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# Columbia River Pore Water Sampling in 100-BC Area, November 2010

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

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# Columbia River Pore Water Sampling in 100-BC Area, November 2010


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Release Approval 6/23/2011 Date

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# Executive Summary

During the Hanford Site weapons production mission (1943 to 1989), some contaminants were released to the Columbia River directly and others, including hexavalent chromium (Cr(VI)), were released to the soil at waste disposal facilities or as unplanned spills or leaks. Some contaminants migrated from the soil into the groundwater and eventually into the Columbia River. This discharge to the river takes place where groundwater seeps up into the river bottom in spaces between rocks and sediment grains. This phenomenon is known as upwelling, and the water in these sediments is termed pore water.

This report summarizes pore water sampling activities conducted during November 2010 in support of DOE/RL-2009-44.[1] It also presents an evaluation of the recent data in conjunction with previously collected pore water data.

In November 2010, workers sampled pore water at two upstream reference stations and at ten stations near 100-BC that were previously sampled. The previous work was conducted during 2009 and early 2010 as part of the work for DOE/RL-2008-11.[2] The purpose of the sampling work was to provide data to assess the Cr(VI) levels in the Columbia River's bed near the 100-BC area. Bulk samples of pore water were collected from the river bed using the Trident[3] probe and associated deployment techniques. Samples were analyzed for total chromium and Cr(VI).

The sampling techniques used were similar to those used during previous studies for the DOE/RL-2008-11 remedial investigation. Field quality control (QC) helped to minimize the variation of the water quality caused by fluctuating river levels. Samples were collected only during relatively low river stage periods, and field teams were allowed to make several attempts around the established stations to locate pore water conductivity readings that were within 10 percent of previous sampling events. The conductivity of upwelling groundwater is higher than that of river water.

---

[1] DOE/RL-2009-44, 2010, *Sampling and Analysis Plan for the 100-BC-1, 100-BC-2, and 100-BC-5 Operable Units Remedial Investigation/Feasibility Study*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www2.hanford.gov/arpir/?content=findpage&AKey=1004211024.

[2] DOE/RL-2008-11, 2008, *Remedial Investigation Work Plan for Hanford Site Releases to the Columbia River*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=0810240394.

[3] Coastal Monitoring Associates (San Diego, California) Trident probe has a patent pending.

Pore water samples were collected in the deep river channel area, near the 100-BC water intake structure, at several locations near the 100-BC outfall pipelines, and near a former waste site during low river periods. Daily river fluctuations were typically about 2 m (6 ft).

Overall, Cr(VI) levels were lower during the November 2010 sampling event than during the two previous sampling events. Only three of the eleven sample results from near 100-BC exceeded the Cr(VI) water quality limit (10 μg/L). The maximum Cr(VI) pore water concentration measured was 13.6 μg/L, compared with 112 and 46 μg/L maxima measured during the previous two sample events.

Some of the Cr(VI) concentrations measured in pore water in the fall of 2009 were higher than those currently measured in 100-BC groundwater. The change in pore water concentrations between the fall of 2009 and the fall of 2010 may be due to one or more of the following:

- Greater dilution with river water in later sampling events (related to river stage)
- Variations in sampling depths in the river bed
- A source of Cr(VI) contamination other than 100-BC groundwater
- Passing of a pulse of high Cr(VI) water, which could have originated from unknown groundwater contamination (i.e., from areas vertically or horizontally not characterized) or could have represented older groundwater contamination
- A data quality problem (e.g., interference of suspended particles/turbidity)

Data were evaluated to determine whether changes in conductivity accounted for the changes in Cr(VI) concentrations in pore water. Because groundwater beneath 100-BC varies significantly in Cr(VI) concentration, even when conductivity is relatively constant, there is not a definitive correlation between Cr(VI) concentration and conductivity. The relationship of Cr(VI) and conductivity at individual stations varied: some showed a positive correlation, others showed a negative correlation, and some had no correlation.

In general, conductivity of samples increased with increasing depth in the river bed. However, as previously noted, the conductivity alone could not explain the change in Cr(VI) concentrations among the three sampling events.

Statistical evaluation of data concluded that Cr(VI) and conductivity measurements were generally consistent with river dilution of groundwater migrating into the river from beneath 100-BC. The major exception was in the fall of 2009, when several pore water samples had high Cr(VI) concentrations that statistical tests classify as outliers. No upstream sources of Cr(VI) have been identified, so it is reasonable to assume that the pore water contamination originated in 100-BC groundwater.

QC data indicate that most of the data were representative. Data quality issues may have affected individual samples but not overall conclusions.

The only remaining explanation for the elevated Cr(VI) in the fall of 2009 and the subsequent drop in concentrations is the passage of an actual pulse of high Cr(VI) water through the hydrogeologic system. Ten monitoring wells were installed after the fall of 2009 to improve characterization of groundwater contamination vertically and horizontally. The Cr(VI) plume was discovered to extend farther west than previously known, but concentrations were less than 50 μg/L (lower than the fall 2009 pore water concentrations). Historically, groundwater concentrations may have been higher, as evidenced by >100 μg/L concentrations during 1998 and 1999, in what was then the only well in western 100-BC.

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# Terms

| | |
|---|---|
| bgs | below ground surface |
| DO | dissolved oxygen |
| EPA | U.S. Environmental Protection Agency |
| MASS1 | Modular Aquatic Simulation System-1D |
| MDL | method detection limit |
| NC | not calculated |
| NTU | Nephelometric Turbidity Units |
| ORP | oxidation-reduction potential |
| QC | quality control |
| RPD | relative percent difference |
| SAP | sampling and analysis plan |

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# 1 Introduction

Between 1943 and 1989, during the Hanford Site weapons production mission, some contaminated materials were discharged to the Columbia River. In addition, waste disposal practices resulted in the release of contaminants to the upland soil. Some of these contaminants migrated from the soil to the groundwater and eventually into the river. This discharge to the river takes place where the groundwater percolates up through the river bottom and mixes with river water and sediment. These areas are known as upwellings, and the intersecting waters are referred to as pore water.

The 100-BC study area is located on the south bank of the Columbia River, upstream from the rest of the Hanford Site former reactor areas (Figure 1-1). Groundwater in the unconfined aquifer beneath 100-BC is contaminated with hexavalent chromium (Cr(VI)), tritium, and strontium-90 at concentrations above water quality standards (DOE/RL-2010-11, *Hanford Site Groundwater Monitoring and Performance Report for 2009*). Chromium concentrations in groundwater range from <10 to approximately 50 µg/L.

Recent pore water characterization activities, performed under the *Remedial Investigation Work Plan for Hanford Site Releases to the Columbia River* (DOE/RL-2008-11), indicated that Cr(VI) was entering the river at concentrations above the aquatic water quality standard at 100-BC (WCH-398, *Data Summary Report for the Remedial Investigation of Hanford Site Releases to the Columbia River, Hanford Site, Washington*). In those studies, pore water samples collected in both deep and shallow river beds near the 100-BC study area had up to ten times the Cr(VI) water quality limit of 10 µg/L (DOE/RL-2008-11; WCH-380, *Field Summary Report for Remedial Investigation of Hanford Site Releases to the Columbia River, Hanford Site, Washington: Collection of Surface Water, Pore Water, and Sediment Samples for Characterization of Groundwater Upwelling*; and WCH-398).

The sampling stations selected for this study corresponded with areas where Cr(VI) concentrations above aquatic cleanup levels had been detected in the earlier pore water sampling events (WCH-398). Two additional stations, BC-Near-shore 1 and BC-Near-shore 2, which had not been previously sampled for pore water and were thought to be out of the influence of 100-BC sources of Cr(VI), were sampled to serve as upriver reference stations.

This report summarizes pore water sampling activities conducted during November 2010 in support of the sampling and analysis plan (SAP), DOE/RL-2009-44, *Sampling and Analysis Plan for the 100-BC-1, 100-BC-2, and 100-BC-5 Operable Units Remedial Investigation/Feasibility Study*. The results of these sampling activities are evaluated in conjunction with previous results.

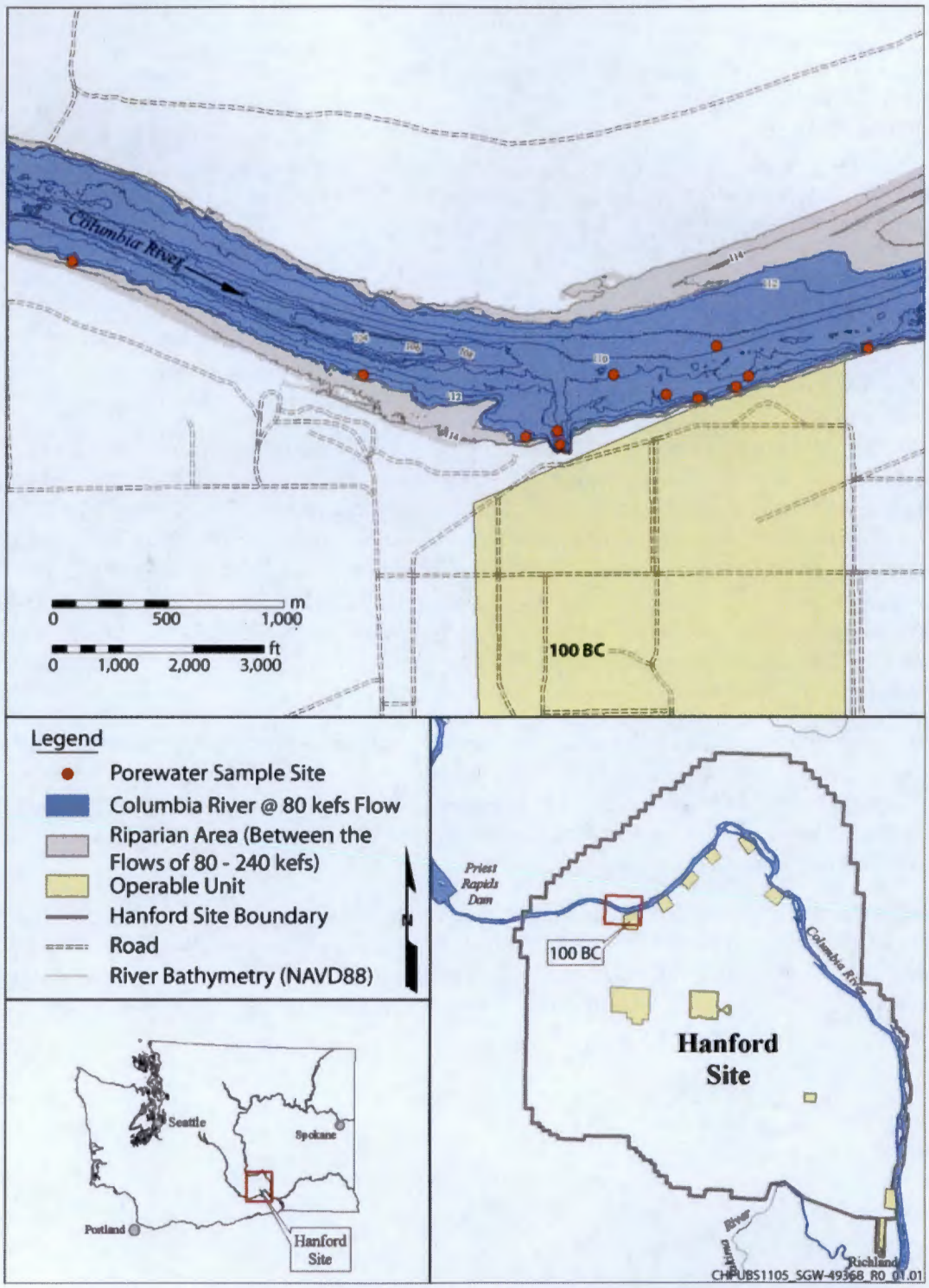


**Figure 1-1. 100-BC Area, Hanford Site, Washington**

# 2 Methods

Bulk samples of pore water were collected using the Trident probe[4] and associated deployment techniques, shown in Figure 2-1. Trident is a liquid phase groundwater mapping and sampling tool, designed for sustained use in complex offshore riverine environments. The probe is mounted on a driving frame that allows samples to be collected in turbulent waters and rocky river beds while keeping the probe stable.

In general, the field sampling techniques and data collected during this sampling effort are similar to the efforts described in WCH-380. The approach was used to detect groundwater upwellings and allowed field teams to collect pore water samples to be analyzed for the presence of specific groundwater contaminants, such as Cr(VI).

Once the offshore deployment vessel was located over a desired station, the driving frame and Trident probe were deployed to the river bed, and the probe was driven 20 to 30 cm (8 to 12 in.) below ground surface (bgs) of the river bed. The sampling tube was then purged using a peristaltic pump on board the vessel. Pore water samples were then drawn to a precleaned bulk sample container when in-situ conductivity readings of the pore water showed the presence of groundwater (greater than ~170 µS/cm) or when the pore water conductivity was similar (generally within 10 percent) to the measurements previously taken during DOE/RL-2008-11 sampling efforts.

## 2.1 Pore Water Sample Collection Guidelines

A great deal of research on the Hanford Site has shown the important role that the Columbia River stage (river level) has on groundwater discharge patterns and contaminant concentrations. Field sampling guidelines developed during the DOE/RL-2008-11 remedial investigation/feasibility study were used for this investigation to help minimize variation of the results associated with river stage fluctuations (WCH-380). The field sampling guidelines were used to help field teams avoid sampling during non-ideal conditions or to qualify the sample results that were collected. Implementation of these guidelines was important for obtaining results that were relatively comparable across space and over time. The following field sampling guidelines were used during this event:

- Collect samples when the river levels have been ≤0.8 m (2.6 ft) above the low water mark for at least one to two hours prior to sampling.
- Intermittently perform pore water conductivity checks at selected sample locations near the work site to check for signs of significant dilution from bank recharge and/or surface water pressure.
- Collect samples when a pore water conductivity reading is at least 90 percent of the conductivity measurements previously reported at the location during prior contaminant sampling events.
- Monitor river levels before and after each sampling event.

[4] Coastal Monitoring Associates (San Diego, California) Trident probe has a patent pending.

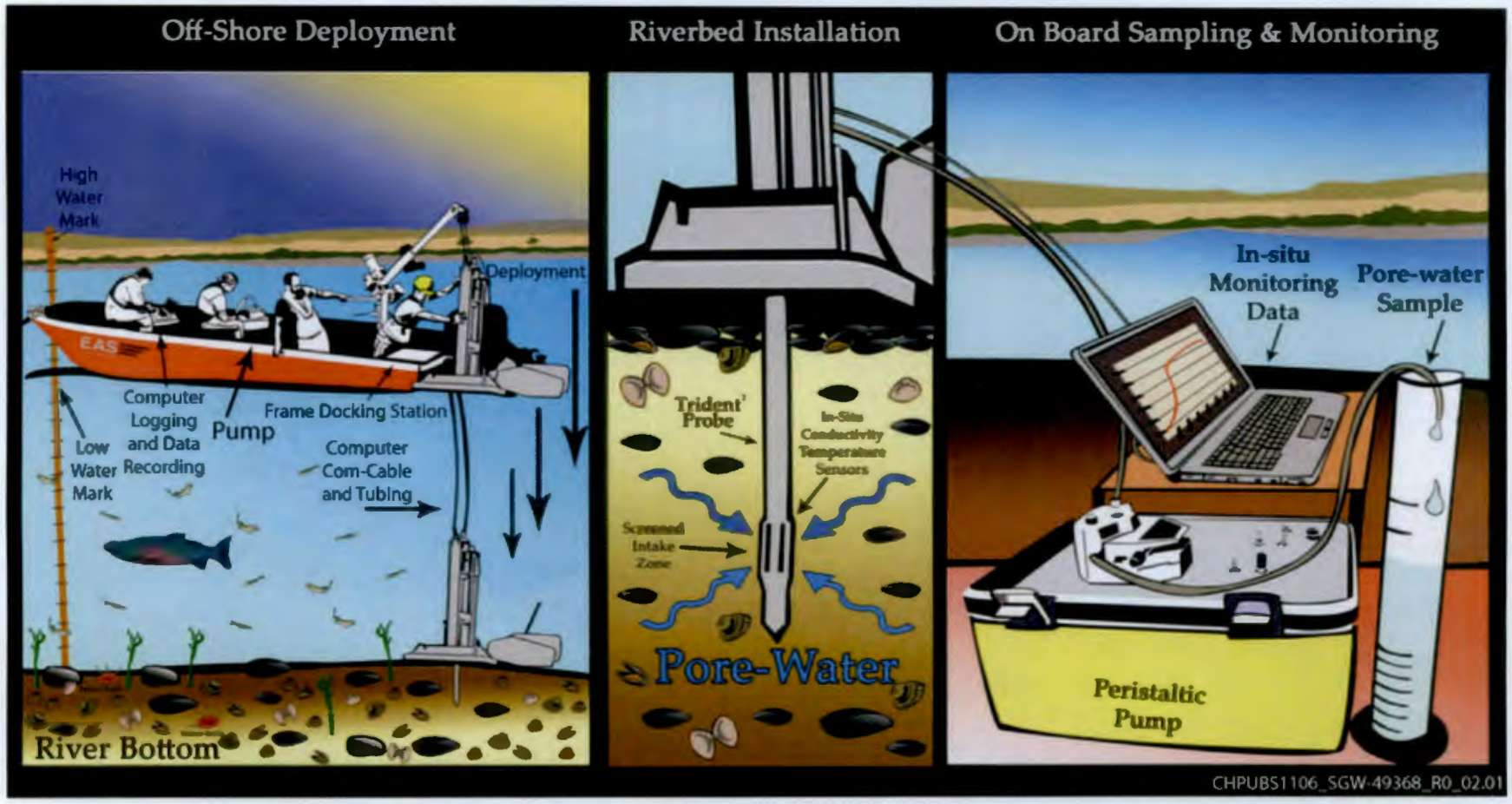


**Figure 2-1. Pore Water Sampling Using the Trident Probe and Associated Deployment Techniques**

A river level gauge established near 100-BC during the previous pore water sampling work (WCH-380) was measured regularly during the November 2010 sampling event to help evaluate the river level before, during, and after sampling. Staff also used the Modular Aquatic Simulation System-1D (MASS1), a one-dimensional unsteady river flow model, developed to characterize river stages and discharges encountered during each sampling event (PNNL-15226, *Hydrodynamic Simulation of the Columbia River, Hanford Reach, 1940-2004*). MASS1 simulates unsteady discharge and water surface elevations at each site by solving the one-dimensional equations of mass and momentum conservation (also known as the St. Venant equations). MASS1 was run with real discharge and forebay data when pore water conductivity readings were taken, and was used to calculate half-hour river discharge and water surface elevations for transects nearest to the groundwater upwelling sample locations. The river stage conditions encountered during the sampling events were summarized. Sampling guidelines called for flagging results with a project-unique qualifier if the river level was >0.8 m (2.6 ft) above the low water mark during the sampling event, or if the sample was collected when pore water conductivity was <90 percent of previous contaminant sampling events (WCH-380 and WCH-398).

## 2.2 Pore Water Sample Collection and Handling

Pore water samples were collected from 20 to 30 cm (8 to 12 in.) bgs at each sample station. Before each sample was collected, ~100 to 150 mL of water was purged and discarded. Once relatively stable, high, in situ pore water conductivity readings were measured, ~500 mL of pore water was collected from each station and placed into tamper-proof, glass, amber, precleaned containers.

Pore water conductivity was monitored in situ during each sample collection event to help verify that the samples were not artificially diluted or short circuited with surface water as a result of over pumping from a shallow point in the river bed. Staff also measured and recorded temperature, pH, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity. Pore water samples were immediately placed into a cooler containing ice until they could be transferred to sampling support staff.

The pore water sampling methods used are provided in Appendix A. Sample results were flagged with project-unique qualifiers if the pore water conductivity changed by >10 percent during any given sample event. Surface water quality data were also obtained at each sample site. The surface water reference probes and opening of the surface water sampling tube were 30 cm (12 in.) above the river bed at all stations.

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# 3 Results

During this sampling event, 13 pore water samples were collected: 11 samples, including one duplicate sample, were collected from 10 previously established stations; and 2 samples were collected upstream of 100-BC and near the southern shoreline to serve as upstream reference pore water sample results (Figure 3-1). Upstream reference samples were collocated with three clusters of aquifer sampling tubes.

Pore water sampling near 100-BC began on November 4, 2010, and was completed on November 16, 2010 (Table 3-1). Quality control (QC) samples consisted of one equipment blank (collected November 4, 2010), one split, and one duplicate sample (Table 3-1). Water depths at the sampling stations ranged from 0.5 to 5.8 m (1.6 to 19 ft). The probe penetration depth ranged from 20 to 31 cm (7.9 to 12.2 in.). The stations farthest offshore had consistently less penetration than the near-shore stations.

Figure 3-2 generally illustrates the river stage fluctuations that occurred during the November 2010 pore water sampling event near 100-BC. River levels typically fluctuated about 2 m (6 ft) daily. The highest river stages shown in Figure 3-2 correspond to river discharges of ~4.5 million L/sec (160,000 $ft^3$/sec), and the lowest river stages correspond to river discharges of ~1.1 million L/sec (40,000 $ft^3$/sec). All samples were collected when the river stage was <0.8 m (2.6 ft) above the low water mark (i.e., the green line) and when river discharges ranged between ~1.08 and 1.7 million L/sec (38,000 and ~60,000 $ft^3$/sec) (see Table 3-1 and Figure 3-2).

## 3.1 Water Quality Results

The water quality field parameter measurements are related to the following variables: groundwater gradients, river bottom elevation horizons, depth of penetration, river stage, and duration of high flows conditions. These conditions all influence hydraulic heads, gradients and, ultimately, the magnitude and extent of groundwater discharge into the river. To compare the river field parameters with pore water parameters, the variable conditions need to be considered.

Table 3-2 includes conductivity measurements from the recent sampling, and Table 3-3 compares minimum and maximum field measurements of pore water and surface water. Appendix B includes pore water and surface water field measurements for each station. Conductivity of pore water ranged from 159 to 355 µS/cm, while surface water ranged from 138 to 152 µS/cm. In general, the greatest difference between conductivity of pore water and surface water was observed in the near-shore stations. Stations farther offshore had smaller, but measureable, conductivity differentials.

In November 2010, the temperature and pH of the pore water were similar to the surface water (Table 3-3). The ORP of a few pore water samples was lower than surface water but on average was not much different from surface water. Station T100BC1J1, located near the intake structure in a sand-silt dominated substrate, was the only station exhibiting a low DO and a negative ORP (indicating an oxygen-depleted environment). Turbidity of the surface water was consistently low (range 1 to 3 Nephelometric Turbidity Units [NTUs]). Turbidity of most pore water samples ranged between 5 and 60 NTU, but the three pore water samples collected from the two deep channel stations had turbidity measurements between 380 and 650 NTU (Appendix B).

Figure 3-3 illustrates the pore water composite sample conductivity measurements. Conductivity measured in the pore water samples confirmed the presence of groundwater upwelling at all stations sampled. The lowest pore water conductivity measured was 159 µS/cm at station T100BC5C, near the deep channel (thalweg) of the river. The highest pore water conductivity obtained was 355 µS/cm at the station farthest downstream (J100BC47). Figure 3-3 also identifies 4 of the 10 (40 percent) established pore water stations that exhibited substantially lower conductivity compared with previous sampling events at those locations (<90 percent; Figure 3-2 and Table 3-2).

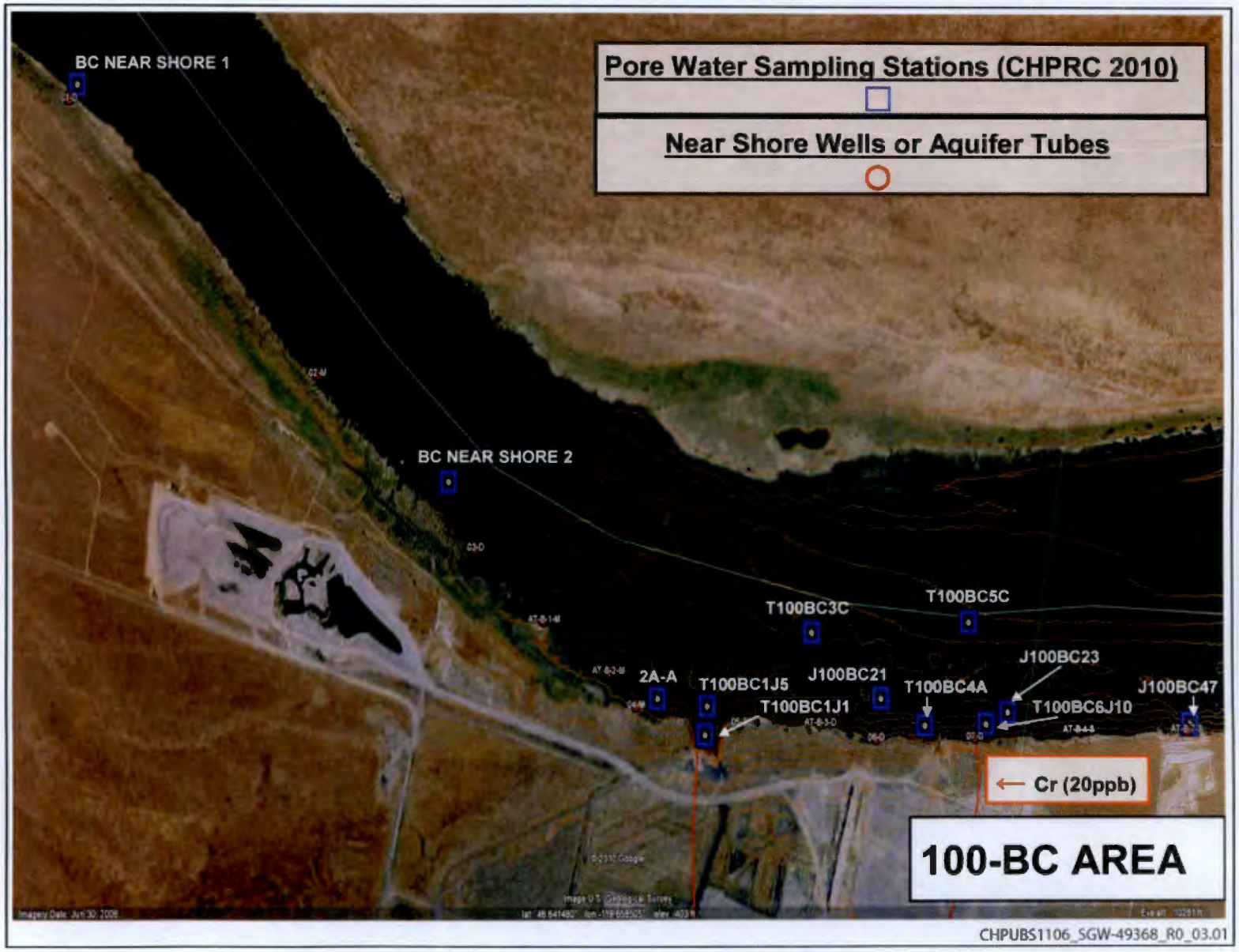


Figure 3-1. Pore Water Sampling Locations near 100-BC during November 2010

**Table 3-1. Summary of Pore Water Samples Collected at 100-BC during November 2010**

| Station Identification | General Location | Sample Date | General Substrate Conditions | Sample Volume (mL) | QC Sample Type | River Flow at Time of Sampling (million L/sec) | River Flow at Time of Sampling (Kcfs) | River Stage Height above Low Water (m) | Field QC Qualifier | Sample Number | River Bed Elevation per NAVD88[a] (m) | Water Depth at Station at Time of Sampling (m) | Pore Water Sensor Depth (cm bgs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A-A | Upstream of Intake Structure | 11/5/2010 | silt/sand | 600 | - | 1.60 | 58 | 0.6 | - | B296J1 | 118.8 | 0.6 | 31 |
| J100BC21 | Moderate Depth | 11/9/2010 | lg/med cobble | 560 | - | 1.63 | 57 | 0.6 | b,c | B296J6 | 115.2 | 3.5 | 20 |
| J100BC47 | Near Shore (128-B-3) | 11/10/2010 | sand | 800 | SPLIT | 1.64 | 40 | 0.5 | - | B296K2 | 118.6 | 0.9 | 31 |
| J100BC23 | Near Shore | 11/14/2010 | medium cobble | 600 | - | 1.08 | 38 | -0.1 | - | B296K1 | 115.6 | 2.5 | 25 |
| T100BC1J1 | Intake Structure | 11/8/2010 | silt/sand | 575 | - | 1.19 | 45 | 0.1 | c | B296J2 | 114.5 | 4.1 | 31 |
| T100BC1J5 | Intake Structure | 11/9/2010 | silt | 600 | - | 1.65 | 42 | 0.7 | - | B296J3 | 113.8 | 5.0 | 31 |
| T100BC3C | Deep Channel | 11/16/2010 | lg/med boulders | 550 | - | 1.69 | 58 | 0.7 | c | B296J4 | 113.6 | 5.8 | 20 |
| T100BC3C | Deep Channel | 11/16/2010 | lg/med boulders | 550 | DUPLICATE | 1.66 | 58 | 0.7 | c | B29B84 | 113.6 | 5.8 | 20 |
| T100BC4A | Near Shore | 11/7/2010 | med/sm cobble | 600 | - | 1.09 | 58 | -0.1 | - | B296J7 | 117.5 | 0.6 | 31 |
| T100BC5C | Deep Channel | 11/14/2010 | med/sm cobble | 550 | - | 1.07 | 38 | -0.1 | c | B296J9 | 115.6 | 3.1 | 23 |
| T100BC6J10 | Near Shore | 11/8/2010 | med/sm cobble | 600 | - | 1.28 | 38 | 0.3 | - | B296K0 | 117.7 | 0.6 | 28 |
| Nearshore 1 | Upstream Reference | 11/4/2010 | med/lg cobble | 700 | - | 1.63 | 60 | 0.7 | - | B296K3 | 119.4 | 1.3 | 25 |
| Nearshore 2 | Upstream Reference | 11/7/2010 | medium cobble | 600 | - | 1.14 | 59 | 0.0 | - | B296K4 | 118.8 | 0.5 | 23 |

a. NAVD88, 1988, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland.

b. Sample conductivity is <90% of WCH-380, *Field Summary Report for Remedial Investigation of Hanford Site Releases to the Columbia River, Hanford Site, Washington: Collection of Surface Water, Pore Water, and Sediment Samples for Characterization of Groundwater Upwelling*, conductivities.

c. In situ readings increased >10% during sample collection event.

Kfcs = thousands of cubic feet per second

lg = large

med = medium

**Table 3-2. Comparison of Cr(VI) Concentrations and Conductivity Measured in Pore Water Samples (2009 through 2010)**

| Station Identification | General Location | August/September 2009 | | January/February 2010 | | | November 2010 | | | Percent Change September 2009 to November 2010 | | Percent Change February 2010 to November 2010 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cond. (µS/cm) | Cr(VI) (µg/L) | Cond. (µS/cm) | Cr(VI) (µg/L) | Cr (Total) (µg/L) | Cond. (µS/cm) | Cr(VI) (µg/L) | Cr (Total) (µg/L) | Cond. | Cr(VI) | Cond. | Cr(VI) |
| 2A-A | Upstream of Intake Structure | 305[a] | 24[a] | 329[a] | 10[a] | 6.7[a] | 305 | 4.4 | 11.4[b] | 0 | -82 | -7 | -56 |
| J100BC21 | Moderate Depth | 332 | 73 | -- | -- | -- | 244 | <2 | 4.92[c] | -27 | -97 | -- | -- |
| J100BC23 | Near Shore | 160 | 91 | 230 | <3.7 | 3.17 | 207 | <2 | 5.2 | 29 | -98 | -10 | NC |
| J100BC47 | Near Shore (128-B-3) | 370 | 28 | 344 | 13 | 8.8 | 355 | 13.6 | 14.5 | -4 | -51 | 3 | 5 |
| T100BC1J1 | Intake Structure | 360 | 18 | 322[a,c] | 5[a,c] | <2[a,c] | 295 | <2 | <1[c] | -18 | -89 | -8 | NC |
| T100BC1J5 | Intake Structure | 334 | 23 | 309 | <3.7 | 1.29 | 304 | <2 | 2.21 | -9 | -91 | -2 | NC |
| T100BC3C | Deep Channel | 240 | 112 | 278 | 22 | 23.6 | 174 | 2.3 | 8.99 | -28 | -98 | -37 | -90 |
| T100BC3C DUP | Deep Channel | -- | -- | -- | -- | -- | 232 | 6.9 | 15.8[c] | -3 | -94 | -17 | -69 |
| T100BC4A | Near Shore | 350[a] | 80[a] | 344 | 46 | 20 | 341 | 12.6 | 13.7[d] | -3 | -84 | -1 | -73 |
| T100BC5C | Deep Channel | 279 | 57 | 163 | <3.7 | 11.1[b] | 159 | <2 | 5.01 | -43 | -96 | -2 | NC |
| T100BC6J10 | Near Shore | 299 | 26 | 302[a] | 10[a] | 10.2[a] | 330 | 12.6 | 14.3 | 10 | -52 | 9 | 26 |
| BC Nearshore 1 | Upstream Reference | -- | -- | -- | -- | -- | 204 | <2 | -- | -- | -- | -- | -- |
| BC Nearshore 2 | Upstream Reference | -- | -- | -- | -- | -- | 281 | <2 | -- | -- | -- | -- | -- |

Note: NC values near or below detection limit skew percentage.

a. Possible dilution of pore water sample is due to exceedance of river stage guidelines during sampling event.

b. Sample was not filtered.

c. Sample conductivity is <90% of prior pore water sample conductivity.

d. Unknown if sample was filtered.

**Table 3-3. Comparison of Selected Water Quality Measurements between Pore Water and Surface Water Samples**

| Parameter | Minimum | | Mean | | Maximum | |
|---|---|---|---|---|---|---|
| | Pore Water | Surface Water | Pore Water | Surface Water | Pore Water | Surface Water |
| Conductivity (µS/cm) | 159 | 138 | 264 | 143 | 355 | 152 |
| Temperature (C°) | 12.4 | 12.3 | 13.5 | 13.5 | 15.6 | 14.7 |
| pH | 7.07 | 7.32 | 7.48 | 7.67 | 7.82 | 8.02 |
| ORP (mV) | -25 | 160 | 258 | 267 | 323 | 312 |
| DO (mg/L) | 7.55 | 8.72 | 8.72 | 9.86 | 10.69 | 10.42 |
| Turbidity (NTU) | 5 | 1 | 136 | 1 | 650 | 3 |

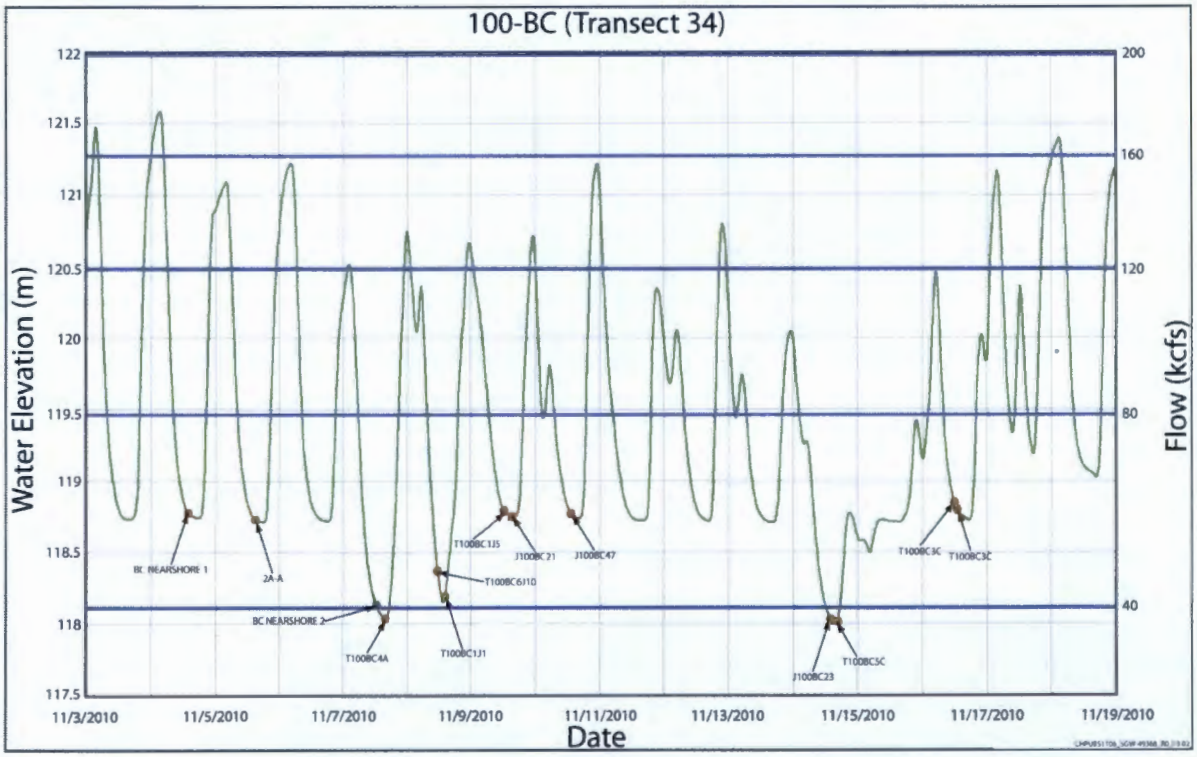


**Figure 3-2. River Level Fluctuations during the November 2010 100-BC Pore Water Sampling Event**

During collection of the duplicate sample from station T100BC3C, conductivity increased from 174 to 232 µS/cm (Figure 3-3). The duplicate sample was collected immediately after the parent sample, so the total volume at this site was two times the volume of all other sites, except the site where the split sample was taken (J100BC47). This is noteworthy because some sites have illustrated increases in the conductivity as the sample volume increased, whereas most had relatively stable conductivity during the sample collection event. Staff attempted to collect a third sample to serve as a more representative (high conductivity) duplicate to the second sample, but the site did not yield enough water.

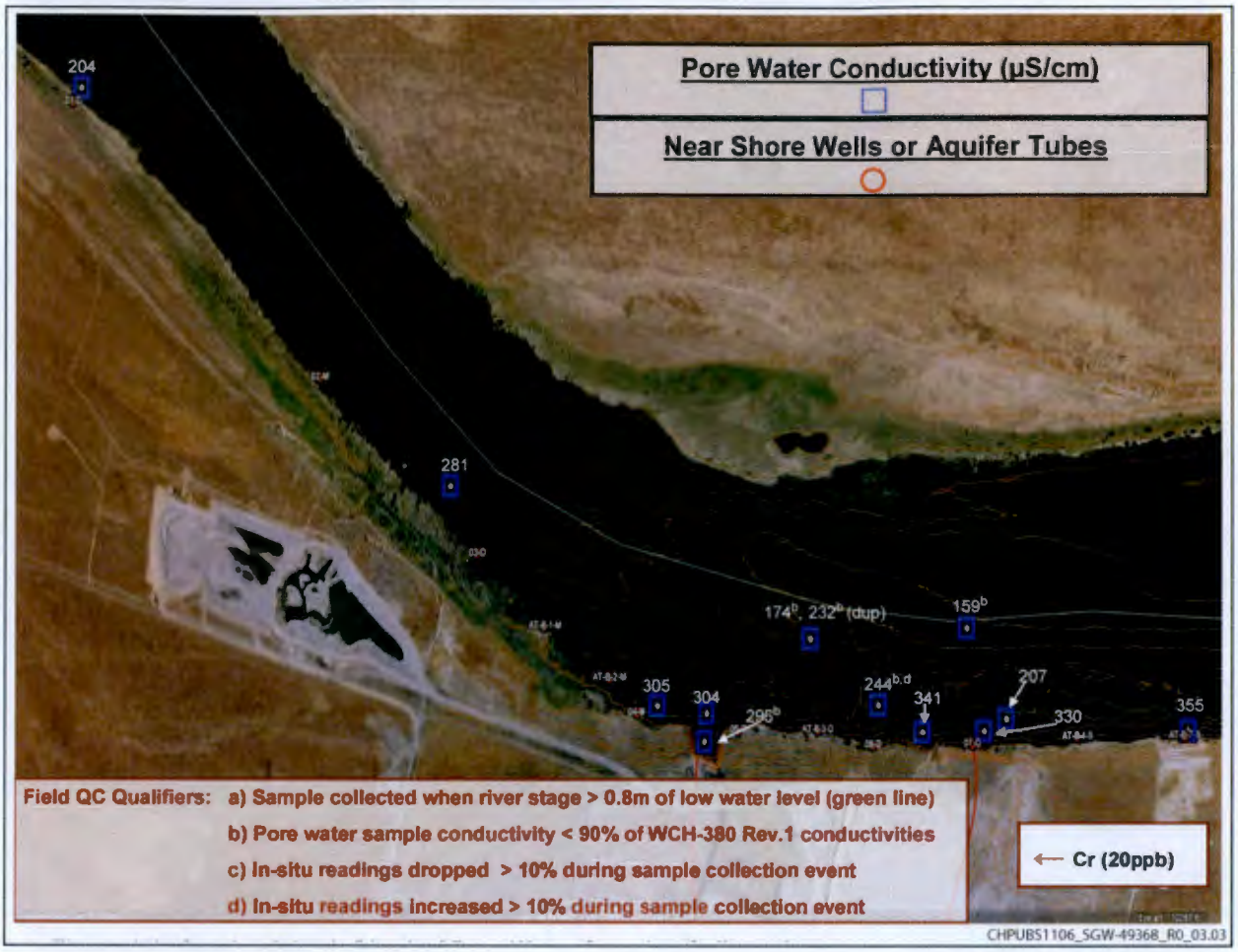


**Figure 3-3. Conductivity (µS/cm) of Pore Water Samples Collected near 100-BC during November 2010**

During the sample collection event, three of the twelve stations exhibited >1 percent increase in conductivity (Table 3-4). Excluding the duplicate station (J100BC47), only one station (J100BC21) showed a conductivity increase of more than 10 percent during sampling. Possibly, the large volume of water sampled before it finally stabilized at these four sites may have resulted from the lag time from recent high (nearly 2 m [6 ft]) river stage cycles that were occurring each day during the current sampling event. The decision to collect pore water samples at four of the ten stations where pore water conductivity was <90 percent of the prior sampling events (T100BC1J1, J100BC21, T100BC5C, and T100BC3C) was made after field crews made several attempts and were unable to locate higher conductivity readings in the immediate vicinity (within ~15 m [50 ft] radius) of the established station.

**Table 3-4. Sample Volumes and Change in Conductivity during Sample Collection**

| Station Identification | Volume (mL) | November 2010 Change in Conductivity during Sample Collection (Percent) |
|---|---|---|
| 2A-A | 600 | 0.0 |
| J100BC21 | 560 | 12.1 |
| J100BC23 | 600 | 0.0 |
| J100BC47 | 800 | 0.8 |
| T100BC1J1 | 575 | 0.3 |
| T100BC1J5 | 600 | -0.3 |
| T100BC3C | 550 | 3.9 |
| T100BC3C DUP* | 550 | 4.8 |
| T100BC4A | 600 | 0.3 |
| T100BC5C | 550 | -6.6 |
| T100BC6J10 | 600 | 0.6 |
| NEARSHORE 1 | 700 | 5.3 |
| NEARSHORE 2 | 600 | -0.4 |

* Conductivity increased 33 percent between parent sample and duplicate.

## 3.2 Hexavalent Chromium Concentrations

Hexavalent chromium was not detected in the upstream reference pore water samples but was detected at five of the ten established stations sampled near 100-BC during November 2010 (Figure 3-4; Table 3-2). The highest Cr(VI) concentration (13.6 µg/L) was measured in a pore water sample collected at station J100BC47, which is directly offshore from waste site 128-B-3. This waste site was not fully remediated because part of it is beyond the water line. The other two Cr(VI) concentrations above 10 µg/L (both 12.6 µg/L) were generally proximal to the 100-BC outfall structure (Figure 3-4) remediation sites. Hexavalent chromium concentrations were measured above the analytical detection limit in the parent and duplicate sample collected at station T100BC3C at 2.3 and 6.9 µg/L, respectively. The ~5 µg/L increase in Cr(VI) concentration measured in the duplicate sample collected at station T100BC3C corresponded to a ~60 µS/cm increase in conductivity change at that location (Figure 3-3). Station 2A-A was the only other station where Cr(VI) (4.4 µg/L) was measured above the 2.0 µg/L detection limit (Figure 3-4) during November 2010.

## 3.3 Quality Control

This section summarizes results of QC sampling in November 2010.

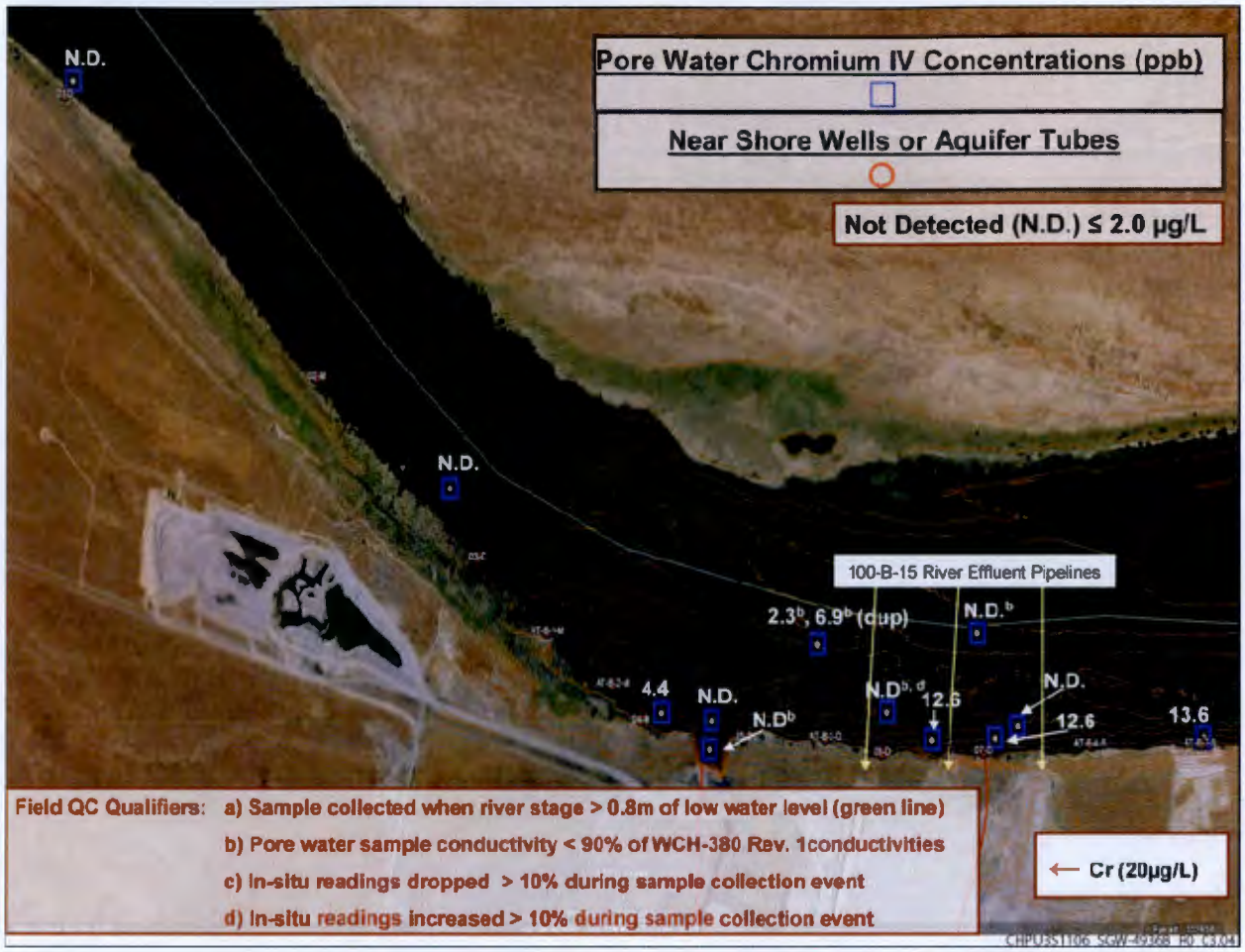


**Figure 3-4. Hexavalent Chromium Concentrations in Pore Water Samples Collected near 100-BC during November 2010**

### 3.3.1 Field Duplicates

In duplicate samples from station T100BC3C, Cr(VI) concentrations were reported at 2.3 and 6.9 µg/L. For routine Hanford Site groundwater monitoring, the accepted QC protocol is to evaluate duplicate results only when at least one of the sample results is greater than five times the method detection limit (MDL), because analytical methods are less precise at the low end of their detection range. Both of the results for the duplicate pair from station T100BC3C were less than five times the MDL (2 µg/L).

Total chromium was reported at 15.8 and 8.99 µg/L in duplicate samples from station T100BC3C in November 2010. The MDL was 1 µg/L, so both results were greater than 5 times the MDL. The relative percent difference (RPD) is 55 percent, which is greater than the 20 percent precision generally acceptable.

The difference in chromium concentrations may relate to the fact that when the duplicate was collected, the conductivity had increased significantly. Thus, the samples were not true duplicates.

### 3.3.2 Split Sample

Two laboratories analyzed samples from station J100BC47 for total chromium and Cr(VI). The Cr(VI) concentrations were reported at 10 and 13.6 µg/L, yielding an RPD of 30.5 percent, which is greater than

the 20 percent precision generally acceptable to the project. Total chromium was reported at 14.5 and 15.1 μg/L, with an RPD of 4 percent, which is within acceptance criteria.

### 3.3.3 Comparison of Total and Hexavalent Chromium

Although not intended as QC samples, comparison of total chromium and Cr(VI) results provides an extra check on data. Dissolved chromium in Hanford Site groundwater is virtually all hexavalent (WHC-SD-EN-TI-302, *Speciation and Transport Characteristics of Chromium in the 100-D/H Areas of the Hanford Site*). Results of filtered total chromium analyses are analogous to Cr(VI) (Appendix C of DOE/RL-2008-01). Total chromium in unfiltered samples might be higher than Cr(VI) results because of possible inclusion of particulate chromium. Total chromium results from November 2010 generally confirmed the Cr(VI) results (Table 3-2).

### 3.3.4 Equipment Blank

Equipment blank results were below detection limits for total chromium and Cr(VI).

## 3.4 Deviations from the Sampling and Analysis Plan

No deviations from the SAP (DOE/RL-2009-44) occurred during this sampling event. All pore water samples were collected when river levels were ≤0.8 m (2.6 ft) above the low water mark (i.e., the green line) as prescribed in DOE/RL-2009-44.

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# 4 Discussion

This chapter provides interpretation of the 100-BC pore water sampling results. It compares the November 2010 sampling results to previous results and considers alternative explanations for changes in Cr(VI) concentrations. Statistical comparisons of pore water and groundwater are consistent with Cr(VI) in 100-BC pore water originating from 100-BC groundwater. The most likely explanation for observed decreases in pore water Cr(VI) concentrations is passage of a Cr(VI) pulse. Alternative explanations for the apparent decrease include changes in river stage, changes in sampling penetration, differences in sample volume, or QC problems. However, none of these explanations is supported by the data, as described in this chapter.

## 4.1 Comparisons to Previous Pore Water Sampling Events near 100-BC

The Cr(VI) concentrations in November 2010 were lower than concentrations measured during previous sampling events (Table 3-2; Figures 4-1 and 4-2). During November 2010, five of the ten established pore water stations had detectable chromium levels, compared with ten of ten[5] in the fall of 2009 and six of ten in January/February 2010. The three highest Cr(VI) concentrations measured during November 2010 were between 12.6 and 13.6 µg/L, whereas the highest Cr(VI) concentrations measured during 2009 were between 80 and 112 µg/L.

Pore water Cr(VI) concentrations decreased at all ten established stations between the fall of 2009 and January/February 2010. Of the nine stations sampled in both January/February 2010 and November 2010, Cr(VI) concentrations decreased at four stations, remained virtually unchanged in four stations, and increased in one station.

In areas of groundwater upwelling, pore water samples represent a mix of groundwater and river water. Lower Cr(VI) concentrations would be expected if sample conductivity was low (i.e., if the sample contained more river water than groundwater). Table 3-2 shows the conductivity values measured in the pore water samples, and footnotes indicate which samples were collected when significantly lower conductivity was measured compared with prior pore water sampling events. Section 4.3 discusses whether sample dilution (as reflected by conductivity) explains the apparent decrease in Cr(VI) concentrations among the three sampling events.

Figure 4-3 illustrates river stage during the three sample events. Average river stage was highest (119.6 m [392.4 ft]) during the middle sampling event (January/February 2010). Average river stage was lowest during fall 2009 (119.2 m [391.1 ft]), and was higher in November 2010 (119.5 m [392.1 ft]). Daily fluctuations also were greater in November 2010 (approximately 2 m [6.5 ft]), compared to 1 m (3.3 ft) in fall 2009.

## 4.2 Comparison of Chromium in Pore Water to Groundwater

One possible explanation for the anomalously high Cr(VI) concentrations in 100-BC pore water in fall 2009 is that it derived from a source other than 100-BC groundwater. No upstream pore water samples were collected in fall 2009, but there are no known sources of Cr(VI) contamination upstream of or across the river from 100-BC. An in-situ source of Cr(VI) (e.g., from sediment) is another potential, but unlikely, source since Cr(VI) is highly soluble.

[5] Not all of the data from the fall 2009 or February 2010 sampling events are evaluated here. Only data from stations that were sampled again in November 2009 are considered.

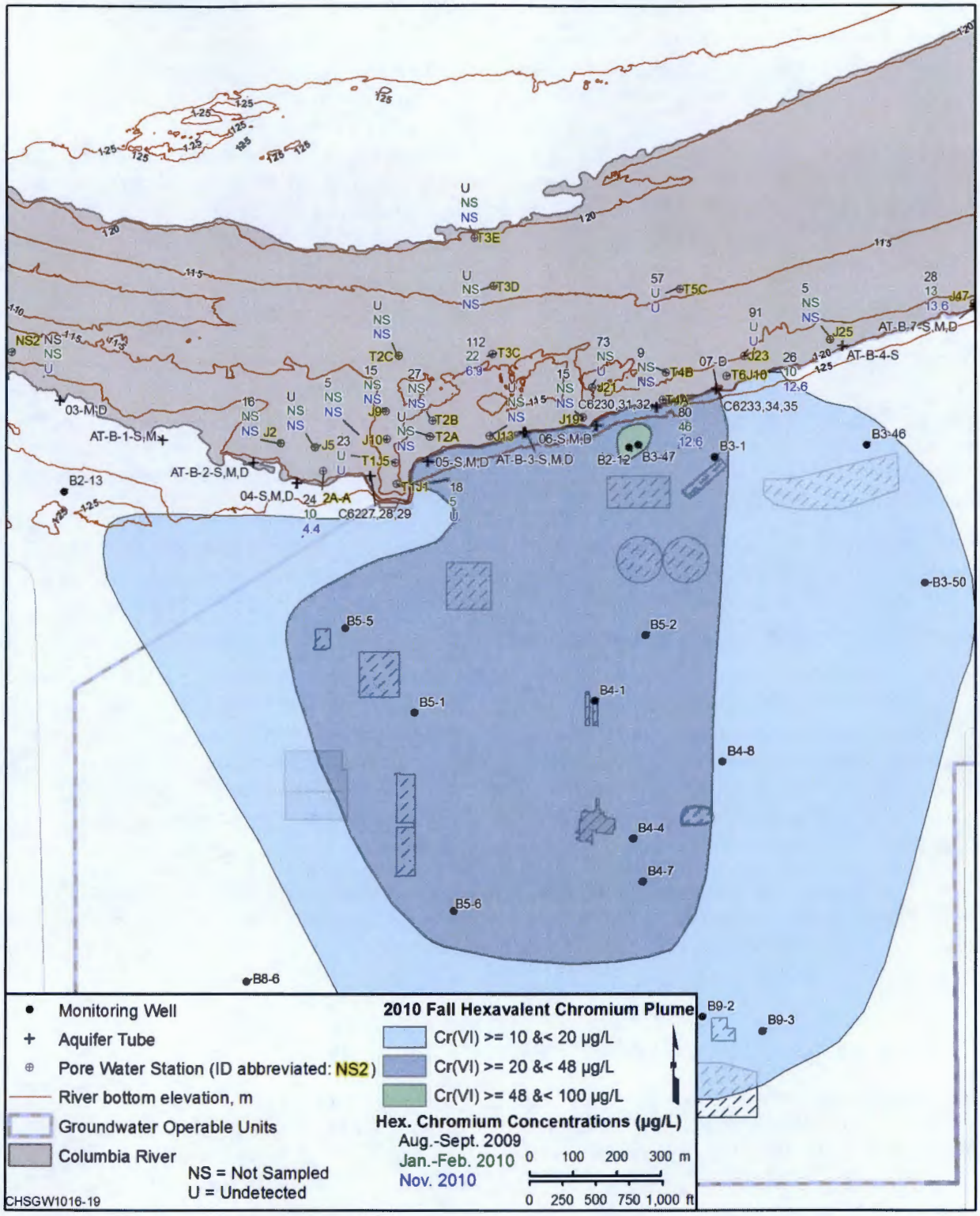



**Figure 4-1. Hexavalent Chromium Concentrations from Three Pore Water Sampling Campaigns at 100-BC, with 2010 Groundwater Contaminant Plume Map**

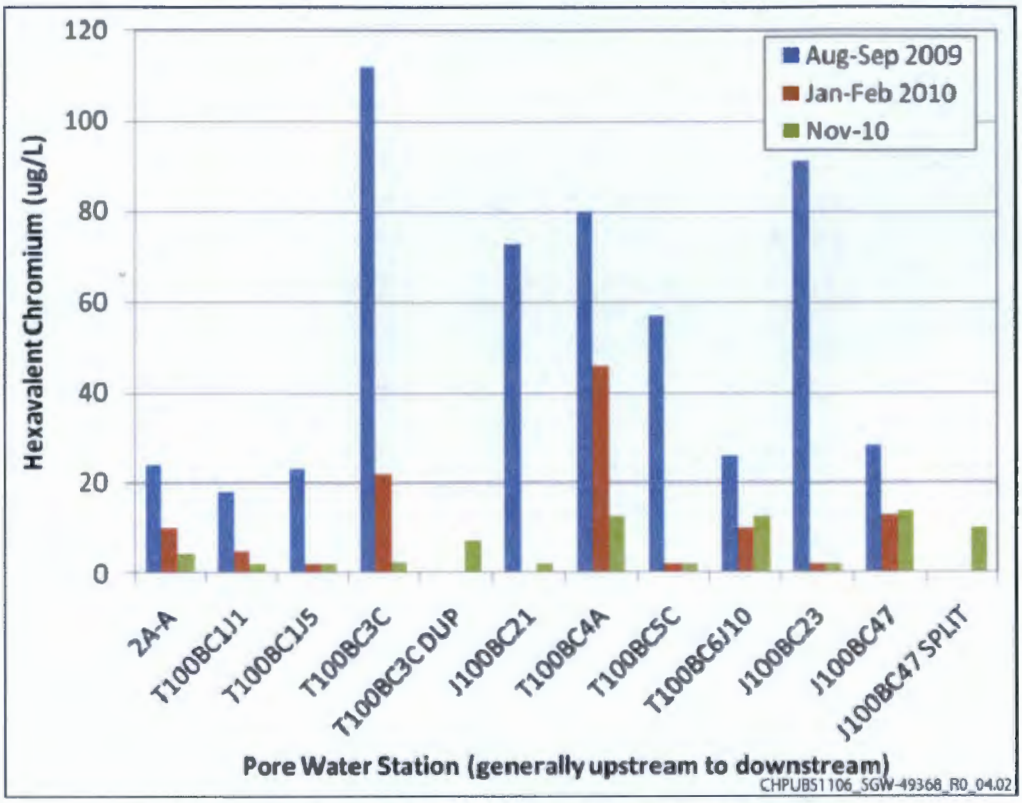



**Figure 4-2. Hexavalent Chromium Concentrations in 100-BC Pore Water, August/September 2009, January/February 2010, and November 2010**

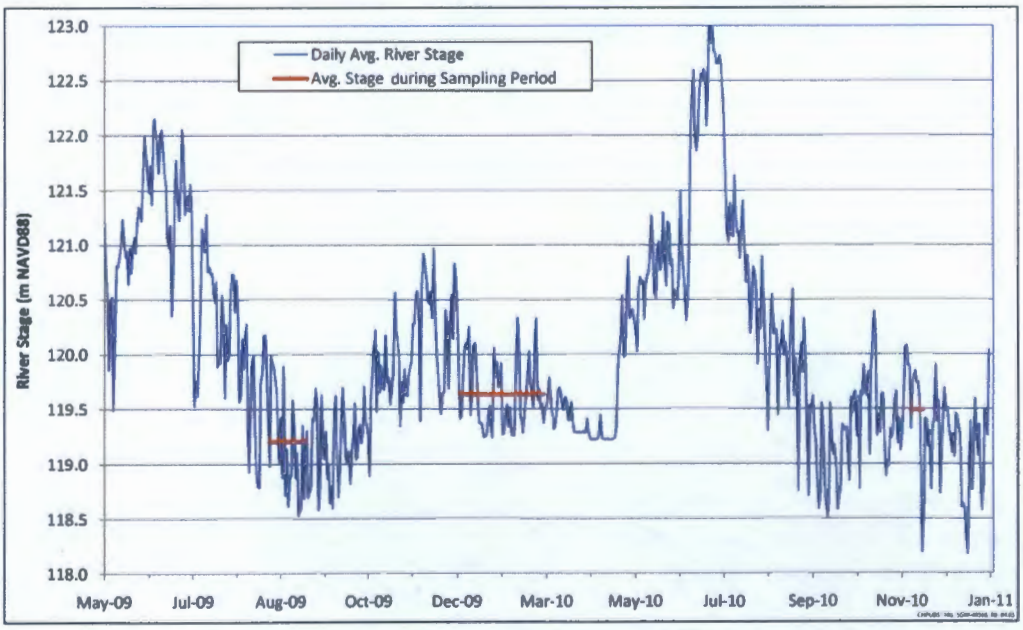



**Figure 4-3. River Stage at 100-BC during Three Pore Water Sampling Events**

Statistical analyses compared Cr(VI) in each of the three pore water sampling events to that in 100-BC groundwater. Because migration rates for groundwater to pore water are unknown, comparing pore water samples to groundwater samples at any specific time may be unrealistic. Therefore, average Cr(VI) concentrations over the previous five years (2006 through 2010) were used for the groundwater comparisons. For most wells, Cr(VI) concentrations were relatively stable over that time period, so the five-year averages are representative. Table 4-1 lists the results of the statistical comparisons.

**Table 4-1. Statistical Comparisons of Groundwater and Pore Water**

| Parameter Date | T-Test | Mann-Whitney W Test |
|---|---|---|
| Chromium Aug/Sep 2009 | 0.00076544 | 0.00955187 |
| Conductivity Aug/Sep 2009 | 0.0643894 | 0.143186 |
| Chromium Jan/Feb 2010 | 0.284813 | 0.102211 |
| Conductivity Jan/Feb 2010 | 0.0238003 | 0.0444625 |
| Chromium Nov 2010 | 0.00289479 | 0.000485605 |
| Conductivity Nov 2010 | 0.00120575 | 0.00329009 |

In order to determine whether Cr(VI) concentrations and conductivity of groundwater and pore water were drawn from the same population, the t-test and Mann-Whitney W test were applied. The t-test assumes normality of the data and equality of variances, but the Mann-Whitney W test does not. Both tests gave consistent results. Values in the table are the probabilities that pore water and groundwater would be more different than observed if they were drawn from the same population. A value less than 0.05 indicates a significant difference in the data sets at the 5 percent level. Hexavalent chromium in January/February 2010 and conductivity in August/September 2009 were not statistically different in pore water and groundwater. The other sample sets were statistically different.

Statistical differences between pore water and groundwater were greatest in August/September 2009, when Cr(VI) concentrations were significantly elevated in pore water relative to groundwater. A statistical difference was also observed in November 2010, when both Cr(VI) and conductivity were lower in pore water than in groundwater. Statistical differences were weaker or insignificant for the other monitoring event, consistent with variable groundwater dilution.

The spatial distributions of pore water and groundwater are easily seen in Figures 4-4 through 4-9. The spatial distribution is consistent with pore water being river diluted groundwater. Hexavalent chromium concentrations and conductivity decrease with increasing distance from shore. The major exception is the August/September 2009 Cr(VI), which was significantly elevated in pore water relative to groundwater at some locations.

Except for Cr(VI) in August/September 2009, Cr(VI) and conductivity values in pore water are always lower than in groundwater. This is evidenced in the distributions of data in the box-and-whiskers plots shown in Figures 4-10 through 4-12.

The box-and-whiskers plots indicate the distribution of results for the sampling events. Each box represents the 50 percent range of a given data set. The vertical line in each box represents the median for that data set. The red cross in the box represents the mean of the data set (on the right border of the box for Cr(VI) in January/February 2010). The "whiskers" represent the minimum and maximum values without considering outliers. Outliers within 1.5 box widths of the mean are represented by small squares beyond the extent of the whiskers. Outliers farther than 1.5 box widths from the mean are represented by

red crosses within the distant small squares. The boxes labeled "CondAve" and "CrAve" represent groundwater results.

The box-and-whiskers plots clearly indicate that, except for August/September 2009, pore water is consistently lower in Cr(VI) and conductivity than 100-BC groundwater. This supports the view that the pore water samples represent river-diluted 100-BC groundwater.

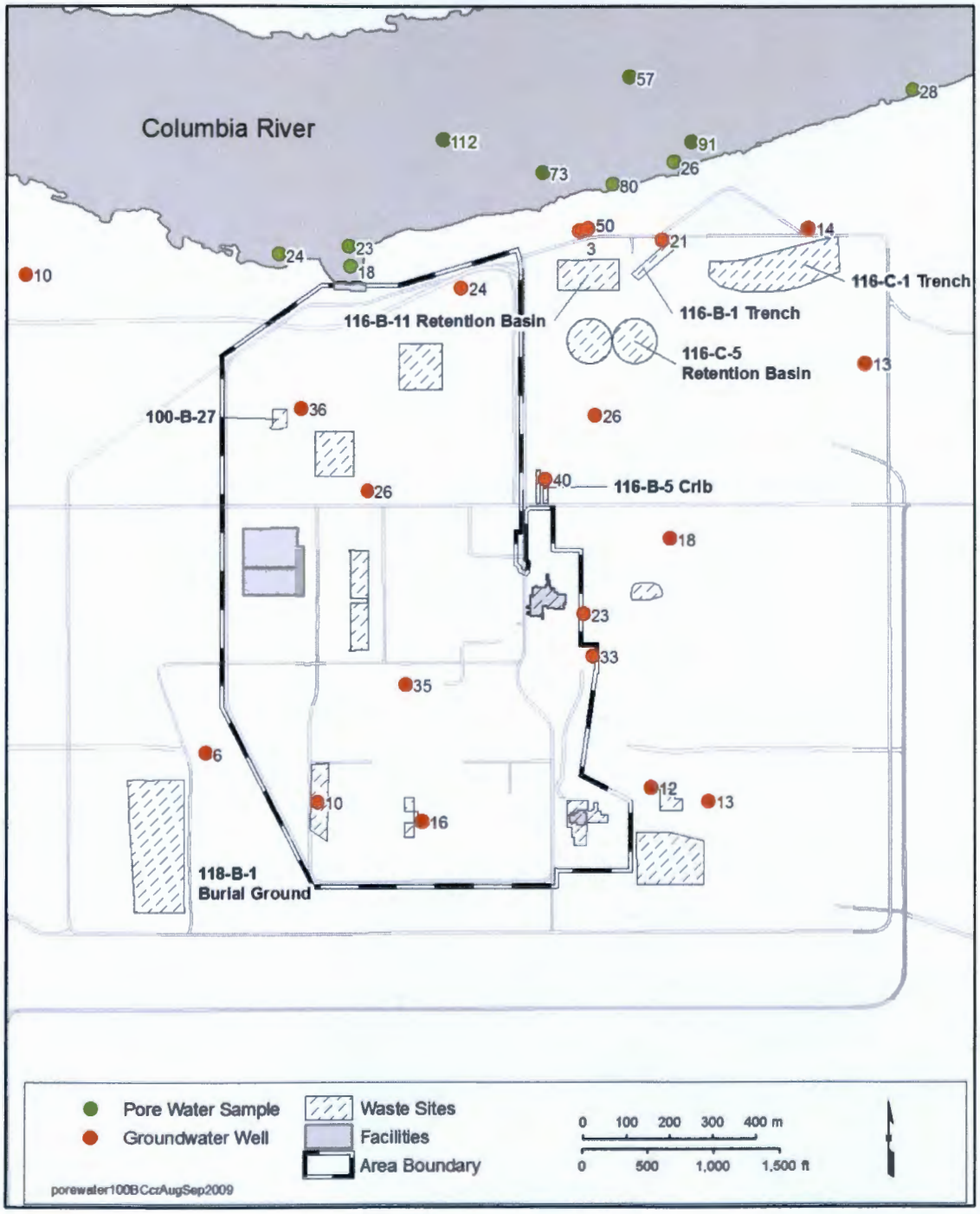



**Figure 4-4. Hexavalent Chromium (µg/L) in 100-BC Pore Water (August/September 2009) and Groundwater (2006–2010 Average) Showing Elevated Cr(VI) Concentration in Pore Water**

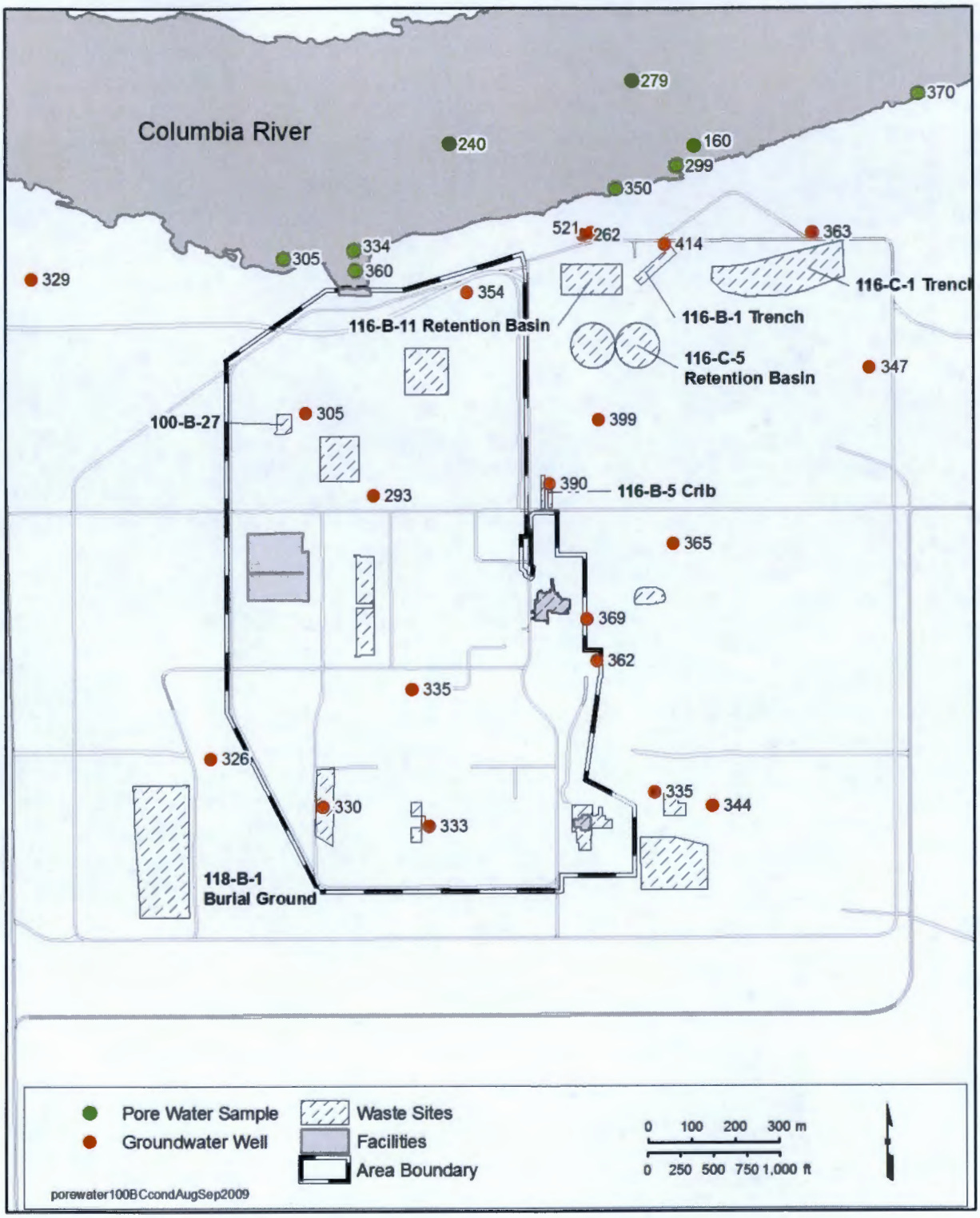



**Figure 4-5. Conductivity (µS/cm) in 100-BC Pore Water (August/September 2009) and Groundwater (2006–2010 Average)**

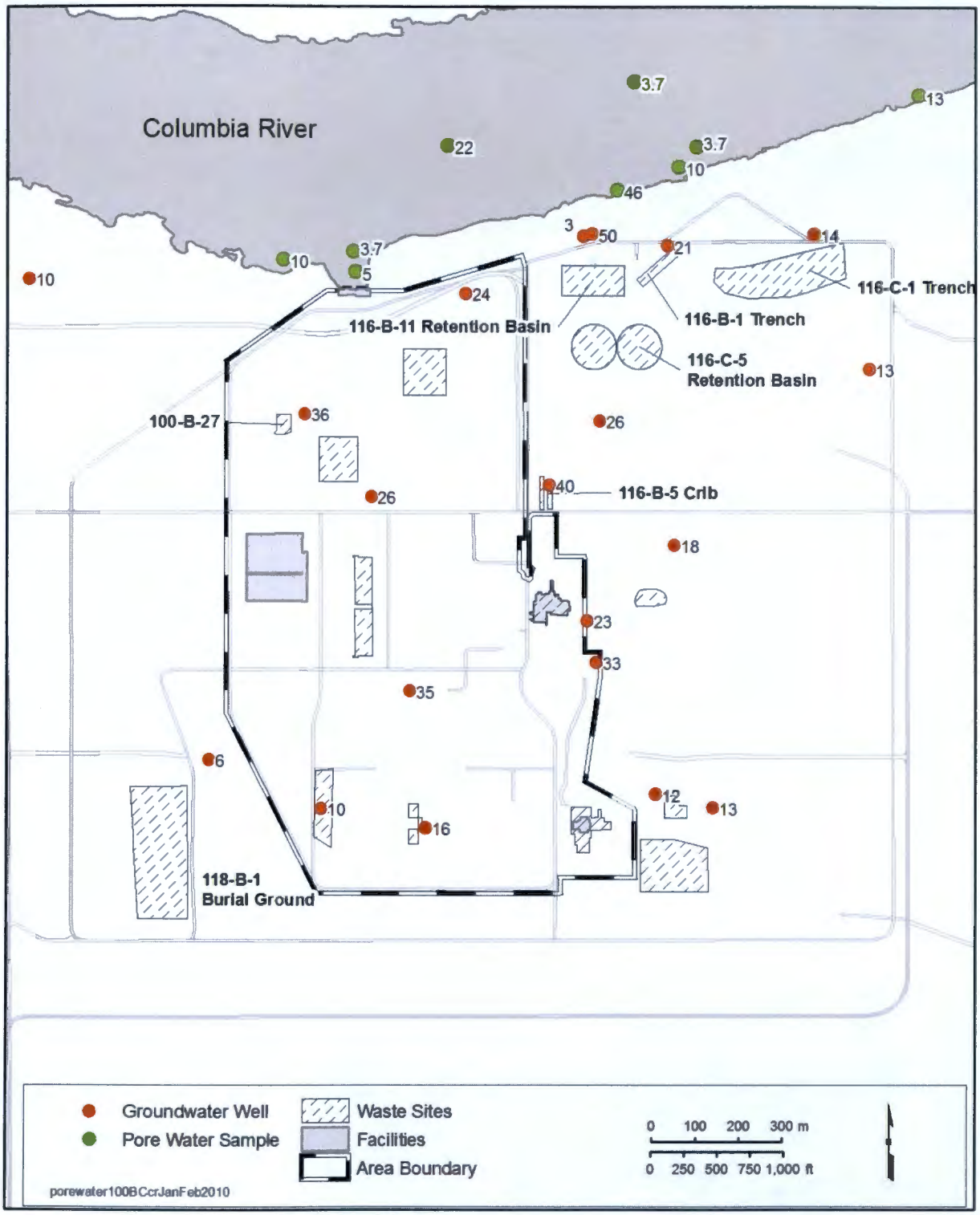



**Figure 4-6. Hexavalent Chromium (µg/L) in 100-BC Pore Water (January/February 2010) and Groundwater (2006–2010 Average) Showing Pore Water Consistent with Diluted Groundwater**

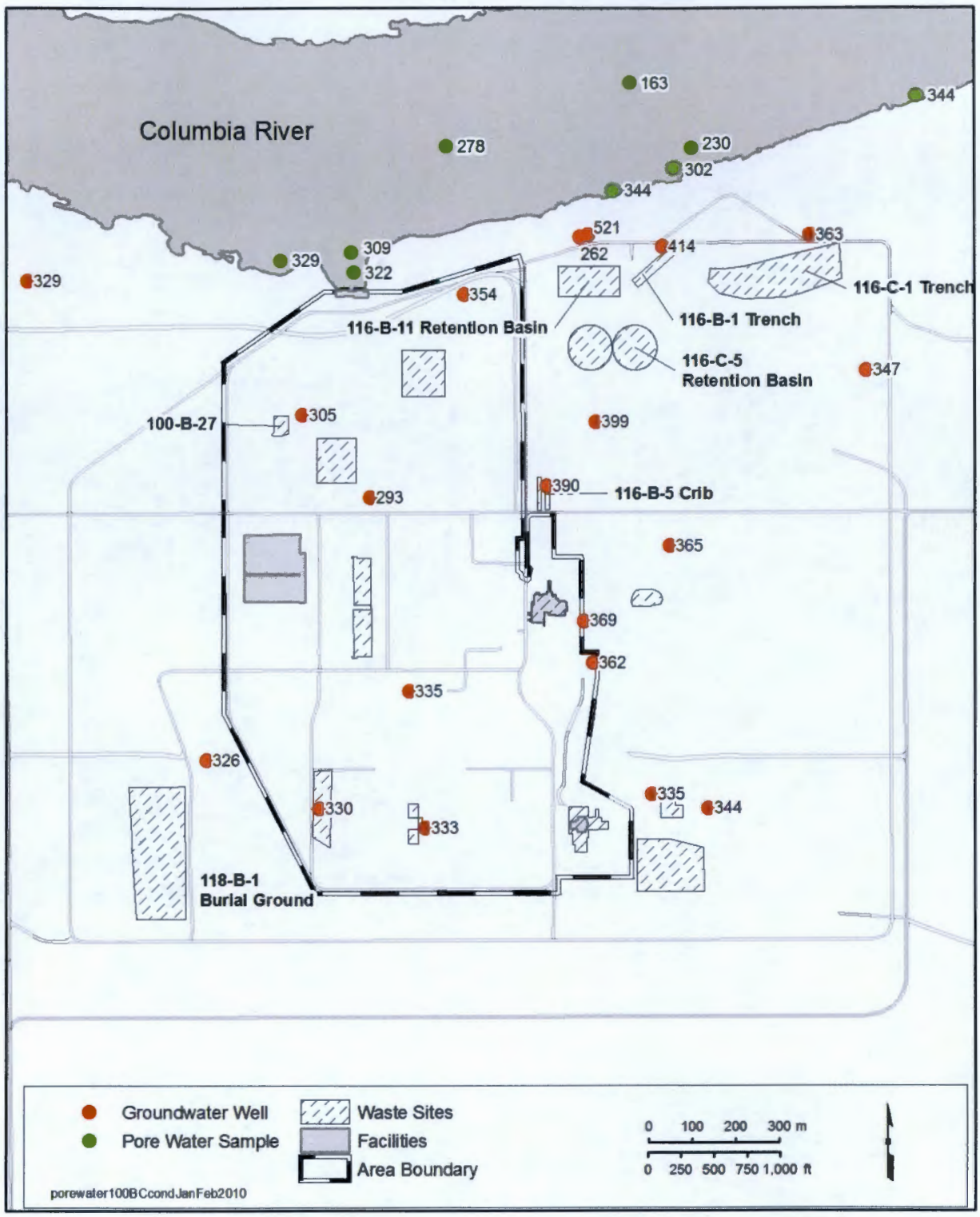



**Figure 4-7. Conductivity (µS/cm) in 100-BC Pore Water (January/February 2010) and Groundwater (2006–2010 Average)**

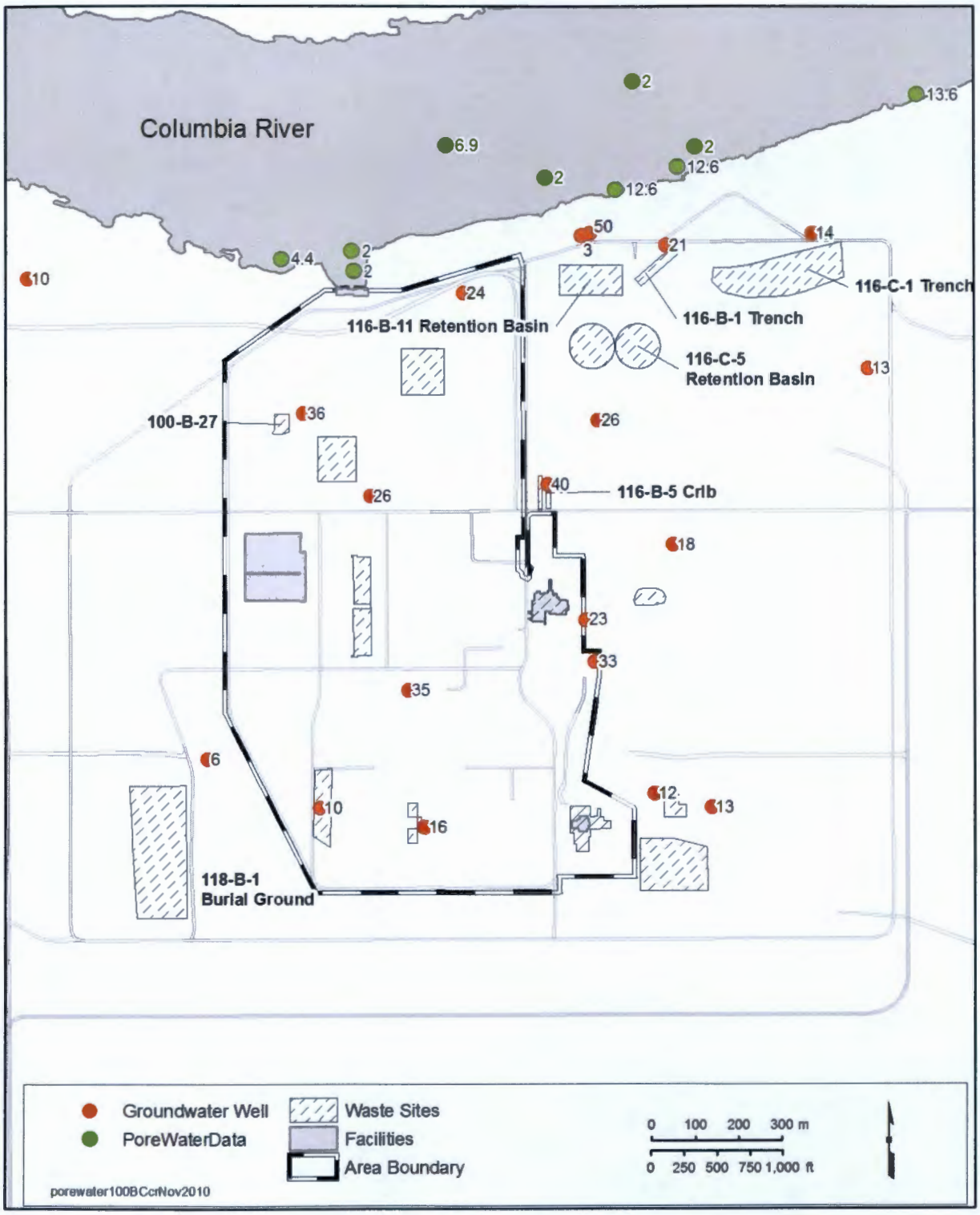



**Figure 4-8. Hexavalent Chromium (µg/L) in 100-BC Pore Water (November 2010) and Groundwater (2006–2010 Average) Showing Decreasing Pore Water Cr(VI)**

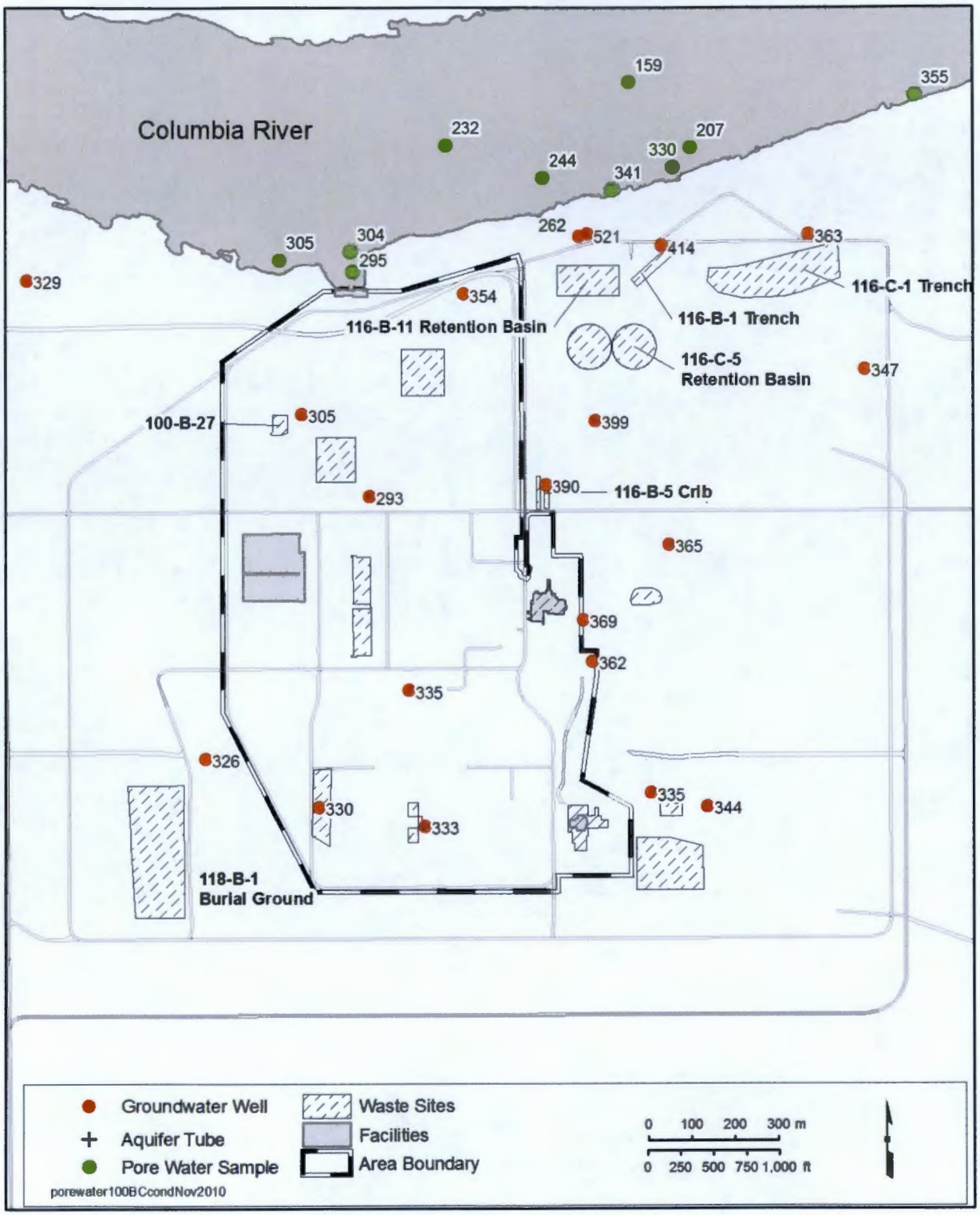



**Figure 4-9. Conductivity (µS/cm) in 100-BC Pore Water (November 2010) and Groundwater (2006–2010 Average)**

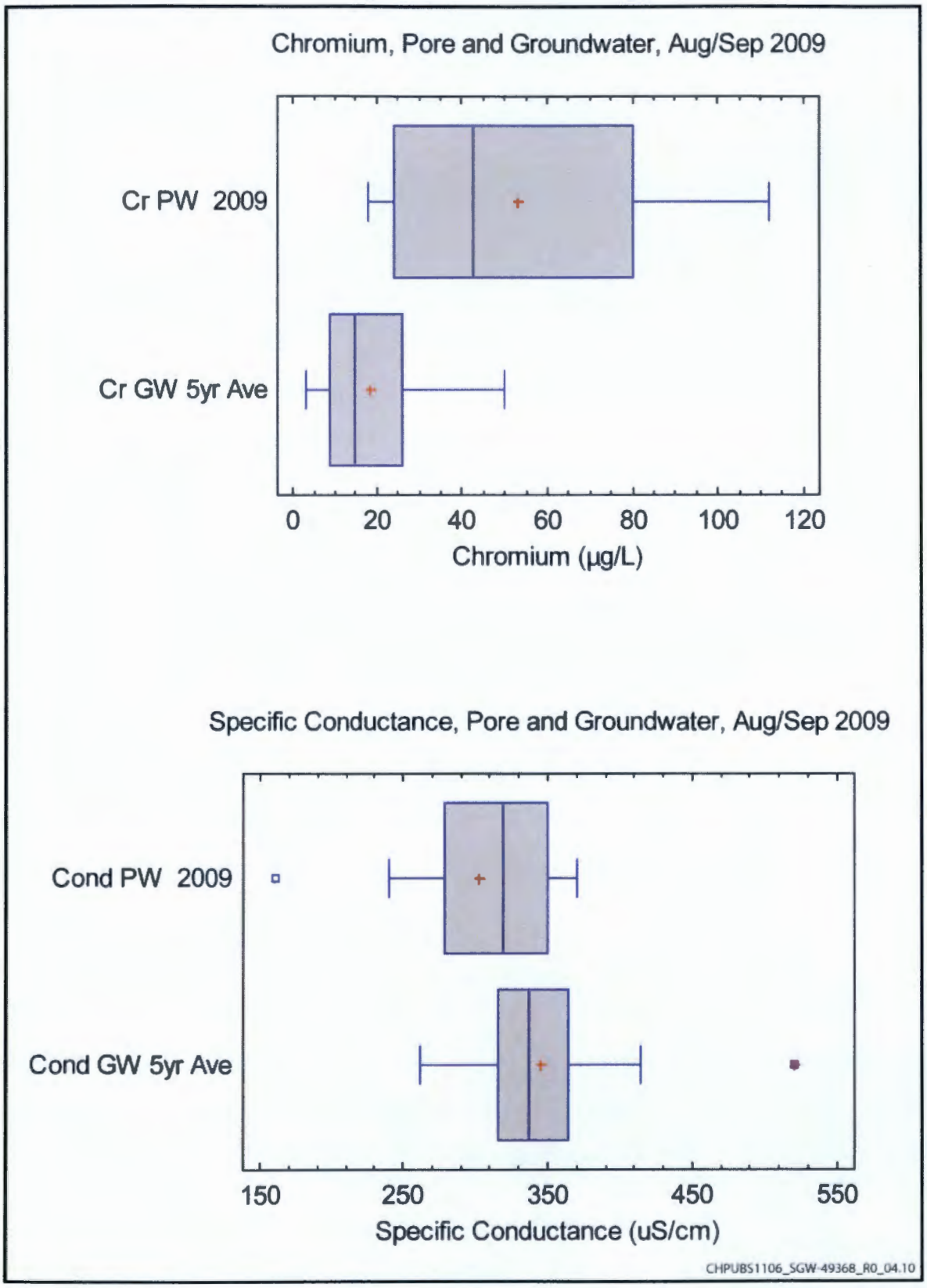



**Figure 4-10. Hexavalent Chromium and Conductivity Box-and-Whiskers Plots (August/September 2009)**

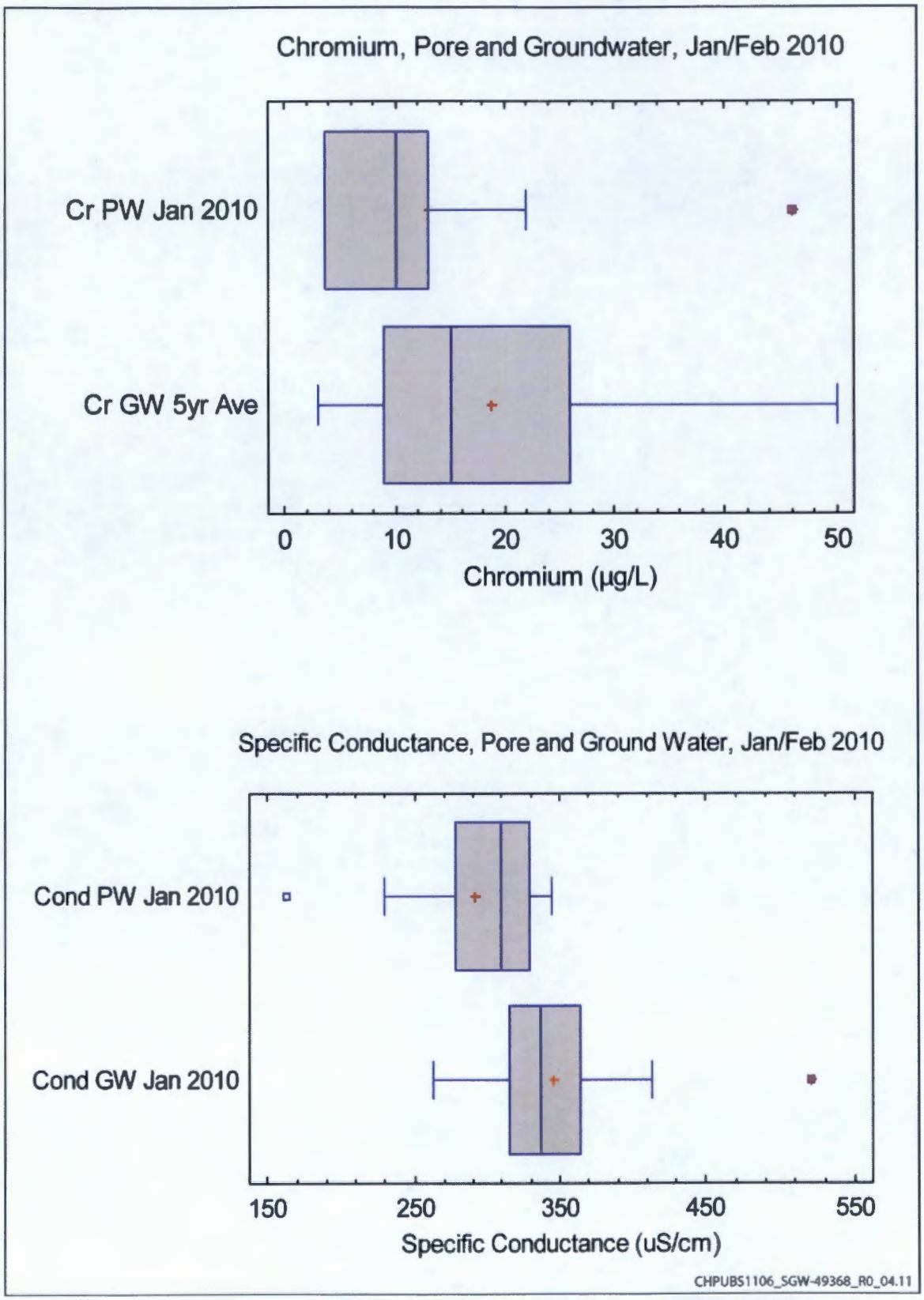



**Figure 4-11. Hexavalent Chromium and Conductivity Box-and-Whiskers Plots (January/February 2010)**

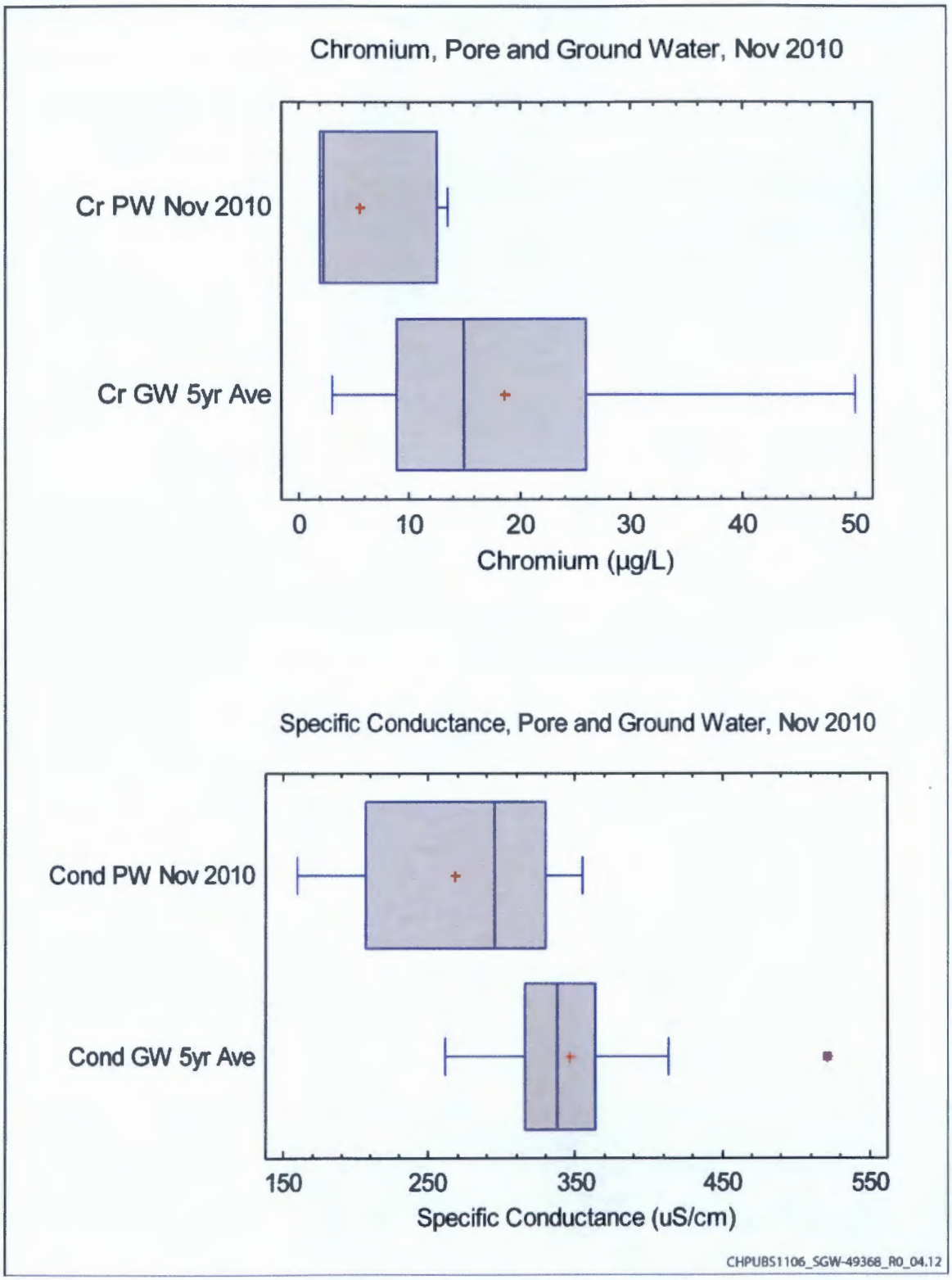



**Figure 4-12. Hexavalent Chromium and Conductivity Box-and-Whiskers Plots (November 2010)**

## 4.3 Relationship between Chromium and Conductivity

In concentrations typically seen in 100-BC groundwater or pore water, dissolved chromium has little effect on conductivity. For example, an increase of 100 µg/L of chromium would only change the pore water conductivity by ~2 µS/cm. Other dissolved ions (e.g., sodium, calcium, and bicarbonate) are present in higher concentrations and have more effect on conductivity. Therefore, conductivity is not a good indicator of chromium concentration in groundwater.

The conductivity of pore water is a good indication of the relative amount of groundwater present in pore water. Groundwater in 100-BC has a conductivity ranging from 300 to 400 µS/cm, while river water typically is 150 µS/cm. Thus, greater mixing with river water decreases both conductivity and Cr(VI) concentrations in pore water. This section investigates whether mixing (dilution) can explain the change in Cr(VI) in 100-BC pore water from August/September 2009 to November 2010.

Table 3-2 compares conductivity and Cr(VI) from the three pore water sampling events. The greatest decreases in Cr(VI) concentrations between 2009 and November 2010 occurred at sampling stations T100BC3C, J100BC23, T100BC21, T100BC4A, and T100BC5C. Conductivity did not correspondingly decrease from highs to lows at some of these stations but did at others (Figures 4-13 through 4-16).

The top panel of Figure 4-15 shows an apparently strong correlation between Cr(VI) and conductivity, with an $r^2$ value of 0.966. The center panel, showing Cr(VI) and conductivity trends, appears to corroborate this interpretation. However, when the conductivity is plotted on a scale more representative of many of the pore water measurements (bottom panel), the correlation is not as apparent. The change in conductivity was only 9 µS/cm (decrease of 2.5 percent) between fall 2009 and November 2010. The change in Cr(VI) concentrations was much greater (decrease of 67 µg/L or 84 percent). Statistical correlation based on just three data points may not represent practical correlation.

If we assume a conductivity change of <10 percent between sampling events can be considered stable, then six of the ten stations repeatedly sampled had conductivities that were stable or increased between fall 2009 and November 2010. Despite the conductivity stability, Cr(VI) concentrations decreased significantly at all ten stations. While some stations exhibited similar Cr(VI) and conductivity relationships, others did not; therefore, a definitive relationship between Cr(VI) and conductivity is not apparent across all sites sampled.

The first plot in Figure 4-17 shows Cr(VI) plotted against conductivity for all pore water samples. There is no correlation between Cr(VI) and conductivity when all the data are considered. Application of the Maximum Normed Residual test determined that the six largest Cr(VI) values (>28 µg/L) were outliers at <2 percent. Removing those values resulted in the weak correlation of higher Cr(VI) with higher conductivity shown in the second plot in that figure.

Plotting the relationship of Cr(VI) and conductivity at each sampling event shows negative correlation in 2009, but weak positive correlations in both 2010 sampling events (Figure 4-18). This lack of a correlation may indicate nonhomogeneous distribution of pore water conductivity. Such nonhomogeneity would be expected, given the nonhomogeneous distribution of Cr(VI) in groundwater. Other variables, such as type of river substrate, may also play a role.

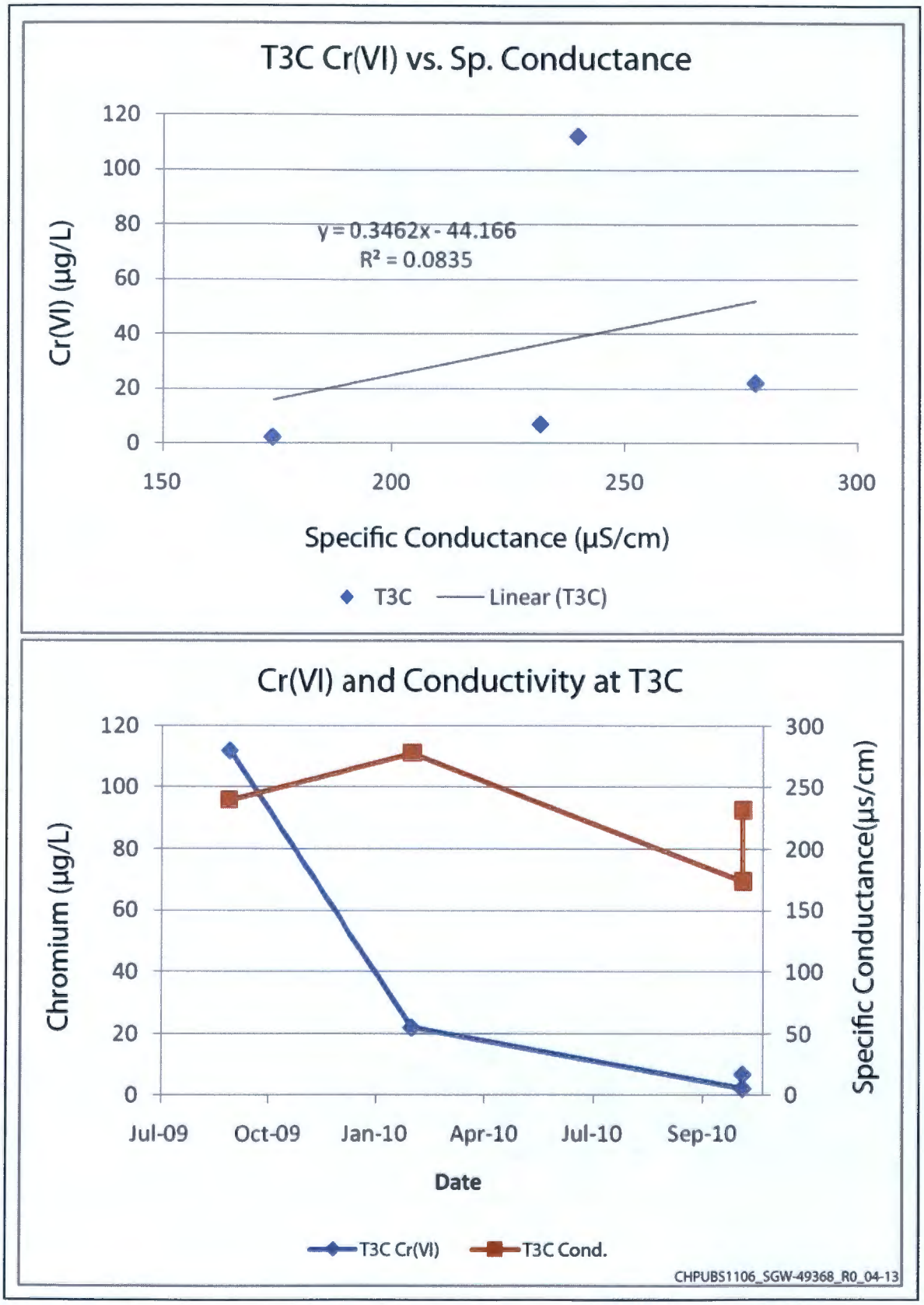



**Figure 4-13. Hexavalent Chromium Relative to Conductivity, Station T100BC3C**

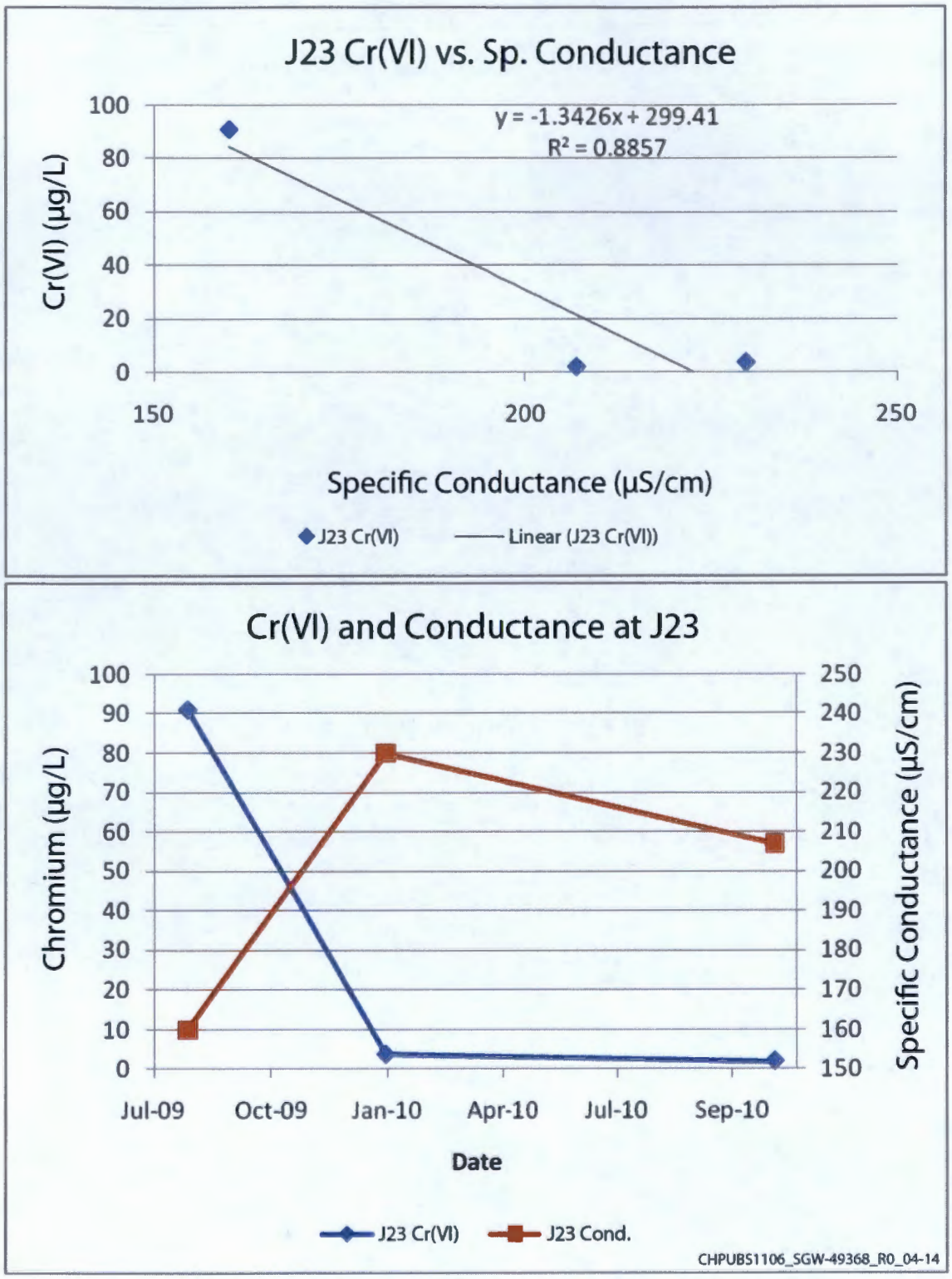



**Figure 4-14. Hexavalent Chromium Relative to Conductivity, Station J100BC23**

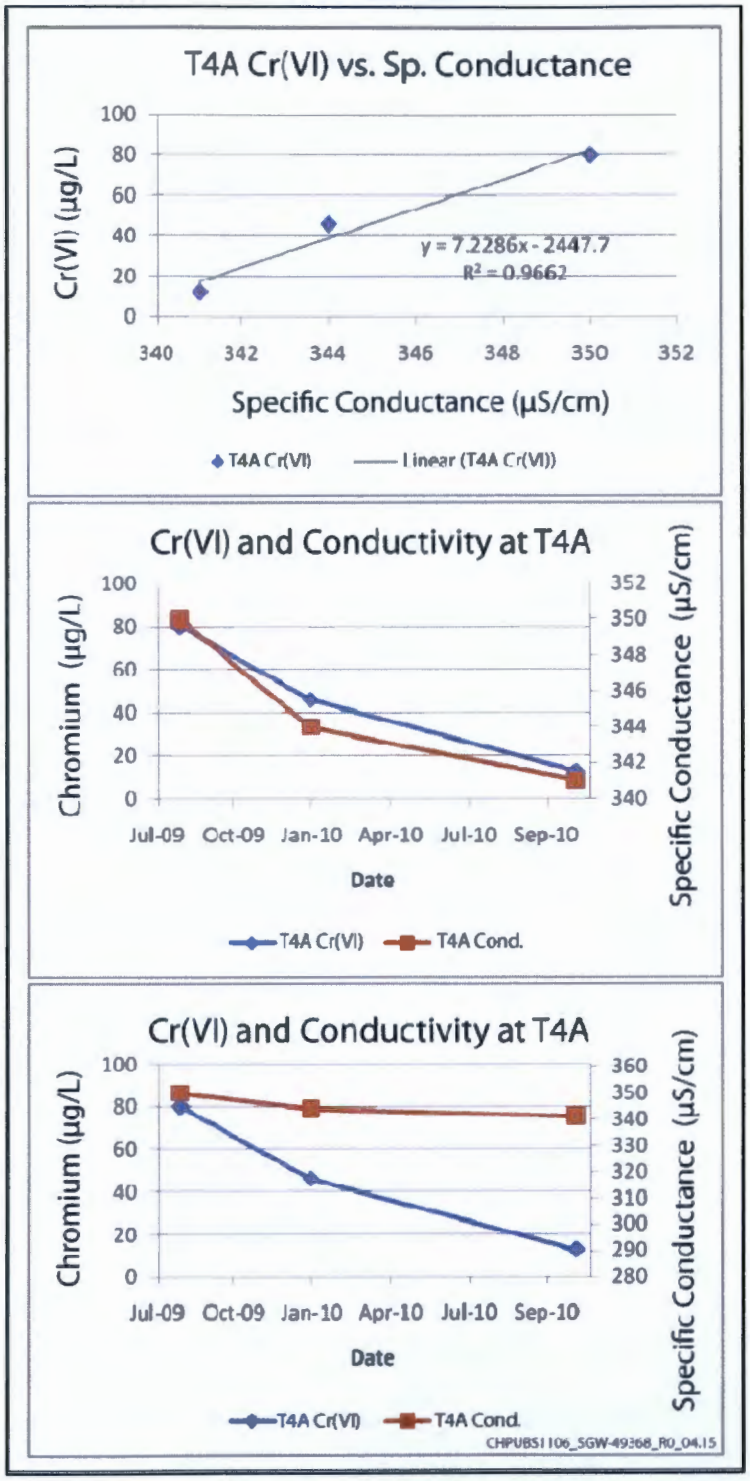



**Figure 4-15. Hexavalent Chromium Relative to Conductivity, Station T100BC4A**

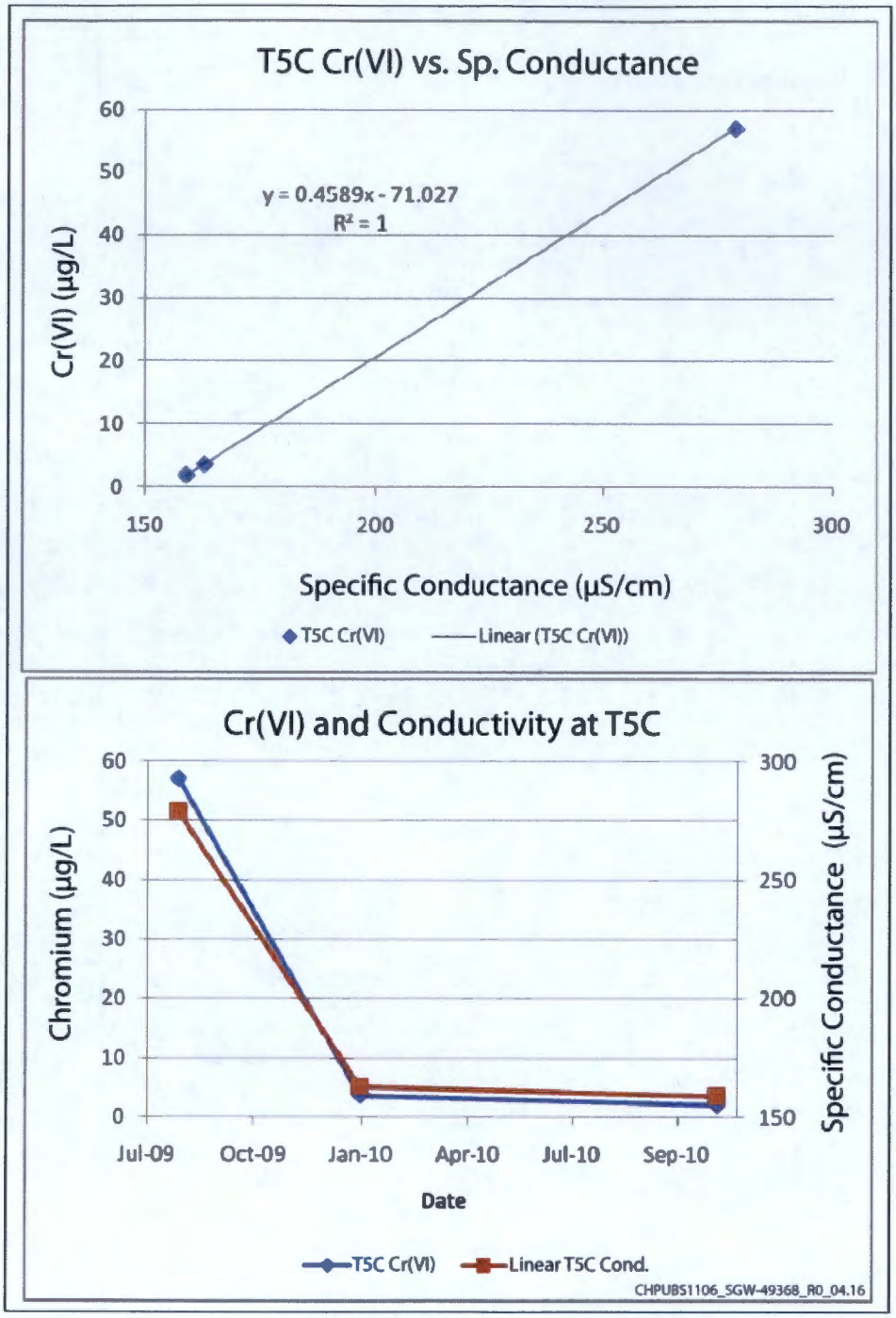
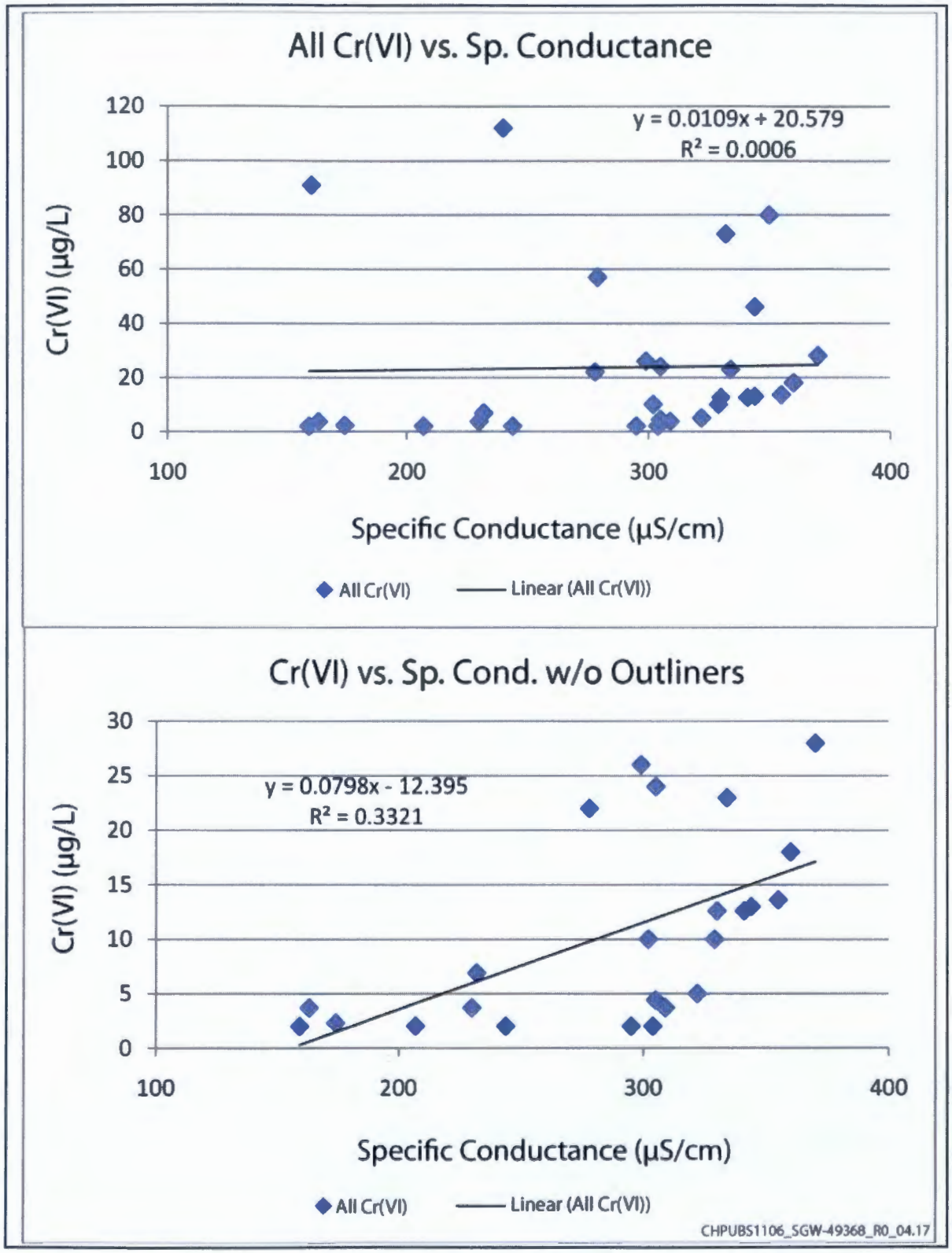



**Figure 4-16. Hexavalent Chromium Relative to Conductivity, Station T100BC5C**




Note: Top of figure includes all data; bottom of figure excludes outliers (chromium >28 µg/L).

**Figure 4-17. Hexavalent Chromium as a Function of Conductivity**

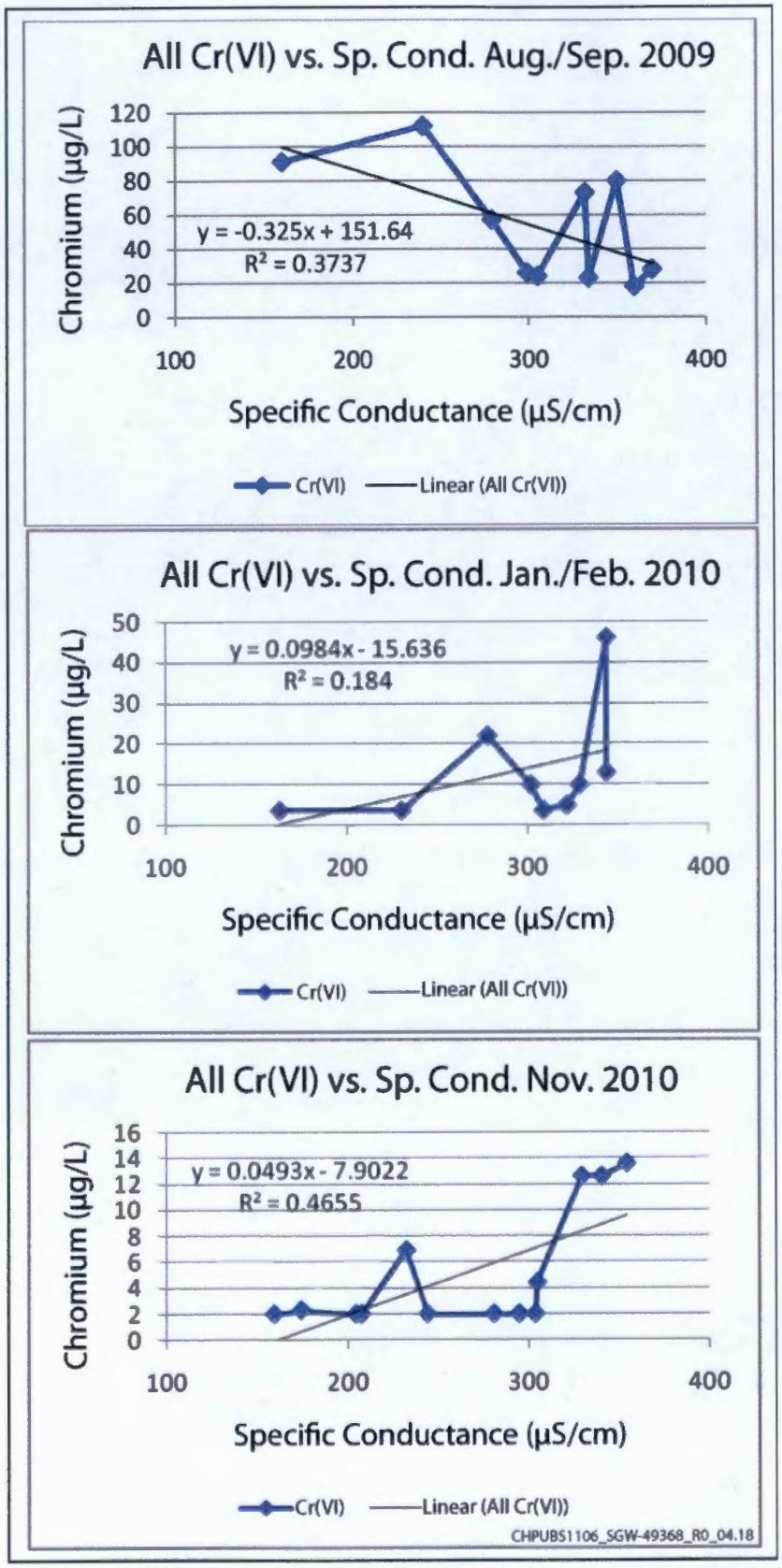



**Figure 4-18. Hexavalent Chromium versus Conductivity, Sampling Events**

Although some sampling stations showed Cr(VI)/conductivity correlation (Figure 4-16), others did not (Figure 4-19). The change in Cr(VI) concentration at stations T100BC6J10 and 2A-A (Figure 4-19) could not be explained by decreasing conductivity. At both of these stations, Cr(VI) concentrations decreased from ~25 to ~10 µg/L or less between fall 2009 and November 2010. Similar trends were observed at many of the stations. The consistency in the patterns of decrease in Cr(VI), and the common occurrence of elevated Cr(VI) concentrations in fall 2009, suggest that an actual change occurred.

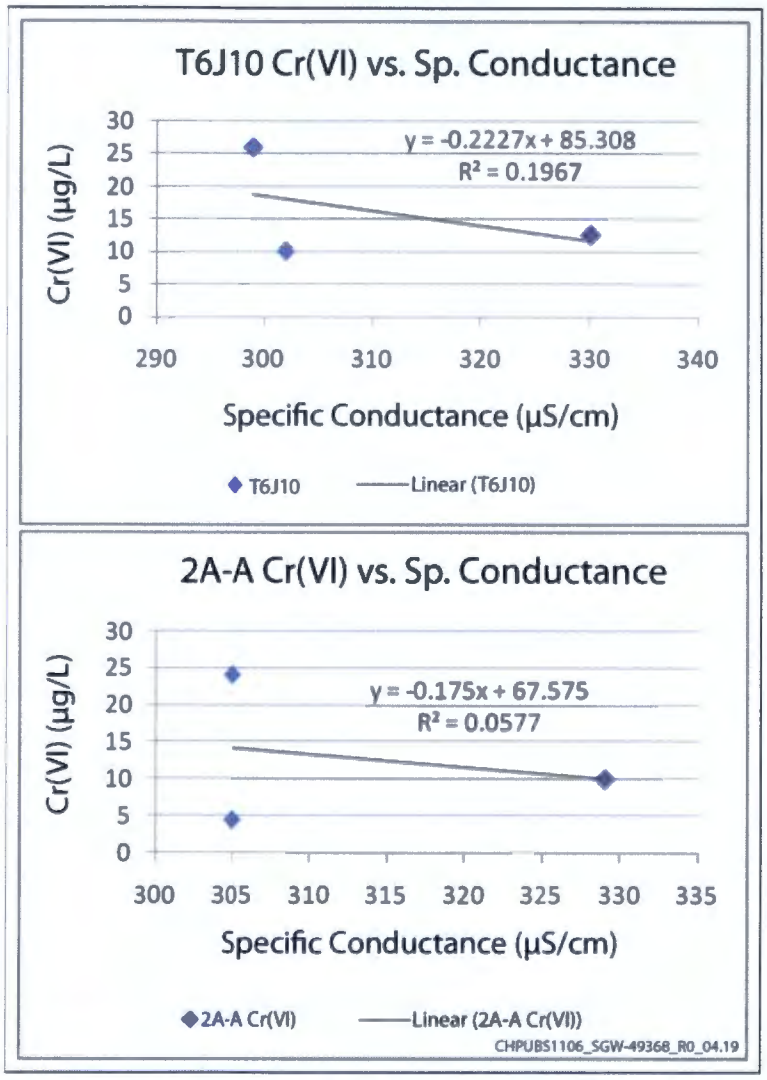



**Figure 4-19. Chromium and Conductivity at Stations T100BC6J10 and 2A-A**

## 4.4 Effects of River Stage

All pore water samples collected during this sampling event (November 2010) were taken when river discharges were minimal (<1.7 million L/sec [60,000 $ft^3$/sec], see Figure 3-2) and when the river stage was less than 0.8 m (2.6 ft) above the low water mark, as prescribed in the SAP (DOE/RL-2009-44). Despite these efforts and some additional time spent repositioning the probe in the general vicinity of the station, lower pore water conductivity measurements were found at seven of the ten established stations during this sampling event. At three of these stations, conductivity was more than 10 percent lower than previously measured at those locations (Table 3-2).

One plausible cause may have been the higher daily river fluctuations that occurred during the November 2010 event compared with the fall 2009 sampling event, when the daily river level fluctuations were typically <1 m (3 ft) and consistently higher concentrations of Cr(VI) were measured (Appendix G of WCH-380). Long-term suppression of relatively high pore water conductivity was also observed in some deep channel regions of the Columbia River during the previous remedial investigation sampling effort (DOE/RL-2008-11). The long-term suppression ceased after more than 48 hours of stable flows during upwelling mapping studies conducted in August 2008 (WCH-380).

## 4.5 Effects of Sampling Depth (Penetration)

Sample depth may affect Cr(VI) and conductivity by altering dilution effects. As the probe penetrates more deeply and the intake is farther away from the river water, less river water is present to dilute the groundwater, and conductivity would be higher. If the groundwater contains Cr(VI ), then Cr(VI) concentrations in the deeper pore water would be higher.

Sample depths varied between 20 and 31 cm (8 to 12 in.). Conductivity tended to be a little higher with sample depth, but the effect was weak (Figures 4-20 through 4-22). In November 2010, Cr(VI) concentrations showed a slight increase with sample depth, but there was little change in Cr(VI) with sample depth during the previous sampling events. Chromium concentrations may not increase with sample depth because not all locations in the river bed lie in the path of Cr(VI) contaminated groundwater. The difference in sample depths (11 cm [4 in.]) may have been insufficient to have a significant impact on Cr(VI) and conductivity levels in the pore samples.

## 4.6 Effects of Sample Volume

Conductivity increased >1 percent during the November 2010 sampling event for three of the twelve stations (Table 3-4). Prolonged pumping to collect relatively large sample volumes may have affected the overall conductivity. However, the greatest increase in conductivity (12.1 percent) was at site J100BC21, with one of the lower sample volumes (560 mL). The split sample site (J100BC47), with a higher volume of 800 mL, had <1 percent change in conductivity. Conductivity increased modestly during collection of the parent sample at site T100BC3C, and also during collection of the duplicate. However, it increased sharply (33 percent) *between* the parent and duplicate; as previously stated, Cr(VI) did not increase significantly between the parent and the duplicate.

## 4.7 Micro-Site Differences between Sampling Events

Samplers attempted to place the Trident probe in the same locations during each sampling event. However, measurement error and field conditions may not allow for exactly the same locations. In addition, locations of upwellings likely are not completely constant. The samplers attempted to locate the upwelling by its conductivity signal in a general region to account for this.

## 4.8 Data Quality

The possibility that data from one or more of the sampling events are grossly unrepresentative is unlikely. QC sampling (e.g., duplicates and blanks) did not indicate systemic problems with data. The fact that elevated Cr(VI) was observed in multiple samples in the fall of 2009 seems to rule out an isolated sampling or laboratory error. Subsequent sampling events had Cr(VI) results generally confirmed by total chromium. The possibility of a sample mixup is remote, since only 100-BC stations were being sampled at the time.

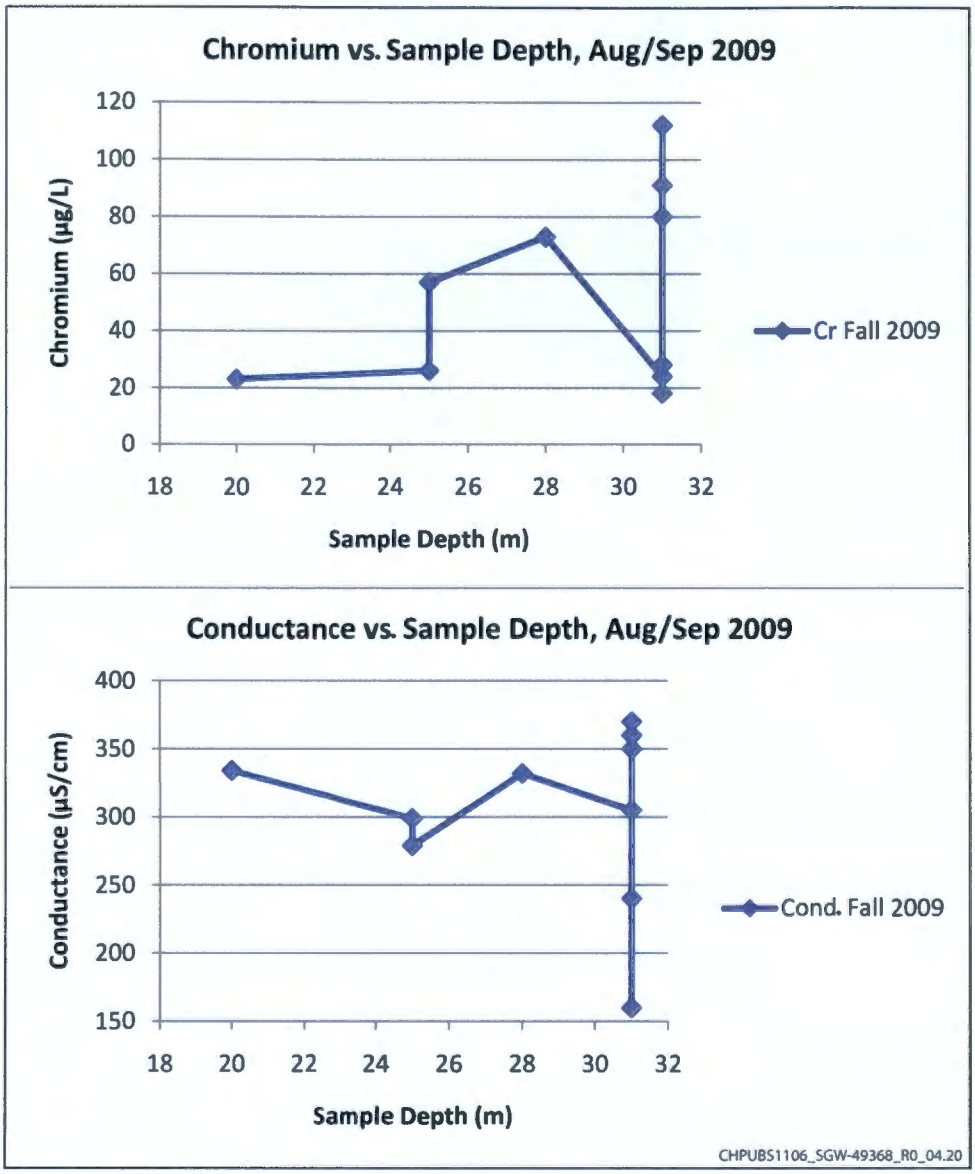



**Figure 4-20. Hexavalent Chromium and Conductivity as a Function of Sample Depth (Penetration), Fall 2009**

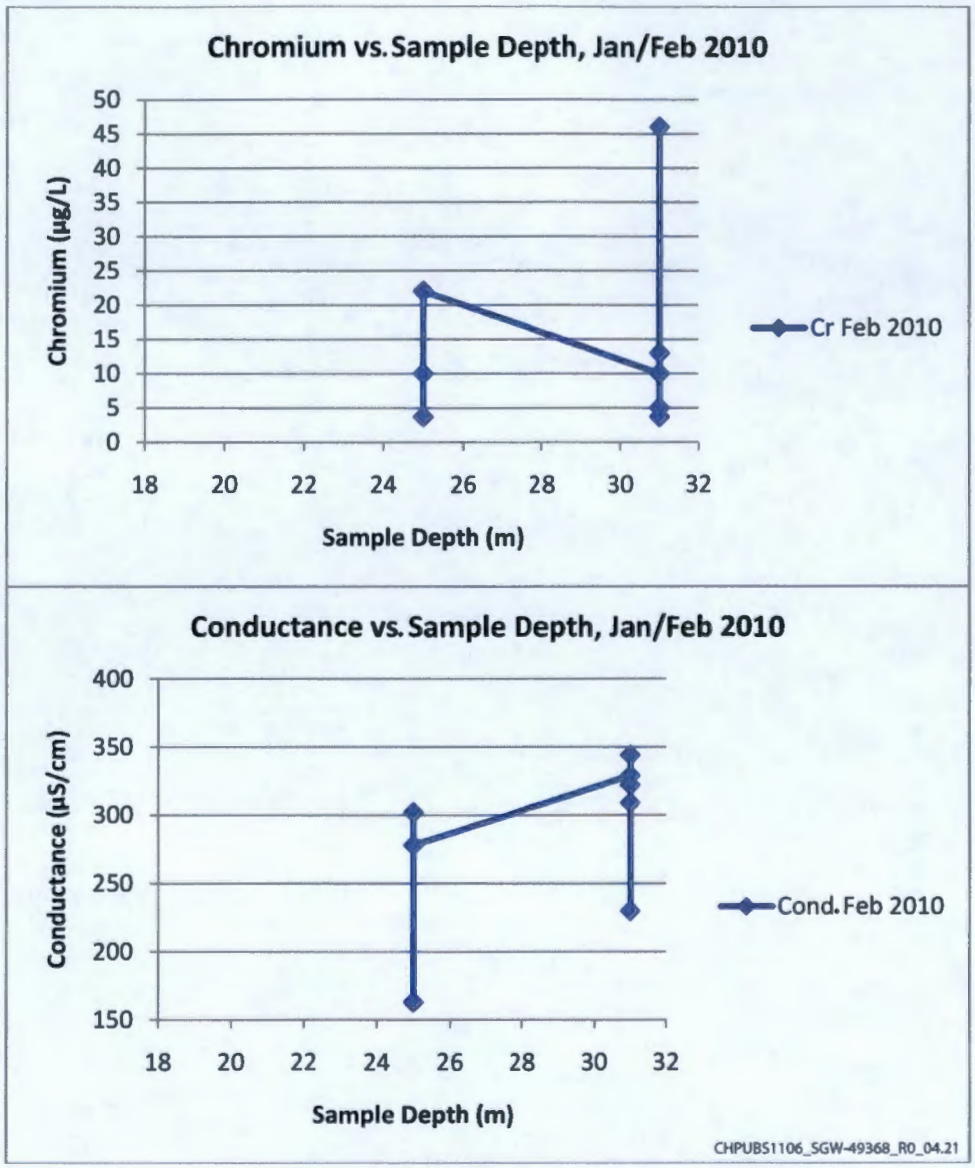



**Figure 4-21. Hexavalent Chromium and Conductivity as a Function of Sample Depth (Penetration), January/February 2010**

Samples from all three sampling events were analyzed for Cr(VI) using a colorimetric method, U.S. Environmental Protection Agency (EPA) Method 7196A (SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*). Turbidity in the samples can interfere with the analysis, resulting in a high bias. The laboratory corrects for this effect by subtracting the absorbance of a blank carried through the method. However, turbidity effects may still be evident. Turbidity measurements are not available from the WCH-380 sampling events (fall 2009 and January/February 2010). Samples collected for Cr(VI) analyses in November 2010 were filtered in the field; therefore, turbidity is not an issue.

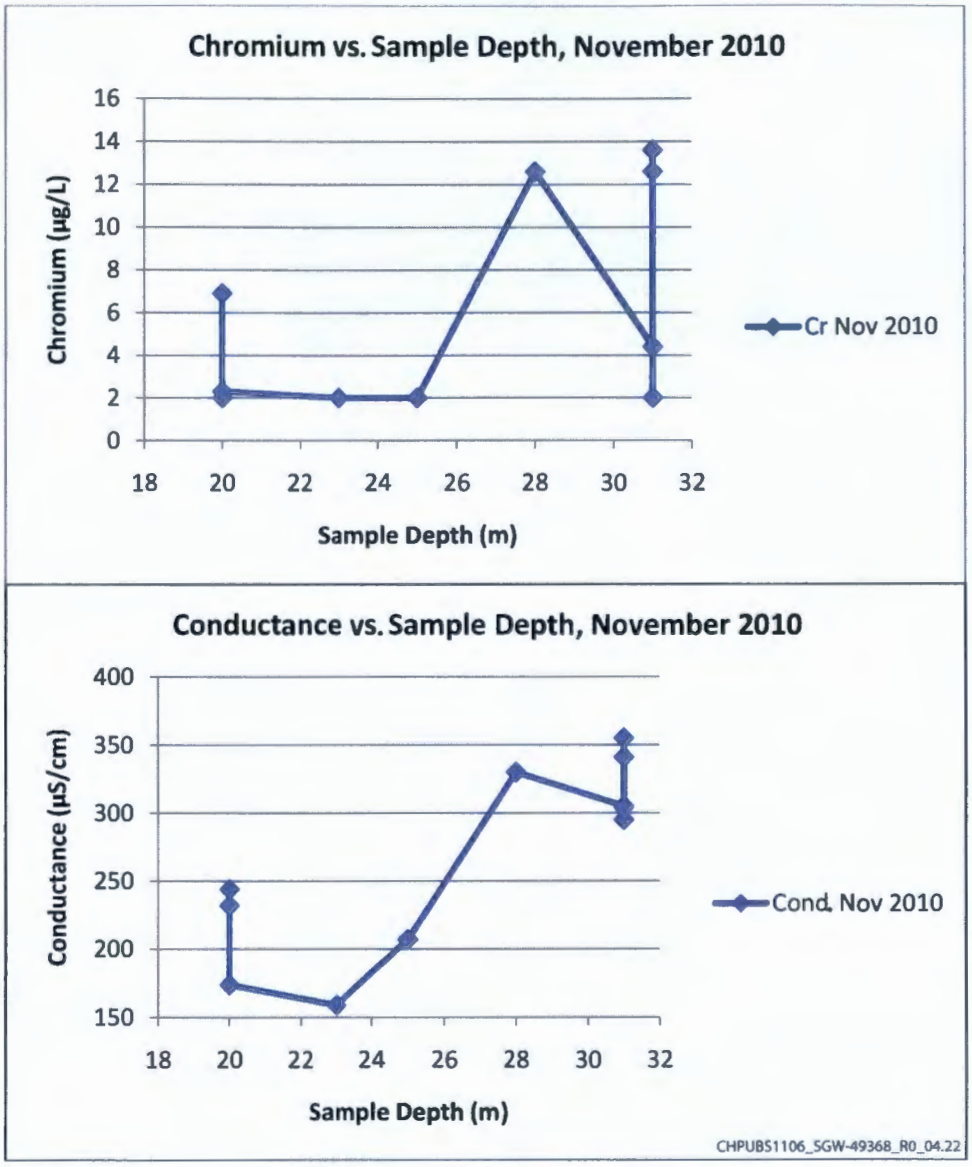



**Figure 4-22. Hexavalent Chromium and Conductivity as a Function of Sampling Depth (Penetration), November 2010**

During the January/February 2010 and November 2010 sampling events, the samples were analyzed for total chromium by EPA Method 200.8 (SW-846). As discussed in Section 3.3, total chromium in filtered samples should equate to Cr(VI). In the November 2010 event, total chromium and Cr(VI) were in agreement; some total chromium results in unfiltered samples were slightly higher than Cr(VI) results, which can be explained by the presence of trivalent chromium. During January/February 2010, total chromium and Cr(VI) results were in agreement with one exception: T100BC4A had significantly higher Cr(VI) than total chromium (46 µg/L compared to 20 µg/L). This suggests a potential high bias in the Cr(VI) results, since the analytical method for Cr(VI) is less accurate than EPA Method 200.8 (SW-846). Total chromium results are not available for the fall 2009 sampling event.

In conclusion, with few exceptions, data quality appears to be acceptable. Data quality problems cannot explain Cr(VI) changes in 100-BC pore water.

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# 5 Conclusions

Analysis of data from three rounds of Columbia River pore water sampling at 100-BC supports the following conclusions:

1. Groundwater flows from the aquifer into the Columbia River. Contaminants such as Cr(VI) present in the pore water were likely derived from 100-BC groundwater. Spatial and statistical evaluation of data concluded that Cr(VI) and conductivity measurements were generally consistent with river dilution of groundwater migrating into the river from beneath 100-BC. The major exception was in fall 2009, when five pore water samples had anomalously high concentrations of Cr(VI). No upstream sources of Cr(VI) have been identified, so it is reasonable to assume that pore water contamination originated in 100-BC groundwater.

2. Pore water Cr(VI) concentrations decreased at all ten stations sampled in both the fall of 2009 and the fall of 2010. Declines ranged from 51 to 98 percent. The maximum concentration in the fall of 2009 was 112 µg/L; in the fall of 2010, it was 13.6 µg/L. The most likely explanation for the decline in pore water Cr(VI) is the passing of a "pulse" of high Cr(VI) water. This water could have originated from unknown groundwater contamination (i.e., from areas vertically or horizontally not characterized), or could have represented older groundwater contamination.

3. Data were evaluated to determine whether changes in conductivity accounted for the changes in Cr(VI) concentrations in pore water. In concentrations typically seen in 100-BC groundwater or pore water, dissolved chromium has little effect on conductivity. Because groundwater beneath 100-BC varies significantly in Cr(VI) concentration even when conductivity is relatively constant, there is no definitive correlation between Cr(VI) concentration and conductivity. The relationship of Cr(VI) and conductivity at individual stations varied: some showed a positive correlation, others a negative correlation, and some no correlation.

4. In general, conductivity of samples increased with increasing depth in the river bed. However, as noted above, the conductivity alone could not explain the change in Cr(VI) concentrations among the three sampling events. Sample volume and differences in microenvironment also did not provide explanation for the changes in Cr(VI) concentration.

5. No systematic problems with data quality were found that would explain apparent changes in Cr(VI) concentrations with time.

Five Cr(VI) outliers in fall 2009 could not be repeated in two subsequent sampling campaigns, despite efforts to duplicate sampling conditions and rule out other effects. The only known, remaining explanation is that a pulse of Cr(VI) contamination passed through the pore water at 100-BC between the fall of 2009 and the fall of 2010.

Concentrations in 100-BC groundwater currently are less than approximately 60 µg/L. However, there is evidence of higher concentrations in the past (e.g., Well 199-B5-1 had concentrations above 100 µg/L in the late 1990s). Until 2010, only Well 199-B5-1 monitored northwestern 100-BC, and no wells monitored at depth in the unconfined aquifer. Thus, the presence of higher concentration plumes in certain areas or depths could have gone undetected. Installation of wells in 2009 and 2010, including characterization sampling of the entire aquifer thickness, confirmed that Cr(VI) concentrations in groundwater currently are less than about 60 µg/L.

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# Appendix A

# Pore Water Sampling Methods

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A3.2 Waste Disposal ..... A-4

**A4 References** ..... **A-5**

# Terms

| | |
|---|---|
| DI | deionized |
| DO | dissolved oxygen |
| ORP | oxidation reduction potential |
| QC | quality control |
| SAP | sampling and analysis plan |

# A1 Introduction

This appendix describes the methods used for pore water sample collection. These activities were performed near or in Hanford contaminated groundwater discharge areas within the Columbia River.

Pore water sampling activities were required to evaluate contaminated groundwater discharge zones within the Columbia River adjacent to the 100-BC, 100-F, and 100-N areas of the Hanford Site. A portable conductivity and temperature probe (Trident[1] probe) was inserted into the Columbia River bed to measure the pore water parameters in situ. The probe also had the capability to collect pore water samples, which were analyzed for specific groundwater contaminants. Pore water sampling was performed to support the following sampling and analysis plans (SAPs):

- *Sampling and Analysis Plan for the 100-BC-1, 100-BC-2, and 100-BC-5 Operable Units Remedial Investigation/Feasibility Study*, DOE/RL-2009-44
- *Sampling and Analysis Plan for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units Remedial Investigation/Feasibility Study*, DOE/RL-2009-43
- *Sampling and Analysis Plan for the 100-NR-2 Operable Unit River Pore Water Investigation*, DOE/RL-2010-69

Sampling activities included collection of pore water using the Trident probe or Trident probe/frame. These activities were conducted using a boat as an operation platform. Sampling methods were analogous to those described in DOE/RL-2008-11, *Remedial Investigation Work Plan for Hanford Site Releases to the Columbia River.*

Through previous pore water sampling work, field sampling guidelines were developed to guide decisions on sampling. The guidelines represent the best conditions for sampling. Pore water sample collection should take place when there are minimal signs of dilution from bank recharge from surface water and/or when river levels are <0.8 m (<2.6 ft) above low water level, and the river flow has been relatively stable for more than 1 hour prior to sampling.

# A2 Equipment and Materials

The following equipment and materials were used during sample collection:

- Communication devices (e.g., cell phones, two-way radio, and very high frequency)
- Tape measure/river staff gauge
- Davit/Capstan system (mounted on vessel)
- Trident docking station (cradle on vessel)
- Specialized anchoring equipment (as necessary)
- Trident probe deck unit (with push pole assembly, as necessary)
- Trident driving frame
- Trident probe communication cables

[1] Coastal Monitoring Associates (San Diego, California) Trident probe has a patent pending.

- Trident and secondary field global positioning system units
- Trident probe armored tips (with backups, as necessary)
- Field computer (with software installed and operational)
- Peristaltic pump and Masterflex® tubing
- A 12 volt deep cycle battery with 750 watt power inverter
- Water quality measuring equipment capable of measuring the following parameters: pH, temperature, conductivity, dissolved oxygen (DO), and oxidation reduction potential (ORP)
- Polyethylene tubing (18+ m [60+ ft])
- Trident tool box and associated spare parts
- Underwater Aqua-Vu camera (one mounted to the frame and 1 for recon surveys)
- Digital camera
- A 500 L+ (132+ gal) graduated cylinder
- Field logbook and associated field record forms
- Sample bottle sets and associated sampling forms (including all necessary sample bottles, sample labels, sampling data sheets, and sample chain of custody forms)
- Nitrile gloves
- Deionized (DI) water (typically, 4 to 8 L [1 to 2 gal] is sufficient for one field day)
- One percent Liqui-nox® solution (typically, 1 L [0.25 gal] is sufficient for one field day)
- Decontamination tools (e.g., brushes and towels)
- A 19 L (5 gal) bucket (for capturing decontamination rinsate fluids)
- Precleaned 9.5 L (2.5 gal) cubitainers (one per station)

## A3 Methods

The following methods were used for sample collection:

- Sampling activities included boating to location, collecting pore water using the Trident probe or Trident probe/frame, and collecting surface water using a peristaltic pump and tubing.
- Measurements of pore water and surface water were made concurrently at each sample location.
- Chain of custody documentation was maintained for all samples.
- Field decontamination was performed on sampling equipment as needed.

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® Masterflex is a registered trademark of Cole-Parmer, Vernon Hills, Illinois.

® Liqui-nox™ is a registered trademark of Alconox, Inc., White Plains, New York.

- Water quality parameter measurements (i.e., pH, temperature, conductivity, DO, and ORP) were recorded on field paperwork.
- Activities associated with this fieldwork were documented in controlled field logbooks.

## A3.1 Pore Water Sampling

Staff performed the following tasks during pore water sampling:

- At the laboratory, all field instruments were calibrated and results were recorded in the field logbook. Trident probe temperature calibration checks were performed monthly. Certificates of analyses and record calibration solution lot numbers and expiration dates were retained in the field logbook.
- At the selected sampling site, decontamination of field sampling equipment was performed by pumping three tube volumes with Liqui-nox solution followed by six volumes of DI water. Decontamination rinsate was discarded in accordance with the applicable operable unit's waste control plan.
- River level, time, and river staff station identification were measured and recorded at the beginning and end of each sampling event. (Note: if river stages were near 0.8 m above the green line or flows were unstable, pore water conductivity was checked and recorded at a nearby pore water baseline sampling station.)
- The Trident pole assembly was pushed or the Trident driving frame was deployed, approximately 6 to 12 in. below the river bed or until it resisted further insertion. The depth of the unit into the sediment was measured and recorded.
- After the peristaltic pump was turned on according to manufacturer's instructions, the system was slowly purged (6 to10 mL/min) until stable readings were achieved. Typically, approximately 100 mL of fluid purging was needed to remove nonrepresentative water from the tubing. Purge water was discarded in accordance with the applicable waste control plan prior to leaving the sampling location or after that area's sampling event was completed.
- Conductivity readings were recorded intermittently while drawing the sample and sampling was stopped or slowed temporarily if the conductivity dropped substantially from the initial reading to allow the conductivity to restore to near the starting value. Because of the variability of each location, the time varied from site to site and with river level. A number of observations such as the probe's position/depth, pump rate, river flow cycles, substrate types, and water depth were made to ensure a consistent measurement of the pore water.
- Once stable readings were attained, the pore water and surface water conductivity and temperature were logged using the Trident computer logging feature.
- Volatile organic analyte samples were collected first (where required by the applicable SAP).
- The desired volume of pore water was collected in precleaned containers, and enough water was collected so that minimum sample volumes were attained and final composite sample water quality readings (conductivity, DO, ORP, and pH) could be obtained.
- Sample labels and custody seals were attached, and samples were immediately placed into a chilled cooler. Remaining composite pore water was emptied into a clean, wide-mouth container to allow for measurement of the selected water quality measurements (pH, conductivity, DO, and ORP). (Note:

the composite sample temperature was ***not*** recorded because this was not representative of the sample temperature. The temperature logged on the Trident unit was used to represent the sample temperature. These parameters were recorded on field paperwork.)

- Time and river level were recorded at the end of sampling, using the nearby river staff gauge, denoting the river staff identification.
- River bed conditions were documented with a digital photograph, using an underwater camera or video recorder.
- A full set of quality control (QC) samples of pore water were collected and one duplicate for every 20 samples was collected, or at least one QC set and one duplicate were collected for fewer than 20 samples.
- The sample tubing was decontaminated by pumping three tubing volumes of Liqui-nox solution, followed by six volumes of DI water, through the sample tubing.
- All decontamination fluids were collected and disposed in accordance with the applicable waste control plan.

## A3.2 Waste Disposal

Staff disposed of all waste in accordance with DOE/RL-2004-30, *Waste Control Plan for the 100-BC-5 Operable Unit*; DOE/RL-200-31, *Waste Control Plan for the 100-FR-3 Operable Unit*; or DOE/RL-2000-41, *Interim Action Waste Management Plan for the 100-NR-2 Operable Unit.*

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# Appendix B

# Data File for November 2010 Pore Water Sampling

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# Terms

| | |
|---|---|
| ags | above ground surface |
| bgs | below ground surface |
| DO | dissolved oxygen |
| NA | not available |
| NTU | Nephelometric Turbidity Units |
| ORP | oxidation reduction potential |
| PRC | Plateau Remediation Company |
| QC | quality control |
| USCOE | U.S. Army Corps of Engineers |

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**Table B-1A. Site Coordinates, Sample Metadata, and Water Quality Data for 100-BC Pore Water Sampling, November 2010**

| Station Identification | General Region | Date | Time (Start) | Time (End) | Latitude[b] (Degrees) | Longitude[b] (Degrees) | Easting[f] (m) | Northing[f] (m) | General Substrate | Bulk Sample Number | Volume (mL) | QC | QC Tied to | QC Volume (mL) | Number of Bottles |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A-A | Upstream of Intake Structure | 11/5/2010 | 14:32 | 15:47 | 46.63757 | -119.65535 | 564667.44 | 145312.33 | silt/sand | B29883 | 600 | - | - | - | 1 |
| J100BC21 | Moderate Depth | 11/9/2010 | 15:00 | 17:55 | 46.63913 | -119.64728 | 565283.02 | 145492.13 | lg/med cobble | B29888 | 560 | - | - | - | 1 |
| J100BC23 | Near Shore | 11/14/2010 | 13:17 | 14:37 | 46.63980 | -119.64260 | 565640.49 | 145570.48 | medium cobble | B29893 | 600 | - | - | - | 1 |
| J100BC47 | Near Shore (128-B-3) | 11/10/2010 | 13:02 | 16:13 | 46.64084 | -119.63597 | 566146.43 | 145691.29 | sand | B29894 | 800 | SPLIT | B29895 | 1000 | 2 |
| T100BC1J1 | Intake Structure | 11/8/2010 | 13:55 | 15:13 | 46.63728 | -119.65335 | 564820.54 | 145281.50 | silt/sand | B29884 | 575 | - | - | - | 1 |
| T100BC1J5 | Intake Structure | 11/9/2010 | 12:00 | 13:20 | 46.63778 | -119.65350 | 564808.63 | 145336.95 | silt | B29885 | 600 | - | - | - | 1 |
| T100BC3C | Deep Channel | 11/16/2010 | 11:21 | 12:18 | 46.63993 | -119.65025 | 565054.69 | 145578.59 | lg/med boulders | B29886 | 550 | - | - | - | 1 |
| T100BC3C | Deep Channel | 11/16/2010 | 12:21 | 13:51 | 46.63993 | -119.65025 | 565054.69 | 145578.59 | lg/med boulders | B29B83 | 550 | DUP | B29886 | 550 | 1 |
| T100BC4A | Near Shore | 11/7/2010 | 15:40 | 16:54 | 46.63897 | -119.64545 | 565423.31 | 145475.86 | med/sm cobble | B29889 | 600 | - | - | - | 1 |
| T100BC5C | Deep Channel | 11/14/2010 | 15:45 | 16:40 | 46.64098 | -119.64438 | 565502.80 | 145700.15 | med/sm cobble | B29891 | 550 | - | - | - | 1 |
| T100BC6J10 | Near Shore | 11/8/2010 | 11:08 | 12:24 | 46.63938 | -119.64330 | 565587.06 | 145523.21 | med/sm cobble | B29892 | 600 | - | - | - | 1 |
| NEARSHORE 1 | Upstream Reference | 11/4/2010 | 13:20 | 14:53 | 46.64453 | -119.68078 | 562712.17 | 146065.15 | med/lg cobble | B29896 | 700 | - | - | - | 1 |
| NEARSHORE 2 | Upstream Reference | 11/7/2010 | 11:56 | 13:23 | 46.64003 | -119.66445 | 563967.50 | 145578.00 | medium cobble | B29897 | 600 | - | - | - | 1 |

**Table B-1B. Site Coordinates, Sample Metadata, and Water Quality Data for 100-BC Pore Water Sampling, November 2010**

| Station Identification | River bed Elevation[a] per NAVD88 (m) | River Discharge[l] (Kcfs) | River Level[a,l] (m) | Nearest USCOE Bathymetry Transect | 40 Kcfs Steady State[l] River Elevation[a] at Nearest Transect | Height[l] (m) above Low Water | Staff Gage Reading Before (m) | Staff Gage Reading After (m) | River Depth at Station (ft) | Pore Water Sensor Depth (in. bgs) | Surface Water Sensor Height (in. ags) | Field QC Qualifier |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A-A | 118.8 | 56.7 | 118.74 | 34 | 118.12 | 0.6 | 0.7 | N/A[d] | 1.9 | 12 | 12 | |
| J100BC21 | 115.2 | 57.6 | 118.61 | 35 | 117.98 | 0.6 | 0.8 | N/A[d] | 11.4 | 8 | 12 | h,k |
| J100BC23 | 115.6 | 38.2 | 117.73 | 36 | 117.80 | -0.1 | 0.2 | 0.2 | 8.2 | 10 | 12 | |
| J100BC47 | 118.6 | 58.0 | 118.03 | 37 | 117.49 | 0.5 | 0.8 | 0.8 | 2.9 | 12 | 12 | |
| T100BC1J1 | 114.5 | 42.2 | 118.20 | 34 | 118.12 | 0.1 | 0.3 | 0.5 | 13.3 | 12 | 12 | h |
| T100BC1J5 | 113.8 | 58.4 | 118.80 | 34 | 118.12 | 0.7 | 0.8 | 0.8 | 16.5 | 12 | 12 | |
| T100BC3C | 113.1 | 59.6 | 118.71 | 35 | 117.98 | 0.7 | 0.7 | 0.7 | 19.0 | 8 | 12 | h, j |
| T100BC3C | 113.1 | 58.5 | 118.66 | 35 | 117.98 | 0.7 | 0.7 | 0.7 | 19.0 | 8 | 12 | j |
| T100BC4A | 117.6 | 38.4 | 117.90 | 35 | 117.98 | -0.1 | 0.2 | 0.2 | 1.9 | 12 | 12 | |
| T100BC5C | 114.9 | 37.9 | 117.88 | 35 | 117.98 | -0.1 | 0.2 | N/A[d] | 10.2 | 9 | 12 | h |
| T100BC6J10 | 117.9 | 45.3 | 118.25 | 35 | 117.98 | 0.3 | 0.3 | 0.3 | 2.1 | 11 | 12 | |

**Table B-1B. Site Coordinates, Sample Metadata, and Water Quality Data for 100-BC Pore Water Sampling, November 2010**

| Station Identification | River bed Elevation[a] per NAVD88 (m) | River Discharge[l] (Kcfs) | River Level[a,l] (m) | Nearest USCOE Bathymetry Transect | 40 Kcfs Steady State[l] River Elevation[a] at Nearest Transect | Height[l] (m) above Low Water | Staff Gage Reading Before (m) | Staff Gage Reading After (m) | River Depth at Station (ft) | Pore Water Sensor Depth (in. bgs) | Surface Water Sensor Height (in. ags) | Field QC Qualifier |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEARSHORE 1 | 119.4 | 57.5 | 118.98 | 31 | 118.28 | 0.7 | 0.7 | 0.7 | 4.1 | 10 | 12 | |
| NEARSHORE 2 | 118.7 | 40.1 | 118.22 | 33 | 118.19 | 0.0 | 0.2 | 0.2 | 1.6 | 9 | 12 | |

1

**Table B-1C. Site Coordinates, Sample Metadata, and Water Quality Data for 100-BC Pore Water Sampling, November 2010**

| Station Identification | Bottom Photo Filename | Logbook Page Number | Composite Pore Water Conductivity (µS/cm) | Trident Sensor Pore Water Temp. (C°) | Composite Pore Water pH | Composite Pore Water ORP (mV) | Composite Pore Water DO (mg/L) | Composite Pore Water Turbidity (NTU) | Surface Water Conductivity (µS/cm) | Trident Sensor Surface Water Temp. (C°) | Surface Water pH | Surface Water ORP (mV) | Surface Water DO (mg/L) | Surface Water Turbidity (NTU) | Diff. in Pore Water and Surface Water Cond. (µS/cm) | Change in Conductivity Reading During Sample Collection (Percent) | Pore Water PRC Sample No. | Cr(VI) (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A-A | 100BC2A-A_11052010.JPG | 15 | 305 | 14.3 | 7.15 | 313 | 8.38 | 5 | 146 | 13.7 | 7.48 | 291 | 10.27 | 3 | 159 | 0.0 | B296J1 | 4.4 |
| J100BC21 | J100BC21_11092010.JPG | 25 | 244 | 13.0 | 7.38 | 283 | 10.69 | 75 | 142 | 13.2 | 7.43 | 284 | 10.17 | 2 | 102 | 12.1 | B296J6 | <2.0 |
| J100BC23 | J100BC23_11142010.JPG | 32 | 207 | 12.9 | 7.64 | 261 | 9.68 | 45 | 142 | 13.0 | 7.32 | 284 | 9.98 | 1 | 65 | 0.0 | B296K1 | <2.0 |
| J100BC47 | J100BC47_11102010.JPG | 28 | 355 | 14.2 | 7.72 | 232 | 10.20 | 6 | 140 | 14.7 | 7.82 | 259 | 10.42 | 2 | 215 | 0.8 | B296K2 | 13.6 |
| T100BC1J1 | T100BC1J1_11082010.JPG | 21 | 295 | 13.6 | 7.07 | -25 | 6.34 | 60 | 151 | 14.6 | 7.47 | 160 | 9.81 | 1 | 145 | 0.3 | B296J2 | <2.0 |
| T100BC1J5 | T100BC1J5_11092010.JPG | 24 | 304 | 14.2 | 7.23 | 289 | 8.62 | 19 | 138 | 12.7 | 7.77 | 281 | 10.21 | 1 | 165 | -0.3 | B296J3 | <2.0 |
| T100BC3C | T100BC3C_11162010.JPG | 40 | 174 | 12.4 | 7.78 | 232 | 8.79 | 650 | 139 | 13.1 | 7.80 | 223 | 8.72 | 3 | 35 | 3.9 | B296J4 | 2.3 |
| T100BC3C | | 41 | 232 | 12.4 | 7.82 | 231 | 7.55 | 450 | 139 | 12.3 | 7.50 | 246 | 9.21 | 3 | 93 | 4.8 | B29B84 | 6.9 |
| T100BC4A | T100BC4A_11072010.JPG | 18 | 341 | 12.7 | 7.65 | 323 | 9.03 | 11 | 144 | 14.4 | 8.02 | 284 | 10.05 | 2 | 197 | 0.3 | B296J7 | 12.6 |
| T100BC5C | T100BC5C_11142010.JPG | 34 | 159 | 12.7 | 7.43 | 311 | 9.52 | 380 | 143 | 12.7 | 7.66 | 282 | 9.74 | 2 | 16 | -6.6 | B296J9 | <2.0 |
| T100BC6J10 | NA[d] | 20 | 330 | 13.8 | 7.78 | 306 | 8.42 | 23 | 141 | 12.6 | 7.90 | 312 | 9.82 | 1 | 189 | 0.6 | B296K0 | 12.6 |
| NEARSHORE 1 | 100BCNS1_11042010.JPG | 12 | 204 | 14.2 | 7.34 | 281 | 7.89 | 38 | 146 | 14.2 | 7.98 | 277 | 10.01 | 1 | 59 | 5.3 | B296K3 | <2.0 |
| NEARSHORE 2 | 100BCNS2_11072010.JPG | 17 | 281 | 15.6 | 7.22 | 313 | 8.22 | 9 | 152 | 14.5 | 7.56 | 283 | 9.76 | 1 | 129 | -0.4 | B296K4 | <2.0 |

a. Elevations are in NAVD88, 1988, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland.

b. Latitude and longitude are in NAD83, 1991, *North American Datum of 1983*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland, as revised.

c. Probe malfunctioned; no reading was recorded.

d. Data are not recorded.

e. Recorded with probe held at surface.

f. NAD83 State Plane Washington South FIPS 4602 Meters.

g. Possible dilution of pore water sample is due to exceedance of river stage guidelines during sampling event.

h. Sample conductivity is <90% of Phase IIb conductivity.

i. In situ readings dropped >10% during sample collection event.

j. Sample conductivity is <90% of Phase III conductivity.

k. In-situ readings increased >10% during sample collection event.

l. Height was calculated with Modular Aquatic Simulation System-1D (PNNL-15226, 2005, *Hydrodynamic Simulation of the Columbia River, Hanford Reach, 1940-2004*, Pacific Northwest National Laboratory, Richland, Washington).

## B1 References

NAD83, 1991, *North American Datum of 1983*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland, as revised.

NAVD88, 1988, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland.

PNNL-15226, 2005, *Hydrodynamic Simulation of the Columbia River, Hanford Reach, 1940-2004*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-15226.pdf.

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# Appendix C

## Photographs of River Bed at Pore Water Stations

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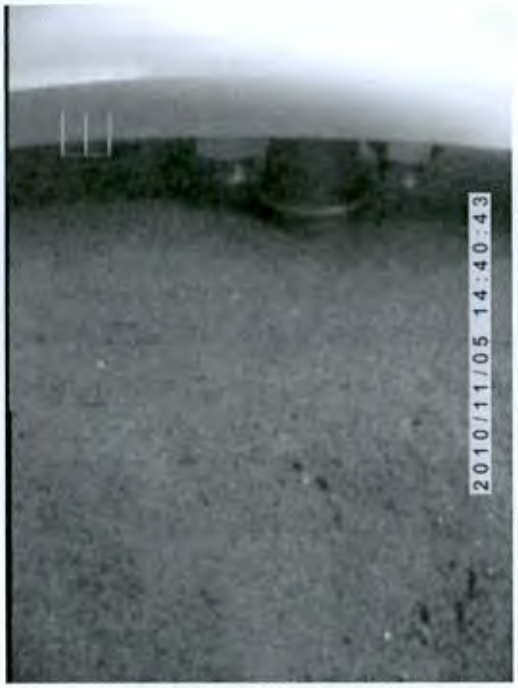



100BC2A-A_11052010.JPG

100BCNear Shore 1_11042010.JPG

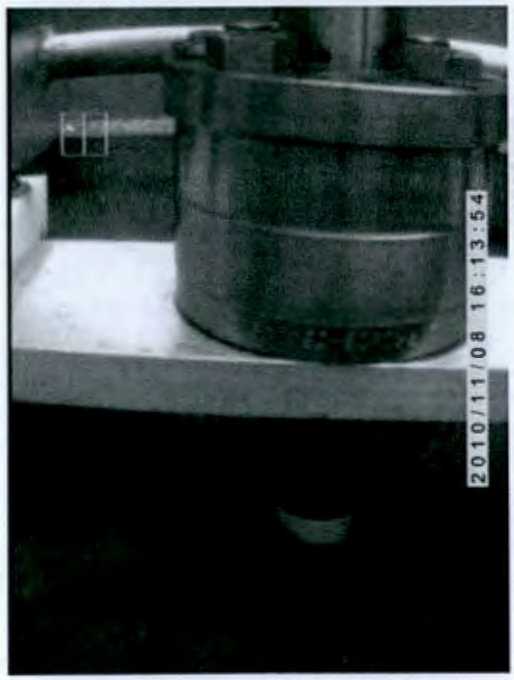
100BCNear Shore 2_11072010.JPG

J100BC21_11092010.JPG

J100BC23_11142010.JPG

J100BC47_10282010.JPG

J100BC47_11102010.JPG




T100BC1J1_11082010.JPG

T100BC15_11092010.JPG

T100BC3C_11162010.JPG

T100BC4A_11072010.JPG

T100BC5C_11142010.JPG

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LABORATORY
NOTEBOOK

100 BC

## NOTEBOOK/LOGBOOK COVERSHEET

| SECTION I | Notebook/Logbook No. HNF-N-701 1 | |
|---|---|---|
| **RECORD COPY** | Date of Issue 11/02/2010 | Copy 1 |
| **Not for Circulation** | Title PORE WATER SAMPLING | |
| Author ANNA RADLOFF | If continued from another notebook/ logbook, give the book number | |

This is a controlled notebook/logbook. The assigned custodian is responsible for this book. See MSC-PRO-10863, *Notebooks and Logbooks*, for instructions about controlling, placing input, preserving, and retiring the notebook/ logbook. When the book is completed or no longer needed, contact your Records Management Specialist for a Retention Schedule. Complete Section II of this form and return the notebook/logbook to Controlled Document Management, A3-95. **DO NOT DESTROY.**

| Responsible Custodian | Hanford ID No. | MSIN | Date Assigned |
|---|---|---|---|
| ANNA RADLOFF | 5143821 | R3-50 | 11/02/2010 |
| | | | |
| | | | |
| | | | |

**SECTION II** Complete this section before returning notebook/logbook to Controlled Document Management, A3-95

Abstract: (Give brief description of contents)

Period Covered: (Inclusive dates - Month/Day/Year) _____

| Custodian's Name | Custodian's Signature and Date |
|---|---|
| Custodian's Manager's Name | Custodian's Manager Signature and Date |
| Retention Schedule: | Specialist Concurrence Name |

BD-6001-256 (REV 1)

Book No. HNF-N-7011 1

TITLE CHPRC Porewater Sampling 2010 Project No. 41274/216515

From Page No. NA

B. Tiller (EAS) initiates Field logbook planned to document all Field records pertinent to the following SAPs, in support of measuring and collecting samples of pore water:

- DOE/RL-2009-44 REV0 SAP for the 100-BC-1, 100-BC-2, and 100-BC-5 O.U.s RIFS.
- DOE/RL-2010-69 DRAFT A: SAP for the 100-NR-2 O.U. RIFS PORE WATER INVESTIGATION
- OTHER RELEVANT CHPRC FIELD SAMPLING INSTRUCTIONS. "Pore Water Sampling" XXXXX REV2.

This Book is Assigned to B. Tiller. DAY TO DAY Logbook custodian will be Zeke Simmons (EAS) Zeke Simmons

RT 10-23-10

RT 10-23-10

| SIGNATURE | DATE | REVIEWED & ENDORSED BY | DATE |
|---|---|---|---|
| B. Tiller | 10-23-10 | [illegible] | 12/20/2010 |

2

BOOK NO.

TITLE PORE WATER SAMPLING Project No. 4/274/216575

From Page No. NA

10/23/2010 Zeke Simmons (EAS) (logbook scribe), Zeke Simmons Rob Curet (EAS), Ron Paulsen (CMA), George Paulsen (CMA)
Tailgate meeting (POD) @ 10:00 at Apel. B. Tiller attended
Weather: Overcaste w/ Showers; River Flow Steady ~55 Kcfs

| Trident Probe Conductivity Calibration Check | | | | | |
|---|---|---|---|---|---|
| Standard | Mfr. | Lot # | Expiration Date | Porewater Probe | Surface Probe |
| 10.5 uS | CP | CC8596 | 4/30/2011 | 104 | 104 |
| 447 | Oakton | 205259 | May/2011 | 454 | 451 |

| Myron L Ultrameter Calibration Check: SN | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| pH* | 7 | Myron L | 1001397 EB | 9/9/2011 | 7.04 |
| | 4 | Myron L | 2003077 JM | 8/3/2011 | 4.07 |
| Cond. | 100.5 | CP | CC8596 | 4/30/2011 | 94.87 |
| | 447 | Oakton | 205259 | 5/2011 | 440.9 |

*ORP is calibrated using results of pH cal. Check

| YSI Dissolved Oxygen Meter Calibration Check: SN | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| D.O. NA | NA | NA | NA | NA | NA |

Zeke Simmons

Zeke Simmons

Field measurements prescribed in these SAP's will be recorded in this logbook.
Metadata of Trident System will be recorded on CMA field record forms.
Substrate: Silt/Sand
2A-A (Station) Weather: Gradually improved to clear skies/Sunshine.

| CHPRC 2010 | | | ES 10/23/2010 | | Date: 10/23/2010 |
|---|---|---|---|---|---|
| Porewater ~~Sample~~ Readings | | | | | |
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg) NAD83 | |
| 2A-A | N/A | before: 0.6 after: 0.6 | Start: 14:20 End: 14:40 | E -119.65532 | N 46.63755 |
| Probe Tip Depth (Inches) (6"-12") | Water quality results from sample composite | | | | |
| | Conductivity (µS/cm) | *See CMA Insitu Record Temp (C°) | ORP | pH | D.O. |
| 12" | 299.4 | 16.31 | 308 | 6.90 | N/A |
| HEIS Sample No.(s) | | Volume (mL) | | Duplicate? Tied To: | # Bottles/Notes: |
| N/A | | N/A | | N/A | N/A |

Zeke Simmons

To Page No. 03

SIGNATURE DATE WITNESSED & UNDERSTOOD BY DATE

Zeke Simmons 10/23/2010 [illegible] 12/20/2010

CONFIDENTIAL

Book No. HNF-N-7011 3

TITLE PORE WATER SAMPLING Project No. 41274/216575

From Page No. 02 10/23/2010 cont'd Station ID: 2A-A

Time: 14:50 Installed Semi-permanent Trident hardened pore water Sampler probe (QA/QC point for station 2A-A).
Substrate: Silt/Sand
Initiated a porewater reading using the above mentioned probe at 14:55. Lost signal at 15:09 rendering incomplete readings. Re-Started at 15:12 yielding results listed in data sheet below.

| CHPRC 2010 | | | ZS 10/23/2010 | | Date: 10/23/2010 |
|---|---|---|---|---|---|
| Porewater Sample Readings | | | | | |
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg) NAD83 | |
| 2A-A | N/A | before: 0.6 after: 0.6 | Start: 15:12 End: 15:20 | E -119.65525 | N 46.63755 |
| Probe Tip Depth (Inches) (6"-12") | Water quality results from sample composite | | | | |
| | Conductivity (µS/cm) | Temp (C°) | ORP | pH | D.O. |
| 12" | 296.8 | 16.3 | 285 | 6.41 | N/A |
| HEIS Sample No.(s) | | Volume (mL) | | Duplicate? Tied To: | # Bottles/Notes: |
| N/A | | N/A | | N/A | N/A |

Zeke Simmons

Decon in field at 15:23 per SAI (See page 1)
- purge Teflon tubing 03 times with 1% liquinox solution
- purge teflon tubing 06 times with DI Water
  - 01 purge = 180 ml ~ Volume of Teflon tubing (V) x 3

Actual Volume of Teflon tubing to be determined using Volume of a cylinder formula. 25ft Teflon tube = 762 cm

$V = \pi r^2 h$

$V = \pi (0.15875)^2 (762\ cm)$ $3V = 180.989 \sim 180\ ml$

$V = \pi (0.0252015 63)(762)$

$V = 60.33\ ml$

50 ft Teflon tube = 1524 cm

$V = \pi (0.15875)^2 (1524\ cm)$ $3V = 361.979 \sim 360\ ml$

$V = \pi (0.0252015 63)(1524)$

$V = 120.66\ ml$

ZS 10/23/2010

To Page No. NA

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zeke Simmons | 10/23/2010 | [illegible] | 10/28/2010 |

CONTINUED ON NEXT

4

Book No. HNF-N-701 1

TITLE PORE WATER SAMPLING

Project No 41274/216575

From Page No. NA

10/27/2010 Zeke Simmons (EAS: logbook scribe) Zeke Simmons, Neil Sullivan (EAS), Ron Paulsen (CMA), George Paulsen (CMA)
Tailgate meeting (POD) at 09:00 held at Apel.
Weather: Sunshine with few clouds & light winds
River Flow: 56 KCFS at 10:00 hrs.

CHPRC 2010 Date: 2010 10 27

| Trident Probe Conductivity Calibration Check | | | | | |
|---|---|---|---|---|---|
| Standard | Mfr. | Lot # | Expiration Date | Porewater Probe | Surface Probe |
| 100.5 uS | Control Co. | CC8596 | 04/30/11 | 98 | 103 |
| 447 | Oakton | 205259 | 05/31/11 | 447 | 459 |

| Myron L Ultrameter Calibration Check: SN | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| pH* | 7 | Myron L Company | 1001397 EB | 09/09/11 | 7.02 |
| | 4 | Myron L Company | 2003077 JM | 08/03/11 | 3.98 |
| Cond. | 100.5 | Control Co. | CC8596 | 04/30/11 | 97.8 |
| | 447 | Oakton | 205259 | 05/31/11 | 441.8 |

*ORP is calibrated using results of pH cal. Check

| YSI Dissolved Oxygen Meter Calibration Check: SN | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| D.O. | Zero | Hanna | 1427 | March of 2014 | ~~0.0~~ 0.17 |

ZS 10/27/2010

Zeke Simmons

100 N Outfall Substrate: Cobble
Water depth at Station: 4.7 ft
12:19 purged 30 ft Teflon tubing with 200 ml surface river water
Cleaned/rinsed Myron unit holding cell 3 x's with surface river water

ZS 10/27/2010

05

SIGNATURE Zeke Simmons DATE 10/27/2010 WITNESSED AND UNDERSTOOD BY [signature] DATE 12/20/2010

Book No. HNF-N-7011 5

TITLE PORE WATER SAMPLING

Project No. 41274/216515

From Page No. 04

| CHPRC 2010 | | | ZS 10/27/2010 | | Date: 10/27/10 |
|---|---|---|---|---|---|
| Porewater ~~Sample~~ Readings | | | | | |
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg) NAD83 | |
| 100N Outfall | NA | before: 0.6 after: 0.6 | Start: 12:51 End: ~13:10 | E -119.57160 | N 46.67528 |
| Probe Tip Depth (Inches) (6"-12") | Water quality results ~~from sample composite~~ ZS 10/27/2010 | | | | |
| | Conductivity (µS/cm) | Temp (C°)* Probe | ORP | pH | D.O. |
| 12" | 287 | 14.654 | NA | NA | NA |
| | Turbidity NA | | | TDS 136.3 | |
| HEIS Sample No.(s) | | Volume (mL) | | Duplicate? Tied To: | # Bottles/Notes: |
| NA | | NA | | NA | NA |
| | | | | | |
| | | | | | |
| | | | | | |
| Surfacewater Readings River Myron | | | | | |
| TDS 65.77 | | Water quality results (after 3x purge water) | | | |
| | Conductivity (µS/cm) | Temp (C°)* | ORP | pH | D.O. |
| | 134.9 | 14.640 | 239 | 7.98 | 9.40 |

*see CMA Insitu Record (from Trident at beginning of sample)

Pore Water (PW) Myron:

Cond 277.7
Temp NA
ORP 251
pH 7.41
DO 7.08
TDS 136.3 ppm

LATE ENTRY: ZS 11/03/2010 The station described below is Station ID T100N1A
T100N1A1 arrived at station at 15:50 Substrate: Cobble
15:55 - 16:00 pumped/purged Teflon tubing with 90 ml surface river water.
This Station is referred to as T100N1A in CMA records for 10/27/2010.
River Water depth at station: 3.1 ft

ZS 10/27/2010

To Page No. 06

SIGNATURE: Zee Sumner DATE: 10/27/2010 WITNESSED & UNDERSTOOD BY: [signature] DATE: 12/28/2010

CONFIDENTIAL

6

Book No. HNF-N-7011

TITLE PORE WATER SAMPLING

Project No. 41274/216575

From Page No. 05

| CHPRC 2010 | | | ZS 10/27/2010 | | Date: 10/27/2010 |
|---|---|---|---|---|---|
| T100NIA 10/27/2010 | | | Porewater Sample Readings Trident | | |
| Station ID: 1 | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg) NAD83 | |
| ~~T100NIAT~~ | NA | before: 0.6 after: 0.6 | Start: 16:05 End: ~16:25 | E -119.56905 | N 46.67788 |
| Probe Tip Depth (Inches) (6"-12") | Water quality results from sample composite | | | | |
| | Conductivity (µS/cm) | Temp (C°)* | ORP | pH | D.O. |
| 11" | 543 | 14.986 | NA | NA | NA |
| | Turbidity NA | | | TDS | |
| HEIS Sample No.(s) | | Volume (mL) | | Duplicate? Tied To: | # Bottles/Notes: |
| NA | | NA | | NA | NA |
| | | | | | |
| | | | | | |
| | | | | | |
| Surfacewater Readings River Myron | | | | | |
| | TDS 66.46 | Water quality results (after 3x purge water) | | | |
| | Conductivity (µS/cm) | Temp (C°)* | ORP | pH | See CMA D.O. Records |
| | 136.2 | NA | 216 | 8.09 | |

*see CMA Insitu Record (from Trident at beginning of sample)

Zeke Simmons

PW Myron:
Cond. 548.5
Temp NA
ORP 218
pH 7.43
DO 3.80
TDS 254.3

Reference Probe:
Temp 14.865
Cond 150

Decon in field at 16:45 per SAI.

ZS 10/27/2010

To Page No. NA

SIGNATURE Zeke Simmons DATE 10/27/2010 WITNESSED & UNDERSTOOD BY [signature] DATE 10/28/2010

Book No. HNF-N-701 1 7

TITLE PORE WATER SAMPLING

Project No. 41274/216575

From Page No. NA

10/28/2010 Zeke Simmons (EAS) Zeke Simmons, Neil Sullivan (EAS)
Ron Paulsen (CMA), George Paulsen (CMA)
08:00 Tailgate meeting (POD) held at Apel.
Weather: Overcast with Showers
River Flow: 56 KCFS at 08:00

| CHPRC 2010 | | | | | Date: 10/28/2010 |
|---|---|---|---|---|---|
| Trident Probe Conductivity Calibration Check | | | | | |
| Standard | Mfr. | Lot # | Expiration Date | Porewater Probe | Surface Probe |
| 100.5 uS | Control Co. | CC8596 | 04/30/11 | 99 | 102 |
| 447 | Oakton | 205259 | 05/31/11 | 449 | 474 |

| Myron L Ultrameter Calibration Check: SN | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| pH* | 7 | Myron L Company | 1001397 EB | 09/09/11 | 7.02 |
| | 4 | Myron L Company | 2003077 JM | 08/03/11 | 3.99 |
| Cond. | 100.5 | Control Co. | CC8596 | 04/30/11 | 93.7 |
| | 447 | Oakton | 205259 | 05/31/11 | NA |

*ORP is calibrated using results of pH cal. Check

| YSI Dissolved Oxygen Meter Calibration Check: SN | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| D.O. | Zero | Hanna | 1427 | March of 2014 | ~~0.18~~ 0.12 |
| | | | | | ZS 10/28/2010 |
| Turbidity NA | | | | | |

Zeke Simmons

ZS 10/28/2010

To Page No. 08

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zeke Simmons | 10/28/2010 | [illegible] | 12/28/2010 |

8

Book No. HNF-N-701 1

TITLE PORE WATER SAMPLING

Project No. 41274/216575

From Page No. 07

| CHPRC 2010 | | | ES 10/28/2010 | | Date: 10/28/2010 |
|---|---|---|---|---|---|
| Porewater Sample Readings Trident | | | | | |
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg) NAD83 | |
| 2A-A | NA | before: 0.7 after: 0.7 | Start: 11:40 End: 12:05 | E -119.65532 | N 46.63755 |
| Probe Tip Depth (Inches) (6"-12") | Water quality results from sample composite | | | | |
| | Conductivity (µS/cm) | Temp (C°)* | ORP | pH | D.O. |
| 12" | 306.8 | NA | NA | NA | NA |
| | Turbidity NA | | | TDS NA | |
| HEIS Sample No.(s) | | Volume (mL) | | Duplicate? Tied To: | # Bottles/Notes: |
| NA | | NA | | NA | NA |
| | | | | | |
| | | | | | |
| Substrate: Silt/Sand | Surfacewater Readings NONE TAKEN | | | | |
| | Water quality results (after 3x purge water) | | | | |
| | Conductivity (µS/cm) | Temp (C°)* | ORP | pH | D.O. |
| | NA | NA | NA | NA | NA |

*see CMA Insitu Record (from Trident at beginning of sample)

ZWS

J100BC47 Substrate: Cobble
Water depth at Station: 3.2 ft

| CHPRC 2010 | | | ES 10/28/2010 | | Date: 10/28/2010 |
|---|---|---|---|---|---|
| Porewater Sample Trident Readings | | | | | |
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg) NAD83 | |
| J100BC47 | NA | before: 0.7 after: 0.7 | Start: 13:00 End: 13:20 | E -119.63627 | N 46.64078 |
| Probe Tip Depth (Inches) (6"-12") | Water quality results from sample composite | | | | |
| | Conductivity (µS/cm) | Temp (C°)* | ORP | pH | D.O. |
| 9" | 279 | 14.820 | NA | NA | NA |
| | Turbidity NA | | | TDS NA | |
| HEIS Sample No.(s) | | Volume (mL) | | Duplicate? Tied To: | # Bottles/Notes: |
| NA | | NA | | NA | NA |
| | | | | | |
| | | | | | |
| | | | | | |
| River | Surfacewater Readings Myron | | | | |
| TDS 66.97 | Water quality results (after 3x purge water) | | | | |
| | Conductivity (µS/cm) | Temp (C°)* | ORP | pH | D.O. |
| | 139.4 | NA | 286 | 7.88 | 9.30 |

*see CMA Insitu Record (from Trident at beginning of sample)

ZWS

To Page No. 09

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zoie Summers | 10/28/2010 | [illegible] | 12/28/2010 |

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TITLE PORE WATER SAMPLING

Project No 41274/216575

From Page No. 08

J1008C47 continued

PW Myron:

Cond 288.4
Temp NA
ORP 278
pH 7.61
DO 6.60
TDS 139.80

Reference Probe:

Cond 150
Temp 14.373

100 N Outfall Substrate: Cobble

| CHPRC 2010 | | | ZS 10/28/2010 | | Date: 10/28/2010 |
|---|---|---|---|---|---|
| Porewater ~~Sample Trident~~ Readings Myron | | | | | |
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg) NAD83 | |
| 100N Outfall | NA | before 0.6 after 0.6 | Start: 13:50 End: ~14:10 | E -119.57160 | N 46.67528 |
| Probe Tip Depth (Inches) (6"-12") | Water quality results from sample composite | | | | |
| | Conductivity (µS/cm) | Temp (C°)* | ORP | pH | D.O. |
| 12" | 350.4 | NA | 334 | 7.60 | 5.68 |
| | Turbidity NA | | | TDS 170.3 | |
| HEIS Sample No.(s) | | Volume (mL) | | Duplicate? Tied To: | # Bottles/Notes: |
| NA | | NA | | NA | NA |
| | | | | | |
| | | | | | |
| | | | | | |
| Surfacewater Readings | | | | | |
| | Water quality results (after 3x purge water) | | | | |
| | Conductivity (µS/cm) | Temp (C°)* | ORP | pH | D.O. |
| | NA | NA | NA | NA | 9.25 |

*see CMA Insitu Record (from Trident at beginning of sample)

Zeke Simmons

T100N1A
~~T100N1A~~ ZS 10/28/2010
Substrate: Cobble
Water depth at Station 3.5 ft

ZS 10/28/2010

To Page No. 10

SIGNATURE Zeke Simmons DATE 10/28/2010 WITNESSED & UNDERSTOOD BY Ann Marie Rodloff DATE 10/28/2010

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Book No HNF-N-701 1

TITLE PORE WATER SAMPLING

Project No 41274/216575

From Page No. 09

| CHPRC 2010 | | | ZS 10/28/2010 | | Date: 10/28/2010 |
|---|---|---|---|---|---|
| 100NIA 10/28/2010 | | | Porewater Sample Trident Readings | | |
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg) NAD83 | |
| ~~100NIA~~ | NA | before 0.6 after 0.6 | Start: 14:31 End: 14:45 | E -119.56900 | N 46.67787 |
| Probe Tip Depth (Inches) (6"-12") | Water quality results from sample composite | | | | |
| | Conductivity (µS/cm) | Temp (C°)* | ORP | pH | D.O. |
| 11" | 648 | 14.824 | NA | NA | NA |
| | Turbidity NA | | | TDS 66.86 | |
| HEIS Sample No.(s) | | Volume (mL) | | Duplicate? Tied To: | # Bottles/Notes: |
| NA | | NA | | NA | NA |
| | | | | | |
| | | | | | |
| | | | | | |
| Surfacewater Readings Myron | | | | | |
| TDS 66.86 | Water quality results (after 3x purge water) | | | | |
| | Conductivity (µS/cm) | Temp (C°)* | ORP | pH | D.O. |
| | 139.3 | NA | 204 | 7.92 | 9.27 |

*see CMA Insitu Record (from Trident at beginning of sample)

Zeke Summers

PW Myron:
Cond 649.5
Temp NA
ORP 144
pH 7.33
DO 3.79
TDS 311.8

Reference Probe:
Cond 150
Temp 14.510

Decon in field at 15:00 per SAI.

Mixed Liguinox solution: At 17:30 hrs. Mixed in Lab 151 (Apel)
-22.0 L 1% Liguinox
- Using DI water from Apel Lab 151/153
- DI water at 17.6 megohm-cm
For CMA de-Con use
DI water provided/supplied from Apel Lab 153
Manufacturer: Barnstead
Model : E-pure
property of Applied Process Engineering Laboratory

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD | DATE |
|---|---|---|---|
| Zeke Summers | 10/28/2010 | [illegible] | 12/28/2010 |

To Page NA

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Book No HNF-N-701 1 11

TITLE PORE WATER SAMPLING

Project No 41274/216575

Front Page No NA

11/04/2010 Zeke Simmons (EAS) Zeke Simmons, Rob Curet (EAS), Chris Smith (CMA), Mark Biser (CMA)
09:00 Tailgate meeting (POD) held at Apel
Weather: Sunshine, Slight breeze
River Flow: 56 KCFS at 08:00

Zeke Simmons

| CHPRC 2010 | | | | | Date: 11-4-10 |
|---|---|---|---|---|---|
| Trident Probe Conductivity Calibration Check | | | | | |
| Standard | Mfr. | Lot # | Expiration Date | Porewater Probe | Surface Probe |
| 100.5 uS | Control Co. | CC8596 | 04/30/11 | 104 | 103 |
| 447 | Oakton | 205259 | 05/31/11 | 454 | 449 |

| Myron L Ultrameter II Calibration Check: SN 6227090 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| pH* | 7 | Myron L Company | 1001397 EB | 09/09/11 | 7 |
| | 4 | Myron L Company | 2003077 JM | 08/03/11 | 3.88 |
| Cond. | 100.5 | Control Co. | CC8596 | 04/30/11 | 98.6 |
| | 447 | Oakton | 205259 | 05/31/11 | 447.1 |

*ORP is calibrated using results of pH cal. Check

| YSI Dissolved Oxygen Meter Calibration Check: SN 09F100411 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| D.O. | Zero | Hanna | 1427 | March of 2014 | 0.3 |

4 point Cal. preceeding

| HANNA Turbidimeter Calibration Check: SN 08292360 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| Turbidity | 100 | Hanna | 0277 | 09/30/2012 | 100 |

2A-A QC Station Start Time 12:02 Conductivity 310
Staff Guage: before: 0.7 after: 0.7 End Time 12:15
EB1 12:10 - 12:35 Sample No. B29887 1 LAG
Equipment Blank Lot No. 043672
Sample Volume 1L

ZS 11/04/2010

To Page No 12

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zeke Simmons | 11/04/2010 | Duncan Radloff | 12/26/2010 |

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Book No HNF-N-7011

TITLE PORE WATER SAMPLING

Project No 41274/216575

From Page No. 11

BC Nearshore 1 Substrate: Medium & large cobble
Water depth at station: 4.1 ft
Telephone Call to Brett Tiller (EAS) regarding Sample volume at 12:52 hrs
Returned telephone call from Brett Tiller (EAS) at 13:35 hrs:
- Conversation: Brett relayed from Aurna Radloff (CHPRC) that we are to collect 550ml - 600ml at a minumum.

| INITIAL Porewater Readings 11/04/2010 | | | | |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[b] | pH[b] | D.O.[c] |
| 210 | 14.208 | 281 | NA | NA |
| Turbidity[c] NA | | | | |

| SurfacewaterReadings | | | | |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[b] | pH[b] | D.O.[c] |
| 145.5 | ~~14.174~~ 14.174 | 277 | 7.98 | 10.01 |
| Turbidity[c] 0.70 NTU | | | | |

LATE ENTRY 11/07/10 Coordinates - Trimble Trimble SN 4636497348

| COMPOSITE Porewater Sample ~~11/04/2010~~ 11/04/2010 | | | | | |
|---|---|---|---|---|---|
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg)NAD83 Trident | |
| BCNS1 | F11-016 | before: 0.7 after: 0.65 | Start: 13:20 End: 14:53 | E -119.68078 | N 46.64453 |
| Probe Tip Depth (Inches) (6"-12") | → Trimble Coordinates N 46.64458011 Accuracy 1.95 ft E-119.68078078 | | | | |
| | Water quality results (Composite) | | | | |
| 10" | Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[b] | pH[b] | D.O.[c] |
| | 204.3 | ~~NA~~ 11/04/2010 14.200 | 281 | 7.34 | 7.89 |
| | Turbidity[c] 38.0 NTU | | | | |

| HEIS Sample No.(s) | Volume (mL) | Duplicate? Tied To: | # Bottles/Notes: |
|---|---|---|---|
| B29896 | ~700ml | NA | 01 1LAG |
| | | | |

| FINAL Porewater Readings | | | | |
|---|---|---|---|---|
| Water quality results (after 3x purge water) | | | | |
| Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[b] | pH[b] | D.O.[c] |
| NA | NA | NA | NA | NA |

a) Myron
b) Trident
c) YSI
d) Hanna Meter

Will Simmons

Sample Volume: ~700ml Bottle Size: 1LAG
Decon in field at 15:00 per SAI.

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| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Will Simmons | 11/04/2010 | Aurna Radloff | 11/28/2010 |

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TITLE PORE WATER SAMPLING Project No. 41214/216575

From Page No. 12

2A-A QC Station Start time 15:45 Conductivity 308
Staff Guage: before 0.65 after 0.65 End Time 15:48 Decon at 16:00/(SAI)
~16:28 I asked Roy Plunkett (CHPRC) for Custody Seals
16:30 - 16:33 Relinquised Sample & Equipment blank
Sample No. B29896 (BC Nearshore 1)
EB1 Sample No. B29887

~16:36 Asked Roy Plunkett for custody seals again (for the 2nd time)
Response: We will put them on the bottles... it Shouldn't be an issue... we will be opening the bottles this evening anyways. We will get you some custody Seals and play by the rules from now on.
Per Roy Plunkett, custody seals were placed on bottles immediately following sample handoff.

Roy Plunkett provided custody seals to EAS at ~17:00.

ZS 11/04/2010

NX

Zee Simmons 11/04/2010 12/28/2010

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Book No. HNF-N-701

TITLE: PORE WATER SAMPLING

Project No. 41274/216575

From Page No. NA

11/05/2010 Zeke Simmons (EAS) Zeke Simmons, Rob Curet (EAS), Chris Smith (CMA), Mark Biser (CMA)
10:00 Tailgate meeting (POD) held at Apel
Weather: Slight overcast / Cloudy
River Flow: 56 KCFS at 08:00 hrs

| | |
|---|---|
| 0100 | 152 KCFS |
| 0200 | 151 KCFS |
| 03:00 | 161 KCFS |
| 04:00 | 83 KCFS |
| 05:00 | 42 KCFS |
| 06:00 | 55 KCFS |
| 07:00 | 56 KCFS |

| CHPRC 2010 | | | | | Date: 11/05/2010 |
|---|---|---|---|---|---|
| Trident Probe Conductivity Calibration Check | | | | | |
| Standard | Mfr. | Lot # | Expiration Date | Porewater Probe | Surface Probe |
| 100.5 uS | Control Co. | CC8596 | 04/30/11 | 104 | 99 |
| 447 | Oakton | 205259 | 05/31/11 | 457 | 451 |

| Myron L Ultrameter II Calibration Check: SN 6227090 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| pH* | 7 | Myron L Company | 1001397 EB | 09/09/11 | 6.94 |
| | 4 | Myron L Company | 2003077 JM | 08/03/11 | 3.78 |
| Cond. | 100.5 | Control Co. | CC8596 | 04/30/11 | 97.27 |
| | 447 | Oakton | 205259 | 05/31/11 | 448.7 |

*ORP is calibrated using results of pH cal. Check

| YSI Dissolved Oxygen Meter Calibration Check: SN 09F100411 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| D.O. | Zero | Hanna | 1427 | March of 2014 | 0.14 |
| | | | 0279 | | 09/2012 |
| | <0.10 | HANNA | HANNA Turbidimeter Calibration Check: SN 08292360 | | 0.05 |
| | Standard | Mfr. Hanna | Lot # 0277 | Expiration Date | Actual Reading |
| Turbidity | 100 | Did 4 point calibration given | | 9/30 12 | 100 |

13:00 Decon per SAI
2A-A QC Station Start time: 13:35 End time: 13:40
Staff guage before: 0.67 Staff guage after: 0.67
Conductivity: 306.9

ZS 11/05/2010

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| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zeke Simmons | ~~10~~ 11/05/2010 ZS 11/05/2010 | [illegible] | 12/28/2010 |

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Book No. HNF-N-701 15

TITLE PORE WATER SAMPLING Project No. 41274/216575

From Page No. 14

ZS 11/05/2010
~~BC Nearshore~~ 2A-A Substrate: Silt/Sand
Water depth at Station: 1.9 ft
Steve Lowe (CHPRC) present on shore at Station 2A-A. 13:40 hrs
Steve Lowe took photos of the operation from shore

| INITIAL Porewater Readings | | | | 11/05/2010 |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[a] | pH[a] | D.O.[c] |
| 308 | ~~14.39~~ 14.272 ZS 11/05/10 | 301 | 7.50 | 8.31 |
| Turbidity[d] 25.0 NTU | | | | |

| SurfacewaterReadings | | | | |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[a] ZS 11/05/2010 | pH[a] ZS 11/05/2010 | D.O.[c] |
| 145.9 | 13.7 | 291 | 7.48 | 10.27 |
| Turbidity[d] 2.5 NTU | | | | |

River depth at Station 1.9 ft

| COMPOSITE Porewater Sample | | | | | |
|---|---|---|---|---|---|
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg)NAD83 Accuracy 1.69 feet | |
| 2A-A | F11-016 | before: 0.67 after: | Start: 14:32 End: 15:47 | E -119.65534518 | N 46.63757212 |
| Probe Tip Depth (Inches) (6"-12") | Water quality results (Composite) | | | | |
| 12" BSG | Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[a] ZS 11/05/2010 | pH[a] ZS 11/05/2010 | D.O.[c] |
| | 304.7 | 14.3 | 313 | 7.15 | 8.38 |
| | Turbidity[d] 5.0 | | | | |

| HEIS Sample No.(s) | Volume (mL) | Duplicate? Tied To: | # Bottles/Notes: |
|---|---|---|---|
| B29883 | ~600 mL | NA | 01 / 1LAG |
| | | | |

| FINAL Porewater Readings | | | | |
|---|---|---|---|---|
| Water quality results ~~(after 3x purge water)~~ ZS 11/05/2010 | | | | |
| Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[a] ZS 11/05/2010 | pH[a] ZS 11/05/2010 | D.O.[c] |
| 303.9 | 14.86 | 313 | 7.54 | 8.21 |

a) Myron
b) Trident
c) YSI
d) Hanna Meter

Turbidity 0.85 NTU

Zeke Simons

Sample Volume: ~600 ml
Bottle Size: 1L Amber Glass (AG)
Decon in field per SAI 16:05 hrs

To Page No. NA

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zeke Simons | 11/05/2010 | Dana M Radloff | 12/06/2010 |

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Book No. HNF-N-7011

TITLE PORE WATER SAMPLING

Project No 41274/216575

From Page No. NA

11/07/2010 Zeke Simmons (EAS) Zeke Simmons, Neil Sullivan (EAS), Chris Smith (CMA), Mark Biser (CMA)
08:30 Tailgate meeting (100) held at Aped
Weather: Mostly Cloudy with Showers in A.M. / Mostly sunny with slight breeze P.M.
River Flow: 38 KCFS at 01:00 hrs

| Time | KCFS |
|---|---|
| 0100 | 130 |
| 0200 | 92 |
| 0300 | 71 |
| 0400 | 39 |
| 0500 | 38 |
| 0600 | 38 |
| 0700 | 38 |

| CHPRC 2010 | | | | Date: 11/07/2010 | |
|---|---|---|---|---|---|
| Trident Probe Conductivity Calibration Check | | | | | |
| Standard | Mfr. | Lot # | Expiration Date | Porewater Probe | Surface Probe |
| 100.5 uS | Control Co. | CC8596 | 04/30/11 | 106 | 100 |
| 447 | Oakton | 205259 | 05/31/11 | 450 | 450 |

| Myron L Ultrameter II Calibration Check: SN 6227090 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| pH* | 7 | Myron L Company | 1001397 EB | 09/09/11 | 6.98 |
| | 4 | Myron L Company | 2003077 JM | 08/03/11 | 3.82 |
| Cond. | 100.5 | Control Co. | CC8596 | 04/30/11 | 97.76 |
| | 447 | Oakton | 205259 | 05/31/11 | 446.8 |

*ORP is calibrated using results of pH cal. Check

| YSI Dissolved Oxygen Meter Calibration Check: SN 09F100411 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| D.O. | Zero | Hanna | 1427 | March of 2014 | 0.14 |

| HANNA Turbidimeter Calibration Check: SN 08292360 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| Turbidity(NTU) | < 0.10 | Hanna | 0279 | 09/30/12 | 0.5 |
| Turbidity(NTU) | 15 | Hanna | 0286 | 10/31/12 | 15.0 |
| Turbidity(NTU) | 100 | Hanna | 0277 | 09/30/12 | 100.0 |
| Turbidity(NTU) | 750 | Hanna | 0285 | 10/31/12 | 750.0 |

10:30 Decon for SAI
2A-A QC Station Start time: 11:00 End time: 11:07
Staff guage: before 0.20 after 0.20 VERY LOW WATER
Conductivity: 306

To Page No. 17

SIGNATURE: Zeke Simmons DATE: 11/07/2010 WITNESSED & UNDERSTOOD BY: [signature] DATE: 11/28/2010

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Book No. HNF-N-701 1 17

TITLE PORE WATER SAMPLING

Project No. 41214/216575

From Page No. 16

BC Nearshore 2 (BCNS2) Substrate: Medium Cobble
Water depth at Station: 1.6 ft

| INITIAL Porewater Readings | | | | Date: 11/07/2010 |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| 283 | 13.895 | 220 | 6.99 | 8.10 |
| Turbidity[d] 80.0 NTU | | | | |

| SurfacewaterReadings | | | | |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| 152 | 14.5 | 283 | 7.56 | 9.76 |
| Turbidity[d] 1.20 NTU | | | | |

| COMPOSITE Porewater Sample | | | | | |
|---|---|---|---|---|---|
| Station ID: | SAF# | VERY LOW Staff Guage (m.m) | Sample Time | Coordinates (deg.deg)NAD83 Accuracy 1.9 ft | |
| BCNS2 | F11-016 | before 0.20 after 0.20 | Start: 11:56 End: 13:23 | E-119.66450409 | N46.64002926 |
| Probe Tip Depth (Inches) (6"-12") 9 inches BSG | Water quality results (Composite) | | | | |
| | Conductivity (µS/cm)[a] | Temp (C°)[b] ZS 11/07/10 | ORP[c] | pH[c] | D.O.[c] |
| | 281 | 15.6 | 313 | 7.22 | 8.22 |
| | Turbidity[d] 8.60 NTU | | | | |

| HEIS Sample No.(s) | Volume (mL) | Duplicate? Tied To: | # Bottles/Notes: |
|---|---|---|---|
| B29897 | ~600 mL | NA | 01 / 1 LAG |
| | | | |

| FINAL Porewater Readings | | | | |
|---|---|---|---|---|
| Water quality results | | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| 278 | 14.025 | 295 | 6.87 | 7.51 |
| Turbidity[d] 7.80 | | | | |

a) Myron
b) Trident
c) YSI
d) Hanna Meter

Zeke Simmons

13:30 Decon per SAI
Sample Volume: ~600 ml
Bottle: 1 LAG
15:38 Cell phone call with Roy Plunkett: Status Update

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| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zeke Simmons | 11/07/2010 | [illegible] | 12/28/2010 |

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Book No. HNF-N-7011

TITLE PORE WATER SAMPLING

Project No 41274/216575

From Page No. 17

T100BC4A Substrate: Medium/Small cobble

Water depth at station: 1.9 ft

**INITIAL Porewater Readings** Date: 11/07/2010

| Water quality results (after purge water) | | | | |
|---|---|---|---|---|
| Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[a] | pH[a] | D.O.[c] |
| 332 | 15.126 | 256 | 7.56 | 7.81 |
| Turbidity[a] 90.0 NTU | | | | |

**SurfacewaterReadings**

| Water quality results (after purge water) | | | | |
|---|---|---|---|---|
| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[a] | pH[a] | D.O.[c] |
| 144 | 14.4 | 284 | 8.02 | 10.05 |
| Turbidity[a] 2.00 NTU | | | | |

**COMPOSITE Porewater Sample**

| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg)NAD83 Accuracy 1.4 ft | |
|---|---|---|---|---|---|
| T100BC4A | F11-016 | before 0.20 after 0.20 | Start: 15:40 End: 16:54 | E-119.64548718 | N46.63896000 |

Probe Tip Depth (Inches) (6"-12") 12 inches BSG

| Water quality results (Composite) | | | | |
|---|---|---|---|---|
| Conductivity (µS/cm)[a] | Temp (C°)[a] 25 11/07/10 | ORP[a] | pH[a] | D.O.[c] |
| 340.5 | 12.7 | 323 | 7.65 | 9.03 |
| Turbidity[a] 11.0 NTU | | | | |

| HEIS Sample No.(s) | Volume (mL) | Duplicate? Tied To: | # Bottles/Notes: |
|---|---|---|---|
| B29889 | ~600 mL | NA | 01 / 1 LAG |
| | | | |

**FINAL Porewater Readings**

| Water quality results | | | | |
|---|---|---|---|---|
| Conductivity (µS/cm)[a] | Temp (C°)[a] 25 11/07/10 | ORP[a] | pH[a] | D.O.[c] |
| 310.4 | 12.7 | 325 | 7.64 | 8.47 |
| Turbidity[a] 11.0 NTU | | | | |

a) Myron
b) Trident
c) YSI
d) Hanna Meter

Zeke Simmons

17:00 Decon per SAI
Sample Volume: ~600 ml
Bottle: 1 LAG
17:03 Cell phone call with Roy Plunkett notifying ETA for Sample/
Coc relinquishment.

To Page No. NK

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zeke Simmons | 11/07/2010 | [illegible] | 11/08/2010 |

CONFIDENTIAL

Book No. HNF-N-7011 19

SUBJECT PORE WATER SAMPLING Project No. 41274/216575

From Page No. NA

11/08/2010 Zeke Simmons (EAS) Zeke Simmons, Neil Sullivan (EAS), Chris Smith (CMA), Mark Biser (CMA)
07:30 Tailgate meeting (POD) held at Apel.
Weather: Sunshine with slight breeze
River Flow: 38 KCFS at ~~0?~~ ZS 11/08/2010 07:00.

| Time | KCFS |
|---|---|
| 0100 | 94 |
| 0200 | 79 |
| 0300 | 133 |
| 0400 | 149 |
| 0500 | 40 |
| 0600 | 38 |
| 0700 | 38 |

07:40 Mixed Liquinox solution as described on Page No. 10 of this logbook (HNF-N-7011). For CMA de-con use. DI water at 17.6 megohm-cm.

| CHPRC 2010 | | | | | Date: 11/08/2010 |
|---|---|---|---|---|---|
| Trident Probe Conductivity Calibration Check | | | | | |
| Standard | Mfr. | Lot # | Expiration Date | Porewater Probe | Surface Probe |
| 100.5 uS | Control Co. | CC8596 | 04/30/11 | 99 | 94 |
| 447 | Oakton | 205259 | 05/31/11 | 454 | 454 |

| Myron L Ultrameter II Calibration Check: SN 6227090 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| pH* | 7 | Myron L Company | 1001397 EB | 09/09/11 | 6.93 |
| | 4 | Myron L Company | 2003077 JM | 08/03/11 | 3.83 |
| Cond. | 100.5 | Control Co. | CC8596 | 04/30/11 | 93.7 |
| | 447 | Oakton | 205259 | 05/31/11 | 446.3 |

*ORP is calibrated using results of pH cal. Check

| YSI Dissolved Oxygen Meter Calibration Check: SN 09F100411 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| D.O. | Zero | Hanna | 1427 | March of 2014 | 0.19 |

| HANNA Turbidimeter Calibration Check: SN 08292360 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| Turbidity(NTU) | < 0.10 | Hanna | 0279 | 09/30/12 | .05 |
| Turbidity(NTU) | 15 | Hanna | 0286 | 10/31/12 | 15 |
| Turbidity(NTU) | 100 | Hanna | 0277 | 09/30/12 | 100 |
| Turbidity(NTU) | 750 | Hanna | 0285 | 10/31/12 | 750 |

ZS 11/08/2010 To Page No. 20

SIGNATURE DATE WITNESSED & UNDERSTOOD BY DATE

Zeke Simmons 11/08/2010 Anna M Rodell 11/08/2010

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Book No. HNF-N-701 1

PORE WATER SAMPLING

Project No. 41274/216575

From Page No. 19

10:00 Decon per SAI.
2A-A QC Station Start time ~10:20 end time ~10:25
Staff guage before 0.3 after 0.3
Conductivity: 305

T100BC6J10 Substrate: Med/Small Cobble
Water depth at Station: 2.1 ft.

| INITIAL Porewater Readings | | | | Date: 11/08/2010 |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[a] | pH[a] | D.O.[c] |
| 311.5 | 13.423 | 340 | 7.27 | 8.35 |
| Turbidity[a] 270 | | | | |

| SurfacewaterReadings | | | | |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[a] 25 11/08/10 | ORP[a] | pH[a] | D.O.[c] |
| 141.4 | 12.6 | 312 | 7.90 | 9.82 |
| Turbidity[a] 0.80 NTU | | | | |

| COMPOSITE Porewater Sample | | | | CMA Trimble | |
|---|---|---|---|---|---|
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg)NAD83 2.04 ft accuracy | |
| T100BC6J10 | F11-0160 | before: 0.3 after: 0.3 | Start: 11:08 End: 12:24 | E-119.643304161 | N46.63940585 |
| Probe Tip Depth (Inches) (6"-12") 11" BSG | Water quality results (Composite) ~600 mL | | | | |
| | Conductivity (µS/cm)[a] | Temp (C°)[a] | ORP[a] | pH[a] | D.O.[c] |
| | 329.9 | 13.831 | 306 | 7.18 | 8.42 |
| | Turbidity[a] 23.0 | | | | |
| HEIS Sample No.(s) | Volume (mL) | | | Duplicate? Tied To: | # Bottles/Notes: |
| B29892 | ~600 mL | | | NA | 01/1LAG |

| FINAL Porewater Readings | | | | |
|---|---|---|---|---|
| Water quality results | | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[a] | ORP[a] | pH[a] | D.O.[c] |
| 331.4 | 13.627 | 301 | 7.12 | 7.56 |
| Turbidity[a] 3.10 | | | | |

a) Myron
b) Trident
c) YSI
d) Hanna Meter

Zeke Simmons

To Page No. 21

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zeke Simmons | 11/08/2010 | [illegible] | 11/22/2010 |

Book No HNF-N-701 1 21

TITLE PORE WATER SAMPLING Project No 41274/216575

From Page No. 20

12:40 Decon in field per SAI

T100BC1J1 Substrate: Silt/Sand
Water depth at station: 13.3 ft.

| INITIAL Porewater Readings | | | | Date: 11/08/2010 |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| 296.2 | 13.601 | -41 (Negative) | 6.99 | 5.29 |
| Turbidity[a] 40.0 | | | | |

| SurfacewaterReadings | | | | |
|---|---|---|---|---|
| Trident Temp 13.845 ZS 11/08/10 | | Water quality results (after purge water) | | |
| Conductivity (µS/cm)[b] | Temp (C°)[a] | ORP[c] | pH[c] | D.O.[c] |
| 150.8 | 14.16 | 100 | 7.47 | 9.81 |
| Turbidity[a] 0.60 | | | | |

| COMPOSITE Porewater Sample | | | | | |
|---|---|---|---|---|---|
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg)NAD83 1.76 ft accuracy | |
| T100BC1J1 | F11-016 | before: 0.3 after 0.5 | Start: 13:55 End: 15:13 | E-119.65336601 | N46.63725932 |
| Probe Tip Depth (Inches) (6"-12") | | | | | |
| 12 inches BSG | Water quality results (Composite) | | | | |
| | Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| | 295.3 | 13.588 | -25 (Negative) | 7.07 | 6.34 |
| | Turbidity[a] 60.0 NTU | | | | |
| HEIS Sample No.(s) | | Volume (mL) | | Duplicate? Tied To: | # Bottles/Notes: |
| B29884 | | ~575 mL | | NA | 01/1LAG |

| FINAL Porewater Readings | | | | |
|---|---|---|---|---|
| Water quality results | | | | |
| Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| 307.7 | 13.6860 | -63 (Negative) | 6.92 | 6.47 |
| Turbidity[a] 3.30 NTU | | | | |

a) Myron
b) Trident
c) YSI
d) Hanna Meter

Zeke Simmons

15:30 Decon per SAI

ZS 11/08/2010

To Page No. 22

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zeke Simmons | 11/08/2010 | Anna Wm Radloff | 12/28/2010 |

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Book No. HNF-N-7011

TITLE PORE WATER SAMPLING

Project No. 41274/216575

From Page No. 21

2A-A QC Station Start Time: ~15:40 End Time: ~15:45

Staff guage: before: 0.5 after: 0.5

Conductivity: 305

16:30 Cell phone call to Anna Radloff: Verifying/confirming Sample delivery

ZS 11/08/2010

NA

SIGNATURE: Pete Simons DATE: 11/08/2010 WITNESSED & UNDERSTOOD BY: Anna Radloff 12/28/2010

Book No. HNF-N-7011 23

TITLE PORE WATER SAMPLING Project No. 41274/216575

From Page No. NA 11/09/2010

Zeke Simmons (EAS) Zeke Simmons, Neil Sullivan (EAS), Chris Smith (CMA), Mark Biser (CMA). 11/09/2010
08:00 Tailgate meeting (POD) held at Apel.
Weather: Mostly Sunny / Partial-few clouds in the A.M. hrs
River Flow: 57 KCFS at 07:00 hrs.

| Time | KCFS |
|---|---|
| 0100 | 104 |
| 0200 | 95 |
| 0300 | 82 |
| 0400 | 69 |
| 0500 | 65 |
| 0600 | 59 |
| 0700 | 57 |

Weather: P.M. hrs - Overcast, breezy → decreasing temperature & rain.

Zeke Simmons

| CHPRC 2010 | | | | Date: 11/09/2010 | |
|---|---|---|---|---|---|
| Trident Probe Conductivity Calibration Check | | | | | |
| Standard | Mfr. | Lot # | Expiration Date | Porewater Probe | Surface Probe |
| 100.5 uS | Control Co. | CC8596 | 04/30/11 | 95 | 96 |
| 447 | Oakton | 205259 | 05/31/11 | 446 | 458 |

| Myron L Ultrameter II Calibration Check: SN 6227090 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| pH* | 7 | Myron L Company | 1001397 EB | 09/09/11 | 6.97 |
| | 4 | Myron L Company | 2003077 JM | 08/03/11 | 3.78 |
| Cond. | 100.5 | Control Co. | CC8596 | 04/30/11 | 93.03 |
| | 447 | Oakton | 205259 | 05/31/11 | 443.5 |

*ORP is calibrated using results of pH cal. Check

| YSI Dissolved Oxygen Meter Calibration Check: SN 09F100411 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| D.O. | Zero | Hanna | 1427 | March of 2014 | 0.17 |
| | | | | | |
| HANNA Turbidimeter Calibration Check: SN 08292360 | | | | | |
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| Turbidity(NTU) | < 0.10 | Hanna | 0279 | 09/30/12 | 0.05 |
| Turbidity(NTU) | 15 | Hanna | 0286 | 10/31/12 | 15 |
| Turbidity(NTU) | 100 | Hanna | 0277 | 09/30/12 | 100 |
| Turbidity(NTU) | 750 | Hanna | 0285 | 10/31/12 | 750 |

| DI Water from Apel Lab 151/153 | | | |
|---|---|---|---|
| Property of | Mfr. | Model | megohm-cm |
| Applied Process Engineering Laboratory | Barnstead | E-pure | 17.5 |

Decon in field per SAI at 10:00 hrs

To Page No. 24

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zeke Simmons | 11/09/2010 | [illegible] | 12/20/2010 |

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Book No. HNF-N-7011

TITLE PORE WATER SAMPLING

Project No. 41274/216575

From Page No. 23

2A-A QC Station Start time: ~~12:55~~ 10:55 ZS 11/09/2010 End time: ~~13:00~~ 11:00 ZS 11/09/2010
Staff guage: 0.75 before: 0.75 after: 0.75
Conductivity: 329.8 ~330

T100BCIJ5 Substrate: Silt
Water depth at Station: 16.5 ft

| INITIAL Porewater Readings | | | | | Date: 11/09/2010 |
|---|---|---|---|---|---|
| Myron Cond. 295.1 | Water quality results (after purge water) | | | | |
| | Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| | 309 | 14.122 | 284 | 7.20 | 7.18 |
| | Turbidity[d] 50.0 NTU | | | | |

| SurfacewaterReadings | | | | |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| 130.4 | 12.721 | 281 | 7.77 | 10.21 |
| Turbidity[d] 0.50 NTU | | | | |

| COMPOSITE Porewater Sample | | | | CMA Trimble | |
|---|---|---|---|---|---|
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg)NAD83 Accuracy 2.08 ft | |
| T100BCIJ5 | F11-016 | before 0.75 after 0.75 | Start: 12:00 End: 13:20 | E-119.05349785 | N46.6377800 |
| Probe Tip Depth (Inches) (6"-12") | TDS 147.4 | | | | |
| 12 inches BSG | Water quality results (Composite) | | | | |
| | Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| | 309.7 | 14.221 | 289 | 7.23 | 8.62 |
| | Turbidity[d] 19.0 NTU | | | | |
| HEIS Sample No.(s) | Volume (mL) | | | Duplicate? Tied To: | # Bottles/Notes: |
| B29885 | ~600 mL | | | NA | 01 / ILAG |

| FINAL Porewater Readings | | | | |
|---|---|---|---|---|
| Water quality results | | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| 305.5 | 13.426 | 292 | 7.32 | 7.29 |
| Turbidity[d] 65.0 NTU | | | | |

a) Myron
b) Trident
c) YSI
d) Hanna Meter

Zke Simmons

Page No. 25

SIGNATURE: Zke Simmons DATE: 11/09/2010 WITNESS / UNDERSTOOD BY: Dan Lundquist DATE: 11/09/2010

Book No. HNF-N-701 1 25

TITLE PORE WATER SAMPLING Project No. 41274/216575

From Page No. 24

13:30 Decon in field per SAI.

21:02 Cell phone call with Roy Plunkett (CHPRC) regarding Sample/traveler relinquishment time.

J100BC21 Substrate: Med/Large Cobble

Water depth at Station: 11.4 ft

| Myron Cond. 216.3 | INITIAL Porewater Readings | | | Date: 11/09/2010 | |
|---|---|---|---|---|---|
| | Water quality results (after purge water) | | | | |
| | Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| | 229 | 13.230 | 285 | 7.23 | 9.40 |
| | Turbidity[d] 950.0 NTU | | | | |

| | SurfacewaterReadings | | | | |
|---|---|---|---|---|---|
| | Water quality results (after purge water) | | | | |
| | Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| | 142.1 | 13.180 | 284 | 7.43 | 10.17 |
| | Turbidity[d] 1.80 NTU | | | | |

| COMPOSITE Porewater Sample | | | | CMA Trimble | |
|---|---|---|---|---|---|
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg)NAD83 Accuracy 1.5ft | |
| J100BC21 | F11-016 | before: 0.75 after: NA | Start: 15:00 End: 17:55 | E-119.64727433 | N46.63914266 |
| Probe Tip Depth (Inches) (6"-12") 8" BSG | Water quality results (Composite) | | | | |
| | Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| | 243.6 | 12.971 | 283 | 7.38 | 10.69 |
| | Turbidity[d] 75.0 NTU | | | | |

| HEIS Sample No.(s) | Volume (mL) | Duplicate? Tied To: | # Bottles/Notes: |
|---|---|---|---|
| B29888 | ~560 mL | NA | 01 / 1LAG |
| | | | |

| | FINAL Porewater Readings | | | | |
|---|---|---|---|---|---|
| | Water quality results | | | | |
| | Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| | 255.2 | | 298 | 7.28 | 10.33 |
| | Turbidity[d] 13.0 NTU | | | | |

a) Myron
b) Trident
c) YSI
d) Hanna Meter

Pete Simmons

18:10 Decon per SAI.

15:41 Cell phone call with Jim Hogan (CHPRC): Status update

19:50 Cell phone call with Jim Hogan regarding Sample relinquishment

To Page No. NA

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Pete Simmons | 11/09/2010 | Dave Wm Radcliff | 11/28/2010 |

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Book No. HNF-N-701 1

TITLE PORE WATER SAMPLING

Project No. 41274/216575

From Page No. NA

11/10/2010 Zeke Simmons (EAS) Zeke Simmons, Neil Sullivan (EAS), Chris Smith (CMA), Mark Biser (CMA)
08:00 Tailgate meeting (POD), held at Apel.
Weather: Sunshine / partial clouds with slight breeze.
River Flow:

| Time | KCFS |
|---|---|
| 0100 | 51 |
| 0200 | NA |
| 0300 | 111 |
| 0400 | 108 |
| 0500 | 51 |
| 0600 | 58 |
| 0700 | 58 |

Zeke Simmons

| CHPRC 2010 | | | | Date: 11/10/2010 | |
|---|---|---|---|---|---|
| Trident Probe Conductivity Calibration Check | | | | | |
| Standard | Mfr. | Lot # | Expiration Date | Porewater Probe | Surface Probe |
| 100.5 uS | Control Co. | CC8596 | 04/30/11 | 95 | 94 |
| 447 | Oakton | 205259 | 05/31/11 | 451 | 450 |

| Myron L Ultrameter II Calibration Check: SN 6227090 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| pH* | 7 | Myron L Company | 1001397 EB | 09/09/11 | 7.05 |
| | 4 | Myron L Company | 2003077 JM | 08/03/11 | 4.01 |
| Cond. | 100.5 | Control Co. | CC8596 | 04/30/11 | 92.87 |
| | 447 | Oakton | 205259 | 05/31/11 | 444.2 |

*ORP is calibrated using results of pH cal. Check

| YSI Dissolved Oxygen Meter Calibration Check: SN 09F100411 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| D.O. | Zero | Hanna | 1427 | March of 2014 | 0.17 |
| | | | | | |
| HANNA Turbidimeter Calibration Check: SN 08292360 | | | | | |
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| Turbidity(NTU) | < 0.10 | Hanna | 0279 | 09/30/12 | 0.05 |
| Turbidity(NTU) | 15 | Hanna | 0286 | 10/31/12 | 15 |
| Turbidity(NTU) | 100 | Hanna | 0277 | 09/30/12 | 100 |
| Turbidity(NTU) | 750 | Hanna | 0285 | 10/31/12 | 750 |

| DI Water from Apel Lab 151/153 | | | |
|---|---|---|---|
| Property of | Mfr. | Model | megohm-cm |
| Applied Process Engineering Laboratory | Barnstead | E-pure | 17.6 |

~~25 10/11/2010~~ 11/10/2010

To Page No. 27

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zeke Simmons | 11/10/2010 | [illegible] | 02/03/2011 |

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Book No. HNF-N-701 1 27

Title PORE WATER SAMPLING Project No. 41274/216575

From Page No. 26

Telephone Call to Awna Rudloff (CHPRC) at 0729. Conversation regarding Site ID No./LOCATION of J100BC47.

ZS ~~10/11/2010~~ 11/10/2010

QC Station
2A-A Start time: 10:25 End time: 10:30
Staff guage: before 0.80 after 0.80
conductivity: 304.4

J100BC47 Substrate: Sand
Water depth at Station: 2.9 ft

12:20 Roy Plunkett (CHPRC) called to inform us that he does have personell (NCO'S/Sample intake) available until ~ 8:30 PM/20:30.

ZS ~~10/11/2010~~ 11/10/2010

Primary Sample collection vessel for SPLIT Sample taken/collected at J100BC47: 100-2.5; 2.5 Gallon LDPE Cubitainer
BOTTLE TYPE: Plastic
QA LEVEL: 01
LOT NO: 038556
MANUFACTURER: EP Scientific Products LLC
200 B.J. Tunnell Blvd.
Miami, OK 74354
Sample collected in cubitainer described above to be SPLIT into 02 1L Amber Glass bottles (1LAG). 1 LAG described below.
112-01A; 1 Liter Amber Narrow Mouth Boston Round
BOTTLE TYPE: Glass
QA LEVEL: 01
LOT NO: 043612
MANUFACTURER: Same as above (EP Scientific Products LLC)

ZS ~~10/11/2010~~ 11/10/2010

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Zeke Summers ~~10/11/2010~~ ZS 11/10/2010 [illegible] 02/03/2011

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Book No. HNF-N-701 1

TITLE: PORE WATER SAMPLING

Project No. 41274/216575

From Page No. 27

| INITIAL Porewater Readings | | | | Date: 11/10/2010 |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[b] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| 160 | 13.176 | 269 | 7.67 | 9.54 |
| Turbidity[d] 130.0 NTU | | | | |

| Trident Cond. Reference Probe, 142 | SurfacewaterReadings | | | |
|---|---|---|---|---|
| Myron Temp, 12.6°C | Water quality results (after purge water) | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| 139.8 | 14.689 | 259 | 7.82 | 10.42 |
| Turbidity[d] 1.50 NTU | | | | |

| COMPOSITE Porewater Sample | | | | | |
|---|---|---|---|---|---|
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg)NAD83 accuracy 2.26 ft | |
| J100BC47 | F11-016 | before 0.80 after: 0.80 | Start: 13:02 End: 16:13 | E-119.6359747 1 | N46.64083715 |
| Probe Tip Depth (Inches) (6"-12") 12 inches BSG | Water quality results (Composite) | | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] | |
| 354.7 | 14.174 | 232 | 7.72 | 10.20 | |
| Turbidity[d] 5.60 NTU | | | | | |

| HEIS Sample No.(s) | Volume (mL) | | Duplicate? Tied To: | # Bottles/Notes: |
|---|---|---|---|---|
| B29894 | ~ 800 mL | | SPLIT | 01/1LAG |
| B29895 | 1000 mL / 1 L | | SPLIT | 01/1LAG |

| FINAL Porewater Readings | | | | |
|---|---|---|---|---|
| Water quality results | | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| 355.7 | 13.404 | 257 | 7.73 | 9.36 |
| Turbidity[d] 1.30 NTU | | | | |

a) Myron
b) Trident
c) YSI
d) Hanna Meter

Zeke Simmons

PURGE
INITIAL PW Readings

At station J100BC47.

| mL | Cond. (µS/cm) | Temp. |
|---|---|---|
| 0 | 148 | 12.840 |
| 30 | 160 | 13.176 |
| 60 | 306 | 13.718 |
| 90 | 322 | 14.213 |
| 120 | 335 | 14.379 |
| 150 | 345 | 14.566 |

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SIGNATURE: Zeke Simmons DATE: 11/10/2010 WITNESSED & UNDERSTOOD BY: [signature] DATE: 11/10/2010

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Book No. HNF-N-701 1 29

TITLE PORE WATER SAMPLING Project No. 41274/216575

From Page No. 28

14:27 Cell phone call with (from) Awna Radloff (CHPRC): Informed Awna that the Sample collection start time at Station ID J100BC47 (Sample No's B29894 & B29895) was 13:02. Collection start time into Cubitainer for Split Sample. = 13:02.

Decon per SAI at 16:30

2A-A QC Station Start time 16:45 End time 16:50
Conductivity: 305

16:44 Cell phone call to Roy Plunkett (CHPRC) regarding Sample relinqishment.

17:09 Cell phone call with Awna Radloff: Informed Awna that sampling at J100BC47 is complete.

17:40 Relinquished Samples & COC's/Travelers to NCO's/Sample intake personell accompanied by Roy Plunkett.

ZS 11/10/2010

To Page No. NA

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zeke Simmons | 11/10/2010 | Awna Radloff | 12/20/2010 |

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Book No. HNF-N-701 1

TITLE PORE WATER SAMPLING

Project No. 41214/216575

From Page No. NA

11/12/2010 Zeke Simmons (EAS) Zeke Simmons
16:00 Cell phone call/"Tailgate Meeting" (POD) with Brett Tiller (EAS).
Discussed hourly Safety Check in with Brett via cell phone.
Weather: Sunshine
River Flow:

| Time | KCFS |
|---|---|
| | |

| Myron L Ultrameter II Calibration Check: SN 6227090 11/12/2010 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| pH* | 7 | Myron L Company | 1001397 EB | 09/09/11 | 7.02 |
| | 4 | Myron L Company | 2003077 JM | 08/03/11 | 3.98 |
| Cond. | 100.5 | Control Co. | CC8596 | 04/30/11 | 97.41 |
| | 447 | Oakton | 205259 | 05/31/11 | 445.0 |

*ORP is calibrated using results of pH cal. Check

Zeke Simmons

2A-A (QC Station)

| Conductivity | Time |
|---|---|
| 303 | 18:15 |
| 307 | 19:15 |
| 305 | 20:15 |
| 306 | 21:15 |
| 306 | 22:15 |
| 306 | 23:15 |

Could not read staff guage with Mag Light (flashlight).

Purged >500 mL between each conductivity reading

Cell phone hourly safety check in with Brett Tiller
(✓ INTICATES COMPLETE)

✓ 17:30
✓ 18:30
✓ 19:30
✓ 20:30
✓ 21:30
✓ 22:30
✓ 23:30

Decon in field per SAI at 23:20 hrs.

ZS 11/12/2010

To Page No. NA

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zeke Simmons | 11/12/2010 | [illegible] | 02/03/2011 |

CONTINUED FROM

Book No. HNF-N-701 1 31

TITLE PORE WATER SAMPLING Project No. 41274/216575

From Page No. NA

11/14/2010 Zeke Simmons (EAS) Zeke Simmons, Rob Curet (EAS), Chris Smith (CMA), Mark Biser (CMA)
Personell mentioned above to be on EAS vessel 2
Neil Sullivan (EAS), Adam Predmore (EAS) to be on EAS vessel 1 (pilot Boat)

08:30 Tailgate meeting (POD) held at Apel: Discussion of hand held radio communication between EAS vessel 1 & EAS vessel 2
Weather: Sunshine
River Flow:

| Time | KCFS |
|---|---|
| 0100 | 66 |
| 0200 | 59 |
| 0300 | 81 |
| 0400 | 79 |
| 0500 | 38 |
| 0600 | 38 |
| 0700 | 38 |

Zeke Simmons

| CHPRC 2010 | | | | | Date: 11-14-10 |
|---|---|---|---|---|---|
| Trident Probe Conductivity Calibration Check | | | | | |
| Standard | Mfr. | Lot # | Expiration Date | Porewater Probe | Surface Probe |
| 100.5 uS | Control Co. | CC8596 | 04/30/11 | 106 | 101 |
| 447 | Oakton | 205259 | 05/31/11 | 452 | 452 |

| Myron L Ultrameter II Calibration Check: SN 6227090 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| pH* | 7 | Myron L Company | 1001397 EB | 09/09/11 | 6.96 |
| | 4 | Myron L Company | 2003077 JM | 08/03/11 | 3.76 |
| Cond. | 100.5 | Control Co. | CC8596 | 04/30/11 | 97.97 |
| | 447 | Oakton | 205259 | 05/31/11 | 448.6 |

*ORP is calibrated using results of pH cal. Check

| YSI Dissolved Oxygen Meter Calibration Check: SN 09F100411 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| D.O. | Zero | Hanna | 1427 | March of 2014 | 0.08 |

| HANNA Turbidimeter Calibration Check: SN 08292360 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| Turbidity(NTU) | < 0.10 | Hanna | 0279 | 09/30/12 | 0.05 |
| Turbidity(NTU) | 15 | Hanna | 0286 | 10/31/12 | 15.0 |
| Turbidity(NTU) | 100 | Hanna | 0277 | 09/30/12 | 100.0 |
| Turbidity(NTU) | 750 | Hanna | 0285 | 10/31/12 | 750.0 |

| DI Water from Apel Lab 151/153 | | | |
|---|---|---|---|
| Property of | Mfr. | Model | megohm-cm |
| Applied Process Engineering Laboratory | Barnstead | E-pure | 17.5 |

To Page No. 32

SIGNATURE Zeke Simmons DATE 11/14/2010 WITNESSED & UNDERSTOOD BY [signature] DATE 02/03/2011

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Book No HNF-N-701 1

TITLE PORE WATER SAMPLING

Project No 41274/216575

From Page No 31

10:30 Decon per SAI in field

2A-A OC Station Start time: 10:30 End time: 10:35
Staff guage: 0.15m before 0.15m after
Conductivity: 308

J100BC23 Substrate: Medium cobble Water depth at station 8.2 ft

| INITIAL Porewater Readings | | | | Date: 11/14/2010 |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[d] | D.O.[c] |
| 225 | 12.994 | 289 | 7.69 | 9.26 |
| Turbidity[a] 220 NTU | | | | |

| SurfacewaterReadings | | | | |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[d] | D.O.[c] |
| 142 | 13.041 | 284 | 7.32 | 9.98 |
| Turbidity[a] 0.95 NTU | | | | |

| COMPOSITE Porewater Sample | | | | | |
|---|---|---|---|---|---|
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg)NAD83 1.62 ft accuracy | |
| J100BC23 | F11-016 | before: 0.15 after: 0.15 | Start: 13:17 End: 14:37 | E-119.6425896 | N46.6398027 |
| Probe Tip Depth (Inches) (6"-12") | | | | | |
| | | | Water quality results (Composite) | | |
| 10 inches BSG | Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[d] | D.O.[c] |
| | 207 | 12.931 | 261 | 7.64 | 9.68 |
| | Turbidity[a] 45.0 NTU | | | | |

| HEIS Sample No.(s) | Volume (mL) | Duplicate? Tied To: | # Bottles/Notes: |
|---|---|---|---|
| B29893 | ~600 mL | NA | 01 / ICAG |
| | | | |

| FINAL Porewater Readings | | | | |
|---|---|---|---|---|
| Water quality results | | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[d] | D.O.[c] |
| 200.8 | 12.931 | 286 | 7.77 | 9.63 |
| Turbidity[a] 11.0 NTU | | | | |

a) Myron
b) Trident
c) YSI
d) Hanna Meter

Luke Simmons

To Page No 33

SIGNATURE Luke Simmons DATE 11/14/2010 WITNESS/UNDERSTOOD BY [signature] DATE 11/23/2010

Book No. HNF-N-701 1 33

TITLE PORE WATER SAMPLING Project No. 41274/216515

From Page No. 32

J100BC23 Continued

PURGE/ Initial PW Readings

| mL | Cond (uS/cm) | Temp. |
|---|---|---|
| 0 | 144 | 12.746 |
| 30 | 183 | 12.810 |
| 60 | 234 | 12.991 |
| 90 | 228 | 13.005 |
| 120 | 222 | 13.016 |
| 150 | NA | NA |

Decon per SAI at 14:45 hrs

13:33 Cell phone call from Jim Hogan (CHPRC) concerning sample relinquishment

13:50 Cell phone call from Brett Tiller (EAS): Status update

15:05 Cell phone call to Jim Hogan concerning sample/traveler/coc relinquishment place and time

15:08 Cell phone call with Anna Radloff (CHPRC) concerning the Station ID No for Station J100BC23/Sample No. B29893 Granted permission to strike the LOCATION No. to correct it. (EX. ~~T100BC23~~ ZS 11/14/2010 J100BC23)

T100BC5C Substrate: Medium cobble/Small cobble

Water depth at Station: 10.2 ft

PURGE/Initial PW Readings

| mL | Cond (uS/cm) | Temp. |
|---|---|---|
| 0 | 142 | 12.878 |
| 30 | 151 | 12.794 |
| 60 | 166 | 12.829 |
| 90 | 166 | 12.827 |
| 120 | 169 | 12.914 |

ZS 11/14/2010

ZS 11/14/2010

ZS 11/14/2010

Page No. 34

Zeke Simons 11/14/2010 Anna Radloff 12/28/2010

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Book No. HNF-N-7011

TITLE PORE WATER SAMPLING

Project No. 41274/216575

From Page No. 33

| INITIAL Porewater Readings | | | | | Date: 11/14/2010 |
|---|---|---|---|---|---|
| Myron Conductivity 159 | Water quality results (after purge water) | | | | |
| | Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| | 170 | 12.829 | 279 | 7.32 | 9.53 |
| | Turbidity[d] 340 NTU | | | | |

| SurfacewaterReadings | | | | | |
|---|---|---|---|---|---|
| 1A2.6 ~ | Water quality results (after purge water) | | | | |
| | Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| | 143 | 12.6888 | 282 | 7.66 | 9.74 |
| | Turbidity[d] 1.60 NTU | | | | |

| COMPOSITE Porewater Sample | | | | | |
|---|---|---|---|---|---|
| T100BCSC Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates Accuracy 1.74 ft (deg.deg)NAD83 | |
| T100BCSC | F11-016 | before: 0.15 after: NA | Start: 15:45 End: 16:40 | E-119.64436901 | N46.64601069 |
| Probe Tip Depth (Inches) (6"-12") 9 inches BSG | Water quality results (Composite) | | | | |
| | Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| | 158.7 | 12.740 | 311 | 7.43 | 9.52 |
| | Turbidity[d] 3800 NTU | | | | |
| HEIS Sample No.(s) | Volume (mL) | | | Duplicate? Tied To: | # Bottles/Notes: |
| B29891 | ~550 mL | | | NA | 01/1LAG |
| | | | | | |

| FINAL Porewater Readings | | | | | |
|---|---|---|---|---|---|
| | Water quality results | | | | |
| | Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| | 146.8 | 12.740 | 307 | 7.74 | 9.58 |
| | Turbidity[d] 400.0 NTU | | | | |

a) Myron
b) Trident
c) YSI
d) Hanna Meter

Zele Simmons

16:50 Decon in field per SAI.

18:00 Samples relinquished to CHPRC Rep(s)/NCO's/Sample intake personell accompanied by Jim Hogan.
COC's/Traveler relinquished/Signed at 18100.

~~25~~ 11/14/2010

To Page No. NA

| SIGNATURE | DATE | WITNESSED & UNDERSTOOD BY | DATE |
|---|---|---|---|
| Zele Simmons | 11/14/2010 | [illegible] | 12/29/2010 |

Book No. HNF-N-701 1 35

TITLE PORE WATER SAMPLING

Project No. 41274/216575

From Page No. NA

11/15/10 Shannan Johnson (EAS) [signature], Rob Ckret (EAS) Chris Smith (CMA), Mark Biser (CMA) on EAS Vessel #2.

Neil Sullivan (EAS) and Adam Predmore (EAS) on EAS Vessel #1 (Pilot Boat).

0800 Tailgate meeting (POD) held at Apel: Discussion of high wind potential and importance of wearing hard hats.

Weather: Mostly Cloudy

[signature]

| CHPRC 2010 | | | | | Date: 11-15-10 |
|---|---|---|---|---|---|
| Trident Probe Conductivity Calibration Check | | | | | |
| Standard | Mfr. | Lot # | Expiration Date | Porewater Probe | Surface Probe |
| 100.5 uS | Control Co. | CC8596 | 04/30/11 | 103 | 98 |
| 447 | Oakton | 205259 | 05/31/11 | 448 | 447 |

| Myron L Ultrameter II Calibration Check: SN 6227090 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| pH* | 7 | Myron L Company | 1001397 EB | 09/09/11 | 7.00 |
| | 4 | Myron L Company | 2003077 JM | 08/03/11 | 3.90 |
| Cond. | 100.5 | Control Co. | CC8596 | 04/30/11 | 98.43 |
| | 447 | Oakton | 205259 | 05/31/11 | 444.3 |

*ORP is calibrated using results of pH cal. Check

| YSI Dissolved Oxygen Meter Calibration Check: SN 09F100411 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| D.O. | Zero | Hanna | 1427 | March of 2014 | 0.09 |
| | | | | | |
| HANNA Turbidimeter Calibration Check: SN 08292360 | | | | | |
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| Turbidity(NTU) | < 0.10 | Hanna | 0279 | 09/30/12 | 0.05 |
| Turbidity(NTU) | 15 | Hanna | 0286 | 10/31/12 | 15 |
| Turbidity(NTU) | 100 | Hanna | 0277 | 09/30/12 | 100 |
| Turbidity(NTU) | 750 | Hanna | 0285 | 10/31/12 | 750 |

| DI Water from Apel Lab 151/153 | | | |
|---|---|---|---|
| Property of | Mfr. | Model | megohm-cm |
| Applied Process Engineering Laboratory | Barnstead | E-pure | 17.5 |

To Page No. 36

SIGNATURE [signature] DATE 11/15/20 WITNESSED & UNDERSTOOD BY [signature] DATE 12/28/2010

CONTINUATION

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Book No. HNF-N-7011

Title: PORE WATER SAMPLING

Project No. 41274/216575

From Page No. 35

Telephone call to Alona Radloff (CHPRC) regarding additional T100BC3C COC. Instructed to place note indicating "to be destroyed" and turn in with other Chain of Custodies (COC). ~0745

1030 Received call from Roy Plunkett (CHPRC) concerning sample relinquishment time and place.
09:30 9/14/15/10
~~11:30~~ Decon per SAI in field.

2A-A QC Station Start Time: 11.35 End Time: 11:40
Staff guage: 0, 60 (11:59)
Conductivity: 304

1325 Telephone call to B. Tiller to relay that 11 attempts have been made ~~to acq~~ 9/15/10 without success to acquire target conductivity. Plan is to verify that there are no leaks and continue attempts.

Column 1 - mL / Column 2 - Conductivity

Attempt #1 (80ft SW of site)
0 141
30 147
60 143

Attempt #2 (40ft SW of site)
0 142
30 145
60 145

Attempt #3 (Dead On)
0 145
30 149
60 149

Attempt #4 (10ft N)
0 145
30 148
60 152

Attempt #5 (10ft S)
0 147
30 150
60 148

Attempt #6 (5ft further N)
0 145
30 145
60 145

To Page No. 36

SIGNATURE: [signature] DATE: 11/15/10 WITNESSED & UNDERSTOOD BY: Alona Radloff DATE: 12/20/10

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Book No. HNF-N-701 1 37

TITLE PORE WATER SAMPLING Project No. 41274/216575

From Page No. 36

Attempt #7 (20 ft further E)
0 145
30 162
60 172

Attempt #8 (20 ft further E)
0 145
30 145
60 145

Attempt #9 (10 ft further N)
0 149
30 150
60 148

Attempt #10 (10 ft further S)
0 147
30 148
60 148

Attempt #11 (20 ft further E)
0 143
30 144
~~60~~ SJ 11/15/10

Attempt #12 (10 ft further N)
0 144
30 147
~~60~~ SJ 11/15/10

Attempt #13 (10 ft further S)
0 145 120 149
30 148
60 148
90 149

Attempt ~~#14~~ (20 ft W)
0 141
30 157
60 152

Attempt #15 (20 ft W)
0 150 46.63981827 (Trimble)
30 147 -119.65019910
60 145 1.57" ft accuracy

Decon per SAI at 15:30. 15:15 call to Roy - no samp

1420 Call between B. Tiller and Steve Lowe determined that if a conductivity of 710 was reached - a sample could be taken. This call and the transfer of the information from B. Tiller to the sampling team took place between attempts 11 and 12.

1500 Due to an expected release from Priest Rapids it was determined by Steve Lowe and B. Tiller to abort any further attempts.

PAGE 0/4

SIGNATURE DATE SIGNATURE OF PAI MISUNDERSTOOD DATE

11/15/10 10/28/2010

CONFIRMATION

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Book No. ~~HNF-701~~ ZS HNF-N-701 1

TITLE PORE WATER SAMPLING

Project No. 4/274/216575

From Page No. 0/A 11/16/2010

Shannan Johnson (EAS) <, Rob Curet (EAS), Chris Smith (CMA), and Mark Biser (CMA) on EAS Vessel #2

Neil Sullivan (EAS) and Alan Predmore (EAS) on Vessel #1 (Pilot Boat).

0745 Tailgate meeting held at APEL: working in windy conditions.

Weather: Partly Cloudy, windy

| CHPRC 2010 | | | | | Date: 11-16-10 |
|---|---|---|---|---|---|
| Trident Probe Conductivity Calibration Check | | | | | |
| Standard | Mfr. | Lot # | Expiration Date | Porewater Probe | Surface Probe |
| 100.5 uS | Control Co. | CC8596 | 04/30/11 | 103 | 102 |
| 447 | Oakton | 205259 | 05/31/11 | 459 | 456 |

| Myron L Ultrameter II Calibration Check: SN 6227090 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| pH* | 7 | Myron L Company | 1001397 EB | 09/09/11 | 6.99 |
| | 4 | Myron L Company | 2003077 JM | 08/03/11 | 3.94 |
| Cond. | 100.5 | Control Co. | CC8596 | 04/30/11 | 98.98 |
| | 447 | Oakton | 205259 | 05/31/11 | 446.6 |

*ORP is calibrated using results of pH cal. Check

| YSI Dissolved Oxygen Meter Calibration Check: SN 09F100411 | | | | | |
|---|---|---|---|---|---|
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| D.O. | Zero | Hanna | 1427 | March of 2014 | 0.09 |
| | | | | | |
| HANNA Turbidimeter Calibration Check: SN 08292360 | | | | | |
| | Standard | Mfr. | Lot # | Expiration Date | Actual Reading |
| Turbidity(NTU) | < 0.10 | Hanna | 0279 | 09/30/12 | 0.05 |
| Turbidity(NTU) | 15 | Hanna | 0286 | 10/31/12 | 15 |
| Turbidity(NTU) | 100 | Hanna | 0277 | 09/30/12 | 100 |
| Turbidity(NTU) | 750 | Hanna | 0285 | 10/31/12 | 750 |

| DI Water from Apel Lab 151/153 | | | |
|---|---|---|---|
| Property of | Mfr. | Model | megohm-cm |
| Applied Process Engineering Laboratory | Barnstead | E-pure | 17.5 |

SIGNATURE

DATE 11/16/10

WITNESSED & UNDERSTOOD BY

To Page No. D-41

12/28/2010

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Book No. HNF-N-701 I 39

Project No. 41274/216575

PORE WATER SAMPLING

From Page No. 38

River Flows

| Time | KCFS |
|---|---|
| 0100 | 75 |
| 0200 | 74 |
| 0300 | 73 |
| 0400 | 79 |
| 0500 | 83 |
| 0600 | 82 |

Decon per SAI 0945

2A-A QC Station Start Time: 1015. End Time: 1020
Staff Gage: .7
Conductivity 305.3
~~T100BC3C~~ 11/16/10 Station: T100BC3C
Column 1 - mL / Column 2 - conductivity

Attempt #1

| | | | | Trimble |
|---|---|---|---|---|
| 0 | 138 | | ~~46.63988~~ 11/16/10 | 46.63989959 |
| 30 | 145 | | ~~-119.65030~~ | -119.65027221 |
| 60 | 146 | 1020 | 18ft depth | ± 1.94 ft |
| 90 | 146 | | | |

Attempt #2

| | | | | |
|---|---|---|---|---|
| 0 | 144 | | | 46.63993122 |
| 30 | 164 | | 19 ft depth | -119.65026194 |
| 60 | 164 | 1040 | | ± 2.3ft. |
| 90 | 167 | | | |
| 120 | 157. | | | |

Phone call to B. Tiller confirms it is acceptable to bottle 168.

Substrate: Lg/med boulders Water Depth: 19ft

SIGNATURE 11/16/10 PRINT NAME & EXPLANATION 12/20/2010

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Title: PORE WATER SAMPLING

Book No: HDF-D-701 1

Project No: 41274/216575

From Page No. 39

Purge / Initial PW Readings

| mL | Conductivity | Temp (C°) |
|---|---|---|
| 0 | 144 | 12.290 |
| 30 | 157 | 12.299 |
| 60 | 162 | 12.347 |
| 90 | 169 | 12.410 |
| 120 | 169 | 12.410 |
| 150 | 168 | 12.384 |

**INITIAL Porewater Readings** Date: 11/16/10

Water quality results (after purge water)

| Conductivity (µS/cm)[a] 11/16/10 | Temp (C°)[b] | ORP[a] | pH[a] | D.O.[c] |
|---|---|---|---|---|
| 163.6 | 12.423 | 213 | 8.14 | 8.93 |
| Turbidity[a] 1000 | | | | |

**SurfacewaterReadings**

Water quality results (after purge water)

| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[a] | pH[a] | D.O.[c] |
|---|---|---|---|---|
| 139.0 | 13.1 | 223 | 7.8 | 8.72 |
| Turbidity[a] 2.60 | | | | |

**COMPOSITE Porewater Sample**

| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg)NAD83 | ±2.04ft accuracy |
|---|---|---|---|---|---|
| T100BC3C | B11-016 | before: .7 after: .7 | Start: 1121 End: 12:10 | E-119.165023444 | N46.63994520 |

Probe Tip Depth (inches) (6"-12") 8" (top 6)

Water quality results (Composite)

| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[a] | pH[a] | D.O.[c] |
|---|---|---|---|---|
| 173.7 | 12.432 | 232 | 7.78 | 8.79 |
| Turbidity[a] 2.60 @11/16/10 1650 | | | | |

| HEIS Sample No.(s) | Volume (mL) | Duplicate? Tied To: | # Bottles/Notes: |
|---|---|---|---|
| B29886 | ~550 mLs | Y B29883 | 1 (+1 Dup) |

**FINAL Porewater Readings**

Water quality results

| Conductivity (µS/cm)[a] | Temp (C°)[b] 11/16/10 | ORP[a] | pH[a] | D.O.[c] |
|---|---|---|---|---|
| 188.4 | 12.437 | 240 | 7.66 | 8.72 |
| Turbidity[a] 1000.0 | | | | |

a) Myron
b) Trident
c) YSI
d) Hanna Meter

SIGNATURE: DATE: 11/16/10 PRESENTED & CHECKED BY: DATE: 12/20/2010

CONFIDENTIAL

Book No. HDF-D-701 1 41

TITLE PORE WATER SAMPLING

Project No. 41274/216575

From Page No. 40

1237 Left msg with Roy Plunkett telling him we were on 2nd sample (for sample relinquishment purposes).
1315 J Hogan calls. He will have the team meet us at the Vernita boat launch.

| INITIAL Porewater Readings | | | | Date: 11/16/10 |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[a] 5/11/11 | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| 183.1 | 12.436 | 239 | 7.68 | 8.65 |
| Turbidity[a] 600 | | | | |

| SurfacewaterReadings | | | | |
|---|---|---|---|---|
| Water quality results (after purge water) | | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[b] 5/11/11 | ORP[c] | pH[c] | D.O.[c] |
| 139.1 | 12.438 274 | 246 | 7.50 | 9.21 |
| Turbidity[a] 3.10 | | | | |

| COMPOSITE Porewater Sample | | | | | |
|---|---|---|---|---|---|
| Station ID: | SAF# | Staff Guage (m.m) | Sample Time | Coordinates (deg.deg)NAD83 ±2.04ft accuracy | |
| T100B6L | F11-016 | before: .7 after: .65 | Start: 12:21 End: 12:51 | E -119.66023444 | N 46.68945 |
| Probe Tip Depth (Inches) (6"-12") | | | | | |
| 8 (bag) | Water quality results (Composite) | | | | |
| | Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| | 231.7 | 12.433 | 231 | 7.82 | 7.55 |
| | Turbidity[a] 450 | | | | |
| HEIS Sample No.(s) | Volume (mL) | | | Duplicate? Tied To: | # Bottles/Notes: |
| B29B83 | ~550 mL | | | D/A/B29B6L | 1 |

| FINAL Porewater Readings | | | | |
|---|---|---|---|---|
| Water quality results | | | | |
| Conductivity (µS/cm)[a] | Temp (C°)[b] | ORP[c] | pH[c] | D.O.[c] |
| 260.3 | 12.435 | 235 | 7.85 | 6.91 |
| Turbidity[a] 16.0 | | TDS 124.7 | | |

a) Myron
b) Trident
c) YSI
d) Hanna Meter

Page No. 42

SIGNATURE: DATE: 11/16/10 WITNESSED & UNDERSTOOD BY: DATE: 12/28/2010

CONFIDENTIAL

42

Book No. HDF-U-761 1

TITLE PORE WATER SAMPLING

Project No. 41274/216575

From Page No. 41

1400 Per call to Brett Tiller an additional sample will be collected.
1420 Left msg with J. Hogan notifying changes.
1530 Flow stopped-discussed options with Brett.
Drove ~~HTF~~ 11/16/10 the beetle 3x and lost conductivity number.

Continued to pump to acquire conductivity values, but was unable to ~~due~~ SJ 11/16/10 do so. Thus, the third sample was not collected. per telephone call with Brett at 1630.
1635 Call to J. Hogan re: sample relinquishment.
1645 Sample equipment deconned per SAI.

1735 Call made to J. Hogan re: sample relinquishment.

1000 Samples relinquished to CHPRC reps sent ~~accompanied~~ SJ 11/16/10 by J. Hogan.

~~1000~~ SJ 11/16/10 Final 2A-A QC Start Time: ~~15:10~~ SJ 11/16/2010 17:10 End Time: ~~15:15~~ SJ 11/16/10 17:15
Staff Gauge: .6
Conductivity: 304.8

SJ 11/16/10

SIGNATURE: [signature] DATE: 11/16/10 WITNESSED & UNDERSTOOD: [signature] DATE: 12/20/2010

10/A

CONTINUED

# Appendix E

## Coastal Monitoring Associates Pore Water Field Log

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# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

SITE: Hanford, Washington

OPERABLE UNIT 100 BC

TRIDENT GPS

Lat N 46.64078

Long W -119.63627

VESSEL GPS

Lat N

Long W

Accuracy (ft)

TIME Start 1230
(on station
End

BOAT Z

Porewater Sampling Method
(Frame, Trident/Handheld, Release Point)

Station ID J100BC47

SURVEY DATE 10-28-2010

PROJECT PHASE CH Fall 2010

WATER DEPTH 3.2

BOTTOM TYPE
Surface cobble/gravel

Layer

## Survey Data Table

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 9" | |
| Temperature [C] | 14.820 | 14.373 |
| Conductivity [mS/cm] | 279 | 150 |

## Porewater Purge Pumping Data

| ml | Cond | Temp |
|---|---|---|
| 0 | 44 | 14.286 |
| 30 | 160 | 14.394 |
| 60 | 285 | 14.690 |
| 90 | 282 | 14.796 |
| 120 | 279 | 14.820 |
| | | |
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Purge the volume of tubing prior to sample collection (circle one) YES NO

## File Information

CMA Computer # 7

| | | | |
|---|---|---|---|
| Data file name (.dat) | BC10_28_2010 | Start Time | 1312 |
| Station gauge reading | .7 | Averaging Time | 1 |
| Field Logbook # | | End Time | 1313 |

| | | | |
|---|---|---|---|
| Pump start time | 1307 | Sample time | |
| Pump end time | | | |
| Picture ID | # 0110 | Sample Number | |

## DO & Ultrameter

| | DO | pH | ORP | TDS | Conductivity |
|---|---|---|---|---|---|
| Sample values | 6.60 | 7.61 | 278 | 139.8 | 288.4 |
| Surface Water | 9.30 | 7.88 | 286 | 66.97 | 139.4 |

Comments/Observations Dc Dc check point

Recorder RP

Sample Collector

# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

SITE: Hanford, Washington

OPERABLE UNIT 100BC

TRIDENT GPS

~~Lat N~~ 119.6907810

~~Long W~~ LCT 46.64453

VESSEL GPS

Lat N

Long W

Accuracy (ft)

TIME (on station) Start 1305 End 1501

BOAT 2

Porewater Sampling Method FRAME 3
(Frame, Trident/Handheld, Release Point)

Station ID BCN51

SURVEY DATE 11-4-10

PROJECT PHASE —

WATER DEPTH 4.1

BOTTOM TYPE
Surface med to large cobble

Layer

## Survey Data Table

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 10" | 1' AGS |
| Temperature [C] | 14.200 | 14.174 |
| Conductivity [mS/cm] | 210 | 142 |

Purge the volume of tubing prior to sample collection (circle one) YES NO

## Porewater Purge Pumping Data

| ml | Cond | Temp |
|---|---|---|
| 0 | 138 | 14.208 |
| 30 | 199 | 14.207 |
| 60 | 203 | 14.204 |
| 90 | 205 | 14.201 |
| 120 | 209 | 14.197 |

## File Information

CMA Computer # 6

| | | | |
|---|---|---|---|
| Data file name (.dat) | BCN51.dat | Start Time | 1327 |
| Station gauge reading | 0.7 | Averaging Time | 60 sec |
| Field Logbook # | HNF-N-701-1 | End Time | 1328 |

| | | | |
|---|---|---|---|
| Pump start time | 1320 | Sample time | 1453 |
| Pump end time | 1453 | | |
| Picture ID | 12343 | Sample Number | B29996 |

## DO & Ultrameter

| | DO | pH | ORP | TDS | Conductivity | Turbidity |
|---|---|---|---|---|---|---|
| Composite Sample values | 7.89 | 7.34 | 281 | 98.11 | 204.3 | 38.0 ntu |
| Surface Water | 10.01 | 7.48 | 277 | 69.92 | 145.5 | 0.70 ntu |

Comments/Observations

RPaulson QA 11-25-2010

Recorder C Smith

Sample Collector Zeke Simmons

RP 11-25-2010

SGW-49368, REV. 0

| Coastal Monitoring Assosciates Porewater Sampling Sheet | | page 2 |
|---|---|---|
| Hanford Site | | |
| Operable Unit 100 BC | | Date 11-4-10 |
| Site ID BC1051 | | Start Time 1320 |

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| 1320 | 0 | 210 | 14.2 |
| 1350 | 300 | 208 | 14.206 |
| 1420 | 600 | 190 | 14.306 |
| 1447 | 800 | 219 | 14.345 |

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| | | | |

AP 11-25-2010

# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

SITE: Hanford, Washington

OPERABLE UNIT 100 BC

TRIDENT GPS

Lat N 46.63753

Long W 119.65533

~~VESSEL GPS~~ Submeter Trimble

Lat N 46.63757212

Long W 119.65534518

Accuracy (ft) 1.69'

TIME (on station) Start 1333 End 1602

BOAT 2

Porewater Sampling Method (Frame, Trident/Handheld, Release Point) 3

Station ID BC2A-A

SURVEY DATE 11-5-10

PROJECT PHASE

WATER DEPTH 1.9'

BOTTOM TYPE

Surface Sandy Silt

Layer

**Survey Data Table**

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 12" bsg | 12" bsg |
| Temperature [C] | 14.272 | 13.930 |
| Conductivity [mS/cm] | 308 | 147 |

**Porewater Purge Pumping Data**

| ml | Cond | Temp |
|---|---|---|
| 0 | 141 | 14.0 |
| 30 | 153 | 13.985 |
| 60 | 256 | 14.303 |
| 90 | 293 | 14.463 |
| 120 | 306 | 14.572 |

Purge the volume of tubing prior to sample collection (circle one) (YES) NO

**File Information**

CMA Computer # 6

| | | | |
|---|---|---|---|
| Data file name (.dat) | 100BC2A-A | Start Time | 1430 |
| Station gauge reading | 0.67 at 1330 | Averaging Time | 1 |
| Field Logbook # | HNF-N-701_1 | End Time | 1431 |

| | | | |
|---|---|---|---|
| Pump start time | 1432 | Sample time | 1547 |
| Pump end time | 1547 | Sample Number | 829883 |
| Picture ID | 12342 | | |

**DO & Ultrameter**

| | DO | pH | ORP | ~~TDS~~ | Conductivity |
|---|---|---|---|---|---|
| Composit Sample values | 8.38 | 7.15 | 313 | | 304.7 |
| Surface Water | 10.22 | 7.48 | 391 | | 145.9 |

Turbidity 5.00 ntu

Comments/Observations

QA RPolson 2010

Recorder L. Smith

Sample Collector Zeke Simmons

| Coastal Monitoring Assosciates Porewater Sampling Sheet | | page 2 |
|---|---|---|
| Hanford Site | | |
| Operable Unit 100 BC | | Date 11-5-10 |
| Site ID 2A-A | | Start Time 1232 |

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| 0 | 0 | 308 | 14.097 |
| 30 | 200 | 313 | 15.001 |
| 60 | 450 | 313 | 14.986 |
| 69 | 600 | 313 | 14.973 |
| END SAMPLE | | | |

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| | | | |

RP
11-25-10

# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

SITE: Hanford, Washington

OPERABLE UNIT 100 BC

TRIDENT GPS

Lat N 46.63897

Long W 119.64545

VESSEL GPS Trimble

Lat N 46.63816000

Long W 119.64548718

Accuracy (ft) 1.4'

TIME (on station) Start 1505 End 1710

BOAT 2

Porewater Sampling Method (Frame, Trident/Handheld, Release Point) 1

Station ID T100BC4A

SURVEY DATE 11-7-10

PROJECT PHASE

WATER DEPTH 1.9

BOTTOM TYPE

Surface Medium/small cobble

Layer

**Survey Data Table**

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 12" bsg | 12" bsg |
| Temperature [C] | 14.841 | 13.907 |
| Conductivity [mS/cm] | 340 | 145 |

**Porewater Purge Pumping Data**

| ml | Cond | Temp |
|---|---|---|
| 0 | 148 | 14.197 |
| 30 | 215 | 14.291 |
| 60 | 272 | 14.642 |
| 90 | 290 | 14.917 |
| 120 | 315 | 15.005 |

Purge the volume of tubing prior to sample collection (circle one) YES NO

**File Information**

CMA Computer # 6

| | | | |
|---|---|---|---|
| Data file name (.dat) | T100BC4A | Start Time | 1538 |
| Station gauge reading | 0.20 | Averaging Time | 1 |
| Field Logbook # | HNF-N-201-1 | End Time | 1539 |

Pump start time 1540

Pump end time 1654

Picture ID 164203 164242

Sample time 1540

Sample Number B29889

**DO & Ultrameter**

| | DO | pH | ORP | ~~TDS~~ | Conductivity |
|---|---|---|---|---|---|
| Sample values | 9.03 | 7.65 | 323 | | 340.5 |
| Surface Water | 10.05 | 8.02 | 284 | | 143.6 |

Turbidity 11.0

2.00 ntu

Comments/Observations

QA R Paulsen 11 25 2010

Recorder C Smith

Sample Collector Zeke Simmons

| Coastal Monitoring Assosciates Porewater Sampling Sheet | | page 2 |
|---|---|---|
| Hanford Site | | |
| Operable Unit 100BC | | Date 11-7-10 |
| Site ID 100 | | Start Time 1540 |

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| 0 | 0 | 340 | 14.302 |
| 30 | 200 | 353 | 15.181 |
| 60 | 500 | 354 | 15.171 |
| 72 | 600 | 354 | 15.130 |

1654 end sampling

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| | | | |

RP

# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

11-7-10

SITE: Hanford, Washington

OPERABLE UNIT 100 BC

TRIDENT GPS

Lat N 46.64005 W

Long W 119.66445 W

VESSEL GPS Trimble

Lat N 46.64002920

Long W 119.66450409

Accuracy (ft) 1.9'

TIME (on station) Start 1122 End 1323

BOAT 2

Porewater Sampling Method (Frame, Trident/Handheld, Release Point) 3

Station ID 100BCN52

SURVEY DATE 11-7-10

PROJECT PHASE

WATER DEPTH 1.6'

BOTTOM TYPE Surface medium silt

Layer

## Survey Data Table

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 9" bsg | 12" ASB |
| Temperature [C] | 13.833 | 13.633 |
| Conductivity [mS/cm] | 284 | 156 |

## Porewater Purge Pumping Data

| ml | Cond | Temp |
|---|---|---|
| 0 | 147 | 13.516 |
| 30 | 232 | 13.676 |
| [illegible] | 267 | 13.852 |
| 120 | [illegible] | [illegible] |
| 60 | [illegible] | [illegible] |
| 90 | 272 | 13.877 |
| 120 | 277 | 13.899 |

Purge the volume of tubing prior to sample collection (circle one) (YES) NO

## File Information

CMA Computer # 6

| | | | |
|---|---|---|---|
| Data file name (.dat) | 100BCN52 | Start Time | 1157 |
| Station gauge reading | 0.20 | Averaging Time | 1 |
| Field Logbook # | HNF-N-701_1 | End Time | 1158 |

Pump start time 1156

Pump end time 1308

Picture ID [illegible] 2010/11/07 12:46:36

Sample time 1156 Start Time

Sample Number 329897

## DO & Ultrameter

| | DO | pH | ORP | ~~TDS~~ | Conductivity |
|---|---|---|---|---|---|
| Sample values | 8.22 | 7.22 | 313 | | 281.1 |
| Surface Water | 9.76 | 7.56 | 283 | | 152 |

Comment

Turbidity 8.60 ntu

1.20

Comments/Observations

Do R Paulson 11-25-2010

Recorder C. Smith

Sample Collector Zelle Simmons

| Coastal Monitoring Assosciates Porewater Sampling Sheet | | page 2 |
|---|---|---|
| Hanford Site | | |
| Operable Unit 100 BC | | Date 11-7-10 |
| Site ID BCN52 | | Start Time 1156 |

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| 0 | 0 | 284 | 13.833 |
| 30 | 200 | 285 | 13.945 |
| 60 | 475 | 285 | 14.003 |
| 90 | 600 | 284 | 14.026 |
| END Sample | | | |

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| | | | |

Co R Pulson 11-25-2010

# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

**SITE:** Hanford, Washington

**OPERABLE UNIT** 100 BC

**TRIDENT GPS**

Lat N 46.63938

Long W 119.64330

**VESSEL GPS**

Lat N 46.67940585

Long W 119.64330461

Accuracy (ft) 2.04'

**TIME** (on station) Start 1045 End 1240

**BOAT** 2

Porewater Sampling Method (Frame 3 Trident/Handheld, Release Point)

**Station ID** T100BC6J10 6J10

**SURVEY DATE** 11-8-10

**PROJECT PHASE**

**WATER DEPTH** 2.1'

**BOTTOM TYPE**

Surface Sand/Weed cobble

Layer

**Survey Data Table**

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 11" bsg | 12" Asg |
| Temperature [C] | 13.659 | 13.200 |
| Conductivity [mS/cm] | 323 | 142 |

**Porewater Purge Pumping Data**

| ml | Cond | Temp |
|---|---|---|
| 0 | 140 | |
| 30 | 238 | |
| 60 | 272 | |
| 90 | 293 | |
| 120 | 309 | |
| 150 | 319 | |

Purge the volume of tubing prior to sample collection (circle one) YES NO

**File Information** CMA Computer # 6

| | | | |
|---|---|---|---|
| Data file name (.dat) | T100BC6J10 | Start Time | 1104 |
| Station gauge reading | 0.3 | Averaging Time | 1 |
| Field Logbook # | HNF-N-TOL-1 | End Time | 1105 |

Pump start time 1108

Pump end time 1224

Picture ID 123456 123610

Sample time 1108

Sample Number B29892

**DO & Ultrameter**

| | DO | pH | ORP | TDS | Conductivity | Turbidity |
|---|---|---|---|---|---|---|
| Composite Sample values | 8.42 | 7.78 | 306 | 160.5 | 329.9 | 23.0 ntu |
| Surface Water | 9.82 | 7.90 | 312 | 67.49 | 141.4 | 0.80 ntu |

Comments/Observations

Recorder Smith

Sample Collector John Simmons

Da R Poulson 11.25.2010

| Coastal Monitoring Assosciates Porewater Sampling Sheet | | page 2 |
|---|---|---|
| Hanford Site | | |
| Operable Unit 100 BC | | Date 11-8-10 |
| Site ID T100BCGJ10 | | Start Time 1108 |

**Porewater Sampling Data**

| | Time | Volume | Cond | Temp |
|---|---|---|---|---|
| 1108 | 0 | 0 | 319 | 13.414 |
| 1138 | 30 | 225 | 341 | 13.774 |
| 1208 | 60 | 550 | 342 | 13.797 |
| 1224 | 76 | 650 | 343 | 13.825 |
| | END Sample | | | |

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| | | | |

QC - RP 11-25-2010

# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

SITE: Hanford, Washington

OPERABLE UNIT 100 BC

TRIDENT GPS

Lat N 46.63727

Long W 119.65335

VESSEL GPS Trimble

Lat N 46.63728932

Long W 119.65336601

Accuracy (ft) 1.76'

TIME (on station) Start 1330 End 1540

BOAT 2

Porewater Sampling Method (Prime, Trident/Handheld, Release Point) 3

Station ID T100BCJ1

SURVEY DATE 11-8-10

PROJECT PHASE

WATER DEPTH 13.3'

BOTTOM TYPE Surface Sandy mud

Layer

**Survey Data Table**

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 12" bsg | 12" bsg |
| Temperature [C] | 13.815 | 13.246 |
| Conductivity [mS/cm] | 312 | 143 |

Purge the volume of tubing prior to sample collection (circle one) YES NO

**Porewater Purge Pumping Data**

| ml | Cond | Temp |
|---|---|---|
| 0 | 149 | 13.812 |
| 30 | 221 | 13.851 |
| 60 | 276 | 13.877 |
| 90 | 295 | 13.910 |
| 120 | 299 | 13.990 |
| 130 | 311 | 13.991 |

**File Information**

CMA Computer # 6

| | | | |
|---|---|---|---|
| Data file name (.dat) | T100BCJ1.dat | Start Time | 1353 |
| Station gauge reading | 0.5 at 1542 | Averaging Time | 1 |
| Field Logbook # | HNF-N-701-1 | End Time | 1354 |

| | | | |
|---|---|---|---|
| Pump start time | 1355 | Sample time | 1355 |
| Pump end time | 1513 | Sample Number | B29884 |
| Picture ID | 161353 161400 | | |

**DO & Ultrameter**

| | DO | pH | ORP | TDS | Conductivity | Turbidity |
|---|---|---|---|---|---|---|
| Composite Sample values | 6.34 | 7.07 | -25 | 143.3 | 295.3 | 60.0 |
| Surface Water | 9.81 | 7.47 | 160 | 72.44 | 150.8 | 0.60 ntu |

Comments/Observations

Qa R Poulson 11-25-2010

Recorder C. Smith

Sample Collector Zelle Simmons

| Coastal Monitoring Assosciates Porewater Sampling Sheet | | page 2 |
|---|---|---|
| Hanford Site | | |
| Operable Unit 100 BC | | Date 11-9-10 |
| Site ID T100BC151 | | Start Time 1355 |

**Porewater Sampling Data**

| mins | Time | Volume | Cond | Temp |
|---|---|---|---|---|
| 1355 | 0 | 0 | 311 | 13.548 |
| | 30 | 225 | 319 | 14.094 |
| | 60 | 550 | 320 | 13.741 |
| 1513 | 78 | 640 | 320 | 13.62 |
| | END SAMPLE | | | |
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**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
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B - RP 11252010

# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

SITE: Hanford, Washington

OPERABLE UNIT 100BC

TRIDENT GPS

Lat N 46.67913

Long W 119.64728

VESSEL GPS

Lat N 46.63914266

Long W 119.64727433

Accuracy (ft) 1.5'

TIME (on station) Start 1422 End

BOAT 2

Porewater Sampling Method (Frame, Trident/Handheld, Release Point) 3

Station ID J100BC21

SURVEY DATE 11-9-10

PROJECT PHASE

WATER DEPTH 11.4

BOTTOM TYPE

Surface Med/large cobble

Layer

**Survey Data Table**

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 8" bsg | 12" bsg |
| Temperature [C] | 13.230 | 12.964 |
| Conductivity [mS/cm] | 222 | 143 |

Purge the volume of tubing prior to sample collection (circle one) YES NO

**Porewater Purge Pumping Data**

| ml | Cond | Temp |
|---|---|---|
| 0 | 147 | |
| 30 | 154 | |
| 60 | 176 | |
| 90 | 191 | |
| 120 | 201 | |
| 150 | 213 | |
| 180 | 218 | |

**File Information**

CMA Computer # 6

| | | | |
|---|---|---|---|
| Data file name (.dat) | J100BC21 | Start Time | 1508 |
| Station gauge reading | 0.75 | Averaging Time | 1 |
| Field Logbook # | HNF-N-701-1 | End Time | 1509 |

| | |
|---|---|
| Pump start time | 1500 |
| Pump end time | 1755 |
| Picture ID | 61223 |

| | |
|---|---|
| Sample time | 1500 |
| Sample Number | B29988 |

**DO & Ultrameter**

| | DO | pH | ORP | TDS | Conductivity | Turbidity |
|---|---|---|---|---|---|---|
| Composite Sample values | 10.69 | 7.38 | 283 | 177.9 | 243.6 | 75.0 |
| Surface Water | 10.17 | 7.43 | 284 | 68.18 | 142.1 | 1.80 |

Comments/Observations

Qc R Paulsen 11.25.2010 - skillen

Recorder C Smith

Sample Collector Zac Simmons

| Coastal Monitoring Assosciates Porewater Sampling Sheet | | page 2 |
|---|---|---|
| Hanford Site | | |
| Operable Unit 100BC | | Date 11-9-10 |
| Site ID T100BC21 | | Start Time 1500 |

**Porewater Sampling Data**

| | Time | Volume | Cond | Temp |
|---|---|---|---|---|
| 1500 | 0 | 0 | 218 | 13.220 |
| 1530 | ~~40~~ 30 | 100 | 232 | 13.053 |
| 1600 | 60 | 200 | 252 | 13.022 |
| 1630 | 90 | 250 | 249 | 12.996 |
| 1700 | 120 | 350 | 254 | 12.974 |
| 1730 | 150 | 480 | 258 | 12.969 |
| 1800 | 180 | 500 | 260 | 12.970 |
| | End Sample | | | |

Qc RP 11252010

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| | | | |

# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

SITE: Hanford, Washington

OPERABLE UNIT 100 BC

TRIDENT GPS

Lat N 46.63778

Long W 119.65350

VESSEL GPS

Lat N 46.6377800

Long W 119.6534 9785

Accuracy (ft) 2.08'

TIME (on station) Start 1115 End 1400

BOAT 2

Porewater Sampling Method (Frame, Trident/Handheld, Release Point) 3

Station ID T100BC 1J5

SURVEY DATE 11-9-10

PROJECT PHASE

WATER DEPTH 16.5

BOTTOM TYPE Surface Mud/silt

Layer

**Survey Data Table**

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 12" bsf | 12" ASF |
| Temperature [C] | 14.122 | 12.730 |
| Conductivity [mS/cm] | 309 | 141 |

Purge the volume of tubing prior to sample collection (circle one) (YES) NO

**Porewater Purge Pumping Data**

| ml | Cond | Temp |
|---|---|---|
| 0 | 143 | 12.769 |
| 30 | 190 | 12.949 |
| 60 | 268 | 13.514 |
| 90 | 292 | 13.722 |
| 120 | 303 | 14.011 |
| 145 ~~150~~ | 306 | 14.127 |

**File Information**

CMA Computer # 6

| | | | |
|---|---|---|---|
| Data file name (.dat) | T100BC1J5 | Start Time | 1158 |
| Station gauge reading | 0.75 | Averaging Time | 1 |
| Field Logbook # | HNF-N-701_1 | End Time | 1159 |

| | | | |
|---|---|---|---|
| Pump start time | 1200 | Sample time | 1200 |
| Pump end time | 1320 | Sample Number | B29885 |
| Picture ID | 1344 | | |

**DO & Ultrameter**

| | DO | pH | ORP | TDS | Conductivity | Turbidity |
|---|---|---|---|---|---|---|
| Composite Sample values | 8.62 | 7.23 | 289 | 147.4 | 303.7 | 19.0 |
| Surface Water | 10.21 | 7.77 | 281 | 66.71 | 138.4 | 0.50 ntu |

Comments/Observations

Recorder C Smith

Sample Collector 2016 Simmons

Q R Paulson 10 25 2016

SGW-49368, REV. 0

| Coastal Monitoring Assosciates Porewater Sampling Sheet | | page 2 |
|---|---|---|
| Hanford Site | | |
| Operable Unit 100 BC | | Date 11-9-10 |
| Site ID T100BC1J5 | | Start Time 1200 |

**Porewater Sampling Data**

| | Time | Volume | Cond | Temp |
|---|---|---|---|---|
| 1200 | 0 | 0 | 309 | 14.122 |
| 1230 | 30 | 200 | 315 | 14.214 |
| 1300 | 60 | 400 | 316 | 14.354 |
| 1330 | 90 | 600 | 314 | 13.263 |

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| | | | |

# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

SITE: Hanford, Washington

OPERABLE UNIT 100 BC

6 tries to get the #

TRIDENT GPS

Lat N 46.64082

Long W 119.63597

TIME (on station) Start 1050 End 1630

BOAT 2

Porewater Sampling Method (Frame, Trident/Handheld, Release Point)

Station ID J100BC47

SURVEY DATE 11-10-10

PROJECT PHASE

WATER DEPTH 2.9'

BOTTOM TYPE Surface SAND Layer

VESSEL GPS

Lat N 46.64083715

Long W 119.63597471

Accuracy (ft) 2.26'

**Survey Data Table**

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 12" 659 | 12" 459 |
| Temperature [C] | 14.213 | 12.829 |
| Conductivity [mS/cm] | 352 | 142 |

**Porewater Purge Pumping Data**

| ml | Cond | Temp |
|---|---|---|
| 0 | 148 | 12.840 |
| 30 | 160 | 13.176 |
| 60 | 306 | 13.718 |
| 90 | 322 | 14.213 |
| 120 | 335 | 14.379 |
| 150 | 345 | 14.566 |

Purge the volume of tubing prior to sample collection (circle one) YES NO

**File Information** CMA Computer # 6

| | | | |
|---|---|---|---|
| Data file name (.dat) | J100BC47 | Start Time | 1305 |
| Station gauge reading | 0.8 | Averaging Time | 1 |
| Field Logbook # | HNF-N-701_1 | End Time | 1306 |

Pump start time 1302

Pump end time 1613

Picture ID Taken

Sample time 1305

Sample Number B29895 B29894

1 Liter 500 ml

**DO & Ultrameter**

| | DO | pH | ORP | TDS | Conductivity |
|---|---|---|---|---|---|
| Composite Sample values | 10.20 | 7.72 | 232 | 172.7 | 354.7 |
| Surface Water | 10.42 | 7.82 | 259 | 67.31 | 139.8 |

Turbidity 5.60 1.50 ntn

Comments/Observations

Recorder L. Smith

Sample Collector Zeke Simmons

Jo R Parker 11 25 2010

| Coastal Monitoring Assosciates Porewater Sampling Sheet | | page 2 |
|---|---|---|
| Hanford Site | | |
| Operable Unit 100 BC | | Date 11/10/2010 |
| Site ID J100BC47 | | Start Time 1305 |

**Porewater Sampling Data**

| | Time | Volume | Cond | Temp |
|---|---|---|---|---|
| 1305 | 0 | 0 | 345 | 14.556 |
| 1335 | 30 | 200 | 361 | 14.991 |
| 1405 | 60 | 400 | 363 | 15.003 |
| 1435 | 90 | 600 | 363 | 14.917 |
| 1505 | 120 | 800 | 364 | 14.956 |
| 1535 | 150 | 1000 | 363 | 14.527 |
| 1605 | 180 | * | 364 | 14.879 |
| | END Sample | | | |

* Did volume/flow check estimate 1800 mls

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| | | | |

# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

**SITE:** Hanford, Washington

**OPERABLE UNIT** 100 BC

**TRIDENT GPS**

Lat N 46.63990

Long W 119.64260

**VESSEL GPS** Trimble

Lat N 46.63988027

Long W 119.64258966

Accuracy (ft) 1.62'

**TIME** (on station) Start 1245 End 1450

**BOAT** 2

**Porewater Sampling Method** (Frame, Trident/Handheld, Release Point) 3

**Station ID** J100BC23

**SURVEY DATE** 11-14-10

**PROJECT PHASE**

**WATER DEPTH** 8.2

**BOTTOM TYPE**

Surface Small/med cobble

Layer

## Survey Data Table

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 10" bsg | 12" bsg |
| Temperature [C] | 13.041 | 12.650 |
| Conductivity [mS/cm] | 218 | 143 |

Purge the volume of tubing prior to sample collection (circle one) YES NO

## Porewater Purge Pumping Data

| ml | Cond | Temp |
|---|---|---|
| 0 | 144 | 12.746 |
| 30 | 193 | 12.810 |
| 60 | 234 | 12.991 |
| 90 | 228 | 13.005 |
| 120 | 222 | 13.016 |

## File Information

CMA Computer # 6

| | | | |
|---|---|---|---|
| Data file name (.dat) | J100BC23 | Start Time | 13.17 |
| Station gauge reading | 0.15 | Averaging Time | 2 |
| Field Logbook # | HNF-N-201_1 | End Time | 13.18 |

Pump start time 1317

Pump end time 1437

Picture ID ~~[illegible]~~

Sample time 1317

Sample Number [illegible]293

## DO & Ultrameter

| | DO | pH | ORP | TDS | Conductivity | Turbidity |
|---|---|---|---|---|---|---|
| Sample values | 9.69 | 7.64 | 261 | 99.62 | 207.4 | 45.0 |
| Surface Water | 9.92 | 7.32 | 284 | 68.05 | 142.2 | 0.95 |

Comments/Observations

Recorder C Smith

Sample Collector Zeke Simmons

R Paulson 11 25 2010

| Coastal Monitoring Assosciates Porewater Sampling Sheet | | page 2 |
|---|---|---|
| Hanford Site | | |
| Operable Unit 100 BC | | Date 11-14-20 |
| Site ID J100BC23 | | Start Time 1317 |

**Porewater Sampling Data**

| | Time | Volume | Cond | Temp |
|---|---|---|---|---|
| 1317 | 0 | 0 | 212 | 12.977 |
| 1347 | 30 | 200 | 214 | 12.915 |
| 1417 | 60 | 500 | 211 | 12.958 |
| 1437 | 87 | 600 | 214 | 12.928 |
| | END SAMPLE | | | |

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| | | | |

Geo R Pierson 11252016

| Coastal Monitoring Assosciates Porewater Sampling Sheet | | page 2 |
|---|---|---|
| Hanford Site | | |
| Operable Unit 100 BC | | Date 11-14-10 |
| Site ID 100 BC2R | | Start Time 1545 |

**Porewater Sampling Data**

| | Time | Volume | Cond | Temp |
|---|---|---|---|---|
| 1545 | 0 | 0 | 170 | 12,845 |
| 1615 | 30 | 200 | 167 | 12,804 |
| 1645 | 60 | 650 | 156 | 12,740 |
| | END | Station | | |

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| | | | |

QC R Rulison 11/15/2010

# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

SITE: Hanford, Washington

OPERABLE UNIT 100BC

TRIDENT GPS

Lat N 46.64100

Long W 119.64440

VESSEL GPS

Lat N 46.64101069

Long W 119.64436901

Accuracy (ft) 1.74'

TIME Start 1505

(on station ✓ End

BOAT 3

Porewater Sampling Method

(Frame, Trident/Handheld, Release Point)

Station ID 100BCSC

SURVEY DATE 11-14-10

PROJECT PHASE

WATER DEPTH 10.2

BOTTOM TYPE

Surface SM/MD/medium coble

Layer

**Survey Data Table**

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 9" bag | 12" ASG |
| Temperature [C] | 12.829 | 12.688 |
| Conductivity [mS/cm] | 170 | 144 |

Purge the volume of tubing prior to sample collection (circle one) YES NO

**Porewater Purge Pumping Data**

| ml | Cond | Temp |
|---|---|---|
| 0 | 142 | 12.878 |
| 30 | 151 | 12.794 |
| 60 | 166 | 12.829 |
| 90 | 166 | 12.827 |
| 120 | 169 | 12.914 |

**File Information**

CMA Computer # 6

| | | | |
|---|---|---|---|
| Data file name (.dat) | 100BCSC | Start Time | 1400 |
| Station gauge reading | 0.15 | Averaging Time | 2 |
| Field Logbook # | HNF-N-701-1 | End Time | 1401 |

Pump start time ~~1557~~ 1545

Pump end time

Picture ID – 100BCSC_11142010

Sample time 1545

Sample Number 1529891

**DO & Ultrameter**

| | DO ✓ | pH ✓ | ORP ✓ | TDS ✓ | Conductivity ✓ |
|---|---|---|---|---|---|
| Sample values | | | | | |
| Surface Water | 9.74 | 7.66 | 282 | 68.0 | 142.6 |

Turbidity 1.60

Comments/Observations

Qa R Paulson 11252010 - see notes

Recorder C. Smith

Sample Collector Zeke Simmons

# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

**SITE:** Hanford, Washington

**OPERABLE UNIT** 100 BC

**TRIDENT GPS**

Lat N ~~119.65027~~ 46.63992

Long W 119.65027

**VESSEL GPS**

Lat N 46.63994520

Long W 119.65023444

Accuracy (ft) 2.04

**TIME** (on station) Start 1010 End

**BOAT** 2

Porewater Sampling Method (Frame, Trident/Handheld, Release Point)

Station ID 100BC3C

**SURVEY DATE** 11-16-10

**PROJECT PHASE**

**WATER DEPTH** 19

**BOTTOM TYPE**

Surface Mud/large boulders

Layer

## Survey Data Table

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 8" [illegible] | 12" [illegible] |
| Temperature [C] | 12.358 | 12.190 |
| Conductivity [mS/cm] | 170 | 142 |

Purge the volume of tubing prior to sample collection (circle one) YES NO

## Porewater Purge Pumping Data

| ml | Cond | Temp |
|---|---|---|
| 0 | 144 | 12.390 |
| 30 | 157 | 12.399 |
| 60 | 162 | 12.347 |
| 90 | 169 | 12.410 |
| 120 | 169 | 12.410 |
| 150 | 168 | 12.384 |

## File Information

CMA Computer # 6

| | | | |
|---|---|---|---|
| Data file name (.dat) | 100BC3C | Start Time | 1114 |
| Station gauge reading | 0.70 | Averaging Time | 1 |
| Field Logbook # | HNF-N-701_1 | End Time | 1115 |

| | | | |
|---|---|---|---|
| Pump start time | 1121 | Sample time | 1121 |
| Pump end time | 1218 | Sample Number | 1529586 |
| Picture ID | TAKEN | | |

## DO & Ultrameter

| | DO | pH | ORP | TDS | Conductivity | Turbidity |
|---|---|---|---|---|---|---|
| Composit Sample values | 8.79 | 7.78 | 232 | 82.74 | 173.7 | 650 |
| Surface Water | 8.72 | 7.8 | 223 | 66.19 | 134 | 2.60 |

Comments/Observations

Qa RPaulsen 11 25 2010

Recorder C Smith

Sample Collector S. Johnson

| Coastal Monitoring Assosciates Porewater Sampling Sheet | | page 2 |
|---|---|---|
| Hanford Site | | |
| Operable Unit 100 BC | | Date 11-16-10 |
| Site ID T100BC3C | | Start Time 11:21 |

**Porewater Sampling Data**

| | Time | Volume | Cond | Temp |
|---|---|---|---|---|
| 1121 | 0 | 0 | 171 | 12.418 |
| 1151 | 30 | 300 | 179 | 12.424 |
| ~~[illegible]~~ 1214 | ~~60~~ | 550 | 186 | 12.432 |

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| | | | |

R Parke 11 25 2010

# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

SITE: Hanford, Washington

OPERABLE UNIT 100 BC

TRIDENT GPS

Lat N 46.63992

Long W 119.65077

VESSEL GPS

Lat N 46.63994520

Long W 119.65023944

Accuracy (ft) 2.04

TIME (on station) Start 1220

End

BOAT 2

Porewater Sampling Method (Frame, Trident/Handheld, Release Point) 3

Station ID T100BC3C (Duplicate) 1

SURVEY DATE 11-16-10

PROJECT PHASE

WATER DEPTH 19

BOTTOM TYPE

Surface Med/Large boulders

Layer

## Survey Data Table

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 8" bsg | 12" bsg |
| Temperature [C] | 12.436 | 12.265 |
| Conductivity [mS/cm] | 185 | 142 |

## Porewater Purge Pumping Data

| ml | Cond | Temp |
|---|---|---|
| | | |

Purge the volume of tubing prior to sample collection (circle one) YES NO

## File Information

CMA Computer # 6

| | | | |
|---|---|---|---|
| Data file name (.dat) | T100BC3C Duplicate | Start Time | 1220 |
| Station gauge reading | 0.70 end 0.65 | Averaging Time | 1 |
| Field Logbook # | HNF-N-701-1 | End Time | 1221 |

Pump start time 1221

Pump end time 1351

Picture ID use original

Sample time 1221

Sample Number 329383

## DO & Ultrameter

| | DO | pH | ORP | TDS | Conductivity | Turbidity |
|---|---|---|---|---|---|---|
| Sample values | 7.55 | 7.82 | 231 | | 231.7 | 4.90 |
| Surface Water | 9.21 | 7.50 | 246 | 66.05 | 139.1 | 3.10 |

Comments/Observations

Recorder C. Smith

Sample Collector S. Johnson

D.R. Parker 11/25/2010

SGW-49368, REV. 0

Duplicate 1

| Coastal Monitoring Associates Porewater Sampling Sheet | | page 2 |
|---|---|---|
| Hanford Site | | |
| Operable Unit 100 BC | | Date 11-16-10 |
| Site ID T100BC3C | | Start Time 1221 |

**Porewater Sampling Data**

| | Time | Volume | Cond | Temp |
|---|---|---|---|---|
| 1221 | 0 | 0 | 189 | 12.434 |
| 1251 | 30 | 250 | 252 | 12.467 |
| 1321 | 60 | ~~250~~ 450 | 258 | 12.434 |
| 1350 | 88 | 550 | 264 | 12.435 |
| | End Sample | | | |

**Porewater Sampling Data**

| Time | Volume | Cond | Temp |
|---|---|---|---|
| | | | |

# COASTAL MONITORING ASSOCIATES POREWATER FIELD LOG SHEET

**SITE:** Hanford, Washington

**OPERABLE UNIT** 100 BC

**TRIDENT GPS**

Lat N 46.63992

Long W 119.65027

**VESSEL GPS** Trimble

Lat N 46.63994520

Long W 119.65023444

Accuracy (ft) 2.04

**TIME** (on station) Start 1406

End

**BOAT** 2

Porewater Sampling Method (Frame, Trident/Handheld, Release Point) 3

**Station ID** T100BC3C

Duplicate 2

**SURVEY DATE** 11-16-10

**PROJECT PHASE**

**WATER DEPTH** 19

**BOTTOM TYPE**

Surface med/large cobble

Layer

## Survey Data Table

| | TRIDENT PROBE | REFERENCE PROBE |
|---|---|---|
| Sensor Depth [in] | 8" bsg | 12" bsg |
| Temperature [C] | 12.390 | 12.297 |
| Conductivity [mS/cm] | 267 | 142 |

Purge the volume of tubing prior to sample collection (circle one) YES NO

## Porewater Purge Pumping Data

| ml | Cond | Temp |
|---|---|---|
| | | |

## File Information

CMA Computer # 6

| | | | |
|---|---|---|---|
| Data file name (.dat) | T100BC3C | Start Time | 1426 |
| Station gauge reading | 0.65 | Averaging Time | 1 |
| Field Logbook # | | End Time | 1427 |

| | | | |
|---|---|---|---|
| Pump start time | 1408 | Sample time | 1408 |
| Pump end time | | | |
| Picture ID | | Sample Number | |

## DO & Ultrameter

| | DO | pH | ORP | TDS | Conductivity | Turbidity |
|---|---|---|---|---|---|---|
| Composite Sample values | | | | | | |
| Surface Water | 9.33 | 7.13 | 266 | 88.41 | 142.7 | 1.40 |

Comments/Observations

Go R. Poulson 11 25 2010

Recorder C. Smith

Sample Collector

# Appendix D

# Field Logbook HNF-N-701

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