PNNL-13827

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

Borehole Data Package for Calendar Year 2001 RCRA Wells at Single-Shell Tank Waste Management Area B-BX-BY

D. G. Horton

March 2002

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

DISCLAIMER

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC06-76RL01830

PNNL-13827

Borehole Data Package for Calendar Year 2001 RCRA Wells at Single-Shell Tank Waste Management Area B-BX-BY

D. G. Horton

March 2002

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

Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

This document is a compilation of the information on well drilling and construction, well development, pump installation, and sediment sampling at three new RCRA wells (299-E33-337, 299-E33-338, and 299-E33-339) constructed at Waste Management Area B-BX-BY in July and August 2001. These wells were constructed to the specifications and requirements described in Washington Administrative Codes 173-160 and 173-303.

Grab samples for geological description and archive were collected every 5 ft throughout the wells. In addition, samples were collected at 5-ft intervals from 40 to 120 ft below ground surface to support the Groundwater/Vadose Zone Integration Project. The boreholes were geophysically logged with spectral gamma-ray and neutron moisture tools. Cesium-137 was the only manmade radionuclide detected in these wells.

Contents

Figure

Tables

1.0 Introduction

Three new *Resource Conservation and Recovery Act* (RCRA) groundwater monitoring wells were installed at the single-shell tank farm Waste Management Area (WMA) B-BX-BY in July and August 2001 in partial fulfillment of Tri-Party Agreement (Ecology et al. 1998) milestone M-24-00M. The well names are 299-E33-337, 299-E33-338, and 299-E33-339. Table 1 correlates the well names with the well numbers. Well 299-E33-337 is located south of the 241-B tank farm, well 299-E33-338 is located at the southeast corner of the 241-B tank farm, and well 299-E33-339 is located at the southeast corner of the 241-BX tank farm. All three wells are new downgradient wells in the groundwater monitoring network. The locations of all wells in the WMA B-BX-BY monitoring network are shown on Figure 1.

The original assessment monitoring plan for WMA B-BX-BY was issued in 1996 (Caggiano 1996). That plan was updated for the continued assessment at WMA B-BX-BY in 2000 (Narbutovskih 2000). The updated plan provides justification for new wells at the WMA. The new wells were constructed to the specifications and requirements described in Washington Administrative Codes 173-160 and 173-303, the updated assessment plan for WMA B-BX-BY (Narbutovskih 2000), and the description of work for well drilling and construction.[1]

This document compiles information on the drilling and construction, well development, pump installation, sediment sampling, and geophysical logging applicable to the installation of the three new wells. Appendix A contains the Well Summary Sheets (as-built diagrams), the Well Construction Summary Reports, the geologist's logs, and well location surveys; 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.

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. The information below can be used for conversion to metric units:

- 1 foot (ft) = 0.3048 meter
- 1 inch (in.) = 2.54 centimeters
- 1 gallon (gal) = 3.785 liters

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

Well Name	Well Number
299-E33-337	C3390
299-E33-338	C3391
299-E33-339	C3392

[1] Letter from J. S. Fruchter (Pacific Northwest National Laboratory) to G. B. Mitchem (Bechtel Hanford Inc.) *Description of Work for Drilling FY 2001 RCRA Groundwater Monitoring Wells*, dated April 16, 2001.

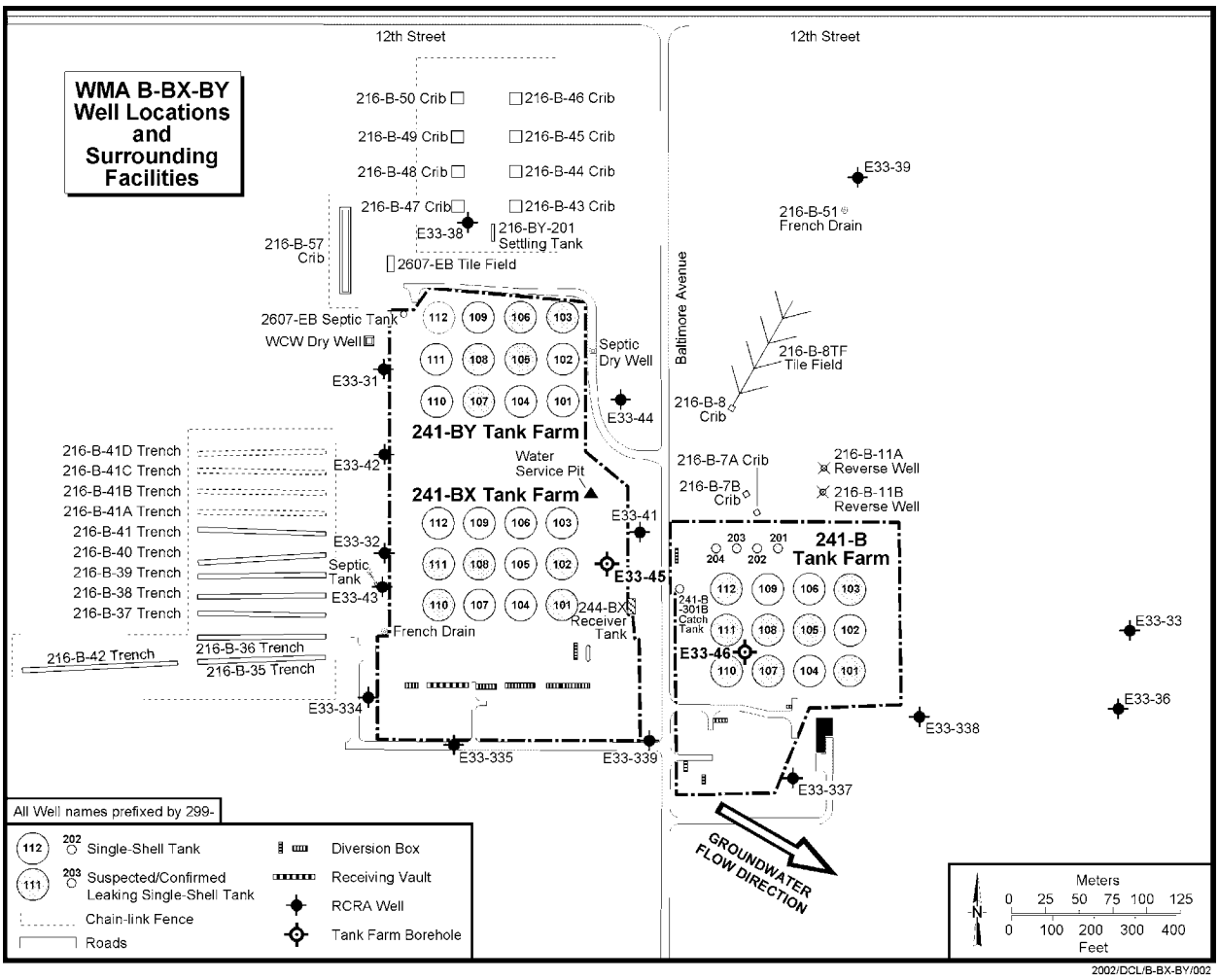


Figure 1. Map of Waste Management Area B-BX-BY and Location of Wells in Groundwater Monitoring Network

2.0 Well 299-E33-337

2.1 Drilling and Sampling

Well 299-E33-337 was drilled in July 2001 with an air rotary drill rig from the surface to a total depth of 286 ft below ground surface (bgs). Temporary 10-¾-in.-outside-diameter, carbon steel casing was used for the entire depth. An undocumented quantity of water was added to the borehole at 255 ft bgs to facilitate drilling.

The sediments encountered during drilling were predominantly sand, sandy gravel, and gravelly sand of the Hanford formation upper gravel sequence (H1 unit) from the surface to about 60 ft bgs; sand and silty sand of the Hanford formation sand sequence (H2 unit) from about 60 to 215 ft bgs; and undifferentiated Hanford formation lower gravel sequence/Plio-Pleistocene gravelly sand and sandy gravel from 215 to 281 ft bgs. Basalt was encountered at 281 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. In addition, 1-gal samples were collected at 5-ft intervals from 40 to 120 ft bgs to support the Groundwater/Vadose Zone Integration Project's Science and Technology purposes. Also, one split spoon sample was taken from 259.9 to 261.9 ft bgs for analysis of particle size distribution. 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 by field screening methods. The borehole was geophysically logged with spectral gamma-ray and neutron moisture tools between July 18 and July 24, 2001. Cesium-137 was the only manmade radionuclide that was detected and occurred from 1 to 2 ft bgs at a concentration of about 0.4 pCi/g. The geophysical logs are in Appendix C.

2.2 Well Completion

The permanent casing and screen were installed in well 299-E33-337 in July and August 2001. A 4-in.-inner-diameter, stainless steel, wire wrap, 20 slot screen was set from 255.36 to 280.39 ft bgs. The permanent casing is 4-in.-inner-diameter, stainless steel from 255.36 ft bgs to 2.1 ft above ground surface. A 2-ft-long stainless steel sump with end cap is below the screen from a depth of 280.39 to 282.4 ft.

A bentonite seal was placed in the bottom 2 ft of the borehole from 286.0 to 283.6 ft bgs. The filter pack is 10 to 20 mesh silica sand from 245.1 to 283.6 ft bgs. The annular seal is bentonite pellets from 245.1 to 239.6 ft bgs, bentonite crumbles from 239.6 to 10.1 ft bgs, and Portland cement grout from 10.1 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 2.71 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 December 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 State Plane Coordinates, 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 2.

Table 2. Survey Data for New Wells at Waste Management Area B-BX-BY

Well Name	Easting (m)	Northing (m)	Elevation (m)	Reference Point
299-E33-337	573821.80	137193.87		Center of casing
			202.716	"X" on rim
	573821.82	137194.18	201.990	Brass cap
299-E33-338	573912.07	137238.24		Center of casing
			201.107	"X" on rim
	573912.11	137238.58	200.260	Brass cap
299-E33-339	573716.86	137221.51		Center of casing
			203.027	"X" on rim
	573716.84	137221.84	202.303	Brass cap

2.3 Well Development and Pump Installation

Well 299-E33-337 was developed on August 22, 2001. A temporary, 1 hp, submersible pump was used to remove approximately 3,140 gal of formation water. First, about 2,660 gal of water were removed from the well at 20 gal/min with a maximum drawdown of about 0.061 ft. The pump intake was at 280.5 ft bgs (20.3 ft below the water table). Second, the pump intake was raised to 269.5 ft bgs (9.3 ft below the water table) and about 480 gal of water were removed at 20 gal/min. The resulting maximum drawdown was 0.017 ft. The final turbidity for both depths was less than 0.5 NTU.

A dedicated Grundfos Redi-Flo2, submersible sampling pump was installed in well 299-E33-337 on August 30, 2001. The sampling pump intake is at 270.35 ft below top of casing (or about 7.1 ft below the water table). The static water level was 263.25 ft below the top of casing (the casing extends 2.71 ft above the concrete pad) on August 30, 2001.

3.0 Well 299-E33-338

3.1 Drilling and Sampling

Well 299-E33-338 was drilled in July and August 2001 with a cable tool drill rig using a drive barrel with split spoon assemblies from the surface to the top of basalt at 271 ft bgs. A hard tool was used from 271 ft to a total depth of 275.6 ft bgs. Temporary 13-in.-outside-diameter, carbon steel casing was used from the surface to 50 ft and 9-in.-outside-diameter, carbon steel casing from the surface to total depth. An undocumented amount of water was added to the borehole at about 271 ft bgs to facilitate removal of sand from the bore.

The sediments encountered during drilling were dominantly silty sandy gravel and silty gravelly sand of the Hanford formation (H1 unit) from the surface to about 31 ft bgs; the Hanford formation H2 unit sand, and silty sand with minor gravel component from about 31 to about 218 ft bgs; a Plio-Pleistocene silt to sandy silt from 218 to 223 ft bgs; and undifferentiated Hanford formation lower gravel sequence/ Plio-Pleistocene silty sandy gravel and sandy gravel from 218 to 271 ft bgs. The top of basalt was encountered at 271 ft bgs. The geologist's log is included in Appendix A.

Borehole 299-E33-338 was continuously sampled by split spoon from the surface to 258 ft bgs. The samples were collected in 2-ft-long, 4-in.-diameter lexan liners and were sent to the laboratory for determination of various physical and chemical properties. The results of those tests will be published elsewhere. In addition, samples for moisture determination were collected from intervals corresponding to each splitspoon sample and grab samples for geologic description and archive were collected every 5 ft throughout the borehole. Also, one split spoon sample was taken from 259.4 to 261.4 ft bgs for analysis of particle size distribution. The 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 by field screening methods. The borehole was geophysically logged with spectral gamma-ray and neutron moisture tools on August 13 and August 14, 2001. Cesium-137 was identified near the ground surface at less than 1 pCi/g. No other manmade contamination was identified.

3.2 Well Completion

The permanent casing and screen were installed in well 299-E33-338 in August 2001. A 4-in.-inner-diameter, stainless steel, wire wrap, 20 slot screen was set from 270.9 to 250.9 ft bgs. An end cap was placed on the bottom of the screen from 271.32 to 270.9 ft bgs. The permanent casing is 4-in.-inner-diameter, stainless steel from 250.9 ft bgs to 2.0 ft above ground surface.

A bentonite plug was placed in the bottom of the borehole from 275.6 to 271.5 ft bgs. The filter pack is 10 to 20 mesh silica sand from 271.5 to 241.0 ft bgs. The annular seal is bentonite pellets from 241.0 to 236.0 ft bgs, bentonite crumbles from 236.0 to 10.6 ft bgs, and Portland cement grout from 10.6 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 2.78 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 December 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 2.

3.3 Well Development and Pump Installation

Well 299-E33-338 was developed on September 4, 2001. A temporary, 1 hp, submersible pump was used to remove approximately 2,380 gal of formation water at 20 gal/min. The pump intake was at 267.5 ft below top of casing (the protective casing extends 2.78 ft above the concrete pad) and drawdown was 0.022 ft. The final turbidity was 0.17 NTU.

A dedicated, Redi Flo-2 submersible sampling pump was installed in well 299-E33-338 on September 5, 2001. The sampling pump intake is at 265.35 ft below top of casings (or about 12.75 ft below the water table). The static water level was 258.1 ft below top of casing on September 5, 2001.

4.0 Well 299-E33-339

4.1 Drilling and Sampling

In July 2001, well 299-E33-339 was drilled with a cable tool drill rig from the surface to a depth of 50 ft and air rotary from 50 ft to the total depth of 285.44 ft bgs. Temporary 10-¾-outside-diameter, carbon steel casing was placed from the surface to 280.1 ft bgs during drilling. An undocumented amount of water was added to the borehole at a depth of 61 ft for dust suppression and at about 245 ft to facilitate drilling.

Preliminary evaluation shows that the sediments encountered during drilling were backfill to 6 ft bgs; Hanford formation sandy gravel and silty sandy gravel with lesser amounts of sand and silty sand (H1 unit) from 6 to 56 ft bgs; Hanford formation sand (H2 unit) from 56 to 223 ft bgs; and undifferentiated Hanford formation/Plio-Pleistocene gravel, sandy gravel, and slightly silty sandy gravel from 223 to 279 ft bgs. The top of basalt was encountered at 279 ft bgs. The geologist's log is in Appendix A.

Sediment samples were collected at approximately 5-ft intervals for geologic description and archive throughout the entire borehole. One split spoon sample was collected from 260.0 to 262.0 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 by field screening methods. The borehole was geophysically logged with spectral gamma-ray and neutron moisture tools between July 26 and August 1, 2001. Cesium-137 was identified at the ground surface at about 0.7 pCi/g. No other man-made radioisotopes were found. The geophysical logs are in Appendix C.

4.2 Well Completion

The permanent casing and screen were installed in well 299-E33-339 in August 2001. A 4-in.-inner-diameter, stainless steel, wire wrap, 20 slot screen was set from 279.3 to 259.4 ft bgs. An end cap was placed on the bottom of the screen from 281.4 to 279.3 ft bgs. The permanent casing is 4-in.-inner-diameter, stainless steel from 259.4 ft bgs to 2.0 ft above ground surface.

A bentonite plug was placed in the bottom of the borehole from 285.44 to 283.1 ft bgs. The filter pack is 10 to 20 mesh silica sand from 283.1 to 249.7 ft bgs. The annular seal is bentonite pellets from 249.7 to 244.4 ft bgs, bentonite crumbles from 244.4 to 10.4 ft bgs, and Portland cement from 10.4 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 2.38 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 December 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 2.

4.3 Well Development and Pump Installation

Well 299-E33-339 was developed on August 21, 2001. A temporary, 1 hp submersible pump was used to remove approximately about 2,400 gal of formation water at 20 gal/min. The pump intake was at 277 ft bgs and drawdown was 0.027 ft. The final turbidity was 0.17 NTU. The static water level was 261.27 ft bgs on August 21, 2001.

A dedicated, Redi Flo-2 submersible sampling pump was installed in well 299-E33-339 on August 30, 2001. The sampling pump intake is at 270.35 ft below top of casing (or 6.15 ft below the water table).

5.0 References

Caggiano, J. A. 1996. *Assessment Groundwater Monitoring Plan for Single-Shell Tank Waste Management Area B-BX-BY*. WHC-SD-ENV-AP-002, 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), Ecology, Olympia, Washington.

Narbutovskih, S. M. 2000. *Groundwater Quality Assessment Plan for Single-Shell Waste Management Area B-BX-BY at the Hanford Site.* PNNL-13022, Pacific Northwest National Laboratory, Richland, Washington.

NAVD88. 1988. North American Vertical Datum of 1988.

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: 07/10/01
Finish Date: 08/03/01
Page 1 of 1

Specification No.: 02200X-SP-V0004	Rev. No.: 0	Well Name: 299-E33-337	~~Temp~~ Well No.: C3390
ECNs: N/A		Approximate Location: South of 241-B Tank Farm	
Project: C401 RCRA Drilling		Other Companies: CHI	
Drilling Company: Resonant Sonics Inc (RSI)		Geologist(s): C. Martinez, C. Trice, J. Hocking	
Driller: Mike Gomez			

TEMPORARY CASING AND DRILL DEPTH

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.
Carbon Steel (FJ) 10 3/4" OD 10" ID	0' - 281'	10 3/4" / 10"
	-	
	-	
	-	
	-	

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

DRILLING METHOD/HOLE DIAMETER

Auger:	Diameter From ____ to ____
Cable Tool:	Diameter From ____ to ____
Air Rotary: OD 10 3/4"	Diameter From 0' to 286'
A.R. w/Sonic:	Diameter From ____ to ____
	Diameter From ____ to ____
	Diameter From ____ to ____

Drilling Fluid: Air

Total Drilled Depth: 286' | Hole Dia @ TD: 10 3/4" | Total Amt. Of Water Added During Drilling: NA

Well Straightness Test Results: Done using a 20.4' long 8.5" OD tool. Passed 07/27/01 | Static Water Level: 259.92' | Date: 08/03/01

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
Spectral Gamma	10' - 283'	7/18/01		-	
Neutron moisture	1 - 260.25'	7/24/01		-	
	-			-	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
4" ID SS 304L Sump	280.39' - 282.4'	FJ80	N/A	Bentonite (Pellets) Hole plug (50#)	283.6' - 286.0'	1/2 bucket	1/4"
4" ID SS 304L screen	255.36' - 280.39'	U	0.020"	Colorado Silica Sand (50#)	245.1' - 283.6'	46 NCW 43 bags	10-20
4" ID SS 304L casing	+2.1' - 255.36'	U	N/A	Bentonite Pellets (50#)	239.6' - 245.1'	95 buckets	1/4"-3/8"
	-			Bentonite crumbles (50#)	10.1' - 239.6'	170 bags	N/A
	-			Portland Cement (94#)	0' - 10.1'	5 bags	N/A

OTHER ACTIVITIES

Aquifer Test: Well Development	Date: 8/22/01	Well Abandoned:	Yes:	No:	Date:
Description: Pumped using submersible pump at 20 gpm for a total of 157 minutes (developed upper & lower parts of screen). DD ~ 0.06'.		Description:			

WELL SURVEY DATA

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

COMMENTS/REMARKS

Vol calcs: bentonite pellets; 0.5 bucket * 0.62 ft³/bucket = 0.31 ft³; colorado silica sand; 46 NCW + 43 bags * 0.535 ft³/bag = 24.61 ft³; bentonite pellets; 4.5 buckets * 0.62 ft³/bucket = 2.79 ft³; bentonite crumbles; 170 bags * 0.71 ft³/bag = 120.78 ft³

Reported By: Charlene Martinez		Reviewed By: DC Weekes	
Title: Geologist	Date: 08/02/01	Title: Geologist	Date:
Signature: Charlene Martinez		Signature: DC Weekes	

vol. calcs (cont.) Portland cement; 5 bags * 1.285 ft³/bag = 6.43 ft³

BHI-EE-181 (12/97)

WELL SUMMARY SHEET

Page 1 of 2

Date: 07/16/01

Well ID: C3390

Well Name: 299-E33-337

Location: South of 241-B Tank Farm

Project: C401 RCRA Drilling

Prepared By: CMartinez Date: 07/16/01

Reviewed By: DCWeekes Date: 8/13/01

Signature: CMartinez 08/03/01

Signature: DCWeekes

CONSTRUCTION DATA

Description	Diagram
6" dia. protective casing set above stainless casing	
4" ID SS 304L casing: +2.1' → 255.36'	
Portland Cement grout: 0 → 10.1'	
Bentonite Crumbles: 10.1' → 239.6'	
1/4" + 3/8" Bentonite Pellets: 239.6' → 245.1'	
4" ID SS 304L 0.020-in. Slot cont. wire-wrap well screen: 255.36' → 280.39'	
10-20 mesh silica sand 245.1' → 283.6'	
4" ID SS 304L Tailpipe: 280.39' → 282.4'	
1/4" Bentonite Pellets (coated): 283.6' → 286.0'	
All temp. casing removed: All depths are in feet below ground surface.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0'-18' Sandy Gravel (sg)
		18'-35' Sand (s)
		35'-37' Gravelly Sand (gs)
40		37'-46' Sand (s)
		46'-60' Sandy Gravel (sg)
		60'-125' Sand (s)
80		
120		125'-138' Silty Sand (ms)
		138'-178' Sand (s)
160		
		178'-185' Slightly Silty Sand
		185'-189' Silty Sand (ms)
		189'-195' Gravelly Sand (GS)
200		195'-205' Sand (s)
		205'-212' Silty Sand (ms)
		212'-215' Sand (s)
		215'-226' Gravelly Sand (gs)
		226'-228' Sandy Gravel (sg)

BHI-EE-189 (12/97)

WELL SUMMARY SHEET

Page 2 of 2

Date: 07/16/01

Well ID: C3390

Well Name: 299-E33-337

Location: South of 241-B Tank Farm

Project: CY01 RCRA Drilling

Prepared By: C. Martinez

Date: 07/16/01 08/03/01

Reviewed By: DC Weekes

Date: 8/13/01

Signature: Charlene Martinez

Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram
All temporary casing removed.	
All depths are in feet below ground surface.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
240		228'-230' Gravel (g)
		230'-259.5' Sandy Gravel (sg)
		259.5'-265' Gravel (g) Trace sand
		265'-281' Sandy Gravel (sg)
280		281'-286' Basalt
		TD = 286' bgs
320		WL = 259.92' bgs 8/3/01

BHI-EE-189 (12/97)

WELL SURVEY DATA REPORT

ERC Project: 22192	**Prepared By:** Gary B. Wagner, P.L.S. **Company:** Rogers Surveying, Inc.
Date Requested: 11/19/01	**Requestor:**
Date of Survey: 12/05/01	**Surveyor:** Rogers Surveying, Inc.
ERC Point of Contact: Mr. Robert Bone	**Survey Co. Point of Contact:** Gary B. Wagner, P.L.S.
Description of Work: Civil surveying for eleven groundwater wells in 200W & 200E Areas.	**Horizontal Datum:** NAD83(91)
	Vertical Datum: NAVD88
	Units: Metric
	Hanford Area Designation: 200E
Coordinate System: Washington State Plane Coordinates (South Zone)	
Horizontal Control Monuments: PUG & HVC-1	
Vertical Control Monuments: HSWB-032	

Well Name	Well ID	Easting	Northing	Elevation	
299-E33-337	C3390	573821.80	137193.87		Center of Casing
				202.716	"X" on Rim
		573821.82	137194.18	201.990	Brass Cap

Notes:

Surveyor Statement:	**Certification Seal**
I, Gary B. Wagner, a professional land surveyor registered in the state of Washington (Registration No. 30440), hereby certify that this report is based on a field survey performed in December, 2001 under my direct supervision and that the data contained here is true and correct.	

BHI-EE-202 (09/98)

BOREHOLE LOG

Page 1 of 10
Date: 07/11/01

Well ID: C3390 | Well Name: 299-E33-337 | Location: South of 241-B Tank Farm
Project: C401 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0	AIR	n/a		0'-18' Sandy Gravel (SG) 35% sand, 65% gravel predominately basalt, 40% qtz (other) 60% basalt. Sand - coarse, sub-rounded, gravel, mod. sorted, sub-rounded. Color 10YR 5/2, (dry) grayish brown. Sample moist. max pebbles < 35 mm. Slight rxn to HCl.	Air Rotary using tricone bit
5	Archive				Grab Archive Sample @ 5.0'
10	Archive			10' Sandy Gravel, same as above.	Grab Archive Sample @ 10.0'
15	Archive			15' Sandy Gravel, same description as above.	Grab Archive Sample @ 15.0'
20	Archive			18'-35' Sand (S), trace gravel, 50% basalt, 50% qtz (other) C-vcse, S-R, moderately sorted. Color 10YR 6/2 (Dry) light brownish gray. Sample moist. NO rxn to HCl.	Grab Archive Sample @ 20.0'
25	Archive				Grab Archive Sample @ 25.0'

Reported By: Charlene Martinez | Title: Geologist | Signature: Charlene Martinez | Date: 07/11/01

Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 8/13/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 2 of 10
Date: 07/11/01

Well ID: C3390 | Well Name: 299-E33-337 | Location: South of 241-B Tank Farm
Project: C401 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
30	AIR Archive AIR	N/A		30' Same description from page 1	Air Rotary
				18'-35'	Grab archive sample @ 30'
35	Archive			35-37' (GS) Gravelly Sand. Sand 85%, gravel 15%, basalt 40%, qtz (other) 60%, sand m-vcse, Trace silt. Gravel - S-A, moderately sorted, Sand SR, poorly sorted. Color 10YR 5/2 (grayish brown) sample moist.	Grab archive sample @ 35'
40	Archive			@ 36.0'. Basalt 50%, qtz (other) 50%, some mica, sand c-vcse, SR, mod. sorted, gravel S-A, mod sorted < 20 mm. Silty gravelly sand Color 10YR 7/2 (light gray)	Am RCT ck'd ovm. CEL @ background
				37'-45' Sand (S) 95% sand 5% gravel same description as above except basalt content down to 45%. Color 10YR 7/2	Grab Archive sample @ 40'
45	Archive			45'-57' sandy gravelly (sm) (sg) 65% sand, 35% gravel. Sand c-vcse, 45% basalt, 55% qtz (other), mod. sorted, gravel SR, well sorted max size = pebble. Color 10YR 7/2	Grab archive sample @ 45' no rxn to HCl
50	Archive			45'-57' Strong rxn to HCl	Grab archive sample @ 50'
55	Archive			57'-60' sandy gravel (sg) 90% gravel, 10% sand. m-vcse, SR, 45-50% basalt 50-55% qtz, gravel mod-sorted, 3A max size	Color 10YR 7/2 strong rxn to HCl pebbles < 40mm sm cobbles (cb) Grab archive sample @ 55'

Reported By: Charlene Martinez | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 07/11/01 | Signature: DC Weekes | Date: 8/13/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 3 of 10
Date: 07/11/01

Well ID: C-3390 | Well Name: 299-E33-337 | Location: South of 241-B Tank Farm
Project: C401 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
60	Archive AIR	N/A		60'-75' Sand (s) 95% sand, gravel 5% m-v case, 50% basalt 50% qtz (other), some mica, moderately sorted, SR, color 10YR 7/2 light gray. No rxn to HCl	Air Rotary Grab sample @ 60'
65	Archive			65' - Same description as above	Grab sample @ 65'
70	Archive				Grab Archive sample @ 70'
75	Archive			75'- 125' Sand (s) 100% sand, f-c, well sorted 70% qtz (other) 30% basalt, SR color 10YR 6/2 (light brownish gray) dry, sample moist. Slight rxn to HCl	Grab Archive sample @ 75'
80	Archive				Grab Archive sample @ 80'
85	Archive			85' Same description as above	Grab Archive sample @ 85'

Reported By: Charlene Martinez | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 07/11/01 | Signature: DC Weekes | Date: 8/13/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 4 of 10
Date: 07/11/01

Well ID: C3390 | Well Name: 299-E33-337 | Location: South of 241-B Tank Farm
Project: CY01 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
90	Archive AIR	N/A		90' Sand (s) 100%, f-c, well-sorted 70% qtz (other), 30% basalt, s-r, color 10YR6/2 (light brownish gray, dry) sample moist. Slight rxn to Hcl	Air Rotary Grab Archive Sample @ 90'
95	Archive				Grab Archive Sample @ 95'
100	Archive			100' Same description as above	Grab Archive Sample @ 100'
105	Archive			105' Sand (100%) same as 90' sample.	Grab Archive Sample @ 105'
110	Archive			110' Sand (s) 100%, f-c, well-sorted 70% qtz (other), 30% basalt, s-r, color 10YR6/2 (dry) sample moist. Slight rxn to HCl.	Grab Archive Sample @ 110'
115	Archive			115' same as above.	Grab Archive Sample @ 115'

Reported By: Charlene Martinez | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 07/11/01 | Signature: DC Weekes | Date: 8/13/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 5 of 10
Date: 07/11/01

Well ID: C3390 | Well Name: 299-E33-337 | Location: South of 241-B Tank Farm
Project: C401 RCRA Drilling | Reference Measuring Point: Ground Surface.

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120	Archive AIR	N/A		120' sand (s): 100% sand, f-c, well-sorted, 70% qtz (other), 30% basalt, s-R, color 10YR 6/2 (dry) sample moist. slight rxn to HCl.	Grab Archive Sample @ 120'
				(cm) 124'-125' – 138' silty sand, (ms) 10% silt, 90% sand, sand f-c, SR mod sorted, color 10YR 6/2 (light brownish gray dry) moist. Rxn to HCl	Grab Archive Sample @ 125'
130	Archive			130' silty sand (ms) same description as above.	Grab Archive Sample @ 130'
135	Archive			135' silty sand (ms) same as 120' sample.	Grab Archive Sample @ 135'
					End of shift 07/11/01
				138' – 178' sand (s) 100% sand, f-cse, poorly sorted 70% qtz (other), 30% basalt color 10YR 5/2 (dry) sample moist. no rxn to HCl. (grayish brown)	Grab Archive Sample @ 140'
140	Archive				
145	Archive			145' sand (s) same description as above. 10YR 5/2 grayish brown. no rxn to HCl	Grab Archive Sample @ 145'

Reported By: Charlene Martinez | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 07/11/01 | Signature: DC Weekes | Date: 8/13/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 6 of 10
Date: 07/12/01

Well ID: C3390 | Well Name: 299-E33-337 | Location: South of 241-B Tank Farm
Project: C401 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
150	Archive AIR	N/A		150' sand (s) 100% f-v cse, poorly sorted, 70% qtz (other), 30% basalt, color 10YR5/2 (dry) sample moist (grayish brown) no rxn to HCl	Air Rotary Grab Archive Sample @ 150'
155	Archive			155' same as above. No rxn to HCl.	Grab Archive Sample @ 155' α, β @ background
160	Archive			160' sand (s) same as 150' sample	Grab Archive Sample @ 160'
165	Archive			165' sand (s) 100% f-v cse, poorly sorted, 70% qtz (other), 30% basalt, color 10YR5/2 (dry) grayish brown, sample moist, no rxn HCl	Grab Archive Sample @ 165'
170	Archive			170' sand (s) same as above description	Grab Archive Sample @ 170'
175	Archive			175' sand (s) same as above.	Grab Archive Sample @ 176'
				178'-185' Slightly silty sand 10% silt, 90% sand, vf-c, poorly sorted 30% basalt	

Reported By: Charlene Martinez | Title: Geologist | Signature: Charlene Martinez | Date: 8/13/01
Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 8/13/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 7 of 10
Date: 07/12/01

Well ID: C3390 | Well Name: 299-E33-337 | Location: South of 241-B Tank Farm
Project: C401 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
180	Archive AIR	N/A		178'-185' (cont) S-R, color 10YR 6/2, dry light brownish gray. Rxn to HCl. micaceous	Air Rotary Grab Archive sample @ 180'
185	Archive			185'-189' Silty Sand (mS) 20% silt, 80% sand, vf-vcse, poorly sorted, basalt 40%, qtz (other) 60%, micaceous, color 10YR 5/2 (grayish brown, dry) sample moist strong rxn to HCl	Grab Archive Sample @ 185'
190	Archive			189'-195' Gravelly Sand (GS) 15% gravel, 85% sand. Sand m-vcse, S-R, poorly sorted, gravel S-A, max gravel = granules. 50% basalt, 50% qtz (other) gravel - well sorted, color 10YR 5/1	Grab Archive Sample @ 190'
195	Archive			(dry) sample moist (gray) micaceous no rxn HCl	Grab Archive Sample @ 195'
200	Archive			195'-205' Sand (S) m-vcse, S-R, poorly sorted, 65% basalt, 35% qtz (other) color 2.5Y 5/1 (gray, dry) Sample moist. No rxn HCl	Grab Archive Sample @ 200'
205	Archive			202'-205' Sand (S) vf-m, SR, mod sorted. rest of description same as above 205'-212' Silty Sand (mS) vf-m, SR, mod sorted 65% basalt, 35% qtz (other) 10% silt, 90% sand. color 10YR 6/2 (dry). No rxn to HCl	Grab Archive Sample @ 205' PM RCT + JH AR readings OK

Reported By: Charlene Martinez | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 07/12/01 | Signature: DC Weekes | Date: 8/13/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 8 of 12
Date: 07/12/01

Well ID: C3390 | Well Name: 299-E33-337 | Location: South of 241-B Tank Farm
Project: C401 RCRA Drilling | Reference Measuring Point: Ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
210	Archive AIR	N/A		210' -212' (ms) silty sand same description as 205'	Grab Archive Sample @ 210'
				212' – 215' sand (s) trace silt, sand m-vcse, poorly sorted, micaceous, SR, 65% basalt, 35% qtz (other) 2.5Y 5/1 (color, dry)	
215	Archive			sample moist, no rxn HCl	
				215' – 226' gravelly sand (gs) sand 85%, gravel 15%, sand f-c, poorly sorted SR, gravel, mod sorted SR 65% basalt	Grab Archive Sample @ 215'
				35% qtz color 10YR 5/1, gray (dry)	
220	Archive			sample moist. No rxn HCl. max size = granules.	Grab Archive Sample @ 220'
225	Archive			225' gravelly sand (gs) same as 215'	Grab Archive Sample @ 225'
				226' – 228' sandy gravel (sg) 45% gravel 35% sand, 70% bas, 30% qtz, gravel - mod sorted	
				228' – 230' gravelly (g) 90% gravel, 10% sand, gravel max size = pebbles, mod sorted, 70% basalt, 30% qtz, SR, sand m-vcse	
230	Archive			230' – 259.5' sandy gravel (sg) 20% sand, 80% gravel sand - f-c poorly sorted, SR, gravel mod sorted 75% basalt, 25% qtz (other) 10YR 6/1 weak rxn to HCl	Grab Archive Sample @ 230', wet - driller injected H_2O
235	Archive			235' sandy gravel (sg) same as above	Grab Archive Sample @ 235'

Reported By: Charlene Martinez | Title: Geologist | Signature: C Charlene Martinez | Date: 07/12/01

Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 8/13/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 9 of 10
Date: 07/12/01

Well ID: C3390 | Well Name: 299-E33-337 | Location: South of 241-B Tank Farm
Project: CY01 RCRA drilling | Reference Measuring Point: Ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
240	Archive A/R	n/a		240' Sandy gravel (sg) 30% sand, 70% gravel. Sand m-c, mod sorted SR. gravel moderately sorted, max size = pebbles SR, 75% basalt, 25% qtz (other) color gray 10YR 6/1 (drg) sample moist, weak rxn to HCl	Grab Archive sample @ 240'
245	Archive A/R			245' - same as above	Grab Archive sx @ 245'
250	Archive A/R			250' - sandy gravel (sG) 40% sand 60% gravel. gravel mod. sorted, max size = med pebbles.	Grab Archive sx @ 250'
255	Archive			255 - sandy gravel (sg) gravel max size = csc pebbles.	Grab Archive @ 255'
260	Archive			258 - sandy gravel (sG) 30% sand 70% gravel. sand m-c, mod sorted, A-SA, gravel mod sorted max size = med pebbles color 10YR 7/3 (very pale brown), dry, weak rxn HCl.	H_2O @ 259.92' bgs; Grab Archive @ 260'; Split Spoon sx → 259.99 → 261.99' BGS
	Split spoon	75% rec		259.5 - becoming increasingly sandy	
265	A/R Archive			260' - Sand 10% fn pebbles sand. 60% basalt 40% qtz sand 40% vcse, 40% csc 20% fn-vfn. SR, color 10YR 5/3 (brown), moist, weak rxn HCl	Grab Archive @ 265'
				260.5' → ~~Sand~~ cr Cobble supported gravelly sand. 40% ~~gr~~ 35% gravel 65% sand	

Reported By: Catherine Trivelpiece / C. Martinez | Reviewed By: DC Weekes
Title: Geologist / Geologist | Title: Geologist
Signature: Catherine Trivelpiece / C. Martinez | Date: 7/13/01 | Signature: DC Weekes | Date: 8/13/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 10 of 10
Date: 7/16/01

Well ID: C3390 | Well Name: 299-E33-337 | Location: South of 241-B Tank Farm
Project: C401 RCRA Drilling | Reference Measuring Point: GS

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
270	Archive	n/a		260.5'→ 265' Gravel - mostly 20% vcse cse pebbles 40% med 40% vfn-fn peb. 70% basalt 30% qtz. SA; poorly sorted, max size 80 mm. Sand: 20% vcs-cse 40% med 40% fn-vfn, trace silt, SR-SA. 10YR 5/2 (grayish brown), moist-wet, no rxn HCl.	Grab archive at 270'
275	Archive			265'-281' - sandy gravel - same as above but appears ground up by bit. 270' - Sandy gravel 275' - sandy Gravel (sG) 30% sand 70% gravel, tr. silt. Sand c-vcsc 50% basalt 50% qtz. mod sorted, Gravel SA, mod sorted, max sized cse pebble. 10YR 7/2. no rxn	Grab archive at 275'
280	Archive			280' - sandy gravel (sg). Same description as above.	Grab Archive Sample @ 280'
285	Archive	NA		281'-286' Basalt. Finely ground, 95% basalt, 5% qtz (other) no rxn HCl black	Grab Archive Sample @ 281'.
290	Archive			TD = 286' bgs 07/16/01	Grab Archive Sample @ 285'
295					

Reported By: C Trice / C Martinez | Reviewed By: DC Weekes
Title: Geologist / Geologist | Title: Geologist
Signature: DC Weekes for C Trice / C Martinez | Date: 07/16/01 | Signature: DC Weekes | Date: 8/13/01

BHI-EE-183 (12/97)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 07/23/01
Finish Date: 08/31/01
Page 1 of 1

Specification No.: 0200X-SP-W0004	Rev. No.: 0	Well Name: 299-E33-338	~~Temp~~ Well No.: C3391
ECNs: NA		Approximate Location: SE corner of 241-B Tank Farm	
Project: C401 RCRA Drilling		Other Companies: CHI	
Drilling Company: Resonant Sonic Inc.		Geologist(s): SM. Faurote, C Martinez, J. Hocking, B. Hudson, RS. Edrington, O.C. Weekes, J. Winchell, B. Raidl	
Driller: Gary Howell WA driller #1930			

TEMPORARY CASING AND DRILL DEPTH

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.
Carbon Steel (FJ) 12"	0' - 50'	13" / 10.5"
Carbon Steel (FJ) 8"	0 - 2710'	9" / 7.5"
	-	
	-	
	-	

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

DRILLING METHOD/HOLE DIAMETER

Auger:	Diameter From ____ to ____
Cable Tool: X 9" / 7.5"	Diameter From 0 to 2756'
Air Rotary:	Diameter From ____ to ____
A.R. w/Sonic:	Diameter From ____ to ____
	Diameter From ____ to ____
	Diameter From ____ to ____

Drilling Fluid: N/A

Total Drilled Depth: 2756' | Hole Dia @ TD: 12"

Total Amt. Of Water Added During Drilling: —

Well Straightness Test Results: Done w/ 20.4', 8.5" OD Tool Passed 09/10/01

Static Water Level: 254.24' Date: 9/4/01

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
Spectral gamma	0' - 275'	8/13 and 8/14/01		-	
Neutron moisture	48' - 256'	8/14/01		-	
	-			-	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
4" ID SS 304L endcap	270.9' - 271.32'	F 480	N/A	Bentonite Holeplug (50# bucket)	271.5' - 275.6'	1 buck	1/4"
4" ID SS 304L screen	250.9' - 270.9'	"	0.020"	Colorado Silica Sand (50# bag)	241.0' - 271.5'	22 bags	10-20
4" ID SS 304L casing	+2.0' - 250.9'	"	N/A	Bentonite Pellets (50# bucket)	236.0' - 241.0'	2 buckets	1/4"
	-			Bentonite Crumbles (50# bag)	10.6' - 236.0'	87 bags	N/A
	-			Portland Cement (94# bag)	0' - 10.6'	8 bags	N/A

OTHER ACTIVITIES

Aquifer Test: Well Development	Date: 9/4/01	Well Abandoned:	Yes:	No:	Date:
Description: Using 1 hp submersible pump with intake set at 263.84 ft bgs with drew water for 119 minutes at 2 gpm with 0.022 ft of drawdown.		Description:			

WELL SURVEY DATA

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

COMMENTS/REMARKS

Vol. calcs: Bentonite holeplug => 0.62 ft³/buck * 1 bucket = 0.62 ft³; 10-20 silica sand => 22 bags * 0.535 ft³/bag = 11.77 ft³; Bentonite pellets => 0.62 ft³/buc * 2 = 1.24 ft³; Bent. crumb. => 87 bags * 0.69 ft³/bag = 60.03; PC = 8 x 1.285 = 10.28 f

Reported By: Charlene Martinez		Reviewed By: DC Weekes	
Title: Geologist	Date: 09/20/01	Title: Geologist	Date: 10/18/01
Signature: Charlene Martinez		Signature: DC Weekes	

Start card # R037814

BHI-EE-181 (12/97)

Page 1 of 2

WELL SUMMARY SHEET

Date: 09/19/01

Well ID: C3391	Well Name: 299-E33-338
Location: SE corner of 241-B Tank Farm	Project: C401 RCRA Drilling
Prepared By: C. Martinez — Date: 09/19/01	Reviewed By: DC Weekes — Date: 9/20/01
Signature: Charlene Martinez	Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram
4" dia. protective casing set above stainless casing.	
4" ID SS 304L casing: +2.0' → 250.9'	
Portland Cement Grout: 0' → 10.6'	
Granular Bentonite: 10.6' → 236.0'	
4" ID SS 304L 0.020-in. slot cont. wire-wrap wellscreen: 250.9' → 270.9'	
Bentonite Pellets: 236.0' → 241.0'	
10-20 mesh silica sand: 241.0' → 271.5'	
4" ID SS 304L Endcap: 270.9' → 271.32'	
1/4" Bentonite Holeplug: 271.5' → 275.6'	
All temp. casing removed; All depths are in feet below ground surface	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0'-12.5' silty sandy GRAVEL (msG)
		12.5'-14.5' silty gravelly SAND (mgS)
		14.5'-15.0' SILT (Si) (lens)
		15.0'-16.5' silty sandy GRAVEL (msG)
		16.5'-20.0' silty SAND (mS)
40		20.0'-31.0' silty sandy GRAVEL (msG)
		31.0'-35.5' silty SAND (mS)
		35.5'-51.5' silty sandy Gravel (msG)
		51.5'-52.0' silt (M) lens
		52.0'-57.7' silty SAND (mS)
80		57.7'-66.3' SAND (S)
		66.3'-71.3' silty SAND (mS)
		71.3'-72.3' SAND (S) lens
		72.3'-94.0' silty SAND (mS)
		94.0'-104.5' slightly silt gravelly SAND (mgS)
120		104.5'-114.0' silty SAND (mS)
		114.0'-127.6' SAND (S)
		127.6'-136.0' silty SAND (mS)
		136.0'-143.2' SAND (S)
		143.2'-167.0' silty SAND (mS)
160		167.0'-169.5' SAND (S)
		169.5'-175.0' silty SAND (mS)
		175.0'-203.5' SAND (S) w/ silt lens (sporadic)
		203.5'-212.5' sl. gravelly SAND (gS)
200		212.5'-216.0' SAND (S)
		216.0'-218.0' silty SAND (mS)
		218.0'-222.4' silt to sandy silt (M)
		222.4'-258.0' silty sandy GRAVEL (msG)

BHI-EE-189 (12/97)

WELL SUMMARY SHEET

Page 2 of 2
Date: 09/20/01

Well ID: C 3391	Well Name: 299-E33-338
Location: SE Corner of 241-B Tank Farm	Project: CY01 RCRA Drilling
Prepared By: C. Martinez Date: 09/19/01	Reviewed By: DC Weekes Date: 9/20/01
Signature: Charlene Martinez	Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
240		
		258' - 271.0' sandy Gravel (sG)
		271' - 275.25' Basalt
280		
300		TD = 275.25' bgs. Static water level at 254.24' bgs (9/4/01). ACW

All temp. casing removed.

All depths are in feet below ground surface

BHI-EE-189 (12/97)

WELL SURVEY DATA REPORT

ERC Project: 22192	**Prepared By:** Gary B. Wagner, P.L.S. **Company:** Rogers Surveying, Inc.
Date Requested: 11/19/01	**Requestor:**
Date of Survey: 12/05/01	**Surveyor:** Rogers Surveying, Inc.
ERC Point of Contact: Mr. Robert Bone	**Survey Co. Point of Contact:** Gary B. Wagner, P.L.S.
Description of Work: Civil surveying for eleven groundwater wells in 200W & 200E Areas.	**Horizontal Datum:** NAD83(91)
	Vertical Datum: NAVD88
	Units: Metric
	Hanford Area Designation: 200E

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
PUG & HVC-1

Vertical Control Monuments:
HSWB-032

Well Name	Well ID	Easting	Northing	Elevation	
299-E33-338	C3391	573912.07	137238.24		Center of Casing
				201.107	"X" on Rim
		573912.11	137238.58	200.260	Brass Cap

Notes:

Surveyor Statement:	**Certification Seal**
I, Gary B. Wagner, a professional land surveyor registered in the state of Washington (Registration No. 30440), hereby certify that this report is based on a field survey performed in December, 2001 under my direct supervision and that the data contained here is true and correct.	

BHI-EE-202 (09/98)

BOREHOLE LOG

Page 1 of 19
Date: 07/23/01

Well ID: C3391	Well Name: 299-E33-338	Location: SE from SE Corner 241-B Tank Farm
Project: RCRA 2001 Drilling		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0	SPLIT SPOON #1			0-7' Silty Sandy Gravel (msG)	Cable tool
				G = 65% (50% cr, 40% m, 10% f), 25%	cont. split spoon
1		100% recov.		sand (20% cr 60% m, 20% f) and 10%	
	1540 hrs			silt in poorly sorted, dry to slightly	moisture sample @ 2'
2	SS #2			moist, SR-SA grained unit	
3		40% recov.			
	1600				moisture sample @ 4'
4	SS #3				
				5' silty sandy gravel (msG), same as	Grab Archive @ 5.0'
5	archive 07/24/01 0815	50% rec.		above. Strong rxn HCl. Gravel ⇒ max size	
				med cobble	moisture sample @ 5.25'
6	no SS sample taken		little or no recovery		
				7'-~~14.5~~ 12.5' Silty Sandy Gravel (msG) G 65%	
7				Sand 25%, silt 10%, 10YR 6/2, slight color	
				chg from above, poorly sorted	α, β @ background
8	SS #4				LEL, CO, org < det.
9		75% rec.			Grab archive @ 10'
	1311 hrs				
10	ARCHIVE 1311 hrs.	ARCHIVE			moisture sample @
	SS #5				10.4'
11		55%			
12	1350 hrs.			12.5' - 14.5' silty gravelly sand (mgS)	
	SS #6			55% sand, 25% gravel, 20% silt, sand	moisture sample @
13				f-cse, poorly sorted, gravel SR-SA, poorly sorted,	12.5'
		100% rec		silt ~~nodules~~,	
14				14.5' -15.0' Silt lens 100% silt, trace sand &	
	1433 hrs			gravel	moisture sample @ 14.6'

Reported By: JMFaurote \ C. Martinez	Reviewed By: DCWeekes
Title: Geologist \ Geologist	Title: Geologist
Signature: JMFaurote \ C. Martinez — Date: 07/23/01	Signature: DCWeekes — Date: 10/16/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 2 of 19
Date: 07/24/01

Well ID: C3391 | Well Name: 299-E33-338 | Location: SE corner of 241-B Tank Farm
Project: C401 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
15		Archive		15.0' – 15.5' Silty Sandy Gravel (msg) 65% gravel, 30% sand, 5% silt. Sand, f-cse SR-SA, poorly sorted, gravel SR, poorly sorted. 70% qtz (other) 30% basalt. no rxn HCl	Grab Archive @ 15'
16	SS #7	100% rec.			
17	1519 hrs			15.5' – 16.5' Silty Gravelly Sand. 75% sand, 10% gravel, 15% silt, sand, vf-cse, poorly sorted, SR. gravel, sm poorly mod sorted, silt nodules, 30% basalt 70% qtz. No rxn HCl	moisture sample @ 17.5'
18	SS #8				
19	1859	100% rec.			moisture sample @ 19.5'
20		Archive		16.5' – 20.0' Silty Sand, 85% sand, 15% silt, sand vf-cse, poorly sorted, SR, basalt 25%, qtz (other) 75%, no rxn HCl.	Grab Archive @ 20'
21	SS #9	90% recovery			
22	07/25/01 0651			20.0' – 25.5' Silty sandy gravel (msg) Same description as 15.0'.	moisture sample @ 22.4'
23	SS #10	90% rec.			α, β @ background LEL < detect.
24	0739				moisture sample @ 24.5'
25	SS #11	Archive		25.5' – 27.5' Slightly Silty Sandy Gravel. 5% silt, 25% sand, 70% Gravel. Sand m-v cse, S-A, poorly sorted, Gravel well-sorted, S-R → S-A, max size sm cobbles	Grab Archive @ 25'
26		100% rec			
27	1001			30% basalt, 70% qtz (other), 10YR 5/2 grayish brown. No rxn HCl. Trace cobbles	moisture sample @ 27.0'
28	SS #12	100% rec		27.5' – 28.0' Silty Sandy Gravel (msg) 65% gravel, 10% silt, 25% sand. Sand vf-cse, SR, poorly sorted, gravel SR-SA, poorly sorted, strong rxn HCl. gray, qtz (other) 70%, bas. 30%, 10YR 6/2 lt brownish	
29	1157				moisture sample @ 29.5'

Reported By: Charlene Martinez | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 07/25/01 | Signature: DC Weekes | Date: 10/16/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 3 of 19
Date: 07/25/01

Well ID: C3391 | Well Name: 299-E33-338 | Location: SE corner of 241-B Tank Farm
Project: C401 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
30	SS #13	Archive		28'— 31' Slightly silty sandy gravel.	Grab Archive @ 30.0'
				10% silt, 40% sand, 50% gravel. sand	
31		100% rec		m-rcse, SA, well sorted, gravel, sm pebbles.	
				SA, well-sorted, trace cobbles. 25% basalt,	
32	1213hrs			75% qtz (other) 10YR 6/2 (lt. brownish gray)	moisture sample @ 32.2'
	SS #14			slight rxn HCl.	
33		80%		31'— 35' Silty Sand. 20% silt, 80%	
				sand, S-R, mod sorted vf-csc, 70% qtz.	
34	1300			30% basalt, 5% C trace gravel. 10YR 6/2 lt grayish	moisture sample @ 34'
	no rec.			brown. No rxn HCl. Silt nodules micaceous	
35		Archive		35'-35.5' (S) Sand 95% vf-csc, 5% silt mod sorted, SR,	
	SS #15			35% bas. 65% qtz (other) 10YR 5/1 (gray	C.B @ background
36				35.5'-51.5' Silty Sandy Gravel (msG) 15% silt	LEL < detect
		100% rec		20% sand, 65% gravel. Sand f-csc, poorly	
37	1345hrs			sorted, SA, gravel SA, moderately poorly sorted max size	moisture sample @ 37.5'
				6m cobbles 10YR 6/2 lt brownish gray 30%	
38	SS #16	75% rec.		bas. 70% qtz. Slight rxn HCl.	
				37' Silty Sandy Gravel. 15% silt 40% sand,	
39	1610hrs			45% gravel sand f-m, mod. sorted, SR,	
	no rec.			gravel, poorly sorted SA, 10% vcse, 40%	moisture sample at
40	SS #17	Archive 55% rec.		med; 50% csc max size 1g pebble. 10YR 6/1	39.5'
	1547hrs			gray. Gravel ped. basalt. 70% qtz (other)	Grab Archive @ 40.0'
41	no rec.			30% basalt. No rxn HCl	
					moisture sample
42	no spilt spoon				@ 41.6'
43	SS #18				
	comp. Pg 9				
44		100% rec			moisture sample @ 44.5'

Reported By: Charlene Martinez | Reviewed By: D C Weekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 07/25/01 | Signature: D C Weekes | Date: 10/16/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 07/26/01

Well ID: C3391 | Well Name: 299-E33-338 | Location: SE corner of 241-B Tank Farm

Project: C101 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
45	07/26/01 0740	Archive		45' same description as 37', page 3	Grab Archive @ 46'
	SS #19				moisture sample @ 47.2'
46					
		100% rec		Silty Sandy Gravel (msG)	
47	0823 hrs			47' %'s changing. Gravel 65%, sand	
	SS #20			25%, silt 10%. Gravel max size = 5m	
48		100% rec.		cobbles. Strong rxn HCl.	
49	0952				moisture sample @ 49.2'
	SS #21				
50		Archive			Grab Archive @ 50.0'
		Recovery 85%			
51				51.5' - 52.0' Silt Lens. Interbedded	Grab Archive @ 51.5'
	1100 hrs	Archive		with silty sandy gravel. Silt, 85% qtz	moisture Sample @ 51.5-52.0'
52	SS #22			(other) 15% basalt, very well sorted. Non-	
		100%		plastic. 2.5Y 6/3 light yellowish brown (dry)	
53				No rxn HCl.	
54	1605				Moisture Sample @ 54'
	NO SS	Archive		52.0' - 52.5' Silty Sandy Gravel (msG) Gravel	
55				65%, sand 25%, silt 10%. Sand f-css,	Grab Archive @ 55'
	SS #23			poorly sorted SA-SR, gravel, poorly sorted, SA	
56		100% rec.		20% qtz (other) 30% basalt, 10YR 6/2	
57	0658			brownish gray. Strong rxn. HCl.	
	SS #24			52.5' - 57.7' Silty Sand (mS) Silt 25%,	moisture sample @
58		100% rec		sand 75%, vf-m, mod sorted SR-SA, silt	57.7'
				nodules, 10YR 5/2 grayish brown. Strong	
59	0741			rxn HCl.	

Reported By: Charlene Martinez | Reviewed By: DC Weekes

Title: Geologist | Title: Geologist

Signature: Charlene Martinez | Date: 07/26/01 | Signature: DC Weekes | Date: 10/16/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 7/27/01

Well ID: C3391 | Well Name: 299-E33-338 | Location: SE Corner of 241-B Tank Farm.

Project: RCRA Drilling FY01 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
60	SS#25	ARCHIVE		57.7' - 66.3' Sand [S]: 95% sand, 5% gravel; sand: med. - v. coarse, well sorted, 5YR 4/3 reddish brown, No RXN. to HCl; gravel: granules (2-4mm), No RXN. to HCl.	Grab Archive @ 60'
61	0807 SS#26	100% rec.			
62					
63	0848	100% rec.		@ 59.9' gravel increases to 10%, max size still granule (2-4mm); still a sand [S] (90% S, 10% G)	
64	SS#27				
65		100% rec.		@ 61.3' silt increases to 5%, gravel decreases; still a sand [S] (90% S, 5% M, 5% G)	Grab Archive @ 66'
66	0956	ARCHIVE			
67	SS#28			66.3' - 71.3' Slightly Silty Sand [(m)S]: 85% Sand, 10% silt, 5% gravel; sand: med. - v. coarse, mod. sort., No RXN to HCl; silt % higher, rxn to HCl; gravel the same, No rxn to HCl.	
68		100% rec.			
69	1025 SS#29				
70		100% rec.		71.3' - 72.3' Sand [S]: see above description (95% S, 5% G, trace silt)	Grab Archive @ 71'
71	1053	ARCHIVE		72.3' - 78.3' Silty Sand [mS]: 80% sand, 20% silt, trace gravel; sand: fine - med., well sort., No rxn to HCl, sub. ang. - sub. rnd., same color; silt % higher; gravel trace, max size = granule (2mm).	
72	SS#30				
73		100% rec.			
74	1216 SS#31			@ 75' gravel increases to 5%; rxn to HCl w/ silt. (75% S, 20% M, 5% G)	

Reported By: Tess Hacking | Title: Geologist | Signature: Tess Hacking | Date: 07/27/01

Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 10/16/01

EE-183 (12/97)

BOREHOLE LOG

Page 6 of 19
Date: 07/27/01

Well ID: C3391 | Well Name: 299-E33-338 | Location: SE Corner of 241-B Tank Farm.
Project: RCRA Drilling FY 01 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
75		100% rec.		78.3' - 79' Slightly Silt Gravelly Sand[(m)gS]: 75% Sand, 15% silt, 10% gravel; sand: v.fine - med. (see description page 5); gravel: sub. ang. - sub. rnd.; silt % down, rxn w/HCl.	Grab Archive @ 76'
76	1236 SS#32	ARCHIVE			
77		100% rec.			
78	1347 SS#33			79' - 94' Slightly Silty Sand [(m)S]: (see description page 5.), rxn to HCl w/silt.	
79		100% rec.			
80	1421 SS#34	ARCHIVE		@ 89' sand becomes fine - v.fine, gravel still @ 5% and silt still strong rxn to HCl.	Grab Archive @ 80'
81		100% rec.			
82	1454 SS#35				
83		100% rec.			
84	1523				
85	SS#36				
86		100% rec.			
87	0725 SS#37	ARCHIVE			Grab Archive @ 87'
88		100% rec.			
89	0755				

Reported By: Jess Hacking | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Jess Hacking | Date: 07/27/01 | Signature: DC Weekes | Date: 10/16/01

EE-183 (12/97)

BOREHOLE LOG

Page 7 of 19
Date: 7/31/01

Well ID: C3391	Well Name: 233-E33-338	Location: SE Corner of 241-B Tank Farm.
Project: RCRA Drilling FY 01		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
90	SS # 38	100% rec.			
91					
92	0928 SS # 39				
93		100% rec.			
94	0850 ARCHIVE SS # 40			94' - 104.5' Slightly Silt Gravelly Sand [(m)g S]: (see description page). 75% sand, 15% silt, 10% gravel.	Grab Archive @ 94'
95		100% rec.			
96	0929 SS # 41				
97		100% rec.			
98	1010 SS # 42			@ 98' sand is fine - med., well sorted, silt rxn to HCl: weak.	
99					
100		100% rec.			
101	1038 ARCHIVE SS # 43				Grab Archive @ 101'
102		100% rec.			
103	SS # 44			@ 103' sand is v. fine - med., well sorted; silt rxn w/HCl: strong.	
104					

Reported By: Jess Hacking		Reviewed By: DC Weekes	
Title: Geologist		Title: Geologist	
Signature: Jess Hacking	Date: 7/31/01	Signature: DC Weekes	Date: 10/16/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 8 of 19
Date: 7/31/01

Well ID: C3391 | Well Name: 233-E33-338 | Location: SE Corner of 241-B Tank Farm.
Project: RCRA Drilling FY 01 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
105	1225 SS#45	40% rec.		104.5' - 114' Silty Sand [mS]: 80% sand, 20% silt, trace gravel; sand: fine - v.fine, v. well sort., sub. rnd.; silt % back up, rxn. to HCl; gravel % down, max size = sm. granule. (similar to description page 5).	
106					
107		100% rec.			
108	1320 SS#46	ARCHIVE			Grab Archive @ 108'
109		100% rec.			
110	1348 SS#47				
111		100% rec.			
112	1433 SS#48				
113		100% rec.			
114	1500 SS#49	ARCHIVE		114' - 127.6' Sand [S]: 95% sand, 5% silt; sand: v.fine - v. coarse, sub. - ang. to sub. rnd., no rxn to HCl, well sort.; Silt % lower, rxn to HCl moderate.	Grab Archive @ 114.45'
115		100% rec.			
116	1611				
117					
118	SS#50				
119		100% rec.		@ 120.5' trace gravel appears, max size = sm. pebble.	

Reported By: Jess Hocking | Reviewed By: DCWeekes
Title: Geologist | Title: Geologist
Signature: Jess Hocking | Date: 7/31/01 | Signature: DCWeekes | Date: 10/16/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 9 of 19
Date: 7/31/01

Well ID: C3391 | Well Name: 299-E33-338 | Location: SE Corner of 241-B Tank Farms
Project: RCRA Drilling FY01 | Reference Measuring Point: Ground Surface.

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120		100% rec.			
	0655 SS # 51	ARCHIVE			Grab Archive @ 120.5'
121					
122		100% rec.			
123	0740 SS # 52			@ 123' trace gravel no longer present; sand: v.fine - v. coarse ; still ~5% silt.	
124		100% rec.			
125	0808 SS # 53	ARCHIVE			Grab Archive @ 125.3'
126					
127		100% rec.			
	0856			127.6' - 136' Silty Sand [mS]: 80% sand, 20% silt; sand: v.fine - med.; silt % increases; (see description page 5).	
128					
129	SS # 54				
130		100% rec.			
131	0932 SS # 55	ARCHIVE			Grab Archive @ 131.3'
132					
133		100% rec.			
134	1023	ARCHIVE			Grab Archive @ 134'

Reported By: Jess Hocking
Title: Geologist
Signature: Jess Hocking Date: 7/31/01

Reviewed By: D.C. Ukeles
Title: Geologist
Signature: D.C. Ukeles Date: 10/16/01

BOREHOLE LOG

Page 10 of 19
Date: 7/31/01

Well ID: C3391 | Well Name: 299-E33-338 | Location: SE Corner of 241-B Tank Farm.
Project: RCRA Drilling FY 01 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
135		100% rec.			
136	1156 SS#57			136' - 143.15' Sand [S]: 95% sand; 5% silt; (see description page 8.)	
137		100% rec.			
138					
139	1243 SS#58	ARCHIVE			Grab Archive @ 139'
140		100% rec.		@ 140.8' sand: fine - med., well sort.; still ~ 5% silt.	
141	1326 SS#59				
142		100% rec.			
143	1401 SS#60			143.15' - 167' Silty Sand [mS]: 80% sand, 20% silt; (see description page 5.)	
144		100% rec.			
145	1445 SS#61	ARCHIVE			Grab Archive @ 145'
146		100% rec.			
147	1545				
148	SS#62				
149		100% rec.			

Reported By: Jess Hacking
Title: Geologist
Signature: Jess Hacking Date: 7/31/01

Reviewed By: DCWeekes
Title: Geologist
Signature: DCWeekes Date: 10/16/01

BOREHOLE LOG

Page 11 of 19
Date: 7/31/01

Well ID: C3391 | Well Name: 299-E33-338 | Location: SE Corner of 241-B Tank Farm
Project: RCRA Drilling FY 01 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
150	1616 SS#63	ARCHIVE		See description on p.10	Grab Archive @ 150'
151		100% rec.			
152	0704 SS#64				
153		100% rec.			
154	0801 SS#65				
155		100% rec.			
156	0858	ARCHIVE			Grab Archive @ 156'
157	SS#66				
158		100% rec.			
159	0926 SS#67				
160		100% rec.			
161	1007 SS#68	ARCHIVE			Grab Archive @ 161.'
162		100% rec.			
163	1030				
164	SS#69				

Reported By: Jess Hocking
Title: Geologist
Signature: DC Weekes for Jess Hocking Date: 10/16/01

Reviewed By: DC Weekes
Title: Geologist
Signature: DC Weekes Date: 10/16/01

RHLEF 183 (12/97)

BOREHOLE LOG

Page 12 of 19
Date: 08/03/01

Well ID: C3391 | Well Name: 299-E33-338 | Location: SE of 241B Tank Farm
Project: 3001 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
165		100% rec.			
166	1211 SS#70	ARCHIVE			Grab Archive @ 166'
167		100% rec.		167' - 169.5' Sand [S]: 95% sand, 5% silt; sand: v. fine - med., sub. ang., well sort., No rxn. to HCl; silt % decreases, strong rxn. to HCl; (see description page).	
168	1239 SS#71				
169		100% rec.		169.5' - 171.45' Silty Sand [mS]: (see description page 10.) 80% sand, 20% silt.	
170	1331 SS#72				
171		100% rec.		171.45' - 173.05' Sandy Silt [sM]: 75% silt, 25% sand; Silt % increases, rxn. to HCl; sand: v.fine - fine, sub. ang. - sub. rnd., well sort., No rxn. to HCl, % decreases.	
172	1501	ARCHIVE			Grab Archive @ 172.5'
173	SS#73	100% recovery		173.05' - 175 Silty Sand [mS]: (see description page 10.) 80% sand, 20% silt.	
174				175-203.5	Grab Sample @ 175'
175	1610	Archive		by 175' the unit is Sand (S) with sporadic lenses of v.sl. silty sand (mS). It is 95% sand (15% cr, 40% m, 40% v & vf), 5% silt. the grains are SA, some SR, and the max. size is 4mm or less, and the unit is moderately sorted. This grey-brown sand exhibits a weak rxn to HCl. The sand also shows ¼" to ½" inch whitish-gray cemented (slightly) nodules that react	
176		100% recovery			
177	SS#74				
178	0716				
179					

Reported By: Jess Hocking / JM Faurot | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: DC Weekes for Jess Hocking JM Faurot Date: 08/03/01 | Signature: DC Weekes Date: 10/16/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 13 of 19
Date: 08/03/01

Well ID: C ~~3358~~ 3391 (now) | Well Name: 299-E33-338 | Location: SE of 241-B Tank Farm
Project: 2001 RCRA drilling | Reference Measuring Point: Ground Surface.

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
180	SS#75	Archive		wk- moderately well w/ HCl. The unit	Grab Sample 180'
				contains mica (muscov, biotite, chlorite	
181		95% recovery		and possibly phlogopite)	
	0802				
182	SS#76				
183					
184	0835				
185		Archive		@185, the average grain size increases	Grab sample @ 185'
	SB# 77			to cr & vcr, approx 50% of sand, w/	
186				30% m and 15% f, w/ 5% st (or less). Unit	
187		100% recovery		continues to react mod- sg to HCl. It	
	1041			continues to be dry to sl. moist	
188	SS#78				
189		100% recovery			
				Grain size returns to 20% cr, 40% m,	
190	1206	Archive		30-35% f, 5-10% silt in lt gy-bn	Grab Sample @ 190'
	SS#79			sand	
191	190.4- 192.4			trace gravel 191-192, max @ ~ 1/2" x 3/8"	
192	1246hrs			unit continues @ 45-55% basalt and silica	
	SS# 80				TH PM check -
193	192.4- 194.6				< detectable
194					

Reported By: JM Faurote | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: JM Faurote | Date: 08/03/01 | Signature: DC Weekes | Date: 10/16/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 08/03/01

Well ID: C3391 | Well Name: 299-E33-338 | Location: SE from 241-B Tank Farm
Project: 2001 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
195		Archive			Grab Sample @ 195'
					total casing 201.6's new
196				Continues as sand, m-cr grnd w/	
				moderate amt of Fe oxides in matrix	
197	SS#81			along with wh-gy cement ($CO_3^=$) that exhibit	
				a mod-sg rxn to HCl. SPORADIC vf gravel	
198		100% recovery		(SA-A, 1/4" to 3/8").	end shift 8/03/01 199.1
199	1432 hr				start 08/06/01 @ 199.1
200					Grab Sample @ 200.'
200.1	SS#82	Archive		Sand is 55% cr, 30% m, 10% f&vf,	
201		100% recovery		with 5% silt, that is comprised of 60%	
202	0712 hr			basalt, is med-dk gn-bn w/ gy-wh $CO_3^=$ cement.	
202.1	SS#83			The sand has a mod-sg rxn to HCl	
203		100% recovery			
204				203.5-212.5 Sl. gravelly sand,	
204.1	0748 hr	Archive		vf-f gravel @ 15%, silt 5% or less, and	Grab Sample @ 205 ft
205				Sand @ 80% (as described above)	
205.3	SS#84				
206		100% recovery			
207	0859 hr			by 206.5 there is an increase in the	
207.3				gravel, to about 20% (80% f, 20% m, w/	
208	SS#85			largest @ <1" x 3/4" x 1/4"). It is basalt rich	
209		100% recovery		and reacts mod to sg to HCl.	

Reported By: JM Faurote | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: JM Faurote | Date: 08/06/01 | Signature: DC Weekes | Date: 10/16/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 08/06/01

Well ID: C3391 | Well Name: 299-E33-338 | Location: SE from 241-B Tank Farm

Project: 2001 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
210 / 210.1	0920 hrs moisture Tin Archive			max gravel size is 1½" x 1" x 3/4", Gravel content ~ 25%, silt incr. to 8%	Grab Sample @ 210'
211	SS#86	100% recovery			
212	0949 hrs moisture Tin			212.5 - 216 Sand 95% Sand, 5% Silt, the sand is lt-bn to tan, SR-SA, vf-to-f grained, slight rxn to HCl. Locally the sand is whitish gray with moderately abundant $CO_3^=$ cement	
212.8 / 213	SS#87	90% recovery	SLOUGH		
214					
214.8 / 215	1150 hrs moisture Tin Archive			silty sand @ 216' to 216 - 218 Silty Sand. Silt content increases to 10-12% in an otherwise vf-f grnd sand.	Grab Sample @ 215'
215.6 / 216	SS#88	100% recovery			
217					
217.6 / 218	1230 hrs moisture tin			218 - 222.4 Silt to sandy silt - Chocolate brown w/ vf-f grnd sand. 20% Sand and 80% silt. It shows v. thin, lenticular med & cr grained lenses of sand distributed throughout.	Pre-Hanford Soils @ 218' bgs
219	SS#89	100% recovery			
220				Sand content decreases to near zero by 219'; there is trace to about 3-5% clay, and the unit is moist to sl. wet.	Grab Sample @ 220'
220.8 / 221	1328 hrs Archive SS#90 moisture Tin @ 220.8				* liquified mud/silt squeezed out the SS weephole. It is NOT saturated.
222					
222.1 / 223	1423 hrs could not retain in drive barrel			222.4 - 258.0' silty Sandy Gravel, SA-SR, 10% Silt, 35% sand, 55% Gravel (40% cr to sm pebbles, 30% m, 30% f) and sand is 20% cr, 50% m, 30% f-vf in a moist, rd-bn (Fe ox stained) unit w/ clasts to 3" x 2½" x 2", large clasts are basalt	RCT PM check < detect. Is this a lower Hanford Gravel or Ringold?
224	SS 91				

Reported By: JM Faurote | Title: Geologist | Signature: JM Faurote | Date: 08/06/01

Reviewed By: DC Ukeles | Title: Geologist | Signature: DC Ukeles | Date: 10/16/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 08/06/01

Well ID: C 3391 | Well Name: 299-E33-338 | Location: SE From 241-B Tank Farm
Project: 2001 RCRA Drilling | Reference Measuring Point: Ground Surface.

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
225	SS#91 contd	Archive 60% recovery	missing	Continues as u. poorly sorted gravel, actual silty-sandy-gravel. The unit is overall wh-gy bn, with $CO_3^=$ as cement that reacts mod to sg with HCl. Max. grain size in the gravel is 3½"x2½"x2". The unit is very poorly sorted and dry.	pushed large rock w/ shoe, limited recovery
226	1524 hrs	moisture tin			Grab Sample @ 225
227	SS#92				
228		100% recovery			
229	0712 hrs	moisture tin			
230		Archive			Grab Sample @ 230'
230.2	SS#93			Gravel size averages 1"-1½", remains a silty-sandy-Gravel (10%m, 30%s, 60%g)	
231				gravels are dominantly basalt. The unit	
232.2	0830 hrs	moisture tin		has slight to moderate (isolated) rxn to HCl	
233					
234	SS#94	95% recovery		Silty-Sandy-Gravel (as above). slight to moderate rxn w/ HCl. v. slightly moist. wh-gy bn. Gravel 1"-1½".	
235	1240 hrs	moisture tin			Grab sample @ 235'
235.8		Archive			
236	SS#95	80% Recovery	missing	Same as above except gravel to 2½" and dry. slightly less sand.	poor recovery in shoe for moisture th
237					
237.8	1317 hrs	moisture tin	missing		
238					
238.8					
239	SS#96			Silty-Sandy-Gravel. Gravel to 1½". M-coarse sand. slightly less silt than above	BH

Reported By: JM Faurote Bill Hudson | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: JM Faurote Bill Hudson | Date: 08/07/01 | Signature: DC Weekes | Date: 10/16/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 17 of 19
Date: 8/7/01

Well ID: C3391 | Well Name: 299 E33 338 | Location: SE from 241-B Tank Farm
Project: 2001 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
240				Gravel rounded to subangular. Slightly moist. Strong rxn w/ HCl. M-C sand SR-SA (60-G, 25% MCS, 15% silt)	
240.8	1407	ARCHIVE MOISTURE TIN			Grab sample 240'
241					
241.9					
242	SS#97	100% recovery		Silty-Sandy-Gravel. Gravel rounded to SA. Strong rxn w/ Hcl. Gy-Wh. Slightly Moist. Few oxide mottles, coarse, distinct. Gravel to 1½".	
243					
243.9	1501	MOISTURE TIN			
244					Grab Sample 245'
	SS#98	ARCHIVE		Same as above except more mottles, and gravel to 2½".	
245		100% recovery			
246	1600	MOISTURE TIN			
247				Gravel is dominantly ½" to 1½" with pebbles/cobbles to 4"x6" x 2-3". large gravels are mainly basalt, and secondarily quartzite. The gravels are SR & R, some SA in a dry, poorly sorted, lt $CO_3^=$ cemented, moderately Fe Ox stained silty (10-12%), sandy (35%) gravel (53-55%).	
247.1	SS#99				
248		100% recovery			
249	0947 hrs	moisture tin			Drum Cuttings
250		Archive			Grab Sample @ 250'
251	SS# 100			V. sdy 250.5-252, silt down to 8-10%; @ 252 silt back to 12-15%	
252					
253	0812 hrs	MOISTURE TIN			*hole caving behind the drive barrel and the casing is free-falling: secured casing
254					

Reported By: BILL HUDSON / JM Faurote | Reviewed By: DC Weekes
Title: GEOSCIENTIST / Geologist | Title: Geologist
Signature: Bill Hudson / JM Faurote | Date: 8/8/01 | Signature: DC Weekes | Date: 10/16/01

RHI-EE-183 (12/97)

BOREHOLE LOG

Page 18 of 19
Date: 08/08/01

Well ID: C3391 | Well Name: 299-E33-338 | Location: SE from 241-B Tank Farm
Project: 2001 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
255		H2O APPROX		Continues as whitish-gy-bn silty sandy Gravel w/ clasts < 3" max, m=12%, s=	Archive sample missed
256					H2O ~ 256
257	SS# 101	recovery		Saturated split spoon - silty sandy Gravel as on previous page this contains cobbles >6"	IH Tech <detect
258	0944 hrs	moisture TIN			
259				1g basalt cobble in drive barrel 258 ≈ 371 Sandy Gravel, silt content	
260	SS# 102 for sieve analysis 1045 hrs	Archive 45% recovery		is 5% or less, sand is 40% and gravel 55% of this variegated in color, quartzite, gneiss, granite and basalt clast dominant unit that is very poorly sorted and saturated.	large broken cobble in drive shoe prevented SS#102 from 100% recov.
261				The average clast size is 1"-2", with the	
262	Drive Barrel			maximum about 5"x3"x2" and Round to sub-round in shape.	
263					<detect γ, P, ∝
264					
265		Archive		v. sdy 265.5 - w/ lg. pebbles & sm. cobbles in generally finegrained Gravel.	
266					
267					
268					
269					

Reported By: JM Faurote | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: JM Faurote | Date: 08/08/01 | Signature: DC Weekes | Date: 10/16/01

BOREHOLE LOG

Page 19 of 19
Date: 08/08/01

Well ID: C3391 | Well Name: 299-E33-338 | Location: SE from 241-B Tank Farm
Project: 2001 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
270	Drive Barrel	Archive NA			
					endshift 08/08/01
271	Hard Tool		BASALT	Basalt Contact @ 271'	end shift 08/09/01
					Casing seated @ 271'
272				TD @ 276.75' on 8/10/01	
273					
274					
275				275.75'	
276					
277					
278					
279					
280					
281					
282					
283					
284					

Reported By: C Martinez/RS Edrington | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: RS Edrington for C. Martinez | Date: 10/16/01 | Signature: DC Weekes | Date: 10/16/01

RHLEE-183 (12/97)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 7/17/01
Finish Date: 8/17/01
Page 1 of 1

Specification No.: 0200X-SP-W0004 | Rev. No.: 0 | Well Name: 299-E33-339 | ~~Temp.~~ Well No.: C3392
ECNs: NA | Approximate Location: SE corner of 241-BX Tank Farm
Project: CY01 RCRA Drilling | Other Companies: CH1
Drilling Company: Resonant Sonic Inc. | Geologist(s): C. Martinez, C. Trice, DC Weekes, J. Hecking
Driller: M. Gomez

TEMPORARY CASING AND DRILL DEPTH

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.
Carbon Steel 10 3/4" / 10 1/8"	0 - 280.9'	10 3/4", 10 1/8"
	-	
	-	
	-	
	-	

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

Total Drilled Depth: ~~284~~ 285.44' NCW | Hole Dia @ TD: ~~10 3/4~~ NCW 10" | Well Straightness Test Results: NOT RUN

DRILLING METHOD/HOLE DIAMETER

Auger:		Diameter From ____	to ____
Cable Tool:	7 1/2" OD	Diameter From 0'	to 50'
Air Rotary:	10" ~~10 3/4"~~ NCW	Diameter From 50'	to ~~284'~~ 285.44'
A.R. w/Sonic:		Diameter From ____	to ____
		Diameter From ____	to ____
		Diameter From ____	to ____
		Diameter From ____	to ____

Drilling Fluid: Air
Total Amt. Of Water Added During Drilling: N/A Some was added.
Static Water Level: 261.27' | Date: 8/21/01

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
Spectral Gamma	0' - 55'	7/27/01	Neutron Moisture	0' - 120'	7/26/01
Spectral Gamma	54' - 164'	7/30/01	Neutron Moisture	120' - 240'	7/26/01
Spectral Gamma	163' - 262'	7/31/01	Neutron Moisture	240' - 263.35'	7/26/01

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	(ft³) Volume	Mesh Size
4" ID endcap, SS	~~279.3 - 281.4~~ ~~281.4 - 282~~ NCW	F480	-	Colorado Silica Sand	249.7' - 283.8'	~~79.88~~ ~~87.33~~	10-20
4" ID screen, SS	259.4 - 279.3	F480	0.020"	Bentonite Pellets	244.4' - ~~249.7'~~ 249.9' NCW	5.70	1/4" + 3/8"
4" ID casing, SS	+2.00 - 259.4	F480	-	Portland Cement	0' - 10.4'	16.52	
	-			Bent Pellets (coated)	283.8' - ~~285.8'~~ 285.9' FJW NCW	1.14	3/8"
	-			Bent. Crumbles	10.4' - ~~244.4'~~ 244.9' FJW	254.8	

OTHER ACTIVITIES

Aquifer Test: Well Development | Date: 8/21/01
Description: Using 1 hp submersible pump with intake set @ 277 ft bgs withdrew water for 120 minutes at 20 gpm with 0.0827 ft drawdown. NCW

Well Abandoned: | Yes: | No: | Date:
Description:

WELL SURVEY DATA

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

COMMENTS/REMARKS

Vol. Calcs.

Reported By: C. Trice
Title: Geologist | Date: 10/18/01
Signature: DC Weekes for C. Trice

Reviewed By: DC Weekes
Title: Geologist | Date: 10/18/01
Signature: DC Weekes

BHI-EE-181 (12/97)

WELL SUMMARY SHEET

Page 1 of 2

Date: 07/18/01

Well ID: C3392	Well Name: 299-E33-339
Location: SE Corner of 241-BX Tank Farm	Project: C401 RCRA Drilling
Prepared By: Jess Hocking	Reviewed By: DC Weekes
Date:	Date: 9/19/01
Signature: Jess Hocking	Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram
6"- dia. protective casing set above stainless casing.	
4" ID SS 304L casing: +2.00 → 259.4'	
Portland cement grout: 0 → 10.4'	
Bentonite crumbles: 10.4' → 244.35'	
1/4" + 3/8" Bentonite pellets: 244.35' → 249.7'	
4" ID SS 304L 0.020 in. slot cont. wire-wrap well screen: 259.4' → 279.3'	
10-20 mesh silica sand 249.7' → 283.1'	
4" ID SS 304L Tailpipe: 279.3' → ~~279.4'~~ 281.4' ~~283.1'~~ DCW	
3/8" Bentonite Pellets (coated): 283.1' → ~~285.544~~ DCW	
All temp. casing removed: All depths are in feet below ground surface.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0'-6' Backfill Material
		6'-15' Silty Sandy Gravel (msG)
		15'-18.5' Slightly Silty Sandy Gravel
		18.5'-20' Silt lens
		20'-23' Sand (S)
40		23'-25' Silty Sand (mS)
		25'-30' Slightly Silt Gravelly Sand
		28' Silt lens
		30'-34' Silty Sandy Gravel (msG)
		34'-37' Silty Sand (mS)
80		37'-37.5' (silt lens) "
		37.5'-55 Silty sandy gravel (mgG)
		55'-56' Sandy Gravel (sG)
		56'-223' Sand (S)
		223'-225' gravelly Sand (gS)
120		225'-235' Sandy Gravel (sG)
		235'-250' sl. silty Sandy Gravel (msG)
160		
200		

BHI-EE-189 (12/97)

Page 2 of 2

WELL SUMMARY SHEET

Date: 7/18/01

Well ID: C3392	Well Name: 299-E33-339
Location: SE Corner of 241-Bx Tank Farm	Project: RCRA FY-01
Prepared By: Jess Hocking Date: 8/17/01	Reviewed By: DCWeekes Date: 9/19/01
Signature: Jess Hocking	Signature: DCWeekes

CONSTRUCTION DATA

Description	Diagram
All temp. casing removed:	
All depths are in feet	
below ground surface.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
240		250'-252' Gravel (G)
		252-253.5' Silt (m)
		253.5'-254 sl silty sandy gravel (msG)
▽		254'-260' Gravel (G)
		260'-275' Sandy Gravel (sG)
280		275'-279' Silty Gravel (mG)
		279'-285.44 DCW Gravel (G) DCW BASALT
		TD = 285.44' bgs
		WL = 261.27' bgs 8/21/01
320		

RHI-EE-189 (12/97)

WELL SURVEY DATA REPORT

ERC Project: 22192	**Prepared By:** Gary B. Wagner, P.L.S. **Company:** Rogers Surveying, Inc.
Date Requested: 11/19/01	**Requestor:**
Date of Survey: 12/05/01	**Surveyor:** Rogers Surveying, Inc.
ERC Point of Contact: Mr. Robert Bone	**Survey Co. Point of Contact:** Gary B. Wagner, P.L.S.
Description of Work: Civil surveying for eleven groundwater wells in 200W & 200E Areas.	**Horizontal Datum:** NAD83(91)
	Vertical Datum: NAVD88
	Units: Metric
	Hanford Area Designation: 200E

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
PUG & HVC-1

Vertical Control Monuments:
HSW0-032

Well Name	Well ID	Easting	Northing	Elevation	
299-E33-339	C3392	573716.86	137221.51		Center of Casing
				203.027	"X" on Rim
		573716.84	137221.84	202.303	Brass Cap

Notes:

Surveyor Statement:	**Certification Seal**
I, Gary B. Wagner, a professional land surveyor registered in the state of Washington (Registration No. 30440), hereby certify that this report is based on a field survey performed in December, 2001 under my direct supervision and that the data contained here is true and correct.	

BHI-EE-202 (09/98)

BOREHOLE LOG

Page 1 of 10
Date: 07/18/01

Well ID: C3392 | Well Name: 299-E33-339 | Location: SE corner of 241-BX Tank Farm
Project: CY01 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0	P/B	n/A		0'-6' Backfill material.	Cable Tool. Drive barrel 7½"/6⅛"
5	Archive			6'-15' Silty Sandy Gravel (msg) 50% gravel, 40% sand, 10% silt. Sand vf-c, poorly sorted, S-R, gravel, poorly sorted, SA, max size = 1g cobbles. 30% Basalt, 70% qtz (other), Rxn to HCl. 10YR 5/1 (gray) dry.	Grab Archive sample @ 5.0'. α, β < detect.
10	Archive				Grab Archive Sample @ 10.0'. α, β < detect.
15	Archive			15'-18.5' slightly Silty Sandy Gravel (mSG) 80% gravel, 15% sand, 5% silt. Sand m-c, S-A, mod. sorted, gravel S-R, poorly sorted max size - med cobbles. 40% basalt, 60% qtz (other) Slight rxn HCl. Color (dry) 10YR 5/1) gray.	Grab Archive Sample @ 15.0' α, β < det.
	Archive				Grab Archive Sample @ 18.5'
20	Archive			18.5'-20' Silt lens. 100% silt Interbedded gravel. Color 10YR 4/3. Brown. (Sample moist.) strong rxn HCl. Low plasticity	Grab Archive Sample @ 20.0'
25	Archive			20'-23' Sand (s) 95% sand, 5% gravel silt nodules, f-vcse, 80% basalt, 20% qtz (other) SA. Color 10YR 4/1 dark gray (dry) Sample moist. no rxn HCl	Grab Archive Sample @ 25.0' α, β < detect.
				23'-25' silty sand (ms) 35% silt, 65% sand Sand f-vcse, 70% basalt, 30% other (qtz)	28.5'-29.0' no return

Reported By: Charlene Martinez | Title: Geologist | Signature: Charlene Martinez | Date: 07/18/01
Reviewed By: DCWeekes | Title: Geologist | Signature: DCWeekes | Date: 8/7/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 2 of 10
Date: 07/18/01

Well ID: C3392 | Well Name: 299-E33-339 | Location: SE Corner of 241-BX Tank Farm
Project: CY01 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
30	Archive DB	N/A		23' (cont.), S-R, poorly sorted, 10YR 5/2 grayish brown. Strong rxn HCl	Grab Archive Sample @ 30' α, β < detect.
				25' – 30' Slightly silt gravelly sand. 10% silt, 15% gravel, 75% sand. vf-csc, poorly sorted, SR-SA, gravel max size pebbles, mod sorted SR, 60% qtz (other) 40% basalt. 10YR 6/1 (dry, gray). No rxn HCl	32' Gravel decreased dramatically
35	Archive			28' silt lens	Grab Archive Sample @ 35' α, β < detect.
				30'–34' silty Sandy Gravel (SG) 10% silt, 40% Sand, 50% Gravel. Sand vf-csc. SA, poorly sorted. Gravel, SR, mod. sorted max size = pebbles. 55% qtz (other) 45% basalt. 10YR 6/1 (gray) Strong rxn HCl.	
40	Archive			34' – 37' Silty Sand (mS) 20% silt, 80% sand, trace gravel. Sand SR, vf-csc, poorly sorted, 45% basalt, 55% qtz (other) 10YR 6/2 (dry) micaceous, strong rxn HCl	Grab Archive Sample @ 45' α, β < detect
				37' silt lens interbedded w/ gravel. max gravel = 5cm cobble. Fe staining evident. Low plasticity. 10YR 5/3 Brown. Strong rxn HCl	
50	Archive AIR(SB)			37.5' – 55' Silty Sandy Gravel (msg) See description from 30-34 feet.	Grab Archive Sample @ 50' α, β < detect.
				50' Silty Sandy Gravel (msg) 15% silt, 30% sand, 55% Gravel. Sand vf-csc, mod sorted SR, Gravel SR, poorly sorted.	Now low risk. 50' Switch to Air Rotary drilling (tricone bit)
65	Archive			max size 5cm cobbles 10YR 6/1 strong rxn HCl	Grab Archive Sample @ 55'
				55'-56' Sandy Gravel (SG) 45% sand 55% gravel. Sand: vcse, SA, well sorted, 55% basalt, 45 qtz. Gravel: SR, mod sorted, max size vcse pebbles. 10YR 6/2 (lt. brn grey), strong rxn HCl	

Reported By: Charlene Martinez | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 07/18/01 | Signature: DC Weekes | Date: 8/7/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 7 of 10
Date: 7/19/01

Well ID: C3392 | Well Name: 299-E33-339 | Location: SE corner of 241-BX Tank Farm
Project: CY01 RCRA | Reference Measuring Point: GS

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
60	Archive AR	NA		56'-58' Sand (S) 90% sand 10% gravel (angular)	Grab Archive Sample @ 60'
				Sand: 60% vcse, 40% csa, SA, mod sorted, quartz	
				58'-223' Sand (S): 20% vcsc, 80% csc,	
				well sorted, SR, (10YR 5/2 (grish brn), 5% basalt	
				weak rxn HCl.	
65	Archive				Grab Archive Sample @ 65'
70	Archive				Grab Archive Sample @ 70'
75	Archive				Grab Archive Sample @ 75'
				80'- sand 10% vcse, 40% csc, 40% med, 10% fine	
80	Archive				Grab Archive Sample @ 80'
85	Archive				Grab Archive Sample @ 85'

Reported By: C Trice | Title: Geologist | Signature: C Trice | Date: 7/19/01
Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 8/7/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 4 of 10
Date: 7/19/01

Well ID: C3392 | Well Name: 299-E33-339 | Location: SE corner of 241-BX tank farm
Project: CY01 RCRA | Reference Measuring Point: GS

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
90	Archive AR	NA			Grab Archive Sample @ 90'
				94' Sand (S) 10% cse 40% med 50% fn-vfn	
95	Archive			10YR6/2 (lt brnish grey) SR weak rxn HCl	Grab Archive Sample @ 95'
				20-30% basalt, 80-70% qtz.	
100	Archive			100' Sand (S) same as above	Grab Archive Sample @ 100'
105	Archive			105' Sand (S) same as above	Grab Archive Sample @ 105'
110	Archive			110' Sand (S) same as above.	Grab Archive Sample @ 110'
115	Archive			115' Sand (S) 10% cse, 40% med, 50% of-vf	Grab Archive Sample @ 115'
				10YR 6/2 (light brownish gray) S-R.	
				30% Basalt, 70% qtz (other) poorly	
				sorted, weak rxn HCl.	

Reported By: C Trice | Title: Geologist | Signature: C Trice | Date: 7/19/01
Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 8/7/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 5 of 12
Date: 7/19/01

Well ID: C3892 | Well Name: 299-E33-339 | Location: SE Corner of 241-BX Tank Farm
Project: CY01 RCRA | Reference Measuring Point: GS

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120'	Archive AR	NA		120' (sand) S, vf-cse, poorly sorted 10YR 6/2, light brownish gray. S-R 70% qtz (other) 30% basalt, poorly sorted, weak rxn HCl.	Grab Archive Sample @ 120'
125'	Archive			125' sand (s) Same as above	Grab Archive Sample @ 125'
130'	Archive			130' 2% cac pebble.	Grab Archive Sample @ 130'
135'	Archive			135' Sand - 20% vcse 60% cse 70% fn-vfn no strong rxn HCl. 137' - gravel increase to ~8%.	Grab Archive Sample @ 135'
140'	Archive			140' Sand (s) 100% sand f-v cse, poorly sorted, 30-35% basalt, 65-70% qtz (other) SA, 10YR 5/2 (dry) sample moist (grayish brown) no rxn HCl	Grab Archive Sample @ 140' α, β < detect.
145'	Archive			145' Sand (s) Same as above	Grab Archive Sample @ 145'

Reported By: C Trice / C. Martinez | Reviewed By: DC Weekes
Title: Geologist / Geologist | Title: Geologist
Signature: C Trice / C Martinez | Date: 7/19/01 | Signature: DC Weekes | Date: 8/7/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 6 of 10
Date: 07/20/01

Well ID: C3392 | Well Name: 299-E33-339 | Location: SE corner of 241-BX Tank Farm
Project: CY01 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
150	Archive AIR	n/a		150' sand (s) 100% vf-vcse, poorly sorted, 30-35% basalt, 65-70% qtz (other) SA 15% vcse, 40% cse, 30% med, 15% f-vf. 10YR 5/2 (dry) sample moist (grayish brown) no rxn HCl.	Grab Archive Sample @ 150'
155	Archive			155' sand (s) same as above.	Grab Archive Sample @ 155'
160	Archive			160' sand (s) see description @ 150'	Grab Archive Sample @ 160'
165	Archive			165' sand (s) 100% f-vcse, SA, 30% basalt, 70% felsic, poorly sorted, 10YR 5/2 (dry) grayish brown. Sample moist, no rxn HCl.	Grab Archive Sample @ 165'
170	Archive			170' sand (s) same as above.	Grab Archive Sample @ 170'
175	Archive			175' sand (s) same description. no rxn HCl.	Grab Archive Sample @ 175'

Reported By: Charlene Martinez
Title: Geologist
Signature: Charlene Martinez Date: 07/20/01

Reviewed By: D C Weekes
Title: Geologist
Signature: D C Weekes Date: 8/7/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 7 of 10
Date: 07/20/01

Well ID: C3392 | Well Name: 299-E33-339 | Location: SE corner of 241-BX Tank Farm
Project: CY01 RCRA Drilling | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
180	Archive AIR	N/A			Grab archive sample @ 180'
185	Archive				Grab archive Sample @ 185'
190	Archive			190- (cm) Gravelly Sand (s) w/ trace gravel. 95% sand, 5% gravel csa mostly	Grab Archive Sample @ 190'
195	Archive				Grab Archive Sample @ 195'
200	Archive				Grab Archive Sample @ 200'
205	Archive				Grab Archive Sample @ 205'

Reported By: C. Trice | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: C. Trice | Date: 7/23/01 | Signature: DC Weekes | Date: 8/7/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 8 of 10
Date: 07/23/01

Well ID: C3392 | Well Name: 299-E33-339 | Location: SE corner of 241-BX Tank farm
Project: C401 RCRA Drilling | Reference Measuring Point: GS

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
210	Archive A1 A1	NA			Grab Archive Sample @ 210'
215	Archive				Grab archive sample @ 215'
				219' – 5% 15% med pebbles;	
220	Archive			221'-222' – 10% cse, 20% med, 40% fn, 20% vfn, 10% silt, (Sand)	Grab Archive Sample @ 220'
				223 [225'] gravelly Sand (gs) increase in gravel ~20% med pebbles, Trace silt. 10YR 7/2 (lt gray) weak rx HCl.	
225	Archive			225' [235'] Sandy GRAVEL (sG) - 70% gravel 30% sand, Gravel - 10% cse pebbles, 20% med pebbles, 70% fn-vfn pebbles, poorly sorted, SR-SA, Sand - 30% vcse, 20% cse, 20% med, 30% fn-vfn. SR. 80% basalt, 20% qtz.	Grab Archive Sample @ 225'
230	Archive			color 10YR 7/2 (dry-lt gray); dry; weak rx HCl	Grab Archive Sample @ 230'
				230' - sandy GRAVEL (sG) 80% gravel 20% sand Gravel – 70% Ang peb, 10% ~~vcse-cse~~ cse-vf, 20% vfn. Sand 80% vcse, 20 vfn-fn. SA, 80% basalt	
235	Archive			20% qtz. 10YR 5/2 (wet - grayish brn / trace silt	Grab Archive Sample @ 235'
				235' [250'] slightly silty Sandy GRAVEL - msg 75% gravel, 20% sand, 5% silt. GRAVEL: mostly med pebbles, SA, poorly sorted, Sand: 80% fine 20 vfn. 10YR 6/2 (Lt brnish gray). 80% basalt. Slight rxn HCl	No cuttings from 239' → 239.5'

Reported By: A. Trice | Title: Geologist | Signature: A Trice | Date: 07/24/01
Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 8/7/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 9 of 10
Date: 7/24/01

Well ID: C3392 | Well Name: 299-E33-339 | Location: SE corner of 241-BX Tank Farm
Project: CY01 RCRA Drilling | Reference Measuring Point: GS

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
240	Archive Air Rotary	NA		236' - gravel increase to predom. vcse pebbles, SR, 80% gravel, 20% sand	Grab Archive Sample @ 240'.
				240' - gravel 80% cse, 20% med-fn, sl. silty 10YR 7/2 (lt gray), SA-SR, weak rxn HCl	
245	Archive				Grab Archive Sample @ 245'
250	Archive			250'-252' - Gravel (G)	Grab Archive Sample @ 250'
	Archive			80% cse, 10% vcse, 10% med-fn, SR, 10YR 6/2 (lt. brnish gray), trace silt, weak rxn HCl.	Grab Archive Sample @ 252'
	Archive			252'-253.5' - Silt lens (M) 100% silt interbedded gravel, 10YR 5/2 (brn), wk HCl	Grab Archive Sample @ 254'
255	Archive			253.5-254' - sl. silty sandy Gravel (msG)	Grab Archive Sample @ 255'
				70-80% gravel, 15-20% sand, 5-10% silt. sand: fn-vcse, SA, poorly sorted. Gravel: SR; mod sorted, max size cse pebbles	
				254'-260' - Gravel (G)	
260	Archive			95% gravel, 5% sand Gravel: see 250'. Sand cse, SA, 80% basalt, 20% qtz. no rxn HCl.	Grab Archive Sample @ 260' *Split spoon 260'-262'
				260'-275' - Sandy Gravel (SG)	
				60% gravel, 40% sand, tr silt. Gravel: 10% sm. cobbles, 10% vcse peb., 10% cse peb., 35% med peb, 35% fn-vfn, SR-A, 10YR 5/3 (brn), poorly sorted, no reaction HCl. Sand fn-vfn, SA-SR.	
265	Archive				Grab Archive Sample @ 265'
					Static water ≈ 260'

Reported By: C. Trice | Title: Geologist | Signature: C. Trice | Date: 7/24/01

Reviewed By: D C Weekes | Title: Geologist | Signature: D C Weekes | Date: 8/7/01

BOREHOLE LOG

Page 10 of 10
Date: 07/25/01

Well ID: C3392 | Well Name: 299-E33-339 | Location: SE Corner of 241 BX Tank Farm
Project: CY01 RCRA Drilling | Reference Measuring Point: GS

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
270	Archive AR	NA			Grab Archive Sx @ 270'
275	Archive			275'-279' silty GRAVEL (mG) 80% gravel, 15% silt, 5% sand Gravel: same	Grab Archive Sx @ 275'
				279' - 285.44' Basalt (G) Gravel.	Grab Archive Sx @ 279'
280	ARCHIVE			80% med peb, 10YR3/2 (very dk brn), 20% vcse sand. A, mod. sorted, no rxn HCl. This actually basalt (solid).	@ 280'
285					TD = ~~284'~~ 285.44' 7/26/01

Reported By: C. Trice | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: C. Trice | Date: 7/25/01 26 DCW | Signature: DC Weekes | Date: 8/7/01

EHLEE-183 (12/97)

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-E33-337, 299-E33-338, and 299-E33-339. The analyses were done by CH2M HILL Hanford, Inc. using standard sieve techniques.

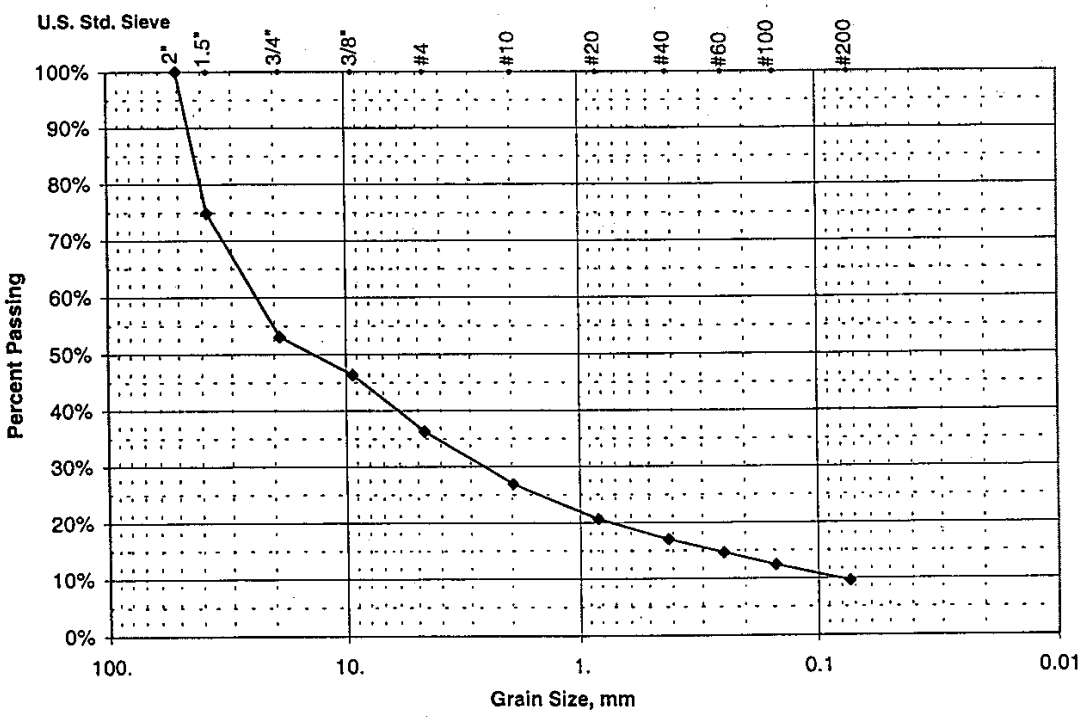
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-E33-337	DEPTH	259.9'-260.9'	SAMPLE#	E33-337-259.9	WELL ID#	C3390
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-9130	DATE	08/23/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
843.30	2"	0.0	0.0	100.0	50.80	
	1.5"	211.8	25.1	74.9	38.10	
	3/4"	395.5	46.9	53.1	19.05	
	3/8"	451.9	53.6	46.4	9.42	
	#4	537.1	63.7	36.3	4.70	
	#10	616.4	73.1	26.9	1.98	
	#20	669.1	79.3	20.7	0.83	
	#40	699.9	83.0	17.0	0.42	
	#60	719.9	85.4	14.6	0.25	
	#100	738.5	87.6	12.4	0.150	
	#200	762.6	90.4	9.6	0.074	

Sieve Analysis Data for Sample E33-337-259.9



Comments: Sandy Gravel

All data are accurately and completely recorded.

Checked By: JMWimett DCWeekes Date: 10/16/01

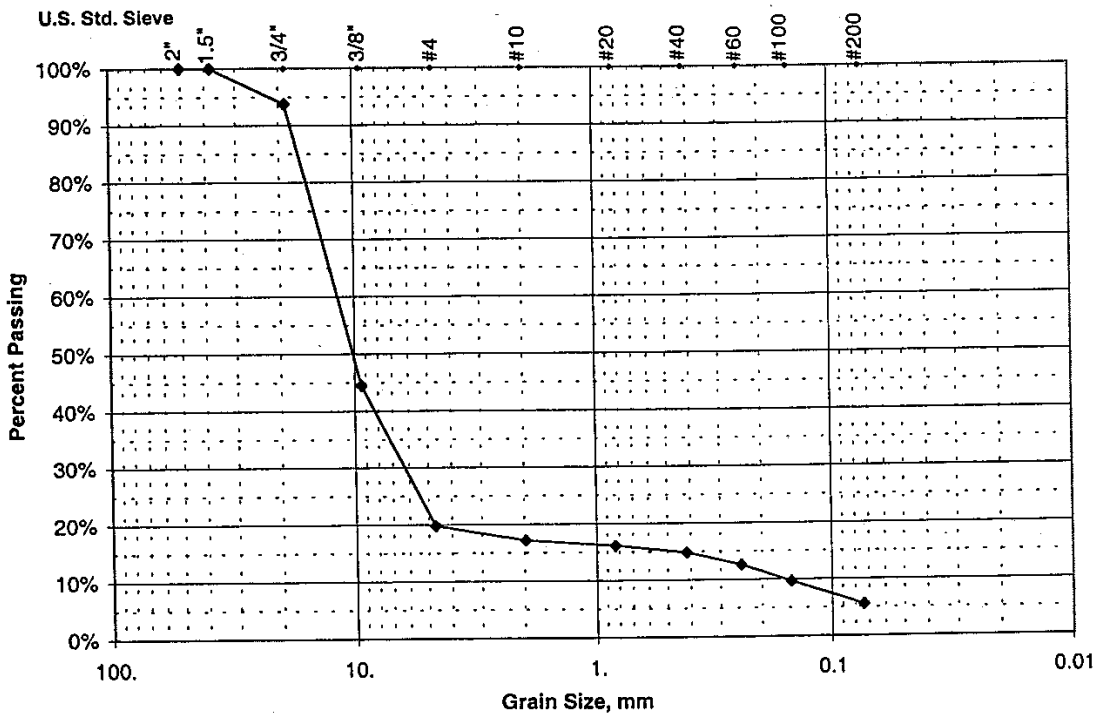
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-E33-337	DEPTH	260.9'-261.9'	SAMPLE#	E33-337-260.9	WELL ID#	C3390
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-9130	DATE	08/23/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
796.20	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	49.2	6.2	93.8	19.05	
	3/8"	442.0	55.5	44.5	9.42	
	#4	638.9	80.2	19.8	4.70	
	#10	659.7	82.9	17.1	1.98	
	#20	667.8	83.9	16.1	0.83	
	#40	678.0	85.2	14.8	0.42	
	#60	695.8	87.4	12.6	0.25	
	#100	719.7	90.4	9.6	0.150	
	#200	751.9	94.4	5.6	0.074	

Sieve Analysis Data for Sample E33-337-260.9



Comments: Sandy Gravel

All data are accurately and completely recorded.

Checked By: JMWimett DCWeekes Date: 10/16/01

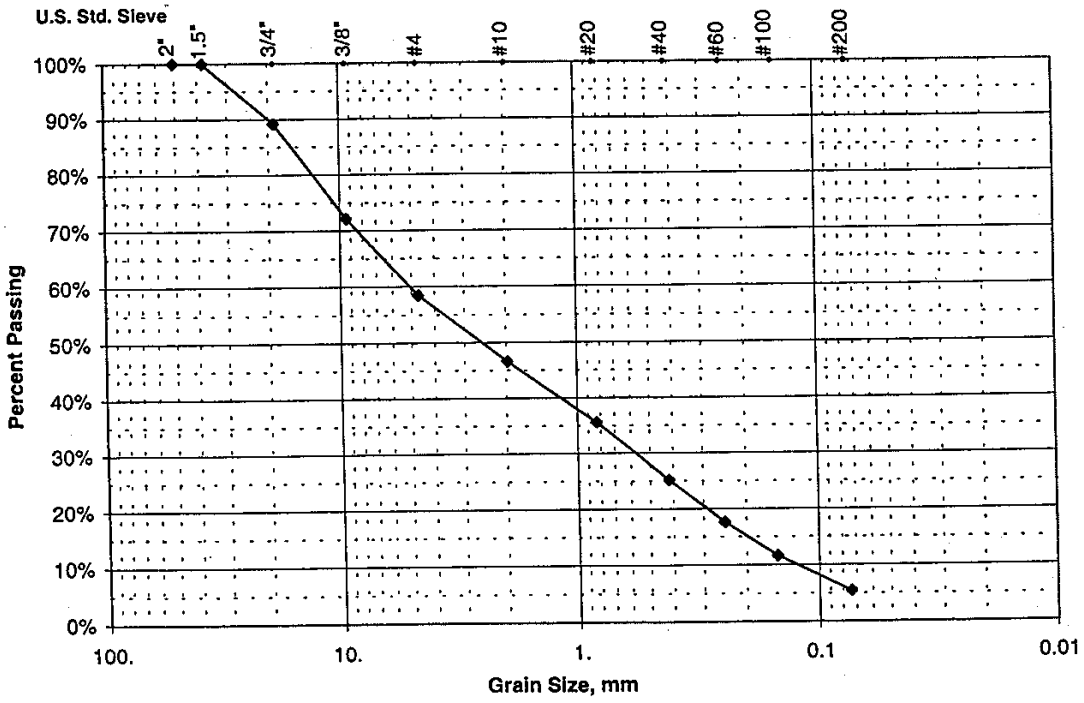
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-E33-338	DEPTH	259.3'-261.3'	SAMPLE#	E33-338-259.3	WELL ID#	C3391
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-9130	DATE	08/23/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
687.40	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	74.3	10.8	89.2	19.05	
	3/8"	191.8	27.9	72.1	9.42	
	#4	285.4	41.5	58.5	4.70	
	#10	367.1	53.4	46.6	1.98	
	#20	442.6	64.4	35.6	0.83	
	#40	514.4	74.8	25.2	0.42	
	#60	566.1	82.4	17.6	0.25	
	#100	607.3	88.3	11.7	0.150	
	#200	649.8	94.5	5.5	0.074	

Sieve Analysis Data for Sample E33-338-259.3



Comments: Sandy Gravel

All data are accurately and completely recorded.

Checked By: DCWeekes Date: 10/16/01

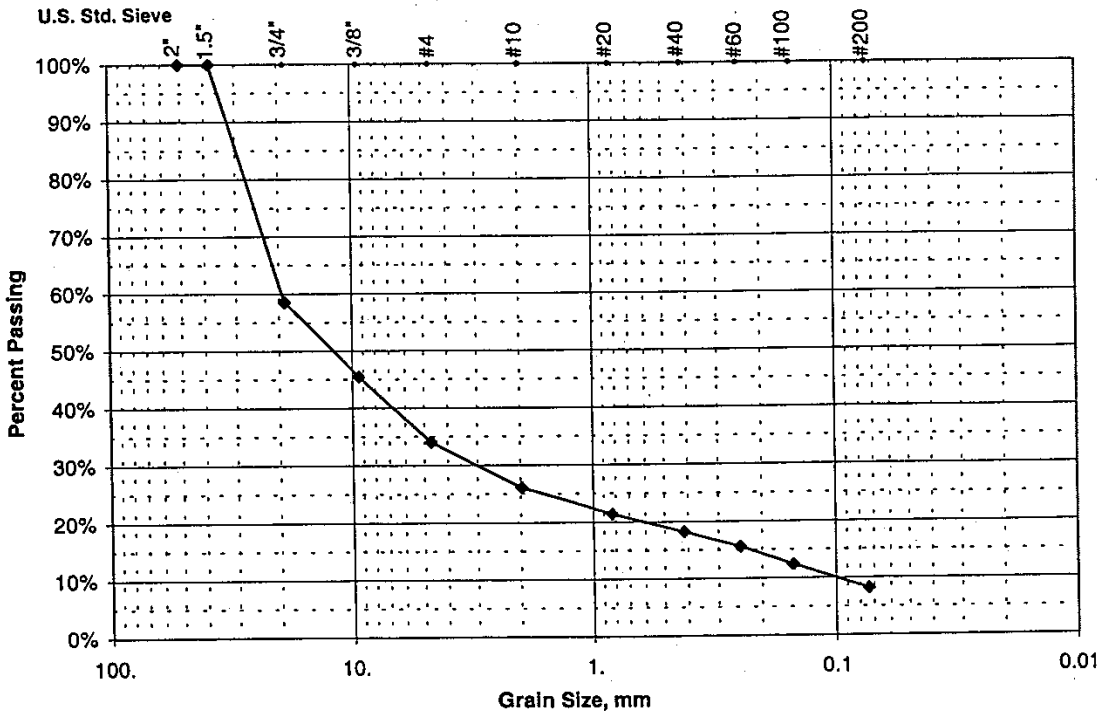
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-E33-339	DEPTH	260.0'-261.0'	SAMPLE#	E33-339-260.0	WELL ID#	C3392
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-9130	DATE	08/23/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
761.50	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	315.8	41.5	58.5	19.05	
	3/8"	415.7	54.6	45.4	9.42	
	#4	502.5	66.0	34.0	4.70	
	#10	562.6	73.9	26.1	1.98	
	#20	598.3	78.6	21.4	0.83	
	#40	622.4	81.7	18.3	0.42	
	#60	643.1	84.5	15.5	0.25	
	#100	666.8	87.6	12.4	0.150	
	#200	699.1	91.8	8.2	0.074	

Sieve Analysis Data for Sample E33-339-260.0



Comments: Sandy Gravel

All data are accurately and completely recorded.

Checked By: DC Weekes Date: 10/16/01

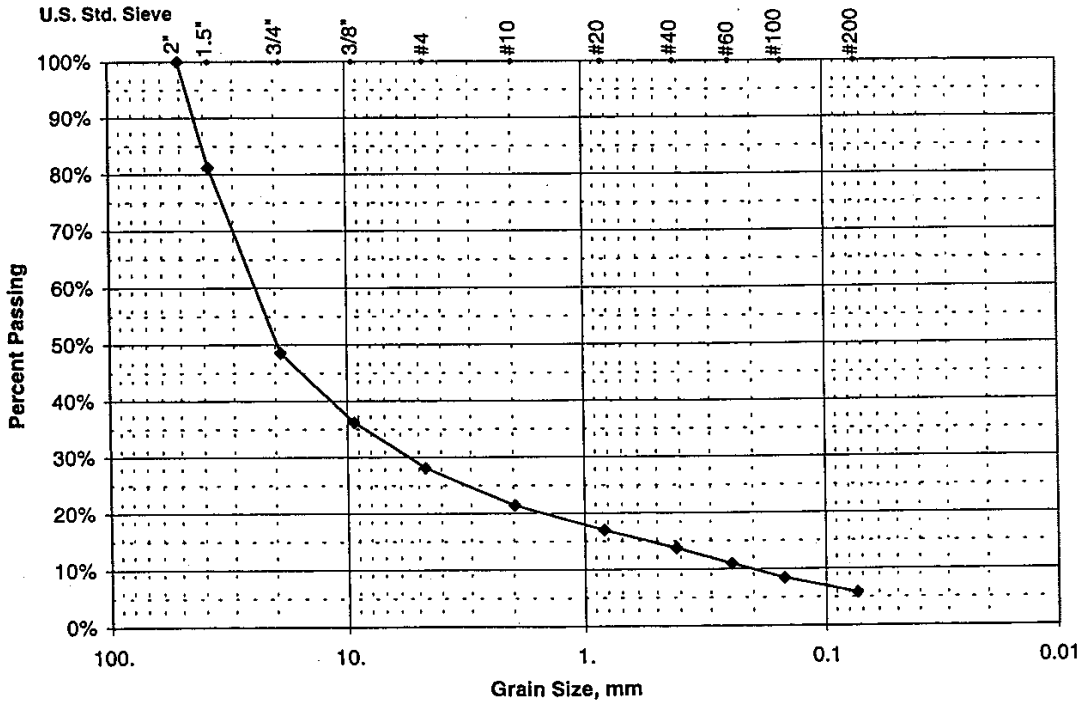
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-E33-339	DEPTH	261.0'-262.0'	SAMPLE#	E33-339-261.0	WELL ID#	C3392
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-9130	DATE	08/23/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
750.00	2"	0.0	0.0	100.0	50.80	
	1.5"	141.0	18.8	81.2	38.10	
	3/4"	385.7	51.4	48.6	19.05	
	3/8"	478.6	63.8	36.2	9.42	
	#4	539.2	71.9	28.1	4.70	
	#10	589.2	78.6	21.4	1.98	
	#20	622.6	83.0	17.0	0.83	
	#40	647.1	86.3	13.7	0.42	
	#60	667.8	89.0	11.0	0.25	
	#100	686.9	91.6	8.4	0.150	
	#200	706.6	94.2	5.8	0.074	

Sieve Analysis Data for Sample E33-339-261.0



Comments: Sandy Gravel

All data are accurately and completely recorded.

Checked By: DC Weekes/JM Wimett Date: 10/16/01

Appendix C

Borehole Geophysical Logs

Appendix C

Borehole Geophysical Logs

This appendix contains the borehole geophysical logs obtained from boreholes 222-E33-337, 299-E33-338, and 299-E33-339. The logs were run and analyzed by MACTEC-ERS. Log header information and log analyses are included with the logs.

299-E33-337 (C3390)

Log Data Report

Borehole Information:

Borehole: 299-E33-337 (C3390)		Site: B Farm Perimeter			
Coordinates		GWL (ft)[1]: ~260		GWL Date: 7/18/01	
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A[3]	N/A	7/16/01	Not available	286	Air Rotary

Casing Information:

Casing Type	Stickup (ft)	Outside Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel-threaded drill pipe	~ 1 in	10.75	9.375	11/16	0	281

Borehole Notes:

This is a RCRA groundwater well that was logged through the drill pipe. There is a void space around the first 16 in. of the casing.

Logging Equipment Information:

Logging System:	Gamma 1D		Type: SGLS (35%)
Calibration Date:		Calibration Reference:	
		Logging Procedure:	MAC-HGLP 1.6.5

Logging System:	RLS 1		Type: Moisture
Calibration Date:	7/11/01	Calibration Reference:	RLSM00.0
		Logging Procedure:	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	Repeat
Date	7/18/01	7/18/01	7/19/01	7/10/01	7/10/01
Logging Engineer	Musial/Spatz	Musial/Spatz	Pearson	Spatz	Spatz
Start Depth (ft)	1	95	144	231	271
Finish Depth (ft)	96	145	232	283	241
Count Time (sec)	200	200	200	200	200
Live/Real	L	L	L	L	L
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	n/a	n/a	n/a	n/a	n/a
Pre-Verification	A0001CAB	A0001CAB	A0002CAB	A0002CAB	A0002CAB
Start File	A0001000	A0001096	A0002000	A0002089	A0002142
Finish File	A0001095	A0001146	A0002088	A0002141	A0002172
Post-Verification	A0001CAA	A0001CAA	A0002CAA	A0002CAA	A0002CAA

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2	3	Repeat	
Date	7/24/01	7/24/01	7/24/01	7/24/01	
Logging Engineer	Spatz/Musial	Musial/Spatz	Musial/Spatz	Spatz	
Start Depth (ft)	1	124	248.0	260	
Finish Depth (ft)	125	249	260.25	229.75	
Count Time (s)	n/a	n/a	n/a	n/a	
Live/Real	n/a	n/a	n/a	n/a	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.25	0.25	0.25	0.25	
ft/min	1.0	1.0	1.0	1.0	
Pre-Verification	C0072CAB	C0072CAB	C0072CAB	C0072CAB	
Start File	C0072000	C0072497	C0082000	C0082055	
Finish File	C0072496	C0072997	C0082054	C0082176	
Post-Verification	C0082CAA	C0082CAA	C0082CAA	C0082CAA	

Logging Operation Notes:

A longer count time (200 sec) was required with the SGLS because of the relatively thick casing. In order to obtain reliable spectra while minimizing overall logging time, the depth interval was increased from 0.5 ft to 1.0 ft.

SGLS log depths are relative to ground level. Two logging runs occurred on both 7/18/01 and 7/19/01 because the liquid nitrogen needed to be recharged. Start of log spectra is at 1 ft below ground surface. Depth to water is about 261 ft. No fine gain adjustments were made during this log run (7/19/01). The hole is open at the end of the drill pipe at 281 ft.

Neutron moisture logs were run on 7/24/01 using the RLS 1, and log depths are relative to ground level. The neutron moisture tool was run centralized.

Analysis Notes:

Analyst:	Sobczyk	Date:	07/27/01	Reference:	

Pre-run and post run verification spectra for the SGLS were evaluated, and the tool was found to be functioning normally. Individual spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL. Corrections were applied for a casing thickness of 11/16 in. from the ground surface to 281 ft. No casing correction was applied at 282 and 283 ft. A correction for water in the borehole was applied at and below 261 ft. Dead time corrections were not necessary.

Moisture calibration models at Hanford for 10-in. holes with ¾-in. casing have not been established. Thus, the neutron log was not processed to estimate volumetric moisture content because the relatively large borehole diameter and casing thickness are beyond the range of conditions for which the tool was calibrated. Neutron data are presented as gross counts. In general, an increase in neutron count is indicative of an increase in moisture content, but a quantitative calculation of volumetric moisture cannot be made at this time.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K, ^{232}Th, ^{238}U, and associated decay progeny), and man-made radionuclides. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable activity (MDA) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing and water corrections. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. A neutron moisture log of neutron counts is also shown on the combination plot.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide that was detected. The only ^{137}Cs concentration occurs at 1 and 2 ft below ground surface. The measured ^{137}Cs concentration is about 0.4 pCi/g.

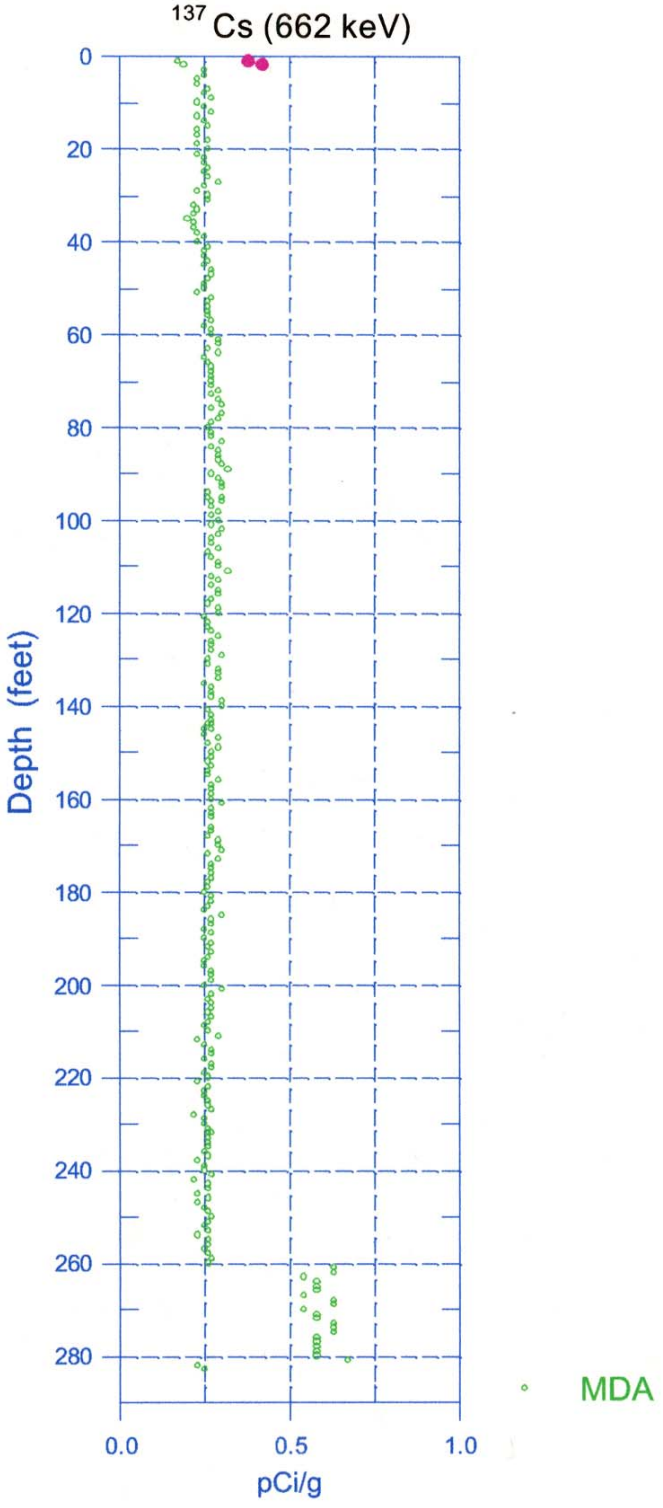
The changes in gross gamma counts depend primarily upon changes in ^{40}K concentrations. The increase in gross gamma counts from about 83 cps to about 100 cps at a log depth of 54 ft corresponds with an increase in apparent ^{40}K concentrations from about 11 pCi/g to 14 pCi/g. Similarly, the decrease in gross gamma counts from 90 cps to 80 cps at a log depth of 218 ft corresponds to a decrease in ^{40}K concentrations from about 13 pCi/g to 11 pCi/g. The abrupt decrease in total gamma counts at a log depth of 261 ft is due to the increased shielding of the detector by groundwater in the borehole. The apparent increase in gross gamma counts at the bottom of the hole (282 ft and 283 ft) occurs because the detector is not being shielded by the drill pipe.

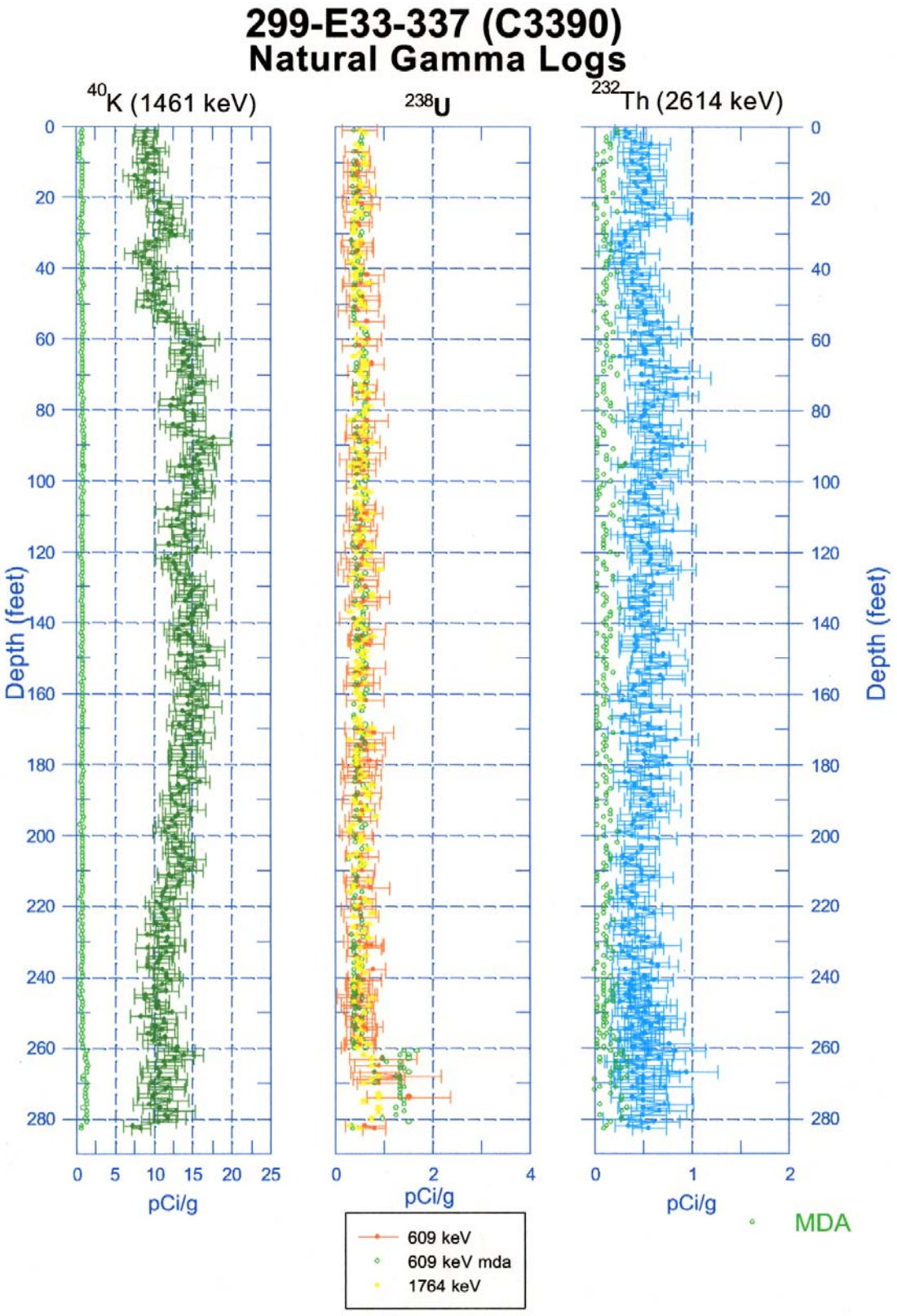
The neutron moisture log showed relatively little response. This lack of response is due at least in part to the low-activity source, short source-to-detector spacing, and large borehole diameter. The slightly elevated neutron cps that occurs between about 19 and 30 ft corresponds with an interval of relatively high total gamma. This zone is interpreted as a layer of finer grained sediments surrounded by coarser sediments. The highest neutron counts occurred in the 121- to 125-ft interval. This interval corresponds with a slight drop in total gamma and ^{40}K activity. An overlap between logging runs one and two occurred between 124 and 125 ft. There was good agreement between the two runs in this overlap.

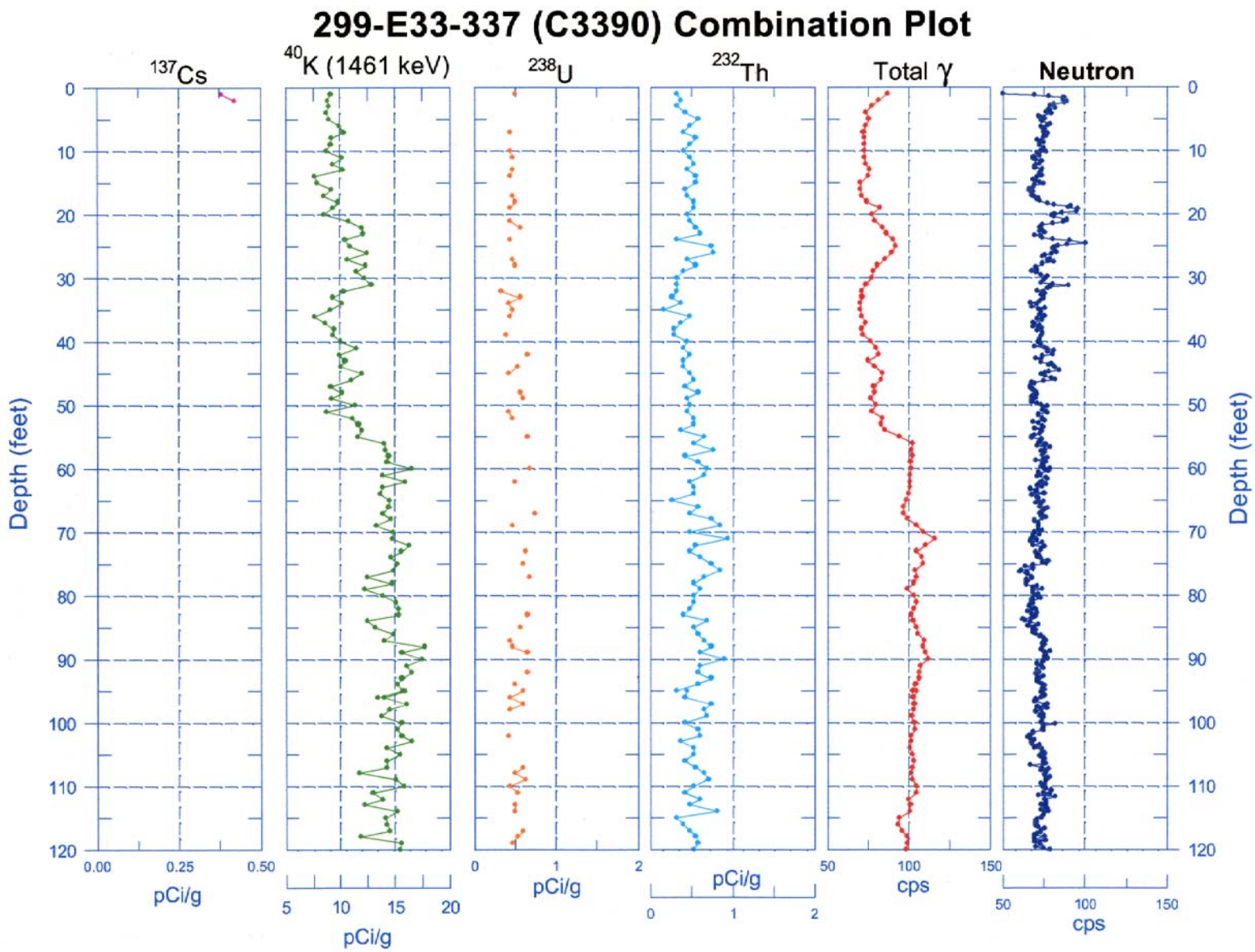
---

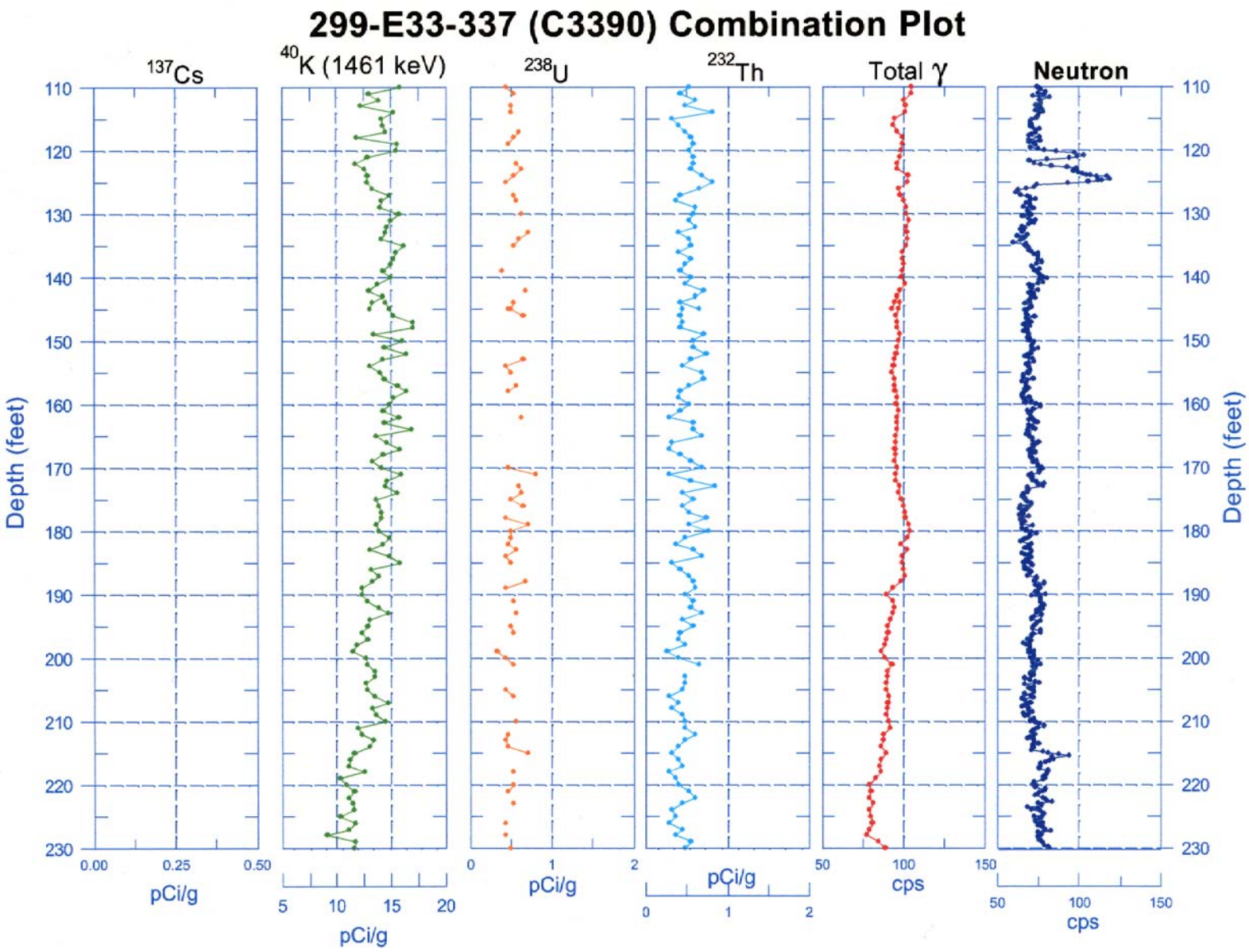
[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not applicable

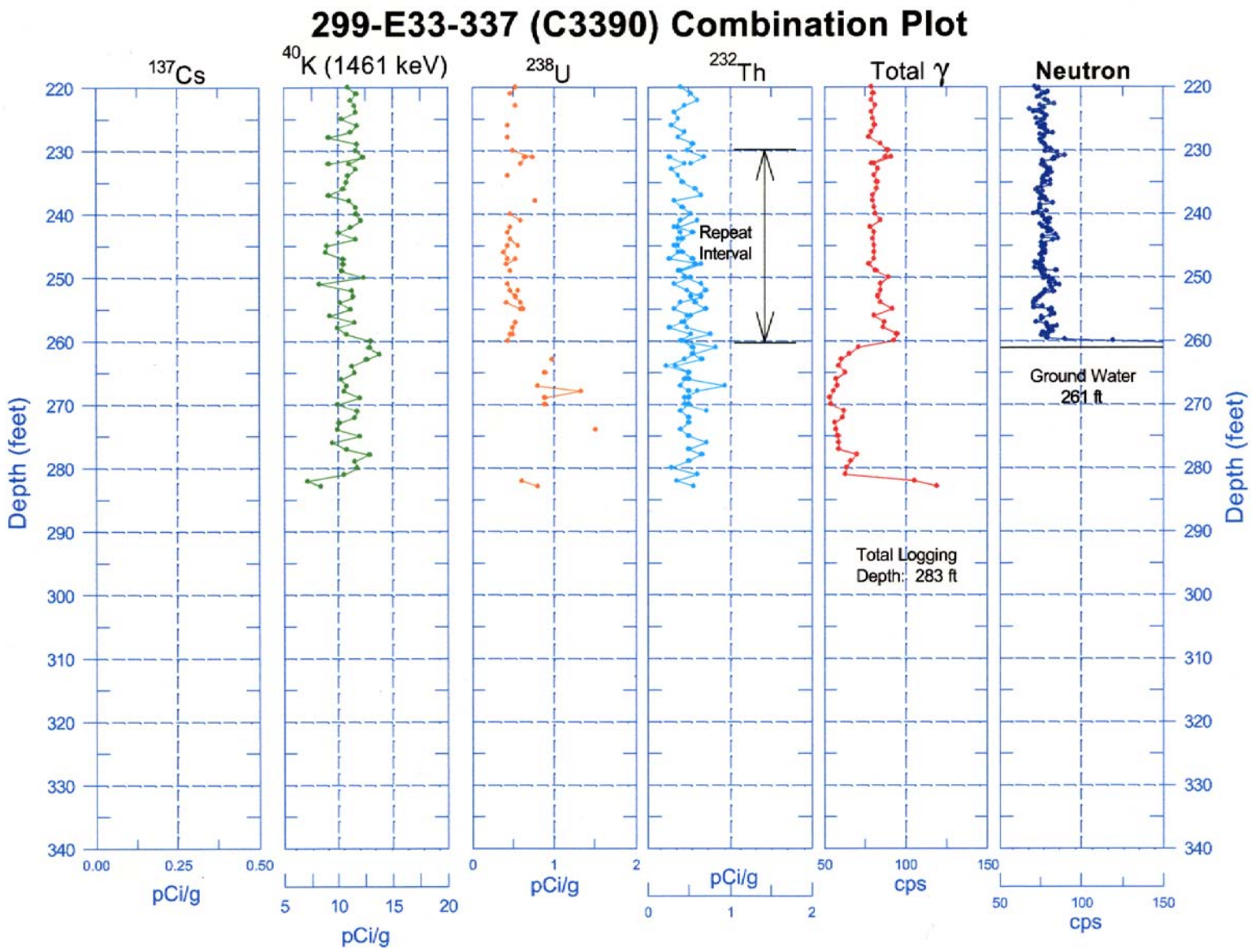
299-E33-337 (C3390)
Man-Made Radionuclide Concentrations




299-E33-337 (C3390)
Natural Gamma Logs
40K (1461 keV)
238U
232Th (2614 keV)
Depth (feet)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
0 5 10 15 20 25
0 2 4
0 1 2
pCi/g
609 keV
609 keV mda
1764 keV
MDA

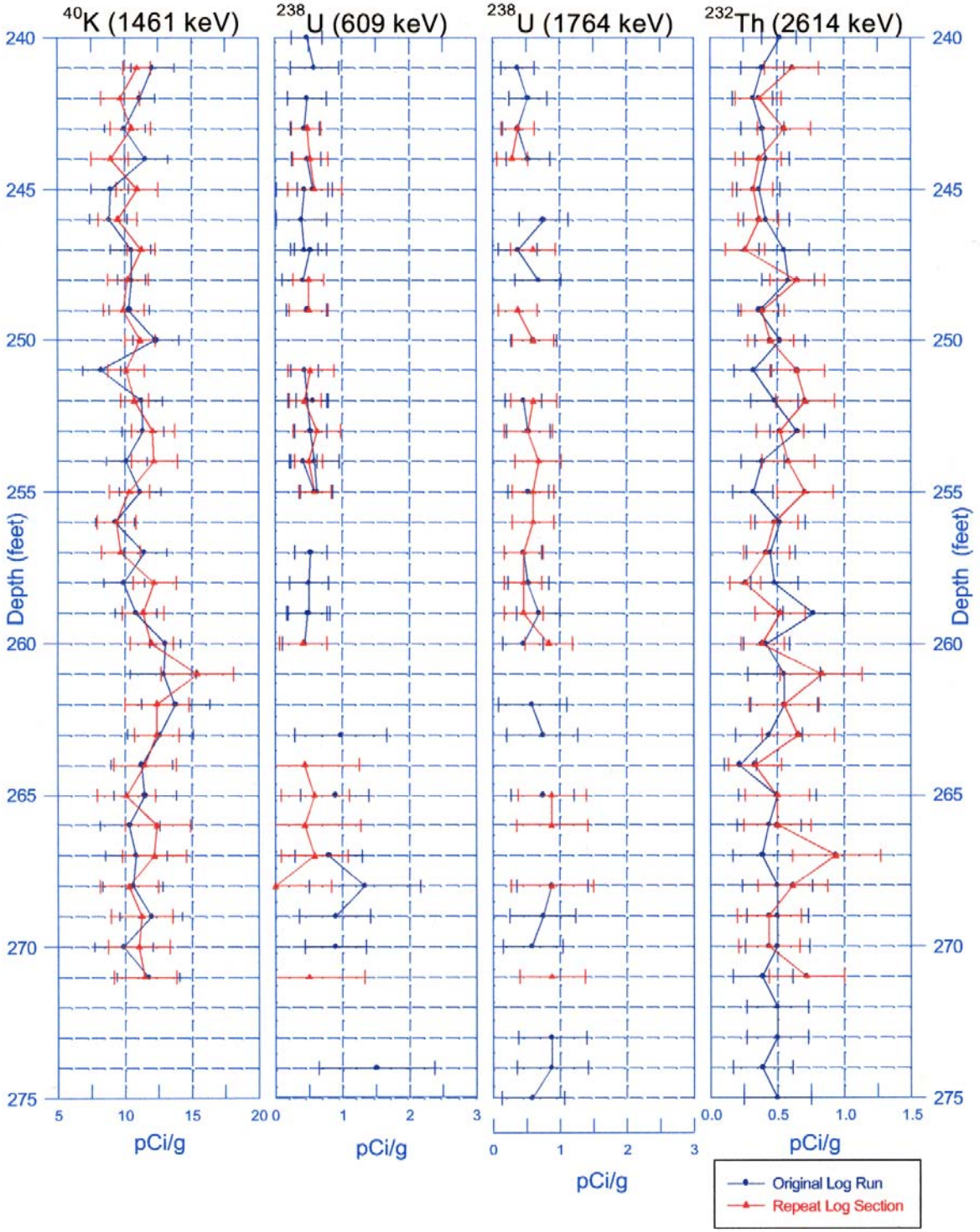

299-E33-337 (C3390) Combination Plot
137Cs
40K (1461 keV)
238U
232Th
Total γ
Neutron
Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
0.00
0.25
0.50
pCi/g
5
10
15
20
pCi/g
0
1
2
pCi/g
0
1
2
pCi/g
50
100
150
cps
50
100
150
cps


299-E33-337 (C3390) Combination Plot
137Cs
40K (1461 keV)
238U
232Th
Total γ
Neutron
Depth (feet)
110
120
130
140
150
160
170
180
190
200
210
220
230
0.00
0.25
0.50
pCi/g
5
10
15
20
pCi/g
0
1
2
pCi/g
0
1
2
pCi/g
50
100
150
cps
50
100
150
cps

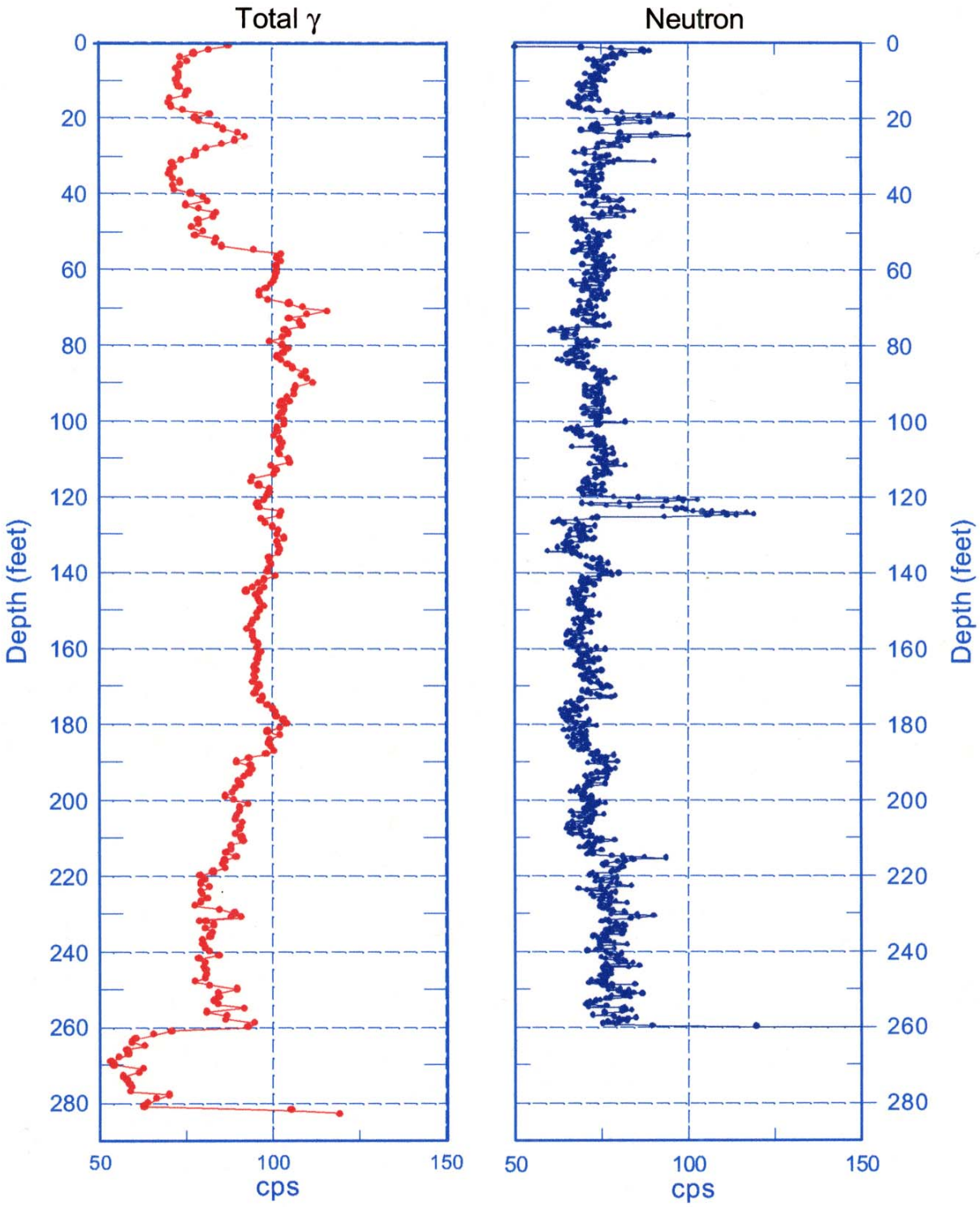

299-E33-337 (C3390) Combination Plot
137Cs
40K (1461 keV)
238U
232Th
Total γ
Neutron
Repeat Interval
Ground Water 261 ft
Total Logging Depth: 283 ft
Depth (feet)
pCi/g
cps

299-E33-337 (C3390)

Rerun Section of Man-Made and Natural Gamma Logs



299-E33-337 (C3390)



299-E33-338 (C3391)

Log Data Report

Borehole Information:

Borehole: 299-E33-338 (C3391)			Site: B Farm Monitoring Well		
Coordinates (Plant)		GWL (ft)[1]:	250.0	GWL Date:	08/13/01
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A[3]	N/A	08/01	N/A	275.0	cable tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel (threaded)	0.25	11.875	10.375	0.75	0	50.0
Steel (threaded)	2.13	10.6875	9.8125	0.4375	0	271.0

Borehole Notes:

The borehole information provided above is derived from personal communication with T. Hottle, Bechtel Hanford Incorporated site representative. The casing information is derived from caliper measurements collected in the field by MACTEC-ERS personnel. Logging measurements are referenced to ground surface.

Logging Equipment Information:

Logging System:	Gamma 2B		Type: SGLS (35%)
Calibration Date:	09/00	Calibration Reference:	GJO-2001-245-TAR
		Logging Procedure:	MAC-HGLP 1.6.5

Logging System:	Gamma 2E		Type: NMLS
Calibration Date:	05/01	Calibration Reference:	GJO-2001-247-TAR
		Logging Procedure:	MAC-HGLP 1.6.5

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3 (Repeat)	4	5 (Repeat)
Date	08/13/01	08/13/01	08/13/01	08/14/01	08/14/01
Logging Engineer	Musial	Musial	Musial	Musial	Musial
Start Depth (ft)	0.0	125.0	207.0	206.0	225.0
Finish Depth (ft)	126.0	207.0	186.0	275.0	218.0
Count Time (sec)	200	200	200	200	200
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	n/a[4]	n/a	n/a	n/a	n/a
Pre-Verification	B0034CAB	B0034CAB	B0034CAB	B0035CAB	B0035CAB
Start File	B0034000	B0034127	B0034210	B0035000	B0035070
Finish File	B0034126	B0034209	B0034231	B0035069	B0035077
Post-Verification	B0034CAA	B0034CAA	B0034CAA	B0035CAA	B0035CAA

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2 (Repeat)			
Date	08/14/01	08/14/01			
Logging Engineer	Musial	Musial			
Start Depth (ft)	48.0	60.0			
Finish Depth (ft)	256.0	81.0			
Count Time (sec)	n/a	n/a			
Live/Real	n/a	n/a			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
ft/min	1.0	1.0			
Pre-Verification	C0011CAB	C0011CAB			
Start File	C0011000	C0011832			
Finish File	C0011831	C0011916			
Post-Verification	C0011CAA	C0011CAA			

Logging Operation Notes:

SGLS and NMLS logging were performed over two separate days. The SGLS logging occurred inside double casing between 0 and 50 ft and through single casing from 50 to 271 ft; the bottom 4 ft of the borehole did not have casing. A longer count time (200 sec) was required with the SGLS because of the relatively thick casing. To obtain reliable spectra while minimizing overall logging time, the depth interval was increased from 0.5 to 1.0 ft. Repeat sections for the SGLS logging were collected from 186 to 207 ft and from 218 to 225 ft.

The NMLS logging occurred from 48 to 256 ft in depth through a single casing except between 48 and 50 ft. The neutron moisture tool was run centralized. A single NMLS logging repeat section was collected between 60 and 81 ft.

Analysis Notes:

Analyst:	Henwood	Date:	08/28/01	Reference:	MAC-VZCP 1.7.9 Rev. 2

Pre-run and post-run verification of the logging tool were performed for each day's log event. The post-run verification for log runs 4 and 5 failed the acceptance criteria. The peak counts per second for the 609- and 1461-keV energy peaks were below the lower control limit. Examination of spectra indicates the detector appears to be functioning normally and the log data are provisionally accepted. The pre-verification spectra collected during log runs 4 and 5 and the post-verification for log runs 1, 2, and 3 were used for the energy and resolution calibration for the data processing.

Each SGLS spectrum collected during a log run was processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL using an efficiency function and corrections for casing and water as appropriate. No dead time corrections were necessary in this borehole as it ranged below 10 percent.

Verification measurements were also collected for the NMLS. Acceptance criteria have not yet been established for the newly deployed logging system. However, the pre- and post-run total count measurements agree within about 5 percent, suggesting the logging system was operating properly.

Moisture calibration models at Hanford for the borehole diameter and casing used in this borehole have not been established. Thus, the neutron log was not processed to estimate volumetric moisture content because the relatively large borehole diameter and casing thickness are beyond the range of conditions for which the tool was calibrated. Borehole diameter is a major factor in neutron response. Neutron data are presented as

gross counts. In general, an increase in neutron count is indicative of an increase in moisture content, but a quantitative calculation of volumetric moisture cannot be made at this time.

The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations rather than the ^{214}Bi peak at 609 keV. The lower energy 609-keV peak could not be distinguished in many of the spectra within the double-cased interval from 0 to 50 ft.

Repeat log plots at selected depth intervals for KUT concentrations and neutron count rate measurements were evaluated. The plots indicate good agreement between successive log runs, demonstrating repeatability in both depth and concentration measurement.

Log Plot Notes:

Separate log plots are provided for the man-made radionuclide (^{137}Cs), naturally occurring radionuclides (^{40}K, ^{232}Th, ^{238}U [KUT]), a combination of man-made, KUT, total gamma and neutron, total gamma plotted with dead time, and repeat section plots for KUT and neutron. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable limit (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, casing corrections, or water corrections. These errors are discussed in the calibration report.

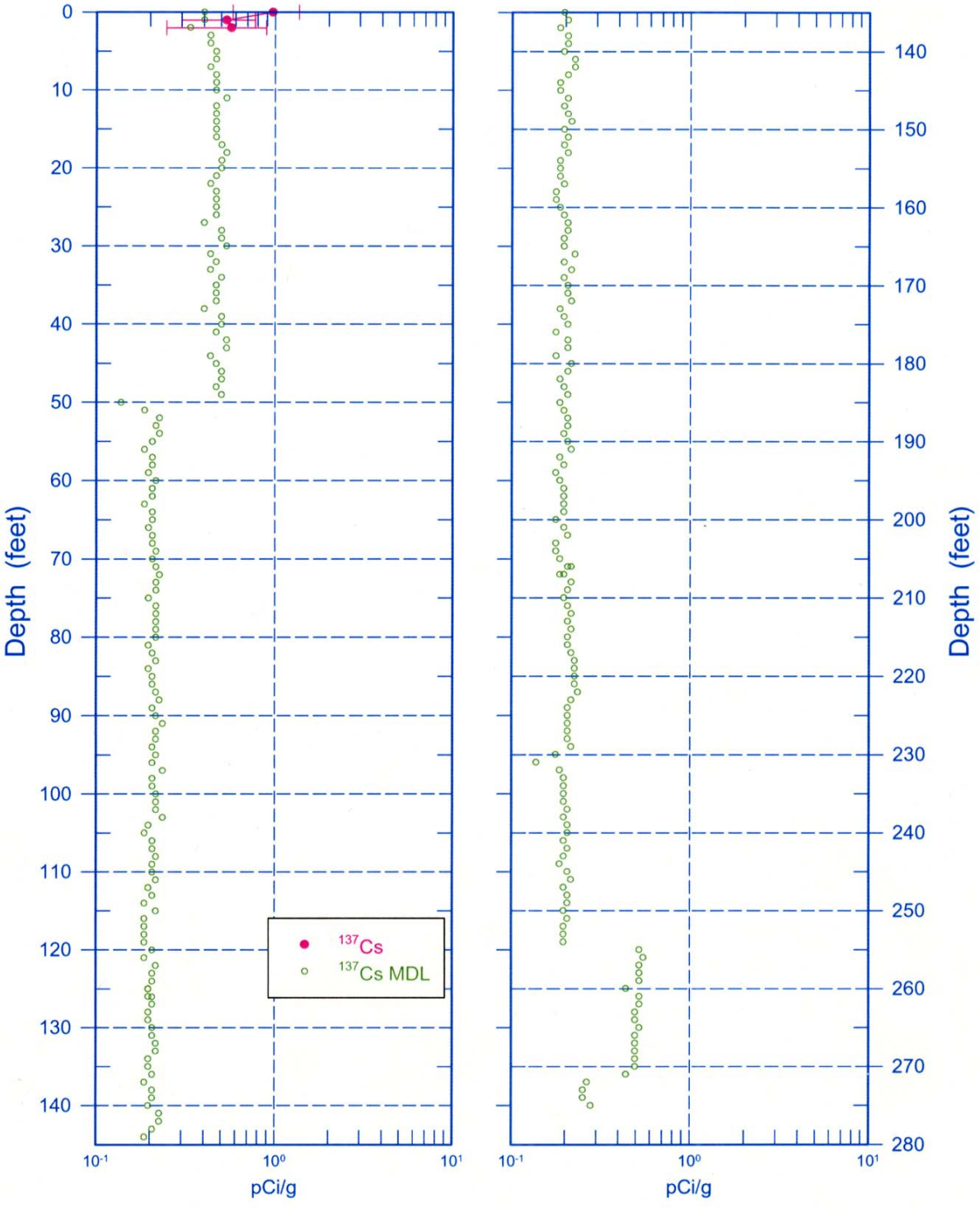
Results and Interpretations:

The only man-made radionuclide detected in this borehole was ^{137}Cs. This radionuclide was measured near the ground surface at less than 1 pCi/g.

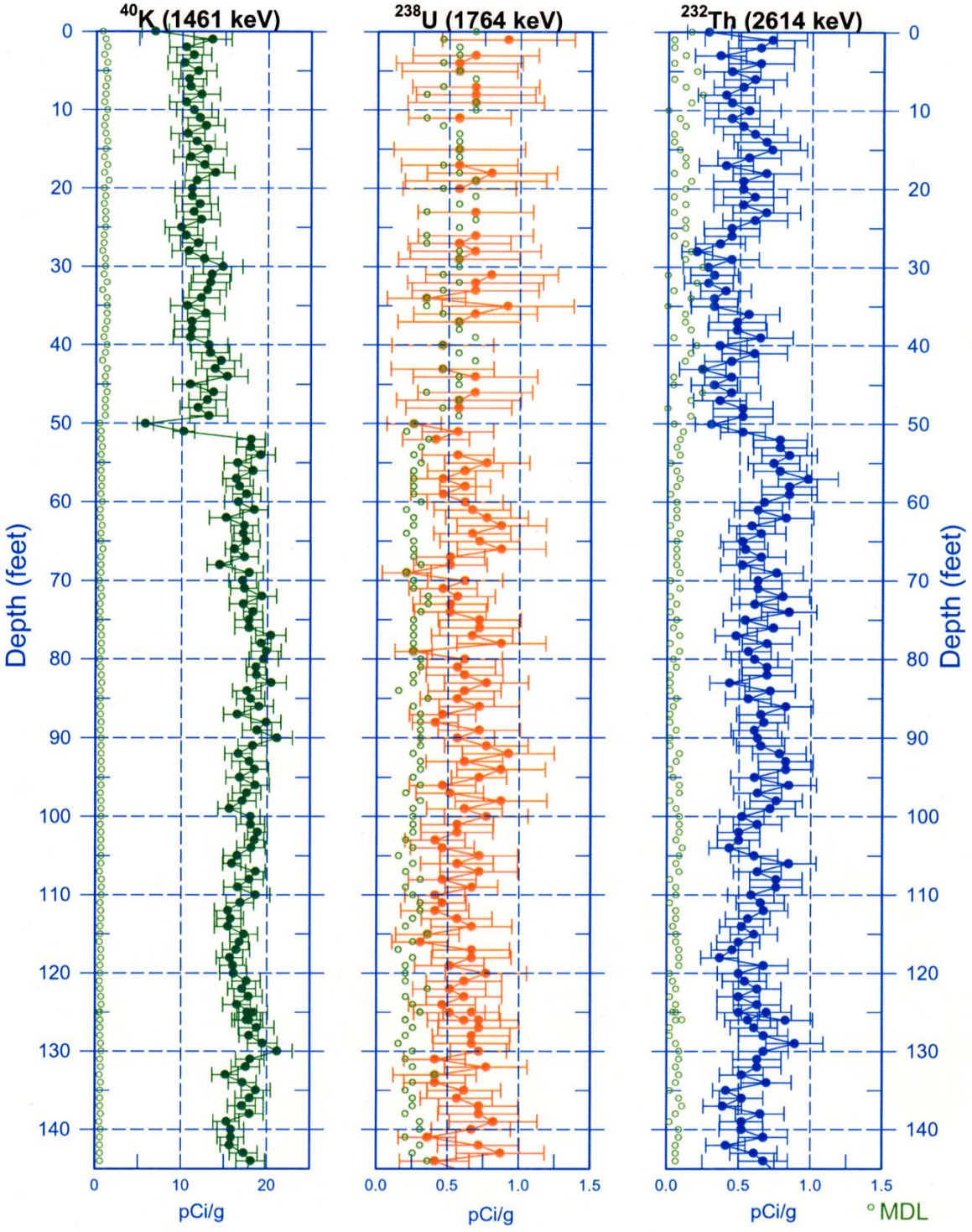
The KUT logs do not have sufficient character in most of the borehole to delineate any definitive lithologic units. Changes in the KUT and total gamma at about 50 ft are the result of a change in the casing configuration. The casing corrections for the interval from 0 to 50 ft are based on a combined thickness for two casings of about 1.25 in. The uncertainty of the casing correction for this thickness is significant and it appears the concentrations have been slightly underestimated in this depth interval.

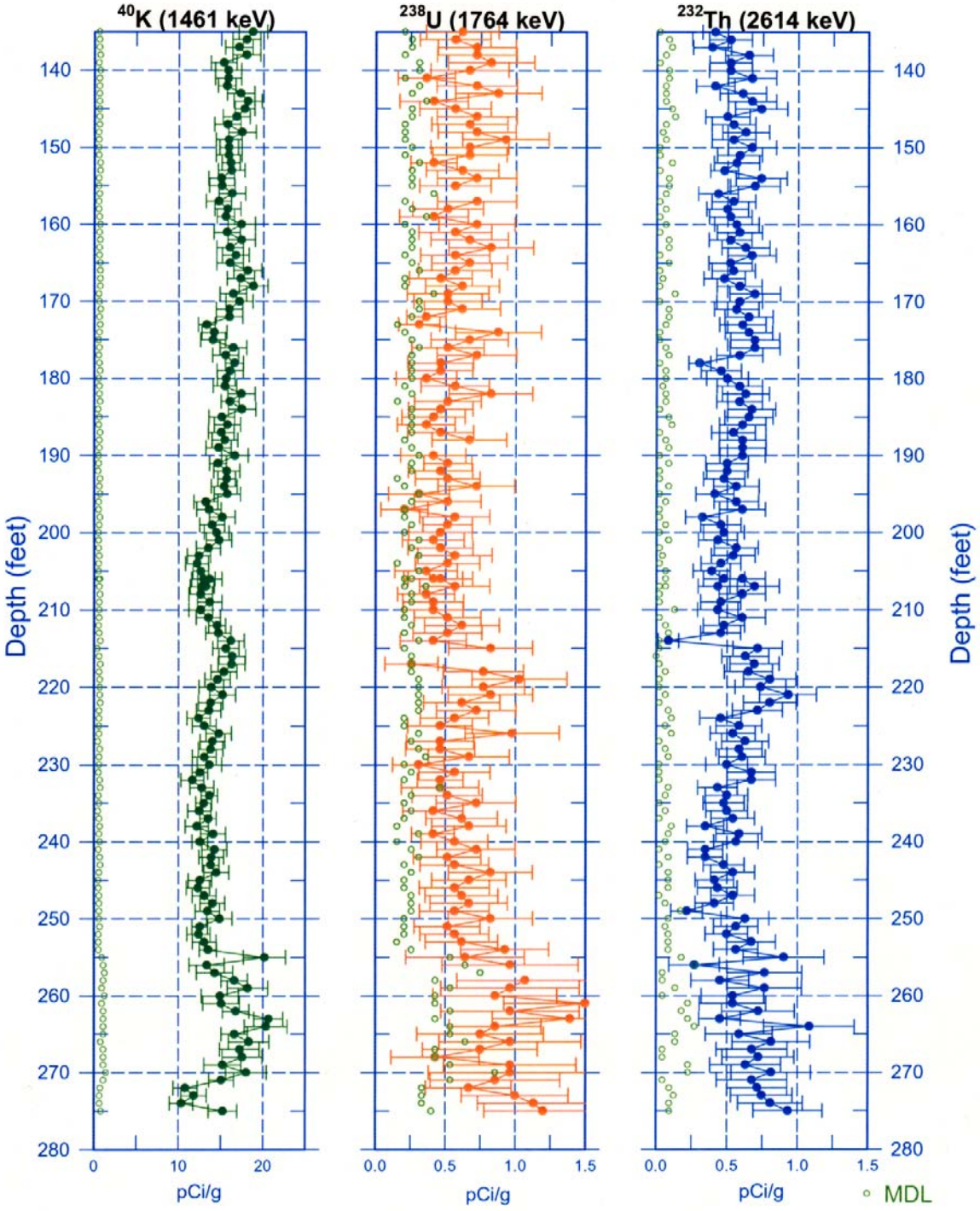
Notable intervals of apparent higher moisture content exist at about 105, 172, and 222 ft. It appears these intervals are associated with finer grained material on the basis of slightly elevated concentrations of ^{232}Th. At the time of neutron logging, groundwater was encountered at about 255 ft.

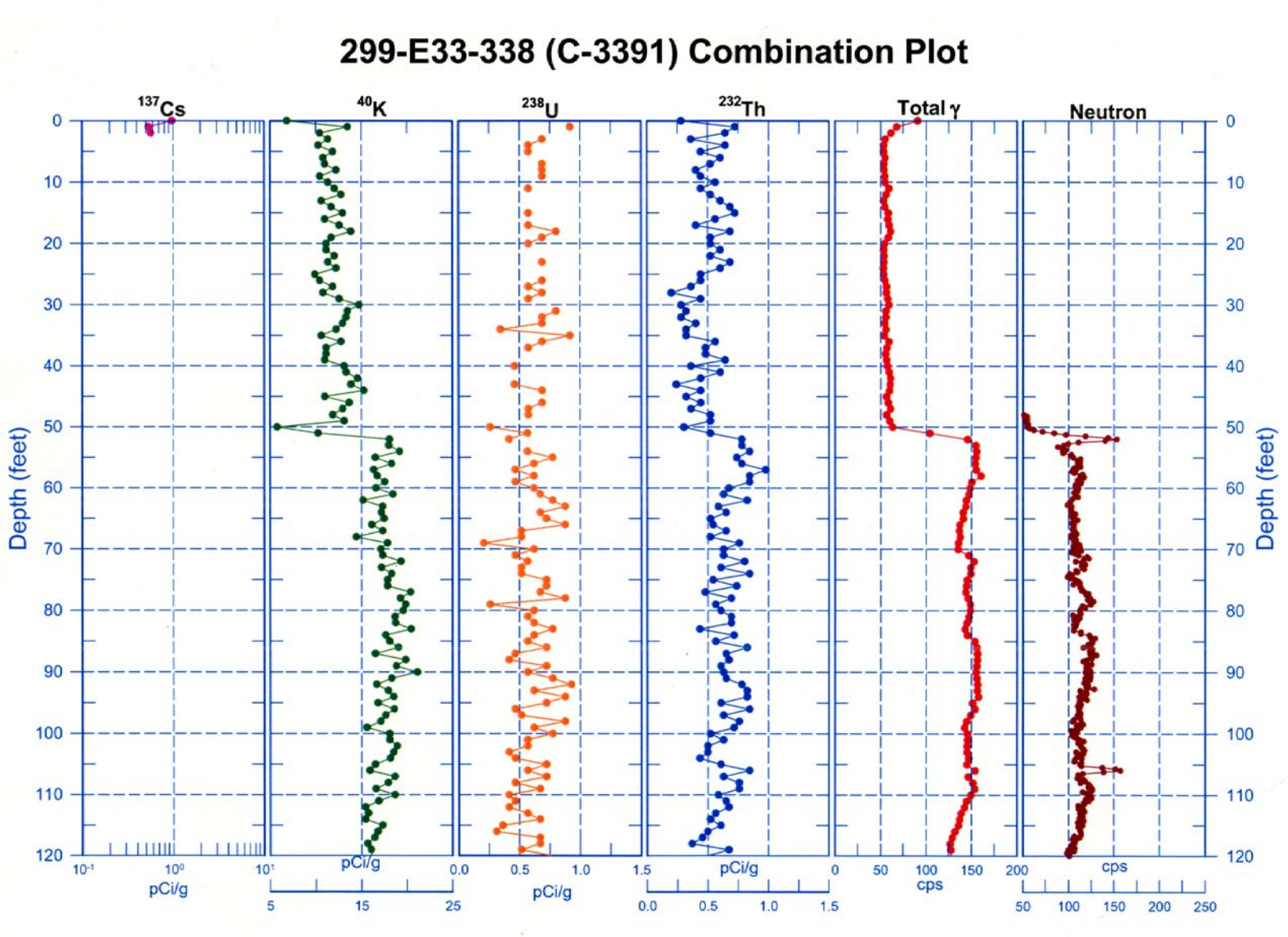
299-E33-338 (C-3391)
Man-Made Radionuclide Concentrations

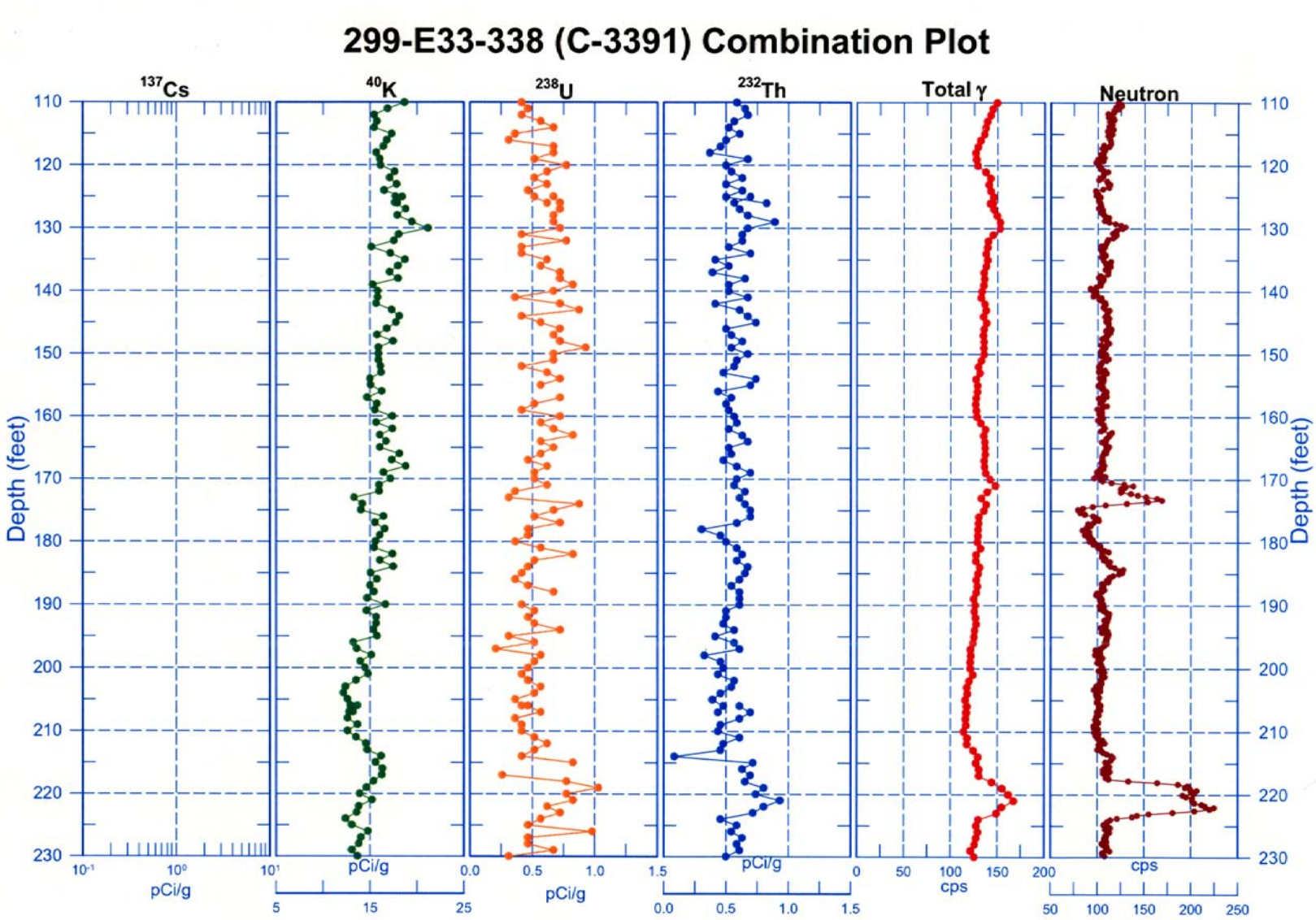


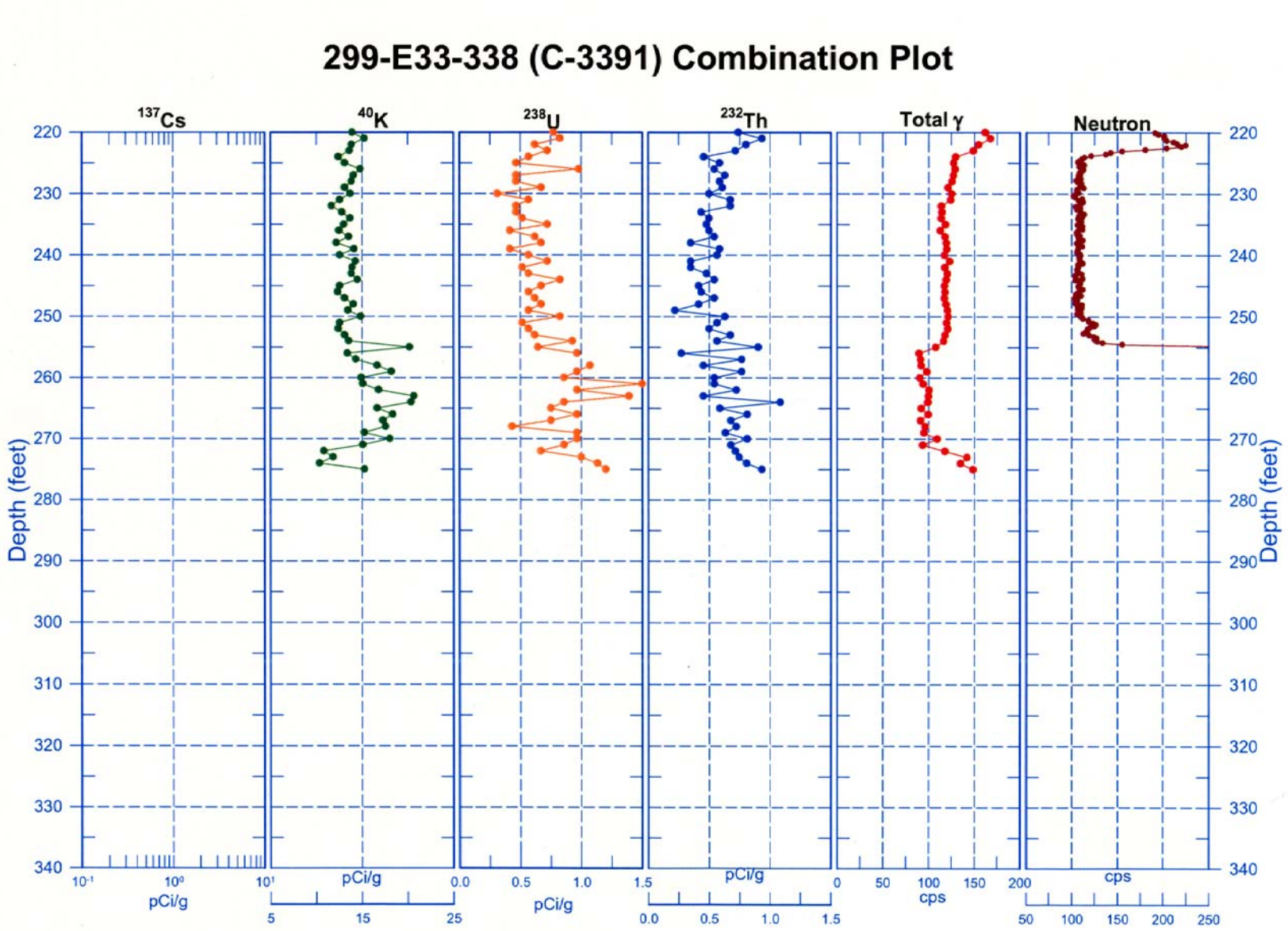
299-E33-338 (C-3391)
Natural Gamma Logs

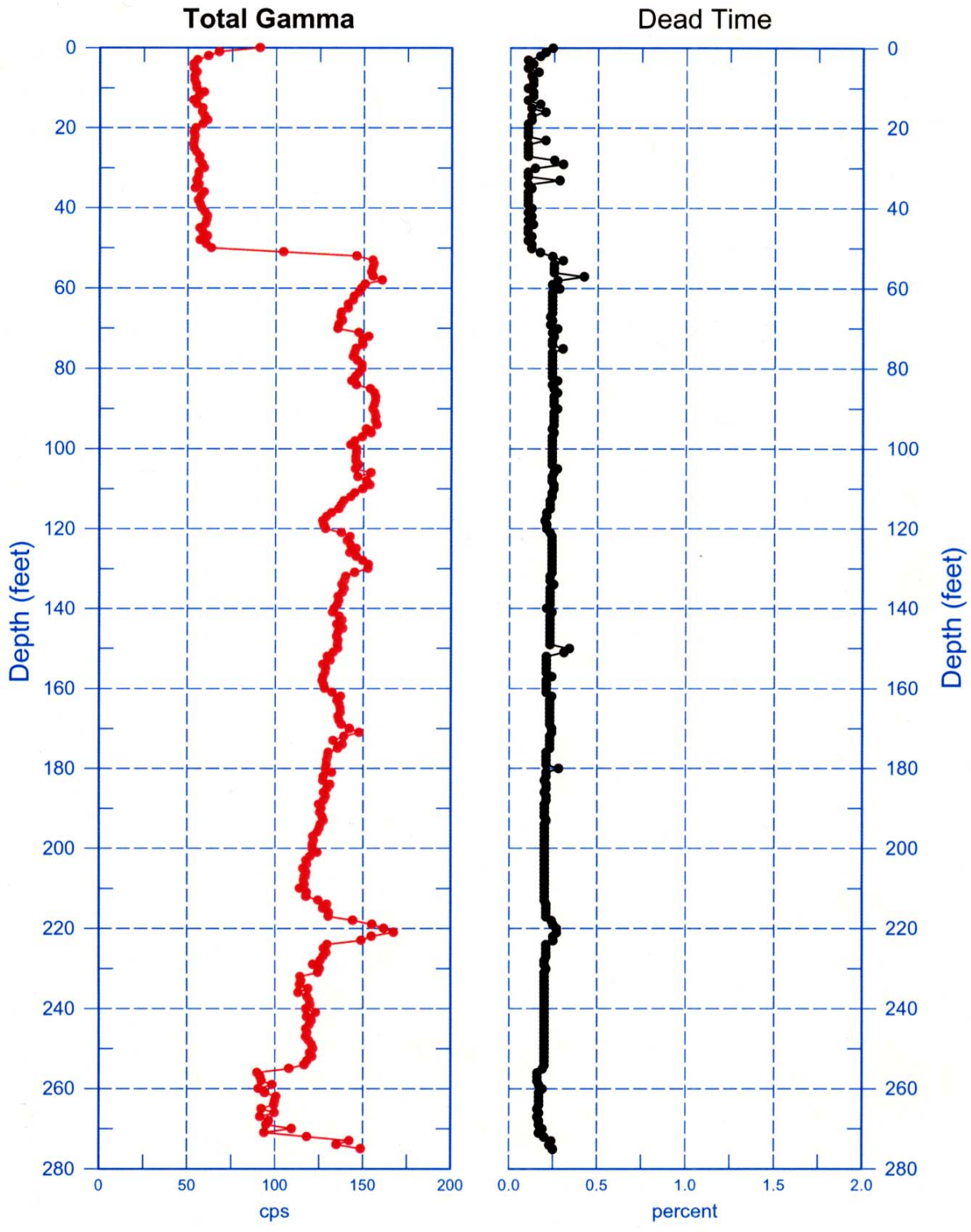



299-E33-338 (C-3391)
Natural Gamma Logs
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Depth (feet)
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
0
10
20
0.0
0.5
1.0
1.5
pCi/g
MDL

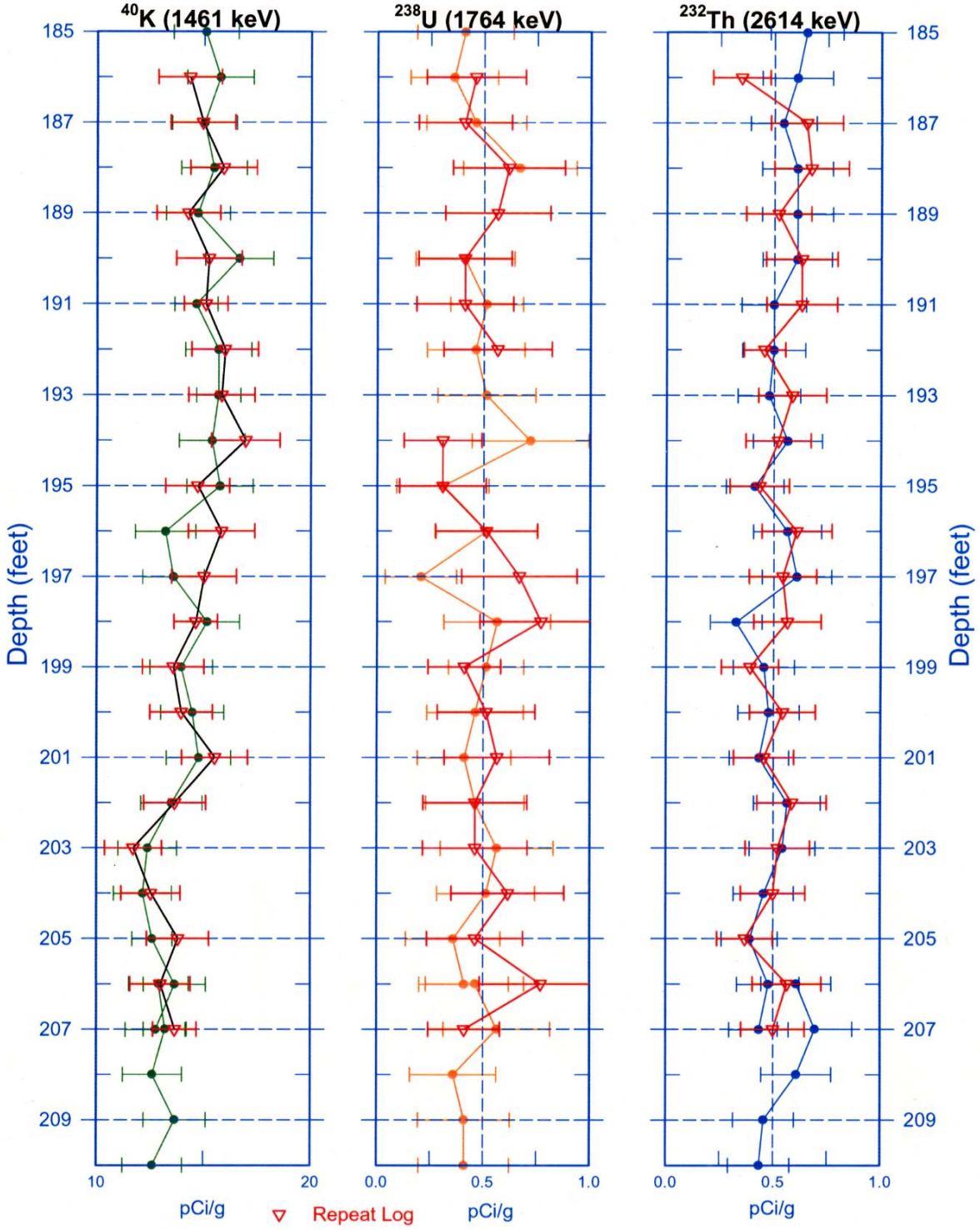

299-E33-338 (C-3391) Combination Plot
137Cs
40K
238U
232Th
Total γ
Neutron
Depth (feet)
pCi/g
cps

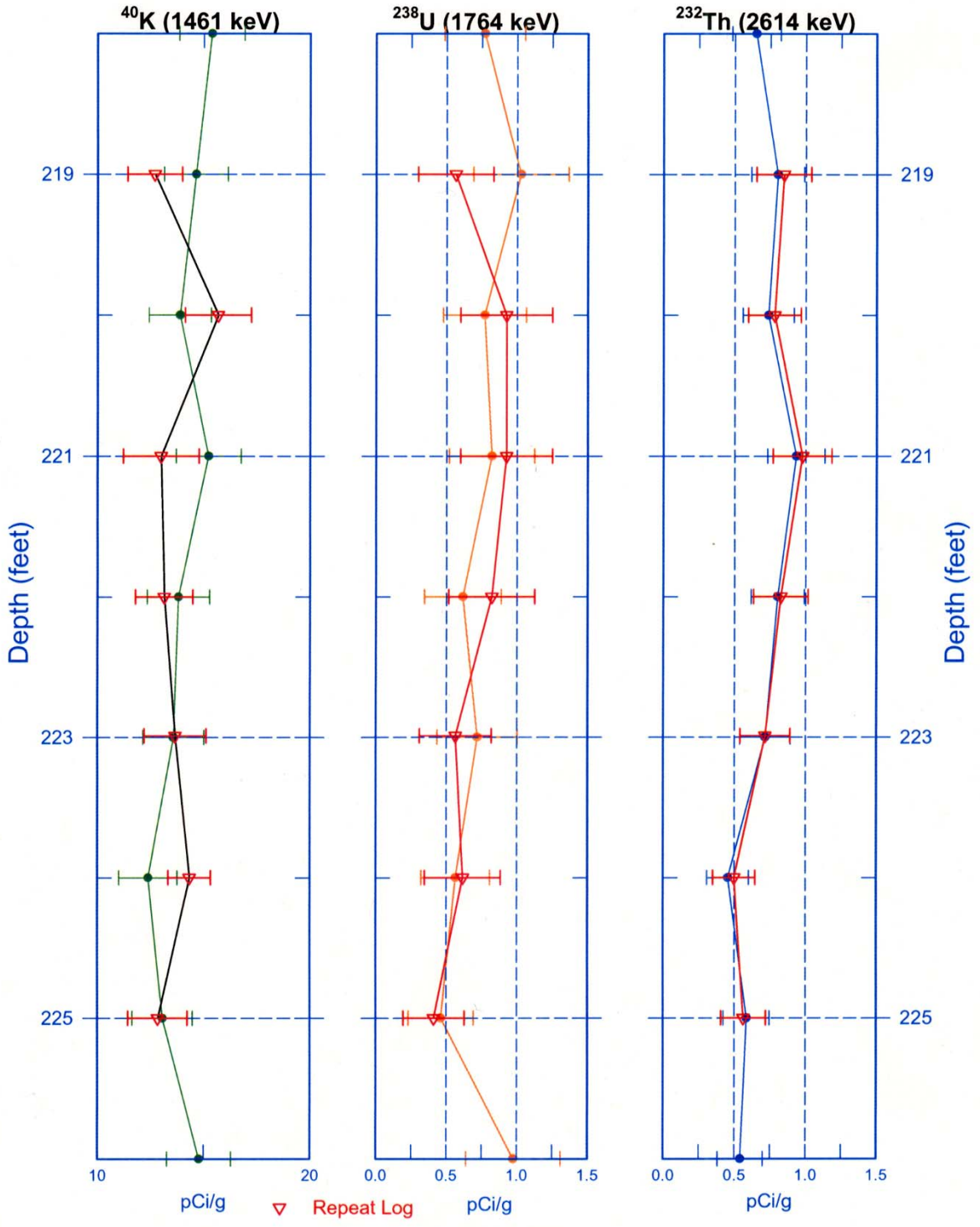

299-E33-338 (C-3391) Combination Plot
137Cs
40K
238U
232Th
Total γ
Neutron
Depth (feet)
pCi/g
cps


299-E33-338 (C-3391) Combination Plot
137Cs
40K
238U
232Th
Total γ
Neutron
Depth (feet)
220
230
240
250
260
270
280
290
300
310
320
330
340
10-1
100
101
pCi/g
5
15
25
0.0
0.5
1.0
1.5
0
50
100
150
200
cps
50
100
150
200
250

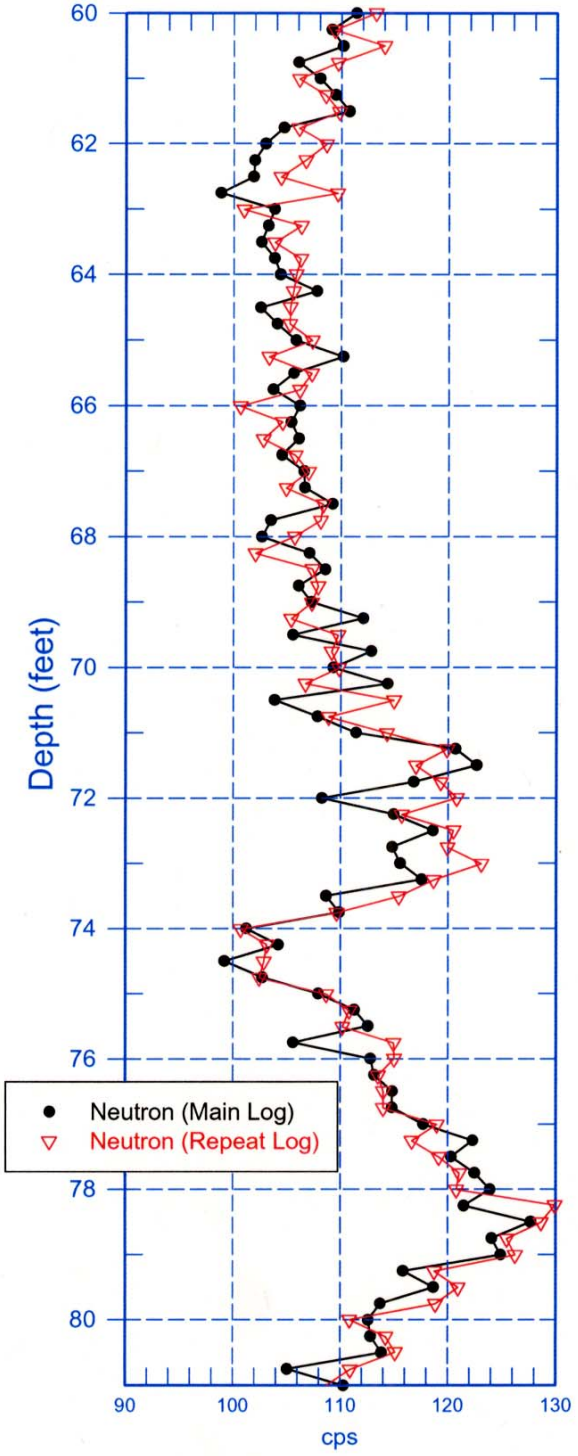

299-E33-338 (C-3391)
Total Gamma
Dead Time
Depth (feet)
Depth (feet)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
0
50
100
150
200
cps
0.0
0.5
1.0
1.5
2.0
percent

299-E33-338 (C-3391)
Natural Gamma Logs (Repeat)




299-E33-338 (C-3391)
Natural Gamma Logs (Repeat)
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Depth (feet)
219
221
223
225
10
20
0.0
0.5
1.0
1.5
pCi/g
Repeat Log

299-E33-338 (C-3391)
Neutron Repeat Section



299-E33-339 (C3392)

Log Data Report

Borehole Information:

Borehole: 299-E33-337 (C3392)		Site: BX Farm Perimeter			
Coordinates		GWL (ft)[1]: ~260		GWL Date: 7/26/01	
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A[3]	N/A	7/19/01	Not available	280.69	

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel-threaded drill pipe	~ 1 in		9 1/4	3/4	0	~281

Borehole Notes:

This is a RCRA groundwater well that was logged through the drill pipe.

Logging Equipment Information:

Logging System: Gamma 2B		Type: SGLS (35%)
Calibration Date:	Calibration Reference:	
	Logging Procedure: MAC-HGLP 1.6.5	

Logging System: RLS 1		Type: Moisture
Calibration Date: 7/11/01	Calibration Reference: RLSM00.0	
	Logging Procedure:	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4/Repeat	
Date	7/27/01	7/30/01	7/31/01	8/01/01	
Logging Engineer	Musial	Musial	Musial	Musial	
Start Depth (ft)	0	54	163	285	
Finish Depth (ft)	55	164	262	233	
Count Time (sec)	200	200	200	200	
Live/Real	L	L	L	L	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	n/a	n/a	n/a	n/a	
Pre-Verification	B00025CAB	B00026CAB	B00027CAB	B00028CAB	
Start File	B0025000	B0026000	B0027000	B0028000	
Finish File	B0025055	B0026110	B0027099	B0028052	
Post Verification	B00025CAA	B00026CAA	B00027CAA	B00028CAA	

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2	3		
Date	7/26/01	7/26/01	7/26/01		
Logging Engineer	Musial/Kos	Musial	Musial		
Start Depth (ft)	0	120	240		
Finish Depth (ft)	120	240	263.25		
Count Time (sec)	n/a	n/a	n/a		
Live/Real	n/a	n/a	n/a		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	0.25	0.25	0.25		
ft/min	1.0	1.0	1.0		
Pre-Verification	C0092CAB	C0092CAB	C0092CAB		
Start File	C009000	C009481	C0010000		
Finish File	C009480	C009961	C0010096		
Post Verification	C0102CAA	C0102CAA	C0102CAA		

Logging Operation Notes:

A longer count time (200 sec) was required with the SGLS because of the relatively thick casing. The borehole was logged in the drill pipe before completion as a groundwater monitoring well. In order to obtain reliable spectra while minimizing overall logging time, the depth interval was increased from 0.5 ft to 1.0 ft.

SGLS log depths are relative to ground level. During logging run 2, a fine gain adjustment occurred at file B0026089 (143 ft) from 2123 to 2126 channels. The hole is open at the end of the drill pipe at 281 ft.

Neutron moisture logs were run on 7/26/01 using the RLS 1, and log depths are relative to ground level. The neutron moisture tool was run centralized. The end of the sonde had about 6 in. of muck on it when brought to surface.

Analysis Notes:

Analyst:	Sobczyk	Date:	08/07/01	Reference:	

Pre-run and post run verification spectra for the SGLS were evaluated. All of the pre-survey verification spectra were within the control limits. The post-survey verification spectrum for logging run 1 (file B00025CAA) was the only post-survey verification spectrum that was outside of the control limits. The peak cps for the 609-keV peak was below the lower control limits for this post run verification spectra. Examinations of spectra indicate that the detector appears to have functioned normally during the log run. Individual spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL. Corrections were applied for a casing thickness of 3/4 in. from the ground surface to 281 ft. No casing correction was applied at 282 to 285 ft. A correction for water in the borehole was applied at and below 262 ft. Dead time corrections were not necessary.

Moisture calibration models at Hanford for 10-in. boreholes with ¾-in. casing have not been established. Thus, the neutron log was not processed to estimate volumetric moisture content because the relatively large borehole diameter and casing thickness are beyond the range of conditions for which the tool was calibrated. Neutron data are presented as gross counts. In general, an increase in neutron count is indicative of an increase in moisture content, but a quantitative calculation of volumetric moisture cannot be made at this time.

There is an apparent cyclic nature to this neutron log, which may be due to the manner in which the borehole was drilled. The period of the cycle appears to be about 12 ft. Water added to the hole during drilling and the use of joint compound at casing connections are potential causes.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K, ^{232}Th, ^{238}U, and associated decay progeny), and man-made radionuclides. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable activity (MDA) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and does not include errors associated with the inverse efficiency function, dead time correction, or casing and water corrections. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. A neutron moisture log of neutron counts is also shown on the combination plot.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide that was detected. ^{137}Cs activity was observed at only one measurement, which was at the ground surface. The measured ^{137}Cs activity is about 0.7 pCi/g.

The changes in gross gamma counts depend primarily upon changes in ^{40}K activities. The increase in gross gamma counts from about 85 cps to about 117 cps at a log depth of 54 ft corresponds with an increase in apparent ^{40}K activity from about 14 pCi/g to 22 pCi/g. Similarly, the increase in gross gamma counts from 106 cps to 130 cps at a log depth of 170 ft corresponds to an increase in ^{40}K activity from about 22 pCi/g to 24 pCi/g as well as an increase in ^{232}Th activity from about 0.8 to 1.4 pCi/g. The increase in gross gamma counts from 90 cps to 150 cps at 244 ft corresponds to an increase in ^{40}K activity from about 16 pCi/g to 22 pCi/g, in ^{232}Th activity from about 0.8 to 1.4 pCi/g, and in ^{238}U activity from about 0.9 to 1.5 pCi/g. These apparent increases in total activity are due to relative decreases in sediment grain size. The apparent decreases in sediment grain size at about 170 ft and at 244 ft correspond with expected increases in neutron cps while the change at 54 ft does not have a corresponding increase in neutron cps. Generally, an increase in neutron counts is expected to occur where an increase gamma ray counts occurs. At a log depth of 54 ft, the increase in total gamma occurs without an increase in neutron counts probably because the spectral gamma ray tool has a deeper radius of investigation than the neutron moisture tool.

The neutron moisture tool's depressed response in this hole is due to the low-activity source, short source-to-detector spacing, and large borehole diameter. The elevated neutron cps that occur at about 170 ft and 244 ft correspond with intervals of relatively high total gamma. These zones are interpreted as layers of finer grained sediments surrounded by coarser sediments. The highest neutron counts occurred in the groundwater as expected. This interval corresponds with a slight drop in total gamma and ^{40}K activity.

The apparent increase in ^{238}U concentration below the groundwater level is interpreted as an indication of dissolved radon (^{222}Rn) in the water. Total gamma counts and count rates for the 1461 keV (^{40}K) and 2615 keV (^{208}Tl / ^{232}Th) gamma lines are observed to decrease below the water level because of increased attenuation as gamma rays pass through the water. Application of the water correction factor compensates for this attenuation. However, count rates for several gamma lines associated with ^{238}U were observed to increase at the groundwater level. These included the 351 keV (^{214}Pb), 609 keV (^{214}Bi), and 1764 keV (^{214}Bi) lines. ^{214}Pb and ^{214}Bi are the eighth and ninth members of a complex decay chain, which begins with ^{238}U and ends with ^{206}Pb. Under normal conditions, members of the decay chain are assumed to be in secular equilibrium, meaning that activities of each member of the chain in proportion to one another. Of the gamma lines emitted by the various ^{238}U decay progeny, those associated with ^{214}Bi and ^{214}Pb are the most prominent, and are commonly used to calculate ^{238}U concentration. In water, the radioactive equilibrium is less likely to be maintained, because Bi and U have differing chemical properties. Therefore, the presence of ^{214}Bi in water is not necessarily an indication of dissolved uranium. However, ^{214}Bi and ^{214}Pb are also decay products of ^{222}Rn, the gaseous member of the decay chain. As a gas, radon is relatively mobile and soluble in water. Establishment of secular equilibrium between ^{214}P, ^{214}Bi, and ^{222}Rn

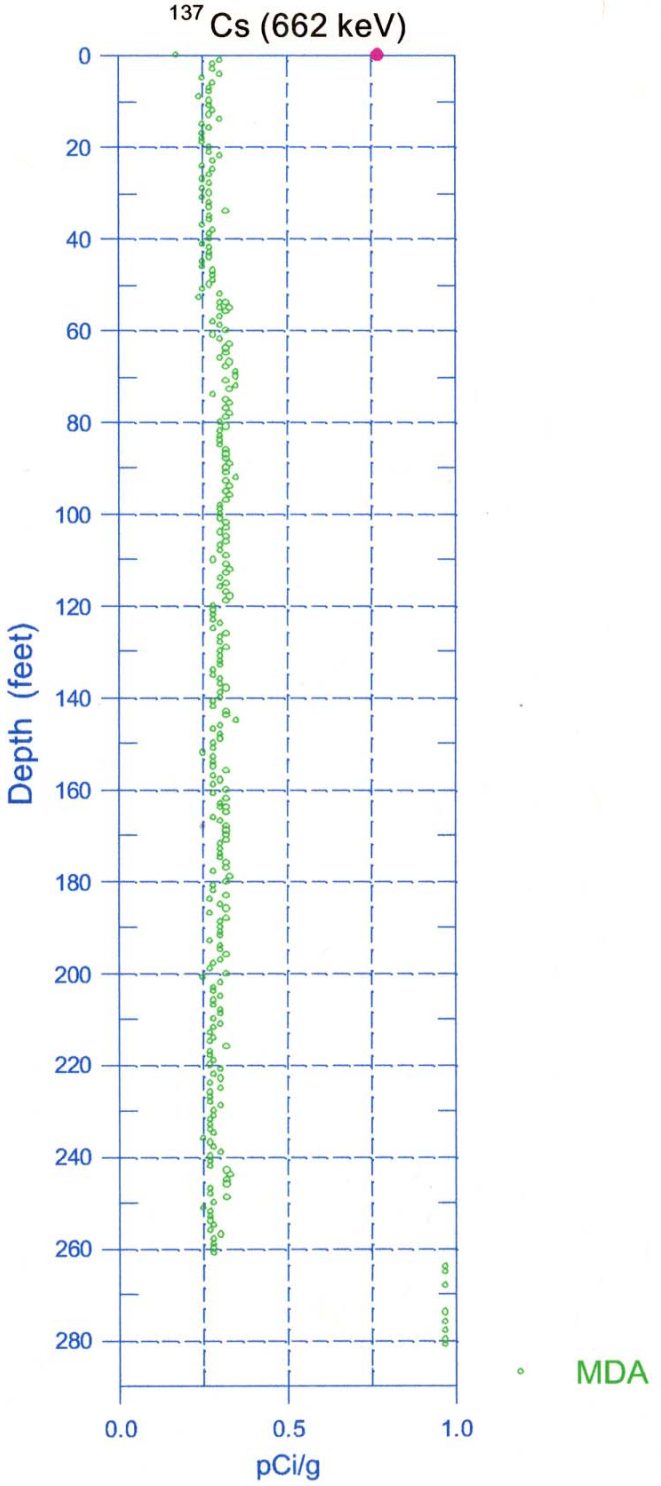
requires only a few hours, and any radon dissolved in the groundwater would also result in increased ^{214}Pb and ^{214}Bi activity.

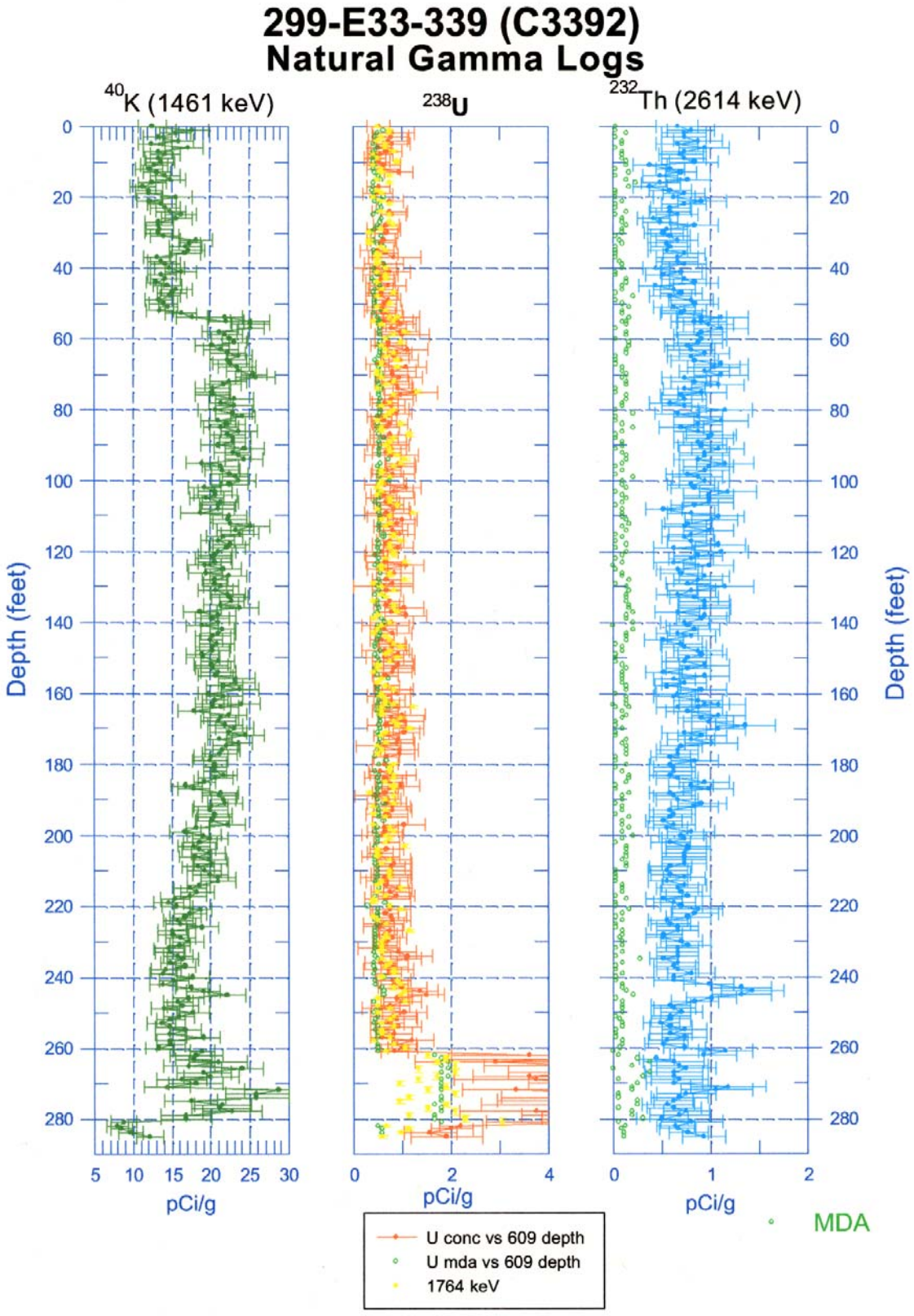
Note that the elevated ^{214}Bi levels observed in the groundwater do <u>not</u> suggest the presence of uranium contamination from a man-made source. Establishment of secular equilibrium between ^{214}Bi and ^{238}U requires a time period on the order of a million years, so the presence of ^{214}Bi is commonly taken as an indication of naturally occurring ^{238}U that has not be subjected to chemical separation. Man-made ^{238}U would be indicated by the presence of the 1001-keV gamma line associated with ^{234m}Pa, with little evidence of the 609- and 1764-keV lines associated with ^{214}Bi. The apparent increase in gross gamma counts at the bottom of the hole (282 ft through 285 ft) occurs because the detector is not being shielded by the drill pipe.

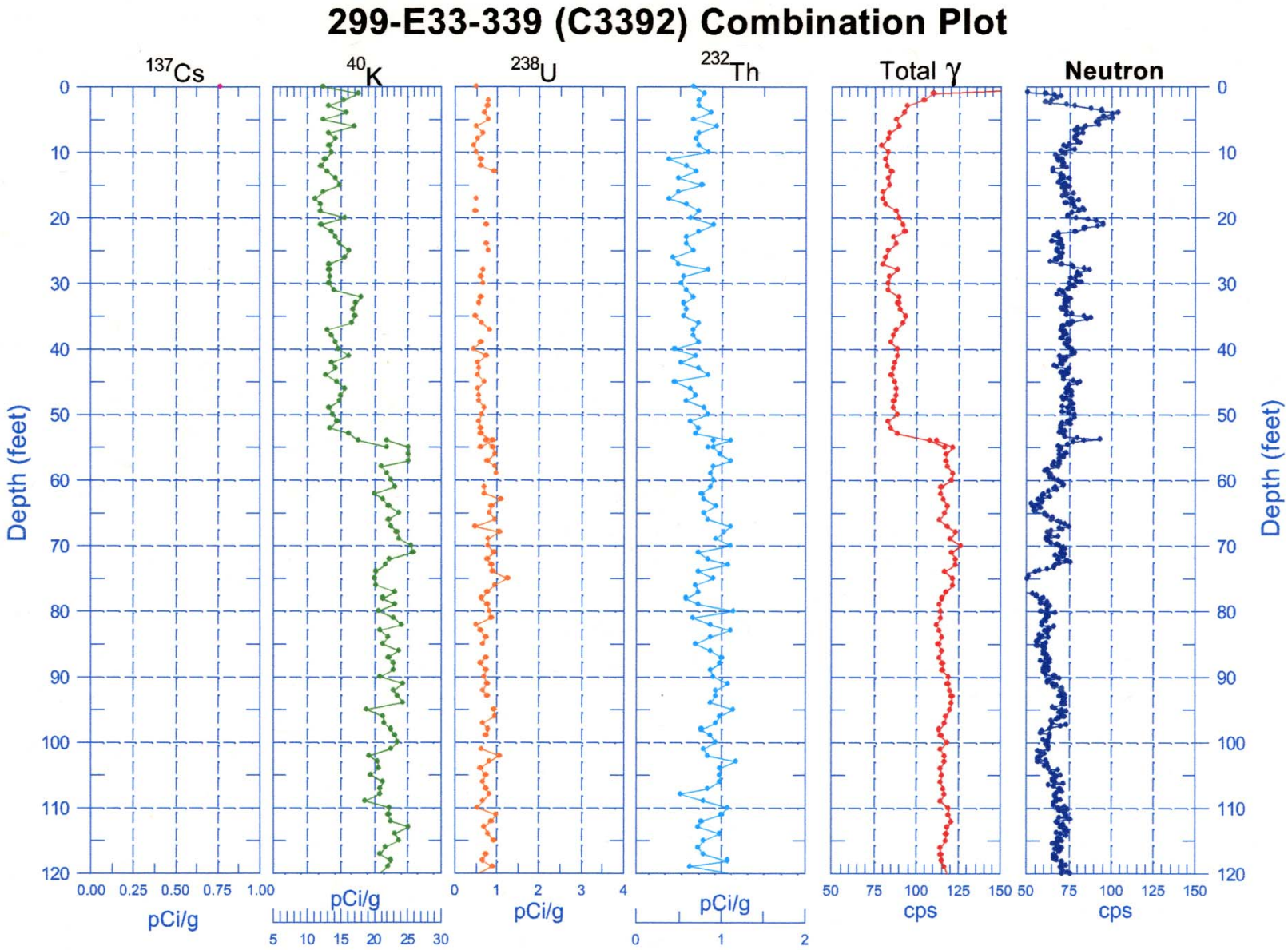
---

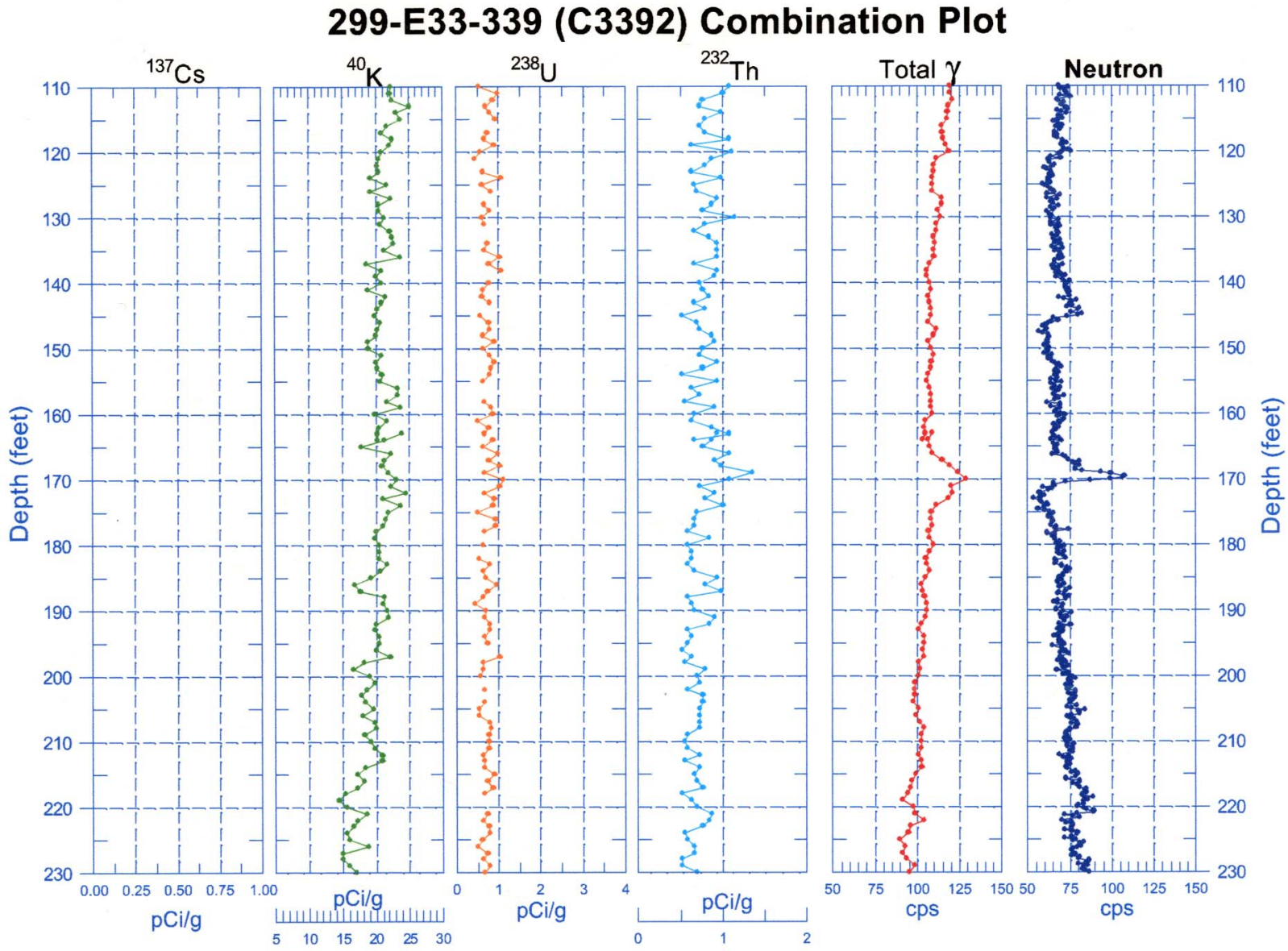
[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not applicable

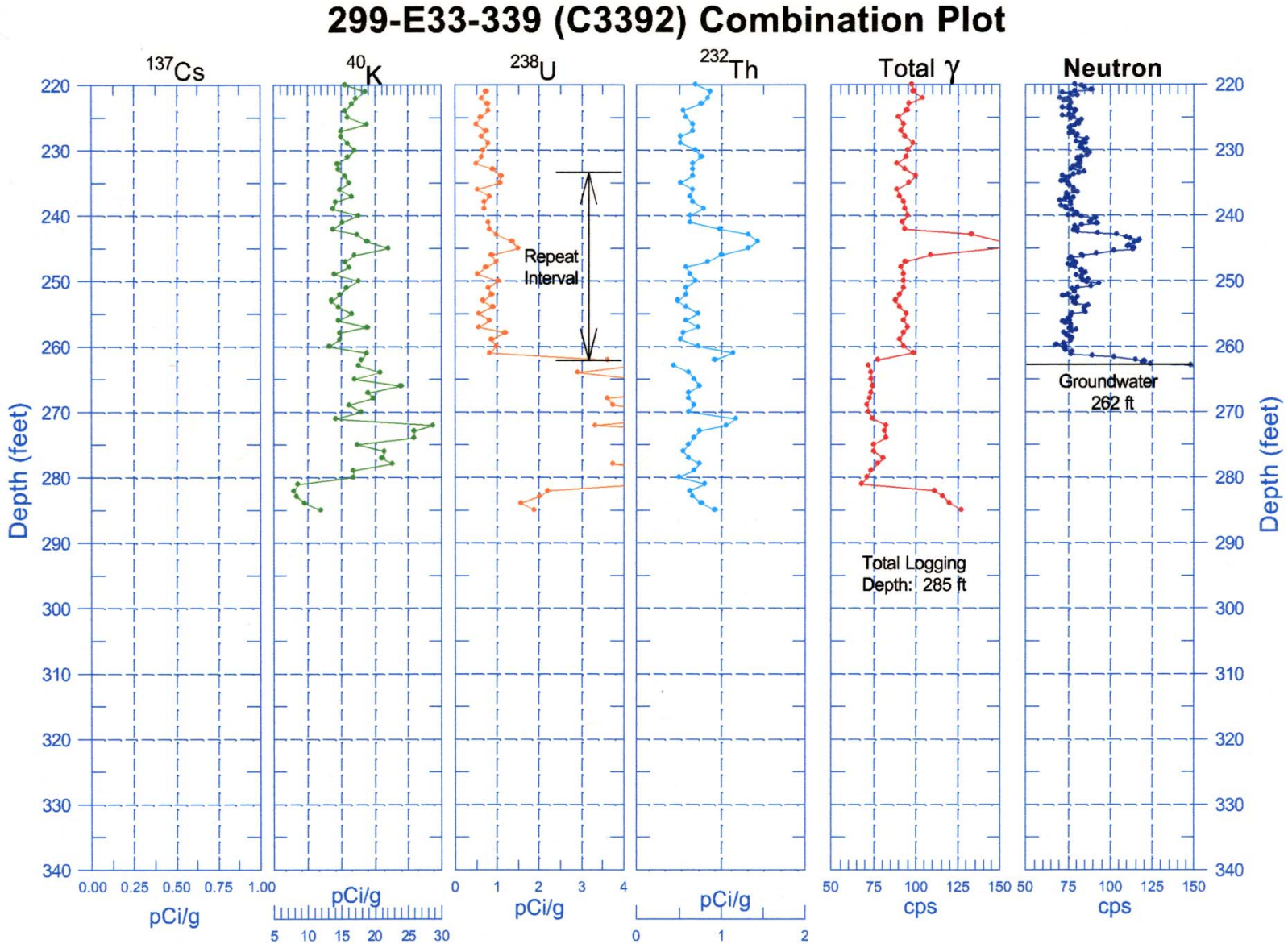
299-E33-339 (C3392)
Man-Made Radionuclide Concentrations

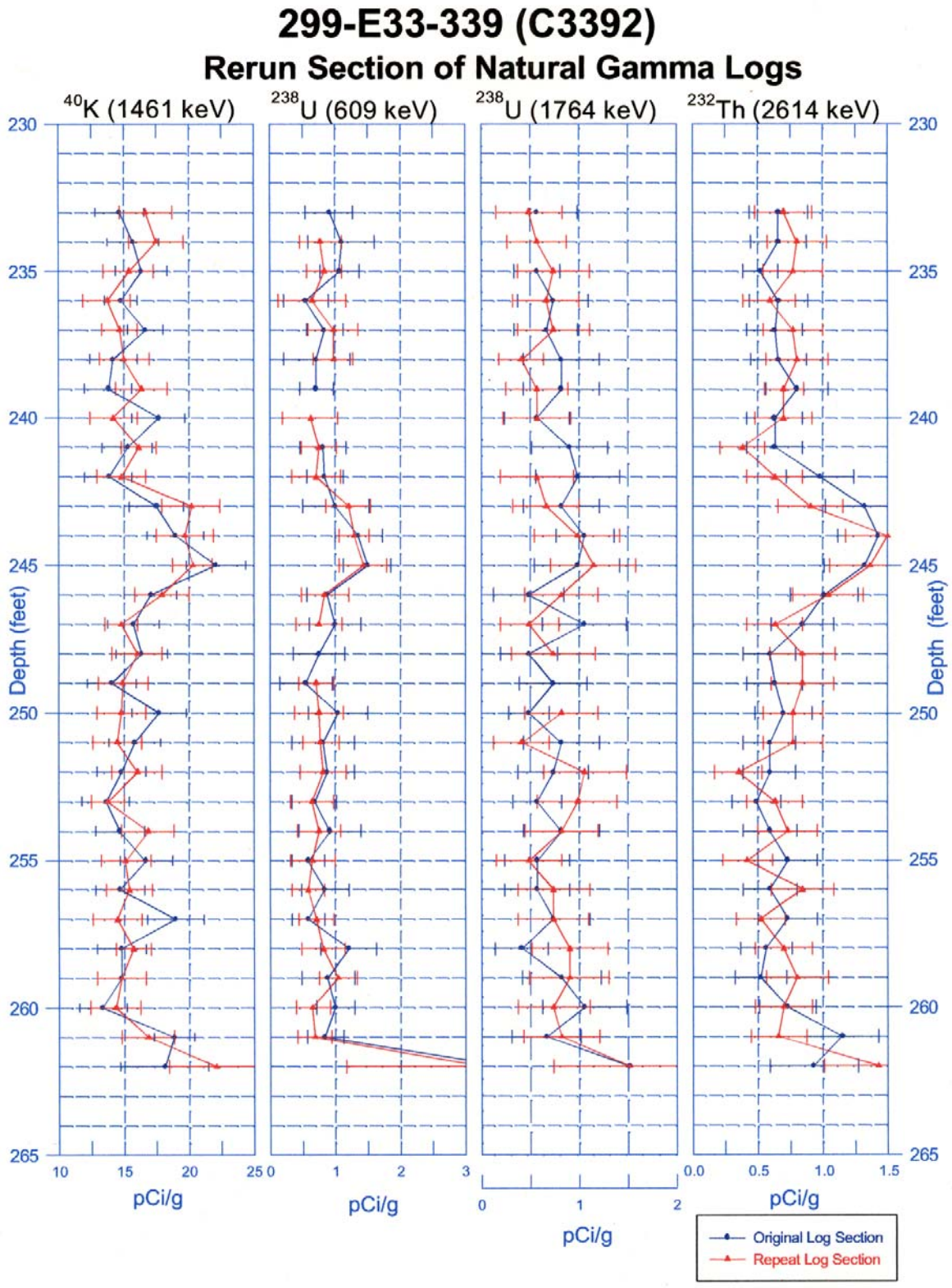



299-E33-339 (C3392)
Natural Gamma Logs
40K (1461 keV)
238U
232Th (2614 keV)
Depth (feet)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
5 10 15 20 25 30
pCi/g
0 2 4
pCi/g
0 1 2
pCi/g
MDA
U conc vs 609 depth
U mda vs 609 depth
1764 keV

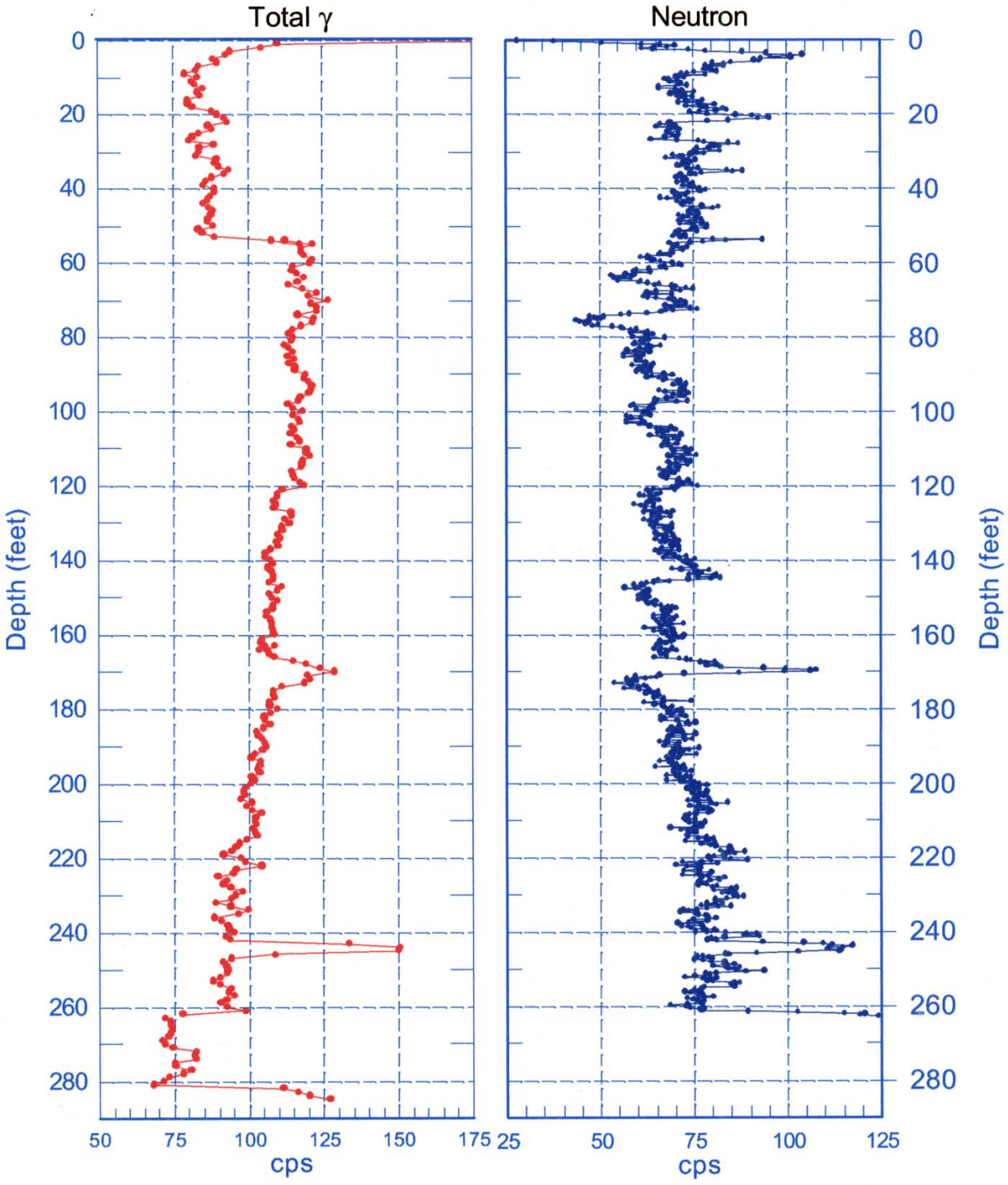

299-E33-339 (C3392) Combination Plot
137Cs
40K
238U
232Th
Total γ
Neutron
Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
0.00 0.25 0.50 0.75 1.00
pCi/g
5 10 15 20 25 30
pCi/g
0 1 2 3 4
pCi/g
0 1 2
pCi/g
50 75 100 125 150
cps
50 75 100 125 150
cps


299-E33-339 (C3392) Combination Plot
137Cs
40K
238U
232Th
Total γ
Neutron
Depth (feet)
110
120
130
140
150
160
170
180
190
200
210
220
230
0.00 0.25 0.50 0.75 1.00
pCi/g
5 10 15 20 25 30
pCi/g
0 1 2 3 4
pCi/g
0 1 2
pCi/g
50 75 100 125 150
cps
50 75 100 125 150
cps


299-E33-339 (C3392) Combination Plot
137Cs
40K
238U
232Th
Total γ
Neutron
Repeat Interval
Groundwater 262 ft
Total Logging Depth: 285 ft
Depth (feet)
pCi/g
cps


299-E33-339 (C3392)
Rerun Section of Natural Gamma Logs
40K (1461 keV)
238U (609 keV)
238U (1764 keV)
232Th (2614 keV)
Depth (feet)
230
235
240
245
250
255
260
265
10
15
20
25
0
1
2
3
0.0
0.5
1.0
1.5
pCi/g
Original Log Section
Repeat Log Section

299-E33-339 (C3392)



Distribution

No. of Copies

OFFSITE

R. Jim
Confederated Tribes and Bands of the Yakama Nation
Environmental Restoration/Waste Management
2808 Main Street
Union Gap, WA 98903

T. Repasky
Confederated Tribes of the Umatilla Indian Reservation
Environmental Planning/Rights Protection
P.O. Box 638
Pendleton, OR 97801

L. Seelatsee
Wanapum Band
Grant County P.U.D.
30 "C" Street S.W.
P.O. Box 878
Ephrata, WA 98823

P. Sobotta
Nez Perce Tribe
Environmental Restoration/Waste Management
P.O. Box 365
Lapwai, ID 83540-0365

ONSITE

3 **DOE Richland Operations Office**

M. J. Furman (2)	A5-13
R. M. Yasek	H6-60

No. of Copies

3 **CH2M HILL Hanford Group, Inc.**

A. J. Knepp (2)	H0-22
D. A. Myers	H0-22

2 **CH2M HILL Hanford, Inc.**

J. V. Borghese	H9-03
D. C. Weekes	H9-02

U.S. Environmental Protection Agency

D. A. Faulk	B5-01

4 **Washington State Department of Ecology**

M. Brown	B5-18
J. A. Caggiano	B5-18
D. Goswami	B5-18
A. D. Huckaby	B5-18

15 **Pacific Northwest National Laboratory**

E. P. Dresel	K9-96
D. G. Horton (3)	K6-81
V. G. Johnson	K6-96
S. P. Luttrell	K6-96
W. J. Martin	K6-81
S. M. Narbutovskih (3)	K6-96
F. A. Spane	K6-96
D. Vela	K6-96
B. A. Williams	K6-81
Hanford Technical Library (2)	P8-55