PNNL-13830

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

Borehole Data Package for Calendar Year 2001 RCRA Well Installation at Single-Shell Tank Waste Management Area T

D. G. Horton

March 2002

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

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Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

This report details the installation of well 299-W10-28 that was installed as a Resource Conservation and Recovery Act groundwater monitoring well at Waste Management Area T in September and October 2001. Along with a description of the drilling and sampling, well completion, well development and pump installation are three appendices. Appendix A contains the Well Summary Sheet, Well Construction Summary Report, and the geologists log. Appendix B contains data on the physical and chemical properties of the sediments and groundwater. Appendix C contains the borehole geophysical logs.

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1.0 Introduction

Well 299-W10-28 (C3400) was installed at the single-shell tank farm Waste Management Area (WMA) T in September and October 2001. The well was installed as a Resource Conservation and Recovery Act (RCRA) groundwater monitoring well in partial fulfillment of Tri-Party Agreement (Ecology et al. 1998) milestone M-24-00M. Well 299-W10-28 is located on the west side of 241-T tank farm between the 216-T-5 trench and the tank farm fence. The well is an upgradient well in the monitoring network that replaces the non-standard RCRA well 299-W10-1. The locations of all wells in the WMA T monitoring network are shown on Figure 1.

The original assessment monitoring plan for WMA T was issued in 1993 (Caggiano and Chou 1993). That plan was updated for the continued assessment at WMA T in 2001 (Hodges and Chou 2001). The updated plan provides justification for the new wells. 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 T (Hodges and Chou 2001), and the description of work for well drilling and construction.[1]

This document compiles information on the drilling and construction, well development, pump installation, and sediment and groundwater sampling applicable to the installation of well 299-W10-28. Appendix A contains the Well Summary Sheet (as-built diagram), the Well Construction Summary Report, and the geologist's log; Appendix B contains physical and chemical properties data; and Appendix C contains the 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 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 meters
- 1 inch (in.) = 2.54 centimeters
- 1 gallon (gal) = 3.785 liters

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

2.0 Well 299-W10-28

2.1 Drilling and Sampling

Well 299-W10-28 was drilled with a cable tool drill rig and drive barrel between 0 and 175 ft below ground surface (bgs) and by hard tool from 175 ft to a total depth of 280 ft bgs. Temporary 11-¾-in.-outside-diameter, carbon steel casing was placed from the surface to 109.8 ft bgs and 8-⅝-in.-outside-diameter

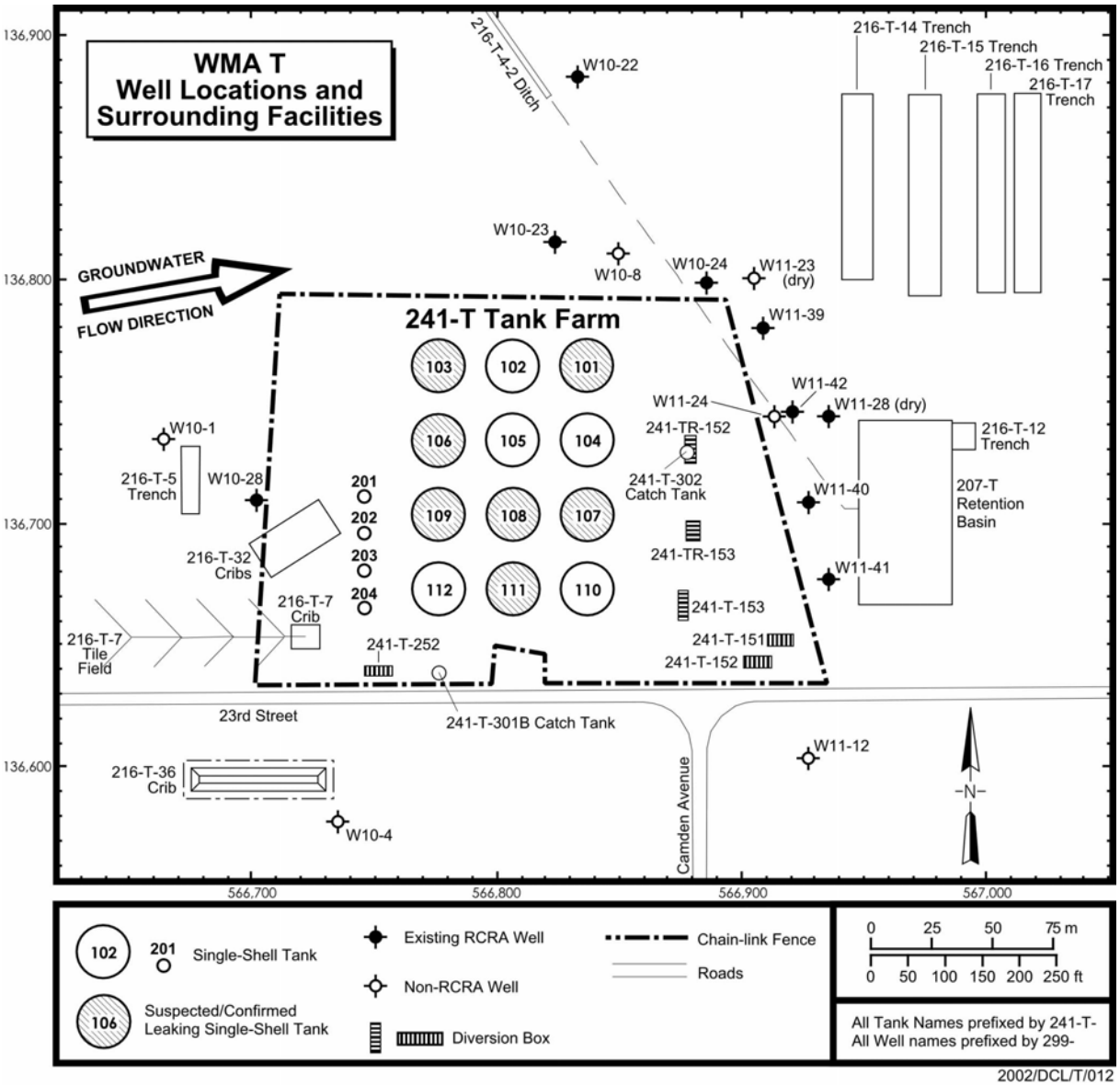

Figure 1. Map of Waste Management Area T and Locations of Wells in the Groundwater Monitoring Network

casing from 0 to 278.4 ft bgs. About 175 gal of water were added to the borehole during hard tool drilling. Also, about 30 gal of water were add during the initial stages of well construction to rinse bentonite, used as a plug in the bottom of the borehole, from the inside of the casing.

Sediments encountered during drilling were the Hanford formation, the Plio-Pleistocene Unit and the Ringold Formation. The uppermost sediments from the surface to ~78 ft bgs were predominantly sandy gravel and sand with lesser amounts of silty sandy gravel of the Hanford formation. These were underlain from 79 to 110 ft bgs by Plio-Pleistocene Unit sand and sandy silt and caliche. Undifferenciated Plio-Pleistocene/Upper Ringold Formation sandy silt and sand exists from a depth of 110 to 128 ft. Silty sandy gravel, silty sand and gravelly sand of the Ringold Formation Unit E occurs from 128 ft to total depth of 280 ft bgs. The geologists log is included in Appendix A.

Grab samples for geologic description and archive were collected every 5 ft from the surface to total depth. Also, two split spoon samples were collected at 228 to 230 ft bgs and at 262 to 264.5 ft bgs for analysis of particle size distribution. The particle size distribution data are in Appendix B.

Two groundwater samples were collected during drilling. The samples were air lifted slurries of cuttings and water obtained during air rotary drilling. One sample was from the water table (252 ft bgs) and the other from total depth (280 ft bgs). The samples were analyzed at the Applied Geology and Geochemistry Laboratories at Pacific Northwest National Laboratory for anions, metals, specific conductance, and technetium-99. All available results are included in Appendix B.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No contamination was noted. The borehole was geophysically logged with spectral gamma and moisture tools on September 29 and October 1, 2001. No manmade radionuclides were detected. The responses in the moisture log below 175 ft depth probably reflects water added to the borehole during hard tool drilling. The borehole logs are in Appendix C.

2.2 Well Completion

The permanent casing and screen were installed in well 299-W10-28 during October 2001. A 4-in.-inner-diameter, stainless steel, wire wrap (0.020 in. slot) screen was set from 225.19 to 260.19 ft bgs. The permanent casing is 4-in.-inner-diameter stainless steel from 225.19 ft bgs to 2.0 ft above ground surface. There is a 2-ft stainless steel sump below the screen from 262.19 to 260.19 ft.

The borehole was backfilled with sand from 280.0 ft to 275 ft bgs and bentonite from 275.0 to 271.6 ft bgs. The filter pack is 10 to 20 mesh silica sand from 271.6 to 215.2 ft bgs. The annular seal is ⅜-in. bentonite pellets from 215.2 to 209.4 ft bgs, bentonite crumbles from 209.4 to 10.3 ft bgs, and Portland cement from 10.3 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 is 2.38 ft above ground surface. The Well Summary Sheet (as-built) and Well Construction Summary Sheet 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 bench marks established by the U.S. Army Corps of Engineers. Survey data are included in Table 1. A copy of the survey data sheet is in Appendix A.

Table 1. Survey Data for Well 299-W10-28 at Waste Management Area T

Well Name	Easting (m)	Northing (m)	Elevation (m)	Reference Point
299-W10-28	566701.55	136709.93		Center of Casing
			206.826	"X" on Rim of Casing
	566701.57	136710.24	206.100	Brass Cap

2.3 Well Development and Pump Installation

Well 299-W10-28 was developed in October 2001. A temporary, 3-hp, submersible pump was used to remove ~3,020 gal of formation water. First, ~2,300 gal of water were pumped from the well at 14 to 30 gal/min with 0.43 ft of drawdown. The pump intake was at 258.5 ft bgs (about 33.0 ft below the water table). Next, the pump was raised about 17 ft to 241.5 ft bgs and 720 gal were removed at 30 gal/min with 0.56 ft of drawdown. The final turbidity was 0.76 NTU.

A dedicated Redi-Flo 2 sampling pump was installed in well 299-W10-28 in October 2001. The sampling pump intake is at 233.82 ft bgs or 8.45 ft below the water table. The depth to water was measured at 225.51 ft bgs on October 17, 2001.

3.0 References

Caggiano, J. A. and C. J. Chou. 1993. *Interim-Status Groundwater Quality Assessment Plan for the Single Shell Tank Waste Management Areas T and TX-TY.* WHC-SD-EN-AP-132, Rev. 0, 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.

Hodges, F. N. and C. J. Chou. 2001. *RCRA Assessment Plan for Single-Shell Tank Waste Management Area T at the Hanford Site.* PNNL-12057, 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: 9-10-01	Finish Date: ~~9-29~~ 10-17-01
Page 1 of 1	

Specification No.: P200X-SP-V0004	Rev. No.: 0	Well Name: 299-W10-28
		~~Temp.~~ Perm. Well No.: C3400
ECNs: NA	Start card # R037816	Approximate Location: west side of 241-T Tank Farm
Project: CY01 RCRA Drilling		Other Companies: BHI, CHI
Drilling Company: Resonant Sonic Inc.		Geologist(s): L. Walker, D.C. Weekes, S.M. Faurote, C. Martinez, JOHN M. WIMETT, D.J. Watson, S. Hocking, R.F Raidl, C. Price
Driller: G. Howell Lic. #1930		

TEMPORARY CASING AND DRILL DEPTH

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.
11 3/4"OD/10 3/4"ID CS FJ	0' - 109.8	12"/10 3/4"
8 5/8"OD/7 5/8"ID CS FJ	0' - 278.4'	
	-	
	-	
	-	

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

DRILLING METHOD/HOLE DIAMETER

Method	Diameter
Auger:	Diameter From ____ to ____
Cable Tool: Drive barrel 9"	Diameter From 0' to 111'
Air Rotary:	Diameter From ____ to ____
A.R. w/Sonic:	Diameter From ____ to ____
Cable tool drivebarrel 7"	Diameter From 111' to 175'
Cable tool hard tool 7.5"	Diameter From 175' to 280'
	Diameter From ____ to ____

Drilling Fluid: N/A

Total Drilled Depth: 280.0'	Hole Dia @ TD: 9"	Total Amt. Of Water Added During Drilling:
Well Straightness Test Results: DONE W/20.4' x 8.5" OD TOOL		Static Water Level: ~~232.21~~ 226.51 Date: ~~9/28/01~~ 10/17/01

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
Spectral Gamma	0' - 277'	10/01/01		-	
Neutron Moisture	0' - 198'	09/29/01		-	
	-			-	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
				SAND FILL	275.0'-280.0	2.5 bags	
4" ID SS304L TAIL PIPE	260.19'-262.19'	F480	N/A	BENTONITE HOLE PLUG (50# buck)	271.6'-275.0'	2 buck.	3/8"
4" ID SS304L SCREEN	225.19'-260.19'	F480	0.020"	COLORADO SILICA SAND (50# bag)	215.2'-271.6'	~~48~~ 57.5 bags	10-20
4" ID SS304L CASING	+2.00'-225.19'	F480	N/A	BENTONITE PELLETS (50# bucket)	209.4'-215.2'	3 buck	3/8"
	-			BENTONITE CRUMBLES (50# bag)	10.3'-209.4'	129.5 bag	N/A
	-			PORTLAND CEMENT (94# bag)	0'-10.3'	9 bags	N/A

OTHER ACTIVITIES

Aquifer Test: WELL DEVELOPMENT	Date: 10-17-01	Well Abandoned:	Yes:	No:	Date:
Description: USING 3 H.P. SUBMERSIBLE PUMP WITH INTAKE SET @ 258.5' bgs 1ST STAGE & 241.5' bgs 2ND STG. PUMP WTR FOR ~~225~~ 235/24 MIN. @ 30 gpm W/0.479' 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 = ~~4.24~~ 1.24 ft.³; 10-20 SILICA SAND => 57.5 bags x 0.535 ft³/bag = ~~25.68~~ 30.76 ft³; BENTONITE PELLETS => 0.62 ft³ buck x 3 = 1.86 ft³; BENT. CRUMBLES => 0.69 ft³ bag x 129.5 = 89.36 ft³;

Reported By: JOHN M. WIMETT		Reviewed By: Charlene Martinez	
Title: GEOTECH	Date: 10-18-01	Title: Geologist	Date: 11/05/01
Signature: [signature]		Signature: Charlene Martinez	

JMW VOLUME: PORTLAND CEMENT = 1.285 ft³ bag x 9 bags = 11.57 ft³ CEMENT.
Sand fill: 2.5 bags * 0.535 ft³/bag = 1.34 ft³

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WELL SUMMARY SHEET

Date: 10/19/01

Well ID: C3400	Well Name: 299-W10-28
Location: WEST OF 241-T TANKFARM-200W	Project: CY01 RCRA DRILLING
Prepared By: JOHN M. WIMETT Date: 10/19/01	Reviewed By: DC Weekes Date: 10/24/01
Signature: J. M. Wimett	Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram
6" ID PROTECTIVE CASING SET ABOVE STAINLESS CASING	
4" ID SS304L CASING: +2.0' → 225.19'	
PORTLAND CEMENT GROUT: 0' → 10.3'	
GRANULAR BENTONITE: 10.3' → 209.4'	
4" ID SS304L 0.020" SLOT CONT. WIREWRAP WELL SCREEN: 225.19' → 260.19'	
3/8" BENTONITE PELLETS: 209.4' → 215.3'	
10-20 MESH SILICA SAND: 215.3' → 271.6'	
4" ID SS304L TAILPIPE: 260.19' → 262.19'	
3/8" BENTONITE HOLE PLUG: 271.6' → 273.9'	
10-20 MESH SAND FILL: 273.9' → 278.3'	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0'-3' SILTY SANDY GRAVEL (msG)
		3'-14' SAND (S)
		14'-24' SANDY GRAVEL (sG)
		24'-27.5' SAND (S)
		27.5'-50' SANDY GRAVEL (sG)
40		
		50'-79.9' SAND (S)
80		79.9'-84.5' SILT & SAND
		84.5'-87' SAND (S)
		87'-96.5' SANDY SILT (sM)
		96.5'-101' CALICHE
		101'-103' SILTY SAND (mS)
120		103'-112' CALICHE
		112'-114' SANDY SILT (sM)
		114'-121' SAND (S) (OCCASIONAL) W/SILT LENSE
		121'-129' SANDY SILT (sM)
		129'-131' SILTY SANDY GRAVEL (msG)
160		131'-142' GRAVELLY SANDY SILT (gsM)
		142'-173' SILTY SANDY GRAVEL (msG)
		173'-274' SILTY SANDY GRAVEL (msG) (MORE CEMENTED THAN ABOVE)
200		
209.4'		
215.3'		
▽		Water level 225.51' (10/17/01)
		Top of screen = 225.19'
		NOT TO SCALE

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WELL SUMMARY SHEET

Page 2 of 2

Date: 10/19/01

Well ID: C3400	Well Name: 299-W10-28
Location: WEST OF 241-T TANK FARM, 200-WEST	Project: CY01 RCRA DRILLING
Prepared By: JOHN M. WIMETT Date: 10/19/01	Reviewed By: DC Weekes Date: 10/24/01
Signature: JMW	Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram
NOTE: ALL TEMP. CASING REMOVED FROM GROUND. ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE.	
Note: 10-20 mesh sand from 273.9'→278.3', bentonite hole plug from 271.6' to 273.9', and 10-20 mesh sand from 215.3' to 271.6'. There is slough from 278.3' to 280'. DCW 10/24/01	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
240		
262.19'		
		274' - 274.5' SILTY SAND (mS)
280		274.5' - 280' GRAVELLY SAND (gS)
		TD = 280' bgs.
320		
		NOT TO SCALE

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:** 200W

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
HSWB-037 & GPS31

Vertical Control Monuments:
HSWB-037

Well Name	Well ID	Easting	Northing	Elevation	
299-W10-028	C3400	566701.55	136709.93		Center of Casing
				206.826	"X" on Rim
		566701.57	136710.24	206.100	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: 9-10-01

Well ID: C3400 | Well Name: 299-W10-28 | Location: West side of 241-T tank Farm 200 W
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	Drive barrel	NA		0→3': Silty Sandy GRAVEL (msG) surface construction fill. 40% Gravel, 45-50% Sand, 10-15% Silt. 2.5Y6/2 (lt. brownish gray), dry; poorly sorted; gravel R-SR, tr caliche on gravel	Cable tool, drive barrel; Casing 11¾" OD / 10¾" ID
5	Archive				5': Grab sample for archive α,β,γ at background levels
				3'→14': SAND (S) 100% Sand, tr gravel, tr silt. Predom Fn-v.Fn at 5', grading to predom cse by 10 to 11 feet. 10YR5/2 (grayish brown) moist, mod-well sorted, SA; 30-40% basalt, 60-70% qtz/Feld. tr gravel (med peb, R) near 10' bgs, weak rxn HCl	
10	Archive				10': Archive grab α,β,γ: background
15	Archive				15': Archive grab α,β,γ: background
				14'→24': Sandy GRAVEL (sG) 75% Gravel, 25% Sand, tr silt 5% sm. cob, 40% v.cse-cse peb, 40% med peb, 15% fn-v.fn peb. Sand predom med-cse 10YR4/2 (dk. grayish brown) moist, poorly sorted; gravel SR-R, sand SA 60% basalt, 40% granitic/qtzite common caliche coating on gravel	
20	Archive				20': Archive α,β,γ: background
25	Archive			18'→20': tr large cobbles - Sharp contact -	25': Archive grab α,β,γ: background
				24'→27.5': SAND (S) 100% sand, Fn-v.Fn. 10YR4/2 (dk. grey brown), moist, well sorted, SA, 30% basalt 70% qtz/feld. tr mica; no rxn HCl	OVM/LEL < detect.

Reported By: L.D. Walker | Title: Geologist | Signature: L.D. Walker | Date: 9-10-01
Reviewed By: Charlene Martinez | Title: Geologist | Signature: Charlene Martinez | Date: 11/05/01

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BOREHOLE LOG

Page 2 of 10
Date: 9-10-01

Well ID: C3400 | Well Name: 299-W10-28 | Location: W. side 241-T tank Farm/200W
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	NA		27.5' → 59' : Sandy GRAVEL (sG)	Cable tool, drive
	Drive barrel			70% Gravel, 25% Sand, 5% silt.	barrel; Casing
				Gravel 5-10% cobble, 35-40% v.cse-cse peb; 55% med-v.fn. Sand v.cse-cse; 10YR3/2 (v. dark grayish brown)	11¾" OD/10¼" ID
35	Archive			moist; poorly sorted; gravel R-SR; Sand SA; tr mica, tr caliche coating on gravel; occ. weak to strong HCl rxn	30': Grab sample for archive α, β, γ: background
				35': silt decrease to tr	35': Archive grab α, β, γ: background
40	Archive			tr iron oxide staining	40': Archive grab α, β, γ: background OVM/LEL < detect
				50% Gravel, 50% Sand, tr silt otherwise as above	
45	Archive				45': Archive grab α, β, γ: background
				Sandy GRAVEL (sG) similar to above; but gravel increase to ~ 60%; 35% Sand, 5% silt	50': Archive grab α, β, γ: background
50	Archive				
					55': Archive grab α, β, γ: background
55	Archive			Silt content increasing to 5-10%	
				59': SAND (S) see next page	

Reported By: L.D. Walker | Reviewed By: Charlene Martinez
Title: Geologist | Title: Geologist
Signature: L.D. Walker | Date: 9-11-01 | Signature: Charlene Martinez | Date: 11/05/01

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BOREHOLE LOG

Page 3 of 10
Date: 9-11-01

Well ID: C3400 | Well Name: 299-W10-28 | Location: W. side 241-T tank farm / 200W
Project: CY'01 RCRA Drilling | Reference Measuring Point: Grounel 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	NA		59' → 79.9': SAND (S)	Cable tool, drive
				tr-5% gravel, 95-100% sand	barrel; Carbon
				Gravel med-v. Fn peb; Sand 20% v. cse,	steel casing
	Drive barrel			~~50%~~ 40% cse, 20% med, 10% Fn-v. Fn.	11¾"/10¼"
				10YR5/2 (grayish brown) moist; mod sorted,	
65	Archive			Ang-SA; 40% basalt, 60% qtz/Feld/other	60': Grab sample
				lithic Fragments; max size ~ 1 cm	for archive
				weak rxn to HCl	α, β, γ: background
					65': Archive grab
70	Archive			Sand - similar to above.	α, β, γ: background
				predom cse-med (sl. Finer than above)	
				tr mica	70': Archive grab
					α, β, γ: background
				tr iron oxide staining	
75	Archive				75': Archive grab
					α, β, γ: background
				79.5' → 84.5': Silt and Sand	
				79.5': Silt layers within sand.	80': Archive grab
80	Archive			10YR5/3 (brown) sl moist, strong	α, β, γ: background
				rxn HCl. Sand is med-cse	OVM/LEL detect.
				Cse sand zone by 82'	
				82' → 84.5': Sandy Silt	
				84.5' → 87': SAND (S)	85': Archive grab
85	Archive			100% Sand, tr silt, med-cse,	α, β, γ: background
				10YR6/4 (lt. yel. brown) sl moist,	* 79.5': Prob. top
				well sorted, SA-A; 30% basalt, 70% qtz/	of upper Plio-Pleist/
				other, tr mica; mod-strong rxn HCl	early Palouse Soil
				87': Sandy SILT (SM)	

Reported By: L. D. Walker | Reviewed By: Charlene Martinez
Title: Geologist | Title: Geologist
Signature: L D Walker | Date: 9-11-01 | Signature: Charlene Martinez | Date: 11/05/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 4 of 10
Date: 9-12-01

Well ID: C 3400 | Well Name: 299-W10-28 | Location: W. side 241-T tank farm / 200 W
Project: CY 01 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			87'→96.5': Sandy SILT (sM)	Cable tool w/ drive
	Drive barrel	LW		40% Sand, 60% Silt. Sand is v. Fn	barrel; Casing
				10YR5/3 (brown) sl moist, well sorted,	11 3/4" OD / 10 1/4" ID
				SA-SR sand, predom qtz/Feld;	
		NA		Strong rxn HCl	90': Grab sample
95	Archive				for Archive
				Silt with v. Fn sand - as above	α, β, γ: background
				96.5': Fragments of massive caliche	
				silt, sand, v. Fn pebbles in pale	95': Archive sample
				brown cement. very strong HCl rxn	α, β, γ: background
100	Archive			96.5'→101': Caliche; massive.	
				Pale brown to pinkish brown, sl moist	100': Archive sample
				101': not as cemented, more of a	
				calcareous silty SAND	
				101'→103': Silty SAND (mS)	105': Archive sample
105	Archive			103'→112': Caliche w/ gravel	
				~20% gravel, 5YR 7/2 (pinkish gray) dry;	⊗ 11 3/4" OD / 10 1/4" ID
				max gravel 5 cm, very strong HCl rxn	Casing set at 109.80'
				107 - .5 feet Calcareous Sand	
				gravel now tr-5%	110': Archive sample
110	Archive			Caliche cemented sand and silt, tr grav.	α, β, γ: background
				112'→114': Sandy SILT (sM)	Drilling with 8 5/8" /
				40% Sand (v. Fn) 60% Silt, mod-strong	7 5/8" casing now
				rxn HCl, sl moist	
115	Archive			114'→121': SAND (S) with occ. silt	115': Archive grab
				lenses 2-3 cm thick. mod-strng HCl	sample
				rxn. Sand Fn-v. Fn; 80% qtz/feld,	α, β, γ: background
				20% basalt/other; sl moist, 10YR5/3	
				(brown) 119': Sand v. Fn	

Reported By: L. D. Walker | Reviewed By: Charlene Martinez
Title: Geologist | Title: Geologist
Signature: L D Walker | Date: 9/13/01 | Signature: Charlene Martinez | Date: 11/05/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 5 of 10
Date: 9-13-01

Well ID: C3400	Well Name: 299-W10-28	Location: W. side 241-T tank farm/200 W
Project: CY '01 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	NA		121' → 129': Sandy SILT (sM)	Cable tool, drive
	Drive			30-40% Sand, 60-70% Silt. Sand	barrel. Casing 8 5/8"/
	barrel			is v. fn. 10YR5/3 (brown), moist; tr	7 5/8"
				horizontal laminations; Sand predom qtz/	120': Grab sample
				Feld; mod rxn HCl	for archive
125	Archive				
					125': Archive, grab
				127': cse sand lens, less than 0.5 ft,	
				then back to silt	
130	Archive			129' → 131': Silty Sandy GRAVEL	130': Archive, grab
				(msG); 60% Gravel, 25% sand 15% silt	
				Gravel tr cobble, predom med-cse peb.	
				Sand med-v. cse; 10YR5/2 (grayish brn)	
				moist; poorly sorted; gravel SR	
135	Archive			mod rxn to HCl.	14 Sept 2001 ↓
				131'-142' Gravelley Sandy Silt	135': archive, 0815
				70% silt, 20% sand, 10% gravel	chip tray samples
				Gravel to 6" max, subrd, predom med	
				crs peb, sand f-med, non plas fines	
140	Archive			10YR ~~5/2~~ 6/1' ~~grayish brn~~ Gray, moist, poorly	140' sample 1100
				sorted. 135', grav inc. to 20%	
				silt dec 60% very dry.	
				142' → 173': Silty Sandy GRAVEL (msG)	
				60% gravel, 20% sand, 20% silt, 10YR 7/2	
145	Archive			light gray (dry), dry, poorly sorted, gravels are	145' sample 1425 hrs.
				A (broken) to R, predom non-basalt, calcerous cement	
				occasionally on gravel, 6" max, slight to mod rxn to HCl	
				sand is predominantly quartz, SA to SR,	End of shift 9/14/01 149'
					Started 9/18/01

Reported By: DCWeekes	Reviewed By: Charlene Martinez
Title: Geologist	Title: Geologist
Signature: DCWeekes Date: 9/14/01	Signature: Charlene Martinez Date: 11/05/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 6 of 10
Date: 9/18/01

Well ID: C3400 | Well Name: 299-W10-28 | Location: W. Side 241-T Tank Farm/200W
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	DB Archive	NA		Silty Sandy GRAVEL (msG) described on p.5.	Cable tool drilling using 7" drive barrel
					150' sample 0752 hrs
155	Archive				155' sample 0955 hrs
160	Archive				160' sample 1248 hrs
					165' sample 1413 hrs.
165	Archive				End of shift 9/18/01 @ 165'
					Start 9/19/01
170	Archive			slightly moist	170' sample 0836 hrs
				173' → 274' : Silty Sandy GRAVEL (msG), 2.5Y6/2 light brownish gray (dry), slightly moist, poorly sorted, areas of deep brown staining FeOx(?), 50% gravel, 35% sand, 15% silt, sand is A-SA, predom. nonbasaltic, gravel is Rounded, mostly nonbasaltic, no to slt rxn to HCl, mica common, more cemented and less silty than material above	173' sample 1038 hrs
	Archive				
175	Archive HT				175' (drive barrel) sample 1243 hrs Started using hard tool bit at 175' 7½" dia bit
					E.O.S. 09/19/01

Reported By: DC Weekes | Reviewed By: Charlene Martinez
Title: Geologist | Title: Geologist
Signature: DC Weekes | Date: 9/19/01 | Signature: Charlene Martinez | Date: 11/05/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 7 of 10
Date: 09/2010/01

Well ID: C3400 | Well Name: 299-W10-28 | Location: W. Side of 241-T Tank Farm 1200 W

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	HIT Archive	n/a		silty sandy gravel. 50% gravel, 30% sand, 20% silt. 10 YR 6/2 Light brownish gray, 40% basalt, 60% qtz (other) slight rxn HCl. Poorly sorted SA-SR. Gravel size undeterminable due to hard tool bit.	cable tool using hard tool bit. Grab Archive@180' A.M. α, β, χ background
185	Archive				Grab Archive@ 185'
190	Archive			Sample wet (slurry)	Grab Archive@ 190'
195	Archive			slurry	Grab Archive@195'
200	Archive				Grab Archive at 200' A.M. α, β, χ @ background
205	Archive				Grab Archive@205'

Reported By: Charlene Martinez | Title: Geologist | Signature: Charlene Martinez | Date: 09/20/01

Reviewed By: L.D. Walker | Title: Geologist | Signature: L.D. Walker | Date: 11-6-01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 8 of 10
Date: 09120101

Well ID: C3400 | Well Name: 299-W10-28 | Location: W. side of 241-T Tank Farm \ 200 W
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
210	HIT Archive	N/A		Silty sandy GRAVEL (same as page 7)	Grab Archive @ 210
					Cable tool using
					hard tool bit
					EOS 09/20/01
					09/21/01
215	ARCHIVE			SILTY SANDY GRAVEL (msG) - SAME AS PAGE 7	GRAB ARCHIVE @ 215
				SLURRY - WET	CABLE TOOL USING
					HARD TOOL BIT, 0745
220	ARCHIVE			SILTY SANDY GRAVEL (msG) - SAME AS ABOVE	GRAB ARCHIVE @ 220
				SLURRY - WET	CABLE TOOL USING
					HARD TOOL BIT
					d,B,&-BKGRD. 0912
225	ARCHIVE			water level = 225.51' bgs (10/17/01)	GRAB ARCHIVE @ 225
					CABLE TOOL USING
					HARD TOOL BIT
					1054
	SPLIT SPOON				
230	ARCHIVE	N/A		SILTY SANDY GRAVEL (msG): 65% GRAVEL	GRAB ARCHIVE @ 230
				25% SAND, 10% SILT. GRAVEL: 50% VC-C, 20% M,	CABLE TOOL USING HARD
				30% F-VF - 15% BASALT; SAND: 50% VC-C,	TOOL BIT 1400
				35% M, 15% F-VF; GRAVEL IS R TO SA, SAND IS	d,B,&-BKGRD.
				SR-SA; MAX. PARTICLE SIZE = 3" DIA. NO RXN HCl,	
235	ARCHIVE			COLOR IS 10YR 6/2 LIGHT BROWNISH GRAY	GRAB ARCHIVE @ 235
					CABLE TOOL/HARD TOOL BIT
					0824 9/24/01
					d,B,&-BKGRD.

Reported By: BJ WATSON | Reviewed By: Charlene Martinez
Title: SCIENTIST | Title: Geologist
Signature: [signature] | Date: 09/24/01 | Signature: Charlene Martinez | Date: 11/05/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 9 of 10
Date: 09/24/01

Well ID: C3400 | Well Name: 299-W10-28 | Location: W. SIDE OF 241-T TANK FARM/200W
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	HLT ARCHIVE	N/A		SILTY SANDY GRAVEL (msG) - SAME AS Pg. 8	GRAB ARCHIVE @ 240'
				SLURRY - WET	CABLE TOOL/HARD TOOL BIT
					0923 hrs.
245	ARCHIVE			SILTY SANDY GRAVEL (msG) - 35% GRAVEL,	GRAB ARCHIVE @ 245'
				40% SAND, 25% SILT. GRAVEL - 10% VC-C,	CABLE TOOL/HARD TOOL BIT
				25% m, 65% F-VF, CONTAINS 35% BASALT, SA-A;	1055 hrs.
				SAND - 20% VC-C, 30% m, 50% F-VF, CONTAINS 25%	IHS DETECT ~1105 hrs.
				BASALT, SA-SR; STRONG RXN HCl; COLOR 10YR 6/2	A, B, X - BKGRD @ 1400 hrs
250	ARCHIVE			LIGHT BROWNISH GRAY; SLURRY - WET; HIGHLY	GRAB ARCHIVE @ 250'
				FRAGMENTED DUE TO HARD TOOL DRILLING	CABLE TOOL/HARD TOOL BIT
					1430 hrs.
				GRAVEL DECREASING	
					9/25/01
255	ARCHIVE			SILTY SAND (mS) - 10% GRAVEL, 55% SAND, 35%	GRAB ARCHIVE @ 255'
				SILT. GRAVEL - 60% m, 40% F-VF, CONTAINS	CABLE TOOL/HARD TOOL BIT
				60% BASALT, A-SR; SAND - 10% VC-C, 40%	0840 hrs
				m, 50% F-VF, SR-A, CONTAINS 35% BASALT;	AM RCT - A, B, X IS BKGRD.
				COLOR 10YR 6/2 LIGHT BROWNISH GRAY, SLIGHT	
260	ARCHIVE			RXN HCl. MAX PARTICLE SIZE 1 in.	GRAB ARCHIVE @ 260'
					1230 hrs
	SPLIT SPOON			262-264' → SAND IS COARSER: 5% VC-C,	SPLIT SPOON ~ 262-264.5
				30% m, 20% F-VF	1230 hrs
					A, B, X - BKGD
265	ARCHIVE	N/A		GRAVEL INCREASING	GRAB ARCHIVE @ 265'
					CABLE TOOL/HARD TOOL BIT
					1600 hrs

Reported By: DJ WATSON | Reviewed By: Charlene Martinez
Title: SCIENTIST | Title: Geologist
Signature: [signature] | Date: 09/27/01 | Signature: Charlene Martinez | Date: 11/05/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 10 of 10
Date: 09/27/01

Well ID: C3400 | Well Name: 299-W10-28 | Location: W. SIDE OF 241-T TANK FARM/200W
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
270	HLT ARCHIVE	n/a		SILTY SANDY GRAVEL (mSG) 50% GRAVEL, 30% SAND, 20% SILT; GRAVEL - 10% m, 90% F-VF @ 1535 hrs.	GRAB SAMPLE @ 270'
				HIGHLY FRAGMENTED DUE TO HARD TOOL USE, A-SA 50% BASALT; SAND - 50% C-VC, 35% m, 15% f-VF, R-SA, 30% BASALT, NE RXN HCl.	CABLE TOOL/HAMMER BIT
275				274-275.5 Silty Sand (mS) Sand 85%, (40% f, 40% m, 20% cr), Silt 15%: the unit is lt yw-bn, moderately sorted, saturated and composed of SA-SR grains of silica & metamorphic rocks w/ ~ 20% basalt.	Archive samples not collected.
280			T.D.	275.5-280 Gravelly Sand (gS), ~~70%~~ 70% sand (30% f, 40% m, 30% cr), 25% gravel (40% f-vf, 60% m) in a SR-SA grained, silica & felsic metamorphics dominant (25% basalt). It is saturated, and the apparent largest grain size is < ½"	END OF HOLE - after "Boiler Test" to insure ~~hole~~ is making H_2O
					TD = 280' bgs
				NOT USED JM Faurote	

Reported By: JM Faurote | Title: Geologist | Signature: JM Faurote | Date: 9/28/01
Reviewed By: Charlene Martinez | Title: Geologist | Signature: Charlene Martinez | Date: 11/05/01

BHI-EE-183 (12/97)

Appendix B

Physical and Chemical Properties Data

Appendix B

Physical and Chemical Properties Data

This appendix includes the results of testing for particle size distribution on split spoon samples from the wells 299-W10-28. The analyses were done by CH2M HILL Hanford, Inc. using standard sieve techniques.

This appendix also contains the results of testing two groundwater samples for technetium-90, uranium-238, metals, and anions. Technetium and uranium were measured by inductively coupled plasma-mass spectrometry and metals by inductively coupled plasma-atomic emission spectrometry. Anions were measured by chromatography. All samples were acidified with 2% HNO_3 and analyzed according to standard operating procedures at PNNL laboratories. Sample depths were 252 ft and 280 ft bgs.

Table B.1. Electrical Conductivity and pH for Samples from Well 299-W10-28

Depth (ft)	pH	EC (mS/cm)
252	7.45	1.381
280	7.36	0.784

Table B.2. Metals in Samples from Well 299-W10-28

Depth (ft)	Al 394.4[(a)] <125[(b)]	As 193.7 <125	B 249.7 <125	Ba 455.4 <25	Ca Rad 393.7 <50	Cd 228.8 <25	Co 228.6 <25	Cr 267.7 <30	Cu 324.8 <50	Fe 274.0 <50
252	<125	(20	(67)	101	37243	<25	<25	44	(16)	1365
275	<125	(77)	(81)	120	59564	<25	(2)	(2)	(1)	(9)

Depth (ft)	K Rad 766 <12500	Mg Rad 279.6 <50	Mn 294.9 <113	Mo 204.6 <25	Ni 231.6 <50	Sr Rad 407.8 <50	Zn 213.9 <25	Na Rad 589.6 <2500	S 182.6 <2500	Ti 334.9 <2500	Zr 343.8 <125
252	8935	11454	235	607	(12)	195	<25	214494	17173	<125	<125
275	9751	18976	551	165	(3)	255	<25	44151	13085	<125	<125

All concentrations are reported in µg/L (ppb).
(a) Wavelength.
(b) Lower limit of quantification.

Table B.3. Technetium-99 and Uranium-238 in Well 299-W10-28

Depth (ft)	Tc-99[(a)] <0.05[(b)] µg/L	U-238 <0.025 µg/L
252	(0.005)	0.219
280	(0.005)	0.149

(a) Isotope of choice.
(b) Lower limit of quantification.

Table B.4. Anions in Samples from Well 299-W10-28

Depth (ft)	Fluoride	Chloride	Nitrite	Bromide	Nitrate	Sulfate	Phosphate	Carbonate
252	1.81	34.10	77.29	<1.00	562.42	51.81	<1.50	48.13
280	0.91	20.81	19.74	<1.00	274.70	40.62	<1.50	52.50

Note: All concentrations reported in parts per million (ppm).

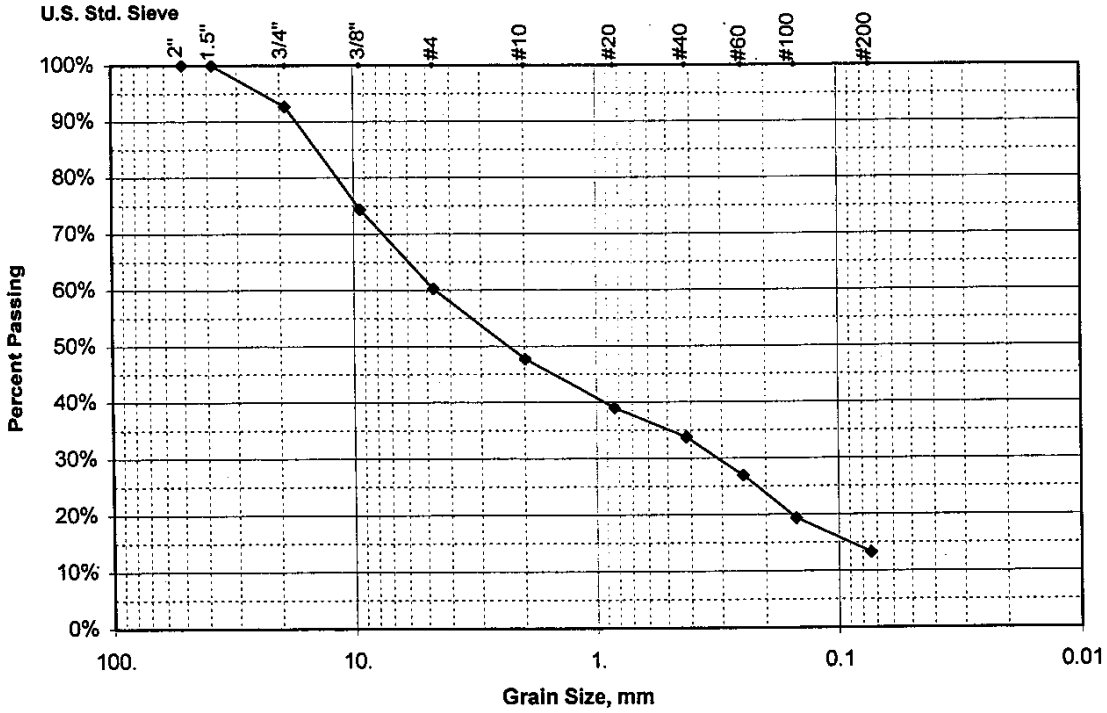
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W14-18	DEPTH	222.0'-224.0'	SAMPLE#	W14-18-222.0	WELL ID#	C3396
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-9601	DATE	11/02/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
985.80	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	71.9	7.3	92.7	19.05	
	3/8"	252.5	25.6	74.4	9.42	
	#4	392.3	39.8	60.2	4.70	
	#10	516.0	52.3	47.7	1.98	
	#20	601.6	61.0	39.0	0.83	
	#40	652.7	66.2	33.8	0.42	
	#60	720.8	73.1	26.9	0.25	
	#100	795.2	80.7	19.3	0.150	
	#200	854.6	86.7	13.3	0.074	

Sieve Analysis Data for Sample W14-18-222.0



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By: JM Wimett DC Weekes Date: 11/2/01

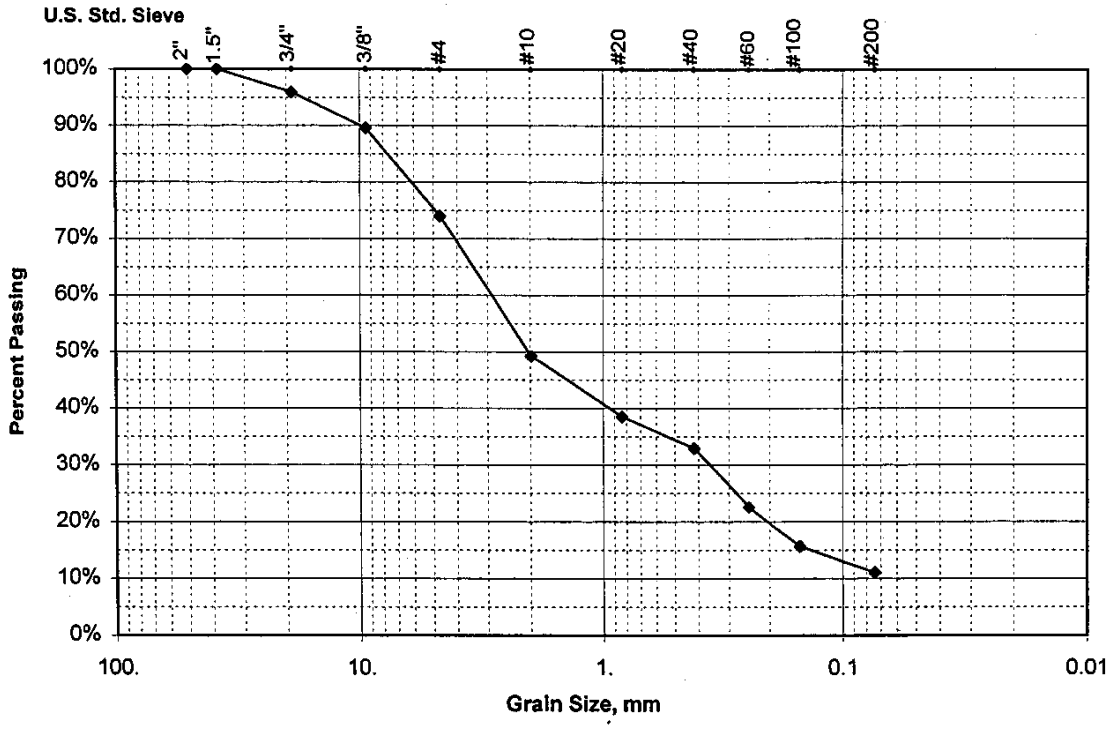
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W14-18	DEPTH	255.0'-257.0'	SAMPLE#	W14-18-255.0	WELL ID#	C3396
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-9601	DATE	11/02/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
974.70	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	39.7	4.1	95.9	19.05	
	3/8"	102.1	10.5	89.5	9.42	
	#4	253.6	26.0	74.0	4.70	
	#10	494.5	50.7	49.3	1.98	
	#20	599.2	61.5	38.5	0.83	
	#40	653.1	67.0	33.0	0.42	
	#60	754.9	77.4	22.6	0.25	
	#100	821.6	84.3	15.7	0.150	
	#200	867.2	89.0	11.0	0.074	

Sieve Analysis Data for Sample W14-18-255.0



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By: JMWimett DCWeekes Date: 11/2/01

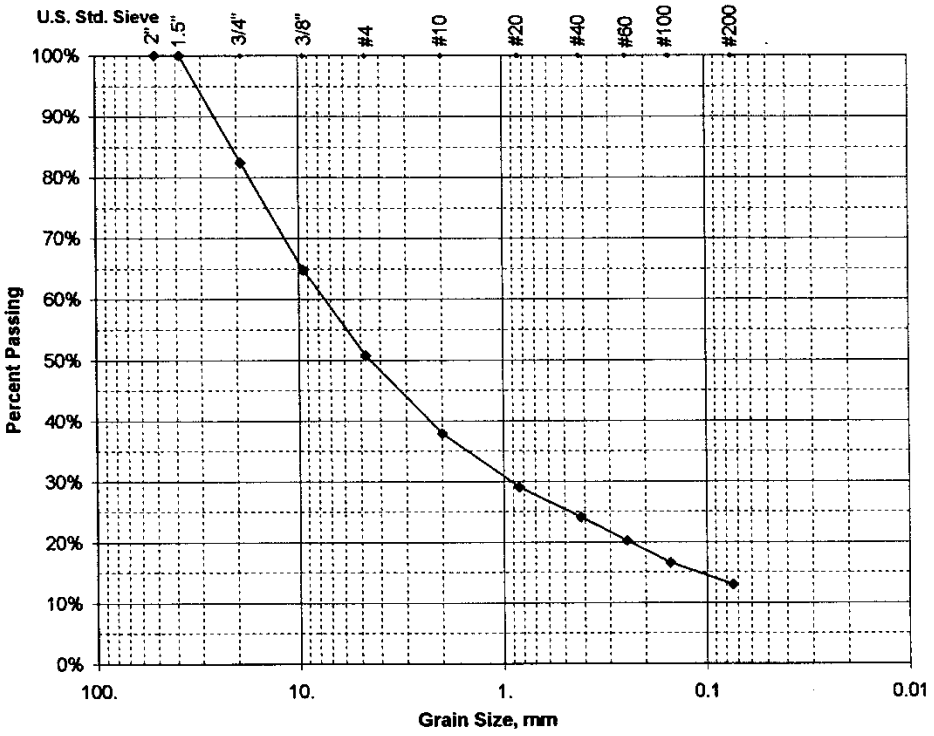
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W10-28	DEPTH	229.0'-231.5'	SAMPLE#	W10-28-229.0	WELL ID#	C3400
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-9601	DATE	#########

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
915.20	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	161.4	17.6	82.4	19.05	
	3/8"	322.3	35.2	64.8	9.42	
	#4	451.4	49.3	50.7	4.70	
	#10	568.9	62.2	37.8	1.98	
	#20	649.9	71.0	29.0	0.83	
	#40	695.2	76.0	24.0	0.42	
	#60	730.7	79.8	20.2	0.25	
	#100	763.6	83.4	16.6	0.150	
	#200	796.6	87.0	13.0	0.074	

Sieve Analysis Data for Sample W10-28-229.0



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By: Date:

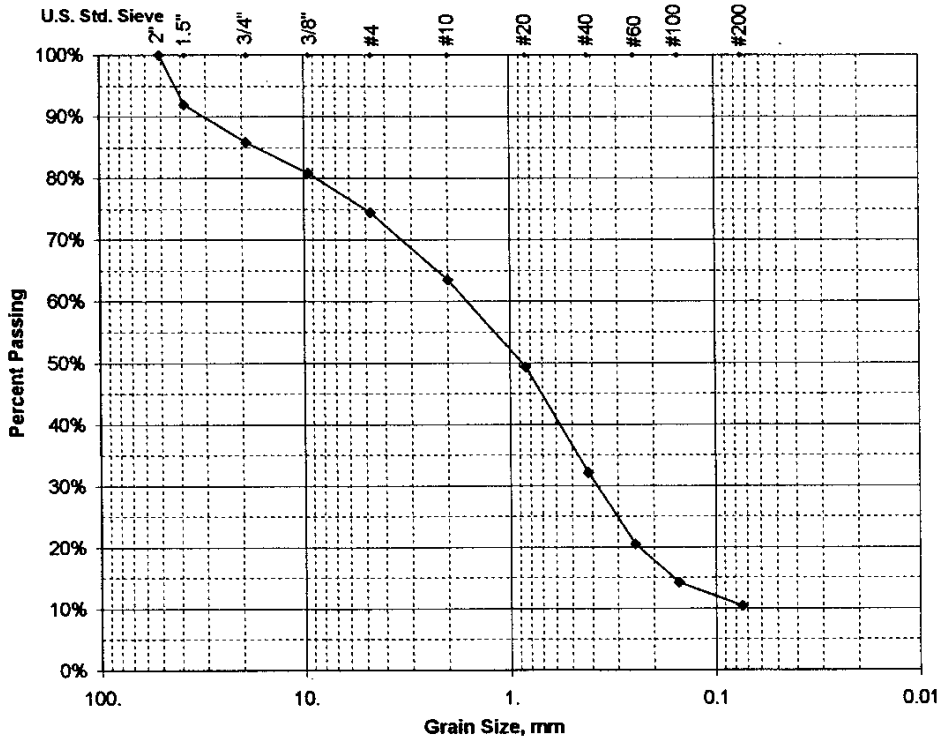
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W10-28	DEPTH	262.0'-264.5'	SAMPLE#	W10-28-262.0	WELL ID#	C3400
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-9601	DATE	#########

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
967.10	2"	0.0	0.0	100.0	50.80	
	1.5"	77.9	8.1	91.9	38.10	
	3/4"	136.9	14.2	85.8	19.05	
	3/8"	186.2	19.3	80.7	9.42	
	#4	247.5	25.6	74.4	4.70	
	#10	353.3	36.5	63.5	1.98	
	#20	490.4	50.7	49.3	0.83	
	#40	656.8	67.9	32.1	0.42	
	#60	769.2	79.5	20.5	0.25	
	#100	830.0	85.8	14.2	0.150	
	#200	867.0	89.6	10.4	0.074	

Sieve Analysis Data for Sample W10-28-262.0



Comments: Sandy Gravel

All data are accurately and completely recorded.

Checked By: Date:

Appendix C

Borehole Geophysical Logs

Appendix C

Borehole Geophysical Logs

This appendix contains the borehole geophysical logs obtained from borehole 299-W10-28. The logs were obtained and analyzed by MACTEC-ERS.

299-W10-28 (C3400)

Log Data Report

Borehole Information:

Borehole: 299-W10-28 (C3400)		Site: West of T Tank Farm		
Coordinates (Plant)		GWL (ft)[1]: 226.7		GWL Date: 9/29/01
North	East	Drill Date: Sept. 2001	TOC[2] Elevation: Unknown	Total Depth (ft): 279.0	Type: Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel thread	0.2	11 3/4	10 1/4	3/4	0	109.9
Steel thread	1.5	8 5/8	7 5/8	1/2	0	276

Borehole Notes:

This borehole is a RCRA groundwater well. Tim Hottle, BHI, reported casing depths and borehole depth on 9/29/01.

The logging engineer measured the pipe stickup at the borehole using a steel tape. Calipers were used to measure casing outside diameter and inside diameter only. The casing thickness is calculated. The logging engineer measured the depth to water with an E-Tape prior to moisture logging.

Logging Equipment Information:

Logging System:	Gamma 1D		Type: SGLS (35%)
Calibration Date:	07/01	Calibration Reference:	GJO-2001-243-TAR
		Logging Procedure:	MAC-HGLP 1.6.5

Logging System:	RLS-1		Type: Moisture
Calibration Date:	07/01	Calibration Reference:	RLSM00.0 (Randall 2001)
		Logging Procedure:	MAC-HGLP 1.6.5

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4
Date	10/01/01	10/01/01	10/02/01	
Logging Engineer	Spatz	Spatz	Spatz	
Start Depth (ft)	0.0	277.0	141.0	
Finish Depth (ft)	141.0	142.0	113.0	
Count Time (sec)	200	200	200	
Live/Real	R	R	R	
Shield (Y/N)	N/A[3]	N/A	N/A	
MSA Interval (ft)	1.0	1.0	1.0	
ft/min	N/A	N/A	N/A	
Pre-Verification	A0005CAB	A0005CAB	A0005CAB	
Start File	A0005000	A0005142	A0005278	

Log Run	1	2	3	4
Finish File	A0005141	A0005277	A0005306	
Post-Verification	A0005CAA	A0005CAA	A0005CAA	
Depth Return Error (ft)	-0.06	NA	0	
Comments			Repeat section	

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2	3	4
Date	09/29/01	09/29/01	09/29/01	
Logging Engineer	Spatz	Spatz	Spatz	
Start Depth (ft)	0.0	98.0	122.0	
Finish Depth (ft)	100.0	198.0	110.0	
Count Time (sec)	N/A[3]	N/A	N/A	
Live/Real	N/A	N/A	N/A	
Shield (Y/N)	N/A	N/A	N/A	
MSA Interval (ft)	0.25	0.25	0.25	
ft/min	1.0 ft/min	1.0 ft/min	1.0 ft/min	
Pre-Verification	C0212CAB	C0212CAB	C0212CAB	
Start File	C0212000	C0212400	C0212498	
Finish File	C0212399	C0212497	C0212545	
Post-Verification	C0212CAA	C0212CAA	C0212CAA	
Depth Return Error (ft)	N/A	N/A	+0.05	
Comments	None	None	Repeat section	

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.

Zero reference is the top of ground surface, and log depths are relative to ground level. Log run 1 was terminated to refill the sonde with liquid nitrogen and to grease the PTO driveline. Fine gain adjustments were made after file A0005127 at 127.0 ft and A0005142 at 277.0 ft during SGLS log run 2.

The neutron log was run on a second logging truck, RLS-1, and neutron-moisture logging started at 105 ft due to double casing down to 109.9 ft.

Analysis Notes:

Analyst:	Sobczyk	Date:	10/16/01	Reference:	MAC-VZCP 1.7.9 Rev. 2

Pre-run and post-run verification spectra for the SGLS were evaluated. The acceptance criteria for field verification of the Gamma 1D logging system are in the process of being established. Examinations of spectra indicate that the detector appears to have functioned normally during the log run, and the log data are provisionally accepted, subject to further review and analysis.

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 the casing configuration described on the first page. A correction for water in the borehole was applied below 226.7 ft as the logging engineer measured this groundwater level. Dead time corrections were not necessary. The rerun of the SGLS showed good repeatability.

Pre-run and post-run verification spectra for the neutron tool were evaluated. The pre-survey verification spectrum (file C0212CAB) recorded 734 gross cps while the post-survey verification spectrum (file C0212CAA) recorded 733 gross cps.

Moisture calibration models at Hanford for 8-in.-diameter casing with 0.322-in. thickness have been established. A casing thickness correction (relative to 8-in. casing) can be estimated. Thus, corrections were applied to the gross neutron counts per second to estimate volumetric moisture content with the established 8-in. hole-size correction and the 1/2-in. casing thickness for 8-in.-diameter casing. Neutron data are also presented as gross counts. In general, an increase in neutron count is indicative of an increase in moisture content.

The rerun of the neutron-moisture tool showed good repeatability with the exception that the two runs appear to be off-depth. This apparent discrepancy is due to acquiring data in continuous mode in different directions. During the original log, data were acquired while going deeper into the hole, and the data are shifted upward about 1.5 in. During the repeat logging, data were acquired while coming out of the hole, and the data are shifted downward about 1.5 in. In addition, the repeat log had a depth return error of 0.6 in. (0.05 ft). Regardless of the logging direction, the depth error is small (1.5 in.).

Log Plot Notes:

Separate log plots are provided for gross gamma, 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 level (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, or casing and water corrections. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. A gross neutron log of neutron counts is also shown on the combination plot.

Results and Interpretations:

The changes in gross gamma counts depend primarily upon changes in ^{40}K activities. No man-made radionuclides were detected. The increase in gross gamma counts from about 45 cps to about 60 cps at a log depth of 56 ft corresponds with an increase in apparent ^{40}K activity from about 10 to 13 pCi/g. This increase in total gamma is interpreted as the Hanford H2. The increase in ^{232}Th activity from about 0.5 to 0.8 pCi/g and the increase in gross gamma counts from 60 cps to 85 cps at 78 ft are tentatively picked to represent the top of the Early Palouse Soil. On the basis of low K-40 activities, the carbonate-rich paleosols of the Pliocene-Pleistocene are interpreted as being between 94 and 109 ft. The caliche layer with characteristically high uranium content (greater than 2.0 pCi/g) is present between 112 and 115 ft. The top of the Ringold is picked at 110 ft, which coincidently is near the base of the 11-in. casing.

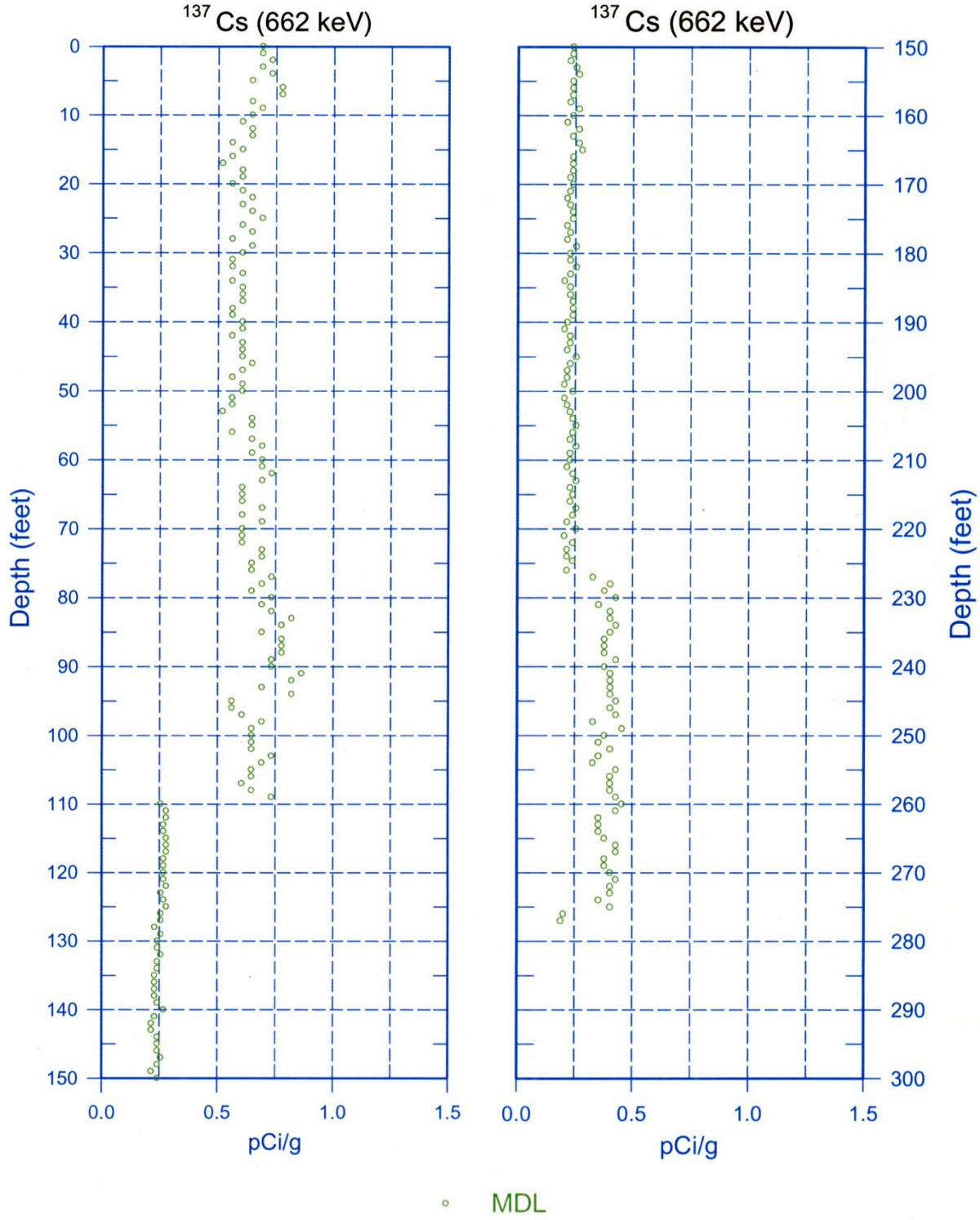
The highest neutron counts occurred in the groundwater as expected. The higher neutron counts that occurred in the 111- to 128-ft interval correspond with a zone of elevated total gamma and probably represent finer grained sediments in the Ringold Formation. The higher neutron counts that occurred between 175 ft and the water table do not correspond with a zone of elevated total gamma.

Reference: Randall, R., 2001. *Certificate of Calibration RLSM00.0*, July 11, 2001, Three Rivers Scientific, Richland, Washington.

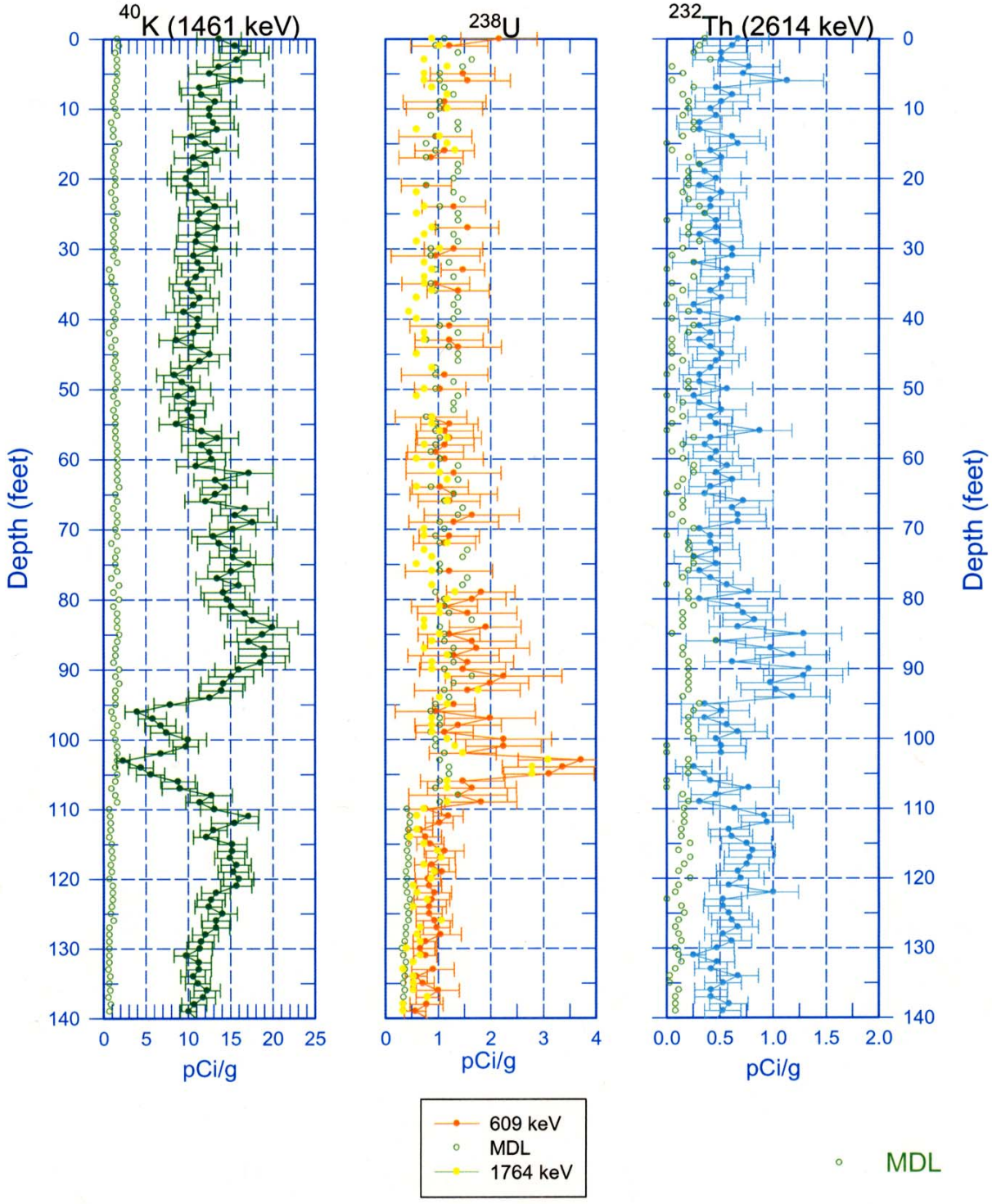
[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not applicable

299-W10-28 (C3400)

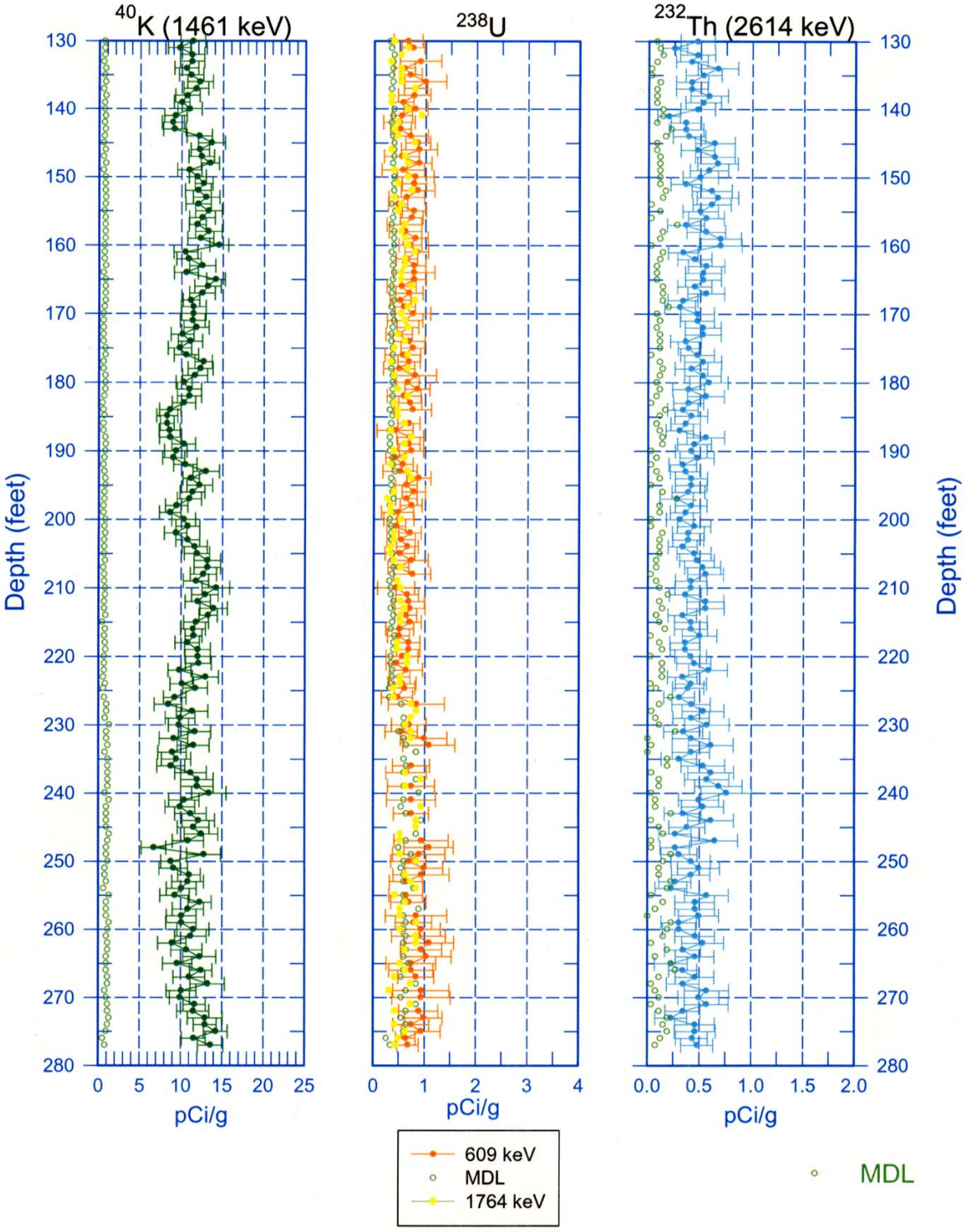
Man-Made Radionuclide Concentrations

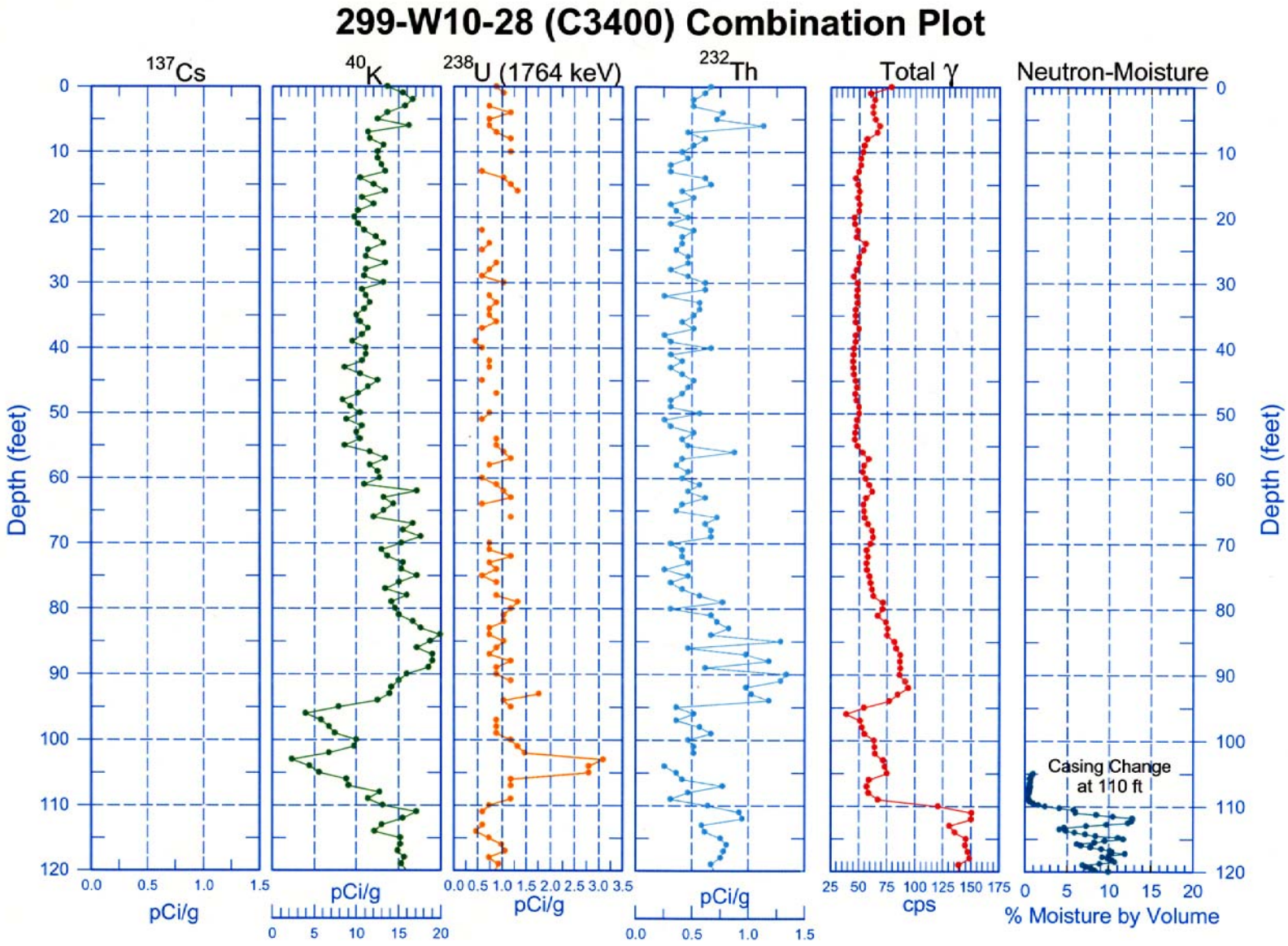


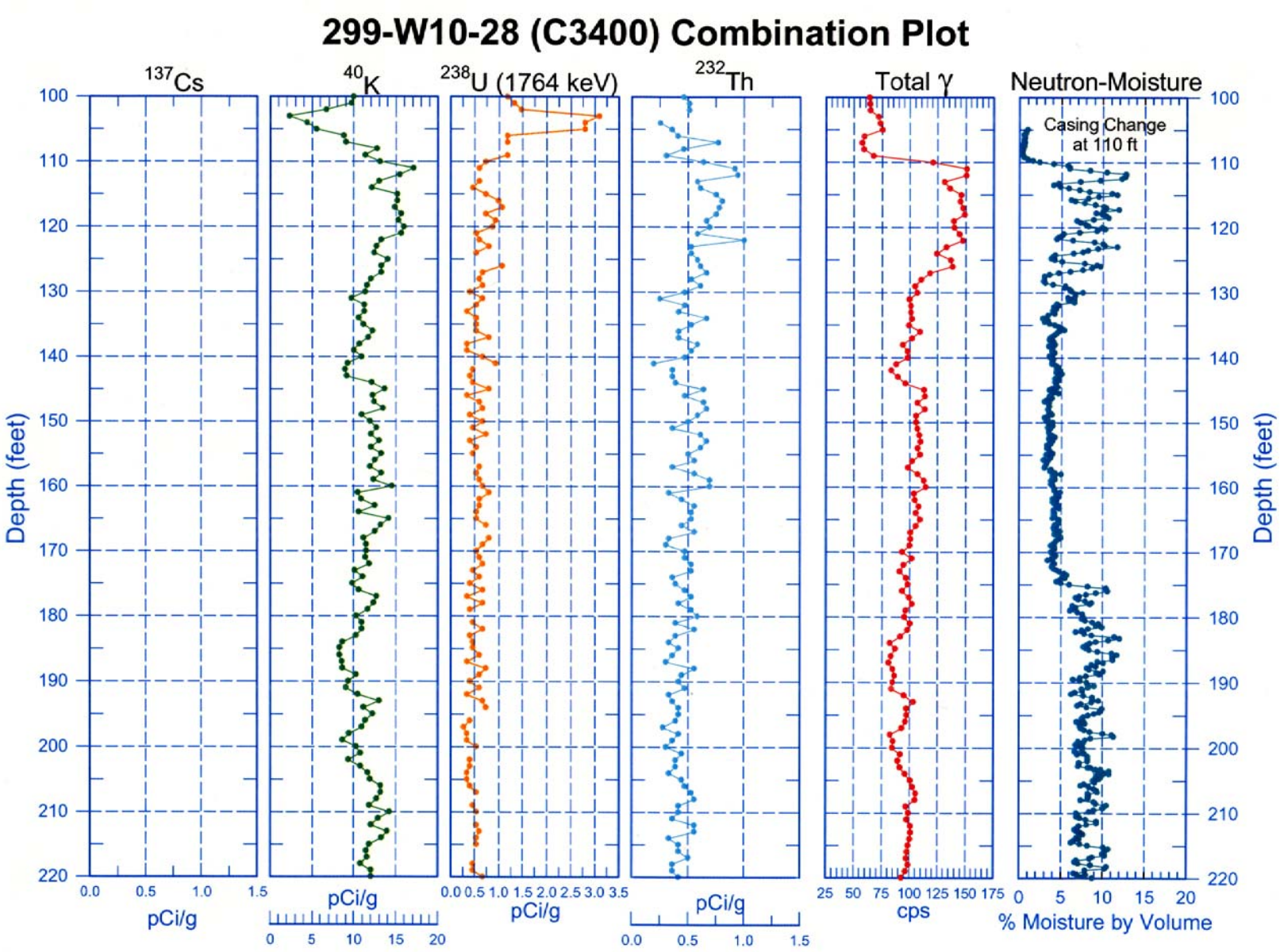
299-W10-28 (C3400)
Natural Gamma Logs

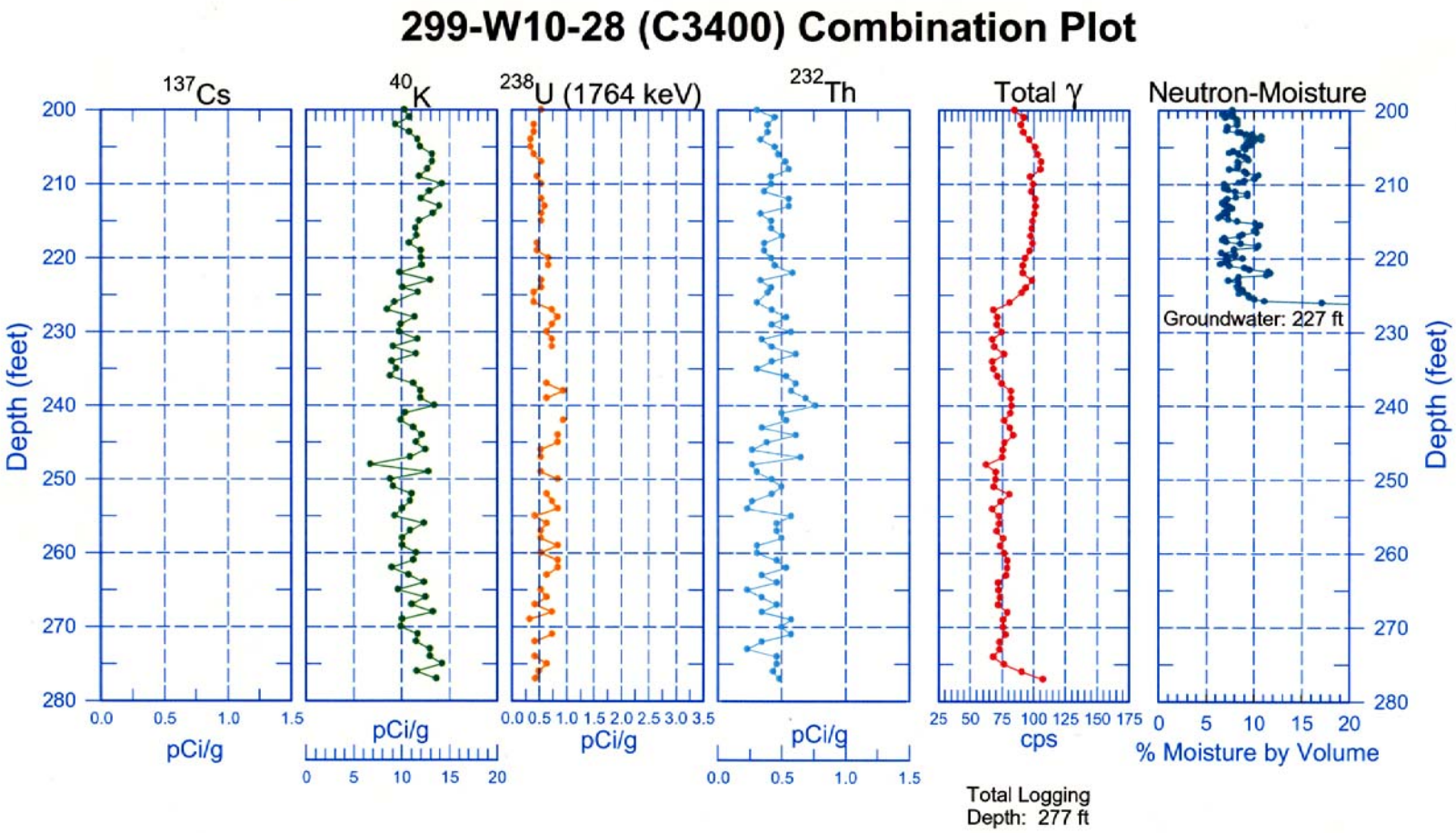


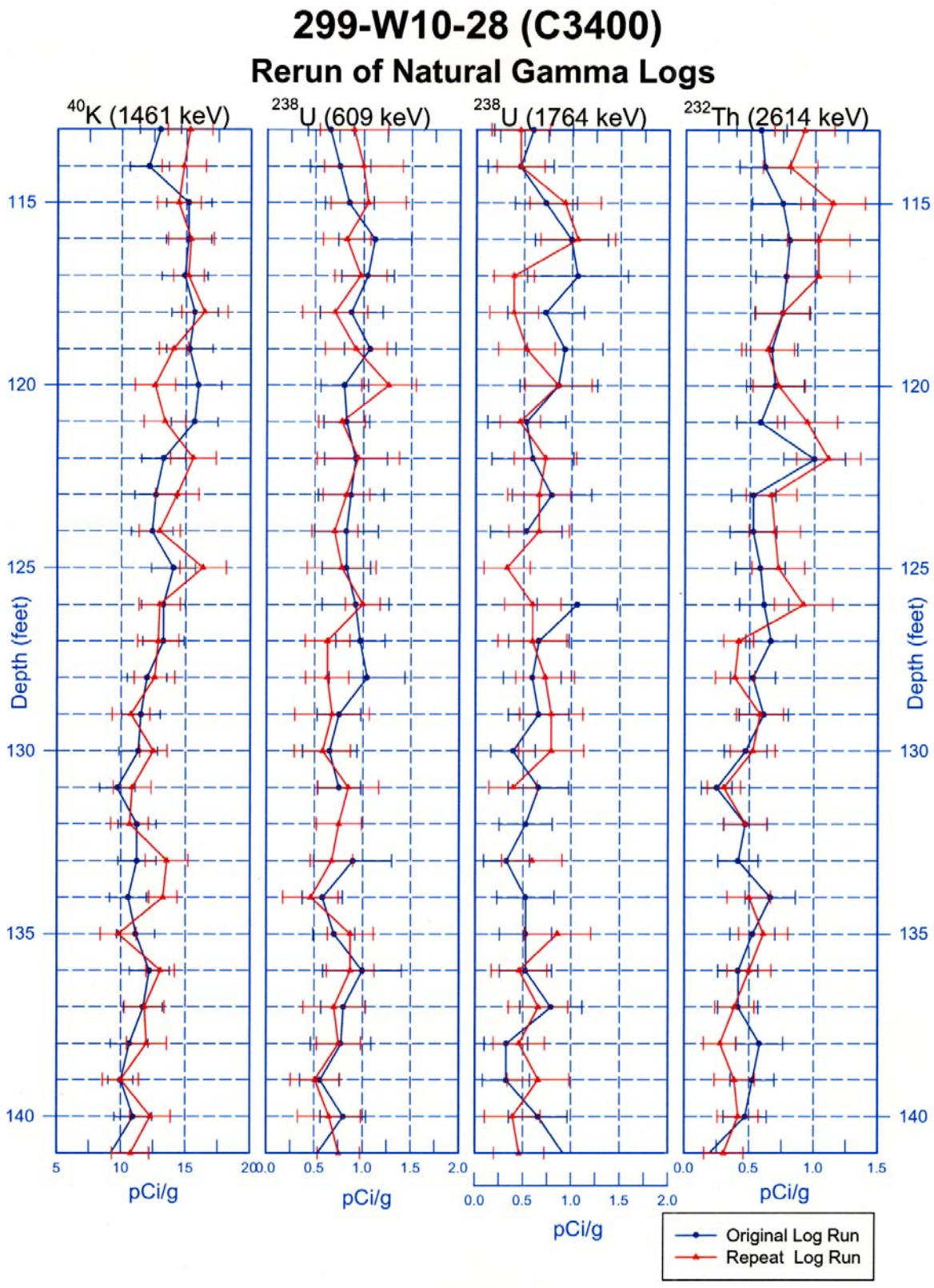
299-W10-28 (C3400)
Natural Gamma Logs

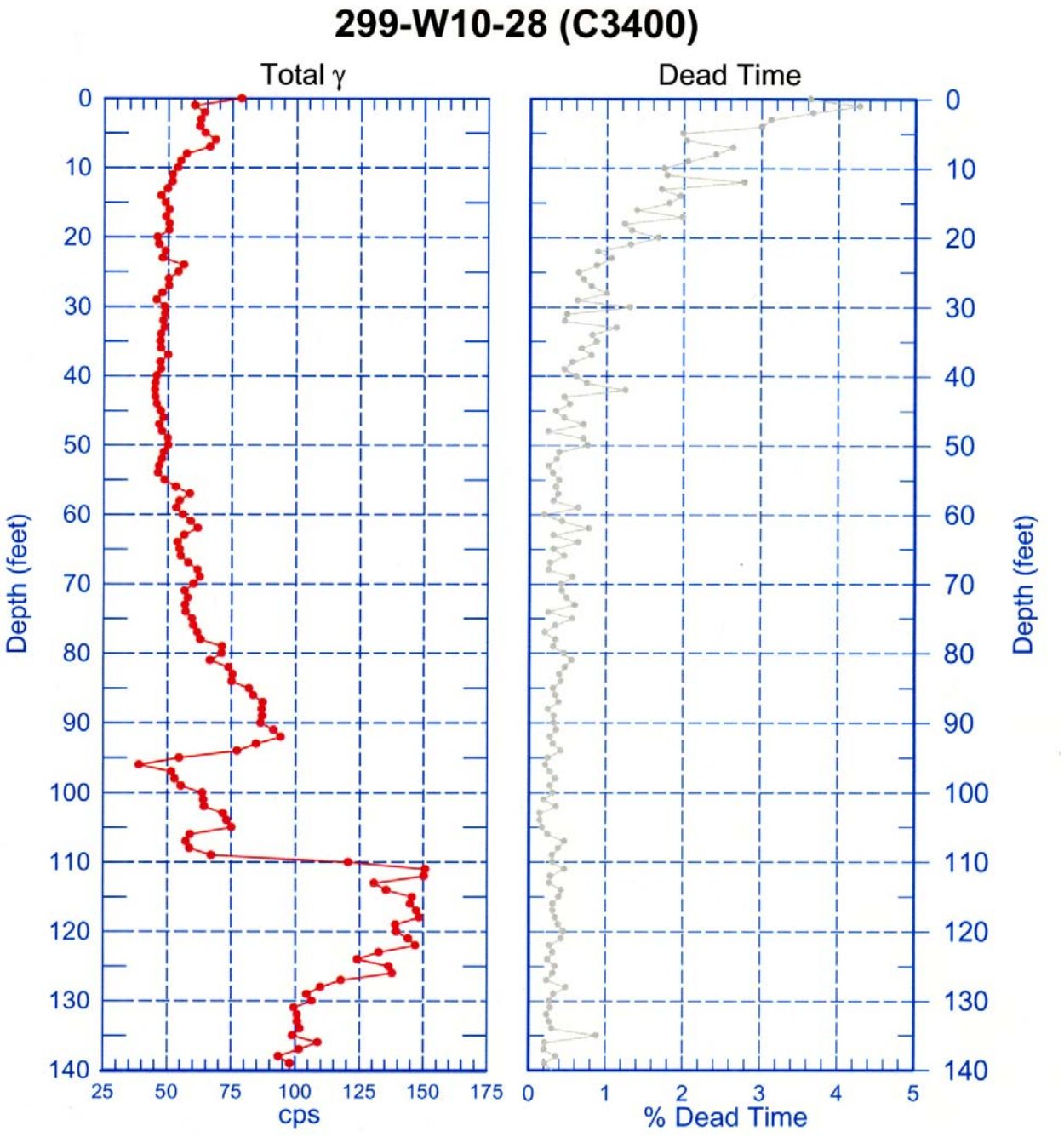


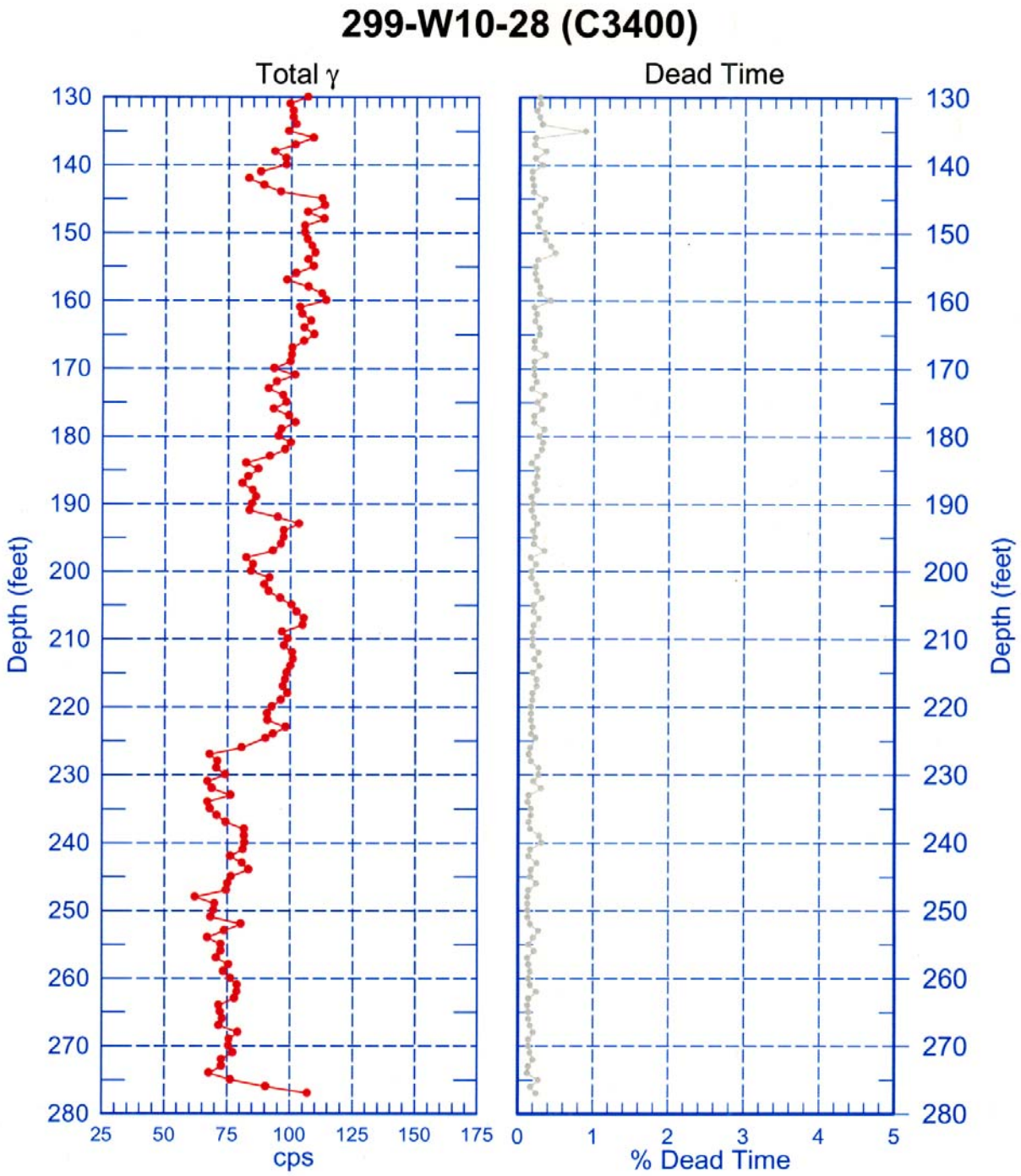

299-W10-28 (C3400) Combination Plot
137Cs
40K
238U (1764 keV)
232Th
Total γ
Neutron-Moisture
Depth (feet)
pCi/g
cps
% Moisture by Volume
Casing Change at 110 ft

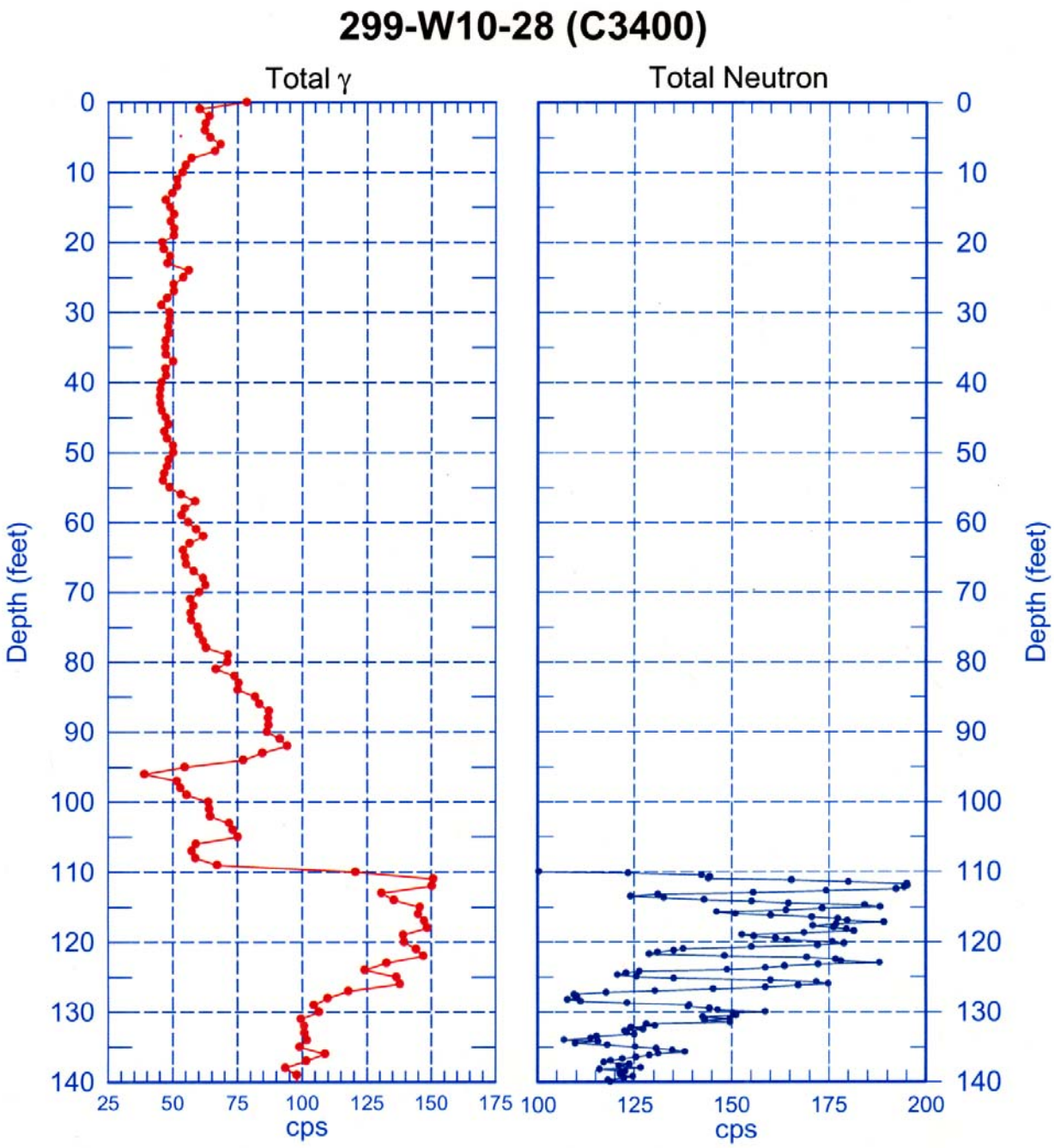

299-W10-28 (C3400) Combination Plot
137Cs
40K
238U (1764 keV)
232Th
Total γ
Neutron-Moisture
Casing Change at 110 ft
Depth (feet)
pCi/g
cps
% Moisture by Volume

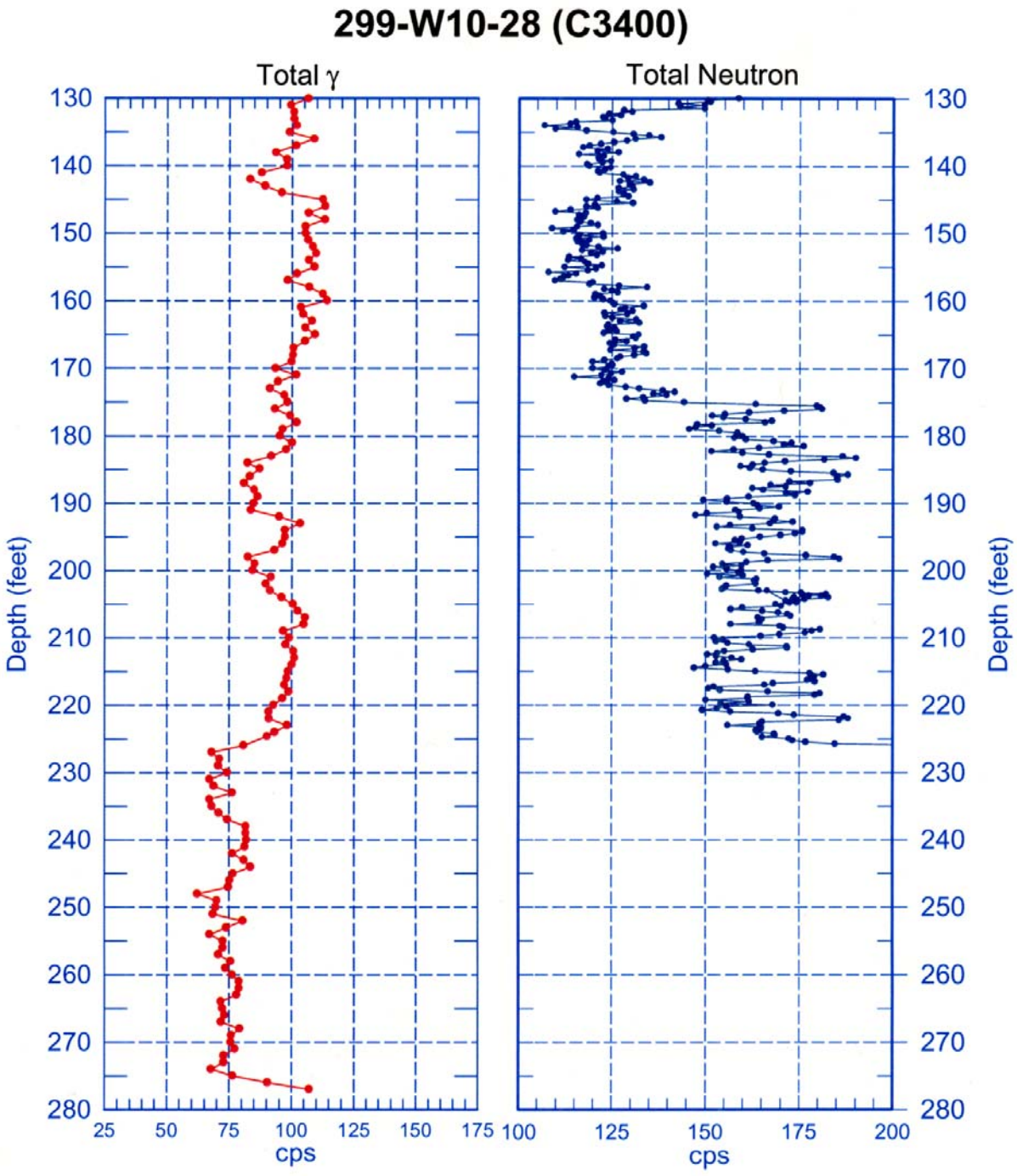

299-W10-28 (C3400) Combination Plot
137Cs
40K
238U (1764 keV)
232Th
Total γ
Neutron-Moisture
Depth (feet)
200
210
220
230
240
250
260
270
280
0.0 0.5 1.0 1.5
pCi/g
0 5 10 15 20
pCi/g
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5
pCi/g
0.0 0.5 1.0 1.5
pCi/g
25 50 75 100 125 150 175
cps
0 5 10 15 20
% Moisture by Volume
Groundwater: 227 ft
Total Logging
Depth: 277 ft

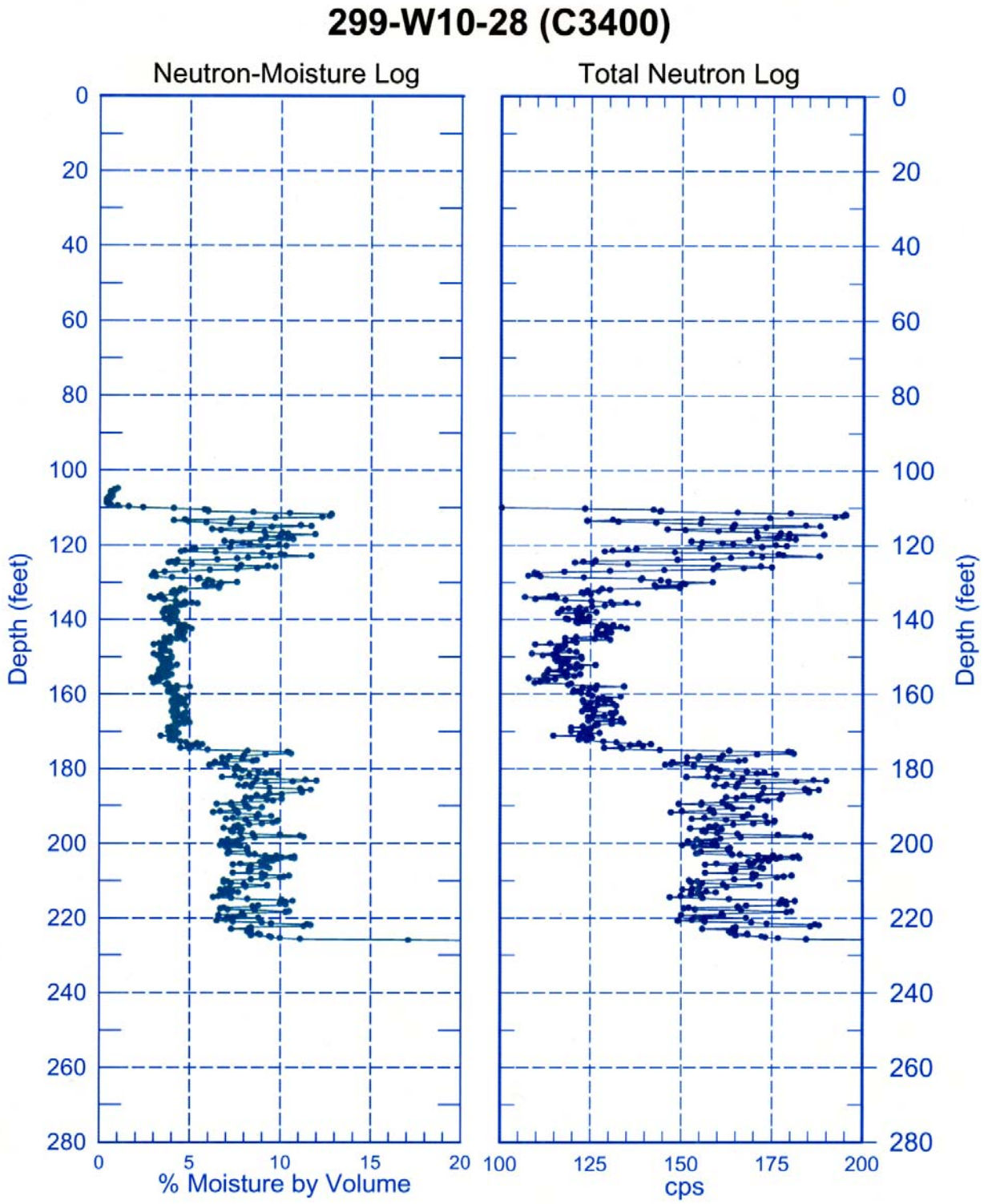

299-W10-28 (C3400)
Rerun of Natural Gamma Logs
40K (1461 keV)
238U (609 keV)
238U (1764 keV)
232Th (2614 keV)
Depth (feet)
115
120
125
130
135
140
5
10
15
20
0.0
0.5
1.0
1.5
2.0
pCi/g
Original Log Run
Repeat Log Run

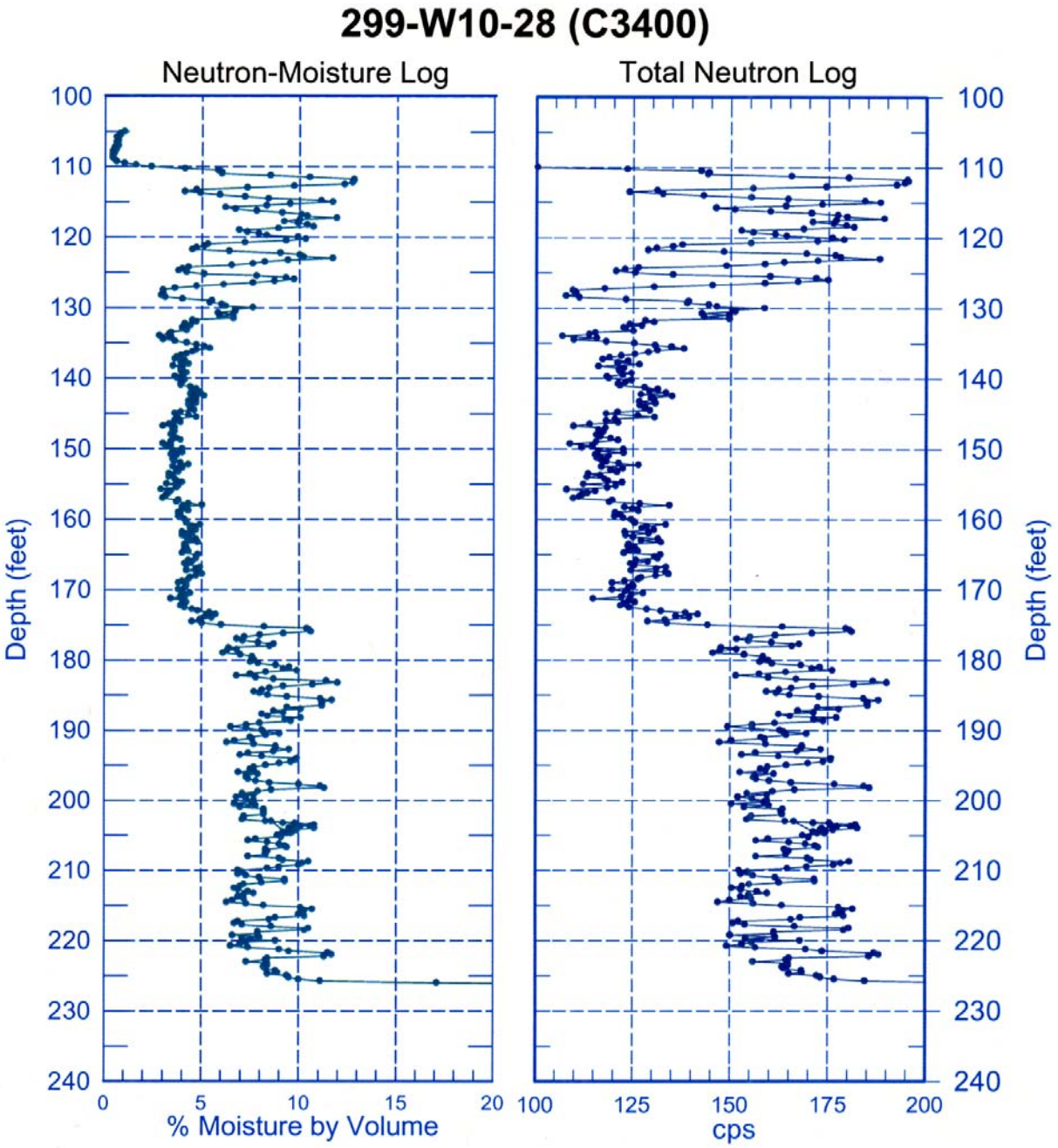

299-W10-28 (C3400)
Total γ
Dead Time
Depth (feet)
Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
25
50
75
100
125
150
175
cps
0
1
2
3
4
5
% Dead Time

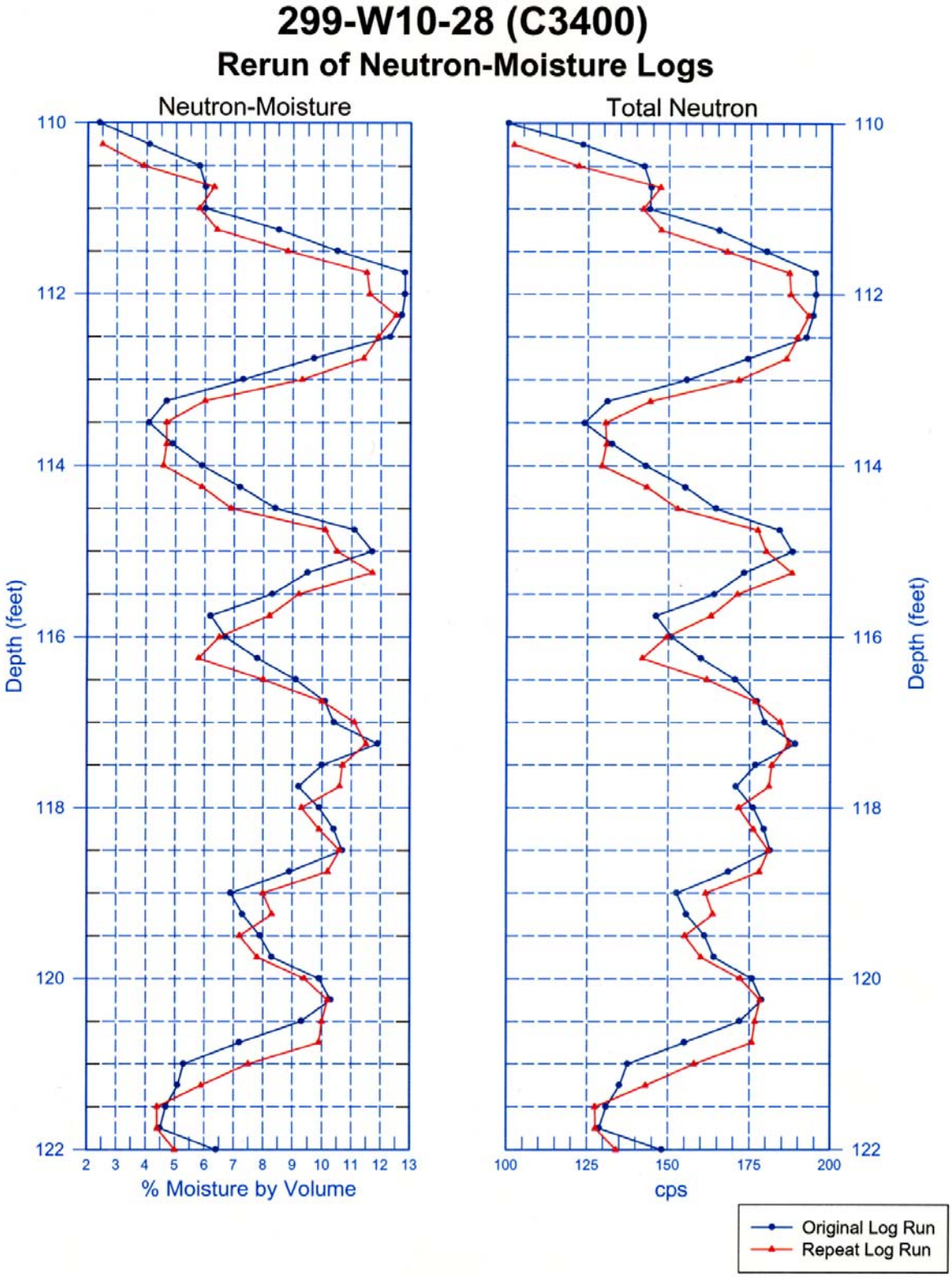

299-W10-28 (C3400)
Total γ
Dead Time
Depth (feet)
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
25
50
75
100
125
150
175
cps
0
1
2
3
4
5
% Dead Time


299-W10-28 (C3400)
Total γ
Total Neutron
Depth (feet)
Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
25
50
75
100
125
150
175
100
125
150
175
200
cps
cps


299-W10-28 (C3400)
Total γ
Total Neutron
Depth (feet)
Depth (feet)
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
25
50
75
100
125
150
175
cps
100
125
150
175
200
cps


299-W10-28 (C3400)
Neutron-Moisture Log
Total Neutron Log
Depth (feet)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
0
5
10
15
20
% Moisture by Volume
100
125
150
175
200
cps


299-W10-28 (C3400)
Neutron-Moisture Log
Total Neutron Log
Depth (feet)
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
0
5
10
15
20
% Moisture by Volume
100
125
150
175
200
cps


299-W10-28 (C3400)
Rerun of Neutron-Moisture Logs
Neutron-Moisture
Total Neutron
Depth (feet)
110
112
114
116
118
120
122
2 3 4 5 6 7 8 9 10 11 12 13
% Moisture by Volume
100 125 150 175 200
cps
Original Log Run
Repeat Log Run

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