PNNL-13200

Borehole Data Package for Wells 299-W22-48, 299-W22-49, and 299-W22-50 at Single-Shell Tank Waste Management Area S-SX

D. G. Horton
V. G. Johnson

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Pacific Northwest National Laboratory
Richland, Washington 99352

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1.0 Introduction

Three new Resource Conservation and Recovery Act (RCRA) groundwater monitoring wells were installed at the single-shell tank farm Waste Management Area (WMA) S-SX in October 1999 through February 2000 in fulfillment of Tri-Party Agreement (Ecology 1996) milestone M-24-41. The wells are 299-W22-48, 299-W22-49, and 299-W22-50. Well 299-W22-48 is located east of the southeast corner of 241-S tank farm and is a new downgradient well in the monitoring network. Well 299-W22-49 is located on the east side of the 241-SX tank farm, adjacent to well 299-W22-39, which it replaces in the monitoring network. Well 299-W22-50 is located at the southeast corner of the 241-SX tank farm and is a replacement for downgradient monitoring well 299-W22-46, which is going dry. The locations of all wells in the WMA S-SX monitoring network are shown on Figure 1.

The original assessment monitoring plan for WMA S-SX was issued in 1996 (Caggiano 1996). That plan was updated for the continued assessment at WMA S-SX in 1999 (Johnson and Chou 1999). The updated plan provides justification for the new wells. The new wells were constructed to the specifications and requirements described in Washington Administrative Code (WAC) 173-160 and WAC 173-303, the updated assessment plan for WMA S-SX (Johnson and Chou 1999), and the description of work for well drilling and construction.[1]

This document compiles information on the drilling and construction, well development, pump installation, and sediment and groundwater sampling applicable to the installation of wells 299-W22-48, 299-W22-49 and 299-W22-50. Appendix A contains the Well Summary Sheets (as-built diagrams), the Well Construction Summary Reports, and the geologist's logs. Appendix B contains results of laboratory analyses of the physical properties of sediment samples obtained during drilling. Appendix C contains borehole geophysical logs, and Appendix D contains the analytical results from groundwater samples obtained during well drilling and construction. Additional documentation concerning well construction is on file with Bechtel Hanford, Inc., Richland, Washington.

English units are used in this report because that is the system of units used by drillers to measure and report depths and well construction details. Conversion to metric is made by multiplying feet by 0.3048 to obtain meters or multiplying inches by 2.54 to obtain centimeters.

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[1] Letter from R. M. Smith, Pacific Northwest National Laboratory, Richland, Washington, to G. C. Henckel, Bechtel Hanford, Inc., dated May 26, 1999, "Description of Work for Drilling of CY 1999 RCRA Monitoring Wells."

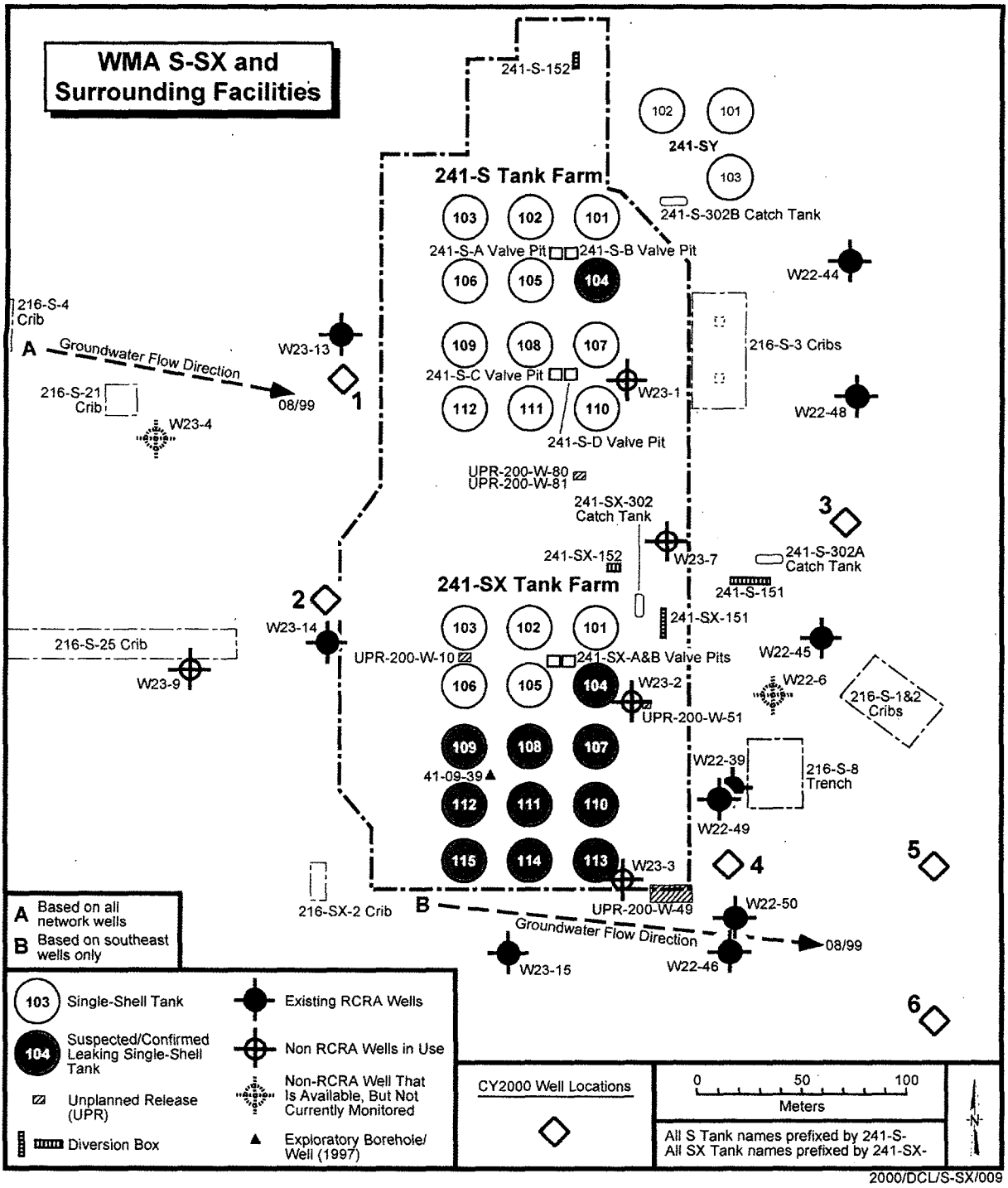

Figure 1. Map of WMA S-SX and Locations of Wells in the Groundwater Monitoring Network

2.0 Well 299-W22-48

2.1 Drilling and Sampling

Well 299-W22-48 was drilled with a cable tool drill rig and split-spoon sampler between 0 and 193.5 ft below ground surface (bgs) and by hard tool from 193.5 ft to total depth of 249 ft bgs. Temporary 11 ¾-in.-outside-diameter, carbon steel casing was placed from the surface to 50 ft bgs and 8 5/8-in.-outside-diameter casing from 50 ft to 246 ft bgs. Two gallons of water were added to the borehole at 132 ft and 1 gal at about 134 ft bgs to facilitate sampling. Approximately 500 gal were added in the depth interval drilled by hard tool.

Sediments encountered during drilling were predominantly sands and sandy gravels of the Hanford formation from the surface to about 134 ft bgs; Plio-Pliestocene silty sands and calcareous silty sands from 134 to about 149 ft bgs; undifferenciated Plio-Pleistocene/Ringold formation silts and sands from 149 ft to 191 ft bgs; and Ringold Formation silty sandy gravels from 191 ft to total depth (249 ft bgs). The geologist noted a possible clastic dike in the samples from 116 ft and 168 ft depths. The geologist's log is included in Appendix A.

The borehole was sampled continuously by split spoon from the surface to 193 ft for analysis of chemical and physical properties. Two additional split spoon samples were obtained from 234 to 236.5 ft bgs and from 240.5 to 242.5 ft bgs. Grab samples for analysis of moisture content were obtained at approximately 5 ft intervals from the surface to the water table from material in the split spoon drive shoe. Also, grab samples for geologic description and archive were collected every 5 ft from hard tool cuttings between 195 ft and total depth. Available results from analytical testing of sediment samples are in Appendix B.

Two water samples were collected by bailer during drilling from 236 ft and 247 ft depths. The analytical results for the sample from 236 ft are in Appendix D. The sample from 247 ft depth was not analyzed.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No contamination was found.

The well was geophysically logged using high resolution, spectral gamma-ray and neutron-neutron moisture instrumentation. Cesium-137 was detected between 1 and 2 ft bgs at a concentration of 5 pCi/g. No other man-made radionuclides were detected. The geophysical logs are in Appendix C.

2.2 Well Completion

The permanent casing and screen were installed in well 299-W22-48 during November 1999. A 4-in.-inner-diameter, stainless steel, wire wrap (0.01 in. slot) screen was set from 241.25 to 226.24 ft bgs.

The permanent casing is 4-in.-inside-diameter, stainless steel from 226.24 ft bgs to 2.0 ft above ground surface. The bottom of the screen has a 4-in. PVC end cap to facilitate future deepening the well if necessary.

The filter pack is 10 to 20 mesh silica sand from 246.5 to 245 ft and 20 to 40 mesh silica sand from 245 to 216.1 ft bgs. The annular seal is Portland cement with bentonite from 216.1 to 209.6 ft bgs, granular bentonite from 209.6 to 10.8 ft bgs, and Portland cement from 10.8 ft to the surface. A 4 ft by 4 ft by 6 in. concrete pad was placed around the well at the surface. A protective casing with locking cap, four protective steel posts, and a brass marker stamped with the well number were set into the concrete. The Well Summary Sheet (as-built) and Well Construction Summary Report are included in Appendix A.

The vertical and horizontal coordinates of the well were surveyed in March 2000. The horizontal position of the well was determined by Global Positioning System observations referenced to horizontal control stations established by Rogers Surveying, Inc., Richland, Washington. The coordinates are Washington Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD 1988 and is based on existing bench marks established by the U.S. Corps of Engineers. Survey data are included in Table 1.

Table 1. Survey Data for New Wells At WMA S-SX

Well Name	Easting m (ft)	Northing m (ft)	Elevation m (ft)	
299-W22-48	566,996.641 (1,860,219.59)	134,425.096 (441,025.888)		Center of Casing
			207.895 (682.068)	"X" on Casing
	566,996.585 (1,860,219.406)	134,425.499 (441,027.210)	207.132 (679.565)	Brass Cap
299-W22-49	566,904.383 (1,859,916.907)	134,201.625 (440,292.717)		Center of Casing
			204.719 (671.648)	"X" on Casing
	566,904.346 (1,859,916.785)	134,201.999 (440,293.944)	203.927 (669.050)	Brass Cap
299-W22-50	566,904.261 (1,859,916.507)	134,139.756 (440,089.739)		Center of Casing
			205.012 (672.610)	"X" on Casing
	566,904.365 (1,859,916.848)	134,140.036 (440,090.654)	204.142 (669.755)	Brass Cap

2.3 Well Development and Pump Installation

Well 299-W22-48 was developed in November 1999. A temporary, 2 hp, submersible pump was used to remove approximately 420 gal of formation water from the well at 1.7 to 3 gal/min. The pump intake was at 240.05 ft bgs. The drawdown was approximately 7 ft at the final flow rate of 3 gal/min. The final turbidity was 1.99 NTU.

A dedicated Hydrostar sampling pump was installed in well 299-W22-48 in December 1999. The sampling pump intake is at 235.33 ft bgs (or about 7.5 ft below the water table). Static water level was 227.85 ft bgs on November 9, 1999.

3.0 Well 299-W22-49

3.1 Drilling and Sampling

Well 299-W22-49 was drilled with a cable tool drill rig from 0 to 50 ft bgs and by air rotary rig from 50 ft to the total depth of 239 ft bgs during October and November 1999. Temporary 11 ¾-in.-outside-diameter, carbon steel casing was placed from the surface to 50 ft bgs and 8 5/8-in.-outside-diameter casing from 50 ft to 236.5 ft bgs. About 35 gal of water were added during drilling at 236 ft bgs to reduce heaving sand.

Preliminary evaluation shows that the sediments encountered during drilling were predominantly sand and silty sand of the Hanford formation from the surface to about 125 ft bgs; Plio-Pliestocene silty sand from about 125 to 145 ft bgs; and Ringold Formation sandy gravels and gravelly sand from 145 ft to total depth (239 ft bgs). The geologist's log is in Appendix A.

Sediment samples were collected at approximately 5 ft intervals for geologic description and archive throughout the entire borehole. Three split spoon samples were collected from 220 to 222 ft, 223 to 224 ft, and 230 to 232 ft bgs for analysis of grain size distribution. Data are in Appendix B. Two groundwater samples were collected by pump at 219 ft and 239 ft bgs during drilling. The results of the groundwater analyses are in Appendix D.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No contamination was noted.

The well was geophysically logged with high resolution, spectral gamma-ray and neutron-neutron moisture instrumentation November 1999. Cesium-137 was identified at the ground surface at a concentration of 8.6 pCi/g. No other contamination was identified. The geophysical logs are in Appendix C.

3.2 Well Completion

The permanent casing and screen were installed in well 299-W22-49 in November 1999. A 4-in.-inside-diameter, stainless steel, continuous wire wrap (0.01 in. slot) screen was set from 232.9 to 217.9 ft bgs. The permanent casing is 4-in.-inside-diameter stainless steel from 217.9 ft bgs to 2.0 ft above ground surface. The bottom of the screen has a 4-in. PVC end cap.

The filter pack is 20 to 40 mesh silica sand from 238.0 to 206.6 ft bgs. The annular seal is Portland cement with bentonite from 206.6 to 184.6 ft bgs, granular bentonite from 184.6 to 13.5 ft bgs, and Portland cement from 13.5 ft to the surface. A 4 ft by 4 ft by 6 in. concrete pad was placed around the well at the surface. A protective casing with locking cap, four protective steel posts, and a brass marker stamped with the well number were set into the concrete. The Well Summary Sheet (as-built) and Well Construction Summary Report are included in Appendix A.

During well construction, approximately 200 ft of tremie pipe broke and fell into the annular space immediately after placing the cement plug above the filter pack. The tremie pipe could not be retrieved and became cemented in place. A camera survey of the borehole and a well straightness test showed no damage to the casing or screen. Measurements of pH (7.75) and conductivity (206 µs/cm) during well development indicate the cement plug had no influence on water chemistry.

The vertical and horizontal coordinates of the well were surveyed in March 2000. The horizontal position of the well was determined by Global Positioning System observations referenced to horizontal control stations established by Rogers Surveying, Inc., Richland, Washington. The coordinates are Washington Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD 1988 and is based on existing bench marks established by the U.S. Corps of Engineers. Survey data are included in Table 1.

3.3 Well Development and Pump Installation

Well 299-W22-49 was developed in November 1999. A temporary, 2 hp submersible pump was used to remove approximately 850 gal of formation water at a final flow rate of 10 gal/min. The pump intake was at 227.4 ft bgs. The drawdown was 2.2 ft and the final turbidity was 4.25 NTU.

A dedicated Hydrostar sampling pump was installed in well 299-W22-49 in December 1999. The sampling pump intake is at 223.2 ft bgs (or about 4.9 ft below the water table). Static water level in the well was 217.3 ft depth on November 15, 1999.

4.0 Well 299-W22-50

4.1 Drilling and Sampling

Well 299-W22-50 was drilled between November 1999 and January 2000. The borehole was drilled by cable tool and drive barrel from 0 to 177.5 ft bgs and by hard tool from 177.5 to 241.0 ft bgs. Air rotary drilling was used to finish the borehole from 241.0 ft to a total depth of 547.5 ft bgs. Temporary carbon steel casing was used during drilling; 11 ¾-in.-outside-diameter casing was placed from 0 to 50.4 ft bgs, 8 5/8-in.-outside-diameter casing from 50.4 to 241.0 ft bgs, 6 5/8-in.-outside-diameter casing from 241 to 474 ft bgs, and 4 ½-in.-outside-diameter casing from 474 to 547.5 ft bgs.

The sediments encountered during drilling were predominantly sand and gravelly sand of the Hanford formation from the surface to about 126 ft bgs; Plio-Pliestocene silt, silty sand and sandy gravel from 126 to about 142 ft bgs; Ringold Formation Unit E sandy gravel and silty sandy gravel from 142 to about 459 ft bgs; Ringold Formation Lower Mud Unit from 459 ft to about 495 ft bgs; and Ringold Formation Unit A gravels from 495 ft to total depth. A possible clastic dike was identified by the geologist at 111 ft depth. The geologist's log is included in Appendix A.

Grab samples were collected at approximately 5 ft intervals from the surface to 20 ft depth and from 180 ft to the bottom of the borehole (except from about 465 to 495 ft depth where returns were poor) for geologic description and archive. Continuous split tube samples were taken from 20 ft to 177 ft depth and from 220 to 223 ft, 227 to 229.5 ft, 232 to 234 ft, and 458 to 460 ft depths for analysis of chemical and physical properties of the sediment. Available analytical results are in Appendix B.

Seven groundwater samples were collected during drilling from 220, 241, 258, 313, 393, 441, and 545 ft bgs. The sample from 220 ft bgs was taken with a bailer; all others were collected with a pump. The results of the groundwater analyses are in Appendix D.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No contamination was noted.

The well was geophysically logged with high resolution, spectral gamma-ray and neutron-neutron moisture instrumentation in November 1999. Cesium-137 was identified at a depth of 1 ft at a concentration of 19 pCi/g. No other man-made radionuclides were identified. All borehole logs are in Appendix C.

4.2 Well Completion

The borehole was abandoned from 547.5 to 240.75 ft bgs. It was filled from 547.5 to 498.5 ft with 4 to 9 mesh sand, from 498.5 to 450.3 ft with cement, and from 450.3 to 273.5 ft with pea gravel.

Bentonite was placed in the borehole from 273.5 to 255 ft and bentonite with natural fill from 255 to 247.35 ft bgs. The abandonment was completed with 4 to 9 mesh sand from 247.35 to 246 ft, cement from 246 to 245.35 ft, and 4 to 9 mesh sand from 245.35 to 240.75 ft bgs.

The permanent casing and screen were installed in well 299-W22-50 during January 2000. A 4-in.-inside-diameter, stainless steel, wire wrap (10 slot) screen was set from 232.96 ft to 217.95 ft bgs. The permanent casing is 4-in.-inside-diameter stainless steel from 217.95 ft bgs to 2.25 ft above ground surface. Centralizers were placed at the top and bottom of the screen and every 40 ft from the screen to the surface. The bottom of the screen has a 4-in. PVC end cap.

The filter pack is 20 to 40 mesh silica sand from 240.75 to 208.2 ft bgs. The annular seal is cement from 208.2 to 199.5 ft bgs, 8 mesh bentonite crumbles from 199.5 ft to 10 ft, and cement from 10 ft to the surface. A protective carbon steel casing with a locking cap extends to 3.5 ft above the surface. A 4 ft by 4 ft by 6 in. concrete pad was placed around the well at the surface. Four protective steel posts and a brass marker stamped with the well number was placed into the concrete. The Well Summary Sheet (as-built) and Well Construction Summary Report are included in Appendix A.

The vertical and horizontal coordinates of the well were surveyed in March 2000. The horizontal position of the well was determined by Global Positioning System observations referenced to horizontal control stations established by Rogers Surveying, Inc., Richland, Washington. The coordinates are Washington Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD 1988 and is based on existing bench marks established by the U.S. Corps of Engineers. Survey data are included in Table 1.

4.3 Well Development and Pump Installation

Well 299-W22-50 was developed in February 2000. A temporary, submersible pump was used to remove approximately 750 gal of formation water from the well at a final flow rate of about 10 gal/min. The pump intake was at 230.08 ft bgs. The drawdown was 7.2 ft and the final turbidity was 3.55 NTU.

A dedicated Hydrostar sampling pump was installed in well 299-W22-50 in February 2000. The sampling pump intake is at 224.06 ft bgs (or 4.8 ft below the water table). Static water level was 219.25 ft bgs on January 26, 2000.

5.0 References

Caggiano, J. A. 1996. *Assessment Groundwater Monitoring Plan for Single-Shell Tank Waste Management Area S-SX.* WHC-SD-EN-AP-191, Westinghouse Hanford Company, Richland, Washington.

Ecology - Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy. 1996. *Hanford Federal Facility Agreement and Consent Order.* Document No. 89-10, Rev. 4 (The Tri-Party Agreement), Ecology, Olympia, Washington.

Johnson, V. G., and C. J. Chou. 1999. *RCRA Assessment Plan for Single-Shell Waste Management Area S-SX at the Hanford Site.* PNNL-12114, Pacific Northwest National Laboratory, Richland, Washington.

RCRA - Resource Conservation and Recovery Act. 1976. Public Law 94-580, as amended, 90 Stat. 2795, 42 USC 6901 et seq.

WAC 173-160, Washington Administrative Code. *Minimum Standards for Construction and Maintenance of Wells.* Olympia, Washington.

WAC 173-303, Washington Administrative Code. *Dangerous Waste Regulations*. Olympia, Washington.

Appendix A

Well Construction and Completion Documentation

WELL SUMMARY SHEET

Date: 11/9/99

Well ID: B8812	Well Name: 299-W22-48
Location: ~50m East of 241-S Tank Farm/200W	Project: RCRA Drilling FY2000
Prepared By: L.D. Walker Date: 11/9/99	Reviewed By: DC Weekes Date: 11/16/99
Signature: LD Walker	Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram
Portland Cement Type I, II 0' → 10.8' below ground surface	
Temporary casing 11¾" OD 0' → 50' bgs	
Stainless Steel casing, type 304, sched. 5, 4½"OD/4"ID +2' → 226.24' bgs	
Granular bentonite 10.8' → 209.6'	
Temp. Casing 8¾" OD 50' → 246'	
Drive barrel, 7" OD 246' → 249'	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0' → 3': Silty Sandy GRAVEL
		3' → 7': SAND
		7' → 10': Sandy GRAVEL
		10' → 10.5': Silty SAND
		10.5' → 23': SAND
25		23' → 37': SAND
		37' → 39': SAND
		39' → 41.5': SAND
		41.5' → 49': Sandy GRAVEL
50		49' → 52.3': SAND
		52.3' → 58.5': Gravelly SAND
		58.5' → 61': Sandy GRAVEL
75		61' → 76': SAND
		76' → 79': SAND
		79' → 81.5': SAND
		81.5' → 89': SAND
		89' → 91.5': SAND
100		91.5' → 92.5': Slightly Silty SAND
		92.5' → 93': SAND
		93' → 101.8': SAND
		101.8' → 134.5': SAND
125		134.5' → 146': Silty SAND

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WELL SUMMARY SHEET

Date: 11/9/99

Well ID: B 8812		Well Name: 299-W22-48	
Location: ~50m East of 241-S Tank Farm/200 W		Project: RCRA Drilling FY2000	
Prepared By: L.D. Walker	Date: 11/9/99	Reviewed By: DC Weekes	Date: 11/16/99
Signature: L.D. Walker		Signature: DC Weekes	

CONSTRUCTION DATA

Description	Diagram
Portland Cement Type I, II 209.6' → 216.1'	
Silica Sand 20-40 mesh 216.1' → 245'	
Silica Sand 10-20 mesh 245' → 246.5'	
Stainless Steel wellscreen 0.010-in. slot cont. wire wrap type 304 SS, 228.24' → 241.25' (LW) 4½" OD / 4" ID	
PVC endcap, 4½" OD/4"ID 241.25' → 241.75'	
Stuff 246.5' → 249'	
All depths in feet below ground.	
All temporary casing removed from ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
150		146' → 149': Caliche
		149' → 161': Slightly Silty SAND
		161' → 168.5': SAND
		168.5' → 170': SILT (clastic dike)
175		170' → 189': SAND
		189' → 191.5': Slightly Silty SAND
200		191.5' → 249': Silty Sandy GRAVEL
225		WL = 227.85' bgs (11/9/99)
250		TD = 249 Feet
		Wellscreen is 226.24 → 241.25 (LW, 11-9-99)

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WELL CONSTRUCTION SUMMARY REPORT

Start Date: 10-11-99
Finish Date: 11-8-99
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Specification No.: 0200X-SP-V0002	Rev. No.: 0	Well Name: 299-W22-48	~~Temp~~ Well No.: B8812
ECNs: NA		Approximate Location: ~50m E. of 241-S Tank Farm/200W	
Project: FY2000 RCRA Drilling		Other Companies: CHI	
Drilling Company: Resonant Sonic International		Geologist(s): D. Weekes, L. Walker	
Driller: M. Wraspir			

TEMPORARY CASING AND DRILL DEPTH

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.
(FJ) 11¾" OD Carbon Steel	0' - 50'	12"/10¼"
(FJ) 8⅝" OD Carbon Steel	0' - 246'	8¾"/7¾"
	-	
	-	
	-	

*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design

DRILLING METHOD/HOLE DIAMETER

Auger:	Diameter From ____ to ____
Cable Tool:	Diameter From 0 to 249'
Air Rotary:	Diameter From ____ to ____
A.R. w/Sonic:	Diameter From ____ to ____
	Diameter From ____ to ____
	Diameter From ____ to ____
	Diameter From ____ to ____

Total Drilled Depth: 249 ft.	Hole Dia @ TD: 7"	Drilling Fluid: Water	
Well Straightness Test Results:		Total Amt. Of Water Added During Drilling: ~500 gallons	
		Static Water Level: 227.85' bgs	Date: 11-9-99

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
RLS Neutron Moisture	0' - 226'	10/27/99		-	
RLS Spectral Gamma	0' - 248'	10/27/99		-	
	-			-	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
4"ID PVC Endcap	241.75' - 241.25'		NA	Silica Sand	246.5 - 245	⅓ bag	10-20
4"ID 304SS ww screen	241.25' - 226.24'		0.010-in	Silica Sand	245 - 216.1	11½ bag	20-40
4"ID 304SS casing (sched. 5)	226.24' - +2'		NA	Portland Cement w/bent.	216.1 - 209.6	½ 3 bag	NA
	-			Granular Bentonite	209.6 - 10.8	120 bag	8-20
	-			Portland Cement	10.8 - 0	8 bag RCW	NA

OTHER ACTIVITIES

Aquifer Test: Pumping well development	Date: 11-3-99	Well Abandoned:	Yes:	No:	Date:
Description: 2-HP elect sub pump		Description:			
Final flow rate 3 gpm with ≈7 Feet of drawdown.					

WELL SURVEY DATA

Date:	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Cap Elevation:

COMMENTS/REMARKS Volume calculations!

Silica Sand: 12 x 1.12 ft^3 = 13.44 ft^3 ; Granular Bentonite: 120 x 0.71 = 85.2 ft^3
Portland Cement: 11 x 1.285 ft^3 = 14.135 ft^3

Reported By: L.D. Walker		Reviewed By: J. Owsley	
Title: Geologist	Date: 11-9-99	Title: S. Engineer	Date: 12-2-99
Signature: L.D. Walker		Signature: J. Owsley	

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BOREHOLE LOG

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Date: 10-11-99

Well ID: B8812 | Well Name: 299-W22-48 | Location: ~ 50 m East of 241-S Tank Farm
Project: RCRA drilling FY 2000 | 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'→3.0': Silty Sandy GRAVEL (msG)	Cable tool C.S. casing
	SS#1 0'→2.0'	60% rec.		40% gravel, 45% sand, 15% silt. Gravel	Shoe OD = 12", ID = 10¼"
	DB ↓	NA		is tr cobble, 30% v. cse peb, 30% cse, 40%	with 5¼" dia split spoon
	SS#2 3.0'→5.5'	100% rec.		med-v. Fn; Sand 10% v. cse-cse, 40% med,	→continuous
5				50% Fn-v. Fn. DK gray brn (10YR 4/2), moist,	rad contam < detect
	SS#3 5.5'→8.0'	100% rec.		poorly sorted; gravel rnd, sand sub-ang,	4" dia. lexan liners
				60% basalt; 40% qtz, granite, other; max	Split spoon 2.0'
				gravel ~ 6 cm, common caliche coating	length w/ 4 x 6"
				on gravel.	lexan liners.
	SS#4 8.0'→10.5'	160 blows 100% rec.			End 10/11/99
10				3.0'→7.0': SAND (S), 95% sand,	Begin 10/12/99
	SS#5 10.5'→13.0'	130 blows 100% rec.		5% silt, Tr v. cse sand, 10% cse, 40%	10.5'→moisture
				med, 40% Fn, 10% v. Fn. Brown (10YR 4/3)	sample
	SS#6 13.0'→15.5	140 blows 100% rec.		moist, well sorted, sub-angular; 40%	
				30% basalt, 70% qtz/other; max size	No rad contam detected
15				~ 2 mm.	OVM < detect
	SS#7 15.5'→18.0'	140 blows 100% rec.		7.0'→10.0': Sandy GRAVEL (sG) similar	15'→moisture samp.
				to above, lower silt content, predom. cse	*Drive split spoon
	SS#8 18.0'→20.5'	160 blows 100% rec.		to med. sand.	samplers, then
				10.0'→10.5': Silty SAND (mS), 60% sand,	drive 11¾" OD casing
20				40% silt, brn (10YR 5/3) moist, well sorted	then clean borehole
	SS#9 20.5'→23.0'	150 blows 100% rec.		sand predom Fn-v. Fn, streng rxn HCl.	w/ 10" OD core barrel.
				10.5'→23.0' SAND (S) 90% sand, 5% gravel	repeat.
	SS#10 23.0'→25.5'	140 blows 100% rec.		5% silt. Sand predom med-Fn, with thin	
				layers of cse-v. cse (less than 0.1' thickness)	20.0'→moisture samp.
25				Grayish brn (10YR 5/2), moist, well sorted, sub	25.0'→moisture samp.
	SS#11 25.5'→28.0'	150 blows 100% rec.		angular; 25% basalt, 75% qtz/other, tr	
				mica, max gravel ~ 1 cm, weak HCl rxn.	
	SS#12 28'→			23': v. cse sand; 40% basalt, 60% qtz/other	

Reported By: L.D. Walker | Reviewed By: DC Weekes DC Weekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 10/12/99 | Signature: DC Weekes | Date: 11/16/99

BOREHOLE LOG

Date: 10-12-99

Well ID: B8812	Well Name: 299-W22-48	Location: ~50m East of 241-S Tank Farm
Project: RCRA drilling FY 2000		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 HC1	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
30	SS #12 →30.5	100% rec.		23.0' → 37.0' : SAND (S), 95% sand,	Cable tool, 11 3/4" OD CS
	SS #13 30.5'→ 33.0'	190 blows 100% rec.		5% silt. Sand 10% v.cse, 30% cse, 50%	casing; cont. 5" OD
				med, 10% Fn- v.Fn., dk grayish brn (10YR	split spoon w/ 4" OD
				4/2), sl moist, mod- well sorted, sub-	lexan liners
	SS #14 33.0'→ 35.5'	100% rec.		angular to angular; 40-45% basalt,	30.0'→ moisture sample
35				55-60% qtz, Felds, other; max size	
	SS #15 35.5'→ 38.0'	100% rec.		~2 mm; weak rxn HCl - local strong rxn.	35.0'→ moisture samp.
				34.5': tr orange - poss. iron oxide stain	
				37.0'→ 39.0': SAND (S), 100% sand, tr	OVM < detect
	SS #16 38.0'→ 40.5'	100% rec.		silt. 10% v.cse - med, 50% Fn, 40% v.Fn.	α, γ, β < detect
40				Pale brown (10YR 6/3), moist, well sorted,	40.0'→ moisture
	SS #17 40.5'→ 43.0'	220 blows 100% rec.		sub-angular; 10-15% basalt, 85-90%	sample
				qtz + feldspar, rxn to HCl weak to none.	
				39.0'→ 41.5': SAND (S) 100% sand,	End 10/12/99
	SS #18 43.0'→ 45.5'	100% rec		similar to med/cse sand above	
45				40-45% basalt, weak rxn HCl	45' moisture sample
~~46~~	~~[illegible]~~	~~[illegible]~~		41.5'→ 49': Sandy GRAVEL (sG),	
	SS#19 46- 48.5	95% rec.		60% g, 30% s, 10% silt; Gravel is 90% bas,	
				10% other, SR-SA, white coating common (CaCO₃?)	
				Some RXN to HCl [Slight to mod], Sand is	
50	SS #20 48.5'→ 51'	100% rec.		basalt-rich, SR-SA, 10YR 6/2 (dry) lt brnish	50' moisture sample
51				gray, moist, poorly sorted, max part = 30 mm	
	SS#21 51'→ 53.5'	100% rec.		Avg clast size increases downhole	
53				49'→ 52.3': SAND (S), 100% sand, tr gravel,	
				10YR 7/2 (dry) light gray, moist; 10% vc, 10% c,	
55	SS#22 53.5'→ 56'	100% rec.		60% m-f, 10% vf, 10% silt; 30% bas, 70% other,	55' moisture sample
56				max size 5mm, SA-SR, strong rxn to HCl, moderately sorted	
	SS#23 56'- 58.5'	100% rec		52.3'→ 58.5': GRAVELLY SAND (gS), 20% gravel, 25% vc, 20% c,	
				30% m-vf, 5% silt; moist, as above color, moderately sorted,	
				gravel is 70% bas, SA-SR; Sand is 60% bas, A-SR, slight rxn to HCl (to strong)	

Reported By: L.D. Walker / DC Weekes		Reviewed By: Pat Moore	
Title: Geologist		Title: Geologist	
Signature: [signature]	Date: 10/13/99	Signature: Pat Moore	Date: 11/17/99

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 2 of 7
Date: 10/13/99

Well ID: B8812 | Well Name: 299-W22-48 | Location: ~50m East of 241-S Tank Farm
Project: RCRA Drilling FY2000 | 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 HC1	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
60	SS#24 DB	100% rec.		58.5'→61': Sandy GRAVEL(SG) 50% gravel, 50% sand, moist, color as above, V poorly sorted, gravels are basalt-rich, SA-R; sand is basalt-rich, A-SR; mod to strong rxn to HCl, large rocks @ 59.5', at least 10 cm	SS#24 stopped at 59.5' due to rock. moisture sample at 60' from drive barrel
63	SS#25 60.5'-63'	100% rec.		61'→76': SAND (S) tr grav, 20% vc-c, 30% m, 40% f-vf, 10% silt, G is basalt-rich, SA-SR; Sand is 30% bas, 70% qtz+other, A-SA, strong rxn to HCl,	
65	SS#26 63'-65.5'	100% rec.			65' moisture sample
68	SS#27 65.5'-68'	100% rec.		max part ~ 4mm, strong rxn to HCl @65' sand is mostly c-m	End of shift 10/13/99
70	SS#28 68'→70.5'	100% rec.		68' - weak rxn HCl	Begin 10/14/99
73	SS#29 70.5'→73'	100% rec.			70.0' moisture sample
75	SS#30 73'→75.5'	100% rec.		73.5'→74.5': Sand predom. med-Fine 15% basalt, 85% qtz/other, weak HCl rxn.	75.0' moisture sample
	SS#31 75.5'→78'	100% rec.		74.5' Sand cse-med as above. 76'→79': SAND (S); 100% sand, tr silt.	
80	SS#32 78'→80.5'	100% rec.		20% med, 60% fn, 20% v.fn; pale brown (10YR6/3) sl. moist, well sorted; SA-SR; 10-15% basalt, 85-90% qtz/other; max size ~ 1mm, weak rxn HCl.	80.0' moisture sample
	SS#33 80.5'→83'	100% rec.		79→81.5': SAND (S) med-cse sand as above.	
85	SS#34 83'→85.5'	100% rec.		81.5'→89.0': SAND (S); predom. fine sand as 76-79.	85.0' moisture sample
	SS#35 85.5'→88.0'	100% rec.			
	SS#36	100%			

Reported By: DC Weekes / L.D. Walker | Reviewed By: Pat Moore
Title: Geologist | Title: Geologist
Signature: DC Weekes / L.D. Walker | Date: 11/16/99 | Signature: Pat Moore | Date: 11/17/99

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 4 of 7
Date: 10/14/99

Well ID: B8812 | Well Name: 299-W22-48 | Location: ~50m E of 241-S Tank Farm
Project: RCRA Drilling FY 2000 | 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
90	SS #36 88-90.5'	100% rec.		89.0'→91.5': SAND (S) med-cse as described above	8 3/4" OD Cs casing
	SS #37 90.5'→93'	100% rec.		91.5'→92.5': Slightly Silty SAND (m) S) 85% sand, 15% silt, similar to Fn sand described above. No rxn HCl	90.0' moisture sample
95	SS #38 93'→95.5'	100% rec.		92.5'→93.0': SAND (S) predom. cse-med, strong rxn HCl	95.0' moisture sample SS #38 very loose sand
	SS #39 95.5'→98'	100 % rec.		93.0'→101.8': SAND (S) tr vcs-cse, 20% med, 50% fn, 30% v. fn, tr silt. Brown (10YR5/3); sl moist, well sorted-mod sort; SA-SR; 15% basalt, 85% qtz/other, tr mica, max size ~1mm, sl rxn HCl.	
100	SS #40 98'→100.5'	100% rec.			100' moisture sample End 10/14/99
	SS #41 100.5'→103'	100% rec.		101.8'→134.5': SAND (S) 100% vf-f sand, tr silt, 10YR 5/3 (moist) brown, moist, v well sorted, strong rxn to HCl, thin zones of medium-vf sand	Sharp contact @ 101.8'
105	SS #42 103'→105.5'	100% rec.			105' moisture sample
	SS #43 105.5'-108'	100% rec.			
110	SS #44 108'-110.5'	100% rec			110' moisture sample
	SS #45 110.5'→113'	100% rec			
115	SS #46 113'→115.5'	100% rec.			115' moisture sample
	SS #47 115.5'→118'	100% rec.			Possible clastic dike(?) @ 116.5': 1" vertical clayey silt (brown)
	SS #48 118'-120.5'	100% rec			

Reported By: L.D. Walker / DC Weekes | Reviewed By: Pat Moore
Title: Geologist | Title: Geologist
Signature: LD Walker DC Weekes | Date: 10/14/99 | Signature: Pat Moore | Date: 11/17/99

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 5 of 9
Date: 10/15/99

Well ID: B8812 | Well Name: 299-W22-48 | Location: ~50m E of 241-S Tank Farm
Project: RCRA Drilling FY2000 | 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
120	SS #48 118→120.5	100% rec.		101.8'→134.5': SAND(S): see p.4 description	Adjusted graphic log from previous page. 120' moisture sample.
	SS #49 120.5'→123'	100% rec.			
	SS #50 123'→125.5'	100% rec.			125 moisture sample.
	SS #51 125.5'→128'	100% rec.			Starting at ~128' the sand is much drier.
	SS #52 128'→130.5'	100% rec.			130' moisture sample.
	SS #53 130.5'→133'	100% rec.		134.5'→146': Silty SAND (mS), 60% sand, 40% silt. Sand is 80% v. Fn, 20% Fn. Pale brown (10YR 6/3), sl moist, well sorted; sub-angular; predom qtz, felds, (basalt < 5%), strong rxn HCl. →difficult to keep in core barrel	131': dry sand-difficult to bring out with core barrel. Add 2 gallons water
	SS #54 133'→135.5'	100% rec. (slough)			135' moisture sample
	SS #55 135.0'→137.5'	100% rec.			
	SS #56 137.5'→140'	80% rec. (none in drive shoe)		138': material is dry	
	SS #57 140'→142.5'	100% rec.		142': trace laminations ~ 1mm in thickness	140' no moisture sample - no material in drive shoe.
	SS #58 142.5'→145'	100% rec.			
	SS #59 145'→147.5'	100% rec.		146'→149': Caliche, in a silty sand. lt. brn (7.5YR/6/3) tr pink, sl-moist→dry, violent rxn HCl. Gravel starting ~148', max size ≈ 2.5 cm. Sub-round, caliche cement.	145' moisture sample very slow hard drilling. SS shoe Flattened.
	SS #60 147.5'→150'	100% rec.		Qtzite, granite predom.	150' moisture sample

Reported By: L.D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: L.D. Walker | Date: 10-19-99 | Signature: DC Weekes | Date: 11/16/99

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 6 of 9
Date: 10-19-99

Well ID: B8812 | Well Name: 299-W22-48 | Location: ~50 m. East of 241-S Tank Farm
Project: RCRA Drilling FY 2000 | 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
150	SS #60			149'→161': Slightly Silty SAND ((m) S)	8¾" OD CS casing;
	SS #61 150'→152.5'	100% rec.		85% sand, 15% silt, tr gravel. Sand 10% cse, 20% med, 40% fn, 30% v. fn; gravel v. fn - fn peb. Lt brnish gray (10YR 6/2), dry, mod sorted; gravel SR, sand SA-SR, predom qtz, 10% basalt; strong to violent rxn to HCl - calcareous	Cont. 5" OD split spoon sampling; cable tool
	SS #62 152.5'→155'	100% rec.			155' moisture sample
155	SS #63 155'→157.5'	100% rec.			
	SS #64 157.5'→160'	100% rec.		157 ft: sand as above, but weak to no rxn with HCl.	
				159 Ft: sand becomes loose and dry. silt content gradually decreasing	160' moisture sample End 10/19/99
160	SS #65 160'→162.5'	100% rec.		161'→168.5': SAND (S); 90-95% sand, 5-10% silt. 10% cse, 40% med, 40% fn, 10% v. fn sand. Lt. brn. gray (10YR 6/2), dry, mod-well sorted; sub-angular; 10-15% mafics, 85-90% qtz, feldspar, other. tr mica. No rxn to HCl.	
	SS #66 162.5'→165'	100% rec.			
165	SS #67 165→167.5'	100% rec.			165' moisture sample
	SS #68 167.5'→170'	100% rec.		166'-167': trace med-fn pebbles w/caliche coatings - strong rxn HCl. Gravel is rounded qtzite.	tr free water at ~170 ft. (drops - not measurable)
170	SS #69 170'→172.5'	100% rec.		168.5'→170': Silt (M) mixed with tracer of sand. Probable clastic dike. Very pale brown (10YR 7/4), moist to wet, strong rxn to HCl.	170' moisture sample
	SS #70 172.5'→175'	100% rec.		170'→189': SAND (S) as described in 161→168.5'. trace of silt/clastic dike 171-172', then only sand. Dry. no rxn to HCl	Clastic dike (?)
175	SS #71 175'→177.5'	100% rec.			175' moisture sample
	SS #72 177.5'→180	100% rec.			* No rad contam. detected at clastic dike

Reported By: L.D. Walker | Title: Geologist | Signature: L.D. Walker | Date: 10-20-99

Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 11/16/99

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 10-20-99

Well ID: B8812 | Well Name: 299-W22-48 | Location: ~50m East of 241-S Tank Farm

Project: RCRA Drilling FY2000 | 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
180	SS #72				8¾" OD CS casing
	NA	NA		170'→189': SAND (S) see page 6 description	Cont. 5" OD split spoon sampling; cable tool
	SS #73 181'→183.5'	100% rec.			180' moisture sample
	SS #74 183.5'→186'	100% rec.			185.5' moisture sample
185	SS #75 186'→188.5'	100% rec.			End 10/20/99
				189'→191.5': Slightly Silty SAND (slS)	Begin 10/21/99
	SS #76 188.5'→191'	100% rec.		Sand as above, with silt content increase to 15-20%. Dry; no rxn HCl	190.5' moisture sample
190	SS #77 191'→193.5'	50% rec.		191': tr med. pebbles	192' moisture sample
				191.5'→249': Silty Sandy GRAVEL (msG)	
	HT ↓ Archive Grab	NA		50-60% Gravel, 30-40% sand, 20% silt. Drilling indicates some cobbles, some round pebbles fn-v. fn are unbroken in hard tool slurry. Sand is 10% v. cse, 30% cse, 40% med, 20% fn-v. fn; poorly sorted, gravel round-sub rnd, sand SA-SR, 20-30% basalt, 70-80% qtz, felds, other tr mica; dried slurry no rxn to HCl.	193.5' switch to Hard Tool drilling
195	HT				195-196': collect HT slurry sample for archive
	Archive Grab				200'→201': archive grab sample
200	HT				Begin 10/22/99
					Drilling indicates more gravel than sand
	Archive and waste charact.				205': Waste characterization sample # B0WPB1 and archive sample
205	HT			209.5'→210' drilling indicates sand, then back to gravel.	

Reported By: L.D. Walker		Reviewed By: DC Weekes	
Title: Geologist		Title: Geologist	
Signature: LD Walker	Date: 10/22/99	Signature: DC Weekes	Date: 11/16/99

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 8 of 9
Date: 10/22/99

Well ID: B8812 | Well Name: 299-W22-48 | Location: ~50m East of 241-S Tank Farm
Project: RCRA Drilling FY 2000 | 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
210	Archive Grab	NA			8¾" OD CS casing
	HT			191.5'→249': Silty Sandy GRAVEL (msG) as described on page 7	cable tool - hard tool
					210' Archive sample
215	Archive Grab				215' Archive sample
	HT				
					220' Archive sample
220	Archive grab				End 10/22/99
	HT				
				225' silt and sand content increasing in the hard tool slurry, otherwise as above	225'→226' Archive and Near Water Table Sample
225	Archive Grab				
	HT				
230	Archive Grab				230' Archive sample
	HT				231' Drilling indicates sand/silt
	SS Sieve #1 234'→236.5'	100% rec.		Silty Sandy GRAVEL (msG) as above. No rxn HCl	233' - water sample W.L.= 228.0'
235					234'→236.5' First Split spoon - Sieve analysis
	HT	NA		236' slurry grab sample for waste characterization: B0PB[LW] B0WPB2, B0WPB4	Also archive 235' Also PNNL hydrol. conductivity.

Reported By: L.D. Walker | Title: Geologist | Signature: L.D. Walker | Date: 10/26/99
Reviewed By: D.C. Weekes | Title: Geologist | Signature: D.C. Weekes | Date: 11/16/99

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 9 of 9
Date: 10-26-99

Well ID: B8812 | Well Name: 299-W22-48 | Location: ~50m East of 241-S Tank Farm
Project: RCRA Drilling FY 2000 | 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
240	Archive				8¾" OD CS casing
	SS Sieve #2 240.5'→242.5'	80% rec.		Silty Sandy GRAVEL (msG) 60% gravel, ~~25~~ 20% sand, ~~15~~ 20% silt. gravel tr cobble, 20% v. cse peb, 50% cse-med, 30% fn-v. fn; sand 10% v. cse-ese, 40% med, 30% fn, 20% v. fn. 2.5Y5/3 (lt olive brown), wet, very poorly sorted, gravel round-sub round, sand SA-SR, sand 85% qtz, feldS, 15% basalt; tr mica	Cable tool-hard tool (PNNL analysis also 240.5'→242.5': Sieve Sample #2 (split spoon) 240'→ archive slurry sample. 245'→ archive slurry sample.
	HT				
245	Archive (grab)				
	HT				
	Archive				
	DB			gravel 60% granite, qtzite, 40% basalt, mafics; max gravel over 200 mm 243' drilling became more difficult. HCl rxn weak at 242'	245'→ increase in water production 245': Some sand heave into borehole.
250					
					249': Drive barrel Archive sample
255				TD = 249 Feet	246': water sample collected 10-28-99 using Kabis sampler Water level = 226.2'
260					
265					

Reported By: L.D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 10/27/99 | Signature: DC Weekes | Date: 11/16/99

BHI-EE-183 (12/97)

WELL SUMMARY SHEET

Page 1 of 2
Date: 11/22/99 DCW 12/27/99

Well ID: B8813		Well Name: 299-W22-49	
Location: SE SX Tank Farm		Project: RCRA Resource Protection well	
Prepared By: Pat Moore	Date: 11/22/99	Reviewed By: DC Weekes	Date: DCW 11/22/99 12/27/99
Signature: Pat Moore		Signature: DC Weekes	

CONSTRUCTION DATA

Description	Diagram
Portland Cement Type I, II 0 → 13.5' below ground surface	
Temporary casing 11¾" OD 0' – 50' bgs	
Stainless steel casing type 304, sched. 5, 4½" OD / 4¼" ID +2' → 233.4' bgs.	
Granular bentonite + bentonite crumbles to 13.5' → 184.6'	
Temp. Casing 8 5/8" OD 50 → 236.4'	
Clean out barrel .8' OD 236.4 → 238'	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0 - 2': Gravelly SAND
		2 - 10.5': SAND
		10.5 - 14.5': Gravelly SAND
		14.5 - 27': SAND
25		27 - 33.1': Silty SAND
		33.1 - 38': slightly silty SAND
		38 - 45': Silty SAND
		45 - 48': Slightly Silty SAND
		48 - 50': Silty SAND
50		50 - 54': SANDY GRAVEL
		54 - 61': Gravelly SAND
		61 - 145': SAND
75		
100		
125		
		145 - 150': Gravelly SAND

BHI-EE-189 (12/97)

WELL SUMMARY SHEET

Date: 11/22/99

Well ID: B8813	Well Name: 299-W22-49
Location: SE SX Tank Farm	Project: RCRA Resource Protection well.
Prepared By: Pat MOORE Date: 11/22/99	Reviewed By: DC Weekes Date: 12/27/99
Signature: Pat Moore	Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram
Portland Cement Type I, II 184.6' → 206.6'	
Silica Sand 20-40 mesh 206.6' → 238'	
Stainless steel well screen 0.010-in slot Continuous wire wrap, type 304 SS, 227.9' → 232.9' (4 1/2" OD, 4 1/4" ID)	
PVC Endcap, 4 1/2" OD/4" ID 232.9' → 233.4'	
Slough 238-239'	
All depths in feet below ground surface	
All temporary casing removed from ground	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
150		150-154': SANDY GRAVEL
		154-160.5' gravelly SAND
		160.5-167': SAND
		167-168': GRAVEL
		168-177': gravelly SAND
175		177-181': sandy GRAVEL
		181-182.5' gravelly SAND
		182.5-189': sandy GRAVEL
		189-194': gravelly SAND
		194-205': sandy GRAVEL
200		205-208' gravelly SAND
		208-239': sandy GRAVEL
		water level = 217.3' bgs (11/15/99)
225		231-239': gravelly SAND
		TD = 239'
250		

BHI-EE-189 (12/97)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 10/26/99
Finish Date: 11/22/99
Page 1 of 1

Specification No.: 0200X-SP-V0002	Rev. No.: 0	Well Name: 299-W22-49	Temp. Well No.: 888/3
ECNs: NA		Approximate Location: SE SX Tank Farm	
Project: RCRA Resource Protection Well		Other Companies: CHI	
Drilling Company: Resonant Sonic International		Geologist(s): Pat Moore, DCWeekes	
Driller: Ken Flower			

TEMPORARY CASING AND DRILL DEPTH

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.
(FJ) 11 3/4" OD Carbon Steel	0 - 50'	12"/11"
(FJ) 8 5/8" OD Carbon Steel	50 - 236.5'	8 5/8"/7 5/8"
	-	
	-	
	-	
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design		

DRILLING METHOD/HOLE DIAMETER

Auger:		Diameter From ____ to ____
Cable Tool:	0.8'	Diameter From 0' to 50'
Air Rotary:	0.6'	Diameter From 50' to 239'
A.R. w/Sonic:		Diameter From ____ to ____
		Diameter From ____ to ____
		Diameter From ____ to ____
		Diameter From ____ to ____

Drilling Fluid: water

Total Drilled Depth: 239' | Hole Dia @ TD: 8" (Nominal) | Total Amt. Of Water Added During Drilling: ~395 gallons

Well Straightness Test Results: Positive | Static Water Level: 217.3' | Date: 11/15/99

GEOPHYSICAL LOGGING 495

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
RLS Neutron moisture	0 - 218	11/9/99		-	
RLS Specral Gamma	0 - 238	11/7/99		-	
	-			-	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
4½ OD PVC End cap	233.4 - 232.9		NA	Silica sand	238 - 206.6'	13.5 bgs	20-40
4½ OD 304SS wwscrn	232.9 - 217.9		.010in	Portland Cement/bent.	206.6 - 184.6'	118 bags	—
4½ OD 304SS casing (Sch. 5)	217.9 - +2		NA	Granular Bentonite	184.6' - 13.5'	108 bags	Pumping Stopped
	-			Portland Cement	13.5' - 0'	11	—
	-				-		

OTHER ACTIVITIES

Aquifer Test: Pumping Well development	Date: 11-15-99	Well Abandoned:	Yes:	No:	Date:
Description: 2-HP electrical submersible pump. Final flow rate 10 gpm with ≈ 2.2' of drawdown.		Description:			

WELL SURVEY DATA

Date:	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Cap Elevation:

COMMENTS/REMARKS Volume calculations:

Silica sand = 13.5 x 1.12 ft³ = 15.12 ft³; bentonite: 108 x 0.71 = 76.68 ft³

Portland cement = 18 x 1.285 ft³ = 23.13 ft³

Reported By: Pat Moore		Reviewed By: J Smith	
Title: Geologist	Date: 11/22/99	Title: Sr. Engineer	Date: 11-22-99
Signature: Pat Moore		Signature: J Smith	

BOREHOLE LOG

Page 1 of 8
Date: 10/27/99

Well ID: B8813 | Well Name: 299-W22-49 | Location: SE corner of SX Tank farm
Project: RCRA Resource Protection Well | 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				0-2' Gravelly SAND (gS) - 10% gravel, 85% sand, 5% silt, 10YR 6/2, light brownish gray, dry, well sorted, Gravels: SR, 25% basalt, 75% other, Sand: 20% basalt, fine-med gr, max particle size = 50 mm, weak RxN to HCl.	cable tool, 11 3/4" casing.
1					
2	Grab 2.5'				grab samples
	Sample #1				every 5', collecting
5					2 - 1 pint jars per sample
	Archive 7.45' #2			2-7' SAND(gS) 10YR/6-2, light. br. gray, dry, well sorted, fine grained sand, < 5 mm max particle size, weak RxN to HCl, 40% basalt, 60% other, SA.	
10				7-10.5' SAND(S): 2.5Y 4/2 dk. gray brn, well sorted, fine-med gr., mod-strong RxN to HCl. One broken SA basalt cobble to 110mm. moist, <5% silt. 50% basalt, SA-SR sand	Rad values 70 cpm higher than background (80 cpm) for most samples < 150 cpm well below regulatory limits
	Archive 12.9' #3 14.5'	NA			
15	Archive 16.9' #4 17.7'			10.5-14.5' gravelly SAND(gS) 90% sand, 10% gravel, gravel SR to 150mm (cobble), 95% basalt sand: moist, 75% med gr, 25% fine grained, 2.5Y 4/3 olive brown, SA, 75% basalt, 25% other weak RxN to HCl.	
20	Archive 22' #5			14.5-25' SAND(S), moist, fine grained to very fine grained, 10YR 5/2, 40% basalt, SA grains. weak RxN HCl very well sorted, 60% basalt, 40% other, max particle size < 5mm	Sample 20' 20 counts above background ≈ 90 cpm
25	Archive 26.9' #6			25-27.1' SAND(S), moist, med. unit fine grained, 2.5Y 4/1 Dark gray, well sorted, 70% med, 30% fine, SA-SR, 60% basalt, 40% other max part = 2mm, mod. rxn to HCl.	
30					

Reported By: Pat Moore | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Pat Moore | Date: 10/27/99 | Signature: DC Weekes | Date: 12/27/99

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 2 of 8
Date: 10/28/99

Well ID: B8813 | Well Name: 299-W22-49 | Location: SE corner of SX Tank Farm
Project: RCRA Resource Protection Well | 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				27 - 33.1 silty SAND (mS), 80% sand, 20% silt, sand: 2.5Y 7/1 (ltgray) silt 5Y 5/2 (gray-br), moist, well sorted, SA, 60% bas., 40% other, max part = 2mm, silt strong rxn to HCl, sl. plastic	cable tool, drive barrel, 11 3/4" casing
	Archive 33.1'				
	#7			33.1 - 38 slightly silty sand (mS), 90% sand, 10% silt, 2.5Y 5/3 lt. olive brown, moist, well sorted, SA, 40% basalt, 60% other, max part = .5mm, sand fine - v.f., mod rxn HCl	Driller notes harder drilling (inc. competency) ~ 35'
35	Archive 38.0				
	#8			38' - 45' silty sand (mS), as above with increasing silt (40%) content and increasing medium gr. sand content (20%); rest f.g. (Lenses of silty/med sand)	Rad 60 cpm cts above background ~35'
40					
	Archive 45.0			45' - 48' slightly silty SAND mS) 90% sand, 10% silt, 2.5Y 5/3, lt. olive br, moist, well sorted, SR, 40% basalt, 60% other, max part: .5mm, sand f.g. mod rxn to HCl.	
45	#9	NA			
	Archive 48.0			48' - 50' silty SAND (mS) 60% fine sand, 40% silt, 2.5Y 5/2 grayish brown, moist to damp, well sorted, SA, 40% basalt, 60% other, max part: .5mm, f.g. sand mod rxn to HCl	
	#10				
50	50.0' #11			50' - 54' Sandy GRAVEL (sG): 40% gravel, 60% sand, tr silt, 2.5Y 5/3 lt olive brown (moist), moist, mod sorting, gravel is SA-SR, mostly basalt; sand is 50% bas, 50% other, A-SA, max part = 6", mod-strong rxn to HCl.	Air rotary, 9 5/8" casing End of shift 10/28/99 Beg. of shift 11/1/99
	(12" recovery) Soil Sample #1				
	Archive 12				
55	(8" recovery) Soil Sample #2			54' - 61.5' gravelly SAND (gS): 20% gravel, 80% sand, tr silt, 2.5Y 6/2, lt. brownish gray (moist), moist, poorly sorted, gravel SA-SR, 60% basalt, sand 40% basalt, max part = 4mm, NO rxn to HCl	End of shift 11/2/99 Beg. of shift 11/2/99
	#12				
	Archive 13				
60					

Reported By: Pat Moore | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Pat Moore | Date: 10/27/99 | Signature: DC Weekes | Date: 12/27/99

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 3 of 8
Date: 11/1/99

Well ID: 08813 | Well Name: 299-W22-49 | Location: SE corner of SX Tank Farm
Project: RCRA Resource Protection Well | 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
60	17" recovery Sock Sample #2 Archive 14	NA		61-~~55~~ 55'-60' pm SAND, (S), 2.5Y 6/2 (lt br. gray moist) moist, well sorted medium + fine grained sand, SA, 40% basalt 60% other, max part = 1mm no Rxn to HCl. trace gravel (5%) SA to 25mm, basaltic	Air Rotary 9 5/8" casing
65	7" recovery Sock Sample #2 Archive 15			~~PZ65~~ 70' sand (S) 2.5Y 5/2 gray brown (moist), moist, well sorted, medium sand to 2mm, SA-SR, 35% basalt, 65% other, no Rxn to HCl. (5%) trace gravel basaltic	
70	6" recovery Sock Sample #2 Archive 16			70-100' sand (S), 2.5Y 5/2 gray br. (moist), moist, well sorted, medium fine sand to 1.5mm, SA-SR, 35-40% basalt, trace basaltic gravel to 10mm, no slight Rxn HCl trace silt (<1%) in clumps.	
75	12" rec. Sock Sample #3 Archive 17				
80	8" rec. Sock Sample #3 Archive 18				
85	14" rec. Sock Sample #4 Archive 19				Waste Designation samples collected @ 85 ft (BOW06, BOW07)
90					

Reported By: Pat Moore | Title: Geologist | Signature: Pat Moore | Date: 11/2/99
Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 12/27/99

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 4 of 8
Date: 11/2/99

Well ID: B8813 | Well Name: 299-W22-49 | Location: SE corner of SX Tank Farm
Project: RCRA Resource Protection Well | 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
90					Air Rotary
	12" rec				8 5/8" casing
	Sock Sample #4				
	Archive 20				
95	3½"				
	Sock				
	Sample #5				
	Archive 21				
100				100'-125': SAND (S), 2.5Y 5/3	
				lt. olive brown (moist) moist, well	
	Sock Sample #6	NA		sorted fine & medium sand, SA-SR,	
	Archive 22			20-25% basalt, rest other, mod.	
105				reac. to HCl, max particle = .5mm	
	Sock Sample #7			5% sand silt (SL. plastic), clumps.	
	Archive 23				
110					
	Sock Sample #8				
	Archive 24				
115					
	Sock Sample #9				
120	Archive 25				

Reported By: Pat Moore | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Pat Moore | Date: 11/2/99 by DW | Signature: DC Weekes | Date: 12/27/99

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 5 of 8
Date: 11-3-99

Well ID: B8813 | Well Name: 299-W22-49 | Location: SE corner of SX Tank Farm/200W
Project: RCRA Resource Protection Well | 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
120		NA			Air rotary
					8 5/8" OD casing
	Sock Sample #10 Archive 26			125'→145': SAND (S) 90% sand, 10% silt. Sand is tr cse-10% med, 40% fn, 50% v. fn. Light olive brown (2.5Y5/4), sl moist, well sorted, sub-angular; 15-20% basalt, 80-85% qtz, Felds, other; max size ~~1mm~~ 0.5mm, weak rxn to HCl.	
125					
	Sock Sample #11 Archive 27				
130					
	Sock Sample #12 Archive 28			slightly Finer than sand above.	
135					
	Sock Sample #13 Archive 29				
140					
	Sock Sample #14 Archive 30				
145				145'→150': Gravelly SAND (gS), 20% gravel, 80% sand, tr silt. Sand similar to above, gravel med-fn peb, sub-round. Gravel 50-60% basalt.	
	Sock Sample #15 Archive 31				
150					

Reported By: L. D. Walker | Reviewed By: DA Weekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 11-3-99 | Signature: DA Weekes | Date: 12/27/99

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 6 of 8
Date: 11-3-99

Well ID: B8813 | Well Name: 299-W22-49 | Location: SE corner of SX Tank Farm
Project: RCRA Resource Protection Well | 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
150		NA		150' → 154': Sandy GRAVEL (sG) 40% gravel, 60% sand, tr silt. Gravel 10% cse peb, 50% med, 40% fn peb; sand 10% cse, 30% med, 40% fn, 20% v. fn, lt. olive brown, moist, poorly sorted; sand SA, gravel SR-SA; sand 10-15% basalt, gravel 40-50% basalt, 50-60% granite, qtzite, other, max size ≈ 3 cm, weak HCl rxn.	Air rotary 8 3/8" OD casing
	Sock Sample #16 Archive 32				
155	Sock Sample #17 Archive 33			154' → 160.5': Gravelly SAND (gS) similar to above sandy gravel, with gradual decrease in gravel content.	~157 Ft. begin adding water to cyclone for dust control.
160	Sock Sample #18 Archive 34			160.5' → 167': SAND (S) 0-5% gravel, 95-100% sand, tr silt.	Digital images recorded of all sock samples
165	Sock Sample #19 Archive 35			167 - 168: GRAVEL (G) 60% basalt, 40% other, SA, 10YR 5/1 (dry) gray, moist, max particle = 25 mm, no Rxn to HCl	
170	Sock Sample #20 Archive 36			168 - 177': Gravelly Sand (gS) 10% gravel, 90% sand, medium sand 2.5Y 5/3 (lt. olive brown), moist, SA, max particle = 35 mm, no Rxn to HCl.	
175	Sock Sample Archive 37			177 - 181: Sandy Gravel (sG), 70% Gravel, 30% sand, gravel SA-SR, 50% basalt, 50% other, 2.5Y 4/3 (moist), olive brown, max part. = 22 mm, no Rxn to HCl med sand, SA, sand 50% basalt 50% other	11-3-99 end shift 175 ft. 11/4/99 begin shift
180					

Reported By: Pat Moore | Title: Geologist | Signature: Pat Moore | Date: 11/3/99
Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 12/27/99

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 7 of 8
Date: 11-4-99

Well ID: B8813 | Well Name: 299-W22-49 | Location: SE corner of SX Tank Farm
Project: RCRA Resource Protection Well | 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
180					Air Rotary
	Sock Sample			181 - 182.5 gravelly SAND (gS)	8 5/8" OD casing
	Archive 38			gravel 10%, sand 90%, CSS+ medium sand	
				2.5Y 5/3 (moist) lt. olive brown, 60%	
185				basalt, 40% other, SA, max particle =	
	Sock Sample			20 mm, no rxn to HCl.	
				182.5 - 189 sandy Gravel (sG)	
	Archive 39			gravel 80%, 20% sand, gravel:	
				30% basalt, 70% other, sand 50% basalt,	
				Gravel SA-SR, moist, 7.5YR 5/3 (dry) brown,	
190				max particle: 30 mm, no rxn to HCl.	Sock Samples
	Sock Sample			189 - 194 gravelly SAND (gS)	recorded with
				25% gravel, 75% sand, : sand	digital camera
	Archive 40			25% basalt 80% other, medium + CSS grains,	
				moist, 2.5Y 6/6 (moist) olive yellow,	
195		NA		SA, max gravel = 45 mm, no rxn to HCl.	
	Sock Sample			194' - ~~200~~ 205: sandy Gravel (sG)	
				75% gravel, 25% sand, tr silt.	
	Archive 41			Gravel 10% cse peb; 40% med, 30% fn,	Stopped adding
				20% v. fn; Sand 10% v. cse - med, 50%	water @ 200'
200				fn, 40% v. fn; pale brown (10YR 6/3), sl	
	Sock Sample			moist, poorly sorted; gravel rnd - sub rnd,	
				Sand sub-angular; gravel 40% basalt,	
	Archive 42			60% qtz, granite, other; sand 75% qtz, 25%	
				basalt, no rxn HCl	
205				205 - 208: gravelly Sand (gS)	
	Sock Sample			90% gravel, 90% sand, sand 20%	
				basalt, 80% other, SA-SR, 2.5Y 6/4	
	Archive 43			lt. yellow brown (dry), moist, max	
210				particle size (gravel) 20 mm, no rxn HCl	

Reported By: Pat Moore | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Pat Moore | Date: 11/4/99 | Signature: DC Weekes | Date: 12/27/99

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 8 of 8
Date: 11-4-99

Well ID: B8813 | Well Name: 299-W22-49 | Location: SE corner of SX Tank Farm
Project: RCRA Resource Protection Well | 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
210	Sock Sample			208'→220': Sandy GRAVEL (sG) 60% gravel, 40% sand, tr silt. Gravel 10% v. cse-cse peb, 50% med, 40% fn-v. fn peb. Sand 10% v.cse-cse, 20% med, 40% fn, 30% v.fn, lt yel. brn (2.5Y 6/4), dry-sl moist, poorly sorted, gravel SR, sand SA-SR, sand 80% qtz, 20% basalt, tr mica, max size ~4 cm, no rxn HCl	Air rotary 8 5/8" casing.
215	Archive 44				
	Sock Sample				
	Archive 45				~218' moist cuttings from cyclone seperator Waste designation Sample B0WY044 B0WY05 (220')
220	split spoon 1	Recovery 1.3'		220-223': Sandy Gravel (sG) 70% Gravel, 30% sand, trace silt, 10YR 5/1 (gray), poorly sorted, saturated, gravel SR, max size = 100mm, no rxn HCl.	Driller notes formation change sandy gravel to gravel @ 220'
	Archive 46				
	split spoon 2	Recovery 1.6'			
225	Archive 47			223-231: Sandy Gravel (sG) 70% Gravel, 30% sand, 10YR 5/2 gray brown, poorly sorted, saturated, SR gravel 20% basalt, 80% other, CSS + red granied sand, 20% basalt 80% other, max gravel = 60mm, no rxn to HCl.	
230	split spoon 3	Recovery 2'		231-239': gravelly SAND 20% Gravel, 80% sand, 2.5Y 5/3 lt. olive brown, saturated, poorly sorted, Gravel: SA-SR, 15% basalt, 85% other, max gravel = 40 mm, SAND: SA, 20% basalt, 80% other, medium CSS grained to 5 mm, trace silt + trace mica, no Rxn to HCl	End 11/5/99 Start 11/8/99 End 11/8/99 TD @ 239'
	Archive 48				
235					
239					

Reported By: Pat Moore | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Pat Moore | Date: 11/5/99 | Signature: DC Weekes | Date: 12/27/99

Page 1 of 4

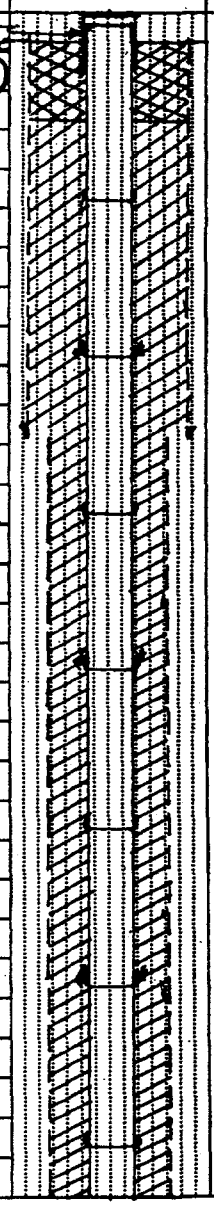
WELL SUMMARY SHEET 0515346

Date: 1/28/00

Well ID: B8814	Well Name: 299-W22-50
Location: 200 W/ outside SE corner 241-SX Tank Farm	Project: RCRA Drilling FY 2000
Prepared By: L.D. Walker/JM Faurote Date: 1/28/00	Reviewed By: DC Weekes Date: 2/9/00
Signature: LD Walker/JM Faurote	Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram
Protective casing (1.13' above SS304 riser)	
Surface Seal: Cement 0'-10.0'	
Bentonite #8 Crumbles from 10.0' to 199.50'	
Stickup on SS304 Riser is 2.25' on 1/28/00	
Centralizer flanges @ 20', then every 40' downhole	
*All temporary casing was removed.	
*All depths are below ground surface.	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0'→1.5': Sandy GRAVEL
		1.5'→9.0': SAND
		9.0'→14': Gravelly SAND
		14'→15.5': SAND
25		15.5'→30': SAND
		30'→53': SAND
50		53'→59': SAND
		59'→62.5': Sandy GRAVEL
		62.5'→129': SAND
75		
100		
125		129'→130.5': SILT
		130.5'→136': Silty SAND
		136'→138': Sandy SILT
		138'→142': Calc. Silty Sandy GRAVEL

BHI-EE-169 (12/97)

WELL SUMMARY SHEET

Date: 1/14/00

Well ID: B8814	Well Name: 299-W22-50
Location: 200W/outside SE corner 241-SX Tank Farm	Project: RCRA Drilling FY 2000
Prepared By: L.D. Walker / JM Faurote Date: 1/14/00	Reviewed By: DC Weekes Date: 2/9/00
Signature: LD Walker / JM Faurote 1/28/00	Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram
Cement: 199.50'-208.2'	
20-40 Silica Sand: 208.2'-240.75'	
top of 10slot, SS304 screen: 217.95'	
Bottom screen: 232.96'	
Bottom end cap: 233.44' w/centralizer	
top of 4-6/6-9 mesh sand: 240.75' to 245.35'.	
245.35' - Cement to ~246	
246'-247.35' 4-6/6-9 mesh sand	
247.35'-255.0' Bentonite plus natural fill.	
255.0'-273.5': Bentonite	
273.5'-450.3': 3/8" Pea Gravel	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
150		142'→152': Sandy GRAVEL
		152'→153': SAND
		153'→156': Sandy GRAVEL
		156'→175.5': SAND
175		175.5'→226': Silty Sandy GRAVEL
200		▼ Water @ 219.25 on 1/26/00
225		226'→229': Sandy GRAVEL
		229'→231': SAND
		231'→~~241.00~~ MD 302': Sandy GRAVEL
250		
275		
295		

BHI-EE-189 (12/97)

WELL SUMMARY SHEET

Date: 1/14/00

Well ID: B 8814	Well Name: 299-W22-50
Location: Outside SE Corner SX Tank Farm	Project: RCRA - FY2000 Drilling
Prepared By: J.M Faurote — Date: 1/28/00	Reviewed By: D.C Weekes — Date: 2/9/00
Signature: J.M Faurote	Signature: D.C Weekes

CONSTRUCTION DATA

Description	Diagram
3/8" Pea Gravel Fill	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
300		
		302'-308': SAND
		308'-313' Gravelly Silty SAND
		313'-333' Silty Sandy GRAVEL
325		
		333'-334': Silty Gravelly SAND
		334'-338': Gravelly Sandy SILT
		338'-343': Gravelly Silty SAND
		343'-348': Gravelly sandy SILT
350		348'-385': Gravelly SAND
375		
		385'-415': Sandy GRAVEL
400		
		415'-422': Silty SAND
425		422'-435': Gravelly SAND

BHI-EE-189 (12/97)

WELL SUMMARY SHEET

Page 4 of 4

Date: 1/17/00

Well ID: B 8814		Well Name: 299-W22-50	
Location: Outside SE Corner SX Tank Farm		Project: RCRA - FY 2000 Drilling	
Prepared By: J.M. Faurote	Date: 1/17/00	Reviewed By: DC Weekes	Date: 2/9/00
Signature: JM Faurote		Signature: DC Weekes	

CONSTRUCTION DATA

Description	Diagram
450.3 – 498.5 : Cement	
Drilled open hole 474-547.5	
498.5 → 547.5 : Abandoned with 4-6 and 6-9 mesh Sand.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
450		
		457'-496' : RINGOLD LOWER MUD
475		
500		496'-T.D. : RINGOLD "A" GRAVEL
525		
547.5		END OF BOREHOLE

BHI-EE-189 (12/97)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 11-10-99
Finish Date: 1-28-00
Page 1 of 1

Specification No.: 02000X-SR-V0002	Rev. No.: 0	Well Name: B 8814	Temp. Well No.: 299-W22-50
ECNs: NA		Approximate Location: Outside SE Corner of SX Tank Farm	
Project: RCRA - FY 2000 Drilling		Other Companies:	
Drilling Company: Resonant Sonic International		Geologist(s): P. Moore, D. Weekes, T. Lee, M. Faurote	
Driller: M. Wraspir			

TEMPORARY CASING AND DRILL DEPTH

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.
11¾" O.D. Carbon Steel FJ	0 - 50.39	11¾"/10½"
Carbon Steel FJ	0 - 241	8⅝"/7¾"
Carbon Steel FJ	____ - 474	6⅝"/5⅝"
Carbon Steel FJ	____ - 547.5	0.37"/0.32"
	____ - ____	

*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design

DRILLING METHOD/HOLE DIAMETER

~~Auger:~~	Cable Tool 11¾" O.D.	Diameter From 0	to 50.39
Cable Tool:	8⅝" O.D.	Diameter From 50.39	to 241.0
Air Rotary:		Diameter From ____	to ____
A.R. w/Sonic:	6⅝"	Diameter From 241	to 474
	4½"	Diameter From 474	to 547.5
		Diameter From ____	to ____
		Diameter From ____	to ____

Drilling Fluid: Air; water

Total Drilled Depth: 547.5	Hole Dia @ TD: 5.625"	Total Amt. Of Water Added During Drilling:	1360 gals
Well Straightness Test Results: Straight to TD.		Static Water Level: 219.25	Date: 1/26/00

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
RLS Spectral Gamma	0 - 240	11/30/99		____ - ____	
Neutron-Neutron Moisture	40 - 219	11/30/99		____ - ____	
Total Gamma-Ray	230 - 546.7	1/4/99		____ - ____	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
SS304 riser	+2.25 - 217.95	F480		Silica Sand, 20-40 mesh (100# bag)	208.2' - 240.75'	23.5	20-40
SS304 screen	217.95 - 232.96'	F480	.010"	Cement, in cu ft	199.5' - 208.2'	11	NA
Plastic end cap	232.96 - 233.44	F480		Bentonite Crumbles (50# Bag)	10.0' - 199.5'	117	#8
	____ - ____				____ - ____		
	____ - ____			Cement, in cu. ft.	0. - 10.0	10	NA

OTHER ACTIVITIES

Aquifer Test:	Date:	Well Abandoned: 247.5'-547.5'	Yes: ✓	No:	Date: 1/28/00
Description:		Description: 4-6 sand (240.75-242.15); Cement (242.15-245.35); 4-6 Sand (245.35-247.35); Natural Fill + Bentonite (247.35-255); Bentonite (255-273.5); ⅜" Pea Gravel (273.5-450.3); Cement (450.3-498.5); Sand to 547.5			

WELL SURVEY DATA

Date:	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Cap Elevation:

COMMENTS/REMARKS

Reported By: J.M. Faurote		Reviewed By:	
Title: Geologist	Date: 1/28/00	Title:	Date:
Signature: J.M. Faurote		Signature:	

BHI-EE-181 (12/97)

BOREHOLE LOG

Page 1 of 9
Date: 11-10-99

Well ID: B8814 | Well Name: 299-W22-50 | Location: outside SE corner 241-SX Tank Farm
Project: RCRA Drilling FY 2000 | 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	DB	NA		0'→1.5': Sandy GRAVEL (sG); 40% gravel, 60% sand, tr silt. Construction material / pad Fill. Poorly sorted, grayish brn (10YR 5/2), dry	Cable tool, 11¾" OD CS casing, 10" drive barrel
5	grab archive			1.5'→9.0': SAND (S); 100% sand, tr silt; tr v. cse sand, 20% cse, 40% med, 40% Fn-v. Fn; dark grayish brown (10YR 4/2), moist, mod sorted; ang-sub angular; 40% basalt, 60% qtz, feld, other; max size ~2 mm; rxn to HCl weak to strong.	Archive sample collected from drive barrel at 5' (two 1-pint jars)
10	grab archive				10' collect archive sample
15	grab archive			9.0'→14': Gravelly SAND (gS); 15% gravel, 85% sand. Gravel 40% cse-med peb, 60% Fn-v. Fn peb, sand 75% v. cse, 20% cse, 5% med-v. Fn; very dk gray (10YR 3/1), moist, mod sorted; SA-SR sand; 60% basalt, 40% qtz/other, max size ≈ 3 cm, weak rxn HCl.	15' collect archive sample.
20	grab archive SS #1 20→22.5'	100% rec.		Salt and Pepper appearance. 14': Thin layer Fine sand with silt 14.5'→15.5': SAND (S) predom cse similar to sand in 9.0'→14'	14.0'→14.5': Silty SAND (mS)
	SS #2 22.5'→25'	100% rec.		15.5'→30': SAND (S) predom med-Fn similar to 1.5-9' sand Thin layers occasional of cse sand 27': thin (0.1') layer silty sand	20' collect archive sample 20': Begin continuous 5" OD x 2.5' split tube samples for PNNL chem. analysis
25	SS #3 25'→27.5'	100% rec.			
	SS #4 27.5'→30.0	100% rec.			

Reported By: L.D. Walker | Title: Geologist | Signature: LD Walker | Date: 11-10-99

Reviewed By: JC Weekes | Title: Geologist | Signature: JC Weekes | Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 2 of 19
Date: 11-11-99

Well ID: B8814 | Well Name: 299-W22-50 | Location: Outside SE corner 241-SX Tank Farm
Project: RCRA Drilling FY2000 | 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	SS #5 30→32.5'	100% rec.			Cable tool; 11 3/4" OD
				30'→53': SAND (S); 100% sand, tr silt. 10% v.cse, 20% cse, 30% med, 40% fn-v.fn; occasional layers less than 0.5' thick predom. cse sand. Med-fn sand brown (10YR 4/3), cse sand gr. brn, moist, mod-well sorted, SA-SR; 30-40% basalt, 60-70% qtz, feld/other. Max size ≈ 2 mm, weak rxn HCl tr mica	CS casing, 10" drive barrel for cleanout
	SS #6 32.5'→35'	100% rec.			Continuous 5" OD split tube samples.
35	SS #7 35'→37.5'	100% rec.			
	SS #8 37.5→40'	100% rec.			No rad contam detected w/ Field instruments
40	SS #9 40'→42.5'	100% rec.			
	SS #10 42.5→45'	100% rec.			OVM < detect
45	SS #11 45'→47.5'	100% rec.			
	SS #12 47.5→50'	100% rec.			
50	SS #13 50→52.5'	100% rec.			11 3/4" casing set at 50.0' bgs
	SS #14 52.5→55	100% rec.		53'→59': SAND (S), tr-5% gravel, 95-100% sand. Gravel fn-v.fn peb, sand 30% v.cse, 30% cse, 40% med-v.fn; grayish brn (10YR 5/2)-salt/pepper appear, dry, mod sorted, SA-SR; 40% basalt, 30% qtz, 30% felds/other, tr iron oxide staining; max peb 7-8 mm, weak rxn HCl	Continue with 8 3/4" OD CS casing.
55	SS #15 55'→57.5'	100% rec.			
	SS #16 57.5'→59.5'	100% rec.			SS refusal at 59.5' →gravel at 59'

Reported By: L.D. Walker | Reviewed By: DCWeekes
Title: Geologist | Title: Geologist
Signature: LDWalker | Date: 11-11-99 | Signature: DCWeekes | Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 11-11-99

Well ID: B8814 | Well Name: 299-W22-50 | Location: Outside SE corner 241-SX Tank Farm
Project: RCRA Drilling FY 2000 | 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
60	SS #17 60→62.5'	100% rec.		59'→62.5': Sandy GRAVEL (sG) 60% gravel, 40% sand, tr silt; gravel 20% v.cse-cse peb, 50% med, 30% fn-v. fn; sand 20% v.cse, 40% cse, 40% med-v. fn, dry, poorly sorted; sand SA, gravel SR-round, 40-50% basalt, 50-60% qtzite, granite, other; max size ≈ 5 cm, weak HCl rxn	Cable tool; 8¾" OD CS casing; Cont. 5" OD split tube samples For PNNL chem. anal.
	SS #18 62.5'→65'	100% rec.			
65	SS #19 65'→67.5'	100% rec.			Begin 11-12-99 Driller notes Firmer drilling condition
	SS #20 67.5'→70'	100% rec.		62.5'→129': SAND (S) 100% sand. Predom med-cse, then fn by 70'. At 70' 10% cse-med, 80% fn, 10% v. fn. Brown, (10YR 5/3), sl moist, well sorted, SA-SR, 80% qtz, Felds, 20% basalt, max size ≈ 1mm, tr mica, tr Fe staining weak rxn HCl	
70	SS #21 70→72.5'	100% rec.			
	SS #22 72.5→75'	100% rec.			
75	SS #23 75→77.5'	100% rec.			
	SS #24 77.5'→80'	100% rec.			OVM < detect No rad. contam. detected w/ Field instruments.
80	SS #25 80→82.5'	100% rec.		81-82': med sand, then back to fn sand as above	
	SS #26 82.5'→85'	100% rec.			
85	SS #27 85'→87.5'	100% rec.			
	SS #28 87.5'→90'	100% rec.			

Reported By: L.D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 11-12-99 | Signature: DC Weekes | Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 4 of 19
Date: 11-12-99

Well ID: B8814 | Well Name: 299-W22-50 | Location: Outside SE corner 241-SX Tank Farm
Project: RCRA Drilling FY 2000 | 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
90	SS #29 90→92.5'	100% rec.		62.5'→129': SAND(S) as described on page 3. Predom. Fn sand, with intervals < 1 Ft. med-cse sand.	Cable tool; 8¾" OD CS casing; Continuous 5" OD split tube samples For PNNL chem. analysis.
	SS #30 92.5→95'	100% rec.		90-91': med sand, then Fine sand	
95	SS #31 95→97.5'	100% rec.			
	SS #32 97.5→100'	100% rec.			
100	SS #33 100→102.5'	100% rec.			
	SS #34 102.5→105'	100% rec.		105': silt stringer noted in Split tube shoe. Less than 0.1' thick, thin laminations	
105	SS #35 105→107.5'	100% rec.		106': very thin silt layer	107.5': sand in SS shoe very moist
	SS #36 107.5→110'	95% rec.			Begin 11-15-99
110	SS #37 110→112.5'	100% rec		111': thin silt layer, very moist, off horizontal angle.	
	SS #38 112.5→115'	100% rec.			Silt Fragments in core barrel clean-out runs between Split tbe samples
115	SS #39 115→117.5'	100% rec.		116': very Fine sand, tr silt, strong rxn HCl	
	SS #40 117.5→120'	95% rec.			

Reported By: L.D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: [signature] | Date: | Signature: [signature] | Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 11-15-99

Well ID: B8814 | Well Name: 299-W22-50 | Location: 200W outside SE corner 241-SX Tank Farm

Project: RCRA Drilling FY 2000 | 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
120	SS #41 120→122.5'	90% rec.		62.5'→129': SAND (S) similar to description on page 3.	Cable tool 8¾" OD CS casing; continuous 5" OD split tube
	SS #42 122.5→125'	100% rec.		121': very fine sand, strong rxn HCl	Samples for PNNL
125	SS #43 125→127.5'	100% rec.		123.5': Fn-med sand, sl moist to dry	chem. analysis
	SS #44 127.5→130'	100% rec.		127': predom. Fn sand	
130	SS #45 130→132.5'	100% rec.		129'→130.5': SILT (M); 100% silt, tr v. Fn sand. lt. olive brown (2.5Y5/3), moist, well sorted, max size ~ 0.1 mm, tr fine horizontal laminations, strong rxn HCl.	
	SS #46 132.5→135'	100% rec.		130.5'→136': Silty SAND (mS); 70% sand, 30% silt. Sand tr med, 25% Fn, 75% v. Fn; lt. yel. brown (2.5Y6/3), sl moist, well sorted, SA-SR, predom. qtz/Felds, tr basalt, strong rxn HCl	
135	SS #47 135→137.5'	100% rec.		135': dry; 136→137: silt content increase	
	SS #48 137.5→140'	100% rec.		136'→138': Sandy SILT (sM) As above, except 40% sand, 60% silt.	Begin 11-16-99
140	SS #49 140→142.5'	100% rec.		138'→142': Calcareous Silty Sandy GRAVEL (msG) 40% gravel, 40% sand, 20% silt. gravel/ v. cse peb - v. fn, round; sand predom Fn-v. fn; grysih brn (2.5Y5/2), wet, poorly sorted; sand 80-90% qtz, 10-20% basalt, violent rxn HCl; max gravel ≈ 5 cm. - silt content decrease, moisture decrease	Sample is saturated but not enough water for e-tape reading - dry by 142.5'
	SS #50 142.5→145'	95% rec.			
145					145': material dry, loose, casing driver very hard-cobbles
	SS #51 146→147'	0% rec.			
	SS #52 148'→150.5'	100% rec.		142'→152': Sandy GRAVEL (sG)	

Reported By: L.D. Walker		Reviewed By: DC Weekes	
Title: Geologist		Title: Geologist	
Signature: LD Walker	Date:	Signature: DC Weekes	Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 11-16-99

Well ID: B8814 | Well Name: 299-W22-50 | Location: 200W outside SE corner 241-SX Tank Farm

Project: RCRA Drilling FY 2000 | 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
150	SS#52			142'→152': Sandy GRAVEL (sG) 50% gravel	Cable tool 8¾" OD CS
	SS #53 150.5→153'	100% rec.		45% sand, 5% silt; gravel tr lg.cob, predom med-v.cse peb, round; sand predom	casing; continuous
				med-cse, SA-SR, dry, lt brnish gray	5" OD split tube sampler
	SS#54 153→155.5'	100% rec.		(10YR6/2), 80% qtz/felds, 20% basalt/other	for PNNL analysis
155				max gravel > 20 cm, weak rxn HCl	
	SS #55 155.5→158'	100% rec.		152'→153': SAND - similar to sand	
				fraction above.	
	SS#56 158→160.5'	75% rec.		153'→156': Sandy GRAVEL (sG)	Begin 11-17-99
160				similar to 142→152', without cobbles	
	SS #57 160.5→163'	100% rec.		156'→175.5': SAND (s) 5% gravel,	
				95% sand. 10% v.cse sand, 20% cse,	
	SS #58 163→165.5'	100% rec.		40% med, 30% fn-v.fn., gray (10YR 6/1),	
				dry, mod sorted, SA; 80% qtz/feld, 20%	
165				basalt, tr Fe-stain; HCl rxn weak/none	
	SS #59 165.5→168'	100% rec.		164-165: short interval gravelly sand.	
				Sand as above, gravel med-cse peb and	
	SS #60 168→170.5'	100% rec.		rounded, predom. qtzite/granite	Sand is dry and
					loose
170	SS#61 170.5→173'	100% rec.			
	SS#62 173→175.5'	100% rec.			
175				175': Gravelly Sand	
	SS #63 175.5'→177.5'	60% rec.			177.5':
				175.5'→226': Silty Sandy GRAVEL	Switch over to
	HT ↓	NA		(msG)	hard tool drilling

Reported By: L. D. Walker | Reviewed By: DC Weekes

Title: Geologist | Title: Geologist

Signature: LD Walker | Date: 11-18-99 | Signature: DC Weekes | Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 11-18-99

Well ID: B8814 | Well Name: 299-W22-50 | Location: 200W outside SE corner 241-SX Tank Farm
Project: RCRA Drilling FY 2000 | 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
180	HT	NA		175.5' → 226': Silty Sandy GRAVEL (ms6)	Cable tool 8¾" op cs
	Archive grab			60% gravel, 35% (lw) sand, 5% (lw) silt.	casing; hard tool
				From last split spoon: gravel 10% cobble,	
				40% v.cse-cse peb, 30% med, 20% Fn-v.Fn.	180.5': Grab sample
				Sand 20% v.cse-cse, 20% med, 40% Fn,	for archive
185	Archive -Grab			20% v. Fn. Lt brnish gray (10YR 6/2),	
	HT			dry; poorly sorted; grave R-SR, sand	185': Archive grab
				SR-SA; 70% qtz/granitic, 30% basalt,	sample
				Max gravel size > 10cm (inferred by drilling)	
				HCl rxn weak to none.	190': Archive grab
190	Grab				sample and chem.
	HT			Drilling indicates smaller gravels -	analysis for PNNL
				no cobbles, but perhaps cemented.	
					195': Grab sample -
195	Grab				Archive and chem.
	HT				
					200': Grab sample -
200	Grab				archive and
					chemical analysis
					205': Grab sample -
205	Grab				archive and
					chemical analysis
				208' → 209': Drill rate increase - then slows	Begin 11-22-99
				at 209' Possible sand content	
				increase 208 → 209'	

Reported By: L.D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 11-22-99 | Signature: DC Weekes | Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 11-22-99

Well ID: B8814 | Well Name: 299-W22-50 | Location: 200W outside SE corner 241-SX Tank Farm

Project: RCRA · Drilling FY 2000 | 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
210	Grab	NA		175.5'→226': Silty Sandy GRAVEL (msG) (from SS: 220.5'→223') 60% gravel, 35% sand, 5% silt. Gravel tr sm. cob, 40% v.cse-cse peb, 30% med, 30% fn-v.fn; sand 10% v.cse-cse, 30% med, 40% fn, 20% v.fn; brown (10YR5/3), wet, poorly sorted; gravel rnd-SR, sand SA-A, gravel 30% basalt, 30% granitic, 40% qtzite/other; Sand 70% qtz, 30% basalt/other, tr mica, MPS ≈ 8cm HCl rxn weak/none; well indurated.	Cable tool 8⅝" OD CS casing; hard tool
215	Grab				210': Grab sample - archive and chem analysis.
					215': Grab sample - archive and chem analysis.
220	Grab			220' Possible sand content increase, faster drilling in saturated zone	220' Grab sample archive and chemical analysis.
	SS: Sieve #1 & chem.	100% rec.		226'→229': Sandy GRAVEL (sG); 50% gravel, 50% sand, tr silt. Gravel as above, sand 10% v.cse-cse, 60% med, 30% fn-v.fn, wet, loose, mod sorted sand (poor overall), gravel rnd-SR, sand SA-SR; sand 80% qtz, 20% basalt/other, MPS ≈ 8-10 cm	220.5'→223': Split tube sample - sieve analysis / chem. anal.
225	Grab				11-23-99: Water sample collected w/ bailer - casing shoe at 220', w.l. = 217.5'
	SS: Sieve #2 & chem	90% rec.		229'→231': SAND (S); 100% sand. Similar to sand above - predom med, SA-SR, mod-well sorted	225': Grab samp - archive
230	Grab			[231': drilling indicates return of gravel]	227'→229.5': Split tube - Sieve analysis / chem anal
	SS: Sieve #3 & chem.	90% rec.			230': Grab samp - archive
235	Grab			231'→234' (not 302'): Sandy GRAVEL (sG); 50% gravel, 47% sand, 2-3% silt; similar to sG at 226→229'.	232'→234': split tube - Sieve anal. / chem anal.
				234'→235': drilling indicates sand lens (sand heaving) 235'-245' SG 45 231'-234'	235': Grab samp - archive - casing drives more easily

Reported By: L.D. Walker | Reviewed By: DC Weekes

Title: Geologist | Title: Geologist

Signature: LD Walker | Date: 11-24-99 | Signature: DC Weekes | Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 9 of 19
Date: 11-24-99

Well ID: B8814 | Well Name: 299-W22-50 | Location: 200W outside SE corner 241-SX Tank Farm
Project: RCRA Drilling FY2000 | 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
240	Grab	NA			Cable Tool (hard tool)
				* During completion - heaving sand from below 241 to ? depth, but zones heaved to depths of 265.	8 5/8" OD CS casing set at 241' bgs
					drill to 243'
				245'-258'	240': Grab samp. archive
245	Grab			Sandy Gravel (SG), 70% gravel, 30% sand, trace silt, gravel 80% CSS, 20% fine 25% basalt, 75% other, 7.5YR 4/6	11-29-99 water sample collected w/elec. sub. pump - casing at 241'
				(wet) Strong brown, wet, mod. sorted, SA-SR, max particle = 35mm, no Rxn to	11/14/99 Mr rotary 6 5/8" casing
250	Grab			HCl, Sand: 35% coarse, 65% medium+fine, 15-20% basalt, wet, moderately sorted,	
				SA-SR, same color as gravel, no Rxn+ HCl.	
					collected waste anr. sample Box#6
255	Grab			258'-262' (SG) sandy gravel,	Clean cuttings from 245-260' bgs.
				primarily coarse sand+ fine gravel as above	
					Collected water
				262-268 sandy Gravel (SG) 35%	Sample w/elec. Sub
260	Grab			gravel, 5% silt, 60% sand, gravels	pump at 258',
				fine to 23mm, 20% basalt, SA-R,	bottom of hole = 264' bgs
				10YR 4/4 (dk yellowish brn) (moist) moist, Sand	Sample #3
				poorly sorted, 40% coarse, 60% med+fine,	
				15-20% basalt, moist, SA, no Rxn to HCl.	
265	Grab				
				268-272 - sandy Gravel (SG)	
270	Grab			coarse sand+ fine gravel, 25-30% basalt	

Reported By: Pat Moore | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Pat Moore | Date: 12/14/99 | Signature: DC Weekes | Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 10 of 19
Date: 12/15/99

Well ID: B8814 | Well Name: 299-W22-50 | Location: 200 W. Area SE corner SX Tank Farm
Project: RCRA Drilling FY 2000 | 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
270	Grab	NA			Air Rotary
					6 5/8" casing
				272-279 Sandy GRAVEL (SG), 60% gravel, 35% sand, 5% silt, Gravels 20% basalt, 5% moderately to poorly sorted, max pebble = 23mm, 10YR 3/4 (moist) dk. yellowish brown, moist-wet, Sand poorly sorted, same color, moist-wet, 0%, 20% basalt, trace mica, primarily coarse to medium gr., no RXN to HCl.	
280	Grab			279-281 Sandy Gravel (SG), fine gravel, coarse sand	
				281-298 Sandy Gravel as 272-279 increasing sand fraction ~ 286-288' (45-50%).	
285	Grab				
290	Grab				
295	Grab				
				298-302 Sandy Gravel, fine gravel coarse sand → fine sand as above.	
300					

Reported By: Pat Noonkee | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Pat Noonkee | Date: 12/15/99 | Signature: DC Weekes | Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 1 of 19
Date: 12/15/99

Well ID: B 8814 | Well Name: 299-W22-50 | Location: 200 W outside SE corner SX Tank Farm
Project: RCRA Drilling FY 2000 | Reference Measuring Point:

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
300	Grab	NA			Air Rotary
				302 - 308 SAND, trace silt, fg gravel, 75% (medium) sand, 20% fine grained, 5% silt, 2.5Y 5/3 (moist) lt. olive brown, moist-wet, V. well sorted, SA-SR, 20% basalt, 80% quartz, max particle = 2mm., NO EXN to HCl.	6 5/8" casing
305	Grab				
				308 - 313 gravelly silty, SAND, 25% gravel, 10% silt, 65% SAND, sand as above (302 - 308), saturated,	
310	Grab				
				313 - 323 silty sandy Gravel, 80% gravel, 10% sand, 10% silt, Fine gravel to 30 mm, R-SA, 15-20% basalt, 10YR 4/2 (moist) dk gray brown, moist - wet, no RXN to HCl.	collecting groundwater sample w submersible pump @ 313' (Entered) bottom of hole = 314 ft. (Sample # 4)
315	Grab				
320	Grab			320 as above, saturated sample.	
				323 - 327 silty sandy gravel, 5% silt, 15% sand, 80% gravel, Gravels (coarse + fine), SA-R, max particle = 40mm, 25-30% basalt, 10YR 4/3 (moist) brown, moist-wet, mod. sorted, NO RXN to HCl, sand, 15-20% basalt, SA-SR, poorly sorted, primarily coarse + fine grained,	
325	Grab				
330					

Reported By: Pat Moore | Title: Geologist | Signature: Pat Moore | Date: 12/15/99
Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 12 of 19
Date: 12/16/99

Well ID: B8814	Well Name: 299-W22-50	Location: 200 W outside SE corner SX Tank Farm
Project: RCRA Drilling FY2000		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
330	Grab	NA		327-333, as above, silty sandy Gravel,	Air Rotary
				increasing sand fraction, 70% gravel, 25% sand,	6 5/8" casing.
				5% silt, sample saturated,	
				333-334, silty gravelly sand	Increased water
				25% gravel, 10% silt, 65% sand,	in samples @ 328'
335	Grab			10YR 4/2 (moist) dk. gray brown, moist wet,	
				15-20% basalt (sand), fine-crs sand,	
				moderate RXN to HCl, Gravel, 30% basalt.	
				334-338 gravelly, sandy silt, (gmM)	
				15% gravel, 20% sand (coarse + fine),	
340	Grab			65% silt, weak RXN to HCl., saturated	
				338-343 - gravelly, silty SAND, gmS	
				25% gravel, 20% silt, 55% sand, wet	
				sand poorly sorted, weak RXN to HCl,	
				343-348 gravelly sandy, silt (gmM)	
345	Grab			as in 334-338 saturated, mod RXN HCl	
				348-385 (395) gravelly SAND,	Difficult to
				25-30% gravel, 5% silt (trace), 70%	collect samples -
				sand, v poorly sorted, sand + gravel 15-20% basalt,	volumes of water,
				SA sand, white mica (muscovite) prevalent,	grabbing samples
350	Grab			saturated, sand primarily med + coarse, RXN HCl.	from cuttings drums.
355	Grab				
360					

Reported By: Pat Moore		Reviewed By: DC Weekes	
Title: Geologist		Title: Geologist	
Signature: Pat Moore	Date: 12/16/99	Signature: DC Weekes	Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 12/16/99

Well ID: B8814	Well Name: 299-W22-50	Location: 200W outside SE corner SX Tank Farm
Project: RCRA Drilling FY 2000		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
360	Grab	NA			Air Rotary 6 5/8" casing
365	Grab				
370	Grab			385-400 sandy GRAVEL, 40% gravel, 50% sand, 10% silt, Gravels 15% basalt, 85% other, A-SR, max part= 30 mm, mod. sorted, fine gravels, 10YR 4/3 (moist) dk yellowish brown, Saturated Sand, v. poorly sorted, 5% coarse, 45% medium, 20% fine grained, 20% basalt, 80% other, mylonite + weathered mica present, no RXN to HCl.	
375	Grab				
380	Grab				
385	Grab				

Reported By: Pat Moore		Reviewed By: DC Weekes	
Title: Geologist		Title: Geologist	
Signature: Pat Moore	Date: 12/16/99	Signature: DC Weekes	Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

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Date: 12/17/99

Well ID: B8814	Well Name: 299-W22-50	Location: 200W outside SE corner SX Tank Farm
Project: RCRA Drilling FY 2000		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
390	Grab	NA			Air Rotary 6 5/8" casing.
395	Grab			395 increasing gravel fraction (~70%)	
400	Grab			400 - 415 Sandy GRAVEL, 45% gravel, 55% sand, 15% basalt, 85% other, gravels: SA to R, max particle size 45mm, 10YR 5/3 (moist) brown, Saturated, no RXN to HCl. Sand: A-5A, 15-20% basalt, white mica present, 20% coarse, 80% medium + fine, moderately sorted.	
405	Grab				
410	Grab				
415	Grab			415 - 422 silty Sand (SM) saturated, 40% silt, 60% fine sand, 10-15% basalt, no RXN HCl, SA, well sorted sand, 10YR 7/6 (moist) yellow	
420					

Reported By: Pat Moore		Reviewed By: DC Weekes	
Title: Geologist		Title: Geologist	
Signature: Pat Moore	Date: 12/17/99	Signature: DC Weekes	Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 12/20/99

Well ID: B8814 | Well Name: 299-W22-50 | Location: 200W of SE corner SX Tank Farm

Project: RCRA Drilling FY 2000 | 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
420	Grab	NA		422-435 gravelly SAND, trace silt, 10-15% gravel, 85-90% medium sand, V. well sorted, Saturated, 15% basalt, micaceous, 2.5Y 6/3 (moist) light yellow brown, no Rxn to HCl.	Air Rotary 6 5/8" casing.
425	Grab				
430	Grab				
435	Grab			435-~~458~~ 459 MF increasing gravel fraction to 25-30% 435-458 sandy GRAVEL (GG) 35% gravel, 65% sand, trace silt, Gravel: 20% basalt, 80% other, SA to 20mm, Saturated, 10YR 5/3 brown, no Rxn to HCl, SAND, SA, 15-20% basalt, 10% mafic & weathered mica, moderate to well sorted gravels (thin), mod. sorted sand, primarily medium grained (70%).	Driller noted silt in cuttings ~454', drilled to 458, less water, less gravel Top of lower unit between 454-458'
440	Grab				
445	Grab				
450	Grab				

Reported By: Pat Moore | Title: Geologist | Signature: Pat Moore | Date: 12/20/99

Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 27 Dec 99

Well ID: BRBIY | Well Name: 299-W22-50 | Location: OUTSIDE SE GARNER SX Tank Farm
Project: RCRA - FY 2000 | 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
450	gab				Air Rotary. 6 3/8" Csg.
455	grab				
	grab			457' – 496' : ~~SANDY GRAVELLY SILT~~ MF (sgM) – poor returns – 50%+ silt, 25% fine grained sand, 25% gravel (gravel and sand as above) silt becoming more clayey with depth, clayey silt, white 10YR 8/1, slight plasticity, NO RXN to HCL. (NOTE: After split was collected at 458' to 460', the casing was pulled back to 455' and the water rose from ~450' To 253'.)	LOWER MUD UNIT = 457' POOR RETURNS Start 27 Dec 99
460	split spoon	50% rec.			
	gw grab				
465	grab		No Returns	No Returns from 466' To	No Returns
470					
475					
~~480~~					

Reported By: T.A. Lee | Reviewed By: DC Weekes
Title: geologist | Title: Geologist
Signature: Timothy A. Lee | Date: | Signature: DC Weekes | Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 1/10/00

Well ID: B 8814 | Well Name: 299-W22-50 | Location: Outside SE Corner SX Tank Farm
Project: RCRA - FY 2000 | 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
480	No Recovery			No Recovery to 485, cleanout reveals clay/silt balls w/ S. gravel	Casing @ 474, open hole to 484 1/10/00: will drill open hole to Basalt, if possible
					One gallon for V. Johnson
485	No Recovery		NO RETURNS	* During cleanout 480-485, a micaceous, med-f sand w/ minimal gravel (<5%) was discharged	
490	Grab	1/3 pint		only 1 pint - very minimal returns - 1/2 full over 8' of drilling: silty-clay or clayey silt w/ sand and local gravel to 1/2", most are 3/8" or less.	
495	No recovery			No Returns - 496 - start "Hard drilling" - returns are gravel (G) w 10% or < sand	Hard drilling started @ 496'
500	Grab	3 pints		Gravel (G) 60% Basalt, 40% Felsic; Gravel is 40% cr, 40% m, 20% f with overall comp. Gravel @ 85% Sand @ 10-15% and silt <5% to 0. It is variegated. The sand is 20-60% and 40% fine, 40% vf.	"TOP of Rng. A?" @ 500' - 1 gal to V. Johnson
505	Grab.	3 Pints		Same as above, but 65% gravel and the sand is 5% cr 40% m & 55% f or vf.	
510					

Reported By: J.M. Faurote | Title: Geologist | Signature: J.M. Faurote | Date: 1/10/00
Reviewed By: D.C. Weekes | Title: Geologist | Signature: D.C. Weekes | Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

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Date: 1/10/00

Well ID: B8814 | Well Name: 299-W22-50 | Location: Outside SE Corner SX Tank Farm
Project: RCRA - FY 2000 | 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
510	Grab			Gravel (GG): Basalt-rich sub-round to round, ½ to 2(?)" gravels of 60% basalt and 40% metamorphics. The unit contains 10 to 15% sand that is med to fine with 10% or < cr grains. Zero to very little silt was recovered, but the off-colored water indicates 0-<5% silt content. The color is variegated.	3 ea ½ pints sample (one for Vern Johnson
515	Grab				3 ea ½ pint samples (One for Vern Johnson)
520	Grab			Same as above	1 gal H_2O for Vern Johnson with 3 ea ½ pint samples One for Vern Johnson
525	Grab				3 ea ½ pint samples (One for Vern Johnson)
530	Grab				3 ea ½ pint Samples (One for Vern Johnson)
535	Grab			~538' - an apparent slight increase in sand and silt, the sand	3 ea ½ pint Samples (One for Vern Johnson)

Reported By: J.M. Faurote | Title: Geologist | Signature: J.M. Faurote | Date: 1/12/00
Reviewed By: D.C. Weekes | Title: Geologist | Signature: D.C. Weekes | Date: 2/9/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 14 of 14
Date: 1/11/00

Well ID: B8814 | Well Name: 299-W22-50 | Location: outside SE corner 241-SX Tank Farm
Project: RCRA Drilling FY 2000 | 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
540	Grab			As from 496': Gravel (G) 80% gravel of which 65% is basaltic, 35% felsic, 15% cr, 60% m, 25% f grains, w/ approx 15% Sand as f & vf grains	1 gal H2O 2 ea 1/2 pint jars
545	Grab				2 ea cuttings jars (1/2 pt); 1 ea H2O (1/2 pt)
	END OF HOLE			The 4" Casing was eventually washed down to 547.35' bgs, which constituted TD	
				* Water sample taken @ TD by Waste Management personnel.	

NOT USED JMF 1/31/00

Reported By: JM Faurote | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: JM Faurote | Date: 1/14/00 | Signature: DC Weekes | Date: 2/9/00

BHI-EE-183 (12/97)

Appendix B

Physical Properties Data

Appendix B

Physical Properties Data

This Appendix includes the results of laboratory testing for pH, conductivity, particle size distribution, moisture content, and bulk density of samples from wells 299-W22-48, 299-W22-49, and 299-W22-50. The analyses of pH, electrical conductivity, moisture content and bulk density were done in the Applied Geology and Geochemistry Group laboratory, Pacific Northwest National Laboratory, Richland, Washington. The work was supervised by Jeff Serne who supplied the data. The analyses of particle size distribution were done by CH2M Hill Hanford Inc.

Moisture content was measured as weight loss after drying an aliquot of the bulk sample at 105°C for 24 hours or until weight was constant for two consecutive measurements.

Electrical conductivity and pH were measured on aliquots of core samples. The measurements were made on unfiltered solutions obtained from a 1:1 sediment:water (by weight) extract unless noted otherwise in this appendix. As a result, the values are diluted by the amount of water used.

Bulk density was obtained from core samples by measuring the weight, length, and diameter of specific core sections.

Particle size analysis was done using standard sieve techniques. Samples were oven dried at 105°C for 24 hours (or until weight was constant for two consecutive measurements) prior to analysis.

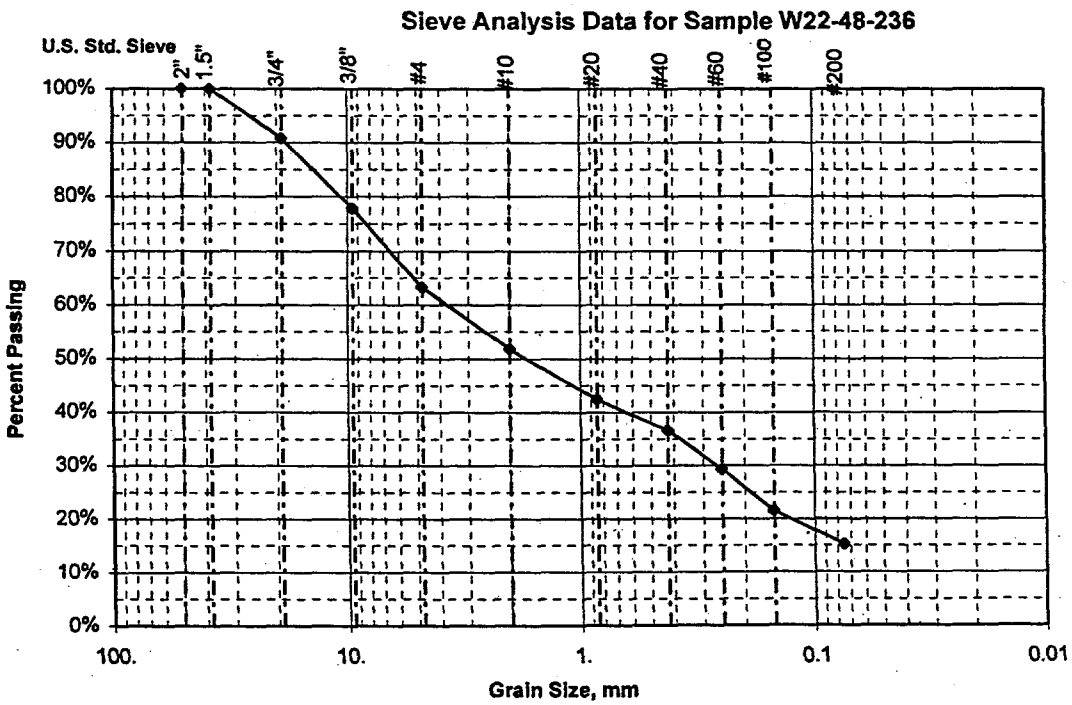
Table B.1. Particle Size Distribution for the 236-ft-Deep Sample from Borehole 299-W22-48

CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-48	DEPTH	236' - 236.5'	SAMPLE#	W22-48-236	WELL ID#	B8812
TESTED BY	DCW	CONTACT	Dave Weekes	PHONE	372-9582	DATE	10/28/99

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
414.70	2"	0.0	0.0	100.0	50.00	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	38.3	9.2	90.8	19.00	
	3/8"	91.9	22.2	77.8	9.50	
	#4	152.5	36.8	63.2	4.75	
	#10	199.9	48.2	51.8	2.00	
	#20	239.0	57.6	42.4	0.85	
	#40	262.7	63.3	36.7	0.43	
	#60	293.1	70.7	29.3	0.25	
	#100	325.8	78.6	21.4	0.150	
	#200	351.9	84.9	15.1	0.075	



Comments: Silty Sandy Gravel: gravel is mostly nonbasalt

All data are accurately and completely recorded.

Checked By: RF Raidl Date: 28 Dec 1999

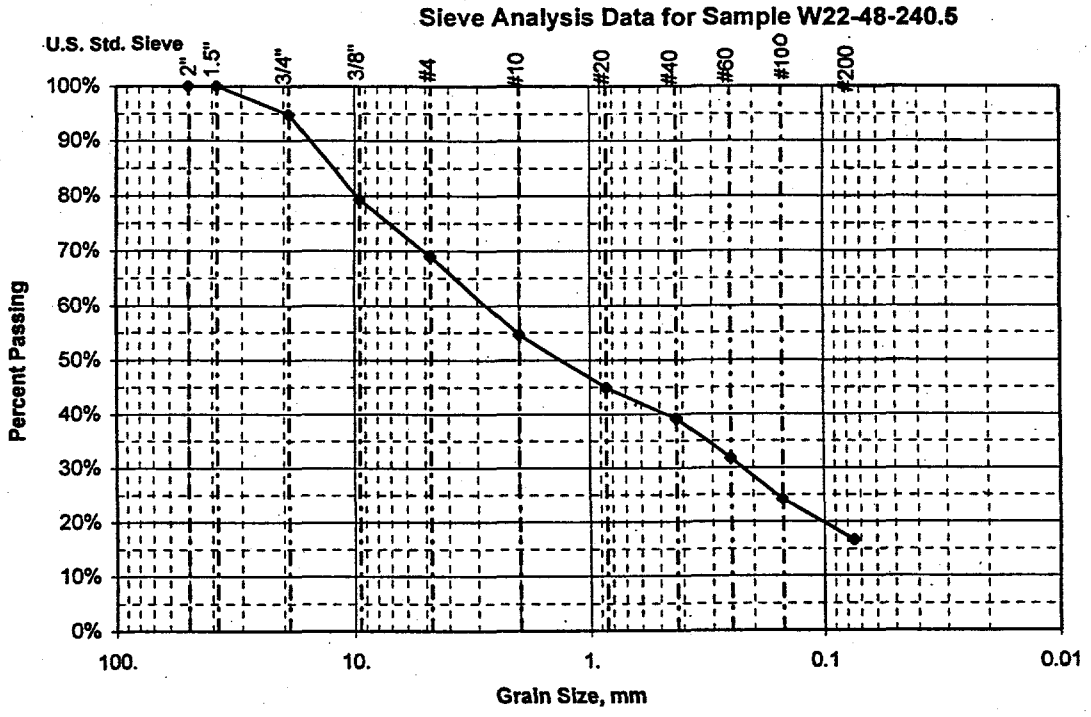
Table B.2. Particle Size Distribution for the 240.5-ft-Deep Sample from Borehole 299-W22-48

CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-48	DEPTH	240.5'	SAMPLE#	W22-48-240.5	WELL ID#	B8812
TESTED BY	DCW	CONTACT	Dave Weekes	PHONE	372-9582	DATE	10/28/99

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
382.00	2"	0.0	0.0	100.0	50.00	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	19.9	5.2	94.8	19.00	
	3/8"	79.1	20.7	79.3	9.50	
	#4	118.6	31.0	69.0	4.75	
	#10	173.4	45.4	54.6	2.00	
	#20	210.5	55.1	44.9	0.85	
	#40	232.6	60.9	39.1	0.43	
	#60	260.5	68.2	31.8	0.25	
	#100	289.9	75.9	24.1	0.150	
	#200	318.5	83.4	16.6	0.075	



Comments: Silty Sandy Gravel: gravel is mostly nonbasalt

All data are accurately and completely recorded.

Checked By: RF Raidl Date: 28 Dec 1999

Table B.3. Moisture Content of Grab Samples and Core Samples from Borehole 299-W22-48

299-W22-48					
Depth (ft bgs)	**Moisture Content (wt %)**	**Depth (ft bgs)**	**Moisture Content (wt %)**	**Depth (ft bgs)**	**Moisture Content (wt %)**
Grab Samples					
10.5	9.10	75.0	2.28	145.0	3.72
15.0	6.55	80.0	2.32	150.0	4.16
20.0	9.36	85.0	7.14	155.0	2.17
25.0	2.31	90.0	3.08	160.0	1.90
30.0	8.64	95.0	4.30	165.0	2.16
35.0	5.96	100.0	4.42	170.0	14.11
40.0	3.91	105.0	12.65	175.0	2.06
45.0	3.03	110.0	2.83	180.0	2.42
50.5	5.20	115.0	4.37	185.5	2.58
55.0	3.22	120.0	4.56	190.5	2.11
60.0	2.77	125.0	2.79	192.0	2.22
65.0	3.44	130.0	2.15		
70.5	2.09	135.0	7.71		
Core Samples					
1.0	3.87	56.0	3.91	124.0	2.66
6.0	9.12	57.5	2.83	126.5	2.60
9.5	4.86	62.0	2.56	131.5	2.88
12.0	6.21	64.5	2.23	134.0	3.51
14.5	7.63	67.0	3.68	136.0	5.70
17.0	5.92	69.5	2.43	143.5	3.83
19.5	7.70	72.0	2.64	146.0	14.86
22.0	5.03	74.5	6.56	148.5	13.58
24.4	2.22	77.0	3.55	151.0	2.81
27.0	6.04	79.5	3.24	155.0	2.11
29.0	10.60	82.0	3.90	158.5	2.18
32.0	5.33	84.5	4.46	163.5	1.88
34.5	3.95	86.5	5.43	167.0	1.87
37.0	5.58	91.5	19.14	170.0	2.99
39.5	7.90	96.5	9.62	172.5	4.97
42.0	2.80	101.5	21.62	176.0	2.84
44.5	2.53	106.5	5.50	182.0	1.84
47.0	1.88	111.5	3.14	187.0	2.32
50.0	5.25	115.5	5.29	192.0	2.21
53.5	2.41	120.5	3.81	235.0	10.47

Table B.4. pH and Conductivity of Aliquots of Core Samples from Boreholes 299-W22-48

Depth (ft bgs)	pH	Conductivity (uS/cm)	Temperature (degrees C)
29.5	7.38	0.224	24.0
32.0	7.97	0.171	24.2
39.5	7.39	0.180	24.3
47.0	7.30	0.126	24.3
56.0	7.20	0.142	24.3
74.5	7.45	0.239	24.3
74.5[(a)]	7.34	0.193	24.6
91.5[(b)]	6.93	1.386	24.6
101.5[(b)]	7.25	1.316	24.6
106.5	7.70	0.177	24.6
115.5	7.39	0.182	24.5
136.0	7.20	0.214	24.5
143.5	7.12	0.186	24.3
146.0[(a)]	7.42	0.493	24.6
146.0	7.37	0.390	24.5
148.5	7.48	0.291	24.5
151.0	7.56	0.208	24.5
163.5	7.46	0.117	24.5
170.0	7.40	0.116	24.5
172.5	7.33	0.190	24.5
187.0	7.58	0.053	24.5
192.0	7.78	0.120	24.5

(a) Duplicate.
(b) UFA = Ultra centrifuge.

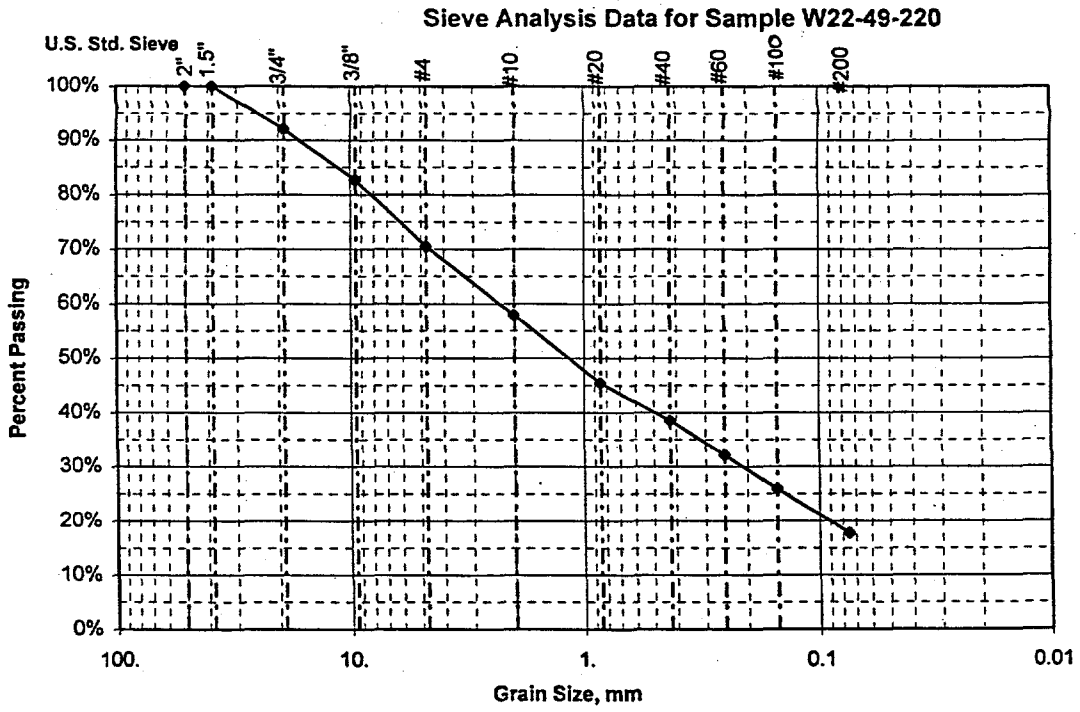
Table B.5. Particle Size Distribution for the 220-ft-Deep Sample from Borehole 299-W22-49

CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-49	DEPTH	220'-221.3'	SAMPLE#	W22-49-220	WELL ID#	B8813
TESTED BY	DCW	CONTACT	Dave Weekes	PHONE	372-9582	DATE	11/08/99

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
721.60	2"	0.0	0.0	100.0	50.00	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	57.5	8.0	92.0	19.00	
	3/8"	124.7	17.3	82.7	9.50	
	#4	213.4	29.6	70.4	4.75	
	#10	304.2	42.2	57.8	2.00	
	#20	394.0	54.6	45.4	0.85	
	#40	443.8	61.5	38.5	0.43	
	#60	489.3	67.8	32.2	0.25	
	#100	534.7	74.1	25.9	0.150	
	#200	593.5	82.2	17.8	0.075	



Comments: Silty Sandy Gravel: basalt clast up to 4 in not sieved

All data are accurately and completely recorded.

Checked By: RF Raidl Date: 28 Dec 1999

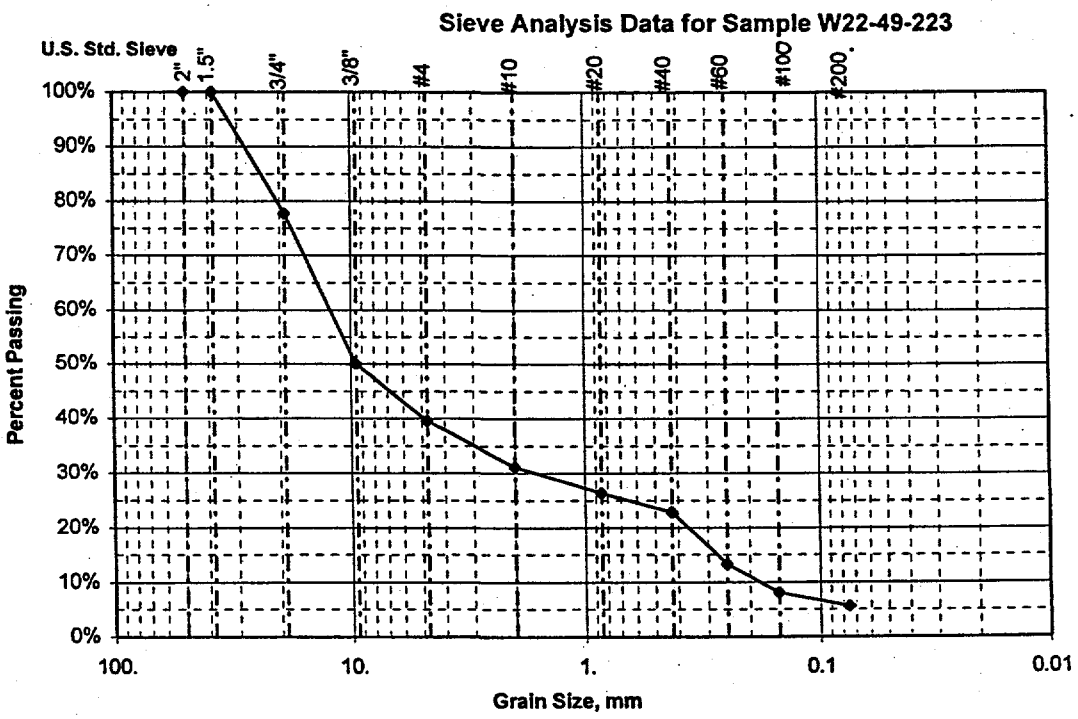
Table B.6. Particle Size Distribution for the 223-ft-Deep Sample from Borehole 299-W22-49

CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-49	DEPTH	223'-224.6'	SAMPLE#	W22-49-223	WELL ID#	B8813
TESTED BY	DCW JCW	CONTACT	Dave Weekes	PHONE	372-9582	DATE	11/08/99

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
763.00	2"	0.0	0.0	100.0	50.00	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	170.0	22.3	77.7	19.00	
	3/8"	382.0	50.1	49.9	9.50	
	#4	461.2	60.4	39.6	4.75	
	#10	525.3	68.8	31.2	2.00	
	#20	561.9	73.6	26.4	0.85	
	#40	588.4	77.1	22.9	0.43	
	#60	661.9	86.7	13.3	0.25	
	#100	701.3	91.9	8.1	0.150	
	#200	720.3	94.4	5.6	0.075	



Comments: Sandy Gravel: non-basaltic gravel

All data are accurately and completely recorded.

Checked By: R F Kaidl Date: 28 Dec 1999

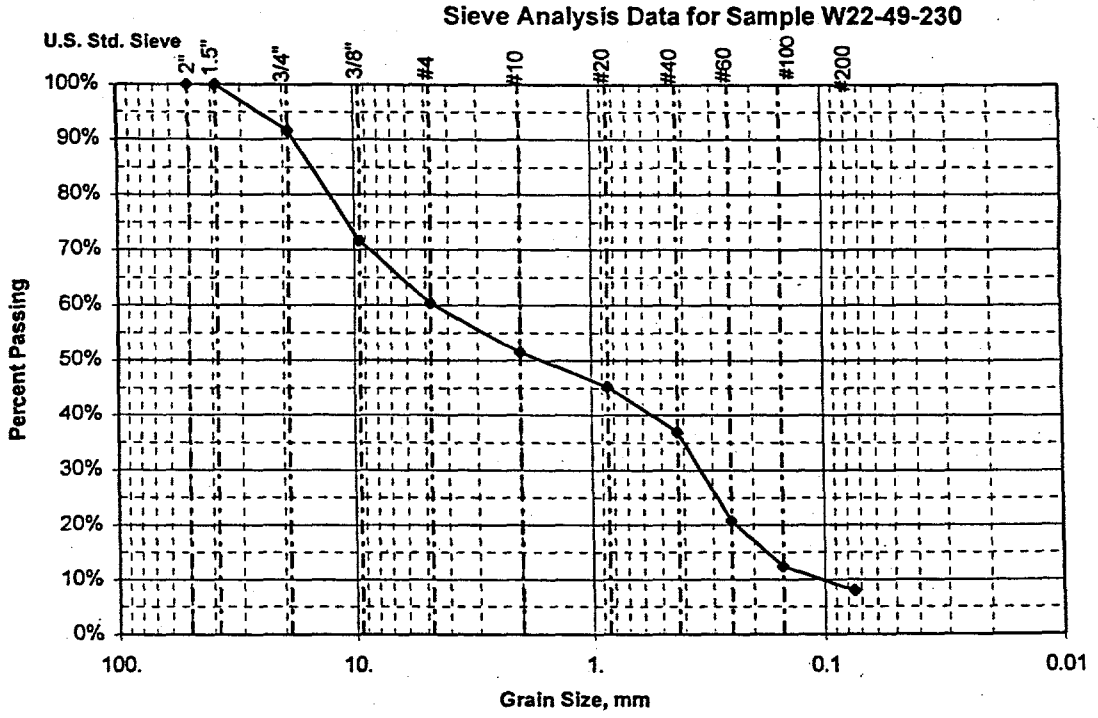
Table B.7. Particle Size Distribution for the 230-ft-Deep Sample from Borehole 299-W22-49

CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-49	DEPTH	230'-232'	SAMPLE#	W22-49-230	WELL ID#	B8813
TESTED BY	DCW	CONTACT	Dave Weekes	PHONE	372-9582	DATE	11/08/99

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
608.70	2"	0.0	0.0	100.0	50.00	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	51.8	8.5	91.5	19.00	
	3/8"	172.6	28.4	71.6	9.50	
	#4	241.6	39.7	60.3	4.75	
	#10	295.3	48.5	51.5	2.00	
	#20	333.4	54.8	45.2	0.85	
	#40	383.7	63.0	37.0	0.43	
	#60	482.3	79.2	20.8	0.25	
	#100	533.3	87.6	12.4	0.150	
	#200	560.1	92.0	8.0	0.075	



Comments: Sandy Gravel: non-basaltic gravel

All data are accurately and completely recorded.

Checked By: RF Raidl Date: 28 Dec 1999

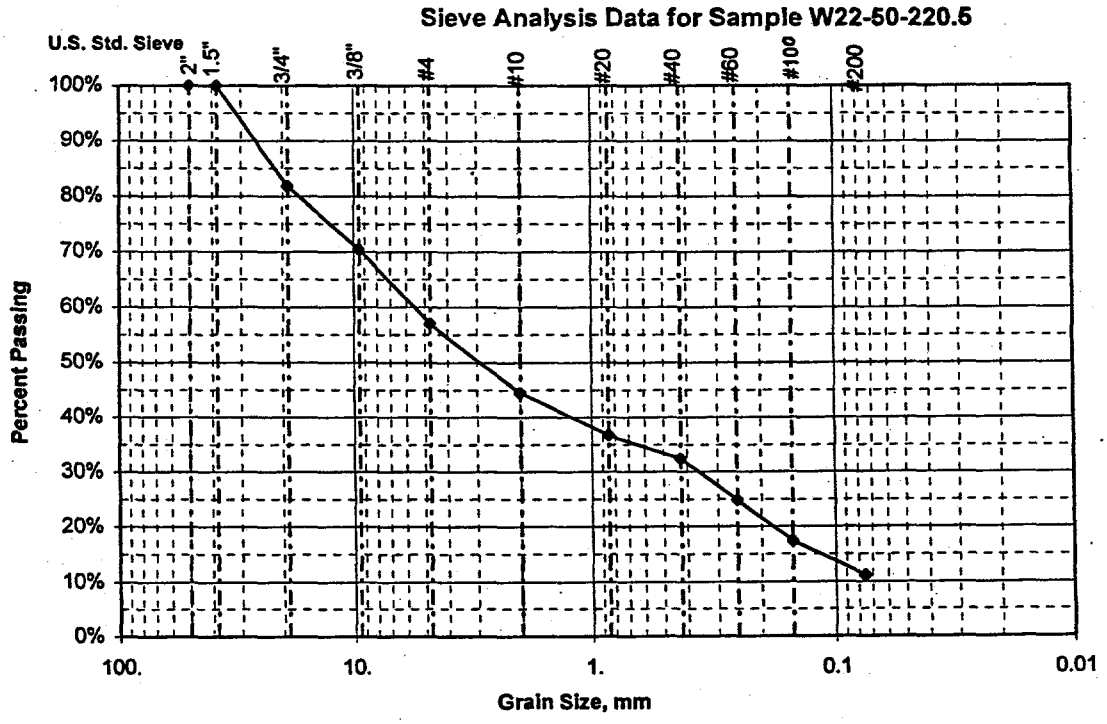
Table B.8. Particle Size Distribution for the 220.5-ft-Deep Sample from Borehole 299-W22-50

CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-50	DEPTH	220.5'-223'	SAMPLE#	W22-50-220.5	WELL ID#	B8814
TESTED BY	DCW	CONTACT	Dave Weekes	PHONE	372-9582	DATE	12/03/1999

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
619.60	2"	0.0	0.0	100.0	50.00	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	112.7	18.2	81.8	19.00	
	3/8"	183.3	29.6	70.4	9.50	
	#4	266.1	42.9	57.1	4.75	
	#10	344.1	55.5	44.5	2.00	
	#20	391.9	63.3	36.7	0.85	
	#40	418.7	67.6	32.4	0.43	
	#60	465.9	75.2	24.8	0.25	
	#100	512.2	82.7	17.3	0.150	
	#200	551.1	88.9	11.1	0.075	



Comments: Silty Sandy Gravel: gravel is predominantly non basalt

All data are accurately and completely recorded.

Checked By: L.D. Walker / [signature] Date: 1-19-00

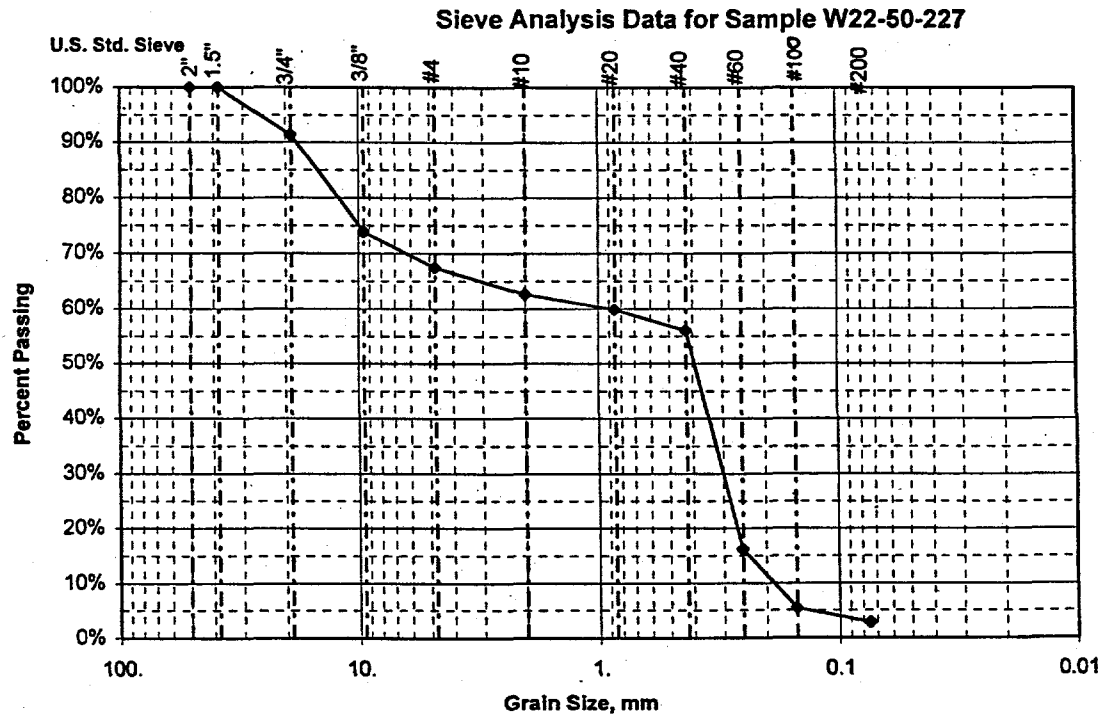
Table B.9. Particle Size Distribution for the 227-ft-Deep Sample from Borehole 299-W22-50

CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-50	DEPTH	227'-229.5'	SAMPLE#	W22-50-227	WELL ID#	B8814
TESTED BY	DCW	CONTACT	Dave Weekes	PHONE	372-9582	DATE	12/03/1999

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
533.50	2"	0.0	0.0	100.0	50.00	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	46.1	8.6	91.4	19.00	
	3/8"	139.4	26.1	73.9	9.50	
	#4	173.9	32.6	67.4	4.75	
	#10	199.5	37.4	62.6	2.00	
	#20	214.3	40.2	59.8	0.85	
	#40	234.5	44.0	56.0	0.43	
	#60	447.1	83.8	16.2	0.25	
	#100	504.9	94.6	5.4	0.150	
	#200	518.7	97.2	2.8	0.075	



Comments: Sandy Gravel: gravel is predominantly non basalt

All data are accurately and completely recorded.

Checked By: L.D. Walker Date: 1-19-00

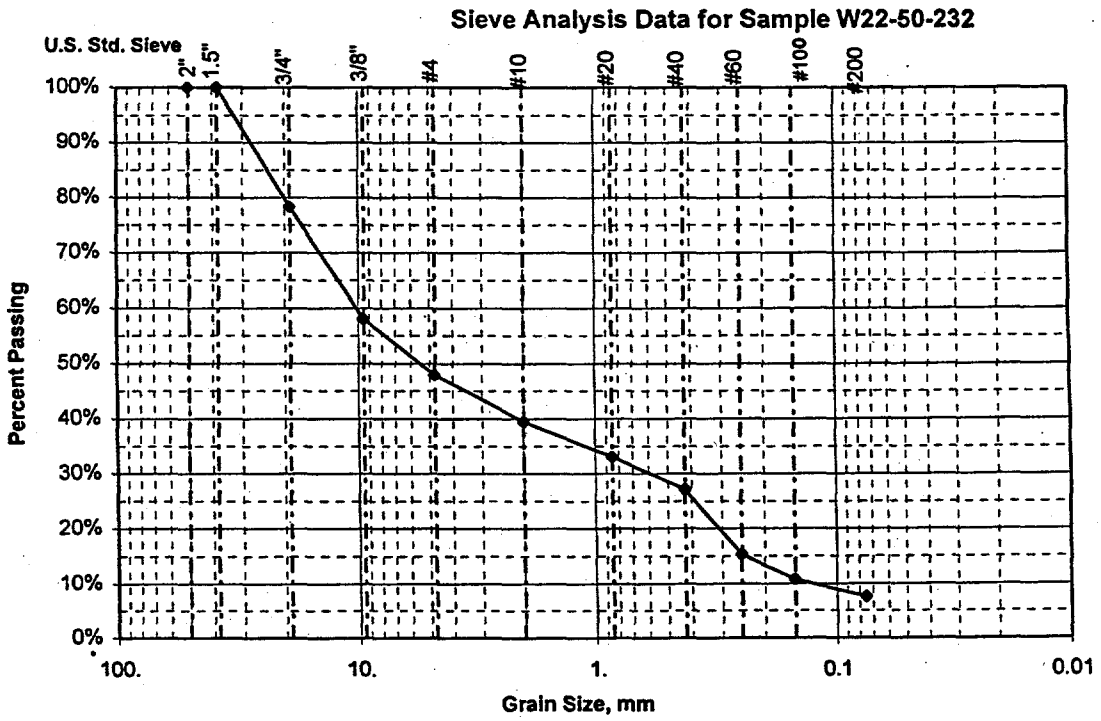
Table B.10. Particle Size Distribution for the 232-ft-Deep Sample from Borehole 299-W22-50

CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-50	DEPTH	232'-234'	SAMPLE#	W22-50-232	WELL ID#	B8814
TESTED BY	DCW	CONTACT	Dave Weekes	PHONE	372-9582	DATE	12/03/1999

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
568.50	2"	0.0	0.0	100.0	50.00	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	123.1	21.7	78.3	19.00	
	3/8"	238.6	42.0	58.0	9.50	
	#4	296.0	52.1	47.9	4.75	
	#10	343.8	60.5	39.5	2.00	
	#20	380.3	66.9	33.1	0.85	
	#40	414.4	72.9	27.1	0.43	
	#60	481.8	84.7	15.3	0.25	
	#100	507.3	89.2	10.8	0.150	
	#200	525.5	92.4	7.6	0.075	



Comments: Sandy Gravel: gravel is predominantly non basalt

All data are accurately and completely recorded.

Checked By: L. D. Walker / [signature] Date: 1-19-00

Table B.11. Moisture Content of Aliquots of Core Samples from Borehole 299-W22-50

299-W22-50					
Depth (ft bgs)	**Moisture Content (wt %)**	**Depth (ft bgs)**	**Moisture Content (wt %)**	**Depth (ft bgs)**	**Moisture Content (wt %)**
20.0	7.33	62.5	3.50	103.5	7.57
21.0	7.01	63.5	2.43	105.0	7.55
22.5	14.46	65.0	5.10	106.0	6.16
23.5	8.55	66.0	3.69	107.5	11.52
25.0	5.80	67.5	7.51	108.5	7.14
26.0	5.51	68.5	5.90	110.0	7.18
26.5	11.47	68.5[(a)]	5.16	111.0	13.86
28.5	2.76	70.0	6.38	112.5	6.99
30.0	12.56	71.0	4.50	113.5	5.88
31.0	4.64	72.5	5.60	115.0	10.17
32.5	8.72	73.5	4.48	116.0	22.12
33.5	4.30	75.0	8.37	116.5[(a)]	22.61
35.0	8.94	76.0	10.30	117.5	5.42
36.0	5.15	77.5	5.74	118.5	7.46
37.5	6.86	78.5	7.32	120.0	8.09
38.5	5.92	80.0	6.94	121.0	10.77
40.0	5.07	81.0	3.61	122.5	4.95
41.0	4.41	82.5	6.48	123.5	3.81
42.5	7.14	83.5	6.92	125.0	4.93
43.5	5.36	85.0	5.48	126.0	3.45
45.0	7.72	86.0	3.99	127.5	10.61
45.0[(a)]	8.01	87.5	5.29	128.5	19.69
46.0	8.64	88.5	3.65	130.0	6.31
47.5	10.60	90.0	6.01	131.0	5.33
48.5	9.26	91.0	2.28	132.5	10.85
50.0	10.37	92.5	5.20	133.5	10.60
51.0	7.62	92.5[(a)]	5.10	135.0	10.00
52.5	2.55	93.5	7.66	136.0	17.01
53.5	2.08	95.0	4.30	137.5	16.14
55.0	8.26	96.0	8.97	138.5	14.08
56.0	4.25	97.5	8.65	140.0	30.10
57.0	2.35	98.5	4.51	140.5[(a)]	29.67
58.0	1.96	100.0	6.15	141.0	8.29
60.0	3.02	101.0	3.36	142.5	2.59
61.0	1.62	102.5	5.79	143.5	2.45

Table B.11. (contd)

299-W22-50					
Depth (ft bgs)	**Moisture Content (wt %)**	**Depth (ft bgs)**	**Moisture Content (wt %)**	**Depth (ft bgs)**	**Moisture Content (wt %)**
143.5	2.45	158.0	2.50	168.0	2.44
148.0	6.74	159.0	2.03	169.0	1.78
149.0	2.86	160.6	2.26	170.5	1.67
150.5	3.14	161.5	1.90	171.5	1.61
151.5	2.60	163.0	1.84	173.0	1.63
153.0	3.14	164.0	1.89	174.0	1.74
154.0	2.80	165.5	1.96	175.5	1.84
155.5	2.28	165.5[(a)]	1.94	176.5	1.92
156.5	2.18	166.5	3.48		

(a) Duplicate.

Table B.12. Bulk Density of Core Samples from Borehole 299-W22-50

299-W22-50					
Depth (ft bgs)	**Bulk Density (g/cc)**	**Depth (ft bgs)**	**Bulk Density (g/cc)**	**Depth (ft bgs)**	**Bulk Density (g/cc)**
20.0	1.5168	63.5	1.6651	107.5	1.7821
21.0	1.5770	65.0	1.7953	108.5	1.9063
22.5	1.6130	66.0	1.6507	110.0	1.8900
23.5	1.9564	67.5	1.7138	111.0	1.6398
25.0	1.8247	68.5	1.6385	112.5	1.9511
26.0	1.6560	70.0	1.6911	113.5	1.7447
27.5	1.7670	71.0	1.8380	115.0	1.8551
28.5	1.7778	72.5	1.8114	116.0	1.4425
30.0	1.6591	73.5	1.7783	117.5	1.8511
31.0	1.6793	75.0	1.8120	118.5	1.9157
32.5	1.7372	76.0	1.7769	120.0	2.0270
33.5	1.8148	77.5	1.6594	121.0	1.8162
35.0	1.7393	78.5	1.7442	122.5	1.8217
36.0	1.7615	80.0	1.8137	123.5	1.7038
37.5	1.7944	81.0	1.9138	125.0	1.8475
38.5	1.7269	82.5	1.7512	126.0	1.7825
40.0	1.8654	83.5	1.9666	127.5	1.7653
41.0	1.8317	85.0	1.8091	128.5	1.6748
42.5	1.7889	86.0	1.8667	130.0	1.8223
43.5	1.6039	87.5	1.7425	131.0	1.7445
45.0	1.7821	88.5	1.8059	132.5	1.4618
46.0	1.6615	90.0	1.8354	133.5	1.7890
47.5	1.7630	91.0	1.9190	135.0	1.7751
48.5	1.7015	92.5	1.7321	136.0	1.7107
50.0	1.7303	93.5	1.8107	137.5	1.9533
51.0	1.7713	95.0	1.7745	138.5	1.8086
52.5	1.9869	96.0	2.0062	140.0	1.5257
53.5	1.8770	97.5	1.7265	141.0	1.9829
55.0	1.9152	98.5	1.6364	142.5	2.1866
56.0	2.0627	100.0	1.8429	143.5	1.8247
57.0	1.8521	101.0	1.8722	148.0	2.2779
58.0	2.2773	102.5	1.7670	149.0	2.1389
60.0	2.1450	103.5	1.6870	150.5	2.1615
61.0	2.1096	105.0	1.8185	151.5	1.9752
62.5	1.7977	106.0	2.0452	153.0	2.1672

Table B.12. (contd)

299-W22-50					
Depth (ft bgs)	**Bulk Density (g/cc)**	**Depth (ft bgs)**	**Bulk Density (g/cc)**	**Depth (ft bgs)**	**Bulk Density (g/cc)**
154.0	2.1035	163.0	2.1539	171.5	1.6449
155.5	1.8439	164.0	2.2439	173.0	1.8754
156.5	1.8184	165.5	1.8402	174.0	1.6874
158.0	1.9804	166.5	1.6174	175.5	0.9508
159.0	1.8810	168.0	1.9345	176.5	1.7542
160.5	1.7227	169.0	1.8252		
161.5	1.7692	170.5	2.0225		

Table B.13. Electrical Conductivity and pH of 1:1 Water Extracts from Samples from Borehole 299-W22-50

299-W22-50			
Depth (ft bgs)	**pH**	**Conductivity (uS/cm)**	**Temperature (degrees C)**
5.0			
10.0			
15.0			
20.0	7.78	0.188	24.6
22.5	7.72	0.221	24.3
25.0	7.68	0.214	24.4
27.5	7.60	0.214	24.4
30.0	7.65	0.217	24.4
32.5	7.67	0.186	24.5
35.0	7.49	0.222	24.5
37.5	7.84	0.203	24.5
40.0	7.03	0.184	24.5
42.5	7.11	0.223	24.5
45.0	7.34	0.227	24.6
45.0[(a)]	7.59	0.221	25.0
47.5	7.40	0.224	24.6
51.0	7.90	0.181	24.7
52.5	7.44	0.181	24.7
55.0	7.32	0.216	24.8
56.0	7.35	0.129	24.8
60.0	10.33	0.553	25.0
67.5	9.00	0.276	24.9
76.0	8.55	0.223	24.8
96.0	7.48	0.320	24.7
96.0[(a)]	7.44	0.286	25.0
111.0	7.45	0.296	24.8
115.0	7.51	0.309	24.8
116.0[(b)]	7.21	1415	24.9
130.0	7.66	0.231	24.9
135.0	8.50	0.227	25.0
140.0[(b)]	7.49	0.956	25.1
141.0	8.12	0.246	25
150.5	7.77	0.191	24.9
160.5	7.74	0.135	25.0
174.0	7.75	0.088	25.0

(a) Duplicate.
(b) Ultra centrifuge.

Appendix C

Borehole Geoophysical Logs

Appendix C

Borehole Geophysical Logs

This appendix contains the borehole geophysical logs obtained from boreholes 299-W22-49, 299-W22-49, and 299-W22-50. The logs were run and analyzed by Waste Management Federal Services Northwest, Inc. Included with the logs are Log Header sheets and Log Analysis Summary Reports.

RLS Spectral Gamma Survey

Waste Management Technical Services

LOG HEADER

Project: RCRA drilling 1999 **Well:** 299-W22-48

Borehole Information

Well #	299-W22-48	Water Depth	226 ft	Total Depth	245 ft
Elevation Reference	n/a	Elevation	n/a ft		
Depth Reference	Ground Surface	Casing Stickup	11.75 in. – 0.38', 8.625 in. – 1.0'		
Casing Diameter	11.75 in.	Depth Interval	0 to 50 ft	Thickness	0.5 in
Casing Diameter	8.625 in.	Depth Interval	0 to 245 ft	Thickness	0.5 in

Logging Information

Log Type:	HPGe Spectral Gamma	
Company	Waste Management Technical Services	
Logging Engineers	J.E. Meisner	
Instrument Series	RLSG07000S00.0	
Logging Unit	RLS-1	
Depth Interval	0' to 166.0'	Prefix A678
	161.0' to 245.5'	A679
Instrument Calibration Date	October 8, 1999	
Calibration Report	WHC-SD-EN-TI-292, Rev. 0	

Analysis Information

Company	Waste Management Technical Services
Analyst	Steven Kos
Date	March 13, 2000
Depth Reference	Ground Surface

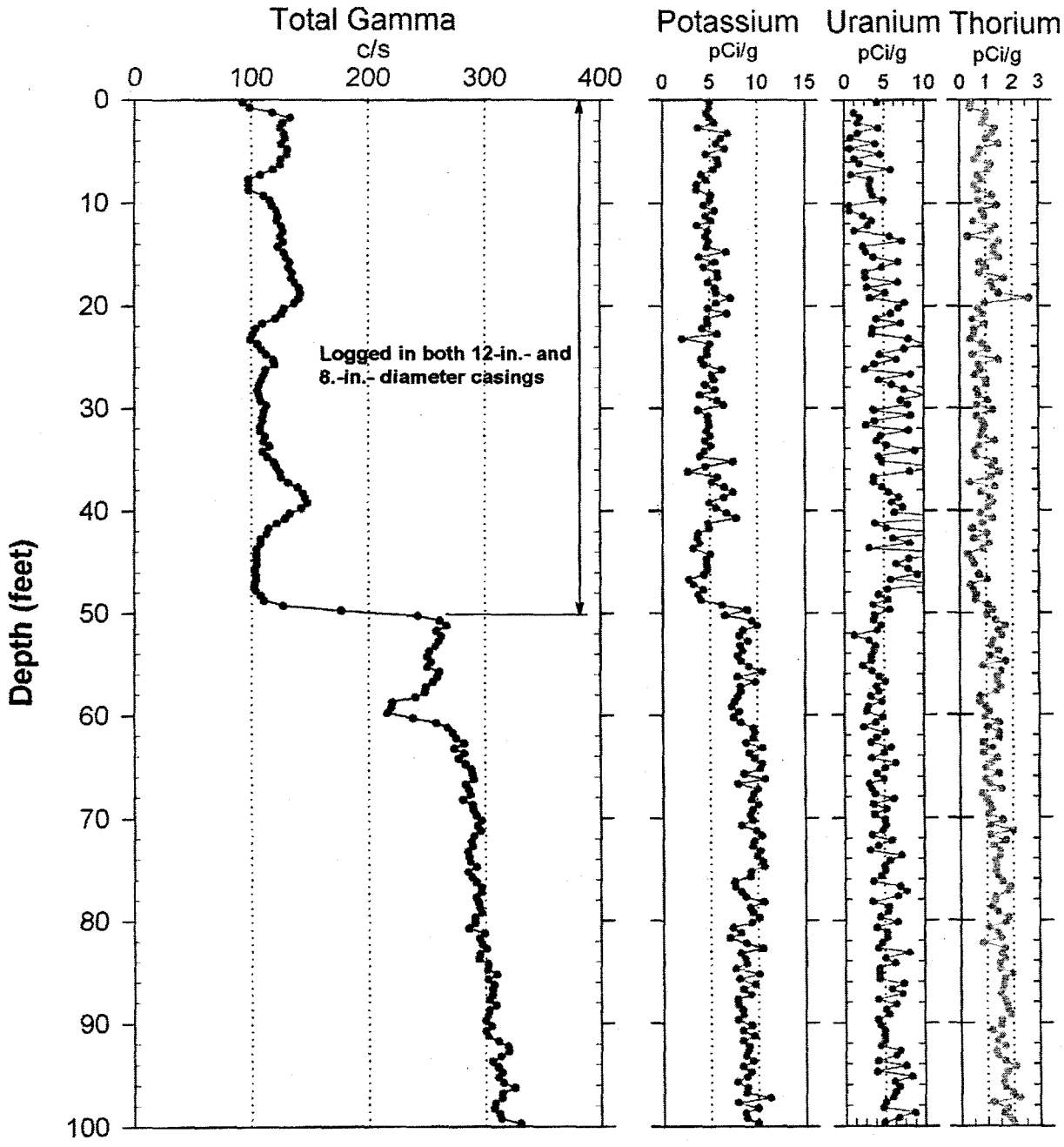
Notes Spectral gamma measurements were acquired at 0.5-ft depth intervals at a logging speed of 1.0 ft. min.

RLS Spectral Gamma Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date: Oct. 27, 1999

Well: 299-W22-48 Depth Datum: Ground Level

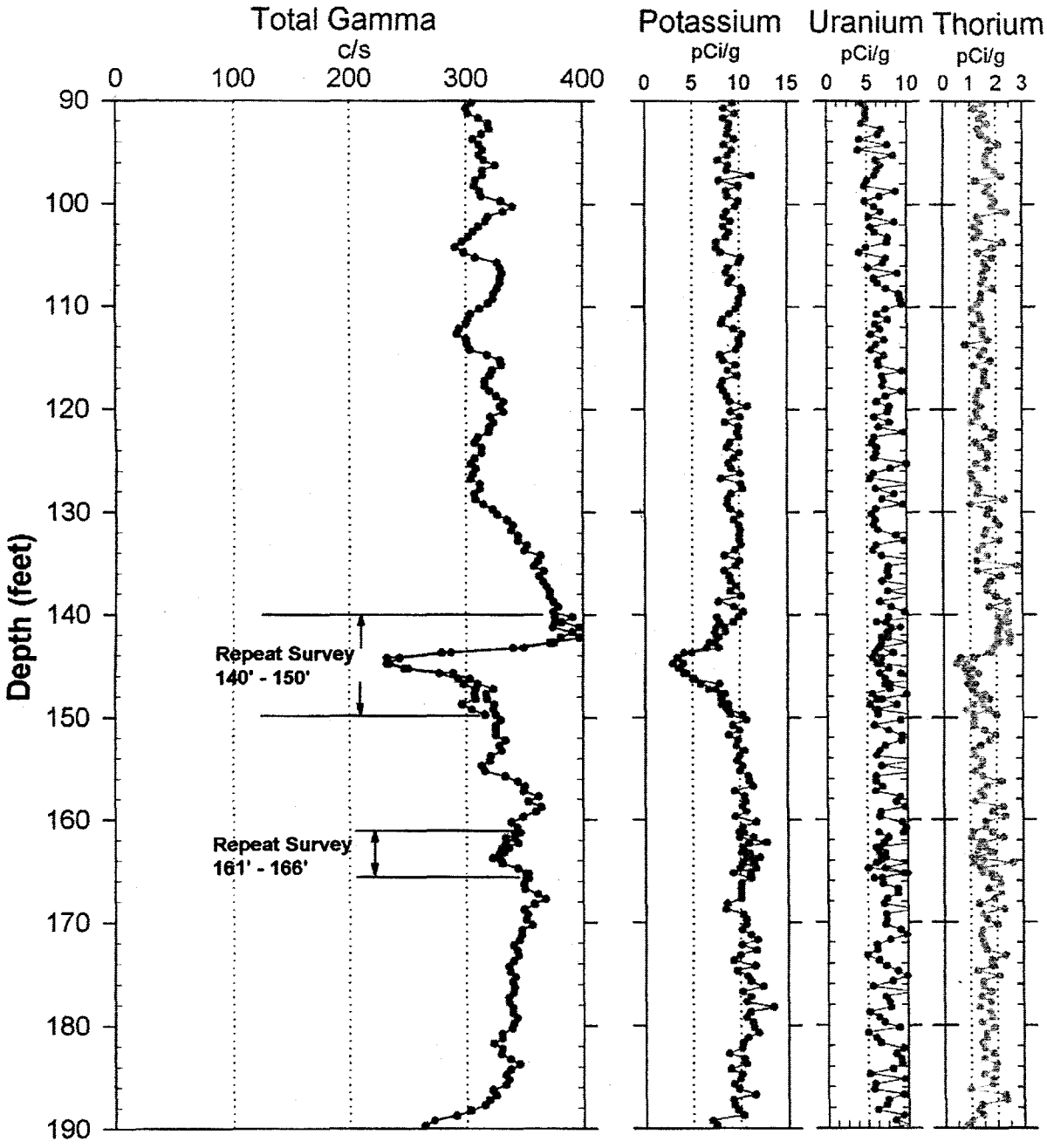


RLS Spectral Gamma Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date: Oct. 27, 1999

Well: 299-W22-48 Depth Datum: Ground Level

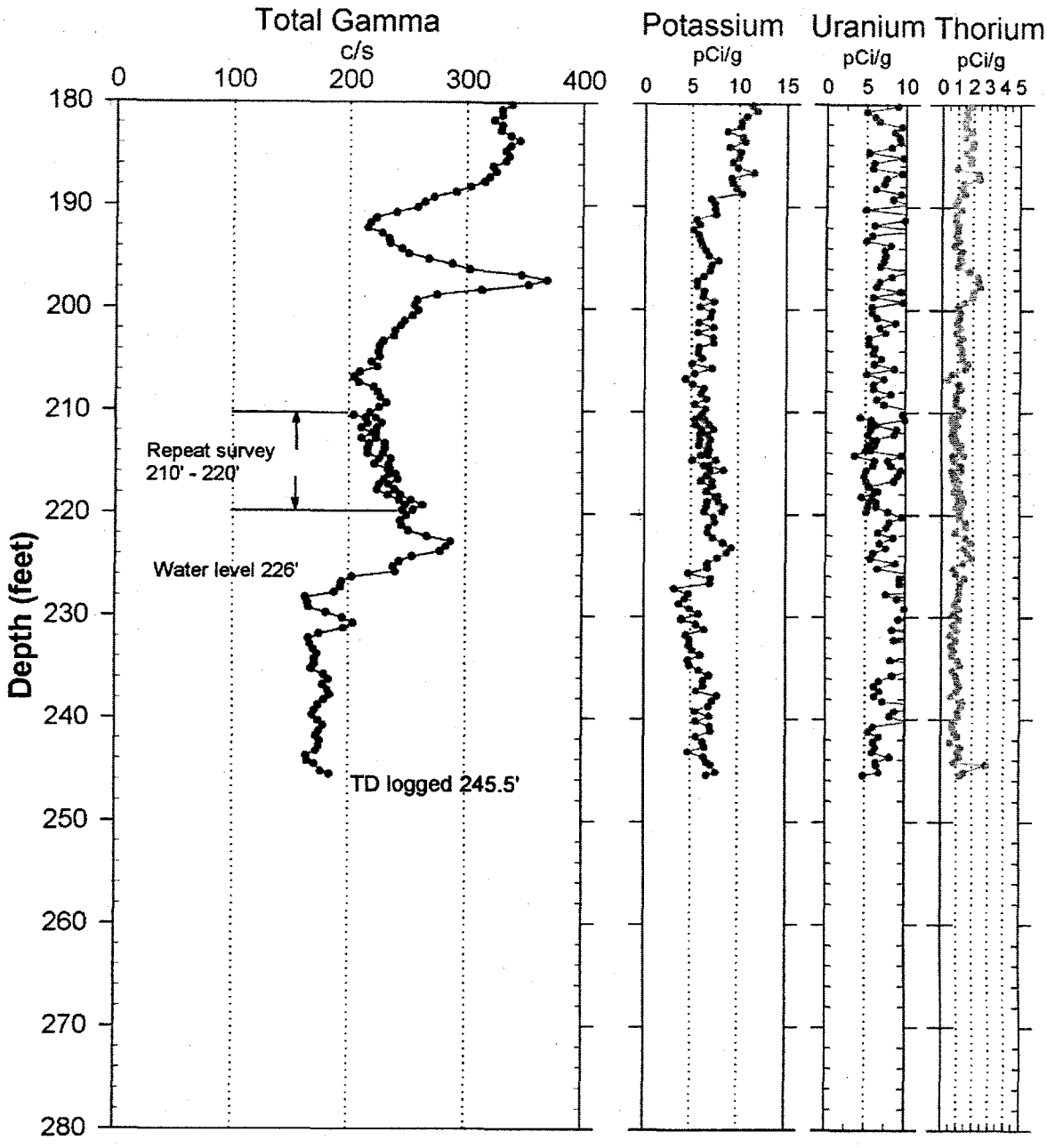


RLS Spectral Gamma Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date: Oct. 27, 1999

Well: 299-W22-48 Depth Datum: Ground Level



RLS Spectral Gamma Survey

Waste Management Technical Services

Summary Report

Project: RCRA Well Drilling 1999 **Well:** 299-W22-48

General Notes:

All log data were collected with reference to ground surface.

System Performance Verification: The pre- and post-log verification passed performance standards, indicating the system was performing to specifications outlined in the procedures.

Repeat Interval: Repeat surveys were conducted between depths of 140 and 150 ft, between depths of 161 and 166 ft, and between depths of 210 and 220 ft. The results show good repeatability of measurements.

Environmental Corrections: The spectral gamma log measurements have been corrected for casing attenuation throughout the entire well, and a water correction was applied to the data acquired in the water to correct for the attenuation of water.

Observations:

Cs-137 was the only man-made radionuclide identified. It was detected between depths of 1 and 2 ft at a concentration of 5 pCi/g.

The range of the concentrations of the naturally occurring radionuclides potassium-40 (^{40}K), uranium, and thorium (KUT) are typical for Hanford formation and Ringold Formation sediments. The concentrations are, for the majority of samples, between 5 and 10 pCi/g, between 0.5 and 10 pCi/g, and between 0.5 and 2 pCi/g respectively. Some erratic peaks are outside of these ranges.

Some of the erratic nature observed on the uranium concentration plot is indicative of the presence of radon in the borehole. Elevated countrates were detected on the paper wipes that are utilized to clean the cable as the logging tool is withdrawn from the borehole. The health physics technician determined that the rate at which the countrates on the wipes diminished was consistent with the decay of radon.

The profile of the total gamma plot, which is the sum of all counts in the spectra for each 0.5-ft depth sample, is most reflective of the ^{40}K concentrations; however, the influence of thorium concentrations (more specifically its gamma rays) on the total gamma countrate can be seen in the region of the borehole between depths of 142 and 146 ft. The most distinctive change in the total gamma countrate occurs at a depth of about 145 ft where the total gamma countrate decreases (and associated decreases in potassium and thorium concentrations). The neutron-neutron moisture log data acquired in this borehole indicate that a lithologic change has occurred in this region of the borehole by an abrupt change in volumetric moisture content at a depth of 145 ft. The higher moisture content indicates finer grained sediments that retain moisture. The volumetric moisture content in the sediments surrounding the borehole increase from a background of about 1 percent to 15 percent at a depth of 145 ft.

The lower gross gamma countrate from ground surface to a depth of 50 ft reflects the attenuation caused by double casings in this region of the borehole. A casing factor is applied to the data during the conversion of the data from counts per second to concentrations in pCi/g; however, the total gamma countrate measurements not casing corrected.

RLS Neutron-Neutron Moisture Survey

Waste Management Technical Services

LOG HEADER

Project: RCRA drilling 1999 **Well:** 299-W22-48

Borehole Information

Well #	299-W22-48	Water Depth	226 ft	Total Depth	245 ft
Elevation Reference	n/a	Elevation	n/a ft		
Depth Reference	Ground Surface	Casing Stickup	11.75 in. – 0.38', 8.625 in. – 1.0'		
Casing Diameter	11.75 in.	Depth Interval	0 to 50 ft	Thickness	0.5 in.
Casing Diameter	8.625 in.	Depth Interval	0 to 245 ft	Thickness	0.5 in.

Logging Information

Log Type:	Neutron-Neutron Moisture	
Company	Waste Management Technical Services	
Logging Engineers	J.E. Meisner	
Instrument Series	RLSM00.0	
Logging Date	October 27, 1999	
Logging Unit	RLS-1	
Depth Interval	0' to 100'	Prefix MS45
	50' to 150'	MA46
	145' to 225.75'	MA47
Instrument Calibration Date	May 13, 1999	
Calibration Report	WHC-SD-EN-TI-306, Rev. 0	

Analysis Information

Company	Waste Management Technical Services
Analyst	Steven Kos
Date	March 15, 2000
Depth Reference	Ground Surface

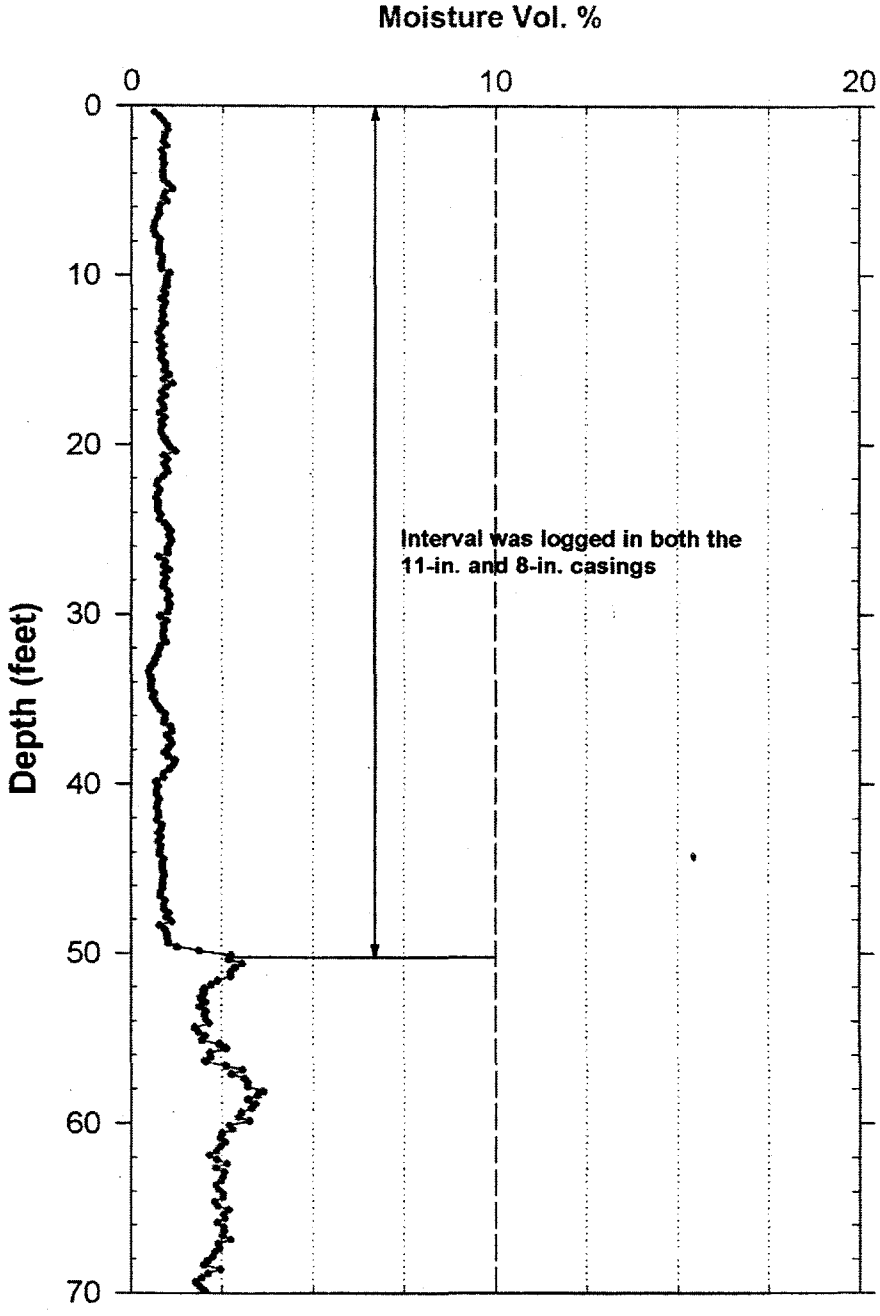
Notes The moisture measurements were acquired at 0.250-ft depth intervals at a logging speed of 1.0 ft per minute.

Neutron-Neutron Moisture Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date : October 27, 1999

Borehole: 299-W22-48 Depth Datum: Ground Level

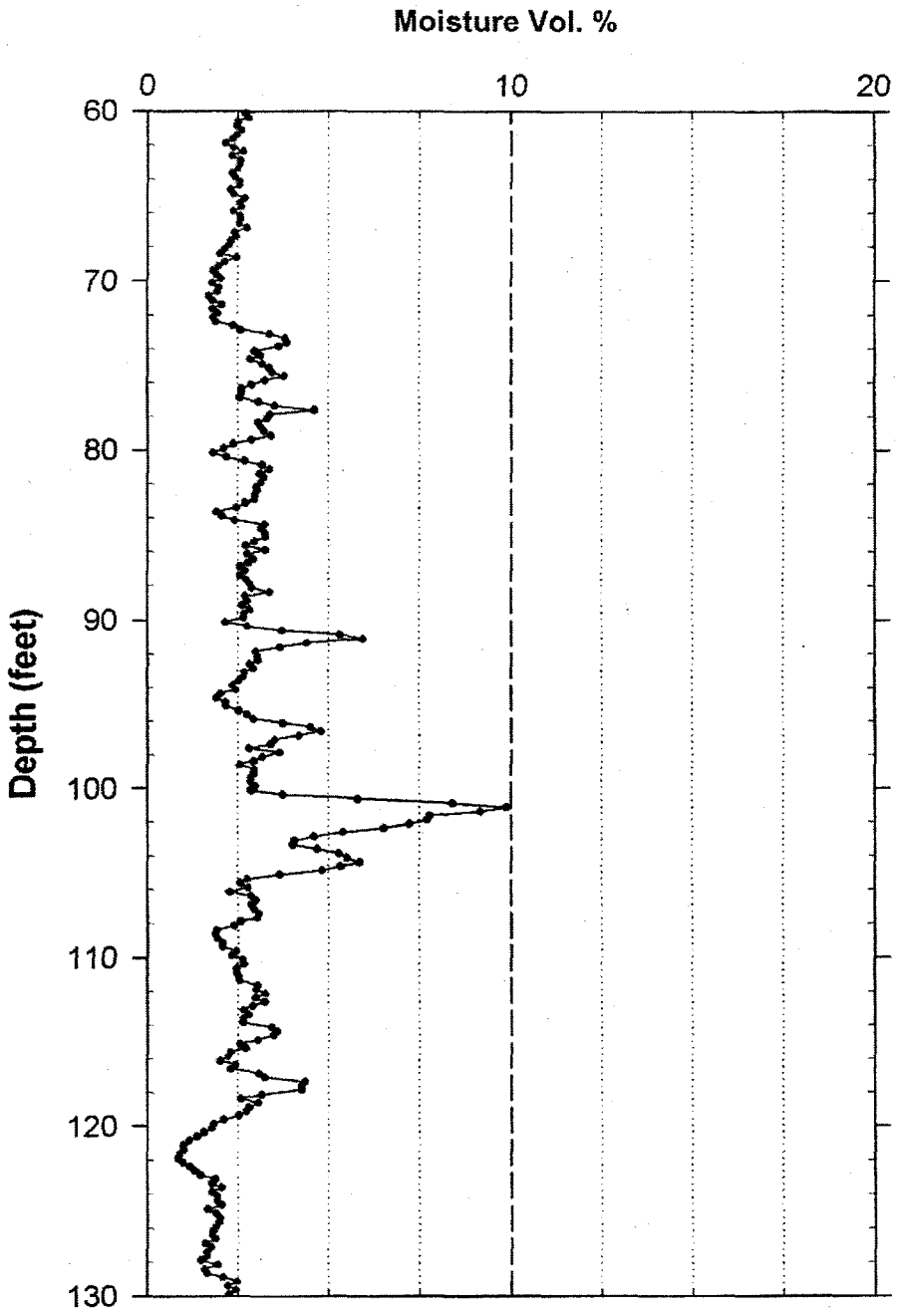


Neutron-Neutron Moisture Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date : October 27, 1999

Borehole: 299-W22-48 Depth Datum: Ground Level

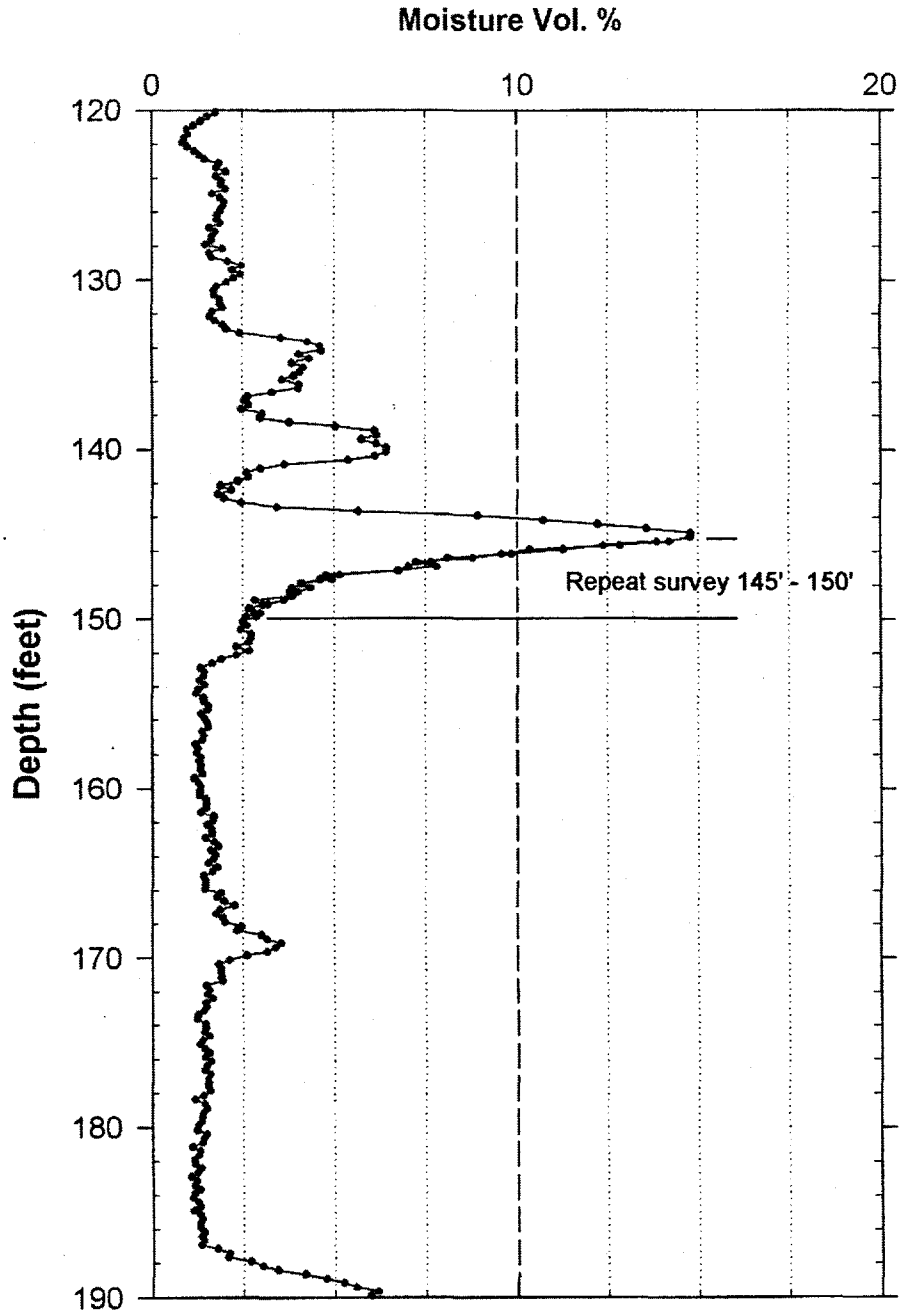


Neutron-Neutron Moisture Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date : October 27, 1999

Borehole: 299-W22-48 Depth Datum: Ground Level

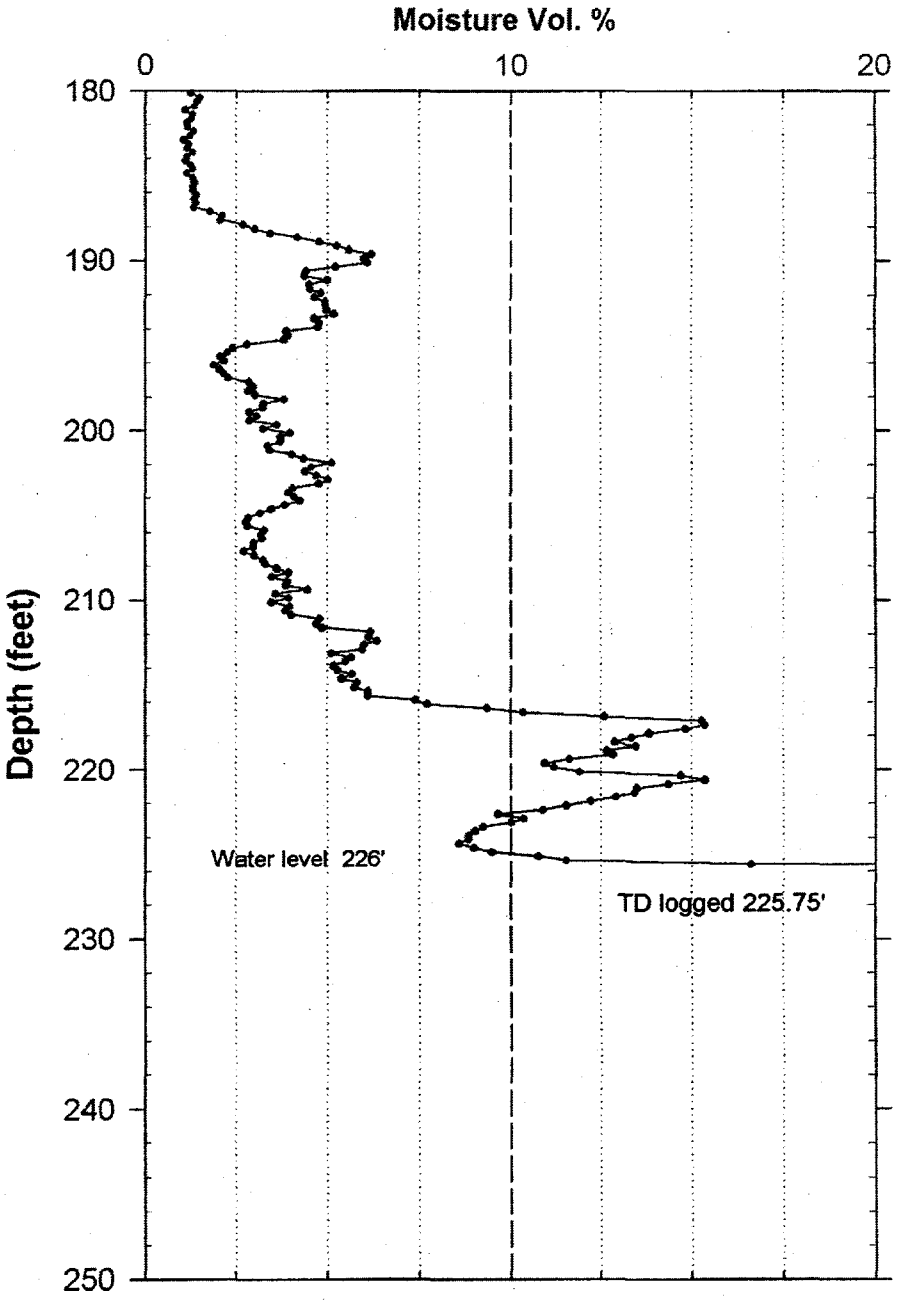


Neutron-Neutron Moisture Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date : October 27, 1999

Borehole: 299-W22-48 Depth Datum: Ground Level



RLS Neutron-Neutron Moisture Survey

Waste Management Technical Services

Summary Report

Project: RCRA Drilling 1999 **Well:** 299-W22-48

General Notes

All log data were collected with reference to ground surface. The moisture survey was conducted in both the 11.75-in.- and 8.625-in-diameter casings (from ground surface to a depth of 50 ft): however, since the logging tool is not calibrated for this casing configuration, these measurements are not valid. The survey was terminated at a depth of 225.75 ft where groundwater was encountered.

System Performance Verification: The pre- and post-survey verification passed performance standards, -3.4% in the shield verifier.

Repeat Interval: A repeat survey was conducted between depths of 145 and 150 ft. The results show good repeatability of the moisture profiles from the original and repeat surveys.

Environmental Corrections: The moisture measurements have been corrected for casing attenuation throughout the entire well. A casing correction for 8.625-in.-diameter casing was applied to the data.

Observations

The moisture values range from one percent volumetric moisture content between depths of 182 and 184 ft, to as high as almost 15 percent volumetric moisture content at a depth of about 145 ft. The low moisture content values between ground surface and a depth of 50 ft occur in the region of the borehole with double casings and these measurements are not valid for determination of moisture content. These measurements can be utilized to determine the bottom of the double casing string, which is located at a depth of 51 ft.

Several peaks of elevated moisture content (above a background of about 2 percent) are observed between depths of about 90 and 145 ft. These peaks most likely correlate with thin intervals of fine-grained sediments that retain moisture. The potassium, uranium, and thorium concentrations (as derived from the spectral gamma survey that was conducted in this borehole) also show variations in concentration in this region of the borehole which indicate variations in lithology. In both the spectral gamma and moisture data, an abrupt change (in log values) occurs at a depth of 145 ft. The potassium and thorium concentrations decrease and the moisture content increases from less than 2 percent to almost 15 percent.

The moisture content increases (to an off-scale value) at a depth of about 227.5 ft where groundwater is encountered.

RLS Spectral Gamma Survey

Waste Management Technical Services

LOG HEADER

Project: RCRA Drilling 1999 **Well:** 299-W22-49

Borehole Information

Well #	299-W22-49	Water Depth	217.6 ft	Total Depth	239 ft
Elevation Reference	n/a	Elevation	n/a ft		
Depth Reference	Ground Surface	Casing Stickup	11 in. – 1.2', 8 in. – 4.7'		
Casing Diameter	11.75 in.	Depth Interval	0 to 50 ft	Thickness	0.5 in
Casing Diameter	8.625 in.	Depth Interval	0 to 235.9 ft	Thickness	0.5 in

Logging Information

Log Type:	HPGe Spectral Gamma	
Company	Waste Management Technical Services	
Logging Engineers	S.E. Kos/ J.E. Meisner	
Logging Date	November, 8, 1999	
Instrument Series	RLSG07000S00.0	
Logging Unit	RLS-1	
Depth Interval	0' to 143.0'	Prefix A680
	140.0' to 238.5'	A681
Instrument Calibration Date	October 8, 1999	
Calibration Report	WHC-SD-EN-TI-292, Rev. 0	

Analysis Information

Company	Waste Management Technical Services
Analyst	Steven Kos
Date	March 13, 2000
Depth Reference	Ground Surface

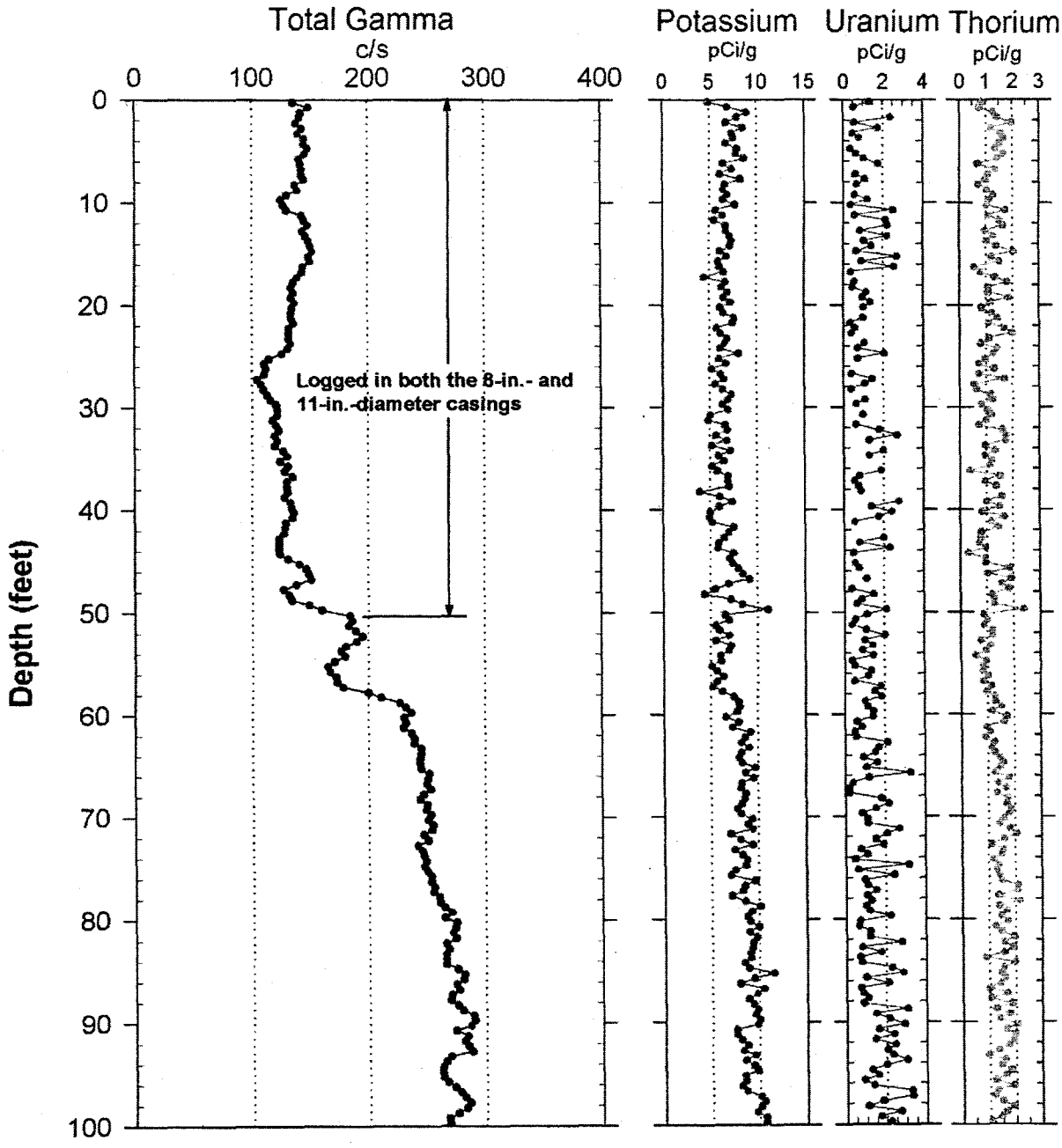
Notes Spectral gamma measurements were acquired at 0.5-ft depth increments at a logging speed of 1.0 ft per minute.

RLS Spectral Gamma Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date: Nov. 8, 1999,

Well: 299-W22-49 Depth Datum: Ground Level

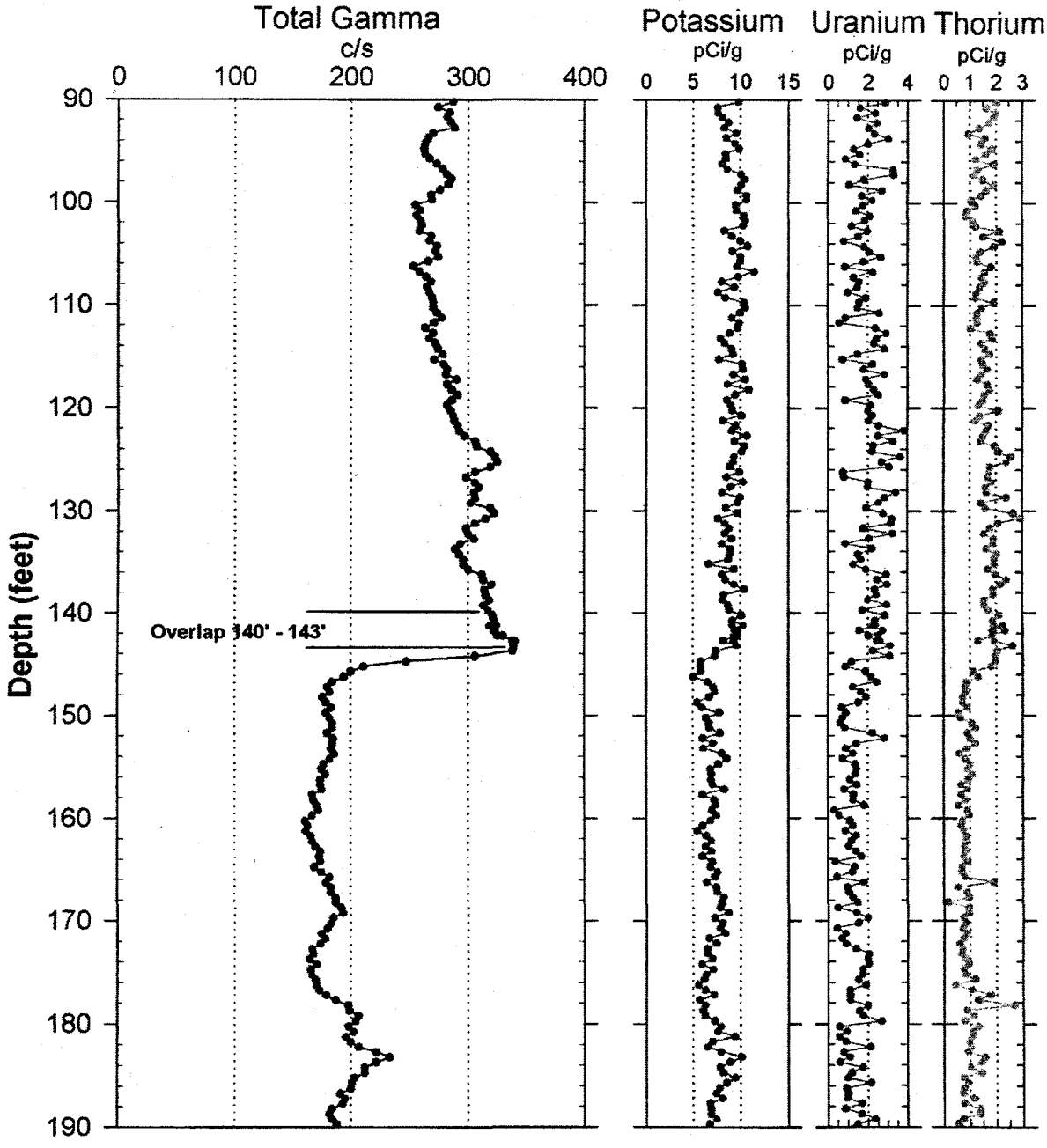


RLS Spectral Gamma Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date: Nov. 8, 1999,

Well: 299-W22-49 Depth Datum: Ground Level

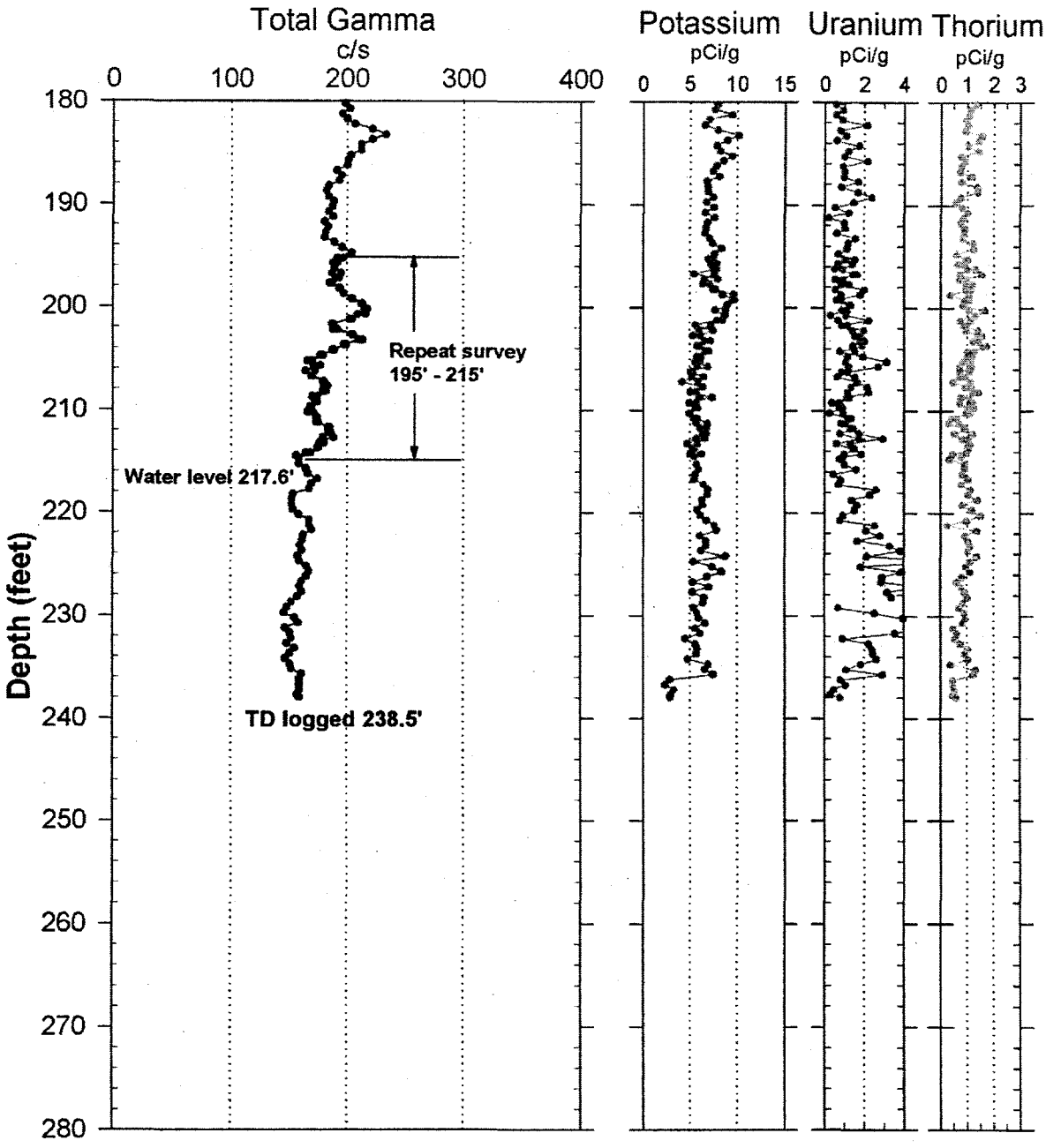


RLS Spectral Gamma Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date: Nov. 8, 1999

Well: 299-W22-49 Depth Datum: Ground Level



RLS Spectral Gamma Survey

Waste Management Technical Services

Summary Report

Project: RCRA Well Drilling 1999 **Well:** 299-W22-49

General Notes:

All log data were collected with reference to ground surface.

System Performance Verification: The pre- and post-log verification passed performance standards, indicating the system was performing to specifications outlined in the procedures.

Repeat Interval: Repeat surveys were conducted between depths of 140.0 and 143.0 ft, and between depths of 195.0 and 215 ft. The results show good repeatability of measurements.

Environmental Corrections: The spectral gamma log measurements have been corrected for casing attenuation throughout the entire well, and a water correction was applied to the data acquired in the water to correct for the attenuation of water.

Observations:

Cs-137 was the only man-made radionuclide identified. It was detected at ground surface at a concentration of 8.6 pCi/g.

The range of the concentrations of the naturally occurring radionuclides potassium-40 (^{40}K), uranium, and thorium (KUT) are typical for Hanford formation and Ringold Formation sediments. The concentrations are, for the majority of samples, between 5 and 10 pCi/g, between 0.5 and 4 pCi/g, and between 0.5 and 2 pCi/g respectively. Some erratic peaks are outside of these ranges.

Some of the erratic nature observed on the uranium concentration plot is indicative of the presence of radon in the borehole. Elevated countrates were detected on the paper wipes that are utilized to clean the cable as the logging tool is withdrawn from the borehole. The health physics technician determined that the rate at which the countrates on the wipes diminished was consistent with the decay of radon.

The profile of the total gamma plot, which is the sum of all counts in the spectra for each 0.5-ft depth sample, is most reflective of the ^{40}K concentrations. However, the influence of uranium and thorium concentrations (more specifically the gamma rays of these radionuclides) on the total gamma countrate can be seen in the region of the borehole between depths of 120 and 144 ft. The most distinctive change in the KUT concentration occurs at depth of about 144 ft, and this change most likely correlates with a distinct lithologic change. The neutron-neutron moisture log data indicate that a lithologic change has occurred in this region of the borehole by an abrupt change in volumetric moisture content at a depth of 145 ft. The volumetric moisture content in the sediments surrounding the borehole decrease rapidly over a one-ft depth interval from as high as 9 percent to less than 1 percent.

The lower gross gamma countrate from ground surface to a depth of 50 ft reflects the attenuation caused by double casings in this region of the borehole. A casing factor is applied to the data during the conversion of the log data from counts per second to concentrations in pCi/g; however, the total gamma countrate measurements are not casing corrected.

RLS Neutron-Neutron Moisture Survey

Waste Management Technical Services

LOG HEADER

Project: RCRA drilling 1999 **Well:** 299-W22-49

Borehole Information

Well #	299-W22-49	Water Depth	217.6 ft	Total Depth	239 ft
Elevation Reference	n/a	Elevation	n/a ft		
Depth Reference	Ground Surface	Casing Stickup	11.75 in. – 1.2', 8.625 in. – 4.7'		
Casing Diameter	11.75 in.	Depth Interval	0 to 50 ft	Thickness	0.5 in.
Casing Diameter	8.625 in.	Depth Interval	0 to 235.9 ft	Thickness	0.5 in.

Logging Information

Log Type:	Neutron-Neutron Moisture	
Company	Waste Management Technical Services	
Logging Engineers	J.E. Meisner	
Instrument Series	RLSM00.0	
Logging Date	November 8, 1999	
Logging Unit	RLS-1	
Depth Interval	45.0' to 144.75'	Prefix MA48
	138' to 217.6'	MA49
Instrument Calibration Date	May 13, 1999	
Calibration Report	WHC-SD-EN-TI-306, Rev. 0	

Analysis Information

Company	Waste Management Technical Services
Analyst	Steven Kos
Date	November 8, 1999
Depth Reference	Ground Surface

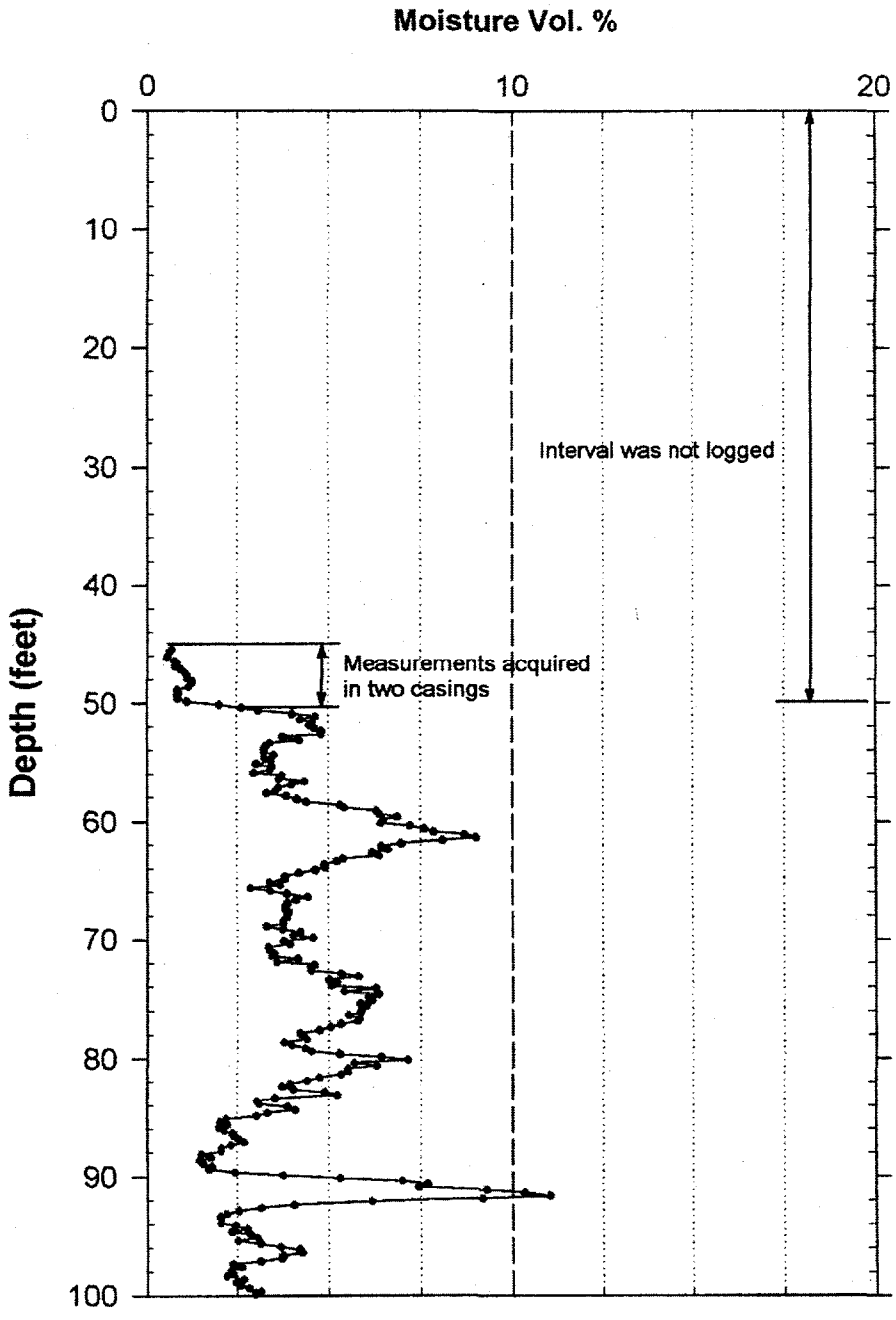
Notes The moisture measurements were acquired at 0.250-ft depth intervals at a logging speed of 0.6 ft per minute.

Neutron-Neutron Moisture Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date : November 8, 1999

Borehole: 299-W22-49 Depth Datum: Ground Level

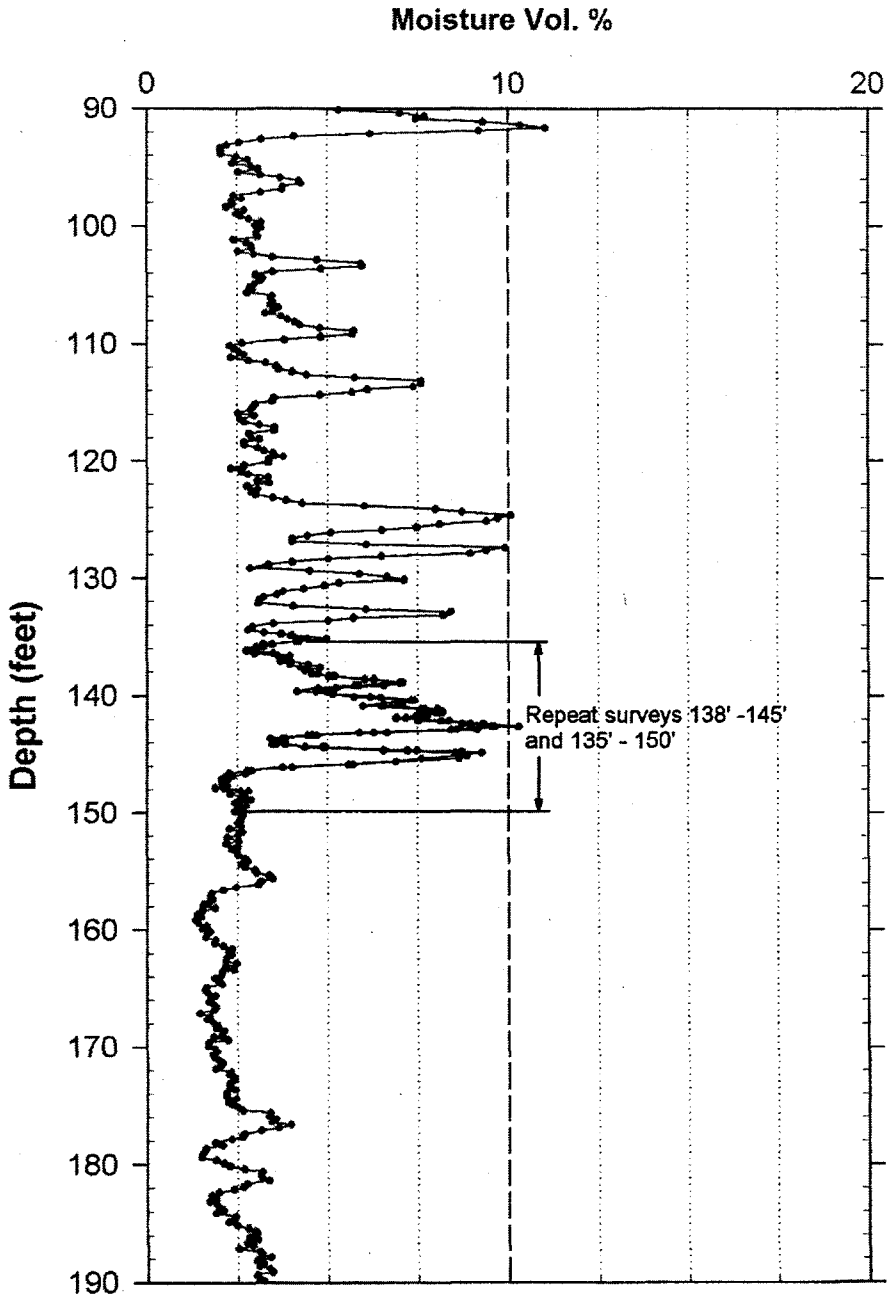


Neutron-Neutron Moisture Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date: November 8, 1999

Borehole: 299-W22-49 Depth Datum: Ground Level

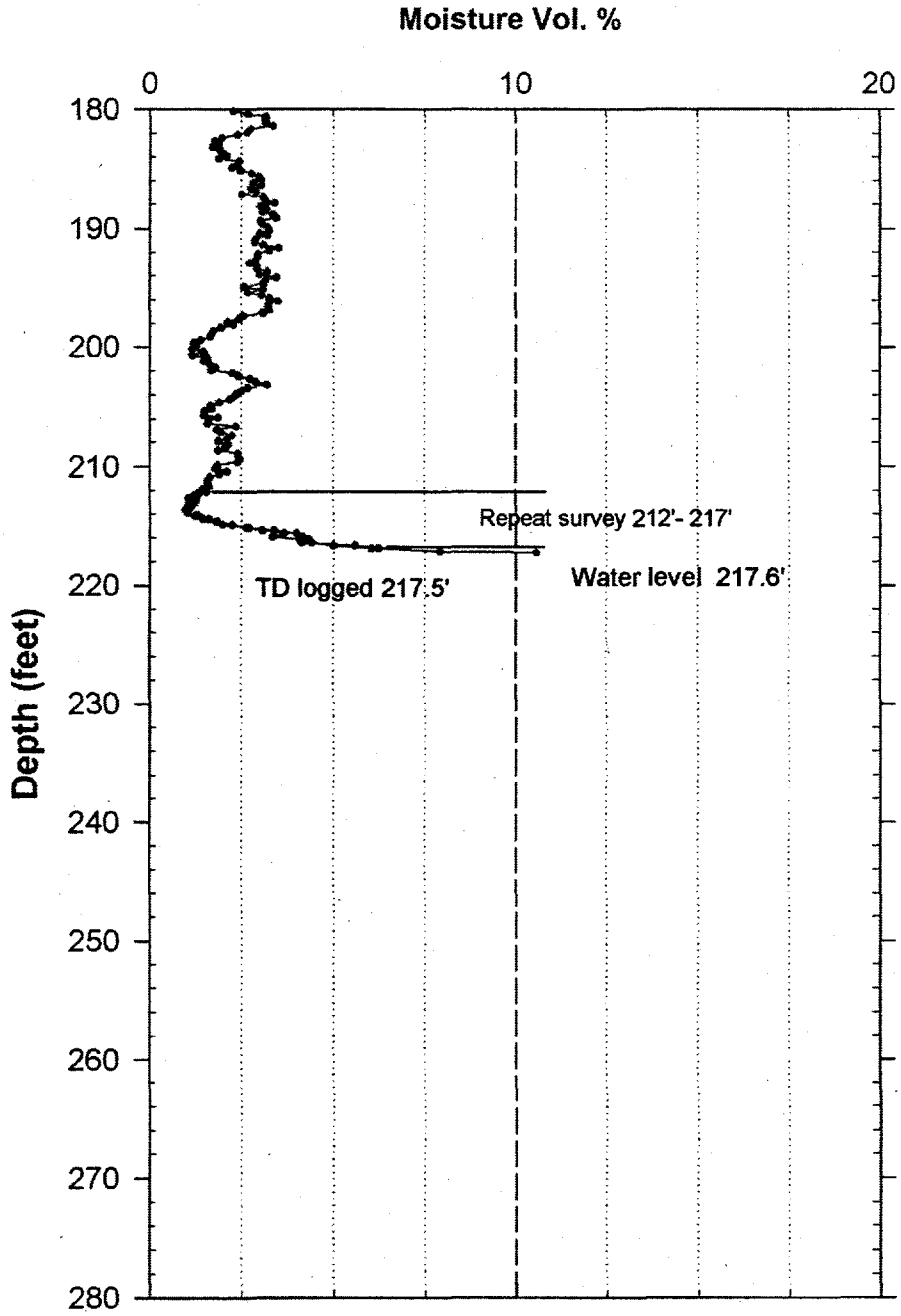


RLS Neutron-Neutron Moisture

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date : November 8,1999

Borehole: 299-W22-49 Depth Datum: Ground Level



RLS Neutron-Neutron Moisture Survey

Waste Management Technical Services

Summary Report

Project: RCRA Drilling 1999 **Well:** 299-W22-49

General Notes

All log data were collected with reference to ground surface. The moisture survey was not conducted in the 11.75-in.-diameter casing (from ground surface to a depth of 50 ft) since the logging tool is not calibrated for this size casing. The survey was terminated at a depth of 217.6 ft where groundwater was encountered.

System Performance Verification: The pre- and post-survey verification passed performance standards, -3.4% in the shield verifier.

Repeat Interval: Repeat surveys were conducted between depths of 138 and 145 ft, between depths of 135 and 150 ft, and between depths of 212 and 217 ft. The results show good repeatability of the moisture profiles from the original and repeat surveys.

Environmental Corrections: The moisture measurements have been corrected for casing attenuation throughout the entire well. A casing correction for 8.625-in.-diameter casing was applied to the data.

Observations

The moisture values range from less than two percent volumetric moisture content at a depth of 63 ft, to as high as almost 19 percent volumetric moisture content at a depth of about 104 ft. The initial low values between depths of 45 and 51 ft were acquired in double casings and are not valid measurements. These measurements can be utilized to determine the bottom of the double casing string, which is located at a depth of 51 ft.

The moisture values are highly variable between depths of 90 and about 146 ft, as indicated by the many narrow peaks. These peaks most likely correlate with thin intervals of fine-grained sediments that retain moisture. The potassium, uranium, and thorium concentrations (as derived from the spectral gamma survey that was conducted in this borehole) show higher concentrations in this region of the borehole, but do not show variations in concentration that can be directly correlated with the narrow peaks on the moisture plot. In both the spectral gamma and moisture data, an abrupt change occurs at a depth of about 145 to 146 ft. The KUT concentrations decrease and the moisture content decreases from almost 10 percent to 2 percent.

The decreased moisture content between depths of 45 and 50 ft is caused from logging in two casings and these measurements are not valid; however, they do show that the bottom of the double casing string occurs at a depth of 50 ft.

The moisture content increases (to an off-scale value) at a depth of about 217 ft where groundwater is encountered.

RLS Spectral Gamma/Sodium Iodide Survey

Waste Management Technical Services

LOG HEADER

Project: RCRA drilling 1999 **Well:** 299-W22-50

Borehole Information

Well #	299-W22-50	Water Depth	218 ft	Total Depth	547.35 ft
Elevation Reference	n/a	Elevation	n/a ft		
Depth Reference	Ground Surface	Casing Stickup	11.75" – 0', 8.625" – 0', 6.625"- 0.67', 3.75 – 4.2'		
Casing Diameter	11.75 in.	Depth Interval	0 to 50 ft	Thickness	0.5 in
Casing Diameter	8.625 in.	Depth Interval	0 to 241 ft	Thickness	0.5 in
Casing Diameter	6.625 in.	Depth Interval	0 to 474 ft	Thickness	0.5 in
Casing Diameter	3.75 in.	Depth Interval	0 to 547.35 ft	Thickness	0.375 in

Logging Information

Log Type:	HPGe Spectral Gamma	
Company	Waste Management Technical Services	
Logging Engineers	J.E. Meisner	
Logging Dates	November 30, 1999, January 14, 2000	
Instrument Series	RLSG07000S00.0/RLSN2.0*	
Logging Unit	RLS-1	
Depth Interval	0' to 145.0'	Prefix A682
	125.0' to 240.5'	A683
	230.0' to 353.5	A695
	350.0' to 475.5'	A696
	440.0' to 545.5'*	A694
Instrument Calibration Date	October 8, 1999/January 18, 1999*	
Calibration Report	WHC-SD-EN-TI-292, Rev. 0	
	WHC-SD-EN-TI-293, Rev. 0*	

*Bottom of the borehole was logged with a sodium iodide detector designated RLSN2.0

Analysis Information

Company	Waste Management Technical Services
Analyst	Steven Kos
Date	March 13, 2000
Depth Reference	Ground Surface

Notes HGPe spectral gamma and sodium iodide logging tools were utilized to log this borehole. Measurements were acquired with both of these tools at 0.5-ft depth increments at a logging speed of 1.0 ft per minute.

RLS Spectral Gamma Survey

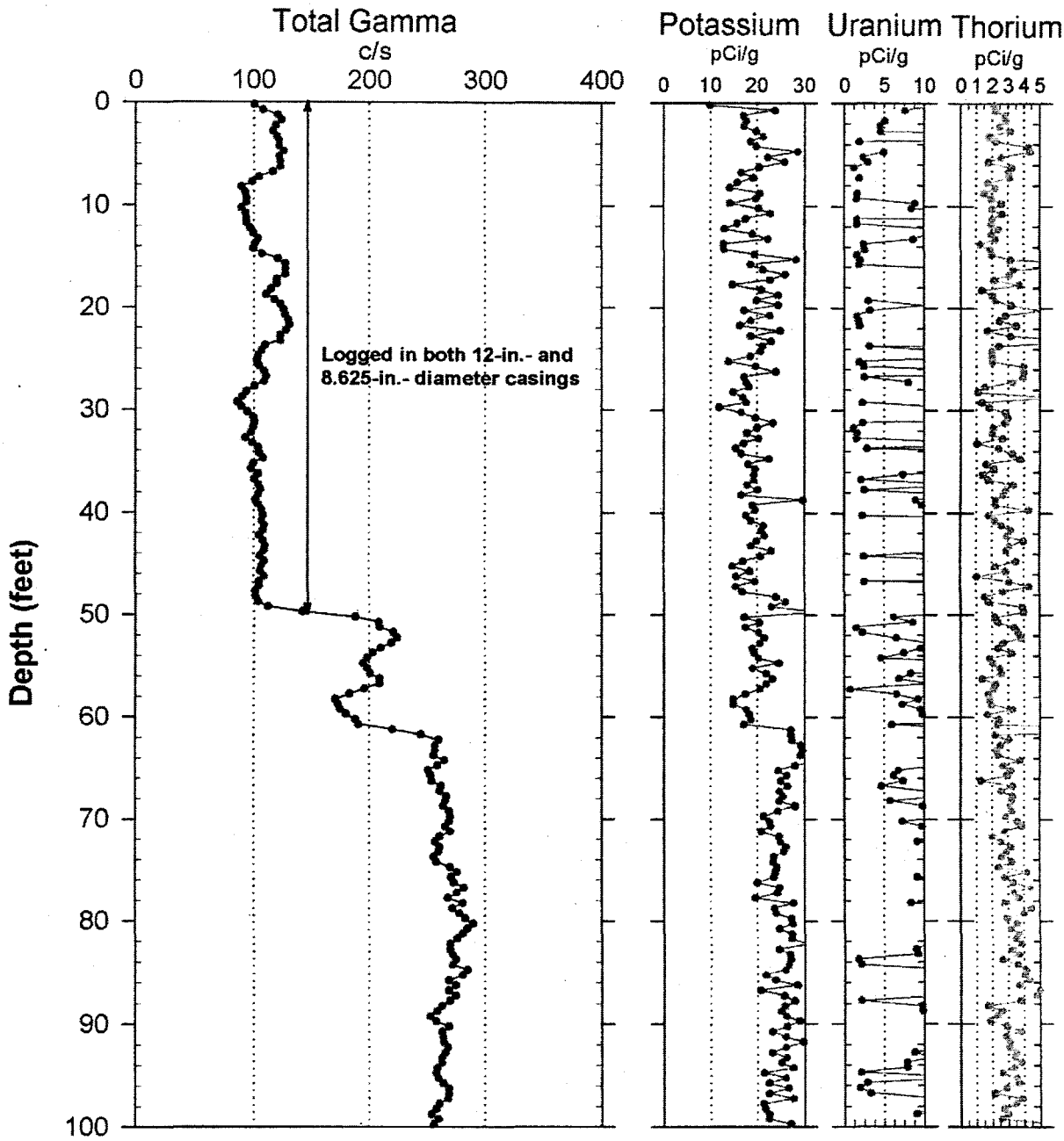
Waste Management Technical Services

Project: RCRA Drilling 1999

Well: 299-W22-50

Log Date: Nov. 30, 1999, Jan. 14&15, 2000

Depth Datum: Ground Level



RLS Spectral Gamma Survey

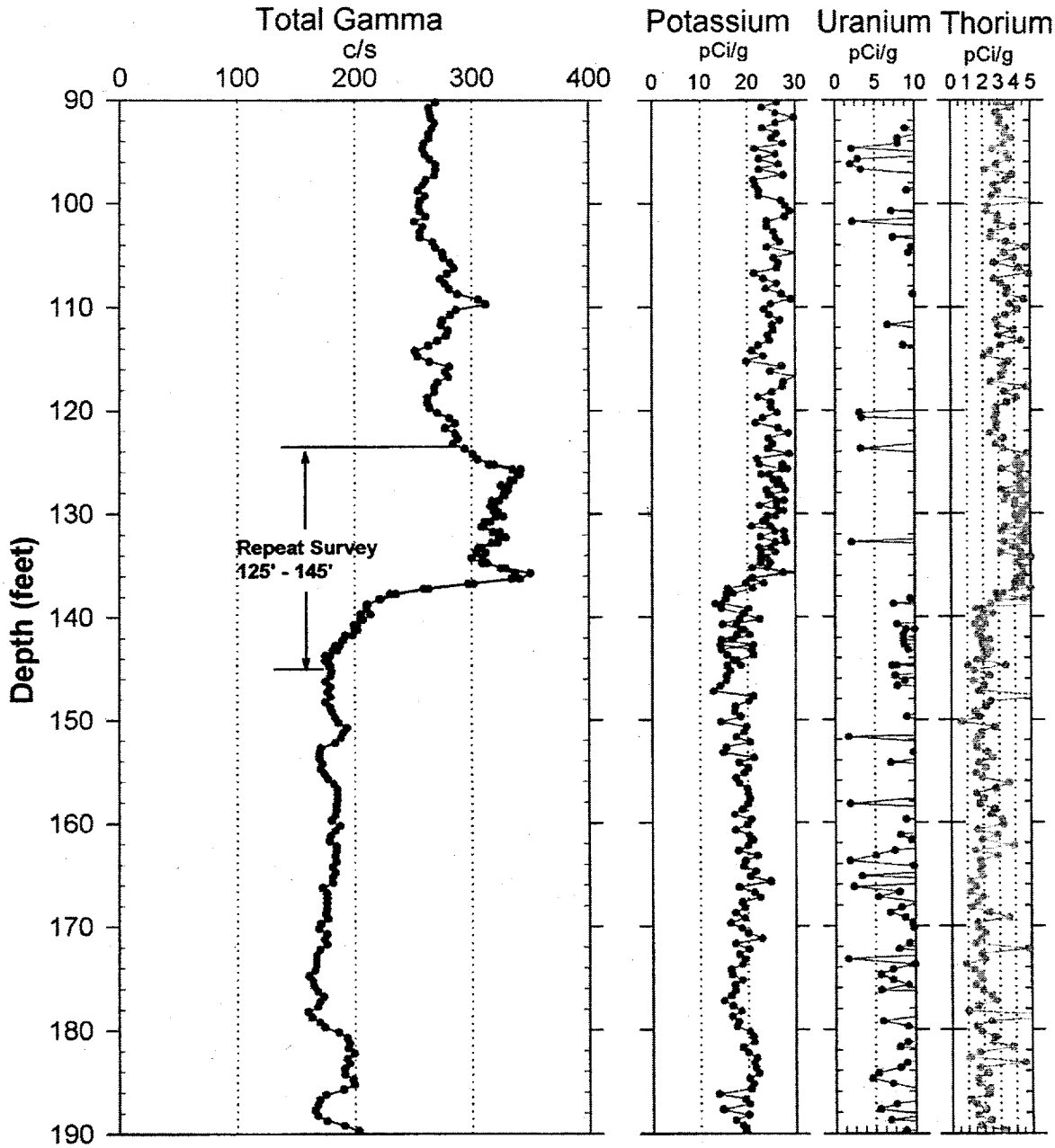
Waste Management Technical Services

Project: RCRA Drilling 1999

Log Date: Nov. 30, 1999, Jan. 14&15, 2000

Well: 299-W22-50

Depth Datum: Ground Level



RLS Spectral Gamma Survey

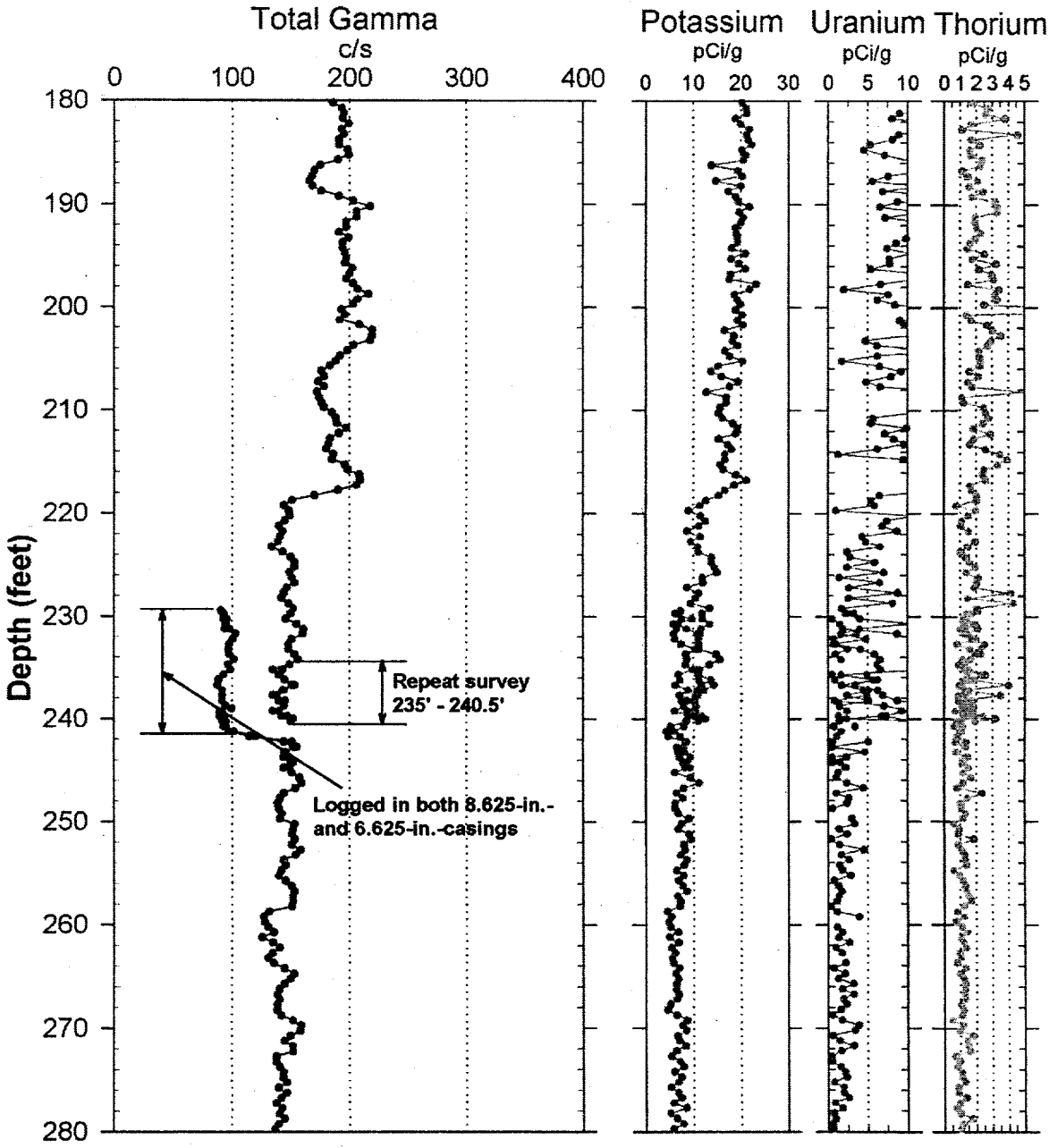
Waste Management Technical Services

Project: RCRA Drilling 1999

Log Date: Nov. 30, 1999
Jan.14&15, 2000

Well: 299-W22-50

Depth Datum: Ground Level



RLS Spectral Gamma Survey

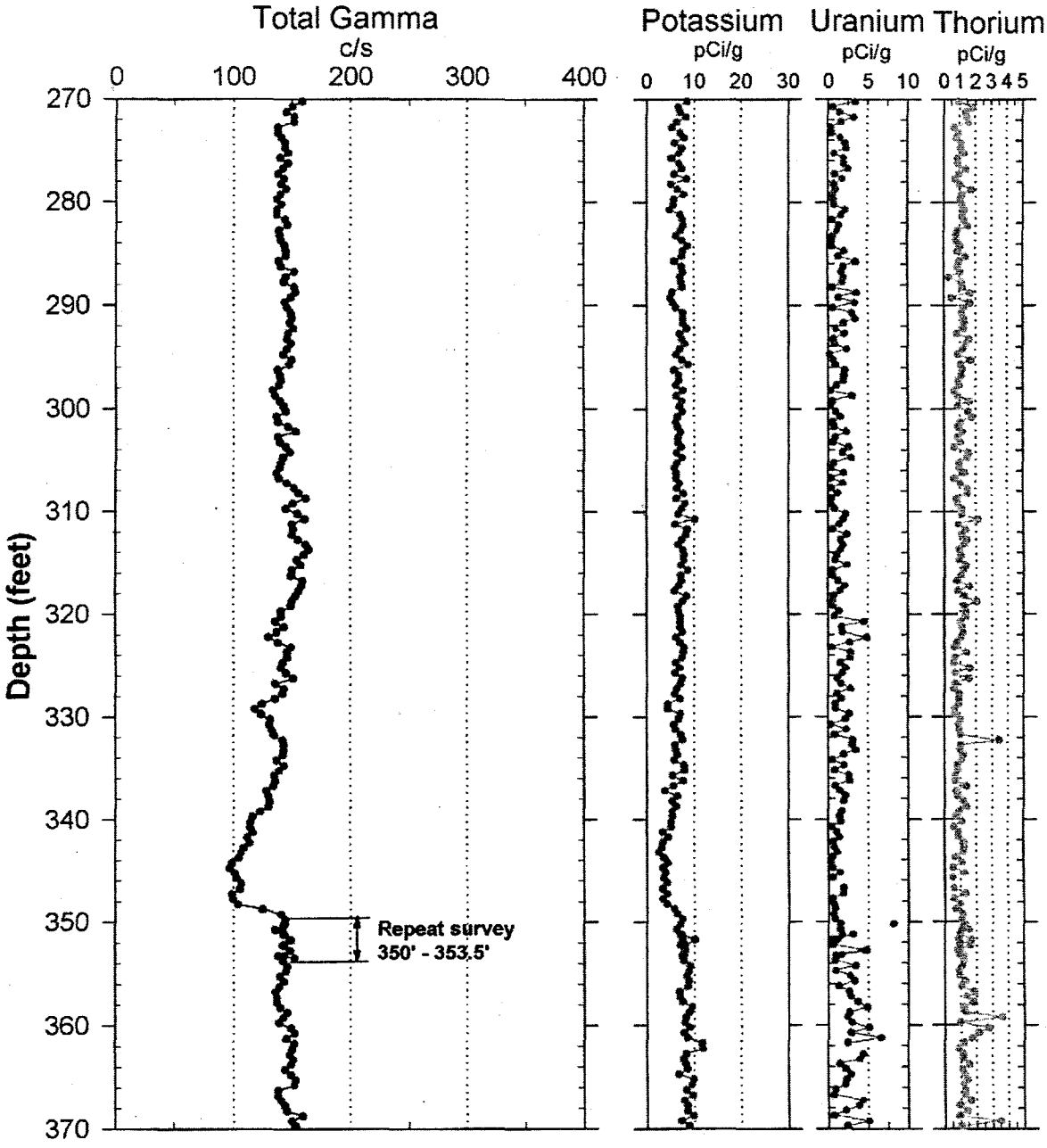
Waste Management Technical Services

Project: RCRA Drilling 1999

Log Date: Nov. 30, 1999
Jan. 14&15, 2000

Well: 299-W22-50

Depth Datum: Ground Level



RLS Spectral Gamma Survey

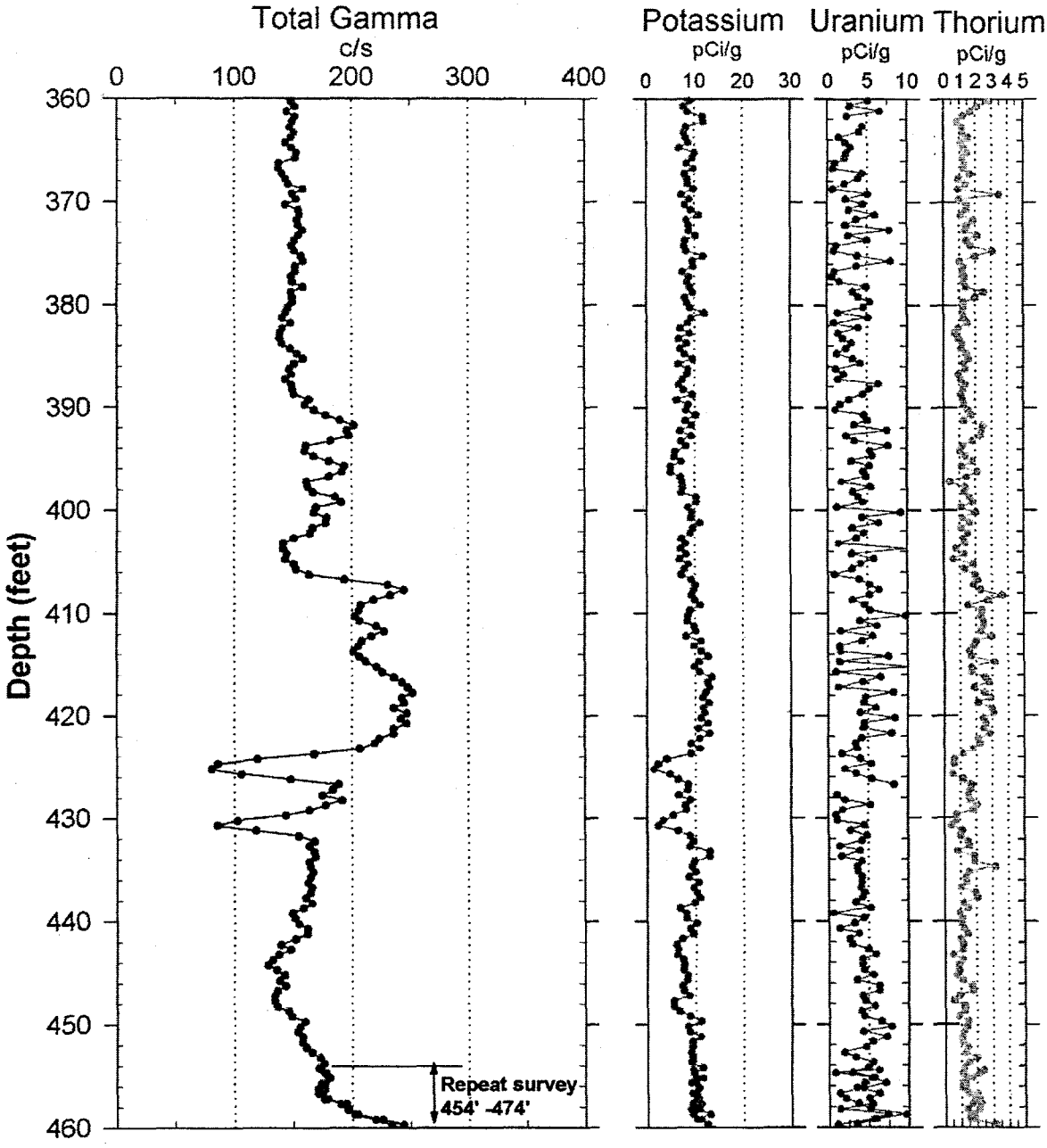
Waste Management Technical Services

Project: RCRA Drilling 1999

Log Date: Nov. 30, 1999
Jan. 14&15, 2000

Well: 299-W22-50

Depth Datum: Ground Level



RLS Spectral Gamma Survey

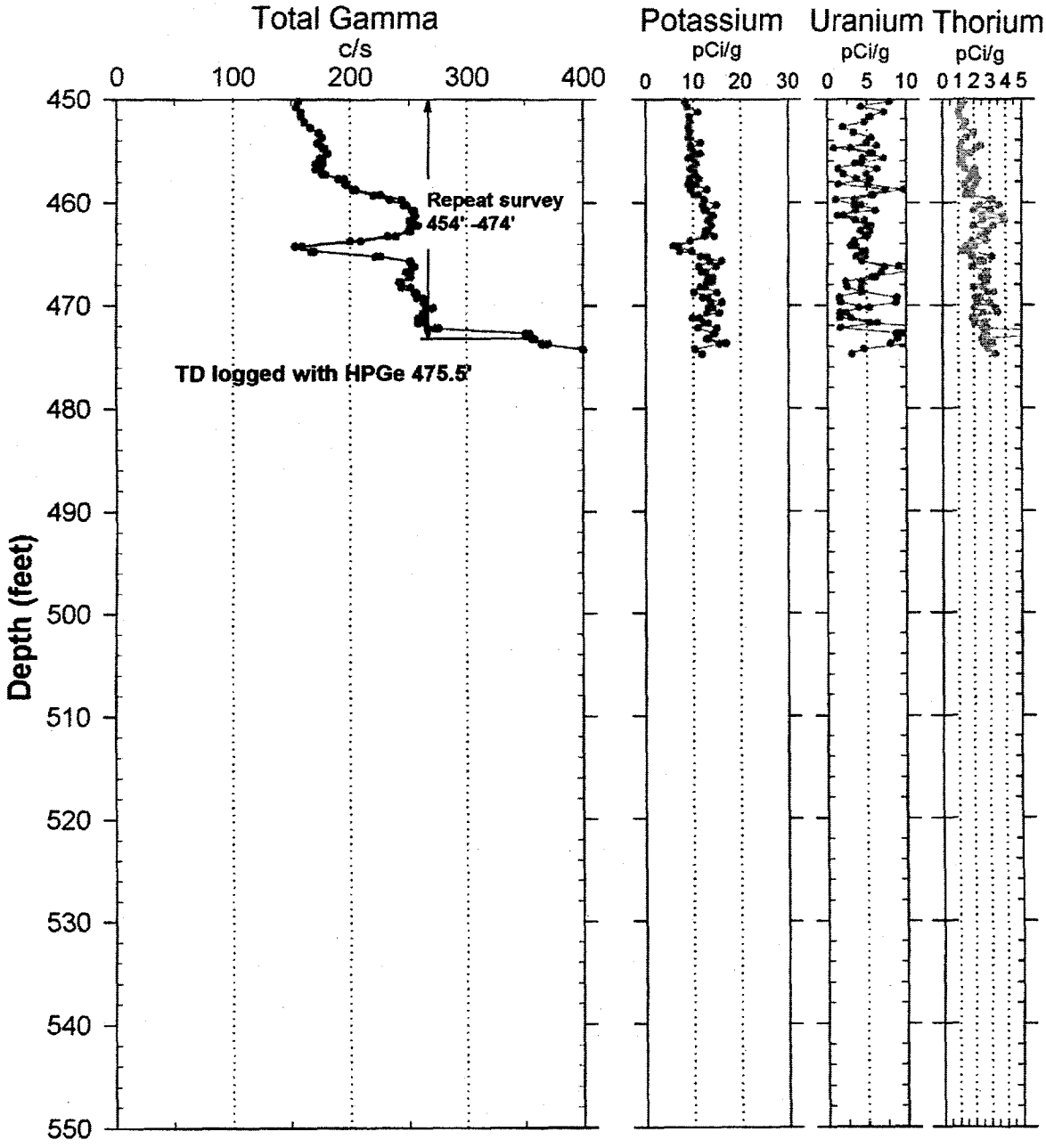
Waste Management Technical Services

Project: RCRA Drilling 1999

Log Date: Nov. 30, 1999
Jan. 14&15, 2000

Well: 299-W22-50

Depth Datum: Ground Level



RLS HPGe and NaI Surveys

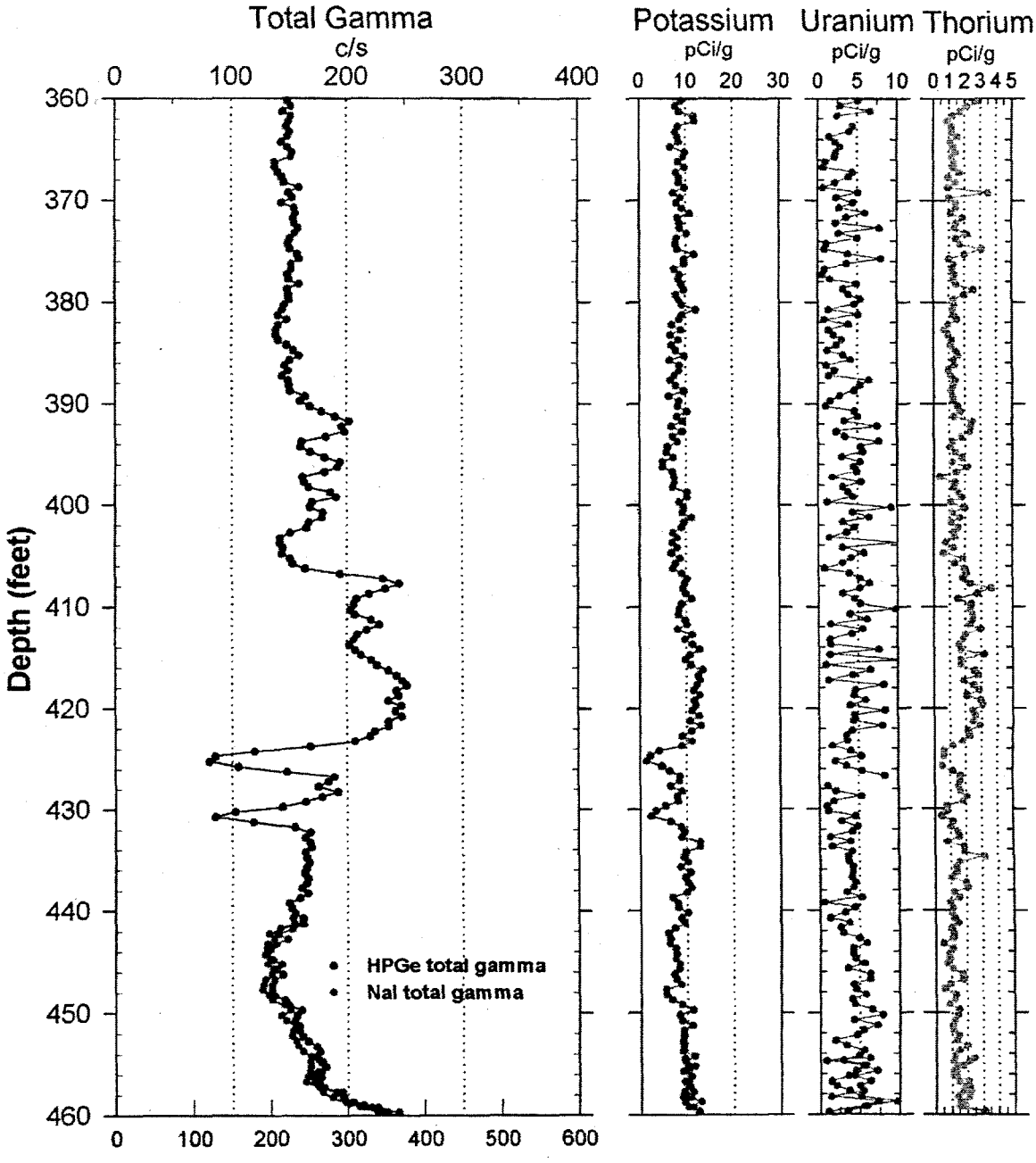
Waste Management Technical Services

Project: RCRA Drilling 1999

Log Date: Nov. 30, 1999
Jan. 14&15, 2000

Well: 299-W22-50

Depth Datum: Ground Level



RLS HPGe and NaI Surveys

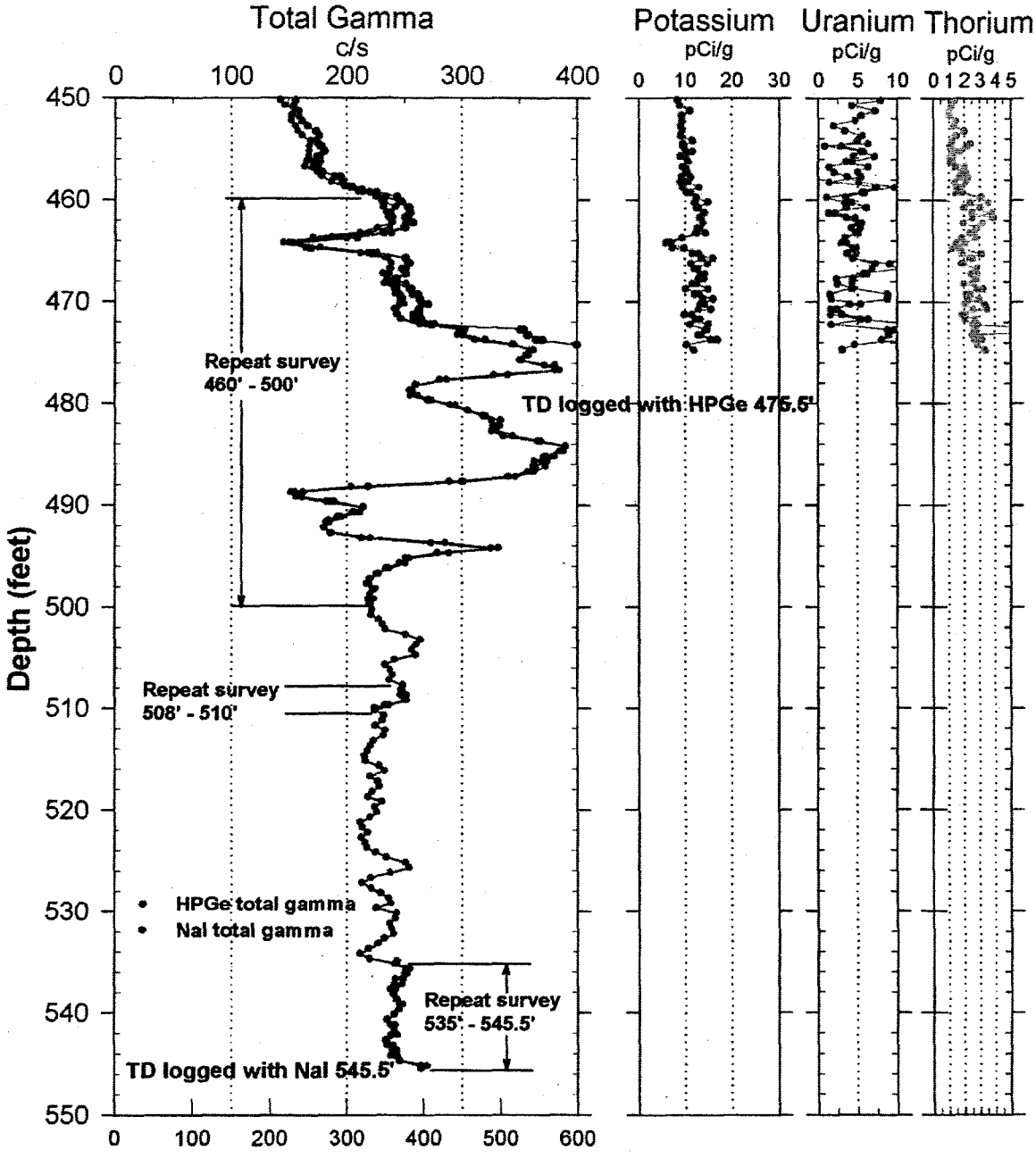
Waste Management Technical Services

Project: RCRA Drilling 1999

Log Date: Nov. 30, 1999
Jan. 14&15, 2000

Well: 299-W22-50

Depth Datum: Ground Level



RLS HPGe and NaI Survey

Waste Management Technical Services

Summary Report

Project: RCRA Well Drilling 1999 **Well:** 299-W22-50

General Notes:

Logging was performed in this borehole with both HPGe and NaI detectors. The NaI detector was utilized only in the 3.75-in.-diameter casing, and was used to acquire only gross gamma measurements. This smaller casing was used to advance the borehole to TD after the 6.625-in.-diameter casing could not be advanced. There was insufficient clearance between the inside surface of the 3.75-in.-diameter casing and the outside surface of the HGPe tool housing.

All log data were collected with reference to ground surface.

System Performance Verification: The pre- and post-log verification passed performance standards, indicating the system was performing to specifications outlined in the procedures.

Repeat Interval: Repeat surveys were conducted between depths of 125.0 and 145.0 ft, between depths of 235.0 and 240.5 ft, between depths of 350 and 353.5 ft, between depths of 454 and 474 ft, between depths of 508 and 510 ft (NaI survey), and between depths of 535 and 545.5 ft (NaI survey). All of the repeat surveys show good repeatability of measurements.

Environmental Corrections: The spectral gamma log measurements have been corrected for casing attenuation throughout the entire well, and a water correction was applied to the data acquired in the water to correct for the attenuation of water.

Observations:

Cs-137 was the only man-made radionuclide identified. It was detected at a depth of 1 ft at a concentration of 19 pCi/g.

The range of the concentrations of the naturally occurring radionuclides potassium-40 (^{40}K), uranium, and thorium (KUT) are typical for Hanford formation and Ringold Formation sediments. The concentrations are, for the majority of samples, between 5 and 25 pCi/g, between 0.5 and 5 pCi/g, and between 1 and 2 pCi/g respectively. Some erratic peaks are outside of these ranges.

Some of the erratic nature observed on the uranium concentration plot (during the first survey from 0 to 240 ft) is indicative of the presence of radon in the borehole. Elevated countrates were detected on the paper wipes that are utilized to clean the cable as the logging tool is withdrawn from the borehole. The health physics technician determined that the rate at which the countrates on the wipes diminished was consistent with the decay of radon.

The profile of the total gamma plot, which is the sum of all counts in the spectra for each 0.5-ft depth sample, is most reflective of the ^{40}K concentrations; however, the influence of uranium and thorium concentrations (more specifically the gamma rays of these radionuclides) on the total gamma countrate can be seen in the region of the borehole between depths of 406 and 430 ft. The most distinctive changes in total gamma countrate (and associated potassium and thorium concentrations) occur at a depth of about 136 ft, and between depths of 424 and 432 ft, where distinct lithologic changes most likely occur. The moisture log acquired in this borehole indicates intermittent thin intervals of elevated moisture content between depths of about 90 and 140 ft.

The lower gross gamma countrate from ground surface to a depth of 50 ft reflects the attenuation caused by double casings in this region of the borehole. A casing factor is applied to the data during the conversion of the log data from counts per second to concentrations in pCi/g; however, the total gamma countrate measurements are not casing corrected.

RLS Neutron-Neutron Moisture Survey

Waste Management Technical Services

LOG HEADER

Project: RCRA drilling 1999 **Well:** 299-W22-50

Borehole Information

Well #	299-W22-50	Water Depth	218 ft	Total Depth	547.35 ft
Elevation Reference	n/a	Elevation	n/a ft		
Depth Reference	Ground Surface	Casing Stickup	11.75"– 0', 8.625" – 0', 6.625" – 0.67', 3.75" – 4.2'		
Casing Diameter	11.75 in.	Depth Interval	0 to 50 ft	Thickness	0.5 in.
Casing Diameter	8.625 in.	Depth Interval	0 to 241 ft	Thickness	0.5 in.
Casing Diameter	6.625 in.	Depth Interval	0 to 474 ft	Thickness	0.5 in.
Casing Diameter	3.75 in.	Depth Interval	0 to 547.35 ft	Thickness	0.375 in.

Logging Information

Log Type:	Neutron-Neutron Moisture	
Company	Waste Management Technical Services	
Logging Engineers	J.E. Meisner	
Instrument Series	RLSM00.0	
Logging Date	November 30, 1999	
Logging Unit	RLS-1	
Depth Interval	0' to 150'	Prefix MA50
	145' to 218.3'	MA51
Instrument Calibration Date	May 13, 1999	
Calibration Report	WHC-SD-EN-TI-306, Rev. 0	

Analysis Information

Company	Waste Management Technical Services
Analyst	Steven Kos
Date	December 16, 1999
Depth Reference	Ground Surface

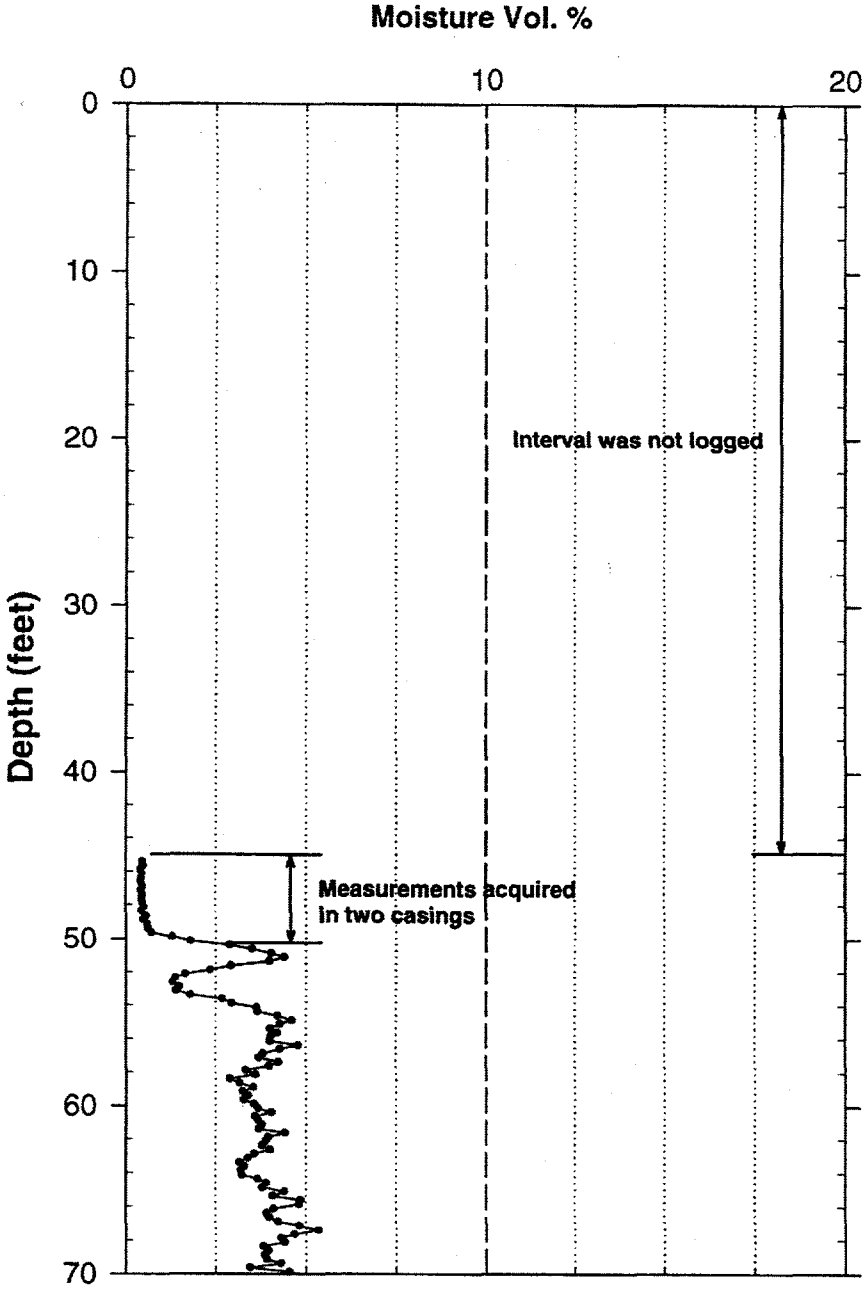
Notes The moisture measurements were acquired at 0.250-ft depth intervals at a logging speed of 1.0 ft per minute.

Neutron-Neutron Moisture Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date : November 30, 1999

Borehole: 299-W22-50 Depth Datum: Ground Level

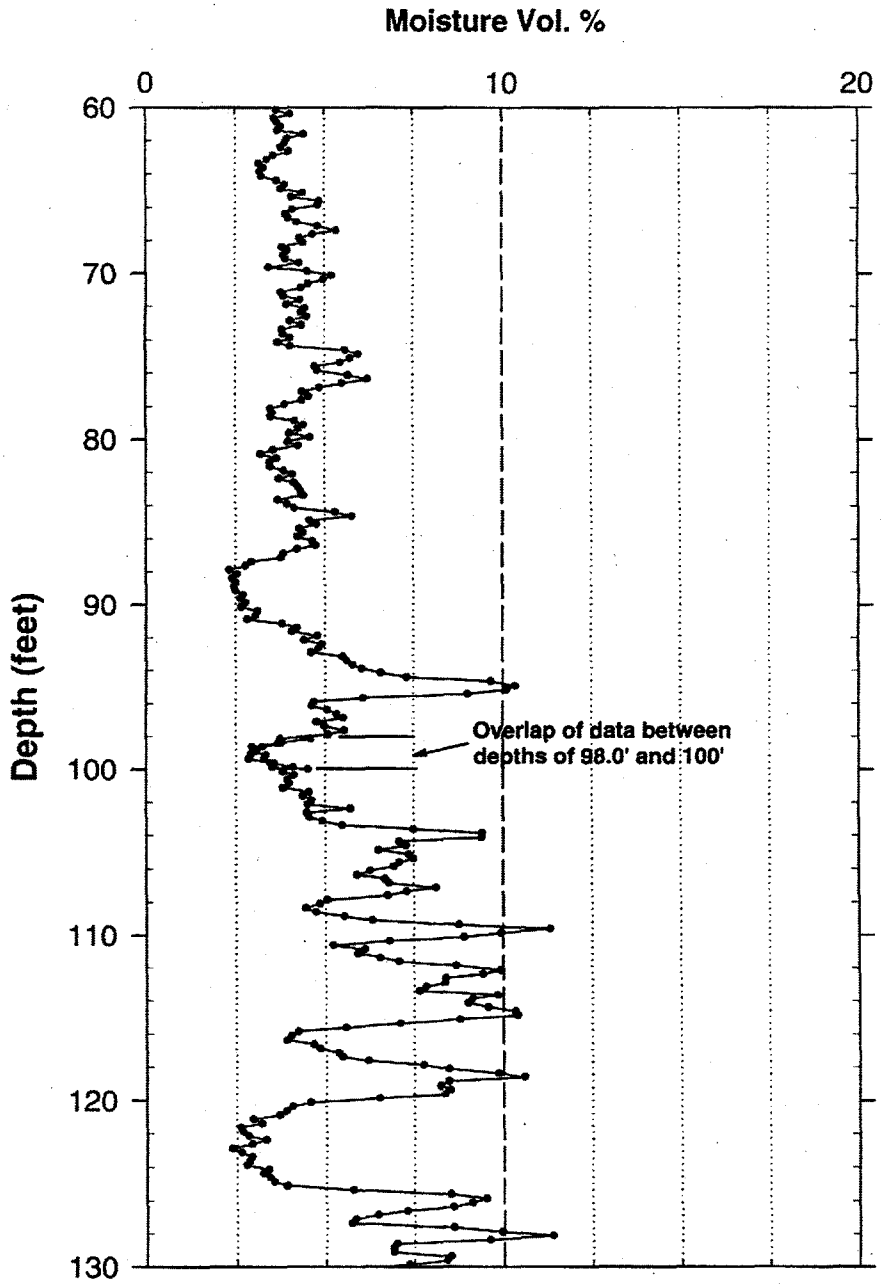


Neutron-Neutron Moisture Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date: November 30, 1999

Borehole: 299-W22-50 Depth Datum: Ground Level

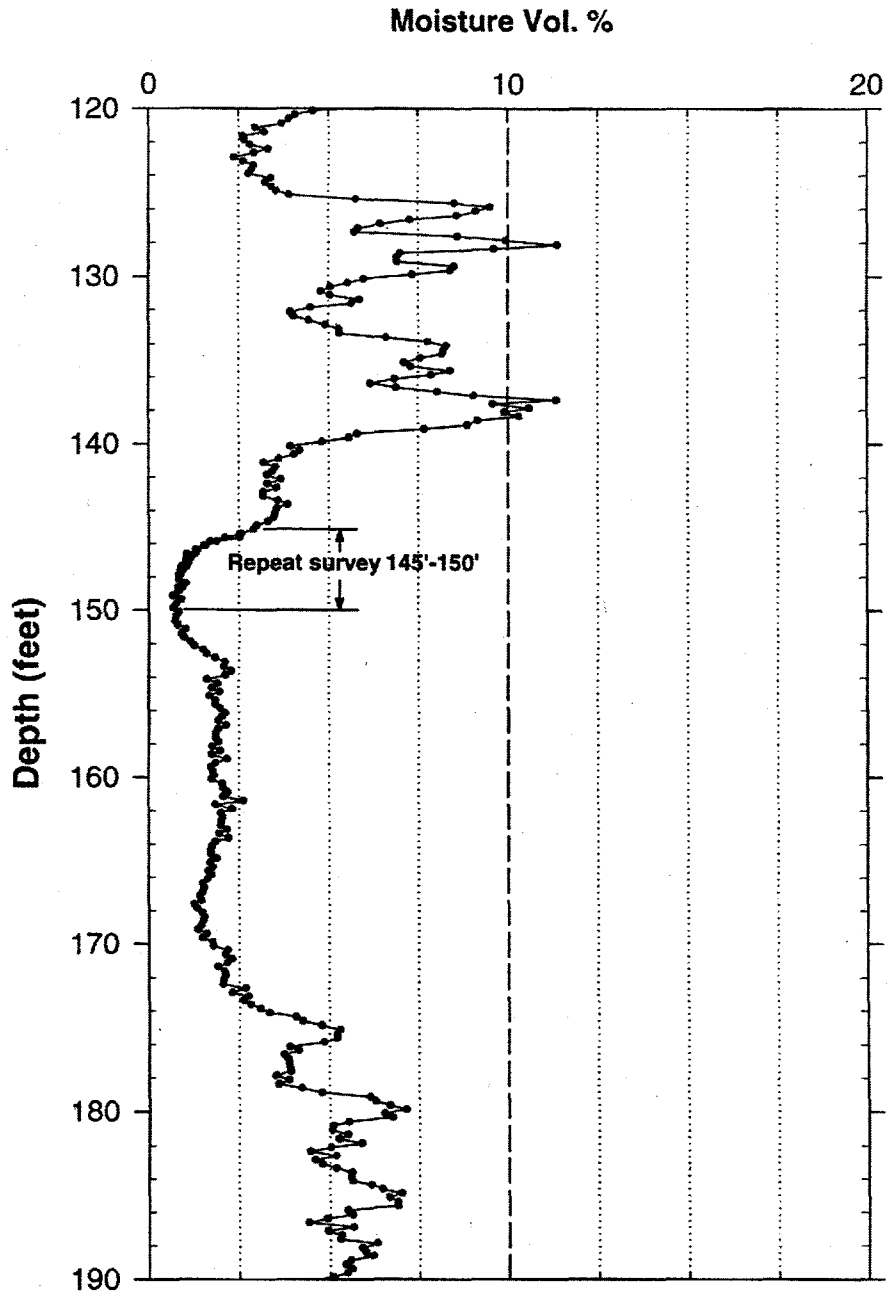


RLS Neutron-Neutron Moisture

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date : November 30,1999

Borehole: 299-W22-50 Depth Datum: Ground Level

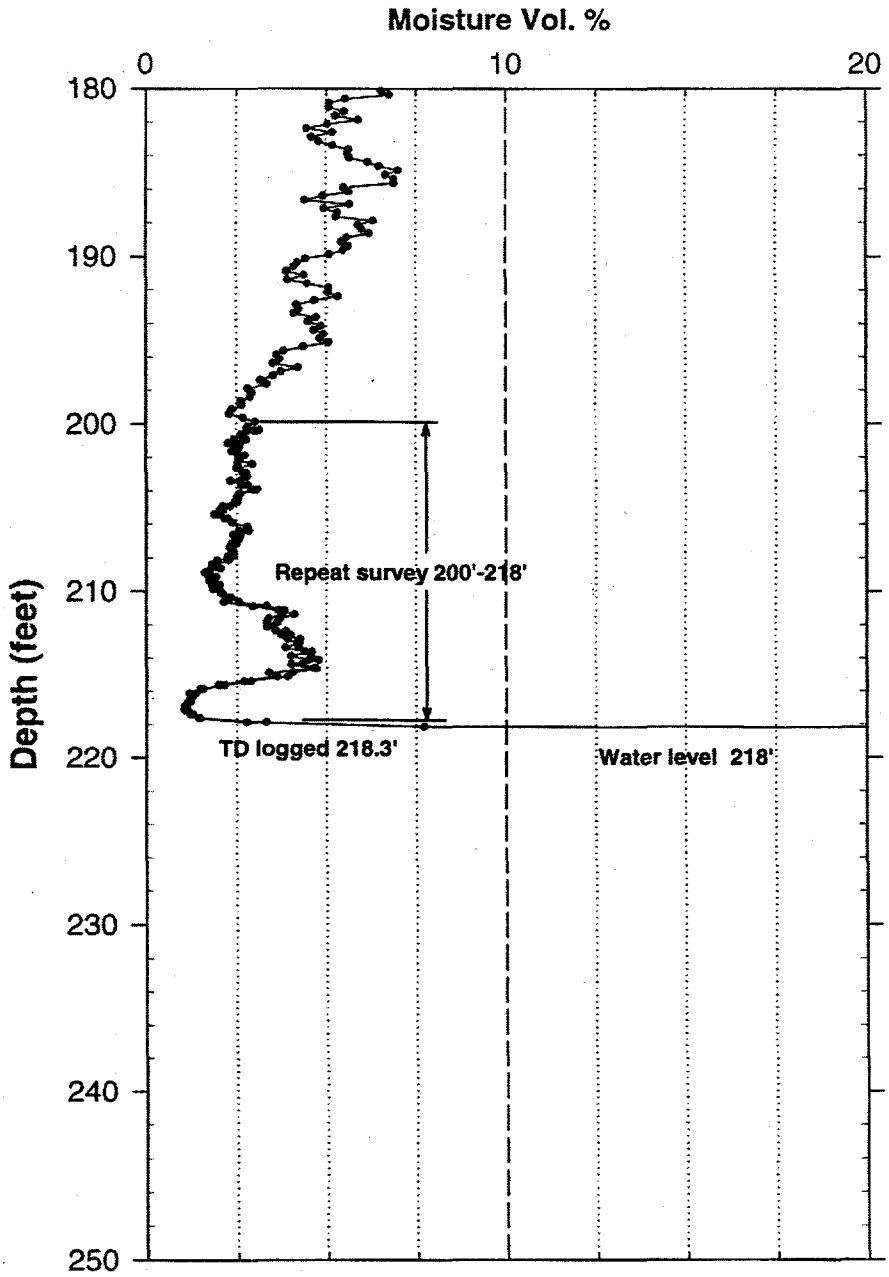


Neutron-Neutron Moisture Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date : November 8,1999

Borehole: 299-W22-50 Depth Datum: Ground Level



RLS Neutron-Neutron Moisture Survey

Waste Management Technical Services

Summary Report

Project: RCRA Drilling 1999 **Well:** 299-W22-50

General Notes

All log data were collected with reference to ground surface. A moisture survey was not conducted in the 11.75-in.-diameter casing (from ground surface to a depth of 50 ft) since the logging tool utilized is not calibrated for this size casing. The survey was terminated at a depth of 218.3 ft where groundwater was encountered.

System Performance Verification: The pre- and post-survey verification passed performance standards, -3.4% in the shield verifier.

Repeat Interval: A repeat survey was conducted between depths of 98 and 100 ft, between depths of 145 and 150 ft, and between depths of 200 and 218 ft. All of the repeat surveys show good repeatability of the moisture profiles from the original and repeat surveys.

Environmental Corrections: The moisture measurements have been corrected for casing attenuation throughout the entire well. A casing correction for 0.5 in.-thick 8.625-in.-diameter casing was applied to the data.

Observations

The moisture values range from less than 1 percent volumetric moisture content at a depth of 149 ft (not including the low values between depths of 45 and 50 ft), to as high as 11 percent volumetric moisture content at a depth of about 137 ft. The low moisture content values between depths of 45 and 50 ft occur in the region of the borehole with double casings and these measurements are not valid for determination of moisture content. These measurements can be utilized to determine the bottom of the double casing string, which is located at a depth of 50 ft.

Several peaks of elevated moisture content (above a background of less than 5 percent) are observed between depths of about 94 and 140 ft. These peaks most likely correlate with thin intervals of fine-grained sediments that retain moisture. The potassium, uranium, and thorium concentrations (as derived from the spectral gamma survey that was conducted in this borehole) doe not have features with which to correlate the moisture peaks with the exception of the data at a depth of 140 ft. At this depth, the potassium and thorium concentrations decrease sharply and the moisture content increases sharply.

The moisture content increases (to an off-scale value) at a depth of about 218 ft where groundwater is encountered.

Appendix D

Groundwater Analytical Data

Appendix D

Groundwater Analytical Data

This appendix contains analytical results from groundwater samples collected during drilling and construction of wells 299-W22-48, 299-W22-49, and 299-W22-50. Columns 6 and 7 in this appendix contain qualifiers that should be considered when using the analytical values. The definition of the qualifiers are given below.

Qualifier	Definition
U	Undetected at the detection limit.
C	For inorganics - blank contamination is above the practical quantitation limit
B	For organics - compound was found in the blank (blank contamination) For inorganics - result is less than the practical quantitation limit
J	For organics - the result is estimated and less than the practical quantitation limit
D	Adjusted dilution factor
E	For inorganics - estimated value due to interference
Q	One or more laboratory QC samples out of specification
H	Hold time exceeded

Table D.1. Analyses of Groundwater from Well 299-W22-48

Constituent	Sample Date	Filtered	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
236 ft bgs								
Aluminum	10/26/99	Y	22.3	ug/L	UC			
Calcium	10/26/99	Y	19400	ug/L	C			
Zinc	10/26/99	Y	14.2	ug/L				
Vanadium	10/26/99	Y	4.8	ug/L	B			
Copper	10/26/99	Y	7.8	ug/L	B			
Cobalt	10/26/99	Y	3.6	ug/L	U			
Chromium	10/26/99	Y	3.2	ug/L	U			
Cadmium	10/26/99	Y	3	ug/L	U			
Beryllium	10/26/99	Y	0.4	ug/L	U			
Barium	10/26/99	Y	87.2	ug/L				
Antimony	10/26/99	Y	57.9	ug/L	U			
Strontium (elemental)	10/26/99	Y	103	ug/L				
Sodium	10/26/99	Y	26300	ug/L		Q		
Silver	10/26/99	Y	8.8	ug/L	U			
Potassium	10/26/99	Y	5250	ug/L				
Nickel	10/26/99	Y	10.3	ug/L	U			
Manganese	10/26/99	Y	306	ug/L				
Iron	10/26/99	Y	40.3	ug/L	C			
Magnesium	10/26/99	Y	5070	ug/L				
Tritium	10/26/99	N	122	pCi/L	U		17	180
Technetium-99	10/26/99	N	39.5	pCi/L			1.7	14
Uranium	10/26/99	N	0.198	ug/L				0.047
Gross beta	10/26/99	N	20.6	pCi/L			2.4	3.7
Gross alpha	10/26/99	N	0.433	pCi/L	U		0.74	0.74
1,4-Dichlorobenzene	10/26/99	N	0.17	ug/L	U			
Total organic carbon	10/26/99	N	8.48	mg/L		H		
Temperature	10/26/99	N	16.1	Deg C				
Total dissolved solids	10/26/99	N	178	mg/L				
pH Measurement	10/26/99	N	8.24	pH		H		
pH Measurement	10/26/99	N	7.97	pH				
Nitrogen in Nitrate	10/26/99	N	3.87	mg/L	D			
Nitrogen in Nitrite	10/26/99	N	0.19	mg/L				
Specific Conductance	10/26/99	N	257	uS/cm	C			
Specific Conductance	10/26/99	N	263	umhos/cm				
Alkalinity	10/26/99	N	74	mg/L				
Trichloroethene	10/26/99	N	0.16	ug/L	U			
1,1,2-Trichloroethane	10/26/99	N	0.23	ug/L	U			
2-Butanone	10/26/99	N	20	ug/L				
1,1-Dichloroethane	10/26/99	N	0.13	ug/L	U			
Carbon tetrachloride	10/26/99	N	0.4	ug/L	J			
Fluoride	10/26/99	N	0.41	mg/L				
Chloride	10/26/99	N	6.91	mg/L	D	Q		
trans-1,2-Dichloroethylene	10/26/99	N	0.11	ug/L	U			
cis-1,2-Dichloroethylene	10/26/99	N	0.15	ug/L	U			
Sulfate	10/26/99	N	21.3	mg/L	D			
Xylenes (total)	10/26/99	N	0.79	ug/L	U			
Tetrachloroethene	10/26/99	N	0.29	ug/L	U			
Carbon disulfide	10/26/99	N	0.13	ug/L	U			
Methylenechloride	10/26/99	N	0.41	ug/L	U			
Vinyl chloride	10/26/99	N	0.1	ug/L	U			
1,1,1-Trichloroethane	10/26/99	N	0.14	ug/L	U			
Benzene	10/26/99	N	0.13	ug/L	U			
1-Butanol	10/26/99	N	7	ug/L	U			
Chloroform	10/26/99	N	0.8	ug/L	J			
Acetone	10/26/99	N	43	ug/L	D			
1,2-Dichloroethane	10/26/99	N	0.14	ug/L	U			
Ethyl cyanide	10/26/99	N	1.5	ug/L	U			
4-Methyl-2-Pentanone	10/26/99	N	0.5	ug/L	J			
Tetrahydrofuran	10/26/99	N	1.6	ug/L	U			
Toluene	10/26/99	N	0.26	ug/L	U			

Table D.2. Analyses of Groundwater from Well 299-W22-49

Constituent	Sample Date	Filtered	Value	Analysis Units	Lab Qualifier		Review Qualifier	Counting Error	Total Analysis Error
219 ft bgs									
1,1,1-Trichloroethane	11/4/99	N	0.14	ug/L		U	H		
1,1,2-Trichloroethane	11/4/99	N	0.23	ug/L		U	H		
1,1-Dichloroethane	11/4/99	N	0.13	ug/L		U	H		
1,2-Dichloroethane	11/4/99	N	0.14	ug/L		U	H		
1,4-Dichlorobenzene	11/4/99	N	0.17	ug/L		U	H		
1-Butanol	11/4/99	N	7	ug/L		U	H		
2-Butanone	11/4/99	N	0.89	ug/L		U	H		
4-Methyl-2-Pentanone	11/4/99	N	0.15	ug/L		U	H		
Acetone	11/4/99	N	0.33	ug/L		U	H		
Alkalinity	11/4/99	N	90	mg/L			H		
Aluminum	11/4/99	Y	64.6	ug/L		BC			
Antimony	11/4/99	Y	57.9	ug/L		U			
Barium	11/4/99	Y	22.5	ug/L					
Benzene	11/4/99	N	0.13	ug/L	U	U	H		
Beryllium	11/4/99	Y	0.4	ug/L	U	U			
Cadmium	11/4/99	Y	3	ug/L	U	U			
Calcium	11/4/99	Y	16200	ug/L	C	C			
Carbon disulfide	11/4/99	N	0.13	ug/L	U	U	H		
Carbon tetrachloride	11/4/99	N	0.6	ug/L	J	J	H		
Chloride	11/4/99	N	5.33	mg/L	D	D	H		
Chloroform	11/4/99	N	0.09	ug/L	U	U	H		
Chromium	11/4/99	Y	3.2	ug/L	U	U			
cis-1,2-Dichloroethylene	11/4/99	N	0.15	ug/L	U	U	H		
Cobalt	11/4/99	Y	3.6	ug/L	U	U			
Copper	11/4/99	Y	5.9	ug/L	B	B			
Ethyl cyanide	11/4/99	N	1.5	ug/L	U	U	H		
Fluoride	11/4/99	N	0.55	mg/L			H		
Gross alpha	11/4/99	N	1.7	pCi/L	U	U		1.2	1.3
Gross beta	11/4/99	N	15	pCi/L				2.3	3.1
Iron	11/4/99	Y	85.8	ug/L	C	C			
Magnesium	11/4/99	Y	5070	ug/L					
Manganese	11/4/99	Y	107	ug/L					
Methylenechloride	11/4/99	N	0.41	ug/L	U	U	H		
Nickel	11/4/99	Y	10.3	ug/L	U	U			
Nitrogen in Nitrate	11/4/99	N	3.06	mg/L	D	D	H		
Nitrogen in Nitrite	11/4/99	N	0.017	mg/L	B	B	H		
pH Measurement	11/4/99	N	8.48	pH			H		
pH Measurement	11/4/99	N	8.94	pH					
Potassium	11/4/99	Y	4980	ug/L					
Silver	11/4/99	Y	8.8	ug/L	U	U			
Sodium	11/4/99	Y	25600	ug/L					
Specific Conductance	11/4/99	N	1940	uS/cm	C	C	H		
Specific Conductance	11/4/99	N	245	umhos/cm					
Strontium (elemental)	11/4/99	Y	70.9	ug/L					
Sulfate	11/4/99	N	13.9	mg/L	D	D	H		
Technetium-99	11/4/99	N	32.5	pCi/L				1.4	14
Temperature	11/4/99	N	16.6	Deg C					
Tetrachloroethene	11/4/99	N	0.29	ug/L	U	U	H		
Tetrahydrofuran	11/4/99	N	1.6	ug/L	U	U	H		
Toluene	11/4/99	N	0.26	ug/L	U	U	H		
Total dissolved solids	11/4/99	N	182	mg/L			H		
Total organic carbon	11/4/99	N	2.94	mg/L			H		
trans-1,2-Dichloroethylene	11/4/99	N	0.11	ug/L	U	U	H		
Trichloroethene	11/4/99	N	0.16	ug/L	U	U	H		
Tritium	11/4/99	N	22000	pCi/L				600	1300
Turbidity	11/4/99	N	1000	NTU					
Uranium	11/4/99	N	0.815	ug/L					0.13
Vanadium	11/4/99	Y	13.4	ug/L					
Vinyl chloride	11/4/99	N	0.1	ug/L	U	U	H		
Xylenes (total)	11/4/99	N	0.79	ug/L	U	U	H		
Zinc	11/4/99	Y	8.9	ug/L	BC	BC			
239 ft bgs									
1,1,1-Trichloroethane	11/8/99	N	0.14	ug/L	U	U			

Table D.2. (contd)

Constituent	Sample Date	Filtered	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
1,1,2-Trichloroethane	11/8/99	N	0.23	ug/L	U			
1,1-Dichloroethane	11/8/99	N	0.13	ug/L	U			
1,2-Dichloroethane	11/8/99	N	0.14	ug/L	U			
1,4-Dichlorobenzene	11/8/99	N	0.17	ug/L	U			
1-Butanol	11/8/99	N	7	ug/L	U			
2-Butanone	11/8/99	N	6	ug/L	J			
4-Methyl-2-Pentanone	11/8/99	N	0.15	ug/L	U			
Acetone	11/8/99	N	13	ug/L				
Alkalinity	11/8/99	N	86	mg/L				
Aluminum	11/8/99	Y	55.7	ug/L	BC			
Antimony	11/8/99	Y	57.9	ug/L	U			
Barium	11/8/99	Y	32.8	ug/L				
Benzene	11/8/99	N	0.13	ug/L	U			
Beryllium	11/8/99	Y	0.45	ug/L	B			
Cadmium	11/8/99	Y	3	ug/L	U			
Calcium	11/8/99	Y	16400	ug/L	C			
Carbon disulfide	11/8/99	N	0.13	ug/L	U			
Carbon tetrachloride	11/8/99	N	1	ug/L	J			
Chloride	11/8/99	N	3.66	mg/L				
Chloroform	11/8/99	N	1	ug/L	J			
Chromium	11/8/99	Y	3.2	ug/L	U			
cis-1,2-Dichloroethylene	11/8/99	N	0.15	ug/L	U			
Cobalt	11/8/99	Y	3.6	ug/L	U			
Copper	11/8/99	Y	4.4	ug/L	U			
Ethyl cyanide	11/8/99	N	1.5	ug/L	U			
Fluoride	11/8/99	N	0.55	mg/L				
Gross alpha	11/8/99	N	1.84	pCi/L	J		1.2	1.2
Gross beta	11/8/99	N	4.92	pCi/L			1.7	1.8
Iron	11/8/99	Y	57.2	ug/L	C			
Magnesium	11/8/99	Y	5320	ug/L				
Manganese	11/8/99	Y	244	ug/L				
Methylenechloride	11/8/99	N	0.41	ug/L	U			
Nickel	11/8/99	Y	10.3	ug/L	U			
Nitrogen in Nitrate	11/8/99	N	1.78	mg/L				
Nitrogen in Nitrite	11/8/99	N	0.019	mg/L	B			
pH Measurement	11/8/99	N	8.13	pH		H		
pH Measurement	11/8/99	N	8.1	pH				
Potassium	11/8/99	Y	3420	ug/L				
Silver	11/8/99	Y	8.8	ug/L	U			
Sodium	11/8/99	Y	26000	ug/L				
Specific Conductance	11/8/99	N	2180	uS/cm	C	H		
Specific Conductance	11/8/99	N	244	umhos/cm				
Strontium (elemental)	11/8/99	Y	67.3	ug/L				
Sulfate	11/8/99	N	15.4	mg/L				
Technetium-99	11/8/99	N	2.96	pCi/L	U		0.14	12
Temperature	11/8/99	N	17.5	Deg C				
Tetrachloroethene	11/8/99	N	0.29	ug/L	U			
Tetrahydrofuran	11/8/99	N	1.6	ug/L	U			
Toluene	11/8/99	N	0.5	ug/L	J			
Total dissolved solids	11/8/99	N	165	mg/L				
Total organic carbon	11/8/99	N	5.53	mg/L				
trans-1,2-Dichloroethylene	11/8/99	N	0.11	ug/L	U			
Trichloroethene	11/8/99	N	0.16	ug/L	U			
Tritium	11/8/99	N	18900	pCi/L			550	1100
Turbidity	11/8/99	N	1000	NTU				
Uranium	11/8/99	N	0.919	ug/L				0.22
Vanadium	11/8/99	Y	9.4	ug/L	B			
Vinyl chloride	11/8/99	N	0.1	ug/L	U			
Xylenes (total)	11/8/99	N	0.79	ug/L	U			
Zinc	11/8/99	Y	12.6	ug/L	C			

Table D.3. Analyses of Groundwater from Well 299-W22-50

Constituent	Sample Date	Filtered	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
220 ft bgs								
1,1,1-Trichloroethane	11/23/99	N	0.23	ug/L	U			
1,1,2-Trichloroethane	11/23/99	N	0.31	ug/L	U			
1,1-Dichloroethane	11/23/99	N	0.19	ug/L	U			
1,2-Dichloroethane	11/23/99	N	0.17	ug/L	U			
1,4-Dichlorobenzene	11/23/99	N	0.14	ug/L	U			
1-Butanol	11/23/99	N	6.6	ug/L	U			
2-Butanone	11/23/99	N	4.5	ug/L	J			
4-Methyl-2-Pentanone	11/23/99	N	1.3	ug/L	U			
Acetone	11/23/99	N	4	ug/L	U			
Alkalinity	11/23/99	N	100	mg/L				
Aluminum	11/23/99	Y	93.2	ug/L	B			
Antimony	11/23/99	Y	40.9	ug/L	U			
Barium	11/23/99	Y	59.5	ug/L	B			
Benzene	11/23/99	N	0.23	ug/L	U			
Beryllium	11/23/99	Y	0.6	ug/L	B			
Cadmium	11/23/99	Y	3.3	ug/L	U			
Calcium	11/23/99	Y	23200	ug/L				
Carbon disulfide	11/23/99	N	0.3	ug/L	U			
Carbon tetrachloride	11/23/99	N	13	ug/L				
Chloride	11/23/99	N	4.8	mg/L				
Chloroform	11/23/99	N	2.3	ug/L	J			
Chromium	11/23/99	Y	3	ug/L	U			
cis-1,2-Dichloroethylene	11/23/99	N	0.18	ug/L	U			
Cobalt	11/23/99	Y	2.8	ug/L	U			
Copper	11/23/99	Y	6.4	ug/L	U			
Ethyl cyanide	11/23/99	N	2.6	ug/L	U			
Fluoride	11/23/99	N	0.42	mg/L				
Gross alpha	11/23/99	N	2.11	pCi/L	U		2.5	2.5
Gross beta	11/23/99	N	1420	pCi/L			50	200
Iron	11/23/99	Y	66.6	ug/L	B			
Magnesium	11/23/99	Y	7300	ug/L				
Manganese	11/23/99	Y	165	ug/L				
Methylenechloride	11/23/99	N	0.37	ug/L	U			
Nickel	11/23/99	Y	12.8	ug/L	U			
Nitrogen in Nitrate	11/23/99	N	13.1	mg/L	D	H		
Nitrogen in Nitrite	11/23/99	N	0.011	mg/L	B	H		
pH Measurement	11/23/99	N	8.4	pH				
Potassium	11/23/99	Y	6880	ug/L				
Silver	11/23/99	Y	5.5	ug/L	U			
Sodium	11/23/99	Y	28200	ug/L				
Specific Conductance	11/23/99	N	0.31	uS/cm	BC			
Strontium (elemental)	11/23/99	Y	104	ug/L				
Sulfate	11/23/99	N	14.2	mg/L				
Technetium-99	11/23/99	N	4240	pCi/L			33	320
Tetrachloroethene	11/23/99	N	0.57	ug/L	U			
Tetrahydrofuran	11/23/99	N	1.5	ug/L	U			
Toluene	11/23/99	N	0.33	ug/L	U			
Total dissolved solids	11/23/99	N	223	mg/L				
Total organic carbon	11/23/99	N	3	mg/L				
trans-1,2-Dichloroethylene	11/23/99	N	0.26	ug/L	U			
Trichloroethene	11/23/99	N	0.16	ug/L	U			
Tritium	11/23/99	N	31400	pCi/L			720	1700
Uranium	11/23/99	N	0.784	ug/L				0.19
Vanadium	11/23/99	Y	12.2	ug/L	B			
Vinyl chloride	11/23/99	N	0.17	ug/L	U			
Xylenes (total)	11/23/99	N	0.61	ug/L	U			
Zinc	11/23/99	Y	11.7	ug/L	B			
241 ft bgs								
1,1,1-Trichloroethane	11/29/99	N	0.23	ug/L	U			
1,1,2-Trichloroethane	11/29/99	N	0.31	ug/L	U			
1,1-Dichloroethane	11/29/99	N	0.19	ug/L	U			
1,2-Dichloroethane	11/29/99	N	0.17	ug/L	U			

Table D.3. (contd)

Constituent	Sample Date	Filtered	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
1,4-Dichlorobenzene	11/29/99	N	0.14	ug/L	U			
1-Butanol	11/29/99	N	6.6	ug/L	U			
2-Butanone	11/29/99	N	0.7	ug/L	U			
4-Methyl-2-Pentanone	11/29/99	N	1.3	ug/L	U			
Acetone	11/29/99	N	4	ug/L	U			
Alkalinity	11/29/99	N	101	mg/L				
Aluminum	11/29/99	Y	42.1	ug/L	B			
Antimony	11/29/99	Y	88.6	ug/L				
Barium	11/29/99	Y	26.9	ug/L	B			
Benzene	11/29/99	N	0.23	ug/L	U			
Beryllium	11/29/99	Y	0.5	ug/L	U			
Cadmium	11/29/99	Y	4.3	ug/L	B			
Calcium	11/29/99	Y	17800	ug/L		Q		
Carbon disulfide	11/29/99	N	0.3	ug/L	U			
Carbon tetrachloride	11/29/99	N	5.6	ug/L				
Chloride	11/29/99	N	2.5	mg/L		Q		
Chloroform	11/29/99	N	0.91	ug/L	J	Q		
Chromium	11/29/99	Y	3	ug/L	U			
cis-1,2-Dichloroethylene	11/29/99	N	0.18	ug/L	U			
Cobalt	11/29/99	Y	4.3	ug/L	B			
Copper	11/29/99	Y	6.4	ug/L	U			
Ethyl cyanide	11/29/99	N	2.6	ug/L	U			
Fluoride	11/29/99	N	0.46	mg/L				
Gross alpha	11/29/99	N	1.97	pCi/L	J		1.3	1.4
Gross beta	11/29/99	N	264	pCi/L			9.2	37
Iron	11/29/99	Y	89	ug/L	B			
Magnesium	11/29/99	Y	6020	ug/L				
Manganese	11/29/99	Y	87.3	ug/L		Q		
Methylenechloride	11/29/99	N	0.37	ug/L	U			
Nickel	11/29/99	Y	12.8	ug/L	U			
Nitrogen In Nitrate	11/29/99	N	2.9	mg/L	D	HQ		
Nitrogen In Nitrite	11/29/99	N	0.0074	mg/L	U	H		
pH Measurement	11/29/99	N	8.1	pH				
pH Measurement	11/29/99	N	7.9	pH				
Potassium	11/29/99	Y	2880	ug/L	B			
Silver	11/29/99	Y	5.5	ug/L	U			
Sodium	11/29/99	Y	20400	ug/L		Q		
Specific Conductance	11/29/99	N	235	umhos/cm				
Specific Conductance	11/29/99	N	0.19	uS/cm	BC			
Strontium (elemental)	11/29/99	Y	68.6	ug/L				
Sulfate	11/29/99	N	12.5	mg/L		Q		
Technetium-99	11/29/99	N	812	pCi/L			14	69
Temperature	11/29/99	N	19.5	Deg C				
Tetrachloroethene	11/29/99	N	0.57	ug/L	U			
Tetrahydrofuran	11/29/99	N	1.5	ug/L	U			
Toluene	11/29/99	N	0.33	ug/L	U			
Total dissolved solids	11/29/99	N	191	mg/L		H		
Total organic carbon	11/29/99	N	0.41	mg/L	B			
trans-1,2-Dichloroethylene	11/29/99	N	0.26	ug/L	U			
Trichloroethene	11/29/99	N	0.16	ug/L	U			
Tritium	11/29/99	N	19900	pCi/L			570	1200
Turbidity	11/29/99	N	320	NTU				
Uranium	11/29/99	N	3.34	ug/L		Q		0.54
Vanadium	11/29/99	Y	20.8	ug/L	B			
Vinyl chloride	11/29/99	N	0.17	ug/L	U			
Xylenes (total)	11/29/99	N	0.61	ug/L	U			
Zinc	11/29/99	Y	23.1	ug/L		Q		
258 ft bgs								
1,1,1-Trichloroethane	12/14/99	N	0.23	ug/L	U			
1,1,2-Trichloroethane	12/14/99	N	0.31	ug/L	U			
1,1-Dichloroethane	12/14/99	N	0.19	ug/L	U			
1,1-Dichloroethene	12/14/99	N	0.23	ug/L	U			
1,2-Dichloroethane	12/14/99	N	0.17	ug/L	U			
1,4-Dichlorobenzene	12/14/99	N	0.14	ug/L	U			
1-Butanol	12/14/99	N	6.6	ug/L	U			
2-Butanone	12/14/99	N	0.7	ug/L	U			
4-Methyl-2-Pentanone	12/14/99	N	1.3	ug/L	U			
Acetone	12/14/99	N	4	ug/L	U			
Alkalinity	12/14/99	N	106	mg/L				

Table D.3. (contd)

Constituent	Sample Date	Filtered	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Aluminum	12/14/99	Y	19.7	ug/L	U			
Antimony	12/14/99	Y	40.9	ug/L	U			
Barium	12/14/99	Y	27.7	ug/L	B			
Benzene	12/14/99	N	0.23	ug/L	U			
Beryllium	12/14/99	Y	0.5	ug/L	U			
Cadmium	12/14/99	Y	3.3	ug/L	U			
Calcium	12/14/99	Y	26300	ug/L				
Carbon disulfide	12/14/99	N	0.3	ug/L	U			
Carbon tetrachloride	12/14/99	N	0.94	ug/L	J			
Chloride	12/14/99	N	3.1	mg/L				
Chlorobenzene	12/14/99	N	0.28	ug/L	U			
Chloroform	12/14/99	N	0.69	ug/L	J			
Chromium	12/14/99	Y	3	ug/L	U			
cis-1,2-Dichloroethylene	12/14/99	N	0.18	ug/L	U			
Cobalt	12/14/99	Y	2.8	ug/L	U			
Copper	12/14/99	Y	6.4	ug/L	U			
Ethyl cyanide	12/14/99	N	2.6	ug/L	U			
Fluoride	12/14/99	N	0.44	mg/L				
Gross alpha	12/14/99	N	1.1	pCi/L	J		0.91	0.94
Gross beta	12/14/99	N	6.34	pCi/L			1.7	1.9
Iron	12/14/99	Y	43.4	ug/L	B			
Magnesium	12/14/99	Y	9250	ug/L				
Manganese	12/14/99	Y	42.7	ug/L				
Methylenechloride	12/14/99	N	0.37	ug/L	U			
Nickel	12/14/99	Y	12.8	ug/L	U			
Nitrogen in Nitrate	12/14/99	N	0.48	mg/L		H		
Nitrogen in Nitrite	12/14/99	N	0.0074	mg/L	U	H		
pH Measurement	12/14/99	N	8.2	pH				
Potassium	12/14/99	Y	3360	ug/L	B			
Silver	12/14/99	Y	5.5	ug/L	U			
Sodium	12/14/99	Y	11600	ug/L				
Specific Conductance	12/14/99	N	228	uS/cm	C			
Strontium (elemental)	12/14/99	Y	97.8	ug/L				
Sulfate	12/14/99	N	14.4	mg/L				
Technetium-99	12/14/99	N	7.03	pCi/L	U		0.35	11
Tetrachloroethene	12/14/99	N	0.57	ug/L	U			
Tetrahydrofuran	12/14/99	N	1.5	ug/L	U			
Toluene	12/14/99	N	0.33	ug/L	U			
Total dissolved solids	12/14/99	N	106	mg/L				
Total organic carbon	12/14/99	N	0.64	mg/L	B			
trans-1,2-Dichloroethylene	12/14/99	N	0.26	ug/L	U			
Trichloroethene	12/14/99	N	0.16	ug/L	U			
Tritium	12/14/99	N	969	pCi/L			97	270
Uranium	12/14/99	N	1.09	ug/L				0.18
Vanadium	12/14/99	Y	38.2	ug/L	B			
Vinyl chloride	12/14/99	N	0.17	ug/L	U			
Xylenes (total)	12/14/99	N	0.61	ug/L	U			
Zinc	12/14/99	Y	164	ug/L				
313 ft bgs								
1,1,1-Trichloroethane	12/15/99	N	0.23	ug/L	U			
1,1,2-Trichloroethane	12/15/99	N	0.31	ug/L	U			
1,1-Dichloroethane	12/15/99	N	0.19	ug/L	U			
1,2-Dichloroethane	12/15/99	N	0.17	ug/L	U			
1,4-Dichlorobenzene	12/15/99	N	0.14	ug/L	U			
1-Butanol	12/15/99	N	6.6	ug/L	U			
2-Butanone	12/15/99	N	0.7	ug/L	U			
4-Methyl-2-Pentanone	12/15/99	N	1.3	ug/L	U			
Acetone	12/15/99	N	4	ug/L	U			
Alkalinity	12/15/99	N	114	mg/L				
Aluminum	12/15/99	Y	26.5	ug/L	U			
Antimony	12/15/99	Y	19.7	ug/L	U			
Barium	12/15/99	Y	27.6	ug/L	B			
Benzene	12/15/99	N	0.23	ug/L	U			
Beryllium	12/15/99	Y	0.2	ug/L	U			
Cadmium	12/15/99	Y	2	ug/L	U			
Calcium	12/15/99	Y	28700	ug/L				
Carbon disulfide	12/15/99	N	0.3	ug/L	U			
Carbon tetrachloride	12/15/99	N	1.5	ug/L	J			

Table D.3. (contd)

Constituent	Sample Date	Filtered	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Chloride	12/15/99	N	4.4	mg/L				
Chloroform	12/15/99	N	0.8	ug/L	J			
Chromium	12/15/99	Y	2.7	ug/L	U			
cis-1,2-Dichloroethylene	12/15/99	N	0.18	ug/L	U			
Cobalt	12/15/99	Y	2.5	ug/L	U			
Copper	12/15/99	Y	4	ug/L	U			
Ethyl cyanide	12/15/99	N	2.6	ug/L	U			
Fluoride	12/15/99	N	0.44	mg/L				
Gross alpha	12/15/99	N	0.828	pCi/L	U		0.97	0.98
Gross beta	12/15/99	N	5.83	pCi/L			1.7	1.9
Iron	12/15/99	Y	95.5	ug/L	B			
Magnesium	12/15/99	Y	10200	ug/L				
Manganese	12/15/99	Y	14.8	ug/L	B			
Methylenechloride	12/15/99	N	0.37	ug/L	U			
Nickel	12/15/99	Y	10	ug/L	U			
Nitrogen in Nitrate	12/15/99	N	0.26	mg/L		H		
Nitrogen in Nitrite	12/15/99	N	0.0074	mg/L	U	H		
pH Measurement	12/15/99	N	7.9	pH				
Potassium	12/15/99	Y	3230	ug/L	B			
Silver	12/15/99	Y	8	ug/L	U			
Sodium	12/15/99	Y	12700	ug/L				
Specific Conductance	12/15/99	N	242	uS/cm	C			
Strontium (elemental)	12/15/99	Y	108	ug/L				
Sulfate	12/15/99	N	14.4	mg/L				
Technetium-99	12/15/99	N	-6.06	pCi/L	U		0.31	12
Tetrachloroethene	12/15/99	N	0.57	ug/L	U			
Tetrahydrofuran	12/15/99	N	1.5	ug/L	U			
Toluene	12/15/99	N	0.33	ug/L	U			
Total dissolved solids	12/15/99	N	130	mg/L				
Total organic carbon	12/15/99	N	0.31	mg/L	B			
trans-1,2-Dichloroethylene	12/15/99	N	0.26	ug/L	U			
Trichloroethene	12/15/99	N	0.16	ug/L	U			
Tritium	12/15/99	N	304	pCi/L	J		39	200
Uranium	12/15/99	N	0.58	ug/L				0.094
Vanadium	12/15/99	Y	27.1	ug/L	B			
Vinyl chloride	12/15/99	N	0.17	ug/L	U			
Xylenes (total)	12/15/99	N	0.61	ug/L	U			
Zinc	12/15/99	Y	267	ug/L				
393 ft bgs								
1,1,1-Trichloroethane	12/17/99	N	0.23	ug/L	U			
1,1,2-Trichloroethane	12/17/99	N	0.31	ug/L	U			
1,1-Dichloroethane	12/17/99	N	0.19	ug/L	U			
1,2-Dichloroethane	12/17/99	N	0.17	ug/L	U			
1,4-Dichlorobenzene	12/17/99	N	0.14	ug/L	U			
1-Butanol	12/17/99	N	6.6	ug/L	U			
2-Butanone	12/17/99	N	0.7	ug/L	U			
4-Methyl-2-Pentanone	12/17/99	N	1.3	ug/L	U			
Acetone	12/17/99	N	4	ug/L	U			
Alkalinity	12/17/99	N	126	mg/L				
Aluminum	12/17/99	Y	26.5	ug/L	U			
Antimony	12/17/99	Y	19.7	ug/L	U			
Barium	12/17/99	Y	43.4	ug/L	B			
Benzene	12/17/99	N	0.23	ug/L	U			
Beryllium	12/17/99	Y	0.2	ug/L	U			
Cadmium	12/17/99	Y	2	ug/L	U			
Calcium	12/17/99	Y	33400	ug/L		Q		
Carbon disulfide	12/17/99	N	0.3	ug/L	U			
Carbon tetrachloride	12/17/99	N	5.6	ug/L				
Chloride	12/17/99	N	15.2	mg/L	D			
Chloroform	12/17/99	N	0.78	ug/L	J			
Chromium	12/17/99	Y	2.7	ug/L	U			
cis-1,2-Dichloroethylene	12/17/99	N	0.18	ug/L	U			
Cobalt	12/17/99	Y	2.5	ug/L	U			
Copper	12/17/99	Y	4	ug/L	U			
Ethyl cyanide	12/17/99	N	2.6	ug/L	U			
Fluoride	12/17/99	N	0.41	mg/L				
Gross alpha	12/17/99	N	3.28	pCi/L			1.8	1.9
Gross beta	12/17/99	N	7.97	pCi/L			1.9	2.2

Table D.3. (contd)

Constituent	Sample Date	Filtered	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Iron	12/17/99	Y	36.4	ug/L	B			
Magnesium	12/17/99	Y	12400	ug/L				
Manganese	12/17/99	Y	31.2	ug/L				
Methylenechloride	12/17/99	N	0.37	ug/L	U			
Nickel	12/17/99	Y	10	ug/L	U			
Nitrogen in Nitrate	12/17/99	N	0.72	mg/L		H		
Nitrogen in Nitrite	12/17/99	N	0.0074	mg/L	U	H		
pH Measurement	12/17/99	N	7.9	pH				
Potassium	12/17/99	Y	3690	ug/L	B			
Silver	12/17/99	Y	8	ug/L	U			
Sodium	12/17/99	Y	14300	ug/L		Q		
Specific Conductance	12/17/99	N	307	uS/cm	C			
Strontium (elemental)	12/17/99	Y	135	ug/L				
Sulfate	12/17/99	N	16.1	mg/L				
Technetium-99	12/17/99	N	-5.98	pCi/L	U		0.31	12
Tetrachloroethene	12/17/99	N	0.57	ug/L	U			
Tetrahydrofuran	12/17/99	N	1.5	ug/L	U			
Toluene	12/17/99	N	0.33	ug/L	U			
Total dissolved solids	12/17/99	N	220	mg/L				
Total organic carbon	12/17/99	N	0.22	mg/L	B			
trans-1,2-Dichloroethylene	12/17/99	N	0.26	ug/L	U			
Trichloroethene	12/17/99	N	0.16	ug/L	U			
Tritium	12/17/99	N	185	pCi/L	U		26	180
Uranium	12/17/99	N	0.787	ug/L				0.13
Vanadium	12/17/99	Y	23.9	ug/L	B			
Vinyl chloride	12/17/99	N	0.17	ug/L	U			
Xylenes (total)	12/17/99	N	0.61	ug/L	U			
Zinc	12/17/99	Y	231	ug/L				
441 ft bgs								
1,1,1-Trichloroethane	12/22/99	N	0.23	ug/L	U	H		
1,1,2-Trichloroethane	12/22/99	N	0.31	ug/L	U	H		
1,1-Dichloroethane	12/22/99	N	0.19	ug/L	U	H		
1,2-Dichloroethane	12/22/99	N	0.17	ug/L	U	H		
1,4-Dichlorobenzene	12/22/99	N	0.14	ug/L	U	H		
1-Butanol	12/22/99	N	6.6	ug/L	U	H		
2-Butanone	12/22/99	N	1.1	ug/L	J	H		
4-Methyl-2-Pentanone	12/22/99	N	1.3	ug/L	U	H		
Acetone	12/22/99	N	4	ug/L	U	H		
Alkalinity	12/22/99	N	115	mg/L		H		
Aluminum	12/22/99	Y	26.5	ug/L	U			
Antimony	12/22/99	Y	19.7	ug/L	U			
Barium	12/22/99	Y	45.8	ug/L	B			
Benzene	12/22/99	N	0.23	ug/L	U	H		
Beryllium	12/22/99	Y	0.2	ug/L	U			
Cadmium	12/22/99	Y	2	ug/L	U			
Calcium	12/22/99	Y	33000	ug/L				
Carbon disulfide	12/22/99	N	0.3	ug/L	U	H		
Carbon tetrachloride	12/22/99	N	0.89	ug/L	J	H		
Chloride	12/22/99	N	10	mg/L	D			
Chloroform	12/22/99	N	0.76	ug/L	J	H		
Chromium	12/22/99	Y	2.7	ug/L	U			
cis-1,2-Dichloroethylene	12/22/99	N	0.18	ug/L	U	H		
Cobalt	12/22/99	Y	2.5	ug/L	U			
Copper	12/22/99	Y	4	ug/L	U			
Ethyl cyanide	12/22/99	N	2.6	ug/L	U	H		
Fluoride	12/22/99	N	0.34	mg/L				
Gross alpha	12/22/99	N	0.857	pCi/L	U		1	1.1
Gross beta	12/22/99	N	5	pCi/L			1.6	1.7
Iron	12/22/99	Y	38.7	ug/L	B			
Magnesium	12/22/99	Y	12500	ug/L				
Manganese	12/22/99	Y	167	ug/L				
Methylenechloride	12/22/99	N	0.37	ug/L	U	H		
Nickel	12/22/99	Y	10	ug/L	U			
Nitrogen in Nitrate	12/22/99	N	2.9	mg/L	D	H		
Nitrogen in Nitrite	12/22/99	N	0.0074	mg/L	U	H		
pH Measurement	12/22/99	N	7.7	pH				
Potassium	12/22/99	Y	3650	ug/L	B			
Silver	12/22/99	Y	8	ug/L	U			

Table D.3. (contd)

Constituent	Sample Date	Filtered	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Sodium	12/22/99	Y	15500	ug/L				
Specific Conductance	12/22/99	N	323	uS/cm	C			
Strontium (elemental)	12/22/99	Y	149	ug/L				
Sulfate	12/22/99	N	19.3	mg/L	D			
Technetium-99	12/22/99	N	0.577	pCi/L	U		0.03	12
Tetrachloroethene	12/22/99	N	0.57	ug/L	U	H		
Tetrahydrofuran	12/22/99	N	1.5	ug/L	U	H		
Toluene	12/22/99	N	0.33	ug/L	U	H		
Total dissolved solids	12/22/99	N	119	mg/L		H		
Total organic carbon	12/22/99	N	0.58	mg/L	B			
trans-1,2-Dichloroethylene	12/22/99	N	0.26	ug/L	U	H		
Trichloroethene	12/22/99	N	0.16	ug/L	U	H		
Tritium	12/22/99	N	-20.1	pCi/L	U		3.1	180
Uranium	12/22/99	N	0.43	ug/L				0.07
Vanadium	12/22/99	Y	15.2	ug/L	B			
Vinyl chloride	12/22/99	N	0.17	ug/L	U	H		
Xylenes (total)	12/22/99	N	0.61	ug/L	U	H		
Zinc	12/22/99	Y	292	ug/L				
545 ft bgs								
1,1,1-Trichloroethane	1/12/00	N	0.23	ug/L	U			
1,1,2-Trichloroethane	1/12/00	N	0.31	ug/L	U			
1,1-Dichloroethane	1/12/00	N	0.19	ug/L	U			
1,1-Dichloroethene	1/12/00	N	0.23	ug/L	U			
1,2-Dichloroethane	1/12/00	N	0.17	ug/L	U			
1,4-Dichlorobenzene	1/12/00	N	0.14	ug/L	U			
1-Butanol	1/12/00	N	6.6	ug/L	U			
2-Butanone	1/12/00	N	0.7	ug/L	U			
4-Methyl-2-Pentanone	1/12/00	N	1.3	ug/L	U			
Acetone	1/12/00	N	4	ug/L	U			
Alkalinity	1/12/00	N	96	mg/L				
Aluminum	1/12/00	Y	20.9	ug/L				
Antimony	1/12/00	Y	40.9	ug/L	U			
Barium	1/12/00	Y	18	ug/L	B			
Benzene	1/12/00	N	0.23	ug/L	U			
Beryllium	1/12/00	Y	0.55	ug/L	B			
Cadmium	1/12/00	Y	3.3	ug/L	U			
Calcium	1/12/00	Y	20200	ug/L				
Carbon disulfide	1/12/00	N	0.3	ug/L	U			
Carbon tetrachloride	1/12/00	N	0.23	ug/L	U			
Chloride	1/12/00	N	5.8	mg/L	D			
Chlorobenzene	1/12/00	N	0.28	ug/L	U			
Chloroform	1/12/00	N	0.23	ug/L	U			
Chromium	1/12/00	Y	3	ug/L	U			
cis-1,2-Dichloroethylene	1/12/00	N	0.18	ug/L	U			
Cobalt	1/12/00	Y	2.8	ug/L	U			
Copper	1/12/00	Y	6.4	ug/L	U			
Ethyl cyanide	1/12/00	N	2.6	ug/L	U			
Fluoride	1/12/00	N	0.73	mg/L				
Gross alpha	1/12/00	N	20.9	pCi/L			3.8	6
Gross beta	1/12/00	N	12.7	pCi/L			2.1	2.8
Iron	1/12/00	Y	218	ug/L				
Magnesium	1/12/00	Y	8010	ug/L				
Manganese	1/12/00	Y	38.1	ug/L				
Methylenechloride	1/12/00	N	0.37	ug/L	U			
Nickel	1/12/00	Y	12.8	ug/L	U			
Nitrogen in Nitrate	1/12/00	N	1.1	mg/L	D			
Nitrogen in Nitrite	1/12/00	N	0.0074	mg/L	U			
pH Measurement	1/12/00	N	8.5	pH				
Potassium	1/12/00	Y	5470	ug/L				
Silver	1/12/00	Y	5.5	ug/L	U			
Sodium	1/12/00	Y	16600	ug/L				
Specific Conductance	1/12/00	N	234	uS/cm	C			
Strontium (elemental)	1/12/00	Y	102	ug/L				
Sulfate	1/12/00	N	18.9	mg/L	D			
Technetium-99	1/12/00	N	-1.99	pCi/L	U		0.1	12
Tetrachloroethene	1/12/00	N	0.57	ug/L	U			
Tetrahydrofuran	1/12/00	N	1.5	ug/L	U			
Toluene	1/12/00	N	0.33	ug/L	U			

Table D.3. (contd)

Constituent	Sample Date	Filtered	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Total dissolved solids	1/12/00	N	145	mg/L				
Total organic carbon	1/12/00	N	1.9	mg/L				
trans-1,2-Dichloroethylene	1/12/00	N	0.26	ug/L	U			
Trichloroethene	1/12/00	N	0.16	ug/L	U			
Tritium	1/12/00	N	-12.1	pCi/L	U		1.7	190
Uranium	1/12/00	N	30.9	ug/L				7.3
Vanadium	1/12/00	Y	13.2	ug/L	B			
Vinyl chloride	1/12/00	N	0.17	ug/L	U			
Xylenes (total)	1/12/00	N	0.61	ug/L	U			
Zinc	1/12/00	Y	302	ug/L				

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