/20/2013	1355	SED		1	5 Gallon Bucket	X	X								
6	√ SE-6-B5	9/24/2013	1244	SED		1	5 Gallon Bucket	X	X								
7	√ SE-6-B6	9/24/2013	1620	SED		1	5 Gallon Bucket	X	X								
8	√ SE-6-B2	9/25/2013	1140	SED		1	5 Gallon Bucket	X	X								
9	√ SE-6-B1	9/25/2013	1049	SED		1	5 Gallon Bucket	X	X								
10	√ SE-TRIB-1	9/26/13	1327	SED		1	5 Gallon Bucket	X	X								

Samples collected by:

Comments/Special Instruction:

RELINQUISHED BY:	**RECEIVED BY:**
Signature: [signature]	**Signature:** gina franco
Print: Dustin Moore	**Print:** GINA FRANCO
Organization: ALS-Kelso	**Organization:** URS CORP.
Date: 12/16/13 **Time:** 1000	**Date:** 12-16-13 **Time:** 1000
RELINQUISHED BY:	**RECEIVED BY:**
Signature: gina franco	**Signature:** [signature]
Print: GINA FRANCO	**Print:** M. McElroy
Organization: URS CORP	**Organization:** PER
12-18-13 11:17	12-18-13 1117

202/2084

6

Pacific EcoRisk

2250 Cordelia Rd., Fairfield, CA 94534

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CHAIN-OF-CUSTODY RECORD

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Address:	501 N. Riverpoint Blvd., Suite 300	**Address:**	15375 SE 30th Place, Suite 250
	Spokane, WA 99202		Bellevue, WA 98007
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E-mail:	kris.mccaig@teck.com	**E-mail:**	afairbrother@exponent.com
Project Name:	UCR Phase 2 Sediment Study		
P.O.#/Ref:			

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Grab/ Comp	Container Number	Container Type	28-d Hyallela Bioassay	10-d Chronomus Bioassay								
1 ✓	SE-7-B3	9/13/2013	1020	SED		1	5 Gallon Bucket	X	X								
2 ✓	SE-REF-7	9/13/2013	1635	SED		1	5 Gallon Bucket	X	X								
3 ✓	SE-7-B1	9/13/2013	1514	SED		1	5 Gallon Bucket	X	X								
4 ✓	SE-7-B5	9/13/2013	1410	SED		1	5 Gallon Bucket	X	X								
5 ✓	SE-7-B2	9/13/2013	0953	SED		1	5 Gallon Bucket	X	X								
6 ✓	SE-7-B4	9/13/2013	1138	SED		1	5 Gallon Bucket	X	X								
7 ✓	SE-7-B6	9/13/2013	1316	SED		1	5 Gallon Bucket	X	X								
8 ✓	SE-REF-6	9/14/2013	1246	SED		1	5 Gallon Bucket	X	X								
9 ✓	SE-REF-8	9/16/2013	1531	SED		1	5 Gallon Bucket	X	X								
10 ✓	SE-8-B3	9/19/13	1516	SED		1	5 Gallon Bucket	X	X								

Samples collected by:

Comments/Special Instruction:

RELINQUISHED BY:		RECEIVED BY:	
Signature:	[signature]	**Signature:**	gina franco
Print:	Dustin Moore	**Print:**	GINA FRANCO
Organization:	ALS-Kelso	**Organization:**	URS CORP.
Date: 12/16/13	**Time:** 1000	**Date:** 12-16-13	**Time:** 1000

RELINQUISHED BY:		RECEIVED BY:	
Signature:	gina franco	**Signature:**	[signature]
Print:	GINA FRANCO	**Print:**	M. McElroy
Organization:	URS CORP	**Organization:**	PER
12-18-13	11:17	12-18-13	11:17

203/2084

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Project Name:	UCR Phase 2 Sediment Study		
P.O.#/Ref:			

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Grab/ Comp	Container Number	Container Type	28-d Hyallela Bioassay	10-d Chronomus Bioassay									
1	✓ SE-TRIB-5	10/9/2013	1453	SED		1	5 Gallon Bucket	X	X									
2	✓ SE-TRIB-4	10/9/2013	1342	SED		1	5 Gallon Bucket	X	X									
3	✓ SE-TRIB-6	10/10/2013	1225	SED		1	5 Gallon Bucket	X	X									
4	✓ SE-3-B3	10/16/2013	1138	SED		1	5 Gallon Bucket	X	X									
5	✓ SE-1-B5	10/18/2013	1754	SED		1	5 Gallon Bucket	X	X									
6	✓ SE-2-B2	10/23/2013	1417	SED		1	5 Gallon Bucket	X	X									
7	✓ SE-2-B1	10/23/2013	1145	SED		1	5 Gallon Bucket	X	X									
8																		
9																		
10																		

Samples collected by:

Comments/Special Instruction:

RELINQUISHED BY:		RECEIVED BY:	
Signature:	[signature]	**Signature:**	Gina Franco
Print:	Dustin Moore	**Print:**	GINA FRANCO
Organization:	ALS-Kelso	**Organization:**	URS CORP.
Date: 12/16/13	**Time:** 1000	**Date:** 12-16-13	**Time:** 1000

RELINQUISHED BY:		RECEIVED BY:	
Signature:	Gina Franco	**Signature:**	[signature]
Print:	GINA FRANCO	**Print:**	M. McElroy
Organization:	URS CORP	**Organization:**	PER
12-18-13	11:17	12-18-13	1117

(8)

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E-mail:	kris.mccaig@teck.com	**E-mail:**	afairbrother@exponent.com
Project Name:	UCR Phase 2 Sediment Study		
P.O.#/Ref:			

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Grab/ Comp	Container Number	Container Type	28-d Hyallela Bioassay	10-d Chronomus Bioassay								
1	√ SE-1B-R2	10/22/2013	1408	SED		1	5 Gallon Bucket	X	X								
2	√ SE-3-R9	10/24/2013	1354	SED		1	5 Gallon Bucket	X	X								
3	√ SE-3-R8	10/24/2013	1206	SED		1	5 Gallon Bucket	X	X								
4																	
5																	
6																	
7																	
8																	
9																	
10																	

Samples collected by:

Comments/Special Instruction:

RELINQUISHED BY:	**RECEIVED BY:**
Signature: [signature]	**Signature:** gina franco
Print: Dustin Moore	**Print:** GINA FRANCO
Organization: ALS-Kelso	**Organization:** URS CORP.
Date: 12/16/13 **Time:** 1000	**Date:** 12-16-13 **Time:** 1000

RELINQUISHED BY:	**RECEIVED BY:**
Signature: gina franco	**Signature:** [signature]
Print: GINA FRANCO	**Print:** M. McElroy
Organization: URS CORP	**Organization:** PER
12-18-13 11:17	12-18-13 11:17

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Project Name:	UCR Phase 2 Sediment Study		
P.O.#/Ref:			

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Grab/ Comp	Container Number	Container Type	28-d Hyallela Bioassay	10-d Chronomus Bioassay									
1	SE-2-R1	10/23/2013	0950	Sed	Grab	1	5-gal	X	X									
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

Samples collected by:

Comments/Special Instruction:

RELINQUISHED BY:		RECEIVED BY:	
Signature: [signature]		Signature: [signature]	
Print: Les Kennedy		Print: Robert Schaadt	
Organization: ALS		Organization: PER	
Date: 12/18/2013	Time: 1210	Date: 12/19/13	Time: 1150
RELINQUISHED BY:		RECEIVED BY:	
Signature:		Signature:	
Print:		Print:	
Organization:		Organization:	
Date:	Time:	Date:	Time:

*Example Matrix Codes: (EFF - Effluent) (FW = Freshwater); (SW = Saltwater); (WW = Wastewater); (STRMW = Stormwater); (SED = Sediment); or other

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

Results To:	Teck American Incorporated	**Invoice To:**	Exponent, Inc.
Address:	501 N. Riverpoint Blvd., Suite 300 Spokane, WA 99202	**Address:**	15375 SE 30th Place, Suite 250 Bellevue, WA 98007
Phone:	509-623-4501	**Phone:**	425-519-8716
Attn:	Kris McCaig	**Attn:**	Anne Fairbrother
E-mail:	kris.mccaig@teck.com	**E-mail:**	afairbrother@exponent.com
Project Name:	UCR Phase 2 Sediment Study		
P.O.#/Ref:			

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Grab/ Comp	Container Number	Container Type	28-d Hyallela Bioassay	10-d Chronomus Bioassay									
1	SE-3-R8	10/24/2013	1206	Sed.	Grab	1	5-gal	X	X									
2																		
3																		
4																		
5																		
6																		

Samples collected by:

Comments/Special Instruction:

RELINQUISHED BY:		RECEIVED BY:	
Signature: Karla Smith		Signature: [signature]	
Print: Karla Smith		Print: Robert Schoandt	
Organization: ALS-Kelso		Organization: PER	
Date: 1/6/14	Time: 1200	Date: 1-7-14	Time: 1215

RELINQUISHED BY:		RECEIVED BY:	
Signature:		Signature:	
Print:		Print:	
Organization:		Organization:	
Date:	Time:	Date:	Time:

*Example Matrix Codes: (EFF - Effluent) (FW = Freshwater); (SW = Saltwater); (WW = Wastewater); (STRMW = Stormwater); (SED = Sediment); or other

USAE WATERWAYS EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME: Upper Columbia River

SAMPLERS: (Signature) Jacob Stanley [signature]

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS							REMARKS
1-13-14	1200	ERDC (UMFS) Control Sed.	1							5 gallon bucket of control sediment

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
[signature]	1-13-14 11:35	[signature] 1/14/14 1135 Robert Schandt (PER)			

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Date /Time	Remarks

WES FORM 2196 R Nov 89 PREVIOUS EDITIONS OBSOLETE

USAE WATERWAYS EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME: Upper Columbia River

SAMPLERS: (Signature) [signature]

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS							REMARKS
3-12-14	14:42	ERDC UMFS Control	1							Sieved to 2mm

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
[signature]	3-13-14 0900	[signature] PER 3/14/14 1200			
Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Date /Time	Remarks	
				recd @ 4.7°C on ice	

WES FORM 2196 R Nov 89 PREVIOUS EDITIONS OBSOLETE

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-1-R1**

Sediment Sample Log-In	
Sample ID #	**33782**
Client Sample ID:	SE-1-R1
Date and Time of Sample Collection:	10/21/13 1140
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 ★
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: ★ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-3-R2**

Sediment Sample Log-In	
Sample ID #	**33783**
Client Sample ID:	SE-3-R2
Date and Time of Sample Collection:	10/14/13 1258
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.5
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * ~~truck~~ fridge therm = 4.3 °C . 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible] Date: 12/18/13 Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-4-B6**

Sediment Sample Log-In	
Sample ID #	**33784**
Client Sample ID:	SE-4-B6
Date and Time of Sample Collection:	10/8/13 1026
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.4
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx 3.5 g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-5-B1**

Sediment Sample Log-In	
Sample ID #	**33785**
Client Sample ID:	SE-5-B1
Date and Time of Sample Collection:	9/28/13 1011
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.6
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-6-B6**

Sediment Sample Log-In	
Sample ID #	**33786**
Client Sample ID:	SE-6-B6
Date and Time of Sample Collection:	9/24/13 1620
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3/5.6*
Sample Temp (°C):	5.4
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-6-R3**

Sediment Sample Log-In	
Sample ID #	**33787**
Client Sample ID:	SE-6-R3
Date and Time of Sample Collection:	9/25/13 1744
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6★
Sample Temp (°C):	5.4
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: ★ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible] Date: 12/18/13 Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-8-B3**

Sediment Sample Log-In	
Sample ID #	**33788**
Client Sample ID:	SE-8-B3
Date and Time of Sample Collection:	9/19/13 1516
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[signature]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[signature]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6★
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: ★ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

	Sign-off:	Date:	Time:
This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	[signature]	12/18/13	1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-8-B4**

Sediment Sample Log-In	
Sample ID #	**33789**
Client Sample ID:	SE-8-B4
Date and Time of Sample Collection:	9/19/13 1249
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	+
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 ★
Sample Temp (°C):	5.6
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	n
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: ★ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible] Date: 12/18/13 Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-G-1**

Sediment Sample Log-In	
Sample ID #	**33790**
Client Sample ID:	SE-G-1
Date and Time of Sample Collection:	9/5/13 1425
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3/5.6*
Sample Temp (°C):	5.9
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.5 g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[illegible]	12/18/13	1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-REF-6**

Sediment Sample Log-In	
Sample ID #	**33791**
Client Sample ID:	SE-REF-6
Date and Time of Sample Collection:	9/14/13 1246
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 ★
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.75 g

Comments: ★ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-TRIB-4**

Sediment Sample Log-In	
Sample ID #	**33792**
Client Sample ID:	SE-TRIB-4
Date and Time of Sample Collection:	10/9/13 1342
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 ★
Sample Temp (°C):	5.8
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.75 g

Comments: ★ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-2B-R1**

Sediment Sample Log-In	
Sample ID #	**33793**
Client Sample ID:	SE-2B-R1
Date and Time of Sample Collection:	10/17/13 1343
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[initials]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[initials]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.75g

Comments: * truck fridge therm. = 4.3 °C. 5.6 °C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [initials] Date: 12/18/13 Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-4-B2**

Sediment Sample Log-In	
Sample ID #	**33794**
Client Sample ID:	SE-4-B2
Date and Time of Sample Collection:	10/5/13 1225
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.8
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5 g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1440

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-4-B4**

Sediment Sample Log-In	
Sample ID #	**33795**
Client Sample ID:	SE-4-B4
Date and Time of Sample Collection:	10/5/13 1451
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	-
Sample Logged in By:	mm
Temperature Blank (°C):	-
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.8
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	-
Type of Container:	5g bucket
Sample Volume:	approx 2.5 g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-5-B3**

Sediment Sample Log-In	
Sample ID #	**33796**
Client Sample ID:	SE-5-B3
Date and Time of Sample Collection:	9/30/13 1350
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.4
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-6-B5**

Sediment Sample Log-In	
Sample ID #	**33797**
Client Sample ID:	SE-6-B5
Date and Time of Sample Collection:	9/24/13 1244
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[signature]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[signature]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 ★
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.5 g

Comments: ★ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[signature]	12/18/13	1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-LAL-1**

Sediment Sample Log-In	
Sample ID #	**33798**
Client Sample ID:	SE-LAL-1
Date and Time of Sample Collection:	9/8/13 1046
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[initials]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	—
Sample Logged in By:	[initials]
Temperature Blank (°C):	—
If No Temp Blank, Cooler Temp (°C):	9.3/5.6 *
Sample Temp (°C):	5.9
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	—
Type of Container:	5g bucket
Sample Volume:	approx. 3.75g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [initials] Date: 12/18/13 Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-LAL-2**

Sediment Sample Log-In	
Sample ID #	**33799**
Client Sample ID:	SE-LAL-2
Date and Time of Sample Collection:	9/8/13 1330
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3/5.6 ★
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: ★ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible] Date: 12/18/13 Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-LAL-3**

Sediment Sample Log-In	
Sample ID #	**33800**
Client Sample ID:	SE-LAL-3
Date and Time of Sample Collection:	9/8/13 1536
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mn
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	—
Sample Logged in By:	mn
Temperature Blank (°C):	—
If No Temp Blank, Cooler Temp (°C):	4.3/5.6 ★
Sample Temp (°C):	5.8
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	—
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: ★truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mn	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-LAL-6**

Sediment Sample Log-In	
Sample ID #	**33801**
Client Sample ID:	SE-LAL-6
Date and Time of Sample Collection:	9/7/13 1509
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: *truck fridge therm = 4.3 °C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-REF-4**

Sediment Sample Log-In	
Sample ID #	**33802**
Client Sample ID:	SE-REF-4
Date and Time of Sample Collection:	9/30/13 1430
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3g

Comments: * truck fridge therm = 4.3 °C. 5.6 °C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-REF-8**

Sediment Sample Log-In	
Sample ID #	**33803**
Client Sample ID:	SE-REF-8
Date and Time of Sample Collection:	9/16/13 1531
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	MM
Chain of Custody present:	y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	MM
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3/5.6 ★
Sample Temp (°C):	5.8
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx 3.5g

Comments: ★truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	MM	12/18/13	1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-REF-9**

Sediment Sample Log-In	
Sample ID #	**33804**
Client Sample ID:	SE-REF-9
Date and Time of Sample Collection:	9/19/13 1525
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3/5.6 ★
Sample Temp (°C):	5.8
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	-
Type of Container:	5g bucket
Sample Volume:	approx 1.25g

Comments: ★ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-2-R3**

Sediment Sample Log-In	
Sample ID #	**33805**
Client Sample ID:	SE-2-R3
Date and Time of Sample Collection:	10/18/13 1236
Sample Collected By:	WRS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.6
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	mm	12/18/13	1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-3-R1**

Sediment Sample Log-In	
Sample ID #	**33806**
Client Sample ID:	SE-3-R1
Date and Time of Sample Collection:	10/13/13 1139
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-3-R8**

Sediment Sample Log-In	
Sample ID #	**33807**
Client Sample ID:	SE-3-R8
Date and Time of Sample Collection:	10/24/13 1206
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[signature]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[signature]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.8
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 2.5 g

Comments: *truck fridge therm = 4.3°C. 5.6°C measured on wall therm. carried in truck.

	Sign-off:	Date:	Time:
This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	[signature]	12/18/13	1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-5-B4**

Sediment Sample Log-In	
Sample ID #	**33808**
Client Sample ID:	SE-5-B4
Date and Time of Sample Collection:	9/27/13 1436
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.6
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3 °C. 5.6 °C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-6-B4**

Sediment Sample Log-In	
Sample ID #	**33809**
Client Sample ID:	SE-6-B4
Date and Time of Sample Collection:	9/26/13 1032
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	-
Sample Logged in By:	[illegible]
Temperature Blank (°C):	-
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 ★
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	-
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: ★ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-7-B2**

Sediment Sample Log-In	
Sample ID #	**33810**
Client Sample ID:	SE-7-B2
Date and Time of Sample Collection:	9/13/13 953
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[signature]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[signature]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [signature] Date: 12/18/13 Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-LAL-4**

Sediment Sample Log-In	
Sample ID #	**33811**
Client Sample ID:	SE-LAL-4
Date and Time of Sample Collection:	9/7/13 1112
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	—
Sample Logged in By:	mm
Temperature Blank (°C):	—
If No Temp Blank, Cooler Temp (°C):	4.3/5.6 *
Sample Temp (°C):	6.0
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	—
Type of Container:	5g bucket
Sample Volume:	approx. 3.5g

Comments: *truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm Date: 12/18/13 Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-REF-1**

Sediment Sample Log-In	
Sample ID #	**33812**
Client Sample ID:	SE-REF-1
Date and Time of Sample Collection:	10/4/13 1246
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.5
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-REF-10b**

Sediment Sample Log-In	
Sample ID #	**33813**
Client Sample ID:	SE-REF-10b
Date and Time of Sample Collection:	9/18/13 1507
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx 3.5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-REF-3**

Sediment Sample Log-In	
Sample ID #	**33814**
Client Sample ID:	SE-REF-3
Date and Time of Sample Collection:	10/1/13 1420
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	MM
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	MM
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.6
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.75g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: MM	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-REF-7**

Sediment Sample Log-In	
Sample ID #	**33815**
Client Sample ID:	SE-REF-7
Date and Time of Sample Collection:	9/13/13 1635
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.8
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-TRIB-3**

Sediment Sample Log-In	
Sample ID #	**33816**
Client Sample ID:	SE-TRIB-3
Date and Time of Sample Collection:	10/1/13 1100
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.5
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.5g

Comments: *truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-1-B5**

Sediment Sample Log-In	
Sample ID #	**33817**
Client Sample ID:	SE-1-B5
Date and Time of Sample Collection:	10/18/13 17:54
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 11:17
Sample Received By:	MM
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	-
Sample Logged in By:	MM
Temperature Blank (°C):	—
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.6
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	—
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm =4.3°C. 5.6 °C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: MM	Date: 12/18/13	Time: 11:40

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-2-B1**

Sediment Sample Log-In	
Sample ID #	**33818**
Client Sample ID:	SE-2-B1
Date and Time of Sample Collection:	10/23/13 1145
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5 g bucket
Sample Volume:	approx. 5g.

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-3-B3**

Sediment Sample Log-In	
Sample ID #	**33819**
Client Sample ID:	SE-3-B3
Date and Time of Sample Collection:	10/16/13 1138
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3 °C. 5.6 °C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[illegible]	12/18/13	1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-3-R7**

Sediment Sample Log-In	
Sample ID #	**33820**
Client Sample ID:	SE-3-R7
Date and Time of Sample Collection:	10/15/13 1705
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx 3.75g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-5-B5**

Sediment Sample Log-In	
Sample ID #	**33821**
Client Sample ID:	SE-5-B5
Date and Time of Sample Collection:	9/27/13 1045
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 ★
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	-
Type of Container:	5g bucket
Sample Volume:	approx. 3.5g

Comments: ★ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible] Date: 12/18/13 Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-5-B6**

Sediment Sample Log-In	
Sample ID #	**33822**
Client Sample ID:	SE-5-B6
Date and Time of Sample Collection:	9/27/13 1233
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[initials]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	-
Sample Logged in By:	[initials]
Temperature Blank (°C):	-
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	-
Type of Container:	5g bucket
Sample Volume:	approx. 3.5g

Comments: * truck fridge therm = 4.3°C, 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[initials]	12/18/13	1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-7-B3**

Sediment Sample Log-In	
Sample ID #	**33823**
Client Sample ID:	SE-7-B3
Date and Time of Sample Collection:	9/13/13 1020
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[signature]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[signature]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.75g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[signature]	12/18/13	1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-7-B6**

Sediment Sample Log-In	
Sample ID #	**33824**
Client Sample ID:	SE-7-B6
Date and Time of Sample Collection:	9/13/13 1316
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	-
Sample Logged in By:	mm
Temperature Blank (°C):	-
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.6
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	-
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: *truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-G-4**

Sediment Sample Log-In	
Sample ID #	**33825**
Client Sample ID:	SE-G-4
Date and Time of Sample Collection:	9/6/13 1116
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[signature]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[signature]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.9
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx 3.5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[signature]	12/18/13	1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-REF-2**

Sediment Sample Log-In	
Sample ID #	**33826**
Client Sample ID:	SE-REF-2
Date and Time of Sample Collection:	10/1/13 1400
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.6
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5 g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-TRIB-2**

Sediment Sample Log-In	
Sample ID #	**33827**
Client Sample ID:	SE-TRIB-2
Date and Time of Sample Collection:	10/7/13 1130
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[signature]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[signature]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3/5.6 *
Sample Temp (°C):	5.9
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [signature] Date: 12/18/13 Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-TRIB-5**

Sediment Sample Log-In	
Sample ID #	**33828**
Client Sample ID:	SE-TRIB-5
Date and Time of Sample Collection:	10/9/13 1453
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	MM
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	MM
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	-
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3 °C. 5.6 °C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: MM	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-2-B2**

Sediment Sample Log-In	
Sample ID #	**33829**
Client Sample ID:	SE-2-B2
Date and Time of Sample Collection:	10/23/13 1417
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.9
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.75g

Comments: * truck fridge therm = 4.3 °C. 5.6 °C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-3-R9**

Sediment Sample Log-In	
Sample ID #	**33830**
Client Sample ID:	SE-3-R9
Date and Time of Sample Collection:	10/24/13 1206
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.5g

Comments: * truck fridge therm. = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-4-B1**

Sediment Sample Log-In	
Sample ID #	**33831**
Client Sample ID:	SE-4-B1
Date and Time of Sample Collection:	10/7/13 1440
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[signature]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	-
Sample Logged in By:	[signature]
Temperature Blank (°C):	-
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	-
Type of Container:	5g bucket
Sample Volume:	approx. 3.5g

Comments: *truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [signature]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-5-B2**

Sediment Sample Log-In	
Sample ID #	**33832**
Client Sample ID:	SE-5-B2
Date and Time of Sample Collection:	9/28/13 1125
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.4
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-6-B1**

Sediment Sample Log-In	
Sample ID #	**33833**
Client Sample ID:	SE-6-B1
Date and Time of Sample Collection:	9/25/13 1049
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mr
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	-
Sample Logged in By:	mr
Temperature Blank (°C):	-
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	-
Type of Container:	5 g bucket
Sample Volume:	approx. 5 g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mr	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-7-B4**

Sediment Sample Log-In	
Sample ID #	**33834**
Client Sample ID:	SE-7-B4
Date and Time of Sample Collection:	9/13/13 1138
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-7-B5**

Sediment Sample Log-In	
Sample ID #	**33835**
Client Sample ID:	SE-7-B5
Date and Time of Sample Collection:	9/13/13 1410
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[signature]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[signature]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6*
Sample Temp (°C):	5.6
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.75g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [signature]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-8-B1**

Sediment Sample Log-In	
Sample ID #	**33836**
Client Sample ID:	SE-8-B1
Date and Time of Sample Collection:	9/20/13 1403
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-G-2**

Sediment Sample Log-In	
Sample ID #	**33837**
Client Sample ID:	SE-G-2
Date and Time of Sample Collection:	9/5/13 1555
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 ★
Sample Temp (°C):	5.9
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx 3.5g

Comments: ★ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-LAL-5**

Sediment Sample Log-In	
Sample ID #	**33838**
Client Sample ID:	SE-LAL-5
Date and Time of Sample Collection:	9/7/13 1218
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 ✱
Sample Temp (°C):	5.9
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: ✱ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-REF-5**

Sediment Sample Log-In	
Sample ID #	**33839**
Client Sample ID:	SE-REF-5
Date and Time of Sample Collection:	9/27/13 1655
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.6
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	-
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-TRIB-1**

Sediment Sample Log-In	
Sample ID #	**33840**
Client Sample ID:	SE-TRIB-1
Date and Time of Sample Collection:	9/26/13 1327
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3/5.6 ✱
Sample Temp (°C):	5.6
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: ✱ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-1B-R2**

Sediment Sample Log-In	
Sample ID #	**33841**
Client Sample ID:	SE-1B-R2
Date and Time of Sample Collection:	10/22/13 1408
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	MM
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	MM
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 ★
Sample Temp (°C):	5.4
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: ★ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: MM	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-1-R2**

Sediment Sample Log-In	
Sample ID #	**33842**
Client Sample ID:	SE-1-R2
Date and Time of Sample Collection:	10/21/13 1450
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	-
Sample Logged in By:	mm
Temperature Blank (°C):	-
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 ✱
Sample Temp (°C):	5.4
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	-
Type of Container:	5g bucket
Sample Volume:	approx 3.5g

Comments: ✱ truck fridge therm = 4.3 °C. 5.6 °C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-4-B3**

Sediment Sample Log-In	
Sample ID #	**33843**
Client Sample ID:	SE-4-B3
Date and Time of Sample Collection:	10/5/13 1333
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.6
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	-
Type of Container:	5g bucket
Sample Volume:	approx 3.75g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-4-B5**

Sediment Sample Log-In	
Sample ID #	**33844**
Client Sample ID:	SE-4-B5
Date and Time of Sample Collection:	10/5/13 915
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	-
Sample Logged in By:	mm
Temperature Blank (°C):	-
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	-
Type of Container:	5g bucket
Sample Volume:	approx. 3.75 g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-6-B2**

Sediment Sample Log-In	
Sample ID #	**33845**
Client Sample ID:	SE-6-B2
Date and Time of Sample Collection:	9/25/13 1140
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[signature]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[signature]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.6
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [signature]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-7-B1**

Sediment Sample Log-In	
Sample ID #	**33846**
Client Sample ID:	SE-7-B1
Date and Time of Sample Collection:	9/13/13 1514
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[signature]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[signature]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: *truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [signature] Date: 12/18/13 Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-8-B2**

Sediment Sample Log-In	
Sample ID #	**33847**
Client Sample ID:	SE-8-B2
Date and Time of Sample Collection:	9/25/13 1140
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm Date: 12/18/13 Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-8-B5**

Sediment Sample Log-In	
Sample ID #	**33848**
Client Sample ID:	SE-8-B5
Date and Time of Sample Collection:	9/20/13 1355
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3/5.6 *
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.5g

Comments: * truck fridge therm = 4.3 °C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[illegible]	12/18/13	1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-8-B6**

Sediment Sample Log-In	
Sample ID #	**33849**
Client Sample ID:	SE-8-B6
Date and Time of Sample Collection:	9/24/13 1620
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	mm
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	mm
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3 / 5.6 *
Sample Temp (°C):	5.5
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 5g

Comments: * truck fridge therm = 4.3 °C. 5.6 °C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-G-3**

Sediment Sample Log-In	
Sample ID #	**33850**
Client Sample ID:	SE-G-3
Date and Time of Sample Collection:	9/6/13 945
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3/5.6 *
Sample Temp (°C):	5.9
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.5g

Comments: * truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible] Date: 12/18/13 Time: 1140

Sediment Sample Log-In

Client: **Exponent** Project #: **20672**

Project Description: **UCR** Sample Description: **SE-TRIB-6**

Sediment Sample Log-In	
Sample ID #	**33851**
Client Sample ID:	SE-TRIB-6
Date and Time of Sample Collection:	10/10/13 1225
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/18/13 1117
Sample Received By:	[illegible]
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	–
Sample Logged in By:	[illegible]
Temperature Blank (°C):	–
If No Temp Blank, Cooler Temp (°C):	4.3/5.6 ☆
Sample Temp (°C):	5.7
Sample Shipped on Ice (Y/N):	no (shipped in fridge truck)
Ice Present (Y/N):	–
Type of Container:	5g bucket
Sample Volume:	approx. 3.75 g

Comments: ☆ truck fridge therm = 4.3°C. 5.6°C measured on wall therm carried in truck.

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [illegible]	Date: 12/18/13	Time: 1140

Sediment Sample Log-In

Client: **Teck/Exponent** Project #: **20672**

Project Description: Ambient Sediment Sample Description: **SE-2-R1**

Sediment Sample Log-In	
Sample ID #	**33852**
Client Sample ID:	SE-2-R1
Date and Time of Sample Collection:	10/03/13 0950
Sample Collected By:	URS
Date and Time of Sample Receipt:	12/19/13 1150
Sample Received By:	RS
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	12/18/13 Yes - Intact x2
Sample Logged in By:	RS
Temperature Blank (°C):	2.2°c Therm (52A)
If No Temp Blank, Cooler Temp (°C):	2.7°c
Sample Temp (°C):	2.1°c
Sample Shipped on Ice (Y/N):	Y
Ice Present (Y/N):	Y (Blue Ice - still frozen)
Type of Container:	5g Bucket
Sample Volume:	~ 5g

Comments: Sample rcvd from FedEx, tape seals intact. RS

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: RS	Date: 12-19-13	Time: 1215

Sediment Sample Log-In

Client: **Teck/Exponent** Project #: **20672**

Project Description: Ambient Sediment Sample Description: **SE-3-R8**

Sediment Sample Log-In	
Sample ID #	**33853**
Client Sample ID:	SE-3-R8
Date and Time of Sample Collection:	10/24/13 1206
Sample Collected By:	URS
Date and Time of Sample Receipt:	1-7-14 1215
Sample Received By:	RS
Chain of Custody present:	Yes
Chain of Custody Seal Present / Intact:	Yes /intact
Sample Logged in By:	RS
Temperature Blank (°C):	1.6 °c
If No Temp Blank, Cooler Temp (°C):	—
Sample Temp (°C):	2.4 °c
Sample Shipped on Ice (Y/N):	Yes
Ice Present (Y/N):	Yes
Type of Container:	5 gal Plastic Bucket
Sample Volume:	~4.5 gal

Comments:

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[signature]	1/7/14	1400

Sediment Sample Log-In

Client: Exponent

Project #: 20672

Project Description: Ambient Sediment

Sample Description: Control Sediment

Sediment Sample Log-In	
Sample ID #	**33854**
Client Sample ID:	ERDC (UMFS) Control Sed.
Date and Time of Sample Collection:	1/13/14 1200
Sample Collected By:	Jacob Stanley
Date and Time of Sample Receipt:	1/14/14 1135
Sample Received By:	RS
Chain of Custody present:	Yes
Chain of Custody Seal Present / Intact:	No Seal
Sample Logged in By:	RS
Temperature Blank (°C):	N/A
If No Temp Blank, Cooler Temp (°C):	5.7°c
Sample Temp (°C):	4.6°c
Sample Shipped on Ice (Y/N):	Yes
Ice Present (Y/N):	Yes
Type of Container:	5gal Plastic Bucket
Sample Volume:	4gal

Comments: Bucket lid seal intact RS

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [signature] Date: 1/14/14 Time: 1210

1300 Blue Spruce Drive, Suite C
Fort Collins, Colorado 80524

AQUATIC BIO SYSTEMS ABS INC.

Toll Free: 800/331-5916
Tel: 970/484-5091 Fax:970/484-2514

ORGANISM HISTORY

DATE:	2/11/2015
SPECIES:	*Hyalella azteca*
AGE:	6 day
LIFE STAGE:	Juvenile
HATCH DATE:	2/5/2015
BEGAN FEEDING:	Immediately
FOOD:	Flake slurry

Water Chemistry Record:	Current	Range
TEMPERATURE:	24°C	23-25°C
SALINITY/CONDUCTIVITY:	--	--
TOTAL HARDNESS (as $CaCO_3$):	160 mg/l	108-216 mg/l
TOTAL ALKALINITY (as $CaCO_3$):	55 mg/l	55-90 mg/l
pH:	7.68	7.58-8.13

Comments:

Facility Supervisor

1300 Blue Spruce Drive, Suite C
Fort Collins, Colorado 80524

AQUATIC BIO SYSTEMS ABS INC.

Toll Free: 800/331-5916
Tel: 970/484-5091 Fax:970/484-2514

ORGANISM HISTORY

DATE: 2/23/2015

SPECIES: *Hyalella azteca*

AGE: 6 day

LIFE STAGE: Juvenile

HATCH DATE: 2/17/2015

BEGAN FEEDING: Immediately

FOOD: Flake slurry

Water Chemistry Record:	Current	Range
TEMPERATURE:	25°C	23-25°C
SALINITY/CONDUCTIVITY:	--	--
TOTAL HARDNESS (as $CaCO_3$):	176 mg/l	115-200 mg/l
TOTAL ALKALINITY (as $CaCO_3$):	45 mg/l	45-75 mg/l
pH:	7.75	7.58-8.13

Comments:

Facility Supervisor

1300 Blue Spruce Drive, Suite C
Fort Collins, Colorado 80524

AQUATIC BIO SYSTEMS ABS INC.

Toll Free: 800/331-5916
Tel: 970/484-5091 Fax:970/484-2514

ORGANISM HISTORY

DATE: 3/3/2015

SPECIES: *Hyalella azteca*

AGE: 6 day

LIFE STAGE: Juvenile

HATCH DATE: 2/25/2015

BEGAN FEEDING: Immediately

FOOD: Flake slurry

Vater Chemistry Record:

	Current	Range
TEMPERATURE:	24°C	23-25°C
SALINITY/CONDUCTIVITY:	--	--
TOTAL HARDNESS (as $CaCO_3$):	198 mg/l	125-200 mg/l
TOTAL ALKALINITY (as $CaCO_3$):	50 mg/l	50-75 mg/l
pH:	7.59	7.58-8.00

omments:

Facility Supervisor

Appendix D

Chain-of-Custody Records and Sediment Log-in Sheets for the Upper Columbia River Site Sediment Samples Received on December 19, 2014, and Long-Term Test Organism Receipt Records

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

SEAL J.J. KELLER SEALS ~~88012290~~ B8012290 BT 12/18/14

Results To:	Teck American Incorporated	Invoice To:	Exponent, Inc.
Address:	501 N. Riverpoint Blvd., Ste 300 Spokane, WA 99202	Address:	15375 SE 30th Place, Ste 250 Bellevue, WA 98007
Phone:	509-623-4501	Phone:	425-519-8716
Attn:	Kris McCaig	Attn:	Anne Fairbrother
E-mail:	Kris.McCaig@teck.com	E-mail:	afairbrother@exponent.com
Project Name:	UCR Phase 2 Sediment Study (see Note 1)		
P.O.#/Ref:			

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Grab/ Comp	Container Number	Container Type	42-d Hyallela Bioassay	50-65-d Chronomus Bioassay									
1	SE-2-R1	~~10/22/2013~~ 10/23/2013	0950	SED	Comp	1	5 GAL POLY BUCKET	X	X									
2	SE-3-B3	10/16/2013	1138	SED	Comp	1	5 GAL POLY BUCKET	X	X									
3	SE-4-B6	10/8/2013	1026	SED	Comp	1	5 GAL POLY BUCKET	X	X									
4	SE-6-B5	9/24/2013	1244	SED	Comp	1	5 GAL POLY BUCKET	X	X									
5	SE-8-B3	9/19/2013	1516	SED	Comp	1	5 GAL POLY BUCKET	X	X									
6	SE-G-1	9/5/2013	1425	SED	Comp	1	5 GAL POLY BUCKET	X	X									
7	SE-G-3	9/6/2013	0945	SED	Comp	2	5 GAL POLY BUCKET	X	X									Note (2)
8	SE-LAL-2	9/8/2013	1330	SED	Comp	1	5 GAL POLY BUCKET	X	X									
9	SE-LAL-3	9/8/2013	1536	SED	Comp	1	5 GAL POLY BUCKET	X	X									
10	SE-LAL-5	9/7/2013	1218	SED	Comp	1	5 GAL POLY BUCKET	X	X									

Samples collected by:

Comments/Special Instruction:

(1) Transfer of samples from ALS/Kelso (WA) to Pacific EcoRisk.

(2) SE-G-3 has 2 containers: K130965-003.02 & K1309645-003.03.

(3) SE-TRIB-3 has 2 containers: K130965-042.02 & K1309645-042.03.

1/9/15 - MM: per email from Jeff Christian (ALS-Kelso), sample date corrected.

RELINQUISHED BY:	RECEIVED BY:
Signature: [signature]	Signature: Pat Savoy
Print: Les Kennedy	Print: PAT SAVOY
Organization: ALS Environmental	Organization: FEDEX
Date: 12/18/2014 Time: 1440	Date: 12/18/14 Time: 1440

RELINQUISHED BY:	RECEIVED BY:
Signature: Pat Savoy	Signature: [signature]
Print: PAT SAVOY	Print: Robert Schaadt
Organization: FEDEX CC	Organization: PER
Date: 12-19-2014 Time: 817	Date: 12-19-14 Time: 0817

*Example Matrix Codes: (EFF - Effluent) (FW = Freshwater); (SW = Saltwater); (WW = Wastewater); (STRMW = Stormwater); (SED = Sediment); or other

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

SEAL J.J. KELLER SEALS B80-12290

Results To:	Teck American Incorporated	Invoice To:	Exponent, Inc.
Address:	501 N. Riverpoint Blvd., Ste 300 Spokane, WA 99202	Address:	15375 SE 30th Place, Ste 250 Bellevue, WA 98007
Phone:	509-623-4501	Phone:	425-519-8716
Attn:	Kris McCaig	Attn:	Anne Fairbrother
E-mail:	Kris.McCaig@teck.com	E-mail:	afairbrother@exponent.com
Project Name:	UCR Phase 2 Sediment Study (see Note 1)		
P.O.#/Ref:			

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Grab/ Comp	Container Number	Container Type	42-d Hyallela Bioassay	50-65-d Chronomus Bioassay								
1	SE-REF-10b	9/18/2013	1507	SED	Comp	1	5 GAL POLY BUCKET	X	X								
2	SE-TRIB-3	10/1/2013	1100	SED	Comp	2	5 GAL POLY BUCKET	X	X								Note (3)
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

Samples collected by:

Comments/Special Instruction:

(1) Transfer of samples from ALS/Kelso (WA) to Pacific EcoRisk.

(2) SE-G-3 has 2 containers: K130965-003.02 & K1309645-003.03.

(3) SE-TRIB-3 has 2 containers: K130965-042.02 & K1309645-042.03.

RELINQUISHED BY:		RECEIVED BY:	
Signature: [signature]		Signature: Pat Savoy	
Print: Les Kennedy		Print: PAT SAVOY	
Organization: ALS Environmental		Organization: FEDEX CO	
Date: 12/18/14	Time: 1440	Date: 12/18/14	Time: 1400
RELINQUISHED BY:		**RECEIVED BY:**	
Signature: Pat Savoy		Signature: [signature]	
Print: PAT SAVOY		Print: Robert Schoadt	
Organization: FEDEX		Organization: PER	
Date: 12-19-14	Time: 8:17	Date: 12-19-14	Time: 0817

*Example Matrix Codes: (EFF - Effluent) (FW = Freshwater); (SW = Saltwater); (WW = Wastewater); (STRMW = Stormwater); (SED = Sediment); or other

Sediment Sample Log-In

Client: **Teck-Exponent** Project #: **20672**

Project Description: **Upper Columbia River** Sample Description: **SE-2-R1**

Sediment Sample Log-In	
Sample ID #	**37077**
Client Sample ID:	K1309683-075.01 SE-2-R1
Date and Time of Sample Collection:	~~10/22/14~~ 7/10/15 ~~15~~ RS 0950 10/23/~~15~~ 13
Sample Collected By:	Teck
Date and Time of Sample Receipt:	12-19-14 0817
Sample Received By:	RS
Chain of Custody present:	Yes
Chain of Custody Seal Present / Intact:	Yes, Intact
Sample Logged in By:	RS
Temperature Blank (°C):	N/A
If No Temp Blank, Cooler Temp (°C):	4°C truck temp
Sample Temp (°C):	4.1°C
Sample Shipped on Ice (Y/N):	N Refrigerated Truck
Ice Present (Y/N):	N
Type of Container:	5 gal poly bucket
Sample Volume:	22 L 75 lb

Comments:

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[signature]	7/10/15	1400

Sediment Sample Log-In

Client: **Teck-Exponent** Project #: **20672**

Project Description: **Upper Columbia River** Sample Description: **SE-3-B3**

Sediment Sample Log-In	
Sample ID #	**37078**
Client Sample ID:	K1309645-056.01 SE-3-B3
Date and Time of Sample Collection:	12/16/13 1138
Sample Collected By:	Teck
Date and Time of Sample Receipt:	12/19/14 0817
Sample Received By:	RS
Chain of Custody present:	Y
Chain of Custody Seal Present / Intact:	Bucket Seal Not Intact
Sample Logged in By:	RS
Temperature Blank (°C):	N/A
If No Temp Blank, Cooler Temp (°C):	4°c Truck Temp.
Sample Temp (°C):	4.2°c
Sample Shipped on Ice (Y/N):	N, Refrigerated Truck
Ice Present (Y/N):	N
Type of Container:	5 gal poly bucket
Sample Volume:	17.5 L 54 lb

Comments:

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [signature]	Date: 7/10/15	Time: 1400

Sediment Sample Log-In

Client: **Teck-Exponent** Project #: **20672**

Project Description: **Upper Columbia River** Sample Description: **SE-4-B6**

Sediment Sample Log-In	
Sample ID #	**37079**
Client Sample ID:	K1309645-052.02 SE-4-B6
Date and Time of Sample Collection:	10/8/13 1026
Sample Collected By:	Teck
Date and Time of Sample Receipt:	12/19/14 0817
Sample Received By:	RS
Chain of Custody present:	Yes
Chain of Custody Seal Present / Intact:	Yes, Intact
Sample Logged in By:	RS
Temperature Blank (°C):	N/A
If No Temp Blank, Cooler Temp (°C):	4°C Truck Temp
Sample Temp (°C):	4.5°C
Sample Shipped on Ice (Y/N):	N, Refrigerated Truck
Ice Present (Y/N):	N
Type of Container:	5 gal poly Bucket
Sample Volume:	24.9 L 53 lb

Comments:

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[signature]	7/10/15	1400

Sediment Sample Log-In

Client: **Teck-Exponent** Project #: **20672**

Project Description: **Upper Columbia River** Sample Description: **SE-6-B5**

Sediment Sample Log-In	
Sample ID #	**37080**
Client Sample ID:	K1309645-027.01 SE-6-B5
Date and Time of Sample Collection:	9/24/13 1244
Sample Collected By:	Teck
Date and Time of Sample Receipt:	12/19/14 0817
Sample Received By:	RS
Chain of Custody present:	Yes
Chain of Custody Seal Present / Intact:	Yes, Intact
Sample Logged in By:	RS
Temperature Blank (°C):	N/A
If No Temp Blank, Cooler Temp (°C):	4°c Truck Temp
Sample Temp (°C):	4.2°c
Sample Shipped on Ice (Y/N):	N, Refrigerated Truck
Ice Present (Y/N):	N
Type of Container:	5 gal poly Bucket
Sample Volume:	21.6 L 47 lb

Comments:

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[illegible]	7/10/15	1400

Sediment Sample Log-In

Client: **Teck-Exponent** Project #: **20672**

Project Description: **Upper Columbia River** Sample Description: **SE-8-B3**

Sediment Sample Log-In	
Sample ID #	**37081**
Client Sample ID:	K1309645-022.01 SE-8-B3
Date and Time of Sample Collection:	9/19/13 1516
Sample Collected By:	Teck
Date and Time of Sample Receipt:	12/19/14 0817
Sample Received By:	RS
Chain of Custody present:	Yes
Chain of Custody Seal Present / Intact:	Yes, Intact
Sample Logged in By:	RS
Temperature Blank (°C):	N/A
If No Temp Blank, Cooler Temp (°C):	4°c Truck Temp
Sample Temp (°C):	4.0°c
Sample Shipped on Ice (Y/N):	N, Refrigerated Truck
Ice Present (Y/N):	N
Type of Container:	5gal poly Bucket
Sample Volume:	23.1 L 50 lb

Comments:

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: mm	Date: 7/10/15	Time: 1400

Sediment Sample Log-In

Client: **Teck-Exponent** Project #: **20672**

Project Description: **Upper Columbia River** Sample Description: **SE-G-01**

Sediment Sample Log-In	
Sample ID #	**37082**
Client Sample ID:	K1309645-001.01 SE-G-1
Date and Time of Sample Collection:	9/5/13 1425
Sample Collected By:	Teck
Date and Time of Sample Receipt:	12/19/14 0817
Sample Received By:	RS
Chain of Custody present:	Yes
Chain of Custody Seal Present / Intact:	Yes, Intact
Sample Logged in By:	RS
Temperature Blank (°C):	N/A
If No Temp Blank, Cooler Temp (°C):	4°c Truck Temp
Sample Temp (°C):	4.6°c
Sample Shipped on Ice (Y/N):	N, Refrigerated Truck
Ice Present (Y/N):	N
Type of Container:	5 gal poly Bucket
Sample Volume:	22.3 L 49 lb

Comments:

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[signature]	7/10/15	1400

Sediment Sample Log-In

Client: **Teck-Exponent** Project #: **20672**

Project Description: **Upper Columbia River** Sample Description: **SE-G-03**

Sediment Sample Log-In	
Sample ID #	**37083**
Client Sample ID:	SE-G-3 K1309645-003.02 / -003.03
Date and Time of Sample Collection:	9/6/13 0945
Sample Collected By:	Teck
Date and Time of Sample Receipt:	12/19/14 0817
Sample Received By:	RS
Chain of Custody present:	Yes
Chain of Custody Seal Present / Intact:	Yes, Intact
Sample Logged in By:	RS
Temperature Blank (°C):	~~003~~ RS N/A
If No Temp Blank, Cooler Temp (°C):	4°C Truck Temp
Sample Temp (°C):	003.02 - 4.2°c / 003.03 - 4.3°c
Sample Shipped on Ice (Y/N):	N, Refrigerated Truck
Ice Present (Y/N):	N
Type of Container:	2 x 5 gal poly Bucket
Sample Volume:	003.02 - 26.7L, 58lbs / 003.03 - 25.9L 56Lbs

Comments:

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [signature] Date: 7/10/15 Time: 1400

Sediment Sample Log-In

Client: **Teck-Exponent** Project #: **20672**

Project Description: **Upper Columbia River** Sample Description: **SE_LAL-2**

Sediment Sample Log-In	
Sample ID #	**37084**
Client Sample ID:	SE-LAL-3 K1309645-006.01
Date and Time of Sample Collection:	9/8/13 1330
Sample Collected By:	Teck
Date and Time of Sample Receipt:	12/19/14 0817
Sample Received By:	RS
Chain of Custody present:	Yes
Chain of Custody Seal Present / Intact:	Yes, Intact
Sample Logged in By:	RS
Temperature Blank (°C):	N/A
If No Temp Blank, Cooler Temp (°C):	4°c Truck Temp
Sample Temp (°C):	4.0°c
Sample Shipped on Ice (Y/N):	N, Refrigerated Truck
Ice Present (Y/N):	N
Type of Container:	5 gal poly Bucket
Sample Volume:	21.6 L 45 lb

Comments: ______

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[illegible]	7/10/15	1400

Sediment Sample Log-In

Client: **Teck-Exponent** Project #: **20672**

Project Description: **Upper Columbia River** Sample Description: **SE_LAL-3**

Sediment Sample Log-In	
Sample ID #	**37085**
Client Sample ID:	SE-LAL-3 K1309645-007.01
Date and Time of Sample Collection:	9/8/13 1536
Sample Collected By:	Teck
Date and Time of Sample Receipt:	12/19/14 0817
Sample Received By:	RS
Chain of Custody present:	Yes
Chain of Custody Seal Present / Intact:	Yes, Intact
Sample Logged in By:	RS
Temperature Blank (°C):	N/A
If No Temp Blank, Cooler Temp (°C):	4°C Truck Temp.
Sample Temp (°C):	4.0°c
Sample Shipped on Ice (Y/N):	N, Refrigerated Truck
Ice Present (Y/N):	N
Type of Container:	5 gal poly Bucket
Sample Volume:	24.1 L 7315

Comments:

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off: [signature] Date: 7/10/15 Time: 1400

Sediment Sample Log-In

Client: **Teck-Exponent** Project #: **20672**

Project Description: **Upper Columbia River** Sample Description: **SE_LAL-5**

Sediment Sample Log-In	
Sample ID #	**37086**
Client Sample ID:	SE-LAL-5 K1309645-009.01
Date and Time of Sample Collection:	9/7/13 1218
Sample Collected By:	Teck
Date and Time of Sample Receipt:	12/19/14 0817
Sample Received By:	RS
Chain of Custody present:	Yes
Chain of Custody Seal Present / Intact:	Bucket Seal NOT intact
Sample Logged in By:	RS
Temperature Blank (°C):	N/A
If No Temp Blank, Cooler Temp (°C):	4 °C Truck Temp.
Sample Temp (°C):	4.1 °C
Sample Shipped on Ice (Y/N):	N, Refrigerated Truck
Ice Present (Y/N):	N
Type of Container:	5 gal poly Bucket
Sample Volume:	23.9 L 51 lb

Comments: ______________________________

	Sign-off:	Date:	Time:
This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	mm	7/10/15	1400

Sediment Sample Log-In

Client: **Teck-Exponent** Project #: **20672**

Project Description: **Upper Columbia River** Sample Description: **SE-REF-10b**

Sediment Sample Log-In	
Sample ID #	**37087**
Client Sample ID:	SE-REF-10b K1309683-019.03
Date and Time of Sample Collection:	9/18/13 1507
Sample Collected By:	Teck
Date and Time of Sample Receipt:	12/19/14 0817
Sample Received By:	RS
Chain of Custody present:	Yes
Chain of Custody Seal Present / Intact:	Yes, Intact
Sample Logged in By:	RS
Temperature Blank (°C):	N/A
If No Temp Blank, Cooler Temp (°C):	4°C Truck Temp
Sample Temp (°C):	4.3°C
Sample Shipped on Ice (Y/N):	N, Refrigerated Truck
Ice Present (Y/N):	N
Type of Container:	5 gal poly Bucket
Sample Volume:	29.2 L 63 lb

Comments:

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	mr	7/10/15	1400

Sediment Sample Log-In

Client: **Teck-Exponent** Project #: **20672**

Project Description: **Upper Columbia River** Sample Description: **SE-TRIB-3**

Sediment Sample Log-In	
Sample ID #	**37088**
Client Sample ID:	SE-TRIB-3 K1309645-042.02 / -042.03
Date and Time of Sample Collection:	10/1/13 1100
Sample Collected By:	Teck
Date and Time of Sample Receipt:	12/19/14 0817
Sample Received By:	RS
Chain of Custody present:	Yes
Chain of Custody Seal Present / Intact:	Bucket Seal Not Intact
Sample Logged in By:	RS
Temperature Blank (°C):	N/A
If No Temp Blank, Cooler Temp (°C):	4°C Truck Temp.
Sample Temp (°C):	042.02 - 5.0°C / 042.03 5.0°C
Sample Shipped on Ice (Y/N):	N, Refrigerated Truck
Ice Present (Y/N):	N
Type of Container:	2x 5gal poly Bucket
Sample Volume:	042.02 - 19.6L 42lb / 042.03 - 22.2L 53lb

Comments: No overlying water observed - 12-19-14-RS

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[signature]	7/10/15	1400

Sediment Sample Log-In

Client: USAE Project #: 20672

Project Description: UCR Sample Description: Sediment / ERDC

Sediment Sample Log-In	
Sample ID #	**34416**
Client Sample ID:	ERDC UMFS Control
Date and Time of Sample Collection:	3/12/14 1442
Sample Collected By:	JMB (USAE)
Date and Time of Sample Receipt:	3/14/14 1200
Sample Received By:	RS
Chain of Custody present:	Yes
Chain of Custody Seal Present / Intact:	No
Sample Logged in By:	RS
Temperature Blank (°C):	N/A
If No Temp Blank, Cooler Temp (°C):	4.7°c
Sample Temp (°C):	2.1°c
Sample Shipped on Ice (Y/N):	Yes
Ice Present (Y/N):	Yes
Type of Container:	3.5 gal Plastic Bucket
Sample Volume:	3.25 gal

Comments: Bucket Lid sealed

This Sample Log-In has been reviewed for completeness, consistency with Chain-of-Custody information, and identification of any water quality measures or other issues of concern	Sign-off:	Date:	Time:
	[signature]	3/19/14	1530

1300 Blue Spruce Drive, Suite C
Fort Collins, Colorado 80524

AQUATIC BIO SYSTEMS ABS INC.

Toll Free: 800/331-5916
Tel: 970/484-5091 Fax:970/484-2514

ORGANISM HISTORY

DATE: 2/11/2015

SPECIES: *Hyalella azteca*

AGE: 6 day

LIFE STAGE: Juvenile

HATCH DATE: 2/5/2015

BEGAN FEEDING: Immediately

FOOD: Flake slurry

Water Chemistry Record:	Current	Range
TEMPERATURE:	24°C	23-25°C
SALINITY/CONDUCTIVITY:	--	--
TOTAL HARDNESS (as $CaCO_3$):	160 mg/l	108-216 mg/l
TOTAL ALKALINITY (as $CaCO_3$):	55 mg/l	55-90 mg/l
pH:	7.68	7.58-8.13

Comments:

Facility Supervisor

1300 Blue Spruce Drive, Suite C
Fort Collins, Colorado 80524

AQUATIC BIO SYSTEMS ABS INC.

Toll Free: 800/331-5916
Tel: 970/484-5091 Fax:970/484-2514

ORGANISM HISTORY

DATE: 2/23/2015

SPECIES: *Hyalella azteca*

AGE: 6 day

LIFE STAGE: Juvenile

HATCH DATE: 2/17/2015

BEGAN FEEDING: Immediately

FOOD: Flake slurry

Water Chemistry Record:	Current	Range
TEMPERATURE:	25°C	23-25°C
SALINITY/CONDUCTIVITY:	--	--
TOTAL HARDNESS (as $CaCO_3$):	176 mg/l	115-200 mg/l
TOTAL ALKALINITY (as $CaCO_3$):	45 mg/l	45-75 mg/l
pH:	7.75	7.58-8.13

Comments:

Facility Supervisor

1300 Blue Spruce Drive, Suite C
Fort Collins, Colorado 80524

AQUATIC BIO SYSTEMS
ABS
INC.

Toll Free: 800/331-5916
Tel: 970/484-5091 Fax:970/484-2514

ORGANISM HISTORY

DATE: 3/3/2015

SPECIES: *Hyalella azteca*

AGE: 6 day

LIFE STAGE: Juvenile

HATCH DATE: 2/25/2015

BEGAN FEEDING: Immediately

FOOD: Flake slurry

Vater Chemistry Record:	Current	Range
TEMPERATURE:	24°C	23-25°C
SALINITY/CONDUCTIVITY:	--	--
TOTAL HARDNESS (as $CaCO_3$):	198 mg/l	125-200 mg/l
TOTAL ALKALINITY (as $CaCO_3$):	50 mg/l	50-75 mg/l
pH:	7.59	7.58-8.00

omments:

Facility Supervisor

Aquatic BioSystems, Inc • Quality Research Organisms

Appendix E

Peeper Methods for *In Situ* Sampling of Sediment Porewater

PEEPER METHODS

Peeper Preparation

Peepers were constructed as described in UCR SOP-9 and Brambaugh (2014) and consisted of a 2.9 mL, low-density polyethylene vial. Briefly, a single 6-mm diameter hole was punched out in the center of each vial cap (with the cap still attached to the vial) using a hole-punch tool (e.g., Roper-Whitney hand punch model 5JR). Vials were cleaned by soaking overnight (with occasional agitation to wet all vial surfaces) in a suitable plastic bottle containing of 4M nitric acid (HNO_3) and 2M hydrochloric acid (HCl) followed by placement in a heated (50°C) water-bath for 20 minutes with occasional agitation to facilitate metals decontamination, after which the vials were triple-rinsed with reverse osmosis, de-ionized water treated to Type 1 specifications (Type 1 water), and then stored in Type 1 water until further preparation.

To prepare the peepers, up to 20 cleaned, punched vials with the attached vial cap in the 'open' position were submerged in a small acid-cleaned plastic tub half-filled with freshly de-oxygenated Type 1 water (fresh de-oxygenated Type 1 water was used for each batch of 20 vials). Using Ansell Dura-Touch powder free vinyl gloves (#34-740, the same gloves used by ALS) that had been thoroughly rinsed with Type 1 water, a submerged vial was grasped and held with its top edge just at the water surface. A 0.45-μm filter membrane was then placed over the vial opening (aligned with minimal overlap near the hinged area of the vial) and the perforated cap was then carefully closed to seal the vial with the membrane in place. Excess membrane material on the outside of the vial was removed, except for a small portion opposite the hinge that was left intact to facilitate grasping both the membrane and cap when opening the vials at the time of collection of the porewater within (i.e. at the time of peeper retrieval [see below]).

Once the vial was sealed, the membrane was inspected for rupture and the peeper was briefly inverted above the water to check for leaks and confirm that there are no air bubbles inside. A small nylon cable tie (approximately 10-cm long) was strapped around the vial to facilitate retrieval. The finished peeper was transferred to a wide-mouth 1-L acid-cleaned high density polyethylene (HDPE) bottle containing de-oxygenated Type 1 water and ~200 mg of metal-chelating resin (e.g., Chelex-100™) placed inside a separate peeper vial. After approximately 20 vials were completed, the storage bottle was "topped off" with de-oxygenated Type 1 water, then capped tightly and placed in a refrigerator. At least 24 hours prior to deployment, the water inside of the storage bottle was de-oxygenated once again.

Peeper Deployment

Peeper deployment was performed at the beginning of each test. Deployment was performed in one of three ways depending on the sediment density and grain size. For most of the sediments, the peeper was pressed into the sediment by grasping the cable tie with plastic hemostat-type forceps, then, pushing the peeper into the sediment until it was submerged. If difficulty was encountered with that approach, (e.g., for sandy or coarse granular sediments), a cavity was first dug into the sediment and the peeper then inserted into the cavity, the cavity was then backfilled as necessary to completely bury the peeper. Lastly, if neither approach was successful, the peeper and sediment were loaded into the sediment toxicity test chamber simultaneously. For all burial methods, the bottom (i.e., closed end) of the peeper was situated next to the wall of the test chamber and the membrane end near the center so as to maximize the sediment volume "seen" by the membrane face. The peeper was buried so that the top edge was between 0.5 and 1 cm below the surface of the sediment.

For each batch of deployed peepers, additional peeper 'blanks' were stored to serve as analytical blanks. After deployment, the de-oxygenated Type 1 water in the storage bottle containing the blank peepers and Chelex 100™ resin was replaced with fresh Type 1 water and the bottle was stored and in a refrigerator (approx. 4 ºC) until peeper retrieval activities were performed.

Peeper Retrieval and Processing

For each sediment, the peepers were retrieved from the sediment in the three "peeper" replicates by grasping the tag end of the attached cable tie with the plastic forceps. The retrieved peepers were carefully agitated while still in the overlying test water to remove loosely-adhering sediment particles. The peeper was then rinsed with a stream of Type 1 water directed tangentially to the lid and membrane until all visible particles were displaced, and the vial was then blotted dry using a laboratory tissue. The membrane and vial cap assembly was carefully opened with a Type 1 water-rinsed, gloved hand by grasping the protruding edge of the membrane in conjunction with the edge of the cap, and then carefully opening the vial to prevent the membrane from falling into the porewater collected within. Prior to collection of the peeper porewater, the tare weight of an acid-cleaned 50-mL low density polyethylene (LDPE) sample collection bottle (provided by ALS) was measured and recorded in the peeper retrieval log. A disposable polyethylene mini-pipette was rinsed by drawing in a small volume of high-purity 1% HNO_3, inverting the pipette, and then expelling the acid. The same sequence was then repeated using Type 1 water. For each sediment sample, the porewater within each of the three peepers was collected and then transferred and composited within the sample collection bottle using the cleaned mini-pipette. The weight of the sample bottle and collected porewater was measured and recorded in the peeper log. Approximately 2.5 mL of high purity 1% (v/v) HNO_3 was then added to each of the three emptied peeper vials using a mechanical pipet with a disposable pipette tip that had been cleaned in a similar fashion as the mini-pipette. The nitric acid was then transferred from the emptied peeper to the sample bottle in the same manner as the peeper porewater. The weight of the sample bottle, peeper porewater, and nitric acid was then measured and recorded in the peeper log.

If peeper membrane fouling was identified, the peeper porewater from the fouled peeper was collected separately from the other non-fouled peepers and noted on the log. Processing of the peeper blanks was performed at the same time as those that were retrieved (i.e. T_7, T_{21}, and T_{42}) and in the same fashion at the test treatment peepers; one peeper blank was processed for each testing batch at each of the peeper retrieval intervals.

Appendix F

Peeper Processing Records for the Upper Columbia River Short-term (10-Day) *Chironomus dilutus* and Short-Term (28-Day) *Hyalella azteca* Tests

Peeper Retrieval Log. Bioassay Batch 1								
Sample ID	Retrieval Date	Retrieval Time	Balance ID	Sample Bottle Weight (g)	Approx. Peeper Sample Volume (mL)	Sample Bottle + Peeper Sample Weight (g)	Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)	Sign Off
PW-1-R1-CD10-T7	1/29/14	0935	FG-E-BAL03	11.6	9	20.6	28.1	AB
PW-3-R2-CD10-T7	1/29/14	0949	FG-E-BAL03	11.5	9	20.5	28.0	AB
PW-4-B6-CD10-T7	1/29/14	1001	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-5-B1-CD10-T7	1/29/14	1033	FG-E-BAL03	11.6	9	20.3	27.9	AB
PW-6-B6-CD10-T7	1/29/14	1046	FG-E-BAL03	11.7	9	20.4	27.9	AB
PW-6-R3-CD10-T7	1/29/14	1109	FG-E-BAL03	11.6	9	20.6	28.1	AB
PW-8-B3-CD10-T7	1/29/14	1123	FG-E-BAL03	11.7	9	20.7	28.2	AB
PW-8-B4-CD10-T7	1/29/14	1136	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-G-1-CD10-T7	1/29/14	1147	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-REF-6-CD10-T7	1/29/14	1156	FG-E-BAL03	11.6	9	20.3	27.8	AB
PW-TRIB-4-CD10-T7	1/29/14	1206	FG-E-BAL03	11.7	9	20.6	28.2	AB
PW-CTL-SS-B1-CD10-T7	1/29/14	1214	FG-E-BAL03	11.6	9	20.3	27.9	AB
PW-CTL-QS-B1-CD10-T7	1/29/14	1229	FG-E-BAL03	11.6	9	20.3	30.4	AB
PW-CTL-ERDC-B1-CD10-T7	1/29/14	1238	FG-E-BAL03	11.5	9	20.3	27.8	AB
PB-CD10-B1-T7	1/29/14	0855	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-1-R1-HA28-T7	1/29/14	1424	FG-E-BAL03	11.6	9	20.3	27.8	AB
PW-3-R2-HA28-T7	1/29/14	1436	FG-E-BAL03	11.5	9	20.2	27.7	AB
PW-4-B6-HA28-T7	1/29/14	1448	FG-E-BAL03	11.6	9	20.1	27.7	AB
PW-5-B1-HA28-T7	1/29/14	1500	FG-E-BAL03	11.6	9	20.1	27.7	AB
PW-6-B6-HA28-T7	1/29/14	1511	FG-E-BAL03	11.6	9	20.2	27.8	AB
PW-6-R3-HA28-T7	1/29/14	1520	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-8-B3-HA28-T7	1/29/14	1537	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-8-B4-HA28-T7	1/29/14	1549	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-G-1-HA28-T7	1/29/14	1604	FG-E-BAL03	11.5	9	~~20.4~~ 20.3 AB	27.9	AB
PW-REF-6-HA28-T7	1/29/14	1614	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-TRIB-4-HA28-T7	1/29/14	1622	FG-E-BAL03	11.6	9	20.6	28.0	AB
PW-CTL-SS-B1-HA28-T7	1/29/14	1633	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-CTL-QS-B1-HA28-T7	1/29/14	1642	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-CTL-ERDC-B1-HA28-T7	1/29/14	1650	FG-E-BAL03	11.5	9	20.4	27.9	AB
PB-HA28-B1-T7	1/29/14	1657	FG-E-BAL03	11.7	9	20.7	28.1	AB

Peeper Retrieval Log: Bioassay Batch 1								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO3 Weight (g)**	**Sign Off**
PW-1-R1-HA28-T21	2/12/14	1050	FG-E-BAL03	11.5	9	20.5	28.0	AB
PW-3-R2-HA28-T21	2/12/14	1101	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-4-B6-HA28-T21	2/12/14	1119	FG-E-BAL03	11.5	9	20.6	28.2	AB
PW-5-B1-HA28-T21	2/12/14	1134	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-6-B6-HA28-T21	2/12/14	1151	FG-E-BAL03	11.7	9	20.7	28.2	AB
PW-6-R3-HA28-T21	2/12/14	1210	FG-E-BAL03	11.5	9	20.5	28.0	AB
PW-8-B3-HA28-T21	2/12/14	1315	FG-E-BAL03	11.7	9	20.7	28.3	AB
PW-8-B4-HA28-T21	2/12/14	1326	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-G-1-HA28-T21	2/12/14	1343	FG-E-BAL03	11.5	9	20.5	28.0	AB
PW-REF-6-HA28-T21	2/12/14	1355	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-TRIB-4-HA28-T21	2/12/14	1406	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-CTL-SS-B1-HA28-T21	2/12/14	1421	FG-E-BAL03	11.7	9	20.6	28.1	AB
PW-CTL-QS-B1-HA28-T21	2/12/14	1434	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-CTL-ERDC-B1-HA28-T2	2/12/14	1445	FG-E-BAL03	11.5	9	20.4	27.9	AB
PB-HA28-B1-T21	2/12/14	1038	FG-E-BAL03	11.6	9	20.6	28.1	AB

Peeper Retrieval Log: Bioassay Batch 2

Sample ID	Retrieval Date	Retrieval Time	Balance ID	Sample Bottle Weight (g)	Approx. Peeper Sample Volume (mL)	Sample Bottle + Peeper Sample Weight (g)	Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)	Sign Off
PW-2-R1-CD10-T7	1/30/14	0822	FG-E-BAL03	11.6	9	20.2	27.9	AB
PW-4-B2-CD10-T7	1/30/14	0834	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-4-B4-CD10-T7	1/30/14	0843	FG-E-BAL03	11.5	9	20.4	27.9	AB
PW-5-B3-CD10-T7	1/30/14	0853	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-6-B5-CD10-T7	1/30/14	0904	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-LAL-1-CD10-T7	1/30/14	0916	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-LAL-2-CD10-T7	1/30/14	0925	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-LAL-3-CD10-T7	1/30/14	0934	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-LAL-6-CD10-T7	1/30/14	0944	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-REF-4-CD10-T7	1/30/14	0953	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-REF-8-CD10-T7	1/30/14	1004	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-CTL-SS-B2-CD10-T7	1/30/14	1014	FG-E-BAL03	11.~~6~~5 AB	9	20.5	28.1	AB
PW-CTL-QS-B2-CD10-T7	1/30/14	1029	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-CTL-ERDC-B2-CD10-T7	1/30/14	1037	FG-E-BAL03	11.5	9	20.5	28.1	AB
PB-CD10-B2-T7	1/30/14	0815	FG-E-BAL03	11.6	~~20~~ AB 9	20.5	28.0	AB
PW-2-R1-HA28-T7	1/30/14	1339	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-4-B2-HA28-T7	1/30/14	1355	FG-E-BAL03	11.6	9	20.6	28.1	AB
PW-4-B4-HA28-T7	1/30/14	1410	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-5-B3-HA28-T7	1/30/14	1419	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-6-B5-HA28-T7	1/30/14	1430	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-LAL-1-HA28-T7	1/30/14	1442	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-LAL-2-HA28-T7	1/30/14	1456	FG-E-BAL03	11.6	9	20.4	27.9	AB
PW-LAL-3-HA28-T7	1/30/14	1506	FG-E-BAL03	11.6	7.3	18.8	26.4	AB
PW-REF-4-HA28-T7	1/30/14	1528	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-REF-8-HA28-T7	1/30/14	1550	FG-E-BAL03	11.~~8~~6 AB	9	20.4	28.0	AB
PW-CTL-SS-B2-HA28-T7	1/30/14	1601	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-CTL-QS-B2-HA28-T7	1/30/14	1613	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-CTL-ERDC-B2-HA28-T7	1/30/14	1621	FG-E-BAL03	11.5	9	20.5	28.1	AB
PB-HA28-B2-T7	1/30/14	1631	FG-E-BAL03	11.6	9	20.6	28.2	AB

Peeper Retrieval Log: Bioassay Batch 2

Sample ID	Retrieval Date	Retrieval Time	Balance ID	Sample Bottle Weight (g)	Approx. Peeper Sample Volume (mL)	Sample Bottle + Peeper Sample Weight (g)	Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)	Sign Off
PW-2-R1-CD10-T7	1/30/14	0822	FG-E-BAL03	11.6	9	20.2	27.9	AB
PW-4-B2-CD10-T7	1/30/14	0834	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-4-B4-CD10-T7	1/30/14	0843	FG-E-BAL03	11.5	9	20.4	27.9	AB
PW-5-B3-CD10-T7	1/30/14	0853	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-6-B5-CD10-T7	1/30/14	0904	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-LAL-1-CD10-T7	1/30/14	0916	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-LAL-2-CD10-T7	1/30/14	0925	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-LAL-3-CD10-T7	1/30/14	0934	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-LAL-6-CD10-T7	1/30/14	0944	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-REF-4-CD10-T7	1/30/14	0953	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-REF-8-CD10-T7	1/30/14	1004	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-CTL-SS-B2-CD10-T7	1/30/14	1014	FG-E-BAL03	11.~~6~~5 AB	9	20.5	28.1	AB
PW-CTL-QS-B2-CD10-T7	1/30/14	1029	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-CTL-ERDC-B2-CD10-T7	1/30/14	1037	FG-E-BAL03	11.5	9	20.5	28.1	AB
PB-CD10-B2-T7	1/30/14	0815	FG-E-BAL03	11.6	~~20~~ AB 9	20.5	28.0	AB
PW-2-R1-HA28-T7	1/30/14	1339	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-4-B2-HA28-T7	1/30/14	1355	FG-E-BAL03	11.6	9	20.6	28.1	AB
PW-4-B4-HA28-T7	1/30/14	1410	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-5-B3-HA28-T7	1/30/14	1419	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-6-B5-HA28-T7	1/30/14	1430	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-LAL-1-HA28-T7	1/30/14	1442	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-LAL-2-HA28-T7	1/30/14	1456	FG-E-BAL03	11.6	9	20.4	27.9	AB
PW-LAL-3-HA28-T7	1/30/14	1506	FG-E-BAL03	11.6	7.3	18.8	26.4	AB
PW-REF-4-HA28-T7	1/30/14	1528	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-REF-8-HA28-T7	1/30/14	1550	FG-E-BAL03	11.~~5~~6 AB	9	20.4	28.0	AB
PW-CTL-SS-B2-HA28-T7	1/30/14	1601	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-CTL-QS-B2-HA28-T7	1/30/14	1613	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-CTL-ERDC-B2-HA28-T7	1/30/14	1621	FG-E-BAL03	11.5	9	20.5	28.1	AB
PB-HA28-B2-T7	1/30/14	1631	FG-E-BAL03	11.6	9	20.6	28.2	AB

Peeper Retrieval Log: Bioassay Batch 2								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO3 Weight (g)**	**Sign Off**
PW-2-R1-HA28-T21	2/13/14	0953	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-4-B2-HA28-T21	2/13/14	1011	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-4-B4-HA28-T21	2/13/14	1025	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-5-B3-HA28-T21	2/13/14	1036	FG-E-BAL03	11.5	9	20.5	28.0	AB
PW-6-B5-HA28-T21	2/13/14	1109	FG-E-BAL03	11.5	9	20.4	27.9	AB
PW-LAL-1-HA28-T21	2/13/14	1131	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-LAL-2-HA28-T21	2/13/14	1140	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-LAL-3-HA28-T21	2/13/14	1156	FG-E-BAL03	11.5	9	20.5	28.0	AB
PW-REF-4-HA28-T21	2/13/14	1208	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-REF-8-HA28-T21	2/13/14	1216	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-CTL-SS-B2-HA28-T21	2/13/14	1600	FG-E-BAL03	11.6	9	20.7	28.2	AB
PW-CTL-QS-B2-HA28-T21	2/13/14	1610	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-CTL-ERDC-B2-HA28-T2	2/13/14	1630	FG-E-BAL03	11.5	9	20.5	28.0	AB
PB-HA28-B2-T21	2/13/14	1640	FG-E-BAL03	11.5	9	20.5	28.1	AB

Peeper Retrieval Log: Bioassay Batch 3								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO3 Weight (g)**	**Sign Off**
PW-2-R3-CD10-T7	1/31/14	0933	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-3-R1-CD10-T7	1/31/14	0956	FG-E-BAL03	11.~~6~~5 AB	9	20.5	28.1	AB
PW-3-R8-CD10-T7	1/31/14	1024	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-5-B4-CD10-T7	1/31/14	1036	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-6-B4-CD10-T7	1/31/14	1048	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-7-B2-CD10-T7	1/31/14	1058	FG-E-BAL03	11.~~7~~6 AB	9	20.4	28.0	AB
PW-LAL-4-CD10-T7	1/31/14	1110	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-REF-1-CD10-T7	1/31/14	1122	FG-E-BAL03	11.6	9	20.7	28.3	AB
PW-REF-10b-CD10-T7	1/31/14	1137	FG-E-BAL03	11.6	9	20.3	27.9	AB
PW-REF-3-CD10-T7	1/31/14	1144	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-REF-7-CD10-T7	1/31/14	1152	FG-E-BAL03	11.6	9	20.4	27.9	AB
PW-TRIB-3-CD10-T7	1/31/14	1205	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-CTL-SS-B3-CD10-T7	1/31/14	1217	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-CTL-QS-B3-CD10-T7	1/31/14	1227	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-CTL-ERDC-B3-CD10-T7	1/31/14	1233	FG-E-BAL03	11.5	9	20.4	28.0	AB
PB-CD10-B3-T7	1/31/14	0920	FG-E-BAL03	11.5	9	20.5	28.0	AB
PW-2-R3-HA28-T7	1/31/14	1524	FG-E-BAL03	11.6	9	20.3	27.8	AB
PW-3-R1-HA28-T7	1/31/14	1558	FG-E-BAL03	11.6	9	20.3	27.8	AB
PW-3-R8-HA28-T7	1/31/14	1609	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-5-B4-HA28-T7	1/31/14	1621	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-6-B4-HA28-T7	1/31/14	1630	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-7-B2-HA28-T7	1/31/14	~~1444~~ 1644 AB	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-LAL-4-HA28-T7	1/31/14	1703	FG-E-BAL03	11.5	9	20.5	28.2	AB
PW-REF-1-HA28-T7	1/31/14	1712	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-REF-10b-HA28-T7	1/31/14	1720	FG-E-BAL03	11.7	9	20.8	28.4	AB
PW-REF-3-HA28-T7	1/31/14	1727	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-REF-7-HA28-T7	1/31/14	1735	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-TRIB-3-HA28-T7	1/31/14	1744	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-CTL-SS-B3-HA28-T7	1/31/14	1757	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-CTL-QS-B3-HA28-T7	1/31/14	1806	FG-E-BAL03	11.5	9	20.4	28.1	AB
PW-CTL-ERDC-B3-HA28-T7	1/31/14	1813	FG-E-BAL03	11.5	9	20.4	28.0	AB
PB-HA28-B3-T7	1/31/14	1520	FG-E-BAL03	11.5	9	AB ~~11.5~~ 20.7	28.2	AB

Peeper Retrieval Log: Bioassay Batch 3								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO3 Weight (g)**	**Sign Off**
PW-2-R3-HA28-T21	2/14/14	1344	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-3-R1-HA28-T21	2/14/14	1354	FG-E-BAL03	11.6	9	20.7	28.3	AB
PW-3-R8-HA28-T21	2/14/14	1406	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-5-B4-HA28-T21	2/14/14	1415	FG-E-BAL03	11.5	9	20.4	27.9	AB
PW-6-B4-HA28-T21	2/14/14	1426	FG-E-BAL03	11.6	9	20.6	28.1	AB
PW-7-B2-HA28-T21	2/14/14	1439	FG-E-BAL03	11.5	9	20.5	28.0	AB
PW-LAL-4-HA28-T21	2/14/14	1622	FG-E-BAL03	11.5	9	20.5	28.0	AB
PW-REF-1-HA28-T21	2/14/14	1631	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-REF-10b-HA28-T21	2/14/14	1641	FG-E-BAL03	11.7	9	20.~~8~~6 AB	28.1	AB
PW-REF-3-HA28-T21	2/14/14	1655	FG-E-BAL03	11.7	9	20.7	28.3	AB
PW-REF-7-HA28-T21	2/14/14	1704	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-TRIB-3-HA28-T21	2/14/14	1714	FG-E-BAL03	11.5	9	20.6	28.2	AB
PW-CTL-SS-B3-HA28-T21	2/14/14	1732	FG-E-BAL03	11.7	9	20.6	28.1	AB
PW-CTL-QS-B3-HA28-T21	2/14/14	1741	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-CTL-ERDC-B3-HA28-T21	2/14/14	1750	FG-E-BAL03	11.5	9	20.5	28.~~0~~1 AB	AB
PB-HA28-B3-T21	2/14/14	1328	FG-E-BAL03	11.7	9	20.~~6~~7 AB	28.3	AB

Peeper Retrieval Log: Bioassay Batch 4								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO3 Weight (g)**	**Sign Off**
PW-1-B5-CD10-T7	2/5/14	0938	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-2-B1-CD10-T7	2/5/14	0954	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-3-B3-CD10-T7	2/5/14	1006	FG-E-BAL03	11.7	9	20.5	28.0	AB
PW-3-R7-CD10-T7	2/5/14	1023	FG-E-BAL03	11.~~6~~5 AB	9	20.6	28.1	AB
PW-5-B5-CD10-T7	2/5/14	1035	FG-E-BAL03	11.6	9	20.6	28.1	AB
PW-5-B6-CD10-T7	2/5/14	1045	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-7-B3-CD10-T7	2/5/14	1058	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-7-B6-CD10-T7	2/5/14	1107	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-G-4-CD10-T7	2/5/14	1121	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-REF-2-CD10-T7	2/5/14	1131	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-TRIB-2-CD10-T7	2/5/14	1139	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-TRIB-5-CD10-T7	2/5/14	1148	FG-E-BAL03	11.6	9	20.6	28.1	AB
PW-CTL-SS-B4-CD10-T7	2/5/14	1158	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-CTL-QS-B4-CD10-T7	2/5/14	1212	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-CTL-ERDC-B4-CD10-T7	2/5/14	1219	FG-E-BAL03	11.7	9	20.6	28.2	AB
PB-CD10-B4-T7	2/5/14	0925	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-1-B5-HA28-T7	2/5/14	1429	FG-E-BAL03	11.7	9	20.8	28.3	AB
PW-2-B1-HA28-T7	2/5/14	1439	FG-E-BAL03	11.6	9	20.7	28.2	AB
PW-3-B3-HA28-T7	2/5/14	1448	FG-E-BAL03	11.7	9	20.7	28.3	AB
PW-3-R7-HA28-T7	2/5/14	1456	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-5-B5-HA28-T7	2/5/14	1507	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-5-B6-HA28-T7	2/5/14	1547	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-7-B3-HA28-T7	2/5/14	1557	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-7-B6-HA28-T7	2/5/14	1604	FG-E-BAL03	11.5	9	20.6	28.2	AB
PW-G-4-HA28-T7	2/5/14	1613	FG-E-BAL03	11.~~6~~7 AB	9	20.7	28.4	AB
PW-REF-2-HA28-T7	2/5/14	1625	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-TRIB-2-HA28-T7	2/5/14	1629	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-TRIB-5-HA28-T7	2/5/14	1641	FG-E-BAL03	11.5	9	20.4	28.1	AB
PW-CTL-SS-B4-HA28-T7	2/5/14	1649	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-CTL-QS-B4-HA28-T7	2/5/14	1704	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-CTL-ERDC-B4-HA28-T7	2/5/14	1720	FG-E-BAL03	11.5	9	20.4	28.0	AB
PB-HA28-B4-T7	2/5/14	1400	FG-E-BAL03	11.6	9	20.7	28.3	AB

Peeper Retrieval Log: Bioassay Batch 4								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO3 Weight (g)**	**Sign Off**
PW-1-B5-HA28-T21	2/19/14	1033	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-2-B1-HA28-T21	2/19/14	1053	FG-E-BAL03	11.7	9	20.6	28.2	AB
PW-3-B3-HA28-T21	2/19/14	1102	FG-E-BAL03	11.5	9	20.4	27.9	AB
PW-3-R7-HA28-T21	2/19/14	1110	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-5-B5-HA28-T21	2/19/14	1120	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-5-B6-HA28-T21	2/19/14	1132	FG-E-BAL03	11.6	9	20.6	28.1	AB
PW-7-B3-HA28-T21	2/19/14	1146	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-7-B6-HA28-T21	2/19/14	1155	FG-E-BAL03	11.7	9	20.5	28.1	AB
PW-G-4-HA28-T21	2/19/14	1320	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-REF-2-HA28-T21	2/19/14	1337	FG-E-BAL03	11.7	9	20.~~5~~6 AB	28.1	AB
PW-TRIB-2-HA28-T21	2/19/14	1347	FG-E-BAL03	11.7	9	20.6	28.1	AB
PW-TRIB-5-HA28-T21	2/19/14	1359	FG-E-BAL03	11.8	9	20.6	28.2	AB
PW-CTL-SS-B4-HA28-T21	2/19/14	1407	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-CTL-QS-B4-HA28-T21	2/19/14	1415	FG-E-BAL03	11.7	9	20.6	28.2	AB
PW-CTL-ERDC-B4-HA28-T21	2/19/14	1425	FG-E-BAL03	11.5	9	20.5	28.1	AB
PB-HA28-B4-T21	2/19/14	1014	FG-E-BAL03	11.6	9	20.4	28.0	AB

Peeper Retrieval Log: Bioassay Batch 5								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO3 Weight (g)**	**Sign Off**
PW-2-B2-CD10-T7	2/6/14	0948	FG-E-BAL03	11.5	9	20.4	28.1	AB
PW-3-R9-CD10-T7	2/6/14	1001	FG-E-BAL03	11.5	9	20.6	28.2	AB
PW-4-B1-CD10-T7	2/6/14	1018	FG-E-BAL03	11.5	9	20.6	28.3	AB
PW-5-B2-CD10-T7	2/6/14	1028	FG-E-BAL03	11.7	9	20.7	28.2	AB
PW-6-B1-CD10-T7	2/6/14	1040	FG-E-BAL03	11.7	9	20.7	28.3	AB
PW-7-B4-CD10-T7	2/6/14	1049	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-7-B5-CD10-T7	2/6/14	1056	FG-E-BAL03	11.6	9	20.7	28.3	AB
PW-8-B1-CD10-T7	2/6/14	1131	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-G-2-CD10-T7	2/6/14	1140	FG-E-BAL03	11.6	9	20.2	27.8	AB
PW-LAL-5-CD10-T7	2/6/14	1148	FG-E-BAL03	11.5	9	20.5	28.0	AB
PW-REF-5-CD10-T7	2/6/14	1159	FG-E-BAL03	11.~~4~~5 AB	9	20.5	28.1	AB
PW-TRIB-1-CD10-T7	2/6/14	1210	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-CTL-SS-B5-CD10-T7	2/6/14	1219	FG-E-BAL03	11.5	9	20.4	27.9	AB
PW-CTL-QS-B5-CD10-T7	2/6/14	1306	FG-E-BAL03	11.5	9	20.5	28.2	AB
PW-CTL-ERDC-B5-CD10-T7	2/6/14	1314	FG-E-BAL03	11.7	9	20.6	28.2	AB
PB-CD10-B5-T7	2/6/14	0935	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-2-B2-HA28-T7	2/6/14	1436	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-3-R9-HA28-T7	2/6/14	1444	FG-E-BAL03	11.7	9	20.6	28.2	AB
PW-4-B1-HA28-T7	2/6/14	1453	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-5-B2-HA28-T7	2/6/14	1504	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-6-B1-HA28-T7	2/6/14	1515	FG-E-BAL03	11.5	9	20.5	28.2	AB
PW-7-B4-HA28-T7	2/6/14	1524	FG-E-BAL03	11.7	9	20.6	28.2	AB
PW-7-B5-HA28-T7	2/6/14	1534	FG-E-BAL03	11.7	9	20.5	28.1	AB
PW-8-B1-HA28-T7	2/6/14	1544	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-G-2-HA28-T7	2/6/14	1550	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-LAL-5-HA28-T7	2/6/14	1604	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-REF-5-HA28-T7	2/6/14	1610	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-TRIB-1-HA28-T7	2/6/14	1619	FG-E-BAL03	11.5	9	20.3	27.8	AB
PW-CTL-SS-B5-HA28-T7	2/6/14	1625	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-CTL-QS-B5-HA28-T7	2/6/14	1633	FG-E-BAL03	11.6	9	20.4	27.9	AB
PW-CTL-ERDC-B5-HA28-T7	2/6/14	1641	FG-E-BAL03	11.5	9	20.3	27.8	AB
PB-HA28-B5-T7	2/6/14	1427	FG-E-BAL03	11.4	9	20.7	28.1	AB

Peeper Retrieval Log: Bioassay Batch 5								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)**	**Sign Off**
PW-2-B2-HA28-T21	2/20/14	1000	FG-E-BAL03	11.7	9	20.7	28.2	AB
PW-3-R9-HA28-T21	2/20/14	1010	FG-E-BAL03	11.7	9	20.7	28.2	AB
PW-4-B1-HA28-T21	2/20/14	1019	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-5-B2-HA28-T21	2/20/14	1029	FG-E-BAL03	11.7	9	20.7	28.2	AB
PW-6-B1-HA28-T21	2/20/14	1040	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-7-B4-HA28-T21	2/20/14	1056	FG-E-BAL03	11.7	9	20.4	27.9	AB
PW-7-B5-HA28-T21	2/20/14	1107	FG-E-BAL03	11.7	9	20.6	28.0	AB
PW-8-B1-HA28-T21	2/20/14	1115	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-G-2-HA28-T21	2/20/14	1124	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-LAL-5-HA28-T21	2/20/14	1135	FG-E-BAL03	11.7	9	20.6	28.0	AB
PW-REF-5-HA28-T21	2/20/14	1410	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-TRIB-1-HA28-T21	2/20/14	1425	FG-E-BAL03	11.7	9	20.5	28.0	AB
PW-CTL-SS-B5-HA28-T21	2/20/14	1436	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-CTL-QS-B5-HA28-T21	2/20/14	1448	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-CTL-ERDC-B5-HA28-T21	2/20/14	1456	FG-E-BAL03	11.5	9	20.4	27.9	AB
PB-HA28-B5-T21	2/20/14	0952	FG-E-BAL03	11.6	9	20.3	28.0	AB

Peeper Retrieval Log: Bioassay Batch 5-RE								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO3 Weight (g)**	**Sign Off**
PW-2-B2-HA28-T7-RE	4/3/14	1148	FG-E-BAL03	11.7	9	20.3	27.8	AB
PW-3-R9-HA28-T7-RE	4/3/14	1157	FG-E-BAL03	11.6	9	20.4	27.9	AB
PW-4-B1-HA28-T7-RE	4/3/14	1206	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-5-B2-HA28-T7-RE	4/3/14	1215	FG-E-BAL03	11.4	9	20.2	27.7	AB
PW-6-B1-HA28-T7-RE	4/3/14	1229	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-7-B4-HA28-T7-RE	4/3/14	1241	FG-E-BAL03	11.6	9	20.4	27.9	AB
PW-7-B5-HA28-T7-RE	4/3/14	1249	FG-E-BAL03	11.6	9	20.4	27.9	AB
PW-8-B1-HA28-T7-RE	4/3/14	1258	FG-E-BAL03	11.6	9	20.3	27.8	AB
PW-G-2-HA28-T7-RE	4/3/14	1305	FG-E-BAL03	11.6	9	20.4	27.9	AB
PW-LAL-5-HA28-T7-RE	4/3/14	1313	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-REF-5-HA28-T7-RE	4/3/14	1321	FG-E-BAL03	11.7	9	20.5	28.0	AB
PW-TRIB-1-HA28-T7-RE	4/3/14	1333	FG-E-BAL03	11.6	9	20.4	27.9	AB
PW-CTL-SS-B5-HA28-T7-RE	4/3/14	1341	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-CTL-QS-B5-HA28-T7-RE	4/3/14	1348	FG-E-BAL03	11.6	9	20.4	27.9	AB
PW-CTL-ERDC-B5-HA28-T7-RE	4/3/14	1355	FG-E-BAL03	11.6	9	20.4	27.9	AB
PB-B5-HA28-T7-RE	4/3/14	1125	FG-E-BAL03	11.5	9	20.2	27.7	AB

Peeper Retrieval Log: Bioassay Batch 5-RE

Sample ID	Retrieval Date	Retrieval Time	Balance ID	Sample Bottle Weight (g)	Approx. Peeper Sample Volume (mL)	Sample Bottle + Peeper Sample Weight (g)	Sample Bottle + Peeper Sample + 1% HNO3 Weight (g)	Sign Off
PW-2-B2-HA28-T21-RE	4/17/14	1359	FG-E-BAL03	~~11.5~~ 11.7 AB	9	~~20.4~~ 20.5 AB	28.0	AB
PW-3-R9-HA28-T21-RE	4/17/14	1429	FG-E-BAL03	11.6	9	20.4	27.8	AB
PW-4-B1-HA28-T21-RE	4/17/14	1442	FG-E-BAL03	11.7	9	20.3	27.8	AB
PW-5-B2-HA28-T21-RE	4/17/14	1451	FG-E-BAL03	11.7	9	20.5	27.9	AB
PW-6-B1-HA28-T21-RE	4/17/14	1502	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-7-B4-HA28-T21-RE	4/17/14	1530	FG-E-BAL03	11.7	9	20.5	28.0	AB
PW-7-B5-HA28-T21-RE	4/17/14	1540	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-8-B1-HA28-T21-RE	4/17/14	1550	FG-E-BAL03	11.7	9	20.5	28.0	AB
PW-G-2-HA28-T21-RE	4/17/14	1559	FG-E-BAL03	11.7	9	20.5	28.0	AB
PW-LAL-5-HA28-T21-RE	4/17/14	1612	FG-E-BAL03	11.7	9	20.5	28.0	AB
PW-REF-5-HA28-T21-RE	4/17/14	1622	FG-E-BAL03	11.7	9	20.6	28.2	AB
PW-TRIB-1-HA28-T21-RE	4/17/14	1637	FG-E-BAL03	11.7	9	20.6	28.1	AB
PW-CTL-SS-B5-HA28-T21-RE	4/17/14	1647	FG-E-BAL03	11.7	9	20.5	28.0	AB
PW-CTL-QS-B5-HA28-T21-RE	4/17/14	1652	FG-E-BAL03	11.7	9	20.4	28.0	AB
PW-CTL-ERDC-B5-HA28-T21-RE	4/17/14	1700	FG-E-BAL03	11.6	9	20.5	28.0	AB
PB-B5-HA28-T21-RE	4/17/14	1355	FG-E-BAL03	11.5	9	20.4	28.0	AB

Peeper Retrieval Log: Bioassay Batch 6								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)**	**Sign Off**
PW-1B-R2-CD10-T7	2/7/14	0919	FG-E-BAL03	11.7	9	20.5	28.1	AB
PW-1-R2-CD10-T7	2/7/14	0930	FG-E-BAL03	11.5	9	20.5	28.0	AB
PW-4-B3-CD10-T7	2/7/14	0939	FG-E-BAL03	11.~~6~~7	9	20.6	28.1	AB
PW-4-B5-CD10-T7	2/7/14	0947	FG-E-BAL03	11.5	9	20.5	28.1	AB
PW-6-B2-CD10-T7	2/7/14	0955	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-7-B1-CD10-T7	2/7/14	1004	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-8-B2-CD10-T7	2/7/14	1013	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-8-B5-CD10-T7	2/7/14	1020	FG-E-BAL03	11.5	9	20.5	28.0	AB
PW-8-B6-CD10-T7	2/7/14	1041	FG-E-BAL03	11.6	9	20.6	28.1	AB
PW-G-3-CD10-T7	2/7/14	1053	FG-E-BAL03	11.5	9	20.4	27.9	AB
PW-TRIB-6-CD10-T7	2/7/14	1100	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-CTL-SS-B6-CD10-T7	2/7/14	1120	FG-E-BAL03	11.7	9	20.6	28.1	AB
PW-CTL-QS-B6-CD10-T7	2/7/14	1127	FG-E-BAL03	11.7	9	20.4	28.1	AB
PW-CTL-ERDC-B6-CD10-T7	2/7/14	1147	FG-E-BAL03	11.6	9	20.5	28.0	AB
PB-CD10-B6-T7	2/7/14	0914	FG-E-BAL03	11.6	9	20.6	28.1	AB
PW-1B-R2-HA28-T7	2/7/14	1442	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-1-R2-HA28-T7	2/7/14	1451	FG-E-BAL03	11.5	9	20.5	28.0	AB
PW-4-B3-HA28-T7	2/7/14	1500	FG-E-BAL03	11.6	9	20.6	28.1	AB
PW-4-B5-HA28-T7	2/7/14	1510	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-6-B2-HA28-T7	2/7/14	1518	FG-E-BAL03	11.6	9	20.5	28.0	AB
PW-7-B1-HA28-T7	2/7/14	1528	FG-E-BAL03	11.7	9	20.5	28.1	AB
PW-8-B2-HA28-T7	2/7/14	1537	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-8-B5-HA28-T7	2/7/14	1544	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-8-B6-HA28-T7	2/7/14	1553	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-G-3-HA28-T7	2/7/14	1606	FG-E-BAL03	11.7	9	20.5	28.0	AB
PW-TRIB-6-HA28-T7	2/7/14	1615	FG-E-BAL03	11.5	9	20.5	28.0	AB
PW-CTL-SS-B6-HA28-T7	2/7/14	1622	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-CTL-QS-B6-HA28-T7	2/7/14	1630	FG-E-BAL03	11.6	9	20.6	28.1	AB
PW-CTL-ERDC-B6-HA28-T7	2/7/14	1636	FG-E-BAL03	11.6	9	20.3 AB ~~28.0~~ AB	28.0	AB
PW-LAL-6-HA28-T7	2/7/14	1646	FG-E-BAL03	11.5	9	20.5	28.0	AB
PB-HA28-B6-T7	2/7/14	1425	FG-E-BAL03	11.7	9	20.5	28.1	AB

Peeper Retrieval Log: Bioassay Batch 6								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO3 Weight (g)**	**Sign Off**
PW-1B-R2-HA28-T21	2/21/14	0918	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-1-R2-HA28-T21	2/21/14	0944	FG-E-BAL03	11.7	9	20.5	28.1	AB
PW-4-B3-HA28-T21	2/21/14	0958	FG-E-BAL03	11.7	9	20.6	28.1	AB
PW-4-B5-HA28-T21	2/21/14	1007	FG-E-BAL03	~~11.6~~ 11.7 AB	9	20.6	28.1	AB
PW-6-B2-HA28-T21	2/21/14	1017	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-7-B1-HA28-T21	2/21/14	1028	FG-E-BAL03	11.7	9	20.5	28.1	AB
PW-8-B2-HA28-T21	2/21/14	1045	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-8-B5-HA28-T21	2/21/14	1100	FG-E-BAL03	11.7	9	20.5	28.1	AB
PW-8-B6-HA28-T21	2/21/14	1114	FG-E-BAL03	11.7	9	20.5	28.0	AB
PW-G-3-HA28-T21	2/21/14	1123	FG-E-BAL03	11.6	9	20.4	27.9	AB
PW-TRIB-6-HA28-T21	2/21/14	1132	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-CTL-SS-B6-HA28-T21	2/21/14	1139	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-CTL-QS-B6-HA28-T21	2/21/14	1147	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-CTL-ERDC-B6-HA28-T21	2/21/14	1154	FG-E-BAL03	11.7	9	20.6	28.0	AB
PW-LAL-6-HA28-T21	2/21/14	1206	FG-E-BAL03	11.7	9	20.4	27.9	AB
PB-HA28-B6-T21	2/21/14	0840	FG-E-BAL03	11.6	9	20.6	28.1	AB

Peeper Retrieval Log: Long-term Bioassay Batch 1								
Sample ID	Retrieval Date	Retrieval Time	Balance ID	Sample Bottle Weight (g)	Approx. Peeper Sample Volume (mL)	Sample Bottle + Peeper Sample Weight (g)	Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)	Sign Off
PW-1-B5-HA42-T7-B1	2/20/15	1040	FG-E-BAL03	11.5	9	20.6	28.4	AB
PW-1B-R2-HA42-T7-B1	2/20/15	1100	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-1-R2-HA42-T7-B1	2/20/15	1108	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-4-B6-HA42-T7-B1	2/20/15	1118	FG-E-BAL03	11.6	9	20.5	28.2	AB
PW-6-B2-HA42-T7-B1	2/20/15	1127	FG-E-BAL03	11.7	9	20.5	28.1	AB
PW-7-B5-HA42-T7-B1	2/20/15	1135	FG-E-BAL03	11.5	9	20.2	27.7	AB
PW-8-B3-HA42-T7-B1	2/20/15	1143	FG-E-BAL03	11.6	9	20.4	27.7	AB
PW-G-1-HA42-T7-B1	2/20/15	1150	FG-E-BAL03	11.6	9	20.2	27.7	AB
PW-G-3-HA42-T7-B1	2/20/15	1158	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-LAL-3-HA42-T7-B1	2/20/15	1453	FG-E-BAL03	11.6	6	17.5	22.6	AB
PW-LAL-5-HA42-T7-B1	2/20/15	1516	FG-E-BAL03	11.6	9	20.4	28.1	AB
PW-REF-10b-HA42-T7-B1	2/20/15	1522	FG-E-BAL03	11.5	9	20.5	28.3	AB
PW-TRIB-3-HA42-T7-B1	2/20/15	1530	FG-E-BAL03	11.6	9	20.4	28.3	AB
PW-CTL-SS-HA42-T7-B1	2/20/15	1537	FG-E-BAL03	11.7	9	20.6	28.6	AB
PW-CTL-QS-HA42-T7-B1	2/20/15	1546	FG-E-BAL03	11.6	9	20.4	28.2	AB
PB-HA42-T7-B1	2/20/15	1608	FG-E-BAL03	11.4	9	20.2	28.0	AB
PW-1-B5-CD50-T7-B1	2/20/15	1613	FG-E-BAL03	11.6	9	20.5	28.3	AB
PW-1B-R2-CD50-T7-B1	2/20/15	1628	FG-E-BAL03	11.7	9	20.5	28.5	AB
PW-1-R2-CD50-T7-B1	2/20/15	1637	FG-E-BAL03	11.7	9	20.6	28.5	AB
PW-4-B6-CD50-T7-B1	2/20/15	1645	FG-E-BAL03	11.4	9	20.4	28.3	AB
PW-6-B2-CD50-T7-B1	2/20/15	1656	FG-E-BAL03	11.6	9	20.4	28.5	AB
PW-7-B5-CD50-T7-B1	2/20/15	1704	FG-E-BAL03	11.5	9	20.3	28.3	AB
PW-8-B3-CD50-T7-B1	2/20/15	1712	FG-E-BAL03	11.6	9	20.4	28.5	AB
PW-G-1-CD50-T7-B1	2/20/15	1719	FG-E-BAL03	11.6	9	20.3	28.3	AB
PW-G-3-CD50-T7-B1	2/20/15	1726	FG-E-BAL03	11.5	9	20.3	28.5	AB
PW-LAL-3-CD50-T7-B1	2/20/15	1732	FG-E-BAL03	11.5	9	20.3	27.5	AB
PW-LAL-5-CD50-T7-B1	2/20/15	1742	FG-E-BAL03	11.4	9	20.1	27.7	AB
PW-REF-10b-CD50-T7-B1	2/20/15	1752	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-TRIB-3-CD50-T7-B1	2/20/15	1802	FG-E-BAL03	11.4	9	20.3	27.9	AB
PW-CTL-SS-CD50-T7-B1	2/20/15	1810	FG-E-BAL03	11.4	9	20.2	28.0	AB
PW-CTL-QS-CD50-T7-B1	2/20/15	1817	FG-E-BAL03	11.5	9	20.4	28.1	AB
PB-CD50-T7-B1	2/20/15	1822	FG-E-BAL03	11.5	9	20.5	28.2	AB

Peeper Retrieval Log: Long-term Bioassay Batch 1								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)**	**Sign Off**
PW-1-B5-HA42-T21-B1	3/6/15	1132	FG-E-BAL03	11.4	9	20.4	28.1	AB
PW-1B-R2-HA42-T21-B1	3/6/15	1140	FG-E-BAL03	11.6	9	20.4	28.1	AB
PW-1-R2-HA42-T21-B1	3/6/15	1150	FG-E-BAL03	11.6	9	20.5	28.2	AB
PW-4-B6-HA42-T21-B1	3/6/15	1158	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-6-B2-HA42-T21-B1	3/6/15	1207	FG-E-BAL03	11.5	9	20.4	28.1	AB
PW-7-B5-HA42-T21-B1	3/6/15	1216	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-8-B3-HA42-T21-B1	3/6/15	1225	FG-E-BAL03	11.6	9	20.5	28.2	AB
PW-G-1-HA42-T21-B1	3/6/15	1233	FG-E-BAL03	11.7	9	20.5	28.1	AB
PW-G-3-HA42-T21-B1	3/6/15	1240	FG-E-BAL03	11.7	9	20.4	28.2	AB
PW-LAL-3-HA42-T21-B1	3/6/15	1248	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-LAL-5-HA42-T21-B1	3/6/15	1255	FG-E-BAL03	11.7	9	20.6	28.3	AB
PW-REF-10b-HA42-T21-B1	3/6/15	1437	FG-E-BAL03	11.6	9	20.4	28.1	AB
PW-TRIB-3-HA42-T21-B1	3/6/15	1445	FG-E-BAL03	11.4	9	20.3	28.0	AB
PW-CTL-SS-HA42-T21-B1	3/6/15	1454	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-CTL-QS-HA42-T21-B1	3/6/15	1500	FG-E-BAL03	11.5	9	20.4	28.1	AB
PB-HA42-T21-B1	3/6/15	1509	FG-E-BAL03	11.4	9	20.1	27.8	AB
PW-1-B5-CD50-T21-B1	3/6/15	1540	FG-E-BAL03	11.5	9	20.1	28.1	AB
PW-1B-R2-CD50-T21-B1	3/6/15	1547	FG-E-BAL03	11.5	6	17.2	22.3	AB
PW-1-R2-CD50-T21-B1	3/6/15	1619	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-4-B6-CD50-T21-B1	3/6/15	1628	FG-E-BAL03	11.7	9	20.5	28.2	AB
PW-6-B2-CD50-T21-B1	3/6/15	1635	FG-E-BAL03	11.7	9	20.3	27.9	AB
PW-7-B5-CD50-T21-B1	3/6/15	1647	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-8-B3-CD50-T21-B1	3/6/15	1655	FG-E-BAL03	11.4	9	20.5	28.0	AB
PW-G-1-CD50-T21-B1	3/6/15	1702	FG-E-BAL03	11.6	9	20.3	27.9	AB
PW-G-3-CD50-T21-B1	3/6/15	1710	FG-E-BAL03	11.7	9	20.4	28.0	AB
PW-LAL-3-CD50-T21-B1	3/6/15	1716	FG-E-BAL03	11.6	9	20.5	28.2	AB
PW-LAL-5-CD50-T21-B1	3/6/15	1724	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-REF-10b-CD50-T21-B1	3/6/15	1731	FG-E-BAL03	11.7	9	20.4	28.0	AB
PW-TRIB-3-CD50-T21-B1	3/6/15	1739	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-CTL-SS-CD50-T21-B1	3/6/15	1746	FG-E-BAL03	11.6	9	20.6	28.1	AB
PW-CTL-QS-CD50-T21-B1	3/6/15	1754	FG-E-BAL03	11.4	9	20.5	28.1	AB
PB-CD50-T21-B1	3/6/15	1800	FG-E-BAL03	11.5	9	20.2	27.8	AB
PW-1B-R2-CD50-T21-B1	3/6/15	1547	FG-E-BAL03	11.5	3	14.4	16.9	AB

Peeper Retrieval Log: Long-term Bioassay Batch 1								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)**	**Sign Off**
PW-1-B5-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–
PW-1B-R2-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–
PW-1-R2-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–
PW-4-B6-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–
PW-6-B2-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–
PW-7-B5-CD50-T42-B1	3-18-15	1727	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-8-B3-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–
PW-G-1-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–
PW-G-3-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–
PW-LAL-3-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–
PW-LAL-5-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–
PW-REF-10b-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–
PW-TRIB-3-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–
PW-CTL-SS-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–
PW-CTL-QS-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–
PB-CD50-T42-B1	–	–	FG-E-BAL03	–	–	–	–	–

Peeper Retrieval Log: Long-term Bioassay Batch 1								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)**	**Sign Off**
PW-1-B5-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-1B-R2-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-1-R2-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-4-B6-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-6-B2-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-7-B5-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-8-B3-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-G-1-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-G-3-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-LAL-3-CD50-T42-B1	3-22-15	1440	FG-E-BAL03	11.5	9	20.4	28.2	AB
PW-LAL-5-CD50-T42-B1	3-23-15	1515	FG-E-BAL03	11.5	9	20.2	27.8	AB
PW-REF-10b-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-TRIB-3-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-CTL-SS-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-CTL-QS-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PB-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—

Appendix G

Peeper Processing Records for the Upper Columbia River Long-Term (Life-Cycle) *Chironomus dilutus* and Long-Term (42-Day) *Hyalella azteca* Tests

Peeper Retrieval Log: Long-term Bioassay Batch 1

Sample ID	Retrieval Date	Retrieval Time	Balance ID	Sample Bottle Weight (g)	Approx. Peeper Sample Volume (mL)	Sample Bottle + Peeper Sample Weight (g)	Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)	Sign Off
PW-1-B5-CD50-T42-B1	3-24-15	1300	FG-E-BAL03	11.4	9	20.4	28.2	AB
PW-1B-R2-CD50-T42-B1	3-24-15	1315	FG-E-BAL03	11.4	9	20.4	28.1	AB
PW-1-R2-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-4-B6-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-6-B2-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-7-B5-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-8-B3-CD50-T42-B1	3-26-15	1700	FG-E-BAL03	see below			—	—
PW-G-1-CD50-T42-B1	3-26-15	1728	FG-E-BAL03	11.6	9	20.2	27.8	AB
PW-G-3-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-LAL-3-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-LAL-5-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-REF-10b-CD50-T42-B1	3-25-15	1008	FG-E-BAL03	11.6	9	20.1	27.9	AB
PW-TRIB-3-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-CTL-SS-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-CTL-QS-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PB-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-8-B3-CD50-T42-B1 Rep M	Clean			11.4	3	14.3	16.7	AB
PW-8-B3-CD50-T42-B1 Rep N	Fouled			11.5	3	14.3	16.9	AB
PW-8-B3-CD50-T42-B1 Rep O	Slightly Fouled			11.4	3	14.4	16.8	AB

Peeper Retrieval Log: Long-term Bioassay Batch 1								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO3 Weight (g)**	**Sign Off**
PW-1-B5-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-1B-R2-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-1-R2-CD50-T42-B1	3-27-15	1525	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-4-B6-CD50-T42-B1	3-27-15	1534	FG-E-BAL03	11.4	9	20.2	27.5	AB
PW-6-B2-CD50-T42-B1	3-27-15	1549	FG-E-BAL03	11.5	9	20.4	28.1	AB
PW-7-B5-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-8-B3-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-G-1-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-G-3-CD50-T42-B1	3-27-15	1606	FG-E-BAL03	11.4	9	20.2	27.8	AB
PW-LAL-3-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-LAL-5-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-REF-10b-CD50-T42-B1	—	—	FG-E-BAL03	—	—	—	—	—
PW-TRIB-3-CD50-T42-B1	3-27-15	~~1621~~ 1611 AB	FG-E-BAL03	11.4	9	20.3	27.9	AB
PW-CTL-SS-CD50-T42-B1	3-27-15	1622	FG-E-BAL03	11.4	9	20.3	27.9	AB
PW-CTL-QS-CD50-T42-B1	3-27-15	1635	FG-E-BAL03	11.5	9	20.3	28.0	AB
PB-CD50-T42-B1	3-27-15	1645	FG-E-BAL03	11.6	9	20.4	28.1	AB

Peeper Retrieval Log: Long-term Bioassay Batch 2								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)**	**Sign Off**
PW-2-B1-HA42-T7-B2	3/4/15	1000	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-2-R1-HA42-T7-B2	3/4/15	1012	FG-E-BAL03	11.6	9	20.5	28.1	AB
PW-3-R7-HA42-T7-B2	3/4/15	1022	FG-E-BAL03	11.6	9	20.4	28.1	AB
PW-4-B1-HA42-T7-B2	3/4/15	1030	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-5-B2-HA42-T7-B2	3/4/15	1038	FG-E-BAL03	11.5	9	20.4	28.2	AB
PW-8-B2-HA42-T7-B2	3/4/15	1048	FG-E-BAL03	11.7	9	20.7	28.3	AB
PW-LAL-2-HA42-T7-B2	3/4/15	1109	FG-E-BAL03	11.4	9	20.4	28.1	AB
PW-G-1-HA42-T7-B2	3/4/15	1118	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-G-3-HA42-T7-B2	3/4/15	1128	FG-E-BAL03	11.5	9	20.6	28.3	AB
PW-LAL-3-HA42-T7-B2	3/4/15	1140	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-LAL-5-HA42-T7-B2	3/4/15	1150	FG-E-BAL03	11.7	9	20.4	28.0	AB
PW-REF-10b-HA42-T7-B2	3/4/15	1158	FG-E-BAL03	11.7	9	20.4	28.1	AB
PW-TRIB-3-HA42-T7-B2	3/4/15	1325	FG-E-BAL03	11.6	9	20.2	27.8	AB
PW-CTL-SS-HA42-T7-B2	3/4/15	1334	FG-E-BAL03	11.6	9	20.4	27.9	AB
PW-CTL-QS-HA42-T7-B2	3/4/15	1342	FG-E-BAL03	11.7	9	20.5	28.1	AB
PB-HA42-T7-B2	3/4/15	1420	FG-E-BAL03	11.6	9	20.5	28.2	AB
PW-2-B1-CD50-T7-B2	3/4/15	1424	FG-E-BAL03	11.7	9	20.4	28.0	AB
PW-2-R1-CD50-T7-B2	3/4/15	1436	FG-E-BAL03	11.7	9	20.7	28.3	AB
PW-3-R7-CD50-T7-B2	3/4/15	1444	FG-E-BAL03	11.6	9	20.2	27.8	AB
PW-4-B1-CD50-T7-B2	3/4/15	1452	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-5-B2-CD50-T7-B2	3/4/15	1500	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-8-B2-CD50-T7-B2	3/4/15	1512	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-LAL-2-CD50-T7-B2	3/4/15	1521	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-G-1-CD50-T7-B2	3/4/15	1530	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-G-3-CD50-T7-B2	3/4/15	1537	FG-E-BAL03	11.6	9	20.6	28.2	AB
PW-LAL-3-CD50-T7-B2	3/4/15	1544	FG-E-BAL03	11.6	9	20.2	27.9	AB
PW-LAL-5-CD50-T7-B2	3/4/15	1553	FG-E-BAL03	11.6	9	20.3	28.0	AB
PW-REF-10b-CD50-T7-B2	3/4/15	1601	FG-E-BAL03	11.6	9	20.5	28.2	AB
PW-TRIB-3-CD50-T7-B2	3/4/15	1610	FG-E-BAL03	11.5	9	20.1	27.8	AB
PW-CTL-SS-CD50-T7-B2	3/4/15	1620	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-CTL-QS-CD50-T7-B2	3/4/15	1627	FG-E-BAL03	11.5	9	20.2	27.9	AB
PB-CD50-T7-B2	3/4/15	1634	FG-E-BAL03	11.5	9	20.3	28.0	AB

Peeper Retrieval Log: Long-term Bioassay Batch 2								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)**	**Sign Off**
PW-2-B1-HA42-T21-B2	3/18/15	0955	FG-E-BAL03	11.5	9	20.2	28.0	AB
PW-2-R1-HA42-T21-B2	3/18/15	1007	FG-E-BAL03	11.4	9	20.4	28.0	AB
PW-3-R7-HA42-T21-B2	3/18/15	1017	FG-E-BAL03	11.4	9	20.1	27.7	AB
PW-4-B1-HA42-T21-B2	3/18/15	1025	FG-E-BAL03	11.5	9	20.4	28.1	AB
PW-5-B2-HA42-T21-B2	3/18/15	1032	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-8-B2-HA42-T21-B2	3/18/15	1040	FG-E-BAL03	11.6	9	20.4	28.1	AB
PW-LAL-2-HA42-T21-B2	3/18/15	1048	FG-E-BAL03	11.4	9	20.3	28.1	AB
PW-G-1-HA42-T21-B2	3/18/15	1058	FG-E-BAL03	11.4	9	20.2	27.9	AB
PW-G-3-HA42-T21-B2	3/18/15	1107	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-LAL-3-HA42-T21-B2	3/18/15	1117	FG-E-BAL03	11.4	9	20.2	27.9	AB
PW-LAL-5-HA42-T21-B2	3/18/15	1126	FG-E-BAL03	11.4	9	20.2	27.8	AB
PW-REF-10b-HA42-T21-B2	3/18/15	1133	FG-E-BAL03	11.4	9	20.3	27.9	AB
PW-TRIB-3-HA42-T21-B2	3/18/15	1140	FG-E-BAL03	11.5	9	20.2	27.8	AB
PW-CTL-SS-HA42-T21-B2	3/18/15	1149	FG-E-BAL03	11.3	9	20.1	27.8	AB
PW-CTL-QS-HA42-T21-B2	3/18/15	1157	FG-E-BAL03	11.6	9	20.4	28.0	AB
PB-HA42-T21-B2	3/18/15	1214	FG-E-BAL03	11.4	9	20.3	28.0	AB
PW-2-B1-CD50-T21-B2	3/18/15	1513	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-2-R1-CD50-T21-B2	3/18/15	1524	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-3-R7-CD50-T21-B2	3/18/15	1532	FG-E-BAL03	11.5	9	20.2	27.8	AB
PW-4-B1-CD50-T21-B2	3/18/15	1539	FG-E-BAL03	11.5	9	20.4	28.1	AB
PW-5-B2-CD50-T21-B2	3/18/15	1547	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-8-B2-CD50-T21-B2	3/18/15	1555	FG-E-BAL03	11.4	9	20.3	27.9	AB
PW-LAL-2-CD50-T21-B2	3/18/15	1604	FG-E-BAL03	11.4	9	20.1	27.7	AB
PW-G-1-CD50-T21-B2	3/18/15	1612	FG-E-BAL03	11.5	9	20.2	27.8	AB
PW-G-3-CD50-T21-B2	3/18/15	1620	FG-E-BAL03	11.4	9	20.4	28.1	AB
PW-LAL-3-CD50-T21-B2	3/18/15	1626	FG-E-BAL03	11.5	9	20.1	27.8	AB
PW-LAL-5-CD50-T21-B2	3/18/15	1634	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-REF-10b-CD50-T21-B2	3/18/15	1645	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-TRIB-3-CD50-T21-B2	3/18/15	1654	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-CTL-SS-CD50-T21-B2	3/18/15	1702	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-CTL-QS-CD50-T21-B2	3/18/15	1713	FG-E-BAL03	11.5	9	20.4	28.0	AB
PB-CD50-T21-B2	3/18/15	1720	FG-E-BAL03	11.4	9	20.3	28.0	AB

Revised 4/7/15 RS

Peeper Retrieval Log: Long-term Bioassay Batch 2								
Sample ID	Retrieval Date	Retrieval Time	Balance ID	Sample Bottle Weight (g)	Approx. Peeper Sample Volume (mL)	Sample Bottle + Peeper Sample Weight (g)	Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)	Sign Off
PW-2-B1-CD50-T42-B2	4-6-15	1116	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-2-R1-CD50-T42-B2	—	—	FG-E-BAL03	—	—	—	—	—
PW-3-R7-CD50-T42-B2	4-6-15	1130	FG-E-BAL03	11.5	9	20.4	28.1	AB
PW-4-B1-CD50-T42-B2	—	—	FG-E-BAL03	—	—	—	—	—
PW-5-B2-CD50-T42-B2	—	—	FG-E-BAL03	—	—	—	—	—
PW-8-B2-CD50-T42-B2	—	—	FG-E-BAL03	—	—	—	—	—
PW-LAL-2-CD50-T42-B2	—	—	FG-E-BAL03	—	—	—	—	—
PW-G-1-CD50-T42-B2	—	—	FG-E-BAL03	—	—	—	—	—
PW-G-3-CD50-T42-B2	—	—	FG-E-BAL03	—	—	—	—	—
PW-LAL-3-CD50-T42-B2	—	—	FG-E-BAL03	—	—	—	—	—
PW-LAL-5-CD50-T42-B2	4-6-15	1140	FG-E-BAL03	11.5	9	20.3	27.8	AB
PW-REF-10b-CD50-T42-B2	4-5-15	2020	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-TRIB-3-CD50-T42-B2	—	—	FG-E-BAL03	—	—	—	—	—
PW-CTL-SS-CD50-T42-B2	—	—	FG-E-BAL03	—	—	—	—	—
PW-CTL-QS-CD50-T42-B2	—	—	FG-E-BAL03	—	—	—	—	—
PB-CD50-T42-B2	—	—	FG-E-BAL03	—	—	—	—	—

4/9/15 reviewed PS

Peeper Retrieval Log: Long-term Bioassay Batch 2

Sample ID	Retrieval Date	Retrieval Time	Balance ID	Sample Bottle Weight (g)	Approx. Peeper Sample Volume (mL)	Sample Bottle + Peeper Sample Weight (g)	Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)	Sign Off
PW-2-B1-CD50-T42-B2	–	–	FG-E-BAL03	–	–	–	–	–
PW-2-R1-CD50-T42-B2	4-8-15	0905	FG-E-BAL03	11.5	9	20.2	27.8	AB
PW-3-R7-CD50-T42-B2	–	–	FG-E-BAL03	–	–	–	–	–
PW-4-B1-CD50-T42-B2	4-8-15	0914	FG-E-BAL03	11.4	9	20.0	27.5	AB
PW-5-B2-CD50-T42-B2	4-8-15	0924	FG-E-BAL03	see below				
PW-8-B2-CD50-T42-B2	4-8-15	0951	FG-E-BAL03	~~11.6~~ 11.5 AB	9	20.3	27.9	AB
PW-LAL-2-CD50-T42-B2	4-8-15	1005	FG-E-BAL03	11.5	9	20.2	27.8	AB
PW-G-1-CD50-T42-B2	4-8-15	1014	FG-E-BAL03	11.5	9	20.2	27.8	AB
PW-G-3-CD50-T42-B2	4-8-15	1021	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-LAL-3-CD50-T42-B2	4-7-15	~~1040~~ 1140	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-LAL-5-CD50-T42-B2	–	–	FG-E-BAL03	–	–	–	–	–
PW-REF-10b-CD50-T42-B2	–	–	FG-E-BAL03	–	–	–	–	–
PW-TRIB-3-CD50-T42-B2	4-8-15	1029	FG-E-BAL03	11.6	9	20.1	27.7	AB
PW-CTL-SS-CD50-T42-B2	4-8-15	1036	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-CTL-QS-CD50-T42-B2	4-8-15	1044	FG-E-BAL03	11.5	9	20.1	27.7	AB
PB-CD50-T42-B2	4-8-15	1051	FG-E-BAL03	11.6	9	20.4	28.0	AB

Peeper with fouled membrane:
PW-5-B2-CD50-T42-B2 "A" 11.3g 3mL 14.2g 16.7g AB

Clean peeper:
PW-5-B2-CD50-T42-B2 "B" 11.4g 3mL 14.4g 16.9g AB

Peeper with orange precipitate:
PW-5-B2-CD50-T42-B2 "C" 11.4g 3 mL 14.2g 16.7g AB

Peeper Retrieval Log: Long-term Bioassay Batch 3								
Sample ID	Retrieval Date	Retrieval Time	Balance ID	Sample Bottle Weight (g)	Approx. Peeper Sample Volume (mL)	Sample Bottle + Peeper Sample Weight (g)	Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)	Sign Off
PW-3-B3-HA42-T7-B3	3/12/15	0945	FG-E-BAL03	11.4	9	20.2	27.9	AB
PW-3-R8-HA42-T7-B3	3/12/15	0953	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-4-B5-HA42-T7-B3	3/12/15	1000	FG-E-BAL03	11.5	9	20.2	27.8	AB
PW-5-B4-HA42-T7-B3	3/12/15	1007	FG-E-BAL03	11.6	9	20.3	27.8	AB
PW-6-B5-HA42-T7-B3	3/12/15	1014	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-7-B2-HA42-T7-B3	3/12/15	1024	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-G-2-HA42-T7-B3	3/12/15	1031	FG-E-BAL03	11.4	9	20.1	27.7	AB
PW-G-1-HA42-T7-B3	3/12/15	1038	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-G-3-HA42-T7-B3	3/12/15	1045	FG-E-BAL03	11.6	9	20.4	28.2	AB
PW-LAL-3-HA42-T7-B3	3/12/15	1053	FG-E-BAL03	11.4	9	20.3	28.0	AB
PW-LAL-5-HA42-T7-B3	3/12/15	1059	FG-E-BAL03	11.4	9	20.3	28.1	AB
PW-REF-10b-HA42-T7-B3	3/12/15	1107	FG-E-BAL03	11.6	9	20.4	28.1	AB
PW-TRIB-3-HA42-T7-B3	3/12/15	1114	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-CTL-SS-HA42-T7-B3	3/12/15	1121	FG-E-BAL03	11.6	9	20.4	28.1	AB
PW-CTL-QS-HA42-T7-B3	3/12/15	1129	FG-E-BAL03	11.5	9	20.3	28.0	AB
PB-HA42-T7-B3	3/12/15	1135	FG-E-BAL03	11.6	9	20.4	28.1	AB
PW-3-B3-CD50-T7-B3	3/12/15	1325	FG-E-BAL03	11.6	9	20.4	28.1	AB
PW-3-R8-CD50-T7-B3	3/12/15	1334	FG-E-BAL03	11.6	9	20.3	28.1	AB
PW-4-B5-CD50-T7-B3	3/12/15	1342	FG-E-BAL03	11.6	9	20.3	28.1	AB
PW-5-B4-CD50-T7-B3	3/12/15	1350	FG-E-BAL03	11.6	9	20.4	28.0	AB
PW-6-B5-CD50-T7-B3	3/12/15	1359	FG-E-BAL03	11.5	9	20.4	28.0	AB
PW-7-B2-CD50-T7-B3	3/12/15	1407	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-G-2-CD50-T7-B3	3/12/15	1415	FG-E-BAL03	11.5	9	20.4	28.1	AB
PW-G-1-CD50-T7-B3	3/12/15	1424	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-G-3-CD50-T7-B3	3/12/15	1432	FG-E-BAL03	11.5	9	20.2	28.0	AB
PW-LAL-3-CD50-T7-B3	3/12/15	1439	FG-E-BAL03	11.7	9	20.5	28.2	AB
PW-LAL-5-CD50-T7-B3	3/12/15	1446	FG-E-BAL03	11.7	9	20.4	28.1	AB
PW-REF-10b-CD50-T7-B3	3/12/15	1454	FG-E-BAL03	11.6	9	20.4	28.1	AB
PW-TRIB-3-CD50-T7-B3	3/12/15	1501	FG-E-BAL03	11.6	9	20.4	28.1	AB
PW-CTL-SS-CD50-T7-B3	3/12/15	1509	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-CTL-QS-CD50-T7-B3	3/12/15	1517	FG-E-BAL03	11.5	9	20.3	27.9	AB
PB-CD50-T7-B3	3/12/15	1524	FG-E-BAL03	11.4	9	20.2	27.9	AB

reviewed 3/27/15 RS

Pacific EcoRisk

COPY

Environmental Consulting and Testing

Peeper Retrieval Log: Long-term Bioassay Batch 3

Sample ID	Retrieval Date	Retrieval Time	Balance ID	Sample Bottle Weight (g)	Approx. Peeper Sample Volume (mL)	Sample Bottle + Peeper Sample Weight (g)	Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)	Sign Off
PW-3-B3-HA42-T21-B3	3/26/15	1006	FG-E-BAL03	11.4	9	20.1	27.7	AB
PW-3-R8-HA42-T21-B3	3/26/15	1015	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-4-B5-HA42-T21-B3	3/26/15	1024	FG-E-BAL03	11.4	9	20.1	27.8	AB
PW-5-B4-HA42-T21-B3	3/26/15	1045	FG-E-BAL03	11.5	9	20.3	27.9	AB
PW-6-B5-HA42-T21-B3	3/26/15	1055	FG-E-BAL03	11.5	9	20.1	27.8	AB
PW-7-B2-HA42-T21-B3	3/26/15	1104	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-G-2-HA42-T21-B3	3/26/15	1113	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-G-1-HA42-T21-B3	3/26/15	1121	FG-E-BAL03	11.4	9	20.1	27.9	AB
PW-G-3-HA42-T21-B3	3/26/15	1129	FG-E-BAL03	11.4	9	20.1	27.9	AB
PW-LAL-3-HA42-T21-B3	3/26/15	1135	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-LAL-5-HA42-T21-B3	3/26/15	1143	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-REF-10b-HA42-T21-B3	3/26/15	1150	FG-E-BAL03	11.6	9	20.3	28.0	AB
PW-TRIB-3-HA42-T21-B3	3/26/15	1159	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-CTL-SS-HA42-T21-B3	3/26/15	1205	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-CTL-QS-HA42-T21-B3	3/26/15	1212	FG-E-BAL03	11.5	9	20.1	27.8	AB
PB-HA42-T21-B3	3/26/15	1220	FG-E-BAL03	11.5	9	20.2	27.8	AB
PW-3-B3-CD50-T21-B3	3/26/15	1450	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-3-R8-CD50-T21-B3	3/26/15	1500	FG-E-BAL03	11.5	9	20.4	28.1	AB
PW-4-B5-CD50-T21-B3	3/26/15	1509	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-5-B4-CD50-T21-B3	3/26/15	1516	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-6-B5-CD50-T21-B3	3/26/15	1526	FG-E-BAL03	11.6	9	20.3	28.0	AB
PW-7-B2-CD50-T21-B3	3/26/15	1534	FG-E-BAL03	11.5	9	20.1	27.8	AB
PW-G-2-CD50-T21-B3	3/26/15	1541	FG-E-BAL03	11.4	9	20.1	27.8	AB
PW-G-1-CD50-T21-B3	3/26/15	1548	FG-E-BAL03	11.5	9	20.2	27.9	AB
PW-G-3-CD50-T21-B3	3/26/15	1555	FG-E-BAL03	11.5	9	20.2	27.8	AB
PW-LAL-3-CD50-T21-B3	3/26/15	1603	FG-E-BAL03	11.5	9	20.3	28.0	AB
PW-LAL-5-CD50-T21-B3	3/26/15	1615	FG-E-BAL03	11.5	9	20.1	27.8	AB
PW-REF-10b-CD50-T21-B3	3/26/15	1624	FG-E-BAL03	11.6	9	20.2	27.8	AB
PW-TRIB-3-CD50-T21-B3	3/26/15	1630	FG-E-BAL03	11.5	9	20.2	27.7	AB
PW-CTL-SS-CD50-T21-B3	3/26/15	1639	FG-E-BAL03	11.5	9	20.4	27.8	AB
PW-CTL-QS-CD50-T21-B3	3/26/15	1646	FG-E-BAL03	11.6	9	20.0	27.5	AB
PB-CD50-T21-B3	3/26/15	1653	FG-E-BAL03	11.5	9	20.3	27.8	AB

Peeper Retrieval Log: Long-term Bioassay Batch 3								
Sample ID	**Retrieval Date**	**Retrieval Time**	**Balance ID**	**Sample Bottle Weight (g)**	**Approx. Peeper Sample Volume (mL)**	**Sample Bottle + Peeper Sample Weight (g)**	**Sample Bottle + Peeper Sample + 1% HNO_3 Weight (g)**	**Sign Off**
PW-3-B3-CD50-T42-B3	4-16-15	1459	FG-E-BAL03	11.6	9	20.3	28.0	AB
PW-3-R8-CD50-T42-B3	4-16-15	1508	FG-E-BAL03	11.6	9	20.2	27.8	AB
PW-4-B5-CD50-T42-B3	4-16-15	1515	FG-E-BAL03	11.6	9	20.1	27.7	AB
PW-5-B4-CD50-T42-B3	4-12-15	1340	FG-E-BAL03	See Below		—	—	AB
PW-6-B5-CD50-T42-B3	4-16-15	1523	FG-E-BAL03	11.6	9	20.2	27.8	AB
PW-7-B2-CD50-T42-B3	4-16-15	1532	FG-E-BAL03	11.7	9	20.2	27.8	AB
PW-G-2-CD50-T42-B3	4-16-15	1540	FG-E-BAL03	11.7	9	20.2	27.8	AB
PW-G-1-CD50-T42-B3	4-16-15	1547	FG-E-BAL03	11.6	9	20.2	27.7	AB
PW-G-3-CD50-T42-B3	4-16-15	1555	FG-E-BAL03	11.5	9	20.3	27.8	AB
PW-LAL-3-CD50-T42-B3	4-16-15	1604	FG-E-BAL03	11.6	9	20.3	27.8	AB
PW-LAL-5-CD50-T42-B3	4-16-15	1611	FG-E-BAL03	11.6	9	20.1	27.7	AB
PW-REF-10b-CD50-T42-B3	4-16-15	1624	FG-E-BAL03	11.6	9	20.1	27.7	AB
PW-TRIB-3-CD50-T42-B3	4-16-15	1633	FG-E-BAL03	11.6	9	20.2	27.8	AB
PW-CTL-SS-CD50-T42-B3	4-16-15	1640	FG-E-BAL03	11.6	9	20.2	27.7	AB
PW-CTL-QS-CD50-T42-B3	4-16-15	1647	FG-E-BAL03	11.6	9	20.1	27.7	AB
PB-CD50-T42-B3	4-16-15	1654	FG-E-BAL03	11.6	9	20.1	27.8	AB

PW-5-B4-CD50-T42-B3 "Clean" 2 peepers
11.5g 6mL 17.2g 22.4g AB

PW-5-B4-CD50-T42-B3 "Fouled" 1 peeper
11.4g 3mL 14.2g 16.7g AB

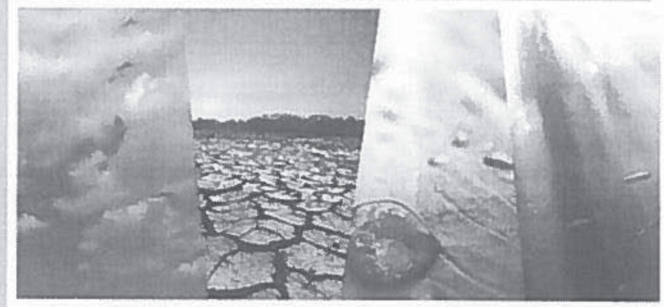
Appendix H

Pre-Test Chemical Analysis of Pacific EcoRisk Control Sediment and Quartz Sand Characteristics

Calscience Environmental Laboratories, Inc.

CALSCIENCE

WORK ORDER NUMBER: 12-05-0618



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Analytical Report For

Client: Pacific Ecorisk
Client Project Name: QAQC
Attention: Jeff Cotsifas
2250 Cordelia Road
Fairfield, CA 94534-1912

Approved for release on 05/22/2012 by:
Danielle Gonsman
Project Manager

ResultLink ▸
Email your PM ▸

ACCREDITED IN ACCORDANCE WITH nelac

7440 Lincoln Way, Garden Grove, CA 92841-1432 · TEL:(714) 895-5494 · FAX:(714) 894-7501 · www.calscience.com

Calscience Environmental Laboratories, Inc.

Contents

Client Project Name: QAQC
Work Order Number: 12-05-0618

Calscience Environmental Laboratories, Inc.

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CASE NARRATIVE

Calscience Work Order No.: 12-05-0618
Project ID: QAQC

Provided below is a narrative of our analytical effort, including any unique features or anomalies encountered as part of the analysis of the sediment samples.

Sample Condition on Receipt

One sediment sample (housed in 16-oz glass containers and a poly bag) was received for this project on May 5, 2012. The sample was transferred to the laboratory in an ice-chest with wet ice, following strict chain-of-custody (COC) procedures. The temperature of the samples upon receipt at the laboratory was 5.1°C. The sample was given laboratory identification numbers, logged into the Laboratory Information Management System (LIMS) and then stored under refrigeration pending sediment chemistry testing.

Tests Performed

Trace Metals by EPA 6020/7471A
Chlorinated Pesticides by EPA 8081A
PAHs by EPA 8270C SIM
PCB Congeners by EPA 8082A (M) GC/ECD
TOC by EPA 9060A
Organotins by Krone et al.
Total Solids by SM 2540B
Grain Size by ASTM D4464M

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Data Summary

The sample results and reporting limits were dry weight corrected.

All samples were homogenized prior to preparation and analysis.

Holding times

All holding times were met.

Calibration

Frequency and control criteria for initial and continuing calibration verifications were met.

Reporting Limits

All Method Detection Limits were met. The results were evaluated to the MDL, and where applicable, "J" flags were reported.

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Blanks

Concentrations of target analytes in the method blank were found to be below reporting limits for all testing with the following exceptions.

Nickel was found in the EPA 6020 Method Blank (below the RL, but above the MDL). The sample results have been flagged with a B-qualifier and are released with no further action since the sample results exceeded the Method Blank results by ten times or more.

Laboratory Control Samples

A Laboratory Control Sample (LCS) analysis was performed at the required frequencies, and unless otherwise noted, all parameters were within the established control limits.

Matrix Spikes

Matrix spike analyses were performed for each applicable analysis on project sample PER Control Sed and non-project samples. All parameters for the project sample were within the established control limits with the following exceptions.

The RPD for Endrin Aldehyde (by EPA 8081A) fell outside the established control limits. The results have been flagged with the appropriate qualifiers and are released with no further action since the LCS/LCSD RPD was within the established control limits.

Surrogates

Surrogate recoveries for all applicable tests and samples were within the established control limits.

Acronyms

LCS/LCSD- Laboratory Control Sample/Laboratory Control Sample Duplicate
PDS/PDSD- Post Digestion Spike/Post Digestion Spike Duplicate
ME- Marginal Exceedance
MS/MSD- Matrix Spike/Matrix Spike Duplicate
RPD- Relative Percent Difference

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Calscience Environmental Laboratories, Inc.

Analytical Report

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received:	05/08/12
Work Order No:	12-05-0618
Preparation:	N/A
Method:	EPA 9060A

Project: QAQC

Page 1 of 1

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-A**	**05/05/12 12:00**	**Sediment**	**TOC 5**	**05/10/12**	**05/10/12 15:11**	**C0510TOCL1**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.
-Results are reported on a dry weight basis.

Parameter	Result	RL	MDL	DF	Qual	Units
Carbon, Total Organic	0.17	0.066	0.016	1		%

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-06-013-719**	**N/A**	**Solid**	**TOC 5**	**05/10/12**	**05/10/12 15:11**	**C0510TOCL1**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Carbon, Total Organic	ND	0.050	0.012	1		%

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RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

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Calscience Environmental Laboratories, Inc.

Analytical Report

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Pacific Ecorisk	Date Received: 05/08/12
2250 Cordelia Road	Work Order No: 12-05-0618
Fairfield, CA 94534-1912	Preparation: N/A
	Method: SM 2540 B

Project: QAQC

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Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-A**	**05/05/12 12:00**	**Sediment**	**N/A**	**05/10/12**	**05/10/12 16:20**	**C0510TSB1**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Solids, Total	75.6	0.100	0.100	1		%

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-05-019-1,922**	**N/A**	**Solid**	**N/A**	**05/10/12**	**05/10/12 16:20**	**C0510TSB1**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Solids, Total	ND	0.100	0.100	1		%

Return to Contents

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Pacific Ecorisk	Date Received: 05/08/12
2250 Cordelia Road	Work Order No: 12-05-0618
Fairfield, CA 94534-1912	Preparation: EPA 3545
	Method: EPA 8081A
	Units: ug/kg
Project: QAQC	Page 1 of 1

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-A**	**05/05/12 12:00**	**Sediment**	**GC 51**	**05/14/12**	**05/17/12 15:09**	**120514L15**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.
-Results are reported on a dry weight basis.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Aldrin	ND	1.3	0.42	1		Endosulfan I	ND	1.3	0.35	1	
Alpha-BHC	ND	1.3	0.43	1		Endosulfan II	ND	1.3	0.37	1	
Beta-BHC	ND	1.3	0.35	1		Endosulfan Sulfate	ND	1.3	0.45	1	
Delta-BHC	ND	1.3	0.34	1		Endrin	ND	1.3	0.47	1	
Gamma-BHC	ND	1.3	0.46	1		Endrin Aldehyde	ND	1.3	0.32	1	
Chlordane	ND	13	4.3	1		Endrin Ketone	ND	1.3	0.46	1	
Dieldrin	ND	1.3	0.44	1		Heptachlor	ND	1.3	0.43	1	
Trans-nonachlor	ND	1.3	0.38	1		Heptachlor Epoxide	ND	1.3	0.47	1	
2,4'-DDD	ND	1.3	0.45	1		Methoxychlor	ND	1.3	0.43	1	
2,4'-DDE	ND	1.3	0.40	1		Toxaphene	ND	26	8.4	1	
2,4'-DDT	ND	1.3	0.40	1		Alpha Chlordane	ND	1.3	0.42	1	
4,4'-DDD	ND	1.3	0.42	1		Oxychlordane	ND	1.3	0.37	1	
4,4'-DDE	ND	1.3	0.40	1		Gamma Chlordane	ND	1.3	0.42	1	
4,4'-DDT	ND	1.3	0.44	1		Cis-nonachlor	ND	1.3	0.39	1	

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2,4,5,6-Tetrachloro-m-Xylene	88	50-130		Decachlorobiphenyl	88	50-130	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-12-858-142**	**N/A**	**Solid**	**GC 51**	**05/14/12**	**05/17/12 14:26**	**120514L15**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Aldrin	ND	1.0	0.31	1		Endosulfan I	ND	1.0	0.26	1	
Alpha-BHC	ND	1.0	0.32	1		Endosulfan II	ND	1.0	0.28	1	
Beta-BHC	ND	1.0	0.26	1		Endosulfan Sulfate	ND	1.0	0.34	1	
Delta-BHC	ND	1.0	0.26	1		Endrin	ND	1.0	0.36	1	
Gamma-BHC	ND	1.0	0.35	1		Endrin Aldehyde	ND	1.0	0.24	1	
Chlordane	ND	10	3.3	1		Endrin Ketone	ND	1.0	0.35	1	
Dieldrin	ND	1.0	0.33	1		Heptachlor	ND	1.0	0.32	1	
Trans-nonachlor	ND	1.0	0.29	1		Heptachlor Epoxide	ND	1.0	0.36	1	
2,4'-DDD	ND	1.0	0.34	1		Methoxychlor	ND	1.0	0.32	1	
2,4'-DDE	ND	1.0	0.31	1		Toxaphene	ND	20	6.3	1	
2,4'-DDT	ND	1.0	0.30	1		Alpha Chlordane	ND	1.0	0.32	1	
4,4'-DDD	ND	1.0	0.32	1		Oxychlordane	ND	1.0	0.28	1	
4,4'-DDE	ND	1.0	0.30	1		Gamma Chlordane	ND	1.0	0.32	1	
4,4'-DDT	ND	1.0	0.33	1		Cis-nonachlor	ND	1.0	0.29	1	

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2,4,5,6-Tetrachloro-m-Xylene	99	50-130		Decachlorobiphenyl	96	50-130	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Project: QAQC

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3545
Method: EPA 8082A (M)/ECD
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-A**	**05/05/12 12:00**	**Sediment**	**GC 41**	**05/17/12**	**05/21/12 16:41**	**120517F02**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.
-Results are reported on a dry weight basis.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
PCB008	ND	0.66	0.27	1		PCB126	ND	0.66	0.38	1	
PCB018	ND	0.66	0.43	1		PCB128	ND	0.66	0.32	1	
PCB027	ND	0.66	0.32	1		PCB132	ND	0.66	0.33	1	
PCB028	ND	0.66	0.34	1		PCB137	ND	0.66	0.26	1	
PCB029	ND	0.66	0.50	1		PCB138/158	ND	1.3	0.33	1	
PCB031	ND	0.66	0.24	1		PCB141	ND	0.66	0.28	1	
PCB033	ND	0.66	0.28	1		PCB149	ND	0.66	0.27	1	
PCB037	ND	0.66	0.45	1		PCB151	ND	0.66	0.22	1	
PCB044	ND	0.66	0.37	1		PCB153	ND	0.66	0.29	1	
PCB049	ND	0.66	0.28	1		PCB156	ND	0.66	0.30	1	
PCB052	ND	0.66	0.31	1		PCB157	ND	0.66	0.44	1	
PCB056	ND	0.66	0.21	1		PCB167	ND	0.66	0.24	1	
PCB060	ND	0.66	0.42	1		PCB168	ND	0.66	0.26	1	
PCB066	ND	0.66	0.29	1		PCB169/199	ND	1.3	0.25	1	
PCB070	ND	0.66	0.33	1		PCB170	ND	0.66	0.33	1	
PCB074	ND	0.66	0.34	1		PCB174	ND	0.66	0.25	1	
PCB077	ND	0.66	0.33	1		PCB177	ND	0.66	0.32	1	
PCB081	ND	0.66	0.27	1		PCB180	ND	0.66	0.41	1	
PCB087	ND	0.66	0.26	1		PCB183	ND	0.66	0.29	1	
PCB095	ND	0.66	0.23	1		PCB184	ND	0.66	0.24	1	
PCB097	ND	0.66	0.27	1		PCB187	ND	0.66	0.29	1	
PCB099	ND	0.66	0.29	1		PCB189	ND	0.66	0.28	1	
PCB101	ND	0.66	0.34	1		PCB194	ND	0.66	0.31	1	
PCB105	ND	0.66	0.32	1		PCB195	ND	0.66	0.29	1	
PCB110	ND	0.66	0.43	1		PCB200	ND	0.66	0.24	1	
PCB114	ND	0.66	0.25	1		PCB201	ND	0.66	0.29	1	
PCB118	ND	0.66	0.33	1		PCB203	ND	0.66	0.26	1	
PCB119	ND	0.66	0.23	1		PCB206	ND	0.66	0.29	1	
PCB123	ND	0.66	0.27	1		PCB209	ND	0.66	0.30	1	

Surrogates:	REC (%)	Control Limits	Qual
2,4,5,6-Tetrachloro-m-Xylene	96	25-200	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

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Calscience Environmental Laboratories, Inc.

Analytical Report

Pacific Ecorisk	Date Received: 05/08/12
2250 Cordelia Road	Work Order No: 12-05-0618
Fairfield, CA 94534-1912	Preparation: EPA 3545
	Method: EPA 8082A (M)/ECD
	Units: ug/kg
Project: QAQC	Page 2 of 2

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-15-202-16**	**N/A**	**Solid**	**GC 41**	**05/17/12**	**05/21/12 16:07**	**120517F02**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
PCB008	ND	0.50	0.20	1		PCB126	ND	0.50	0.29	1	
PCB018	ND	0.50	0.33	1		PCB128	ND	0.50	0.24	1	
PCB027	ND	0.50	0.24	1		PCB132	ND	0.50	0.25	1	
PCB028	ND	0.50	0.26	1		PCB137	ND	0.50	0.20	1	
PCB029	ND	0.50	0.38	1		PCB138/158	ND	1.0	0.25	1	
PCB031	ND	0.50	0.18	1		PCB141	ND	0.50	0.21	1	
PCB033	ND	0.50	0.22	1		PCB149	ND	0.50	0.21	1	
PCB037	ND	0.50	0.34	1		PCB151	ND	0.50	0.17	1	
PCB044	ND	0.50	0.28	1		PCB153	ND	0.50	0.22	1	
PCB049	ND	0.50	0.21	1		PCB156	ND	0.50	0.22	1	
PCB052	ND	0.50	0.23	1		PCB157	ND	0.50	0.34	1	
PCB056	ND	0.50	0.16	1		PCB167	ND	0.50	0.18	1	
PCB060	ND	0.50	0.32	1		PCB168	ND	0.50	0.19	1	
PCB066	ND	0.50	0.22	1		PCB169/199	ND	1.0	0.19	1	
PCB070	ND	0.50	0.25	1		PCB170	ND	0.50	0.25	1	
PCB074	ND	0.50	0.26	1		PCB174	ND	0.50	0.19	1	
PCB077	ND	0.50	0.25	1		PCB177	ND	0.50	0.24	1	
PCB081	ND	0.50	0.21	1		PCB180	ND	0.50	0.31	1	
PCB087	ND	0.50	0.20	1		PCB183	ND	0.50	0.22	1	
PCB095	ND	0.50	0.17	1		PCB184	ND	0.50	0.18	1	
PCB097	ND	0.50	0.20	1		PCB187	ND	0.50	0.22	1	
PCB099	ND	0.50	0.22	1		PCB189	ND	0.50	0.21	1	
PCB101	ND	0.50	0.25	1		PCB194	ND	0.50	0.24	1	
PCB105	ND	0.50	0.24	1		PCB195	ND	0.50	0.22	1	
PCB110	ND	0.50	0.32	1		PCB200	ND	0.50	0.18	1	
PCB114	ND	0.50	0.19	1		PCB201	ND	0.50	0.22	1	
PCB118	ND	0.50	0.25	1		PCB203	ND	0.50	0.20	1	
PCB119	ND	0.50	0.17	1		PCB206	ND	0.50	0.22	1	
PCB123	ND	0.50	0.20	1		PCB209	ND	0.50	0.23	1	

Surrogates:	REC (%)	Control Limits	Qual
2,4,5,6-Tetrachloro-m-Xylene	107	25-200	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

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Calscience Environmental Laboratories, Inc.

Analytical Report

Pacific Ecorisk		Date Received:	05/08/12
2250 Cordelia Road		Work Order No:	12-05-0618
Fairfield, CA 94534-1912		Preparation:	EPA 3545
		Method:	EPA 8270C SIM PAHs
		Units:	ug/kg
Project: QAQC			Page 1 of 1

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-B**	**05/05/12 12:00**	**Sediment**	**GC/MS AAA**	**05/14/12**	**05/15/12 17:42**	**120514L14**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.
-Results are reported on a dry weight basis.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Acenaphthene	ND	13	2.4	1		Fluoranthene	4.9	13	1.3	1	J
Acenaphthylene	ND	13	2.0	1		Fluorene	ND	13	1.9	1	
Anthracene	ND	13	1.1	1		Indeno (1,2,3-c,d) Pyrene	2.1	13	1.4	1	J
Benzo (a) Anthracene	2.8	13	2.1	1	J	2-Methylnaphthalene	ND	13	2.4	1	
Benzo (a) Pyrene	3.2	13	1.3	1	J	1-Methylnaphthalene	ND	13	2.6	1	
Benzo (b) Fluoranthene	2.7	13	1.3	1	J	1-Methylphenanthrene	ND	13	2.1	1	
Benzo (e) Pyrene	2.4	13	2.0	1	J	Naphthalene	ND	13	4.0	1	
Benzo (g,h,i) Perylene	2.6	13	1.2	1	J	Perylene	3.6	13	2.3	1	J
Benzo (k) Fluoranthene	2.4	13	1.8	1	J	Phenanthrene	4.5	13	1.3	1	J
Biphenyl	ND	13	1.8	1		Pyrene	6.1	13	1.3	1	J
Chrysene	2.7	13	1.5	1	J	1,6,7-Trimethylnaphthalene	ND	13	1.9	1	
Dibenz (a,h) Anthracene	ND	13	1.4	1		Dibenzothiophene	ND	13	1.8	1	
2,6-Dimethylnaphthalene	ND	13	2.2	1							

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2-Fluorobiphenyl	98	14-146		Nitrobenzene-d5	146	18-162	
p-Terphenyl-d14	104	34-148					

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-14-437-23**	**N/A**	**Solid**	**GC/MS AAA**	**05/14/12**	**05/15/12 17:16**	**120514L14**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Acenaphthene	ND	10	1.8	1		Fluoranthene	ND	10	0.98	1	
Acenaphthylene	ND	10	1.5	1		Fluorene	ND	10	1.5	1	
Anthracene	ND	10	0.81	1		Indeno (1,2,3-c,d) Pyrene	ND	10	1.1	1	
Benzo (a) Anthracene	ND	10	1.6	1		2-Methylnaphthalene	ND	10	1.8	1	
Benzo (a) Pyrene	ND	10	1.0	1		1-Methylnaphthalene	ND	10	2.0	1	
Benzo (b) Fluoranthene	ND	10	1.0	1		1-Methylphenanthrene	ND	10	1.6	1	
Benzo (e) Pyrene	ND	10	1.5	1		Naphthalene	ND	10	3.0	1	
Benzo (g,h,i) Perylene	ND	10	0.94	1		Perylene	ND	10	1.7	1	
Benzo (k) Fluoranthene	ND	10	1.4	1		Phenanthrene	ND	10	1.0	1	
Biphenyl	ND	10	1.4	1		Pyrene	ND	10	0.99	1	
Chrysene	ND	10	1.2	1		1,6,7-Trimethylnaphthalene	ND	10	1.4	1	
Dibenz (a,h) Anthracene	ND	10	1.0	1		Dibenzothiophene	ND	10	1.3	1	
2,6-Dimethylnaphthalene	ND	10	1.7	1							

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2-Fluorobiphenyl	107	14-146		Nitrobenzene-d5	151	18-162	
p-Terphenyl-d14	109	34-148					

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

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Calscience Environmental Laboratories, Inc.

Analytical Report

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Project: QAQC

Date Received:	05/08/12
Work Order No:	12-05-0618
Preparation:	EPA 3550B
Method:	Organotins by Krone et al.
Units:	ug/kg

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Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-A**	**05/05/12 12:00**	**Sediment**	**GC/MS JJJ**	**05/11/12**	**05/17/12 17:16**	**120511L14**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.
-Results are reported on a dry weight basis.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Dibutyltin	ND	4.0	0.86	1		Tetrabutyltin	ND	4.0	1.0	1	
Monobutyltin	ND	4.0	0.86	1		Tributyltin	ND	4.0	0.76	1	

Surrogates:	REC (%)	Control Limits	Qual
Tripentyltin	96	50-130	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-07-016-933**	**N/A**	**Solid**	**GC/MS JJJ**	**05/11/12**	**05/17/12 15:14**	**120511L14**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Dibutyltin	ND	3.0	0.65	1		Tetrabutyltin	ND	3.0	0.77	1	
Monobutyltin	ND	3.0	0.65	1		Tributyltin	ND	3.0	0.58	1	

Surrogates:	REC (%)	Control Limits	Qual
Tripentyltin	99	50-130	

Return to Contents

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Pacific Ecorisk		Date Received:	05/08/12
2250 Cordelia Road		Work Order No:	12-05-0618
Fairfield, CA 94534-1912		Preparation:	EPA 3050B
		Method:	EPA 6020
		Units:	mg/kg
Project: QAQC			Page 1 of 1

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-B**	**05/05/12 12:00**	**Sediment**	**ICP/MS 04**	**05/10/12**	**05/10/12 18:23**	**120510L01E**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.
-Results are reported on a dry weight basis.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Arsenic	5.33	0.132	0.0121	1		Nickel	29.2	0.132	0.0113	1	B
Cadmium	0.0473	0.132	0.0165	1	J	Selenium	ND	0.132	0.0669	1	
Chromium	25.2	0.132	0.0241	1		Silver	0.0175	0.132	0.0128	1	J
Copper	4.61	0.132	0.0143	1		Zinc	24.0	1.32	0.148	1	
Lead	3.91	0.132	0.00975	1							

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**096-10-002-2,296**	**N/A**	**Solid**	**ICP/MS 04**	**05/10/12**	**05/11/12 19:28**	**120510L01E**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Parameter	Result	RL	MDL	DF	Qual
Arsenic	ND	0.100	0.00914	1		Nickel	0.0206	0.100	0.00853	1	J
Cadmium	ND	0.100	0.0125	1		Selenium	ND	0.100	0.0506	1	
Chromium	ND	0.100	0.0182	1		Silver	ND	0.100	0.00966	1	
Copper	ND	0.100	0.0108	1		Zinc	ND	1.00	0.112	1	
Lead	ND	0.100	0.00737	1							

Return to Contents

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

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Calscience Environmental Laboratories, Inc.

Analytical Report

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Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received:	05/08/12
Work Order No:	12-05-0618
Preparation:	EPA 7471A Total
Method:	EPA 7471A

Project: QAQC

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Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
PER Control Sed.	**12-05-0618-1-A**	**05/05/12 12:00**	**Sediment**	**Mercury**	**05/09/12**	**05/09/12 16:38**	**120509L05E**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.
-Results are reported on a dry weight basis.

Parameter	Result	RL	MDL	DF	Qual	Units
Mercury	0.0118	0.0265	0.00778	1	J	mg/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-12-452-302**	**N/A**	**Solid**	**Mercury**	**05/09/12**	**05/09/12 14:00**	**120509L05E**

Comment(s): -Results were evaluated to the MDL (DL), concentrations >= to the MDL (DL) but < RL (LOQ), if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Mercury	ND	0.0200	0.00588	1		mg/kg

Return to Contents

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

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PARTICLE SIZE SUMMARY

(ASTM D422 / D4464M)

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA
94534-1912

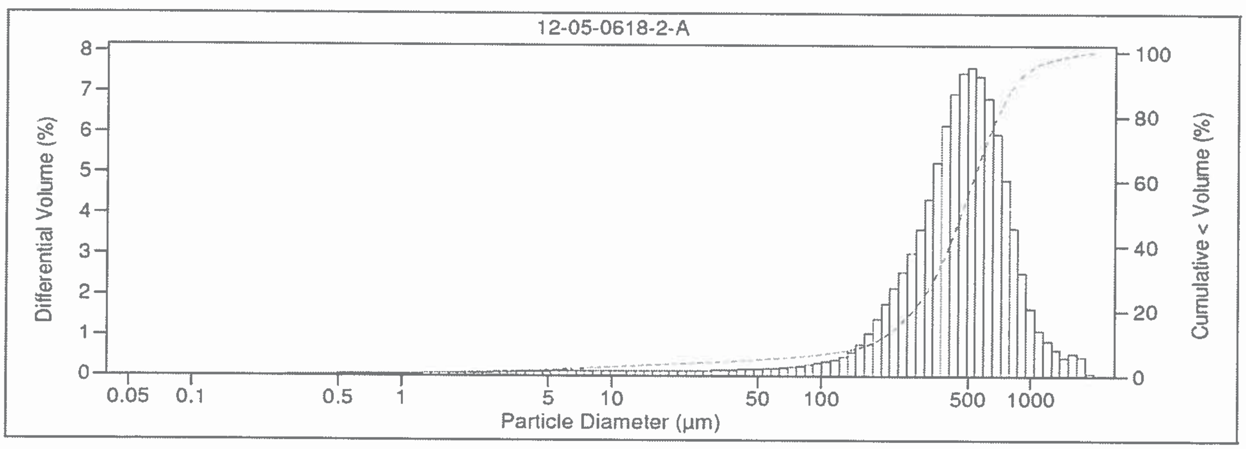
Date Sampled: 05/05/12
Date Received: 05/08/12
Work Order No: 12-05-0618
Date Analyzed: 05/09/12
Method: ASTM D4464M

Project: QAQC

Page 1 of 1

Sample ID	Depth ft	Description	Mean Grain Size mm
PER Control Sed.		Coarse Sand	0.542

Particle Size Distribution, wt by percent								
Total Gravel	Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Silt	Clay	Total Silt & Clay
2.43	4.83	37.87	37.77	9.73	2.12	3.78	1.46	5.24



Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3050B
Method: EPA 6020

Project QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
12-05-0729-12	**Solid**	**ICP/MS 04**	**05/10/12**	**05/10/12**	**120510S01A**

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Arsenic	25.00	97	97	72-132	0	0-13	
Cadmium	25.00	104	100	85-121	4	0-12	
Chromium	25.00	103	97	20-182	4	0-15	
Copper	25.00	108	95	25-157	6	0-22	
Lead	25.00	105	103	62-134	2	0-23	
Nickel	25.00	102	91	46-154	6	0-15	
Selenium	25.00	92	93	54-132	0	0-14	
Silver	12.50	90	91	78-126	1	0-15	
Zinc	25.00	79	90	23-173	3	0-18	

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RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - PDS / PDSD

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3050B
Method: EPA 6020

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	PDS / PDSD Batch Number
12-05-0729-12	Solid	ICP/MS 04	05/10/12	05/10/12	120510S01A

Parameter	SPIKE ADDED	PDS %REC	PDSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Arsenic	25.00	101	101	75-125	0	0-13	
Cadmium	25.00	98	98	75-125	0	0-12	
Chromium	25.00	95	96	75-125	1	0-15	
Copper	25.00	99	98	75-125	0	0-22	
Lead	25.00	105	103	75-125	1	0-23	
Nickel	25.00	96	97	75-125	1	0-15	
Selenium	25.00	96	97	75-125	1	0-14	
Silver	12.50	87	86	75-125	2	0-15	
Zinc	25.00	87	88	75-125	0	0-18	

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RPD - Relative Percent Difference , CL - Control Limit

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Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received:	05/08/12
Work Order No:	12-05-0618
Preparation:	N/A
Method:	EPA 9060A

Project QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
12-05-0443-6	**Sediment**	**TOC 5**	**05/10/12**	**05/10/12**	**C0510TOCS1**

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Carbon, Total Organic	3.0	95	96	75-125	1	0-25	

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RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Duplicate

Pacific Ecorisk		Date Received:	05/08/12
2250 Cordelia Road		Work Order No:	12-05-0618
Fairfield, CA 94534-1912		Preparation:	N/A
		Method:	SM 2540 B

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared:	Date Analyzed:	Duplicate Batch Number
12-05-0640-21	**Sediment**	**N/A**	**05/10/12**	**05/10/12**	**C0510TSD1**

Parameter	Sample Conc	DUP Conc	RPD	RPD CL	Qualifiers
Solids, Total	94.4	93.6	1	0-10	

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RPD - Relative Percent Difference , CL - Control Limit

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Quality Control - Spike/Spike Duplicate

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 7471A Total
Method: EPA 7471A

Project QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
12-05-0627-1	**Solid**	**Mercury**	**05/09/12**	**05/09/12**	**120509S05**

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Mercury	0.8350	92	87	71-137	5	0-14	

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RPD - Relative Percent Difference , CL - Control Limit

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Calscience Environmental Laboratories, Inc.

Quality Control - PDS / PDSD

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 7471A Total
Method: EPA 7471A

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	PDS / PDSD Batch Number
12-05-0627-1	**Solid**	**Mercury**	**05/09/12**	**05/09/12**	**120509S05**

Parameter	SPIKE ADDED	PDS %REC	PDSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Mercury	0.8350	105	106	75-125	2	0-14	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

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Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received:	05/08/12
Work Order No:	12-05-0618
Preparation:	EPA 3550B
Method:	Organotins by Krone et al.

Project QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
12-05-0477-1	**Sediment**	**GC/MS JJJ**	**05/11/12**	**05/17/12**	**120511S14**

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Tetrabutyltin	100.0	114	108	50-130	6	0-20	
Tributyltin	100.0	93	86	50-130	8	0-20	

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RPD - Relative Percent Difference , CL - Control Limit

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Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3545
Method: EPA 8081A

Project QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
PER Control Sed.	**Sediment**	**GC 51**	**05/14/12**	**05/18/12**	**120514S15**

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Aldrin	5.000	90	84	50-135	7	0-25	
Alpha-BHC	5.000	93	81	50-135	15	0-25	
Beta-BHC	5.000	92	85	50-135	8	0-25	
Delta-BHC	5.000	86	77	50-135	11	0-25	
Gamma-BHC	5.000	92	79	50-135	15	0-25	
Dieldrin	5.000	97	90	50-135	8	0-25	
4,4'-DDD	5.000	99	95	50-135	3	0-25	
4,4'-DDE	5.000	96	101	50-135	5	0-25	
4,4'-DDT	5.000	92	90	50-135	2	0-25	
Endosulfan I	5.000	97	89	50-135	9	0-25	
Endosulfan II	5.000	93	84	50-135	11	0-25	
Endosulfan Sulfate	5.000	103	91	50-135	12	0-25	
Endrin	5.000	111	99	50-135	11	0-25	
Endrin Aldehyde	5.000	81	56	50-135	37	0-25	4
Endrin Ketone	5.000	98	84	50-135	15	0-25	
Heptachlor	5.000	101	94	50-135	8	0-25	
Heptachlor Epoxide	5.000	89	82	50-135	8	0-25	
Methoxychlor	5.000	108	107	50-135	1	0-25	
Alpha Chlordane	5.000	93	89	50-135	4	0-25	
Gamma Chlordane	5.000	101	97	50-135	3	0-25	

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RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3545
Method: EPA 8270C SIM PAHs

Project QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
PER Control Sed.	**Sediment**	**GC/MS AAA**	**05/14/12**	**05/15/12**	**120514S14**

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Acenaphthene	100.0	83	85	40-160	2	0-20	
Acenaphthylene	100.0	84	85	40-160	1	0-20	
Anthracene	100.0	80	79	40-160	2	0-20	
Benzo (a) Anthracene	100.0	106	98	40-160	8	0-20	
Benzo (a) Pyrene	100.0	94	88	40-160	7	0-20	
Benzo (b) Fluoranthene	100.0	97	96	40-160	1	0-20	
Benzo (g,h,i) Perylene	100.0	87	83	40-160	5	0-20	
Benzo (k) Fluoranthene	100.0	98	93	40-160	5	0-20	
Chrysene	100.0	91	86	40-160	5	0-20	
Dibenz (a,h) Anthracene	100.0	82	80	40-160	3	0-20	
Fluoranthene	100.0	99	92	40-160	7	0-20	
Fluorene	100.0	89	91	40-160	2	0-20	
Indeno (1,2,3-c,d) Pyrene	100.0	93	90	40-160	4	0-20	
2-Methylnaphthalene	100.0	88	88	40-160	1	0-20	
1-Methylnaphthalene	100.0	93	95	40-160	1	0-20	
Naphthalene	100.0	88	88	40-160	1	0-20	
Phenanthrene	100.0	89	87	40-160	2	0-20	
Pyrene	100.0	103	104	40-160	2	0-46	

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RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: 05/08/12
Work Order No: 12-05-0618
Preparation: EPA 3545
Method: EPA 8082A (M)/ECD

Project QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
PER Control Sed.	**Sediment**	**GC 41**	**05/17/12**	**05/21/12**	**120517S02**

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
PCB008	2.000	94	101	50-200	7	0-30	
PCB018	2.000	88	97	50-200	10	0-30	
PCB028	2.000	83	101	50-200	20	0-30	
PCB044	2.000	96	110	50-200	13	0-30	
PCB052	2.000	69	93	50-200	29	0-30	
PCB066	2.000	75	82	50-200	9	0-30	
PCB077	2.000	79	84	50-200	6	0-30	
PCB101	2.000	84	91	50-200	8	0-30	
PCB105	2.000	86	93	50-200	7	0-30	
PCB118	2.000	82	90	50-200	10	0-30	
PCB126	2.000	80	83	50-200	4	0-30	
PCB128	2.000	87	93	50-200	7	0-30	
PCB138/158	2.000	76	84	50-200	9	0-30	
PCB153	2.000	86	96	50-200	11	0-30	
PCB170	2.000	74	87	50-200	16	0-30	
PCB180	2.000	79	88	50-200	11	0-30	
PCB187	2.000	77	85	50-200	10	0-30	
PCB195	2.000	94	103	50-200	10	0-30	
PCB206	2.000	83	93	50-200	11	0-30	
PCB209	2.000	85	91	50-200	7	0-30	

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RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: N/A
Work Order No: 12-05-0618
Preparation: EPA 3050B
Method: EPA 6020

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
096-10-002-2,296	Solid	ICP/MS 04	05/10/12	05/11/12	120510L01E

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Arsenic	25.00	108	106	80-120	2	0-20	
Cadmium	25.00	106	106	80-120	1	0-20	
Chromium	25.00	106	105	80-120	1	0-20	
Copper	25.00	115	111	80-120	4	0-20	
Lead	25.00	104	103	80-120	1	0-20	
Nickel	25.00	108	103	80-120	4	0-20	
Selenium	25.00	110	108	80-120	2	0-20	
Silver	12.50	94	95	80-120	2	0-20	
Zinc	25.00	107	106	80-120	1	0-20	

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RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: N/A
Work Order No: 12-05-0618
Preparation: N/A
Method: EPA 9060A

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-06-013-719	**Solid**	**TOC 5**	**05/10/12**	**05/10/12**	**C0510TOCL1**

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Carbon, Total Organic	0.60	96	96	80-120	0	0-20	

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RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received:	N/A
Work Order No:	12-05-0618
Preparation:	EPA 7471A Total
Method:	EPA 7471A

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-12-452-302	**Solid**	**Mercury**	**05/09/12**	**05/09/12**	**120509L05E**

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Mercury	0.8350	98	98	82-124	0	0-16	

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RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: N/A
Work Order No: 12-05-0618
Preparation: EPA 3550B
Method: Organotins by Krone et al.

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-07-016-933	**Solid**	**GC/MS JJJ**	**05/11/12**	**05/17/12**	**120511L14**

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Tetrabutyltin	100.0	127	126	50-130	1	0-20	
Tributyltin	100.0	100	96	50-130	4	0-20	

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RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: N/A
Work Order No: 12-05-0618
Preparation: EPA 3545
Method: EPA 8081A

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-12-858-142	**Solid**	**GC 51**	**05/14/12**	**05/18/12**	**120514L15**

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	ME CL	RPD	RPD CL	Qualifiers
Aldrin	5.000	89	104	50-135	36-149	16	0-25	
Alpha-BHC	5.000	104	106	50-135	36-149	1	0-25	
Beta-BHC	5.000	94	94	50-135	36-149	0	0-25	
Delta-BHC	5.000	87	89	50-135	36-149	2	0-25	
Gamma-BHC	5.000	102	104	50-135	36-149	2	0-25	
Dieldrin	5.000	105	105	50-135	36-149	1	0-25	
4,4'-DDD	5.000	96	97	50-135	36-149	1	0-25	
4,4'-DDE	5.000	96	98	50-135	36-149	2	0-25	
4,4'-DDT	5.000	96	98	50-135	36-149	2	0-25	
Endosulfan I	5.000	111	111	50-135	36-149	0	0-25	
Endosulfan II	5.000	97	97	50-135	36-149	0	0-25	
Endosulfan Sulfate	5.000	101	102	50-135	36-149	1	0-25	
Endrin	5.000	115	116	50-135	36-149	1	0-25	
Endrin Aldehyde	5.000	95	95	50-135	36-149	0	0-25	
Endrin Ketone	5.000	103	104	50-135	36-149	1	0-25	
Heptachlor	5.000	107	108	50-135	36-149	1	0-25	
Heptachlor Epoxide	5.000	100	100	50-135	36-149	0	0-25	
Methoxychlor	5.000	104	106	50-135	36-149	1	0-25	
Alpha Chlordane	5.000	102	102	50-135	36-149	1	0-25	
Gamma Chlordane	5.000	103	104	50-135	36-149	1	0-25	

Total number of LCS compounds : 20
Total number of ME compounds : 0
Total number of ME compounds allowed : 1
LCS ME CL validation result : Pass

RPD - Relative Percent Difference , CL - Control Limit

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Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

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Pacific Ecorisk
2250 Cordelia Road
Fairfield, CA 94534-1912

Date Received: N/A
Work Order No: 12-05-0618
Preparation: EPA 3545
Method: EPA 8270C SIM PAHs

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-14-437-23	**Solid**	**GC/MS AAA**	**05/14/12**	**05/15/12**	**120514L14**

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	ME CL	RPD	RPD CL	Qualifiers
Acenaphthene	100.0	99	98	48-108	38-118	0	0-11	
Acenaphthylene	100.0	97	96	40-160	20-180	2	0-20	
Anthracene	100.0	89	89	40-160	20-180	0	0-20	
Benzo (a) Anthracene	100.0	117	108	40-160	20-180	7	0-20	
Benzo (a) Pyrene	100.0	98	97	40-160	20-180	1	0-20	
Benzo (b) Fluoranthene	100.0	108	104	40-160	20-180	3	0-20	
Benzo (g,h,i) Perylene	100.0	92	90	40-160	20-180	2	0-20	
Benzo (k) Fluoranthene	100.0	103	107	40-160	20-180	4	0-20	
Chrysene	100.0	99	100	40-160	20-180	1	0-20	
Dibenz (a,h) Anthracene	100.0	91	89	40-160	20-180	2	0-20	
Fluoranthene	100.0	101	98	40-160	20-180	3	0-20	
Fluorene	100.0	103	102	40-160	20-180	1	0-20	
Indeno (1,2,3-c,d) Pyrene	100.0	101	99	40-160	20-180	2	0-20	
2-Methylnaphthalene	100.0	99	99	40-160	20-180	0	0-20	
1-Methylnaphthalene	100.0	108	107	40-160	20-180	1	0-20	
Naphthalene	100.0	102	103	40-160	20-180	0	0-20	
Phenanthrene	100.0	94	95	40-160	20-180	2	0-20	
Pyrene	100.0	101	99	40-160	20-180	2	0-16	

Total number of LCS compounds : 18
Total number of ME compounds : 0
Total number of ME compounds allowed : 1
LCS ME CL validation result : Pass

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RPD - Relative Percent Difference , CL - Control Limit

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Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Pacific Ecorisk		Date Received:	N/A
2250 Cordelia Road		Work Order No:	12-05-0618
Fairfield, CA 94534-1912		Preparation:	EPA 3545
		Method:	EPA 8082A (M)/ECD

Project: QAQC

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-15-202-16	**Solid**	**GC 41**	**05/17/12**	**05/21/12**	**120517F02**

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	ME CL	RPD	RPD CL	Qualifiers
PCB008	2.000	94	91	50-200	25-225	2	0-30	
PCB018	2.000	66	55	50-200	25-225	19	0-30	
PCB028	2.000	77	75	50-200	25-225	3	0-30	
PCB044	2.000	91	88	50-200	25-225	3	0-30	
PCB052	2.000	74	72	50-200	25-225	3	0-30	
PCB066	2.000	70	67	50-200	25-225	4	0-30	
PCB077	2.000	72	70	50-200	25-225	3	0-30	
PCB101	2.000	83	81	50-200	25-225	3	0-30	
PCB105	2.000	74	71	50-200	25-225	4	0-30	
PCB118	2.000	74	72	50-200	25-225	2	0-30	
PCB126	2.000	66	63	50-200	25-225	4	0-30	
PCB128	2.000	89	90	50-200	25-225	1	0-30	
PCB138/158	2.000	65	65	50-200	25-225	1	0-30	
PCB153	2.000	74	72	50-200	25-225	4	0-30	
PCB170	2.000	71	68	50-200	25-225	5	0-30	
PCB180	2.000	73	69	50-200	25-225	5	0-30	
PCB187	2.000	75	71	50-200	25-225	5	0-30	
PCB195	2.000	84	82	50-200	25-225	2	0-30	
PCB206	2.000	76	73	50-200	25-225	3	0-30	
PCB209	2.000	81	77	50-200	25-225	5	0-30	

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Total number of LCS compounds : 20
Total number of ME compounds : 0
Total number of ME compounds allowed : 1
LCS ME CL validation result : Pass

RPD - Relative Percent Difference , CL - Control Limit

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Calscience Environmental Laboratories, Inc.

Glossary of Terms and Qualifiers

Work Order Number: 12-05-0618

Qualifier	Definition
*	See applicable analysis comment.
<	Less than the indicated value.
>	Greater than the indicated value.
1	Surrogate compound recovery was out of control due to a required sample dilution. Therefore, the sample data was reported without further clarification.
2	Surrogate compound recovery was out of control due to matrix interference. The associated method blank surrogate spike compound was in control and, therefore, the sample data was reported without further clarification.
3	Recovery of the Matrix Spike (MS) or Matrix Spike Duplicate (MSD) compound was out of control due to matrix interference. The associated LCS and/or LCSD was in control and, therefore, the sample data was reported without further clarification.
4	The MS/MSD RPD was out of control due to matrix interference. The LCS/LCSD RPD was in control and, therefore, the sample data was reported without further clarification.
5	The PDS/PDSD or PES/PESD associated with this batch of samples was out of control due to a matrix interference effect. The associated batch LCS/LCSD was in control and, hence, the associated sample data was reported without further clarification.
6	Surrogate recovery below the acceptance limit.
7	Surrogate recovery above the acceptance limit.
B	Analyte was present in the associated method blank.
BU	Sample analyzed after holding time expired.
E	Concentration exceeds the calibration range.
ET	Sample was extracted past end of recommended max. holding time.
HD	The chromatographic pattern was inconsistent with the profile of the reference fuel standard.
HDH	The sample chromatographic pattern for TPH matches the chromatographic pattern of the specified standard but heavier hydrocarbons were also present (or detected).
HDL	The sample chromatographic pattern for TPH matches the chromatographic pattern of the specified standard but lighter hydrocarbons were also present (or detected).
J	Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.
ME	LCS/LCSD Recovery Percentage is within Marginal Exceedance (ME) Control Limit range.
ND	Parameter not detected at the indicated reporting limit.
Q	Spike recovery and RPD control limits do not apply resulting from the parameter concentration in the sample exceeding the spike concentration by a factor of four or greater.
SG	The sample extract was subjected to Silica Gel treatment prior to analysis.
X	% Recovery and/or RPD out-of-range.
Z	Analyte presence was not confirmed by second column or GC/MS analysis.

Solid - Unless otherwise indicated, solid sample data is reported on a wet weight basis, not corrected for % moisture. All QC results are reported on a wet weight basis.
MPN - Most Probable Number

Pacific EcoRisk
ENVIRONMENTAL CONSULTING & TESTING
2250 Cordelia Rd., Fairfield, CA 94534
(707)207-7760

12-05-0618

CalScience CHAIN-OF-CUSTODY RECORD

Client Name:	Pacific EcoRisk
Client Address:	2250 Cordelia Rd. Fairfield, CA 94534
Sampled By:	PER
Phone:	(707) 207-7760
FAX:	(707) 207-7916
Project Manager:	Jeff Cotsifas
Project Name:	QAQC
PO Number:	PER QAQC

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Container Number	Container Type	* See Analyte List	Grain Size Analysis									
1	PER Control Sed.	5/5/12	12:00	Sed	1	500ml glass	X										
2	PER Control Sed.	5/5/12	12:00	Sed	1	poly bag		X									

Correct Containers:	Yes	No	
Sample Temperature:	Ambient	Cold	Warm
Sample Preservative:	Yes	No	
Turnaround Time:	STD	Specify:	

Comments:

5 Day TAT.

RELINQUISHED BY

Signature: Steve Hummel	Signature:
Print: Steve Hummel	Print:
Organization: PER	Organization:
DATE: 5/7/12 TIME: 0900	DATE: TIME:

RECEIVED BY

Signature:	Signature: [signature]
Print:	Print: S. PATEL
Organization:	Organization: CEL
DATE: TIME:	DATE: 5/8/12 TIME: 1300

*MATRIX CODES: (SED = Sediment); (FW = Freshwater); (WW = Wastewater); (STRMW = Stormwater)

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ANALYTE LIST

0618

Pacific EcoRisk
2250 Cordelia Rd.
Fairfield, CA 94534

Project Proponent: **Pacific EcoRisk**

Project #: PER QAQC

Site #: PER Control Sed.

Standard Ocean Disposal List (SF Bay)

Analyte	Method Use	SAP Targeted MRL	
Solids, Total	EPA 160.3	±0.1%	X
Total Organic Carbon	EPA 415.1	±0.1%	X
Grain Size	ASTM 1992	±0.1%	X
Arsenic	EPA 6020	2 mg/kg	X
Cadmium	EPA 6020	0.3 mg/kg	X
Chromium	EPA 6020	5 mg/kg	X
Copper	EPA 6020	5 mg/kg	X
Lead	EPA 6020	5 mg/kg	X
Nickel	EPA 6020	5 mg/kg	X
Silver	EPA 6020	0.2 mg/kg	X
Zinc	EPA 6020	1 mg/kg	X
Mercury	EPA 7471A	0.02 mg/kg	X
Selenium	EPA 7742	0.1 mg/kg	X
2,4'-DDD	EPA 8081B	2 µg/kg	X
2,4'-DDE	EPA 8081B	2 µg/kg	X
2,4'-DDT	EPA 8081B	2 µg/kg	X
4,4'-DDD	EPA 8081B	2 µg/kg	X
4,4'-DDE	EPA 8081B	2 µg/kg	X
4,4'-DDT	EPA 8081B	2 µg/kg	X
Total DDT	EPA 8081B	2 µg/kg	X
Aldrin	EPA 8081B	2 µg/kg	X
alpha-BHC	EPA 8081B	2 µg/kg	X
beta-BHC	EPA 8081B	2 µg/kg	X
Chlordane	EPA 8081B	20 µg/kg	X
delta-BHC	EPA 8081B	2 µg/kg	X
Dieldrin	EPA 8081B	2 µg/kg	X
Endosulfan I	EPA 8081B	2 µg/kg	X
Endosulfan II	EPA 8081B	2 µg/kg	X
Endosulfan Sulfate	EPA 8081B	2 µg/kg	X
Endrin	EPA 8081B	2 µg/kg	X
Endrin Aldehyde	EPA 8081B	2 µg/kg	X
gamma-BHC (Lindane)	EPA 8081B	2 µg/kg	X
Heptachlor	EPA 8081B	2 µg/kg	X
Heptachlor Epoxide	EPA 8081B	2 µg/kg	X
Toxaphene	EPA 8081B	20 µg/kg	X
PCB 008	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 018	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 028	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 031	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 033	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 044	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 049	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 052	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 056	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 060	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 066	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 070	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 074	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 087	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 095	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 097	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 099	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 101	EPA 8082 (congeners)	0.5 µg/kg	X

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PCB 105	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 110	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 118	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 128	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 132	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 138	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 141	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 149	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 151	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 153	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 156	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 158	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 170	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 174	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 177	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 180	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 183	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 187	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 194	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 195	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 201	EPA 8082 (congeners)	0.5 µg/kg	X
PCB 203	EPA 8082 (congeners)	0.5 µg/kg	X
Acenaphthene	EPA 8270C	20 µg/kg	X
Acenaphthylene	EPA 8270C	20 µg/kg	X
Anthracene	EPA 8270C	20 µg/kg	X
Benz(a)anthracene	EPA 8270C	20 µg/kg	X
Benzo(a)pyrene	EPA 8270C	20 µg/kg	X
Benzo(e)pyrene	EPA 8270C	20 µg/kg	X
Benzo(b)fluoranthene	EPA 8270C	20 µg/kg	X
Benzo(g,h,i)perylene	EPA 8270C	20 µg/kg	X
Benzo(k)fluoranthene	EPA 8270C	20 µg/kg	X
Biphenyl	EPA 8270C	20 µg/kg	X
Chrysene	EPA 8270C	20 µg/kg	X
Dibenz(a,h)anthracene	EPA 8270C	20 µg/kg	X
Dibenzothiophene	EPA 8270C	20 µg/kg	X
Dimethylnapthalene 2, 6-	EPA 8270C	20 µg/kg	X
Fluoranthene	EPA 8270C	20 µg/kg	X
Fluorene	EPA 8270C	20 µg/kg	X
Indeno(1,2,3-cd)pyrene	EPA 8270C	20 µg/kg	X
Methylnapthalene, 1-	EPA 8270C	20 µg/kg	X
Methylnapthalene, 2-	EPA 8270C	20 µg/kg	X
Methylphenanthrene, 1-	EPA 8270C	20 µg/kg	X
Naphthalene	EPA 8270C	20 µg/kg	X
Perylene	EPA 8270C	20 µg/kg	X
Phenanthrene	EPA 8270C	20 µg/kg	X
Pyrene	EPA 8270C	20 µg/kg	X
Trimethylnapthalene, 2, 3, 5-	EPA 8270C	20 µg/kg	X
Di-butyltin	Krone 1989	10 µg/kg	X
Mono-Butyltin	Krone 1989	10 µg/kg	X
Tetra-butyltin	Krone 1989	10 µg/kg	X
Tri-butyltin	Krone 1989	10 µg/kg	X

If you have any questions regarding this request as checked, please call Jeff Cotsifas at (707)207-7760

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0618

From: (707) 207-7760
Yuliya Khadiyeva
PACIFIC ECORISK
2250 Cordelia Road

Fairfield, CA 94534

Origin ID: CCRA

FedEx Express

E

J12101112190225

Ship Date: 07MAY12
ActWgt: 15.0 LB
CAD: 2549479/INET3250

Delivery Address Bar Code

SHIP TO: (714) 895-5494 BILL SENDER

Danielle Gonsman
Calscience Environmental Labs
7440 Lincoln Way

Garden Grove, CA 92841

Ref # PER Sediment Ctl
Invoice #
PO #
Dept #

TUE - 08 MAY A1
STANDARD OVERNIGHT

TRK# 7935 3779 7856
0201

92 APVA

92841
CA-US
SNA

512G3/61A4/A278

After printing this label:
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Calscience Environmental Laboratories, Inc.

WORK ORDER #: 12-05-0618

SAMPLE RECEIPT FORM

Cooler 1 of 1

CLIENT: Pacific EcoRisk

DATE: 05/08/12

TEMPERATURE: Thermometer ID: SC2 (Criteria: 0.0 °C – 6.0 °C, not frozen)

Temperature 5.4 °C - 0.3 °C (CF) = 5.1 °C ☐ Blank ☑ Sample

☐ Sample(s) outside temperature criteria (PM/APM contacted by: ______).

☐ Sample(s) outside temperature criteria but received on ice/chilled on same day of sampling.

☐ **Received at ambient temperature, placed on ice for transport by Courier.**

Ambient Temperature: ☐ Air ☐ Filter Initial: JP

CUSTODY SEALS INTACT:

☐ Cooler ☐ ______ ☐ No (Not Intact) ☑ Not Present ☐ N/A Initial: JP

☐ Sample ☐ ______ ☐ No (Not Intact) ☑ Not Present Initial: TS

SAMPLE CONDITION:	Yes	No	N/A
Chain-Of-Custody (COC) document(s) received with samples	☑	☐	☐
COC document(s) received complete	☑	☐	☐
☐ Collection date/time, matrix, and/or # of containers logged in based on sample labels.			
☐ No analysis requested. ☐ Not relinquished. ☐ No date/time relinquished.			
Sampler's name indicated on COC	☑	☐	☐
Sample container label(s) consistent with COC	☑	☐	☐
Sample container(s) intact and good condition	☑	☐	☐
Proper containers and sufficient volume for analyses requested	☐	☑	☐
Analyses received within holding time	☑	☐	☐
pH / Res. Chlorine / Diss. Sulfide / Diss. Oxygen received within 24 hours	☐	☐	☑
Proper preservation noted on COC or sample container	☐	☐	☑
☐ Unpreserved vials received for Volatiles analysis			
Volatile analysis container(s) free of headspace	☐	☐	☑
Tedlar bag(s) free of condensation	☐	☐	☑

CONTAINER TYPE:

Solid: ☐4ozCGJ ☐8ozCGJ ☑16ozCGJ ☐Sleeve (____) ☐EnCores® ☐TerraCores® ☑ Z

Water: ☐VOA ☐VOAh ☐VOAna₂ ☐125AGB ☐125AGBh ☐125AGBp ☐1AGB ☐1AGBna₂ ☐1AGBs ☐500AGB ☐500AGJ ☐500AGJs ☐250AGB ☐250CGB ☐250CGBs ☐1PB ☐1PBna ☐500PB ☐250PB ☐250PBn ☐125PB ☐125PBznna ☐100PJ ☐100PJna₂ ☐______ ☐______ ☐______

Air: ☐Tedlar® ☐Summa® **Other:** ☐______ **Trip Blank Lot#:**______ **Labeled/Checked by:** TS

Container: C: Clear A: Amber P: Plastic G: Glass J: Jar B: Bottle Z: Ziploc/Resealable Bag E: Envelope **Reviewed by:** VC

Preservative: h: HCL n: HNO_3 na₂: $Na_2S_2O_3$ na: NaOH p: H_3PO_4 s: H_2SO_4 u: Ultra-pure znna: $ZnAc_2$+NaOH f: Filtered **Scanned by:** VC

SOP T100_090 (12/06/11)

SINCE 1949
NEW ENGLAND SILICA, INC.
1370 JOHN FITCH BLVD., RT. 5, P.O. BOX 185
SOUTH WINDSOR, CT 06074-0185
(860) 289-7778 • (800) NES-1949
FAX (860) 282-9885
www.newenglandsilica.com

Interlocking Concrete Pavers and Retaining Walls
Industrial Sands / Ground Silica / Aggregates / Consumer Products
Abrasive Blast Equipment and Supplies / DuPont Abrasives

Sands of Time

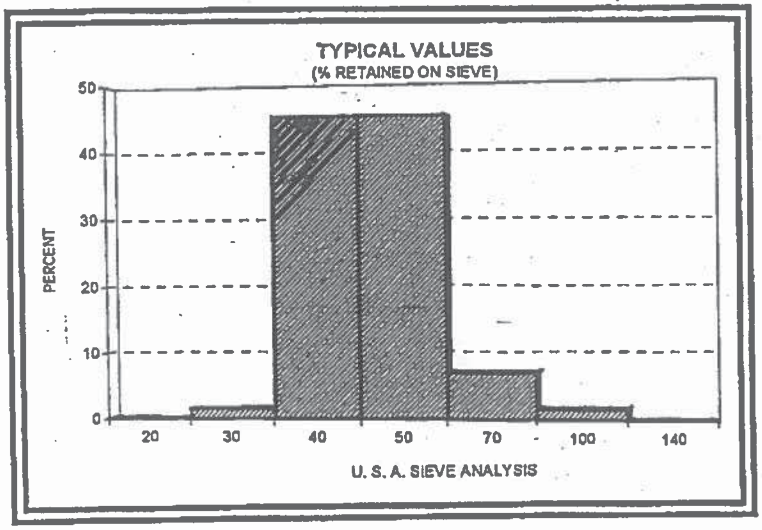
PRODUCT DATA

#45

FLINT SILICA #15

UNGROUND SILICA

PLANT: OTTAWA, ILLINOIS



USA STD SIEVE SIZE	MILLIMETERS	% RETAINED		CUMULATIVE % PASSING
		INDIVIDUAL	CUMULATIVE	
20	0.850	0.0	0.0	100.0
30	0.600	1.5	1.5	98.5
40	0.425	45.0	46.5	53.5
50	0.300	45.0	91.5	8.5
70	0.212	7.0	98.5	1.5
100	0.150	1.5	100.0	0.0
140	0.106	0.0	100.0	0.0

TYPICAL PHYSICAL PROPERTIES

AFS[(1)] ACID DEMAND (@pH-7)........................ <1
AFS GRAIN FINENESS.. 36
COLOR.. WHITE
GRAIN SHAPE.. ROUND
HARDNESS (MOHS) 7

MELTING POINT (DEGREES F).......... 3100
MINERAL .... QUARTZ
MOISTURE CONTENT (%)............... <0.05
pH 7.0
SPECIFIC GRAVITY (g/cc).................... 2.65

(1) American Foundrymen's Society

TYPICAL CHEMICAL ANALYSIS, %

SiO_2 (SILICON DIOXIDE) 99.8
Fe_2O_3 (IRON OXIDE).. 0.015
Al_2O_3 (ALUMINUM OXIDE) 0.042
TiO_2 (TITANIUM DIOXIDE)................................ 0.013

MgO (MAGNESIUM OXIDE) .... <0.01
Na_2O (SODIUM OXIDE)...................... <0.01
K_2O (POTASSIUM OXIDE)................. <0.01
LOI (LOSS ON IGNITION)....................... 0.10

TOTAL P.02

Appendix I

Data for the Determination of *Chironomus dilutus* Weights at Test Initiation (T_0) for Short-Term (10-Day) Tests

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent**
Test Material: **T_0**
Project #: **20672** Test ID #: **54721-54734**
Test Date: **01/22/14**

Initial Ashed Pan Wt Date: 1/16/14 Sign-off: CD
Dry Wt Date: 1/24/14 Sign-off: CD
Final Ashed Wt Date: 1/25/14 Sign-off: CD
Batch #: **1** Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	# of Larvae	Mean Dry Weight (mg)	Mean Ash Free Dry Weight (mg)
1	T_0-A	135.59	137.73	136.61	10	0.214	0.112
2	T_0-B	124.81	128.55	127.05	10	0.374	0.150
3	T_0-C	136.48	146.31	144.95	10	0.983	0.136
4	T_0-D	132.45	133.22	132.61	10	0.077	0.061
5	T_0-E	144.27	145.86	144.66	10	0.159	0.120
6	T_0-F	122.89	124.44	123.17	10	0.155	0.127
7	T_0-G	133.56	135.95	134.52	10	0.239	0.143
8	T_0-H	121.37	123.32	122.25	10	0.195	0.107
QA		121.02	121.05	121.14			

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent** Initial Ashed Pan Wt Date: 1/17/14 Sign-off: CD

Test Material: **T_0** Dry Wt Date: ~~1/17/14~~ 1/25/14 Sign-off: CD

Project #: **20672** Test ID #: **54735-54749** Final Ashed Wt Date: 1-27-14 Sign-off: YK

Test Date: 1/23/14 Batch #: **2** Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	# of Larvae	Mean Dry Weight (mg)	Mean Ash Free Dry Weight (mg)
1	T_0-A	134.65	135.91	135.11	10	0.126	0.080
2	T_0-B	134.88	136.15	135.50	10	0.127	0.065
3	T_0-C	129.16	129.88	129.38	10	0.072	0.050
4	T_0-D	135.89	137.10	136.22	10	0.121	0.088
5	T_0-E	123.08	124.03	123.31	10	0.095	0.072
6	T_0-F	100.13	101.15	100.32	10	0.102	0.083
7	T_0-G	136.83	137.85	137.02	10	0.102	0.083
8	T_0-H	130.39	131.76	130.79	10	0.137	0.097
QA 1		142.70	142.71	142.76			

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent**
Test Material: **T_0**
Project #: **20672** Test ID #: **54750-54764**
Test Date: 1/24/14

Initial Ashed Pan Wt Date: 1/17/14 Sign-off: CD
Dry Wt Date: 1/28/14 Sign-off: CD
Final Ashed Wt Date: 1/29/14 Sign-off: CD
Batch #: **3** Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	# of Larvae	Mean Dry Weight (mg)	Mean Ash Free Dry Weight (mg)
1	T_0 - A	131.83	132.84	132.12	10	0.101	0.072
2	T_0 - B	127.34	127.98	127.43	10	0.064	0.055
3	T_0 - C	127.27	127.97	127.38	10	0.070	0.059
4	T_0 - D	129.10	130.14	129.32	10	0.104	0.082
5	T_0 - E	131.60	132.30	131.67	10	0.070	0.063
6	T_0 - F	141.37	142.62	141.71	10	0.125	0.091
7	T_0 - G	123.18	123.94	123.25	10	0.076	0.069
8	T_0 - H	125.63	126.38	125.75	10	0.075	0.063
QA 1		124.70	124.73	124.71			

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent**
Test Material: **T_0**
Project #: **20672** Test ID #: **54765-54779**
Test Date: 1/29/14

Initial Ashed Pan Wt Date: 1/17/14 Sign-off: CD
Dry Wt Date: 1/31/14 Sign-off: CD
Final Ashed Wt Date: 2/3/14 Sign-off: CD
Batch #: 4 Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	# of Larvae	Mean Dry Weight (mg)	Mean Ash Free Dry Weight (mg)
1	T_0-A	126.89	128.73	127.65	10	0.184	0.108
2	T_0-B	119.60	122.43	121.59	10	0.283	0.084
3	T_0-C	136.43	137.40	136.68	10	0.097	0.072
4	T_0-D	124.57	125.99	125.06	10	0.142	0.093
5	T_0-E	117.89	119.68	118.87	10	0.179	0.081
6	T_0-F	133.81	134.91	134.19	10	0.110	0.072
7	T_0-G	127.57	131.01	130.09	10	0.344	0.092
8	T_0-H	129.55	130.94	130.03	10	0.139	0.091
QA 1		118.83	118.84	118.78			

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent**
Test Material: T_0
Project #: **20672** Test ID #: **54780-54794**
Test Date: ~~1/31/14~~ CO 1/30/14

Initial Ashed Pan Wt Date: 1/17/14 Sign-off: CO
Dry Wt Date: 2/2/14 Sign-off: CO
Final Ashed Wt Date: 2/4/14 Sign-off: CO
Batch #: 5 Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	# of Larvae	Mean Dry Weight (mg)	Mean Ash Free Dry Weight (mg)
1	T_0-A	126.15	127.18	126.55	10	0.103	0.063
2	T_0-B	133.83	134.67	134.13	10	0.084	0.054
3	T_0-C	130.48	131.45	130.66	10	0.097	0.079
4	T_0-D	121.23	122.61	122.00	10	0.138	0.061
5	T_0-E	132.51	134.50	133.77	10	0.199	0.073
6	T_0-F	118.65	119.50	118.91	10	0.085	0.059
7	T_0-G	133.41	135.44	134.79	10	0.203	0.065
8	T_0-H	125.45	127.05	126.37	10	0.160	0.068
QA 1		134.20	134.21	134.24			

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent** Initial Ashed Pan Wt Date: 1/17/14 Sign-off: CD

Test Material: **T_0** Dry Wt Date: 2/2/14 Sign-off: CD

Project #: **20672** Test ID #: **54795-54808** Final Ashed Wt Date: 2/4/14 Sign-off: CD

Test Date: 1/31/14 Batch #: **6** Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	# of Larvae	Mean Dry Weight (mg)	Mean Ash Free Dry Weight (mg)
1	T_0-A	128.68	129.17	128.89	10	0.049	0.028
2	T_0-B	121.51	121.90	121.65	10	0.039	0.025
3	T_0-C	120.80	121.34	121.10	10	0.054	0.024
4	T_0-D	137.19	137.68	137.42	10	0.049	0.026
5	T_0-E	119.64	120.50	120.19	10	0.086	0.031
6	T_0-F	129.53	130.12	129.82	10	0.059	0.030
7	T_0-G	118.77	119.48	119.22	10	0.071	0.026
8	T_0-H	124.~~14~~69	125.29	125.00	10	0.060	0.029
QA1		~~124.69~~ 124.14	124.15	124.14			

Appendix J

Test Data for the Evaluation of Upper Columbia River Sediment Short-Term (10-Day) Toxicity to *Chironomus dilutus*: Batch 1

10-Day *Chironomus dilutus* Sediment Toxicity Test Data

Client: Exponent — Org. Supplier: PER — Randomization: C.12.7
Project#: 20672 — Org. Log #: 7827, 43, 45 — Batch #: 1
Test ID#: 54732 — Org. Age/Size: 9-10 d

Test Material: CTL-SS-B1

Day	Date	Test Material (CTL-SS-B1)	Parameter	Value	Meter ID	Sign-off
0	1/22/14	# Live Organisms	pH	8.03	PH19	AM Change: PQ
		A 10, B 10, C 10, D 10	D.O. (mg/L)	8.6	RD07	WQ: PQ
		E 10, F 10, G 10, H 10	Conductivity (µS/cm)	352	EC09	Initiation Time: 0900
			Alkalinity (mg/L)	67	PH18/DT8	Initiation Counts: PQ
			Hardness (mg/L)	92	0.8	Confirmation Counts: CB
			Ammonia (mg/L)	<1.00	DR3800	PM Feed: PQ
			Temp. (°C)	22.0	84A	
1	1/23/14	# of Mortalities	Old D.O. (mg/L)	6.6	RD04	AM Change: KB WQ: KB
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.9	RD04	Mortality Counts: KB
		E 0, F 0, G 0, H 0	Temp. (°C)	22.2	84A	PM Change: KB PM Feed: KB
2	1/24/14	# of Mortalities	Old D.O. (mg/L)	5.2	RD07	AM Change: DS WQ: [illegible]
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.5	RD07	Mortality Counts: [illegible]
		E 0, F 0, G 0, H 0	Temp. (°C)	22.6	~~YSI~~ 84A	PM Change: [illegible] PM Feed: [illegible]
3	1/25/14	# of Mortalities	Old D.O. (mg/L)	4.7	RD07	AM Change: CB WQ: CB
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.5	RD07	Mortality Counts: CB
		E 0, F 0, G 0, H 0	Temp. (°C)	22.6	82A	PM Change: [illegible] PM Feed: [illegible]
4	1/26/14	# of Mortalities	Old D.O. (mg/L)	4.8	RD07	AM Change: PQ WQ: PQ
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.9	RD07	Mortality Counts: PQ
		E 0, F 0, G 0, H 0	Temp. (°C)	22.6	84A	PM Change: PQ PM Feed: PQ
5	1.27.14	# of Mortalities	Old D.O. (mg/L)	6.5	RD05	AM Change: SVV WQ: EKL
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	6.8	RD05	Mortality Counts: SVV
		E 0, F 0, G 0, H 0	Temp. (°C)	22.9	84A	PM Change: EKL PM Feed: SVV
6	1/28/14	# of Mortalities	Old D.O. (mg/L)	4.2	RD07	AM Change: MF WQ: PQ
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	6.6	RD07	Mortality Counts: MF
		E 0, F 0, G 0, H 0	Temp. (°C)	23.1	84A	PM Change: PQ PM Feed: SVV
7	1/29/14	# of Mortalities	Old D.O. (mg/L)	5.0	RD07	AM Change: MF WQ: MF
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	6.8	RD07	Mortality Counts: MF
		E 0, F 0, G 0, H 0	Temp. (°C)	23.3	84A	PM Change: CB PM Feed: MF
8	* 1.30.14	# of Mortalities	Old D.O. (mg/L)	5.0	RD07	AM Change: SVV WQ: PQ
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.0	RD07	Mortality Counts: PQ
		E 0, F 0, G 0, H 0	Temp. (°C)	22.9	82A	PM Change: PQ PM Feed: SVV
9	1.31.14	# of Mortalities	Old D.O. (mg/L)	7.7	RD07	AM Change: PQ WQ: PQ/KP
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.9	RD07	Mortality Counts: PQ
		E 0, F 0, G 0, H 0	Temp. (°C)	23.1	84A	PM Change: PQ PM Feed: KP
10	2/1/14	# Alive	pH	7.61	PH15	WQ: CB
		A 10, B 9, C 10, D 10	D.O. (mg/L)	8.1	RD07	Termination Counts: CB
		E 8, F 9, G 10, H 10	Conductivity (µS/cm)	360	EC04	Termination Time: 905
			Alkalinity (mg/L)	76	PH18/DT8	
			Hardness (mg/L)	110	0.8	
			Ammonia (mg/L)	<1.00	DR3800	
			Temp. (°C)	23.3	84A	

* aeration initiated based on measured PM D.O. of 1.9 mg/L

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent** Initial Ashed Pan Wt Date: 1/18/14 Sign-off: CD

Test Material: **CTL-SS-B1** Dry Wt Date: 2/3/14 Sign-off: CD

Project #: **20672** Test ID #: **54732** Final Ashed Wt Date: 2/5/14 Sign-off: CD

Test Date: 1-22-14 Batch #: 1 Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	Initial # of Organisms Loaded	# of Live Organisms			Mean Dry Weight (mg)	Biomass Dry Weight (mg)	Mean Ash Free Dry Wt. (mg)	Biomass Ash Free Dry Wt. (mg)
						Larvae	Pupae	Adult				
89	CTL-SS-B1 A	131.93	153.41	138.42	10	10	–	–	2.148	2.148	1.499	1.499
90	CTL-SS-B1 B	120.74	141.50	126.77	10	9	–	–	2.307	2.076	1.637	1.473
91	CTL-SS-B1 C	129.95	153.09	~~136.6~~ 137.53	10	10	–	–	2.314	2.314	1.556	1.556
92	CTL-SS-B1 D	128.43	151.72	~~137.4~~ CD 134.90	10	10	–	–	2.329	2.329	1.682	1.682
93	CTL-SS-B1 E	145.89	168.55	152.54	10	8	–	–	2.833	2.266	2.001	1.601
94	CTL-SS-B1 F	134.41	157.40	140.42	10	9	–	–	2.554	2.299	1.887	1.698
95	CTL-SS-B1 G	130.88	151.37	136.66	10	10	–	–	2.049	2.049	1.471	1.471
96	CTL-SS-B1 H	131.67	153.25	138.56	10	10	–	–	2.158	2.158	1.469	1.469
QA 10		136.60	136.58	136.63								

10-Day *Chironomus dilutus* Sediment Toxicity Test Data

Client: Exponent | Org. Supplier: PER | Randomization: C.12.10
Project#: 20672 | Org. Log #: 7827, 43, 45 | Batch #: 1
Test ID#: 54733 | Org. Age/Size: 9-10d

Day	Date	Test Material CTL-QS-B1	Parameter	Value	Meter ID	Sign-off
0	1/22/14	# Live Organisms: A 10, B 10, C 10, D 10, E 10, F 10, G 10, H 10	pH	7.99	PH19	AM Change: PA
			D.O. (mg/L)	8.9	RD07	WQ: PA
			Conductivity (µS/cm)	327	EC09	Initiation Time: 0900
			Alkalinity (mg/L)	60	pH18/DT8	Initiation Counts: PA
			Hardness (mg/L)	90	0.8	Confirmation Counts: CB
			Ammonia (mg/L)	<1.00	DR3800	PM Feed: PA
			Temp. (°C)	~~21.5~~ 22.1	84A	
1	1/23/14	# of Mortalities: A 0, B 0, C 0, D 0, E 0, F 0, G 0, H 0	Old D.O. (mg/L)	6.0	RD04	AM Change: KB WQ: KB
			New D.O. (mg/L)	7.9	RD04	Mortality Counts: KB
			Temp. (°C)	22.6	84A	PM Change: KB PM Feed: KB
2	1/24/14	# of Mortalities: A 0, B 0, C 0, D 0, E 0, F 0, G 0, H 0	Old D.O. (mg/L)	5.4	RD07	AM Change: DS WQ: 2
			New D.O. (mg/L)	7.4	RD07	Mortality Counts: 2
			Temp. (°C)	22.7	84A	PM Change: 2 PM Feed: 2
3	1/25/14	# of Mortalities: A 0, B 0, C 0, D 0, E 0, F 0, G 0, H 0	Old D.O. (mg/L)	4.6	RD07	AM Change: CB WQ: CB
			New D.O. (mg/L)	7.2	RD07	Mortality Counts: CB
			Temp. (°C)	22.6	82A	PM Change: 2 PM Feed: 2
4	1/26/14	# of Mortalities: A 0, B 0, C 0, D 0, E 0, F 0, G 0, H 0	Old D.O. (mg/L)	4.7	RD07	AM Change: PA WQ: PA
			New D.O. (mg/L)	7.9	RD07	Mortality Counts: PA
			Temp. (°C)	22.6	84A	PM Change: PA PM Feed: PA
5	1.27.14	# of Mortalities: A 0, B 0, C 0, D 0, E 0, F 0, G 0, H 0	Old D.O. (mg/L)	5.2	RD05	AM Change: SVV WQ: SKL
			New D.O. (mg/L)	7.1	RD05	Mortality Counts: SVV
			Temp. (°C)	23.0	84A	PM Change: SKL PM Feed: SVV
6	1/28/14	# of Mortalities: A 0, B 0, C 0, D 0, E 0, F 0, G 0, H 0	Old D.O. (mg/L)	4.9	RD07	AM Change: MF WQ: PA
			New D.O. (mg/L)	7.1	RD07	Mortality Counts: MF
			Temp. (°C)	23.0	84A	PM Change: PA PM Feed: SVV
7	1/29/14 *	# of Mortalities: A 0, B 0, C 0, D 0, E 0, F 0, G 0, H 0	Old D.O. (mg/L)	4.8	RD07	AM Change: MF WQ: MF
			New D.O. (mg/L)	7.0	RD07	Mortality Counts: MF
			Temp. (°C)	23.8	84A	PM Change: MA PM Feed: MF
8	1.30.14	# of Mortalities: A 0, B 0, C 0, D 0, E 0, F 0, G 0, H 0	Old D.O. (mg/L)	7.7	RD07	AM Change: SVV WQ: PA
			New D.O. (mg/L)	8.0	RD07	Mortality Counts: PA
			Temp. (°C)	23.3	82A	PM Change: PA PM Feed: SVV
9	1.31.14	# of Mortalities: A 0, B 0, C 0, D 0, E 0, F 0, G 0, H 0	Old D.O. (mg/L)	7.6	RD07	AM Change: PA WQ: PA/MA
			New D.O. (mg/L)	8.1	RD07	Mortality Counts: PA
			Temp. (°C)	23.3	84A	PM Change: PA PM Feed: KB
10	2/1/14	# Alive: A 10, B 10, C 10, D 10, E 10, F 8, G 9, H 10	pH	7.70	PH15	WQ: CB
			D.O. (mg/L)	8.3	RD07	Termination Counts: CB
			Conductivity (µS/cm)	332	EC04	Termination Time: ~~900~~ 930
			Alkalinity (mg/L)	✓ 78	pH10/DT8	
			Hardness (mg/L)	✓ 98	0.8	
			Ammonia (mg/L)	1.17	DR3800	
			Temp. (°C)	23.3	84A	

* aeration initiated based on measured PM D.O. of 1.3 mg/L

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent**
Test Material: **CTL-QS-B1**
Project #: **20672** Test ID #: **54733**
Test Date: 1-22-14

Initial Ashed Pan Wt Date: 1/18/14 Sign-off: CD
Dry Wt Date: 2/3/14 Sign-off: CD
Final Ashed Wt Date: 2/5/14 Sign-off: CD
Batch #: 1 Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	Initial # of Organisms Loaded	# of Live Organisms			Mean Dry Weight (mg)	Biomass Dry Weight (mg)	Mean Ash Free Dry Wt. (mg)	Biomass Ash Free Dry Wt. (mg)
						Larvae	Pupae	Adult				
97	CTL-QS-B1 A	144.48	160.65	147.23	10	10	–	–	1.617	1.617	1.342	1.342
98	CTL-QS-B1 B	148.61	163.63	150.34	10	10	–	–	1.502	1.502	1.329	1.329
99	CTL-QS-B1 C	126.64	144.43	129.57	10	10	–	–	1.779	1.779	1.486	1.486
100	CTL-QS-B1 D	133.13	152.72	138.11	10	10	–	–	1.959	1.959	1.461	1.461
101	CTL-QS-B1 E	133.49	149.62	136.38	10	10	–	–	1.613	1.613	1.324	1.324
102	CTL-QS-B1 F	122.17	134.50	123.54	10	8	–	–	1.541	1.233	1.370	1.096
103	CTL-QS-B1 G	123.02	137.66	125.21	10	9	–	–	1.627	1.464	1.383	1.245
104	CTL-QS-B1 H	142.10	157.31	144.13	10	10	–	–	1.521	1.521	1.318	1.318
QA 11		125.90	125.90	126.02								

10-Day *Chironomus dilutus* Sediment Toxicity Test Data

Client: **Exponent** Org. Supplier: **PER** Randomization: C.12.4

Project#: **20672** Org. Log #: 7827, 43, 45 Batch #: **1**

Test ID#: **54734** Org. Age/Size: 9-10 d

Day	Date	Test Material CTL-ERDC-B1	Parameter	Value	Meter ID	Sign-off
0	1/22/14	# Live Organisms	pH	7.58	PH19	AM Change: PA
		A 10 B 10 C 10 D 10	D.O. (mg/L)	8.7	RD07	WQ: PA
		E 10 F 16 G 10 H 10	Conductivity (µS/cm)	336	EC09	Initiation Time: 0900
			Alkalinity (mg/L)	69	pH18/DT8	Initiation Counts: PA
			Hardness (mg/L)	88	0.8	Confirmation Counts: AA
			Ammonia (mg/L)	2.51	DR3800	PM Feed: PA
			Temp. (°C)	22.1	84A	
1	1/23/14	# of Mortalities	Old D.O. (mg/L)	5.4	RD04	AM Change: MB WQ: MB
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.9	RD04	Mortality Counts: MB
		E 0 F 0 G 0 H 0	Temp. (°C)	22.1	84A	PM Change: MB PM Feed: MB
2	1/24/14	# of Mortalities	Old D.O. (mg/L)	5.7	RD07	AM Change: JS WQ: JL
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.1	RD07	Mortality Counts: JL
		E 0 F 0 G 0 H 0	Temp. (°C)	22.9	84A	PM Change: JL PM Feed: JL
3	1/25/14	# of Mortalities	Old D.O. (mg/L)	4.3	RD07	AM Change: AA WQ: AA
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.3	RD07	Mortality Counts: AA
		E 0 F 0 G 0 H 0	Temp. (°C)	22.8	82A	PM Change: JL PM Feed: JL
4	1/26/14	# of Mortalities	Old D.O. (mg/L)	5.2	RD07	AM Change: PA WQ: PA
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.8	RD07	Mortality Counts: PA
		E 0 F 0 G 0 H 0	Temp. (°C)	22.9	84A	PM Change: PA PM Feed: PA
5	1.27.14	# of Mortalities	Old D.O. (mg/L)	6.5	RD05	AM Change: SVV WQ: SVV
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.1	RD05	Mortality Counts: SVV
		E 0 F 0 G 0 H 0	Temp. (°C)	22.9	84A	PM Change: SVV PM Feed: SVV
6	1/28/14	# of Mortalities	Old D.O. (mg/L)	4.6	RD07	AM Change: MF WQ: PA
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.3	RD07	Mortality Counts: MF
		E 0 F 0 G 0 H 0	Temp. (°C)	23.1	84A	PM Change: PA PM Feed: SVV
7	1/29/14 *	# of Mortalities	Old D.O. (mg/L)	4.5	RD07	AM Change: MF WQ: MF
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	6.7	RD07	Mortality Counts: MF
		E 0 F 0 G 0 H 0	Temp. (°C)	23.4	84A	PM Change: AA PM Feed: MF
8	1.30.14	# of Mortalities	Old D.O. (mg/L)	7.8	RD07	AM Change: SVV WQ: PA
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	8.0	RD07	Mortality Counts: PA
		E 0 F 0 G 0 H 0	Temp. (°C)	23.3	82A	PM Change: PA PM Feed: SVV
9	1.31.14	# of Mortalities	Old D.O. (mg/L)	7.6	RD07	AM Change: PA WQ: PA/KP
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	8.1	RD07	Mortality Counts: PA
		E 0 F 0 G 0 H 0	Temp. (°C)	23.3	84A	PM Change: PA PM Feed: KP
10	2/1/14	# Alive	pH	7.81	PH15	WQ: AA
		A 9 B 8 C 9 D 10	D.O. (mg/L)	8.2	RD07	Termination Counts: MM
		E 10 F 10 G 10 H 10	Conductivity (µS/cm)	290	EC04	Termination Time: 900
			Alkalinity (mg/L)	58	pH18/DT8	
			Hardness (mg/L)	82	0.8	
			Ammonia (mg/L)	2.74	DR3800	
			Temp. (°C)	23.3	84A	

* aeration initiated based on measured P.M. D.O. of 1.7mg/L

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent**
Test Material: **CTL-ERDC-B1**
Project #: **20672** Test ID #: **54734**
Test Date: 1-22-14

Initial Ashed Pan Wt Date: 1/18/14 Sign-off: CD
Dry Wt Date: 2/3/14 Sign-off: CD
Final Ashed Wt Date: 2/5/14 Sign-off: CD
Batch #: 1 Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	Initial # of Organisms Loaded	# of Live Organisms			Mean Dry Weight (mg)	Biomass Dry Weight (mg)	Mean Ash Free Dry Wt. (mg)	Biomass Ash Free Dry Wt. (mg)
						Larvae	Pupae	Adult				
105	CTL-ERDC-B1 A	124.94	145.58	131.77	10	9	–	–	2.293	2.064	1.534	1.381
106	CTL-ERDC-B1 B	131.12	151.06	137.00	10	8	–	–	2.493	1.994	1.758	1.406
107	CTL-ERDC-B1 C	130.48	147.27	135.80	10	9	–	–	1.866	1.679	1.274	1.147
108	CTL-ERDC-B1 D	138.16	160.27	145.69	10	10	–	–	2.211	2.211	1.458	1.458
109	CTL-ERDC-B1 E	120.49	142.66	126.75	10	10	–	–	2.217	2.217	1.591	1.591
110	CTL-ERDC-B1 F	131.64	152.37	138.09	10	10	–	–	2.073	2.073	1.428	1.428
111	CTL-ERDC-B1 G	132.38	151.22	138.27	10	10	–	–	1.884	1.884	1.295	1.295
112	CTL-ERDC-B1 H	122.12	145.23	129.29	10	10	–	–	2.311	2.311	1.594	1.594
QA 12		129.34	129.32	129.39								

10-Day *Chironomus dilutus* Sediment Toxicity Test Data

Client: Exponent Org. Supplier: PER Randomization: C.12.1

Project#: 20672 Org. Log #: 7827, 7845, 7843 Batch #: 1

Test ID#: 54721 Org. Age/Size: 9-10 days

Day	Date	Test Material SE-1-R1	Parameter	Value	Meter ID	Sign-off:
0	1/22/14	# Live Organisms	pH	8.10	PH19	AM Change: PA
		A 10, B 10, C 10, D 10	D.O. (mg/L)	8.9	RD07	WQ: PA
		E 10, F 10, G 10, H 10	Conductivity (µS/cm)	336	EC09	Initiation Time: 0900
			Alkalinity (mg/L)	62	PH18/DT8	Initiation Counts: CG
			Hardness (mg/L)	91	0.8	Confirmation Counts: PA
			Ammonia (mg/L)	<1.00	DR3800	PM Feed: PA
			Temp. (°C)	22.0	84A	
1	1/23/14	# of Mortalities	Old D.O. (mg/L)	6.1	RD04	AM Change: KB WQ: KB
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.5	RD04	Mortality Counts: KB
		E 0, F 0, G 0, H 0	Temp. (°C)	22.1	84A	PM Change: KB PM Feed: KB
2	1/24/14	# of Mortalities	Old D.O. (mg/L)	5.4	RD07	AM Change: DS WQ: [illegible]
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.1	RD07	Mortality Counts: [illegible]
		E 0, F 0, G 0, H 0	Temp. (°C)	22.5	84A	PM Change: [illegible] PM Feed: [illegible]
3	1/25/14	# of Mortalities	Old D.O. (mg/L)	4.8	RD07	AM Change: CG WQ: CG
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.5	RD07	Mortality Counts: CG
		E 0, F 0, G 0, H 0	Temp. (°C)	23.1	82A	PM Change: [illegible] PM Feed: [illegible]
4	1/26/14	# of Mortalities	Old D.O. (mg/L)	5.5	RD07	AM Change: PQ WQ: PQ
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.2	RD07	Mortality Counts: PQ
		E 0, F 0, G 0, H 0	Temp. (°C)	22.6	84A	PM Change: PQ PM Feed: PQ
5	1.27.14 *	# of Mortalities	Old D.O. (mg/L)	5.3	RD05	AM Change: SW WQ: [illegible]
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.2	RD05	Mortality Counts: SW
		E 0, F 0, G 0, H 0	Temp. (°C)	23.0	84A	PM Change: [illegible] PM Feed: SW
6	1/28/14	# of Mortalities	Old D.O. (mg/L)	4.7	RD07	AM Change: MF WQ: PQ
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	6.9	RD07	Mortality Counts: MF
		E 0, F 0, G 0, H 0	Temp. (°C)	22.9	84A	PM Change: PQ PM Feed: SW
7	1/29/14	# of Mortalities	Old D.O. (mg/L)	7.6	RD07	AM Change: MF WQ: MF
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	8.1	RD07	Mortality Counts: MF
		E 0, F 0, G 0, H 0	Temp. (°C)	23.4	84A	PM Change: [illegible] PM Feed: MF
8	1.30.14	# of Mortalities	Old D.O. (mg/L)	7.7	RD07	AM Change: SW WQ: PA
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	8.0	RD07	Mortality Counts: PA
		E 0, F 0, G 0, H 0	Temp. (°C)	23.2	82A	PM Change: [illegible] PM Feed: SW
9	1.31.14	# of Mortalities	Old D.O. (mg/L)	5.4	RD07	AM Change: PQ WQ: PQ/KB
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.7	RD07	Mortality Counts: PQ
		E 0, F 0, G 0, H 0	Temp. (°C)	23.1	84A	PM Change: DS PM Feed: KB
10	2/1/14	# Alive	pH	7.57	PH15	WQ: CG
		A 9, B 9, C 10, D 9	D.O. (mg/L)	8.4	RD07	Termination Counts: CG
		E 9, F 10, G 10, H 9	Conductivity (µS/cm)	341	EC04	Termination Time: 1030
			Alkalinity (mg/L)	✓ 76	PH18/DT8	
			Hardness (mg/L)	✓ 106	0.8	
			Ammonia (mg/L)	<1.00	DR3800	
			Temp. (°C)	23.4	84A	

* aeration initiated based on measured PM D.O. of 1.9 mg/L

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent** Initial Ashed Pan Wt Date: 1/18/14 Sign-off: CD

Test Material: **SE-1-R1** Dry Wt Date: 2/3/14 Sign-off: CD

Project #: **20672** Test ID #: **54721** Final Ashed Wt Date: 2/5/14 Sign-off: CD

Test Date: 1-22-14 Batch #: 1 Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	Initial # of Organisms Loaded	# of Live Organisms			Mean Dry Weight (mg)	Biomass Dry Weight (mg)	Mean Ash Free Dry Wt. (mg)	Biomass Ash Free Dry Wt. (mg)
						Larvae	Pupae	Adult				
1	SE-1-R1 A	138.23	156.50	141.74	10	9	–	–	2.030	1.827	1.640	1.476
2	SE-1-R1 B	135.66	154.87	140.57	10	9	–	–	2.134	1.921	1.589	1.430
3	SE-1-R1 C	139.05	156.72	143.57	10	10	–	–	1.767	1.767	1.315	1.315
4	SE-1-R1 D	133.65	147.35	137.06	10	9	–	–	1.522	1.370	1.143	1.029
5	SE-1-R1 E	127.11	140.47	130.86	10	8	1	–	1.670	~~1.336~~ 1.484	1.201	~~0.961~~ 1.068
6	SE-1-R1 F	135.16	151.52	139.70	10	10	–	–	1.636	1.636	1.182	1.182
7	SE-1-R1 G	128.92	146.39	134.11	10	10	–	–	1.747	1.747	1.228	1.228
8	SE-1-R1 H	125.45	137.88	128.10	10	9	–	–	1.381	1.243	1.087	0.978
QA 1		128.11	128.13	128.23								

10-Day *Chironomus dilutus* Sediment Toxicity Test Data

Client: **Exponent** Org. Supplier: **PER** Randomization: C.12.7

Project#: **20672** Org. Log #: 7827, 45, 43 Batch #: **1**

Test ID#: **54722** Org. Age/Size: 9-10

Day	Date	Test Material SE-3-R2	Water Quality Measurements: Parameter	Value	Meter ID	Sign-off
0	1/22/14	# Live Organisms	pH	7.99	pH19	AM Change: PA
		A 10 B 10 C 10 D 10	D.O. (mg/L)	8.5	RD07	WQ: PA
		E 10 F 10 G 10 H 10	Conductivity (µS/cm)	378	EC09	Initiation Time: 0900
			Alkalinity (mg/L)	~~122~~ 90	pH18/DT8	Initiation Counts: CA
			Hardness (mg/L)	123	0.8	Confirmation Counts: PA
			Ammonia (mg/L)	<1.00	DR3800	PM Feed: PA
			Temp. (°C)	22.0	84A	
1	1/23/14	# of Mortalities	Old D.O. (mg/L)	5.6	RD04	AM Change: KB WQ: KB
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	6.7	RD04	Mortality Counts: KB
		E 0 F 0 G 0 H 0	Temp. (°C)	22.0	84A	PM Change: KB PM Feed: KB
2	1/24/14	# of Mortalities	Old D.O. (mg/L)	4.7	RD07	AM Change: Z WQ: Z
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	6.6	RD07	Mortality Counts: Z
		E 0 F 0 G 0 H 0	Temp. (°C)	22.6	84A	PM Change: Z PM Feed: Z
3	1/25/14	# of Mortalities	Old D.O. (mg/L)	4.6	RD07	AM Change: CA WQ: CA
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.3	RD07	Mortality Counts: CA
		E 0 F 0 G 0 H 0	Temp. (°C)	22.5	82A	PM Change: Z PM Feed: Z
4	1/26/14 *	# of Mortalities	Old D.O. (mg/L)	4.8	RD07	AM Change: PA WQ: PA
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.8	RD07	Mortality Counts: PA
		E 0 F 0 G 0 H 0	Temp. (°C)	22.5	84A	PM Change: PO PM Feed: PO
5	1.27.14	# of Mortalities	Old D.O. (mg/L)	7.3	RD05	AM Change: SW WQ: EW
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.7	RD05	Mortality Counts: SVV
		E 0 F 0 G 0 H 0	Temp. (°C)	23.1	84A	PM Change: EW PM Feed: SVV
6	1/28/14	# of Mortalities	Old D.O. (mg/L)	6.6	RD07	AM Change: MF WQ: PA
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.8	RD07	Mortality Counts: MF
		E 0 F 0 G 0 H 0	Temp. (°C)	23.1	84A	PM Change: PA PM Feed: SVV
7	1/29/14	# of Mortalities	Old D.O. (mg/L)	7.8	RD07	AM Change: MF WQ: MF
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.8	RD07	Mortality Counts: MF
		E 0 F 0 G 0 H 0	Temp. (°C)	23.4	84A	PM Change: CA PM Feed: MF
8	1.30.14	# of Mortalities	Old D.O. (mg/L)	7.2	RD07	AM Change: SVV WQ: PA
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.7	RD07	Mortality Counts: PA
		E 0 F 0 G 0 H 0	Temp. (°C)	23.2	82A	PM Change: A PM Feed: SVV
9	1.31.14	# of Mortalities	Old D.O. (mg/L)	7.6	RD07	AM Change: PA WQ: PA/KP
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	8.1	RD07	Mortality Counts: PA
		E 0 F 0 G 0 H 0	Temp. (°C)	23.0	84A	PM Change: PA PM Feed: KP
10	2/1/14	# Alive	pH	7.60	pH15	WQ: CA
		A 8 B 10 C 10 D 10	D.O. (mg/L)	8.3	RD07	Termination Counts: CA
		E 10 F 10 G 9 H 9	Conductivity (µS/cm)	344	EC09	Termination Time: 1000
			Alkalinity (mg/L)	√ 78	pH18/DT8	
			Hardness (mg/L)	√ 100	0.8	
			Ammonia (mg/L)	1.35	DR3800	
			Temp. (°C)	23.3	84A	

* aeration initiated based on measured PM D.O. of 2.1 mg/L

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent**
Test Material: **SE-3-R2**
Project #: **20672** Test ID #: **54722**
Test Date: 1-22-14

Initial Ashed Pan Wt Date: 1/18/14 Sign-off: CO
Dry Wt Date: 2/3/14 Sign-off: CD
Final Ashed Wt Date: 2/5/14 Sign-off: CD
Batch #: 1 Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	Initial # of Organisms Loaded	# of Live Organisms			Mean Dry Weight (mg)	Biomass Dry Weight (mg)	Mean Ash Free Dry Wt. (mg)	Biomass Ash Free Dry Wt. (mg)
						Larvae	Pupae	Adult				
9	SE-3-R2 A	121.40	144.49	128.60	10	7	1	–	3.299	~~2.304~~ 2.566	2.270	~~1.589~~ 1.766
10	SE-3-R2 B	130.09	159.45	140.57	10	10	–	–	2.936	2.936	1.888	1.888
11	SE-3-R2 C	123.07	144.87	130.80	10	9	1	–	2.422	~~2.180~~ 2.422	1.563	~~1.407~~ 1.563
12	SE-3-R2 D	132.14	158.53	140.98	10	10	–	–	2.639	2.639	1.755	1.755
13	SE-3-R2 E	133.26	158.08	140.16	10	10	–	–	2.482	2.482	1.792	1.792
14	SE-3-R2 F	122.65	150.57	132.98	10	10	–	–	2.792	2.792	1.759	1.759
15	SE-3-R2 G	139.21	166.36	148.34	10	9	–	–	3.017	2.715	2.002	1.802
16	SE-3-R2 H	116.23	139.89	123.79	10	9	–	–	2.629	2.366	1.789	1.610
QA 2		123.94	123.99	123.97								

10-Day *Chironomus dilutus* Sediment Toxicity Test Data

Client: **Exponent** Org. Supplier: **PER** Randomization: C.12.6

Project#: **20672** Org. Log #: 7827, 43, 45 Batch #: **1**

Test ID#: **54723** Org. Age/Size: 9-10 days

Day	Date	Test Material SE-4-B6				Water Quality Measurements Parameter	Value	Meter ID	Sign-off:
0	1/22/14	# Live Organisms				pH	8.08	pH19	AM Change: PA
		A 10	B 10	C 10	D 10	D.O. (mg/L)	8.8	RD07	WQ: PA
		E 10	F 10	G 10	H 10	Conductivity (µS/cm)	334	EC09	Initiation Time: 0900
						Alkalinity (mg/L)	57	pH18/DT8	Initiation Counts: PA
						Hardness (mg/L)	106	0.8	Confirmation Counts: [illegible]
						Ammonia (mg/L)	<1.00	DR3800	PM Feed: PA
						Temp. (°C)	22.1	84A	
1	1/23/14	# of Mortalities				Old D.O. (mg/L)	6.8	RD04	AM Change: KB WQ: KB
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.5	RD04	Mortality Counts: KB
		E 0	F 0	G 0	H 0	Temp. (°C)	22.5	84A	PM Change: KB PM Feed: KB
2	1/24/14	# of Mortalities				Old D.O. (mg/L)	5.3	RD07	AM Change: DS WQ: [illegible]
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	6.9	RD07	Mortality Counts: [illegible]
		E 0	F 0	G 0	H 0	Temp. (°C)	22.6	84A	PM Change: [illegible] PM Feed: [illegible]
3	1/25/14	# of Mortalities				Old D.O. (mg/L)	5.3	RD07	AM Change: [illegible] WQ: [illegible]
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.4	RD07	Mortality Counts: [illegible]
		E 0	F 0	G 0	H 0	Temp. (°C)	22.7	82A	PM Change: [illegible] PM Feed: [illegible]
4	1/26/14	# of Mortalities				Old D.O. (mg/L)	4.4	RD07	AM Change: PA WQ: PA
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.7	RD07	Mortality Counts: PA
		E 0	F 0	G 0	H 0	Temp. (°C)	23.0	84A	PM Change: PA PM Feed: PA
5	1.27.14 *	# of Mortalities				Old D.O. (mg/L)	5.2	RD05	AM Change: SVV WQ: [illegible]
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	6.6	RD05	Mortality Counts: SVV
		E 0	F 0	G 0	H 0	Temp. (°C)	22.9	84A	PM Change: [illegible] PM Feed: SVV
6	1/28/14	# of Mortalities				Old D.O. (mg/L)	4.7	RD07	AM Change: MF WQ: PA
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.3	RD07	Mortality Counts: MF
		E 0	F 0	G 0	H 0	Temp. (°C)	23.0	84A	PM Change: PA PM Feed: SVV
7	1/29/14	# of Mortalities				Old D.O. (mg/L)	7.7	RD07	AM Change: MF WQ: MF
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.0	RD07	Mortality Counts: MF
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	84A	PM Change: [illegible] PM Feed: MF
8	1.30.14	# of Mortalities				Old D.O. (mg/L)	6.9	RD07	AM Change: SVV WQ: PA
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.6	RD07	Mortality Counts: PA
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	82A	PM Change: PA PM Feed: SVV
9	1.31.14	# of Mortalities				Old D.O. (mg/L)	7.5	RD07	AM Change: PA WQ: PA/KB
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.2	RD07	Mortality Counts: PA
		E 0	F 0	G 0	H 0	Temp. (°C)	23.0	84A	PM Change: [illegible] PM Feed: KB
10	2/1/14	# Alive				pH	7.67	pH15	WQ: [illegible]
		A 9	B 9	C 8	D 8	D.O. (mg/L)	8.3	RD07	Termination Counts: [illegible]
		E 9	F 10	G 9	H 10	Conductivity (µS/cm)	334	EC04	Termination Time: 1510
						Alkalinity (mg/L)	68	pH18/DT8	
						Hardness (mg/L)	96	0.8	
						Ammonia (mg/L)	<1.00	DR3800	
						Temp. (°C)	23.4	84A	

*aeration initiated based on measured PM D.O. of 2.3 mg/L

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent** Initial Ashed Pan Wt Date: 1/18/14 Sign-off: CD

Test Material: **SE-4-B6** Dry Wt Date: 2/3/14 Sign-off: CD

Project #: **20672** Test ID #: **54723** Final Ashed Wt Date: 2/5/14 Sign-off: CD

Test Date: 1-22-14 Batch #: 1 Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	Initial # of Organisms Loaded	# of Live Organisms: Larvae	Pupae	Adult	Mean Dry Weight (mg)	Biomass Dry Weight (mg)	Mean Ash Free Dry Wt. (mg)	Biomass Ash Free Dry Wt. (mg)
17	SE-4-B6 A	124.33	139.61	129.72	10	8	1	–	1.910	~~1.528~~ 1.698	1.236	~~0.989~~ 1.099
18	SE-4-B6 B	131.34	149.49	134.62	10	9	–	–	2.017	1.815	1.652	1.487
19	SE-4-B6 C	133.27	150.69	138.51	10	8	–	–	2.178	1.742	1.523	1.218
20	SE-4-B6 D	128.73	140.88	131.54	10	8	–	–	1.519	1.215	1.168	0.934
21	SE-4-B6 E	122.68	139.44	126.40	10	9	–	–	1.862	1.676	1.449	1.304
22	SE-4-B6 F	134.24	150.51	140.40	10	~~10~~ 9	1	–	1.808	~~1.627~~ 1.808	1.123	~~1.011~~ 1.123
23	SE-4-B6 G	120.89	138.10	127.25	10	9	–	–	1.912	1.721	1.206	1.085
24	SE-4-B6 H	125.37	143.76	131.59	10	9	1	–	2.043	~~1.839~~ 2.043	1.352	~~1.217~~ 1.352
QA 3		134.77	3.00 134.76	134.89								

10-Day *Chironomus dilutus* Sediment Toxicity Test Data

Client: **Exponent** Org. Supplier: **PER** Randomization: C.12.4

Project#: **20672** Org. Log #: 7827, 43, 45 Batch #: **1**

Test ID#: **54724** Org. Age/Size: 9-10 d

Day	Date	Test Material SE-5-B1				Parameter	Value	Meter ID	Sign-off
0	1/22/14	# Live Organisms				pH	8.07	pH19	AM Change: PA
		A 10	B 10	C 10	D 10	D.O. (mg/L)	8.6	RD07	WQ: PA
		E 10	F 10	G 10	H 10	Conductivity (µS/cm)	336	EC09	Initiation Time: 0900
						Alkalinity (mg/L)	55	PH18/DT8	Initiation Counts: CA
						Hardness (mg/L)	96	0.8	Confirmation Counts: PA
						Ammonia (mg/L)	<1.00	DR3800	PM Feed: PA
						Temp. (°C)	22.0	84A	
1	1/23/14	# of Mortalities				Old D.O. (mg/L)	6.9	RD04	AM Change: VB WQ: VB
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.8	RD04	Mortality Counts: VB
		E 0	F 0	G 0	H 0	Temp. (°C)	22.0	84A	PM Change: VB PM Feed: VB
2	1/24/14	# of Mortalities				Old D.O. (mg/L)	5.4	RD07	AM Change: DS WQ: [illegible]
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.5	RD07	Mortality Counts: [illegible]
		E 0	F 0	G 0	H 0	Temp. (°C)	22.7	84A	PM Change: [illegible] PM Feed: [illegible]
3	1/25/14	# of Mortalities				Old D.O. (mg/L)	5.2	RD07	AM Change: CA WQ: CA
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.3	RD07	Mortality Counts: CA
		E 0	F 0	G 0	H 0	Temp. (°C)	22.8	82A	PM Change: [illegible] PM Feed: [illegible]
4	1/26/14	# of Mortalities				Old D.O. (mg/L)	4.7	RD07	AM Change: PL WQ: PA
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.6	RD07	Mortality Counts: PA
		E 0	F 0	G 0	H 0	Temp. (°C)	22.9	84A	PM Change: PA PM Feed: PL
5	1.27.14 *	# of Mortalities				Old D.O. (mg/L)	5.2	RD05	AM Change: SVV WQ: [illegible]
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	6.7	RD05	Mortality Counts: SVV
		E 0	F 0	G 0	H 0	Temp. (°C)	22.9	84A	PM Change: [illegible] PM Feed: SVV
6	1/28/14	# of Mortalities				Old D.O. (mg/L)	5.1	RD07	AM Change: MF WQ: PA
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.2	RD07	Mortality Counts: MF
		E 0	F 0	G 0	H 0	Temp. (°C)	23.1	84A	PM Change: PA PM Feed: SVV
7	1/29/14	# of Mortalities				Old D.O. (mg/L)	7.4	RD07	AM Change: MF WQ: MF
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.1	RD07	Mortality Counts: MF
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	84A	PM Change: CA PM Feed: MF
8	1.30.14	# of Mortalities				Old D.O. (mg/L)	7.8	RD07	AM Change: SVV WQ: PA
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.0	RD07	Mortality Counts: PA
		E 0	F 0	G 0	H 0	Temp. (°C)	23.1	82A	PM Change: PA PM Feed: SVV
9	1.31.14	# of Mortalities				Old D.O. (mg/L)	7.7	RD07	AM Change: PA WQ: KP
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.1	RD07	Mortality Counts: PA
		E 0	F 0	G 0	H 0	Temp. (°C)	23.1	84A	PM Change: PA PM Feed: KP
10	2/1/14	# Alive				pH	7.47	pH15	WQ: MA
		A 9	B 5	C 5	D 10	D.O. (mg/L)	8.5	RD07	Termination Counts: CA
		E 9	F 9	G 6	H 9	Conductivity (µS/cm)	359	EC04	Termination Time: 1100
						Alkalinity (mg/L)	✓ 84	PH18/DT8	
						Hardness (mg/L)	✓ 110	0.4	
						Ammonia (mg/L)	<1.00	DR3800	
						Temp. (°C)	23.4	84A	

*aeration initiated based on measured PM D.O. of 2.4 mg/L

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent** Initial Ashed Pan Wt Date: 1/18/14 Sign-off: CD

Test Material: **SE-5-B1** Dry Wt Date: 2/3/14 Sign-off: CD

Project #: **20672** Test ID #: **54724** Final Ashed Wt Date: 2/5/14 Sign-off: CD

Test Date: 1-22-14 Batch #: 1 Balance ID: Bal 01

Pan ID	Replicate		Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	Initial # of Organisms Loaded	# of Live Organisms			Mean Dry Weight (mg)	Biomass Dry Weight (mg)	Mean Ash Free Dry Wt. (mg)	Biomass Ash Free Dry Wt. (mg)
							Larvae	Pupae	Adult				
25	SE-5-B1	A	123.53	149.64	134.32	10	9	–	–	2.901	2.611	1.702	1.532
26	SE-5-B1	B	124.01	136.61	128.88	10	5	–	–	2.520	1.260	1.546	0.773
27	SE-5-B1	C	135.25	152.64	141.19	10	5	–	–	3.478	1.739	2.290	1.145
28	SE-5-B1	D	126.83	153.01	138.18	10	10	–	–	2.618	2.618	1.483	1.483
29	SE-5-B1	E	122.19	144.14	131.37	10	9	–	–	2.439	2.195	1.419	1.277
30	SE-5-B1	F	119.95	146.42	131.46	10	9	–	–	2.941	2.647	1.669	1.502
31	SE-5-B1	G	120.75	142.21	129.90	10	6	–	–	3.577	2.146	2.052	1.231
32	SE-5-B1	H	117.35	142.48	128.47	10	9	–	–	2.792	2.513	1.557	1.401
QA 4			125.73	125.78	125.86								

10-Day *Chironomus dilutus* Sediment Toxicity Test Data

Client: **Exponent** Org. Supplier: **PER** Randomization: C.12.3

Project#: **20672** Org. Log #: 7827, 43, 45 Batch #: **1**

Test ID#: **54725** Org. Age/Size: 9-10 d

Day	Date	Test Material SE-6-B6	Parameter	Value	Meter ID	Sign-off
0	1/22/14	# Live Organisms	pH	8.05	pH19	AM Change: PQ
		A 10 B 10 C 10 D 10	D.O. (mg/L)	8.6	RD07	WQ: PQ
		E 10 F 10 G 10 H 10	Conductivity (µS/cm)	329	EC09	Initiation Time: 0900
			Alkalinity (mg/L)	50	pH18/DT8	Initiation Counts: [illegible]
			Hardness (mg/L)	94	0.8	Confirmation Counts: PQ
			Ammonia (mg/L)	<1.00	DR3800	PM Feed: PQ
			Temp. (°C)	22.0	84A	
1	1/23/14	# of Mortalities	Old D.O. (mg/L)	6.1	RD04	AM Change: KB WQ: KB
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.6	RD04	Mortality Counts: KB
		E 0 F 0 G 0 H 0	Temp. (°C)	22.3	84A	PM Change: KB PM Feed: KB
2	1/24/14	# of Mortalities	Old D.O. (mg/L)	5.3	RD07	AM Change: [illegible] WQ: [illegible]
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.4	RD07	Mortality Counts: [illegible]
		E 0 F 0 G 0 H 0	Temp. (°C)	23.0	84A	PM Change: [illegible] PM Feed: [illegible]
3	1/25/14	# of Mortalities	Old D.O. (mg/L)	4.1	RD07	AM Change: CB WQ: CB
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.2	RD07	Mortality Counts: CB
		E 0 F 0 G 0 H 0	Temp. (°C)	22.7	82A	PM Change: [illegible] PM Feed: [illegible]
4	1/26/14	# of Mortalities	Old D.O. (mg/L)	5.3	RD07	AM Change: PQ WQ: PQ
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.6	RD07	Mortality Counts: PQ
		E 0 F 0 G 0 H 0	Temp. (°C)	22.6	84A	PM Change: PQ PM Feed: PQ
5	1.27.14 *	# of Mortalities	Old D.O. (mg/L)	5.6	RD05	AM Change: SW WQ: [illegible]
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	6.8	RD05	Mortality Counts: SW
		E 0 F 0 G 0 H 0	Temp. (°C)	23.1	84A	PM Change: [illegible] PM Feed: SW
6	1/28/14	# of Mortalities	Old D.O. (mg/L)	4.6	RD07	AM Change: MF WQ: PQ
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	6.8	RD07	Mortality Counts: MF
		E 0 F 0 G 0 H 0	Temp. (°C)	23.1	84A	PM Change: PQ PM Feed: SW
7	1/29/14	# of Mortalities	Old D.O. (mg/L)	7.3	RD07	AM Change: MF WQ: MF
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	8.0	RD07	Mortality Counts: MF
		E 0 F 0 G 0 H 0	Temp. (°C)	23.7	84A	PM Change: [illegible] PM Feed: MF
8	1.30.14	# of Mortalities	Old D.O. (mg/L)	6.8	RD07	AM Change: SW WQ: PQ
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.5	RD07	Mortality Counts: PQ
		E 0 F 0 G 0 H 0	Temp. (°C)	23.3	82A	PM Change: PQ PM Feed: SW
9	1.31.14	# of Mortalities	Old D.O. (mg/L)	7.6	RD07	AM Change: PQ WQ: PQ/CP
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	8.1	RD07	Mortality Counts: PQ
		E 0 F 0 G 0 H 0	Temp. (°C)	23.1	84A	PM Change: PQ PM Feed: KB
10	2/1/14	# Alive	pH	7.57	pH15	WQ: CB
		A 9 B 9 C 7 D 6	D.O. (mg/L)	8.4	RD07	Termination Counts: CB
		E 10 F 8 G 6 H 5	Conductivity (µS/cm)	317	EC04	Termination Time: 1145
			Alkalinity (mg/L)	✓ 54	pH18/DT8	
			Hardness (mg/L)	✓ 100	0.8	
			Ammonia (mg/L)	<1.00	DR3800	
			Temp. (°C)	23.4	84A	

* aeration initiated based on measured PM DO of 2.3 mg/L

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent**	Initial Ashed Pan Wt Date: 1/18/14	Sign-off: CD
Test Material: **SE-6-B6**	Dry Wt Date: 2/3/14	Sign-off: CD
Project #: **20672** Test ID #: **54725**	Final Ashed Wt Date: 2/5/14	Sign-off: CD
Test Date: 1-22-14	Batch #: 1	Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	Initial # of Organisms Loaded	# of Live Organisms			Mean Dry Weight (mg)	Biomass Dry Weight (mg)	Mean Ash Free Dry Wt. (mg)	Biomass Ash Free Dry Wt. (mg)
						Larvae	Pupae	Adult				
33	SE-6-B6 A	128.70	152.35	137.06	10	9	–	–	2.628	2.365	1.699	1.529
34	SE-6-B6 B	136.78	156.74	143.61	10	9	–	–	2.218	1.996	1.459	1.313
35	SE-6-B6 C	124.58	143.13	131.10	10	7	–	–	2.650	1.855	1.719	1.203
36	SE-6-B6 D	~~155.~~ 115.67 CD	133.79	121.60	10	6	–	–	3.020	1.812	2.032	1.219
37	SE-6-B6 E	121.08	137.97	126.92	10	8	2	–	2.111	~~1.689~~ 2.111	1.381	~~1.105~~ 1.381
38	SE-6-B6 F	136.47	154.40	142.77	10	8	–	–	2.241	1.793	1.454	1.163
39	SE-6-B6 G	135.42	152.49	142.16	10	6	–	–	2.845	1.707	1.722	1.033
40	SE-6-B6 H	122.63	139.19	128.38	10	5	–	–	3.312	1.656	2.162	1.081
QA 5		122.61	122.63	122.71								

10-Day *Chironomus dilutus* Sediment Toxicity Test Data

Client: Exponent Org. Supplier: PER Randomization: C.12.6

Project#: 20672 Org. Log #: 7827, 43, 45 Batch #: 1

Test ID#: 54726 Org. Age/Size: 9-10 d

Day	Date	Test Material SE-6-R3				Water Quality Measurements Parameter	Value	Meter ID	Sign-off:
0	1/22/14	# Live Organisms				pH	8.01	PH19	AM Change: PQ
		A 10	B 10	C 10	D 10	D.O. (mg/L)	8.7	RD07	WQ: PQ
		E 10	F 10	G 10	H 10	Conductivity (µS/cm)	326	EC09	Initiation Time: 0900
						Alkalinity (mg/L)	54	PH18/DT8	Initiation Counts:
						Hardness (mg/L)	92	0.8	Confirmation Counts: PQ
						Ammonia (mg/L)	<1.00	DR3800	PM Feed: PQ
						Temp. (°C)	22.2	84A	
1	1/23/14	# of Mortalities				Old D.O. (mg/L)	6.2	RD04	AM Change: KB WQ: KB
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.6	RD04	Mortality Counts: KB
		E 0	F 0	G 0	H 0	Temp. (°C)	22.2	84A	PM Change: KB PM Feed: KB
2	1/24/14	# of Mortalities				Old D.O. (mg/L)	5.5	RD07	AM Change: DS WQ:
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.1	RD07	Mortality Counts:
		E 0	F 0	G 0	H 0	Temp. (°C)	22.7	84A	PM Change: PM Feed:
3	1/25/14	# of Mortalities				Old D.O. (mg/L)	4.5	RD07	AM Change: WQ:
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.2	RD07	Mortality Counts:
		E 0	F 0	G 0	H 0	Temp. (°C)	22.8	82A	PM Change: PM Feed:
4	1/26/14	# of Mortalities				Old D.O. (mg/L)	4.7	RD07	AM Change: PQ WQ: PQ
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.3	RD07	Mortality Counts: PQ
		E 0	F 0	G 0	H 0	Temp. (°C)	23.0	84A	PM Change: PQ PM Feed: PQ
5	1.27.14	# of Mortalities				Old D.O. (mg/L)	5.3	RD05	AM Change: SVV WQ: EKK
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.1	RD05	Mortality Counts: SVV
		E 0	F 0	G 0	H 0	Temp. (°C)	23.2	84A	PM Change: EKK PM Feed: SVV
6	1/28/14	# of Mortalities				Old D.O. (mg/L)	4.2	RD07	AM Change: MF WQ: PQ
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	6.9	RD07	Mortality Counts: MF
		E 0	F 0	G 0	H 0	Temp. (°C)	23.1	84A	PM Change: PQ PM Feed: SVV
7	1/29/14	# of Mortalities				Old D.O. (mg/L)	4.2	RD07	AM Change: MF WQ: MF
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.0	RD07	Mortality Counts: MF
		E 0	F 0	G 0	H 0	Temp. (°C)	23.7	84A	PM Change: PM Feed: MF
8	1.30.14	# of Mortalities				Old D.O. (mg/L)	5.0	RD07	AM Change: WQ: PQ
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	6.9	RD07	Mortality Counts: PQ
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	82A	PM Change: PQ PM Feed: SVV
9	1.31.14	# of Mortalities				Old D.O. (mg/L)	7.6	RD07	AM Change: PQ WQ:
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.0	RD07	Mortality Counts: PQ
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	84A	PM Change: PQ PM Feed: KP
10	2/1/14	# Alive				pH	7.59	PH15	WQ:
		A 7	B 8	C 7	D 9	D.O. (mg/L)	8.4	RD07	Termination Counts:
		E 8	F 8	G 8	H 9	Conductivity (µS/cm)	320	EC04	Termination Time: 1400
						Alkalinity (mg/L)	52	PH18/DT8	
						Hardness (mg/L)	90	0.8	
						Ammonia (mg/L)	<1.00	DR3800	
						Temp. (°C)	23.4	84A	

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: Exponent
Test Material: SE-6-R3
Project #: 20672 Test ID #: 54726
Test Date: 1-22-14

Initial Ashed Pan Wt Date: 1/18/14 Sign-off: CD
Dry Wt Date: 2/3/14 Sign-off: CD
Final Ashed Wt Date: 2/5/14 Sign-off: CD
Batch #: 1 Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	Initial # of Organisms Loaded	# of Live Organisms			Mean Dry Weight (mg)	Biomass Dry Weight (mg)	Mean Ash Free Dry Wt. (mg)	Biomass Ash Free Dry Wt. (mg)
						Larvae	Pupae	Adult				
41	SE-6-R3 A	135.65	152.92	141.84	10	7	–	–	2.467	1.727	1.583	1.108
42	SE-6-R2 B	114.44	132.17	120.24	10	8	–	–	2.216	1.773	1.491	1.193
43	SE-6-R2 C	115.59	132.20	121.15	10	7	–	–	2.373	1.661	1.579	1.105
44	SE-6-R2 D	121.10	140.95	128.55	10	9	–	–	2.206	1.985	1.378	1.240
45	SE-6-R2 E	114.14	132.15	119.50	10	8	–	–	2.251	1.801	1.581	1.265
46	SE-6-R2 F	122.55	142.05	128.80	10	8	–	–	2.444	1.955	1.656	1.325
47	SE-6-R2 G	115.22	134.44	121.16	10	8	–	–	2.403	1.922	1.661	1.328
48	SE-6-R2 H	118.16	137.42	124.27	10	9	–	–	2.140	1.926	1.461	1.315
QA 5		122.61	122.63	122.71								

10-Day *Chironomus dilutus* Sediment Toxicity Test Data

Client: **Exponent** Org. Supplier: **PER** Randomization: c.12.9

Project#: **20672** Org. Log #: 7827, 43, 45 Batch #: **1**

Test ID#: **54727** Org. Age/Size: 9-10 d

Day	Date	Test Material SE-8-B3				Water Quality Measurements Parameter	Value	Meter ID	Sign-off
0	1/22/14	# Live Organisms				pH	7.95	pH19	AM Change: PG
		A 10	B 10	C 10	D 10	D.O. (mg/L)	8.7	RD07	WQ: PG
		E 10	F 10	G 10	H 10	Conductivity (µS/cm)	326	EC04	Initiation Time: 0900
						Alkalinity (mg/L)	59	pH18/DT8	Initiation Counts: PG
						Hardness (mg/L)	90	0.8	Confirmation Counts: [illegible]
						Ammonia (mg/L)	<1.00	DR3800	PM Feed: PG
						Temp. (°C)	22.0	84A	
1	1/23/14	# of Mortalities				Old D.O. (mg/L)	~~2.7~~ 6.1	RD04	AM Change: [illegible] WQ: [illegible]
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.6	RD04	Mortality Counts: [illegible]
		E 0	F 0	G 0	H 0	Temp. (°C)	22.3	84A	PM Change: [illegible] PM Feed: [illegible]
2	1/24/14	# of Mortalities				Old D.O. (mg/L)	4.6	RD07	AM Change: [illegible] WQ: [illegible]
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.0	RD07	Mortality Counts: [illegible]
		E 0	F 0	G 0	H 0	Temp. (°C)	22.6	84A	PM Change: [illegible] PM Feed: [illegible]
3	1/25/14	# of Mortalities				Old D.O. (mg/L)	4.2	RD07	AM Change: [illegible] WQ: [illegible]
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.5	RD07	Mortality Counts: [illegible]
		E 0	F 0	G 0	H 0	Temp. (°C)	22.8	83A	PM Change: [illegible] PM Feed: [illegible]
4	1/26/14	# of Mortalities				Old D.O. (mg/L)	5.1	RD07	AM Change: PG WQ: PG
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.8	RD07	Mortality Counts: PG
		E 0	F 0	G 0	H 0	Temp. (°C)	22.5	84A	PM Change: PG PM Feed: PG
5	1.27.14 *	# of Mortalities				Old D.O. (mg/L)	5.7	RD05	AM Change: SVV WQ: [illegible]
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.0	RD05	Mortality Counts: SVV
		E 0	F 0	G 0	H 0	Temp. (°C)	23.0	84A	PM Change: [illegible] PM Feed: SVV
6	1/28/14	# of Mortalities				Old D.O. (mg/L)	5.0	RD07	AM Change: MF WQ: PG
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	6.6	RD07	Mortality Counts: MF
		E 0	F 0	G 0	H 0	Temp. (°C)	23.0	84A	PM Change: PG PM Feed: SVV
7	1/29/14	# of Mortalities				Old D.O. (mg/L)	8.2	RD07	AM Change: MF WQ: MF
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.2	RD07	Mortality Counts: MF
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	84A	PM Change: [illegible] PM Feed: MF
8	1.30.14	# of Mortalities				Old D.O. (mg/L)	6.7	RD07	AM Change: SVV WQ: PG
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.6	RD07	Mortality Counts: PG
		E 0	F 0	G 0	H 0	Temp. (°C)	23.1	82A	PM Change: PG PM Feed: SVV
9	1.31.14	# of Mortalities				Old D.O. (mg/L)	7.3	RD07	AM Change: PG WQ: PG/KF
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.0	RD07	Mortality Counts: PG
		E 0	F 0	G 0	H 0	Temp. (°C)	23.2	84A	PM Change: PG PM Feed: PG
10	2/1/14	# Alive				pH	7.68	pH15	WQ: [illegible]
		A 9	B 9	C 9	D 10	D.O. (mg/L)	8.5	RD07	Termination Counts: [illegible]
		E 6	F 10	G 7	H 7	Conductivity (µS/cm)	318	EC04	Termination Time: 1130
						Alkalinity (mg/L)	✓ 46	pH18/DT8	
						Hardness (mg/L)	✓ 90	0.8	
						Ammonia (mg/L)	<1.00	DR3800	
						Temp. (°C)	23.3	84A	

* aeration initiated based on measured PM D.O. of 2.4 mg/L

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: Exponent
Test Material: SE-8-B3
Project #: 20672 Test ID #: 54727
Test Date: 1-22-14

Initial Ashed Pan Wt Date: 1/18/14 Sign-off: CD
Dry Wt Date: 2/3/14 Sign-off: CD
Final Ashed Wt Date: 2/5/14 Sign-off: CD
Batch #: 1 Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	Initial # of Organisms Loaded	# of Live Organisms			Mean Dry Weight (mg)	Biomass Dry Weight (mg)	Mean Ash Free Dry Wt. (mg)	Biomass Ash Free Dry Wt. (mg)
						Larvae	Pupae	Adult				
49	SE-8-B3 A	113.93	134.49	120.62	10	9	–	–	2.284	2.056	1.541	1.387
50	SE-8-B3 B	118.68	135.13	123.90	10	9	–	–	1.828	1.645	1.248	1.123
51	SE-8-B3 C	121.05	141.50	127.78	10	9	–	–	2.272	2.045	1.524	1.372
52	SE-8-B3 D	119.50	140.49	126.25	10	10	–	–	2.099	2.099	1.424	1.424
53	SE-8-B3 E	128.94	144.39	133.60	10	6	–	–	2.575	1.545	1.798	1.079
54	SE-8-B3 F	125.00	142.82	130.92	10	10	–	–	1.782	1.782	1.190	1.190
55	SE-8-B3 G	117.73	133.29	122.80	10	7	–	–	2.223	1.556	1.499	1.049
56	SE-8-B3 H	127.38	144.41	132.62	10	7	–	–	2.433	1.703	1.684	1.179
QA 6		131.20	131.22	131.30								

10-Day *Chironomus dilutus* Sediment Toxicity Test Data

Client: Exponent | Org. Supplier: PER | Randomization: C.12.7

Project#: 20672 | Org. Log #: 7827, 43, 45 | Batch #: 1

Test ID#: 54728 | Org. Age/Size: 9-10 d

Day	Date	Test Material SE-8-B4	Parameter	Value	Meter ID	Sign-off:
0	1/22/14	# Live Organisms	pH	7.97	PHI9	AM Change: PA
		A 10, B 10, C 10, D 10	D.O. (mg/L)	8.5	RD07	WQ: PA
		E 10, F 10, G 10, H 10	Conductivity (µS/cm)	329	EC09	Initiation Time: 0400
			Alkalinity (mg/L)	60	PH18/DT8	Initiation Counts: PA
			Hardness (mg/L)	91	0.8	Confirmation Counts: CA
			Ammonia (mg/L)	<1.00	DR3800	PM Feed: PA
			Temp. (°C)	22.0	84A	
1	1/23/14	# of Mortalities	Old D.O. (mg/L)	6.0	RD04	AM Change: KB WQ: KB
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.8	RD04	Mortality Counts: KB
		E 0, F 0, G 0, H 0	Temp. (°C)	22.5	84A	PM Change: KB PM Feed: KB
2	1/24/14	# of Mortalities	Old D.O. (mg/L)	5.3	RD07	AM Change: DS WQ: [illegible]
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.1	RD07	Mortality Counts: [illegible]
		E 0, F 0, G 0, H 0	Temp. (°C)	22.7	84A	PM Change: [illegible] PM Feed: [illegible]
3	1/25/14	# of Mortalities	Old D.O. (mg/L)	4.6	RD07	AM Change: CA WQ: CA
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.5	RD07	Mortality Counts: CA
		E 0, F 0, G 0, H 0	Temp. (°C)	22.8	82A	PM Change: [illegible] PM Feed: [illegible]
4	1/26/14	# of Mortalities	Old D.O. (mg/L)	4.6	RD07	AM Change: PA WQ: PA
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.8	RD07	Mortality Counts: PA
		E 0, F 0, G 0, H 0	Temp. (°C)	22.5	84A	PM Change: PA PM Feed: PA
5	1.27.14	# of Mortalities	Old D.O. (mg/L)	5.3	RD05	AM Change: SVV WQ: [illegible]
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	6.7	RD05	Mortality Counts: SVV
		E 0, F 0, G 0, H 0	Temp. (°C)	23.2	84A	PM Change: [illegible] PM Feed: SVV
6	1/28/14	# of Mortalities	Old D.O. (mg/L)	4.5	RD07	AM Change: MF WQ: PA
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	6.5	RD07	Mortality Counts: MF
		E 0, F 0, G 0, H 0	Temp. (°C)	23.0	84A	PM Change: PA PM Feed: SVV
7	1/29/14 *	# of Mortalities	Old D.O. (mg/L)	5.2	RD07	AM Change: MF WQ: MF
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.0	RD07	Mortality Counts: MF
		E 0, F 0, G 0, H 0	Temp. (°C)	23.6	84A	PM Change: CA PM Feed: MF
8	1.30.14	# of Mortalities	Old D.O. (mg/L)	4.8	RD07	AM Change: SVV WQ: PA
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.7	RD07	Mortality Counts: PA
		E 0, F 0, G 0, H 0	Temp. (°C)	23.3	82A	PM Change: PA PM Feed: SVV
9	1.31.14	# of Mortalities	Old D.O. (mg/L)	7.9	RD07	AM Change: PA WQ: MKP
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	8.1	RD07	Mortality Counts: PA
		E 0, F 0, G 0, H 0	Temp. (°C)	23.3	84A	PM Change: PA PM Feed: PA
10	2/1/14	# Alive	pH	7.58	PHI5	WQ: CA
		A 7, B 10, C 7, D 10	D.O. (mg/L)	8.3	RD07	Termination Counts: MM
		E 7, F 7, G 8, H 7	Conductivity (µS/cm)	321	EC04	Termination Time: 1330
			Alkalinity (mg/L)	✓ 54	PH18/DT8	
			Hardness (mg/L)	✓ 100	0.8	
			Ammonia (mg/L)	<1.00	DR3800	
			Temp. (°C)	23.3	84A	

* aeration initiated based on measured PM D.O. of 2.1 mg/L

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent** | Initial Ashed Pan Wt Date: 1/18/14 | Sign-off: CD

Test Material: **SE-8-B4** | Dry Wt Date: 2/3/14 | Sign-off: CD

Project #: **20672** Test ID #: **54728** | Final Ashed Wt Date: 2/5/14 | Sign-off: CD

Test Date: 1-22-14 | Batch #: 1 | Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	Initial # of Organisms Loaded	# of Live Organisms			Mean Dry Weight (mg)	Biomass Dry Weight (mg)	Mean Ash Free Dry Wt. (mg)	Biomass Ash Free Dry Wt. (mg)
						Larvae	Pupae	Adult				
57	SE-8-B4 A	126.20	142.07	131.26	10	7	–	–	2.267	1.587	1.544	1.081
58	SE-8-B4 B	138.96	159.91	146.23	10	10	–	–	2.095	2.095	1.368	1.368
59	SE-8-B4 C	129.42	145.25	134.35	10	7	–	–	2.261	1.583	1.557	1.090
60	SE-8-B4 D	120.36	139.79	126.80	10	10	–	–	1.943	1.943	1.299	1.299
61	SE-8-B4 E	140.45	156.43	145.27	10	7	–	–	2.283	1.598	1.594	1.116
62	SE-8-B4 F	117.81	134.28	122.41	10	7	–	–	2.353	1.647	1.696	1.187
63	SE-8-B4 G	118.81	135.97	124.87	10	8	–	–	2.145	1.716	1.388	1.110
64	SE-8-B4 H	116.15	132.53	120.93	10	7	–	–	2.340	1.638	1.657	1.160
QA 7		~~137.3~~ CD 137.24	137.22	137.21								

10-Day *Chironomus dilutus* Sediment Toxicity Test Data

Client:	Exponent	Org. Supplier:	PER	Randomization:	C.12.8
Project#:	20672	Org. Log #:	7827, 4345	Batch #:	1
Test ID#:	54729	Org. Age/Size:	9-10 d		

Day	Date	Test Material SE-G-1	Parameter	Value	Meter ID	Sign-off
0	1/22/14	# Live Organisms	pH	8.01	PH19	AM Change: PA
		A 10, B 10, C 10, D 10	D.O. (mg/L)	9.0	RD07	WQ: PA
		E 10, F 10, G 10, H 10	Conductivity (µS/cm)	334	EC09	Initiation Time: 0900
			Alkalinity (mg/L)	59	pH18/DT8	Initiation Counts: PA
			Hardness (mg/L)	91	0.8	Confirmation Counts: CC
			Ammonia (mg/L)	<1.00	DR3800	PM Feed: PA
			Temp. (°C)	22.0	84A	
1	1/23/14	# of Mortalities	Old D.O. (mg/L)	6.4	RD04	AM Change: KB WQ: KB
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.7	RD04	Mortality Counts: KB
		E 0, F 0, G 0, H 0	Temp. (°C)	22.5	84A	PM Change: KB PM Feed: KB
2	1/24/14	# of Mortalities	Old D.O. (mg/L)	5.3	RD07	AM Change: DS WQ: ZL
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.2	RD07	Mortality Counts: ZL
		E 0, F 0, G 0, H 0	Temp. (°C)	22.7	84A	PM Change: ZL PM Feed: ZL
3	1/25/14	# of Mortalities	Old D.O. (mg/L)	4.7	RD07	AM Change: CC WQ: CC
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.2	RD07	Mortality Counts: CC
		E 0, F 0, G 0, H 0	Temp. (°C)	22.6	82A	PM Change: ZL PM Feed: ZL
4	1/26/14	# of Mortalities	Old D.O. (mg/L)	4.2	RD07	AM Change: PA WQ: PA
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.7	RD07	Mortality Counts: PA
		E 0, F 0, G 0, H 0	Temp. (°C)	22.6	84A	PM Change: PA PM Feed: PA
5	1.27.14	# of Mortalities	Old D.O. (mg/L)	5.9	RD05	AM Change: SVV WQ: SVV
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.4	RD05	Mortality Counts: SVV
		E 0, F 0, G 0, H 0	Temp. (°C)	23.1	84A	PM Change: SVV PM Feed: SVV
6	1/28/14	# of Mortalities	Old D.O. (mg/L)	4.5	RD07	AM Change: MF WQ: PA
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	6.8	RD07	Mortality Counts: MF
		E 0, F 0, G 0, H 0	Temp. (°C)	23.1	84A	PM Change: PA PM Feed: SVV
7	1/29/14	# of Mortalities	Old D.O. (mg/L)	4.3	RD07	AM Change: MF WQ: MF
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	6.9	RD07	Mortality Counts: MF
		E 0, F 0, G 0, H 0	Temp. (°C)	23.3	84A	PM Change: CC PM Feed: MF
8	* 1.30.14	# of Mortalities	Old D.O. (mg/L)	4.9	RD07	AM Change: SVV WQ: PA
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	6.9	RD07	Mortality Counts: PA
		E 0, F 0, G 0, H 0	Temp. (°C)	23.0	82A	PM Change: PA PM Feed: SVV
9	1.31.14	# of Mortalities	Old D.O. (mg/L)	7.1	RD07	AM Change: PA WQ: PA/KP
		A 0, B 0, C 0, D 0	New D.O. (mg/L)	7.8	RD07	Mortality Counts: PA
		E 0, F 0, G 0, H 0	Temp. (°C)	23.1	84A	PM Change: PA PM Feed: PA
10	2/1/14	# Alive	pH	7.68	PH15	WQ: CC
		A 10, B 10, C 10, D 9	D.O. (mg/L)	8.3	RD07	Termination Counts: MM
		E 7, F 9, G 10, H 10	Conductivity (µS/cm)	331	EC04	Termination Time: 935
			Alkalinity (mg/L)	✓ 68	pH18/DT8	
			Hardness (mg/L)	✓ 92	0.8	
			Ammonia (mg/L)	<1.00	DR3800	
			Temp. (°C)	23.4	84A	

* aeration initiated based on measured PM D.O. of 2.2 mg/L

10-Day *Chironomus dilutus* Sediment Toxicity Test Weight Data

Client: **Exponent**
Test Material: **SE-G-1**
Project #: **20672** Test ID #: **54729**
Test Date: 1-22-14

Initial Ashed Pan Wt Date: 1/18/14 Sign-off: CD
Dry Wt Date: 2/3/14 Sign-off: CD
Final Ashed Wt Date: 2/5/14 Sign-off: CD
Batch #: 1 Balance ID: Bal 01

Pan ID	Replicate	Initial Ashed Pan Wt (mg)	Dry Pan + Larvae Wt. (mg)	Ashed Pan + Larvae Wt. (mg)	Initial # of Organisms Loaded	# of Live Organisms			Mean Dry Weight (mg)	Biomass Dry Weight (mg)	Mean Ash Free Dry Wt. (mg)	Biomass Ash Free Dry Wt. (mg)
						Larvae	Pupae	Adult				
65	SE-G-1 A	125.23	147.12	130.31	10	10	–	–	2.189	2.189	1.681	1.681
66	SE-G-1 B	125.68	143.20	128.82	10	10	–	–	1.752	1.752	1.438	1.438
67	SE-G-1 C	131.62	152.75	137.46	10	10	–	–	2.113	2.113	1.529	1.529
68	SE-G-1 D	117.58	132.52	120.28	10	9	–	–	1.660	1.494	1.360	1.224
69	SE-G-1 E	128.75	142.15	130.39	10	7	–	–	1.914	1.340	1.680	1.176
70	SE-G-1 F	129.56	146.98	132.99	10	9	–	–	1.936	1.742	1.554	1.399
71	SE-G-1 G	127.29	145.72	131.79	10	10	–	–	1.843	1.843	1.393	1.393
72	SE-G-1 H	122.16	138.44	125.24	10	10	–	–	1.628	1.628	1.320	1.320
QA 8		123.82	123.87	123.89								

10-Day *Chironomus dilutus* Sediment Toxicity Test Data

Client: **Exponent** Org. Supplier: **PER** Randomization: C.12.5
Project#: **20672** Org. Log #: 7827,43,45 Batch #: **1**
Test ID#: **54730** Org. Age/Size: 9-10d

Day	Date	Test Material SE-REF-6				Parameter	Value	Meter ID	Sign-off
0	1-22.14	# Live Organisms				pH	7.97	PH19	AM Change: PA
		A 10	B 10	C 10	D 10	D.O. (mg/L)	8.7	RD07	WQ: PA
		E 10	F 10	G 10	H 10	Conductivity (µS/cm)	329	EC09	Initiation Time: 0900
						Alkalinity (mg/L)	58	PH18/DT8	Initiation Counts: PA
						Hardness (mg/L)	96	0.8	Confirmation Counts: [illegible]
						Ammonia (mg/L)	<1.00	DR3800	PM Feed: PA
						Temp. (°C)	22.1	84A	
1	1/23/14	# of Mortalities				Old D.O. (mg/L)	6.3	RD04	AM Change: KB WQ: KB
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.0	RD04	Mortality Counts: KB
		E 0	F 0	G 0	H 0	Temp. (°C)	22.4	84A	PM Change: KB PM Feed: KB
2	1/24/14	# of Mortalities				Old D.O. (mg/L)	5.3	RD07	AM Change: DS WQ: [illegible]
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.3	RD07	Mortality Counts: [illegible]
		E 0	F 0	G 0	H 0	Temp. (°C)	22.8	84A	PM Change: [illegible] PM Feed: [illegible]
3	1/25/14	# of Mortalities				Old D.O. (mg/L)	4.6	RD07	AM Change: CB WQ: CB
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.2	RD07	Mortality Counts: CB
		E 0	F 0	G 0	H 0	Temp. (°C)	22.7	82A	PM Change: [illegible] PM Feed: [illegible]
4	1/26/14	# of Mortalities				Old D.O. (mg/L)	5.2	RD07	AM Change: PA WQ: PA
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.6	RD07	Mortality Counts: PA
		E 0	F 0	G 0	H 0	Temp. (°C)	22.7	84A	PM Change: PA PM Feed: PA
5	1.27.14	# of Mortalities				Old D.O. (mg/L)	5.6	RD05	AM Change: SVV WQ: [illegible]
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	6.7	RD05	Mortality Counts: SVV
		E 0	F 0	G 0	H 0	Temp. (°C)	23.0	84A	PM Change: [illegible] PM Feed: SVV
6	1/28/14	# of Mortalities				Old D.O. (mg/L)	4.6	RD07	AM Change: MF WQ: PA
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	6.7	RD07	Mortality Counts: MF
		E 0	F 0	G 0	H 0	Temp. (°C)	23.1	84A	PM Change: PA PM Feed: SVV
7	1/29/14	# of Mortalities				Old D.O. (mg/L)	4.4	RD07	AM Change: MF WQ: MF
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.0	RD07	Mortality Counts: MF
		E 0	F 0	G 0	H 0	Temp. (°C)	23.4	84A	PM Change: CB PM Feed: MF
8	1.30.14	# of Mortalities				Old D.O. (mg/L)	4.9	RD07	AM Change: SVV WQ: PA
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.2	RD07	Mortality Counts: PA
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	82A	PM Change: PA PM Feed: SVV
9	1.31.14	# of Mortalities				Old D.O. (mg/L)	7.7	RD07	AM Change: PA WQ: PA/KP
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.9	RD07	Mortality Counts: PA
		E 0	F 0	G 0	H 0	Temp. (°C)	22.9	84A	PM Change: PA PM Feed: PA
10	2/1/14	# Alive				pH	7.50	PH15	WQ: [illegible]
		A 9	B 9	C 10	D 9	D.O. (mg/L)	5.4	RD07	Termination Counts: [illegible]
		E 10	F 10	G 9	H 8	Conductivity (µS/cm)	332	EC04	Termination Time: 1005
						Alkalinity (mg/L)	✓ 76	PH18/DT8	
						Hardness (mg/L)	✓ 102	0.8	
						Ammonia (mg/L)	<1.00	DR3800	
						Temp. (°C)	23.4	84A	

APPENDIX F

BACKSCATTER ELECTRON MICROSCOPY REPORT

March 16, 2017
Dave Enos, LHG, RG
Manager, Dormant Properties
Teck American Incorporated
501 N Riverpoint Blvd, Suite 300
Spokane, WA 99202

RE: Final Report:
Characterization of selected Upper Columbia River Sediment by CCSEM (computer-controlled scanning electron microscopy)
RJ Lee Group Project Number TLH411317

Dear Mr. Enos:

This letter summarizes results of computer-controlled scanning electron microscopy (CCSEM) in the backscattered electron (BE) imaging mode, incorporating energy dispersive spectroscopy (EDS), performed for the Upper Columbia River (UCR) remedial investigation study identified as "Phase 2 Sediment Study" for the 42 samples received from Teck American Incorporated (TAI) on December 11, 2014. The sediment samples are listed in Table A1 (Tables identified with a leading "A" are provided at the end of this report), with the RJ Lee Group (RJLG) sample ID and information provided to RJLG (TAI Sample number, and River mile). The purpose of the analyses was to determine the amount of slag and the slag particle-size distributions in the samples.

Introduction

Slag Composition

The morphology and composition of glassy slag particles found in sediments in the UCR have been described by Cox et al. (2005).[1] Cox et al. (2005) describe the matrix of slag particles as "a glassy calcium-iron-silicate with varying amounts of aluminum", which is illustrated as a glassy particle in their Figure 11A. These previous descriptions of composition and texture of slag in UCR sediments are used in this study to generally define the characteristics with which to identify the glassy slags found in sediments in the UCR. Crystalline byproducts of smelting, including crystalline slag varieties if any, are not identified in this study. The major elements in the glassy slag are Fe, Si and Ca, with a minor amount of Al. Also commonly present in smaller amounts in some of the particles were Zn, Na, Mg, Mn, Cu and K. Among the morphological features displayed by some glassy slag particles are "rounded and angular features often with needle-like projections, conchoidal fracture patterns, and small cavities or vugs" (Cox et al.

[1] Note that Cox's report assumed that all slag found in the UCR had been discharged by the Trail smelter in Trail, British Columbia; the report does not reference Le-Roi/Northport smelter in Northport, Washington, which also discharged slag to the UCR, copper smelting in the area, or potentially other slag sources.

2005). Some of these features are shown by example in Figure 1 and 2. (The scanning electron microscope (SEM) images acquired in the project consist of two backscattered electron images. The upper-left image is at a low magnification and contains a small square outlining magnified image to the right. The EDS spectrum acquired at the location of the small box is shown at the bottom. If the particle was previously analyzed by CCSEM, the CCSEM particle number and the CCSEM micro image are also displayed.) Some glassy slag particles display internal texture including spherical or near-spherical blebs (commonly sulfur-bearing phases), or dendritic structures (commonly iron oxides and oxyhydroxides) (Cox, et al., 2005, Figure 12B and 12C) as shown in Figures 3 and 4. Cox et al. (2005) also noted that some slag particles have a "flaked surface" of weathering rinds, and Cox reported compositions showing a reduction of the "often-mobile" calcium and iron. Figures 5 and 6 show a core and "weathering rind" respectively.

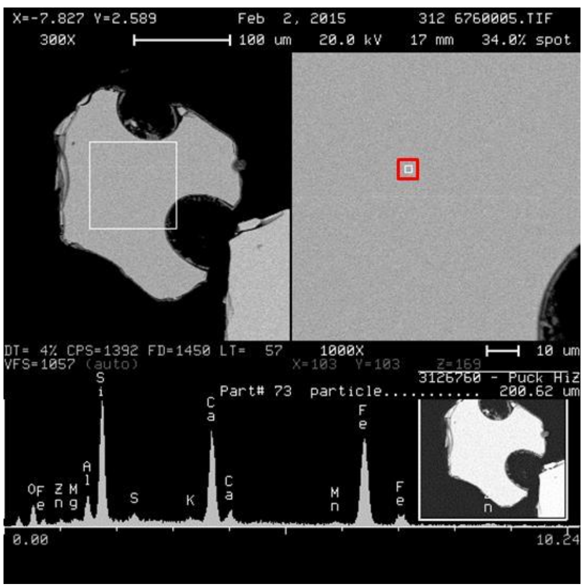


Figure 1 – Backscattered electron (BE) images and EDS spectrum of glassy slag showing characteristic morphology and composition (Sample SE-3-C1, 3126760).

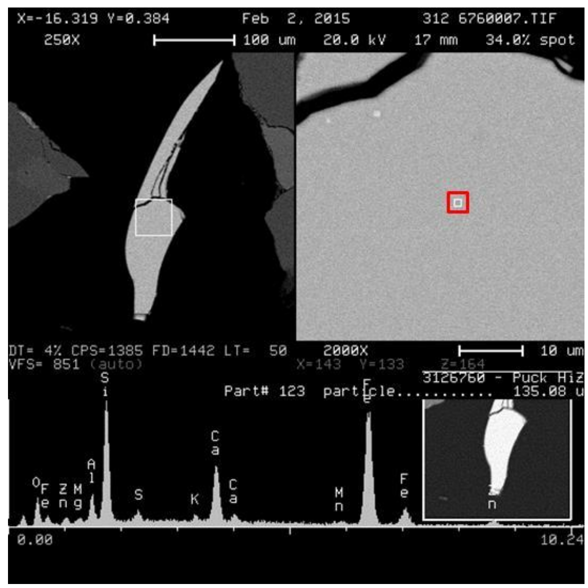


Figure 2 – BE images and EDS spectrum of glassy slag showing characteristic morphology and composition (Sample SE-3-C1, 3126760).

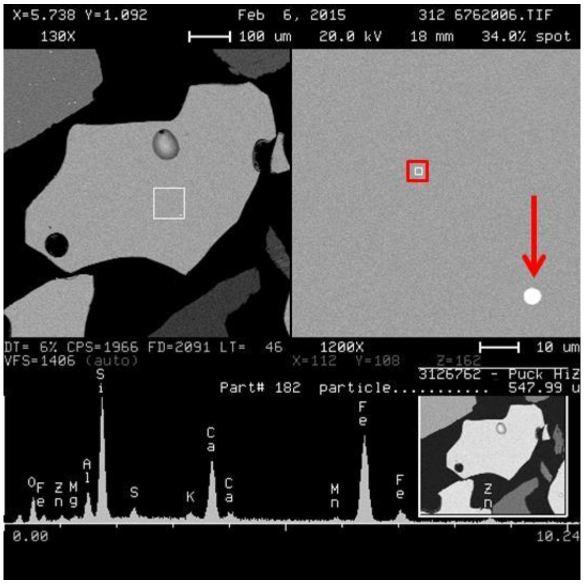


Figure 3 – BE images and EDS spectrum of slag matrix with a bleb texture (arrow). (Sample SE-3-B4, 3126762).

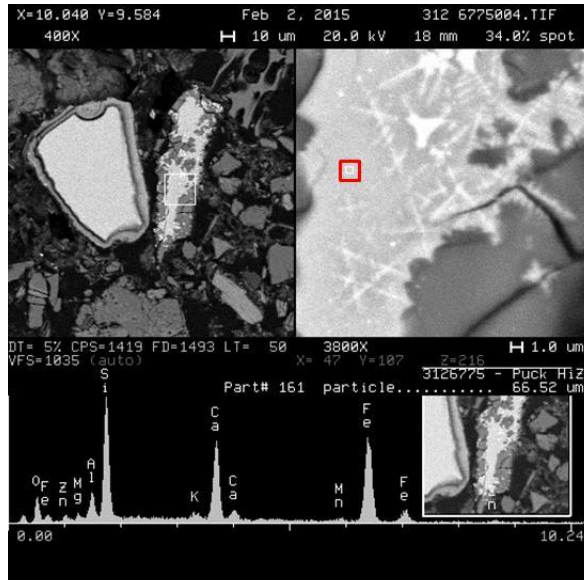


Figure 4 – BE images and EDS spectrum of slag matrix with a dendritic texture. (Sample SE-4-C4, 3126775).

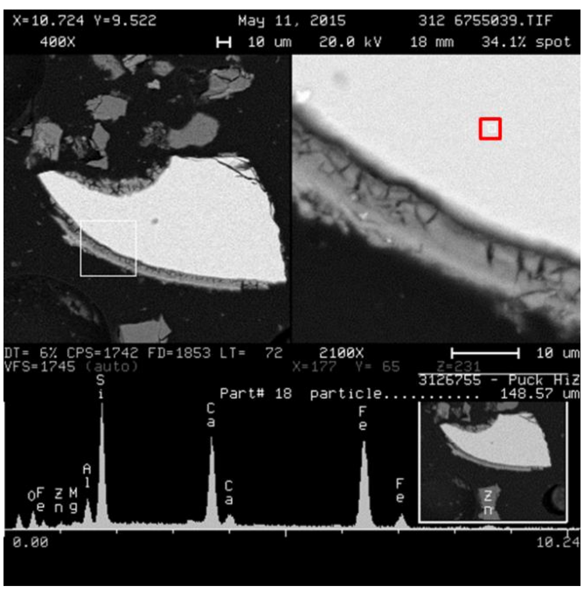


Figure 5 – BE images and EDS spectrum of pristine slag core of particle 18 in Sample SE–2-R3 (3126755).

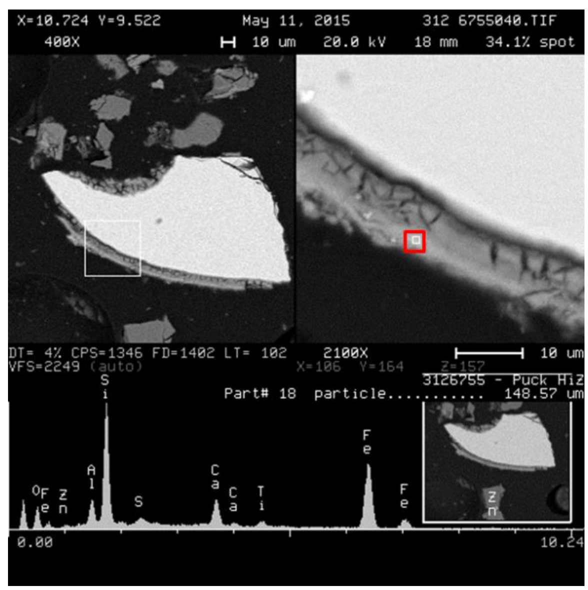


Figure 6 – BE images and EDS spectrum of altered slag rim of particle 18 in sample SE–2-R3 (3126755).

Overview of CCSEM

The SEM works by rastering a beam of electrons over a sample. The interaction between the electron beam and the sample causes some beam electrons to be scattered back off the sample (backscattered electrons, BE). These backscattered electrons can be detected, and an image is then created in 256 shades of gray. Computer-controlled SEM analysis operates on the principle that in the BE imaging mode, features have a brightness that is proportional to the average atomic number of that feature. In the polished epoxy mounts, the epoxy background is darker than the particulate (except for carbon or other light element materials), allowing particles to be identified using image analysis techniques by setting a particle threshold brightness value between the dark epoxy and the bright mineral.

In the analysis, the SEM computer directs scanning and acquires a BE image of the first field, which is saved electronically. Figure 7A shows the first low magnification (25x) field image. The image is interrogated and the first particle is detected. Figure 7B shows a detected particle. Once detected, its periphery is determined, and size and shape descriptors are calculated using image analysis (IA) procedures. In addition, x-rays are generated by the interaction of the electron beam and the particle, resulting in an x-ray energy spectrum. Each element has a characteristic EDS spectrum; the location and shape of peaks are used to identify that element. The particle size, shape and composition data are tabulated in an electronic file. In addition, a "zoomed in" image (microimage) of the particle and the 2048 channel EDS spectrum is saved for each particle as a TIFF file. The analysis continues until all particles in that field are analyzed, and additional fields are analyzed until a stopping criterion is met, which is either total area or total time and is based on the professional judgment of the analyst. The magnification is changed to a high magnification (200x), and additional fields (Figure 7C) are inspected and particles characterized (Figure 7D) until that stopping criterion is met. In this study, the low magnification analysis was stopped when all fields in the sample were inspected. The higher magnification inspection continued for a total of 2 hours, and the number of fields analyzed ranged from 187 to 617 (Table 1).

Table 1 – Number of fields analyzed, area analyzed and number of particles detected at the low magnification and high magnification analysis of each sample. The stopping criterion for the low magnification analysis was all fields and the stopping criterion for the high magnification analysis was 2 hours.

		Low Mag			High Mag		
RJLG ID	Client ID	Fields	Area (mm^2)	Particles	Fields	Area (mm2)	Particles
3126743	SE-LAL-5	16	202.322	16	341.00	67.275	885
3126744	SE-1-R5	16	202.322	249	402.04	79.435	512
3126744R	SE-1-R5	16	202.322	293	390.52	77.159	376
3126745	SE-1-R1	16	202.322	446	277.38	54.804	963
3126746	SE-1-R2	16	202.322	327	440.00	86.935	341
3126747	SE-1-B5	16	202.322	439	187.00	36.927	1084
3126748	SE-1-R8	16	202.322	369	257.47	50.872	1000
3126749	SE-1B-R3	16	202.322	265	328.78	64.96	562
3126750	SE-1B-C3	16	202.322	324	252.02	49.795	840
3126751	SE-1B-C1	16	202.322	376	190.68	37.675	783
3126752	SE-2-B1	16	202.322	48	565.00	111.633	200
3126753	SE-2-B2	16	202.322	245	410.02	81.013	516
3126754	SE-2-R1	16	202.322	608	301.73	59.615	699
3126755	SE-2-R3	16	202.322	169	246.50	48.704	1001
3126756	SE-2B-R1	16	202.322	189	284.48	56.208	567
3126757	SE-2B-C4	16	202.322	340	437.02	86.347	293
3126758	SE-2B-C3	16	202.322	184	356.46	70.429	748
3126759	SE-3-B1	16	202.322	392	361.55	71.436	537
3126760	SE-3-C1	16	202.322	197	238.62	47.146	1055
3126761	SE-3-B2	16	202.322	538	381.02	75.283	356
3126762	SE-3-B4	16	202.322	362	335.23	66.234	631
3126762R	SE-3-B4	16	202.322	414	330.02	65.206	480
3126763	SE-3-R7	16	202.322	392	411.02	81.21	348
3126763R	SE-3-R7	16	202.322	438	320.29	63.284	509
3126763R2	SE-3-R7	20	252.903	432	331.29	65.455	437
3126764	SE-3-R8	36	455.225	648	348.02	68.763	412
3126765	SE-3-R10	16	202.322	837	280.02	55.327	720
3126766	SE-3-R9	16	202.322	127	412.03	81.408	589
3126767	SE-3-C4	16	202.322	310	395.02	78.049	428
3126768	SE-3B-C3	16	202.322	423	402.28	79.483	336
3126769	SE-4-R1	16	202.322	323	289.02	57.105	778
3126770	SE-4-B1	16	202.322	347	364.43	72.004	475
3126771	SE-4-B6	16	202.322	534	338.61	66.903	520
3126771D	SE-4-B6	16	202.322	520	334.45	66.081	417
3126771R	SE-4-B6	16	202.322	425	280.51	55.424	635
3126772	SE-4-B2	16	202.322	413	405.02	80.025	330
3126773	SE-4-B4	16	202.322	347	292.89	57.869	704
3126774	SE-4-B5	16	202.322	216	335.83	66.353	611
3126775	SE-4-C4	16	202.322	3	274.84	54.304	828
3126776	SE-4B-C3	16	202.322	0	279.31	55.186	991
3126777	SE-REF-3	16	202.322	6	447.24	88.366	493
3126778	SE-5-B2	16	202.322	0	516.78	102.105	322
3126779	SE-5B-C1	16	202.322	0	572.02	113.021	181
3126780	SE-6-B4	16	202.322	0	540.24	106.74	295
3126781	SE-6B-C4	16	202.322	25	386.00	76.266	200
3126782	SE-7-B1	16	202.322	1	596.56	117.869	88
3126783	SE-8-B3	16	202.322	0	616.71	121.849	23
3126784	SE-8B-C2	16	202.322	23	380.05	75.091	637

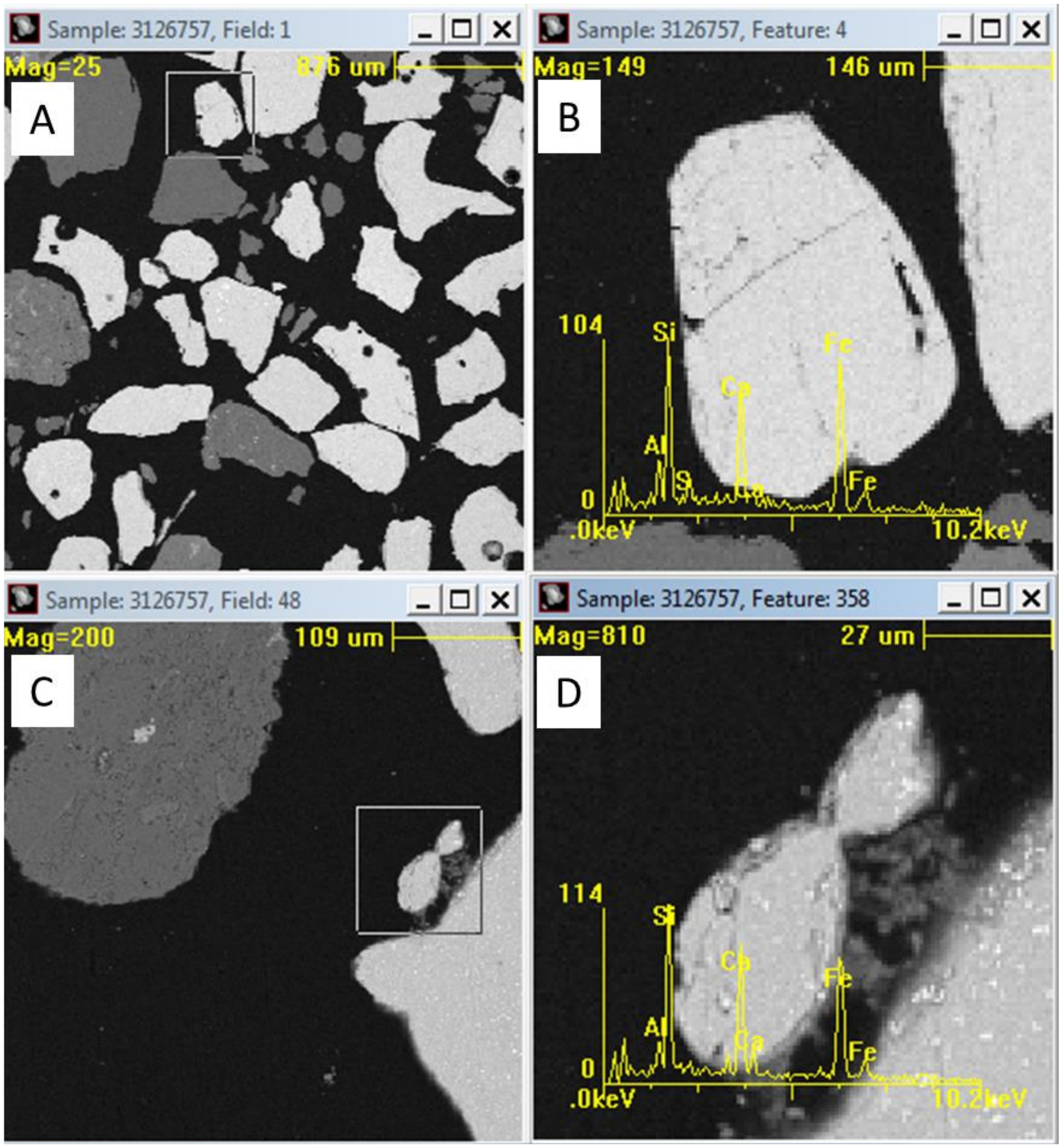


Figure 7 – Illustrates low magnification field (A) and a detected particle with EDS spectrum (B), and high magnification field (C) and a detected particle with EDS spectrum (D).

Where the material of interest is composed of relatively higher atomic number elements, a threshold brightness value can be selected to ignore the background (epoxy) and the relatively low atomic number particles (e.g., quartz, feldspar, etc.), thus increasing the number of the brighter particles of interest that can be analyzed in a given amount of time. This is referred to as a High-Z analysis where Z refers to atomic number.

When High-Z analysis is conducted, CCSEM analysis then requires that an appropriate image brightness and contrast be obtained, and that an appropriate image brightness threshold value be selected. This threshold value must be lower than the particles of interest. In a conservative setup, this value can be considerably lower than the intended particle type and still be effective in excluding the majority of the particles that are not of interest.

The data tabulated in the CCSEM analysis are used to classify particle types. In the case of unknown particle types, the general procedure is to construct preliminary rules for classification. After this classification, the data are reviewed and the rules modified if necessary until the analyst is satisfied that the classification is done correctly. For example, assume rules are being written to characterize particle class X. All compositional data for the particles satisfying the first iteration rules are displayed, as well as compositions that are outside the rules. The various elements defining that class are sorted from large to small. If the composition of an excluded particle is part of a compositional continuum with the particles in that class, and the morphological characteristics are consistent with that class, the rule is expanded to include particles of that type.

Procedures – Data Acquisition

Sample Preparation
The samples were received wet in glass jars in a cooler packed with ice. The jar containing sample SE-1-R5 (3126744) was broken, but the sample did not appear to be compromised. Each sample was assigned an RJ Lee Group identification number and logged into the RJ Lee Group database. The samples were stored under refrigeration (3-5°C) until preparation. Preparation was accomplished by removing a sample from the refrigerator and drying it overnight at 110° C. The dry sample was screened at 4 mm, and the retained +4 mm material was weighed; these weights are presented in Table A2. The volume of the passing fraction was reduced using a channel riffle splitter with 6 mm-wide channels in order to obtain a small volume subsample suitable for mounting. Each volume reduction was performed twice and quarters were combined. The reduced-volume sample was sieved using a number 10 mesh (2 mm) screen and the coarse (+2 mm) and fine (-2 mm) fractions were weighed. The weight percentages are shown in Table A2. Because it is difficult to collect a representative sample of the very coarse material that occurs in very small numbers, the coarsest fraction (+4 mm) is not included in the normalized percent of the -4 to +2 mm and -2 mm fractions in that table.

In this study, the -2 mm fraction particulate was prepared as a polished mount. A polished sample mount yields a more consistent EDS signal and a better estimate of volume than a strewn particle mount, and exposes particle interiors to inspection. The -2 mm fraction was mixed with epoxy, placed into a square mounting "ring" and allowed to cure overnight. The hardened mount was polished using a series of grits to as fine as 3 μm. This sample mount was photographed and given a thin coating of carbon under vacuum to provide a path to ground and to eliminate charging effects while under the electron beam. Carbon and aluminum tape was affixed to each sample mount for calibration purposes. Material from both coarse fractions was retained for optical and SEM examination and archived.

CCSEM Analysis Design for UCR Sediment
General
The High-Z CCSEM analysis was performed on the polished mounts of -2 mm particulate. The analysis was performed at two magnifications. The entire sample was scanned at a magnification of 25x, in which particles larger than 125 μm in diameter were characterized.

Randomly selected fields were also scanned an additional 2 hours at a magnification of 200x, in which particles larger than 15 µm were characterized. Various size and shape measures were automatically collected and written to an electronic file along with chemical composition, the EDS peak area percent for identified elements. It should be noted that all chemical percentages in this report are based on the relative peak area of the various elements. Although peak areas relate to actual chemical abundance in a general way, this measure does not provide weight percentages for the components. The peak area percentages of the EDS spectrum may be processed by adjusting for the effects of atomic number, absorption and fluorescence (ZAF) to obtain an estimate of weight percent. It should be noted, however, that this procedure does not improve the ability to distinguish among particles of different chemical compositions.[2]

The CCSEM analysis was performed on an Aspex PSEM 2000 with an accelerating voltage of 20 KeV, a beam current of 30-35 nA and a drive of 7-8 V in the BE imaging mode. A brightness threshold was used to categorize particles into relatively lower and relatively higher average atomic number. The relatively low atomic number particles included minerals such as quartz and feldspar, with average atomic numbers around 10.0 to 10.6. The threshold defining relatively high average atomic number particles was selected just above the brightness of feldspar. The relatively high atomic number particles included slag and other materials (e.g., biotite and hedenbergite with average atomic numbers from 11.4 to 12.2), which were then detected and sized (linear dimensions and area). Elemental compositions (EDS peak area percent) of relatively high atomic number particles were determined using EDS in the raster mode. Elements analyzed were Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, Cr, Mn, Fe, Zn, Zr, and Ba, which include the major and minor elements in the glassy slag and the elements in common mineral types in the river sediment. The size and compositional data (EDS peak area percent by element) were saved to a file for summarizing.

Magnification and Particle Size

The results obtained using the two magnifications were prorated based on the relative area analyzed and combined. Because the area analyzed at the higher magnification was less than that analyzed at the lower magnification, the high magnification data were normalized to the larger area of the low magnification. For example, for sample SE-2-R3 (1326755), 202 μm^2 was analyzed at the low magnification and 49 μm^2 was analyzed at the high magnification. Because 4.1 times the area was analyzed at the low magnification, the high magnification data were scaled up by that amount before being combined with the low magnification data.

Image Brightness and Contrast

Preliminary inspection of prepared sample mounts revealed brightness contrast settings that would allow the relatively low brightness (e.g., quartz or feldspar) particles and the relatively high brightness particles (e.g., iron-bearing phases) to be distinguished. Once the brightness and contrast settings were adjusted for optimum imaging, the image intensity (which ranges from 0 to 255) for carbon tape and aluminum tape were determined to be 30 and 150 respectively (See Figure 8A). Carbon and aluminum tape fixed to each sample were used to set

[2] Chemical compositions do not suffice as a proxy for this method of identifying slag content. Taken by themselves, none of the rules are sufficient to distinguish slag.

brightness and contrast for all subsequent analyses to assure image consistency among all analyses.

Particle Detect Threshold Brightness Value

A conservative brightness threshold value was selected at 150, just above feldspar, so the slag (and other compositions) will be detected. Figure 8B shows a brightness line scan passing over three particles. The first particle is above threshold and will be detected. Figure 8C shows the composition and texture of slag. The second particle is above threshold and will be detected. It is a rock fragment consisting of an iron-bearing aluminosilicate (Figure 8D), feldspar and chlorite. The third particle is below threshold and will not be detected. It is a two-phase particle consisting of feldspar (Figure 8E) and quartz.

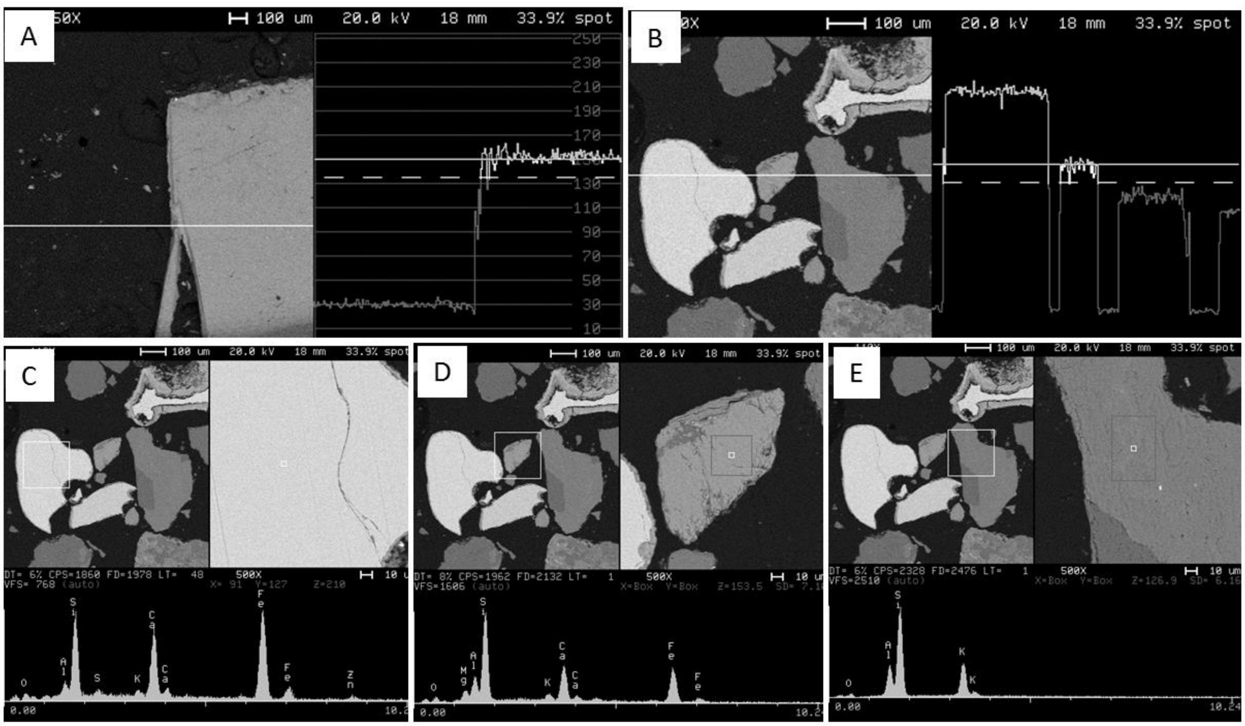


Figure 8. A shows a line scan of brightness across carbon (left) and aluminum (right). B shows a line scan of brightness across three particles. C, D and E are images and EDS spectra illustrating the morphology and composition of the three particles described in the text.

Post-CCSEM Analysis Review.

After the CCSEM analysis was completed, selected particles were analyzed in the manual mode to document representative particles. This quality assurance step was based on the professional judgment and at the discretion of the analyst. Typically, 10 or more slag particles were reviewed for each sample. To select particles for review, the tabulated particle compositional data were sorted to identify particles rich in Si, Ca and Fe. Every nth (approximately) particle was selected for review where "n" was selected based on the number of particles identified. For example, approximately every thirtieth particle in sample SE-1-R2 (3126746) was reviewed.

Procedures – Characterization of Glassy Slag

Once the particle-by-particle data were acquired, rules were written to define the particle types, and the overall abundances of those types. Size distributions for all particles in each class also were determined.

Definition of Glassy Slag and Altered Slag

After the CCSEM analysis was complete, the stored data were processed for particle type identification. The major elements (Fe, Si and Ca) are variable in slag, and they also are abundant elements in other minerals as well. To distinguish glassy slag particles from other Fe, Si, and Ca-containing minerals, relative proportions of the major elements were displayed in a Fe-Si-Ca ternary diagram. Review of the tabulated compositional data and the particle shape and internal texture displayed in SEM images for this study (although not all slag in the UCR) indicates that all glassy slag identified in this study has the combination of Fe, Si and Ca at 70 EDS peak area percent or more. Particles that fit this compositional threshold were plotted in a ternary diagram (Figure 9), where normalized Fe, Si and Ca are the apices. This ternary plotting was conducted on five samples which, based on the professional judgment of the investigator, represented slag presence in the sample set. This diagram shows the structure of the compositional data from one sample (SE-2-R3, 3126755) (used as an example for illustrative purposes). Cluster A includes particles that are over 60% Fe, and review of representative images indicate that these particles are not slag. Clusters B and C are mostly silicate minerals with a small amount of iron and higher in aluminum, such as amphibole, pyroxene or garnet. These particles show morphology and internal texture of minerals illustrated in Figure 10. However, there are particles in the region of these clusters that display the morphology and internal texture of slag such as those illustrated in Figures 1 to 4. The particles in Cluster D all display the morphology and internal texture of a slag with a composition distinct from minerals. The literature (e.g., Cox, 2005) suggests that altered slag should plot to the left of the main slag cluster (see arrow, Figure 9).

In order to assess the composition of altered slag, 20 particles of slag with one or more alteration rims were analyzed by manual SEM (MSEM) techniques. These normalized compositions are plotted in the ternary diagram in Figure 11. Note that the altered slag is reduced in calcium compared to Slag1, but not in iron. Of the 30 "altered" slag compositions, the five circled rims were low in average atomic number and would not be detected in a High-Z CCSEM analysis. No attempt was made to quantify the proportion of relatively low atomic number altered slag particles that may have been missed for all samples due to low brightness. However, five of the 30 examples in Figure 11 were not selected based on brightness (i.e., 17%), so this may be a first approximation. The locations of the remaining compositions in the Fe-Si-Ca ternary diagram were used to define the differentiation between slag and altered slag. It should be noted that in the CCSEM analysis, the EDS spectrum is acquired from the entire defined particle. If a thin alteration rim is present, the composition will not be sufficient to push the composition sufficiently to the left in the ternary diagram to be defined as Altered Slag. To be identified as Altered Slag, the particle is most likely a spalled alteration rim or a slag particle that most of its sectioned area has been altered.

To create rules that can classify the slag in all the samples, preliminary rules were written to define the dominant slag (referred to as "Slag1" in this report) at Cluster D in Figure 9, the Altered Slag to the left of Cluster D, and the slag interspersed with minerals in the region of Clusters B and C (referred to as "Slag2" in this report). Particles near the edges of the defined Fe-Si-Ca clusters were inspected to determine if the inside particles belonged to that cluster class and that the outside particles should be excluded and the rules were adjusted if appropriate. This procedure was repeated as additional samples were acquired until a stable solution was achieved. The rules are summarized in Table 2 and illustrated in the ternary diagram of Figure 12.

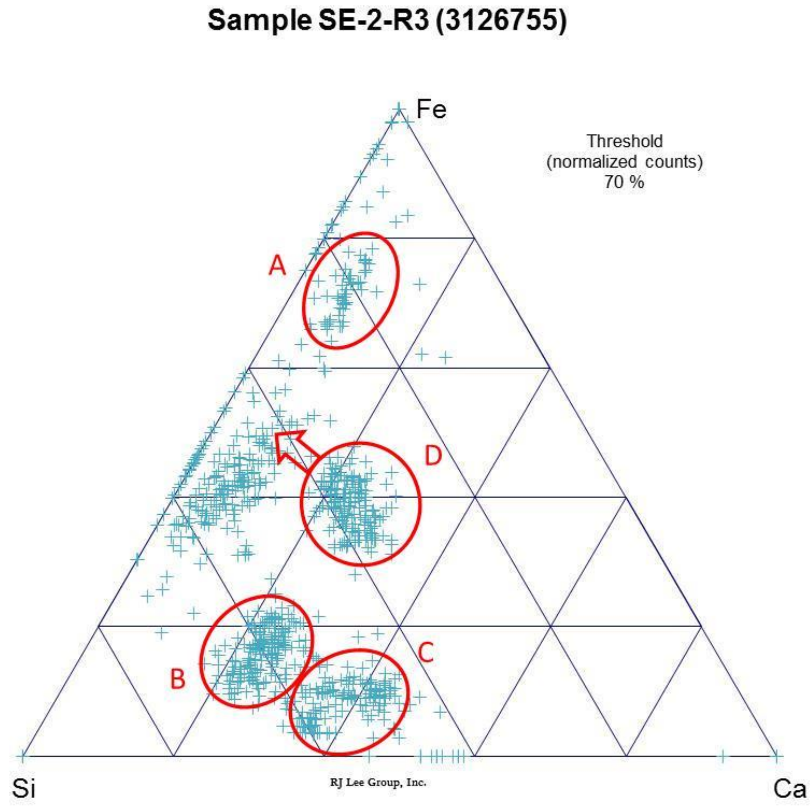


Figure 9 – Ternary diagram showing the relative proportions of Si, Ca, and Fe of all particle having a total of 70 EDS peak area percent or more for the CCSEM analysis of sample SE-2-R3. A is iron-rich particles, B and C are minerals with some Slag2 (similar to Slag1 but lower Fe concentration), and D is the major slag composition. The arrow points to the direction of alteration by calcium reduction.

The identification of Slag2 was more complicated in that its composition overlapped minerals. The image and spectrum of each particle assigned to that class was inspected and particles displaying the texture of minerals (see Figure 10) were rejected. Because the internal texture was required for positive identification of the Slag2, the small particles in the second magnification (less than 125 um diameter) were not considered. Based on the data acquired for Slag1, this would under-report Slag2 by about 2% by volume (See Table A3).

Finally, rare occurrences of a chromium slag (Slag3 in this report) were observed. A representative image and spectrum for the three slags are shown in Figure 13.

The rules defining each slag are shown in Table 2. Each rule consists of multiple components describing a complex composition. The components include: A] the total of major elements (component 2) B] elemental totals (components 3 and 4), C] Individual major elements (components 5 to 10) and D] minor elements (components 11 to 14). Slag2 also requires analysis at the low magnification (25x) only.

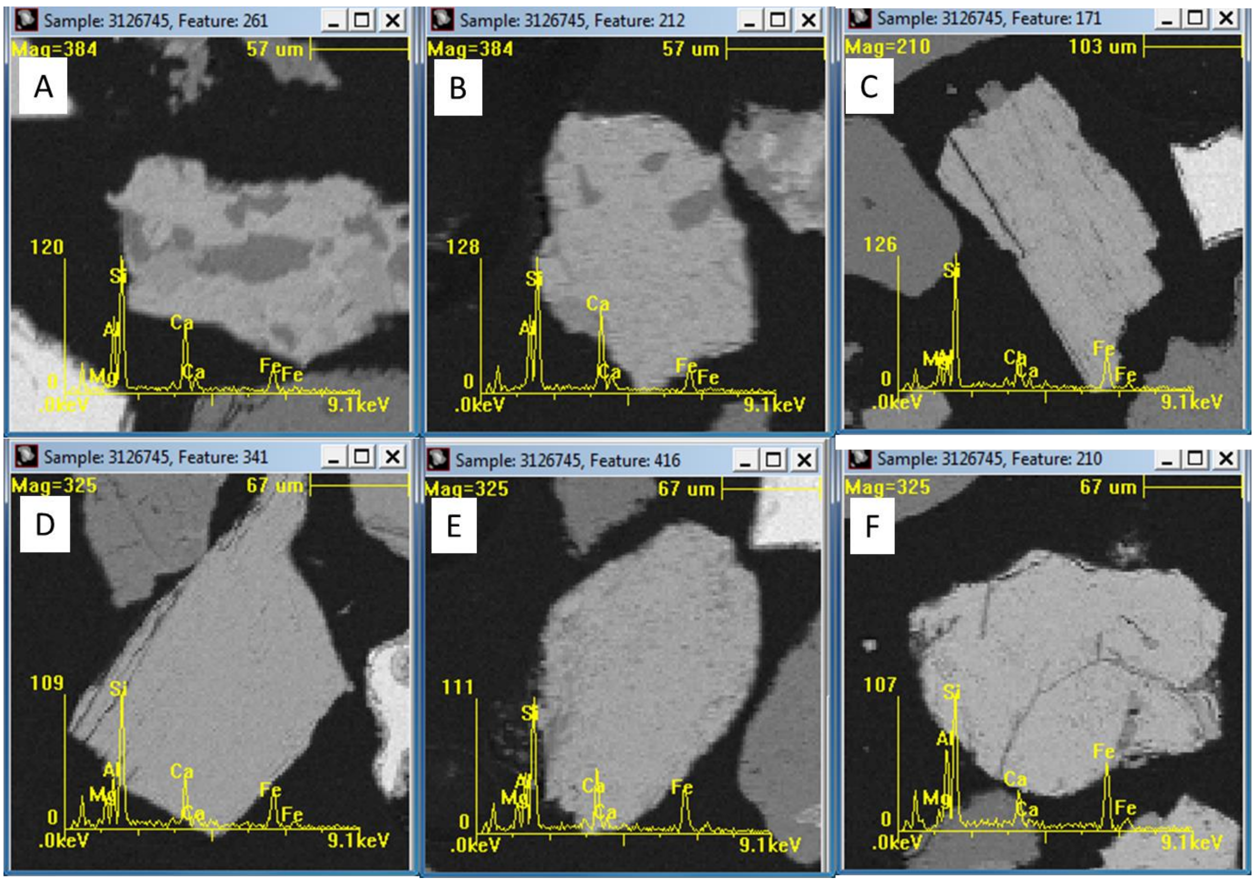


Figure 10. BE images and EDS spectra of non-slag SiCaFe-rich particles. A and B display multiple components of a rock fragment. C and D show parallel surfaces or internal cracks, E shows fine scale internal texture and F shows internal cracking.

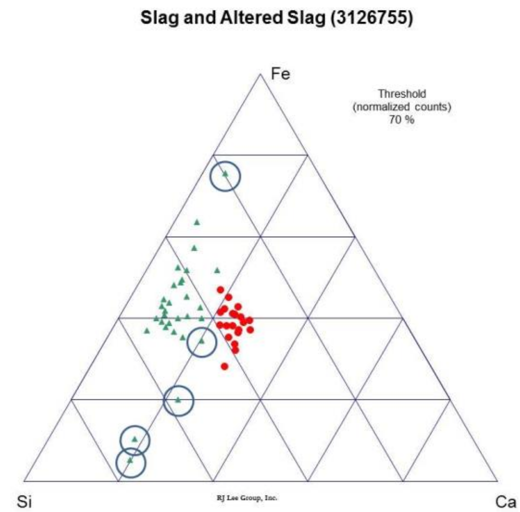


Figure 11 – Ternary diagram showing the EDS peak area percentages of Si, Ca and Fe of slag cores (red circles) and altered slag rim (green triangles) as determined by MSEM. The altered slag with circles have low image brightness and would not be detected in the CCSEM analysis.

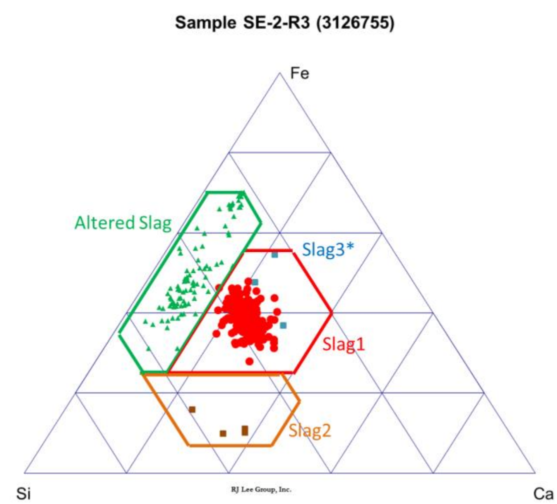


Figure 12 – Ternary diagram showing the EDS peak area percentages for three particle types in sample SE-2-R3 (3126755). The data for the rare Slag3 were derived from different samples.

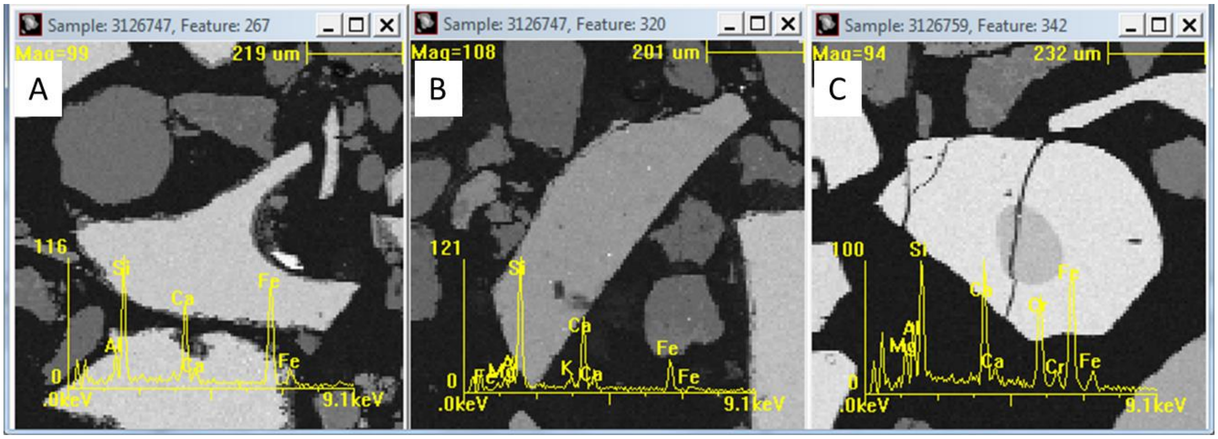


Figure 13 – Representative images of Slag1 (A), Slag2 (B), and Slag3 (C).

Table 2 - The rules used to identify various Slags. The values are EDS peak area percentages, or ratios of those percentages.

Rule Component	Rule Definition	Slag1	Altered Slag	Slag2	Slag3
1	Magnification	-	-	25x	-
2	Si+Ca+Fe	≥70	≥70	-	-
3	Mg+Al+Si+S+K+Ca+Mn+Fe+Zn	≥94	≥94	≥94	-
4	Mg+Al+Si+Ca+Cr+Fe	-	-	-	≥90
5	Si/(Si+Ca+Fe)	0.20 to 0.60	0.15 to 0.65	0.38 to 0.65	
6	Si	-	-	-	12 to 22
7	Fe/(Si+Ca+Fe)	0.25 to 0.55	0.25 to 0.70	0.07 to 0.41	
8	Fe	-	-	-	19 to 40
9	Ca/(Si+Ca+Fe)	0.15 to 0.40	0.02 to 0.15	0.10 to 0.45	-
10	Ca	-	-	-	8 to 23
11	Al	≤10	≤10	5 to 25	4 to 16
12	Mg	≤5	≤5	≤15	≤16
13	Mg+Al	-	-	≤29	-
14	Cr	-	-	-	16 to 33

Sample Slag Volume Estimate

The total area of glassy slag within the analyzed area of the prepared sample was determined using CCSEM software. Each field of analysis was electronically recorded and the portion of the sample that was epoxy was determined so the area of slag could be compared to the total area of particles. As derived mathematically[3], the area percent of the slag is a consistent estimate of the volume percent of the slag.

Particle Size Distribution

In the CCSEM analysis, the particle periphery is detected and the particle area determined. The diameter of a circle with the same area of the particles (Dcirc) was used to represent particle

[3] Chayes, F., 1956, Petrographic Modal Analysis, Chapter 1, Section 5 The Area-Volume or Delesse Relation, John Wiley & Sons, Inc.

size. Because the particle size is determined in the plane of the polished mount, which may not go through the particle center, this is referred to as an apparent diameter. Note that this method of measuring particle size was selected for simplicity; actual particle shapes are irregular.

Particle size is based on a contiguous particle periphery. A limitation to the CCSEM software is that touching particles are considered as a single particle, and are given the diameter based on the total area. Touching particles are rare when the slag content is small, but more common when the slag is abundant. Sample SE-3-B2 had a high concentration of slag. The data were manually reviewed for the 471 particles identified as slag. It was found that 29 (6.1%) of those were actually multiple particles. No attempt was made to address this issue in the size distribution data.

Epoxy Area determination by Image Analysis

The prepared sample mounts consist of particulate and epoxy. In order to determine the area percent of various particle types, the area of epoxy needs to be subtracted from the total area analyzed. The CCSEM analysis indicates the area of the prepared sample that comprises a particle type, but because it was a High-Z analysis the total area of all particles was not determined. However, because backscatter intensity standards (carbon and aluminum) were placed on each sample and the brightness and contrast set to consistent values in all analyses, the dark epoxy can be determined for all samples using image analysis techniques.

The intensity (brightness) distribution in the low magnification field images for three initial samples was determined using the ImageJ image analysis program (developed by the National Institutes of Health). Figure 14 illustrates a field image showing the dark epoxy, medium brightness particles including rock fragments and high brightness particles including slag. Inspection of the intensity histograms of these 48 fields confirmed tri-modal distributions of brightness levels that could consistently segment the images into low (epoxy), medium (relatively low atomic number particles) and high (relatively high atomic number particles) intensity features. Figure 15 shows the image brightness histogram and the image segmented into low intensity (0 to 70), medium intensity (71 to 170) and high intensity (171 to 255) regions. The CCSEM detection limit was set to 150, as it is more conservative and could reject non-slag particles based on composition.

Once these intensity ranges were identified using the interactive ImageJ, a script was written in MatLab® to perform the area segmentation automatically. This allowed the area of epoxy to be subtracted from the total area analyzed by CCSEM resulting in the total particle area. Comparing the area of Slag and Altered Slag to the total particle area reveals the percent of the slag varieties.

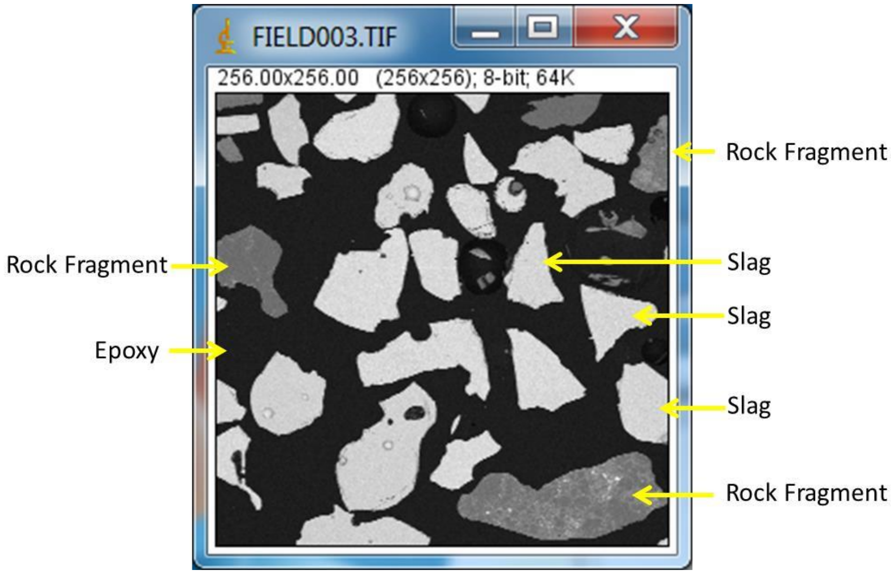


Figure 14 – Screen capture image of a low magnification field.

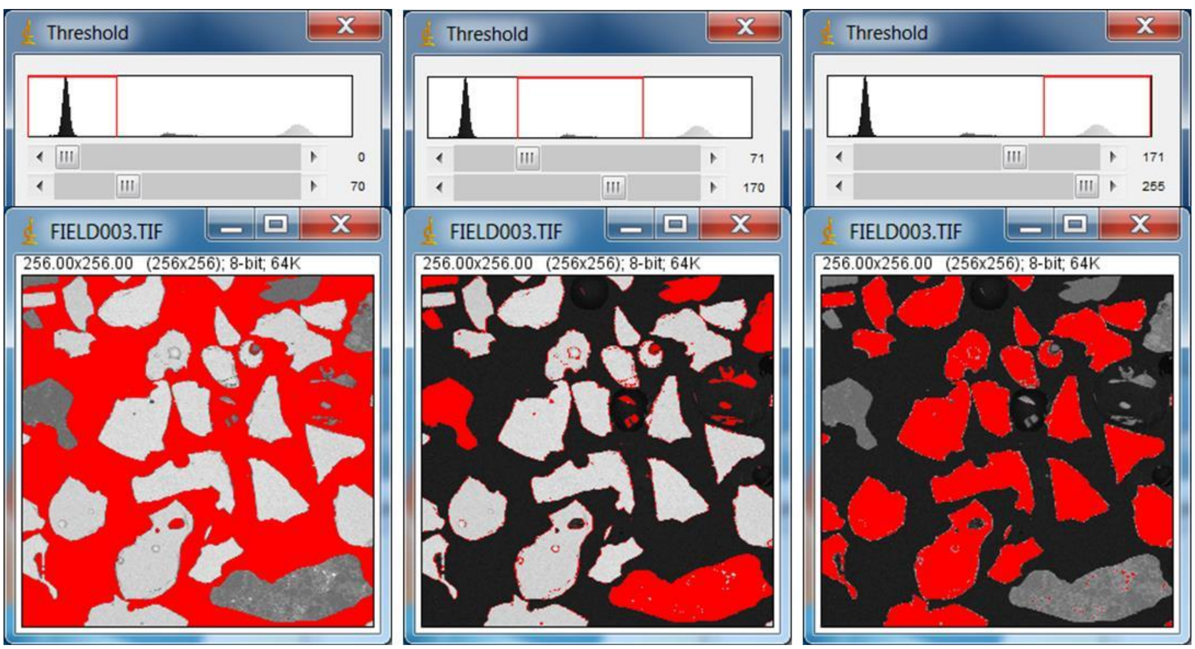


Figure 15 – Screen capture image of the same field segmented into low intensity epoxy (brightness 0 to 70), medium intensity particles that exclude slag (brightness 71 to 170), and high intensity particles dominated by slag (171 to 255).

Quality Assurance

Quality assurance steps were conducted to validate and confirm analytical results. This included comparison of CCSEM High-Z results to Image Analysis results, manual review of two samples, and duplicate and replicate analysis.

Comparison of CCSEM High-Z Analysis to Image Analysis

As described above, Image Analysis procedures applied to the low magnification fields was used to determine the relative proportion of particle and epoxy in a sample mount. Inspection of the intensity histograms (see Figure 15) indicated that there are two brightness intensity modes in the particle range. If slag is the only particle type present with a high average atomic number, the high brightness intensity peak would represent slag. The plot of the CCSEM percent slag versus the percent of particles determined by image brightness greater than 171 is shown in Figure 16. There is a very high correlation between the two measures.

The presence of other bright phases (including, for example, zircon, iron oxide, ilmenite and sphene) (Figure 17) indicates this assumption is not strictly true, but the bright phases other than slag tend to be small and do not comprise a large portion of the bright phases.

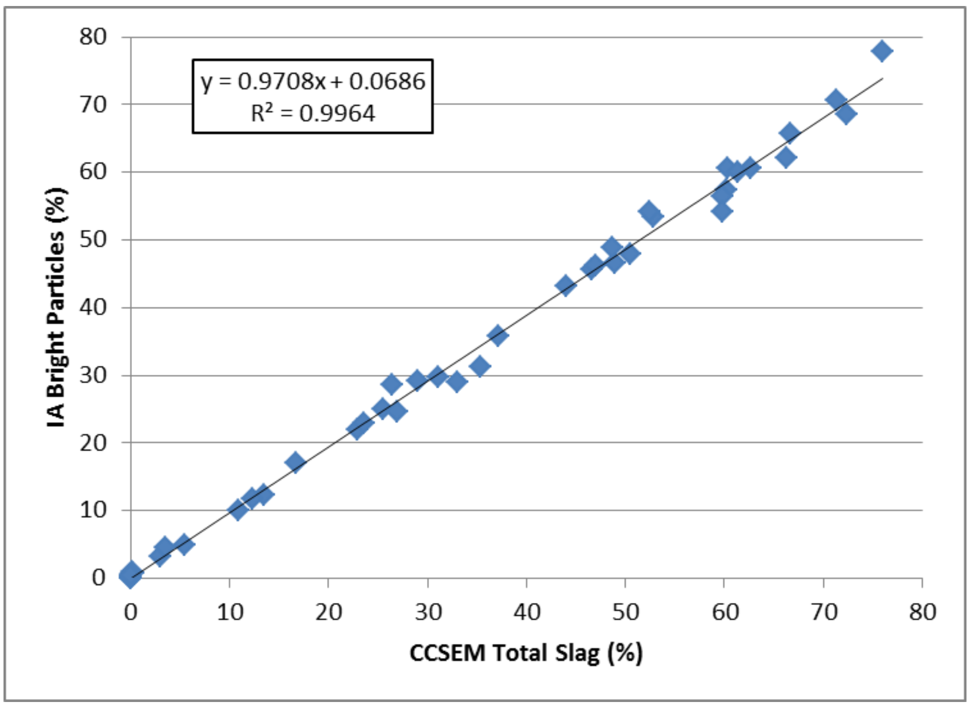


Figure 16 – Scatter plot of the area percent total glassy slag identified by CCSEM and the percent materials defined simply by high brightness. The equation and correlation coefficient for the best fit line is displayed.

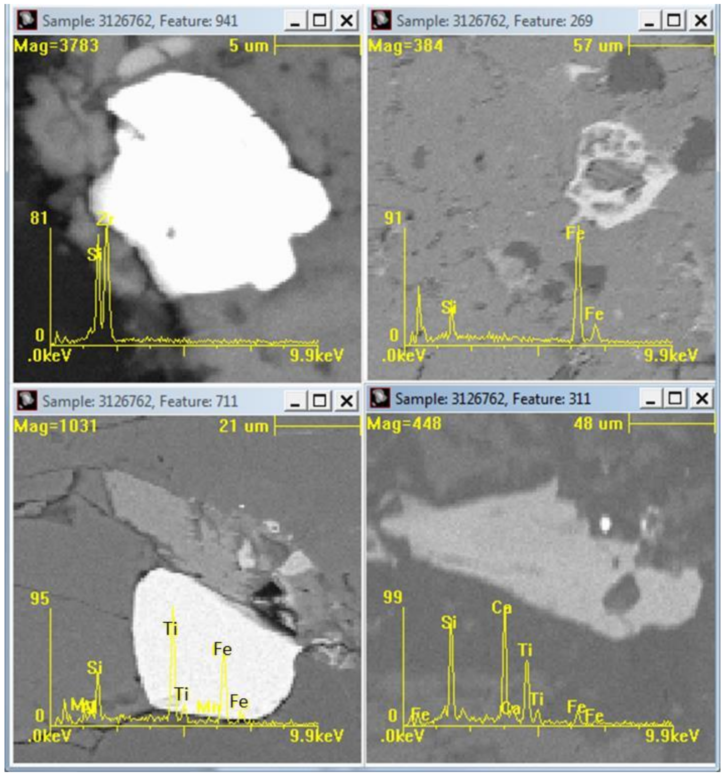


Figure 17 – SEM images showing zircon (top left), iron oxide (top right), ilmenite (bottom left) and sphene (bottom right).

Manual Review of Two Samples

The vast majority of the slag occurs in the low magnification particle size range. The slag can be reasonably identified by brightness, shape and texture observable in the acquired field images. A visual review of the field images of two samples (SE-3-B4, 3126762 and SE-3-R7, 3126763) was performed by inspecting the low magnification field images and determining which particles were identified as slag by CCSEM. Slag area can be underrepresented if slag particles are not detected or are undersized. Slag area can be overrepresented if slag particles are counted more than once. The difference between the manual review and CCSEM analysis is estimated to be 4.5% for SE-3-B4 (3126762) slag area and 2.7% for SE-3-R7 (3126763) slag area.

Duplicate Analyses and Replicate Sample Mounts

A duplicate analysis was performed on the original sample mount of sample SE-4-B6 (3126771). The results are shown in Table 3.

Table 3 – Results of duplicate analysis of SE-4-B6 (3126771).

	% Epoxy	Slag1% CCSEM	Slag% IA	Altered Slag% CCSEM
First Run	0.500	60.0	57.4	0.15
Second Run	0.498	59.6	56.5	0.19

A second mount was prepared and analyzed for three samples and two additional mounts were prepared and analyzed for another sample. The replicate sample mount results for Slag1, Slag2 and the Altered Slag are shown in Table 4. The Slag1 percentages in the 2-mount samples ranged from about 25 to 66%. Absolute differences in Slag1 were between 1 and 7% of the total and relative differences were between 1.8 and 19.9%. The fourth 3-mount sample had an absolute difference of 18% and a relative difference of 34.8%. The Slag2 and the Altered Slag had larger relative differences though small differences in absolute percent, ranging up to about 0.6%.

Table 4 – Slag EDS peak area percent for multiple mounts showing the maximum difference (if three analyses) the difference normalized to the average and the RSD estimated using the relative range. The same mount for sample SE-3-R7 was analyzed twice, so the Prep1 is the average of the two runs.

Client ID	RJLG ID	Type	Anal. 1 (% slag)	Anal. 2 (% slag)	Anal. 3 (% slag)	Max Diff (% slag)	Rel. Diff. %	RSD
SE-1-R5	3126744	Slag1	25.4	31.0	-	5.6	19.9	5.0
SE-3-B4	3126762	Slag1	59.8	66.5	-	6.7	10.6	5.9
SE-3-R7	3126763	Slag1	43.9	62.2	52.2	18.3	34.7	10.8
SE-4-B6	3126771	Slag1	59.8	60.9		1.1	1.8	1.0
SE-1-R5	3126744	Slag2	0.119	0.0927	-	0.026	24.8	0.02
SE-3-B4	3126762	Slag2	0.540	0.155	-	0.386	111.0	0.3
SE-3-R7	3126763	Slag2	0.117	0.510	0.712	0.595	133.2	0.4
SE-4-B6	3126771	Slag2	0.202	0.475		0.274	80.9	0.2
SE-1-R5	3126744	Alt Slag	0.0326	0.038		0.005	15.3	0.005
SE-3-B4	3126762	Alt Slag	0.108	0.0628		0.045	52.9	0.04
SE-3-R7	3126763	Alt Slag	0.061	0.0573	0.0818	0.025	36.7	0.01
SE-4-B6	3126771	Alt Slag	0.169	0.561		0.392	107.4	0.3

The sample variability is typical for counting individual discrete particles with variations in size and density. Sample heterogeneity, and the difficulty in capturing a representative subsample even using the riffle splitter and combining quarters, likely contributed to variations shown in Table 4. The presence or absence of few large particles in a population of hundreds can contribute to differences in the measured totals. The differences in measured Slag1 content in the three SE-3 R7 (3126763) prepared samples is influenced largely to no particles larger than 1000 µm, three particles between 1100 and 1233 µm, and three particles between 1000 and 1100 µm, in the three analyses respectively.

Assessment of the Coarse Fractions (+4 mm and -4 to +2 mm)

The +4 mm particles were photographed and the +4 mm particles and -4 to +2 mm particles were inspected using a binocular microscope to determine if slag particles were present.

Because slag was not the only dark component, questionable dark particles were mounted and analyzed in the SEM. Based on color and morphology, one sample (SE-1B-R3, 3126749) contained one Slag2 particle in the +4 mm fraction (approximately 4.25 mm) and another in the +2 mm fraction (Figures 18 and 19). Other than noting the presence of possible coarse slag, the observation of two particles does not significantly affect the slag abundance identified in this sample.

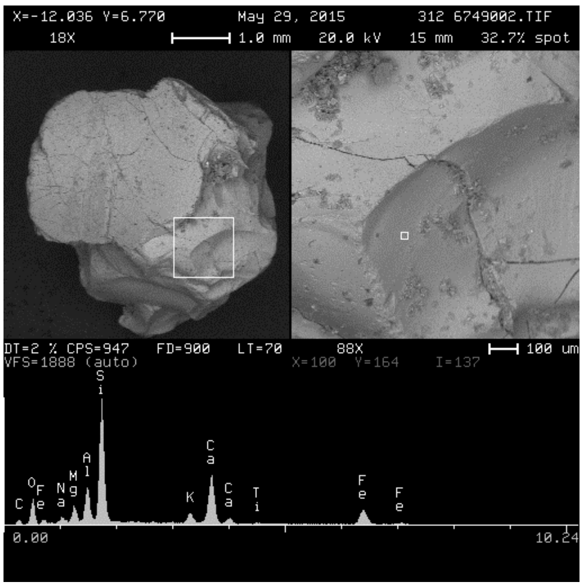


Figure 18 – BE images and EDS spectrum of particle in the +4 mm size range with slag-like morphology and consistent with Slag2 composition. (Sample SE-1B-R3 3126749)

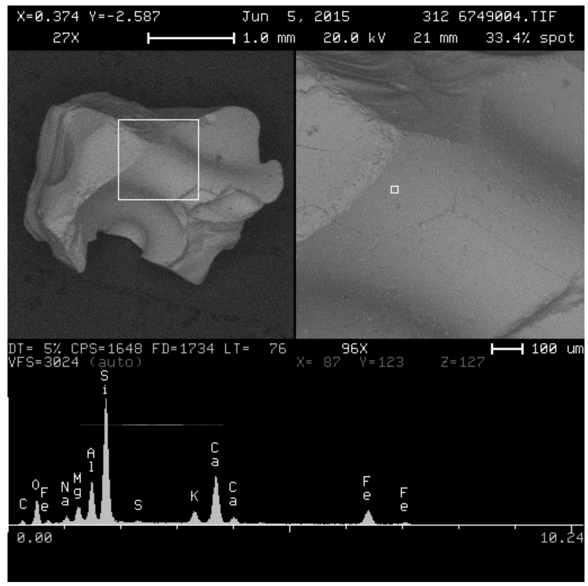


Figure 19 – BE images and EDS spectrum of particle in the -4 to +2 mm size range with slag-like morphology and consistent with Slag2 composition. (Sample SE-1B-R3 3126749)

Results

The calculated area percent (= volume percent) of three varieties of glassy slag and altered slag by CCSEM and percent bright particles by image analysis for each sample are presented in Table A1 following this report. The weight percent by particle size data are presented in Table A2. The +4 mm data are normalized to the whole sample. Because the coarsest particles are likely derived from local sources, the two finer fractions are normalized to 100%. The apparent size distributions of area percent in size bins are presented in Table A3. The size bins are defined as Dcirc (the diameter of a circle with the same area as the particle) in half phi gradations from 6 phi medium silt (15 μm) to -2 phi granule (4000 μm). Although three varieties of glassy slag were differentiated, the vast majority was a single type. Over 98% of the slag was coarser than 125 μm.

Reference

Cox, S.E., Bell, P.R., Lowther, J.S., and VanMetre, P.C., 2005, Vertical Distribution of Trace-element Concentrations and Occurrence of Metallurgical Slag Particles in Accumulated Bed Sediments of Lake Roosevelt, Washington, September 2002, US Geological Survey Scientific Investigations Report 2004-5090.

These results are submitted pursuant to RJ Lee Group's current terms and conditions of sale, including the company's standard warranty and limitation of liability provisions. No responsibility or liability is assumed for the manner in which the results are used or interpreted. RJ Lee Group will store samples from this project for a period of thirty (30) days after the end of this work scope, after which they will be stored but fees will apply. Samples can be returned at your request.

Should you have any questions regarding this information, please do not hesitate to contact us.

Sincerely,

Stephen K. Kennedy, Ph.D.
Senior Scientist
Technical Consulting Services

Table A1 – Sample identification, River Mile, percent Slag1, Slag2, Slag3 and Total Slag based on CCSEM Analysis, percent bright particles based on Image Analysis, and percent Altered Slag based on CCSEM. RJLG IDs appendment: R – reprepared sample mount; D - duplicate analysis on the same mount.

RJLG ID	Client ID	River Mile	Slag	Slag2	Slag3	Total	IA	AltSlag
3126743	SE-LAL-5	N/A	0.0000	0.0000	0.0000	0.0000	0.260	0.0000
3126744	SE-1-R5	745	25.4	0.119	0.0000	25.5	25.0	0.0326
3126744R	SE-1-R5	745	31.0	0.0927	0.0000	31.1	29.8	0.0380
3126745	SE-1-R1	745	16.6	0.132	0.0000	16.8	17.1	0.205
3126746	SE-1-R2	743	32.9	0.166	0.0000	33.0	29.0	0.0862
3126747	SE-1-B5	738	26.3	0.734	0.0000	27.0	24.6	1.232
3126748	SE-1-R8	738	13.6	0.0000	0.0000	13.6	12.4	0.101
3126749	SE-1B-R3	735	48.0	0.895	0.0000	48.9	46.7	0.192
3126750	SE-1B-C3	735	10.5	0.381	0.0000	10.9	10.1	0.177
3126751	SE-1B-C1	735	29.0	0.0000	0.0000	29.0	29.1	0.509
3126752	SE-2-B1	733	0.234	0.0848	0.0000	0.319	0.742	0.0057
3126753	SE-2-B2	733	12.2	0.0524	0.0000	12.3	11.8	0.0735
3126754	SE-2-R1	733	22.8	0.0883	0.0000	22.9	21.9	0.430
3126755	SE-2-R3	732	2.93	0.0716	0.0000	3.0	3.22	0.197
3126756	SE-2B-R1	728	23.5	0.179	0.0000	23.6	22.9	0.0520
3126757	SE-2B-C4	729	70.8	0.544	0.0000	71.3	70.7	0.609
3126758	SE-2B-C3	727	5.44	0.0000	0.0000	5.4	4.85	0.574
3126759	SE-3-B1	726	48.2	0.0512	0.449	48.7	48.9	0.0243
3126760	SE-3-C1	724	20.1	6.38	0.0000	26.4	28.5	0.732
3126761	SE-3-B2	725	71.7	0.689	0.00328	72.4	68.6	0.0238
3126762	SE-3-B4	724	59.8	0.540	0.0000	60.4	60.6	0.108
3126762R	SE-3-B4	724	66.5	0.155	0.0000	66.7	65.7	0.0628
3126763	SE-3-R7	723	43.9	0.117	0.0000	44.0	43.2	0.0610
3126763R	SE-3-R7	723	62.2	0.510	0.0000	62.7	60.5	0.0573
3126763R2	SE-3-R7	723	52.2	0.712	0.0000	52.9	53.5	0.0818
3126764	SE-3-R8	722	75.3	0.724	0.0000	76.0	77.8	0.0312
3126765	SE-3-R10	721	46.0	0.587	0.0000	46.6	45.7	0.435
3126766	SE-3-R9	722	3.58	0.0113	0.0000	3.6	4.58	0.498
3126767	SE-3-C4	722	48.9	1.55	0.0000	50.5	47.9	0.387
3126768	SE-3B-C3	716	66.3	0.0000	0.0000	66.3	62.2	0.0370
3126769	SE-4-R1	711	45.5	1.50	0.0000	47.0	46.2	0.0646
3126770	SE-4-B1	711	51.6	0.888	0.0000	52.5	54.1	0.179
3126771	SE-4-B6	709	60.0	0.201	0.0000	60.2	57.4	0.145
3126771D	SE-4-B6	709	59.6	0.202	0.0000	59.8	56.5	0.193
3126771R	SE-4-B6	709	60.9	0.475	0.0000	61.4	60.0	0.561
3126772	SE-4-B2	709	59.5	0.285	0.0000	59.8	54.1	1.23
3126773	SE-4-B4	707	33.7	1.65	0.0923	35.4	31.3	0.551
3126774	SE-4-B5	705	34.8	2.32	0.0000	37.1	35.7	0.229
3126775	SE-4-C4	705	0.234	0.0000	0.0000	0.234	0.928	0.0180
3126776	SE-4B-C3	692	0.024	0.0000	0.0000	0.024	0.492	0.0510
3126777	SE-REF-3	689	0.001	0.0000	0.0000	0.0005	0.173	0.0032
3126778	SE-5-B2	678	0.003	0.0000	0.0000	0.003	0.109	0.0006
3126779	SE-5B-C1	673	0.013	0.0000	0.0000	0.013	0.192	0.0000
3126780	SE-6-B4	664	0.0000	0.0000	0.0000	0.0000	0.168	0.0000
3126781	SE-6B-C4	652	0.0000	0.0000	0.0000	0.0000	0.045	0.0005
3126782	SE-7-B1	645	0.0000	0.0000	0.0000	0.0000	0.045	0.0011
3126783	SE-8-B3	604	0.0000	0.0000	0.0000	0.0000	0.028	0.0000
3126784	SE-8B-C2	599	0.0000	0.0000	0.0000	0.0000	0.325	0.0042
Percent Slag by Type			30.0	0.48	0.01	30.5		
Slag Type Distribution			98.4	1.58	0.04	100.0		

Table A2 – Weight percent by particle size. The finer two fractions are normalized to 100%

Sample ID	Client ID	+4 mm	-4 mm +2 mm	-2 mm
3126743	SE-LAL-5	0.00	0.30	99.70
3126744	SE-1-R5	0.08	0.78	99.22
3126745	SE-1-R1	0.00	0.00	100.00
3126746	SE-1-R2	0.00	0.00	100.00
3126747	SE-1-B5	0.00	1.68	98.32
3126748	SE-1-R8	0.00	0.00	100.00
3126749	SE-1B-R3	0.76	22.26	77.74
3126750	SE-1B-C3	0.02	0.00	100.00
3126751	SE-1B-C1	0.00	0.00	100.00
3126752	SE-2-B1	0.25	0.00	100.00
3126753	SE-2-B2	0.00	0.00	100.00
3126754	SE-2R1	0.62	1.75	98.25
3126755	SE-2-R3	0.00	0.00	100.00
3126756	SE-2B-R1	0.00	4.17	95.83
3126757	SE-2B-C4	0.27	5.95	94.05
3126758	SE-2B-C3	2.27	0.00	100.00
3126759	SE-3-B1	0.00	1.73	98.27
3126760	SE-3-C1	0.00	6.33	93.67
3126761	SE-3-B2	1.45	1.76	98.24
3126762	SE-3-B4	0.00	1.88	98.12
3126763	SE-3-R7	0.00	0.36	99.64
3126764	SE-3-R8	0.00	2.02	97.98
3126765	SE-3-R10	1.32	0.00	100.00
3126766	SE-3-R9	0.00	0.00	100.00
3126767	SE-3-C4	0.00	0.00	100.00
3126768	SE-3B-C3	0.02	0.60	99.40
3126769	SE-4-R1	4.58	5.91	94.09
3126770	SE-4-B1	0.05	0.92	99.08
3126771	SE-4-B6	0.07	0.23	99.77
3126772	SE-4-B2	0.17	0.00	100.00
3126773	SE-4-B4	0.00	0.00	100.00
3126774	SE-4-B5	0.10	0.00	100.00
3126775	SE-4-C4	0.00	0.00	100.00
3126776	SE-4B-C3	0.54	2.33	97.67
3126777	SE-REF-3	0.14	0.00	100.00
3126778	SE-5-B2	0.00	0.00	100.00
3126779	SE-5B-C1	0.00	0.00	100.00
3126780	SE-6-B4	0.00	0.00	100.00
3126781	SE-6B-C4	0.00	0.00	100.00
3126782	SE-7-B1	0.00	0.00	100.00
3126783	SE-8-B3	0.00	0.00	100.00
3126784	SE-8B-C2	0.11	0.00	100.00

Table A3 – Slag1 area percent distribution (excluding Slag2 and Slag3) by particle apparent diameter (Dcirc) in µm. The last two columns and rows show the total distribution of fine (less than 125 um) and coarse (greater than 125 um) Slag1 relative to the total sample material.

RJLG ID	Client ID	< 22	22 to 31	31 to 44	44 to 62	62 to 88	88 to 125	125 to 177	177 to 250	250 to 350	350 to 500	500 to 710	710 to 1000	1000 to 1410	1410 to 2000	2000 to 2830	2830 to 4000	>4000	% Fine slag	% Coarse slag
3126743	SE-LAL-5	None																		
3126744	SE-1-R5	0.042	0.07	0.12	0.36	0.63	0.71	1.2	6.2	17.7	33.4	33.8	5.7	0.0	0.0	0.0	0.0	0.0	0.49	24.91
3126744R	SE-1-R5	0.053	0.041	0.13	0.21	0.57	0.81	1.4	5.3	14.7	42.7	25.4	8.6	0.0	0.0	0.0	0.0	0.0	0.57	30.43
3126745	SE-1-R1	0.065	0.10	0.32	0.67	1.3	1.7	8.0	16.8	33.9	33.4	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.70	15.90
3126746	SE-1-R2	0.072	0.032	0.11	0.38	0.64	1.0	1.9	9.2	22.6	49.6	14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.72	32.18
3126747	SE-1-B5	0.085	0.10	0.26	0.58	1.1	1.2	3.9	10.9	25.1	30.6	26.2	0.0	0.0	0.0	0.0	0.0	0.0	0.87	25.43
3126748	SE-1-R8	0.047	0.12	0.19	0.82	1.3	2.4	7.2	25.5	35.4	27.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.67	12.93
3126749	SE-1B-R3	0.018	0.028	0.088	0.25	0.35	0.3	0.4	0.9	4.2	29.2	49.0	15.3	0.0	0.0	0.0	0.0	0.0	0.49	47.51
3126750	SE-1B-C3	0.17	0.15	0.53	0.85	2.4	3.7	14.8	29.5	29.5	16.4	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.82	9.68
3126751	SE-1B-C1	0.036	0.12	0.25	0.33	0.49	1.2	3.5	7.1	21.9	43.6	21.5	0.0	0.0	0.0	0.0	0.0	0.0	0.72	28.58
3126752	SE-2-B1	0.10	0.000	0.66	1.57	2.8	10.5	21.0	17.8	0.0	45.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.04	0.20
3126753	SE-2-B2	0.030	0.11	0.25	0.54	0.88	1.8	5.6	14.3	42.3	30.1	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.45	11.75
3126754	SE-2-R1	0.12	0.23	0.55	1.34	2.4	3.7	12.4	26.8	27.8	20.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	1.90	20.90
3126755	SE-2-R3	0.39	0.49	1.3	4.93	11.5	20.1	34.7	24.5	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.13	1.80
3126756	SE-2B-R1	0.059	0.099	0.10	0.50	0.60	0.58	0.89	5.1	12.5	29.3	30.7	15.8	3.7	0.0	0.0	0.0	0.0	0.46	23.04
3126757	SE-2B-C4	0.017	0.035	0.072	0.13	0.34	0.17	0.32	1.2	3.2	21.1	46.2	26.1	1.2	0.0	0.0	0.0	0.0	0.54	70.26
3126758	SE-2B-C3	0.65	0.99	2.8	5.18	7.9	18.3	26.7	33.4	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.95	3.49
3126759	SE-3-B1	0.034	0.048	0.13	0.42	0.77	0.52	1.6	5.0	13.3	33.4	32.0	12.7	0.0	0.0	0.0	0.0	0.0	0.92	47.28
3126760	SE-3-C1	0.004	0.031	0.23	0.15	0.46	0.23	1.50	1.82	5.18	13.7	33.7	30.7	12.3	0.0	0.0	0.0	0.0	0.55	48.65
3126761	SE-3-B2	0.029	0.045	0.044	0.24	0.50	0.26	0.74	2.8	12.9	37.4	33.5	10.4	1.2	0.0	0.0	0.0	0.0	0.80	70.90
3126762	SE-3-B4	0.033	0.052	0.13	0.21	0.49	0.48	1.0	2.4	8.2	19.5	40.3	23.3	3.8	0.0	0.0	0.0	0.0	0.84	58.96
3126762R	SE-3-B4	0.081	0.12	0.16	0.26	0.66	0.35	0.62	1.6	8.5	26.7	34.6	23.5	2.7	0.0	0.0	0.0	0.0	1.08	65.42
3126763	SE-3-R7	0.048	0.065	0.21	0.28	0.54	0.54	1.1	5.2	18.0	28.8	29.7	15.5	0.0	0.0	0.0	0.0	0.0	0.74	43.16
3126763R	SE-3-R7	0.031	0.057	0.15	0.28	0.47	0.39	0.74	2.8	9.2	31.0	33.3	16.8	4.8	0.0	0.0	0.0	0.0	0.86	61.34
3126763R2	SE-3-R7	0.027	0.035	0.15	0.30	0.47	0.51	0.70	2.6	10.9	23.9	38.9	17.7	3.8	0.0	0.0	0.0	0.0	0.78	51.42
3126764	SE-3-R8	0.075	0.057	0.10	0.15	0.24	0.11	0.36	0.7	1.9	13.1	38.7	35.3	8.1	1.0	0.0	0.0	0.0	0.55	74.75
3126765	SE-3-R10	0.061	0.083	0.22	0.40	1.0	1.5	3.5	10.1	27.6	36.2	17.4	2.0	0.0	0.0	0.0	0.0	0.0	1.52	44.58
3126766	SE-3-R9	0.26	0.24	1.2	1.4	4.9	5.4	19.3	16.6	47.3	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.48	3.10
3126767	SE-3-C4	0.018	0.027	0.07	0.19	0.31	0.42	1.1	1.6	6.6	35.2	42.3	12.2	0.0	0.0	0.0	0.0	0.0	0.50	48.40
3126768	SE-3B-C3	0.049	0.095	0.17	0.31	0.42	0.54	0.93	3.1	7.2	28.2	34.9	22.7	1.4	0.0	0.0	0.0	0.0	1.05	65.25
3126769	SE-4-R1	0.010	0.044	0.10	0.16	0.40	0.43	1.0	2.4	8.0	28.2	36.8	19.9	2.5	0.0	0.0	0.0	0.0	0.53	45.27
3126770	SE-4-B1	0.022	0.056	0.08	0.20	0.42	0.34	0.59	2.3	7.7	28.2	42.1	14.8	3.2	0.0	0.0	0.0	0.0	0.58	51.02
3126771	SE-4-B6	0.031	0.072	0.08	0.29	0.50	0.61	1.2	3.8	15.4	39.8	29.2	7.6	1.5	0.0	0.0	0.0	0.0	0.96	59.04
3126771D	SE-4-B6	0.037	0.043	0.12	0.22	0.57	0.65	1.1	4.0	16.0	41.3	30.1	4.5	1.5	0.0	0.0	0.0	0.0	0.98	58.62
3126771R	SE-4-B6	0.027	0.051	0.081	0.25	0.62	0.39	0.99	2.6	12.7	35.5	35.6	9.5	1.6	0.0	0.0	0.0	0.0	0.87	60.03
3126772	SE-4-B2	0.026	0.051	0.09	0.23	0.45	0.34	0.75	3.3	14.8	37.4	36.7	4.2	1.6	0.0	0.0	0.0	0.0	0.70	58.80
3126773	SE-4-B4	0.046	0.072	0.12	0.17	0.50	0.69	2.0	6.1	19.8	43.7	23.9	2.8	0.0	0.0	0.0	0.0	0.0	0.54	33.16
3126774	SE-4-B5	0.010	0.031	0.07	0.24	0.24	0.24	0.60	1.1	3.7	41.0	42.2	10.5	0.0	0.0	0.0	0.0	0.0	0.28	34.52

Table 3A continued

RJLG ID	Client ID	< 22	22 to 31	31 to 44	44 to 62	62 to 88	88 to 125	125 to 177	177 to 250	250 to 350	350 to 500	500 to 710	710 to 1000	1000 to 1410	1410 to 2000	2000 to 2830	2830 to 4000	>4000	% Fine slag	% Coarse slag
3126775	SE-4-C4	0.81	4.8	15.0	21.7	50.0	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.23	0.00
3126776	SE-4B-C3	21.2	28.9	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.02	0.00
3126777	SE-REF-3	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
3126778	SE-5-B2	40.6	59.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
3126779	SE-5B-C	0.000	14.3	19.2	0.0	66.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.00
3126780	SE-6-B4	None																		
3126781	SE-6B-C4	None																		
3126782	SE-7-B1	None																		
3126783	SE-8-B3	None																		
3126784	SE-8B-C2	None																		
Total																			28.88	1442.68
% Slag																			1.96	98.04

APPENDIX G

RIVER MILE DESIGNATIONS

CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

BERA	baseline ecological risk assessment
NHD	National Hydrography Dataset
QAPP	quality assurance project plan
RM	river mile
UCR	Upper Columbia River
USGS	US Geological Survey
WDFW	Washington State Department of Fish and Wildlife

1 INTRODUCTION

This appendix of the Phase 2 Sediment Study Data Summary and Data Gap Report (data summary report) describes how river mile delineations for the Columbia River as presented on maps in the data summary report were determined. River mile delineations are assigned along the length of a river to identify the approximate distance (in miles) from the mouth of a river. River mile delineations in previous sampling plans and data reports for the Upper Columbia River (UCR) Site have not always been consistent because of a discrepancy in river mile indexing on United States Geological Survey (USGS) quadrangle maps. Therefore, a standard river mile indexing system was selected for use in this report, as well as in future sampling efforts and the baseline ecological risk assessment (BERA). In addition to delineating the river mile markings along the Columbia River, this appendix also describes the method used to assign a particular river mile designation to each of the samples collected for the Phase 2 sediment study.

2 RIVER MILE DELINEATIONS

This section describes USGS river mile delineation discrepancies on USGS maps and the delineation system selected for the data summary report and future mapping efforts for the UCR Site.

2.1 HISTORICAL USGS DELINEATIONS

The differences in Columbia River river mile delineations on available historical USGS 7.5 minute (1:24,000) quadrangles for the Rice quadrangle (USGS 2015) are as follows:

- **1985 Edition.** There is an error in the river mile indexing system along the Columbia River at the point where the Rice quadrangle meets the Bangs Mountain quadrangle. The river mile designation jumps from 690 to 692, skipping river mile (RM) 691.

- **1993 Edition.** In this edition, USGS renumbered river miles downstream from RM 692, this time including RM 691 but then omitting RM 681. In addition, RM 682 was moved so that it was placed only about 0.5 mile from RM 680, and the spacing of each river mile between RM 682 and RM 690 was revised. In 2007 the Washington State Department of Fish and Wildlife (WDFW) generated a river mile layer from this 1993 version of the Rice quadrangle (Ecology 2014).

- **1996 Edition.** In this edition, the river mile indexing on the Rice quadrangle is the same as that on the 1985 edition, with RM 691 omitted from the map.

- **Post-1996**. The more recent versions of the Rice quadrangle do not have river mile markings.

It should be noted that even though the river mile designations are identified as "river miles," they are only approximations of 1-mile increments. The average distance between river mile points (following the Columbia River centerline) is 5,441 feet (1.03 miles), and distances range from 3,665 feet (0.69 miles) to 8,898 feet (1.69 miles). Therefore, they should be considered and used as index markers only.

2.2 SELECTED DELINEATION SYSTEM

For the standard river mile delineations for the data summary report, the USGS numbering system from the 1985 and 1996 editions (which skips RM 691) was used. This delineation system will also be used for the BERA. Although these editions omitted RM 691, the use of this system maintains consistency with both earlier project work and the current version of USGS maps. In addition, because the river mile delineations are used as an index system for identifying sampling locations, rather than as a measurement of distance, the error is not expected to affect any future data evaluations to be conducted for the BERA.

The Phase 2 sediment study quality assurance project plan (QAPP) (Exponent et al. 2013) appears to have used the river mile markings from the 1993 edition of the Rice quadrangle, consistent with the Phase 1 sediment study (EPA 2006). Thus, the river mile markings used for the data summary report differ from those used in the QAPP. The only differences in the river mile markings between the QAPP and the data summary report are upstream of RM 680, based on the discrepancies in the 1993 and 1996 editions of the USGS map. All RM delineations along the Columbia River downstream of RM 680 are the same in both the QAPP and the data summary report.

3 RIVER MILE DESIGNATIONS FOR SAMPLES

For the data summary report, each sampling location was assigned a river mile number to the nearest tenth of a river mile. This was accomplished using the river mile delineations discussed in Section 2.2 above along with the current river centerline obtained from the digitized National Hydrography Dataset (NHD) (USGS 2014). The NHD centerline was divided into segments between each of the river mile markers, and each of those segments was further subdivided into tenths of equal lengths. Each segment was then given the river mile designation of its downstream endpoint. For example, if a centerline segment was between RM 734.1 and RM 734.2, the segment was given the designation of RM 734.1. Then for each sampling location, an algorithm was used to assign the river mile designation of the closest centerline segment to the sampling location. The river mile assignments for the sampling locations were reviewed to correct any designations that were obviously incorrect because of bends or oxbows in the centerline that caused the algorithm to assign an incorrect upstream or downstream designation. Four locations for the Phase 2 sediment study were corrected manually: 7-C2, REF-5, TRIB-3, and 4-C6.

For the Phase 2 sediment study QAPP (Exponent et al. 2013), the river mile designations for sampling locations were assigned using the closest river mile marker, instead of the closest centerline segment divided into tenths, as described above for the data summary report. A list of the RM designations for each sampling location from the Phase 2 sediment study QAPP and data summary report are presented in Table G-1[1].

4 REFERENCES

Ecology. 2014. GIS data [online]. Washington State Department of Ecology. [Cited July 17, 2015.] Available from: http://www.ecy.wa.gov/services/gis/data/data.htm.

EPA. 2006. Phase I sediment sampling data evaluation - Upper Columbia River site, CERCLA RI/FS. Draft final. US Environmental Protection Agency Region 10, Washington, DC.

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USGS. 2014. Hydrography [online]. US Geological Survey. [Cited July 17, 2015.] Available from: http://nhd.usgs.gov/.

USGS. 2015. Historical topographic map collection, 1:24,000 quadrangle for Rice, WA [online]. US Geological Survey. [Cited October 20, 2015.] Available from: http://ngmdb.usgs.gov/maps/topoview/viewer/#12/48.5063/-118.1811://ngmdb.usgs.gov/maps/topoview/viewer/%2312/48.5063/-118.1811.

[1] The RM delineation markings along the Columbia River are the same in both the QAPP and the data summary report downstream of RM 680. However, some of the RM designations for specific samples collected downstream of RM 680 may not be the same because of different methodologies in identifying the RMs associated with each sample.

UPPER COLUMBIA RIVER

Phase 2 Sediment Study Data Summary and Data Gap Report Addendum No. 1

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June 2018

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ACRONYMS AND ABBREVIATIONS

MDL	method detection limit
MRL	method reporting limit
QAPP	quality assurance project plan

UNITS OF MEASURE

μg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
μmol/g	micromoles per gram

1. INTRODUCTION

This addendum describes changes to a subset of the bioassay chemistry data originally presented in the *Final Upper Columbia River Phase 2 Sediment Study Data Summary and Data Gap Report*, issued in May 2017 (Windward et al. 2017). These changes apply to the sediment and porewater chemistry results from the chronic 50-day midge (*Chironomus dilutus)* life cycle tests and the chronic 42-day amphipod (*Hyalella azteca*) tests (hereinafter "long-term bioassays"). The affected figures and data tables in the May 2017 final data report are presented in this addendum, and can be used to replace the affected pages in the data report (Windward et al. 2017).

Results for field sediment, field porewater, and short-term bioassays were not affected and remain as reported in the data report (Windward et al. 2017).

2. DESCRIPTION OF DATA MODIFICATIONS

Phase 2 long-term bioassay data modifications were necessitated by the following:

1. The data were originally reported to the method reporting limit (MRL) instead of the method detection limit (MDL), which affected the numerical value in the project database for analytical results reported as nondetected (i.e., U-qualified results). The Phase 2 sediment quality assurance project plan (QAPP) (Exponent et al. 2013) states that the data will be reported to the MDL.
2. A subset of data in the project database was inadvertently truncated. For this subset, the analytical results were rounded and reported in the database with fewer significant figures than were reported by the analytical laboratory.

The MDL/MRL data reporting error was addressed by updating the result field in the database for nondetected results to match the MDLs reported by the analytical laboratory. Nondetected results previously reported to the MRL are now reported to the MDL.

The data truncation issue was resolved by revising the affected results in the database to match the numerical values and number of significant figures reported by the analytical laboratory.

These changes affected the long-term bioassay sediment and porewater data, as well as data for the rinsewater, centrifuge, and peeper blanks. Lists of the figures and tables in the May 2017 data report that have been revised as a result of the data corrections are included in front of the figures and tables and the end of this addendum[1].

Numbers of modified results are listed by parameter in Table 2-1 for detected results and in Table 2-2 for nondetected results. These tables also present the minimum, mean, and maximum differences between the originally reported dataset and the corrected dataset. The corrected data are included in the project database at http://teck-ucr.exponent.com.

The corrections noted resulted in either non-detected values being reported to a lower concentration relative to the MRLs that were originally reported, or more precise measurements being reported with more significant figures rather than reporting rounded values. The overall data quality was not affected and the data are considered usable as described in the original report (Windward et al. 2017).

[1] All of the long-term bioassay figures and tables are included in this addendum with the original figure and table numbers for ease of replacement, although not all of the figures were affected by the data modifications.

3. REFERENCES

Exponent, HDR/HydroQual, Parametrix, Cardwell, Integral. 2013. Upper Columbia River final quality assurance project plan for the Phase 2 sediment study. Prepared for Teck American Inc. Exponent, HDR/HydroQual, Parametrix, Cardwell Consulting, Integral, Bellevue, WA.

Windward, Exponent, Parametrix, HDR. 2017. Final Phase 2 sediment study data summary and data gap report. Windward Environmental LLC, Exponent, Parametrix, Inc., and HDR, Inc., Seattle, WA.

FIGURES

These figures were revised in this addendum (all figures are included in this section).

Sediment Figures

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5-3f Antimony in Sediment from Long−Term Bioassays
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5-6ac Dissolved Zinc in Porewater from Long−Term Bioassays

Note:
Figures were updated for one or both of the following reasons: 1) Non-detected values (i.e., U-flagged results) previously reported to the method reporting limit (MRL) were updated to report to the method detection limit (MDL); 2) Results previously truncated were modified to report the same number of significant figures reported by the analytical laboratory, with no rounding.

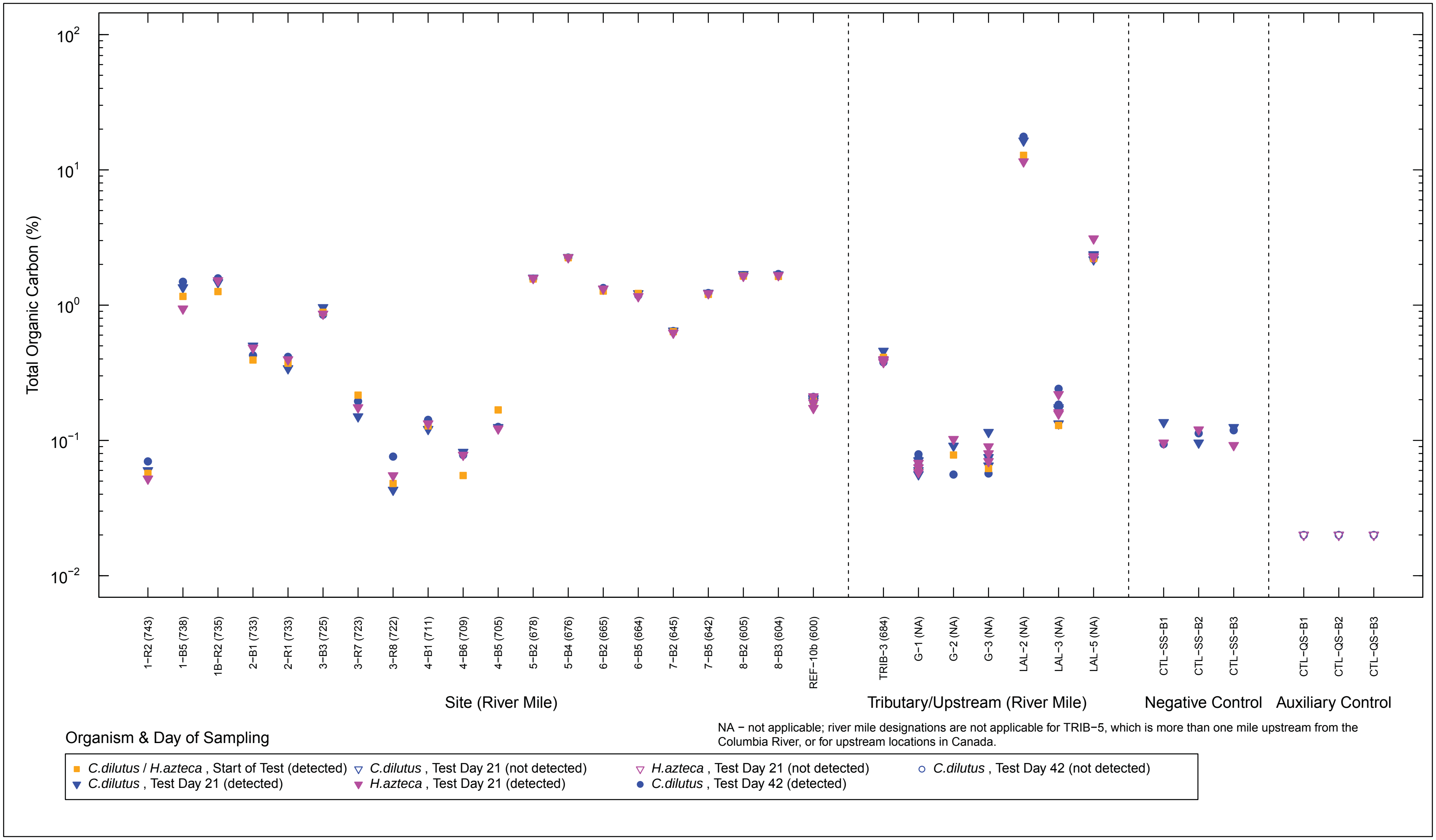


Figure 5−3a. Total Organic Carbon in Sediment from Long−Term Bioassays

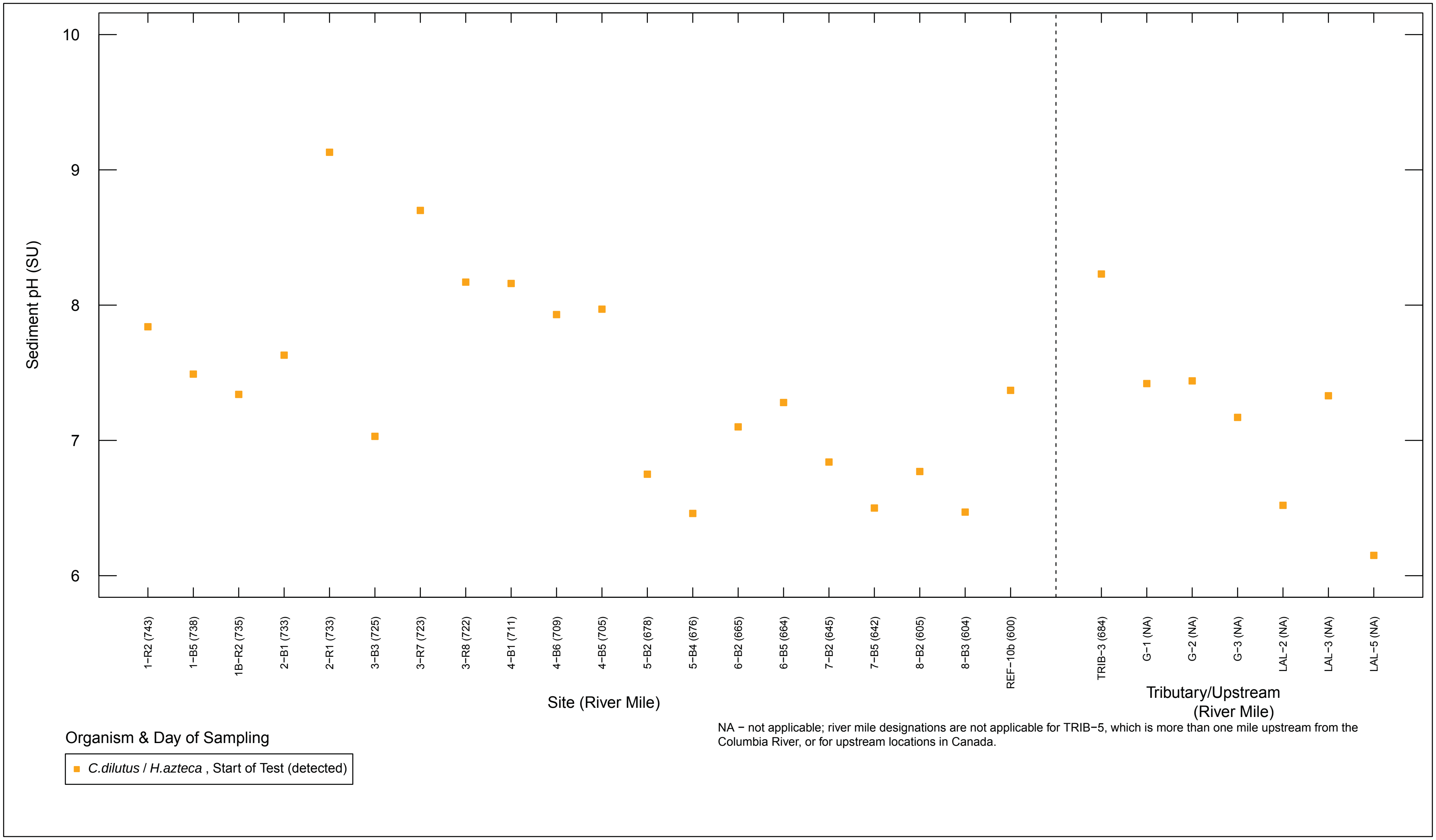


Figure 5−3b. pH in Sediment from Long−Term Bioassays

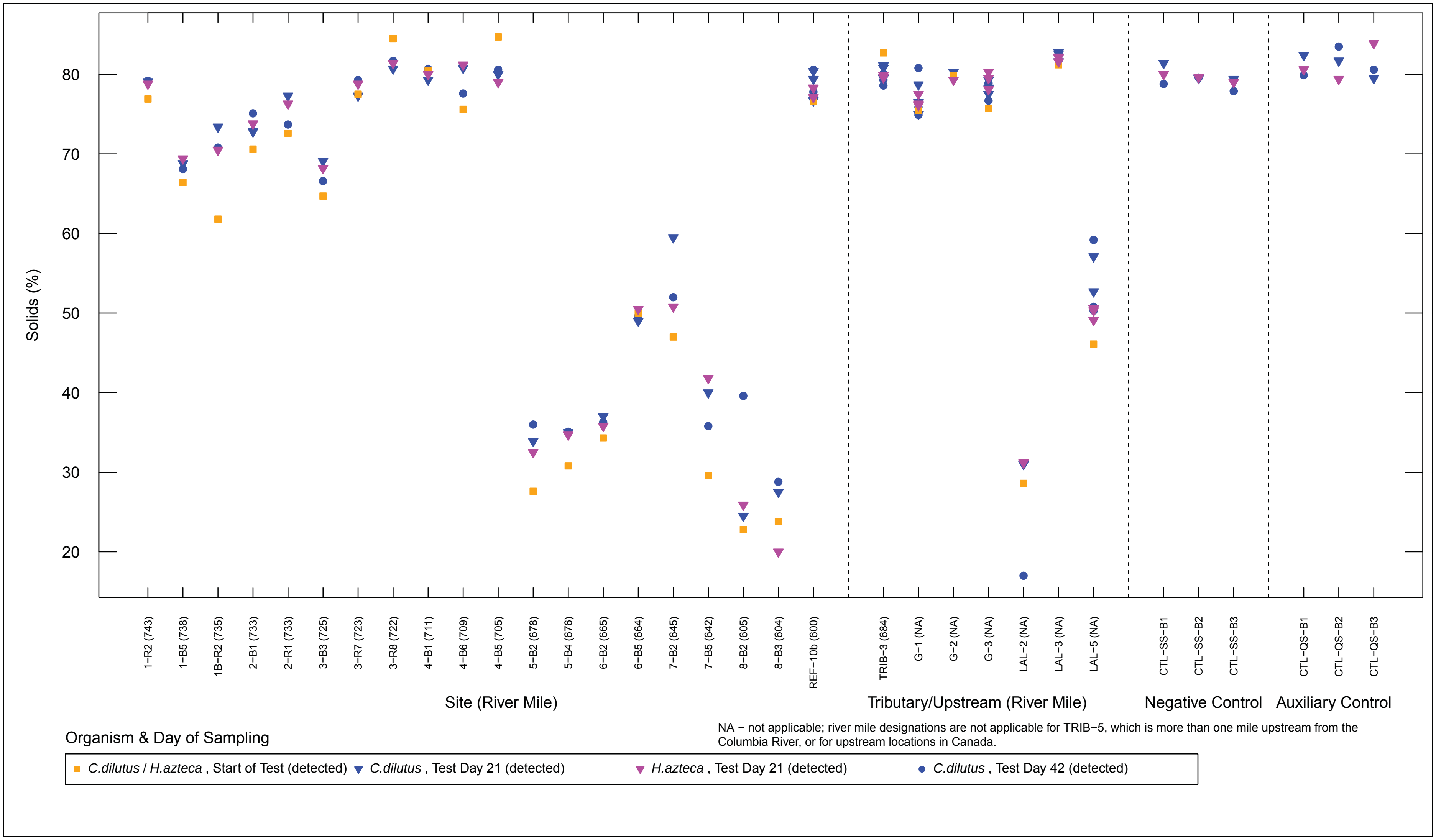


Figure 5−3c. Solids in Sediment from Long−Term Bioassays

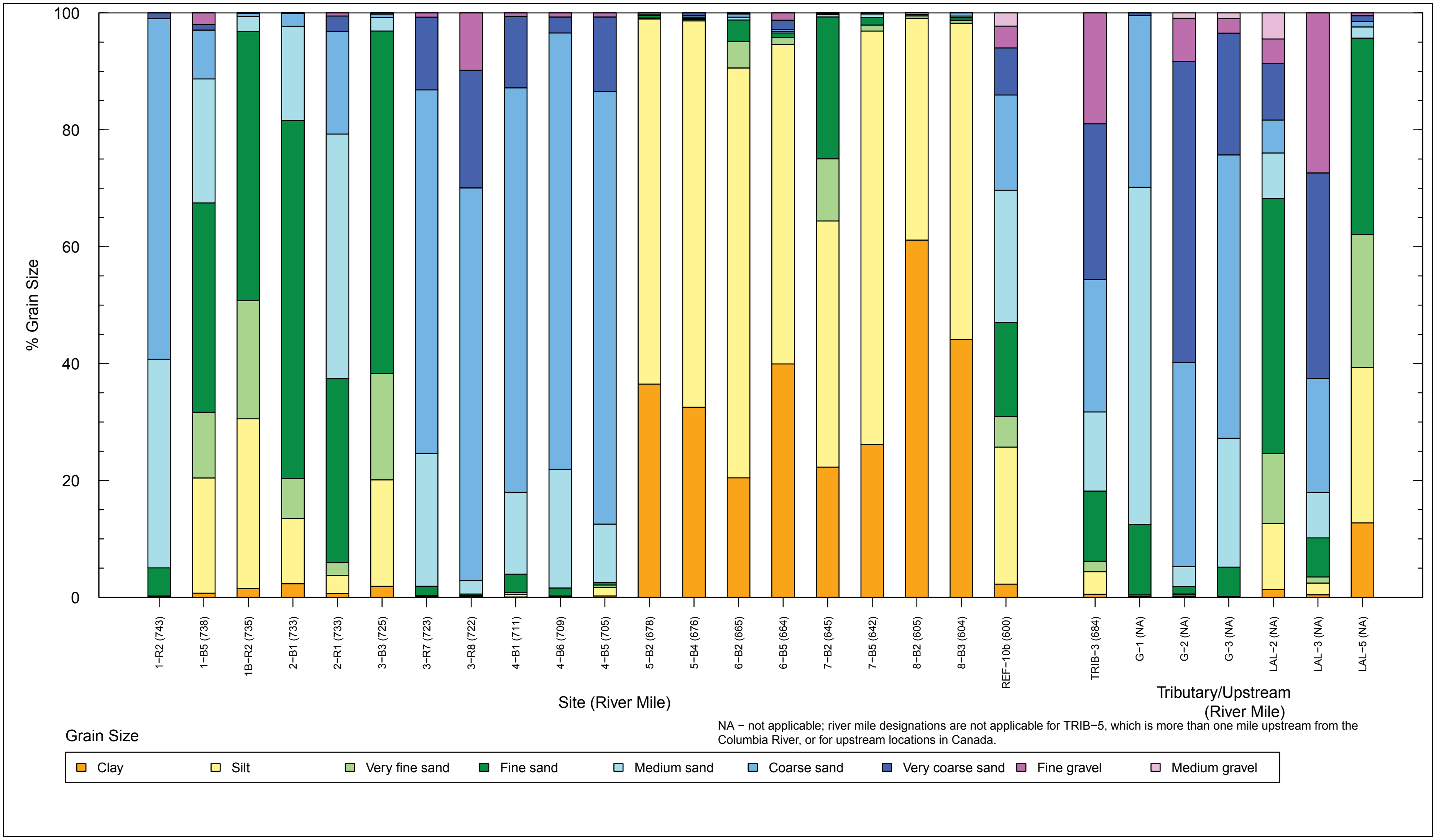


Figure 5−3d. Grain Size Distribution in Sediment from Long−Term Bioassays Analyzed at the Start of Test

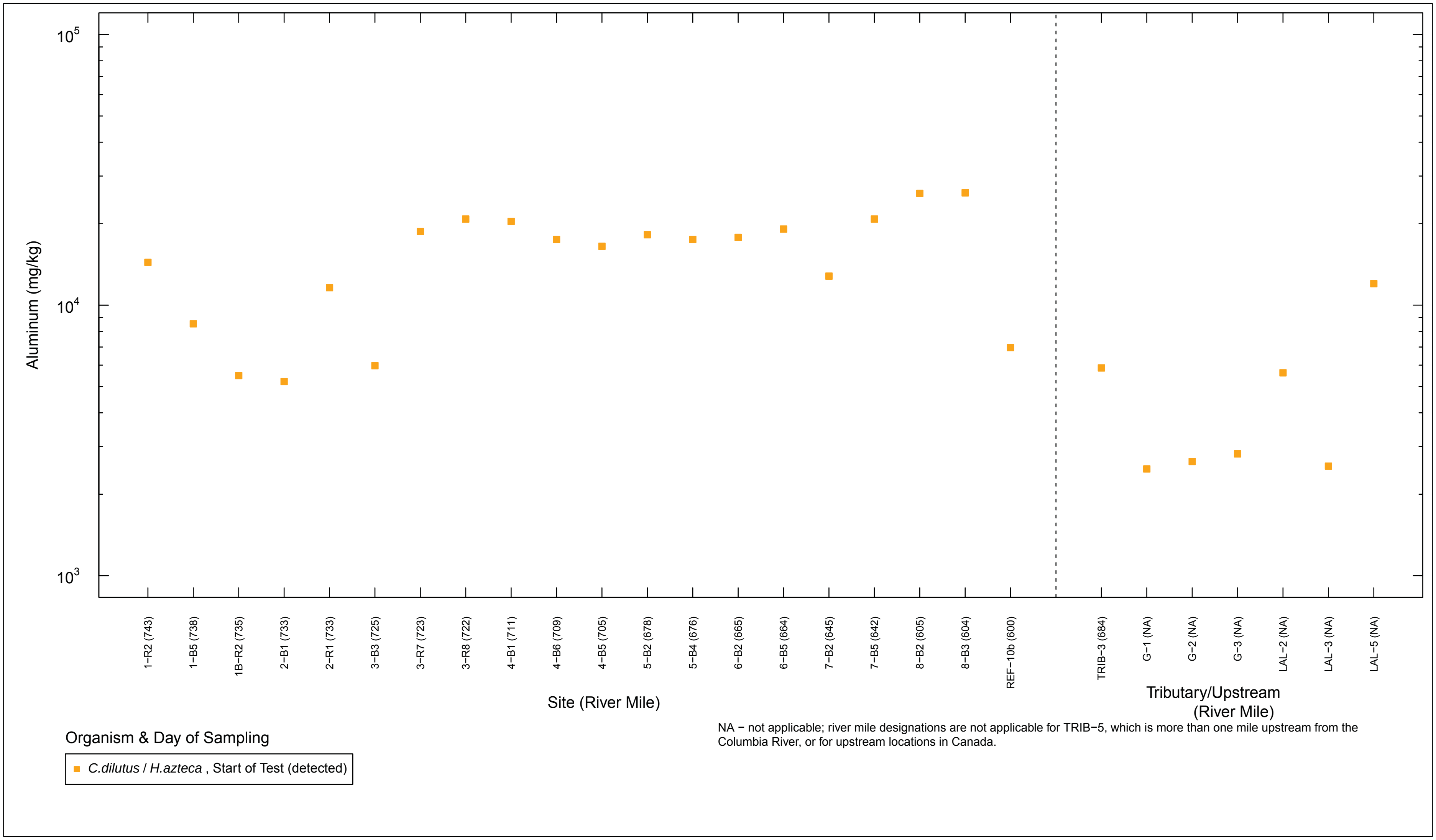


Figure 5−3e. Aluminum in Sediment from Long−Term Bioassays

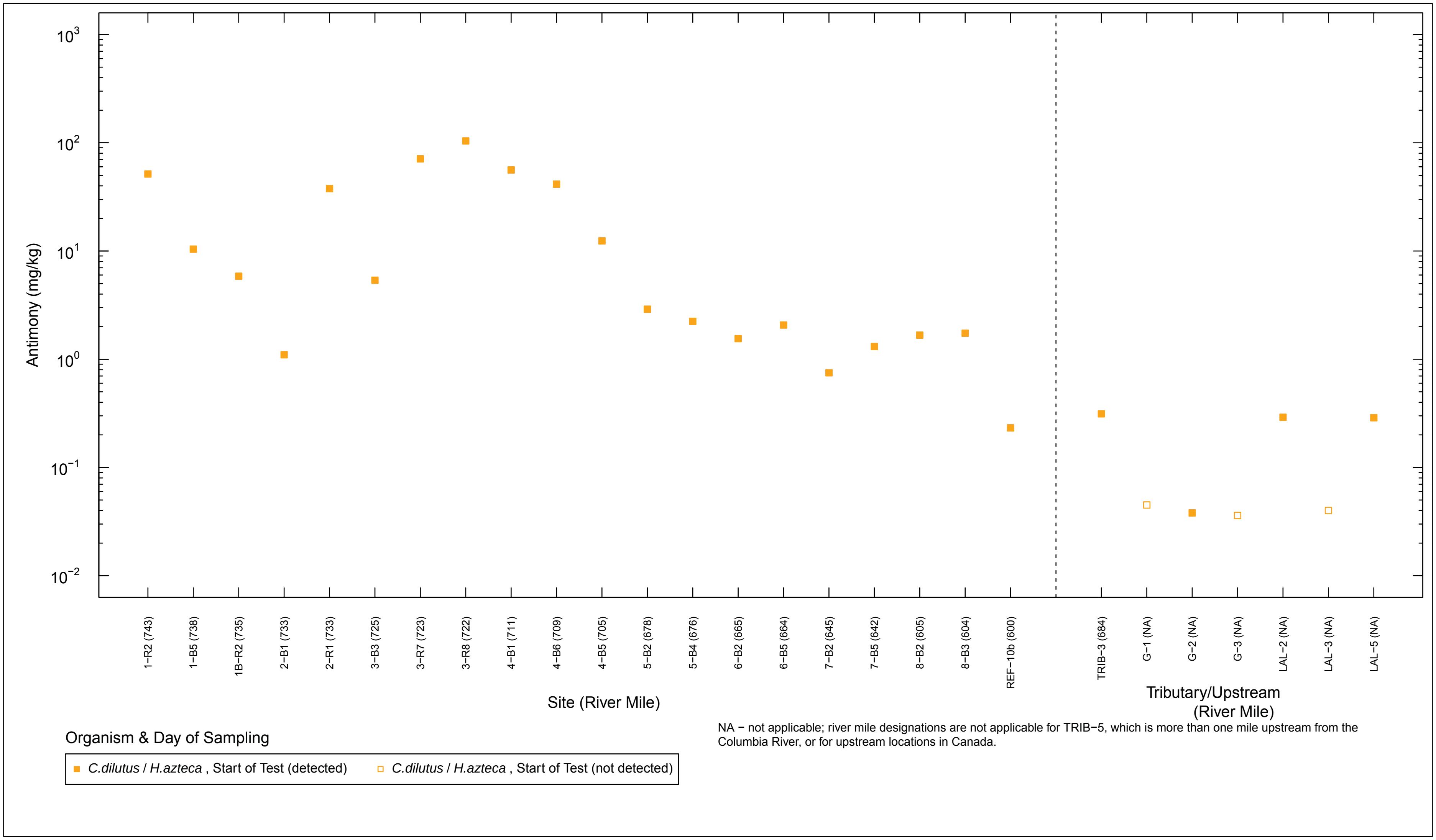


Figure 5−3f. Antimony in Sediment from Long−Term Bioassays

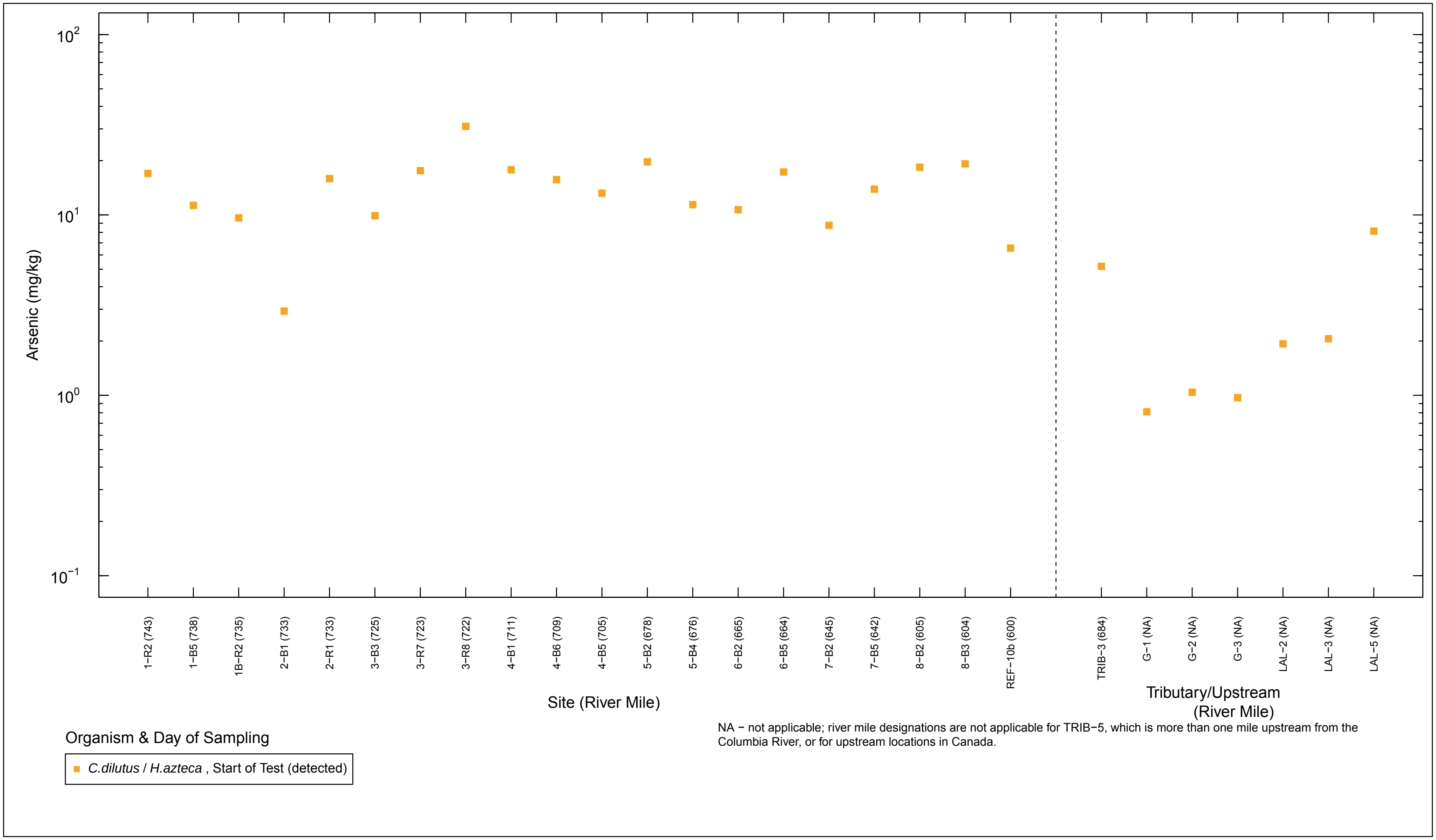


Figure 5−3g. Arsenic in Sediment from Long−Term Bioassays

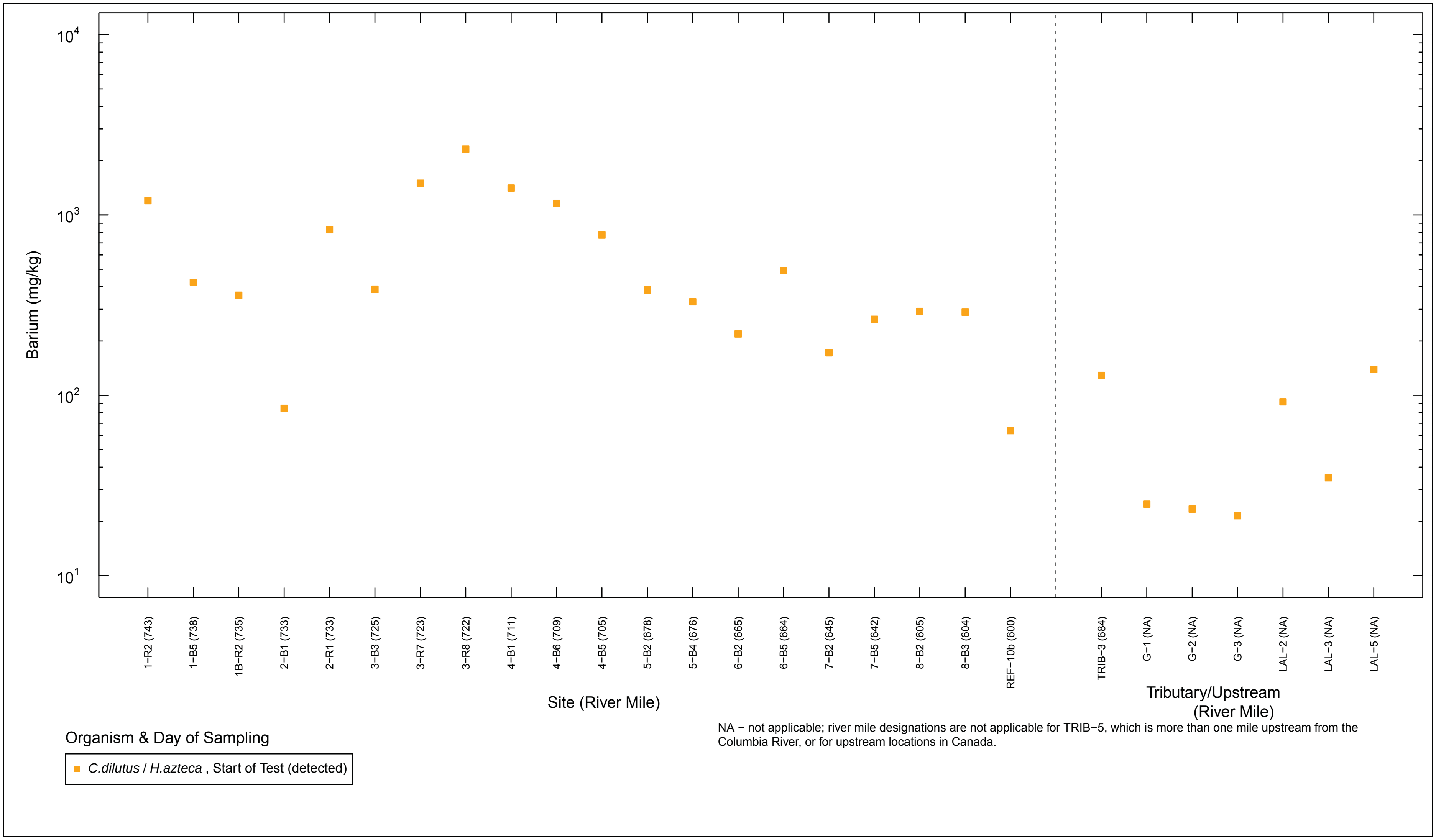


Figure 5−3h. Barium in Sediment from Long−Term Bioassays

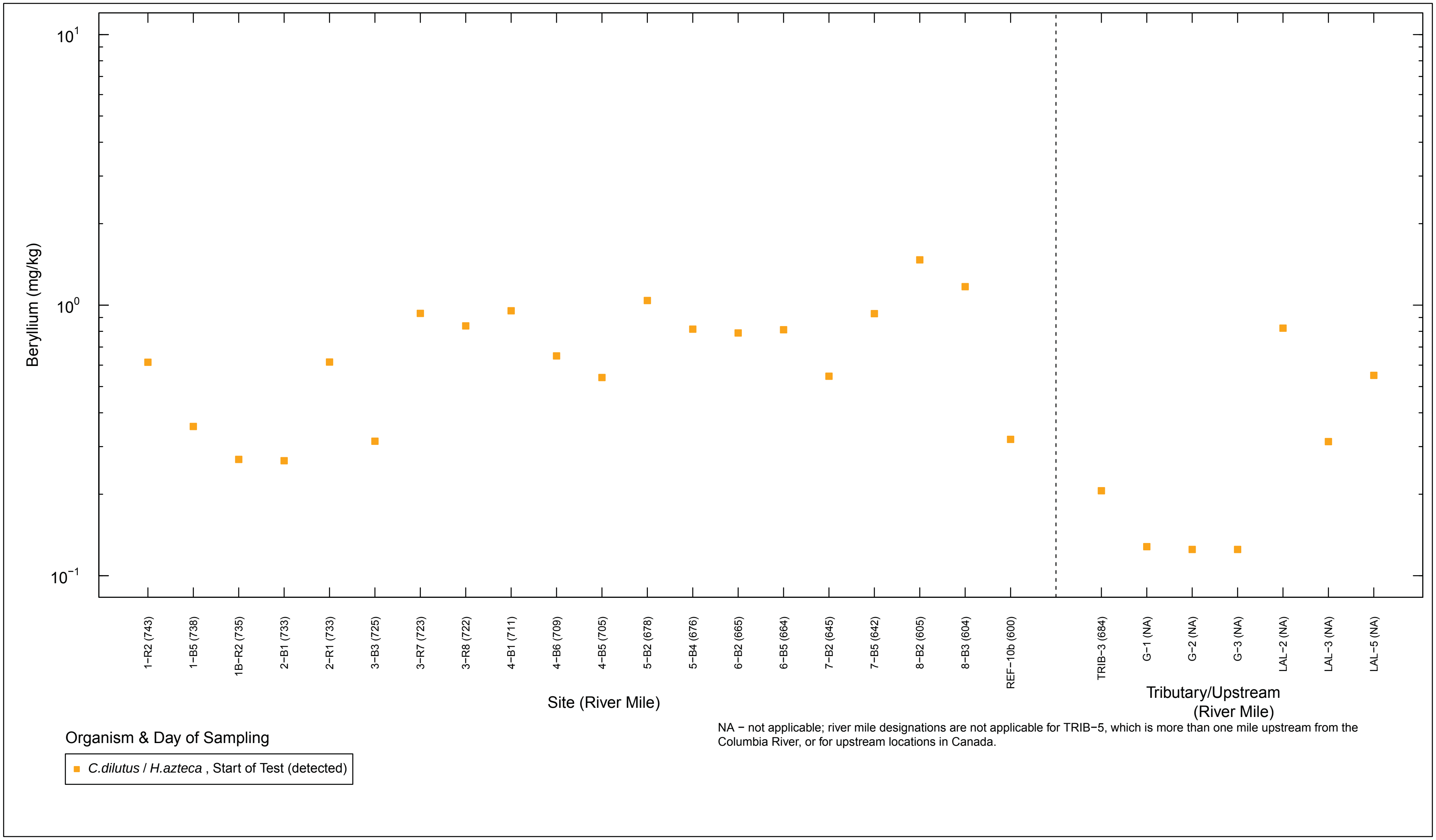


Figure 5−3i. Beryllium in Sediment from Long−Term Bioassays

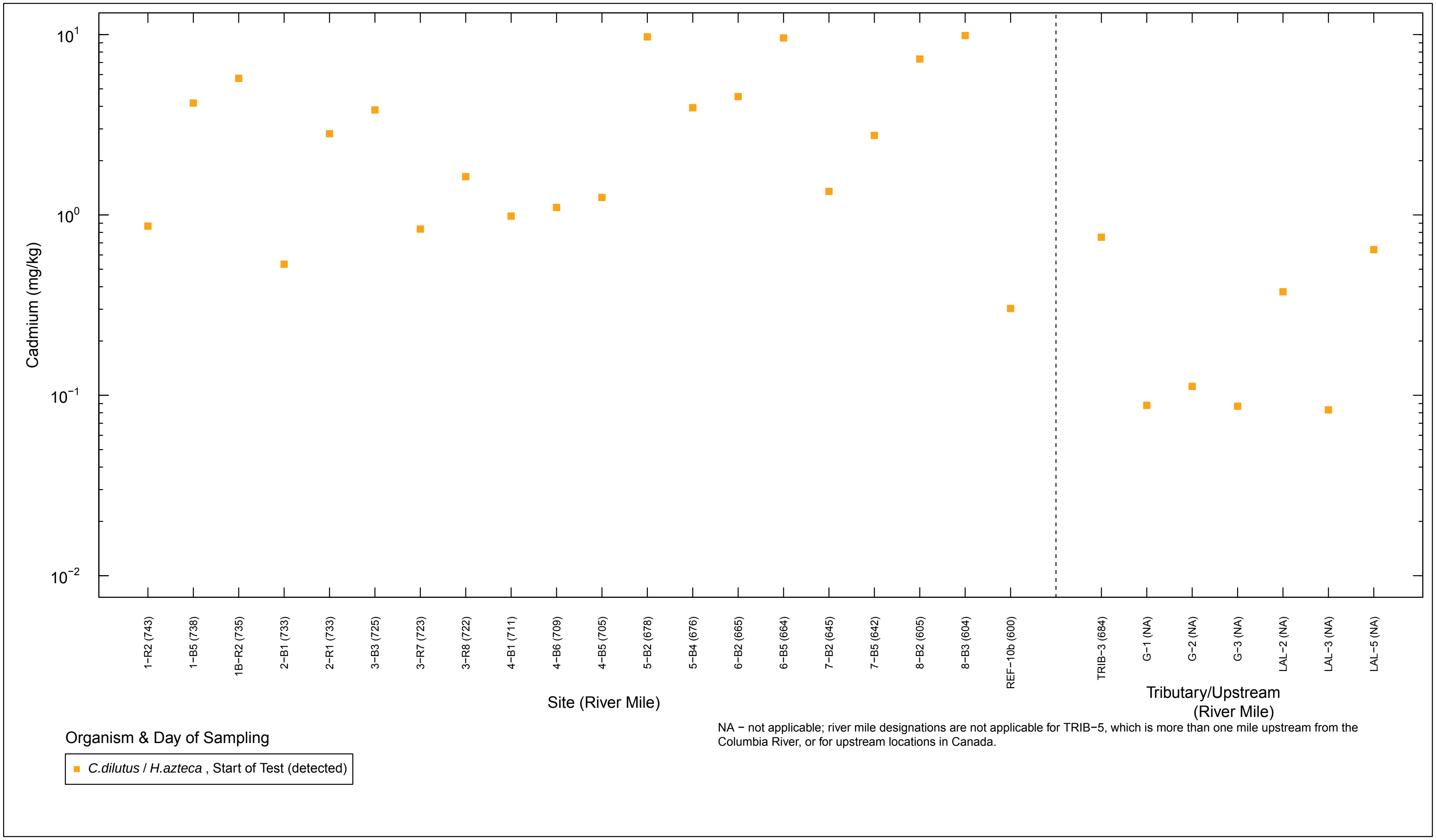


Figure 5−3j. Cadmium in Sediment from Long−Term Bioassays

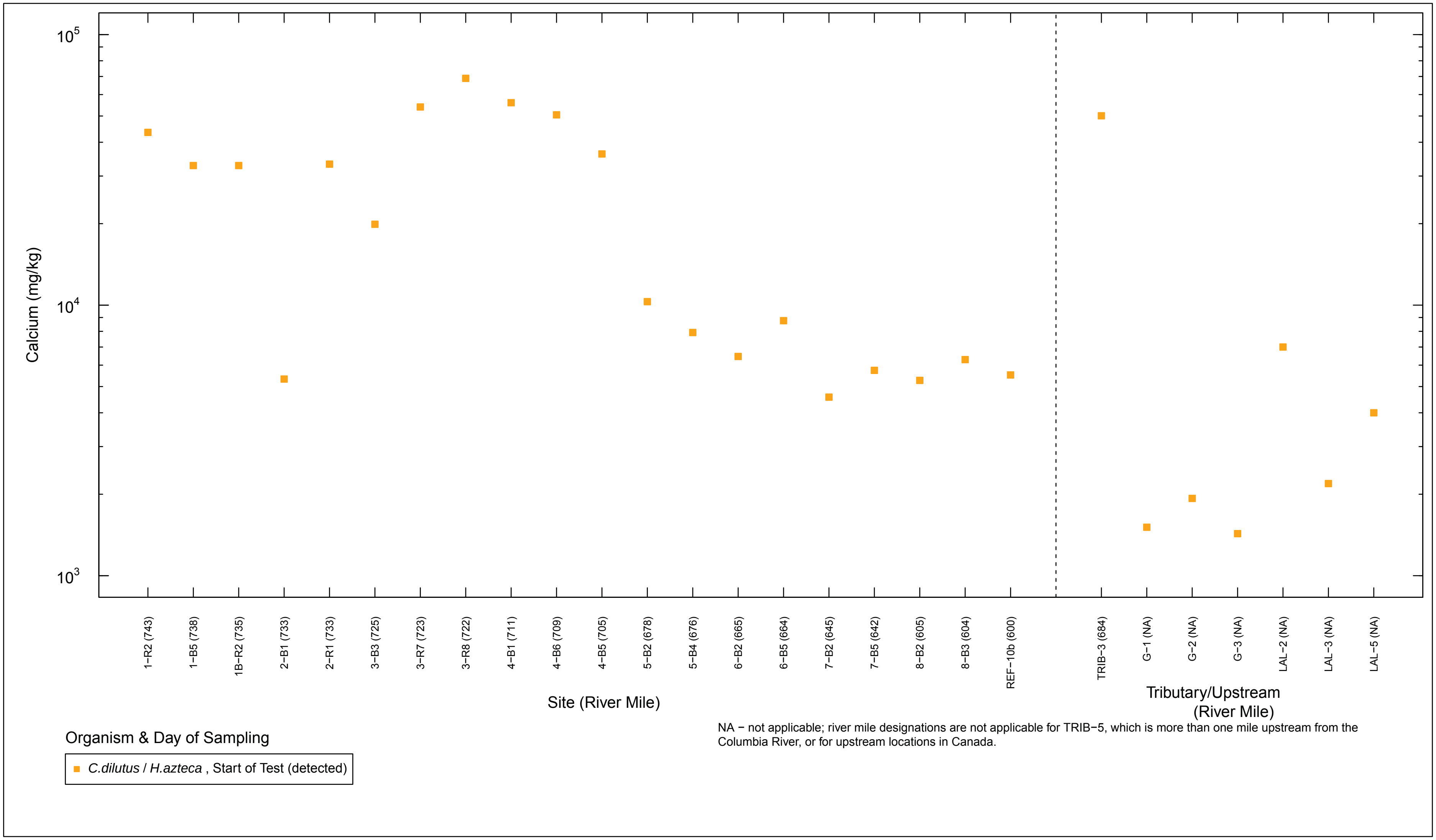


Figure 5−3k. Calcium in Sediment from Long−Term Bioassays

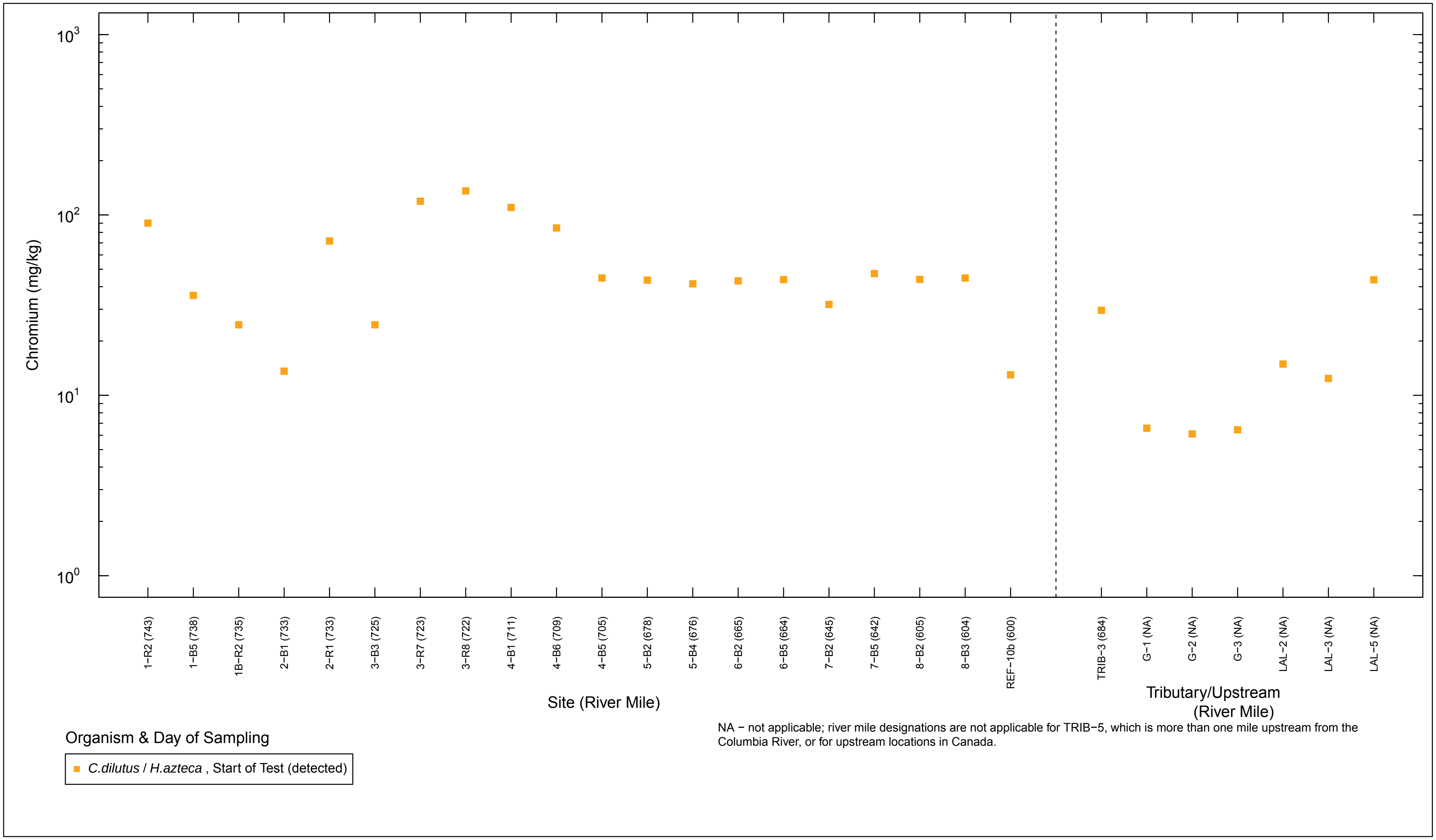


Figure 5−3l. Chromium in Sediment from Long−Term Bioassays

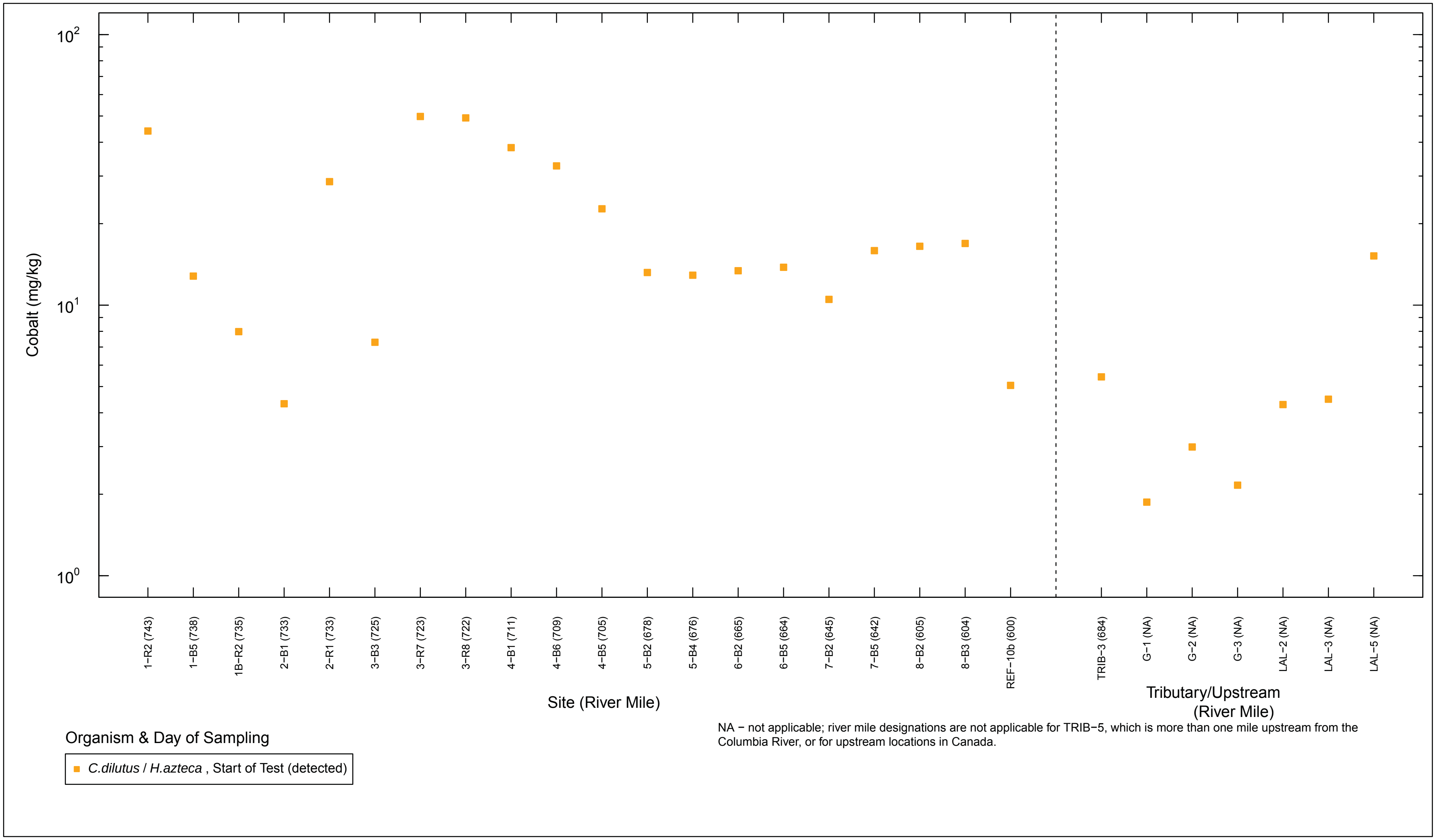


Figure 5−3m. Cobalt in Sediment from Long−Term Bioassays

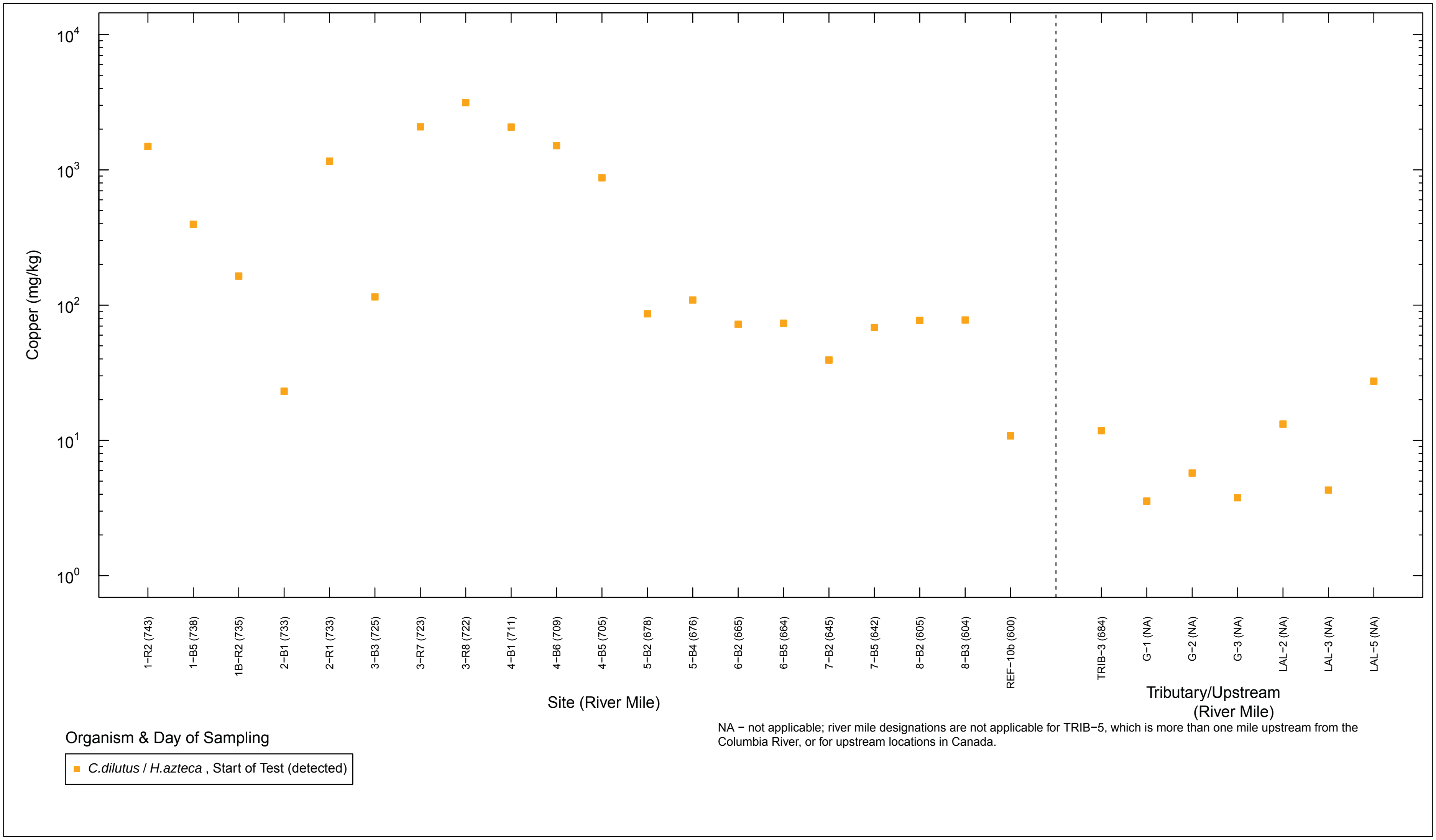


Figure 5−3n. Copper in Sediment from Long−Term Bioassays

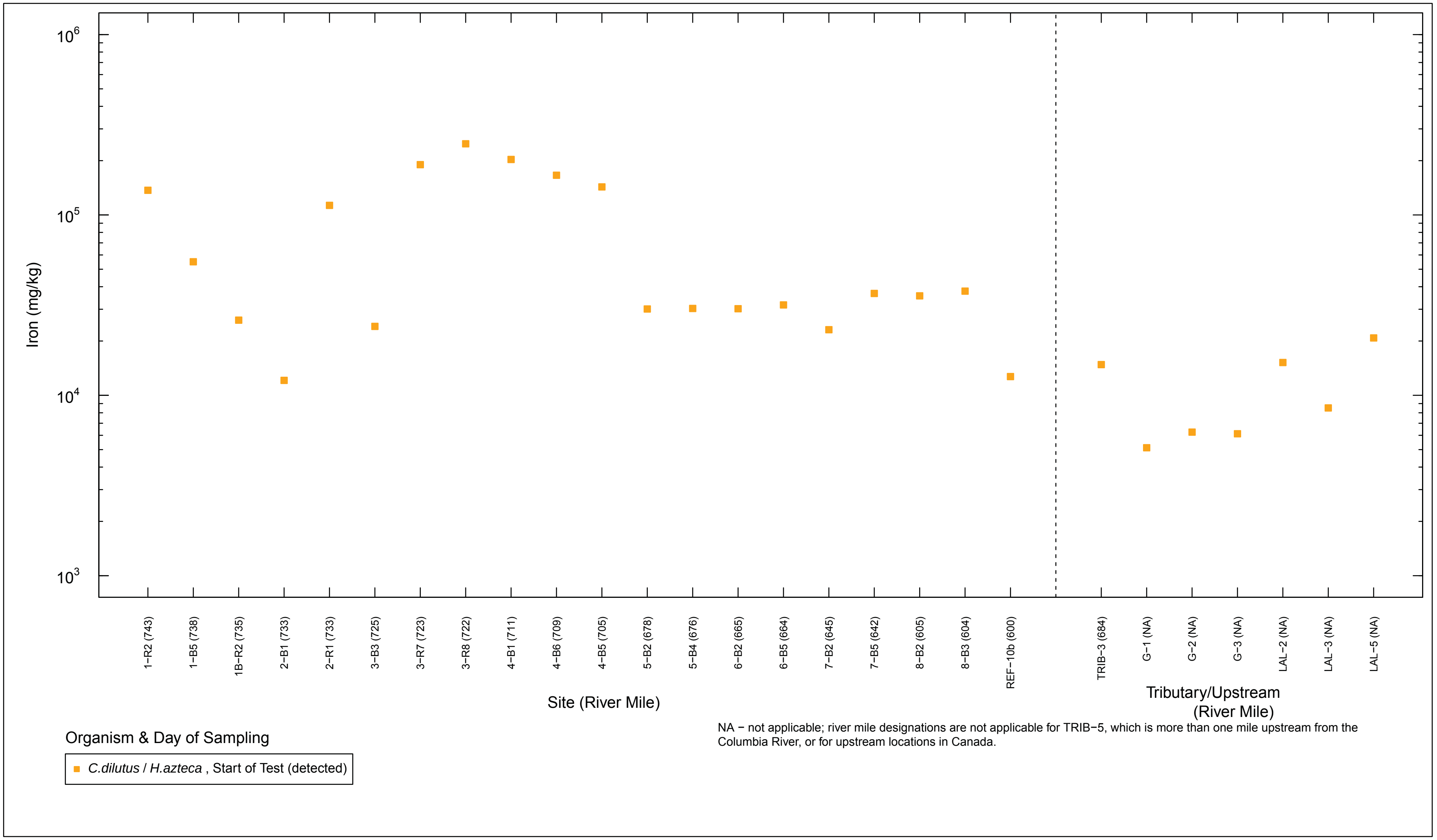


Figure 5−3o. Iron in Sediment from Long−Term Bioassays

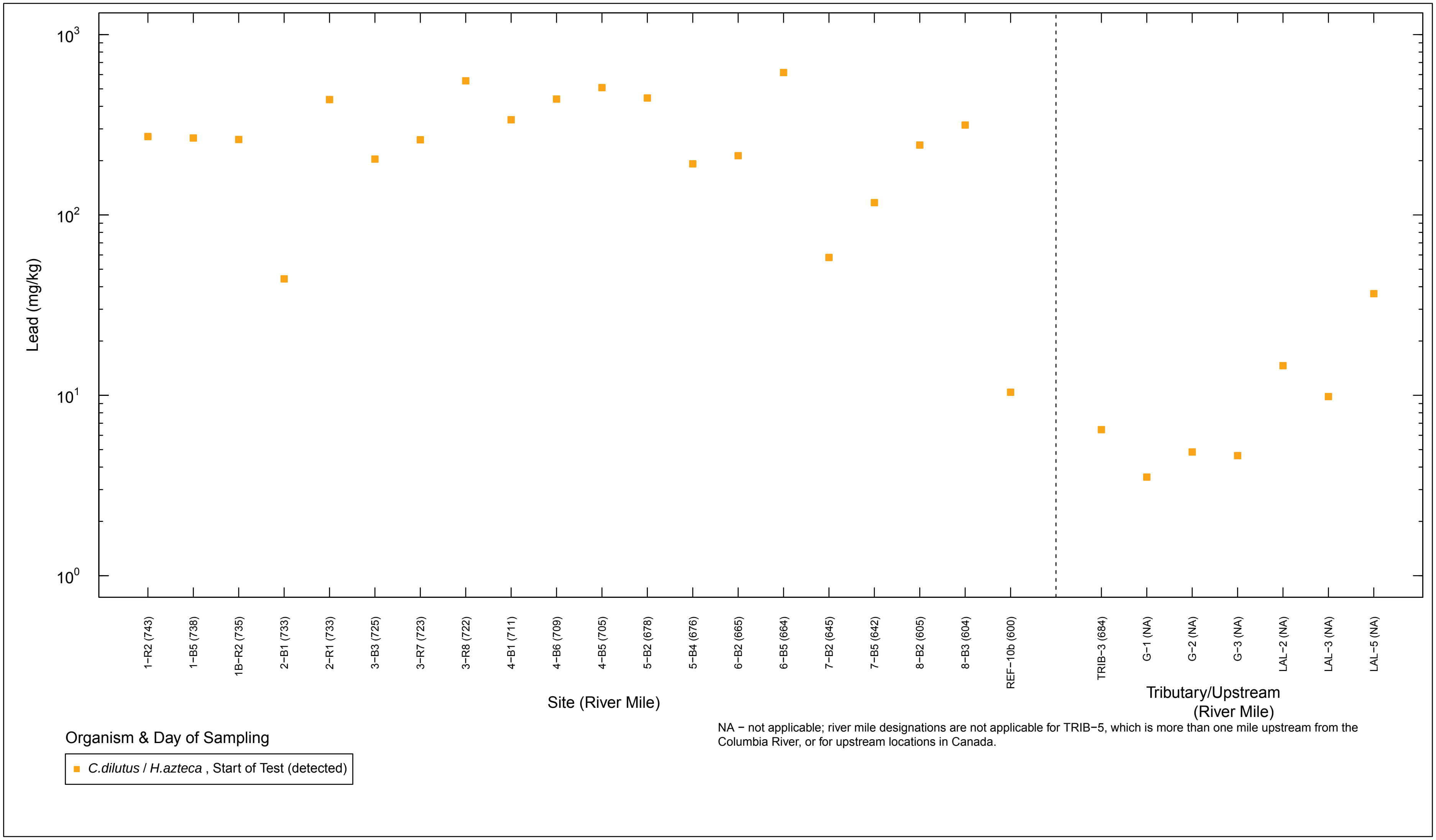


Figure 5−3p. Lead in Sediment from Long−Term Bioassays

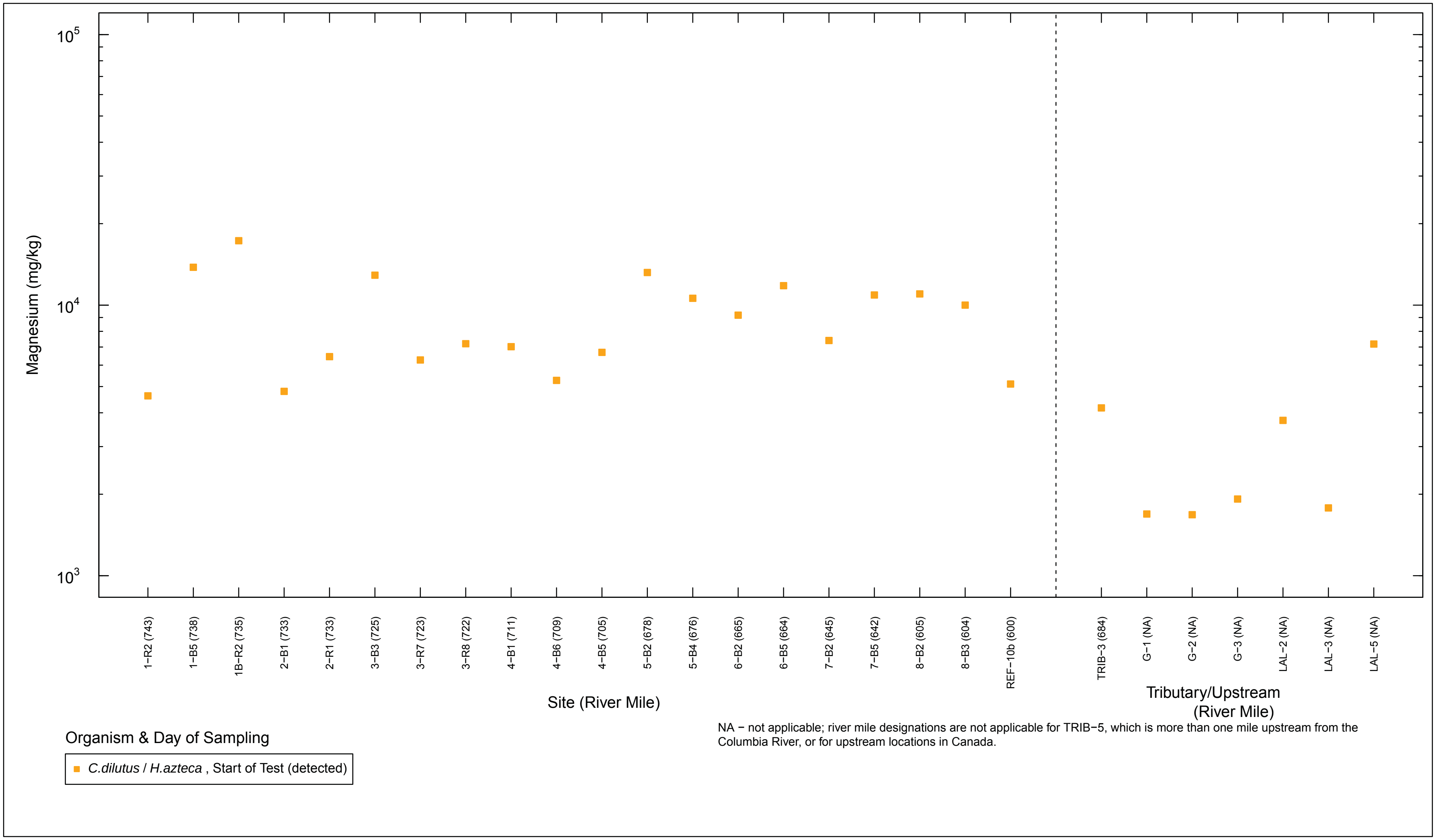


Figure 5−3q. Magnesium in Sediment from Long−Term Bioassays

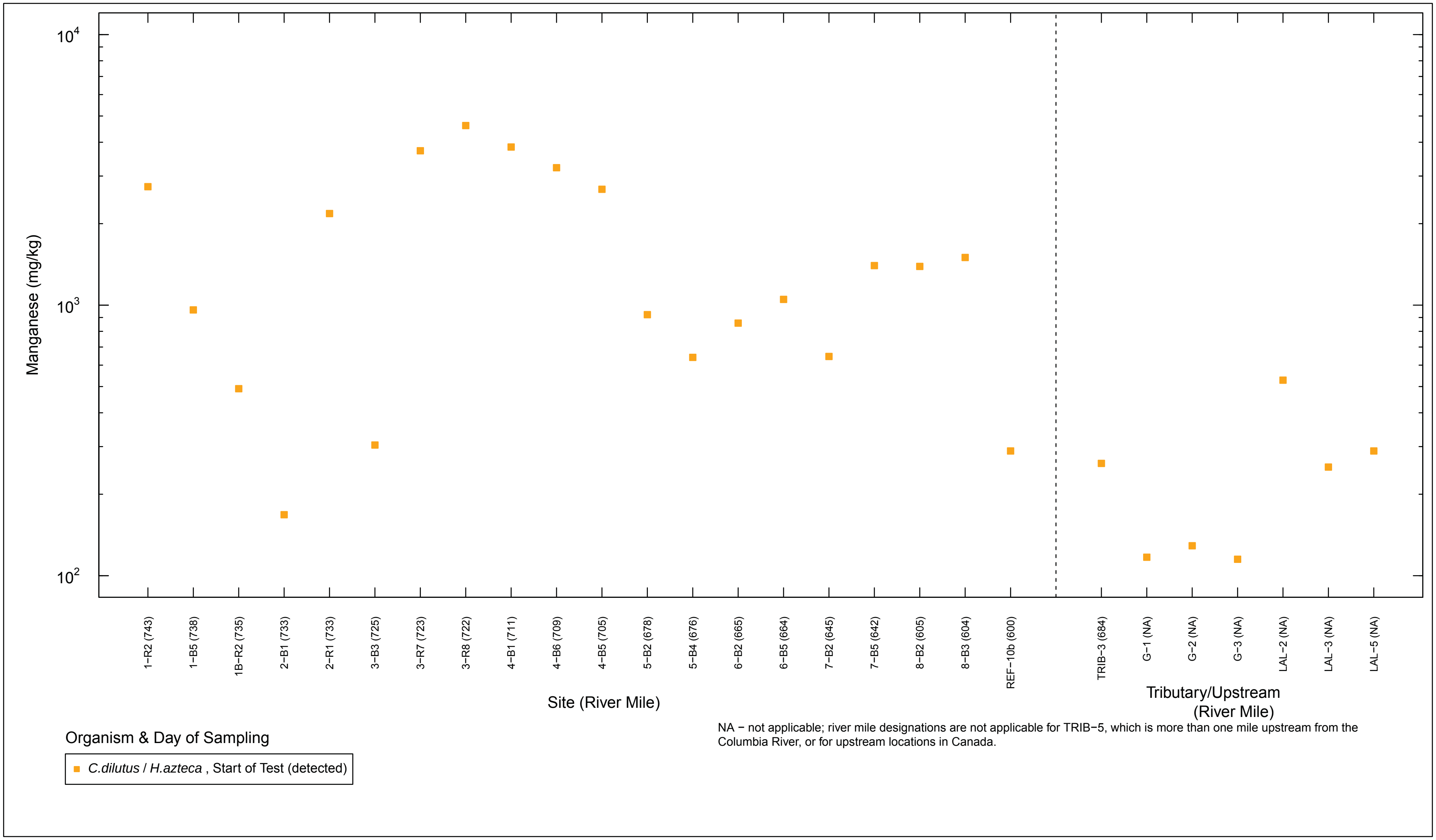


Figure 5−3r. Manganese in Sediment from Long−Term Bioassays

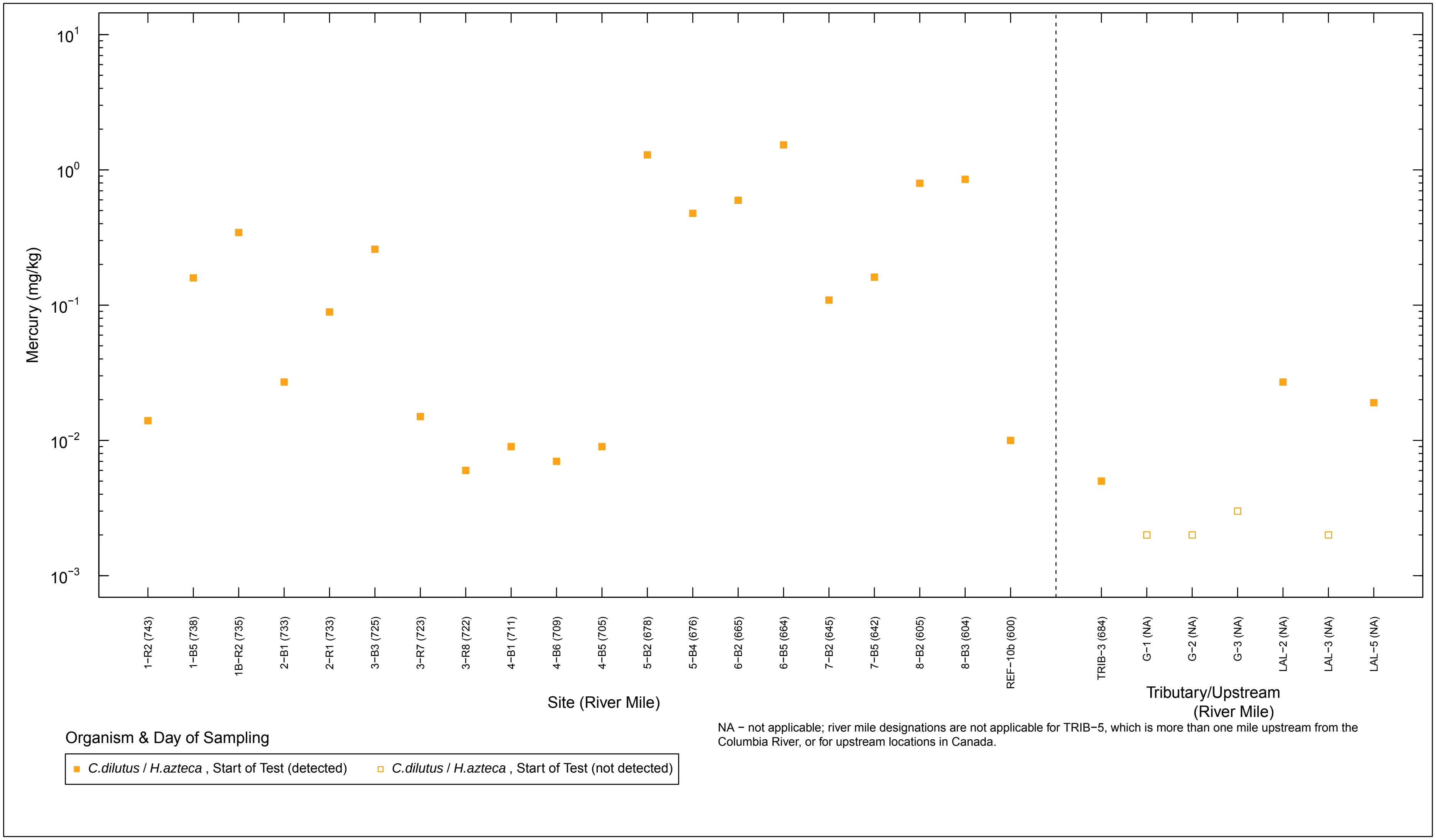


Figure 5−3s. Mercury in Sediment from Long−Term Bioassays

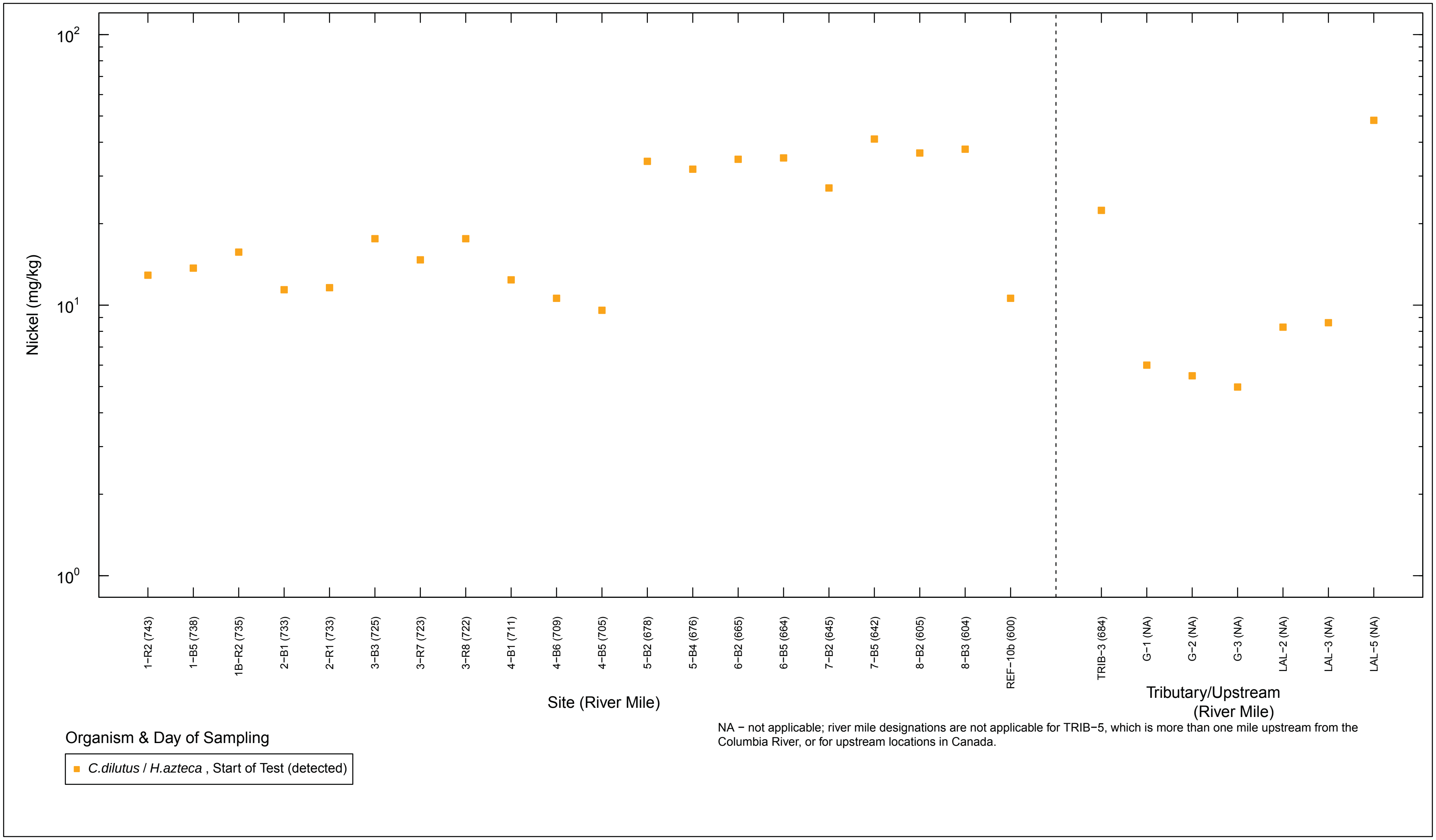


Figure 5−3t. Nickel in Sediment from Long−Term Bioassays

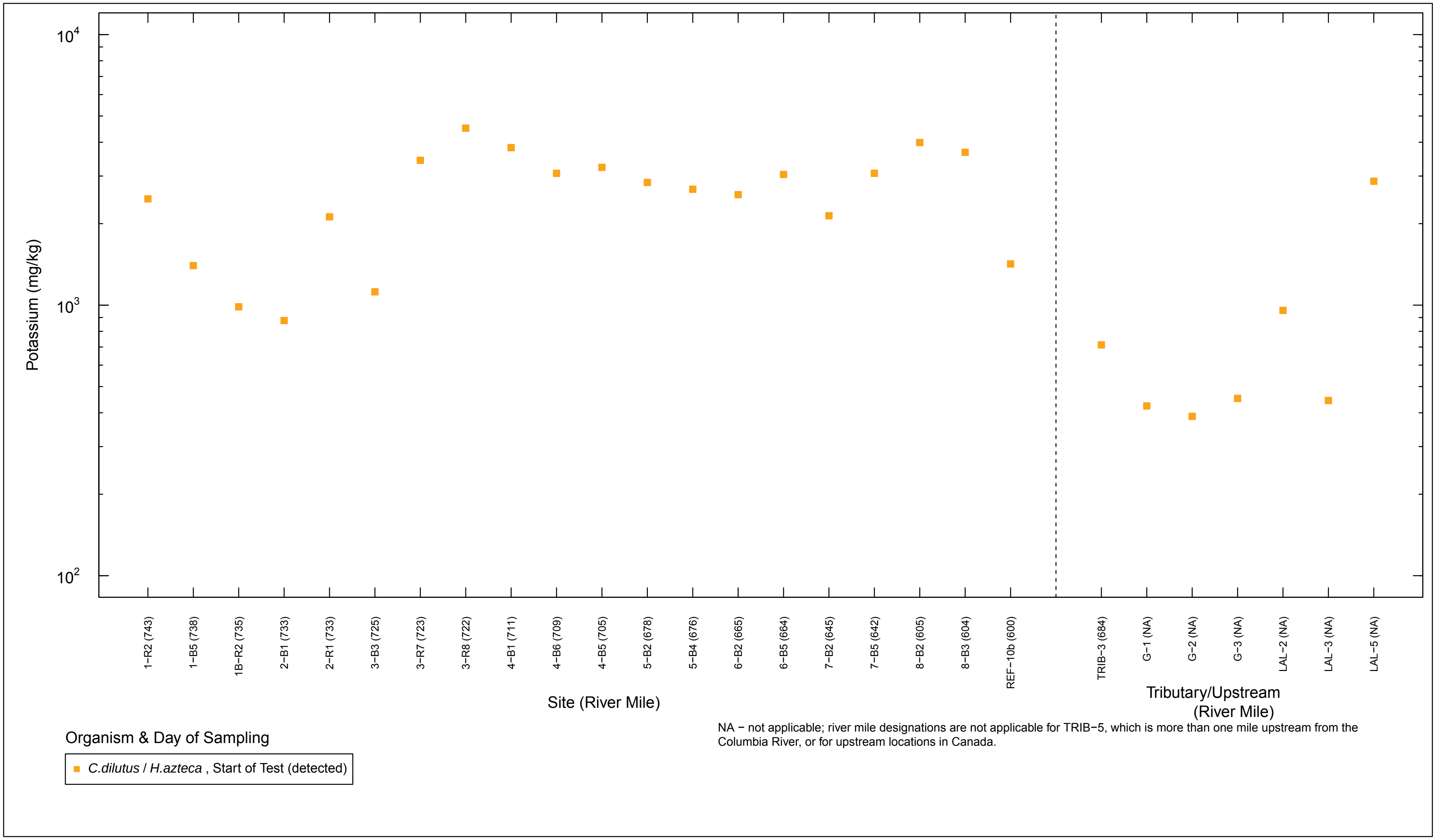


Figure 5−3u. Potassium in Sediment from Long−Term Bioassays

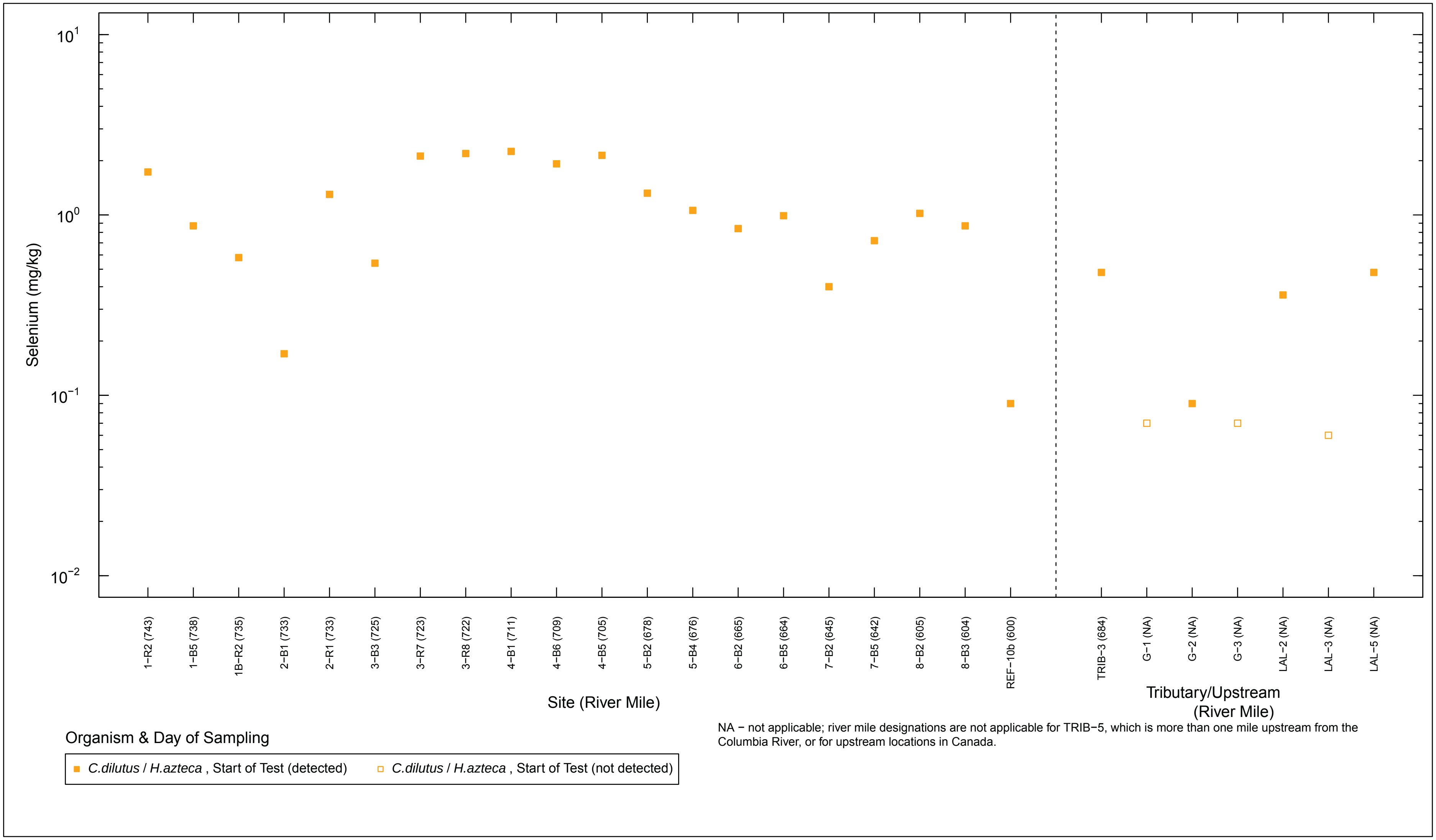


Figure 5−3v. Selenium in Sediment from Long−Term Bioassays

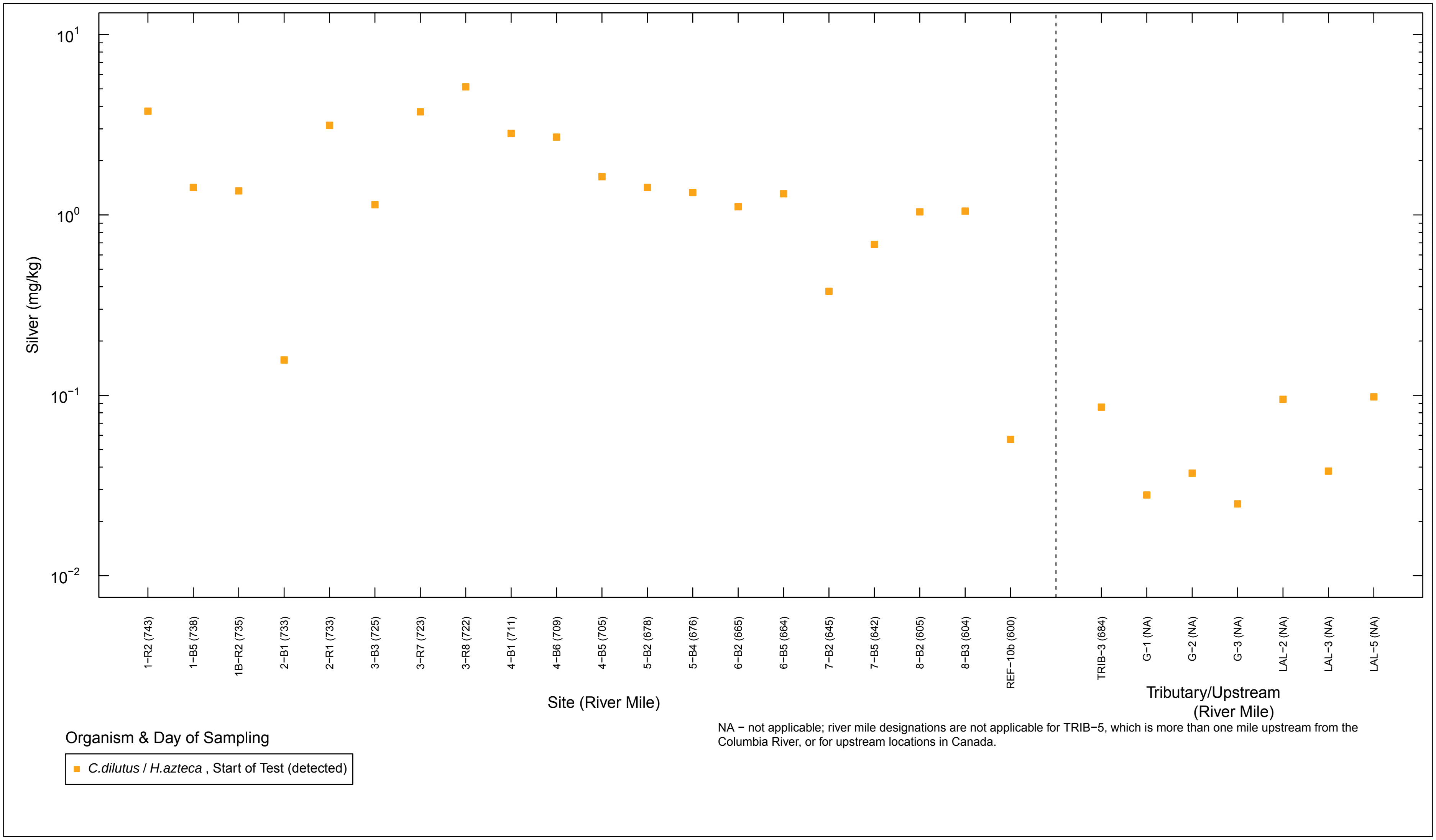


Figure 5−3w. Silver in Sediment from Long−Term Bioassays

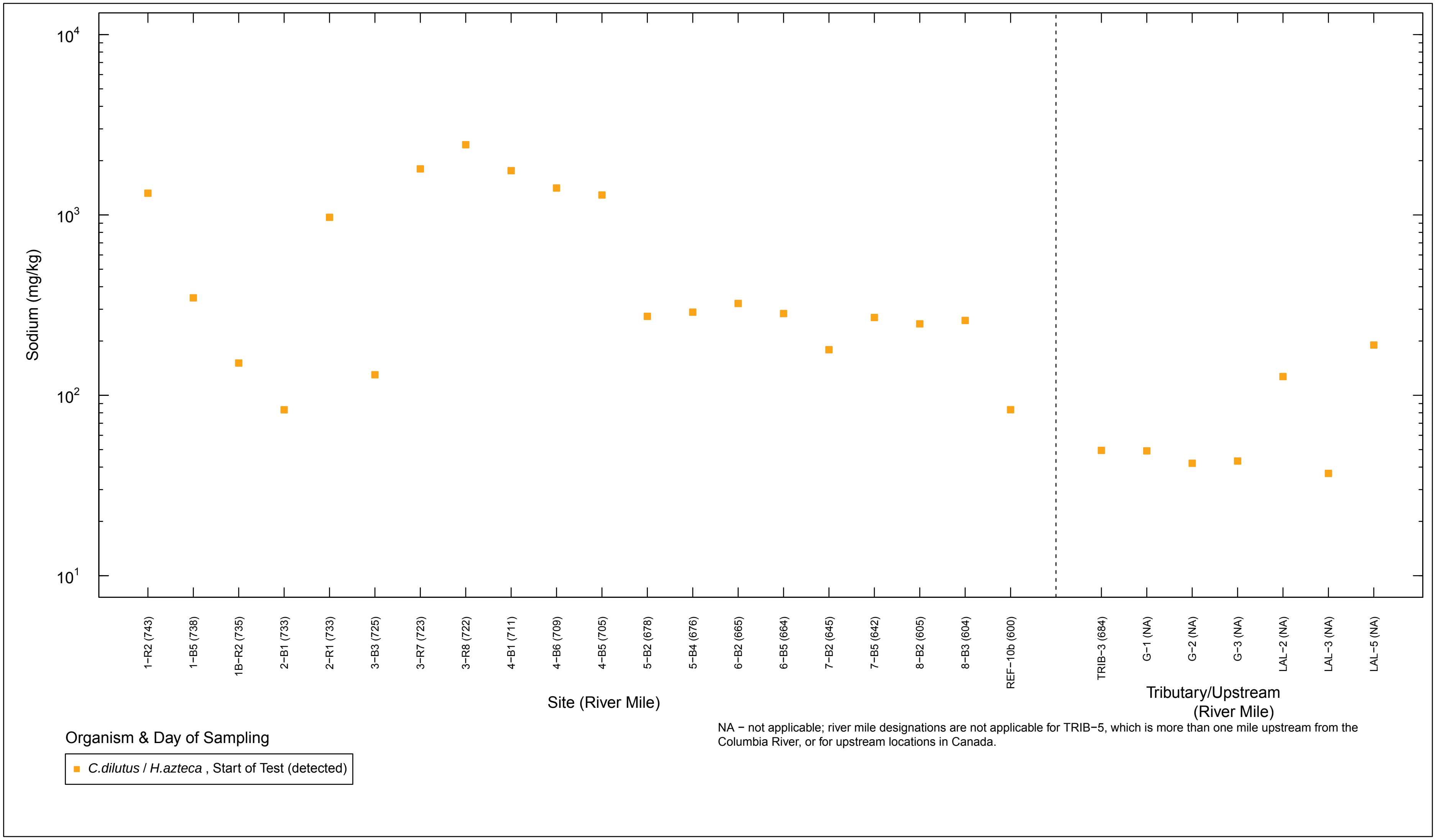


Figure 5−3x. Sodium in Sediment from Long−Term Bioassays

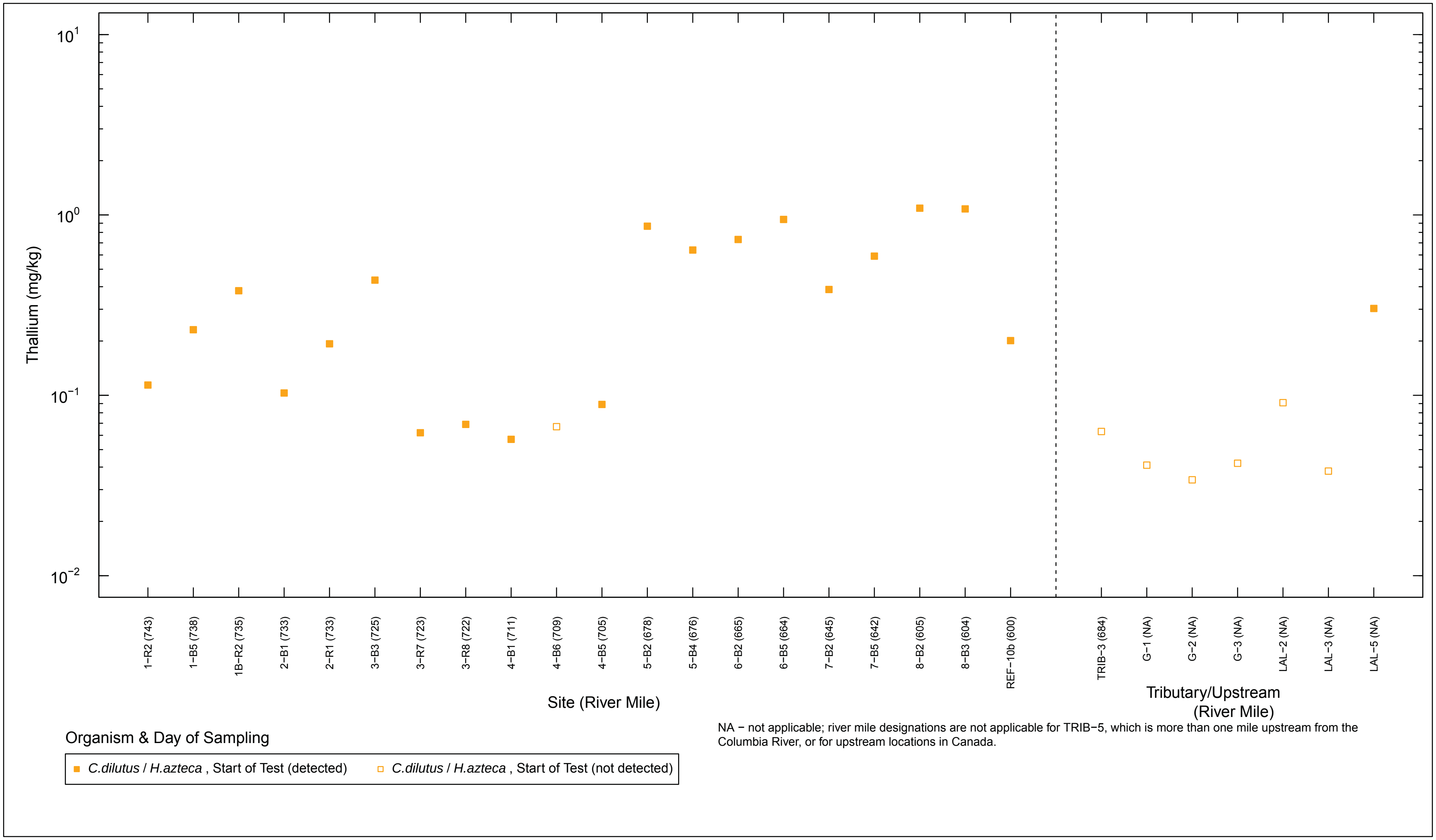


Figure 5−3y. Thallium in Sediment from Long−Term Bioassays

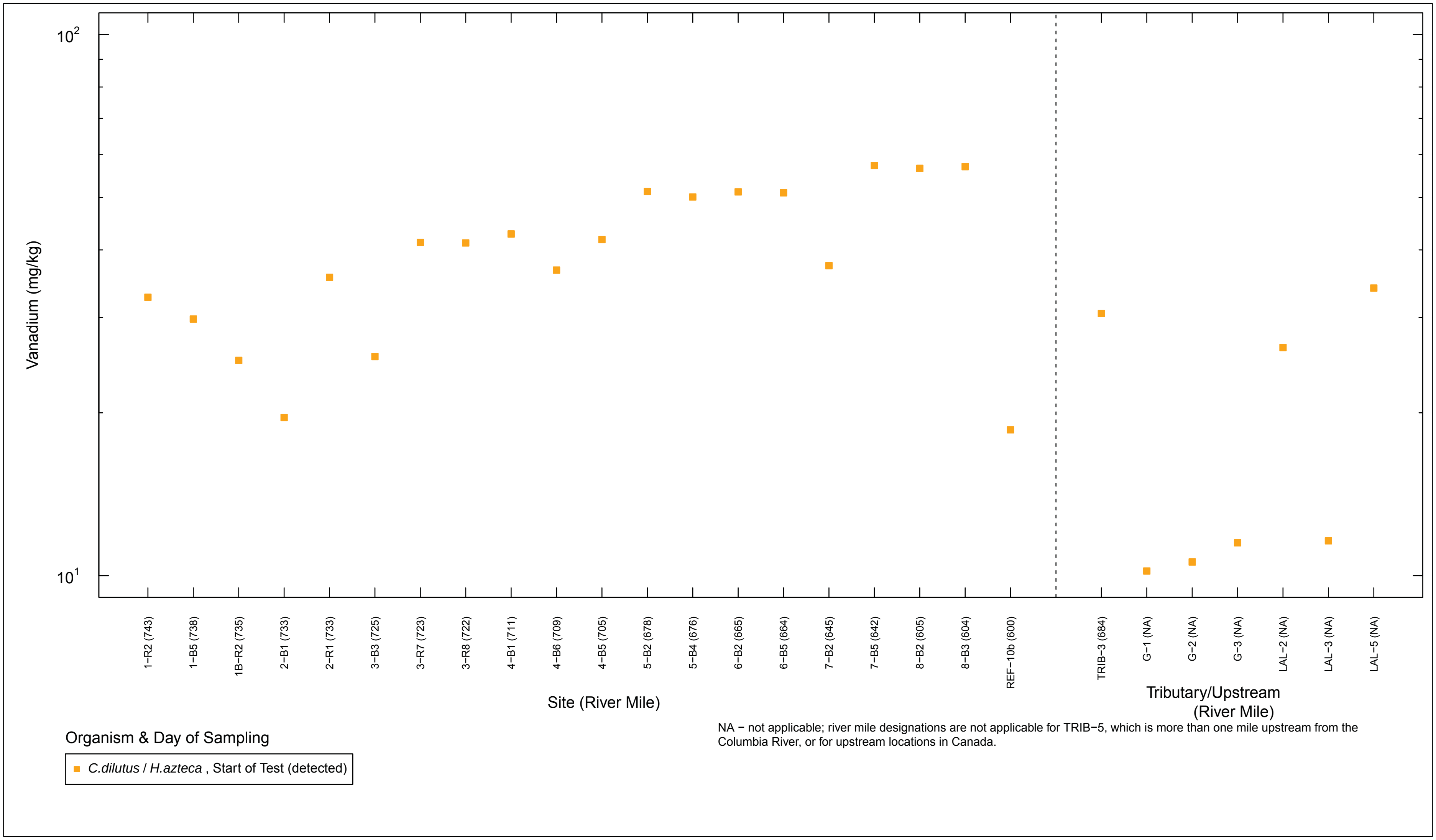


Figure 5−3z. Vanadium in Sediment from Long−Term Bioassays

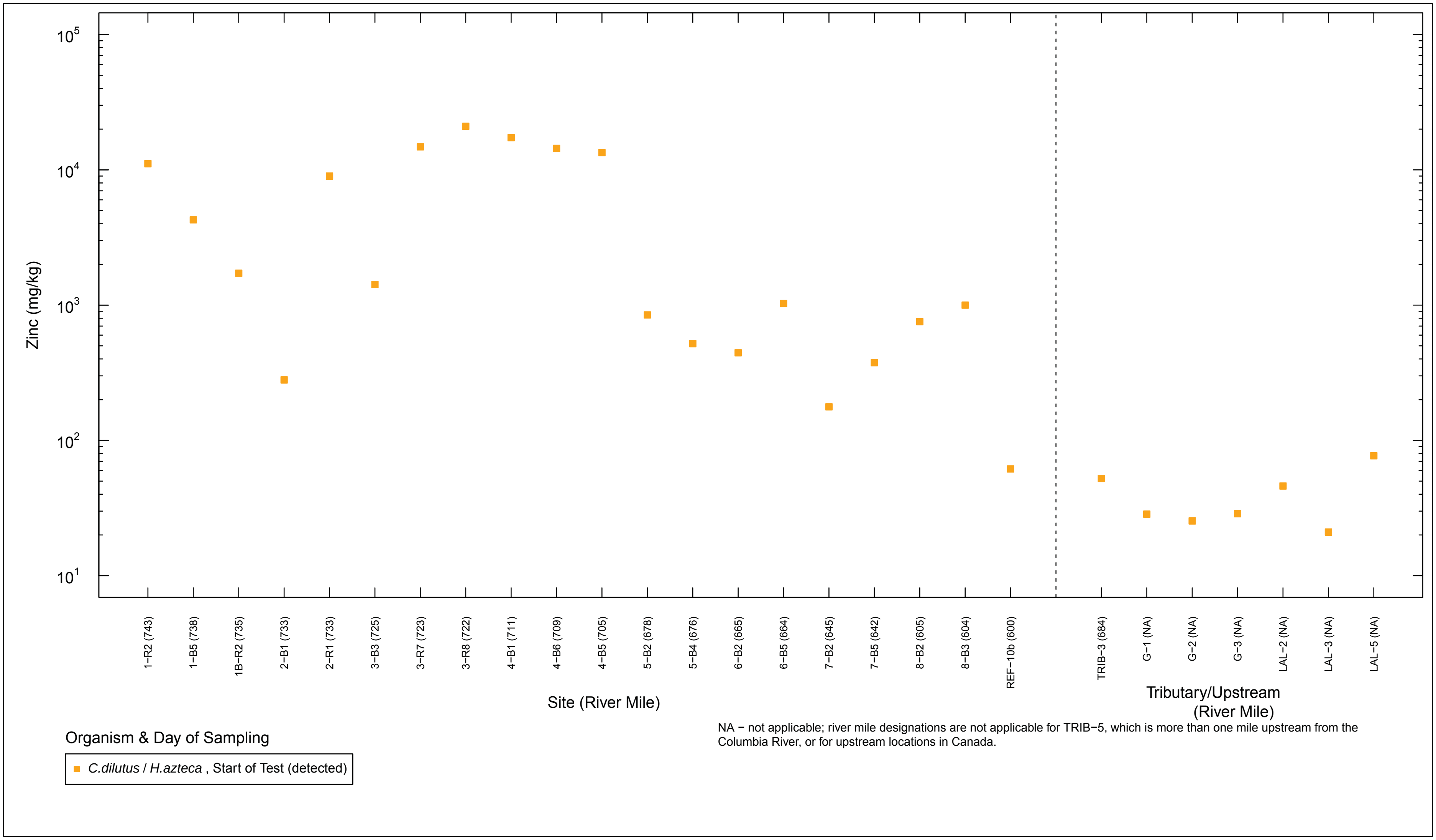


Figure 5−3aa. Zinc in Sediment from Long−Term Bioassays

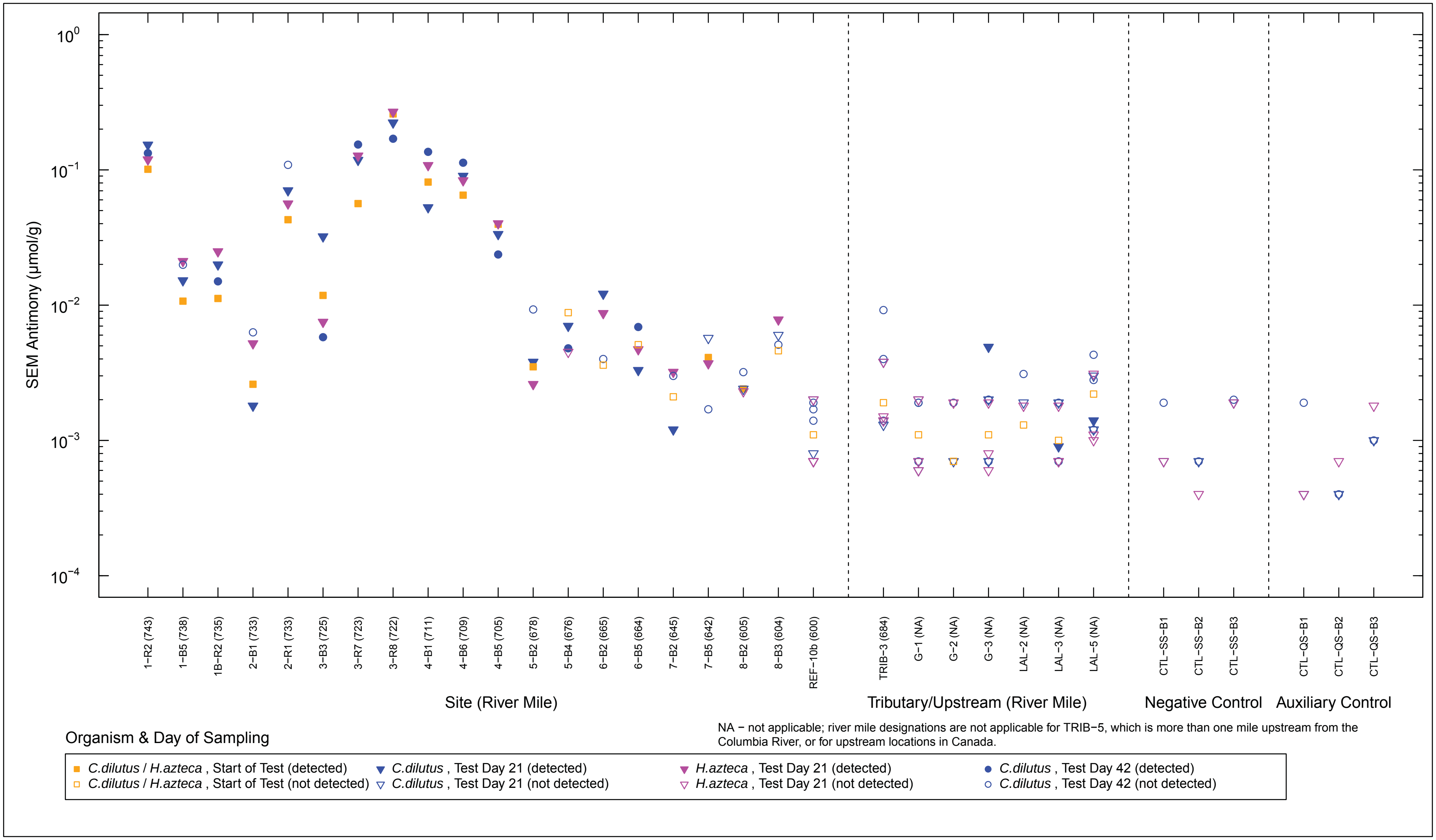


Figure 5−3ab. SEM Antimony in Sediment from Long−Term Bioassays

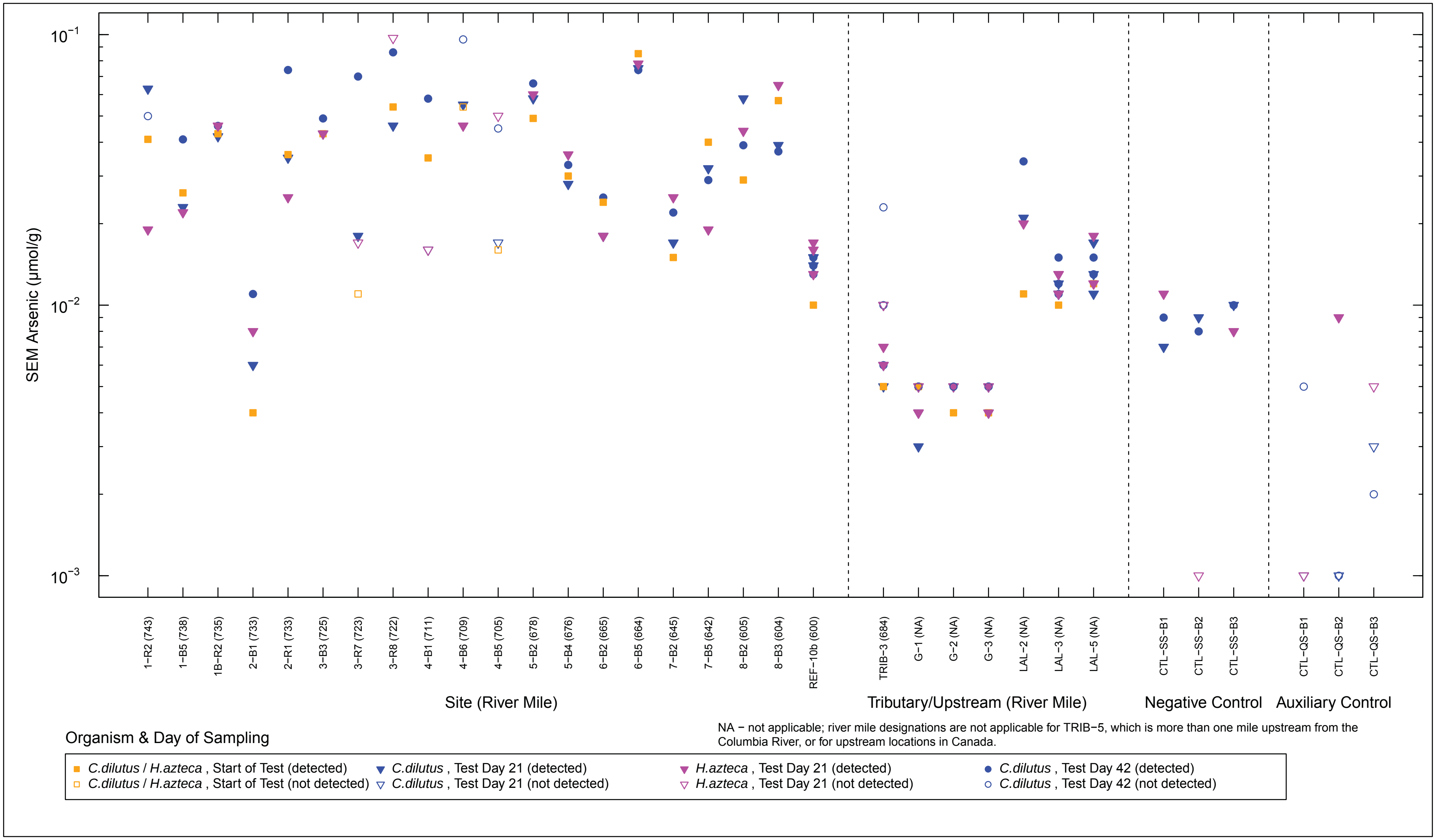


Figure 5−3ac. SEM Arsenic in Sediment from Long−Term Bioassays

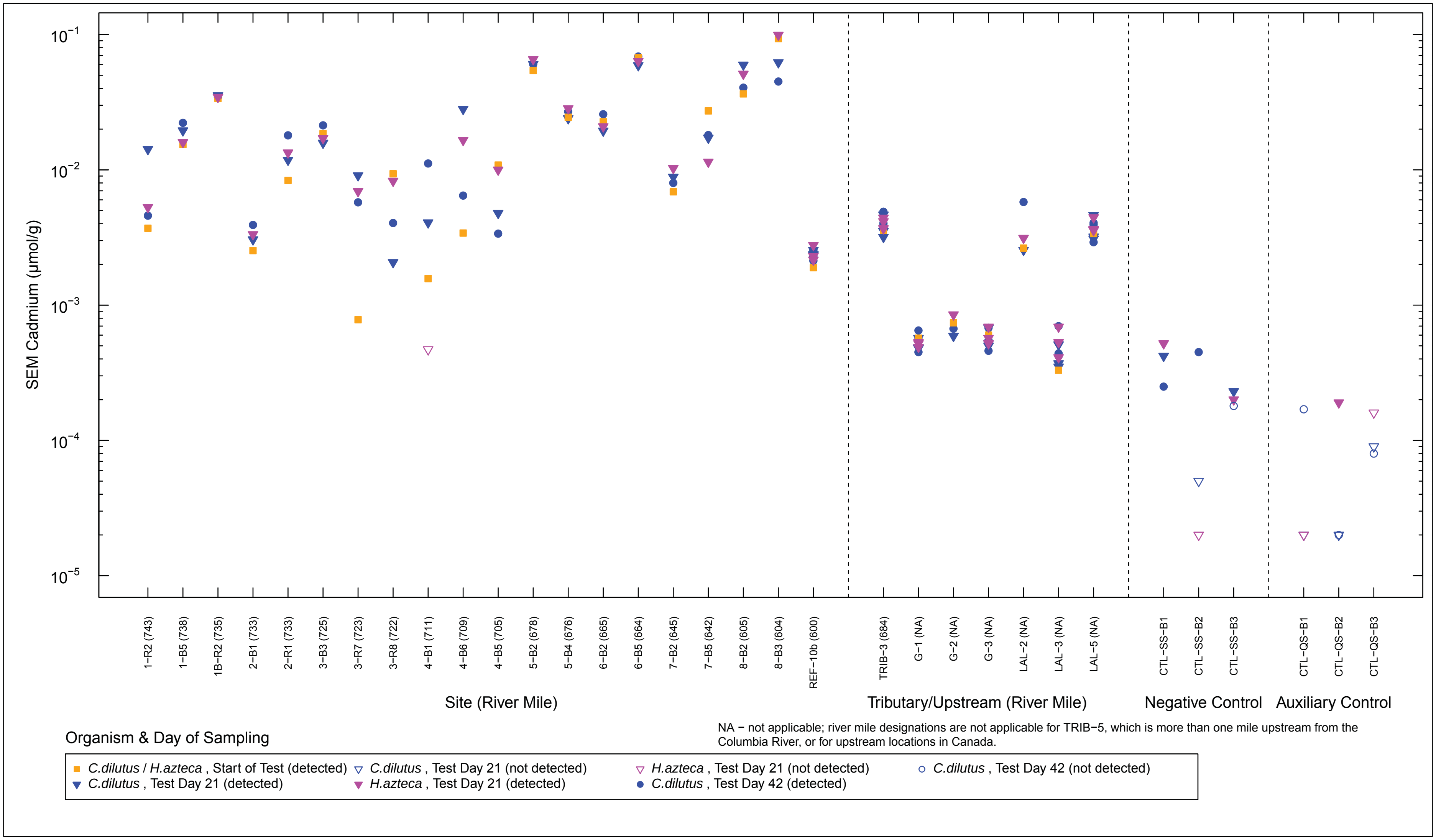


Figure 5−3ad. SEM Cadmium in Sediment from Long−Term Bioassays

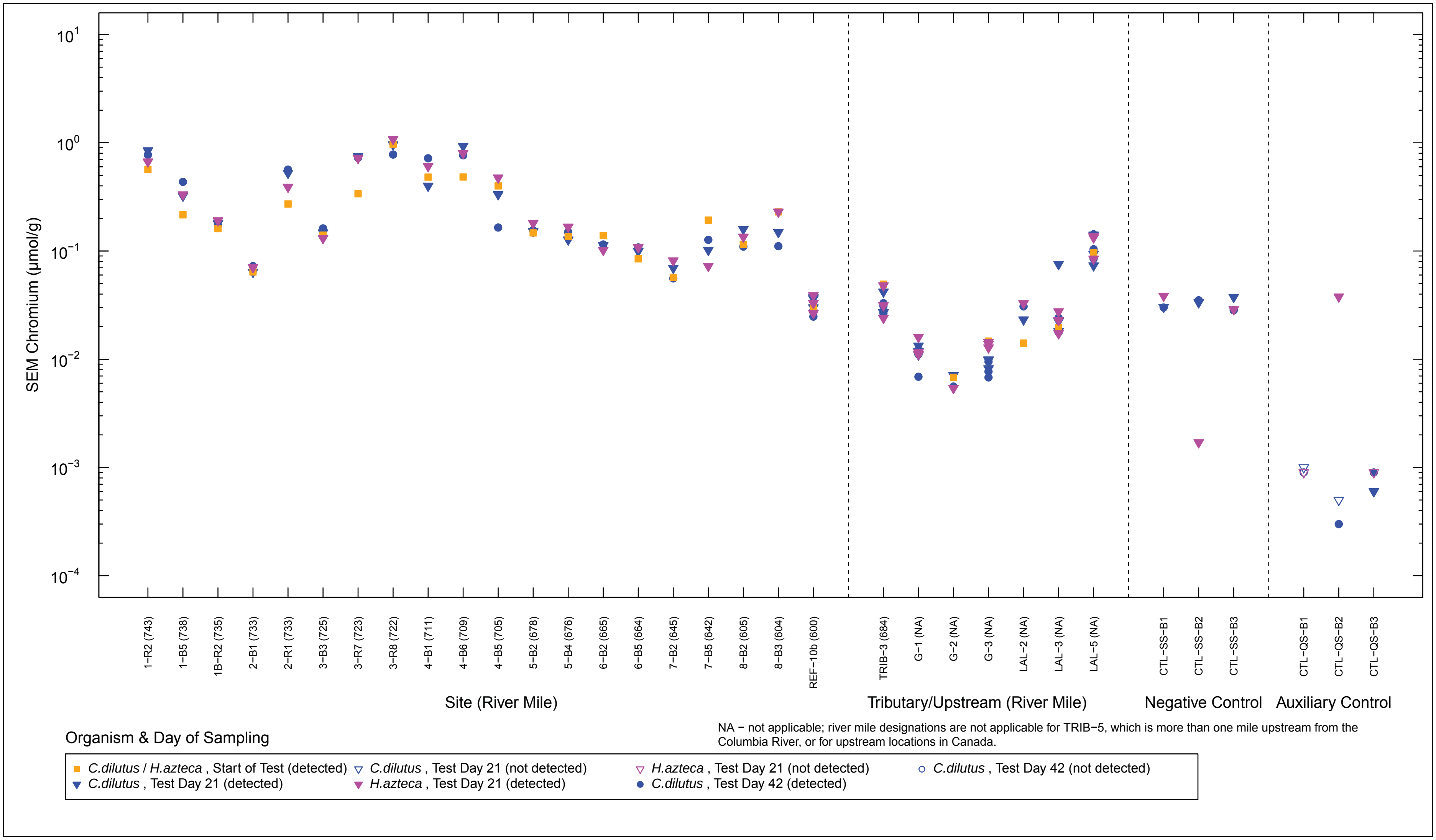


Figure 5−3ae. SEM Chromium in Sediment from Long−Term Bioassays

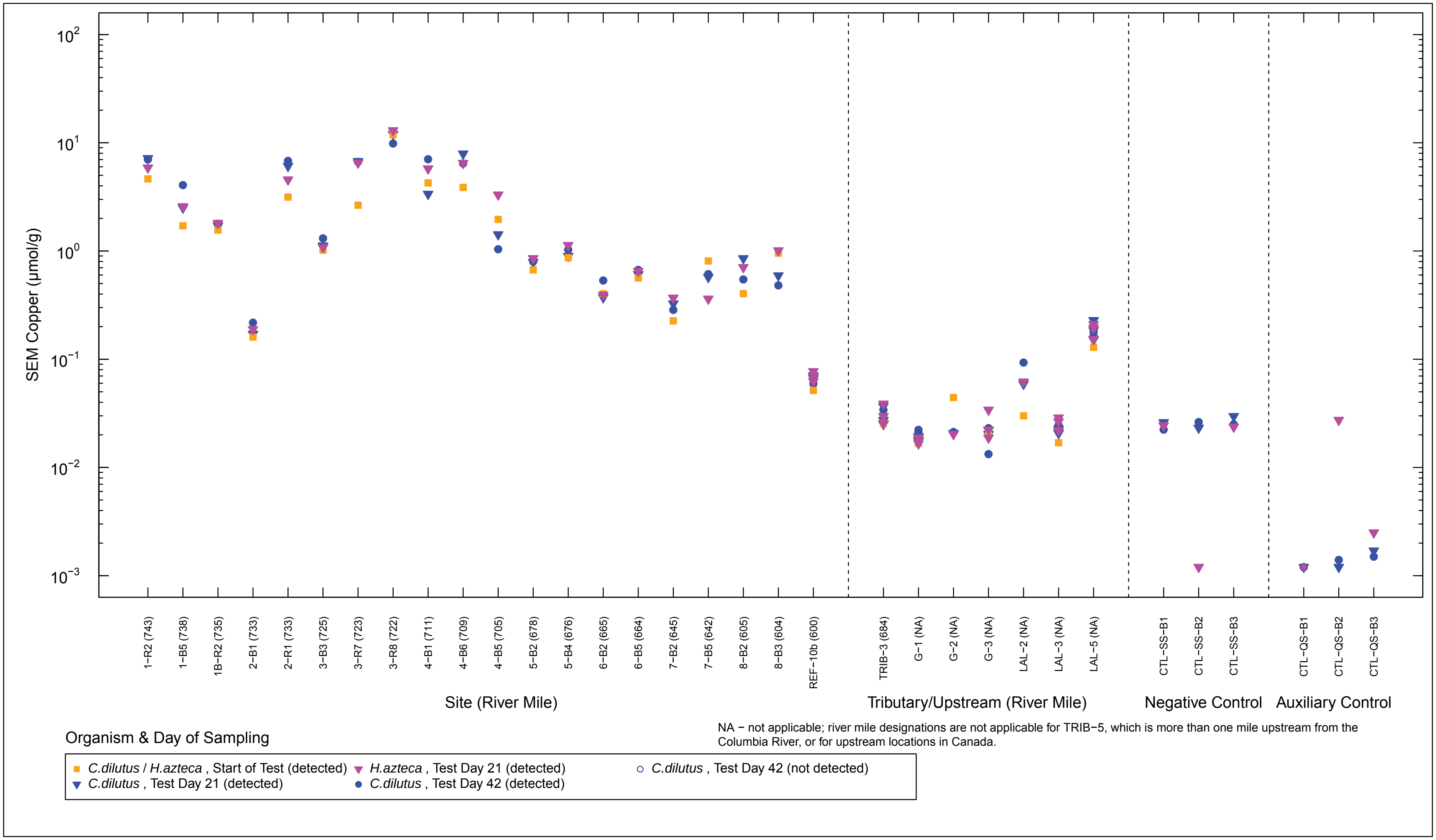


Figure 5−3af. SEM Copper in Sediment from Long−Term Bioassays

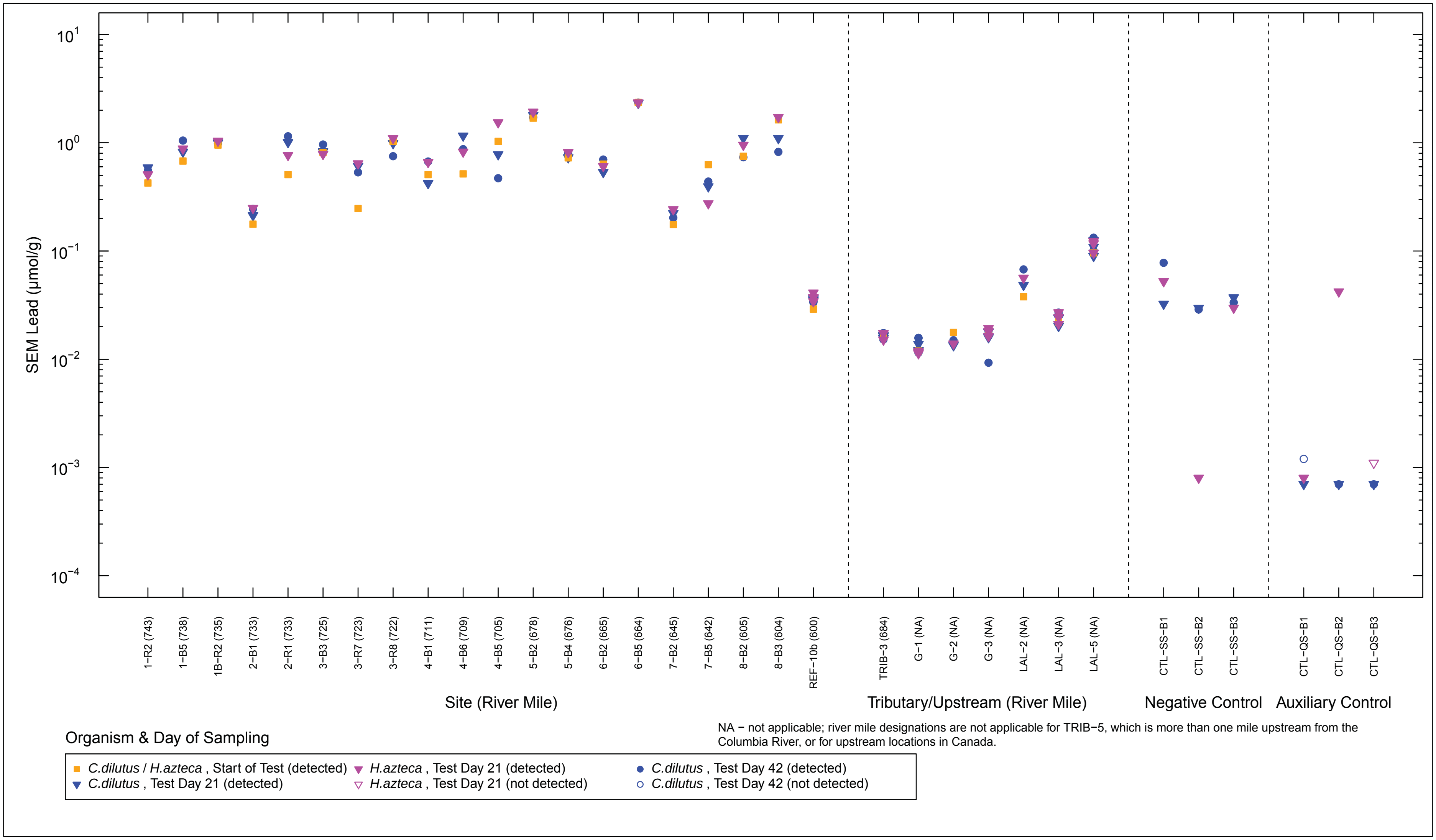


Figure 5−3ag. SEM Lead in Sediment from Long−Term Bioassays

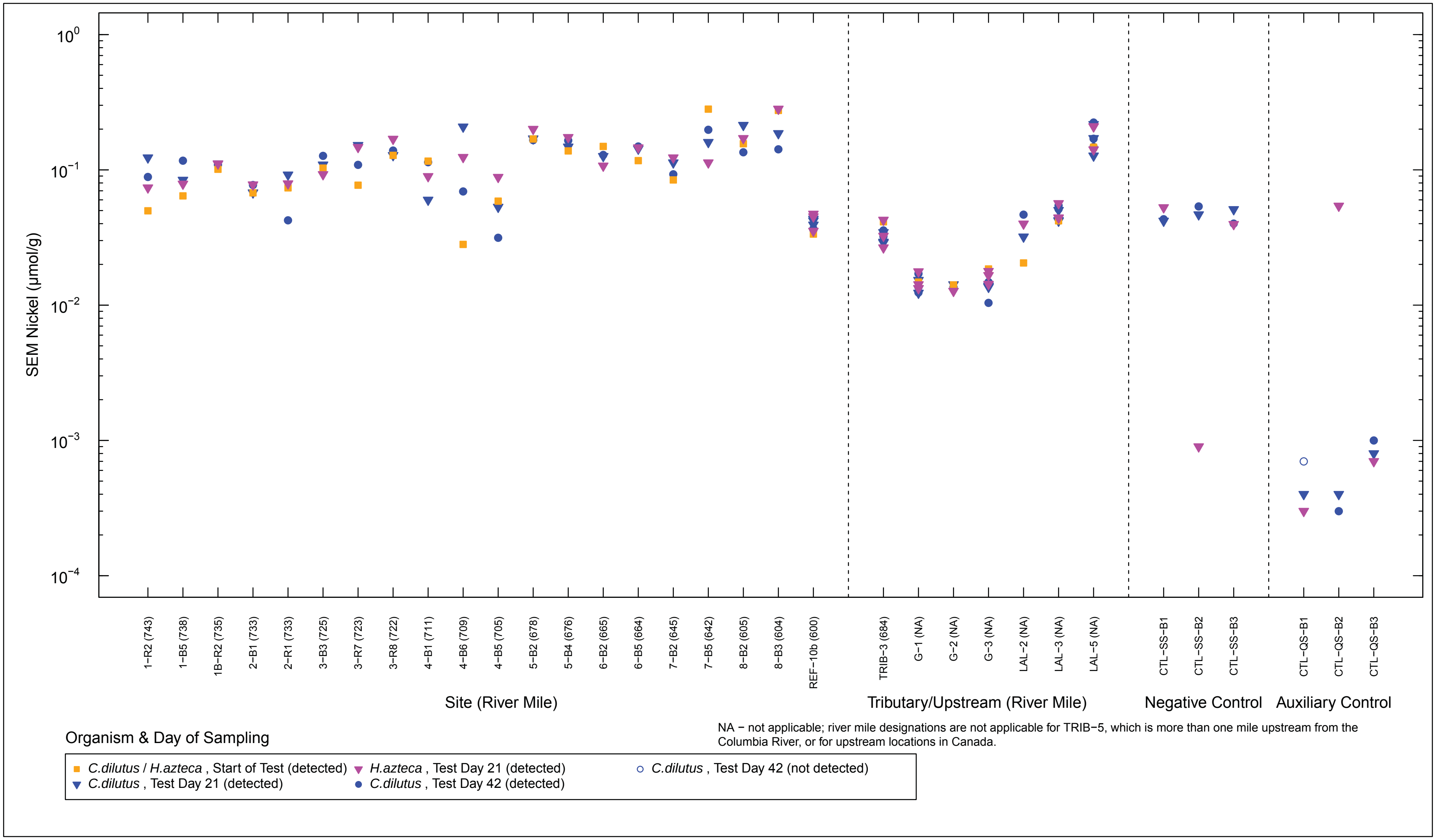


Figure 5−3ah. SEM Nickel in Sediment from Long−Term Bioassays

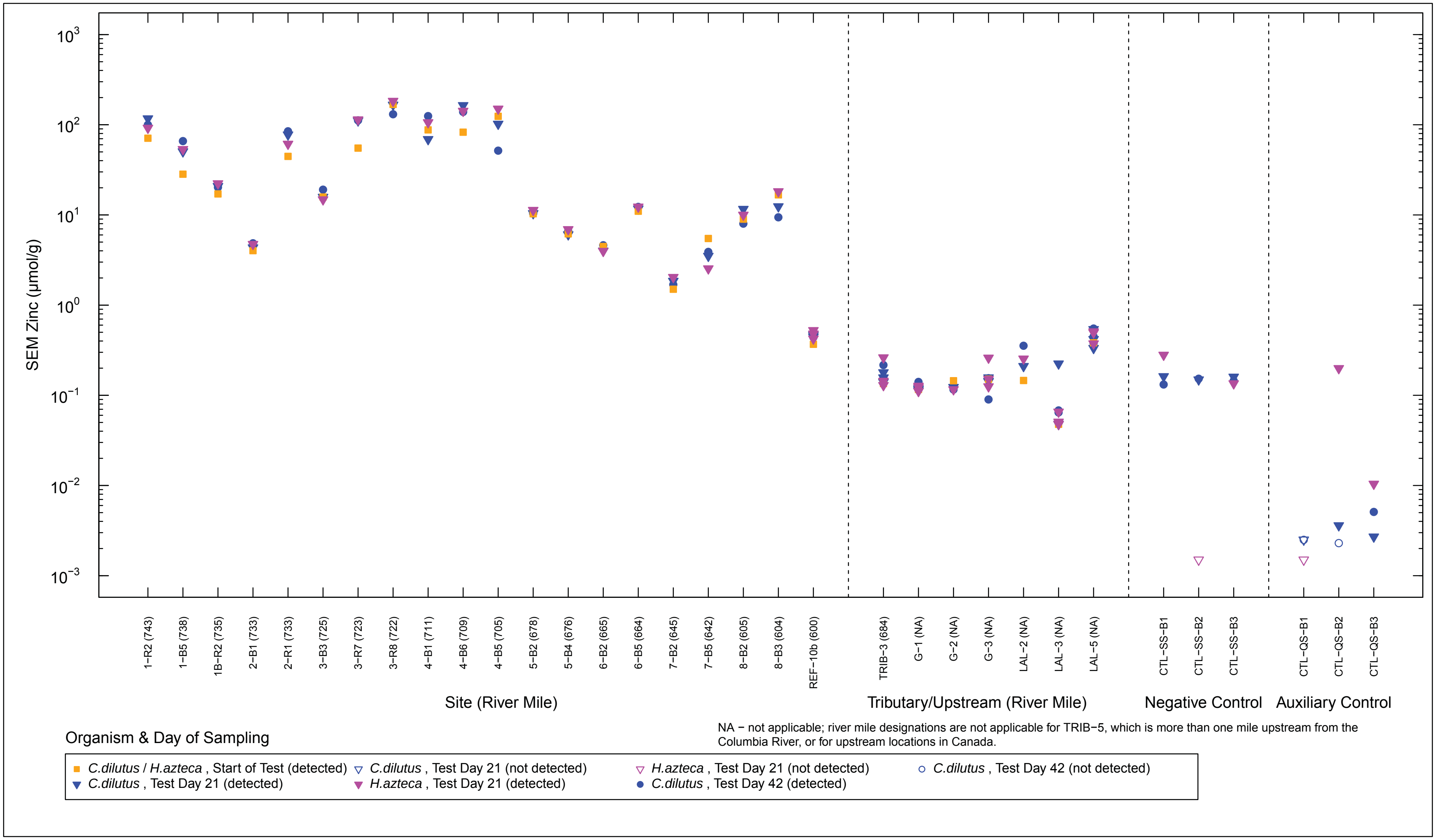


Figure 5−3ai. SEM Zinc in Sediment from Long−Term Bioassays

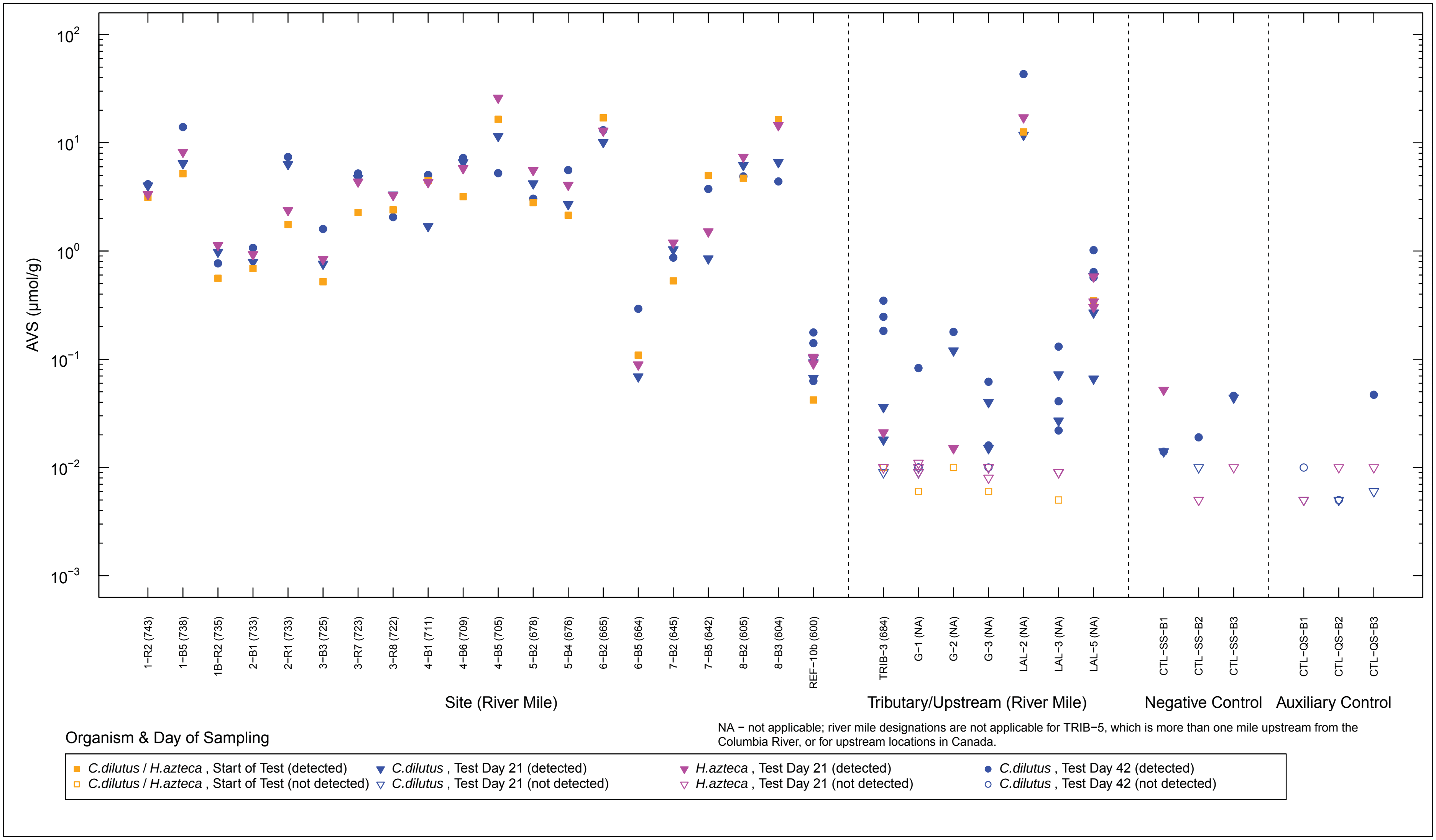
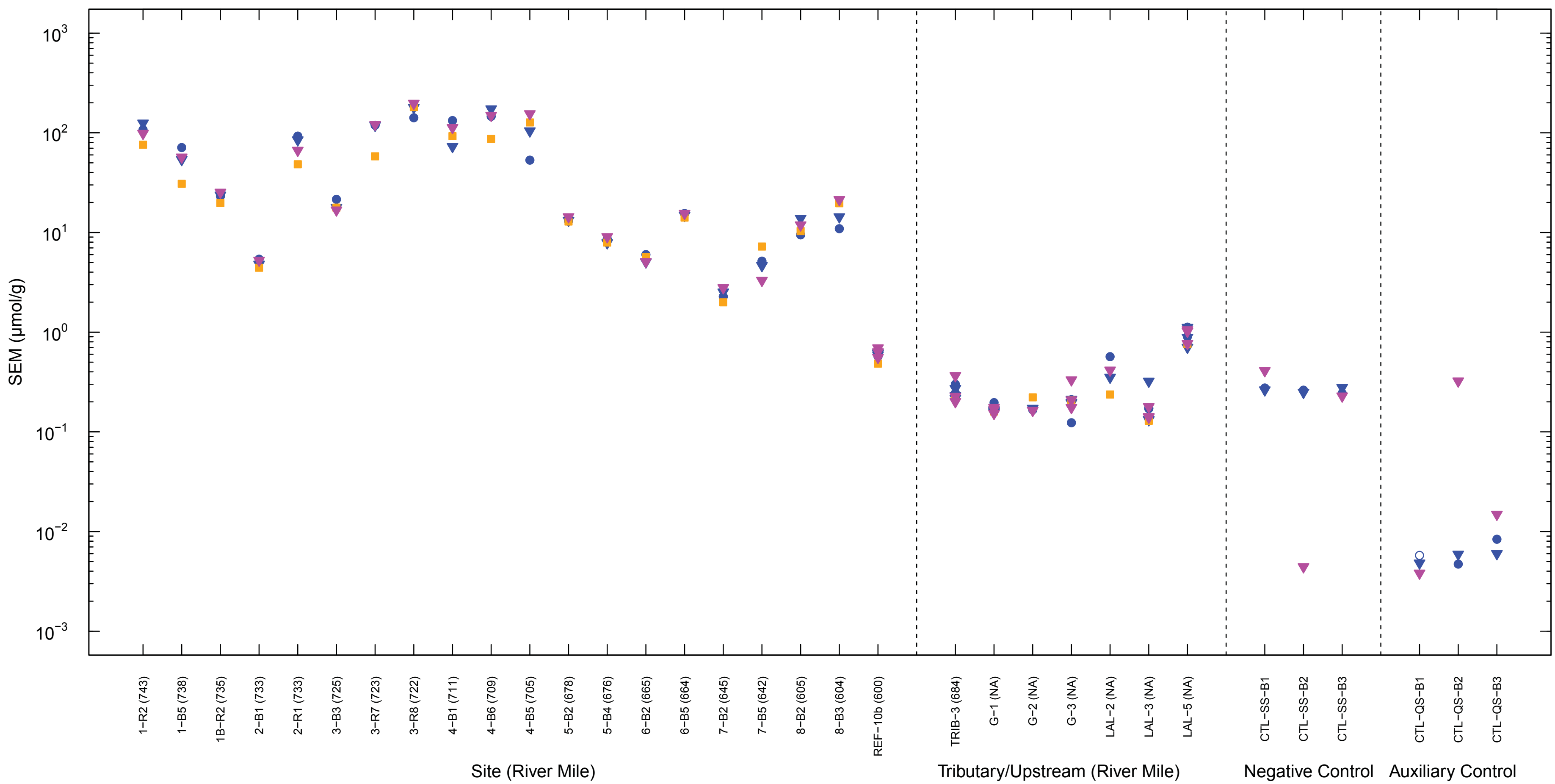


Figure 5−3aj. AVS in Sediment from Long−Term Bioassays



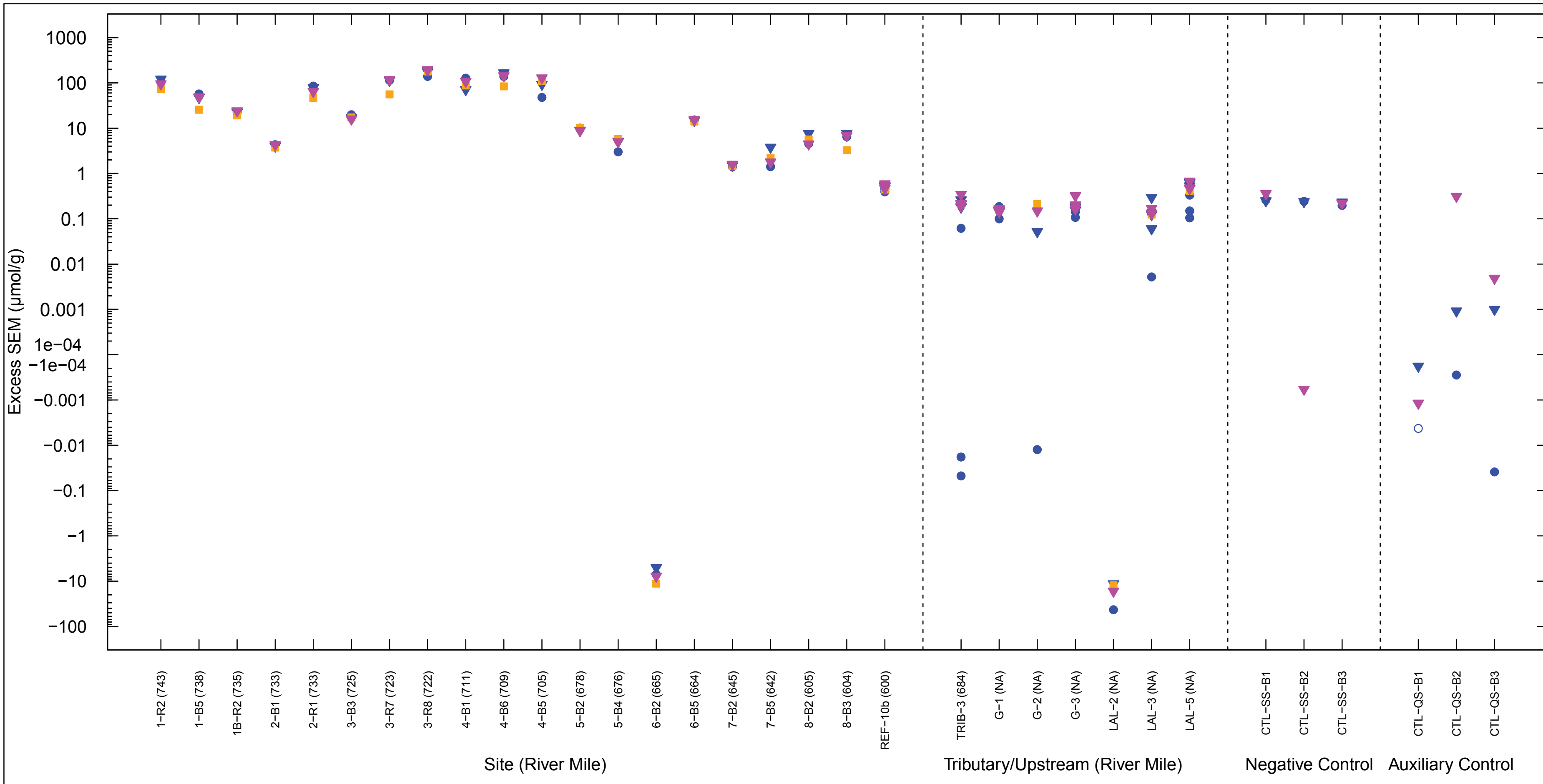
NA − not applicable; river mile designations are not applicable for TRIB−5, which is more than one mile upstream from the Columbia River, or for upstream locations in Canada.

Note: SEM is the sum of individual SEM concentrations of cadmium, copper, lead, nickel, and zinc. For nondetected concentrations of individual SEM metals, the detection limit was used in the sum.

Organism & Day of Sampling

C.dilutus / *H.azteca* , Start of Test (detected)
C.dilutus , Test Day 21 (detected)
H.azteca , Test Day 21 (detected)
C.dilutus , Test Day 42 (detected)
C.dilutus , Test Day 42 (no SEM metals detected)

Figure 5−3ak. SEM in Sediment from Long−Term Bioassays



NA − not applicable; river mile designations are not applicable for TRIB−5, which is more than one mile upstream from the Columbia River, or for upstream locations in Canada.

Note: SEM is the sum of individual SEM concentrations of cadmium, copper, lead, nickel, and zinc. For nondetected concentrations of individual SEM metals, the detection limit was used in the sum.

Organism & Day of Sampling

C.dilutus / *H.azteca* , Start of Test (detected)
C.dilutus , Test Day 21 (detected)
H.azteca , Test Day 21 (detected)
C.dilutus , Test Day 42 (detected)
C.dilutus , Test Day 42 (no SEM metals detected)

Figure 5−3al. Excess SEM in Sediment from Long−Term Bioassays

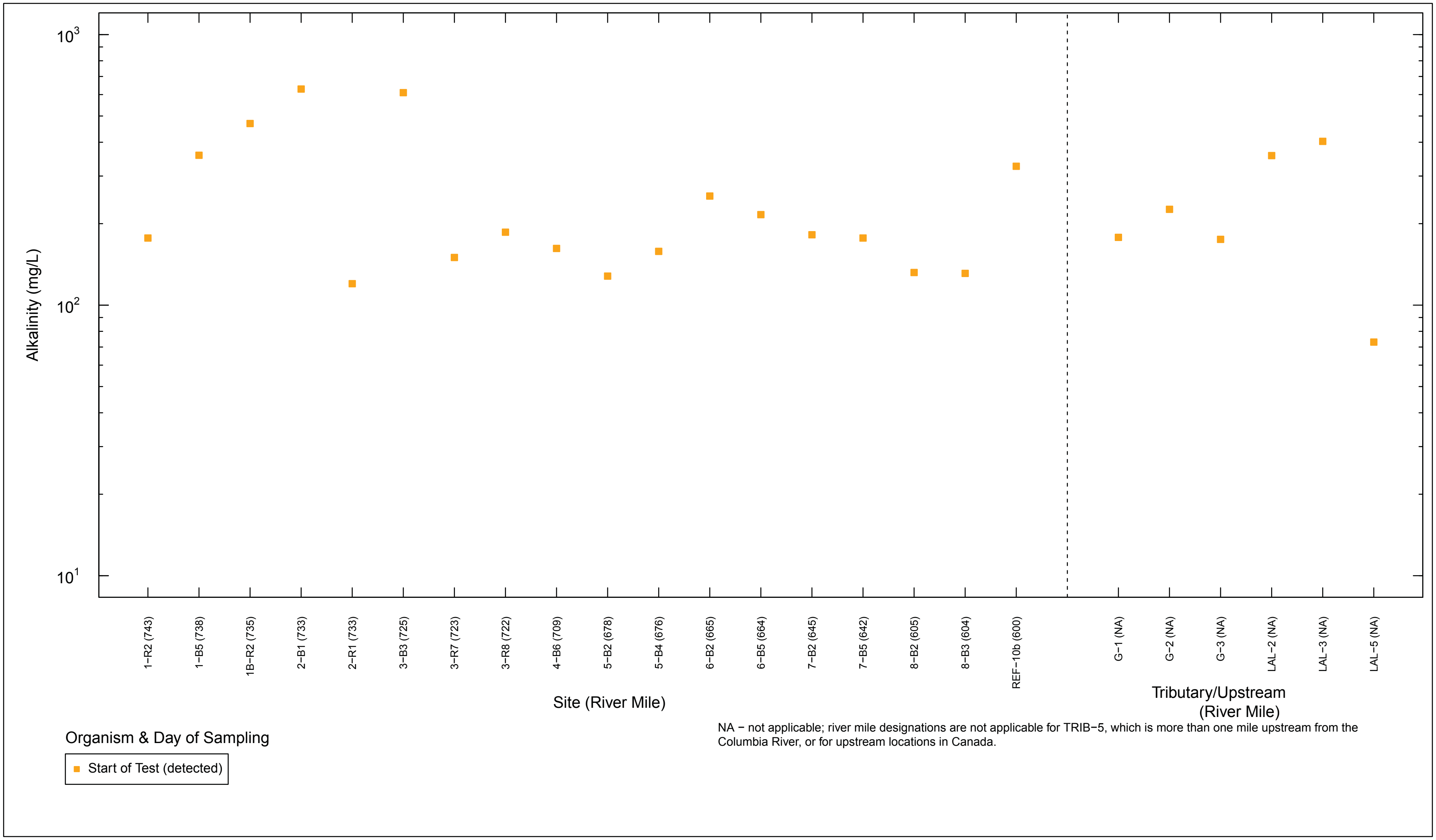


Figure 5−6a. Alkalinity in Porewater from Long−Term Bioassays

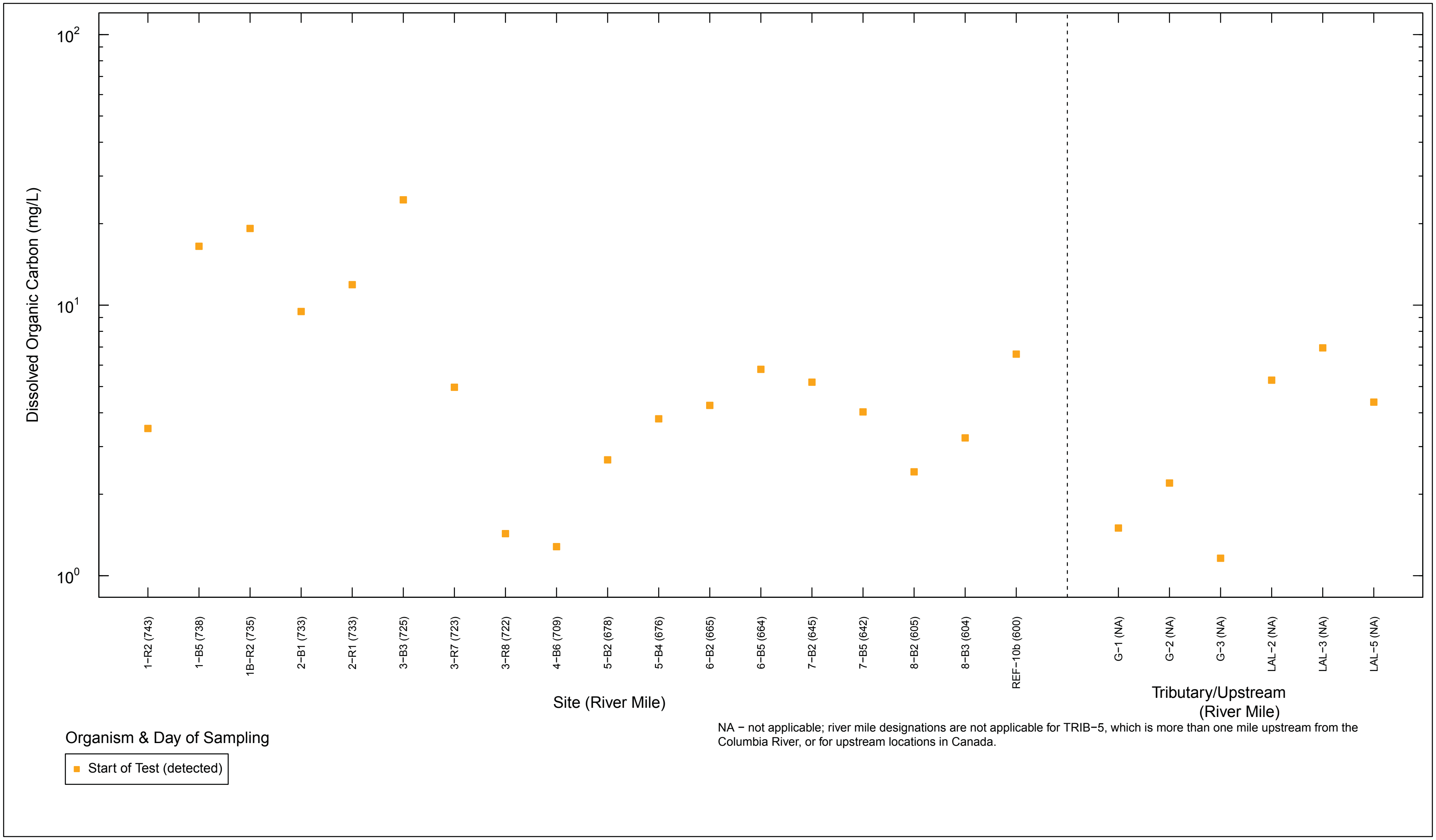


Figure 5−6b. Dissolved Organic Carbon in Porewater from Long−Term Bioassays

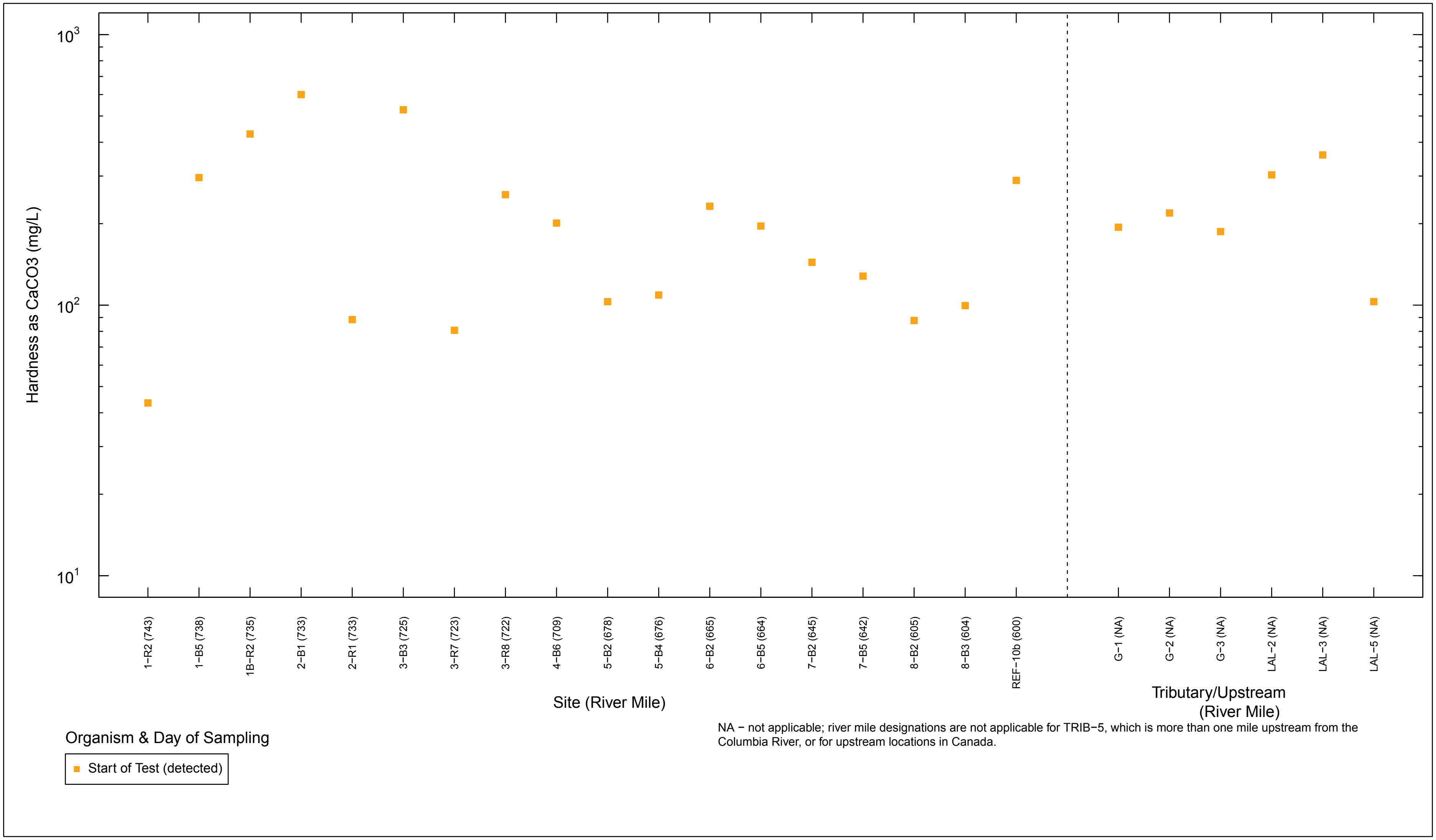


Figure 5−6c. Hardness as CaCO3 in Porewater from Long−Term Bioassays

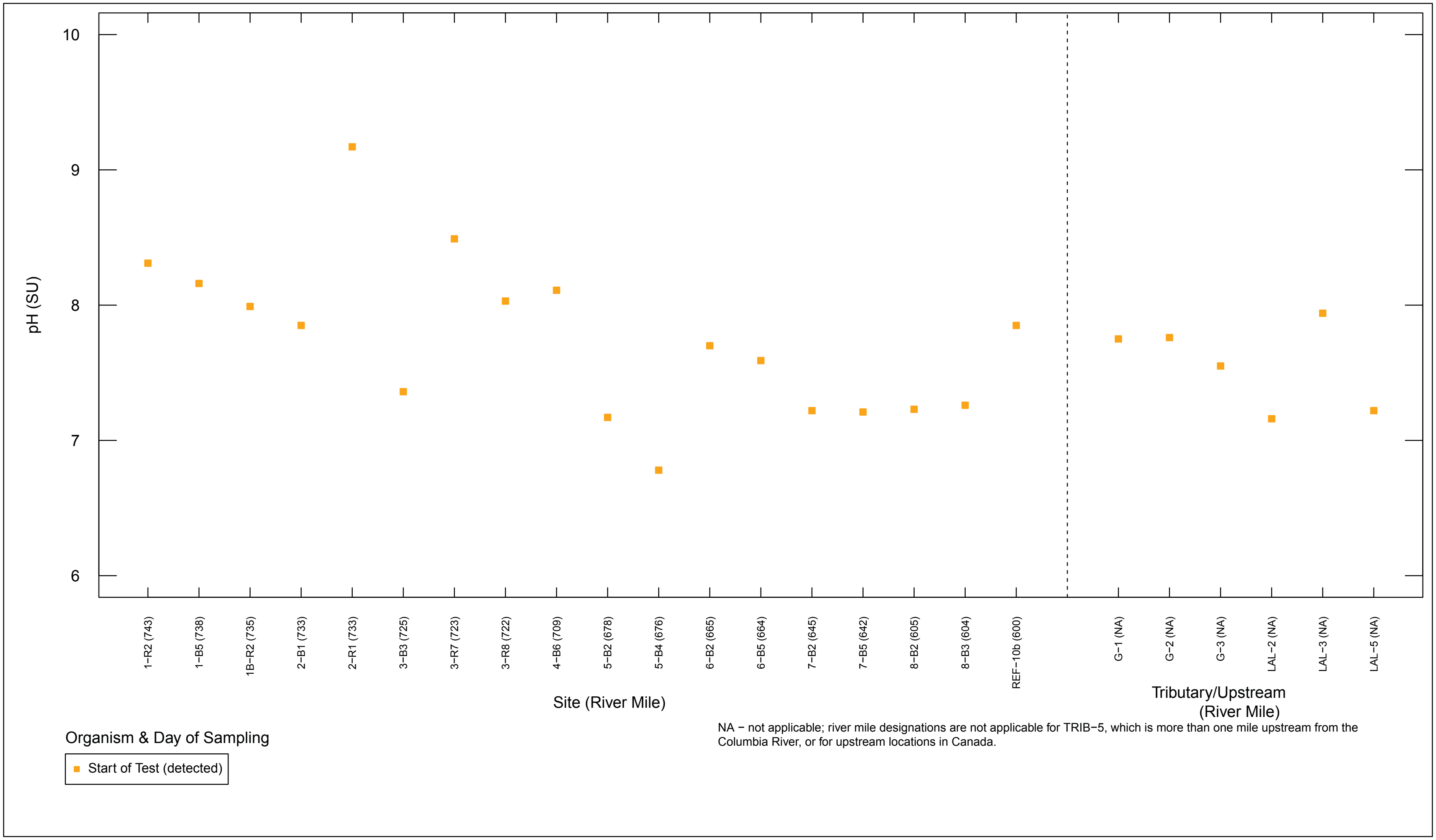


Figure 5−6d. pH in Porewater from Long−Term Bioassays

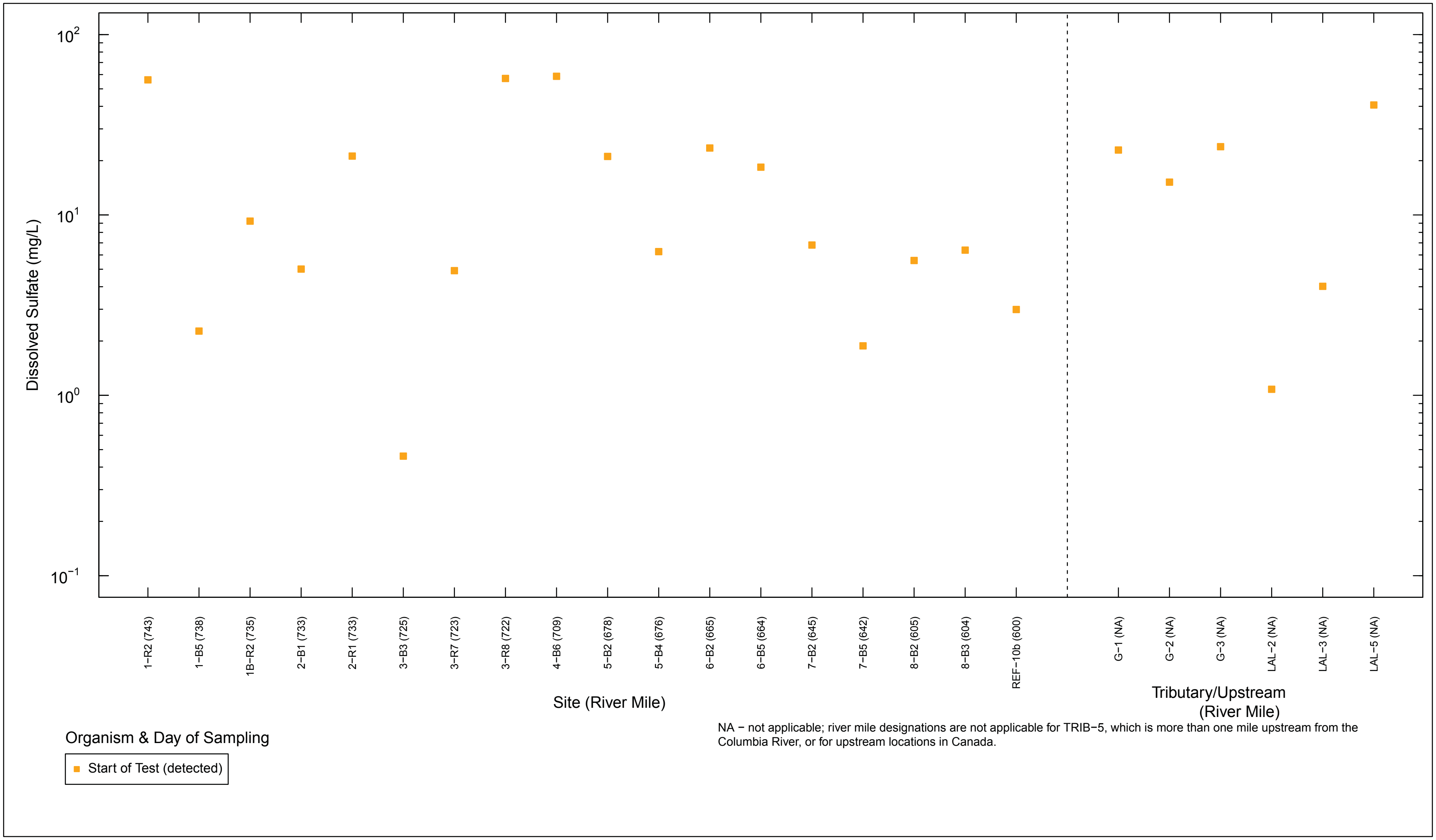


Figure 5−6e. Dissolved Sulfate in Porewater from Long−Term Bioassays

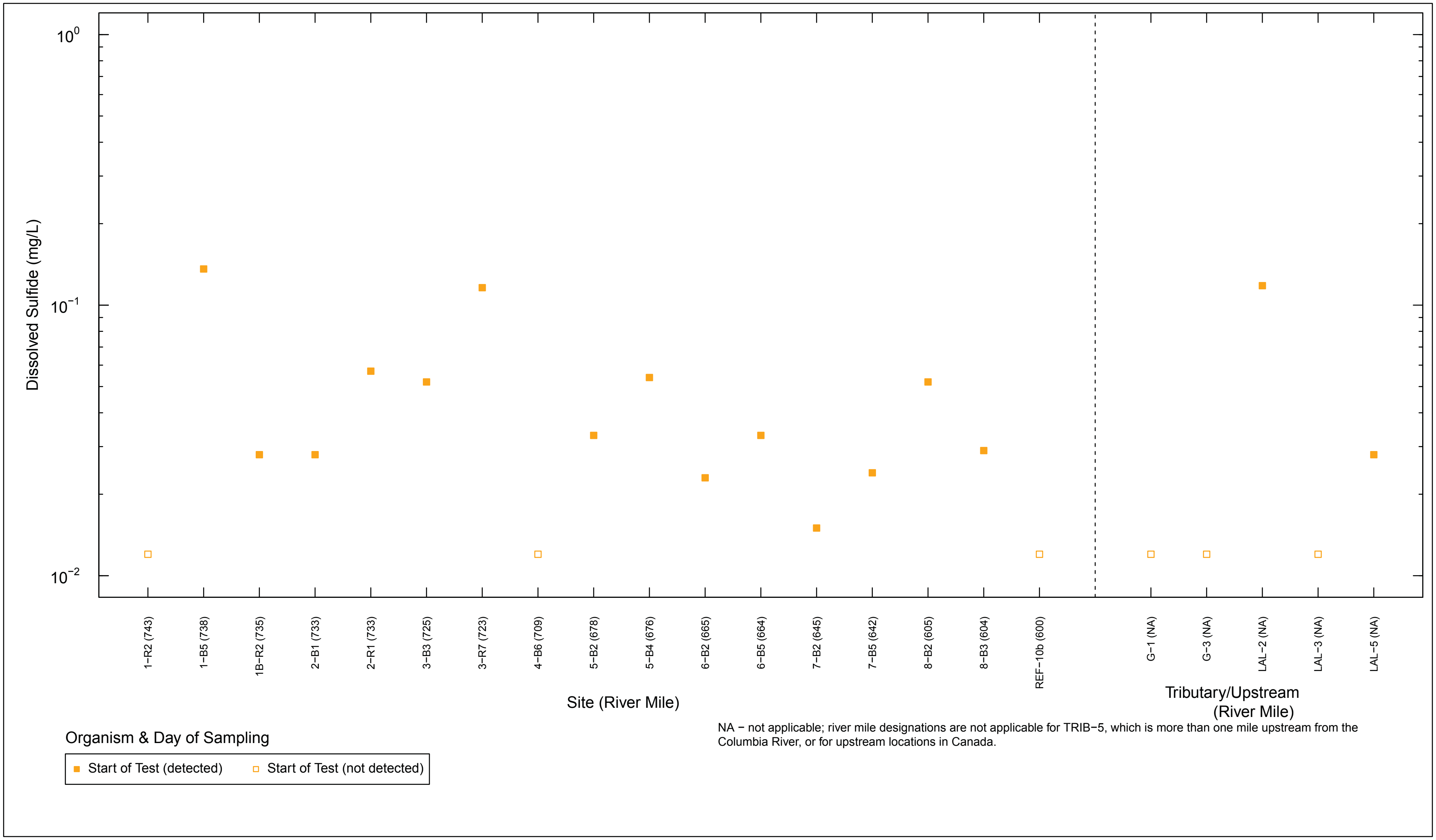


Figure 5−6f. Dissolved Sulfide in Porewater from Long−Term Bioassays

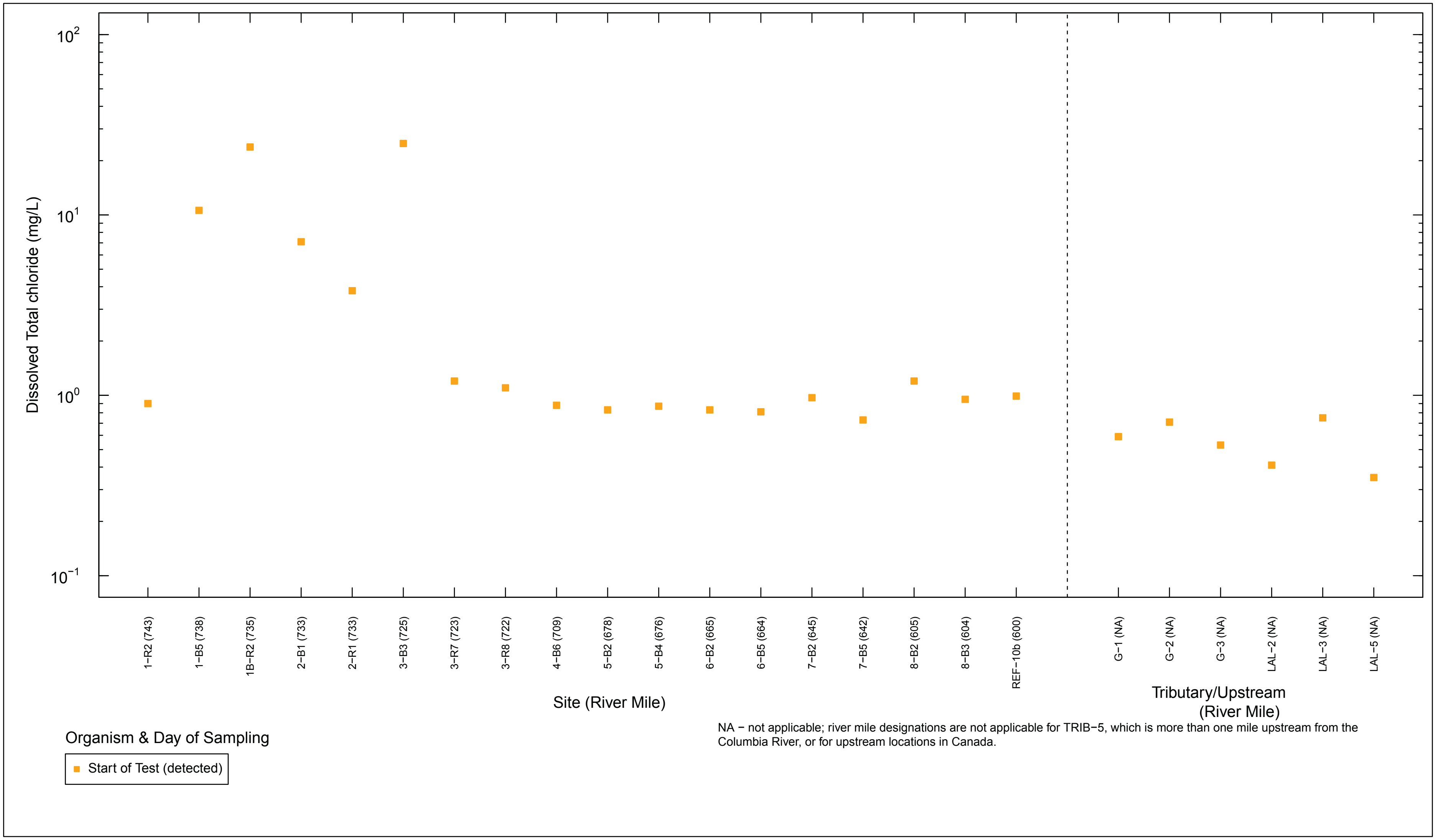


Figure 5−6g. Dissolved Total Chloride in Porewater from Long−Term Bioassays

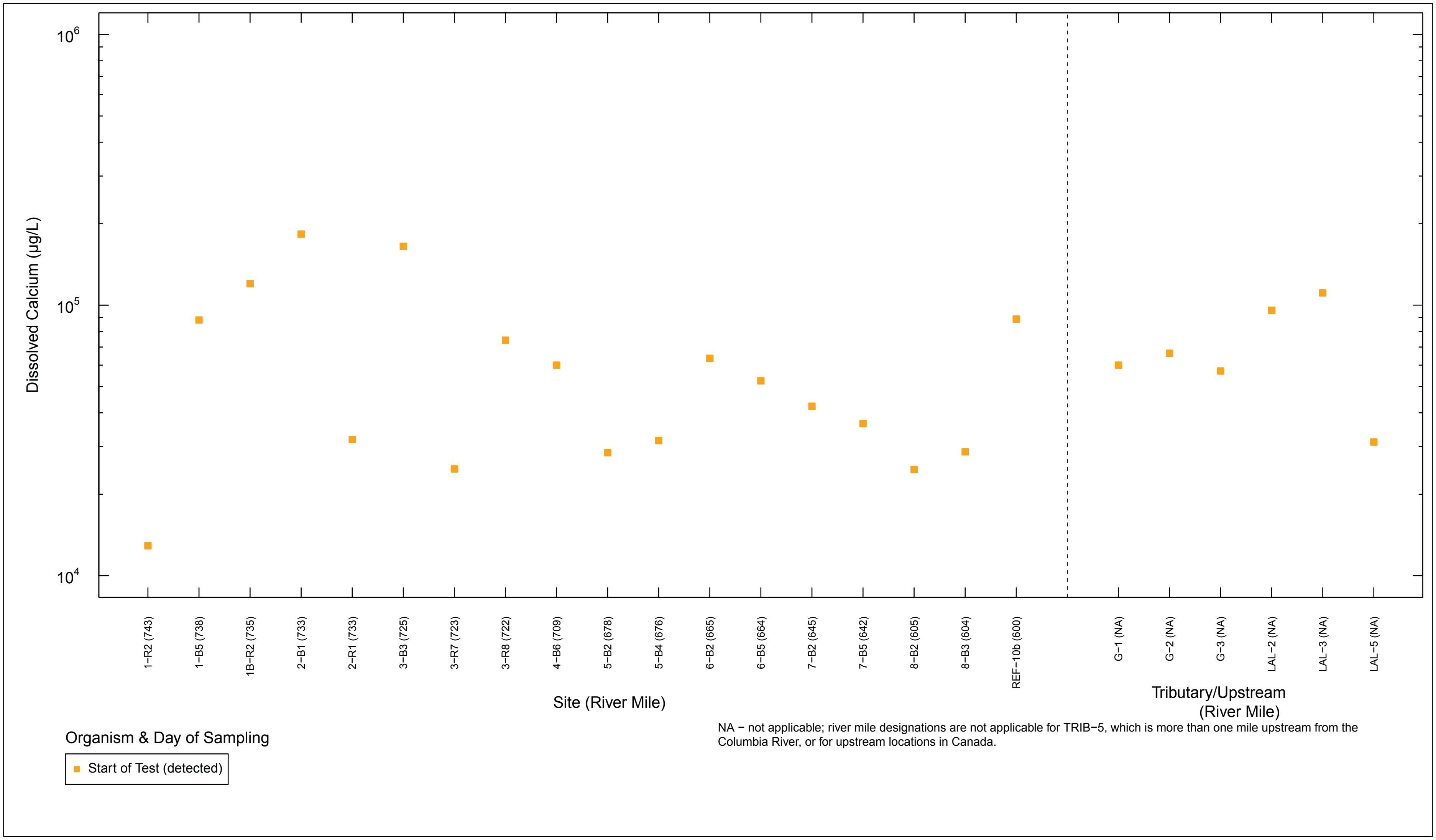


Figure 5−6h. Dissolved Calcium in Porewater from Long−Term Bioassays

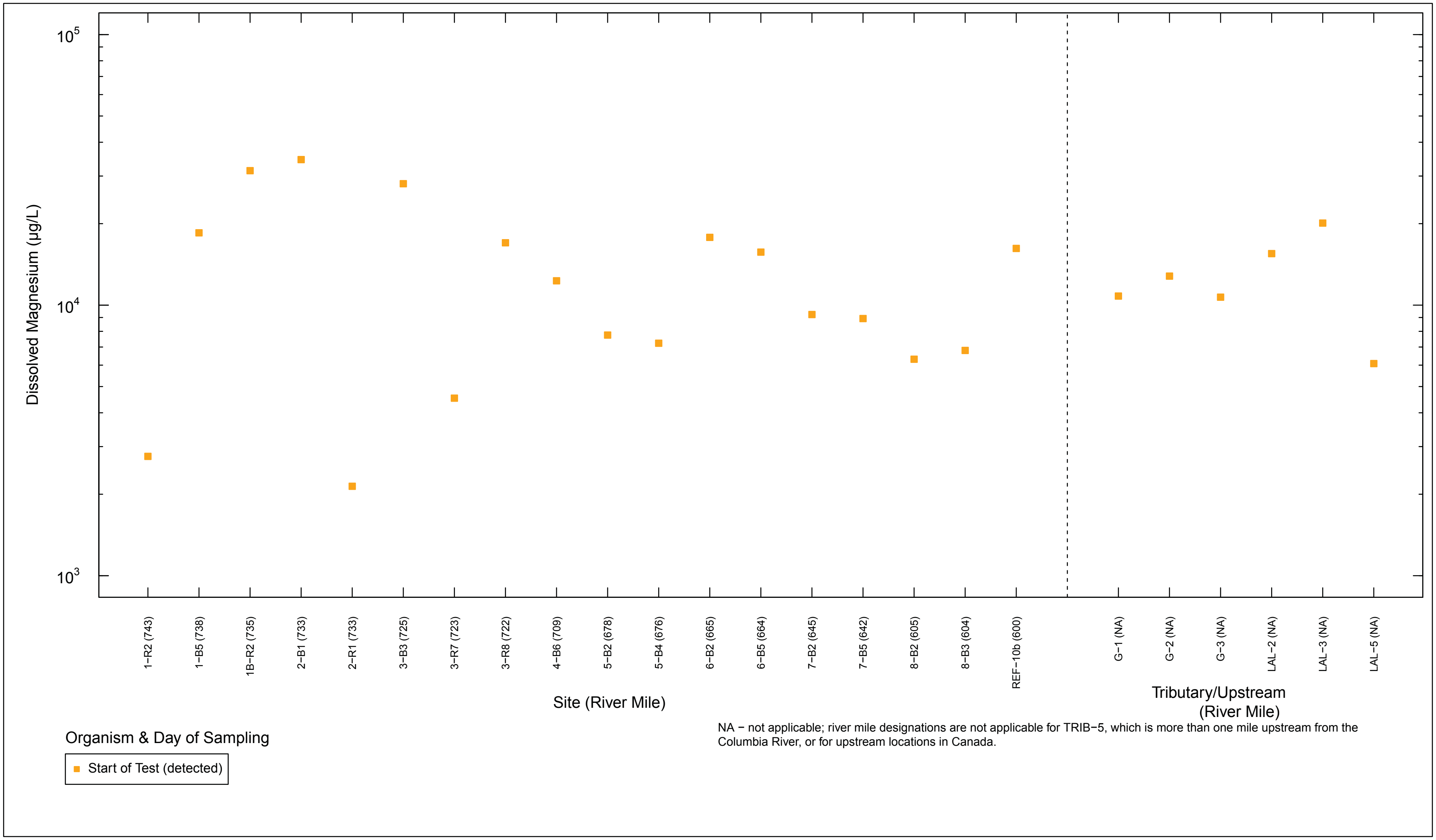


Figure 5−6i. Dissolved Magnesium in Porewater from Long−Term Bioassays

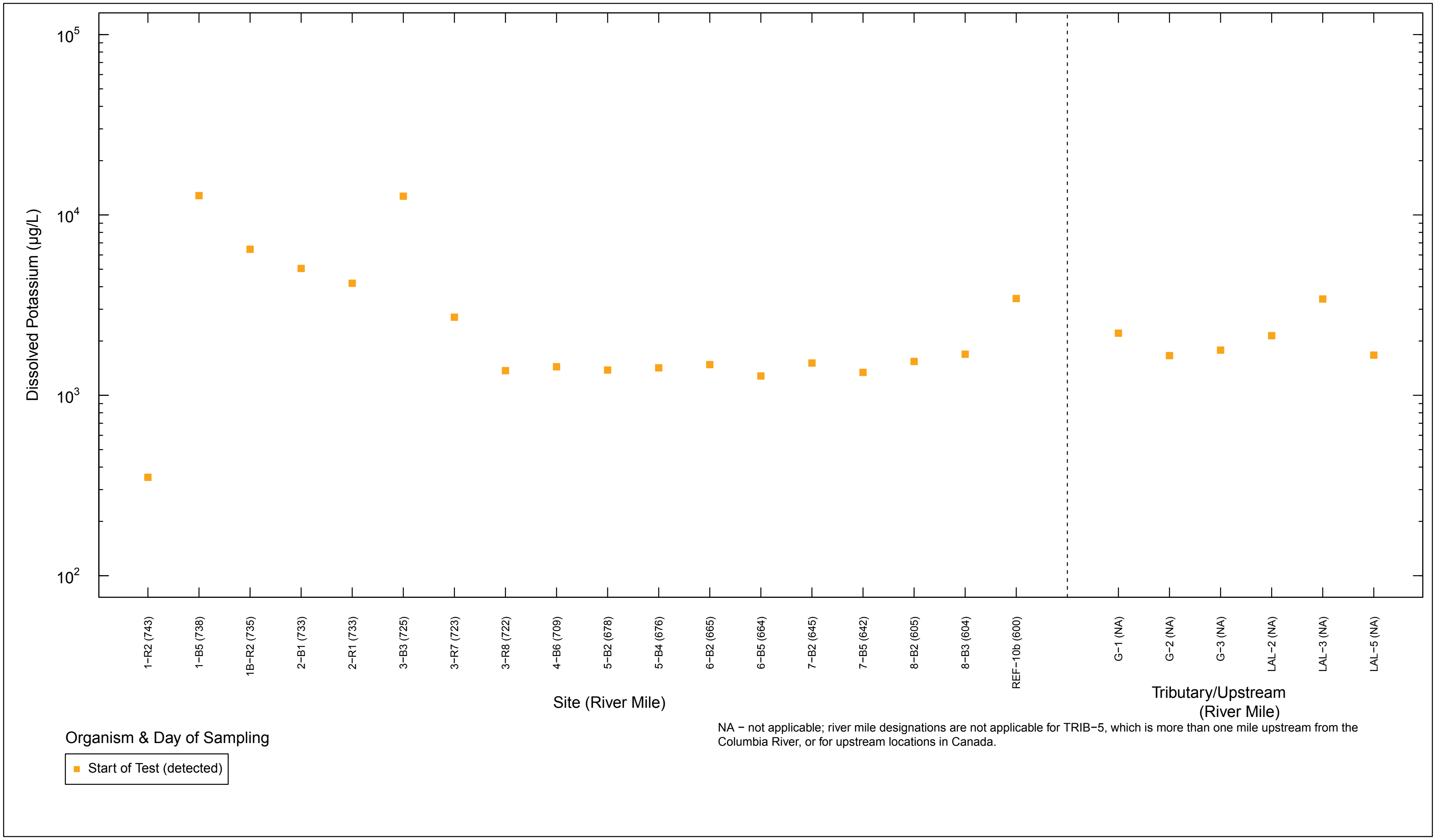


Figure 5−6j. Dissolved Potassium in Porewater from Long−Term Bioassays

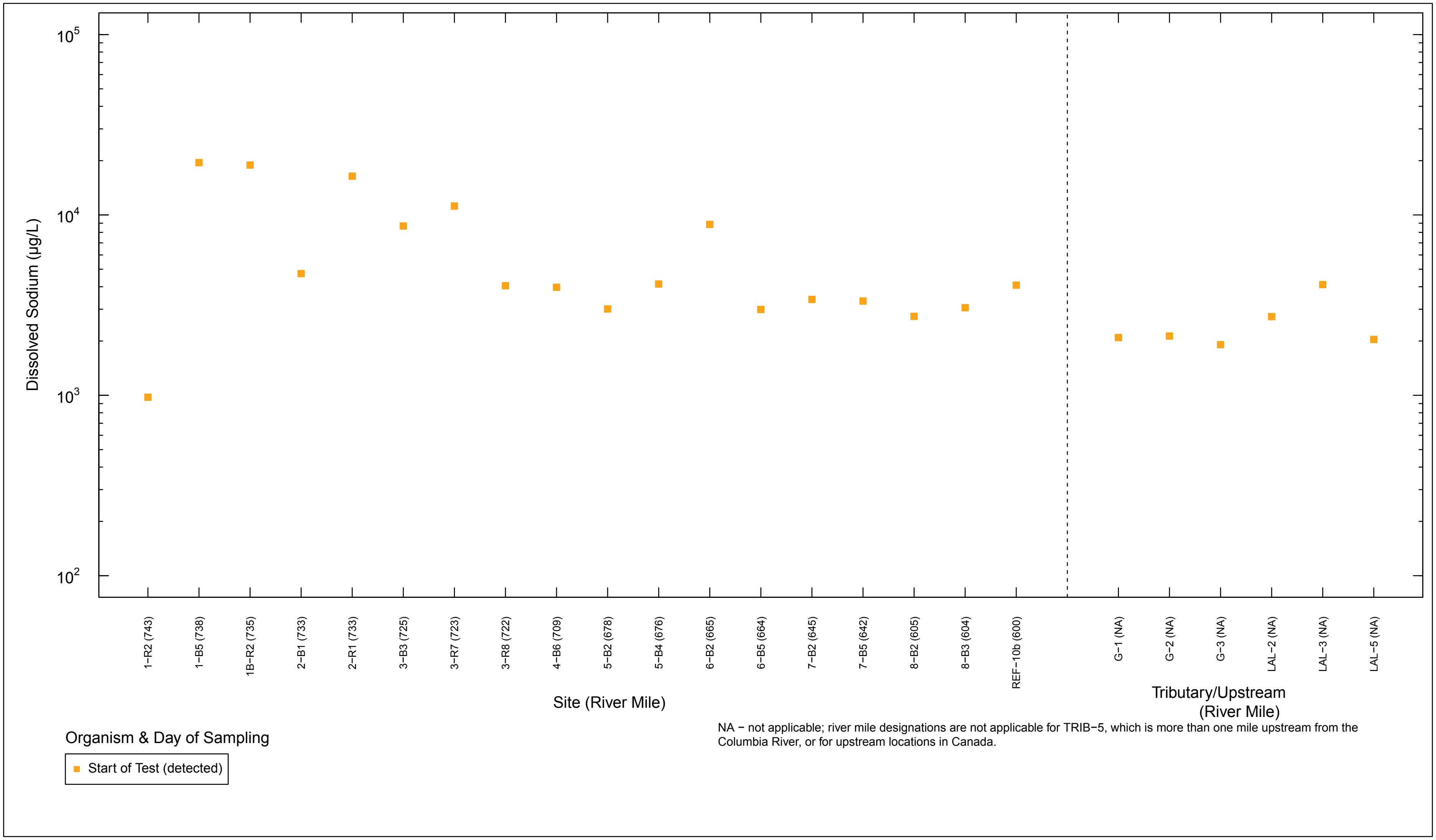


Figure 5−6k. Dissolved Sodium in Porewater from Long−Term Bioassays

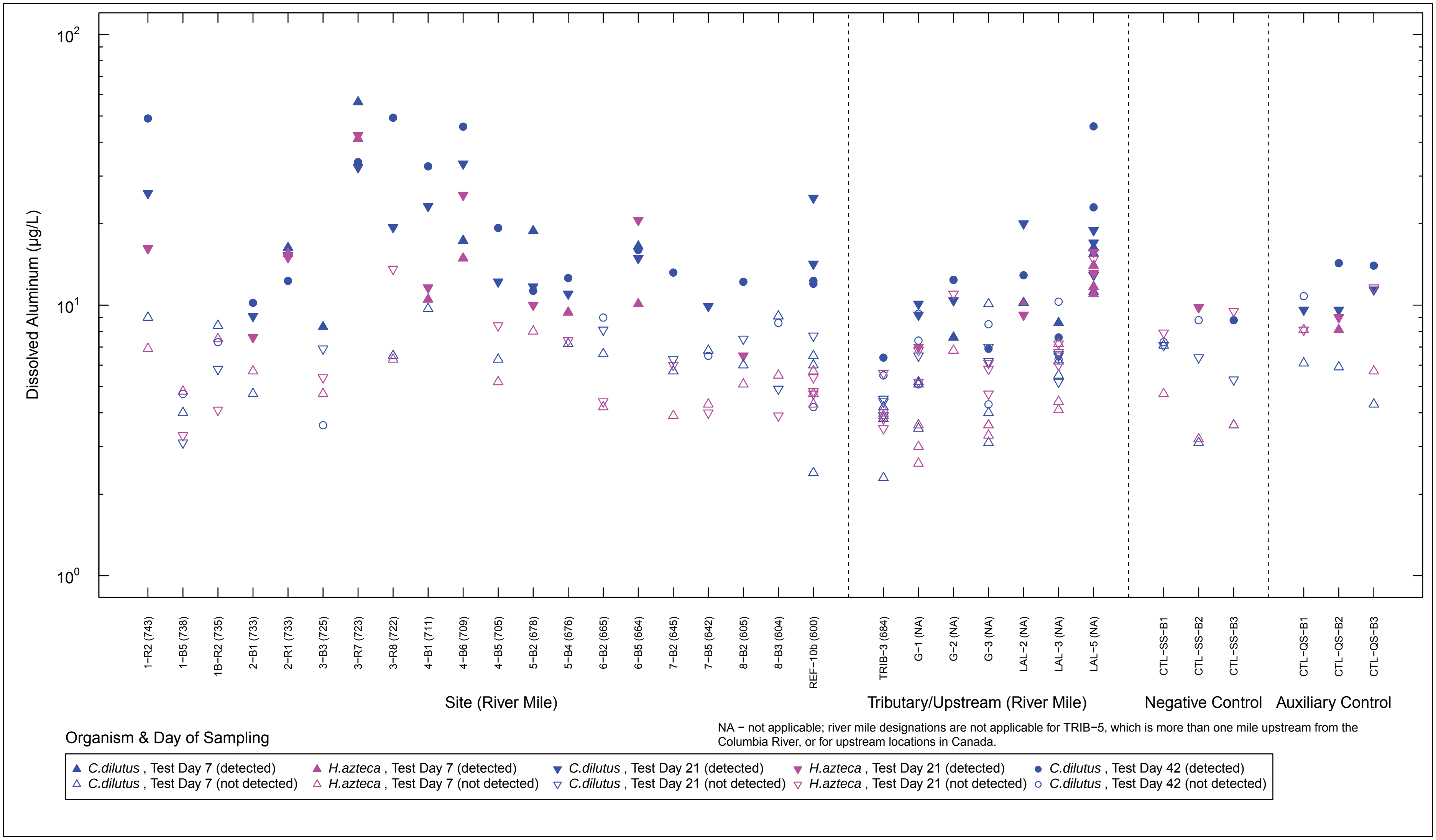


Figure 5−6l. Dissolved Aluminum in Porewater from Long−Term Bioassays

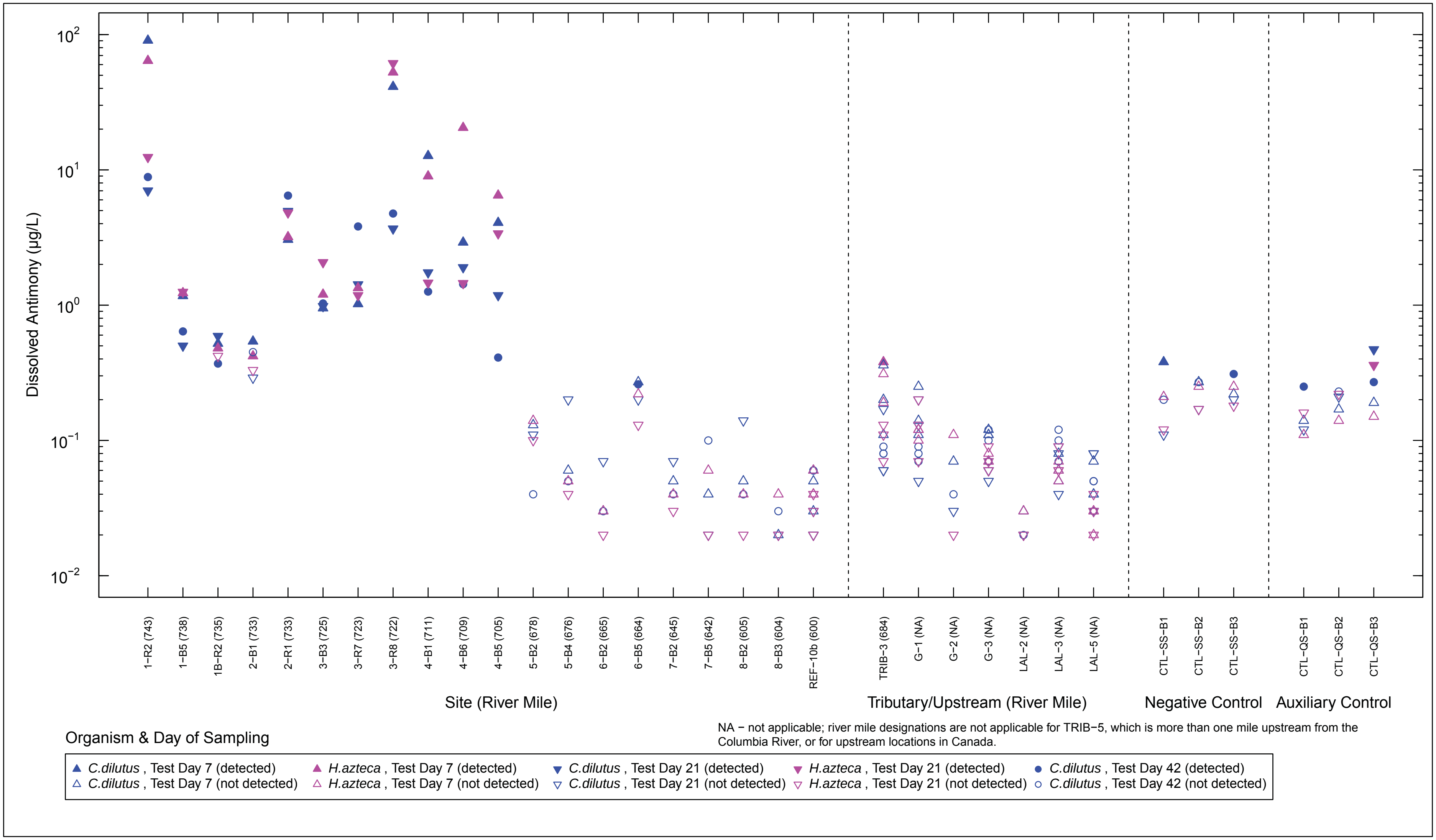


Figure 5−6m. Dissolved Antimony in Porewater from Long−Term Bioassays

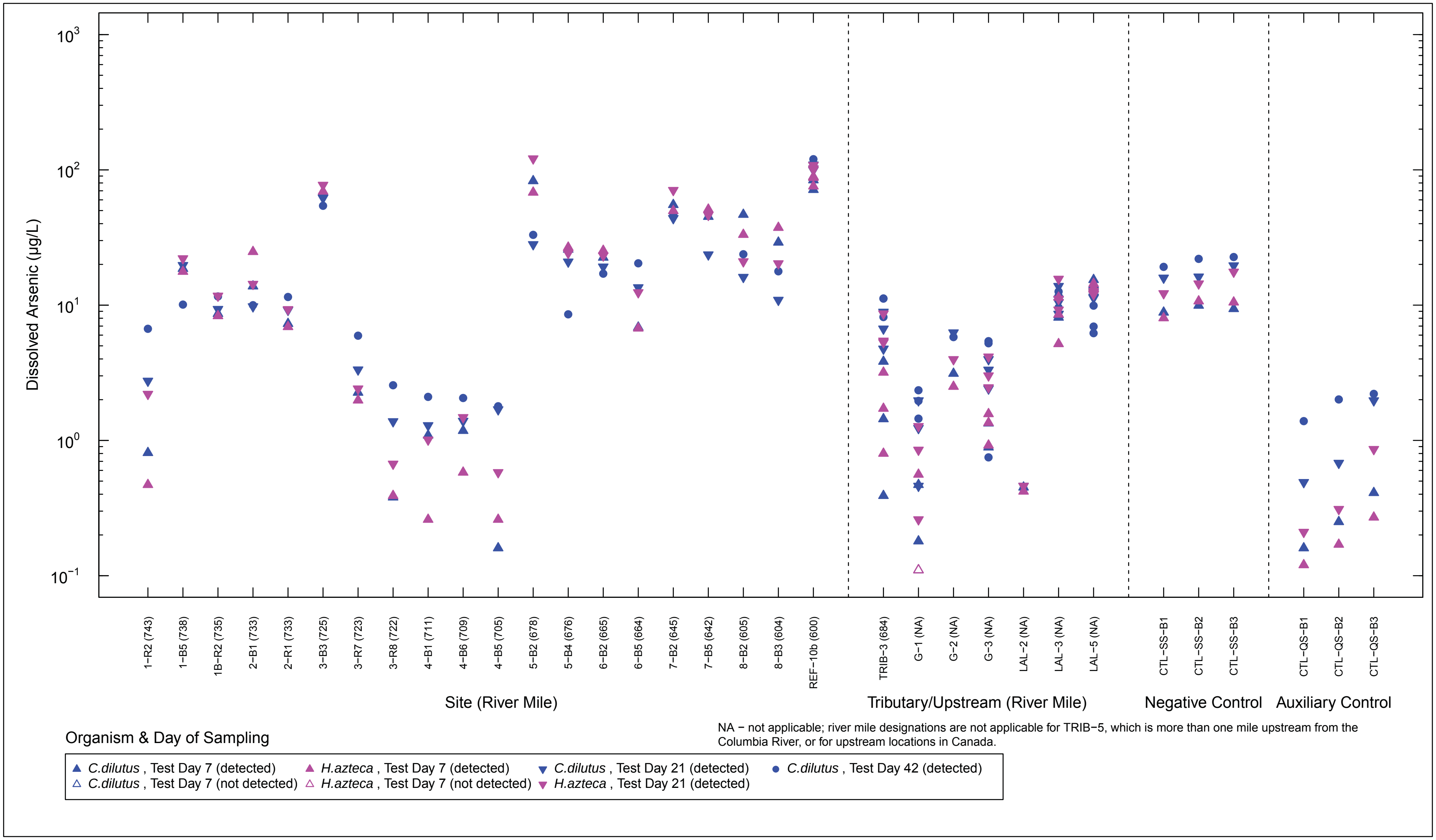


Figure 5−6n. Dissolved Arsenic in Porewater from Long−Term Bioassays

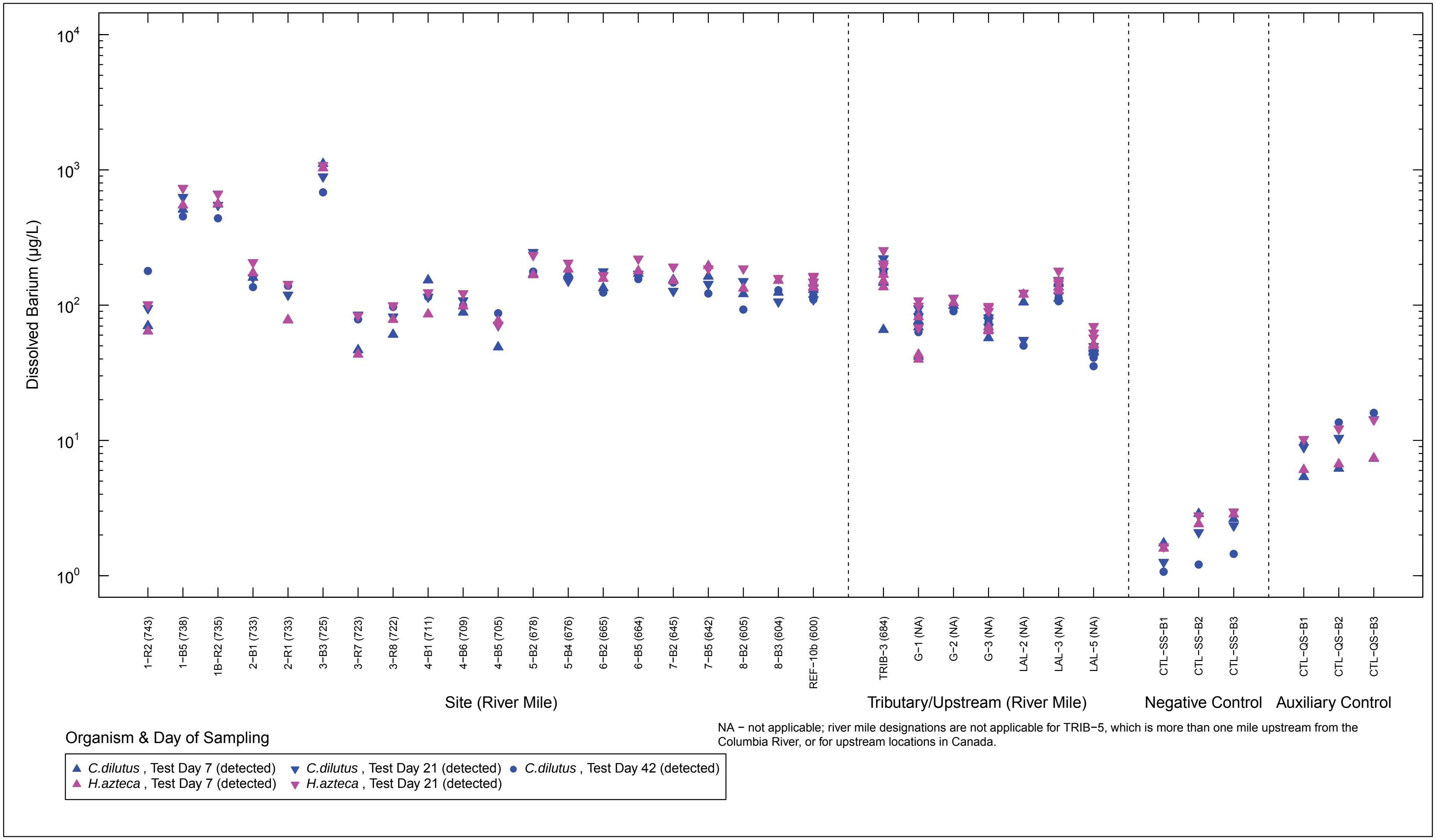


Figure 5−6o. Dissolved Barium in Porewater from Long−Term Bioassays

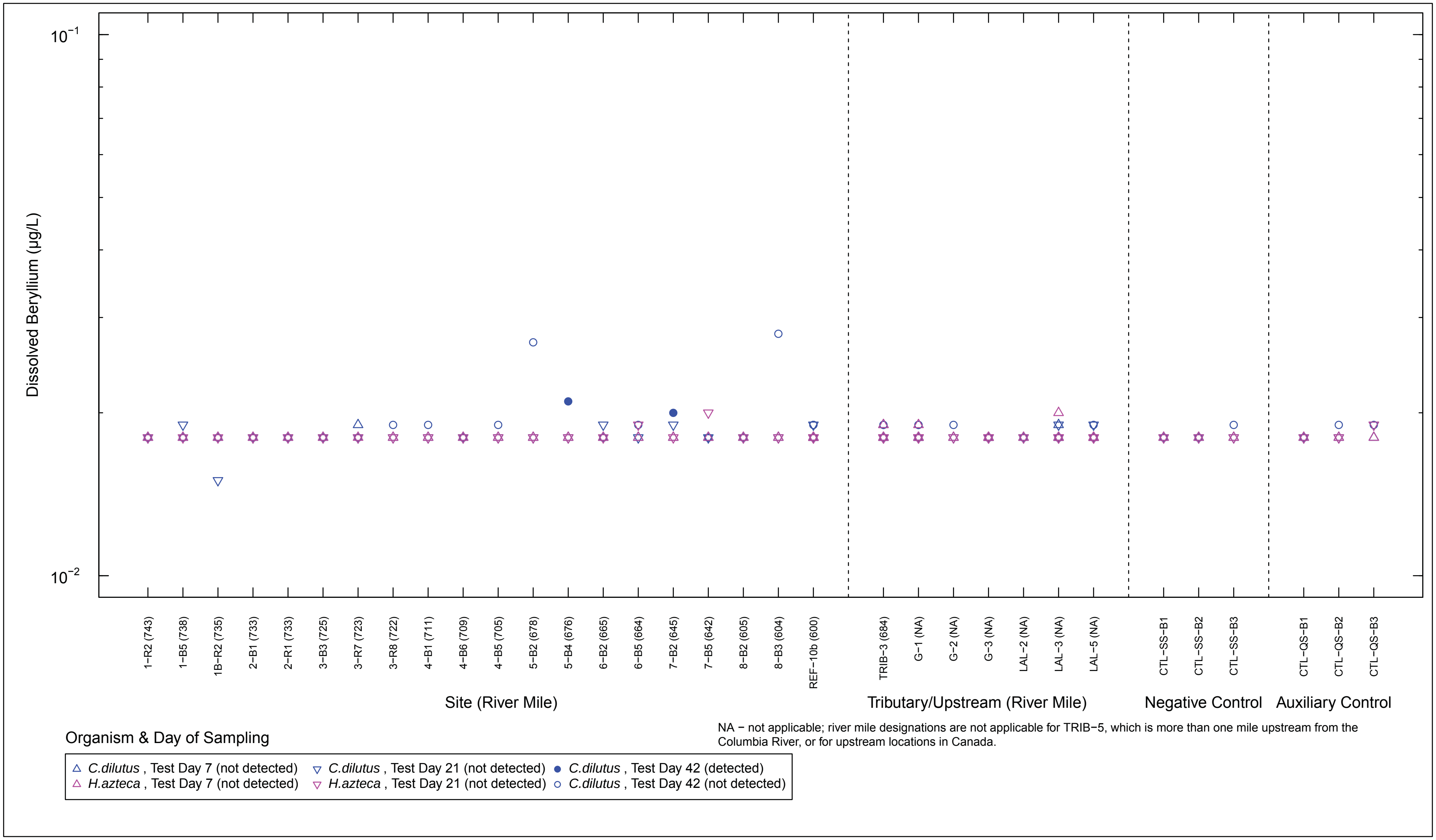


Figure 5−6p. Dissolved Beryllium in Porewater from Long−Term Bioassays

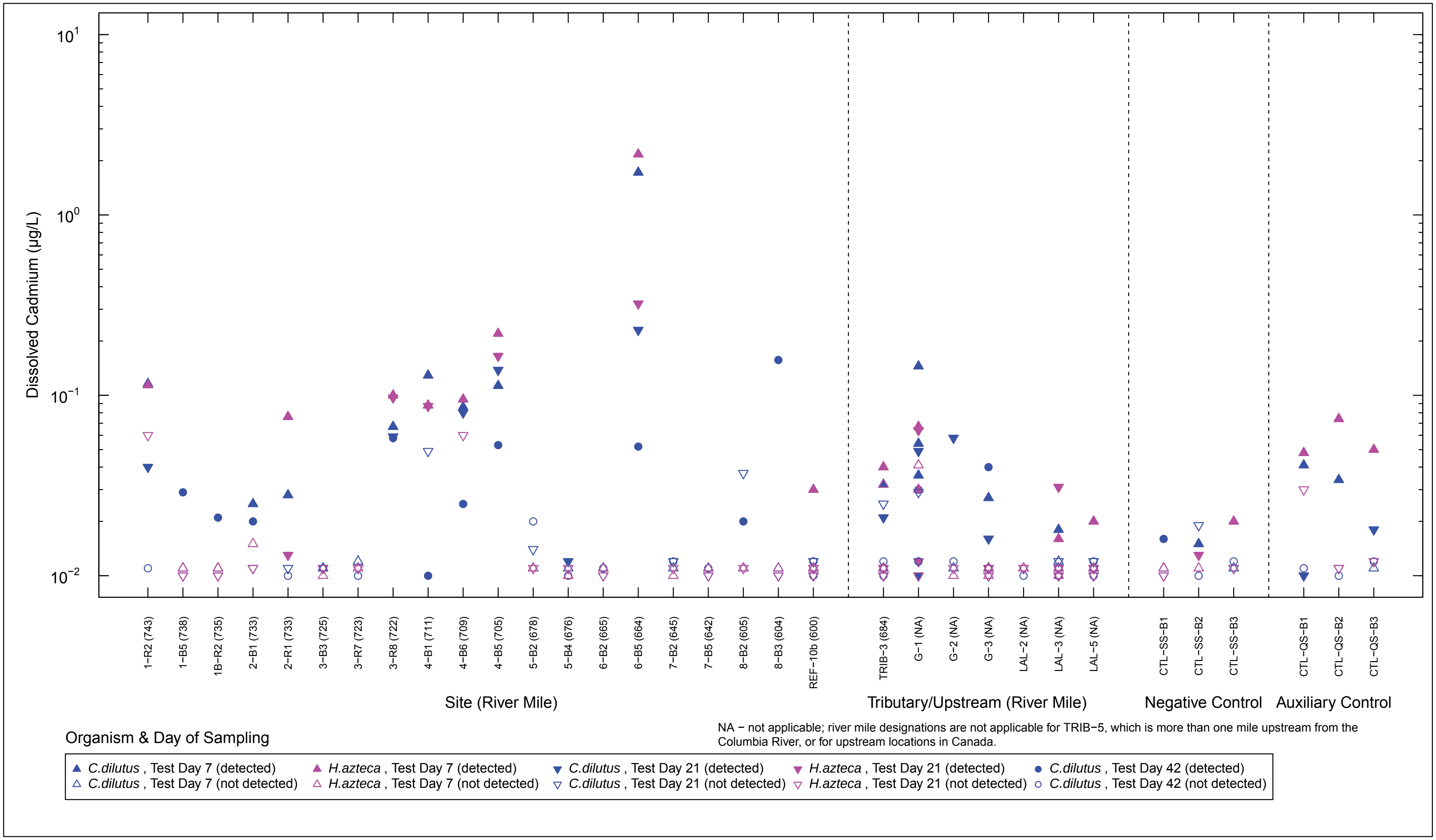


Figure 5−6q. Dissolved Cadmium in Porewater from Long−Term Bioassays

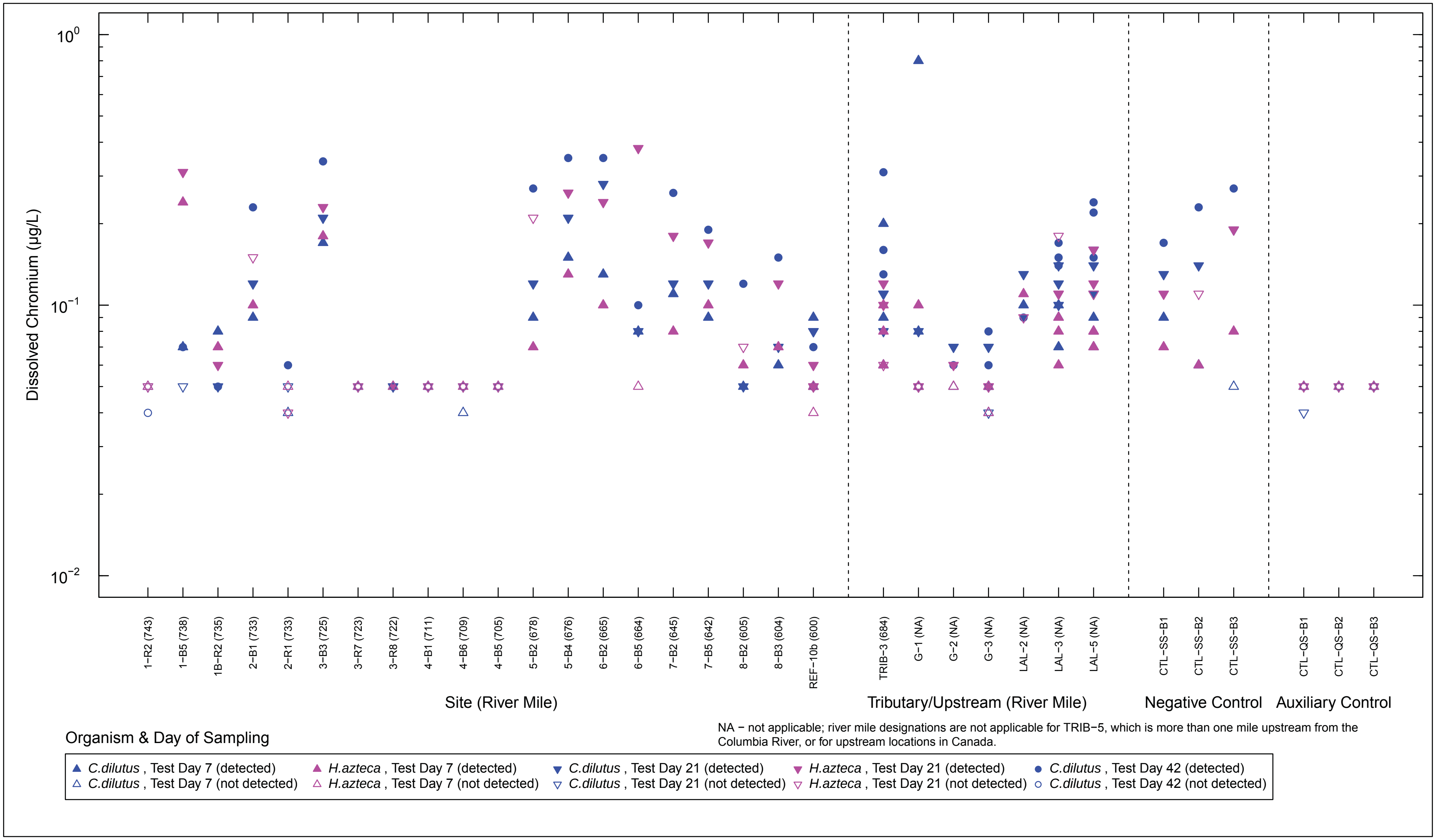


Figure 5−6r. Dissolved Chromium in Porewater from Long−Term Bioassays

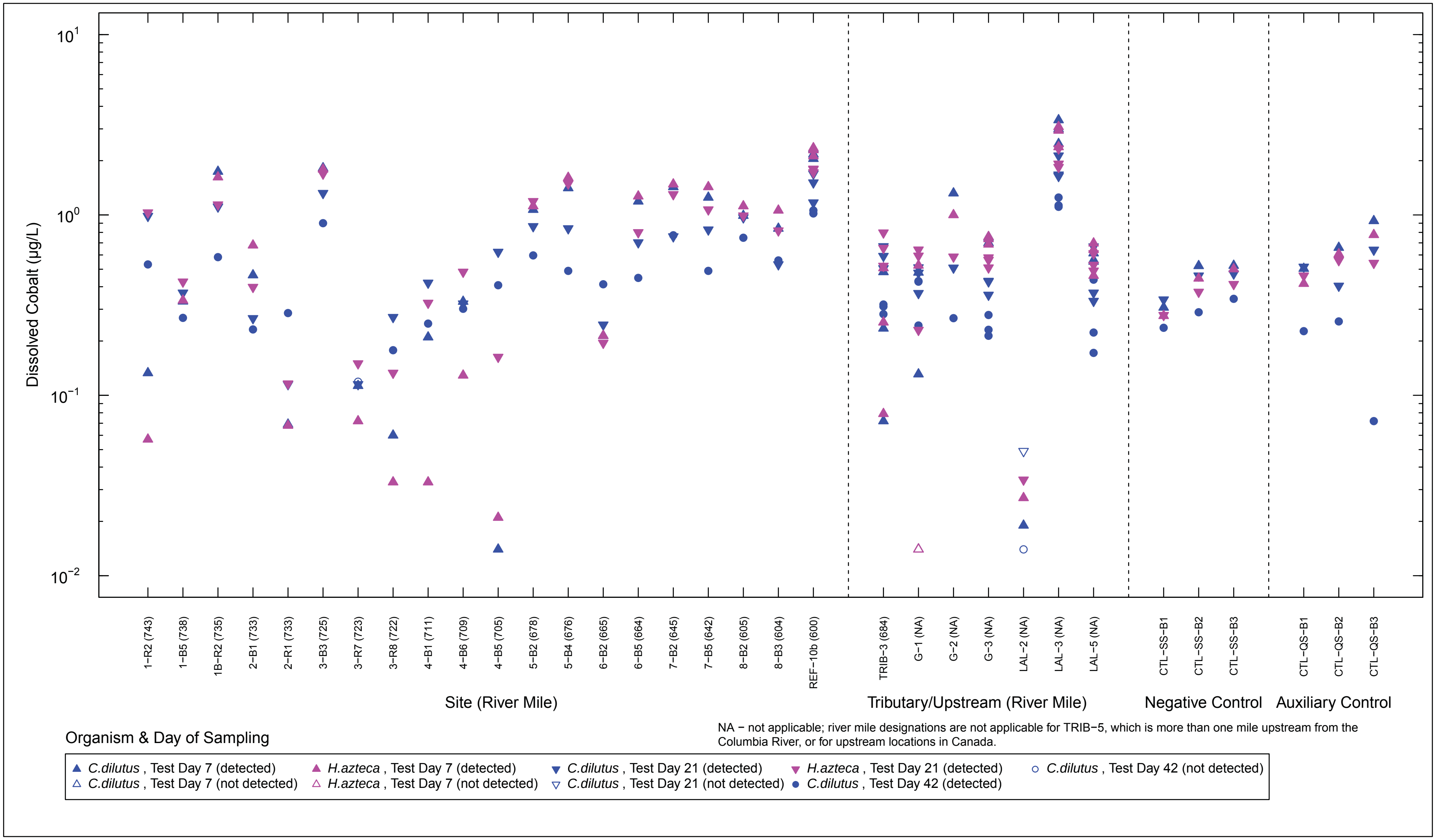


Figure 5−6s. Dissolved Cobalt in Porewater from Long−Term Bioassays

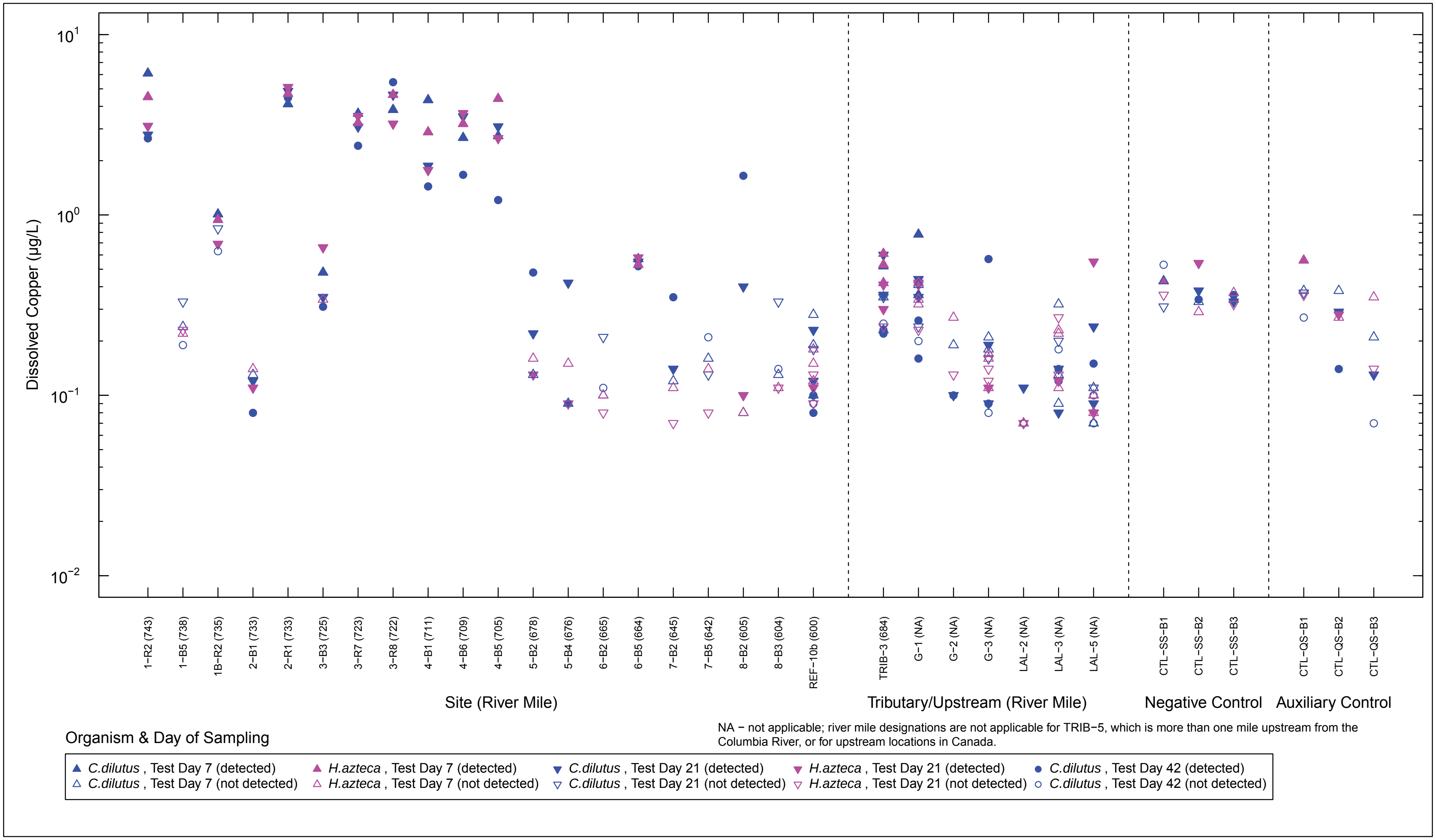


Figure 5−6t. Dissolved Copper in Porewater from Long−Term Bioassays

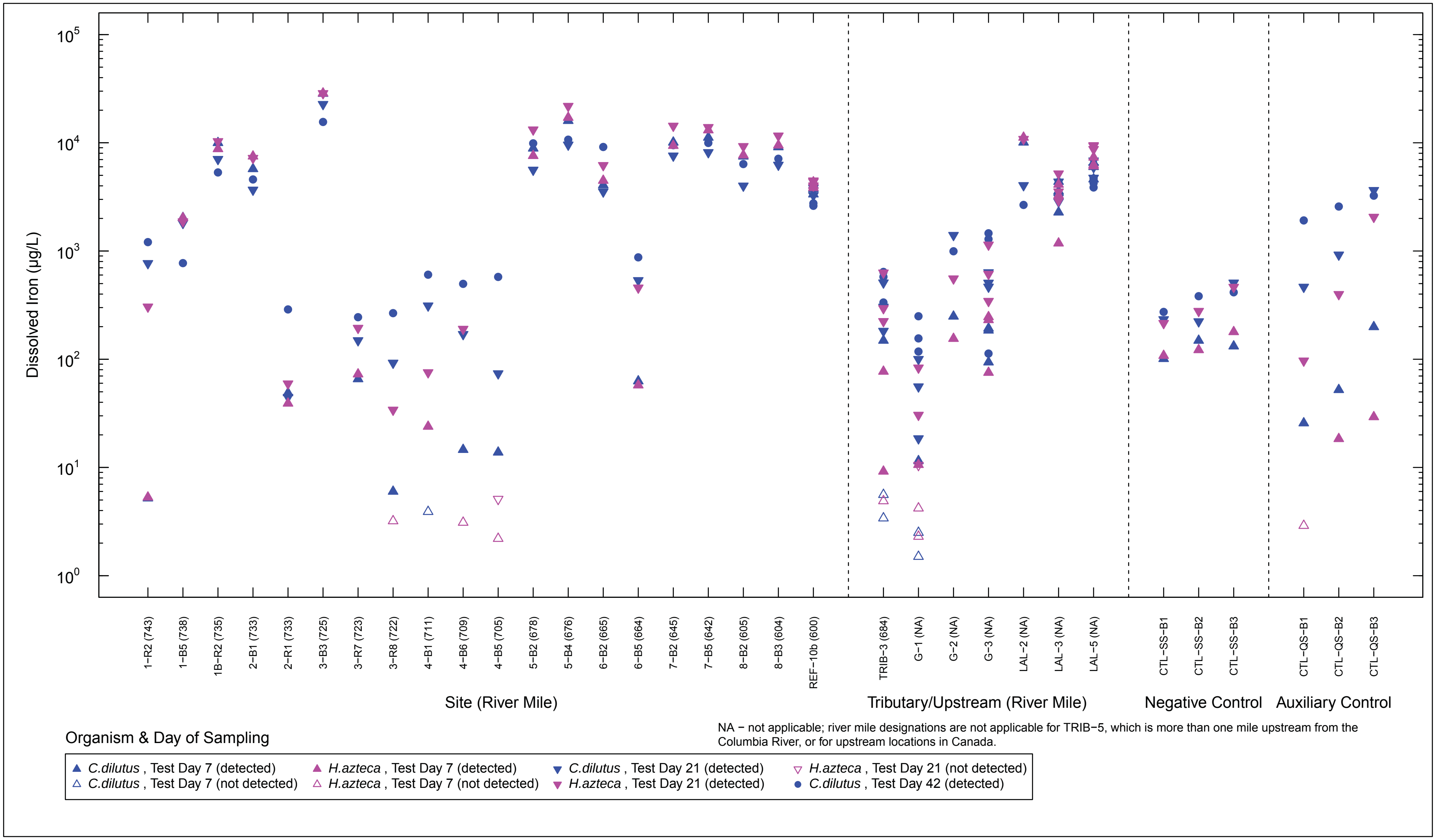


Figure 5−6u. Dissolved Iron in Porewater from Long−Term Bioassays

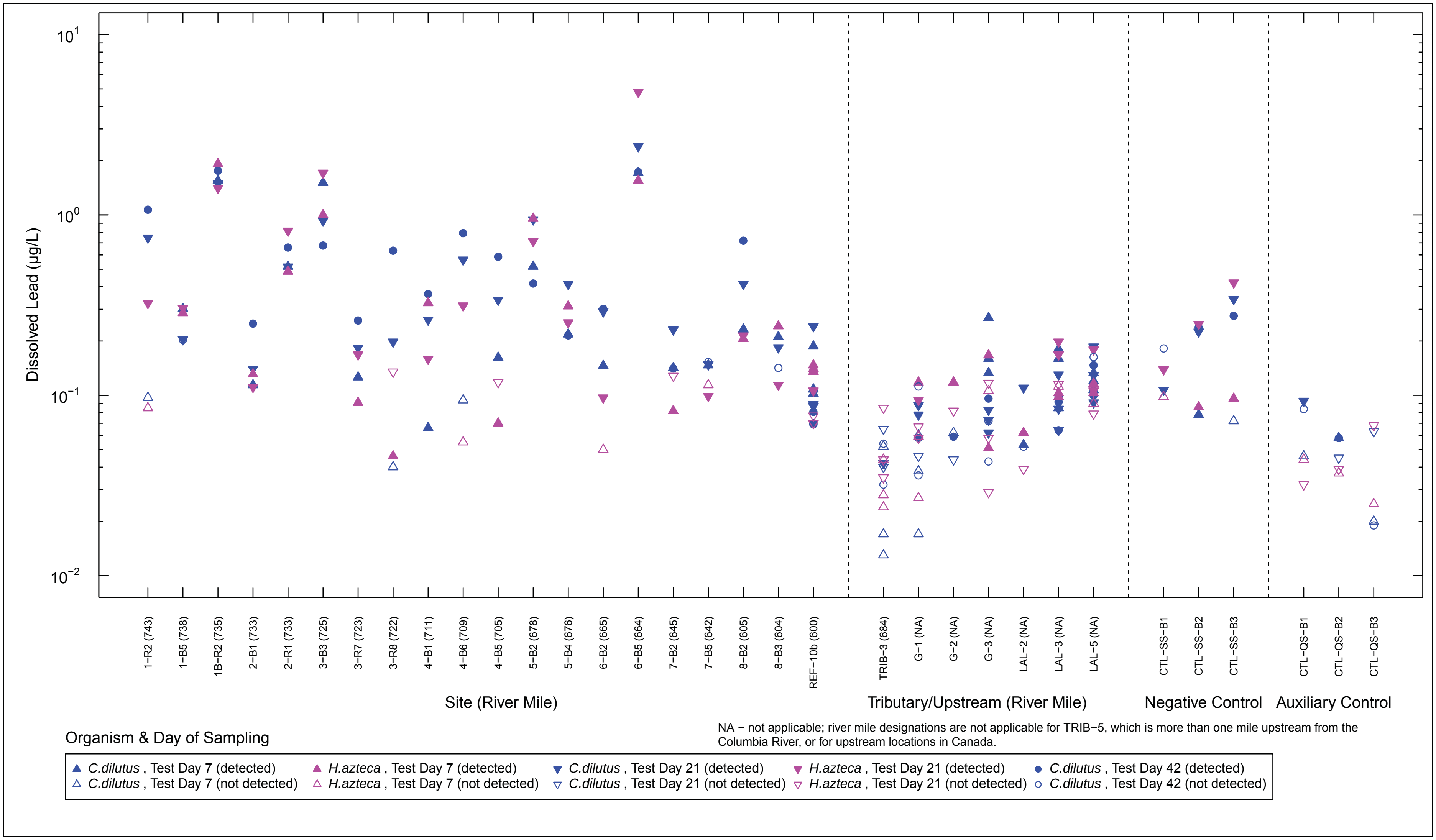


Figure 5−6v. Dissolved Lead in Porewater from Long−Term Bioassays

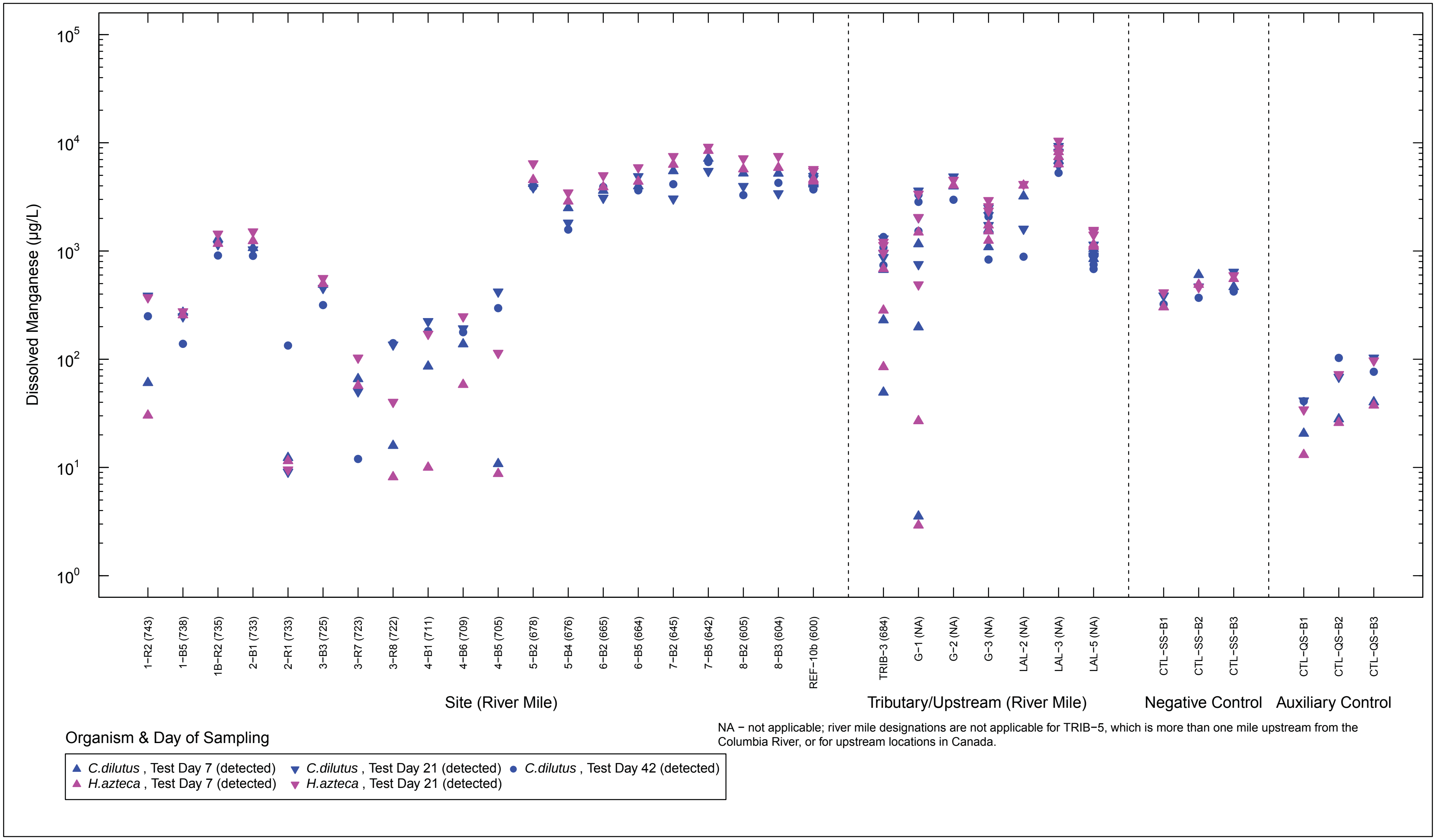


Figure 5−6w. Dissolved Manganese in Porewater from Long−Term Bioassays

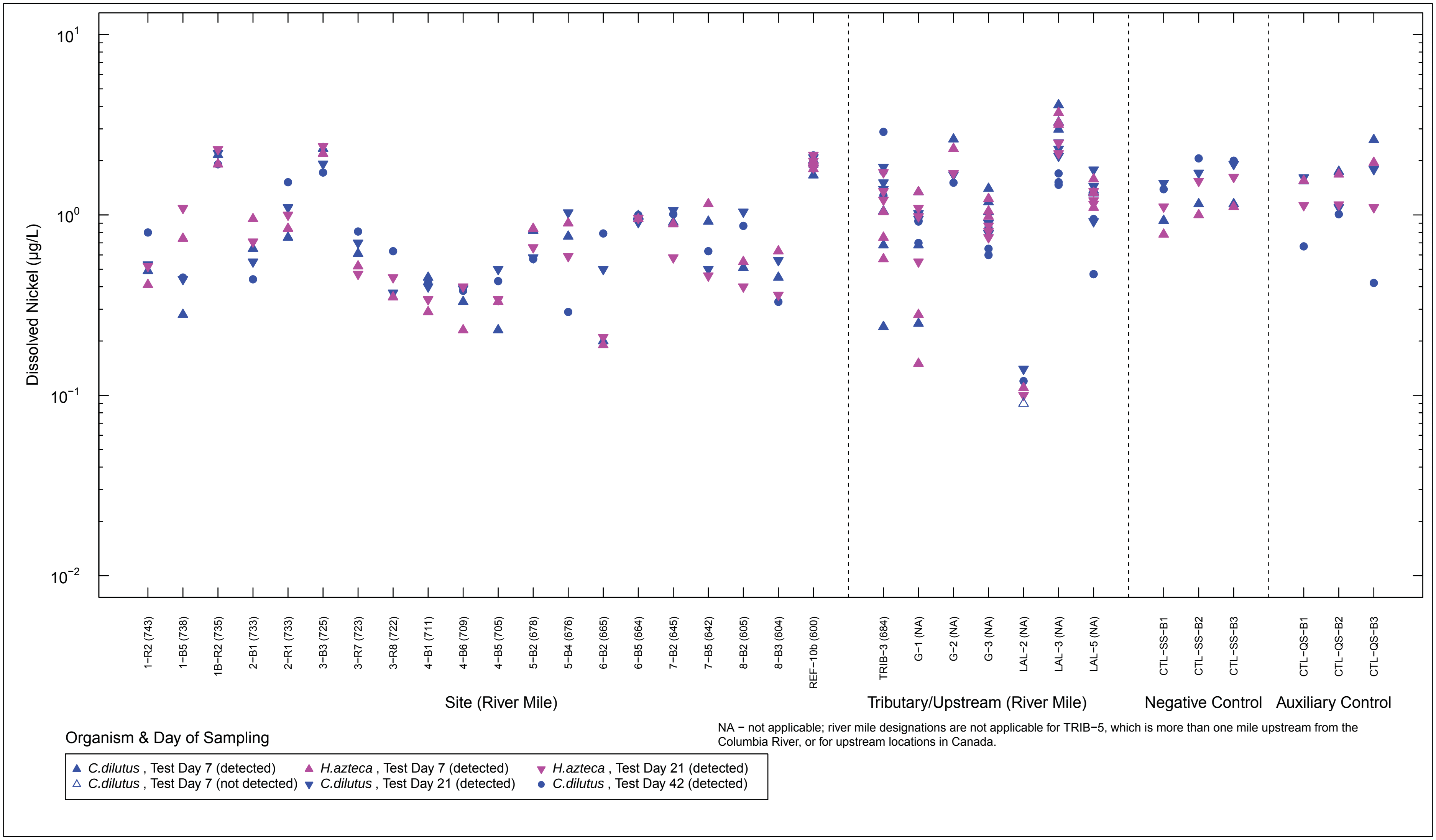


Figure 5−6x. Dissolved Nickel in Porewater from Long−Term Bioassays

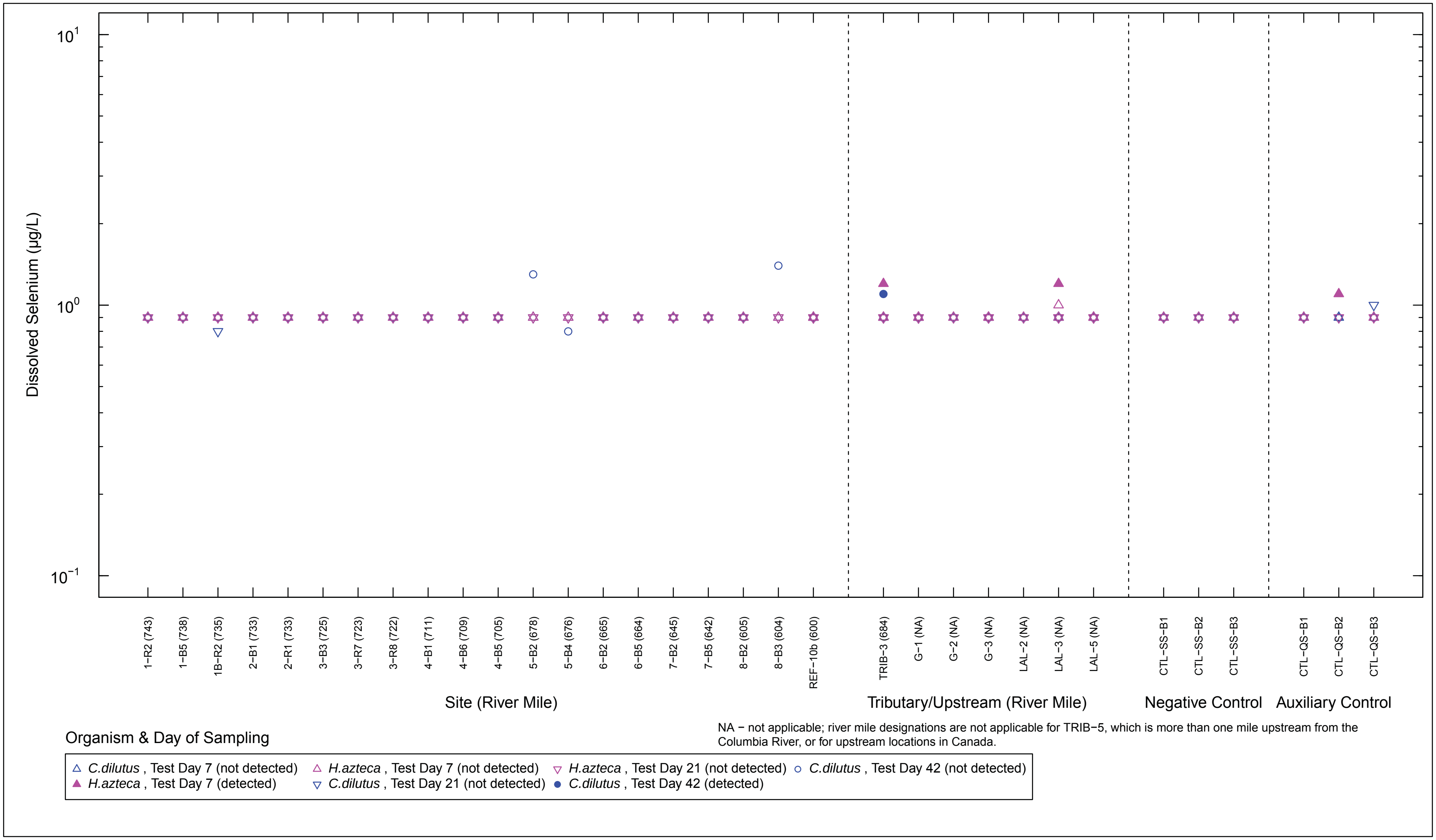


Figure 5−6y. Dissolved Selenium in Porewater from Long−Term Bioassays

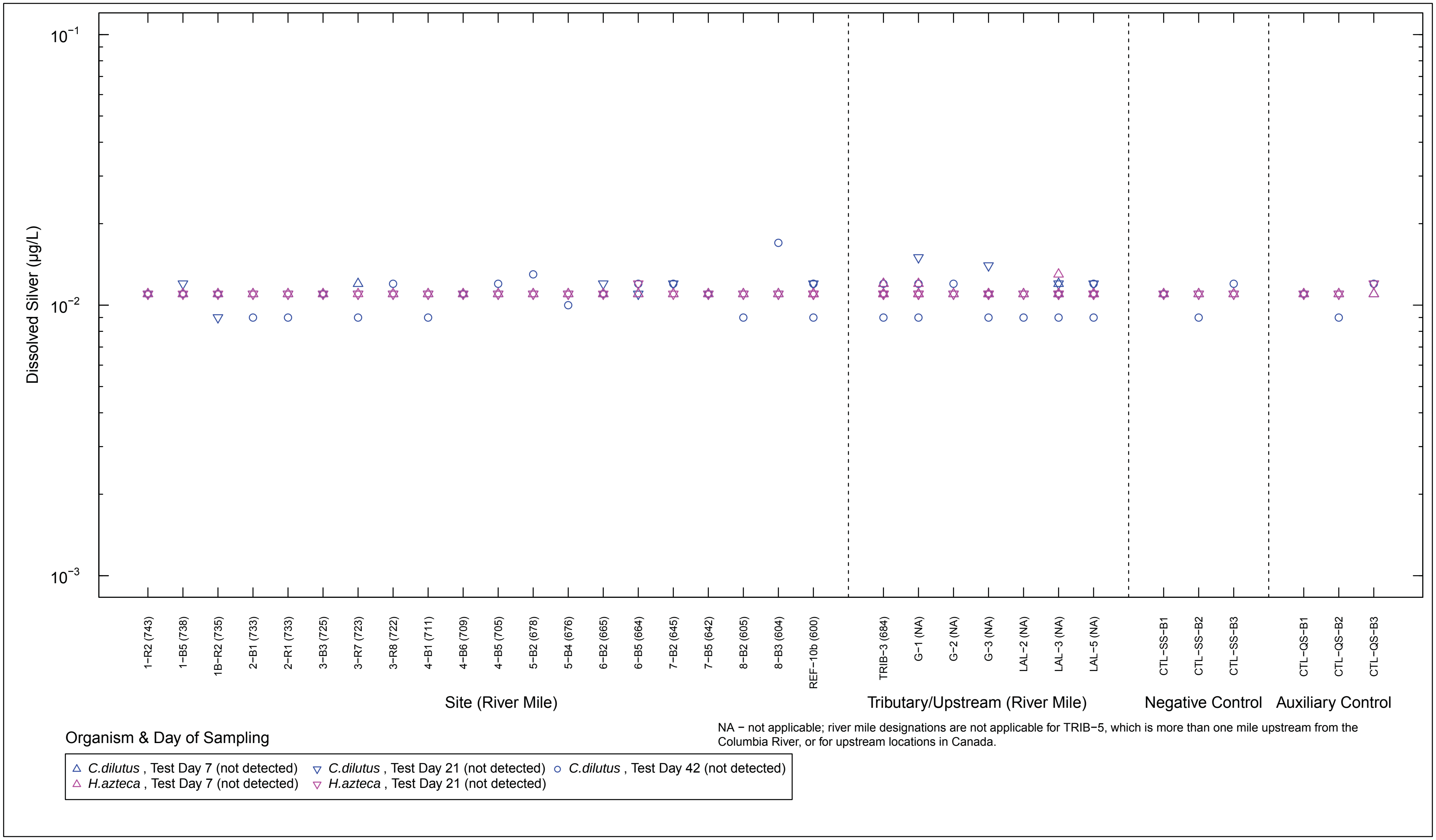


Figure 5−6z. Dissolved Silver in Porewater from Long−Term Bioassays

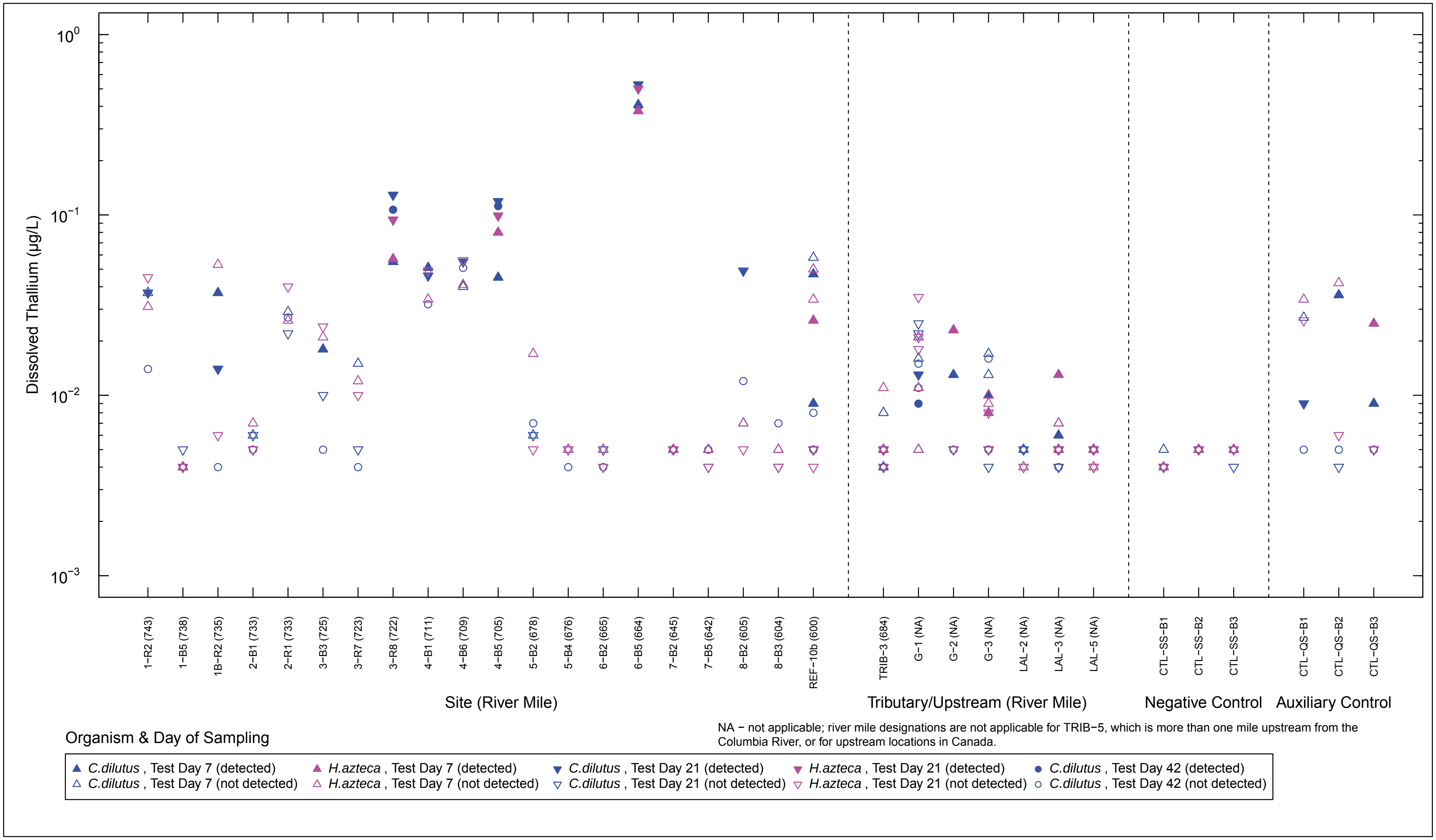


Figure 5−6aa. Dissolved Thallium in Porewater from Long−Term Bioassays

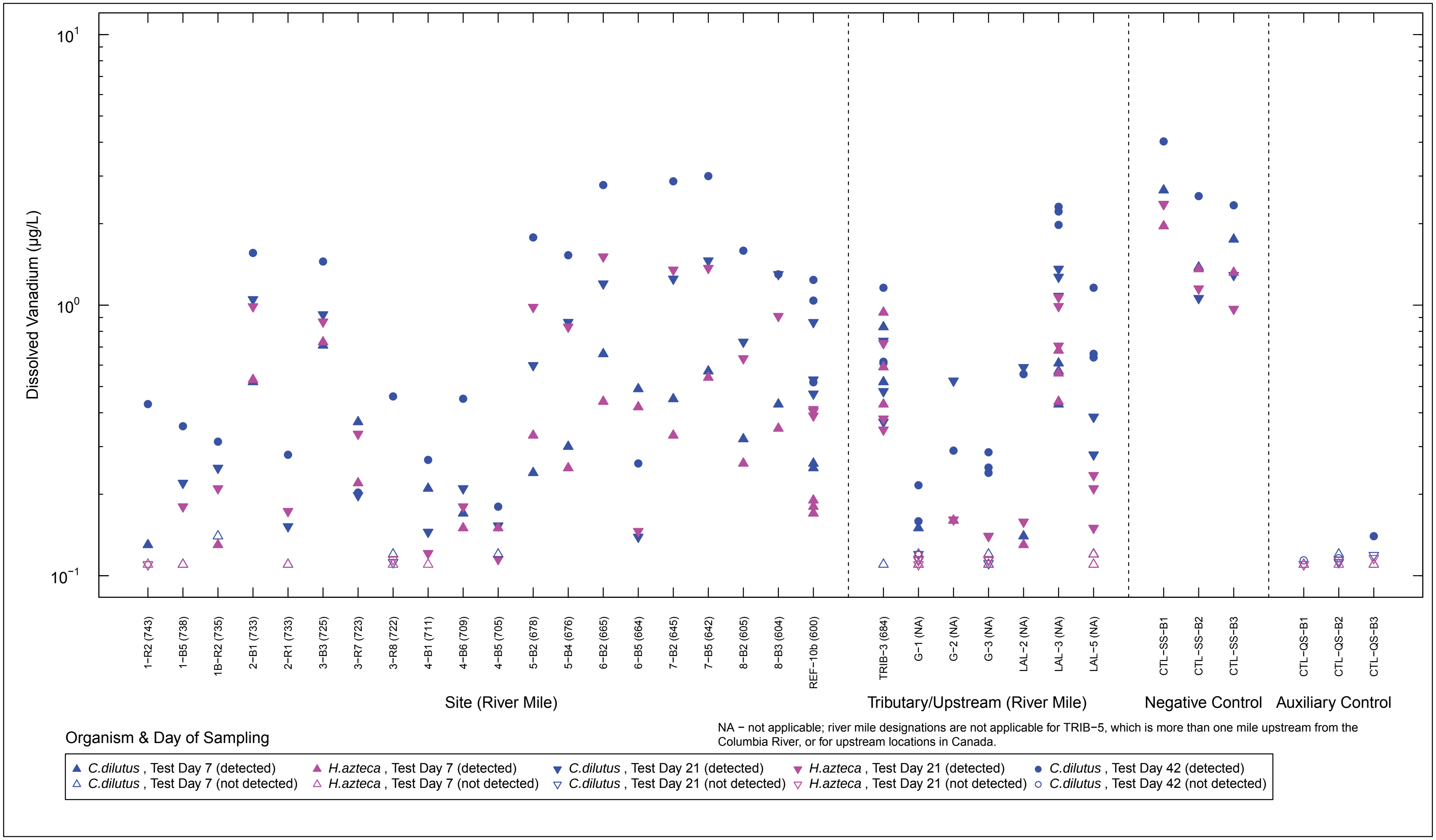


Figure 5−6ab. Dissolved Vanadium in Porewater from Long−Term Bioassays

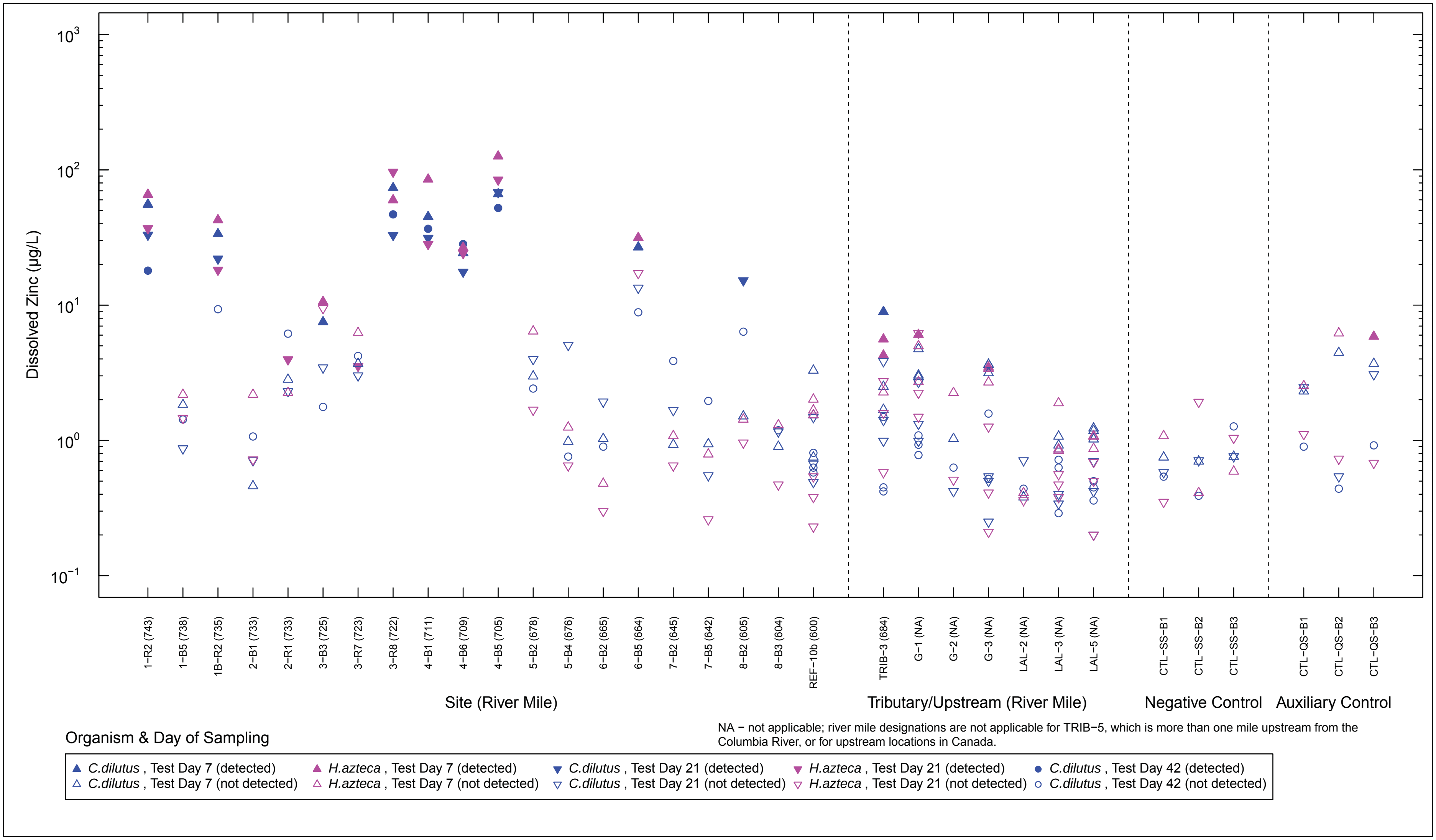


Figure 5−6ac. Dissolved Zinc in Porewater from Long−Term Bioassays

TABLES

These tables are new or revised in this addendum (only new or revised tables are included in this section).

New Summary Tables

2-1 Summary of Revisions to Results Reported as Detected at or above the MDL

2-2 Summary of Revisions to Results Reported as Not Detected (U-flagged Results)

Sediment Tables

5-3a Long-Term Bioassay Sediment Summary Statistics for *Chironomus dilutus* and *Hyalella azteca* at Start of the Test

5-3b Long-Term Bioassay Sediment Summary Statistics for *Chironomus dilutus* on Test Day 21

5-3c Long-Term Bioassay Sediment Summary Statistics for *Hyalella azteca* on Test Day 21

5-3d Long-Term Bioassay Sediment Summary Statistics for *Chironomus dilutus* on Test Day 42

Porewater Tables

5-6a Long-Term Bioassay Porewater Summary Statistics for *Chironomus dilutus* and *Hyalella azteca* at the Start of the Test

5-6b Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Chironomus dilutus* on Test Day 7 (µg/L)

5-6c Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Hyalella azteca* on Test Day 7 (µg/L)

5-6d Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Chironomus dilutus* on Test Day 21 (µg/L)

5-6e Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Hyalella azteca* on Test Day 21 (µg/L)

5-6f Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Chironomus dilutus* on Test Day 42 (µg/L)

Note:
Tables were updated for one or both of the following reasons: 1) Non-detected values (i.e., U-flagged results) previously reported to the method reporting limit (MRL) were updated to report to the method detection limit (MDL); 2) Results previously truncated were modified to report the same number of significant figures reported by the analytical laboratory, with no rounding.

Table 2-1. Summary of Revisions to Results Reported as Detected at or above the MDL

Analyte	Units	Number of Detected Results	Number of Revised Detected Results	Minimum Difference	Mean Difference	Maximum Difference	Minimum Value[a]	Mean Value[a]	Maximum Value[a]
Sediment[b]									
Organic carbon	percent	154	90	0.001	0.00492	0.009	0.043	1.03	17.6
Sulfide (AVS)	µmol/g	126	44	0.001	0.00486	0.009	0.014	3.64	43.2
Antimony	mg/kg	24	6	0.001	0.00517	0.009	0.038	17.2	104
Beryllium	mg/kg	28	22	0.001	0.00541	0.009	0.122	0.594	1.47
Cadmium	mg/kg	28	13	0.002	0.00438	0.008	0.025	2.69	9.87
Cobalt	mg/kg	29	1	0.003	0.003	0.003	0.113	15.8	49.8
Mercury	mg/kg	24	16	0.001	0.00613	0.009	0.005	0.284	1.53
Silver	mg/kg	28	12	0.003	0.0065	0.008	0.013	1.28	5.13
Thallium	mg/kg	20	17	0.001	0.00435	0.009	0.057	0.428	1.09
SEM Antimony	µmol/g	60	35	0.0001	0.00431	0.0099	0.0009	0.0531	0.268
SEM Arsenic	µmol/g	130	89	0.001	0.00469	0.009	0.003	0.025	0.086
SEM Cadmium	µmol/g	150	49	0.00027	0.00495	0.0097	0.00019	0.013	0.09927
SEM Chromium	µmol/g	159	129	0.0001	0.00468	0.0096	0.0003	0.171	1.08
SEM Copper	µmol/g	163	103	0.0003	0.00514	0.0097	0.0011	1.32	13
SEM Lead	µmol/g	162	128	0.0002	0.00522	0.0098	0.0007	0.425	2.36
SEM Nickel	µmol/g	163	150	0.0001	0.00515	0.0099	0.0003	0.0812	0.282
SEM Zinc	µmol/g	158	73	0.0001	0.00518	0.0096	0.0027	23.2	183
Porewater[c]									
Sulfide	mg/L	16	16	0.002	0.00538	0.009	0.015	0.0516	0.136
Beryllium	µg/L	2	1	0.001	0.001	0.001	0.02	0.0205	0.021
Cadmium	µg/L	69	49	0.001	0.00531	0.009	0.01	0.116	2.17
Cobalt	µg/L	219	136	0.001	0.00478	0.009	0.014	0.752	3.36
Lead	µg/L	151	123	0.001	0.00504	0.009	0.042	0.377	4.8
Thallium	µg/L	38	29	0.001	0.00566	0.009	0.006	0.0967	0.528
Vanadium	µg/L	168	49	0.001	0.00488	0.009	0.115	0.729	4.03

Notes:

Data for blanks (i.e., rinsate blanks, centrifuge blanks, and peeper blanks) were not included in calculations.

[a] For detected values in the updated long-term bioassay dataset; included to provide context to the minimum, mean, and maximum differences

[b] Includes revised sediment results for bulk sediment (Test Day [T]1), the 50-day *Chironomus dilutus* life cycle test (T21 and T42), and the chronic 42-day *Hyalella azteca* test (T21)

[c] Includes revised porewater results for centrifuged porewater (T1), the 50-day *Chironomus dilutus* life cycle test (T7, T21, and T42), and the chronic 42-day *Hyalella azteca* test (T7 and T21)

AVS - acid volatile sulfide

MDL - method detection limit

SEM - simultaneously extracted metals

Table 2-2. Summary of Revisions to Results Reported as Nondetected (U-flagged) Results

Analyte	Units	Number of Nondetected Results	Number of Revised Nondetected Results	Minimum Difference	Mean Difference	Maximum Difference	Minimum Value[a]	Mean Value[a]	Maximum Value[a]
Sediment[b]									
Organic carbon	percent	10	10	0.03	0.03	0.03	0.02	0.02	0.02
Sulfide (AVS)	µmol/g	38	38	0.005	0.0186	0.03	0.005	0.00847	0.011
Antimony	mg/kg	5	4	0.003	0.0213	0.071	0.019	0.0366	0.045
Barium	mg/kg	1	1	0.32	0.32	0.32	0.19	0.19	0.19
Beryllium	mg/kg	1	1	0.02	0.02	0.02	0.01	0.01	0.01
Cadmium	mg/kg	1	1	0.017	0.017	0.017	0.013	0.013	0.013
Mercury	mg/kg	5	5	0.008	0.0158	0.018	0.002	0.0022	0.003
Potassium	mg/kg	1	1	19.8	19.8	19.8	5.7	5.7	5.7
Selenium	mg/kg	5	5	0.12	0.148	0.25	0.06	0.08	0.13
Silver	mg/kg	1	1	0.022	0.022	0.022	0.008	0.008	0.008
Thallium	mg/kg	9	8	0.001	0.00438	0.009	0.008	0.0459	0.091
SEM Antimony	µmol/g	104	93	0.0026	0.00656	0.0269	0.0004	0.00325	0.109
SEM Arsenic	µmol/g	34	34	0.003	0.0367	0.144	0.001	0.0177	0.097
SEM Cadmium	µmol/g	14	14	0.00016	0.000524	0.00419	0.00002	0.000107	0.00047
SEM Chromium	µmol/g	5	2	0.0037	0.00375	0.0038	0.0005	0.00084	0.001
SEM Copper	µmol/g	1	1	0.0035	0.0035	0.0035	0.0012	0.0012	0.0012
SEM Lead	µmol/g	2	2	0.0012	0.0012	0.0012	0.0011	0.00115	0.0012
SEM Nickel	µmol/g	1	1	0.0017	0.0017	0.0017	0.0007	0.0007	0.0007
Porewater[c]									
Sulfide	mg/L	8	8	0.008	0.008	0.008	0.012	0.012	0.012
Antimony	µg/L	166	16	0.09	0.0969	0.14	0.02	0.1	0.45
Arsenic	µg/L	3	3	1.03	1.03	1.03	0.11	0.11	0.11
Beryllium	µg/L	223	222	0.015	0.022	0.033	0.015	0.0182	0.028
Cadmium	µg/L	156	152	0.001	0.0323	0.079	0.01	0.0127	0.06
Chromium	µg/L	87	79	0.4	0.408	0.43	0.04	0.0556	0.21
Cobalt	µg/L	6	6	0.009	0.0203	0.026	0.014	0.0373	0.119
Copper	µg/L	113	7	0.15	0.161	0.17	0.07	0.202	0.84
Lead	µg/L	74	67	0.001	0.00519	0.009	0.013	0.069	0.203
Nickel	µg/L	1	1	0.37	0.37	0.37	0.09	0.09	0.09
Selenium	µg/L	221	221	1.1	1.4	2.1	0.8	0.904	1.4
Silver	µg/L	225	225	0.004	0.0289	0.047	0.009	0.0111	0.017
Thallium	µg/L	187	166	0.001	0.0276	0.053	0.004	0.0107	0.058
Vanadium	µg/L	57	56	0.328	0.342	0.351	0.11	0.114	0.14
Zinc	µg/L	183	3	0.92	0.927	0.94	0.2	1.81	17.2

Notes:

Data for blanks (i.e., rinsate blanks, centrifuge blanks, and peeper blanks) were not included in calculations.

[a] For nondetected values in the updated long-term bioassay dataset; included to provide context to the minimum, mean, and maximum differences

[b] Includes revised sediment results for bulk sediment (Test Day [T]1), the 50-day *Chironomus dilutus* life cycle test (T21 and T42), and the chronic 42-day *Hyalella azteca* test (T21)

[c] Includes revised porewater results for centrifuged porewater (T1), the 50-day *Chironomus dilutus* life cycle test (T7, T21, and T42), and the chronic 42-day *Hyalella azteca* test (T7 and T21)

AVS - acid volatile sulfide

SEM - simultaneously extracted metals

Table 5-3a. Long-Term Bioassay Sediment Summary Statistics for Chironomus dilutus and Hyalella azteca at Start of the Test

Analyte	Number of Samples	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[a]	Mean Nondetected Value[a]	Maximum Nondetected Value[a]	Overall Minimum Value[a]	Overall Mean Value[a]	Overall Maximum Value[a]
Site Samples											
Conventional Parameters											
Organic carbon (%)	20	20	0.048	0.817	2.24	--	--	--	0.048	0.817	2.24
pH	20	20	6.46	7.45	9.13	--	--	--	6.46	7.45	9.13
Solids (%)	20	20	22.8	57.9	84.7	--	--	--	22.8	57.9	84.7
Sulfide (AVS; µmol/g)	20	20	0.042	4.47	17	--	--	--	0.042	4.47	17
Grain size (%)											
Clay	20	20	0	14.9	62.62	--	--	--	0	14.9	62.62
Silt	20	20	0.03	28.7	73.91	--	--	--	0.03	28.7	73.91
Very fine sand	20	20	0.04	4.16	19.92	--	--	--	0.04	4.16	19.92
Fine sand	20	20	0.17	14.5	61.57	--	--	--	0.17	14.5	61.57
Medium sand	20	20	0.23	10.8	42.54	--	--	--	0.23	10.8	42.54
Coarse sand	20	20	0	22.8	74.72	--	--	--	0	22.8	74.72
Very coarse sand	20	20	0	3.8	20.22	--	--	--	0	3.8	20.22
Fine gravel	20	20	0	1.01	9.84	--	--	--	0	1.01	9.84
Medium gravel	20	20	0	0.112	2.24	--	--	--	0	0.112	2.24
Metals/Metalloids (mg/kg)											
Aluminum	20	20	5220	15500	26000	--	--	--	5220	15500	26000
Antimony	20	20	0.232	20.6	104	--	--	--	0.232	20.6	104
Arsenic	20	20	2.93	14.4	31	--	--	--	2.93	14.4	31
Barium	20	20	63.7	647	2320	--	--	--	63.7	647	2320
Beryllium	20	20	0.266	0.712	1.47	--	--	--	0.266	0.712	1.47
Cadmium	20	20	0.303	3.65	9.87	--	--	--	0.303	3.65	9.87
Calcium	20	20	4570	24700	68900	--	--	--	4570	24700	68900
Chromium	20	20	13	55.4	136	--	--	--	13	55.4	136
Cobalt	20	20	4.32	20.8	49.8	--	--	--	4.32	20.8	49.8
Copper	20	20	10.8	682	3140	--	--	--	10.8	682	3140
Iron	20	20	12100	79300	248000	--	--	--	12100	79300	248000
Lead	20	20	10.4	290	616	--	--	--	10.4	290	616
Magnesium	20	20	4620	9080	17300	--	--	--	4620	9080	17300
Manganese	20	20	168	1680	4610	--	--	--	168	1680	4610
Mercury	20	20	0.006	0.338	1.53	--	--	--	0.006	0.338	1.53
Nickel	20	20	9.57	21.8	41.1	--	--	--	9.57	21.8	41.1
Potassium	20	20	877	2620	4510	--	--	--	877	2620	4510
Selenium	20	20	0.09	1.16	2.25	--	--	--	0.09	1.16	2.25
Silver	20	20	0.057	1.77	5.13	--	--	--	0.057	1.77	5.13

Table 5-3a. Long-Term Bioassay Sediment Summary Statistics for Chironomus dilutus and Hyalella azteca at Start of the Test

Analyte	Number of Samples	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[a]	Mean Nondetected Value[a]	Maximum Nondetected Value[a]	Overall Minimum Value[a]	Overall Mean Value[a]	Overall Maximum Value[a]
Site Samples (continued)											
Metals/Metalloids (mg/kg)											
Sodium	20	20	83.1	696	2450	--	--	--	83.1	696	2450
Thallium	20	19	0.057	0.435	1.09	0.0335	0.0335	0.0335	0.0335	0.415	1.09
Vanadium	20	20	18.6	40.1	57.3	--	--	--	18.6	40.1	57.3
Zinc	20	20	61.5	5690	21000	--	--	--	61.5	5690	21000
SEM (µmol/g)											
Antimony	20	14	0.0024	0.0494	0.259	0.00055	0.00211	0.0044	0.00055	0.0352	0.259
Arsenic	20	17	0.004	0.0365	0.085	0.0055	0.0135	0.027	0.004	0.0331	0.085
Cadmium	20	20	0.00078	0.0221	0.09338	--	--	--	0.00078	0.0221	0.09338
Chromium	20	20	0.0301	0.261	0.971	--	--	--	0.0301	0.261	0.971
Copper	20	20	0.0515	2.09	11.9	--	--	--	0.0515	2.09	11.9
Lead	20	20	0.0291	0.776	2.36	--	--	--	0.0291	0.776	2.36
Nickel	20	20	0.0281	0.113	0.281	--	--	--	0.0281	0.113	0.281
Zinc	20	20	0.368	38.2	168	--	--	--	0.368	38.2	168
Tributary and Upstream Samples											
Conventional Parameters											
Organic carbon (%)	7	7	0.062	2.25	12.8	--	--	--	0.062	2.25	12.8
pH	7	7	6.15	7.18	8.23	--	--	--	6.15	7.18	8.23
Solids (%)	7	7	28.6	67.1	82.7	--	--	--	28.6	67.1	82.7
Sulfide (AVS; µmol/g)	7	2	0.348	6.47	12.6	0.0025	0.0037	0.005	0.0025	1.85	12.6
Grain size (%)											
Clay	7	7	0	2.12	12.35	--	--	--	0	2.12	12.35
Silt	7	7	0	6.23	25.83	--	--	--	0	6.23	25.83
Very fine sand	7	7	0.15	5.38	22.06	--	--	--	0.15	5.38	22.06
Fine sand	7	7	1.25	16.4	44.62	--	--	--	1.25	16.4	44.62
Medium sand	7	7	1.86	16.5	58.56	--	--	--	1.86	16.5	58.56
Coarse sand	7	7	0.9	23.2	49.52	--	--	--	0.9	23.2	49.52
Very coarse sand	7	7	0.45	20.7	50.41	--	--	--	0.45	20.7	50.41
Fine gravel	7	7	0	8.69	27.52	--	--	--	0	8.69	27.52
Medium gravel	7	7	0	0.921	4.56	--	--	--	0	0.921	4.56
Aluminum	7	7	2480	4850	12000	--	--	--	2480	4850	12000
Antimony	7	4	0.038	0.233	0.313	0.018	0.0202	0.0225	0.018	0.142	0.313
Arsenic	7	7	0.81	2.88	8.14	--	--	--	0.81	2.88	8.14
Barium	7	7	21.5	66.4	139	--	--	--	21.5	66.4	139
Beryllium	7	7	0.125	0.324	0.822	--	--	--	0.125	0.324	0.822

Table 5-3a. Long-Term Bioassay Sediment Summary Statistics for Chironomus dilutus and Hyalella azteca at Start of the Test

Analyte	Number of Samples	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[a]	Mean Nondetected Value[a]	Maximum Nondetected Value[a]	Overall Minimum Value[a]	Overall Mean Value[a]	Overall Maximum Value[a]
Tributary and Upstream Samples (continued)											
Metals/Metalloids (mg/kg)											
Cadmium	7	7	0.083	0.306	0.752	--	--	--	0.083	0.306	0.752
Calcium	7	7	1430	9740	50100	--	--	--	1430	9740	50100
Chromium	7	7	6.11	17.1	43.7	--	--	--	6.11	17.1	43.7
Cobalt	7	7	1.87	5.2	15.2	--	--	--	1.87	5.2	15.2
Copper	7	7	3.56	9.97	27.4	--	--	--	3.56	9.97	27.4
Iron	7	7	5120	11000	20800	--	--	--	5120	11000	20800
Lead	7	7	3.52	11.5	36.6	--	--	--	3.52	11.5	36.6
Magnesium	7	7	1680	3170	7180	--	--	--	1680	3170	7180
Manganese	7	7	115	241	528	--	--	--	115	241	528
Mercury	7	3	0.005	0.017	0.027	0.001	0.00113	0.0015	0.001	0.00793	0.027
Nickel	7	7	4.98	14.9	48.2	--	--	--	4.98	14.9	48.2
Potassium	7	7	388	892	2870	--	--	--	388	892	2870
Selenium	7	4	0.09	0.353	0.48	0.03	0.0333	0.035	0.03	0.216	0.48
Silver	7	7	0.025	0.0581	0.098	--	--	--	0.025	0.0581	0.098
Sodium	7	7	36.9	76.8	190	--	--	--	36.9	76.8	190
Thallium	7	1	0.303	0.303	0.303	0.017	0.0258	0.0455	0.017	0.0654	0.303
Vanadium	7	7	10.2	19.3	34	--	--	--	10.2	19.3	34
Zinc	7	7	21	39.8	77	--	--	--	21	39.8	77
SEM (µmol/g)											
Antimony	7	0	--	--	--	0.00035	0.000664	0.0011	0.00035	0.000664	0.0011
Arsenic	7	7	0.004	0.00729	0.012	--	--	--	0.004	0.00729	0.012
Cadmium	7	7	0.00033	0.00169	0.00357	--	--	--	0.00033	0.00169	0.00357
Chromium	7	7	0.0068	0.0304	0.0969	--	--	--	0.0068	0.0304	0.0969
Copper	7	7	0.0167	0.0403	0.129	--	--	--	0.0167	0.0403	0.129
Lead	7	7	0.0119	0.0313	0.0961	--	--	--	0.0119	0.0313	0.0961
Nickel	7	7	0.0141	0.0426	0.147	--	--	--	0.0141	0.0426	0.147
Zinc	7	7	0.0477	0.16	0.382	--	--	--	0.0477	0.16	0.382
Negative Control Samples (CTL-SS)											
Conventional Parameters											
Organic carbon (%)	1	1	0.086	0.086	0.086	--	--	--	0.086	0.086	0.086
pH	1	1	8.47	8.47	8.47	--	--	--	8.47	8.47	8.47
Solids (%)	1	1	79.6	79.6	79.6	--	--	--	79.6	79.6	79.6
Sulfide (AVS; µmol/g)	1	0	--	--	--	0.0035	0.0035	0.0035	0.0035	0.0035	0.0035

Table 5-3a. Long-Term Bioassay Sediment Summary Statistics for Chironomus dilutus and Hyalella azteca at Start of the Test

Analyte	Number of Samples	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[a]	Mean Nondetected Value[a]	Maximum Nondetected Value[a]	Overall Minimum Value[a]	Overall Mean Value[a]	Overall Maximum Value[a]
Negative Control Samples (CTL-SS) (continued)											
Grain size (%)											
Clay	1	1	0.79	0.79	0.79	--	--	--	0.79	0.79	0.79
Silt	1	1	3.37	3.37	3.37	--	--	--	3.37	3.37	3.37
Very fine sand	1	1	0.14	0.14	0.14	--	--	--	0.14	0.14	0.14
Fine sand	1	1	19.93	19.9	19.93	--	--	--	19.93	19.9	19.93
Medium sand	1	1	48.3	48.3	48.3	--	--	--	48.3	48.3	48.3
Coarse sand	1	1	25.32	25.3	25.32	--	--	--	25.32	25.3	25.32
Very coarse sand	1	1	0.7	0.7	0.7	--	--	--	0.7	0.7	0.7
Fine gravel	1	1	0	0	0	--	--	--	0	0	0
Medium gravel	1	1	0	0	0	--	--	--	0	0	0
Metals/Metalloids (mg/kg)											
Aluminum	1	1	3420	3420	3420	--	--	--	3420	3420	3420
Antimony	1	0	--	--	--	0.0215	0.0215	0.0215	0.0215	0.0215	0.0215
Arsenic	1	1	6.29	6.29	6.29	--	--	--	6.29	6.29	6.29
Barium	1	1	8.19	8.19	8.19	--	--	--	8.19	8.19	8.19
Beryllium	1	1	0.122	0.122	0.122	--	--	--	0.122	0.122	0.122
Cadmium	1	1	0.025	0.025	0.025	--	--	--	0.025	0.025	0.025
Calcium	1	1	3970	3970	3970	--	--	--	3970	3970	3970
Chromium	1	1	25.1	25.1	25.1	--	--	--	25.1	25.1	25.1
Cobalt	1	1	5.79	5.79	5.79	--	--	--	5.79	5.79	5.79
Copper	1	1	4.02	4.02	4.02	--	--	--	4.02	4.02	4.02
Iron	1	1	10900	10900	10900	--	--	--	10900	10900	10900
Lead	1	1	5.71	5.71	5.71	--	--	--	5.71	5.71	5.71
Magnesium	1	1	3200	3200	3200	--	--	--	3200	3200	3200
Manganese	1	1	199	199	199	--	--	--	199	199	199
Mercury	1	1	0.015	0.015	0.015	--	--	--	0.015	0.015	0.015
Nickel	1	1	26.2	26.2	26.2	--	--	--	26.2	26.2	26.2
Potassium	1	1	646	646	646	--	--	--	646	646	646
Selenium	1	0	--	--	--	0.035	0.035	0.035	0.035	0.035	0.035
Silver	1	1	0.013	0.013	0.013	--	--	--	0.013	0.013	0.013
Sodium	1	1	361	361	361	--	--	--	361	361	361
Thallium	1	0	--	--	--	0.0145	0.0145	0.0145	0.0145	0.0145	0.0145
Vanadium	1	1	19.4	19.4	19.4	--	--	--	19.4	19.4	19.4
Zinc	1	1	19.9	19.9	19.9	--	--	--	19.9	19.9	19.9

Table 5-3a. Long-Term Bioassay Sediment Summary Statistics for Chironomus dilutus and Hyalella azteca at Start of the Test

Analyte	Number of Samples	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[a]	Mean Nondetected Value[a]	Maximum Nondetected Value[a]	Overall Minimum Value[a]	Overall Mean Value[a]	Overall Maximum Value[a]
Negative Control Samples (CTL-SS) (continued)											
SEM (µmol/g)											
Antimony	1	0	--	--	--	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
Arsenic	1	1	0.003	0.003	0.003	--	--	--	0.003	0.003	0.003
Cadmium	1	0	--	--	--	0.000055	0.000055	0.000055	0.000055	0.000055	0.000055
Chromium	1	1	0.0151	0.0151	0.0151	--	--	--	0.0151	0.0151	0.0151
Copper	1	1	0.0127	0.0127	0.0127	--	--	--	0.0127	0.0127	0.0127
Lead	1	1	0.0185	0.0185	0.0185	--	--	--	0.0185	0.0185	0.0185
Nickel	1	1	0.0256	0.0256	0.0256	--	--	--	0.0256	0.0256	0.0256
Zinc	1	1	0.0694	0.0694	0.0694	--	--	--	0.0694	0.0694	0.0694
Auxiliary Control Samples (CTL-QS)											
Conventional Parameters											
Organic carbon (%)	1	0	--	--	--	0.01	0.01	0.01	0.01	0.01	0.01
pH	1	1	7.56	7.56	7.56	--	--	--	7.56	7.56	7.56
Solids (%)	1	1	76.9	76.9	76.9	--	--	--	76.9	76.9	76.9
Sulfide (AVS; µmol/g)	1	0	--	--	--	0.003	0.003	0.003	0.003	0.003	0.003
Grain size (%)											
Clay	1	1	0	0	0	--	--	--	0	0	0
Silt	1	1	0	0	0	--	--	--	0	0	0
Very fine sand	1	1	0.03	0.03	0.03	--	--	--	0.03	0.03	0.03
Fine sand	1	1	2.39	2.39	2.39	--	--	--	2.39	2.39	2.39
Medium sand	1	1	37.51	37.5	37.51	--	--	--	37.51	37.5	37.51
Coarse sand	1	1	61.26	61.3	61.26	--	--	--	61.26	61.3	61.26
Very coarse sand	1	1	0.07	0.07	0.07	--	--	--	0.07	0.07	0.07
Fine gravel	1	1	0	0	0	--	--	--	0	0	0
Medium gravel	1	1	0	0	0	--	--	--	0	0	0
Metals/Metalloids (mg/kg)											
Aluminum	1	1	7.2	7.2	7.2	--	--	--	7.2	7.2	7.2
Antimony	1	0	--	--	--	0.0095	0.0095	0.0095	0.0095	0.0095	0.0095
Arsenic	1	1	0.18	0.18	0.18	--	--	--	0.18	0.18	0.18
Barium	1	0	--	--	--	0.095	0.095	0.095	0.095	0.095	0.095
Beryllium	1	0	--	--	--	0.005	0.005	0.005	0.005	0.005	0.005
Cadmium	1	0	--	--	--	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065
Calcium	1	0	--	--	--	9.65	9.65	9.65	9.65	9.65	9.65
Chromium	1	1	0.15	0.15	0.15	--	--	--	0.15	0.15	0.15
Cobalt	1	1	0.113	0.113	0.113	--	--	--	0.113	0.113	0.113

Table 5-3a. Long-Term Bioassay Sediment Summary Statistics for Chironomus dilutus and Hyalella azteca at Start of the Test

Analyte	Number of Samples	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[a]	Mean Nondetected Value[a]	Maximum Nondetected Value[a]	Overall Minimum Value[a]	Overall Mean Value[a]	Overall Maximum Value[a]
Auxiliary Control Samples (CTL-QS) (continued)											
Metals/Metalloids (mg/kg)											
Copper	1	1	1.03	1.03	1.03	--	--	--	1.03	1.03	1.03
Iron	1	1	76.5	76.5	76.5	--	--	--	76.5	76.5	76.5
Lead	1	0	--	--	--	0.4	0.4	0.4	0.4	0.4	0.4
Magnesium	1	1	3.79	3.79	3.79	--	--	--	3.79	3.79	3.79
Manganese	1	1	0.19	0.19	0.19	--	--	--	0.19	0.19	0.19
Mercury	1	0	--	--	--	0.001	0.001	0.001	0.001	0.001	0.001
Nickel	1	1	0.49	0.49	0.49	--	--	--	0.49	0.49	0.49
Potassium	1	0	--	--	--	2.85	2.85	2.85	2.85	2.85	2.85
Selenium	1	0	--	--	--	0.065	0.065	0.065	0.065	0.065	0.065
Silver	1	0	--	--	--	0.004	0.004	0.004	0.004	0.004	0.004
Sodium	1	0	--	--	--	4.2	4.2	4.2	4.2	4.2	4.2
Thallium	1	0	--	--	--	0.004	0.004	0.004	0.004	0.004	0.004
Vanadium	1	1	0.05	0.05	0.05	--	--	--	0.05	0.05	0.05
Zinc	1	0	--	--	--	0.25	0.25	0.25	0.25	0.25	0.25
SEM (µmol/g)											
Antimony	1	0	--	--	--	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Arsenic	1	0	--	--	--	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015
Cadmium	1	0	--	--	--	0.000045	0.000045	0.000045	0.000045	0.000045	0.000045
Chromium	1	1	0.0008	0.0008	0.0008	--	--	--	0.0008	0.0008	0.0008
Copper	1	1	0.0011	0.0011	0.0011	--	--	--	0.0011	0.0011	0.0011
Lead	1	1	0.0007	0.0007	0.0007	--	--	--	0.0007	0.0007	0.0007
Nickel	1	1	0.0005	0.0005	0.0005	--	--	--	0.0005	0.0005	0.0005
Zinc	1	0	--	--	--	0.00075	0.00075	0.00075	0.00075	0.00075	0.00075

Notes:

Results for site samples include results for potential reference samples.

Results for tributary and upstream samples include one tributary location in the United States and six upstream locations in Canada.

Averaged results have three significant figures applied.

[a] Calculated with nondetected results at one-half of the detection limit.

-- no value

AVS - acid volatile sulfide

CTL-QS - quartz sand auxiliary control

CTL-SS - Pacific EcoRisk negative control sediment

SEM - simultaneously extracted metals

Table 5-3b. Long-Term Bioassay Sediment Summary Statistics for *Chironomus dilutus* on Test Day 21

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Site Samples											
Conventional Parameters											
Organic carbon (%)	22	22	0.043	0.793	2.26	--	--	--	0.043	0.793	2.26
Solids (%)	22	22	24.5	62.8	80.8	--	--	--	24.5	62.8	80.8
Sulfide (AVS; µmol/g)	22	22	0.067	3.6	11.5	--	--	--	0.067	3.6	11.5
SEM (µmol/g)											
Antimony	22	16	0.0012	0.0523	0.223	0.00035	0.00147	0.003	0.00035	0.0384	0.223
Arsenic	22	20	0.006	0.035	0.075	0.008	0.00825	0.0085	0.006	0.0326	0.075
Cadmium	22	22	0.00207	0.0212	0.06218	--	--	--	0.00207	0.0212	0.06218
Chromium	22	22	0.03	0.297	0.961	--	--	--	0.03	0.297	0.961
Copper	22	22	0.0668	2.52	12	--	--	--	0.0668	2.52	12
Lead	22	22	0.0353	0.761	2.32	--	--	--	0.0353	0.761	2.32
Nickel	22	22	0.0392	0.117	0.214	--	--	--	0.0392	0.117	0.214
Zinc	22	22	0.444	43.7	166	--	--	--	0.444	43.7	166
Tributary and Upstream Samples											
Conventional Parameters											
Organic carbon (%)	17	17	0.056	1.5	16.4	--	--	--	0.056	1.5	16.4
Solids (%)	17	17	31	72.1	82.8	--	--	--	31	72.1	82.8
Sulfide (AVS; µmol/g)	17	11	0.015	1.19	11.8	0.0045	0.00467	0.005	0.0045	0.769	11.8
SEM (µmol/g)											
Antimony	17	3	0.0009	0.0024	0.0049	0.0003	0.000782	0.0019	0.0003	0.00107	0.0049
Arsenic	17	14	0.003	0.00914	0.021	0.0025	0.00333	0.005	0.0025	0.00812	0.021
Cadmium	17	17	0.00035	0.00176	0.00465	--	--	--	0.00035	0.00176	0.00465
Chromium	17	17	0.0071	0.0362	0.141	--	--	--	0.0071	0.0362	0.141
Copper	17	17	0.0175	0.054	0.229	--	--	--	0.0175	0.054	0.229
Lead	17	17	0.0115	0.0346	0.125	--	--	--	0.0115	0.0346	0.125
Nickel	17	17	0.0123	0.0512	0.217	--	--	--	0.0123	0.0512	0.217
Zinc	17	17	0.0478	0.189	0.539	--	--	--	0.0478	0.189	0.539
Negative Control Samples (CTL-SS)											
Conventional Parameters											
Organic carbon (%)	3	3	0.096	0.119	0.136	--	--	--	0.096	0.119	0.136
Solids (%)	3	3	79.4	80.1	81.4	--	--	--	79.4	80.1	81.4
Sulfide (AVS; µmol/g)	3	2	0.014	0.029	0.044	0.005	0.005	0.005	0.005	0.021	0.044

Table 5-3b. Long-Term Bioassay Sediment Summary Statistics for *Chironomus dilutus* on Test Day 21

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Negative Control Samples (CTL-SS) (continued)											
SEM (µmol/g)											
Antimony	3	0	--	--	--	0.00035	0.00055	0.00095	0.00035	0.00055	0.00095
Arsenic	3	3	0.007	0.00867	0.01	--	--	--	0.007	0.00867	0.01
Cadmium	3	2	0.00023	0.000325	0.00042	0.000025	0.000025	0.000025	0.000025	0.000225	0.00042
Chromium	3	3	0.0303	0.0337	0.0375	--	--	--	0.0303	0.0337	0.0375
Copper	3	3	0.0232	0.0263	0.0297	--	--	--	0.0232	0.0263	0.0297
Lead	3	3	0.0297	0.0331	0.0371	--	--	--	0.0297	0.0331	0.0371
Nickel	3	3	0.0419	0.0465	0.051	--	--	--	0.0419	0.0465	0.051
Zinc	3	3	0.149	0.157	0.162	--	--	--	0.149	0.157	0.162
Auxiliary Control Samples (CTL-QS)											
Conventional Parameters											
Organic carbon (%)	3	0	--	--	--	0.01	0.01	0.01	0.01	0.01	0.01
Solids (%)	3	3	79.5	81.2	82.4	--	--	--	79.5	81.2	82.4
Sulfide (AVS; µmol/g)	3	0	--	--	--	0.0025	0.00267	0.003	0.0025	0.00267	0.003
SEM (µmol/g)											
Antimony	3	0	--	--	--	0.0002	0.0003	0.0005	0.0002	0.0003	0.0005
Arsenic	3	0	--	--	--	0.0005	0.000833	0.0015	0.0005	0.000833	0.0015
Cadmium	3	0	--	--	--	0.00001	0.0000217	0.000045	0.00001	0.0000217	0.000045
Chromium	3	1	0.0006	0.0006	0.0006	0.00025	0.000375	0.0005	0.00025	0.00045	0.0006
Copper	3	3	0.0012	0.00137	0.0017	--	--	--	0.0012	0.00137	0.0017
Lead	3	3	0.0007	0.0007	0.0007	--	--	--	0.0007	0.0007	0.0007
Nickel	3	3	0.0004	0.000533	0.0008	--	--	--	0.0004	0.000533	0.0008
Zinc	3	2	0.0027	0.00315	0.0036	0.00125	0.00125	0.00125	0.00125	0.00252	0.0036

Notes:

Results for site samples include results for potential reference samples.

Results for tributary and upstream samples include 6 tributary locations in the United States and 10 upstream locations in Canada.

Averaged results have three significant figures applied.

[a] Number of results for site samples is 22 instead of 20 because one location, REF-10b, was included in all three batches (see Table 2-13). Number of results for tributary and upstream samples is 17 instead of 7 because five locations were included in all three batches (see Table 2-13).

[b] Calculated with nondetected results at one-half of the detection limit.

-- no value

AVS - acid volatile sulfide

CTL-QS - quartz sand auxiliary control

CTL-SS - PER negative control sediment

SEM - simultaneously extracted metals

Table 5-3c. Long-Term Bioassay Sediment Summary Statistics for *Hyalella azteca* on Test Day 21

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Site Samples											
Conventional Parameters											
Organic carbon (%)	22	22	0.052	0.766	2.25	--	--	--	0.052	0.766	2.25
Solids (%)	22	22	20	62	81.4	--	--	--	20	62	81.4
Sulfide (AVS; µmol/g)	22	22	0.089	4.91	26	--	--	--	0.089	4.91	26
SEM (µmol/g)											
Antimony	22	17	0.0026	0.0524	0.268	0.00035	0.00102	0.00225	0.00035	0.0407	0.268
Arsenic	22	18	0.008	0.0333	0.078	0.008	0.0225	0.0485	0.008	0.0314	0.078
Cadmium	22	21	0.00216	0.0233	0.09927	0.000235	0.000235	0.000235	0.000235	0.0222	0.09927
Chromium	22	22	0.0266	0.302	1.08	--	--	--	0.0266	0.302	1.08
Copper	22	22	0.0625	2.59	13	--	--	--	0.0625	2.59	13
Lead	22	22	0.0342	0.818	2.35	--	--	--	0.0342	0.818	2.35
Nickel	22	22	0.0353	0.117	0.282	--	--	--	0.0353	0.117	0.282
Zinc	22	22	0.423	46	183	--	--	--	0.423	46	183
Tributary and Upstream Samples											
Conventional Parameters											
Organic carbon (%)	17	17	0.058	1.26	11.5	--	--	--	0.058	1.26	11.5
Solids (%)	17	17	31.2	71.4	82.2	--	--	--	31.2	71.4	82.2
Sulfide (AVS; µmol/g)	17	6	0.015	3.06	17.1	0.004	0.00477	0.0055	0.004	1.08	17.1
SEM (µmol/g)											
Antimony	17	0	--	--	--	0.0003	0.000747	0.0019	0.0003	0.000747	0.0019
Arsenic	17	14	0.004	0.00957	0.02	0.0025	0.00333	0.005	0.0025	0.00847	0.02
Cadmium	17	17	0.00041	0.00193	0.00444	--	--	--	0.00041	0.00193	0.00444
Chromium	17	17	0.0054	0.0379	0.137	--	--	--	0.0054	0.0379	0.137
Copper	17	17	0.0166	0.0552	0.21	--	--	--	0.0166	0.0552	0.21
Lead	17	17	0.0113	0.0363	0.123	--	--	--	0.0113	0.0363	0.123
Nickel	17	17	0.0127	0.056	0.209	--	--	--	0.0127	0.056	0.209
Zinc	17	17	0.0478	0.197	0.509	--	--	--	0.0478	0.197	0.509
Negative Control Samples (CTL-SS)											
Conventional Parameters											
Organic carbon (%)	3	3	0.092	0.103	0.12	--	--	--	0.092	0.103	0.12
Solids (%)	3	3	79	79.5	80	--	--	--	79	79.5	80
Sulfide (AVS; µmol/g)	3	1	0.052	0.052	0.052	0.0025	0.00375	0.005	0.0025	0.0198	0.052

Table 5-3c. Long-Term Bioassay Sediment Summary Statistics for *Hyalella azteca* on Test Day 21

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
SEM (µmol/g)											
Antimony	3	0	--	--	--	0.0002	0.0005	0.00095	0.0002	0.0005	0.00095
Arsenic	3	2	0.008	0.0095	0.011	0.0005	0.0005	0.0005	0.0005	0.0065	0.011
Cadmium	3	2	0.0002	0.00036	0.00052	0.00001	0.00001	0.00001	0.00001	0.000243	0.00052
Chromium	3	3	0.0017	0.023	0.0384	--	--	--	0.0017	0.023	0.0384
Copper	3	3	0.0012	0.0164	0.0244	--	--	--	0.0012	0.0164	0.0244
Lead	3	3	0.0008	0.0277	0.0524	--	--	--	0.0008	0.0277	0.0524
Nickel	3	3	0.0009	0.0311	0.0527	--	--	--	0.0009	0.0311	0.0527
Zinc	3	2	0.135	0.208	0.28	0.00075	0.00075	0.00075	0.00075	0.139	0.28
Auxiliary Control Samples (CTL-QS)											
Conventional Parameters											
Organic carbon (%)	3	0	--	--	--	0.01	0.01	0.01	0.01	0.01	0.01
Solids (%)	3	3	79.4	81.3	83.9	--	--	--	79.4	81.3	83.9
Sulfide (AVS; µmol/g)	3	0	--	--	--	0.0025	0.00417	0.005	0.0025	0.00417	0.005
SEM (µmol/g)											
Antimony	3	0	--	--	--	0.0002	0.000483	0.0009	0.0002	0.000483	0.0009
Arsenic	3	1	0.009	0.009	0.009	0.0005	0.0015	0.0025	0.0005	0.004	0.009
Cadmium	3	1	0.00019	0.00019	0.00019	0.00001	0.000045	0.00008	0.00001	0.0000933	0.00019
Chromium	3	1	0.0378	0.0378	0.0378	0.00045	0.00045	0.00045	0.00045	0.0129	0.0378
Copper	3	3	0.0012	0.0104	0.0274	--	--	--	0.0012	0.0104	0.0274
Lead	3	2	0.0008	0.0215	0.0421	0.00055	0.00055	0.00055	0.00055	0.0145	0.0421
Nickel	3	3	0.0003	0.0184	0.0541	--	--	--	0.0003	0.0184	0.0541
Zinc	3	2	0.0104	0.105	0.199	0.00075	0.00075	0.00075	0.00075	0.0701	0.199

Notes:

Results for site samples include results for potential reference samples.

Results for tributary and upstream samples include 6 tributary locations in the United States and 10 upstream locations in Canada.

Averaged results have three significant figures applied.

[a] Number of results for site samples is 22 instead of 20 because one location, REF-10b, was included in all three batches (see Table 2-13). Number of results for tributary and upstream samples is 17 instead of 7 because five locations were included in all three batches (see Table 2-13).

[b] Calculated with nondetected results at one-half of the detection limit.

-- no value

AVS - acid volatile sulfide

CTL-QS - quartz sand auxiliary control

CTL-SS - Pacific EcoRisk negative control sediment

SEM - simultaneously extracted metals

Table 5-3d. Long-Term Bioassay Sediment Summary Statistics for *Chironomus dilutus* on Test Day 42

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Site Samples											
Conventional Parameters											
Organic carbon (%)	22	22	0.07	0.802	2.25	--	--	--	0.07	0.802	2.25
Solids (%)	22	22	28.8	62.8	81.7	--	--	--	28.8	62.8	81.7
Sulfide (AVS; µmol/g)	22	22	0.063	4.1	14	--	--	--	0.063	4.1	14
SEM (µmol/g)											
Antimony	22	10	0.0048	0.0762	0.17	0.0007	0.00694	0.0545	0.0007	0.0384	0.17
Arsenic	22	19	0.011	0.0422	0.086	0.0225	0.0318	0.048	0.011	0.0408	0.086
Cadmium	22	22	0.00213	0.0198	0.06891	--	--	--	0.00213	0.0198	0.06891
Chromium	22	22	0.0248	0.289	0.78	--	--	--	0.0248	0.289	0.78
Copper	22	22	0.0596	2.61	9.86	--	--	--	0.0596	2.61	9.86
Lead	22	22	0.0336	0.733	2.35	--	--	--	0.0336	0.733	2.35
Nickel	22	22	0.0315	0.105	0.198	--	--	--	0.0315	0.105	0.198
Zinc	22	22	0.44	41.5	139	--	--	--	0.44	41.5	139
Tributary and Upstream Samples											
Conventional Parameters											
Organic carbon (%)	17	17	0.056	1.57	17.6	--	--	--	0.056	1.57	17.6
Solids (%)	17	17	17	71	82.6	--	--	--	17	71	82.6
Sulfide (AVS; µmol/g)	17	14	0.016	3.34	43.2	0.005	0.005	0.005	0.005	2.75	43.2
SEM (µmol/g)											
Antimony	17	0	--	--	--	0.00035	0.00119	0.0046	0.00035	0.00119	0.0046
Arsenic	17	11	0.005	0.0122	0.034	0.0025	0.00442	0.0115	0.0025	0.00944	0.034
Cadmium	17	17	0.00042	0.00207	0.00579	--	--	--	0.00042	0.00207	0.00579
Chromium	17	17	0.0056	0.0341	0.143	--	--	--	0.0056	0.0341	0.143
Copper	17	17	0.0133	0.0561	0.213	--	--	--	0.0133	0.0561	0.213
Lead	17	17	0.0093	0.0365	0.133	--	--	--	0.0093	0.0365	0.133
Nickel	17	17	0.0104	0.0551	0.224	--	--	--	0.0104	0.0551	0.224
Zinc	17	17	0.0496	0.197	0.551	--	--	--	0.0496	0.197	0.551
Negative Control Samples (CTL-SS)											
Conventional Parameters											
Organic carbon (%)	3	3	0.094	0.109	0.119	--	--	--	0.094	0.109	0.119
Solids (%)	3	3	77.9	78.8	79.6	--	--	--	77.9	78.8	79.6
Sulfide (AVS; µmol/g)	3	3	0.014	0.0263	0.046	--	--	--	0.014	0.0263	0.046
SEM (µmol/g)											
Antimony	3	0	--	--	--	0.00035	0.000767	0.001	0.00035	0.000767	0.001
Arsenic	3	3	0.008	0.009	0.01	--	--	--	0.008	0.009	0.01
Cadmium	3	2	0.00025	0.00035	0.00045	0.00009	0.00009	0.00009	0.00009	0.000263	0.00045
Chromium	3	3	0.0284	0.0312	0.0351	--	--	--	0.0284	0.0312	0.0351
Copper	3	3	0.0224	0.0246	0.0263	--	--	--	0.0224	0.0246	0.0263
Lead	3	3	0.0289	0.0468	0.0779	--	--	--	0.0289	0.0468	0.0779
Nickel	3	3	0.0401	0.0457	0.0537	--	--	--	0.0401	0.0457	0.0537
Zinc	3	3	0.132	0.143	0.153	--	--	--	0.132	0.143	0.153

Table 5-3d. Long-Term Bioassay Sediment Summary Statistics for *Chironomus dilutus* on Test Day 42

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Auxiliary Control Samples (CTL-QS)											
Conventional Parameters											
Organic carbon (%)	3	0	--	--	--	0.01	0.01	0.01	0.01	0.01	0.01
Solids (%)	3	3	79.9	81.3	83.5	--	--	--	79.9	81.3	83.5
Sulfide (AVS; µmol/g)	3	1	0.047	0.047	0.047	0.0025	0.00375	0.005	0.0025	0.0182	0.047
SEM (µmol/g)											
Antimony	3	0	--	--	--	0.0002	0.00055	0.00095	0.0002	0.00055	0.00095
Arsenic	3	0	--	--	--	0.0005	0.00133	0.0025	0.0005	0.00133	0.0025
Cadmium	3	0	--	--	--	0.00001	0.000045	0.000085	0.00001	0.000045	0.000085
Chromium	3	2	0.0003	0.0006	0.0009	0.00045	0.00045	0.00045	0.0003	0.00055	0.0009
Copper	3	2	0.0014	0.00145	0.0015	0.0006	0.0006	0.0006	0.0006	0.00117	0.0015
Lead	3	2	0.0007	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.000667	0.0007
Nickel	3	2	0.0003	0.00065	0.001	0.00035	0.00035	0.00035	0.0003	0.00055	0.001
Zinc	3	1	0.0051	0.0051	0.0051	0.00115	0.0012	0.00125	0.00115	0.0025	0.0051

Notes:

Results for site samples include results for potential reference samples.

Results for tributary and upstream samples include 6 tributary locations in the United States and 10 upstream locations in Canada.

Averaged results have three significant figures applied.

[a] Number of results for site samples is 22 instead of 20 because one location, REF-10b, was included in all three batches (see Table 2-13). Number of results for tributary and upstream samples is 17 instead of 7 because five locations were included in all three batches (see Table 2-13).

[b] Calculated with nondetected results at one-half of the detection limit.

-- no value

AVS - acid volatile sulfide

CTL-QS - quartz sand auxiliary control

CTL-SS - Pacific EcoRisk negative control sediment

SEM - simultaneously extracted metals

Table 5-6a. Long-Term Bioassay Porewater Summary Statistics for *Chironomus dilutus* and *Hyalella azteca* at the Start of the Test

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Site Samples											
Conventional Parameters											
Alkalinity (mg/L)	18	18	120	254	629	--	--	--	120	254	629
DOC (mg/L)	18	18	1.28	7.26	24.5	--	--	--	1.28	7.26	24.5
Hardness as $CaCO_3$ (mg/L)	18	18	43.5	217	600	--	--	--	43.5	217	600
pH	18	18	6.78	7.75	9.17	--	--	--	6.78	7.75	9.17
Sulfate (mg/L)	18	18	0.46	17.1	58.7	--	--	--	0.46	17.1	58.7
Sulfide (mg/L)	17[c]	14	0.015	0.0486	0.136	0.006	0.006	0.006	0.006	0.0411	0.136
Total chloride (mg/L)	18	18	0.73	4.58	24.9	--	--	--	0.73	4.58	24.9
Metals/Metalloids (µg/L)											
Calcium	18	18	12900	64300	183000	--	--	--	12900	64300	183000
Magnesium	18	18	2140	13700	34500	--	--	--	2140	13700	34500
Potassium	18	18	351	3450	12800	--	--	--	351	3450	12800
Sodium	18	18	976	6890	19500	--	--	--	976	6890	19500
Upstream Samples											
Conventional Parameters											
Alkalinity (mg/L)	6	6	73	235	403	--	--	--	73	235	403
DOC (mg/L)	6	6	1.16	3.58	6.95	--	--	--	1.16	3.58	6.95
Hardness as $CaCO_3$ (mg/L)	6	6	103	228	359	--	--	--	103	228	359
pH	6	6	7.16	7.56	7.94	--	--	--	7.16	7.56	7.94
Sulfate (mg/L)	6	6	1.08	18	40.7	--	--	--	1.08	18	40.7
Sulfide (mg/L)	5[c]	2	0.028	0.073	0.118	0.006	0.006	0.006	0.006	0.0328	0.118
Total chloride (mg/L)	6	6	0.35	0.557	0.75	--	--	--	0.35	0.557	0.75
Metals/Metalloids (µg/L)											
Calcium	6	6	31200	70200	111000	--	--	--	31200	70200	111000
Magnesium	6	6	6080	12700	20100	--	--	--	6080	12700	20100
Potassium	6	6	1660	2150	3420	--	--	--	1660	2150	3420
Sodium	6	6	1910	2500	4110	--	--	--	1910	2500	4110
Negative Control Samples (CTL-SS)											
Conventional Parameters											
Alkalinity (mg/L)	1	1	288	288	288	--	--	--	288	288	288
DOC (mg/L)	1	1	5.59	5.59	5.59	--	--	--	5.59	5.59	5.59
Hardness as $CaCO_3$ (mg/L)	1	1	276	276	276	--	--	--	276	276	276
pH	1	1	8.18	8.18	8.18	--	--	--	8.18	8.18	8.18
Sulfate (mg/L)	1	1	258	258	258	--	--	--	258	258	258
Sulfide (mg/L)	1	0	--	--	--	0.006	0.006	0.006	0.006	0.006	0.006
Total chloride (mg/L)	1	1	403	403	403	--	--	--	403	403	403
Metals/Metalloids (µg/L)											
Calcium	1	1	41800	41800	41800	--	--	--	41800	41800	41800
Magnesium	1	1	41600	41600	41600	--	--	--	41600	41600	41600
Potassium	1	1	26500	26500	26500	--	--	--	26500	26500	26500
Sodium	1	1	405000	405000	405000	--	--	--	405000	405000	405000

Table 5-6a. Long-Term Bioassay Porewater Summary Statistics for *Chironomus dilutus* and *Hyalella azteca* at the Start of the Test

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Auxiliary Control Samples (CTL-QS)											
Conventional Parameters											
Alkalinity (mg/L)	1	1	40	40	40	--	--	--	40	40	40
DOC (mg/L)	1	1	5.26	5.26	5.26	--	--	--	5.26	5.26	5.26
Hardness as $CaCO_3$ (mg/L)	1	1	94.3	94.3	94.3	--	--	--	94.3	94.3	94.3
pH	1	1	7.83	7.83	7.83	--	--	--	7.83	7.83	7.83
Sulfate (mg/L)	1	1	25.8	25.8	25.8	--	--	--	25.8	25.8	25.8
Sulfide (mg/L)	1	0	--	--	--	0.006	0.006	0.006	0.006	0.006	0.006
Total chloride (mg/L)	1	1	56.6	56.6	56.6	--	--	--	56.6	56.6	56.6
Metals/Metalloids (µg/L)											
Calcium	1	1	28200	28200	28200	--	--	--	28200	28200	28200
Magnesium	1	1	5800	5800	5800	--	--	--	5800	5800	5800
Potassium	1	1	1540	1540	1540	--	--	--	1540	1540	1540
Sodium	1	1	19900	19900	19900	--	--	--	19900	19900	19900

Notes:

Results for site samples include results for potential reference samples.

Results for upstream samples include 6 upstream locations in Canada.

Averaged results have three significant figures applied.

[a] The number of results for site samples is 18 instead of 20 because porewater could not be collected for 2 locations (4-B1 and 4-B5) at the start of the test because samples consisted primarily of sand. The number of results for tributary and upstream samples is 6 instead of 7 because porewater could not be collected for the tributaroy location (TRIB-3) at the start of the test because sample consisted primarily of sand.

[b] Calculated with nondetected results at one-half of the detection limit.

[c] Number of results is less than for other analytes because some of the sulfide data were rejected (see Section 4.3.6.3).

-- no value

$CaCO_3$ - calcium carbonate

CTL-QS - quartz sand auxiliary control

CTL-SS - PER negative control sediment

DOC - dissolved organic carbon

Table 5-6b. Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Chironomus dilutus* on Test Day 7 (µg/L)

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Site Samples											
Aluminum	22	6	8.3	22.3	56.3	1.2	3.28	4.85	1.2	8.45	56.3
Antimony	22	11	0.52	14.4	90.5	0.01	0.0359	0.135	0.01	7.23	90.5
Arsenic	22	22	0.16	30.9	88.7	--	--	--	0.16	30.9	88.7
Barium	22	22	46.6	204	1110	--	--	--	46.6	204	1110
Beryllium	22	0	--	--	--	0.009	0.00902	0.0095	0.009	0.00902	0.0095
Cadmium	22	8	0.025	0.286	1.72	0.0055	0.00554	0.006	0.0055	0.107	1.72
Chromium	22	14	0.05	0.0936	0.17	0.02	0.0238	0.025	0.02	0.0682	0.17
Cobalt	22	22	0.014	0.919	2.32	--	--	--	0.014	0.919	2.32
Copper	22	10	0.48	2.95	6.1	0.04	0.0729	0.14	0.04	1.38	6.1
Iron	22	21	5.2	5930	28500	1.95	1.95	1.95	1.95	5660	28500
Lead	22	19	0.066	0.425	1.71	0.02	0.0385	0.0485	0.02	0.372	1.71
Manganese	22	22	10.8	2430	7160	--	--	--	10.8	2430	7160
Nickel	22	22	0.2	0.903	2.33	--	--	--	0.2	0.903	2.33
Selenium	22	0	--	--	--	0.45	0.45	0.45	0.45	0.45	0.45
Silver	22	0	--	--	--	0.0055	0.00552	0.006	0.0055	0.00552	0.006
Thallium	22	8	0.009	0.0838	0.408	0.002	0.00811	0.029	0.002	0.0356	0.408
Vanadium	22	17	0.13	0.368	0.71	0.055	0.06	0.07	0.055	0.298	0.71
Zinc	22	8	7.5	41.6	73.5	0.23	0.845	1.845	0.23	15.6	73.5
Tributary and Upstream Samples											
Aluminum	17	5	7.6	11.8	16.3	1.15	2.63	5.1	1.15	5.34	16.3
Antimony	17	0	--	--	--	0.015	0.0574	0.18	0.015	0.0574	0.18
Arsenic	17	16	0.18	5.33	15.4	0.055	0.055	0.055	0.055	5.02	15.4
Barium	17	17	41.7	87.3	148	--	--	--	41.7	87.3	148
Beryllium	17	0	--	--	--	0.009	0.00906	0.0095	0.009	0.00906	0.0095
Cadmium	17	6	0.018	0.052	0.145	0.0055	0.00555	0.006	0.0055	0.0219	0.145
Chromium	17	12	0.06	0.153	0.8	0.02	0.024	0.025	0.02	0.115	0.8
Cobalt	17	16	0.019	0.969	3.36	0.007	0.007	0.007	0.007	0.912	3.36
Copper	17	3	0.36	0.553	0.78	0.035	0.0939	0.205	0.035	0.175	0.78
Iron	17	13	11.5	2950	10100	0.75	1.63	2.8	0.75	2260	10100
Lead	17	9	0.053	0.146	0.269	0.0065	0.0215	0.0425	0.0065	0.0875	0.269
Manganese	17	17	3.54	2340	8890	--	--	--	3.54	2340	8890
Nickel	17	16	0.24	1.55	4.07	0.045	0.045	0.045	0.045	1.46	4.07
Selenium	17	0	--	--	--	0.45	0.45	0.45	0.45	0.45	0.45
Silver	17	0	--	--	--	0.0055	0.00556	0.006	0.0055	0.00556	0.006
Thallium	17	3	0.006	0.00967	0.013	0.002	0.00432	0.0105	0.002	0.00526	0.013
Vanadium	17	8	0.14	0.426	0.83	0.055	0.0578	0.06	0.055	0.231	0.83
Zinc	17	1	8.93	8.93	8.93	0.19	1.03	2.37	0.19	1.5	8.93
Negative Control Samples (CTL-SS)											
Aluminum	3	0	--	--	--	1.55	2.3	3.55	1.55	2.3	3.55
Antimony	3	1	0.38	0.38	0.38	0.11	0.123	0.135	0.11	0.208	0.38
Arsenic	3	3	8.84	9.39	9.94	--	--	--	8.84	9.39	9.94
Barium	3	3	1.74	2.41	2.87	--	--	--	1.74	2.41	2.87
Beryllium	3	0	--	--	--	0.009	0.009	0.009	0.009	0.009	0.009

Table 5-6b. Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Chironomus dilutus* on Test Day 7 (µg/L)

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Negative Control Samples (CTL-SS) (continued)											
Cadmium	3	1	0.015	0.015	0.015	0.0055	0.0055	0.0055	0.0055	0.00867	0.015
Chromium	3	2	0.06	0.075	0.09	0.025	0.025	0.025	0.025	0.0583	0.09
Cobalt	3	3	0.307	0.451	0.524	--	--	--	0.307	0.451	0.524
Copper	3	0	--	--	--	0.165	0.183	0.215	0.165	0.183	0.215
Iron	3	3	101	127	149	--	--	--	101	127	149
Lead	3	1	0.078	0.078	0.078	0.036	0.0425	0.049	0.036	0.0543	0.078
Manganese	3	3	303	457	603	--	--	--	303	457	603
Nickel	3	3	0.93	1.08	1.15	--	--	--	0.93	1.08	1.15
Selenium	3	0	--	--	--	0.45	0.45	0.45	0.45	0.45	0.45
Silver	3	0	--	--	--	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
Thallium	3	0	--	--	--	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
Vanadium	3	3	1.38	1.93	2.66	--	--	--	1.38	1.93	2.66
Zinc	3	0	--	--	--	0.35	0.368	0.38	0.35	0.368	0.38
Auxiliary Control Samples (CTL-QS)											
Aluminum	3	0	--	--	--	2.15	2.72	3.05	2.15	2.72	3.05
Antimony	3	0	--	--	--	0.07	0.0833	0.095	0.07	0.0833	0.095
Arsenic	3	3	0.16	0.273	0.41	--	--	--	0.16	0.273	0.41
Barium	3	3	5.38	6.31	7.34	--	--	--	5.38	6.31	7.34
Beryllium	3	0	--	--	--	0.009	0.009	0.009	0.009	0.009	0.009
Cadmium	3	2	0.034	0.0375	0.041	0.0055	0.0055	0.0055	0.0055	0.0268	0.041
Chromium	3	0	--	--	--	0.025	0.025	0.025	0.025	0.025	0.025
Cobalt	3	3	0.504	0.697	0.927	--	--	--	0.504	0.697	0.927
Copper	3	0	--	--	--	0.105	0.162	0.19	0.105	0.162	0.19
Iron	3	3	25.7	92.3	199	--	--	--	25.7	92.3	199
Lead	3	1	0.058	0.058	0.058	0.01	0.0165	0.023	0.01	0.0303	0.058
Manganese	3	3	20.6	29.6	40.2	--	--	--	20.6	29.6	40.2
Nickel	3	3	1.54	1.96	2.61	--	--	--	1.54	1.96	2.61
Selenium	3	0	--	--	--	0.45	0.45	0.45	0.45	0.45	0.45
Silver	3	0	--	--	--	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
Thallium	3	2	0.009	0.0225	0.036	0.0135	0.0135	0.0135	0.009	0.0195	0.036
Vanadium	3	0	--	--	--	0.055	0.0567	0.06	0.055	0.0567	0.06
Zinc	3	0	--	--	--	1.155	1.74	2.225	1.155	1.74	2.225

Notes:

Results for site samples include results for potential reference samples.

Results for tributary and upstream samples include one tributary location in the United States and six upstream locations in Canada.

Averaged results have three significant figures applied.

[a] The number of results for site samples is 22 instead of 20 because one location, REF-10b, was included in all three batches (see Table 2-13).
The number of results for tributary and upstream samples is 17 instead of 7 because five locations were included in all three batches (see Table 2-13).

[b] Calculated with nondetected results at one-half of the detection limit.

-- no value

CTL-QS - quartz sand auxiliary control

CTL-SS - PER negative control sediment

Table 5-6c. Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Hyalella azteca* on Test Day 7 (µg/L)

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Site Samples											
Aluminum	22	6	9.4	16.9	41.2	1.95	2.71	4	1.95	6.59	41.2
Antimony	22	11	0.42	14.6	64.1	0.015	0.0345	0.11	0.015	7.31	64.1
Arsenic	22	22	0.26	31	89	--	--	--	0.26	31	89
Barium	22	22	43.2	208	1030	--	--	--	43.2	208	1030
Beryllium	22	0	--	--	--	0.009	0.009	0.009	0.009	0.009	0.009
Cadmium	22	8	0.03	0.362	2.17	0.005	0.00554	0.0075	0.005	0.135	2.17
Chromium	22	11	0.06	0.109	0.24	0.02	0.0245	0.025	0.02	0.0668	0.24
Cobalt	22	22	0.021	0.95	2.35	--	--	--	0.021	0.95	2.35
Copper	22	9	0.53	3.23	4.7	0.04	0.0769	0.17	0.04	1.37	4.7
Iron	22	19	5.3	6750	28700	1.1	1.42	1.6	1.1	5830	28700
Lead	22	18	0.046	0.451	1.92	0.025	0.038	0.057	0.025	0.376	1.92
Manganese	22	22	8.16	2680	8460	--	--	--	8.16	2680	8460
Nickel	22	22	0.19	0.935	2.19	--	--	--	0.19	0.935	2.19
Selenium	22	0	--	--	--	0.45	0.45	0.45	0.45	0.45	0.45
Silver	22	0	--	--	--	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
Thallium	22	4	0.026	0.135	0.377	0.002	0.0101	0.0265	0.002	0.0328	0.377
Vanadium	22	17	0.13	0.316	0.73	0.055	0.055	0.055	0.055	0.257	0.73
Zinc	22	8	10.6	56	126	0.24	1.1	3.205	0.24	21.1	126
Tributary and Upstream Samples											
Aluminum	17	4	10.2	11.7	14	1.3	2.08	3.6	1.3	4.35	14
Antimony	17	1	0.38	0.38	0.38	0.01	0.0456	0.155	0.01	0.0653	0.38
Arsenic	17	15	0.42	5.27	14.4	0.055	0.055	0.055	0.055	4.66	14.4
Barium	17	17	39.7	93.6	168	--	--	--	39.7	93.6	168
Beryllium	17	0	--	--	--	0.009	0.00912	0.01	0.009	0.00912	0.01
Cadmium	17	5	0.016	0.0346	0.067	0.005	0.0075	0.0205	0.005	0.0155	0.067
Chromium	17	11	0.06	0.0827	0.11	0.02	0.0242	0.025	0.02	0.0621	0.11
Cobalt	17	15	0.027	0.985	3.08	0.007	0.007	0.007	0.007	0.87	3.08
Copper	17	3	0.42	0.52	0.61	0.035	0.0964	0.21	0.035	0.171	0.61
Iron	17	14	9.2	2880	11200	1.15	1.9	2.45	1.15	2370	11200
Lead	17	9	0.051	0.104	0.167	0.012	0.0306	0.056	0.012	0.0695	0.167
Manganese	17	17	2.92	2380	8230	--	--	--	2.92	2380	8230
Nickel	17	17	0.11	1.41	3.69	--	--	--	0.11	1.41	3.69
Selenium	17	2	1.2	1.2	1.2	0.45	0.453	0.5	0.45	0.541	1.2
Silver	17	0	--	--	--	0.0055	0.00562	0.0065	0.0055	0.00562	0.0065
Thallium	17	3	0.008	0.0147	0.023	0.002	0.00382	0.0105	0.002	0.00574	0.023
Vanadium	17	8	0.13	0.491	0.94	0.055	0.0561	0.06	0.055	0.261	0.94
Zinc	17	4	3.47	4.85	6.05	0.205	0.974	2.495	0.205	1.88	6.05
Negative Control Samples (CTL-SS)											
Aluminum	3	0	--	--	--	1.6	1.92	2.35	1.6	1.92	2.35
Antimony	3	0	--	--	--	0.105	0.118	0.125	0.105	0.118	0.125
Arsenic	3	3	8.03	9.74	10.7	--	--	--	8.03	9.74	10.7
Barium	3	3	1.59	2.28	2.85	--	--	--	1.59	2.28	2.85
Beryllium	3	0	--	--	--	0.009	0.009	0.009	0.009	0.009	0.009

Table 5-6c. Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Hyalella azteca* on Test Day 7 (µg/L)

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Negative Control Samples (CTL-SS) (continued)											
Cadmium	3	1	0.02	0.02	0.02	0.0055	0.0055	0.0055	0.0055	0.0103	0.02
Chromium	3	3	0.06	0.07	0.08	--	--	--	0.06	0.07	0.08
Cobalt	3	3	0.276	0.407	0.501	--	--	--	0.276	0.407	0.501
Copper	3	1	0.43	0.43	0.43	0.145	0.165	0.185	0.145	0.253	0.43
Iron	3	3	108	136	179	--	--	--	108	136	179
Lead	3	2	0.086	0.091	0.096	0.049	0.049	0.049	0.049	0.077	0.096
Manganese	3	3	303	449	554	--	--	--	303	449	554
Nickel	3	3	0.78	0.963	1.11	--	--	--	0.78	0.963	1.11
Selenium	3	0	--	--	--	0.45	0.45	0.45	0.45	0.45	0.45
Silver	3	0	--	--	--	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
Thallium	3	0	--	--	--	0.002	0.00233	0.0025	0.002	0.00233	0.0025
Vanadium	3	3	1.32	1.55	1.96	--	--	--	1.32	1.55	1.96
Zinc	3	0	--	--	--	0.205	0.347	0.54	0.205	0.347	0.54
Auxiliary Control Samples (CTL-QS)											
Aluminum	3	1	8.1	8.1	8.1	2.85	3.45	4.05	2.85	5	8.1
Antimony	3	0	--	--	--	0.055	0.0667	0.075	0.055	0.0667	0.075
Arsenic	3	3	0.12	0.187	0.27	--	--	--	0.12	0.187	0.27
Barium	3	3	6.07	6.71	7.39	--	--	--	6.07	6.71	7.39
Beryllium	3	0	--	--	--	0.009	0.009	0.009	0.009	0.009	0.009
Cadmium	3	3	0.048	0.0573	0.074	--	--	--	0.048	0.0573	0.074
Chromium	3	0	--	--	--	0.025	0.025	0.025	0.025	0.025	0.025
Cobalt	3	3	0.416	0.6	0.776	--	--	--	0.416	0.6	0.776
Copper	3	1	0.56	0.56	0.56	0.135	0.155	0.175	0.135	0.29	0.56
Iron	3	2	18.4	23.9	29.3	1.45	1.45	1.45	1.45	16.4	29.3
Lead	3	0	--	--	--	0.0125	0.0177	0.022	0.0125	0.0177	0.022
Manganese	3	3	13.1	25.5	37.5	--	--	--	13.1	25.5	37.5
Nickel	3	3	1.55	1.73	1.95	--	--	--	1.55	1.73	1.95
Selenium	3	1	1.1	1.1	1.1	0.45	0.45	0.45	0.45	0.667	1.1
Silver	3	0	--	--	--	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
Thallium	3	1	0.025	0.025	0.025	0.017	0.019	0.021	0.017	0.021	0.025
Vanadium	3	0	--	--	--	0.055	0.055	0.055	0.055	0.055	0.055
Zinc	3	1	5.86	5.86	5.86	1.265	2.18	3.1	1.265	3.41	5.86

Notes:

Results for site samples include results for potential reference samples.

Results for tributary and upstream samples include one tributary location in the United States and six upstream locations in Canada.

Averaged results have three significant figures applied.

[a] The number of results for site samples is 22 instead of 20 because one location, REF-10b, was included in all three batches (see Table 2-13).
The number of results for tributary and upstream samples is 17 instead of 7 because five locations were included in all three batches (see Table 2-13).

[b] Calculated with nondetected results at one-half of the detection limit.

-- no value

CTL-QS - quartz sand auxiliary control

CTL-SS - PER negative control sediment

Table 5-6d. Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Chironomus dilutus* on Test Day 21 (µg/L)

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Site Samples											
Aluminum	22	14	9.1	18.4	33.3	1.55	3.14	4.05	1.55	12.8	33.3
Antimony	22	10	0.5	2.39	7.01	0.01	0.0496	0.145	0.01	1.12	7.01
Arsenic	22	22	1.29	27.6	109	--	--	--	1.29	27.6	109
Barium	22	22	70.8	208	891	--	--	--	70.8	208	891
Beryllium	22	0	--	--	--	0.0075	0.00902	0.0095	0.0075	0.00902	0.0095
Cadmium	22	6	0.012	0.0932	0.23	0.005	0.00747	0.0245	0.005	0.0308	0.23
Chromium	22	14	0.05	0.117	0.28	0.025	0.025	0.025	0.025	0.0836	0.28
Cobalt	22	22	0.115	0.729	1.69	--	--	--	0.115	0.729	1.69
Copper	22	16	0.12	1.65	4.86	0.065	0.168	0.42	0.065	1.24	4.86
Iron	22	22	44.6	4230	22700	--	--	--	44.6	4230	22700
Lead	22	22	0.087	0.5	2.4	--	--	--	0.087	0.5	2.4
Manganese	22	22	9.09	2150	5470	--	--	--	9.09	2150	5470
Nickel	22	22	0.37	0.954	2.2	--	--	--	0.37	0.954	2.2
Selenium	22	0	--	--	--	0.4	0.448	0.45	0.4	0.448	0.45
Silver	22	0	--	--	--	0.0045	0.00555	0.006	0.0045	0.00555	0.006
Thallium	22	8	0.014	0.122	0.528	0.002	0.00329	0.011	0.002	0.0465	0.528
Vanadium	22	20	0.139	0.635	1.46	0.055	0.0555	0.056	0.055	0.583	1.46
Zinc	22	7	15.2	31.5	68.2	0.245	1.36	6.7	0.245	10.9	68.2
Tributary and Upstream Samples											
Aluminum	17	7	9.2	14.1	20	1.95	2.85	3.5	1.95	7.47	20
Antimony	17	0	--	--	--	0.01	0.0379	0.1	0.01	0.0379	0.1
Arsenic	17	17	0.46	6.36	13.8	--	--	--	0.46	6.36	13.8
Barium	17	17	44.1	107	221	--	--	--	44.1	107	221
Beryllium	17	0	--	--	--	0.009	0.00906	0.0095	0.009	0.00906	0.0095
Cadmium	17	5	0.01	0.0308	0.058	0.005	0.00675	0.0145	0.005	0.0138	0.058
Chromium	17	14	0.05	0.105	0.16	0.02	0.0233	0.025	0.02	0.0906	0.16
Cobalt	17	16	0.333	0.729	2.13	0.0245	0.0245	0.0245	0.0245	0.687	2.13
Copper	17	12	0.08	0.233	0.6	0.055	0.106	0.175	0.055	0.195	0.6
Iron	17	17	18.5	2120	6820	--	--	--	18.5	2120	6820
Lead	17	13	0.042	0.0938	0.186	0.02	0.0244	0.0325	0.02	0.0775	0.186
Manganese	17	17	753	2880	9300	--	--	--	753	2880	9300
Nickel	17	17	0.14	1.36	2.52	--	--	--	0.14	1.36	2.52
Selenium	17	0	--	--	--	0.45	0.45	0.45	0.45	0.45	0.45
Silver	17	0	--	--	--	0.0055	0.00576	0.0075	0.0055	0.00576	0.0075
Thallium	17	1	0.013	0.013	0.013	0.002	0.00353	0.0125	0.002	0.00409	0.013
Vanadium	17	12	0.14	0.634	1.36	0.0555	0.0576	0.06	0.0555	0.464	1.36
Zinc	17	0	--	--	--	0.1	0.474	1.92	0.1	0.474	1.92
Negative Control Samples (CTL-SS)											
Aluminum	3	0	--	--	--	2.65	3.13	3.55	2.65	3.13	3.55
Antimony	3	0	--	--	--	0.055	0.08	0.1	0.055	0.08	0.1
Arsenic	3	3	15.9	17.2	19.6	--	--	--	15.9	17.2	19.6
Barium	3	3	1.26	1.9	2.34	--	--	--	1.26	1.9	2.34
Beryllium	3	0	--	--	--	0.009	0.009	0.009	0.009	0.009	0.009

Table 5-6d. Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Chironomus dilutus* on Test Day 21 (µg/L)

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Negative Control Samples (CTL-SS) (continued)											
Cadmium	3	0	--	--	--	0.005	0.00667	0.0095	0.005	0.00667	0.0095
Chromium	3	3	0.13	0.153	0.19	--	--	--	0.13	0.153	0.19
Cobalt	3	3	0.339	0.424	0.472	--	--	--	0.339	0.424	0.472
Copper	3	2	0.33	0.355	0.38	0.155	0.155	0.155	0.155	0.288	0.38
Iron	3	3	223	321	508	--	--	--	223	321	508
Lead	3	3	0.107	0.224	0.341	--	--	--	0.107	0.224	0.341
Manganese	3	3	386	498	640	--	--	--	386	498	640
Nickel	3	3	1.5	1.71	1.91	--	--	--	1.5	1.71	1.91
Selenium	3	0	--	--	--	0.45	0.45	0.45	0.45	0.45	0.45
Silver	3	0	--	--	--	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
Thallium	3	0	--	--	--	0.002	0.00217	0.0025	0.002	0.00217	0.0025
Vanadium	3	3	1.06	1.57	2.36	--	--	--	1.06	1.57	2.36
Zinc	3	0	--	--	--	0.29	0.342	0.38	0.29	0.342	0.38
Auxiliary Control Samples (CTL-QS)											
Aluminum	3	3	9.6	10.2	11.4	--	--	--	9.6	10.2	11.4
Antimony	3	1	0.47	0.47	0.47	0.06	0.0825	0.105	0.06	0.212	0.47
Arsenic	3	3	0.49	1.05	1.97	--	--	--	0.49	1.05	1.97
Barium	3	3	8.9	11.2	14.3	--	--	--	8.9	11.2	14.3
Beryllium	3	0	--	--	--	0.009	0.00917	0.0095	0.009	0.00917	0.0095
Cadmium	3	2	0.01	0.014	0.018	0.0055	0.0055	0.0055	0.0055	0.0112	0.018
Chromium	3	0	--	--	--	0.02	0.0233	0.025	0.02	0.0233	0.025
Cobalt	3	3	0.404	0.52	0.64	--	--	--	0.404	0.52	0.64
Copper	3	2	0.13	0.21	0.29	0.185	0.185	0.185	0.13	0.202	0.29
Iron	3	3	465	1680	3640	--	--	--	465	1680	3640
Lead	3	1	0.093	0.093	0.093	0.0225	0.027	0.0315	0.0225	0.049	0.093
Manganese	3	3	41.4	71	103	--	--	--	41.4	71	103
Nickel	3	3	1.1	1.5	1.79	--	--	--	1.1	1.5	1.79
Selenium	3	0	--	--	--	0.45	0.467	0.5	0.45	0.467	0.5
Silver	3	0	--	--	--	0.0055	0.00567	0.006	0.0055	0.00567	0.006
Thallium	3	1	0.009	0.009	0.009	0.002	0.00225	0.0025	0.002	0.0045	0.009
Vanadium	3	0	--	--	--	0.055	0.0568	0.0595	0.055	0.0568	0.0595
Zinc	3	0	--	--	--	0.27	1.01	1.535	0.27	1.01	1.535

Notes:

Results for site samples include results for potential reference samples.

Results for tributary and upstream samples include one tributary location in the United States and six upstream locations in Canada.

Averaged results have three significant figures applied.

[a] The number of results for site samples is 22 instead of 20 because one location, REF-10b, was included in all three batches (see Table 2-13).
The number of results for tributary and upstream samples is 17 instead of 7 because five locations were included in all three batches (see Table 2-13).

[b] Calculated with nondetected results at one-half of the detection limit.

-- no value

CTL-QS - quartz sand auxiliary control

CTL-SS - PER negative control sediment

Table 5-6e. Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Hyalella azteca* on Test Day 21 (µg/L)

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Site Samples											
Aluminum	22	9	6.5	17.3	42.4	1.65	2.9	6.8	1.65	8.78	42.4
Antimony	22	9	1.18	9.92	61.3	0.01	0.0469	0.21	0.01	4.09	61.3
Arsenic	22	22	0.58	36	121	--	--	--	0.58	36	121
Barium	22	22	71.6	248	1080	--	--	--	71.6	248	1080
Beryllium	22	0	--	--	--	0.009	0.00907	0.01	0.009	0.00907	0.01
Cadmium	22	5	0.013	0.137	0.322	0.005	0.00821	0.03	0.005	0.0374	0.322
Chromium	22	12	0.05	0.176	0.38	0.02	0.0385	0.105	0.02	0.113	0.38
Cobalt	22	22	0.116	0.874	1.8				0.116	0.874	1.8
Copper	22	14	0.1	1.82	5.11	0.035	0.055	0.115	0.035	1.18	5.11
Iron	22	21	34	7260	28600	2.55	2.55	2.55	2.55	6930	28600
Lead	22	17	0.097	0.689	4.8	0.035	0.0528	0.0675	0.035	0.544	4.8
Manganese	22	22	9.53	3340	9140	--	--	--	9.53	3340	9140
Nickel	22	22	0.21	0.919	2.4	--	--	--	0.21	0.919	2.4
Selenium	22	0	--	--	--	0.45	0.45	0.45	0.45	0.45	0.45
Silver	22	0	--	--	--	0.0055	0.00552	0.006	0.0055	0.00552	0.006
Thallium	22	3	0.094	0.231	0.501	0.002	0.0075	0.028	0.002	0.038	0.501
Vanadium	22	20	0.115	0.606	1.51	0.055	0.0563	0.0575	0.055	0.556	1.51
Zinc	22	8	3.54	37	96.5	0.115	1.25	8.6	0.115	14.2	96.5
Tributary and Upstream Samples											
Aluminum	17	4	7	11.3	15.7	1.75	3.35	7.4	1.75	5.21	15.7
Antimony	17	0	--	--	--	0.01	0.0374	0.1	0.01	0.0374	0.1
Arsenic	17	17	0.26	6.39	15.6	--	--	--	0.26	6.39	15.6
Barium	17	17	57.4	124	254	--	--	--	57.4	124	254
Beryllium	17	0	--	--	--	0.009	0.009	0.009	0.009	0.009	0.009
Cadmium	17	3	0.012	0.0357	0.064	0.005	0.00532	0.0055	0.005	0.0107	0.064
Chromium	17	8	0.05	0.104	0.16	0.025	0.0383	0.09	0.025	0.0691	0.16
Cobalt	17	17	0.034	0.79	2.33	--	--	--	0.034	0.79	2.33
Copper	17	8	0.08	0.3	0.55	0.035	0.0783	0.135	0.035	0.183	0.55
Iron	17	16	30.5	3360	10800	5.25	5.25	5.25	5.25	3170	10800
Lead	17	5	0.094	0.149	0.198	0.0145	0.0337	0.0585	0.0145	0.0676	0.198
Manganese	17	17	489	3390	10400	--	--	--	489	3390	10400
Nickel	17	17	0.1	1.3	2.51	--	--	--	0.1	1.3	2.51
Selenium	17	0	--	--	--	0.45	0.45	0.45	0.45	0.45	0.45
Silver	17	0	--	--	--	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
Thallium	17	0	--	--	--	0.002	0.00424	0.0175	0.002	0.00424	0.0175
Vanadium	17	12	0.14	0.439	1.07	0.055	0.0568	0.0575	0.055	0.327	1.07
Zinc	17	0	--	--	--	0.1	0.599	3.1	0.1	0.599	3.1
Negative Control Samples (CTL-SS)											
Aluminum	3	1	9.8	9.8	9.8	3.95	4.35	4.75	3.95	6.17	9.8
Antimony	3	0	--	--	--	0.06	0.0783	0.09	0.06	0.0783	0.09
Arsenic	3	3	12.2	14.7	17.6	--	--	--	12.2	14.7	17.6
Barium	3	3	1.64	2.46	2.97	--	--	--	1.64	2.46	2.97
Beryllium	3	0	--	--	--	0.009	0.009	0.009	0.009	0.009	0.009

Table 5-6e. Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Hyalella azteca* on Test Day 21 (µg/L)

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Negative Control Samples (CTL-SS) (continued)											
Cadmium	3	1	0.013	0.013	0.013	0.005	0.00525	0.0055	0.005	0.00783	0.013
Chromium	3	2	0.11	0.15	0.19	0.055	0.055	0.055	0.055	0.118	0.19
Cobalt	3	3	0.278	0.355	0.413	--	--	--	0.278	0.355	0.413
Copper	3	1	0.54	0.54	0.54	0.16	0.17	0.18	0.16	0.293	0.54
Iron	3	3	215	319	464	--	--	--	215	319	464
Lead	3	3	0.139	0.269	0.421	--	--	--	0.139	0.269	0.421
Manganese	3	3	413	490	594	--	--	--	413	490	594
Nickel	3	3	1.11	1.42	1.62	--	--	--	1.11	1.42	1.62
Selenium	3	0	--	--	--	0.45	0.45	0.45	0.45	0.45	0.45
Silver	3	0	--	--	--	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
Thallium	3	0	--	--	--	0.002	0.00233	0.0025	0.002	0.00233	0.0025
Vanadium	3	3	0.967	1.49	2.36	--	--	--	0.967	1.49	2.36
Zinc	3	0	--	--	--	0.175	0.552	0.96	0.175	0.552	0.96
Auxiliary Control Samples (CTL-QS)											
Aluminum	3	1	9	9	9	4.05	4.93	5.8	4.05	6.28	9
Antimony	3	1	0.36	0.36	0.36	0.08	0.095	0.11	0.08	0.183	0.36
Arsenic	3	3	0.21	0.46	0.86	--	--	--	0.21	0.46	0.86
Barium	3	3	10.2	12.2	14.2	--	--	--	10.2	12.2	14.2
Beryllium	3	0	--	--	--	0.009	0.00917	0.0095	0.009	0.00917	0.0095
Cadmium	3	0	--	--	--	0.0055	0.00883	0.015	0.0055	0.00883	0.015
Chromium	3	0	--	--	--	0.025	0.025	0.025	0.025	0.025	0.025
Cobalt	3	3	0.46	0.52	0.56	--	--	--	0.46	0.52	0.56
Copper	3	1	0.28	0.28	0.28	0.07	0.125	0.18	0.07	0.177	0.28
Iron	3	3	96.7	852	2060	--	--	--	96.7	852	2060
Lead	3	0	--	--	--	0.016	0.0232	0.034	0.016	0.0232	0.034
Manganese	3	3	34.2	67.9	97	--	--	--	34.2	67.9	97
Nickel	3	3	1.1	1.12	1.14	--	--	--	1.1	1.12	1.14
Selenium	3	0	--	--	--	0.45	0.45	0.45	0.45	0.45	0.45
Silver	3	0	--	--	--	0.0055	0.00567	0.006	0.0055	0.00567	0.006
Thallium	3	0	--	--	--	0.0025	0.00617	0.013	0.0025	0.00617	0.013
Vanadium	3	0	--	--	--	0.055	0.0567	0.058	0.055	0.0567	0.058
Zinc	3	0	--	--	--	0.34	0.42	0.555	0.34	0.42	0.555

Notes:

Results for site samples include results for potential reference samples.

Results for tributary and upstream samples include one tributary location in the United States and six upstream locations in Canada.

Averaged results have three significant figures applied.

[a] The number of results for site samples is 22 instead of 20 because one location, REF-10b, was included in all three batches (see Table 2-13).
The number of results for tributary and upstream samples is 17 instead of 7 because five locations were included in all three batches (see Table 2-13).

[b] Calculated with nondetected results at one-half of the detection limit.

-- no value

CTL-QS - quartz sand auxiliary control

CTL-SS - PER negative control sediment

Table 5-6f. Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Chironomus dilutus* on Test Day 42 (µg/L)

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Site Samples											
Aluminum	22	15	10.2	22.8	49.3	1.8	3.14	4.5	1.8	16.5	49.3
Antimony	22	11	0.26	2.66	8.86	0.015	0.0436	0.225	0.015	1.35	8.86
Arsenic	22	22	1.79	30.6	120	--	--	--	1.79	30.6	120
Barium	22	22	78.6	182	683	--	--	--	78.6	182	683
Beryllium	22	2	0.02	0.0205	0.021	0.009	0.00963	0.014	0.009	0.0106	0.021
Cadmium	22	10	0.01	0.0445	0.157	0.005	0.00583	0.01	0.005	0.0234	0.157
Chromium	22	16	0.05	0.169	0.35	0.02	0.0242	0.025	0.02	0.13	0.35
Cobalt	22	21	0.178	0.585	1.75	0.0595	0.0595	0.0595	0.0595	0.561	1.75
Copper	22	16	0.08	1.44	5.45	0.045	0.114	0.315	0.045	1.08	5.45
Iron	22	22	245	4690	15600	--	--	--	245	4690	15600
Lead	22	18	0.07	0.596	1.76	0.0345	0.0709	0.1015	0.0345	0.501	1.76
Manganese	22	22	12	2160	6650	--	--	--	12	2160	6650
Nickel	22	22	0.29	0.952	2.14	--	--	--	0.29	0.952	2.14
Selenium	22	0	--	--	--	0.4	0.468	0.7	0.4	0.468	0.7
Silver	22	0	--	--	--	0.0045	0.00552	0.0085	0.0045	0.00552	0.0085
Thallium	22	3	0.107	0.206	0.4	0.002	0.00547	0.0255	0.002	0.0329	0.4
Vanadium	22	22	0.18	1.08	3	--	--	--	0.18	1.08	3
Zinc	22	5	18	36.4	52.3	0.29	1.54	4.67	0.29	9.47	52.3
Tributary and Upstream Samples											
Aluminum	17	8	6.4	16.4	45.8	2.15	3.46	5.15	2.15	9.53	45.8
Antimony	17	0	--	--	--	0.01	0.0371	0.06	0.01	0.0371	0.06
Arsenic	17	17	0.44	6.5	12.6	--	--	--	0.44	6.5	12.6
Barium	17	17	35.4	93.2	184	--	--	--	35.4	93.2	184
Beryllium	17	0	--	--	--	0.009	0.00918	0.0095	0.009	0.00918	0.0095
Cadmium	17	2	0.03	0.035	0.04	0.005	0.00553	0.006	0.005	0.009	0.04
Chromium	17	13	0.06	0.151	0.31	0.025	0.025	0.025	0.025	0.121	0.31
Cobalt	17	16	0.172	0.458	1.25	0.007	0.007	0.007	0.007	0.431	1.25
Copper	17	10	0.09	0.204	0.57	0.035	0.0679	0.125	0.035	0.148	0.57
Iron	17	17	113	1840	4690	--	--	--	113	1840	4690
Lead	17	7	0.058	0.0929	0.147	0.016	0.0335	0.0815	0.016	0.0579	0.147
Manganese	17	17	683	2400	6930	--	--	--	683	2400	6930
Nickel	17	17	0.12	1.1	2.89	--	--	--	0.12	1.1	2.89
Selenium	17	1	1.1	1.1	1.1	0.45	0.45	0.45	0.45	0.488	1.1
Silver	17	0	--	--	--	0.0045	0.00529	0.006	0.0045	0.00529	0.006
Thallium	17	1	0.009	0.009	0.009	0.002	0.00328	0.008	0.002	0.00362	0.009
Vanadium	17	16	0.159	0.835	2.31	0.06	0.06	0.06	0.06	0.789	2.31
Zinc	17	0	--	--	--	0.145	0.347	0.79	0.145	0.347	0.79
Negative Control Samples (CTL-SS)											
Aluminum	3	1	8.8	8.8	8.8	3.65	4.03	4.4	3.65	5.62	8.8
Antimony	3	1	0.31	0.31	0.31	0.1	0.118	0.135	0.1	0.182	0.31
Arsenic	3	3	19.2	21.3	22.7	--	--	--	19.2	21.3	22.7
Barium	3	3	1.07	1.24	1.45	--	--	--	1.07	1.24	1.45
Beryllium	3	0	--	--	--	0.009	0.00917	0.0095	0.009	0.00917	0.0095

Table 5-6f. Long-Term Bioassay Porewater Summary Metal/Metalloid Statistics for *Chironomus dilutus* on Test Day 42 (µg/L)

Analyte	Number of Samples[a]	Number of Detected Values	Minimum Detected Value	Mean Detected Value	Maximum Detected Value	Minimum Nondetected Value[b]	Mean Nondetected Value[b]	Maximum Nondetected Value[b]	Overall Minimum Value[b]	Overall Mean Value[b]	Overall Maximum Value[b]
Negative Control Samples (CTL-SS) (continued)											
Cadmium	3	1	0.016	0.016	0.016	0.005	0.0055	0.006	0.005	0.009	0.016
Chromium	3	3	0.17	0.223	0.27	--	--	--	0.17	0.223	0.27
Cobalt	3	3	0.237	0.29	0.343	--	--	--	0.237	0.29	0.343
Copper	3	2	0.34	0.35	0.36	0.265	0.265	0.265	0.265	0.322	0.36
Iron	3	3	274	358	416	--	--	--	274	358	416
Lead	3	2	0.238	0.257	0.276	0.091	0.091	0.091	0.091	0.202	0.276
Manganese	3	3	323	372	423	--	--	--	323	372	423
Nickel	3	3	1.39	1.82	2.06	--	--	--	1.39	1.82	2.06
Selenium	3	0	--	--	--	0.45	0.45	0.45	0.45	0.45	0.45
Silver	3	0	--	--	--	0.0045	0.00533	0.006	0.0045	0.00533	0.006
Thallium	3	0	--	--	--	0.002	0.00233	0.0025	0.002	0.00233	0.0025
Vanadium	3	3	2.34	2.97	4.03	--	--	--	2.34	2.97	4.03
Zinc	3	0	--	--	--	0.195	0.367	0.635	0.195	0.367	0.635
Auxiliary Control Samples (CTL-QS)											
Aluminum	3	2	14	14.2	14.3	5.4	5.4	5.4	5.4	11.2	14.3
Antimony	3	2	0.25	0.26	0.27	0.115	0.115	0.115	0.115	0.212	0.27
Arsenic	3	3	1.39	1.87	2.21	--	--	--	1.39	1.87	2.21
Barium	3	3	9.41	13	16	--	--	--	9.41	13	16
Beryllium	3	0	--	--	--	0.009	0.00933	0.0095	0.009	0.00933	0.0095
Cadmium	3	0	--	--	--	0.005	0.0055	0.006	0.005	0.0055	0.006
Chromium	3	0	--	--	--	0.025	0.025	0.025	0.025	0.025	0.025
Cobalt	3	3	0.072	0.185	0.257	--	--	--	0.072	0.185	0.257
Copper	3	1	0.14	0.14	0.14	0.035	0.085	0.135	0.035	0.103	0.14
Iron	3	3	1920	2580	3250	--	--	--	1920	2580	3250
Lead	3	1	0.058	0.058	0.058	0.0095	0.0258	0.042	0.0095	0.0365	0.058
Manganese	3	3	41	73.6	103	--	--	--	41	73.6	103
Nickel	3	3	0.42	0.7	1.01	--	--	--	0.42	0.7	1.01
Selenium	3	0	--	--	--	0.45	0.45	0.45	0.45	0.45	0.45
Silver	3	0	--	--	--	0.0045	0.00533	0.006	0.0045	0.00533	0.006
Thallium	3	0	--	--	--	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
Vanadium	3	1	0.14	0.14	0.14	0.057	0.0575	0.058	0.057	0.085	0.14
Zinc	3	0	--	--	--	0.22	0.377	0.46	0.22	0.377	0.46

Notes:

Results for site samples include results for potential reference samples.

Results for tributary and upstream samples include one tributary location in the United States and six upstream locations in Canada.

Averaged results have three significant figures applied.

[a] The number of results for site samples is 22 instead of 20 because one location, REF-10b, was included in all three batches (see Table 2-13).
The number of results for tributary and upstream samples is 17 instead of 7 because five locations were included in all three batches (see Table 2-13).

[b] Calculated with nondetected results at one-half of the detection limit.

-- no value

CTL-QS - quartz sand auxiliary control

CTL-SS - PER negative control sediment