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Revision 0

Annual Performance Report for the 200-DV-1 Operable Unit Perched Water Extraction, Fiscal Year 2015

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

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Richland, Washington 99352

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Terms

bgs	below ground surface
CCU	Cold Creek unit
CCU_g	Cold Creek unit gravel
CCU_z	Cold Creek unit silt
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CSM	conceptual site model
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ETF	Effluent Treatment Facility
FY	fiscal year
H2	Hanford formation sand dominated unit
HEIS	Hanford Environmental Information System
OU	operable unit
P&T	pump and treat
RCRA	*Resource Conservation and Recovery Act of 1976*
SST	single-shell tank
TPA	Tri-Party Agreement

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1 Summary of Fiscal Year 2015 Activities

Contaminated perched water is present in the deep vadose zone at the B Complex Area located in the Inner Area of the Hanford Site (Figure 1). The B Complex Area includes waste sites in the 200-DV-1 Operable Unit (OU) and the single-shell tank (SST) farms in Waste Management Area B-BX-BY (Figure 2). The perched water contains uranium, technetium-99, and nitrate at concentrations that have exceeded 100,000 µg/L, 50,000 pCi/L, and 800,000 µg/L, respectively. This perched water is a continuing source of contamination to groundwater in the underlying unconfined aquifer. Characterization and remediation of the contaminated perched water is being conducted as part of the 200-DV-1 OU, which was created in 2010 to support remedy selection for waste sites with deep vadose zone contamination.

The perched water zone is estimated to extend from the east-central portion of the BX Tank Farm northeast to the 216-B-8 Crib and to include the northwest portion of the B Tank Farm (Figure 2). The top of the perched water zone is approximately 68.6 m (225 ft) below ground surface (bgs) and extends to approximately 4.6 m (15 ft) above the water table at its lowest point. Perched water has been detected in this area since 1991 during drilling of *Resource Conservation and Recovery Act of 1976* (RCRA) wells to characterize groundwater contamination in the underlying unconfined aquifer. Significant perched water was encountered during the drilling of well 299-E33-344 in January 2008 (Figure 2). This well was planned to be drilled into the unconfined aquifer as part of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) remedial investigation for the 200-BP-5 Groundwater OU, but drilling was terminated in the deep vadose zone because high levels of radiological contamination were detected in the perched water. The well was completed as a monitoring well in the perched zone (SGW-39626, *Borehole Summary Report for the Installation of Seven Groundwater Monitoring Wells at the 200-BP-5 Operable Unit, CY 2008*).

Extraction of the contaminated perched water began in August 2011 to collect information on the perched zone and to reduce migration of contamination to the unconfined aquifer. The U.S. Department of Energy (DOE) initiated the action through a change notice (TPA-CN-428, *Tri-Party Agreement Change Notice Form: DOE/RL-2007-18, Rev. 1, Remedial Investigation/Feasibility Study Work Plan for the 200-BP-5 Groundwater Operable Unit*) to the Washington State Department of Ecology (Ecology) et al., 1989, *Hanford Federal Facility Agreement and Consent Order*, also known as the Tri-Party Agreement (TPA). Well 299-E33-344 was configured for use as the extraction well.

Perched water pumping from well 299-E33-344 has continued in accordance with DOE/RL-2011-40, *Field Test Plan for the Perched Water Pumping/Pore Water Extraction Treatability Test*, which was prepared in response to TPA (Ecology et al., 1989) Milestone M-015-50. As of September 30, 2015, approximately 1,140,000 L (300,000 gal) of perched water containing approximately 68.5 kg (151 lb) of uranium, 2.1 g (4.6×10^{-3} lb) of technetium-99, and 583.1 kg (1,285 lb) of nitrate have been removed from the perched zone.

Removal of the contaminated perched water is slow due to the relatively low permeability of the sand that contains the contaminated water. The perched water must be pumped at a low flow rate. After the extraction well (299-E33-344) is pumped dry, the pump in the well is cycled off to allow the perched water to refill the area drained around the well. The pump is then cycled on again. This first phase of perched water extraction is referred to as gravity drain because recharge of the well occurs naturally.

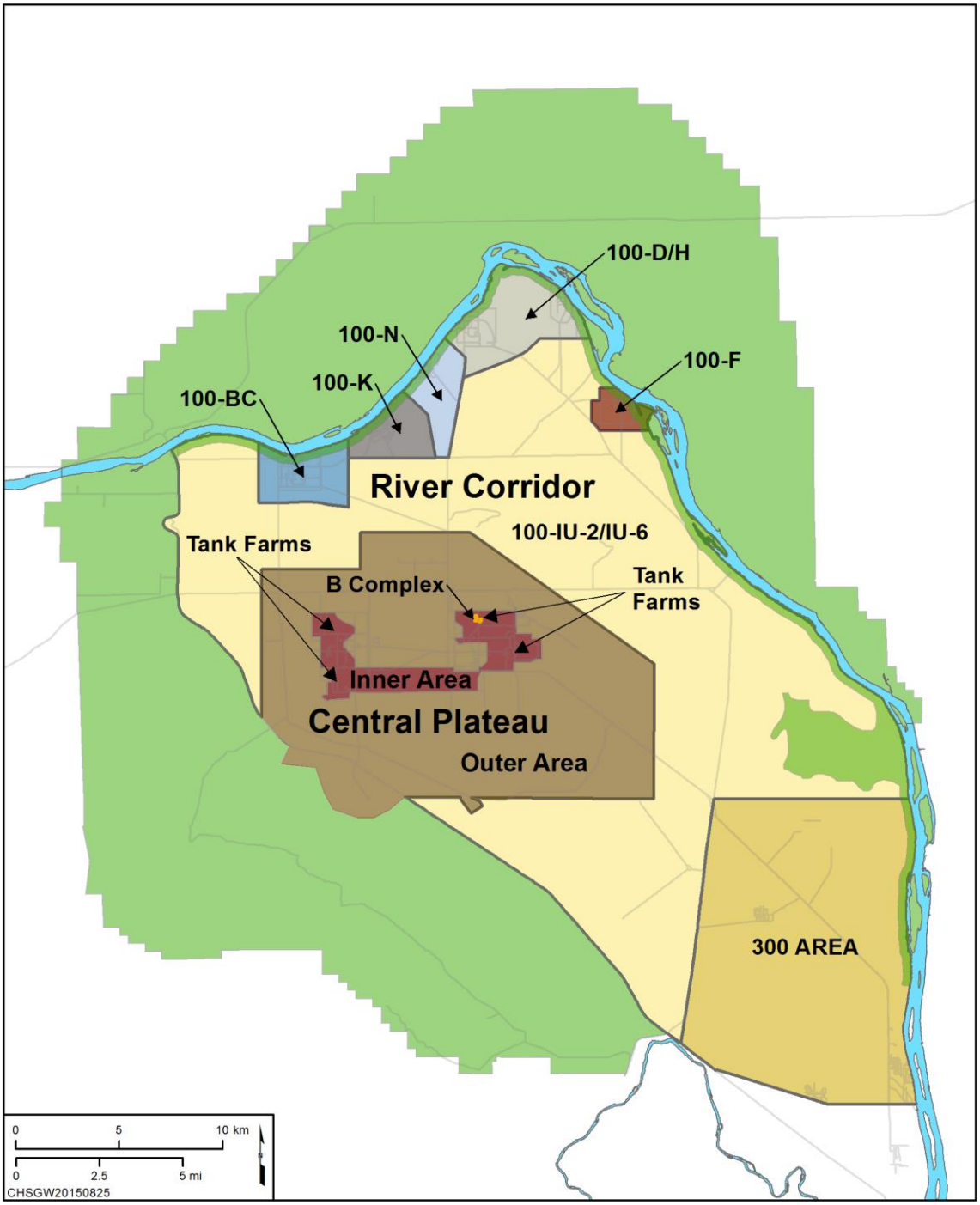
Two additional phases of perched water extraction are described in the treatability test plan (DOE/RL-2011-40). The second phase of perched water pumping would add a vacuum system to accelerate recharge into the well. Based on the results of the enhanced perched water pumping using the vacuum system, a third phase could be implemented to extract pore water in the perched zone. As of September 30, 2015, the vacuum enhanced pumping phase of the treatability test plan has not been

implemented because the natural recharge rate has been sufficient to maintain pumping from the extraction well.

Two 200-DV-1 OU perched water extraction wells were drilled in fiscal year (FY) 2014 (wells 299-E33-350 and 299-E33-351). Extraction of perched water using these two additional wells is anticipated to begin in FY 2016. A 200-BP-5 OU groundwater monitoring well (299-E33-360) was drilled in the perched water area at the end of FY 2014. Depth-discrete sediment samples were collected from the perched zone during drilling operations and submitted for pore water analysis in FY 2015.

The action memorandum that documents selection of the alternative for extraction and treatment of perched water as a non-time-critical removal action was issued in December 2014 (DOE/RL 2014 34, Action Memorandum for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction). Draft A of the removal action work plan (DOE/RL 2014 37, Removal Action Work Plan for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction) and associated sampling and analysis plan (DOE/RL 2014 51, Sampling and Analysis Plan for 200-DV-1 Operable Unit Perched Water Pumping/ Pore Water Extraction) for the non-time-critical removal action were provided to the U.S. Environmental Protection Agency (EPA) and Ecology for review in July 2015. Perched water extraction from wells 299 E33 344, 299 E33 350, and 299 E33 351 as a non-time critical removal action is anticipated to begin in FY 2016.

The purpose of this report is to summarize the results of the perched water extraction operations through the end of FY 2015, evaluate the results of the sediment pore water analysis in samples from the 200 BP 5 OU groundwater monitoring well (299 E33 360), present the updated conceptual site model (CSM) for the perched water zone, and provide the status and path forward for remediation of contaminated perched water.



Source: Modified from DOE/RL-2011-118, *Hanford Site Groundwater Monitoring for 2011*.

Figure 1. Location of the B Complex Area on the Hanford Site

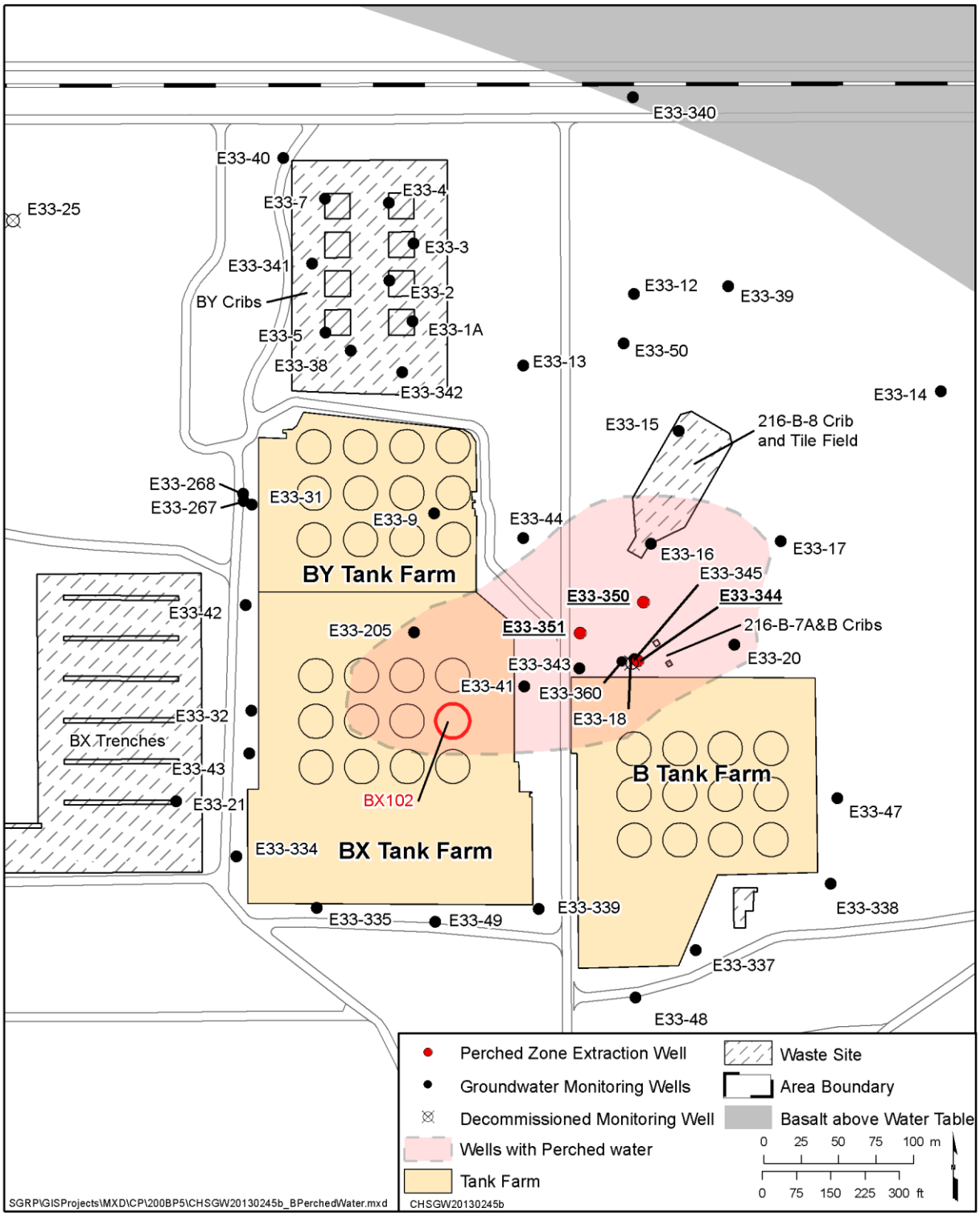


Figure 2. Location of Waste Sites, Tank Farms, and Wells in the B Complex Area

2 200-DV-1 Operable Unit Perched Water Extraction

DOE initiated extraction of contaminated perched water from well 299-E33-344 on August 30, 2011. A dedicated submersible pump was installed in the well with an automatic on-off pump control regulated by a water level sensor (transducer) (Figure 3). When the perched water level in well 299-E33-344 reaches the high-level set point, the pump turns on and the water is pumped into an aboveground water collection system (approximately 23 to 27 L [6 to 7 gal] per cycle). The extracted water accumulates in an aboveground, 11,355 L (3,000 gal) high-density polyethylene double wall collection container located near the wellhead (Figure 4). Once pumping lowers the water level to the low-level set point, the pump shuts off to allow the well to recover. This on-off cycle, with durations typically 25 to 35 minutes, has continued since extraction began, with the exception of the temporary shutdowns described in this chapter. The accumulated perched water in the aboveground container near the well is periodically transferred to the Effluent Treatment Facility (ETF) for treatment. Figure 4 shows the configuration of the perched water extraction site.

In September 2011, the pump was programmed to begin operations when the water level in the well reached 2.4 m (8 ft) above the pump (i.e., the high set point) and cease operations when the water level in the well fell to 0.15 m (0.5 ft) above the pump (i.e., the low set point). In April 2012, the high set point was lowered to 2.1 m (7 ft) above the pump to reduce the length of time that the pump was not operating.

Prior to initiation of perched water extraction, between July 2008 and August 2011, nine water quality samples were collected from well 299-E33-344. Uranium concentrations ranged from 788 to 5,300 µg/L; technetium-99 concentrations ranged from 4,130 to 6,200 pCi/L; and nitrate concentrations ranged from 417,000 to 580,000 µg/L (Table 1). On October 4, 2011, the first perched water sample was collected after initiation of full-scale pumping, and concentrations of all three contaminants were higher than in samples taken prior to pumping operations. Increases in uranium and technetium-99 were dramatic (Figure 5). Concentrations also increased in nearby groundwater wells 299-E33-345 (Figure 6) and 299-E33-18 (Figure 7). While well 299-E33-18 was decommissioned in 2013, concentrations of uranium and technetium-99 in well 299-E33-345 have continued to increase significantly over the years since pumping began. Concentrations have varied in samples collected during extraction operations, but uranium and technetium-99 concentrations in the perched water well (299-E33-344) are still significantly elevated compared to the pre-pumping concentrations (Table 1 and Figure 5). Chapter 4 provides additional discussion of these changes in perched water and groundwater chemistry.

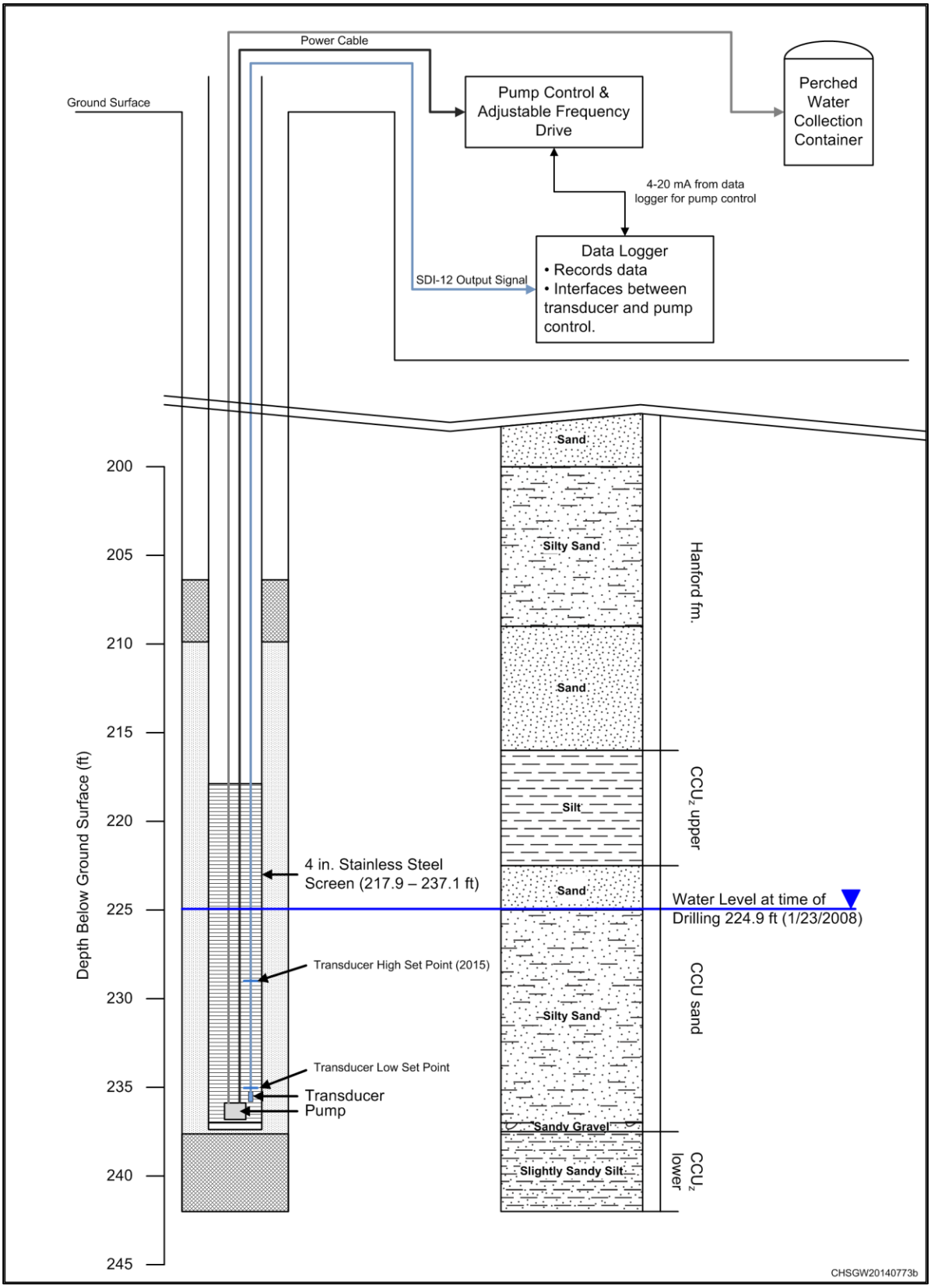


Figure 3. Configuration of Perched Water Extraction Well 299-E33-344

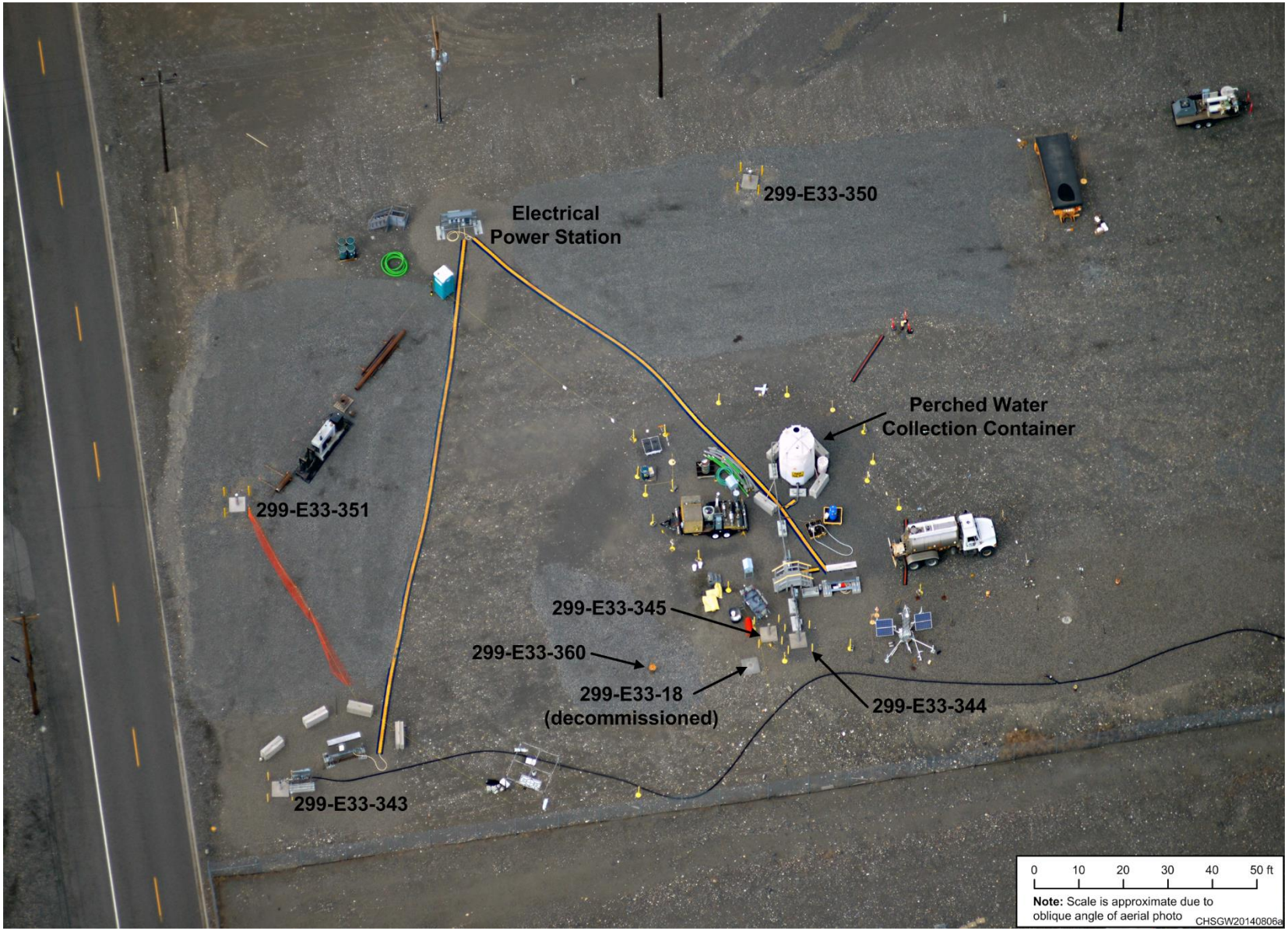


Figure 4. Configuration of the Perched Water Extraction Site (Photographed August 2014)

Table 1. Well 299-E33-344 Perched Water Sample Data

Sampling Date	Uranium (pCi/L)	Technetium-99 (pCi/L)	Nitrate (µg/L)
07/15/2008	897	4,400	436,000
09/19/2008	788	4,130	522,000
11/18/2008	1,820	4,800	483,000
05/22/2009	1,460	5,400	—
06/26/2009	—	—	474,000
08/04/2009	5,300	5,900	478,000
08/04/2009	4,940	5,800	483,000
11/12/2009	2,980	6,200	417,000
11/12/2009	2,910	6,000	433,000
05/24/2010	1,660	5,900	469,000
12/19/2010	409	4,320	580,000
12/19/2010	—	5,400	—
09/07/2011	4,500	5,640	401,000
10/04/2011	63,600	37,800	604,000
12/05/2011	71,500	45,100	810,000
04/23/2012	51,500	22,100	456,000
08/02/2012	26,600	12,200	522,000
02/05/2013	37,300	51,000	637,000
08/13/2013	60,800	33,000	474,000
10/22/2013	102,000	—	—
10/22/2013	106,000	—	—
04/22/2014	76,100	51,000	435,000
04/22/2014	38,800	39,000	549,000
06/24/2014	28,800	15,700	316,000
07/30/2014	29,700	17,200	360,000
08/20/2014	77,500	42,500	580,000
09/25/2014	99,300	53,300	611,000
10/30/2014	40,600	20,400	361,000
11/19/2014	30,900	16,400	332,000

Table 1. Well 299-E33-344 Perched Water Sample Data

Sampling Date	Uranium (pCi/L)	Technetium-99 (pCi/L)	Nitrate (µg/L)
12/30/2014	37,800	17,200	368,000
02/26/2015	111,000	20,300	351,000
05/20/2015	76,100	35,200	540,000
08/11/2015	83,900	40,900	620,000

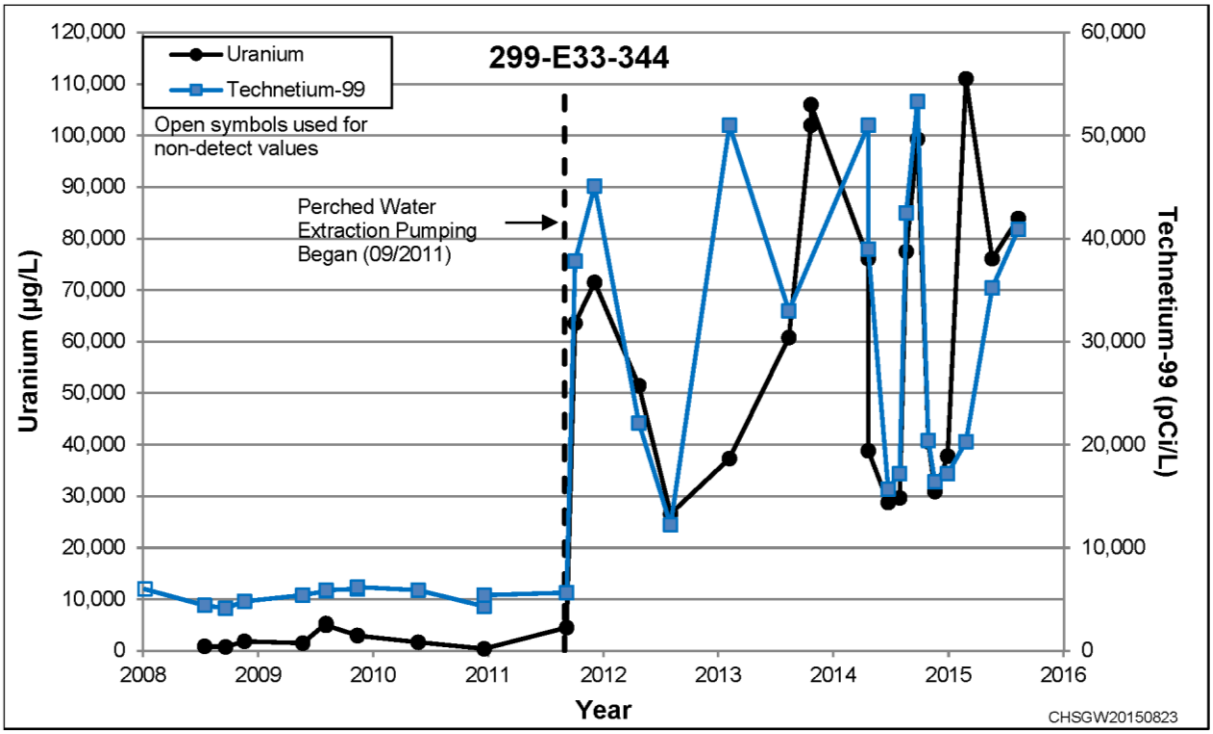


Figure 5. Increase in Uranium and Technetium-99 Concentrations in Perched Water Extraction Well 299-E33-344 after Pumping Began

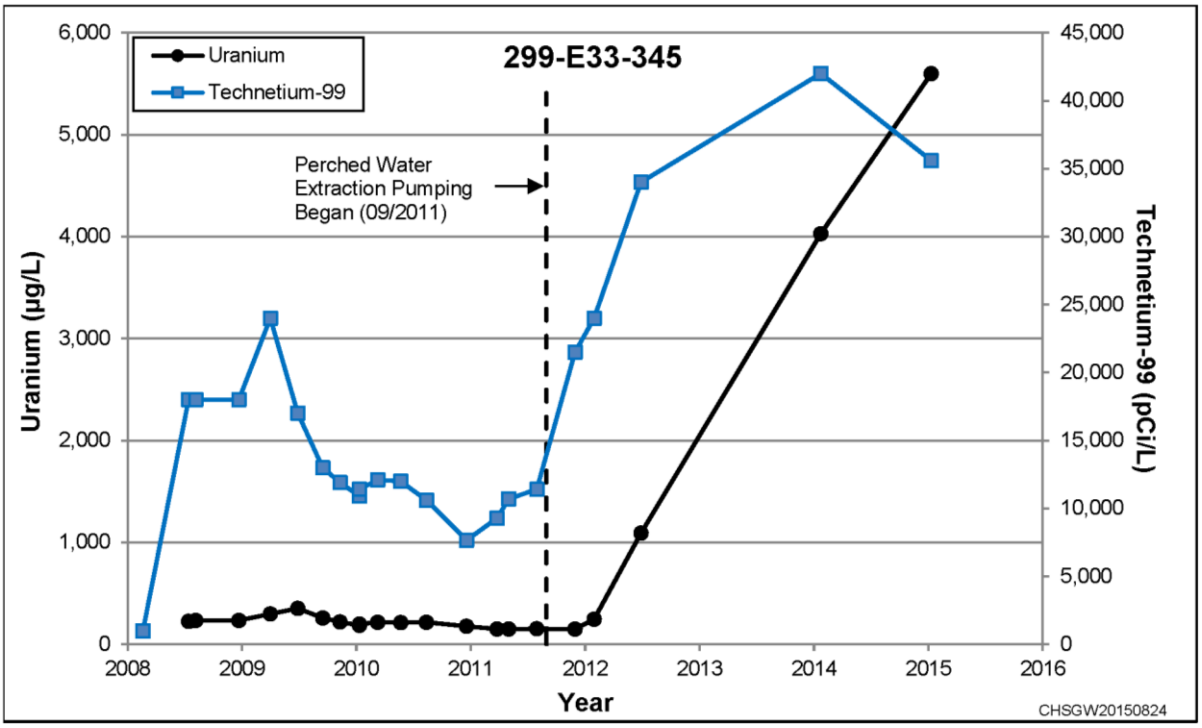
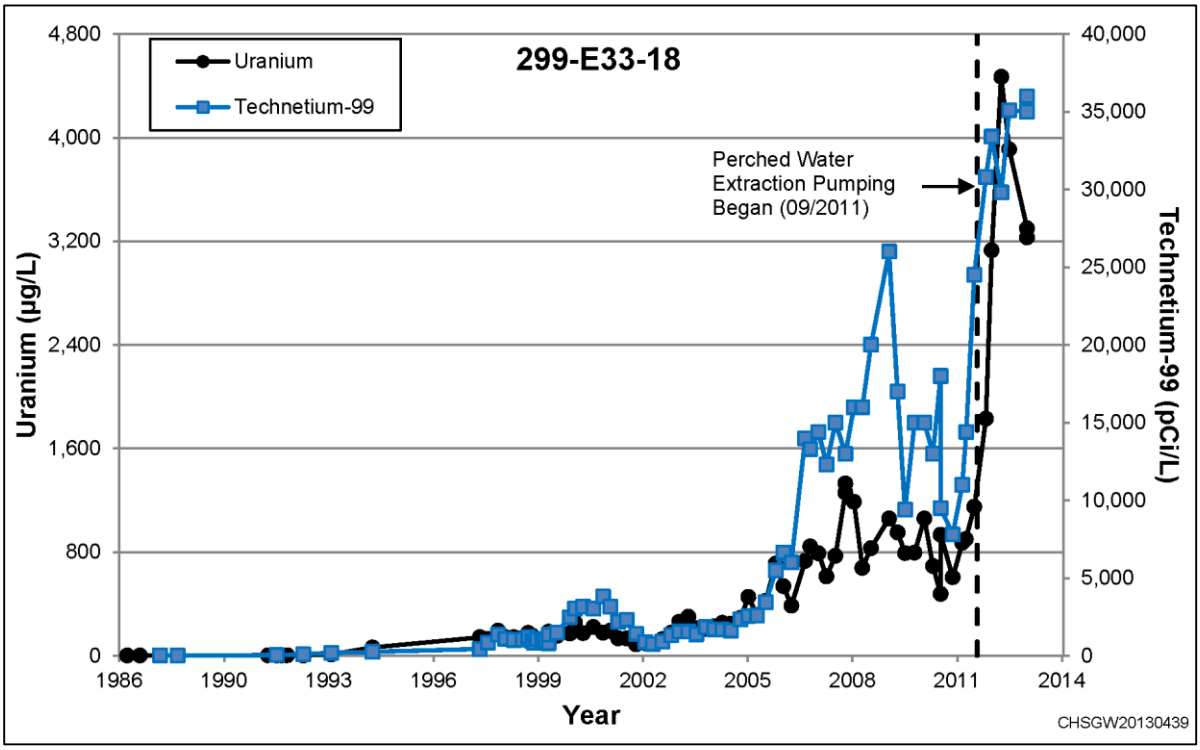


Figure 6. Increase in Uranium and Technetium-99 Concentrations in Groundwater Monitoring Well 299-E33-345 after Pumping Began from Well 299-E33-344



Note: Well 299-E33-18 was decommissioned in 2013.

Figure 7. Increase in Uranium and Technetium-99 Concentrations in Groundwater Monitoring Well 299-E33-18 after Pumping Began from Well 299-E33-344

Perched water pumping operations have been temporarily shut down several times since initiation of perched water extraction. In December 2011, the submersible pump failed, and operations were stalled until the pump was replaced. The system was restarted in April 2012. Pumping continued until the end of April 2012 when algae concentrations that prevented treatment at ETF were discovered in the collected water. Residual water that had remained in the collection container since the December 2011 shutdown had been subjected to increasing ambient temperature, which facilitated the growth of algae.
In May 2012, a metering pump was installed in the pipe to the collection container to administer a copper sulfate solution to the collection container in an effort to control algae growth, and perched water pumping subsequently resumed. In June 2012, the copper sulfate metering pump failed and was replaced with a diaphragm pump. Thereafter, the copper sulfate solution was added weekly to the process to control algae growth. Perched water pumping continued until September 2012, when the pumping system was turned off. Pumping resumed in October 2012. In September 2013, the pumping system was turned off to evaluate treatment options for perched water with unusually high uranium concentrations.
The reported uranium concentration was determined to be incorrect, and the system was restarted in October 2013. Pumping continued throughout FYs 2014 and 2015 with only minimal downtime.
The pumping system was turned off on August 20, 2015, to allow installation of new equipment and the addition of perched water extraction wells 299-E33-350 and 299-E33-351.

Figure 8 shows the volume of extracted perched water transferred from the collection container to ETF each week through August 20, 2015. The weekly volume extracted has declined gradually from FY 2011 to mid-FY 2014. This could be a result of the increase in time for well 299-E33-344 to recharge following pumping. The average recharge time has increased approximately 10 minutes with continued extraction over the last couple of years. The current recharge time is approximately 35 minutes. The increase in the recharge time indicates that it is taking progressively longer for additional perched water to refill the well after it has been pumped. The extraction rate has remained at approximately 5,700 L (1,500 gal) per week from mid-FY 2014 through FY 2015.

Since pumping began, approximately 1,140,000 L (300,000 gal) of perched water containing approximately 68.5 kg (151 lb) of uranium, 2.1 g (4.6×10^{-3} lb) of technetium-99, and 583.1 kg (1,285 lb) of nitrate have been removed from the perched zone (Table 2)

Table 2. Perched Water Extracted and Contaminants Removed from Well 299-E33-344

Fiscal Year	Duration	Perched Water Extracted (L [gal])	Uranium Removed (kg [lb])	Technetium-99 Removed (g [lb])	Nitrate Removed (kg [lb])
2012	08/2011 to 09/2012	246,657 (65,167)	12.0 (26.5)	0.37 (8.1×10^{-4})	131.0 (288.9)
2013	10/2012 to 09/2013	349,367 (92,303)	13.1 (28.9)	0.74 (1.6×10^{-3})	202.6 (446.7)
2014	10/2013 to 09/2014	286,222 (75,620)	24.1 (53.2)	0.59 (1.3×10^{-3})	137.2 (302.4)
2015	10/2014 to 09/2015	257,626 (68,065)	19.3 (42.4)	0.41 (9.0×10^{-4})	112.2 (247.4)
Total	08/2011 to 09/2015	1,139,872 (301,155)	68.5 (151)	2.1 (4.6×10^{-3})	583.1 (1,285)

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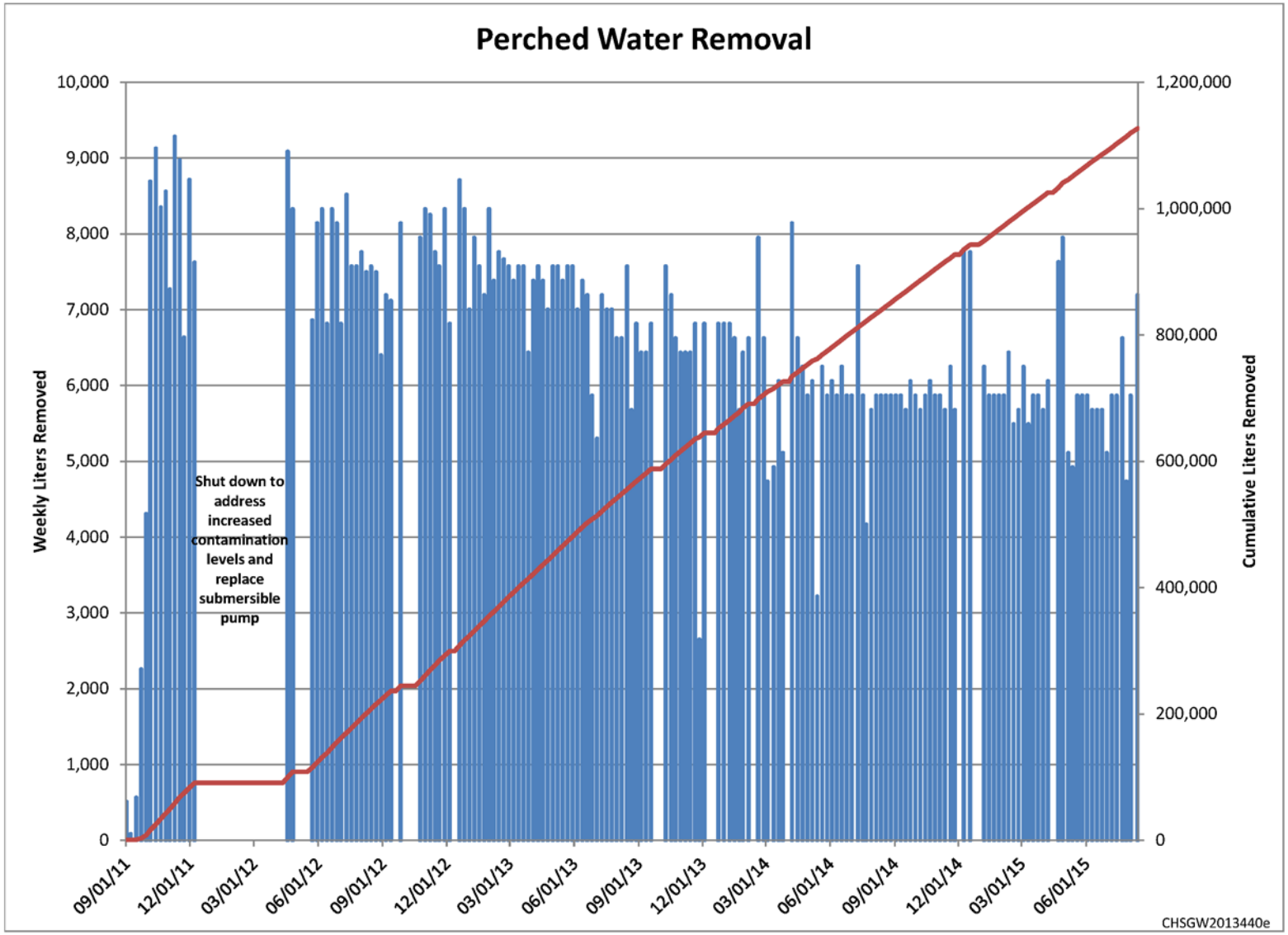
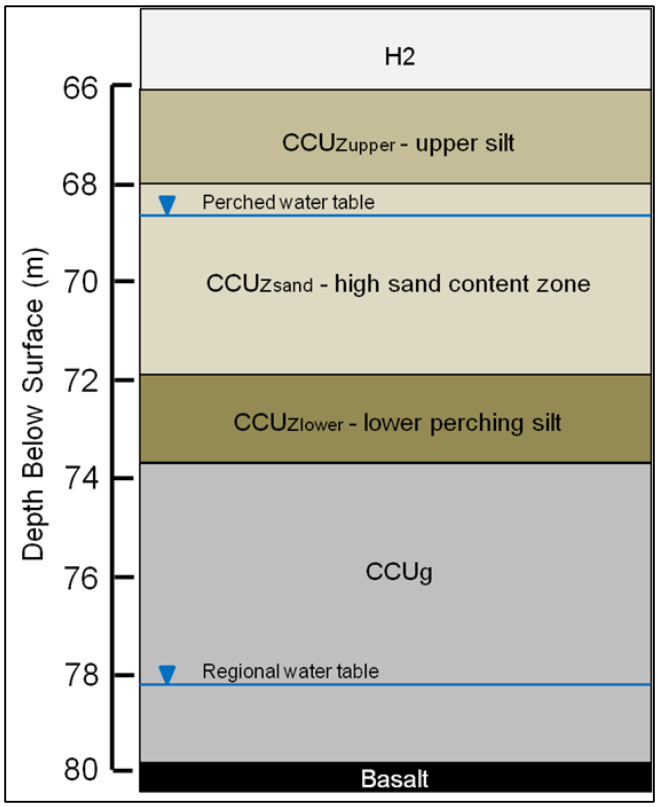


Figure 8. Well 299-E33-344 Perched Extraction History

3 Characterization of the Perched Water Zone

Figure 9 illustrates the generalized conceptual stratigraphic model of the perched water zone. The full thickness of the Hanford formation sand dominated unit (H2) is not depicted. The Cold Creek unit (CCU) silt (CCU_z) in the area with perched water is composed of a lower perching silt ($CCU_{z\ lower}$), a high sand content zone ($CCU_{z\ sand}$), and upper silt zone ($CCU_{z\ upper}$). The underlying Cold Creek unit gravel (CCU_g) contains the regional groundwater aquifer and is underlain by basalt.



Reference: PNNL-22449, *Perched-Water Evaluation for the Deep Vadose Zone Beneath the B, BX, and BY Tank Farms Area of the Hanford Site*.

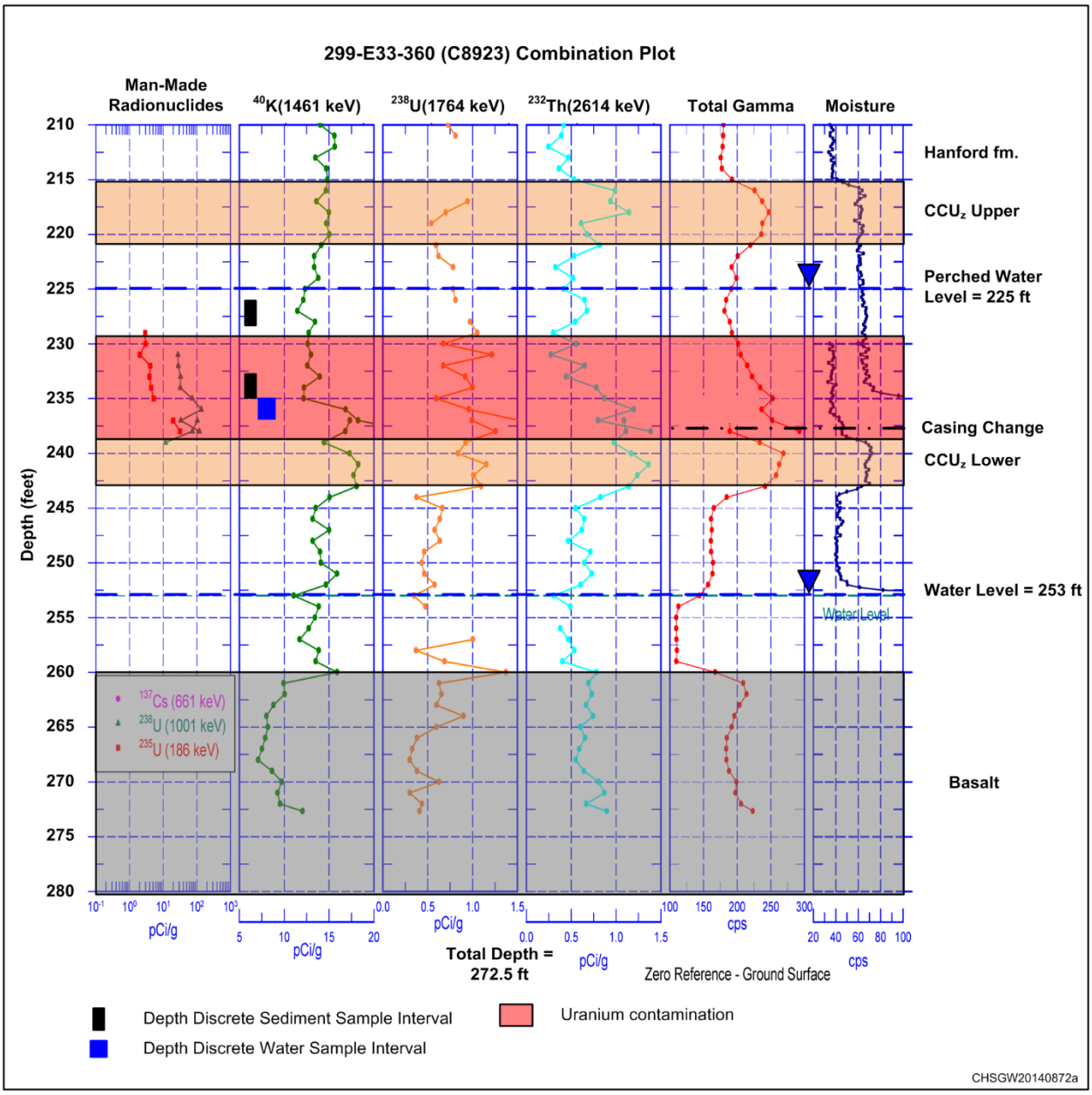
Figure 9. Generalized Conceptual Stratigraphic Model of the Perched Water Zone

One new groundwater monitoring well (299-E33-360 [C8923]) was drilled through the perched water zone in August 2014 (Figure 2). The sampling instruction for well 299-E33-360 (SGW-57810, *Sampling Instruction for Conceptual Model Refinement during the Drilling of Wells 299-E25-237, 299-E33-360, and 299-E33-361 in 200 East*) included collection of two sediment samples for pore water analysis, one perched water sample, and geophysical borehole logs. Results of the perched water sample and geophysical borehole logs were reported in the FY 2014 perched water annual report (SGW-58147, *Annual Performance Report for the 200-DV-1 Operable Unit Perched Water Extraction, Fiscal Year 2014)*. Two sediment samples were submitted for pore water analysis in FY 2015.

The two depth-discrete, split-spoon sediment samples were collected within the saturated perched water CCU sand interval (Figure 10) from 69.1 to 69.8 m (226.7 to 228.9 ft) and 71.1 to 71.9 m (233.4 to 235.8 ft) bgs (Table 3). Pore water was analyzed in one sample from each split-spoon sample. The purpose of analyzing pore water in the samples was to investigate the variability of contamination with depth in the perched zone at well 299-E33-360. Results of the pore water analysis are provided in

Appendix A, which includes photographs of the sediment samples and the core log for the well. Table 4 summarizes uranium, technetium-99, and nitrate concentrations in the pore water.

Uranium and nitrate results increased with depth, consistent with contaminant migration downward through the CCU_z sand layer. Uranium and nitrate concentrations were an order of magnitude higher at 71.1 to 71.3 m (233.4 to 234.0 ft) bgs than at 69.5 to 69.6 m (227.9 to 228.4 ft) bgs. At 71.1 to 71.3 m (233.4 to 234.0 ft) bgs, pore water concentrations of uranium and nitrate were comparable to collocated perched water concentrations (Table 5) at 71.7 m (235.2 ft) bgs. The presence of higher uranium concentrations in the deeper sample is consistent with geophysical logging results (Man-Made Radionuclides in Figure 10). The total gamma activity on the geophysical log is higher at the location of the deeper sample than the shallower sample (Total Gamma in Figure 10), indicating an increase in clay-rich minerals. The lithology of the deeper sample is described as very fine sand with occasional rust colored laminations (Appendix A). The geophysical log and lithologic description are consistent with increased fine-grained sediment and iron oxide content in the deeper sample. Most of the uranium is likely sorbed on this finer-grained sediment, particularly on the iron oxide material. Technetium-99 was not detected in the pore water of either sample, which may be because the reporting limit for the pore water analyses (Appendix A) was higher than the technetium-99 concentration in the collocated perched water sample (Table 5). However, based on the similarity between the uranium and nitrate concentrations in the pore water sample at 71.1 to 71.3 m (233.4 to 234.0 ft) bgs and the collocated perched water sample at 71.7 m (235.2 ft) bgs, the concentration of technetium-99 in the pore water sample at 71.1 to 71.3 m (233.4 to 234.0 ft) bgs may be approximately 19,850 pCi/L, the average technetium-99 concentration in the collocated perched water sample.



Reference: modified from SGW-58147, *Annual Performance Report for the 200-DV-1 Operable Unit Perched Water Extraction, Fiscal Year 2014.*

Figure 10. Borehole Composite Log Showing the Perched Zone and Unconfined Aquifer Detail in New Well 299-E33-360

Table 3. Sample Collection Summary for Well 299-E33-360 (C8923)

Well Name (Identification Number)	Sample Type	Sample Depth (m [ft] bgs)	Sample Date	Sample HEIS Number
299-E33-360 (C8923)	Split-Spoon Sediment	69.1 to 69.3 (226.8 to 227.4)	08/07/2014	B2XM90
299-E33-360 (C8923)	Split-Spoon Sediment	69.3 to 69.5 (227.4 to 227.9)	08/07/2014	B2XM89
299-E33-360 (C8923)	Split-Spoon Sediment	69.5 to 69.6 (227.9 to 228.4)	08/07/2014	B2XM88
299-E33-360 (C8923)	Split-Spoon Sediment	69.6 to 69.8 (228.4 to 228.9)	08/07/2014	B2XM87
299-E33-360 (C8923)	Split-Spoon Sediment	71.1 to 71.3 (233.4 to 234.0)	08/07/2014	B2XM94
299-E33-360 (C8923)	Split-Spoon Sediment	71.3 to 71.5 (234.0 to 234.6)	08/07/2014	B2XM93
299-E33-360 (C8923)	Split-Spoon Sediment	71.5 to 71.7 (234.6 to 235.2)	08/07/2014	B2XM92
299-E33-360 (C8923)	Split-Spoon Sediment	71.7 to 71.9 (235.2 to 235.8)	08/07/2014	B2XM91

Note: Table is based on PNNL-SA-109672, *Analytical Data Report for Sediment Samples Collected From 200 East Area M-24 Wells C8922 and C8923* (provided as Appendix A of this report).

bgs = below ground surface

HEIS = Hanford Environmental Information System

Table 4. Well 299-E33-360 Sediment Pore Water Sample Data

Sampling Date	Sample HEIS Number	Sample Depth	Uranium	Technetium-99	Nitrate
		(m [ft] bgs)	(µg/L)	(µg/L)[a]	(g/L)
8/07/2014	B2XM88	69.5 to 69.6 (227.9 to 228.4)	34,700	<41	0.625
	B2XM94	71.1 to 71.3 (233.4 to 234.0)	236,000	<410	1.68

a. Technetium-99 analyzed by inductively coupled plasma/mass spectrometry and reported in units of µg/L (Appendix A of this report).

bgs = below ground surface

HEIS = Hanford Environmental Information System

Table 5. Well 299-E33-360 Perched Water Sample Data

Sampling Date	Sample Depth	Uranium	Technetium-99	Nitrate
	(m [ft] bgs)	(µg/L)	(pCi/L)	(g/L)
8/11/2014	71.7 (235.2)	256,000	19,700	1.78
8/11/2014	71.7 (235.2)	257,000	20,000	1.78
Average	71.7 (235.2)	256,500	19,850	1.78

4 Conceptual Site Model

Integration and interpretation of borehole hydrogeologic, geochemical, and geophysical data sets were used to resolve the nature of the perching horizon and the location and extent of the contaminated water within the perching zone (Section A7 of SGW-53604, *Path Forward Recommendations Report for the Uranium Contamination in the B Area*). The resulting CSM indicates that the contaminated perched water is contained within a localized silty sand lens deposited in a structural low on top of a low permeability paleosol (silt) layer (lower CCU_z silt) in the CCU (Figure 11). The top of the contaminated sand lens is defined between approximately 67 and 68.6 m (220 and 225 ft) bgs, based on geophysical logs. The maximum thickness of the sand lens is approximately 4.6 m (15 ft). The lateral and vertical extent of the perched water is limited to the region containing the sand lens and underlying lower perching silt zone ($CCU_{z\ lower}$). The bottom of the perched sand lens is approximately 4.6 m (15 ft) above the unconfined aquifer at its lowest point. The underlying perching silt layer ($CCU_{z\ lower}$) forms a natural barrier that slows contaminant migration from the saturated sand layer to the aquifer.

Liquid wastes containing uranium, technetium-99, and nitrate migrated vertically and laterally in the subsurface decades ago and accumulated within the CCU sand lens. Major sources of contaminated water are considered to be the nearby 200-DV-1 OU waste sites 216-B-7A&B Cribs and 216-B-8 Crib and Tile Field, which were used for subsurface infiltration of liquid wastes from 1947 through 1967 and from 1951 through 1952, respectively, and the SST 241-BX-102, which released liquid waste to the subsurface when it was inadvertently overfilled in 1951. Unplanned releases near the SSTs 241-B-105 and 241-B-106 also may have contaminated groundwater (DOE/RL-2012-53, *Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area B-BX-BY*); however, the signature contaminant (cyanide) has not been detected at well 299-E33-344.

Dramatic changes in perched water chemistry and increases in contaminant concentrations occurred after the initiation of perched water extraction at well 299-E33-344 (Figure 5). The initial extraction of perched water from this well is thought to have removed the lower concentration residual water that had accumulated from disposal operations that occurred several decades ago at the 216-B-7A&B and 216-B-8 Cribs; these cribs are located on the eastern margin of the perching silt layer (Figure 2). The large volumes of wastewater disposed to these cribs most likely saturated the perched water zone. Continued perched water pumping expanded the perched water capture area and pulled higher concentrations of uranium, technetium-99, and nitrate from the west side of the perched zone, nearer the 241-BX-102 tank release, to the extraction well (Figures A-15 and A-16 in SGW-53604).

In addition to the increased contaminant concentrations in the perched zone samples obtained from extraction well 299-E33-344, uranium, technetium-99, and nitrate concentration increases began shortly thereafter in groundwater monitoring well 299-E33-18 (Figure 7), followed by increases in groundwater monitoring well 299-E33-345 (Figure 6). These groundwater monitoring wells are located less than 3.5 m (11.5 ft) horizontally from perched zone extraction well 299-E33-344. Technetium-99 concentrations in both groundwater monitoring wells were already higher than in the perched zone well prior to initiation of perched water extraction. However, uranium and nitrate concentrations in the groundwater monitoring wells were lower than in the perched zone extraction well prior to initiation of perched water extraction. This indicates that the unconfined aquifer beneath the perched zone was already contaminated with technetium-99 and low levels of the other contaminants.

Geophysical logging results for well 299-E33-18 have shown that increasing uranium concentrations occurred over time along the outside of the casing downward toward the water table (Figure A-23 in SGW-53604). These data indicate that well 299-E33-18, an older unsealed well, may have been providing a more direct travel pathway for the perched water vadose zone contamination to migrate to the unconfined aquifer. Well 299-E33-18 was perforated, pressure grouted, and decommissioned on June 26, 2013, to eliminate the potential for contaminant migration along the unsealed well. Groundwater

monitoring results from nearby wells will be evaluated to determine if concentrations changed (decreased) because of well decommissioning.

The two new perched water wells (299-E33-350 and 299-E33-351) and the new groundwater monitoring well (299-E33-360) also encountered the CCU interval and the highly contaminated perched water. The characterization results (Chapter 3 of this document and Chapter 3 of SGW-58147) confirm the existing CSM, indicating that the lateral extent of the contaminated perched water is within the region mapped (Figure 2), supporting the conclusion that this highly contaminated perched water is slowly migrating through the $CCU_{z\ lower}$ and impacting the unconfined aquifer.

The perched water extraction system installed in well 299-E33-344 has operated for 1,198 days since pumping began in August 2011. The approximate 1,140,000 L (300,000 gal) recovered through September 30, 2015, represents approximately 15 percent of the estimated 7.6 million L (2 million gal) of perched water contained within the sand layer (PNNL-22499, *Perched-Water Evaluation for the Deep Vadose Zone Beneath the B, BX, and BY Tank Farms Area of the Hanford Site*).

The CSM for the perched water zone provides the basis for identifying uncertainties associated with the nature and extent of the contaminated perched water. Hydraulic properties of the perched zone were derived from hydrologic testing completed in 2014 in the two new wells (299-E33-350 and 299-E33-351) (PNNL-23380, *Field-Derived Hydraulic Properties for Perched-Water Aquifer Wells 299-E33-350 and 299-E33-351, Hanford Site B-Complex Area*). Water level observations and initial pumping conditions to be obtained from the new perched water wells will be further evaluated to develop estimates of the volume of remaining perched water. The new information and data will support the evaluation of the extent and thickness of the perched water zone and the area of potential groundwater impact.

Pacific Northwest National Laboratory simulated recharge and perched water conditions and concluded that a coupled approach of perched water removal and recharge rate reduction would create the most significant decrease in contaminant flux to the groundwater (PNNL-22499).

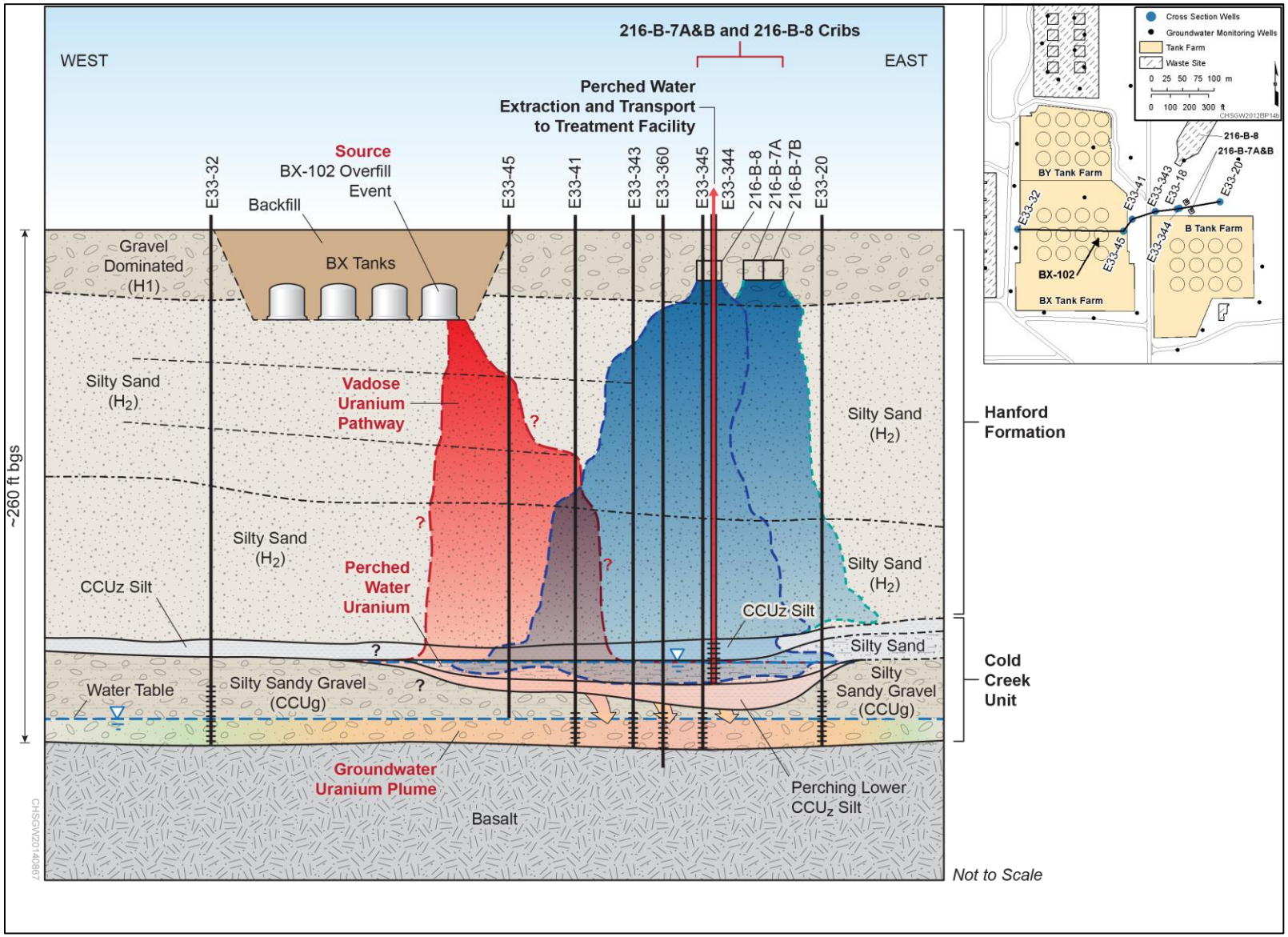


Figure 11. Conceptual Site Model of the Cold Creek Unit Perching Zone

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5 Status and Path Forward for Remedial Action

Perched water extraction using well 299-E33-344 continued during FY 2015 as Phase 1 of the treatability test (DOE/RL-2011-40). Vacuum enhanced recovery of perched water (Phase 2 of the treatability test) and pore water extraction (Phase 3 of the treatability test) were not implemented during FY 2015.

Perched water extraction is being transitioned from treatability testing to operating as a CERCLA non-time-critical removal action. Table 6 lists the documents prepared in FY 2015 as part of the transition; these documents were provided to EPA and Ecology for review in July 2015. The treatability test is planned to continue until the uranium treatment train is installed at the 200 West Pump and Treat (P&T) in September 2015. Once the train is operational, the removal action will be initiated in accordance with the removal action work plan (DOE/RL-2014-37). It is anticipated that the non-time-critical removal action will begin in FY 2016.

The alternative selected in the action memorandum (DOE/RL-2014-34) for the non-time-critical removal action is continued extraction of perched water and transfer of the water by truck to the 200 West P&T, where the water will be treated and then injected into the aquifer below the 200 West Area. The perched water may alternatively be transferred to 200 West P&T by pipeline, when available.

The two new 200-DV-1 OU perched water wells (299-E33-350 and 299-E33-351) to be added to the extraction system are anticipated to begin pumping during FY 2016. The three extraction wells (299-E33-344, 299-E33-350, and 299-E33-351) will be used to extract perched water for the removal action (DOE/RL-2014-34). The need for implementing vacuum enhanced recovery of perched water and pore water extraction will be evaluated as the removal action is conducted. Data will be collected during initial pumping to support the interpretation of the volume of perched water remaining. Extraction data using the two new wells will be used to refine the CSM. Extraction from the new wells will result in accelerated perched water zone remediation. Groundwater monitoring beneath the perched water zone in the new 200-BP-5 OU well 299-E33-360 will also support the evaluation of continued groundwater impacts from the perched water interval.

Draft A of DOE/RL-2011-102, *Remedial Investigation/Feasibility Study and RCRA Facility Investigation/Corrective Measures Study Work Plan for the 200-DV-1 Operable Unit*; was provided to Ecology for review in March 2015 in accordance with TPA (Ecology et al., 1989) Milestone M-015-110A. Additional perched water actions, if needed, will be identified in the 200-DV-1 OU record of decision.

Table 6. Documents Prepared in Fiscal Year 2015 to Transition Extraction of Perched Water to a Non-Time-Critical Removal Action

Date	Document	Scope
June 2015	DOE/RL-2014-37, *Removal Action Work Plan for 200-DV-1 Operable Unit Perched Water/Pore Water Extraction* (Draft A)	The removal action work plan is limited to extraction, transport, treatment, and disposal of contaminated perched water from the 200-DV-1 Operable Unit.
June 2015	DOE/RL-2014-51, *Sampling and Analysis Plan for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction* (Draft A)	The scope of the sampling and analysis plan is to collect and analyze perched water samples from the three perched water extraction wells and an aboveground 11,355 L (3,000 gal) container at the 200-DV-1 Operable Unit perched water site.

Most recommendations from FY 2013 (SGW-53604) were implemented in FY 2014, including continuous perched water extraction using an automated water level transducer, geophysical logging at three newly installed wells (299-E33-350, 299-E33-351, and 299-E33-360) in the perched water zone, and decommissioning of well 299-E33-18 and replacement with well 299-E33-360 (Chapter 6 of SGW-58147). The new water level and barometric monitoring instrumentation will be installed in well 299-E33-344 during preparation for initiation of the removal action. FY 2013 recommendations that were not implemented in FY 2014 or 2015 include vacuum enhanced extraction of perched water and monthly/quarterly pump shutdowns to collect water level data. Implementation of these recommendations was deferred to the non-time-critical removal action.

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Appendix A

Analytical Data Report for Sediment Samples Collected from Groundwater Well 299-E33-360 (C8923)

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A1 Introduction

This appendix provides the laboratory report for analyses of pore water in sediment samples collected from the new groundwater well 299-E33-360 (C8923), located at the B Complex Area in the Inner Area of the Hanford Site. The laboratory report (PNNL-SA-109672, *Analytical Data Report for Sediment Samples Collected From 200 East Area M-24 Wells C8922 and C8923*) was prepared by Pacific Northwest National Laboratory for CH2M HILL Plateau Remediation Company. The laboratory report contains the following information for samples from this well:

- Cover sheet
- Narrative
- Analytical results
- Quality control
- Geologic logs
- Geologic photographs

Sample depths corresponding to Hanford Environmental Information System (HEIS) sample numbers for well 299-E33-360 are provided on the geologic photographs in this appendix and in Table 3 in the main text of this report.

This appendix also provides the laboratory report for analyses of pore water in sediment samples collected from the new groundwater well 299-E25-237 (C8922). This well is not located in the B Complex Area. Results for these samples are not discussed in this report.

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U.S. DEPARTMENT OF ENERGY

PNNL-SA-109672

Analytical Data Report for Sediment Samples Collected From 200 East Area M-24 Wells C8922 and C8923

MMV Snyder
KJ Cantrell

April 2015

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To: Greg Thomas

From: Michelle Snyder and Kirk Cantrell

Environmental Sciences Laboratory
Energy and Environment Directorate, Pacific Northwest National Laboratory

Subject: Analytical Data Report of Samples Collected for the analysis of M-24 wells C8922 and C8923, Sample delivery group (SDG) ESL140001, SAF number F14-036.

This letter contains the following information for sample delivery group ESL140001

- Cover Sheet
- Narrative
- Analytical Results
- Quality Control
- Geologic Logs
- Geologic Photos

Introduction

On December 3, 2014 samples were received from the M-24 wells for geochemical analyses.

Analytical Results/Methodology

The analyses for this project were performed at the 331 building located in the 300 Area of the Hanford Site. The analyses were performed according to Pacific Northwest National Laboratory (PNNL) approved procedures and/or nationally recognized test procedures. The data sets include the sample identification numbers, analytical results, estimated quantification limits (EQL), and quality control data.

Quality Control

The preparatory and analytical quality control requirements, calibration requirements, acceptance criteria, and failure actions are defined in the on-line QA plan "Conducting Analytical Work in Support of Regulatory Programs" (CAWSRP). This QA plan implements the Hanford Analytical Services Quality Assurance Requirements Documents (HASQARD) for PNNL.

Definitions

Dup	Duplicate
RPD	Relative Percent Difference
NR	No Recovery (percent recovery less than zero)
ND	Non-Detectable
%REC	Percent Recovery
UFA	Ultracentrifuge

Sample Receipt

Samples were received with a chain of custody (COC) and were analyzed according to the sample identification numbers supplied by the client.

All samples were received with custody seals intact.

Analytical Results

All reported analytical results meet the requirements of the CAWSRP or client specified SOW unless otherwise noted.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor Battelle Memorial Institute, nor any of their employees, makes **any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights**. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or Battelle Memorial Institute. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

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The following analyses were performed on the following samples included in this report:

Metals 1:1 DI Water Extract by ICPMS
Alkalinity, Titrimetic (pH 4.5)
Anions By Ion Chromatography
Hexavalent Chromium by Colorimetric Determination
Iodine-129 1:1 DI Water Extract by ICPMS
Metals 1:1 Water Extract by ICPOES
Metals UFA by ICPMS
Metals UFA by ICPOES
Moisture Content
pH of Waters By Electrode
Tc_U 1:1 DI Water Extract by ICPMS
Tc_U UFA by ICPMS
Carbon-14 1:1 Water Extract by LSC
Tritium 1:1 Water Extract by LSC
Gross Alpha and Beta 1:1 Water Extract by LSC

SAMPLES ANALYZED IN THIS REPORT

Sample No.	Laboratory ID	Matrix	Date Collected	Date Received
B2YPH4	1412006-01	SOIL	11/24/14 13:52	12/3/14 12:20
B2YPH3	1412006-02	SOIL	11/24/14 13:52	12/3/14 12:20
B2YPH2	1412006-03	SOIL	11/24/14 13:52	12/3/14 12:20
B2YPH1	1412006-04	SOIL	11/24/14 13:52	12/3/14 12:20
B2YPH8	1412006-05	SOIL	11/24/14 15:25	12/3/14 12:20
B2YPH7	1412006-06	SOIL	11/24/14 15:25	12/3/14 12:20
B2YPH6	1412006-07	SOIL	11/24/14 15:25	12/3/14 12:20
B2YPH5	1412006-08	SOIL	11/24/14 15:25	12/3/14 12:20
B2YPJ2	1412006-09	SOIL	11/25/14 07:47	12/3/14 12:20
B2YPJ1	1412006-10	SOIL	11/25/14 07:47	12/3/14 12:20
B2YPJ0	1412006-11	SOIL	11/25/14 07:47	12/3/14 12:20
B2YPH9	1412006-12	SOIL	11/25/14 07:47	12/3/14 12:20
B2YPJ6	1412006-13	SOIL	11/25/14 08:50	12/3/14 12:20
B2YPJ5	1412006-14	SOIL	11/25/14 08:50	12/3/14 12:20
B2YPJ4	1412006-15	SOIL	11/25/14 08:50	12/3/14 12:20
B2YPJ3	1412006-16	SOIL	11/25/14 08:50	12/3/14 12:20
B2YPK0	1412006-17	SOIL	11/25/14 09:51	12/3/14 12:20
B2YPJ9	1412006-18	SOIL	11/25/14 09:51	12/3/14 12:20
B2YPJ8	1412006-19	SOIL	11/25/14 09:51	12/3/14 12:20
B2YPJ7	1412006-20	SOIL	11/25/14 09:51	12/3/14 12:20
B2YPK4	1412006-21	SOIL	11/25/14 10:39	12/3/14 12:20
B2YPK3	1412006-22	SOIL	11/25/14 10:39	12/3/14 12:20
B2YPK2	1412006-23	SOIL	11/25/14 10:39	12/3/14 12:20
B2YPK1	1412006-24	SOIL	11/25/14 10:39	12/3/14 12:20
B2YPK8	1412006-25	SOIL	11/25/14 11:33	12/3/14 12:20
B2YPK7	1412006-26	SOIL	11/25/14 11:33	12/3/14 12:20
B2YPK6	1412006-27	SOIL	11/25/14 11:33	12/3/14 12:20
B2YPK5	1412006-28	SOIL	11/25/14 11:33	12/3/14 12:20
B2YPL2	1412006-29	SOIL	11/25/14 12:54	12/3/14 12:20
B2YPL1	1412006-30	SOIL	11/25/14 12:54	12/3/14 12:20
B2YPL0	1412006-31	SOIL	11/25/14 12:54	12/3/14 12:20
B2YPK9	1412006-32	SOIL	11/25/14 12:54	12/3/14 12:20
B2XM90	1412006-33	SOIL	8/7/14 11:08	12/3/14 12:20
B2XM89	1412006-34	SOIL	8/7/14 11:08	12/3/14 12:20
B2XM88	1412006-35	SOIL	8/7/14 11:08	12/3/14 12:20
B2XM87	1412006-36	SOIL	8/7/14 11:08	12/3/14 12:20
B2XM94	1412006-37	SOIL	8/7/14 14:13	12/3/14 12:20
B2XM93	1412006-38	SOIL	8/7/14 14:13	12/3/14 12:20
B2XM92	1412006-39	SOIL	8/7/14 14:13	12/3/14 12:20
B2XM91	1412006-40	SOIL	8/7/14 14:13	12/3/14 12:20

Wet Chemistry/UFA

Alkalinity as CaCO3 (ug/mL) by Standard Methods 2320B

Lab ID	Client ID.	Results	EQL	Analyzed	Batch
1412006-31	B2YPL0	4.53E1	N/A	3/18/15	5C12004
1412006-35	B2XM88	1.44E2	N/A	3/18/15	5C12004
1412006-37	B2XM94	3.76E2	N/A	3/18/15	5C12004

Wet Chemistry/1:1 Water Extract

Alkalinity as CaCO3 (ug/g dry) by Standard Methods 2320B

Lab ID	Client ID.	Results	EQL	Analyzed	Batch
1412006-01	B2YPH4	4.29E1	2.43E1	3/18/15	5C12003
1412006-09	B2YPJ2	4.22E1	2.45E1	3/18/15	5C12003
1412006-13	B2YPJ6	4.65E1	2.46E1	3/18/15	5C12003

Wet Chemistry

Moisture Content (% by Weight) by PNNL-ESL-WC

Lab ID	Client ID.	Results	EQL	Analyzed	Batch
1412006-01	B2YPH4	3.75E0	N/A	2/18/15	5B12001
1412006-02	B2YPH3	2.87E0	N/A	2/18/15	5B12001
1412006-03	B2YPH2	3.18E0	N/A	2/18/15	5B12001
1412006-04	B2YPH1	2.85E0	N/A	2/18/15	5B12001
1412006-05	B2YPH8	3.17E0	N/A	2/18/15	5B12001
1412006-06	B2YPH7	4.33E0	N/A	2/18/15	5B12001
1412006-07	B2YPH6	3.30E0	N/A	2/18/15	5B12001
1412006-08	B2YPH5	3.19E0	N/A	2/18/15	5B12001
1412006-09	B2YPJ2	4.20E0	N/A	2/18/15	5B12001
1412006-10	B2YPJ1	3.81E0	N/A	2/18/15	5B12001
1412006-11	B2YPJ0	3.56E0	N/A	2/18/15	5B12001
1412006-12	B2YPH9	3.47E0	N/A	2/18/15	5B12001
1412006-13	B2YPJ6	4.39E0	N/A	2/18/15	5B12001
1412006-14	B2YPJ5	4.33E0	N/A	2/18/15	5B12001
1412006-15	B2YPJ4	4.12E0	N/A	2/18/15	5B12001
1412006-16	B2YPJ3	3.32E0	N/A	2/18/15	5B12001
1412006-17	B2YPK0	4.84E0	N/A	2/18/15	5B12001
1412006-18	B2YPJ9	4.15E0	N/A	2/18/15	5B12001
1412006-19	B2YPJ8	3.38E0	N/A	2/18/15	5B12001
1412006-20	B2YPJ7	3.55E0	N/A	2/18/15	5B12001
1412006-21	B2YPK4	4.28E0	N/A	2/18/15	5B12001
1412006-22	B2YPK3	3.71E0	N/A	2/18/15	5B12001
1412006-23	B2YPK2	3.85E0	N/A	2/18/15	5B12001
1412006-24	B2YPK1	3.31E0	N/A	2/18/15	5B12001
1412006-25	B2YPK8	4.12E0	N/A	2/18/15	5B12001
1412006-26	B2YPK7	3.97E0	N/A	2/18/15	5B12001
1412006-27	B2YPK6	3.68E0	N/A	2/18/15	5B12001
1412006-28	B2YPK5	4.00E0	N/A	2/18/15	5B12001
1412006-29	B2YPL2	1.78E1	N/A	2/18/15	5B12001
1412006-30	B2YPL1	1.96E1	N/A	2/18/15	5B12001
1412006-31	B2YPL0	2.55E1	N/A	2/18/15	5B12001
1412006-32	B2YPK9	2.58E1	N/A	2/18/15	5B12001
1412006-33	B2XM90	2.79E1	N/A	2/18/15	5B12001
1412006-34	B2XM89	2.76E1	N/A	2/18/15	5B12001
1412006-35	B2XM88	2.97E1	N/A	2/18/15	5B12001
1412006-36	B2XM87	2.99E1	N/A	2/18/15	5B12001
1412006-37	B2XM94	2.95E1	N/A	2/18/15	5B12001
1412006-38	B2XM93	2.62E1	N/A	2/18/15	5B12001
1412006-39	B2XM92	2.53E1	N/A	2/18/15	5B12001
1412006-40	B2XM91	2.56E1	N/A	2/18/15	5B12001

Wet Chemistry/UFA

pH (pH Units) by PNNL-ESL-pH

Lab ID	Client ID.	Results	EQL	Analyzed	Batch
1412006-31	B2YPL0	7.48E0	N/A	2/27/15	5C27002
1412006-35	B2XM88	7.78E0	N/A	2/27/15	5C27002
1412006-37	B2XM94	7.20E0	N/A	2/27/15	5C27002

Wet Chemistry/1:1 Water Extract

pH (pH Units) by AGG-pH-001

Lab ID	Client ID.	Results	EQL	Analyzed	Batch
1412006-01	B2YPH4	7.97E0	N/A	2/27/15	5C27001
1412006-09	B2YPJ2	7.66E0	N/A	2/27/15	5C27001
1412006-13	B2YPJ6	7.71E0	N/A	2/27/15	5C27001

Anions by Ion Chromatography/UFA

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
Client ID.	**B2YPL0**		**Lab ID:**	**1412006-31**			
16984-48-8	Fluoride	<2.00E1	ug/mL	2.00E1	3/05/15	5C09002	PNNL-ESL-IC
16887-00-6	Chloride	6.16E1	ug/mL	5.00E1	3/05/15	5C09002	PNNL-ESL-IC
14797-65-0	Nitrite	<1.00E2	ug/mL	1.00E2	3/05/15	5C09002	PNNL-ESL-IC
14797-55-8	Nitrate	3.25E2	ug/mL	1.00E2	3/05/15	5C09002	PNNL-ESL-IC
14808-79-8	Sulfate	2.12E3	ug/mL	1.50E2	3/05/15	5C09002	PNNL-ESL-IC
Client ID.	**B2XM88**		**Lab ID:**	**1412006-35**			
16984-48-8	Fluoride	<2.00E1	ug/mL	2.00E1	3/05/15	5C09002	PNNL-ESL-IC
16887-00-6	Chloride	8.77E1	ug/mL	5.00E1	3/05/15	5C09002	PNNL-ESL-IC
14797-65-0	Nitrite	<1.00E2	ug/mL	1.00E2	3/05/15	5C09002	PNNL-ESL-IC
14797-55-8	Nitrate	6.25E2	ug/mL	1.00E2	3/05/15	5C09002	PNNL-ESL-IC
14808-79-8	Sulfate	5.11E2	ug/mL	1.50E2	3/05/15	5C09002	PNNL-ESL-IC
Client ID.	**B2XM94**		**Lab ID:**	**1412006-37**			
16984-48-8	Fluoride	<2.00E1	ug/mL	2.00E1	3/05/15	5C09002	PNNL-ESL-IC
16887-00-6	Chloride	8.76E1	ug/mL	5.00E1	3/05/15	5C09002	PNNL-ESL-IC
14797-65-0	Nitrite	<1.00E2	ug/mL	1.00E2	3/05/15	5C09002	PNNL-ESL-IC
14797-55-8	Nitrate	1.68E3	ug/mL	1.00E2	3/05/15	5C09002	PNNL-ESL-IC
14808-79-8	Sulfate	1.11E3	ug/mL	1.50E2	3/05/15	5C09002	PNNL-ESL-IC

Anions by Ion Chromatography/1:1 Water Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
Client ID.	**B2YPH4**		**Lab ID:**	**1412006-01**			
16984-48-8	Fluoride	4.71E-1	ug/g dry	1.03E-1	3/07/15	5C09001	PNNL-ESL-IC
16887-00-6	Chloride	3.51E0	ug/g dry	2.58E-1	3/07/15	5C09001	PNNL-ESL-IC
14797-65-0	Nitrite	<5.16E-1	ug/g dry	5.16E-1	3/07/15	5C09001	PNNL-ESL-IC
14797-55-8	Nitrate	4.44E0	ug/g dry	5.16E-1	3/07/15	5C09001	PNNL-ESL-IC
14808-79-8	Sulfate	7.05E1	ug/g dry	7.74E-1	3/07/15	5C09001	PNNL-ESL-IC
Client ID.	**B2YPJ2**		**Lab ID:**	**1412006-09**			
16984-48-8	Fluoride	3.40E-1	ug/g dry	1.04E-1	3/09/15	5C09001	PNNL-ESL-IC
16887-00-6	Chloride	3.02E0	ug/g dry	2.60E-1	3/09/15	5C09001	PNNL-ESL-IC
14797-65-0	Nitrite	<5.20E-1	ug/g dry	5.20E-1	3/09/15	5C09001	PNNL-ESL-IC
14797-55-8	Nitrate	7.92E0	ug/g dry	5.20E-1	3/09/15	5C09001	PNNL-ESL-IC
14808-79-8	Sulfate	9.57E1	ug/g dry	7.81E-1	3/09/15	5C09001	PNNL-ESL-IC
Client ID.	**B2YPJ6**		**Lab ID:**	**1412006-13**			
16984-48-8	Fluoride	3.59E-1	ug/g dry	1.04E-1	3/09/15	5C09001	PNNL-ESL-IC
16887-00-6	Chloride	2.64E0	ug/g dry	2.61E-1	3/09/15	5C09001	PNNL-ESL-IC
14797-65-0	Nitrite	<5.22E-1	ug/g dry	5.22E-1	3/09/15	5C09001	PNNL-ESL-IC
14797-55-8	Nitrate	7.13E0	ug/g dry	5.22E-1	3/09/15	5C09001	PNNL-ESL-IC
14808-79-8	Sulfate	8.98E1	ug/g dry	7.84E-1	3/09/15	5C09001	PNNL-ESL-IC

Hexavalent Chromium/1:1 Water Extract

Chromium, Hexavalent (ug/g dry) by Colorimetric Determination

Lab ID	Client ID.	Results	EQL	Analyzed	Batch
1412006-01	B2YPH4	<5.16E-2	5.16E-2	3/12/15	5C16002
1412006-09	B2YPJ2	<5.20E-2	5.20E-2	3/12/15	5C16002
1412006-13	B2YPJ6	<5.22E-2	5.22E-2	3/12/15	5C16002

Hexavalent Chromium/UFA

Chromium, Hexavalent (ug/mL) by PNNL-ESL-IC

Lab ID	Client ID.	Results	EQL	Analyzed	Batch
1412006-31	B2YPL0	<5.00E-2	5.00E-2	3/12/15	5C16003
1412006-35	B2XM88	<5.00E-2	5.00E-2	3/12/15	5C16003
1412006-37	B2XM94	<5.00E-2	5.00E-2	3/12/15	5C16003

Total Metals by PNNL-ESL-ICP-OES/1:1 Water Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
Client ID.	**B2YPH4**		**Lab ID:**	**1412006-01**			
7440-70-2	Calcium	1.79E1	ug/g dry	1.56E0	3/06/15	5C05007	PNNL-ESL-ICP-OES
7440-48-4	Cobalt	<4.50E-1	ug/g dry	4.50E-1	3/06/15	5C05007	PNNL-ESL-ICP-OES
7439-89-6	Iron	<3.61E-1	ug/g dry	3.61E-1	3/06/15	5C05007	PNNL-ESL-ICP-OES
7440-09-7	Potassium	5.99E0	ug/g dry	4.44E0	3/06/15	5C05007	PNNL-ESL-ICP-OES
7439-95-4	Magnesium	4.72E0	ug/g dry	1.68E-1	3/06/15	5C05007	PNNL-ESL-ICP-OES
7440-02-0	Nickel	<3.33E-1	ug/g dry	3.33E-1	3/06/15	5C05007	PNNL-ESL-ICP-OES
7782-49-2	Selenium	<4.13E0	ug/g dry	4.13E0	3/06/15	5C05007	PNNL-ESL-ICP-OES
7440-23-5	Sodium	1.75E1	ug/g dry	2.74E0	3/06/15	5C05007	PNNL-ESL-ICP-OES
Client ID.	**B2YPJ2**		**Lab ID:**	**1412006-09**			
7440-70-2	Calcium	2.54E1	ug/g dry	1.57E0	3/06/15	5C05007	PNNL-ESL-ICP-OES
7440-48-4	Cobalt	<4.54E-1	ug/g dry	4.54E-1	3/06/15	5C05007	PNNL-ESL-ICP-OES
7439-89-6	Iron	<3.64E-1	ug/g dry	3.64E-1	3/06/15	5C05007	PNNL-ESL-ICP-OES
7440-09-7	Potassium	4.92E0	ug/g dry	4.48E0	3/06/15	5C05007	PNNL-ESL-ICP-OES
7439-95-4	Magnesium	6.01E0	ug/g dry	1.70E-1	3/06/15	5C05007	PNNL-ESL-ICP-OES
7440-02-0	Nickel	<3.36E-1	ug/g dry	3.36E-1	3/06/15	5C05007	PNNL-ESL-ICP-OES
7782-49-2	Selenium	<4.17E0	ug/g dry	4.17E0	3/06/15	5C05007	PNNL-ESL-ICP-OES
7440-23-5	Sodium	1.99E1	ug/g dry	2.77E0	3/06/15	5C05007	PNNL-ESL-ICP-OES
Client ID.	**B2YPJ6**		**Lab ID:**	**1412006-13**			
7440-70-2	Calcium	2.39E1	ug/g dry	1.58E0	3/06/15	5C05007	PNNL-ESL-ICP-OES
7440-48-4	Cobalt	<4.56E-1	ug/g dry	4.56E-1	3/06/15	5C05007	PNNL-ESL-ICP-OES
7439-89-6	Iron	<3.65E-1	ug/g dry	3.65E-1	3/06/15	5C05007	PNNL-ESL-ICP-OES
7440-09-7	Potassium	4.53E0	ug/g dry	4.50E0	3/06/15	5C05007	PNNL-ESL-ICP-OES
7439-95-4	Magnesium	5.40E0	ug/g dry	1.70E-1	3/06/15	5C05007	PNNL-ESL-ICP-OES
7440-02-0	Nickel	<3.37E-1	ug/g dry	3.37E-1	3/06/15	5C05007	PNNL-ESL-ICP-OES
7782-49-2	Selenium	<4.18E0	ug/g dry	4.18E0	3/06/15	5C05007	PNNL-ESL-ICP-OES
7440-23-5	Sodium	1.97E1	ug/g dry	2.78E0	3/06/15	5C05007	PNNL-ESL-ICP-OES

Total Metals by PNNL-ESL-ICP-OES/UFA

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
Client ID.	**B2YPL0**		**Lab ID:**	**1412006-31**			
7440-70-2	Calcium	6.35E5	ug/L	4.90E2	3/06/15	5C06001	PNNL-ESL-ICP-OES
7440-48-4	Cobalt	<1.83E2	ug/L	1.83E2	3/06/15	5C06001	PNNL-ESL-ICP-OES
7439-89-6	Iron	7.89E1	ug/L	4.90E1	3/06/15	5C06001	PNNL-ESL-ICP-OES
7440-09-7	Potassium	1.83E4	ug/L	2.96E3	3/06/15	5C06001	PNNL-ESL-ICP-OES
7439-95-4	Magnesium	1.56E5	ug/L	3.43E1	3/06/15	5C06001	PNNL-ESL-ICP-OES
7440-02-0	Nickel	<2.27E2	ug/L	2.27E2	3/06/15	5C06001	PNNL-ESL-ICP-OES
7440-23-5	Sodium	1.66E5	ug/L	4.47E2	3/06/15	5C06001	PNNL-ESL-ICP-OES
Client ID.	**B2XM88**		**Lab ID:**	**1412006-35**			
7440-70-2	Calcium	1.37E5	ug/L	4.90E2	3/06/15	5C06001	PNNL-ESL-ICP-OES
7440-48-4	Cobalt	<1.83E2	ug/L	1.83E2	3/06/15	5C06001	PNNL-ESL-ICP-OES
7439-89-6	Iron	<4.90E1	ug/L	4.90E1	3/06/15	5C06001	PNNL-ESL-ICP-OES
7440-09-7	Potassium	1.69E4	ug/L	2.96E3	3/06/15	5C06001	PNNL-ESL-ICP-OES
7439-95-4	Magnesium	4.90E4	ug/L	3.43E1	3/06/15	5C06001	PNNL-ESL-ICP-OES
7440-02-0	Nickel	<2.27E2	ug/L	2.27E2	3/06/15	5C06001	PNNL-ESL-ICP-OES
7440-23-5	Sodium	3.29E5	ug/L	4.47E2	3/06/15	5C06001	PNNL-ESL-ICP-OES
Client ID.	**B2XM94**		**Lab ID:**	**1412006-37**			
7440-70-2	Calcium	4.44E5	ug/L	4.90E2	3/06/15	5C06001	PNNL-ESL-ICP-OES
7440-48-4	Cobalt	<1.83E2	ug/L	1.83E2	3/06/15	5C06001	PNNL-ESL-ICP-OES
7439-89-6	Iron	<4.90E1	ug/L	4.90E1	3/06/15	5C06001	PNNL-ESL-ICP-OES
7440-09-7	Potassium	2.86E4	ug/L	2.96E3	3/06/15	5C06001	PNNL-ESL-ICP-OES
7439-95-4	Magnesium	1.35E5	ug/L	3.43E1	3/06/15	5C06001	PNNL-ESL-ICP-OES
7440-02-0	Nickel	<2.27E2	ug/L	2.27E2	3/06/15	5C06001	PNNL-ESL-ICP-OES
7440-23-5	Sodium	5.40E5	ug/L	4.47E2	3/06/15	5C06001	PNNL-ESL-ICP-OES

Radionuclides by ICP-MS/1:1 Water Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
Client ID.	**B2YPH4**		**Lab ID:**	**1412006-01**			
15046-84-1	Iodine-129	<8.04E-3	ug/g dry	8.04E-3	4/08/15	5D08006	PNNL-ESL-ICPMS
Client ID.	**B2YPJ2**		**Lab ID:**	**1412006-09**			
15046-84-1	Iodine-129	<8.11E-3	ug/g dry	8.11E-3	4/08/15	5D08006	PNNL-ESL-ICPMS
Client ID.	**B2YPJ6**		**Lab ID:**	**1412006-13**			
15046-84-1	Iodine-129	<8.14E-3	ug/g dry	8.14E-3	4/08/15	5D08006	PNNL-ESL-ICPMS
Client ID.	**B2YPL0**		**Lab ID:**	**1412006-31**			
15046-84-1	Iodine-129	<1.18E-2	ug/g dry	1.18E-2	4/08/15	5D08007	PNNL-ESL-ICPMS
Client ID.	**B2XM88**		**Lab ID:**	**1412006-35**			
15046-84-1	Iodine-129	<1.24E-2	ug/g dry	1.24E-2	4/08/15	5D08007	PNNL-ESL-ICPMS
Client ID.	**B2XM94**		**Lab ID:**	**1412006-37**			
15046-84-1	Iodine-129	<1.24E-2	ug/g dry	1.24E-2	4/08/15	5D08007	PNNL-ESL-ICPMS

Radionuclides by ICP-MS/1:1 Water Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
Client ID.	**B2YPH4**		**Lab ID:**	**1412006-01**			
14133-76-7	Technetium-99	<4.03E-5	ug/g dry	4.03E-5	3/06/15	5C05004	PNNL-ESL-ICPMS
U-238	Uranium 238	3.49E-4	ug/g dry	8.26E-5	3/06/15	5C05004	PNNL-ESL-ICPMS
Client ID.	**B2YPJ2**		**Lab ID:**	**1412006-09**			
14133-76-7	Technetium-99	<4.06E-5	ug/g dry	4.06E-5	3/06/15	5C05004	PNNL-ESL-ICPMS
U-238	Uranium 238	3.31E-4	ug/g dry	8.33E-5	3/06/15	5C05004	PNNL-ESL-ICPMS
Client ID.	**B2YPJ6**		**Lab ID:**	**1412006-13**			
14133-76-7	Technetium-99	<4.07E-5	ug/g dry	4.07E-5	3/06/15	5C05004	PNNL-ESL-ICPMS
U-238	Uranium 238	3.55E-4	ug/g dry	8.36E-5	3/06/15	5C05004	PNNL-ESL-ICPMS

Radionuclides By ICP-MS/UFA

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
Client ID.	**B2YPL0**		**Lab ID:**	**1412006-31**			
14133-76-7	Technetium-99	<4.10E-1	ug/L	4.10E-1	3/06/15	5C05005	PNNL-ESL-ICPMS
U-238	Uranium 238	3.77E1	ug/L	1.06E0	3/06/15	5C05005	PNNL-ESL-ICPMS
Client ID.	**B2XM88**		**Lab ID:**	**1412006-35**			
14133-76-7	Technetium-99	<4.10E1	ug/L	4.10E1	3/06/15	5C05005	PNNL-ESL-ICPMS
U-238	Uranium 238	3.47E4	ug/L	1.06E2	3/06/15	5C05005	PNNL-ESL-ICPMS
Client ID.	**B2XM94**		**Lab ID:**	**1412006-37**			
14133-76-7	Technetium-99	<4.10E2	ug/L	4.10E2	3/06/15	5C05005	PNNL-ESL-ICPMS
U-238	Uranium 238	2.36E5	ug/L	1.06E3	3/06/15	5C05005	PNNL-ESL-ICPMS

RCRA Metals By PNNL-ESL-ICPMS/1:1 Water Extract

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
Client ID.	**B2YPH4**		**Lab ID:**	**1412006-01**			
14092-98-9	Chromium	<7.11E-3	ug/g dry	7.11E-3	3/12/15	5C12001	PNNL-ESL-ICPMS
7440-38-2	Arsenic	<5.85E-3	ug/g dry	5.85E-3	3/12/15	5C12001	PNNL-ESL-ICPMS
14378-37-1	Silver	<6.46E-3	ug/g dry	6.46E-3	3/12/15	5C12001	PNNL-ESL-ICPMS
14336-64-2	Cadmium	<1.18E-3	ug/g dry	1.18E-3	3/12/15	5C12001	PNNL-ESL-ICPMS
15010-01-2	Barium	8.12E-3	ug/g dry	3.78E-4	3/12/15	5C12001	PNNL-ESL-ICPMS
15756-10-2	Mercury	<1.35E-3	ug/g dry	1.35E-3	3/12/15	5C12001	PNNL-ESL-ICPMS
Client ID.	**B2YPJ2**		**Lab ID:**	**1412006-09**			
14092-98-9	Chromium	<7.17E-3	ug/g dry	7.17E-3	3/12/15	5C12001	PNNL-ESL-ICPMS
7440-38-2	Arsenic	<5.90E-3	ug/g dry	5.90E-3	3/12/15	5C12001	PNNL-ESL-ICPMS
14378-37-1	Silver	<6.51E-3	ug/g dry	6.51E-3	3/12/15	5C12001	PNNL-ESL-ICPMS
14336-64-2	Cadmium	<1.19E-3	ug/g dry	1.19E-3	3/12/15	5C12001	PNNL-ESL-ICPMS
15010-01-2	Barium	6.07E-3	ug/g dry	3.81E-4	3/12/15	5C12001	PNNL-ESL-ICPMS
15756-10-2	Mercury	<1.36E-3	ug/g dry	1.36E-3	3/12/15	5C12001	PNNL-ESL-ICPMS
Client ID.	**B2YPJ6**		**Lab ID:**	**1412006-13**			
14092-98-9	Chromium	<7.20E-3	ug/g dry	7.20E-3	3/12/15	5C12001	PNNL-ESL-ICPMS
7440-38-2	Arsenic	<5.93E-3	ug/g dry	5.93E-3	3/12/15	5C12001	PNNL-ESL-ICPMS
14378-37-1	Silver	<6.53E-3	ug/g dry	6.53E-3	3/12/15	5C12001	PNNL-ESL-ICPMS
14336-64-2	Cadmium	<1.20E-3	ug/g dry	1.20E-3	3/12/15	5C12001	PNNL-ESL-ICPMS
15010-01-2	Barium	9.54E-3	ug/g dry	3.82E-4	3/12/15	5C12001	PNNL-ESL-ICPMS
15756-10-2	Mercury	<1.37E-3	ug/g dry	1.37E-3	3/12/15	5C12001	PNNL-ESL-ICPMS

RCRA Metals By PNNL-ESL-ICPMS/UFA

CAS #	Analyte	Results	Units	EQL	Analyzed	Batch	Method
Client ID.	**B2YPL0**		**Lab ID:**	**1412006-31**			
14092-98-9	Chromium	<1.92E0	ug/L	1.92E0	3/12/15	5C12002	PNNL-ESL-ICPMS
7440-38-2	Arsenic	<4.68E0	ug/L	4.68E0	3/12/15	5C12002	PNNL-ESL-ICPMS
14687-58-2	Selenium	1.87E2	ug/L	1.36E1	3/12/15	5C12002	PNNL-ESL-ICPMS
14378-37-1	Silver	<4.16E-1	ug/L	4.16E-1	3/12/15	5C12002	PNNL-ESL-ICPMS
14336-64-2	Cadmium	<1.01E0	ug/L	1.01E0	3/12/15	5C12002	PNNL-ESL-ICPMS
13981-97-0	Barium	2.70E1	ug/L	6.24E-1	3/30/15	5C12002	PNNL-ESL-ICPMS
14191-87-8	Mercury	<7.83E-1	ug/L	7.83E-1	3/30/15	5C12002	PNNL-ESL-ICPMS
Client ID.	**B2XM88**		**Lab ID:**	**1412006-35**			
14092-98-9	Chromium	<1.92E0	ug/L	1.92E0	3/12/15	5C12002	PNNL-ESL-ICPMS
7440-38-2	Arsenic	<4.68E0	ug/L	4.68E0	3/12/15	5C12002	PNNL-ESL-ICPMS
14687-58-2	Selenium	1.61E1	ug/L	1.36E1	3/12/15	5C12002	PNNL-ESL-ICPMS
14378-37-1	Silver	<4.16E-1	ug/L	4.16E-1	3/12/15	5C12002	PNNL-ESL-ICPMS
14336-64-2	Cadmium	<1.01E0	ug/L	1.01E0	3/12/15	5C12002	PNNL-ESL-ICPMS
13981-97-0	Barium	2.01E0	ug/L	6.24E-2	3/31/15	5C12002	PNNL-ESL-ICPMS
14191-87-8	Mercury	<7.83E-2	ug/L	7.83E-2	3/31/15	5C12002	PNNL-ESL-ICPMS
Client ID.	**B2XM94**		**Lab ID:**	**1412006-37**			
14092-98-9	Chromium	<1.92E0	ug/L	1.92E0	3/12/15	5C12002	PNNL-ESL-ICPMS
7440-38-2	Arsenic	<4.68E0	ug/L	4.68E0	3/12/15	5C12002	PNNL-ESL-ICPMS
14687-58-2	Selenium	3.43E1	ug/L	1.36E1	3/12/15	5C12002	PNNL-ESL-ICPMS
14378-37-1	Silver	<4.16E-1	ug/L	4.16E-1	3/12/15	5C12002	PNNL-ESL-ICPMS
14336-64-2	Cadmium	<1.01E0	ug/L	1.01E0	3/12/15	5C12002	PNNL-ESL-ICPMS
13981-97-0	Barium	2.42E0	ug/L	6.24E-2	3/31/15	5C12002	PNNL-ESL-ICPMS
14191-87-8	Mercury	<7.83E-2	ug/L	7.83E-2	3/31/15	5C12002	PNNL-ESL-ICPMS

Tritium/Water Extract

Client ID	Lab ID	Results	Units	MDA	Analyzed	Method
B2YPH4	1412006-01	<4.25E+00	pCi/g dry	4.25E+00	3/24/2015	AGG-RRL-002
B2YPJ2	1412006-09	<4.91E+00	pCi/g dry	4.91E+00	3/24/2015	AGG-RRL-002
B2YPJ6	1412006-13	<5.20E+00	pCi/g dry	5.20E+00	3/24/2015	AGG-RRL-002

Carbon-14/Water Extract

Client ID	Lab ID	Results	Units	MDA	Analyzed	Method
B2YPH4	1412006-01	<8.73E-01	pCi/g dry	8.73E-01	3/21/2015	AGG-RRL-002
B2YPJ2	1412006-09	<4.33E-01	pCi/g dry	4.33E-01	3/21/2015	AGG-RRL-002
B2YPJ6	1412006-13	<8.62E-01	pCi/g dry	8.62E-01	3/21/2015	AGG-RRL-002

Carbon-14/Water Extract

Client ID	Lab ID	Results	Units	Analyzed	Method
B2YPH4	1412006-01	ND	pCi/g dry	3/27/2015	AGG-RRL-002
B2YPJ2	1412006-09	ND	pCi/g dry	3/27/2015	AGG-RRL-002
B2YPJ6	1412006-13	ND	pCi/g dry	3/27/2015	AGG-RRL-002

Wet Chemistry - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5C12003 - 1:1 Water Extract (pH_EC_Alk)										
Blank (5C12003-BLK1)				Prepared: 02/27/15 Analyzed: 03/18/15						
Alkalinity as CaCO3	<2.35E1	2.35E1	ug/g wet							
Duplicate (5C12003-DUP1)		**Source: 1412006-01**		Prepared: 02/27/15 Analyzed: 03/18/15						
Alkalinity as CaCO3	4.21E1	2.43E1	ug/g dry		4.29E1			1.79	35	
Batch 5C27001 - 1:1 Water Extract (pH_EC_Alk)										
Blank (5C27001-BLK1)				Prepared & Analyzed: 02/27/15						
pH	6.22E0	N/A	pH Units							
Duplicate (5C27001-DUP1)		**Source: 1412006-01**		Prepared & Analyzed 03/06/15						
pH	7.98E0	N/A	pH Units		7.97E0			0.125	35	

Anions by Ion Chromatography - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5C09001 - 1:1 Water Extract (IC)										
Blank (5C09001-BLK1)				Prepared & Analyzed: 03/05/15						
Fluoride	<1.00E-1	1.00E-1	ug/g wet							
Chloride	<2.50E-1	2.50E-1	"							
Nitrite	<5.00E-1	5.00E-1	"							
Nitrate	<5.00E-1	5.00E-1	"							
Sulfate	<7.50E-1	7.50E-1	"							
LCS (5C09001-BS1)				Prepared & Analyzed: 03/05/15						
Fluoride	1.96E0	1.00E-1	ug/g wet	2.00E0		98.0	80-120			
Chloride	5.02E0	2.50E-1	"	5.00E0		100	80-120			
Nitrite	1.00E1	5.00E-1	"	1.00E1		100	80-120			
Nitrate	9.96E0	5.00E-1	"	1.00E1		99.6	80-120			
Sulfate	1.50E1	7.50E-1	"	1.50E1		99.9	80-120			
Duplicate (5C09001-DUP1)		**Source: 1412006-01**		Prepared: 03/05/15 Analyzed: 03/07/15						
Fluoride	3.62E-1	1.03E-1	ug/g dry		4.71E-1			26.0	35	
Chloride	3.50E0	2.58E-1	"		3.51E0			0.0285	35	
Nitrite	<5.16E-1	5.16E-1	"		ND				35	
Nitrate	4.31E0	5.16E-1	"		4.44E0			3.08	35	
Sulfate	7.03E1	7.74E-1	"		7.05E1			0.279	35	
Post Spike (5C09001-PS1)		**Source: 1412006-13**		Prepared: 03/05/15 Analyzed: 03/07/15						
Fluoride	1.14E0	N/A	ug/mL	7.69E-1	3.44E-1	103	75-125			
Chloride	4.36E0	N/A	"	1.92E0	2.53E0	95.2	75-125			
Nitrite	3.73E0	N/A	"	3.85E0	ND	96.9	75-125			
Nitrate	9.86E0	N/A	"	3.85E0	6.83E0	78.9	75-125			
Sulfate	8.88E1	N/A	"	5.77E0	8.59E1	49.3	75-125			

Post-Spike Recovery for Sulfate (49.3%) was outside acceptable limits (75-125) in 5C09001-PS1 for Anions by IC-WE. The native sample concentration was greater than 5 time the spike concentration. There should be no impact to data as reported.

Hexavalent Chromium/1:1 Water Extract - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5C16002 - 1:1 Water Extract (Cr6)										
Blank (5C16002-BLK1)				Prepared & Analyzed: 03/12/15						
Chromium, Hexavalent	<5.00E-2	5.00E-2	ug/g wet							
LCS (5C16002-BS1)				Prepared & Analyzed: 03/12/15						
Chromium, Hexavalent	4.98E-1	5.00E-2	ug/g wet	5.00E-1		99.6	70-130			
Duplicate (5C16002-DUP1)		**Source: 1412006-01**		Prepared & Analyzed: 03/12/15						
Chromium, Hexavalent	<5.16E-2	5.16E-2	ug/g dry		ND				35	

Hexavalent Chromium/Water - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5C16003 - UFA (Cr6)										
Matrix Spike (5C16003-MS1)		**Source: 1412006-37**		Prepared & Analyzed: 03/12/15						
Chromium, Hexavalent	4.98E-1	N/A	ug/mL	5.00E-1	ND	99.6	75-125			

Total Metals by PNNL-ESL-ICP-OES/1:1 Water Extract - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5C05007 - 1:1 Water Extract (ICP/ICPMS)										
Blank (5C05007-BLK1)				Prepared: 03/05/15	Analyzed: 03/06/15					
Calcium	<1.51E0	1.51E0	ug/g wet							
Cobalt	<4.36E-1	4.36E-1	"							
Iron	<3.50E-1	3.50E-1	"							
Potassium	<4.30E0	4.30E0	"							
Magnesium	<1.63E-1	1.63E-1	"							
Nickel	<3.22E-1	3.22E-1	"							
Selenium	<4.00E0	4.00E0	"							
Sodium	<2.66E0	2.66E0	"							
LCS (5C05007-BS1)				Prepared: 03/05/15	Analyzed: 03/06/15					
Calcium	4.82E0	1.51E0	ug/g wet	5.00E0		96.5	80-120			
Cobalt	5.04E0	4.36E-1	"	5.00E0		101	80-120			
Iron	4.96E0	3.50E-1	"	5.00E0		99.2	80-120			
Potassium	4.76E1	4.30E0	"	5.00E1		95.2	80-120			
Magnesium	4.80E0	1.63E-1	"	5.00E0		96.0	80-120			
Nickel	5.07E0	3.22E-1	"	5.00E0		101	80-120			
Selenium	5.03E0	4.00E0	"	5.00E0		101	80-120			
Sodium	4.93E0	2.66E0	"	5.00E0		98.7	80-120			
Post Spike (5C05007-PS1)		**Source: 1412006-13**		Prepared: 03/05/15	Analyzed: 03/06/15					
Calcium	2.82E3	N/A	ug/L	5.00E2	2.29E3	106	75-125			
Cobalt	2.53E2	N/A	"	2.50E2	ND	102	75-125			
Iron	5.04E2	N/A	"	5.00E2	4.42E0	100	75-125			
Potassium	1.72E3	N/A	"	1.25E3	4.33E2	103	75-125			
Magnesium	1.01E3	N/A	"	5.00E2	5.17E2	98.2	75-125			
Nickel	5.18E2	N/A	"	5.00E2	ND	105	75-125			
Selenium	5.24E2	N/A	"	5.00E2	3.17E1	98.4	75-125			
Sodium	2.51E3	N/A	"	5.00E2	1.88E3	124	75-125			

Total Metals by PNNL-ESL-ICP-OES - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5C06001 - Special Extract (ICP/ICPMS)										
Blank (5C06001-BLK1)				Prepared & Analyzed: 03/06/15						
Calcium	<4.90E2	4.90E2	ug/L							
Cobalt	<1.83E2	1.83E2	"							
Iron	<4.90E1	4.90E1	"							
Potassium	<2.96E3	2.96E3	"							
Magnesium	<3.43E1	3.43E1	"							
Nickel	<2.27E2	2.27E2	"							
Sodium	<4.47E2	4.47E2	"							
Post Spike (5C06001-PS1)		**Source: 1412006-37**		Prepared & Analyzed: 03/06/15						
Calcium	4.64E4	N/A	ug/L	5.00E2	4.44E4	390	75-125			
Cobalt	2.56E2	N/A	"	2.50E2	2.97E0	101	75-125			
Iron	4.88E2	N/A	"	5.00E2	ND	98.9	75-125			
Potassium	4.29E3	N/A	"	1.25E3	2.86E3	114	75-125			
Magnesium	1.45E4	N/A	"	5.00E2	1.35E4	215	75-125			
Nickel	5.20E2	N/A	"	5.00E2	1.35E0	104	75-125			
Sodium	5.62E4	N/A	"	5.00E2	5.40E4	433	75-125			

Post-Spike Recovery for Calcium (390%) was outside acceptable limits (75-125) in 5C06001-PS1 for ICP-OES Vadose-UFA. The native sample concentration was greater than 5 time the spike concentration. There should be no impact to data as reported.

Post-Spike Recovery for Magnesium (215%) was outside acceptable limits (75-125) in 5C06001-PS1 for ICP-OES Vadose-UFA. The native sample concentration was greater than 5 time the spike concentration. There should be no impact to data as reported.

Post-Spike Recovery for Sodium (433%) was outside acceptable limits (75-125) in 5C06001-PS1 for ICP-OES Vadose-UFA. The native sample concentration was greater than 5 time the spike concentration. There should be no impact to data as reported.

Radionuclides by ICP-MS/1:1 Water Extract - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5C05004 - 1:1 Water Extract (ICP/ICPMS)										
Blank (5C05004-BLK1)				Prepared: 02/27/15 Analyzed: 03/06/15						
Technetium-99	<3.90E-5	3.90E-5	ug/g wet							
Uranium 238	<8.00E-5	8.00E-5	"							
Post Spike (5C05004-PS1)		**Source: 1412006-13**		Prepared: 03/05/15 Analyzed: 03/06/15						
Uranium 238	1.11E0	N/A	ug/L	1.00E0	6.79E-2	104	75-125			
Batch 5D08006 - 1:1 Water Extract (ICP/ICPMS)										
Blank (5D08006-BLK1)				Prepared: 02/27/15 Analyzed: 04/08/15						
Iodine-129	<7.44E-3	7.44E-3	ug/g wet							
Post Spike (5D08006-PS1)		**Source: 1412006-13**		Prepared & Analyzed: 04/08/15						
Iodine-129	9.26E-1	N/A	ug/L	1.00E0	3.90E-1	53.6	75-125			
Batch 5D08007 - 1:1 Water Extract (ICP/ICPMS)										
Post Spike (5D08007-PS1)		**Source: 1412006-31**		Prepared & Analyzed: 04/08/15						
Iodine-129	-1.71E-1	N/A	ug/L	1.00E0	ND	11.5	75-125			

Post-Spike Recovery for Iodine-129 (53.6 and 11.5%) were outside acceptable limits (75-125) in 5D08006-PS1 and 5D08007-PS1 for ICP-MS I-129-WE. The native sample concentrations were ND, and all other QC were within acceptable limits. There should be no impact to data as reported.

Radionuclides By ICP-MS - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5C05005 - Special Extract (ICP/ICPMS)										
Post Spike (5C05005-PS1)		**Source: 1412006-31**		Prepared: 03/05/15 Analyzed: 03/06/15						
Technetium-99	1.09E0	N/A	ug/L	1.01E0	ND	108	75-125			
Uranium 238	1.41E0	N/A	"	1.00E0	3.77E-1	104	75-125			

RCRA Metals By PNNL-ESL-ICPMS/1:1 Water Extract - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5C12001 - 1:1 Water Extract (ICP/ICPMS)										
Blank (5C12001-BLK1)				Prepared & Analyzed: 03/12/15						
Chromium	<6.89E-3	6.89E-3	ug/g wet							
Arsenic	<5.67E-3	5.67E-3	"							
Silver	<6.26E-3	6.26E-3	"							
Cadmium	<1.15E-3	1.15E-3	"							
Barium	<3.66E-4	3.66E-4	"							
Mercury	<1.31E-3	1.31E-3	"							
LCS (5C12001-BS1)				Prepared & Analyzed: 03/12/15						
Chromium	4.90E0	1.38E0	ug/g wet	5.00E0		98.0	80-120			
Arsenic	4.43E0	1.13E0	"	5.00E0		88.6	80-120			
Silver	4.84E0	1.25E0	"	5.00E0		96.8	80-120			
Cadmium	4.69E0	2.29E-1	"	5.00E0		93.7	80-120			
Barium	4.90E0	7.32E-2	"	5.00E0		97.9	80-120			
Duplicate (5C12001-DUP1)		**Source: 1412006-01**		Prepared & Analyzed: 03/12/15						
Chromium	<7.11E-3	7.11E-3	ug/g dry		ND				35	
Arsenic	<5.86E-3	5.86E-3	"		ND				35	
Silver	<6.46E-3	6.46E-3	"		ND				35	
Cadmium	<1.18E-3	1.18E-3	"		ND				35	
Barium	7.17E-3	3.78E-4	"		8.12E-3			12.5	35	
Mercury	<1.35E-3	1.35E-3	"		ND				35	
Post Spike (5C12001-PS1)		**Source: 1412006-01**		Prepared & Analyzed: 03/12/15						
Chromium	2.49E0	N/A	ug/L	2.50E0	1.50E-2	99	75-125			
Arsenic	2.87E0	N/A	"	2.50E0	3.83E-1	99.4	75-125			
Silver	2.45E0	N/A	"	2.50E0	ND	98.2	75-125			
Cadmium	2.58E0	N/A	"	2.50E0	ND	104	75-125			
Barium	3.26E0	N/A	"	2.50E0	7.87E-1	99	75-125			
Mercury	2.38E0	N/A	"	2.50E0	1.00E-3	95.3	75-125			

RCRA Metals By PNNL-ESL-ICPMS - Quality Control
Environmental Science Laboratory

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5C12002 - Special Extract (ICP/ICPMS)										
Post Spike (5C12002-PS1)		**Source: 1412006-31**		Prepared & Analyzed: 03/12/15						
Chromium	2.45E0	N/A	ug/L	2.50E0	7.80E-2	94.9	75-125			
Arsenic	2.54E0	N/A	"	2.50E0	3.28E-1	88.6	75-125			
Selenium	2.10E1	N/A	"	2.50E0	1.87E1	95.2	75-125			
Silver	2.39E0	N/A	"	2.50E0	ND	95.8	75-125			
Cadmium	2.50E0	N/A	"	2.50E0	3.70E-2	98.4	75-125			
Barium	5.22E0	N/A	"	2.50E0	2.70E0	101	75-125			
Mercury	2.31E0	N/A	"	2.50E0	ND	106	75-125			

PHOTOGRAPHS FROM BOREHOLE C8923

C8923
Borehole ID
B2XM88
Sample Number
up
227.90-228.40
Depth from Chain-of-Custody

C8923
Borehole ID
B2XM87
Sample Number
up
228.40-228.90
Depth from Chain-of-Custody

C8923
Borehole ID
B2XM93
Sample Number
up
233.99-234.59
Depth from Chain-of-Custody

C8923
Borehole ID
B2XM92
Sample Number
up
234.59-235.19
Depth from Chain-of-Custody

C8923
Borehole ID
B2XM91
Sample Number
235.19-235.79
Depth from Chain-of-Custody
up

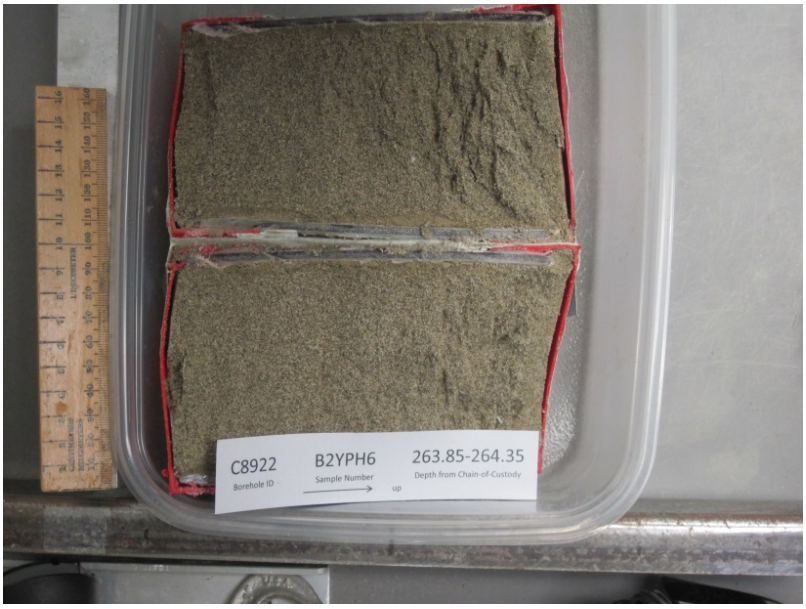
PHOTOGRAPHS FROM BOREHOLE C8922

C8922
Borehole ID
B2YPH2
Sample Number
up
261.4-261.9
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPH1
Sample Number
up
261.9-262.4
Depth from Chain-of-Custody

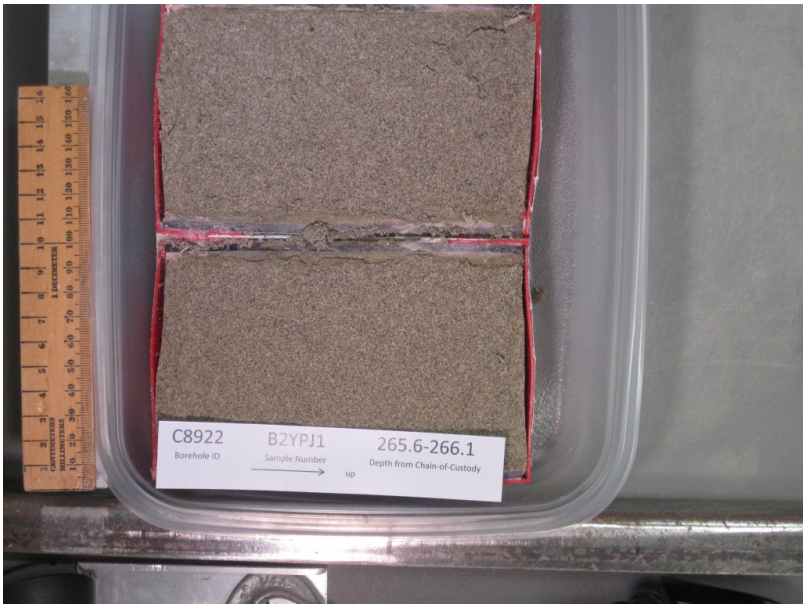
C8922
Borehole ID
B2YPH8
Sample Number
up
262.85-263.35
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPH7
Sample Number
up
263.35-263.85
Depth from Chain-of-Custody


C8922
Borehole ID
B2YPH6
Sample Number
up
263.85-264.35
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPH5
Sample Number
up
264.35-264.85
Depth from Chain-of-Custody

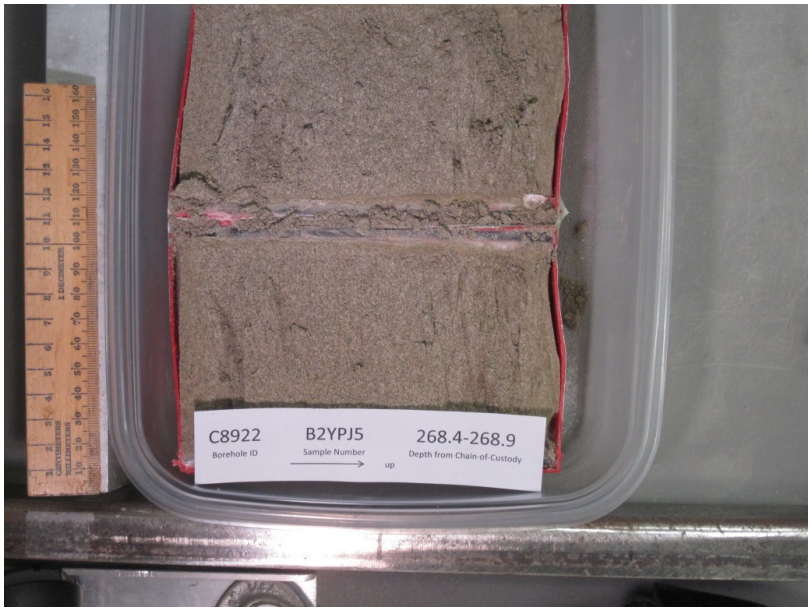
C8922
Borehole ID
B2YPJ2
Sample Number
up
265.1-265.6
Depth from Chain-of-Custody


C8922
Borehole ID
B2YPJ1
Sample Number
up
265.6-266.1
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPJ0
Sample Number
up
266.1-266.6
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPH9
Sample Number
up
266.6-267.1
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPJ6
Sample Number
up
267.9-268.4
Depth from Chain-of-Custody

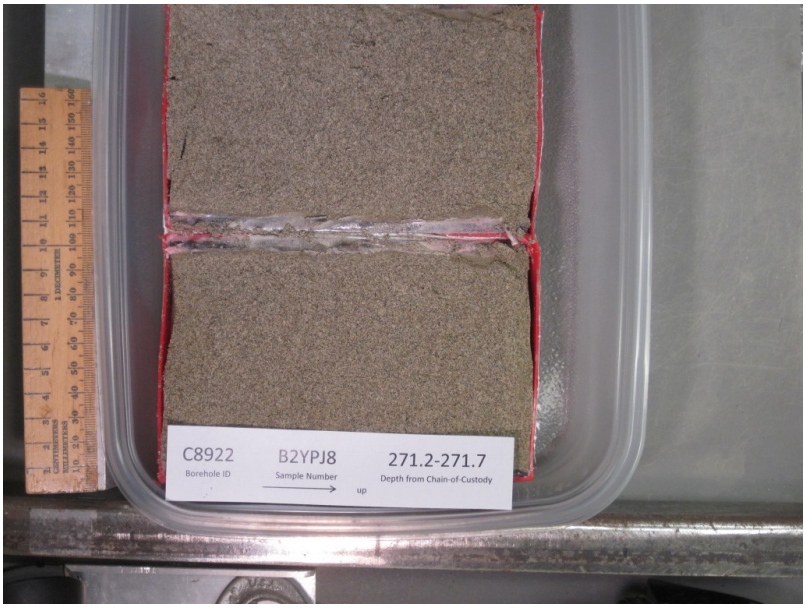

C8922
Borehole ID
B2YPJ5
Sample Number
up
268.4-268.9
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPJ4
Sample Number
up
268.9-269.4
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPJ3
Sample Number
up
269.4-269.9
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPK0
Sample Number
up
270.2-270.7
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPJ9
Sample Number
up
270.7-271.2
Depth from Chain-of-Custody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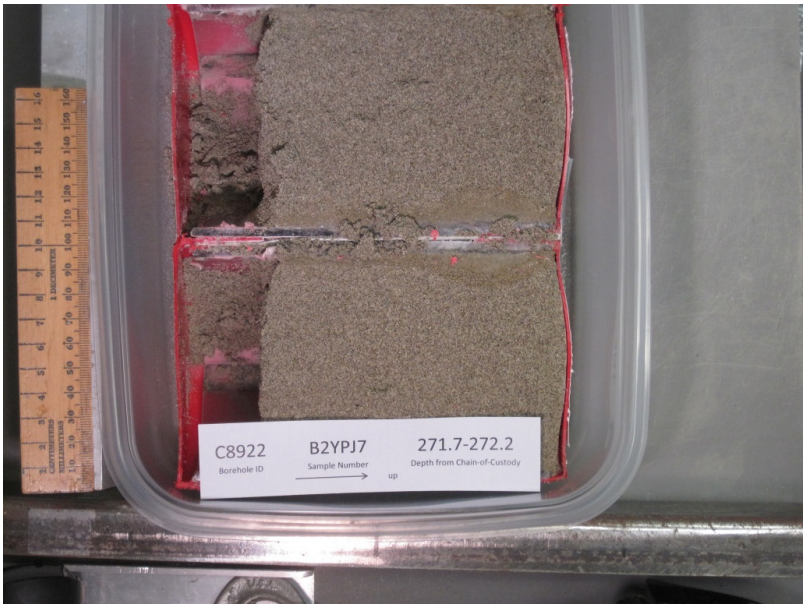
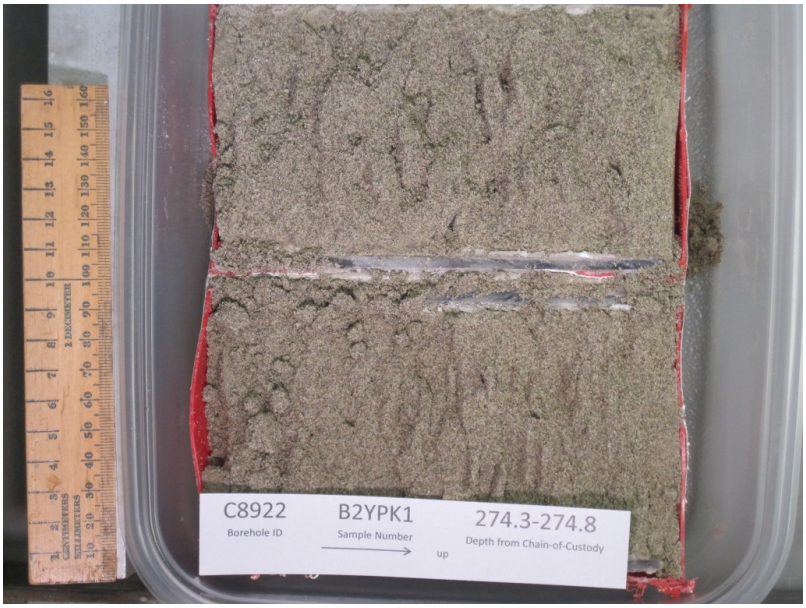
Borehole ID
B2YPJ8
Sample Number
up
271.2-271.7
Depth from Chain-of-Custody

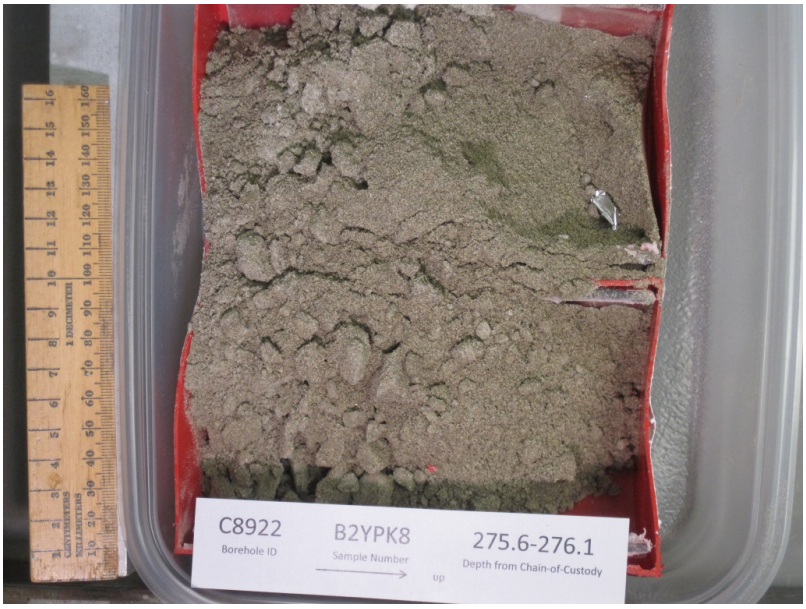

C8922
Borehole ID
B2YPJ7
Sample Number
up
271.7-272.2
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPK4
Sample Number
up
272.8-273.3
Depth from Chain-of-Custody

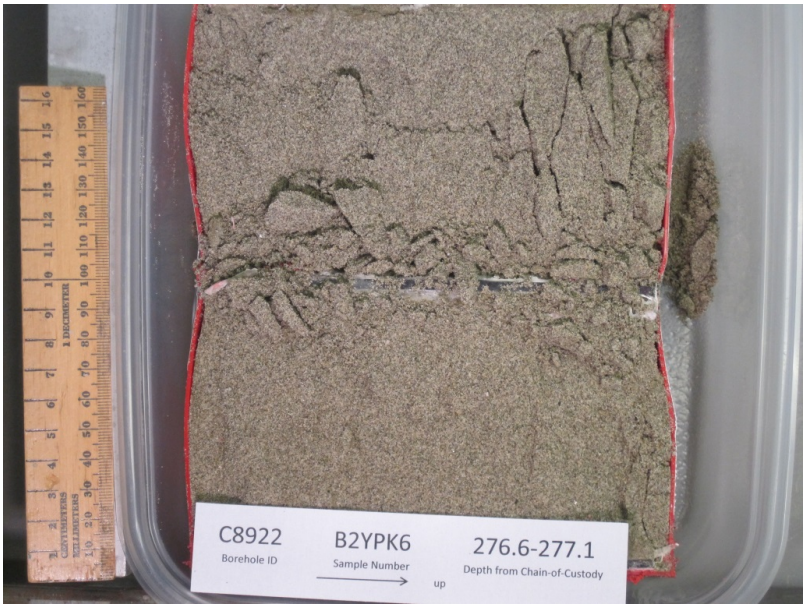
C8922
Borehole ID
B2YPK3
Sample Number
up
273.3-273.8
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPK2
Sample Number
up
273.8-274.3
Depth from Chain-of-Custody


C8922
Borehole ID
B2YPK1
Sample Number
up
274.3-274.8
Depth from Chain-of-Custody

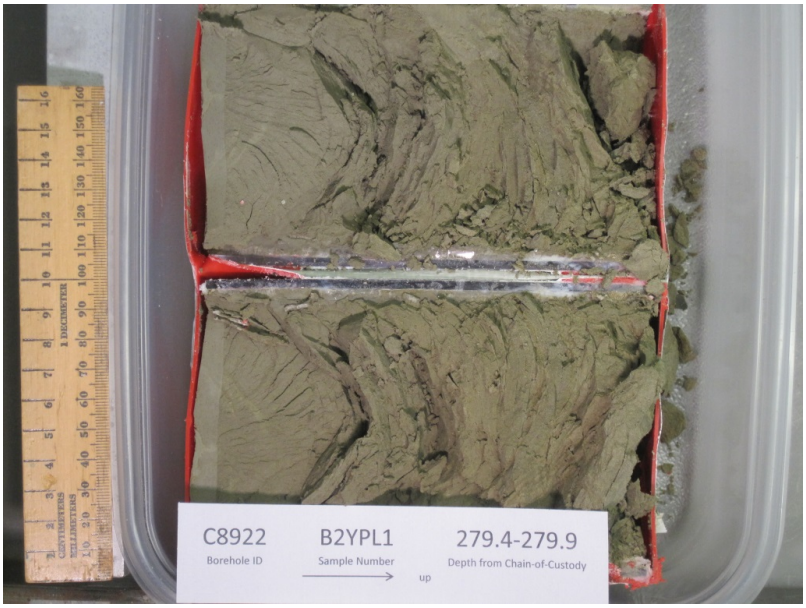

C8922
Borehole ID
B2YPK8
Sample Number
up
275.6-276.1
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPK7
Sample Number
up
276.1-276.6
Depth from Chain-of-Custody


C8922
Borehole ID
B2YPK6
Sample Number
up
276.6-277.1
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPK5
Sample Number
up
277.1-277.6
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPL2
Sample Number
up
278.9-279.4
Depth from Chain-of-Custody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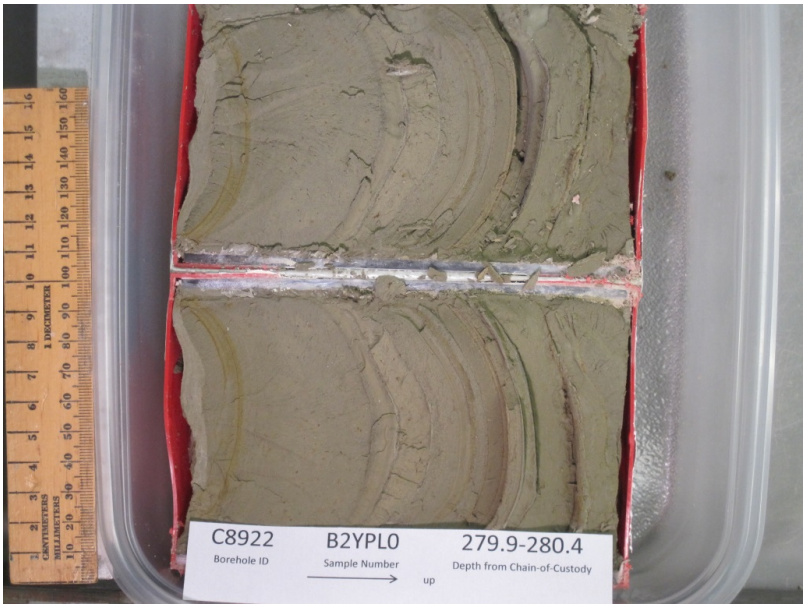
Borehole ID
B2YPL1
Sample Number
up
279.4-279.9
Depth from Chain-of-Custody


C8922
Borehole ID
B2YPL0
Sample Number
up
279.9-280.4
Depth from Chain-of-Custody

C8922
Borehole ID
B2YPK9
Sample Number
up
280.4-280.9
Depth from Chain-of-Custody

Pacific Northwest National Laboratory	CORE LOG	Boring/Well No C8922	Depth	Date 2/12/2015	Sheet 1 of 5
		Location 200 East Area	Project		

Logged by George Last (Print) (Sign)
Reviewed by (Print) (Sign) Date
Lithologic Class. Scheme Folk/Wentworth Procedure D9781-99-GVL-01 Rev 0
Drilling Contractor
Driller
Drill Method

DEPTH (FT)	SAMPLES TYPE	SAMPLES HEIS ID NUMBER	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, maximum grain size, consolidation, structure, etc.)	COMMENTS
260.4-260.9	C	B2YPH4	m-D		SLIGHTLY SILTY SAND. 0% Gravel, 80% Sand, 20% Silt. Sand ranges from medium to very fine, mostly fine, subangular, 85% felsic, 15% mafic. No obvious structure of stratification. Sample is very soft in consistancy. Moist color is 2.5Y 5/2, grayish brown, has weak reaction to HCl.	Whole core, 60% full.
260.9-261.4	C	B2YPH3	m-D		Stratified. Top (260.9-261.0) is SLIGHTLY SILTY SAND, same as above, fine sand. Lower Portion (261-261.4) is coarser. SLIGHTLY SILTY SAND, 0% Gravel, 90% Sand 10% Silt, Sand is mostly medium to fine, ranges up to coarse, 70% felsic, 30% mafic, subangular. Moist color is 2.5Y 5/2 grayish brown, with weak reaction. Contact is fairly sharp. Sample has soft to firm consistancy.	Whole core. 100% full
261.4-261.9	C	B2YPH2	m-D		SLIGHTLY SILTY SAND. 0% Gravel. 90% Sand, 10% Silt. Sand is mostly medium to fine, ranges to coarse, subangular, 70% felsic, 30% mafic. Moist color is 2.5Y 5/3, light olive brown, with no reaction to HCl. Sample has firm consistency. No obvious structures or stratification.	Whole core. 100% full.
261.9-262.4	C	B2YPH1	m-D		SAND. 0% Gravel, 100% Sand, trace of silt (bottom 90%). Gradational contact with slightly silty sand above. Sand is mostly medium, ranging from coarse to very fine. Subangular, 60% felsic, 40% mafic. Weak laminations. Moist to dry color is 2.5Y 5/2, grayish brown. Soft to firm consistency. No to weak reaction to HCl.	Whole core. 80% full.
262.85-263.35	C	B2YPH8	m-D		SLIGHTLY SILTY SAND. 0% gravel, 90% Sand, 10% Silt. Sand is mostly fine to very fine, ranges up to medium, 90% felsic, 10% mafic. Weak laminations, mostly in consistency (soft to firm). Moist to dry color is 2.5Y 5/2, grayish brown. Sand is subangular. Weak to strong reaction to HCl, firm laminations are strong.	Whole core. 70% full.
263.35-263.85	C	B2YPH7	m-D		SAND 0% gravel, 100% Sand. Sand is fine to very fine, well sorted, subangular, 80% felsic, 20% mafic. Weakly laminated. Moist to dry color is 2.5Y 5/2, grayish brown. Firm consistency. Weak to no reaction to HCl.	Whole core. 100% full.
263.85-264.35	C	B2YPH6	m		SAND. 0% gravel. 100% sand. Sand mostly fine to very fine, ranges up to med. 75% felsic, 25% mafic, subangular. weakly laminated in top 25%. Moist sample is 2.5Y 5/2, grayish brown. Firm consistency. No reaction to HCl.	Whole split core, 100% full

W = Wet, M = Moist, SM = Slightly Moist, D = Dry

2006/DCL/FORMS/CoreLog/001 (006/09)

Pacific Northwest National Laboratory	CORE LOG	Boring/Well No C8922 Location 200 East Area	Depth	Date 2/13/2015 Project	Sheet 2 of 5

Logged by George Last (Print) (Sign)
Reviewed by (Print) (Sign) Date
Lithologic Class. Scheme Folk/Wentworth Procedure DTB1-99-GUL-01 Rev 0
Drilling Contractor
Driller
Drill Method

DEPTH (FT)	SAMPLES TYPE	SAMPLES ID NUMBER	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, maximum grain size, consolidation, structure, etc.)	COMMENTS
264.35 264.85	C	B2YP15	M-D		SAND. 100% sand, mostly fine sand, well sorted. Ranges to medium sand. subangular, 80% felsic, 20% mafic. No obvious stratification or laminating/structure. Soft consistency. Moist to dry color is 2.5Y5/2, grayish brown. No reaction to HCl.	SPLIT CORE 65% Full
265.1 265.6	C	B2YPJ2	m-D		SLIGHTLY SILTY SAND. 90% Sand, 10% Silt. Mostly fine to very fine sand. SAND. 100% Sand, trace of silt, mostly fine sand, one band of silter material at ~265.4'. Subangular, 85% felsic, 15% mafic. Hard consistency, moist color is 2.5Y5/2, grayish brown. Weak reaction to HCl.	SPLIT CORE, 100% Full.
265.6 266.1	C	B2YPJ1	m-D		SAND. 100% Sand, mostly fine to very fine, subangular, 85% felsic, 15% mafic. No obvious stratification or structure. Moist color is 2.5Y 5/2, grayish brown. Firm to hard consistency. No reaction to HCl.	SPLIT CORE, 100% full.
266.1 266.6	C	B2YPJ0	m		SAND. 100% Sand, mostly fine to very fine, subangular, 85% felsic, 15% mafic. No obvious structure or stratification. Hard consistency. Moist color is 2.5Y5/2 grayish brown. No reaction to HCl.	SPLIT CORE. 100% full.
266.6 267.1	C	B2YPH9	m		SAND. 100% Sand. Mostly fine to very fine, subangular, 85% felsic, 15% mafic. No obvious structure or stratification. Firm to Hard consistency. Moist color is 2.5Y5/2, grayish brown. No reaction to HCl.	SPLIT CORE. 70% full.
267.9 268.4	C	B2YPJ6	m		SLIGHTLY SILTY SAND. 90% Sand, 10% Silt. Mostly fine to very fine sand, subangular, 90% felsic, 10% mafic. Weak laminations due to changes in consistancy, mostly firm. Moist color is 2.5Y5/2, grayish brown. Strong reaction to HCl.	SPLIT CORE. 75% full.

W = Wet, M = Moist, SM = Slightly Moist, D = Dry

2006/DCL/FORMS/CoreLog/001 (006/09)

Pacific Northwest National Laboratory	CORE LOG	Boring/Well No C8922	Depth	Date 2/13/2015	Sheet 3 of 5
		Location 200 East Area	Project		

Logged by George Last (Print) (Sign)
Reviewed by (Print) (Sign) Date
Lithologic Class. Scheme Folk/Wentworth Procedure D9TB1-99-GUL-01 Rev 0
Drilling Contractor
Driller
Drill Method

DEPTH (FT.)	SAMPLES TYPE	SAMPLES ID NUMBER	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, maximum grain size, consolidation, structure, etc.)	COMMENTS
268.4-268.9	C	B2YPJ5	m		SLIGHTLY SILTY SAND. 90% Sand, 10% Silt. Mostly fine to very fine sand, sub-angular, 90% felsic, 10% mafic. Weak laminations, particularly in the top 25%. Hard consistency. Strong reaction to HCl. Moist color is 2.5Y 5/2, grayish brown.	SPLIT CORE, 100% full.
268.9-269.4	C	B2YPJ4	m		SAND. 100% Sand, fine to very fine, mostly fine. subangular, 85% felsic, 15% mafic. Top 5% of core looks finer and siltier (same as above). Weakly laminated, some foreset laminations near bottom. Hard consistency. Weak to strong reaction to HCl. Moist color is 2.5Y 5/2, grayish brown.	SPLIT CORE. 100% full.
269.4-269.9	C	B2YPJ3	M		SAND. 100% Sand, mostly fine, ranges up to medium. 80% felsic, 20% mafic. Very weak laminations - maybe artifact of sampling. Look a little more coarse than above. Consistency is firm. No reaction to HCl.	SPLIT CORE. 100% full.
270.2-270.7	C	B2YPK0	M		SLIGHTLY SILTY SAND. 80% Sand, 20% silt. Some weak stratification within a siltier band at ~ 270.5ft, diffuse contact. Sand is mostly fine to very fine, sub-angular, 95% felsic, 5% mafic (but covered with silt). Hard consistency. Weak to strong reaction to HCl.	SPLIT CORE. 100% full.
270.7-271.2	C	B2YPJ9	M		SAND. 100% Sand, trace of silt, gets fine at top, diffuse contact with slightly silty sand above. Sand is mostly fine to very fine, subangular, 85% felsic, 15% mafic, No obvious sedimentary structures. Moist color is 2.5Y 5/2, grayish brown. Hard consistency. Weak reaction to HCl.	SPLIT CORE. 100% full.
271.2-271.7	C	B2YPJ8	M		SAND. 100% Sand, fine to very fine, mostly fine, subangular, 85% felsic, 15% mafic. No obvious stratification, very weak horizontal lamination. Moist color is 2.5Y 5/2 grayish brown. Hard consistency. Weak reaction to HCl.	SPLIT CORE, 100% full.
271.7-272.2	C	B2YPJ7	M		SAND. 100% Sand, mostly fine to very fine, mostly fine, subangular, 80% felsic 20% mafic. No obvious stratification or structure. Moist color is 2.5Y 5/2, grayish brown. Hard consistency. No to weak reaction to HCl.	SPLIT CORE. 80% full.

W = Wet, M = Moist, SM = Slightly Moist, D = Dry

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Pacific Northwest National Laboratory	CORE LOG	Boring/Well No C8922	Depth	Date 2/13/2015	Sheet 4 of 5
		Location 200 East Area	Project	2/16/2015	

Logged by George Last (Print) (Sign)
Reviewed by (Print) (Sign) Date
Lithologic Class. Scheme Folk/Wentworth Procedure DQTB1-99-GVL-01 Rev D
Drilling Contractor
Driller
Drill Method

2/16/2015 | 2/13/2015

DEPTH (FT)	SAMPLES TYPE	SAMPLES ID NUMBER	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, maximum grain size, consolidation, structure, etc.)	COMMENTS
272.8	C	B2YPK4	M			SPLIT CORE. 60% full.
273.3					SLIGHTLY SILTY SAND. 90% Sand, 10% Silt. Sand is fine to very fine, subangular, 85% felsic, 15% mafic (but covered in silt). No obvious stratification or structure, but very loose/disturbed. Very soft consistancy. Weak reaction to HCl.	
273.3	C	B2YPK3	D		SLIGHTLY SILTY SAND 85% Sand, 15% silt. Sand is fine to very fine, subangular,	SPLIT CORE. 100% fall.
273.8					80% felsic, 20% mafic (but covered in silt). No obvious stratification or structure.	May have dried out over
					Firm consistancy. Weak to strong reaction to HCl. Dry color is 2.5Y 6/1, gray.	weekend.
273.8	C	B2YPK2	D		SAND. 100% Sand, trace of silt. Sand is fine to very fine, subangular, 85%	SPLIT CORE. 100% full.
274.3					felsic, 15% mafic. Weakly laminated, particularly in the top 25%. Dry color	
					is 2.5Y 6/2, light brownish gray. Hard consistancy. Weak reaction to HCl.	
274.3	C	B2YPK1	M-D		SAND. 100% Sand. Sand is fine to very fine, mostly fine, well sorted, sub-	SPLIT CORE. 100% fall.
274.8					angular, 85% felsic, 15% mafic. Weakly laminated. Moist to dry color is	
					2.5Y 5/2, grayish brown. Firm consistancy. Weak reaction to HCl.	
275.6	C	B2YPK8	D			SPLIT CORE. 75% full.
276.1					SLIGHTLY SILTY SAND. 90% Sand, 10% silt. Sand is fine to very fine, Subangular, 85%	Disturbed.
					felsic, 15% mafic (but covered in silt). No obvious stratification or structure. Very soft.	
					Dry color is 2.5Y 6/2, light brownish gray. Weak to strong reaction to HCl.	
276.1	C	B2YPK7	M-D		SAND. 100% Sand, fine to very fine, subangular, 85% felsic, 15% mafic.	SPLIT CORE. 100% full.
276.6					Weakly laminated. Hard consistancy. Moist to dry color is 2.5Y 5/2.	
					grayish brown. Weak to strong reaction to HCl.	
276.6	C	B2YPK6	M		SAND. 100% Sand, fine to very fine, mostly fine, subangular, 80% felsic,	SPLIT CORE. 100% full.
277.1					20% mafic. Very weak laminations in top 25%. Hard consistancy. Moist	
					color is 2.5Y 5/2, grayish brown. No reaction to HCl.	

W = Wet, M = Moist, SM = Slightly Moist, D = Dry

2006/DCL/FORMS/CoreLog/001 (006/09)

Pacific Northwest National Laboratory	CORE LOG	Boring/Well No CB922	Depth	Date	Sheet 5 of 5
		Location 200 East Area	Project		

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Reviewed by _____ (Print) _____ (Sign) Date _____
Lithologic Class. Scheme Folk/Wentworth Procedure DT81-99-GVL-01 Rev D

Drilling Contractor _____
Driller _____
Drill Method _____

DEPTH (FT.)	SAMPLES TYPE	SAMPLES ID NUMBER	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, maximum grain size, consolidation, structure, etc.)	COMMENTS
277.1-277.6	C	B2YPK5	M		SAND. 100% Sand, mostly fine sand, well sorted, subangular, 80% felsic, 20% mafic, some weak laminations. Soft consistency. Moist color is 2.5Y 5/2, grayish brown. No reaction to HCl.	SPLIT CORE, 100% Full.
278.9-279.4	C	B2YPL2	M		SILT. 100% Silt, trace of sand (very fine). Well laminated (disturbed by sampling. Moist color is 2.5Y 5/2, grayish brown. Hard consistency. Weak reaction to HCl. No strength. No clay, not plastic.	SPLIT CORE. 100% full.
279.4-279.9	C	B2YPL1	M		SILT. 100% Silt, well laminated in the top 75% of core. Massive and a bit finer in lower 25%, perhaps some clay size sed. Moist color is 2.5Y 4/2, dark grayish brown. Hard consistency. No strength or plasticity. Weak reaction to HCl. Very compacted.	SPLIT CORE. 100% full.
279.9-280.4	C	B2YPL0	M		SILT. 100% Silt to clay size sed. well laminated in places and massive in the lower 40%. Hard consistency. No strength or plasticity. Moist color is 2.5Y 4/2, dark grayish brown, some rusty laminations at bottom. Weak reaction to HCl.	SPLIT CORE. 100% full.
280.4-280.9	C	B2YPK9	M-W		SILT. 100% silt to clay (size), trace of very fine sand, laminated. Hard consistence. 2.5Y 5/2, grayish brown. Weak reaction to HCl, some rust.	SPLIT CORE. 70% full.
					SLIGHTLY SILTY SANDY GRAVEL. 50% Gravel, 40% Sand, 10% Silt (+clay). Gravel ranges to 2.0 cm round to subround, mostly 80% mafic (basalt). Sand is med. to very coarse, subangular, 40% mafic, 60% felsic. Weak to strong reaction to HCl.	

W = Wet, M = Moist, SM = Slightly Moist, D = Dry

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Pacific Northwest National Laboratory	CORE LOG	Boring/Well No C8923	Depth	Date 2/12/2015	Sheet 1 of 2
		Location 200 East Area	Project		

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Lithologic Class. Scheme Folk/Wentworth Procedure DT81-99-GVL-01 Rev 0
Drilling Contractor
Driller
Drill Method

DEPTH (FT)	SAMPLES TYPE	SAMPLES ID NUMBER	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, maximum grain size, consolidation, structure, etc.)	COMMENTS
226.7-227.4	C	B2XM90	W		SLIGHTLY SILTY SAND. 0% Gravel, 90% Sand, 10% Silt. Sand is mostly fine to very fine sand, subangular, 95% felsic, 5% mafic. Wet color is 2.5Y 3/2 very dark grayish brown. weak reaction to HCl. No obvious structure. Consistency is firm.	Whole core sample, 100% full. C8923.
227.4-227.9	C	B2XM89	W		SLIGHTLY SILTY SAND. 0% Gravel, 90% Sand, 10% Silt. Sand is mostly fine to very fine, fairly well sorted. Some weak laminations present. 95% felsic, 5% mafic. Wet color is 2.5Y 4/2, dark grayish brown. Firm consistency. Wet sample has weak reaction to HCl.	whole core, 100% full.
227.9-228.4	C	B2XM88	W		SLIGHTLY SILTY SAND, to about 228.5 ft (top 20% of core). Same as above. This is underlain by slightly finer sand, mostly very fine, slightly silty very fine sand, dark color lamination at contact. Lower 80% sent of sample. Very fine sand is subangular, 95% felsic, 5% mafic. Wet color is 2.5Y 4/2, dark grayish brown. Firm, weak laminations, wet sample has weak reaction to HCl.	whole core, 100% full.
228.4-228.9	C	B2XM87	W		SLIGHTLY SILTY SAND. 0% Gravel, 90% Sand, 10% silt. Sand is mostly very fine, subangular, 95% felsic, 5% mafic, no obvious structure, except one dark colored glob in center of core. Firm consistency. Wet color is 2.5Y 4/2, dark grayish brown. Wet sample has weak reaction to HCl.	whole core, 75% full.
233.39-233.99	C	B2XM94	W		SLIGHTLY SILTY SAND. 0% Gravel, 90% Sand, 10% Silt. Sand is mostly very fine, well sorted. Weak lamination, evidenced by isolated rust colored laminations. Firm consistency. 95% felsic, 5% mafic. Wet color is 2.5Y 4/2, dark grayish brown. Wet sample has weak reaction to HCl.	whole core, 100% full.
233.99-234.59	C	B2XM93	M		SAND. 0% Gravel, 95% Sand, 5% Silt. Sand is mostly very fine, well laminated (horizontal), many rust colored laminations. No obvious changes through out core. Sand is near 100% felsic. Moist color is 2.5Y 4/3 olive brown. Sample has hard consistency. Moist sample has weak reaction to HCl.	whole core. 100% full.
234.59-235.19	C	B2XM92	M		SAND. 0% Gravel. 95% SAND, 5% Silt. Sand is mostly very fine, well sorted, and well laminated, particularly top ½ of sample, with occasional rust colored layers. Sand is nearly 100% felsic. Hard to very hard consistency. Moist color is 2.5Y 5/2 grayish brown. Moist sample has strong reaction to HCl.	whole core, 100% full.

W = Wet, M = Moist, SM = Slightly Moist, D = Dry

2006/DCL/FORMS/CoreLog/001 (006/09)

Pacific Northwest National Laboratory	CORE LOG	Boring/Well No C8923	Depth	Date 2/12/2015	Sheet 2 of 2
		Location 200 East Area	Project		

Logged by George Last (Print) (Sign)
Reviewed by _____ (Print) (Sign) Date _____
Lithologic Class. Scheme Folk/Wentworth Procedure ~~PTB1-97-BVL-01~~ Rev 0

Drilling Contractor _____
Driller _____
Drill Method _____

DEPTH (FT.)	SAMPLES TYPE	SAMPLES ID NUMBER	MOISTURE	GRAPHIC LOG C	Z	S	G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, maximum grain size, consolidation, structure, etc.)	COMMENTS
235.19	C	B2XM91	M					TOP (235.2 to 235.3) is very fine, weakly laminated sand same as above.	Whole core, 100%
235.79								Lower 3/4 (235.3 to 235.8) is highly laminated (varved), alternating layers	Lower portion looks
								grading from SILTY SAND (very fine), to CLAY (dark colored). Varves are ~	like lake varves.
								15mm thick, horizontal. Sample is hard to very hard in consistancy, clay	
								even breaks. Most color ranges from 2.5Y 4/2 (dark grayish brown) (clay) +	
								2.5Y 4/3, olive brown (sand). Most sample shows weak reaction to HCl	
								(clay layers) to strong reaction (sandier seds).	
									Note: graphic logs made
									with reference to the core
									photos, on 2/11/2015.

W = Wet, M = Moist, SM = Slightly Moist, D = Dry

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