BHI-01541
Rev. 0

116-H-1 Characterization Borehole Results

Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Environmental Restoration

Submitted by: Bechtel Hanford, Inc.

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116-H-1 Characterization Borehole Results

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1.0 INTRODUCTION

This report summarizes characterization activities associated with drilling and sampling of borehole C3048, which is located within the 116-H-1 Trench at the 100-HR-1 Area of the Hanford Site. The 116-H-1 waste site is an unlined, inactive trench located south of the 116-H-7 Retention Basin (Figure 1) near the H Reactor effluent retention basins. The site received contaminated water that was diverted from the retention basin during fuel ruptures. The trench received approximately 90,000,000 L (23,780,000 gal) of reactor cooling water from 116-H-7 and unknown amounts of water and sludge from 107-H deactivation from 1952 through 1958. The site also received approximately 90 kg (198 lb) of sodium dichromate.

1.1 DESCRIPTION

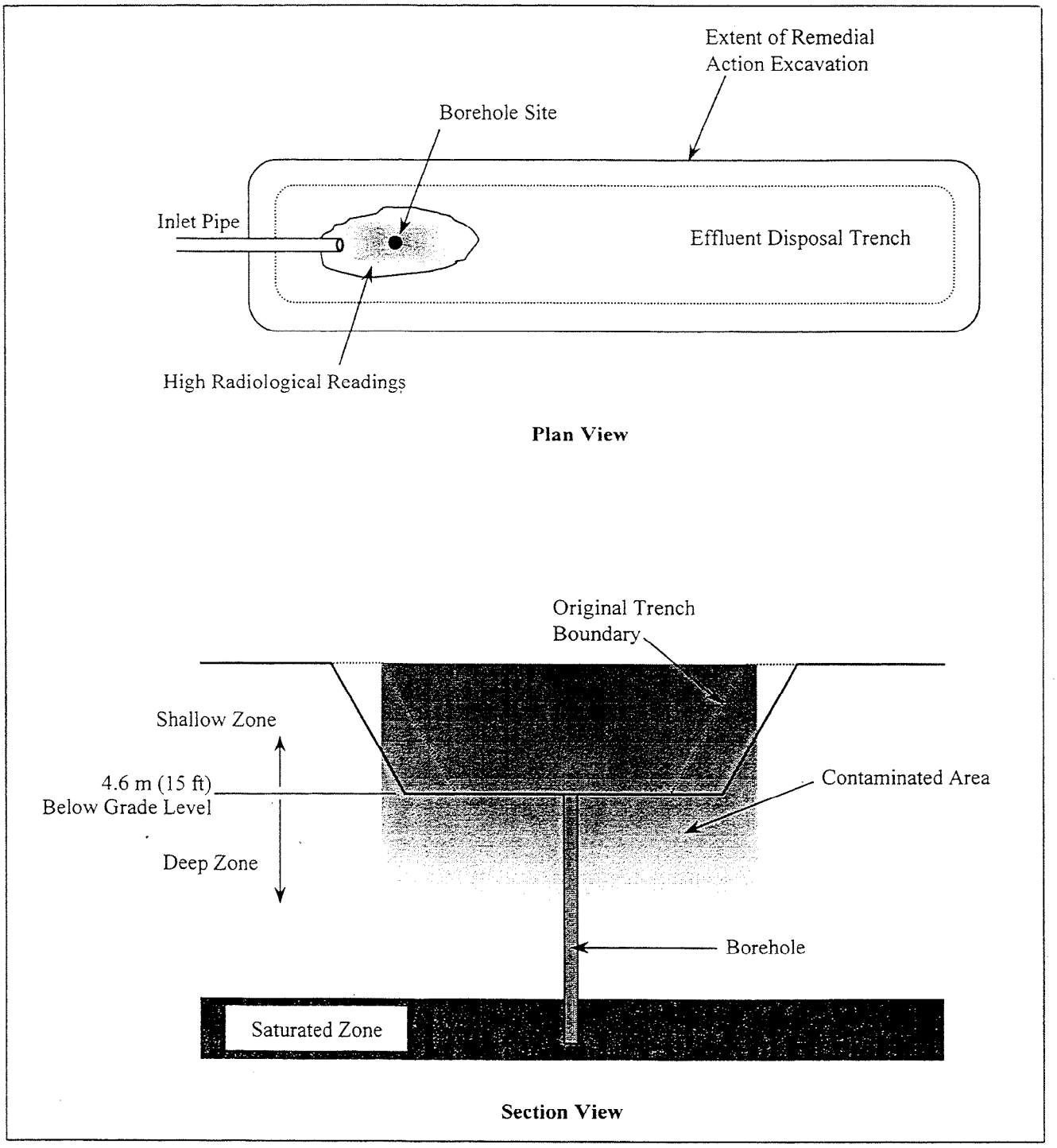
The 116-H-1 site was remediated in the spring of 2000. Characterization for site closeout and verification are provided in the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2000) and the *Instruction Guide for Remediation of the 100 Area Waste Sites* (BHI 1999). According to these documents, vertical distribution and concentration of the contaminants of concern in the deep zone below the site must be identified for site closure. The concentration and distribution of contaminants of concern was assessed through the sampling of a borehole. Borehole sampling began on May 1, 2000, and ended on May 5, 2000.

The primary objective of this activity was to determine the vertical extent of contamination within the deep zone soils below the 116-H-1 Trench. The “deep zone” refers to the portion of the vadose between the bottom of the waste site and the water table. Characterization activities were completed in accordance zone with *116-H-1 Vadose Zone Characterization Borehole Effort -- Description of Work* (DOW) (BHI 2000). Data quality objectives are defined in Appendix A of the DOW. The data were used to calibrate verification modeling for closeout of waste sites within the 100-H Area.

At the time of the borehole characterization, the site was an open trench approximately 4.6 m (15.1 ft) below the existing grade. The borehole was drilled at the north end of the trench, approximately 5.0 m (16.4 ft) from the influent pipeline (Figure 1). The borehole was drilled to groundwater to a total depth of approximately 9.76 m (32 ft) below the bottom the trench. Samples were collected every meter along with one groundwater sample. The borehole was abandoned after completion of the sampling.

In addition, moisture data were collected at depth to determine if dust-suppressant water could potentially drive contaminants into the groundwater.

Figure 1. Conceptual Site Model for the 116-H-1 Waste Site.



2.0 TECHNICAL DATA

The borehole was installed with a cable-tool drill rig. In order to reduce the potential spread of radiological contamination during drilling, the borehole was telescoped at 4.9 m (15.1 ft) from DN250 to DN225. Split-spoon sampling began at 0.76 m (2.5 ft). At the completion of the sampling, all temporary carbon steel casing was removed and the borehole was abandoned with bentonite and cement. A brass cap was placed at the surface of the borehole and surveyed (N 578088.75, E 152453.09, elevation 146.77 m).

To collect the water sample, a 1-L poly bailer was lowered into the well. The bailer was removed and the contents were poured directly into 3.8-L (1-gal) jugs. Once the sediment was settled, the water was filtered through 0.45-micron filters directly into the sample containers.

3.0 SUBSURFACE GEOLOGY

The geology of the Hanford Site consists of the Hanford formation at the surface that overlies the Ringold Formation and the Columbia River Basalt Group. In the 100-H Area the Hanford formation consists of pebble-cobble gravel and thin innerbeds of sand and silt. (Further description of the soil type is listed in the borehole log in Appendix A.) The formation is locally carbonate cemented at 5.64 m (18.5 ft). Borehole 116-H-1 was drilled from the bottom of an excavation, encountered water at the depth of 8.01 m (26.5 ft) below ground surface (bgs), and was completed at a depth of 9.76 m (32 ft). The top of the Ringold Formation was not penetrated with this borehole.

4.0 SAMPLING DESCRIPTION

The borehole was drilled to a depth of 9.76 m (32 ft) below the trench bottom. Eight soil samples were taken between 0.76 m (2.5 ft) and 7.8 m (25.8 ft) at 1-m intervals (elevation 145.7 to 138.6 m). A total of eight soil and one groundwater samples were taken. Appendix A provides the raw data for the samples. The drilling began at the bottom of the excavation, which was roughly 4.6 m (15 ft) below the original subsurface prior to remediation. Final sample data are listed in Tables 1 and 2, which summarize the analytical results for the contaminants of concern and the depth (elevation in National Geodetic Vertical Datum 88) for each corresponding sample.

One groundwater sample was taken at 8.08 m (26.5 ft) and analyzed for contaminants of concern as well as inductively coupled plasma metals**.**

Table 1. Summary of Soil Contaminant of Concern Results. (2 Pages)

HEIS Number	Elevation (m) NGVD (88)	Gamma Energy Analysis											
		Carbon-14			Cobalt-60			Cesium-137			Europium-152		
		Result (pCi/g)	Q	MDA (pCi/g)	Result (pCi/g)	Q	MDA (pCi/g)	Result (pCi/g)	Q	MDA (pCi/g)	Result (pCi/g)	Q	MDA (pCi/g)
B0Y2B4	N/A	0.837	U	4.2	U	U	0.016	U	U	0.015	U	U	0.039
B0Y270	145.7	0.708	U	4.5	1.4		0.1	33.5		0.25	50.6		0.68
B0Y272	144.7	0.359		4.2	0.481		0.041	29.8		0.079	5.79		0.26
B0Y2B2	144.7	7.89	J	4.4	0.459		0.061	26.7		0.13	5.46		0.33
B0Y2B3	144.7	0.268	U	0.75	0.456		0.0218	27.4		0.0424	5		0.136
B0Y274	143.4	0.623		4.6	U	U	0.036	0.151		0.039	0.486		0.081
B0Y276	142.5	-1	U	4.3	U	U	0.029	0.08	J	0.033	0.258		0.055
B0Y278	141.4	-0.237	U	4.8	U	U	0.056	U	U	0.049	0.156		0.089
B0Y280	140.6	0.77	U	4.3	U	U	0.029	U	U	0.028	0.13		0.062
B0Y282	139.5	-0.649	U	4.3	U	U	0.041	U	U	0.038	U	U	0.1
B0Y284	138.6	-1.27	U	4.6	U	U	0.035	U	U	0.034	0.066	U	0.068

HEIS Number	Elevation (m) NGVD (88)	Gamma Energy Analysis						ICP Metals					
		Europium-154			Europium-155			Arsenic			Mercury		
		Result (pCi/g)	Q	MDA (pCi/g)	Result (pCi/g)	Q	MDA (pCi/g)	Result (mg/kg)	Q	MDA (mg/kg)	Result (mg/kg)	Q	MDA (mg/kg)
B0Y2B4	N/A	U	U	0.057	U	U	0.041	2.9		0.26	U	U	0.02
B0Y270	145.7	4.18		0.43	U	U	0.73	16.6		0.28	0.12		0.02
B0Y272	144.7	0.497		0.16	U	U	0.16	2.6		0.23	0.06		0.02
B0Y2B2	144.7	0.728		0.25	U	U	0.21	1.6		0.25	0.08		0.02
B0Y2B3	144.7	0.388	U	0.118	0.0786	U	0.129	2.3		0.2	0.02	J	0.0072
B0Y274	143.4	U	U	0.12	U	U	0.13	2.4		0.26	U	U	0.02
B0Y276	142.5	U	U	0.1	U	U	0.067	1.7		0.27	U	U	0.02
B0Y278	141.4	U	U	0.18	U	U	0.082	1.7		0.26	U	U	0.02
B0Y280	140.6	U	U	0.11	U	U	0.07	2.7		0.25	U	U	0.02
B0Y282	139.5	U	U	0.15	U	U	0.13	4.1		0.28	0.02		0.02
B0Y284	138.6	U	U	0.13	U	U	0.077	U	U	0.28	U	U	0.02

Table 2. Summary of Soil Contaminant of Concern Results. (2 Pages)

HEIS Number	Elevation (m) NGVD (88)	Hex Chromium			Isotopic Analysis						Strontium Analysis		
		Chromium +6			Plutonium-239/240			Uranium-238			Total Strontium		
		Result (mg/kg)	Q	MDA (mg/kg)	Result (pCi/g)	Q	MDA (pCi/g)	Result (pCi/g)	Q	MDA (pCi/g)	Result (pCi/g)	Q	MDA (pCi/g)
B0Y2B4	N/A	U	U	0.43	-0.014	U	0.065	0.138	J	0.11	-0.065	U	0.019
B0Y270	145.7	U	U	0.42	0.543		0.084	0.459		0.13	1.84		0.21
B0Y272	144.7	U	U	0.41	0.299		0.053	0.499		0.11	1.66		0.14
B0Y2B2	144.7	U	U	0.41	0.281	J	0.063	0.35	J	0.12	1.65		0.2
B0Y2B3	144.7	0.16		0.008	0.453	J	0.0494	0.543	J	0.046	2.15		0.129
B0Y274	143.4	U	U	0.41	0.022		0.024	0.461		0.098	1.23		0.14
B0Y276	142.5	U	U	0.41	0.004	U	0.049	0.747	J	0.1	1.42		0.16
B0Y278	141.4	U	U	0.41	-0.017	U	0.057	0.28	J	0.11	1.54		0.17
B0Y280	140.6	0.47		0.41	-0.023	U	0.057	0.317		0.13	1.31		0.17
B0Y282	139.5	0.59		0.42	-0.004	U	0.054	0.24		0.11	1.16		0.14
B0Y284	138.6	U	U	0.4	-0.024	U	0.071	0.28		0.12	0.765	J	0.21

HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
MDA = minimum detectable activity
NGVD = National Geodetic Vertical Datum
Q = qualifier

Table 3. Summary of Water Contaminant of Concern Results.

HEIS Number	Elevation (m) NGVD (88)	Gamma Energy Analysis								
		Carbon-14			Cobalt-60			Cesium-137		
		Result (pCi/g)	Q	MDA (pCi/g)	Result (pCi/g)	Q	MDA (pCi/g)	Result (pCi/g)	Q	MDA (pCi/g)
B0Y3V6	138.6	31.6		38		U	13		U	14
B0Y3V8	138.6	-0.97		39		U	8.2	U	U	6.6

HEIS Number	Elevation (m) NGVD (88)	Gamma Energy Analysis								
		Europium-152			Europium-154			Europium-155		
		Result (pCi/g)	Q	MDA (pCi/g)	Result (pCi/g)	Q	MDA (pCi/g)	Result (pCi/g)	Q	MDA (pCi/g)
B0Y3V6	138.6		U	36		U	40		U	29
B0Y3V8	138.6		U	17		U	22		U	15

HEIS Number	Elevation (m) NGVD (88)	Isotopic Analysis						Strontium Analysis		
		Plutonium-239/240			Uranium-238			Total Strontium		
		Result (pCi/g)	Q	MDA (pCi/g)	Result (pCi/g)	Q	MDA (pCi/g)	Result (pCi/g)	Q	MDA (pCi/g)
B0Y3V6	138.6	-0.03		0.088	U		1500	17.7		0.35
B0Y3V8	138.6	0.004		0.049	0.993		0.1	21		0.42

HEIS Number	Elevation (m) NGVD (88)	ICP Metals						Hex Chromium		
		Arsenic			Mercury			Chromium +6		
		Result (kg/mg)	Q	MDA (kg/mg)	Result (mg/kg)	Q	MDA (mg/kg)	Result (mg/kg)	Q	MDA (mg/kg)
B0Y3V6	138.6	214		32	0.81		0.1			
B0Y3V8	138.6	3.2		3.2	0.1		0.1			

HEIS Number	Elevation (m) NGVD (88)	Hex Chromium		
		Chromium +6		
		Result (mg/kg)	Q	MDA (mg/kg)
B0Y3V7	138.6	0.001		0.002
B0Y2V9	138.6	0.01		0.002

Samples to determine moisture content were also collected during the drilling of the borehole. The results of the moisture content can be found in Table 3.

Table 4. Summary of Water Moisture Content Results.

HEIS Number	Elevation (m) NAVD (88)	Container Number	Container Weight	Wet Sample + Container	Dry Sample + Container	Moisture Content (%)
B0Y270	145.7	1	11.76	28.78	27.93	5.3
B0Y272	144.7	2	11.84	28.44	28.1	2.1
B0Y274	143.4	3	11.84	30.98	30.58	2.1
B0Y276	142.5	4	10.68	29.66	29.27	2.1
B0Y278	141.4	5	11.74	32.94	32.58	1.7
B0Y278 Dup	141.4	6	11.84	32.01	31.65	1.8
B0Y280	140.6	7	11.87	32.21	31.54	3.4
B0Y282	139.5	8	10.96	34.35	32.94	6.4

5.0 CONCLUSIONS

The data indicate that contaminant levels decrease as the elevation during sampling decreases. The highest concentration of contaminants were found within the first 2 m of sampling at 146 to 144 m and decreased significantly within depth. Appendix B presents graphs of 116-H-1 vadose zone characterization borehole data.

The moisture content for the soil samples indicates no significant water penetration to groundwater. All of the samples designate moisture content below 10%, which is acknowledged at the Hanford Site as ambient conditions (Pacific Northwest National Laboratory Sisson and Lui Test Site). Ambient conditions indicate that no man-made precipitation has penetrated groundwater. At the 116-H-1 site, ambient conditions are significant because the effect of the water used in dust suppression for soil remediation on groundwater was in question. Thus, ambient conditions indicate that water used as a dust suppressant during remediation does not appear to drive contaminants deeper into the soil. The final results can be found in Table 3.

6.0 REFERENCES

BHI, 1999, *Instruction Guide for Remediation of the 100 Area Waste Sites*, 0100X-IG-G001, Rev. 2, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2000, *116-H-1 Vadose Zone Characterization Borehole Effort – Description of Work*, BHI-01332, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

DOE-RL, 2000, *100 Area Remedial Action Sampling and Analysis Plan*, DOE/RL-96-22, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

APPENDIX A

116-H-1 BOREHOLE LOG

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116-H-1 Drilling Split Spoon Sampling EL-1500-1

Sampler(s): Renee Nielson, Mike Stankovich CHI/AFS
Purpose: To develop a vertical profile of the distribution and concentration of metals and radioactive contamination in the deep zone from the bottom of the excavated trench into the groundwater.
RCT Support(s): Traci Rued
Other Support(s): Mike Faurote, Geologist
Date: Monday, May 1, 2000
DOW: BHI-01332 Draft A
FIG: N/A
SAF: B00-048
COC No(s): B00-048-01 (Severn Trent), B00-048-02 (RCF), B00-048-18 (TMA/RECRA)
RWP: GW-0128, Rev. 0
Procedures: BHI-EE-01, 1.5, Rev. 3, Revision Order A, Field Logbooks
BHI-EE-01, 1.15, Rev. 2, Sampling Documents
BHI-EE-01, 3.0, Rev. 3, Chain of Custody
BHI-EE-01, 3.1, Rev. 2, Revision Order A, Sampling Packaging and Shipping
BHI-EE-01, 3.2, Rev. 0, Field Decontamination of Field Instruments
BHI-EE-01, 4.0, Rev. 2, Revision Order A, Soil and Sediment Sampling
BHI-EE-01, 4.2, Rev. 3, Revision Order A, Sample Storage and Shipping Facility
SSWMI WMI-GRP4-001, Rev. 1

Time	Notes
0700	Plan of the day conducted by J. Jimenez. Attendees include R. Nielson – Sampler, M. Stankovich – Sampler, M. Faurote – Geologist, T. Rued – RCT, and Layne Christensen Drilling personnel. RCT T. Rued reviews the Radiological Work Permit (RWP). The area where the work will be performed is posted an RBA. When the drilling begins, the hole will become a Contamination Area (CA) and the RCT will act as the CA boundary. All drilling equipment, sampling equipment, and soil removed from the hole will be surveyed by the RCT.
0730	Drill crew will need to pick up some equipment at 100D before beginning work.
0820	R. Nielson and M. Stankovich prepare to collect equipment blank.
0834	Sample **B0Y2B4 (TMA/RECRA)** collected. Bottle set lot numbers are as follows: 60ml aG – G/2 9341010, 120ml aG – G8355010, 250ml aG – F8264010, 1 liter aG – J8342010. Silica sand is used for the equipment blank. The sample will be associated with the first set of split spoon samples collected.
0915	Crew enters the (RBA). The drill rig is already set up.
0920	An ERDF can is delivered. All soil removed from the hole by the drillers will be placed in yellow plastic sleeving and placed in the can for shipment to ERDF. Waste generated by the samplers (gloves, teri-wipes, etc) will be placed inside of the can. M. Faurote will provide a list to J. Jimenez of all of the sleeves and other waste that are placed inside of the can.
0955	Begin drilling. Samplers need a drive pin for the split spoon sampler. R. Nielson contacts J. Jimenez.
1030	Ready to take split spoon sample.
1035	J. Jimenez arrives with the drive pin.

Renee Nielson

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116-H-1 Drilling Split Spoon Sampling EL-1500-1

1040	Crew prepares to exit the RBA for a break.
1106	Split spoon sampler attached. Begin split spoon sampling at 2.5 ft.
1115	Split spoon to surface. Drillers remove the split spoon from the drill rig. RCT surveys the split spoon prior to it being opened.
1119	Split spoon opened. Sample collected from 2.5 ft. to 4.5 ft. bgs. 75% recovery. Material is silty sandy gravel, cemented. A more in depth sample description reported by the Geologist is recorded on a Borehole Log sheet. A copy of the Borehole Log sheet is taped into this logbook on page 132 & 133. Material is removed from the stainless steel sleeves and placed in a large stainless steel mixing bowl. Using a stainless steel spoon, the material is thoroughly mixed. Rocks greater than ½" are removed.
1120	Drive barrel on drill rig. Drillers begin drilling to next sample depth.
1131	Sample **B0Y270 (TMA/RECRA/RECRA), B0Y271 (RCF)** collected. Lot numbers of bottle sets are as follows: 60 ml aG – G/2 9055060, 120ml aG - G8355010, 250ml aG - F 8264010, 1 liter aG - J 8342010. Equipment blank B0Y2B4 is associated with this sample. Sample containers are surveyed for smearable contamination by the RCT, then custody sealed and placed on ice.
1200	Drillers are ready for second split spoon.
1203	Begin split spoon sampling @ 6.0 ft.
1210	Break for lunch.
1300	Continue drilling.
1330	Split spoon to surface. Drillers remove the split spoon from the drill rig. RCT surveys the split spoon prior to it being opened.
1335	Split spoon opened. Sample collected from 6.0 ft. to 7.7 ft. bgs. 80% recovery. Material is silty sandy gravel, cemented. A more in depth sample description reported by the Geologist is recorded on a Borehole Log sheet. A copy of the Borehole Log sheet is taped into this logbook on pages 132 & 133. Material is removed from the sleeves and placed in a large stainless steel mixing bowl. Using a stainless steel spoon, the material is thoroughly mixed. Rocks greater than ½" are removed.
1350	Sample **B0Y272 (TMA/RECRA), B0Y273 (RCF)** collected. QA/QC samples are collected at this interval. **B0Y2B2 (Duplicate to TMA/RECRA), B0Y2B3 (Split to Severn Trent)**. Lot numbers of bottle sets are as follows: 60 ml aG - G/2 9055060, 120ml aG - G8355010, 250ml aG - F8264010, 1 liter aG - J 8342010. Sample containers are surveyed for smearable contamination by the RCT, then custody sealed and placed on ice.
1400	Drive barrel to next sample depth.
1500	Exit RBA for break.
1515	Return from break. Continue drilling.
1700	Have not hit sample depth. Ground is very cemented. Quit for the day.

RJN 5/10/00

Renee Nielson 5/10/00

Renee Nielson Renee Nielson

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116-H-1 Drilling Split Spoon Sampling EL-1500-1

Sampler(s): Renee Nielson, Mike Stankovich CHI/AFS
Purpose: To develop a vertical profile of the distribution and concentration of metals and radioactive contamination in the deep zone from the bottom of the excavated trench into the groundwater.
RCT Support(s): Traci Rued
Other Support(s): Mike Faurote, Geologist
Date: Tuesday, May 2, 2000
DOW: BHI-01332 Draft A
FIG: N/A
SAF: B00-048
COC No(s): B00-048-20, -21, -22, -23 (TMA/RECRA), B00-048-04, -05, -06, -07 (RCF)
RWP: GW-0128, Rev. 0
Procedures: BHI-EE-01, 1.5, Rev. 3, Revision Order A, Field Logbooks
BHI-EE-01, 1.15, Rev. 2, Sampling Documents
BHI-EE-01, 3.0, Rev. 3, Chain of Custody
BHI-EE-01, 3.1, Rev. 2, Revision Order A, Sampling Packaging and Shipping
BHI-EE-01, 3.2, Rev. 0, Field Decontamination of Field Instruments
BHI-EE-01, 4.0, Rev. 2, Revision Order A, Soil and Sediment Sampling
BHI-EE-01, 4.2, Rev. 3, Revision Order A, Sample Storage and Shipping Facility
SSWMI WMI-GRP4-001, Rev. 1

Time	Notes
0700	Plan of the day conducted by J. Jimenez. Attendees include R. Nielson – Sampler, M. Stankovich – Sampler, M. Faurote – Geologist, T. Rued – RCT, and Layne Christensen Drilling personnel. Safety meeting conducted by Layne Christensen personnel.
0750	Crew enters the RBA.
0803	Begin drilling.
0815	Begin split spoon sampling.
0830	Split spoon to surface. Refusal. Attached another split spoon sampler to try again.
0842	Split spoon to surface.
0845	Split spoon sampler opened. 100% recovery but some was slough material. Only the bottom two liners will be used for the sample. Interval considered for sample is from 10.2 ft. to 11.6 ft. The material is removed from the sleeves and placed in a large stainless steel mixing bowl. The material is light gray with some rocks. A more in depth sample description is reported by the Geologist and recorded on the Borehole Log sheet. A copy of the Borehole Log sheet is taped into this logbook on page 132 & 133.
0905	Sample **B0Y274 (TMA/RECRA), B0Y275 (RCF)** collected. Lot numbers of bottle sets are as follows: 60ml aG – G/2 9055060, 120ml aG – G8355010, 250ml aG – G8264010, 1 liter aG – J8342010. Sample containers are surveyed by the RCT, custody sealed, and placed on ice.
0910	Begin driving to next sample depth.
0946	Drilled to a depth of 13.0 ft.
0947	Crew prepares to exit RBA for break.
1008	Resume drilling. Drillers prepare to drive casing.
1021	Drive casing to 13.5 ft.

Renee Nielson

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116-H-1 Drilling Split Spoon Sampling EL-1500-1

1040 Begin split spoon sampling at 13.2 ft.

1051 Split spoon to surface. Overdriven by approximately 0.5 ft. Drillers removed the split spoon from drill rig. RCT surveys the split spoon prior to it being opened. Will use the bottom two sleeves for the sample.

1100 Continue driving to next sample depth.

1109 Split spoon sampler opened. Sample collected from 13.2 ft. to 15.0 ft. 100% recovery. Only the bottom two liners will be used for the sample. The material is removed from the stainless steel sleeves and placed in a large stainless steel mixing bowl. The material is light gray with some rocks. A more in depth sample description is reported by the Geologist and recorded on the Borehole Log sheet. A copy of the Borehole Log sheet is taped into this logbook on page 132 & 133.

1120 Sample **B0Y274 (TMA/RECRA), B0Y275 (RCF)** collected. Lot numbers of bottle sets are as follows: 60ml aG – G/2 9055060, 120ml aG – G8355010, 250ml aG – G8264010, 1 liter aG – J8342010. Sample containers are surveyed by the RCT, custody sealed, and placed on ice.

1149 Shut down for lunch.

1235 Resume work.

1430 Sample **B0Y278 (TMA/RECRA), B0Y279 (RCF)** collected. Sample is from 16.5 ft to 18.5 ft. 100% recovery from the split spoon. Only the bottom two liners will be used for the sample. The material is removed from the stainless steel sleeves and placed into a stainless steel bowl. The material is light gray with some rocks. A more in depth sample description is reported by the Geologist and recorded on the Borehole Log sheet. A copy of the Borehole Log sheet is taped into this logbook on page 132 & 133. The material is thoroughly homogenized before being placed into sample containers. Rocks greater than ½" are removed. Lot numbers of bottle sets are as follows: 60ml aG – G/2 9055060, 120ml aG – G8355010, 250ml aG – G8264010, 1 liter aG – J8342010. Sample containers are surveyed by the RCT, custody sealed, and placed on ice.

1700 Sample **B0Y280 (TMA/RECRA), B0Y281 (RCF)** collected. Sample is from 19.3 ft to 21.3 ft. 100% recovery from the split spoon. Only the bottom two liners will be used for the sample. The material is removed from the stainless steel sleeves and placed into a stainless steel bowl. The material is sandy gravel. A more in depth sample description is reported by the Geologist and recorded on the Borehole Log sheet. A copy of the Borehole Log sheet is taped into this logbook on page 132 & 133. The material is thoroughly homogenized before being placed into sample containers. Rocks greater than ½" are removed. Lot numbers of bottle sets are as follows: 60ml aG – G/2 9055060, 120ml aG – G8355010, 250ml aG – G8264010, 1 liter aG – J8342010. Sample containers are surveyed by the RCT, custody sealed, and placed on ice.

1720 Survey out of the RBA. Drilling completed for the day.

RJN 5/10/00

Renee Nielson 5/10/00

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116-H-1 Drilling Split Spoon Sampling EL-1500-1

Sampler(s): Renee Nielson, Mike Stankovich CHI/AFS
Purpose: To develop a vertical profile of the distribution and concentration of metals and radioactive contamination in the deep zone from the bottom of the excavated trench into the groundwater.
RCT Support(s): Traci Rued
Other Support(s): Mike Faurote, Geologist
Date: Wednesday, May 3, 2000
DOW: BHI-01332 Draft A
FIG: N/A
SAF: B00-048 and B00-049
COC No(s): B00-048-24, -25, B00-049-03 (TMA/RECRA), B00-048-08, -09, B00-049-01 (RCF), B00-049-02 (Severn Trent)
RWP: GW-0128, Rev. 0
Procedures: BHI-EE-01, 1.5, Rev. 3, Revision Order A, Field Logbooks
BHI-EE-01, 1.15, Rev. 2, Sampling Documents
BHI-EE-01, 3.0, Rev. 3, Chain of Custody
BHI-EE-01, 3.1, Rev. 2, Revision Order A, Sampling Packaging and Shipping
BHI-EE-01, 3.2, Rev. 0, Field Decontamination of Field Instruments
BHI-EE-01, 4.0, Rev. 2, Revision Order A, Soil and Sediment Sampling
BHI-EE-01, 4.2, Rev. 3, Revision Order A, Sample Storage and Shipping Facility
SSWMI WMI-GRP4-001, Rev. 1

Time	Notes
0700	Plan of the day conducted by J. Jimenez. Attendees include R. Nielson – Sampler, M. Stankovich – Sampler, M. Faurote – Geologist, T. Rued – RCT, and Layne Christensen Drilling personnel.
0740	Begin drilling. RCT will not need to survey everything as it comes out of the hole. There has been no contamination detected. Coordinates for the borehole are North – 578088.75, East – 152453.09, Elevation – 146.77.
0807	Drilled to 23 feet. Ready for split spoon.
0830	Sample **B0Y282 (TMA/RECRA), B0Y283 (RCF)** collected. Sample is from 23 feet to 24.8 feet. 85% recovery from the split spoon. The three bottom liners will be used for the sample. The material is removed from the stainless steel sleeves and placed into a stainless steel bowl. The material is sandy soil with some rocks. A more in depth sample description is reported by the Geologist and recorded on the Borehole Log sheet. A copy of the Borehole Log sheet is taped into this logbook on page 132 & 133. The material is thoroughly homogenized before being placed into sample containers. Rocks greater than ½" are removed. Lot numbers of bottle sets are as follows: 60ml aG – G/2 9055060, 120ml aG – G8355010, 250ml aG – G8264010, 1 Liter aG – J8342010. Sample containers are custody sealed and placed on ice.
0835	Begin drilling to next sample depth.
0905	Sample **B0Y284 (TMA/RECRA), B0Y285 (RCF)** collected. Sample is from 25.8 feet to 27.8 feet. 80% recovery from the split spoon. Hit water at approximately 26.5 feet. The three bottom liners will be used for the sample. The material is removed from the stainless steel sleeves and placed into a stainless steel bowl. The material is sandy soil

enee Nielson

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116-H-1 Drilling Split Spoon Sampling EL-1500-1

with some rocks. A more in depth sample description is reported by the Geologist and recorded on the Borehole Log sheet. A copy of the Borehole Log sheet is taped into this logbook on page 132 & 133. The material is thoroughly homogenized before being placed into sample containers. Rocks greater than ½" are removed. Per M. Stankovich, no moisture tin will be collected at this interval. Lot numbers of bottle sets are as follows: 60ml aG – G/2 9055060, 120ml aG – G8355010, 250ml aG – G8264010, 1 Liter aG – J8342010. Sample containers are custody sealed and placed on ice.

0904 Drillers add 5 feet of casing.

0924 Drive casing.

1000 Crew prepares to survey out of the zone for a break.

1020 Water is at 28.2 feet, bottom of the hole currently at 30 feet.

1025 Add 5 feet of casing.

1037 Drive casing.

1055 Bottom of hole at 32 feet. Casing at 32 feet. Prepare to collect a water sample using a poly bailer.

1110 Sample **B0Y3V6 (TMA), B0Y3V7 (Severn Trent), B0Y3W0 (RCF)** collected from the borehole. A one-liter poly bailer is lowered into the well to collect the water sample. The bailer is removed and the contents in poured directly into unpreserved sample containers. The samples collected are unfiltered. This process in repeated until all sample containers are full. Bottle set lot numbers are as follows: 500ml Poly – L7352020, 1-Liter poly – C9264010, 1 Liter aG – H9298010.

1125 Sample **B0Y3V6 (TMA), B0Y3V7 (Severn Trent), B0Y3W0 (RCF)** collected from the borehole. A one-liter poly bailer is lowered into the well to collect the water sample. The bailer is removed and the contents in poured directly into four one-gallon jugs, lot number ST9357030. Once the sediment settled a little, the water was filtered through a .45 micron filter directly into the sample containers. Sample container lot numbers are the same as above. All samples are custody sealed and placed on ice.

1140 Sampling for the borehole is complete. Drillers will begin pulling the casing. Well construction data reported by the Geologist is recorded on the Well Summary Sheet taped into this logbook on page 134. All stainless steel sampling equipment used in split spoon sampling will be pressure cleaned with water only, before being surveyed out of the RBA. Items that are cleaned are recorded on a Field Cleaning and/or Decontamination sheet that is taped into this logbook on page 135.

RJN 5/10/00

Renee Nielson 5/10/00

Renee Nielson

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116-H-1 Drilling Split Spoon Sampling EL-1500-1

BORE HOLE LOG

Date: 5/1/00

Well ID: C3048 | Well Name: C3048 | Location: North end 116-H-1 Pit, 100-H

Project: 116-H-1 Pit Characterization | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-18.5 Silty Sandy Gravel (msG) Unit is 65% G, 20-25% S and 10-15% m in a poorly sorted, Sub-round to Sub-angular, cemented ($CaCO_3$ & Fe Ox) gravel. Grain size varies from f-cr (max. gr. is 6"), f is 20%, m @ 30% cr @ 30%. Sand is f-med grained, with a coarse fraction @ < 10%. The unit is gray-brown to med. gray-brown and difficult to drill. Variegated lithology, where 30% is basalt, the remainder is fore metamorphics and intrusive igneous. ~11', gravel content drops to 50%, silt increases to 15-18% and the remainder is f-m w/ <15% cr sand THEN RETURNS TO the gravel as described above. All cuttings have med-Sg Rxn to HCl.	Cleaned out/advanced borehole with drive barrel between split-spoon intervals.
	SPLIT SPOON 75%	2.5' ~500 CPM 4.5'			
5	SPLIT SPOON	6' 80% recov 7.7'	CEMENT?		5-6' - Possible concrete block - or heavily cemented gravel
10	SPLIT SPOON	11.6'			@11' = refusal @ 8'-10" full spoon - caught Slough, but from 10.2-11.6
	SPLIT SPOON	13.2 to 15.0			
15	SPLIT SPOON	16.5 18.5		18.5-32.0 Sandy Gravel: variegated lithology: Basalt ~30%, metamorphics and igneous constitute the gravel of 15% f, 30% m and 55% cr grns in 70% Gravel unit. Sand is f-cr grnd, w/ 45% being med. in sub-Round to sub-angular grains. The color is lt-rd-bn w/ bk when moist but br-gy to gy-bn when dry. Grain size to 2.5" with most @ 1/2"+1 1/2" diameter. Silt may be 5% or <	* This unit certainly looks cemented - with CEMENT @ 18.5'
20	SPLIT SPOON	19.3 21.3			a v.sm. nodule of gold to other colored material seen in bowl when homogenizing the sample.
	SPLIT SPOON	23 85% 24.5			
25	SPLIT SPOON	25.8 80% 27.8			
▽ 26.5					

Reported By: JM Faurote		Reviewed By: DC Weekes	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 5/2/00	Signature: DC Weekes	Date: 5/5/00

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R. Nielson / R. Nielson 5/10/00

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116-H-1 Drilling Split Spoon Sampling El-1500

BOREHOLE LOG

Page 1 of 2
Date: 5/3/00

Well ID: C3048	Well Name: C3048	Location: N. end of 116-H-1 Pit
Project: 116-H-1 Pit Characterization borehole		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
30				Continues as Sandy Gravel to TD	Sand is heaving into the casing
	END OF HOLE @ 32' +15				
				NOT USED JMFaurote 5/3/00	

Reported By: J.M. Faurote
Title: Geologist
Signature: JMFaurote Date: 5/3/00

Reviewed By: DC Weekes
Title: Geologist
Signature: DC Weekes Date: 5/5/00

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R. Nielson 5/10/00

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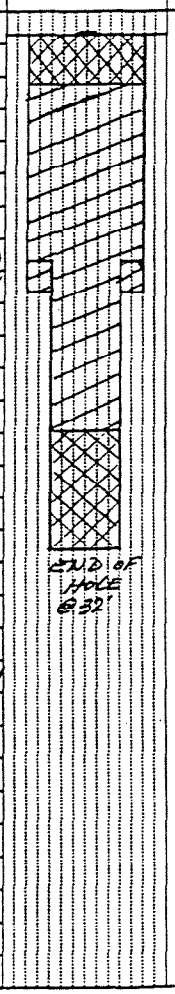
116-H-1 Drilling Split Spoon Sampling EL-1500-1

WELL SUMMARY SHEET			Page 1 of 1
			Date: 5/4/00
Well ID: C 3048		Well Name: C 3048	
Location: 116-H-1 Pit, 100-H		Project: 116-H-1 Characterization	
Prepared By: J.M. Faurote	Date: 5/4/00	Reviewed By: D.C. Weekes	Date: 5/5/00
Signature: JMFaurote		Signature: DCWeekes	



CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
Brass Cap @ Surface		0		
Cement from 0-2.9'				0-18.5 Silty Sandy Gravel, Cemented
3/8" Bentonite Crumbles from 2.9' - 24.5'				
		10		
3/8" Bentonite Pellets (Hydrated) annular seal from 14' to 15.8'				
Cement from 24.5 to 32'		20		18.5-TD (32') Sandy Gravel
		▼		
		30		32' end of hole
0-16' 10 3/4" temp. casing	END OF HOLE @ 32'			
16'-32' 9" temp. casing				Water Level @ 26.5', on 5/3/00
All Temporary Casing Removed				
All depths are below ground surface.				

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R. Nielson 5/10/00

116-H-1 Drilling Split Spoon Sampling EI-1500-1

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FIELD CLEANING AND/OR DECONTAMINATION

Project: 100H RA.

Location of Cleaning/Decontamination: 116-H-1

Borehole/Well No.: C 3048

Destination: NA

The following equipment has been field cleaned and/or decontaminated following EIP 6.2 Rev.

List types of detergent: ☐ Non-phosphate ☒ Other water only

Rigs Equipment	ID No.
☐	
☐	
☐ NA	
☐	

Cleaning ☒ Yes ☐ No

Decontamination ☐ Yes ☒ No

Downhole Equipment		Size	Date
☐ Baskets	10 Ea.		5-4-00
☐ Retain Ring	10 Ea.		~~5-5-00~~ 5-4-00
☐ Drive Shoe	10 Ea.		~~5-5-00~~ 5-4-00 MO 5-4-00
☐ Split Spoon halfs	12 Ea.	2 ft	~~5-5-00~~ 5-4-00
☐ Sleeves	42 Ea.	3 ft	5-4-00
☐ Drive Pins	3 Ea.	1 Large 2 small	5-4-00
☐ Bowls	10 Ea.	Large	5-4-00
☐ Spoons	20 Ea.	Large + Small	5-4-00
☐	Ea.		
☐	Ea.		
☐	Ea.		
☐	Ea.		
☐	Ea.		

Remarks:

Reviewed 5/4/00

Person Conducting Decontamination Print/Sign Name	Date	Reviewed by FTL/Designee Print/Sign Name	Date
M Stankovich	5-4-00		

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Reviewed / R. Nielson Continued on page N/A

APPENDIX B

116-H-1 BOREHOLE DATA

Figure B-1. 116-H-1 Vadose Zone Characterization Borehole Data: C-14, Co-60, Eu-154, and Eu-155.

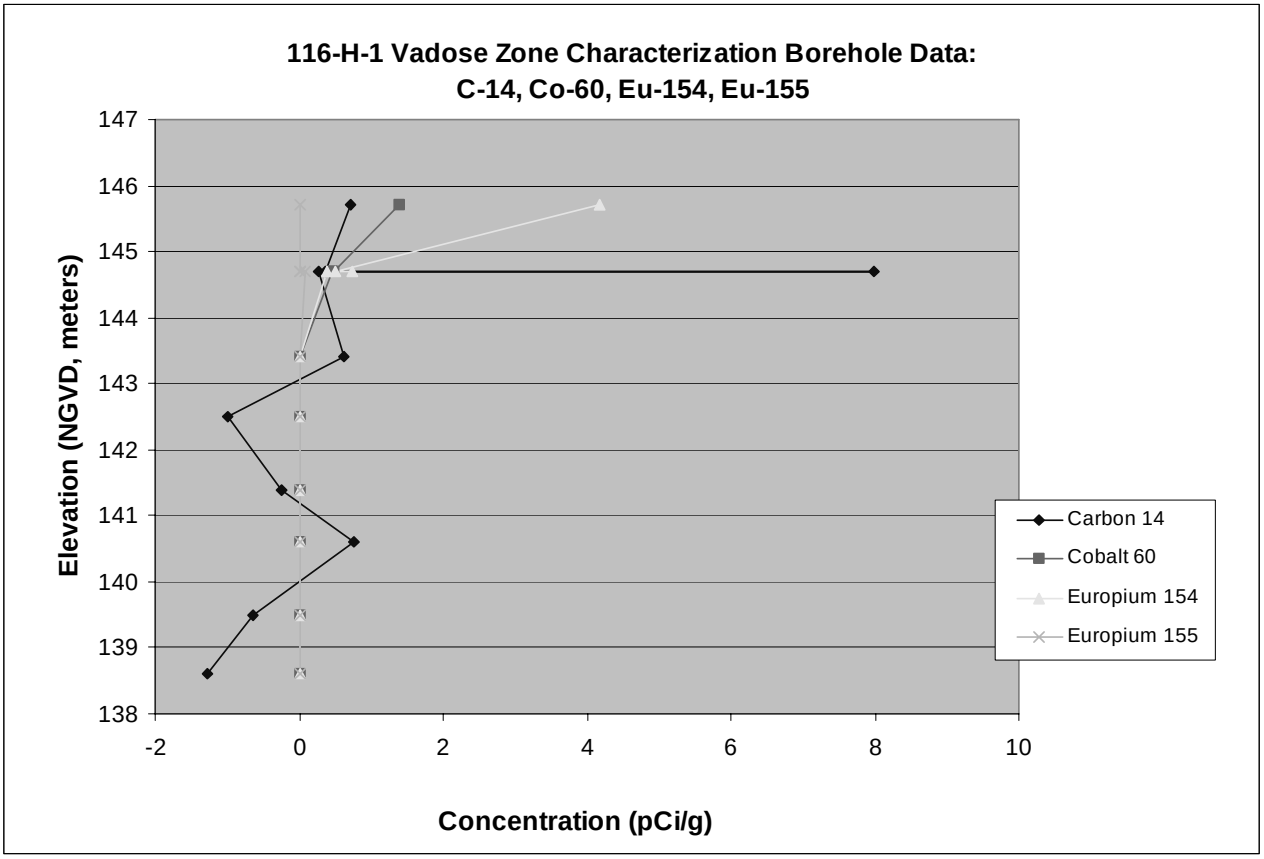


Figure B-2. 116-H-1 Vadose Zone Characterization Borehole Data: Eu-152 and Cs-137.

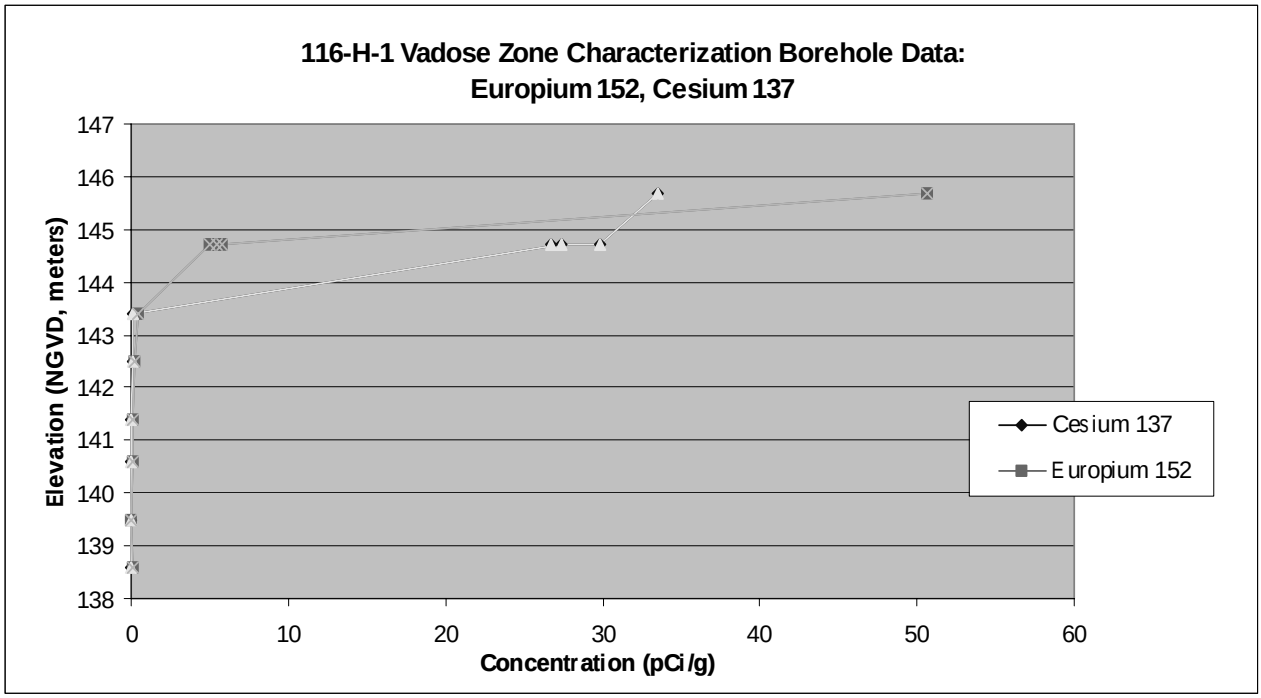


Figure B-3. 116-H-1 Vadose Zone Characterization Borehole Data: Pu-239/240, U-238, and Sr.

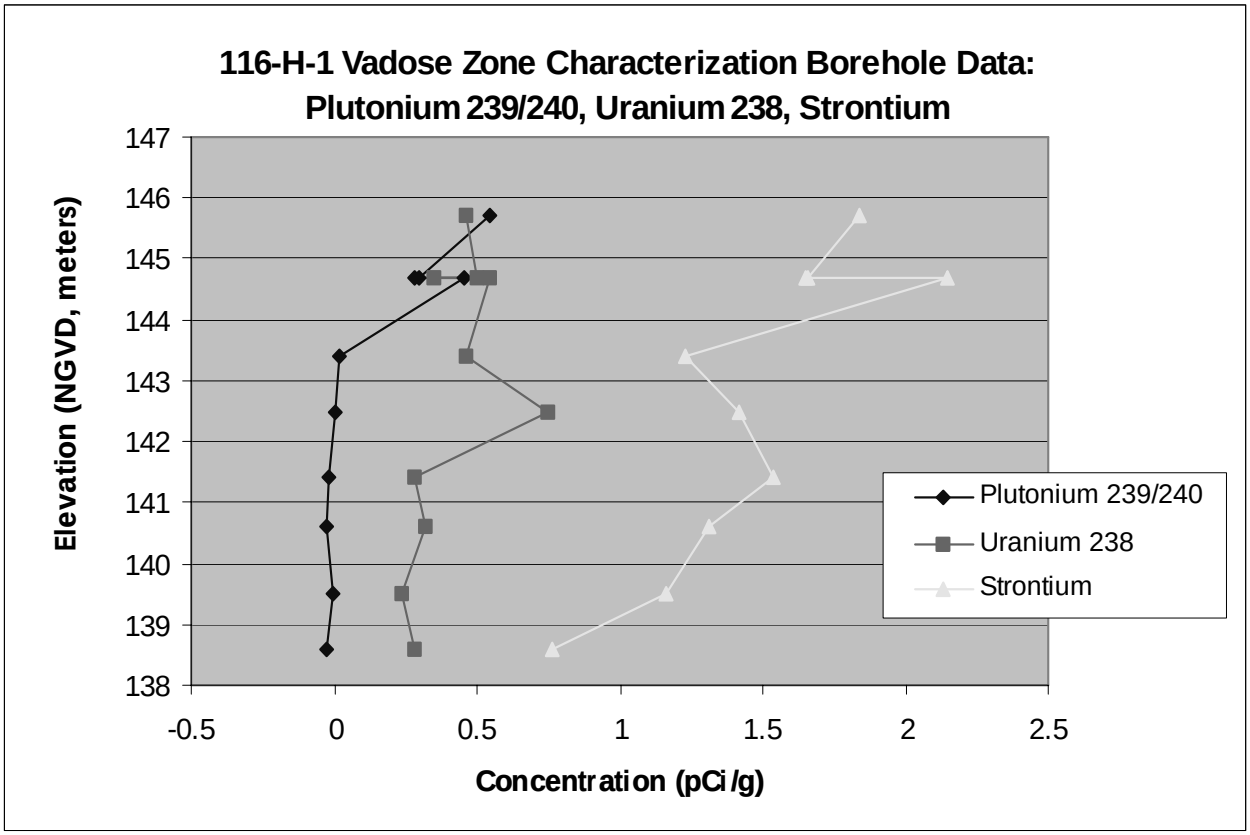


Figure B-4. 116-H-1 Vadose Zone Characterization Borehole Data: ICP Metals.

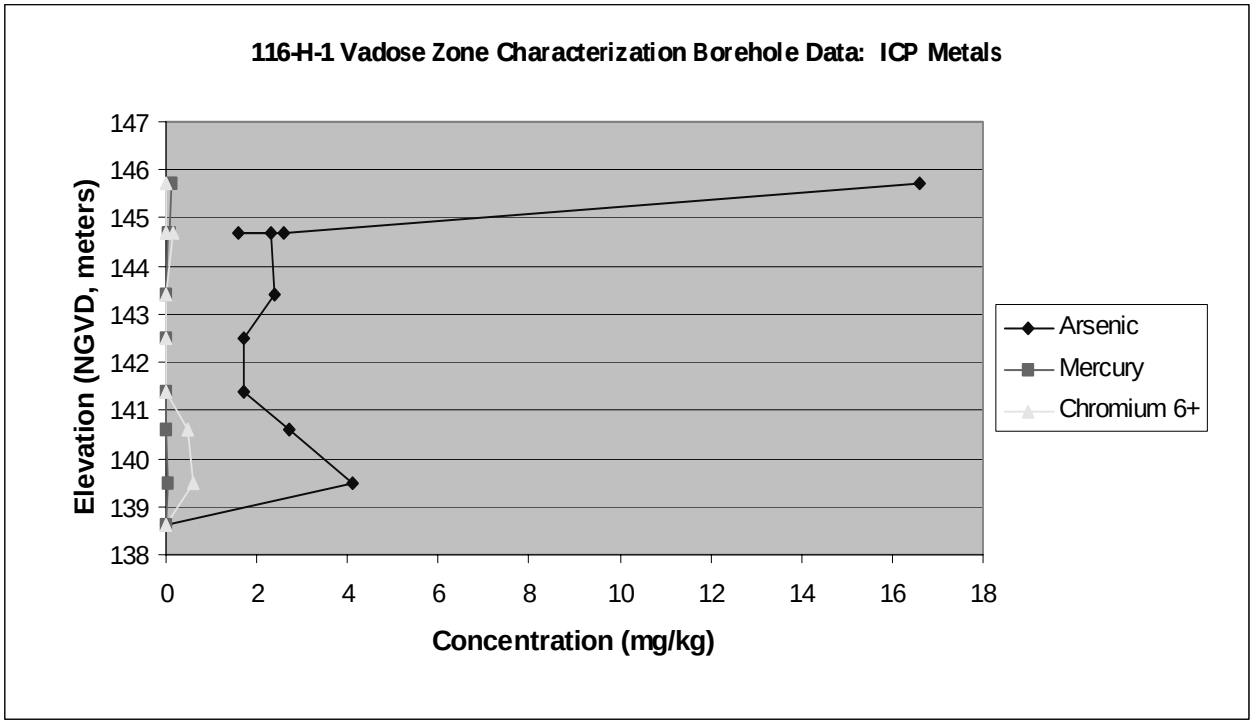
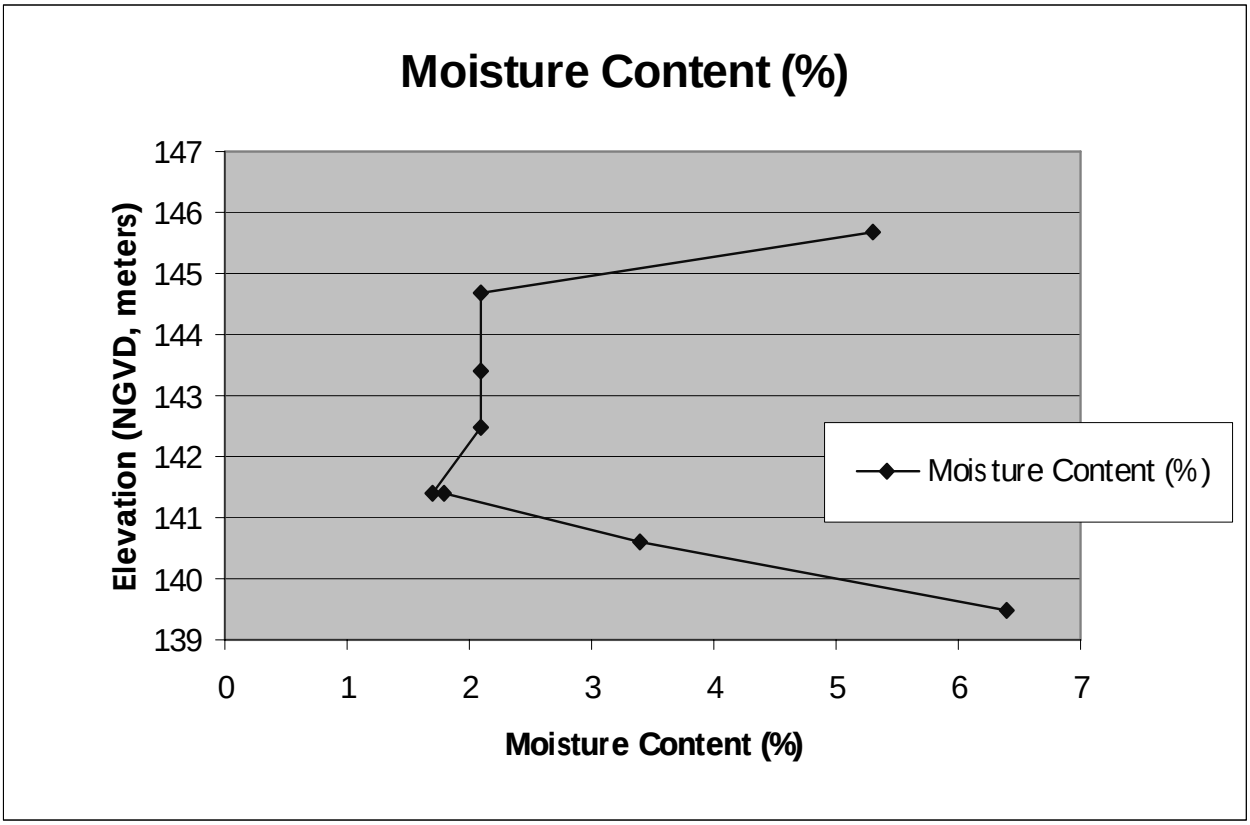


Figure B-5. 116-H-1 Moisture Content of Soil, Characterization Borehole Data.



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