1246632
[0067971H]

SGW-59185
Revision 0

Borehole Summary Report for the Installation of Twelve Wells in the 100-HR-3 Operable Unit, FY 2015

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

ch2m

P.O. Box 1600
Richland, Washington 99352

RECEIVED
OCT 26 2017
EDMC

Approved for Public Release;
Further Dissemination Unlimited

288

1246632

SGW-59185
Revision 0

Borehole Summary Report for the Installation of Twelve Wells in the 100-HR-3 Operable Unit, FY 2015

Document Type: RPT Program/Project: S&GRP

J. Carter
Freestone Environmental, Inc.

Date Published
September 2015

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

ch2m SM
P.O. Box 1600
Richland, Washington 99352

APPROVED
By Ashley R Jenkins at 7:46 am, Sep 24, 2015

Release Approval Date

RECEIVED
OCT 26 2017
EDMC

Approved for Public Release;
Further Dissemination Unlimited

TRADEMARK DISCLAIMER

Reference herein to any specific commercial product, process, or service by tradename, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy.

Printed in the United States of America

Contents

1 Introduction 1-1

1.1 Purpose and Scope 1-1

2 Field Activities 2-1

2.1 General Information 2-1

2.1.1 Well Drilling and Borehole Logging 2-1

2.1.2 Sampling and Health and Safety Screening 2-1

2.1.3 Well Construction and Development 2-2

3 Site Specific Information for Groundwater Wells 3-1

3.1 Well 199-H4-92 (C8792) 3-1

3.2 Well 699-97-60 (C8793) 3-4

3.3 Well 699-97-61 (C8794) 3-6

3.4 Well 699-93-48C (C8929) 3-7

3.5 Well 199-H6-7 (C8947) 3-8

3.6 Well 199-H5-16 (C8948) 3-8

3.7 Well 199-H4-93 (C8949) 3-10

3.8 Well 699-95-45B (C8950) 3-11

3.9 Well 199-H6-8 (C8951) 3-12

3.10 Well 199-D5-159 (C9377) 3-13

3.11 Well 699-97-47B (C9485) 3-15

3.12 Well 199-H1-46 (C9486) 3-16

4 Geologic Observations 4-1

4.1 General Geology Description 4-1

4.2 Borehole Geology 4-1

4.2.1 Borehole Geology for Well 199-H4-92 (C8792) 4-1

4.2.2 Borehole Geology for Well 699-97-60 (C8793) 4-2

4.2.3 Borehole Geology for Well 699-97-61 (C8794) 4-3

4.2.4 Borehole Geology for Well 699-93-48C (C8929) 4-3

4.2.5 Borehole Geology for Well 199-H6-7 (C8947) 4-4

4.2.6 Borehole Geology for Well 199-H5-16 (C8948) 4-4

4.2.7 Borehole Geology for Well 199-H4-93 (C8949) 4-5

4.2.8 Borehole Geology for Well 699-95-45B (C8950) 4-5

4.2.9 Borehole Geology for Well 199-H6-8 (C8951) 4-5

4.2.10 Borehole Geology for Well 199-D5-159 (C9377) 4-6

4.2.11 Borehole Geology for Well 199-H4-92 (C9485) 4-7

4.2.12 Borehole Geology for Well 199-H1-46 (C9486) 4-7

4.3 Hydrogeology 4-8

4.4 Contaminants 4-8
5 Waste Management 5-1
5.1 Vadose and Saturated Zone Cuttings 5-1
5.2 Purgewater 5-1
6 Civil Survey 6-1
7 Well Acceptance 7-1
8 References 8-1

Figures

Figure 1-1. New Well Locations in the 100-HR-3 1-3
Figure 3-1. Layne Christenson Layne Christensen Company AP1000 Becker Hammer Rig. 3-1

Tables

Table 1-1. Identification of New Wells in the 100-HR-3 OU 1-2
Table 3-1. Well Construction Information 3-2
Table 3-2. Well Development Information 3-3
Table 3-3. C8792 Split-Spoon Sample 3-4
Table 3-4. C8792 Groundwater Samples Collected During Drilling and Development 3-4
Table 3-5. C8793 Split-Spoon Samples 3-5
Table 3-6. C8793 Groundwater Samples Collected During Drilling and Development 3-5
Table 3-7. C8794 Split-Spoon Samples 3-6
Table 3-8. C8794 Groundwater Samples Collected During Drilling and Development 3-6
Table 3-9. C8929 Split-Spoon Samples 3-7
Table 3-10. C8929 Groundwater Samples Collected During Drilling and Development 3-7
Table 3-11. C8947 Split-Spoon Samples 3-8
Table 3-12. C8948 Split-Spoon Samples 3-9
Table 3-13. C8948 Groundwater Samples Collected During Drilling and Development 3-9
Table 3-14. C8948 Step-Drawdown Test 3-9
Table 3-15. C8949 Split-Spoon Samples 3-10
Table 3-16. C8949 Groundwater Samples Collected During Drilling and Development 3-10
Table 3-17. C8950 Split-Spoon Samples 3-11
Table 3-18. C8950 Groundwater Samples Collected During Drilling and Development 3-11
Table 3-19. C8951 Split-Spoon Samples 3-12

Table 3-20. C8951 Groundwater Samples Collected During Drilling and Development....3-13
Table 3-21. C8951 Step-Drawdown Test....3-13
Table 3-22. C9377 Split-Spoon Samples....3-14
Table 3-23. C9377 Groundwater Samples Collected During Drilling and Development....3-14
Table 3-24. C9377 Step-Drawdown Test....3-15
Table 3-25. C9485 Split-Spoon Samples....3-15
Table 3-26. 9485 Groundwater Samples Collected During Drilling and Development....3-16
Table 3-27. C9486 Split-Spoon Samples....3-16
Table 3-28. 9486 Groundwater Samples Collected During Drilling and Development....3-17
Table 4-1. Hexavalent Chromium (Cr(VI)) Samples....4-9
Table 6-1. Surveyed Well Locations....6-1

Appendices

A Well Documentation for C8792 (199-H4-92)....A-i
B Well Documentation for C8793 (699-97-60)....B-i
C Well Documentation for C8794 (699-97-61)....C-i
D Well Documentation for C8929 (699-93-48C)....D-i
E Well Documentation for C8947 (199-H6-7)....E-i
F Well Documentation for C8948 (199-H5-16)....F-i
G Well Documentation for C8949 (199-H4-93)....G-i
H Well Documentation for C8950 (699-95-45B)....H-i
I Well Documentation for C8951 (199-H6-8)....I-i
J Well Documentation for C9377 (199-D5-159)....J-i
K Well Documentation for C9485 (699-97-47B)....K-i
L Well Documentation for C9486 (199-H1-46)....L-i

Terms

bgs	below ground surface
BTR	Buyer's Technical Representative
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CHPRC	CH2M Hill Plateau Remediation Company
Cr(VI)	hexavalent chromium
D.O.	dissolved oxygen
Ecology	Washington State Department of Ecology
ft	feet
gal	gallons
gpm	gallons per minute
HCl	hydrochloric acid
HEIS	Hanford Environmental Information System
IDW	Investigation-Derived Waste
mg/L	milligrams per liter
NH_3	ammonia
NMLS	Neutron Moisture Logging System
NR	not recorded
NTU	Nephelometric Turbidity Units
OU	operable unit
ppm	parts per million
Ringold unit E	Ringold Formation member of Wooded Island-unit E
RUM	Ringold upper mud unit
SGLS	Spectral Gamma Logging System
SN3	Stoller Newport News Nuclear, Inc.
TD	total depth
VOC	Volatile Organic Compound
WAC	*Washington Administrative Code*

Metric Conversion Chart

Into Metric Units			Out of Metric Units		
If you know	*Multiply by*	*To get*	*If you know*	*Multiply by*	*To get*
Length			**Length**		
inches	25.40	millimeters	millimeters	0.0394	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles (statute)	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.0929	sq. meters	sq. meters	10.764	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.591	sq. kilometers	sq. kilometers	0.386	sq. miles
acres	0.405	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.349	grams	grams	0.0353	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
tons (short)	0.907	ton (metric)	ton (metric)	1.102	tons (short)
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.034	ounces
tablespoons	15	milliliters	liters	2.113	pints
ounces	29.573	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.473	liters	cubic meters	35.315	cubic feet
quarts	0.946	liters	cubic meters	1.308	cubic yards
gallons	3.785	liters			
cubic feet	0.0283	cubic meters			
cubic yards	0.764	cubic meters			
Radioactivity			**Radioactivity**		
picocurie	37	millibecquerel	millibecquerel	0.027	picocurie

1 Introduction

This report presents field-generated records and summarizes field activities performed during the drilling and construction of twelve pump-and-treat wells in the 100-HR-3 Groundwater Operable Unit (OU) of the Hanford Site. Eight extraction/monitoring and four injection/monitoring wells were installed to expand the existing HX and DX pump-and-treat monitoring and remediation network for improved contaminant mass removal and delineation.

The 100-HR-3 OU is located in the north central portion of the Hanford Site along the southern shoreline of the Columbia River, approximately 28 miles north-northwest of Richland, Washington. The 100-HR-3 groundwater OU includes the 100-D and 100-H reactor areas and the area between the reactors informally known as the "Horn".

The primary groundwater contaminants of concern in the 100-HR-3 OU are hexavalent chromium (Cr[VI]), strontium-90, and nitrate. Co-contaminants of concern are uranium and tritium.

Cr(VI) groundwater contamination originated primarily from planned discharges of chromium-treated cooling water to retention basins, planned and unplanned discharges of concentrated sodium dichromate solution used to treat the reactor cooling water, and a planned discharge of reactor coolant effluent during a large-scale infiltration test. Strontium-90 contamination originated from planned and unplanned releases of radiologically-contaminated water from the reactor fuel storage basins and from reactor fuel failure incidents. Nitrate contamination originated primarily from the operational use and subsequent disposal of both nitric acid and ammonia, but it is also present due to septic system and sewer line leakages as well as historical agricultural activities. Tritium originated primarily from reactor operations at 105-D and 105-DR, as well as from discharges at liquid waste disposal facilities in the 100-N Area. Residual uranium contamination is associated with the demolished and remediated 183-H Solar Evaporation Basin Site.

The installation of the twelve groundwater wells supports Ecology et al., (1989), *Hanford Federal Facility Agreement and Consent Order*, and was designed in compliance with requirements of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA). The wells were installed as part of the CERCLA preferred remedial alternative outlined in EPA/ROD/R10-96/134, *Record of Decision for the 100-HR-3 and 100-KR-4 Groundwater Operable Units Interim Action* and will operate in accordance with DOE/RL-96-84, *Remedial Design Report and Remedial Action Work Plan for the 100-HR-3 and 100-KR-4 Groundwater Operable Units Interim Action.* The wells also support objectives discussed in SGW-54542, *Recommendations and Technical Justification for New and Replacement Wells and Re-alignment of Existing Wells Associated with Interim Remedial Actions at 100-D/H Area* and SGW-57584, *Recommendations and Technical Justification for New Wells and Re-alignment of Existing Wells Associated with Interim Remedial Actions at 100-HR-3: FY 2014 and FY 2015*.

Drilling and construction activities occurred from March 2, 2015 through July 6, 2015 and were performed by Stillwater, LLC and its' subcontractor Layne Christensen Company under the direction of CH2M HILL Plateau Remediation Company (CHPRC). Freestone Environmental Services, Inc. provided well site geology and well construction documentation services, Stoller Newport News Nuclear, Incorporated (SN3) provided geophysical logging services.

1.1 Purpose and Scope

The purpose of this document is to compile field records and summarize observations and measurements made during the drilling and construction of the twelve new groundwater wells. This report includes field

notes and forms, well construction details, well development data, and geologic observations. Additional information provided in this report includes civil survey results and records of the management of investigation-derived waste and the well acceptance.

The primary controlling document for the drilling and construction activities was SGW-58281, *Description of Work for the Installation of Twelve New Groundwater Wells in the 100-HR-3 Operable Unit, FY 2014.* Soil and groundwater sampling activities were performed in accordance with addendums 2, 4, 5 and 6 of DOE/RL-2013-35, *100-HR-3 Groundwater Operable Unit Well Installation Sampling and Analysis Plan.*

The locations of the twelve new groundwater wells are shown in Figure 1-1. Well identification and drilling date information are presented in Table 1-1. Borehole geologic logs, well summary sheets, well development and testing data, sample collection summaries, photographic logs, well survey reports, and geophysical logs for each well are located in Appendices A-L. For convenience, all wells are referred to in the text by their well identification number (e.g. C8792).

Table 1-1. Identification of New Wells in the 100-HR-3 OU

Well ID	Well Name	Well Type	Ecology ID Number	Well Activity Dates	
				Drilling Start Date	Well Completion Date
C8792	199-H4-92	Extraction	BIN123	April 8, 2015	April 21, 2015
C8793	699-97-60	Monitoring or Extraction	BIN119	March 18, 2015	May 14, 2015
C8794	699-97-61	Monitoring or Extraction	BIN114	April 30, 2015	May 26, 2015
C8929	699-93-48C	Injection	BIN113	June 18, 2015	July 1, 2015
C8947	199-H6-7	Injection	BIN127	March 26, 2015	April 8, 2015
C8948	199-H5-16	Extraction	BIN124	March 12, 2015	April 6, 2015
C8949	199-H4-93	Extraction	BIN141	April 23, 2015	May 5, 2015
C8950	699-95-45B	Injection	BIN120	April 2, 2015	April 27, 2015
C8951	199-H6-8	Injection	BIN128	March 31, 2015	April 15, 2015
C9377	199-D5-159	Extraction	BIF398	March 2, 2015	March 17, 2015
C9485	699-97-47B	Extraction	BIN107	June 5, 2015	June 12, 2015
C9486	199-H1-46	Extraction	BIN106	June 15, 2015	June 23, 2015

Ecology = Washington State Department of Ecology

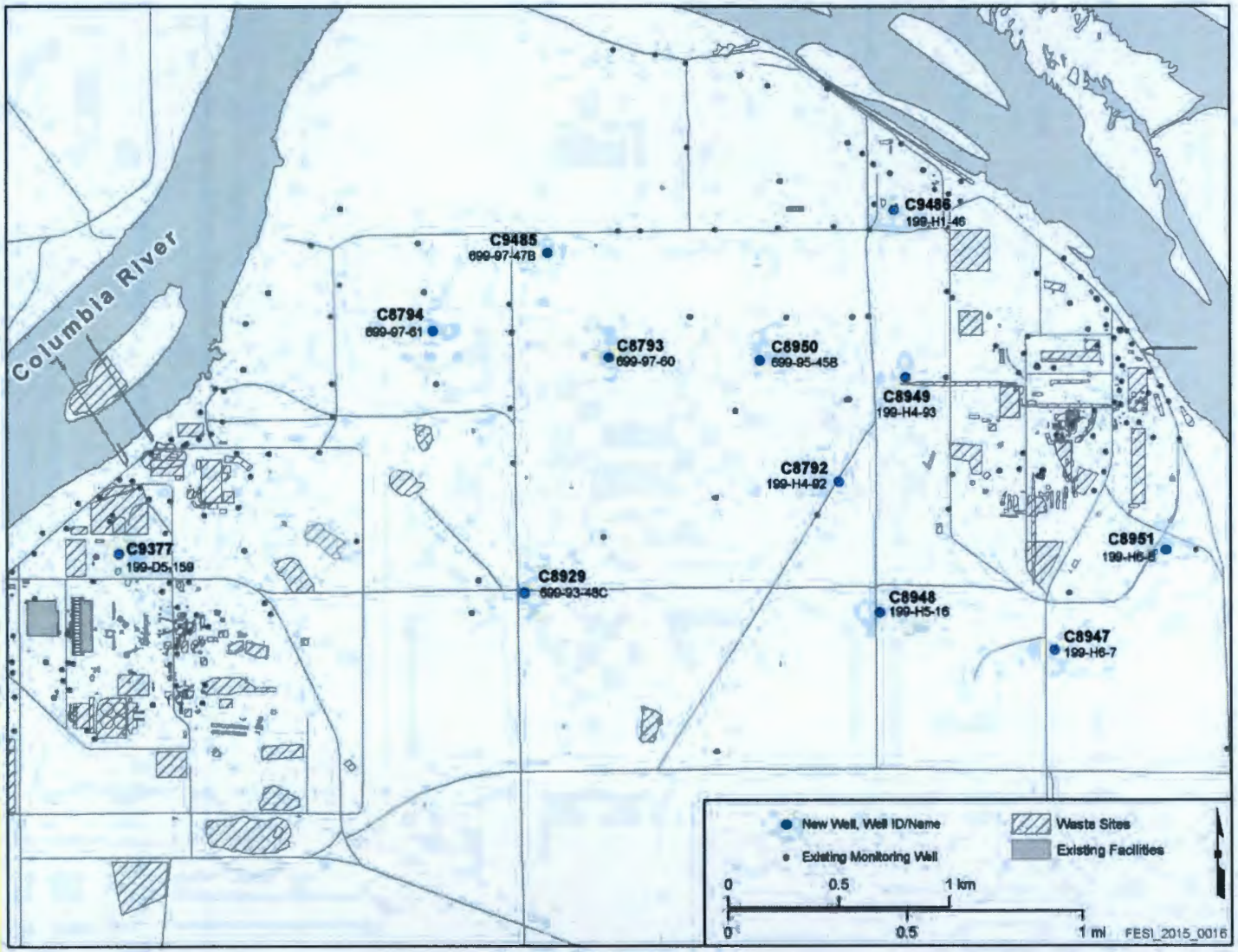


Figure 1-1. New Well Locations in the 100-HR-3

This page intentionally left blank.

2 Field Activities

This section summarizes the field activities associated with the twelve groundwater wells. Drilling, sampling, and construction details common to all of the wells are summarized in Section 2.1. Well-specific information is presented in Tables 3-1 and 3-2, and Section 3.

2.1 General Information

Sections 2.1.1 through 2.1.3 summarize activities common to the drilling, sampling, and installation of the twelve groundwater wells.

2.1.1 Well Drilling and Borehole Logging

The boreholes were drilled and constructed to Washington State standards as detailed in the *Washington Administrative Code* (WAC) 173-160, *Minimum Standards for Construction and Maintenance of Wells.* Well construction activities were recorded and borehole geology was logged in accordance with CHPRC procedures SGRP-PRO-EN-50030 (GRP-EE-02-14.1), *Drilling, Remediating, and Decommissioning Resource Protection Wells and Geotechnical Soil Borings,* and SGRP-PRO-EN-50025 (GRP-EE-01-7.0), *Geologic Logging.*

2.1.1.1 Borehole Geologic Logging and Photography

Detailed descriptions of all drill cuttings were recorded according to CHPRC procedure GRP-EE-01-7.0. Scaled digital photographs were taken in the field to accompany the field description. Geologic logs and drill cutting photographic logs for each borehole are presented in Appendices A through L.

2.1.1.2 Geophysical Logging

Each borehole was logged using SN3's Spectral Gamma Logging System (SGLS) and Neutron Moisture Logging System (NMLS) to identify natural and man-made gamma-emitting radionuclides and moisture levels in each borehole. Borehole logging was performed through the temporary casing to produce a geophysical log of the entire length of the borehole. Log Data Reports of all geophysical logging results, provided by SN3, are presented in Appendices A through L.

2.1.2 Sampling and Health and Safety Screening

Sections 2.1.2.1 through 2.1.2.6 summarize the sampling and health and safety activities common to all twelve wells.

2.1.2.1 Archive Lithologic Sampling

Archive samples were collected from the drill cuttings at each borehole at 5-ft intervals. Samples were placed in labeled pint-sized glass jars and sequential chip tray compartments for archive storage.

2.1.2.2 Sieve Sampling and Analysis

Sediment samples were collected for sieve analysis throughout the saturated zone every 5 ft and subsequently composited over 10-ft intervals. A sieve analysis was performed on each composite sample in accordance with SGRP-PRO-OP-50037 (GRP-EE-05-1.21), *Particle Size Distribution of Soil-Wet Sieve Analysis*. Sieve analyses were used to determine the appropriate screen slot size for each completed well. Sieve analysis results are presented in Appendices A through L.

2.1.2.3 Split-Spoon Sampling

Samples were collected using split-spoon samplers at each borehole for chemical analysis. Split-spoon samples were collected by driving a decontaminated 4-in diameter split-spoon sampler 2.5 ft through the

sampling interval or until refusal. Split-spoon sample depths and associated Hanford Environmental Information System (HEIS) numbers are included for each individual well in Section 2.2.

2.1.2.4 Groundwater Sampling

Groundwater samples were collected near the top, bottom, and/or midpoint of the unconfined, semi-confined and/or confined aquifer during drilling using a temporary submersible pump. When conditions prevented sample collection at the planned depth due to insufficient yield or heaving sands, the borehole was advanced 5 to 10 ft for sample collection.

Boreholes were purged for a minimum of three borehole volumes and until the dissolved oxygen level stabilized at or above 7 mg/L to ensure that groundwater samples are representative of undisturbed groundwater conditions. When sampling conditions did not permit the three-borehole purge volume or dissolved oxygen stabilization, the buyers' technical representative (BTR) was contacted and sampling occurred following approval. Drilling has been shown to create reducing conditions proximate to the borehole, which may result in inaccurate Cr(VI) chemical analysis results.

Groundwater samples were collected by CHPRC nuclear chemical operators after three well volumes had been purged and field parameters (temperature, pH, conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential) were allowed to stabilize within 10 percent of variance over three consecutive measurements as outlined in CHPRC procedure SGRP-PRO-SMP-50043 (GRP-FS-04-G-004), *Operational Monitoring Groundwater Sampling*. Final groundwater samples were also collected at the end of well development for laboratory analysis. All groundwater sample depths and associated HEIS numbers are included in the site specific information for each well (Section 2.2).

2.1.2.5 Radiological Field Screening

A radiological control technician performed radiological surveys of the drill cuttings, geologic samples, temporary drive casing, and driller's control station every morning and afternoon using standard field screening instruments. No field measurements above background levels were reported during drilling activities.

2.1.2.6 Air Quality Monitoring

Air quality monitoring for volatile organic contamination was performed twice daily by an industrial hygienist technician during drilling and well development. The drillers' breathing zone near the wellhead, the fresh drill cuttings, and geologic samples were surveyed for volatile organic compounds using a photo-ionization detector. Additional air quality monitoring was conducted in the breathing zone during groundwater sampling. Reported field measurements above background levels during drilling activities are included in the site specific information for each well (Section 2.2).

2.1.3 Well Construction and Development

Sections 2.1.3.1 through 2.1.3.5 summarize well construction and development properties and activities common to all twelve wells. Specific information regarding well construction and development is presented in Table 3-1 and Section 3. Well summary sheets included in Appendices A through L provide visual representations of each well design as-built.

2.1.3.1 Well Screen and Casing

Wells were constructed using 6-in or 10-in nominal diameter, schedule 10, 304/304L stainless steel casing, continuous wire-wrap well screen, and a sump with end cap. Temporary casing diameters were selected to ensure a 4-in minimum annulus during well construction, as specified under WAC 173-160.

2.1.3.2 Primary Filter Pack

Filter packs for all wells consist of Colorado Silica Sand extending from below the well sump to between 3.5 and 5.3 ft above the top of the screen. Silica sand size varied between 10-20, 8-16, 6-12, and 8-12 mesh. Following the placement of each 10-ft interval of filter pack within a saturated zone, the filter pack was surged using a dual surge block until measured settling met CHPRC well development specifications (i.e. less than 0.1 ft of settling in 15 minutes of surging).

2.1.3.3 Annular Seal

Annular seal materials include 3/8-in bentonite pellets, medium granular bentonite crumbles or chips, and type I/II cement grout. High strength concrete mix was used to seal the final ¼–1 ft of annular space. Annular seal material depths is presented in Table 3-1 and Section 3.

2.1.3.4 Surface Completion

The surface completion consists of a stainless steel protective casing, a 4-ft-by-4-ft concrete pad, and a protective cap with locking hasp. Four painted 3-in diameter steel posts were installed at each corner of the cement pad, extending to 3 ft above the ground surface.

2.1.3.5 Well Development

Well development generally occurred at each well following completion. Development was performed with a submersible pump. Wells were developed at one or more intervals depending on the length of the screen and the height of the water table within the screen. Each interval was pumped until water was less than five nephelometric turbidity units (NTU) and additional water quality parameters (conductivity, pH, and temperature) stabilized. The water level was monitored using an In-Situ Inc., Level TROLL[1] 700 pressure transducer accompanied by an electronic depth sounder where necessary and Rugged Reader[2] datalogger. Final development data is summarized in Table 3-2. Well development was performed in accordance with CHPRC procedure SGRP-PRO-OP-50024 (GRP-EE-01-6.3), *Well Development and Testing*.

2.1.3.6 Washington State Department of Ecology Identification

Well tags with unique Washington State Department of Ecology identification numbers were affixed to the protective casing of each well. These identification numbers are located in Table 1-1.

---

[1] Level TROLL® Instrument is a registered trademark of In-Situ, Inc., Fort Collins, Colorado.

[2] RuggedReader® Handheld Computer is a registered trademark of In-Situ, Inc., Fort Collins, Colorado.

This page intentionally left blank.

3 Site Specific Information for Groundwater Wells

This section summarizes the borehole drilling and sampling, split-spoon and groundwater sampling, and well construction, development, and testing activities specific to each well. Well construction information for each well is summarized in Table 3-1. Well development information for each well is summarized in Table 3-2.

3.1 Well 199-H4-92 (C8792)

Borehole C8792 was drilled from April 9, 2015 to April 15, 2015 by Layne Christensen Company using an AP1000 Becker Hammer Drill rig (Figure 3-1), dual-wall air percussion, and both 18-in nominal diameter single-wall and 10¾-in nominal diameter dual-wall threaded carbon steel casing to advance to a total depth (TD) of 58.84 feet below ground surface (ft bgs). Approximately 1-2 gallons of water per foot of advance (approximately 90 gallons total) were added during drilling for dust suppression in the vadose zone and to loosen casing in the saturated zone. All temporary casing was removed during well construction.

Figure 3-1. Layne Christenson Layne Christensen Company AP1000 Becker Hammer Rig.

Table 3-1. Well Construction Information

Well ID	Total Depth Drilled (ft)	Permanent Screen and Casing[a]					Surface Seal[b] (ft)	Annular Seal[c] (ft)	Bentonite Seal[d] (ft)	Primary Filter Pack[e] (ft)	Filter Pack Size (ft)
		Casing Size	Blank Casing (ft)	Screen (ft)	Screen Slot Size (in)	Sump/ End Cap (ft)					
C8792	58.8	10-in	+2.1–30.9	30.9–51.0 51.0–56.0	75 20	51.0–56.0	0–13.0	13.0–26.8	26.8–27.2	27.2–50.6 50.6–58.8	6–12 10–20
C8793	89.0	6-in	+2.1–74.0	74.0–84.1	20	84.1–87.1	0–67.4	N/A	67.4–70.3	70.3–89.0	10–20
C8794	99.2	6-in	+2.0–82.3	82.3–92.3	20	92.3–95.3	0–10.9	10.9–36.0 36.0–69.4[b]	69.4–77.0	77.0–99.2	10–20
C8929	67.0	6-in	+2.1–31.7	31.7–61.8	75	61.8–64.8	0–13.9	13.9–28.1	N/A	28.1–67.0	6–12
C8947	54.7	6-in	+2.0–23.0	23.0–43.0	75	43.0–46.0	0–14.1	14.1–17.1	17.1–19.5 47.5–54.5	19.5–47.5	6–12
C8948	68.2	10-in	+1.9–34.2	34.2–54.3 54.3–60.0	50 60	60.0–64.9	0–12.8	12.8–28.5	28.5–29.2	29.2–52.4 52.4–60.5 60.5–68.2	8–16 8–12 8–16
C8949	58.0	10-in	+1.9–31.9	31.9–51.9 51.9–56.9	75 20	51.9–56.9	0–11.2	11.2–27.2	27.2–28.0	28.0–52.1 52.1–57.9	6–12 10–20
C8950	46.0	6-in	+1.4–20.2	20.2–40.2	50	40.2–43.2	0–10.1	10.1–13.9	13.9–15.8	15.8–46.0	8–16
C8951	74.6	6-in	+1.8–39.4	39.4–44.4 44.4–64.4 64.4–69.4	70 75 50	69.4–72.4	0–14.1	14.1–33.1	33.1–34.5	34.5–64.3 64.3–74.6	6–12 8–16
C9377	106.5	6-in	+2.1–73.7	73.7–98.7	75	98.7–104.0	0–15.7	15.7–68.5	68.5–69.8	69.8–106.5	6–12
C9485	38.4	10-in	+2.4–22.6	22.6–32.9 32.9–37.9	75 20	32.9–37.9	0–14.0	14.0–18.4	18.4–19.0	19.0–33.4 33.4–37.9	6–12 10–20
C9486	50.4	10-in	+1.5–20.4	20.4–40.4 40.4–45.4	50 20	40.4–45.4	0–13.0	13.0–15.4	15.4–16.2	16.2–40.1 40.1–48.5	8–16 10–20

All measurements in feet below ground surface unless otherwise marked.

a. Schedule 10, Type 304/304L Stainless Steel

b. Type I/II cement grout

c. Medium bentonite chips or crumbles

d. Coated bentonite pellets (3/8-in)

e. Silica Sand

+ = above ground surface

N/A = not applicable

Table 3-2. Well Development Information

Well ID	Static Water Level (ft bgs and date)	Intake Depth (ft bgs)	Duration (minutes)	Average Flow Rate (gpm)	Final Turbidity (NTU)	Final Drawdown (ft)	Total Gallons Pumped
C8792	33.7 (4/22/15)	43.96	81	40	2.44	9.8	3,240
C8793	33.4 (5/27/15)	81	105	5	4.39	36.5	525
C8794	34.1 (5/27/15)	86.6	83	10	2.33	41.0	830
C8929	43.5 (7/6/15)	57.8	80	101	0.45	9.0	8,080
C8947[a]	41.0 (4/8/15)	–	–	–	–	–	–
C8948	37.4 (4/1/15)	56.5	66	57	3.88	9.2	3,755
C8949	44.3 (5/7/15)	54.0	79	220	1.08	1.6	17,380
C8950	31.0 (4/28/15)	37.5	173	10.1	0.27	1.6	1,750
C8951	42.2 (5/1/15)	65.7	175	107	3.63	6.8	18,725
C9377	85.9 (3/23/15)	99.7	86	60	0.63	5.7	5,160
C9485	29.1 (6/15/15)	33.4	150	3	3.12	9.1	390
C9486	32.8 (6/24/15)	39.5	143	12	4.05	6.9	1,645

a. C8947 was not developed due to the lack of water in the borehole.

bgs = below ground surface

ft = feet

gpm = gallons per minute

NTU = nephelometric turbidity unit

A split-spoon soil sample was collected near the bottom of the unconfined aquifer (Table 3-3). Pumped groundwater samples were collected near the bottom of the unconfined aquifer during drilling and at the midpoint of the screened interval during development using a submersible pump (Table 3-4). Due to a slow recharge rate during pumping, the CHPRC BTR accepted sampling prior to a three-borehole volume purge. The borehole was logged to 45.25 ft using a NMLS and to 54.0 ft using a SGLS on April 16, 2015.

Table 3-3. C8792 Split-Spoon Sample

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
4/14/15	48.0–51.0	Split-spoon	Soil	25	B30BP5

ft bgs = feet below ground surface HEIS = *Hanford Environmental Information System*

Well construction was performed from April 17, 2015 to April 21, 2015. The well was constructed as a 10-in diameter extraction well with a 20-ft long 75-slot screened interval above a 5-ft long 20-slot sump with end cap. Centralizers were installed above and below the 75-slot screen. The annulus was filled from depth to surface with 8.2 ft of 10-20 mesh filter pack around the sump, 23.4 ft of 6-12 mesh filter pack around the screen, 0.4 ft of bentonite pellets, 13.8 ft of bentonite chips, and 13 ft of cement grout.

The well was developed on April 22, 2015 with a with a fifteen horsepower submersible pump. Well development information is presented in Table 3-2. Static water level was measured before well development at 33.72 ft bgs on April 21, 2015.

Table 3-4. C8792 Groundwater Samples Collected During Drilling and Development

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Volume Purged (gal)	Turbidity (NTU)	D.O. at Sample Collection (mg/L)	HEIS #
4/14/15	48.4	Groundwater pumped	1	60	259	4.75	B30BR4, B30BR5
4/22/15	43.96	Groundwater pumped	40.2	3256.2	1.25	7.60	B30BP6, B30BP7, B30BP8, B30BP9, B30BY7

D.O. = dissolved oxygen
ft bgs = feet below ground surface
gpm = gallons per minute
mg/L = milligrams per liter
HEIS = *Hanford Environmental Information System*
gal = gallon(s)
NTU = nephelometric turbidity unit

3.2 Well 699-97-60 (C8793)

Borehole C8793 was drilled from May 18, 2015 to April 22, 2015 jointly by Stillwater, LLC using a Bucyrus-Erie 22-W Series 3 cable-tool drill rig and by Layne Christensen Company using an AP1000 Becker Hammer Drill rig. The borehole was drilled by core barrel with 13½-in nominal diameter casing by the cable-tool rig to 53.9 ft bgs and then by dual-wall air percussion and 10¾-in nominal diameter casing with the Becker Hammer rig to TD at 89.03 ft bgs. The borehole was drilled approximately 4 ft below the base of the first water-bearing unit within the Ringold upper mud unit (RUM). All temporary casing was removed during well construction.

Split-spoon soil samples were collected near the top, throughout the middle, and at the bottom of the unconfined aquifer (Table 3-5). Pumped groundwater samples were collected near the top, middle, and bottom of the unconfined aquifer during drilling and at the bottom of the screened interval during development using a submersible pump (Table 3-6). Due to a slow recharge rate during pumping, the CHPRC BTR accepted sampling prior to a three-borehole volume purge. The borehole was logged to 34.25 ft using a NMLS and to 88.0 ft using SGLS on April 9, 2015 and April 23, 2015.

Table 3-5. C8793 Split-Spoon Samples

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
3/23/15	33.22–35.72	Split-spoon	Soil	80	B30JM7
4/06/15	49.8–52.3	Split-spoon	Soil	100	B30JM8
4/21/15	65.1–67.6	Split-spoon	Soil	100	B30JM9
4/21/15	76.0–78.5	Split-spoon	Soil	100	B30JN0
4/22/15	86.1–88.7	Split-spoon	Soil	100	B30JN1, B30JN2

ft bgs = feet below ground surface
HEIS = Hanford Environmental Information System

Well construction was performed from May 11, 2015 to May 14, 2015. The well was constructed as a 6-in diameter monitoring well with a 10-ft long 20-slot screened interval. Centralizers were not installed during construction due to a narrow annulus. Approximately 400 gallons of water were added in efforts to remove a bentonite plug in the casing that formed during construction. The annulus was filled from depth to surface with 1.7 ft of natural slough, 22.2 ft of 10-20 mesh filter pack around the screen, 3 ft of bentonite pellets, and 69.4 ft of cement grout.

The well was developed on May 27, 2015 with a with a one-half horsepower submersible pump. Well development information is presented in Table 3-2. Static water level was measured prior to well development at 33.4 ft bgs on May 27, 2015.

Table 3-6. C8793 Groundwater Samples Collected During Drilling and Development

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Volume Purged (gal)	Turbidity (NTU)	D.O. at Sample Collection (mg/L)	HEIS #
3/23/15	39.81	Groundwater pumped	1.07	47.1	>1000	6.82	B30JN8, B30JN9
4/08/15	49.7	Groundwater pumped	4.5	320	25.5	8.72	B30JP0, B30JP1, B30JP2
4/22/15	79.0	Groundwater pumped	2	132	49.4	6.98	B30JP3, B30JP4
5/27/15	81.0	Groundwater pumped	5	540	4.39	NR	B30JN3, B30JN4, B30JN5, B30JN6, B30JN7, B30JP5

D.O. = dissolved oxygen
ft bgs = feet below ground surface
gpm = gallons per minute
NR = not recorded
HEIS = *Hanford Environmental Information System*
gal = gallon(s)
NTU = nephelometric turbidity unit
mg/L = milligrams per liter

3.3 Well 699-97-61 (C8794)

Borehole C8794 was drilled from April 30, 2015 to May 11, 2015 by Layne Christensen Company with an AP1000 Becker Hammer Drill rig (Figure 3-1), using dual-wall air percussion to advance to a TD of 99.1 ft bgs. Two sizes of threaded carbon steel temporary casing were used to advance to TD: 13½-in diameter outer casing to 69.6 ft bgs and 10¾-in diameter outer casing to 98.7 ft bgs. Approximately 2 to 3 gallons of water were added per 5 ft of advance (approximately 50 gallons total) during drilling for dust suppression in the vadose zone and to loosen casing within the saturated zone. The borehole was drilled approximately 4 ft below the base of the first water-bearing unit within the RUM. All temporary casing was removed during well construction.

Split-spoon soil samples were collected during drilling near the top, throughout the middle, and at the bottom of the unconfined aquifer (Table 3-7). Pumped groundwater samples were collected near the top, middle, and bottom of the unconfined aquifer during drilling and at the bottom of the screened interval during development using a submersible pump (Table 3-8). The borehole was logged to 33.76 ft using a NMLS on May 6, 2015 and to 92.0 ft using a SGLS on May 12, 2015.

Table 3-7. C8794 Split-Spoon Samples

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
5/04/15	37.5–40.0	Split-spoon	Soil	40	B30JR9
5/05/15	51.4–53.9	Split-spoon	Soil	100	B30JT0
5/07/15	77.9–80.4	Split-spoon	Soil	100	B30JT1
5/07/15	88.1–90.6	Split-spoon	Soil	100	B30JT2
5/11/15	98.4–100.9	Split-spoon	Soil	100	B30JT3,B30JT4,B30JT5

ft bgs = feet below ground surface
HEIS = Hanford Environmental Information System

Table 3-8. C8794 Groundwater Samples Collected During Drilling and Development

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Volume Purged (gal)	Turbidity (NTU)	D.O. at Sample Collection (mg/L)	HEIS #
5/04/15	38.7	Groundwater pumped	10.3	278	7.23	7.92	B30JP6, B30JP7
5/05/15	49.9	Groundwater pumped	15.8	790	180	7.58	B30JP8, B30JP9
5/07/15	88.1	Groundwater pumped	1.25	43.8	>1,000	5.18	B30JR0,B30JR1,B30JR2
5/27/15	86.0	Groundwater pumped	10	83	2.33	NR	B30JR3, B30JR4, B30JR5, B30JR6, B30JR7

D.O. = dissolved oxygen
ft bgs = feet below ground surface
gpm = gallons per minute
NR = not recorded
HEIS = *Hanford Environmental Information System*
gal = gallon(s)
NTU = nephelometric turbidity unit
mg/L = milligrams per liter

Well construction was performed from May 19, 2015 to May 26, 2015.The well was constructed as a 6-in diameter extraction well with a 10-ft long 20-slot screened interval. Centralizers were not installed during construction due to a narrow annulus. The annulus was filled from depth to surface with 22.2 ft of 10-20 mesh filter pack around the screen, 7.6 ft of bentonite pellets, 33.4 ft of cement grout, 25.1 ft of bentonite chips, and 10.9 of cement grout.

The well was developed on May 27, 2015 with a with a one-half horsepower submersible pump. Well development information is presented in Table 3-2. Static water level was measured prior to well development at 34.2 ft bgs on May 11, 2015.

3.4 Well 699-93-48C (C8929)

Borehole C8929 was drilled from June 18, 2015 to June 23, 2015 by Layne Christensen Company with an AP1000 Becker Hammer Drill rig (Figure 3-1), using dual-wall air percussion and 10¾-in threaded carbon steel temporary casing to advance to a TD of 67.0 ft bgs. Approximately 1 to 5 gallons of water of water were added per 5 ft if advance (approximately 165 gallons) during drilling for dust suppression in the vadose zone and to loosen casing within the saturated zone.

A split-spoon soil sample was collected near the middle of the unconfined aquifer (Table 3-9). Pumped groundwater samples were collected during drilling near the midpoint of the aquifer and during development near the bottom of the screened interval using a submersible pump (Table 3-10). The borehole was logged to 41.0 ft using a NMLS and to 66.0 ft using a SGLS on June 24, 2015.

Table 3-9. C8929 Split-Spoon Samples

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
6/18/15	49.4–51.9	Split-spoon	Soil	75	B30JY8

ft bgs = feet below ground surface
HEIS = *Hanford Environmental Information System*

Table 3-10. C8929 Groundwater Samples Collected During Drilling and Development

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Volume Purged (gal)	Turbidity (NTU)	D.O. at Sample Collection (mg/L)	HEIS #
6/23/15	48.8	Groundwater pumped	1.6	92.8	153	7.53	B30K16, B30K17
7/06/15	57.78	Groundwater pumped	101	8,080	1.04	8.02	B30K00, B30K01, B30K02, B30K03, B30K04, B30K05, B30K06, B30K07, B30K08 B30K09, B30K10, B30K11, B30K12, B30K13, B30K14, B30K15, B30K18

D.O. = dissolved oxygen
ft bgs = feet below ground surface
gpm = gallons per minute
HEIS = *Hanford Environmental Information System*
NTU = nephelometric turbidity unit
mg/L = milligrams per liter

Well construction was performed from June 25, 2015 to July 1, 2015. The well was constructed as a 6-in diameter injection well with a 30-ft long 75- slot screened interval. Centralizers were not installed during construction due to a narrow annulus. The annulus was filled from depth to surface with 38.9 ft of 6-12 mesh filter pack around the screen, 14.2 ft of bentonite crumbles, and 13.9 ft of cement grout. The drilling contractor received concurrence to exclude the bentonite pellet seal from the BTR.

The well was developed on July 6, 2015 using a five horsepower submersible pump. Well development information is presented in Table 3-2. Static water level was measured prior to well development at 41.03 ft bgs.

3.5 Well 199-H6-7 (C8947)

Borehole C8947 was drilled from March 26, 2015 to March 31, 2015 by Layne Christensen Company with an AP1000 Becker Hammer Drill rig (Figure 3-1), using dual-wall air percussion, and dual-wall 10¾-in nominal diameter threaded carbon steel temporary casing to advance to a TD of 54.7 ft bgs. Approximately 1 to 2 gallons of water per foot of advance (approximately 70 gallons total) were added during drilling in the vadose zone for dust suppression.

Split-spoon soil samples were collected near the top of the expected unconfined aquifer and near the bottom of the borehole (Table 3-11). The borehole was logged to 53.0 ft using a NMLS and to 54.0 ft using a SGLS on March 31, 2015.

Table 3-11. C8947 Split-Spoon Samples

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
3/30/15	25.6–28.1	Split-spoon	Soil	80	B30JB0, B30JB1, B30J99
3/30/15	46.25–48.75	Split-spoon	Soil	100	B30JB2

ft bgs = feet below ground surface HEIS = *Hanford Environmental Information System*

Well construction was performed from April 7, 2015 to April 8, 2015. The well was constructed as a 6-in diameter injection well with a 20-ft long 75-slot screened interval. The annulus was filled from depth to surface with 7 ft of bentonite pellet seal, 28 ft of 6-12 mesh filter pack around the screen, 2.4 ft of bentonite pellets, 3 ft of bentonite chips, and 14.1 ft of cement grout. This well was not developed due to an unexpectedly low level of groundwater encountered at this location. Static water level was measured at 40.98 ft bgs on April 8, 2015.

3.6 Well 199-H5-16 (C8948)

Borehole C8948 was drilled from March 12, 2015 to March 25, 2015 by Layne Christensen Company with an AP1000 Becker Hammer Drill rig (Figure 3-1), using dual-wall air percussion, and both 18-in nominal diameter single-wall and 10¾-in nominal diameter dual-wall threaded carbon steel casing to advance to a TD of 68.5 ft bgs. Approximately 1 to 2 gallons of water per foot of advance (approximately 155 gallons total) were added during drilling in the vadose zone for dust suppression and to loosen casing in the saturated zone. All temporary casing was removed during well construction.

A split-spoon soil sample was collected near the midpoint of the unconfined aquifer (Table 3-12). Pumped groundwater samples were collected near the midpoint of the unconfined aquifer during drilling and near the bottom of the screened interval during development (Table 3-13). The borehole was logged to 42.25 ft using a NMLS and to 65.0 ft using a SGLS on March 26, 2015.

Table 3-12. C8948 Split-Spoon Samples

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
3/24/15	45.6–47.6	Split-spoon	Soil	75	B30J83

ft bgs = feet below ground surface HEIS = *Hanford Environmental Information System*

Well construction was performed from March 31, 2015 to April 6, 2015. The well was constructed as a 10-in diameter extraction well with a 20-ft long 50-slot screened interval and a 5-ft long 60-slot screened interval. Centralizers were installed above and below the screen and at approximately 14 ft bgs. The annulus was filled with 7.7 ft of 8-16 mesh filter pack at the base, 8.1 ft of 8-12 mesh filter pack around the 60-slot screen, 23.2 ft of 8-16 mesh filter pack around the 50-slot screen, 0.7 ft of bentonite pellets, 15.7 ft of bentonite chips, and 12.8 ft of cement grout.

The well was developed from April 1 to April 2, 2015 with a with a five horsepower submersible pump. Well development information is presented in Table 3-2. Static water level was measured at 37.9 ft bgs on April 6, 2015.

Table 3-13. C8948 Groundwater Samples Collected During Drilling and Development

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Volume Purged (gal)	Turbidity (NTU)	D.O. at Sample Collection (mg/L)	HEIS #
3/24/15	46.3	Groundwater pumped	2.5	150	18.2	10.23	B30J84, B30J85, B30J86
4/02/15	56.54	Groundwater pumped	100	6900	6.51	8.69	B30J87, B30J88, B30J89, B30J92, B30J90, B30J93, B30J91

D.O. = dissolved oxygen
ft bgs = feet below ground surface
gpm = gallons per minute
HEIS = *Hanford Environmental Information System*
NTU = nephelometric turbidity unit
mg/L = milligrams per liter

Table 3-14. C8948 Step-Drawdown Test

Step Interval	Intake Depth (ft bgs)	Duration (min)	Discharge (gpm)	Volume Pumped (gal)	Final Drawdown (ft)
1	56.5	30	37	1,110	2.9
2		51	73	3,825	7.5
3		30	102	3,060	10.0

ft bgs = feet below ground surface
gpm = gallons per minute
min = minute(s)
gal = gallon(s)

A step-drawdown test was conducted following well development on April 2, 2015, using a five horsepower submersible pump and in accordance with SGRP-PRO-OP-50024. During the step-drawdown test, pumping was performed at three progressively increasing constant flow rates for a minimum of thirty minutes per interval. Step-drawdown test information is included in Table 3-14.Construction at this well was completed on April 6, 2015 following well development and the step-drawdown test.

3.7 Well 199-H4-93 (C8949)

Borehole C8949 was drilled from April 23, 2015 to April 28, 2015 by Layne Christensen Company with an AP1000 Becker Hammer Drill rig (Figure 3-1), using dual-wall air percussion, and both 18-in nominal diameter single-wall and 10¾-in nominal diameter dual-wall threaded carbon steel casing to advance to a TD of 58.5 ft bgs. Approximately 1 to 2 gallons of water per foot of advance, approximately 65 gallons total, were added during drilling in the vadose zone for dust suppression and to loosen casing in the saturated zone. Low concentrations of Volatile Organic Compounds (VOCs) and ammonia (NH_3) were detected during drilling in drill casing at C8949 on April 28, 2015, but not within the breathing zone. All temporary casing was removed during well construction.

A split-spoon soil sample was collected near the midpoint of the unconfined aquifer (Table 3-15). One borehole volume of groundwater was air lifted from the borehole prior to purging the borehole with a submersible pump during preparation for groundwater sample collection. Pumped groundwater samples were collected near the midpoint of the unconfined aquifer during drilling and near the bottom of the screened interval during development (Table 3-16). The borehole was logged to 47.75 ft using a NMLS and to 55.0 ft using a SGLS on April 29, 2015.

Table 3-15. C8949 Split-Spoon Samples

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
4/07/15	45.4–47.9	Split-spoon	Soil	N/A	B30JH5

ft bgs = feet below ground surface HEIS = *Hanford Environmental Information System*

Table 3-16. C8949 Groundwater Samples Collected During Drilling and Development

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Volume Purged (gal)	Turbidity (NTU)	D.O. at Sample Collection (mg/L)	HEIS #
4/28/15	48.2	Groundwater pumped	6	132	10.8	8.05	B30JJ7, B30JJ8
5/07/15	51.1	Groundwater pumped	220	17,400	8.66	8.19	B30JH6, B30JH7, B30JH8, B30JJ0, B30JH9, B30JJ1

D.O. = dissolved oxygen
ft bgs = feet below ground surface
gpm = gallons per minute
HEIS = *Hanford Environmental Information System*
NTU = nephelometric turbidity unit
mg/L = milligrams per liter

Well construction was performed from April 30, 2015 to May 5, 2015. The well was constructed as a 10-in diameter extraction well with a 15-ft long 75-slot screened interval and a 5-ft long 20-slot sump with end cap. Centralizers were installed above and below the 75-slot screen. The annulus was filled from depth to surface with 5.82 ft 10-20 mesh filter pack around the sump, 24.1 ft 6-12 filter pack around the 75-slot screen, 0.8 ft bentonite pellets, 16.0 ft bentonite chips and 11.2 ft cement grout.

The well was developed on May 7, 2015 with a with a five horsepower submersible pump. Well development information is presented in Table 3-2. Static water level was measured at 43.82 ft bgs on May 7, 2015.

3.8 Well 699-95-45B (C8950)

Borehole C8950 was drilled from April 2, 2015 to April 7, 2015 by Layne Christensen Company with an AP1000 Becker Hammer Drill rig (Figure 3-1), using dual-wall air percussion and 10¾-in nominal diameter dual-wall threaded carbon steel casing to advance to a TD of 46.0 ft bgs. Approximately 1 to 2 gallons of water per foot of advance (approximately 70 gallons total) were added during drilling in the vadose zone for dust suppression. Low concentrations (0.4 parts per million [ppm]) of VOCs were detected at the drill rig on April 7, 2015. All temporary casing was removed during well construction.

A split-spoon soil sample was collected near the midpoint of the unconfined aquifer (Table 3-17). Pumped groundwater samples were collected near the midpoint of the unconfined aquifer during drilling and near the bottom of the screened interval during development (Table 3-18). Due to a slow recharge rate during pumping, the CHPRC BTR accepted sampling prior to a three-borehole volume purge. The borehole was logged to 44.5 ft using a NMLS and to 45.0 ft using a SGLS on April 8, 2015.

Table 3-17. C8950 Split-Spoon Samples

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
4/07/15	36.3–38.8	Split-spoon	Soil	50	B30JL6

ft bgs = feet below ground surface HEIS = *Hanford Environmental Information System*

Table 3-18. C8950 Groundwater Samples Collected During Drilling and Development

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Volume Purged (gal)	Turbidity (NTU)	D.O. at Sample Collection (mg/L)	HEIS #
4/07/15	36.3	Groundwater pumped	6	366	2.87	9.55	B30JM3, B30JM4
4/28/15	38.32	Groundwater pumped	10.8	1868.4	0.17	8.19	B30JL7, B30JL8, B30JL9, B30JM1, B30JM0, B30JM2

D.O. = dissolved oxygen
ft bgs = feet below ground surface
gpm = gallons per minute
HEIS = *Hanford Environmental Information System*
NTU = nephelometric turbidity unit
mg/L = milligrams per liter

Well construction was performed from April 23, 2015 to April 27, 2015. The well was constructed as a 6-in diameter extraction well with a 20-ft long 50-slot screened interval. Centralizers were not installed during construction due to a narrow annulus. The annulus was filled from depth to surface with 30.2 ft 8-16 mesh filter pack around the 50-slot screen, 2.0 ft bentonite pellets, 3.8 ft bentonite crumbles and 10.0 ft cement grout.

The well was developed on April 28, 2015 with a with a one-half horsepower submersible pump. Well development information is presented in Table 3-2. Static water level was measured at 30.75 ft bgs on April 7, 2015.

3.9 Well 199-H6-8 (C8951)

Borehole C8951 was drilled from March 31, 2015 to April 1, 2015 by Layne Christensen Company with an AP1000 Becker Hammer Drill rig (Figure 3-1), using dual-wall air percussion and 10¾-in nominal diameter dual-wall threaded carbon steel casing to advance to a TD of 74.6 ft bgs. Approximately 1 to 2 gallons of water per foot of advance, approximately 65 gallons total, were added during drilling in the vadose zone for dust suppression. All temporary casing was removed during well construction.

Split-spoon soil samples were collected near the top and bottom of the unconfined aquifer (Table 3-19). Pumped groundwater samples were collected near the top and bottom of the unconfined aquifer during drilling and near the bottom of the screened interval during development (Table 3-20). The CHPRC BTR accepted sampling upon groundwater parameter stabilization (prior to a three-borehole volume purge) during drilling. The borehole was logged to 43.5 ft using a NMLS and to 73.0 ft using a SGLS on April 2, 2015.

Table 3-19. C8951 Split-Spoon Samples

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
3/31/15	45.6–48.1	Split-spoon	Soil	50	B30JD7
4/01/15	57.1–59.6	Split-spoon	Soil	70	B30JD8

ft bgs = feet below ground surface HEIS = *Hanford Environmental Information System*

Well construction was performed from April 9, 2015 to April 15, 2015. The well was constructed as a 6 in diameter injection well with a 5-ft long 70-slot screen, 20-ft long 75-slot screen, and 5-ft long 50-slot screen. Centralizers were not installed during construction due to a narrow annulus. The annulus was filled with 10.3 ft 8-16 mesh filter pack around the 50-slot section of screen at the base, 29.8 ft 6-12 mesh filter pack around the 75-slot and 70-slot screen, 1.4 ft bentonite pellets, 19.0 ft bentonite crumbles and 14.1 ft cement grout.

The well was developed on April 16, 2015 with a with a five horsepower submersible pump. Well development information is presented in Table 3-2. Static water level was measured at 42.01 ft bgs on April 14, 2015.

A step-drawdown test was conducted following well development on April 16, 2015, using a five horsepower submersible pump and in accordance with SGRP-PRO-OP-50024. During the step-drawdown

test, pumping was performed at three progressively increasing constant flow rates for a minimum of thirty minutes per interval. Step-drawdown test information is included in Table 3-21.

Table 3-20. C8951 Groundwater Samples Collected During Drilling and Development

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Volume Purged (gal)	Turbidity (NTU)	D.O. at Sample Collection (mg/L)	HEIS #
4/01/15	49.0	Groundwater pumped	1.6	195	93	7.82	B30JH0, B30JH1
4/01/15	59.6	Groundwater pumped	1.1	76	903	6.67	B30JH2, B30JH3
4/16/15	65.74	Groundwater pumped	107	18,725	3.32	9.27	B30JD9, B30JF0, B30JF1, B30JF3, B30JF5, B30JF6, B30JF7, B30JF2, B30JF4, B30JF8, B30JF9, B30JH4

D.O. = dissolved oxygen
ft bgs = feet below ground surface
gpm = gallons per minute
HEIS = *Hanford Environmental Information System*
NTU = nephelometric turbidity unit
mg/L = milligrams per liter

Table 3-21. C8951 Step-Drawdown Test

Step Interval	Intake Depth (ft bgs)	Duration (min)	Discharge (gpm)	Volume Pumped (gal)	Final Drawdown (ft)
1	65.7	30	39	1,170	2.2
2		33	81	2,673	4.6
3		30	122	3,660	7.0

ft bgs = feet below ground surface
gpm = gallons per minute
min = minute(s)
gal = gallon(s)

3.10 Well 199-D5-159 (C9377)

Borehole C9377 was drilled from March 2, 2015 to March 4, 2015 by Layne Christensen Company with an AP1000 Becker Hammer Drill rig (Figure 3-1), using dual-wall air percussion, and 10¾-in nominal diameter dual-wall threaded carbon steel casing to advance to a TD of 106.5 ft bgs. Approximately one gallon of water was added per foot of drilling for dust suppression and to and to loosen casing in the saturated zone, and approximately fifty gallons were added to flush out the borehole after drilling was complete.

Split-spoon soil samples were collected within the unconfined aquifer (Table 3-22). Low concentrations (0.8 ppm) of NH_3 were detected at split spoon sample collection from 91.7-94.2 ft bgs on March 3, 2015, but not within the breathing zone. Pumped groundwater samples were collected near the bottom of the unconfined aquifer during drilling and at the bottom of the screened interval during development

(Table 3-23). The borehole was logged to 90.5 ft using a NMLS and to 106.0 ft using a SGLS on March 5, 2015.

Table 3-22. C9377 Split-Spoon Samples

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
3/03/15	39.9–42.4	Split-spoon	Soil	30	B30JK0,
3/03/15	91.7–94.2	Split-spoon	Soil	75	B30JK4
3/04/15	100.0–102.5	Split-spoon	Soil	25	B30JK5

ft bgs = feet below ground surface HEIS = *Hanford Environmental Information System*

Well construction was performed from March 10, 2015 to March 17, 2015. The well was constructed as a 6-in diameter extraction well with a 25-ft long 75-slot screen. Centralizers were not installed during construction due to a narrow annulus. The annulus was filled from depth to surface with 36.7 ft of 6-12 mesh filter pack around the 75-slot screen, 1.3 ft bentonite pellets, 52.8 ft bentonite chips and 15.7 ft cement grout.

The well was developed on March 23, 2015 with a with a five horsepower submersible pump. Well development information is presented in Table 3-2. Static water level was measured at 82.67 ft bgs on March 4, 2015.

Table 3-23. C9377 Groundwater Samples Collected During Drilling and Development

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Volume Purged (gal)	Turbidity (NTU)	D.O. at Sample Collection (mg/L)	HEIS #
3/03/15	91.4	Groundwater pumped	5.5	190	57.4	9.66	B30JL2, B30JL3
3/23/15	97.23	Groundwater pumped	60	5,100	0.63	NA	B30JK6, B30JK7, B30JK8, B30JL0, B30JL1, B30JL5

D.O. = dissolved oxygen HEIS = *Hanford Environmental Information System*
ft bgs = feet below ground surface NTU = nephelometric turbidity unit
gpm = gallons per minute mg/L = milligrams per liter

A step-drawdown test was conducted following well development on March 24, 2015, using a five horsepower submersible pump and in accordance with SGRP-PRO-OP-50024. During the step-drawdown test, pumping was performed at three progressively increasing constant flow rates for a minimum of thirty minutes per interval. Step-drawdown test information is included in Table 3-24.

Table 3-24. C9377 Step-Drawdown Test

Step Interval	Intake Depth (ft bgs)	Duration (min)	Discharge (gpm)	Volume Pumped (gal)	Final Drawdown (ft)
1	96.9	32	46	1,472	4.3
2		51	76	3,876	6.7
3		30	91	2,730	8.8

ft bgs = feet below ground surface; min = minute(s)
gpm = gallons per minute; gal = gallon(s)

3.11 Well 699-97-47B (C9485)

Borehole C9485 was drilled from June 5, 2015 to June 9, 2015 by Layne Christensen Company with an AP1000 Becker Hammer Drill rig (Figure 3-1), using dual-wall air percussion and both 18-in nominal diameter single-wall and 10¾-in nominal diameter dual-wall threaded carbon steel casing to advance to a TD of 38.4 ft bgs. Approximately 1 to 2 gallons of water per foot of advance (approximately 55 gallons total) were added during drilling in the vadose zone for dust suppression.

Split-spoon soil samples were collected near the midpoint of the unconfined aquifer (Table 3-25). Pumped groundwater samples were collected near the midpoint of the unconfined aquifer and near the bottom of the screened interval during development (Table 3-26). The borehole was logged to 31.5 ft using a NMLS and to 37.0 ft using a SGLS on June 10, 2015.

Table 3-25. C9485 Split-Spoon Samples

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
6/08/15	32.2–34.7	Split-spoon	Soil	100	B30PY2

ft bgs = feet below ground surface; HEIS = *Hanford Environmental Information System*

Well construction was performed from June 11, 2015 to June 12, 2015. The well was constructed as a 10-in diameter extraction well with a 10-ft long 75-slot screen and 5-ft long 20-slot sump with end cap. Centralizers were installed at the top and the bottom of the screened interval. The annulus was filled with 4.5 ft 10-20 mesh filter pack around the sump, 14.4 ft 6-12 mesh filter pack around the 75-slot screen, 0.6 ft bentonite pellets, 4.4 ft bentonite chips and 14.0 ft cement grout.

The well was developed on June 15, 2015 with a with a one-half horsepower submersible pump. Well development information is presented in Table 3-2. Static water level was measured prior to well development at 26.1 ft bgs on June 15, 2015.

Table 3-26. 9485 Groundwater Samples Collected During Drilling and Development

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Volume Purged (gal)	Turbidity (NTU)	D.O. at Sample Collection (mg/L)	HEIS #
6/09/15	31.7	Groundwater pumped	0.7	74	5.39	9.11	B30R04, B30R05
6/15/15	33.4	Groundwater pumped	2.6	390	3.12	9.09	B30PY3, B30PY4, B30PY5, B30PY7, B30PY9, B30R00, B30R01, B30PY6, B30PY8, B30R02, B30R03, B30R06

D.O. = dissolved oxygen
ft bgs = feet below ground surface
gpm = gallons per minute
HEIS = *Hanford Environmental Information System*
NTU = nephelometric turbidity unit
mg/L = milligrams per liter

3.12 Well 199-H1-46 (C9486)

Borehole C9486 was drilled from June 15, 2015 to June 17, 2015 by Layne Christensen Company with an AP1000 Becker Hammer Drill rig (Figure 3-1), using dual-wall air percussion and both 18-in nominal diameter single-wall and 10 ¾-in nominal diameter dual-wall threaded carbon steel casing to advance to a TD of 50.4 ft bgs. Approximately 1 to 2 gallons of water per foot of advance (approximately 50 gallons total) were added during drilling in the vadose zone for dust suppression.

Split-spoon soil samples were collected near the top and midpoint of the unconfined aquifer (Table 3-27). Pumped groundwater samples were collected near the top of the unconfined aquifer and near the midpoint of the screened interval during development (Table 3-28). The borehole was logged to 32.5 ft using a NMLS and to 48.0 ft using a SGLS on June 18, 2015.

Table 3-27. C9486 Split-Spoon Samples

Date	Sample Depth (ft bgs)	Sample Method	Media	Recovery %	HEIS number
6/16/15	27.3–29.8	Split-spoon	Soil	75	B30R45, B30R46, B30R47
6/16/15	36.3–38.8	Split-spoon	Soil	50	B30R48

ft bgs = feet below ground surface
HEIS = *Hanford Environmental Information System*

Well construction was performed from June 22, 2015 to June 23, 2015. The well was constructed as a 10-in diameter extraction well with a 20-ft long 50-slot screen and a 5-ft long 20-slot sump with end cap. Centralizers were installed between the 20-slot sump and 50-slot screen and at the top of the 50-slot screen. The annulus was filled from depth to surface with 8.4 ft 10-20 mesh filter pack around the sump, 23.9 ft 8-16 mesh filter pack around the 50-slot screen, 0.8 ft bentonite pellets, 2.4 ft bentonite chips and 13.0 ft cement grout.

The well was developed on June 24, 2015 with a with a five horsepower submersible pump. Well development information is presented in Table 3-2. Static water level was measured at 33.4 ft bgs on June 17, 2015.

Table 3-28. 9486 Groundwater Samples Collected During Drilling and Development

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Volume Purged (gal)	Turbidity (NTU)	D.O. at Sample Collection (mg/L)	HEIS #
6/17/15	36.22	Groundwater pumped	3.7	455.1	24.1	9.34	B30R55, B30R56, B30R57
6/24/15	39.5	Groundwater pumped	11.5	1644.5	2.07	12.88	B30R49, B30R50, B30R51, B30R53, B30R52, B30R54, B30R58

D.O. = dissolved oxygen
ft bgs = feet below ground surface
gpm = gallons per minute
HEIS = *Hanford Environmental Information System*
NTU = nephelometric turbidity unit
mg/L = milligrams per liter

This page intentionally left blank.

4 Geologic Observations

The following sections summarize the general geology in the area of the twelve new wells and present the stratigraphy encountered during the drilling of each well.

4.1 General Geology Description

The major stratigraphic units encountered during this project included Holocene eolian, alluvial and anthropogenic deposits, the Pleistocene Hanford formation, and the Miocene- Pliocene Ringold Formation. The gravel facies dominates the Hanford formation within the project area and consists of coarse-grained basaltic sands, gravels, and boulders. In the 100-HR-3 OU, Hanford formation matrix sands are less basaltic than elsewhere on site. The Hanford formation overlies the Ringold Formation within the project area. The exact location of the Hanford formation was not distinguishable in nine of the twelve boreholes. In the boreholes where it was clearly identifiable (C8793, C8794, and C9733), the Hanford formation ranged in thickness from 38 ft (C9377) to 45.5 (C8793) ft.

The Ringold Formation encountered during this drilling project includes the Ringold Formation member of Wooded Island – unit E (Ringold unit E) and the RUM. The Ringold unit E is characterized as clast-supported gravels with fine to coarse-grained sand matrix and lesser silt fractions. Clasts associated with the Ringold unit E are predominately quartzite and silicic volcanics with lesser amounts of basalt. The sand matrix mineralogy is predominately quartzo-feldspathic. The Ringold unit E overlies the lacustrine silt and clay deposit of the RUM encountered at the three boreholes. The Ringold unit E was not present or was unidentifiable in nine of the twelve boreholes. Where identifiable, it was thickest at C9377 (46 ft) and thinnest at C8289 (10.5 ft). The RUM is primarily comprised of silt and clay typically described as various shades of brown to olive-brown. At C8793 and C8794, drilling continued beyond the RUM contact to 38.1 ft and 32.2 ft (respectively) below the RUM.

4.2 Borehole Geology

The following discussion focuses on the geologic conditions encountered at each individual borehole. Original borehole logs are presented in Appendices A through L.

Due to the disconformable and gradational contact between the Hanford formation and Ringold unit E, exact contacts were difficult to identify in the field. Stratigraphic unit contacts included in this document are based on field drill cuttings examination (e.g. lithology, texture, color, reaction to 10 percent dilute hydrochloric acid [HCl]), and drilling observations (e.g. drill rate). As such, the unit contacts included herein should not be considered final. It should be noted that geologic field descriptions of Becker Hammer drill cuttings may not be completely representative of the geologic formation due to sorting, crushing, and binding as the cuttings exit the borehole. Final stratigraphic unit contact depths will be determined during the remedial investigation data review and will incorporate the field observations, borehole geophysical logging information, and regional stratigraphic interpretations. The basis for the field stratigraphic unit contacts is included in the individual borehole summaries below.

4.2.1 Borehole Geology for Well 199-H4-92 (C8792)

At C8792, gravel fill is present from ground surface to 5 ft bgs, underlain by a sandy silt layer to 6 ft bgs. Beneath these is a sandy gravel unit to 51 ft bgs. The sandy gravel is comprised of 60 to 75 percent gravel, 25 to 40 percent sand, and up to 2 percent silt. The gravel fraction is comprised of poorly sorted, rounded to subrounded, 70 percent felsic, fine pebbles to large cobbles. The sand fraction consists of angular to subangular, 60 to 70 percent felsic, very fine to very coarse, poorly sorted grains that become well sorted with depth. A weak to moderate reaction to HCl was observed from 6 to 35 ft bgs with the

exception of sediments from 20 to 25 ft bgs, which exhibited no reaction to HCl. The color of the fine fraction throughout this interval transitions with depth from a reddish-yellow hued brown (7.5YR4/2) to a yellower hued brown (10YR4/3), based on a Munsell® soil color chart[3]. Groundwater was encountered at 33.7 ft bgs on April 14, 2015.

At 51 ft bgs, a sharp contact with a light brownish gray (10YR6/2) clayey silt of low plasticity was encountered. Pinkish white (7.5 YR 8/2) calcareous nodules are present which react strongly to HCl, while the surrounding clayey silt exhibits a weak reaction to HCl. Based on the distinct change in the lithology and sediment color 51 ft bgs was interpreted to be the RUM contact. At 53 ft bgs, a transition to a sandy silt was encountered that continued to the TD of 57.8 ft bgs. The sandy silt consists of 25 percent angular, quartzo-feldspathic, very fine sand, and 75 percent yellowish brown (10YR5/4) silt exhibiting low plasticity. The borehole and photographic logs for C8792 are presented in Appendix A.

4.2.2 Borehole Geology for Well 699-97-60 (C8793)

Sediments encountered at C8793 is overlain by 5 ft of silty sandy gravel fill followed by unconsolidated silty sandy gravel and sandy gravel from 5 to 40 ft bgs, with a 4-ft sand lens at 20 ft bgs. Sediment from 5 to 20 ft bgs is comprised of 40 to 50 percent gravel, 35 to 40 percent sand, and 13 to 20 percent silt. The gravel fraction consists of very poorly sorted, rounded to angular, very fine pebbles to large cobbles fining downward. The maximum clast size encountered was 210 mm, located within the first 5 ft of sediment. The sand fraction in this unit consists of very poorly sorted, rounded to angular, very fine to very coarse grains. This unit is 50 to 60 percent mafic within the gravel fraction and 75 to 85 percent mafic within the sand fraction. The fine fraction darkens with depth from light yellowish brown (2.5Y6/3) to grayish brown (2.5Y5/2). Sediment exhibited a strong to moderate reaction to HCl that weakened with depth. The 4-ft thick well-sorted sand lens at 20 ft bgs is comprised of 8 percent gravel, 89 percent sand, and 3 percent silt. Both muscovite and caliche were noted within the sand lens.

Sediment from 24 to 40 ft bgs is comprised of 45 to 60 percent gravel, 33 to 50 percent sand, and 5 to 13 percent silt. Mafic content alternated between 60-70 and 20-30 percent within the gravel fraction and between 70 and 30 percent within the sand fraction. Muscovite is intermittent throughout the interval. The color ranged from gray (2.5Y6/1) to very dark grayish brown (2.5Y3/2). Due to these observations, 20 to 40 ft bgs is interpreted as Hanford formation and reworked Ringold unit E. At 40 ft bgs, a distinct change in lithology and hydraulic conductivity (1 gallon per minute) and muscovite content is interpreted as the Hanford/Ringold unit E contact.

From 40 to 50.5 ft bgs, sediments grade from silty sandy gravel to sandy gravel with depth, containing 50 to 60 percent gravel, 35 percent sand, and 13 percent silt decreasing to 5 percent with depth. The gravel fraction consists of very poorly sorted, angular to subrounded, 70 percent felsic, very fine to very coarse pebbles. The sand fraction consists of very poorly sorted, angular to subrounded, 50 percent felsic, very fine to very coarse grains. The fine fraction is dark grayish brown (2.5Y4/2) with mica present throughout.

At 55.5 ft bgs a distinct contact with a light yellowish brown (10YR6/4) to strong brown (10YR8/2) sandy silt exhibiting low to no plasticity was encountered. The sandy silt is 20 to 30 percent sand and 70 to 80 percent silt. The sand fraction is comprised of fine to very fine, well sorted, felsic grains. Based on the distinct change in the lithology and sediment color, this is interpreted to be the contact between the Ringold unit E and the RUM. From 65 ft bgs to a TD of 88.6 ft bgs, low to very high amounts of

[3] Munsell® Soil Color Charts is a registered trademark of X-Rite, Inc. Grand Rapids, Michigan.

cementation, as well as laminated carbonates as thick as 50 mm, and carbonate nodules to 25 mm in diameter were observed. The borehole and photographic logs for C8793 are presented in Appendix B.

4.2.3 Borehole Geology for Well 699-97-61 (C8794)

Surficial sediments at C8794 are gravel fill to 1 ft bgs underlain by a silt layer to 3 ft bgs. From 3 to 52 ft bgs, sediments are sandy gravel to gravel to silty sandy gravel. The sandy gravel to 44 ft bgs contains 40 to 75 percent gravel, 25 to 60 percent sand, and trace silt. The gravel fraction is poorly to moderately sorted with depth, consisting of subrounded to rounded very fine pebbles to small cobbles. The sand fraction consists of poorly to well sorted, angular to subangular, very fine to very coarse grains. Mafic content increases with depth from 50 to 70 percent in the gravel fraction, 30 to 80 percent in the sand fraction. Weak to moderate reactions to HCl were observed from 20 to 25 ft bgs. The color of the fine fraction is grayish brown (2.5Y5/2). No reaction to HCl was observed. The gravel from 30 to 40 ft bgs is comprised of 90 percent gravel and 10 percent sand, and exhibits a moderate reaction to HCl from 35 to 40 ft bgs. The silty sandy gravel from 44 to 52 ft bgs contains 30 percent clayey silt exhibiting medium plasticity. Due to the presence of the clayey silt and the alternating mafic content in the sandy gravel, 44 ft bgs is interpreted as Hanford formation and reworked Ringold unit E. The Ringold unit E contact at this location is interpreted to be at 52 ft bgs based on an increase in silt and mica and low hydraulic conductivity. At 52 ft bgs, a distinct change in lithology, hydraulic conductivity (1 gallon per minute) and muscovite content is interpreted as the Hanford/Ringold unit E contact.

At 52 ft bgs, a light olive brown (2.5Y5/3) sandy gravel was encountered, comprised of 30 to 50 percent gravel, 30 to 40 percent sand, and 5 to 10 percent silt. The gravel fraction consists of well sorted, angular to subangular, 70 percent felsic, very fine to very coarse pebbles. The maximum clast size observed was 60 mm, and 80 percent of the clasts were 8 to 16 mm in diameter. The sand fraction consists of well-sorted, subrounded, 80 percent felsic, very fine to medium grains.

At 67 ft bgs, a sharp contact with silty clay was encountered that spans the remainder of the borehole to TD at 99.2 ft bgs. Based on the distinct change in the lithology and sediment color, this is interpreted to be the contact between the Ringold unit E and the RUM. The silty clay is 80 percent clay and 20 percent silt of medium plasticity. From 75 ft bgs to TD, cementation and caliche veins are present and the sediment has very high dry strength and exhibits low plasticity. The color ranges from light olive brown (2.5Y5/4) to very pale brown (10YR7/3). A strong to very strong reaction to HCl was observed, particularly strong in contact with caliche veins from 75 ft bgs to TD. The borehole and photographic logs for C8794 are presented in Appendix C.

4.2.4 Borehole Geology for Well 699-93-48C (C8929)

Sediments at C8929 consist of sandy gravel and gravelly sand from ground surface to 55 ft bgs with a gravel interval from 50 to 55 ft bgs. The sandy gravel is comprised of 50 to 75 percent gravel, 25 to 60 percent sand, and trace to 10 percent silt and the gravelly sand, from 15 to 35 ft bgs, is light yellowish brown (2.5Y6/3) and contains 10 to 15 percent gravel, 85 to 90 percent sand, and trace silt. The gravel fraction is of moderately to poorly sorted with depth, and consists of subrounded to angular, very fine pebbles to small cobbles. The sand fraction consists of well to poorly sorted, angular to subangular, very fine to very coarse grains in a coarsening downward sequence. Mafic content ranges from 50 to 85 percent within the gravel fraction and 50 to 80 percent within the sand fraction. The color of the fine fraction ranges from very dark grayish brown (2.5Y3/2) to light yellowish brown (2.5Y6/3). Reactivity to HCl decreases with depth from strong to weak. Due to a decrease in basalt content in the gravel and sand fractions and a color change to olive brown (2.5Y 4/43), the Hanford/Ringold unit E contact is inferred to be between 50 and 55 ft bgs.

From 55 to 62 ft bgs, the sediments consist of sandy gravel. The gravel fraction consists of poorly sorted, subrounded to well rounded, medium pebbles to small cobbles. The sand fraction consists of very fine to medium grains, 60 percent of which are fines. No reaction to HCl was observed.

At 62 ft bgs, a light yellowish brown (2.5Y6/3) clayey silt was encountered that is comprised of 5 percent sand and 95 percent silt and clay. The clay exhibits medium plasticity. No reaction to HCl was observed. Based on the distinct change in the lithology and sediment color, this was interpreted to be the RUM contact. Drilling continued into the RUM to a TD of 67 ft bgs. The borehole and photographic logs for C8929 are presented in Appendix D.

4.2.5 Borehole Geology for Well 199-H6-7 (C8947)

Sediments encountered at C8947 at the ground surface are gravel fill to 1 ft bgs underlain by a silt layer to 3 ft bgs. Sandy gravel is present from 1 to 44.5 ft bgs. The sandy gravel is comprised of 40 to 70 percent gravel increasing with depth, 30 to 55 percent sand decreasing with depth, and up to 5 percent silt. The gravel fraction consists of well sorted, rounded to subrounded very fine pebbles to large cobbles. The maximum clast size encountered was 180 mm. The sand fraction in this unit consists of well sorted, angular to subangular, very fine to coarse grains. Gravel grades from 50 to 60 percent felsic with depth, and sand is 60 percent felsic throughout. No reaction to HCl was observed with the exception of a weak reaction observed from ground surface to 10 ft bgs. The color of the fine fraction throughout this interval transitions with depth from gray (5YR6/1) to light olive brown (2.5YR5/3). The Hanford/Ringold unit E contact was not present or could not be determined at this location.

At 44.5 ft bgs, an abrupt transition to clayey silt was encountered that spans the remainder of the borehole to TD at 54.7 ft bgs. Based on the distinct change in the lithology and the sediment color this is interpreted as the RUM contact. The sediment is 100 percent clayey silt transitioning from light grayish brown (2.5Y6/2) to brown (7.5YR4/2) with depth. Pinkish white (7.5 YR 8/2) calcareous nodules are present to 48.8 ft bgs that react strongly to HCl, no other reaction to HCl was observed within the clayey silt. The borehole and photographic logs for C8947 are presented in Appendix E.

4.2.6 Borehole Geology for Well 199-H5-16 (C8948)

The uppermost 7 ft of sediment at C8948 is silty sand, followed by sandy gravel to 59.7 ft bgs. The silty sand to 7 ft bgs is comprised of 70 percent well sorted sand and 30 percent silt, with occasional rounded, basalt-dominated, fine pebbles. The sandy gravel to 59.7 ft bgs is comprised of 55 to 75 percent gravel, 25 to 45 percent sand, and up to 5 percent silt. The gravel fraction consists of well to moderately sorted, rounded to subrounded, very fine pebbles to large cobbles. The maximum clast size ranges from 40 mm to 160 mm. The mafic content of the gravels increases with depth from 50 to 70 percent. The sand fraction in this unit consists of well sorted, angular to subangular, 50 to 60 percent felsic, fine to very coarse grains. The average particle size is coarse. Sediments from ground surface to 8 ft bgs exhibit a weak to strong reaction to HCl that increases with depth, while sediments below this exhibit no reaction to HCl. The color of the fine fraction throughout this interval is olive brown (2.5Y4/3). The Hanford/Ringold unit E was not present or could not be determined at this location. Groundwater was encountered at 37.9 ft bgs on March 24, 2015.

At 59.7 ft bgs, a distinct contact with a pale brown (10YR6/3) to light yellowish brown (10YR6/4) silt containing trace sand was encountered. Based on the distinct change in the lithology and the sediment color this is interpreted as the RUM contact. Drilling continued into the RUM to a TD of 68.5 ft bgs. Weak reactions to dilute HCl were observed from 60 to 65 ft bgs, with no reaction occurring at 65 ft bgs, and strong reactions on white (10YR8/1) calcareous veining at TD. The borehole and photographic logs for C8948 are presented in Appendix F.

4.2.7 Borehole Geology for Well 199-H4-93 (C8949)

Sediments at C8949 are overlain by gravel fill from ground surface to 2 ft bgs, followed by a layer of silt from 2 to 7 ft bgs and sandy gravel to 52 ft bgs. The silt to 7 ft bgs is comprised of 90 percent silt and 10 percent well sorted, subangular sand. The sandy gravel to 52 ft bgs is comprised of 70 to 80 percent gravel, 18 to 28 percent sand, and 2 percent silt. The gravel fraction consists of poorly sorted, rounded to subrounded, very fine pebbles to small cobbles. The gravel is 70 percent felsic. The sand fraction in this unit is well to poorly sorted with depth, and consists of angular to subangular, 60 percent felsic, very fine to very coarse grains. Sediments from 45 to 52 ft bgs exhibit a weak reaction to HCl. The color of the fine fraction throughout this interval darkens downward from pale brown (10YR6/3) to dark gray (7.5YR4/1). The Hanford/Ringold unit E was not present or could not be determined at this location.

At 52 ft bgs, a grayish brown (10YR5/2) to dark yellowish brown (10YR4/4) silt containing trace to 10 percent sand increasing with depth, was encountered. Caliche nodules and cementation were noted set 55 ft bgs. Based on the distinct change in the lithology and the sediment color this is interpreted as the RUM contact. Drilling continued into the RUM to a TD of 58.0 ft bgs. The borehole and photographic logs for C8949 are presented in Appendix G.

4.2.8 Borehole Geology for Well 699-95-45B (C8950)

Sediments at C8950 are overlain by gravel fill from ground surface to 2 ft bgs followed by a layer of sandy silt from 2 to 4 ft bgs. The sandy silt to 4 ft bgs contains 40 percent well sorted, subangular to angular sand and 60 percent silt, and exhibits a moderate reaction to HCl. From 4 to 40 ft bgs is sandy gravel containing a gravel interval from 20 to 30 ft bgs. The sandy gravel to 40 ft bgs contains 65 to 70 percent gravel, 30 percent sand, and up to 5 percent silt. The gravel fraction consists of subrounded to rounded, 65 percent felsic, fine pebbles to small cobbles that coarsen downward, with a clast size of up to 200 mm. The sand fraction consists of well sorted, angular to subangular, fine to very coarse grains in a fining downward sequence. The gravel interval from 20 to 30 ft bgs contains 10 percent more gravel than the surrounding sediments and the sand fraction is medium to very coarse. The Hanford/Ringold unit E was not present or could not be determined at this location.

At 40 ft bgs, a pale brown (10YR6/3) silty clay was encountered. The silty clay is 100 percent silty clay, exhibiting low to no plasticity and no reaction to HCl. Based on the distinct change in the lithology and the sediment color this unit was interpreted as the RUM contact. Drilling continued into the RUM to a TD of 46.3 ft bgs. At the TD, the silty clay transitions to a sandy silt containing 10 percent sand. The sand fraction consists of angular to subangular, felsic, fine to very fine grains with trace mica present. A weak reaction to HCl was observed. The borehole and photographic logs for C8950 are presented in Appendix H.

4.2.9 Borehole Geology for Well 199-H6-8 (C8951)

Sediments at C8951 are sandy gravel from ground surface to 69.5 ft bgs with a gray (7.5YR5/1) gravelly sand interval from 38 to 41 ft bgs. The sandy gravel to 69.5 ft bgs is comprised of 40 to 75 percent gravel, 25 to 60 percent sand, and trace silt. The gravelly sand interval from 38 to 41 ft bgs is 60 percent mafic and contains 20 percent gravel, 80 percent sand, and trace silt. The gravel fraction consists of poorly sorted, rounded to subangular, very fine pebbles to large cobbles. The gravel fraction grades from 40 to 60 percent mafic with depth, and has a maximum clast size of 250 mm. The sand fraction consists of well sorted, angular to subrounded, fine to coarse grains. The fine fraction transitions from brown (10YR5/3) to grayish brown (10YR5/2) with depth. The sand fraction is 60 percent felsic throughout. No reaction to HCl was observed with the exception of sediments from ground surface to 10 ft bgs, which exhibited a weak reaction to HCl. The Hanford/Ringold unit E was not present or could not be determined at this location.

At 69.5 ft bgs, a brown (10YR5/3) clayey silt was encountered. The clayey silt exhibits low to medium plasticity and no reaction to HCl. Based on the distinct change in the lithology and the sediment color this is interpreted as the RUM contact. Drilling continued into the RUM to a TD of 73.7 ft bgs. The borehole and photographic logs for C8951 are presented in Appendix I.

4.2.10 Borehole Geology for Well 199-D5-159 (C9377)

The sediments encountered at C9377 consist of 10 ft of an olive brown (2.5Y4/3) silty sand grading to 5 ft of gravelly sandy silt, followed by sandy gravel to 53 ft bgs. The uppermost 15 ft is comprised of 5 to 25 percent gravel increasing with depth, 30 to 45 percent very fine, well-sorted sand, and 45 to 50 percent silt with very strong to strong reactions to HCl. From 15 to 53 ft bgs, a sandy gravel is present that is comprised of 50 to 70 percent gravel, 30 to 45 percent sand increasing with depth, and up to 5 percent silt decreasing with depth. The gravel fraction consists of rounded, 50 to 80 percent mafic, very fine pebbles to large cobbles with the exception of 50 to 53 ft bgs, at which point clasts less than 20 mm are rounded and 80 percent felsic and clasts greater than 20 mm are angular and 80 percent mafic. Average clast size is 50 mm and maximum clast size is 180 mm. The sand fraction consists of poorly to well sorted, angular, very fine to very coarse grains throughout with the exception of 25 to 45 ft bgs, which contains coarse to very coarse grained sands. The felsic content of the sands increases from 10 to 50 percent with depth. The fine fraction transitions with depth from very dark gray (2.5Y3/1) to very dark grayish brown (2.5Y3/2). Due to a decrease in basalt content in both the gravel and sand, reworked sediments grading into the Ringold unit E contact are inferred to be located between 45 and 53 ft bgs. The Ringold unit E contact at this location is interpreted to be at 53 ft bgs based on a sharp increase in quartzo-feldspathic content and an apparent change in color to light yellowish brown (2.5Y6/4).

From 53 to 85 ft bgs is a sandy gravel containing an interval of sand from 55 to 60 ft bgs. The sandy gravel from 53 to 85 ft bgs is comprised of 40 to 60 percent gravel increasing with depth, 30 to 60 percent sand, and trace to 10 percent silt with a quartzo-feldspathic content ranging from 90 to 100 percent. The gravel fraction consists of rounded to subangular clasts that coarsen with depth from very fine pebbles to very coarse pebbles with a maximum clast size of 60 mm. The sand fraction consists of well to very well sorted, very fine to medium grains. The fine fraction is light yellowish brown (2.5Y6/4). Sediments exhibited no reaction to HCl. The sand interval from 55 to 60 ft bgs is comprised of was noted as 95 percent well sorted, very fine to medium sand and 5 percent gravel.

From 85 to 99 ft bgs is a gravel unit that transitions to a silty sandy gravel. The gravel unit to 95 ft bgs is comprised of 80 percent gravel, 20 percent sand, and trace to 10 percent silt. The gravel fraction consists of rounded to angular, 70 to 80 percent felsic, coarse pebbles to small cobbles that coarsen downward, with an average clast size of 40 mm and a maximum clast size of 100 mm. The sand fraction consists of rounded to subrounded, light olive (2.5 Y5.3), very fine to very coarse grains that coarsen downward. At 95 ft bgs, sediments transition to dark grayish brown (2.5Y4/2) silty sandy gravel composed of 70 percent gravel, 15 percent sand, and 15 percent silt. The gravel fraction consists of rounded, 95 percent felsic, coarse pebbles to small cobbles. The sand fraction consists of subrounded, medium to coarse grains.

At 99 ft bgs, a pale yellow (2.5Y7/4) silty clay was encountered. The silty clay is comprised of 5 percent gravel, 5 percent sand, and 90 percent silty clay. The gravel fraction consists of well-rounded, 95 percent felsic, very fine to medium pebbles. The sand fraction is very fine. The silty clay fraction has a very high plasticity and exhibits no reaction to HCl. Based on the distinct change in the lithology and sediment color, this is interpreted to be the contact between the Ringold unit E and the RUM. At 105 ft bgs, a light yellowish brown (2.5Y6/3) caliche exhibiting a strong reaction to HCl was encountered. Drilling continued into the RUM to a TD of 106.5 ft bgs. The borehole and photographic logs for C9377 are presented in Appendix J.

4.2.11 Borehole Geology for Well 199-H4-92 (C9485)

Sediments at C9485 grade from silty sandy gravel to sandy gravel to gravel from ground surface to 33 ft bgs. The gravel fraction of these sediments increased from 60 to 85 percent with depth, the sand fraction ranged from 30 to 14 percent, and the silt fraction decreased from 12 to 1 percent with depth. The gravel fraction consists of poorly sorted, rounded to angular, very fine pebbles to small cobbles. The sand fraction consists of well to poorly sorted (greater sorting with depth), well rounded to subangular, very fine to very coarse grains. Gravel graded from 10 to 80 percent felsic with depth, while sand was 25 to 75 percent felsic throughout. Mica was present from 15 to 25 ft bgs. Clay coatings and clay nodules of medium plasticity were encountered from ground surface to 10 ft bgs. A weak to strong reaction to HCl was observed throughout with the exception of sediments from 25 to 30 ft bgs, which show no reaction to HCl. Drilling speed decreased with depth. Based on the presence of basalt clasts in the gravel fraction, variable reactivity with HCl, silt and mica throughout, and decreased drilling rates with depth, sediments to 33 ft bgs are interpreted as reworked Ringold unit E sediments.

At 33 ft bgs, yellowish brown (10YR5/4), high plasticity clayey silt was encountered. The clayey silt is comprised of 9 percent gravel, 10 percent sand, and 81 percent clayey silt. The gravel fraction consists of fine pebbles to small cobbles. The sand fraction consists of very well sorted, well rounded, very fine to coarse, predominantly very fine grains. The clayey silt is 90 percent felsic. Caliche nodules present exhibit a strong reaction to HCl. Based on the distinct change in the lithology and sediment color, this is interpreted to be the contact between reworked Ringold unit E sediments and the RUM. Drilling continued into the RUM to a TD of 38.4 ft bgs. The borehole and photographic logs for C9485 are presented in Appendix K.

4.2.12 Borehole Geology for Well 199-H1-46 (C9486)

Sediments at C9486 consist of a series of gravel and sandy gravel intervals from ground surface to 40 ft bgs. Sediments to 25 ft bgs are comprised of 75 to 92 percent gravel, 5 to 20 percent sand, and 3 to 5 percent silt. The gravel fraction consists of poorly sorted, subrounded, medium pebbles to large cobbles, with a maximum clast size of 250 mm. Mafic content decreases from 85 to 65 percent with depth. The sand fraction consists of well sorted, subrounded, very fine to medium sized grains. Felsic content increases from 60 to 80 percent with depth. No reaction to HCl was observed and the fine fraction is nonplastic. The fine fraction is very dark to dark grayish brown (2.5Y3/2 to 2.5Y4/2). Gravels within the 20-25 ft bgs interval exhibit moderate reactions to HCl. At 25 ft bgs is a sandy gravel comprised of 50 percent rounded gravel, 40 percent sand, and 10 percent silt. The sand fraction consists of moderately sorted, subangular, medium to very coarse grains that are 50 percent felsic. The fine fraction exhibits a weak reaction to HCl and low plasticity. The Hanford/Ringold unit E was not present or could not be determined at this location.

At 40 ft bgs, a light olive brown (2.5Y5/6), moderately plastic clayey silt was encountered. Based on the distinct change in the lithology and sediment color, this is interpreted to be the RUM contact. The clayey silt is comprised of 6 percent gravel, 10 to 15 percent sand increasing with depth, and 84 percent clayey silt. The gravel fraction consists of well sorted, well rounded, fine to very coarse pebbles fining downward . Gravels are 65 percent felsic. The sand fraction consists of well sorted, 60 percent felsic, very fine to fine grained sand. A weak to moderate reaction to HCl was observed. Clay nodules are present. Drilling continued into the RUM to a TD of 50.4 ft bgs. The borehole and photographic logs for C9486 are presented in Appendix L.

4.3 Hydrogeology

Regional groundwater flow in the 100-H Area is primarily to the northeast toward the Columbia River, but is locally influenced by pump-and-treat operations, erosional channels in the RUM (DOE/RL-2006-75, *Supplement to the 100-HR-3 and 100-KR-4 Remedial Design Report and Remedial Action Work Plan for the Expansion of the 100-KR-4 Pump-and-Treat System)*, and fluctuations in river stage. Regional groundwater flow in 100-D is to the west generally, with flow going across the Horn from the northern portion of 100-D area.

At the twelve borehole locations, the vadose zone occurs within the Holocene deposits and the Hanford formation, and the uppermost Ringold Formation unit E, and ranges in thickness from 82.67 ft at C9377 to 26.5 ft at C9485. The unconfined aquifer occurs within the Holocene deposits, Hanford formation and the Ringold Formation unit E, ranging in thickness from 3.52 ft at C8947 to 33.2 ft at C8794. The silt and silty clay of the RUM is treated herein as an aquitard, and defines the bottom of the unconfined aquifer in the 100-HR-3 OU. The RUM was encountered at all twelve of the borehole locations and ranged in depth from 33 ft bgs at C9485 to 99 ft bgs at C9377. Wells at C8793 and C8794 were installed with well screens below the RUM with piezometric surfaces of 33.4 ft bgs and 34.1 ft bgs, respectively.

Well development data are summarized in Table 3-2. Maximum drawdown levels measured during final well development varied from 1.6 ft at C8949 (220 gallons per minute (gpm) pumping rate) to 40.5 ft at C8794 (10 gpm pumping rate). Pumping rates during final well development were primarily influenced by pump capacity and pump depth.

4.4 Contaminants

Groundwater contamination at the 100-HR-3 OU originated primarily from products used and disposed of during reactor operations, and from discharges to the 116-DR-1&2 Trench during the 1967 infiltration test. The primary contaminants of concern in the 100-HR-3 OU are Cr(VI), strontium-90, and nitrate. Other contaminants of concern are uranium and tritium. Groundwater samples were collected during drilling and following well development at each location. Field screen concentrations of Cr(VI) were measured onsite using a Hach® Spectrophotometer DR 2800[4] (Table 4-1).

[4] Hach® DR 2800 Spectrophotometer is a registered trademark of Hach Company, Loveland, CO

Table 4-1. Hexavalent Chromium (Cr(VI)) Samples

Well ID	Sample Depth (ft bgs w/ date)	HEIS #	Cr(VI) Concentration (mg/L)
C8792	48.4 (4/14/15)	B30BR4	0.053
C8793	39.81(3/23/15)	B30JN8	0.071
	48.7 (4/7/15)	B30JP0	0.028
	79.0 (4/22/15)	B30JP3	0.057
C8794	38.7 (5/04/15)	B30JP6	0.021
	49.9 (5/05/15)	B30JP8	0.015
	88.1 (5/07/15)	B30JR0	0.056
C8929	48.8 (6/23/15)	B30K16	0.002
C8948	46.3 (3/24/15)	B30J84	0.028
C8949	48.2 (4/28/15)	B30JJ7	0.052
C8950	36.3 (4/7/15)	B30JM3	0.007
C8951	48.9 (4/1/15)	B30JH0	0.011
	59.6 (4/1/15)	B30JH2	0.007
C9377	91.4 (3/3/15)	B30JL2	0.081
C9485	31.56 (6/9/15)	B30R04	0.008
C9486	36.22 (6/17/15)	B30R55	0.055

ft bgs = feet below ground surface

mg/L = milligrams per liter

This page intentionally left blank.

5 Waste Management

Waste from individual wells was managed according to DOE/RL-97-01, *Interim Action Waste Management Plan for the 100-HR-3 and 100-KR-4 Operable Units* as well as SGRP-PRO-OP-50120, (GRP-OP-0006), *Waste Packaging and Handling at S&GRP*. Waste generated during drilling activities included drill cuttings, decontamination water, personal protective equipment, and miscellaneous solid waste.

5.1 Vadose and Saturated Zone Cuttings

All vadose and saturated zone drill cuttings were released into tip dumpsters, dewatered, and placed in designated waste roll off boxes per SGRP-PRO-OP-50034 (GRP-EE-02-14.5), *Returning Vadose Zone Drill Cuttings/Soils to the Environment*. Dewatered fluid was treated as purgewater. Water-absorbing crystals were spread over the dewatered drill cuttings to capture free liquids that could not be dewatered, allowing the waste container to be designated as solid waste. Miscellaneous solid waste associated with drill cuttings, including nitrile gloves, plastic bags used to collect drill cuttings, and other waste associated with sampling activities, were contained in clear plastic bags and placed in the designated roll off box. All waste was managed as Investigation-Derived Waste (IDW) and surveyed by Radiological Control Technicians and Industrial Hygiene personnel, and transferred to Environmental Restoration Disposal Facility for disposal. Roll off boxes were transported to the Environmental Restoration and Disposal Facility for disposal.

5.2 Purgewater

Purgewater was generated during well drilling, development activities, and from water decanted from the tip dumpster containing saturated drill cuttings. All purgewater was managed in accordance with DOE/RL-2009-39, *Investigation-Derived Waste Purgewater Management Action Memorandum* and DOE/RL-2009-80, *Investigation Derived Waste Purgewater Management Work Plan*. Purgewater was contained onsite in a poly-tank or purgewater truck and later transported to either the Modular Storage Unit or Effluent Treatment Facility.

This page intentionally left blank.

6 Civil Survey

The well locations were surveyed in accordance with CHPRC procedure SGRP-PRO-SMP-52857 (GRP-EE-01-1.6), *Survey Requirements and Techniques*. Vertical survey data were recorded using NAVD88, *North American Vertical Datum of 1988* and the horizontal coordinates were recorded using the Washington State Plane (South Zone) NAD83, *North American Datum of 1983*, with the 1991 adjustment for horizontal coordinates. Surveyed locations of the boreholes are presented in Table 5-1.

Table 6-1. Surveyed Well Locations

Well Name	Well ID	Type	Northing[a] (m)	Easting[a] (m)	Ground Surface Elevation[b] (Brass Cap) (m)
C8792	199-H4-92	Extraction	152233.84	576723.30	127.640
C8793	699-97-60	Monitoring/Extraction	152794.99	575682.05	127.509
C8794	699-97-61	Monitoring/Extraction	152914.15	574891.51	128.334
C8929	699-93-48C	Injection	151728.96	575312.13	130.600
C8947	199-H6-7	Injection	151478.02	577704.08	128.415
C8948	199-H5-16	Extraction	151646.31	576906.80	129.175
C8949	199-H4-93	Extraction	152703.33	577025.75	129.704
C8950	699-95-45B	Injection	576365.99	152780.01	126.814
C8951	199-H6-8	Injection	151928.15	578205.59	128.667
C9377	199-D5-159	Extraction	151910.82	573474.25	143.302
C9485	699-97-47B	Extraction	153265.29	575408.55	125.709
C9486	199-H1-46	Extraction	153456.95	576986.90	125.791

a Northing and easting coordinates are based on Washington State Plane Coordinates NAD83, *North American Datum of 1983*.

b Vertical Elevation values are based on NAVD88, *North American Vertical Datum of 1988* and are rounded to 0.01 m.

This page intentionally left blank.

7 Well Acceptance

Well acceptance is the final step in the well construction process and represents confirmation of meeting requirements of the work scope. Well acceptance also serves as the contractual completion of the finished product.

Representatives from CHPRC and StillWater LLC participated in the acceptance inspection for the twelve wells: C9377 on March 25, 2015; C8947 and C8948 on April 16, 2015; C8792, C8949, C8950, and C8951 on May 21, 2015; C8793 and C8794 on June 15, 2015; and C8929, C9485, and C9486 on July 7, 2015. Final well acceptance was documented by completion of a checklist and signatures from representatives of the drilling contractor and CHPRC. A Quality Assurance Work Site Assessment will be prepared to document well acceptance.

This page intentionally left blank.

8 References

CH2M Hill Plateau Remediation Company Soil and Groundwater Remediation Project Procedures:

SGRP-PRO-EN-50025 (GRP-EE-01-7.0), *Geologic Logging*

SGRP-PRO-EN-50030 (GRP-EE-02-14.1), *Drilling, Remediating, and Decommissioning Resource Protection Wells and Geotechnical Soil Borings*

SGRP-PRO-OP-50024 (GRP-EE-01-6.3), *Well Development and Testing*

SGRP-PRO-OP-50034 (GRP-EE-02-14.5), *Returning Vadose Zone Drill Cuttings/Soils to the Environment*

SGRP-PRO-OP-50037 (GRP-EE-05-1.21), *Particle Size Distribution of Soil-Wet Sieve Analysis*

SGRP-PRO-OP-50120, (GRP-OP-0006), *Waste Packaging and Handling at S&GRP*

SGRP-PRO-SMP-50043 (GRP-FS-04-G-004), *Operational Monitoring Groundwater Sampling*

SGRP-PRO-SMP-52857 (GRP-EE-01-1.6), *Survey Requirements and Techniques*

Other References:

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, (CERCLA), Public Law 96-150, 94 Stat. 2767, 42 USC 9601 et seq.

DOE/RL-96-84, *Remedial Design Report and Remedial Action Work Plan for the 100-HR-3 and 100-KR-4 Groundwater Operable Units Interim Action*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-97-01 , 2005, *Interim Action Waste Management Plan for the 100-HR-3 and 100-KR-4 Operable Units,* Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2006-75, 2008, *Supplement to the 100-HR-3 and 100-KR-4 Remedial Design Report and Remedial Action Work Plan for the Expansion of the 100-KR-4 Pump-and-Treat System,* Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2009-39, *Investigation-Derived Waste Purgewater Management Action Memorandum,* U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2009-80, *Investigation Derived Waste Purgewater Management Work Plan,* U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2013-35, *100-HR-3 Groundwater Operable Unit Well Installation Sampling and Analysis Plan,* Rev 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2013-35-ADD2, *100-HR-3 Groundwater Operable Unit New Well Installation Sampling and Analysis Plan,* Rev 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2013-35-ADD4, *100-HR-3 Groundwater Operable Unit Well Installation Sampling and Analysis Plan, Addendum 4: 699-93-48C and /99-D5-159,* Rev 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2013-35-ADD5, *1 00-HR-3 Groundwater Operable Unit Well Installation Sampling and Analysis Plan, Addendum 5: Wells 199-H6-7, 199-H6-8, 199-H5-16, 199-H4-93, and 699-95- 45B,* Rev 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2013-35-ADD6, *100-HR-3 Groundwater Operable Unit Well Installation Sampling and Analysis Plan, Addendum 6: Wells 199-HI-46 and 699-97-47B,* Draft, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

NAD83, 1991, *North American Datum of 1983*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Springs, Maryland, as revised.

NAVD88, 1988, *North American Vertical Datum of 1988,* National Geodetic Survey, Federal Geodetic Control Committee, Silver Springs, Maryland.

ROD/R10-96/134, 1996, *Declaration of the Record of Decision for the 100-HR-3 and 100-KR-4 Operable Units,* U.S. Department of Energy, Richland Operations Office, Richland, Washington.

SGW-54542, 2013, *Recommendations and Technical Justification for New and Replacement Wells and Re-alignment of Existing Wells Associated with Interim Remedial Actions at 100-D/H Area,* Rev. 0, CH2M Hill Plateau Remediation Company, Richland, Washington.

SGW-57584, 2014, *Recommendations and Technical Justification for New Wells and Re-alignment of Existing Wells Associated with Interim Remedial Actions at 100-HR-3: FY 2014 and FY 2015,* Rev. 0, CH2M Hill *Plateau Remediation Company, Richland, Washington.*

SGW-58281, 2014, *Description of Work for the Installation of Twelve New Groundwater Wells in the 100-HR-3 Operable Unit,* Rev. 0, CH2M Hill Plateau Remediation Company, Richland, Washington.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

Appendix A

Well Documentation for C8792 (199-H4-92)

- Well Summary Sheet
- Borehole Log
- Log Data Report
- Photographic Log
- Final Survey Report

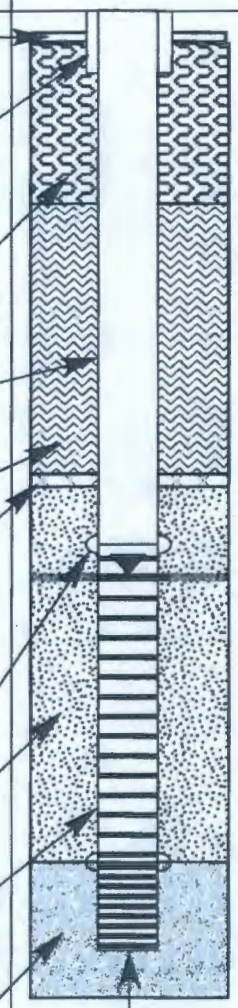
This page intentionally left blank.

4/9/15 AJG 7/16/15

WELL SUMMARY SHEET	Start Date: ~~4/08/2015~~ 4/22/15 Finish Date: ~~4/21/2015~~	Page 1 of 1

Well ID: C8792		Well Name: 199-H4-92	
Location: 1030 m WSW of H Reactor		Project: 12 GW Wells in 100-HR-3 OU	
Prepared By: Jessa Szecsody	Date: 5/26/15	Reviewed By: MEHRER	Date: 7-6-15
Signature:		Signature:	

CONSTRUCTION DATA

Description	Diagram
Concrete Pad: 0.5 ft above ground surface (ags) 12-in Protective Casing: 2.66 ft above concrete pad - 1.84 ft below ground surface (bgs) Type I/II Portland Cement Grout: 0 - 13 ft bgs 10-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.1 ft ags - 30.92 ft bgs Cetco Medium Bentonite Chips: 13 - 26.8 ft bgs 3/8 in Cetco Coated Bentonite Pellet Seal: 26.8 - 27.2 ft bgs Stainless steel centralizers installed at the top of the sump and the top of the screened interval 6-12 mesh Premier Colorado Silica Filter Pack Sand: 27.2 - 50.63 ft bgs 10-in I.D. Schedule 10, Type 304/304L, 75-slot (0.075 in.) Stainless Steel Screen: 30.92 - 50.97 ft bgs 10-20 mesh Premier Colorado Silica Filter Pack Sand: 50.63 -58.84 ft bgs 10-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screened Sump: 50.97 - 56.0 ft bgs Depths are in ft below ground surface. Borehole drilled with 18-in O.D. casing from 0.0 - 57.8 ft bgs All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
0		0 - 5 Pad construction gravel: Fill
		5 - 6 Sandy Silt (sM)
		6- 51 Sandy Gravel (sG)
10		
20		
30		Static Water Level: 33.72 ft bgs (4/21/2015)
40		
50		51 - 53 Silt (M)
		53 - 57.8 Sandy Silt (sM)
60		
70		
		Total Depth: 58.8 ft bgs 4/17/15
80		

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 2
Date: 4/16/15

Well ID: C8792	Well Name: 199-H4-92	Location: 1030 M WSW OF H REACTOR
Project: 12 NEW WELLS IN 100 HR-3 OU		Reference Measuring Point: G.S

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	G			0-5' PAD CONSTRUCTION GRAVEL	BECKER HAMMER
				5-6' SM SANDY SILT VISIBLE ROOT - & WOOD FRAGMENTS UNABLE	DRILL RIG - TRIPLE CASING.
				TO SAMPLE	WATER ADDED FOR
				6'-33' (SG) SANDY GRAVEL - GRAVEL	DUST CONTROL FROM
5	G			@ 10' 70% G, 28% S, 2% M,	SURFACE DOWNWARD
				G - FN PEB - LGC, POOR SORT SR-R	DRILLER ESTIMATES
				70% FELSIC 30% BASAL S - VC TO VF	1-2 GAL/FT ADVANCE
				SA-A 10% QTZ OTHER TR FEQX	
				7.5YR 4/2 BROWN WK HCl RXN	ALL COLOR DESCRIPTIONS
10	G				ARE FROM MOIST,
					AS-RECEIVED SAMPLES
					UNLESS NOTED
15	G			@ 15' AS ABOVE, MOD HCl RXN,	
				G MAX 50 MM	
20	G			@ 20' G AS ABOVE 120 MM MAX	
				SAND AS ABOVE COLOR NOW	
				10YR 4/3 BROWN. NO HCl RXN	
25	G			@ 25' SG 60% G, 40% S, TR	
				M. G AS ABOVE, S AS ABOVE	
				WK HCl RXN.	
30	G			Sandy Gravel	
				@ 30' (SG) NOW 70% G, 30% S, TR M	
				MAX 150 MM OTHERWISE AS ABOVE	
				Sandy Gravel	
				33'-35' (SG) 75% G, 25% S TR M	
				G FREDOM F-C PEB. MAX 40 MM, AVE	WL @ 33.7' 4/14/15
35	G			20 MM, BASALT COMPOSITION, S AS	
				ABOVE, M AS ABOVE	
				35-51' SG 75% G 25% S TR M	
				G - FIN PEB - COB MAX 150 x 200 MM	
				SR-R, POOR SORT, 70% F, 30% M,	

Reported By: GREG KASTA		Reviewed By: Kevin Bergstrom	
Title: GEOLOGIST		Title: Sr. Geologist	
Signature: [signature]	Date: 4/18/15	Signature: [signature]	Date: 8/3/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 2
Date: 4/16/15

Well ID: C8792 | Well Name: 199-H4-92 | Location: 1030 m WSW OF H REACTOR

Project: 12 New Wells IN 100-HR-3 OU | 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
40	G			S- VF-VC, AVE MED SA-A, WELL SORTED 10YR 4/3 BROWN. NO HCl RXN	Becker Hammer Triple-wall casing
				@ 40' G AS ABOVE COBBLES NOW MAX 150 MM SAND AS ABOVE	
45	G			@ 45' G MORE FINES -MAX 70 MM AVG 30 MM POOR SORT SAS ABOVE NO HCl RXN	B30BP5 SPLIT SPOON ~~B30BP5~~
	WATER	SPLIT SPOON 23% RECOVERY		@ 50 DESCRIPTION AS AT 45'	48-51' WATER SAMPLE
50	G			Silt @ 51'-53? M-MUD (ROM) (M) 100% 10YR 6/2 LT BROWNISH GRAY WK HCl RXN ON GRAY - ST HCl RXN ON 7.5YR 8/2 PINKISH WHITE CALICHE? NODULES. LOW PLASTIC, MOIST	INTAKE @ 44.5 BGS CASING @ 48' BGS=sample depth HCLS # B30BR4
55				53-58.8 SM SANDY MUD 25% 3,750M 10YR 5/4 YELLOWISH BROWN NO HCl RXN. NONPLASTIC, MOIST	
	G			AS RECEIVED. S-VFS, A, 100% QTZ	BROWN CLAY STRONGLY ADHESIVE ON DRILL CASING
60				TD = 58.8' bgs 4/17/15 Static water level = 33.7' 4/21/15 casing depth = 57.8'	

Not used
K.S. 4/21/15

Reported By: Greg Kasza | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: [signature] Date: 4/18/15 | Signature: [signature] Date: 8/3/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

199-H4-92 (C8792)
Log Data Report

Borehole Information:

Log Date:	2015-04-16	Filename:	C8792_HG-NM_2015-04-16	Site:	100 H
Coordinates (WA St Plane)		DTW[1] (ft):	45.4	DTW Date:	04/16/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	04/15/15	N/A	58	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	2.15	16 1/2	15	3/4	2.15	57.8

Borehole Notes:

The onsite geologist provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). The Becker drilling method employs a double wall drive pipe where compressed air is forced down the outer casing and geologic material is returned to the surface inside the inner casing. The inner casing was removed prior to logging. Depth to water inside the casing was measured at 45.4 ft by the logging engineer using an e-tape. The maximum logging depth achieved was 54 ft where the sonde was unweighted in mud.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1L	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	11/12/14	Serial No.:	47-TP32211A
Calibration Reference:	HGLP-CC-111, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 1H	Type:	NMLS[4]
Effective Calibration Date:	11/13/14	Serial No.:	H310700352
Calibration Reference:	HGLP-CC-112, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	3	4 Repeat			
HEIS Number	1018696	1018697			
Date	04/16/15	04/16/15			
Logging Engineer	Pope	Pope			
Start Depth (ft)	0.0	25.0			
Finish Depth (ft)	54.0	30.0			
Count Time (sec)	100	100			
Live/Real	R	R			

[1] depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

Stoller Newport News Nuclear

Log Run	3	4 Repeat			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AL247CAB	AL247CAB			
Start File	AL247000	AL247055			
Finish File	AL247054	AL247060			
Post-Verification	AL247CAA	AL247CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	No fine gain adjustments made	No fine gain adjustments made			

NMLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1018698	1018699			
Date	04/16/15	04/16/15			
Logging Engineer	Pope	Pope			
Start Depth (ft)	0.0	20.0			
Finish Depth (ft)	45.25	25.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AH207CAB	AH207CAB			
Start File	AH207000	AH207182			
Finish File	AH207181	AH207202			
Post-Verification	AH207CAA	AH207CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	None	None			

Logging Operation Notes:

A centralizer was installed on the sondes.

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Analysis Notes:

Analyst:	P.D. Henwood	Date:	04/30/15	Reference:	HGLP-MAN-003, Rev. 0

A casing correction for a 3/4-in. thick casing was applied to 54 ft. No additional correction was applied for the casing joints which are in excess of 1.15-in. and occur at approximately 10-ft intervals.

A correction for water was applied below 45 ft in depth.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as AL20141112, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

NMLS data are reported in counts per second as there is no calibration for conversion to volumetric moisture in large diameter casings.

The HGU[5] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected in the borehole. MDLs for Cs-137 and Pu-239 are plotted for the entire borehole.

The relatively thick casing joints beginning at 8 ft and occurring at 10 ft intervals are indicated by reduced count rates on the total gamma log and moisture log.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

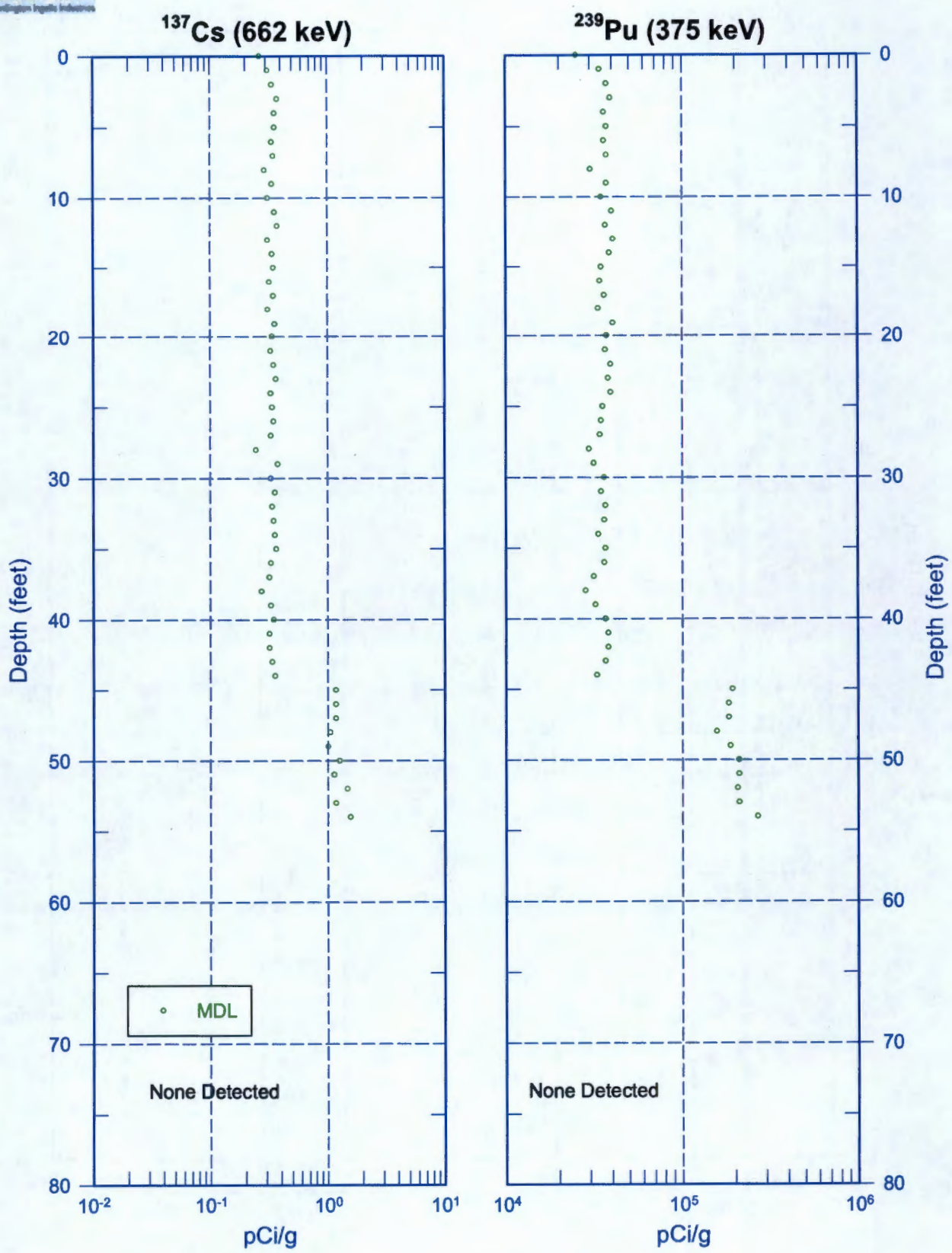
List of Log Plots:

Depth Reference is ground surface.

Manmade Radionuclides (0-80 ft)
Natural Gamma Logs (0-80 ft)
Combination Plot (0-120 ft)
Total Gamma & Moisture (0-80 ft)
Total Gamma & Hanford Gamma Unit (0-80 ft)
Repeat Section of Natural Gamma Logs (25 to 30 ft)
Moisture Repeat Section (20 to 25 ft)

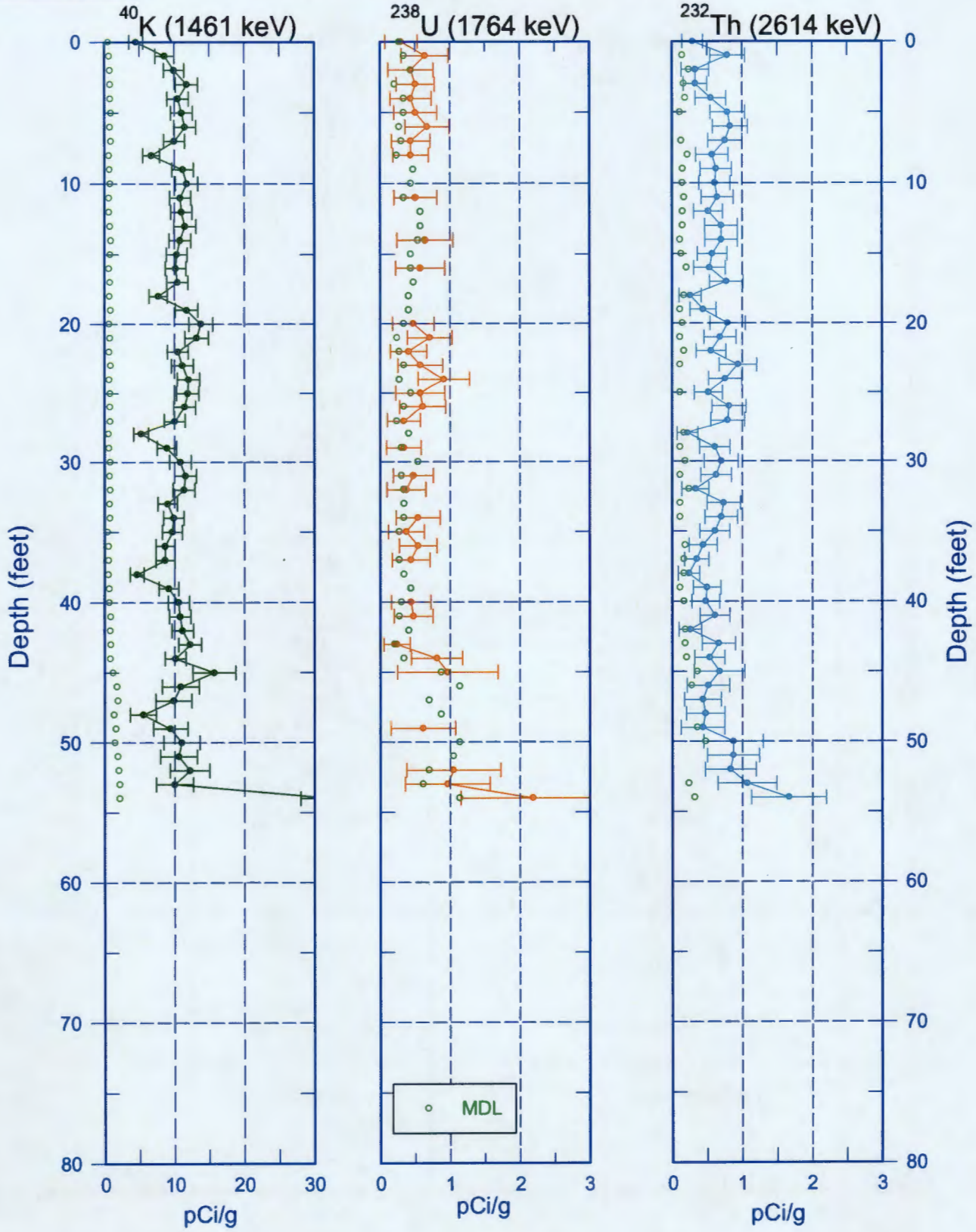
[5] Hanford Gamma Unit

199-H4-92 (C8792)
Manmade Radionuclides



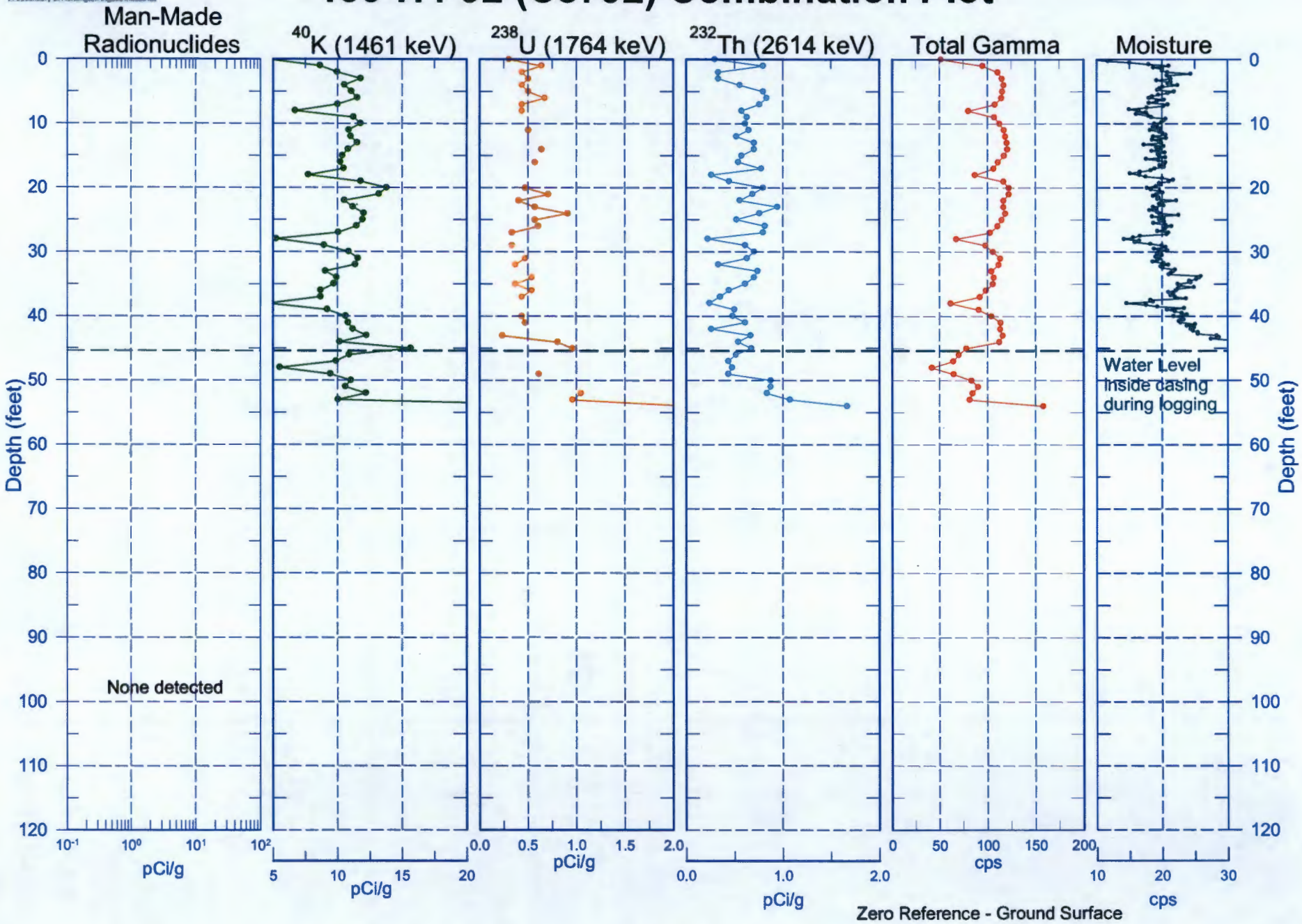
Zero Reference - Ground Surface

199-H4-92 (C8792)
Natural Gamma Logs

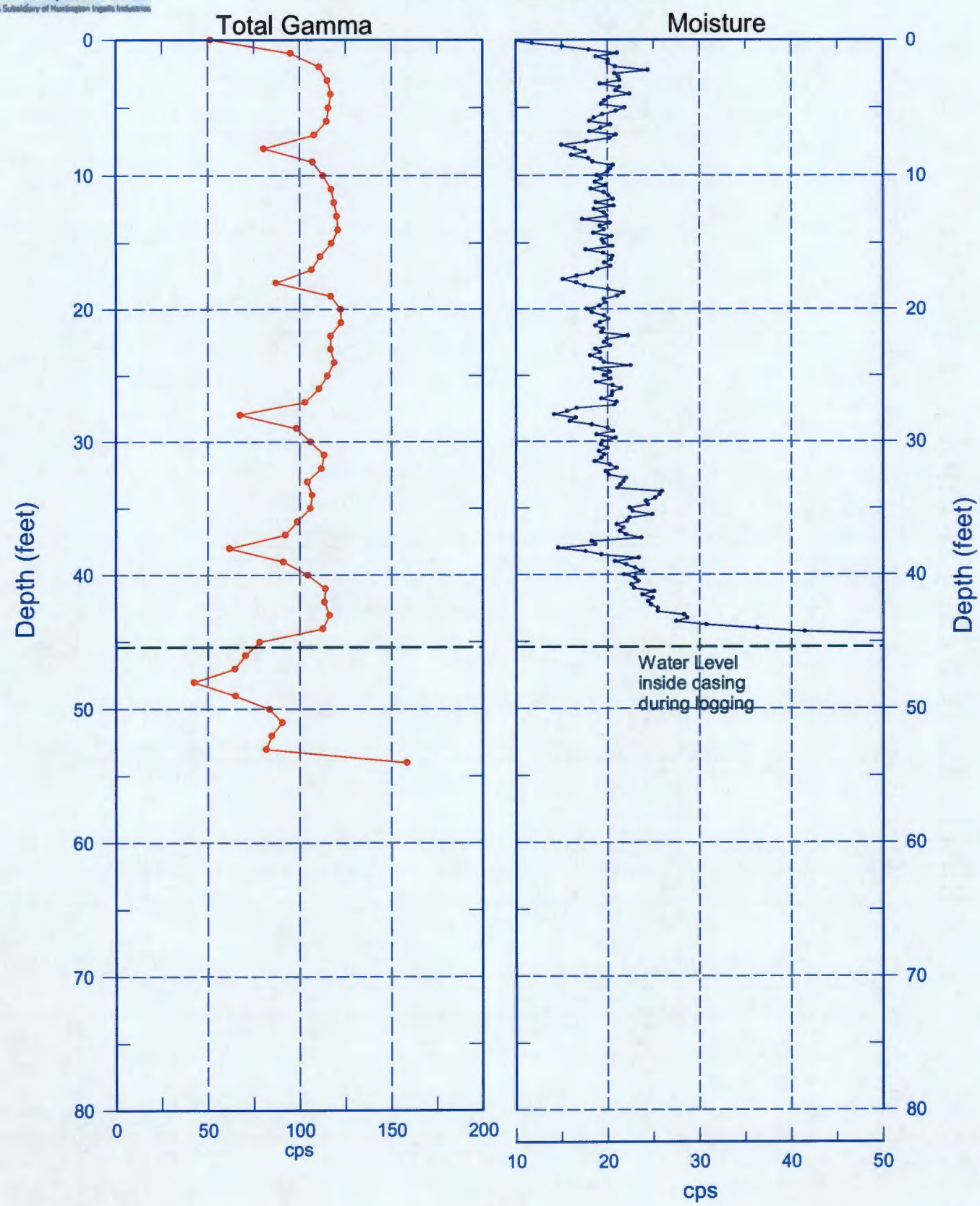


Zero Reference - Ground Surface

199-H4-92 (C8792) Combination Plot



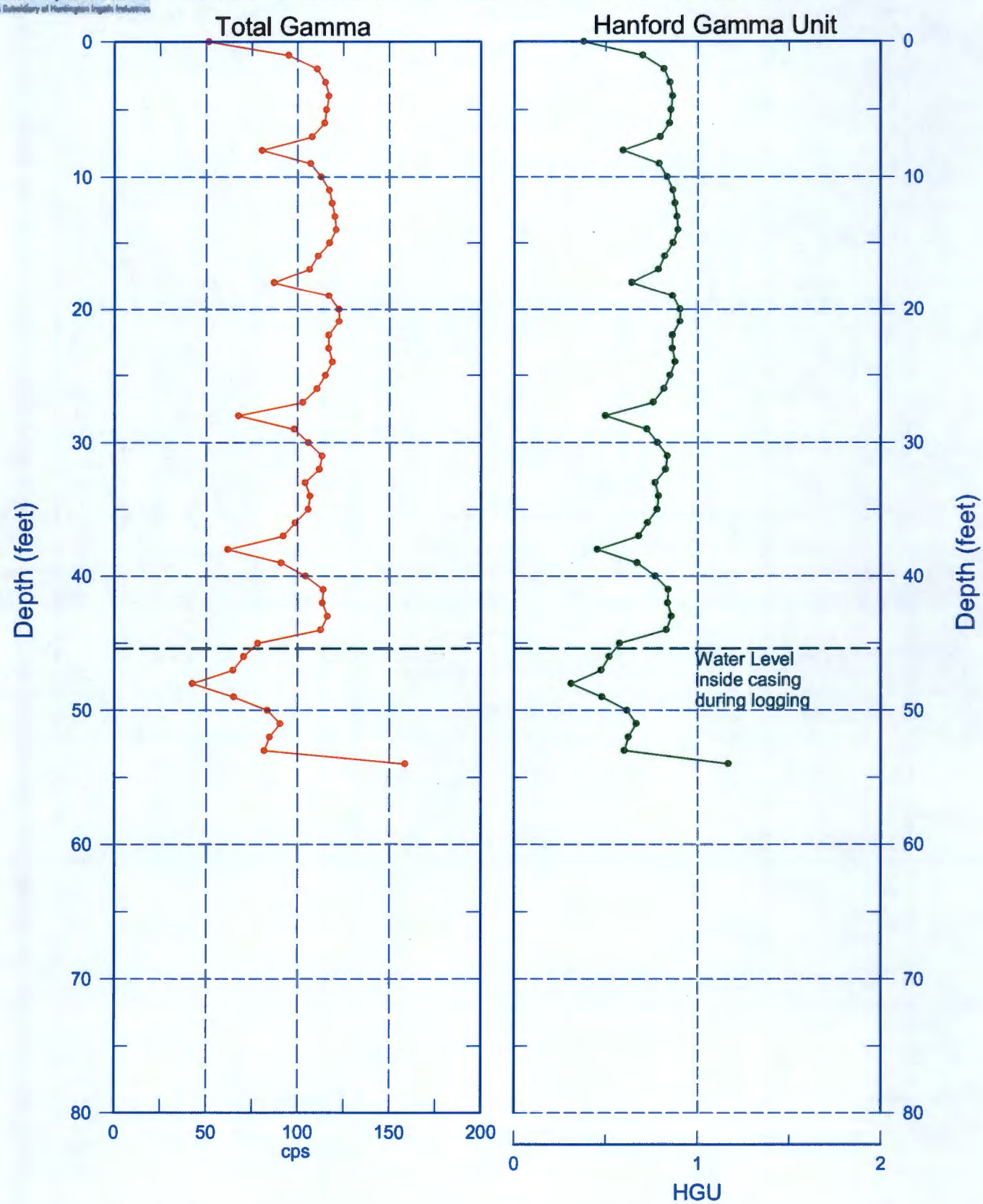
199-H4-92 (C8792)
Total Gamma & Moisture



Reference - Ground Surface

199-H4-92 (C8792)

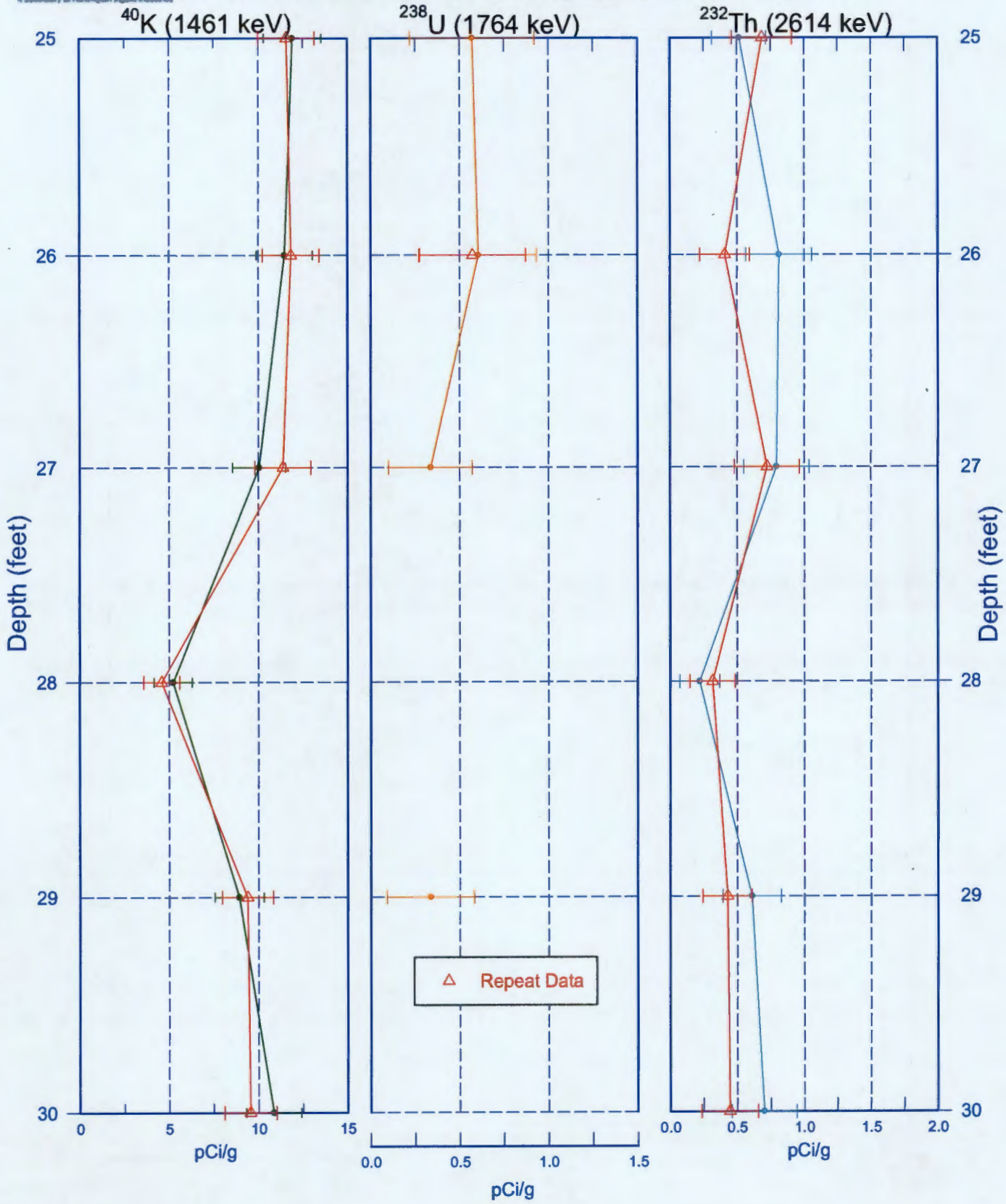
Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

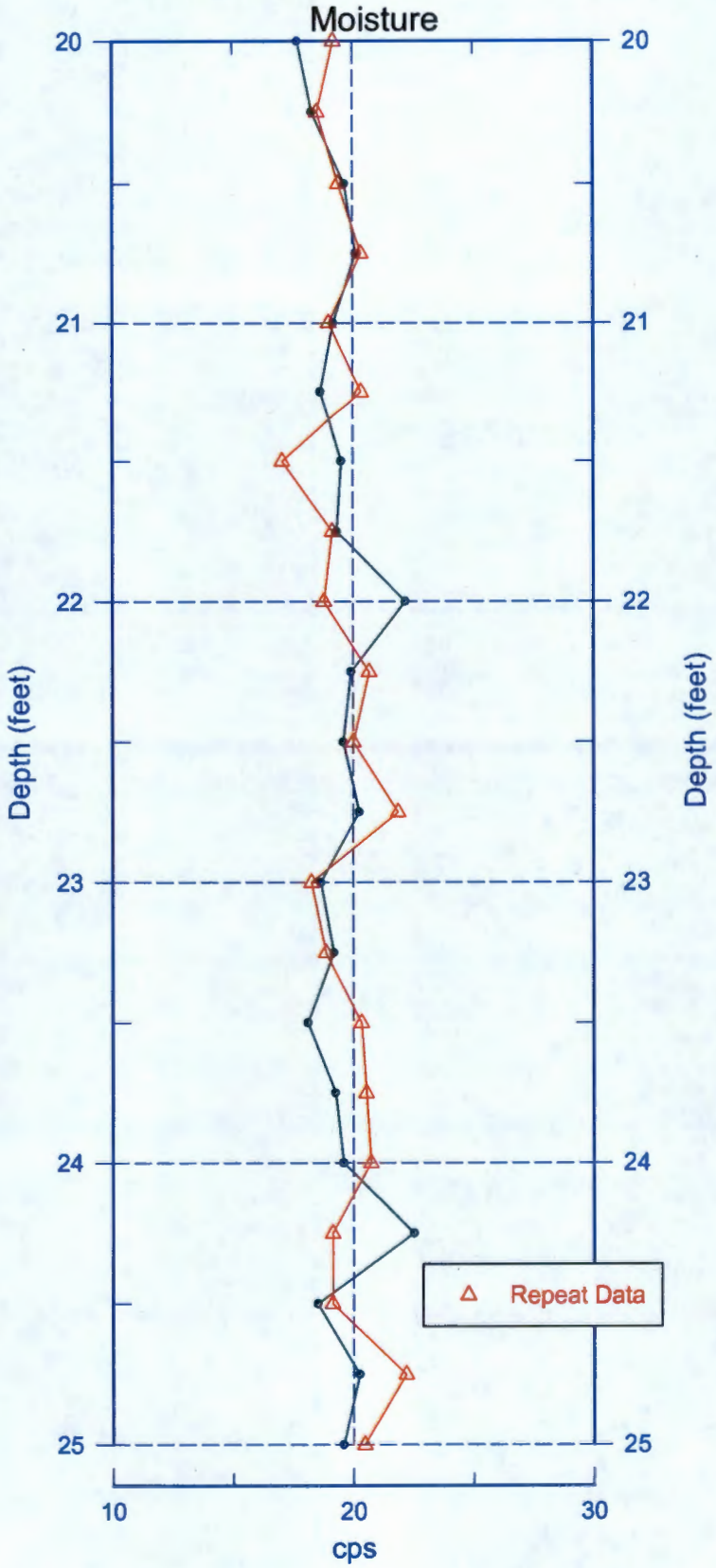
199-H4-92 (C8792)

Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

199-H4-92 (C8792)
Moisture Repeat Section



Reference - Ground Surface

FREESTONE
C8792 10 ft

FREESTONE

FREESTONE
C8792 25 ft

C8792 30 ft

FREESTONE
C8792 35 ft

C8792 40 ft

cm
FREESTONE
C8792 45

cm
FREESTONE
C8792 50 ft

cm
FREESTONE
C8792 51 ft

cm
FREESTONE
C8792 58 ft

SURVEY DATA REPORT				Request No. 153-098
Project No.	Title HR-3 Well C8792 (199-H4-92) Final Survey			File No. 1HT14R26
Job. No. CACN: 303413-JPRC	Prepared By N.P. Fastabend	Date 5/14/15	Reviewer LBM	

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casing) and elevations of completed Well C8792 (199-H4-92) at 100H Area.	Survey File	OR		
	J.D. Mehrer	1		
	K.M. Whitley	1		
	J.L. Smoot	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheet

A-6006-495 (REV 0)

WELL SURVEY DATA REPORT

Project:	Prepared By: Neil P. Fastabend Company: CHPRC
Date Requested: 4/23/15	Requestor: Kelly Whitley (CHPRC)
Date of Survey: 5/14/15	Surveyor: Lawrence B. Munnell (PLS)
Fluor Hanford Point of Contact:	Survey Co. Point of Contact: Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of Well C8792 (199-H4-92) at 100H Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 100H

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
HSWB-029 (COE) and HSWB-030 (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C8792	199-H4-92	576723.30	152233.84		Center of Casing
				128.438	"X" on Rim
				127.640	Brass Survey Marker

Notes:

128.128 Top Inner Casing, North Edge

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify that this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

5-14-15

A-6003-659 (04/03)

Appendix B

Well Documentation for C8793 (699-97-60)

- Well Summary Sheet
- Borehole Log
- Log Data Report
- Photographic Log
- Final Survey Report

This page intentionally left blank.

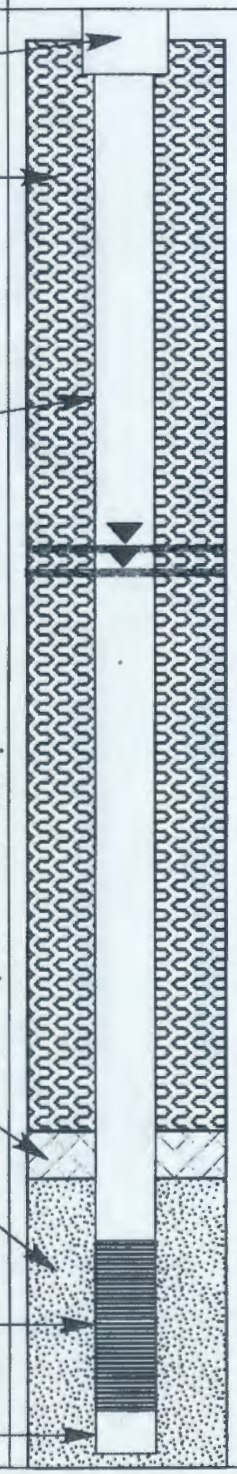
WELL SUMMARY SHEET

Start Date: 3/18/2015
Finish Date: ~~5/14/2015~~ 5/27/15 AZG 7/16/15

Well ID: C8793	Well Name: 699-97-60
Location: 0.6 mile SW of HX Pump & Treat Facility	Project: 12 GW Wells in HR-3 OU
Prepared By: Jessa Szecsody — Date: 5/14/15	Reviewed By: [illegible] — Date: 7-21-15
Signature: [illegible]	Signature: [illegible]

CONSTRUCTION DATA

Description	Diagram
8-in Protective Casing: 3.09 ft ags - 1.91 ft below ground surface (bgs)	
Type I/II Portland Cement Grout: 0 - 67.4 ft bgs	
6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.14 ft ags - 74.04 ft bgs	
Dual string temporary casing did not permit use of centralizers during permanent casing installation	
Depths are in ft below ground surface.	
Borehole drilled with 13 1/2-in O.D. casing from 0 - 53.9 ft bgs	
Borehole drilled with 10 3/4-in O.D. casing from 53.9 - 88.2 ft bgs	
All temporary drill casing was removed from the ground.	
3/8 in Cetco Coated Bentonite Pellet Seal: 67.4 - 70.3 ft bgs	
10-20 mesh Premier Colorado Silica Filter Pack Sand: 70.3 - 89.03 ft bgs	
6-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen: 74.04 - 84.05 ft bgs	
6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 84.05 - 87.05 ft bgs	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
0		0 - 5 Gravel pad
		5 - 20 Silty Sandy Gravel (msG)
10		
20		20 - 21.5 Gravelly Sand (gS)
		21.5 - 24 Sand (S)
		24 - 25 Sandy Gravel (sG)
		25 - 30 Silty Sandy Gravel (msG)
30		30 - 40 Sandy Gravel (sG)
		Static W.L.: 31.50 ft bgs (3/19/15)
		Static W.L. after screened in rum: 32.49 ft bgs (4/22/15)
40		40 - 45 Silty Sandy Gravel (msG)
		45 - 50.5 Sandy Gravel (sG)
50		50.5 - 89.03 Sandy Silt (sM)
60		
70		
80		Total Depth: 89.03 ft bgs (4/22/15)

A-6003-643 (REV 1)

WELL SUMMARY SHEET	Start Date: 3/18/2015 Finish Date: ~~5/14/2015~~	Page 2 of 2
Well ID: C8793	Well Name: 699-97-60 5/27/15 AEG 7/16/15	
Location: 0.6 m SW of HX Pump & Treat Facility	Project: 12 GW Wells in HR-3 OU	
Prepared By: Jessa Szecsody — Date: 6/09/15	Reviewed By: B. MEHRER	Date: 7-21-15
Signature:	Signature:	

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description (ft bgs)
10-20 mesh Premier Colorado Silica Filter Pack Sand: 70.3 - 89.03 ft bgs		90		50.5 - 89.03 Sandy Silt (sM)
		100		
		110		Total Depth: 89.03 (4/22/15)
		120		
		130		
		140		
		150		
Dual string temporary casing did not permit use of centralizers during permanent casing installation				
Depths are in ft below ground surface.		160		
Borehole drilled with 13 1/2-in O.D. casing from 0 - 55.4 ft bgs				
Borehole drilled with 10 3/4-in O.D. casing from 55.4 - 88.2 ft bgs		170		
All temporary drill casing was removed from the ground.				

BOREHOLE LOG

Page 1 of 3

Date: 3/18/15 - 4/22/15

Well ID: C8793	Well Name: 699-97-60	Location: ~0.6 m SW of HX Pump & Treat Facility
Project: 12 new groundwater wells in 100-HR-3 OU		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-5' - Drill pad - crushed gravel with silty sand.	Cable tool with drive barrel, 13¾" OD threaded casing. Grab samples collected every 5' or at changes in lithology.
5'	G			5-10' Silty Sandy GRAVEL (msG); 45% gravel, 35% sand, 15% silt. Gravel = VPS, Fine pebble to large cobble; max = 210 mm; R-A; 50% basalt. Sand = VPS-VF-VC; R-A; 60% VF-F; 85% basalt. Silt: 2.5Y6/3 light yellowish brown; nonplastic; gritty. Dry. Strong rxn to HCl. Occasional small sticks/twigs.	
10'	G			10' - Silty Sandy GRAVEL (msG): 50% Gravel, 37% Sand, 13% Silt. Gravel: VPS; R-A; SC-VFP; 50% Felsic; max = 85 mm. Sand: VPS; VF-VC; R-A; 70% C-VC; 75% mafic. Silt: 2.5Y6/2 light brownish gray. Very dry to slightly moist. Strong rxn to HCl. Nonplastic.	
15'	G			15' - Silty Sandy GRAVEL (msG): 40% gravel, 40% sand, 20% silt. Gravel: VPS; R-A; SC-VFP; 60% basalt; max = 80 mm. Sand: VPS; VF-VC; R-A; 30% C-VC; 80% mafic. 2.5Y5/2 grayish brown. Weak to Moderate rxn to HCl. Dry to slightly moist. Nonplastic	
20'	G			20'-21.5' Gravelly SAND (gS): 20% gravel, 78% sand, 2% silt. Gravel: VPS; R-A; 70% SC-VFP; max = 80 mm; 70% felsic. Sand: PS VF-VC; A-SA; 80% m-VF; 30% mafic. 2.5Y6/2 light brownish gray. Moderate rxn to HCl. Dry to moist. Nonplastic.	
21.5'	G			21.5' - SAND (S): 8% gravel, 89% sand, 3% silt. Gravel: VPS; R-A; 80% MP-SC; max = 69 mm; 60% mafic. Sand: WS; F-VF; R-SA; 30% mafic. 2.5Y6/2 light brownish gray. Moderate rxn to HCl; dry to slightly moist. Some muscovite present in sand/silt. (21.5'-24')	
25'	G			24'-25' Sandy GRAVEL (sG): 45% gravel, 50% sand, 5% silt. Gravel: VPS; VFP-SC; R-A; 50% mafic; max = 86 mm. Sand: VPS; VF-VC; A-SR; 30% mafic. 2.5Y6/1 gray. HCl rxn is weak in sand, strong on cementation around gravels. Dry to slightly moist. Nonplastic. Some cementation around gravel. Some muscovite.	
30'	G			25'-30' Silty Sandy GRAVEL (msG): 50% gravel, 37% sand, 13% silt. GRAVEL: VPS; R-A; VFP-Small Cobbles; 70% mafic, max = 120 mm. Sand: VPS; VF-VC; A-SR; 20% C-VC; 70% mafic. 2.5Y6/1 gray. Strong rxn to HCl, dry. (25'-30')	

Not used

Reported By: J.V. SZESSDY		Reviewed By: Kevin Bergstrom	
Title: Geologist		Title: Sr. Geologist	
Signature:	Date: 4/22/15	Signature:	Date: 9/3/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 3

Date: 3/18/15-4/22/15

Well ID: C8793 | Well Name: 699-97-60 | Location: ~0.6 mi SW of HX Pump & Treat Facility

Project: 12 new Groundwater Wells in 100-HR-3OU | 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'	G			30'-40' - sandy Gravel (sG) - 55% gravel, 40% sand, 5% silt. Gravel: VFP-SC; VPS; R-A; 60% mafic; max 100 mm. Sand: VPS; A-SA; VF-VC; 40% medium; 30% C-VC; 30% mafic. 5Y5/1 gray. Weak rxn to HCl. Moist.	Cable tool with drive barrel, 13½" OD threaded casing. Grab samples collected every 5' or at changes in lithology.
			3/19/15 4/22/15		Static Water Level: 33.4' bgs (5/27/15)
35'	G SS 33.22' 35.72'	80% recovery 32 blows		35' @ 35' - Gravel ↑ 60%, Sand ↓ 33%, Silt ↑ 7%. Gravel: SR-A; >20 mm = R-SR; <20 mm = A-R; max = 80 mm; 20% mafic. Sand = A-SR; 2.5Y 3/2 very dark grayish brown.	Split spoon sample: 33.22'-35.72', 80% recovery. HEIS # B30JM7 water @ ~~33.0~~ bgs on 3/19/15 ~~4/22/15~~ 31.5' bgs (unconfined)
40'	G W			40'-45' - silty sandy Gravel (msG): 50% gravel, 37% sand; 13% silt. Gravel: VPS-VFP-VCP; <20 mm = A-SR; >20 mm = SA-R; max = 60 mm; 70% felsic. Sand: VPS; A-SR; VF-VC; 60% medium; 50% felsic. Silt: 2.5Y 4/2 dark grayish brown. Moist. Weak rxn to HCl. Mica present in sand.	W: 39.81' water sample
45'	G			45-50.5' sandy Gravel (sG): 60% gravel, 35% sand, 5% silt. Gravel: VPS; VFP-VCP; <20 mm = A-SR; >20 mm = SA-R; max = 60 mm; 70% felsic. Sand: VPS; A-SR; VF-VC; 60% medium; 50% felsic. Silt: 2.5Y 4/2 dark grayish brown. Moist. Weak rxn to HCl. Mica present in sand.	~~45'-88.6' (TD) drilled with Becker HAMMER. All samples were recovered moist; no water added while drilling.~~ W: 48.7' water sample.
50'	G SS 49.8 52.3	100% recovery		@ 50' - max gravel = 100 mm. 50.5'-88.6' - sandy Silt (sM): 20% sand, 80% silt. 10YR 4/4 light yellowish brown; low plasticity. Moist. Strong rxn to HCl.	Particle size distribution difficult to determine - see sieve analysis. Split spoon: 49.8'-52.3'. HEIS # B30JM8
55'	G			@ 55.4' - Sand: WS; FS-VFS; 100% felsic. Mud: 7.5YR 4/6 strong brown. No rxn to HCl. Non plastic. Trace mica. 10YR 8/2 very pale brown when dry (mud).	13½" casing Shoe @ 53.9' bgs 4/8/15 — 55.4' bgs end of cable tool. Telescope 10¾" Becker Hammer casing and advance hole with Becker Hammer rig. No water added during Becker Hammer drilling until after TD reached and sampled. Water then used only to clean casing.
60'	G				
65'	G 65.1' SS 67.6'	100% recovery		@ 65' - some high cementation layers up to 50 mm thick. Strong rxn to HCl.	Split spoon sample: 65.1'-67.6'. HEIS # B30JM9

Reported By:	JESSA SZECSODY & GREG KASA	Reviewed By:	Kevin Bergstrom
Title:	Geologist	Title:	Sr. Geologist
Signature:		Signature:	
Date:	4/22/15	Date:	8/3/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 3

Date: 4/22/15

Well ID: C8793 | Well Name: 699-97-60 | Location: 0.6 mi SW of HX PUT PLANT

Project: 12 NEW WELLS AT 100 HR 3 OU | Reference Measuring Point: G.S.

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
70	G			50.5' @ 70' SAME AS ABOVE - LESS	ALL SAMPLES
				CEMENTATION - Sandy Silt (SM): 20% sand, 80% silt.	RECEIVED MOIST
				Sand: WS; FS-VFS; 100% felsic. Mud: 7.5YR 4/6 strong brown.	BECKER HAMMER
				Strong rxn to HCl. Nonplastic. Moist. Trace mica.	DRILLED - NO WATER
					ADDED UNTILL AFTER
75	G			@ 75' SM SANDY SILT AS ABOVE	TD SAMPLE COLLECTION
	G 76'			INCREASED CARBONATE CEMENTATION	DTW = 32.7' bgs 5/11/15 (in RUM)
	SS	100% recovery		NODULES TO 25 mm DIAMETER &	
	G 78.5'			LAYERS TO 50 mm THICK HIGH STRENGTH	Split spoon sample: 76'-78.5'
	W			@ 76' VERY HIGH CEMENTATION	HE15# B30JN0
80				PLATES 200 mm DIA x 50 mm THICK	W: 79.0' bgs = water sample
				10YR 5/3 BROWN AS MOIST	
				10YR 8/1 WHITE AS AIR DRIED	
				NO PLASTICITY, STRONG HCl RXN.	
				@ 78' DESCRIPTION AS AT 75'	
85				LESS MASSIVE CEMENTATION STR HCl RXN	
	86.1'			@ 80' SM 30% S, 70% M 7.5YR	
	SS	100% recovery		4/6 STRONG BROWN INTERVALS OF	
	88.7'			V. HIGH CEMENTATION BUT NO VISIBLE	Split spoon sample: 86.1'-88.7'
				CALICHE - STR HCl RXN	HE15# B30JN1 & B30JN2 (DUP)
90				@ 85 COLOR & GRAIN SIZE AS	
				AT 80'; NO/LOW STRENGTH (CEMENTATION)	
				@ 88.6 LITHOLOGY AS ABOVE	88.6 SAMPLE FROM
				10YR 6/4 LT YELLOWISH BROWN	SPLIT SPOON SHOE
				VARIABLE CEMENTATION	
				LOW - VHIGH; STRONG HCl RXN.	
					Reached TD @ 89.05' bgs on
					4/22/15; Shoe @ 88.2'.
					DTW = 32.49' bgs 4/22/15
				not used	

Reported By: GREG L. KASZA | Reviewed By: Kevin Bergstrom

Title: GEOLOGIST | Title: Sr. Geologist

Signature: [signature] Date: 4/23/15 | Signature: [signature] Date: 8/3/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

699-97-60 (C8793)
Log Data Report

Borehole Information:

Log Date:	2015-04-23	Filename:	C8793_HG-NM_2015-04-23	Site:	100 H
Coordinates (WA St Plane)		DTW[1] (ft) :	34.3	DTW Date:	04/09/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	04/22/15	N/A	88.5	Cable/Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0.6	13 1/4	12 1/4	1/2	0.6	54
Becker	2.4	10 5/8	9	13/16	2.4	88.2
Becker	2.7	8 1/4	8	1/8	2.7	88.2

Borehole Notes:

The onsite geologist provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). Two drilling methods were used to drill this borehole. Cable Tool was used from ground surface to 54 ft. The remainder of the borehole was drilled with the Becker method. This drilling method employs a double wall drive pipe where compressed air is forced down the outer casing and geologic material is returned to the surface inside the inner casing. The outer casing thickness could not be measured as the inner casing did not allow access. The above reported casing thickness for the outer casing is estimated. Depth to water inside the casing was measured at 34.3 ft by the logging engineer using an e-tape. The maximum logging depth achieved was 88.5 ft,

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1L	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	11/12/14	Serial No.:	47-TP32211A
Calibration Reference:	HGLP-CC-111, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 1H	Type:	NMLS[4]
Effective Calibration Date:	11/13/14	Serial No.:	H310700352
Calibration Reference:	HGLP-CC-112, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	3	4 Repeat	5	6 Repeat	
HEIS Number	1018684	1018685	1018686	1018687	
Date	04/09/15	04/09/15	04/23/15	04/23/15	
Logging Engineer	Pope	Pope	Pope	Pope	

[1] depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

Stoller Newport News Nuclear

Log Run	3	4 Repeat	5	6 Repeat	
Start Depth (ft)	0.0	20.0	50.0	55.0	
Finish Depth (ft)	52.0	25.0	88.0	59.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	AL245CAB	AL245CAB	AL250CAB	AL250CAB	
Start File	AL245000	AL245053	AL250000	AL250039	
Finish File	AL245052	AL245058	AL250038	AL250043	
Post-Verification	AL245CAA	AL245CAA	AL250CAA	AL250CAA	
Depth Return Error (in.)	N/A	0.0	N/A	0.5 high	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

NMLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1018688	1018689			
Date	04/09/15	04/09/15			
Logging Engineer	Pope	Pope			
Start Depth (ft)	0.0	20.0			
Finish Depth (ft)	34.25	24.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AH204CAB	AH204CAB			
Start File	AH204000	AH204138			
Finish File	AH204137	AH204154			
Post-Verification	AH204CAA	AH204CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	None	None			

Logging Operation Notes:

A centralizer was installed on the sondes.

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Analysis Notes:

Analyst:	P.D. Henwood	Date:	04/30/15	Reference:	HGLP-MAN-003, Rev. 0

A casing correction for a 1/2-in. thick casing was applied to 54 ft. From 50 to 54 ft (log run 5) a combined casing correction for a 1.4375-in. thick casing (0.5 + 0.125-in. + 0.8125 for the 1/2-, 1/8-, and 13/16-in. thick casings) was

applied to the log data. Below 54 ft, a combined correction for a 0.9375-in. thick casing (0.8125 + 0.125 for the 13/16- and 1/8-in. thick casings) was applied. No additional correction was applied for the casing joints which are in excess of 1.15-in. and occur at approximately 10-ft intervals.

A correction for water was applied below 34 ft in depth.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as AL20141112, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

NMLS data are reported in count per second as there is no calibration for conversion to volumetric moisture for multiple casings and large diameters.

The HGU[5] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected in the borehole. MDLs for Cs-137 and Pu-239 are plotted for the entire borehole.

The relatively thick casing joints beginning at 58 ft and occurring at 10 ft intervals are indicated by reduced count rates on the total gamma log.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

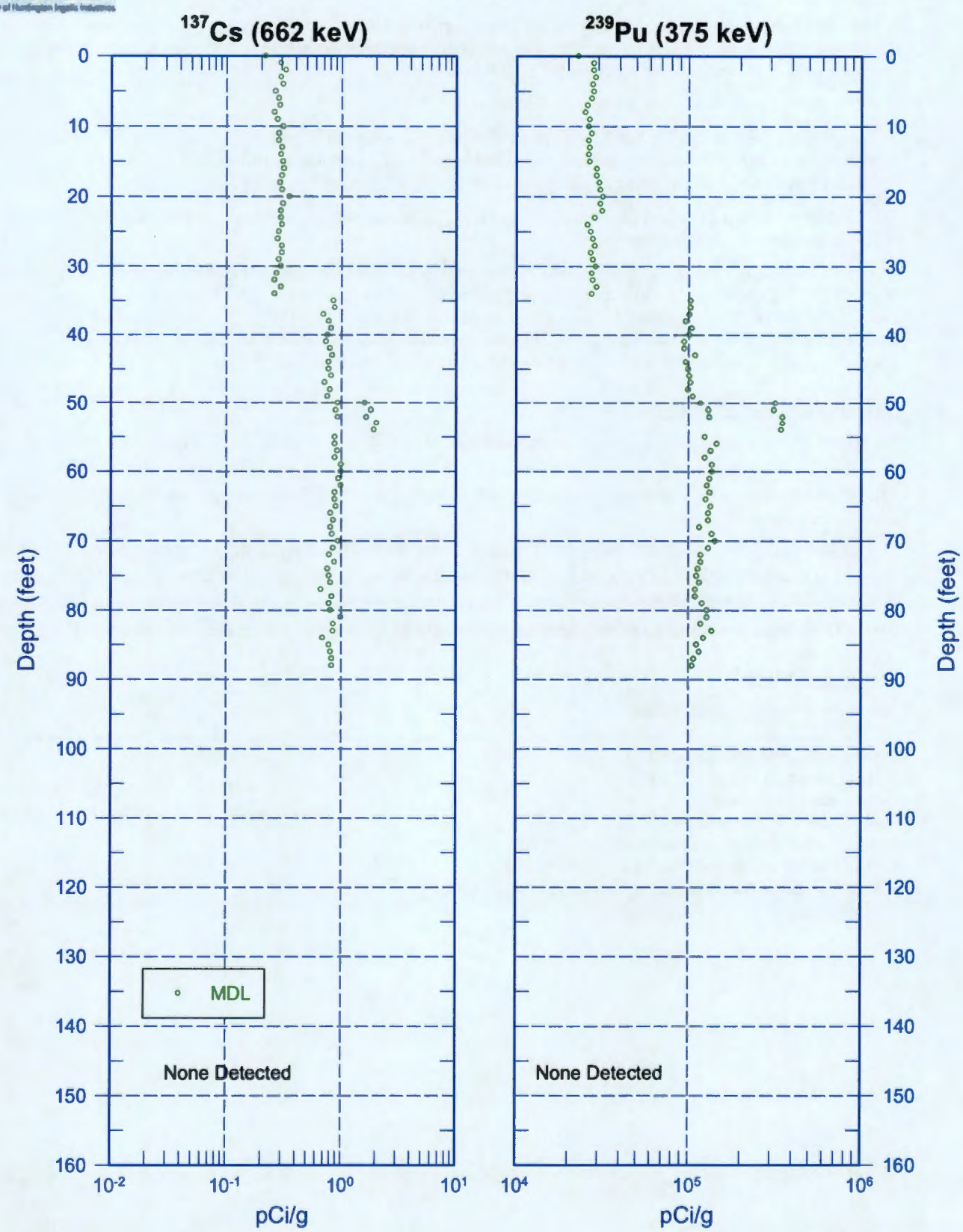
List of Log Plots:

Depth Reference is ground surface.

Manmade Radionuclides (0-160 ft)
Natural Gamma Logs (0-160 ft)
Combination Plot (0-120 ft)
Total Gamma & Moisture (0-160 ft)
Total Gamma & Hanford Gamma Unit (0-160 ft)
Repeat Section of Natural Gamma Logs (20 to 25 ft)
Repeat Section of Natural Gamma Logs (55 to 59 ft)
Moisture Repeat Section (20 to 24 ft)

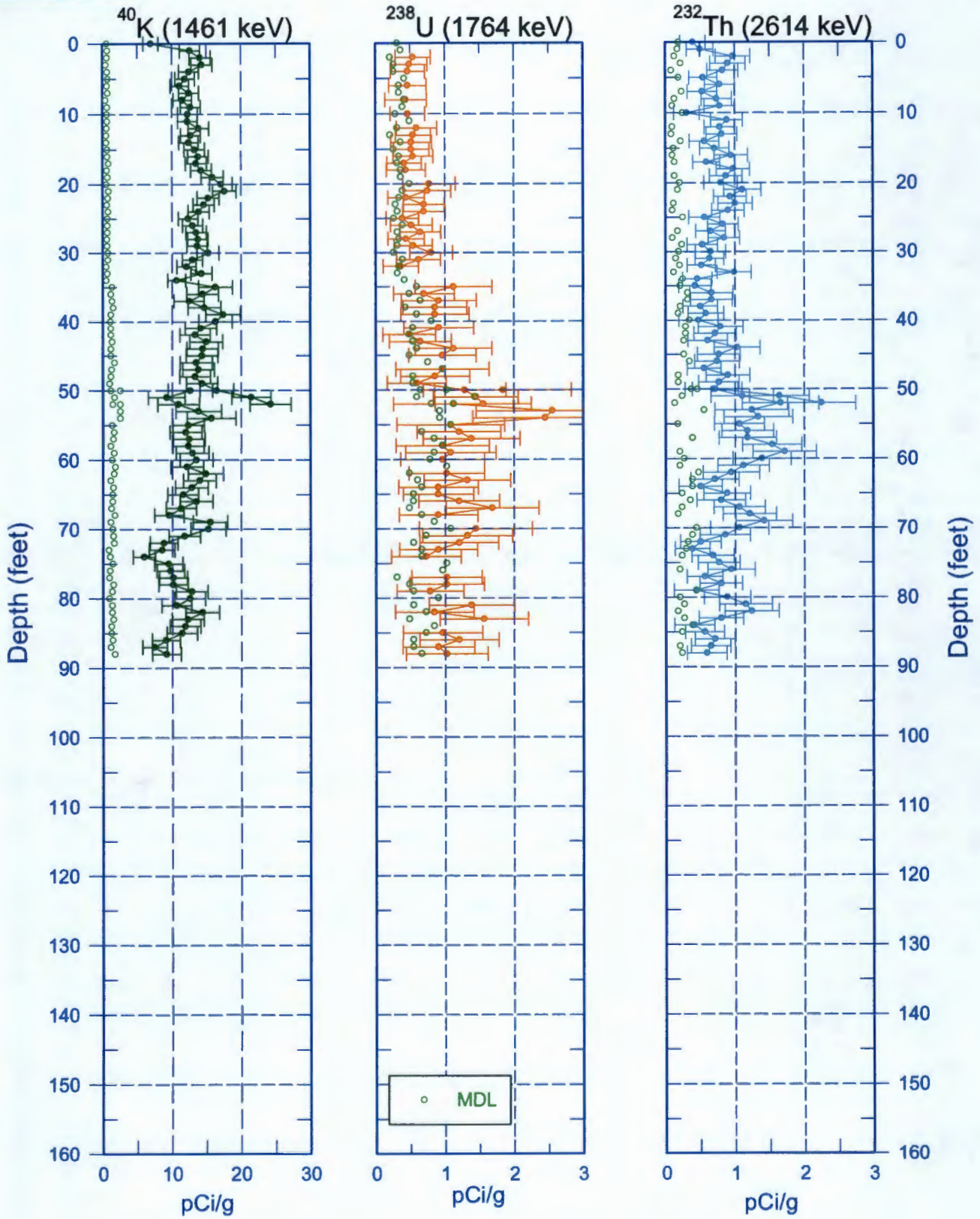
[5] Hanford Gamma Unit

699-97-60 (C8793)
Manmade Radionuclides



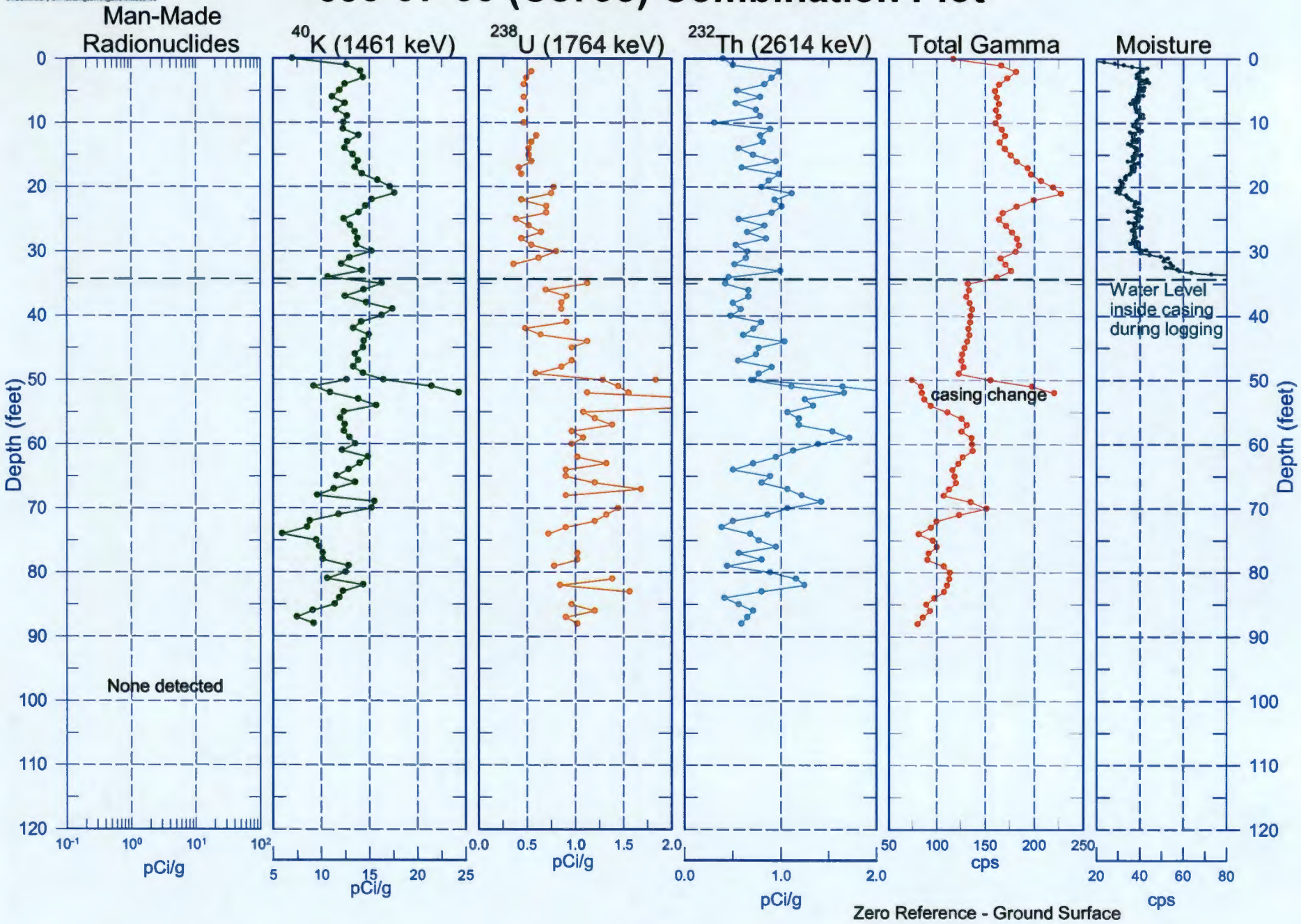
Zero Reference - Ground Surface

699-97-60 (C8793)
Natural Gamma Logs

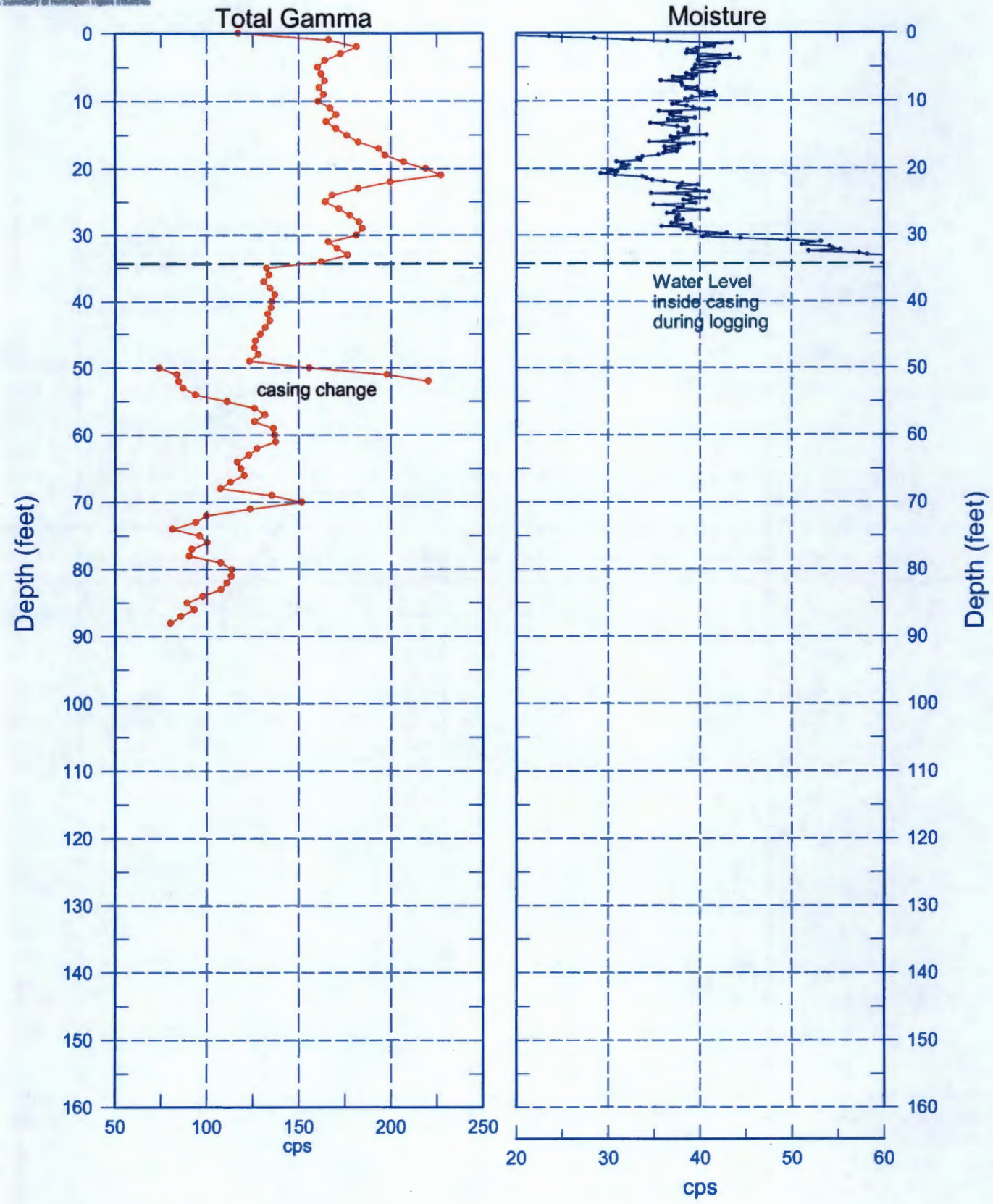


Zero Reference - Ground Surface

699-97-60 (C8793) Combination Plot

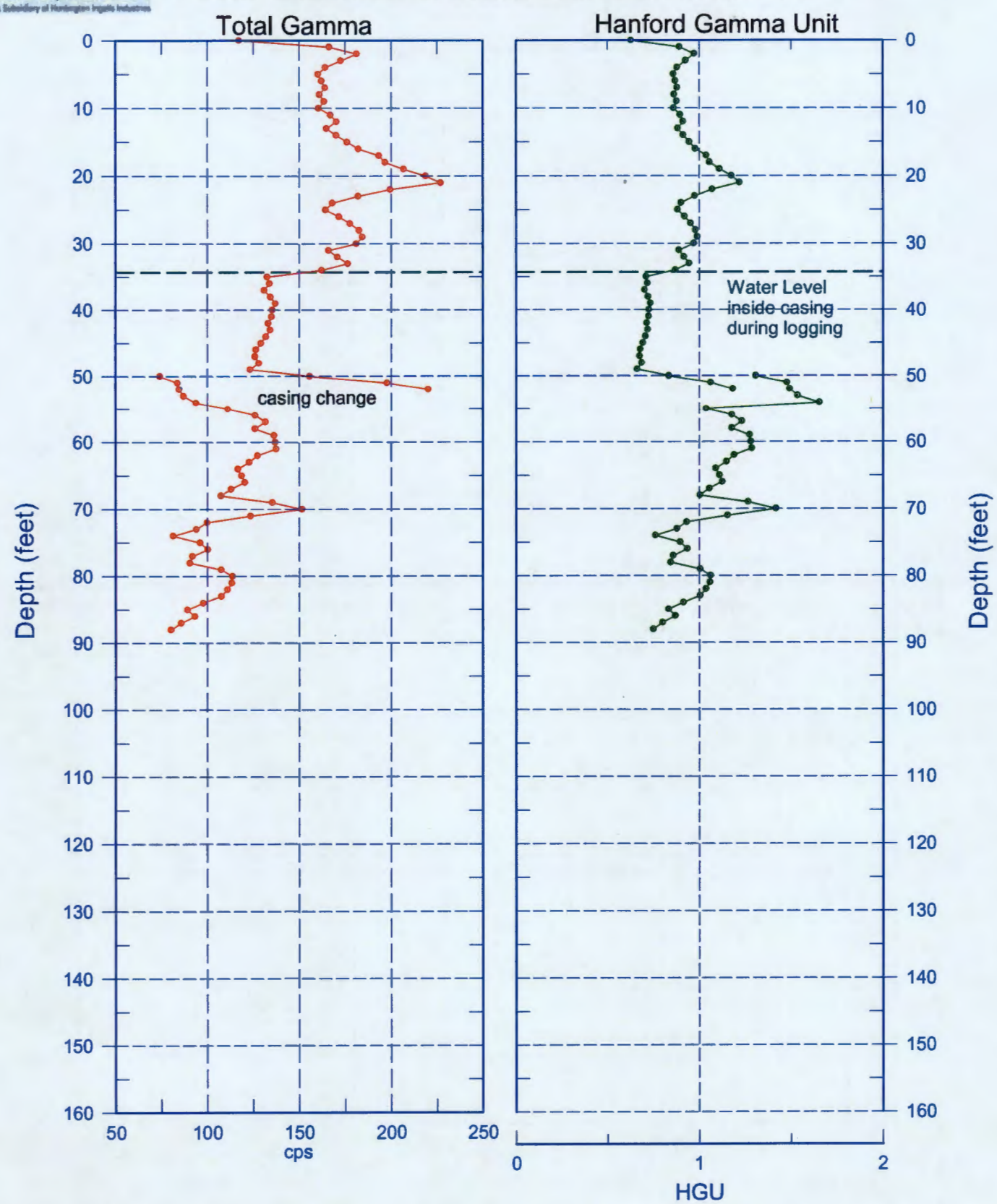


699-97-60 (C8793)
Total Gamma & Moisture



Reference - Ground Surface

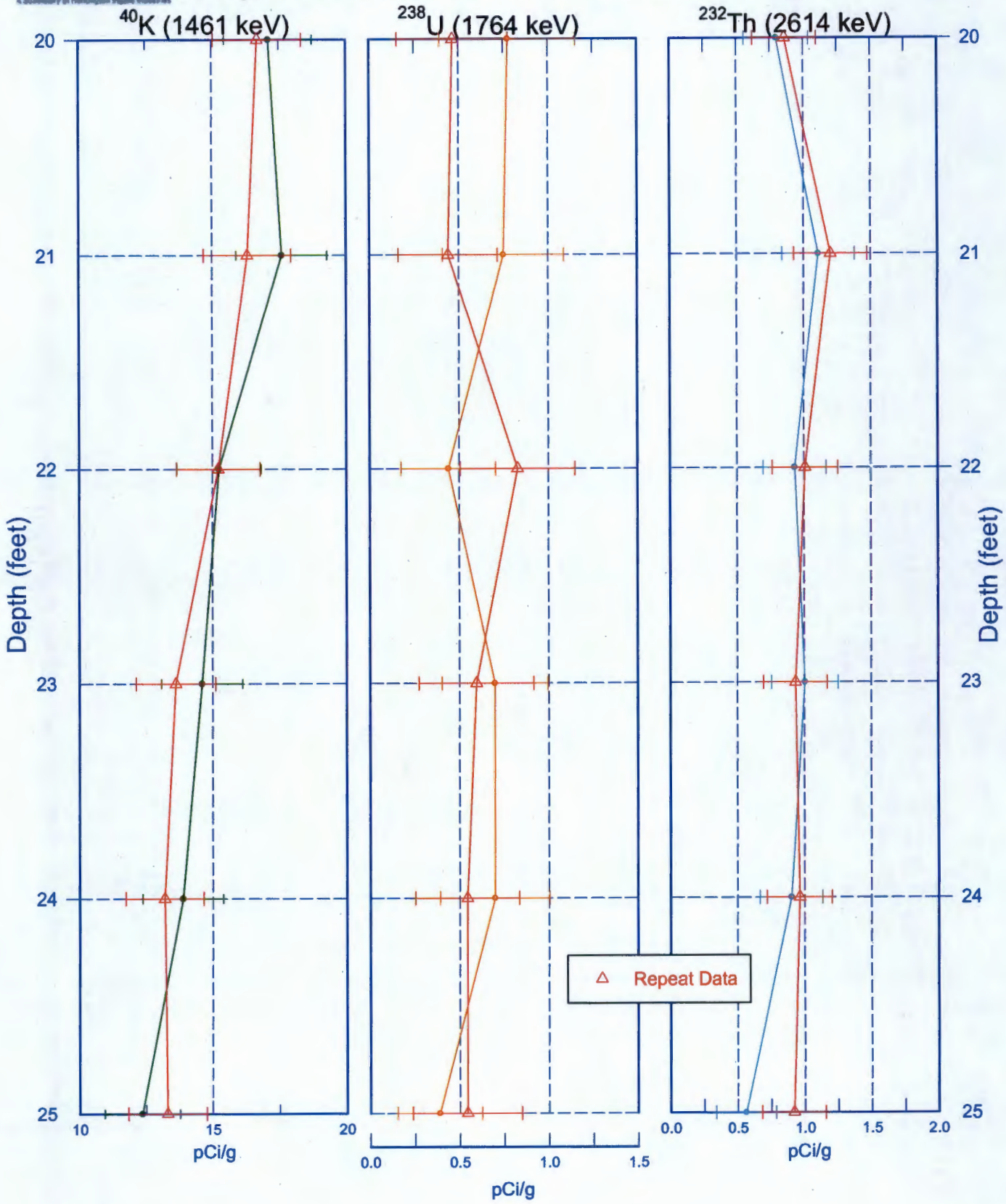
699-97-60 (C8793)
Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

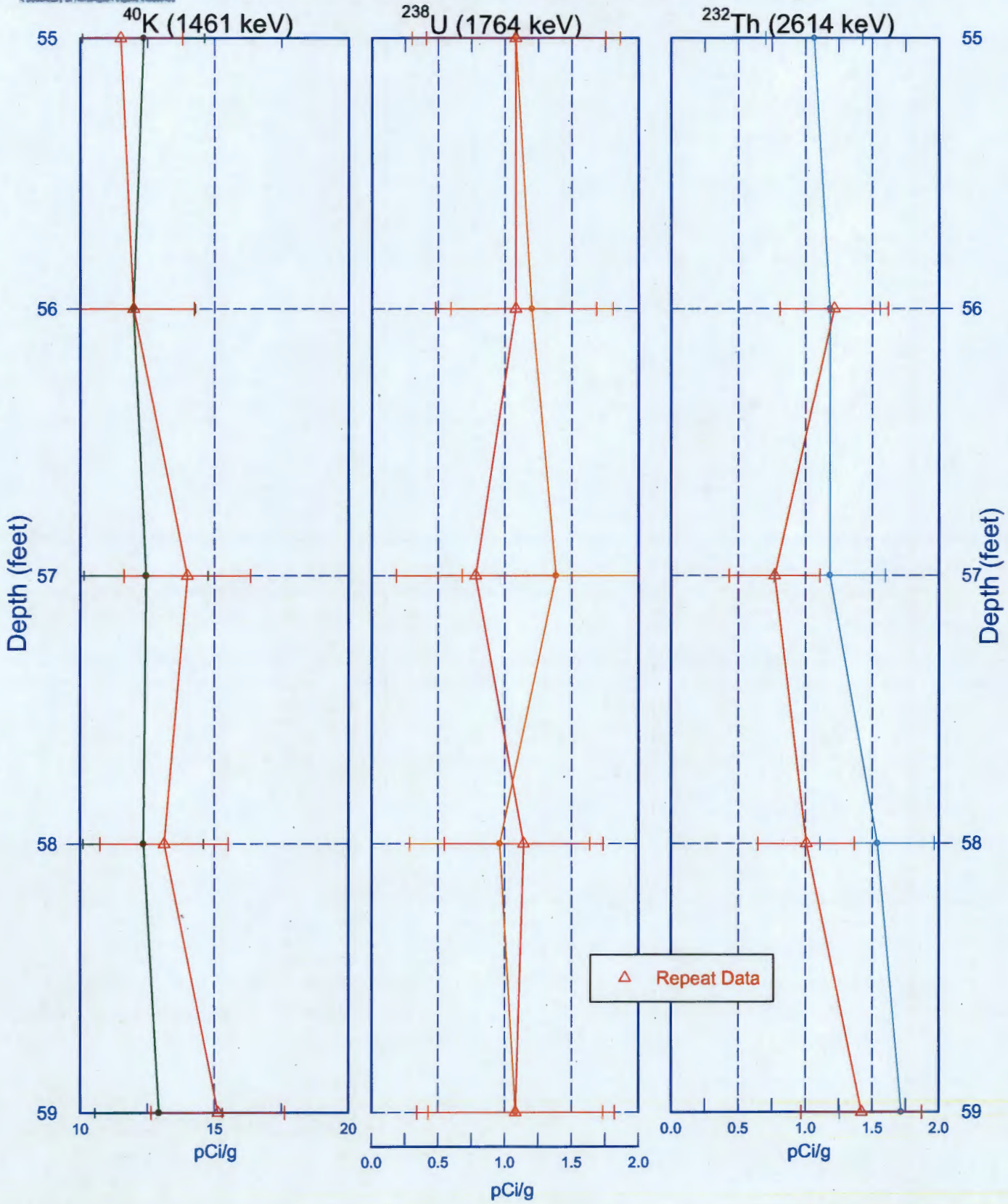
699-97-60 (C8793)

Repeat Section of Natural Gamma Logs



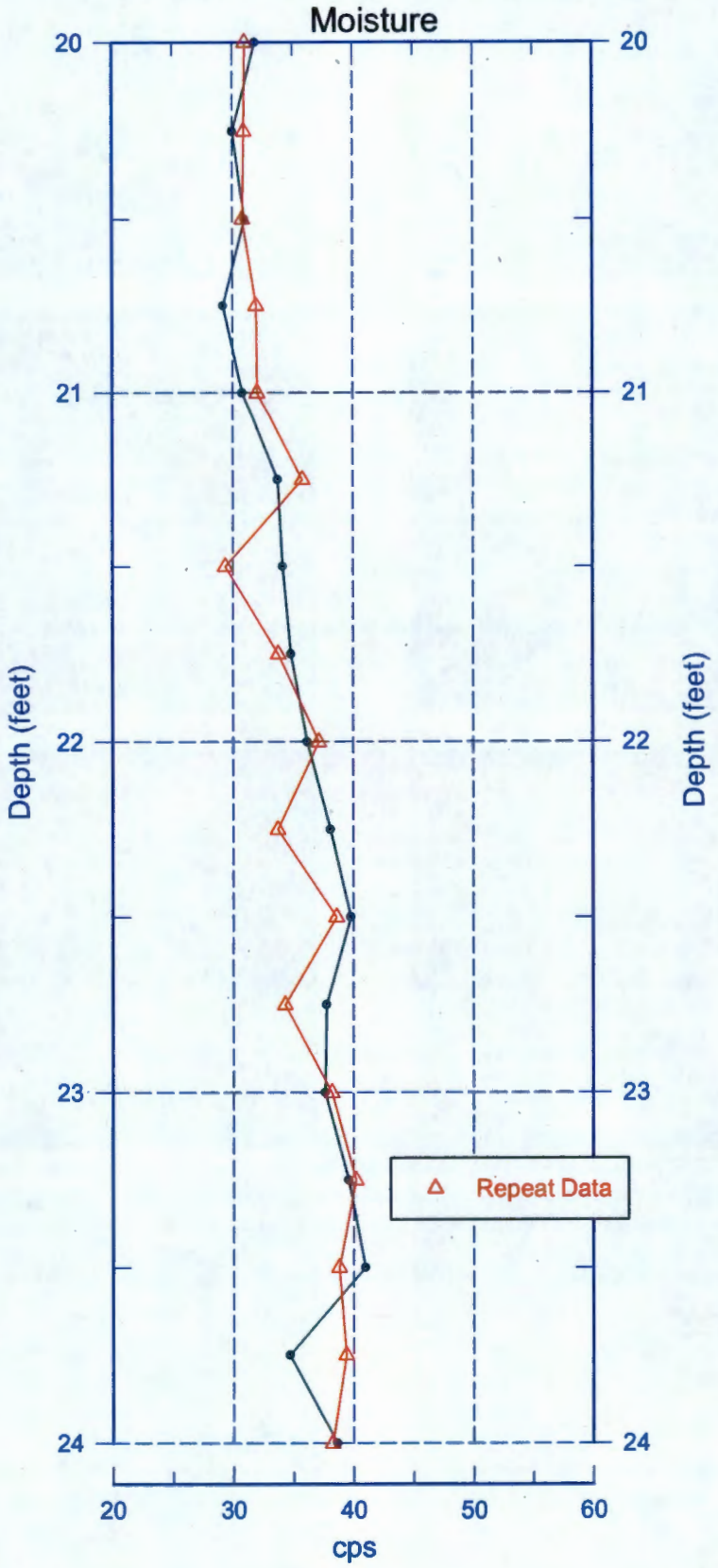
Zero Reference - Ground Surface

699-97-60 (C8793)
Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

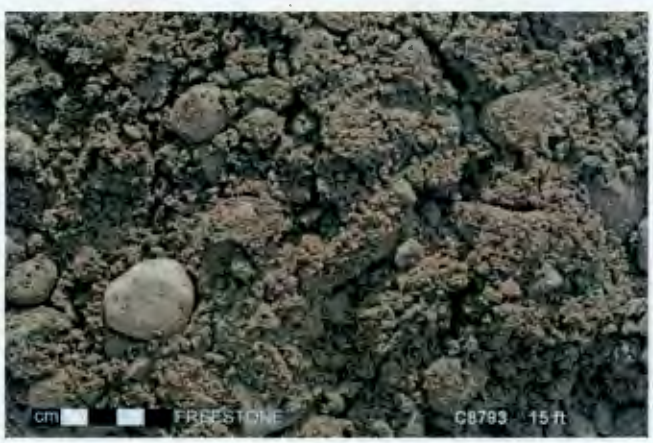
699-97-60 (C8793)
Moisture Repeat Section



Reference - Ground Surface

cm
FREESTONE
C6793 5 ft

cm
FREESTONE
C6793 10 ft


cm
FREESTONE
C6793 15 ft

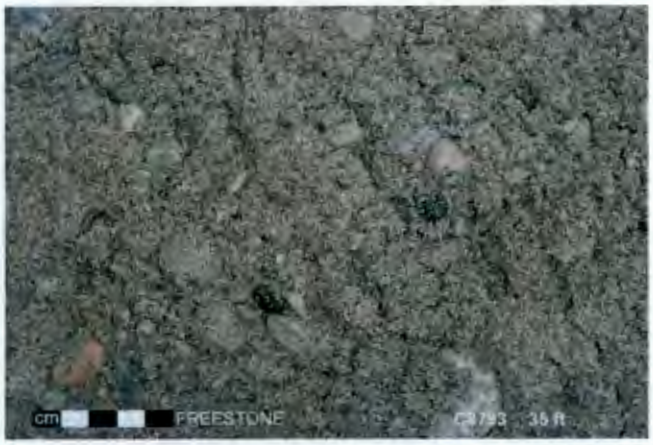
cm
FREESTONE
C6793 20 ft

cm
FREESTONE
C6793 22 ft

cm
FREESTONE
C6793

cm
FREESTONE
C6793 25 ft

cm
FREESTONE
C6793 30 ft


cm
FREESTONE
C8793 35 ft

cm
FREESTONE
C8793 40 ft

cm
FREESTONE
C8793 45 ft

cm
FREESTONE
C8793 50 ft

cm
FREESTONE
C8793 51 ft

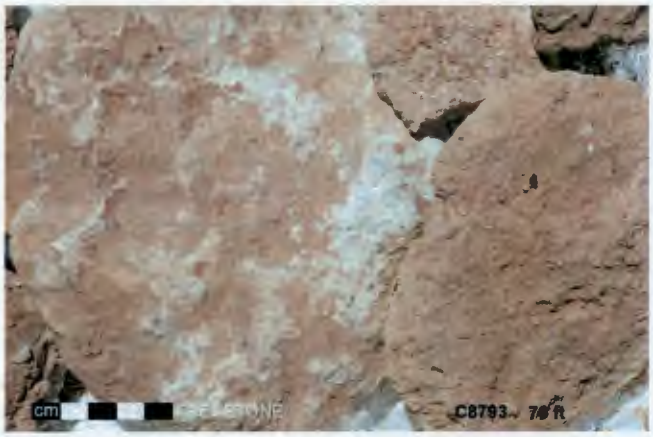
cm
FREESTONE
C8793 55 ft

cm
FREESTONE
C8793 60 ft

cm
FREESTONE
C8793 65 ft

cm
FREESTONE
C8793 70 ft

cm
FREESTONE
C8793


cm
FREESTONE
C8793 76 ft

cm
FREESTONE
C8793 78 ft

cm
FREESTONE
C8793 80 ft

cm
FREESTONE

cm
FREESTONE

SURVEY DATA REPORT				Request No. 153-130
Project No.	Title HR-3 Wells C8793 and C8794 Final Surveys			File No. 6AT14R26
Job. No. CACN: 303594-JPRC	Prepared By N.P. Fastabend	Date 6/23/15	Reviewer LBM	

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casings) and elevations of completed HR-3 Wells C8793 (699-97-60) and C8794 (699-97-61).	Survey File	OR		
	J.D. Mehrer	1		
	K.M. Whitley	1		
	J.L. Smoot	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheets

A-6006-495 (REV 0)

WELL SURVEY DATA REPORT

Project:	Prepared By: Neil P. Fastabend Company: CHPRC
Date Requested: 06/16/15	Requestor: Jim Mehrer (CHPRC)
Date of Survey: 06/23/15	Surveyor: Lawrence B. Munnell (CHPRC)
Fluor Hanford Point of Contact:	Survey Co. Point of Contact: Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of HR-3 Well C8793 (699-97-60).	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 600A

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
G49 (COE) and P324 (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C8793	699-97-60	575682.05	152794.99		Center of Casing
				128.267	"X" on Rim
				127.509	Brass Survey Marker

Notes:

127.981 Top Inner Casing, North Edge

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

6-23-15

A-6003-659 (04/03)

Appendix C

Well Documentation for C8794 (699-97-61)

- Well Summary Sheet
- Borehole Log
- Log Data Report
- Photographic Log
- Final Survey Report

This page intentionally left blank.

WELL SUMMARY SHEET	Start Date: 4/30/2015 Finish Date: ~~5/26/2015~~	Page 1 of 2

Well ID: C8794		Well Name: 699-97-61 5/27/15 RSG 7/16/15	
Location: 1800 m NE of 105-D Reactor		Project: 12 GW Wells in HR-3 OU	
Prepared By: Jessa Szecsody	Date: 6/09/15	Reviewed By: J.D. MEHRER	Date: 7-21-15
Signature:		Signature:	

CONSTRUCTION DATA

Description

8-in Protective Casing: 3.05 ft ags - 1.95 ft below ground surface (bgs)

Type I/II Portland Cement Grout: 0 - 10.9 ft bgs

Cetco Medium Bentonite Chips: 10.9 - 36.0 ft bgs

6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.0 ft ags - 82.29 ft bgs

Dual string temporary casing did not permit use of centralizers during permanent casing installation

Depths are in ft below ground surface.

Borehole drilled with 13 1/2-in O.D. casing from 0 - 69.6 ft bgs

Borehole drilled with 10 3/4-in O.D. casing from 69.6 - 98.7 ft bgs

All temporary drill casing was removed from the ground.

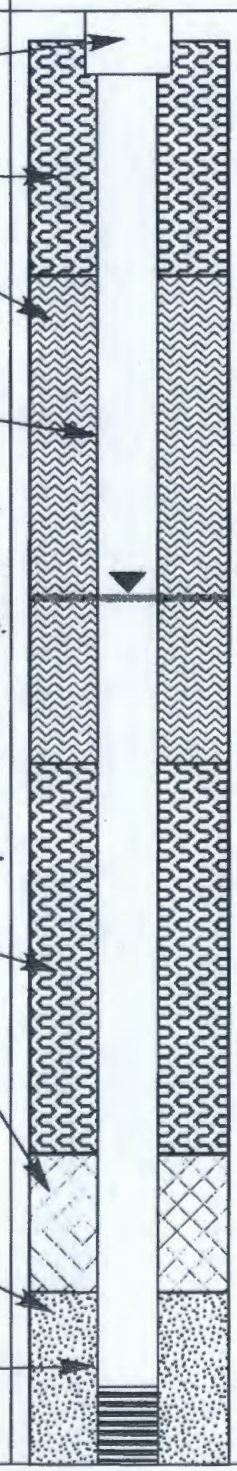
Type I/II Portland Cement Grout: 36.0 - 69.4 ft bgs

3/8 in Cetco Coated Bentonite Pellet Seal: 69.4 - 77.0 ft bgs

10-20 mesh Premier Colorado Silica Filter Pack Sand: 77.0 - 99.2 ft bgs

6-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen: 82.29 - 92.3 ft bgs

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 10, 20, 30, 40, 50, 60, 70, 80

Graphic Log

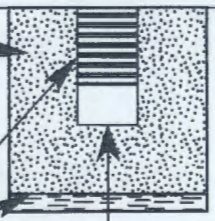
Lithologic Description (ft bgs)

0 - 1 Gravel pad
1 - 3 Silt (M)
3 - 30 Sandy Gravel (sG)
30 - 40 Gravel (G)
Static W.L.: 33.8 ft bgs (5/4/2015)
Static W.L after screened in rum: 34.2 ft bgs (5/11/15)
40 - 44 Sandy Gravel (sG)
44 - 52 Silty Sandy Gravel (msG)
52 - 67 Sandy Gravel (sG)
67 - 100.9 Silt (M)

A-6003-643 (REV 1)

WELL SUMMARY SHEET	Start Date: 4/30/2015 Finish Date: ~~5/26/2015~~ 5/27/15 RSG 7/14/15	Page 2 of 2
Well ID: C8794	Well Name: 699-97-61	
Location: 1800 m NE of 105-D Reactor	Project: 12 GW Wells in HR-3 OU	
Prepared By: Jessa Szecsody — Date: 6/09/15	Reviewed By: J.D. MEHRER	Date: 7-21-15
Signature:	Signature:	

CONSTRUCTION DATA

Description	Diagram
10-20 mesh Premier Colorado Silica Filter Pack Sand: 77.0 - 99.2 ft bgs 6-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen: 82.29 - 92.3 ft bgs Natural slough: 99.2 - 100.9 ft bgs 6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 92.3 - 95.3 ft bgs	

Dual string temporary casing did not permit use of centralizers during permanent casing installation

Depths are in ft below ground surface.

Borehole drilled with 13 1/2-in O.D. casing from 0 - 69.6 ft bgs

Borehole drilled with 10 3/4-in O.D. casing from 69.6 - 99.2 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
90		67 - 100.9 Silt (M)
100		
		Total Depth: 100.9 ft bgs (5/11/15)
110		
120		
130		
140		
150		
160		
170		

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 3

Date: 4/30-

Well ID: C8794	Well Name: 699-97-61	Location: 1800m NE of 105-D Reactor
Project: 12 New wells @ 100-HR-3 OU		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-1' Pad gravel Pitrun and Crushed	Becker Hammer with
				1-3' Brown silt (m) No sample	Triple wall casing,
				collected, TR. roots, 10YR 4/2 Dark brownish gray	13 1/2 & 9 3/4
				3-30' sandy gravel (SG) 75%	
				dark brown gray, gravel 75%, 25% sand	10YR 4/2 dark brownish gray
5	G			and trace silt. Gravel: Poorly	
				sorted very fine to very coarse	
				pebbles with occasional small	
				cobble. 70% felsic, 30% mafic until	
				20' bgs where increased mafics	
10	G			may be due to a crushed basalt	
				cobble. Sub rounded to rounded	
				pebbles. Sand: poorly sorted v.fine	
				to v.coarse, 70% felsic, 30%	
				basalt, subangular to angular.	
15	G			no rxn w/HCl, moist	
20	G			20' Hit basalt boulder mafics incr	Drillers add ~2-3
				in gravel 70% mafic 30% felsic and	gal water per 5'
				in sands 70% mafic 30% felsic.	
				20-25' occasional weak reaction	
				to HCL around gravel.	
25	G				
				2.5Y 4/3	
30	G			30'-40' olive brown Gravel (G) 90%	
				gravel, 10% sand, trace silt. Gravel:	occ. Small cobble, max-110mm
				very fine to very coarse pebble with 80%	
				being coarse pebble that has a 50/50	
				mafic to felsic ratio. fine to medium	13 1/2" casing to 69.6' bgs 5/5/15
35				pebbles were 90% mafic sub angular to	5/4/15 DTW = 33.8'
				rounded. Sand: very fine to fine, well	W: 38.7' water sample
	G			sorted 70% mafic, 30 felsic sub angular	Split spoon sample: 37.5'-
37.5				35-40' sand had moderate reaction	40' bgs. 40% recovery
5YR 4/6 38.5	SS W	40% recovery		to HCL	HEIS # B30JB9

Reported By: Kim Schuyler, Tracy Mallgren	Reviewed By: Kevin Bergstrom
Title: Geologist	Title: Sr. Geologist
Signature: Kim Schuyler, Tracy Mallgren Date: 4/30/15	Signature: Kevin Bergstrom Date: 8/3/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 3
Date: 4/30-

Well ID: C8794	Well Name: 699-97-(6)	Location: 1800m NE of 105-D Reactor
Project: 12 New wells @ 100-HR-3 OU		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
40	G SS			40'-44' Sandy gravel (sG) 40% gravel, 60% sand and trace silt. Gravel: vf pebbles - small cobbles. 50% vfp, 50% sc max clast 80 mm. Med sorted, sub rounded 50% mafic 50% felsic. Sand: vf-c 80% m grain. fines (VF-FS) 10% mafic, med-c 80% mafic well sorted, sub angular, 2.5Y 5/2 grayish brown, wet, no rxn to HCL	40'-67': mica in sand (trace) Becker Hammer w/ 8 in. tri.p. wall casing. 13 1/2" casing advanced to 69.6'.
45	G			44'-52': Silty Sandy Gravel 40% gravel 30% Sand 30% Silt/clay. Gravel: m-vc p max 70mm. Med sorted, sub rounded - rounded 60% mafic 40% felsic ~5% mafics are basalt. Sand: vf-c 80% ~~maf~~ TR of 5/15 med. fines (VF-FS) 10% maf. med-c 80% maf, well sorted, sub angular, 2.5Y 5/2 grayish brown, wet, no rxn HCL. Silt/Clay: med. plasticity	
50	W				W: 49.9' bgs water sample
	G SS	100% recovery			SS: split spoon sample 51.4'-53.9' bgs. 100% recovery. HEIS# B30JT0
55	G			52'-67': Sandy Gravel (sG) 50% gravel, 40% Sand, 10% silt. Gravel vf-vc pebble, max 60mm. 80% mp. Well sorted. Vf-mp angular - sub angular, c-vc p sub rounded. 70% felsic 30% mafic. Sand: vf-m sand 85% med. well sorted, sub rounded, 80% felsic 20% mafic 2.5Y 5/3 light olive brown, wet, no rxn to HCL	
60	G			@ 55'-67 Gravel ↓ 30%, Sand ↑ 65%, Silt ↓ 5%	
65				67-100: Mud (M) 100% mud, 80% clay, 20% Silt. 2.5Y 5/4 light olive brown occl strong rxn w/HCl, moist, med. plasticity	
	G			@ 75' Cemented mud, 10YR 7/3 very pale brown, Strong rxn w/HCl on caliche veins, moist, not workable, extreme dry strength	drill rate ↓↓
70					
75	G				
	SS				

Reported By: Tracy Mallgren Kim Schuyler	Reviewed By: Kevin Bergstrom
Title: Geologist	Title: Sr. Geologist
Signature: [signature] Kim Schuyler Date: 5/5/15	Signature: [signature] Date: 8/3/15

A-6003-842 (03/03)

BOREHOLE LOG

Page 3 of 3
Date: 5/7/15

Well ID: C8794 | Well Name: 699-97-61 | Location: 1800m NE of 105-D Reactor

Project: 12 New Wells @ 100-HR-3 OU | 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
80	SS G	100% recovery		67-100.9 Mud (M), 10% sand, 90% mud. Sand: 100% VFS, very well sorted. Mud: 50% clay, 50% silt, tightly compacted low plasticity, 10YR 4/4 dark yellowish brown, weak rxn w/HCl, slightly moist, low dry strength	Becker Hammer with dual-wall casing. OD=10 3/4"
	G				Split spoon sample: 77.9-80.4 HEIS # B30JT1
85				@ 83' ↑sand to 15%, mud: clay ↓ to 30%, silt ↑70%, 10YR 8/3 very pale brown, no rxn w/HCl, wet formation begin to produce some water ~1gal/min	
	W SS G	100% recovery			Split spoon sample: 88.1-90.6'
90				@ 90' no clay, 85% silt, 15% sand. loosely compacted	HEIS# B30JT2 W water sample: 88.1'
				@ 95' Mud is 20% clay, 70% silt, sand still at 15%, 10YR 4/4 Dark yellowish brown.	HEIS # B30JR0, B30JR1 (Field), DUP: B30JR2
95	G			@ 100' no sand clay 40% silt 60% med plasticity	
100	SS	100% recovery			Split spoon sample: 98.4-100.9' HEIS# B30JT3, B30JT4 (DUP) TD = 100.9' bgs 5/11/15 tagged TD = 99.2' bgs
					~~Reached TD @ 99.1' bgs on 5/11/15~~ ~~Shoe @ 98.7' bgs (5/11/15)~~ 6/23/15
				Not used TW 5/11/15	TD remeasured @ completion 5/19/15: ~~[illegible]~~ 99.2' bgs 6/23/15 DTW = 34.2' bgs (5/11/15) 6/24/15

Reported By: Kim Schuyler Tracy Mallgren | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: Kim Schuyler [illegible] Date: 5/11/15 | Signature: [illegible] Date: 9/3/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

699-97-61 (C8794)
Log Data Report

Borehole Information:

Log Date:	2015-05-12	Filename:	C8794_HG-NM_2015-05-12	Site:	West of 100 H
Coordinates (WA St Plane)		DTW[1] (ft) :	33.8	DTW Date:	05/06/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	05/11/15	N/A	99.1	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0.2	13 7/16	13 1/16	3/8	0.2	69.6
Threaded Steel	2.2	11 3/4	UNK	UNK	2.2	98.7
Threaded Steel	2.55	8 1/2	8	1/4	2.55	98.7

Borehole Notes:

The onsite geologist provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). No measurement could be acquired on the 11 3/4-in. casing. This drilling method employs a double wall drive pipe where compressed air is forced down the outer casing and geologic material is returned to the surface inside the inner casing. Water inside the casing was measured at 33.8 ft by the logging engineer with an e-tape. The maximum logging depth achieved was 92 ft where the sonde unweighted in sand or mud.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1L	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	11/12/14	Serial No.:	47-TP32211A
Calibration Reference:	HGLP-CC-111, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 5T	Type:	60% HPGe SGLS[4]
Effective Calibration Date:	03/19/15	Serial No.:	54-TP13441B
Calibration Reference:	HGLP-CC-115, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 5P	Type:	NMLS[5]
Effective Calibration Date:	04/15/15	Serial No.:	H34055445
Calibration Reference:	HGLP-CC-116, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

[1] depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4] Spectral Gamma Logging System
[5] Neutron Moisture Logging System

A SUBSIDIARY OF HUNTINGTON INGALLS INDUSTRIES
2439 Robertson Drive • Richland, WA 99354 • Telephone (509) 946-6455 • www.stoller.com

Stoller Newport News Nuclear

SGLS Log Run Information:

Log Run	3	4	5 Repeat		
HEIS Number	1018732	1018733	1018734		
Date	05/06/15	05/12/15	05/12/15		
Logging Engineer	Pope	Pope	Pope		
Start Depth (ft)	0.0	45.0	70.0		
Finish Depth (ft)	50.0	92.0	75.0		
Count Time (sec)	100	100	100		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	1.0	1.0	1.0		
Log Speed (ft/min)	N/A	N/A	N/A		
Pre-Verification	FTC8794201556 AV00CAB1	AL254CAB	AL254CAB		
Start File	FTC8794201556 AD000000	AL255000	AL255048		
Finish File	FTC8794201556 AD005000	AL255047	AL255053		
Post-Verification	None	AL255CAA	AL255CAA		
Depth Return Error (in.)	N/A	N/A	0.0		
Comments	Log run was ended at 50 ft to investigate a problem	No fine gain adjustments made	No fine gain adjustments made		

NMLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1018735	1018736			
Date	05/06/15	05/06/15			
Logging Engineer	Felt	Felt			
Start Depth (ft)	0.0	10.0			
Finish Depth (ft)	33.76	14.01			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	FPC8794201556 AV00CAB1	FPC8794201556 AV00CAB1			
Start File	FPC8794201556 AD000000	FPC8794201556 BD001000			
Finish File	FPC8794201556 AD003376	FPC8794201556 BD001401			
Post-Verification	FPC8794201556 BV00CAA1	FPC8794201556 BV00CAA1			
Depth Return Error (in.)	0.0 low	0.0 low			
Comments	None	None			

Stoller Newport News Nuclear

Logging Operation Notes:

A centralizer was installed on the sondes.

Logging was terminated at 50 ft in depth during log run 3 to investigate a spectrum that appeared unusual. Water apparently entered the sonde during logging. The sonde was taken for drying, cleaning, and testing. A post-verification spectrum was not acquired. A repeat log run was also not completed.

The remaining pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Analysis Notes:

Analyst:	R. G. McCain/ P. D. Henwood	Date:	06/25/15	Reference:	HGLP-MAN-003, Rev. 0

A casing correction for a 3/8-in. thick casing was applied to the log data from ground surface to 50 ft for log run 3. From 48 to 69 ft, a casing correction for a 1-in. thick casing was applied. Below 69 ft, a correction for a 5/8-in. thick casing was applied. No correction was applied for casing joints which can be in excess of 1.5-in.

A correction for water was applied below 33.8 ft in depth.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL templates identified as FTb20150315 and 1L20141112, using efficiency functions and corrections for casing and dead time as determined by annual calibrations.

NMLS data are reported in counts per second as there is no calibration for conversion to volumetric moisture for dual-cased boreholes.

The HGU[6] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected in the borehole. MDLs for Cs-137 are plotted for the entire borehole.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

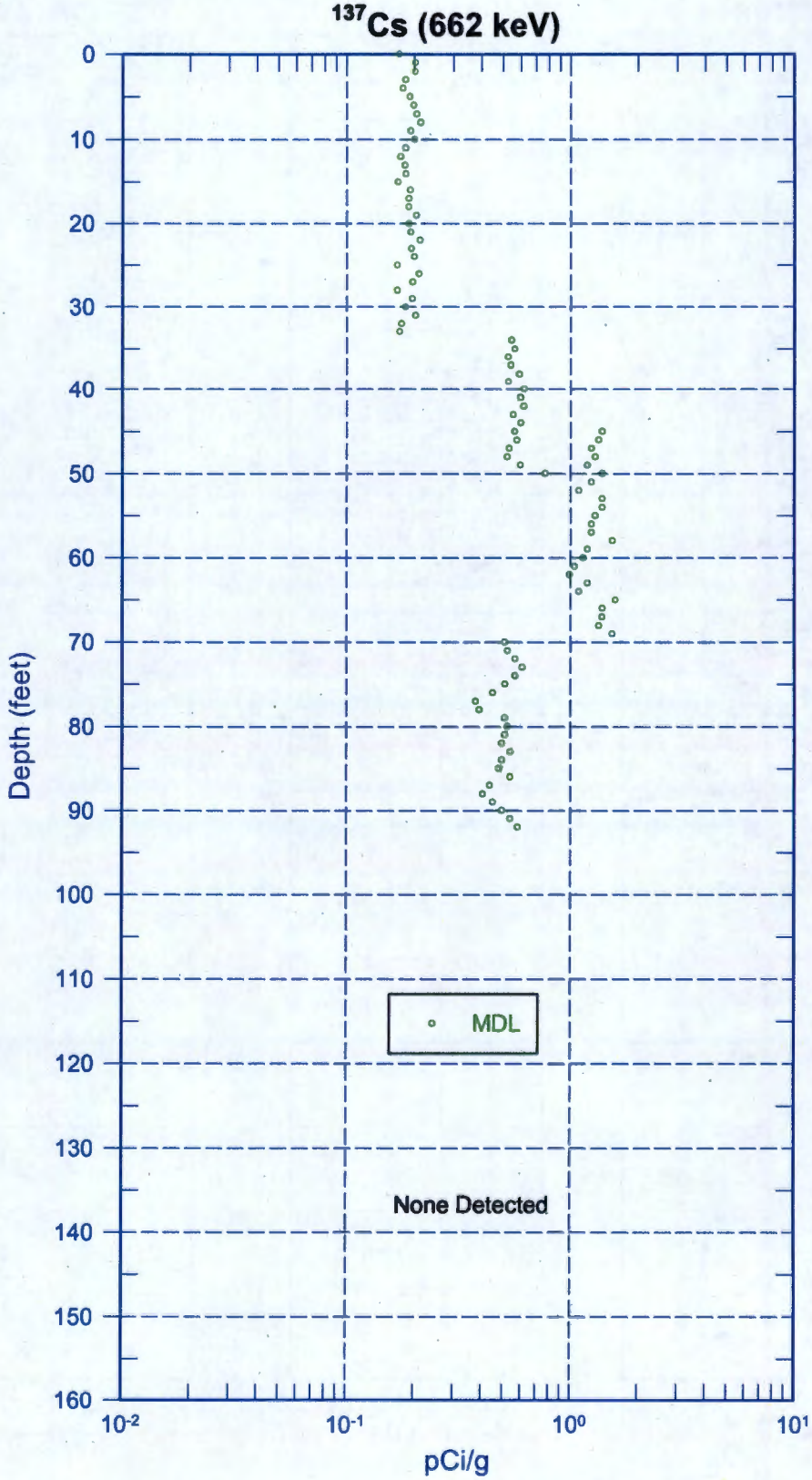
List of Log Plots:

Depth Reference is ground surface.

Manmade Radionuclides (0-160 ft)
Natural Gamma Logs (0-160 ft)
Combination Plot (0-120 ft)
Total Gamma & Moisture (0-160 ft)
Total Gamma & Hanford Gamma Unit (0-160 ft)
Repeat Section of Natural Gamma Logs (70-75 ft)
Moisture Repeat Section (10-15 ft)

[6] Hanford Gamma Unit

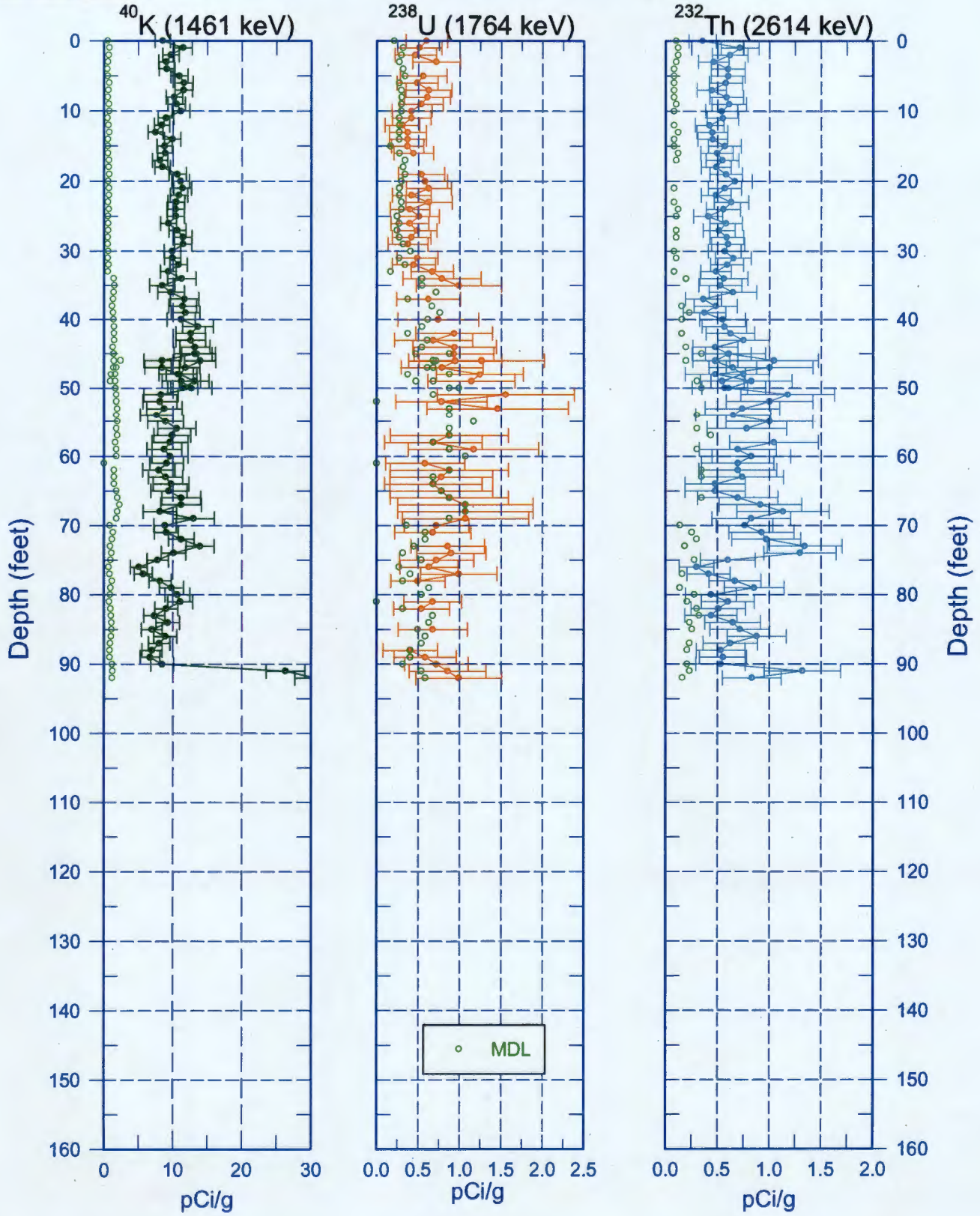
699-97-61 (C8794)
Manmade Radionuclides



Zero Reference - Ground Surface

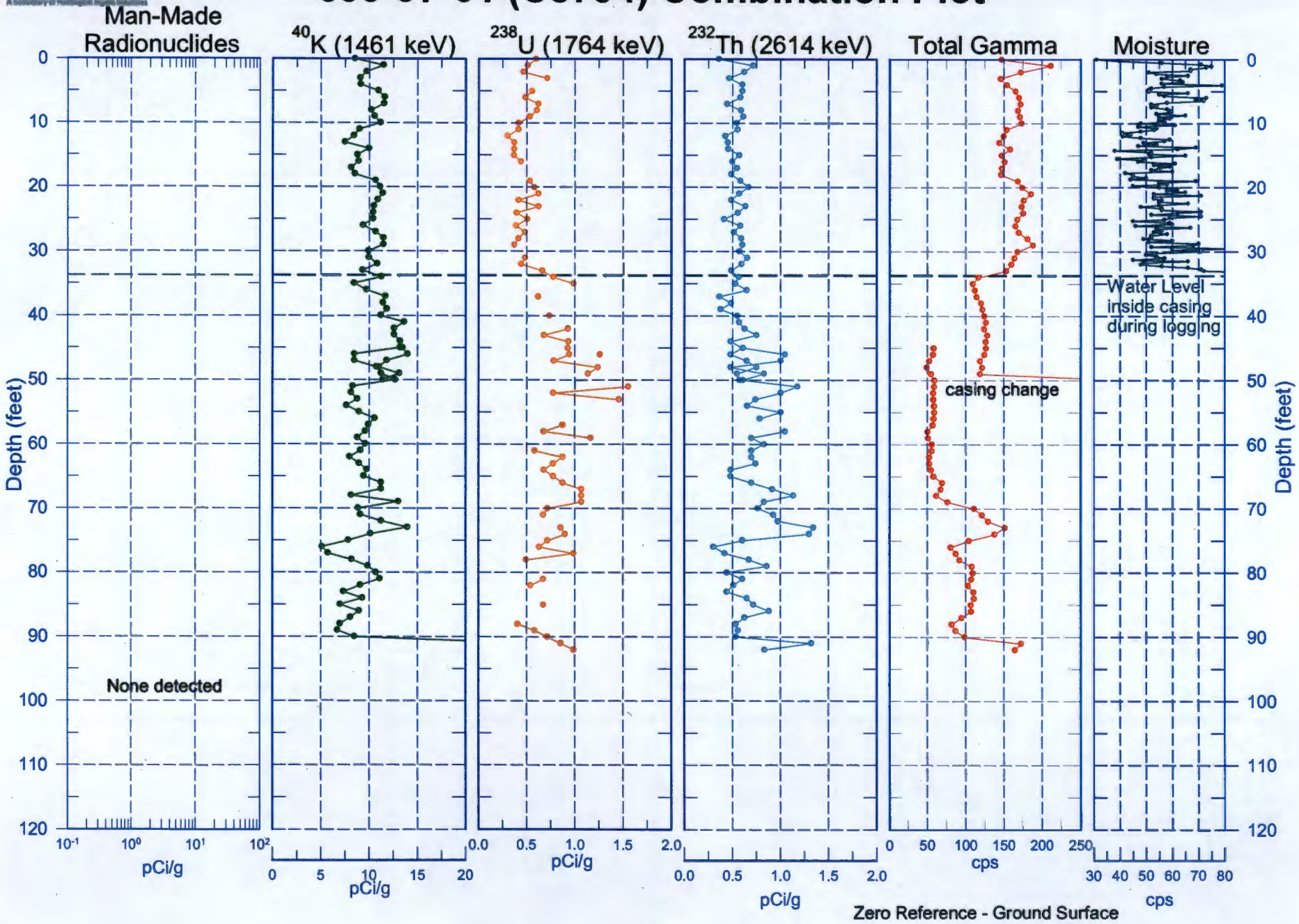
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

699-97-61 (C8794)
Natural Gamma Logs

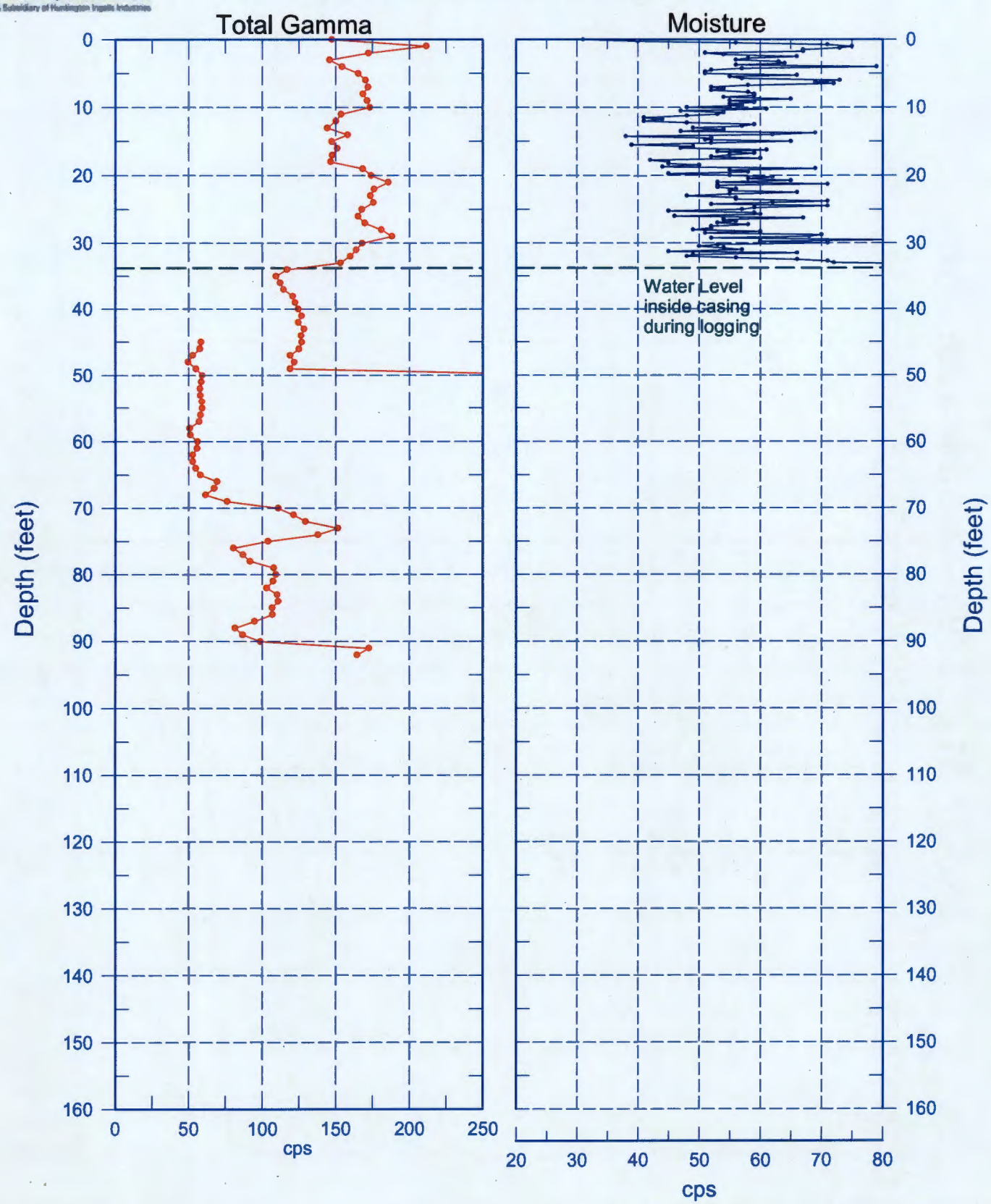


Zero Reference - Ground Surface

699-97-61 (C8794) Combination Plot

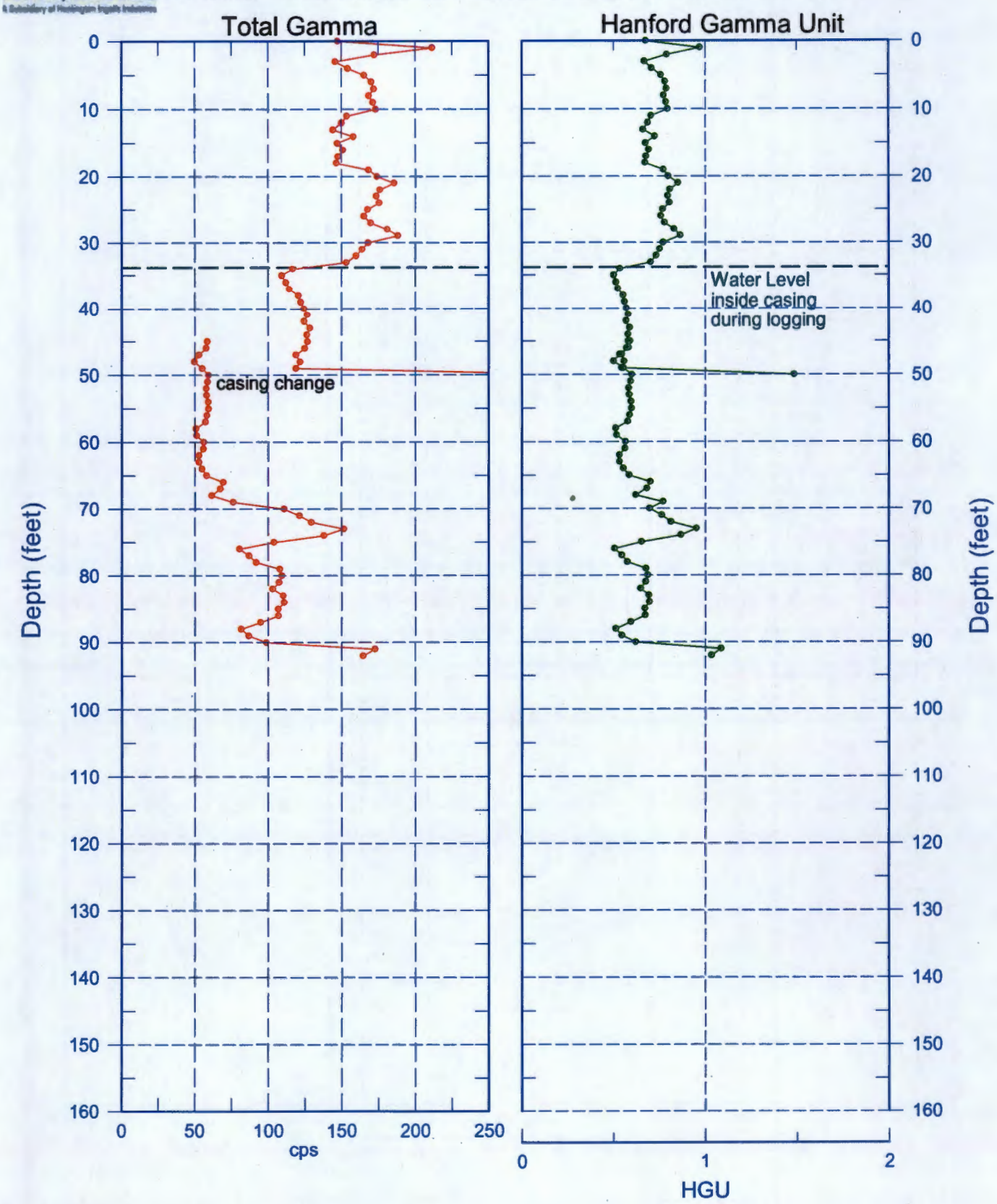


699-97-61 (C8794)
Total Gamma & Moisture



Reference - Ground Surface

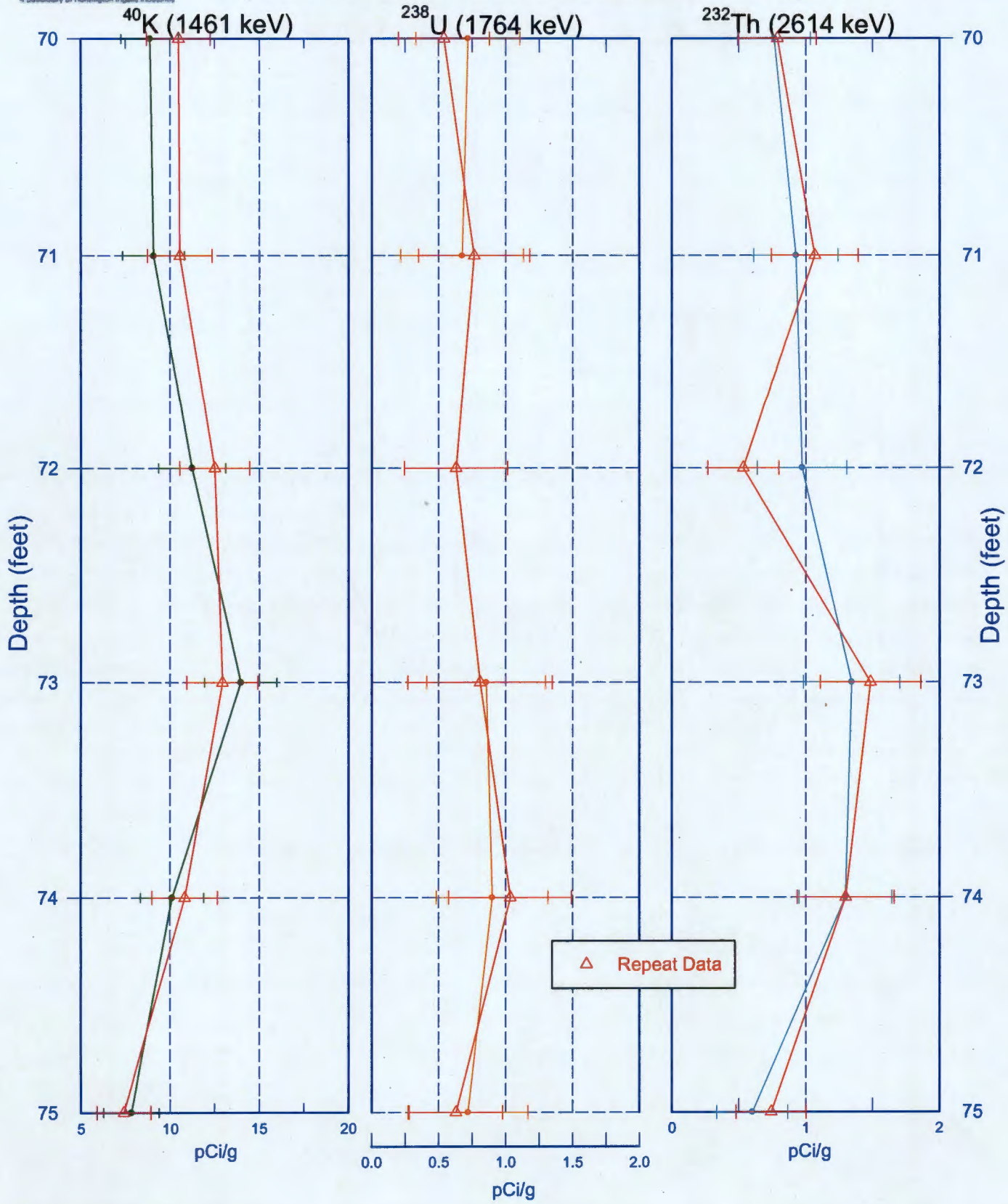
699-97-61 (C8794)
Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

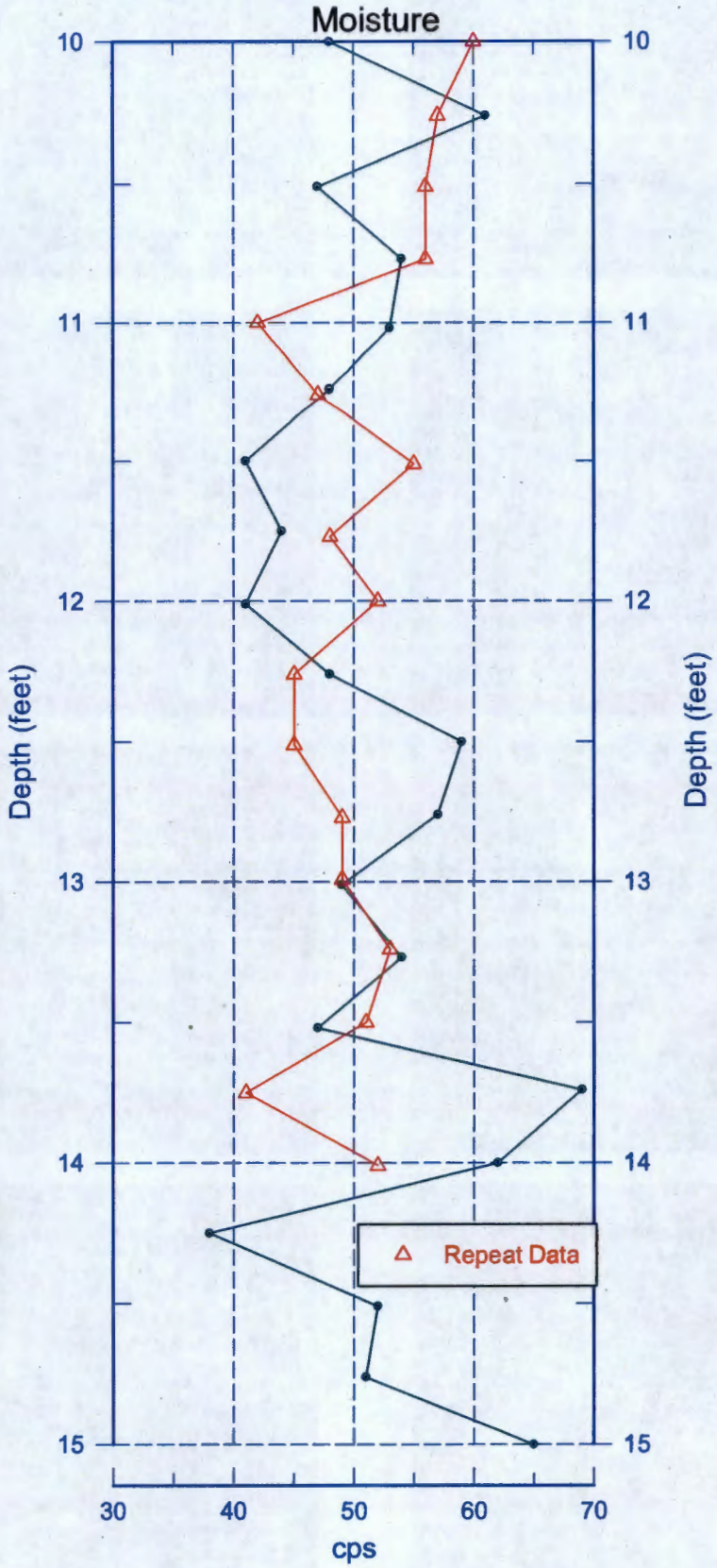
699-97-61 (C8794)

Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

699-97-61 (C8794)
Moisture Repeat Section



Reference - Ground Surface

cm
FREESTONE
C8794 20 ft

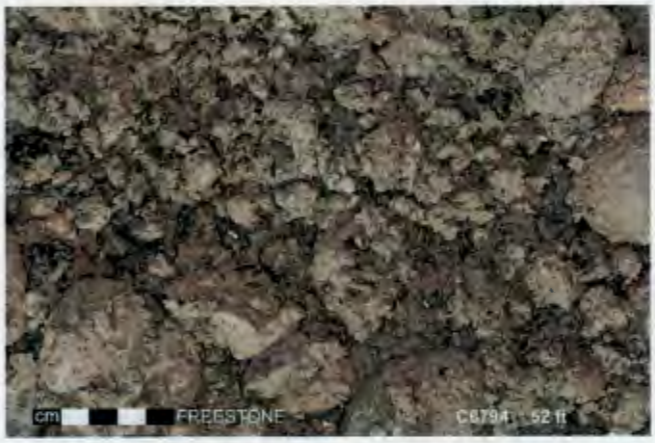
cm
FREESTONE
C8794 25 ft

cm
FREESTONE
C8794 30 ft

cm
FREESTONE
C8794 37 ft

cm
FREESTONE
C8794 40 ft

cm
FREESTONE
C8794 44 ft


cm
FREESTONE
C8794 52 ft

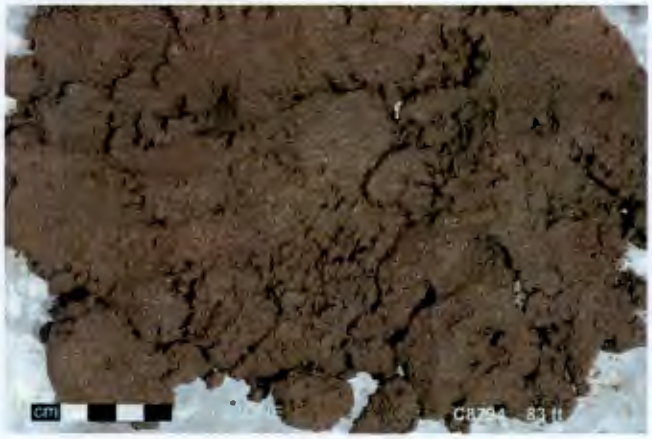
cm
FREESTONE
C8794 55 ft

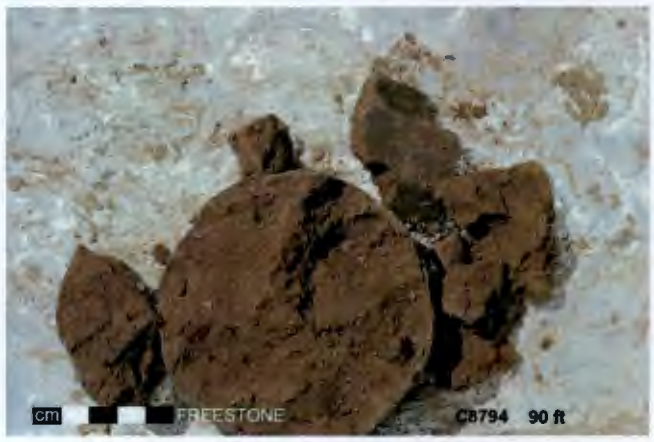
cm
FREESTONE
C8794 62 ft

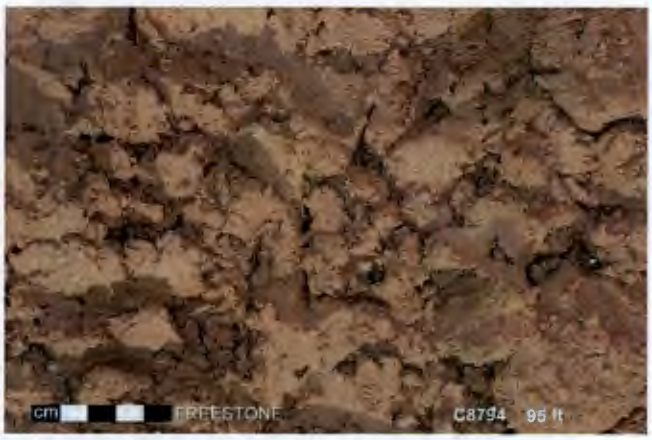
cm
FREESTONE
C8794 67 ft

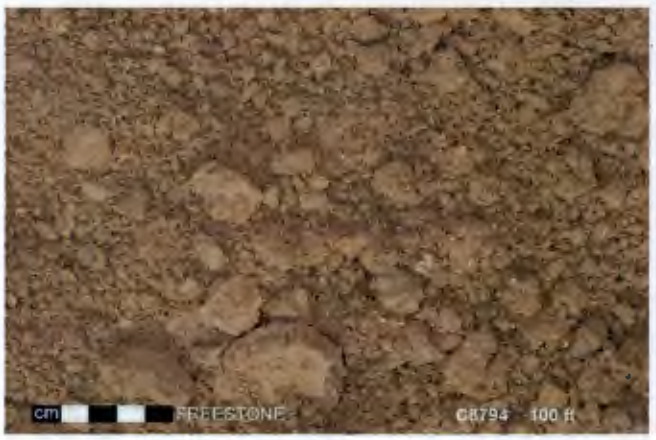
cm
FREESTONE
C8794 75 ft

cm
FREESTONE
C8794 80 ft


cm
C8794 83 ft


cm
FREESTONE
C8794 90 ft


cm
FREESTONE
C8794 95 ft


cm
FREESTONE
C8794 100 ft

SURVEY DATA REPORT				Request No. 153-130
Project No.	Title HR-3 Wells C8793 and C8794 Final Surveys			File No. 6AT14R26
Job. No. CACN: 303594-JPRC	Prepared By N.P. Fastabend	Date 6/23/15	Reviewer LBM	

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casings) and elevations of completed HR-3 Wells C8793 (699-97-60) and C8794 (699-97-61).	Survey File	OR		
	J.D. Mehrer	1		
	K.M. Whitley	1		
	J.L. Smoot	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheets

WELL SURVEY DATA REPORT

Project:	**Prepared By:** Neil P. Fastabend **Company:** CHPRC
Date Requested: 06/16/15	**Requestor:** Jim Mehrer (CHPRC)
Date of Survey: 06/23/15	**Surveyor:** Lawrence B. Munnell (CHPRC)
Fluor Hanford Point of Contact:	**Survey Co. Point of Contact:** Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of HR-3 Well C8794 (699-97-61).	**Horizontal Datum:** NAD83(91) **Vertical Datum:** NAVD88 **Units:** Meters **Hanford Area Designation:** 600A

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
G49 (COE) and P324 (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C8794	699-97-61	574891.51·	152914.15·		Center of Casing
				129.075·	"X" on Rim
				128.334 ·	Brass Survey Marker

Notes:

128.769· Top Inner Casing, North Edge

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

6-23-15

Appendix D

Well Documentation for C8929 (699-93-48C)

- Well Summary Sheet
- Borehole Log
- Log Data Report
- Photographic Log
- Final Survey Report

This page intentionally left blank.

WELL SUMMARY SHEET

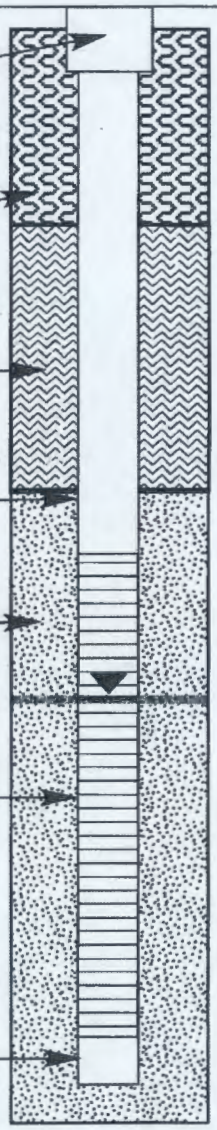
Start Date: 6/18/2015
Finish Date: ~~7/01/2015~~ 7/6/15 A.S. 7/16/15

Page 1 of 1

Well ID: C8929	Well Name: ~~699-993-48C~~ 699-93-48C
Location: 1.4 km E of 105-D Reactor	Project: 12 GW Wells in HR-3 OU
Prepared By: Tracy Mallgren — Date: 7/06/15	Reviewed By: J.D. MEHRER — Date: 7-21-15
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
8-in Protective Casing: 3.00 ft above ground surface (ags) - 2.00 ft below ground surface (bgs)	
Type I/II Portland Cement Grout: 0 - 13.9 ft bgs	
Cetco #8 Bentonite Crumbles: 13.9 - 28.1 ft bgs	
6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.1 ft ags - 31.72 ft bgs	
6-12 mesh Premier Colorado Silica Filter Pack Sand: 28.1 - 67 ft bgs	
6-in I.D. Schedule 10, Type 304/304L, 75-slot (0.075 in.) Stainless Steel Screen: 31.72 - 61.81 ft bgs	
6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 61.81 - 64.82 ft bgs	



Depths are in ft below ground surface.

Borehole drilled with 10 1/2-in O.D. casing from 0.0 - 65.9 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
0		0 - 15 Sandy Gravel (sG)
10		
		15 - 35 Gravelly Sand (gS)
20		
30		
		35 - 50 Sandy Gravel (sG)
40		Static Water Level: 40.3 ft bgs (06/23/15)
50		50 - 55 Gravel (G)
		55 - 62 Sandy Gravel (sG)
60		
		62 - 67 Silt (M)
70		Total Depth: 67.0 (6/23/15)
80		

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 3
Date: 6/23/15

Well ID: C-8929 | Well Name: 699-93-48C | Location: 2.1 km E of 105D

Project: 12 GW wells in 100-HR3-OU | Reference Measuring Point: Ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-15 Sandy Gravel (sG) 55% Gravel 40% Sand 5% Silt. Gravel: vfp-vcp mod sort, 80% ~10mm max 40mm 85% maf, angular. Sand: vf-vc, poor sort, 50% vf, 75% maf, angular.	Becker Hammer Dual wall casing Grab samples every 5' or change in lith
5	G			2.5Y 4/2 Dark grayish brown, Strong rxn HCL	Drillers adding ~ 1-5 gal every 5'
10	G			@ 10' Silt incr. to 10% and color 2.5Y 4/4 olive brown with mod rxn HCL Max gravel clast size incr. 70mm	
15	G			15-35' Gravelly Sand (gS) 10% Gravel, 90% Sand, Trace Silt. Gravel: vfp-smc mod. sort 60% ~ 20mm max 70mm, 70% maf., sub angular. Sand: f-med, well sort, 90% med, 50/50 maf-fel, sub ang, 2.5Y 6/3 light yellowish brown mod rxn HCL	
20	G				
25	G				
30	G			@ 30'-35' Gravel incr. to 15%	
35	G			35-50: Sandy Gravel (sG): 40% Gravel, 60% Sand, Trace Silt. full description on page 2	

Reported By: Tracy Mallgren | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: [signature] Date: 6/23/15 | Signature: [signature] Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 2
Date: 6/23/15

Well ID: C8929 | Well Name: 699-93-48C | Location: ~1.4km E of 105D

Project: 12 GW wells in 100-HR3-00 | 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
40	G			35-50: Sandy Gravel (SG) 40% Gravel, 60% Sand, To Silt. Gravel: fp-smc, mod sort, 60% 30mm, max 80mm, 50/50 maf-fel, sub round. Sand: f-vc, well sort, 85% vc, 50/50 maf-fel, sub ang, 2.5Y 3/2 very dark grayish brown, w/ rxn HCL	Becker Hammer Dual wall casing Grab samples every 5' or change in lith.
45	G			@45-50' Gravel incr. to 75%. Sand decr. to 25%. Max clast size incr. to 120mm.	Water level at 41.6' bgs (6/18/15) 48.8: Water sample HEIS # B30K16 49.4-51.9: split spoon sample. HEIS # B30J78
50	W3 G SS	75% recovery		50-55 Gravel (G): 90% Gravel 10% Sand Trace silt. Gravel: mp-smc poor sort, max 110mm 65% fel, subround. Sand: vf-med, mod sort, 60% fines. 50/50 fel-maf, subangular 2.5Y 4/3 olive brown, w/ rxn HCL	
55	G			55-62 Sandy Gravel (SG): 50% Gravel 45% Sand 5% Silt Gravel: vfp-smc poor sort, 30% 60mm max 115mm, 75% fel wel rounded. Sand vf-vc mod sort, 75% c and vc, 80% fel, subangular 2.5Y 4/4 olive brown. No rxn HCL	
60	G				
65	G			62-67: Silt & Clay (M) 5% Sand, 95% silt & clay. Clay moderatly cemented and has mod plasticity. 2.5Y 6/3 light yellowish brown no rxn HCL	TD: 67' bgs 6/23/15 DTW: 40.3' bgs 6/23/15

not used KB 7/8/15

Reported By: Tracy Mallgren | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: [signature] Date: 6/23/15 | Signature: [signature] Date: 7/22/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

699-93-48C (C8929)
Log Data Report

Borehole Information:

Log Date:	2015-06-24	Filename:	C8929_HG-NM_2015-06-24	Site:	100 H
Coordinates (WA St Plane)		DTW[1] (ft):	40.1	DTW Date:	06/24/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	06/23/15	N/A	67	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	2.2	8 3/8	8	3/16	2.2	67
Threaded Steel	1.9	10 3/4	UNK	UNK	1.9	67

Borehole Notes:

The onsite geologist provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). Casing thickness for the outer casing could not be measured. It is estimated at approximately 13/16-in. thick. This drilling method employs a double wall drive pipe where compressed air is forced down the outer casing and geologic material is returned to the surface inside the inner casing. Water inside the casing was measured at 40.1 ft by the logging engineer with an e-tape. The maximum logging depth achieved was 66.75 ft.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1L	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	11/12/14	Serial No.:	47-TP32211A
Calibration Reference:	HGLP-CC-111, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 1H	Type:	NMLS[4]
Effective Calibration Date:	11/13/14	Serial No.:	H310700352
Calibration Reference:	HGLP-CC-112, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1018741	1018742			
Date	06/24/15	06/24/15			
Logging Engineer	Pope	Pope			
Start Depth (ft)	0.0	35.0			
Finish Depth (ft)	66.0	42.0			
Count Time (sec)	100	100			

[1] depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

Stoller Newport News Nuclear

Log Run	1	2 Repeat			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AL261CAB	AL261CAB			
Start File	AL261000	AL261067			
Finish File	AL261066	AL261074			
Post-Verification	AL261CAA	AL261CAA			
Depth Return Error (in.)	N/A	1.0 high			
Comments	No fine gain adjustments made	No fine gain adjustments made			

NMLS Log Run Information:

Log Run	3	4 Repeat			
HEIS Number	1018743	1018744			
Date	06/24/15	06/24/15			
Logging Engineer	Pope	Pope			
Start Depth (ft)	0.0	20.0			
Finish Depth (ft)	41.0	24.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AH214CAB	AH214CAB			
Start File	AH214000	AH214165			
Finish File	AH214164	AH214181			
Post-Verification	AH214CAA	AH214CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	None	None			

Logging Operation Notes:

A centralizer was installed on the SGLS sonde: the moisture sonde was positioned as close as possible to the casing's wall.

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Analysis Notes:

Analyst:	P. D. Henwood	Date:	06/26/15	Reference:	HGLP-MAN-003, Rev. 0

A casing correction for a 1.0-in. thick casing was applied to the log data. No correction was applied for the casing joints which may be in excess of 1.5-in. and occur at approximately 10-ft intervals.

A correction for water was applied below 40.1 ft in depth.

Stoller Newport News Nuclear

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 1L20141112, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

NMLS data are reported in counts per second as there is no calibration for conversion to volumetric moisture for dual-cased boreholes.

The HGU[5] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected in the borehole. MDLs for Cs-137 are plotted for the entire borehole.

The relatively thick casing joints beginning at 6 ft and occurring at 10 ft intervals are indicated by reduced count rates on the total gamma log. The moisture log also appears to indicate effects of casing joints.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

List of Log Plots:

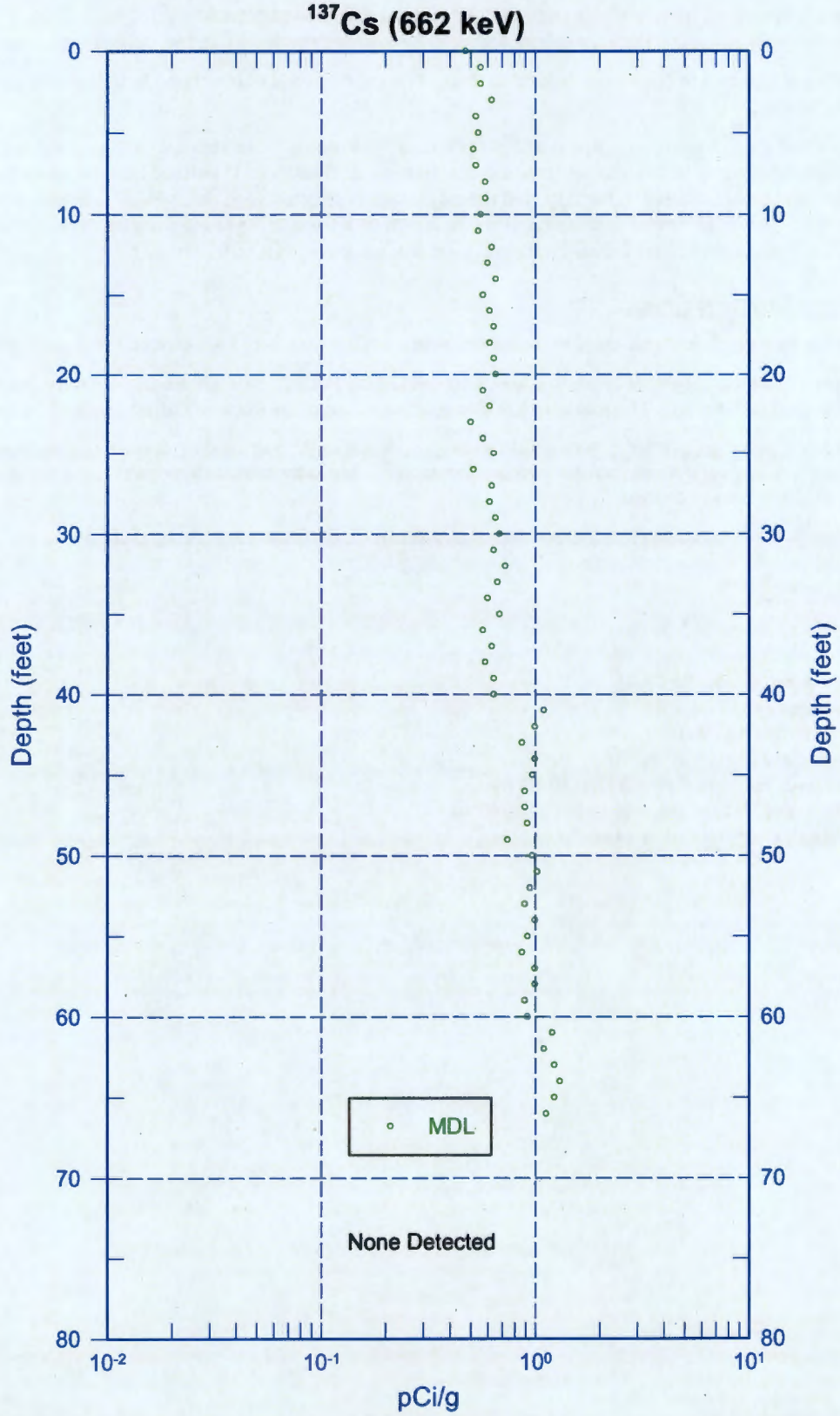
Depth Reference is ground surface.

Manmade Radionuclides (0-80 ft)
Natural Gamma Logs (0-80 ft)
Combination Plot (0-120 ft)
Total Gamma & Moisture (0-80 ft)
Total Gamma & Hanford Gamma Unit (0-80 ft)
Repeat Section of Natural Gamma Logs (35 to 42 ft)
Moisture Repeat Section (20 to 24 ft)

[5] Hanford Gamma Unit

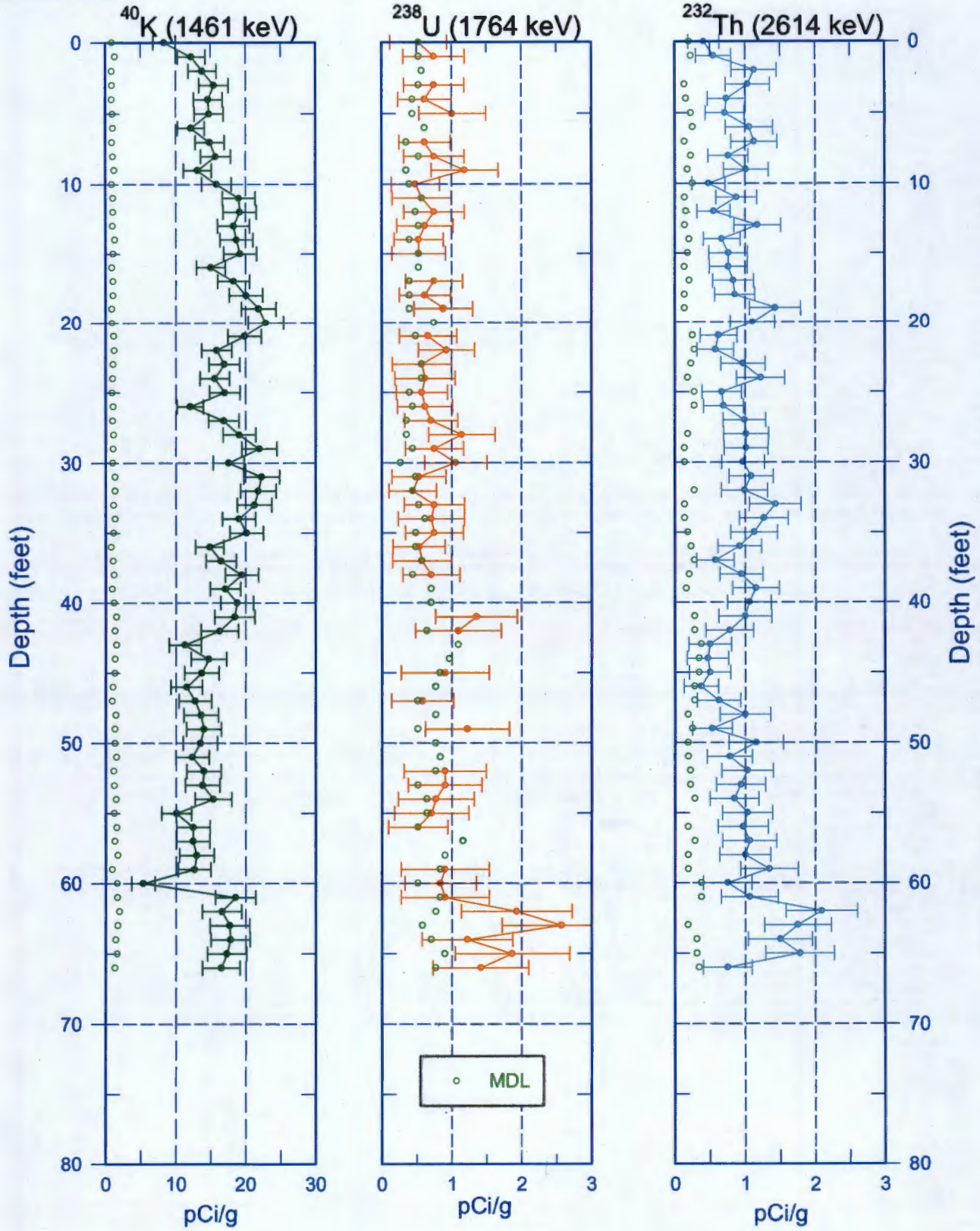
A SUBSIDIARY OF HUNTINGTON INGALLS INDUSTRIES
2439 Robertson Drive • Richland, WA 99354 • Telephone (509) 376-6455 • www.stoller.com

699-93-48C (C8929)
Manmade Radionuclides



Zero Reference - Ground Surface

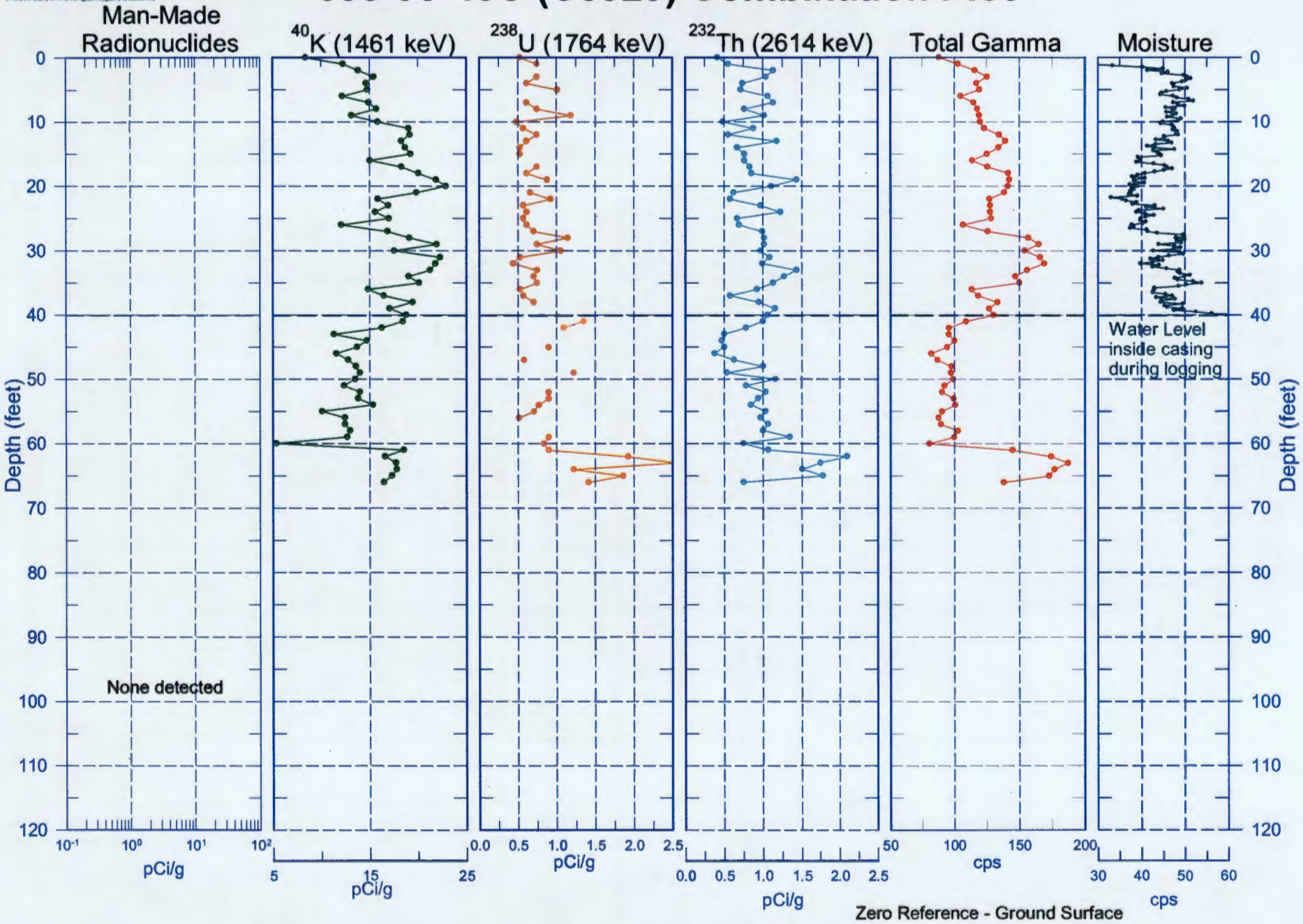
699-93-48C (C8929)
Natural Gamma Logs



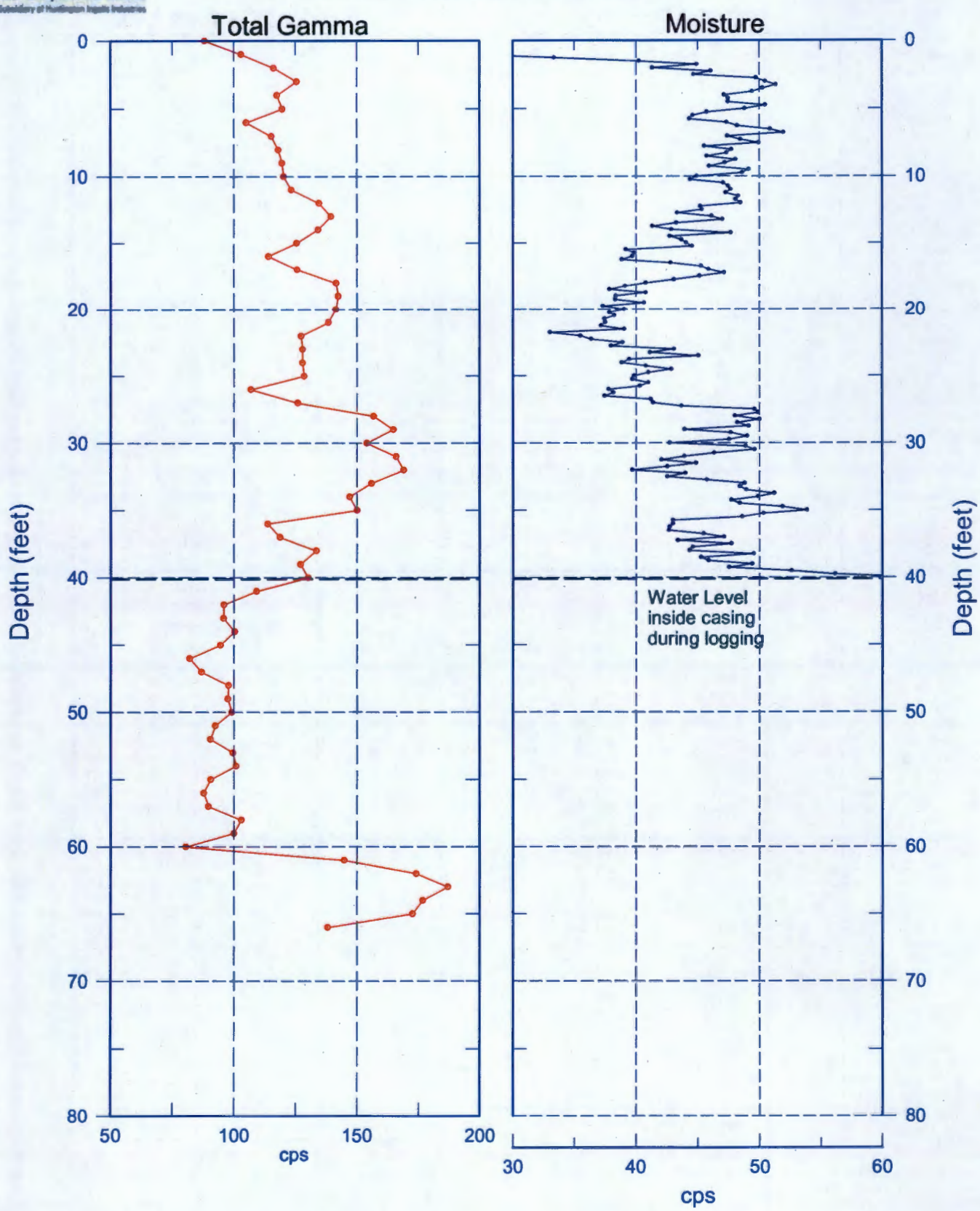
Zero Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

699-93-48C (C8929) Combination Plot

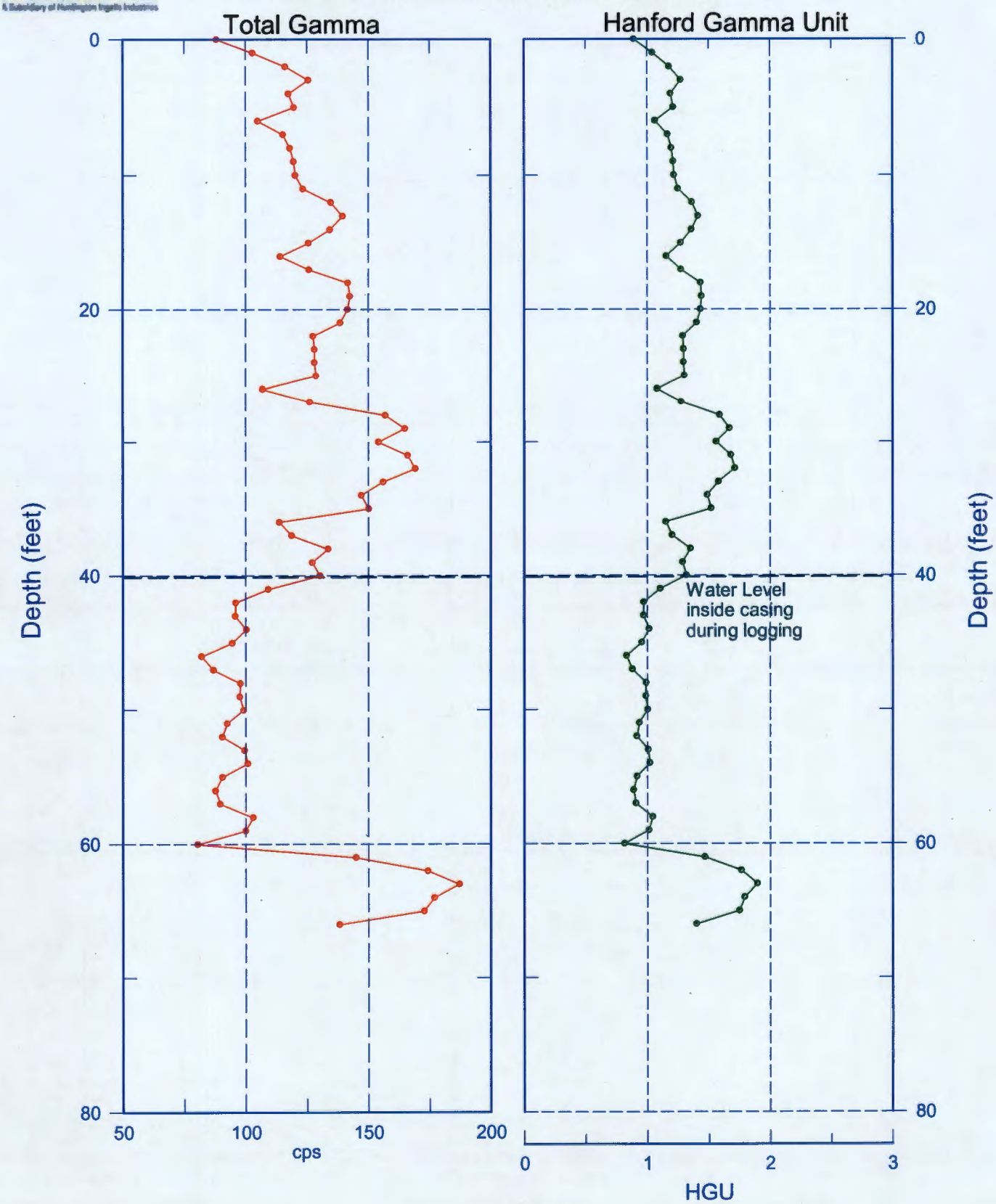


699-93-48C (C8929)
Total Gamma & Moisture



Reference - Ground Surface

699-93-48C (C8929)
Total Gamma & Hanford Gamma Unit

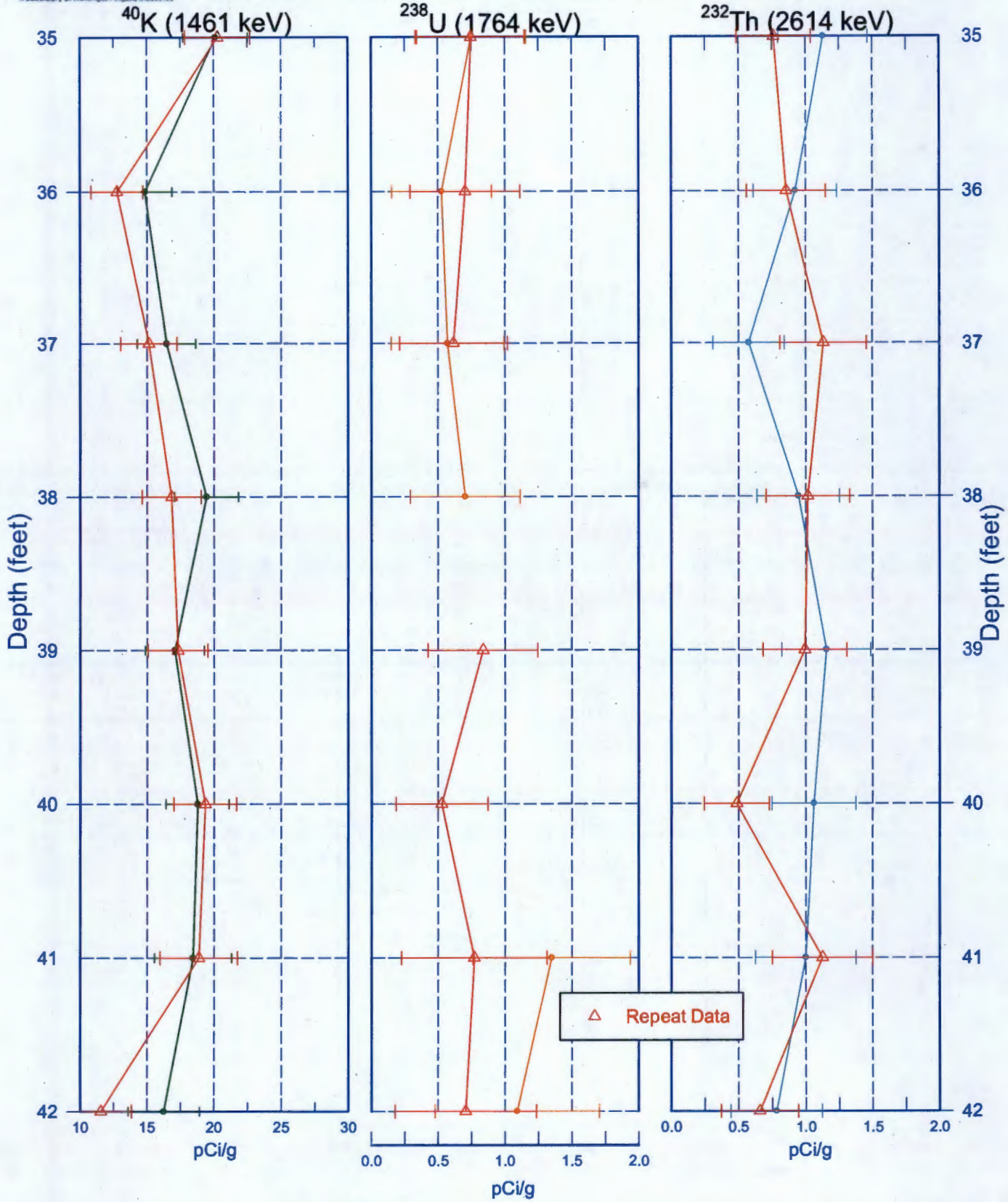


Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

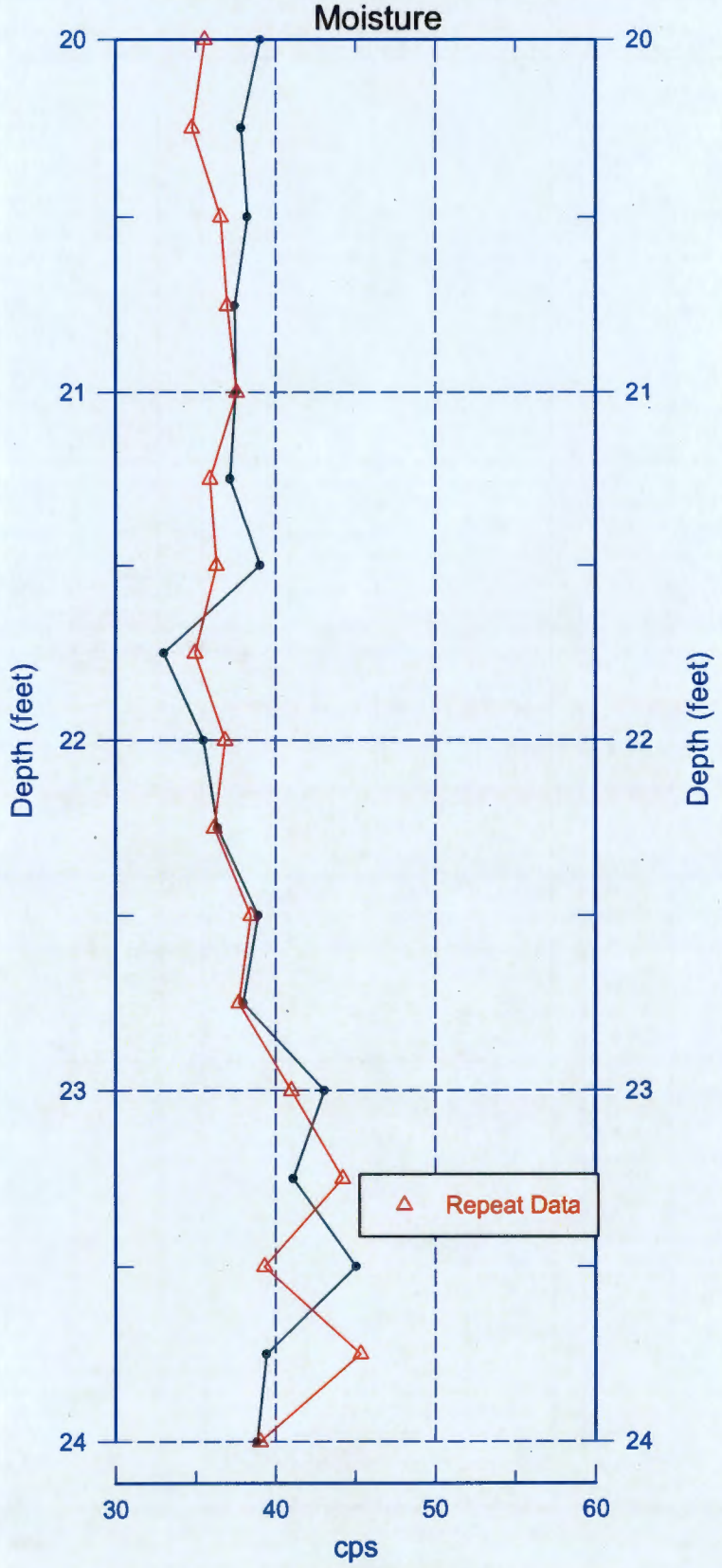
699-93-48C (C8929)

Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

699-93-48C (C8929)
Moisture Repeat Section



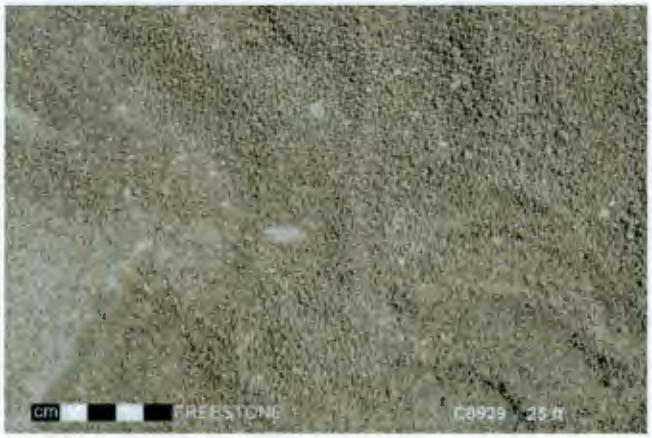
Reference - Ground Surface

cm
FREESTONE
C8929

cm
FREESTONE
C8929 10 ft

cm
FREESTONE
C8929 15 ft

cm
FREESTONE
C8929 20 ft


cm
FREESTONE
C8929 25 ft

cm
FREESTONE
C8929 30 ft

cm
C8929 35 ft

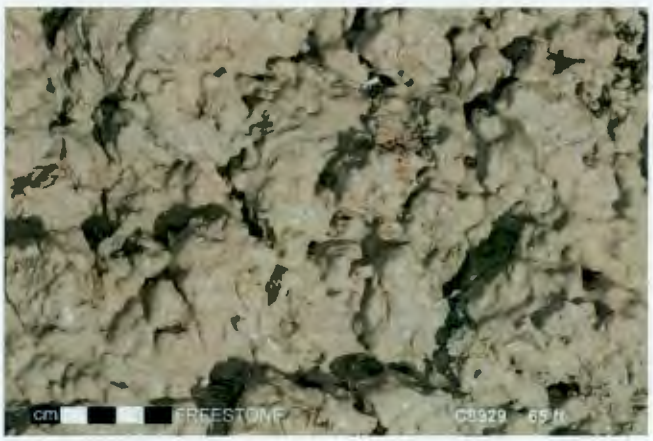
cm
C8929 40 ft

cm
FREESTONE
C8929 45 ft

cm
FREESTONE
C8929 50 ft

cm
FREESTONE
C8929 55 ft

cm
FREESTONE
C8929 60 ft


cm
FREESTONE
C8929 65 ft

SURVEY DATA REPORT				Request No. 154-143
Project No.	Title HR-3 Well C8929 (699-93-48C) Final Survey			File No. 6AT14R26
Job. No. CACN: 303662-JPRC	Prepared By N.P. Fastabend	Date 7/22/15	Reviewer LBM	

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casing) and elevations of completed HR-3 Well C8929 (699-93-48C).	Survey File	OR		
	J.D. Mehrer	1		
	K.M. Whitley	1		
	J.L. Smoot	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheet

WELL SURVEY DATA REPORT

Project:	Prepared By: Neil P. Fastabend Company: CHPRC
Date Requested: 07/07/15	Requestor: Jim Mehrer (CHPRC)
Date of Survey: 07/22/15	Surveyor: Lawrence B. Munnell (CHPRC)
Fluor Hanford Point of Contact:	Survey Co. Point of Contact: Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of HR-3 Well C8929 (699-93-48C) located between 100D and 100H Areas.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 600A

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
P324 (COE) and G49 (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C8929	699-93-48C	575312.13	151728.96		Center of Casing
					"X" on Rim
				130.600	Brass Survey Marker

Notes:

131.360 Top of Baseplate, North Edge

131.340 Top of Outer Casing, N. Edge

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

7-22-15

Appendix E

Well Documentation for C8947 (199-H6-7)

- Well Summary Sheet
- Borehole Log
- Log Data Report
- Photographic Log
- Final Survey Report

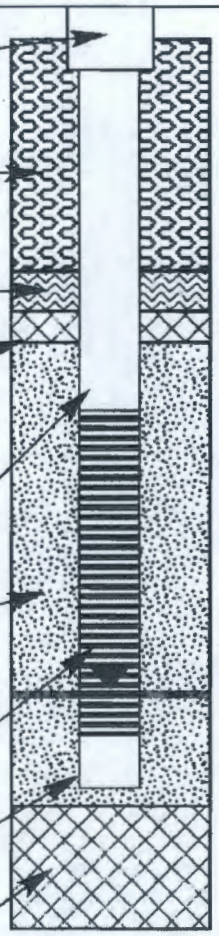
This page intentionally left blank.

WELL SUMMARY SHEET	Start Date: 3/26/2015 Finish Date: 4/8/2015	Page 1 of 1

Well ID: C8947		Well Name: 199-H6-7	
Location: 1.1 km South of H Reactor		Project: 12 GW Wells in HR-3 OU	
Prepared By: Jessa Szecsody	Date: 5/26/15	Reviewed By: J.D. MEHRER	Date: 7-20-15
Signature:		Signature:	

CONSTRUCTION DATA

Description	Diagram
8-in Protective Casing: 2.98 ft ags - 2.02 ft below ground surface (bgs)	
Type I/II Portland Cement Grout: 0 - 14.1 ft bgs	
Cetco Medium Bentonite Chips: 14.1 - 17.1 ft bgs	
3/8 in Cetco Coated Bentonite Pellet Seal: 17.1 - 19.5 ft bgs	
6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.0 ft ags - 23.0 ft bgs	
6-12 mesh Premier Colorado Silica Filter Pack Sand: 19.5 - 47.5 ft bgs	
6-in I.D. Schedule 10, Type 304/304L, 75-slot (0.075 in.) Stainless Steel Screen: 23.0 - 43.01 ft bgs	
6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 43.01 - 46.02 ft bgs	
3/8 in Cetco Coated Bentonite Pellet Seal: 47.5 - 54.5 ft bgs	



Dual string temporary casing did not permit use of centralizers during permanent casing installation

Depths are in ft below ground surface.

Borehole drilled with 10 3/4-in O.D. casing from 0.0 - 54.3 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
0		0 - 44.5 Sandy Gravel (sG)
10		
20		
30		
40		Static Water Level: 40.98 ft bgs (4/08/2015)
		44.5 - 54.7 Silt (M)
50		
		Total Depth: 54.7 ft bgs (3/30/15)
60		
70		
80		

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 2

Date: 3/26 – 3/30/15

Well ID: C8947	Well Name: 199-H6-7	Location: 1.1 KM So of H Reactor
Project: 12 New Wells in 100-HR3 OU		Reference Measuring Point: G5 - Gravel Pad

Depth (FL)	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	G			0-44.5' Sandy Gravel SG	Becker Hammer
				G-40% SS59% Silt 5%	Layne AP-1000
				G 2-40 mm Max 70 mm 50% M, 50% Felsic	Dual Casing 10 3/4 OD
				SR-D well sorted, Sand VF-C Dnec	Driller Adding
				Well Sorted SA-A 40% Mafic 60% Qtz,	≈1-2 Gal/ft water
5	G			Other 5YR 6/1 Gray, wk HCl Rxn	for dust suppression
				Dry	
				@ 10' 60% G 40% S TrM Description	
				As Above, 2.5Y 3/3 Dk Olive Brn	
				No HCl Rxn	
10	G				
15	G			@ 15' 70% G 30% S TrM	
				G As Above Max 120 mm - More Coarse	
				S As Above 2.5Y 5/3 Lt Olive Brn	
20	G			@ 20' G-10-50 mm Max 100	
				Description As Above	
					Dust Control
25	G	80% Recovery		@ 25' As Above	Water Stopped
					Before Split Spoon
					Collection
					25.6-28.1 Split Spoon
					Collected
30	G			@ 30' Larger Cobbles Max 180 x	Dust Control Resumed
				150 mm (Felsic) Still 40% Mafic	
				60% Felsic. Still ≈ 30% Sand	
				Except where washed out of sample	
35	G			@ 35' As Above Max 150 x 120	
				Cobbles	

Reported By: Greg L. Kasza		Reviewed By: Kevin Bergstrom	
Title: Geologist		Title: Sr. Geologist	
Signature: Greg L. Kasza	Date: 4/3/15	Signature: Kevin Bergstrom	Date: 4/29/15

A-6003-842 (03/03)

BOREHOLE LOG

Page 2 of 2

Date: 3/30/15

Well ID: C8947	Well Name: 59-H6-7	Location: 1.1Km So. of H REACTOR	
Project: 12 NEW WELLS IN 100-HR-3		Reference Measuring Point: G.S.	

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
40				@ 40 SMALLER COBBLES MAX 120	
				M.M. STILL 40% MAFIC 60% FELSIC	
45	G			@ 44.5 RUM CONTACTED - ABOUT	DRILLED
				CHANGE 100% M 2.5Y 6/2	DRY ↓ TO TD
				LT GRAYISH BROWN, MOIST, NO HCl	46.25 - 48.75
	SS			RXN ON GRAY GROUND MASS STRONG	SPLIT SPOON 100%
				HCl RXN ON 7.5YR 8/2 PINKISH	RECOVERY
50	G			WHITE CALICHE NODULES LOW PLASTIC	
				@ 48.8 COLOR CHANGE TO	
				7.5YR 4/2 BROWN - NO MORE	
		52.6 3/31		CALICHE, NO HCl RXN	SWL: 40.98' bgs
				COLOR CONTINUES TO 54.7' BGS	4/8/15
55	G 54.7 T.D.			T.D. LOW PLASTICITY.	WT 52.6

Reported By: GREG L. KASZA		Reviewed By: KEVIN Bergstrom	
Title: GEOLOGIST		Title: Sr. Geologist	
Signature: [signature]	Date: 4/3/15	Signature: [signature]	Date: 4-29-15

A-6003-642 (03/03)

Stoller Newport News Nuclear

199-H6-7 (C8947)
Log Data Report

Borehole Information:

Log Date:	2015-03-31	Filename:	C8947_HG-NM_2015-03-31	Site:	100 H
Coordinates (WA St Plane)		DTW[1] (ft):	52.95	DTW Date:	03/31/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	03/30/15	N/A	54.6	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	2.0	8 1/2	8	1/4	2.0	54.6
Threaded Steel	1.7	10 5/8	9	13/16	1.7	54.6

Borehole Notes:

The onsite geologist provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). The drilling method employs a double wall drive pipe where compressed air is forced down the outer casing and geologic material is returned to the surface inside the inner casing. On March 31, 2015, water inside the casing was measured at 52.95 ft by the logging engineer using an e-tape. The maximum logging depth achieved was 54 ft.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1L	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	11/12/14	Serial No.:	47-TP32211A
Calibration Reference:	HGLP-CC-111, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 1H	Type:	NMLS[4]
Effective Calibration Date:	11/13/14	Serial No.:	H310700352
Calibration Reference:	HGLP-CC-112, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	3	4 Repeat			
HEIS Number	1018667	1018668			
Date	03/31/15	03/31/15			
Logging Engineer	Pope/Meisner	Pope/Meisner			
Start Depth (ft)	0.0	41.0			
Finish Depth (ft)	54.0	48.0			

[1] depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

Stoller Newport News Nuclear

Log Run	3	4 Repeat			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AL241CAB	AL241CAB			
Start File	AL241000	AL241055			
Finish File	AL241054	AL241062			
Post-Verification	AL241CAA	AL241CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	No fine gain adjustments made	No fine gain adjustments made			

NMLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1018669	1018670			
Date	03/31/15	03/31/15			
Logging Engineer	Pope/Meisner	Pope/Meisner			
Start Depth (ft)	0.0	38.0			
Finish Depth (ft)	53.0	44.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AH200CAB	AH200CAB			
Start File	AH200000	AH200213			
Finish File	AH200212	AH200237			
Post-Verification	AH200CAA	AH200CAA			
Depth Return Error (in.)	N/A	0.5 high			
Comments	None	None			

Logging Operation Notes:

A centralizer was installed on the sondes.

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Analysis Notes:

Analyst:	P.D. Henwood	Date:	04/08/15	Reference:	HGLP-MAN-003, Rev. 0

A combined casing correction for a 1.0625-in. thick casing (0.25+0.8125-in. for the 1/4- and 13/16-in. thick casings) was applied to the log data. No correction was applied for the casing joints which are in excess of 1.15-in. and occur at approximately 10-ft intervals.

A correction for water was applied below 52 ft in depth.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 1L20141112, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

NMLS data are reported in count per second as there is no calibration for conversion to volumetric moisture for a casing diameter greater than 8-in.

The HGU[5] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected in the borehole. MDLs for Cs-137 and Pu-239 are plotted for the entire borehole.

The relatively thick casing joints beginning at 3 ft and occurring at 10 ft intervals are indicated by reduced count rates on the total gamma log. The moisture count rate also appears to indicate the effect of casing joints.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content. A preliminary moisture log was provided immediately after data collection to the BTR. This log indicated the static water level at approximately 40 ft, and suggested the upper contact for the Ringold Upper Mud (RUM) is at 44.25 ft. The SGLS log data and subsequent water level measurements appear to corroborate that interpretation.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

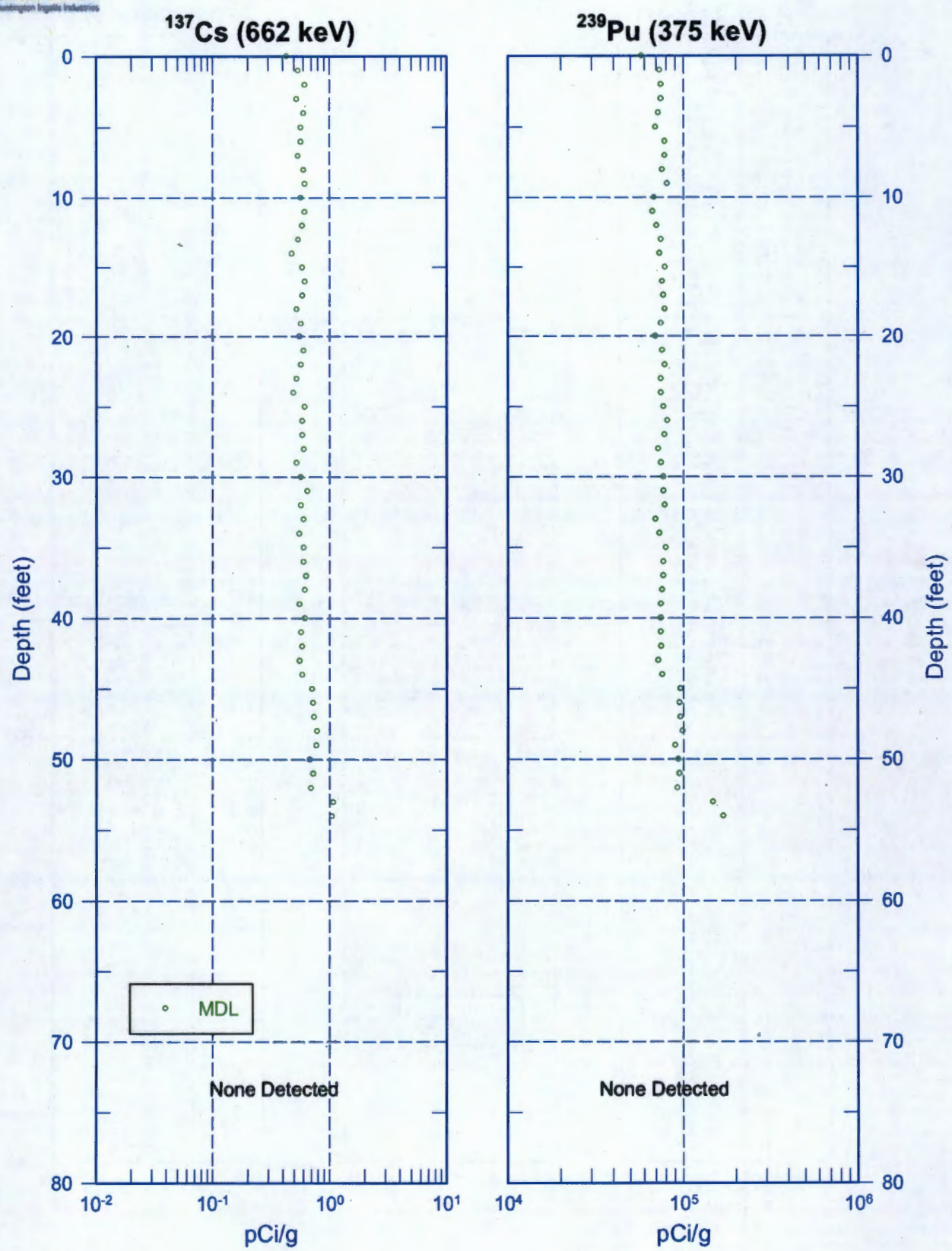
List of Log Plots:

Depth Reference is ground surface.

Manmade Radionuclides (0-80 ft)
Natural Gamma Logs (0-80 ft)
Combination Plot (0-120 ft)
Total Gamma & Moisture (0-80 ft)
Total Gamma & Hanford Gamma Unit (0-80 ft)
Repeat Section of Natural Gamma Logs (41 to 48 ft)
Moisture Repeat Section (38 to 44 ft)

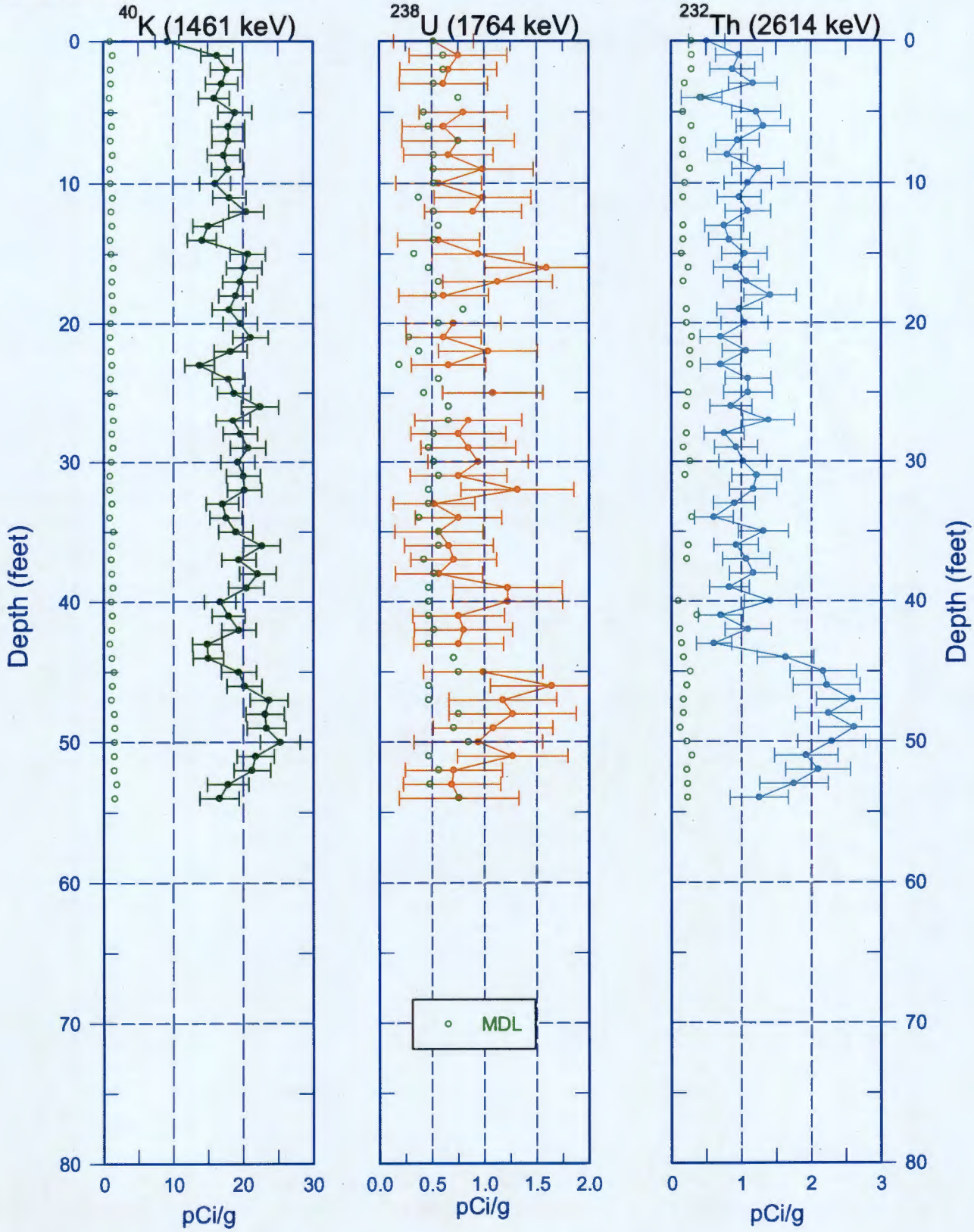
[5] Hanford Gamma Unit

199-H6-7 (C8947)
Manmade Radionuclides



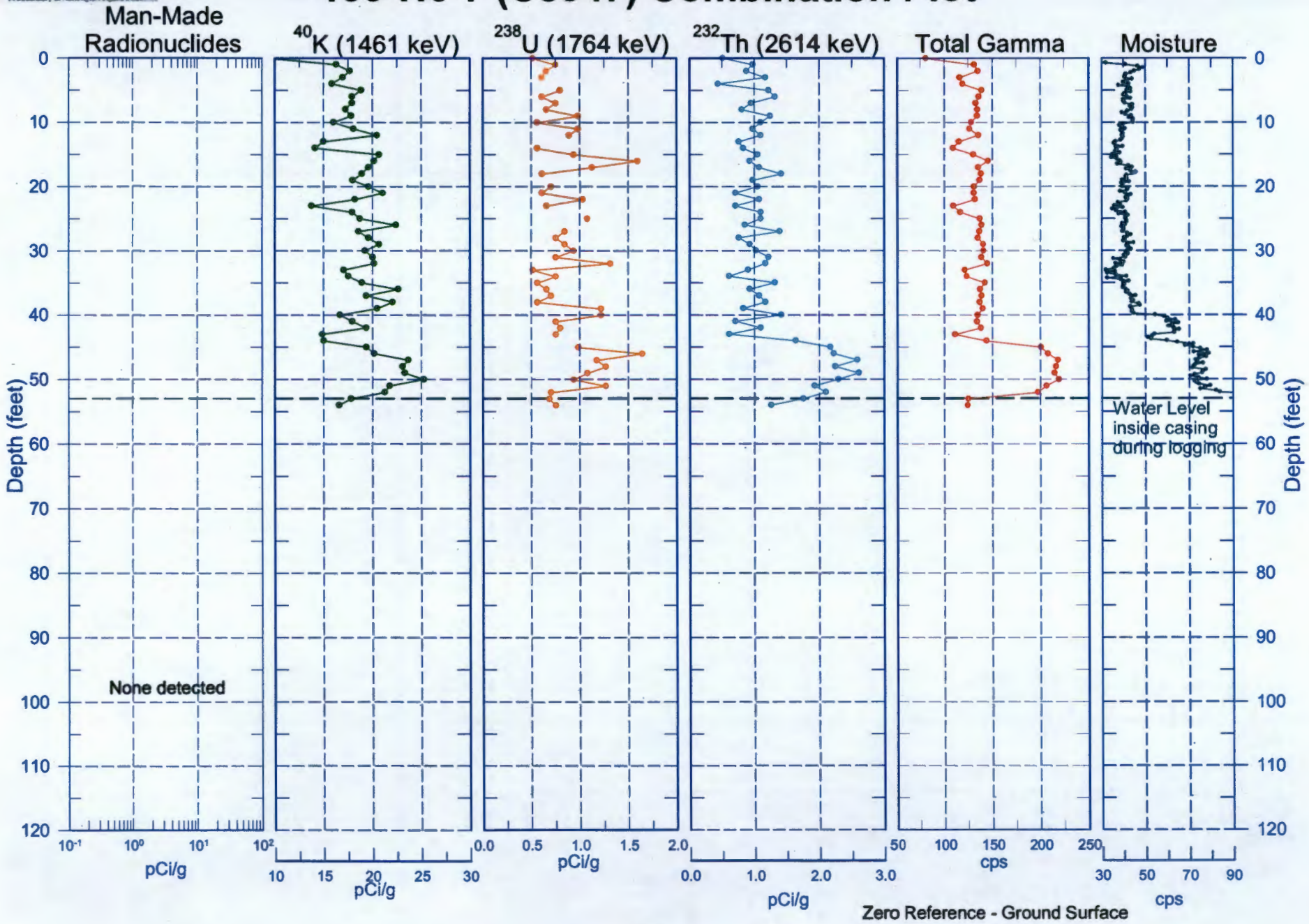
Zero Reference - Ground Surface

199-H6-7 (C8947)
Natural Gamma Logs

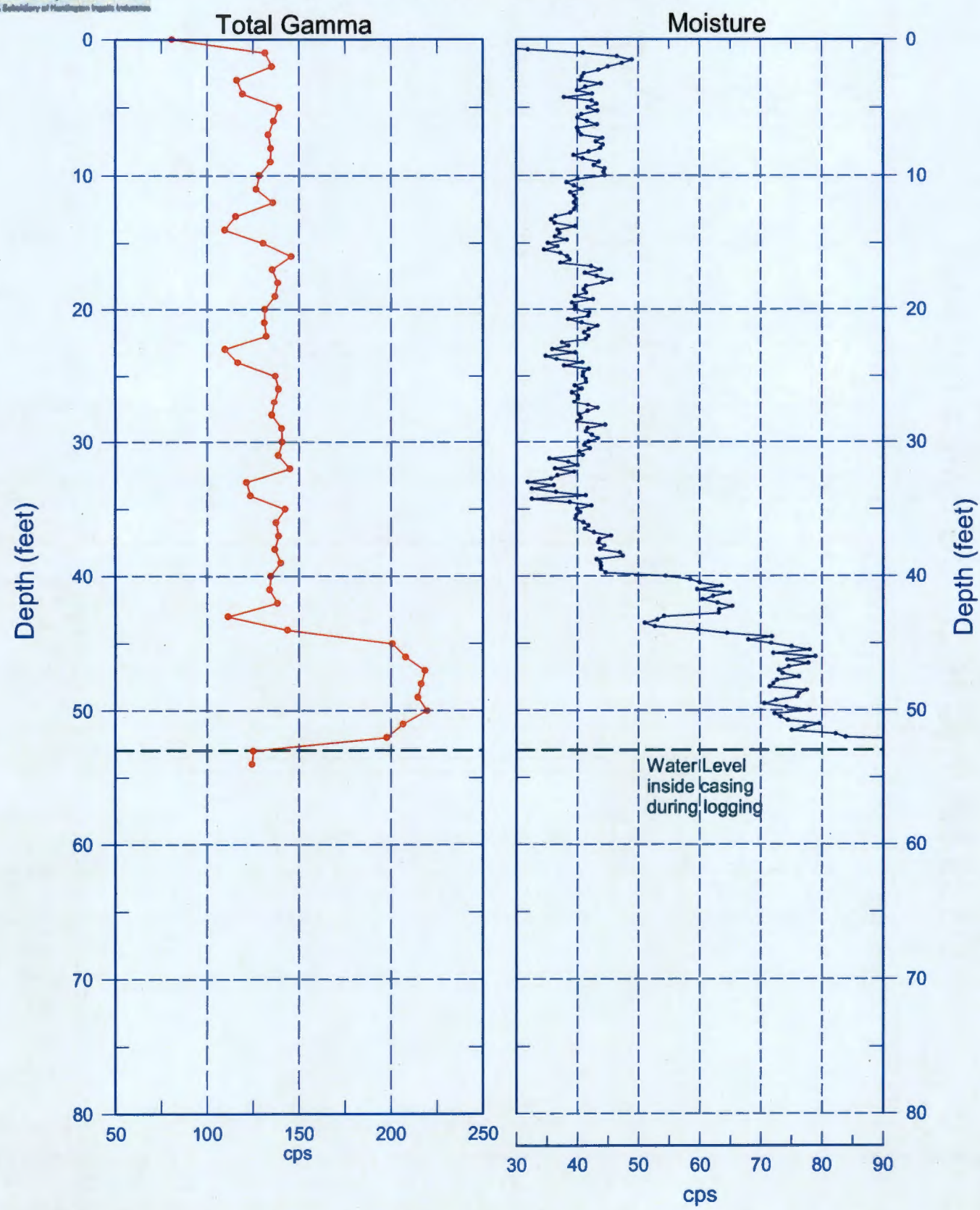


Zero Reference - Ground Surface

199-H6-7 (C8947) Combination Plot

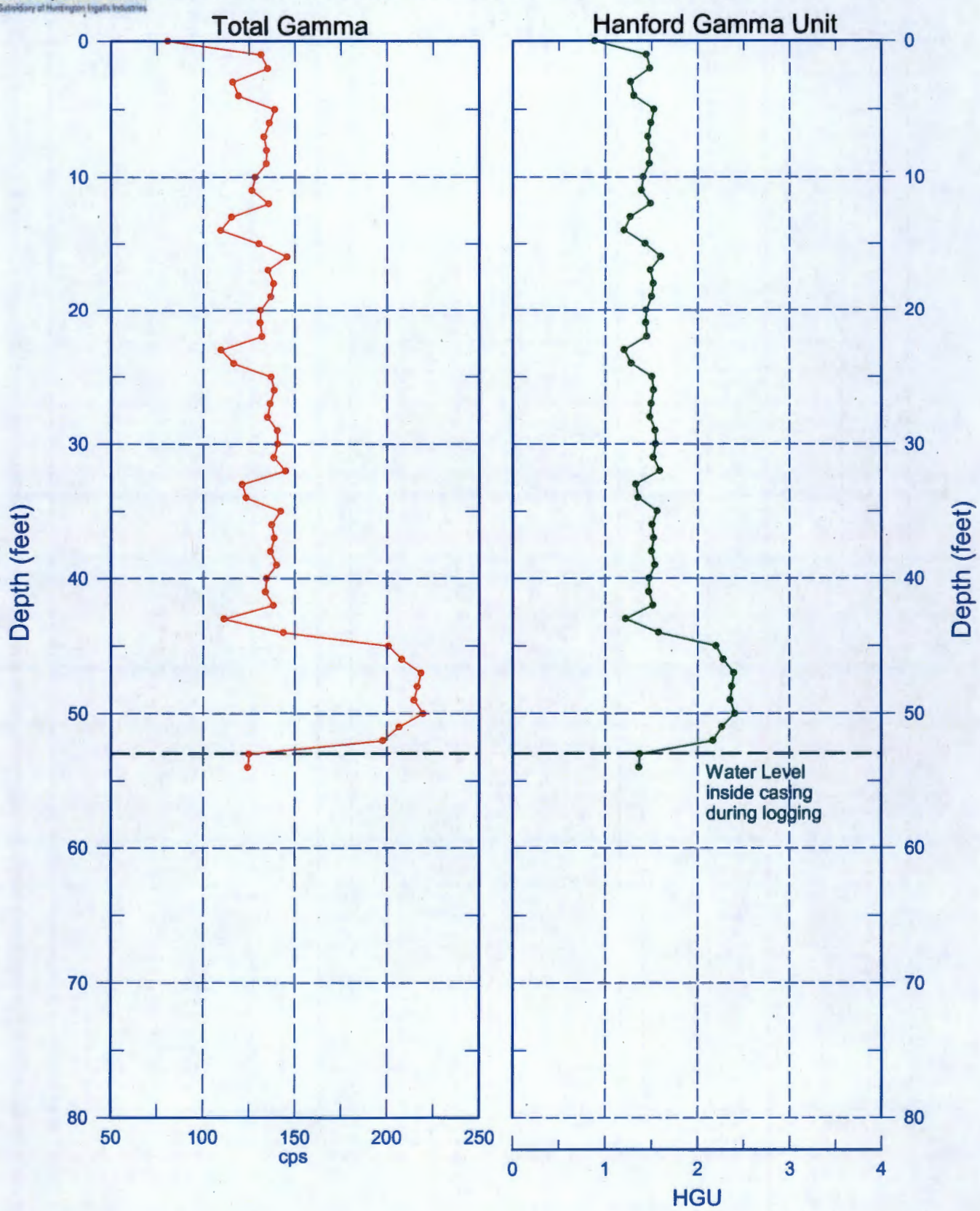


199-H6-7 (C8947)
Total Gamma & Moisture



Reference - Ground Surface

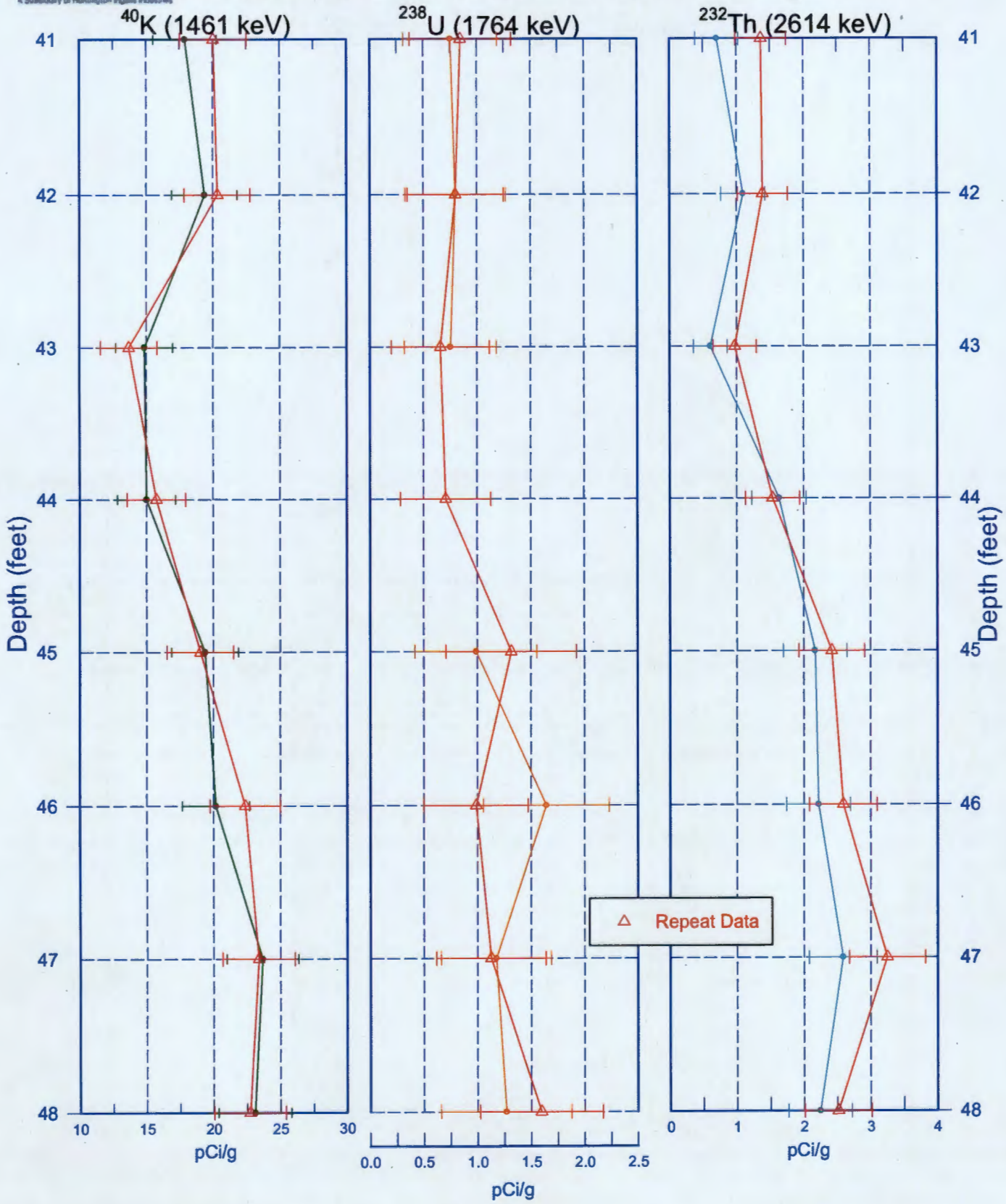
199-H6-7 (C8947)
Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

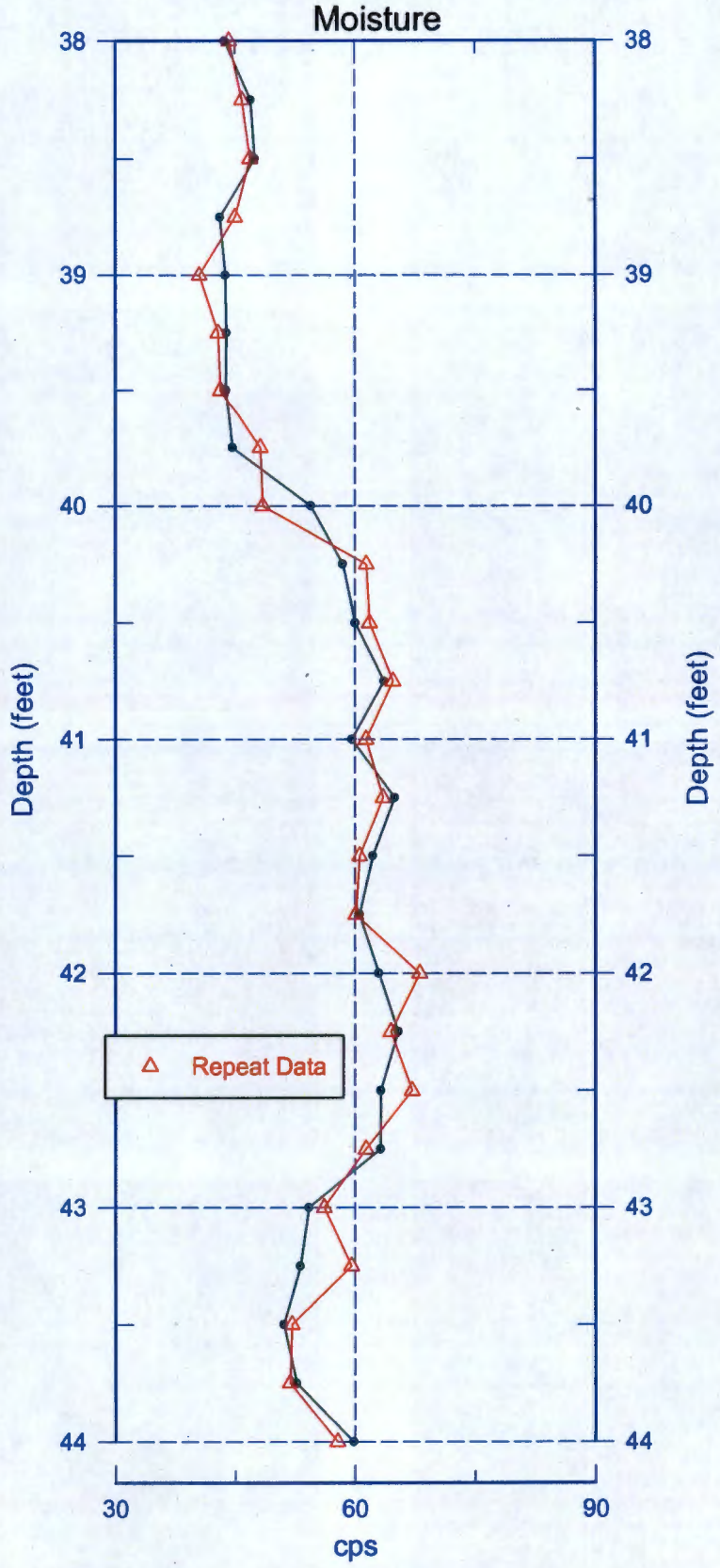
199-H6-7 (C8947)

Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

199-H6-7 (C8947)
Moisture Repeat Section



Reference - Ground Surface

cm
FREESTONE
C8947 5 ft

cm
FREESTONE
C8947 10 ft

cm
FREESTONE
C8947 15 ft

cm
FREESTONE
C8947 20 ft

cm
FREESTONE
C8947 25 ft

cm
FREESTONE
C8947 30 ft

cm
FREESTONE
C8947 35 ft

cm
FREESTONE
C8947 40 ft

cm
FREESTONE
C8947 44 ft

cm
FREESTONE
C8947 49 ft

cm
FREESTONE
C8947 50 ft

cm
FREESTONE
C8947 55 ft

SURVEY DATA REPORT				Request No. 153-100
Project No.	Title HR-3 Wells C8947 and C8951 Final Surveys			File No. 1HT14R27
Job. No. CACN: 303413-JPRC	Prepared By N.P. Fastabend	Date 5/14/15	Reviewer LBM	

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casings) and elevations of completed Wells C8947 (199-H6-7) and C8951 (199-H6-8) at 100H Area.	Survey File	OR		
	J.D. Mehrer	1		
	K.M. Whitley	1		
	J.L. Smoot	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheets

A-6006-495 (REV 0)

WELL SURVEY DATA REPORT

Project:	Prepared By: Neil P. Fastabend Company: CHPRC
Date Requested: 4/23/15	Requestor: Kelly Whitley (CHPRC)
Date of Survey: 5/14/15	Surveyor: Lawrence B. Munnell (PLS)
Fluor Hanford Point of Contact:	Survey Co. Point of Contact: Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of Well C8947 (199-H6-7) at 100H Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 100H

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
HSWB-029 (COE) and HSWB-030 (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C8947	199-H6-7	577704.08	151478.02		Center of Casing
				129.156	"X" on Rim
				128.415	Brass Survey Marker

Notes:

128.854 Top Inner Casing, North Edge

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify that this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

5-14-15

A-6003-659 (04/03)

Appendix F

Well Documentation for C8948 (199-H5-16)

- Well Summary Sheet
- Borehole Log
- Log Data Report
- Photographic Log
- Final Survey Report

This page intentionally left blank.

3/16/15 7/16/15

WELL SUMMARY SHEET

Start Date: ~~3/12/2015~~
Finish Date: 4/06/2015

Well ID: C8948	Well Name: 199-H5-16
Location: 1200 m SW of 100-H reactor	Project: 12 GW Wells in 100-HR-3 OU
Prepared By: Jessa Szecsody — Date: 5/26/15	Reviewed By: J.D. MEHRER — Date: 7-21-15
Signature:	Signature:

CONSTRUCTION DATA

Description

12-in Protective Casing: 3.65 ft ags - 1.35 ft below ground surface (bgs)

Type I/II Portland Cement Grout: 0 - 12.8 ft bgs

10-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 1.86 ft ags - 34.22 ft bgs

Cetco Medium Bentonite Chips: 12.8 - 28.5 ft bgs

3/8 in Cetco Coated Bentonite Pellet Seal: 28.5 - 29.2 ft bgs

10-in I.D. Schedule 10, Type 304/304L, 50-slot (0.050 in.) Stainless Steel Screen: 34.22 - 54.30 ft bgs

8-16 mesh Premier Colorado Silica Filter Pack Sand: 29.2 - 52.4 ft bgs

8-12 mesh Premier Colorado Silica Filter Pack Sand: 52.4 - 60.5 ft bgs

10-in I.D. Schedule 10, Type 304/304L, 60-slot (0.060 in.) Stainless Steel Screen: 54.30 - 60.02 ft bgs

Stainless steel centralizer installed at top of sump, top of screened interval, and at 40 ft intervals within casing

8-16 mesh Premier Colorado Silica Filter Pack Sand: 60.5 - 68.2 ft bgs

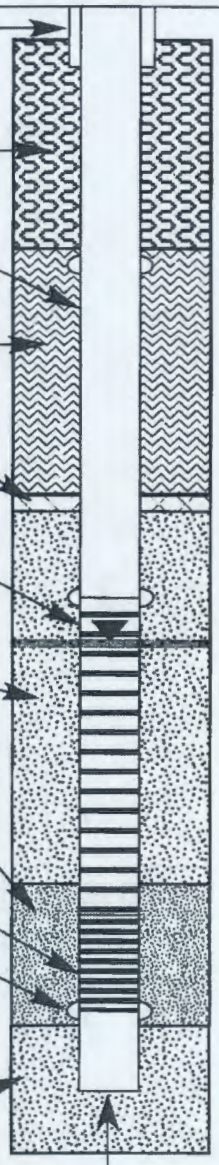
10-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 60.02 - 64.86 ft bgs

Depths are in ft below ground surface.

Borehole drilled with 16 1/2-in O.D. casing from 0.0 - 68.5 ft bgs

All temporary drill casing was removed from the ground.

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 10, 20, 30, 40, 50, 60, 70, 80

Graphic Log

Lithologic Description (ft bgs)

0 - 7 Silty Sand (mS)

7 - 59.7 Sandy Gravel (sG)

Static Water Level: 37.91 ft bgs (04/06/15)

59.7 - 68.5 Silt (M)

Total Depth: 68.5 ft bgs (3/25/15)

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 2

Date: 3/12/15-3/25/15

Well ID: C8948	Well Name: 199-H5-16	Location: 1200 m SW of 100-H reactor
Project: 12 new wells in 100-HR-3 O.U.		Reference Measuring Point: ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-7' SILTY SAND (m S)	Becker hammer
				TR GRAVEL 70% SAND, 30% SILT	TRIPLE CASING
				FINE PEBBLE GRAVEL; RND 10mm MAX	CNT MAY BE HIGHER
				PROTOM BASALT. SAND - VF, WELL SORTED	THAN 7' BGS DUE TO
				SR-A; 2.5Y 4/3 OLIVE BROWN	RETURN HOSE KINKS
				WEAK HCL RXN TR MOISTURE	BEGAN ADDING WATER
5	G			7'-59.7' SANDY GRAVEL (SG)	↓5' TO CONTROL DUST
				55% G, 40% SAND, 5% SILT G=2-95mm	DRILLER ESTIMATES 1-2GPM
	G			(F-C) MAX 60mm, 60% BASALT, SR-R	GAL/FT ADVANCE
				WELL SORTED S=F-VC AVE C, WELL SORTED, SA-A	
10	G			40% MAFIC 60% QTZ-OTHER, 2.5YR 4/3	ALL COLOR DESCRIPTIONS
				OLIVE BRN, STRONG HCl RXN @8'	ARE FROM WET SAMPLES
				NO HCL RXN BELOW 8'	
15	G			@15' G MAX 40 MM 50% BASALTS/	
				MAFIC 50% QTZ/FELSIC	
20	G			@20' G NOW 50%; C PEBBLE TO	2.5Y 3/1 - 2.5Y 4/1
				SM. COBBLE, SAND NO CHANGE	V DK GRAY - DK GRAY
				IN DISCRIPTION MAX 110 MM	WHEN SILTS ARE WASHED
				60% BASALTS/MAFICS 40% FELSIC	OUT OF SAMPLE
25	G			@25' G NOW 75% VF PEBBLE	DUST CONTROL WATER
				TO SM COBBLE, MAX 90MM	MAY HAVE BEEN ≈
				SAND AS ABOVE 25% OF CONTENT	3GAL PER FT IN THIS
				ONLY TR SILT	AREA & WASHED OUT
					SILTS FROM SAMPLE
30	G			@30' G LARGER COARSE SIZES	
				MAX 160 MM 60% BASALTS/MAFICS	
				40% FELSICS	
35	G			@35 SAME AS ABOVE	
					WT @37.9. ON 3/24/15
		WT @37.9'			

Reported By: Joshua Holland / Greg Kaza		Reviewed By: Kevin Bergstrom	
Title: Geologist		Title: Sr. Geologist	
Signature: [signature] / Greg Kaza 3/25/15	Date: 3/12/15	Signature: [signature]	Date: 4-27-15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 2

Date: 3/25/15

Well ID: C8948 | Well Name: 199-H5-16 | Location: 1.2 KM SW OF 100-H REACTOR

Project: 12 NEW WELLS IN 100-HR-3 OU | Reference Measuring Point: GROUND SURFACE (WELL PAD)

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
				CONTINUED FROM AS ABOVE	
40	G			7 - 59.7 SANDY GRAVEL (SG) @40'	BELOW WATER TABLE
				75% G, 25% S. TR M	1-2 GAL/FT WATER
				G 2-32 MM (F-C) MAX 80 MM	STILL ADDED FOR DUST
				70% BASALT/MAFICS 30% FELSICS	CONTROL (600 CFM
45	G -W-	- SS 45.6 TO 47.6		SR-R WELL-MODERATE SORTED	AIR @ 350 PSI)
				S = F-VC AVE C WELL SORTED SA-A	
				40% MAFIC 60% FTR OTHER 2.5Y	
				4/3 OLIVE BROWN, 2.5Y 4/1 DK GRAY	45.6' SAMPLE 001
				WHEN SILTS WASHED OUT OF SAMPLE	SPLIT SPOON B30JB3
50	G			@45' 65% G, 35% S	45.6' PUMPED G W
				TR M OTHERWISE AS ABOVE	SAMPLE T002 & T002 DUP
				@50' MAX 90 MM	B30JB4, JB5, & JB6
				% AS ABOVE	
				@55' MAX 70 MM	
55	G			SANDS AS ABOVE	
				59.7 TO 68.5 TD (M) SILT	SHARP CONTACT
				& CLAY ≈100% TR VF SAND NEAR	OBSERVED IN CUTTINGS
				CONTACT	DISCHARGE
60	G@ 3	59.7 CNT		@60: 10YR 6/3 PALE BRN	
				WEAK HCl RXN NONPLASTIC	
65	G			@65' 10YR 5/2 GRAYISH BRN	
				NO HCl RXN SLIGHTLY PLASTIC	
	G	TD@ 68.5		@68.5 10YR 6/4 LT YELLOWISH	TD - 68.5' BGS
70				BRN STRONG HCl RXN ON FRACTURE	3/25/15
				FILLING (10YR 8/1) WHITE	
				SLIGHT RXN ON GROUNDMASS	
				NOT USED	

Reported By: GREG L. KASZA | Reviewed By: KEVIN Bergstrom

Title: GEOLOGIST | Title: Sr. Geologist

Signature: [signature] Date: 3/25/15 | Signature: [signature] Date: 4-27-15

A-6003-642 (03/03)

Stoller Newport News Nuclear

199-H5-16 (C8948)
Log Data Report

Borehole Information:

Log Date:	2015-03-26	Filename:	C8948_HG-NM_2015-03-26	Site:	100 H
Coordinates (WA St Plane)		DTW[1] (ft):	42.8	DTW Date:	03/26/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	03/25/15	N/A	68.9	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	1.5	18	16	1.0	1.5	68.5

Borehole Notes:

The onsite geologist provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). The drilling method employs a double wall drive pipe where compressed air is forced down the outer casing and geologic material is returned to the surface inside the inner casing. In addition, a larger 16-in. casing was installed to total depth. The dual wall casing was removed prior to logging. Water inside the casing was measured at 42.8 ft by the logging engineer with an e-tape. The driller reported he added water after setting the casing in mud. The maximum logging depth achieved was 65 ft.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 4N	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	01/08/15	Serial No.:	45-TP22010A
Calibration Reference:	HGLP-CC-113, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 4M	Type:	NMLS[4]
Effective Calibration Date:	10/13/14	Serial No.:	H340207279
Calibration Reference:	HGLP-CC-109, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	3	4 Repeat			
HEIS Number	1018663	1018664			
Date	03/26/15	03/26/15			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	0.0	58.0			
Finish Depth (ft)	65.0	65.0			

[1] depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

Stoller Newport News Nuclear

Log Run	3	4 Repeat			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	DNL61CAB	DNL61CAB			
Start File	DNL61000	DNL61066			
Finish File	DNL61065	DNL61073			
Post-Verification	DNL61CAA	DNL61CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	No fine gain adjustments made	No fine gain adjustments made			

NMLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1018665	1018666			
Date	03/26/15	03/26/15			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	0.0	39.0			
Finish Depth (ft)	42.25	42.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	DMY52CAB	DMY52CAB			
Start File	DMY52000	DMY52170			
Finish File	DMY52169	DMY52182			
Post-Verification	DMY52CAA	DMY52CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	None	None			

Logging Operation Notes:

A centralizer was installed on the sondes.

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Analysis Notes:

Analyst:	P.D. Henwood	Date:	04/01/15	Reference:	HGLP-MAN-003, Rev. 0

A casing correction for a 1-in. thick was applied to the log data. No correction was applied for the casing joints which are in excess of 1.15-in. and occur at approximately 10-ft intervals.

A correction for water was applied below 42 ft in depth.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 4N20150108, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

NMLS data are reported in count per second as there is no calibration for conversion to volumetric moisture for borehole diameters greater than 8-in.

The HGU[5] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected in the borehole. MDLs for Cs-137 and Pu-239 are plotted for the entire borehole.

The relatively thick casing joints beginning at 8 ft and occurring at 10 ft intervals are indicated by reduced count rates on the total gamma log. The moisture log also appears to indicate effects of casing joints.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

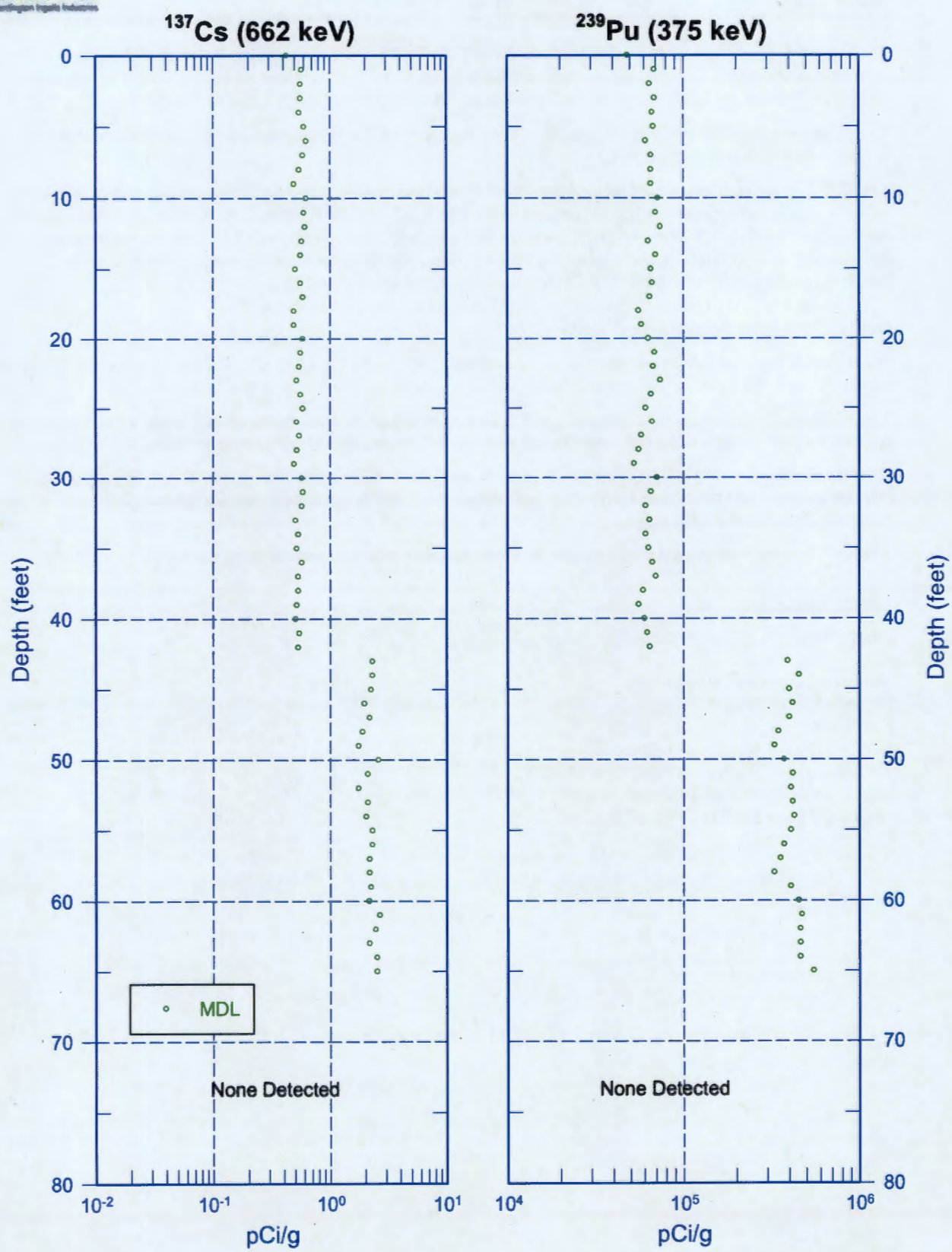
List of Log Plots:

Depth Reference is ground surface.

Manmade Radionuclides (0-80 ft)
Natural Gamma Logs (0-80 ft)
Combination Plot (0-120 ft)
Total Gamma & Moisture (0-80 ft)
Total Gamma & Hanford Gamma Unit (0-80 ft)
Repeat Section of Natural Gamma Logs (58 to 65 ft)
Moisture Repeat Section (39 to 42 ft)

[5] Hanford Gamma Unit

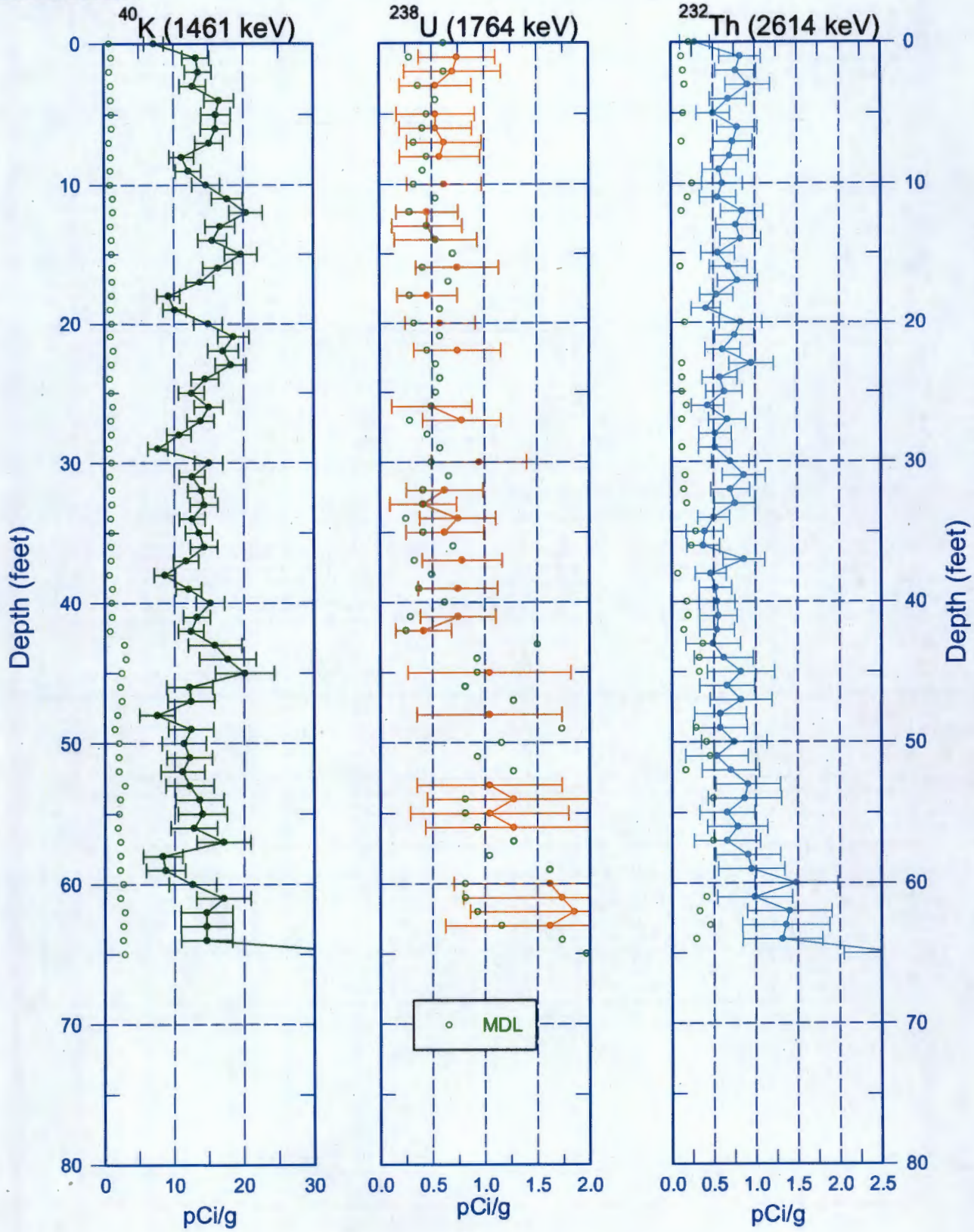
199-H5-16 (C8948)
Manmade Radionuclides



Zero Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

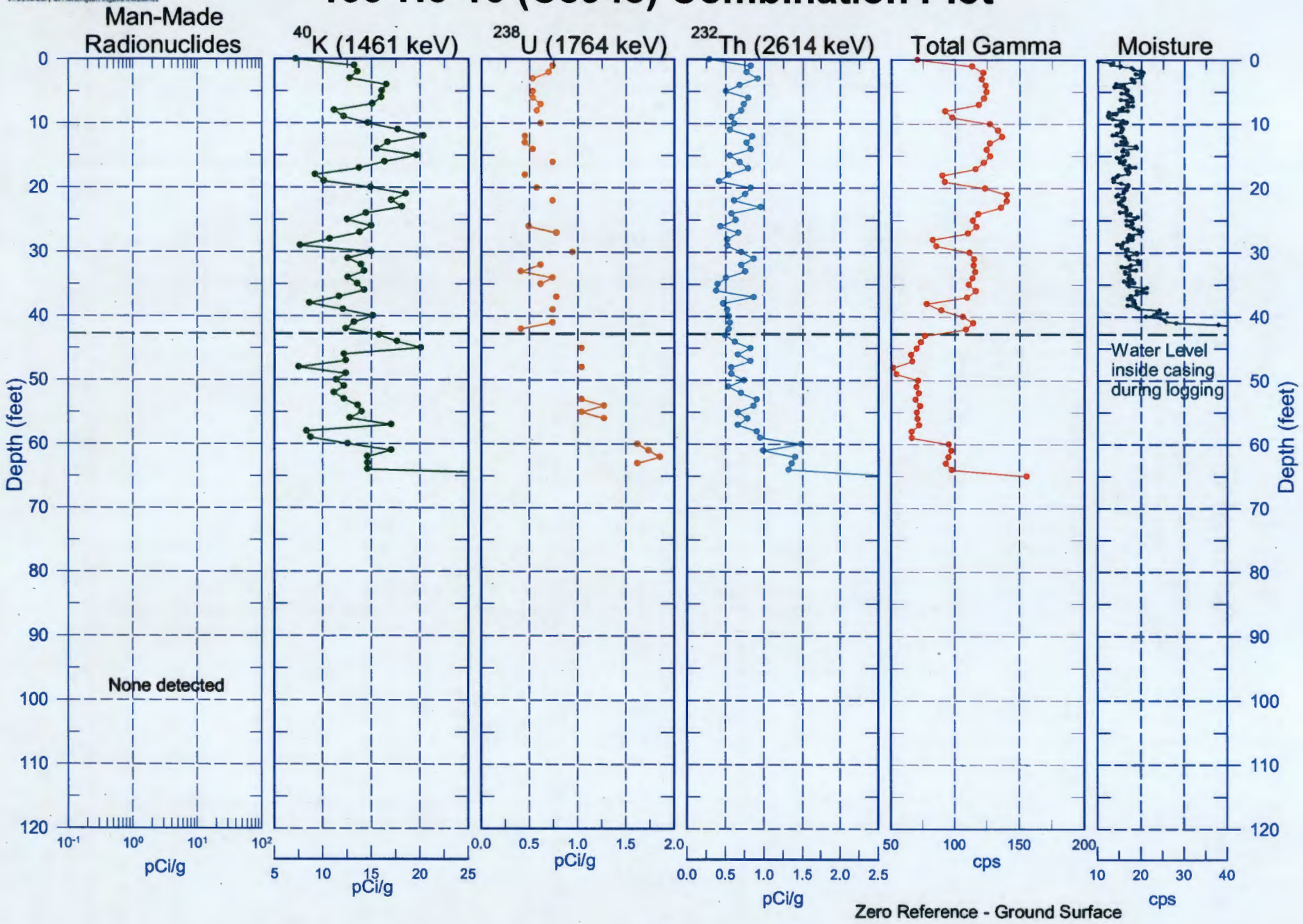
199-H5-16 (C8948)
Natural Gamma Logs



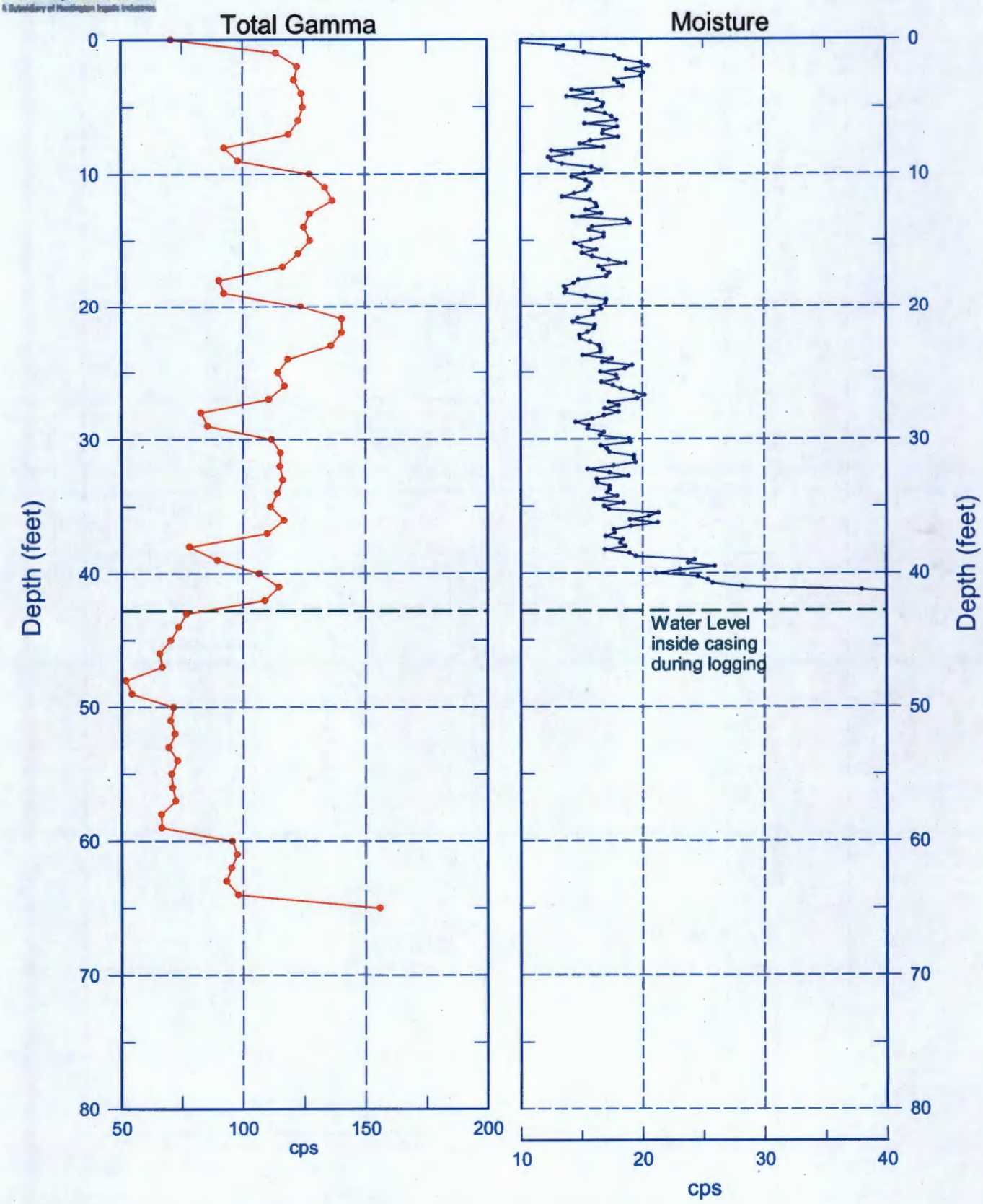
Zero Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

199-H5-16 (C8948) Combination Plot

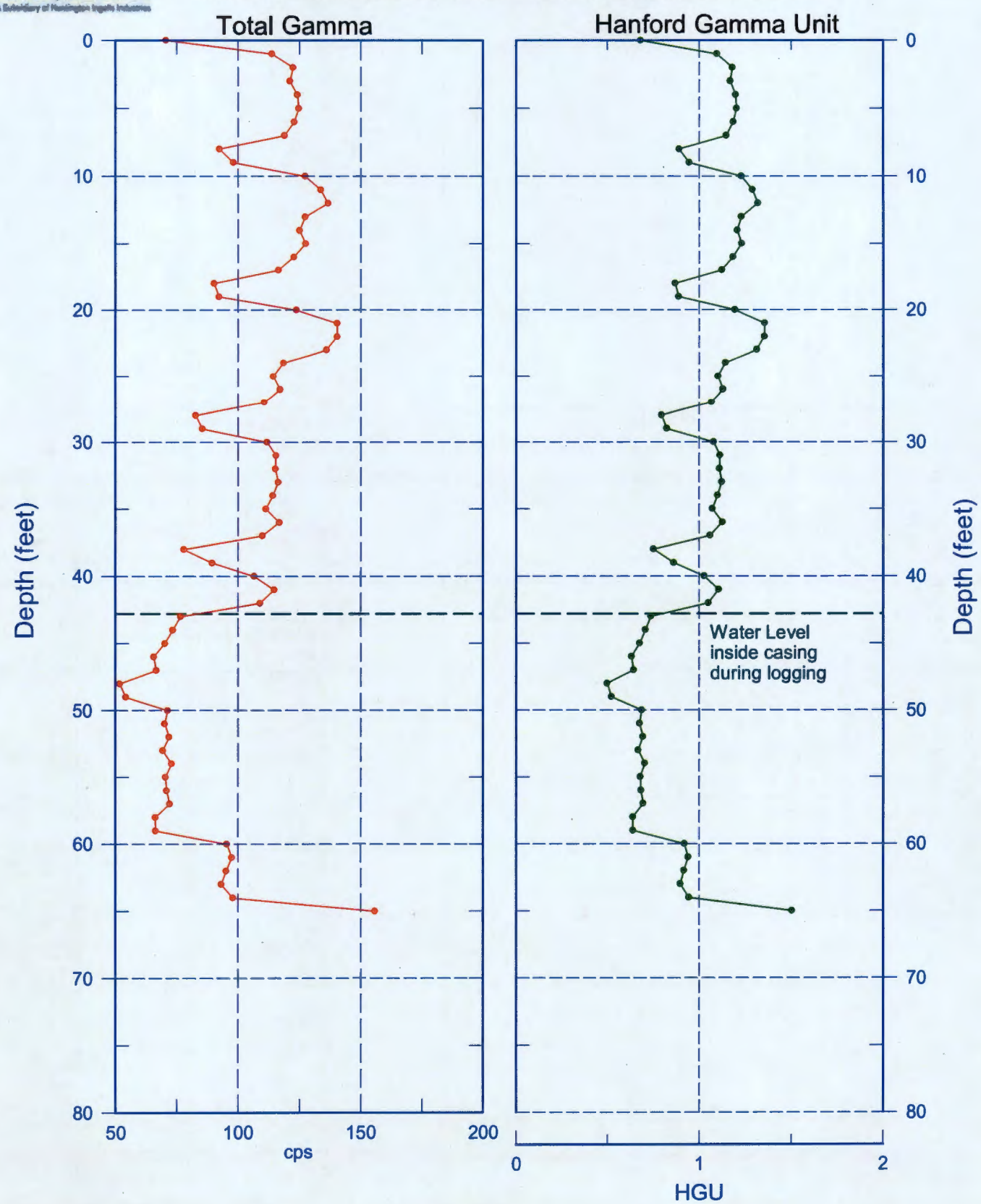


199-H5-16 (C8948)
Total Gamma & Moisture



Reference - Ground Surface

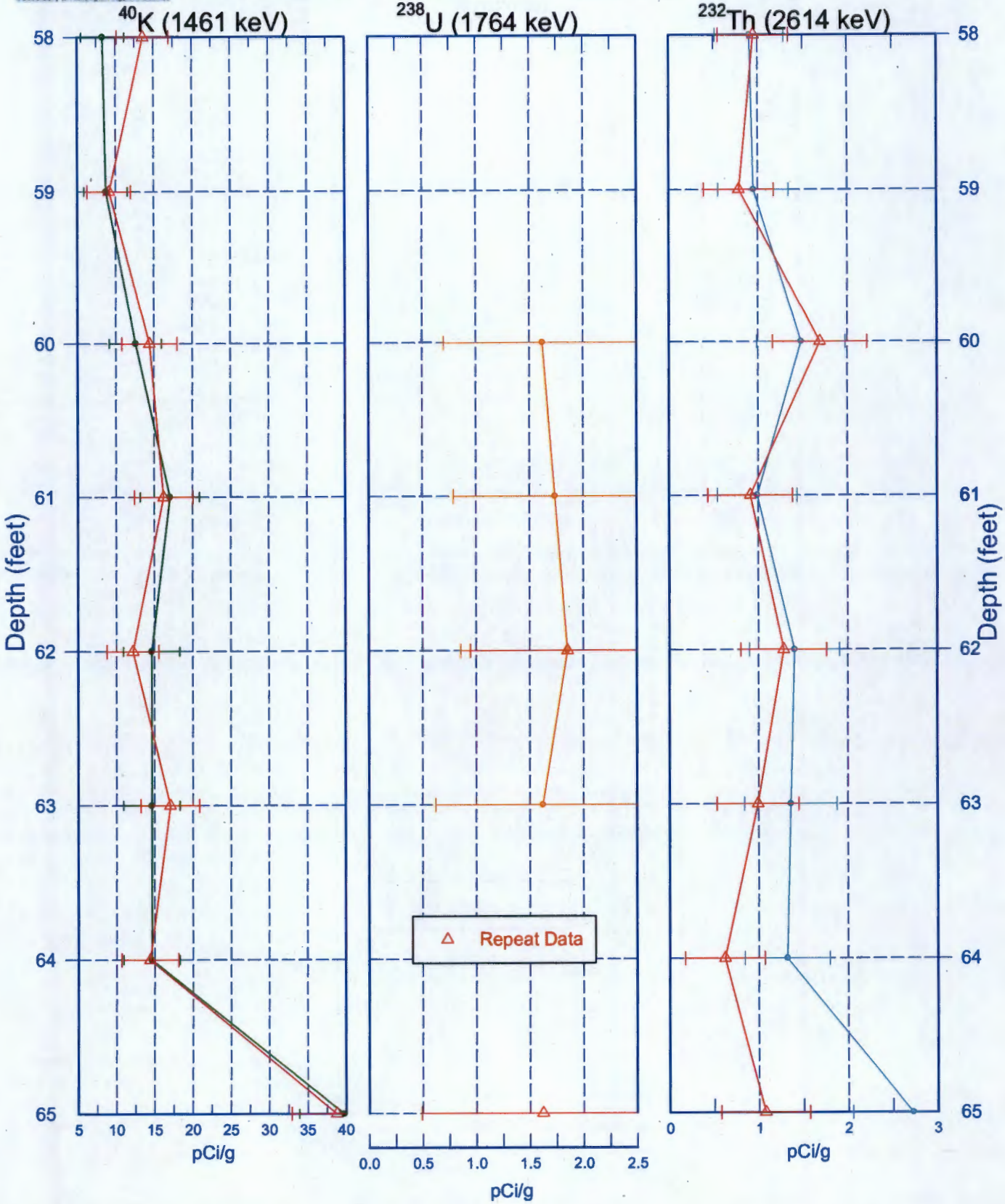
199-H5-16 (C8948)
Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

199-H5-16 (C8948)

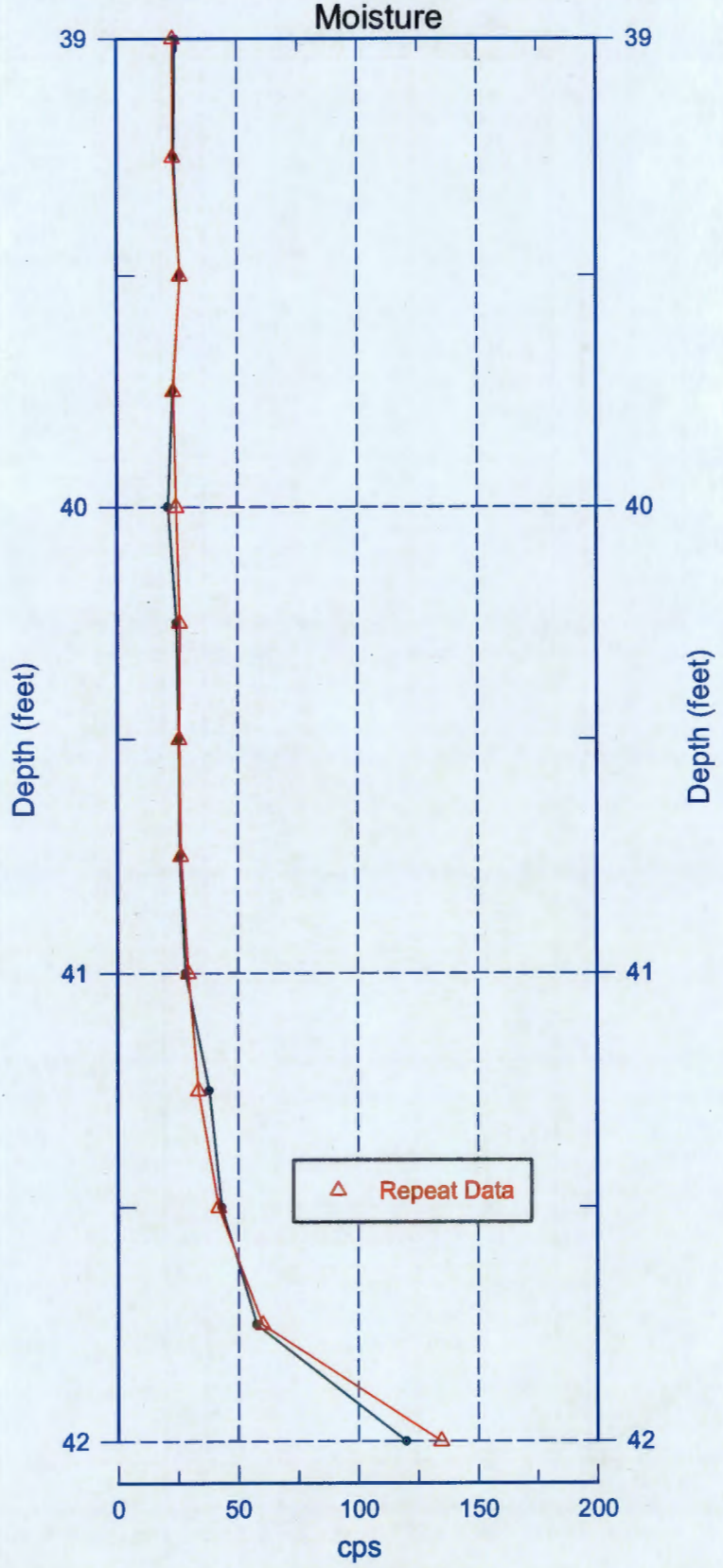
Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

199-H5-16 (C8948)
Moisture Repeat Section



Reference - Ground Surface

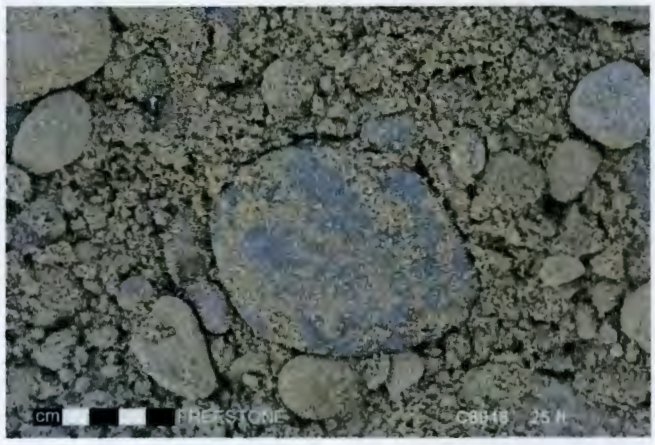
cm
FREESTONE
C8948 5 ft

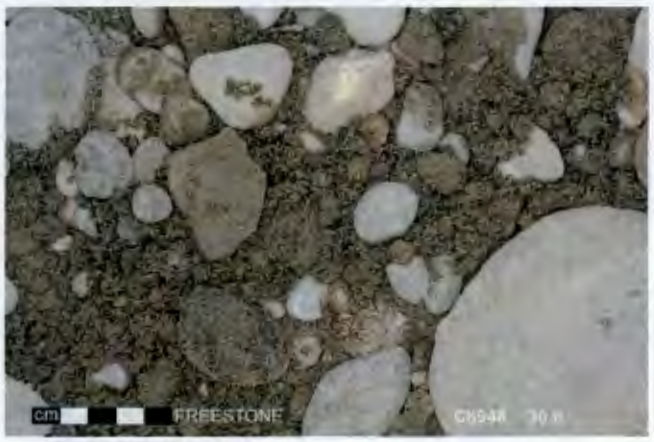
cm
FREESTONE
C8948 8 ft

cm
FREESTONE
C8948 10 ft

cm
FREESTONE
C8948 15 ft

cm
FREESTONE
C8948 20 ft

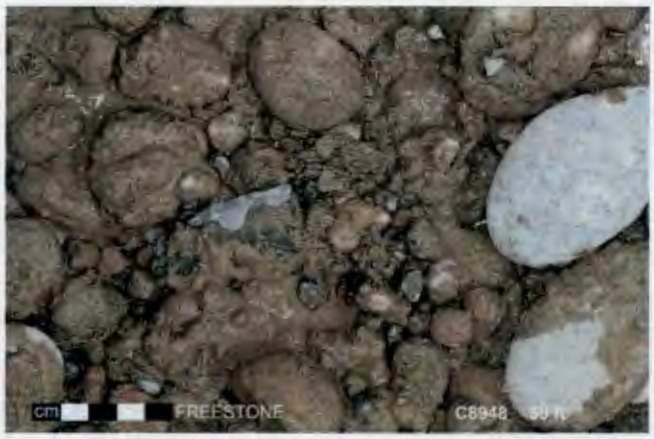

cm
FREESTONE
C8948 25 ft


cm
FREESTONE
C8948 30 ft

cm
FREESTONE
C8948 35 ft

cm
FREESTONE
C8948 40 ft

cm
FREESTONE
C8948 45 ft


cm
FREESTONE
C8948 50 ft

cm
FREESTONE
C8948 55 ft

cm
FREESTONE
C8948 60 ft

cm
FREESTONE
C85MI 65 ft

cm
FREESTONE
C8948 68 ft

SURVEY DATA REPORT				Request No. 153-099
Project No.	Title HR-3 Well C8948 (199-H5-16) Final Survey			File No. 1HT14R27
Job. No. CACN: 303594-JPRC	Prepared By N.P. Fastabend	Date 5/14/15	Reviewer LBM	

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casing) and elevations of completed Well C8948 (199-H5-16) at 100H Area.	Survey File	OR		
	J.D. Mehrer	1		
	K.M. Whitley	1		
	J.L. Smoot	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheet

A-6006-495 (REV 0)

WELL SURVEY DATA REPORT

Project:	Prepared By: Neil P. Fastabend Company: CHPRC
Date Requested: 4/23/15	Requestor: Kelly Whitley (CHPRC)
Date of Survey: 5/14/15	Surveyor: Lawrence B. Munnell (PLS)
Fluor Hanford Point of Contact:	Survey Co. Point of Contact: Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of Well C8948 (199-H5-16) at 100H Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 100H

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
HSWB-029 (COE) and HSWB-030 (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C8948	199-H5-16	576906.80	151646.31		Center of Casing
				129.929	"X" on Rim
				129.175	Brass Survey Marker

Notes:

129.633 Top Inner Casing, North Edge

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify that this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

5-14-15

Appendix G

Well Documentation for C8949 (199-H4-93)

- Well Summary Sheet
- Borehole Log
- Log Data Report
- Photographic Log
- Final Survey Report

This page intentionally left blank.

WELL SUMMARY SHEET

Start Date: 4/23/2015
Finish Date: ~~5/5/2015~~ 5/7/15 RSG 7/10/15

Page 1 of 1

Well ID: C8949	Well Name: 199-H4-93
Location: 800 m WNW from 100-H reactor	Project: 12 GW Wells in 100-HR-3 OU
Prepared By: Jessa Szecsody — Date: 5/27/15	Reviewed By: J.D. MEHRER — Date: 7-21-15
Signature:	Signature:

CONSTRUCTION DATA

Concrete Pad: 0.5 ft above ground surface (ags)

12-in Protective Casing: 2.44 ft above concrete pad - 2.06 ft below ground surface (bgs)

Type I/II Portland Cement Grout: 0 - 11.2 ft bgs

3/8 in Cetco Medium Bentonite Chips: 11.2 - 27.2 ft bgs

10-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 1.92 ft ags - 31.9 ft bgs

3/8 in Cetco Coated Bentonite Pellet Seal: 27.2 - 28.0 ft bgs

Stainless steel centralizer installed from the top of the sump and top of screened interval

6-12 mesh Premier Colorado Silica Filter Pack Sand: 28.0- 52.1 ft bgs

10-in I.D. Schedule 10, Type 304/304L, 75-slot (0.075 in.) Stainless Steel Screen: 31.90 - 51.90 ft bgs

10-20 mesh Premier Colorado Silica Filter Pack Sand: 52.1 - 57.92 ft bgs

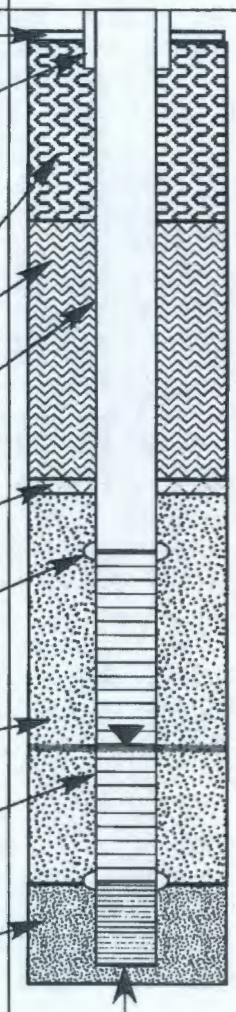
10-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screened Sump: 51.90 - 56.90 ft bgs

Depths are in ft below ground surface.

Borehole drilled with 18-in O.D. casing from 0.0 - 58.45 ft bgs

All temporary drill casing was removed from the ground.

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 10, 20, 30, 40, 50, 60, 70, 80

Graphic Log

Lithologic Description (ft bgs)

- 0 - 2 Gravel Pad; Fill
- 2 - 7 Silt (M)
- 7 - 52 Sandy Gravel (sG)
- Static Water Level: 43.82 ft bgs (05/07/15)
- 52 - 58 Silt (M)
- Total Depth: 58 ft bgs (4/28/15)

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 2
Date: 4/23 - 4/29/15

Well ID: C8949	Well Name: 199-H4-93	Location: 800 m WNW FROM 100-H REACTOR
Project: 12 NEW WELLS @ 100-HR-3 OU		Reference Measuring Point: G.S.

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-2 WELL PAD CRUSHED GRAVEL TOP COVERS - CONSTRUCTION FILL BENEATH	BECKER HAMMER RIG TRIPLE CASING - 18" OD
				2-7' (M) SILT 10% SAND, 90% SILT S-FS TO VFS 10YR 5/3 BROWN MOIST, WELL SORTED, SA, NO HCl RXN	WATER ADDED FOR DUST CONTROL AS NEEDED - OFF @ SPLIT SPOON INTERVALS ABOVE WATER TABLE
5	G			7-52 (SG) SANDY GRAVEL @10' 70% G, 28% S, 2% M G-VFP-SM Cobble MAX 100 mm, SR-R 70% FELSIC 30% BASALT/OTHER POOL SORTED S-F-C ABEC WELL SORT, SA-A	1-2 GAL/FT ADVANCE WHEN USED COLOR
10	G			40% MAFIC, 60% QTZ/OTHER, 10YR 6/3 PALE BROWN NO HCl RXN, MOIST @ 15' 80% G, 18% S, 2% M AS ABOVE S GETTING COARSER	ALL DESCRIPTIONS ARE FROM MOIST, AS RECEIVED SAMPLES UNLESS NOTED
15	G				
20	G			@20' 70% G, 28% S, 2% M 7.5 YR 5/1 GRAY MAX 100 x 150 mm OTHERWISE AS ABOVE	
25	G			@ 25' MAX 150MM OTHERWISE AS ABOVE	
30	G			@ 30' AS ABOVE S CONTINUES VF-VC, 40% M-60% QTZ OTHER SA-A, TR FE STAIN NO HCl RXN.	
35	G			@35' AS ABOVE - VCOARSE GRAVEL MAX 200 x 150MM	HARD/SLOW DRILLING 50 MIN/10FT

Reported By: Greg Kasza		Reviewed By: Kevin Bergstrom	
Title: Geologist		Title: Sr. Geologist	
Signature: Kim Schuyler for Greg Kasza	Date: 4/29/15	Signature: Kevin Bergstrom	Date: 7/23/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 2
Date: 4/23 – 4/29/15

Well ID: C8949	Well Name: PA-H4-93	Location: 800 M. WNW FROM 100 H REACTOR	
Project: 12 NEW WELLS @ 100-H/R-3 OU		Reference Measuring Point: G.S	

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
40	G			@ 40' DESCRIPTION AS ABOVE	W.L. = 43.52' BGS
				7-52' Sandy Gravel (SG), 70%	(4/28/15)
				gravel, 28% Sand, 2% Silt, Gravel: max	
				200mm, VCP-small cobble, VFP-VF, poorly sorted	→ NO rxn w/HCl, poorly sorted
				SR-R 70% felsks, Sand: VF-VC, 10% felsks, SA-A	7.5YR 5/1 Gray
45	G			@ 45' AS ABOVE NOW 7.5YR 4/1	SPLIT SPOON B30JH5
				DARK GRAY WK HCl RXN	45.4' – 47.9'
		55 100% recovery			WATER SAMPLE B30JT
	W				@ 48.2 BGS
50	G			@ 50' AS ABOVE NO CHANGES	Static water level:
				NOTED w/ SILT	43.82' (5/7/15)
	G			@ 52' - 59.0' - A TRS 9990 M	
				10YR 5/2 GRAYISH BROWN, MOIST	
				WK HCl RXN LOW PLASTICITY	
55	G			@ 55 M 1070 S 9090 M	
				10YR 5/4 YELLOWISH BRN MOIST	
				S VFS WELL SORTED SA-A, TR	
				CALICHE / CARBONATE NODULES	
	G			LAYERS OF HIGH CONCENTRATION	TD @ 58.0' BGS
60				NON-PLASTIC ST. HCl RXN ON	4/28/15
				CALICHE	18" casing shoe = 58.4' bgs
				@ 58 TD NOW 10YR 4/4 –	
				DK YELLOWISH BROWN OTHERWISE	
				AS ABOVE	

NOT USED
KS 7/3/15

Reported By: Greg Kasza		Reviewed By: Kevin Bergstrom	
Title: Geologist		Title: Sr. Geologist	
Signature: Kim Schuyler on behalf of Greg Kasza	Date: 4/29/15	Signature: Kevin Bergstrom	Date: 7/23/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

199-H4-93 (C8949)
Log Data Report

Borehole Information:

Log Date:	2015-04-29	Filename:	C8949_HG-NM_2015-04-29	Site:	100 H
Coordinates (WA St Plane)		DTW[1] (ft):	48.15	DTW Date:	04/29/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	04/28/15	N/A	55	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	1.55	18	16	1.0	1.55	55

Borehole Notes:

The onsite geologist provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). This drilling method employs a double wall drive pipe where compressed air is forced down the outer casing and geologic material is returned to the surface inside the inner casing. The inner casing was removed prior to logging. Water inside the casing was measured at 48.15 ft by the logging engineer with an e-tape. The maximum logging depth achieved was 55 ft.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1L	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	11/12/14	Serial No.:	47-TP32211A
Calibration Reference:	HGLP-CC-111, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 5P	Type:	NMLS[4]
Effective Calibration Date:	04/15/15	Serial No.:	H34055445
Calibration Reference:	HGLP-CC-116, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1018700	1018701			
Date	04/29/15	04/29/15			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	0.0	40.0			
Finish Depth (ft)	55.0	48.0			
Count Time (sec)	100	100			

[1] depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

Stoller Newport News Nuclear

Log Run	1	2 Repeat			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AL251CAB	AL251CAB			
Start File	AL251000	AL251056			
Finish File	AL251055	AL251064			
Post-Verification	AL251CAA	AL251CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	No fine gain adjustments made	No fine gain adjustments made			

NMLS Log Run Information:

Log Run	3	4 Repeat			
HEIS Number	1018702	1018703			
Date	04/29/15	04/29/15			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	0.0	15.0			
Finish Depth (ft)	47.75	20.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	FPC8949201542 9 AV00CAB1	FPC8949201542 9 AV00CAB1			
Start File	AD000000	BD001500			
Finish File	AD004775	BD002000			
Post-Verification	FPC8949201542 9 BV00CAA1	FPC8949201542 9 BV00CAA1			
Depth Return Error (in.)	N/A	0.0			
Comments	None	None			

Logging Operation Notes:

A centralizer was installed on the sondes.

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Analysis Notes:

Analyst:	P.D. Henwood	Date:	05/18/15	Reference:	HGLP-MAN-003, Rev. 0

A casing correction for a 1-in. thick was applied to the log data. No correction was applied for the casing joints which are in excess of 1.5-in. and occur at approximately 10-ft intervals.

A correction for water was applied below 48 ft in depth.

Stoller Newport News Nuclear

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 1L20141112, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

NMLS data are reported in counts per second as there is no calibration for conversion to volumetric moisture for borehole diameters greater than 8-in.

The HGU[5] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected in the borehole. MDLs for Cs-137 and Pu-239 are plotted for the entire borehole.

The relatively thick casing joints beginning at 8 ft and occurring at 10 ft intervals are indicated by reduced count rates on the total gamma log. The moisture log also appears to indicate effects of casing joints.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

List of Log Plots:

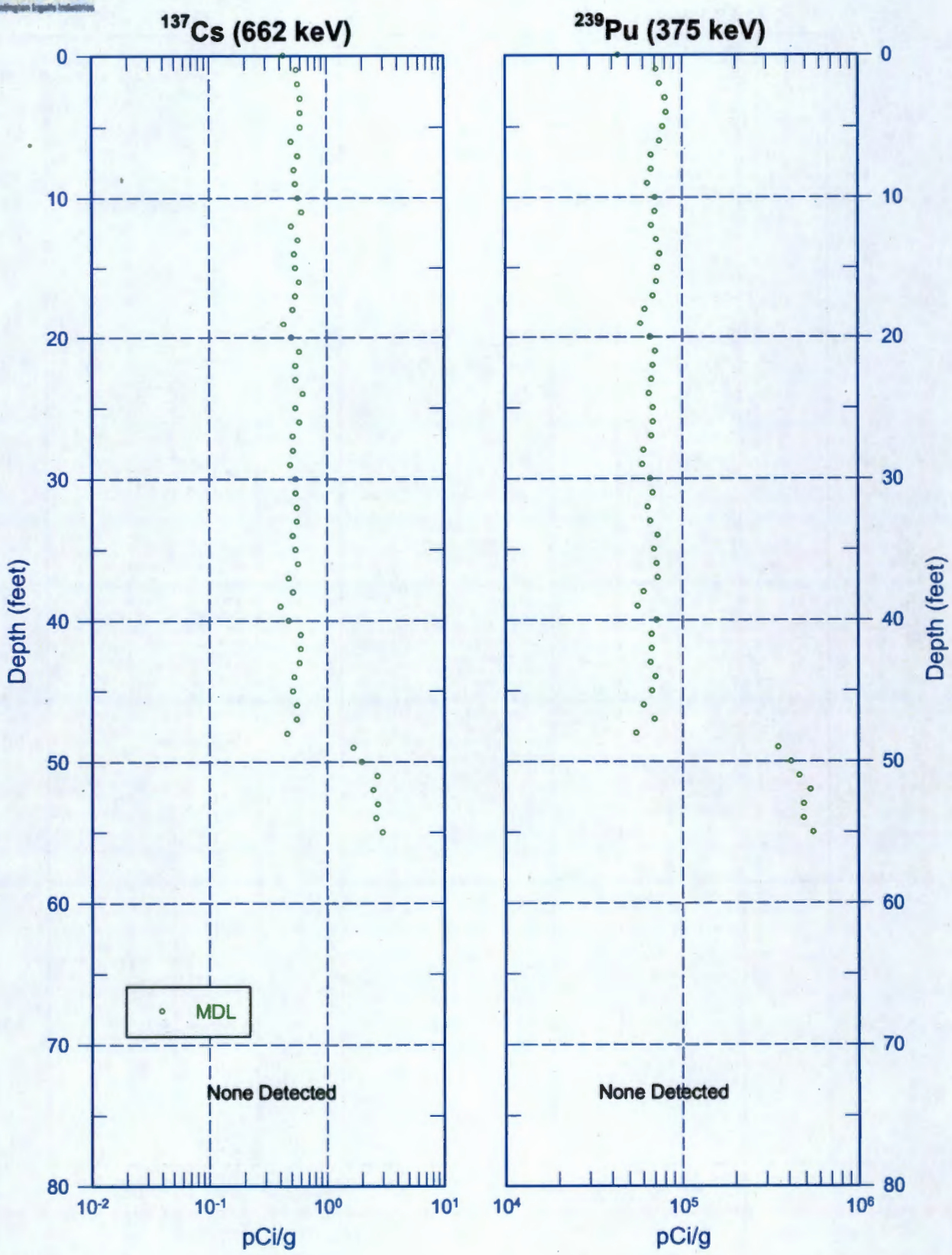
Depth Reference is ground surface.

Manmade Radionuclides (0-80 ft)
Natural Gamma Logs (0-80 ft)
Combination Plot (0-120 ft)
Total Gamma & Moisture (0-80 ft)
Total Gamma & Hanford Gamma Unit (0-80 ft)
Repeat Section of Natural Gamma Logs (40 to 48 ft)
Moisture Repeat Section (15 to 20 ft)

[5] Hanford Gamma Unit

A SUBSIDIARY OF HUNTINGTON INGALLS INDUSTRIES
2439 Robertson Drive • Richland, WA 99354 • Telephone (509) 946-6455 • www.stoller.com

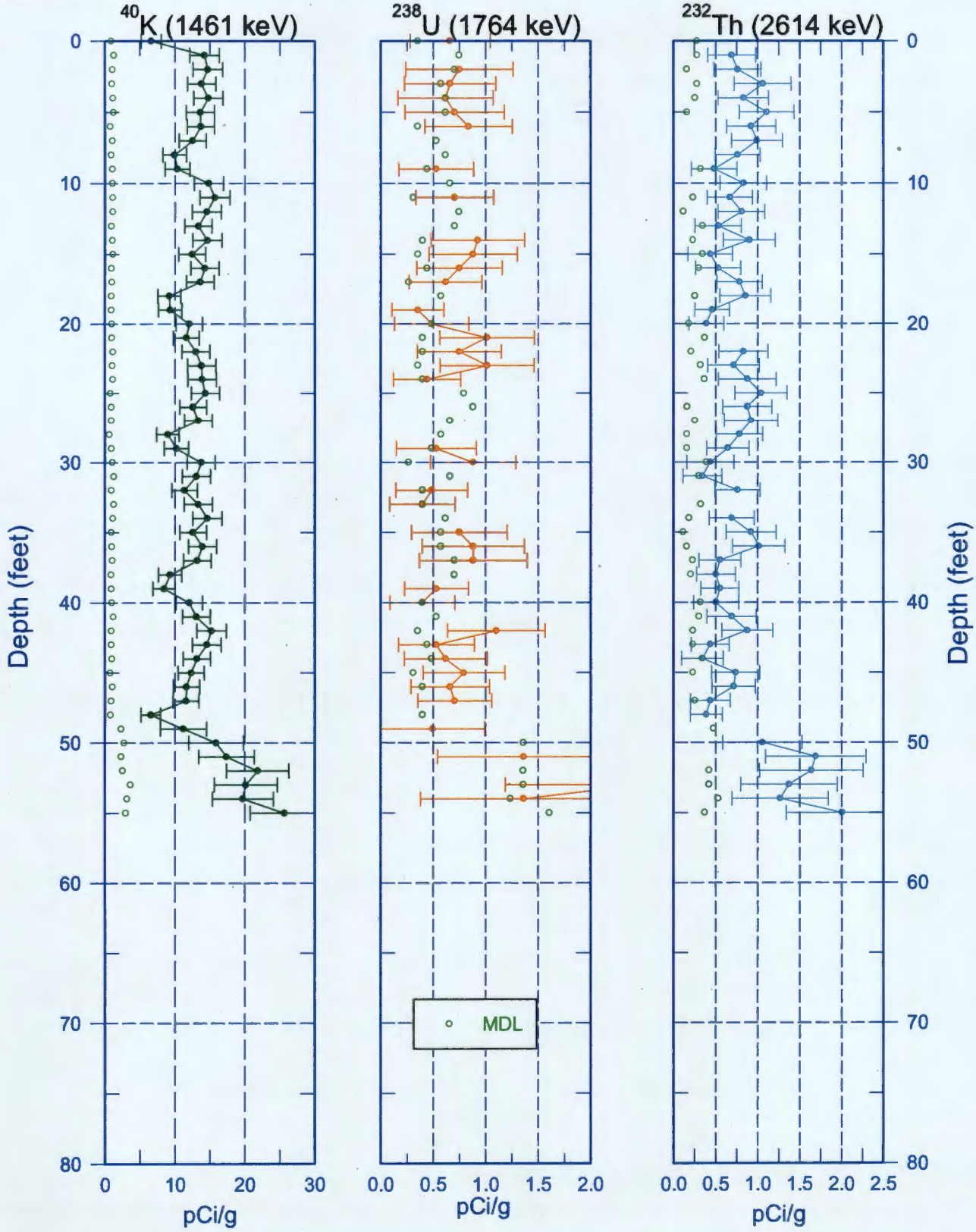
199-H4-93 (C8949)
Manmade Radionuclides



Zero Reference - Ground Surface

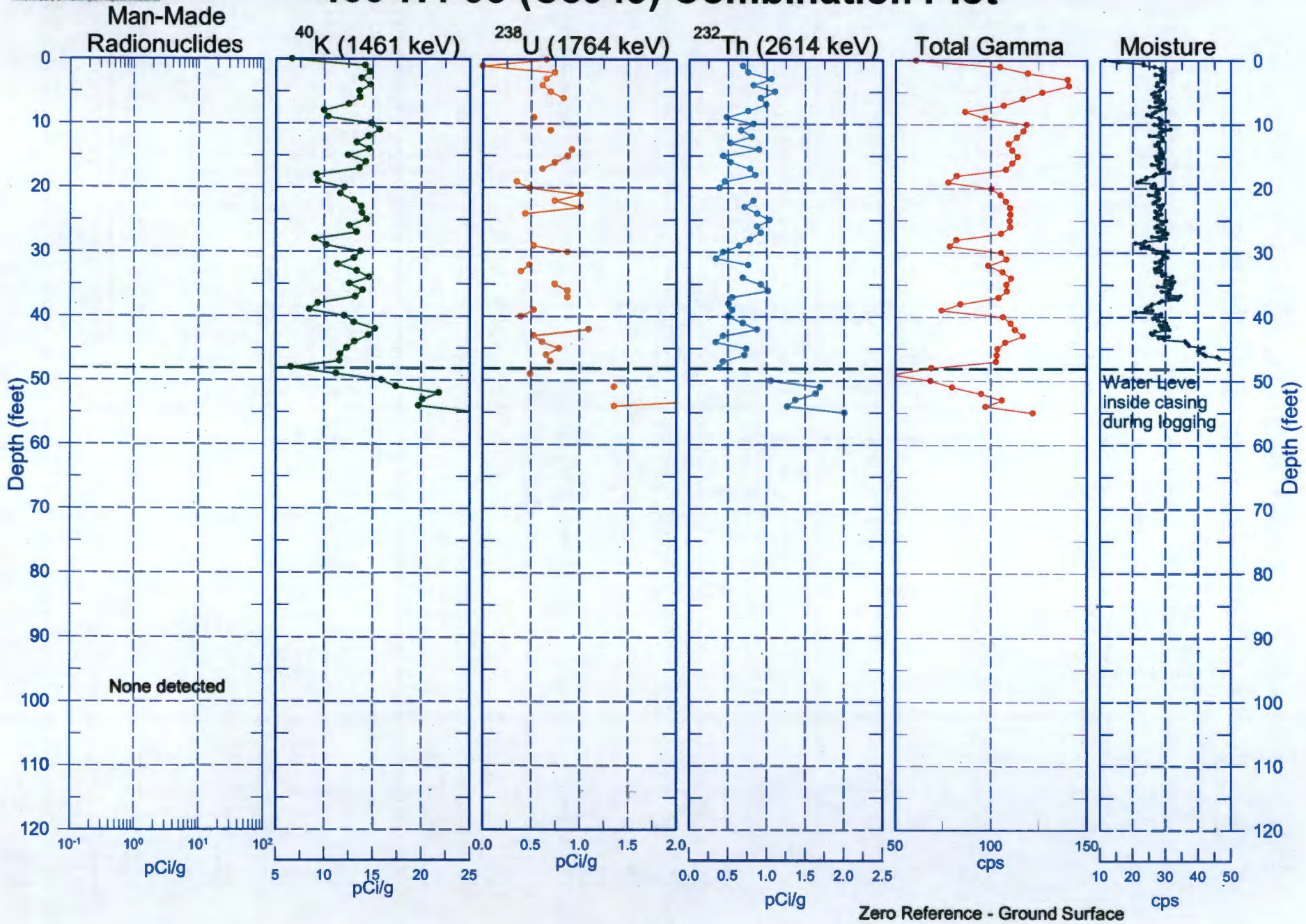
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

199-H4-93 (C8949)
Natural Gamma Logs

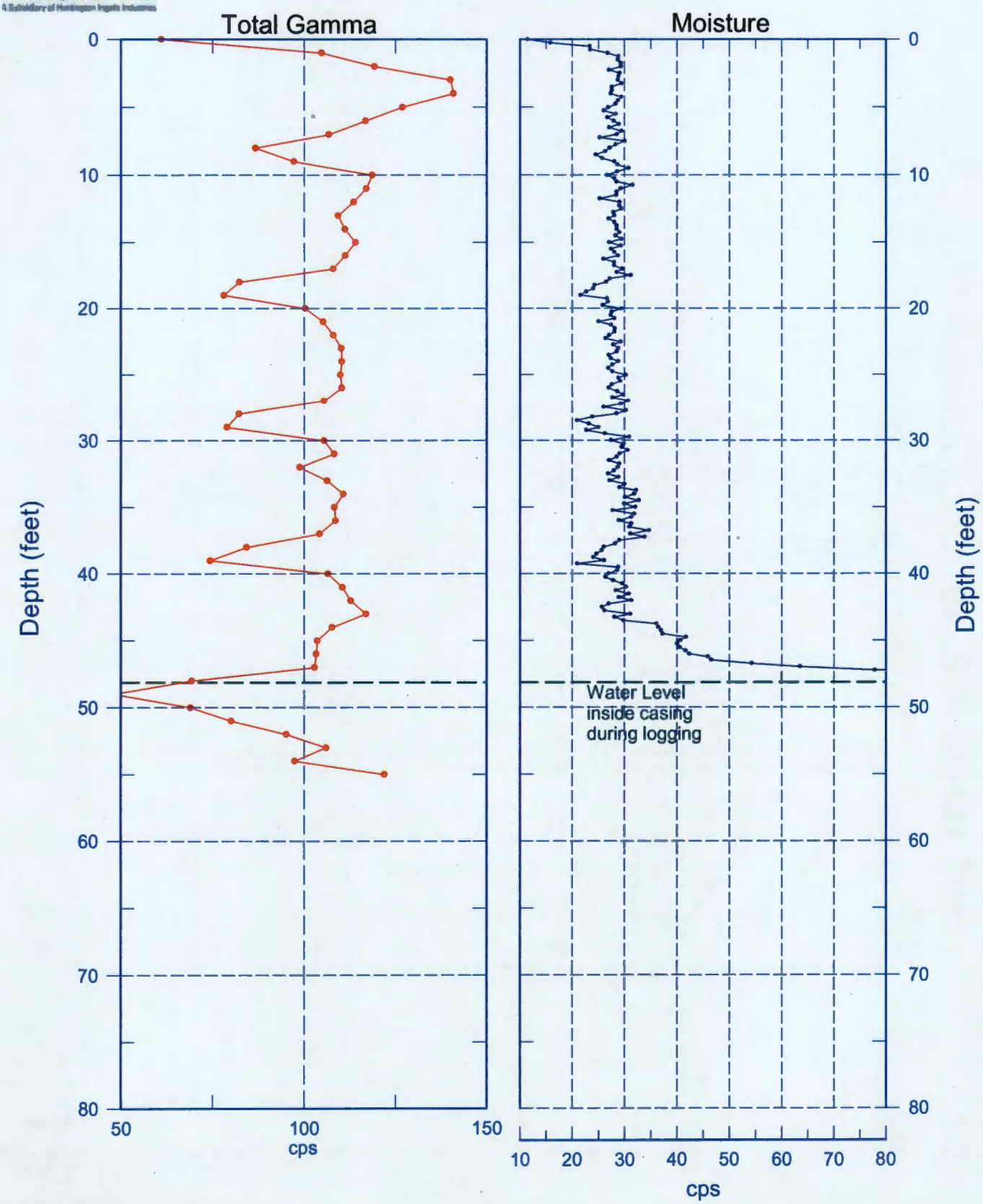


Zero Reference - Ground Surface

199-H4-93 (C8949) Combination Plot

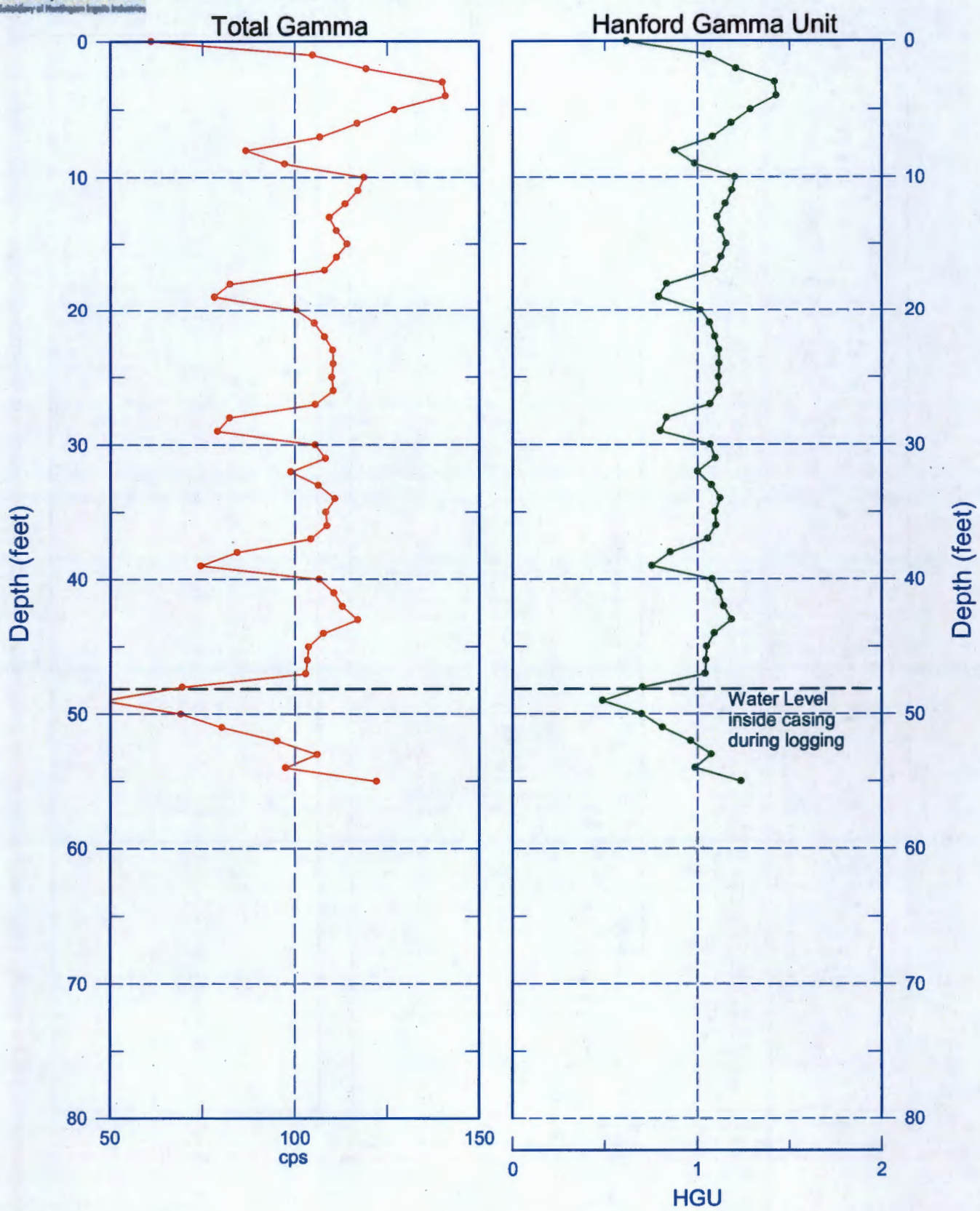


199-H4-93 (C8949)
Total Gamma & Moisture



Reference - Ground Surface

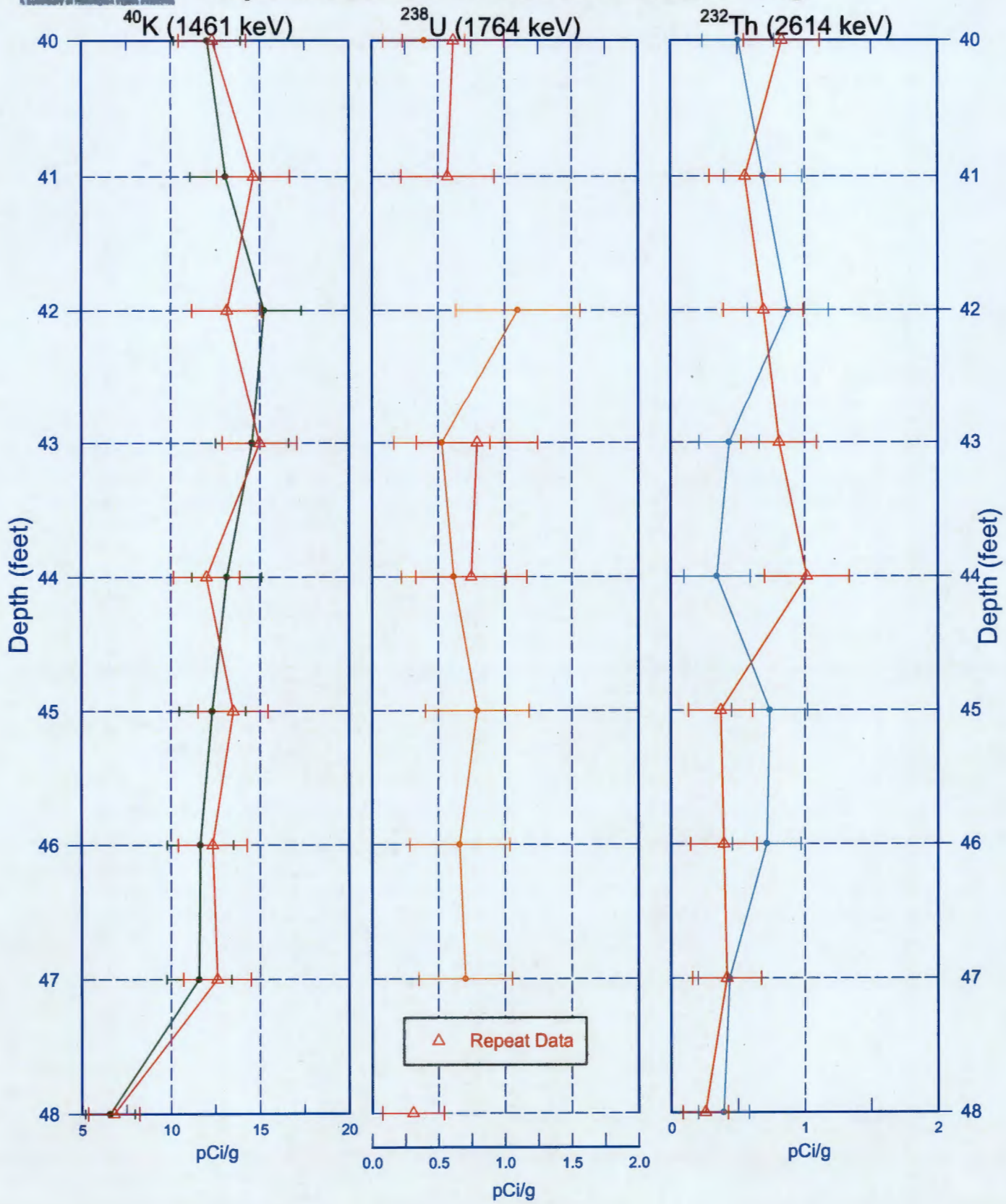
199-H4-93 (C8949)
Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

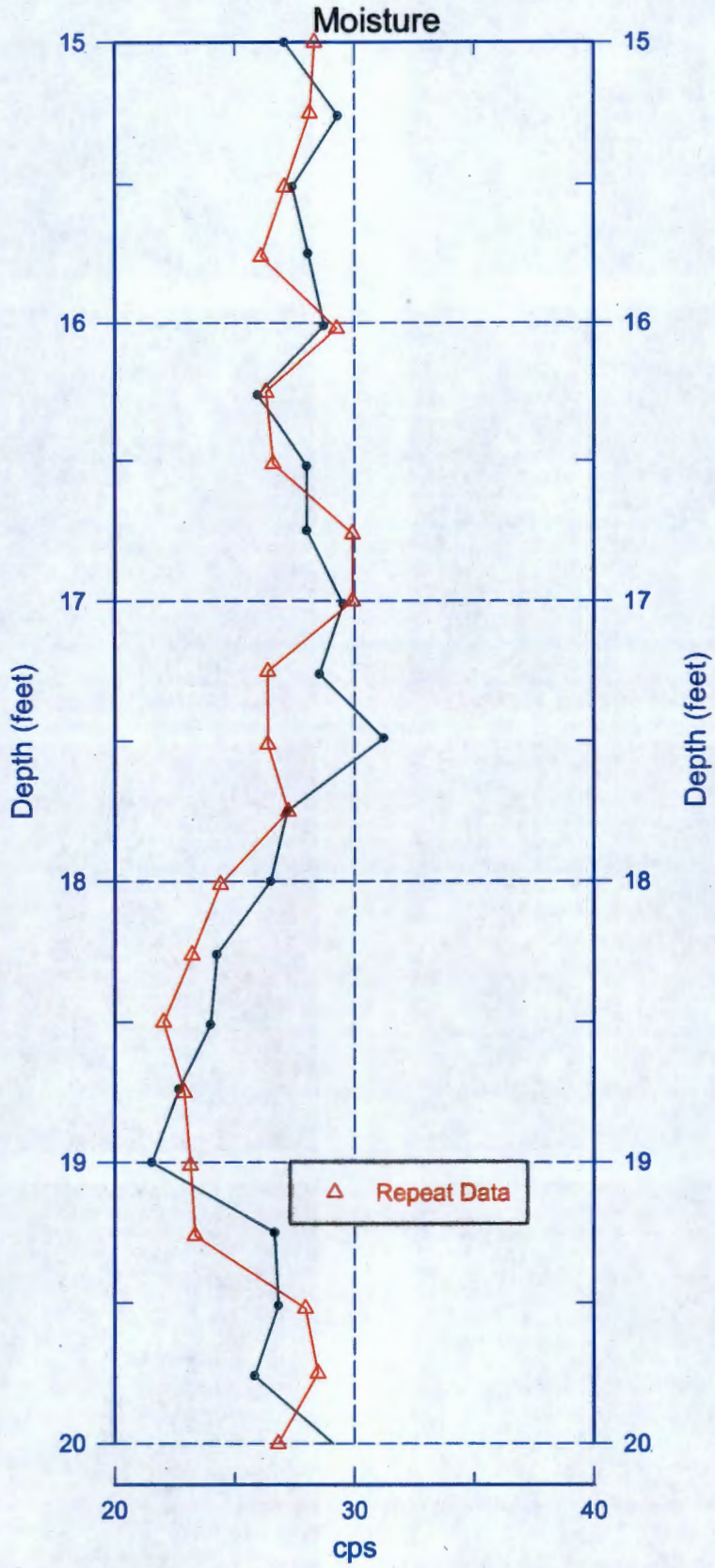
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

199-H4-93 (C8949)
Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

199-H4-93 (C8949)
Moisture Repeat Section



Reference - Ground Surface

cm
FREESTONE
C8949 5 ft

cm
FREESTONE
C8949 10 ft

cm
FREESTONE
C8949 15 ft

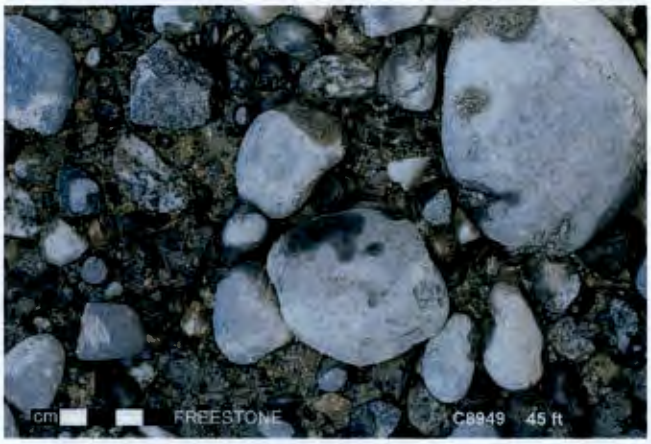
cm
FREESTONE
C8949 20 ft

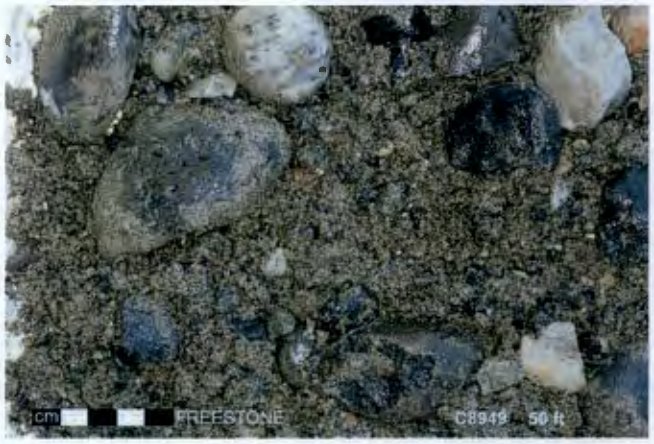
cm
FREESTONE
C8949 25 ft

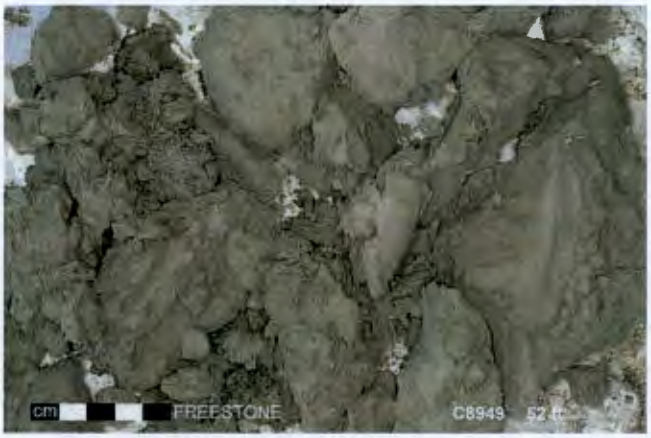
cm
FREESTONE
C8949 30 ft

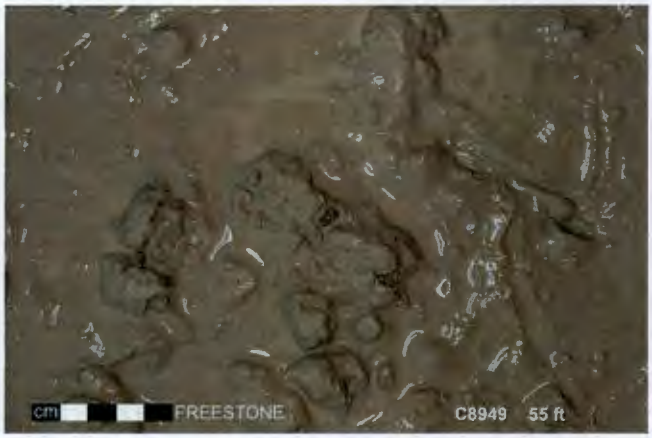
cm
FREESTONE
C8949 35 ft

cm
FREESTONE
C8949 40 ft


cm
FREESTONE
C8949 45 ft


cm
FREESTONE
C8949 50 ft


cm
FREESTONE
C8949 52 ft


cm
FREESTONE
C8949 55 ft

cm
FREESTONE
C8949 58 ft

SURVEY DATA REPORT				Request No. 153-113
Project No.	Title HR-3 Well C8949 (199-H4-93) Final Survey			File No. 1HT14R27
Job. No. CACN: 303594-JPRC	Prepared By N.P. Fastabend	Date 6/2/15	Reviewer LBM	

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casing) and elevations of completed HR-3 Well C8949 (199-H4-93) located on west side of 100H Area.	Survey File	OR		
	J.D. Mehrer	1		
	K.M. Whitley	1		
	J.L. Smoot	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheet

WELL SURVEY DATA REPORT

Project:	Prepared By: Neil P. Fastabend Company: CHPRC
Date Requested: 05/13/15	Requestor: Jim Mehrer (CHPRC)
Date of Survey: 06/02/15	Surveyor: Lawrence B. Munnell (CHPRC)
Fluor Hanford Point of Contact:	Survey Co. Point of Contact: Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of HR-3 Well C8949 (199-H4-93) located on west side of 100H Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 100H

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
G49 (COE) and HSWB-030 (CHPRC)

Well ID	Well Name	Easting	Northing	Elevation	
C8949	199-H4-93	577025.75	152703.33		Center of Casing
				130.428	"X" on Rim
				129.704	Brass Survey Marker

Notes:

130.118 Top Inner Casing, North Edge

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

6-2-15

A-6003-659 (04/03)

Appendix H

Well Documentation for C8950 (699-95-45B)

- Well Summary Sheet
- Borehole Log
- Log Data Report
- Photographic Log
- Final Survey Report

This page intentionally left blank.

WELL SUMMARY SHEET

Start Date: 4/02/2015
Finish Date: ~~4/27/2015~~ 4/28/15 ASG 9/10/15

Page 1 of 1

Well ID: C8950	Well Name: 699-95-45B
Location: 1400 m W of 100-H reactor	Project: 12 GW Wells in 100-HR-3 OU
Prepared By: Jessa Szecsody — Date: 5/27/15	Reviewed By: D. MEHRER — Date: 7-21-15
Signature:	Signature:

CONSTRUCTION DATA

Description

Concrete Pad: 0.5 ft above ground surface (ags)

8-in Protective Casing: 2.35 ft above concrete pad - 2.15 ft below ground surface (bgs)

Type I/II Portland Cement Grout: 0 - 10.05 ft bgs

Bentonite Crmbles: 10.05 - 13.85 ft bgs

3/8 in Cetco Coated Bentonite Pellet Seal: 13.85 - 15.8 ft bgs

6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 1.35 ft ags - 20.2 ft bgs

8-16 mesh Premier Colorado Silica Filter Pack Sand: 15.8 - 46.0 ft bgs

6-in I.D. Schedule 10, Type 304/304L, 50-slot (0.050 in.) Stainless Steel Screen: 20.2 - 40.2 ft bgs

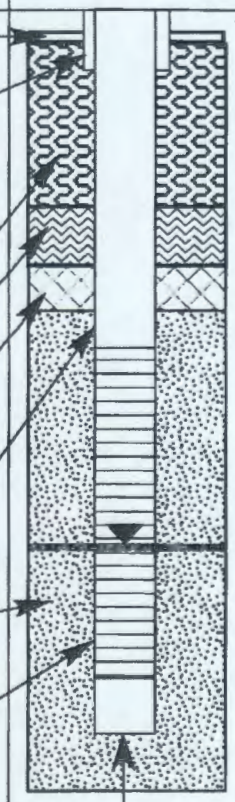
6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 40.2 - 43.2 ft bgs

Depths are in ft below ground surface.

Borehole drilled with 10 3/4-in O.D. casing from 0.0 - 46.3 ft bgs

All temporary drill casing was removed from the ground.

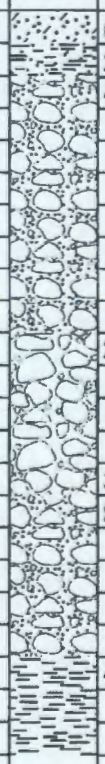
Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 10, 20, 30, 40, 50, 60, 70, 80

Graphic Log



Lithologic Description (ft bgs)

0 - 2 Gravel Pad; Fill
2 - 4 Sandy Silt (sM)
4 - 25 Sandy Gravel (sG)
25 - 30 Gravel (G)
30 - 40 Sandy Gravel (sG)
Static Water Level: 30.75 ft bgs (04/07/15)
40 - 46.3 Silt (M)
Total Depth: 46.3 ft bgs (04/07/15)

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 2
Date: 4/2 – 4/7/15

Well ID: C8950	Well Name: 699-95-45B	Location: 1400 m (W) of H REACTOR	
Project: 12 NEW WELLS IN 100-HR-3 OU		Reference Measuring Point: GROUND SURFACE	

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-2' PAD CONSTRUCTION GRAVEL	DECKER HAMMER
				2-4' SANDY SILT (SM) 40% S, 60% M	DRILL RIG, DUAL CASING
				10YR 5/3 BROWN WELL SORTED SA-A	WATER ADDED FOR
				70% QTZ-OTHER MODERATE HCl REN moist	DUST CONTROL FROM
				4-25 SANDY GRAVEL (SG) 65% G,	SURFACE ↓. DRILLER
5	G			30% S, TR-5% M. G-FN-C	ESTIMATES 1-2 GAL/FT
				PEBBLE MAX 70 mm 35% M AND 65% F.	ADVANCE
				SR-RND. SAND VC-F, SA-A WELL SORTED, poorly	ALL COLOR DESCRIPTIONS
				10 YR 5/3 BROWN OK HCl REN, moist, 65% felsic	ARE FROM MOIST,
				@ 10' SAND LESS COARSE	AS RECEIVED SAMPLES
10	G				UNLESS NOTED
15	G			@ 15' AS ABOVE, COLOR NOW	
				7.5 YR 5/2 AS RECEIVED, BROWN	
				GRAVEL COARSER TO V.C. PEBBLE	
20	G			@ 20 G NOW FP-SM COBBLE	
				MAX 200 MM	
				25-30'	
25	G			@ 25 (G) GRAVEL 80% G, 20% S.	
				M PEB-VCP MAX 100 mm SR-R	
				35% M, 65% FELSIC WELL SORTED	
				SAND VC-M, SA-A WELL SORTED, 65% felsics	
				7.5 YR 5/2 BROWN, moist, no rxn w/HCl	
30	G	30.75 ▼		@ 30-40 (SG), 70% G, 30% S	
				REST OF DESCRIPTION AS ABOVE	WL = 30.75' BGS
					4/7/15
		WATER SAMPLE			B30JM3, B30JM5
35	G			@ 35' AS ABOVE	WATER SAMPLE
		36.2			SPLIT SPOON B30JL6
		50% recovery ↑ 35			
		38.5			

Reported By: GREG KASZA		Reviewed By: Kevin Bergstrom	
Title: GEOLOGIST		Title: Sr. Geologist	
Signature: [signature]	Date: 4/7/15	Signature: [signature]	Date: 7/23/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 2

Date: 4/7/15

Well ID: C8950 | Well Name: 699-95-45B | Location: 1400 m W. of H Reactor

Project: 12 New Well in 100-HR-3 OU | 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
40	G			(M) 40' MUD (CLAY) 10YR 6/3	RUM Contact @
				PALE BROWN NO HCl RXN	40' BGS.
				MOIST LOW PLASTIC	Becker Hammer w/
				40-46.3'	10 3/4" dual casing
45	G			46.30 TD ~~SM~~ S-10% ~~M~~ F-20%	SILT, MUD.
				S-VFS-FS MOSTLY VFS SA-A 100% FERRIL, QTZ	46.3 TD (4/7/15)
				M WK HCl RXN MOIST NON PLASTIC	10 3/4" casing @ 46.3' bgs
				TR MICA 7.5YR BROWN	DTW = 30.75' bgs (4/7/15)
50					

Not used 4/9/15

Reported By: Greg Kaza | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: [signature] Date: 4/7/15 | Signature: [signature] Date: 7/23/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

699-95-45B (C8950)
Log Data Report

Borehole Information:

Log Date:	2015-04-08	Filename:	C8950_HG-NM_2015-04-08	Site:	100 H
Coordinates (WA St Plane)		DTW[1] (ft) :	44.6	DTW Date:	04/08/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	04/07/15	N/A	46.3	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0.6	8 1/2	8	1/4	0.6	46.3
Threaded Steel	0.35	10 3/4	9 1/2	5/8	0.35	46.3

Borehole Notes:

The onsite geologist provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). The drilling method employs a double wall drive pipe where compressed air is forced down the outer casing and geologic material is returned to the surface inside the inner casing. On April 8, 2015, water inside the casing was measured at 44.6 ft by the logging engineer using an e-tape. The maximum logging depth achieved was 45 ft.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1L	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	11/12/14	Serial No.:	47-TP32211A
Calibration Reference:	HGLP-CC-111, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 1H	Type:	NMLS[4]
Effective Calibration Date:	11/13/14	Serial No.:	H310700352
Calibration Reference:	HGLP-CC-112, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	2	3 Repeat			
HEIS Number	1018675	1018676			
Date	04/08/15	04/08/15			
Logging Engineer	Pope	Pope			
Start Depth (ft)	0.0	33.0			
Finish Depth (ft)	45.0	38.0			

[1] depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

Stoller Newport News Nuclear

Log Run	2	3 Repeat			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AL244CAB	AL244CAB			
Start File	AL244000	AL244046			
Finish File	AL244045	AL244051			
Post-Verification	AL244CAA	AL244CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	No fine gain adjustments made	No fine gain adjustments made			

NMLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1018677	1018678			
Date	04/08/15	04/08/15			
Logging Engineer	Pope	Pope			
Start Depth (ft)	0.0	28.0			
Finish Depth (ft)	44.5	32.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AH203CAB	AH203CAB			
Start File	AH203000	AH203179			
Finish File	AH203178	AH203195			
Post-Verification	AH203CAA	AH203CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	None	None			

Logging Operation Notes:

A centralizer was installed on the sondes.

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Analysis Notes:

Analyst:	P.D. Henwood	Date:	04/20/15	Reference:	HGLP-MAN-003, Rev. 0

A combined casing correction for a 0.875-in. thick casing (0.25+0.625-in. for the 1/4- and 5/8-in. thick casings) was applied to the log data. No correction was applied for the casing joints which are in excess of 1.15-in. and occur at approximately 10-ft intervals.

A correction for water was applied below 44 ft in depth.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 1L20141112, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

NMLS data are reported in count per second as there is no calibration for conversion to volumetric moisture for a casing diameter greater than 8-in.

The HGU[5] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected in the borehole. MDLs for Cs-137 and Pu-239 are plotted for the entire borehole.

The relatively thick casing joints beginning at 5 ft and occurring at 10 ft intervals are indicated by reduced count rates on the total gamma log.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

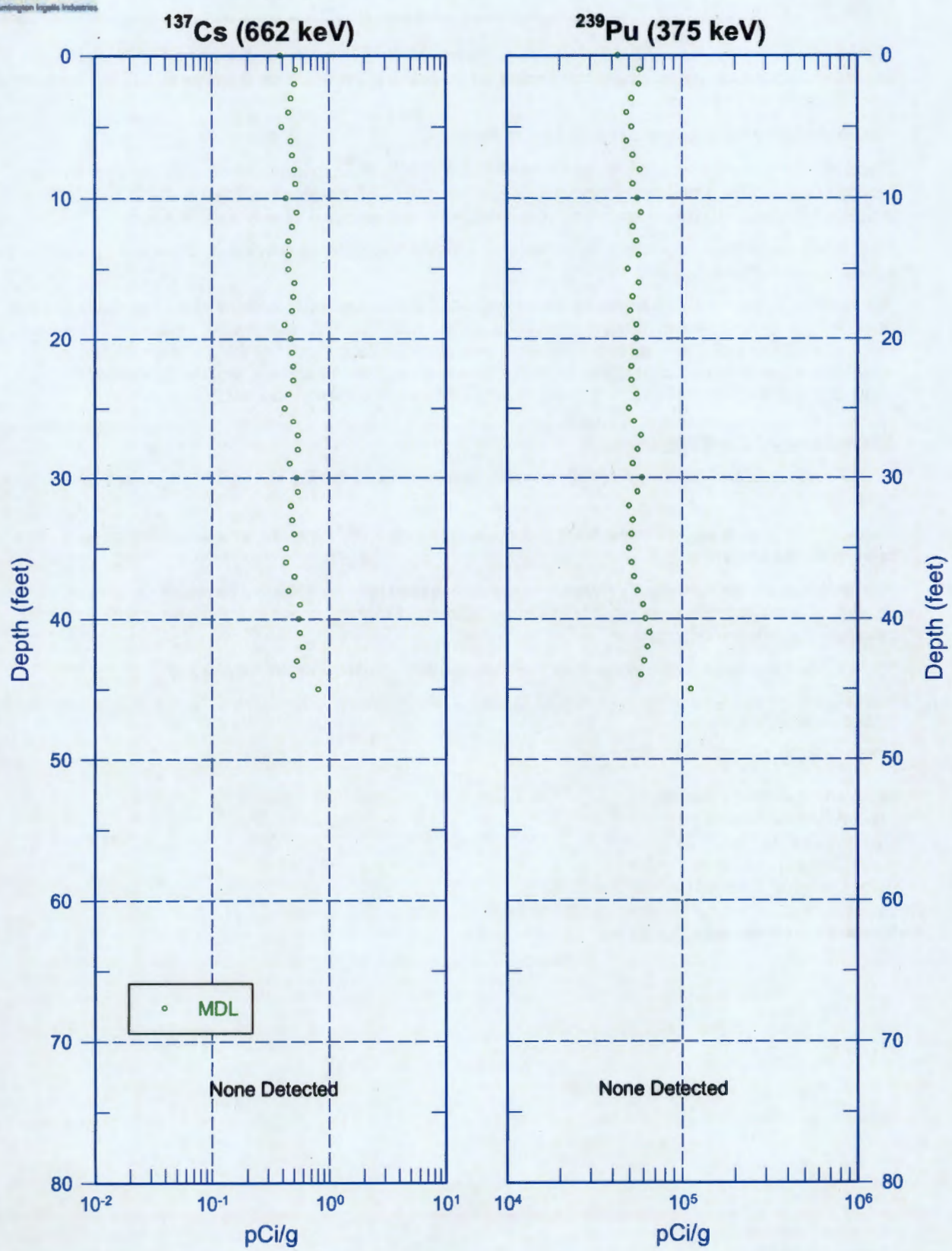
List of Log Plots:

Depth Reference is ground surface.

Manmade Radionuclides (0-80 ft)
Natural Gamma Logs (0-80 ft)
Combination Plot (0-120 ft)
Total Gamma & Moisture (0-80 ft)
Total Gamma & Hanford Gamma Unit (0-80 ft)
Repeat Section of Natural Gamma Logs (33 to 38 ft)
Moisture Repeat Section (28 to 32 ft)

[5] Hanford Gamma Unit

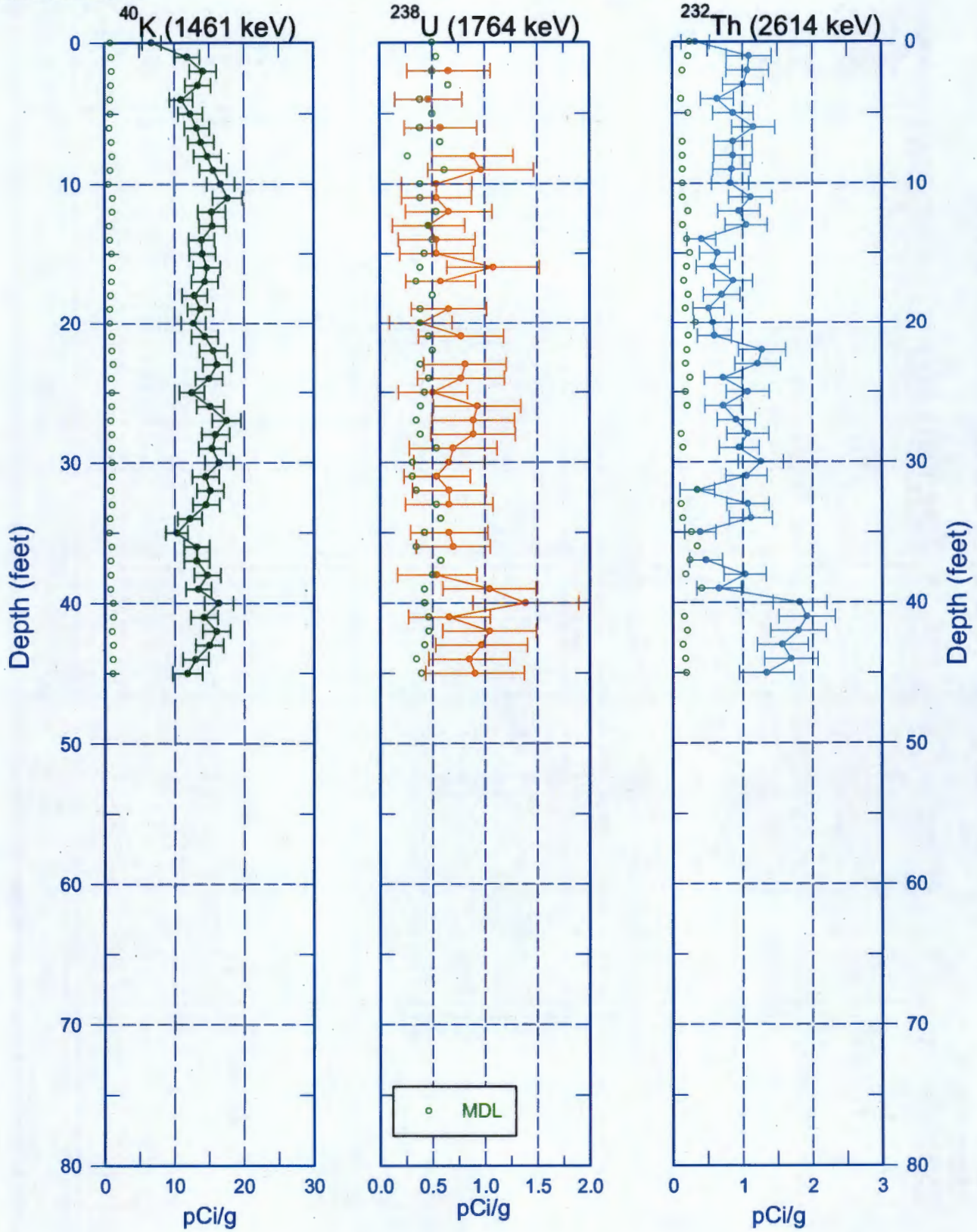
699-95-45B (C8950)
Manmade Radionuclides



Zero Reference - Ground Surface

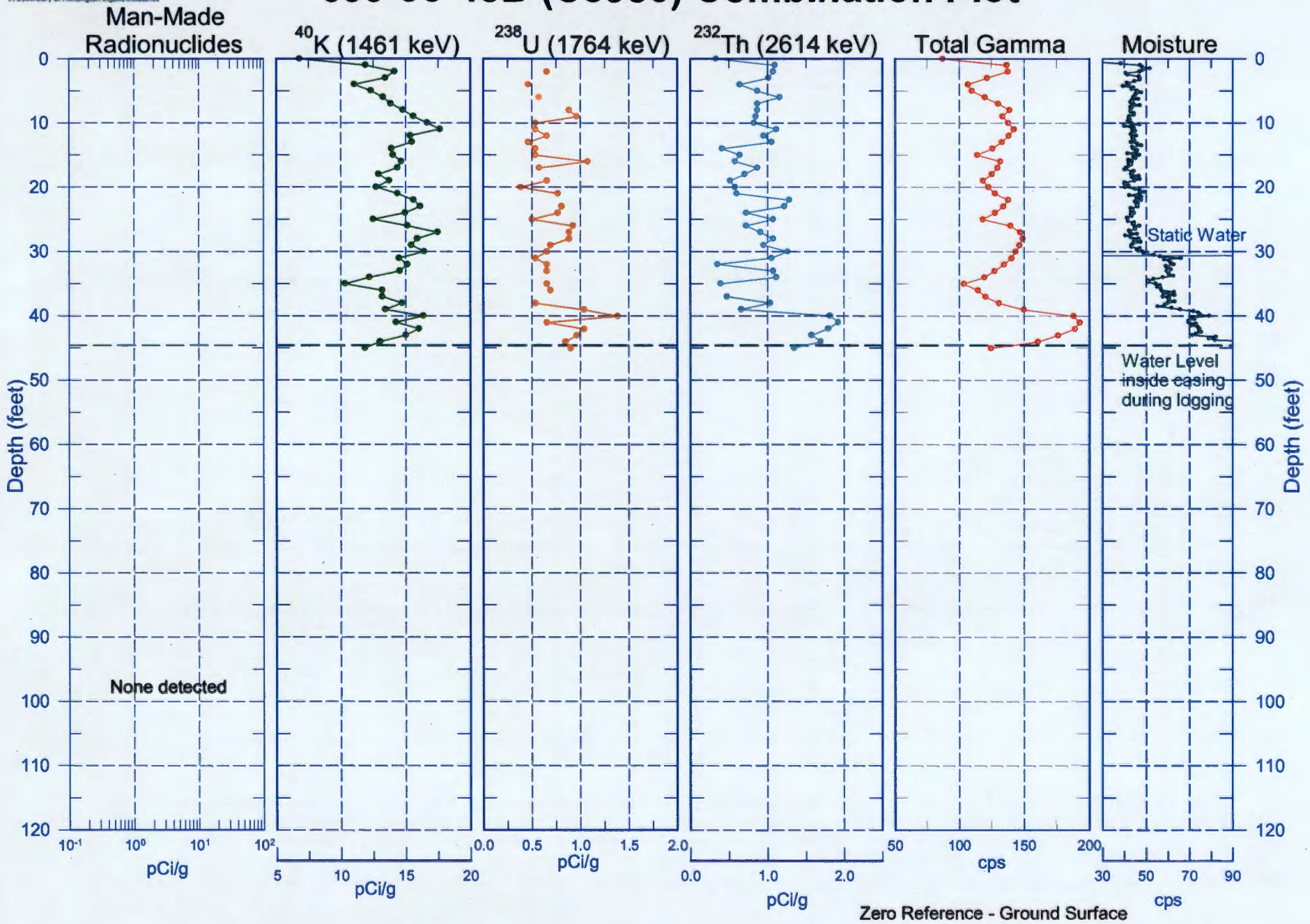
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

699-95-45B (C8950)
Natural Gamma Logs

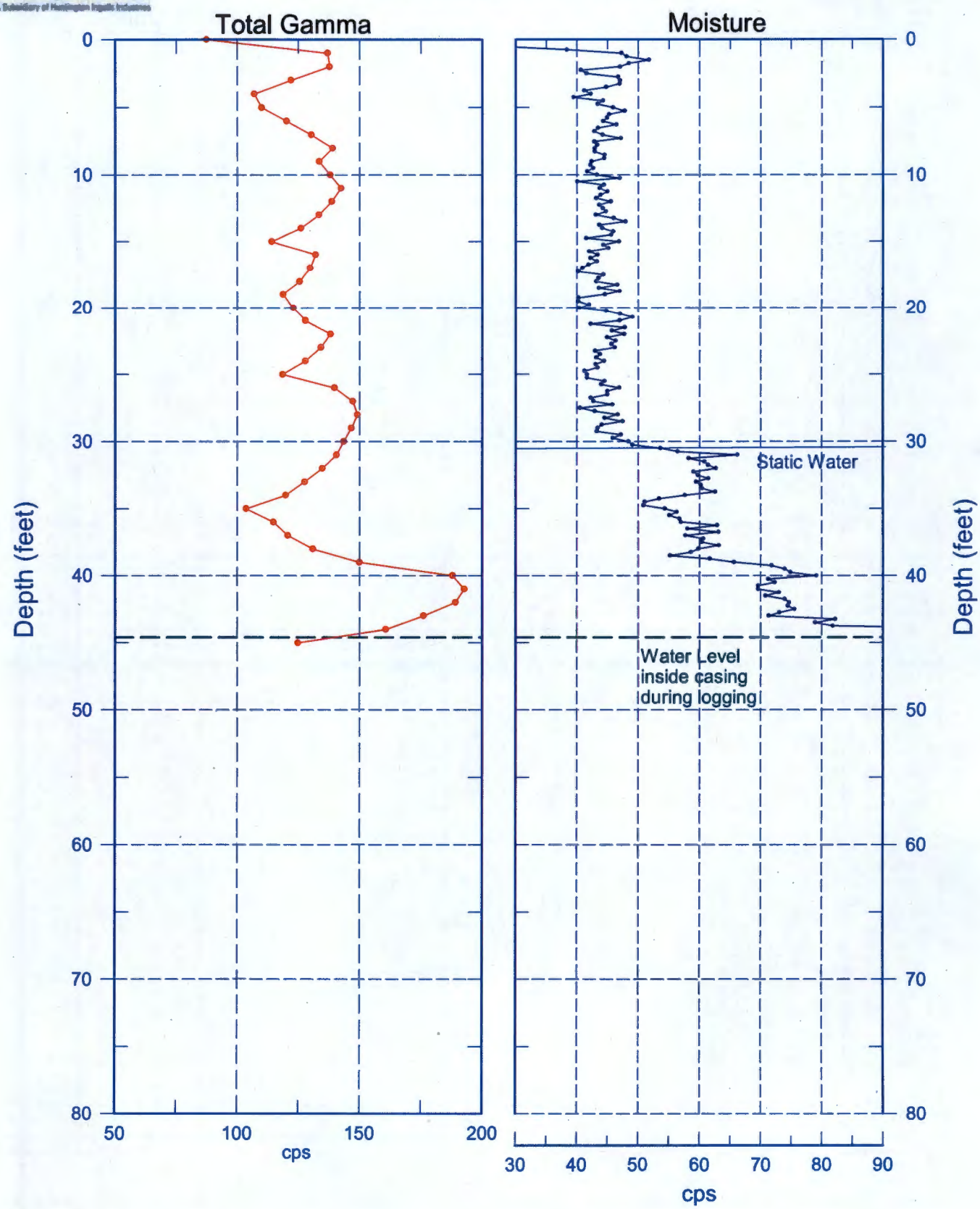


Zero Reference - Ground Surface

699-95-45B (C8950) Combination Plot

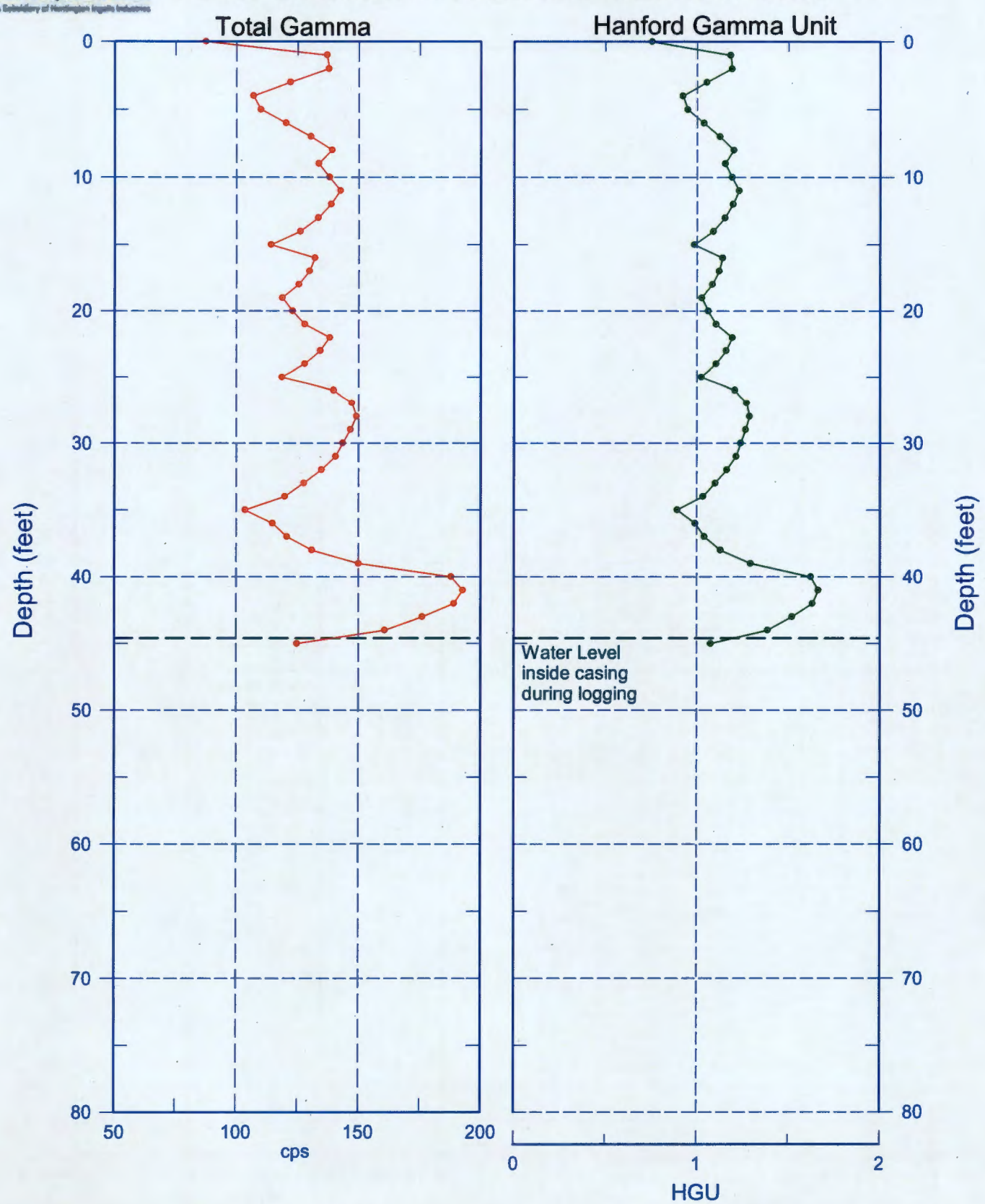


699-95-45B (C8950)
Total Gamma & Moisture



Reference - Ground Surface

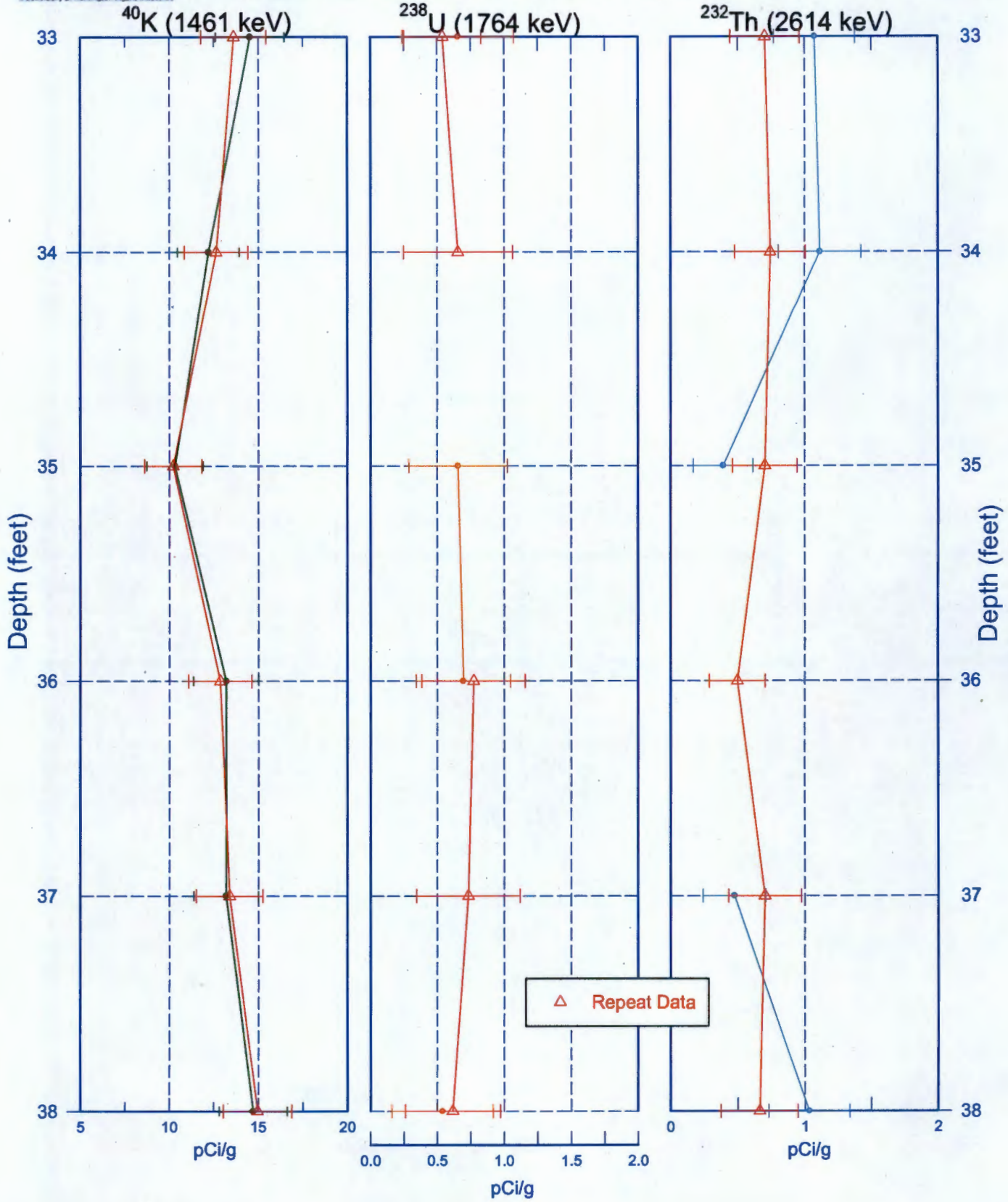
699-95-45B (C8950)
Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

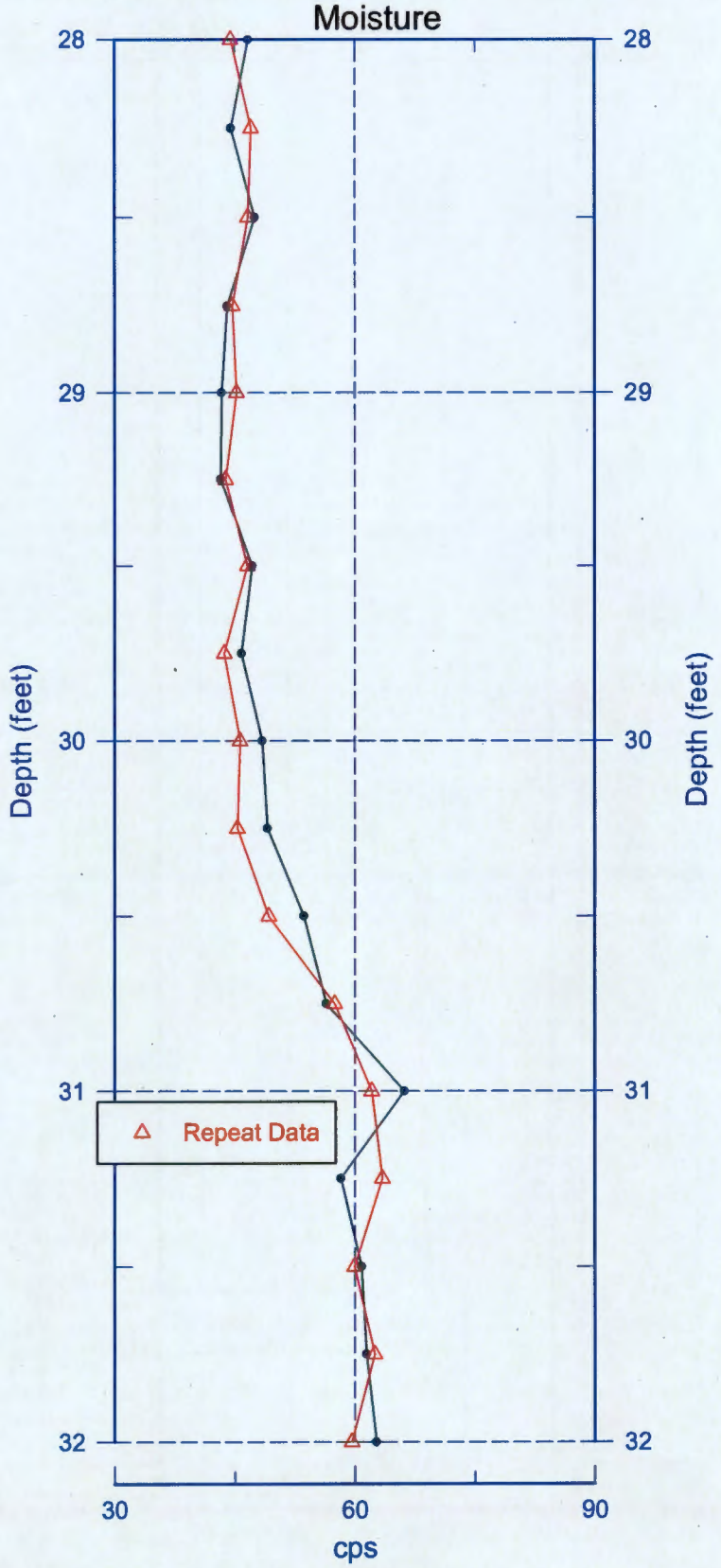
699-95-45B (C8950)
Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

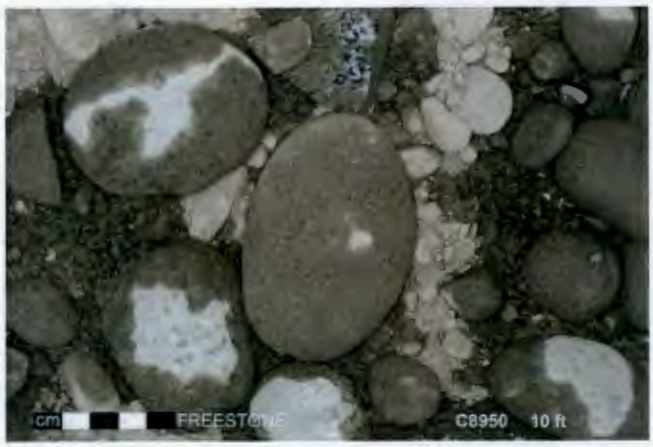
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

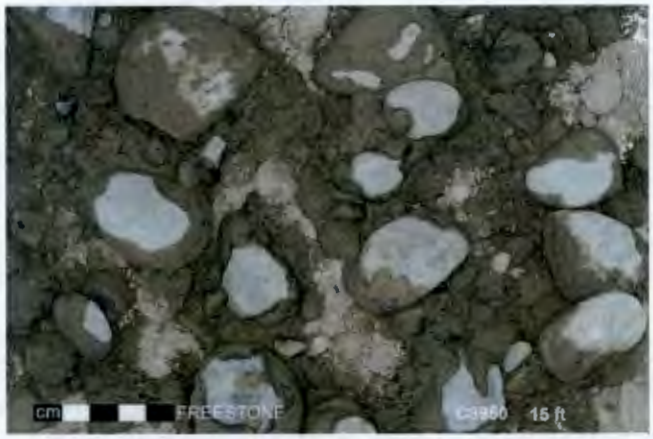
699-95-45B (C8950)
Moisture Repeat Section



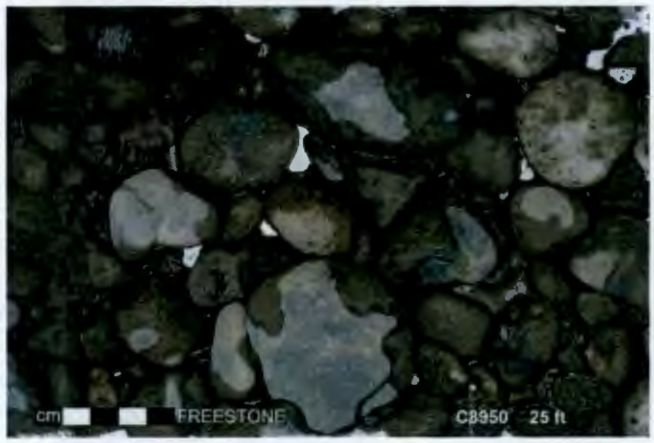
Reference - Ground Surface

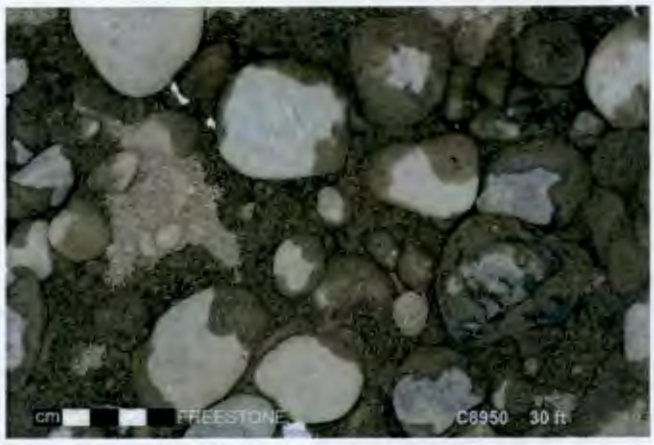
cm
FREESTONE
C8950 5 ft

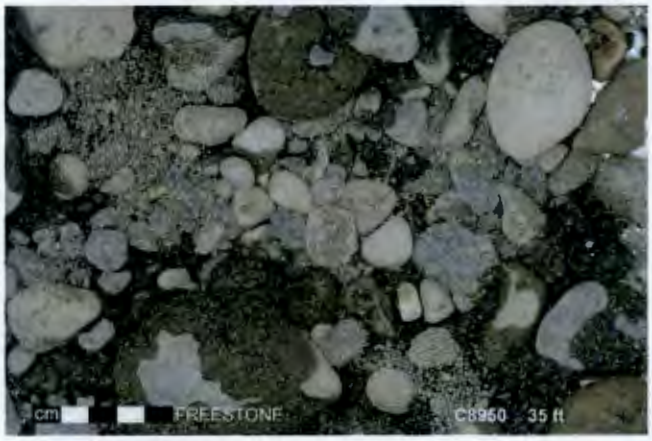

cm
FREESTONE
C8950 10 ft


cm
FREESTONE
C8950 15 ft

cm
FREESTONE
C8950 20 ft


cm
FREESTONE
C8950 25 ft


cm
FREESTONE
C8950 30 ft


cm
FREESTONE
C8950 35 ft

cm
FREESTONE
C8950 40 ft

cm
FREESTONE
C8950 46 ft

SURVEY DATA REPORT

Request No.	Project No.	Title	File No.
153-114		HR-3 Well C8950 (699-95-45B) Final Survey	6AT14R26

Job. No.	Prepared By	Date	Reviewer
CACN: 303594-JPRC	N.P. Fastabend	6/2/15	LBM

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casing) and elevations of completed HR-3 Well C8950 (699-95-45B) located west of 100H Area.	Survey File	OR		
	J.D. Mehrer	1		
	K.M. Whitley	1		
	J.L. Smoot	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheet

A-6006-495 (REV 0)

WELL SURVEY DATA REPORT

Project:	Prepared By: Neil P. Fastabend Company: CHPRC
Date Requested: 05/13/15	Requestor: Jim Mehrer (CHPRC)
Date of Survey: 06/02/15	Surveyor: Lawrence B. Munnell (CHPRC)
Fluor Hanford Point of Contact:	Survey Co. Point of Contact: Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of HR-3 Well C8950 (699-95-45B) located west of 100H Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 600A

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
G49 (COE) and HSWB-030 (CHPRC)

Well ID	Well Name	Easting	Northing	Elevation	
C8950	699-95-45B	576365.99	152780.01		Center of Casing
				127.542	"X" on Rim
				126.814	Brass Survey Marker

Notes:

127.239 Top Inner Casing, North Edge

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

6-2-15

Appendix I

Well Documentation for C8951 (199-H6-8)

- Well Summary Sheet
- Borehole Log
- Log Data Report
- Photographic Log
- Final Survey Report

This page intentionally left blank.

WELL SUMMARY SHEET	Start Date: 3/31/2015 Finish Date: ~~4/15/2015~~	Page 1 of 1
Well ID: C8951	Well Name: 199-H6-8 4/16/15 RAG 4/16/15	
Location: 700 m SSE of H Reactor	Project: 12 GW Wells in 100-HR-3 OU	
Prepared By: Jessa Szecsody — Date: 5/26/15	Reviewed By: J.D. MEHRER — Date: 7-21-15	
Signature:	Signature:	

CONSTRUCTION DATA

Description

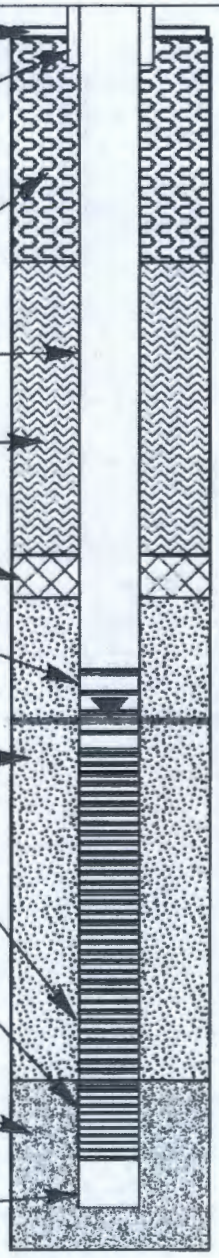
- Concrete Pad: 0.5 ft above ground surface (ags)
- 8-in Protective Casing: 2.37 ft above concrete pad - 2.13 ft below ground surface (bgs)
- Type I/II Portland Cement Grout: 0 - 14.1 ft (bgs)
- 6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 1.78 ft ags - 39.38 ft bgs
- Cetco Medium Bentonite Granulars: 14.1 - 33.1 ft bgs
- 3/8 in Cetco Coated Bentonite Pellet Seal: 33.1 - 34.5 ft bgs
- 6-in I.D. Schedule 10, Type 304/304L, 70-slot (0.070 in.) Stainless Steel Screen: 39.38 - 44.38 ft bgs
- 6-12 mesh Premier Colorado Silica Filter Pack Sand: 34.5 - 64.3 ft bgs
- 6-in I.D. Schedule 10, Type 304/304L, 75-slot (0.075 in.) Stainless Steel Screen: 44.38 - 64.39 ft bgs
- 6-in I.D. Schedule 10, Type 304/304L, 50-slot (0.050 in.) Stainless Steel Screen: 64.39 - 69.4 ft bgs
- 8-16 mesh Premier Colorado Silica Filter Pack Sand: 64.3 - 74.6 ft bgs
- 6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 69.4 - 72.4 ft bgs

Depths are in ft below ground surface.

Borehole drilled with 10 3/4-in O.D. casing from 0.0 - 74.61 ft bgs

All temporary drill casing was removed from the ground.

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
0		0 - 38 Sandy Gravel (sG)
10		
20		
30		
40		38 - 41 Gravelly Sand (gS) 41 - 69.5 Sandy Gravel (sG) Static Water Level: 42.01 ft bgs (04/14/15)
50		
60		
70		69.5 - 74.6 Silt (M)
80		Total Depth: 74.61 ft bgs (4/9/15)

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 2
Date: 3/31 – 4/1/15

Well ID: C8951	Well Name: 199-H6-8	Location: 700 M SSE OF H. REACTOR	
Project: 12 NEW WELLS @ 100 HR 3 OV		Reference Measuring Point: G.S.	

Depth (FL)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-38' SANDY GRAVEL SG	BECKER HAMMER
				G-60%, 40% S, TR M, G-30%	LAYNE AP 1000
				2-40 MM VFP-VCP, 40% M-COARSE SR-R POORLY SORTED	DUAL CONCENTRIC CASING
				SAND F-C AND C. WELL SORTED, SA-A,	10 3/4" OD
				40% MAFIC, 60% QTZ/OTHER, 10YR 5/3	DRILLER ADDING
				BRN (AS RECEIVED) MOIST, 10YR 6/3	1-2 GAL/FT WATER
5	G			PALE BRN WHEN AIR DRIED, WK HCl RXN	FOR DUST SUPPRESSION
				@ 10' G 70%, 30% S MAX G	
				= 150 MM	
10	G				
15	G			@ 15' NOW 7.5 YR 5/1 GRAY	
				NO HCl RXN	
20	G			@ 20' AS ABOVE	
25	G			@ 25' G MORE COARSE MAX 200 MM	
30	G			@ 30' G LESS COARSE MAX 150 MM	
35	G			@ 35' G = 50%, 50% S, TR M	
				DESCRIPTION SAME AS ABOVE	
				38' – 41' GRAVELY SAND GS 20% G	
38				80% S, TR M. G – FAI POR, MAX 20	
				MM, 60% M – 40% F WELL SORTED, RND	

Reported By: GREG KASZA		Reviewed By: KEVIN Bergstrom	
Title: GEOLOGIST		Title: Sr. Geologist	
Signature: [signature]	Date: 4/2/15	Signature: [signature]	Date: 4-29-15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 2
Date: 4/2/15

Well ID: C8951 | Well Name: 199-H6-8 | Location: 700 m SSE of H Reactor

Project: 12 New Wells @ 100 HR-3 OU | 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
40'	G			S= SA-SR F-C 60% Qtz Other	
				40% Mafic, Well Sorted 7.5YR 5/1	
				Gray	
		43.75		4/2 -69.5' Sandy Gravel (SG)	
				G-40% 60% S G-F-C Poor	
45'	G			Max 70mm SR-SA Poor Sorted	
		45.6		S-As Above 10YR 5/2 Grayish	45.6-48.1' BGS Split
		SS		Brown - No HCl rxn	Spoon B30JD7
					GW Sample B30JH0E1
	G.W	48.1			Borehole @49.6
50'	G			@ 50' As Above G max 100 mm	
55'	G			@ 55' SG 75% G, S-25%, Tr M	
				G- FN Peb-Sm Cob max 200 mm	
		57.1		60% Mafic 40% Felsic SR-R Poor	57.1-59.6 Split Spoon
		SS		Sorted. S - 40% Mafic 60% Qtz/	B30JB8 50% Rec.
				Other F-C Well Sorted 10YR 5/2	GW Sample B30JH2E3
60'	G.W. SG	59.6		Grayish Brown No HCl rxn	Borehole @59.6
				@60' As Above	
65'	G			@ 65' G-Max 250 mm	- Boulder plugged Cyclone on drill rig
69.5				69.5 to 73.7' BGS M 100%	
70'	G			(Rum) 10YR 5/3 Brown, Moist	
				No HCl rxn Low-Mod Plasticity	KAB 4/2/15
					WT 43.75
73.6	G				
75'			73.7 TD		

Reported By: Greg L. Kaser		Reviewed By: Kevin Bergstrom	
Title: Geologist		Title: Sr Geologist	
Signature: [signature]	Date: 4/2/15	Signature: [signature]	Date: 4-29-15

A-6003-642 (03/03)

Stoller Newport News Nuclear

199-H6-8 (C8951)
Log Data Report

Borehole Information:

Log Date:	2015-04-02	Filename:	C8951_HG-NM_2015-04-02	Site:	100 H
Coordinates (WA St Plane)		DTW[1] (ft):	44.3	DTW Date:	04/02/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	04/01/15	N/A	73.7	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	2.95	8 5/8	8	1/4	2.95	73.7
Threaded Steel	3.2	10 5/8	9	13/16	3.2	54.6

Borehole Notes:

The onsite geologist provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). The drilling method employs a double wall drive pipe where compressed air is forced down the outer casing and geologic material is returned to the surface inside the inner casing. On April 2, 2015, water inside the casing was measured at 44.3 ft by the logging engineer using an e-tape. The maximum logging depth achieved was 73 ft.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1L	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	11/12/14	Serial No.:	47-TP32211A
Calibration Reference:	HGLP-CC-111, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 1H	Type:	NMLS[4]
Effective Calibration Date:	11/13/14	Serial No.:	H310700352
Calibration Reference:	HGLP-CC-112, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1018671	1018672			
Date	04/02/15	04/02/15			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	0.0	64.0			
Finish Depth (ft)	73.0	71.0			

[1] depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

Stoller Newport News Nuclear

Log Run	1	2 Repeat			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AL243CAB	AL243CAB			
Start File	AL243000	AL243074			
Finish File	AL243073	AL243081			
Post-Verification	AL243CAA	AL243CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	No fine gain adjustments made	No fine gain adjustments made			

NMLS Log Run Information:

Log Run	3	4 Repeat			
HEIS Number	1018673	1018674			
Date	04/02/15	04/02/15			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	0.0	37.0			
Finish Depth (ft)	43.5	43.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AH202CAB	AH202CAB			
Start File	AH202000	AH202175			
Finish File	AH202174	AH202199			
Post-Verification	AH202CAA	AH202CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	None	None			

Logging Operation Notes:

A centralizer was installed on the sondes.

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Analysis Notes:

Analyst:	P.D. Henwood	Date:	04/16/15	Reference:	HGLP-MAN-003, Rev. 0

A combined casing correction for a 1.0625-in. thick casing (0.25+0.8125-in. for the 1/4- and 13/16-in. thick casings) was applied to the log data. No correction was applied for the casing joints which are in excess of 1.15-in. and occur at approximately 10-ft intervals.

A correction for water was applied below 44 ft in depth.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 1L20141112, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

NMLS data are reported in count per second as there is no calibration for conversion to volumetric moisture for a casing diameter greater than 8-in.

The HGU[5] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected in the borehole. MDLs for Cs-137 and Pu-239 are plotted for the entire borehole.

The relatively thick casing joints beginning at 2 ft and occurring at 10 ft intervals are indicated by reduced count rates on the total gamma log. The moisture count rate also appears to indicate the effect of casing joints.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

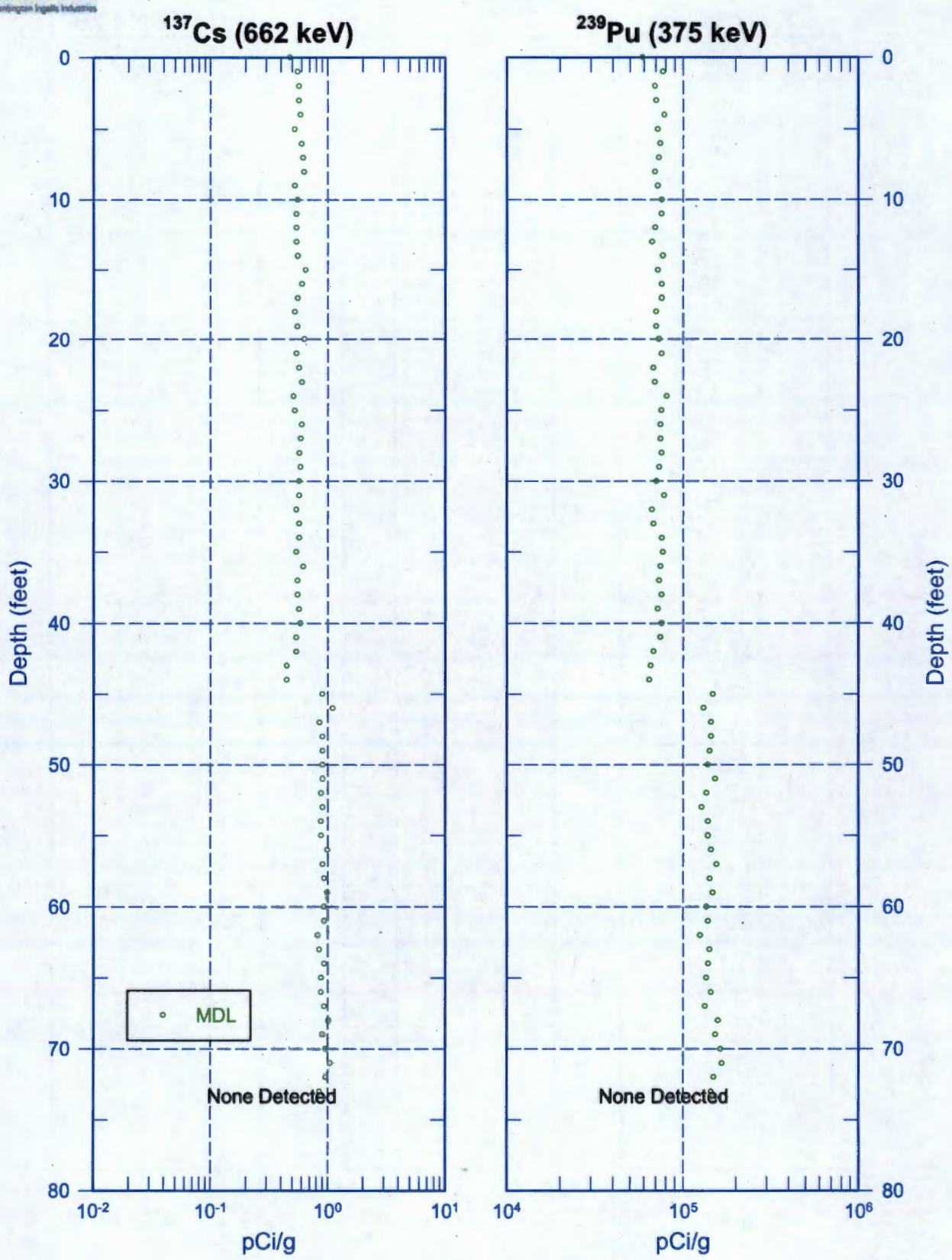
List of Log Plots:

Depth Reference is ground surface.

Manmade Radionuclides (0-80 ft)
Natural Gamma Logs (0-80 ft)
Combination Plot (0-120 ft)
Total Gamma & Moisture (0-80 ft)
Total Gamma & Hanford Gamma Unit (0-80 ft)
Repeat Section of Natural Gamma Logs (64 to 71 ft)
Moisture Repeat Section (37 to 43 ft)

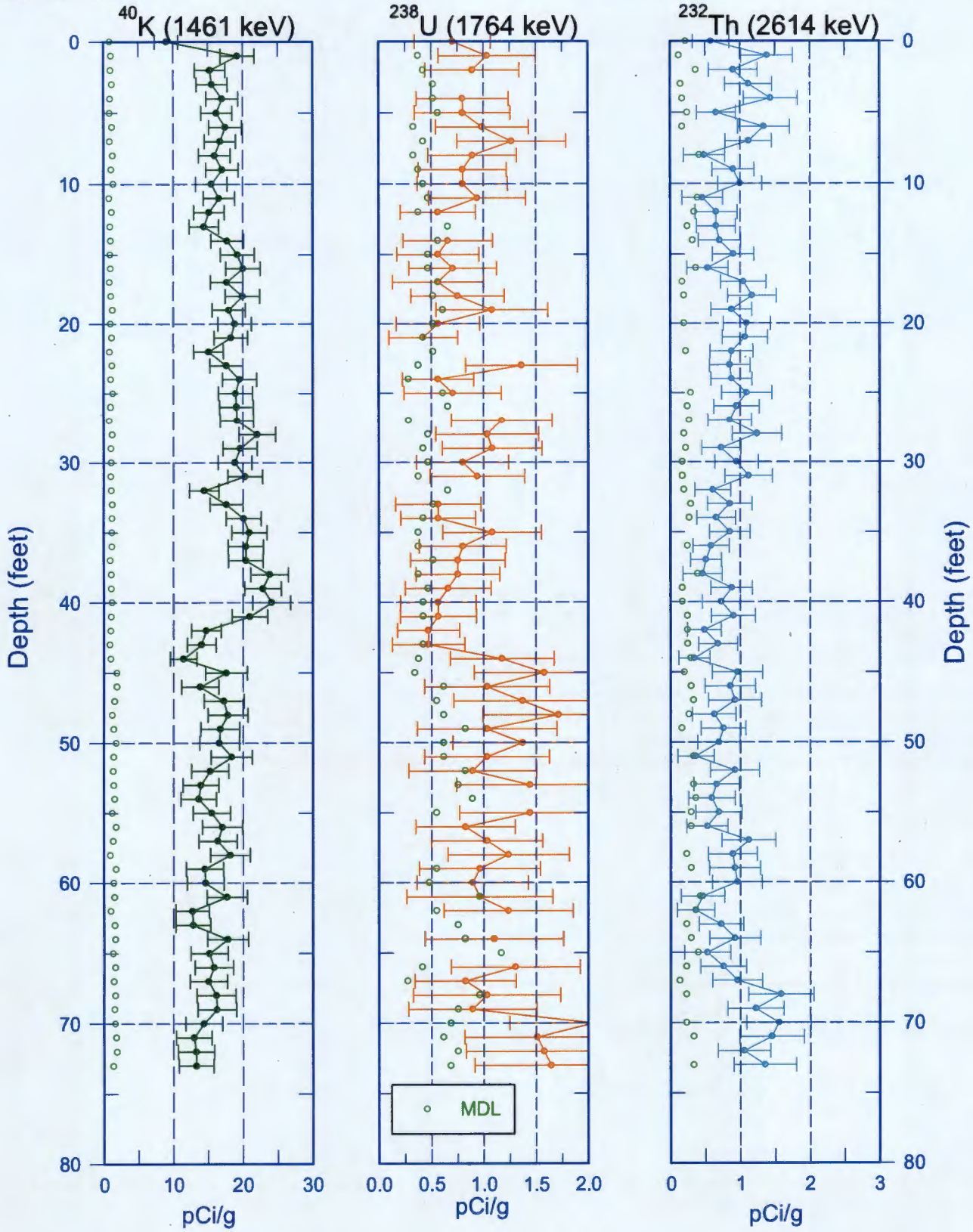
[5] Hanford Gamma Unit

199-H6-8 (C8951)
Manmade Radionuclides



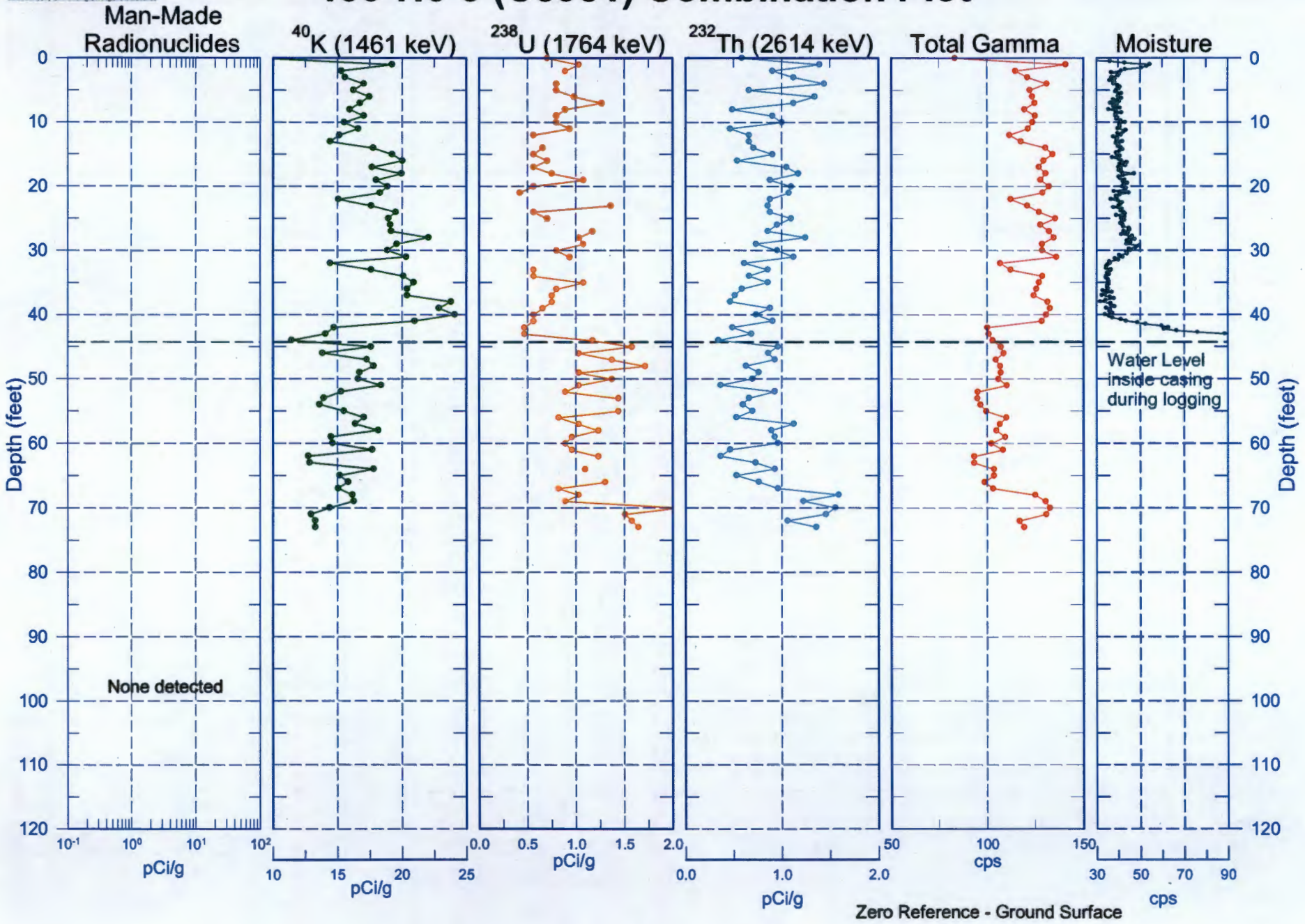
Zero Reference - Ground Surface

199-H6-8 (C8951)
Natural Gamma Logs

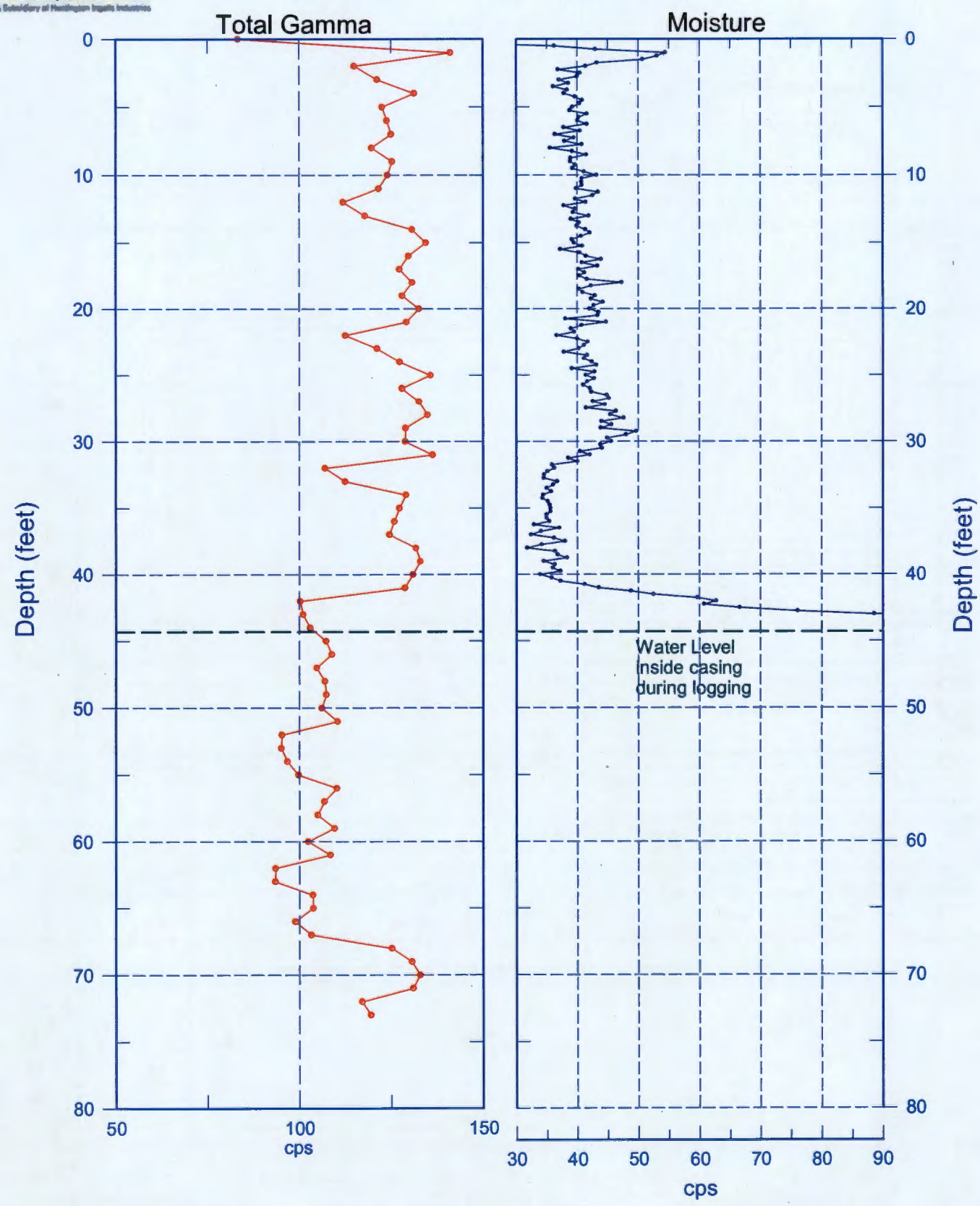


Zero Reference - Ground Surface

199-H6-8 (C8951) Combination Plot



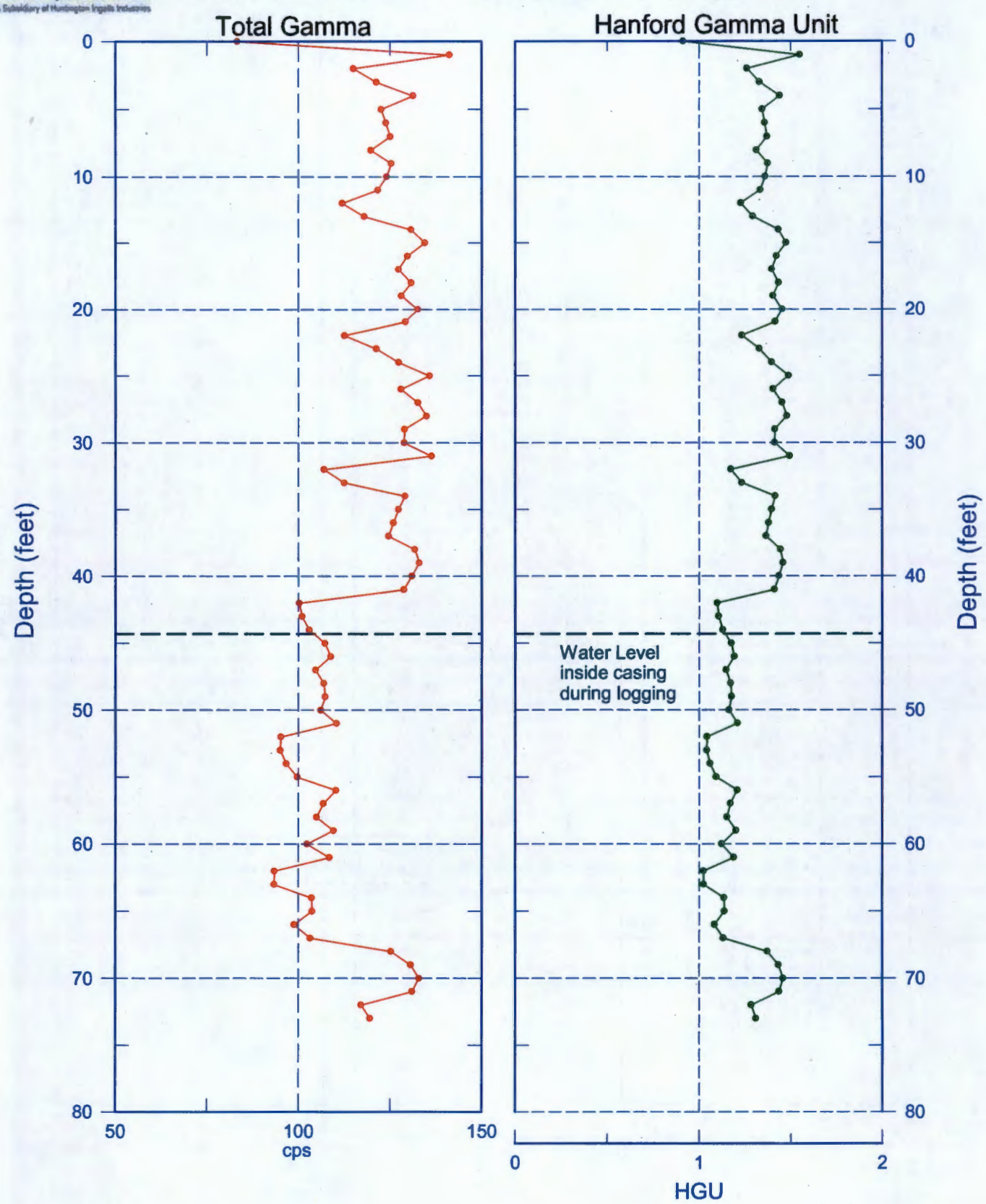
199-H6-8 (C8951)
Total Gamma & Moisture



Reference - Ground Surface

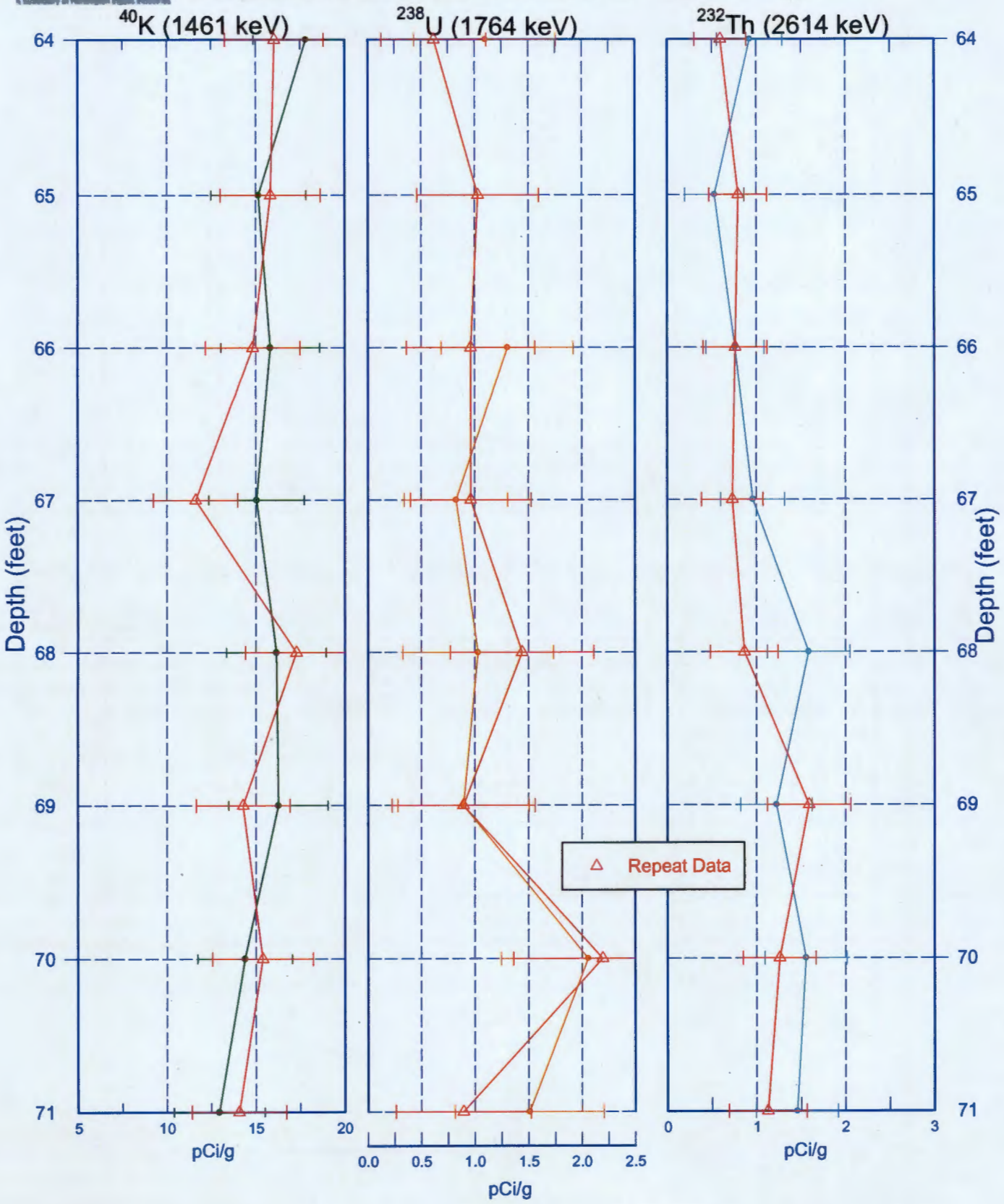
199-H6-8 (C8951)

Total Gamma & Hanford Gamma Unit



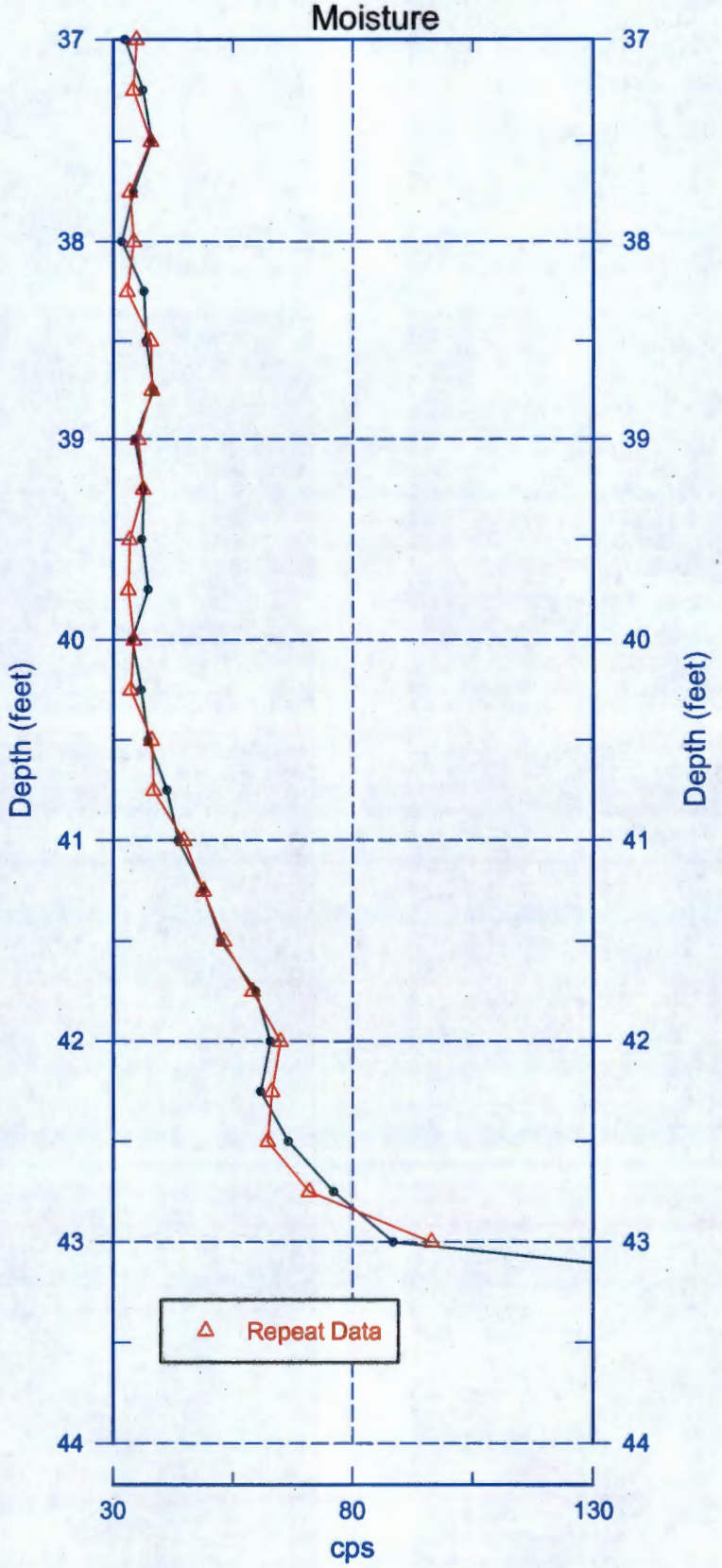
Reference - Ground Surface

199-H6-8 (C8951)
Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

199-H6-8 (C8951)
Moisture Repeat Section

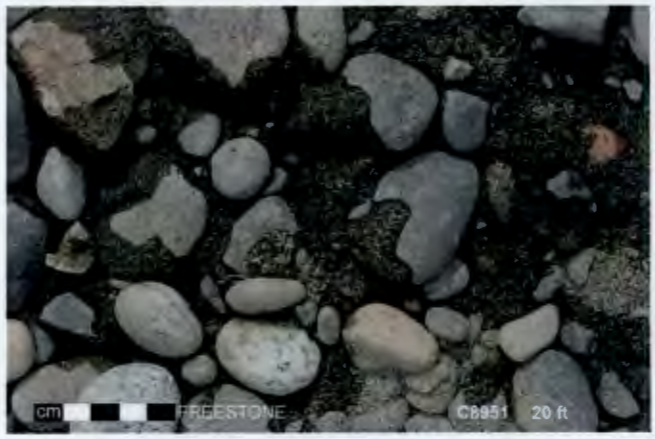


Reference - Ground Surface

cm
FREESTONE
C8951 5 ft

cm
FREESTONE
C8951 10 ft

cm
FREESTONE
C8951 15 ft


cm
FREESTONE
C8951 20 ft

cm
FREESTONE
C8951 25 ft

cm
FREESTONE
C8951 30 ft

cm
FREESTONE
C8951 35 ft

cm
FREESTONE
C8951 40 ft

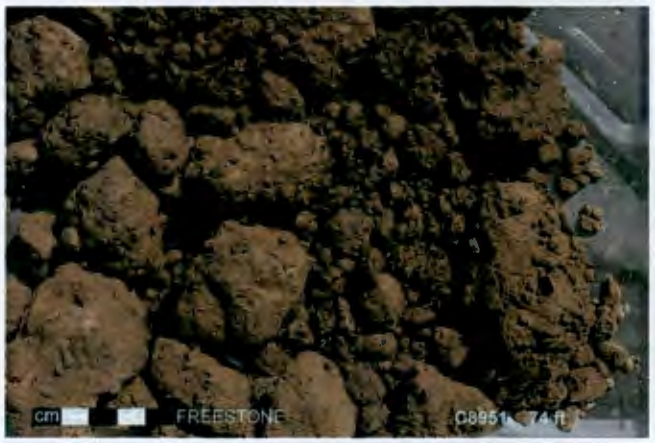
cm
FREESTONE
C8951 45 ft

cm
FREESTONE
C8951 50 ft

cm
FREESTONE
C8951 55 ft

cm
FREESTONE
C8951 60 ft

cm
FREESTONE
C8951 70 ft


cm
FREESTONE
C8951 74 ft

SURVEY DATA REPORT				Request No. 153-100
Project No.	Title HR-3 Wells C8947 and C8951 Final Surveys			File No. 1HT14R27
Job. No. CACN: 303413-JPRC	Prepared By N.P. Fastabend	Date 5/14/15	Reviewer LBM	

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casings) and elevations of completed Wells C8947 (199-H6-7) and C8951 (199-H6-8) at 100H Area.	Survey File	OR		
	J.D. Mehrer	1		
	K.M. Whitley	1		
	J.L. Smoot	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheets

WELL SURVEY DATA REPORT

Project:	Prepared By: Neil P. Fastabend Company: CHPRC
Date Requested: 4/23/15	Requestor: Kelly Whitley (CHPRC)
Date of Survey: 5/14/15	Surveyor: Lawrence B. Munnell (PLS)
Fluor Hanford Point of Contact:	Survey Co. Point of Contact: Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of Well C8951 (199-H6-8) at 100H Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 100H

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
HSWB-029 (COE) and HSWB-030 (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C8951	199-H6-8	578205.59	151928.15		Center of Casing
				129.389	"X" on Rim
				128.667	Brass Survey Marker

Notes:

129.054 Top Inner Casing, North Edge

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify that this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

5-14-15

A-6003-659 (04/03)

Appendix J

Well Documentation for C9377 (199-D5-159)

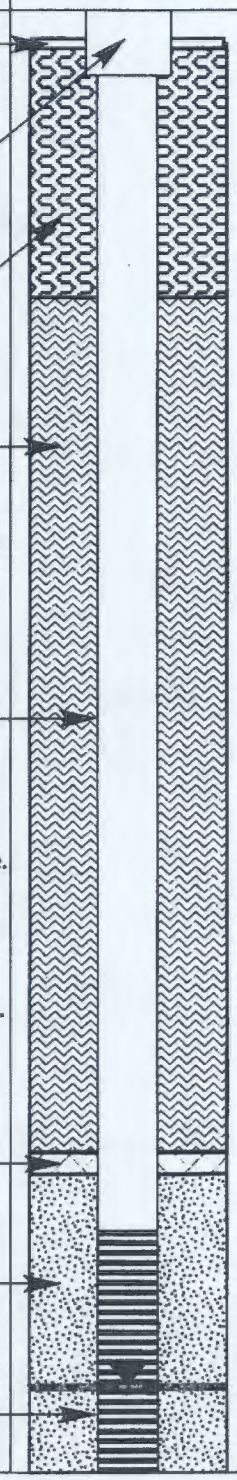
- Well Summary Sheet
- Borehole Log
- Log Data Report
- Photographic Log
- Final Survey Report

This page intentionally left blank.

WELL SUMMARY SHEET	Start Date: 3/2/2015 Finish Date: ~~3/17/2015~~	Page 1 of 2
Well ID: C9377	Well Name: 199-D5-159 3/23/15 RSG 7/16/15	
Location: 500m NW of 100D reactor	Project: 12 GW Wells in HR-3 OU	
Prepared By: Joshua Holland — Date: 4/3/15	Reviewed By: J.D. MEHRER — Date: 7-21-15	
Signature:	Signature:	

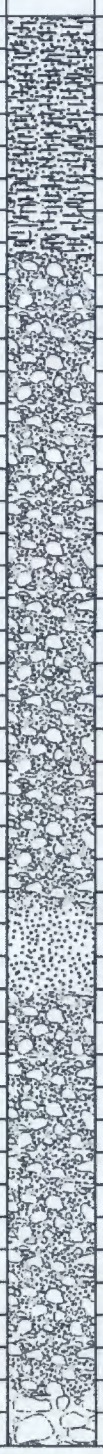
CONSTRUCTION DATA

Description	Diagram
Concrete Pad: 0.5 ft above ground surface (ags)	
8-in Protective Casing: 2.50 ft above concrete pad - 2.0 ft below ground surface (bgs)	
Type I/II Portland Cement Grout: 0 - 15.7 ft bgs	
3/8 in Cetco Medium Bentonite Chips: 15.7 - 68.5 ft bgs	
6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.01 ft ags - 73.68 ft bgs	
Depths are in ft below ground surface. Borehole drilled with 10 3/4-in O.D. casing from 0.0 - 106.5 ft bgs. All temporary drill casing was removed from the ground.	
3/8 in Cetco Coated Bentonite Pellet Seal: 68.5 - 69.8 ft bgs	
6-12 mesh Premier Colorado Silica Filter Pack Sand: 69.8 - 106.5 ft bgs	
6-in I.D. Schedule 10, Type 304/304L, 75-slot (0.075 in.) Stainless Steel Screen: 73.68 - 98.68 ft bgs	



GEOLOGIC/HYDROLOGIC DATA

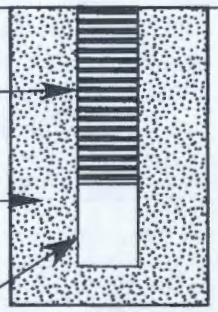
Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
0		0 - 10 Silty Sand (mS)
10		10 - 15 Gravelly Sandy Silt (gsM)
		15 - 55 Sandy Gravel (sG)
20		
30		
40		
50		55 - 60 Sand (S)
60		60 - 85 Sandy Gravel (sG)
70		
80		Static Water Level: 82.67 ft bgs (3/4/2015)
		85 - 95 Gravel (G)



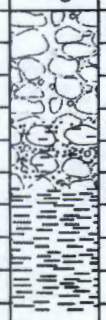
A-6003-643 (REV 1)

WELL SUMMARY SHEET	Start Date: 3/2/2015 Finish Date: ~~3/17/2015~~ 3/23/15 ABG 7/16/15	Page 2 of 2
Well ID: C9377	Well Name: 199-D5-159	
Location: 500m NW of 100D reactor	Project: 12 GW Wells in HR-3 OU	
Prepared By: Joshua Holland — Date: 4/3/15	Reviewed By: D. MERRER	Date: 7-21-15
Signature:	Signature:	

CONSTRUCTION DATA

Description	Diagram
6-in I.D. Schedule 10, Type 304/304L, 75-slot (0.075 in.) Stainless Steel Screen: 73.68 - 98.68 ft bgs 6-12 mesh Premier Colorado Silica Filter Pack Sand: 69.8 - 106.5 ft bgs 6-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 98.68 - 104.04 ft bgs	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
90		85 - 95 Gravel (G)
		95 - 99 Silty Sandy Gravel (msG)
100		99 - 106.5 Silt (M)
110		Total Depth: 106.5 ft bgs (3/4/15)
120		
130		
140		
150		
160		
170		

Depths are in ft below ground surface.

Borehole drilled with 10 3/4-in O.D. casing from 0.0 - 106.5 ft bgs

All temporary drill casing was removed from the ground.

BOREHOLE LOG

Page 1 of 3

Date: 3/2/15

Well ID: C9377	Well Name: 199-D5-159	Location: ~500m NW of 100D Reactor
Project: 12 GW wells in 4R-300		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-15' 10' Silty Sand (mS) gravel 5%, Sand 45%, Silt 50%, Gravel = 10-20mm Rounded, max = 170mm metamorphic, 80% basalt. Sand: VF very well sorted Silt 2.5Y 4/3 olive brown, very strong rxn w/HCl, very slightly moist	Becker Hammer AP-1000 Duel casing, 10 3/4" OD
5	G				5' may not be representative due to partially blocked return hose
10	G			10-15 (GSM) Gravelly Sandy Silt gravel: 10-60mm, R, 80% basalt Avg = 30mm, max = 60mm. Sand: VF, very well sorted, 2.5Y 4/3 olive brown strong rxn w/HCl, moist	30% sand 25% gravel 45% silt
15	G			15-55 Sandy Gravel (SG) 60% gravel, 45% Sand, 5% Silt. Gravel = 2-40mm max = 150mm, 70% basalt, R occl cobbles avg = 30mm. Sand: c-VC, avg = VC, well sorted, A 90% basalt, 2.5Y 3/1 very dark gray no rxn w/HCl	Driller adding ~ 1 gallon/ft water
20	G			@20' gravel size ↑ avg = 50mm 50% mafics	
25	G			@25 more cobbles present 150-180mm, R, 70% basalt Sand ↓ 30%, gravel ↑ 70% Sand VF-VC very poorly sorted A, 90% basalt, avg = VC	
30	G				
35	G				36-39.9 no water added Split spoon: 39.9-42.4
	T	30% recovery SS			

Reported By: Kim Schuyler		Reviewed By: Kevin Bergstrom	
Title: Geologist		Title: Sr. Geologist	
Signature: Kim Schuyler	Date: 3/2/15	Signature: [illegible]	Date: 8/3/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 3
Date: 3/3/15

Well ID: C9377	Well Name: 199-D5-159	Location: ~500m NW of 100D reactor
Project: 12 GW Wells in HR-3 OU		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
40	G 30%			15-55 Sandy Gravel (SG) Gravel=70% 10-60mm Avg=50mm, cobbles 150-180mm R, 70% basalt. Sand: 30%, VF-VC, very poorly sorted, A, 90% basalt, tr. silt 2.5Y 3/1 very dark gray, no rxn w/ HCl, moist	Becker Hammer Dual casing, 10 3/4" OD Archives collected at 5' intervals moisture due to water added while drilling
45	G			@45' decrease basalt in gravel to 50%. Sand well sorted vc 50% basalt, 5% silt 2.5Y 3/2 very dark grayish brown, no cobbles	@46' add water @50' drill rate ↑↑↑ possible gradational contact ~45'
50	G			@50' gravels >20mm Round, 10% basalt, <20mm A, 80% basalt	
	G			Ringold (SG) 53' Gravel: 45%, 100% quartzites, granite Schist, other felsics, 2-10mm R→SA 30-50mm→R, max=60mm. Sand: 50%, m-VF, avg=FS very well sorted. 5% silt 2.5Y 6/4 light yellowish brown, no rxn w/HCl, moist, 95% felsics	Ringold contact at 53' Adding ~1 gal/ft of water
55	G			55-60 Sand (S), Gravel=5%, R, 10mm 95% felsics, Sand=m-VF well sorted, avg=FS trace silt 2.5Y 6/4 light yellowish brown no rxn w/HCl	
60	G			60-65 Sandy Gravel (SG) 40% gravel, 60% sand Gravel=10-30mm very well rounded 95% felsics, Sand=m-VF avg=m well sorted. 2.5Y 6/4 light yellowish brown, no rxn w/HCl @65' ↑ silt 10%	
65	G				
70	G				
75	G			@75' Sand is med. sorted, but avg size ↓ to FS	Stainless steel tagger weight lost in primary filter pack during surging on 3/12/15. Approx depth = 74.8' bgs

Reported By: Kim Schuyler		Reviewed By: Kevin Bergstrom	
Title: Geologist		Title: Sr. Geologist	
Signature: Kim Schuyler	Date: 3/3/15	Signature: [illegible]	Date: 3/3/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 3 (~3 pages)
Date: 3/3/15

Well ID: C9377	Well Name: 199-D5-159	Location: ~500m NW of 100D Reactor
Project: 12 GW wells in HR-3 OU		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
80	G			60-80.5 Sandy Gravel @ 80' ↑ gravel to 60%, 30% sand, 10% silt. Gravel 20-60mm, R, 90% felsics, Avg = 40mm Sand = m-vf avg = fs, 2.5Y 6/4 light yellowish brown, slightly moist, no rxn w/HCl	Becker Hammer Dual casing 10 3/4" OD. Stopped adding water at 80'
85	G			85-95 Gravel (G) Gravel = 80% Sand = 20%, tr silt. Gravel: 30-70mm max = 100mm, avg = 30mm, R, 80% felsics. Sand = m-vf, avg = fs, 2.5Y 5/3 light olive, moist, no rxn w/HCl.	cuttings @ ~85' are moist, casing is at 87.9; tried to tag water = no water
90	G			@ 90' gravel size ↑ 40-90mm avg = 50mm, 75% felsics, SR-A Sand = m-vc, poorly sorted, avg = c SR, 85% felsics, wet	Casing at 90.3', cuttings are wet. 1st DTW = 84.2' 3/3/15 82.67' 3/4/15
95	G	W SS 75% recovery		↑ silt to 10% 95-99 Silty Sandy Gravel (msG) 70% gravel, 15% sand, 15% silt gravel = 20-70mm R, 95% felsics, ocnl 120mm cobble. Sand = vf, mod. sorted m-c 80% felsic avg = c SR, 2.5Y 4/2 dark greyish brown, no rxn w/ HCl, wet	Split spoon: 91.7-94.2' water sample: 91.4' Split spoon: 100.0-102.5' RUM @ ~99' 3/4/15
100	G	SS 25% recovery		99-106.5 Silt and clay (m) 5% gravel, 5% sand, 90% mud. Gravel ocnl 2-15mm well rounded 95% felsics. Sand = vf, very well sorted. Clay very high plasticity 2.5Y 7/4 pale yellow no rxn w/HCl, wet	added ~50 gallons of water to clean out borehole (105-106') Total Depth = 106.5' 3/4/15
105	G			@ 105' 2.5Y 6/3 light yellowish brown caliche present in clay. Very strong rxn w/HCl	
110				Not Used FS 7/3/15	

Reported By: Kim Schuyler		Reviewed By: Kevin Bergstrom	
Title: Geologist		Title: Sr. Geologist	
Signature: Kim Schuyler	Date: 3/3/15	Signature: Kevin Bergstrom	Date: 8/3/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

199-D5-159 (C9377)
Log Data Report

Borehole Information:

Log Date:	2015-03-05	Filename:	C9377_HG-NM_2015-03-05	Site:	100 D
Coordinates (WA St Plane)		DTW[1] (ft):	90.5	DTW Date:	03/05/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	03/04/15	N/A	106.5	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0.3	8 5/8	8 1/8	1/4	0.3	106
Threaded Steel	0.0	11 3/4	10 3/8	11/16	0.0	106

Borehole Notes:

The onsite geologist provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). The drilling method (Becker dual-wall reverse circulation) employs a double wall drive pipe where compressed air is forced down the outer casing and geologic material is returned to the surface inside the inner casing. It is reported after drilling, water was blown out of the borehole to near total depth and the casing sealed in mud near the end of the day on March 4, 2015. On March 5, 2015, water inside the casing was measured at 90.5 ft by moisture logging. The geologist reports static water on March 4, 2015 at 82.7 ft. The maximum logging depth achieved was 106 ft.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1L	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	11/12/14	Serial No.:	47-TP32211A
Calibration Reference:	HGLP-CC-111, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 1H	Type:	NMLS[4]
Effective Calibration Date:	11/13/14	Serial No.:	H310700352
Calibration Reference:	HGLP-CC-112, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	4	5 Repeat			
HEIS Number	1018658	1018659			
Date	03/05/15	03/05/15			
Logging Engineer	Pope/Meisner	Pope/Meisner			

[1] depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

Stoller Newport News Nuclear

Log Run	4	5 Repeat			
Start Depth (ft)	0.0	105.0			
Finish Depth (ft)	106.0	95.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AL240CAB	AL240CAB			
Start File	AL240000	AL240107			
Finish File	AL240106	AL240117			
Post-Verification	AL240CAA	AL240CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	No fine gain adjustments made	Fine gain adjustment at 66 ft			

NMLS Log Run Information:

Log Run	1	2	3 Repeat		
HEIS Number	1018660	1018661	1018662		
Date	03/05/15	03/05/15	03/05/15		
Logging Engineer	Pope/Meisner	Pope/Meisner	Pope/Meisner		
Start Depth (ft)	0.0	62.0	60.0		
Finish Depth (ft)	62.5	90.5	69.0		
Count Time (sec)	15	15	15		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	0.25	0.25	0.25		
Log Speed (ft/min)	N/A	N/A	N/A		
Pre-Verification	AH199CAB	AH199CAB	AH199CAB		
Start File	AH199000	AH199250	AH199365		
Finish File	AH199249	AH199364	AH199401		
Post-Verification	AH199CAA	AH199CAA	AH199CAA		
Depth Return Error (in.)	N/A	N/A	2.0 high		
Comments	Tool malfunction at 62 and 62.5 ft. Sonde reset and continued logging from 62 ft.	None	None		

Logging Operation Notes:

A centralizer was installed on the sondes.

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Stoller Newport News Nuclear

Analysis Notes:

Analyst:	P.D. Henwood	Date:	03/12/15	Reference:	HGLP-MAN-003, Rev. 0

A combined casing correction for a 0.9375-in. thick casing (0.25+0.6875-in. for the 1/4- and 11/16-in. thick casings) was applied to the log data. No additional correction was applied for the casing joints which are in excess of 1.15-in.-thick and occur at approximately 10-ft intervals. The effect of the casing joints can be clearly seen in the total gamma log.

A correction for water was applied below 90 ft in depth.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 1L20141112, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

NMLS data are reported in counts per second. No calibration is available for boreholes of this diameter. However, the NMLS is still useful as a means to assess relative moisture content.

The HGU[5] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected in the borehole. MDLs for Cs-137 and Pu-239 are plotted for the entire borehole.

The relatively thick casing joints beginning at 5 ft and occurring at 10 ft intervals are indicated by reduced count rates on the total gamma log.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

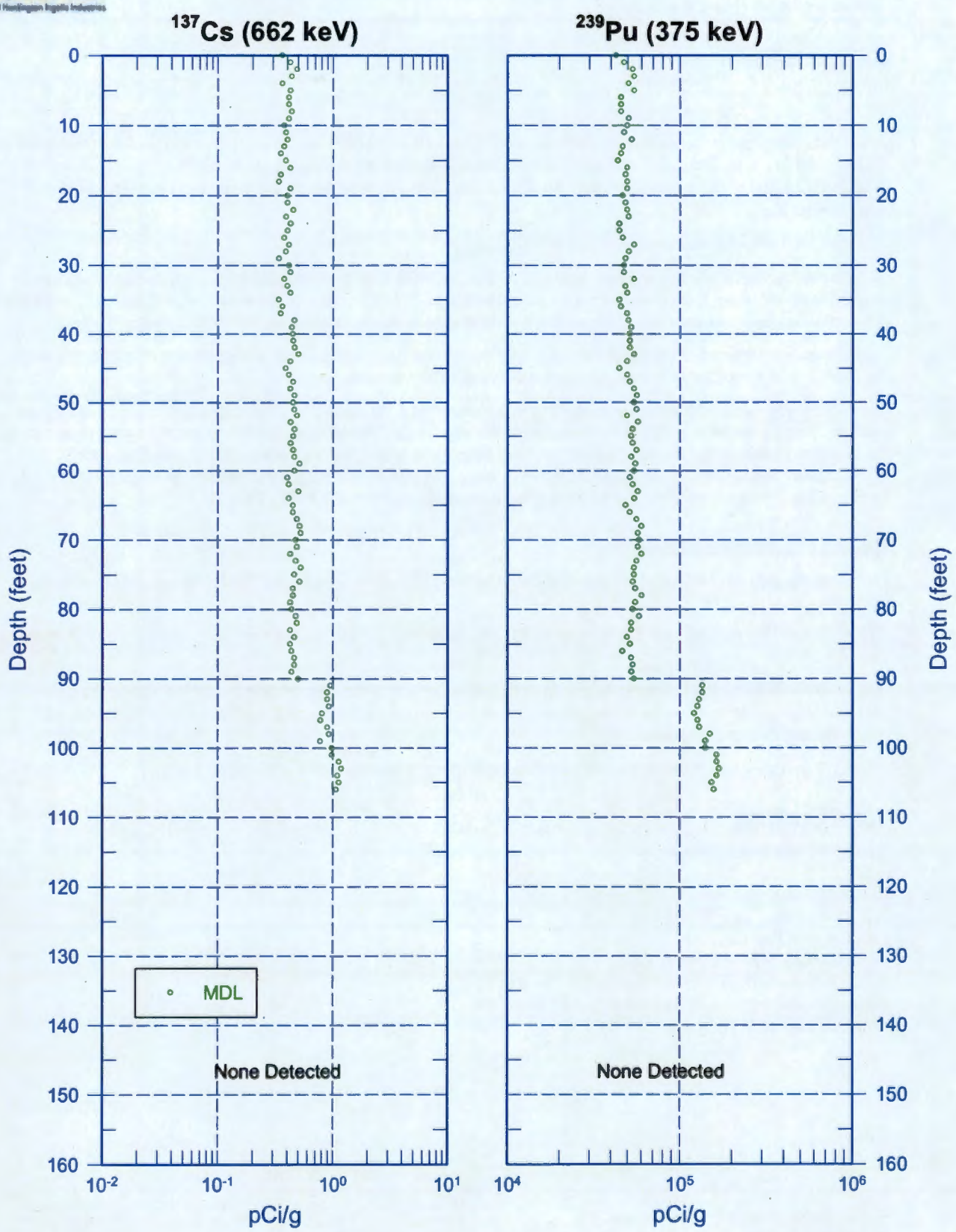
List of Log Plots:

Depth Reference is ground surface.

Manmade Radionuclides (0-160 ft)
Natural Gamma Logs (0-160 ft)
Combination Plot (0-120 ft)
Total Gamma & Moisture (0-160 ft)
Total Gamma & Hanford Gamma Unit (0-160 ft)
Repeat Section of Natural Gamma Logs (95 to 105 ft)
Moisture Repeat Section (60 to 69 ft)

[5] Hanford Gamma Unit

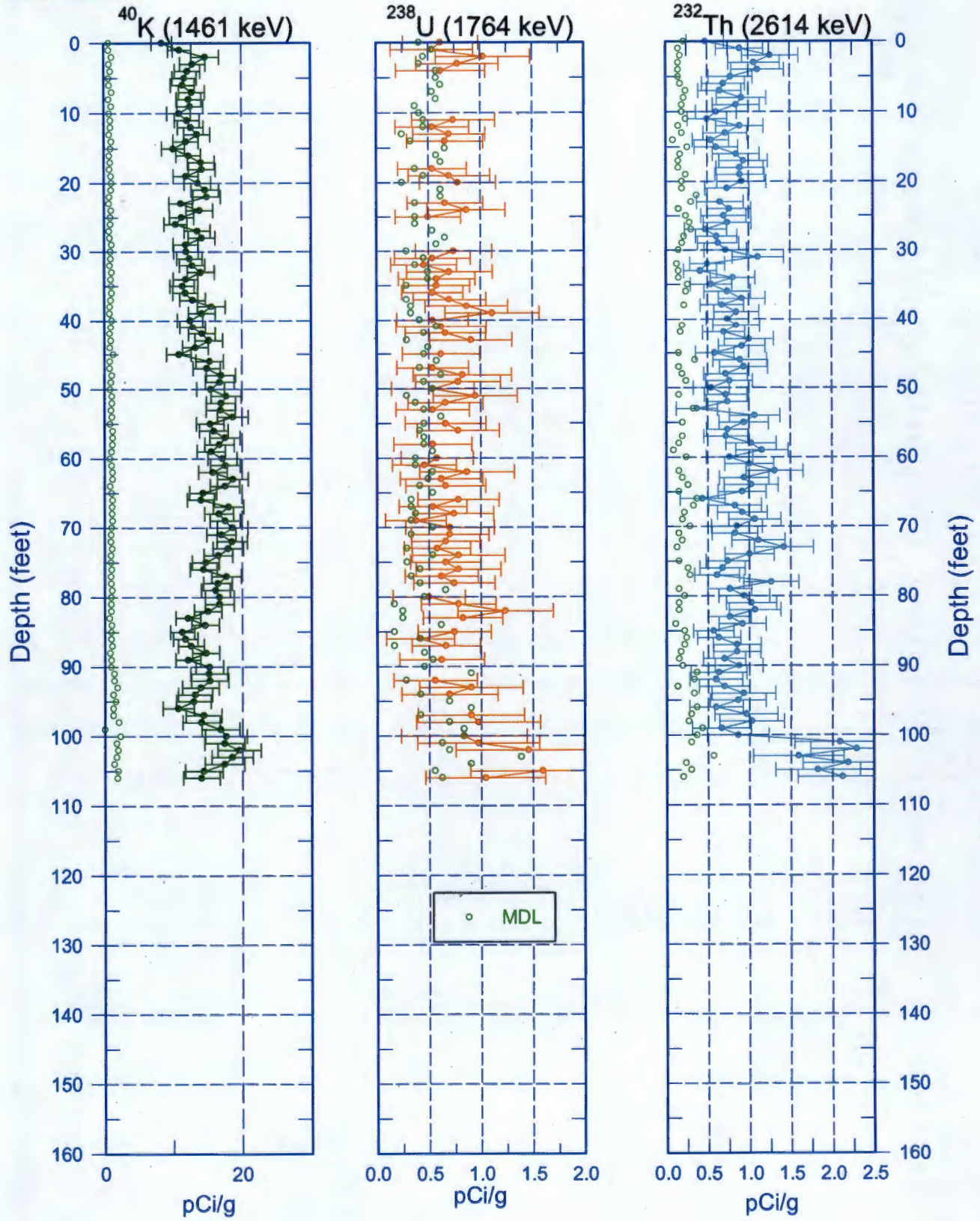
199-D5-159 (C9377)
Manmade Radionuclides



Zero Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

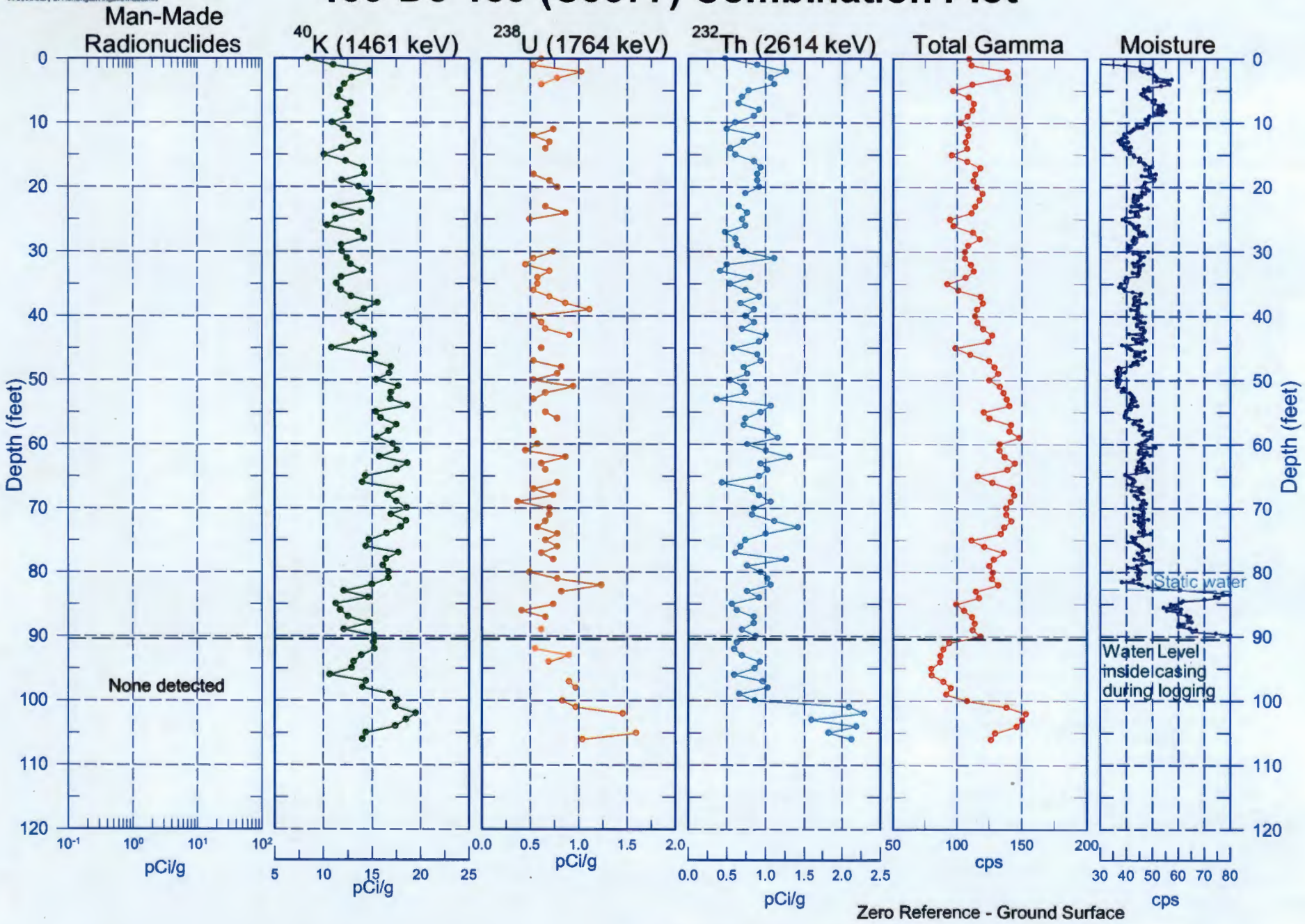
199-D5-159 (C9377)
Natural Gamma Logs



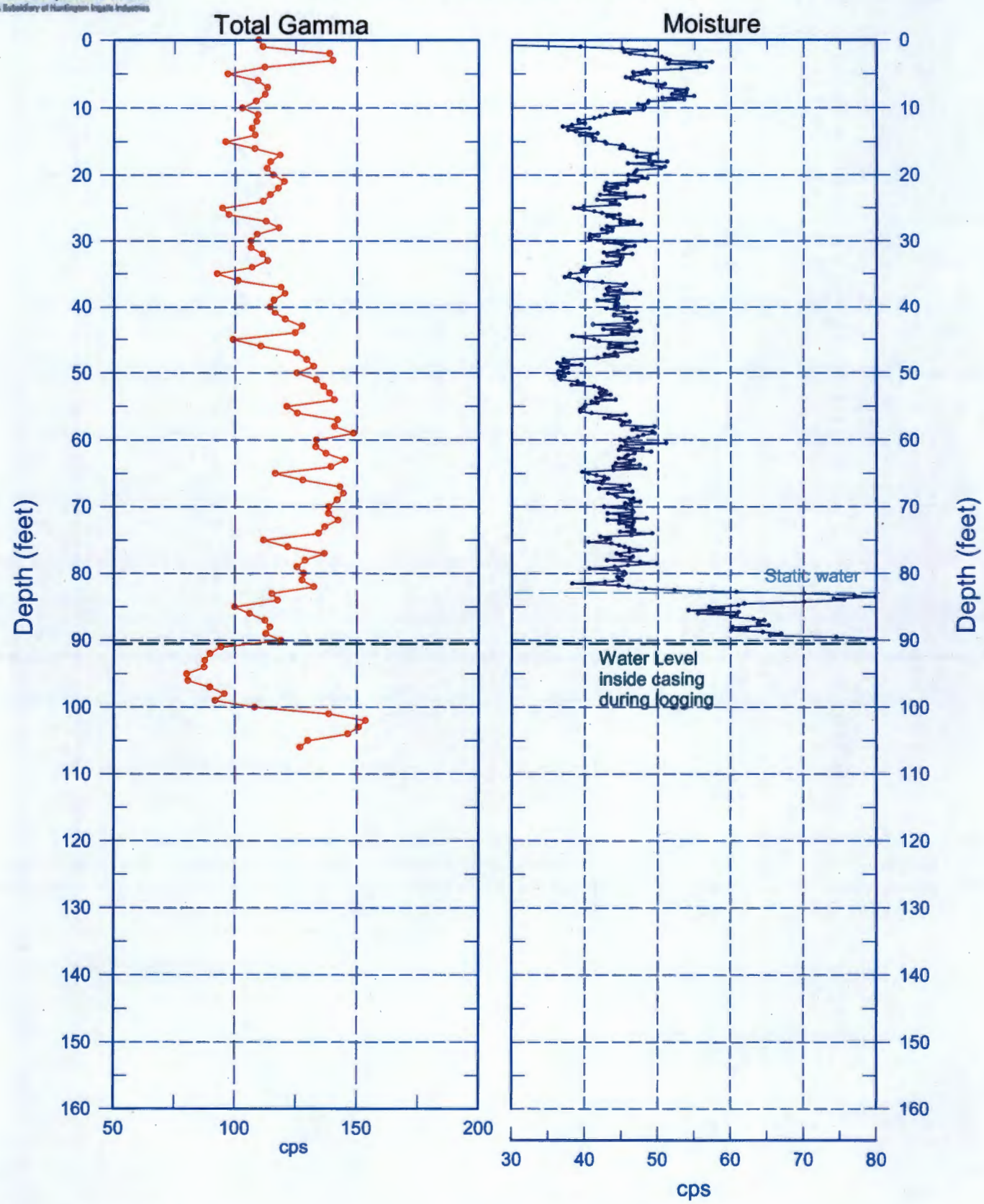
Zero Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

199-D5-159 (C9377) Combination Plot

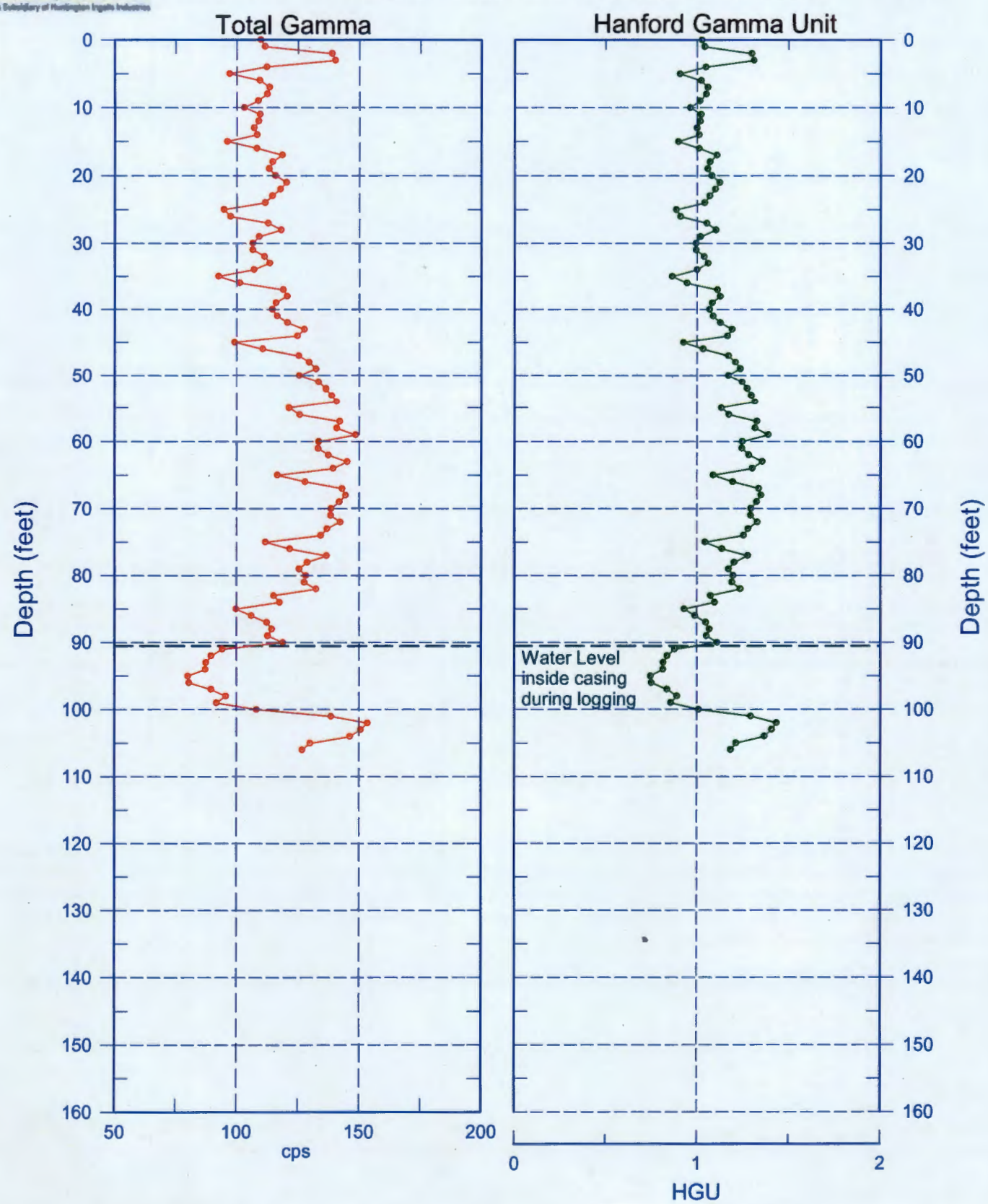


199-D5-159 (C9377)
Total Gamma & Moisture



Reference - Ground Surface

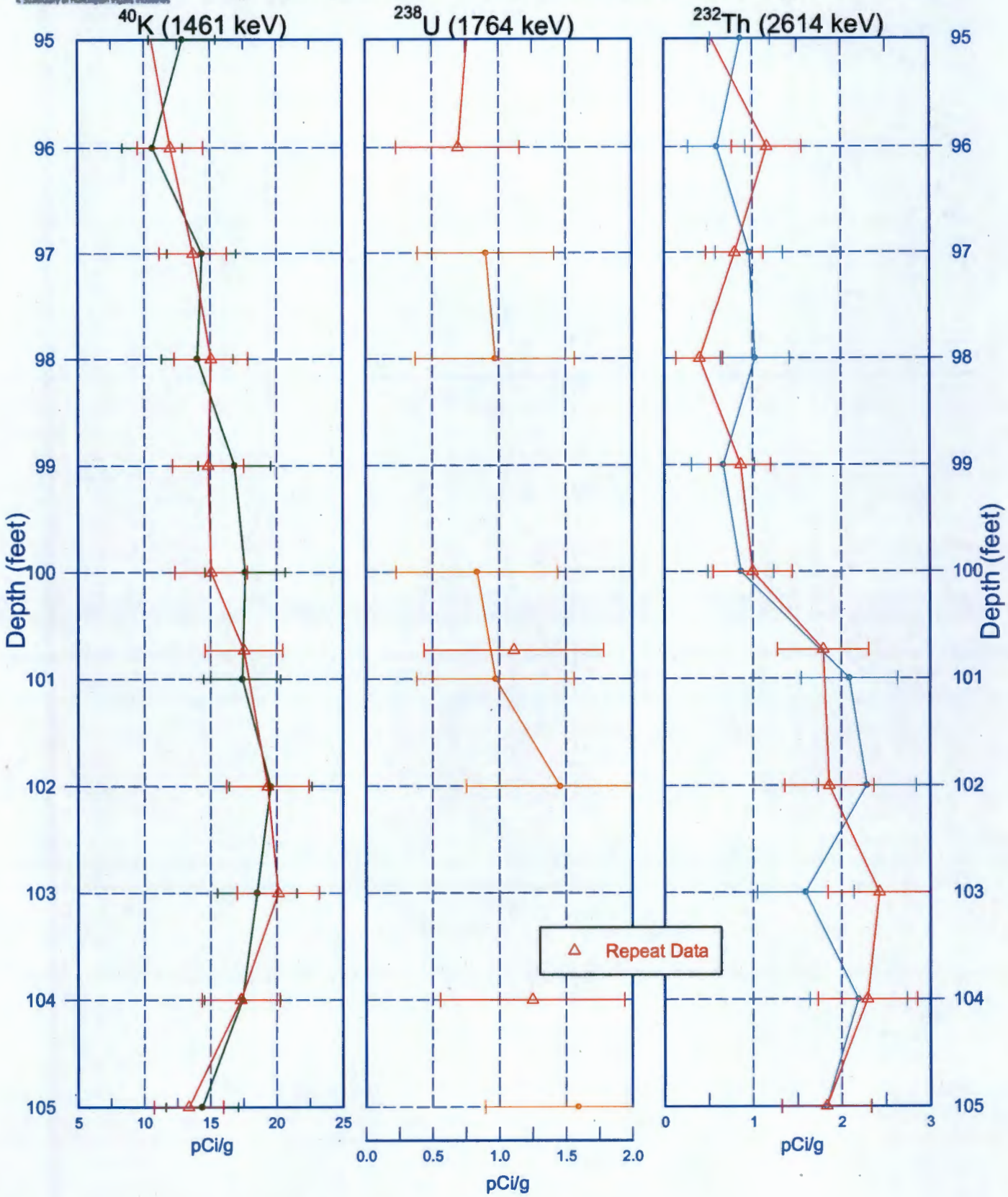
199-D5-159 (C9377)
Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

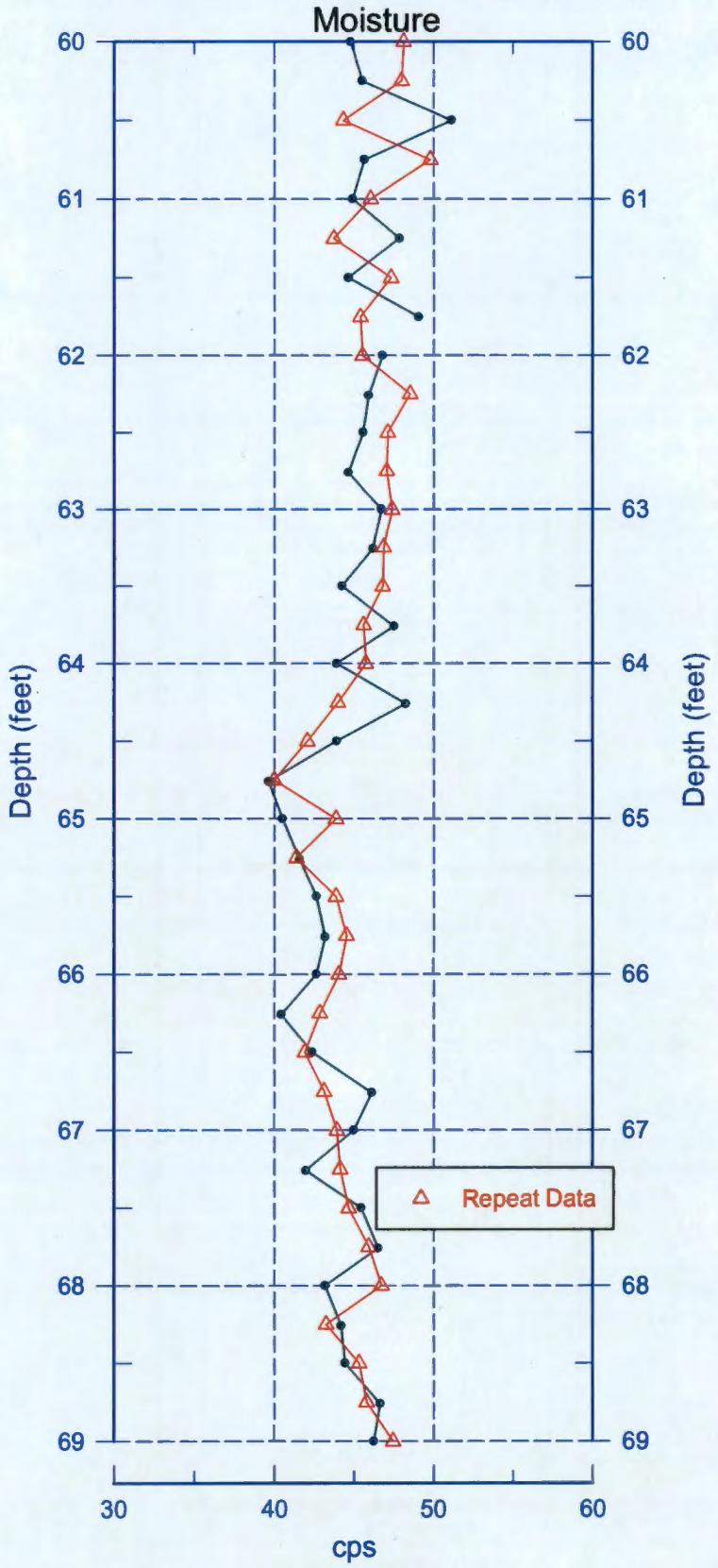
199-D5-159 (C9377)

Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

199-D5-159 (C9377)
Moisture Repeat Section



Reference - Ground Surface

cm
FREESTONE
C9377

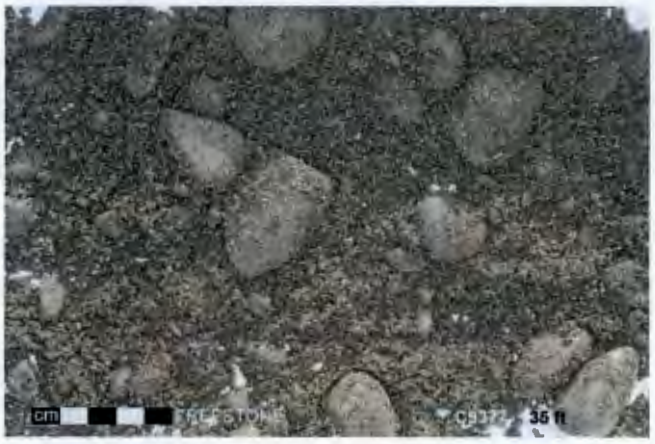
cm
FREESTONE
10 ft

cm
FREESTONE
C9377

cm
FREESTONE
C9377
20 ft

cm
FREESTONE
C9377

cm
FREESTONE
C9377


cm
FREESTONE
C9377
35 ft

cm
FREESTONE
C9377

cm
FREESTONE
C9377 45 ft

cm
FREESTONE
C9377 50 ft

cm
FREESTONE
C9377 53 ft

cm
FREESTONE
C9377 55 ft

cm
FREESTONE
C9377 60 ft

cm
FREESTONE
C9377 65 ft

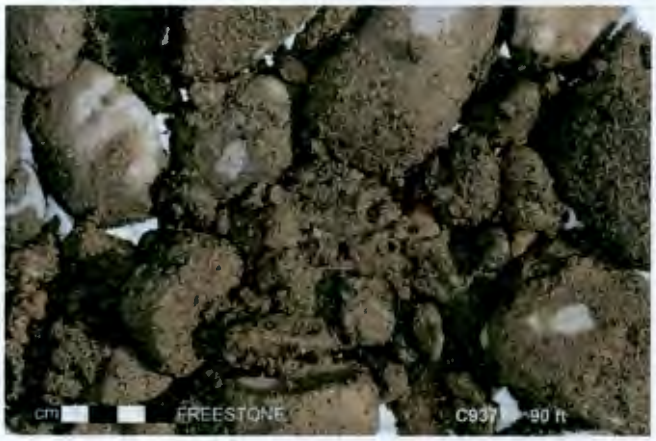
cm
FREESTONE
C9377 70 ft

cm
FREESTONE
C9377 75 ft

cm
FREESTONE
C9377 80 ft

cm
FREESTONE
C9377 85 ft

cm
FREESTONE
C9377 87 ft


cm
FREESTONE
C9377 90 ft

cm
FREESTONE
C9377 95 ft

cm
C9377 99 ft

cm
FREESTONE
C9377 105 ft

SURVEY DATA REPORT				Request No. 153-097
Project No.	Title HR-3 Well C9377 (199-D5-159) Final Survey			File No. 1DT14R26
Job. No. CACN: 303594-JPRC	Prepared By N.P. Fastabend	Date 5/14/15	Reviewer LBM	

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casing) and elevations of completed Well C9377 (199-D5-159) at 100D Area.	Survey File	OR		
	J.D. Mehrer	1		
	K.M. Whitley	1		
	J.L. Smoot	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheet

A-6006-495 (REV 0)

WELL SURVEY DATA REPORT

Project:	Prepared By: Neil P. Fastabend Company: CHPRC
Date Requested: 4/23/15	Requestor: Kelly Whitley (CHPRC)
Date of Survey: 5/13/15	Surveyor: Lawrence B. Munnell (PLS)
Fluor Hanford Point of Contact:	Survey Co. Point of Contact: Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of Well C9377 (199-D5-159) in 100D Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 100D

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
100D-1 (CHPRC) and D-6 (CHPRC)

Well ID	Well Name	Easting	Northing	Elevation	
C9377	199-D5-159	573474.25	151910.82		Center of Casing
				144.069	"X" on Rim
				143.302	Brass Survey Marker

Notes:

143.768 Top Inner Casing, North Edge

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify that this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

5-14-15

A-6003-659 (04/03)

Appendix K

Well Documentation for C9485 (699-97-47B)

- Well Summary Sheet
- Borehole Log
- Log Data Report
- Photographic Log
- Final Survey Report

This page intentionally left blank.

WELL SUMMARY SHEET

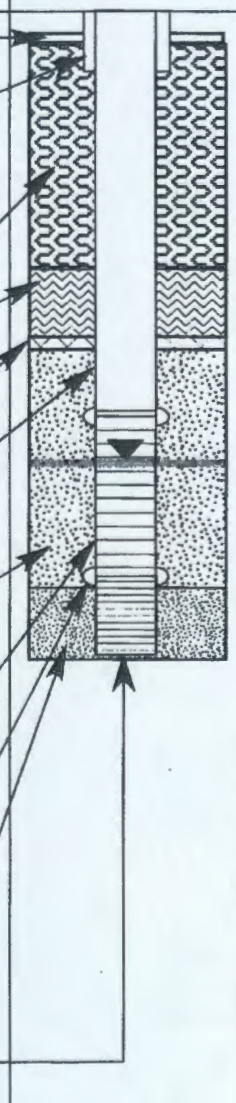
Start Date: 6/05/2015
Finish Date: ~~6/12/2015~~ 6/15/15 AS 6-16-15

Page 1 of 1

Well ID: C9485	Well Name: 699-97-47B
Location: 500 m NW of C8793	Project: 12 GW Wells in 100-HR-3 OU
Prepared By: Jessa Szecsody — Date: 6/16/15	Reviewed By: J.D. MEHRER — Date: 7-21-15
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
Concrete Pad: 0.53 ft above ground surface (ags)	
12-in Protective Casing: 2.47 ft above concrete pad - 2.0 ft below ground surface (bgs)	
Type I/II Portland Cement Grout: 0 - 14.0 ft bgs	
3/8 in Cetco Medium Bentonite Chips: 14.0 - 18.4 ft bgs	
3/8 in Cetco Coated Bentonite Pellet Seal: 18.4 - 19.0 ft bgs	
10-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.42 ft ags - 22.57 ft bgs	
6-12 mesh Premier Colorado Silica Filter Pack Sand: 19.0 - 33.4 ft bgs	
10-in I.D. Schedule 10, Type 304/304L, 75-slot (0.075 in.) Stainless Steel Screen: 22.57 - 32.89 ft bgs	
Stainless steel centralizer installed from the top of the sump and top of the screen	
10-20 mesh Premier Colorado Silica Filter Pack Sand: 33.4 - 37.93 ft bgs	
10-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen with End Cap: 32.89 - 37.91 ft bgs	



Depths are in ft below ground surface.

Borehole drilled with 18-in O.D. casing from 0.0 - 38.2 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
0		0 - 10 Silty Sandy Gravel (msG)
10		10 - 30 Sandy Gravel (sG)
20		Static Water Level: 26.1 ft bgs (06/15/15)
30		30 - 33 Gravel (G)
		33 - 38.4 Silt (M)
40		
50		
60		
70		
80		Total Depth: 38.4 ft bgs (6/9/15)

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 1

Date: 6/5/15 - 6/9/15

Well ID: C9485	Well Name: 699-97-47B	Location: 500m NW of C8793	
Project: 12 Wells in 100HR OU 2015		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-10' bgs; SILTY SANDY GRAVEL (msG)	Becker Hammer
				60% Gravel, 28% Sand, 12% Silt	Grab samples every 5'
				Gravel: VFP-LCob; 25cm Max; 50% cobble; PS;	
				A-SA≤MP<SR-R; 90% bslt, 10% other	Small amounts of water
				Sand: VF-VC, 75% VF-M, 25% C-VC; PS; R-SR;	is added during drilling
5	G			60% felsic, 15% mafic, 25% basalt. Weak HCl rxn.	process to decrease dust.
				Dry. Clayey silt coating gravels, some pliable	~1-2 gal/ft
				nodules - med. plasticity. Micaceous.	Casing: 18" OD / 16" ID
				2.5Y 6/2 light brownish gray (damp)	Double wall: 10 3/4" OD / 7 7/8" ID
					Formation 0-25' naturally
10	G			@10' bgs; 60% Gravel, 30% Sand, 10% Silt; less clay;	dry; moisture color
				Dral boulder; 2.5Y 5/2 grayish brown; Strong HCl rxn.	due to added water
				10-30' bgs; SANDY GRAVEL (sG) 10-30'	(not natural)
				@15' bgs; 65% Gravel, 25% Sand, 10% Silt	Drilling speed decreased
				Gravel: VFP-SCob; 10% VF-FP, 40% M-VCP, 60% Cob,	@12' bgs
15	G			20cm Max; PS; A-SA≤MP<SR-R; 40% felsic, 30% mafic, 30% bslt.	
				Sand: VF-VC, 20% VF-F, 60% M-C, 20% VC; PS; SR	
				50% felsic, 20% mafic, 30% basalt. Dry. Strong HCl rxn.	
				Micaceous. 10YR 5/2 grayish brown (damp)	
20	G			@20' bgs; 72% Gravel, 25% Sand; 3% Silt	
				Sand: M-VC, 25% M, 75% C-VC; MS; 40% felsic,	
				20% mafic, 40% bslt. Gravel as above. Weak HCl rxn.	
				@25' bgs; 75% Gravel, 24% Sand; 1% Silt	
				Gravel: VFP-SCob, VF-MP 25%, 50% C-VCP, 25% SCob,	
25	G	DTW 26.5' 6/9/15		20cm Max; PS; A≤MP<R; 40% felsic, 30% mafic, 30% bslt.	
				Sand: M-VC, 20% M, 80% C-VC; SA-SR; 50% bslt, 25% mfc, 25% fsc.	
				Dry; no HCl rxn; no mica; 10YR 4/2 dk. grayish brown (moist).	
				@30' bgs; 85% Gravel, 14% S, 1% Silt; GRAVEL (G) 30-33' bgs	
				G: VFP-SB, 20% VF-MP, 30% C-VCP; 50% Cob-Bldr, 30cm Max.	
30	G			MS; A≤FP<SR-R; 60% fsc, 20% mfc, 20% bslt	
				S: F-VC, 80% M-C; WS; WR; 75% fsc, 10% mfc, 15% bslt	
	GW			Moist; wk HCl rxn; 10YR 5/1 gray (dry)	Water Sample @ 31.6'
	32.2	Spht spoon 100% Recovery 28 blows		@33' bgs; Contact with clayey silt	Drilling speed decreased
	34.7			33' bgs - 38.4' bgs; SILT (M)	@35' bgs
35	G			G: 9%, 10% Sand, 81% clayey silt	Tight formation (RUM)
				G: FP-SCob, 50% FP-P, 50% Cob	
				S: VF-C, 80% VF-F, 20% M-C; VWS; WR,	Final casing depth: 38.2' bgs
		6/9/15		90% felsic, 10% other; 10YR 5/4 yellowish brown; (wet)	
	TD: 38.4'			high plasticity; caliche nodules exhibit strong HCl rxn.	

Reported By: Janine Carter		Reviewed By: Kevin Bergstrom	
Title: Geologist		Title: Sr. Geologist	
Signature: Janine Carter	Date: 6/9/15	Signature: [signature]	Date: 8/3/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

699-97-47B (C9485)
Log Data Report

Borehole Information:

Log Date:	2015-06-10	Filename:	C9485_HG-NM_2015-06-10	Site:	100 H
Coordinates (WA St Plane)		DTW[1] (ft):	31.6	DTW Date:	06/10/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	06/09/15	N/A	38.3	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	1.75	18 1/8	16 1/8	1.0	-1.75	38.3

Borehole Notes:

The onsite geologist provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). This drilling method employs a double wall drive pipe where compressed air is forced down the outer casing and geologic material is returned to the surface inside the inner casing. The inner casing was removed prior to logging. Water inside the casing was measured at 31.6 ft by the logging engineer with an e-tape. The maximum logging depth achieved was 37 ft.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1L	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	11/12/14	Serial No.:	47-TP32211A
Calibration Reference:	HGLP-CC-111, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 1H	Type:	NMLS[4]
Effective Calibration Date:	11/13/14	Serial No.:	H310700352
Calibration Reference:	HGLP-CC-112, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1018724	1018725			
Date	06/10/15	06/10/15			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	0.0	28.0			
Finish Depth (ft)	37.0	34.0			
Count Time (sec)	100	100			
Live/Real	R	R			

[1] depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

Stoller Newport News Nuclear

Log Run	1	2 Repeat			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AL259CAB	AL259CAB			
Start File	AL259000	AL259038			
Finish File	AL259037	AL259044			
Post-Verification	AL259CAA	AL259CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	No fine gain adjustments made	No fine gain adjustments made			

NMLS Log Run Information:

Log Run	3	4 Repeat			
HEIS Number	1018726	1018727			
Date	06/10/15	06/10/15			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	0.0	24.0			
Finish Depth (ft)	31.5	29.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AH212CAB	AH212CAB			
Start File	AH212000	AH212127			
Finish File	AH212126	AH212147			
Post-Verification	AH212CAA	AH212CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	None	None			

Logging Operation Notes:

A centralizer was installed on the SGLS sonde. A centralizer was not installed on the NMLS sonde.

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Analysis Notes:

Analyst:	A.D. Pope	Date:	06/22/15	Reference:	HGLP-MAN-003, Rev. 1a

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as AL20141112, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

A correction for a 1-in. thick casing was applied to the log data. No correction was applied for the casing joints which are in excess of 1.5-in. and occur at approximately 10-ft intervals.

A correction for water was applied below 31 ft in depth.

NMLS data are reported in counts per second as there is no calibration for conversion to volumetric moisture for borehole diameters greater than 8-in.

The HGU[5] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected in the borehole. MDLs for Cs-137 and Pu-239 are plotted for the entire borehole.

The relatively thick casing joints beginning at 8 ft and occurring at 10 ft intervals are indicated by reduced count rates on the total gamma log. The moisture log also appears to indicate effects of casing joints.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

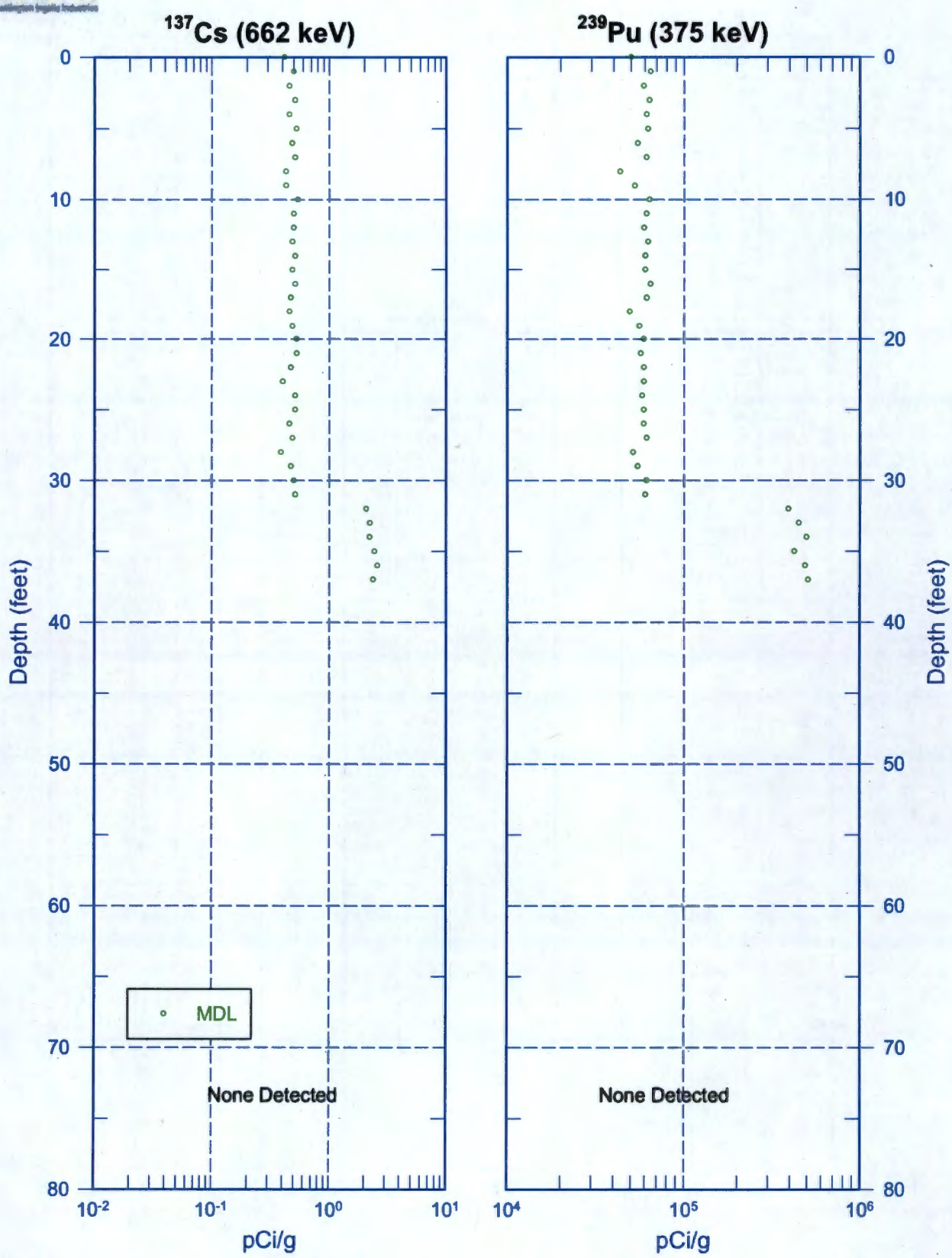
List of Log Plots:

Depth Reference is ground surface.

Manmade Radionuclides (0-80 ft)
Natural Gamma Logs (0-80 ft)
Combination Plot (0-120 ft)
Total Gamma & Moisture (0-80 ft)
Total Gamma & Hanford Gamma Unit (0-80 ft)
Repeat Section of Natural Gamma Logs (28 to 34 ft)
Moisture Repeat Section (24 to 29 ft)

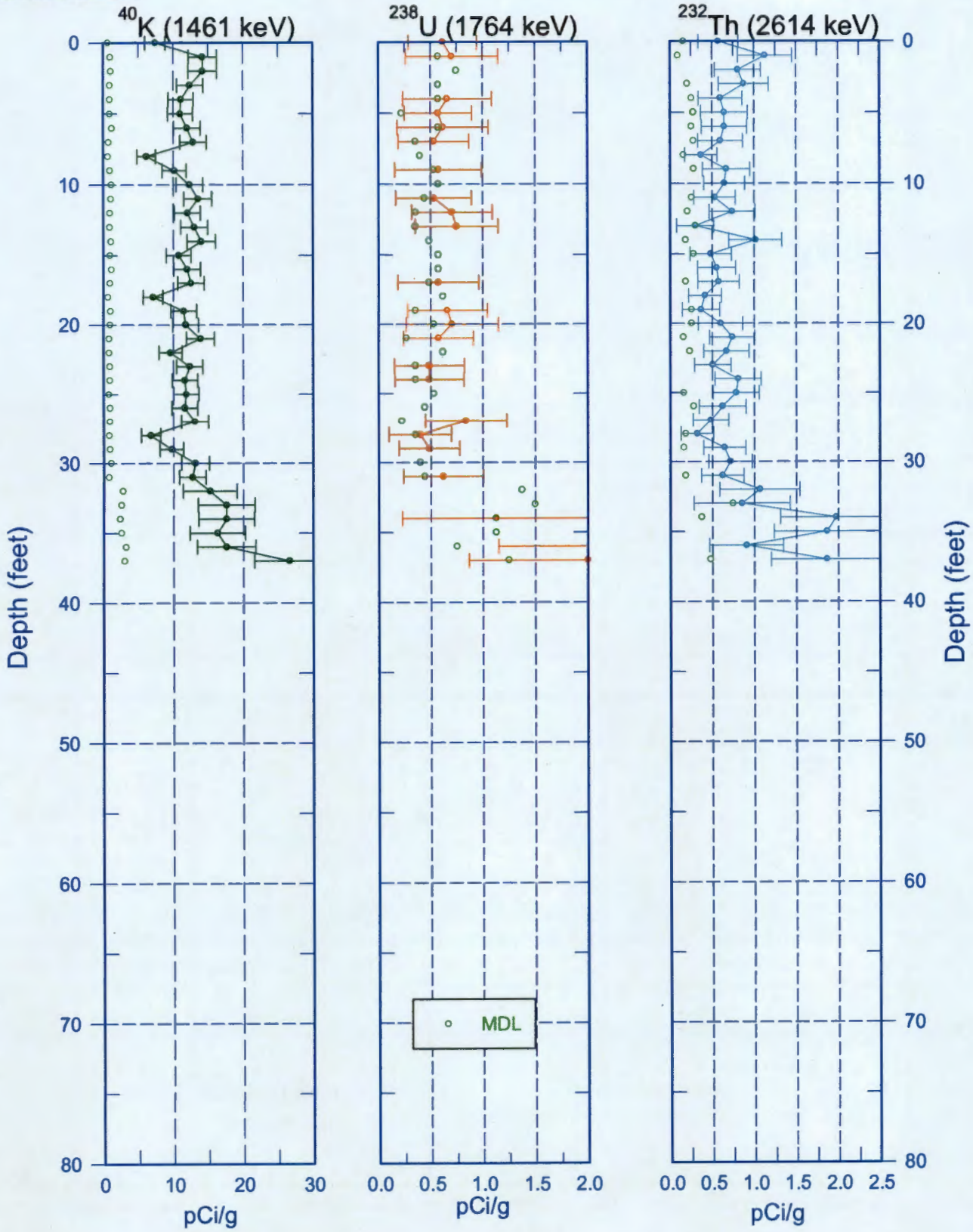
[5] Hanford Gamma Unit

699-97-47B (C9485)
Manmade Radionuclides



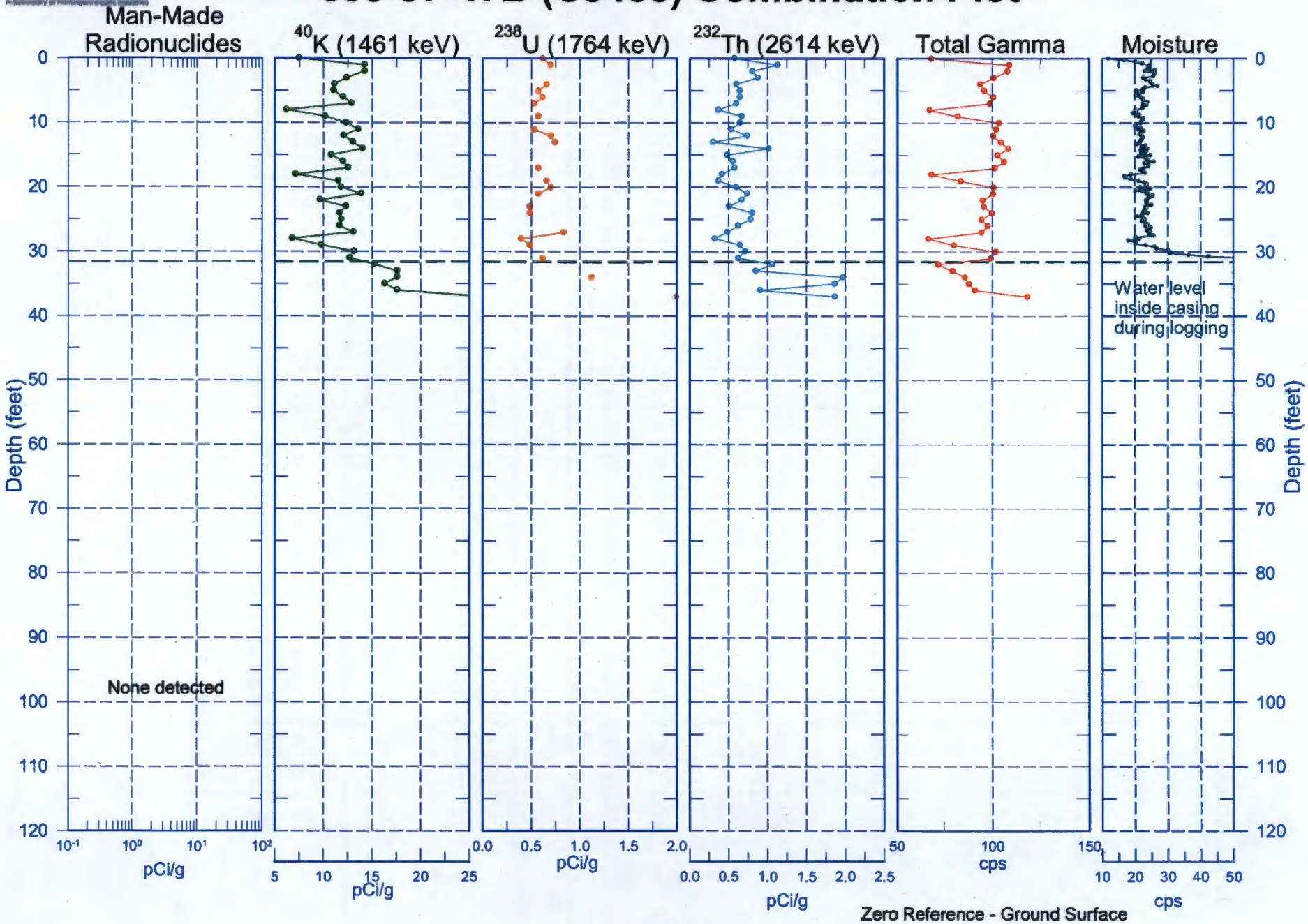
Zero Reference - Ground Surface

699-97-47B (C9485)
Natural Gamma Logs

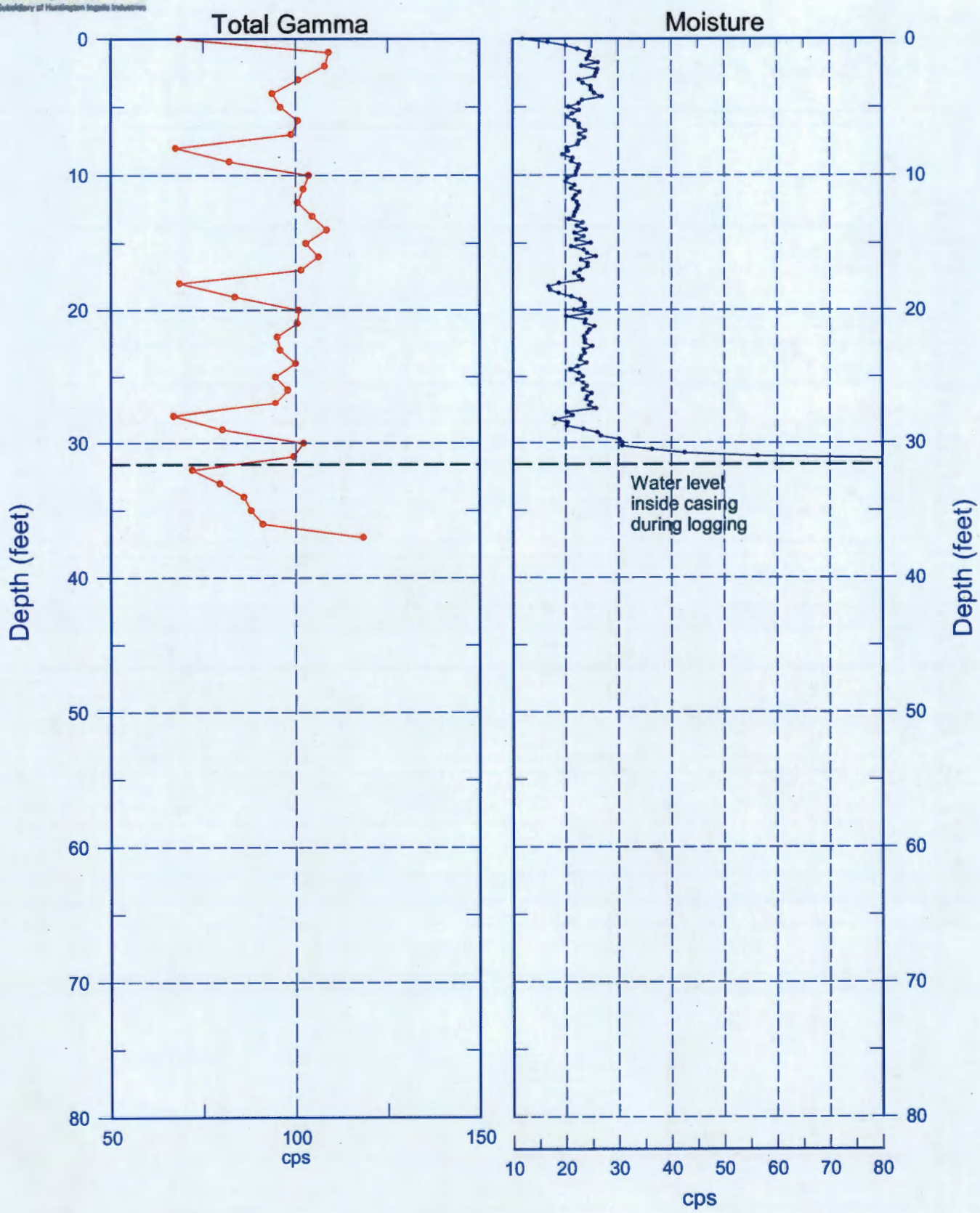


Zero Reference - Ground Surface

699-97-47B (C9485) Combination Plot

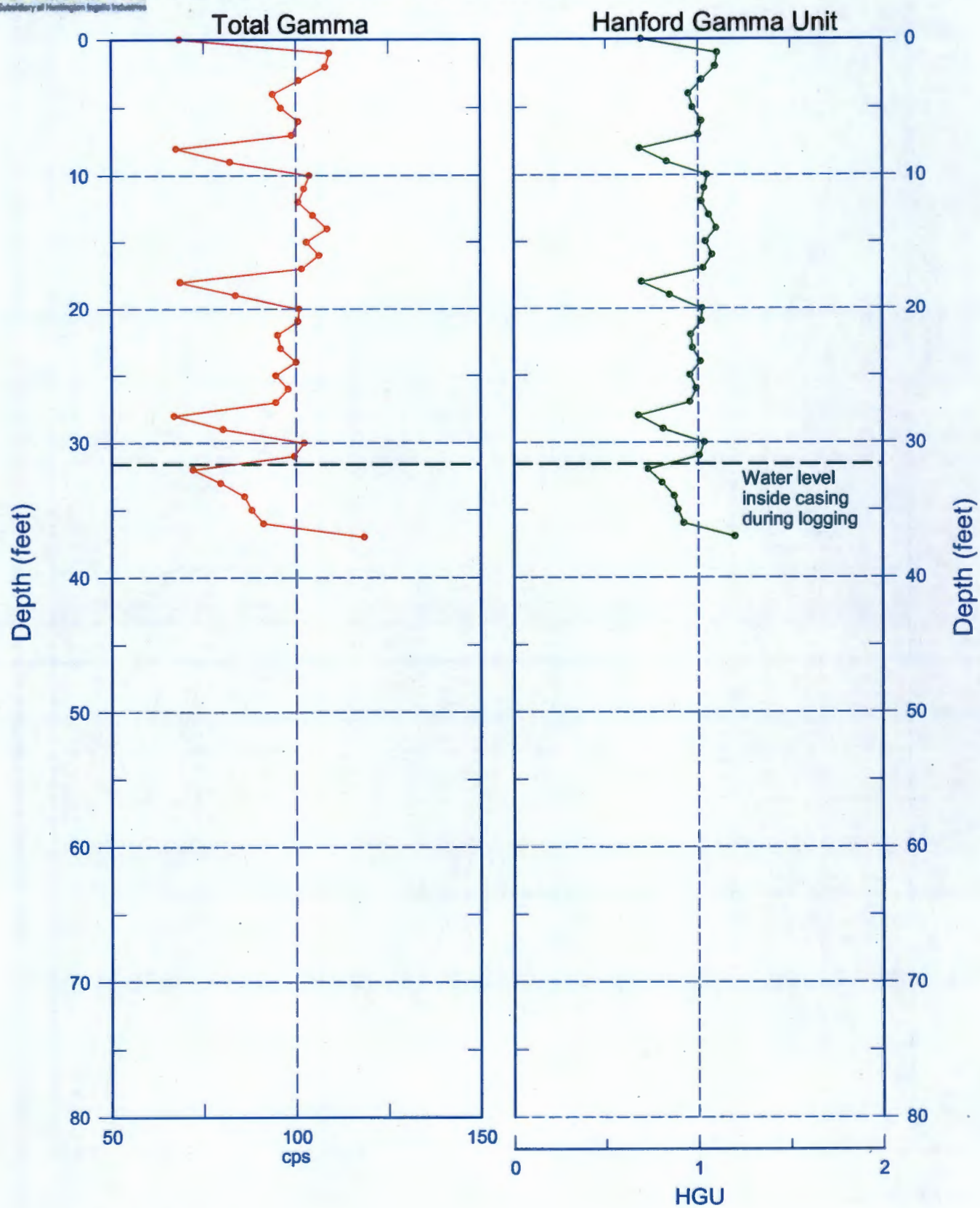


699-97-47B (C9485)
Total Gamma & Moisture



Reference - Ground Surface

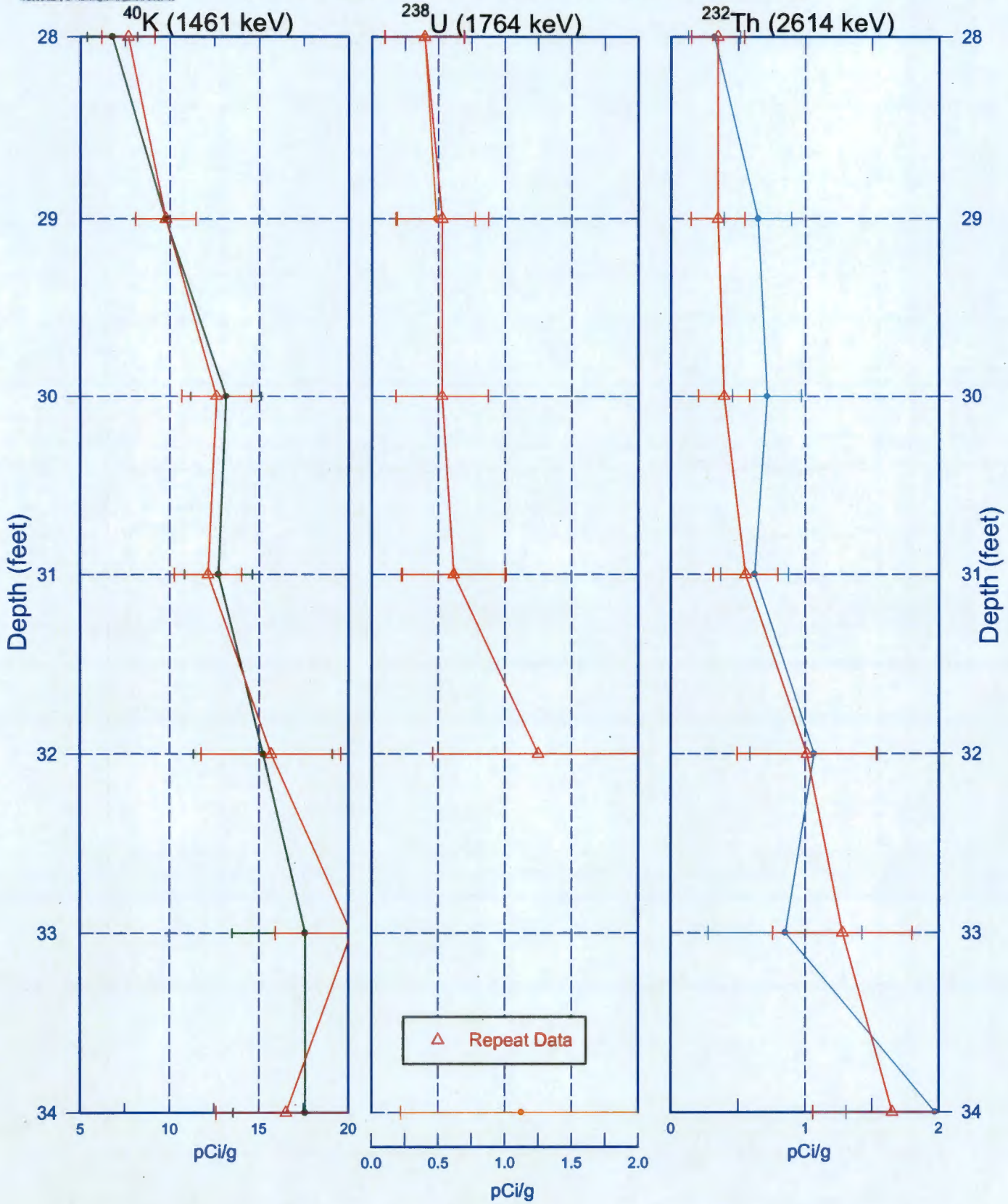
699-97-47B (C9485)
Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

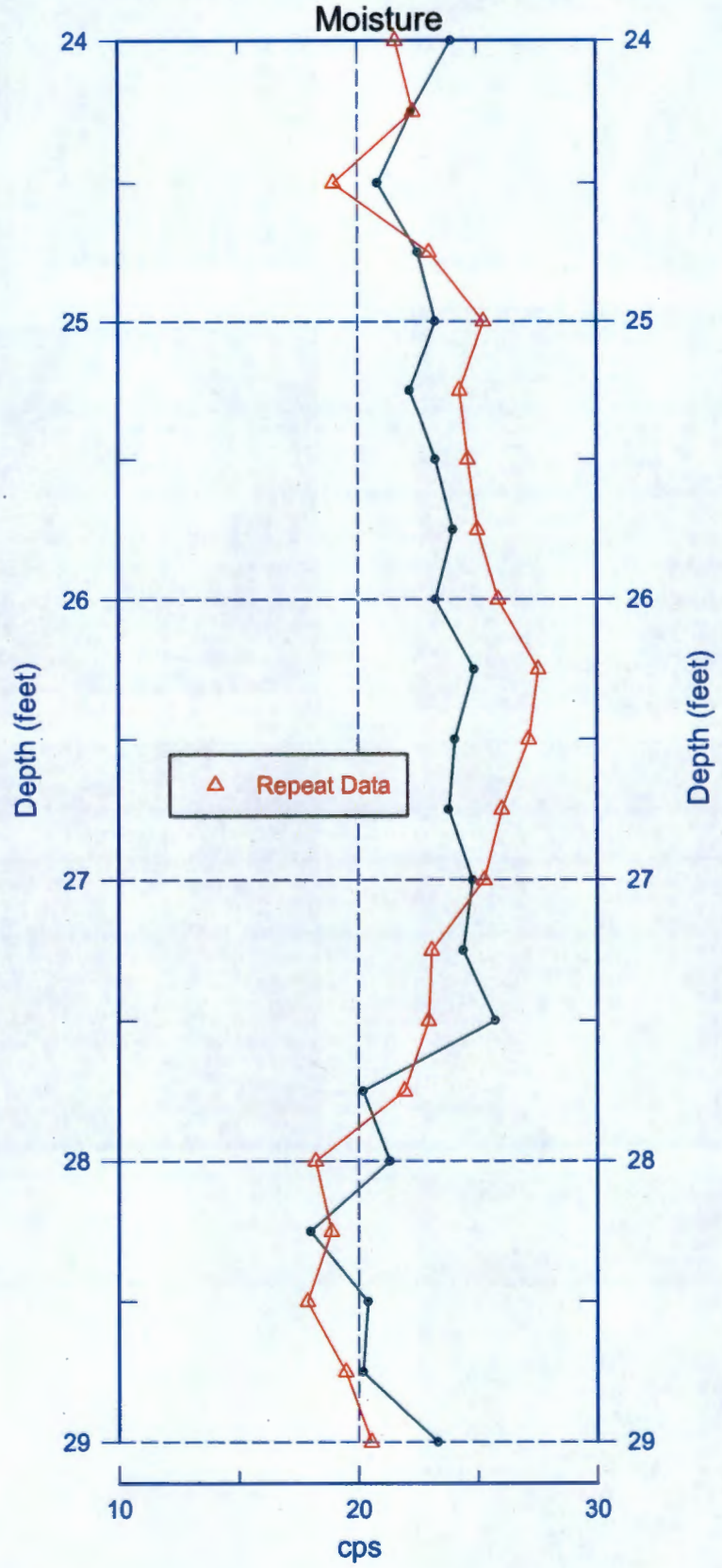
699-97-47B (C9485)

Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

699-97-47B (C9485)
Moisture Repeat Section



Reference - Ground Surface

cm
FREESTONE
C9485 5 ft

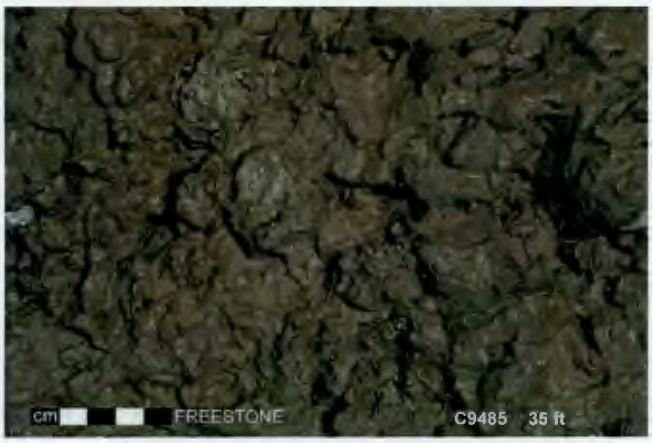
cm
FREESTONE
C9485 10 ft

cm
FREESTONE
C9485 15 ft

cm
FREESTONE
C9485 20 ft

cm
FREESTONE
C9485 26 ft

cm
FREESTONE
C9485 30 ft


cm
FREESTONE
C9485 35 ft

SURVEY DATA REPORT				Request No. 153-131
Project No.	Title HR-3 Well C9485 (699-97-47B) Final Survey			File No. 6AT14R26
Job. No. CACN: 303594-JPRC	Prepared By N.P. Fastabend	Date 6/23/15	Reviewer LBM	

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casing) and elevations of completed HR-3 Well C9485 (699-97-47B).	Survey File	OR		
	J.D. Mehrer	1		
	K.M. Whitley	1		
	J.L. Smoot	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheet

WELL SURVEY DATA REPORT

Project:	Prepared By: Neil P. Fastabend Company: CHPRC
Date Requested: 06/16/15	Requestor: Jim Mehrer (CHPRC)
Date of Survey: 06/23/15	Surveyor: Lawrence B. Munnell (CHPRC)
Fluor Hanford Point of Contact:	Survey Co. Point of Contact: Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of HR-3 Well C9485 (699-97-47B).	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 600A

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
G49 (COE) and P324 (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C9485	699-97-47B	575408.55	153265.29		Center of Casing
				126.462	"X" on Rim
				125.709	Brass Survey Marker

Notes:

126.283 Top Inner Casing, North Edge

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

6-23-15

A-6003-659 (04/03)

Appendix L

Well Documentation for C9486 (199-H1-46)

- Well Summary Sheet
- Borehole Log
- Log Data Report
- Photographic Log
- Final Survey Report

This page intentionally left blank.

6/15/15 ASG 7/16/15

WELL SUMMARY SHEET

Start Date: ~~5/15/2015~~
Finish Date: ~~6/23/2015~~ 6/24/15

Page 1 of 1

Well ID: C9486	Well Name: 199-H1-46
Location: 1000 m NW of 105-H reactor	Project: 12 GW Wells in 100-HR-3 OU
Prepared By: Jessa Szecsody — Date: 6/25/15	Reviewed By: M. MEHRER — Date: 7-21-15
Signature:	Signature:

CONSTRUCTION DATA

Description

12-in Protective Casing: 3.03 ft ags - 1.97 ft below ground surface (bgs)

Type I/II Portland Cement Grout: 0 - 13.0 ft bgs

Cetco Medium Bentonite Chips: 13.0 - 15.4 ft bgs

3/8 in Cetco Coated Bentonite Pellet Seal: 15.4 - 16.2 ft bgs

10-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 1.53 ft ags - 20.37 ft bgs

Stainless steel centralizers installed at top of sump and top of screened interval

10-in I.D. Schedule 10, Type 304/304L, 50-slot (0.050 in.) Stainless Steel Screen: 20.37 - 40.38 ft bgs

8-16 mesh Premier Colorado Silica Filter Pack Sand: 16.2 - 40.1 ft bgs

10-20 ~~8-12~~ mesh Premier Colorado Silica Filter Pack Sand: 40.1 - 48.5 ft bgs
ASG 7/16/15

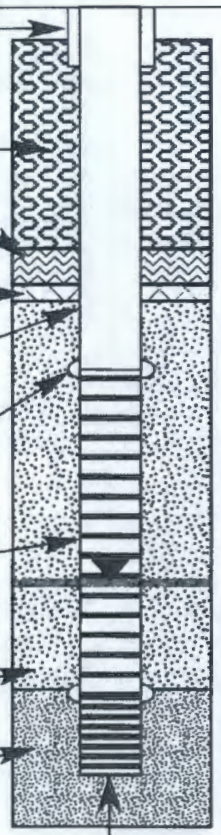
10-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screened Sump: 40.38 - 45.42 ft bgs

Depths are in ft below ground surface.

Borehole drilled with 18-in O.D. casing from 0.0 - 48.2 ft bgs

All temporary drill casing was removed from the ground.

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 10, 20, 30, 40, 50, 60, 70, 80

Graphic Log

Lithologic Description (ft bgs)

- 0 - 5 Gravel (G)
- 5 - 20 Sandy Gravel (sG)
- 20 - 25 Gravel (G)
- 25 - 40 Sandy Gravel (G)
- Static Water Level: 33.4 ft bgs (06/17/15)
- 40 - 50.4 Silt (M)
- Total Depth: 50.4 ft bgs (6/17/15)

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 2
Date: 6/17/15

Well ID: C9486 | Well Name: 199-H1-4b | Location: ~1000 mNW of 105-H

Project: 12 GW Wells in 100-HR-3 O.U. | Reference Measuring Point: Ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-5 Gravel (G) 90% Gravel 5% Sand 5% Silt Gravel: mp-1c poorly sorted 45% 30mm max 150mm 85% mof. sub round. Sand: vf, well sorted 2.5Y 5/4 lt olive brown. No rxn HCl moist	Becker Hammer Triple wall casing Grab sample every 5' or change in lith.
5	G			5-20: sandy Gravel (sG) 75% Gravel, 20% Sand 5% Silt. Gravel: fp-1c poor sort, max 250mm 80% mof sub c. Sand: med, well sort, 60% fel 2.5Y 3/2 very dark grayish brown. No rxn HCl. Silt non plastic moist	Drillers adding 3-5 gal H_2O every 3-5 ft
10	G				
15	G			@15' color change 2.5Y 4/2 dark grayish brown	
20	G			20-25: Gravel (G) 92% Gravel, 5% Sand, 3% Silt Gravel: mp-1c poor sort, max 250mm 65% mof. sub c. Sand: med, well sort, 80% fel 2.5Y 5/2 Grayish brown mod rxn HCl. Silt non plastic, moist	
25	G			25-40 Sandy Gravel (sG) Gravel 50% Sand 40%: Silt 10%. Gravel: fp-1c poor sort, max 150mm, 70% mof, round Sand: m-vc, mod sort, 70% med, 50/50 mafic-fel, sub angular 2.5Y 4/3 olive brown wk rxn HCl. Silt has low plasticity, moist	27.3-29.8: split spoon 75% recovery HEIS # B30R45 initial DTW = 34.28' bgs (6/16/15)
30	SS G				DTW = 33.4 (6/17/15)
35	G	33.4			36.2: Water sample HEIS: B30R55 B30R57 (DUP) 36.3-38.8: split spoon B30R56 50% recovery. HEIS # B30R48
	WS SS				

Reported By: Tracy Mallgren
Title: Geologist
Signature: [signature] Date: 6/17/15

Reviewed By: Kevin Bergstrom
Title: Sr. Geologist
Signature: [signature] Date: 8/3/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 2
Date: 6/17/15

Well ID: C9486 | Well Name: 199-H1-46 | Location: ~1000m NW 105H

Project: 12 GW Wells in 100-HR-3 OU | 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
40	G			40-50.4' Silt (m) 6% Gravel, 10% Sand 84% mud. Gravel: vcp, well sorted max 60mm, 65% felsic, well rounded Sand: vf-f, well sorted, 60% felsic 2.5Y 5/6 light olive brown, wk-mod rxn w/HCl. mud: mod plasticity, clay nodules wet	Becker Hammer Triple wall casing Grab Samples collected every 5' or change in lithology
45	G			@45' Tr gravels: f. pebbles & ↑sand to 15%	
50				DTB = 50.4' bgs TD DTW = 33.4' bgs	
55				Not used 6/17/15	

Reported By: Tracy Mallgren | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr Geologist

Signature: [signature] Date: 6/17/15 | Signature: [signature] Date: 8/3/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

199-H1-46 (C9486)
Log Data Report

Borehole Information:

Log Date:	2015-06-18	Filename:	C9486_HG-NM_2015-06-18	Site:	100 H
Coordinates (WA St Plane)		DTW[1] (ft):	32.45	DTW Date:	6/18/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	06/17/15	N/A	50.4	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.) Outer	Diameter (in.) Inside	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	1.45	18-1/8	16-1/8	1.0	1.45	50.4

Borehole Notes:

The onsite geologist provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter (rounded to the nearest 1/16-in.). This drilling method employs a double wall drive pipe where compressed air is forced down the outer casing and geologic material is returned to the surface inside the inner casing. The inner casing was removed prior to logging. Water inside the casing was measured at 32.45 ft by the logging engineer with an e-tape. The maximum logging depth achieved was 48 ft.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1L	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	11/12/14	Serial No.:	47-TP32211A
Calibration Reference:	HGLP-CC-111, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 1H	Type:	NMLS[4]
Effective Calibration Date:	11/13/14	Serial No.:	H310700352
Calibration Reference:	HGLP-CC-112, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1018728	1018729			
Date	06/18/15	06/18/15			
Logging Engineer	Felt	Felt			
Start Depth (ft)	0.0	20.0			
Finish Depth (ft)	48.0	25.0			
Count Time (sec)	100	100			

[1] depth to water inside casing
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

A SUBSIDIARY OF HUNTINGTON INGALLS INDUSTRIES
2439 Robertson Drive • Richland, WA 99354 • Telephone (509) 946-6455 • www.stoller.com

Stoller Newport News Nuclear

Log Run	1	2 Repeat			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AL260CAB	AL260CAB			
Start File	AL260000	AL260049			
Finish File	AL260048	AL260054			
Post-Verification	AL260CAA	AL260CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	No fine gain adjustments made	No fine gain adjustments made			

NMLS Log Run Information:

Log Run	3	4 Repeat			
HEIS Number	1018730	1018731			
Date	06/18/15	06/18/15			
Logging Engineer	Felt	Felt			
Start Depth (ft)	0.0	15.0			
Finish Depth (ft)	32.5	19.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AH213CAB	AH213CAB			
Start File	AH213000	AH213131			
Finish File	AH213130	AH213147			
Post-Verification	AH213CAA	AH213CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	None	None			

Logging Operation Notes:

A centralizer was installed on the sondes.

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Analysis Notes:

Analyst:	K. Felt	Date:	06/20/15	Reference:	HGLP-MAN-003, Rev. 0

A casing correction for a 1-in. thick casing was applied to the log data. No correction was applied for the casing joints which are in excess of 1.5-in. and occur at approximately 10-ft intervals.

A correction for water was applied below 32.45 ft in depth.

Stoller Newport News Nuclear

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 1L20141112, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

NMLS data are reported in counts per second as there is no calibration for conversion to volumetric moisture for borehole diameters greater than 8-in.

The HGU[5] is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected in the borehole. MDLs for Cs-137 and Pu-239 are plotted for the entire borehole.

The relatively thick casing joints beginning at 9 ft and occurring at 10 ft intervals are indicated by reduced count rates on the total gamma log. The moisture log also appears to indicate effects of casing joints.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

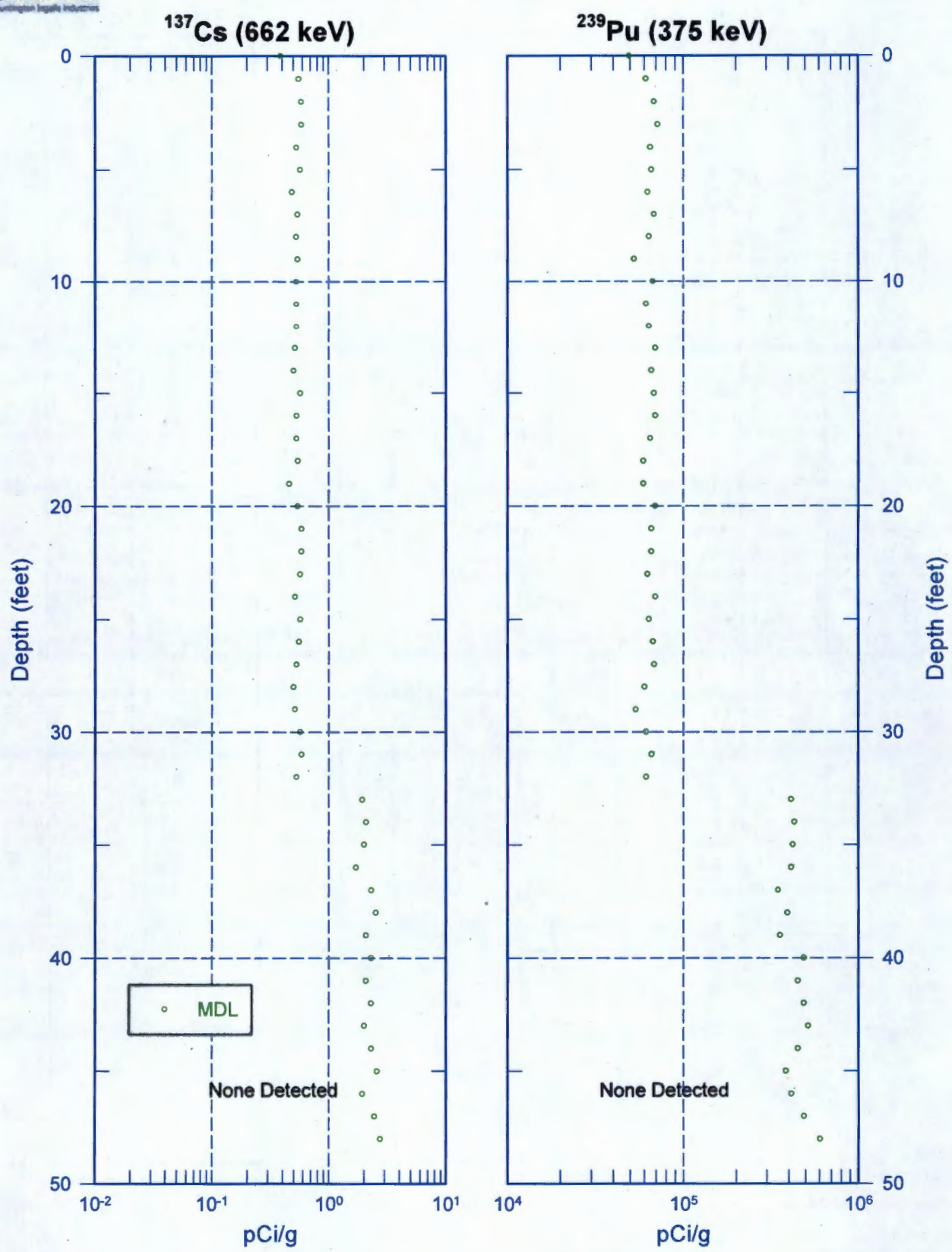
List of Log Plots:

Depth Reference is ground surface.

Manmade Radionuclides (0-50 ft)
Natural Gamma Logs (0-50 ft)
Combination Plot (0-120 ft)
Total Gamma & Moisture (0-50 ft)
Total Gamma & Hanford Gamma Unit (0-50 ft)
Repeat Section of Natural Gamma Logs (20-25 ft)
Moisture Repeat Section (15-19 ft)

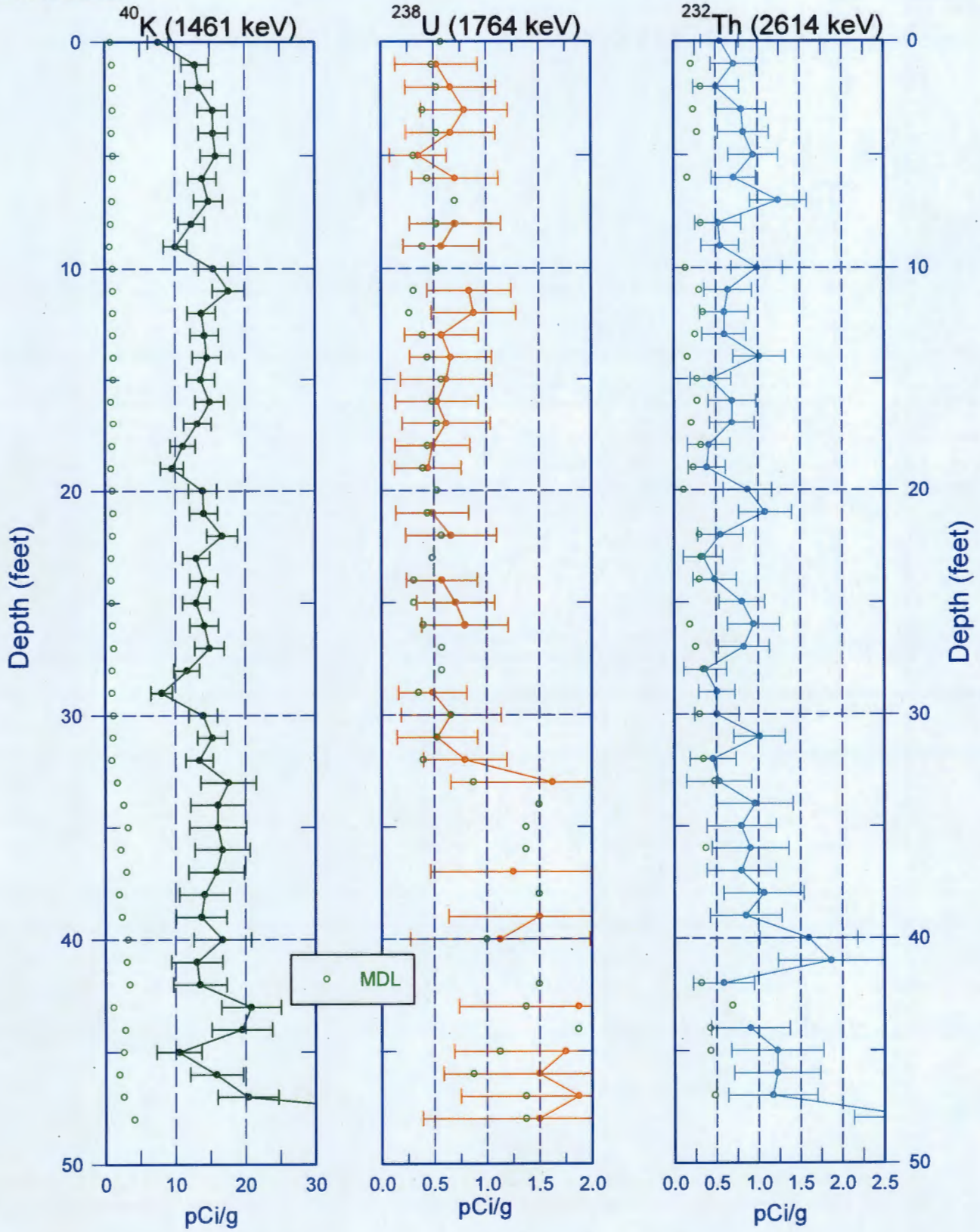
[5] Hanford Gamma Unit

199-H1-46 (C9486)
Manmade Radionuclides



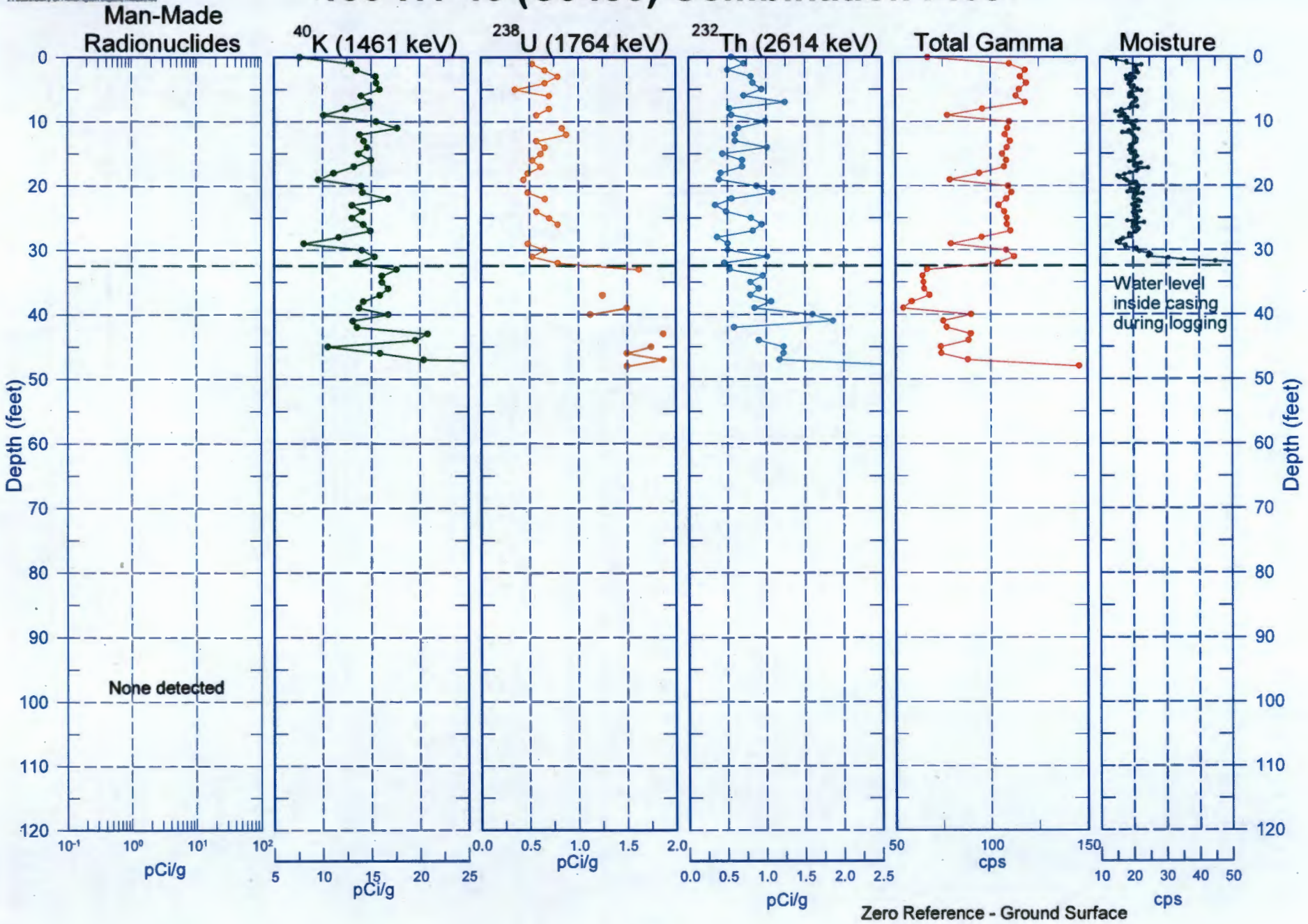
Zero Reference - Ground Surface

199-H1-46 (C9486)
Natural Gamma Logs

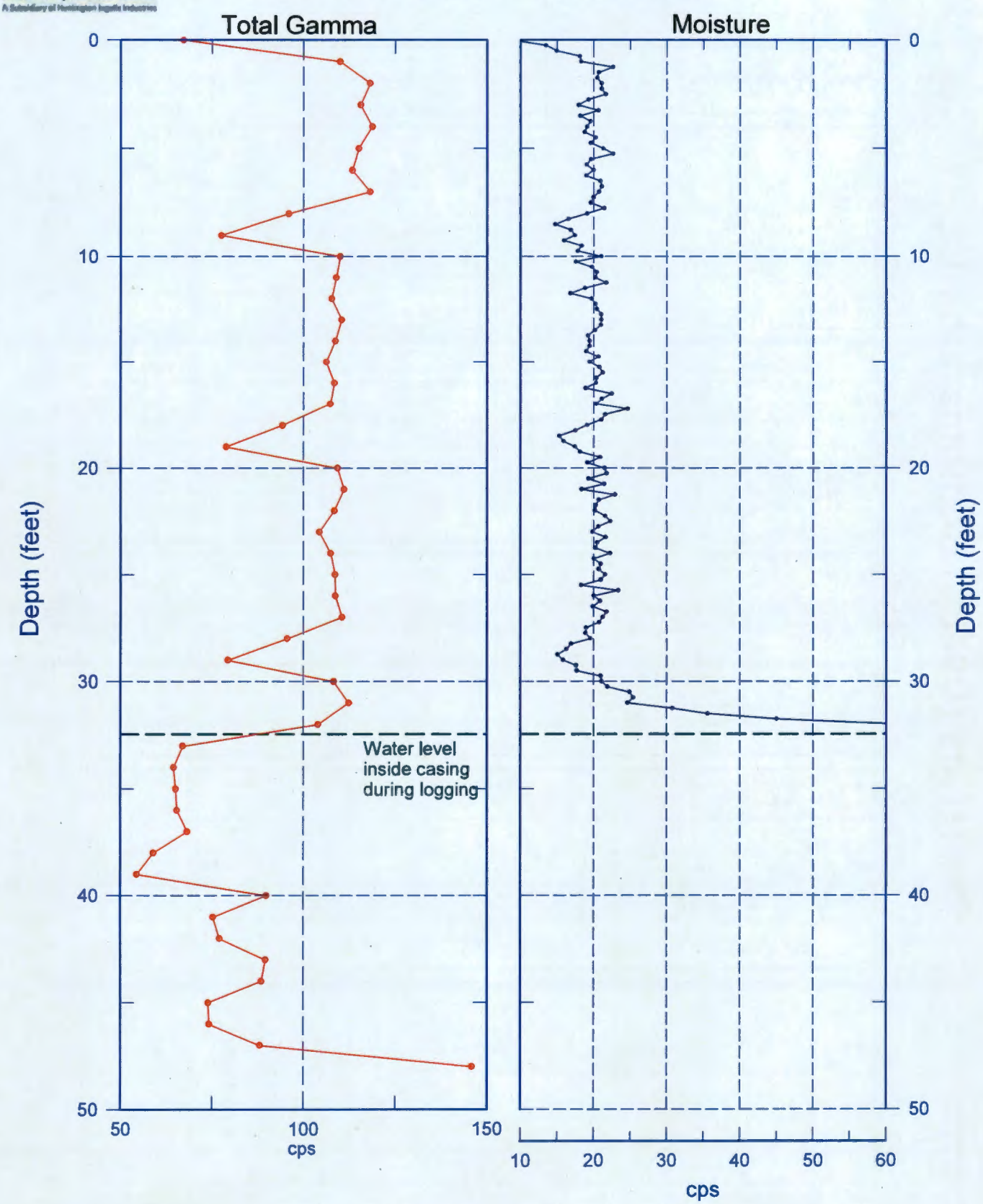


Zero Reference - Ground Surface

199-H1-46 (C9486) Combination Plot

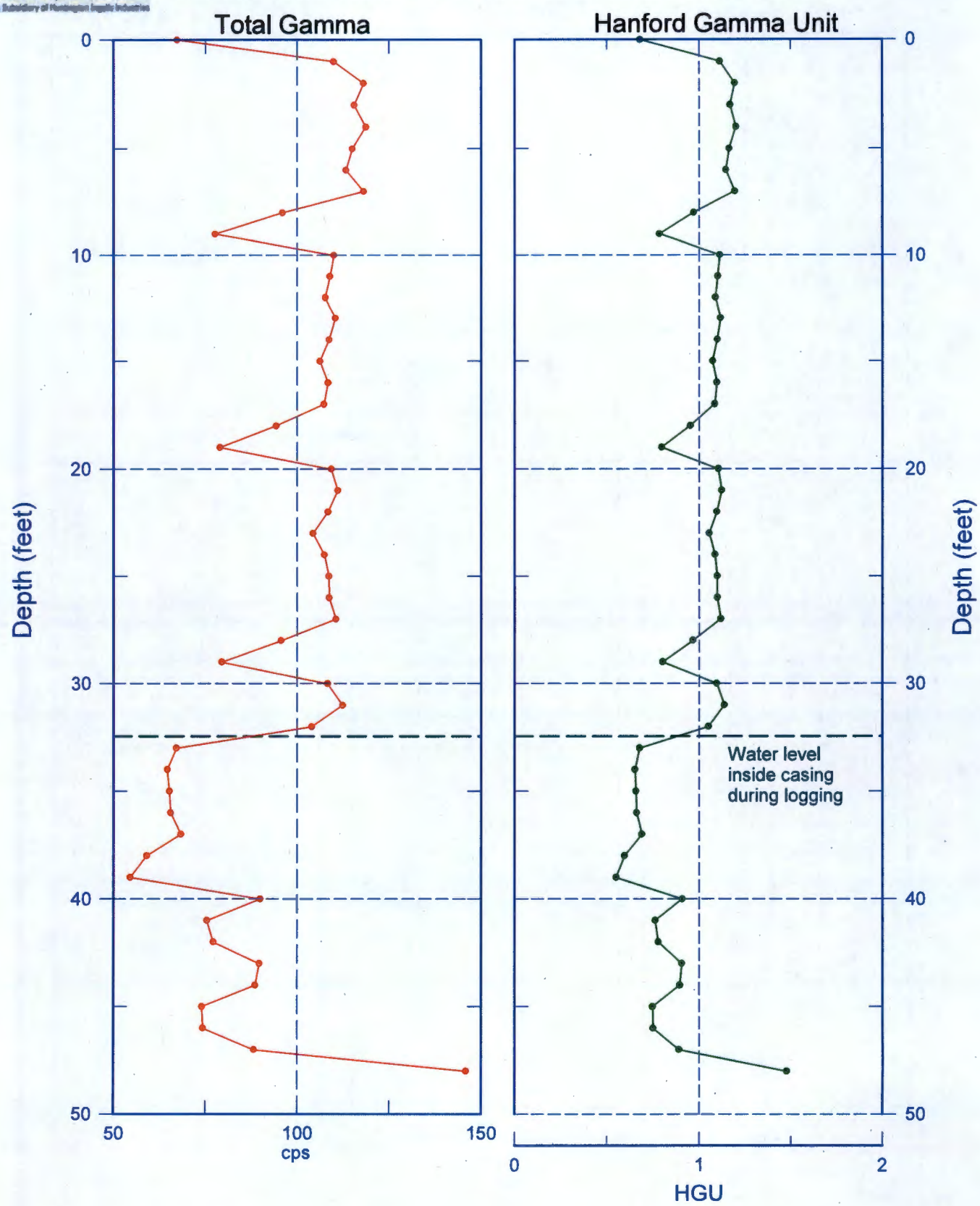


199-H1-46 (C9486)
Total Gamma & Moisture



Reference - Ground Surface

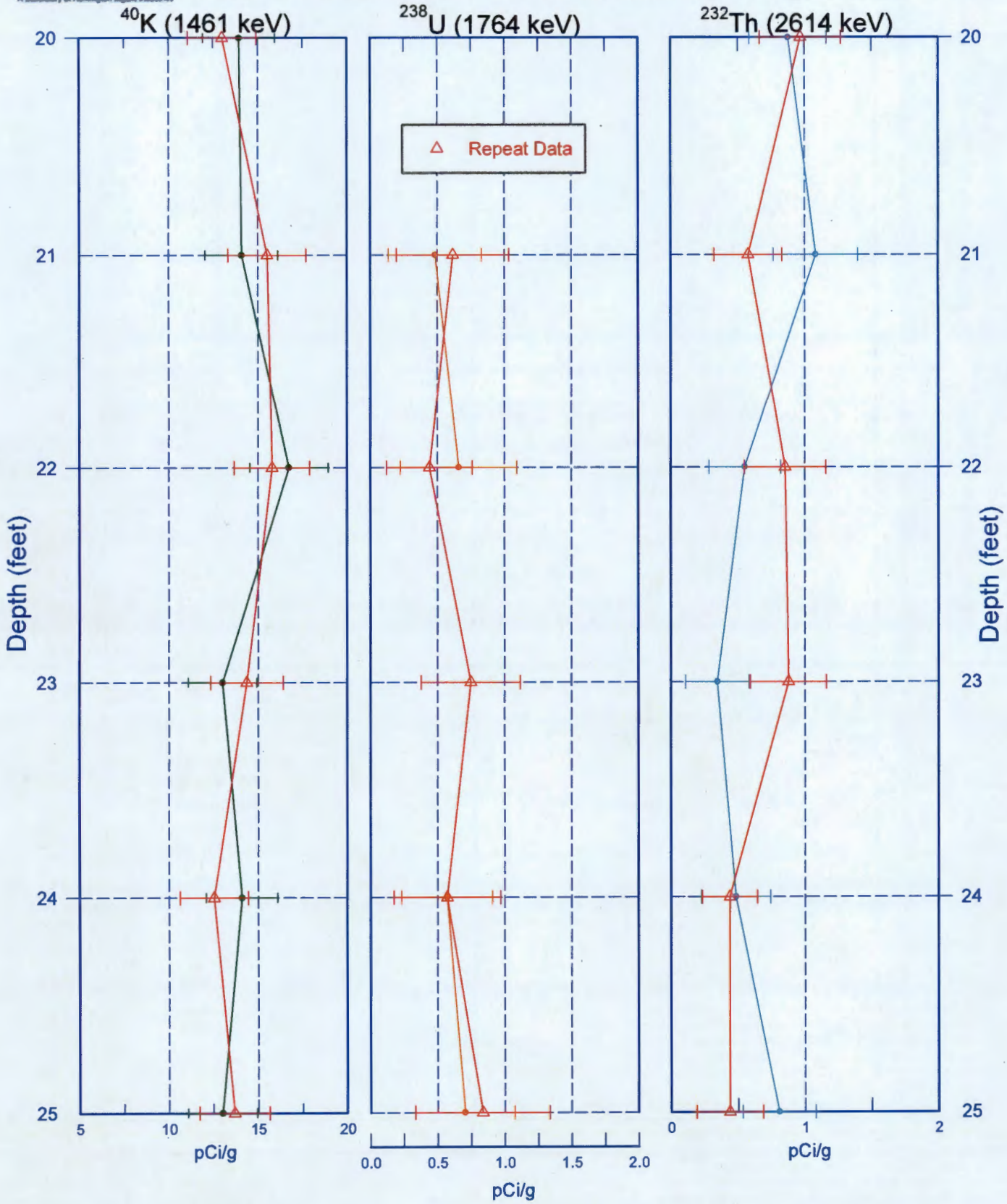
199-H1-46 (C9486)
Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

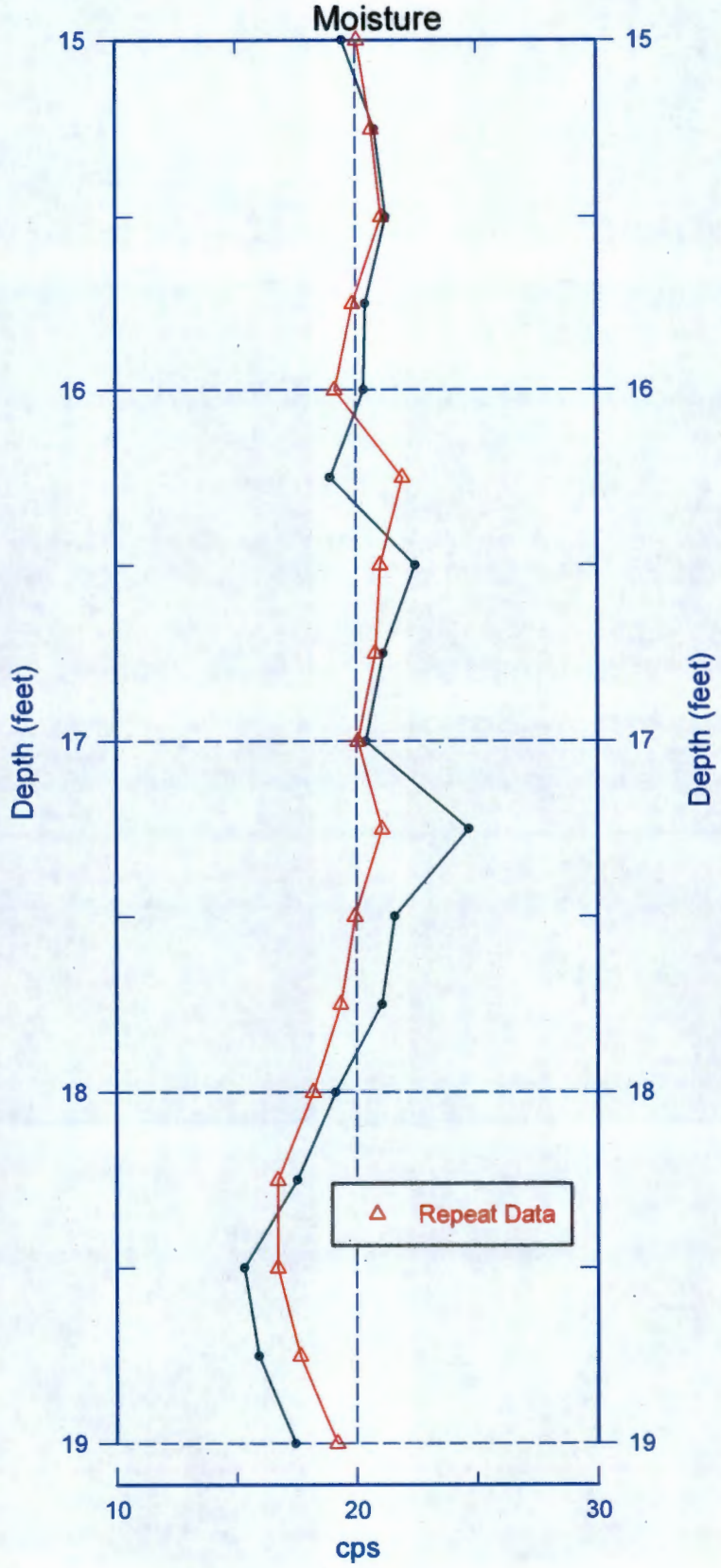
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

199-H1-46 (C9486)
Repeat Section of Natural Gamma Logs



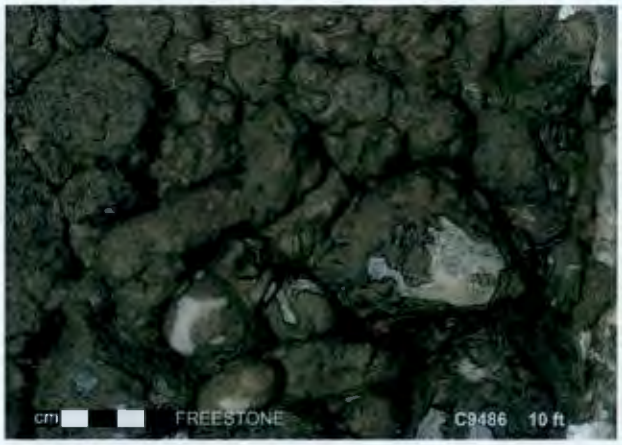
Zero Reference - Ground Surface

199-H1-46 (C9486)
Moisture Repeat Section



Reference - Ground Surface

cm
FREESTONE
C9486 5 ft


cm
FREESTONE
C9486 10 ft

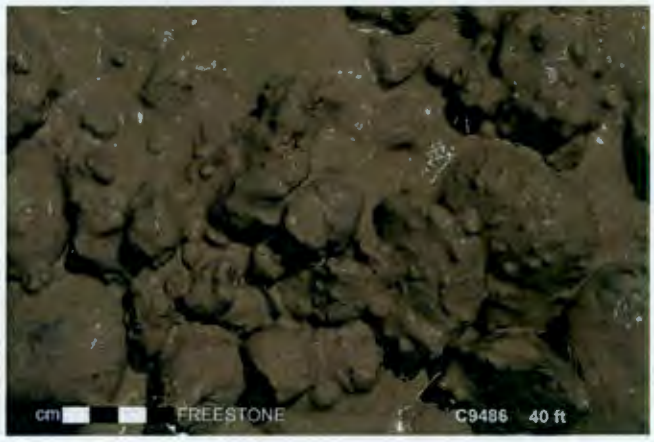
cm
FREESTONE
C9486 15 ft

cm
FREESTONE
C9486 20 ft

cm
FREESTONE
C9486 25 ft

cm
FREESTONE
C9486 30 ft

cm
FREESTONE
C9486 35 ft


cm
FREESTONE
C9486 40 ft

cm
FREESTONE
C9466 45 ft

SURVEY DATA REPORT				Request No. 154-144
Project No.	Title HR-3 Well C9486 (199-H1-46) Final Survey			File No. 1HT14R27
Job. No. CACN: 303662-JPRC	Prepared By N.P. Fastabend	Date 7/23/15	Reviewer LBM	

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casing) and elevations of completed HR-3 Well C9486 (199-H1-46) located on the northwest side of 100H Area.	Survey File	OR		
	J.D. Mehrer	1		
	K.M. Whitley	1		
	J.L. Smoot	1		
	J.B. Geiger	1		
	B.J. Howard	1		
Horizontal Coordinate System: WCS83S/91 (Meters) Vertical Datum: NAVD88 (Meters)	A.J. Green	1		

SURVEY RESULTS AND COMMENTS

See Attached Well Survey Data Report Sheet

WELL SURVEY DATA REPORT

Project:	Prepared By: Neil P. Fastabend Company: CHPRC
Date Requested: 07/07/15	Requestor: Jim Mehrer (CHPRC)
Date of Survey: 07/23/15	Surveyor: Lawrence B. Munnell (CHPRC)
Fluor Hanford Point of Contact:	Survey Co. Point of Contact: Neil P. Fastabend
Description of Work: Obtain final survey coordinates (C/L Casing) and elevations of HR-3 Well C9486 (199-H1-46) located on northwest side of 100H Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 100H

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
HSWB-030 (COE) and HSWB-029 (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C9486	199-H1-46	576986.90·	153456.95·		Center of Casing
				126.531·	"X" on Rim
				125.791·	Brass Survey Marker

Notes:

126.069· Top Inner Casing, North Edge

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify this report is based on a field survey performed by me, or under my direct supervision.

LAWRENCE B. MUNNELL
STATE OF WASHINGTON
16216
REGISTERED
PROFESSIONAL LAND SURVEYOR

7-23-15

A-6003-659 (04/03)

Distribution

Onsite

Electronic Copies Only	CHPRC	
	D.P. Capelle	R3-60
	J.B. Geiger	R3-60
	A.J. Green	R3-60
	K.M. Whitley	R3-50
	B.A. Williams	H8-51
	K.A. Ivarson	R3-50