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**Borehole Data Package for 1998
Wells Installed at Single-Shell Tank
Waste Management Area T**

D. G. Horton
F. N. Hodges

March 1999



Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

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Pacific Northwest National Laboratory
Richland, Washington 99352

Acknowledgment

The analyses of particle size distribution, moisture content, pH, electrical conductivity, cation exchange capacity, and alkalinity were done in the Applied Geology and Geochemistry Group laboratory, Pacific Northwest National Laboratory, Richland, Washington. The work was supervised by Jeff Serne. His laboratory also produced the 1:1 water:sediment extracts for major cation and anion analyses. The cation analyses were done at the Chemical Analysis Laboratory at the University of Georgia in Athens, Georgia. The anion analyses were done in the Pacific Northwest National Laboratory interfacial geochemistry laboratory. Mr. Serne provided interpretations of all the physical and chemical data from sediment samples, and those interpretations are incorporated into this report. His contribution is very much appreciated.

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1.0 Introduction

Two new Resource Conservation and Recovery Act (RCRA) groundwater monitoring wells were installed at the single-shell tank farm Waste Management Area (WMA) T in August through November of 1998 in fulfillment of Tri-Party Agreement (Ecology 1996) Milestone M-24-37. The wells are 299-W10-23 and 299-W10-24. Well 299-W10-23 replaces well 299-W10-15 and well 299-W10-24 replaces well 299-W11-27; both new wells are located north of WMA T and are downgradient monitoring wells. The locations of all wells in the extended monitoring network for WMA T are shown on Figure 1.

The groundwater monitoring plan for WMA T (Caggiano and Goodwin 1991) describes the hydrogeology of the 200 West Area and WMA T. An Interim Change Notice to the groundwater monitoring 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.

This document compiles information on the drilling and construction, well development, pump installation, and sediment testing applicable to wells 299-W10-23 and 299-W10-24. Appendix A contains copies of the geologist's log, the Well Construction Summary Report, and Well Summary Sheet (as-built diagram); Appendix B contains results of laboratory analyses of particle size distribution, pH, conductivity, and moisture content; Appendix C contains geophysical logs analyses; and Appendix D contains analytical results from groundwater samples obtained during well construction. Aquifer tests (slug tests) were performed on both new wells after well completions. Results of the aquifer tests will be reported elsewhere. Additional documentation concerning well construction is on file with Bechtel Hanford, Inc., Richland, Washington.

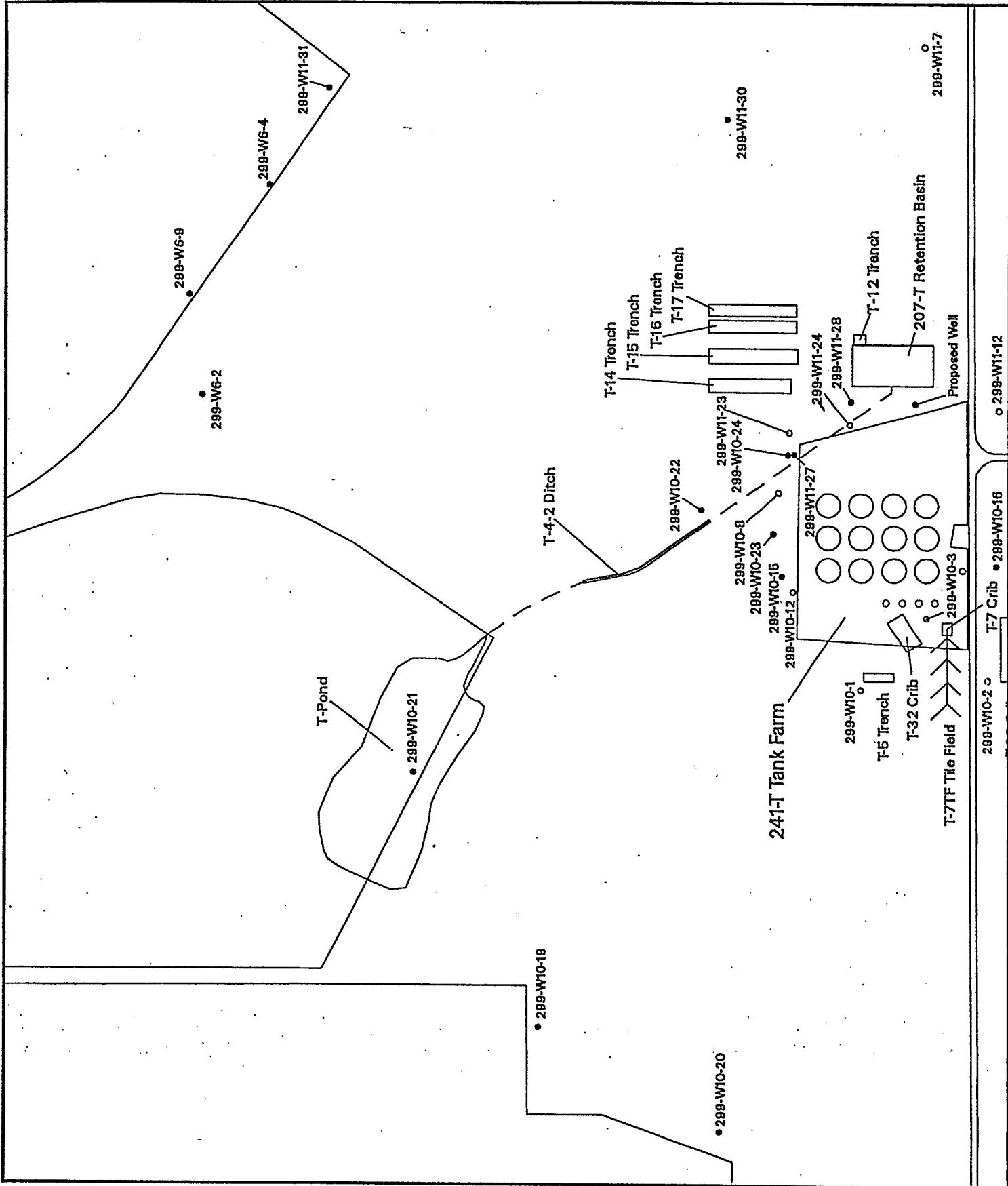
English units are used in this report because they are used by drillers to measure and report depths and well construction details. The conversion is made by multiplying feet by 0.3048 to obtain meters or multiplying inches by 2.54 to obtain centimeters.

2.0 Well 299-W10-23

2.1 Drilling

Well 299-W10-23 was drilled using an air rotary rig. The well was drilled to a total depth of 272 ft below ground surface (bgs) during August 1998. Temporary 8 5/8-in.-outside-diameter, carbon steel casing was used from ground surface to total depth. No water was added to the well during drilling. Static water level was 223.61 ft bgs on August 19, 1998.

Sediments encountered during drilling were sand, gravelly sand, and sandy gravel of the Hanford formation from the surface to about 80 ft bgs; silty sands and sands of the Plio-Pleistocene Unit from 80



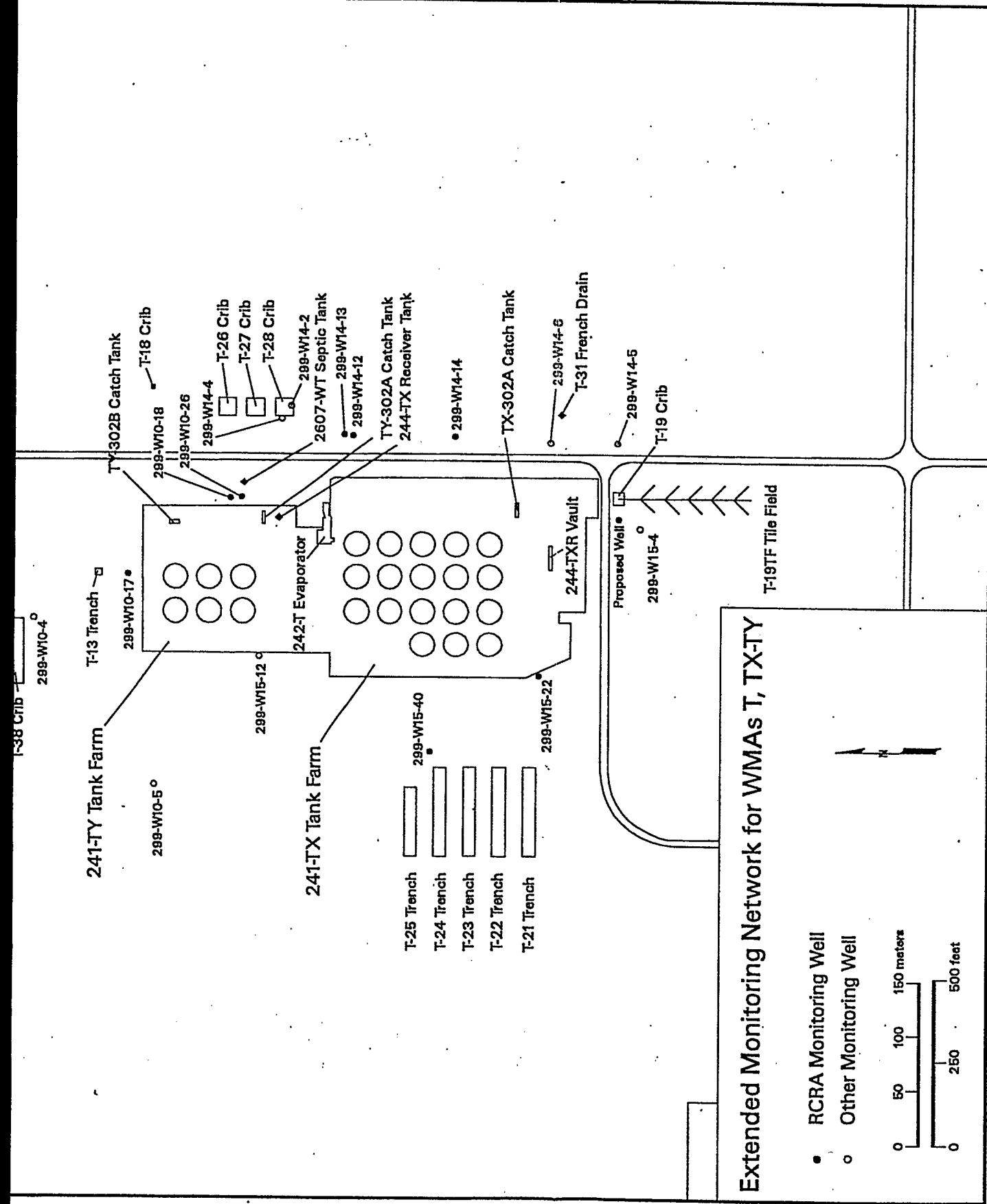


Figure 1. Map of Waste Management Area T and Locations of Wells in the Groundwater Monitoring Network
~ /home/tk3394/arcwork/Tfarmextnd.map-0925-98

to about 134 ft bgs (based on geophysical log correlation); and sandy gravel and silty sandy gravel of the Ringold Formation Unit E from 134 ft bgs to total depth of 272 ft bgs.

Grab samples were collected at 21, 62, 202, and 210 ft bgs for measurement of pH, moisture content, electrical conductivity, particle size distribution, total inorganic carbon, and extractable ions; particle size distribution was determined only on the shallower two samples. The sediment at 21 ft bgs is gravel with a moisture content of 3.3 weight percent; the sediment at 62 ft bgs is sand with 13 weight percent moisture.

The sediment from 62 ft bgs had more salts extracted during the 1:1 water:sediment extraction than did the other three samples, which are coarser grained. This is consistent with other samples from other well sites. Laboratory results of all analyses are in Appendix B.

Split spoon samples were collected from 75 to 77 and from 86 to 88 ft bgs (100% recovery for both samples) for analysis of physical and hydraulic properties; no analyses have been done to date. Sediment samples also were collected for geologic description and archive at approximately 5-ft intervals throughout the borehole. The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No contamination was found.

The well was logged using high resolution, spectral gamma-ray instrumentation on August 15, 1998. No man-made radionuclides were detected. The geophysical log is in Appendix C.

2.2 Well Completion

The permanent casing and screen were installed in well 299-W10-23 in August 1998. A 4-in.-inner-diameter, stainless steel, wire wrap (0.01 in. slot) screen was set from 225.8 to 260.9 ft bgs. The permanent casing is 4-in.-inner-diameter stainless steel from 225.8 ft bgs to 2.3 ft above ground surface. The bottom of the screen has a 4-in. end cap.

The filter pack is 20 to 40 mesh silica sand from 267.0 to 220.3 ft bgs. The annular seal is 0.25-in. bentonite pellets from 220.0 to 214.4 ft bgs; medium bentonite chips from 214.4 to 5.0 ft bgs; and cement from 5.0 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 pad. The Well Construction Summary Report and the Well Summary Sheet (as-built) are in Appendix A.

The vertical and horizontal coordinates of the well were surveyed in December 1998. The horizontal position of the well was determined by global positioning system observations referenced to horizontal control stations established by 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 bench marks established by the U.S. Army Corps of Engineers. Survey data are included in Table 1.

Table 1. Survey Data for New Wells at Waste Management Area T

Well Name	Easting (m)	Northing (m)	Elevation (m)	Point Description
299-W10-23	566,823.7285	136,815.339	207.4907	Center of Casing
	566,823.732	136,815.6445		“X” on Casing
299-W10-24	566,885.426	136,798.7795	206.6901	Brass Cap
	566,885.427	136,799.1845		Center of Casing
			209.7553	“X” on Casing
			208.9782	Brass Cap

2.3 Well Development and Pump Installation

Well 299-W10-23 was developed on September 21, 1998. A temporary, 2 hp submersible pump was used to remove approximately 700 gal of formation water from the well at 8 gal/min. The final turbidity was 1.6 NTU.

A dedicated Hydrostar sampling pump was installed in well 299-W10-23 on October 31, 1998. The sampling pump intake is at 241.50-ft depth relative to the brass cap (see Table 1).

3.0 Well 299-W10-24

3.1 Drilling

Well 299-W10-24 was drilled using an air rotary rig to a total depth of 432.5 ft bgs during October 1998. Temporary 8 5/8-in.-outside-diameter, carbon steel casing was used from ground surface to total depth. No water was added to the well during drilling, but 250 gal were added during completion activities. Static water level was 231.41 ft bgs on October 21, 1998.

Sediments encountered during drilling were sandy gravel and gravelly sand of the Hanford formation from the surface to about 83 ft bgs; sand, silty sand and caliche of the Plio-Pleistocene Unit from 83 to about 128 ft bgs; and gravel, sandy gravel and silty, sandy gravel of the Ringold Formation Unit E from 118 ft bgs to total depth at 432 ft. The Ringold Formation, lower mud unit was encountered at 409 to 413 ft bgs.

Grab samples were collected at 22 ft and 59 ft bgs for analysis of particle size distribution and split spoon samples were collected at 83 and 91 ft bgs (100% recovery for both samples). No analyses have been made from the latter two samples. Particle size data from the shallower samples indicate that the sediment from 22 ft bgs is 80 weight percent gravel and the sediment from 59 ft bgs is sand and gravel. Particle size distribution data are in Appendix B.

Sediment samples also were collected for geologic description and archive at approximately 5-ft intervals throughout the borehole. The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No contamination was found.

Well 299-W10-24 was logged using high resolution, spectral gamma-ray instrumentation on October 17, 1998. Cesium-137 was identified between 1 and 10 ft bgs with a maximum activity of 3 pCi/g. Cesium-137 was also identified intermittently with activity less than 0.3 pCi/g to the bottom of the well. The geophysical logs are in Appendix C.

Groundwater samples were collected in the upper most aquifer at 286, 332, 383, 402, and 431 ft bgs. Analytical result are in Appendix D.

3.2 Well Completion

Well 299-W10-24 was backfilled with 10 to 20 mesh silica sand to 415.6 ft bgs and cement grout from 415.6 to 274 ft bgs. A 4-in.-inner-diameter, stainless steel, wire wrap (0.01 in. slot) screen was set from 268 to 232.9 ft bgs. Permanent, 4-in.-inner-diameter, stainless steel casing was installed from 232.9 ft bgs to 1.8 ft above ground surface. Stainless steel centralizers were place above and below the screen and at every 40 ft from the screen to the surface. The bottom of the screen has a 4-in. stainless steel, end cap.

10 to 20 and 8 to 16 mesh silica sand was placed around the casing from 274 to 260.2 ft bgs, and 20 to 40 mesh silica sand was placed from 260.2 to 221 ft bgs. Bentonite pellets (3/8 in.) were placed from 221 to 218.5 ft bgs and medium bentonite chunks from 218.5 to 9.1 ft bgs. The remainder of the annulus was filled with cement grout. A 4 ft by 4 ft by 6 in. concrete pad was placed around the well at the surface. A protective casing with locking cap, four protective steel posts, and a brass marker stamped with the well number were set into the concrete. The Well Construction Summary Report and the Well Summary Sheet (as-built) are included in Appendix A.

The vertical and horizontal coordinates of the well were surveyed in December 1998. The horizontal position of the well was determined by global positioning system observations referenced to horizontal control stations established by 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 bench marks established by the U.S. Army Corps of Engineers. Survey data are included in Table 1.

3.3 Well Development and Pump Installation

Well 299-W10-24 was developed on October 23, 1998. A temporary, 2 hp submersible pump was used to remove approximately 2,100 gal of formation water from the well at 10 gal/min. The final turbidity was 4.19 NTU.

A dedicated Hydrostar sampling pump was installed in well 299-W10-24 on November 11, 1998. The sampling pump intake is at 251.20 ft depth relative to the brass cap (see Table 1).

4.0 References

Caggiano, J. A., and S. M. Goodwin. 1991. *Interim Status Groundwater Monitoring Plan for the Single-Shell Tanks*. WHC-SD-EN-AP-012, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

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

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: 8-11-98

Finish Date: 8-19-98

Page 1 of 1

Specification No.: O200X-SP- Rev. No.: 1			Well Name: B8545 Temp Well No.: 299-W10-23		
ECNs: NA V0001			Approximate Location: 50' N of 241-T Tank Farm, 200 W		
Project: RCRA Drilling 1998			Other Companies: CH2M Hill		
Drilling Company: Layne Christensen			Geologist(s): L. Walker		
Driller: W. Franklin					
TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD/HOLE DIAMETER		
Size/Grade/Lbs. Per FT	Interval	Shoe O.D.I.D.	Auger:	Diameter From _____ to _____	
8 1/2" ID / FT	0' - 272'	8 1/2" / 8"	Cable Tool:	Diameter From _____ to _____	
CS	- - -	- - -	Air Rotary: ✓ (Odex)	Diameter From 0' to 272'	
- - -	- - -	- - -	A.R. w/Sonic:	Diameter From _____ to _____	
- - -	- - -	- - -	- - -	Diameter From _____ to _____	
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design			Diameter From _____ to _____		
			Drilling Fluid: Air		
Total Drilled Depth: 272 ft		Hole Dia @ TD: 9 1/2"		Total Amt. Of Water Added During Drilling: none	
Well Straightness Test Results: NA		Static Water Level: 223.61'		Date: 8-19-98	
GEOPHYSICAL LOGGING					
Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
Spectral KUT	0' - 263'	8-15-98	- - -	- - -	- - -
- - -	- - -	- - -	- - -	- - -	- - -
COMPLETED WELL					
Size/Wt/Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack Volume Mesh Size
4" ID SS	+2.3 - 225.78	FJ	NA	Cement (concrete)	0' - 5.0 3.86 ft ³ NA
4" ID wire wrap SS	225.78 - 260.88	FJ	0.010-in	Bentonite chips	5.0 - 214.4 60.72 ft ³ medium
4" ID SS	260.88 - 261.21	FJ	NA	Silica Sand Bent pellets	214.4 - 220.3 1.86 ft ³ 1/4"
- - -	- - -	- - -	- - -	Silica Sand	220.3 - 267.0 22.4 ft ³ 20-40
- - -	- - -	- - -	- - -	Native Ffill	267.0 - 272.0 NA NA
OTHER ACTIVITIES					
Aquifer Test:		Date:		Well Abandoned:	
Description:		-		Yes: No: X Date:	
WELL SURVEY DATA					
Date:		Protective Casing Elevation:			
Washington State Plane Coordinates:		Brass Cap Elevation:			
COMMENTS/REMARKS					
CS = carbon steel, SS = stainless steel ; Volume calc: concrete = 1.285 x 3 = 3.86 ft ³ Bentonite chips = 0.69 x 88 = 60.72 ft ³ ; Bentonite pellets = 0.62 x 3 = 1.86 ft ³ 20-40 Silica Sand = 1.12 x 20 = 22.4 ft ³					
Reported By: L. D. Walker		Reported By: Edward Rafosz			
Title: Geologist		Date: 8-20-98		Title: Field Engineer	
Signature: <i>L.D. Walker</i>		Signature: <i>Edward C. Rafosz</i>			

WELL SUMMARY SHEET				Boring or Well No. 299-W10-23 / B8545
				Sheet 1 of 2
Location 50 Ft. N of 241-T Tank Farm		Project RCRA Drilling - 1998		
Reviewed By DCWeekes DCWeekes 8/25/98		Prepared by: L.D. Walker / <i>L.D. Walker</i>		
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram	Graphic Log	Lithologic Description	
Concrete : 0' - 5.0'			0'- 9': Silty Sand	
			9'- 20': Sandy Gravel	
			20'- 34': Sandy Gravel	
			34'-36': Silty Sand	
			36'- 43.5': Sandy Gravel	
			43.5'- 48': Sand	
			48'- 52': Gravelly Sand	
			52'- 56': Sand	
Medium Bentonite Chips: 5.0' - 214.4'			56'-75': Gravelly Sand	
			75'- 80': Sand	
4 1/2" (OD) - 4" (ID) type 304 stainless steel casing: + 2.3' - 225.78'			80'-106': Silty Sand - Calcareous	
			98'-99': fn gravel	
			101'-106': brittle caliche	
			106'-114': Sand, calcareous	
			114'-123': Silty Sand	
			123'-131': thin beds cse Sand and Silty Sand	
			131'-149': Silty Sandy Gravel	
			149'-173': Sandy Gravel	

WELL SUMMARY SHEET			Boring or Well No. 299-W10-23 / 88545
			Sheet <u>2</u> of <u>2</u>
Location <u>50 ft N of 241-T Tank Farm, 200W</u>			Project <u>RCRA Drilling 1998</u>
Reviewed By <u>NCWeekes DCWeekes 8/25/98</u>			Prepared by: L.D. Walker/ <u>LWalker</u>
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA
Description	Diagram	Graphic Log	Lithologic Description
		170	
		180	<u>173'-198': Silty Sandy Gravel</u>
		190	
		200	<u>198'-208': Sandy Gravel</u>
		210	
		220	
		230	
		240	
		250	<u>256'-258': Sand</u>
		260	<u>258'-272': Silty Sandy Gravel</u>
		270	
		280	<u>TD = 272 ft</u> <u>water level = 223.61' (8-19-98)</u>
<u>1/4" Bentonite Pellets :</u> <u>214.4" - 220.3"</u>			
<u>20-40 mesh Silica Sand:</u> <u>220.3' - 267.0'</u>			
<u>4½" OD (4" ID) type 304 SS</u> <u>continuous wire wrap 0.010-in</u> <u>slot screen: 225.78' - 260.88'</u> <u>Slough: 267.0' - 272.0'</u>			
<u>Bottom of 4½" OD (4" ID)</u> <u>type 304 SS endcap at</u> <u>261.21'</u>			
<u>9½" borehole to 272 ft.</u> <u>8½" OD carbon steel casing</u> <u>to 271.8'</u>			
<u>All temporary casing removed</u> <u>from the ground.</u>			
<u>Depths are measured from:</u> <u>ground surface</u>			

A-6000-384 (01/93)

BOREHOLE LOG				Boring or Well No. 299-W10-23 / B8545
				Sheet 1 of 4
Location ~50 ft. N of 241-T Tank Farm, 200 W			Project RCRA Drilling 1998	
Prepared By <u>A. Miller / L.D. Walker</u> (Sign/Print Name)	Date <u>8-11-98</u>	Reviewed By <u>Edward Pyle / Edward Pifice</u> (Sign/Print Name)	Date <u>08/20/98</u>	
Depth	Sample	Graphic Log	Sample Description	Comments
(0)	Type and No.	Blows or Recovery	Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
10	Air Rotary (Odex)	NA	0'-9': Silty Sand (m S) (10% gravel, 60% sand, 30% silt). Sand tr med, 40% fn, 60% v. fn, 10YR7/2, light grey, dry	8" Odex drill bit, 9 1/2" borehole, 8 5/8" OD temp cs casing End shift 8/11/98
20	Sieve #1 Grab sample		9'-20': Sandy Gravel (sG) (60% gravel, 40% sand, tr silt) gravel tr cobble, 20% cse-v. cse peb, 60% med, 20% fn. Sand content increases at 20 ft.	Add 10.0' of 8"Ø cs casing Total = 25.3' Poor returns 10'-20': air into formation
30	Air Rotary (Odex)		20'-34': Sandy Gravel (SG) (40% gravel, 60% sand, tr silt) Gravel 80% med-fn, sand 20% v. cse, 50% cse, 30% med-fn, sand 80% basalt, such angular, dry color 10YR6/1 (grey)	Add 10.0' 8"Ø cs casing; Total = 35' OVM, LEL < detect
40			34'-36': Silty Sand (m S) (60% sand, 40% silt) weak HCl rxn	Add 10.0' 8"Ø cs casing Total = 45.3'
50			36'-43.5': Sandy Gravel (sG) (40% gravel, 55% sand, 5% silt), sand 80% cse, 20% fn; silt in thin layers	Add 10.0' 8"Ø cs casing
60	Sieve #2 Grab sample		43.5'-48': Sand (S) 100% sand 40% v. cse, 40% cse, 20% med-fn, 70% qtz 20% basalt, 10% other, 10YR7/3 - pale brown	Total = 55.3'
70			48'-52': Gravelly Sand (g S) 20% gravel (med-fn) 80% sand (cse), tr silt gravel rounded, sand color as above.	Add 10.0' 8"Ø cs casing Total = 65.3'
			52'-56': Sand (S) (5% gravel, 90% sand 5% silt), weak HCl rxn, sl. moist	
			56'-75': Gravelly Sand (g S) (15% gravel, 80% sand, 5% silt); gravel 60% fn peb, 40% v. fn peb; sand 50% v. cse-cse, 40% med, 10% fn, color 10YR7/3	200 PSI and loosing air into formation Grab sample for sieve analysis #2 → 62'-63'
			75'-80': Sand (S) (tr gravel, 95% sand, 5% silt) gravel fn-v. fn, sand 60% med, 40% fn-v. fn, 10YR6/2, moist, mod sorted, sub ang-ang, 70% qtz, 15%	Collect split spoon #1; 100% rec. 4" Lexan liners, 75.0'-77.0' basalt no rxn to HCl

BOREHOLE LOG				Boring or Well No. 299-W10-23 / B8545
				Sheet 2 of 4
Location ~50 Ft. N of 241-T Tank Farm, 200W				Project RCRA Drilling 1998
Prepared By <u>D. Walker/L.D. Walker</u> Date <u>8-12-98</u> (Sign/Print Name)				Reviewed By <u>David Rahn/William Rahn</u> Date <u>8/22/98</u> (Sign/Print Name)
Depth	Sample	Graphic Log	Sample Description	Comments
(80')	Type and No.	Blows or Recovery	Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Air Rotary (Odex)	NA ↓	80'-106': Silty Sand (mS); sand 50% fn, 50% v.fn; color 10YR5/3-brown, moist, mod-strong HCl rxn (calcareous), mod sorted - 60% sand, 40% silt, tr mica	8" Odex drill bit 9 1/2" borehole 8 1/8" OD cs casing Split spoon #2 88.0'-88.0'; 100% rec. End Shift 8-12-98
85'	SS #2	100%		Casing at 85 ft.
90	Air Rotary (Odex)	NA		No rad contam. detected
100			98'-99': gravel fn-v.fn at 10% 101'-106': Silty Sand cemented-caliche 106'-114': Sand (S) (sand 95%, silt 5%); sand 50% cse, 30% med, 20% fn-v. fn, 5YR5/3-redish brown. SI moist, mod sorted, sub ang; 70% qtz, 30% basalt	Add 10.0' 8"Øcs casing Total = 115.3'
110			101'-106': tightest drilling dry and brittle caliche strong HCl rxn. Calcareous.	
114'-123'			Silty Sand (mS) similar to above → (80'-106')	
120			123'-131': thin beds (1ft or less) alternate cse Sand and Silty Sand as described above; moist	Add 10.0' 8"Øcs casing total = 135.3'
130			131'-149': Silty Sandy Gravel (msG) (gravel 50%, sand 35%, silt 15%) gravel lg cob to fn peb, 60% med peb, sand 20% v.cse, 30% cse, 40% med, 10% fn-v. fn, silt comes and goes in beds 10YR4/1, dk grey, dry, poorly sorted, gravel round - sub round, sand sub-angular, gravel and sand 60% basalt, 40% qtz, granitics, other. Mod-strong HCl rxn	134': drilling indicates cobbles 4-6" diameter. only lasts to 136' OVM, LEL < detect.
140				Add 10.0' 8"Øcs casing Total = 155.3'
150			149'-173': Sandy Gravel (SG) similar to above; silt decrease to < 5%; basalt content decrease, sand 20% basalt, 70% qtz. Still poorly sorted.	149'-150': drilling indicates large cobbles No rad contam. detected.

BOREHOLE LOG				Boring or Well No. 299-W10-23 / B8545
				Sheet <u>3</u> of <u>4</u>
Location ~50' N. of 241-T Tank Farm, 200W			Project RCRA Drilling 1998	
Prepared By <u>J.D. Walker</u> / L.D. Walker Date <u>8-13-98</u> (Sign/Print Name)			Reviewed By <u>Edward Relyea</u> / <u>EDWARD RELEYEA</u> Date <u>09/19/98</u> (Sign/Print Name)	
Depth	Sample		Sample Description	Comments
	Type and No.	Blows or Recovery	Graphic Log	Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl
(160)	Air- Rotary (Odex)	NA		8" Odex drill bit 9 1/2" borehole 8 5/8" OD CS casing Drilling indicates lg cobbles 163'-165' End of shift 8-13-98
170				
180				
190				
200	Grab			LEL, OVM < detect
202'-203'				198'-208': Sandy Gravel (sG) Similar to above, silt content < 5% Sand 80% med, 10YR 5/2, mod Sortifd, no rxn to HCl. Collect grab sample 202'-203'
210	Grab			
210-211'				208'-256': Silty Sandy Gravel (msG) (gravel 40%, sand 50%, silt 10%) gravel tr sm. cobbles, 30% v.cse-cse peb; 40% med, 30% fn-v.fn; sand 20% v.cse, 30% cse, 40% med, 10% Fine; 10YR 5/2 - gray brn, moist, poor-mod sorting; gravel sub round, sand 75% qtz, 10% basalt, 15% feld; no rxn HCl. Collect grab sample 210'-211'
220				
230				At 220', all further drill cuttings contained in 55-gal drums. 230' → drill cuttings are wet.

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 8/22/98

Finish Date: 10/21/98

Page 1 of 1

Specification No.: 0200X-SP- V001	Rev. No.: 1	Well Name: 299-W10-24	Temp. Well No.: B8546
ECNs: NA		Approximate Location: 25' North of 241-T Tank Farm, 200W	
Project: RCRA Drilling 1998		Other Companies: CH2M Hill	
Drilling Company: Layne Christensen		Geologist(s): DC Weekes, JM Faurote	
Driller: M. Wraspir, R.			
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 3/4" / 100psi	0' - 9.9'	11 5/8" / 10 3/4"	Cable Tool: 8 5/8" Diameter From 0' to 11.5'
carbon steel 8 5/8" / 8 psi	0' - 432'	8 5/8" / 7 5/8"	Air Rotary: TUBEX 7 5/8" Diameter From 11.5' to 432.5'
	-		A.R. w/Sonic: Diameter From _____ to _____
	-		Diameter From _____ to _____
	-		Diameter From _____ to _____
*Indicate Welded (W) - Flush Joint (F.J) Coupled (C) & Thread Design		Diameter From _____ to _____	
Drilling Fluid: Air			
Total Drilled Depth: 432.5'	Hole Dia @ TD: 9"	Total Amt. Of Water Added During Drilling: 250 gallons *	
Well Straightness Test Results: NA		Static Water Level: 231.41'	Date: 10/22/98

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
RLS Spec. KUT	0' - 422'	10/17/98			
	-			-	
	-			-	
	-			-	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval	Annual Seal/Filter Pack	Volume	Mesh Size
4" ID Type 304 ss	+1.8' - 232.94'	FJ	NA	3/8" bentonite pellets	218.5' - 221'	1-50# bags	NA	
4" ID Wire wrap ss (Type 304)	232.94' - 268.03'	FJ	0.010" in	Colorado Silica Sand	221' - 260.2'	18-100# sacks	24-40	
4" ID SS end cap	268.03' - 268.35'	FJ	NA	Colorado Silica Sand	260.2' - 274'	12-100# sacks	10-20%	P-16
Cement Grout	0' - 9.1'	7 9/16" SACKS	NA	Cement Grout	274' - 415.6'	28-94# sacks	NA	
Med. bentonite chunks	9.1' - 218.5'	11" 50# sacks	NA	Colorado Silica Sand	415.6' - 431.5'	12-100# sacks	10-20%	

OTHER ACTIVITIES

Aquifer Test:	Date:	Well Abandoned:	Yes: <input type="checkbox"/>	No: <input checked="" type="checkbox"/>	Date:
Description:		Description:			

WELL SURVEY DATA

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

COMMENTS/REMARKS

Originally 10" carbon steel was set to 9.9' however it was withdrawn and only 9m 8" casing was set. Slough from 431.5' - 432.5'. *water added during well completion to "unhitch" sand

Reported By: DC Weekes	Reviewed by: L.D. Walker Reported By:
Title: Geologist	Date: 10/22/98
Signature: DC Weekes	Signature: L.D. Walker

0502412

WELL SUMMARY SHEET			Page <u>1</u> of <u>2</u>
Well ID:	Well Name:	Date: 10/21/98	
Location: 25' North of 241-T Tank Farm, ²⁰⁰ W	Project: RCRA Drilling 1998		
Prepared By: DC Weekes Date: 10/21/98	Reviewed By: L.D. Walker Date: 10/23/98		
Signature: <u>DC Weekes</u>			Signature: <u>L.D. Walker</u>
CONSTRUCTION DATA			GEOLOGIC/HYDROLOGIC DATA
Description	Diagram	Depth in Feet	Graphic Log
8" carbon steel protective case: +3.1' - 2.9'		0	0'-2': Backfill (cobbles, sand, silt)
Cement grout: 0' - 9.1'			2'-5': Silty Sandy GRAVEL (msG)
SS centralizers below and above the screen and at about 40ft intervals as shown.		50	5'-7': SAND (S)
4½" OD (4" ID) Type 304 stainless steel riser: +1.8' - 232.94'.		7'-36'	7'-36': Silty Sandy GRAVEL
Medium bentonite chunks: 9.1' - 218.5'		36'-39'	36'-39': Gravelly SAND (gs)
¾" bentonite pellets (Rel-Plug: 218.5-221'; 20-40 mesh Colored Silica Sand: 221-228.2')		39'-42'	39'-42': Sandy GRAVEL (sG)
10-20 and 8-16 mesh Colored Silica Sand: 260.2' - 274'		42'-59'	42'-59': SAND
4½" OD (4" ID) stainless steel continuous wire wrap 0.010-in slot screen (Type 304): 232.94' - 268.03'		59'-83.2'	59'-83.2': Sandy GRAVEL
Bottom of 4½" OD screen cap @ 268.35'		83.2'-84'	83.2'-84': Silty SAND (ms)
Cement Grout: 274' - 415.6'		84'-86'	84'-86': SAND, 86'-98' Silty SAND
Depths from ground surface		98'-108'	98'-108': CALICHE (calc. sand)
		108'-119'	108'-119': Sandy SILT
		119'-128'	119'-128': SAND
		128'-148'	128'-148': Sandy GRAVEL
		148'-190'	148'-190': Silty Sandy GRAVEL
		190'-228'	190'-228': Silty Sandy GRAVEL
		228'-305'	228'-305': Sandy GRAVEL
		250+	Water level = 231.41' (10/21/98)
			Water Sample at 286' (1.44)

BOREHOLE LOG					Boring or Well No. 299-W10-24 (B8546)
					Sheet 2 of 6
Location 25' North of 241-T Tank Farm, Z00W					Project RCRA Drilling 1998
Prepared By DC Weekes Date 10/3/98 (Sign/Print Name)					Reviewed By RD Waller / L.D. Walker Date 10/23/98 (Sign/Print Name)
Depth (ft)	Sample		Sample Description	Comments	
Type and No.	Blows or Recovery	Graphic Log	Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level	
80	ODEX ↓ SS #1 83.1-83.5 100% recovery	NA ↓	83'-83.1': Sandy GRAVEL (sG), see p. 1, @ 80' 10YR 6/2 light brownish gray (dry), dry to slightly moist	Lemon liners in ss - each capped and retained	
83.2'-84'	ODEX	NA	83.2'-84': Silty SAND (mS), mostly rf sand, 25% silt, 10YR 5/3 brown (moist), 10YR 6/3, pale brown (dry), moist, well sorted, mostly quartz, max 2mm, strong rxn to HCl	Lemon liners - each capped + retained	
90	SS #2 91.5-92.5 100% rec.	↓	84'-86': SAND (S), mostly m-c, tr gravel, colors as above, moist, caliche chunks	End of shift 10/2/98	
100	ODEX	NA	86'-87.5': coarse sand + fine gravel, moderately sorted, SA-SR, mostly quartzic, max 20mm, strong to moderate rxn to HCl	Caliche may start deeper in hole due to pipe tally mixup	
110			87.5'-88.5': Silty SAND (mS), same		
120			88.5'-89.5': 45.83.2'-84'; tr mica		
130			89.5'-90.5': CALICHE, highly calcareous sand, 2.5Y 8/2 white (dry), dry, mostly calcareous, strong rxn to HCl		
140			90.5'-91.5': sandy SILT, 40% rf sand, 60% silt, 10YR 6/2 light brownish gray (dry), dry to moist, well sorted, low plasticity, strong rxn to HCl		
150			91.5'-92.5': SAND (S), f-vf, 10YR 6/2 light brownish gray (dry), dry, well sorted, A-SA, mostly quartz, strong rxn to HCl	Hard (slower) drilling; V. little air return from ~128'-132'	
			92.5'-93.5': Sandy GRAVEL (sG), 60%-70% gravel, 5-10% silt, 2.5Y 6/2 light brownish gray (dry), dry, poorly sorted, A (due to drilling), 60% bas, 40% other, max 20mm, moderate rxn to HCl		
			93.5'-94.5':		
			94.5'-95.5': Silty Sandy GRAVEL (msG), 60-80% gravel, 10-15% silt, 2.5Y 7/2 light gray (dry), dry, poorly sorted, A-R, 50% bas, 50% other, max 1½", mod rxn to HCl		
			95.5'-96.5': no to weak rxn to HCl		

BOREHOLE LOG

Boring or Well No. 299-W10-24(B8546)

Sheet 3 of 6

Location 25' North of 241-T Tank Farm, 200W

Project RCRA Drilling 1998

Prepared By DR. Weekes 10/10/98
(Sign/Print Name)Reviewed By DR. Walker / L.D. Walker Date 10/5/98
(Sign/Print Name)

MAR 3 1 1999

Depth (ft)	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery		Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sizing, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	
160	ODEX	NA			End of shift 10/3/98
170				mod rxn to HCl	
180				mod rxn to HCl	
190				190'-228': Silty Sandy GRAVEL (msG), 50-70% gravel , 10-20% silt, less basaltic, mod-strong rxn to HCl, gravels are commonly oxidized (FeOx), basalt content 30-40%, gravel is SR-R, max size 25 mm, 10YR6/2 light brownish gray (dry), dry	
200				gravels commonly oxidized (FeOx), basalt content 30-40%, Strong rxn to HCl	
210					
220					End of shift 10/5/98
230				228'-305' Sandy Gravel (SG) 5-10% silt, 60-70% Gravel. Basalt is 30-40%, variable lithologies, mod rxn to HCl Gravel is SR-R, mod. sorted. Some Fe'nx stains. Color generally 10YR6/2	WL in nearby well is 231.4 ft.

A-5000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W10-24 (B88546)

Sheet 4 of 6

Location 25' North of 241-T Tank Farm, 200W

Project RCRA Drilling 1998

Prepared By DC Weekes Date 10/10/98
(Sign/Print Name)

Reviewed By A. Walker / L.D. Walker Date 10/23/98
(Sign/Print Name)

BOREHOLE LOG		Boring or Well No. <u>299-W10-24(B8546)</u>
		Sheet <u>5</u> of <u>6</u>

Location 25' North of 241-T Tank Farm, 200W

Project RCRA Drilling 1998

Prepared By DC Weekes DC Weekes Date 10/14/98
 (Sign/Print Name)

Reviewed By A. Walker / L.D. Walker Date 10/23/98
 (Sign/Print Name)

Depth (ft)	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery		Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralsogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
320	ODEX	NA		305'-355': GRAVEL (G), see p. 4 for description	
330				no to weak rxn to HCl	Water producer Water Sample 332' (DGH) End of shift 10/10/98
340				no to weak rxn to HCl	Water producer
350				no to v. weak rxn to HCl, sands are very micaceous, basal content of gravels is ~10-30%	Water producer Possible sand lens 355-357'
355'				Sandy GRAVEL (sG), not distinct contact 50-75% gravel, 5-10% silt, 5Y 1/2 olive gray/wet, 5Y 1/2 gray/dry); sands are very	Possible sand lens 355-357' not distinct contact
360				micaceous, A-SA, mostly quartz; gravel is 10-30% bas, broken clasts to R, 70-90% mixed lithology, FeOx common, poorly sorted, no rxn to HCl	water producer
370				very little silt@ 370', 75% gravel	water producer
380				no rxn to HCl	Water producer Water Sample 383' (DGH) End of shift 10/13/98
390				very little silt@ 390', 75% gravel, no rxn to HCl, bas content increases to 40-50%	water producer
				very little silt@ 400', 75% gravel, bas ~40%	water producer

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Appendix B

Physical and Chemical Properties Data

Appendix B

Physical and Chemical Properties Data

This appendix includes the results of laboratory testing for pH, conductivity, particle size distribution, moisture content, total inorganic carbon, and major cations and anions from 1:1 water:sediment extractions.

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

Total inorganic carbon was measured from an air-dried aliquot of the <2mm fraction. The sample was combusted in a total carbon analyzer at 975°C and the weight of evolved carbon dioxide was determined and converted to calcium carbonate equivalent. Reagent grade calcium carbonate was used as a standard. Instrument precision was ± 3 wt% based on replicate measurements of reagent grade calcium carbonate.

Exchangeable cations were determined by inductively coupled plasma analysis (ICP) after exchange with an ammonium acetate solution. Twenty grams of air dried sediment were mixed with 50 mL of 1M ammonium acetate for 16 h. Electrical conductivity, pH, and major cations and anions were determined from a 1:1 water:sediment extract. The concentrations of major cations were measured with ICP, anions were determined by ion chromatography (IC), and alkalinity was measured by titration. Electrical conductivity and pH were determined from unfiltered aliquots and cations and anions from aliquots of solution filtered through 0.45 μm membranes.

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

Table B.1. Moisture Content, pH, and Electrical Conductivity for Samples from Well 299-W10-23

Depth (ft)	Moisture Content (wt. %)	pH	Electrical Conductivity ($\mu\text{S}/\text{cm}$)
21 - 22	3.34	8.99	125 @ 22.4°C
62 - 63	12.95	8.49	187 @ 22.4°C
202 - 203	3.77	8.1	67 @ 22.5°C
210 - 211	6.95	7.8	47 @ 22.5°C

Table B.2. Extractable Cations and Anions from Samples from Well 299-W10-23

Depth (ft)	Cations (mg/L)						Total Cations (meq/L)	Monovalent Cations (%)	Divalent Cations (%)
	Ba	Ca	K	Mg	Na	Sr			
21-22	0.02	5.76	0.77	0.81	8.34	0.02	0.74	51.91	48.09
62-63	0.03	13.59	0.81	3.32	6.00	0.08	1.24	22.80	77.20
202-203	0.03	3.32	0.27	1.19	3.14	0.02	0.41	35.18	64.82
210-211	0.02	1.62	0.04	0.54	1.29	0.01	0.18	31.30	68.70

Depth (ft)	Total Inorganic Carbon (wt%)	Alkalinity as CaCO ₃	Anions (mg/L)				Anions (meq/L)	Electrical Balance (%)
			F	Cl	NO ₃	SO ₄		
21-22	5.36	44.67	0.21	1.86	<0.06	15.82	1.29	-54.30
62-63	9.54	79.50	0.26	8.29	<0.06	19.88	2.25	-58.29
202-203	1.58	13.17	0.23	6.45	<0.06	3.48	0.53	-25.99
210-211	2.05	17.08	0.25	1.05	<0.06	2.62	0.44	-82.45

Table B.3. Particle Size Distributions of Samples from Wells 299-W10-23 and 299-W10-24

Particle Size (mm)	Sieve	Weight of Dry Sample (g)	Weight Percent	Particle Size (mm)	Sieve	Weight of Dry Sample (g)	Weight Percent
299-W10-23—Depth 21 to 22 ft							
2	10	216.14	86.8	2	10	962.8	80.7
0.88	20	19.95	8.0	0.88	20	131.79	11.0
0.425	40	10.51	4.2	0.425	40	47.51	4.0
0.25	60	0.48	0.2	0.25	60	17.12	1.4
0.106	140	0.24	0.1	0.106	140	16.68	1.4
0.075	200	0.16	0.1	0.075	200	4.66	0.4
>0.075	Pan	1.58	0.6	<0.075	Pan	12.21	1.0
		Total	249.06			Total	1192.77
299-W10-23—Depth 62 to 63 ft							
2	10	21.82	19.7	2	10	165.1	37.47
0.88	20	23.55	21.2	0.88	20	135.4	30.7
0.425	40	35.11	31.6	0.425	40	85.09	19.31
0.25	60	20.54	18.5	0.25	60	23.07	5.2
0.106	140	5.13	4.6	0.106	140	16.59	3.8
0.075	200	1.04	0.9	0.075	200	4.47	1.01
>0.075	Pan	3.85	3.5	<0.075	Pan	10.93	2.5
		Total	111.04			Total	440.65
299-W10-24—Depth 60 ft							
2	10	165.1	37.47	2	10	962.8	80.7
0.88	20	135.4	30.7	0.88	20	131.79	11.0
0.425	40	85.09	19.31	0.425	40	47.51	4.0
0.25	60	23.07	5.2	0.25	60	17.12	1.4
0.106	140	16.59	3.8	0.106	140	16.68	1.4
0.075	200	4.47	1.01	0.075	200	4.66	0.4
>0.075	Pan	10.93	2.5	<0.075	Pan	12.21	1.0
		Total	1192.77			Total	100.0

Appendix C

Geophysical Logs

Appendix C

Geophysical Logs

This appendix contains the high purity, germanium spectral gamma-ray log for wells 299-W10-23 and 299-W10-24. The logs were run by Waste Management Federal Services Northwest, Inc. and log data analyses completed by Three Rivers Scientific Company. Included with the logs are Log Header sheets, Acceptance QA Processing data, and Log Analysis Summary Reports.

RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Log Header

Project: RCRA Drilling – FY1998

Well: 299 - W10 - 23

Log Type: HPGe Spectral Gamma Ray

Borehole Information

Well ID	<u>B8545</u>	Water Depth	<u>225.3</u> ft	Total Depth	<u>275.3</u>
ft					
Elevation Reference	<u>Ground</u>	Elevation	<u>n/a</u> ft		
Depth Reference	<u>Ground Surface</u>	Casing Stickup	<u>4.4</u> ft		
Casing Diameter	<u>8</u> in	Depth Interval	<u>0 to 275.3</u> ft	Thickness	<u>0.322</u> in
Casing Diameter	<u> </u> in	Depth Interval	<u> </u> ft	Thickness	<u> </u> in

Logging Information

Log Type:	HPGe Spectral Gamma Ray		
Company	Waste Management Federal Services NW		
Date/Archive File Name	Aug 15, 1998 H2W10023		
Logging Engineers	J.Meisner		
Instrument Series	RLSG3.1		
Logging Unit	RLS2		
Depth Interval	0 to 200 ft	Prefix B207	
	197.5 to 263.5 ft	Prefix B208	
Instrument Calibration Date	Sep 11, 1998		
Calibration Report	WHC-SD-EN-TI-292, Rev. 0		

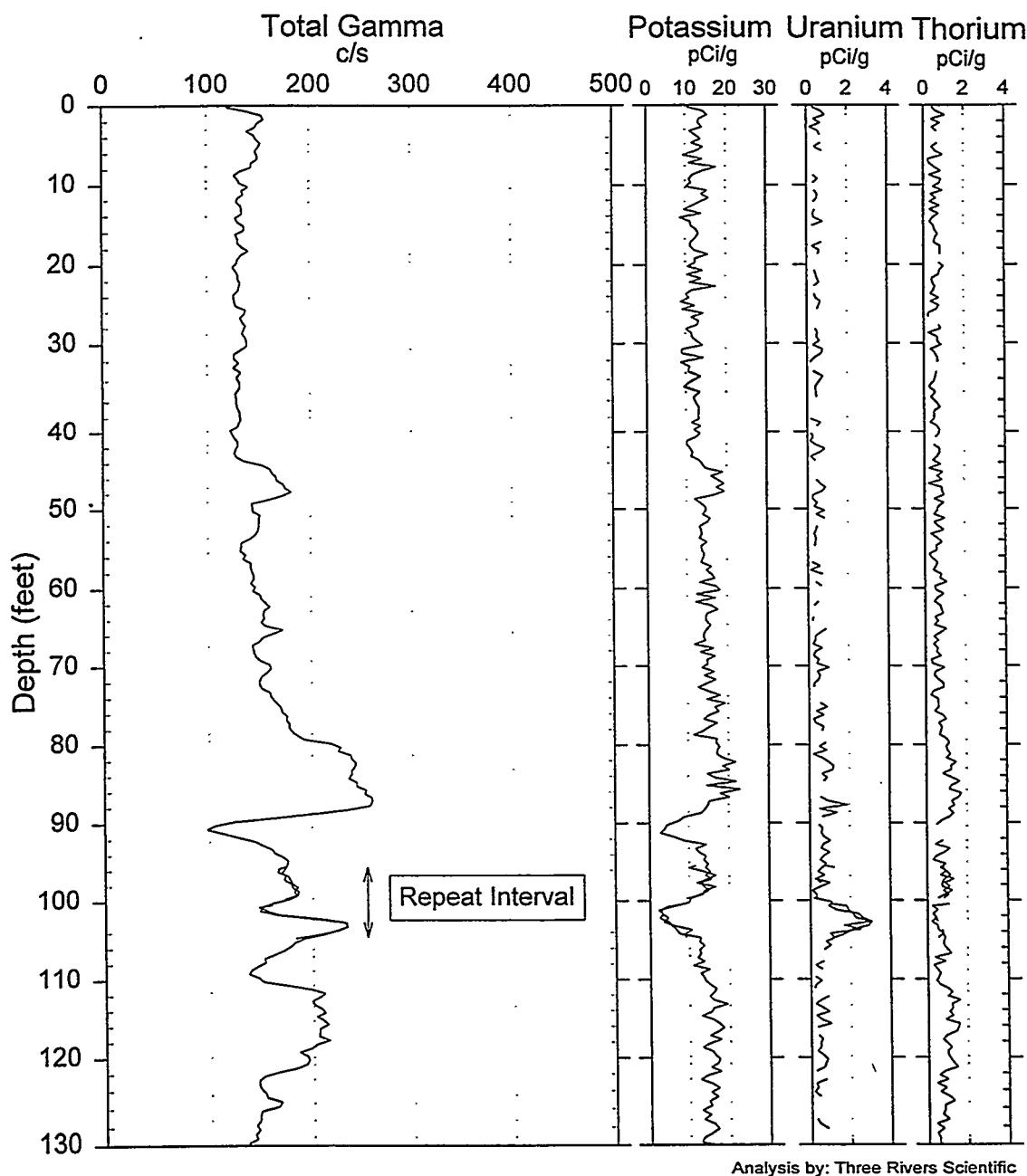
Analysis Information

Company	Three Rivers Scientific
Analyst	Russ Randall
Date	December 13, 1998
Notes <u>No man made radionuclides were detected.</u>	

RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1998 Log Date: Aug 15, 1998
Borehole: 299-W10-23 (B8545) Naturally Occurring Radionuclides



RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

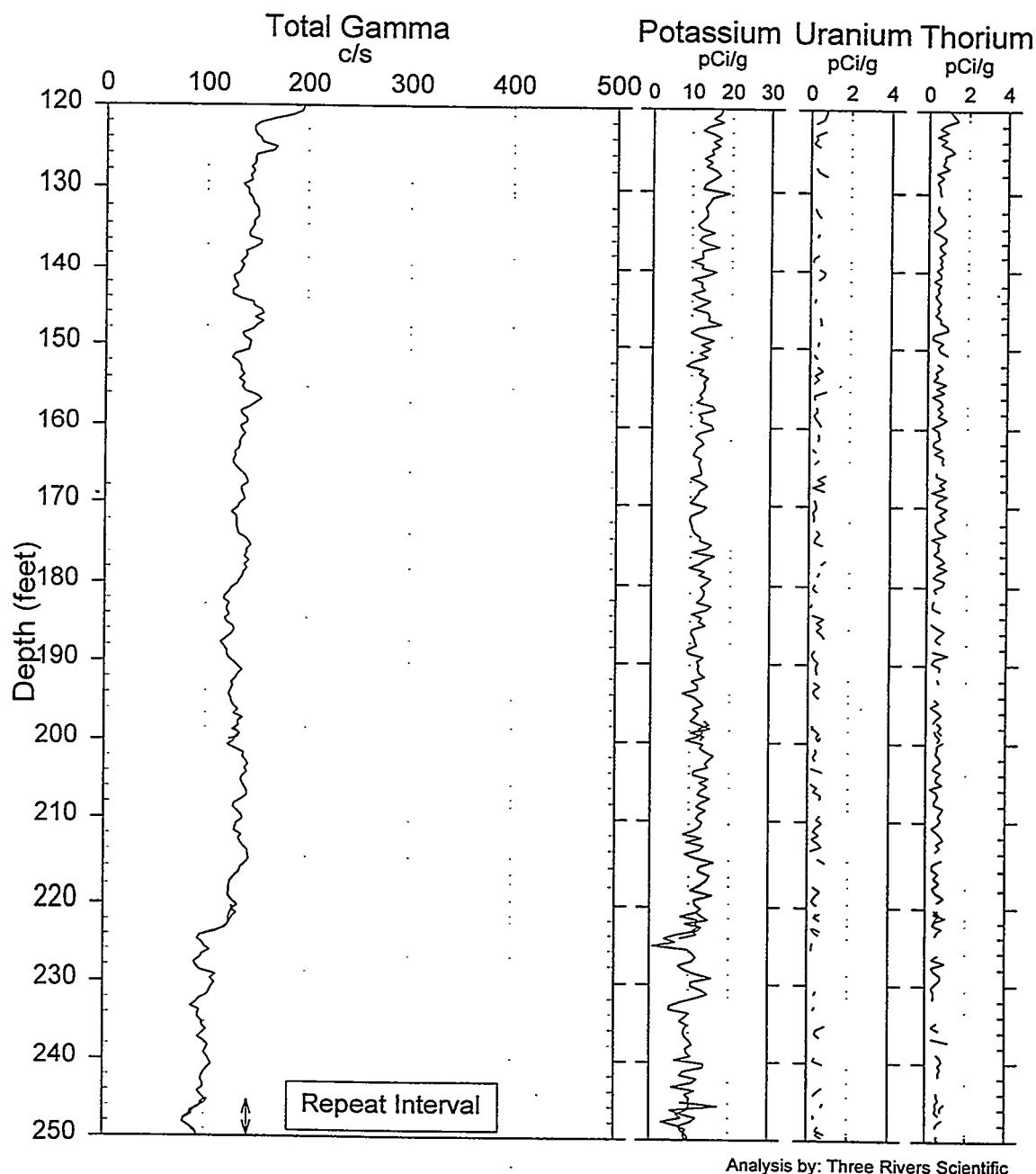
Project: RCRA Drilling - FY1998

Log Date:

Aug 15, 1998

Borehole: 299-W10-23 (B8545)

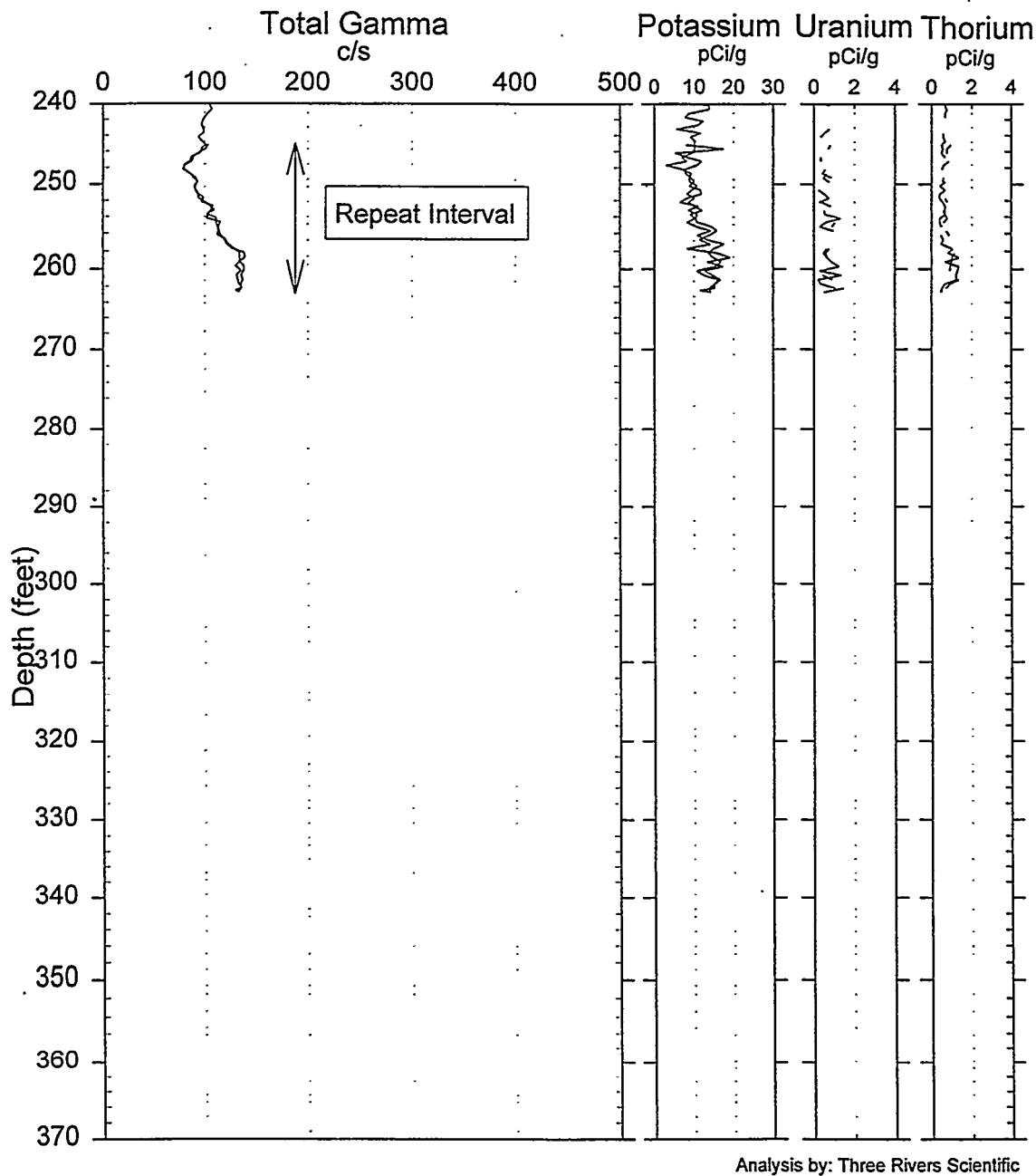
Naturally Occurring Radionuclides



RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1998 Log Date: Aug 15, 1998
Borehole: 299-W10-23 (B8545) Naturally Occurring Radionuclides

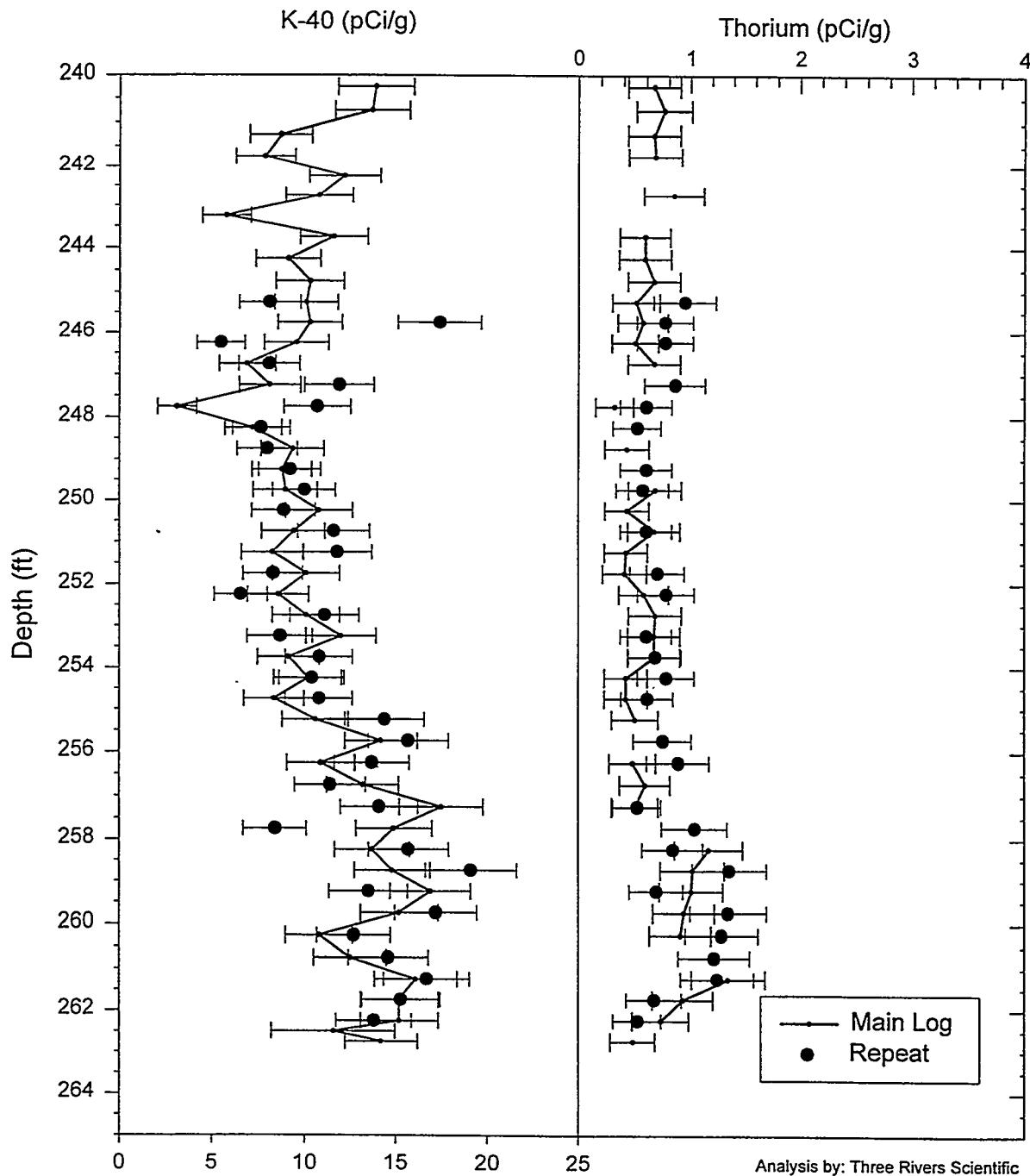


RLS Spectral Gamma Ray Borehole Survey

Acceptance QA Processing

Project: RCRA Drilling - FY1998
Borehole: 299-W10-23 (B8545)

Log Date: Aug. 15, 1998
Compare Main Log & Repeat



Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey
Waste Management Federal Services NW

Log Analysis Summary Report

Project:	RCRA Drilling - FY1998	Well ID:	299-W10-23
Log Type:	HPGe Spectral Gamma Ray	Log Dates:	Aug 15, 1998

General Notes:

Total gamma is a response to formation lithology for the entire depth logged.

The system dead-time limit was not exceeded (less than 5%) for the borehole survey.

System Performance Verify: The pre- and post-log verification was performed using coleman #2 mantle, and passed the equipment performance check. The maximum FWHM for the 583 keV gamma ray photo peak for the survey date was 2.51 keV. The maximum acceptable FWHM resolution is 3.10 keV for probe RLSG3.1 on the log date.

Repeat Interval: The repeat interval, 245 to 262 feet, agrees with the main log within acceptable limits, refer to the Acceptance QA Processing plots.

Environmental Corrections: The KUT concentrations have been corrected for casing attenuation (entire well) and water inside the casing (below 225.3 feet) for a centralized detector configuration. No casing correction was applied to the total gamma due to Compton downscatter interference.

Radionuclides:

No man-made radionuclides were detected, even using a factor of 4 summing technique.

Analysis by: Three Rivers Scientific

RLS Spectral Gamma-Ray Borehole Survey

Waste Management Federal Services NW

Log Header

Project: RCRA Drilling – FY1999

Well: 299 - W10 - 24

Log Type: HPGe Spectral Gamma-Ray

Borehole Information

Well ID	<u>B8546</u>	Water Depth	<u>231.4</u> ft	Total Depth	<u>432.0</u> ft
Elevation Reference	<u>No Data</u>	Elevation	<u>n/a</u> ft		
Depth Reference	<u>Ground Surface</u>	Casing Stickup	<u>1.6</u> ft		
Casing Diameter	<u>8</u> in	Depth Interval	<u>0 to 423.5</u> ft	Thickness	<u>0.50</u> in
Casing Diameter	<u> </u> in	Depth Interval	<u> </u> ft	Thickness	<u> </u> in

Logging Information

Log Type:	HPGe Spectral Gamma Ray
Company	Waste Management Federal Services NW
Date/Archive File Name	Oct 17, 1998 H2W10024
Logging Engineers	<u>A.Pearson</u>
Instrument Series	RLSG3.1
Logging Unit	RLS2
Depth Interval	0 to 120 ft Prefix B219 135 to 240 ft Prefix B220 235 to 360 ft Prefix B221 355 to 423 ft Prefix B222 423 to 400 ft Prefix B222 (repeat)
Instrument Calibration Date	Sep 11, 1998
Calibration Report	WHC-SD-EN-TI-292, Rev. 0

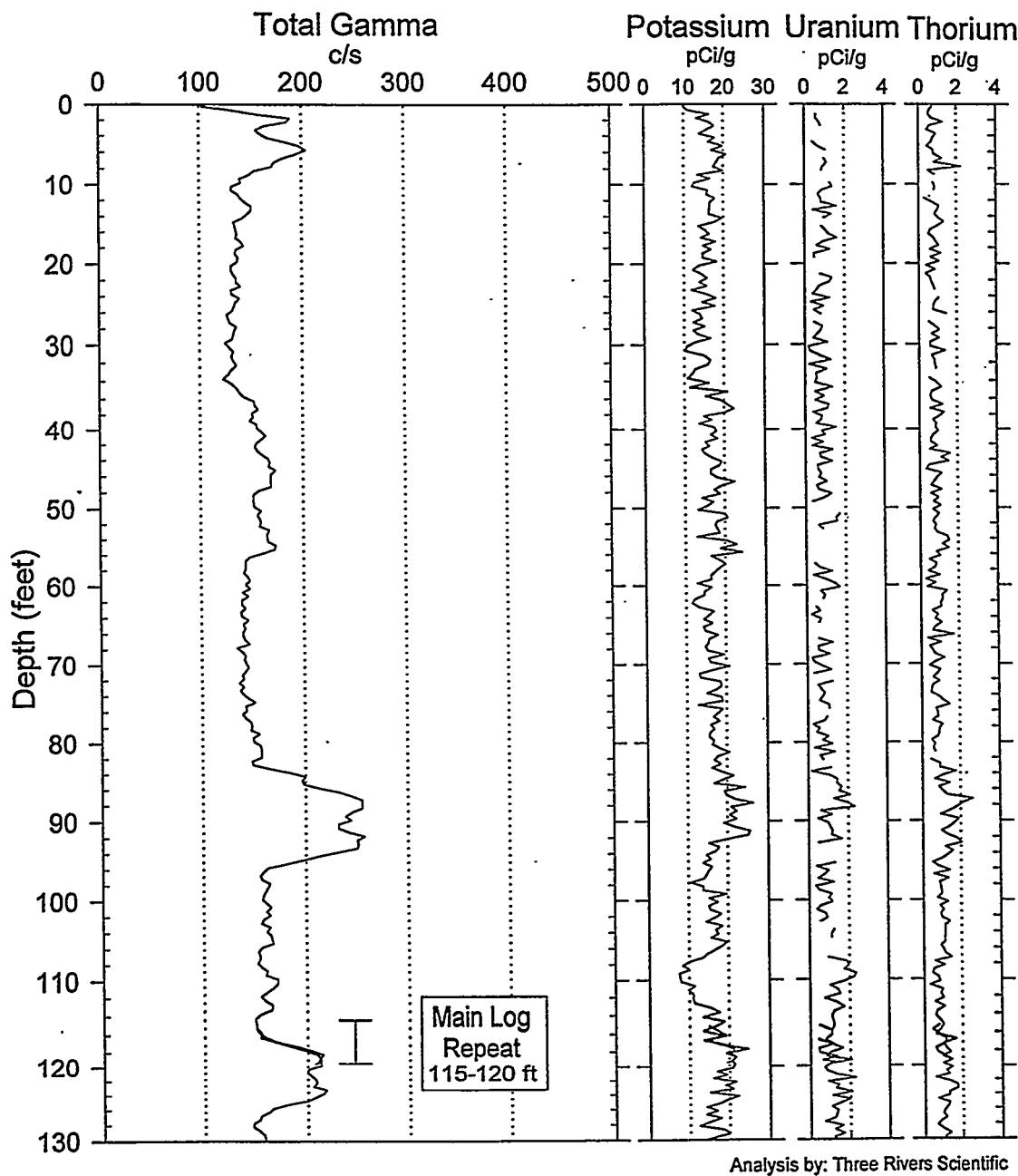
Analysis Information

Company	Three Rivers Scientific
Analyst	Randall Price
Date	Oct 27, 1998
Notes	Cs-137 was identified near the surface (1 to 10 ft) with a maximum concentration of 3 pCi/g and at intermittent locations (less than 0.3 pCi/g) to the bottom of the well. No other man made radionuclides were detected.

RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

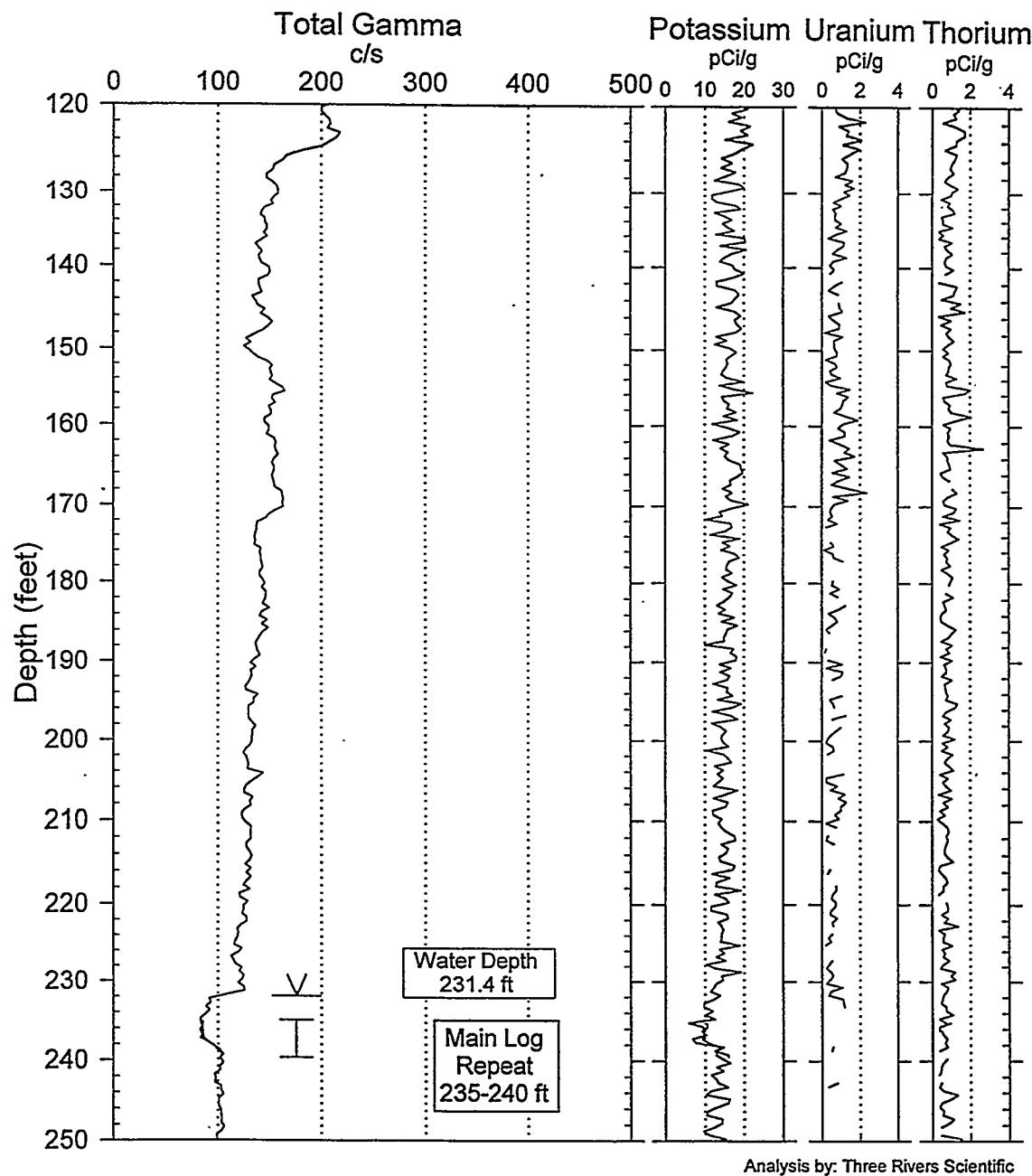
Project: RCRA Drilling - FY1999 Log Date: Oct. 17, 1998
Borehole: 299-W10-24 (B8546) Naturally Occurring Radionuclides



RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

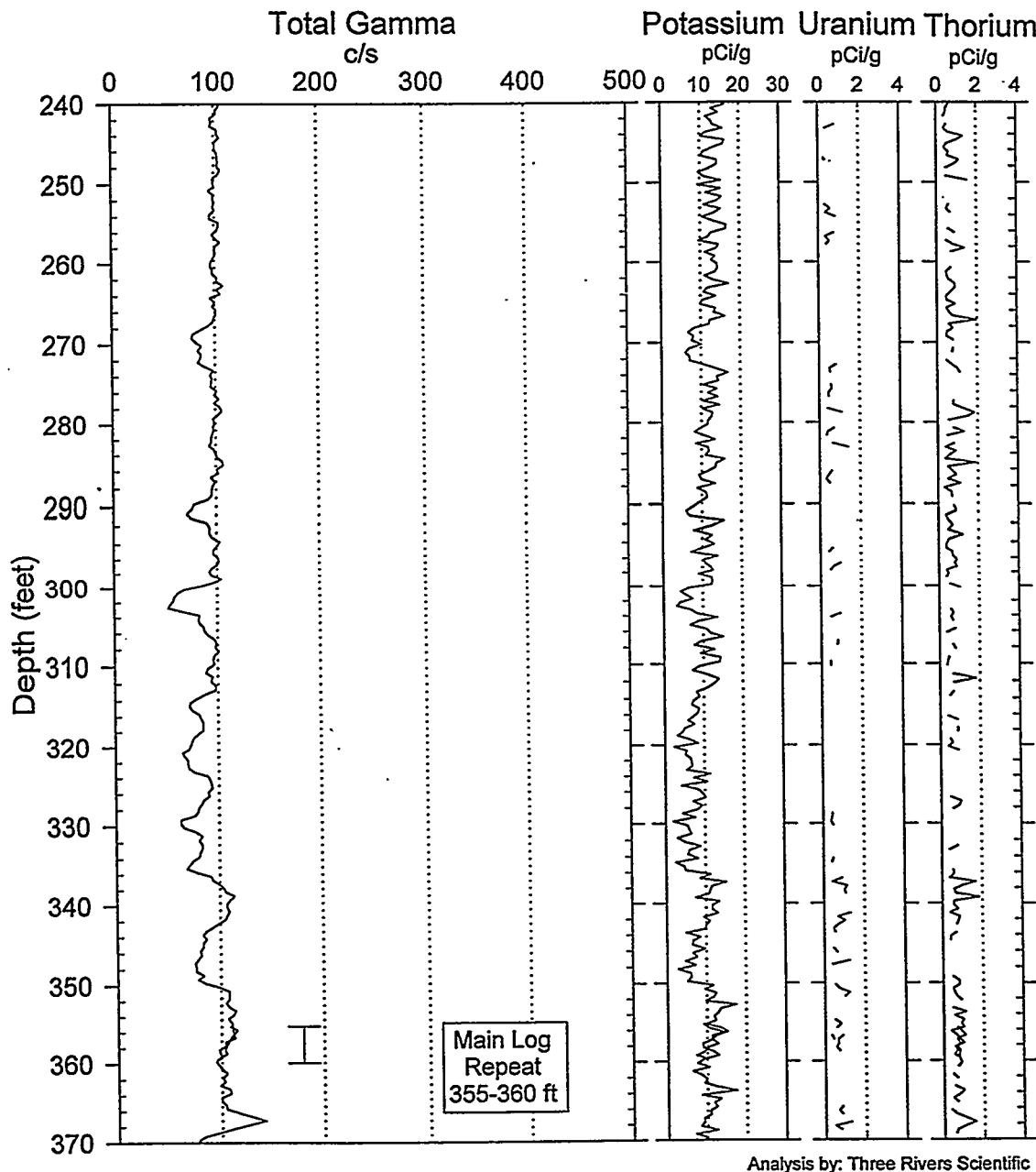
Project: RCRA Drilling - FY1999 Log Date: Oct. 17, 1998
Borehole: 299-W10-24 (B8546) Naturally Occurring Radionuclides



RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

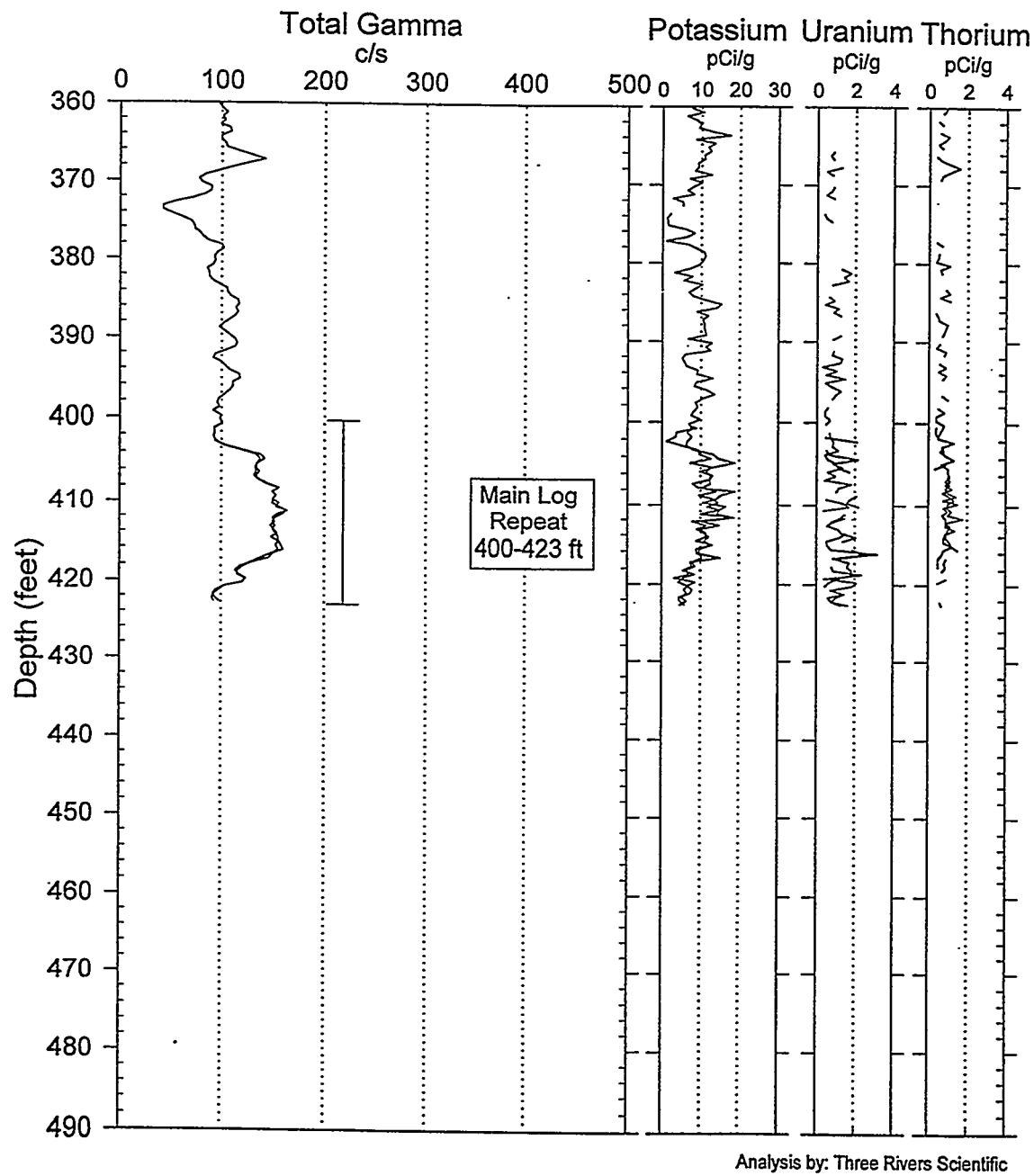
Project: RCRA Drilling - FY1999 Log Date: Oct. 17, 1998
Borehole: 299-W10-24 (B8546) Naturally Occurring Radionuclides



RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

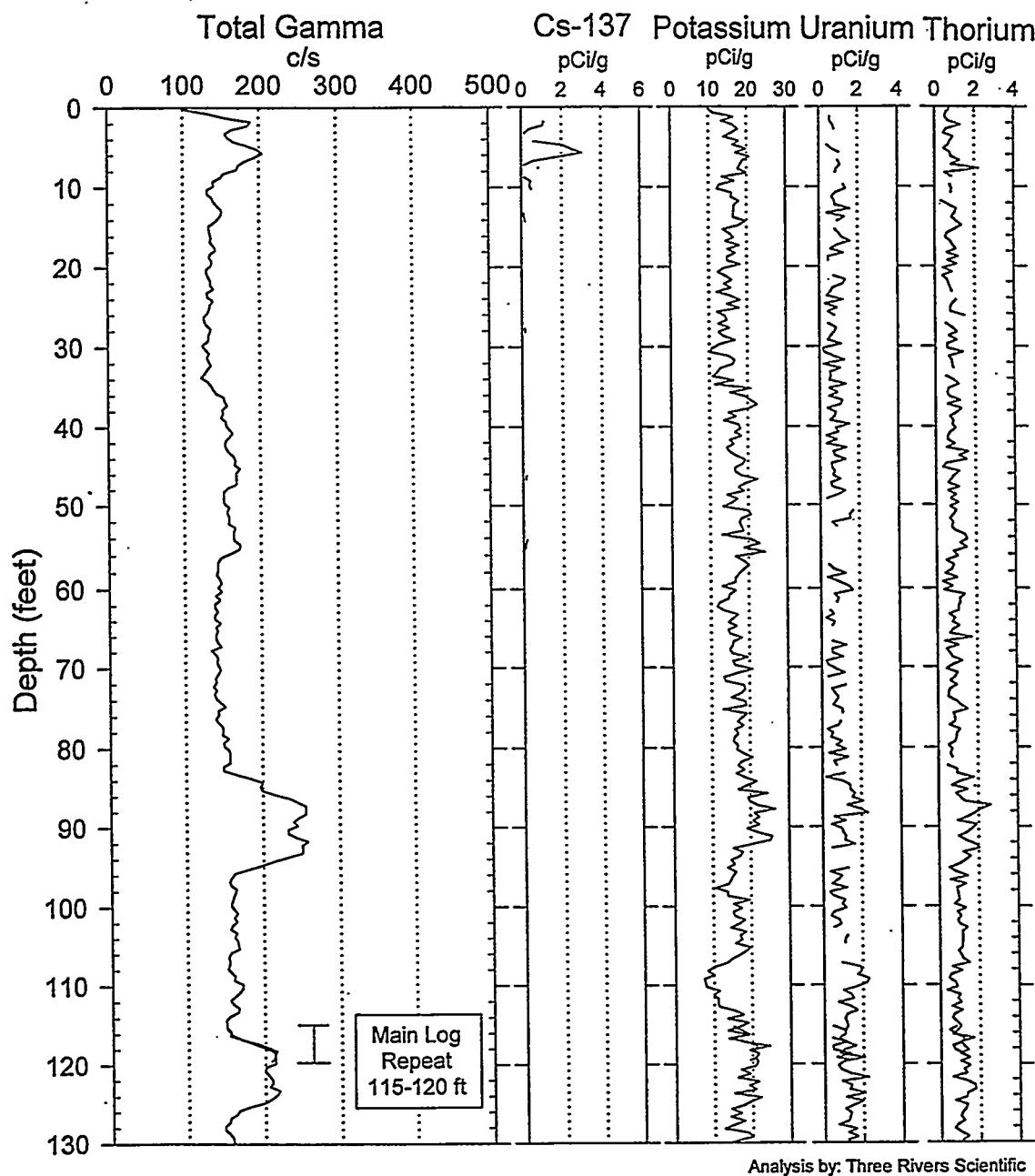
Project: RCRA Drilling - FY1999 Log Date: Oct. 17, 1998
Borehole: 299-W10-24 (B8546) Naturally Occurring Radionuclides



RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

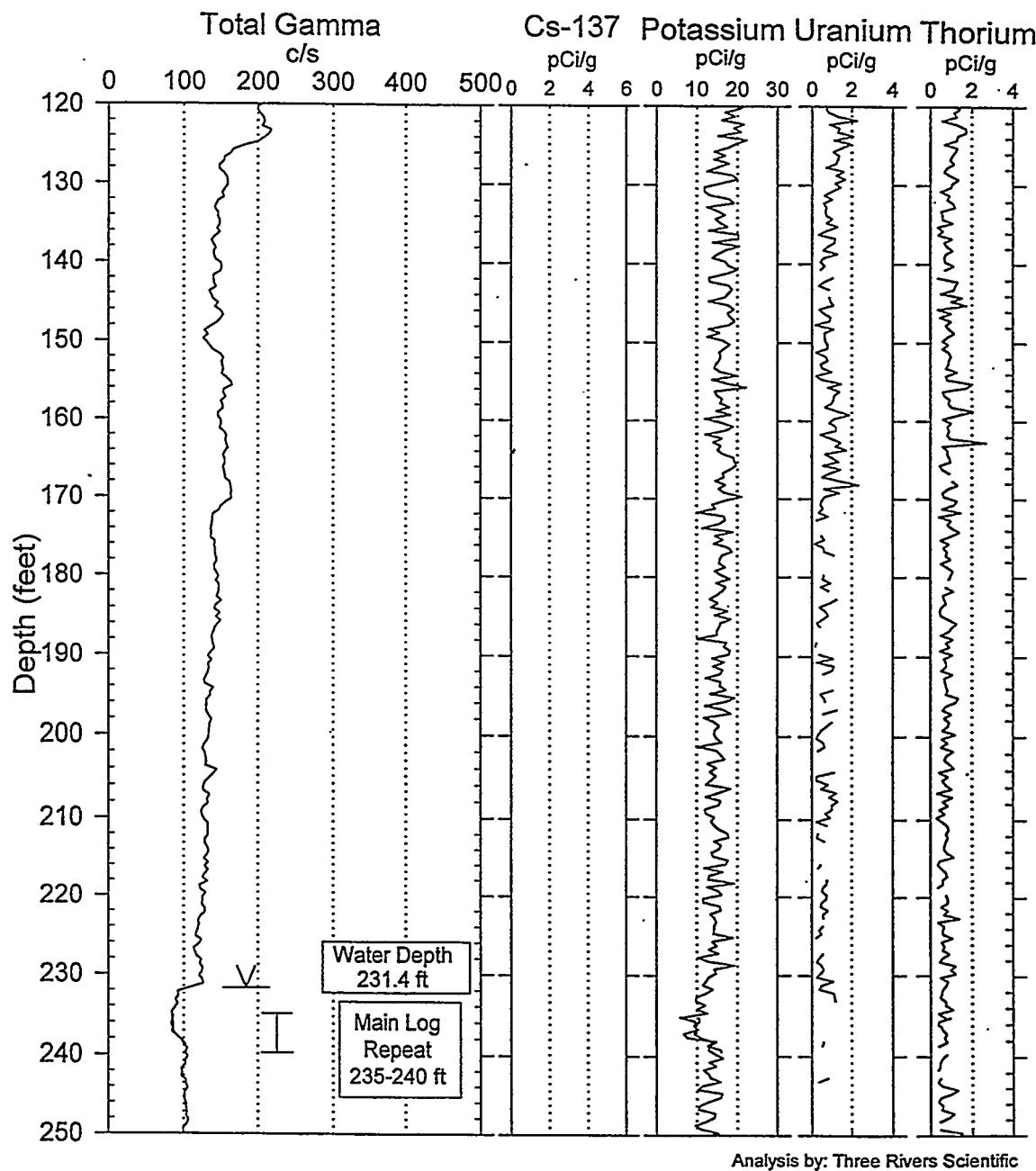
Project: RCRA Drilling - FY1999 Log Date: Oct. 17, 1998
Borehole: 299-W10-24 (B8546) Natural Radionuclides & Cs-137



RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1999 Log Date: Oct. 17, 1998
 Borehole: 299-W10-24 (B8546) Natural Radionuclides & Cs-137

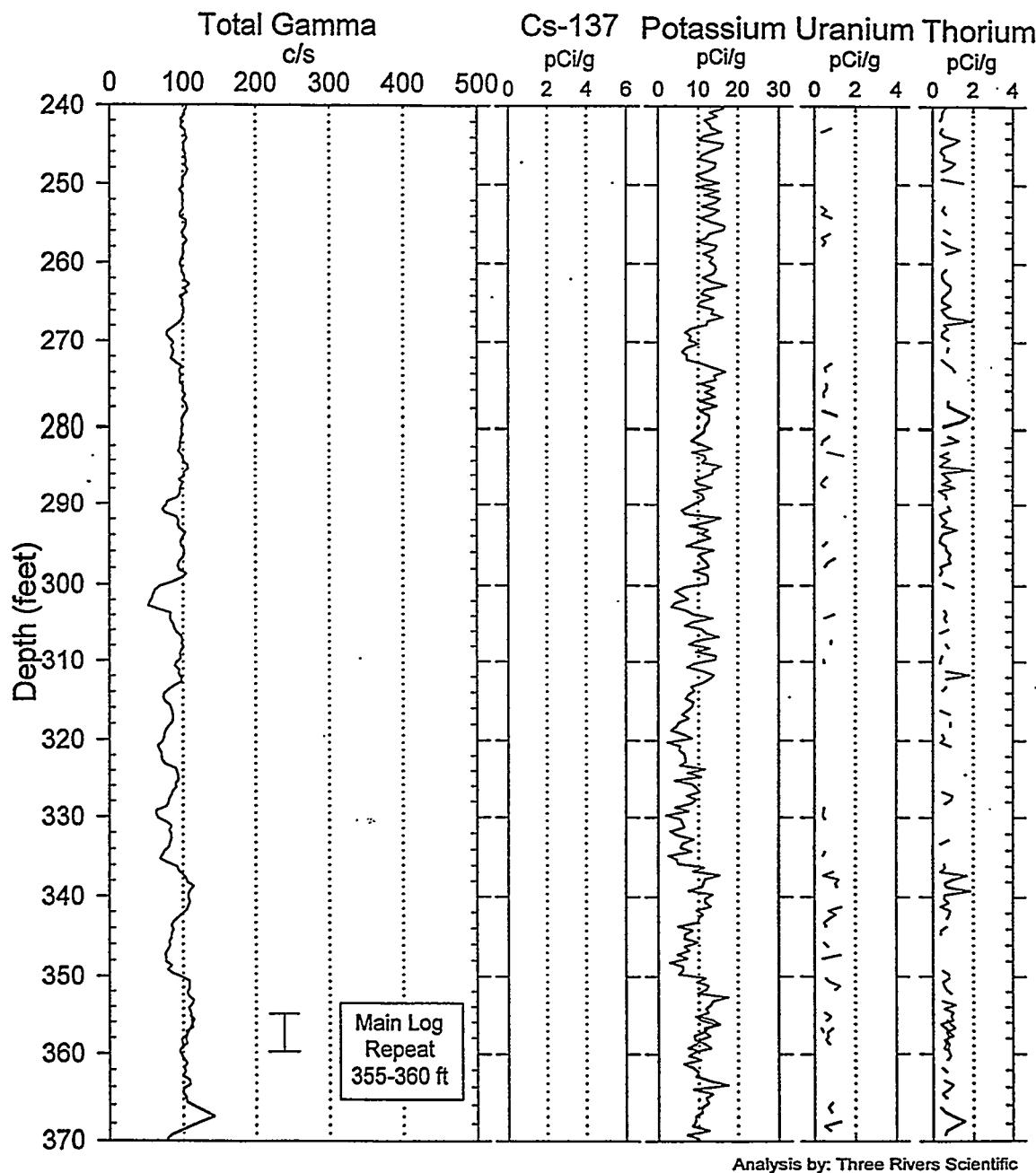


Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

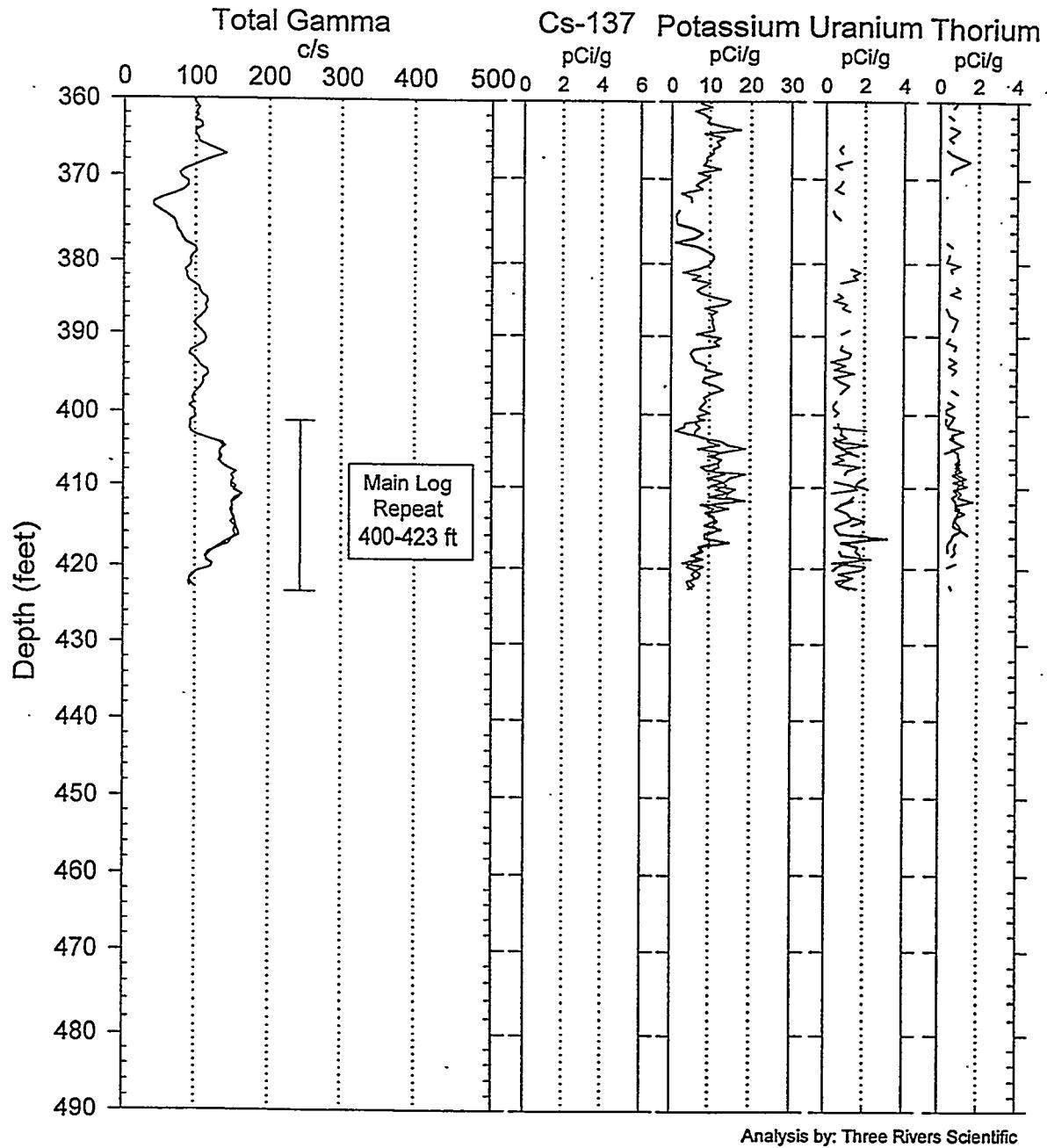
Project: RCRA Drilling - FY1999 Log Date: Oct. 17, 1998
Borehole: 299-W10-24 (B8546) Natural Radionuclides & Cs-137



RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1999 Log Date: Oct. 17, 1998
Borehole: 299-W10-24 (B8546) Natural Radionuclides & Cs-137

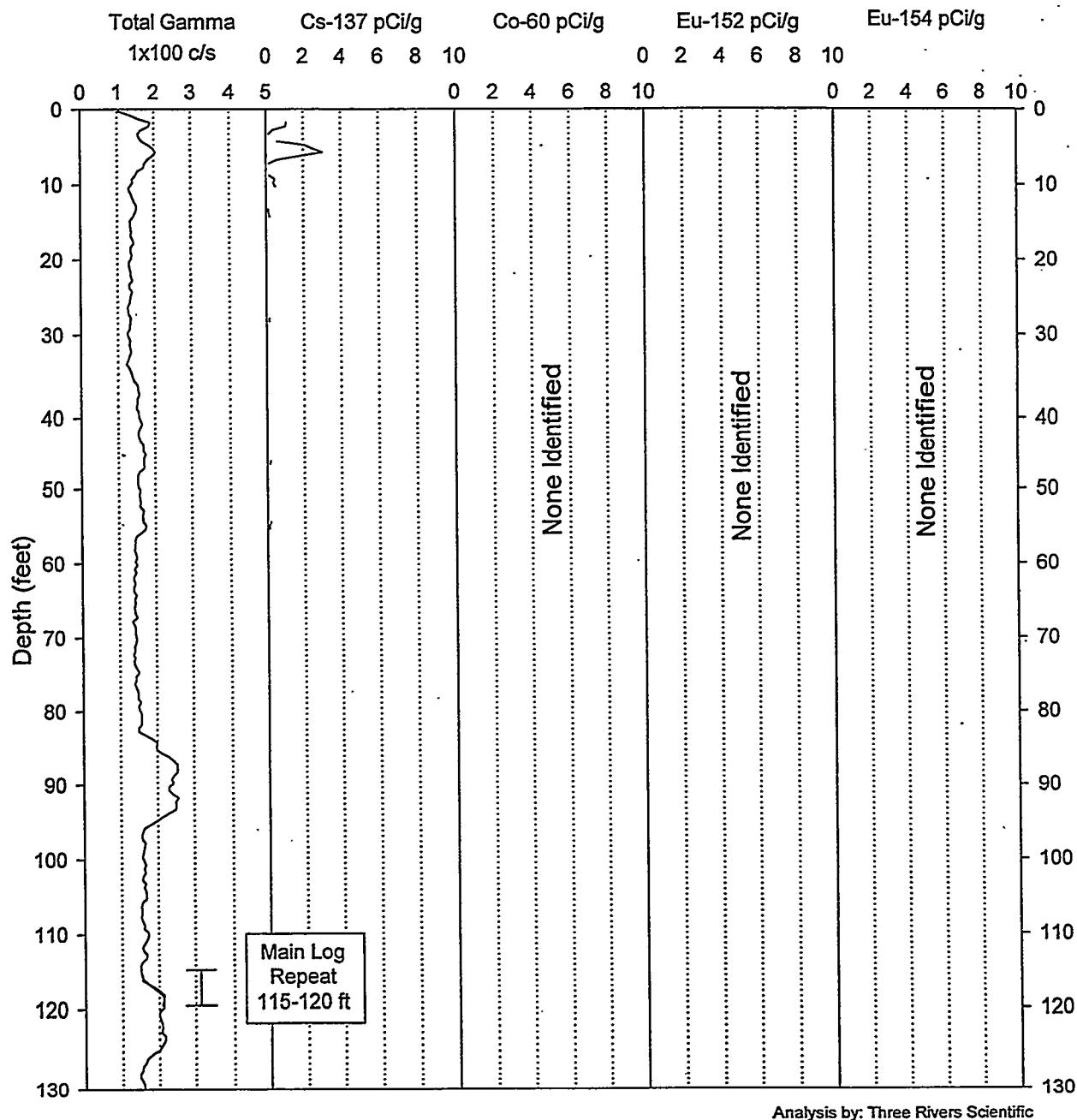


RLS Spectral Gamma-Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1999 Log Date: Oct. 17, 1998

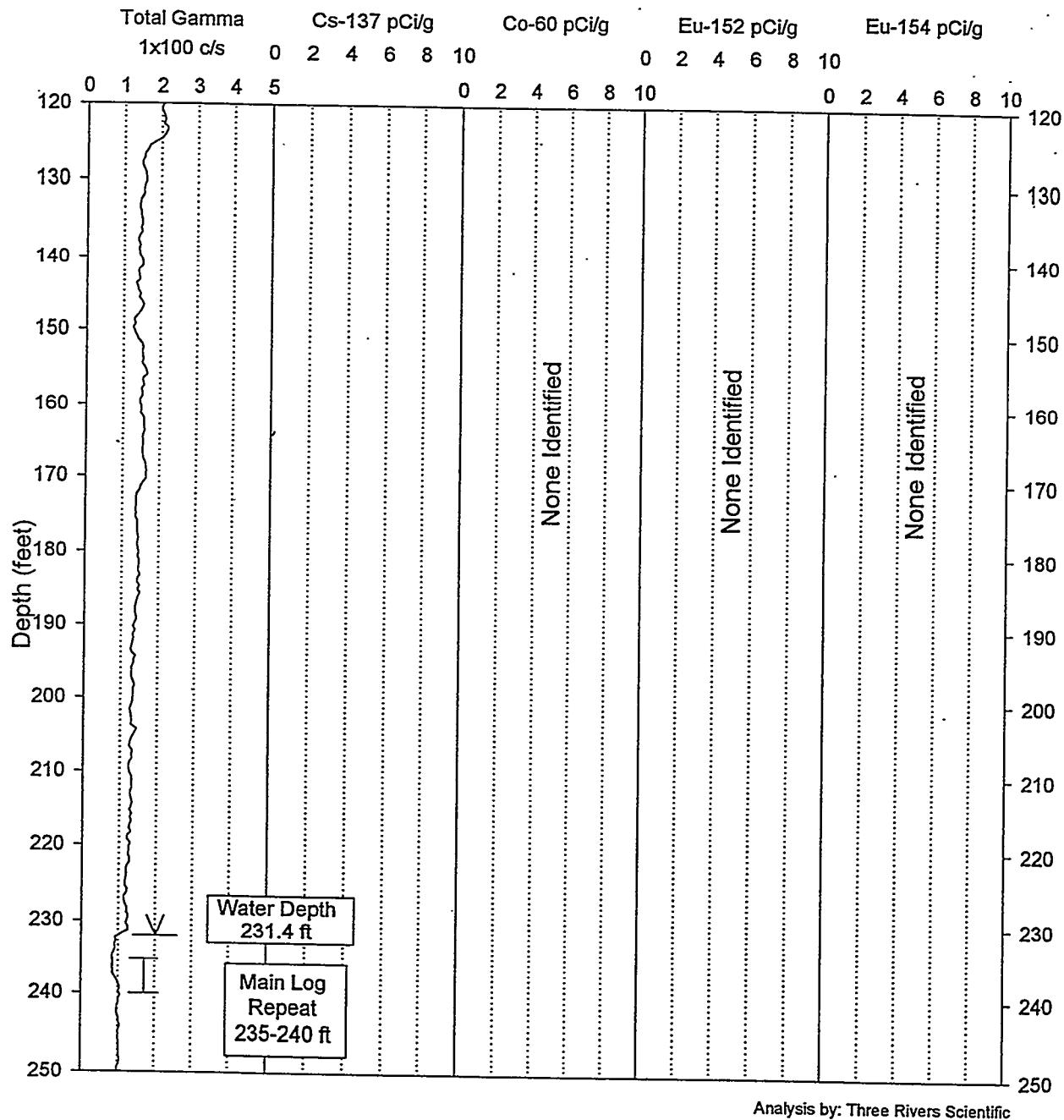
Borehole: 299-W10-24 (B8546) Man-Made Radio-Isotopes of Concern



RLS Spectral Gamma-Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1999 Log Date: Oct. 17, 1998
 Borehole: 299-W10-24 (B8546) Man-Made Radio-Isotopes of Concern

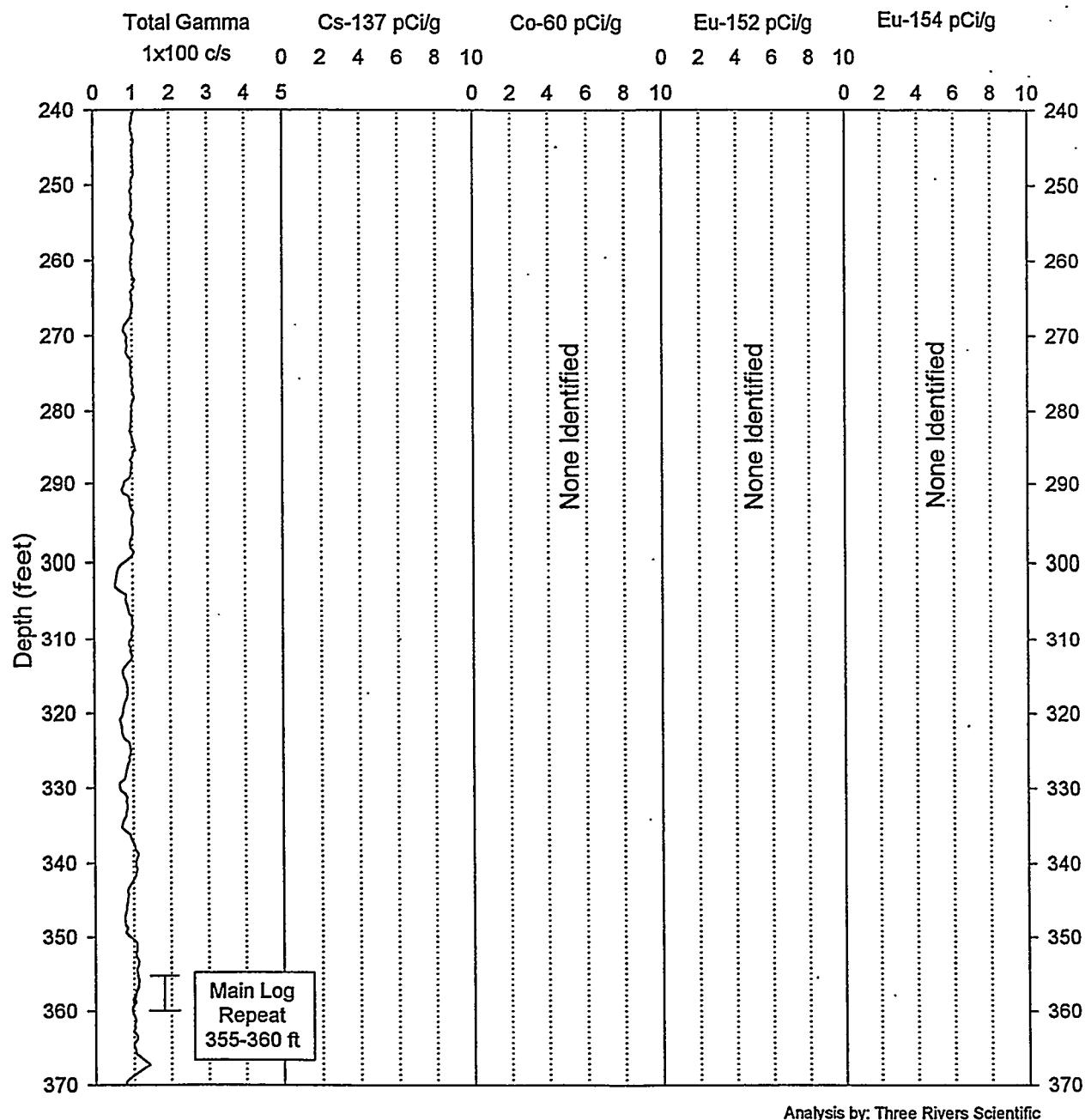


RLS Spectral Gamma-Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1999 Log Date: Oct. 17, 1998

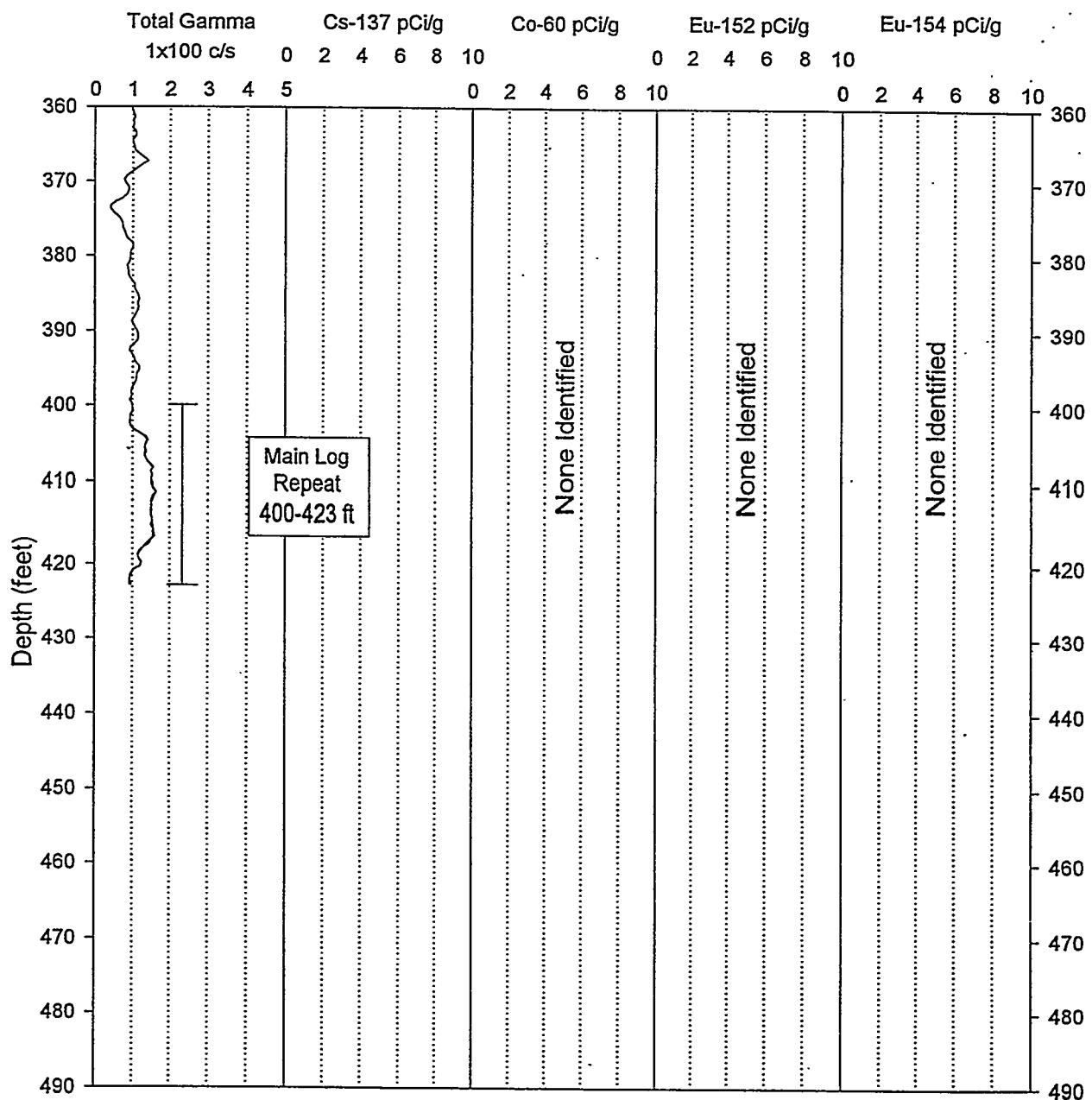
Borehole: 299-W10-24 (B8546) Man-Made Radio-Isotopes of Concern



RLS Spectral Gamma-Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1999 Log Date: Oct. 17, 1998
Borehole: 299-W10-24 (B8546) Man-Made Radio-Isotopes of Concern



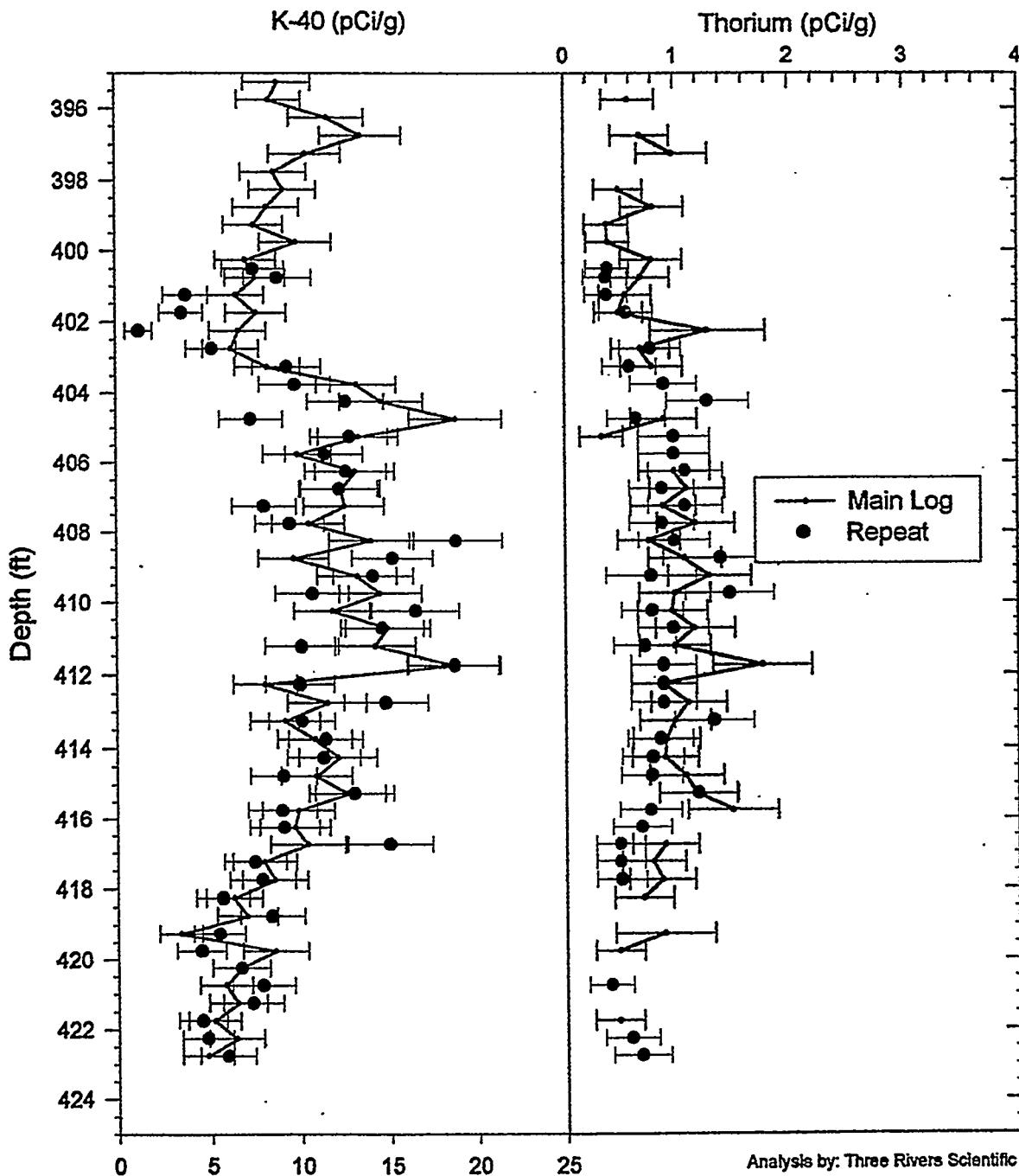
Analysis by: Three Rivers Scientific

RLS Spectral Gamma-Ray Borehole Survey

Acceptance QA Processing

Project: RCRA Drilling - FY1999
Borehole: 299-W10-24 (B8546)

Log Date: Oct. 17, 1998
Compare Main Log & Repeat

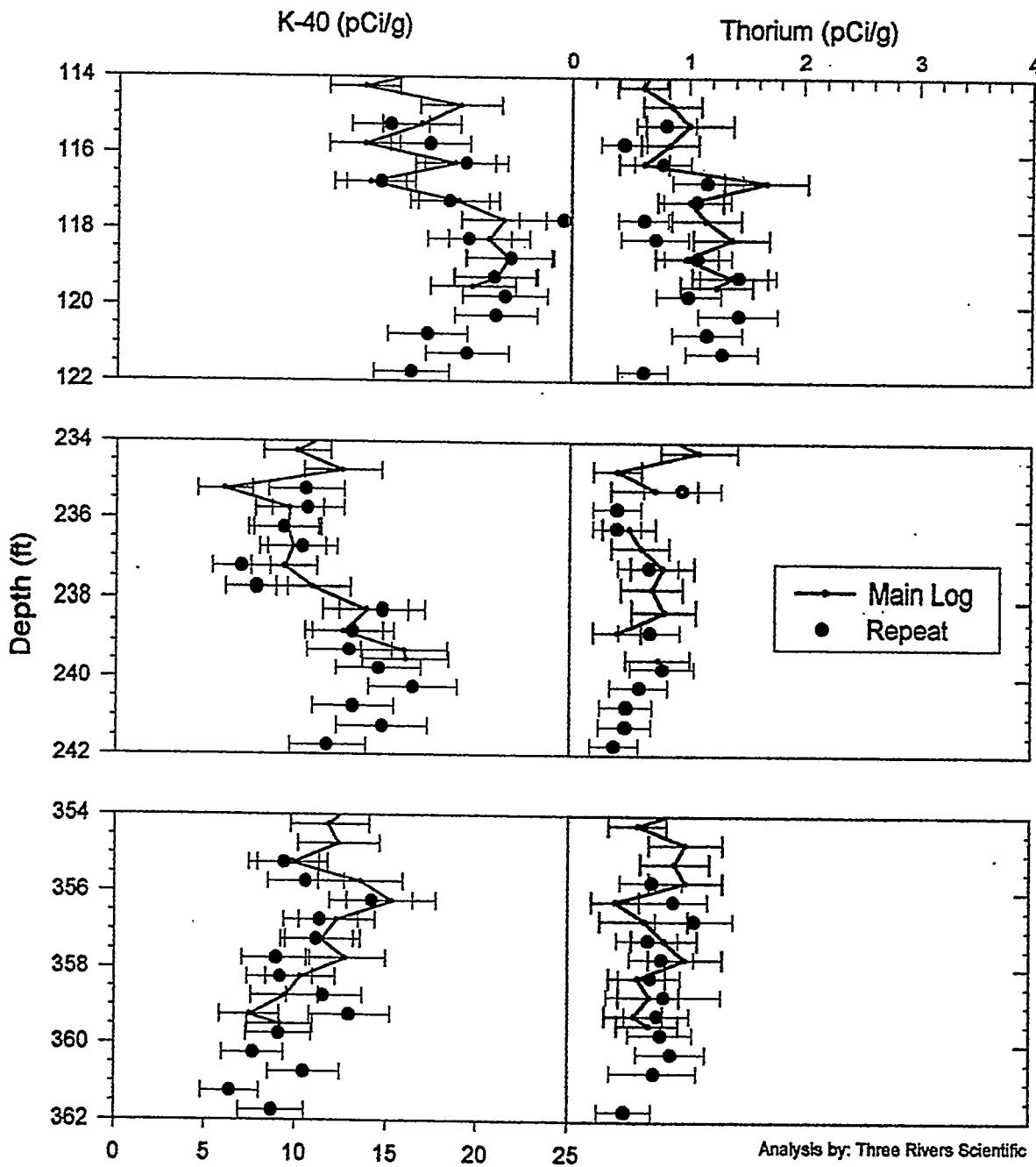


RLS Spectral Gamma-Ray Borehole Survey

Acceptance QA Processing

Project: RCRA Drilling - FY1999
Borehole: 299-W10-24 (B8546)

Log Date: Oct. 17, 1998
Compare Main Log & Repeat



RLS Spectral Gamma-Ray Borehole Survey
Waste Management Federal Services NW

Log Analysis Summary Report

Project:	RCRA Drilling - FY1999	Well ID:	299-W10-24
Log Type:	HPGe Spectral Gamma-Ray	Log Dates:	Oct 17, 1998

General Notes:

Total gamma is a response to man made gamma-ray emitters and formation lithology from surface to 10 feet, and a function of formation lithology below 10 feet.

The system dead-time limit was not exceeded (less than 5%) for the borehole survey.

System Performance Verify: The pre- and post-log verification was performed using coleman #2 mantle, and passed the equipment performance check. The maximum FWHM for the 583 keV gamma ray photo peak for both survey dates was 2.48 keV. The maximum acceptable FWHM resolution is 3.10 keV for probe RLSG3.1 on the log dates.

Repeat Interval: The repeat interval, 400 to 423 ft, and repeat at data set interface depths agree with the main log within acceptable limits, refer to the Acceptance QA Processing plots.

Environmental Corrections: The KUT and man made radionuclide concentrations have been corrected for casing attenuation (entire well) and water inside the casing (below 231.4 ft) for a centralized detector configuration. No casing correction was applied to the total gamma due to Compton downscatter interference.

Radionuclides:

Cs-137 was identified near the surface (1 to 10 ft) with a maximum concentration of 3 pCi/g at 5 feet and at intermittent locations (less than 0.3 pCi/g at depths greater than 10 ft) to the bottom of the well. No other man made radionuclides detected.

Analysis by: Three Rivers Scientific

Appendix D

Groundwater Chemistry Data

Appendix D

Groundwater Chemistry Data

This appendix contains analytical results from five groundwater samples collected from 287, 325, 383, 402, and 431 ft bgs during drilling of well 299-W10-24. Columns 6 and 7 in this appendix contain qualifiers that should be considered when using the analytical values. The definition of the qualifiers are given below.

- U Undetected at the detection limit.
- C Inorganics - blank contamination is above the practical quantitation limit.
- B Organics - compound was found in the blank (blank contamination); inorganics - result is less than the practical quantitation limit.
- J Organics - the result is estimated and less than the practical quantitation limit.
- D Adjusted dilution factor.
- H Hold time exceeded.

Table D.1. Groundwater Analytical Results of Five Samples from Well 299-W10-24

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
287 ft Depth								
Tritium	Y	10/9/98	29,600	pCi/L			745	2,330
Cesium-137	Y	10/9/98	0.71	pCi/L	U		2.3	2.3
Cobalt-60	Y	10/9/98	-1.13	pCi/L	U		2.58	2.58
Gross beta	Y	10/9/98	221	pCi/L			8.43	20.5
Beryllium-7	Y	10/9/98	13.4	pCi/L	U		38.2	38.2
Cesium-134	Y	10/9/98	-1.27	pCi/L	U		2.55	2.55
Antimony-125	Y	10/9/98	-3.83	pCi/L	U		6.25	6.25
Europium-152	Y	10/9/98	2.55	pCi/L	U		6.26	6.26
Europium-154	Y	10/9/98	-0.819	pCi/L	U		7.57	7.57
Iodine-129	Y	10/9/98	0.826	pCi/L	U		0.298	0.31
Strontium (elemental)	Y	10/9/98	148	µg/L				
Sodium	Y	10/9/98	257,000	µg/L				
Silver	Y	10/9/98	5	µg/L	U			
Potassium	Y	10/9/98	5,990	µg/L	C			
Nickel	Y	10/9/98	10.8	µg/L	U			
Manganese	Y	10/9/98	31.6	µg/L				
Magnesium	Y	10/9/98	10,700	µg/L				
Iron	Y	10/9/98	63.3	µg/L	C			
1,2-Dichloroethane	N	10/9/98	0.12	µg/L	U			
1,4-Dichlorobenzene	N	10/9/98	0.17	µg/L	U			
Cobalt-60	N	10/9/98	1.82	pCi/L	U		2.82	2.82
Strontium-90	N	10/9/98	0.102	pCi/L	U		0.304	0.306
Cesium-137	N	10/9/98	0.00217	pCi/L	U		2.39	2.39
Tritium	N	10/9/98	29,300	pCi/L			739	2,310
Calcium	Y	10/9/98	31,700	µg/L	C			
Zinc	Y	10/9/98	10.4	µg/L				
Sulfate	N	10/9/98	60.7	mg/L	D			
Europium-152	N	10/9/98	2.67	pCi/L	U		5.65	5.65
Europium-155	N	10/9/98	0.536	pCi/L	U		4.28	4.28
Antimony-125	N	10/9/98	-1.45	pCi/L	U		5.26	5.26
Technetium-99	N	10/9/98	358	pCi/L			11	50.9
Cesium-134	N	10/9/98	-0.256	pCi/L	U		2.3	2.3
Ruthenium-106	N	10/9/98	-11.6	pCi/L	U		23.7	23.7
Beryllium-7	N	10/9/98	10.3	pCi/L	U		32	32
1,1-Dichloroethane	N	10/9/98	0.13	µg/L	U			
Carbon disulfide	N	10/9/98	0.6	µg/L	J			
Methylenechloride	N	10/9/98	0.2	µg/L	BJ			
Vinyl chloride	N	10/9/98	0.18	µg/L	U			
1,1,1-Trichloroethane	N	10/9/98	0.13	µg/L	U			
Benzene	N	10/9/98	0.12	µg/L	U			
1-Butanol	N	10/9/98	2.8	µg/L	U			
Chloroform	N	10/9/98	10	µg/L				
Turbidity	N	10/9/98	52.2	NTU				
Total organic carbon	N	10/9/98	0.832	mg/L	B			

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Temperature	N	10/9/98	19.2	Deg C				
Total dissolved solids	N	10/9/98	1,030	mg/L				
pH Measurement	N	10/9/98	8.06	pH				
Nitrogen in Nitrate	N	10/9/98	120	mg/L	D	H		
Nitrogen in Nitrite	N	10/9/98	0.034	mg/L	UD	H		
Conductivity	N	10/9/98	1,338	μmhos/cm				
Alkalinity	N	10/9/98	153	mg/L				
Trichloroethene	N	10/9/98	6	μg/L				
1,1,2-Trichloroethane	N	10/9/98	0.11	μg/L	U			
2-Butanone	N	10/9/98	0.61	μg/L	U			
Acetone	N	10/9/98	2	μg/L	BJ			
Carbon tetrachloride	N	10/9/98	490	μg/L	D			
Fluoride	N	10/9/98	4.34	mg/L	D			
Chloride	N	10/9/98	30.1	mg/L	CD			
trans-1,2-Dichloroethylene	N	10/9/98	0.05	μg/L	U			
cis-1,2-Dichloroethylene	N	10/9/98	0.13	μg/L	U			
Europium-154	N	10/9/98	5.74	pCi/L	U		6.25	6.25
Iodine-129	N	10/9/98	0.789	pCi/L	U		0.227	0.24
Potassium-40	N	10/9/98	18.8	pCi/L	U		53.6	53.6
Xylenes (total)	N	10/9/98	0.78	μg/L	U			
Tetrachloroethene	N	10/9/98	0.2	μg/L	J			
Gross beta	N	10/9/98	60.2	pCi/L			4.73	7.12
Gross alpha	N	10/9/98	1.22	pCi/L	U		2.15	2.16
Toluene	N	10/9/98	0.5	μg/L	J			
4-Methyl-2-Pentanone	N	10/9/98	0.24	μg/L	U			
Ethyl cyanide	N	10/9/98	1.8	μg/L	U			
Vanadium	Y	10/9/98	28.8	μg/L				
Copper	Y	10/9/98	3.3	μg/L	B			
Cobalt	Y	10/9/98	2.4	μg/L	U			
Chromium	Y	10/9/98	39	μg/L				
Cadmium	Y	10/9/98	2.6	μg/L	U			
Beryllium	Y	10/9/98	0.5	μg/L	U			
Barium	Y	10/9/98	46	μg/L				
Antimony	Y	10/9/98	33	μg/L	U			
Aluminum	Y	10/9/98	20.6	μg/L	UC			
Europium-155	Y	10/9/98	-3.79	pCi/L	U		5.96	5.96
Technetium-99	Y	10/9/98	417	pCi/L			11.7	57.2
Ruthenium-106	Y	10/9/98	15.6	pCi/L	U		25.7	25.7
Potassium-40	Y	10/9/98	-37.7	pCi/L	U		51.9	51.9
Gross alpha	Y	10/9/98	0.923	pCi/L	U		1.44	1.45
Strontium-90	Y	10/9/98	0.0468	pCi/L	U		0.199	0.199
332 ft Depth								
Tritium	Y	10/12/98	26,700	pCi/L			704	2,120
Cesium-137	Y	10/12/98	0.0866	pCi/L	U		2.39	2.39

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Strontium-90	Y	10/12/98	0.0466	pCi/L	U		0.213	0.213
Cobalt-60	Y	10/12/98	2.25	pCi/L	U		3.19	3.19
Gross alpha	Y	10/12/98	1.73	pCi/L	U		1.51	1.52
Gross beta	Y	10/12/98	79.9	pCi/L			4.82	8.65
Potassium-40	Y	10/12/98	-42.7	pCi/L	U		48.4	48.4
Beryllium-7	Y	10/12/98	28.4	pCi/L	U		37.5	37.5
Ruthenium-106	Y	10/12/98	-3.15	pCi/L	U		19.9	19.9
Cesium-134	Y	10/12/98	-1.85	pCi/L	U		2.21	2.21
Technetium-99	Y	10/12/98	374	pCi/L			11.2	52.6
Antimony-125	Y	10/12/98	-3.84	pCi/L	U		6.32	6.32
Europium-155	Y	10/12/98	1.84	pCi/L	U		5.69	5.69
Europium-152	Y	10/12/98	-3.83	pCi/L	U		6.19	6.19
Iodine-129	Y	10/12/98	0.383	pCi/L	U		0.213	0.216
Europium-154	Y	10/12/98	-0.562	pCi/L	U		6.49	6.49
Aluminum	Y	10/12/98	26.6	µg/L	BC			
Iron	Y	10/12/98	234	µg/L	C			
Magnesium	Y	10/12/98	17,300	µg/L				
Manganese	Y	10/12/98	55.2	µg/L				
Nickel	Y	10/12/98	10.8	µg/L	U			
Potassium	Y	10/12/98	6,230	µg/L	C			
Silver	Y	10/12/98	5	µg/L	U			
Sodium	Y	10/12/98	196,000	µg/L				
Strontium (elemental)	Y	10/12/98	210	µg/L				
Antimony	Y	10/12/98	33	µg/L	U			
Barium	Y	10/12/98	64.1	µg/L				
Beryllium	Y	10/12/98	0.5	µg/L	U			
Cadmium	Y	10/12/98	2.6	µg/L	U			
Chromium	Y	10/12/98	14.6	µg/L				
Cobalt	Y	10/12/98	2.4	µg/L	U			
Copper	Y	10/12/98	2.9	µg/L	U			
Vanadium	Y	10/12/98	13.6	µg/L				
Zinc	Y	10/12/98	32.3	µg/L				
Calcium	Y	10/12/98	49,800	µg/L	C			
Tritium	N	10/12/98	26,200	pCi/L			697	2,080
Cesium-137	N	10/12/98	-0.894	pCi/L	U		2.27	2.27
Strontium-90	N	10/12/98	0.209	pCi/L	U		0.256	0.26
Cobalt-60	N	10/12/98	-1.25	pCi/L	U		2.28	2.28
1,4-Dichlorobenzene	N	10/12/98	0.17	µg/L	U			
1,2-Dichloroethane	N	10/12/98	0.12	µg/L	U			
Ethyl cyanide	N	10/12/98	1.8	µg/L	U			
4-Methyl-2-Pentanone	N	10/12/98	0.24	µg/L	U			
Toluene	N	10/12/98	0.3	µg/L	J			
Gross alpha	N	10/12/98	1.95	pCi/L	U		1.85	1.87
Gross beta	N	10/12/98	72.9	pCi/L			4.87	7.98
Tetrachloroethene	N	10/12/98	0.5	µg/L	J			
Xylenes (total)	N	10/12/98	0.78	µg/L	U			

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Potassium-40	N	10/12/98	6.43	pCi/L	U		35	35
Beryllium-7	N	10/12/98	13.8	pCi/L	U		36.5	36.5
Ruthenium-106	N	10/12/98	14.5	pCi/L	U		21.6	21.6
Cesium-134	N	10/12/98	0.701	pCi/L	U		2.31	2.31
Technetium-99	N	10/12/98	316	pCi/L			10.4	46.5
Antimony-125	N	10/12/98	5.51	pCi/L	U		5.01	5.01
Europium-155	N	10/12/98	-2.27	pCi/L	U		6.04	6.04
Europium-152	N	10/12/98	4.47	pCi/L	U		5.77	5.77
Sulfate	N	10/12/98	58.9	mg/L	D			
Iodine-129	N	10/12/98	0.433	pCi/L	U		0.208	0.212
Europium-154	N	10/12/98	1.42	pCi/L	U		6.83	6.83
cis-1,2-Dichloroethylene	N	10/12/98	0.13	µg/L	U			
trans-1,2-Dichloroethylene	N	10/12/98	0.05	µg/L	U			
Chloride	N	10/12/98	25	mg/L	CD			
Fluoride	N	10/12/98	4.96	mg/L	D			
Carbon tetrachloride	N	10/12/98	1,600	µg/L	D			
Acetone	N	10/12/98	0.21	µg/L	U			
Chloroform	N	10/12/98	25	µg/L				
1-Butanol	N	10/12/98	2.8	µg/L	U			
Benzene	N	10/12/98	0.12	µg/L	U			
1,1,1-Trichloroethane	N	10/12/98	0.13	µg/L	U			
Vinyl chloride	N	10/12/98	0.18	µg/L	U			
Methylenechloride	N	10/12/98	0.4	µg/L	BJ			
Carbon disulfide	N	10/12/98	0.15	µg/L	U			
1,1-Dichloroethane	N	10/12/98	0.13	µg/L	U			
2-Butanone	N	10/12/98	0.61	µg/L	U			
1,1,2-Trichloroethane	N	10/12/98	0.11	µg/L	U			
Trichloroethene	N	10/12/98	11	µg/L				
Alkalinity	N	10/12/98	154	mg/L				
Conductivity	N	10/12/98	1,156	µmhos/cm				
Nitrogen in Nitrite	N	10/12/98	0.017	mg/L	U			
Nitrogen in Nitrate	N	10/12/98	100	mg/L	D			
pH Measurement	N	10/12/98	7.75	pH				
Total dissolved solids	N	10/12/98	923	mg/L				
Temperature	N	10/12/98	18.8	Deg C				
Total organic carbon	N	10/12/98	0.558	mg/L	B			
Turbidity	N	10/12/98	27.2	NTU				
383 ft Depth								
Tritium	Y	10/13/98	19,500	pCi/L			604	1,590
Cesium-137	Y	10/13/98	-1.48	pCi/L	U		2.26	2.26
Strontium-90	Y	10/13/98	-0.0374	pCi/L	U		0.269	0.27
Cobalt-60	Y	10/13/98	-0.343	pCi/L	U		2.7	2.7
Gross alpha	Y	10/13/98	3.21	pCi/L			1.94	1.98
Gross beta	Y	10/13/98	47.3	pCi/L			3.72	5.71

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Potassium-40	Y	10/13/98	-29.9	pCi/L	U		55	55
Beryllium-7	Y	10/13/98	18.6	pCi/L	U		30.3	30.3
Ruthenium-106	Y	10/13/98	0.552	pCi/L	U		21.1	21.1
Cesium-134	Y	10/13/98	-0.953	pCi/L	U		2.34	2.34
Technetium-99	Y	10/13/98	199	pCi/L			8.82	34.3
Antimony-125	Y	10/13/98	1.16	pCi/L	U		5.25	5.25
Europium-155	Y	10/13/98	1.18	pCi/L	U		4.37	4.37
Europium-152	Y	10/13/98	-1.85	pCi/L	U		5.17	5.17
Iodine-129	Y	10/13/98	0.465	pCi/L	U		0.222	0.227
Europium-154	Y	10/13/98	-1.5	pCi/L	U		7.06	7.06
Aluminum	Y	10/13/98	20.6	µg/L	UC			
Iron	Y	10/13/98	251	µg/L	C			
Magnesium	Y	10/13/98	27,700	µg/L				
Manganese	Y	10/13/98	55.5	µg/L				
Nickel	Y	10/13/98	10.8	µg/L	U			
Potassium	Y	10/13/98	6,960	µg/L	C			
Silver	Y	10/13/98	5	µg/L	U			
Sodium	Y	10/13/98	98,200	µg/L				
Strontium (elemental)	Y	10/13/98	323	µg/L				
Antimony	Y	10/13/98	33	µg/L	U			
Barium	Y	10/13/98	86	µg/L				
Beryllium	Y	10/13/98	0.5	µg/L	U			
Cadmium	Y	10/13/98	2.6	µg/L	U			
Chromium	Y	10/13/98	9	µg/L	B			
Cobalt	Y	10/13/98	2.4	µg/L	U			
Copper	Y	10/13/98	3.2	µg/L	B			
Vanadium	Y	10/13/98	12.4	µg/L				
Zinc	Y	10/13/98	64.4	µg/L				
Calcium	Y	10/13/98	78,500	µg/L	C			
Tritium	N	10/13/98	20,600	pCi/L			623	1,670
Acetone	N	10/13/98	18	µg/L	BJD			
Carbon tetrachloride	N	10/13/98	780	µg/L	D			
Fluoride	N	10/13/98	2.27	mg/L	D			
Chloride	N	10/13/98	18.7	mg/L	CD			
trans-1,2-Dichloroethylene	N	10/13/98	0.11	µg/L	UD			
cis-1,2-Dichloroethylene	N	10/13/98	0.25	µg/L	UD			
Europium-154	N	10/13/98	-2.51	pCi/L	U		5.47	5.47
Iodine-129	N	10/13/98	0.243	pCi/L	U		0.216	0.218
Sulfate	N	10/13/98	61.2	mg/L	D			
Europium-152	N	10/13/98	-1.53	pCi/L	U		5.18	5.18
Europium-155	N	10/13/98	5.79	pCi/L	U		4.71	4.71
Antimony-125	N	10/13/98	0.241	pCi/L	U		6.03	6.03
Technetium-99	N	10/13/98	212	pCi/L			9.04	35.6
Cesium-134	N	10/13/98	-0.532	pCi/L	U		2.29	2.29
Ruthenium-106	N	10/13/98	-11.4	pCi/L	U		23.3	23.3

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Beryllium-7	N	10/13/98	11.9	pCi/L	U		33.3	33.3
Potassium-40	N	10/13/98	-5.14	pCi/L	U		47.2	47.2
Xylenes (total)	N	10/13/98	1.6	µg/L	UD			
Tetrachloroethene	N	10/13/98	0.23	µg/L	UD			
Gross beta	N	10/13/98	48.6	pCi/L			3.81	5.79
Gross alpha	N	10/13/98	6.41	pCi/L			3.52	3.57
Toluene	N	10/13/98	0.16	µg/L	UD			
4-Methyl-2-Pentanone	N	10/13/98	0.47	µg/L	UD			
Ethyl cyanide	N	10/13/98	3.5	µg/L	UD			
1,2-Dichloroethane	N	10/13/98	0.24	µg/L	UD			
1,4-Dichlorobenzene	N	10/13/98	0.34	µg/L	UD			
Cobalt-60	N	10/13/98	0.259	pCi/L	U		2.22	2.22
Strontium-90	N	10/13/98	-0.107	pCi/L	U		0.258	0.259
Cesium-137	N	10/13/98	1.11	pCi/L	U		2.11	2.11
Tritium	N	10/13/98	20,500	pCi/L			615	1,660
Calcium	Y	10/13/98	78,800	µg/L	C			
Zinc	Y	10/13/98	67.9	µg/L				
Vanadium	Y	10/13/98	12.9	µg/L				
Copper	Y	10/13/98	2.9	µg/L	U			
Cobalt	Y	10/13/98	2.4	µg/L	U			
Chromium	Y	10/13/98	8.5	µg/L	B			
Cadmium	Y	10/13/98	2.6	µg/L	U			
Beryllium	Y	10/13/98	0.5	µg/L	U			
Barium	Y	10/13/98	86.4	µg/L				
Antimony	Y	10/13/98	33	µg/L	U			
Strontium (elemental)	Y	10/13/98	325	µg/L				
Sodium	Y	10/13/98	98,400	µg/L				
Silver	Y	10/13/98	5	µg/L	U			
Potassium	Y	10/13/98	7,440	µg/L	C			
Nickel	Y	10/13/98	10.8	µg/L	U			
Manganese	Y	10/13/98	56.2	µg/L				
Magnesium	Y	10/13/98	27,800	µg/L				
Iron	Y	10/13/98	261	µg/L	C			
Aluminum	Y	10/13/98	21.5	µg/L	BC			
Europium-154	Y	10/13/98	-3.48	pCi/L	U		7.69	7.69
Iodine-129	Y	10/13/98	0.363	pCi/L	U		0.25	0.253
Europium-152	Y	10/13/98	-3.1	pCi/L	U		6.44	6.44
Europium-155	Y	10/13/98	-2.02	pCi/L	U		4.45	4.45
Antimony-125	Y	10/13/98	0.659	pCi/L	U		5.41	5.41
Technetium-99	Y	10/13/98	200	pCi/L			8.85	34.4
Cesium-134	Y	10/13/98	-3.2	pCi/L	U		2.34	2.34
Ruthenium-106	Y	10/13/98	-16	pCi/L	U		23.9	23.9
Beryllium-7	Y	10/13/98	6.72	pCi/L	U		26.8	26.8
Potassium-40	Y	10/13/98	-10.3	pCi/L	U		51.5	51.5
Gross beta	Y	10/13/98	49.8	pCi/L			3.88	6.04
Gross alpha	Y	10/13/98	-1.01	pCi/L	U		1.02	1.02

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Cobalt-60	Y	10/13/98	1.51	pCi/L	U		2.29	2.29
Strontium-90	Y	10/13/98	-0.0389	pCi/L	U		0.233	0.233
Cesium-137	Y	10/13/98	2.03	pCi/L	U		2.34	2.34
Total organic carbon	N	10/13/98	0.417	mg/L	B			
Total dissolved solids	N	10/13/98	787	mg/L				
Nitrogen in Nitrate	N	10/13/98	78.8	mg/L	D			
Nitrogen in Nitrite	N	10/13/98	0.017	mg/L	U			
Alkalinity	N	10/13/98	0.299	mg/L	U			
Trichloroethene	N	10/13/98	6	µg/L	DJ			
1,1,2-Trichloroethane	N	10/13/98	0.22	µg/L	UD			
2-Butanone	N	10/13/98	1.2	µg/L	UD			
1,1-Dichloroethane	N	10/13/98	0.25	µg/L	UD			
Carbon disulfide	N	10/13/98	0.3	µg/L	UD			
Methylenechloride	N	10/13/98	8	µg/L	BJD			
Vinyl chloride	N	10/13/98	0.36	µg/L	UD			
1,1,1-Trichloroethane	N	10/13/98	0.26	µg/L	UD			
Benzene	N	10/13/98	0.24	µg/L	UD			
1-Butanol	N	10/13/98	5.7	µg/L	UD			
Chloroform	N	10/13/98	13	µg/L	D			
Tritium	Y	10/13/98	20,500	pCi/L			618	1,660
Cesium-137	N	10/13/98	1.77	pCi/L	U		2.41	2.41
Strontium-90	N	10/13/98	0.143	pCi/L	U		0.274	0.277
Cobalt-60	N	10/13/98	0.184	pCi/L	U		2.67	2.67
1,4-Dichlorobenzene	N	10/13/98	0.17	µg/L	U			
1,2-Dichloroethane	N	10/13/98	0.12	µg/L	U			
Ethyl cyanide	N	10/13/98	1.8	µg/L	U			
4-Methyl-2-Pentanone	N	10/13/98	0.24	µg/L	U			
Toluene	N	10/13/98	0.08	µg/L	U			
Gross alpha	N	10/13/98	2.46	pCi/L	U		1.78	1.8
Gross beta	N	10/13/98	50.2	pCi/L			3.89	5.93
Tetrachloroethene	N	10/13/98	0.11	µg/L	U			
Xylenes (total)	N	10/13/98	0.78	µg/L	U			
Potassium-40	N	10/13/98	22.7	pCi/L	U		39.5	39.5
Beryllium-7	N	10/13/98	-17.6	pCi/L	U		32.4	32.4
Ruthenium-106	N	10/13/98	-2.59	pCi/L	U		19.5	19.5
Cesium-134	N	10/13/98	-1.4	pCi/L	U		2.38	2.38
Technetium-99	N	10/13/98	195	pCi/L			8.78	33.9
Antimony-125	N	10/13/98	-0.359	pCi/L	U		5.11	5.11
Europium-155	N	10/13/98	-1.02	pCi/L	U		5.85	5.85
Europium-152	N	10/13/98	0.205	pCi/L	U		4.89	4.89
Sulfate	N	10/13/98	60.2	mg/L	D			
Iodine-129	N	10/13/98	0.389	pCi/L	U		0.254	0.257
Europium-154	N	10/13/98	-0.792	pCi/L	U		7.57	7.57
cis-1,2-Dichloroethylene	N	10/13/98	0.13	µg/L	U			
trans-1,2-Dichloroethylene	N	10/13/98	0.05	µg/L	U			

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Chloride	N	10/13/98	18.7	mg/L	CD			
Fluoride	N	10/13/98	2.22	mg/L	D			
Carbon tetrachloride	N	10/13/98	730	µg/L	D			
Acetone	N	10/13/98	0.21	µg/L	U			
Chloroform	N	10/13/98	13	µg/L				
1-Butanol	N	10/13/98	2.8	µg/L	U			
Benzene	N	10/13/98	0.12	µg/L	U			
1,1,1-Trichloroethane	N	10/13/98	0.13	µg/L	U			
Vinyl chloride	N	10/13/98	0.18	µg/L	U			
Methylenechloride	N	10/13/98	0.16	µg/L	U			
Carbon disulfide	N	10/13/98	0.3	µg/L	J			
1,1-Dichloroethane	N	10/13/98	0.13	µg/L	U			
2-Butanone	N	10/13/98	0.61	µg/L	U			
1,1,2-Trichloroethane	N	10/13/98	0.11	µg/L	U			
Trichloroethene	N	10/13/98	6	µg/L				
Alkalinity	N	10/13/98	144	mg/L				
Nitrogen in Nitrite	N	10/13/98	0.017	mg/L	U			
Nitrogen in Nitrate	N	10/13/98	78.8	mg/L	D			
Total dissolved solids	N	10/13/98	787	mg/L				
Total organic carbon	N	10/13/98	0.278	mg/L	B			
402 ft Depth								
Tritium	Y	10/15/98	12,700	pCi/L		498	1,110	
Cesium-137	Y	10/15/98	-0.742	pCi/L	U	2.02	2.02	
Strontium-90	Y	10/15/98	0.0961	pCi/L	U	0.232	0.234	
Cobalt-60	Y	10/15/98	0.238	pCi/L	U	2.52	2.52	
Gross alpha	Y	10/15/98	0.824	pCi/L	U	1.43	1.44	
Gross beta	Y	10/15/98	34.4	pCi/L		3.19	4.44	
Potassium-40	Y	10/15/98	9.13	pCi/L	U	39.9	39.9	
Beryllium-7	Y	10/15/98	4	pCi/L	U	30.5	30.5	
Ruthenium-106	Y	10/15/98	-17.6	pCi/L	U	22.8	22.8	
Cesium-134	Y	10/15/98	-1.87	pCi/L	U	2.92	2.92	
Technetium-99	Y	10/15/98	128	pCi/L		7.76	27.6	
Antimony-125	Y	10/15/98	-4.36	pCi/L	U	6.01	6.01	
Europium-155	Y	10/15/98	4.51	pCi/L	U	5.54	5.54	
Europium-152	Y	10/15/98	-0.996	pCi/L	U	5.47	5.47	
Iodine-129	Y	10/15/98	0.263	pCi/L	U	0.184	0.186	
Europium-154	Y	10/15/98	3	pCi/L	U	6.87	6.87	
Aluminum	Y	10/15/98	20.6	µg/L	UC			
Iron	Y	10/15/98	260	µg/L	C			
Magnesium	Y	10/15/98	28,700	µg/L				
Manganese	Y	10/15/98	67.4	µg/L				
Nickel	Y	10/15/98	10.8	µg/L	U			
Potassium	Y	10/15/98	5,800	µg/L				
Silver	Y	10/15/98	5	µg/L	U			
Sodium	Y	10/15/98	57,100	µg/L				

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Strontium (elemental)	Y	10/15/98	335	µg/L				
Antimony	Y	10/15/98	33	µg/L	U			
Barium	Y	10/15/98	81.1	µg/L				
Beryllium	Y	10/15/98	0.5	µg/L	U			
Cadmium	Y	10/15/98	2.6	µg/L	U			
Chromium	Y	10/15/98	2.7	µg/L	U			
Cobalt	Y	10/15/98	2.4	µg/L	U			
Copper	Y	10/15/98	5.8	µg/L	B			
Vanadium	Y	10/15/98	10	µg/L				
Zinc	Y	10/15/98	19.3	µg/L				
Calcium	Y	10/15/98	80,200	µg/L	C			
Tritium	N	10/15/98	12,100	pCi/L			488	1,070
Cesium-137	N	10/15/98	0.41	pCi/L	U		2.38	2.38
Strontium-90	N	10/15/98	0.0581	pCi/L	U		0.196	0.196
Cobalt-60	N	10/15/98	0.584	pCi/L	U		2.88	2.88
1,4-Dichlorobenzene	N	10/15/98	0.17	µg/L	U			
1,2-Dichloroethane	N	10/15/98	0.12	µg/L	U			
Ethyl cyanide	N	10/15/98	1.8	µg/L	U			
4-Methyl-2-Pentanone	N	10/15/98	0.24	µg/L	U			
Toluene	N	10/15/98	0.4	µg/L	J			
Tetrahydrofuran	N	10/15/98	1.5	µg/L	U			
Gross alpha	N	10/15/98	0.866	pCi/L	U		1.25	1.26
Gross beta	N	10/15/98	32.9	pCi/L			3.17	4.39
Tetrachloroethene	N	10/15/98	0.11	µg/L	U			
Xylenes (total)	N	10/15/98	0.78	µg/L	U			
Potassium-40	N	10/15/98	-8.75	pCi/L	U		37.2	37.2
Beryllium-7	N	10/15/98	3.67	pCi/L	U		38.5	38.5
Ruthenium-106	N	10/15/98	4.03	pCi/L	U		21.3	21.3
Cesium-134	N	10/15/98	0.184	pCi/L	U		2.54	2.54
Technetium-99	N	10/15/98	126	pCi/L			7.74	27.4
Antimony-125	N	10/15/98	-2.03	pCi/L	U		5.62	5.62
Europium-155	N	10/15/98	3.65	pCi/L	U		5.2	5.2
Europium-152	N	10/15/98	-4.76	pCi/L	U		6.04	6.04
Sulfate	N	10/15/98	59.7	mg/L	D			
Iodine-129	N	10/15/98	0.33	pCi/L	U		0.169	0.172
Europium-154	N	10/15/98	0.638	pCi/L	U		7.45	7.45
cis-1,2-Dichloroethylene	N	10/15/98	0.13	µg/L	U			
trans-1,2-Dichloroethylene	N	10/15/98	0.05	µg/L	U			
Chloride	N	10/15/98	16.2	mg/L	CD			
Fluoride	N	10/15/98	1.37	mg/L	D			
Carbon tetrachloride	N	10/15/98	360	µg/L	D			
Acetone	N	10/15/98	0.21	µg/L	U			
Chloroform	N	10/15/98	7	µg/L				
1-Butanol	N	10/15/98	2.8	µg/L	U			
Benzene	N	10/15/98	0.12	µg/L	U			

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
1,1,1-Trichloroethane	N	10/15/98	0.13	µg/L	U			
Vinyl chloride	N	10/15/98	0.18	µg/L	U			
Methylenechloride	N	10/15/98	0.16	µg/L	U			
Carbon disulfide	N	10/15/98	0.4	µg/L	J			
1,1-Dichloroethane	N	10/15/98	0.15	µg/L	U			
2-Butanone	N	10/15/98	0.61	µg/L	U			
1,1,2-Trichloroethane	N	10/15/98	0.11	µg/L	U			
Trichloroethene	N	10/15/98	4	µg/L	J			
Alkalinity	N	10/15/98	129	mg/L				
Nitrogen in Nitrite	N	10/15/98	0.017	mg/L	U			
Nitrogen in Nitrate	N	10/15/98	68.1	mg/L	D			
Total dissolved solids	N	10/15/98	712	mg/L				
Total organic carbon	N	10/15/98	0.594	mg/L	BC			
431 ft Depth								
Tritium	Y	10/16/98	9,220	pCi/L		423	847	
Cesium-137	Y	10/16/98	0.643	pCi/L	U	2.14	2.14	
Strontium-90	Y	10/16/98	0.0978	pCi/L	U	0.257	0.258	
Cobalt-60	Y	10/16/98	2.21	pCi/L	U	2.46	2.46	
Gross alpha	Y	10/16/98	-0.0595	pCi/L	U	1.13	1.13	
Gross beta	Y	10/16/98	24.6	pCi/L		2.78	3.52	
Potassium-40	Y	10/16/98	-35.9	pCi/L	U	46.7	46.7	
Beryllium-7	Y	10/16/98	21.3	pCi/L	U	35.2	35.2	
Ruthenium-106	Y	10/16/98	3.23	pCi/L	U	20.4	20.4	
Cesium-134	Y	10/16/98	-1.5	pCi/L	U	2.17	2.17	
Technetium-99	Y	10/16/98	105	pCi/L		7.28	24.8	
Antimony-125	Y	10/16/98	1.14	pCi/L	U	6.06	6.06	
Europium-155	Y	10/16/98	0.0152	pCi/L	U	4.2	4.2	
Europium-152	Y	10/16/98	2.05	pCi/L	U	5.4	5.4	
Iodine-129	Y	10/16/98	0.258	pCi/L	U	0.178	0.18	
Europium-154	Y	10/16/98	1.1	pCi/L	U	5.71	5.71	
Aluminum	Y	10/16/98	20.6	µg/L	UC			
Iron	Y	10/16/98	213	µg/L	C			
Magnesium	Y	10/16/98	30,400	µg/L				
Manganese	Y	10/16/98	71.4	µg/L				
Nickel	Y	10/16/98	10.8	µg/L	U			
Potassium	Y	10/16/98	6,040	µg/L	C			
Silver	Y	10/16/98	5	µg/L	U			
Sodium	Y	10/16/98	41,900	µg/L				
Strontium (elemental)	Y	10/16/98	348	µg/L				
Antimony	Y	10/16/98	33	µg/L	U			
Barium	Y	10/16/98	82.4	µg/L				
Beryllium	Y	10/16/98	0.5	µg/L	U			
Cadmium	Y	10/16/98	2.6	µg/L	U			
Chromium	Y	10/16/98	2.7	µg/L	U			
Cobalt	Y	10/16/98	2.4	µg/L	U			

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Copper	Y	10/16/98	5.2	µg/L	B			
Vanadium	Y	10/16/98	10.8	µg/L				
Zinc	Y	10/16/98	27.4	µg/L				
Calcium	Y	10/16/98	84,500	µg/L	C			
Tritium	N	10/16/98	8,660	pCi/L			410	806
Cesium-137	N	10/16/98	0.684	pCi/L	U		2.13	2.13
Strontium-90	N	10/16/98	0.0475	pCi/L	U		0.323	0.324
Cobalt-60	N	10/16/98	0.0535	pCi/L	U		2.47	2.47
1,4-Dichlorobenzene	N	10/16/98	0.17	µg/L	U			
1,2-Dichloroethane	N	10/16/98	0.12	µg/L	U			
Ethyl cyanide	N	10/16/98	1.8	µg/L	U			
4-Methyl-2-Pentanone	N	10/16/98	0.24	µg/L	U			
Toluene	N	10/16/98	0.08	µg/L	U			
Gross alpha	N	10/16/98	-0.769	pCi/L	U		0.729	0.733
Gross beta	N	10/16/98	29.2	pCi/L			2.98	4
Tetrachloroethene	N	10/16/98	0.11	µg/L	U			
Xylenes (total)	N	10/16/98	0.78	µg/L	U			
Potassium-40	N	10/16/98	16.3	pCi/L	U		58.6	58.6
Beryllium-7	N	10/16/98	19.7	pCi/L	U		30.6	30.6
Ruthenium-106	N	10/16/98	-10.9	pCi/L	U		20.8	20.8
Cesium-134	N	10/16/98	0.601	pCi/L	U		1.9	1.9
Technetium-99	N	10/16/98	96.2	pCi/L			7.12	24
Antimony-125	N	10/16/98	3.22	pCi/L	U		5.45	5.45
Europium-155	N	10/16/98	0.784	pCi/L	U		4.05	4.05
Europium-152	N	10/16/98	1.61	pCi/L	U		5.19	5.19
Sulfate	N	10/16/98	56.9	mg/L	CD			
Iodine-129	N	10/16/98	0.0405	pCi/L	U		0.233	0.233
Europium-154	N	10/16/98	6.23	pCi/L	U		7.59	7.59
cis-1,2-Dichloroethylene	N	10/16/98	0.13	µg/L	U			
trans-1,2-Dichloroethylene	N	10/16/98	0.05	µg/L	U			
Chloride	N	10/16/98	13.6	mg/L	D			
Fluoride	N	10/16/98	0.721	mg/L				
Carbon tetrachloride	N	10/16/98	220	µg/L	D			
Acetone	N	10/16/98	0.21	µg/L	U			
Chloroform	N	10/16/98	6	µg/L				
1-Butanol	N	10/16/98	2.8	µg/L	U			
Benzene	N	10/16/98	0.12	µg/L	U			
1,1,1-Trichloroethane	N	10/16/98	0.13	µg/L	U			
Vinyl chloride	N	10/16/98	0.18	µg/L	U			
Methylenechloride	N	10/16/98	0.16	µg/L	U			
Carbon disulfide	N	10/16/98	0.3	µg/L	J			
1,1-Dichloroethane	N	10/16/98	0.13	µg/L	U			
2-Butanone	N	10/16/98	0.61	µg/L	U			
1,1,2-Trichloroethane	N	10/16/98	0.11	µg/L	U			
Trichloroethene	N	10/16/98	3	µg/L	J			

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Alkalinity	N	10/16/98	123	mg/L				
Nitrogen in Nitrite	N	10/16/98	0.017	mg/L	U	H		
Nitrogen in Nitrate	N	10/16/98	63.7	mg/L	D	H		
Total dissolved solids	N	10/16/98	658	mg/L		H		
Total organic carbon	N	10/16/98	0.512	mg/L	BC			
Conductivity	N	12/15/98	1,225	µmhos/cm				
pH Measurement	N	12/15/98	8.63	pH				
Temperature	N	12/15/98	18.1	Deg C				
Turbidity	N	12/15/98	4.82	NTU				

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