



Borehole Data Package for Calendar Year 2000-2001 RCRA Wells at Single-Shell Tank Waste Management Area S-SX

D. G. Horton
V. G. Johnson

August 2001



Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RL01830

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1.0 Introduction

Six 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 July 2000 through March 2001 in partial fulfillment of Tri-Party Agreement (Ecology et al. 1998) milestones M-24-00L and M-24-00M. The wells are 299-W22-80, 299-W22-81, 299-W22-82, 299-W22-83, 299-W23-20, and 299-W23-21. Table 1 correlates the well name with the well number. Well 299-W22-80 is located outside the southeast corner of SX tank farm and is a new downgradient well in the monitoring network. Well 299-W22-81 is a new downgradient well located east of the S and SX tank farm. Well 299-W22-82 is located downgradient of the WMA at approximately 100 m east of the southeast corner of tank farm SX and well 299-W22-83 is located approximately 100 m southeast of the southeast corner of tank farms SX. Wells 299-W23-20 and 299-W23-21 are located just outside the west S and SX fences respectively and are new upgradient wells in the monitoring network. 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^(a).

This document compiles information on the drilling and construction, well development, pump installation, and sediment sampling applicable to the installation of the six new wells. 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 physical properties testing; and Appendix C contains borehole geophysical logs. Additional documentation concerning well construction is on file with Bechtel Hanford, Inc., Richland, Washington.

Table 1. Well Names and Well Numbers for Wells Drilled During Calendar Year 2000-2001

Well Name	Well Number
299-W22-80	C3115
299-W22-81	C3123
299-W22-82	C3124
299-W22-83	C3126
299-W23-20	C3112
299-W23-21	C3113

(a) Letter from J. S. Fruchter, Pacific Northwest National Laboratory, to G. C. Henckel, Bechtel Hanford, Inc., "Description of Work for Drilling CY 2000 RCRA Groundwater Monitoring Wells," dated May 12, 2000.



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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. To convert feet to meters, multiply by 0.3048; to convert inches to centimeters multiply by 2.54.

2.0 Well 299-W22-80

Well 299-W22-80 is located outside the southeast corner of the SX tank farm. The well was drilled in September 2000.

2.1 Drilling and Sampling

Well 299-W22-80 was drilled with an air rotary drill rig from the surface to a total depth of 251 ft below ground surface (bgs). Temporary 9-in.-outside-diameter, carbon steel casing was used for the entire depth. Approximately 500 gal of water were added to the borehole at 250 ft bgs to suppress flowing sand.

The sediments encountered during drilling were predominantly sand and silty sand of the Hanford formation from the surface to about 128 ft bgs; Plio-Pleistocene sand with minor silty sandy gravel from about 128 to about 158 ft bgs; and Ringold Formation sandy gravel and gravelly sand from about 158 ft to total depth (251 ft bgs). The geologist's log is included in Appendix A.

Grab samples for geologic description and archive were collected every five feet throughout the borehole. Also, three split spoon samples were taken from 213.3 to 215.8 ft, 232.0 to 234.5 ft, and from 241.0 to 243.5 ft bgs for analysis of particle size distribution in support of screen slot and filter pack selection. The deepest split spoon sample contained considerable flowing sand. Particle size distribution data are in Appendix B.

Five groundwater samples were collected during drilling. The samples were air lifted slurries of cuttings and water obtained during air rotary drilling. The slurries were filtered using a peristaltic pump and a 0.4- μ m filter cartridge prior to analysis in the field. The samples were tested for nitrate and specific conductance as a screen for contamination. All analyzed nitrate levels are below the 45 mg/L maximum contaminant level. The analytical results are shown in Table 2.

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

Table 2. Analytical Results from Groundwater Samples from New Wells at Waste Management Area S-SX

Well	Depth to Water (ft)	Sample Depth (ft)	Nitrate (mg/L) ^(a)	Specific Conductance (μS/cm)
299-W22-80	205	213	8.7	290
		227	8.4	198
		232	8.1	220
		242	8.1	220
		259	4.2	235
299-W23-21	216	259	1.0	213
(a) Nitrate is mg/L as NO ₃ ⁻ . Analyses were done by the HACH cadmium reduction method (Method 8039) using a DR/2010 portable spectrophotometer. Reagent blank corrected.				

2.2 Well Construction

The permanent casing and screen were installed in well 299-W22-80 in September 2000. A 4-in.-inner-diameter, stainless steel, wire wrap, 20 slot screen was set from 240.05 to 205.03 ft bgs. The permanent casing is 4-in.-inner-diameter, stainless steel from 205.03 ft bgs to 2.2 ft above ground surface. A 2-ft-long stainless steel sump is below the screen from 242.05 to 240.05 ft depth.

The filter pack is 10 to 20 mesh silica sand from 248.4 to 194.8 ft bgs. The annular seal is bentonite pellets from 194.8 ft to 187.1 ft, granular bentonite from 187.1 ft to 10.2 ft, and Portland cement grout from 10.2 ft bgs 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 protective casing extends 2.86 ft above the concrete pad. 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 2001. 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, and the U.S. Army Corps of Engineers. The coordinates are Washington Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD 1988 and is based on existing benchmarks established by the U.S. Army Corps of Engineers. Survey data are included in Table 3.

Table 3. Survey Data for New Wells at Waste Management Area S-SX

Well Name	Easting (m)	Northing (m)	Elevation (m)	
299-W22-80	566,842.851	134,125.649		Center of Casing
			200.851	“X” on Rim of Casing
	566,842.923	134,126.030	199.971	Brass Cap
299-W22-81	567,000.263	134,354.189		Center of Casing
			206.644	Top of Casing
	567,000.235	134354.504	205.909	Brass Cap
299-W22-82	567,004.731	134,167.070		Center of Casing
			206.872	Top of Casing
	567,004.714	134,167.407	206.127	Brass Cap
299W22-83	567,009.082	134,092.576		Center of Casing
			207.015	Top of Casing
	567,009.058	134,092.945	206.338	Brass Cap
299-W23-20	566,717.669	134,446.189		Center of Casing
			203.795	“X” on Rim of Casing
	566,717.817	134,446,568	203.095	Brass Cap
299-W23-21	566,707.737	134,293.994		Center of Casing
			203.352	“X” on Rim of Casing
	566,707.718	134,294.273	202.579	Brass Cap

2.3 Well Development and Pump Installation

Well 299-W22-80 was developed in September 2000. A temporary, 3 hp, submersible pump was used to remove approximately 1,945 gal of formation water. First, about 1,015 gal of water were removed from the well at 29 gal/min with a drawdown of about 2.9 ft. The pump intake was at 236.64 ft bgs (31.04 ft below the water table). Second, about 930 gal of water were removed at 30 gal/min with the pump intake at 215.7 ft bgs resulting in 3 ft drawdown. The final turbidity was 2.75 NTU.

A dedicated Hydrostar sampling pump was installed in well 299-W22-80 in September 2000. The sampling pump intake is at 214.46 ft bgs (or about 8.83 ft below the water table). Static water level was 205.29 ft bgs on September 11, 2000.

3.0 Well 299-W22-81

Well 299-W22-81 is located east of the S-SX tank farm. The well was drilled in January 2001.

3.1 Drilling and Sampling

Well 299-W22-81 was drilled with a cable tool drill rig from the surface to a total depth of 269 ft bgs. Temporary 10 5/8-in.-outside-diameter, carbon steel casing was used for the entire depth. The well was advanced using drive barrel from the surface to 131 ft depth and by hard tool from 131 ft to total depth.

The sediments encountered during drilling were dominantly sand with lesser amounts of silty sandy gravel and slightly silty sand of the Hanford formation from the surface to about 140 ft bgs; Plio-Pleistocene silty sand from about 140 to about 163 ft bgs; and Ringold Formation silty sandy gravel and sandy gravel with minor silty sand from about 163 ft to total depth (269 ft bgs). The geologist's log is included in Appendix A.

Grab samples for geologic description and archive were collected every five feet throughout the borehole. Also, three split spoon samples were taken from 238 to 240 ft, 246.3 to 248.3 ft, and from 260.5 to 262.5 ft bgs for analysis of particle size distribution in support of screen slot and filter pack selection. Particle size distribution data are in Appendix B.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No contamination was found. The borehole was geophysically logged with spectral gamma-ray and neutron moisture tools on January 22, 2001. No manmade radionuclides were identified.

3.2 Well Construction

The permanent casing and screen were installed in well 299-W22-81 in January 2001. A 4-in.-inner-diameter, stainless steel, wire wrap, 20 slot screen was set from 261.72 to 226.75 ft bgs. The permanent casing is 4-in.-inner-diameter, stainless steel from 226.75 ft bgs to 2.2 ft above ground surface. A 2-ft-long stainless steel sump is below the screen from 263.72 to 261.72 ft depth.

The filter pack is 10 to 20 mesh silica sand from 270.0 to 216.7 ft bgs. The annular seal is bentonite pellets from 216.7 ft to 209.9 ft, granular bentonite from 209.9 ft to 11.0 ft, and Portland cement grout from 11.0 ft bgs to the surface. A 4 ft by 4 ft by 6 in. concrete pad was placed around the well at the surface. A 6-in. stainless steel protective casing with locking cap, four protective steel posts, and a brass marker stamped with the well number were set into the concrete. The protective casing extends 2.37 ft above the concrete pad. 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 May 2001. 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, and the U.S. Army Corps of Engineers. The coordinates are Washington Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD 1988 and is based on existing benchmarks established by the U.S. Army Corps of Engineers. Survey data are included in Table 3.

3.3 Well Development and Pump Installation

Well 299-W22-81 was developed in March 2001. A temporary, 1 hp, submersible pump was used to remove approximately 2,325 gal of formation water. First, about 1,805 gal of water were removed from the well at 8.5 gal/min with a drawdown of about 22 ft. The pump intake was at 260.3 ft bgs (34.04 ft below the water table). Second, about 520 gal of water were removed at 8 gal/min with the pump intake at 240.33 ft bgs resulting in 12.9 ft of drawdown. The final turbidity was 1.81 NTU.

A dedicated, Redi Flo-2 submersible sampling pump was installed in well 299-W22-81 in March 2001. The sampling pump intake is at 237 ft bgs (or about 11.1 ft below the water table). Static water level was 225.9 ft bgs on March 26, 2001.

4.0 Well 299-W22-82

Well 299-W22-82 is located east of the southeast corner of SX tank farm. The well was drilled during January and February 2001.

4.1 Drilling and Sampling

Well 299-W22-82 was drilled with a cable tool drill rig from the surface to a 270 ft bgs. Temporary 10 3/4-in.-outside-diameter, carbon steel casing was placed from the surface to 270 ft during drilling. The borehole was advanced by drive barrel from the surface to 110 ft bgs and by hard tool from 110 ft to total depth (270 ft). Two gal of water were added at 110 to 112 ft, 10 gal at 152 ft and 10 to 15 gal at 260 ft depths to improve sample returns. About 400 gal of water were added at total depth to prevent sand heave.

Preliminary evaluation shows that the sediments encountered during drilling were Hanford formation sand with lesser amounts of silty sand gravelly sand from the surface to 111 ft depth. Plio-Pleistocene silt was encountered from 111 to 112 ft and silty sand from 112 to 137.5 ft bgs. The sediments between 138 ft and 270 ft were dominantly silty sandy gravel with minor gravelly silty sand and silty sand of the Ringold Formation. 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 230 to 232.5 ft, 243.5 to 246 ft, and 260 to 262.5 ft bgs for analysis of grain size distribution. Data are in Appendix B.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No contamination was noted. The borehole was geophysically logged with spectral gamma-ray and neutron moisture tools on February 13, 2001. No manmade radioisotopes were found. The geophysical logs are in Appendix C.

4.2 Well Construction

The permanent casing and screen were installed in well 299-W22-82 in February 2001. A 4-in.-inner-diameter, stainless steel, continuous wire wrap (20 slot) screen was set from 261.2 to 226.1 ft bgs. The permanent casing is 4-in.-inner-diameter stainless steel from 226.1 ft bgs to 2.0 ft above ground surface. A 2-ft-long sump from 263.2 to 261.2 ft is attached to the bottom of the screen.

The filter pack is 10 to 20 mesh silica sand from 263.1 to 215.7 ft bgs. The annular seal is bentonite pellets from 215.7 to 209.4 ft bgs, granular bentonite from 209.4 to 10 ft bgs, and Portland cement with bentonite powder from 10 ft to the surface. A 4 ft by 4 ft by 6 in. concrete pad was placed around the well at the surface. A 6-in. stainless steel protective casing with locking cap, four protective steel posts, and a brass marker stamped with the well number were set into the concrete. The inner casing extends 1.41 ft above the concrete pad and the protective casing extends 2.43 ft above the concrete pad. 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 May 2001. 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 and the U.S. Army Corps of Engineers. The coordinates are Washington Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD 1988 and is based on existing benchmarks established by the U.S. Army Corps of Engineers. Survey data are included in Table 3.

4.3 Well Development and Pump Installation

Well 299-W22-82 was developed in March 2001. A temporary, 1 hp, submersible pump was used to remove approximately about 2,770 gal of formation water. First, about 2,258 gal of water were removed at 8 to 10 gal/min with the pump intake at 263.2 ft bgs resulting in 18.8 ft of drawdown. Second, about 512 gal of water were removed at 8 gal/min with the pump intake at 243.15 ft bgs; drawdown was 15.5 ft. The final turbidity was 4.3 NTU.

A dedicated, Redi Flo-2 submersible sampling pump was installed in well 299-W22-82 in March 2001. The sampling pump intake is at 237.4 ft bgs (or 11.1 ft below the water table). Static water level in the well was 226.27 ft bgs on February 23, 2001.

5.0 Well 299-W22-83

Well 299-W22-83 is located ~100 m southeast of the southeast corner of the SX tank farm. The well was drilled in February and March 2001.

5.1 Drilling and Sampling

Well 299-W22-83 was drilled with a cable tool drill rig from the surface to a total depth of 269 ft bgs. Temporary 10 3/4-in.-outside-diameter, carbon steel casing was used for the entire depth. The well was advanced using drive barrel from the surface to 150 ft and by hard tool from 150 ft to total depth. Seven gal of water were added to the borehole at 80 ft and 3 gal at 133 ft to facilitate drilling. One hundred ten gal were added between 150 ft and 268 ft during hard tool drilling. Finally, 100 gal were added at total depth to prevent sand heave.

The sediments encountered during drilling were dominantly sand with lesser amounts of silty sand and gravelly sand of the Hanford formation from the surface to about 134 ft bgs. Plio-Pleistocene silty sand and sandy silt (calcrete) were present from 134 ft to about 144 ft bgs. Sandy gravelly silt, sand, silty sand, and sandy gravelly silt of possible Upper Ringold Formation was encountered between 144 ft and 195 ft and Ringold Formation silty sandy gravel silty sandy gravel of the Lower Ringold Formation occurred between 195 ft and total depth (275 ft bgs). The geologist's log is included in Appendix A.

Grab samples for geologic description and archive were collected every 5 ft throughout the borehole. Also, three split spoon samples were taken from 232 to 234 ft, 247 to 249 ft, and from 262 to 264 ft bgs for analysis of particle size distribution in support of screen slot and filter pack selection. Particle size distribution data are in Appendix B.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No contamination was found. The borehole was geophysically logged with spectral gamma-ray and neutron moisture tools on March 7, 2001. No manmade radionuclides were identified.

5.2 Well Construction

The permanent casing and screen were installed in well 299-W22-83 in March 2001. A 4-in.-inner-diameter, stainless steel, wire wrap, 20 slot screen was set from 261.3 to 226.3 ft bgs. The permanent casing is 4-in.-inner-diameter, stainless steel from 226.3 ft bgs to 2.0 ft above ground surface. A 2-ft-long stainless steel sump is below the screen from 263.3 to 261.3 ft depth.

The filter pack is 10 to 20 mesh silica sand from 263.3 to 216.3 ft bgs. The annular seal is bentonite pellets from 216.3 ft to 211.3 ft, bentonite crumbles from 211.3 ft to 10.0 ft, and Portland cement grout from 10.0 ft bgs to the surface. A 4 ft by 4 ft by 6 in. concrete pad was placed around the well at the surface. A 6-in. stainless steel protective casing with locking cap, four protective steel posts, and a brass marker stamped with the well number were set into the concrete. The protective casing extends 2.23 ft

above the concrete pad and the inner 4-in. casing extends 1.24 ft above the pad. 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 May 2001. 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 and the U.S. Army Corps of Engineers. The coordinates are Washington Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD 1988 and is based on existing benchmarks established by the U.S. Army Corps of Engineers. Survey data are included in Table 3.

5.3 Well Development and Pump Installation

Well 299-W22-83 was developed in March 2001. A temporary, 3 hp, submersible pump was used to remove approximately 2,250 gal of formation water. First, about 1,520 gal of water were removed from the well at 10 gal/min with a maximum drawdown of about 29 ft and a final drawdown of 9.8 ft. The pump intake was at 260.47 ft bgs (32.7 ft below the water table). Second, about 730 gal of water were removed at 10 gal/min with the pump intake at 250.47 ft bgs (22.7 ft below the water table) resulting in 7.2 ft of drawdown. The final turbidity was 3.11 NTU.

A dedicated, Redi Flo-2 submersible sampling pump was installed in well 299-W22-83 in March 2001. The sampling pump intake is at 237 ft bgs (or about 9.2 ft below the water table). Static water level was 227.77 ft bgs on March 21, 2001.

6.0 Well 299-W23-20

Well 299-W23-20 is located outside the west fence of the S tank farm. The well was drilled during July and August 2000.

6.1 Drilling and Sampling

Well 299-W23-20 was drilled with an air rotary drill rig from the surface to a total depth of 260 ft bgs. Temporary 8 5/8-in.-outside-diameter, carbon steel casing was placed from the surface to 260 ft during drilling. An unknown amount of water was added to the borehole at 142 ft and 195 ft bgs to flush the system and clear plugged lines.

Preliminary evaluation shows that the sediments encountered during drilling were Hanford formation silty sandy gravel, sandy gravel, and gravelly sand from the surface to 36 ft depth and sand with minor gravelly sand from 36 to 117 ft depth. Calcareous, slightly silty sand and silty sand of the Plio-Pleistocene unit were encountered from 117 to 157 ft bgs. There was no recovery between depths of 139 and 148 ft but drilling did not indicate a change in lithology. There also was no recovery between 157 and 169 ft. Sediments from 169 ft to total depth (260 ft bgs) were mostly sandy gravel with some silty sandy gravel of the Ringold Formation. 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 219.5 to 222.0 ft, 236.0 to 237.5 ft and 250 to 252.6 ft bgs for analysis of grain size distribution. Data are in Appendix B.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. On July 28, 2000, drilling was suspended because the field radiation screening results collected the previous day were 700 counts per minute above background. The area was posted as a soil contamination zone although the action level was 5,000 decays per minute and laboratory analysis of radiation screening samples collected the previous day did not show the presence of any contamination. No other contamination was noted.

6.2 Well Construction

The permanent casing and screen were installed in well 299-W23-20 in August 2000. A 4-in.-inner-diameter, stainless steel, continuous wire wrap (20 slot) screen was set from 250.5 to 215.5 ft bgs. The permanent casing is 4-in.-inner-diameter stainless steel from 215.5 ft bgs to 2.0 ft above ground surface. A 2-ft-long sump from 252.5 to 250.5 is attached to the bottom of the screen.

The filter pack is 10 to 20 mesh silica sand from 260.5 to 205.0 ft bgs. The annular seal is bentonite pellets from 205 to 200.1 ft bgs, bentonite crumbles from 200.1 to 10 ft bgs, and Portland cement grout from 10 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 inner casing extends 1.30 ft above the concrete pad and the protective casing extends 2.23 ft above the concrete pad. 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 2001. 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, and the U.S. Army Corps of Engineers. The coordinates are Washington Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD 1988 and is based on existing benchmarks established by the U.S. Army Corps of Engineers. Survey data are included in Table 3.

6.3 Well Development and Pump Installation

Well 299-W23-20 was developed in August 2000. A temporary, 3 hp, submersible pump was used to remove approximately about 2,690 gal of formation water. First, about 1,363 gal of water were removed at 29 gal/min with the pump intake at 248.8 ft bgs resulting in 2 ft drawdown. Second, about 1,325 gal of water were removed at 26 gal/min with the pump intake at 228.8 ft bgs; drawdown was not recorded. The final turbidity was 1.95 NTU.

A dedicated Hydrostar sampling pump was installed in well 299-W23-20 in August 2000. The sampling pump intake is at 220.8 ft bgs (or 5.24 ft below the water table). Static water level in the well was 215.6 ft bgs on August 24, 2000.

7.0 Well 299-W23-21

Well 299-W23-21 is located just outside the west fence of the SX tank farm. The well was drilled during September and October 2000.

7.1 Drilling and Sampling

Well 299-W23-21 was drilled with a cable tool drill rig using a drive barrel from the surface to 70 ft bgs, split spoon sampler from 70 to 140 ft bgs, and hard tool from 140 ft to a total depth of 259 ft bgs. Temporary 11 3/4-in.-outside-diameter, carbon steel casing was placed from the surface to 76.4 ft bgs and 8 5/8-in.-outside-diameter casing from the surface to 253.5 ft bgs. About 80 gal of water are reported to have been used between 235 and 250 ft, but more water may have been added throughout the hard tooled interval.

Preliminary evaluation shows that the sediments encountered during drilling were predominantly sandy gravel, sand and gravelly sand of the Hanford formation from the surface to about 99 ft bgs. Calcareous silty sand, slightly silty sand, and sandy silt of the Plio-Pleistocene unit occur from 99 to 147 ft bgs. Undifferentiated Plio-Pleistocene and/or Upper Ringold Formation sandy silt, sand, and silty gravelly sand exist from 147 ft to about 168 ft bgs. Ringold Formation sandy gravel and silty sandy gravel occur from 168 ft to total depth. The geologist's log is in Appendix A.

The borehole was continuously sampled by split spoon from 70 ft to 140 ft bgs for detailed characterization. Also, three split spoon samples were collected from 217 to 219.5 ft, 232 to 234.5 ft and from 247.5 to 250 ft bgs for determination of particle size distribution. The particle size data are in Appendix B; the results of detailed characterization will be presented elsewhere. Grab samples of sediment were collected at approximately 5-ft intervals throughout the borehole for geologic description and archive.

One groundwater sample was collected at 259 ft bgs with a bailer during drilling. The slurry was filtered using a peristaltic pump and a 0.4- μ m filter cartridge prior to analysis in the field. The sample was tested for nitrate and specific conductance as a screen for contamination. The analyzed nitrate level is below the 45 mg/L maximum contaminant level. The analytical result is shown in Table 2.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. Values up to 860 ppm CO and 26% lower explosive limit were detected at about 248 ft bgs. Work was temporarily stopped. No other high meter readings and no contamination were noted in the borehole.

The well was geophysically logged with high resolution, spectral gamma-ray and neutron-neutron moisture instrumentation in October 2000. No manmade radionuclides were detected. The geophysical logs are in Appendix C.

7.2 Well Construction

The permanent casing and screen were installed in well 299-W23-21 in November 2000. A 4-in.-inner-diameter, stainless steel, continuous wire wrap, 20 slot screen was set from 249.69 to 212.58 ft bgs. The permanent casing is 4-in.-inner-diameter stainless steel from 212.58 bgs to 2.1 ft above ground surface. A 2-ft-long stainless steel sump was placed below the screen from 251.87 to 249.69 ft bgs.

The filter pack is 10 to 20 mesh silica sand from 257.5 to 202.0 ft bgs. The annular seal is bentonite pellets from 202.0 to 193.7 ft bgs, granular bentonite from 193.7 to 10.1 ft bgs, and Portland cement grout from 10.1 ft depth 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 permanent casing extends 2.1 ft and the protective casing extends 3.1 ft above the concrete pad. 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 2001. 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, and the U.S. Army Corps of Engineers. The coordinates are Washington Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD 1988 and is based on existing benchmarks established by the U.S. Army Corps of Engineers. Survey data are included in Table 3.

7.3 Well Development and Pump Installation

Well 299-W23-21 was developed in November 2000. A temporary, submersible pump was used to remove approximately 1,500 gal of formation water from the well. Initially, 25 ft of drawdown occurred using a pump rate of 6 gal/min. The flow rate was adjusted to 4.5 gpm resulting in 15 ft of drawdown and later to 5.0 gal/min resulting in 17 ft of drawdown. The final turbidity was 4.89 NTU.

A dedicated, Redi Flo-2 submersible sampling pump was installed in well 299-W23-21 in December 2000. The sampling pump intake is at 223 ft bgs (or about 10 ft below the water table). Static water level in the well was 212.7 ft bgs on December 27, 2000.

8.0 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. 1998. *Hanford Federal Facility Agreement and Consent Order*. Document No. 89-10, Rev. 5 (The Tri-Party Agreement), 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 CONSTRUCTION SUMMARY REPORT						Start Date: 9-1-00	
						Finish Date: 9-11-00	
						Page 1 of 1	
Specification No.:		Rev. No.:		Well Name: 299-W22-80		Temp. Well No.: C3115	
ECNs:				Approximate Location: S. of 241- TX Tank Farm / 200W			
Project: CY 2000 RCRA Drilling				Other Companies: CHI			
Drilling Company: Resonant Sonic Int.				Geologist(s): T. Lee			
Driller: Kelly Cowden				L. Walker			
TEMPORARY CASING AND DRILL DEPTH				DRILLING METHOD/HOLE DIAMETER			
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.		Auger:	Diameter From _____ to _____		
(FJ) Carbon Steel	0' - 250.3	9" / 7 5/8"		Cable Tool:	Diameter From _____ to _____		
				Air Rotary: <input checked="" type="checkbox"/> 8 5/8"	Diameter From 0' to 251'		
				A.R. w/Sonic:	Diameter From _____ to _____		
					Diameter From _____ to _____		
					Diameter From _____ to _____		
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter From _____ to _____			
				Drilling Fluid:			
Total Drilled Depth: 251'		Hole Dia @ TD: 9"		Total Amt. Of Water Added During Drilling:			
Well Straightness Test Results:				Static Water Level: 205.29'		Date: 9-11-00	
GEOPHYSICAL LOGGING							
Sondes (type)	Interval	Date		Sondes (type)	Interval	Date	
COMPLETED WELL							
Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
SS304L 4" / 4.5" casing	+2.2 - 205.03		NA	Portland Cement Grout	0' - 10.2'	7 bags	NA
4" / 4.5" SS304L Screen	205.03' - 240.05'		0.020	Bentonite, granular	10.2' - 187.1'	76 bags	
4" / 4.5" SS304L Sump	240.05' - 242.05'		NA	Bentonite, pellets	187.1' - 194.8'	5 bush	3/8"
				Colorado Silica Sand	194.8' - 242.4'	96 bags	10-20
OTHER ACTIVITIES							
Aquifer Test: Well Development			Date: 9-11-00		Well Abandoned:		Yes: No: Date:
Description: Monitor drawdown and recovery				Description:			
WELL SURVEY DATA							
Date:				Protective Casing Elevation:			
Washington State Plane Coordinates:				Brass Cap Elevation:			
COMMENTS/REMARKS							
Vol. Calcs: 10-20 Silica Sand - 0.54 ft ³ /50-lb bag X 96 bags = 51.84 ft ³ ; Bentonite pellets - 0.62 ft ³ /bucket X 5 buckets = 3.1 ft ³ ; Granular bentonite - 0.73 ft ³ /50-lb bag X 76 bags = 55.48 ft ³							
Reported By: L.D. Walker				Reviewed By: J. Ruten			
Title: Geologist		Date: 9-11-00		Title: Senior Geologist		Date: 9/11/00	
Signature: L.D. Walker				Signature: J. Ruten			

WELL SUMMARY SHEET				Page <u>1</u> of <u>2</u>	
				Date: <u>9-6-00</u>	
Well ID: <u>C 3115</u>			Well Name: <u>299-W22-80</u>		
Location: <u>South of 241-TX Tank Farm / 200W</u>			Project: <u>CY 2000 RCRA Drilling</u>		
Prepared By: <u>L.D. Walker</u>		Date: <u>9/11/00</u>	Reviewed By: <u>DC Weekes</u>		Date: <u>9/11/00</u>
Signature: <u>L.D. Walker</u>			Signature: <u>DC Weekes</u>		
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram		Graphic Log	Lithologic Description	
0' → 10.2': Portland Cement		0		0' → 12': Slightly Silty SAND	
6" Protective Casing					
0' → +3.2'					
+2.2' → 205.03' 187.1': SS type 304 well casing, 4" ID / 4.5" OD		25		12' → 55': Silty SAND	
10.2' → 187.1': Granular Bentonite		50			
				55' → 72': SAND	
		75		72' → 133': Silty SAND	
Temporary Casing		100			
8 5/8" OD / 7 5/8" ID		125			
				133' → 138': Silty Sandy GRAVEL	
All depths in feet below ground surface					
All temp. casing removed.					

WELL SUMMARY SHEET				Page <u>2</u> of <u>2</u>	
				Date: <u>9-6-00</u>	
Well ID: <u>C3115</u>			Well Name: <u>299-W22-80</u>		
Location: <u>South of 241-TX Tank Farm/200W</u>			Project: <u>CY 2000 RCRA Drilling</u>		
Prepared By: <u>L. D. Walker</u>		Date: <u>9/11/00</u>	Reviewed By: <u>DG Weekes</u>		Date: <u>9/11/00</u>
Signature: <u>L. D. Walker</u>			Signature: <u>DG Weekes</u>		
CONSTRUCTION DATA		Diagram	Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description				Graphic Log	Lithologic Description
			150		138' → 158': SAND
187.1' → 194.8':					
3/8" Bentonite pellets					158' → 177': Sandy GRAVEL
			175		
194.8' → 248.4':					177' → 185': Gravelly SAND
Silica Sand, 10-20 mesh					185' → 212': Sandy GRAVEL
205.03' → 240.05':			200		
Well screen, type 304 SS,					212' → 237': Silty Sandy GRAVEL
0.020-in slot cont. wire-wrap,					
4" ID / 4.5" OD					
			225		237' → 251': Sandy GRAVEL
240.05' → 242.05': Sump					
type 304 SS, 4" / 4.5"					
			250		TD = 251 ft.
248.4' → 251.0': SLUFF					
Total SS 4" / 4 1/2" material					W.L. = 205.29' bgs
is 244.25' (+2.2-242.05')					(9-11-00)
			275		
All depths in Feet below					
ground surface					
All temp. casing removed					
from the ground					

BOREHOLE LOG						Page <u>1</u> of <u>9</u>
Well ID: <u>C3115</u> Well Name: <u>299-W22-80</u> Location: <u>200W / South of 241 SX Tank Farm</u>						Date: <u>9-1-00</u>
Project: <u>CY 2000 RCRA Drilling</u> Reference Measuring Point: <u>ground surface</u>						
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level	
0					AIR ROTARY 8 3/8" C.D.	
1				0' → 12' slightly Silty SAND (ms)	CSG, 7 1/4" tricone bit	
2				80-85% sand, 15-20% silt;		
3				sand is 25% v. CSE - CSE / 40% med /		
4				35% fn - v. fn.; 2.5 Y, 6/1 (gray);		
5	grab -			dry; med. sorted; sand = SA - A;	5': Grab sample	
6	archival			60% basalt, 40% Felds; NO RXN to HCL	for archive + waste	
7	characterization				characterization	
8					RT = nothing over BG 13	
9					HEIS RAD = Bay W04	
10	grab -				10': Grab sample	
11	archival				for archive	
12				12' → ^{55' Re} 23' Silty SAND (ms)	13' - RCT sees nothing	
13				75-80% sand, 20-25% silt;	above background	
14				80% med, 20% fn - v. fn; dry;		
15	grab -			10 YR, 5/2 (grayish brown); poorly	15': Grab sample	
16	archival			sorted; sand A - SA; 50% basaltic,	for archive and	
17	characterization			50% granitic; med RXN to HCL	waste characterization	
18					HEIS RAD = Bay W05	
19						
20	grab -				20': Grab sample	
21					for archive	
22				23' → ^{55' Re} SAND (s) He	23': RCT sees nothing	
23				tr - 5% silt 95-100% sand;	above background	
24	grab -				25': grab sample	
25					for archive	
26						
27						
28						
29						
30						

Reported By: <u>T.A. Lee</u>	GRAPHICS BY: <u>JX MURRAY</u>	Reviewed By: <u>DC Weekes</u>
Title: <u>Geologist</u>	Date: <u>9/13/00</u>	Title: <u>Geologist</u>
Signature: <u>[Signature]</u>	Date: <u>9-1-00</u>	Signature: <u>[Signature]</u>
		Date: <u>9/14/00</u>

BOREHOLE LOG					Page <u>2</u> of <u>9</u>	
					Date: <u>9-1-00</u>	
Well ID: <u>C3115</u>		Well Name: <u>299-W22-80</u>		Location: <u>South of 2415x Tank farm</u>		
Project: <u>RCRA well Drilling</u>				Reference Measuring Point: <u>ground surface</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level	
30	grab			Silty SAND (mS) - similar to above - slightly finer grained	30': grab sample for archive	
35	grab					35': grab sample for archive
40	grab					40': grab sample for archive
45	grab					45': grab sample for archive
50	grab					50': grab sample for archive
55	grab				55' → 72' SAND (s)	55': grab sample for archive
					fr - <5% silt 95-100% sand; 40% ^{fine} cse/ 60% med-v.f.n.; 2.5Y, 7/1 (light grey); sl. moist; mod sorted; sand - A-SA; 40% basalt/ 60% Feld; mod-strong Rxn to HCL	50'-65' drilled like gravel

Reported By: <u>T. A. Lee / Graphics by Jill Murray</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>geologist / Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>Timothy A. Lee</u>	Date: <u>9-1-00</u>	Signature: <u>DC Weekes</u>	Date: <u>9/14/00</u>

BOREHOLE LOG					Page <u>3</u> of <u>9</u>
					Date: <u>9-1-00</u>
Well ID: <u>C3115</u>		Well Name: <u>299 - 022 - 80</u>		Location: <u>South of SX Tank Farm</u>	
Project: <u>RCRA Well drilling</u>			Reference Measuring Point: <u>Ground Surface</u>		
Depth (ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
60	grab		—	SAND (s) - similar to above	60': grab sample for archive
65	grab		—		65': grab sample for archive
70	grab		—		70': grab sample for archive
75	grab		—	72' → 133' Silty SAND (mS) 75-80% sand, 25-20% silt; 80% fn, 80% v. fn; 10YR, 7/2 (light gray); sl. moist; mod- strong RXN to HCL	75': grab sample for archive
80	grab		—		80': Grab sample for archive
85	grab		—		85': Grab sample for archive

Reported By: <u>T.A. Lee/Graphics by Jill MURRAY</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist/Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>[Signature]</u>	Date: <u>9-1-00</u>	Signature: <u>[Signature]</u>	Date: <u>9/14/00</u>

BOREHOLE LOG					Page 4 of 9
					Date: 9-5-00
Well ID: C3115		Well Name: 299-W22-80		Location: South of Sy Tah farm	
Project: RCRA well Drilling		Reference Measuring Point: ground surface			
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
90	Grab			Silty SAND (mS) - similar to above	90': grab sample for archive
	Air Rotary				93': begin 9/5/00
					Air rotary
					8 5/8" OD CS casing
95	Grab-Archive				95': Grab sample for archive.
100	Grab-Archive			72' → 133': Silty SAND (mS) 75-80% Sand, 20-25% Silt. Sand is 30% Fh, 70% v. Fh. 10YR 5/3 (brown) s/ moist, well sorted; SA; 85-90% qtz, Felds 10-15% basalt/other, strong rxn to HCl	100': Grab-archive
					Drill rate ~ 5 ft./minute
105	Grab-Archive				105': Grab-archive
					α, β, γ at background levels
110	Grab-Archive				110': Grab-archive
115	Grab-Archive			Silty SAND - as above tr mica	115': Grab-archive

Reported By: J.A. Lee / L.D. Walker		Reviewed By: DC Weekes	
Title: geologist		Title: Geologist	
Signature: [Signature]	Date: 9-1-00	Signature: [Signature]	Date: 9/14/00

BOREHOLE LOG					Page <u>5</u> of <u>9</u>	
					Date: <u>9-5-00</u>	
Well ID: <u>C 3115</u>		Well Name: <u>299-W22-80</u>		Location: <u>200 W / South of 241-SX Tank Farm</u>		
Project: <u>CY 2000 RCRA Drilling</u>				Reference Measuring Point: <u>Ground Surface</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery				
120	Grab- Archive			72' → 133': Silty SAND (ms)	Air Rotary; 8 5/8"	
				- as described on previous page.	120': Grab sample for archive	
125	Grab- Archive				125': Grab - archive	
					Drill rate: 5'/min.	
130	Grab- Archive				128' - 130': Silt increase to ~30% s/ increase in moisture	
					Very strong rxn HCl	
135	Grab- Archive				133' → 138': Silty Sandy GRAVEL (msG); 40% Gravel, 45% Sand, 15% silt. Gravel predom med-cse peb. Sand v. cse - med. 10YR 6/3 (pale brown), sl moist; poorly sorted, Gravel SA, sand SA-A; 30% basalt, 70% gtzite, granitic, other. Max size 4-5 cm. Strong rxn HCl.	
140	Grab- Archive				135': Grab - archive	
					140': Grab - archive	
145	Grab- Archive				138' → 158': SAND (S), 5% Gravel, 95% Sand, tr silt. Sand fn-med peb; Sand 10% v. cse, 60% cse, 20% med, 10% fn - v. fn. 10YR 5/2 (gray brn) sl moist; med sorted; SA-A; 30-40% basalt, 60-70% gtz/feld/other; weak rxn HCl.	
					145': Grab - archive	

Reported By: <u>L.D. Walker</u>		Reviewed By: <u>DC Wecker</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>[Signature]</u>	Date: <u>9-5-00</u>	Signature: <u>[Signature]</u>	Date: <u>9/14/00</u>

BOREHOLE LOG					Page <u>6</u> of <u>9</u>
					Date: <u>9-5-00</u>
Well ID: <u>C3/15</u>		Well Name: <u>299-W22-80</u>		Location: <u>S. of 241-SX Tank Farm/200W</u>	
Project: <u>CY 2000 RCRA Drilling</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (Ft.)	Sample		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
	Type No.	Blows Recovery			
150	Grab- Archive			138' → 158': SAND - as described on previous page. 100% Sand, tr silt	Air rotary; 8 7/8" on CS casing.
					150': Grab sample for archive.
155	Grab- Archive				155': Grab-archive
				158' → 177': Sandy GRAVEL (SG) 50-60% Gravel, 40-50% Sand, tr silt.	160': Grab-archive
160	Grab- Archive			Gravel 30% v. cse-cse peb, 20% med, 40% fn, 10% v. fn peb; Sand 20% v. cse, 50% cse, 20% med, 10% fn- v. fn. 10YR 5/2 (gray brown) s/ moist	165': Grab-archive
				to dry; poorly sorted; SA; Gravel 30% basalt, 70% qtzite/granitic/other;	Drill rate: 5' / 2 min.
165	Grab- Archive			Sand 80-85% qtz/Feld, 15-20% basalt/other lithic frags; Max size ~ 5-6 cm; no rxn HCl.	-Adding water for dust control
					170': Grab-archive
170	Grab- Archive				
					175': Grab-archive
175	Grab- Archive			177' → 185': Gravelly SAND (GS) description on next page.	

Reported By: <u>L.D. Walker</u>		Reviewed By: <u>DCU/kekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>L.D. Walker</u>	Date: <u>9-5-00</u>	Signature: <u>[Signature]</u>	Date: <u>9/14/00</u>

BOREHOLE LOG					Page <u>7</u> of <u>9</u>
					Date: <u>9-5-00</u>
Well ID: <u>C3115</u>		Well Name: <u>299- W22- 80</u>		Location: <u>S. of 241-SX Tank Farm</u>	
Project: <u>CY 2000 RCRA Drilling</u>			Reference Measuring Point: <u>Ground Surface</u>		
Depth (Ft.)	Sample		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
	Type No.	Blows Recovery			
180	Grab- Archive			177' → 185': Gravelly Sand (gS) 10-15% Gravel, 85-90% Sand. Gravel predom fn - med peb.; Sand 10% v-cse to cse, 60% med, 30% fn-v. fn. 10YR5/3 (brn) sl moist; mod sorted, Sand SA-SR, 90% qtz/feld, 10% basalt/other, no rxn HCl.	Air Rotary; 8 5/8" op CS casing 180': Grab sample for archive
185	Grab- Archive			- gradual contact - 185' → 212': Sandy GRAVEL (sG) 60% Gravel, 40% sand, tr silt.	185': Grab- archive
190	Grab- Archive			Gravel 20% cse peb, 40% med, 30% fn, 10% v. fn peb; Sand 10% v. cse- cse, 50% med, 30% fn, 10% v. fn. 10YR5/2 (grayish brown) sl moist;	190': Grab- archive
195	Grab- Archive			poorly sorted; gravel SR-SA, Sand SA, Gravel 30 25% basalt, 75% qtzite, granitic, other; Sand 10% basalt, 90% qtz/ felds; tr mica; no rxn HCl.	195': Grab- archive
200	Grab- Archive			195' → 197': Sand content up to 60%, then back to ~ 60-70% gravel.	200': Grab- archive
205	Grab- Archive				Drill rate: 5 ft / 4 min.
					205': Grab- archive

Reported By: <u>L.D. Walker</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>[Signature]</u>	Date: <u>9-5-00</u>	Signature: <u>[Signature]</u>	Date: <u>9/14/00</u>

BOREHOLE LOG					Page <u>8</u> of <u>9</u>
					Date: <u>9-5-00</u>
Well ID: <u>C3115</u>		Well Name: <u>299-W22-80</u>		Location: <u>S. of 241-SX Tank Farm / 200W</u>	
Project: <u>CY 2000 RCRA Drilling</u>			Reference Measuring Point: <u>Ground Surface</u>		
Depth (Ft.)	Sample		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
	Type No.	Blows Recovery			
210	Grab- Archive				Air Rotary; 8 5/8"
				Silt content increasing	OD CS casing
				212' → 237': Silty Sandy GRAVEL	210': Grab sample
				(MSG); 60% Gravel, 25-30% Sand,	For archive.
215	ST #1 Sieve analysis	100% rec.		10-15% silt. Gravel to sm. cob,	213.3' → 215.8': Split
	Grab- archive			20% v.cse peb, 30% cse, 40% med,	tube sample for
				10% F _n -v. F _n ; Sand 30% v.cse-cse,	sieve analysis
				30% med, 40% F _n -v. F _n ; 10YR 4/2	215': Grab - archive
				(dk grayish brown) wet; poorly sorted,	
220	Grab- Archive			gravel R-SA, sand SR-SA; Gravel	220': Grab - archive
				20% basalt, 30% granitic, 50% qtzite/other	
				Sand predom qtz/felds; max size ~ 10 cm,	α, β, γ at background
				no rxn HCl.	levels
					225': Grab - archive
225	Grab- Archive				End 9-5-00
			more water produced during	Begin 9-6-00	
			drilling - washing fines out of		
			rotary chip cuttings - difficult	230': Grab - archive	
			to estimate silt content except		
230	Grab- Archive		in split tube samples.	Depth to water:	
				205.3'	
				232 → 234.5': Split	
			MSG - similar to above	tube sample for	
				sieve analysis.	
235	ST #2 Sieve analysis	90% rec.		* B105V1, B105V2	
				B105W2, B0YVP5	
			production of med-fn sand increasing	Waste Charact.	
			in the rotary cuttings	Samples - ^{from First} two ST	

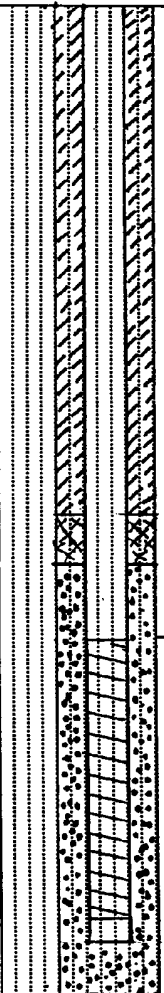

Reported By: <u>L.D. Walker</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>L.D. Walker</u>	Date: <u>9-6-00</u>	Signature: <u>DC Weekes</u>	Date: <u>9/14/00</u>

BOREHOLE LOG					Page <u>9</u> of <u>9</u>
					Date: <u>9-6-00</u>
Well ID: <u>C3115</u>		Well Name: <u>299-W22-80</u>		Location: <u>S. of 241-SX Tank Farm / 200W</u>	
Project: <u>CY 2000 RCRA Drilling</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (Ft.)	Sample		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
	Type No.	Blows Recovery			
240	Grab-Archive			237' → 251': Sandy GRAVEL (sG)	Air rotary; 8 3/4" OD
	ST #3 Sieve analysis	100% rec.		Similar to msG described on previous page, with silt content down to 5-10%	CS casing 240': Grab Sample For archive
245	Grab-Archive			⊗ heaving sand in split tube sample #3 with casing shoe at 242'	241 → 243.5': split tube sample for sieve analysis.
	Air Rotary ↓			Sandy GRAVEL - 40% Gravel, 55% Sand, 5% silt. Gravel 10%	245': Grab-Archive
250	Grab-Archive			v. cse peb, 30% cse, 40% med, 20% Fn - v. Fn. Sand 10% v.cse - cse, 60% med, 30% Fn. Sand 10YR 4/3 (brown) wet; med - well sorted; Gravel R-SR, sand SR-SA; Sand 85% qtz/ Felds, 15% basalt/other, tr mica.	250': Grab-archive TD = 251'
255					
260					
265					

Reported By: <u>L.D. Walker</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>[Signature]</u>	Date: <u>9-6-00</u>	Signature: <u>[Signature]</u>	Date: <u>9/14/00</u>

WELL CONSTRUCTION SUMMARY REPORT					Start Date: 1-9-01		
					Finish Date: 01/31/01		
					Page 1 of 1		
Specification No.: 0200W-SP C0007		Rev. No.: 0		Well Name: 299-W22-81		Temp. Well No.: C3123	
ECNs: NA				Approximate Location: E. of 241 SX Tank Farm/200 W			
Project: RCRA Drilling CY 2001				Other Companies: BHI, CHI			
Drilling Company: Resonant Sonic International				Geologist(s): L.D. Walker, P. Vellines, S.M. Faurer			
Driller: Gary Howell				S. Wright, S. Kessler, J.K. Murray, DC Weekes			
TEMPORARY CASING AND DRILL DEPTH				DRILLING METHOD/HOLE DIAMETER			
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.		Auger:	Diameter From _____ to _____		
Carbon Steel 10 5/8" / 9 5/8"	0 - 269'	11" / 9 5/8"		Cable Tool: 10 5/8" / 9 5/8"	Diameter From 0 to 269'		
				Air Rotary:	Diameter From _____ to _____		
				A.R. w/Sonic:	Diameter From _____ to _____		
					Diameter From _____ to _____		
					Diameter From _____ to _____		
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter From _____ to _____			
				Drilling Fluid:			
Total Drilled Depth: 270'		Hole Dia @ TD: 9"		Total Aml. Of Water Added During Drilling:			
Well Straightness Test Results: Passed				Static Water Level: 225.9' BGS		Date: 3/26/01	
GEOPHYSICAL LOGGING							
Sondes (type)	Interval	Date		Sondes (type)	Interval	Date	
SPECTRAL GAMMA	0 - 268.15'	1/22/01					
NEUTRON	0 - 235.71'	1/22/01					
COMPLETED WELL							
Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
4" ID SS End cap (sump)	261.72' - 263.72'	F480	NA				
4" ID SS NW screen	226.75' - 261.72'	F480	20	Portland cement	0 - 11'	9 bags	N/A
4" ID 304SS casing (schedule 5)	+2' - 226.75'	F480	NA	Granular bentonite	11' - 209.9'	161.5 bags	N/A
				Bentonite pellets (36")	209.9' - 216.7'	6 bags	36"
				Silica Sand	216.7' - 270'	635 bags	10/20
OTHER ACTIVITIES							
Aquifer Test:		Date:		Well Abandoned:		Yes:	No:
Description:				Description:			
WELL SURVEY DATA							
Date:				Protective Casing Elevation:			
Washington State Plane Coordinates:				Brass Cap Elevation:			
COMMENTS/REMARKS							
Portland cement in 94# bags, granular bentonite in 50# bags, bentonite pellets in 50# bags, silica sand in 50# bags.							
Reported By: C. TRICE				Reviewed By: DC Weekes			
Title: Geologist		Date: 4/10/01		Title: Geologist		Date: 4/11/01	
Signature: [Signature]				Signature: [Signature]			

<div style="float: right; text-align: right;"> Page <u>1</u> of <u>2</u> Date: <u>2/5/01</u> </div> <div style="clear: both;"></div>				
WELL SUMMARY SHEET				
Well ID: <u>299-C3123</u>		Well Name: <u>299-W22-81</u>		
Location: <u>EAST SIDE 241-5 TANK FARM</u>		Project: <u>RCRA CY2001</u>		
Prepared By: <u>JMurray / DCWeekes</u> Date: <u>2/5/01</u>		Reviewed By: <u>JMaurate</u> Date: <u>02/05/01</u>		
Signature: <u>JMurray / DCWeekes</u>		Signature: <u>JMaurate</u>		
CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log Lithologic Description	
6-in dia protective ss casing set 1' above the 4-in casing		0	0'-9.5' SILTY SANDY GRAVEL	
		9.5	9.5'-19' SLIGHTLY SILTY SAND	
4-in ID sch 5 ss 304L well casing:		19	19'-34' SAND	
+2 → 226.75'		25		
Portland cement grout:		34	34'-40' SLIGHTLY SILTY SAND	
0' → 11		40	40'-45' SLIGHTLY SILT GRAVELLY SAND	
Granular bentonite:		45	45'-48' SILTY SANDY GRAVEL	
11' → 209.9'		50	48'-70' SLIGHTLY SILTY SAND	
Temporary Casing:		70	70'-140' SAND	
10 5/8" / 9 5/8" set STD (269')		75		
		100		
		125		
All depths in feet below ground surface				
All temporary casing removed from the ground				

WELL SUMMARY SHEET				Page <u>2</u> of <u>2</u>	
				Date: <u>2/5/01</u>	
Well ID: <u>C 3123</u>			Well Name: <u>299- W22- 81</u>		
Location: <u>East Side 241-S Tank Farm / 200W</u>			Project: <u>RCRA CY 2001</u>		
Prepared By: <u>L. D. Walker</u>		Date: <u>2/5/01</u>	Reviewed By: <u>DC Weekes</u>		Date: <u>2/5/01</u>
Signature: <u>[Signature]</u>			Signature: <u>[Signature]</u>		
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram		Graphic Log	Lithologic Description	
Bentonite pellets, 3/8" 209.9' → 216.7'		150		140' → 163': Silty SAND	
				163' → 174': Silty Sandy GRAVEL	
Silica sand, 10-20 mesh 216.7' → 270'		175		174' → 178': Silty SAND	
Well Screen: 4-in ID, 0.020-in slot cont. wire wrap, ss type 304: 226.75' → 261.72'		200		178' → 259': Silty Sandy GRAVEL	
Sump: 4-in ID ss 304 261.72' → 263.72'		225		WL = 225.5' 1/29/01	
Total 4-in ID ss material is 262.72' (+2' → 263.72')		250		259' → 270': Sandy GRAVEL	
				TD = 270'	
		275			
All depths in feet below ground surface					
All temp. casing removed from the ground.					

BOREHOLE LOG						Page <u>1</u> of <u>9</u>
						Date: <u>1-9-01</u>
Well ID: <u>C 3123</u>		Well Name: <u>299- W22- 81</u>		Location: <u>E. side 241- S Tank Farm / 200 W</u>		
Project: <u>RCRA Drilling, CY 2001</u>				Reference Measuring Point: <u>Ground Surface</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level	
0	Drive Barrel	NA			Cable tool drive	
5	Grab- Archive			0' → 9.5': Silty Sandy GRAVEL (msG); 40% Gravel, 45% Sand, 15% Silt. Gravel 5% cobble, 30% v.cse peb, 40% csc-med, 25% fn-v.fn peb, Sand 30% v.cse-cse, 50% med, 20% fn-v.fn. 10YR 4/2 (dk grayish brn) moist; poorly sorted; Gravel R-SR, Sand SA-A. 60% basalt, 40% qtzite, other; max size ≈ 10 cm; rxn to HCl weak to strong- tr calcite coatings on some gravel.	barrel; 10 5/8" OD CS casing 5': Collect grab sample for archive α, β at background levels	
10	Grab- Archive			9.5' → 19': Slightly Silty SAND (mS); 5% Gravel, 80% Sand, 15% Silt. Gravel tr csc-med Peb, predom v.fn peb, Sand 30% v.cse, 40% csc-med, 30% fn-v.fn; 10YR 5/2 (gr brn), sl moist; med-poor sorted, Sand SA-A, 40% basalt, 60% qtz/ feld/ other; tr iron oxide; weak to no rxn HCl.	10': Collect grab for archive α, β, γ background 0-12' DRUM Samples: TMA RCT RCRA B112D2, B112C3, B10F93	
15	Grab- Archive			19' → 34': SAND (S); 5% Gravel, 90% Sand, 5% Silt. Similar to above with decrease in silt content.	15': Grab-Archive α, β, γ at background	
20	Grab- Archive			25'- HCl rxn mod. sand still coarse-v.coarse 70-75% silt frag. are dk. gray & HCl reactive Pebbles ↓ to trace	20': Grab-Archive α, β, γ at background End 1-9-01 13'-20' DRUM Samples B112D3, B112C4 25'- Grab Sample RAD @ background	
25	Grab- Archive					

Reported By: <u>L.D. Walker / JILL MURRAY</u>	Reviewed By: <u>DC Weekes</u>
Title: <u>Geologist / Geologist</u>	Title: <u>Geologist</u>
Signature: <u>[Signature]</u> Date: <u>1/10/01</u>	Signature: <u>[Signature]</u> Date: <u>1/29/01</u>


BOREHOLE LOG					Page <u>2</u> of <u>9</u>
					Date: <u>1/10/01</u>
Well ID: <u>C3123</u>		Well Name: <u>299-W22-81</u>		Location: <u>EAST SIDE 241-S TANK FARM</u>	
Project: <u>RCRA DRILLING CY2001</u>				Reference Measuring Point: <u>GROUND SURFACE</u>	
Depth (FL)	Sample		Graphic Log	Sample Description	Comments:
	Type No. DRIVE BARREL	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
30	GRAB ARCHIVE	NA		30' - silts ↑ slightly, grvls less frequent	30' GRAB/ARCHIVE NO RAD ABOVE BACKGROUND
35	GRAB ARCHIVE			34' - 40' SLIGHTLY SILTY SAND SAND 85% Silt 15% Trace grvls: Sands	35' GRAB/ARCHIVE NO RAD ABOVE BACKGROUND
40	GRAB ARCHIVE			poorly sorted, subang, 75% coarse, 10% med, 10% fine 5% v. fine, HCl reactive, Basalt 75%; Moist color	37' - Silt stringer HCl reactive, <1'
45	GRAB ARCHIVE			2.5Y 4/2 PK. Brownish Gray: Silts dk gray w/ Fe oxide stains 5YR 5/4 Reddish Brown: Grv comp. pebbles	40' GRAB/ARCHIVE BACKGROUND RAD
50	GRAB ARCHIVE			36' - thin cobble layer 40' - 45' SLIGHTLY SILTY GRAVELLY SAND Grvls 15% Silt 15% SAND 70%: Grvls poorly sorted lg. peb max, subang, sm. pebs domin, Sands coarse-v. coarse 60% 10% med, 10% fine, 20% v. fine, poorly sort. subang.	45' GRAB/ARCHIVE BACKGROUND RAD
55	GRAB ARCHIVE			Silts dk gray w/ white coating HCl rxn Basalt 65% Moist color 10YR 5/2	45' GRAB/ARCHIVE BACKGROUND RAD
				45' - 48' Silty SANDY GRAY Gravelly lg. pebbles down. HCl rxn same color poorly sorted, sr. sm. cobs max ^{clst} 40% grvls, 15% silt, 45% sand	
				48' - 70' SLIGHTLY SILTY SAND SAND 85%, Silt 15%, Trace grvls: Sands mod sorted	50' GRAB/ARCHIVE RAD = BACKGROUND
				45% coarse, 45% v. coarse, 10% other; No HCl rxn, subang-subround Grvls - sm. pebbles → Silts are HCl reactive w/ calcareous coatings on chunks of clays	
				2.5Y 4/2 PK BROWNISH GRAY = moist → Basalt ~ 70%	
				Trace grvls have ↑ in size @ 55' to sm. cobbles.	55' GRAB/ARCHIVE RAD @ BACKGROUND
				58' SILT content ↓ some	

Reported By: <u>JILL MURRAY</u>		Reviewed By: <u>D. C. Weekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>Jill Murray</u>	Date: <u>1/10/01</u>	Signature: <u>D. C. Weekes</u>	Date: <u>1/29/01</u>

BOREHOLE LOG					Page <u>3</u> of <u>9</u>	
					Date: <u>1/10/01</u>	
Well ID: <u>C3123</u>		Well Name: <u>299-WZZ-81</u>		Location: <u>EAST SIDE 241-S TANK FARM</u>		
Project: <u>RCTRA DRILLING CY2001</u>				Reference Measuring Point: <u>GROUND SURFACE</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description		Comments:
	Type No. <small>DRIVE BARREL</small>	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl		Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
60	GRAB+ ARCHIVE	NA	-	SAME AS ABOVE ~ EXCEPT sand size ↓		60' - Grab/Archive
			0	cse-med = 80% of sand fraction, subrand		RAD @ BACKGROUND
65	GRAB+ ARCHIVE		0			65' - GRAB/ARCHIVE
			0			RAD @ BACKGROUND
70	GRAB+ ARCHIVE		-	70'-140': SAND		RAD @ BACKGROUND
			-	90% sand 10% silt → sands; well sorted, rounded		
			-	to subrand v. fine sand 90%, fine sand 10%; No HCl rxn		Begin 1-11-01
			-	silt dk gray; basalt 60%; Moist color 2.5 Y 6/2		
			-	light brownish gray		
75	Grab- Archive		-	75': Sand becoming coarser		75': Grab - Archive
			-	~ 5% silt, Sand predom Fn-med.		Red at background
80	Grab- Archive		-	80': Sand Finer: as above, but		80': Grab - Archive
			-	now predom. Fn - v. fn.		Red - background
85	Grab- Archive		-			85': Grab - Archive
			-			Red - background

Reported By: <u>JILL MURRAY</u> / <u>L.D. Walker</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>Jill Murray</u> / <u>L.D. Walker</u>	Date: <u>1-11-01</u>	Signature: <u>DC Weekes</u>	Date: <u>1/29/01</u>

BOREHOLE LOG					Page <u>4</u> of <u>9</u>	
					Date: <u>1-11-01</u>	
Well ID: <u>C3123</u>		Well Name: <u>299- W22 - 81</u>		Location: <u>E. side 241- S Tank Farm / 200W</u>		
Project: <u>RCRA Drilling CY2001</u>				Reference Measuring Point: <u>Ground Surface</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level	
90	Grab- Archive	NA			Cable tool - drive	
	Drive Barrel					barrel. Casing is 10 5/8" OD CS
95	Grab- Archive			SAND (S) 95-100% Sand, fr-5% Silt. 10% cse, 40% med, 30% Fh, 20% v. Fh. 10YR5/2 (grayish brown), sl moist; Med-well sorted, SA-SR; 30% basalt, 70% qtz, felds, other; max size ~1.0 mm; weak rxn HCl.	90': Grab sample for Archive d, B, X at background levels.	

BOREHOLE LOG					Page <u>5</u> of <u>9</u>
					Date: <u>1-11-01</u>
Well ID: <u>C 3123</u>		Well Name: <u>299- W22 - 81</u>		Location: <u>E. side 241-S Tank Farm/200W</u>	
Project: <u>RCRA Drilling CY 2001</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120	Grab- Archive	NA			Cable tool - drive
120	Drive barrel			SAND (S) as above.	barrel. 10 5/8"
120				95-100% Sand, tr-5% Silt.	OD CS casing
120				10YR 5/3 (brown), sl moist; well sorted,	
120				SA predom; 30% Fn, 70% v. Fn;	120': Grab sample
125	Grab- Archive			occ. thin (<0.1') layer of med-cse sand,	for archive
125				20% basalt, 80% qtz/feld/other;	α, β, γ at background
125				max size ~ 1 mm; no rxn HCl.	
125					125': Grab - Archive
125					Rad - background
130	Grab- Archive			130': v. fn sand w/ trace of orange	
130				staining	130': Grab - Archive
130					Rad - background
130					End 1-11-01
135	Grab- Archive				1-12-01 Begin
135				Hard tool drilling	
135				135': Grab - Archive	
135				Rad - background	
140	Grab- Archive		140' → 163': Silty SAND (mS)	140': Grab - Archive	
140			80% Sand, 20% Silt. Similar	Rad - background	
140			to above with higher silt content		
140			Sand 20% Fn, 80% v. Fn. Well sorted,		
140			SA-SR, 10YR 4/3 (brown) wet color		
145	Grab- Archive		weak rxn HCl	145': Grab - Archive	
145				Rad - background	
145					
145					
145					
145					

Reported By: <u>L.D. Walker</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>[Signature]</u>	Date: <u>1-15-01</u>	Signature: <u>[Signature]</u>	Date: <u>1/29/01</u>

BOREHOLE LOG						Page <u>6</u> of <u>9</u>
Well ID: <u>C 3123</u> Well Name: <u>299-W22-81</u> Location: <u>E. side 241-S Tank Farm / 200W</u>						Date: <u>1-15-01</u>
Project: <u>RCRA Drilling CY 2001</u> Reference Measuring Point: <u>Ground Surface</u>						
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level	
150	Grab- Archive	Hard tool		Silty SAND (mS)	Cable tool - hard tool. 10 5/8" OD	
				80% Sand, 20% Silt. Sand 20% med, 40% Fm, 40% v. Fm. 10YR 4/3 (brn)	CS casing	
				wet in hard tool slurry. Mod-well	150': Grab sample	
155	Grab- Archive			sorted, SR-SA; 20-25% basalt, 75-80% qtz, feld/other, tr mica; weak rxn HCl (on dry sample)	For Archive	
				155' tr lithic frags 2-4 mm	155': Grab-Archive	
					Rad - background	
160	Grab- Archive			drilling indicates sharp transition to gravel at 163'	160': Grab-Archive	
					Rad - background	
165	Grab- Archive			163' → 174': Silty Sandy GRAVEL (mS G) 35% Gravel, 50% Sand, 15% Silt. Brown color of silt similar to above. Poorly sorted, sand SA; gravel Fragments show trace of SR, Gravel 40% basalt, 60% granitic/other	165': Grab-Archive	
				Sand 35% basalt, 75% qtz/feld	Rad - background	
170	Grab- Archive		drilling indicates gradual decrease in gravel content	End 1-15-01		
				Begin 1-16-01		
175	Grab- Archive		174' → 178': Silty SAND (mS) 5% gravel, 70% Sand, 25% Silt, tr clay on drill bit.	175': Grab-Archive		
				Borehole designated radiological low risk		

Reported By: <u>L.D. Walker</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>[Signature]</u>	Date: <u>1-16-01</u>	Signature: <u>[Signature]</u>	Date: <u>1/29/01</u>

BOREHOLE LOG					Page <u>7</u> of <u>9</u>	
Well ID: <u>C3123</u>		Well Name: <u>299-W22-81</u>		Location: <u>E. side 241-S Tank Farm / 200W</u>		
Project: <u>RCRA Drilling CY 2001</u>				Reference Measuring Point: <u>Ground Surface</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery				
180	Grab- Archive HT	NA			Cable tool - hand tool	
				178' → 259': Silty Sandy GRAVEL (ms G) 40% Gravel, 45% Sand, 15% Silt. Gravel predom med-cse pch judging by fragments and drilling characteristics. R-SR; Sand predom med-fn; 20% basalt, 80% qtz/felds, SA; max size sm. cobble	10 5/8" OD CS casing	
185	Grab- Archive				180': Grab sample for Archive	
					185': Grab - Archive	
190	Grab- Archive				190': Gravel content increase to ~ 50% silt ~ 10%	Encl 1-16-01
					195': Grab - Archive	
195	Grab- Archive				200': Grab - Archive	
					Silty Sandy GRAVEL - as above	
200	Grab- Archive				205': Grab - Archive	
205	Grab- Archive				Sand Fraction predom fn - v. fn	

Reported By: <u>L.D. Walker</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>[Signature]</u>	Date: <u>1-17-01</u>	Signature: <u>[Signature]</u>	Date: <u>4/11/01</u>

BOREHOLE LOG					Page <u>8</u> of <u>9</u>
					Date: <u>1-17-01</u>
Well ID: <u>C 3123</u>	Well Name: <u>299- W22-81</u>		Location: <u>E. side 241-S Tank Farm/200W</u>		
Project: <u>RCRA Drilling CY 2001</u>			Reference Measuring Point: <u>Ground Surface</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
210	Grab- Archive HT	NA		Silty Sandy GRAVEL (msg)	Cable tool - hard tool
				50% Gravel, 35-40% Sand, 10-15% Silt.	10 3/8" ODCS casing
				10YR 4/3 (brown from silt); poorly sorted,	210': Grab - archive
				gravel frags broken by drilling - show	
215	Grab- Archive			sides round to sub-round. Sand	215': Grab - archive
				SA. Gravel 20% basalt, 80% granitic/ qtzite/other; Sand predom fn-v.fn	
				30% basalt, 70% qtz/feld/other.	220': Grab - archive
220	Grab- Archive				
					End 1-17-01
					Start 1-18-01
225	Grab- Archive			225' silty sandy GRAVEL (msg)	225': Grab/Archive
			as above.		
230	Grab- Archive		230' silty sandy GRAVEL (msg)	230': Grab - Archive	
			as above.		
235	Grab- Archive		235' silty sandy gravel (msg)	235': Grab - Archive	
			as above.		
				230'-240.5' split	
				Spoon #1 sieve	
				analysis	
Reported By: <u>L.D. Walker</u>			Reviewed By: <u>DC Weekes</u>		
Title: <u>Geologist</u>			Title: <u>Geologist</u>		
Signature: <u>L.D. Walker</u>		Date: <u>1-18-01</u>	Signature: <u>DC Weekes</u>		Date: <u>4/11/01</u>

Page 9 of 9
Date: 1/18/01

[illegible]

Reviewed By: DCWeekes

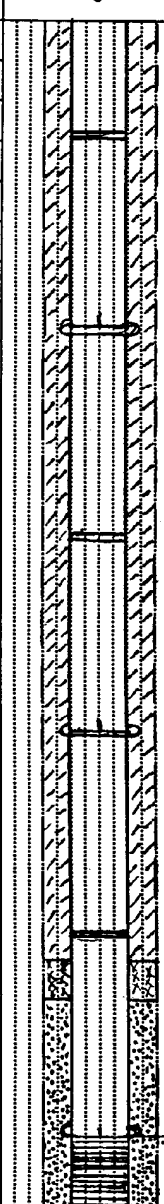
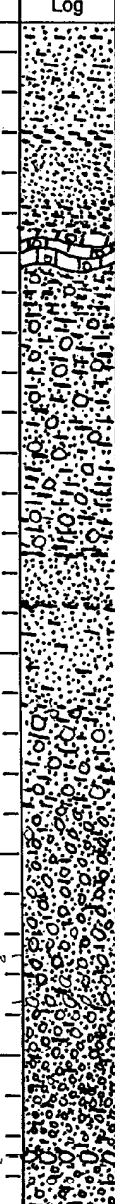
Title: Geologist

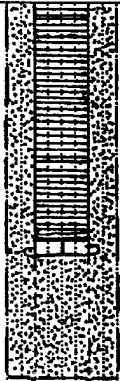

Signature: <i>[Signature]</i>	Date: 4/11/01
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WELL CONSTRUCTION SUMMARY REPORT

				2/22/01			
				Finish Date: 3/14/01			
Specification No.: 0200W-3P 0007				Rev. No.: 0			
ECNs: NA				Well Name: 299-W22-83			
Project: C100 RCRA Drilling				Approximate Location: EAST SIDE of SX Tank Farm			
Drilling Company: RSI				Other Companies: CHI			
Driller: Gary Howell				Geologist(s): DCWeekes, C Martinez, C Trice			
TEMPORARY CASING AND DRILL DEPTH				DRILLING METHOD/HOLE DIAMETER			
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger:	Diameter From _____ to _____			
Carbon STEEL	0 - 275'	11" / 10" ⁵ / ₈	Cable Tool: (9")	Diameter From 0 to 275'			
10 ³ / ₄ " / 10 ³ / ₈ " 9 1/2"	-	10 ⁷ / ₈ " / 9 1/4"	Air Rotary:	Diameter From _____ to _____			
-	-	-	A.R. w/Sonic:	Diameter From _____ to _____			
-	-	-		Diameter From _____ to _____			
-	-	-		Diameter From _____ to _____			
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter From _____ to _____			
			Drilling Fluid: H ₂ O				
Total Drilled Depth: 275'		Hole Dia @ TD: 9"	Total Amt. Of Water Added During Drilling: 223 gallons				
Well Straightness Test Results: PASSED		3/3/01	Static Water Level: 227.05'		Date: 3/14/01		
GEOPHYSICAL LOGGING							
Sondes (type)	Interval	Date	Sondes (type)	Interval	Date		
SPECTRAL Gamma	0 - 275'	3/7/01		-			
Neutron	0' - 236'	3/7/01		-			
COMPLETED WELL							
Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
4" ID endcap, SS304	261.3 - 263.3	F480	NA	Colorado Silica Sand	216.3 - 263.3	58 bags	10-20
4" ID screen, SS3	226.3 - 261.3	F480	0.020"	Bentonite Pellets 1/4"	211.3 - 216.3	5 buc.	1/4"
4" ID casing,	22.0 - 226.3	F480	NA	Bentonite Crumbles	10' - 211.3	149 bags	3/8"
	-			Portland Cement (Cement)	0' - 10'	8 bags	
OTHER ACTIVITIES							
Aquifer Test:		Date:	Well Abandoned:		Yes:	No:	Date:
Description:		Description:					
WELL SURVEY DATA							
Date:		Protective Casing Elevation:					
Washington State Plane Coordinates:		Brass Cap Elevation:					
COMMENTS/REMARKS							
Vol calcs: 10-20 Silica Sand: 0.535 ft ³ /bag x 58 bags = 31.03 ft ³ ; BENTONITE PELLETS 0.62 ft ³ /bucket x 5 buckets = 3.1 ft ³ ; Bentonite crumbles 0.71 ft ³ /bag x 149 bags = 105.79 ft ³ ; Portland Cement: 1.285 ft ³ /bag x 8 bags = 10.28 ft ³							
Reported By: C. TRICE		Reported By: JMFaurate					
Title: Geologist		Date: 3/14/01	Title: Geologist		Date: 4/10/01		
Signature: C. Trice		Signature: JMFaurate					

WELL SUMMARY SHEET				Page <u>1</u> of <u>3</u>			
				Date: <u>02/28/01</u>			
Well ID: <u>C 3126</u>			Well Name: <u>299-W22-83</u>				
Location: <u>East of SX Tank Farm</u>			Project: <u>RCRA F401 Drilling</u>				
Prepared By: <u>Charlene Martinez</u>		Date: <u>02/28/01</u>		Reviewed By: <u>DC Weekes</u>			
Signature: <u>Charlene Martinez</u>		Signature: <u>DC Weekes</u>					
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA				
Description	Diagram		Graphic Log	Lithologic Description			
6" DIA. PROTECTIVE CASING 1.0' above the 4" casing		0'		0'-0.5' Gravel, basalt rich.			
4.5' 00/4" ID WELL CASING, SS TYPE 304		A-R sand + gravel					
+2.0' → 226.3'		0.5'-12' Sand(s), 95% to 100%					
Portland Cement Grout		gravel 0-5%					
0' → 10.0'		20'		12'-19' sand(s) or gravel (0-10%)			
		19'-30.5' sand(s) 100% sand.					
		trace gravel					
		30.5'-32' Gravelly sand					
		40'		32' silt stringer			
		32.5'-45' sand(s) bn-gr.					
		m-f med sorted					
		46'-51.5' coarse gr stringer of sand, thin lenses of silt					
		60'		51.5'-57.5' gravel stringer 0-5.5'			
		poorly sorted, large cobbles					
		57.5'-65.5' Gravelly sand					
		65.5'-72.0' Sand(s)					
		80'		72.0' slightly silty sand (m)s			
		83' minor silt lens detected					
All depths in Feet below ground surface.				100'			
All temp. casing removed from ground.				116'			

WELL SUMMARY SHEET			Page <u>2</u> of <u>3</u>	
			Date: <u>03/01/01</u>	
Well ID: <u>C3126</u>		Well Name: <u>299-W22-83</u>		
Location: <u>East of SX Tank Farm</u>		Project: <u>RCRA FY01 Drilling</u>		
Prepared By: <u>Charlene Martinez</u>	Date: <u>03/01/01</u>	Reviewed By: <u>MC Weekes</u>	Date: <u>4/3/01</u>	
Signature: <u>Charlene Martinez</u>		Signature: <u>MC Weekes</u>		
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
all depth in feet below ground surface.		120		72.0' → 128.0' slightly silty sands (s)
All temp. casing removed from ground.				129' very thin clayey silt
				129' → 134' sand (s) (micaceous)
				134' → 137' sandy silt (sm)
				137' → 141' calcareous (sandy silt) (sm) + gravel
				141' → 146' sandy silt (sm) + gravel
				146' → 170' sandy gravelly silt (sgm)
Granular Bentonite 10.0' → 211.3'		160		170' → 175' sand (s)
		180		175' → 185' silty sand (ms)
				185' → 196' sandy gravelly silt (sgm)
		200		195' → 236' silty sandy gravel
		220		Water Depth 227.05' base 3/14/01
Bentonite Pellets 1/4" 211.3' → 216.3'				
Silica Sand, 10-20 mesh 216.3' → 275'				232' - 234' splitspoon sand gravel w/ cobbles

WELL SUMMARY SHEET				Page <u>3</u> of <u>3</u>	
				Date: <u>03/06/01</u>	
Well ID: <u>C 3126</u>			Well Name: <u>299-W22-83</u>		
Location: <u>East of SX Tank Farm</u>			Project: <u>RCRA FY01 Drilling</u>		
Prepared By: <u>Charlene Martinez</u>		Date: <u>03/06/01</u>	Reviewed By: <u>DC Weekes</u>		Date: <u>4/3/01</u>
Signature: <u>Charlene Martinez</u>			Signature: <u>DC Weekes</u>		
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram		Graphic Log	Lithologic Description	
Well Screen, 4" ID, 0.020- in slot continuous wire-wrap SS type 304, 226.3' → 261.3'		240		236' → 275' silty sandy gravel	
Sump, 4" ID SS Type 304 261.3' → 263.3'		260		247' → 249' split spoon silty sandy gravel w/ cobbles.	
TOTAL SS 4" ID material is 265.30' (226.0' → 263.3')		280		I.D. = 275'	
All depths in feet below ground surface.					
All temp casing removed from ground.					

BOREHOLE LOG						Page <u>1</u> of <u>10</u>
						Date: <u>2/22/01</u>
Well ID: <u>C3126</u>		Well Name: <u>299-WZZ-83</u>		Location: <u>East Side of 241-SK Tank Farm</u>		
Project: <u>CY00 RCRA Drilling</u>				Reference Measuring Point: <u>Ground surface</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level	
0	Drive Barrel (DB)	NA		0'-0.5' GRAVEL (Backfill) Basalt rich, A-R, sand and gravel	Cable tool drilling w/ drive barrel	
5	Grab			0.5'→12' SAND(S): 95-100% sand, 0-5% gravel, 10YR5/4 yellowish brown (dry), dry, moderately sorted, A-SA, 20% bas, 80% qtz and other, primarily vf-m sand	Background readings: on spoils area: 290 cpm 3.5 cpm α	
10	Grab				Grab sample @ 5' Cd B & α	
15	Grab			12'→19' SAND(S): 90-100% sand, 0-10% gravel, mostly f-c sand, 10YR4/2 dark grayish brown (moist), moist, 50% bas, 50% other, moderately sorted, A-SA, "salt & pepper" look	Grab sample @ 15' Cd B & α	
20	Grab			19'→30.5' SAND(S): 100% sand, tr gravel, 10YR5/2 grayish brown (moist), moist, moderate sorting, A-SA, vf-m sand	Grab sample @ 20' Cd B & α	
25	Grab				Grab sample @ 25' Cd B & α	
Reported By: <u>DL Weekes</u>				Reviewed By: <u>JMFaurato</u>		
Title: <u>Geologist</u>				Title: <u>Geologist</u>		
Signature: <u>DL Weekes</u>		Date: <u>2/22/01</u>		Signature: <u>JMFaurato</u>		
				Date: <u>4/10/01</u>		

BOREHOLE LOG					Page <u>2</u> of <u>10</u>
					Date: <u>2/23/01</u>
Well ID: <u>C3126</u>		Well Name: <u>299-422-83</u>		Location: <u>East of SXTank Farm</u>	
Project: <u>RCRA FY01 Drilling</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
30	GRAB DB			30.5-32' <u>Silty Gravelly Sand</u> <u>coarse sand and fine gravel beginning</u> <u>at 30.5'. Sand is 50% cr, 30% m & 20% f. < 20% s, < 10% g, < 5% c.</u>	Grab Sample @ 30'
35	Grab	Grab		<u>Basalt in both sections is</u> <u>65%, with felsics being 35%. The color</u> <u>is black to med dk gy to bn-gy, 10 YR 5/2.</u>	Grab Sample 35'
40	Grab			<u>The unit is moist</u> <u>32' silty SILT stringer, then back into</u> <u>bn-gy sand, med-fine grnd, med.</u> <u>sorted. As previously described</u>	Grab Sample @ 40'
45	GRAB			<u>Coarse grained stringers of sand, Bk.</u> <u>to dk-gy, < 8" thick, then thin,</u> <u>discontinuous? silt lenses/stringers*</u>	Grab Sample @ 45'
50	Grab			<u>Overall silt content is 15-20% now</u> <u>is silty sand.</u>	Grab Sample @ 50'
55	Grab			<u>f-v.f. gravel stringer 51.5-57.5 it is</u> <u>gray, whitish-gray w/ 35% g, 65% s and</u> <u>gravel is 60% basalt. SA-SR, poorly sorted.</u>	Grab Sample @ 55'
				<u>Sand is vf-cr grnd, 55% basalt, dry</u> <u>large cobble, then cr sand w 10% g,</u> <u>then poorly sorted sand w/ vf gravel.</u>	Grab Sample @ 55'

Reported By: JM Faurote

Title: Geologist

Signature: JM Faurote

Reviewed By: DC Whinn

Title: Geologist

Signature: DC Whinn

Date: 2/23/01

Date: 4/3/01

BOREHOLE LOG					Page <u>3</u> of <u>10</u>
Well ID: <u>C3126</u>		Well Name: <u>299-W22-83</u>		Date: <u>02/23/01</u>	
Project: <u>RCRA FY01 Drilling</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
60	Grab	NA		57.5-65.5 <u>Gravelly Sand</u> <u>Sandy Gravel Lens in the</u> <u>Grab Sample @ 60'</u> sand. max size is 2", average size <u>< d 8, B, α</u> is 1/2". G= 25%, s=65%. the unit is lt-gy to wh-gy overall due to apparent calcareous (?) cement.	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
65	Grab			Gradational change to a lt to med yellowish-bn to lt tan f. grnd <u>Grab Sample @ 65'</u> SAND (95% s, 5% m) <u>< d 8, B, α</u>	
70	Grab			Grades into medium and coarse sand, then back into vt-f & m sand. <u>Grab Sample @ 70'</u> <u>< d 8, B, α</u>	
75	Grab			72' → 125' <u>slightly</u> <u>Silt content to 15%, Silty Sand (m/s)</u> <u>Grab Sample @ 75'</u> vt-c, 10YR 6/3 pale brown (dry), <u>slightly</u> moist <u>< d B, 8, α</u> to dry, moderately sorted, A-SR, 10-20% bas, 90-80% otha (mostly qtz), strong rxn rxn to HCl	
80	Grab			<u>Grab sample @ 80'</u> <u>< d B, 8, α</u> <u>End of shift 2/23/01 80'</u>	
83	Grab			minor silt lenses noted ~ 83' silt content to 15%, slightly silty sand (m/s), vt-m 10YR 6/3 pale brown (dry), slightly moist to dry, moderately sorted A-SR, 10-20% basalt, 80-90% qtz & other <u>Grab sample @ 83'</u> <u>< d B, 8, α</u>	

Reported By: <u>JM Faurak / DC Wecker</u>	Reviewed By: <u>L.D. Walker</u>
Title: <u>Geologist</u>	Title: <u>Geologist</u>
Signature: <u>JM Faurak / DC Wecker</u>	Signature: <u>L.D. Walker</u>
Date: <u>2/27/01</u>	Date: <u>4/10/01</u>

BOREHOLE LOG					Page <u>4</u> of <u>10</u>
					Date: <u>02/26/01</u>
Well ID: <u>C3126</u>		Well Name: <u>299-W22-83</u>		Location: <u>East of SX Tank Farm</u>	
Project: <u>BCRA EYD Drilling</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (ft.)	Sample		Graphic Log	Sample Description	
	Type No.	Blows Recovery		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	Grab DB	NA		90' minor silt nodules. silt content to 15% slightly silty sand (m)s vf-c 10YR 6/3 pale brown (dry) slightly moist to dry, moderately sorted A-SR 10-20% basalt, 80-90% other (qtz).	Grab sample @ 90' <u>02/26/01</u> Cd B Rdc
95	Grab			strong rxn to HCl.	Grab sample @ 95' <u>02/26/01</u> Cd B Rdc
				95' same as above	
100	Grab			100' minor silt nodules. silt to 15% slightly silty sand (m)s vf-c 10YR 6/3 pale brown (dry) slightly moist to dry, moderately sorted A-SR 10-20% basalt, 80-90% other (qtz) strong rxn to HCl	Grab sample @ 100' <u>02/26/01</u> Cd B Rdc
105	Grab			105' minor silt nodules. silt to 15% slightly silty sand (m)s vf-c 10YR 6/3 pale brown (dry) slightly moist to dry, moderately sorted A-SR 10-20% basalt, 80-90% other (qtz)	Grab sample @ 105' <u>02/26/01</u> Cd B Rdc
110	Grab			Same description as 105'	Grab sample @ 110' <u>02/26/01</u> Cd B Rdc
115	Grab			115' minor ^{fine} silt nodules. silt content to 15% slightly silty sand (m)s vf-c 10YR 6/3 pale brown (dry) slightly moist to dry, moderately sorted A-SR 10-20% basalt, 80-90% other (qtz).	Grab sample @ 115' <u>02/26/01</u> Cd B Rdc
				End of shift	<u>02/26/01</u>

Reported By: <u>C. Martinez / DC Weekes</u>		Reviewed By: <u>JM Faurote</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>C. Martinez</u>	Date: <u>2/27/01</u>	Signature: <u>JM Faurote</u>	Date: <u>4/10/01</u>

BOREHOLE LOG					Page <u>5</u> of <u>10</u>
					Date: <u>2/27/01</u>
Well ID: <u>C3126</u>		Well Name: <u>299-W22-83</u>		Location: <u>East of SX Tank Farm</u>	
Project: <u>RCRA FY01 Drilling</u>				Reference Measuring Point: <u>Ground surface</u>	
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120	Grab DB	NA	-	Slightly silty SAND (m)S continues as described on p.4, mostly vf-f sand	Grab @ 120' cd Bja
125	Grab		-		Grab @ 125' cd Bja
130	Grab		-	Very thin clayey silt observed @ ~129'	1 cobble found @ ~129' Grab @ 130' cd Bja
135	Grab		-	Micaceous @ ~133' 134' → 137' Sandy SILT (SM): 25% vf-f sand, 75% silt, 10YR 6/4 light yellowish brown (dry), moist (probably from water added to boring @ ~133-134'), well sorted, max part 1mm	Harder drilling @ 134' Grab @ 135' cd Bja
140	Grab		-	137' → 141' CALCRETE [Sandy SILT] (SM): mostly sand & silt with calcareous cement, some areas of solid cement, tr-5% small gravel, 10YR 8/2 very pale brown (dry), dry to moist, pyrolusite dendrites present, gravel content increases down hole	Distinct contact @ 137' Grab @ 137' cd Bja
145	Grab		-	141' → 145' Sandy, silty (SM): some calcareous cement, up to 15% gravel up to 1/2" size 10YR 7/3 pale brown (dry), dry, sand 20% vf-f, silt 45%. Strong rxn to HCl cobbles to 3" SA-SR	cobbles ≥ 3" ~143' Grab @ 145' cd Bja
148			-	145' - 149' Same as above - no cement	End of shift 2/27/01

Reported By: <u>DCWeekes</u>		Reviewed By: <u>JM Faurote</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>DCWeekes</u>	Date:	Signature: <u>JM Faurote</u>	Date: <u>4/10/01</u>

BOREHOLE LOG					Page <u>16</u> of <u>10</u>
					Date: <u>02/28/01</u>
Well ID: <u>C 3126</u>		Well Name: <u>299-W22-83</u>		Location: <u>East of SX Tank Farm</u>	
Project: <u>RCRA FY01 Drilling</u>				Reference Measuring Point: <u>Ground surface</u>	
Depth (ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
150	Grab DB	NA		150' → 155' ^{gravelly} sandy silt (sm). up to 15% gravel vfk 7/8 is gray/pale brown (dry) dry, sand 20% vf-c, silt 45%, SA-SR grains/gravel Strong rxn to HCl.	Grab sample @ 150' Cd, B, R, α
155	Grab HT			155' → 160' sandy gravelly silt. up to 15% gravel dk gr/brown (wet), sand 20% f-c, silt 45%, A-SR grain/gravel. Basalt ≈ 30%. No rxn to HCl. gravel < 10mm	Grab sample @ 155' Slurry only H ₂ O added Cd, B, R, α
160	Grab			160' ^{gravelly} sandy silt (sm), < 15% gravel, dk gr/brown (wet) sand 25% f-c, silt 45%, A-SR grains. Basalt 50% qtz (other) 50%. No rxn to HCl.	Grab sample @ 160' Slurry only H ₂ O added Cd, B, R, α
165	Grab			165' → 170' ^{gravelly} sandy silt (sm) same description as above. Gravel size is increasing silt is decreasing	Grab sample @ 165' Slurry H ₂ O added
170	Grab			170' → 175' sand(s) < 10% gravel. dark gray (wet) sand vf-c, A-SR grains 60-70% basalt, qtz (other) 30-40%	Grab sample @ 170' Slurry H ₂ O added
176	Grab			175' → 185' ^{brownish} silty sand (m) dark gray (wet) silt 30%, sand 70% vf-c, A-SR grains 60-70% basalt, qtz (other) 40-30%	Grab sample @ 176' Slurry H ₂ O added



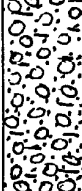
Reported By: <u>Charlene Martinez</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>Charlene Martinez</u>	Date: <u>03-01-01</u>	Signature: <u>DC Weekes</u>	Date: <u>4/3/01</u>

BOREHOLE LOG					Page <u>7</u> of <u>10</u>
					Date: <u>03/02/01</u>
Well ID: <u>C3126</u>		Well Name:		Location: <u>East of SX Tank Farm</u>	
Project: <u>RCRA FY01 Drilling</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
180	grab HT	NA		180-185' silty sand (ms) dark br/gr (wet) silt ~ 30%, sand ~ 70%, vf-c, A-SR grains 40-70% basalt, 30-40% other	grab sample @ 180' H ₂ O added (slurry)
185	grab HT			185-195' sandy gravelly silt (sgm) dk br/gr (wet) gravel 15-20%, sand vf-c, A-SR grains 50% basalt, 50% other. Possibly cemented.	grab sample @ 185' H ₂ O added (slurry) L d B X α
190	grab HT			190-195' sandy gravelly silt (sgm). Same description as above.	grab sample @ 190' H ₂ O added (slurry)
				Harder drilling. Driller feels gravel may be cemented.	
195	grab HT			195-200' silty sandy gravel (msg) dark br/gr (wet) gravel 35-45%, possibly cemented, sand vf-c, A-SR grains/gravel silt, basalt 50%, felsics 50%	grab sample @ 195' H ₂ O added (slurry)
200	grab HT			200' silty sandy gravel (msg) same description as above	grab sample @ 200' H ₂ O added (slurry)
205	grab HT			205' silty sandy gravel (msg) dk br/gr (wet) gravel 35-45% possibly cemented sand vf-c, A-SR grains/gravel. Some silt basalt 50%, felsics 50%.	grab sample @ 205' H ₂ O added (slurry) L d B X α
					End of Shift 03/02/01

Reported By: <u>Charlene Martinez</u>		Reviewed By: <u>DCU Wekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>Charlene Martinez</u>	Date: <u>03/02/01</u>	Signature: <u>DCU Wekes</u>	Date: <u>4/3/01</u>

BOREHOLE LOG					Page <u>9</u> of <u>10</u>
					Date: <u>03105101</u>
Well ID: <u>C 3126</u>		Well Name: <u>299 - W22-93</u>		Location: <u>East of SX Tank Farm</u>	
Project: <u>RCRA FY01 Drilling</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
210	grab HT	NA		210' silty sandy gravel (msq) dk br/gr (wet)	grab sample @ 210'
				gravel 35-45%, possibly cemented, sand v-f-c	H ₂ O added (slurry)
				A-SR grains/gravel, some silt, bas 50-60%	LD BTR
				felsics 40-50%	
215	grab HT			215' same description as above	grab sample @ 215'
					H ₂ O added (slurry)
					LD BTR
				220' silty sandy gravel (msq) dk br/gr (wet)	grab sample @ 220'
220	grab HT			gravel 35-45%, sand v-f-c, A-SR grains/	LD BTR
				gravel, some silt, basalt 50%, felsics 50%	
				225' same description as above	grab sample @ 225'
225	grab HT				LD BTR
				GW tagged @ 227.9'	
				(03106101)	
230	grab HT		230' same description as above	grab sample @ 230'	
	split spoon	90-100% rcvd	232-234' silty sandy gravel (split spoon) ^{small} cobbles,	split spoon 232-234'	
			dk br/gr (wet) gravel 35-45%, sand v-f-c, silt	90-100% recovery	
			A-SR, poorly sorted	End Shift (3-5-01)	
235	grab HT	NA	235' silty sandy gravel (msq) dk br/gr (wet)	grab sample @ 235'	
			gravel 35-45%, sand v-f-c, A-SR grains/gravel	H ₂ O added (slurry)	
			same silt basalt 50-60%, felsics 40-50%	LD BTR	

Reported By: <u>Charlene Martinez</u>		Reviewed By: <u>DC Weeks</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>Charlene Martinez</u>	Date: <u>03105101</u>	Signature: <u>DC Weeks</u>	Date: <u>4/3/01</u>

BOREHOLE LOG					Page 9 of 10	
					Date: 3/5/01	
Well ID: C3126		Well Name: 299-W22-83		Location: East of SX Tank Farm		
Project: RCRA FY01 Drilling				Reference Measuring Point: Ground Surface		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery			Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level	
240	Grab HT	NA		240' silty sandy gravel (sq) dk br/gr (wet) gravel 35-45%, sand v-f-c, A-SR grains/gravel. some silt, basalt 50-60%, felsic 40-50%	Grab @ 240' slurry H ₂ O added	
245	Grab HT	NA		245' same description as above.	grab @ 245' slurry H ₂ O added	
	Split Spoon			247' split spoon has sm cobbles < 2", sq dk br/gr (wet) gravel 35-45%, sand v-f-c, A-SR grains/gravel. some silt, basalt 50-60%, felsic 40-50%. Poorly sorted	split spoon 247'-248'	
250	Grab HT	NA		250' silty sandy gravel (msq) dk br/gr (wet) gravel 35-45%, sand v-f-c, A-SR grains/gravel. some silt, basalt 50-60%, felsic 40-50%.	grab @ 250' slurry H ₂ O added	
255	Grab HT	NA		255' same description as above.	grab @ 255' slurry	
260	Grab HT	NA		260' silty sandy gravel (msq) dk br/gr (wet) gravel 35-45%, sand v-f-c, noticeable silt nodules, grains A-SR. Basalt 50%, felsic 50%.	Grab @ 260' slurry End of shift 03/04/01	
	Split Spoon			262'-264' split spoon silty sandy gravel (msq) cobbles (sm) < 2", dk br/gr (wet) gravel 35-45%, grainal gravel A-SR, Bas. 50%, felsic 50%	split spoon 262'-264' poorly sorted	
265	Grab HT	NA		265' silty sandy gravel (msq) dk br/gr (wet) gravel 35-45%, silt, sand v-f-c, grains/gravel A-SR, Basalt 50%, felsic 50%	grab @ 265' slurry	

Reported By: Charlene Martinez		Reviewed By: DCWeekes	
Title: Geologist		Title: Geologist	
Signature: Charlene Martinez	Date: 3/6/01	Signature: DCWeekes	Date: 4/3/01

BOREHOLE LOG					Page <u>10</u> of <u>10</u>
					Date: <u>03/07/01</u>
Well ID: <u>C 3126</u>		Well Name: <u>299-W23-83</u>		Location: <u>East of SX Tank Farm</u>	
Project: <u>RCRA FY 01 Drilling</u>				Reference Measuring Point: <u>Ground surface</u>	
Depth (Ft.)	Sample		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
	Type No.	Blows Recovery			
270	Grab HT	NA ↓		270' silty sandy gravel (msq) dk br/gr (wet) gravel 35-45% silt, sand v-f-c, grains/ gravel A-SR, basalt 50%, felsic 50%, poorly sorted.	grab @ 270' slurry
275	Grab			275' same as above description	grab @ 275' slurry
280				285' TD	

WELL CONSTRUCTION SUMMARY REPORT						Start Date: 7-27-00	
						Finish Date: 8/21/00	
						Page 1 of 1	
Specification No.:		Rev. No.:		Well Name: 299-W23-20		Temp. Well No.: C 3112	
ECNs:				Approximate Location: W. Fence 241-S Tank Farm/200W			
Project: CY2000 RCRA Drilling				Other Companies: Resow BHI, CHI			
Drilling Company: Resonant Sonic International				Geologist(s): L.D. Walker, J.K. MURRAY			
Driller: Kelly Cowden, MoWRASIR							
TEMPORARY CASING AND DRILL DEPTH				DRILLING METHOD/HOLE DIAMETER			
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger:	Diameter From _____ to _____			
FJ 8 5/8" CS	0 - 260	8 5/8" / 7 7/8"	Cable Tool:	Diameter From _____ to _____			
	-		Air Rotary: 8 5/8"	Diameter From 0' to 260'			
	-		A.R. w/Sonic:	Diameter From _____ to _____			
	-			Diameter From _____ to _____			
	-			Diameter From _____ to _____			
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter From _____ to _____			
Drilling Fluid:							
Total Drilled Depth: 260'		Hole Dia @ TD: 8 5/8"		Total Amt. Of Water Added During Drilling:			
Well Straightness Test Results: STRAIGHT				Static Water Level: 214.45		Date: 8/10/00	
GEOPHYSICAL LOGGING							
Sondes (type)	Interval	Date	Sondes (type)	Interval	Date		
	-			-			
	-			-			
	-			-			
COMPLETED WELL							
Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
SS304L CASING 4" ID	+2' - 215.5		NA	Colorado Silica SAND	205' - 260.5'	96 bags	10-20
SS304L SCREEN	215.5 - 250.5		0.020	BENTONITE PELLETS	200.1' - 205'	3 burl	3/16"
SS316L SUMP	250.5 - 252.5		NA	BENTONITE CRUMBLES	10' - 200.1'	90 bags	
	-			PORTLAND CEMENT GROUT	0 - 10'	10 bags	NA
	-			2 PREMIUM GEL	0 - 10'	1/5 bag	NA
OTHER ACTIVITIES							
Aquifer Test: WELL DEVELOPMENT		Date: 8/21/00		Well Abandoned:		Yes:	No: Date:
Description: MONITOR DRAWDOWN AND RECOVERY				Description:			
WELL SURVEY DATA							
Date:				Protective Casing Elevation:			
Washington State Plane Coordinates:				Brass Cap Elevation:			
COMMENTS/REMARKS							
Vol. Calcs: 10-20 silica sand - 0.54 ft ³ /50lb-bag x 96 bag = 51.84 ft ³ ; Bentonite pellets - 0.62 ft ³ /bucket x 3 buckets = 1.86 ft ³ ; Granular bentonite - 0.73 ft ³ /bag x 90 bag = 65.70 ft ³							
Reported By: JILL MURRAY				Reviewed By: J. Auten / AUTEN			
Title: GEOLOGIST		Date: 9/12/00		Title: Sr. Design Engr.		Date: 9/21/00	
Signature: <i>Jill K. Murray</i>				Signature: <i>J. Auten</i>			

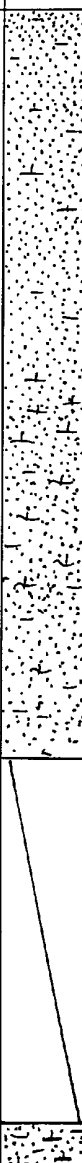
WELL SUMMARY SHEET				Page <u>1</u> of <u>2</u>	
				Date: <u>8/15/00</u>	
Well ID: <u>C3112</u>			Well Name: <u>299- W23-20</u>		
Location: <u>W. Fence of 241-S Tank Farm/200 W</u>			Project: <u>CY 2000 RCRA Drilling</u>		
Prepared By: <u>L.D. Walker JK MURRAY</u>		Date: <u>8/15/00</u>	Reviewed By: <u>DC Weekes</u>		Date: <u>8/25/00</u>
Signature: <u>L.D. Walker JK Murray</u>			Signature: <u>DC Weekes</u>		
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram		Graphic Log	Lithologic Description	
		0		0' → 6': Silty Sandy GRAVEL	
0'-10' PORTLAND CEMENT TYPE I+II GROUT				6' → 19': Sandy GRAVEL	
STAINLESS STEEL CASING 304L +2' → 215.5' 4" ID, 4.5" OD		25		19' → 34': Gravelly SAND	
10' - 200.1' BENTONITE CRUMBLES				34' → 36': Sandy GRAVEL	
		50		36' → 55': SAND	
PERMANENT OUTER CASING EMPLACED WITH A 3' STICKUP				55' → 83': SAND	
TEMP. CASING 8 5/8" OD, 7 5/8" ID		75		83' → 87': Gravelly SAND	
				87' → 94': SAND	
		100		94' → 102': Gravelly SAND	
				102' → 117': SAND	
		125		117' → 139': Slightly Silty SAND	
All depths below ground surface				139' → 148': No Returns	
All temp. casing removed.					

WELL SUMMARY SHEET				Page <u>2</u> of <u>2</u>	
			Date: <u>8/15/00</u>		
Well ID: <u>C 3112</u>		Well Name: <u>299 - W23 - 20</u>			
Location: <u>W. fence of 241-S Tank Farm/200 W</u>		Project: <u>CY 2000 RCRA Drilling</u>			
Prepared By: <u>L.D. Walker JK MURRAY</u> Date: <u>8/15/00</u>		Reviewed By: <u>DCU bekas</u>		Date: <u>8/25/00</u>	
Signature: <u>L.D. Walker JK Murray</u>		Signature: <u>DCU bekas</u>			
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram		Graphic Log	Lithologic Description	
		150		148' → 153': Silty SAND	
				153' → 157': Silty Sandy (w/caliche) GRAVEL	
				157' → 169': No Returns	
		175		169' → 184': Silty Sandy GRAVEL	
				184' → 220': Sandy GRAVEL	
92' 195' = 200.1 - 205' BENTONITE PELLETS			200		
SCREEN 215.5' - 250.5'			214.29 DTW 8/15/00		
304L SS 0.020 in slot			225		
Cont. wire wrap, 4" ID, 4.5" OD					220' → 260.5': Sandy GRAVEL
SANDPACK: 205' - 260.5'			250		
SILICA, 10-20 MESH					
250.5 - 252.5 SUMP					
316L SS 4" ID, 4.5" OD					
		275			
All depths below ground surf. All temp. casing removed.				TD = 260.5'	

BOREHOLE LOG					Page <u>1</u> of <u>9</u>
					Date: <u>7-27-00</u>
Well ID: <u>C 3112</u>		Well Name: <u>299-W/23-20</u>		Location: <u>West side 241-SX Tank Farm</u>	
Project: <u>CY 2000 RCRA Drilling</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (Ft.)	Sample		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
	Type No.	Blows Recovery			
0	Air Rotary			0' → 6': Silty Sandy GRAVEL (MSG) 40% Gravel, 45-50% Sand, 10-15% silt. Gravel med-cse peb, Sand predom. med-cse; 7.5YR 5/2 (brn), dry, poorly sorted; Probable backfill.	Air Rotary, 8 5/8" OD. CS casing 7 1/4" tricone bit
5	Grab- Archive	Waste character: rad: BOY VN1 chem: BOYVX1		6' → 19': Sandy GRAVEL (SG) 60% Gravel, 35% Sand, 5% silt. (drilling indicates tr. cobble) 25% v.cse- cse peb, 50% med peb, 25% fn-v.fn. Sand 40% v.cse, 30% cse, 30% med-v.fn; 10YR 5/2 (grayish brn), dry, poorly sorted Gravel is SR-SA, sand SA-A. Sand predom. basalt, gravel mixed -probable ^{possible} backfill. Mod rxn to HCl. -gravel content decreasing-	5': grab sample for archive (one pint) and waste charact. 10': 1-pint grab sample for archive * 600-700 dpm α, β direct readings 15': archive grab and waste characterization W.C. → BOYVX1 rad: BOYVN1 and BOYVN2
10	Grab- Archive			19' → 34': Gravelly SAND (GS) Gravel 10-15%, 85-90% Sand, tr silt. Gravel tr-5% med peb, 45% fn peb, 50% v.fn peb; Sand 30% v.cse, 40% cse, 30% med-fn; 10YR 5/1 (gray) dry, med sorted; SA, 60-70% basalt, 30-40% qtz, felds, other; max size ≈ 10 mm; no rxn HCl. 25-26': predom med-cse sand, then back to gravelly sand.	
15	Grab- Archive	Waste character: rad: BOY VN2 chem: BOYVX1			
20	Grab- Archive				
25	Grab- Archive				
Reported By: <u>L.D. Walker</u>				Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>				Title: <u>Geologist</u>	
Signature: <u>LD Walker</u>		Date: <u>7-27-00</u>		Signature: <u>DC Weekes</u> Date: <u>8/25/00</u>	

BOREHOLE LOG					Page <u>2</u> of <u>9</u>
					Date: <u>7-27-00</u>
Well ID: <u>C 3112</u>		Well Name: <u>299- W23- 20</u>		Location: <u>West side 241-SX Tank Farm</u>	
Project: <u>CY 2000 RCRA Drilling</u>		Reference Measuring Point: <u>Ground Surface</u>			
Depth (Ft.)	Sample		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
	Type No.	Blows Recovery			
30	Grab- Archive			Gravelly SAND (gS) as described above.	Air Rotary, 8 5/8" OD CS casing 7 1/4" tricone
				34' → 36': Sandy GRAVEL (SG)	
				50% Gravel, 50% Sand, tr silt.	30': Grab samples
35	Grab- Archive			Gravel 30% cse-med peb, 50% Fn peb, 20% v. Fn peb; Sand 25% v. cse, 30% cse, 40% med, 5% Fn; 10YR5/1 (gray); dry, poorly sorted; gravel SR, sand SA; 60% basalt, 40%	35': For archive
				qtz & other, max size ~ 3-4 cm, no rxn HCl.	
40	Grab- Archive			36' → 55': SAND (S)	40': Grab sample for archive
				tr- 5% Gravel, 95-100% Sand, tr silt. Sand ^{40%} 20% v. cse- cse, 40%	
				med, 20% Fn-v. Fn. 10YR 4/1 (dk. gry)	45': Grab sample archive
45	Grab- Archive			dry; med. sorted; 60-70% basalt, 30-40% qtz, felds other- tr mica	drill rate- 5' / 4 minutes
				no rxn HCl.	
				50' grab sample for archive	
50	Grab- Archive		51' → 52': ~ 5% gravel		
			Sand becoming Finer		
55	Grab- Archive		55' → 83': SAND (S)	55' grab sample for archive.	
			100% Sand, tr silt. Sand		
			20% cse, 50% med, 30% Fn-v. Fn.		
			10YR 6/3 (pale brown), 40% basalt, 60% qtz/other		
Reported By: <u>L.D. Walker</u>				Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>				Title: <u>Geologist</u>	
Signature: <u>L.D. Walker</u>		Date: <u>7-27-00</u>	Signature: <u>DC Weekes</u>		Date: <u>8/25/00</u>

BOREHOLE LOG					Page <u>3</u> of <u>9</u>	
					Date: <u>7-27-00</u>	
Well ID: <u>C 3112</u>		Well Name: <u>299-W23-20</u>		Location: <u>W. side 241- SX Tank Farm</u>		
Project: <u>CY 2000 RCRA Drilling</u>			Reference Measuring Point: <u>Ground Surface</u>			
Depth (ft.)	Sample		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	
	Type No.	Blows Recovery				
60	Grab- Archive				Air Rotary, 8 5/8"	
						OD CS casing
						7 1/4" tri-cone
65	Grab- Archive					60': Grab sample for archive
						65': grab sample for archive
70	Grab- Archive				70': grab sample for archive	
75	Grab- Archive				75': grab sample for archive	
					77': driller reports harder drilling	
80	Grab- Archive				80' → 81': Silt content 5-10%	
					80': grab sample for archive	
85	Grab- Archive				83' → 87': Gravelly SAND (GS) 15% Gravel, 85% Sand, tr silt.	
					Gravel med-fn pcb, SR; sand similar to above, tr mica, max size ~2cm.	
					85': grab sample for archive	
Reported By: <u>L.D. Walker</u>			Reviewed By: <u>DC Weekes</u>			
Title: <u>Geologist</u>			Title: <u>Geologist</u>			
Signature: <u>L.D. Walker</u>		Date: <u>7-27-00</u>	Signature: <u>DC Weekes</u>		Date: <u>8/25/00</u>	

BOREHOLE LOG					Page <u>5</u> of <u>9</u>
					Date: <u>7-27-00</u>
Well ID: <u>C3112</u>		Well Name: <u>299-W23-20</u>		Location: <u>W. side 241-SX Tank Farm / 200 W</u>	
Project: <u>CY 2000 RCRA Drilling</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (FL)	Sample		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
	Type No.	Blows Recovery			
120	<u>120</u> <u>Grab-Archive</u>			<u>117' → 139': Slightly Silty SAND (mS)</u>	<u>Air rotary, 8 5/8" OD</u>
				<u>80-90% Sand, 10-20% silt.</u>	<u>CS casing</u>
				<u>Sand tr cse, 20% med, 40% fn, 40% v. fn. 10YR 6/3 (pale brown), sl moist,</u>	<u>120': grab sample for archive</u>
				<u>well to med sorted; SA-SR, 80% gtz -</u>	
125	<u>Grab-Archive</u>			<u>or feld, 20% basalt/other; tr mica</u>	<u>125' grab sample for archive</u>
				<u>mod-strong rxn HCl.</u>	<u>Drill rate: 20'/20min</u>
				<u>130': very strong rxn to HCl - possible</u>	<u>130' grab sample for archive</u>
130	<u>Grab-Archive</u>			<u>caliche powdered by air rotary</u>	
					<u>end shift 7/27/00</u>
				<u>Resume: 7/28/00</u>	
				<u>135' grab sample for archive</u>	
135	<u>Grab-Archive</u>			<u>poor returns</u>	
				<u>No returns - drilling does not indicate a change in sediment</u>	<u>No samples collected</u>
140				<u>139' → 148'</u>	<u>From 140' and 145'.</u>
145				<u>148' → 153': Silty SAND (mS)</u>	
				<u>see next page</u>	
Reported By: <u>L.D. Walker</u>				Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>				Title: <u>Geologist</u>	
Signature: <u>L.D. Walker</u>		Date: <u>7-28-00</u>		Signature: <u>DC Weekes</u>	
				Date: <u>8/25/00</u>	

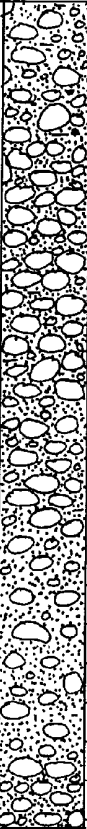
BOREHOLE LOG					Page <u>6</u> of <u>9</u>
Well ID: <u>C 3112</u>		Well Name: <u>299-W23-20</u>		Location: <u>W. Side 241-SX Tank Farm</u>	
Project: <u>CY 2000 RCRA Drilling</u>			Reference Measuring Point: <u>Ground Surface</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description Group Name, Grain Size 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
	Type No.	Blows Recovery			
150	Grab- Archive			148' → 153': Silty SAND (ms)	Air Rotary; 8 5/8"
				70% Sand, 30% Silt. Sand is	OD CS casing
				20% F _n , 80% v. F _n . 10YR 6/3	7 1/4" tricone bit
				(pale brn); wet from water added	
155	Grab- Archive			to clear bit & lines; well sorted, SA-SR; predom qtz/felds, tr mica,	150': grab sample
				strong HCl rxn - calcareous.	For archive
					155': Grab sample
				153' → 157': Silty Sandy GRAVEL	For archive
				(ms G). 60% Gravel, 30% Sand,	
160				20% silt. Gravel 30% cse peb, 7	
					160': no returns
				(157' → 169'): no returns	
				cyclone plugged with fines	
				50% med peb, 20% F _n -v. F _n ; Sand	165': no returns
165				predom F _n -v. F _n ; 10YR 6/3 (pl brn)	
				moist, poorly sorted; gravel SA-	Drill rate ~
				SR ⇒ with caliche coatings; Gravel	1 ft./1 min.
				60% basalt, 40% granitic/other, max	
				size ~ 4 cm; HCl rxn strong	
170	Grab- Archive				170': grab sample
				169' → 184': Silty Sandy GRAVEL	For archive
				(ms G) 60-70% Gravel, 15-20%	LEL, OVM < detect.
				sand, 10-15% ^{20%} Silt. Similar	α, β, γ < detect.
				to gravels above with out the	
				caliche coatings. Still mod-strong	175' grab sample
175	Grab- Archive			HCl rxn in silt.	For archive
				176' driller notes large cobble	
				or small boulder	

Reported By: <u>L.D. Walker</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>L.D. Walker</u>	Date: <u>7/28/00</u>	Signature: <u>DC Weekes</u>	Date: <u>8/25/00</u>

BOREHOLE LOG					Page <u>7</u> of <u>9</u>
					Date: <u>7-28-00</u>
Well ID: <u>C 3112</u>		Well Name: <u>299-W23-20</u>		Location: <u>W. side 241-SX Tank Farm/200W</u>	
Project: <u>CY 2000 RCRA Drilling</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
180'	Grab- Archive			169' → 184': Silty Sandy GRAVEL (m s G)	Air Rotary; 8 5/8" OD CS Casing
				silt content decreasing	
				184' → 220': Sandy GRAVEL (sG)	180': grab sample for archive
185'	Grab- Archive			70% Gravel, 25% Sand, 5% silt.	
				Gravel is tr & v. cse peb, 30% cse, 40% med, 30% fn - v. fn peb. Sand predom med-fn; 10YR 5/2 (grayish brn), moist, poorly sorted; Gravel R-SA, Sand SR-SA,	185': grab sample for archive
190'	Grab- Archive			Gravel 50% basalt, 50% granitic, quartzite; Sand 70% qtz, 30% basalt/other, mica, max size ~ 5 cm; Weak rxn HCl.	190': grab sample for archive
195'	Grab- Archive			Water added to circulating air to clear plugged lines	195': grab sample for archive
200'	Grab- Archive				200': grab sample for archive
205'	Grab- Archive		205': decrease in sand and silt content - but Fines could be washed out by water added at bit.	205': grab sample for archive	
			Gravel size increase - predom. cse peb.		
Reported By: <u>L.D. Walker</u>				Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>				Title: <u>Geologist</u>	
Signature: <u>L.D. Walker</u>		Date: <u>7-28-00</u>		Signature: <u>DC Weekes</u> Date: <u>8/25/00</u>	

BOREHOLE LOG					Page 8 of 9
					Date: 7-28-00
Well ID: C3112		Well Name: 299-W23-20		Location: W. side 241-SX Tank Farm/200W	
Project: CY 2000 RCRA Drilling				Reference Measuring Point: Ground Surface	
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
210	Grab-Archive			Sandy GRAVEL (SG)	Air Rotary; 8 5/8"
				-as described above-	OD CS casing
					210': Grab sample for archive
215	Grab-Archive				End 7/28/00
					Begin 7/31/00
					215': Grab-archive
					220': grab sample for archive and
220	Grab-Archive and Waste C.	100% rec.			Waste Charact.
	Split #1 Spoon Sieve analysis				HEIS #BOYVX2, BOYVN3
					219.5' → 222.0': split tube sample #1 for sieve analysis
225	Grab-Archive			R-SA; Sand SR-SA; Gravel 40% basalt 60% granitic, qtzite, other; Sand 15-20% basalt, 80-85% qtz/Feld; max size ~ 8 cm; no rxn HCL	End 7/31/Begin 8/1
				225': Archive	
230	Grab-Archive			228' → 230': water production decreases	230': Archive
				230 → 235': Sand content increase; water production increase	LEL, OVM < detect.
					W.L. = 215' → 214.5'
235	Grab-Archive and Waste C.			Sandy GRAVEL (SG) - similar to above. 60-65% gravel, 30% sand, 5-10% silt. Gravel R-SR, Sand SR, 10YR 4/3 (brn), wet, Sand predom. med size.	235': Archive, bgs
	ST #2 - Sieve analysis	100% rec.			Waste Ch: BOYVX3, BOYVN4
					236.0' → 237.5': ST #2 for sieve analysis

Reported By: L.D. Walker		Reviewed By: DC Weekes	
Title: Geologist		Title: Geologist	
Signature: <i>LD Walker</i>	Date: 8-1-00	Signature: <i>DC Weekes</i>	Date: 8/25/00

BOREHOLE LOG						Page <u>9</u> of <u>9</u>
Well ID: <u>C 3112</u> Well Name: <u>299-W23-20</u> Location: <u>W. side 241-Sx Tank Farm / 200W</u>						Date: <u>8-1-00</u>
Project: <u>CY 2000 RCRA Drilling</u> Reference Measuring Point: <u>Ground Surface</u>						
Depth (Fl.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level	
240	Grab- Archive				Air Rotary; 8 5/8" OD	
					CS casing	
				drilling indicates possible thin sand lenses 0.1' - 0.2' thick.	240': Grab sample for archive	
					End 8/1 / Begin 8/2	
245	Grab- Archive				245': Grab-archive	
					250': Grab-archive	
					220' → 260.5': Sandy GRAVEL (SG)	
					65-70% Gravel, 30% Sand, tr-5% silt. Gravel tr sm cob, 20% v. cse peb, 40% cse peb, 30% med, 10% fn-v. fn; Sand 20% v. cse-cse, 60% med, 20% fn-v. fn; 10YR 4/2 (dk gry brn), wet, mod - poorly sorted; Gravel R-SR, sand SR-SA; Gravel mixed basalt, granite, quartz, & other; Sand 80% qtz, feld, 20% basalt & other lith fragments; max size 8-10 cm; no rxn HCl.	
250	Grab- Archive	90% rec.			250.1' → 252.6': Split tube sample #3 for sieve analysis	
	Split tube #3 - sieve analysis				255': Grab for archive	
255	Grab- Archive			260' Grab for archive		
				255': Sand content increase to 50%.		
260	Grab- Archive			tr silt - otherwise as above.		
				260': Sand decrease to ~30%		
265				TD = 260.5'		
				8-3-00 water level = 214.1'		
				w/ casing at 260.0' → 0.5'		
				open hole		

Reported By: <u>L.D. Walker</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>LD Walker</u>	Date: <u>8/3/00</u>	Signature: <u>DC Weekes</u>	Date: <u>8/25/00</u>

FIELD ACTIVITY REPORT TUBULAR GOODS TALLY										Page <u>1</u> of <u>1</u>		
Date: <u>8/15/00</u>												
Well Name: <u>299-W23-20</u>					Well I.D.: <u>C 3112</u>							
TEMPORARY				PERMANENT*					SCREEN/CAP*			
Jt.#	Length (ft.)	Jt.#	Length (ft.)	Jt.#	Length (ft.)	C	Jt.#	Length (ft.)	C	Jt.#	Length (ft.)	Jt.#
1	10.6	21	10.0	1	20.03	C	21			1	2.00' sump	C
2	5.0	22	10.0	2	20.03		22			2	5.00	
3	10.0	23	5.0	3	20.03	C	23			3	9.99	
4	10.0	24	5.0	4	20.02		24			4	10.00	
5	10.0	25	5.0	5	20.03	C	25			5	10.00	
6	10.0	26	5.0	6	20.03		26			6		
7	10.0	27	5.0	7	20.04	C	27			7		
8	10.0	28	5.0	8	20.04		28			8		
9	10.0	29	5.0	9	20.03	C	29			9		
10	10.0	30	5.0	10	20.02	C	30			10		
11	10.0	31	5.0	11	20.03	C	31			11		
12	10.0	32	5.0	12			32			12		
13	10.0	33	-5.0	13			33			13		
14	10.0	34	260.6'	14			34			14		
15	10.0	35		15			35			15		
16	10.0	36		16			36			16		
17	10.0	37		17			37			17		
18	10.0	38		18			38			18		
19	10.0	39		19			39			19		
20	10.0	40		20			40			20		
Tot		Tot		Tot	220.3		Tot			Tot	36.99'	

15' Screen
20' screen

*Indicate those joints with centralizers with a C in the available box.
ALL casing length shall be measured to the nearest 0.01 ft.

Comments/Remarks: <u>Added 5' of temp casing to begin completion.</u>
* All temporary casing removed *

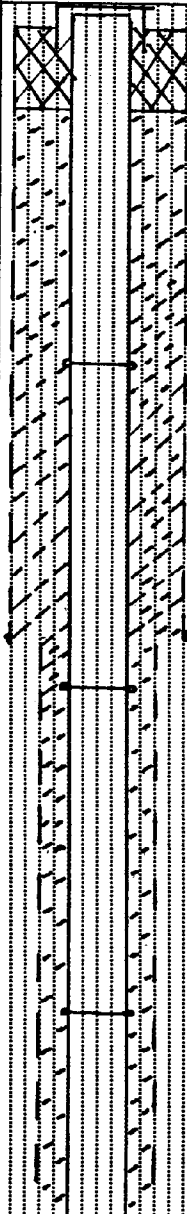
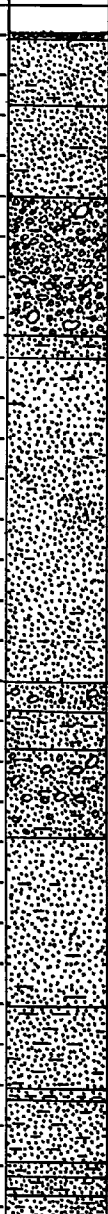
JRM-OK-	
Temporary: O.D./I.D. <u>8 5/8" / 7 5/8"</u>	Permanent: O.D./I.D. <u>4.5" / 4" 4.5" / 4"</u> Screen: O.D./I.D. <u>4.5" / 4"</u>
PERMANENT CASING + SCREEN ARE SS 304L. SCREEN IS .020 SLOT.	
TAILPIPE IS SS 316L w/ 4" ID + 4.5" OD. There is two extra joint WITH A CENTRALIZER BECAUSE THAT WAS WHAT WAS AVAILABLE AT TIME OF INSTALLATION.	
STAINLESS stickup of 4.8' cut to 2.0'	
PERMANENT OUTER CASING 6.0' piece replaced with a 3.0' stickup.	

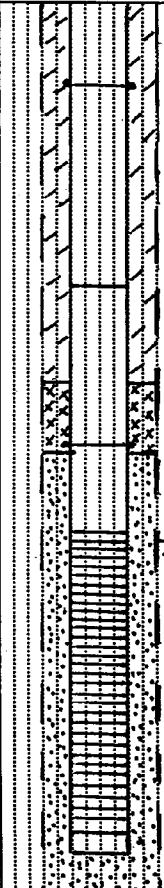

Reported By: <u>JILL MURRAY</u>		Reviewed By: <u>M. L. Johnson</u>	
Title: <u>Geologist</u>	Date: <u>8/15/00</u>	Title: <u>BHI STR</u>	Date: <u>9-8-00</u>
Signature: <u>Jill K. Murray</u>		Signature: <u>M. L. Johnson</u>	

BHI-EE-182 (12/97)

WELL CONSTRUCTION SUMMARY REPORT					Start Date: 9/26/00	
					Finish Date: 11/7/00	
					Page 1 of 1	
Specification No.: 0200W-SR-C 0007		Rev. No.: 0		Well Name: 299-W23-21		Temp Well No.: C3113
ECNs: NA				Approximate Location: West side of 2415x Tank Farm		
Project: RCRA FY 2000 Drilling				Other Companies: BHI & CHI		
Drilling Company: Resonant Sonic International				Geologist(s): J.M. Faurote & G.S. Thomas		
Driller: Mo Waspi						
TEMPORARY CASING AND DRILL DEPTH				DRILLING METHOD/HOLE DIAMETER		
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.		Auger:	Diameter From _____ to _____	
11 3/4" OD Carbon Steel	0 - 76.41			Cable Tool:	Diameter From 65 to 257'	
8 5/8" OD Carbon Steel	0 - 253.5	9" / 7 3/8"		Air Rotary:	Diameter From _____ to _____	
				A.R. w/Sonic:	Diameter From _____ to _____	
					Diameter From _____ to _____	
					Diameter From _____ to _____	
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter From _____ to _____		
Thread design casing.						
				Drilling Fluid: H ₂ O		
Total Drilled Depth: 259'		Hole Dia @ TD: 8.5"		Total Amt. Of Water Added During Drilling: 500 gallons		
Well Straightness Test Results: 20.2' L x 6 1/2" OD Touched Bottom				Static Water Level: 212.88		Date: 11/3/00
GEOPHYSICAL LOGGING						
Sondes (type)	Interval	Date		Sondes (type)	Interval	Date
Spectral gamma	0' - 257'	10/31/00 (4.5)				
RLS Neutron-Neutron	0' - 213'	10/31/00 (Top)				
COMPLETED WELL						
Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume Mesh Size
55 304 L Casing 4" ID	72.10 - 212.58		NA	Colorado Silica Sand	202.0 - 257.5	36.5 bags 10-20
55 304 L Screen 4" ID	212.58 - 249.69		0.020	Bentonite Pellets	192.7 - 202.0	4 buckets
55 316 L Sump 4" ID	249.69 - 257.67		NA	Bentonite Crumbles	10.1 - 192.7	132 bags
				Portland Cement Grout	65 - 10.1	10 bags
OTHER ACTIVITIES						
Aquifer Test:		Date:	Well Abandoned:		Yes:	No: Date:
Description:				Description:		
WELL SURVEY DATA						
Date:				Protective Casing Elevation:		
Washington State Plane Coordinates:				Brass Cap Elevation:		
COMMENTS/REMARKS						
161 Cals: 10-20 silica sand - 0.54 ft ³ /50 lb bag X 36.5 bags = 1971 ft ³ . Bentonite Pellets - 2.62 ft ³ /bucket X 4 buckets = 24.8 ft ³ . Granular Bentonite - 0.73 ft ³ /bag X 132 bags = 96.36 ft ³						
Reported By: G.S. Thomas / DC Weekes				Reported By: [Signature]		
Title: Scientist		Date: 11/7/00		Title:		Date:
Signature: Greg Thomas DC Weekes				Signature: [Signature]		

J

WELL SUMMARY SHEET				Page <u>1</u> of <u>2</u>	
				Date: <u>11/7/00</u>	
Well ID: <u>C 3113</u>			Well Name: <u>Z99-W23-21</u>		
Location: <u>West of 241 Sx Tank Farm</u>			Project: <u>RCRA FY 2000 Drilling</u>		
Prepared By: <u>G.S. Thomas</u>		Date: <u>11/7/00</u>	Reviewed By: <u>DC Weekes</u>		Date: <u>12/20/00</u>
Signature: <u>[Signature]</u>			Signature: <u>[Signature]</u>		
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram		Graphic Log	Lithologic Description	
6-in diameter protective ss casing set 1.0' above the 4-in casing		0		0-0.5': Gravel	
				0.5'-8.5': Sand	
				8.5'-20.0': Sand to slightly Silty Sand	
4-in ID schd. 5, ss 304L well casing:		25		20.0'-36.8': Sandy Gravel	
+2.10' → 212.58' bgs				36.8'-38.5': Silty Sand	
Portland Cement Grout:				38.5'-40.0': slightly Gravelly Sand	
0' → 10.1'		50		40.0'-80.0': Sand	
Granular Bentonite					
10.1' → 193.7'		75			
Temporary Casing:				80.0'-83.0': Gravelly Sand	
11 3/4" / 10 3/4" set at 76.41'				83.0'-88.0': Silty Sand	
8 5/8" / 7 5/8" to 263.5'				88.0'-99.0': Gravelly Sand	
		100		99.0'-120.5': Sand	
	125	120.5'-130.5': Silty Sand			
		130.5'-131.5': Sandy Silt			
		131.5'-139.0': Silty Sand			
		139.0'-141.5': slightly Silty Sand			
		141.5'-143.5': Silty Sand			
		143.5'-147.0': slightly Silty Sand			
All depths in feet below ground surface					
All temp. casing removed from the ground.					


WELL SUMMARY SHEET				Page <u>2</u> of <u>2</u>	
Date: <u>11/7/00</u>					
Well ID: <u>C 3113</u>			Well Name: <u>299-W23-21</u>		
Location: <u>West side of 241 SX Tank Farm</u>			Project: <u>RCRA FY 2000 Drilling</u>		
Prepared By: <u>G.S. Thomas</u>		Date: <u>11/7/00</u>	Reviewed By: <u>DC Weekes</u>		Date: <u>12/20/00</u>
Signature: <u>G.S. Thomas</u>			Signature: <u>DC Weekes</u>		
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram		Graphic Log	Lithologic Description	
Bentonite Pellets:		150		147'-153': Sandy Silt	
193.7' - 202.0'				153'-158': Slightly Silty Gravelly Sand	
Silica Sand: 10-20 mesh				158'-168': Sand	
202.0' - 257.5'				168'-189': Sandy Gravel	
Well Screen				189'-193': Slightly Silty Gravelly Sand	
4-in ID, 0.020-in. slot				193'-197.5': Gravelly Silty Sand	
Cont. wire-wrap, SS type				197.5' - 204': Gravelly Sandy Silt	
304:				W.L. = 212.88' bgs (11/3/00)	
212.58' → 249.69'				204'-214': Silty Sandy Gravel	
Sump:				214'-219': Gravelly Sandy Silt	
4 in ID SS 304 L				219'-240': Silty Sandy Gravel	
249.69' → 251.87'				240'-255': Sandy Gravel	
Total 4 in ID SS material				255'-259': Gravelly Silty Sand	
is 253.97' (+2.10' + 251.87')				TD 259'	
All depths in feet below ground surface					
All temp. casing removed from the ground					

Date: 9/26/00

Location: West of SX Tank Farm

Reference Measuring Point: Ground Surface

Reported By: <i>JM Faurote</i>		Reviewed By: <i>DC Weekes</i>	
Title: <i>Geologist</i>		Title: <i>Geologist</i>	
Signature: <i>JM Faurote</i>	Date: <i>9/29/00</i>	Signature: <i>DC Weekes</i>	Date: <i>11/3/00</i>

BOREHOLE LOG					Page <u>2</u> of <u>2</u>
Well ID: <u>C3113</u>		Well Name: <u>299-W23-21</u>		Date: <u>9/29/00</u>	
Project: <u>RCRA FY2000 Drilling</u>			Reference Measuring Point: <u>Ground Surface</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
30	Archive			Gy-bn to lt-bn moist sandy silt w/clay.	Cable tool (drive barrel)
				Back into sandy gravel, largest is 1 1/2" x 2"	Archive @ 1527 hrs.
				no visible silt, 60% basalt, pepper and salt in appearance.	
				34-36 large size is 4" diam. metamorphic -	
35	Archive			still dominantly sandy gravel - f-med grained	
				tight sandy silt @ 36' to 36.5, then into	@ 37' end shift 9/29/00
				36.5-38.5 Silty Sand, light brown, vf-med grnd	
				sand w/ brown silt and muscovite, the unit is damp, 85% sand, 15% silt, 60% basalt.	
				38.5-40.0 Sl. Gravelly Sand, that changes into	40' Arch. samp @ 0702, 10/1
40	Archive			a very slightly silty sand.	
				40.0-80.0 Sand, silt content is 3.5%.	
				Sand is brown (7.5YR 4/3), grains are	
			60% med, 35% f, 5% cr in med. well sorted unit		
45	Archive	Time 0745	of sub-round to round grains. It has a very		
			weak reaction to HCl. The unit is 55-60%		
			Basalt with the remaining grains being		
			silica and/or metamorphic granules. The unit		
			is slightly moist.		
50	Archive	Time 0803	Slight increase in silt content		
55	Archive	@ 0843 hrs			
				RCT gets < detect	
				on tools and soils	
			thin silty stringer 58-58.5		

Reported By: <u>J.M. Faurote</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>JM Faurote</u>	Date: <u>10/2/00</u>	Signature: <u>DC Weekes</u>	Date: <u>11/3/00</u>

BOREHOLE LOG					Page <u>3</u> of <u>7</u>
					Date: <u>10/2/00</u>
Well ID: <u>C3113</u>		Well Name: <u>299-W23-21</u>		Location: <u>West of 241-SX Tank Farm</u>	
Project: <u>RCRA FY2000 Drilling</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
60	Archive	0909		v. thin silt stringers (1/2-1" thick) that are moist. The silt is brown.	Cable tool Drilling
				Continues as the same med and fine grained Sand as previously described.	
65	Archive	0947			
70	Archive	1022		sporadic, discontinuous silt stringers that react strongly, or moderately strong to HCl and BEGIN	
	SPLIT SPOON SAMPLER			the intervening sand has little or no rxn.	SPLIT SPOON
	SPLIT SPOON	overdriven			SAMPLING FROM
		1154 hrs			70' to 140',
75	Archive			med & cr grnd sand 76-77'	CONTINUOUS
	SS#3			H2O leaked out end of shoe - came from the formation, @ ~ 77.5' → water seepage @ cleaned 77-79', 10/10/00	
	Archive				
	SS#4				
80	Archive			Gravelly Sand. 80'-81' Sand gravel w/ CaCO ₃ cement. Contact dy 5 / S.G.	
	1021 hrs				
	SS#5	START AGAIN on 10/10/00	v. strong Rxn to HCl. The unit is 60% basalt and 40% felsic. The unit consists of 40% G,		
	Archive		55% S and 5% m. The sand is poorly sorted, Sub-ang. to sub-rd, 30% cr, 45% m, 25% f. The gravels are sub-ang. to sub-rd, 70% f, 30% m grnd. The unit is variegated in color, but generally white to light gray-brown. the unit is dry.	81-82' - lt. bn. silt w/ <10% sand - moist w/ <well defined shallow ripple marks	
	SS#6	10/18/00 1105 hrs			
85	Archive				
	SS#7	10/18/00 1200 hrs	83-88 v. silty sand, m: 15-18%. Sand is med-f grnd poorly sorted, moist, or-bn to brn w rd- or to red hematite staining and cement. SPORADIC Granite small pebbles. v. sm. clastic dikes	* B4 - Poss. carbonized Plant remains	
	SS#8	10/18/00	86' 1" clastic dikes of cr. sand and hvy hematite staining		

Reported By: <u>J.M. Faurote</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>JM Faurote</u>	Date: <u>10/18/00</u>	Signature: <u>DC Weekes</u>	Date: <u>11/3/00</u>

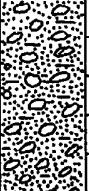
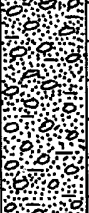
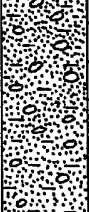
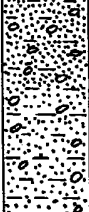
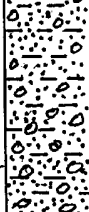

BOREHOLE LOG					Page 4 of 9	
					Date: 10/18/00	
Well ID: C3113		Well Name: 299-W23-21		Location: West of 241 SX Tanks Farm		
Project: RCRA FY2000 Drilling				Reference Measuring Point: Ground Surface		
Depth (ft.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery				
90	SS#9 10/18/00 1340	Archive		88- 99 Gravelly Sand (gs) 55% Borehole cable tool and 35% gravel (F-m. grad) in 16-med gy. 90-94 drilling and black sand of 90% f, 30% m and 30% c grains that are poorly sorted, sub-round to sub-angular. Is CaCO3 cemented. The unit is dry, and locally iron oxide stained. The unit contains ~ 8% silt.		
95	SS#10 10/18/00 1418	Archive				
	SS#11 10/18/00 1445	Archive				
	SS#12 10/18/00 1500	Archive				
100	SS#13 10/18/00 1605	Archive			99-120.5 Sand (s) 50-60% Quartz, 90% f. fine - fine, 10% medium, trace coarse, 10YR 5/4 (yellowish brown), moist, poorly sorted, sub-round to sub angular. Silt content increasing 10-15%, trace mica.	
	SS#14 10/19/00 0756	Archive				
105	SS#15 10/19/00 0826	Archive			Silt content decreasing < 5%, lithic increase to ~ 15%, mostly Quartz with some staining.	
	SS#16 10/19/00 0910	Archive				
110	SS#17 10/19/00 0956	Archive			silt ~ 10%	
	SS#18 10/19/00 1019	Archive				
115	SS#19 10/19/00 1052	Archive				
	SS#20 10/19/00 1117	Archive				

Reported By: JMFaurate / G.S. Thomas		Reviewed By: DCWeekes	
Title: Geologist / Scientist		Title: Geologist	
Signature: JMFaurate / G.S. Thomas	Date: 10/19/00	Signature: DCWeekes	Date: 11/3/00

BOREHOLE LOG						Page <u>5</u> of <u>9</u>
Well ID: <u>C 3113</u> Well Name: <u>299 - W23 - 21</u> Location: <u>West of 241 St Tank Farm</u>						Date:
Project: <u>RCRA FY 2000 Drilling</u> Reference Measuring Point: <u>Ground surface</u>						
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level	
120	<div style="border: 1px solid black; padding: 2px;"> <div style="display: flex; justify-content: space-between;"> SS # 21 10/19/00 </div> <div style="border-bottom: 1px solid black; padding: 2px 0;">1152</div> <div style="display: flex; justify-content: space-between;"> SS # 22 10/19/00 </div> <div style="border-bottom: 1px solid black; padding: 2px 0;">1256</div> </div>	Archive		120.5 - 123 Silty Sand (mS). 25-35% silt, 70-75% v.f.-f. sand, moist, 10 YR 5/4 (brown), sand grains orange, yellow, clear & subrounded, strong Rxn to HCl, layered, iron staining	Cable tool drilling	
				123 - 124 decreasing silt to slightly silty SAND		
				124 - 130.5 Silty Sand as above		
125	<div style="border: 1px solid black; padding: 2px;"> <div style="display: flex; justify-content: space-between;"> SS # 23 10/19/00 </div> <div style="border-bottom: 1px solid black; padding: 2px 0;">1328</div> <div style="display: flex; justify-content: space-between;"> SS # 24 10/19/00 </div> <div style="border-bottom: 1px solid black; padding: 2px 0;">1415</div> </div>	Archive				
130	<div style="border: 1px solid black; padding: 2px;"> <div style="display: flex; justify-content: space-between;"> SS # 25 10/19/00 </div> <div style="border-bottom: 1px solid black; padding: 2px 0;">1450</div> <div style="display: flex; justify-content: space-between;"> SS # 26 10/20/00 </div> <div style="border-bottom: 1px solid black; padding: 2px 0;">1335</div> </div>	Archive		130 - 131.5 Sandy SILT (sM) 55% silt, 45% Sand, Sand v.f.-f., 25% mafic, moist, 10 YR 5/4 (brown), low plasticity, layered		
135	<div style="border: 1px solid black; padding: 2px;"> <div style="display: flex; justify-content: space-between;"> SS # 27 10/20/00 </div> <div style="border-bottom: 1px solid black; padding: 2px 0;">1416</div> <div style="display: flex; justify-content: space-between;"> SS # 28 10/20/00 </div> <div style="border-bottom: 1px solid black; padding: 2px 0;">1456</div> </div>	Archive		136.5 - 140 Silty SAND (mS) 40% silt, 60% Sand, Sand v.f.-f., 20 mafic, moist, 10 YR 5/4 (brown), medium Rxn HCl, sand lenses from		
140	<div style="border: 1px solid black; padding: 2px;"> <div style="display: flex; justify-content: space-between;"> SS # 29 10/20/00 </div> <div style="border-bottom: 1px solid black; padding: 2px 0;">1488</div> </div>	Archive	140.5 - 141.5 Slightly silty SAND (mS). 15% silt 85% SAND. Sand v.fine-fine, moist, 10 YR 5/4 (brown), medium Rxn to HCl.	Changed to drive barrel at 140'		
			141.5 - 143.5 Silty Sand			
145	<div style="border: 1px solid black; padding: 2px;"> <div style="display: flex; justify-content: space-between;"> SS # 30 10/20/00 </div> <div style="border-bottom: 1px solid black; padding: 2px 0;">1528</div> </div>	Archive	143.5 - 147 Slightly silty SAND (mS). 15% silt 85% Sand. Sand v.f.-f., moist, 10 YR 5/4 (brown) 35% mafic.	Changed to hard tool bit at 145' (after archive sample collected)		


Reported By: <u>G.S. Thomas</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Scientist</u>		Title: <u>Geologist</u>	
Signature: <u>G.S. Thomas</u>	Date: <u>10/23/00</u>	Signature: <u>DC Weekes</u>	Date: <u>11/3/00</u>

BOREHOLE LOG						Page <u>6</u> of <u>9</u>
						Date: <u>10/23/00</u>
Well ID: <u>C 3113</u>		Well Name: <u>299- W23- 21</u>		Location: <u>West of 241 St Tank Farm</u>		
Project: <u>RCRA FY 2000 Drilling</u>				Reference Measuring Point: <u>Ground Surface</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level	
150	///	Archive	[Symbol]	147-153 Sandy SILT (SM), 30-40% fine to very fine sand, 60-70% silt, 10% mafic & 90% felsic, Moist, strong Rxn HCL, 2.5 YR 7/3 (pale yellow) when dry, non plastic.	Cable tool drilling using hard tool bit	
155	///	Archive	[Symbol]	153-158 Slightly Silt Gravelly SAND (MG), 10-15% silt, 10-15% gravel, 70-80% SAND. Gravel 70% basalt & 30% felsic as fine pebbles and coated with CaCO ₃ . Sand 30% C, 30% M, 40% f-v.f. with 30% basalt & 70% felsic, strong Rxn HCL, 10 YR 5/3 (brown) when moist		
160	///	Archive	[Symbol]	158-162 Sand (S). 3-5% v.f. - f pebbles, 7-10% silt, 85-90% SAND. Sand 25-30% C-UC, 30-35% M, 35-45% f-v.f. 50% basalt, 50% felsic, strong Rxn HCL, 10 YR 5/3 (brown) when moist		
165	///	Archive	[Symbol]	162-168 Sand (S). 30% v.f. - f sand and 70% medium sand. 25-30% basalt, 70-75% felsic, strong Rxn HCL, 10 YR 5/3 (brown)		
170	///	Archive	[Symbol]	168-184 Sandy GRAVEL (SG), Gravel 35%, Sand 60%, silt 5%. Gravel broken into pebbles of 5-10% M, 15-20% f, 70-80% v.f. SAND 55-60% CS, 35% M, 10% v.f. - f. SAND & Gravel 75-80% mafic & 20-25% felsic, No Rxn HCL, Color of fine & v. fine sand 2.5 Y 4/1 (dark Gray) when wet.		
175	///	Archive	[Symbol]			

BOREHOLE LOG						Page <u>7</u> of <u>9</u>
						Date: <u>10/24/00</u>
Well ID: <u>C 3113</u>		Well Name: <u>299-W23-21</u>		Location: <u>West of 241 st Tank Farm</u>		
Project: <u>RCRA FY 2000 Drilling</u>				Reference Measuring Point: <u>Ground Surface</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:	
Type No.	Blows Recovery			Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level	
180	1111	Archive			Cable tool drilling Using hard tool bit	
185	1111	Archive		184- 189 Sandy Gravel (SG) Gravel 35%, Sand 60%, Silt 8%. Gravel broken into pebbles of 5% m, 4% f, 55% v.f. Sand 30% C-VC, 45% m, 25% f-v.f. Gravel & Sand 50-55% Mafic, 45-50% felsic, No Bxn HCL, Color 2.5 Y 5/2 (Grayish brown) in slurry.		
190	1111	Archive		189- 193 Slightly Silty Gravelly Sand (m) GS. Gravel 22%, Silt 18%, Sand 60%. Gravel broken into pebbles of 10% m, 10-15% f, 75-80% v.f. Sand 5% v.c, 5% c, 60% m, 20% f, 5% v.f. Mafic 60%, No Bxn, Color 2.5 Y 5/2 (Grayish brown)		
195	1111	Archive		193-197.5 Gravelly Silty Sand (GMS). Gravel 20%, Sand 50%, Silt 30% Same description as above for gravel & sand content.		
200	1111	Archive		197.5-204 Gravelly Sandy Silt (GmM) Gravel 27%, Sand 31%, Silt 42%. Gravel broken into pebbles of 5% m, 4% f, 55% v.f. Sand 5% v.c, 20% c, 50% m, 20% f, 5% v.f. Mafic 40-50%, No Bxn, Color 2.5 Y 5/2 (Grayish brown)		
205	1111	Archive		204-209 Silty Sandy Gravel (MSG). Gravel 45% Sand 28% Silt 27%. Gravel & sand description is the same as 200.		
Reported By: <u>G.S. Thomas</u>				Reviewed By: <u>DC Weekes</u>		
Title: <u>Scientist</u>				Title: <u>Geologist</u>		
Signature: <u>[Signature]</u>		Date: <u>10/26/00</u>		Signature: <u>[Signature]</u> Date: <u>11/3/00</u>		

BOREHOLE LOG						Page <u>8</u> of <u>9</u>
Well ID: <u>C-3113</u> Well Name: <u>299-023-21</u> Location: <u>West of 241 SX Tank Farm</u>						Date: <u>10/26/00</u>
Project: <u>RCLR FY 2000 Drilling</u> Reference Measuring Point: <u>Ground Surface</u>						
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level	
210		Archive		209-214 Silty Sandy Gravel (msG). Gravel 34% Sand 35% Silt 31%. Gravels broken into pebbles of 3% m, 50% f, 47% vf. 1 broken v.c. Pebble. Sand 25% vc, 25% c, 30% m, 15% f, 5% vf. Mafic 40%.	Cable tool drilling using hard tool bit except where split spoon driven.	
215		Archive		214-219 Gravelly Sandy Silt (gmM). Gravel 25% Sand 36%, Silt 40%. Gravel broken into pebbles of 3% m, 30% f, 57% vf. Sand 20% vc, 20% c, 25% m, 25% f, 10% vf. 40% Mafic.		
		Rad sample			Rad sample out of waste drum.	
	SS # 29 10/26/00 1215					
220		Archive		219-224 Silty Sandy Gravel (msG). Gravel 46% Sand 33%, Silt 21%. Gravel large & small cobbles present, 1% vc, 2% c, 7% m, 40% f, 50% vf, Sand 18% vc, 15% c, 25% m, 40% f, 5% vf. 40% Mafic. Gravels sub-wellrounded or broken, moderate weathering.	Chem sample out of waste drum.	
225		Archive		224-240 Silty Sandy Gravel. Gravel 53% Sand 21%, Silt 21%. Mafic 60%. Gravel 5% m, 45% f, 50% vf. Sand 30% vc, 30% c, 20% m, 10% f, 10% vf.	and shift 10/26/00	
		Rad sample			Rad sample out of waste drum.	
				Continues as silty Sandy Gravel w/ 15% m, 40% mf, 30% s and 55% G		
230		Archive			split drove very hard.	
	SS # 30 10/27/00				at least one > 4" rock @ 231'. The unit is highly variegated in color, it is bn, bk, or, tan, gy, gn-gy and various light shades. The unit is moist, but not saturated and appears strongly altered (acidic solutions?) and exhibits FeOx (hematite, goethite?) matrix and staining. Gravel is sub-round to round and 1/4 to 3/4 in size.	
235		Archive		Add Regd H2O		

Reported By: <u>G.S. Thomas / JMfaurote</u>		Reviewed By: <u>DCWeekes</u>	
Title: <u>Scientist / Geologist</u>		Title: <u>Geologist</u>	
Signature: <u>Aug Thomas / JMfaurote</u>	Date: <u>10/27/00</u>	Signature: <u>DCWeekes</u>	Date: <u>11/3/00</u>

BOREHOLE LOG					Page <u>9</u> of <u>9</u>
Well ID: <u>C3113</u> Well Name: <u>299-W23-21</u> Location: <u>West of 241st Tank Farm</u>					Date: <u>10/27/00</u>
Project: <u>ACRA FY2000 DRILLING</u> Reference Measuring Point: <u>Ground Surface</u>					
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving, Sampling Tool, Sampler Size, Water Level
240	1111	Archive		240-255 Sandy Gravel	Hard tool bit drilling
245				~240 Silt decreases, sand increases - Sandy Gravel. Gravel 50%, Sand 40% silt 5%. Gravel is f-med grained, sand is f-cr grained w/ 35% F, 45% m & 10% cr in sub-round to round, med. sorted, variegated (conchoidal) color is lt-med gy br, wet. Abundant silica based fragments.	24% LELE 20% O ₂
250	SS # 31 10/27/00 1559	recovery end shift 10/27/00		246-247, 248 heaving sand - did not discern any increased penetration rate.	248' Co @ 860 ppm in casing, 420 ppm when running tool into hole - at the surface 22 drum - 0133 Seal. (242-247.5')
255				V. sty gravel, strongly altered clasts and matrix - what appears to have been CaCO ₃ now seems to be CaSO ₄ ·H ₂ O - loose, friable.	
260	1111	Archive		the unit is not saturated, and contains 5-10% clay (alteration byproduct?) in 15-20% silt matrix that shows minimal sand. The gravels (50%) are well rounded, f-med grad. max size is 1.5x2", most are 1" or less. The unit is difficult to drill; it appears to have been subjected to heavy nitric or sulfuric acid concentrations - Pure Guess!	
265				255-256 Gravely Silty Sand (gms). Gravel 21%, Silt 26%, Sand 43%. Gravel broken into pebbles, <1% c, 20% med, 20% f, 50% vt. Sand 35% vt, 25% c, 20% m, 15% f, 5% vt. 30% mafic.	
270				T.D. 259' bgs	
275					
280					
285					

Reported By: <u>J.M. Faurote / G.S. Thomas</u>	Reviewed By: <u>DC Weekes</u>
Title: <u>Geologist / Scientist</u>	Title: <u>Geologist</u>
Signature: <u>J.M. Faurote / G.S. Thomas</u> Date: <u>10/30/00</u>	Signature: <u>DC Weekes</u> Date: <u>11/3/00</u>

Appendix B

Physical Properties Data

Appendix B

Physical Properties Data

This Appendix includes the results of testing for particle size distribution on split spoon samples from the wells 299-W22-80, 299-W22-81, 299-W22-82, 299-W22-83, 299-W23-20, and 299-W23-21. The analyses were done by CH2M Hill Hanford Inc using standard sieve techniques.

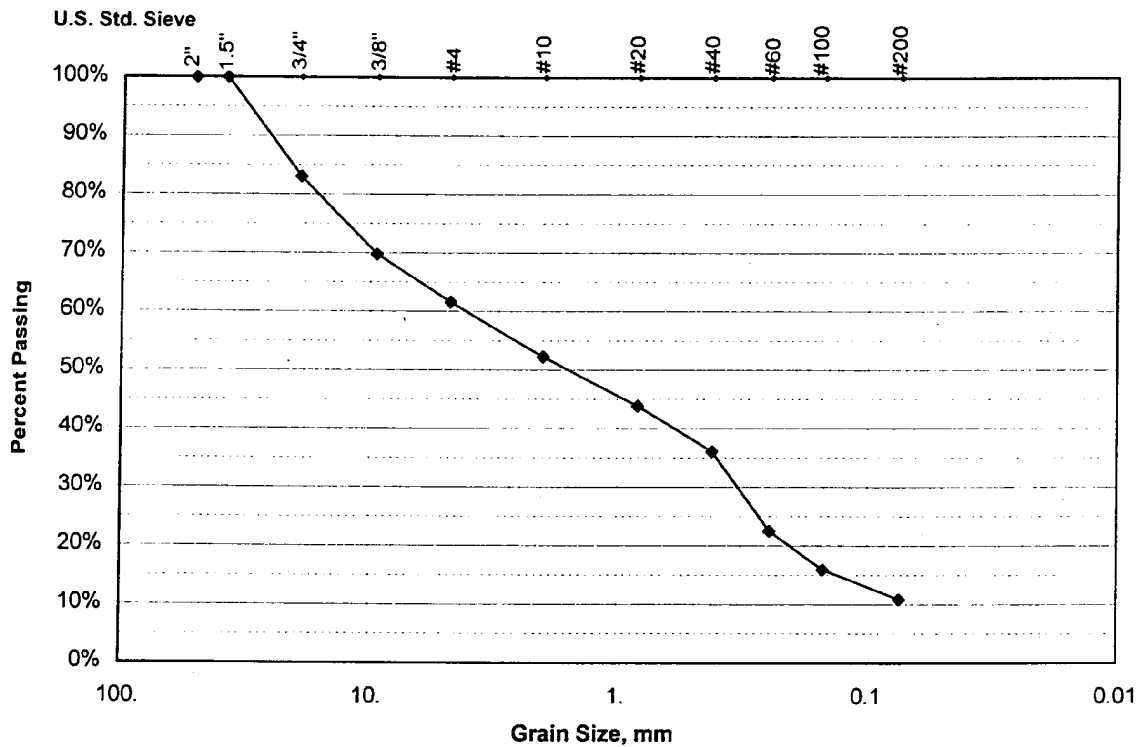
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-80	DEPTH	213.3'-215.8'	SAMPLE#	W22-80-213.3	WELL ID#	C3115
TESTED BY	JMW	CONTACT	Dave Weekes	PHONE	372-9524	DATE	09/08/2000

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
982.30	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	167.4	17.0	83.0	19.05	
	3/8"	297.6	30.3	69.7	9.42	
	#4	377.7	38.5	61.5	4.70	
	#10	469.1	47.8	52.2	1.98	
	#20	551.9	56.2	43.8	0.83	
	#40	627.6	63.9	36.1	0.42	
	#60	761.1	77.5	22.5	0.25	
	#100	825.8	84.1	15.9	0.150	
	#200	875.7	89.1	10.9	0.074	

Sieve Analysis Data for Sample W22-80-213.3



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By: *DM Weekes*

Date: *9/19/00*

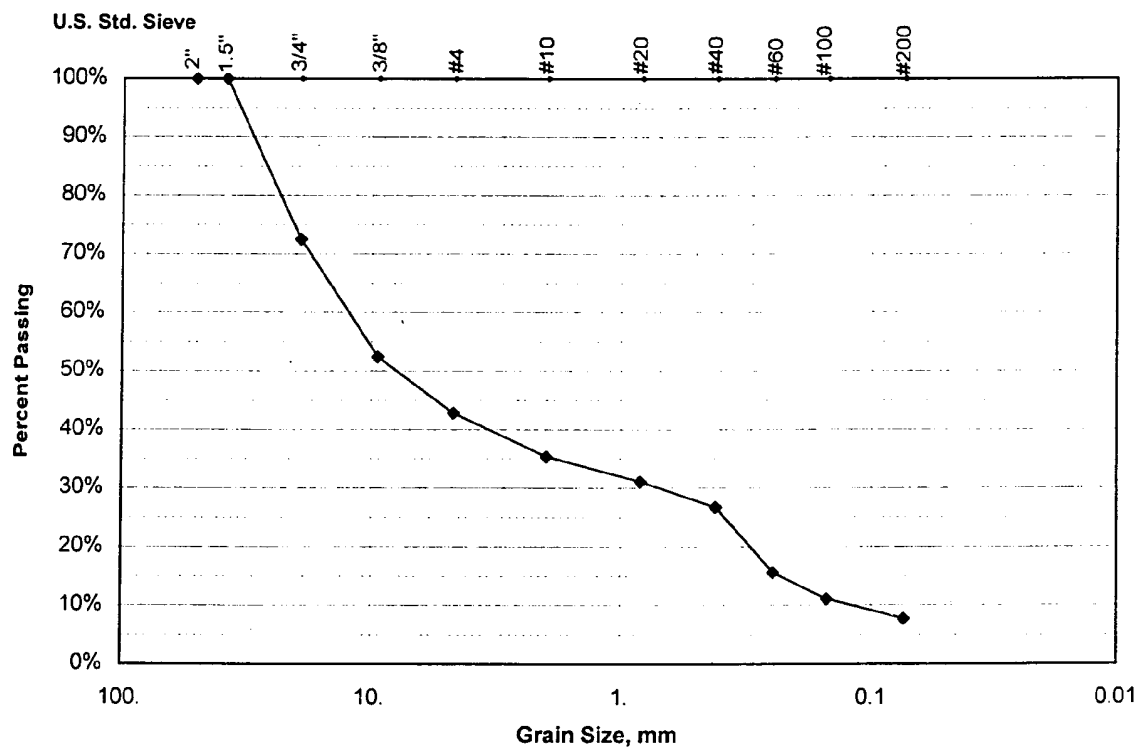
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-80	DEPTH	232.0'-234.5'	SAMPLE#	W22-80-232.0	WELL ID#	C3115
TESTED BY	JMW	CONTACT	Dave Weekes	PHONE	372-9524	DATE	09/08/2000

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
925.30	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	254.5	27.5	72.5	19.05	
	3/8"	440.3	47.6	52.4	9.42	
	#4	529.3	57.2	42.8	4.70	
	#10	598.0	64.6	35.4	1.98	
	#20	637.7	68.9	31.1	0.83	
	#40	678.2	73.3	26.7	0.42	
	#60	780.7	84.4	15.6	0.25	
	#100	823.1	89.0	11.0	0.150	
	#200	853.8	92.3	7.7	0.074	

Sieve Analysis Data for Sample W22-80-232.0



Comments: Sandy Gravel

All data are accurately and completely recorded.

Checked By: *[Signature]*

Date: 9/19/00

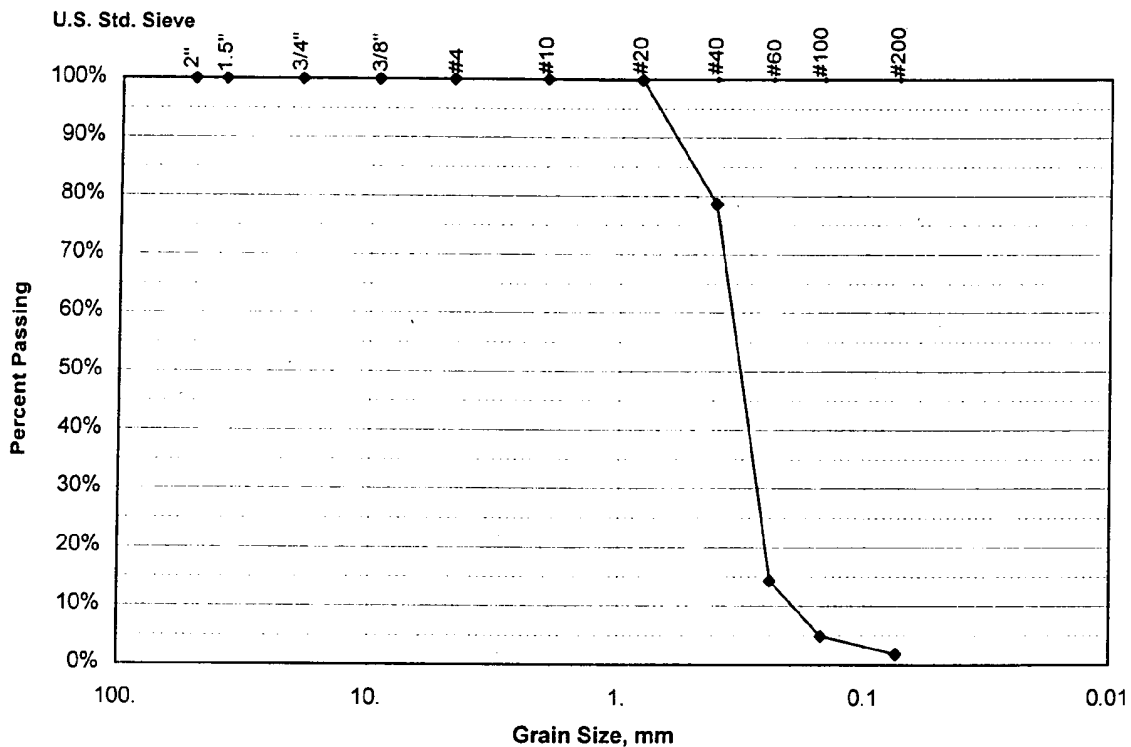
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-80	DEPTH	241.0'-243.5'	SAMPLE#	W22-80-241.0	WELL ID#	C3115
TESTED BY	JMW	CONTACT	Dave Weekes	PHONE	372-9524	DATE	09/08/2000

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
663.90	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	0.0	0.0	100.0	19.05	
	3/8"	0.0	0.0	100.0	9.42	
	#4	0.0	0.0	100.0	4.70	
	#10	0.0	0.0	100.0	1.98	
	#20	1.0	0.2	99.8	0.83	
	#40	141.6	21.3	78.7	0.42	
	#60	568.6	85.6	14.4	0.25	
	#100	631.2	95.1	4.9	0.150	
	#200	651.4	98.1	1.9	0.074	

Sieve Analysis Data for Sample W22-80-241.0



Comments: Sand (Well Heaving Sand)

All data are accurately and completely recorded.

Checked By: *Dave Weekes*

Date: 9/19/00

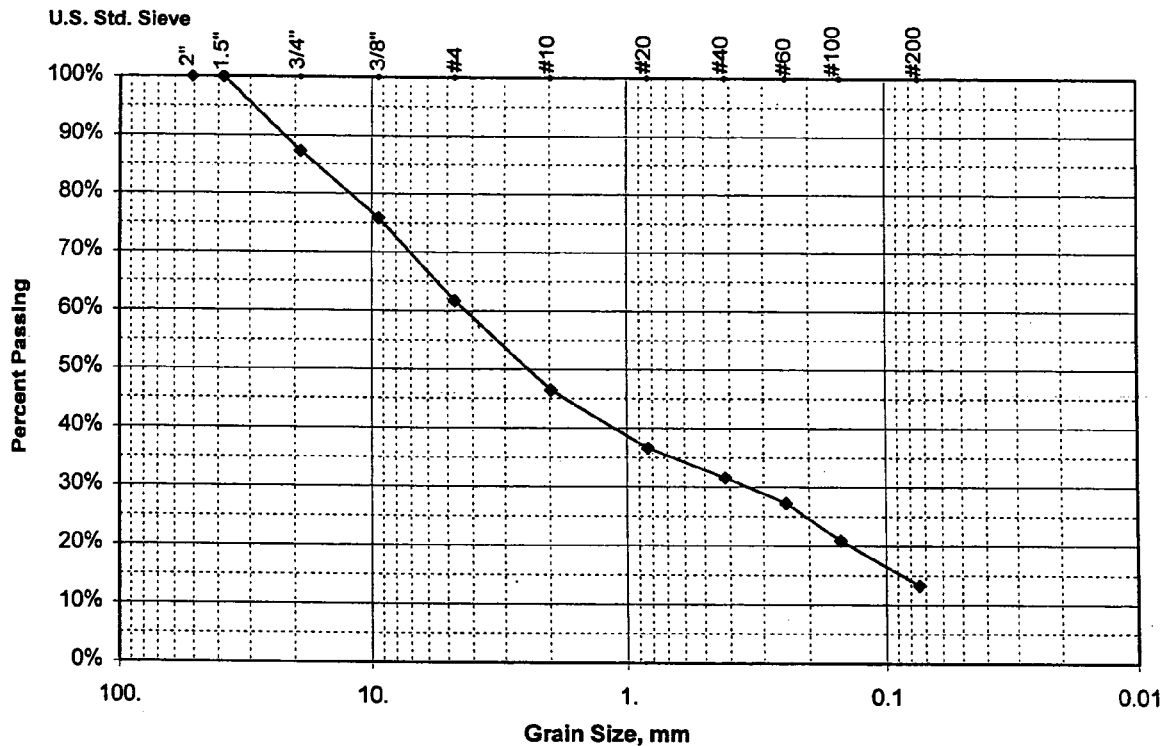
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-81	DEPTH	238.0'-239.5'	SAMPLE#	W22-81-238.0	WELL ID#	C3123
TESTED BY	John Wimet	CONTACT	Dave Weekes	PHONE	372-9130	DATE	01/26/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
980.10	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	124.9	12.7	87.3	19.05	
	3/8"	236.9	24.2	75.8	9.42	
	#4	375.9	38.4	61.6	4.70	
	#10	525.2	53.6	46.4	1.98	
	#20	621.3	63.4	36.6	0.83	
	#40	671.2	68.5	31.5	0.42	
	#60	713.0	72.7	27.3	0.25	
	#100	775.4	79.1	20.9	0.150	
	#200	850.3	86.8	13.2	0.074	

Sieve Analysis Data for Sample W22-81-238.0



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By: *D. Weekes*

Date: *4/3/01*

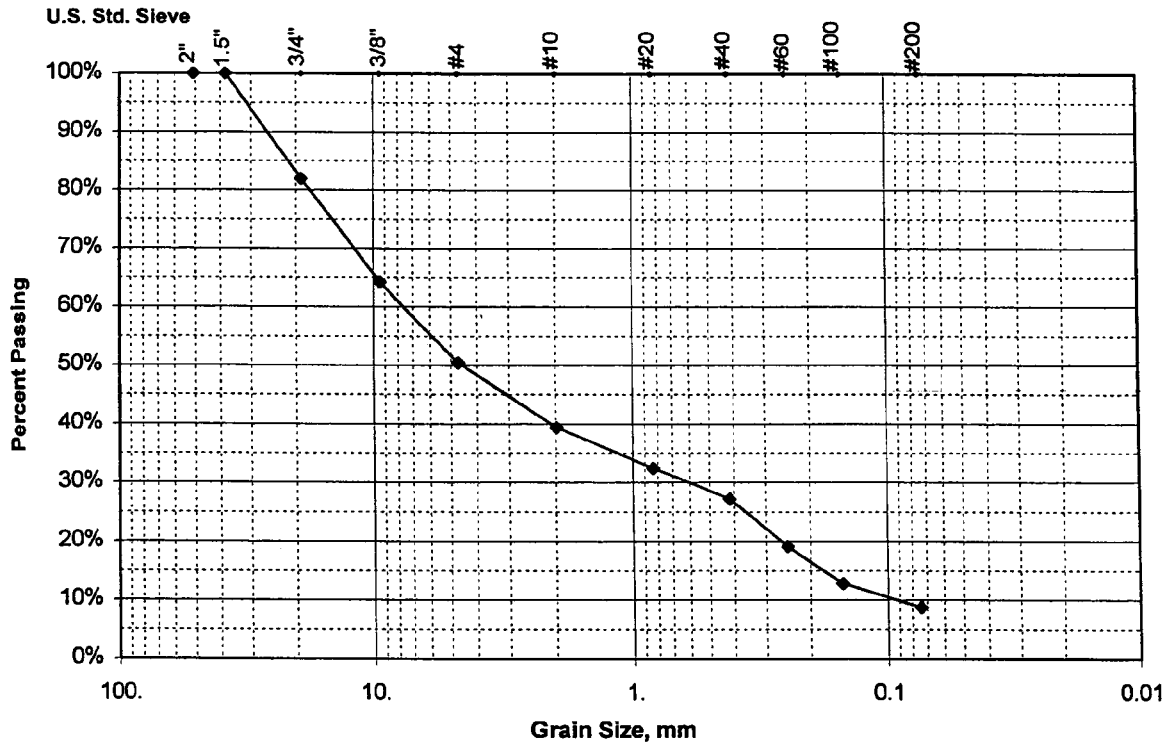
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-81	DEPTH	246.3'-247.8'	SAMPLE#	W22-81-246.3	WELL ID#	C3123
TESTED BY	John Wimet	CONTACT	Dave Weekes	PHONE	372-9130	DATE	01/26/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
982.80	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	177.7	18.1	81.9	19.05	
	3/8"	352.1	35.8	64.2	9.42	
	#4	487.1	49.6	50.4	4.70	
	#10	595.6	60.6	39.4	1.98	
	#20	664.3	67.6	32.4	0.83	
	#40	715.5	72.8	27.2	0.42	
	#60	795.2	80.9	19.1	0.25	
	#100	857.3	87.2	12.8	0.150	
	#200	897.0	91.3	8.7	0.074	

Sieve Analysis Data for Sample W22-81-246.3



Comments: Sandy Gravel

All data are accurately and completely recorded.

Checked By: *McWeekes*

Date: *4/3/01*

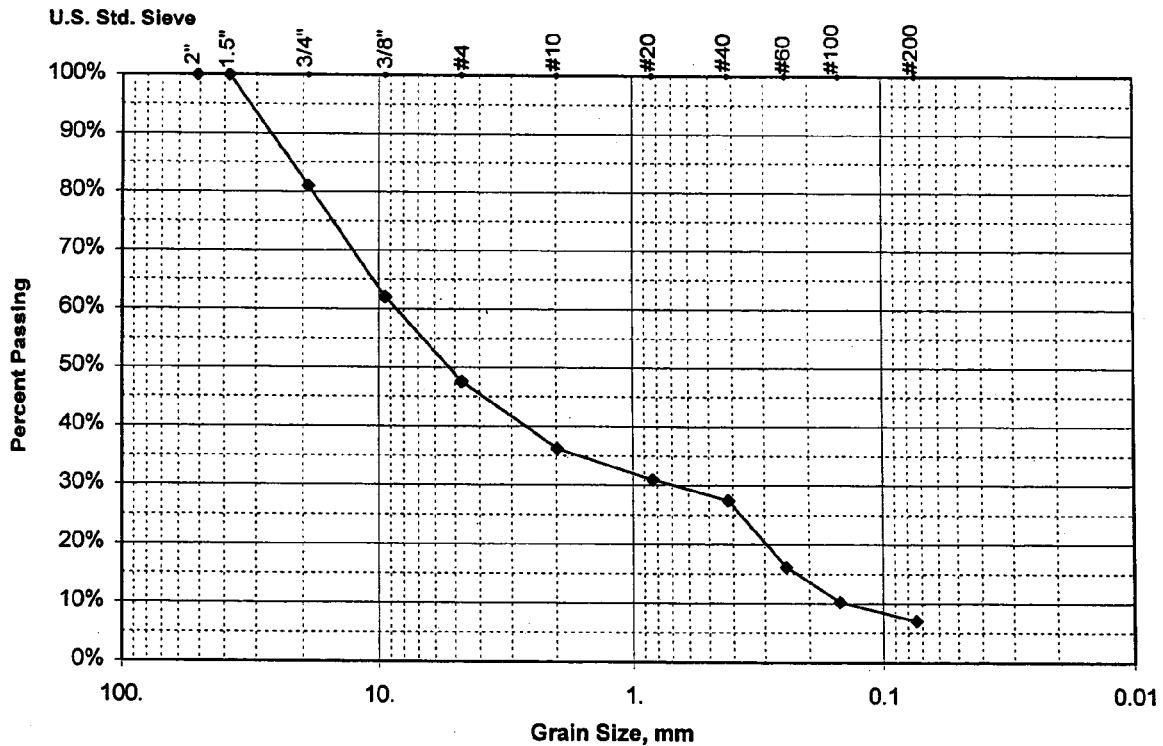
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-81	DEPTH	260.5'-262.5'	SAMPLE#	W22-81-260.5	WELL ID#	C3123
TESTED BY	John Wimett	CONTACT	Dave Weekes	PHONE	372-9130	DATE	01/26/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
968.50	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	184.1	19.0	81.0	19.05	
	3/8"	368.3	38.0	62.0	9.42	
	#4	507.8	52.4	47.6	4.70	
	#10	617.6	63.8	36.2	1.98	
	#20	668.9	69.1	30.9	0.83	
	#40	702.7	72.6	27.4	0.42	
	#60	811.9	83.8	16.2	0.25	
	#100	869.7	89.8	10.2	0.150	
	#200	900.6	93.0	7.0	0.074	

Sieve Analysis Data for Sample W22-81-260.5



Comments: Sandy Gravel

All data are accurately and completely recorded.

Checked By: *[Signature]*

Date: 4/3/01

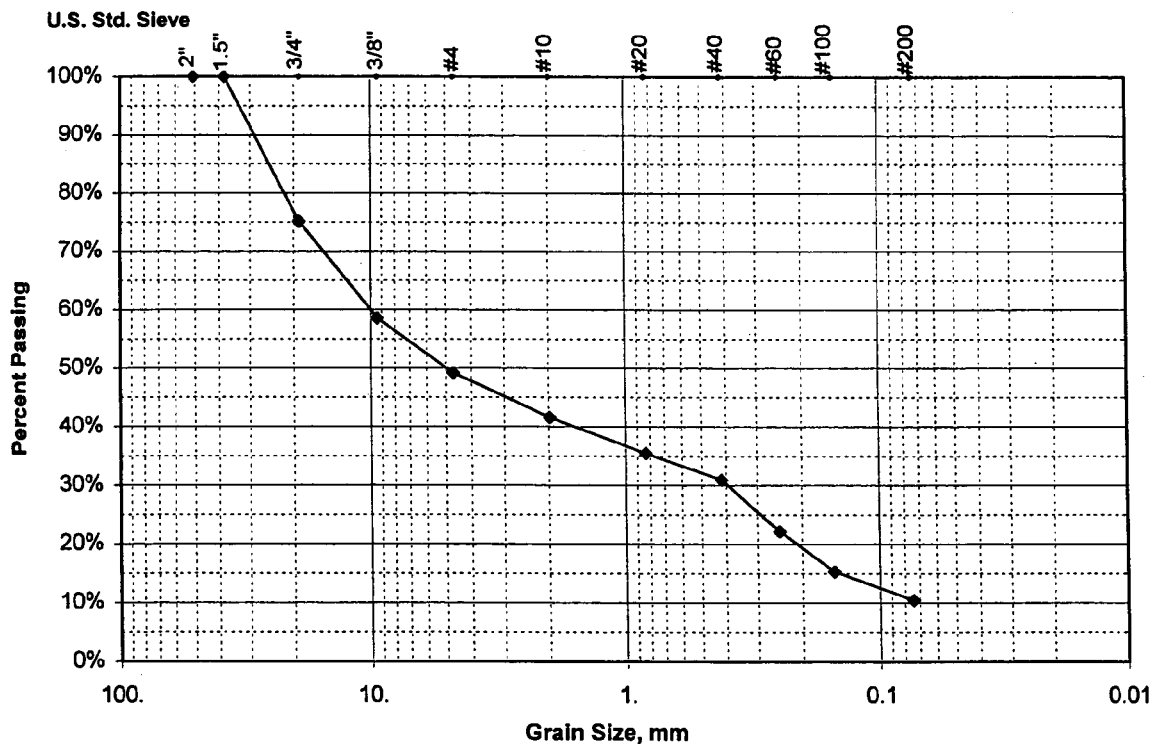
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-83	DEPTH	233.0'-234.0'	SAMPLE#	W22-83-233.0	WELL ID#	C3126
TESTED BY	John Wimett	CONTACT	Dave Weekes	PHONE	372-9130	DATE	03/23/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
983.00	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	244.7	24.9	75.1	19.05	
	3/8"	407.6	41.5	58.5	9.42	
	#4	500.2	50.9	49.1	4.70	
	#10	574.4	58.4	41.6	1.98	
	#20	634.4	64.5	35.5	0.83	
	#40	679.2	69.1	30.9	0.42	
	#60	765.4	77.9	22.1	0.25	
	#100	832.8	84.7	15.3	0.150	
	#200	880.7	89.6	10.4	0.074	

Sieve Analysis Data for Sample W22-83-233.0



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By: *D. Weekes*

Date: 4/3/01

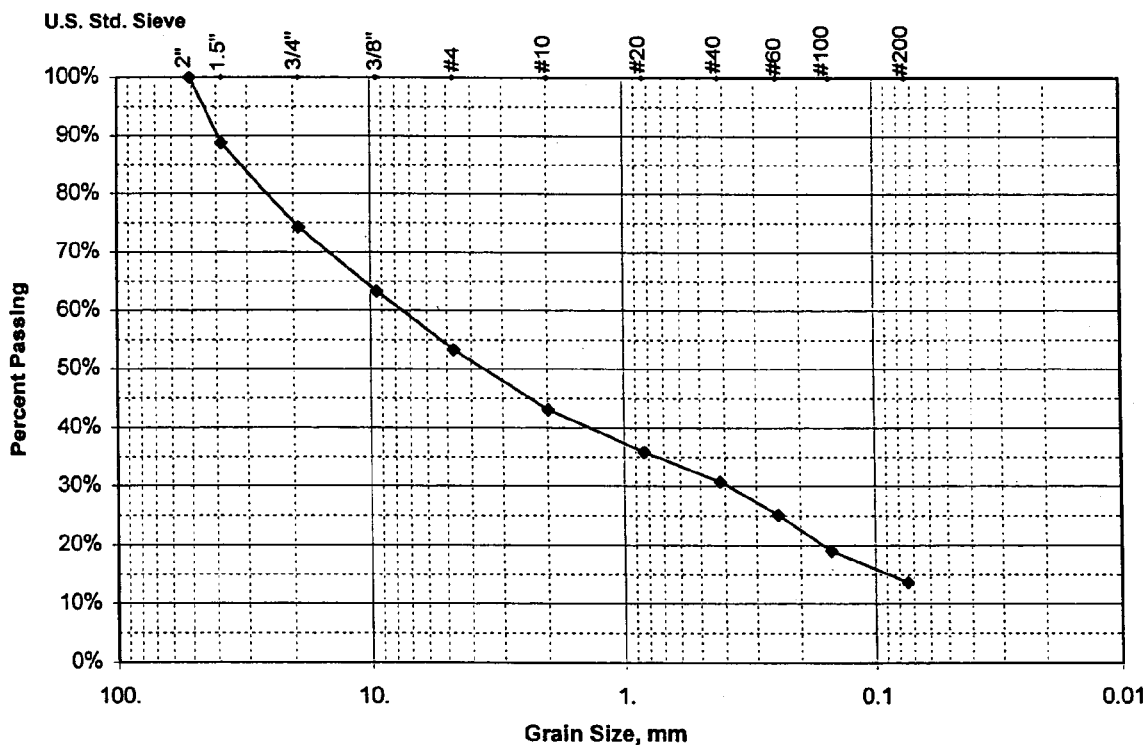
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-83	DEPTH	248.0'-249.0'	SAMPLE#	W22-83-248.0	WELL ID#	C3126
TESTED BY	John Wimett	CONTACT	Dave Weekes	PHONE	372-9130	DATE	03/23/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
963.70	2"	0.0	0.0	100.0	50.80	
	1.5"	108.8	11.3	88.7	38.10	
	3/4"	248.5	25.8	74.2	19.05	
	3/8"	354.0	36.7	63.3	9.42	
	#4	450.2	46.7	53.3	4.70	
	#10	548.6	56.9	43.1	1.98	
	#20	618.4	64.2	35.8	0.83	
	#40	667.4	69.3	30.7	0.42	
	#60	721.4	74.9	25.1	0.25	
	#100	780.8	81.0	19.0	0.150	
	#200	832.6	86.4	13.6	0.074	

Sieve Analysis Data for Sample W22-83-248.0



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By: *[Signature]*

Date: 4/3/01

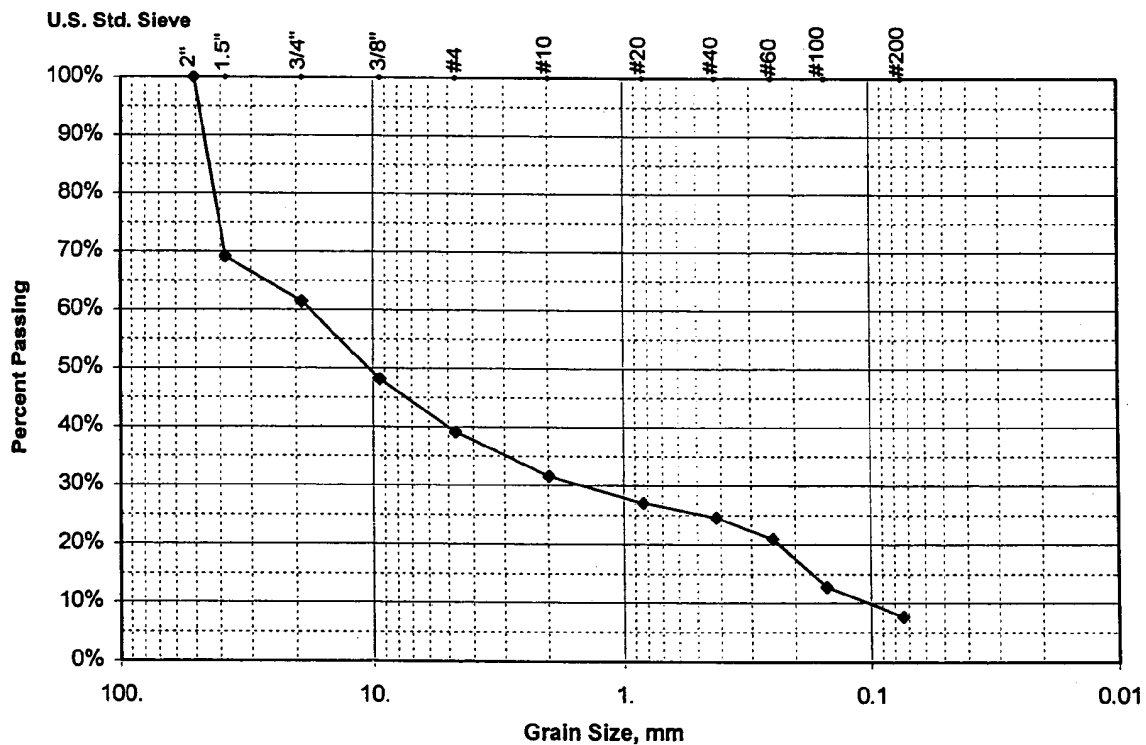
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W22-83	DEPTH	262.0'-264.0'	SAMPLE#	W22-83-262.0	WELL ID#	C3126
TESTED BY	John Wimett	CONTACT	Dave Weekes	PHONE	372-9130	DATE	03/23/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
980.90	2"	0.0	0.0	100.0	50.80	
	1.5"	302.9	30.9	69.1	38.10	
	3/4"	378.3	38.6	61.4	19.05	
	3/8"	509.1	51.9	48.1	9.42	
	#4	597.7	60.9	39.1	4.70	
	#10	671.3	68.4	31.6	1.98	
	#20	715.6	73.0	27.0	0.83	
	#40	739.9	75.4	24.6	0.42	
	#60	775.0	79.0	21.0	0.25	
	#100	856.0	87.3	12.7	0.150	
	#200	905.7	92.3	7.7	0.074	

Sieve Analysis Data for Sample W22-83-262.0



Comments: Sandy Gravel

All data are accurately and completely recorded.

Checked By: *McAfee*

Date: 4/3/01

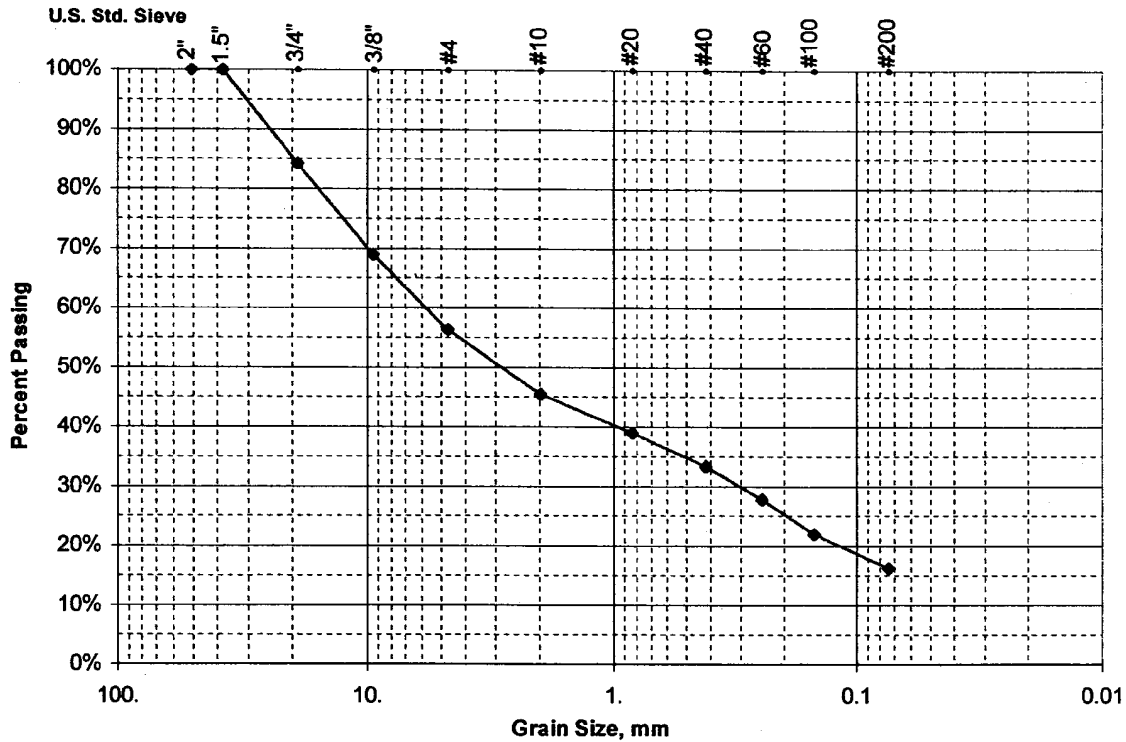
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W23-20	DEPTH	219.5'-220.0'	SAMPLE#	W23-20-219.5	WELL ID#	C3112
TESTED BY	JMW	CONTACT	Dave Weekes	PHONE	372-9524	DATE	08/02/2000

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
708.60	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	111.9	15.8	84.2	19.05	
	3/8"	219.9	31.0	69.0	9.42	
	#4	309.7	43.7	56.3	4.70	
	#10	387.0	54.6	45.4	1.98	
	#20	432.4	61.0	39.0	0.83	
	#40	472.5	66.7	33.3	0.42	
	#60	511.6	72.2	27.8	0.25	
	#100	553.3	78.1	21.9	0.150	
	#200	593.8	83.8	16.2	0.074	

Sieve Analysis Data for Sample W23-20-219.5



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By:

Date:

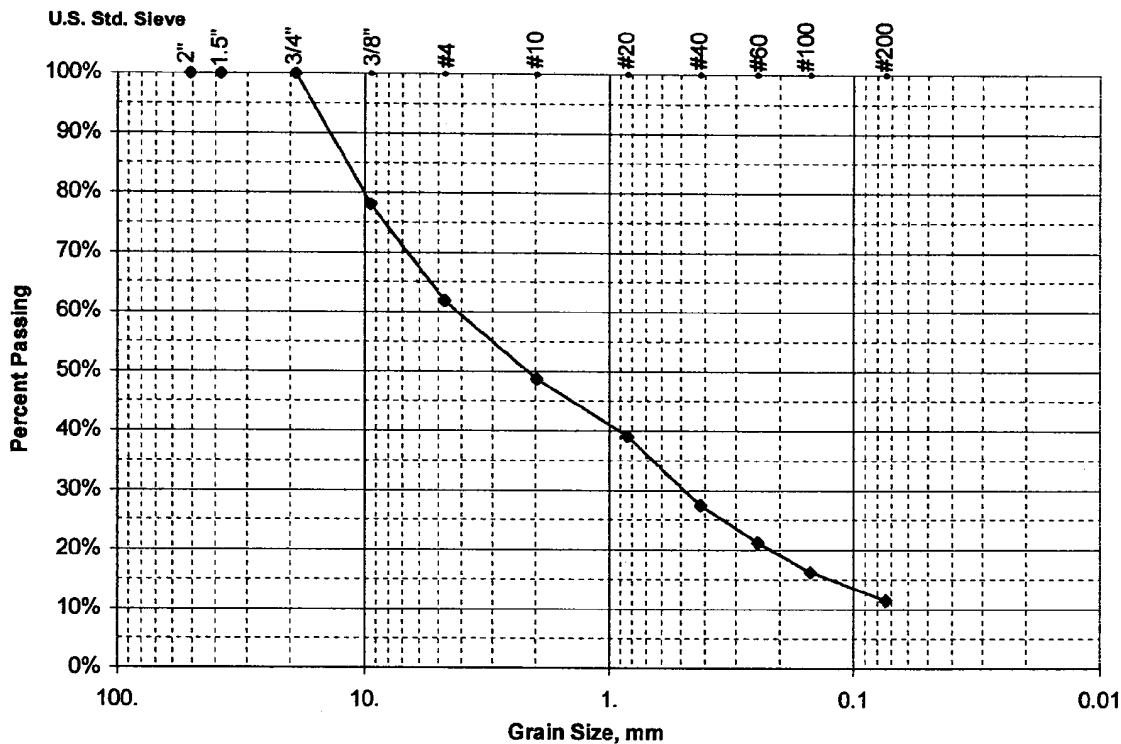
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W23-20	DEPTH	236.0'-237.5'	SAMPLE#	W23-20-236	WELL ID#	C3112
TESTED BY	JMW	CONTACT	Dave Weekes	PHONE	372-9524	DATE	08/02/2000

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
874.40	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	0.0	0.0	100.0	19.05	
	3/8"	192.1	22.0	78.0	9.42	
	#4	334.0	38.2	61.8	4.70	
	#10	448.6	51.3	48.7	1.98	
	#20	532.4	60.9	39.1	0.83	
	#40	634.5	72.6	27.4	0.42	
	#60	689.2	78.8	21.2	0.25	
	#100	732.8	83.8	16.2	0.150	
	#200	774.3	88.6	11.4	0.074	

Sieve Analysis Data for Sample W23-20-236



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By:

Date:

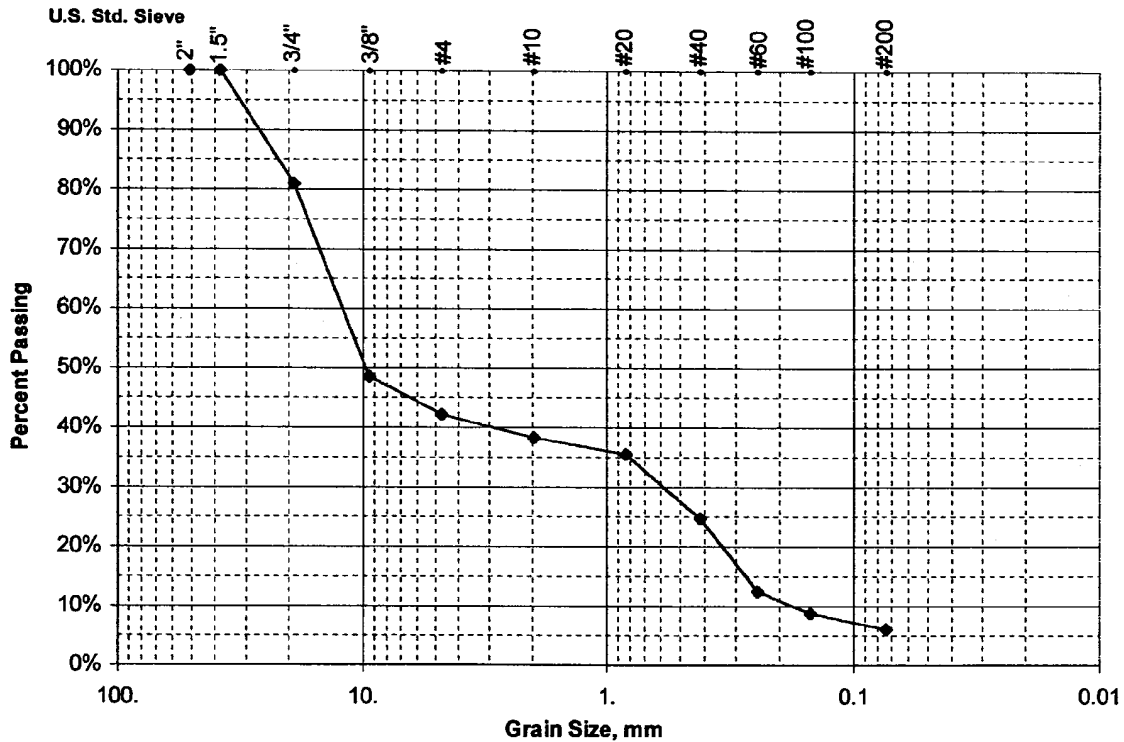
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-w23-20	DEPTH	250.1'-252.6'	SAMPLE#	W23-20-250.1	WELL ID#	C3112
TESTED BY	JMW	CONTACT	Dave Weekes	PHONE	372-9524	DATE	08/03/2000

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
972.50	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	185.3	19.1	80.9	19.05	
	3/8"	500.5	51.5	48.5	9.42	
	#4	562.2	57.8	42.2	4.70	
	#10	600.3	61.7	38.3	1.98	
	#20	626.9	64.5	35.5	0.83	
	#40	732.0	75.3	24.7	0.42	
	#60	851.8	87.6	12.4	0.25	
	#100	888.1	91.3	8.7	0.150	
	#200	913.6	93.9	6.1	0.074	

Sieve Analysis Data for Sample W23-20-250.1



Comments: Sandy Gravel

All data are accurately and completely recorded.

Checked By:

Date:

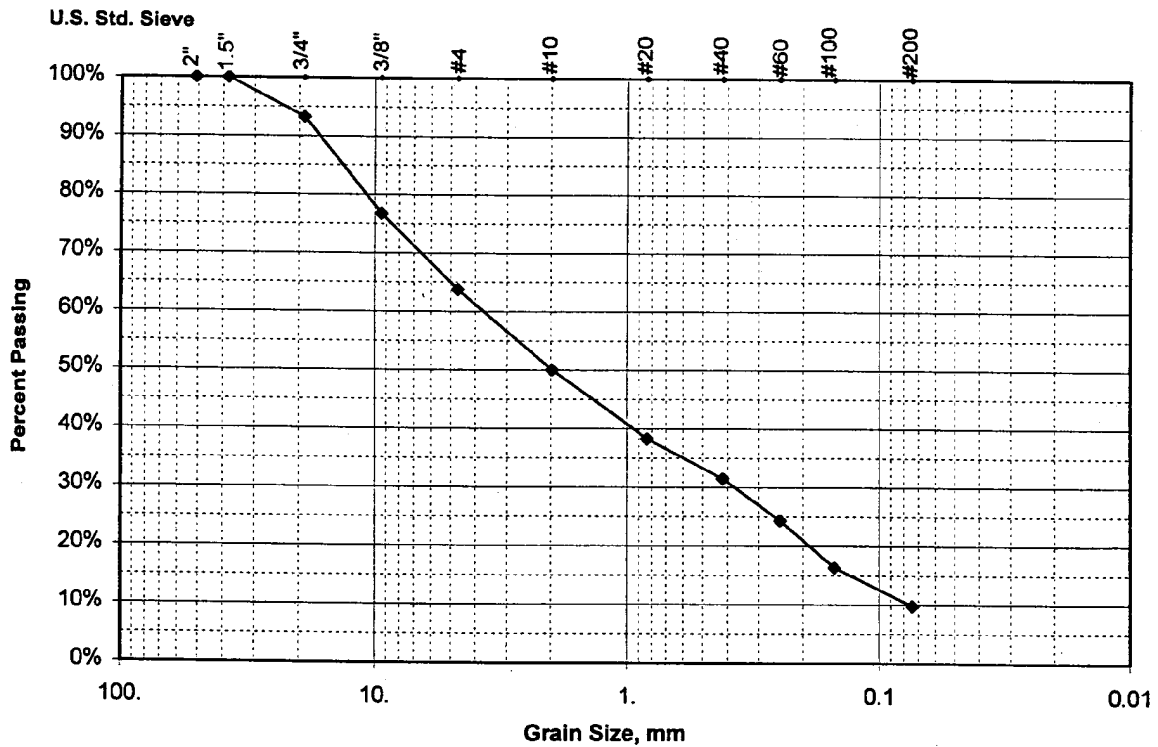
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W23-21	DEPTH	217.0'-219.5'	SAMPLE#	W23-21-217.0	WELL ID#	C3113
TESTED BY	JMW	CONTACT	Dave Weekes	PHONE	372-9524	DATE	11/09/2000

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
949.60	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	64.1	6.8	93.2	19.05	
	3/8"	221.1	23.3	76.7	9.42	
	#4	344.4	36.3	63.7	4.70	
	#10	474.4	50.0	50.0	1.98	
	#20	585.9	61.7	38.3	0.83	
	#40	651.3	68.6	31.4	0.42	
	#60	718.3	75.6	24.4	0.25	
	#100	794.6	83.7	16.3	0.150	
	#200	856.9	90.2	9.8	0.074	

Sieve Analysis Data for Sample W23-21-217.0



Comments: *dkw*
Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By: *DK Weekes*

Date: 11/14/00

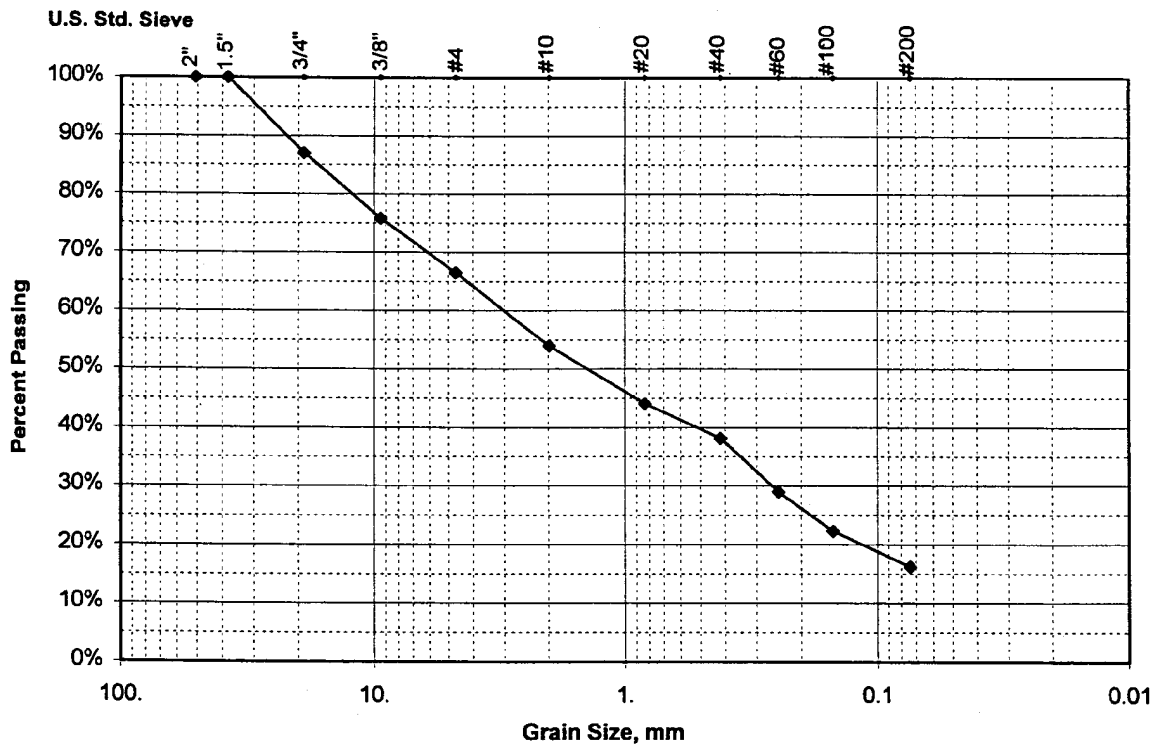
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W23-21	DEPTH	232.0'-234.0'	SAMPLE#	W23-21-232.0	WELL ID#	C3113
TESTED BY	JMW	CONTACT	Dave Weekes	PHONE	372-9524	DATE	11/09/2000

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
982.80	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	127.9	13.0	87.0	19.05	
	3/8"	237.9	24.2	75.8	9.42	
	#4	329.4	33.5	66.5	4.70	
	#10	452.5	46.0	54.0	1.98	
	#20	549.9	56.0	44.0	0.83	
	#40	607.6	61.8	38.2	0.42	
	#60	698.0	71.0	29.0	0.25	
	#100	763.9	77.7	22.3	0.150	
	#200	823.1	83.8	16.2	0.074	

Sieve Analysis Data for Sample W23-21-232.0



Comments: *Silly* Sandy Gravel

All data are accurately and completely recorded.

Checked By: *DC Weekes*

Date: *11/14/00*

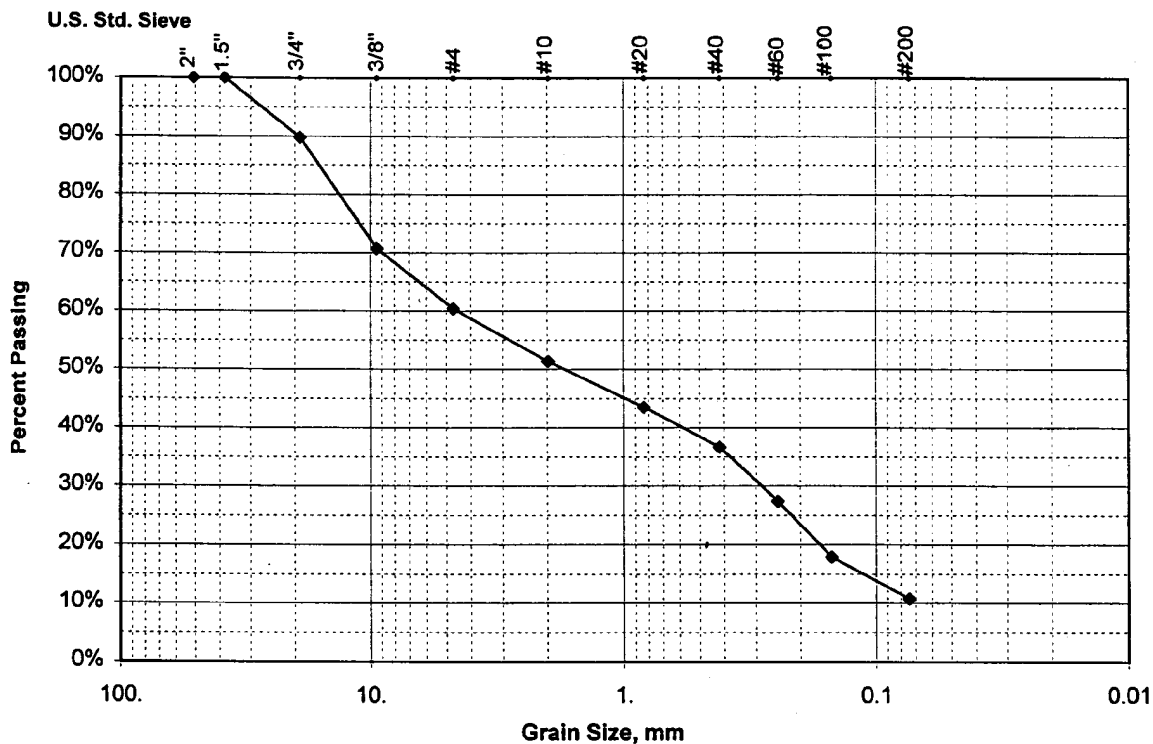
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W23-21	DEPTH	247.5'-248.5'	SAMPLE#	W23-21-247.5	WELL ID#	C3113
TESTED BY	JMW	CONTACT	Dave Weekes	PHONE	372-9524	DATE	11/09/2000

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
981.20	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	100.3	10.2	89.8	19.05	
	3/8"	287.8	29.3	70.7	9.42	
	#4	388.9	39.6	60.4	4.70	
	#10	477.1	48.6	51.4	1.98	
	#20	554.7	56.5	43.5	0.83	
	#40	621.2	63.3	36.7	0.42	
	#60	712.3	72.6	27.4	0.25	
	#100	805.5	82.1	17.9	0.150	
	#200	875.5	89.2	10.8	0.074	

Sieve Analysis Data for Sample W23-21-247.5



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By: *[Signature]*

Date: 11/14/00

Appendix C

Borehole Geophysical Logs

Appendix C

Borehole Geophysical Logs

This appendix contains the borehole geophysical logs obtained from boreholes 299-W22-81, 299-W22-83, 299-W22-83, and 299-W23-21. The logs were run and analyzed by Duratek, Waste Management Federal Services Northwest, Inc. and MacTec Inc. Log Header sheets and Log Analysis Summary Reports are included with the logs.

Log Data Report 299-W22-81

Borehole Information

Site: East of SX Tank Farm; RCRA well			Site Number: 299-W22-81	
N-Coord: N/A		E-Coord: N/A		TOC Elev: N/A
GW Depth: 235.4 ft	Log Date: 1/22/01	Date Drilled: 01/22/01	TD, (ft): 268.4 ft	
Casing Record (all casing depths in feet relative to ground surface)				Page: 1
Type:	ID, in.	Thick, in.	Top	Bottom
Steel-thread	9.25	0.75	1.9' AGS	269.0'

Borehole Notes:

Borehole 299-W22-81 (C3123) was drilled in January 2001 to a total depth of 268.4 ft. A cable-tool drilling rig was used to install the borehole. Single casing was present from 1.9 ft above ground surface to a total depth of 269.0 ft and was comprised of 9.25-in.-diameter, 0.75-in.-thick threaded steel. At the time analysis was performed, the borehole coordinates and ground surface elevation were not available. The zero reference for all log depths is the ground surface. The depth to water reported by the well site geologist was 226.3 ft, but the measurements from the neutron logging suggest the depth to water was at approximately 235.4 ft at the time of logging.

Equipment Information

Log System: 2B	Type: HPGe	Efficiency: 35%
Cal Date: Feb-00	Cal Ref: GJO-HAN-30	Log Proc: MAC-VZCP 1.7.10-1, Rev 3

Logging Information

Log Event	A	A				
Log Run No.	1	2				
Date	1/22/01	1/22/01				
Logging Engineer	A. Pearson	A. Pearson				
Start depth, (ft)	0.0	130.0				
Finish depth (ft)	160.0	264.0				
Count time (sec)	n/a	n/a				
Live Time / Real Time:	L	L				
Shield	None	None				
MSA Interval, (ft)	0.5	0.5				
Logging speed, (ft/min)	0.7 ft/min	0.7 ft/min				

Logging Operation Notes:

Logging operations were performed by MACTEC-ERS under contract with Duratek Federal Services, who also specified the logging parameters. This borehole was logged with the MACTEC-ERS Spectral Gamma Logging System (SGLS) in two log runs to a total depth of 264 ft. Details for the SGLS logging events and log runs are presented in the *Logging Information* section of this report. Neutron logging events are not recorded in this Log Data Report.

Log run two (130-264 ft) overlaps part of log run one (0-160 ft) and defines the repeat interval (130-160 ft) for the SGLS survey. The repeat log run was performed to check for depth and concentration repeatability.

Log Data Report

299-W22-81

Analysis Information

Analyst: R. Spatz, R. McCain

Date: 2/12/01

Analysis Ref: MAC-VZOP 1.7.9, Rev. 2

Page: 2

Analysis Notes:

Log analysis was performed by MACTEC-ERS under contract with Duratek Federal Services. The pre- and post-survey field verification spectra met the acceptance criteria established for peak shape and detector efficiency. The energy calibration and peak-shape calibration from these spectra were used in processing the log spectra. Dead time was less than 10% throughout the borehole and no dead time corrections were applied. Repeat logging intervals were collected at the depths shown in the combination plot. Excellent repeatability is shown, confirming an acceptable performance of the logging systems.

A casing correction factor for 0.75-in.-thick steel casing was applied to the data between depths of 0 and 264 ft. A water correction factor was also applied to spectral data collected below the depth of 235.4 ft. At the time of logging, grout was not present around the borehole.

Gamma-ray photon peaks associated with specific energies were used to calculate concentrations in picocuries per gram (pCi/g) for naturally occurring radionuclides potassium-40 (K-40), uranium-238 (U-238), and thorium-232 (Th-232) (KUT), with gamma-ray energies of 1460.8, 609.3, and 2614.5 keV, respectively.

Shorter than optimal system counting time (0.7 ft/min) for relatively thick casing (0.75-in.-thick) is the cause of the intermittent detection of U-238 (609.3 keV).

Spectral data analysis at the 85.75- and 165.75-ft depths, using the routine processing software, calculated two very low concentrations of Cs-137. Review of the spectra shows high counting errors; therefore, the peaks are not considered statistically valid. In the absence of additional Cs-137 being detected from above or below these intervals, the existence of the Cs-137 could not be corroborated and was removed from the log plots.

Higher than average KUT concentrations below the depth of 256 ft may be attributed to a lithology change, or the absence of casing, which caused the concentrations to be overestimated at this depth.

Neutron data acquired with the SGLS using Duratek Federal Services' neutron moisture sonde are presented in neutron count rate instead of percent volumetric moisture, because this tool is not calibrated on the SGLS.

Log Plot Notes:

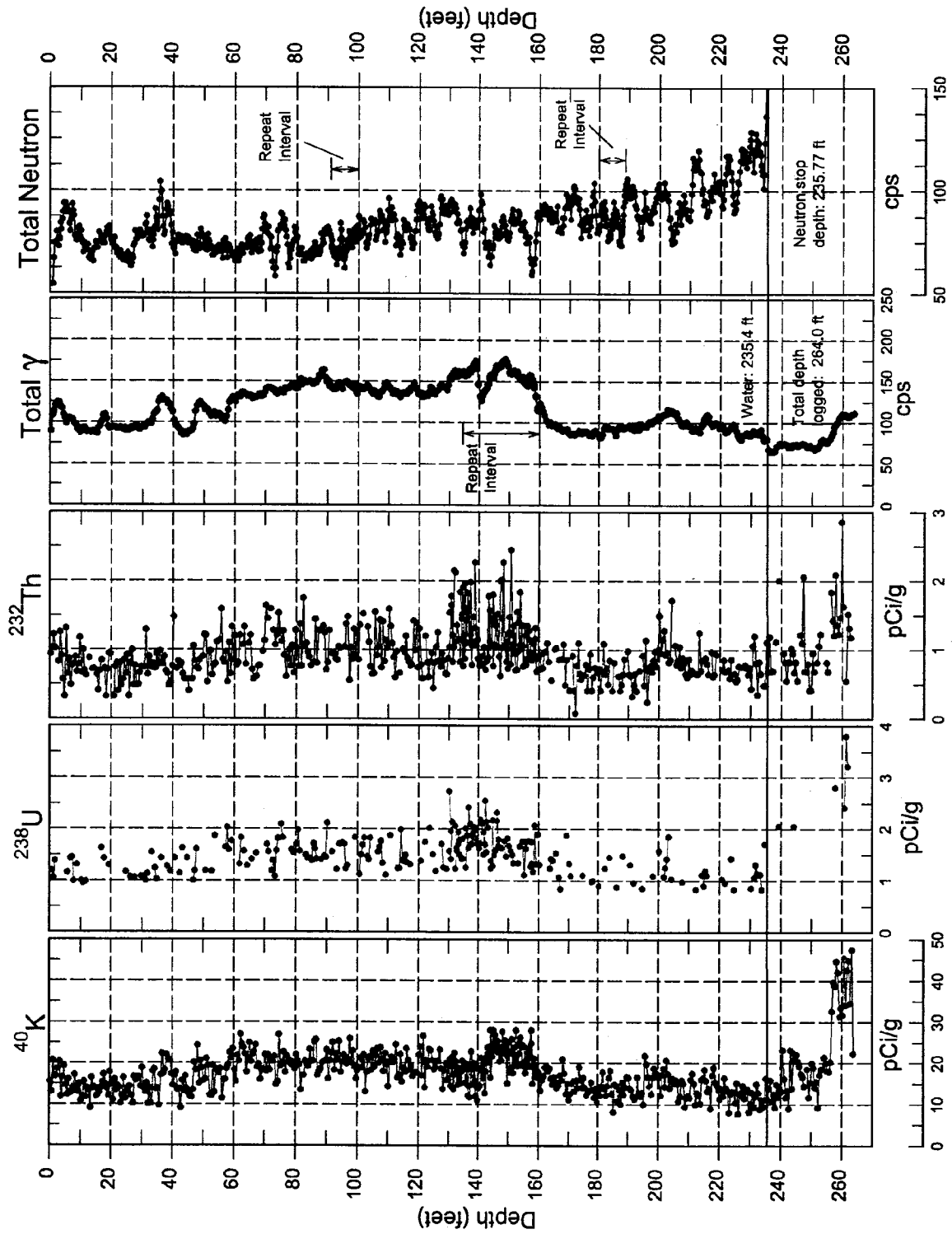
Separate log plots are provided for total gamma, total neutron, and naturally occurring radionuclides (KUT). A plot of the total neutron count rate is provided on the combination plot as well as on several plots showing total gamma and total neutron count rates.

Results / Interpretations:

Borehole 299-W22-81 was logged with the SGLS on January 22, 2001. A neutron and spectral gamma survey were both conducted in this borehole and recorded as log Events A and B, respectively.

Man-made contaminants were not detected by the SGLS survey. Naturally occurring U-238 and Th-232 concentrations increase between 130 and 140 ft, and KUT concentrations increase between 142 and 160 ft, which may indicate lithology changes. The total gamma count rate correlates at those depths where KUT concentrations increase. Neutron logging detected ground water at the 235.4-ft depth.

299-W22-81 Combination Plot



Spectral Gamma Survey

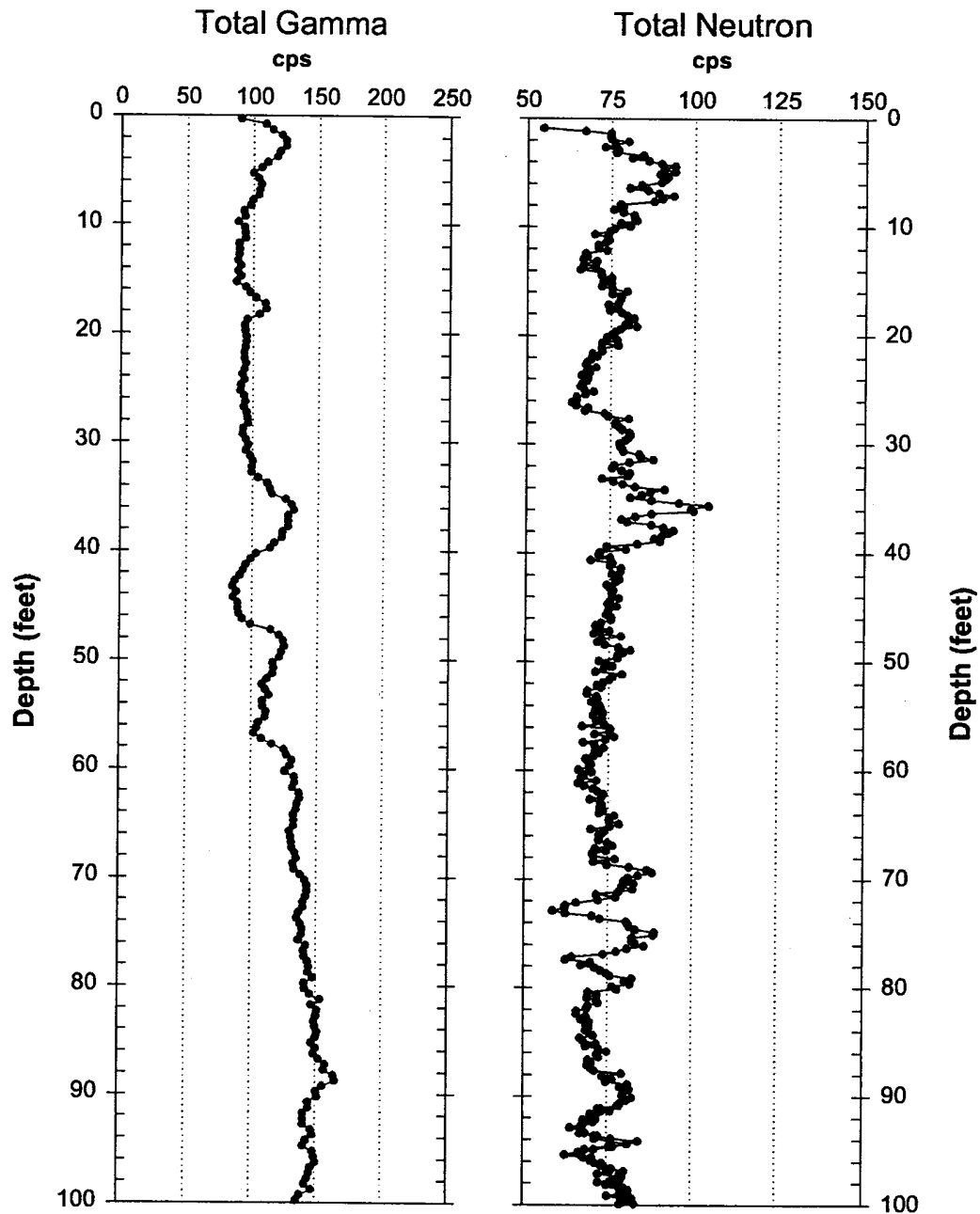
Duratek Federal Services

Project: RCRA Well

Well: 299-W22-81

Log Date: January 22, 2001

Depth Datum: Ground Level



Spectral Gamma Survey

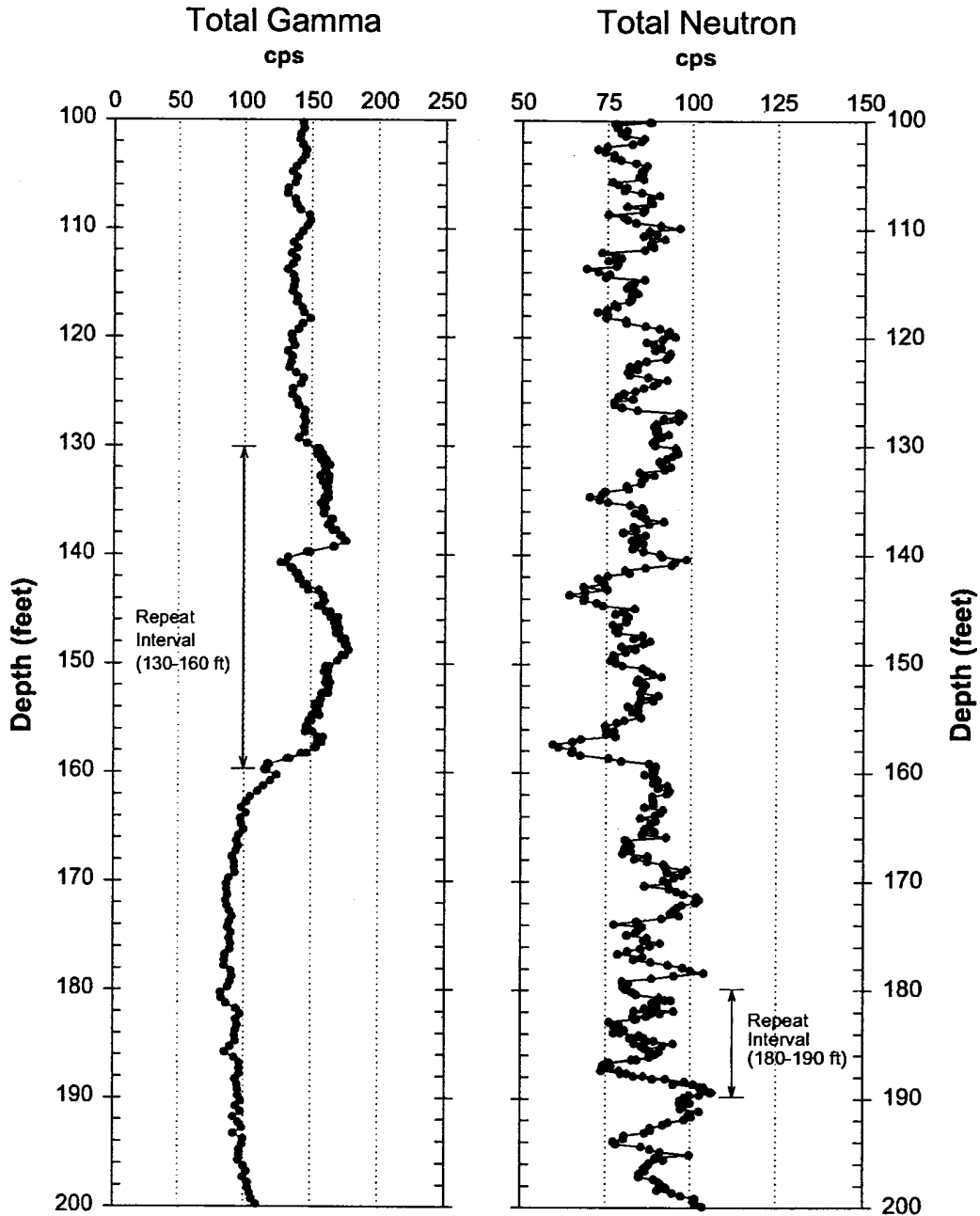
Duratek Federal Services

Project: RCRA Well

Well: 299-W22-81

Log Date: January 22, 2001

Depth Datum: Ground Level



Spectral Gamma Survey

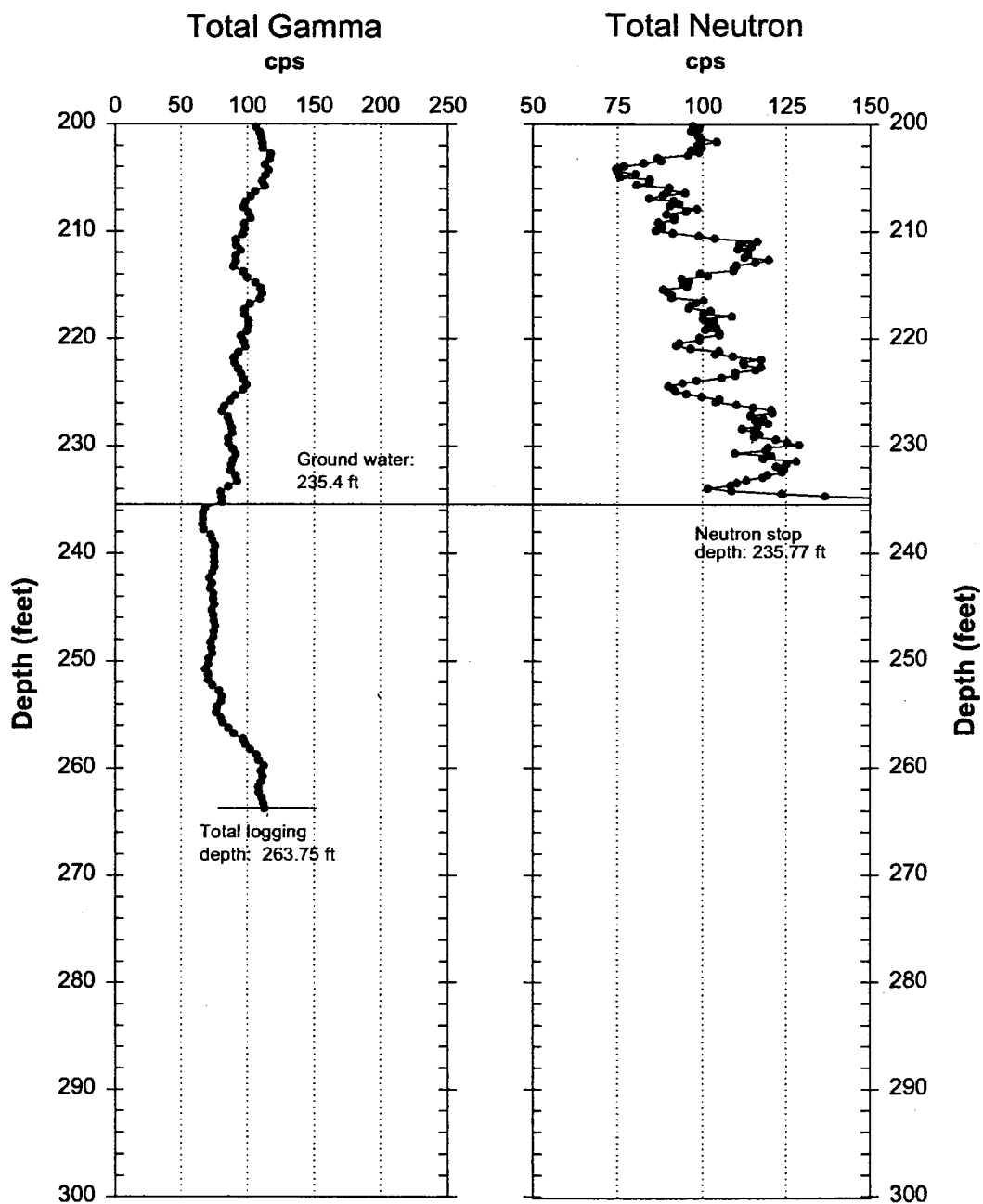
Duratek Federal Services

Project: RCRA Well

Well: 299-W22-81

Log Date: January 22, 2001

Depth Datum: Ground Level



Spectral Gamma Survey

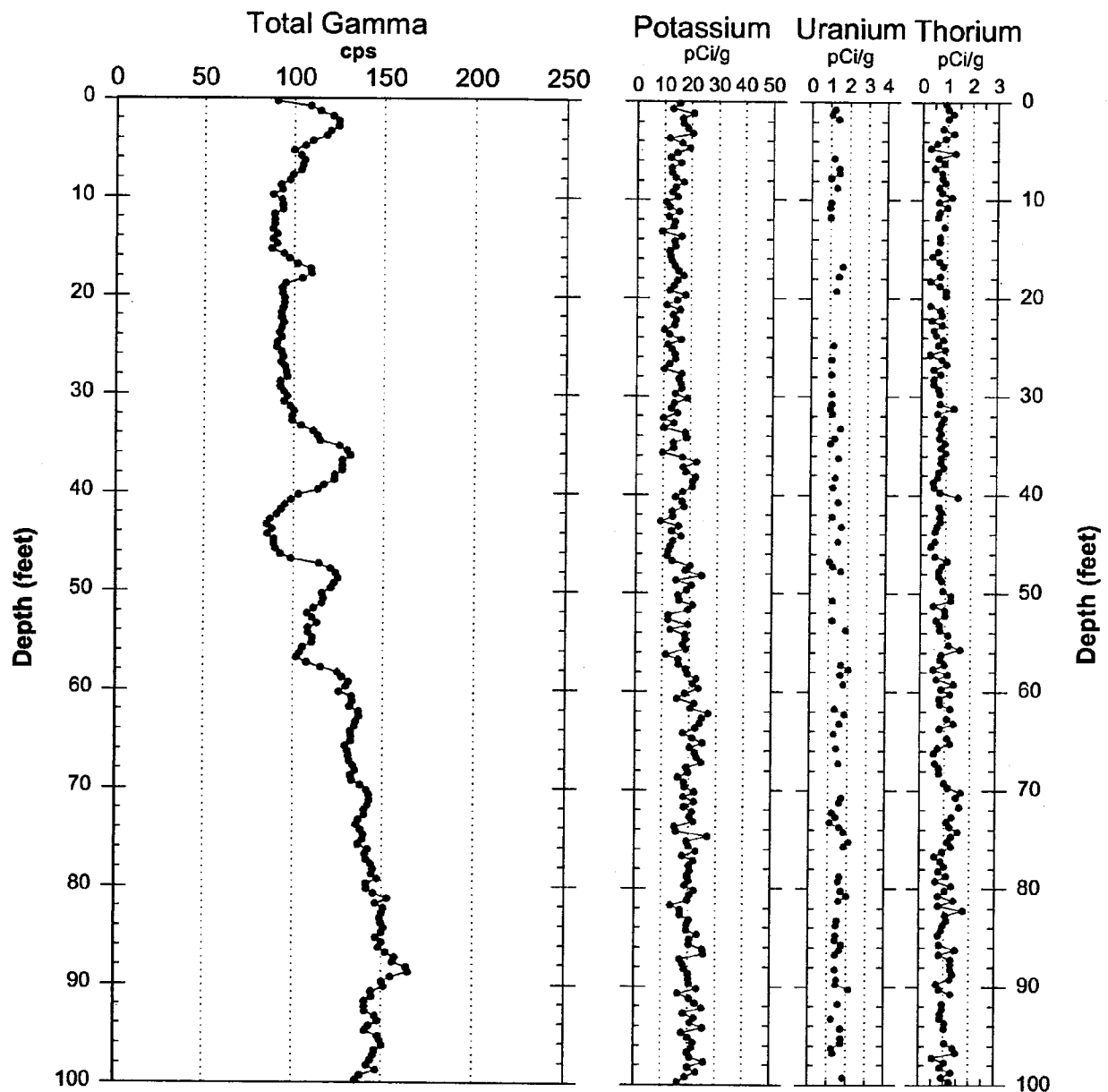
Duratek Federal Services

Project: RCRA Well

Well: 299-W22-81

Log Date: January 22, 2001

Depth Datum: Ground Level



Spectral Gamma Survey

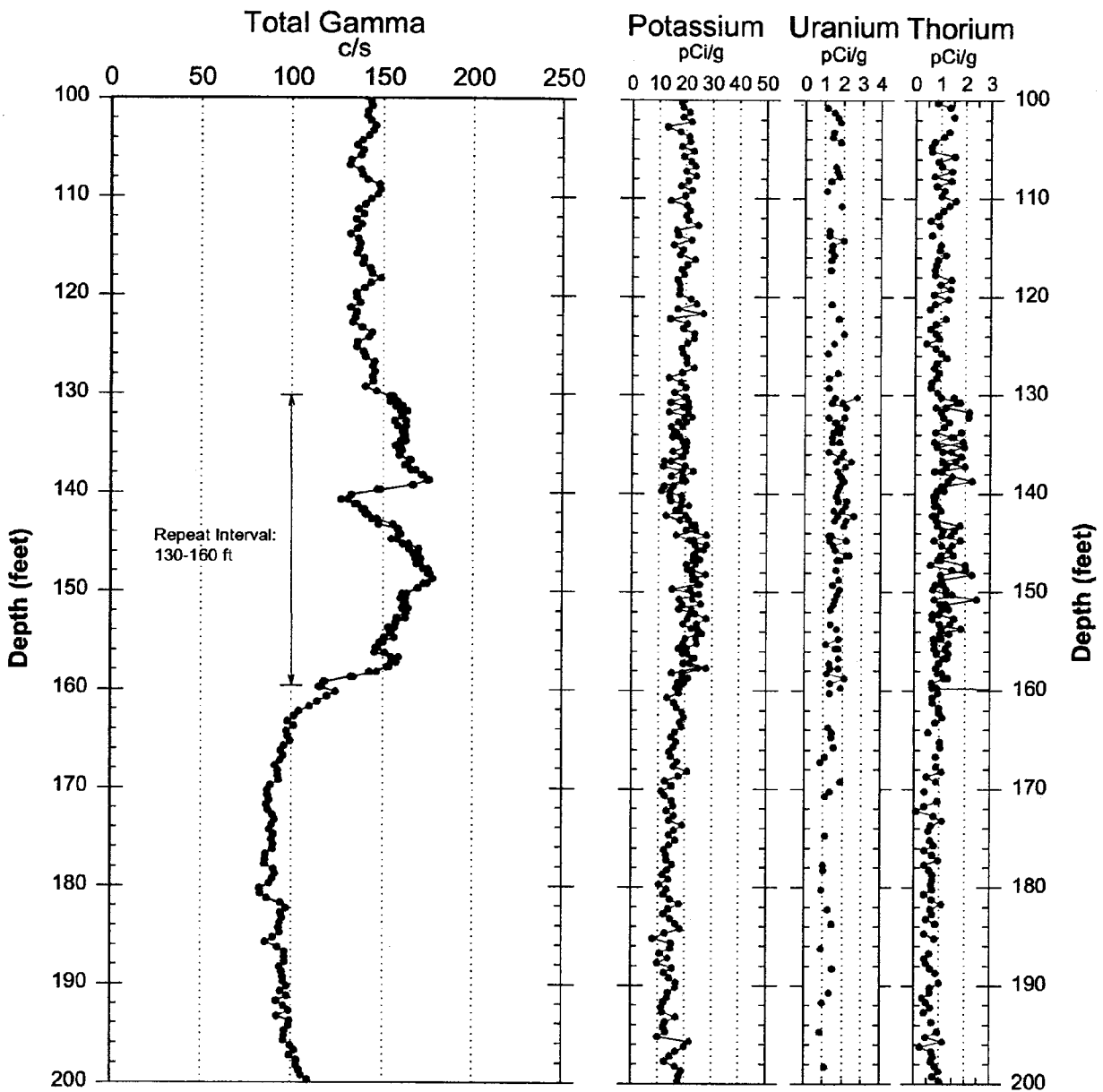
Duratek Federal Services

Project: RCRA Well

Log Date: January 22, 2001

Well: 299-W22-81

Depth Datum: Ground Level



Spectral Gamma Survey

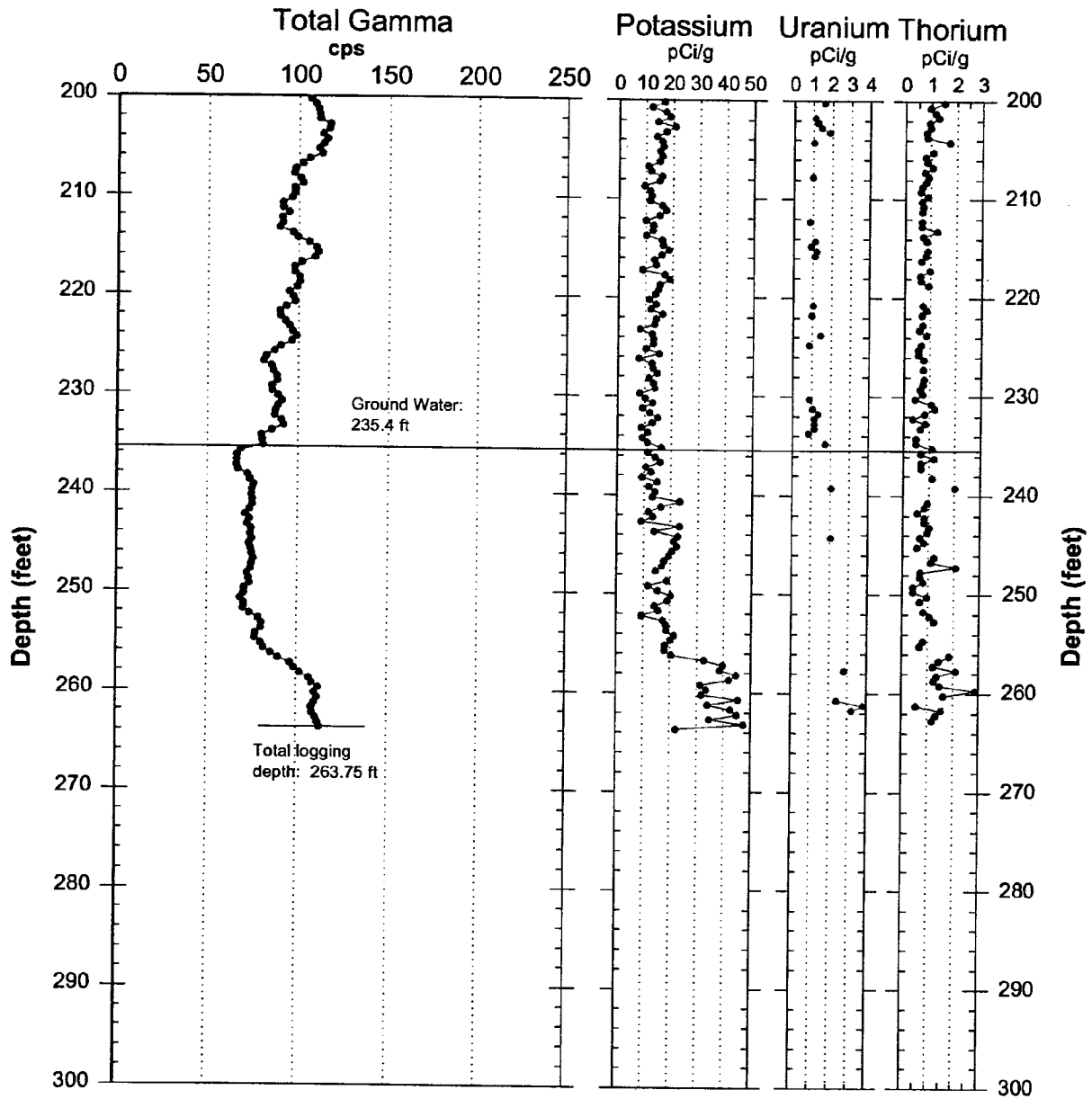
Duratek Federal Services

Project: RCRA Well

Log Date: January 22, 2001

Well: 299-W22-81

Depth Datum: Ground Level



Neutron-Neutron Moisture Borehole Survey

Duratek Federal Services, Inc.

Log Header

Project: 2000 RCRA Drilling

Well: 299-W22-81

Log Type: Moisture Gauge

Borehole Information

Well # <u>C3123</u>	Water Depth <u>235*</u> ft	Total Depth <u>269</u> ft
Elevation Reference <u>n/a</u>	Elevation <u>n/a</u> ft	
Depth Reference <u>Ground Surface</u>	Casing Stickup <u>1.9</u> ft	
Casing Diameter <u>9.25ID</u> in	Depth Interval <u>0 to 269</u> ft	Thickness <u>0.75</u> in

*235 ft water depth is from log response of 1-22-01, geologist's set water depth at 226 ft

Logging Information

Log Type:	Moisture Gauge	
Company	Duratek Federal Services, Inc.	
Date/Archive File Name	January 22, 2001	2W22081
Logging Engineers	<u>A. Pearson</u>	
Instrument Series	RLSM00.0	
Logging Unit	RLS-2	
Depth Interval	0 to 100 ft	Prefix FOBA1
	90 to 190 ft	FOBA2
	180 to 236 ft	FOBA3
Instrument Calibration Date	July 14, 2000	
Calibration Report	WHC-SD-EN-TI-306, Rev. 0	

Analysis Information

Company	Three Rivers Scientific
Analyst	Russ Randall
Date	February 5, 2001
Notes	<u>Moisture values range from 3% to 21% for the depths logged. The onset of high moisture readings at 235 feet is due to the proximity of the water level in the borehole. No valid calibration is available for the 9.25 inch casing diameter from surface to 269 feet. The calibration for the 10.75 inch borehole diameter was extrapolated from standard diameter conditions, and casing correction applied to all depths logged.</u>

Moisture Log Analysis & Summary

Duratek Federal Services, Inc.

Project: 2000 RCRA Drilling
Log Type: Moisture Gauge

Well ID: 299-W22-81
Log Date: January 22, 2001

General Notes:

The largest borehole diameter for the calibration models is an 8.64 inch borehole diameter, with .32 inch casing thickness, and the borehole diameter in these log data is 10.75 inches. Therefore, an extrapolation was calculated for the applied calibration coefficients to match the conditions of the logged borehole. The method of extrapolation generated conservative estimates for the moisture values (possibly lower values than a valid calibration). The size differential of this borehole from the calibration standard is at the limits of rigorous extrapolation; however, the resultant moisture values appear to be near those commonly encountered for vadose zone results at the Hanford site.

Log data collected with a depth reference of ground surface.

System Performance Verify: The pre- and post-log verification passed performance standards, +1.3% change from start of log to end of log, in the shield verify.

Repeat Interval: Based on the repeat intervals from 91 to 100 feet and 181 to 190 feet, the logging system performed according to specifications.

Environmental Corrections: The moisture levels have been corrected for casing thickness (0.75 inch) for all well depths logged. No formation density correction has been applied because density values are not available.

Observations:

The moisture levels show values ranging from 3% to 21% for all depth intervals logged. The abnormally high readings that begin at 235 feet are a response to the water level at 235 feet. Note that geologist's information puts the water depth at 226 feet. The date of the geologist's information is unknown, but the moisture log response puts the water depth of 235 feet on January 22, 2001.

Analysis by: Three Rivers Scientific

RLS Neutron-Neutron Moisture

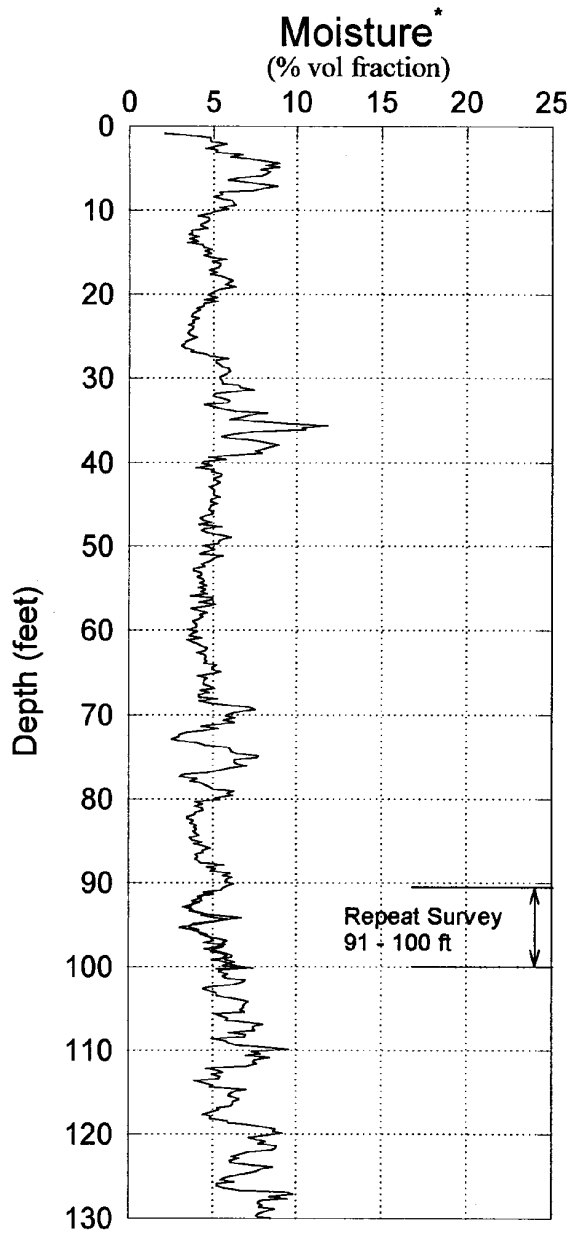
Duratek Federal Services, Inc.

Project: 2000 RCRA Drilling

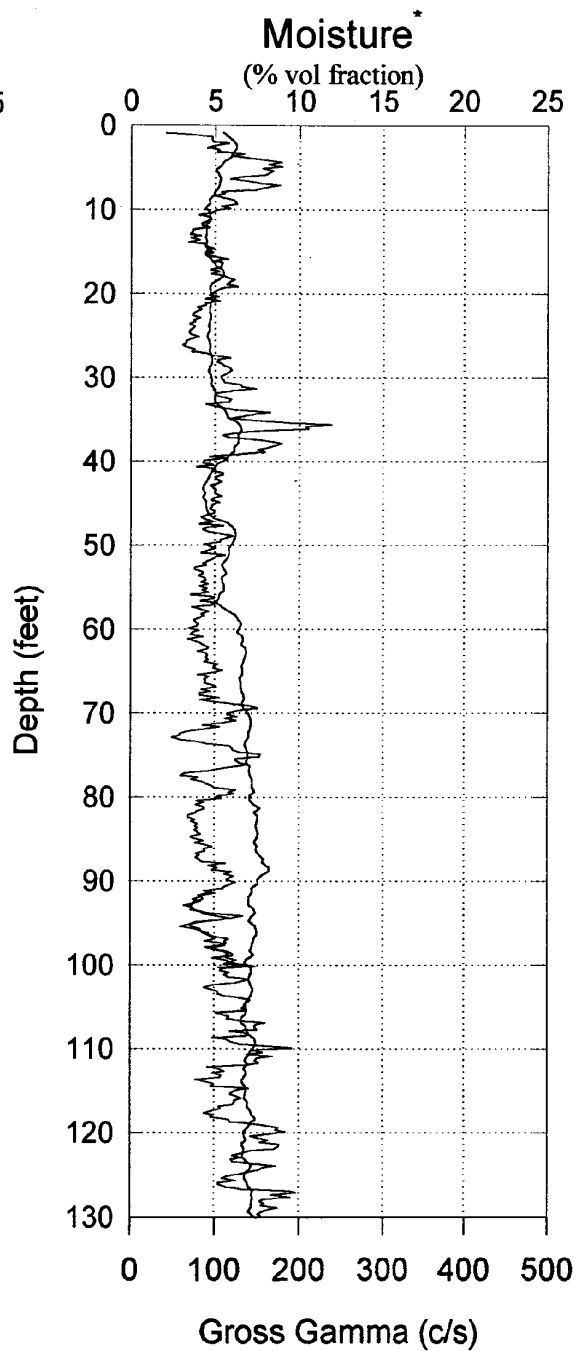
Log Date : January 22, 2001

Borehole: 299-W22-81

Depth Datum : Ground Surface



* Calibration extrapolated to 10.75 inch borehole diameter
Casing thickness correction for 0.75 inch
Analysis by Three Rivers Scientific



RLS Neutron-Neutron Moisture

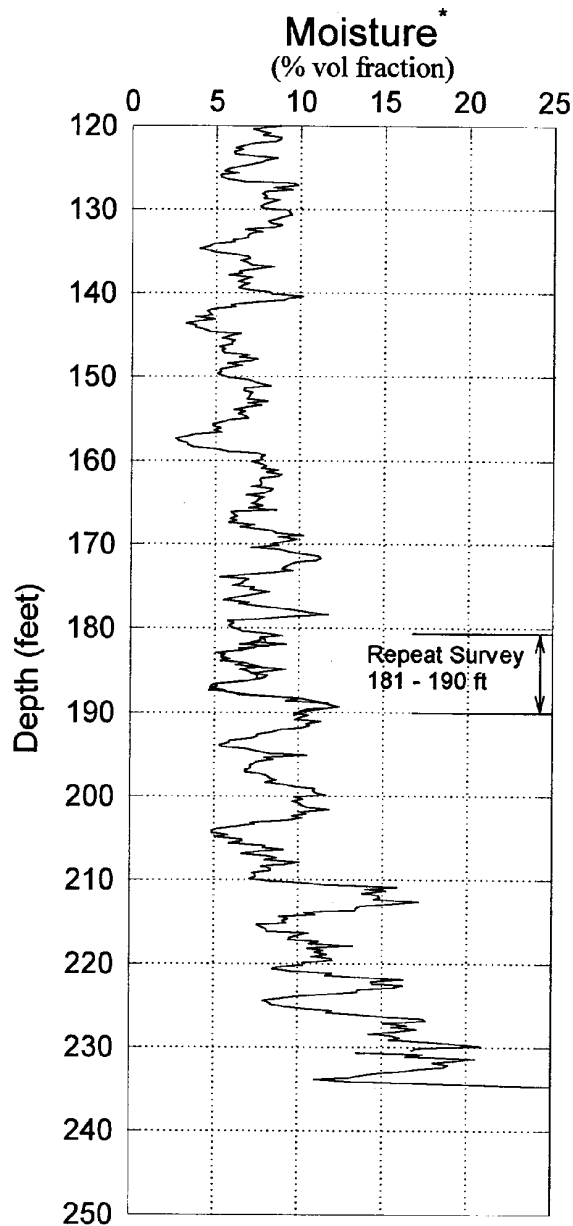
Duratek Federal Services, Inc.

Project: 2000 RCRA Drilling

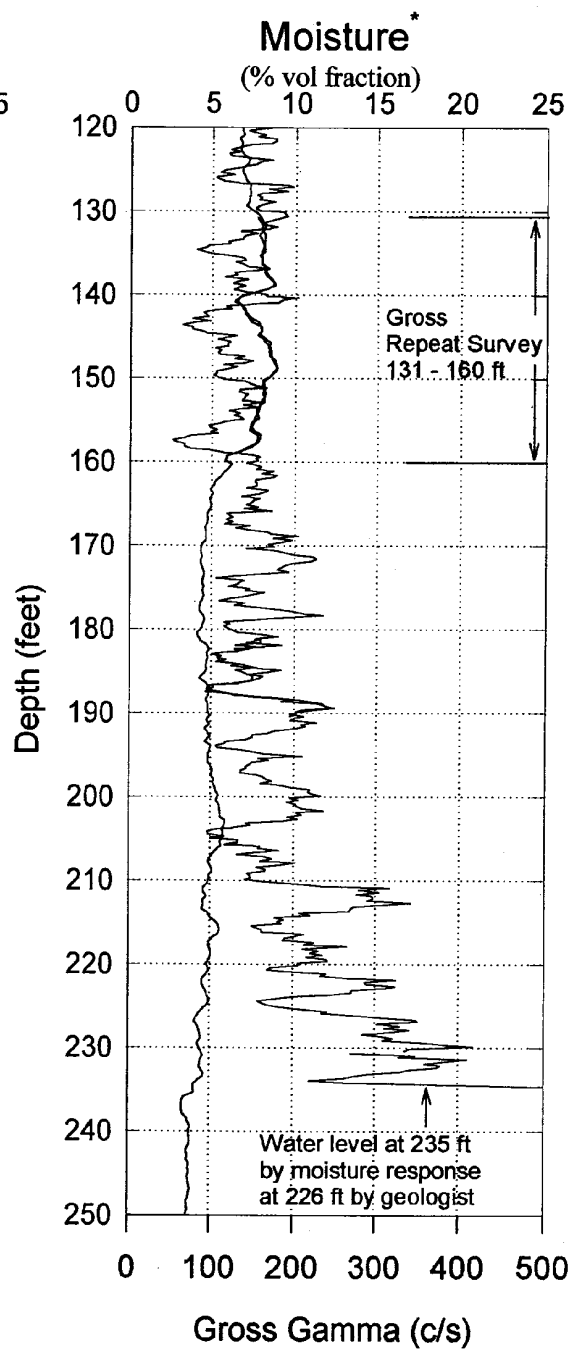
Log Date : January 22, 2001

Borehole: 299-W22-81

Depth Datum : Ground Surface



* Calibration extrapolated to 10.75 inch borehole diameter
Casing thickness correction for 0.75 inch
Analysis by Three Rivers Scientific



Spectral Gamma & Moisture Survey

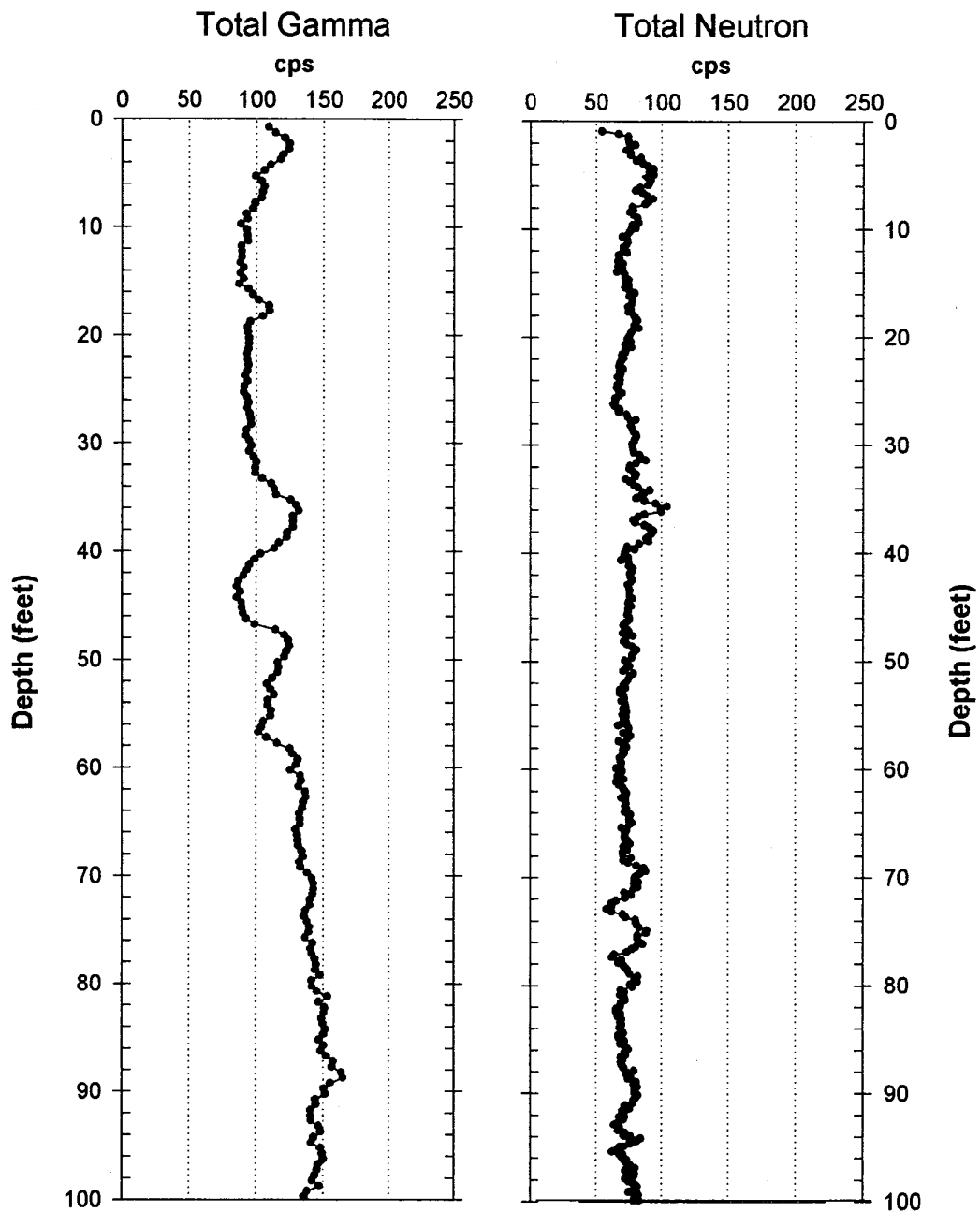
Duratek Federal Services

Project: RCRA Well

Log Date: January 23 & 24, 2001

Well: 299-W22-81

Depth Datum: Ground Level



Spectral Gamma & Moisture Survey

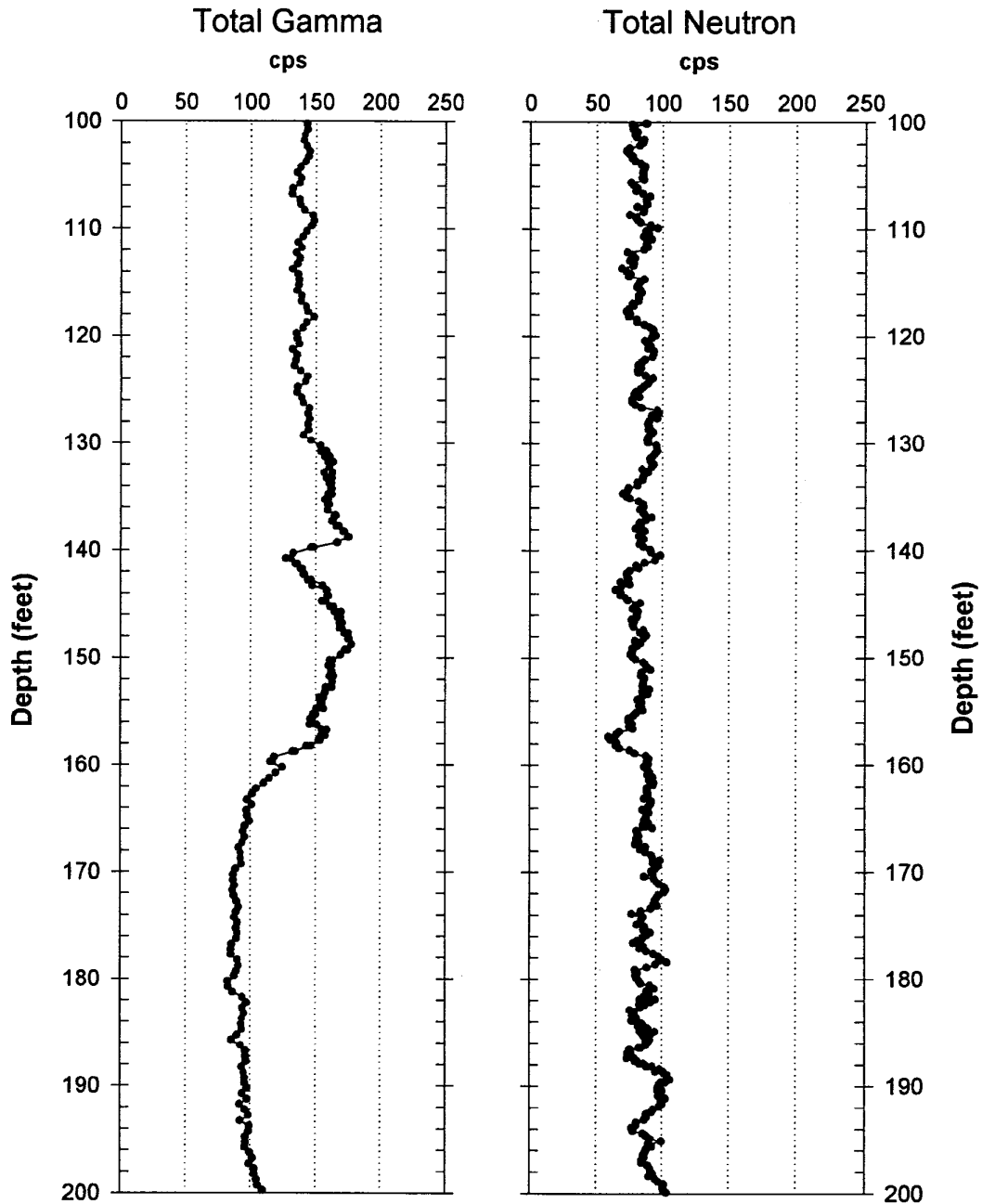
Duratek Federal Services

Project: RCRA Well

Log Date: January 23&24, 2001

Well: 299-W22-81

Depth Datum: Ground Level



Spectral Gamma & Moisture Survey

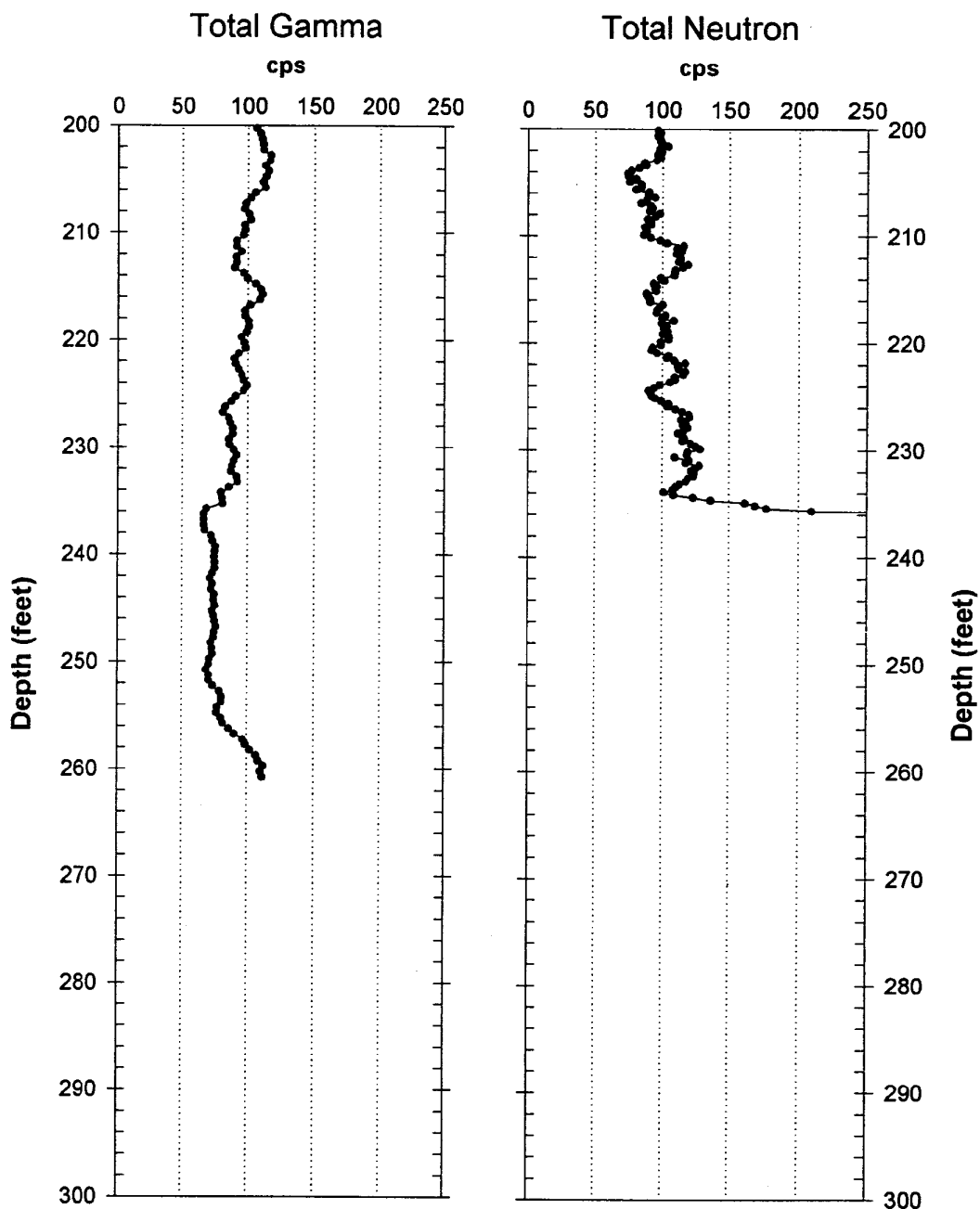
Duratek Federal Services

Project: RCRA Well

Well: 299-W22-81

Log Date: January 23&24, 2001

Depth Datum: Ground Level



RLS Spectral Gamma Ray Borehole Survey

Duratek Federal Services

Log Header

Project: RCRA Drilling

Well: 299-W22-83

Log Type: HPGe Spectral Gamma Ray

Borehole Information

Well # <u>C3126</u>	Water Depth <u>236*</u> ft	Total Depth <u>274.2</u> ft
Elevation Reference <u>n/a</u>	Elevation <u>n/a</u> ft	
Depth Reference <u>Ground Surface</u>	Casing Stickup <u>1.75</u> ft	
Casing Diameter <u>9.25 ID</u> in	Depth Interval <u>0 to 273</u> ft	Thickness <u>0.75</u> in

*Water depth determined from Moisture Log

Logging Information

Log Type:	HPGe Spectral Gamma Ray		
Company	Duratek Federal Services		
Date/Archive File Name	March 7, 2001 H2W22083		
Logging Engineers	<u>R. Steffler</u>		
Instrument Series	RLSG07000S01.0		
Logging Unit	RLS-1		
Depth Interval	0 to 50 ft	Prefix	A710
	48 to 160 ft		A711
	135 to 273 ft		A712
Instrument Calibration Date	Oct 6, 2000		
Calibration Report	WHC-SD-EN-TI-292, Rev 0.		

Analysis Information

Company	Three Rivers Scientific
Analyst	Russ Randall
Date	March 12, 2001
Notes	<u>No man-made contamination was detected. Many depth intervals have the natural uranium levels below detection threshold. The water level from 236 to 273 also reduces the gross gamma and raises detection thresholds.</u>

Spectral Gamma Ray Log Analysis & Summary

Waste Management Federal Services

Project: RCRA Drilling
Log Type: HPGe Spectral Gamma Ray

Well: 299-W22-83
Log Date: March 7, 2001

General Notes:

Total gamma is a response to geologic concentrations of natural radionuclides. A change in sensitivity of gross gamma to geologic concentrations of natural radionuclides occurs at the water level (236 feet).

Log data collected with a depth reference of ground surface.

System Performance Verify: The pre- and post-log verification passed performance standards; a -0.03% change was observed in the gross, (based upon borehole survey data sheet). The FWHM of the 583 keV photo peak was also within specifications for pre- and post-log verification.

Repeat Interval: Based on the repeat interval, the logging system performed as per specifications.

Environmental Corrections: All radionuclide concentrations have been corrected for casing attenuation (entire well). Water correction was applied to depths deeper than 236 feet. The information on the borehole survey data sheet indicates the water depth of 225 feet, but the moisture log response and the HPGe log response puts the water depth at 236 feet. No casing correction was applied to the total gamma due to Compton downscatter interference.

Radionuclides:

No man-made radionuclide contamination was detected. This observation was confirmed using a summing technique for the spectral data.

The natural uranium concentration is below detection threshold over many intervals. The changes in gross gamma from 130 to 150 and from 190 to 230 feet are reflected by changes in potassium, uranium, and thorium; which are indicative of geologic effects. Note that the use of the uranium signal is difficult due to the high statistical deviations and the high detection threshold. The drop in gross gamma at 236 feet is due to the water attenuation within the well. The rise in gross at 264 feet is reflected in a rise in the potassium and uranium over this same interval indicative of geologic changes just below the water level.

Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

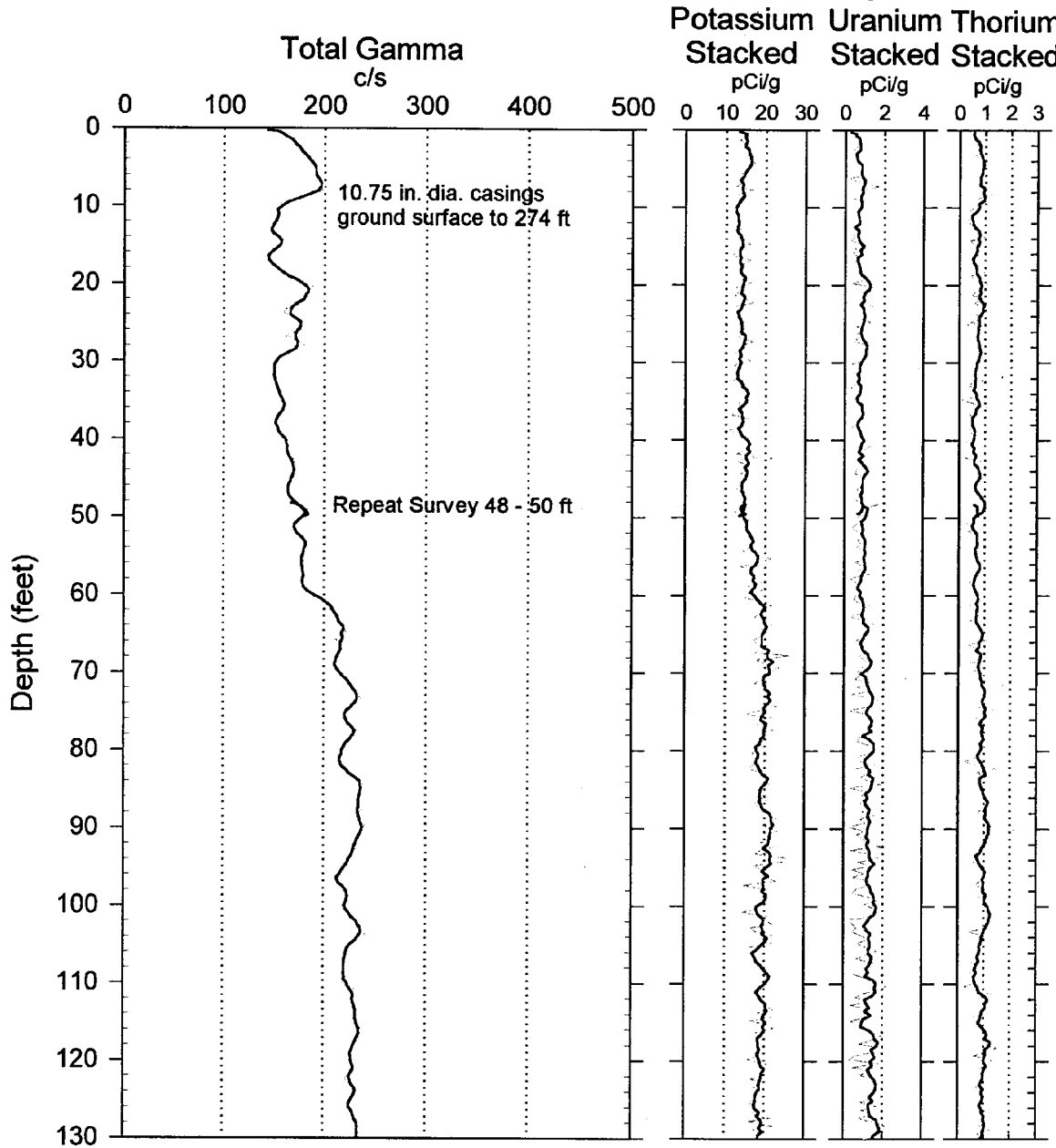
Duratek Federal Services

Project: RCRA Drilling

Log Date: March 7, 2001

Borehole: 299-W22-83

Naturally Occurring Radionuclides



Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

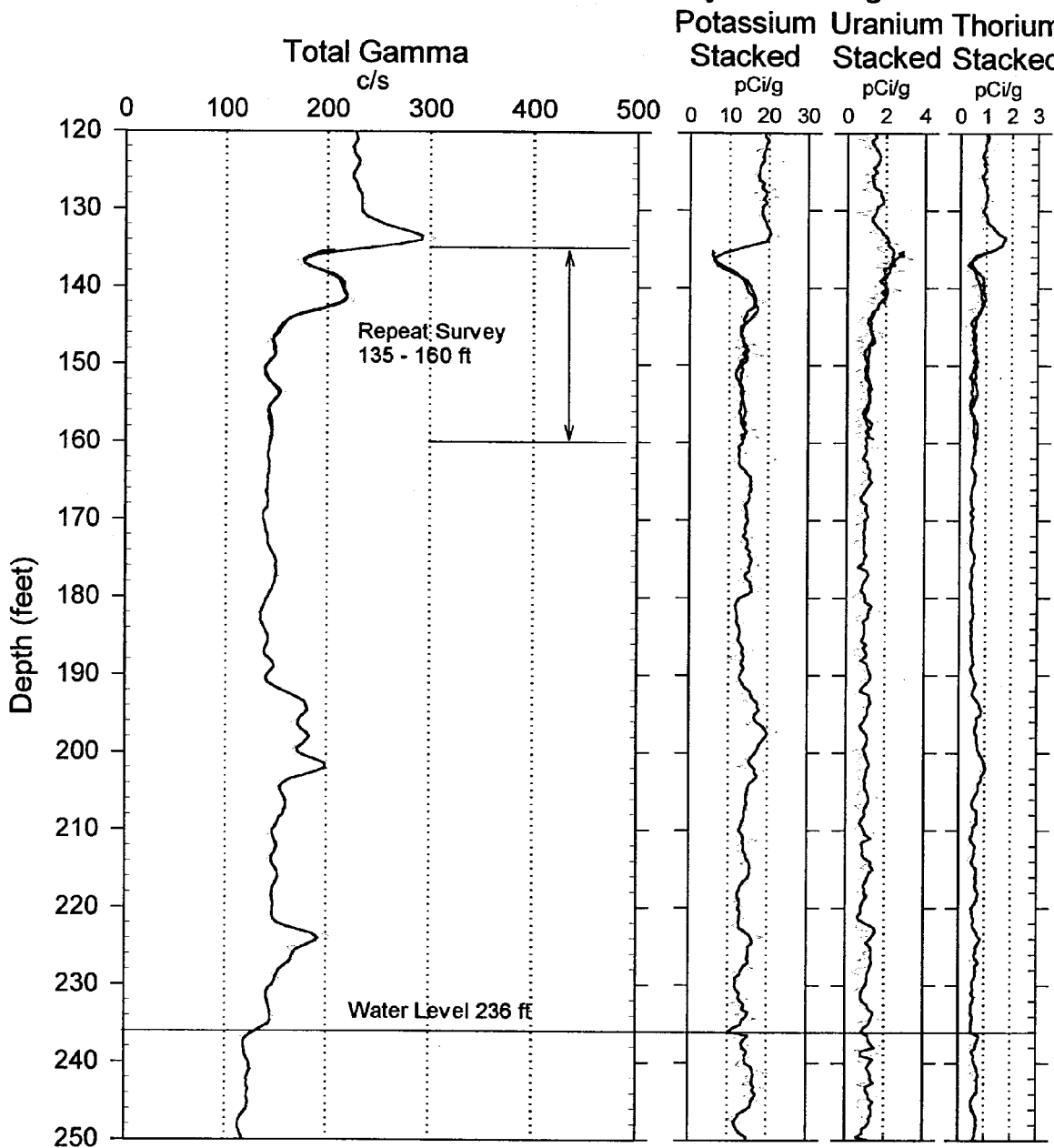
Duratek Federal Services

Project: RCRA Drilling

Log Date: March 7, 2001

Borehole: 299-W22-83

Naturally Occurring Radionuclides



Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

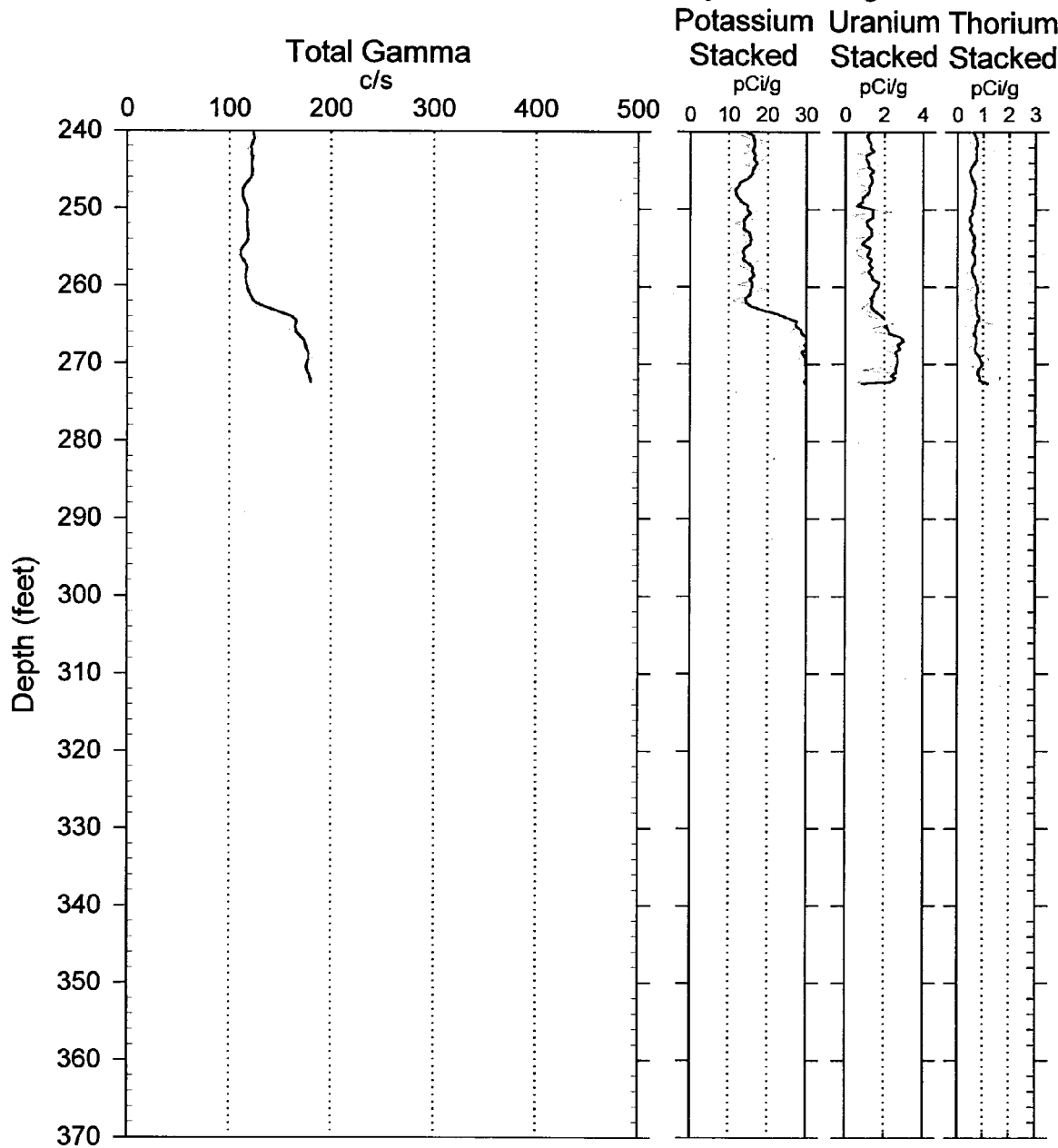
Duratek Federal Services

Project: RCRA Drilling

Log Date: March 7, 2001

Borehole: 299-W22-83

Naturally Occurring Radionuclides



Analysis by: Three Rivers Scientific

Neutron-Neutron Moisture Borehole Survey

Duratek Federal Services, Inc.

Log Header

Project: RCRA Drilling

Well: 299-W22-83

Log Type: Moisture Gauge

Borehole Information

Well # <u>C3126</u>	Water Depth <u>236*</u> ft	Total Depth <u>274.2</u> ft
Elevation Reference <u>n/a</u>	Elevation <u>n/a</u> ft	
Depth Reference <u>Ground Surface</u>	Casing Stickup <u>1.75</u> ft	
Casing Diameter <u>9.25 ID</u> in	Depth Interval <u>0 to 274</u> ft	Thickness <u>0.75</u> in

*Water level determined from Moisture Log

Logging Information

Log Type:	Moisture Gauge		
Company	Duratek Federal Services, Inc.		
Date/Archive File Name	March 8, 2001 M2W22083		
Logging Engineers	<u>J. Meisner</u>		
Instrument Series	RLSM00.0		
Logging Unit	RLS-1		
Depth Interval	0 to 100 ft	Prefix	MA91
	95 to 200 ft		MA92
	175 to 234 ft		MA93
Instrument Calibration Date	July 14, 2000		
Calibration Report	WHC-SD-EN-TI-306, Rev. 0		

Analysis Information

Company	Three Rivers Scientific
Analyst	Russ Randall
Date	March 12, 2001
Notes	<u>Moisture values range from 2% to 18% for the depths logged. The onset of high moisture readings at 234 feet is due to the proximity of the water level in the borehole. No valid calibration is available for the 9.25 inch casing diameter from surface to 273 feet. The calibration for the 10.75 inch borehole diameter was extrapolated from standard diameter conditions, and casing correction applied to all depths logged.</u>

RLS Neutron-Neutron Moisture

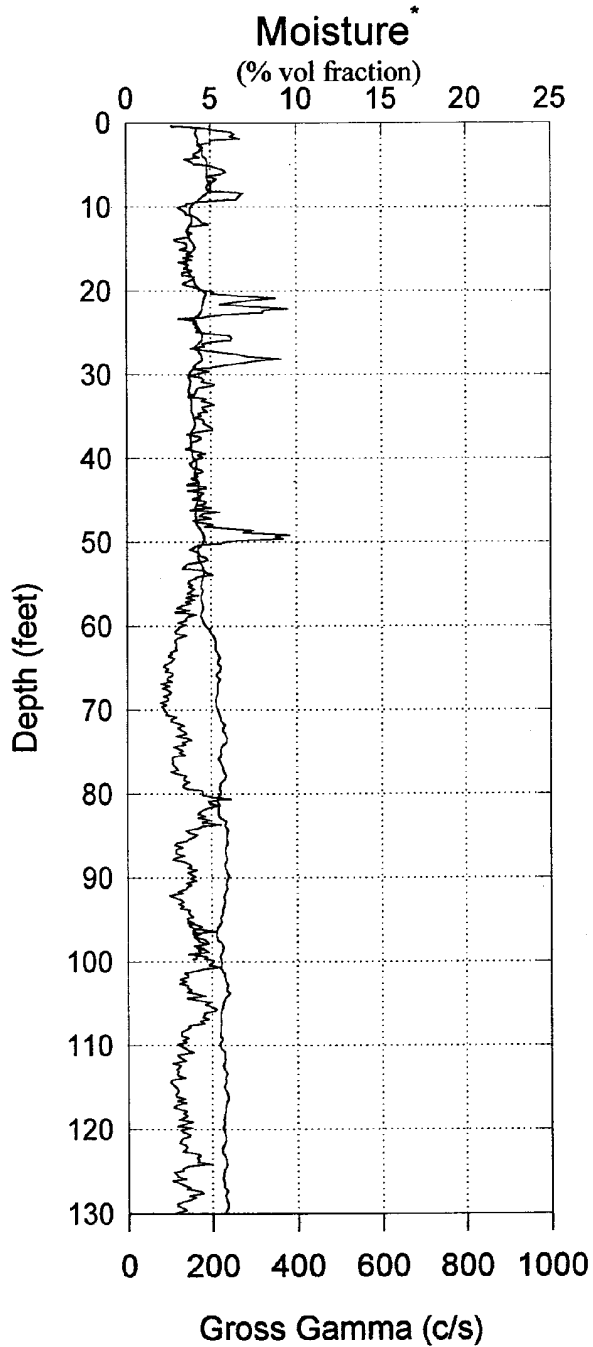
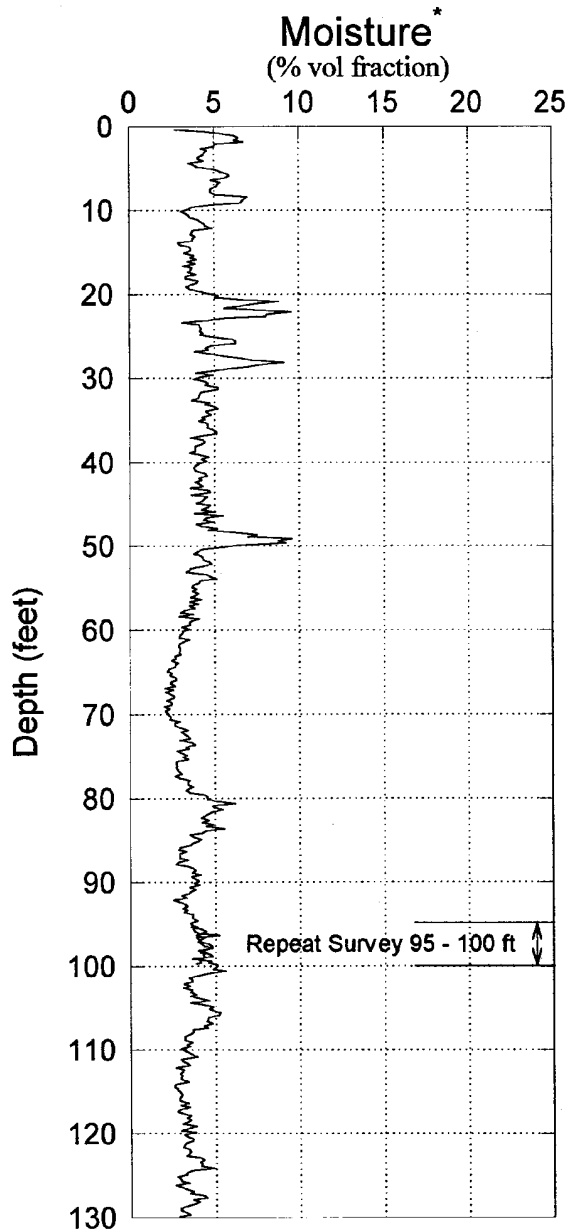
Duratek Federal Services, Inc.

Project: RCRA Drilling

Log Date : March 8, 2001

Borehole: 299-W22-83

Depth Datum : Ground Surface



* Calibration extrapolated to 10.75 inch borehole diameter
Casing thickness correction for 0.75 inch
Analysis by Three Rivers Scientific

RLS Neutron-Neutron Moisture

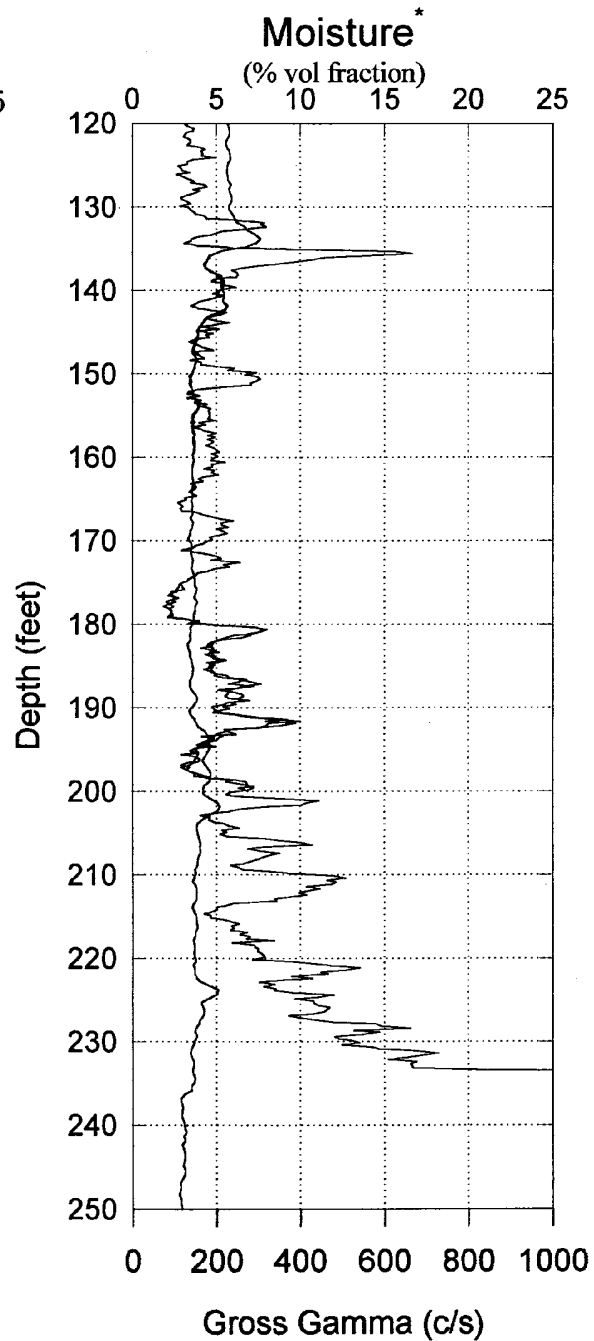
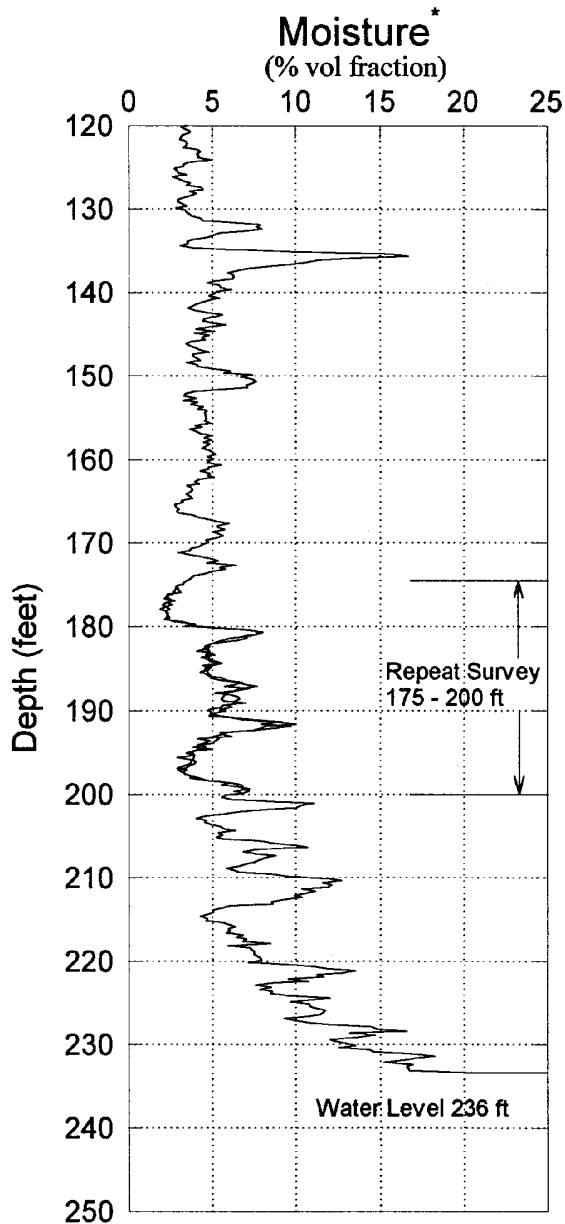
Duratek Federal Services, Inc.

Project: RCRA Drilling

Log Date : March 8, 2001

Borehole: 299-W22-83

Depth Datum : Ground Surface



* Calibration extrapolated to 10.75 inch borehole diameter
Casing thickness correction for 0.75 inch
Analysis by Three Rivers Scientific

Moisture Log Analysis & Summary

Duratek Federal Services, Inc.

Project: RCRA Drilling
Log Type: Moisture Gauge

Well ID: 299-W22-83
Log Date: March 8, 2001

General Notes:

The largest borehole diameter for the calibration models is an 8.64 inch borehole diameter, with .32 inch casing thickness, and the borehole diameter in these log data is 10.75 inches. Therefore, an extrapolation was calculated for the applied calibration coefficients to match the conditions of the logged borehole. The method of extrapolation generated conservative estimates for the moisture values (possibly lower values than a valid calibration). The size differential of this borehole from the calibration standard is at the limits of rigorous extrapolation.

Log data collected with a depth reference of ground surface.

System Performance Verify: The pre- and post-log verification passed performance standards, -7.4% change from start of log to end of log, in the shield verify.

Repeat Interval: Based on the repeat intervals from 95 to 100 feet and 175 to 200 feet, the logging system performed according to specifications.

Environmental Corrections: The moisture levels have been corrected for casing thickness (0.75 inch) for all well depths logged. No formation density correction has been applied because density values are not available.

Observations:

The moisture levels show values ranging from 2% to 18% for all depth intervals logged. The average readings are somewhat lower than usual for Hanford vadose zone moisture levels, indicating that the calibration extrapolation is under correcting for the borehole diameter of this borehole. The abnormally high readings that begin at 234 feet are a response to the water level at 236 feet. Note that geologist's information puts the water depth at 225 feet. The date of the geologist's information is unknown, but the moisture log response and the HPGe log response put the water depth of 236 feet on March 8, 2001.

RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services

Log Header

Project: 2000 RCRA Drilling

Well: 299-W23-21

Log Type: HPGe Spectral Gamma Ray

Borehole Information

Well # <u>C3113</u>	Water Depth <u>212.5</u> ft	Total Depth <u>257.5</u> ft
Elevation Reference <u>n/a</u>	Elevation <u>n/a</u> ft	
Depth Reference <u>Ground Surface</u>	Casing Stickup <u>3.86</u> ft	
Casing Diameter <u>10.125 ID</u> in	Depth Interval <u>0 to 70</u> ft	Thickness <u>0.75</u> in
Casing Diameter <u>7.625 ID</u> in	Depth Interval <u>0 to 253.5</u> ft	Thickness <u>0.5</u> in

Logging Information

Log Type:	HPGe Spectral Gamma Ray	
Company	Waste Management Federal Services	
Date/Archive File Name	October 30, 2000	H2W23021
Logging Engineers	<u>J. Meisner</u>	
Instrument Series	RLSG07000S01.0	
Logging Unit	RLS-1	
Depth Interval	0 to 160 ft	Prefix A702
	146 to 243.5 ft	Prefix A703
Instrument Calibration Date	Oct 6, 2000	
Calibration Report	WHC-SD-EN-TI-292, Rev 0.	

Analysis Information

Company	Three Rivers Scientific
Analyst	Russ Randall
Date	November 25, 2000
Notes	<u>No man-made contamination was detected. The depth interval 0 to 80 feet shows the natural uranium levels are at or below detection threshold. Likewise, the thorium levels are at or below detection levels from 210 to 243 feet. The dual casing from 0 to 70 feet reduces the gross gamma and raises detection thresholds. The water level from 212 to 265 also reduces the gross gamma and raises detection thresholds.</u>

RLS Spectral Gamma Ray Borehole Survey

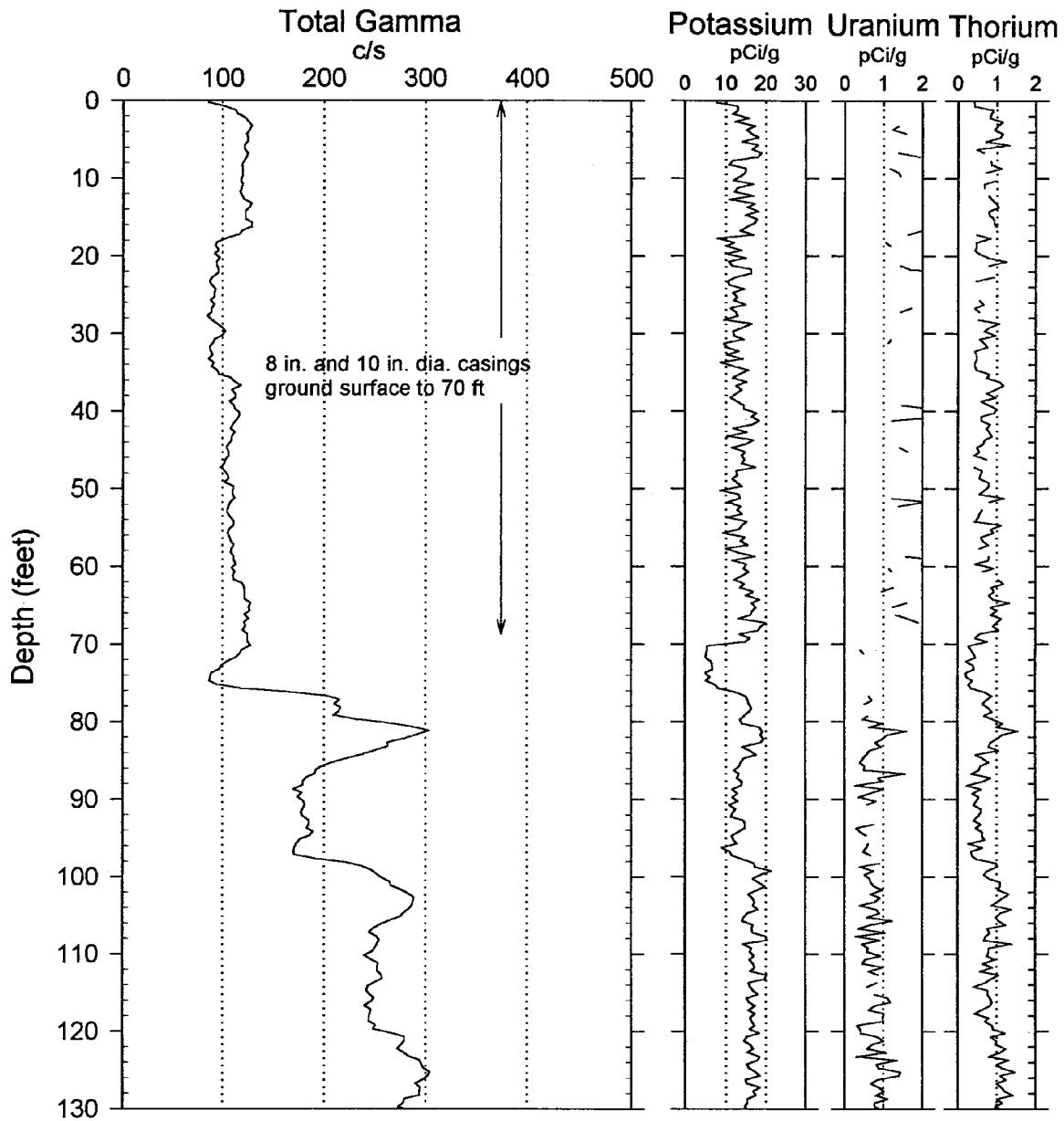
Waste Management Federal Services

Project: 2000 RCRA Drilling

Log Date: October 30 & 31, 2000

Borehole: 299-W23-21

Naturally Occurring Radionuclides



Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

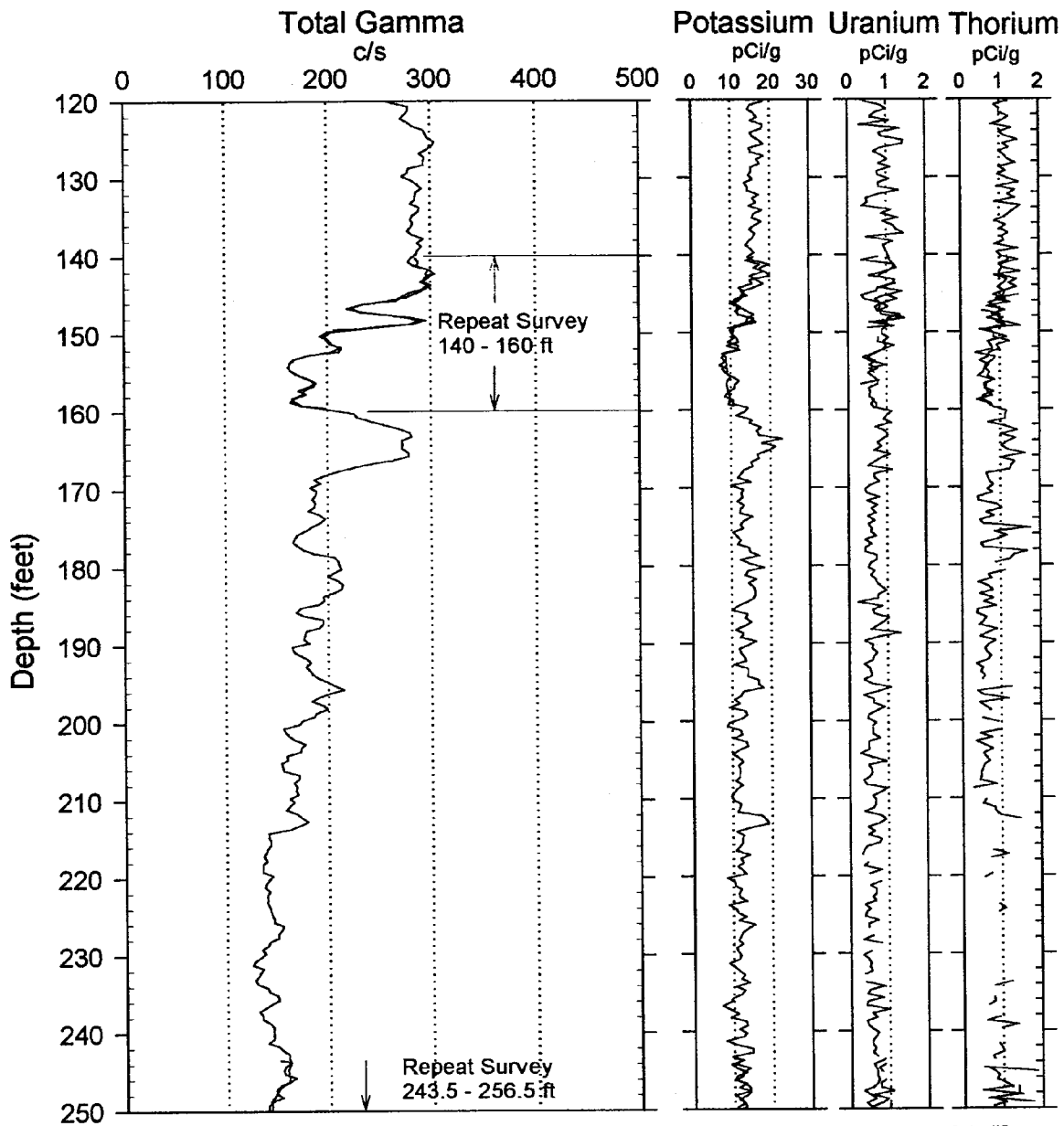
Waste Management Federal Services

Project: 2000 RCRA Drilling

Log Date: October 30 & 31, 2000

Borehole: 299-W23-21

Naturally Occurring Radionuclides



Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

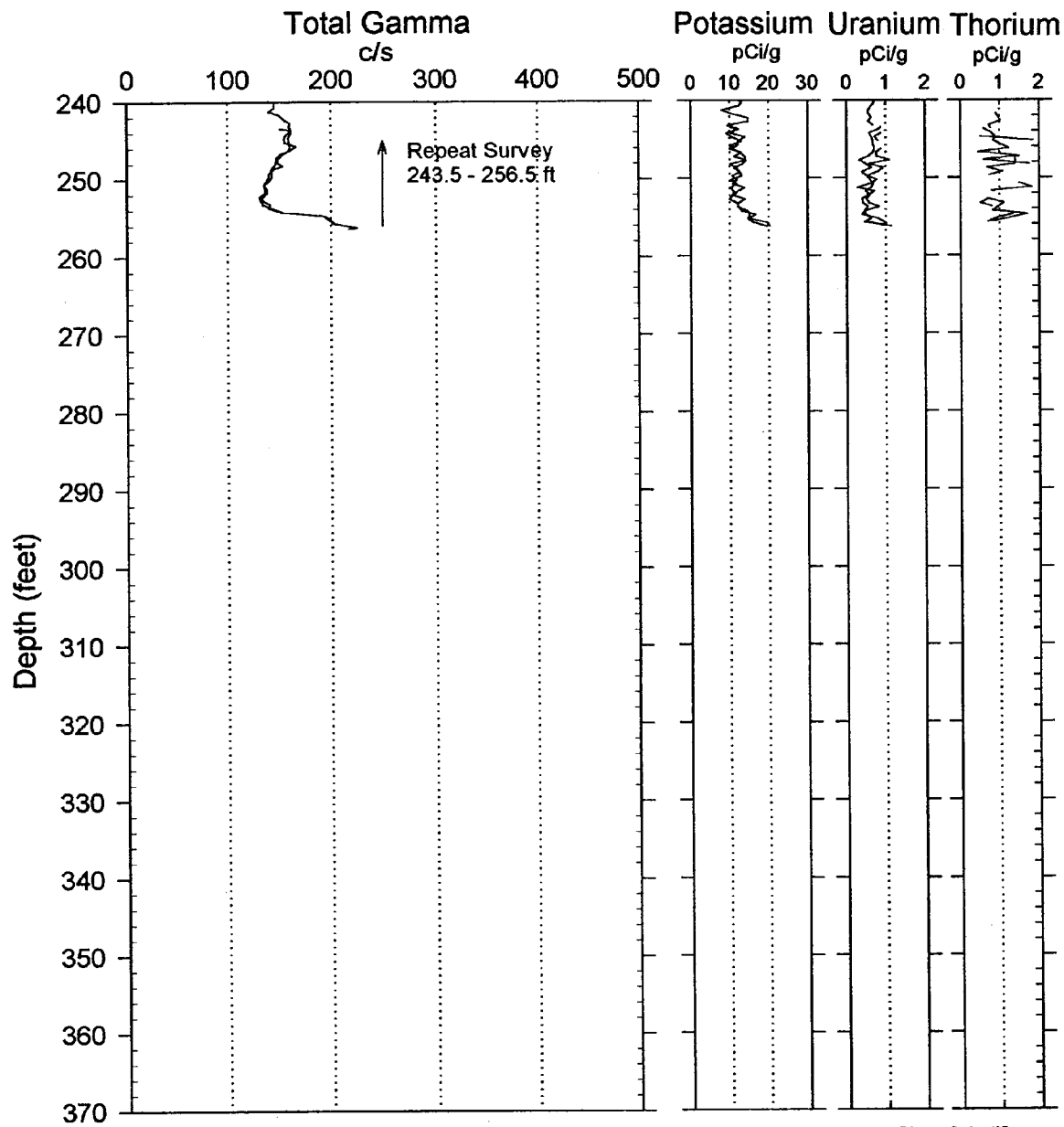
Waste Management Federal Services

Project: 2000 RCRA Drilling

Log Date: October 30 & 31, 2000

Borehole: 299-W23-21

Naturally Occurring Radionuclides



Analysis by: Three Rivers Scientific

Spectral Gamma Ray Log Analysis & Summary

Waste Management Federal Services

Project: 2000 RCRA Drilling
Log Type: HPGe Spectral Gamma Ray

Well: 299-W23-21
Log Date: October 30 & 31, 2000

General Notes:

Total gamma is a response to geologic concentrations of natural radionuclides. Two changes in sensitivity of gross gamma to geologic concentrations of natural radionuclides occur at the dual casing change (70 feet) and the water level (212 feet).

Log data were collected with a depth reference of ground surface.

System Performance Verify: The pre- and post-log verification passed performance standards; a -9.1% and +0.3% change was observed in the gross (day 1 and day 2, respectively). The FWHM of the 583 keV photo peak was also within specifications for pre- and post-log verification.

Repeat Interval: Based on the repeat interval, the logging system performed as per specifications.

Environmental Corrections: All radionuclide concentrations have been corrected for casing attenuation (entire well). Water correction was applied to depths deeper than 212 feet. No casing correction was applied to the total gamma due to Compton downscatter interference.

Radionuclides:

No man-made radionuclide contamination was detected.

The natural uranium concentration is below detection threshold from 0 to 80 feet, and the thorium is below detection threshold from 210 to 240 feet. Both of these intervals have additional gamma attenuation due to dual casing from 0 to 70 feet and the water annulus from 212 to 265 feet.

The changes in gross gamma from 75 to 110 feet are reflected by changes in potassium, uranium, and thorium; which is indicative of geologic effects.

Analysis by: Three Rivers Scientific

Neutron-Neutron Moisture Borehole Survey

Waste Management Federal Services

Log Header

Project: 2000 RCRA Drilling

Well: 299-W23-21

Log Type: Moisture Gauge

Borehole Information

Well # <u>C3113</u>	Water Depth <u>212.5</u> ft	Total Depth <u>257.5</u> ft
Elevation Reference <u>n/a</u>	Elevation <u>n/a</u> ft	
Depth Reference <u>Ground Surface</u>	Casing Stickup <u>3.86</u> ft	
Casing Diameter <u>10.25 ID</u> in	Depth Interval <u>0 to 70</u> ft	Thickness <u>0.75</u> in
Casing Diameter <u>7.625 ID</u> in	Depth Interval <u>0 to 253.5</u> ft	Thickness <u>0.5</u> in

Logging Information

Log Type:	Moisture Gauge	
Company	Waste Management Federal Services	
Date/Archive File Name	October 31, 2000	M2W23021
Logging Engineers	J. Meisner	
Instrument Series	RLSM00.0	
Logging Unit	RLS-1	
Depth Interval	0 to 8; 65 to 164 ft	Prefix MA68
	140 to 202 ft	MA69
Instrument Calibration Date	July 14, 2000	
Calibration Report	WHC-SD-EN-TI-306, Rev. 0	

Analysis Information

Company	Three Rivers Scientific
Analyst	Russ Randall
Date	November 25, 2000
Notes	<u>Moisture values range from 2% to 32% for the depths logged. The onset of high readings at 212 feet is due to the proximity of the water level in the borehole. No valid calibration is available for the 10 inch casing diameter from surface to 70 feet, thus the application of the 8 inch calibration is plotted as a blue line (with circle symbols) over 0 to 8.5 and 65 to 70 feet.</u>

RLS Neutron-Neutron Moisture

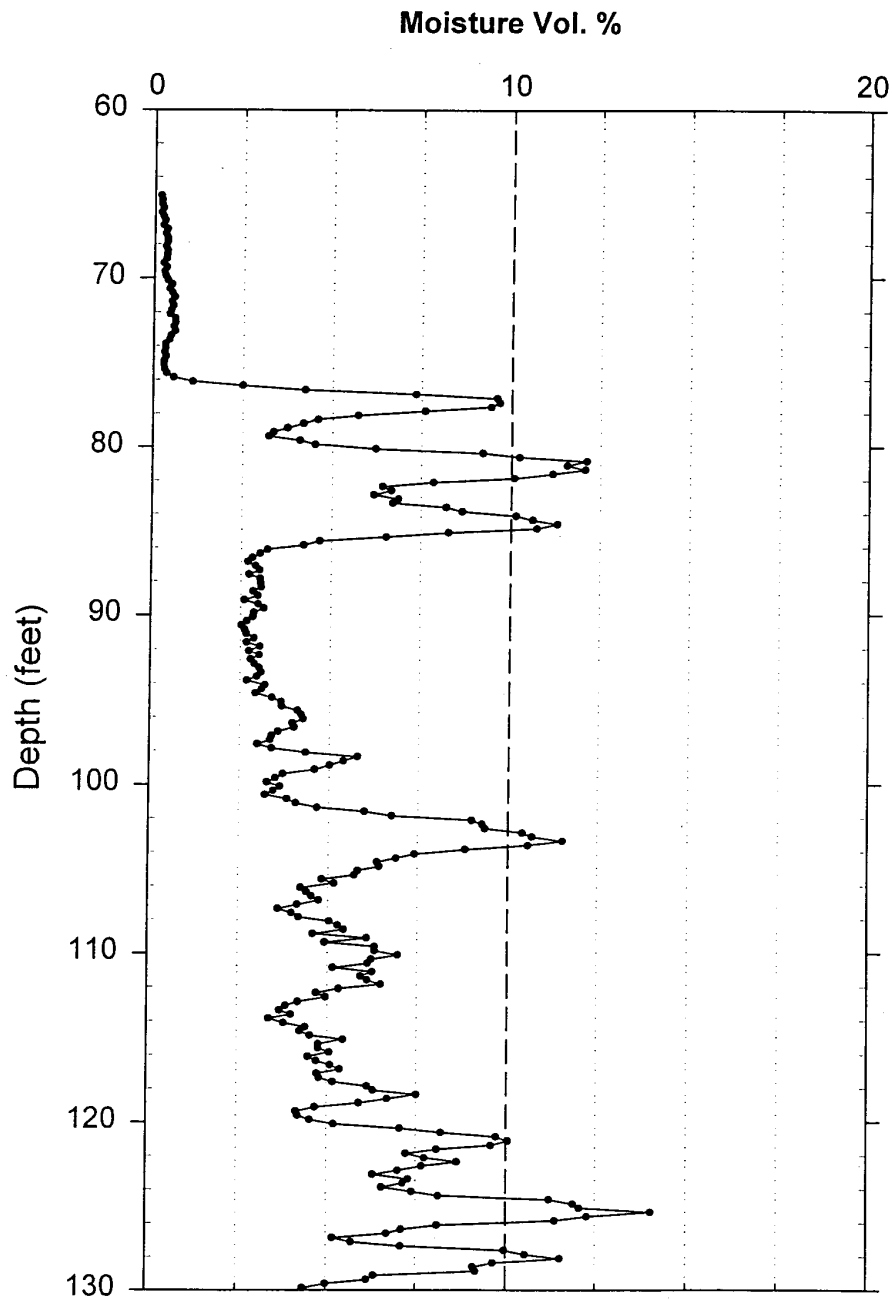
Waste Management Federal Services

Project: RCRA Drilling

Log Date : October 31, 2000

Borehole: 299-W23-21

Depth Datum: Top of Casing



RLS Neutron-Neutron Moisture

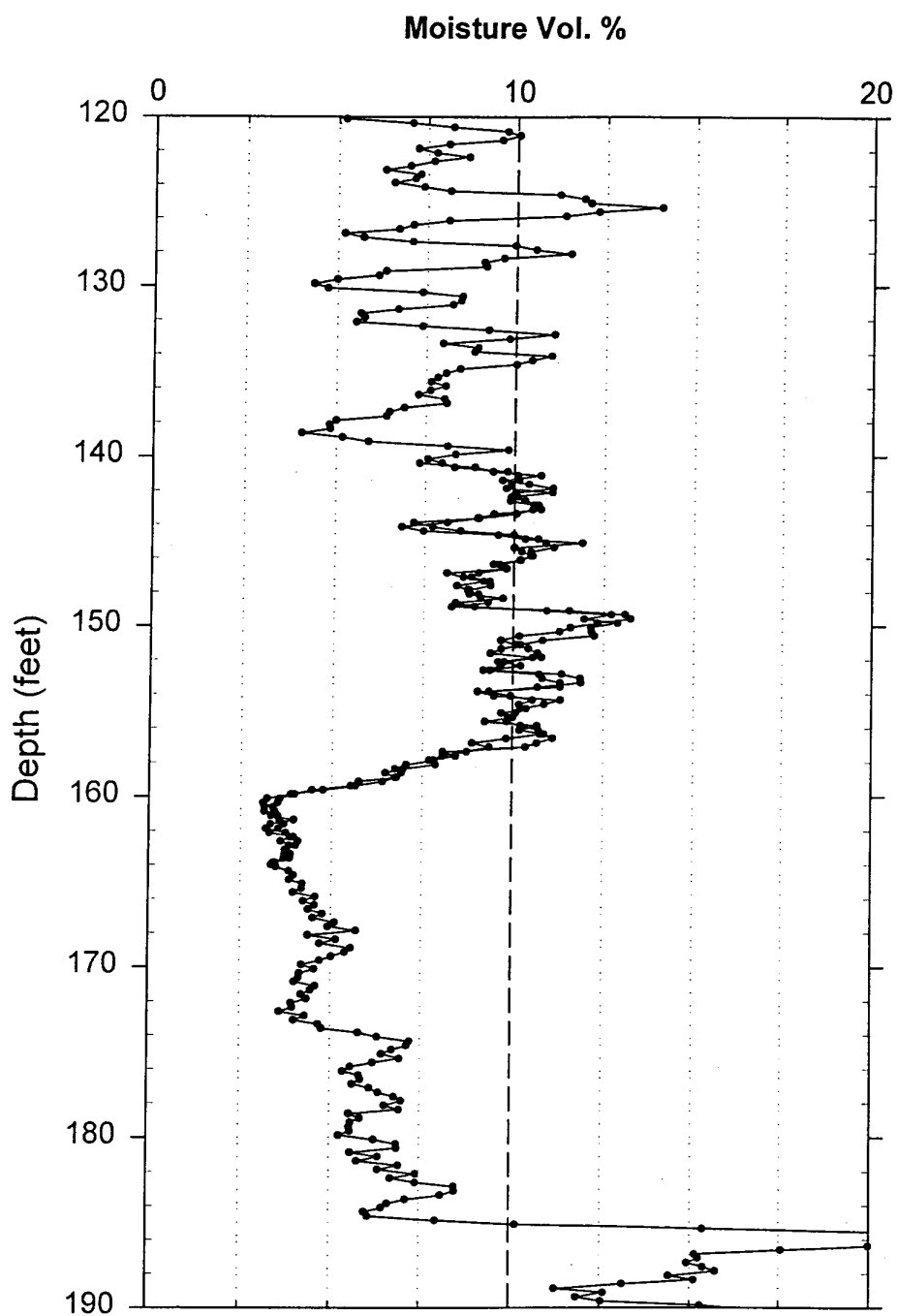
Waste Management Federal Services

Project: RCRA Drilling

Log Date : October 31, 2000

Borehole: 299-W23-21

Depth Datum: Top of Casing

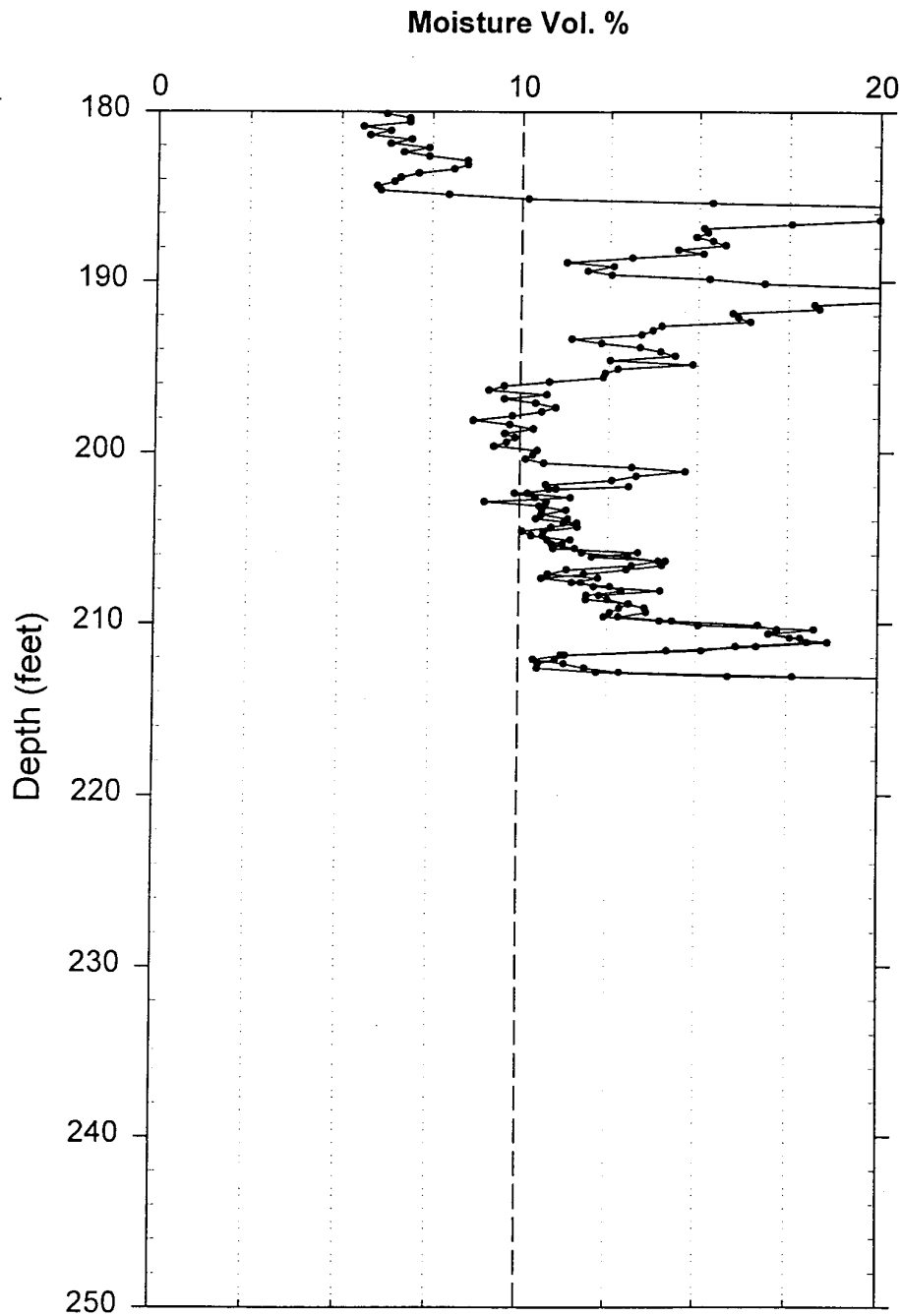


RLS Neutron-Neutron Moisture

Waste Management Federal Services

Project: RCRA Drilling
Borehole: 299-W23-21

Log Date : October 31, 2000
Depth Datum: Top of Casing



Moisture Log Analysis & Summary

Waste Management Federal Services

Project: 2000 RCRA Drilling
Log Type: Moisture Gauge

Well ID: 299-W23-21
Log Date: October 31, 2000

General Notes:

The 8 inch calibration coefficients were used for all logged depths. The 8 inch calibration standard has an 8.64 inch borehole diameter, with .32 inch casing thickness, and the borehole diameter in these log data is 8.625 inches. The depth interval from 0 to 8.5 feet and from 65 to 70 feet has both the 8 inch and 10 inch casing. Thus the inappropriate use of the 8 inch calibration over these depths is plotted with a blue line and circle symbols. Note: no calibration exists for the 10 inch casing.

Log data were collected with a depth reference of ground surface.

System Performance Verify: The pre- and post-log verification passed performance standards, -0.9% change from start of log to end of log, in the shield verify.

Repeat Interval: Based on the repeat interval from 140 to 164 feet and 202 to 213 feet, the logging system performed according to specifications.

Environmental Corrections: The moisture levels have been corrected for casing thickness (0.5 inch) for all well depths logged. No formation density correction has been applied because density values are not available.

Observations:

The moisture levels show values ranging from 2% to 32% for the depth interval from 70 feet to 212 feet. The abnormally high readings that begin at 212 feet are a response to the water level at 212 feet.

Variable moisture structure shows from 75 to 212 feet. Over this depth interval, there is some correlation with the gross gamma signature, and sections with little correlation. Therefore, moisture content is sensitive to the geologic structure over this interval, while the changes in natural radionuclides is not as sensitive to the geologic structure.

The very low readings from 65 to 70 feet may be due to voids behind the casing.

Analysis by: Three Rivers Scientific

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