SGW-59346
Revision 0

Borehole Summary Report for the Installation of Seven M-24 Tri-Party Agreement Groundwater Monitoring Wells 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

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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Terms

B Plant	221-B Canyon
bgs	below ground surface
CCU	Cold Creek unit
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CHPRC	CH2M Hill Plateau Remediation Company
D.O.	dissolved oxygen
Ecology	Washington State Department of Ecology
ft	feet
gal	gallon
gpm	gallons per minute
HCl	hydrochloric acid
HEIS	Hanford Environmental Information System
hp	horsepower
ID	Identification
LERF	Liquid Effluent Retention Facility
NMLS	Neutron Moisture Logging System
NTU	nephelometric turbidity unit
OU	operable unit
RCRA	*Resource Conservation and Recovery Act of 1976*
RTF	Ringold Formation member of Taylor Flat
Ringold E	Ringold Formation member of Wooded Island – unit E
RLM	Ringold Formation member of Wooded Island – lower mud unit
Ringold A	Ringold Formation member of Wooded Island – unit A
SGLS	Spectral Gamma Logging System
SN3	Stoller Newport News Nuclear, Inc
TD	total depth
VOC	volatile organic compound
WAC	*Washington Administrative Code*
WMA	Waste Management Area

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 seven Tri-Party Agreement M-24 Milestone groundwater monitoring wells in the 200-UP-1 and 200-BP-5 Groundwater Operable Units (OUs) at the Hanford Site. The seven monitoring wells were installed to better support the characterization and vertical profiling of aquifer contaminant plumes and to determine the extent, concentration, and rate-of-movement of dangerous waste constituents.

The 200-UP-1 and 200-BP-5 OUs are located in the center of the Hanford Site, approximately 20 miles north-northwest of Richland, Washington and include portions of the 200-West and 200-East Areas. Four of the seven wells are associated with the 200-UP-1 OU and were installed in 200-West at the Waste Management Area (WMA) S-SX (Tank Farms) to replace *Resource Conservation and Recovery Act of 1976* (RCRA) wells that are dry, nearly dry, or out of compliance. Three of the seven wells are associated with the 200-BP-5 Groundwater OU and were installed in the 200-East Area. One of which was installed to satisfy RCRA requirements at the Liquid Effluent Retention Facility (LERF) and two of which were installed to satisfy *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) requirements at the 216-B-12 Crib and 221-B Canyon (B Plant). The seven monitoring well installations support Ecology et al., (1989), *Hanford Federal Facility Agreement and Consent Order* and were designed in compliance with requirements of both RCRA and CERCLA.

The wells installed in 200-West will monitor technetium-99, tritium, total chromium, and nitrate that leaked from the WMA S-SX Tank Farms. The well installed downgradient of LERF in 200-East, will expand the current groundwater level monitoring network around the facility. The two wells installed near the 216-B-12 Crib and B Plant will monitor nitrate, tritium, and uranium contamination that originated from past process condensate disposal.

The project scope of work for the groundwater monitoring wells was described in SGW-58433, *Description of Work for the Installation of Eight M-24 Tri-Party Agreement Groundwater Monitoring Wells, FY 2015.* The project originally planned for drilling, sampling, and well construction at eight locations, however, one location (C9449) was removed from the investigation due to conflicting WMA C waste retrieval operations. At the completion of the project, the four 200-West wells were completed approximately 40 feet (ft) below static water and the three 200-East wells were completed near the bottom of the unconfined aquifer.

Drilling and well construction activities associated with the seven new groundwater monitoring wells were conducted between March 24, 2015 and July 22, 2015 by both StillWater LLC. and Layne Christensen Co. 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, Inc (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 seven new groundwater monitoring wells. This report includes field notes and forms prepared during the drilling and construction of the wells, well construction details, well development data, geophysical logs, and digital photos of the drill cuttings. Additional information provided in this report includes descriptions of the subsurface geology encountered at the wells, results of the well location and elevation civil survey, descriptions of the management and disposition of drilling-derived waste, and a summary of the well acceptance activity.

The primary controlling document for the drilling and construction activities was SGW-58433, *Description of Work for the Installation of Eight M-24 Tri-Party Agreement Groundwater Monitoring Wells, FY 2015,* Rev. 0. Sampling activities were performed in accordance with DOE/RL-2010-130, *Sampling and Analysis Plan for Installation of Single-Shell Tank Waste Management Area S-SX RCRA Monitoring Wells 299-W22-93 and 299-W22-94;* SGW-58277, *Sampling Instructions for Installation of Single-Shell Tank Waste Management Area S-SX Monitoring Wells 299-W22-115, 299-W22-116, and 299-W23-236*, Rev. 0; and SGW-58328, *Sampling Instruction for the FY2015 M-24 200 East Groundwater Monitoring Well Drilling and Installations*, Rev. 0.

The locations of the seven new groundwater wells are shown in Figure 1-1. Well identification and drilling date information are presented in Table 1-1. Appendices A (C8202), B (C9430), C (C9431), D (C9432), E (C8913), F (C9447), and G (C9448) contain the geologic borehole log, well summary sheet, well development and testing data, sample collection summary, photographic log, well survey report, and geophysical log for the respective well. For convenience, all wells are referred to in the text by their well identification number (e.g., C8202).

Table 1-1. Identification of New Wells

Well ID	Well Name	Well Type	Ecology ID Number	Well Activity Dates	
				Drilling Start Date	Well Completion Date
200-West Area Wells					
C8202	299-W22-93	Replacement/Monitoring	BIN118	5/6/2015	5/13/2015
C9430	299-W22-115	Replacement/Monitoring	BIN116	5/15/2015	6/4/2015
C9431	299-W22-116	Replacement/Monitoring	BIN139	4/7/2015	4/27/2015
C9432	299-W23-236	Replacement/Monitoring	BIN 117	4/13/2015	5/11/2015
200-East Area Wells					
C8913	299-E26-15	RCRA/Monitoring	BIN121	5/19/2015	6/12/2015
C9447	299-E28-31	CERCLA/Monitoring	BIN126	3/24/2015	6/2/2015
C9448	299-E28-32	CERCLA/Monitoring	BIN125	5/28/2015	7/22/2015

Ecology = Washington State Department of Ecology

Figure 1-1. New Well Locations in 200-West Area and 200-East Area

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2 Field Activities

This section summarizes the field activities associated with the seven groundwater wells. Drilling, sampling, and construction details common to all the wells, or common to all wells in an area, are summarized in Section 2.1. Well-specific information is presented in Tables 2-1 and 2-2, and Section 2.2. Geologic borehole logs, well summary sheets, geophysical logs, and drill cutting photographs for each borehole are presented in Appendices A through G.

2.1 General Information

The boreholes were drilled and the wells were constructed to Washington State standards detailed in the WAC 173-160*, "Minimum Standards for Construction and Maintenance of Wells."* Drilling 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.*

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

2.1.1 Well Drilling and Borehole Logging

Sections 2.1.1.1 and 2.1.1.2 summarize activities common to the drilling and logging of the seven groundwater wells.

2.1.1.1 Borehole Geologic Logging and Photography

Detailed descriptions of all drill cuttings were recorded according to CHPRC procedure SGRP-PRO-EN-50025. Scaled digital photographs were taken in the field to accompany the field description. Geologic logs and drill cutting photographs for each borehole are presented in Appendices A through G.

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. All casing strings were logged individually. Log Data Reports of all geophysical logging results, provided by SN3, are presented in Appendices A through G.

2.1.2 Sampling and Health and Safety Screening

Sections 2.1.2.1 through 2.1.2.4 summarize the sampling and health and safety activities common to all four groundwater wells.

2.1.2.1 Archive Lithologic Sampling

Archive samples were collected from the drill cuttings at each borehole at 5-ft intervals and at changes in litholoy. 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

200-West Area
Sediment samples were collected for sieve analysis every 5 ft and composited over the entire saturated zone. Sieve analyses were performed in accordance with SGRP-PRO-OP-50037 (GRP-EE-05-1.21), *Particle Size Distribution of Soil-Wet Sieve Analysis,* on each composite sample. Sieve analysis results

were used to determine the appropriate screen slot size for the completed well and are presented in Appendices A through D.

200-East Area
Sediment samples were collected for sieve analysis every 5 ft and composited into 10 ft intervals. Sieve analyses were performed in accordance with SGRP-PRO-OP-50037, on each composite sample. Sieve analysis results were used to determine the appropriate screen slot size for the completed well and are presented in Appendices E through G.

2.1.2.3 Groundwater Sampling

Groundwater samples were collected from certain boreholes using a temporary submersible pump. Groundwater samples were collected by a nuclear chemical operator once 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 prior to sample collection according to CHPRC procedure SGRP-PRO-SMP-50060 (GRP-FS-04-G-028), *Field Characterization and Treatment Monitoring Activities Groundwater Sampling*. All groundwater sample depths and associated Hanford Environmental Information System (HEIS) numbers are included in Section 2.2.

2.1.2.4 Radiological Field Screening

200-West Area
A radiological control technician performed radiological surveys of the drill cuttings, geologic samples, temporary drive casing, and drillers' control station every morning and afternoon at all of the wells using standard field screening instruments. Radiological support switched to continuous coverage while in the saturated zone.

200-East Area
A radiological control technician performed radiological surveys of the drill cuttings, geologic samples, temporary drive casing, and drillers' control station every morning and afternoon at all of the wells using standard field screening instruments.

2.1.2.5 Air Quality Monitoring

Air quality monitoring was performed by an industrial hygienist technician twice daily to check for volatile organic compound (VOC) vapors. The drillers' breathing zone near the wellhead, the fresh drill cuttings, and geologic samples were surveyed for VOCs using a photoionization detector. Air quality was also monitored during groundwater sampling.

2.1.3 Well Construction and Development

Sections 2.1.3.1 through 2.1.3.6 summarize well construction and development properties and activities common to all seven wells. Specific information regarding well construction and development can be found in Table 2-1 and Section 2.2. Well summary sheets included in Appendices A through G provide visual representations of each well design as-built.

2.1.3.1 Well Screen and Casing

Wells were constructed using 4-in nominal diameter, schedule 304/304L stainless steel casing, continuous wire wrap well screen, and a sump with end cap. Temporary casing diameters were selected to ensure the annulus was a "minimum of four inches greater in diameter than the nominal size of the permanent casing", as specified under WAC 173-160.

2.1.3.2 Primary Filter Pack

The primary filter pack surrounding the screen at all wells consists of 10-20 mesh Colorado Silica Sand. Following placement of each 10-ft interval, 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 may be found in Table 2-1 and Section 2.2.

2.1.3.4 Surface Completion

The surface completion consists of a 6-in nominal diameter 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 and extend to 3 ft above the ground surface.

2.1.3.5 Well Development

Well development occurred at each well following completion and in accordance with CHPRC procedure SGRP-PRO-OP-50024 (GRP-EE-01-6.3), *Well Development and Testing*. Well development occurred at each well following completion. The wells were developed at one or more intervals depending on the length of the screen. Each interval was pumped until turbidity was less than 5 nephelometric turbidity units (NTU) and additional water quality parameters (conductivity, pH, and temperature) stabilized.

At all seven wells, the water level was monitored using an In-Situ Inc., Level TROLL[1] 700 pressure transducer and Rugged Reader[2] datalogger. Final development data is summarized in Table 2-2.

2.1.3.6 Washington State Department of Ecology Identification

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

2.2 Site Specific Information for Groundwater Wells

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

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

[2] Rugged Reader is a registered trademark of In-Situ, Inc., Fort Collins, Colorado.

Table 2–1. Well Construction Information

Well ID	Total Depth Drilled (ft)	Permanent Screen and Casing[a]					Surface Seal[b] (ft bgs)	Annular Seal[c] (ft bgs)	Bentonite Seal[d] (ft bgs)	Primary Filter Pack[e] (ft bgs)	Filter Pack Mesh Size
		Casing Size (in)	Blank Casing (ft bgs)	Screen (ft bgs)	Screen Slot Size	Sump/ End Cap (ft bgs)					
200-West Area Wells											
C8202	288.1	4-in	+1.5–245.2	245.2–280.2	20	280.2–285.2	0–10.0	10.0–240.8	–	240.8–288.1	10–20
C9430	272.3	4-in	+2.1–230.8	230.8–265.9	20	265.9–270.9	0–10.1	10.1–226.7	–	226.7–272.3	10–20
C9431	275.3	4-in	+2.0–235.0	235.0–270.0	20	270.0–275.0	0–10.5	10.5–230.6	–	230.6–275.3	10–20
C9432	261.3	4-in	+2.1–219.8	219.8–254.8	20	254.8–259.8	0–10.0	10.0–215.4	–	215.4–261.3	10–20
200-East Area Wells											
C8913	206.3	4-in	+2.0–191.1	191.1–206.4	30	–	0–9.6	9.6–186.6	–	186.6–206.9	10–20
C9447	362.0	4-in	+2.0–335.4	335.4–345.4	20	345.42–350.5	0–14.2	14.2–296.5 296.5–318.6	318.6–331.6 352.3–362.0	331.6–352.3	10–20
C9448	372.4	4-in	+2.0–361.4	361.4–371.4	20	–	0–15.3	15.3–305.4 305.4–350.1[b]	350.1–358.0	358.0–371.7	10–20

a. Schedule 10, Type 304/304L Stainless Steel
b. Type I/II Portland cement grout
c. Medium bentonite chips, crumbles
d. Coated bentonite pellets (3/8–in)
e. Silica sand
\+ = above ground surface
– = not applicable
ft bgs = feet below ground surface
in =inch

Table 2-2. 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
200-West Area Wells							
C8202	245.4 (5/18/15)	U: 264.6 L: 274.6	U: 61 L: 70	U: 33 L: 30	U: 0.9 L: 1.29	U: 5.7 L: 5.3	U: 2,013 L: 2,100
C9430	232.1 (6/5/15)	U: 252.8 L: 263.4	U: 67 L: 150	U: 26 L: 26	U: 2.45 L: 4.71	U: 10.44 L: 25.08	U:1,742 L: 3,744
C9431	237.3 (5/11/15)	U: 249.6 L: 269.6	U: 48 L: 61	U: 25 L: 25	U: 0.98 L: 1.47	U: 0.0 L: 0.0	U: 1,200 L: 1,525
C9432	220.5 (5/12/2015)	U: 234.2 L: 249.3	U: 71 L: 122	U: 11 L: 27	U: 3.62 L: 4.73	U: 4.1 L: 11.3	U: 781 L: 3,294
200-East Area Wells							
C8913	203.4 (6/16/2015)	205.0	45	6.7	1.77	0.4	301.5
C9447	296.7 (6/4/2015)	341.6	890	8.25	29.0	40.5	7,342.5
C9448	304.9 (7/23/2015)	367.2	70	16.7	2.33	29.4	1,169

ft bgs = feet below ground surface
gpm = gallons per minute
L = lower interval
U = upper interval
NTU = nephelometric turbidity unit

2.2.1 Well 299-W22-93 (C8202)

Borehole C8202 was drilled on May 6, 2015 by Layne Christensen Co. using an AP1000 Becker Hammer drill rig (Figure 2-1), dual-wall air percussion, and 8⅞-in nominal diameter dual-wall threaded carbon steel casing to reach a total depth (TD) of 288.1 feet below ground surface (ft bgs). Approximately 1-2 gallons of water per foot of advance (approximately 370 gallons total) were added during drilling for dust suppression in the vadose zone and to loosen casing in the saturated zone. The borehole was logged after placement of the 8⅞-in casing to a TD of 288.1 ft bgs on May 7, 2015 using SGLS and on May 8, 2015 using NMLS.

Figure 2-1. Layne Christenson Company AP1000 Becker Hammer Rig.

A borehole straightness test was successfully performed on May 11, 2015 and well construction was performed from May 11, 2015 to May 15, 2015. The well was constructed as a 4-in diameter monitoring well with a 35-ft long 20-slot screened interval above a 5-ft long sump. Centralizers were not installed during construction due to a narrow annulus. The annulus was filled from depth to surface with 48.1 ft of 10-20 mesh sand, 230.8 ft of bentonite chips, and 10.0 ft of cement grout. All temporary casing was removed during well construction.

Well development occurred on May 18, 2015, using a Centri Pro 3 horsepower (hp) submersible pump. Well development information may be found in Table 2-2. Static water level was measured before well development at 254.4 ft bgs on May 18, 2015.

2.2.2 Well 299-W22-115 (C9430)

Drilling at borehole C9430 was performed on May 15, 2015 by Layne Christensen Co. using an AP1000 Becker Hammer drill rig, dual-wall air percussion, and 8⅞-in nominal diameter dual-wall threaded carbon steel casing to reach a TD of 272.3 ft bgs. Approximately 1-2 gallons of water per foot of advance (approximately 350 gallons total) were added during drilling for dust suppression in the vadose zone and to loosen casing in the saturated zone. The borehole was logged after placement of the 8⅞-in temporary casing to a TD of 272.3 ft bgs on May 18, 2015 using NMLS and on May 19, 2015 using SGLS.

A borehole straightness test was performed on May 21, 2015 and well construction was performed from May 21, 2015 to June 4, 2015. The well was constructed as a 4-in diameter monitoring well with a 35-ft

long 20-slot screened interval above a 5-ft long sump. Centralizers were not installed during construction due to a narrow annulus. The annulus was filled from depth to surface with 45.6 ft of 10-20 mesh sand, 216.6 ft of bentonite chips, and 10.1 ft of cement grout. All temporary casing was removed during well construction.

Well development occurred on June 5, 2015 using a TriSeal 3 hp submersible pump. Static water level was measured before well development at 232.1 ft bgs on June 5, 2015.

2.2.3 Well 299-W22-116 (C9431)

Drilling at borehole C9431 was performed from April 7, 2015 to April 9, 2015 by Layne Christensen Co. using an AP1000 Becker Hammer drill rig, dual-wall air percussion, and 8⅞-in nominal diameter dual-wall threaded carbon steel casing to reach a TD of 275.3 ft bgs. Approximately 1-2 gallons of water per foot of advance (approximately 350 gallons total) were added during drilling for dust suppression in the vadose zone and to loosen casing in the saturated zone. The borehole was logged after placement of the 8⅞-in temporary casing to 275.3 ft bgs on April 9, 2015 using NMLS and on April 13, 2015 using SGLS.

A borehole straightness test was performed on April 20, 2015 and well construction was performed from April 20, 2015 to April 27, 2015. The well was constructed as a 4-in diameter monitoring well with a 35-ft long 20-slot screened interval above a 5-ft long sump. Centralizers were not installed during construction due to a narrow annulus. The annulus was filled from depth to surface with 44.7 ft of 10-20 mesh sand, 220.1 ft of bentonite chips, and 10.5 ft of cement grout. All temporary casing was removed during well construction.

Well development occurred on May 11, 2015, using a 3 hp submersible pump. Static water level was measured before well development at 237.3 ft bgs on May 11, 2015.

2.2.4 Well 299-W23-236 (C9432)

Drilling at borehole C9432 was performed from April 13, 2015 to April 16, 2015 by Layne Christensen Co. using an AP1000 Becker Hammer drill rig, dual-wall air percussion, and 8⅞-in nominal diameter dual-wall threaded carbon steel casing to reach a TD of 261.3 ft bgs. An ammonia odor was detected by the drillers during drilling activities and then measured (10 ppm) by the industrial hygienist at the borehole entrance. Work was temporarily suspended until the lead industrial hygienist determined it was safe for work to continue.

Pumped groundwater samples were collected during drilling using a 3 hp submersible pump and are summarized in Table 2-3. The borehole was purged for a minimum of three borehole volumes and in accordance with CHPRC procedure SGRP-PRO-SMP-50060. The borehole was logged to a TD of 261.3 ft bgs from April 20, 2015 to April 21, 2015 using NMLS and from April 21, 2015 to April 22, 2015 using SGLS after placement of the 8⅞-in temporary casing.

A borehole straightness test was performed on April 28, 2015 and well construction was performed from April 28, 2015 to May 11, 2015. The well was constructed as a 4-in diameter monitoring well with a 35-ft long 20-slot screened interval above a 5-ft long sump. Centralizers were not installed during construction due to a narrow annulus. The annulus was filled from depth to surface with 45.9 ft of 10-20 mesh sand, 205.4 ft of bentonite chips, and 10.0 ft of cement grout. Several pieces of carbon steel casing became contaminated with low-level fixed radiological contamination and were kept in a radioactive material area when not in use. The contaminated casing was treated as miscellaneous solid waste and was transferred to Environmental Restoration Disposal Facility for disposal at the end of well completion. All temporary casing was removed during well construction.

Well development occurred from May 12, 2015 to May 13, 2015, using a 3 hp submersible pump. Static water level was measured before well development at 220.5 ft bgs on May 12, 2015.

Table 2-3. C9432 Groundwater Samples Collected During Drilling

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Vol. Purged (gal)	Turbidity (NTU)	D.O at Sample Collection (mg/L)	HEIS number
4/15/15	228.7	Groundwater pumped	1	76	29.1	7.20	B31358,B31359
4/16/15	261.4	Groundwater pumped	5	335	11.2	8.09	B31360,B31361

D.O. = dissolved oxygen
ft bgs = feet below ground surface
gal = gallon
gpm = gallons per minute
HEIS = *Hanford Environmental Information System*
NTU = nephelometric turbidity unit

2.2.5 Well 299-E26-15 (C8913)

Drilling at borehole C8913 was performed from May 19, 2015 to May 20, 2015 by Layne Christensen Co. using an AP1000 Becker Hammer drill rig, dual-wall air percussion, and 8⅞-in nominal diameter dual-wall threaded carbon steel casing to reach a TD of 206.9 ft bgs. Continuous radiological support was required during drilling and construction activities due to low-level radiological contamination in the surrounding soil. The borehole was logged to a TD of 206.9 ft bgs on May 21, 2015 using NMLS and from May 26, 2015 to May 27, 2015 using SGLS after placement of the 8⅞-in temporary casing.

A borehole straightness test was performed on June 11, 2015 and well construction was performed from June 11, 2015 to June 12, 2015. The well was constructed as a 4-in diameter monitoring well with a 15-ft long 30-slot screened interval with an endcap. Centralizers were not installed during construction due to a narrow annulus. The annulus was filled from depth to surface with 20.3 ft of 10-20 mesh sand, 177.0 ft of bentonite chips, and 9.6 ft of cement grout. All temporary casing was removed during well construction.

Well development occurred on June 16, 2015 using a Pulstar Pump Rig and ½-hp submersible pump. Static water level was measured before well development at 203.4 ft bgs on June 16, 2015.

2.2.6 Well 299-E28-31 (C9447)

Drilling at borehole C9447 was performed from March 24, 2015 to June 4, 2015 by StillWater LLC. using a Bucyrus-Erie 22-W Series 3 cable-tool rig and both 13⅜-inch and 11⅞-inch nominal diameter threaded carbon steel casing to reach a TD of 362.0 ft bgs. The borehole was drilled by core barrel with 13⅜-in nominal diameter casing to 138.9 ft bgs and then with 11⅞ -in nominal diameter casing to TD. Radiological field measurements detected radiation readings slightly above background levels on cuttings during drilling, but were not significant enough to suspend operations.

Pumped groundwater samples were collected during drilling using a 3 hp submersible pump and are summarized in Table 2-4. The borehole was purged for a minimum of three borehole volumes and in accordance with CHPRC procedure SGRP-PRO-SMP-50060. The borehole was logged on April 1, 2015 using SGLS and NMLS following placement of the 13⅜-in temporary casing to a depth of 138.9 ft bgs.

On May 11, 2015 and May 12, 2015, following the placement of the 11⅞-in casing, the remainder of the borehole was logged using SGLS and NMLS.

Table 2-4. C9447 Groundwater Samples Collected During Drilling

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Vol. Purged (gal)	Turbidity (NTU)	D.O at Sample Collection (Mg/L)	HEIS number
4/13/15	305.5	Groundwater pumped	5.8	359.6	61.1	6.57	B30T27,B30T28, B30T39, B30T59
4/15/15	320.96	Groundwater pumped	12.7	1,143	>1,000	4.75	B30T31, B30T32, B30T40, B30T61
4/23/15	340.97	Groundwater Pumped	1.75	351.3	>1,000	2.31	B30T35,B30T36, B350T41, B30T63
4/28/15	348.7	Groundwater Pumped	5.3	641.3	>1,000	0.65	B30T37,B30T38, B30T42,B30T64

D.O. = dissolved oxygen
ft bgs = feet below ground surface
gal = gallon
gpm = gallons per minute
HEIS = *Hanford Environmental Information System*
NTU = nephelometric turbidity unit

A borehole straightness test was performed on May 14, 2015 and well construction was performed from May 14, 2015 to June 2, 2015. The well was constructed as a 4-in diameter monitoring well with a 10-ft long 20-slot screened interval above a 5-ft long sump. Centralizers were installed above and below the screen and at 40-ft intervals to ground surface. The annulus was filled from depth to surface with 9.7 ft of coated bentonite pellets, 20.7 ft of 10-20 mesh sand, 13.0 ft of coated bentonite pellets, 22.1 ft of cement grount, 282.3 ft of bentonite chips, and 14.2 ft of cement grout.

Well development occurred on June 3, 2015 and June 4, 2015 using a Pulstar Pump and a Grundfos[3] 3 hp submersible pump. Static water level was measured before well development at 296.7 ft bgs on June 3, 2015. Well development was considered complete by the BTR after 890 minutes of pumping and with a turbidity reading of 29.0 NTU.

2.2.7 Well 299-E28-32 (C9448)

Drilling at borehole C9448 was performed from May 28, 2015 to July 7, 2015 by StillWater LLC. using a Bucyrus-Erie 22-W Series 3 cable-tool rig and both 13⅜-inch and 11⅞-inch nominal diameter carbon steel casing to reach a TD of 372.4 ft bgs. The 13⅜-in casing was used to 138.8 ft bgs and the 11⅞ -in casing to TD. Continuous radiological support was required due to low-level radiological contamination in the surrounding soil.

Pumped groundwater samples were collected during drilling using a 3 hp submersible pump and are summarized in Table 2-5. Due to low recharge, only two borehole volumes were purged before the first water sample was collected. All other samples were purged the requiste three borehole volumes and in accordance with CHPRC procedure SGRP-PRO-SMP-50060. The borehole was logged on June 4, 2015 and June 8, 2015 using SGLS and NMLS following placement of the 13⅜-in temporary casing to a depth

[3] Grundfos is a registered trademark of Grundfos Group, Downer Grove, Illinois.

of 140.0 ft bgs. On July 9, 2015 through July 14, 2015, following the placement of the 11⅞-in casing, the borehole was logged using NMLS to a depth of 305.0 ft bgs and SGLS to a depth of 371.0 ft bgs.

Table 2-5. C9448 Groundwater Samples Collected During Drilling

Date	Depth (ft bgs)	Sample Method	Pump Rate (gpm)	Vol. Purged (gal)	Turbidity (NTU)	D.O at Sample Collection (Mg/L)	HEIS number
6/22/15	314.0	Groundwater pumped	2	110	>1,000	N/R	B30T43, B30T44, B30T65,B30T45, B30T46, B30T66
6/25/15	329.0	Groundwater pumped	16.6	979.4	>1,000	1.91	B30T47, B30T48, B30T67
7/1/15	347.6	Groundwater Pumped	2.8	252	30.9	1.97	B30T51, B30T52, B30T69, B30T57
7/8/15	367.3	Groundwater Pumped	15	1425	27.0	1.24	B30T53, B30T54, B30T70

D.O. = dissolved oxygen
ft bgs = feet below ground surface
gal = gallon
gpm = gallons per minute
HEIS = *Hanford Environmental Information System*
NTU = nephelometric turbidity unit
N/R =.not recorded

A borehole straightness test was performed on July 7, 2015 and well construction was performed from July 15, 2015 to July 22, 2015. The well was constructed as a 4-in diameter monitoring well with a 10-ft long 20-slot screened interval with an endcap. Stainless steel centralizers were installed at the top of the screened interval and at 40 ft intervals. The annulus was filled from depth to surface with 14.4 ft of 10-20 mesh sand, 7.9 ft of coated bentonite pellets, 44.7 ft of cement grount, 290.1 ft of bentonite chips, and 15.3 ft of cement grout.

Well development occurred on July 23, 2015 using a Pulstar Pump and a TriSeal 3 hp submersible pump. Static water level was measured before well development at 304.9 ft bgs on July 23, 2015.

3 Geologic Observations

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

3.1 General Geology Description

200-West Area
The major stratigraphic units encountered during drilling in the 200-West Area included sand and gravel of the Hanford formation and/or surficial deposits, fine-grained silt and caliche of the Cold Creek unit (CCU), sand of the Ringold Formation member of Taylor Flat (RTF), and sand and gravel of the Ringold Formation member of Wooded Island unit E (Ringold E). Significant difference in sediment thicknesses were observed at each borehole due to structural, depositional, and erosional variations at each site.

The Hanford formation sediments were sand-dominated within the area and had a composition averaging 50% mafic and 50% quartz-feldspar. At the four 200-West borehole locations, the Hanford formation was thickest at C9431 (140 ft) and thinnest at C9430 (120 ft). A disconformity underlies the Hanford formation within the area, followed by the CCU, a fine-grained silt and caliche paleosol deposit. The CCU was thickest at C9430 (35 ft) and thinnest at C9431 (10 ft). A second disconformity underlies the CCU within the area, which was followed by the predominantly quartzo-feldspathic sand of the RTF. The RTF was thickest at C8202 and C9431 (25 ft) and thinnest at C9432 (6 ft) within the area. Underlying the RTF is the Ringold E. The Ringold E was characterized as clast-supported quartzo-feldspathic gravels with a fine- to coarse-grained sand matrix and lesser silt fraction. Drilling concluded in the Ringold E at all four locations driller in the 200-West Area.

200-East Area
The major stratigraphic units encountered during drilling in the 200-East Area included sand and gravel of the Hanford formation and/or surficial deposits, sand and gravel of the CCU, sand and gravel of the Ringold Formation member of Wooded Island unit A (Ringold A), and basalt. Significant difference in sediment thicknesses were observed at each borehole due to structural, depositional and erosional variations at each site.

The Hanford formation sediments were sand dominated within the area and had a composition averaging 50% mafic and 50% quartz-feldspar. At the three 200-East Area borehole locations, the Hanford formation was thickest at C9448 (244 ft) and thinnest at C8913 (207 ft). The CCU disconformably underlies the Hanford formation, within the area. The CCU within the area was observed as a gravel supported by predominately quartzo-feldspathic sand. At the three 200-East area borehole locations, the CCU was thickest at C9447 (99 ft) and not present at C8913. Disconformably following the CCU at C9447 is Ringold A. Ringold A was observed as a quartz-feldspar-lithic gravel supported by quartzo-feldspathic sand and silt and was 21 ft thick at C9447. For borehole C9448, the depth and appearance of the CCU and Ringold A were unable to be distinguished based on field logs. Drilling concluded at all three locations once basalt bedrock was confirmed.

3.2 Borehole Geology

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

Stratigraphic unit contacts included in this document are based on field drill cuttings examination (i.e., lithology, texture, color, reaction to 10 percent dilute hydrochloric acid [HCl], etc.) and drilling observations (i.e., drill rate) in the field. 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.

3.2.1 Borehole Geology for Well 299-W22-93 (C8202)

The sediments encountered from ground surface to 135 ft bgs consisted of sand with sandy gravel intervals from 15 to 25 and 40 to 55 ft bgs and silty sand from 80 to 100 ft bgs. Gravel content ranged from trace to 70 percent, sand ranged from 27 to 100 percent and silt/clay ranged from trace to 30 percent. The gravel fraction consists of poorly to moderately sorted, subangular to subrounded, very fine to very coarse pebbles comprised of 90 percent basalt. The sand fraction near ground surface was a poorly to well sorted, very fine to very coarse sand comprised of 95 percent mafic grains. The sand graded into a very well sorted, very fine to medium sand comprised of 90 percent felsic grains at 65 ft bgs. The fine fraction was a light yellowish brown (2.5Y 6/3) to dark grayish brown (2.5Y 4/2) silt, based on a Munsell® soil color chart[4]. Strong reactions to HCl were observed from 0 to 15 ft and occasional weak to moderate reactions were observed throughout the remainder of the interval. At 135 ft bgs a distinct lithology change from sand to silt occurred. This change in lithology coincides with previous descriptions of the Hanford formation and CCU contact and therefore 135 ft bgs has been interpreted as the contact between the Hanford formation and CCU.

Sandy clayey silt was encountered from 135 to 155 ft bgs. The silt percentage ranged from 85 to 90 percent and the sand percentage ranged from 10 to 15 percent. The sand was comprised of very fine, 90 percent felsic grains. The clayey silt was light olive brown (2.5Y 5/4) and exhibited medium plasticity and no reaction to HCl. A change in lithology from sandy clayey silt to sand at 155 ft bgs occurred and coincide with previous descriptions made of the CCU and RTF contact, therefore 155 ft bgs has been interpreted as the contact between CCU and RTF.

Sands encountered from 155 to 180 ft bgs consisted of 90 to 97 percent sand, 3 to 10 percent silt and occasional gravels. The sand was a well sorted, subangular, very fine to very coarse, 50 percent felsic grained. The silt exhibited a low plasticity and a mild reaction to HCl. The color of the fine fraction was olive brown (2.5Y 4/3). At 180 ft bgs a gradual change to gravelly sand was observed. This gradual change in lithology coincides with previous descriptions of the RTF and Ringold E contact and therefore has been interpreted as the contact between the RTF and Ringold E.

The sediments encountered from 180 to 288.1 ft bgs ranged from sand to gravel with a few intervals of silty sandy gravels. The gravel fraction consisted of poorly to very well sorted, subrounded to well rounded, very fine pebble to small cobbles comprised of 20 to 95 percent mafic clasts. The sand fraction consisted of well sorted, subangular to subrounded, very fine to very coarse, 20 to 80 percent felsic grains. The clayey silt fraction exhibited low to moderate plasticity. The color of the fine fraction ranged from light olive brown (2.5Y 5/4) to olive brown (2.5Y 4/3). No reactions to HCl were observed throughout this interval. Drilling continued until 288.1 ft bgs.

3.2.2 Borehole Geology for Well 299-W22-115 (C9430)

The sediments encountered from ground surface to 120 ft bgs consisted of primarily sand with a sandy gravel interval from 35 to 55 ft bgs and sandy silt to silty sand interval from 75 to 85 ft bgs. The sand was poorly to well sorted, angular to rounded, very fine to very coarse grained with a 60 to 80 percent felsic

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

composition. The gravel consisted of very poorly to poorly sorted, angular to rounded, very fine to very coarse pebbles with a 40 to 50 percent felsic composition. Weak to strong reactions to HCl were observed throughout this interval. The color of the fine fraction ranged from dark grayish brown (2.5Y 3/2) to light olive brown (2.5Y 5/3). At 120 ft bgs the lithology graded to silt. This distinct change in lithology coincides with previous descriptions of the Hanford formation and CCU contact and therefore 120 ft bgs has been interpreted as the contact between the Hanford formation and the CCU.

Silt was encountered from 120 to 150 ft bgs. The silt ranged from 90 to 100 percent silt/clay and 0 to 10 percent sand. The well sorted, very fine grained sand was 95 percent felsic. The clayey silt exhibited low to high plasticity. Weak to strong reactions to HCl were observed throughout this interval. The color of the fine fraction was olive brown (2.5Y 4/4). At 150 ft bgs a 5-ft thick sandy gravel was encountered with a strong reaction to HCl and 80 percent basaltic gravel content. Because of the strong reaction to HCl, and the high basaltic gravel percentage, the gravel encountered from 150 to 155 ft bgs is proposed to be the bottom of the CCU gravel-dominated unit.

Sand was encountered from 155 to 170 ft bgs. The sand consisted of 95 percent sand and 5 percent gravel. The gravel fraction was poorly sorted, angular to rounded, very fine to medium pebble clasts comprised of 50 percent felsic grains. The sand fraction was poorly sorted, angular to subrounded, very fine to coarse grained sand comprised of 80 percent felsic grains. The color was olive brown (2.5Y 4/3). No reaction to HCl was observed throughout this interval. From 170 to 175 ft bgs an increase in gravel content is observed that coincides with previous descriptions of the change between the RTF and Ringold E. Because of the change in lithology, 170 to 175 ft bgs is proposed to be a gradational contact between the RTF and the Ringold E.

From 170 to 272.3 ft bgs the material encountered was predominately sandy gravel with intervals of sand, gravelly sand, and silty sandy gravel. The gravel fraction was very poorly to poorly sorted, angular to rounded, very fine pebble to large cobble clasts comprised of 50 to 90 percent felsic grains. The sand fraction consisted of very poorly to moderately sorted, angular to rounded, very fine to very coarse, 60 to 90 percent felsic grains. The silt/clay fraction exhibited low plasticity. Weak to no reactions to HCl were observed, with exception to 175 to 185 ft bgs where strong and moderate reactions were observed. The color of the fine fraction ranged from olive brown (2.5Y 4/3) to dark olive brown (2.5Y 3/3). Drilling continued until 272.3 ft bgs.

3.2.3 Borehole Geology for Well 299-W22-116 (C9431)

The sediments encountered from ground surface to 140 ft bgs consisted of sand with and interval of gravelly sand from 55 to 70 ft bgs. The sediment was 80 to 100 percent sand, 0 to 15 percent gravel and 0 to 10 percent silt/clay. The gravel fraction was subangular, very small to small pebble clasts comprised of 90 to 100 percent basalt. The sand fraction was moderate to well sorted, subrounded to well rounded, very fine to very coarse grained comprised of 20 to 90 percent basalt. A strong reaction to HCl was observed from 0 to 15 ft bgs, and occasional weak reactions were observed from 15 ft to 55 ft bgs. No reactions to HCl were observed from 55 to 120 ft bgs. The color of the fine fraction ranged from yellowish brown (10YR 5/4) to brown (10YR 4/3). At 120 ft bgs the silt/clay content increased to 10 percent and occasional clay nodules exhibiting low plasticity and strong reactions to HCl were observed. At 140 ft bgs a distinct change to sandy silt occurred. This change in lithology coincides with previous descriptions of the Hanford formation and CCU contact and therefore 140 ft bgs has been interpreted as the contact between the Hanford formation and the CCU.

The sediment encountered at 140 to 150 ft bgs was sandy silt to silty sandy gravel. The sand was a moderately sorted, subrounded, very fine to coarse sand comprised of 100 percent felsic grains. The gravel fraction was poorly sorted, angular to subangular, small pebble to small cobble clasts comprised of

75 percent gravel. The silt/clay was approximately 25 percent clay and exhibited low to medium plasticity. A strong reaction to HCl was observed on the clay modules throughout this interval. The color of the fine fraction was light olive brown (2.5Y 5/4). At 150 ft bgs a decrease in silt/clay content and change in lithology to a gravelly sand was encountered. This change in lithology coincides with previous descriptions of the CCU and RTF contact and therefore 150 ft bgs has been interpreted as the contact between the CCU and RTF.

The sediment encountered from 150 to 175 ft bgs consisted of sand and gravelly sand. The sediment was 5 to 20 percent gravel, 75 to 95 percent sand, and 0 to 5 percent silt/clay. The gravel fraction was poorly sorted, subrounded, small pebble to small cobble clasts comprised of 90 percent basalt. The sand fraction was poorly to well sorted, subrounded, very fine to very coarse, 40 to 50 percent basaltic grains. No clay was present throughout this interval. A strong reaction to HCl was observed from 150 to 160 ft bgs. No reaction to HCl was observed from 160 to 175 ft bgs. The color of the fine fraction ranged from olive brown (2.5Y 5/4) to very dark grayish brown (10YR 3/2). At 175 ft bgs a gradual change to sandy gravel occurred, this gradational change in lithology coincides with previous descriptions of the RTF and Ringold E contact and therefore 175 ft bgs has been interpreted as a gradational contact between the RTF and Ringold E.

The sediment encountered from 175 to 275.3 ft bgs ranged from sandy gravel to gravel. The sediment was 40 to 95 percent gravel, 5 to 60 percent sand and 0 to 9 percent silt/clay. The gravel fraction was very poorly to moderately sorted, angular to rounded, very fine pebble to large cobbles comprised of 20 to 100 percent felsic clasts. The sand fraction was poorly to very well sorted, subangular to well rounded, very fine to very coarse sand comprised of 5 to 80 percent felsic grains. The color of the fine fraction ranged from light yellowish brown (2.5Y 6/4) to olive brown (2.5Y 4/4). No reactions to HCl or clay nodules were observed throughout this interval. Drilling continued until 275.3 ft bgs.

3.2.4 Borehole Geology for Well 299-W23-236 (C9432)

The sediments encountered at C9432 consisted of sands, gravelly sands and sandy gravels from 0 to 85 ft bgs. The sediment was 2 to 30 percent gravel and 70 to 98 percent sand, only trace silt was observed throughout this interval. The gravel fraction was poorly to moderately sorted, angular to rounded, very fine to very coarse pebbles comprised of 20 to 40 percent felsic clasts. The sand fraction was poorly to moderately sorted, angular to subrounded, very fine to very coarse grains comprised of 30 to 60 percent felsic grains.

The sediment encountered from 85 to 135 ft bgs was predominately silty sand, with intervals of sand and slightly silty sand. Sand content ranged from 60 to 90 percent and silt/clay content ranged from 10 to 30 percent, only trace gravel was present. The sand fraction was moderately to well sorted, very fine to medium sand comprised of 70 percent felsic grains. The silt/clay fraction was light brownish grey (2.5Y 6/2) to light olive brown (2.5Y 5/3) silt exhibiting a moderate to strong reaction to HCl. At 135 ft bgs an increase in the clay content occurred which has been interpreted as the contact between the Hanford formation and the CCU

The sediment encountered from 135 to 150 ft bgs was silty sand and sandy silt. The sediment was 30 to 70 percent sand and 30 to 70 percent silt/clay, only trace gravel was present. The sand fraction was a well sorted, very fine to fine sand. The mud fraction was 60 to 70 percent silt and 30 to 40 percent low to moderate plasticity clay. Moderate to strong reactions to HCl were observed throughout this interval. The color of the fine fraction was light olive brown (2.5Y 5/3). At 150 ft bgs a coarsening and increase in sand content occurred, this coarsening coincides with previous descriptions of the CCU and RTF contact, therefore 150 ft bgs has been interpreted as the CCU and RTF contact.

The material encountered from 150 to 156 ft bgs comprised of silty sand. The sand fraction was very fine to medium sand and the mud fraction was 70 percent silt and 30 percent low to moderate plasticity clay. The color was light olive brown (2.5Y 5/3) and a strong reaction to HCl was observed. At 156 ft bgs a sharp change in lithology to a sandy gravel was encountered, this change in lithology coincides with previous descriptions of the RTF and Ringold E contact; therefore, 156 ft bgs has been interpreted as the RTF and Ringold E contact.

The material encountered from 156 to 261.3 ft bgs ranged from sandy gravel to gravel. The sediment was 45 to 95 percent gravel, 5 to 55 percent sand and 0 to 10 percent silt/clay. The gravel fraction was very poorly to moderately sorted, angular to rounded, very fine pebble to large cobbles comprised of 60 to 90 percent felsic clasts. The sand fraction was very poorly to moderately sorted, angular to subrounded, very fine to very coarse sand comprised of 60 to 95 percent felsic grains. The fine fraction ranged from light olive brown (2.5Y 5/3) to olive brown (2.5Y 4/3). Medium to strong reactions to HCl were observed from 156 to 180 ft bgs. Drilling continued until 261.3 ft bgs.

3.2.5 Borehole Geology for Well 299-E26-15 (C8913)

The sediments encountered at C8913 consisted of gravelly sand, sandy gravel and gravel from 0 to 206.9 ft bgs with exception to 30 to 35 ft bgs where a slightly sandy gravelly silt was encountered. The sediment ranged from 20 to 90 percent gravel, 10 to 80 percent sand and 0 to 15 percent silt. The gravel fraction was poorly to very well sorted, angular to rounded, very fine pebble to coarse pebbles comprised of 50 to 90 percent mafic clasts. Occasional large cobbles were observed. The sand fraction was a poorly to well sorted, angular, very fine to very coarse sand comprised of 50 to 90 percent felsic grains. The fine fraction ranged from grayish brown (2.5Y 5/2) to very dark gray (2.5YR 3/1). No reaction to HCl was observed during drilling. Basalt was encountered at 206.9 ft bgs. No basalt was recovered due to the drill not being able to return a sufficient amount of cuttings. Drilling stopped at 206.9 ft bgs.

3.2.6 Borehole Geology for Well 299-E28-31 (C9447)

The sediments encountered at C9447 consisted of silty sandy gravel, gravelly silty sand, sandy gravel and gravelly sand from 0 to 30 ft bgs. Gravel content ranged from 20 to 60 percent, sand ranged from 20 to 80 percent and silt/clay ranged from trace to 25 percent. The gravel fraction was very poorly to moderately sorted, subangular to subrounded, very fine pebble to small cobbles comprised of 40 to 65 percent felsic clasts. The sand fraction was a poorly to well sorted, angular to subrounded, very fine to very coarse sand comprised of 50 to 60 percent felsic grains. Mild to moderate reactions to HCl were observed from 0 to 25 ft bgs. The color of the fine fraction throughout this interval ranged from pale yellow (2.5Y 7/3) to light brownish gray (2.5Y 6/2).

The sediments encountered from 30 to 231 ft bgs consisted primarily of sand with occasional gravelly sand and sandy gravel intervals. Gravel content ranged from 5 to 75 percent, sand ranged from 25 to 100 percent, only trace silt/clay was present. The gravel fraction was well sorted, angular to subrounded, very fine to medium pebbles comprised of 30 to 60 percent felsic clasts. The sand fraction was poorly to well sorted, subangular to subrounded, very fine to very coarse sand comprised of 40 to 70 percent felsic grains. Occasional mild reactions to HCl were observed from 30 to 160 ft bgs, and moderate to strong reactions to HCl were observed from 160 to 173 and 215 to 231 ft bgs. The color of the fine fraction ranged from light brownish gray (2.5Y 6/2) to gray (2.5Y 6/1). At 231 ft bgs, a sharp change in lithology to sandy gravel occurred, this sharp change in lithology coincides with previous descriptions of the Hanford formation and CCU contact, therefore 231 ft bgs has been interpreted as the contact between the Hanford formation and CCU.

The sediments encountered from 231 ft to 353 ft bgs consisted of primarily sandy gravel with occasional intervals of gravel, gravelly sand and silty sandy gravel. Gravel content ranged from 25 to 90 percent, sand ranged from 20 to 85 percent and silt/clay ranged from trace to 20 percent. The gravel fraction was very poorly to moderately sorted, angular to rounded, very fine pebble to large cobbles comprised of 60 to 80 percent felsic clasts. The sand fraction was very poorly to well sorted, subangular to rounded, very fine to very coarse sand comprised of 60 to 80 percent felsic grains. Basalt was encountered at 353 ft bgs.

Drilling continued into the basalt until 362 ft bgs. The basalt appeared to be vesicular flow top with approximately ten percent of it having undergone secondary mineralization. The colors ranged from very dark gray (10YR 3/1) to black (10YR 2/1).

3.2.7 Borehole Geology for Well 299-E28-32 (C9448)

The sediments encountered at C9448 consisted of predominately sand, with intervals of silt, sandy silt, silty sand, silty sandy gravel, gravelly sand and sandy gravel from 0 to 244 ft bgs. Gravel content ranged from 0 to 80 percent, sand ranged from 5 to 100 percent and silt ranged from 0 to 95 percent. The gravel fraction was very poorly to well sorted, angular to rounded, very fine pebble to large cobbles comprised of 80 to 90 percent mafic clasts. The sand fraction was a poorly to well sorted, angular, very fine to very coarse sand comprised of 20 to 80 percent mafic grains. A strong reaction to HCl was observed from 0 to 11 ft bgs and a slight reaction to HCl was observed from 11 to 45 ft bgs. No further reactions to HCl were observed. The color of the fine fraction ranged from dark olive brown (2.5Y 3/3), dark brown (10YR 3/3) to gray (2.5Y 5/1). The observed silt exhibited a low plasticity.

The sediments encountered from 244 to 295 ft bgs consisted of silty gravelly sand, silty sandy gravel, sandy gravel, and gravel. Gravel content ranged from 20 to 80 percent, sand ranged from 18 to 80 percent and silt ranged from 0 to 12 percent. The gravel fraction was very poor to well sorted, angular to rounded, very fine pebble to boulders comprised of 60 to 90 percent mafic clasts. The sand fraction was a poorly to well sorted, angular, very fine to coarse sand comprised of 80 percent mafic clasts. The color of the fine fraction ranged from dark olive brown (2.5Y 3/3) to grayish brown (2.5Y 5/2). Weak reactions to HCl were observed throughout this interval. At 295 ft bgs, an increase in felsic content occurred, this change coincides with previous descriptions of the contact between the Hanford formation and the Ringold Formation, therefore 295 ft bgs has been interpreted as the contact between the Hanford and Ringold Formation. Based on nearby descriptions, this contact is likely with the CCU or Ringold E.

The sediments encountered from 295 ft bgs to 372 ft bgs consisted of primarily sandy gravel with occasional intervals of gravel, gravelly sand, sand, silty sandy gravel and sand. Gravel content ranged from 25 to 75 percent, sand ranged from 25 to 90 percent and silt ranged from 5 to 30 percent. The gravel fraction was poorly sorted, angular to rounded, very fine pebble to very coarse pebble clasts comprised of 20 to 40 percent mafic clasts. The sand fraction was a well sorted, angular, very fine to very coarse sand comprised of 10 to 40 percent mafic grains. The color of the fine fraction ranged from olive brown (2.5Y 4/3) to very dark grayish brown (2.5Y 3/2). Slight rections to HCl were observed from 395 to 316 ft bgs, no other reactions to HCl were observed. Basalt was encountered at 372 ft bgs.

Drilling continued into the basalt until 372.4 ft bgs. The basalt appeared to be weathered vesicular basalt flow top with minimal secondary mineralization.

3.3 Hydrogeology

The regional groundwater flow in the unconfined aquifer is toward the east within the southern 200-West Area (DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*). The base of the unconfined aquifer is the Ringold Formation member of Wooded Island - lower mud unit (RLM). If absent, the unconfined aquifer extends through the underlying Ringold A, to the top of basalt. The four

new groundwater wells did not extend to the RLM and are screened at the water table and within Ringold E. At the four borehole locations in 200-West, the vadose zone occurs within the Holocene deposits, Hanford formation, CCU, RTF and Ringold E and ranges in thickness from 220.5 ft at C9432 to 245.4 ft at C8202.

Due to ongoing water table declines in the 200 East Area, groundwater flow within the unconfined aquifer completed an 180 degree flow direction change in July 2011 Since July 2011 the flow direction has maintained a south-southeast flow from the south part of the Gable Gap into the northwest quarter of 200-East(2013 GW report). Elsewhere in 200-East, the groundwater flow direction is towards the east. The unconfined aquifer system beneath 200 East is composed of the Hanford formation, CCU, and Ringold A, depending on specific well location (PNNL-12261, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, Hanford Site, Washington*). The base of the unconfined aquifer is the top of basalt, as the RLM is not currently considered present at the 200 East well locations. At the three borehole locations in 200-East, the vadose zone ranges in thickness from 203.4 ft at C8913 to 304.9 ft at C9448.

Well development data are summarized in Table 2-2. Maximum drawdown levels measured during final well development varied from 0 ft at C9431 (25 gpm pumping rate) to 40.5 ft at C9447 (8.3 gpm pumping rate). Pumping rates during final well development were primarily influenced by pump capacity and intake depth.

3.4 Contaminants

200-West Area
Groundwater beneath WMA S-SX, within the 200-UP-1 OU, is contaminated primarily with chromium, nitrate, technetium-99, carbon tetrachloride, and tritium. Chromium, nitrate, and technetium-99 originate from the tank farms, although nitrate also originates from an upgradient source. Carbon tetrachloride and tritium are from upgradient sources. Low levels of iodine-129 and selenium-79 also have been found in the groundwater. Recent groundwater plume maps for the WMA S-SX vicinity are provided in DOE/RL-2014-32 and SGW-58277.

200-East Area
Previous depth discrete groundwater sampling during the CERCLA remedial investigation for the 200-BP-5 Groundwater OU (DOE/RL-2007-18, *Remedial Investigation/Feasibility Study Work Plan for the 200-BP-5 Groundwater Operable Unit*) found elevated concentrations of nitrate, tritium, and uranium in the B Plant area. Nitrate, technetium-99, tritium, and uranium are contaminants of interest at wells 299-E28-31 (C9447) and 299-E28-32 (C9448). No groundwater samples are being collected at the other wells. In a RCRA assessment, it was determined that the dangerous waste constituent cyanide was impacting groundwater quality at monitoring wells downgradient of WMA C (SGW-58328). Other contaminants at this location have included nitrate, iodine-129, and technetium-99. The groundwater beneath LERF contains elevated nitrate and sulfate.

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4 Waste Management

Waste generated during the activities described in this document were managed according to DOE/RL-2000-51, *Interim Action Waste Management Plan for the 200-UP-1 Operable Unit;* DOE/RL-2003-30, *Waste Control Plan for the 200-BP-5 Operable Unit;* and SGRP-PRO-OP-50120, *Waste Packaging and Handling at S&GRP.* Waste generated during drilling activities included drill cuttings, decontamination water, and miscellaneous solid waste.

4.1 Vadose Zone Cuttings

Vadose zone drill cuttings from above the historic high water mark at boreholes C8202, C9430, C9431, C9432 and C9447 all were stockpiled on plastic sheeting with the expectation that they would not be chemically or radiologically contaminated. Field radiological and organic vapor surveys did not detect contamination on the stockpile during the drilling operations. Following completion of the drilling and well completion activities at the boreholes, the CHPRC Waste Management Lead authorized spreading the drill cuttings at or near the point of generation. This decision was made following the process established by CHPRC procedure SGRP-PRO-OP-50034 (GRP-EE-02-14.5), *Returning Vadose Zone Drill Cuttings/Soils to the Environment.*

Vadose zone drill cuttings at boreholes C9448 and C8913 were stored in designated roll off boxes. Miscellaneous solid waste associated with vadose zone 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. Roll off boxes were periodically surveyed by Radiological Control Technicians and Industrial Hygiene personnel, and eventually transferred to Environmental Restoration Disposal Facility for disposal.

4.2 Saturated Zone Cuttings

All drill cuttings collected at or below the water table were released into tip dumpsters, dewatered, and placed in designated waste roll off boxes. 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 saturated drill cuttings, including nitrile gloves, plastic bags, and other waste associated with sampling activities, were contained in clear plastic bags and placed in the designated roll off box. Roll-off boxes were periodically surveyed by radiological control technician and Industrial Hygiene personnel, and transported to the Environmental Restoration and Disposal Facility for disposal after well completion.

4.3 Purgewater

Purgewater was generated during borehole drilling, well development activities, and from water decanted from the tip dumpster containing saturated drill cuttings. 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 on site in a poly-tank or purgewater truck and later transported to either the Modular Storage Unit or Effluent Treatment Facility.

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5 Civil Survey

Vertical and horizontal surveys were performed following well completion 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 coordinates and elevation for each well location are presented in Table 5-1 and survey data sheets are included in Appendices A through G.

Table 5-1. Surveyed Well Locations

Well Name	Well ID	Type	Northing[a] (m)	Easting[a] (m)	Ground Surface Elevation[b] (Brass Cap) (m)
200-West Area Wells					
C8202	299-W22-93	Replacement/Monitoring	134485.98	566949.07	206.887
C9430	299-W22-115	Replacement/Monitoring	134292.43	566939.39	203.607
C9431	299-W22-116	Replacement/Monitoring	134139.92	566900.50	204.169
C9432	299-W23-236	Replacement/Monitoring	134128.15	566798.66	199.890
200-East Area Wells					
C8913	299-E26-15	RCRA/Monitoring	137051.44	575926.46	182.404
C9447	299-E28-31	CERCLA/Monitoring	136608.90	573358.37	212.400
C9448	299-E28-32	CERCLA/Monitoring	136392.19	573449.93	214.761

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.

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6 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 Stillwater LLC. and CHPRC participated in the acceptance inspection for the seven wells: C8202, C9431, and C9432 on May 21, 2015; C9430 and C9447 on June 15, 2015; C8913 on June 17, 2015; and C9448 on July 29, 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.

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7 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-SMP-50060 (GRP-FS-04-G-028), *Field Characterization and Treatment Monitoring Activities Groundwater Sampling*

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

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

Other References:

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq.

DOE/RL-2000-51, 2005, *Interim Action Waste Management Plan for the 200-UP-1 Operable Unit*, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=DA01095942.

DOE/RL-2003-30, 2007, *Waste Control Plan for the 200-BP-5 Operable Unit,* Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington, available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0089342.

DOE/RL-2007-18, 2008, *Remedial Investigation/Feasibility Study Work Plan for the 200-BP-5 Groundwater Operable Unit*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington, available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0901220536.

DOE/RL-2009-39, 2009, *Investigation-Derived Waste Purgewater Management Action Memorandum,* Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0096133.

DOE/RL-2009-80, 2009, *Investigation Derived Waste Purgewater Management Work Plan*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0094946.

DOE/RL-2010-130, 2011, *Sampling and Analysis Plan for Installation of Single-Shell Tank Waste Management Area S-SX RCRA Monitoring Wells 299-W22-93 and 299-W22-94*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=1104280894

DOE/RL-2014-32, 2014, *Hanford Site Groundwater Monitoring Report for 2013*, Rev.0, U.S. Department of Energy, Richland Operations Office, Richland, Washington, available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0084842.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington, available at: http://www.hanford.gov/?page=91&parent=0.

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.

PNNL-12261, 2000, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, Hanford Site, Washington*, Pacific Northwest National Laboratory, Richland, Washington.
Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-12261.PDF

Resource Conservation and Recovery Act of 1976, 42 U.S.C 6901, et seq.

SGW-58277, 2014, *Sampling Instructions for Installation of Single-Shell Tank Waste Management Area S-SX Monitoring Wells 299-W22-115, 299-W22-116, and 299-W23-236*, CH2M Hill Plateau Remediation, Richland, Washington.

SGW-58328, 2014, *Sampling Instruction for the FY2015 M-24 200 East Groundwater Monitoring Well Drilling and Installations*, CH2M Hill Plateau Remediation, Richland, Washington.

SGW-58433, 2015, *Description of Work for the Installation of Eight M-24 Tri-Party Agreement Groundwater Monitoring Wells in FY 2015*, Rev. 0, CH2M Hill Plateau Remediation, 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, available at: *http://apps.leg.wa.gov/wac/default.aspx?cite=173-160*

Appendix A

Well Documentation for C8202 (299-W22-93)

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

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WELL SUMMARY SHEET

Start Date: 5/06/2015
Finish Date: ~~5/13/2015~~ 5/18/15 MAG 11/16/15

Well ID: C8202
Well Name: 299-W22-93
Location: 10 m E of 241 S
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/27/15
Reviewed By: MEHRER Date: 7-22-15
Signature:
Signature:

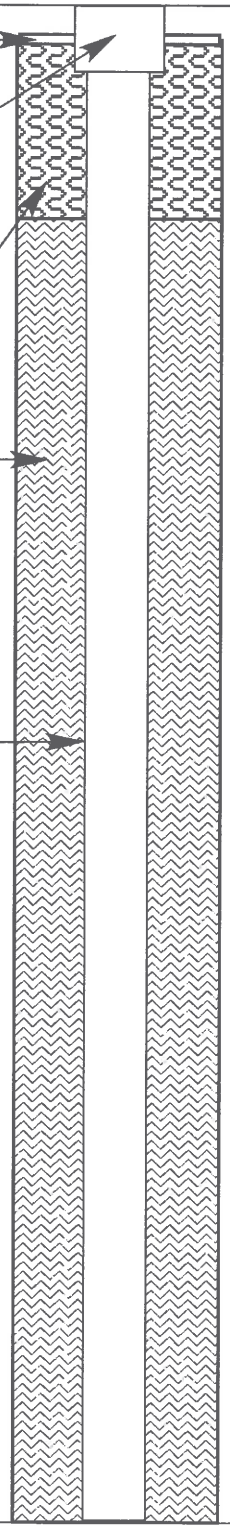
CONSTRUCTION DATA

Description	Diagram
Concrete Pad: 0.5 ft above ground surface (ags)	
6-in Protective Casing: 2.94 ft ags - 2.06 ft below ground surface (bgs)	
Type I/II Portland Cement Grout: 0 - 10.0 ft bgs	
3/8 in Cetco Medium Bentonite Chips: 10.0 - 240.8 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.05 ft ags - 244.7 ft bgs	

Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 288.1 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 Sand (S)
10		15 - 25 Sandy Gravel (sG)
20		25 - 40 Sand (S)
30		40 - 55 Sandy Gravel (sG)
40		55 - 80 Sand (S)
50		80 - 100 Silty Sand (mS)
60		
70		
80		

A-6003-643 (REV 1)

WELL SUMMARY SHEET

Start Date: 5/06/2015
Finish Date: ~~5/13/2015~~ 5/18/15 AJG 7/10/15

Well ID: C8202
Well Name: 299-W22-93
Location: 10 m E of 241 S
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/27/15
Reviewed By: D. MEHRER Date: 7-22-15
Signature:
Signature:

CONSTRUCTION DATA

Description	Diagram
3/8 in Cetco Medium Bentonite Chips: 10.0 - 240.8 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.05 ft ags - 244.7 ft bgs	
Depths are in ft below ground surface.	
Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 288.1 ft bgs	
All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
90		80 - 100 Silty Sand (mS)
100		100 - 135 Sand (S)
110		
120		
130		135 - 155 Silt (M)
140		
150		155 - 180 Sand (S)
160		
170		

A-6003-643 (REV 1)

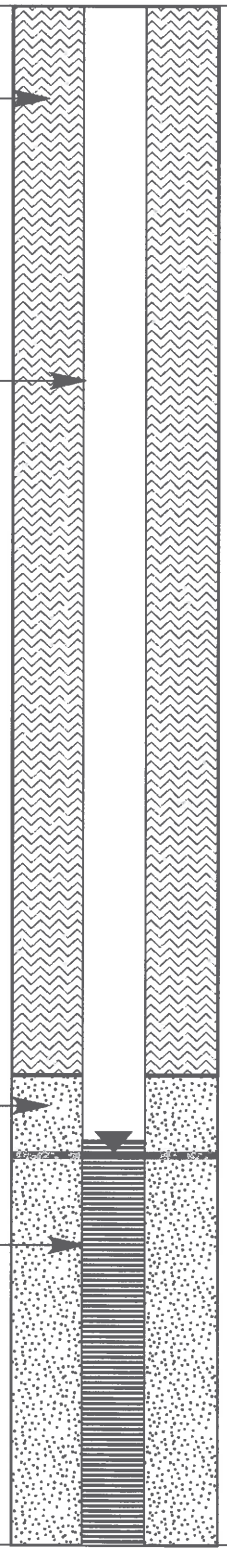
WELL SUMMARY SHEET

Start Date: 5/06/2015
Finish Date: ~~5/13/2015~~ 5/18/15 RJG 7/10/15

Well ID: C8202
Well Name: 299-W22-93
Location: 10 m E of 241 S
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/27/15
Reviewed By: J.D. MEHRER Date: 7-22-15
Signature:
Signature:

CONSTRUCTION DATA

Description	Diagram
3/8 in Cetco Medium Bentonite Chips: 10.0 - 240.8 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.05 ft ags - 244.7 ft bgs	
10-20 mesh Premier Colorado Silica Filter Pack Sand: 240.8 - 288.1 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen: 244.7 - 279.7 ft bgs	



Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 288.1 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
180		155 - 180 Sand (S)
		180 - 190 Gravelly Sand (gS)
190		190 - 195 Silty Sandy Gravel (msG)
		195 - 200 Sandy Gravel (sG)
200		200 - 210 Gravel (G)
210		210 - 215 Sand (S)
		215 - 230 Sandy Gravel (sG)
220		
230		230 - 250 Gravel (G)
240		Static Water Level: 244.6 ft bgs (05/11/15)
250		250 - 255 Silty Sandy Gravel (msG)
		255 - 260 Sand (S)
260		260 - 265 Sandy Gravel (sG)
		265 - 288.1 Silty Sandy Gravel (msG)

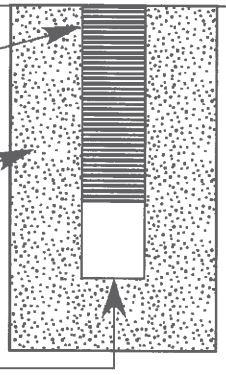
A-6003-643 (REV 1)

WELL SUMMARY SHEET

Start Date: 5/06/2015
Finish Date: ~~5/13/2015~~

Well ID: C8202
Well Name: 299-W22-93 5/18/15 RSG 7/14/15
Location: 10 m E of 241 S
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/27/15
Reviewed By: J.D. MEHRER Date: 7-22-15
Signature:
Signature:

CONSTRUCTION DATA

Description	Diagram
4-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen: 244.7 - 279.7 ft bgs 10-20 mesh Premier Colorado Silica Filter Pack Sand: 240.8 - 288.1 ft bgs 4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 279.7 - 284.7 ft bgs	

Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 288.1 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
270		265 - 288.1 Silty Sandy Gravel (msG)
280		
290		Total Depth: 288.1 ft bgs (5/6/2015) Straightness Test: 5/11/2015, Pass
300		
310		
320		
330		
340		
350		

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 8
Date: 5/6-5/7

Well ID: C8202 | Well Name: 299-W22-93 | Location: 10 m East of 241 S
Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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	G				Becker Hammer, 8 7/8" casing. Samples collected every 5'
				0-15' Sand (S): 5% Gravel, 90% Sand, 5% Silt. Gravel: vf-m pebble, well sorted, avg 98% 5mm, Max 20mm 95% mafic 5% felsic, sub angular-ang Sand: vf-c, well sorted, 80% vf-m, 95% mafic 5% felsic, sub rounded. 2.5Y 4/3 Olive brown, strong rxn HCl moist.	Estimated 1 to 2 gallons H_2O added per foot advanced outside H_2O table
5	G				
10	G				
15	G			15-25': Sandy Gravel (sG): 40% Gravel, 50% Sand, 10% Silt. Gravel: vf-vc pebble, poorly sorted, 30% vc peb, max clast 60mm, 95% mafic 5% felsic, subrounded. Sand: vf-vc, mod sorting, 40% vc rest fines, 95% mafic 5% felsic, sub angular. 2.5Y 4/3 Olive brown, ~~Strong~~ TM 5/17 V MOD rxn HCl, moist.	
20	G				
25	G			@ 20-25': Gravel 40-45% Silt 5%.	
30	G			25'-40': Sand (S): 5% Gravel, 95% Sand, Tr Silt: Gravel: vf pebble, well sorted, max clast 4mm, 40% mafic 60% felsic, sub rounded. Sand: m-vc, well sorted, 70% mafic 30% felsic, sub angular. 2.5Y 4/2 Dark grayish brown, NO rxn HCl moist.	
35	G			@30-35' Sand 50% mafic 50% felsic	
				@35'-40' Sand size range f-vc 70% mafic 30% felsic	@37' one 200m cobble

Reported By: Tracy Mollgren / Kim Schuyler		Reviewed By: Kevin Bergstrom	
Title: Geologist		Title: Sr. Geologist	
Signature:	Date: 5/7/15	Signature:	Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 8
Date: 5/6-5/7

Well ID: C8202 | Well Name: 299-W22-93 | Location: 10 m East of 841 S

Project: 8 MTA TPA GW Monitoring Wells FY2015 | 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'-55' Sandy Gravel (sG) 70%. Gravel 27%. Sand 3%. Silt. Gravel: f-c pebble, mod sorting, 90% 10mm max 25mm, 90% mafic, 10% felsic, sub-angular - subrounded. Sand: vf-vc, 50% vc poor sorting, 60% felsic 40% mafic, sub angular 2.5Y 4/2 Dark grayish brown, NO rxn HCL, moist @ 45-50' Gravel ↓ to 60%, Sand ↑ 38%, Silt ↓ 2%. Gravel size vf-vc pebble 80% mafic 20% felsic. Sand size c-vc 50% mafic 50% felsic	Becker Hammer 8 7/8" casing Samples collected every 5' @ 40' ↑↑ drillrate
45	G				
50	G				@ 50' ↑↑ drillrate
55	G			55-80' Sand (S) 5% Gravel 98% Sand, 2% Silt. Gravel: vf pebble, well sorted, max 4mm, 65% mafic 35% felsic, sub rounded. Sand: vf-vc mod sorting, 85% coarse, 70% felsic, 30% mafic sub angular. 2.5Y 5/3 light olive brown no rxn HCL moist	
60	G				@ 60' ↑↑ drillrate
65	G			@ 65'-80': Sand 1 to 100% and gravel + Silt ↓ to trace. Sand vf-m, very well sorted 98% med, 90% felsic 10% mafic 2.5Y 6/3 lt yellowish brown. wk-mod rxn HCL	
70	G				
75	G				

Reported By: Tracy Mallgren Kim Schuyler | Title: Geologist | Signature: Kim Schuyler | Date: 5/7/15

Reviewed By: Kevin Bergstrom | Title: Sr. Geologist | Signature: Kevin Rybe | Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 8
Date: 5/6 - 5/7

Well ID: C8202 | Well Name: 299-W22-93 | Location: 10 m East of 241 S
Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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			@ 80-85' Sand ↓ to 98% Silt ↑ to 2%.	Becker Hammer 8 7/8" casing. Samples collected every 5 ft
				80' static	
85	G			85'-100': Silty Sand (mS) Trace gravels, 70% Sand 30% Silt Sand: vf-f, very well sorted, 90% felsic 2.5Y 6/3 lt yellowish brown, wk rxn to HCl. Silt had low plasticity.	
90	G				
95	G				
100	G			100-135': Sand (S): Trace Gravels, 95% Sand, 5% Silt. Sand: vf-f, very well sorted, 90% felsic 2.5Y 6/3 lt yellowish brown, mod rxn to HCl, moist. Silt has low plasticity.	@100' ↓ drillrate
105	G				
110	G			@ 110-125 Sand ↓ to 92% Silt ↑ to 8% Wk-mod rxn to HCl	
115	G				

Reported By: Tracy Mallgren Kim Schuyler | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: Tracy Mallgren Kim Schuyler | Date: 5/7/15 | Signature: Kevin Bergstrom | Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 4 of 8
Date: 5/6-5/7

Well ID: C8202 | Well Name: 299-W22-93 | Location: 10 m East of 2419
Project: 8 M24 TPA GW Monitoring Wells FY2015 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120	G			100-135 Sand(s): Tr gravel, 92% sand 8% silt. Sand: vf-f, very well sorted, 90% felsic, 2.5Y 6/3 light yellowish brown weak-mod rxn w/HCl, moist, silt has low plasticity	Becker Hammer 8 7/8" casing. Samples collected every 5'
125	G			@125-135 Sand ↓ to 90% Silt ↑ to 10%	
130	G				
135	G			135-155: Silt (M) Very trace Gravels, 15% Sand, 85% Silt/Clay (Mud) Sand: vf, well sorted, 90% felsic 10% mafic ~~sl~~ TMS17 2.5Y5/4 lt olive brown No rxn to HCl, moist. Mud has medium plasticity	@135' proposed contact between Hanford + Cold Creek unit (Ccu) based off Δ lithology + Δ color
140	G				
145	G			@145'-155' Sand ↓ to 10% Mud ↑ to 90%	
150	G				
155	G			155'-180' Sand (S) SIZ 95 TMS 2% Gravel, 95% Sand 3% Silt, Gravel: vf pebble very well sorted at ~2mm, 98% mafic sub-angular. Sand: M-VC well sorted 95%	@155' TM drillrate @155' proposed contact between CCU + Taylor flat (Rtf) based on Δ lithology

Reported By: Tracy McAllgren | Title: Geologist | Signature: [signature] | Date: 5/7/15
Reviewed By: Kevin Bergstrom | Title: S.C. Geologist | Signature: [signature] | Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 5 of 8
Date: 5/6-5/7

Well ID: C8202 | Well Name: 299-W22-93 | Location: 10 m East of 241 S
Project: 8 MB4 TPA GW Monitoring Wells FY2015 | 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
160	G			coarse. 50/50 mafic-felsic ratio, sub angular 2.5Y 4/3 olive brown. mild rxn to HCl, moist. occ. mica in sand. Silt has low plasticity.	Becker Hammer 8 3/4" casing. Samples collected every 5'
165	G			@165'-170' Sand ↓ to 90%, Silt ↑ to 10%. Sand size vf-m, 90% Medium 2.5Y 5/4 to olive brown No rxn to HCl.	
170	G			@170'-180' Sand ↑ to 97%. Silt ↓ to 3%. Sand size m-vc 95% coarse, sub angular 2.5Y 4/3 olive brown.	
175	G				
180	G			180'-190': Gravelly Sand (gS) 10% Gravel, 87% Sand, 3% Silt. Gravel: vf-c pebble, poor sorting, 60% vf pebble 40% coarse. Max clast 25mm, 95% mafic 5% felsic, subrounded-rounded Sand: m-c, well sorted, 95% coarse, subrounded. 2.5Y 4/3 olive brown, mod. rxn to HCl, moist. Occ mica in sand. Silt has low plasticity	@180' ↓↓ drillrate @180' prepared contact between Rtf + Ringold E based on Δ lithology
185	G				
190	G			190'-195' Silty Sandy Gravel (msG) 40% Gravel 45% Sand 15% Silt/Clay(Mud) Gravel: vf p-sm c, poor sorting avg m peb, max (2)mm 85% mafic 15% felsic sub rounded Sand: vf-vc 80% coarse, well sorted, 90% mafic subang. Silt has mod plasticity. No rxn to HCl 2.5Y 4/3 olvie brown	@190' many drill method caused angulars, one 180mm. cobble @191' ↓↓ drillrate @194 ↑ drillrate mud @198 ↓↓ drillrate
195	G			195'-200': Sandy Gravel (sG) 50% Gravel,	

Reported By: Tracy Mallgren | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: [signature] | Date: 5/7/15 | Signature: [signature] | Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page Co of 8
Date: 5/6 - 5/7

Well ID: C8207 | Well Name: 299-W22-93 | Location: 10 m East of 241 S
Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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
200	G			40% Sand 10% Silt Gravel: vf p-sm c, poor sorting 50% mpeb, max 70mm, 40% mafic 60% felsic, sub-rounded-rounded. Sand vf-m, well sorted 90% fines, 50/50 mafic-felsic 2.5Y 5/4 lt olive brown No rxn to HCl, moist, occ mica, Silt has mod plasticity.	Bedrer Hammer 8 7/8" Casing, Samples collected every 5' @200' one 180mm cobble @205' ↑↑ drillrate
205	G				
210	G			200'-210': Gravel (G) 90% Gravel, 10% Sand, Tr Silt Gravel f-vc pt sm c 85% c peb, mod-well sorted max 70mm 50/50 mafic-felsic sub-well rounded. Sand: vf-c 80% Med, well sorted sub rounded 2.5Y 5/4 lt olive brown, No rxn to HCl moist, mica noticed Silt has low plasticity.	@210' ↓↓ drillrate
215	G			210'-215': Sand (S) Trace gravel, 98% Sand, 2% silt. Sand: vf-m, well sorted 95% fine, 95% felsic, 2.5Y 6/4 lt yellowish brown, No rxn to HCl, moist, mica noticed, Silt has low plasticity.	
220	G			215'-230': Sandy Gravel (sG) 50% Gravel 50% Sand, Trace Silt. Gravel vf peb-sm c poor sorting, 80 mm max clast, 80% felsic, rounded Sand: vf-vc well sorted 90% Med, 80% felsic sub angular 2.5Y 5/4 lt olive brown, moist, No rxn to HCl, mica noticed in sand.	
225	G				
230	G			230'-250' Gravel (G) 85% Gravel, 15% Sand, Tr Silt. Gravel fp-sm c poor-mod sorted avg 10-30mm max 120mm 75% felsic sub-well rounded. Sand vf-vc mod sorted, 75% felsic, sub angular. 2.5Y 4/3 olive brown, No rxn to HCl, moist, occ mica.	
235	G				

Reported By: Tracy Mallgren | Title: Geologist | Signature: [signature] | Date: 5/7/15
Reviewed By: Kevin Bergstrom | Title: Sr. Geologist | Signature: [signature] | Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

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Date: 5/6&5/7

Well ID: C8202 | Well Name: 299-W22-93 | Location: 10 m East of 241 S

Project: 8 M24 TPA GW Monitoring Wells FY2015 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
240	G			230-250 Gravel (G) 85% gravel, 15% Sand, tr Silt. Gravel: fp-sc, poor-mod sorted, avg 10-30 mm, max=120mm, 75% felsic sub-well rounded. Sand vf-vc, mod. sorted 75% felsic, ~~sub-well rounded~~ subangular 2.5Y 4/3 olive brown, no rxn w/HCl moist, occl mica	Rechrer Hammer, 8 3/8" casing, archive samples collected every 5' @241' drillers stop adding H2O, natural soil moisture DTW encountered @ ~241', verified @244.6' bgs on 5/11/15
245	G		DTW		
250	G			250-255' Silty Sandy Gravel 35% Gravel 50% Sand 15% Silt. Gravel vfp-mp mod sorted, 80% vfp max 30mm 80% felsic sub rounded Sand vf-vc well sorted 95% med, 75% felsic, subang, 2.5Y 4/3 olive brown No rxn to HCL, moist, Silt has non-low plasticity, no apparent clay.	@250' ↑↑ drillrate
255	G			255-260': Sand (S) Trace Gravel 95% sand, 5% Silt, Sand: m-c, well sorted 95% med, 95% felsic, sub ang 2.5Y 6/4 lt yellowish brown, No rxn to HCL, moist. Silt has low plasticity.	@258 ↓↓ drillrate
260	G			260-265' Sandy Gravel 30% Gravel, 60% Sand, 10% silt. Gravel vfp-cp poor sort, 70% 20-30mm max 35mm, 70% felsic, sub rounded-rounded Sand: vf-m, well sorted, 90% fine, 85% felsic, 2.5Y 6/4 lt yellowish brown, No rxn to HCL, moist, mica noticed, Silt has low plasticity	@262' Slight ↑↑ H2O production
265	G			265-288.1: Silty Sandy Gravel (ms(G)) 60% Gravel, 25% Sand, 15% Silt. Gravel: vf p-sm c, poor sorting, 20-30mm avg 100mm max, 90% felsics, well rounded. Sand: vf, well sorted, 80% felsics, 2.5Y 4/4 Olive brown, No rxn to HCL, moist until 270' then wet, mica in sand Silt has low plasticity.	
270	G				
275	G				

Reported By: Tracy Mallgren | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: Geologist | Date: 5/7/15 | Signature: [signature] | Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 8 of 8

Date: 5/6 - 5/7

Well ID: C8207 | Well Name: 299-W22-93 | Location: 10 m East of 241 S

Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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
280				265-288.1' Silty Sandy Gravel (msG) 60% G, 20% S, 20% M. Gravel: 90% felsic, CP-SC, 100mm max, poorly sorted, well rounded. Sand: VF, well sorted, 80% felsic, well rounded. No rxn to HCl. Wet. Olive Brown (2.5Y 4/4) silt exhibits low plasticity	Becker Hammer, 8 3/8" casing, Archive sample collected every 5'
285					Reached TD @ 288.1' bgs on 5/6/15 Shoe @ 286.0' bgs DTW confirmed @ 244.6' bgs (5/11/15)

Reported By: Tracy Mallgren | Title: Geologist | Signature: [signature] | Date: 5/7/15

Reviewed By: Kevin Bergstrom | Title: Sr. Geologist | Signature: [signature] | Date: 7/22/15

A-6003-642 (03/03)

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299-W22-93 (C8202)
Log Data Report

Borehole Information:

Log Date:	2015-05-08	Filename:	C8202_HG-NM_2015-05-08	Site:	East of S Farm
Coordinates (WA St Plane)		DTW[1] (ft) :	245.1	DTW Date:	05/07/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	05/06/15	N/A	289	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Threaded Steel	0.8	6	5 3/4	1/8	0.8	289
Threaded Steel	0.4	9	8 1/4	3/8	0.4	289

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. Water inside the casing was measured at 245.1 ft by the logging engineer with an e-tape. The maximum logging depth achieved was 287.9 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	3 Repeat		
HEIS Number	1018704	1018705	1018706		
Date	05/07/15	05/07/15	05/07/15		
Logging Engineer	Pope	Pope	Pope		
Start Depth (ft)	287.0	0.0	50.0		

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

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Log Run	1	2	3 Repeat		
Finish Depth (ft)	50.0	49.0	79.0		
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	AL252CAB	AL252CAB	AL252CAB		
Start File	AL252000	AL252238	AL252288		
Finish File	AL252237	AL252287	AL252317		
Post-Verification	AL252CAA	AL252CAA	AL252CAA		
Depth Return Error (in.)	0.5 low	N/A	0.0		
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made		

NMLS Log Run Information:

Log Run	4	5	6 Repeat		
HEIS Number	1018707	1018708	1018709		
Date	05/08/15	05/08/15	05/08/15		
Logging Engineer	Spatz	Spatz	Spatz		
Start Depth (ft)	0.0	230.0	10.0		
Finish Depth (ft)	230.25	244.75	35.0		
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	FPC8202201558 AV00CAB1	FPC8202201558 AV00CAB1	FPC8202201558 AV00CAB1		
Start File	FPC8202201558 AD000000	FPC8202201558 BD023000	FPC8202201558 CD001000		
Finish File	FPC8202201558 AD023025	FPC8202201558 BD024475	FPC8202201558 CD003500		
Post-Verification	FPC8202201558 AV00CAA1	FPC8202201558 CV00CAA1	FPC8202201558 CV00CAA1		
Depth Return Error (in.)	N/A	3.0 high	0.5 high		
Comments	None	None	None		

Logging Operation Notes:

A centralizer was not installed on the sondes.

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

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Analysis Notes:

Analyst:	P.D. Henwood	Date:	05/20/15	Reference:	HGLP-MAN-003, Rev. 0

A casing correction for a 1/2-in. thick casing was applied to the log data. No correction was applied for the casing joints which are in excess of 1-in. and occur at approximately 10-ft intervals.

A correction for water was applied below 245 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 multiple casings in a borehole.

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 5 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 (0-310 ft)
Natural Gamma Logs (0-160 ft)
Natural Gamma Logs (150-310 ft)
Combination Plot (0-120 ft)
Combination Plot (110-230 ft)
Combination Plot (220-340 ft)
Combination Plot (0-300 ft)
Total Gamma & Moisture (0-160 ft)
Total Gamma & Moisture (150-310 ft)
Total Gamma & Hanford Gamma Unit (0-300 ft)
Repeat Section of Natural Gamma Logs (50 to 79 ft)
Moisture Repeat Section (10 to 35 ft)

[5] Hanford Gamma Unit

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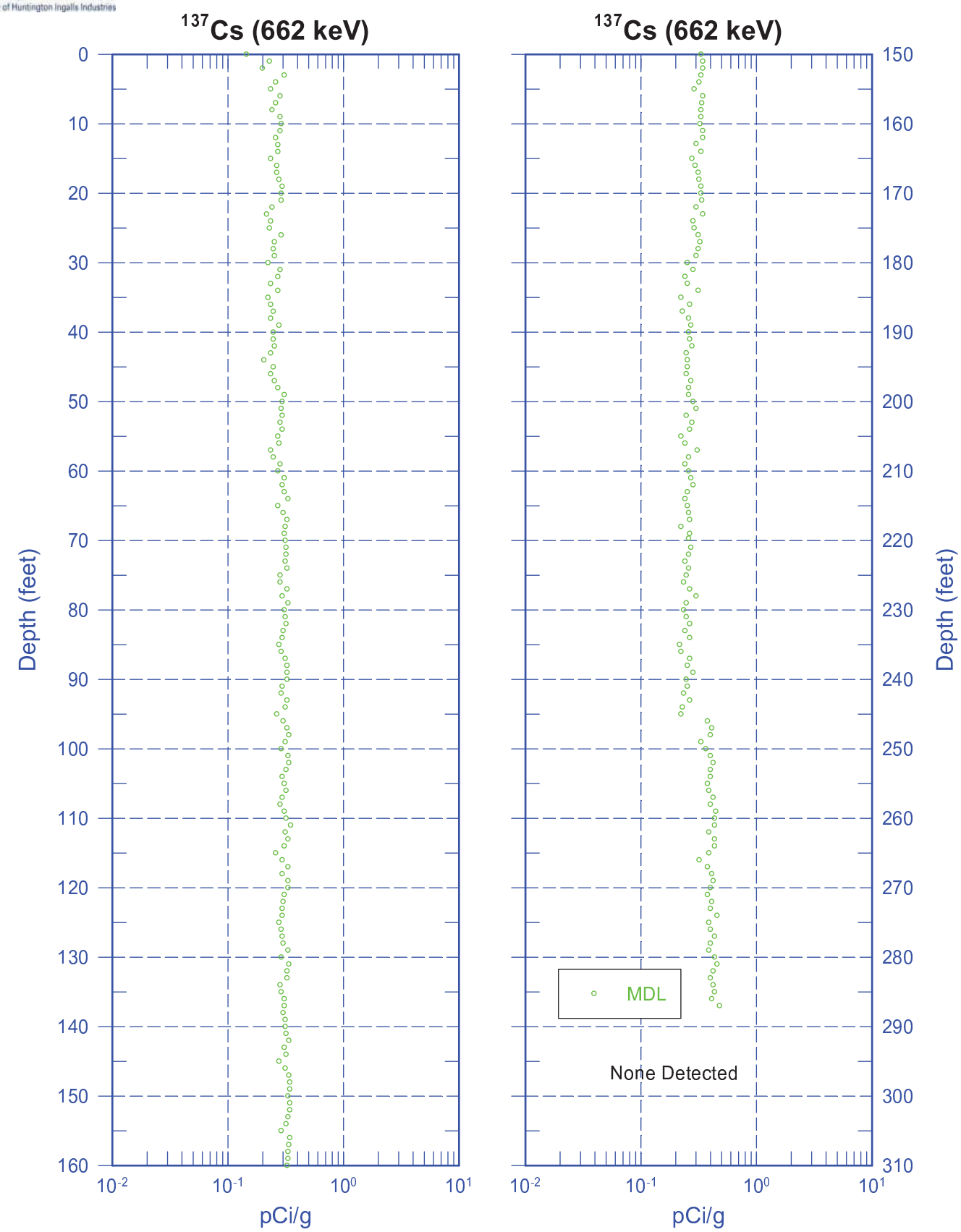
299-W22-93 (C8202)
Manmade Radionuclides



Zero Reference - Ground Surface

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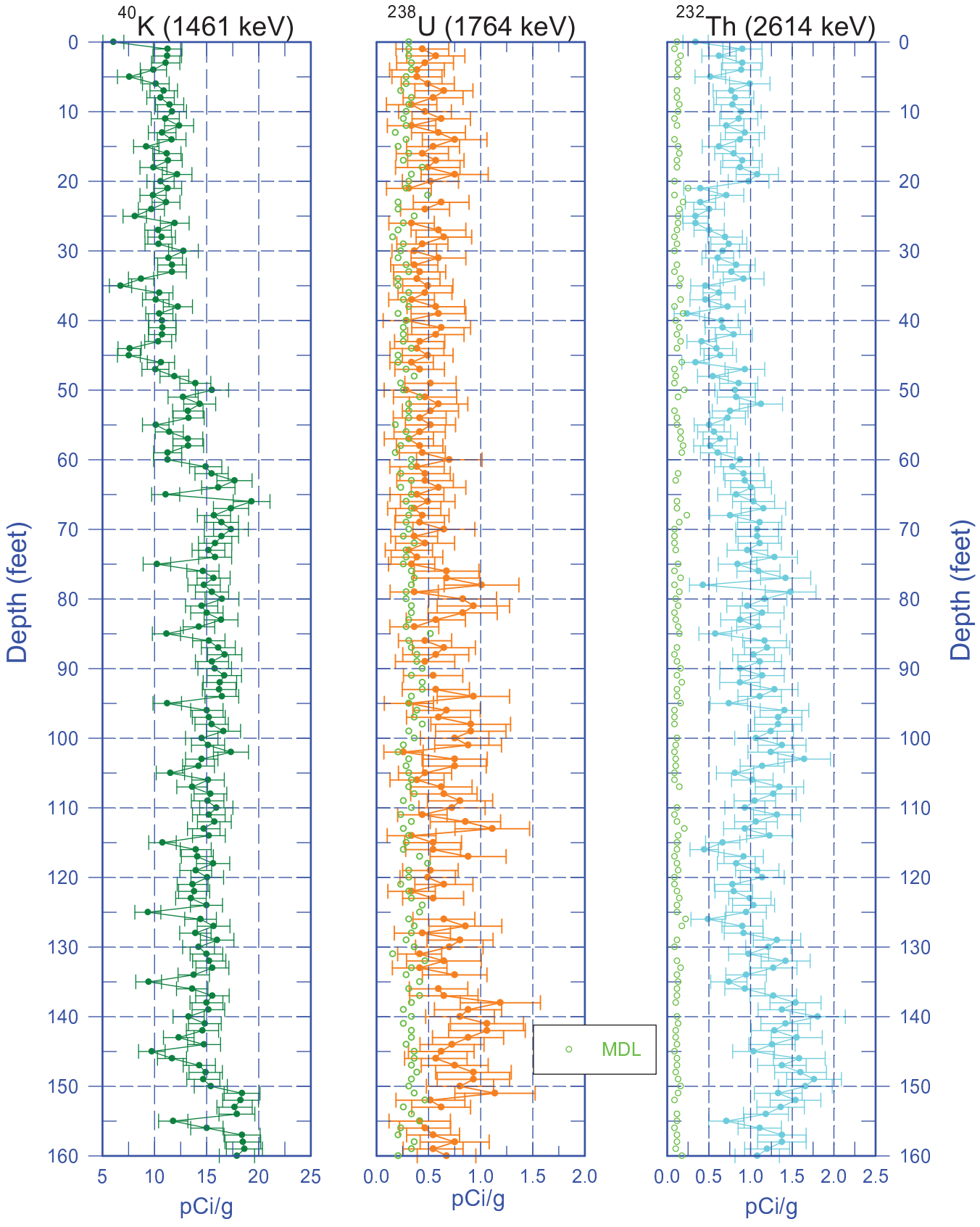
299-W22-93 (C8202)
Natural Gamma Logs



Zero Reference - Ground Surface

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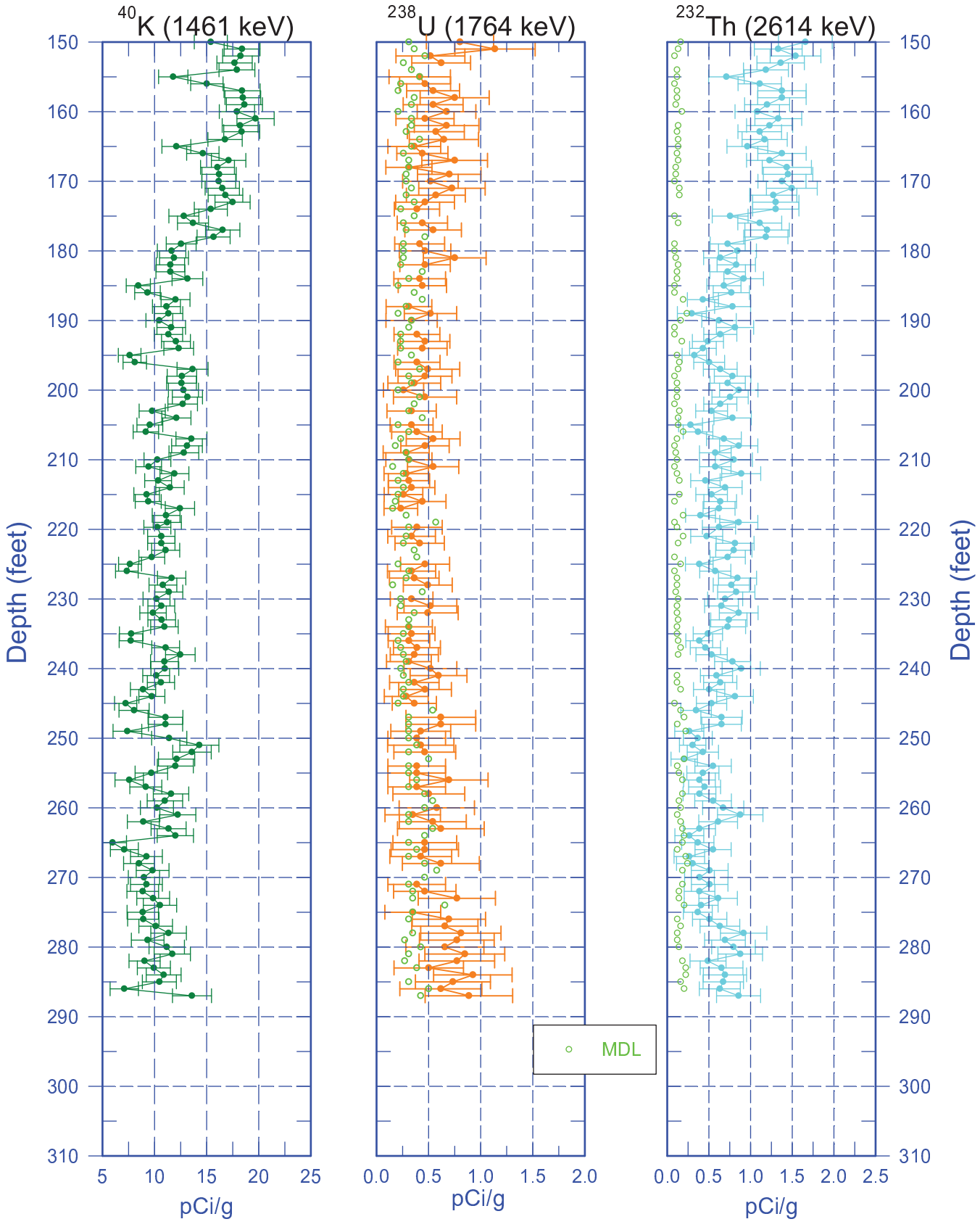
299-W22-93 (C8202)
Natural Gamma Logs



Zero Reference - Ground Surface

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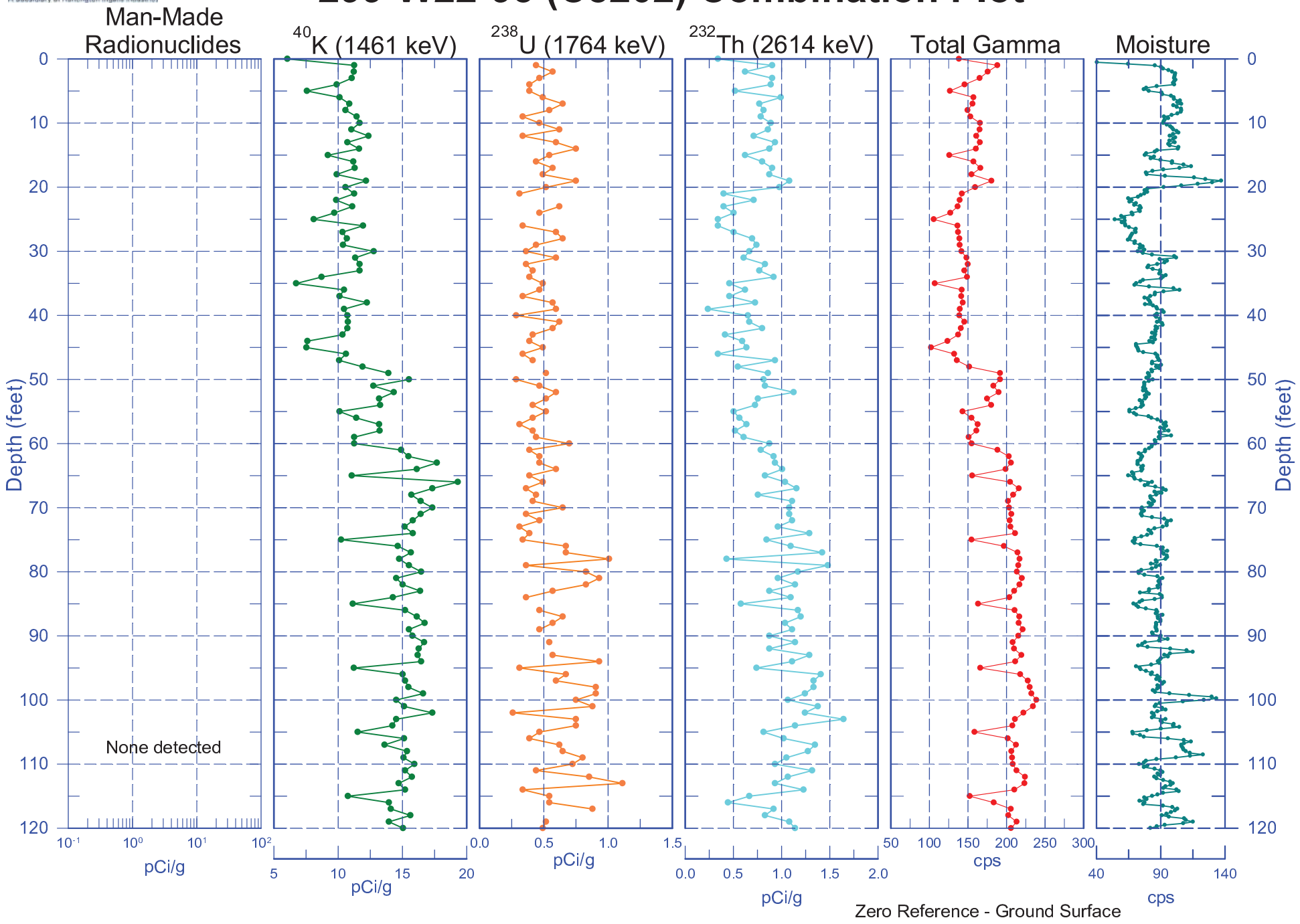
299-W22-93 (C8202) Combination Plot



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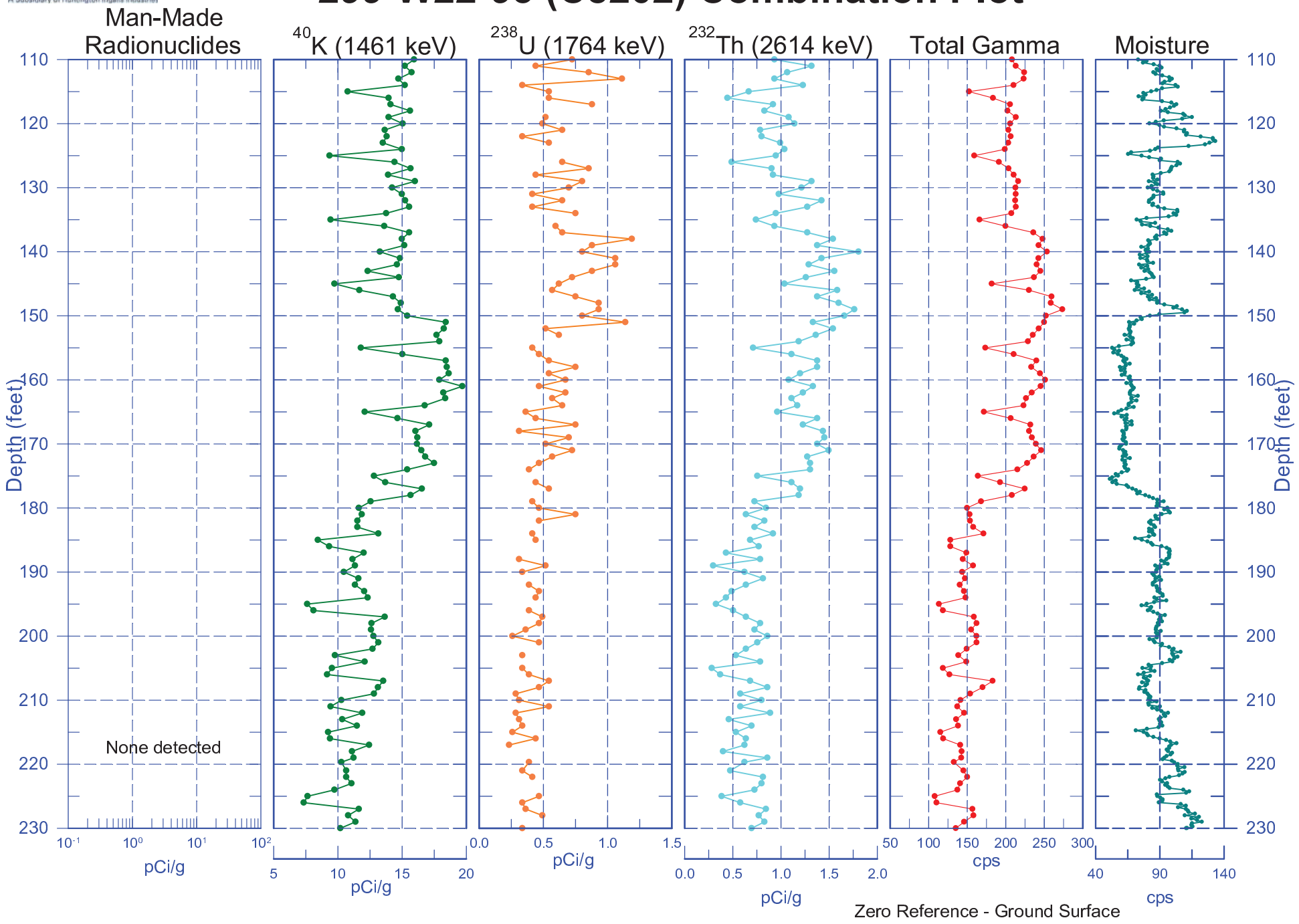
299-W22-93 (C8202) Combination Plot



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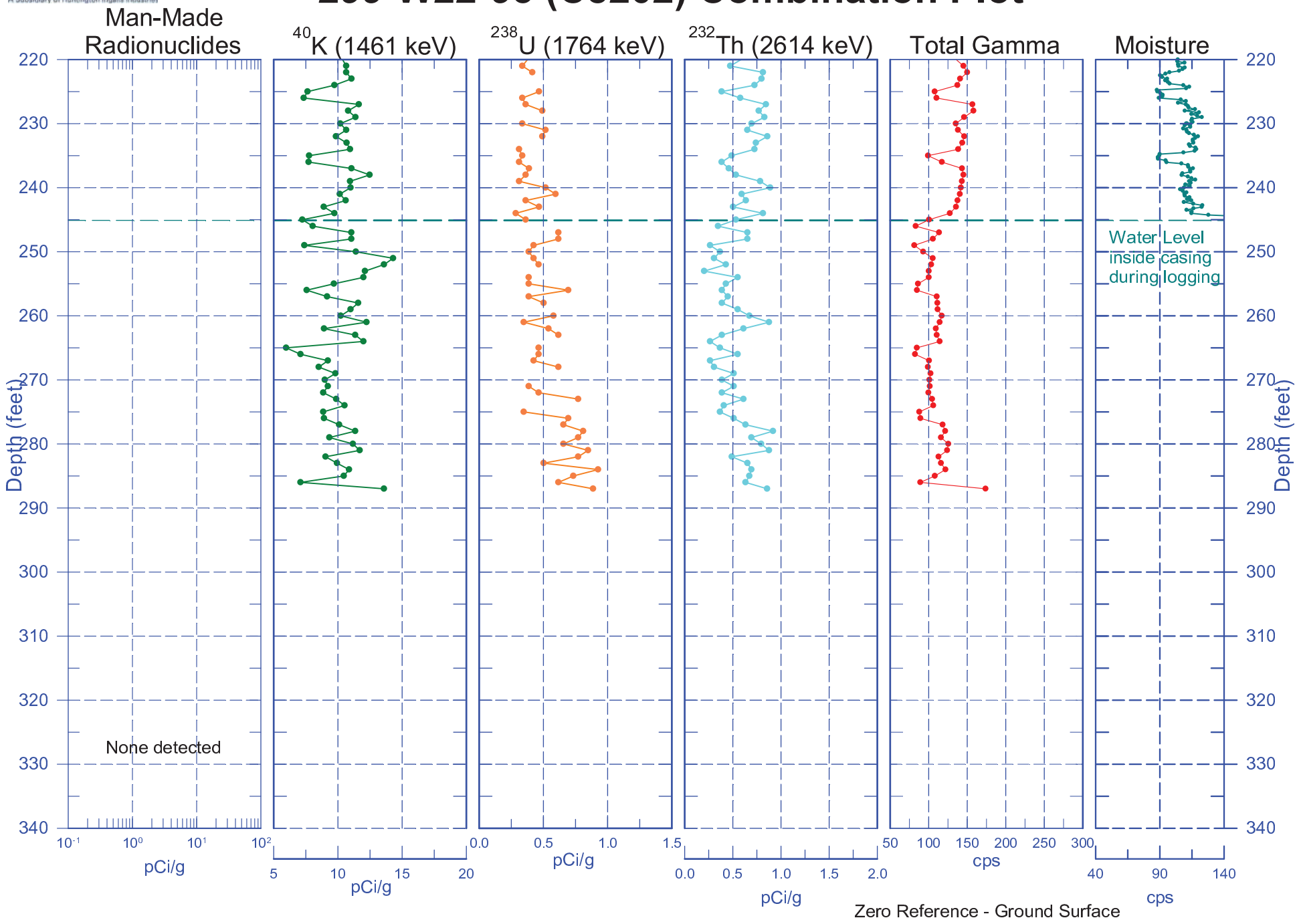
299-W22-93 (C8202) Combination Plot



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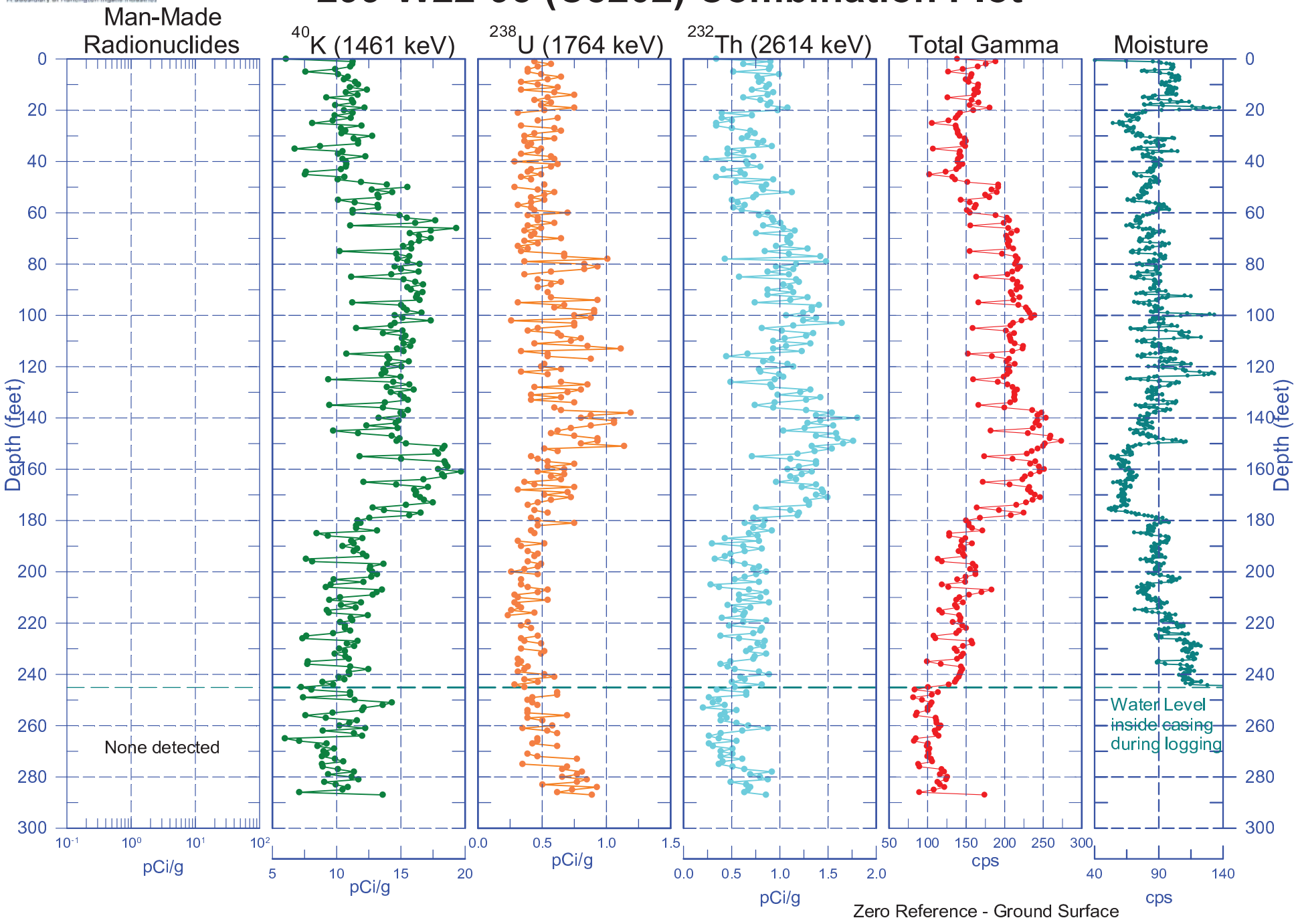
299-W22-93 (C8202) Combination Plot



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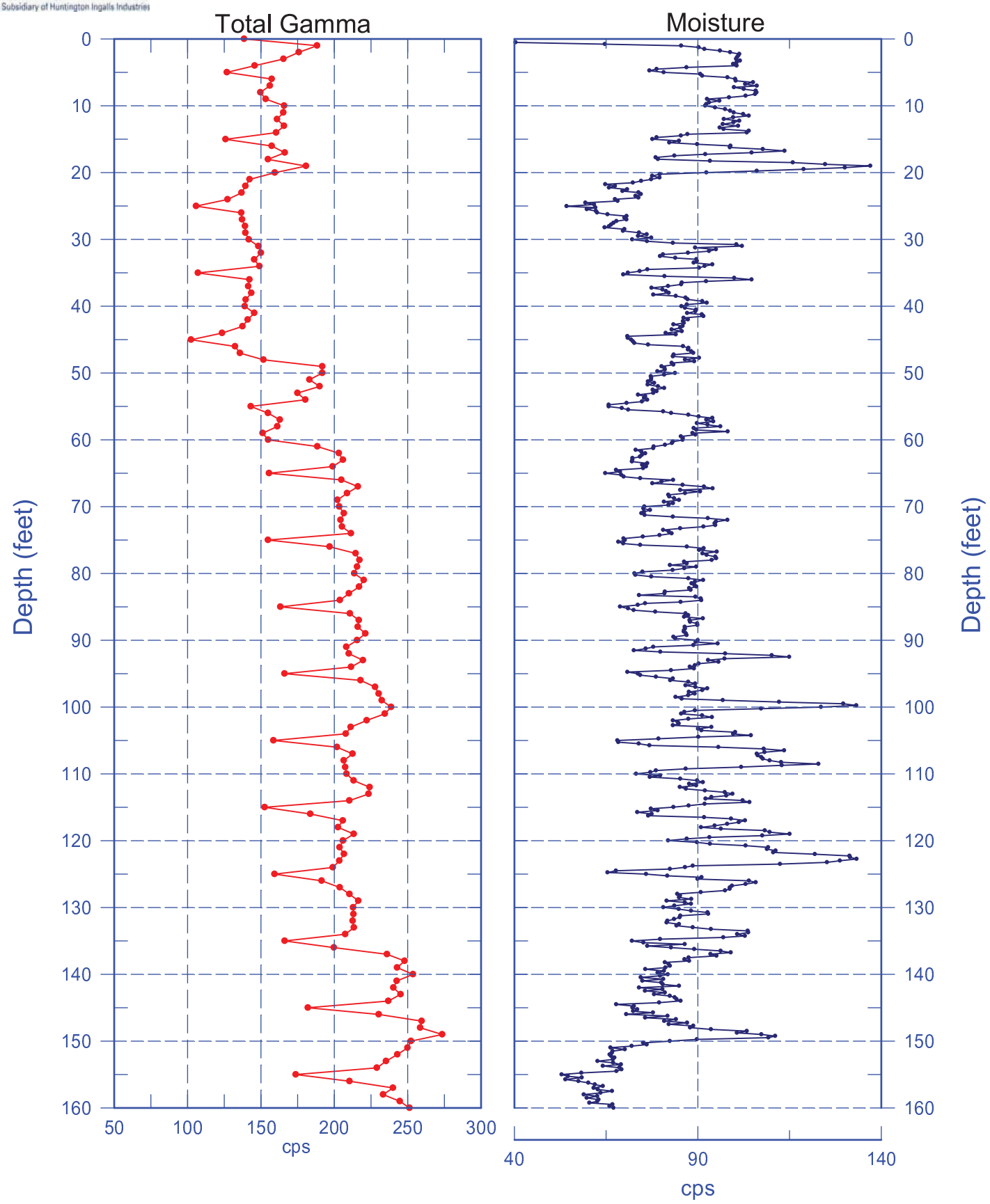
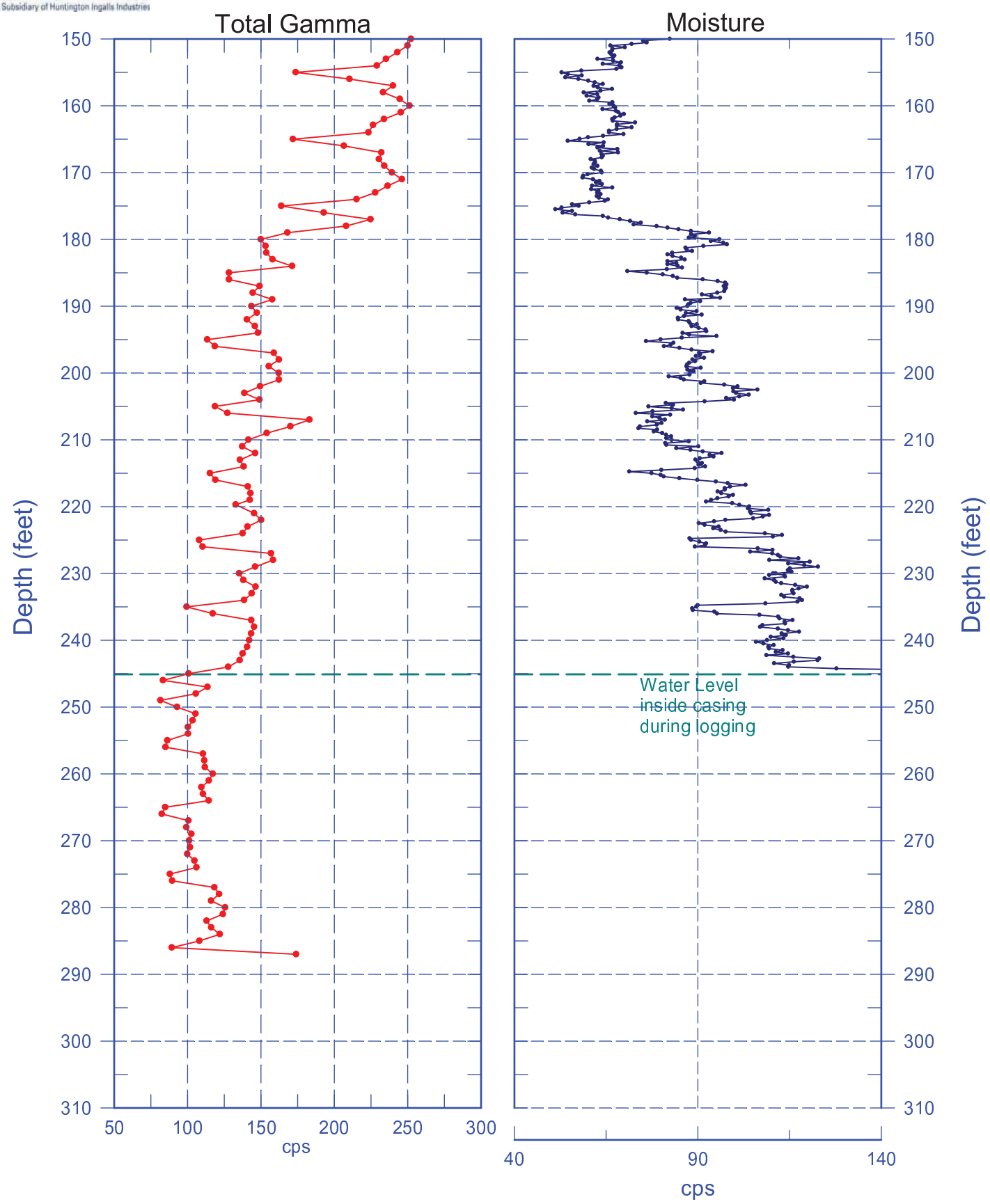
299-W22-93 (C8202)
Total Gamma & Moisture



Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-W22-93 (C8202)
Total Gamma & Moisture



Reference - Ground Surface

Stoller Newport News Nuclear
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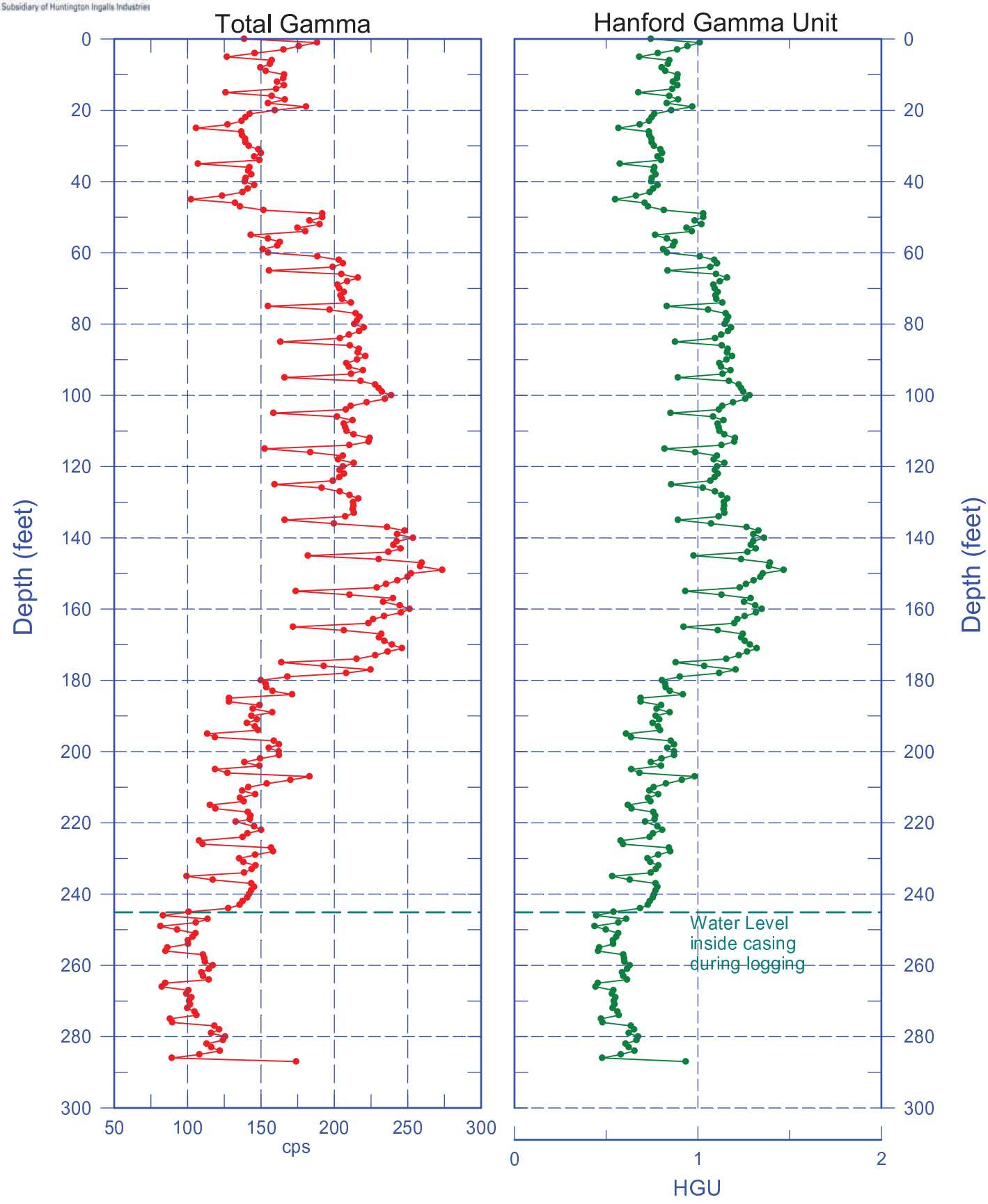
299-W22-93 (C8202)
Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

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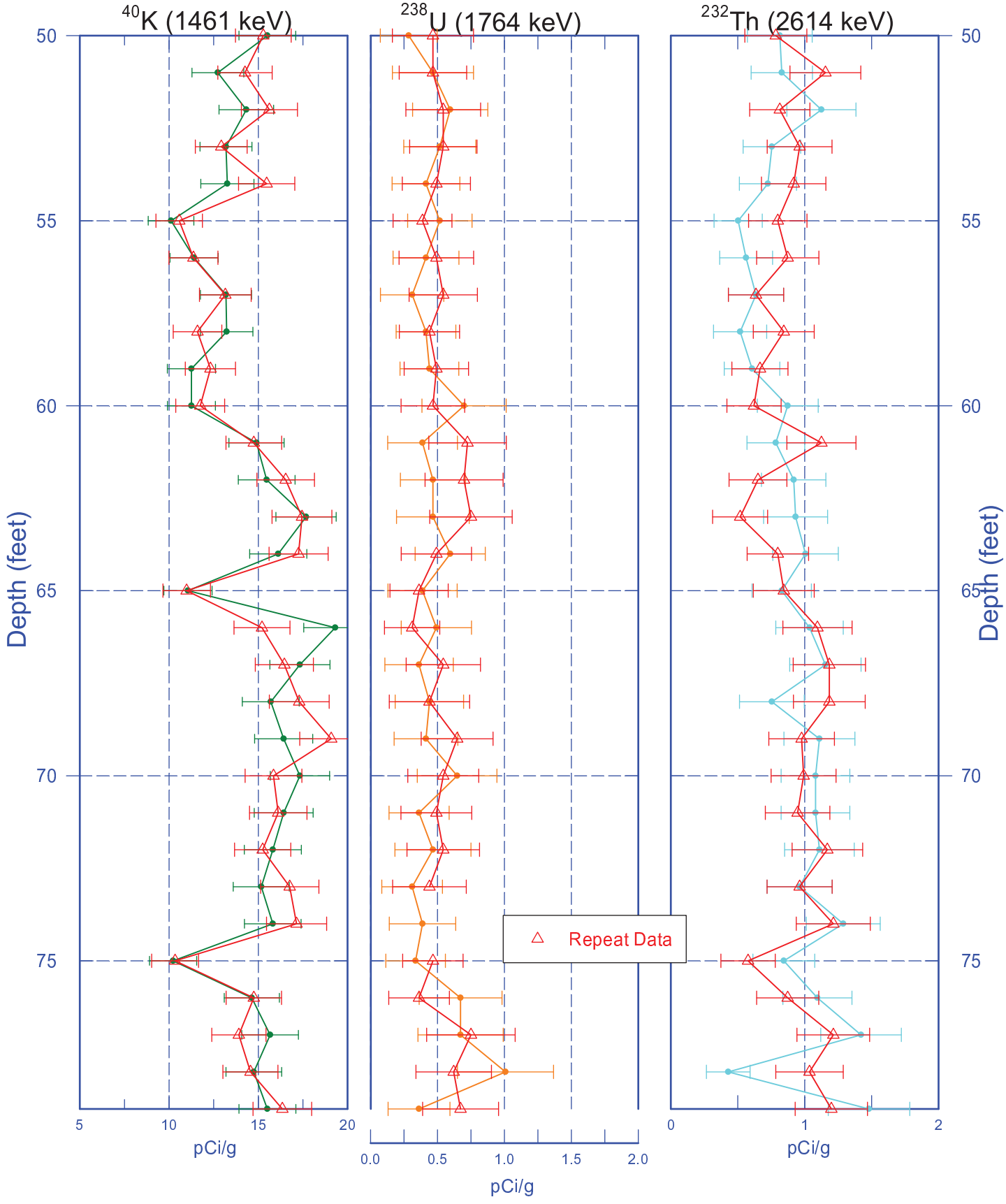
299-W22-93 (C8202)

Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

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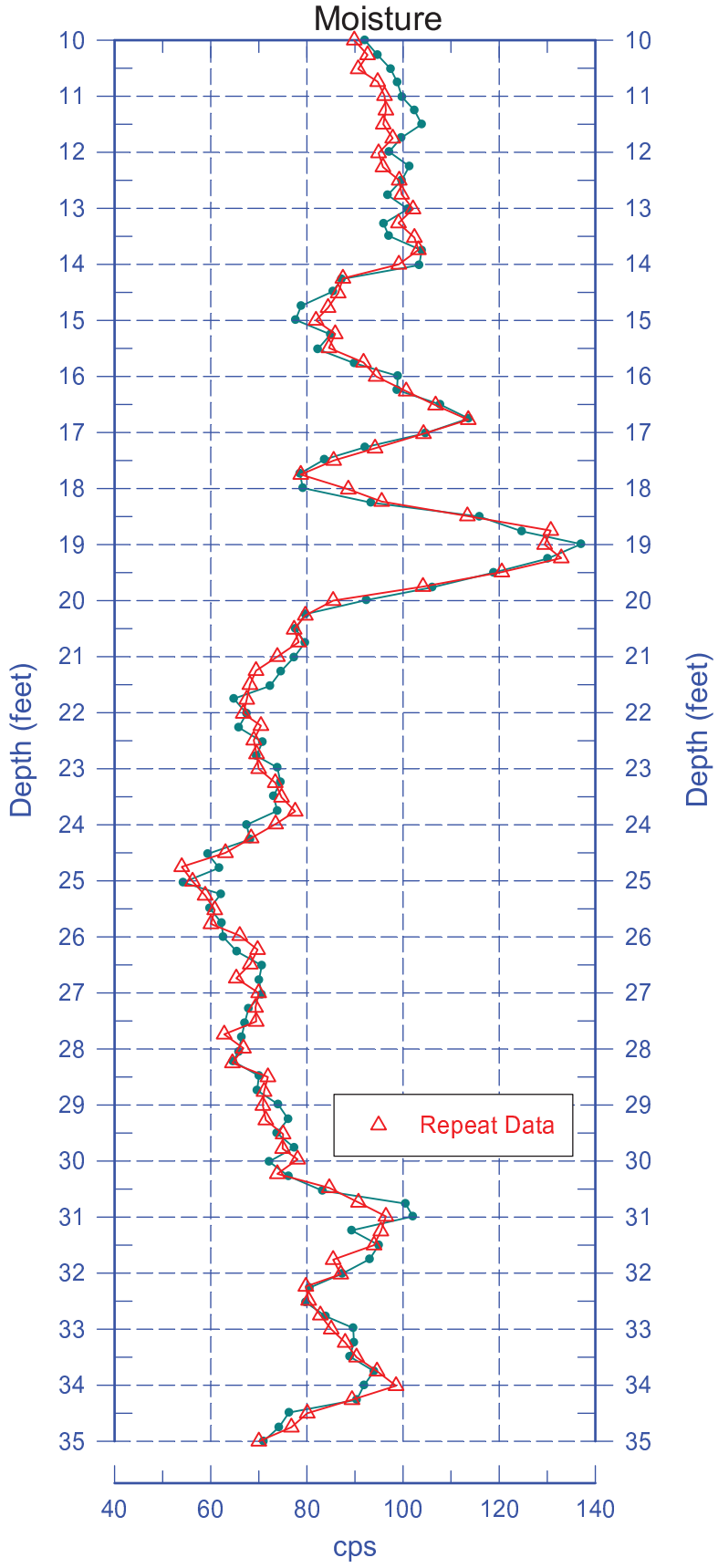
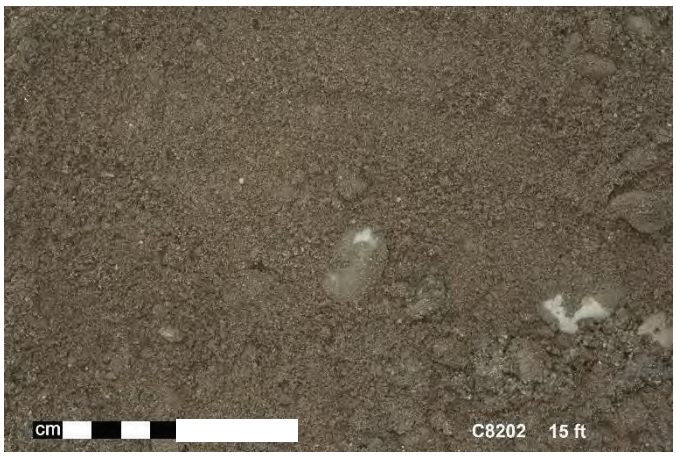
299-W22-93 (C8202)
Moisture Repeat Section



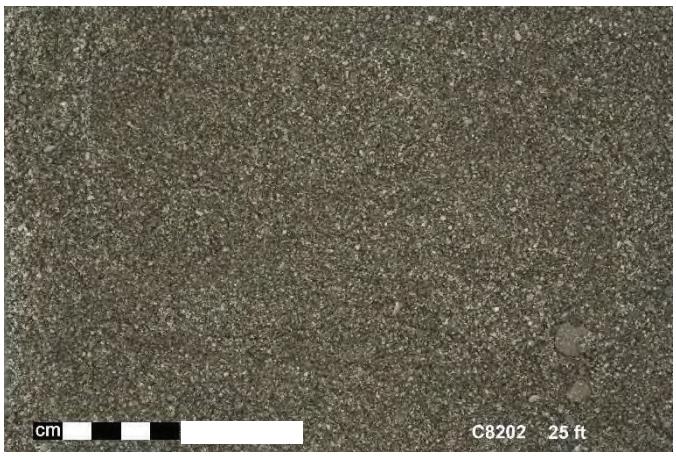
Reference - Ground Surface

cm
C8202 5 ft

cm
C8202 10 ft


cm
C8202 15 ft

cm
C8202 20 ft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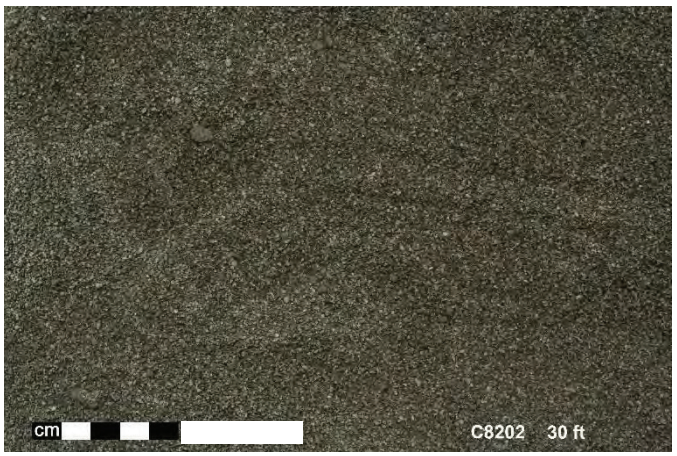
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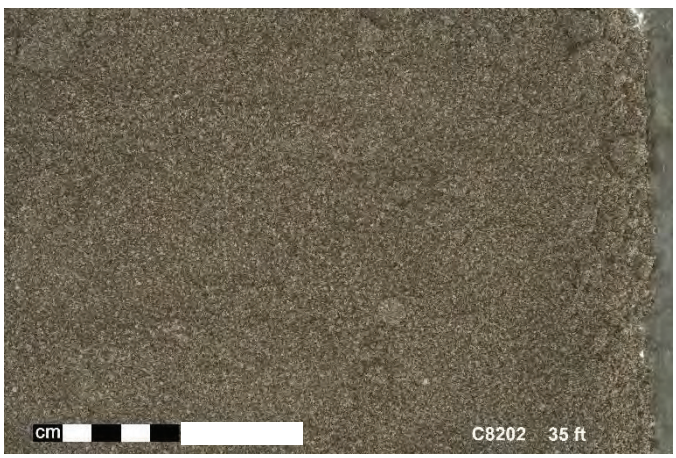
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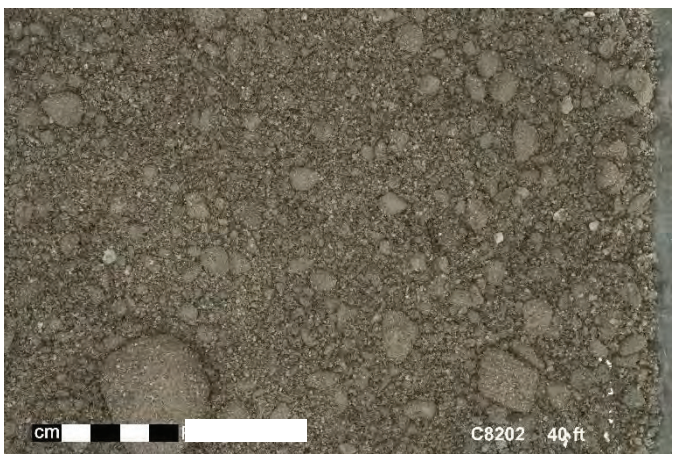

cm
C8202 40 ft

cm
C8202 45 ft

cm
C8202 50 ft

cm
C8202 55 ft

cm
C8202 60 ft

cm
C8202 65 ft

cm
C8202 70 ft

cm
C8202 75 ft

cm
C8202 80 ft

cm
C8202 85 ft

cm
C8202 90 ft

cm
C8202 95 ft

cm
C8202 100 ft

cm
C8202 105 ft

cm
C8202 110 ft

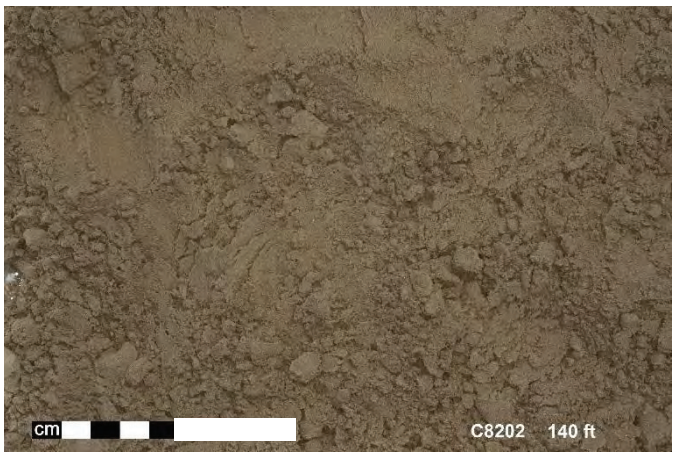
cm
C8202 115 ft

cm
C8202 120 ft

cm
C8202 125 ft

cm
C8202 130 ft

cm
C8202 135 ft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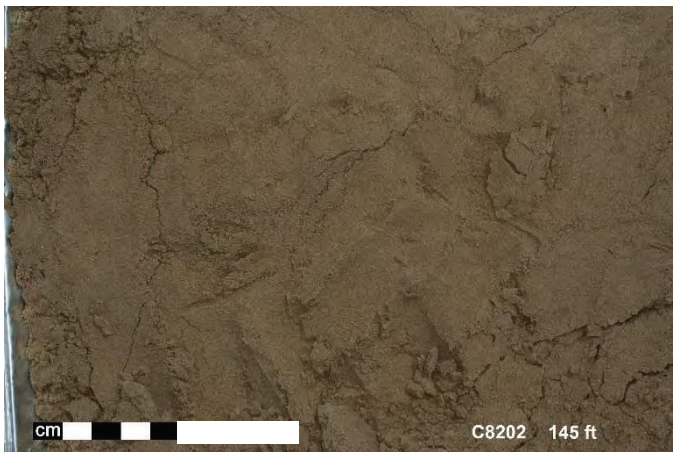
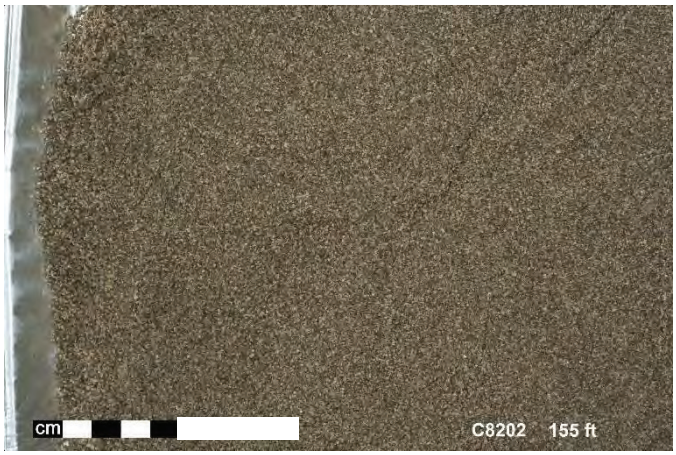
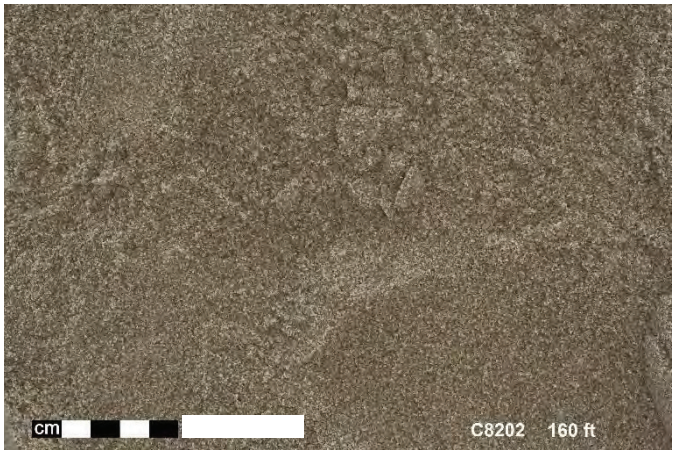
C8202 140 ft


cm
C8202 145 ft

cm
C8202 150 ft


cm
C8202 155 ft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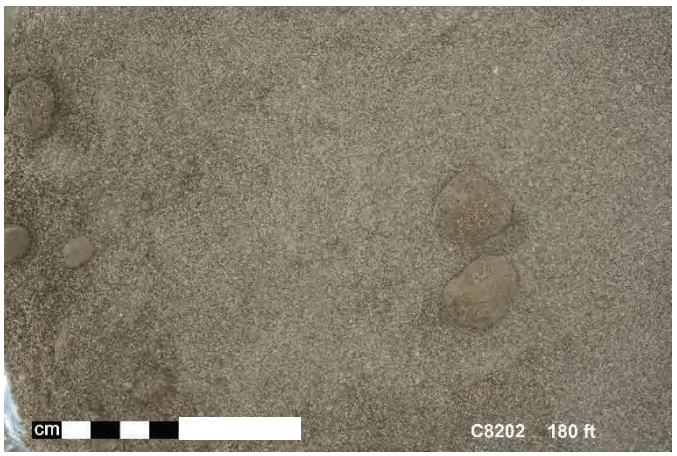
C8202 160 ft

cm
C8202 165 ft

cm
C8202 170 ft

cm
C8202 175 ft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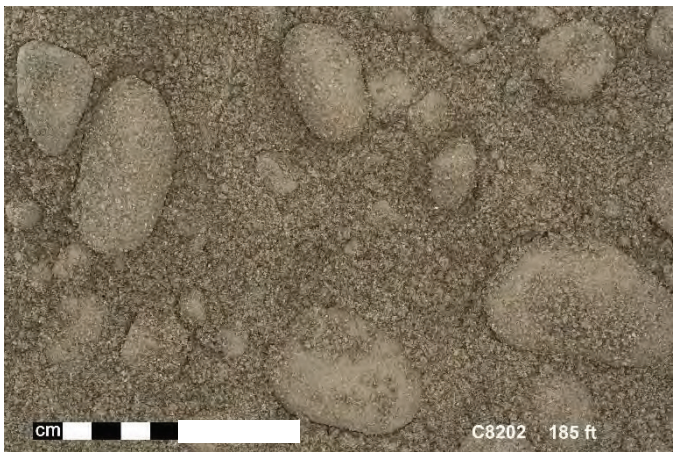
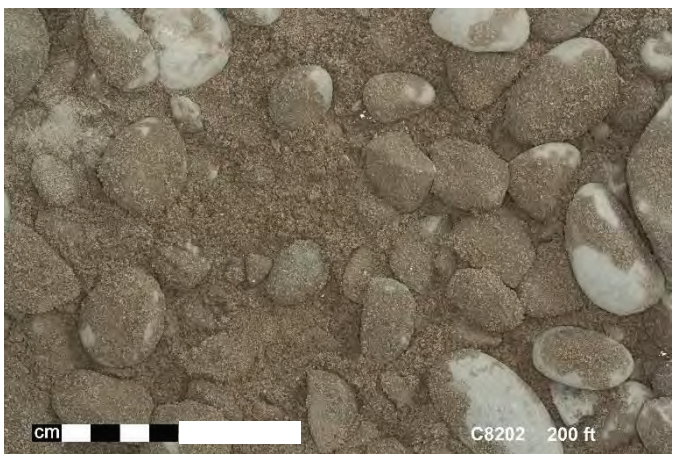
C8202 180 ft


cm
C8202 185 ft

cm
C8202 190 ft

cm
C8202 195 ft


cm
C8202 200 ft

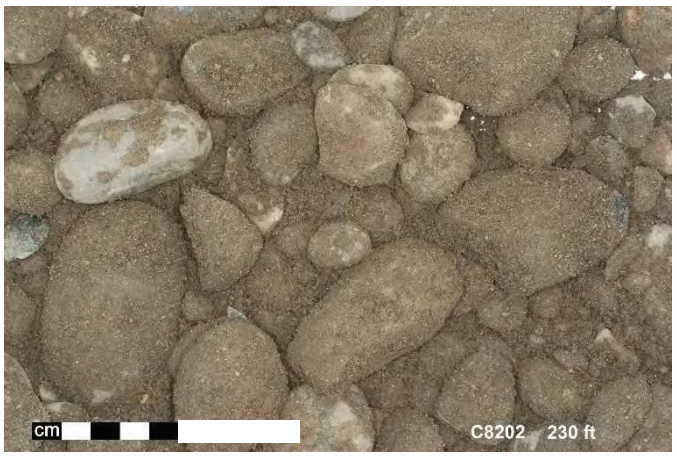
cm
C8202 205 ft

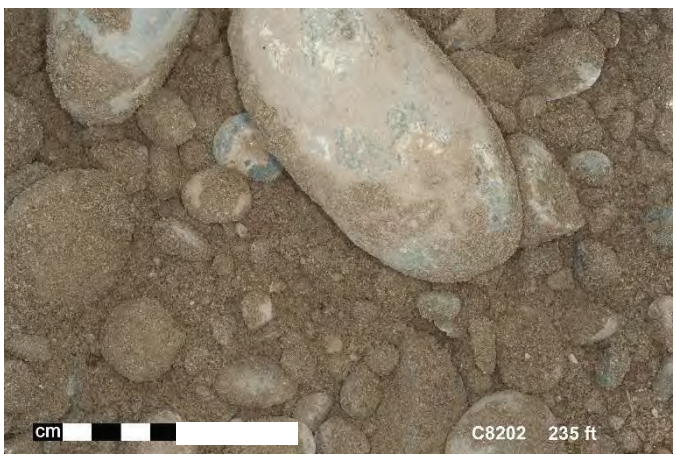
cm
C8202 210 ft

cm
C8202 215 ft

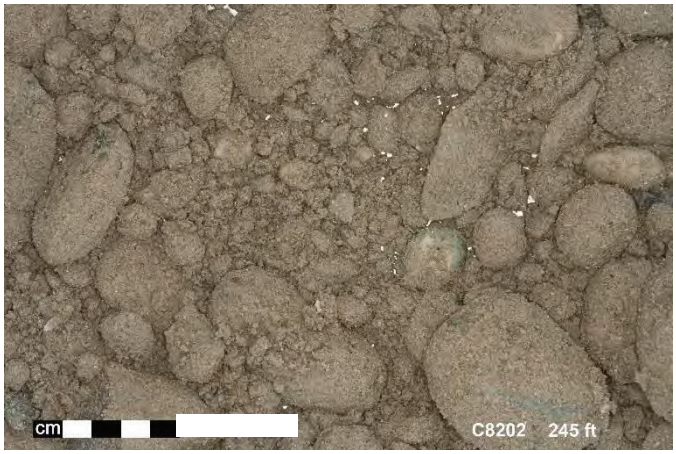
cm
C8202 220 ft

cm
C8202 225 ft


cm
C8202 230 ft


cm
C8202 235 ft

cm
C8202 240 ft


cm
C8202 245 ft

cm
C8202 250 ft

cm
C8202 255 ft

cm
C8202 260 ft

cm
C8202 265 ft

cm
C8202 270 ft

cm
C8202 275 ft

cm
C8202 280 ft

SURVEY DATA REPORT			Request No. 153-123
Project No.	Title: 200W M-24 Wells C8202 & C9432 Final Surveys		File No. 2WT12R25
Job. No. CACN: 303595-JPRC	Prepared By: N.P. Fastabend	Date: 6/3/15	Reviewer: LBM

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casings) and elevations of completed M-24 Wells C8202 (299-W22-93) and C9432 (299-W23-236) in 200W 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: 06/01/15	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 M-24 Well C8202 (299-W22-93) in 200W Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 200W

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
2W-141 (CHPRC) and 2W-49 (CHPRC)

Well ID	Well Name	Easting	Northing	Elevation	
C8202	299-W22-93	566949.07'	134485.98'		Center of Casing
				207.629'	"X" on Rim
				206.887'	Brass Survey Marker

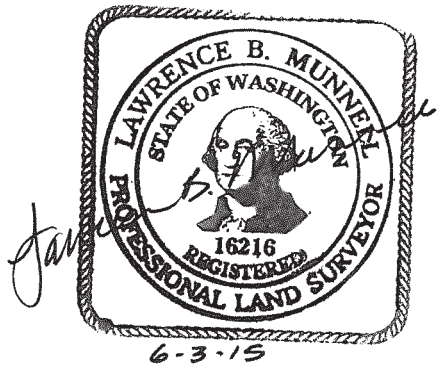
Notes:

207.336' 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.



A-6003-659 (04/03)

Appendix B

Well Documentation for C9430 (299-W22-115)

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

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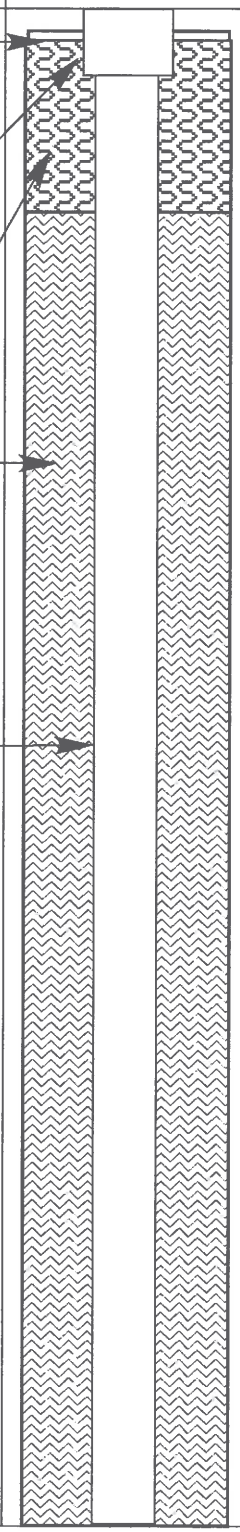
WELL SUMMARY SHEET

Start Date: 5/15/2015
Finish Date: 6/5/2015
Page 1 of 4

Well ID: C9430	Well Name: 299-W22-115
Location: 50 m E of 241-SX	Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/27/15	Reviewed By: D. MEHRER Date: 7-22-15
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
Concrete Pad: 0.5 ft above ground surface (ags)	
6-in Protective Casing: 3.19 ft ags - 1.81 ft below ground surface (bgs)	
Type I/II Portland Cement Grout: 0 - 10.1 ft bgs	
8-20 mesh Bentonite Crumbles: 10.1 - 226.7 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.08 ft ags - 230.82 ft bgs	
Depths are in ft below ground surface.	
Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 271.0 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 Sand (S)
10		15 - 20 Gravelly Sand (gS)
20		20 - 35 Sand (S)
30		35 - 55 Sandy Gravel (sG)
40		55 - 75 Sand (S)
50		75 - 80 Sandy Silt (sM)
60		80 - 85 Silty Sand (mS)
70		85 - 120 Sand (S)
80		

A-6003-643 (REV 1)

WELL SUMMARY SHEET	Start Date: 5/15/2015 Finish Date: 6/5/2015	Page 2 of 4

Well ID: C9430	Well Name: 299-W22-115
Location: 50 m E of 241-SX	Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/27/15	Reviewed By: L.D. MEHRER Date: 7-22-15
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
8-20 mesh Bentonite Crumbles: 10.1 - 226.7 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.08 ft ags - 230.82 ft bgs	
Depths are in ft below ground surface. Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 271.0 ft bgs. All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
90		85 - 120 Sand (S)
100		
110		
120		120 - 125 Sandy Silt (sM)
		125 - 150 Silt (M)
130		
140		
150		150 - 155 Sandy Gravel (sG)
		155 - 170 Sand (S)
160		
170		170 - 175 Gravelly Sand (gS)
		175 - 185 Silty Sandy Gravel (msG)

A-6003-643 (REV 1)

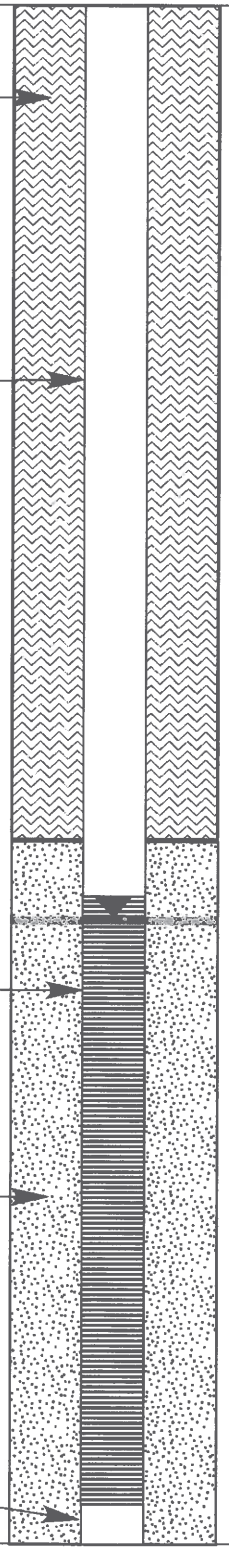
WELL SUMMARY SHEET

Start Date: 5/15/2015
Finish Date: 6/5/2015
Page 3 of 4

Well ID: C9430	Well Name: 299-W22-115
Location: 50 m E of 241-SX	Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/27/15	Reviewed By: D. MEHRER Date: 7-22-15
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
8-20 mesh Bentonite Crumbles: 10.1 - 226.7 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.08 ft ags - 230.82 ft bgs	
Depths are in ft below ground surface. Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 271.0 ft bgs. All temporary drill casing was removed from the ground.	
4-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen: 230.82 - 265.85 ft bgs	
10-20 mesh Premier Colorado Silica Filter Pack Sand: 226.7 - 272.3 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 265.85 - 270.86 ft bgs	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
180		175 - 185 Silty Sandy Gravel (msG)
		185 - 220 Sandy Gravel (sG)
190		
200		
210		
220		220 - 225 Sand (S)
		225 - 230 Sandy Gravel (sG)
230		230 - 235 Gravel (G)
		Static Water Level: 231.2 ft bgs (5/18/15)
		235 - 245 Sandy Gravel (sG)
240		
		245 - 255 Slightly Silty Gravelly Sand ((m)gS)
250		
		255 - 265 Silty Sandy Gravel (msG)
260		
		265 - 272.3 Gravel (G)

A-6003-643 (REV 1)

WELL SUMMARY SHEET

Start Date: 5/15/2015
Finish Date: 6/5/2015
Page 4 of 4

Well ID: C9430
Well Name: 299-W22-115
Location: 50 m E of 241-SX
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/27/15
Reviewed By: J.D. MEHRER Date: 7-20-15
Signature:
Signature:

CONSTRUCTION DATA

Description	Diagram
10-20 mesh Premier Colorado Silica Filter Pack Sand: 226.7 - 272.3 ft bgs 4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 265.85 - 270.86 ft bgs Depths are in ft below ground surface. Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 271.0 ft bgs All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
270		265 - 272.3 Gravel (G)
		Static Water Level: 321.2 ft bgs (05/18/15)
		Total Depth: 272.3 ft bgs (05/18/15)
280		
290		
300		
310		
320		
330		
340		
350		

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 7
Date: 5/15/15

Well ID: C9430 | Well Name: 299-W22-115 | Location: ~50 m E ~~W~~ of 241 SX

Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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' SAND (S); trace gravel, 100% sand, trace silt. Gravel: 20-35 mm sized pebbles, 100% mafic. Sand: well sorted, VF-C, 70%. F-VF, 30% C-M, 30% mafic. 2.5Y3/3 dark olive brown, strong rxn to HCl. ~~Damp~~ moist	BECKER HAMMER, 8 3/8" OD Threaded casing, dual wall.
5	5/15/15 G				Grab samples collected every ~~5'~~ 5' and/or at changes in lithology (labeled "G" in Sample type)
10	5/15/15 G				1 to 2 gallons H_2O added per foot drilled while outside ~~water~~ groundwater table
15	5/15/15 G			15'-20' GRAVELLY SAND (gS); 15% gravel, 80% sand, 5% silt Gravel: VF-VC Pebbles, VPS, A-R, 50 mm max, 50% mafic. Sand: VF-VC, PS, A-SR, 60% mafic, 2.5Y3/2 very dark grayish brown, moderate rxn to HCl. Damp.	
20	5/15/15 G			20'-35' SAND (S); 5% gravel, 95% sand, trace silt. Gravel: VFP-VCP, MS, max 35 mm, 50% mafic. Sand: VC-VF, 5% VF, 85% C-VC, WS, A-SR, 30% mafic. 2.5Y3/1 very dark gray, weak rxn to HCl, damp.	
25	5/15/15 G			@25' ↓ gravel to 0. Sand: 10% C, 90% VF-M, MS. 2.5Y 3/2 very dark grayish brown	
30	5/15/15 G			@30' Sand: 30% C, 40% M	
35	5/15/15 G			35'-55' SANDY GRAVEL (SG); 50% gravel, 50% sand, trace silt. Gravel: VFP-VCP, A-R, PS, 50% >20 mm, max = 40 mm, 60% mafic. Sand: VF-VC, A-R, PS, 70% C-VC, 70% felsic. 2.5Y3/2 very dark grayish brown, strong rxn to HCl, damp to dry.	

Reported By: J.V. Szecsody
Title: Geologist
Signature: [signature] Date: 5/18/15

Reviewed By: Kevin Bergstrom
Title: Sr. Geologist
Signature: [signature] Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 7
Date: 5/15/15

Well ID: C9430 | Well Name: 299-W22-115 | Location: ~50 m E/W of 241 SX

Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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	SG G			35'-55' SANDY GRAVEL (sG); 50% gravel, 50% sand, trace silt. Gravel: VFP-VCP, A-R, PS, 50% 20mm, max 40mm, 60% mafic Sand: VF-VC, A-R, PS, 70% C-VC, 70% felsic. ~~2.5Y3/2 very dark grayish brown, strong rxn to HCl, damp~~ 2.5Y4/2 dark grayish brown. Moderate rxn to HCl. Damp to dry @45' gravel ↓40%, sand ↑60%. Sand felsic ↓60%. 2.5Y4/3 olive brown. Dry.	BECKER HAMMER 8 3/8" OD dual wall threaded casing. Grab samples collected every 5' and/or at changes in lithology (labeled "G" in sample type)
45	SG G				
50	SG G			@50' gravel ↑60%, sand ↓40%. Gravel CF-VFP, A-SR, max 25mm. Sand felsic ↓50%. 2.5Y4/2 Dark grayish brown.	@51' drill rate increases
55	SG G			55'-75' SAND (S): 0% gravel, 100% sand, 0% silt. Sand: VF-C, A-SA, WS, 80% M-C, 85% felsic. 2.5Y5/3 Light olive brown, weak to moderate rxn to HCl, dry.	
60	SG G				
65	SG G			@65' trace gravel (<2%), very fine pebbles, A-SA, 70% felsic. Sand: 50% M-C, MS	
70	SG G			@70' Sand: 60% C-VC. Moderate rxn to HCl.	
75	SM G			75'-80' SANDY SILT (sM); 0% gravel, 20% sand, 80% silt. Sand: Coarse and very fine, coarse is A-SA < 5%, 95% is VF sand, WS, 95% felsic. 2.5Y5/3 Light olive brown, moderate rxn to HCl, dry. Mica abundant. Nonplastic	

Reported By: J.V. Szecsody | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: [signature] Date: 5/18/15 | Signature: [signature] Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 7

Date: 5/15/15

Well ID: C9430 | Well Name: 299-W22-115 | Location: ~50 m E of 241 SX 5/16/15

Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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			80-85' SILTY SAND (mS); 70% sand, 30% silt. Sand: VF, WS, 95% felsic. 2.5Y5/3 light olive brown. Moderate rxn to HCl, dry. Abundant mica. Nonplastic.	BECKER HAMMER 9⅝" OD dual wall threaded casing
85	G			85'-120' SAND (S); 90% sand, 10% silt. SAND: VF-VC, A-SR, VPS, 30% C-VC, 70% M-VF, 80% felsic. 2.5Y5/3 light olive brown, Strong rxn to HCl, Dry to damp. Little mica present.	Grab samples collected every 5' and/or at changes in lithology (labeled "G" in sample type)
90	G			@90' sand ↓ coarse = 15% C-VC, 85% M-VF trace silt, sand ↑ 100%	@92' drill rate decreases
95	G			@95' Sand ↓ coarse = 10% C, no very coarse, 90% M-VF	
100	G			@100' Sand ↓ coarse = 5%. Weak rxn to HCl	
105	G			@105' Sand ↓ coarse < 5%, 80% F-VF, PS, 2.5Y4/3 olive brown. Weak to moderate rxn to HCl. Mica abundant. Silt 10%, Sand 90%	
110	G			@110' Silt ↓ 5%, Sand ↑ 95%. Sand: 50% F-VF, 40% M. Moderate rxn to HCl	
115	G				

Reported By: J.V. SZECSODY | Title: Geologist | Signature: [signature] | Date: 5/18/15

Reviewed By: Kevin Bergstrom | Title: Sr. Geologist | Signature: [signature] | Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 4 of 7
Date: 5/15/15

Well ID: C9430 | Well Name: 299-W22-115 | Location: ~50 m E SSW of 241 SX

Project: 8 M24 TPA GW Monitoring Wells FY2015 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120	G			120'-125' SANDY SILT (sM); 30% sand, 70% silt. SAND: Coarse and VF, C<5% is A-SA, VF>95%, WS, 90% felsic. 2.5Y4/4 olive brown, Strong rxn to HCl. Damp to dry. Little mica.	BECKER HAMMER 9⅝" OD threaded casing, dual wall. Grab samples collected every 5' and/or at changes in lithology (labeled "G" in Sample Type)
125	G			125'-150' SILT (sM); 10% sand, 90% silt. Sand: VF, A-SA, WS, trace coarse, 95% felsic. 2.5Y4/4 olive brown, weak rxn to HCl, Dry, little mica.	@122' drill rate decreases
130	G			@130' Moderate rxn to HCl. Abundant mica.	@130' proposed contact between Hanford & Cold Creek Unit (CCU) based on Δ lithology
135	G			@135' sand ↓5%, silt ↑95%. 30% of mud is clay. 2.5Y5/3 Light olive brown. Moist. Little mica. Low plasticity.	
140	G			@140' sand ↓0%, silt 100%. 70% of mud is clay-swelling clay. 2.5Y4/3 olive brown. Strong rxn to HCl. Damp to dry. Little mica. High plasticity.	
145	G			@145' sand ↑5%, silt ↓95%. 30% of mud is clay. SAND: VF, WS, 90% felsic. 2.5Y5/3 Light olive brown. Dry. Low Plasticity.	@149' drill rate decreases
150	SG G			150'-155' SANDY GRAVEL (sG); 30% gravel, 65% sand, 5% silt. Gravel: VFP-SC, A-SR, PS, 75mm max. Sand: VF-VC, PS, 50% felsic. 2.5Y4/3 olive brown. Strong rxn to HCl, moist, little mica present.	@153' drill rate increases
155	S G			155'-170' SAND (S); gravel <5%, >95% sand, trace silt. Gravel: VF-M Pebbles, A-SA, max=12mm, 80% matic. Sand: VF-VC, VPS, 60% C-M, <5% VC, 70% felsic. 2.5Y4/3 olive brown. No rxn to HCl. Dry. Little mica. Occasional silty clay nodule.	@155' Contact between CCU & Ringold Taylor Flat (RTF) based on Δ lithology

Reported By: J.V. Sreesady | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: [signature] Date: 5/18/15 | Signature: [signature] Date: 7/22/15

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BOREHOLE LOG

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Date: 5/15/15

Well ID: C9430 | Well Name: 299-W22-115 | Location: ~50 m E (RS sketch) of 241 SX

Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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
160	5/14/15 S G			155-170' SAND (S); 5% gravel, 95% sand, trace silt. Gravel: VFP-MP, R-A, PS, max 25 mm, 5% mafic. Sand: VF-C, 90% C-M, A-SR, PS, 80% felsic. 2.5Y 4/3 olive brown. No rxn to HCl. Dry. Cementation on gravels. Little mica.	BECKER HAMMER ~~8"~~ OD 8 3/8" Threaded casing, dual wall
165	5/14/15 S G			@165' no cementation on gravels.	Grab samples collected every 5' and/or at changes in lithology (labeled "G" in sample type)
170	5/14/15 gS G			170'-175' GRAVELLY SAND (gS); 15% gravel, 85% sand, trace silt. Gravel: VFP-SC, A-R, max = 100 mm, 80% cobbles, 5/12/15 cobbles are rounded, VFP-FP are angular and = 5%, 75% felsic. Sand: VF-C, A-SR, PS, 85% C-M, 80% felsic. 2.5Y 4/3 olive brown, weak rxn to HCl. Dry. Little mica.	@171' drillers add water from 170-175' Contact between RTF and Ringold unit E based on Δ lithology
175	5/14/15 msG G			175'-185' Silty Sandy Gravel (msG); ~~5/14/15~~ gravel = 60% ~~20% 5/12/15~~ sand, 20% silt. Gravel: VFP-VCP, A-R, VPS, VCP are rounded, VF-F = A-SA, max = 60 mm. 85% felsic. Sand: VF-VC, A-SA, VPS, 90% felsic. 2.5Y 5/4 Light ~~olive~~ brown, strong rxn to HCl. Wet. Some mica. Silt is low plasticity.	
180	5/14/15 msG G			@180' Gravel: VFP-SC, R-A, VPS, max = 95 mm, 50% felsic Sand: 60% felsic. 2.5Y 4/3 olive brown. Moderate rxn to HCl. 150 mm Cobbles	
185	5/12/15 SG G			185' ~~5/14/15~~ ~220' ~~200-215~~ SANDY GRAVEL (sG); ~~35% gravel, 65% sand, trace silt.~~ 5/12/15 30% gravel, 70% sand, trace silt. GRAVEL: VFP-SC, R-A, VPS, max = 70 mm, 70% felsic. Sand: VF-VC, VC < 5%, VF-M = 80%, 80% felsic. 2.5Y 4/3 olive brown. Weak rxn to HCl. Dry. Some mica.	
190	5/11/15 SG G			@190 max gravel = 100 mm	@193' drillers add water @199' drillers add water
195	5/11/15 SG G			@195 Gravel ↑ 40%, Sand ↓ 15%, silt 5%. Gravel: VFP-VCP, C-VC = rounded, max 64 mm, 85% felsic. Sand VF-C, VPS, 5% Coarse. Little mica	

Reported By: J.V. Saccody | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: [signature] Date: 5/18/15 | Signature: [signature] Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

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Date: 5/15/15

Well ID: C9430 | Well Name: 299-W22-115 | Location: ~50 m ~~W~~ E of 241 SX (state plane)
Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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
200	G			185'-~~210~~' SANDY GRAVEL (sG); 45% gravel, 55% sand, trace silt. GRAVEL: VFP-SC, A-R, PS, max 100 mm, 90% felsic. Sand: VF-VC, A-R, C-VC = 10% and angular, VPS, 90% felsic. 2.5Y4/3 olive brown, weak rxn to HCl, dry, little mica present.	Becker Hammer 9"/8" 05 dual wall threaded casing. Grab Samples collected every 5' and/or change in lithology (G)
205	G			@ 205' sand ↓ 50%, silt 5%. GRAVEL: VFP-LC, max 135 mm. SAND: C-VF, PS, <5% C, 95% M-F. Damp to dry. Occassional silt nodules of low plasticity. ~~Gravel is 30% mafic~~ Gravel 50% mafic. (silt 1%)	
210	G			@ 210' gravel ↓ 30%, Sand ↑ 60%, Silt ↑ 10%. Max gravel size = 155 mm, gravel 30% mafic. Silt nodules have no plasticity.	
215	G			@ 215' gravel ↑ 50%, Sand ↓ 45%, silt ↓ 5%. Sand: 10% C, VPS. No silt nodules.	
220	G			220'-225' Sand (S); trace gravel, 100% sand. Trace gravel is FP-VFP, A-SA, 70% felsic. Sand: F-VF well sorted, 90% felsic. 2.5Y4/3 olive brown, No rxn to HCl, dry. Mica abundant; Muscovite abundant (as mica fraction)	
225	G			225'-230' Sandy Gravel (sG); 40% gravel, 60% sand, trace silt. Gravel: VFP-SC, R-SA, 80% MP-SC, 80% felsic. Sand: VF-C, A-R, VPS, 10% coarse, 90% felsic. 2.5Y4/3 olive brown, No rxn to HCl, Dry, mica present. (230-235')	
230	G			~~230'-240'~~ GRAVEL (G); 90% gravel, 8% sand, 2% silt. Gravel: VFP-LC, A-R, VPS, max = 140 mm, 70% CP-LC, 80% felsic. Sand: F-VC, A-R, VPS, 80% felsic. 2.5Y4/3 olive brown. No rxn to HCl. Dry. Mica Present.	DTW = ~~230.16' bgs~~ 231.14' bgs (5/4/15) encountered @ 231.15' (5/18/15)
235	G			235'-245' SANDY GRAVEL (sG); 75% gravel, 25% sand, trace silt. Gravel: VFP-LC, A-R, VPS, max = 150 mm, 90% felsic. Sand: VF-VC, PS, VC < 5%, M-VF = 90%, 90% felsic. 2.5Y4/3 olive brown. Weak rxn to HCl, dry, little mica	

Reported By: J.V. Szecsody | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: [signature] | Date: 5/18/15 | Signature: [signature] | Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

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Date: 5/15/15

Well ID: C9430 | Well Name: 299-W22-115 | Location: ~50 m E ~~W~~ 5/18/15 of 241 SX

Project: 8 M24 TPA GW Monitoring Wells FY2015 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
240	G			235'-245' SANDY GRAVEL (SG); 75% gravel, 25% sand. Gravel: VFP-SC, R-SR, 60% is CP-SC and R-SR, <CP is A-R, max = 105mm, 70% felsic. Sand: VF-VC, A-R, VPS, C-VC = 25%, 80% felsic. 2.5Y4/3 olive brown. No rxn to HCl, dry, mica present.	Becker Hammer 8 7/8" OD dual wall threaded casing
245	G			245' ~~5/18/15~~ 255' SLIGHTLY SILTY GRAVELLY SAND (mgS); 25% gravel, 55% sand, 20% silt (20% of silt is clay). Gravel: VFP-VCP, A-R, PS, max = 50mm, 60% felsic. Sand: VF-C, A-R, 70% Course, 80% felsic. 2.5Y4/3 olive brown. No rxn to HCl, moist, mica present. High Plasticity silt nodules present.	Grab samples collected every 5' and/or change in lithology (G)
250	G			@250' gravel ↑30%, Sand ↑60%, silt ↓10%. (20% of silt is clay). Sand: VF-VC, VPS, 80% VF-M. Weak rxn to HCl. Silt nodules low plasticity.	
255	G			~265' ~~5/18/15~~ 255'-~~265~~ SILTY SANDY GRAVEL (msG); 45% gravel, 30% sand, 25% silt. Gravel: VFP-SC, A-R, PS, max = 95mm, 90% felsic. Sand: VF-C, 80% M-VF, MS, 80% felsic. 2.5Y4/3 olive brown. Weak rxn to HCl, moist, mica present.	
260	G			@260' gravel ↓40%, Sand ↑45%, silt ↓15%. (20% of silt is clay). Max gravel = 120mm. Sand VF-VC, 5% C-VC, VPS. Silt nodules. Mica abundant. 2.5Y3/3 dark olive brown. Fraction of mica is white muscovite. ~~272.3' 5/18/15~~	
265	G			265' ~~272'~~ GRAVEL (G); 90% gravel, 5% sand, 5% silt. Gravel: VFP-VCP, A-R, PS, max = 50mm, 80% felsic. Sand: VF-VC, A-R, PS, <5% C-VC, 85% felsic. 2.5Y3/3 dark olive brown. No rxn to HCl, wet, mica present.	
270	G			@270' ~~gravel ↓5% 5/18/15 silt ↑5%~~ gravel ↓85%, silt ↑10%. VFP-SC gravel, max gravel = 115mm. mica abundant.	~~Encountered @ 271.5' JH~~ ~~DTW = 232.16 (6/4/15) JH~~ ~~5/19/15 JH~~ 7/16
				Total depth: 272.3' bgs (5/18/15) Shoe @ 271.0' bgs	DTW = 232.16 (6/9/15)

Reported By: J.V. SZECSODY | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: [signature] Date: 5/18/15 | Signature: [signature] Date: 7/22/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

299-W22-115 (C9430)
Log Data Report

Borehole Information:

Log Date:	2015-05-19	Filename:	C9430_HG-NM_2015-05-19	Site:	East of SX Farm
Coordinates (WA St Plane)		DTW[1] (ft) :	232.13	DTW Date:	05/18/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	05/18/15	N/A	272	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Threaded Steel	0.63	6 1/4	6	1/8	-0.63	271
Threaded Steel	0.15	9	8	1/2	-0.15	271

Borehole Notes:

The onsite geologist provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter of the inner casing (rounded to the nearest 1/16-in.). 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. 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 May 18, 2015, water inside the casing was measured at 232.13 ft by the logging engineer using an e-tape. The maximum logging depth achieved was 272 ft, approximately 1 ft below the reported casing depth.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 4N	Type:	60% HPGe SGLS[3]
Effective Calibration Date:	1/8/15	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	1	2	3	4 Repeat	
HEIS Number	1018737	1018745	1018746	1018738	
Date	05/19/15	05/19/15	05/19/15	05/19/15	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	0.0	272.0	157.0	40.0	
Finish Depth (ft)	135.0	156.0	134.0	67.0	

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

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Log Run	1	2	3	4 Repeat	
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	DNL71CAB	DNL71CAB	DNL71CAB	DNL71CAB	
Start File	DNL71000	DNL71136	DNL71253	DNL71277	
Finish File	DNL71135	DNL71252	DNL71276	DNL71304	
Post-Verification	DNL71CAA	DNL71CAA	DNL71CAA	DNL71CAA	
Depth Return Error (in.)	NA	Low 4	NA	Low 0.5	
Comments	Fine gain adjustment made after files 068, 108, and 126.	Fine gain adjustment made after files 163 and 171.	No fine gain adjustment made. Refilled sonde with liquid nitrogen.	Repeat section. No fine gain adjustment made.	

NMLS Log Run Information:

Log Run	1	2 Repeat	3 Repeat		
HEIS Number	1018739	1018740	1018740		
Date	5/18/15	5/18/15	5/18/15		
Logging Engineer	Pope	Pope	Pope		
Start Depth (ft)	0.0	80.0	86.25		
Finish Depth (ft)	232.25	86.0	103.0		
Count Time (sec)	15	15	15		
Live/Real	R	R	R		
Shield (Y/N)	NA	NA	NA		
MSA Interval (ft)	0.25	0.25	0.25		
Log Speed (ft/min)	NA	NA	NA		
Pre-Verification	DMY62CAB	DMY62CAB	DMY62CAB		
Start File	DMY62000	DMY62930	DMY72000		
Finish File	DMY62929	DMY62954	DMY72067		
Post-Verification	DMY72CAA	DMY72CAA	DMY72CAA		
Depth Return Error (in.)	NA	NA	0.0		
Comments	None	None	Changed file root to avoid going over 999 spectra.		

Logging Operation Notes:

A centralizer was not installed on either the moisture sonde or the SGLS sonde due to the small diameter of the casing.

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

Analysis Notes:

Analyst:	A. D. Pope	Date:	06/25/15	Reference:	HGLP-MAN-003, Rev. 0

A combined casing correction for a 0.625-in. thick casing (0.125 + 0.5-in. for the 1/8- and 1/2-in. thick casings) was applied to the SGLS 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.

A correction for water was applied below 232 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 DN20150108_C113, 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 multiple 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:

Cs-137 was detected at the ground surface at about 0.5 pCi/g, at 2.0 ft at 1.2 pCi/g, and at 7.0 ft at 0.2 pCi/g. MDLs for Cs-137 are plotted for the entire borehole.

The relatively thick casing joints beginning at about 10 ft and occurring at 10 ft intervals are indicated by reduced count rates on the total gamma log. The moisture count rates are also affected by the 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 (0-310 ft)
Natural Gamma Logs (0-160 ft)
Natural Gamma Logs (150-310 ft)
Combination Plot (0-120 ft)
Combination Plot (110-230 ft)
Combination Plot (220-340 ft)
Combination Plot (0-280 ft)
Total Gamma & Moisture (0-160 ft)
Total Gamma & Moisture (150-310 ft)
Total Gamma & Hanford Gamma Unit (0-280 ft)
Repeat Section of Natural Gamma Logs (40-67 ft)
Moisture Repeat Section (80-103 ft)

[5] Hanford Gamma Unit

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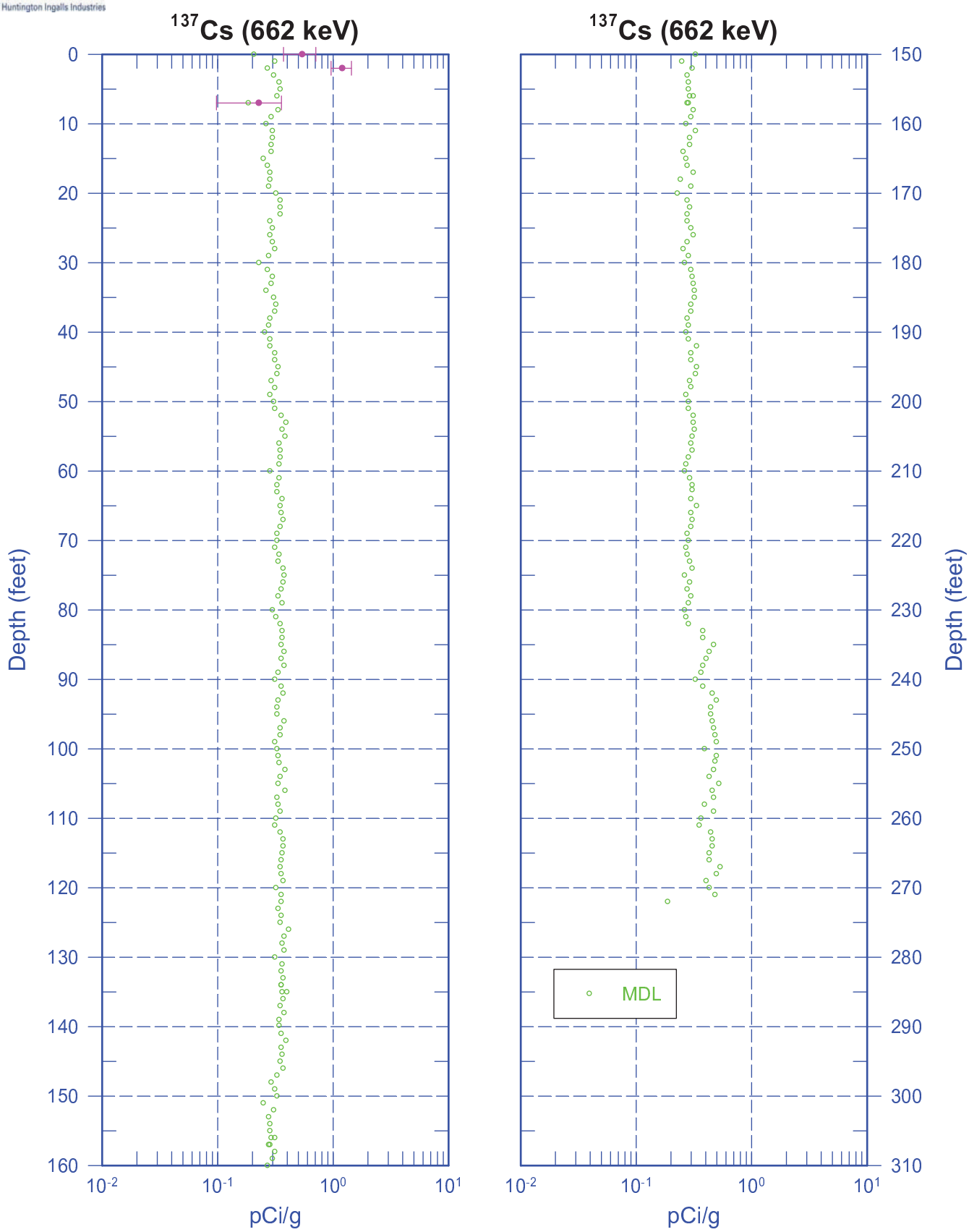
299-W22-115 (C9430)
Manmade Radionuclides



Zero Reference - Ground Surface

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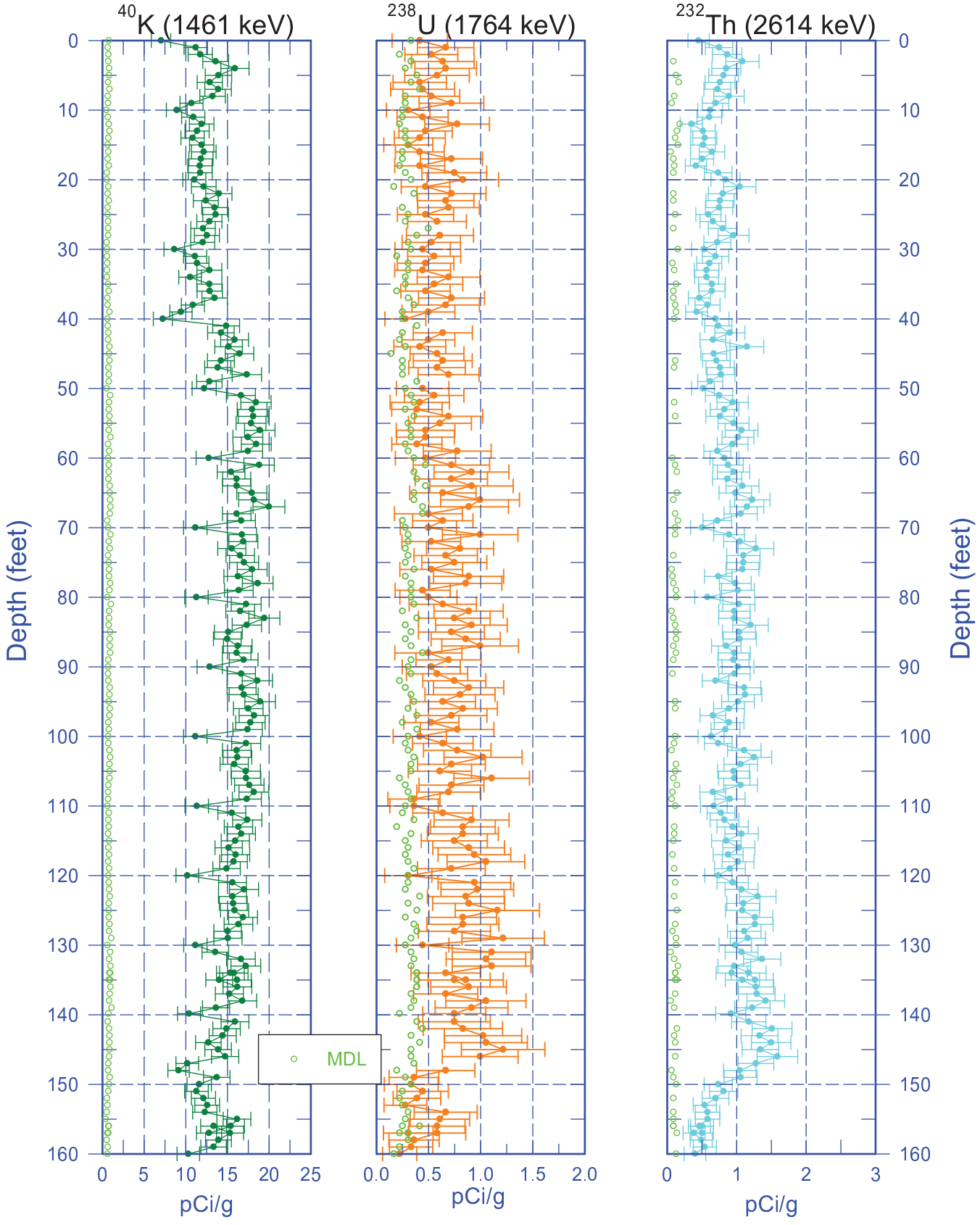
299-W22-115 (C9430)
Natural Gamma Logs



Zero Reference - Ground Surface

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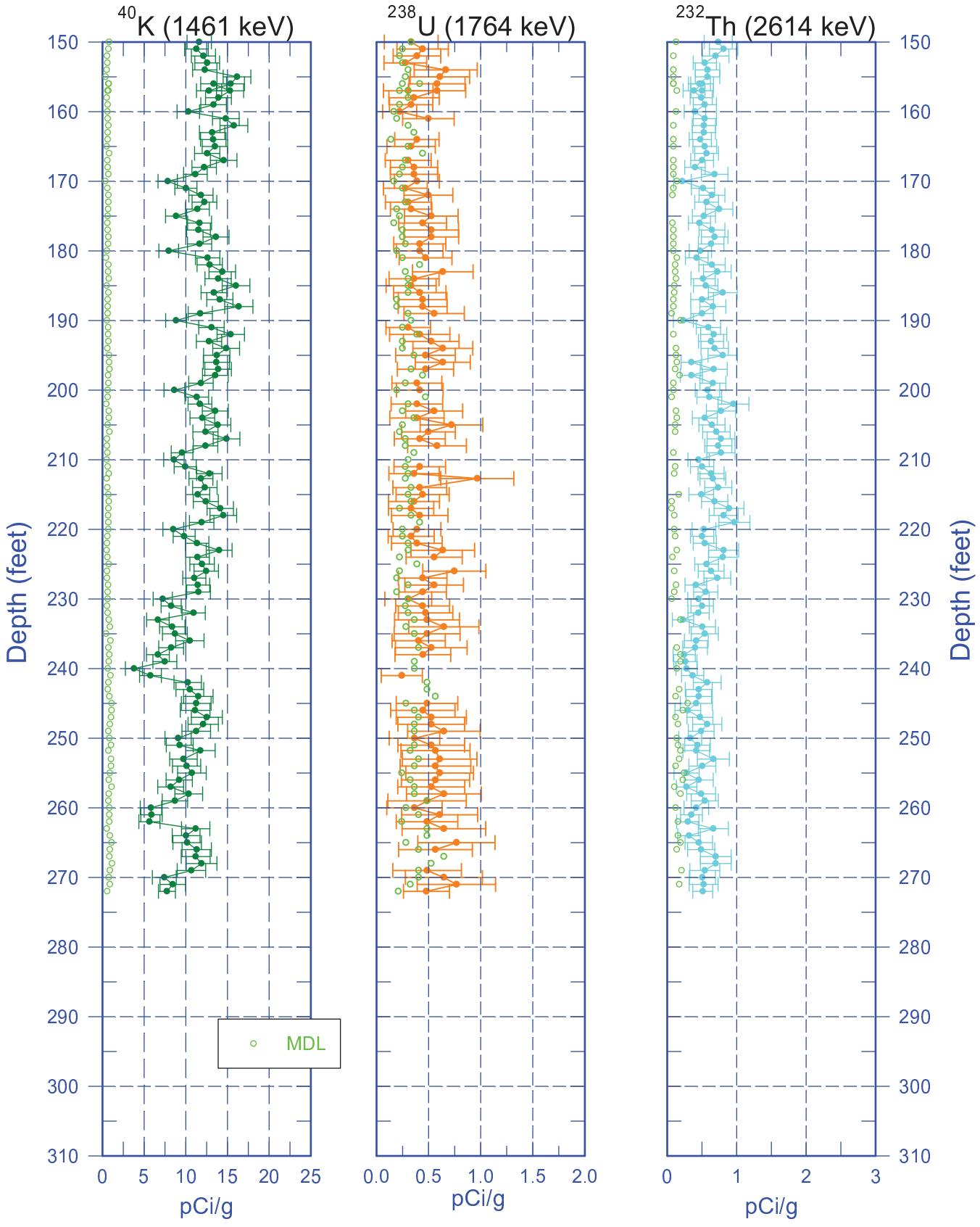
299-W22-115 (C9430)
Natural Gamma Logs



Zero Reference - Ground Surface

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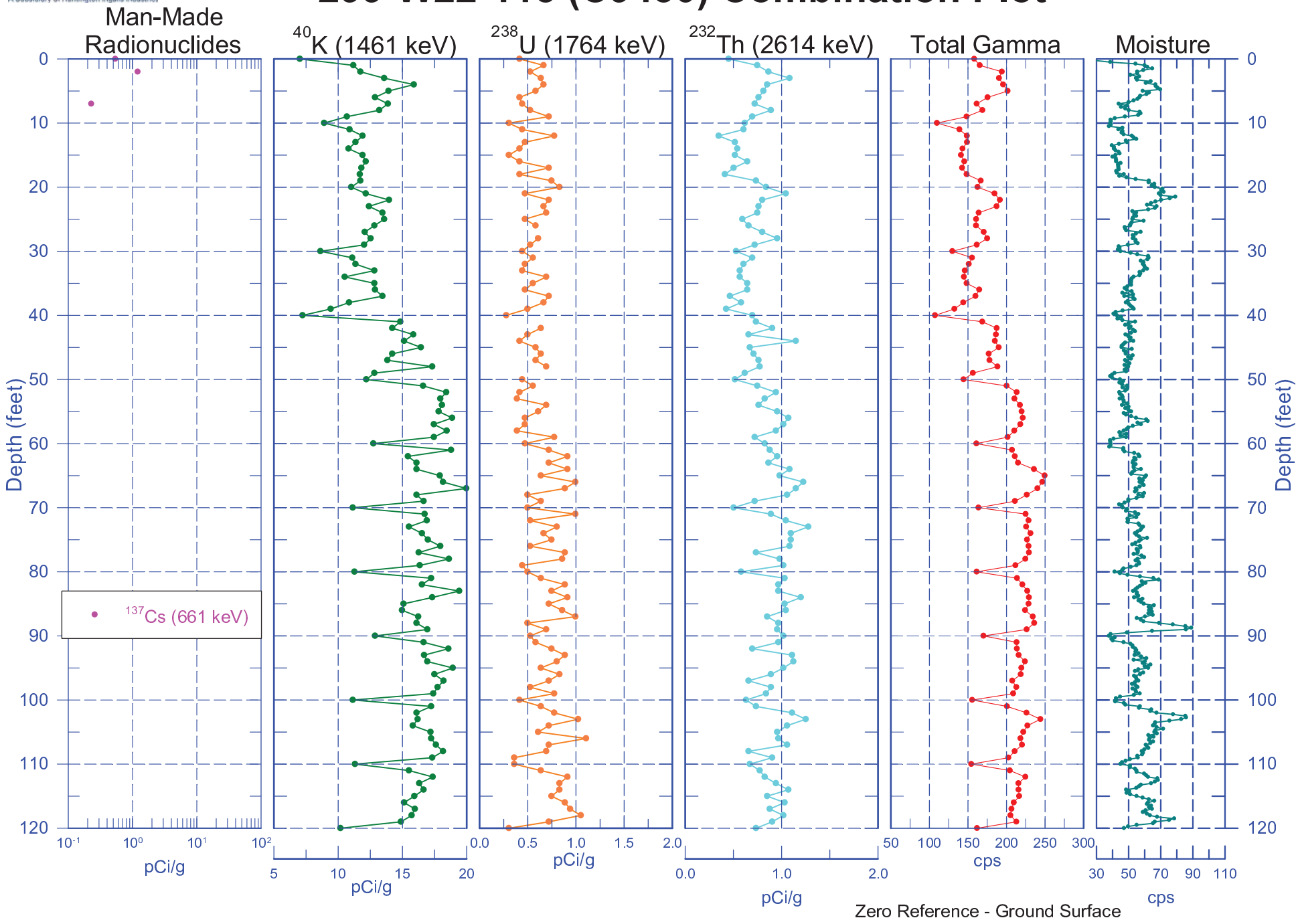
299-W22-115 (C9430) Combination Plot



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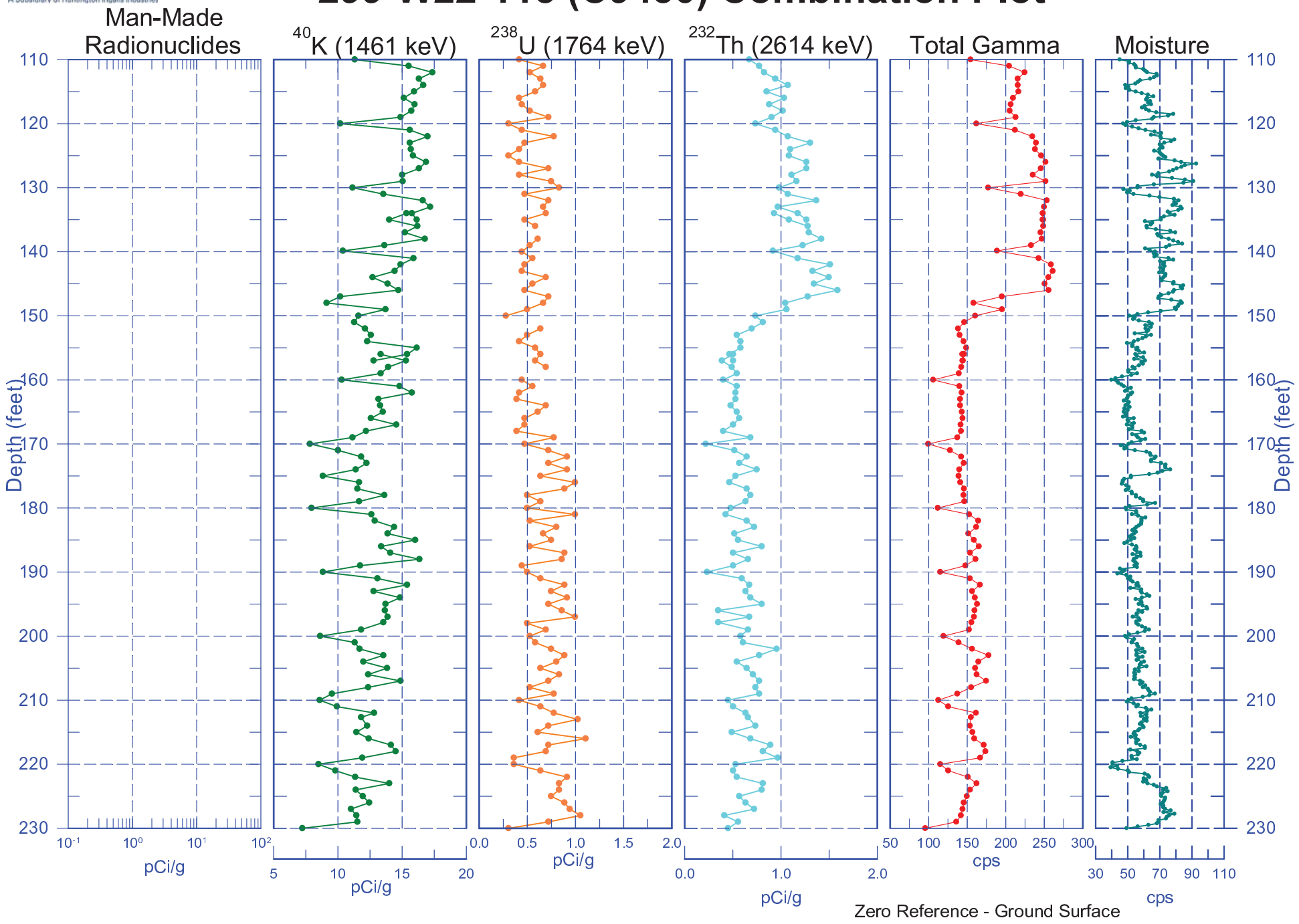
299-W22-115 (C9430) Combination Plot



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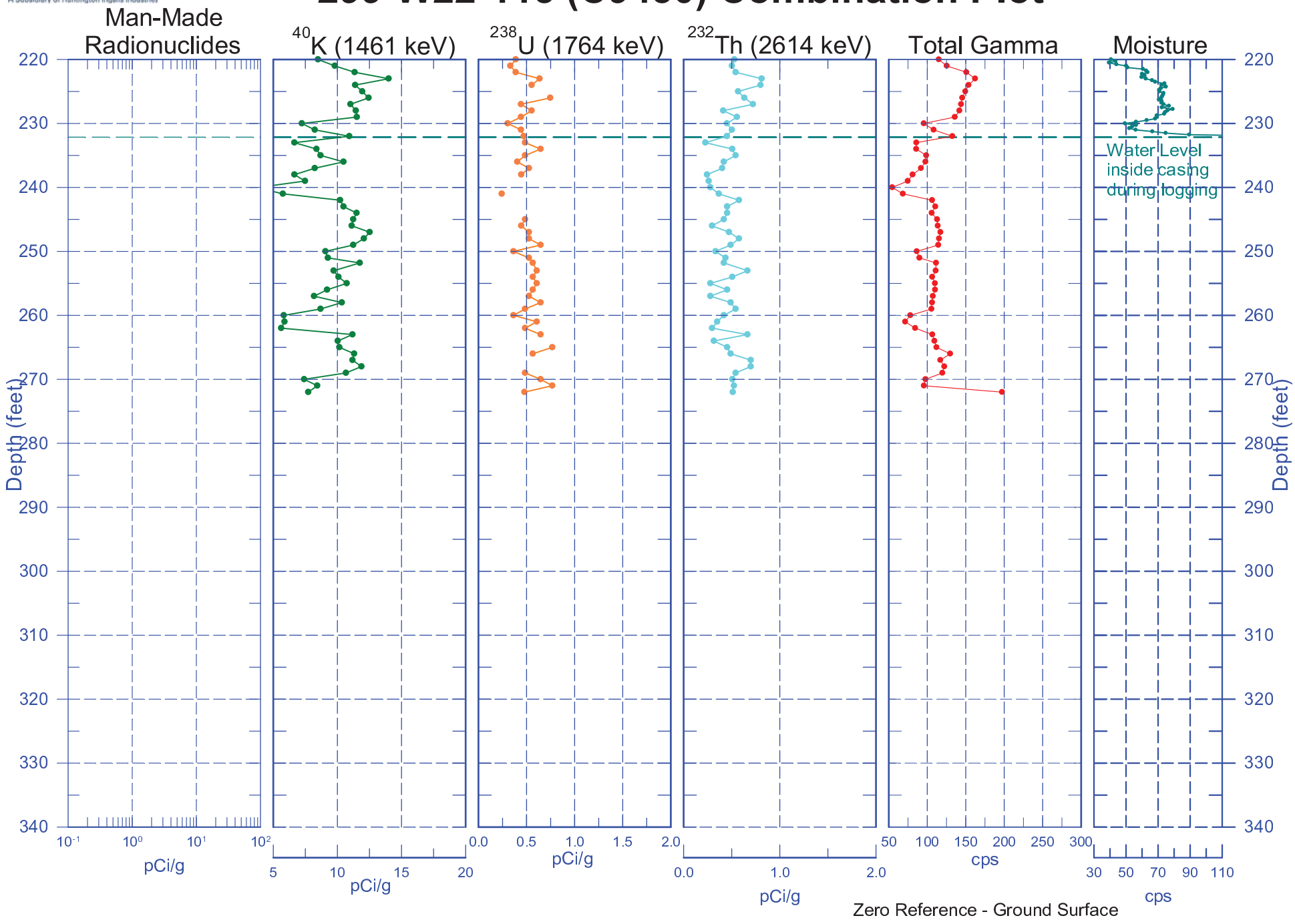
299-W22-115 (C9430) Combination Plot



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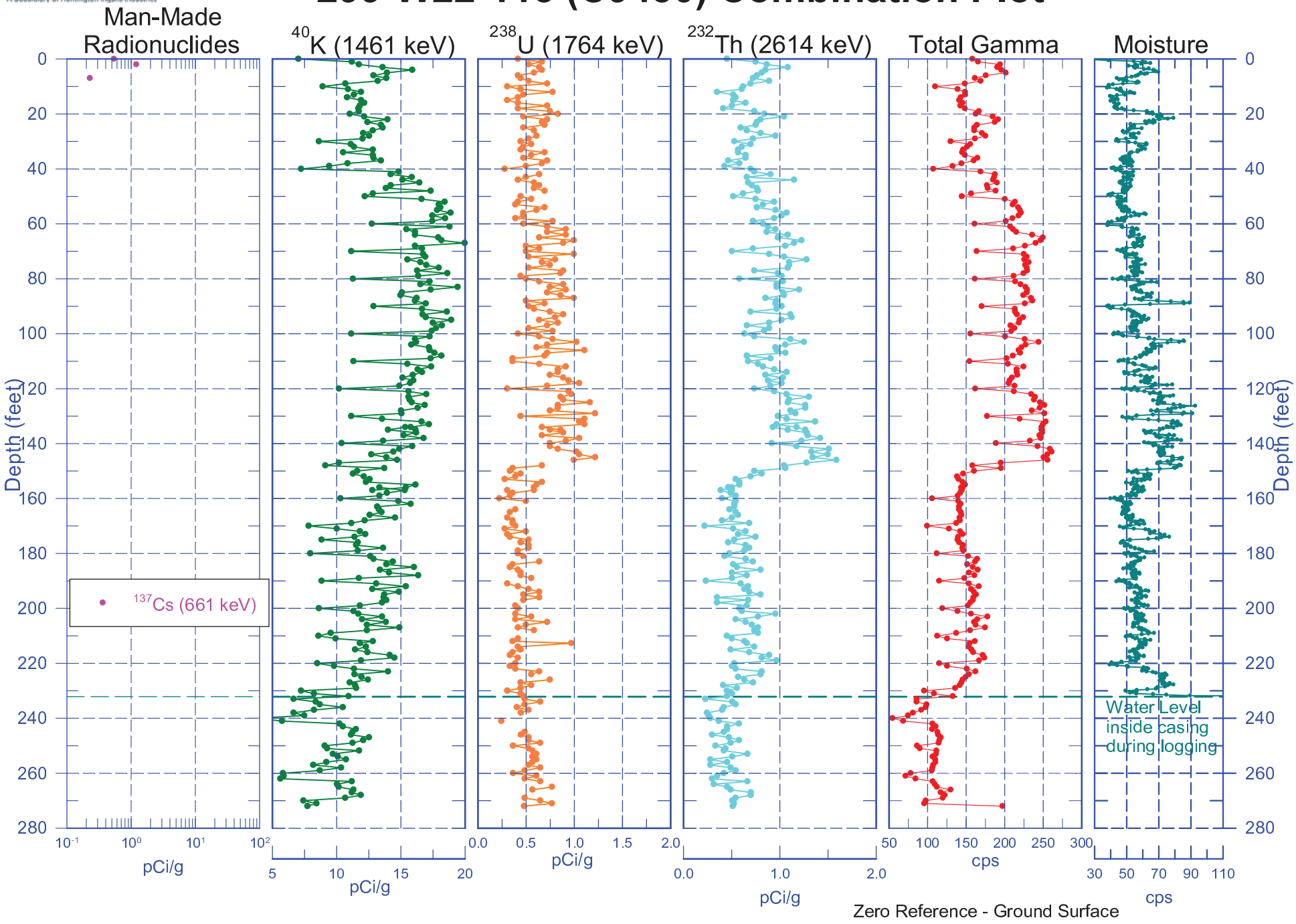
299-W22-115 (C9430) Combination Plot



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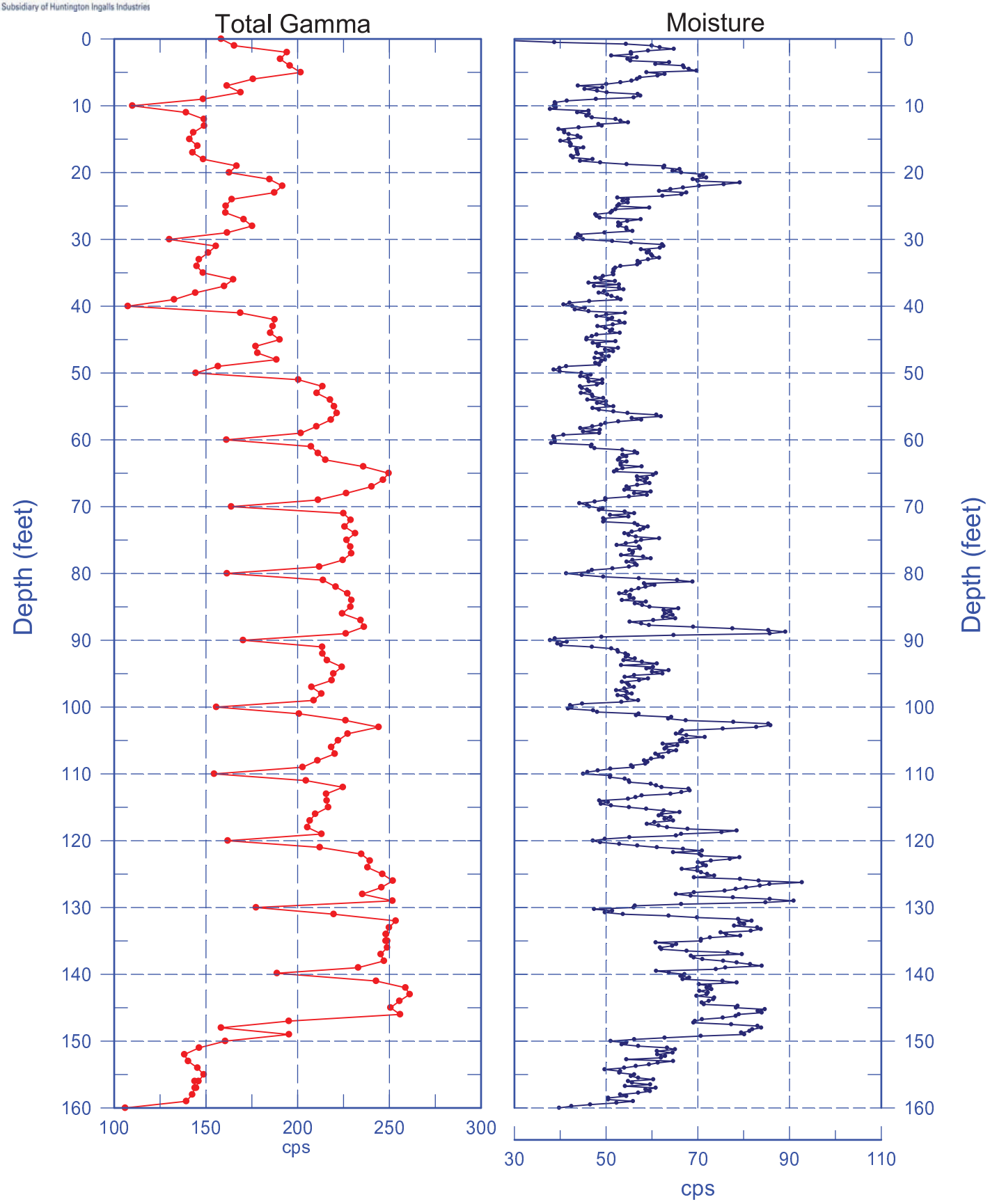
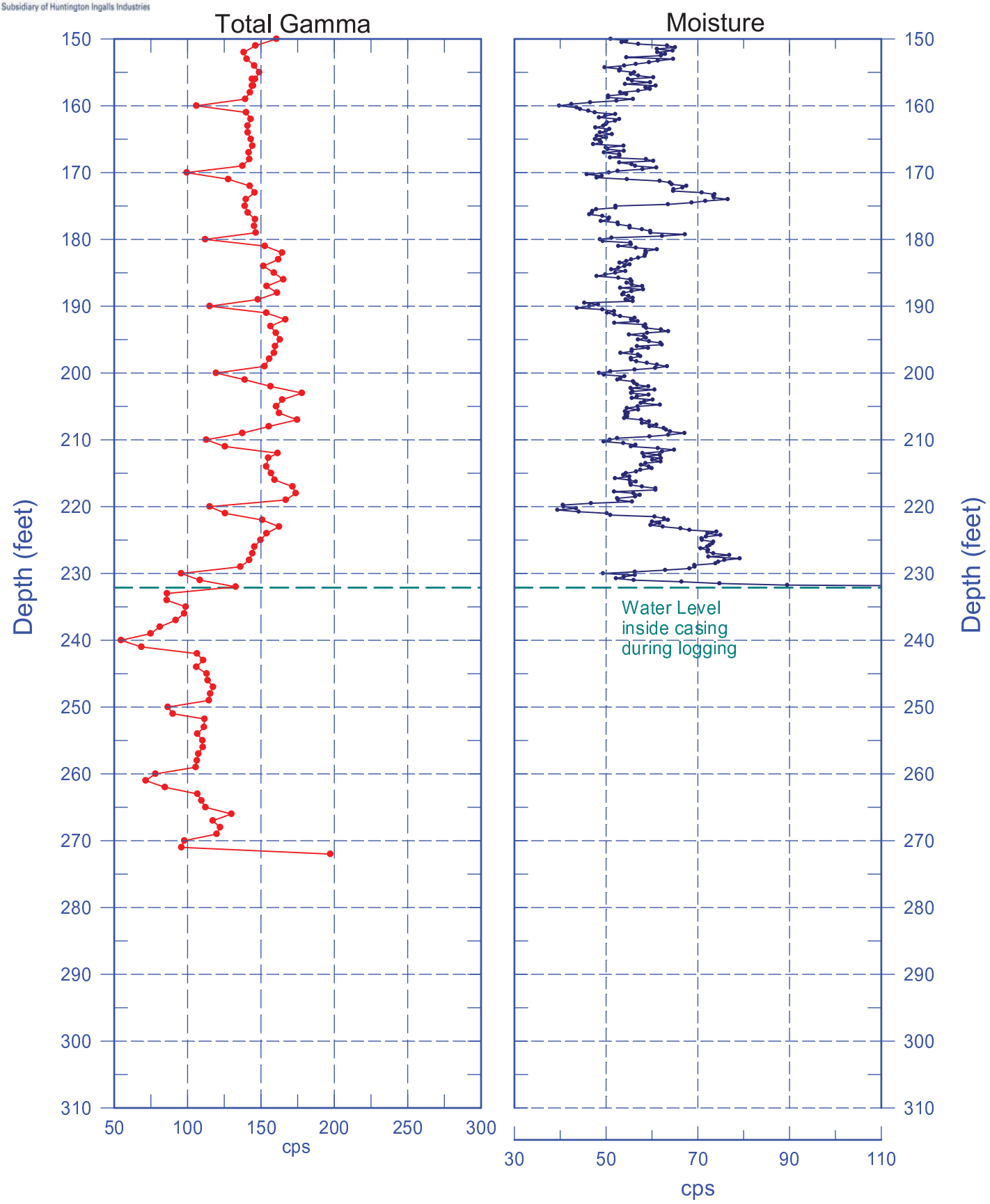
299-W22-115 (C9430)
Total Gamma & Moisture



Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-W22-115 (C9430)
Total Gamma & Moisture



Reference - Ground Surface

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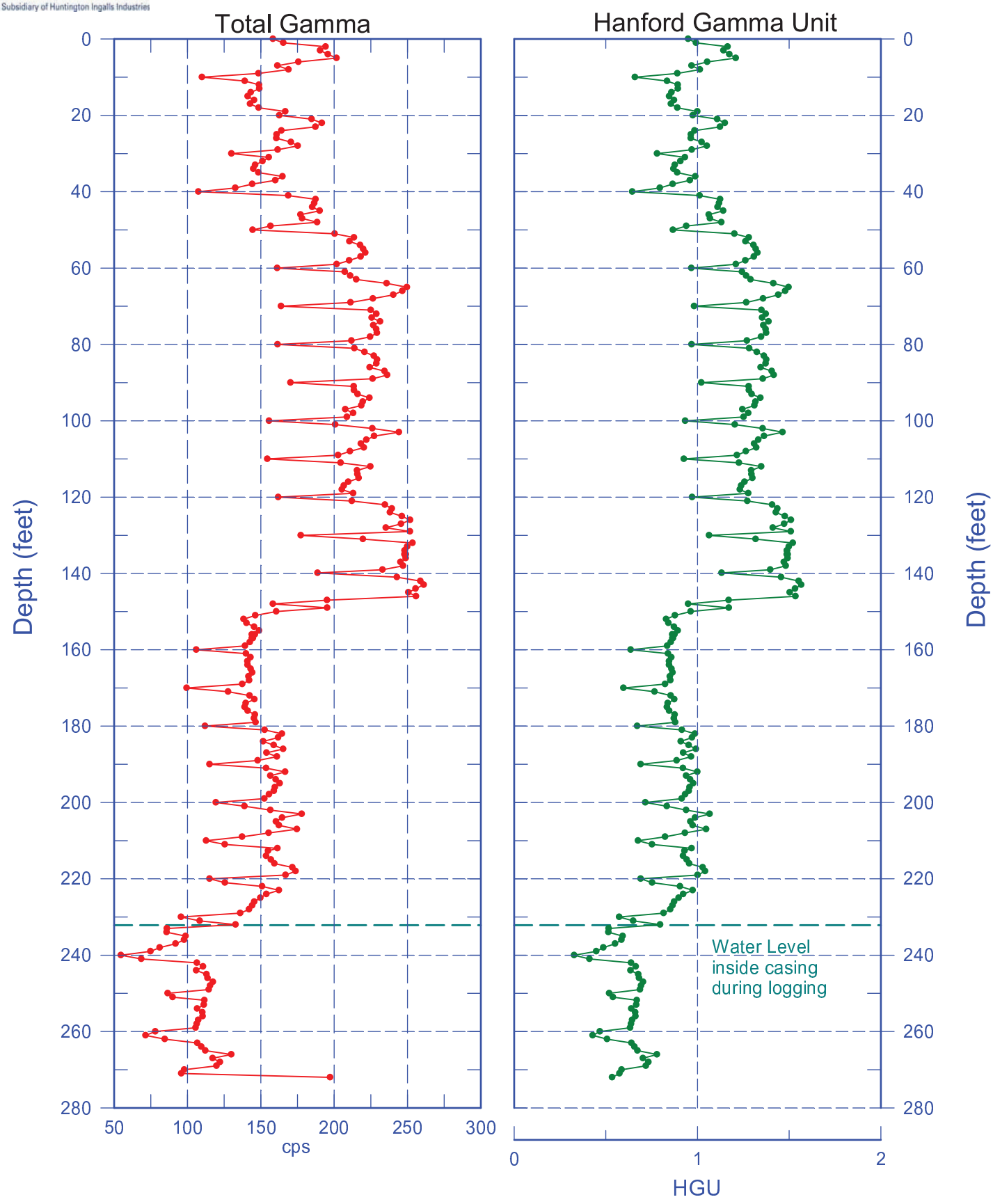
299-W22-115 (C9430)

Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

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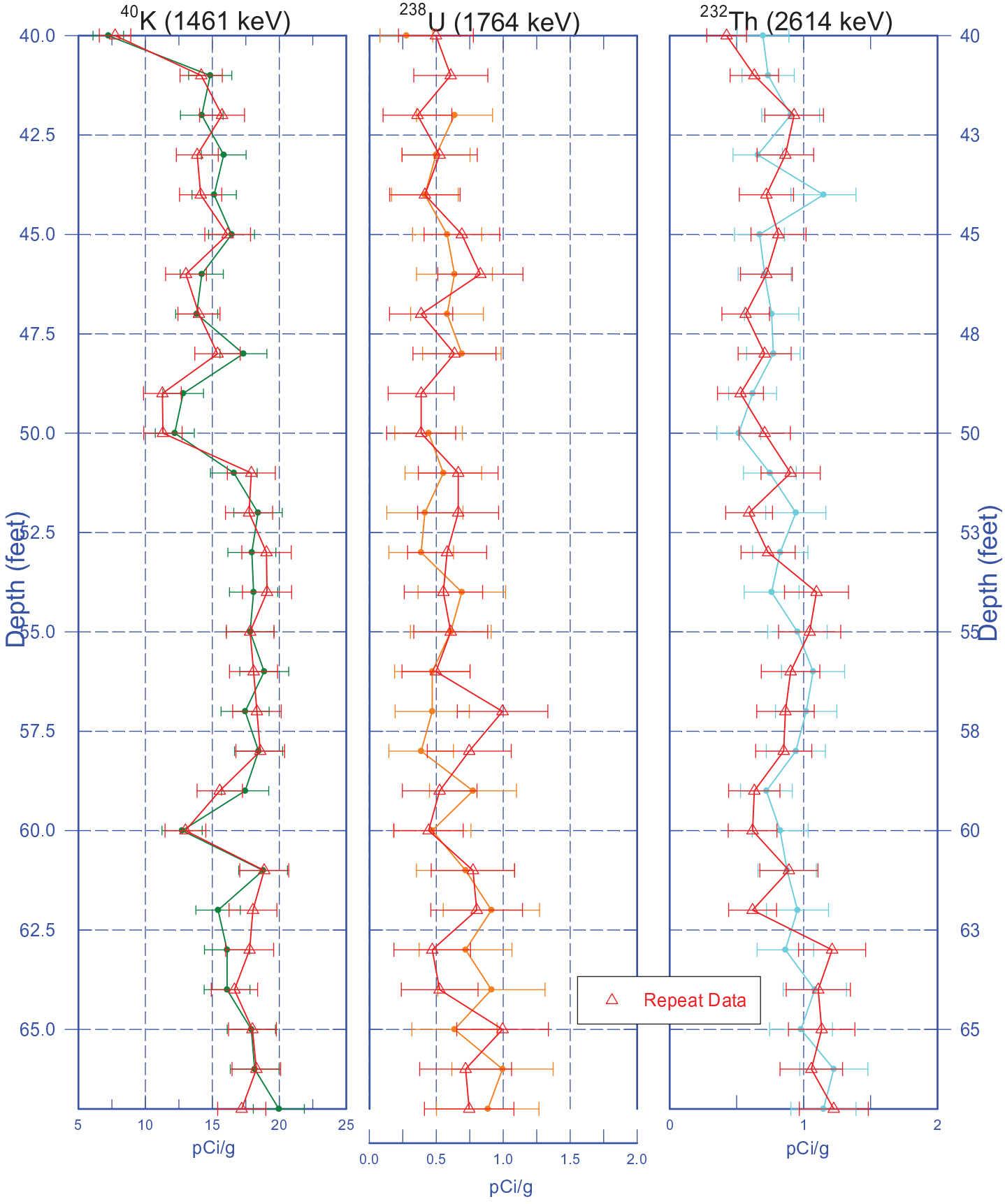
299-W22-115 (C9430)

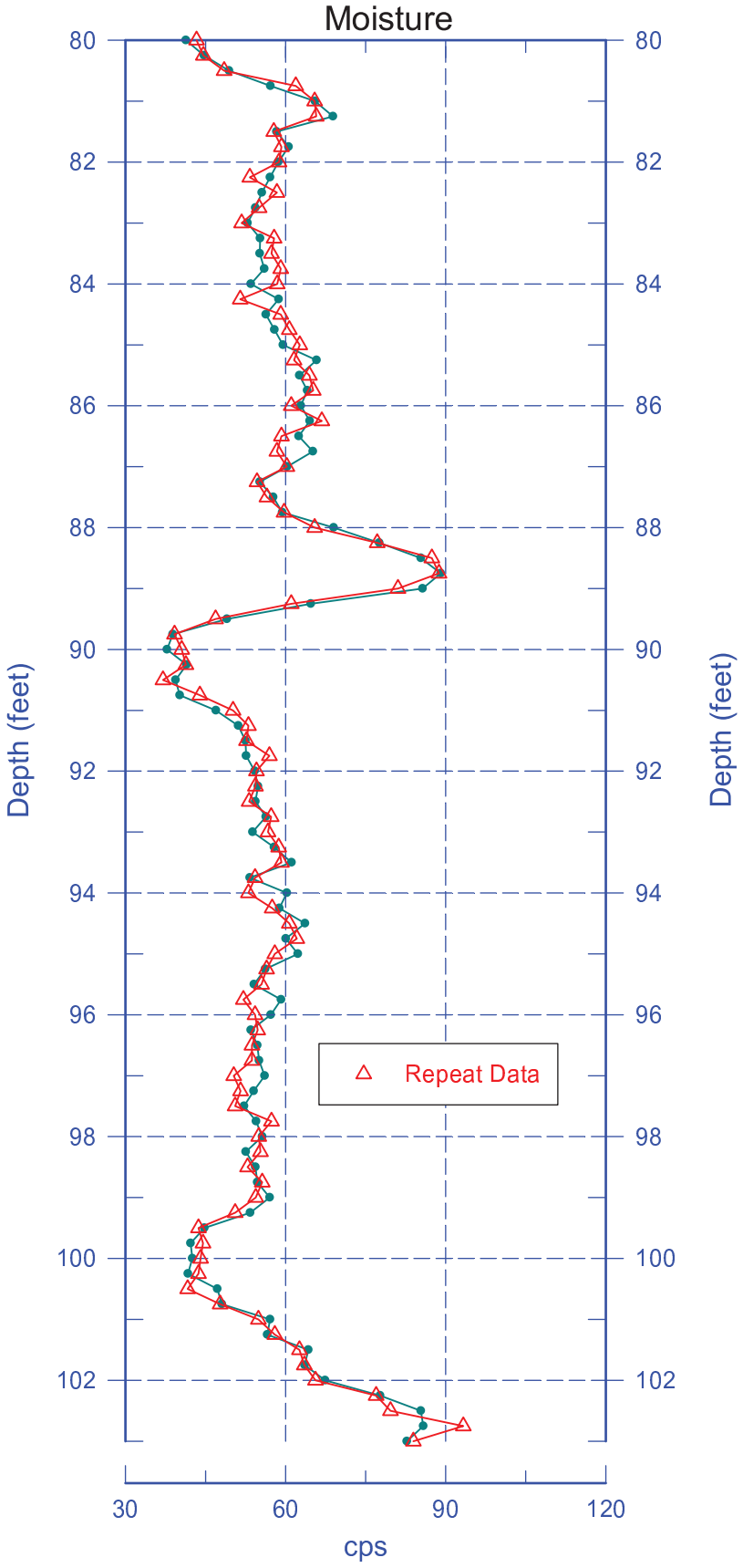
Repeat Section of Natural Gamma Logs



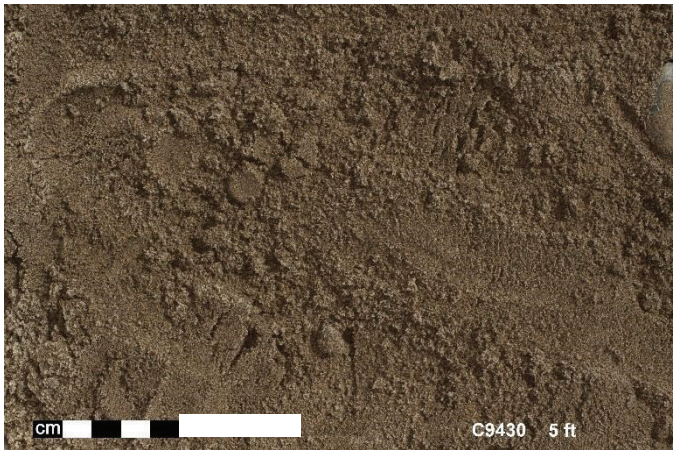
Zero Reference - Ground Surface

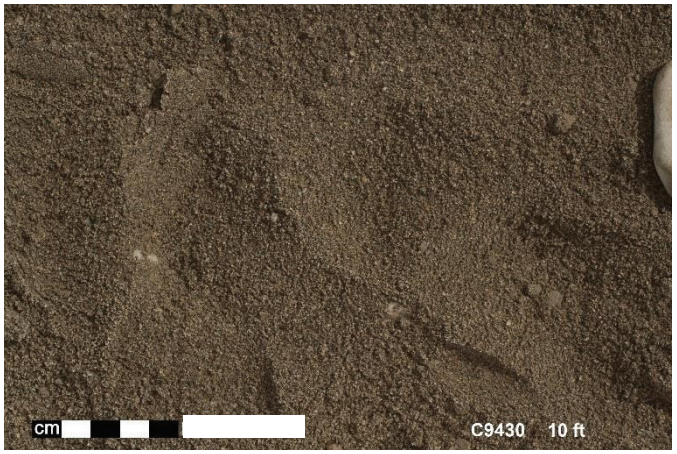
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-W22-115 (C9430)
Moisture Repeat Section

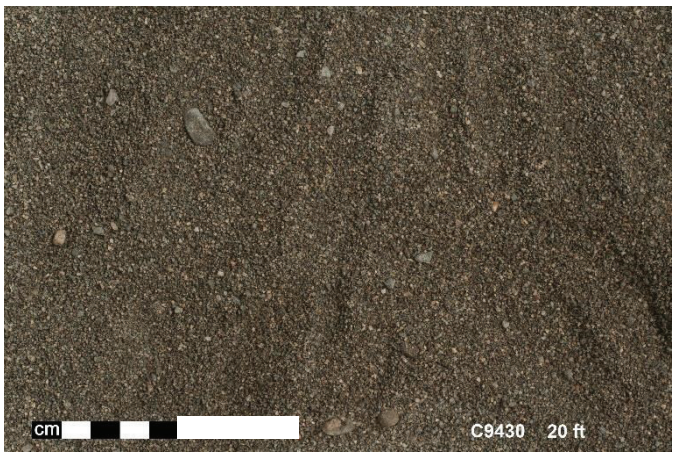


Reference - Ground Surface


cm
C9430 5 ft

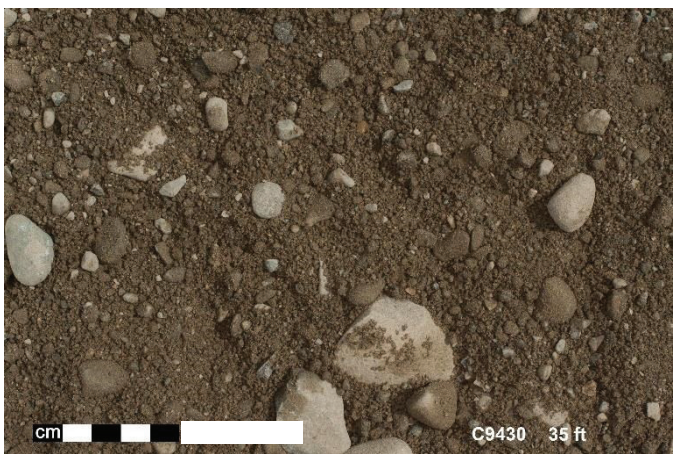

cm
C9430 10 ft

cm
C9430 15 ft


cm
C9430 20 ft

cm
C9430 25 ft

cm
C9430 30 ft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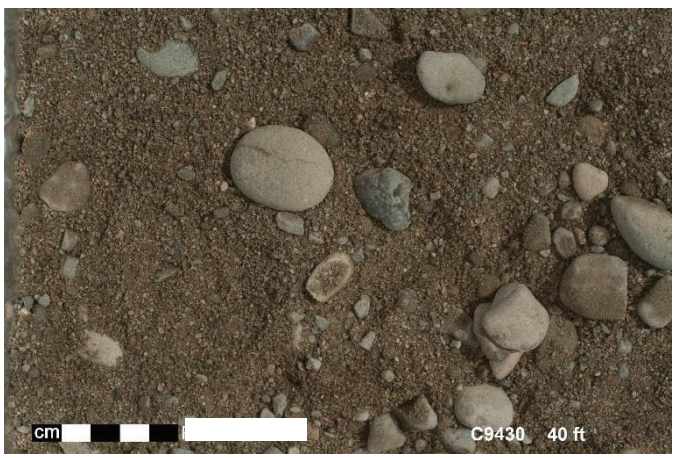
C9430 35 ft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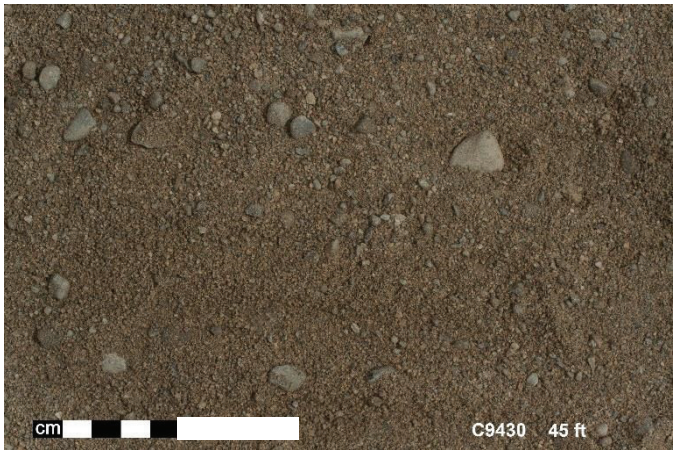
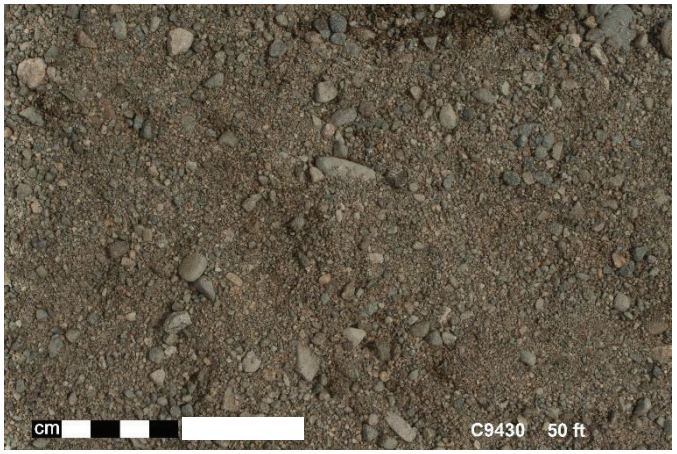
C9430 40 ft


cm
C9430 45 ft


cm
C9430 50 ft

cm
C9430 55 ft

cm
C9430 60 ft

cm
C9430 65 ft

cm
C9430 70 ft

cm
C9430 75 ft

cm
C9430 80 ft

cm
C9430 85 ft

cm
C9430 90 ft

cm
C9430 95 ft

cm
C9430 100 ft

cm
C9430 105 ft

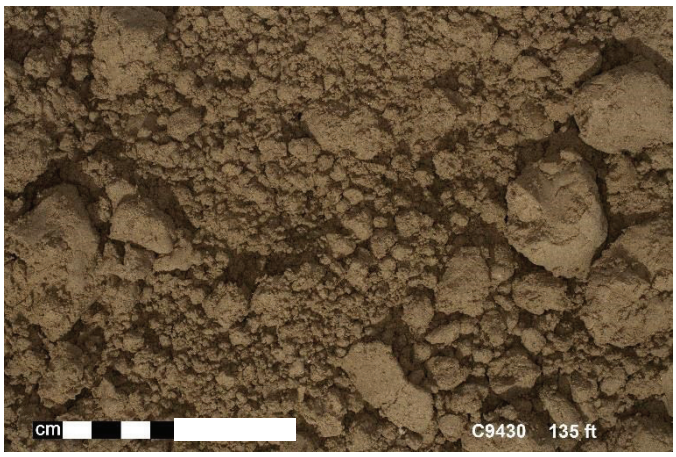
cm
C9430 110 ft

cm
C9430 115 ft

cm
C9430 120 ft

cm
C9430 125 ft

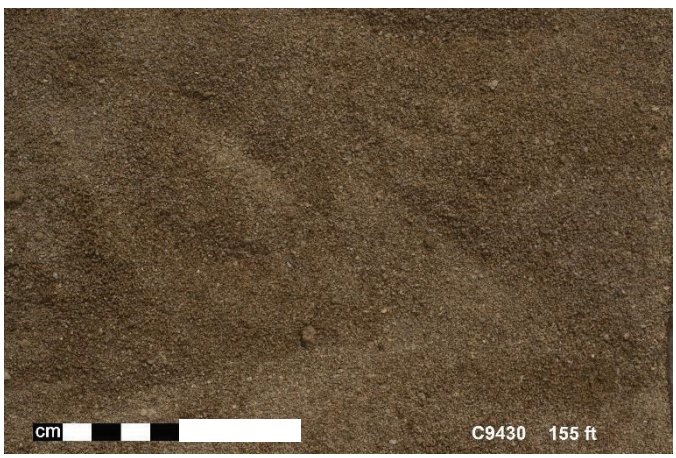
cm
C9430 130 ft


cm
C9430 135 ft

cm
C9430 140 ft

cm
C9430 145 ft

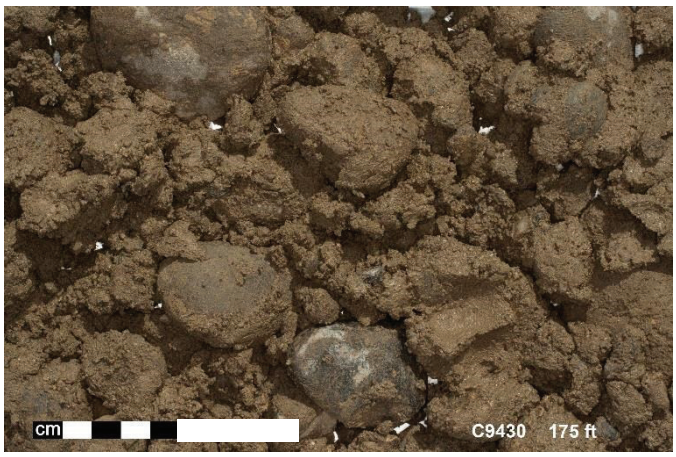
cm
C9430 150 ft


cm
C9430 155 ft

cm
C9430 160 ft

cm
C9430 165 ft

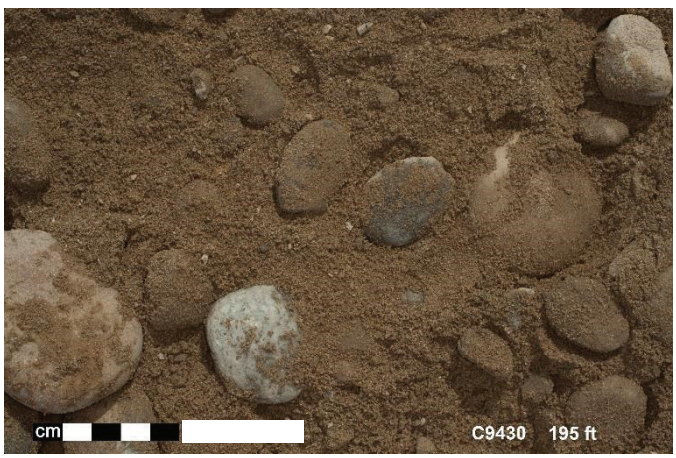
cm
C9430 170 ft


cm
C9430 175 ft

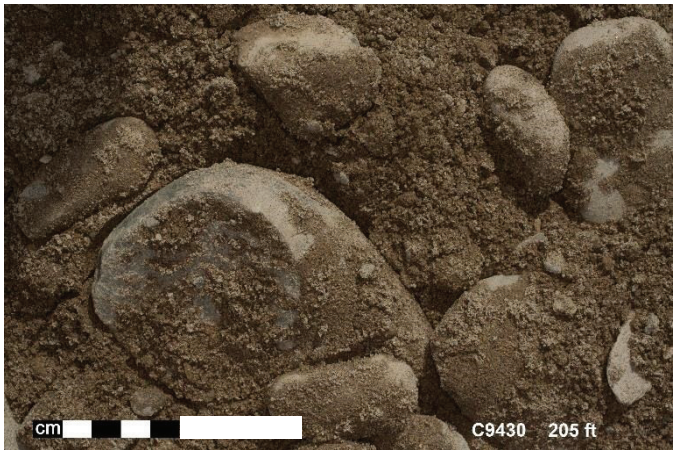
cm
C9430 180 ft

cm
C9430 185 ft

cm
C9430 190 ft


cm
C9430 195 ft

cm
C9430 200 ft


cm
C9430 205 ft

cm
C9430 210 ft

cm
C9430 215 ft

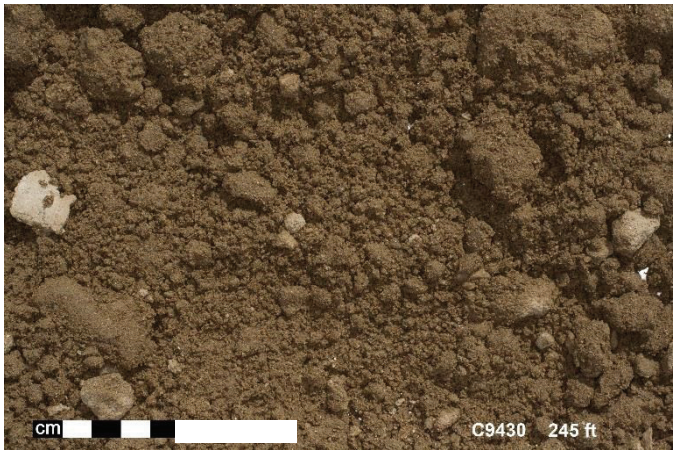
cm
C9430 220 ft

cm
C9430 225 ft

cm
C9430 230 ft

cm
C9430 235 ft

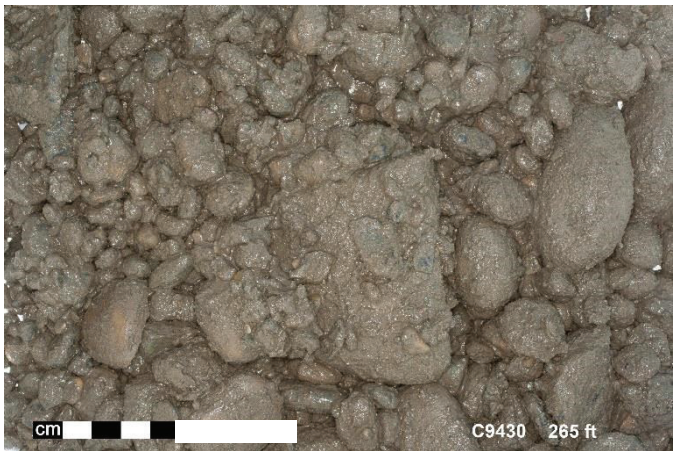
cm
C9430 240 ft

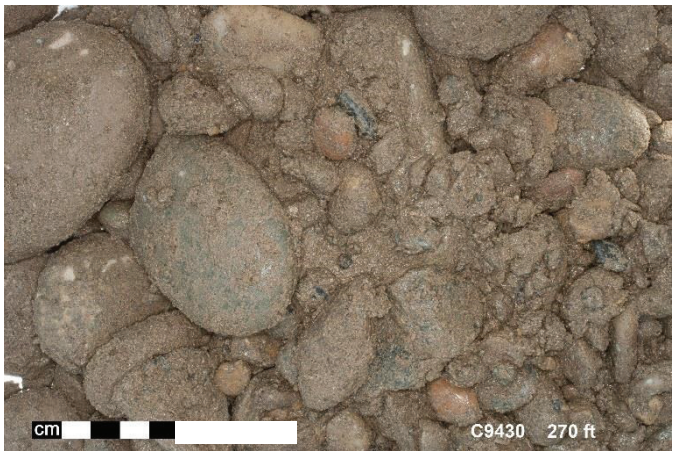

cm
C9430 245 ft

cm
C9430 250 ft

cm
C9430 255 ft

cm
C9430 260 ft


cm
C9430 265 ft


cm
C9430 270 ft

SURVEY DATA REPORT

Request No. 153-132

Project No.	Title	File No.
	200W M-24 Well C9430 Final Survey	2WT12R25

Job. No.	Prepared By	Date	Reviewer
CACN: 303595-JPRC	N.P. Fastabend	6/22/15	LBM

DESCRIPTION OF WORK

Obtained final coordinates (C/L Casing) and elevations of completed M-24 Well C9430 (299-W22-115) in 200W Area.

Horizontal Coordinate System: WCS83S/91 (Meters)
Vertical Datum: NAVD88 (Meters)

DISTRIBUTION	SDR	PLOT	DWG
Survey File	OR		
J.D. Mehrer	1		
K.M. Whitley	1		
J.L. Smoot	1		
J.B. Geiger	1		
B.J. Howard	1		
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: 06/13/15	Requestor: Jim Mehrer (CHPRC)
Date of Survey: 06/22/15	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 M-24 Well C9430 (299-W22-115) located east of 241-SX Tank Farm in 200W Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 200W

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
2W-73 (CHPRC) and 2W-157 (CHPRC)

Well ID	Well Name	Easting	Northing	Elevation	
C9430	299-W22-115	566939.39	134292.43		Center of Casing
				204.366	"X" on Rim
				203.607	Brass Survey Marker

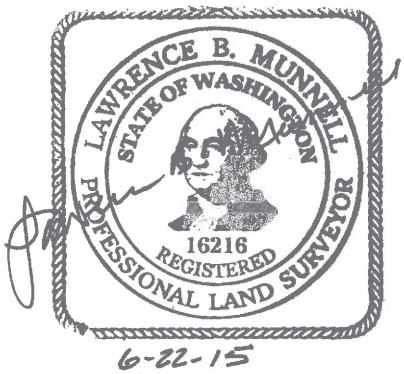
Notes:

204.068 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.



6-22-15

A-6003-659 (04/03)

Appendix C

Well Documentation for C9431 (299-W22-116)

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

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4/8/15 ASG 7/16/15

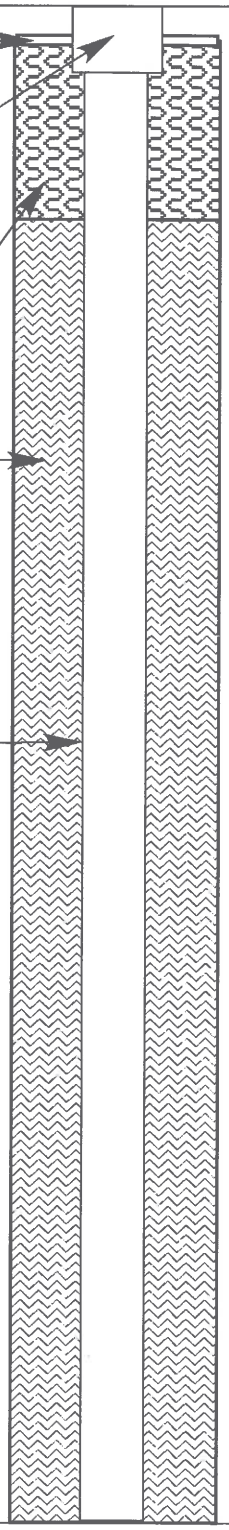
WELL SUMMARY SHEET

Start Date: ~~4/07/2015~~ 5/11/15
Finish Date: ~~5/12/2015~~

Well ID: C9431	Well Name: 299-W22-116
Location: 25 m SE of 241 SX	Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/26/15	Reviewed By: D. MEHRER Date: 7-23-15
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
Concrete Pad: 0.5 ft above ground surface (ags)	
6-in Protective Casing: 2.92 ft ags - 2.08 ft below ground surface (bgs)	
Type I/II Portland Cement Grout: 0 - 10.5 ft bgs	
Cetco Bentonite Crumbles: 10.5 - 230.6 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 1.99 ft ags - 234.99 ft bgs	
Depths are in ft below ground surface.	
Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 272.4 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 - 55 Sand (S)
10		
20		
30		
40		
50		
		55 - 70 Gravelly Sand (gS)
60		
70		70 - 120 Sand (S)
80		

A-6003-643 (REV 1)

WELL SUMMARY SHEET

Start Date: ~~4/07/2015~~ 5/11/15 (4/8/15 ARG 7/16/15)
Finish Date: ~~5/12/2015~~

Well ID: C9431	Well Name: 299-W22-116
Location: 25 m SE of 241 SX	Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/26/15	Reviewed By: D. MEHRER Date: 7-23-15
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
Cetco Bentonite Crumbles: 10.5 - 230.6 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 1.99 ft ags - 234.99 ft bgs	
Depths are in ft below ground surface.	
Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 272.4 ft bgs	
All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
90		70 - 140 Sand (S)
100		
110		
120		
130		
140		140 - 145 Sandy Silt (sM)
		145 - 150 Silty Sandy Gravel (msG)
150		150 - 160 Gravelly Sand (gS)
160		160 - 165 Sand (S)
		165 - 175 Gravelly Sand (gS)
170		
		175 - 185 Sandy Gravel (sG)

A-6003-643 (REV 1)

4/8/15 RJS 4/16/15

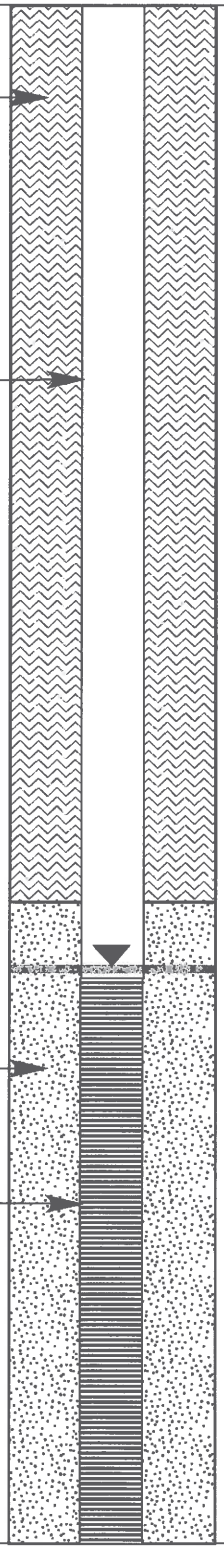
WELL SUMMARY SHEET

Start Date: ~~4/07/2015~~ 5/11/15
Finish Date: ~~5/12/2015~~

Well ID: C9431	Well Name: 299-W22-116
Location: 25 m SE of 241 SX	Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/26/15	Reviewed By: [illegible] Date: 7-23-15
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
Cetco Bentonite Crumbles: 10.5 - 230.6 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 1.99 ft ags - 234.99 ft bgs	
10-20 mesh Premier Colorado Silica Filter Pack Sand: 230.6 - 275.3 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen: 234.99 - 270.01 ft bgs	
Depths are in ft below ground surface.	
Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 272.4 ft bgs	
All temporary drill casing was removed from the ground.	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
180		175 - 185 Sandy Gravel (sG)
		185 - 190 Sand (S)
190		190 - 230 Sandy Gravel (sG)
200		
210		
220		
230		230 - 275.3 Gravel (G)
		Static Water Level: 234.6 ft bgs (04/20/15)
240		
250		
260		

A-6003-643 (REV 1)

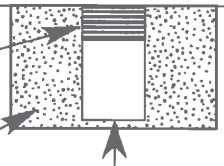
4/8/15 A36 7/16/15

WELL SUMMARY SHEET

Start Date: ~~4/07/2015~~ 5/11/15
Finish Date: ~~5/12/2015~~

Well ID: C9431
Well Name: 299-W22-116
Location: 25 m SE of 241 SX
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/26/15
Reviewed By: D. MEHRER Date: 7-23-15
Signature:
Signature:

CONSTRUCTION DATA

Description	Diagram
4-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen: 234.99 - 270.01 ft bgs 10-20 mesh Premier Colorado Silica Filter Pack Sand: 230.6 - 275.3 ft bgs 4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 270.01 - 275.01 ft bgs	

Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 272.4 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
270		230 - 275.3 Gravel (G)
280		
290		Straightness Test: 04/20/2015, Pass Total Depth: 275.3 ft bgs (4/9/2015)
300		
310		
320		
330		
340		
350		

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 7
Date: 4/7/15

Well ID: C9431 | Well Name: 299-W22-116 | Location: 25 m SE of 241 SX

Project: SGW Monitoring Wells, M24 TPA, FY2015 | 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				0-55' bgs; SAND; 98% Sand, 2% Silt Sand is vf-c, 95% vf-m, v.ws, WR, 90% basalt Silt is 10YR 4/4, dk. yellow brown; strong HCl rxn. Slightly moist; trace mica	AP 1,000 becker hammer drill rig Grab samples every 5' Added 1 to 2 gallons H_2O per foot while out of water table
5	G				
10	G			@ 10' bgs; ↑ Gravel, 5%; ↓ Sand, 93%; ↑ Silt, 2% Gravel is v.sm peb; max med. peb; SA, WS, 90% basalt,	
15	G			@ 15' bgs; 3% Gravel, 95% Sand, 2% Silt Sand is vf-vc, 70% f-c; MS; WR-SR on courser grains. Slight HCl rxn.	
20	G			@ 20' bgs; 98% Sand, 2% Silt No HCl rxn, trace mica	
25	G			@ 25' bgs; Same as above	
30	G			@ 30' bgs; 95% Sand, 5% Silt; Sand is vf-c; 95% vf-f; 10YR 4/3, brown, slightly moist	
35	G			@ 35' bgs; 98% Sand, 2% Silt Sand is vf-m, 80% vf-f, VWS; VWR; max course	

Reported By: Joshua Holland & Janine Carter | Reviewed By: Kevin Bergstrom

Title: Geologist / Geologist | Title: Sr. Geologist

Signature: [signature] JanCarter | Date: 4/7/15 | Signature: [signature] | Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 7
Date: 4/7/15

Well ID: C9431 | Well Name: 299-W22-116 | Location: 25 m SE of 241 SX
Project: 8 M24 TPA GW Monitoring Wells FY 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
40	G			0-55' bgs; SAND; 98% Sand, 2% Silt Sand is vf-m, 80% vf-f; VWS; VWR; 20% bslt Silt is 10YR 4/3, brown, moist.	API 000 becher hammer drilling Grab samples every 5'
45	G			@45' bgs; same as above	
50	G			@50' bgs; 100% Sand; vf-m, 95% f-m; VWR, VWS; 20% basalt. 10YR 4/3, Brown, moist, trace mica.	
55	G			55-70' bgs; GRAVELLY SAND(gS) Gravel is 15%; Sand 80%; 5% Silt Gravel-fine smpeb, SA, WS, 90% basalt Sand is vf-vc; 50% c, SA, MS, 75% basalt Silt is 10YR 4/3, brown. No HCl rxn; tr. mica. Slighty moist.	
60	G			@60' bgs; same as above	
65	G			@65' bgs; ocnl sm cob; max 70mm. 10YR 5/4, yellowish brown; no HCl rxn, dry	
70	G			@70' bgs; increase in sand: 70-120' bgs; SAND(S) Gravel: 5%; Sand; 90%; Silt: 5% Gravel is v.sm peb-smpeb; WS, SA, 100% basalt Sand is vf-vc, 80% f-c; WS; WR; 25% basalt Silt is 10YR 5/4, yellowish brown, dry; tr. mica	
75	G			@75' bgs; 95% Sand, 5% silt Sand is vf-c; 90% vf-f; WS; WR; 20% bslt No HCl rxn, dry, trace mica	

Reported By: Joshua Holland & Janine Carter | Reviewed By: Kevin Bergstrom
Title: Geologist / Geologist | Title: Sr. Geologist
Signature: [signature] JaCarter | Date: 4/7/15 | Signature: [signature] | Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 7
Date: 4/7/15

Well ID: C9431 | Well Name: 299-W22-116 | Location: 25m SE of 241 SX
Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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			~~75~~ 70 (positive) - 120' bgs; SAND(s); 95% Sand, 5% silt Sand is vf-c, 90% vf-f; WS; WR; 20% bslt No HCl rxn, dry, loose, trace mica.	AP1000 bedrock hammer drill rig Grab samples every 5'
85	G			@85' bgs; same as above	
90	G			@90' bgs; Sand is finer: vf-m,	
95	G			@95' bgs; same as above	
100	G			@100' bgs; 10YR4/3, brown; trace mica	
105	G			@105' bgs; Sand is vf-c, 90% f-m; WS; WR 90% felsic, dry, loose, trace mica Less silt; 2%; 98% sand.	
110	G			@110' bgs; 98% Sand, 2% silt	
115	G			@115' bgs; 95% sand, 5% silt Sand is vf-m, 95% vf-f, 95% felsic Occ clay nodules, 1-2 cm. Slightly moist, 2.5Y4/4 olive brown, 1% mica	

Reported By: Joshua Holland & Janine Carter | Reviewed By: Kevin Bergstrom
Title: Geologist Geologist | Title: Sr. Geologist
Signature: [signature] [signature] Date: 4/7/15 | Signature: [signature] Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 4 of 7
Date: 4/7/15

Well ID: C9431 | Well Name: 299-W22-118 | Location: 25m SE of 241 SX

Project: 8 GW Monitoring Wells, M24 TPA, FY2015 | Reference Measuring Point: ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120	G			~~75~~-120' bgs; SAND (S); 95% Sand, 5% silt Sand is vf-m, 95% vf-f; 95% felsic; 1% mica Occ'l clay nodules, 1-2cm. 2.5Y4/4 olive brown.	API 009 Grab samples every 5'
				120-140' bgs; ~~SILTY~~ SAND (~~SM~~ SW) 90% Sand, 10% silt. Sand is same as above; no HCl rxn in general, strong rxn on clay nodules. 1% mica; low compaction	
125	G				
130	G			@130' bgs: same as above	
135	G			@135' bgs; Sand is vf-f; WS; WR, 100% felsic; small clay nodules.	
140	G			140'-145' bgs; SANDY SILT (sM) 25% Sand, 75% Silt/clay Silt/clay is approx. ¼ clay; exhibit low plasticity. Strong HCl rxn on clay nodules Slightly wet	↓↓ Drill rate @140' proposed contact between Hanford & Cold Creek unit (CCU) based on Δ lithology
145	G			145-150' bgs; SILTY SANDY GRAVEL (msG) 50% Gravel, 30% Sand, 20% Silt; moist to wet Gravel is SP-SC, max 60mm; coated in clay & CaCO3; A-SA; PS; 75% basalt Sand is VF-C, 90% F-M; MS; SR; 100% felsic 2.5Y5/4 light olive brown; 2.5Y6/3 light yellowish brown nodules. HCl rxn on nodules Nodules exhibit med plasticity. Tr: mica	
150	G			160: 5Y4/4 silt @150' 20%G, 75%S, 5%M	
155	G			~~150-155~~ 150-160' bgs; GRAVELLY SAND (gS) Gravel is SP-SC; PS; SR; max 70mm; 90% basalt Sand is VF-VC, 25% VF-M, 75% C-VC; PS; SR 40% basalt. 2.5Y4/3 olive brown, strong HCl rxn; slightly wet; no clay nodules	@150' proposed contact between CCU & Ringold Taylor Flats member (RTF) based on Δ lithology

Reported By: Joshua Holland & Janine Carter | Title: Geologist | Signature: [signature] Date: 4/7/15

Reviewed By: Kevin Bergstrom | Title: Sr. Geologist | Signature: [signature] Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 5 of 7
Date: 4/7/15

Well ID: C9431 | Well Name: 299-W22-116 | Location: 25 m SE of 241 SX
Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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
160	G				AP1000 - Becker Hom.
				160-165' bgs; SAND (S)	Grab samples every 5'
				5% Gravel, 95% Sand	
				no clay as above; Sand is different:	
				f-C, 90% C; WS; SR; 50% basalt/mafic,	
165	G			50% felsic. 10YR 3/2 very dark grayish	
				brown; no rxn to HCl; no mica, slightly moist,	
				165' bgs; GRAVELLY SAND (gS) 165-175	
				15% Gravel, 85% Sand	
				same as above	
170	G			170' bgs; Gravel is SP-SC; max 140mm; WR;	
				PS; 90% basalt	
				Gradual increase in gravel	
175	G			175', ↑ Gravel, 40%; ↓ Sand, 60%	Slight compaction
				Sand is VF-M, 60% F-M; MS; SR;	
				30% basalt. 2.5Y 4/3 olive brown	
				175-185'	
180	G			~~180'~~ bgs; SANDY GRAVEL (sG)	@175' proposed contact
				KS 4/27/15 70% Gravel, 30% Sand	between RTF & Rongold unit E
				No HCl rxn; dry	based on Δ lithology
185	G			~~185'~~ SC 185'-190' gpd 5/26/15	
				~~185' bgs~~; SAND (S)	
				5% Gravel, 95% Sand	
				Gravel is SP-MP; WR; 80% basalt	
190	G			Sand is VF-M; VWS; 95% basalt	↓↓ Drill rate
				2.5Y 6/4 light yellowish brown	↑ Drill rate
				No HCl rxn; dry; mica	
				190' bgs: 60% Gravel, 32% Sand, 8% Silt	
				~~SLIGHTLY SILTY~~ SANDY GRAVEL (mSG) KS 5/26/15 KS 4/27/15	
195	G			G: SP-SC; PS; SA; 140mm max; 60% basalt	↓↓ Drill rate
				S: VF-C, 90% F-M; WS; WR; 90% basalt (190'-230') → moist gpd 5/26/15	
				@195' bgs; SANDY GRAVEL (sG)	
				70% Gravel, 25% Sand, 5% silt	

Reported By: Joshua Holland & Janine Carter | Title: Geologist | Signature: [signature] [signature] | Date: 4/7/15

Reviewed By: Kevin Bergstrom | Title: Sr. Geologist | Signature: [signature] | Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 6 of 7
Date: 4/9/15

Well ID: C9431 | Well Name: 299-~~E~~W22-116 | Location: 25 m SE of 241 SX

Project: 8 M24 TPA GW Monitoring wells FY2015 | 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
200	G1			200' bgs; SANDY GRAVEL (SG) [190-230'] GM 5/26/15 slightly Silty 2.5Y 6/4 light yellowish brown 70% Gravel, ~~31% Sand~~, 9% silt, 21% sand, wet GM 5/26/15	AP1000 Becher Hammer drilling, Grab samples collected every 5'
205	G			@205' bgs; same as above Sand is F-C, 90% M; WS; WR; 80% Felsic Gravel is SP-MC; MS; SR-R; 150mm max 2.5Y 5/3 light olive brown; no HCl rxn; moist Gravel is 60% basalt	
210	G			@210' bgs; SANDY GRAVEL (SG) 75% Gravel, 20% Sand, 5% Silt Gravel: SP-SC, 80% LP; SA-WR; PS; 60% basalt Sand: VF-VC, 60% F-M; PS; SR-SA; 80% felsic 2.5Y 4/3 olive brown; no HCl rxn; moist	
215	G			@215' bgs; 70% Gravel, 25% Sand, 5% Silt Gravel: SP-MC, 30% MC, max 200mm; 60% basalt; PS Sand: VF-VC, 20% C-VC; R-SA; MS; 80% felsic No rxn to HCl	
220	G				
225	G			@225': Gravel% Felsic content TT to 80%, max size TT to 80mm, Sands sorting TT to WS, 80% FS-MS.	
230	G			230-275.3' Gravel (G) 85% G, 10% S, 5% M Gravel: 70% felsic, VFP-LC, max=150, VPS, A-R Sand: 80% felsic, VFS-VCS, 80% FS-MS, SA, PS.	@231' TT drillrate
235	G	▽		moist. No rxn to HCl. Olive Brown (2.5Y 4/4) @235' Gravel content TT to 95% sand content TT to 5% Trace M. Gravel felsic content TT to 80%, Sorting TT to MS, avg= 35mm. Moisture content Δ to wet.	DTW encountered 4/9/15 @234.9' bgs * Sand % may be artificially low due to drilling method (Cont. next page)

Reported By: Joshua Hallal & Janine Carter | Reviewed By: Kevin Bergstrom

Title: Geologist Geologist | Title: Sr. Geologist

Signature: [signature] [signature] Date: 4/9/15 | Signature: [signature] Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 7 of 7
Date: 4/9/15

Well ID: C9431 | Well Name: 299-W22-116 | Location: 25 m SE of 241 SX
Project: 8 MGY TPA GW monitoring wells | Reference Measuring Point: ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
240	G			230-275.3' Gravel: 95% G, 5% S, Trace M Gravel: 80% Felsic, VFPL-C, MS, VES, max=100mm, SA-R Sand: 80% Felsic, VFS-VCS, mod sorting, 70% MS-CS, SR, wet	AP1000 Bechtel Hammer Drilling, Grab samples collected every 5'
245	G				* bechtel hammer flushes fines in the water table, very little Sand was observed in grab samples or the tip dumped from 230' to 275.3' as recorded
250	G			@250' avg gravel size ↑↑ to 70mm, sand Δ to 70% VFS-FS	
255	G			@255' Gravel content ↓↓ to 90%, sand @ 5%, mud @5%. avg gravel size ↓↓ to 50mm. Sand sorting ↓↓ to PS, 80% FS-MS. Rounding ↑↑ to SR.	@257' ↓↓ drillrate
260	G			@260' Gravel avg size ↓↓ to 30mm.	@262' ↑↑ drillrate
					@264' ↑↑ drillrate
265	G			@265' Sand felsic content ↓↓ to 60%	
					@268' ↓↓ drillrate
270	G			@270' Gravel Felsic content ↑↑ to 100%, Sand felsic content ↑↑ to 80%, Sorting ↑↑ to Mod. sorting, 70% VFS-FS. Gravel content ↑↑ to 100%, Trace sand + mud	DTW@ 234.7' bgs (4/22/15) TD @275.3' bgs on 4/9/15 Shoe @272.43' bgs
275	G			@275' Gravel felsic content ↓↓ to 90%.	

Reported By: Joshua Holland | Title: Geologist | Signature: | Date: 4/9/15
Reviewed By: Kevin Bergstrom | Title: Sr. Geologist | Signature: | Date: 7/22/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

299-W22-116 (C9431)
Log Data Report

Borehole Information:

Log Date:	2015-04-13	Filename:	C9431_HG-NM_2015-04-13	Site:	Near SX Farm
Coordinates (WA St Plane)		DTW[1] (ft) :	234.7	DTW Date:	04/13/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	04/09/15	N/A	274	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Threaded Steel	2.65	6 1/4	6	1/8	2.65	274
Threaded Steel	2.2	9	8	1/2	2.2	274

Borehole Notes:

The onsite geologist provided the total depth and casing depth. The logging engineer measured casing stick-up and casing diameter of the inner casing (rounded to the nearest 1/16-in.). 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. 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 13, 2015, water inside the casing was measured at 234.7 ft by the logging engineer using an e-tape. The maximum logging depth achieved was 275 ft, approximately 1 ft below the reported casing depth.

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		
HEIS Number	1018679	1018680	1018681		
Date	04/13/15	04/13/15	04/13/15		
Logging Engineer	Spatz	Spatz	Spatz		
Start Depth (ft)	275.0	83.0	54.0		
Finish Depth (ft)	55.0	55.0	0.0		

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

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Log Run	3	4 Repeat	5		
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	AL246CAB	AL246CAB	AL246CAB		
Start File	AL246000	AL246221	AL246250		
Finish File	AL246220	AL246249	AL246304		
Post-Verification	AL246CAA	AL246CAA	AL246CAA		
Depth Return Error (in.)	N/A	0.5 high	0.0		
Comments	No fine gain adjustments made	Brought to surface and refilled with liquid nitrogen No fine gain adjustments made	No fine gain adjustments made		

NMLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1018682	1018683			
Date	04/09/15	04/09/15			
Logging Engineer	Pope	Pope			
Start Depth (ft)	0.0	120.0			
Finish Depth (ft)	235.25	144.0			
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	AH205CAB	AH205CAB			
Start File	AH205000	AH206000			
Finish File	AH205941	AH206096			
Post-Verification	AH205CAA	AH206CAA			
Depth Return Error (in.)	N/A	1.0 high			
Comments	None	None			

Logging Operation Notes:

A centralizer was installed on the moisture sonde; no centralizer was installed for the SGLS due to the small diameter casing.

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

Analysis Notes:

Analyst:	P.D. Henwood	Date:	04/22/15	Reference:	HGLP-MAN-003, Rev. 0

A combined casing correction for a 0.625-in. thick casing (0.125 + 0.5-in. for the 1/8- and 1/2-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 234 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 for a multiple 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:

Cs-137 was detected at the ground surface at 0.2 pCi/g. MDLs for Cs-137 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 is also affected by the 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 generally indicate that the respective systems were working properly. The moisture repeat data from 121 to 121.75 ft were in error. The reason for the spurious data is unknown. The remainder of the repeat section was consistent with the main log data and the post verification indicated no sonde problems. Therefore, the data from the main log are accepted.

List of Log Plots:

Depth Reference is ground surface.

Manmade Radionuclides (0-310 ft)
Natural Gamma Logs (0-160 ft)
Natural Gamma Logs (150-310 ft)
Combination Plot (0-120 ft)
Combination Plot (110-230 ft)
Combination Plot (220-340 ft)
Combination Plot (0-280 ft)
Total Gamma & Moisture (0-160 ft)
Total Gamma & Moisture (150-310 ft)
Total Gamma & Hanford Gamma Unit (0-280 ft)
Repeat Section of Natural Gamma Logs (55 to 83 ft)
Moisture Repeat Section (120 to 144 ft)

[5] Hanford Gamma Unit

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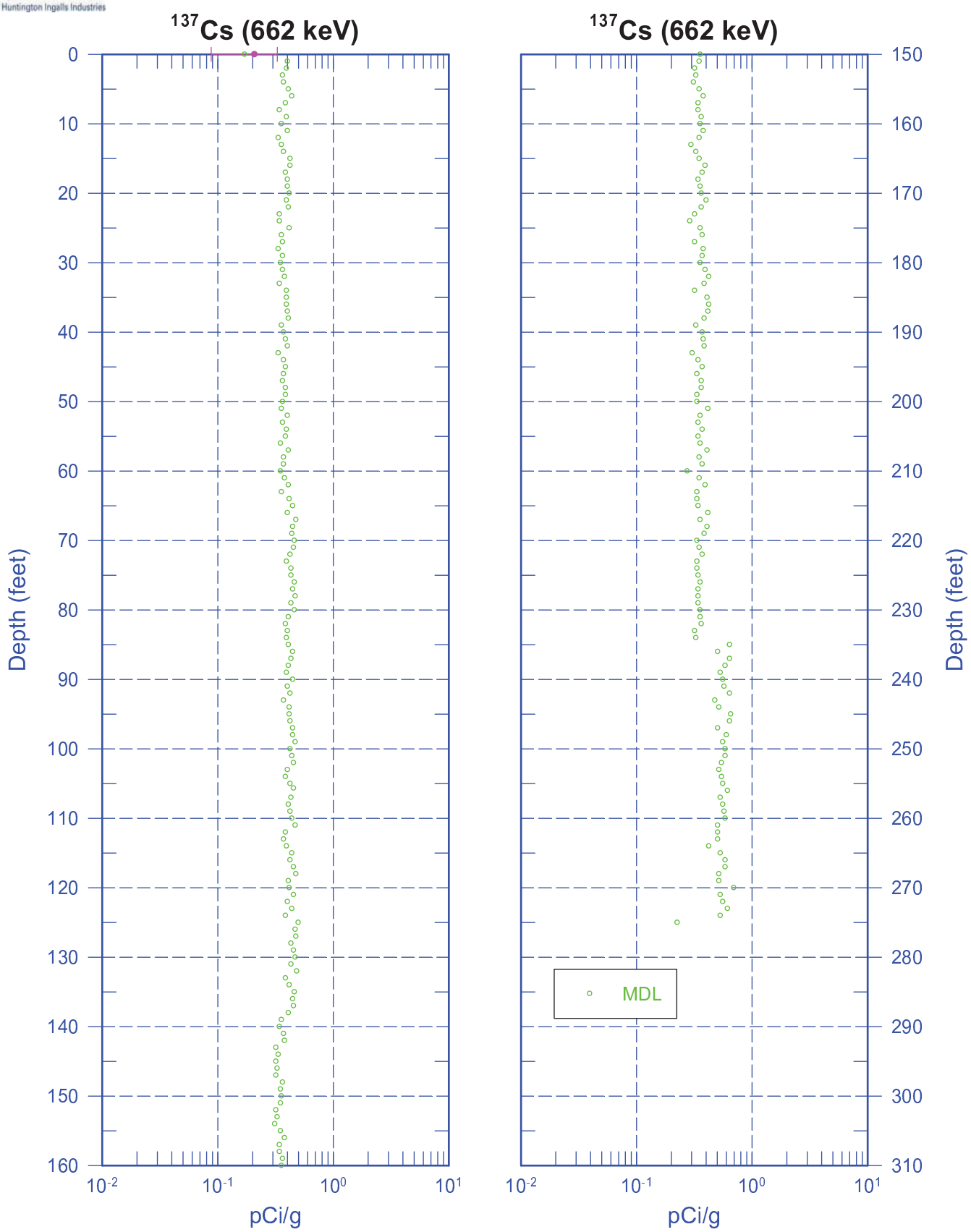
299-W22-116 (C9431)
Manmade Radionuclides



Zero Reference - Ground Surface

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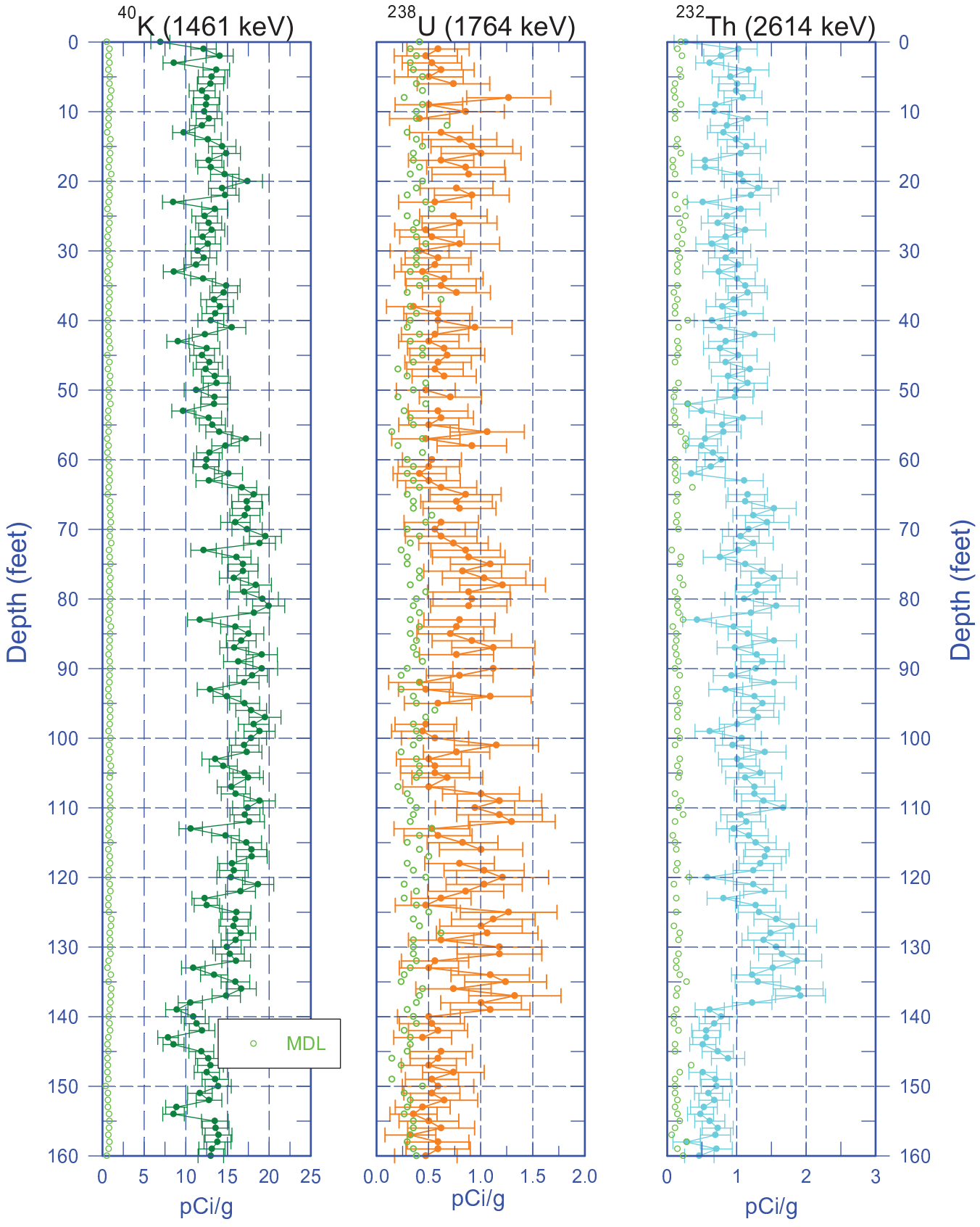
299-W22-116 (C9431)
Natural Gamma Logs



Zero Reference - Ground Surface

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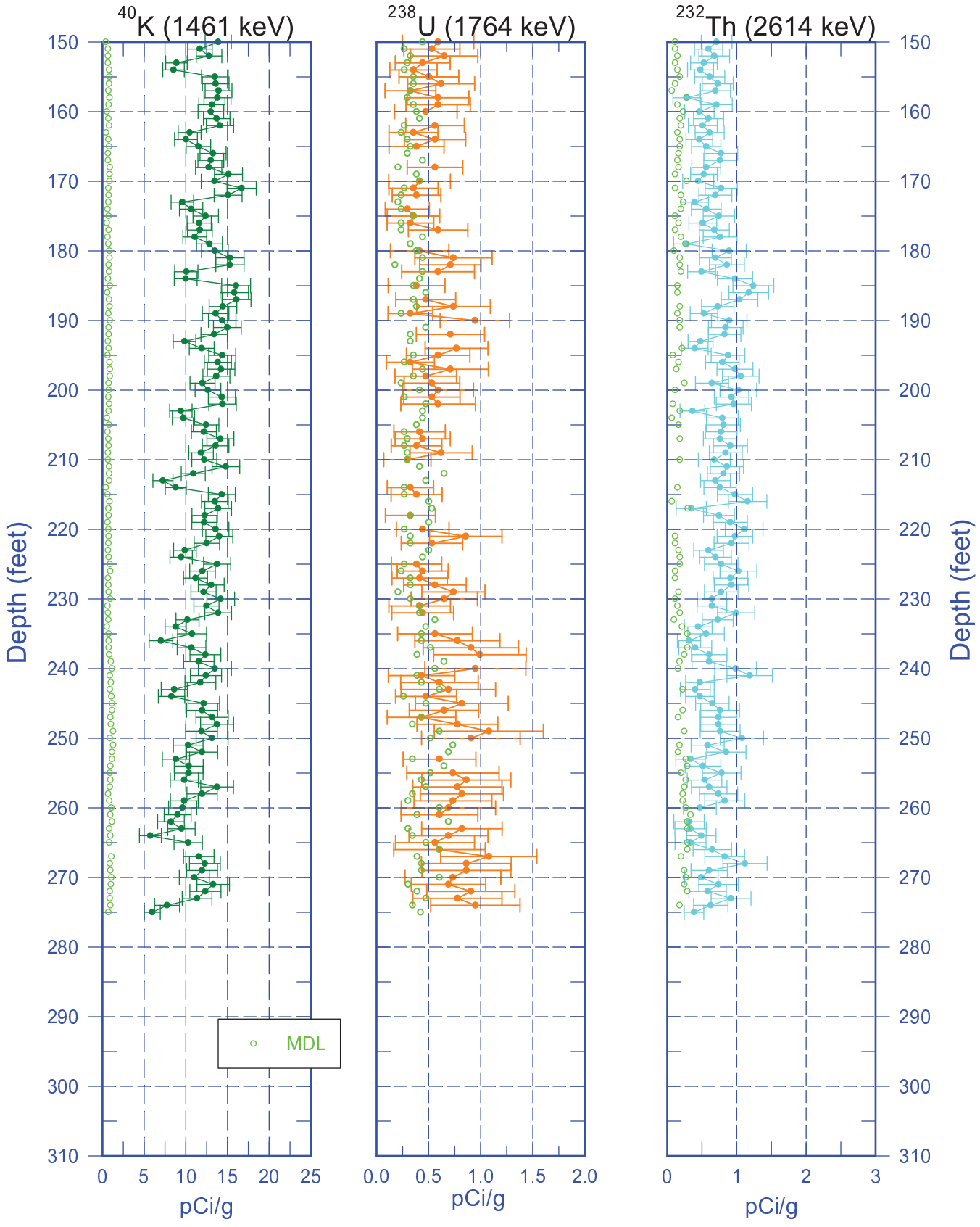
299-W22-116 (C9431)
Natural Gamma Logs



Zero Reference - Ground Surface

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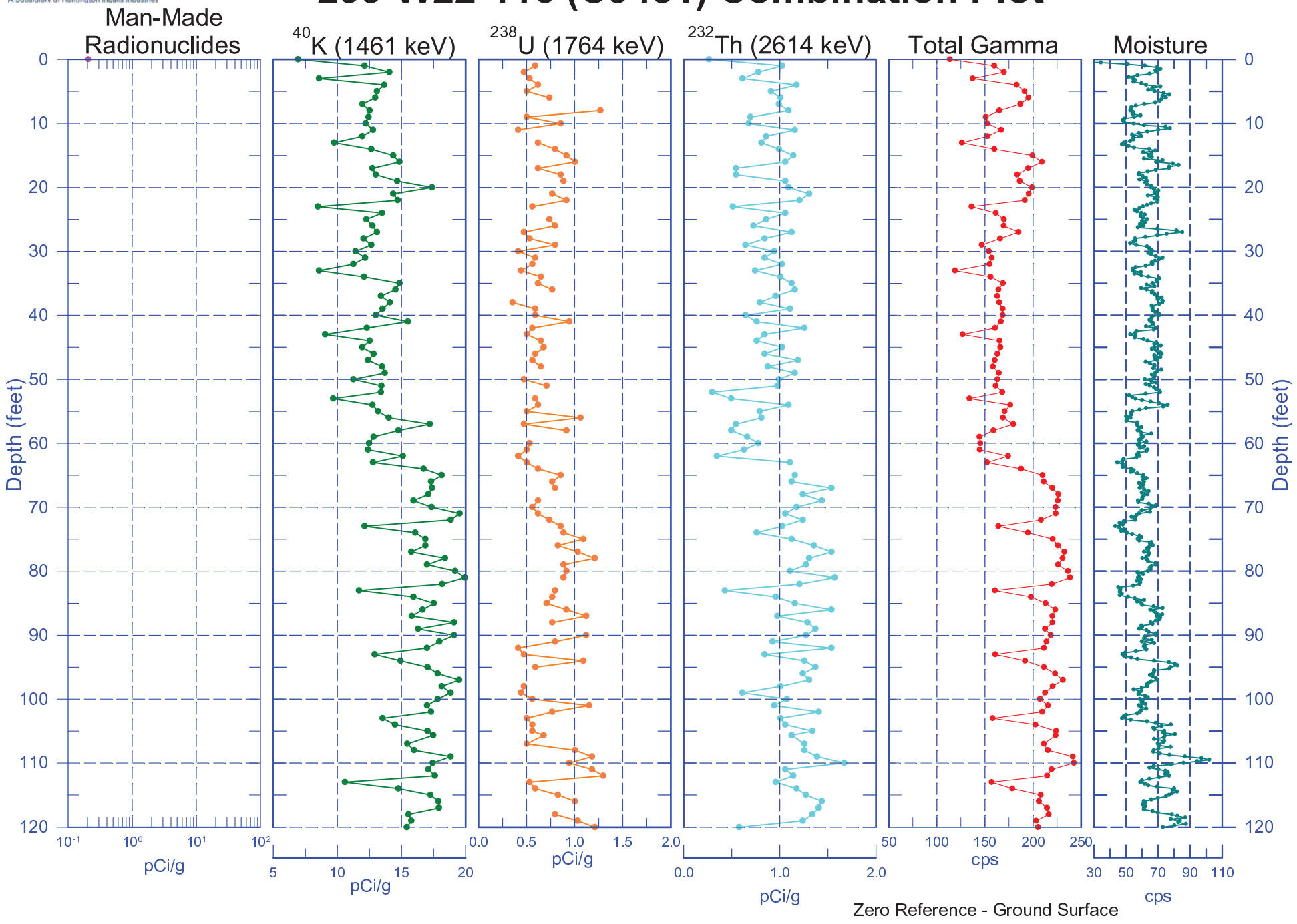
299-W22-116 (C9431) Combination Plot



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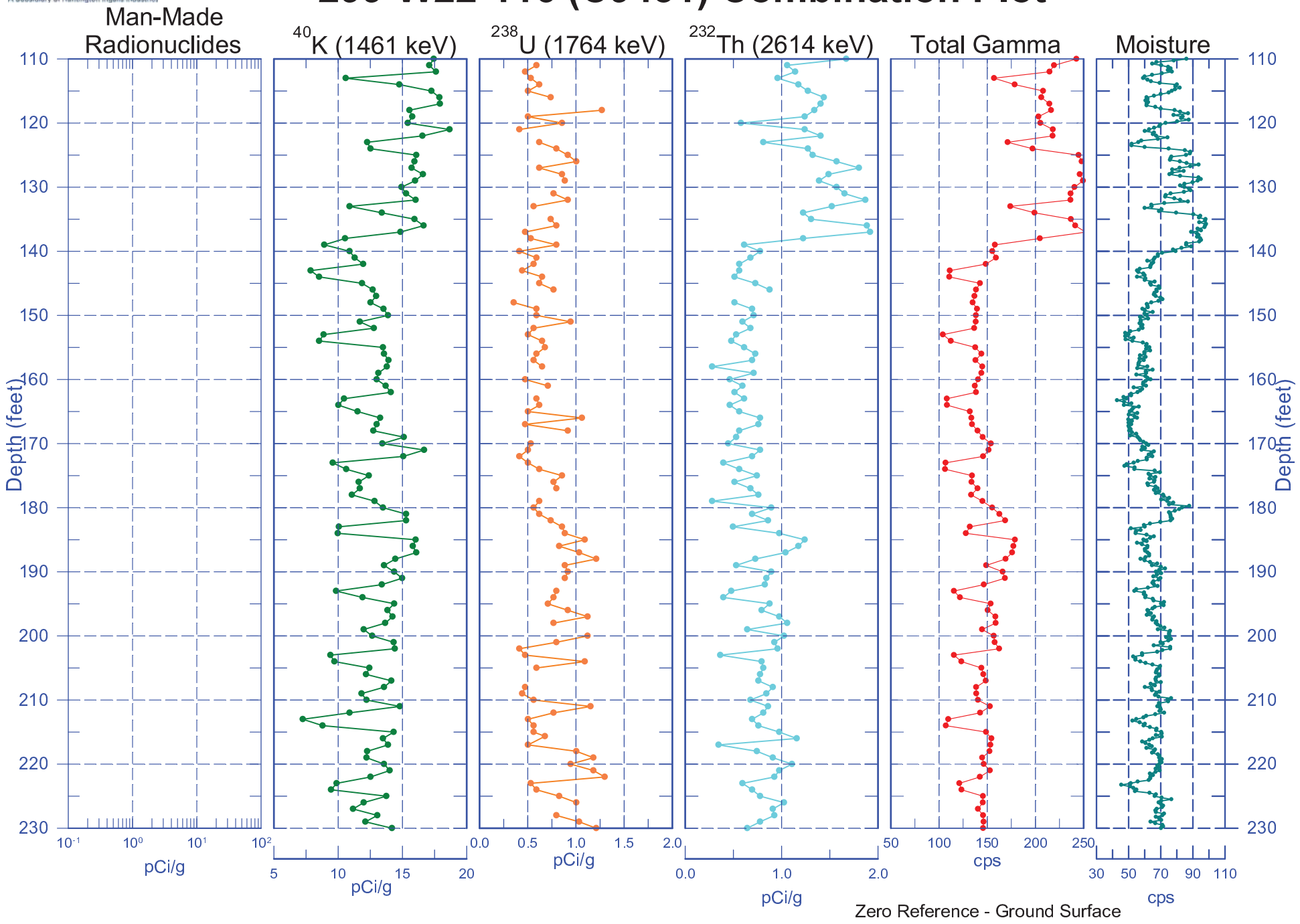
299-W22-116 (C9431) Combination Plot



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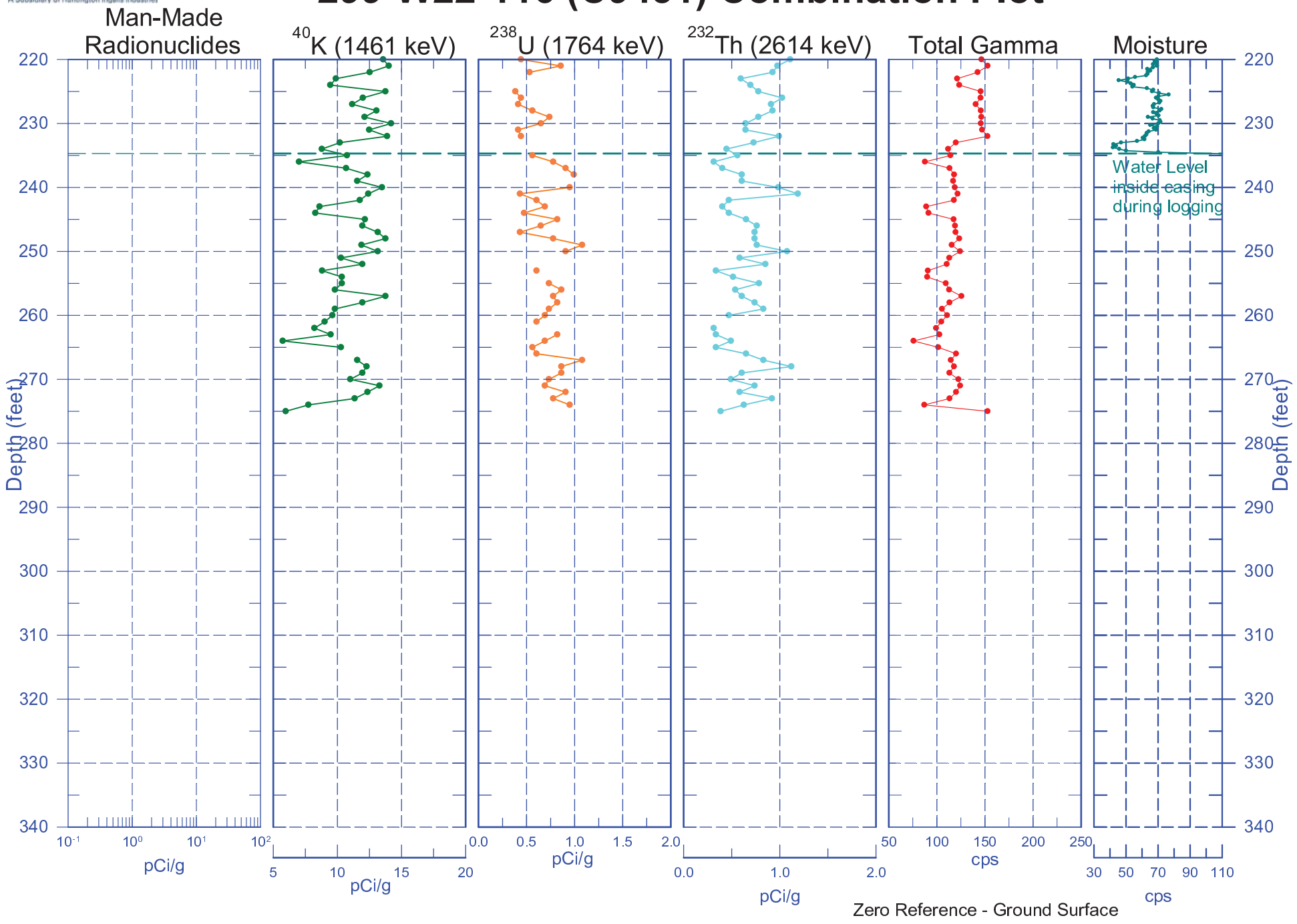
299-W22-116 (C9431) Combination Plot



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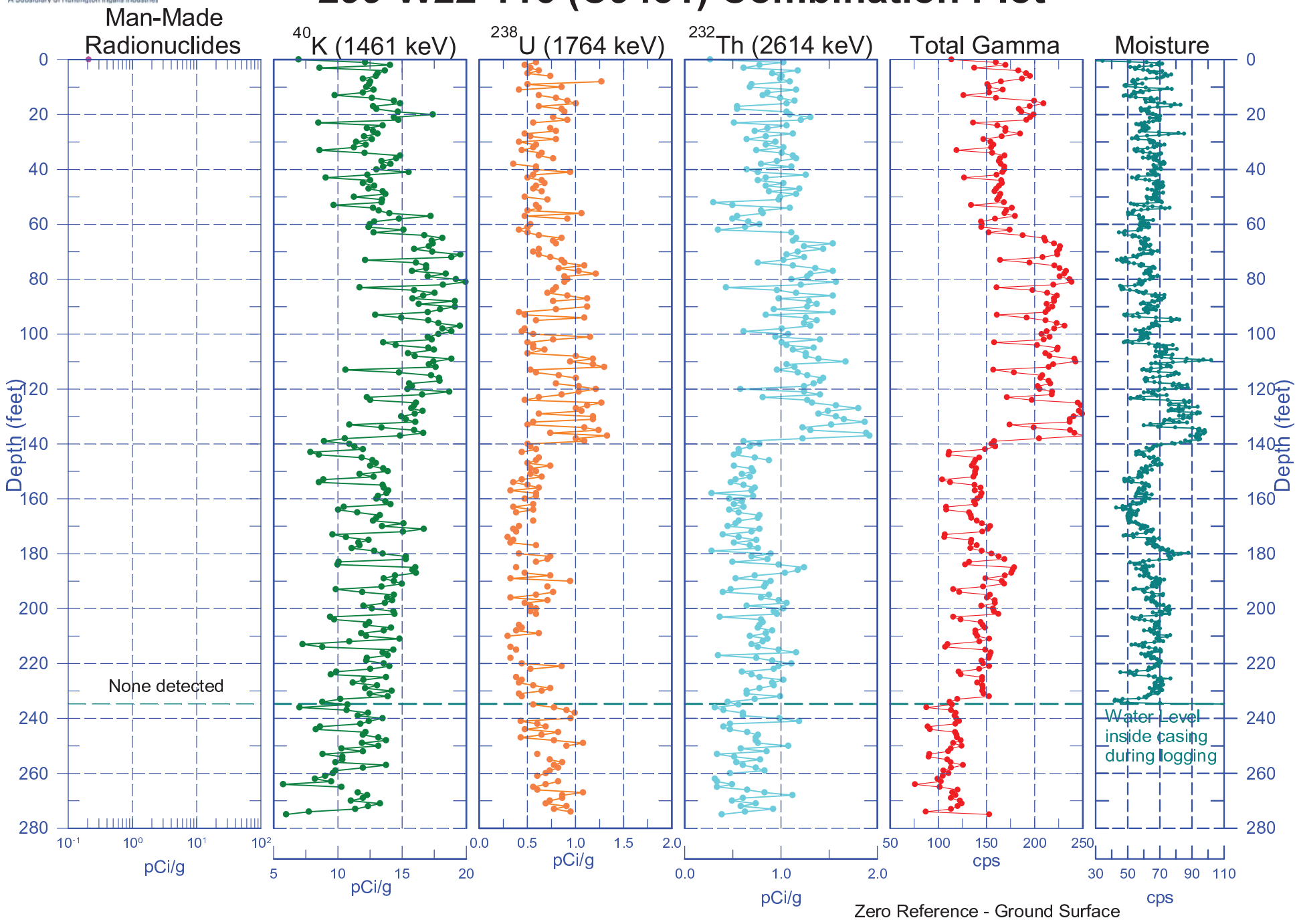
299-W22-116 (C9431) Combination Plot



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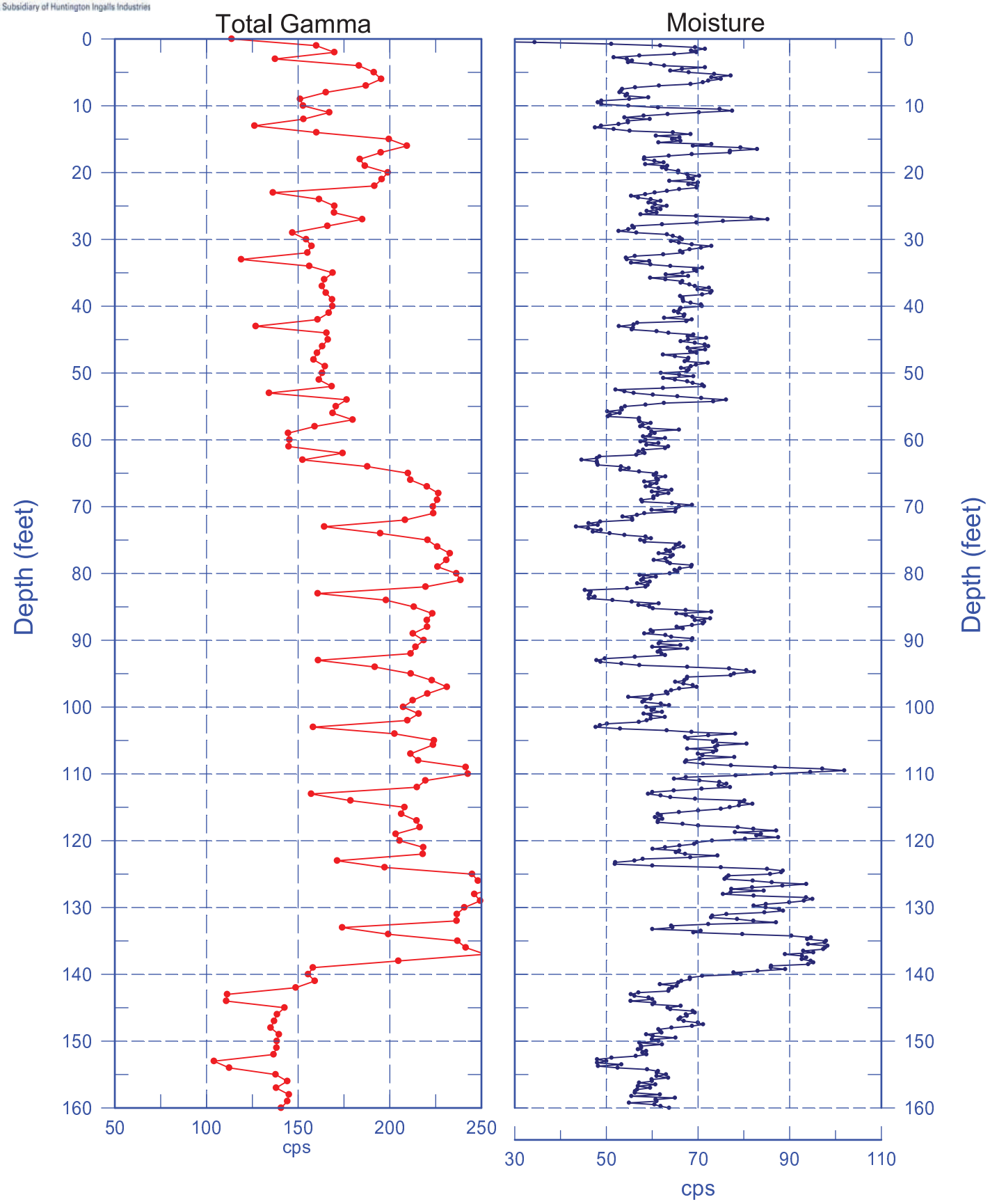
299-W22-116 (C9431)
Total Gamma & Moisture



Reference - Ground Surface

Stoller Newport News Nuclear
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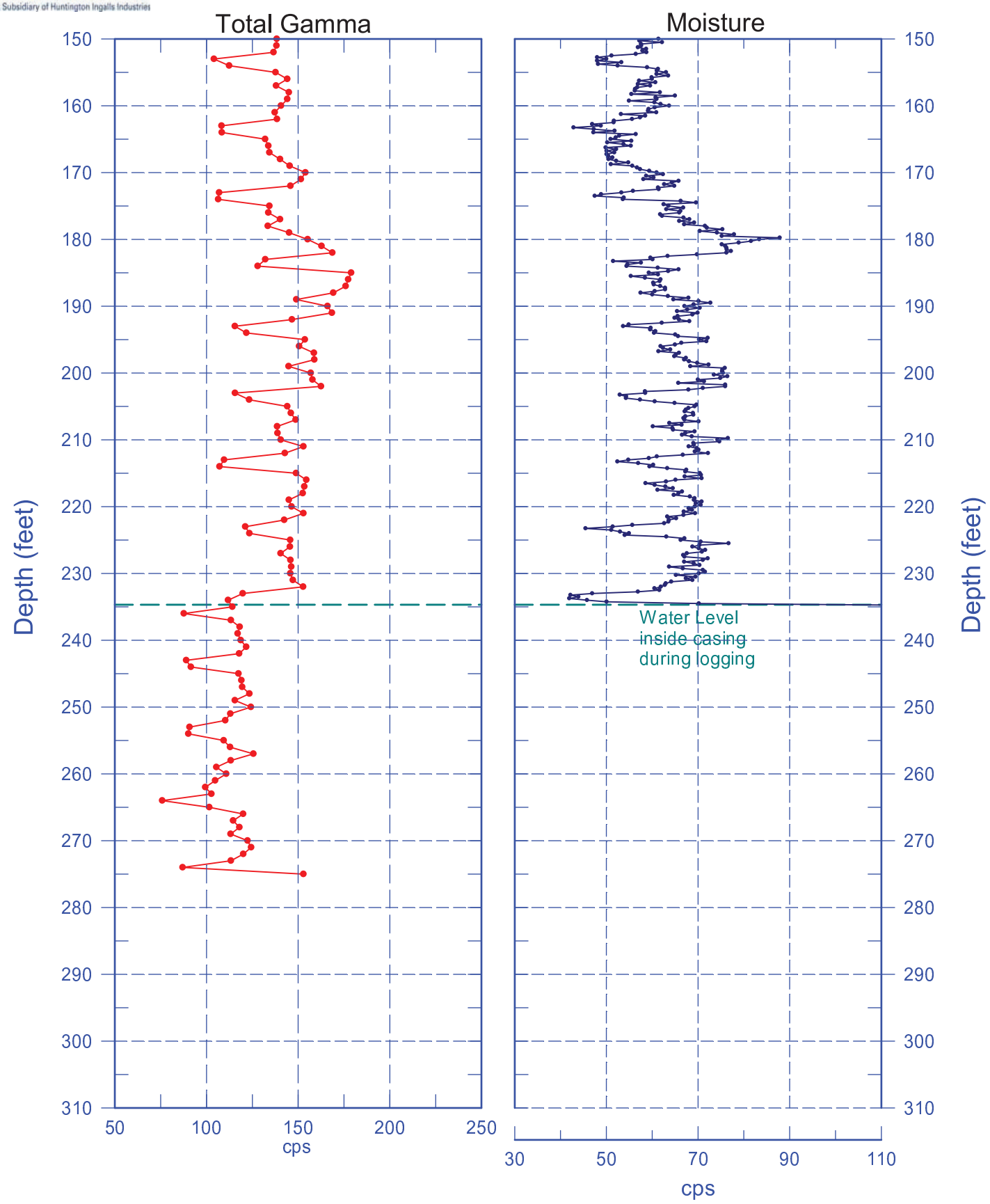
299-W22-116 (C9431)
Total Gamma & Moisture



Reference - Ground Surface

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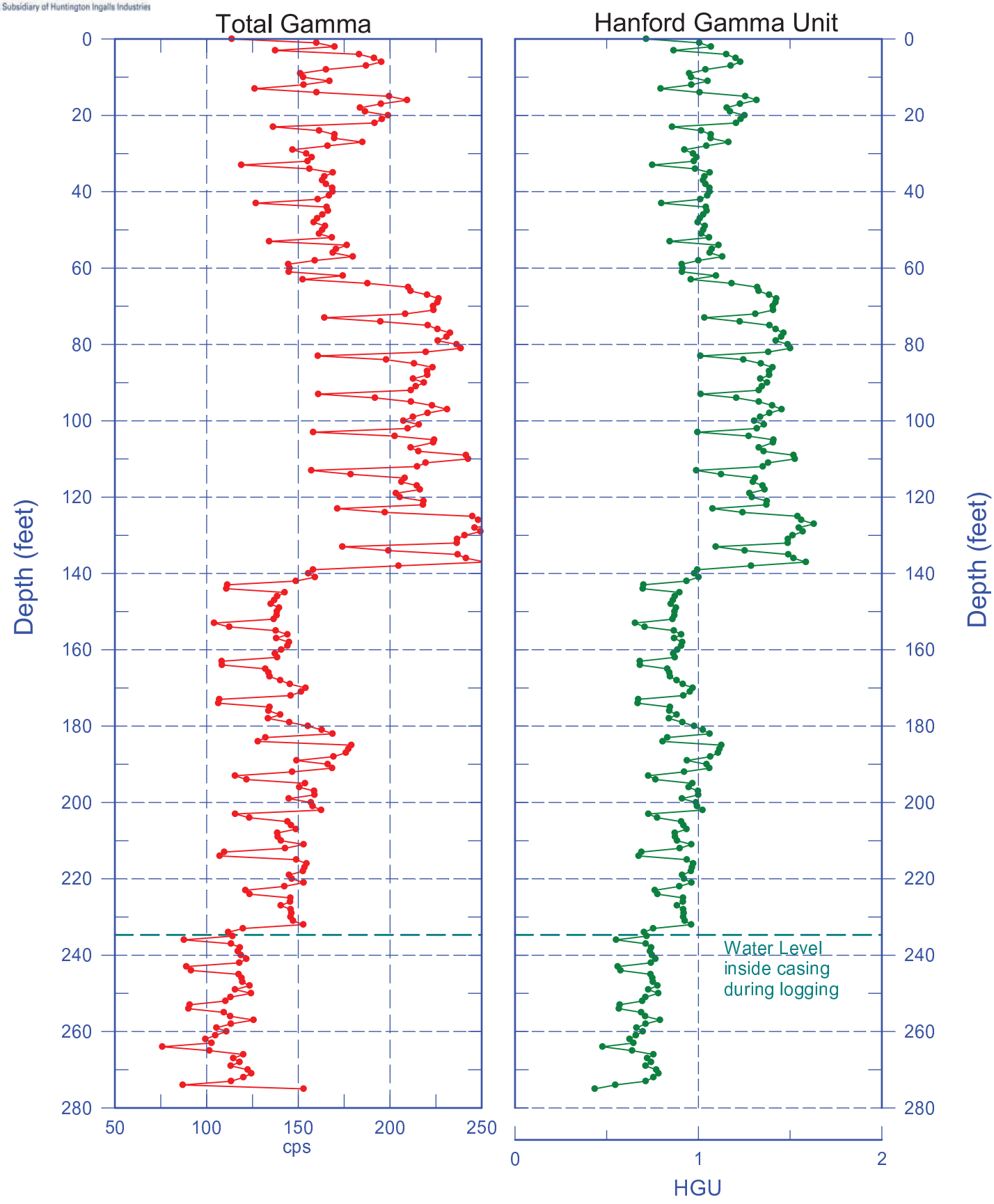
299-W22-116 (C9431)

Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

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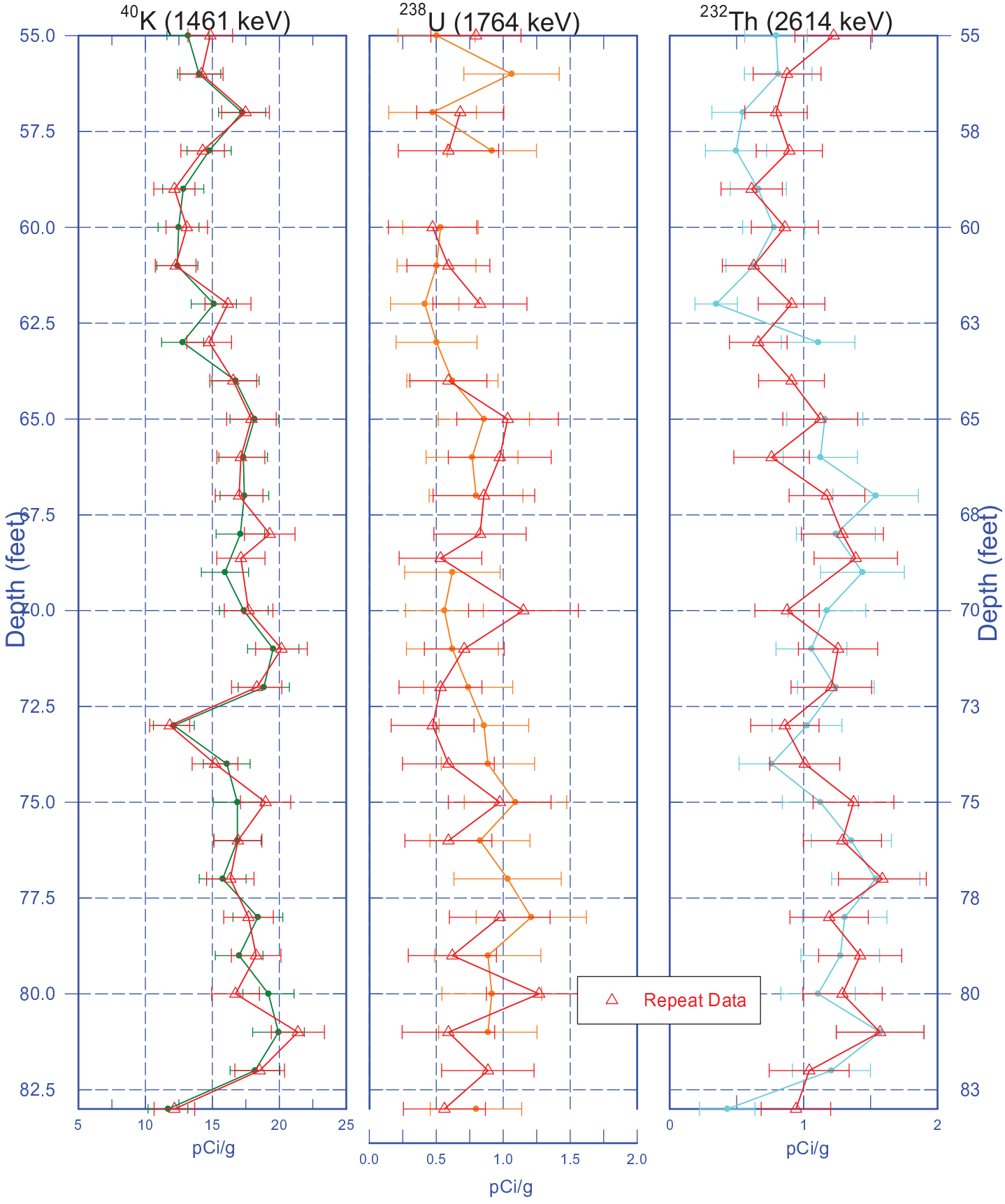
299-W22-116 (C9431)

Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

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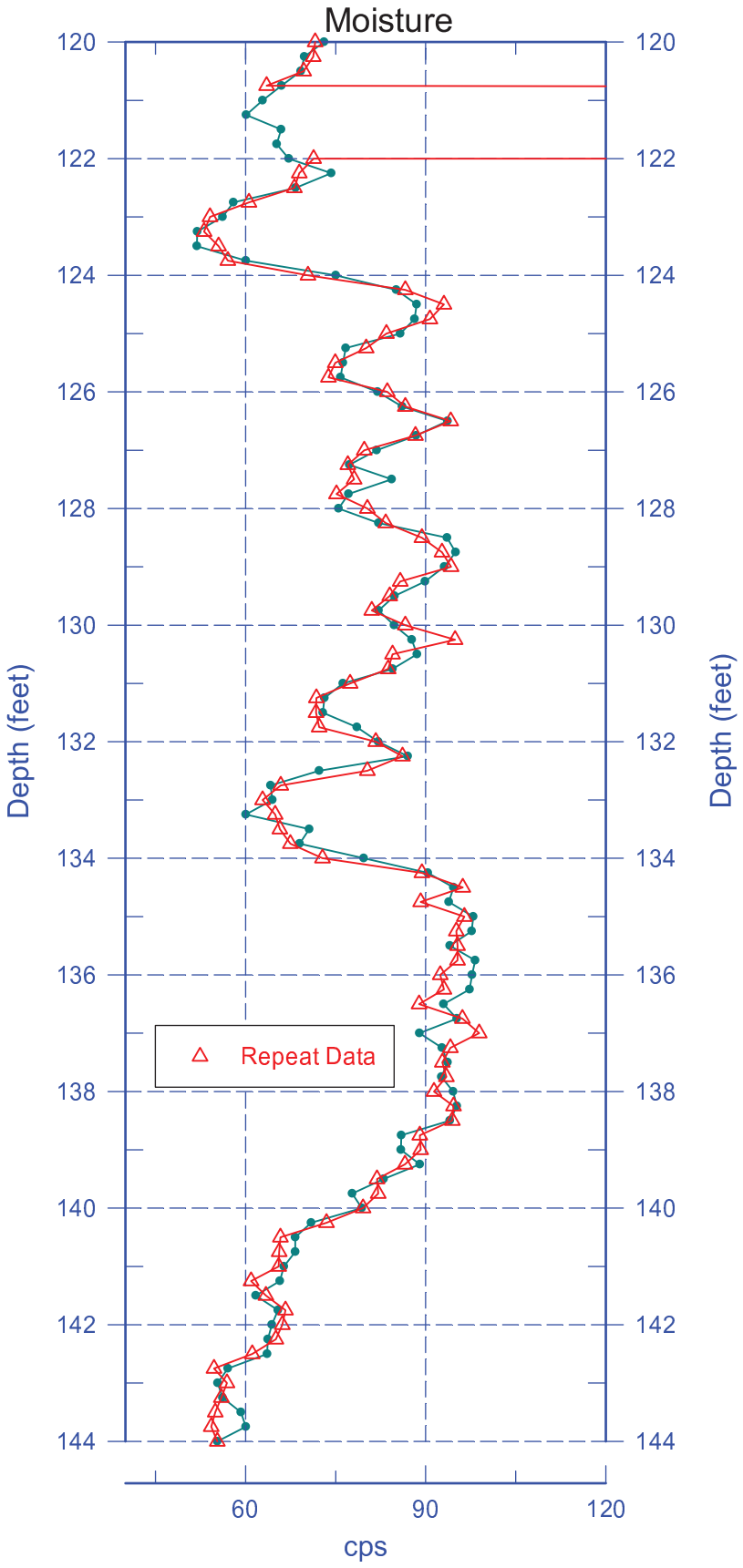
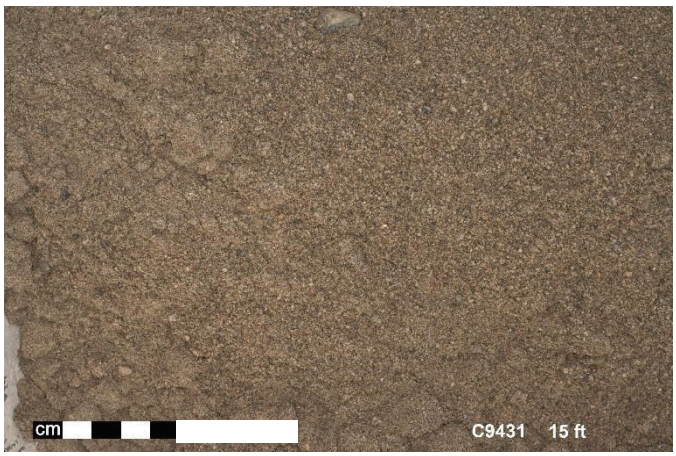
299-W22-116 (C9431)
Moisture Repeat Section



Reference - Ground Surface

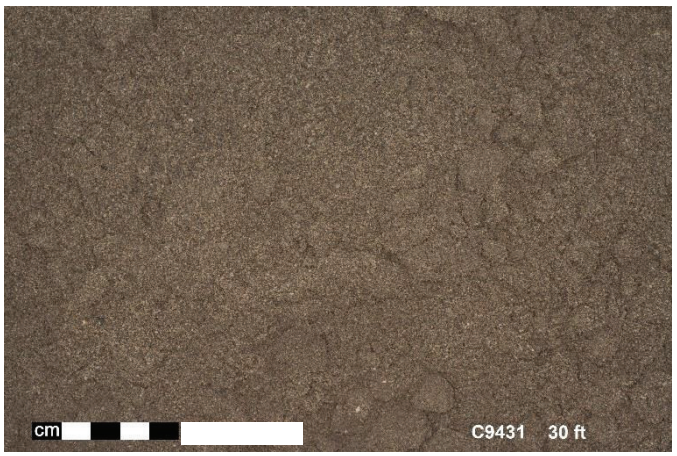
cm
C9431 5 ft

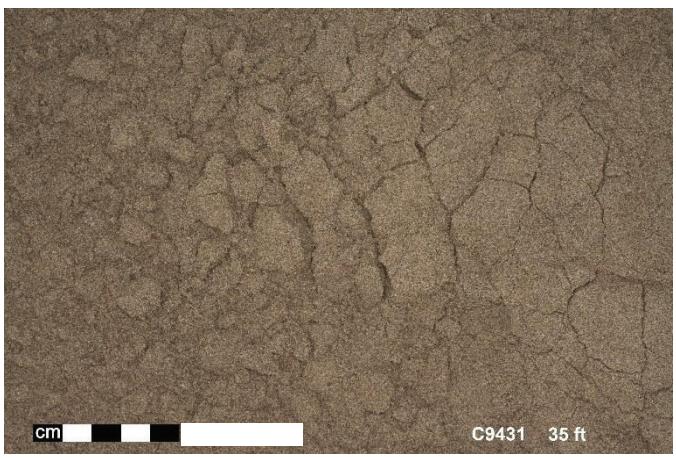
cm
C9431 10 ft

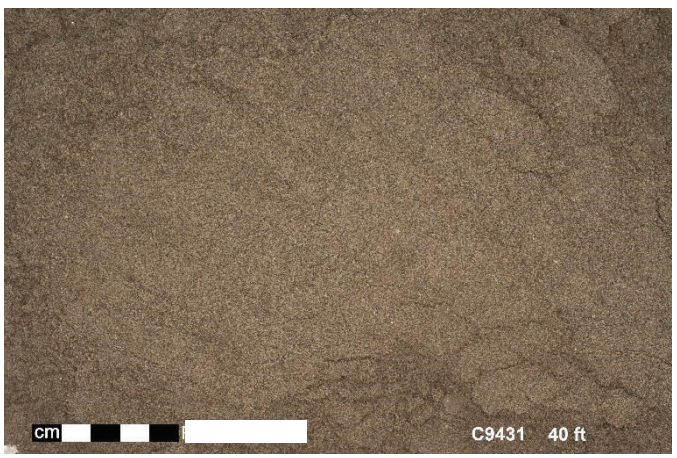

cm
C9431 15 ft

cm
C9431 20 ft

cm
C9431 25 ft

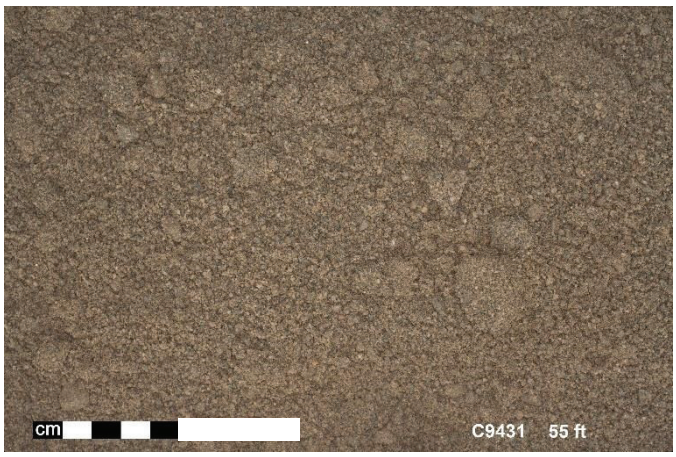

cm
C9431 30 ft


cm
C9431 35 ft


cm
C9431 40 ft

cm
C9431 45 ft

cm
C9431 50 ft


cm
C9431 55 ft

cm
C9431 60 ft

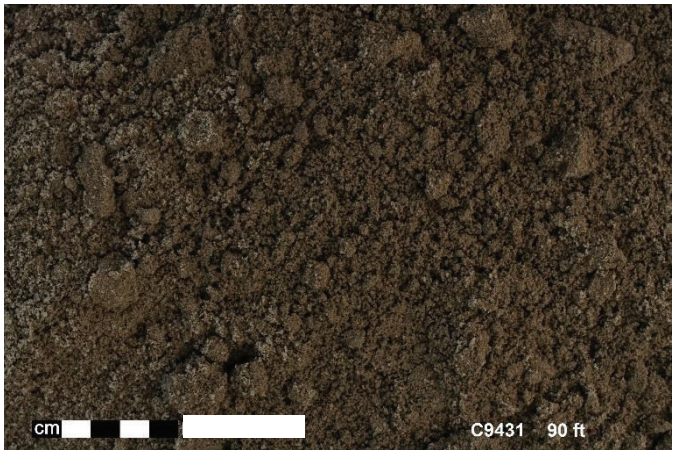
cm
C9431 65 ft

cm
C9431 70 ft

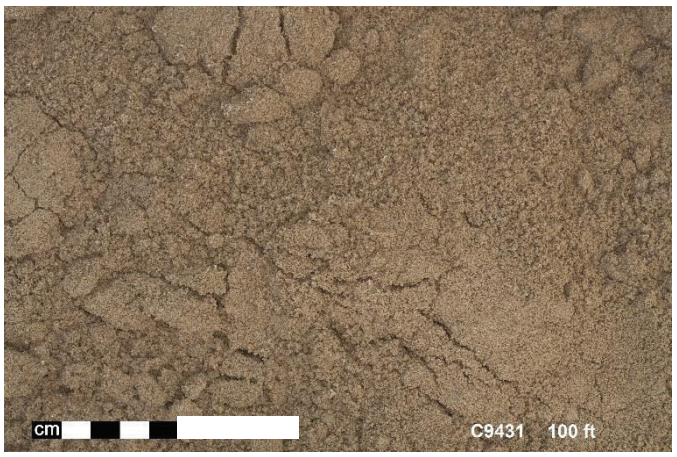
cm
C9431 75 ft

cm
C9431 80 ft

cm
C9431 85 ft

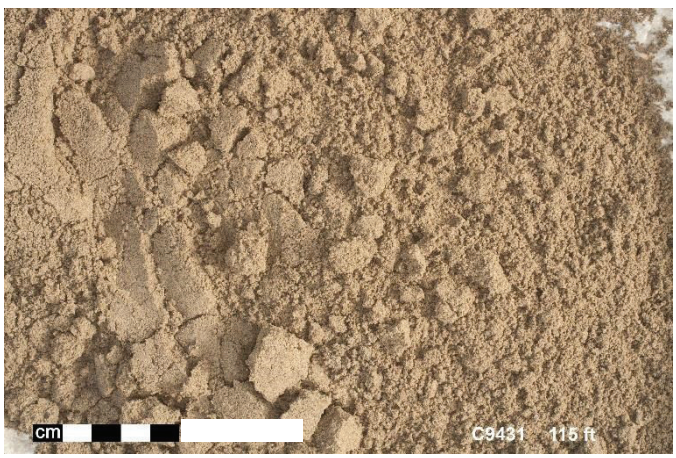

cm
C9431 90 ft

cm
C9431 95 ft


cm
C9431 100 ft

cm
C9431 105 ft

cm
C9431 110 ft

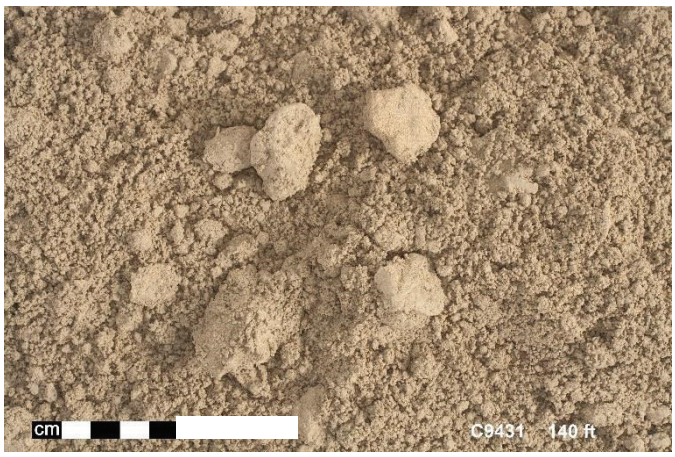

cm
C9431 115 ft

cm
C9431 120 ft

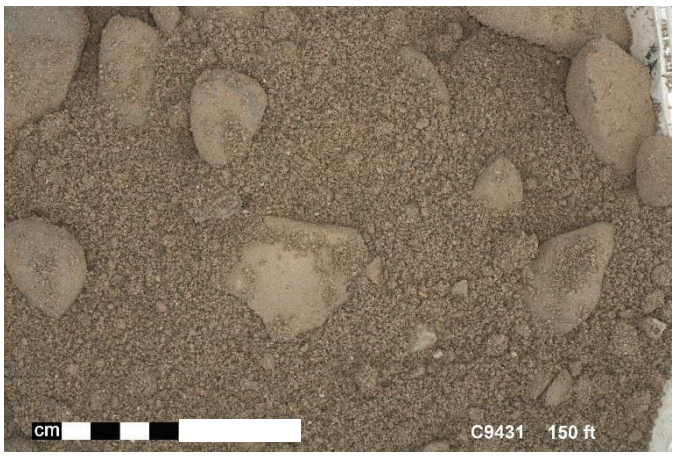
cm
C9431 125 ft

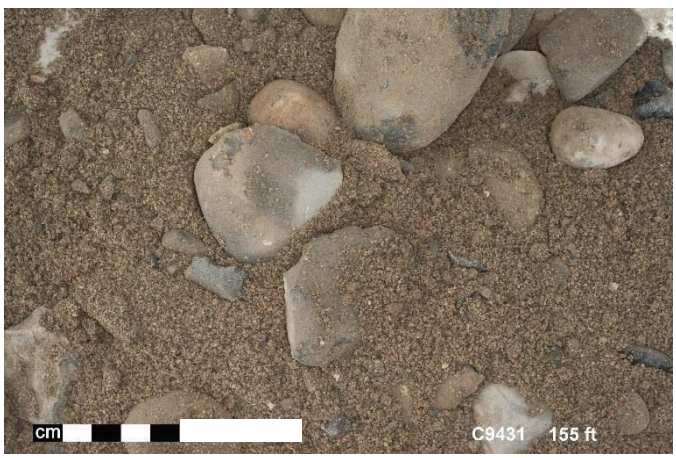
cm
C9431 130 ft

cm
C9431 135 ft

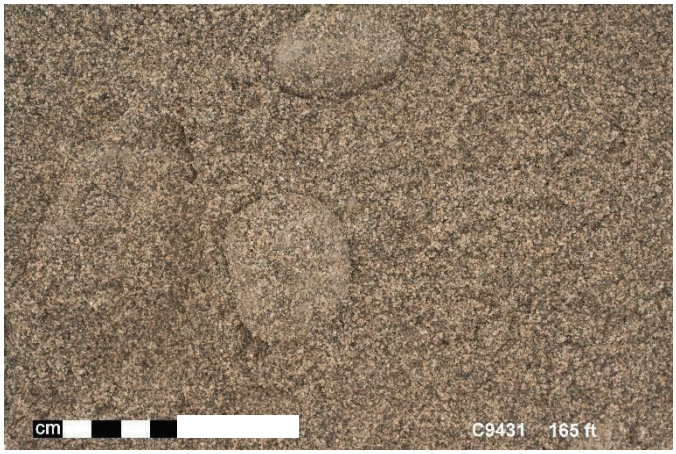

cm
C9431 140 ft

cm
C9431 145 ft


cm
C9431 150 ft


cm
C9431 155 ft

cm
C9431 160 ft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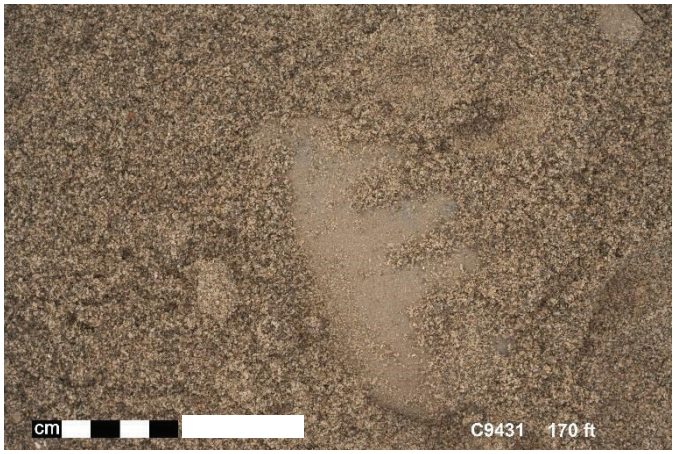
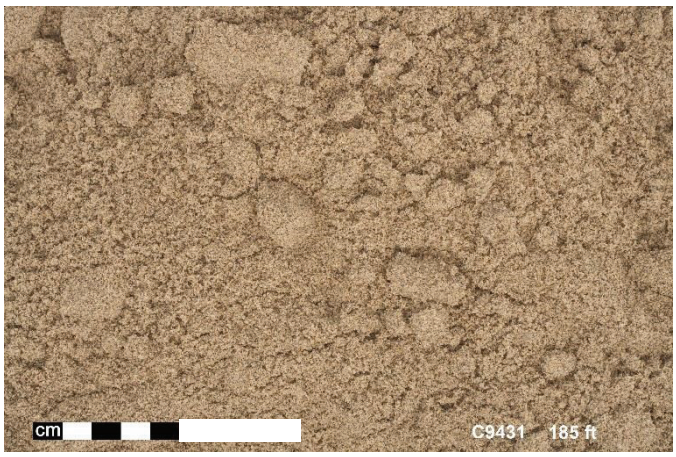

cm
C9431 170 ft

cm
C9431 175 ft

cm
C9431 180 ft


cm
C9431 185 ft

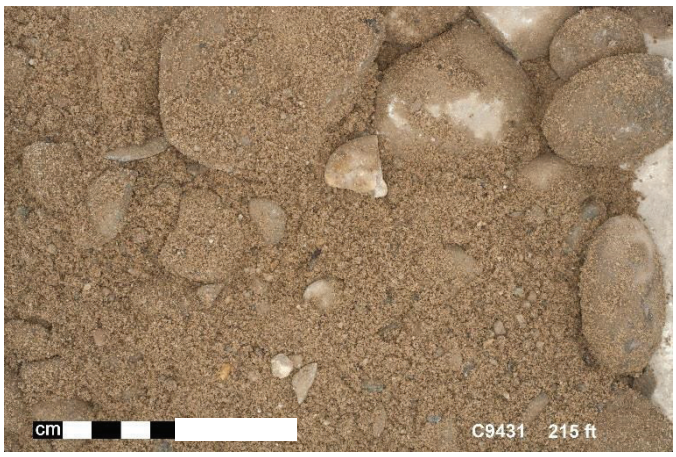
cm
C9431 190 ft

cm
C9431 195 ft

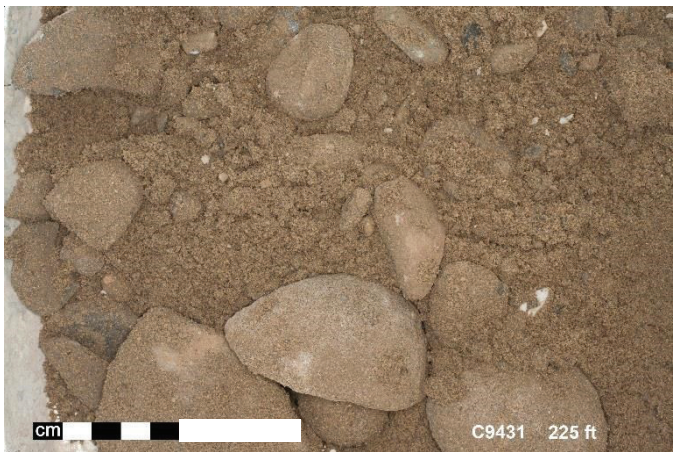
cm
C9431 200 ft

cm
C9431 205 ft

cm
C9431 210 ft


cm
C9431 215 ft

cm
C9431 220 ft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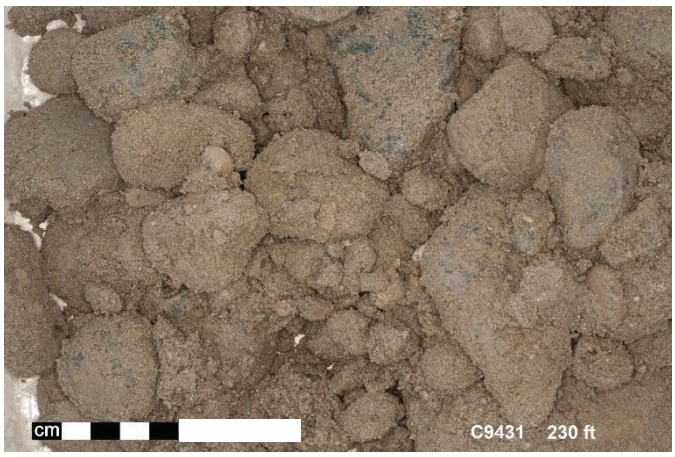
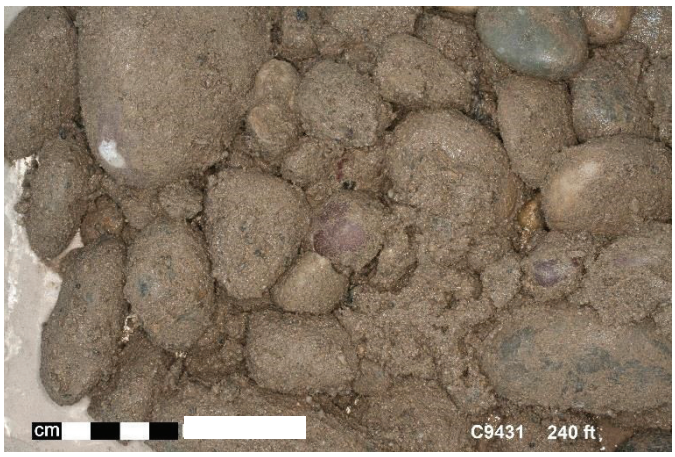
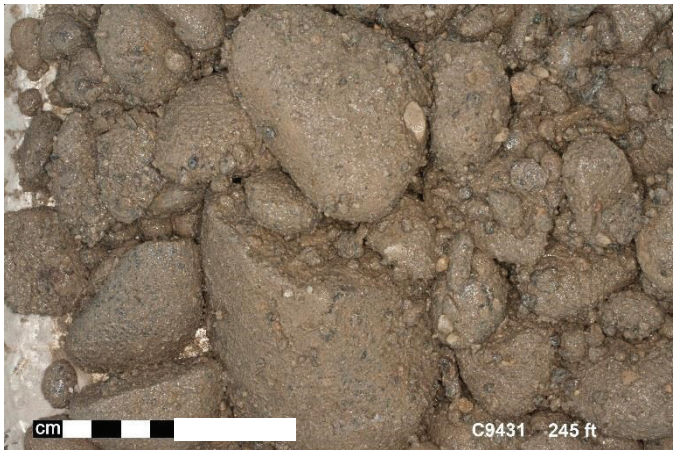
C9431 225 ft

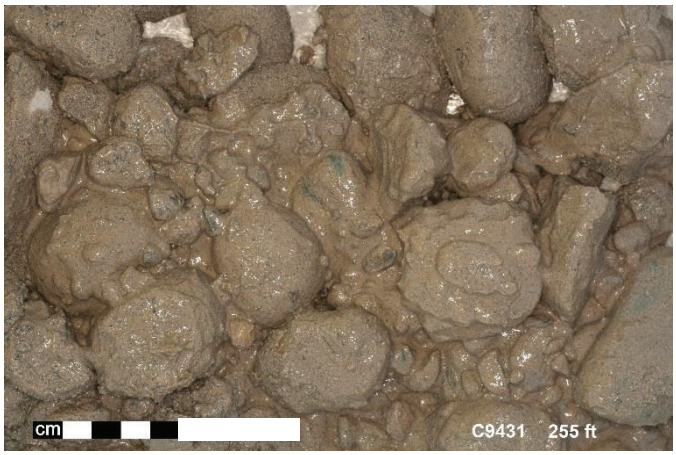

cm
C9431 230 ft

cm
C9431 235 ft


cm
C9431 240 ft


cm
C9431 245 ft

cm
C9431 250 ft


cm
C9431 255 ft

cm
C9431 260 ft

cm
C9431 265 ft

cm
C9431 270 ft

cm
C9431 275 ft

SURVEY DATA REPORT			Request No. 153-112
Project No.	Title 200W M-24 Well C9431 (299-W22-116) Final Survey		File No. 2WT12R25
Job. No. CACN: 303595-JPRC	Prepared By N.P. Fastabend	Date 6/1/15	Reviewer CBM

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casing) and elevations of completed M-24 Well C9431 (299-W22-116).	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: 06/01/15	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 M-24 Well C9431 (299-W22-116) located southeast of 241-SX Tank Farm in 200W Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 200W

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
2W-73 (CHPRC) and 2W-157 (CHPRC)

Well ID	Well Name	Easting	Northing	Elevation	
C9431	299-W22-116	566900.50	134139.92		Center of Casing
				204.909	"X" on Rim
				204.169	Brass Survey Marker

Notes:

204.609 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.

6-1-15

A-6003-659 (04/03)

Appendix D

Well Documentation for C9432 (299-W23-236)

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

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WELL SUMMARY SHEET

Start Date: 4/13/2015
Finish Date: 5/13/2015
Page 1 of 3

Well ID: C9432	Well Name: 299-W23-236
Location: 25 m S of 241 SX	Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/27/15	Reviewed By: D. MEHRER Date: 7-23-15
Signature:	Signature:

CONSTRUCTION DATA

Description

6-in Protective Casing:
3.07 ft ags - 1.93 ft
below ground surface (bgs)

Type I/II Portland Cement Grout:
0 - 10.0 ft bgs

Cetco Bentonite Crumbles:
10.0 - 215.4 ft bgs

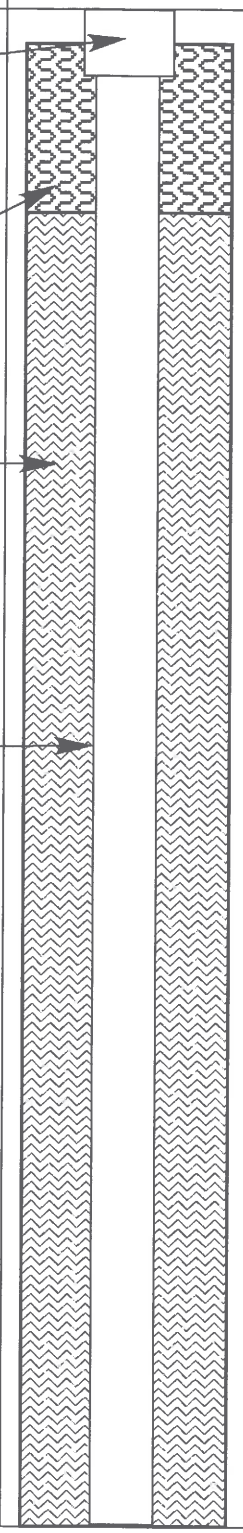
4-in I.D. Schedule 10, Type 304/304L,
Stainless Steel Blank Casing:
2.07 ft ags - 219.76 ft bgs

Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D.
casing from 0.0 - 261.3 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 - 25 Gravelly Sand (gS)
10		
20		
		25 - 70 Sand (S)
30		
40		
50		
60		
70		70 - 85 Sandy Gravel (sG)
80		
		85 - 120 Silty Sand (mS)

A-6003-643 (REV 1)

WELL SUMMARY SHEET

Start Date: 4/13/2015
Finish Date: 5/13/2015

Well ID: C9432
Well Name: 299-W23-236
Location: 25 m S of 241 SX
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody
Date: 5/27/15
Reviewed By: J.D. MEHRER
Date: 7-23-15
Signature:
Signature:

CONSTRUCTION DATA

Description

Cetco Bentonite Crumbles:
10.0 - 215.4 ft bgs

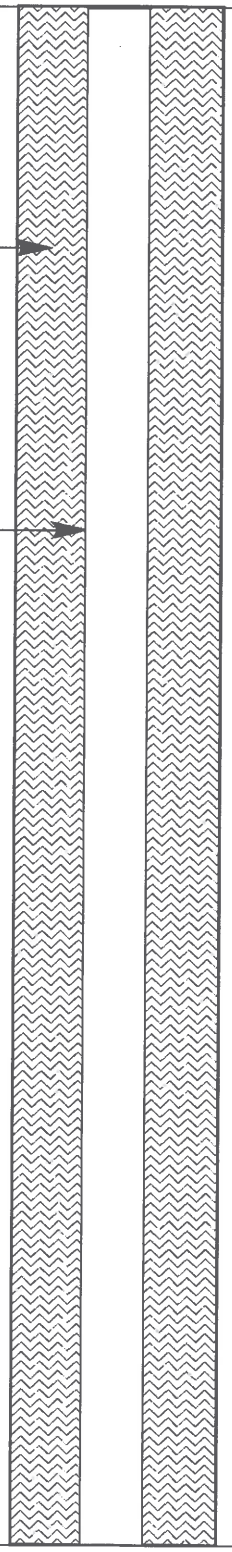
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing:
2.07 ft ags - 219.76 ft bgs

Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 261.3 ft bgs

All temporary drill casing was removed from the ground.

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
90		85 - 120 Silty Sand (mS)
100		
110		
120		120 - 130 Sand (S)
130		130 - 135 Slightly Silty Sand ((m)S)
		135 - 145 Silty Sand (mS)
140		
		145 - 150 Sandy Silt (sM)
150		150 - 155 Silty Sand (mS)
		155 - 160 Silty Sandy Gravel (msG)
160		160 - 170 Sandy Gravel (sG)
170		170 - 180 Gravel (G)

A-6003-643 (REV 1)

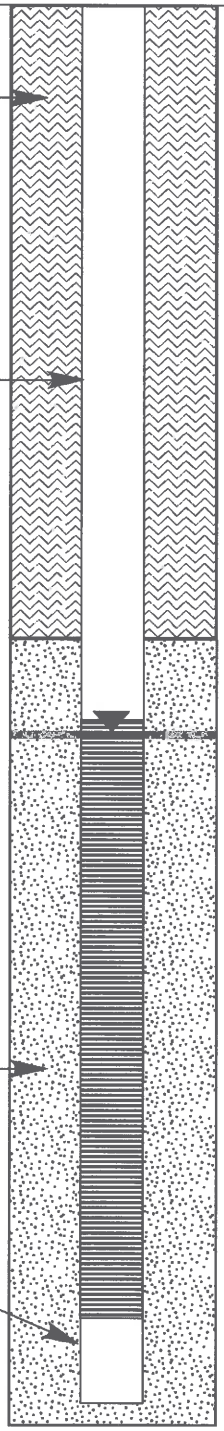
WELL SUMMARY SHEET

Start Date: 4/13/2015
Finish Date: 5/13/2015
Page 3 of 3

Well ID: C9432
Well Name: 299-W23-236
Location: 25 m S of 241 SX
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/27/15
Reviewed By: L.D. MEHRER Date: 7/23/15
Signature:
Signature:

CONSTRUCTION DATA

Description	Diagram
3/8 in Cetco Medium Bentonite Chips: 10.0 - 215.4 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.07 ft ags - 219.76 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen: 219.76 - 254.77 ft bgs	
10-20 mesh Premier Colorado Silica Filter Pack Sand: 215.4 - 261.3 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 254.77 - 259.79 ft bgs	
Depths are in ft below ground surface.	
Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 261.3 ft bgs	
All temporary drill casing was removed from the ground.	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
180		170 - 180 Gravel (G)
		180 - 205 Sandy Gravel (sG)
190		
200		
		205 - 210 Gravel (G)
210		210 - 261.3 Sandy Gravel (sG)
220		Static Water Level: 220.7 ft bgs (04/15/15)
		Total Depth: 261.3 ft bgs (4/16/15)
230		
240		
250		
260		

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 7
Date: 4/13/15

Well ID: C9432 | Well Name: 299-W23-236 | Location: 25 m South of 241 SX
Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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				0-25': gravelly SAND (gS) 25% gravel, 75% sand, trace silt. Gravel: max: 60 mm, VFP-VCP, 60% FP, SA-SR, MS, 20% felsics. Sand: MS-VCS, 80% VCS, A-SR, MS, 30% felsic. 2.5Y 5/1 grey, no rxn w/ HCl, dry	Becker Hammer grab samples collected every 5' or change in lithology
5	G				
10	G				
15	G				
20	G			@20': ↑↑ sand content 90%, ↓↓ gravel 10%. ↑↑ felsic to 40% (sand ≥ gravel). Sand: VFS-VCS, 60% MS, PS.	
25	G			25-70': SAND(S) 2% gravel, 98% sand, trace silt. Gravel: occasional VFP-FP, SA-A, 40% felsic Sand: VFS-VCS, 70% CS, MS, A-SR, 40% felsic 2.5Y 6/2 light brownish grey, no rxn w/ HCl, dry	
30	G			@30' ↓↓ sand size VFS-CS, 80% MS	
35	G				

Reported By: Kim Schuyler KIRA MURRAY
Title: Geologist
Signature: Kim Schuyler Kira Murray Date: 4/13/15

Reviewed By: Kevin Bergstrom
Title: Sr Geologist
Signature: K Rpl Date: 7/20/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 7

Date: 4/13/14

Well ID: C9432 | Well Name: 299-W23-236 | Location: 25 m South of 241 SX

Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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			**25-70':** SAND(S) 2% gravel, 98% sand, trace silt. Gravel: occasional VFP-FP, SA-A, 40% felsic. Sand: VFS-CS, 80% MS, MS, A-SR, 50% felsic. 2.5 Y 6/2 light brownish grey, no rxn w/ HCl, dry	Becker Hammer grab samples collected every 5' or change in lithology
45	G				
50	G			**@50':** ↑↑ sand size VFS-VCS, 60% MS, 30% CS	
55	G			**@55':** color change to 2.5 Y 7/2 light grey	
60	G			**@60':** mod-strong rxn w/ HCl	
65	G				
70	G			**70-85':** sandy GRAVEL (sG) 30% gravel, 70% sand, trace silt. Gravel: max: 62mm, VFP-VCP, 60% FP, PS, A-R, 40% felsic. Sand: VFS-VCS, 50% VCS, PS, A-SR, 60% felsic. 2.5 Y 6/2 light brownish grey, mod-strong rxn w/ HCl, dry	
75	G			**@75'** ↑↑ sand size, MS-VCS, 80% VCS	@75' added 1 gal H_2O

Reported By: KIRA MURRAY		Reviewed By: Kevin Bergstrom	
Title: Geologist		Title: Sr. Geologist	
Signature: Kira Murray	Date: 4/13/14	Signature: Kevin Bergstrom	Date: 7/20/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 7
Date: 4/14/15

Well ID: C9432 | Well Name: 299-W23-236 | Location: 25m South of 241 SX
Project: B M24 TPA GW Monitoring wells FY2015 | 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			70-85 sandy GRAVEL (SG) 30% gravel, 70% sand, tr silt. Gravel: max = 160mm, VFP-VCP, 60% FP, PS, A→R 40% felsics. Sand: MS-VCS, 80% VCS PS, A-SR, 60% felsics. 2.5Y 6/2 light brownish grey, mod-strong rxn w/HCl dry	Becker Hammer grab samples collected every 5' or change in lithology
85	G			85-120: slightly Silty SAND (mS) 80% sand 20% silt. Sand: VFS-MS, 80% VFS, WS 2.5Y 6/2 light brownish grey mod-strong rxn w/HCl, dry	@85' change in formation
90	G				
95	G			@95' clay ↑ 5% color change to 2.5Y 5/3 light olive brown, wet	@95' add 3gal H_2O
100	G			@100 ↓sand to 60%, 40% mud mud: 85% silt, 15% clay, low plasticity, 2.5Y 4/3 olive brown mod-strong rxn w/HCl wet	
105	G			@105' sand ↑ to 80%, silt ↓ 20% sand dist ↑ to 60% mS, sorting to m-WS, no clay present	@105' add 4gal H_2O
110	G				
115	G			@115' sand: VFS-CS, 60% FS, mod. sorted 70% felsics. mud = 85% silt, 15% clay, low plasticity 2.5Y 4/3 olive brown, mod-strong rxn w/HCl, wet	

Reported By: Kim Schuyler
Title: Geologist
Signature: Kim Schuyler Date: 4/14/15

Reviewed By: Kevin Bergstrom
Title: Sr. Geologist
Signature: Kevin Bergstrom Date: 7/20/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 4 of 7
Date: 4/14/15

Well ID: C9432 | Well Name: 299-W23-236 | Location: 25m South of 241 SX

Project: 8 M24 TPA GW Monitoring Wells FY2015 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120				120-130(S) Sand. 90% Sand, 10% Silt Sand: VFS-MS, 80% FS, 70% felsics, MS 2.5Y 7/2 light grey, mod-vig rxn w/HCl dry	Becker Hammer grab samples collected every 5' or change in lithology
125					
130				130-135 Slightly Silty Sand ((m)S) 85% sand, 15% Silt. Sand: VFS-MS 80% FS, 70% felsics, MS, 2.5Y 7/2 light grey, mod-vig. rxn w/HCl, dry	
135				135-145 Silty Sand (mS) 70% sand 30% mud. Sand: VFS-FS, WS, mud: 30% clay 70% Silt, low-mod plasticity 2.5Y 5/3 light olive brown, mod-strong rxn w/HCl, moist	@135' proposed contact between Hanford + Cold Creek Unit (CCU) based on increase in mud/clay content, likely gradational
140					
145				145-150 Sandy Silt (sM) 30% sand 70% mud. Sand: VFS-FS, WS. mud: 40% clay, 60% Silt, mod plasticity, 2.5Y 5/3 light olive brown, mod-vig rxn w/HCl, moist	@145 add ~2gal of H_2O
150				150-155 Silty Sand (mS) 60% sand 40% mud. Sand: VFS-MS, 70% FS. mud: 30% clay, 70% Silt low-mod plasticity 2.5Y 5/3 light olive brown, mod-vig rxn w/HCl	@150' proposed contact* between CCU + Ringold Taylor Flat (RTF) based on coarsening
155				155-160' Silty sandy Gravel (mSG) 70% gravel, 15% Sand, 15% mud. Gravel: max ~150mm, VFP-LC, 50% VCP, PS, A-R multiple +100mm cobbles, 30% felsics Sand: VFS-VCS, 60% MS, PS, SA-SR 60% felsics. Mud: 15% clay, low plasticity 2.5Y 4/3 olive brown, strong rxn w/HCl, wet	@155' add 3gal H_2O @156 ↓↓ drill rate 156' ~~deter~~ proposed to be contact w/ Ringold E, Δ lithology

Reported By: Kim Schuyler | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: Kim Schuyler | Date: 4/14/15 | Signature: Kevin Bergstrom | Date: 7/20/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 5 of 7
Date: 4/14/15

Well ID: C9432 | Well Name: 299-W23-236 | Location: 25 m South of 241 SX
Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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
160	G			160-170': Sandy GRAVEL (sG) 70% gravel, 20% sand, 10% silt. Gravel: max: 130mm, VFP-LC, 80% LC, PS, A-R, % felsic. sand: VFS-VCS, 80% CS, VPS, A-SR, 60% felsic. Silt: no clay. 2.5Y 4/3 olive brown, strong rxn w/ HCl, wet	Becker Hammer
					@162' add 10 gal H_2O
					Difficulty recovering sediment. Grab samples collected every 5' or change in lithology
165	G				
170	G			170-180': gravel (G) 95% gravel, 5% sand, trace silt. Gravel: max: 180 mm, VFP-SC, 50% CP, occl. 70-100mm cobbles, PS, SR-R, 60% felsic. sand: VFS-VCS, 80% CS, VPS, A-SR, 60% felsic. 2.5Y 5/3 light olive brown, mod-strong rxn w/ HCl, wet.	
175	G				
180	G			180-205': Sandy GRAVEL (sG) 75% gravel, 25% sand, trace silt. Gravel: max: 110mm, VFP-SC, 50% CP, PS, SR-R, 70% felsic. Sand: VFS-VCS, 80% CS, VPS, A-SR, 70% felsic. 2.5Y 5/3 light olive brown, no rxn to HCl, wet	
185	G				
190	G			@190': gravel content ↓↓45%, sand ↑↑55.	
195	G			@195': gravel content ↑↑60%, sand ↓↓40%	@196' add 10 gal H_2O

Reported By: KIRA MURRAY | Title: GEOLOGIST | Signature: Kira Murray | Date: 4/14/15

Reviewed By: Kevin Bergstrom | Title: Sr. Geologist | Signature: Kevin Bergstrom | Date: 7/20/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 6 of 7
Date: 4/14/15

Well ID: C9432 | Well Name: 299-W23-236 | Location: 25m South of 241 SX
Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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
200	G			**180-205':** sandy GRAVEL (sG) 60% gravel, 40% sand, trace silt. Gravel: max: 110mm, VFP-SC, 50% CP, PS, SR-R, 70% felsic. Sand: VFS-VCS, 80% CS, VPS, A-SR, 70% felsic. 2.5Y 5/3 light olive brown, no rxn w/ HCl, wet	Becker Hammer Grab samples collected every 5' or change in lithology
205	G			**205-210':** gravel (G): 85% gravel, 10% sand, 5% silt. gravel: max: 100mm, VFP-SC, 60% VCP, VPS, 60% felsic, A-R. Sand: VFS-VCS, 70% CS, PS, SA-SR, 80% felsic. 2.5Y 5/3, light olive brown, no rxn w/HCl, wet	
210	G			**210-2613':** ~~SG~~ KM 4/14/15 sandy GRAVEL (sG): 45% gravel, 55% sand, trace silt. Gravel: max: 140mm, VFP-LC, 60% VCP, VPS, SA-R, 80% felsic. Sand: VFS-CS, 60% MS, MS, A-SR, 80% felsic. 2.5Y 5/3 light olive brown, no rxn w/ HCl, wet	@212' Add water (a lot - unable to determine before encountering water table)
215	G			**@215':** gravel content ↑↑ to 60%, sand ↓↓ to 35%, silt ↑↑ to 5%	
220	G				DTW encountered on 4/14/15, first accurately measured @ 220.65' bgs on 4/15/15
225	G			**@225':** silt content ↑↑ to 15% w/some clay. Cannot determine plasticity. Sand is well sorted, VFS-MS, 80% FS.	
230	G	2287' GW		**@230':** silt content ↓↓ to 5%, sand: VFS-CS, 60% MS, MS	@230' Drillrate @ 2 min/ft
235	G			@235': Gravel angularity Δ to SR, moisture Δ to moist, Color change to Olive Brown (2.5Y 4/4)	@233' Drillrate ↑↑ to 30 sec per foot

Reported By: KIRA MURRAY | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: Kira Murray | Date: 4/14/15 | Signature: Kevin Rpb | Date: 7/20/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 7 of 7
Date: 4/16/15

Well ID: C9432 | Well Name: 299-W23-236 | Location: 25m South of 241 SX
Project: 8 M24 TPA GW Monitoring Wells FY2015 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
240	G			240-261.3' Sandy Gravel (SG) 60%G, 35%S, 5%M. Gravel: 90% felsic, VFP-SC, max=80mm, MS, avg=VCP, SR. Sand: 95% felsic, VFS-VCS, MS, 80% MS-CS, SA-R. moist. No rxn to HCl. Olive Brown (2.5Y 4/4)	Rechrer Hammer @241' ↓↓ drillrate
245	G			@245': Gravel content ↑↑ to 70%, sand content ↓↓ to 25% mud @ 5%. Sand sorting ↓↓ to PS, 70% MS-CS.	
250	G			@250': max gravel size ↑↑ to 130mm, gravel Δ to A-R. Sand ~~sorting~~ felsic content ↓↓ to 80% moisture Δ to wet.	@249' ↑↑ drillrate, ↑↑ water production @251' ↓↓ drillrate, ↑↑ water production, driller method did not cause the increase in water production.
255	G			@255': Gravel content ↑↑ to 79%, sand content ↓↓ to 16%, 5% mud. max gravel size ↓↓ to 100mm. Gravel + Sand ↓↓ to 70% felsic.	
260	G			@260': Gravel content ↓↓ to 50%, sand content ↑↑ to 40%, mud content ↑↑ to 10%.	Reached TD @ 261.3' bgs 4/16/15 Casing shoe @ 261.4' bgs

Reported By: Joshua Holland | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: [signature] | Date: 4/16/15 | Signature: [signature] | Date: 7/20/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

299-W23-236 (C9432)
Log Data Report

Borehole Information:

Log Date:	2015-04-22	Filename:	C9432_HG-NM_2015-04-22	Site:	Near 241-SX Farm
Coordinates (WA St Plane)		DTW[1] (ft) :	220.5	DTW Date:	04/21/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	04/20/15	N/A	261.4	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Becker	1.15	6 3/8	6	3/16	1.15	261.4
Becker	0.8	9	7 1/4	7/8	0.8	261.4

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 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. Depth to water inside the casing was determined from the moisture log. The maximum logging depth achieved was 261ft.

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	6 Repeat		
HEIS Number	1018690	1018691	1018692		
Date	04/21/15	04/22/15	04/22/15		
Logging Engineer	Pope	Pope	Pope		
Start Depth (ft)	261.0	0.0	90.0		
Finish Depth (ft)	90.0	89.0	116.0		
Count Time (sec)	100	100	100		

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

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Log Run	4	5	6 Repeat		
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	AL248CAB	AL249CAB	AL249CAB		
Start File	AL248000	AL249000	AL249090		
Finish File	AL248172	AL249089	AL249116		
Post-Verification	AL248CAA	AL249CAA	AL249CAA		
Depth Return Error (in.)	1.0 low	N/A	0.0		
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made		

NMLS Log Run Information:

Log Run	1	2	3 Repeat		
HEIS Number	1018693	1018694	1018695		
Date	04/20/15	04/21/15	04/21/15		
Logging Engineer	Pope	Pope	Pope		
Start Depth (ft)	0.0	184.0	80.0		
Finish Depth (ft)	185.0	220.5	102.0		
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	AH208CAB	AH209CAB	AH209CAB		
Start File	AH208000	AH209000	AH209147		
Finish File	AH208740	AH209146	AH209235		
Post-Verification	AH208CAA	AH209CAA	AH209CAA		
Depth Return Error (in.)	0.5 low	N/A	1.0 low		
Comments	None	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:	05/05/15	Reference:	HGLP-MAN-003, Rev. 0

A casing correction for a 1.0625-in. thick casing (0.875 + 0.1875-in. for the 7/8- and 3/16-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 220 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 as there is no calibration for conversion to volumetric moisture for multiple 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 are plotted for the entire borehole.

The relatively thick casing joints beginning at 10 ft and occurring at 10 ft intervals are indicated by reduced count rates on the total gamma log. The moisture count rate is also affected by the 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 (0-310 ft)
Natural Gamma Logs (0-160 ft)
Natural Gamma Logs (150-310 ft)
Combination Plot (0-120 ft)
Combination Plot (110-230 ft)
Combination Plot (220-340 ft)
Combination Plot (0-280 ft)
Total Gamma & Moisture (0-160 ft)
Total Gamma & Moisture (150-310 ft)
Total Gamma & Hanford Gamma Unit (0-280 ft)
Repeat Section of Natural Gamma Logs (99 to 116 ft)
Moisture Repeat Section (80 to 102 ft)

[5] Hanford Gamma Unit

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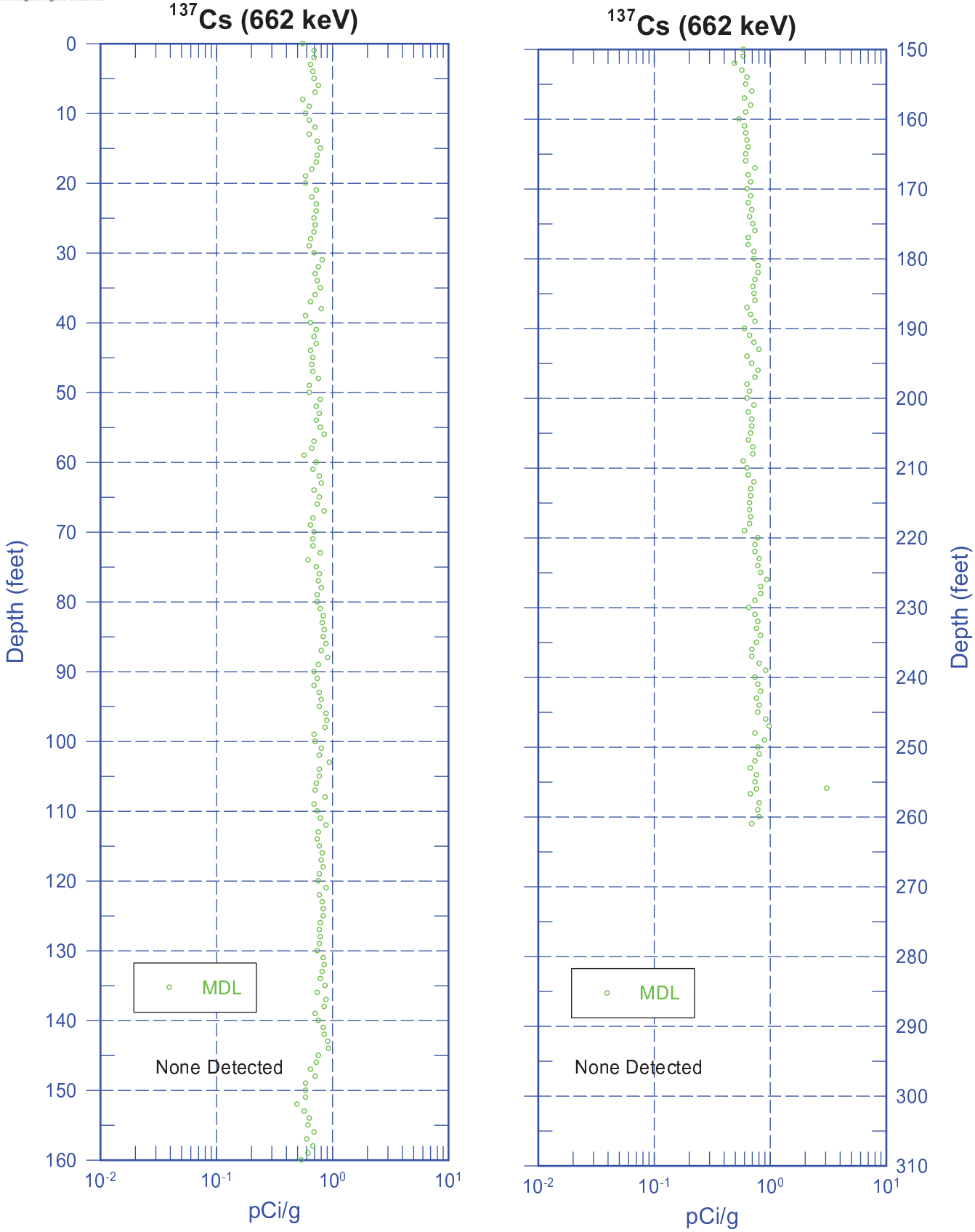
299-W23-236 (C9432)
Manmade Radionuclides



Zero Reference - Ground Surface

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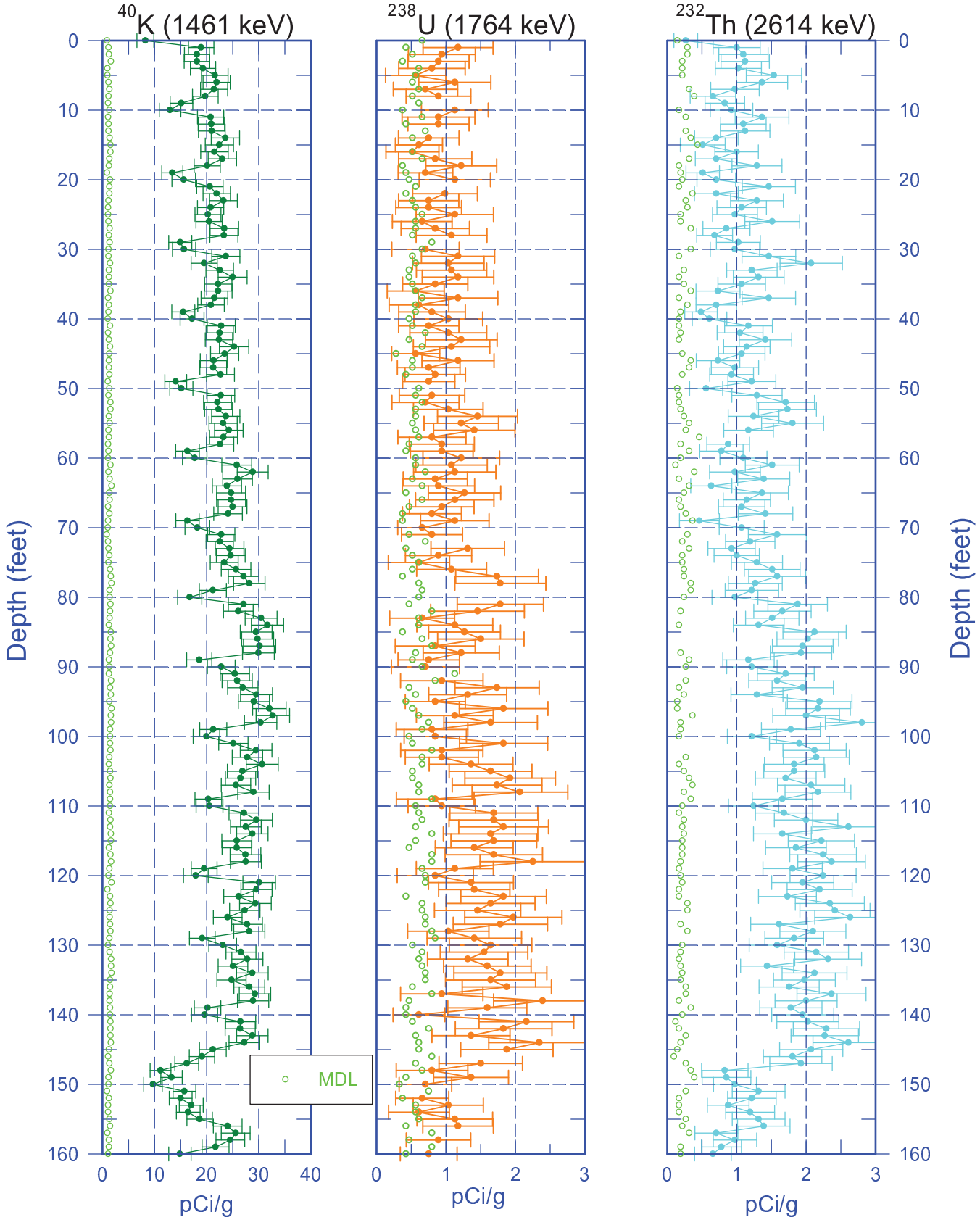
299-W23-236 (C9432)
Natural Gamma Logs



Zero Reference - Ground Surface

Stoller Newport News Nuclear
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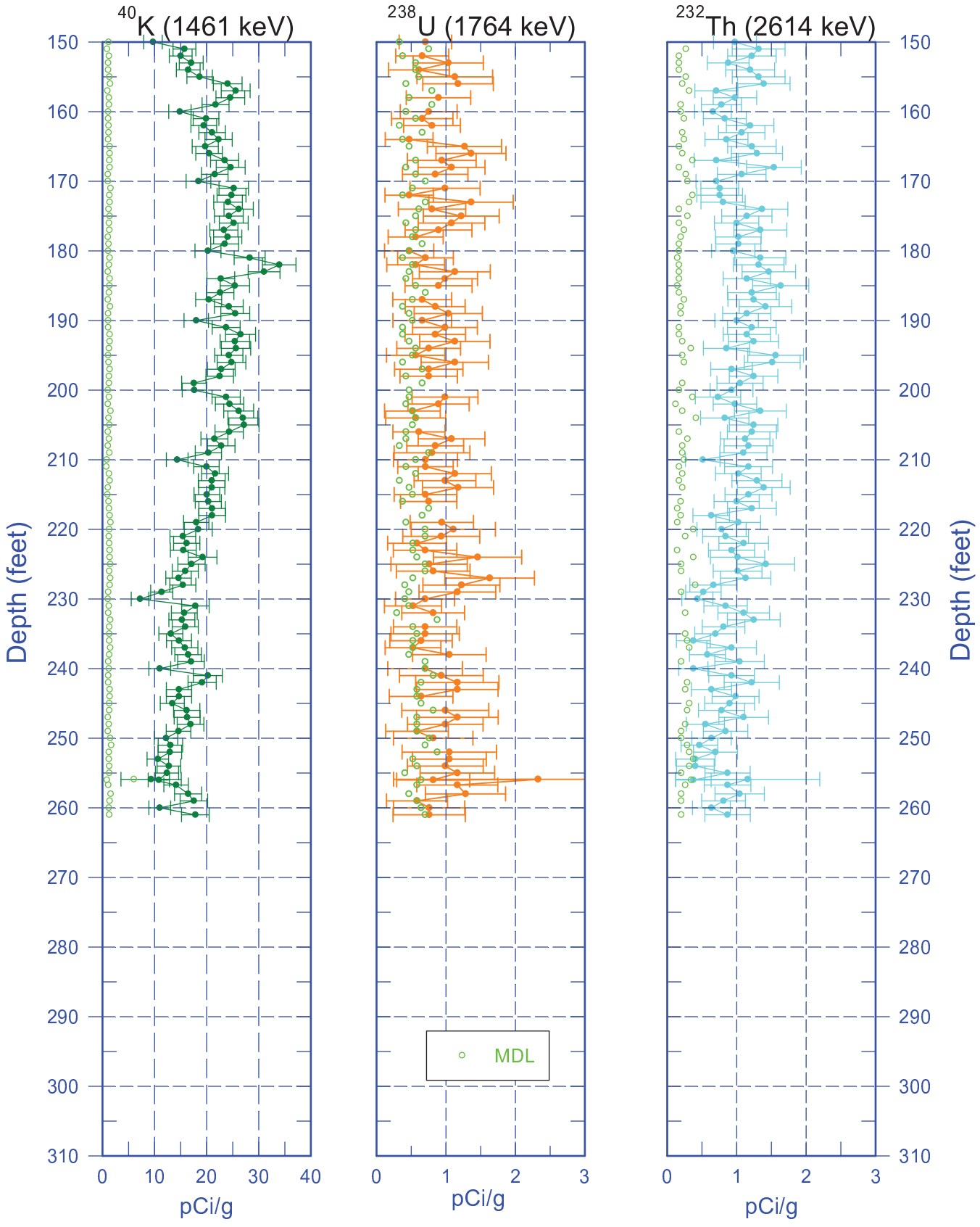
299-W23-236 (C9432)
Natural Gamma Logs



Zero Reference - Ground Surface

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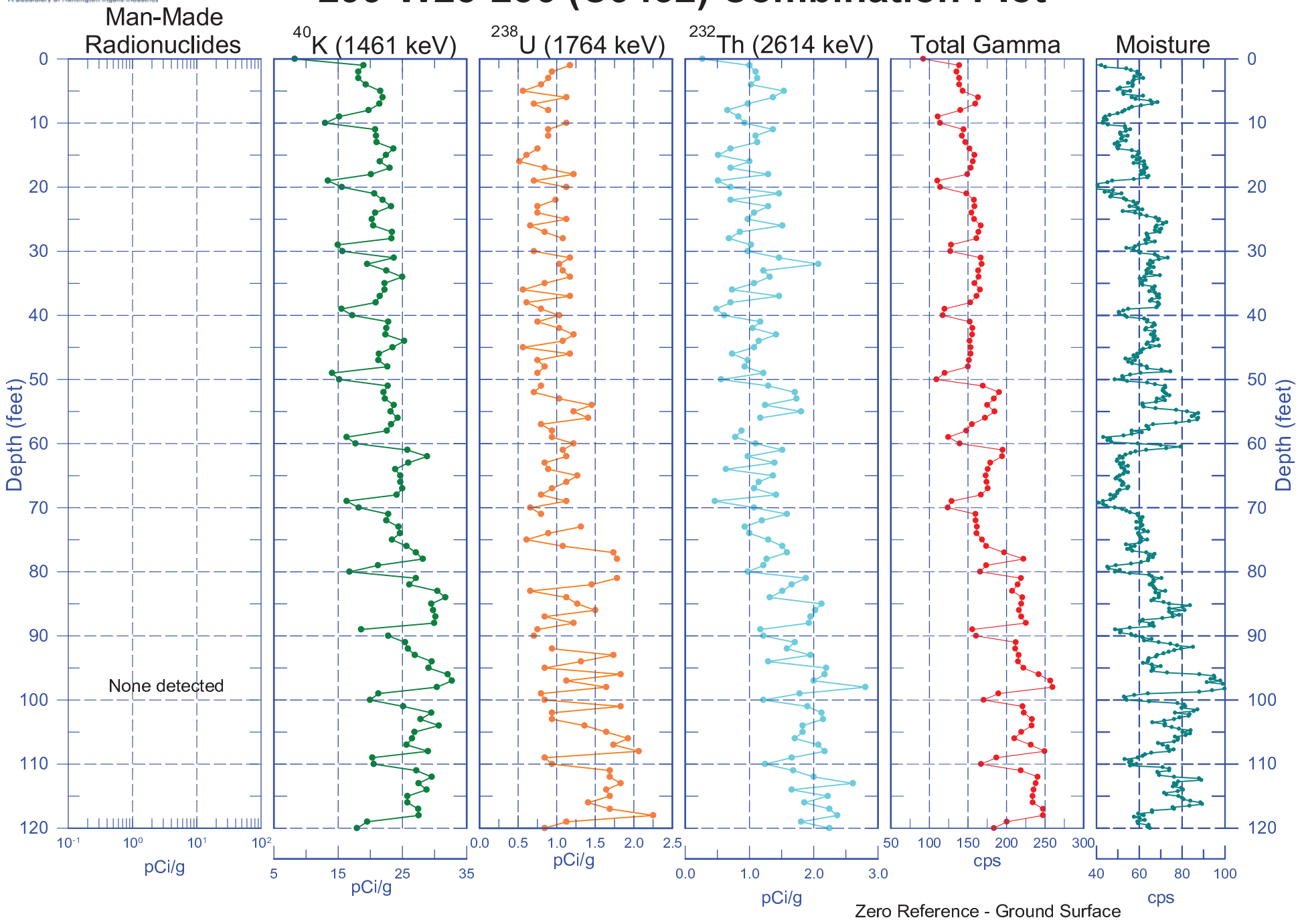
299-W23-236 (C9432) Combination Plot



Stoller Newport News Nuclear
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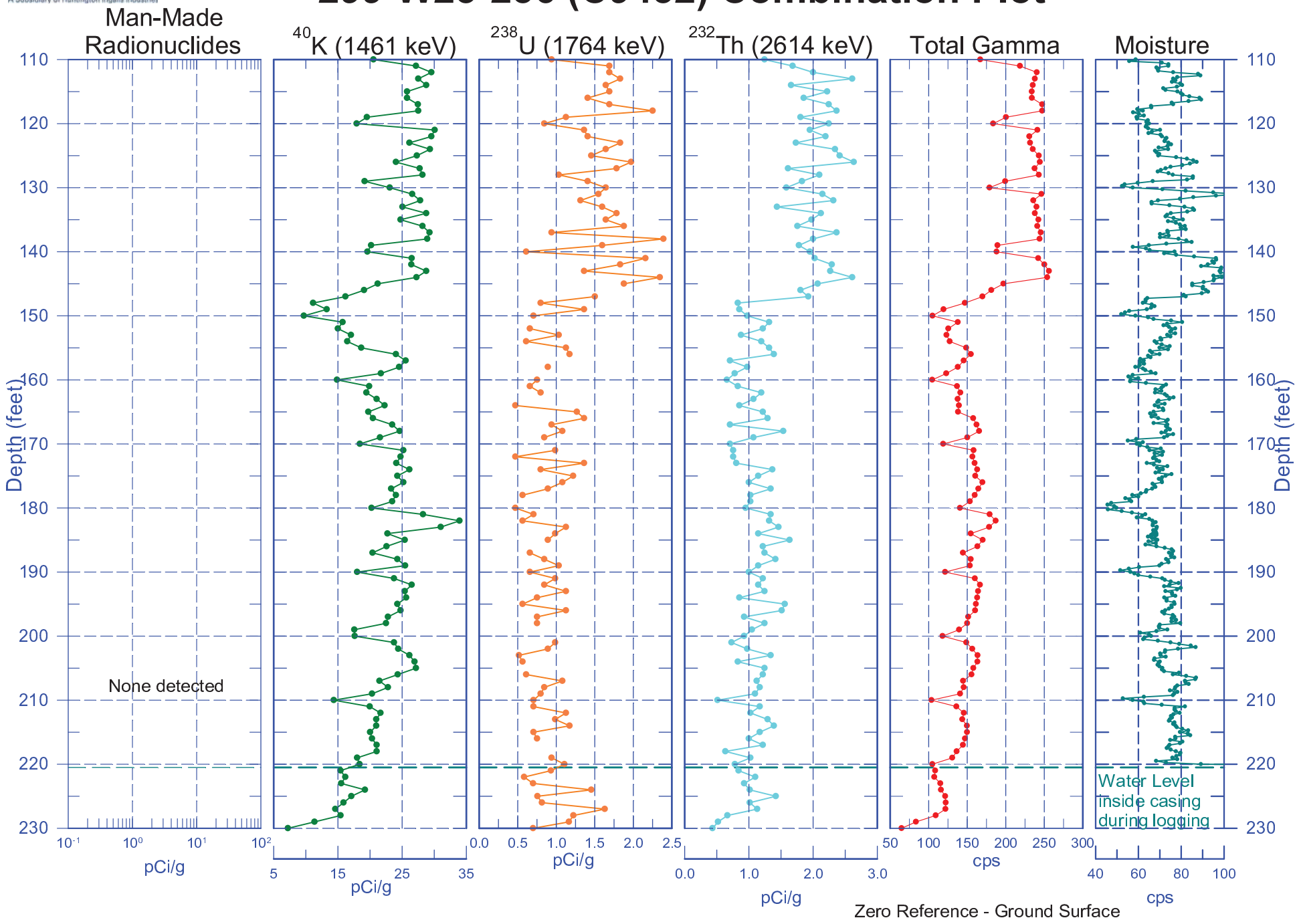
299-W23-236 (C9432) Combination Plot



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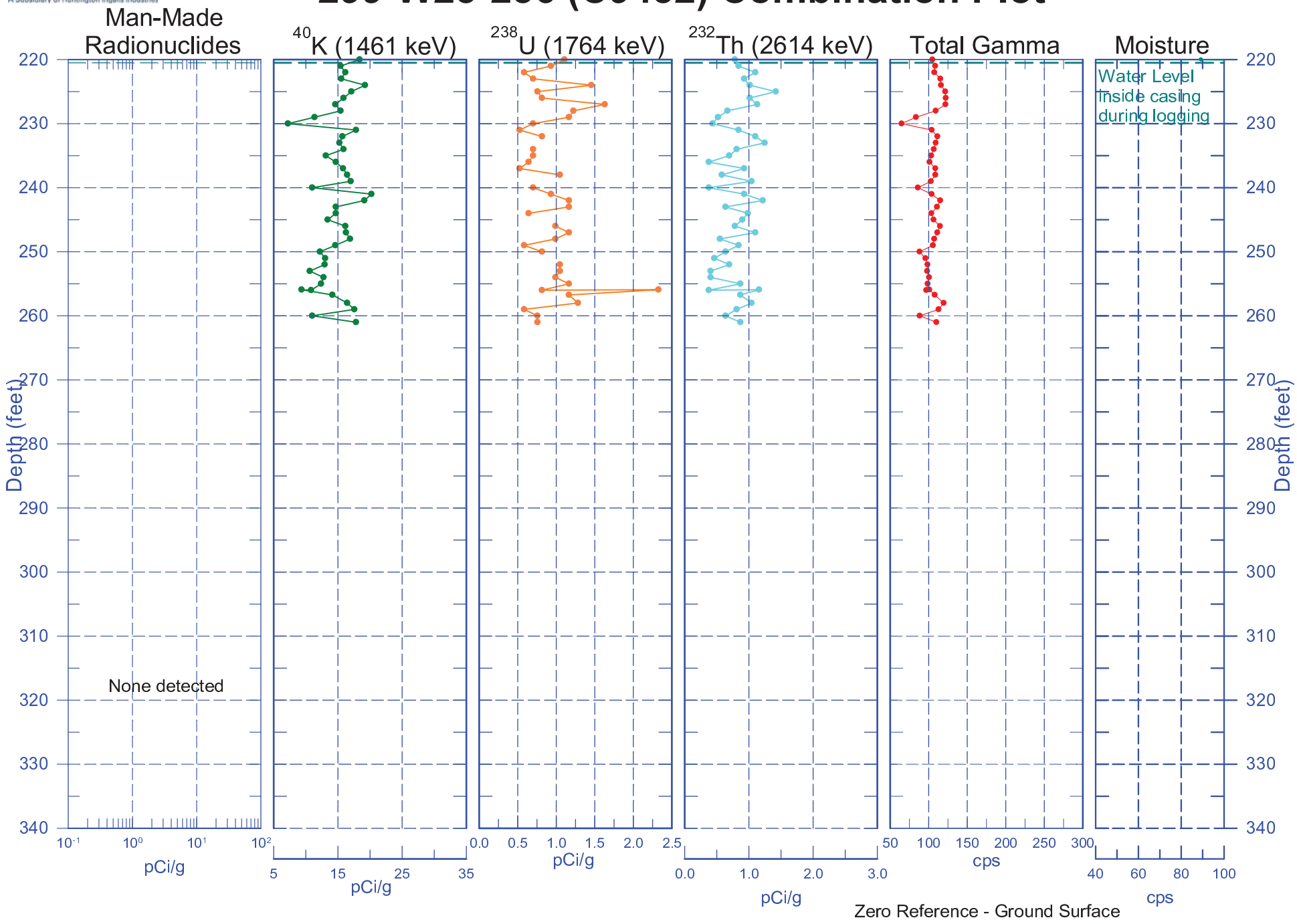
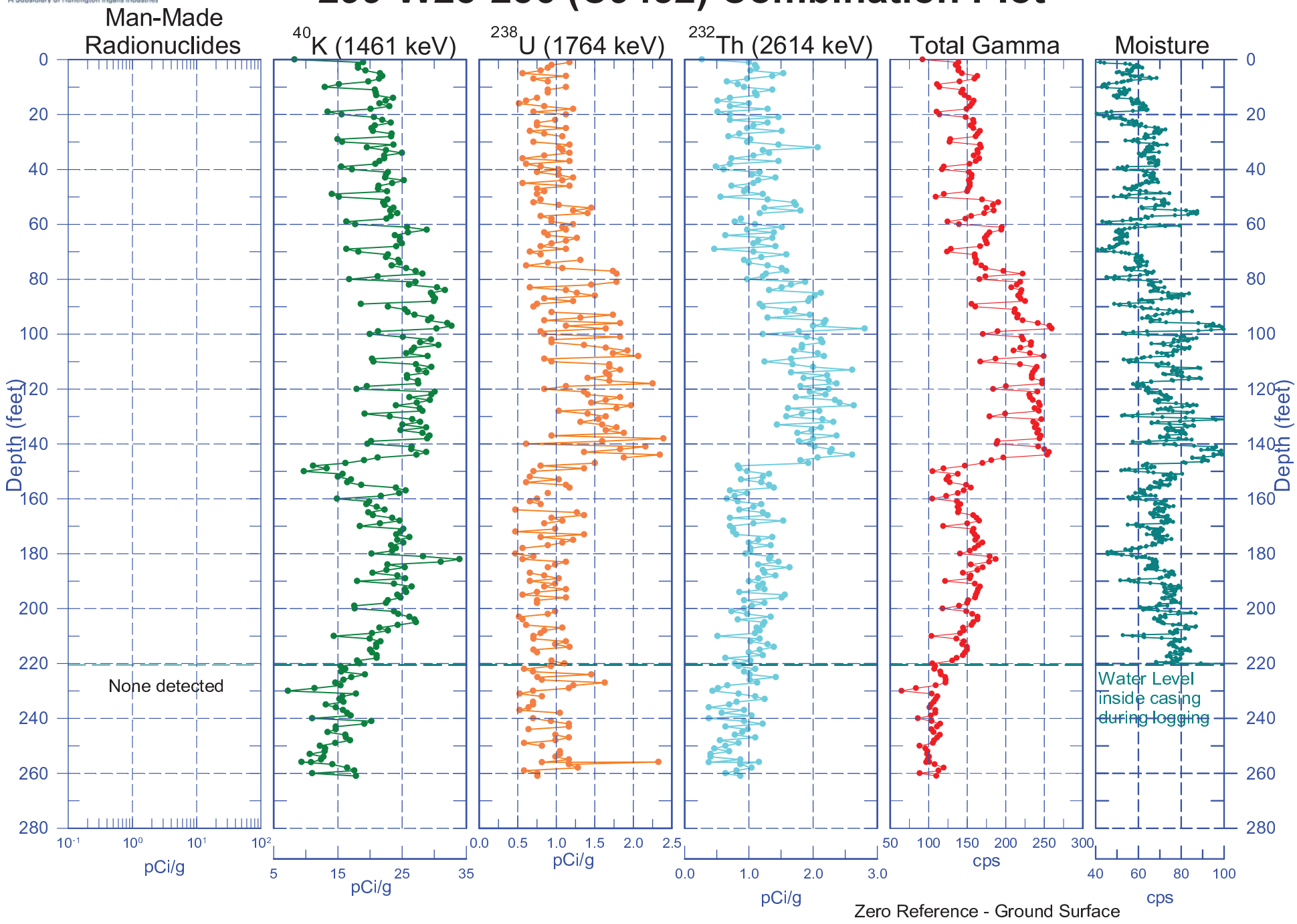
299-W23-236 (C9432) Combination Plot



Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-W23-236 (C9432) Combination Plot



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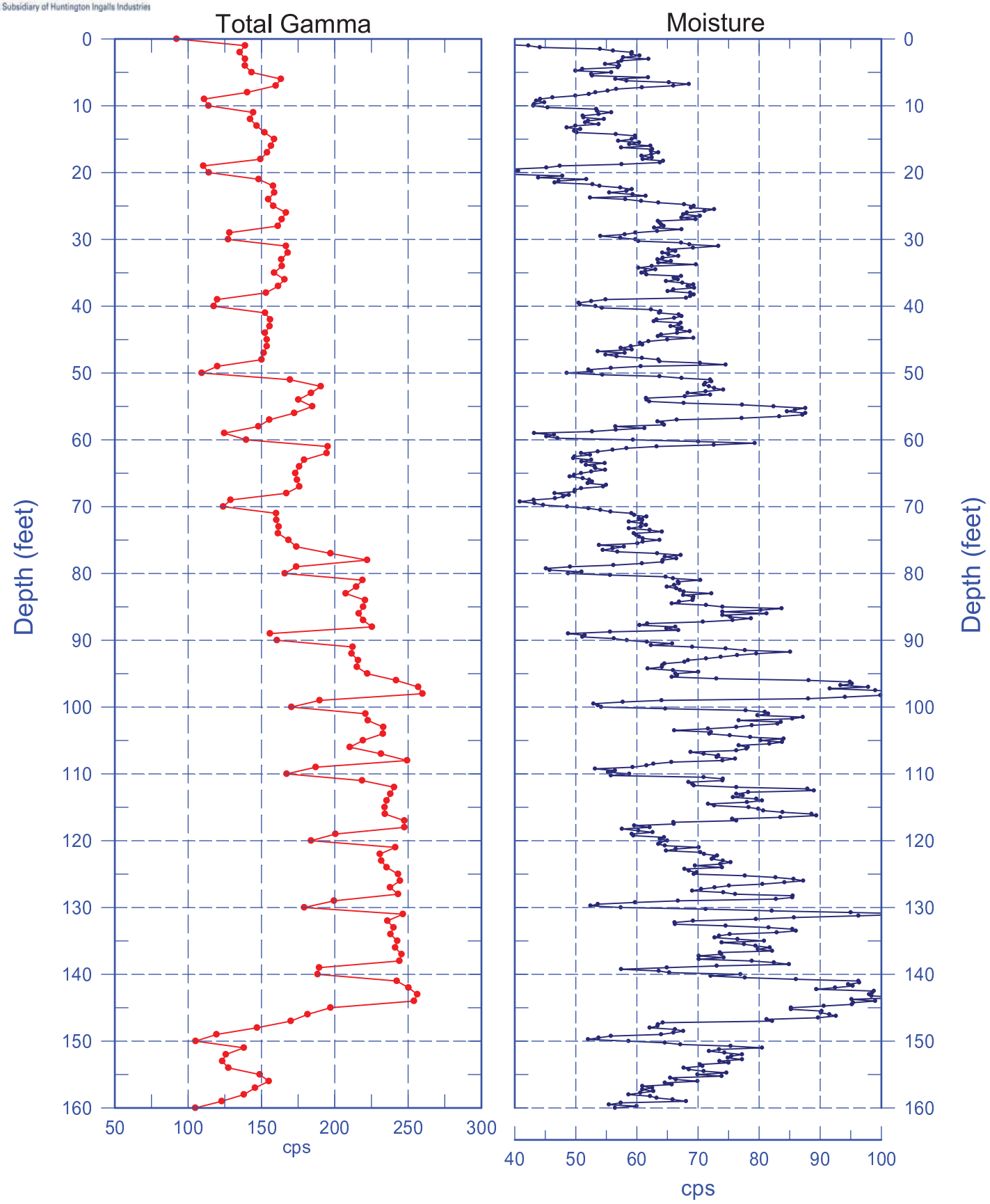
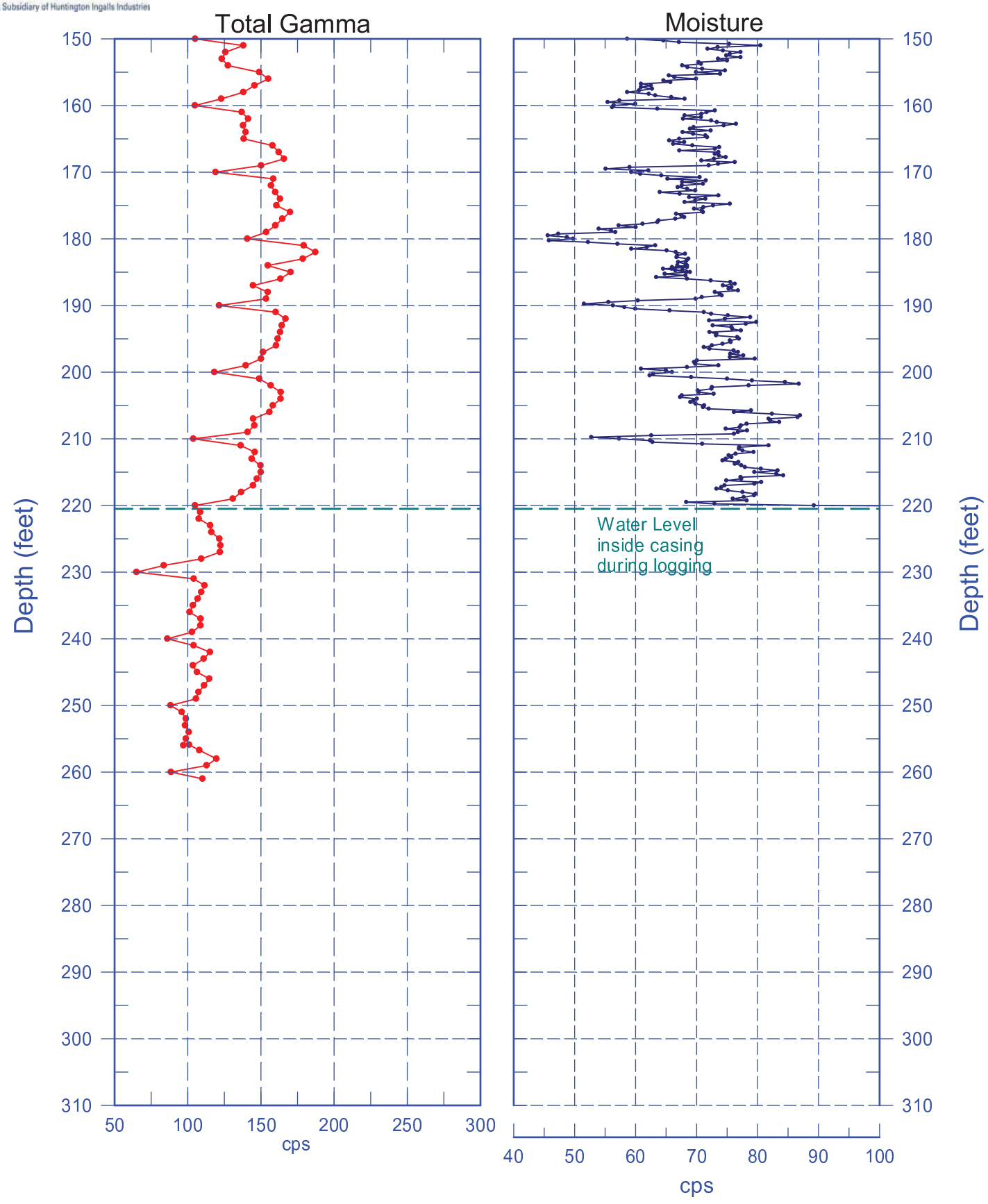
299-W23-236 (C9432)
Total Gamma & Moisture



Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-W23-236 (C9432)
Total Gamma & Moisture



Reference - Ground Surface

Stoller Newport News Nuclear
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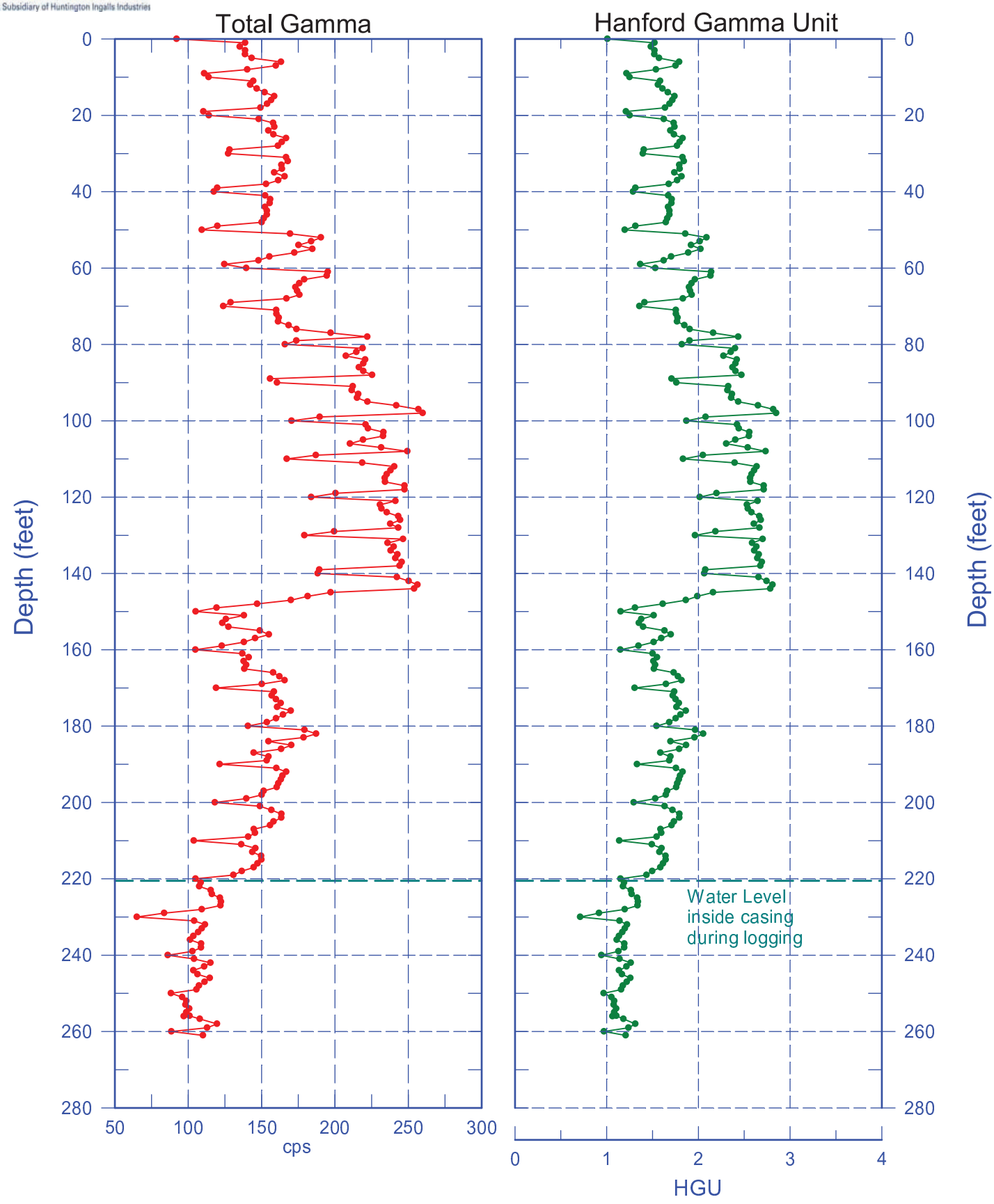
299-W23-236 (C9432)

Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

Stoller Newport News Nuclear
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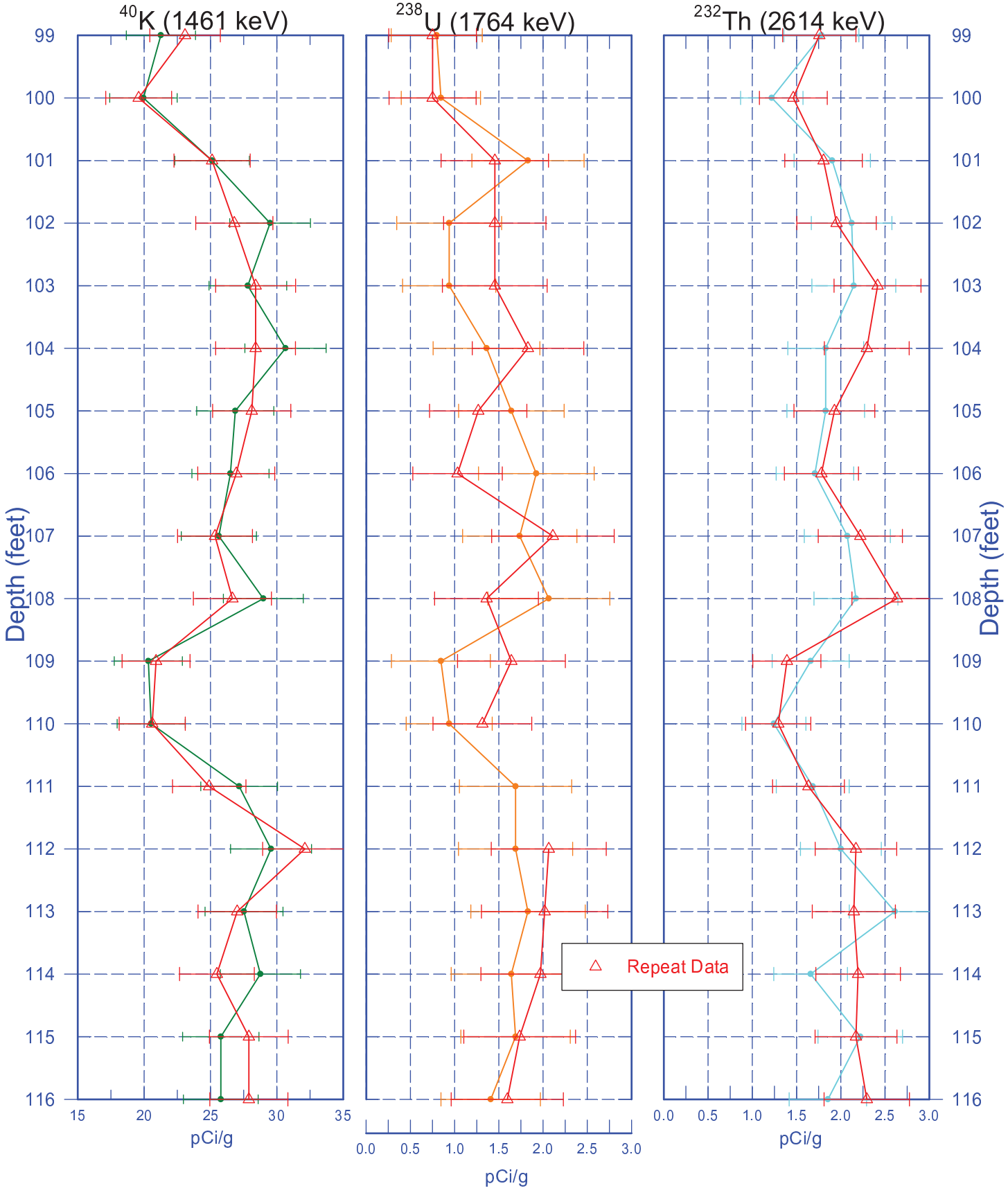
299-W23-236 (C9432)

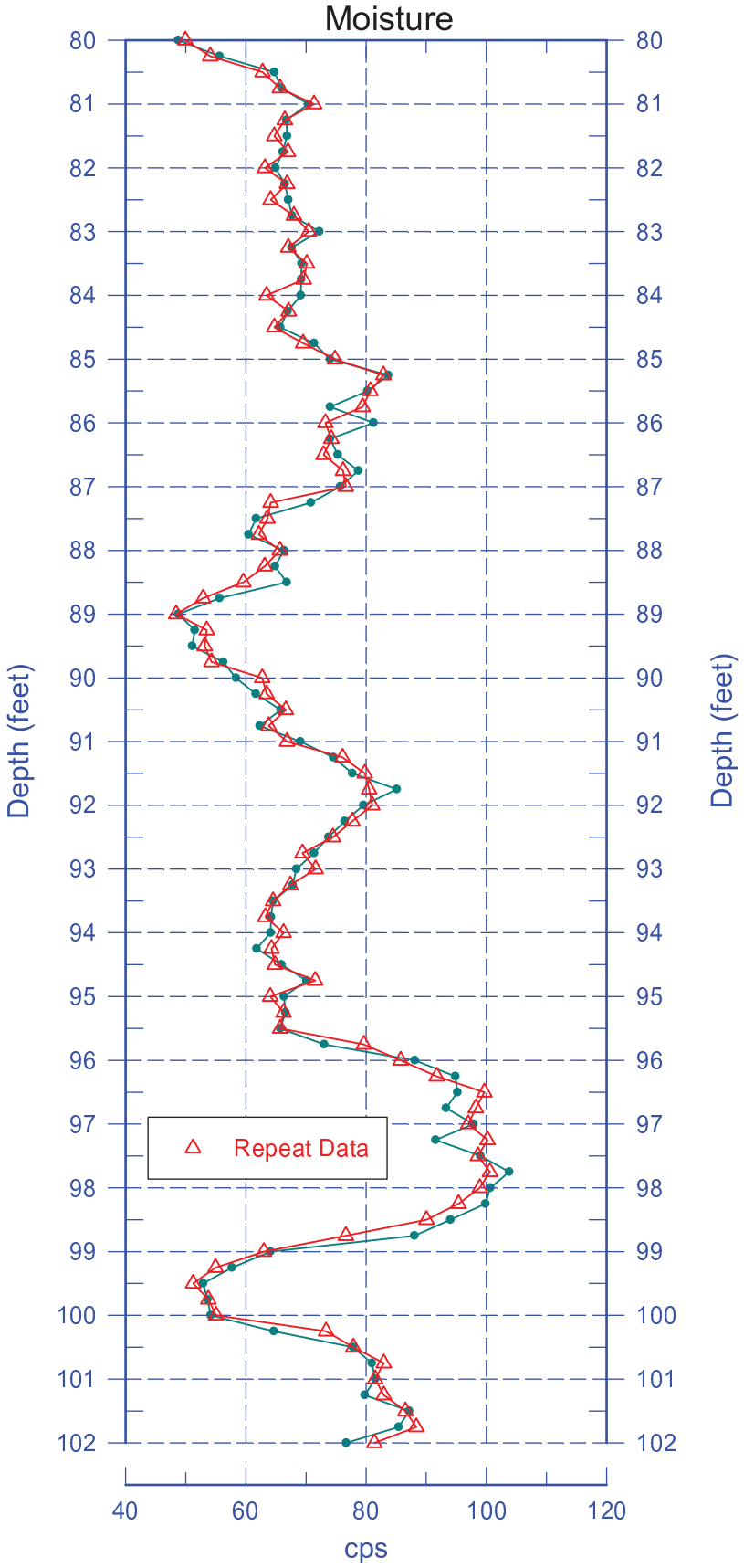
Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-W23-236 (C9432)
Moisture Repeat Section



Reference - Ground Surface

cm
C9432 5 ft

cm
C9432 10 ft

cm
C9432 15 ft

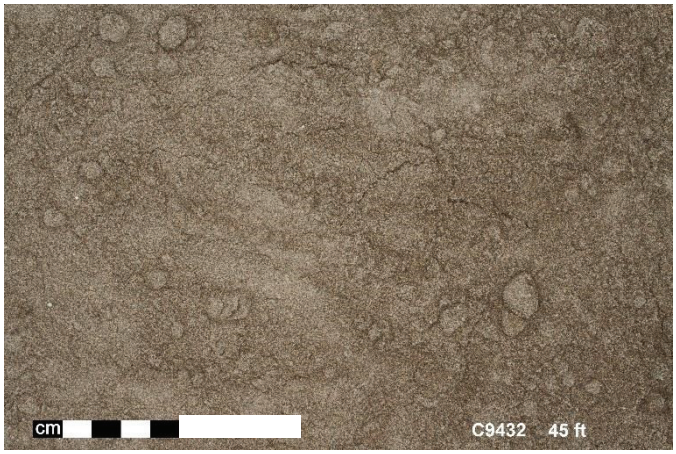
cm
C9432 20 ft

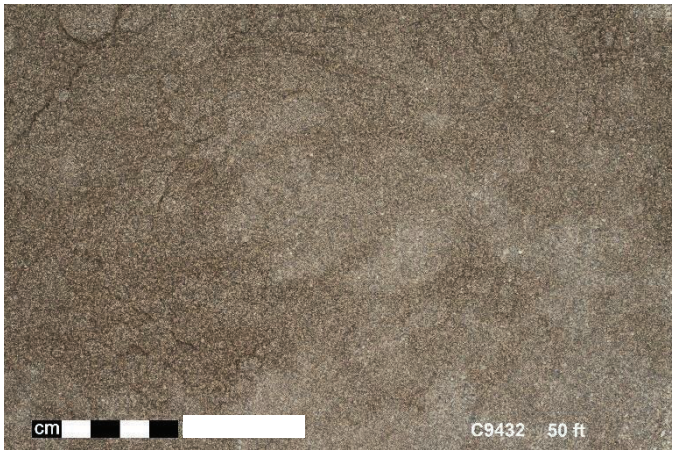
cm
C9432 25 ft

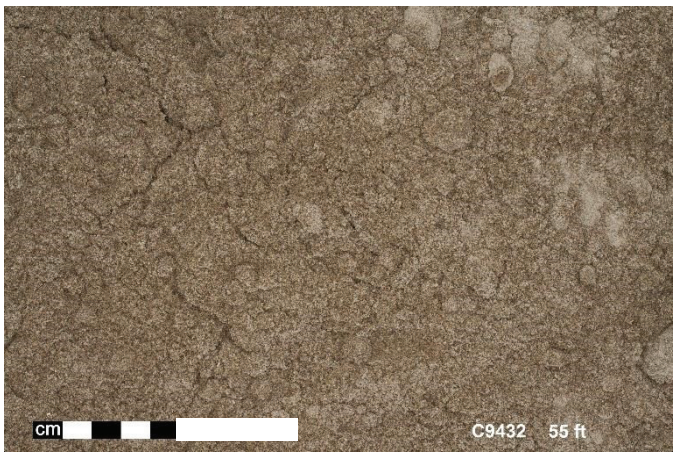
cm
C9432 30 ft

cm
C9432 35 ft

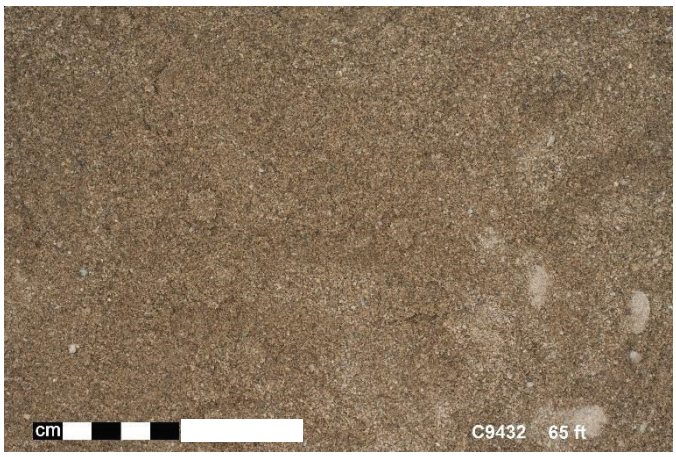
cm
C9432 40 ft


cm
C9432 45 ft

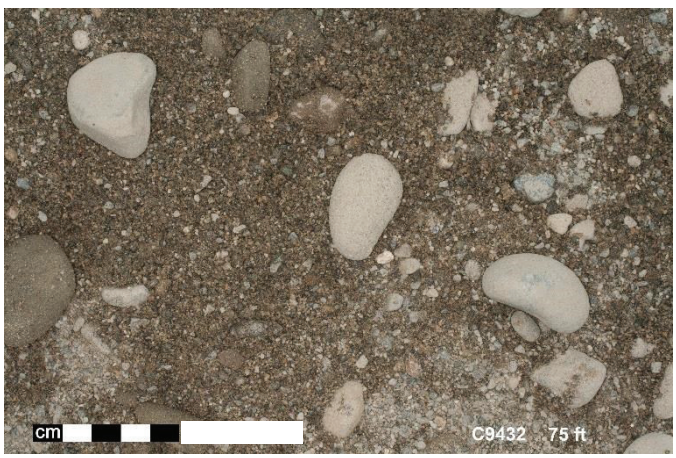

cm
C9432 50 ft


cm
C9432 55 ft

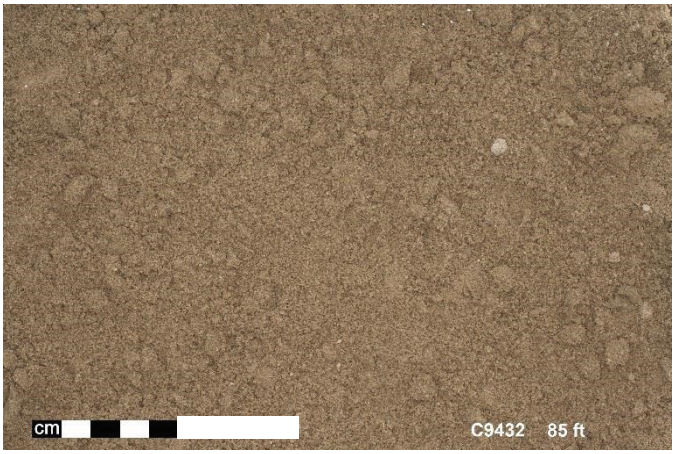
cm
C9432 60 ft

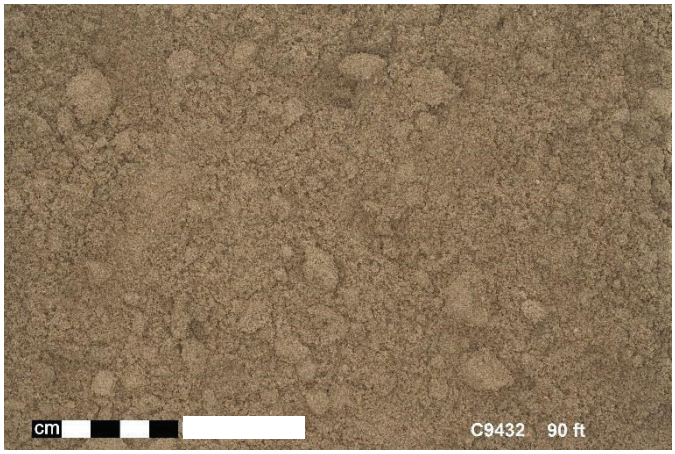

cm
C9432 65 ft

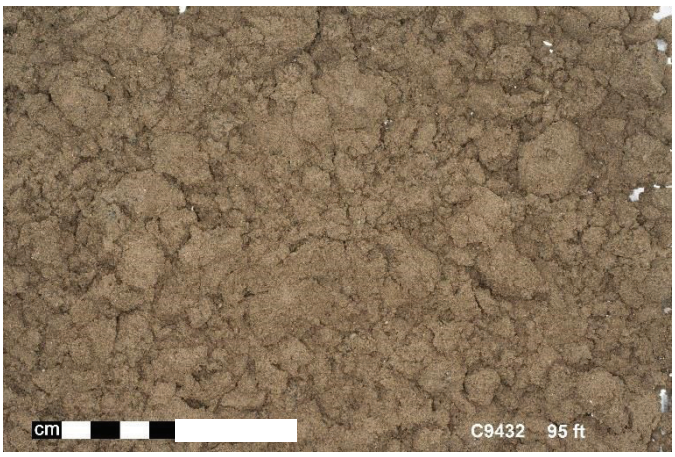
cm
C9432 70 ft

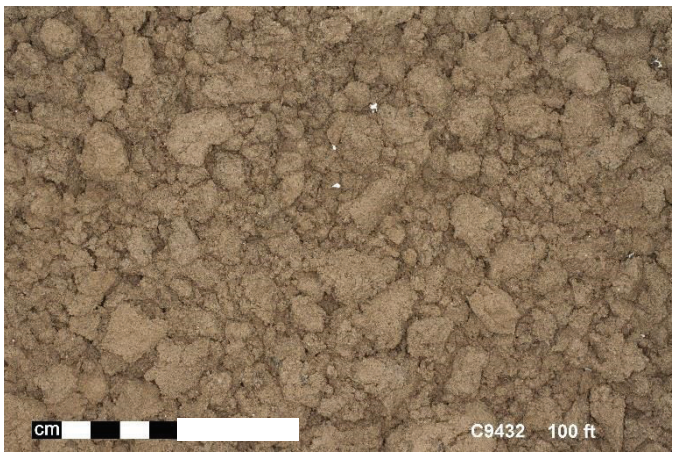

cm
C9432 75 ft

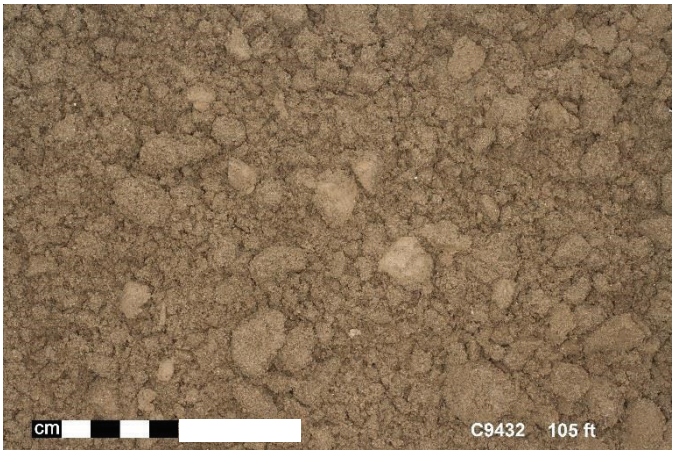
cm
C9432 80 ft


cm
C9432 85 ft


cm
C9432 90 ft


cm
C9432 95 ft


cm
C9432 100 ft

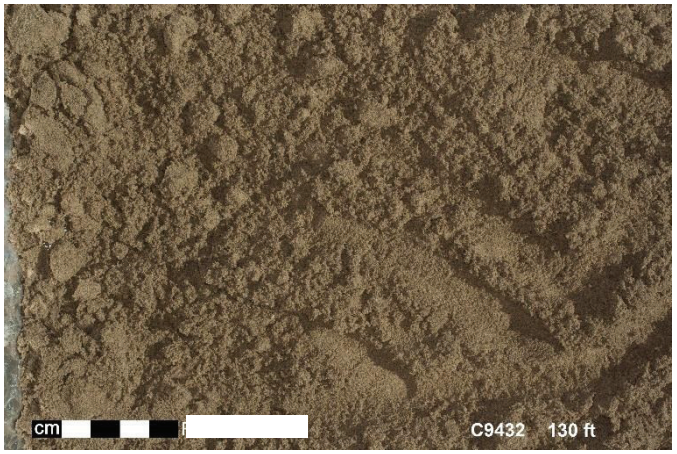

cm
C9432 105 ft

cm
C9432 110 ft

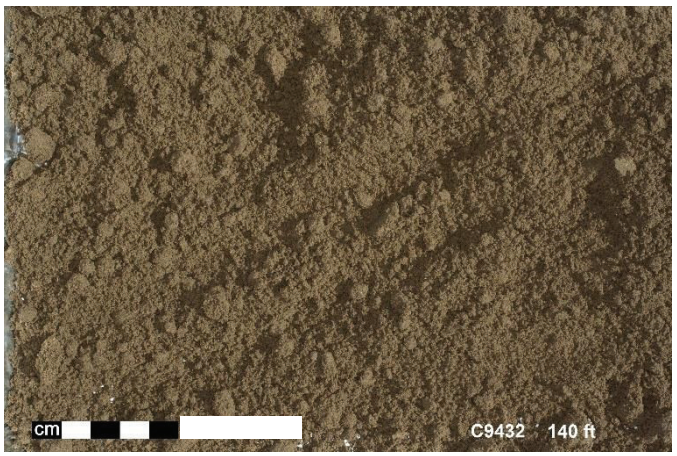
cm
C9432 115 ft

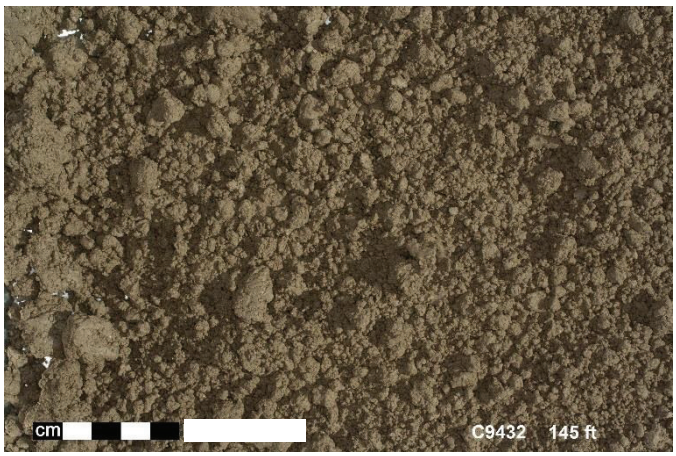
cm
C9432 120 ft

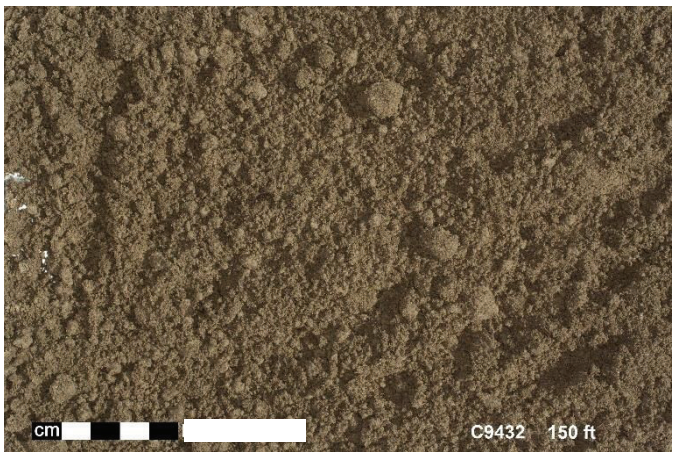
cm
C9432 125 ft


cm
C9432 130 ft

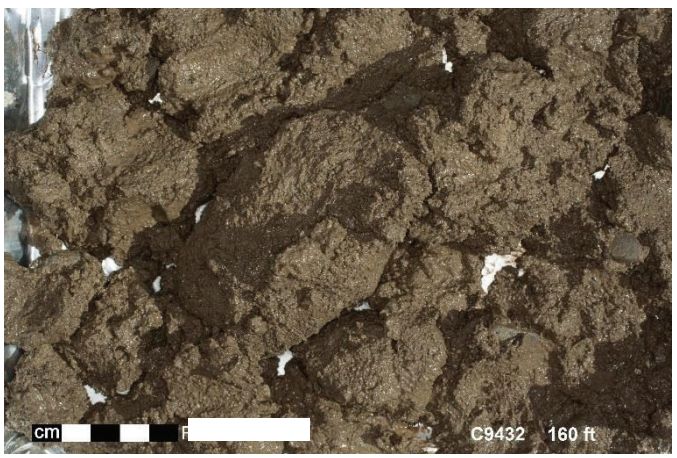
cm
C9432 135 ft


cm
C9432 140 ft


cm
C9432 145 ft

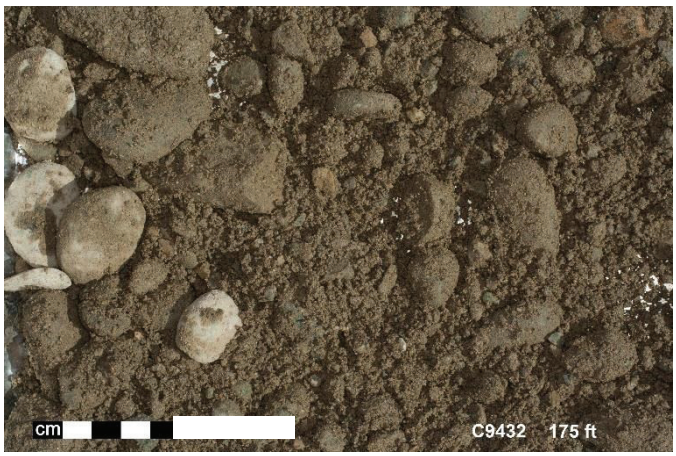

cm
C9432 150 ft

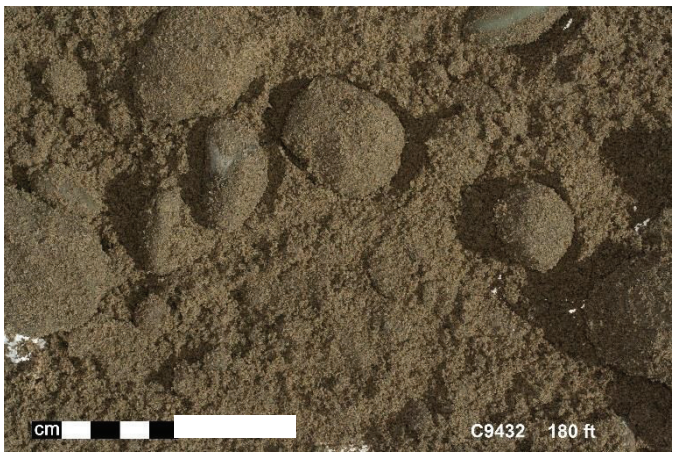
cm
C9432 155 ft


cm
C9432 160 ft

cm
C9432 165 ft

cm
C9432 170 ft

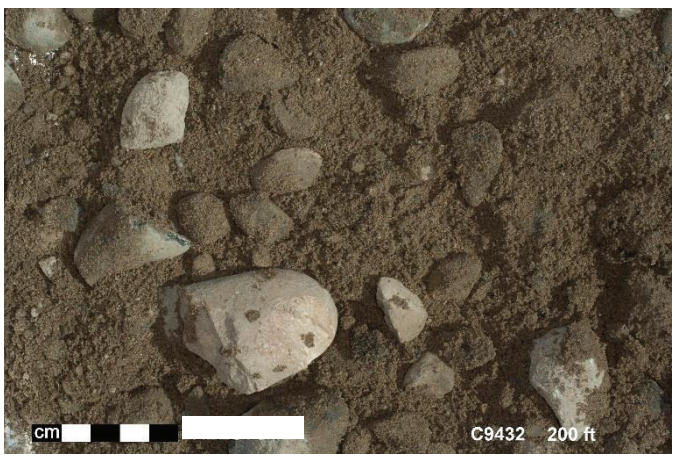

cm
C9432 175 ft


cm
C9432 180 ft

cm
C9432 185 ft

cm
C9432 190 ft

cm
C9432 195 ft


cm
C9432 200 ft

cm
C9432 205 ft

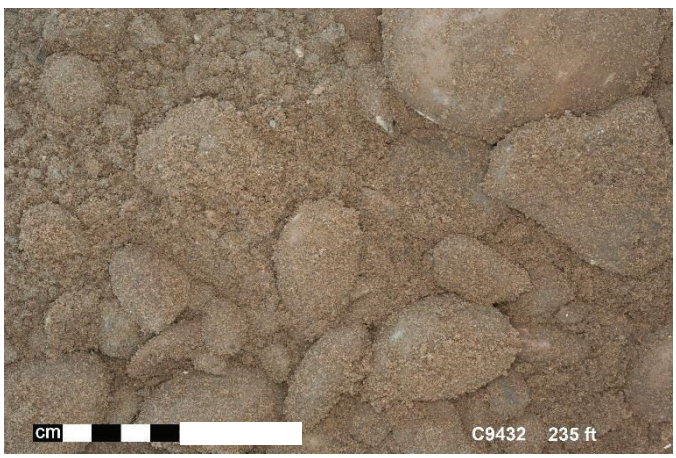
cm
C9432 210 ft

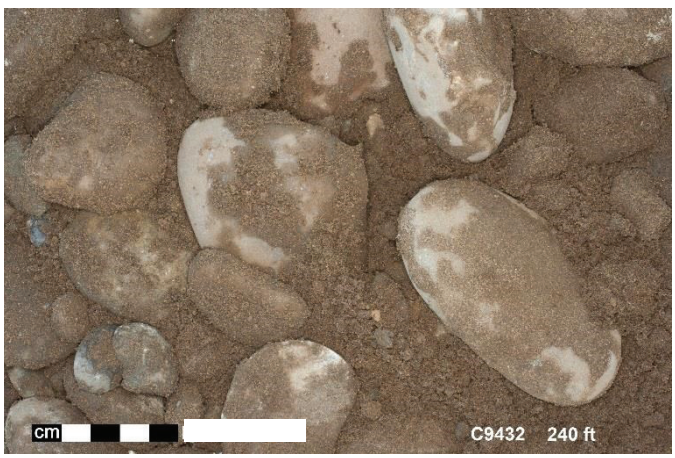
cm
C9432 215 ft

cm
C9432 220 ft

cm
C9432 225 ft

cm
C9432 230 ft


cm
C9432 235 ft


cm
C9432 240 ft

cm
C9432 245 ft

cm
C9432 250 ft

cm
C9432 255 ft

cm
C9432 260 ft

SURVEY DATA REPORT			Request No. 153-123
Project No.	Title: 200W M-24 Wells C8202 & C9432 Final Surveys		File No. 2WT12R25
Job. No. CACN: 303595-JPRC	Prepared By: N.P. Fastabend	Date: 6/3/15	Reviewer: LBM

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casings) and elevations of completed M-24 Wells C8202 (299-W22-93) and C9432 (299-W23-236) in 200W 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: 06/01/15	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 M-24 Well C9432 (299-W23-236) in 200W Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 200W

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
2W-72 (CHPRC) and 2W-73 (CHPRC)

Well ID	Well Name	Easting	Northing	Elevation	
C9432	299-W23-236	566798.66'	134128.15'		Center of Casing
				200.651'	"X" on Rim
				199.890'	Brass Survey Marker

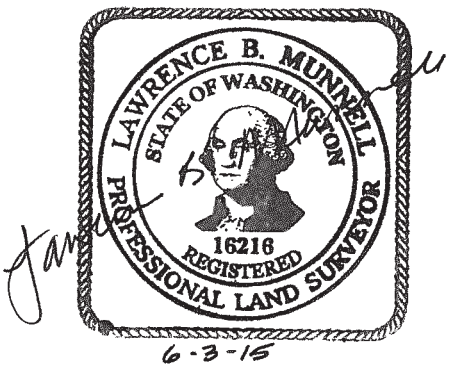
Notes:

200.347' 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.



6-3-15

A-6003-659 (04/03)

Appendix E

Well Documentation for C8913 (299-E26-15)

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

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WELL SUMMARY SHEET

Start Date: 5/19/2015
Finish Date: ~~6/12/2015~~ 6/16/15 ASG 7/16/15

Well ID: C8913
Well Name: 299-E26-15
Location: 20 m S of catch basin 242AL-43
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody
Date: 6/12/15
Reviewed By: J.D. MEHRER Environmental Scientist
Date: 7-22-15
Signature:
Signature:

CONSTRUCTION DATA

Concrete Pad: 0.5 ft above ground surface (ags)

6-in Protective Casing: 3.1 ft ags - 1.9 ft below ground surface (bgs)

Type I/II Portland Cement Grout: 0 - 9.6 ft bgs

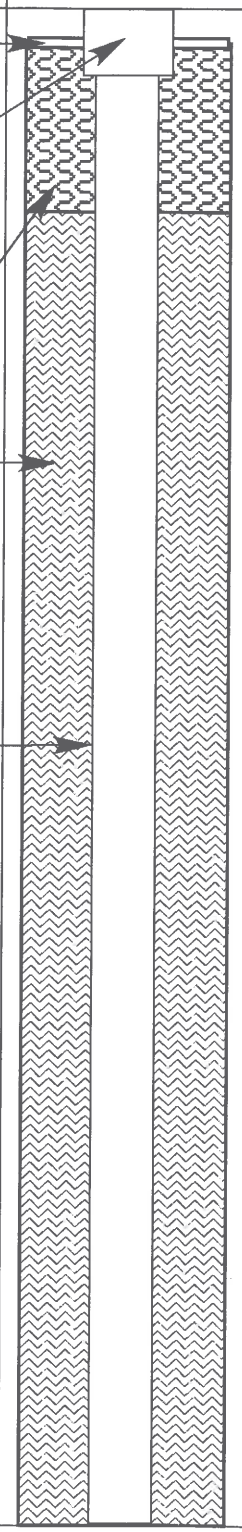
Cetco Bentonite Crumbles: 9.6 - 186.6 ft bgs

4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.00 ft ags - 191.08 ft bgs

Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 206.2 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 - 20 Gravel (G)
10		
20		20 - 30 Sandy Gravel (sG)
30		30 - 35 Silty Sand (mS)
		35 - 40 Sandy Gravel (sG)
40		40 - 60 Gravelly Sand (gS)
50		
60		60 - 70 Gravel (G)
70		70 - 75 Sandy Gravel (sG)
		75 - 85 Gravel (G)
80		
		85 - 95 Sandy Gravel (sG)

A-6003-643 (REV 1)

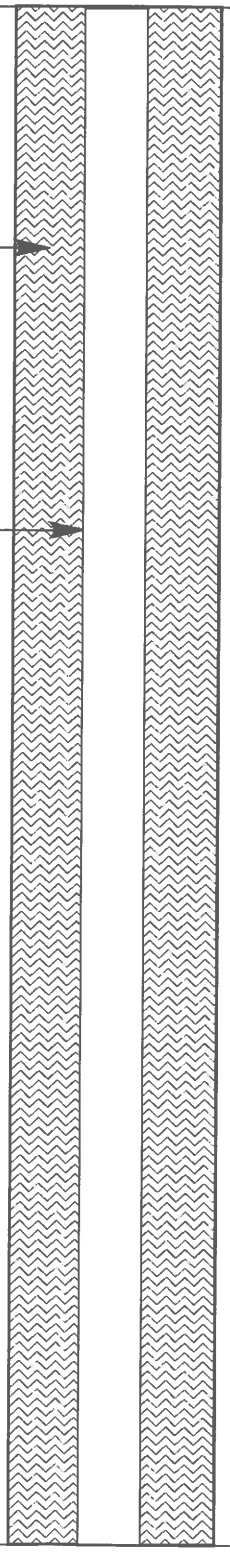
WELL SUMMARY SHEET

Start Date: 5/19/2015
Finish Date: ~~6/12/2015~~ 6/16/15 AIG 7/16/15

Well ID: C8913
Well Name: 299-E26-15
Location: 20 m S of catch basin 242AL-43
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 6/12/15
Reviewed By: D. MEHRER Date: 7-22-15
Signature:
Signature:

CONSTRUCTION DATA

Description	Diagram
Cetco Bentonite Crumbles: 9.6 - 186.6 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.00 ft ags - 191.08 ft bgs	
Depths are in ft below ground surface. Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 206.2 ft bgs. All temporary drill casing was removed from the ground.	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
90		85 - 95 Sandy Gravel (sG)
		95 - 190 Gravel (G)
100		
110		
120		
130		
140		
150		
160		
170		

A-6003-643 (REV 1)

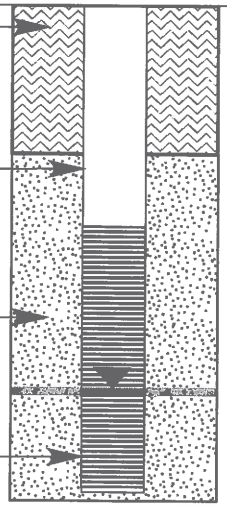
WELL SUMMARY SHEET

Start Date: 5/19/2015
Finish Date: ~~6/12/2015~~ 6/16/15 AEG 7/16/15

Well ID: C8913
Well Name: 299-E26-15
Location: 20 m S of catch basin 242AL-43
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 6/12/15
Reviewed By: J.D. MEHRER Date: 7-22-15
Signature:
Signature:

CONSTRUCTION DATA

Description	Diagram
Cetco Bentonite Crumbles: 9.6 - 186.6 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.00 ft ags - 191.08 ft bgs	
10-20 mesh Premier Colorado Silica Filter Pack Sand: 186.6 - 206.9 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, 30-slot (0.030 in.) Stainless Steel Screen: 191.08 - 206.43 ft bgs	



Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 206.2 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
180		95 - 190 Gravel (G)
190		190 - 208 Sandy Gravel (sG)
200		Static Water Level: 200.4 ft bgs (05/20/15)
		Total Depth: 206.9 ft bgs (05/20/15)
210		
220		
230		
240		
250		
260		

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 6
Date: 5/19/15

Well ID: C8913 | Well Name: 299-E26-15 | Location: 20m South of Catch Basin 242AL-43
Project: 8 M24 TPA GW Monitoring Well | 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'-20' Gravel (G) 90% Gravel, 10% Sand. Gravel: F-VC, max= 50mm, rounded to angular, 80% VC, 20% F, 60% Mafic, poorly sorted. Sand: VF-C, angular, 70% C, 30% VF, 80% mafic, poorly sorted. 2.5yr 5/2, Grayish brown, No rxn to HCl. Moist.	• Drilling: AP1000 Becker Hammer. • Grab samples every 5'. • 8 3/8" OD temp casing used. • 0'-10' bgs, no grab samples due to possible contamination. • Drillers adding water (~2gal/5ft) for dust suppresion.
5					
10					
15	G				
20	G			20'-30' Sandy Gravel (sG) 50% Gravel, 50% Sand. Gravel: MP-VCP, max= 50mm, Subrounded to angular, 80% mafic, poorly sorted. Sand: VFS-VCS, angular, 80% mafic, poorly sorted. 2.5yr 4/1, dark Grey, No rxn to HCl @ 25' bgs ↓ gravel size	
25	G				
30	G			Slightly Silty Gravelly Sand ((m) g S) 30'-35' ~~Silty Sand (vg S)~~ 20% Gravel, 65% Sand, 15% Silt. Gravel: VFP-FP, max=7mm Very angular, 60% mafic, well sorted. Sand: F-VFS, well sorted, 90% mafic. 2.5yr 4/1, dark Grey no rxn to HCL. Moist	
35	G			35'-40' Sandy Gravel (sG) 50% Gravel, 50% Sand. Gravel: FP-VCP, angular, 60% mafic, poorly sorted Sand: VFS-VCS, angular, 60% mafic, poorly sorted 2.5yr 4/1, dark Grey, no rxn to HCL. Moist	

Reported By: Cameron Penner-Ash | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: [signature] | Date: 5/19/15 | Signature: [signature] | Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 6
Date: 5-19-15

Well ID: C8913 | Well Name: 299-E26-15 | Location: 20m South of Catch Basin 242AL-43
Project: 8 M24 TPA GWA Monitoring Well | 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'-60' Gravelly Sand (gS) 20% Gravel, 80% Sand. Gravel: FP-VFP, angular, 50% mafic, well sorted. Sand: FS-CS, angular, 50% mafic, well sorted. 2.5yr 4/1, dark gray, no rxn to HCL. Moist	• Drilling: AP1000 Becker Hammer • Grab samples every 5'. • 9 7/8" OD Temp. Casing used. • 0'-10' bgs, no grab samples collected due to possible contamination. • Drillers adding water (~2gal / 5ft) for dust supression.
45	G			@ 45' bgs ↑ Gravel: FP-MP	
50	G				
55	G			@ 55' bgs ↑ >120 mm Cobbles	
60	G			60'-70' Gravel (G) 90% Gravel, 10% Sand. Gravel: MP-VCP, Subrounded, max: 70mm, moderate sorting, 80% mafic. Sand: VFS-CS, angular, poorly sorted, 70% mafic. 2.5yr 3/1, Very dark gray. No rxn to HCL. Moist.	
65	G			@ 65' bgs ↑ Trace silt	
70	G			70'-75' Sandy Gravel (sG) 70% Gravel, 30% Sand, Trace silt. Gravel: FP-MP, max: 70 mm, 80% mafic, angular. Sand: FS-CS, 70% mafic, angular, poorly sorted. 2.5yr 4/2, dark grey brown. NO rxn HCL. Moist.	
75	G				

Reported By: Cameron Penner-Ash | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: [signature] Date: 5/19/15 | Signature: [signature] Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 6
Date: 5/19/15

Well ID: C8913 | Well Name: 299-E26-15 | Location: 20m South of Catch Basin 242AL-43

Project: 8 M24 TPAGW Monitoring Well | 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			75'-85' Gravel (G) 80% Gravel, 15% Sand 5% silt. Gravel: VCP-VFP, cobbles/VCP = well rounded, VFP = angular, max: 75mm, 80% mafic. Sand: FS-CS, 70% mafic, poorly sorted. 2.5yr 4/2, dark grey brownish. No rxn to HCL. Moist.	• Drilling: AP1000 Beeker Hammer • Grab samples every 5'. • 9 5/8" OD Temp. casing used. • 0'-10' bgs, no grab samples collected due to possible contamination. • Drillers adding water (~2gal / 5ft) for dust supression.
85	G			85'-95' Sandy Gravel (sG) 70% Gravel, 30% Sand. Gravel: MP-VCP, max: 70mm, 90% mafic, subrounded, Sand: CS-VCS, well sorted, angular, 70% mafic. 2.5yr 4/1, dark grey. No rxn to HCL. Moist.	
90	G				
95	G			@ 95' bgs ↑ Trace silt 95'-190' Gravel (G) 80% Gravel, 20% Sand. Gravel: CP-FP, max: 20mm, 80% mafic, angular, poorly sorted. Sand: CS, well sorted, angular, 80% mafic. 2.5yr 3/1, very dark grey, no rxn to HCL. Moist.	
100	G				
105	G			@ 105' bgs Max clast ↑ 65mm	
110	G				
115	G				

Reported By: Cameron Penner-Ash | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: [signature] Date: 5/19/15 | Signature: [signature] Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 4 of 6
Date: 5/19/15

Well ID: C8913 | Well Name: 299-E26-15 | Location: 20m South of Catch Basin 242AL-43
Project: 8 M24 TPA GW Monitoring Wells | Reference Measuring Point: ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120	G			95'-190' Gravel (G) 80% Gravel, 20% Sand. Gravel: CP-FP, max: 20mm, 80% mafic, angular, poorly sorted. Sand: CS, well sorted, angular, 80% mafic. 2.5 yr 3/1, very dark gray. No rxn to HCl. Moist. @ 125' bgs max: 80mm	• Drilling: AP1000 Becker Hammer • Grab samples every 5'. • 9 7/8" OD Temp casing used. • 0'-10' bgs, no grab samples due to possible contamination • Drillers adding water (~2 gal/5ft) for dust suppression.
125	G				
130	G				
135	G				
140	G			@ 140' bgs max: 200mm	
145	G			@ 145' bgs ↑ Silt to trace	
150	G				
155	G				

Reported By: Cameron Penner-Ash | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: [signature] Date: 5/19/15 | Signature: [signature] Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 5 of 6
Date: 5/14/15

Well ID: C8913 | Well Name: 299-E26-15 | Location: 20m South of Catch Basin 241AL-43

Project: 8 TPA M24 GW Monitoring Wells | 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
160	6			95'-190' Gravel (G) 80% Gravel, 20% Sand. Gravel: CP-FP, max: 20mm, 80% mafic, angular, poorly sorted. Sand: CS, well sorted, angular, 80% mafic. 2.5yr 3/1, very dark gray. no rxn to HCL, moist.	• Drilling: AP1000 Becur Hammer. • Grab samples every 5'. • 9 7/8" OD Temp casing used. • 0'-10' bgs, no grab samples due to possible contamination. • Drillers adding water (~2 gal / 5 ft) for dust suppresion.
165	6				
170	6				
175	6			@ 175' bgs Pebbles become more rounded.	
180	6			@ 180' bgs Color change: 5yr 3/1, dark olive gray.	
185	6			@ 185' bgs Color change: 2.5yr 4/3, Olive brown.	
190	6			190'-208' Sandy Gravel (sG) 60% Gravel 40% Sand. Gravel: FP-CP, max: 30mm, 90% mafic, angular, poorly sorted. Sand: CS, well sorted, angular, 90% mafic. 5yr 3/2, dark olive gray. No rxn to HCl, Moist.	206.9' bgs Reached DTB @ ~~199.1~~ bgs on 5/20/15 Shoe @ ~~199.1~~ bgs 206.2' bgs
200	6	▼ 200.4 5/20/15		@ 200' bgs max: 200 mm Cobble	DTW encountered @ 200.4' bgs on 5/20/15

Reported By: Cameron Penner-Ash | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: [signature] Date: 5/14/15 | Signature: [signature] Date: 7/22/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 6 of 6
Date: 5/15/15

Well ID: C8913 | Well Name: 299-E26-15 | Location: 20 m South of Catch Basin 242AL-43

Project: 8 M24 TPA GW Monitoring Wells | 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
205	6			190'-~~206.9~~ 208' Sandy Gravel (sG) 60% Gravel 40% Sand. Gravel: FP-CP, max: 200mm, 90% mafic, angular, poorly sorted. Sand: CS, well-sorted, angular, 90% mafic. 5yr 3/2, dark olive grag. Nor xn to HCl, moist.	• Drilling: AP1000 Becker Hammer • Grab samples every 5'. • 9"&10 Temp. Casing used. • 0'-10' bgs, no grab samples due to possible contamination. • Drillers adding water (~2gal / 5ft) for dust suppression. - unable to collect archive of basalt; drill rig could not return a sufficient amount of basalt cuttings
210				206.9 - basalt encountered Total Depth: 206.9' bgs 5/20/15 Depth to water: 200.4' bgs 5/20/15	

Reported By: Cameron Penner-Ash | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: [signature] Date: 5/19/15 | Signature: [signature] Date: 7/22/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

299-E26-15 (C8913)
Log Data Report

Borehole Information:

Log Date:	2015-05-27	Filename:	C8913_HG-NM_2015-05-27	Site:	South of LERF
Coordinates (WA St Plane)		DTW[1] (ft) :	200.35	DTW Date:	05/21/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	05/20/15	N/A	207	Becker

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Threaded Steel	0.4	6 3/8	6	3/16	0.4	207
Threaded Steel	0.0	9	7 1/4	7/8	0.0	207

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. Water inside the casing was measured at 200.35 ft by the logging engineer with an e-tape. The maximum logging depth achieved was 207 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	5 Repeat		
HEIS Number	1018719	1018720	1018721		
Date	05/26/15	05/27/15	05/27/15		
Logging Engineer	Spatz	Spatz	Spatz		
Start Depth (ft)	0.0	189.0	183.0		
Finish Depth (ft)	190.0	207.0	204.0		
Count Time (sec)	100	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	3	4	5 Repeat		
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	AL256CAB	AL257CAB	AL257CAB		
Start File	AL256000	AL257000	AL257019		
Finish File	AL256190	AL257018	AL257040		
Post-Verification	AL256CAA	AL257CAA	AL257CAA		
Depth Return Error (in.)	2.5 low	N/A	0.5 low		
Comments	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	1018722	1018723			
Date	05/21/15	05/21/15			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	0.0	20.0			
Finish Depth (ft)	200.5	41.0			
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	AH210CAB	AH210CAB			
Start File	AH210000	AH210803			
Finish File	AH210802	AH210887			
Post-Verification	AH210CAA	AH210CAA			
Depth Return Error (in.)	1.0 low	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:	06/12/15	Reference:	HGLP-MAN-003, Rev. 0

A casing correction for a 1.0625-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 200 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 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 5 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:

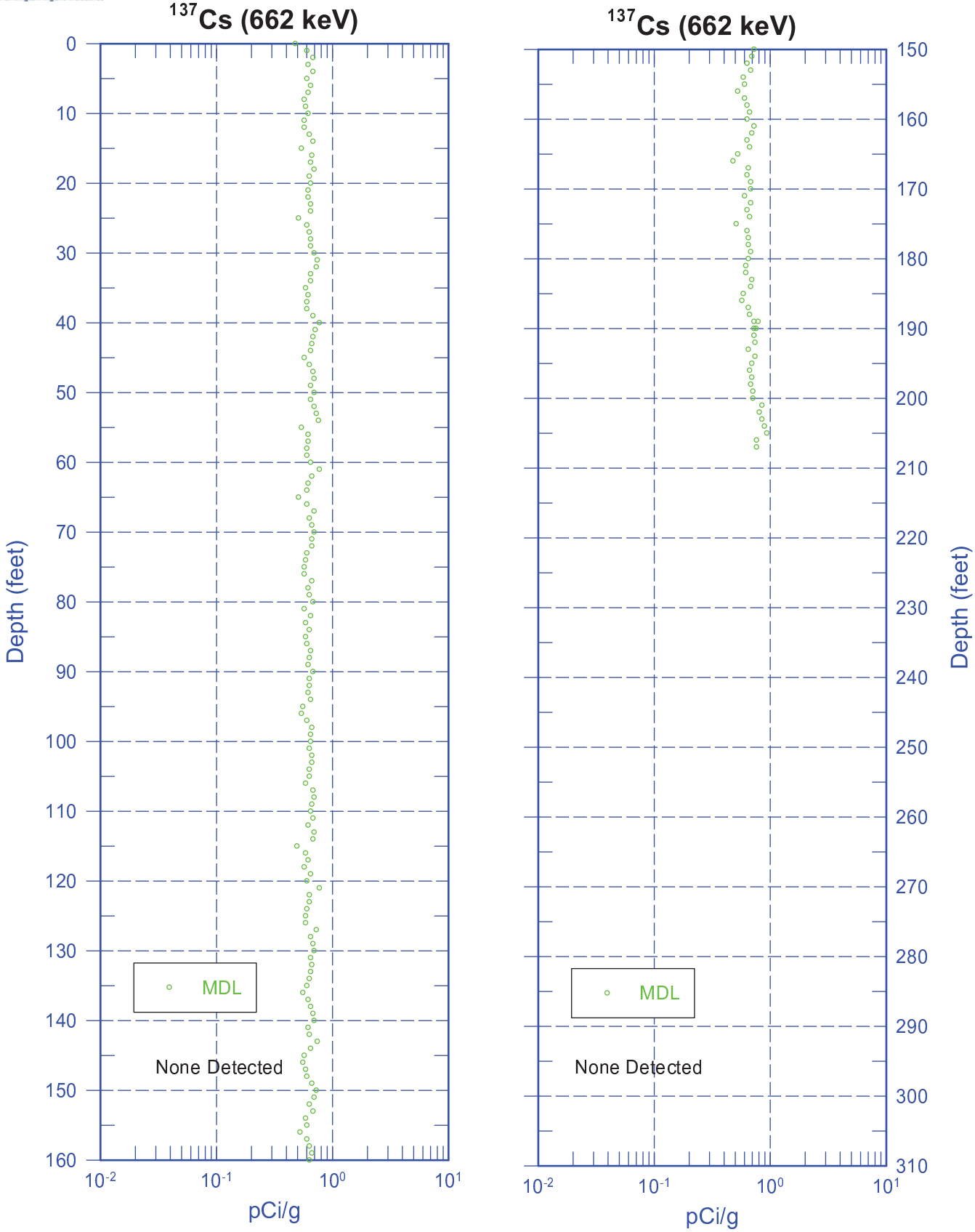
Depth Reference is ground surface.

Manmade Radionuclides (0-310 ft)
Natural Gamma Logs (0-160 ft)
Natural Gamma Logs (150-310 ft)
Combination Plot (0-120 ft)
Combination Plot (110-230 ft)
Combination Plot (0-220 ft)
Total Gamma & Moisture (0-220 ft)
Total Gamma & Hanford Gamma Unit (0-220 ft)
Repeat Section of Natural Gamma Logs (183 to 204 ft)
Moisture Repeat Section (20 to 41 ft)

[5] Hanford Gamma Unit

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

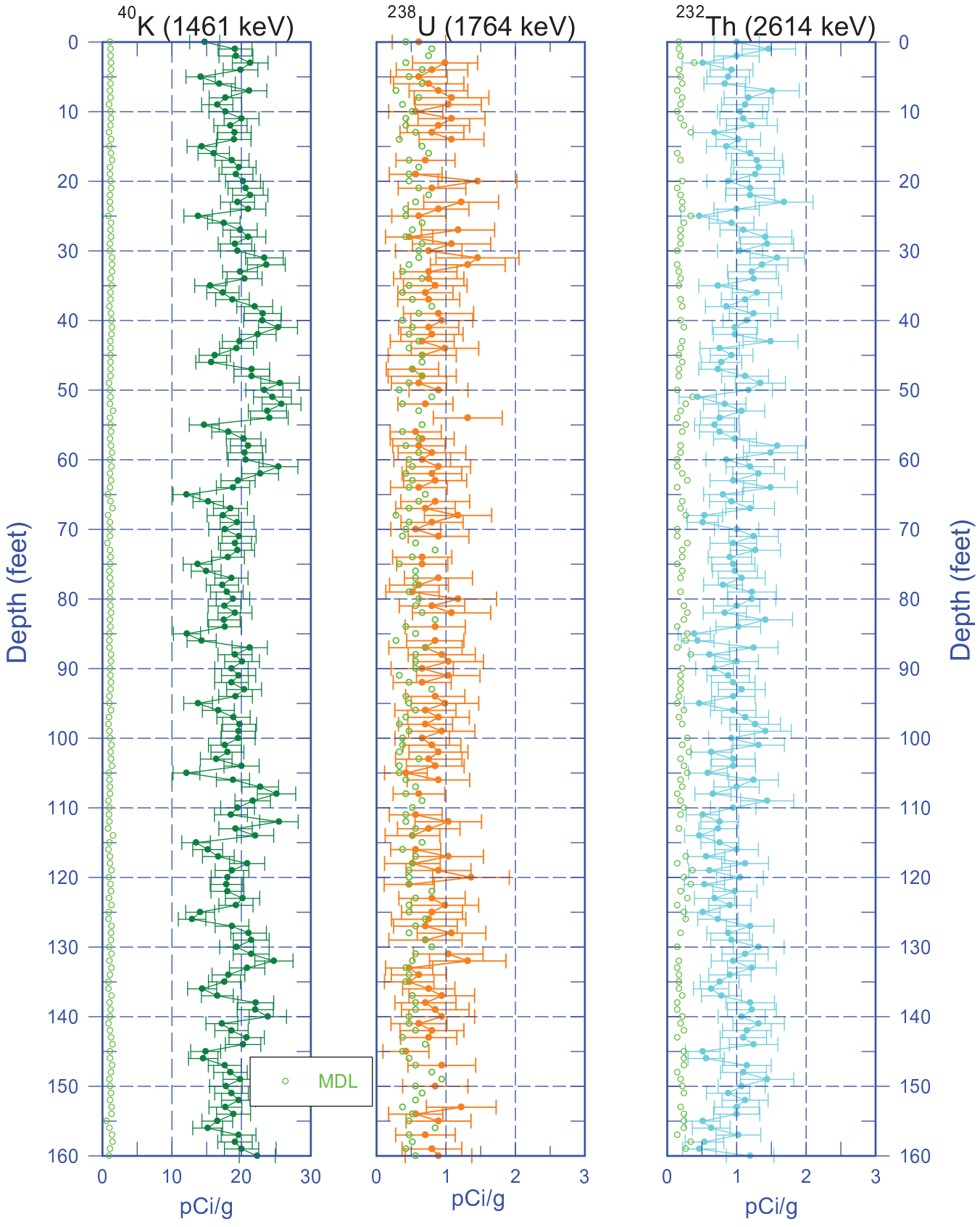
299-E26-15 (C8913)
Manmade Radionuclides



Zero Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

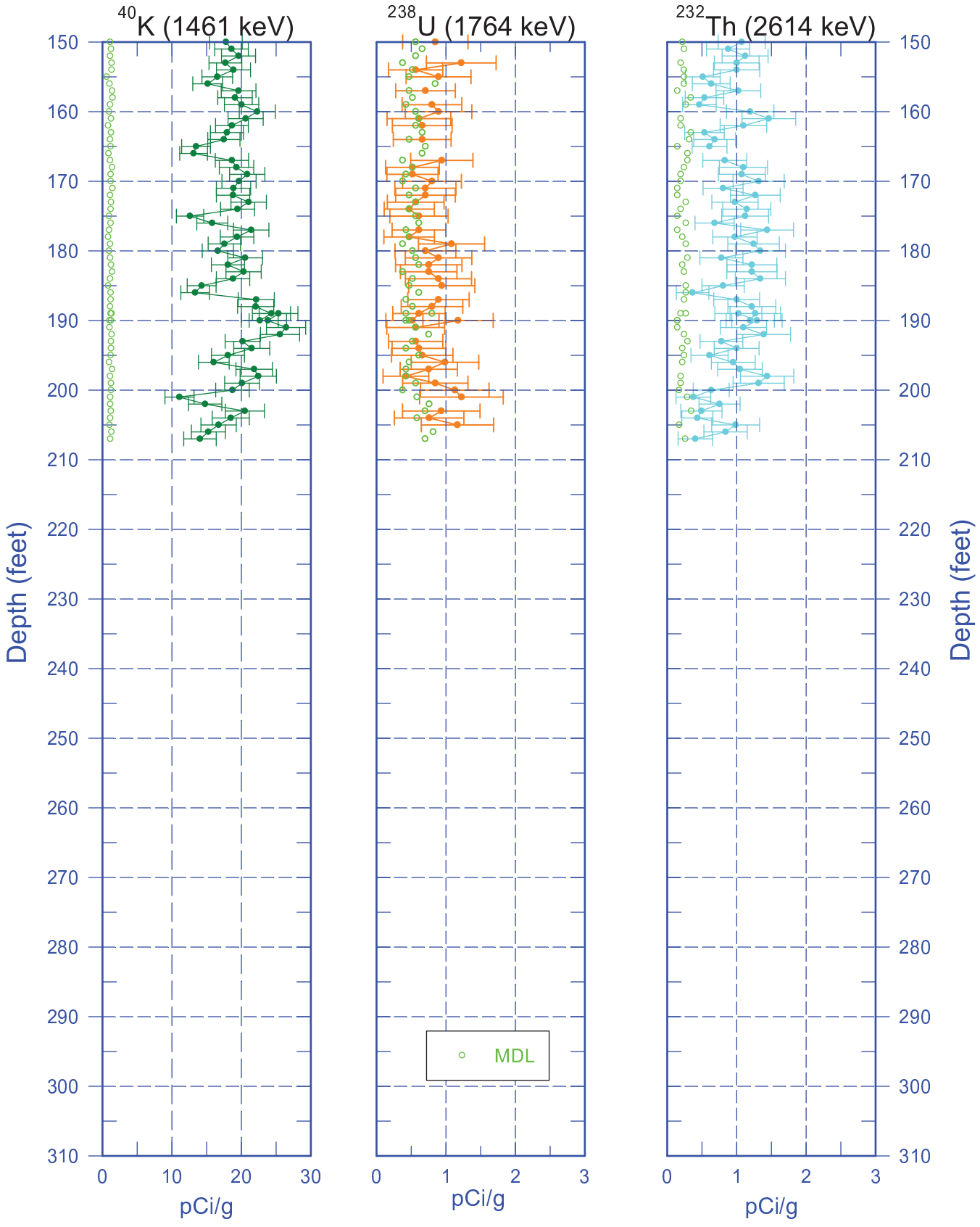
299-E26-15 (C8913)
Natural Gamma Logs



Zero Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

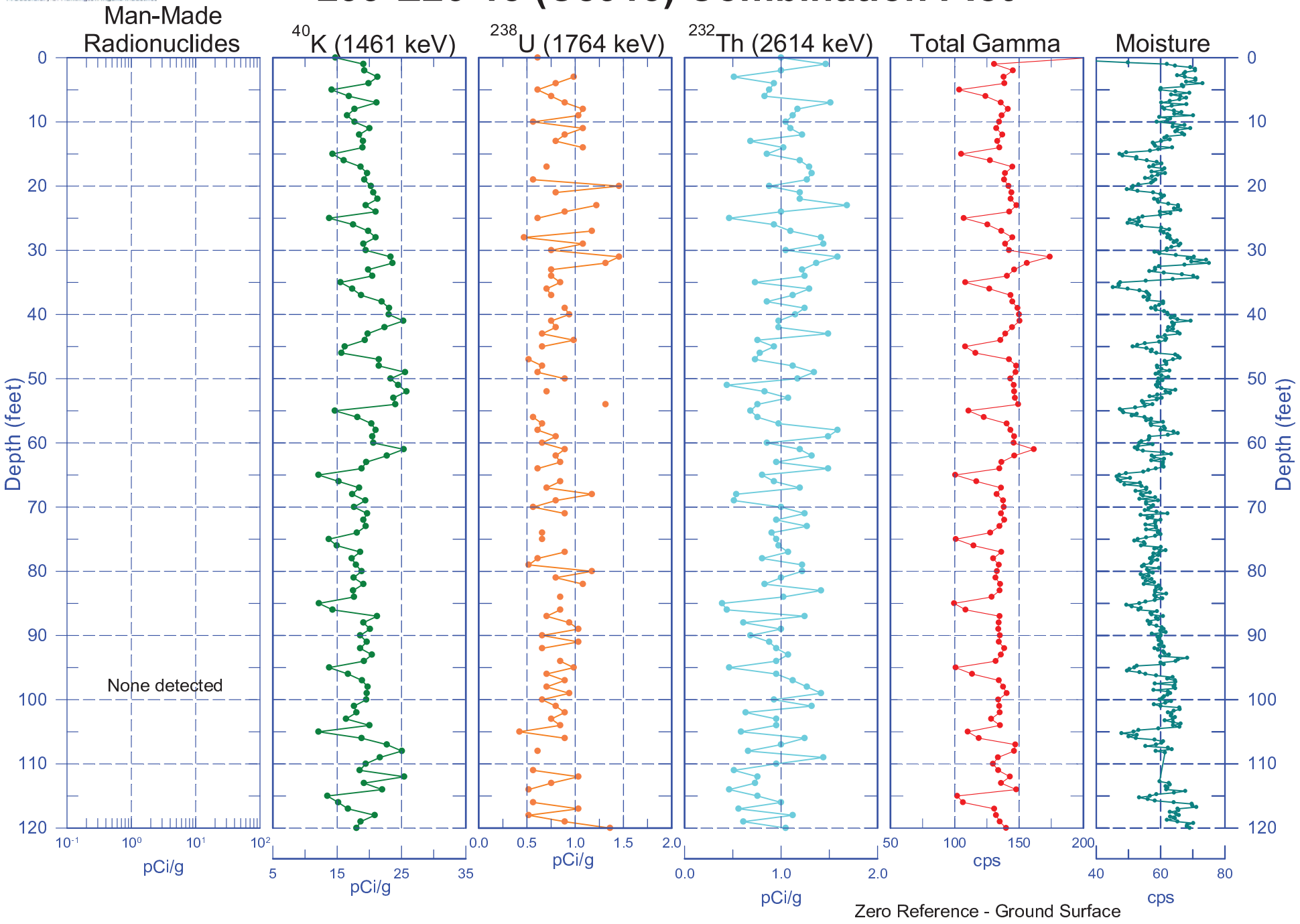
299-E26-15 (C8913)
Natural Gamma Logs



Zero Reference - Ground Surface

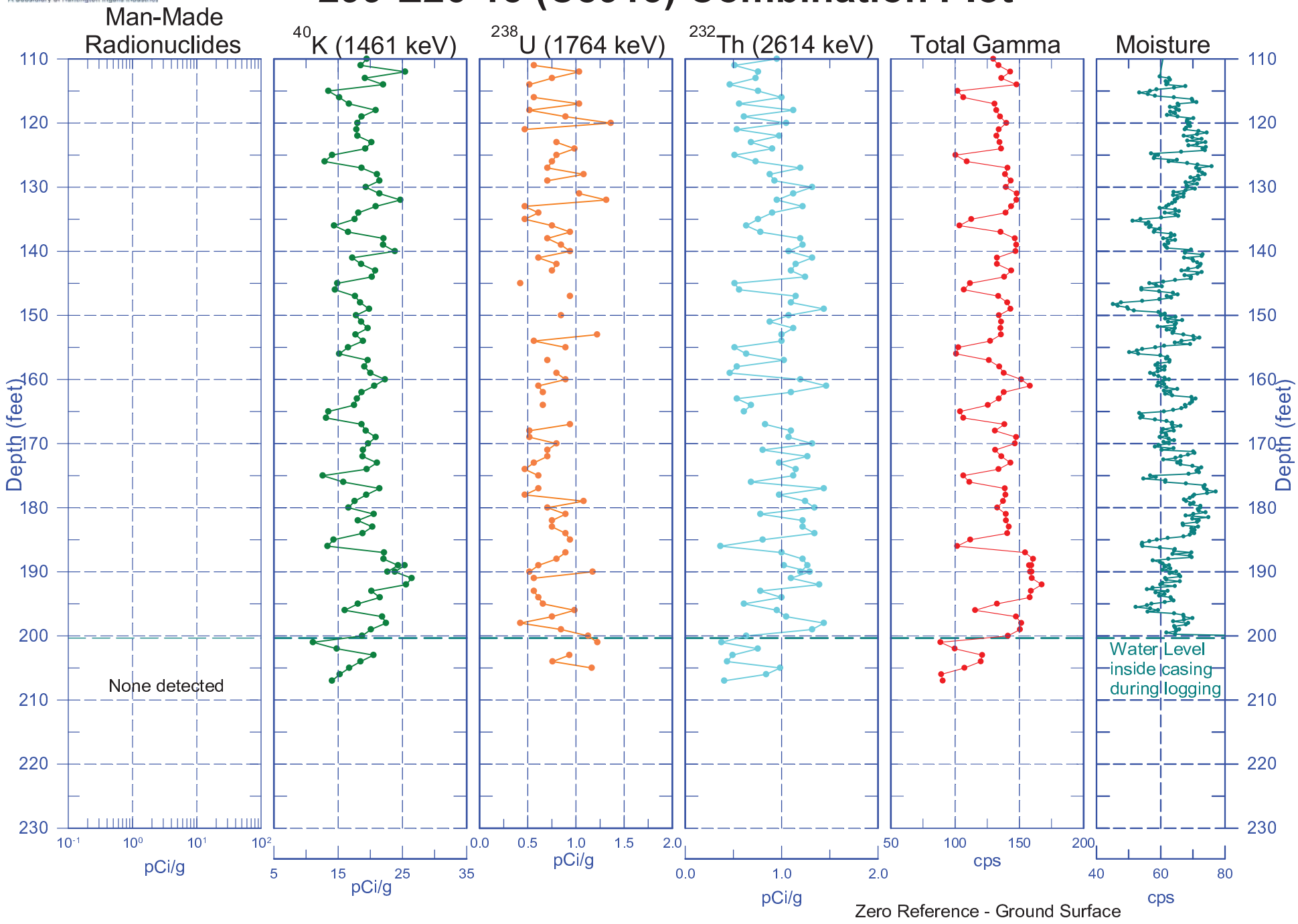
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E26-15 (C8913) Combination Plot



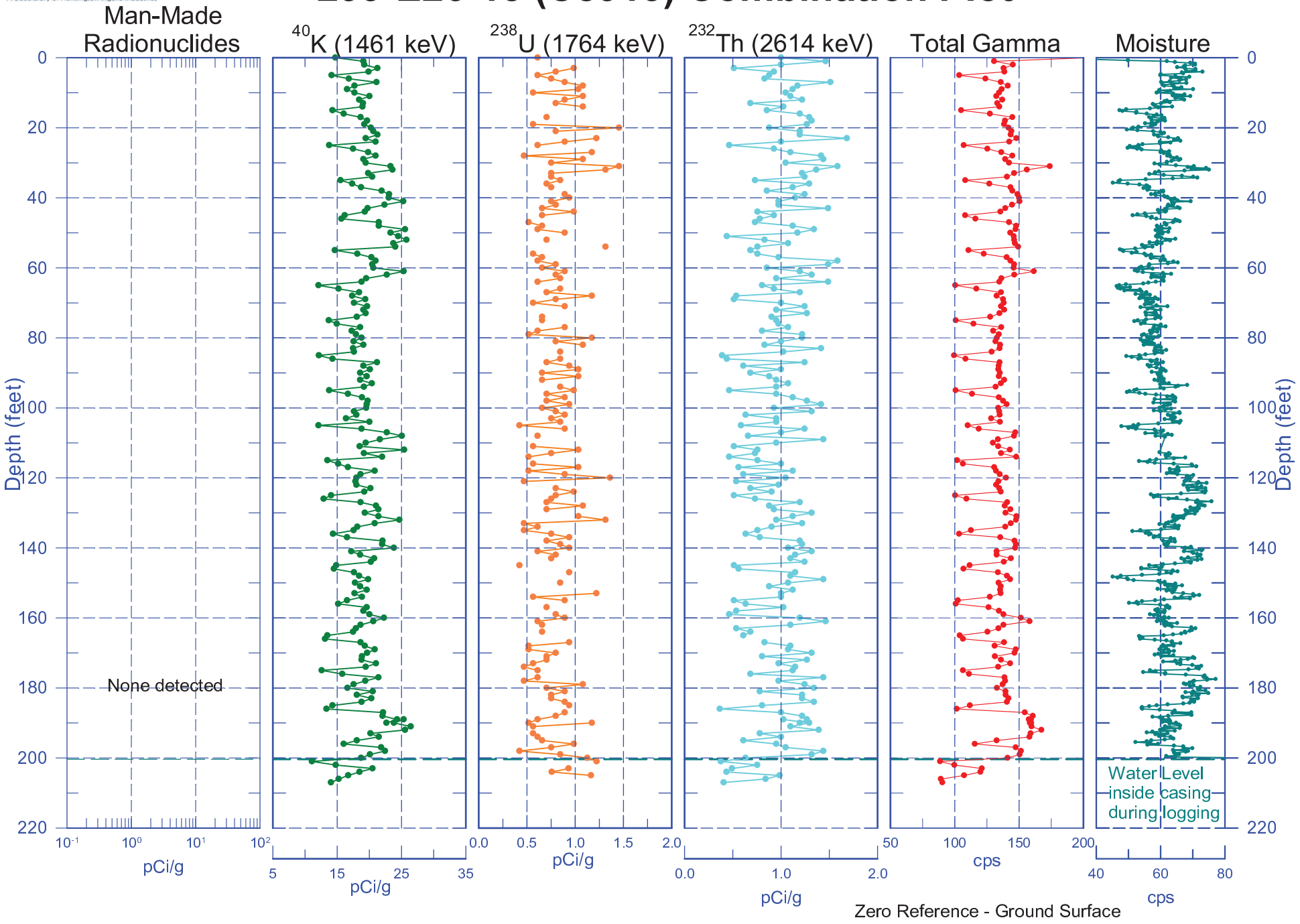
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E26-15 (C8913) Combination Plot



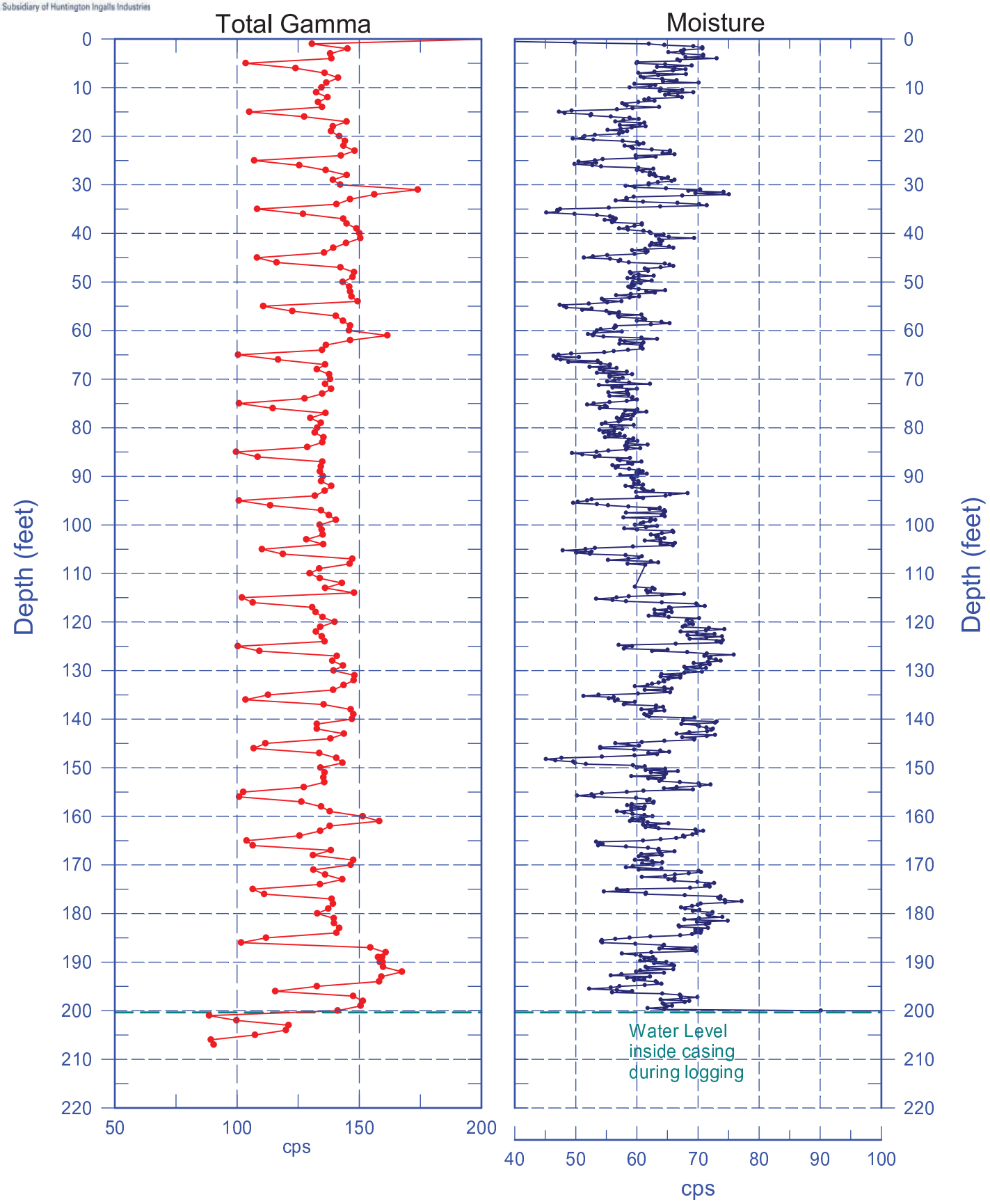
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E26-15 (C8913) Combination Plot



Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E26-15 (C8913)
Total Gamma & Moisture

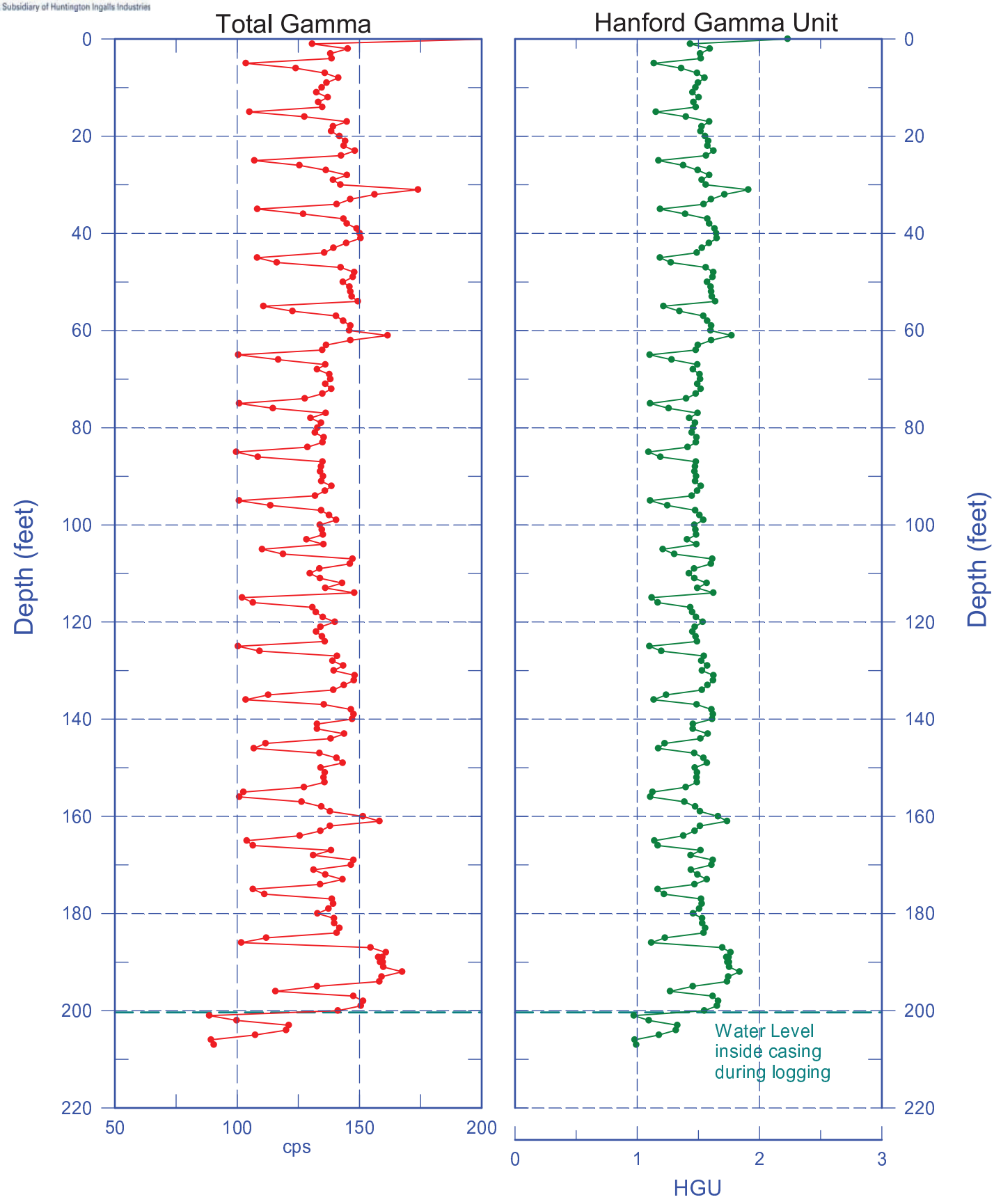


Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E26-15 (C8913)

Total Gamma & Hanford Gamma Unit

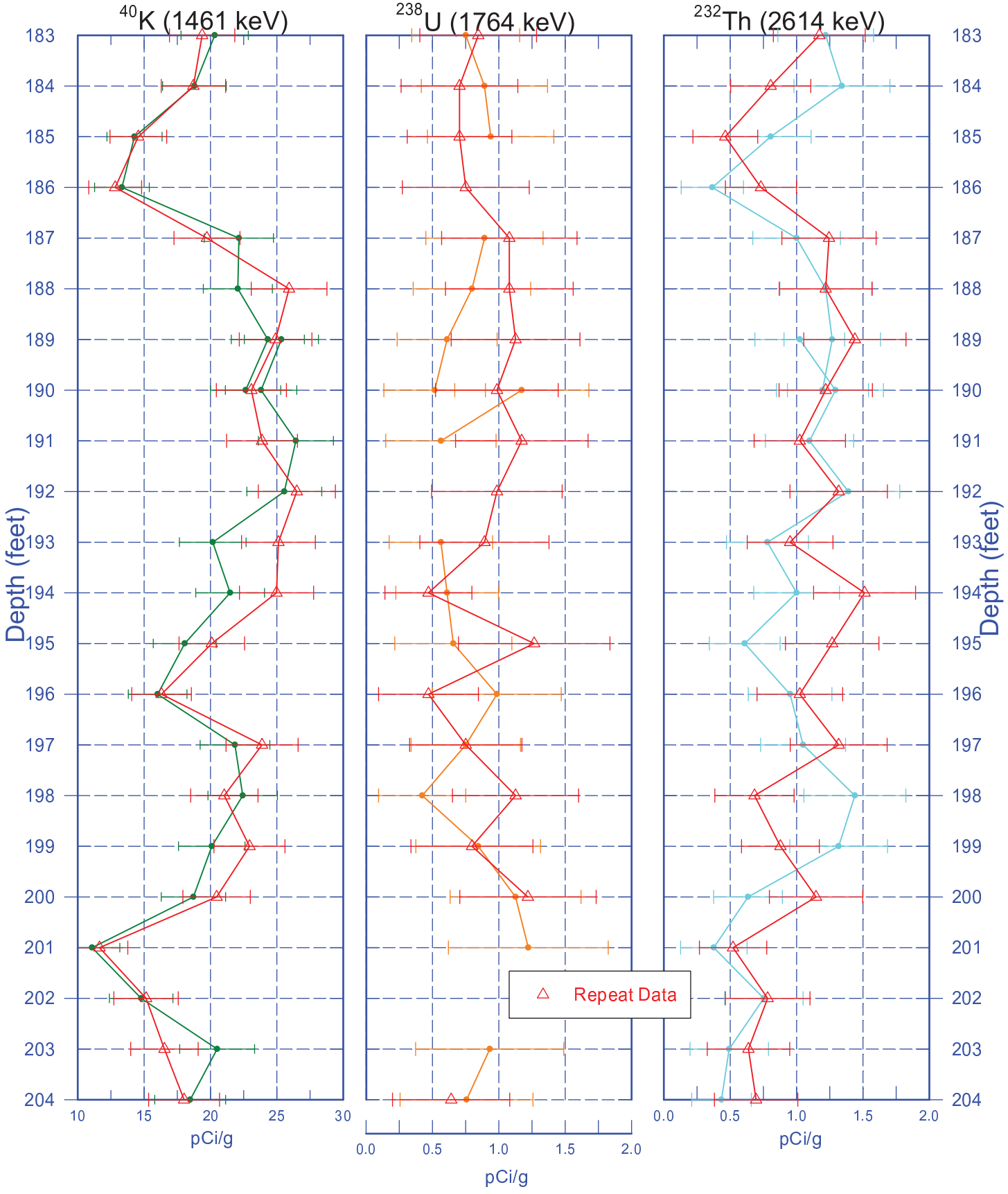


Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E26-15 (C8913)

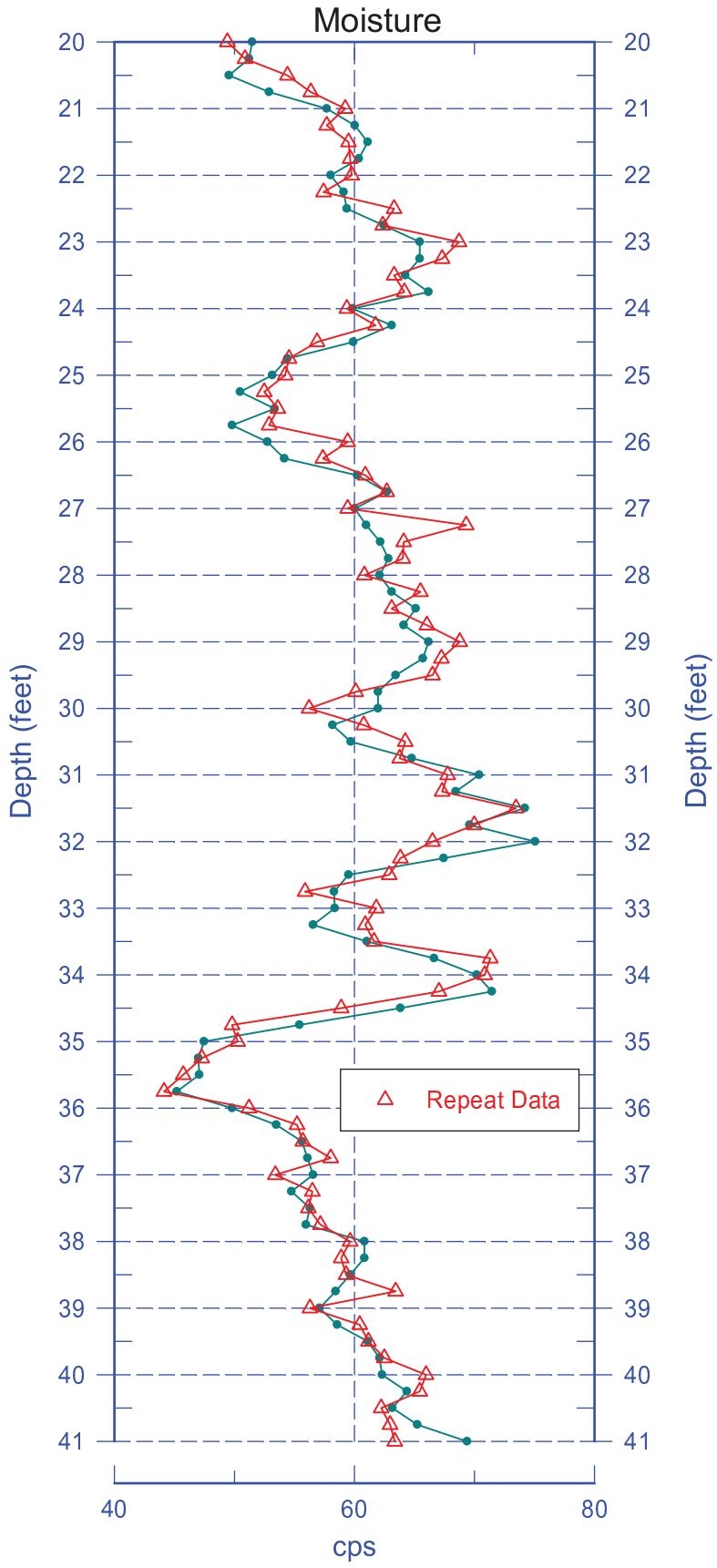
Repeat Section of Natural Gamma Logs



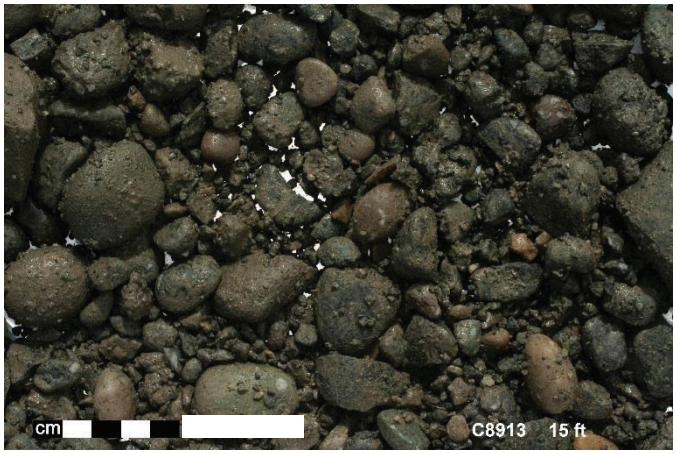
Zero Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

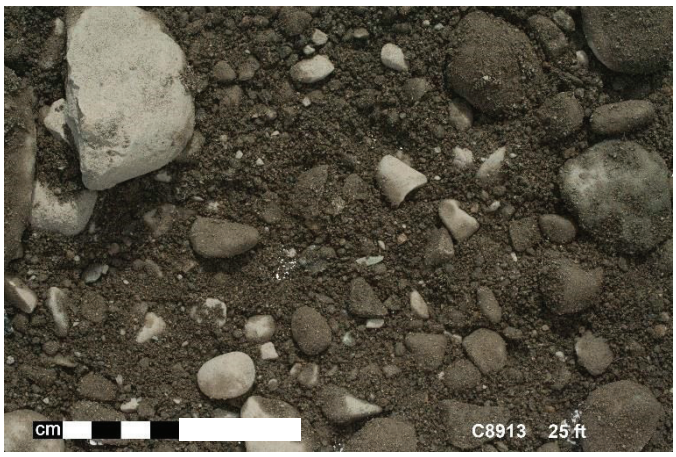
299-E26-15 (C8913)
Moisture Repeat Section



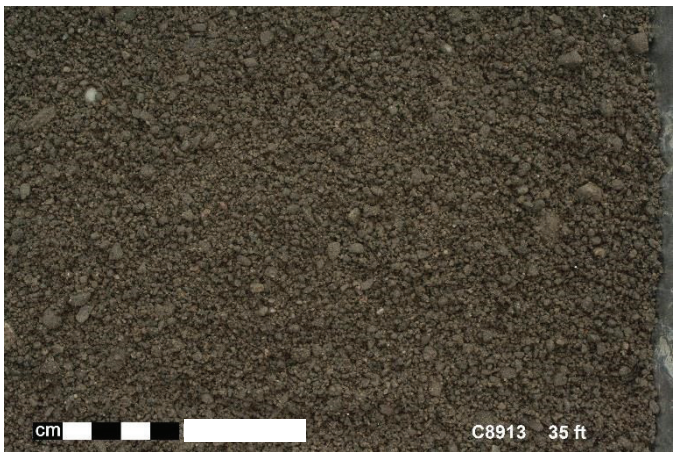
Reference - Ground Surface

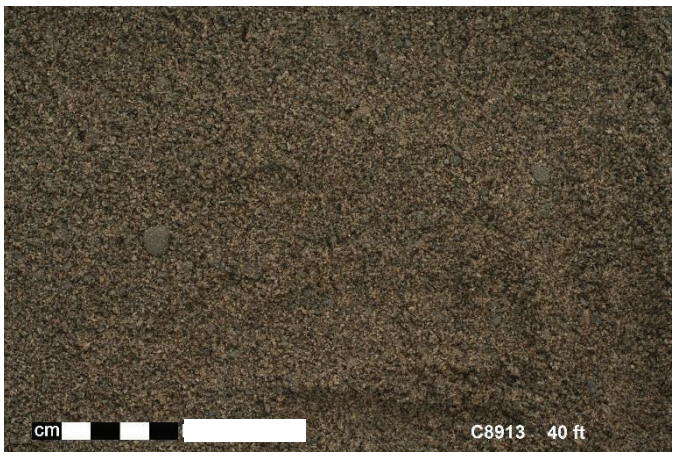

cm
C8913 15 ft

cm
C8913 20 ft


cm
C8913 25 ft

cm
C8913 30 ft


cm
C8913 35 ft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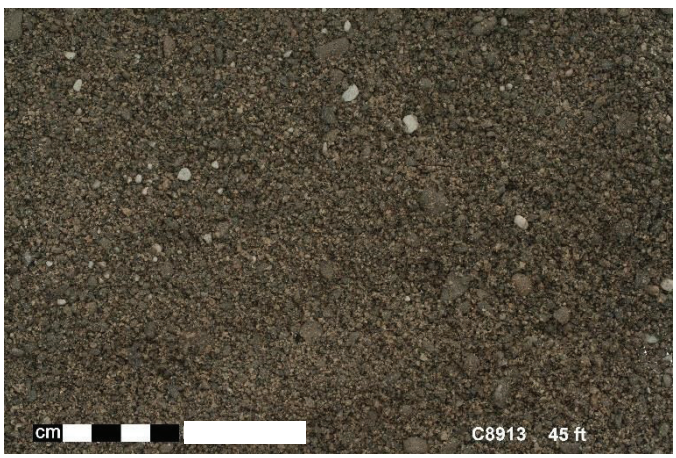
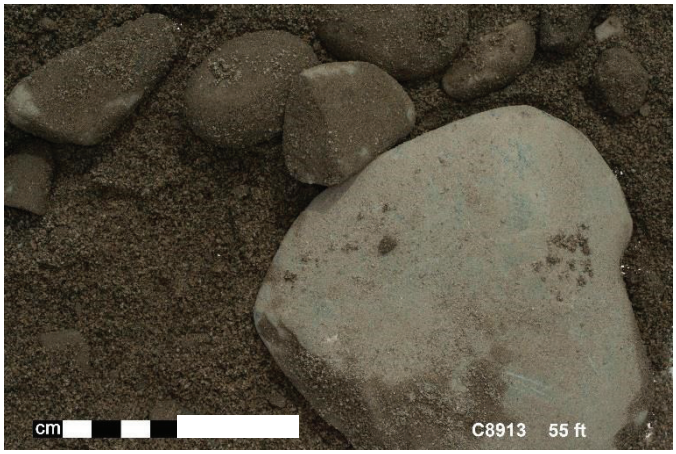
C8913 40 ft

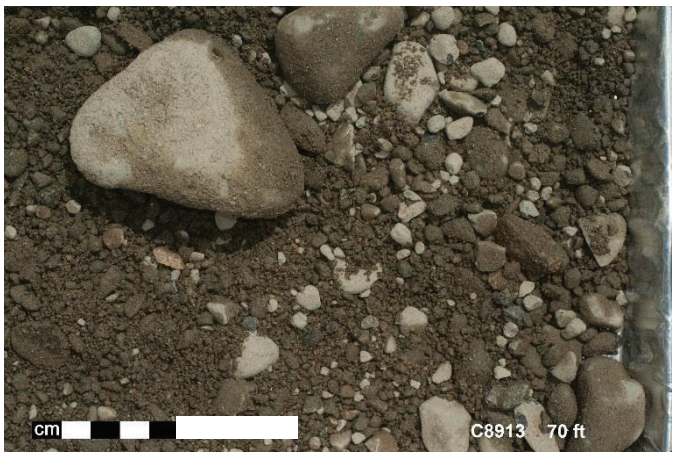

cm
C8913 45 ft

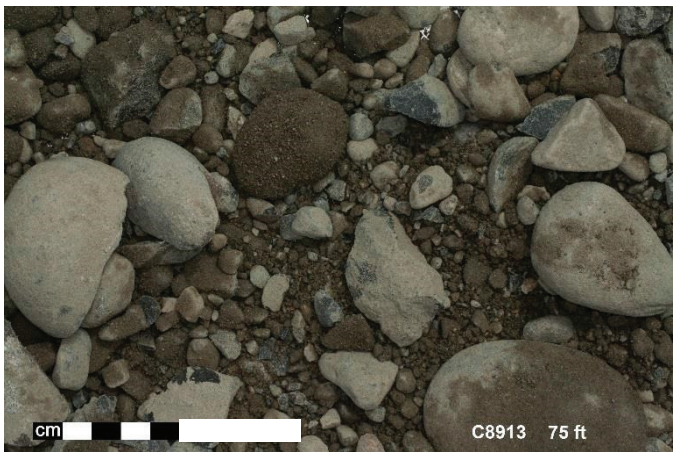
cm
C8913 50 ft


cm
C8913 55 ft

cm
C8913 60 ft

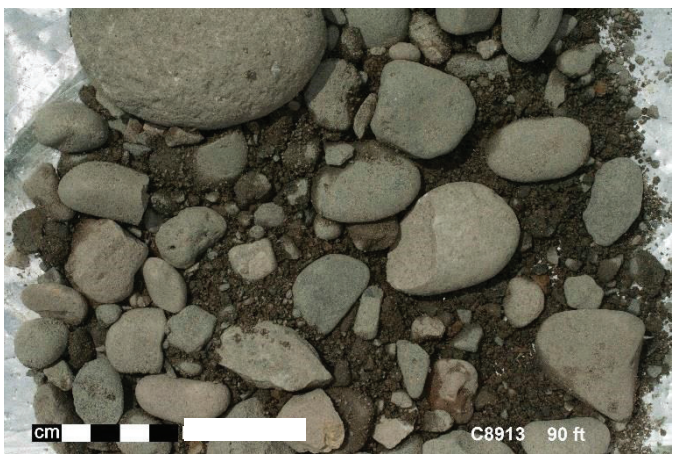
cm
C8913 65 ft


cm
C8913 70 ft

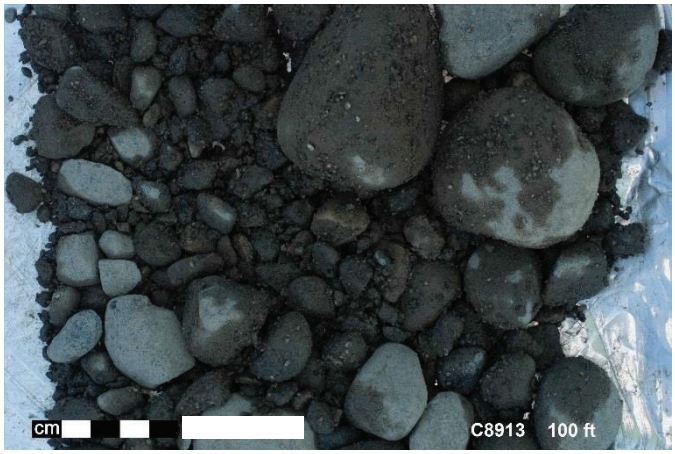

cm
C8913 75 ft

cm
C8913 80 ft

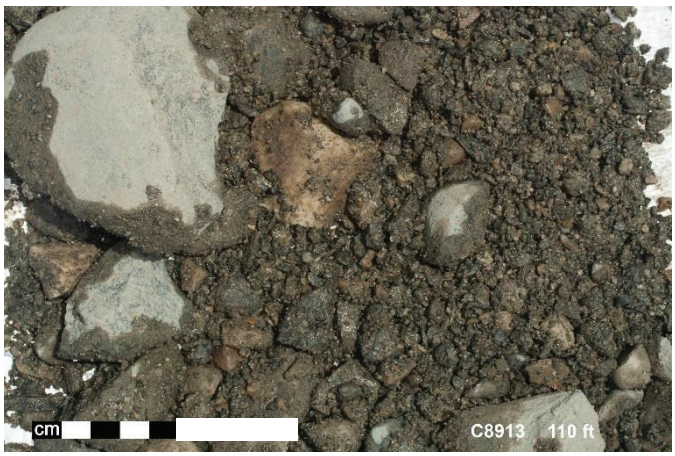
cm
C8913 85 ft


cm
C8913 90 ft

cm
C8913 95 ft


cm
C8913 100 ft

cm
C8913 105 ft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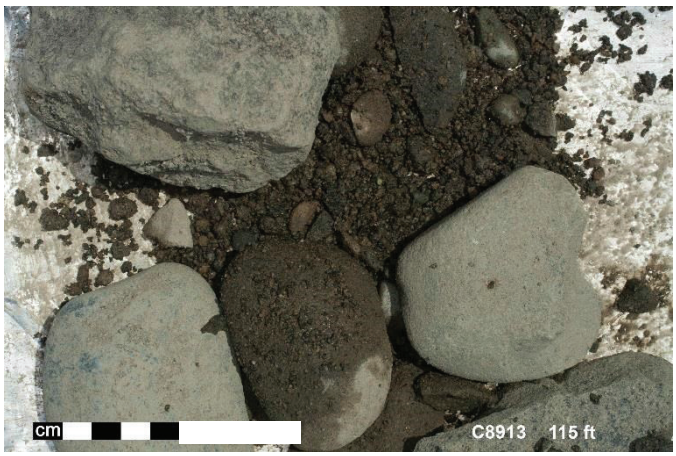
C8913 110 ft

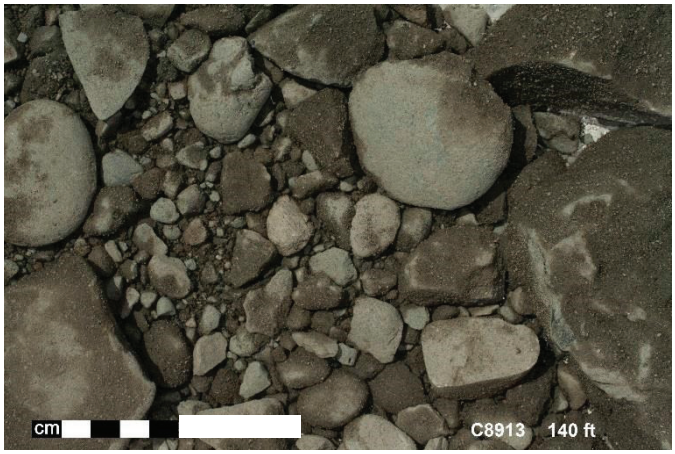

cm
C8913 115 ft

cm
C8913 120 ft

cm
C8913 125 ft

cm
C8913 130 ft

cm
C8913 135 ft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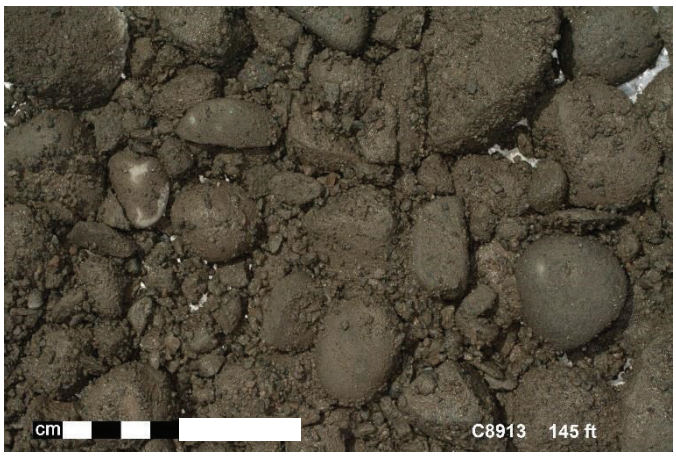
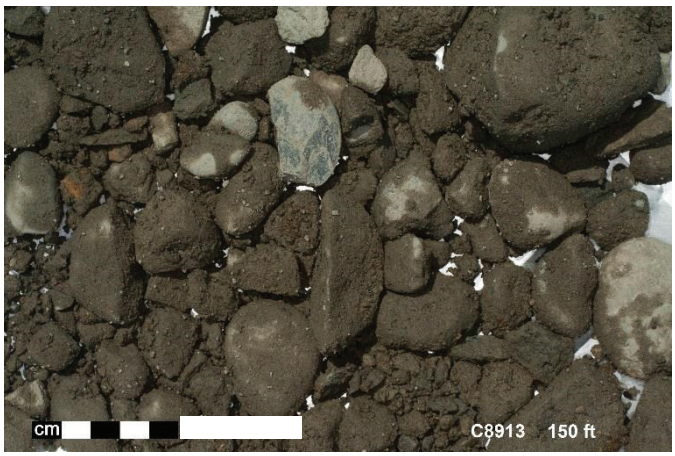
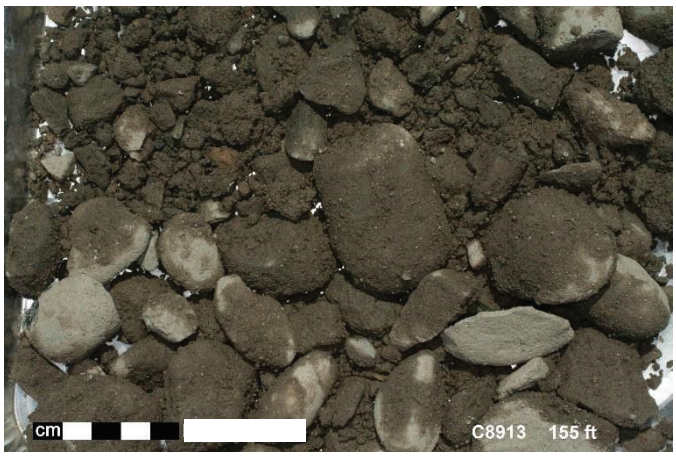
C8913 140 ft


cm
C8913 145 ft


cm
C8913 150 ft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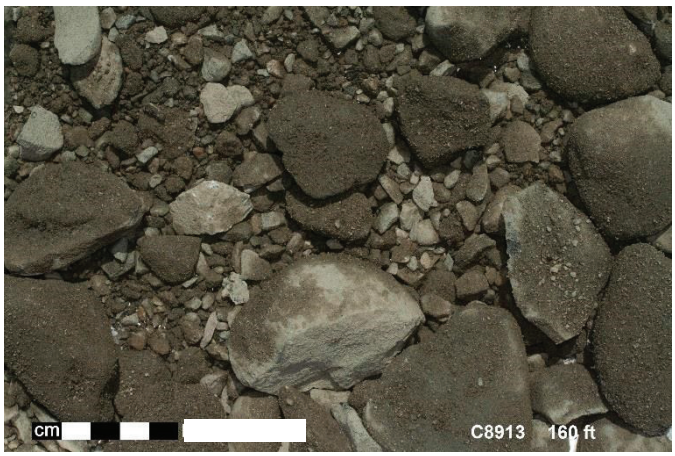
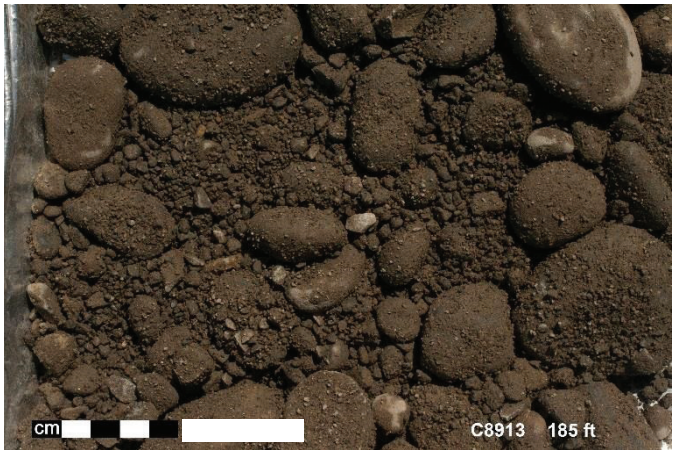
C8913 155 ft


cm
C8913 160 ft

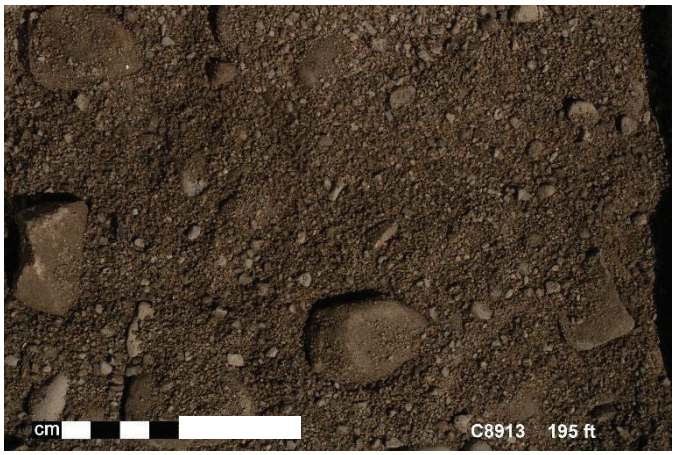
cm
C8913 165 ft

cm
C8913 170 ft

cm
C8913 175 ft


cm
C8913 185 ft

cm
C8913 190 ft


cm
C8913 195 ft

cm
C8913 200 ft

cm
C8913 206 ft

SURVEY DATA REPORT			Request No. 153-133
Project No.	Title 200W M-24 Wells C8913 and C9447 Final Surveys		File No. 2ET12R26
Job. No. CACN: 303595-JPRC	Prepared By N.P. Fastabend	Date 6/22/15	Reviewer LBM

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casings) and elevations of completed M-24 Wells C8913 (299-E26-15) and C9447 (299-E28-31) in 200E 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: 06/13/15	Requestor: Jim Mehrer (CHPRC)
Date of Survey: 06/22/15	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 M-24 Well C8913 (299-E26-15) located on south side of LERF Basins in 200E Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 200E

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
RB-1 (CHPRC) and 2E-102 (CHPRC)

Well ID	Well Name	Easting	Northing	Elevation	
C8913	299-E26-15	575926.46'	137051.44'		Center of Casing
				183.183'	"X" on Rim
				182.404'	Brass Survey Marker

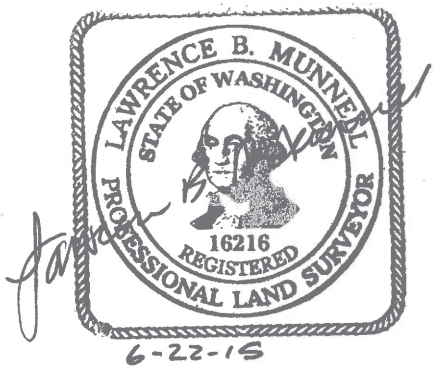
Notes:

182.891' 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.



A-6003-659 (04/03)

Appendix F

Well Documentation for C9447 (299-E28-31)

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

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WELL SUMMARY SHEET

3/25/15 ABG 7/16/15

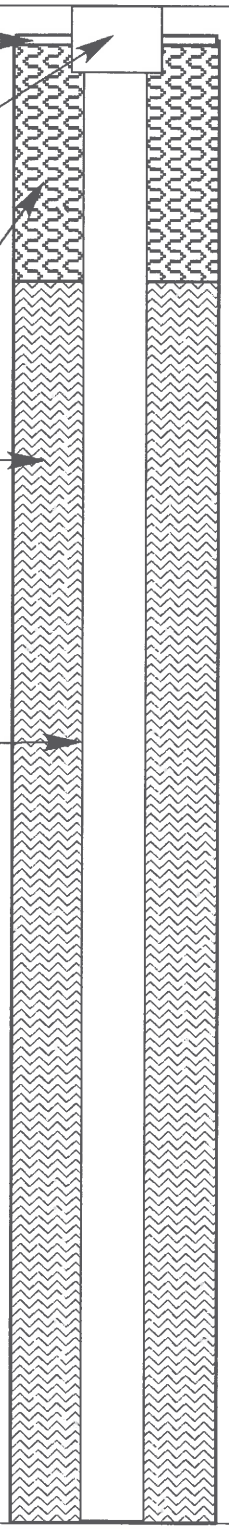
Start Date: ~~3/24/2015~~ 6/4/15

Finish Date: ~~6/02/2015~~

Well ID: C9447	Well Name: 299-E28-31
Location: 300 m North of B Plant	Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Tracy Mallgren Date: 6/09/15	Reviewed By: L.D. MEHRER Date: 7-31-15
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
Concrete Pad: 0.5 ft above ground surface (ags)	
6-in Protective Casing: 3.00 ft ags - 2.00 ft below ground surface (bgs)	
Type I/II Portland Cement Grout: 0 - 14.2 ft bgs	
Cetco Medium Bentonite Chips: 14.2 - 296.5 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.02 ft ags - 335.42 ft bgs	



Depths are in ft below ground surface.

Borehole drilled with 13 3/8-in O.D. casing from 0.0 - 138.94 ft bgs and 11 7/8-in OD casing from 138.94 - 359.4 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 - 15 Gravelly Silty Sand (gmS)
		15 - 20 Silty Sandy Gravel (msG)
20		20 - 25 Sandy Gravel (sG)
		25 - 30 Gravelly Sand (gS)
30		30 - 173 Sand (S)
40		
50		
60		
70		
80		

A-6003-643 (REV 1)

3/25/15 ATG 7/14/15

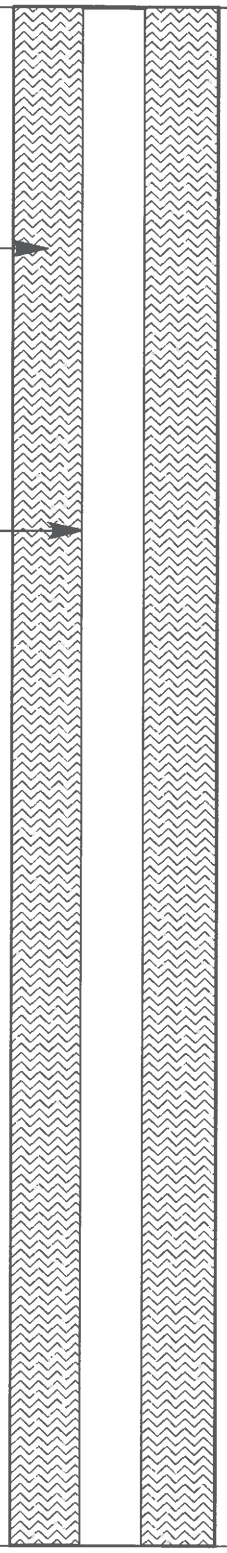
WELL SUMMARY SHEET

Start Date: ~~3/24/2015~~ 6/4/15
Finish Date: ~~6/02/2015~~ 6/9/15

Well ID: C9447	Well Name: 299-E28-31
Location: 300 m North of B Plant	Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Tracy Mallgren Date: 6/09/15	Reviewed By: D. MEHRER Date: 7-23-15
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
Cetco Medium Bentonite Chips: 14.2 - 296.5 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.02 ft ags - 335.42 ft bgs	
Depths are in ft below ground surface. Borehole drilled with 13 3/8-in O.D. casing from 0.0 - 138.94 ft bgs and 11 7/8-in OD casing from 138.94 - 359.4 ft bgs. All temporary drill casing was removed from the ground.	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
90		30 - 173 Sand (S)
100		
110		
120		
130		
140		
150		
160		
170		173 - 190 Sandy Gravel (sG)

A-6003-643 (REV 1)

WELL SUMMARY SHEET

Start Date: ~~3/24/2015~~ 6/4/15 3/25/15 ABG 7/16/15
Finish Date: ~~6/02/2015~~

Well ID: C9447
Well Name: 299-E28-31
Location: 300 m North of B Plant
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Tracy Mallgren Date: 6/09/15
Reviewed By: J.D. MEHRER Date: 7-23-15
Signature:
Signature:

CONSTRUCTION DATA

Description	Diagram
Cetco Medium Bentonite Chips: 14.2 - 296.5 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.02 ft ags - 335.42 ft bgs	
Depths are in ft below ground surface. Borehole drilled with 13 3/8-in O.D. casing from 0.0 - 138.94 ft bgs and 11 7/8-in OD casing from 138.94 - 359.4 ft bgs. All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
180		173 - 190 Sandy Gravel (sG)
190		190 - 195 Gravelly Sand (gS)
		195 - 205 Sandy Gravel (sG)
200		205 - 215 Gravelly Sand (gS)
210		215 - 231 Sand (S)
220		
230		231 - 235 Sandy Gravel (sG)
		235 - 240 Gravel (G)
240		240 - 252 Sandy Gravel (sG)
250		252 - 255 Gravelly Sand (gS)
		255 - 298 Sandy Gravel (sG)
260		

A-6003-643 (REV 1)

3/25/15 ASG 7/16/15

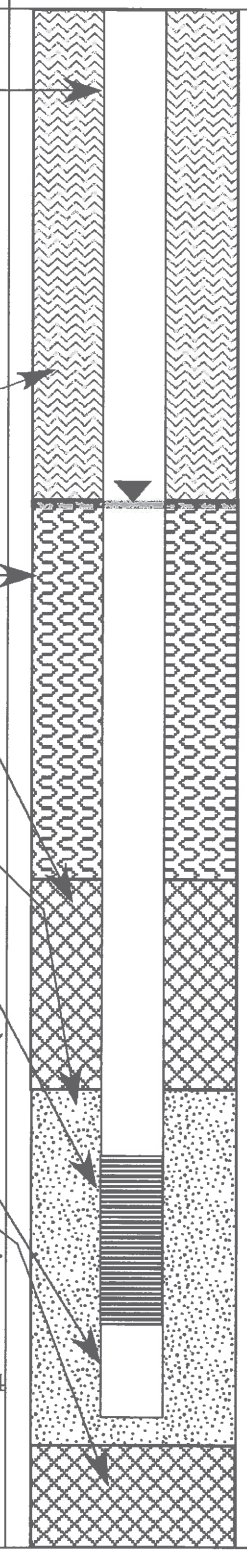
WELL SUMMARY SHEET

Start Date: ~~3/32/2015~~ 6/1/15
Finish Date: ~~6/02/2015~~

Well ID: C9447
Well Name: 299-E28-31
Location: 300 m North of B Plant
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Tracy Mallgren Date: 6/09/15
Reviewed By: D. MEHRER Date: 7-23-15
Signature:
Signature:

CONSTRUCTION DATA

Description	Diagram
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.02 ft ags - 335.42 ft bgs	
Cetco Medium Bentonite Chips: 14.2 - 296.5 ft bgs	
Type I/II Portland Cement Grout: 296.5 - 318.6 ft bgs	
3/8-in Cetco Coated Bentonite Pellet Seal: 318.6 - 331.6 ft bgs	
10-20 mesh Premier Colorado Silica Filter Pack Sand: 331.6 - 352.3 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen: 335.42 - 345.42 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 345.42 - 350.45 ft bgs	
3/8-in Cetco Coated Bentonite Pellet Seal: 352.3 - 362.0 ft bgs	
Depths are in ft below ground surface.	
Borehole drilled with 13 3/8-in O.D. casing from 0.0 - 138.94 ft bgs and 11 7/8-in OD casing from 138.94 - 359.4 ft bgs	
All temporary drill casing was removed from the ground.	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
270		255 - 298 Sandy Gravel (sG)
280		
290		
		Static Water Level: 29.9 ft bgs (5/11/15)
300		298 - 300 Silty Sandy Gravel (msG)
		300 - 315 Gravel (G)
310		
		315 - 325 Sandy Gravel (sG)
320		
		325 - 330.5 Gravelly Sand (gS)
330		330.5 - 337 Silty Sandy Gravel (msG)
		337 - 344 Sandy Gravel (sG)
340		
		344 - 353 Silty Sandy Gravel (msG)
350		
		353 - 362 Basalt

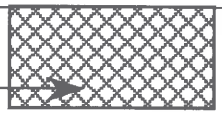
A-6003-643 (REV 1)

WELL SUMMARY SHEET

Start Date: ~~3/32/2015~~ 3/25/15 RJG 7/16/15
Finish Date: ~~6/02/2015~~ 6/4/15

Well ID: C9447
Well Name: 299-E28-31
Location: 300 m North of B Plant
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Tracy Mallgren Date: 6/09/15
Reviewed By: D. MEHRER Date: 7-23-15
Signature:
Signature:

CONSTRUCTION DATA

Description	Diagram
3/8-in Cetco Coated Bentonite Pellet Seal: 352.3 - 362.0 ft bgs	

Depths are in ft below ground surface.

Borehole drilled with 13 3/8-in O.D. casing from 0.0 - 138.94 ft bgs and 11 7/8-in OD casing from 138.94 - 359.4 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
360		353 - 362 Basalt
370		
380		
		Straightness Test: 05/14/2015, Pass
390		Total Depth: 362.0 ft bgs (5/11/2015)
400		
410		
420		
430		
440		

BOREHOLE LOG

Page 1 of 10 (KS 5/13/15)

Date: 3/25/15

Well ID: C9447 | Well Name: 299-E28-31 | Location: ~300 m N of B plant

Project: 8 M24 TPA GW monitoring wells FY2015 | 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' Silty Sandy Gravel (msG) 60%G, 20% S, 20%M Gravel: 65% felsic, VFP-SC, VPS, max-80mm, avg= VCP, SA-SR. Sand: 60% felsic, VFS-VCS, bimodal, 40% VFS, 40% CS-VCS, SA-SR. Dry. Fines: mod rxn to HCL. Pale Yellow (2.5Y 7/3)	Drilling with cable tool & drive barrel method Grab samples every 5' & at lithology changes
5	G				
10	G			10-15' Gravelly Silty Sand (gmS) 25%G, 50%S, 25%M Gravel: 40% felsic, VFP-VCP, VPS, max-50mm, avg=CP, SA-SR. Sands: 60% felsic, VFS-VCS, bimodal, 40% VFS, 40% CS-VCS, SA-SR Dry. fines: mod rxn to HCL. Light Yellowish Brown (2.5Y 6/3)	
15	G			15-20' Silty Sandy Gravel (msG) 35%G, 45%S, 20%M Gravel: 60% felsic, VFP-SC, VPS, max=80mm, avg=CP, SA. Sand: 60% felsic, VFS-VCS, PS, 40% VCS, VCS grains 80% basalt, A-SA. Occl mild rxn to HCL. Light Yellowish Brown (2.5Y 6/3)	@17' noticible increase in soil moisture
20	G			20-25' Sandy Gravel (sG) 35%G, 60%S, 5%M Gravel: 40% felsic, MS, max=30mm, avg=MP, VFP-CP, SR. Sand: 50% felsic, WS, VFS-VCS, 80% VCS, SA. moist. occl mild rxn to HCL. Grayish Brown (2.5Y 5/2) @23' color change to light gray (2.5Y 7/2)	
25	G			25-30' Gravelly Sand (gS) 20%G, 80% S, Trace M Gravel: 50% felsic, max=20mm, VFP-CP, MS, Avg=FP, SA-SR. Sand: 50% felsic, VFS-VCS, WS, 80% VCS, SA. Dry. No rxn to HCL. Light Brownish Gray (2.5Y 6/2)	
30	G			30'-173 Sand (S) 3%G, 97% S, Trace M Gravel: VFP, 70% basalt, SA. Sand: 50% felsic, Mod. sorting, VFS-VCS, 80% CS-VCS, SA. Dry. occl. mod rxn to HCL. Light Brownish Gray (2.5Y 6/2)	
35	G			@35': Gravel % TT to 5, sand % VV to 95.	@35' Add 2 gallons H_2O

Reported By: Joshua Holland | Title: Geologist | Signature: [signature] | Date: 3/26/15

Reviewed By: Kevin Bergstrom | Title: Sr. Geologist | Signature: [signature] | Date: 7/20/15

A-6003-642 (03/03)

KS 5/13/15

BOREHOLE LOG

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Date: 3/26/15

Well ID: C9447 | Well Name: 299-E28-31 | Location: ~300m N of B plant

Project: 8 M24 TPA GW monitoring wells FY2015 | 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, 30 wt% sizing Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
40	G			40-173 Sand(s) 5%G, 95%S, Trace M Gravel: FP-VFP, 40% felsic, SA. Sand: 50% felsic, VFS-VCS, WS, 90% CS-VCS, SA. No rxn to HCL. Dry. Light Brownish Gray (2.5Y 6/2)	@ Drilling with cable tool + drive barrel method @40' Add 4 gall H2O Grab samples every 5' & at lithology changes
45	G			@45': gravel size ↓↓ to VFP, Sand sorting ↑↑ to VWS, MS-VCS, 95% CS-VCS, No mud.	@45' Add 4 gall H2O
50	G			@50': sand sorting ↓↓ to PS, 60% CS-VCS occl. mild rxn to HCl, gravel % ↓↓ to 2%, sand % ↑↑ to 98%.	@50' Add 2 gall H2O
55	G			@55': Gravel: felsic ↑↑ to 50%. Sand: ↑↑ to 70% Felsic, Mod sorting, 70% MS-CS, A-SR	@55' Add 6 gallons H2O
60	G			@60': 100% sand, increase to 80% felsic, ↑↑ to SR	@60' Add 10 gallons H2O
	G			@64' 1' 100% VFS-FS lens	
65	G			@65': Gravel content ↑↑ to 10%, sand content ↓↓ to 90%. Gravel as previously described, Sand sorting ↓↓ to PS, 50% VCS, angularity △ to A-SR. Slightly moist.	
70	G			@70': Gravel content ↓↓ to 5%, Sand content ↑↑ to 95%	
75	G			@75': Sand content ↑↑ to 100%, sorting ↑↑ to mod. sorting, 70% MS-CS	↓↓ drillrate

Reported By: Joshua Holland | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: [signature] Date: 3/30/15 | Signature: [signature] Date: 7/20/15

A-6003-642 (03/03)

VMS 13/15

BOREHOLE LOG

Page 3 of 10
Date: 3/30/15

Well ID: C9447 | Well Name: 299-E28-31 | Location: ~300 m N of B Plant

Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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, 30 KS 3/15 Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
80	G			80'-173 Sand (S) 100% Sand, Trace mud. Sand: 70% felsic, VFS-VCS, Mod. sorted, 70% MS-CS, SA. No rxn to HCL dry. Light Brownish Gray (2.5Y 6/2). Occl. $CaCO_3$ cemented, matrix supported nodules	Cable tool: Drive barrel Grab samples every 5' & at lithology changes
85	G			@85': Color change to light yellowish brown (2.5Y 6/4)	
90	G			@90': Gravel content ↑↑ to 10%, sand content ↓↓ to 90%. Gravel: 30% felsic, VFP, A-R. Sand: sorting ↓↓ to PS, 60% med. sand No nodules present	
95	G			@95': Sand: sorting ↓↓ to VPS. No nodules present	
100	G			@100': color change to (2.5Y 8/1) Pale Yellow. Nodules present again	
105	G			@105': gravel content ↓↓ to 5%, sand content ↑↑ to 95%. Gravel: ↑↑ to 50% felsic, A-SR.	
110	G			@110': sand sorting ↑↑ to Mod. sorting, 70% CS, color change to Light Brownish Gray (2.5Y 6/2)	
115	G			@115': Sand sorting ↑↑ to MS, felsic content ↑↑ to 85%	

Reported By: Joshua Holland | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: [signature] Date: 3/30/15 | Signature: [signature] Date: 7/20/15

A-6003-642 (03/03)

5/13/15

BOREHOLE LOG

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Date: 3/31/15

Well ID: C9447 | Well Name: 299-E28-31 | Location: ~300m N of B Plant

Project: 8 M24 TPA GW Monitoring Wells FY2015 | Reference Measuring Point: ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120	G			120-130' Sand(s) 5%G, 95% S, Trace M. Gravel: VFP, 50% felsic, SA. Sand: 85% felsic, mod. sorting, 70% med. sand, FS-VCS, SA. Moist. occl. mild rxn to HCl. Light Brownish Gray (2.5Y 6/2)	Drilling with cable tool & drive barrel method. Grab samples every 5' & at lithology changes
125	G			@125' Sand sorting W to PS. few matrix supported nodules present	
130	G			@130': Sand felsic content W to 75%. occl Strong rxn to matrix supported nodules	@130' Add 8 gallons H2O
135	G			@135': Sand content M to 100%.	@135' Add 2 gallons H2O
					@138.94' bottom of 1st casing string
140	G			@140': Sorting M to MS	@140' Add 5 gallons H2O
145	G				@145' Add 6 gallons H2O
150	G				
155	G			@155': gravel content M to 5%, Sand W to 95% Gravel: 60% felsic, VFP-FP, A-SA.	

Reported By: Joshua Holland | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: [signature] Date: 4/2/15 | Signature: [signature] Date: 7/20/15

A-6003-642 (03/03)

BOREHOLE LOG

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Date: 4/2/15

Well ID: C9447	Well Name: 299-E28-31	Location: ~300 m N of B Plant
Project: 8 M24 TPA GW Monitoring Wells FY2015		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
160	G			**160-173'** Sand (S) 100% Sand: 85% felsic, PS, VFS-VCS, 60% med sand, SA. Dry. Occ strong rxn to HCl. Light Brownish Gray (2.5Y 6/2)	Drilling with cable tool & drive barrel method. Grab samples every 5' & at lithology changes
165	G			@165': felsic content ↓↓ to 70%, sorting ↑↑ to mod. 70% CS/VCS, VCS are 70% basaltic.	@165' ~~3hr 40~~ Add 4 gallons H2O
170	G			@170': sorting ↑↑ to WS, 80% MS/CS	
175	G			**173-190'** Sandy Gravel (gS) 40%G, 60%S, Trace M. Gravel: 30% felsic, VFP-VCP, max=40mm, avg=FP-MP, MS, A-SR. Sand: 30% felsic, MS-VCS, mod sorting, SA-SR, 60% VCS. Gray (2.5Y 6/1) No rxn to HCl. Dry. @175': max gravel size & avg size ↓↓ to 25mm, VFP. Sand sorting ↓↓ to PS, felsic content ↑↑ to 40%	
180	G			@180': sand sorting ↓↓ VPS, VFS-VCS.	
185	G				
190	G			**190-195'** Gravelly Sand (gS) 20%G, 80%S, trace M. Gravel: VFP, 30% felsic, A-SA. Sand: 40% felsic, FS-VCS, PS, 50% VCS, SA-SR. slightly moist. No rxn to HCl. Gray. (2.5Y 6/1)	@190' Add 3 gallons H2O
195	G			**195-205'** Sandy Gravel (sG) 30%G, 70%S, Trace M. Gravel: 30% felsic, VFP-MP, max 15mm, Mod. sorted, A-SA. Sand: 60% felsic, VFS-VCS, well sorted, 80% MS/CS, A-SR. No reaction to HCl. dry. Gray (2.5Y 6/1)	

Reported By: Joshua Holland		Reviewed By: Kevin Bergstrom	
Title: Geologist		Title: Sr. Geologist	
Signature:	Date: 4/6/15	Signature:	Date: 7/20/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 6 of 10 (KS 5/13/15)
Date: 4/6/15

Well ID: C9447 | Well Name: 299-E28-31 | Location: ~300m N of B Plant
Project: 8 M24 TPA GW Monitoring Wells FY2015 | Reference Measuring Point: ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description	Comments
				Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
200	G			195 ft bgs 200-205' Sandy Gravel (sG) 75% G, 25% S, Trace M Gravel: 30% felsic, VFP-MP, CP, WS, avg=FP/VFP, A-SR. Sand: 40% felsic, VFS-VCS, A-SA, PS, 50% VCS. Dry. No rxn to HCl. Gray (2.5Y 6/1)	drilling with cable Tool + Drive barrel Method @205' Add 2 gallons H2O Grab samples every 5' & at lithology changes
205	G			205-215' Gravelly Sand (gS) 25% G, 75% S, Trace M Gravel: 40% felsic, VFP-MP, well sorted, Avg=FP, A-SR. Sand: 40% felsic, VFS-VCS, A-SA, PS, 50% VCS, dry. No rxn to HCl. Gray (2.5Y 6/1)	
210	G			@210': gravel content W to 15%, Sand M to 85% Sand=felsic content M to 60%, Sorting M to MS, 70% CS/VCS. Color change to Light Grayish Brown (2.5Y 6/2)	@210' Add 3 gallons H2O
215	G			215-231' Sand (S) 5% G, 95% S, Trace M. Gravel: 50% felsic, VFP-FP, A-SA. Sand: 75% felsic, VFS-VCS, mod. sorting, 70% MS/CS, A-SA. Dry. Occl. mod. rxn to HCl, occl. matrix supported HCl reactive nodules. Light Grayish Brown (2.5Y 6/2)	@215' Add 2 gallons H2O
220	G			@220': Sand sorting M to WS, 80% MS/CS, only trace VFP, Sand content M to 100%.	
225	G			@225': Gravel content M to 5%, VFP, A-SA. Sand W to 95%. Sand sorting W to MS, 70% MS/CS. @226': 6" Silt lens. No rxn. Light Olive Brown (2.5Y 5/3)	@225' Add 4 gallons H2O
230	G			@230': Gravel: content M to 9%, Sand W to 91% @231': Sand: sorting W to PS, 50% VCS. VCS grains are 80% basalt.	@230' Add 4 gallons H2O
235	G			231-235' Sandy Gravel (sG) 75% G, 25% S, Trace M Gravel: 70% felsic, VFP-LG, VPS, A-R. Sand: 60% felsic, VFS-VCS, 50% VCS, SA-R. Dry. No rxn to HCl. Light Grayish Brown (2.5Y 6/2)	@231' W drillrate from 231' to 235' Add 8gall H2O
				235-240' Gravel (G) 85% G, 15% S, Trace M Gravel: 75% felsic, VFP-LG, max=140mm, A-R. Sand: 60% felsic VFS-VCS, PS, 50% VCS, SA-R. Wet. Occl mild rxn to HCl. Dark Grayish Brown (2.5Y 4/2)	@231' proposed contact of surficial/Hanford fm. with the Cold Creek Unit, Δ lithology, M in Gravel @238' Add 2 gallons H2O

Reported By: Joshua Holland | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: | Date: 4/6/15 | Signature: | Date: 7/20/15

A-6003-642 (03/03)

7, KS 5/13/15, KS 5/18/15

BOREHOLE LOG

Page 6 of 10
Date: 4/7/15

Well ID: C9447 | Well Name: 299-E28-31 | Location: 300m N of B Plant
Project: 8 M24 TPA GW Monitoring Wells FY2015 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
240	G			**240-252'**: sandy GRAVEL (sG). Gravel: 70%, sand: 30%, trace M. GRAVEL: max size: 135mm, VFP-LC, 60% MP-CP, VPS, SA-SR, 65% felsic. SAND: VFS-VCS, PS, SA-SR, 60% felsic. Dry, mod-strong rxn w/ HCl, light brownish grey (2.5Y 6/2)	Drilling w/ cable tool & Drive barrel Grab samples every 5' & @ lithology changes
245	G			@245': gravel content ↓ to 65%, sand ↑ to 35%	
250	G				@251' add 2 gal H_2O
	G			**252-255'**: gravelly SAND (gS). Sand: 85%, gravel: 15%. GRAVEL: max: 12mm, VFP-MP, 50% FP, SA-SR, PS, 60% felsic. SAND: FS-CS, 60% CS, SA-SR, MS, 75% felsic. Dry, no rxn to HCl, light grey (2.5Y 7/1)	@253' Add 1 gal H_2O
255	G			**255-298'**: sandy GRAVEL (sG) ~~75% G~~ kem 5/11/15 Gravel: 75%, Sand: 25%, trace silt. GRAVEL: max: 250mm, VFP-LC, 50% CP-VCP, A-R (larger clasts = R-SR, pebbles = A), PS, 70% felsic. SAND: VFS-VCS, 50% CS, VPS, SA-SR, 60% felsic. Dry, mod rxn to HCl, light brownish grey (2.5Y 6/2).	@258' ↓↓ drill rate
260	G				
265	G			@265': gravel ↓↓ to 40%, sand ↑↑ to 60%. gravel size VFP-VCP, 60% MP, MS weak rxn to HCl	@265' add 4 gal H_2O ↓↓ drill rate
270	G			@270': gravel ↑↑ to 65%, sand ↓↓ to 32%, silt ↑↑ to 3%. GRAVEL: VFP-LC (50% VCP), PS, 75% felsic.	
275	G			@275': gravel avg. size ↑↑ (60% sc). sand increase in felsic% to 70%	@278' Add 1 gal H_2O @279' Add 1 gal H_2O

Reported By: KIRA MURRAY | Reviewed By: Kevin Bergstrom
Title: GEOLOGIST | Title: Sr. Geologist
Signature: Kira Murray | Date: 4/7/15 | Signature: Kevin Bergstrom | Date: 7/20/15

A-6003-642 (03/03)

KB 5/19/15

BOREHOLE LOG

Page 8 of 10
Date: 4/8/15

Well ID: C9447 | Well Name: 299-E28-31 | Location: ~300m N of B Plant
Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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
280	G			255' clear 270-298' bgs; SANDY GRAVEL (sG)	Drilling w/ cable tool & drive barrel
				65% G, 32% S, 3% M. Gravel is VFP-LC; 50% VCP; Max 5B; R-SA; PS; 75% felsic	Grab samples every 5' & at lithology changes
				Sand is VF-VC, 5% M; PS; A-SR; 60% felsic. Dry; weak rxn to HCl; light brownish grey, 2.5Y 6/2.	
285	G			@285' bgs; same as above.	@286' Add 2 gal H_2O
					Drilling is slow
290	G			@290' bgs; ↑ gravel, 77%; ↓ sand, 20%; 3% silt	*288-298', occnl.
				Gravel: VFP-LC, 50% VCP-SC, Max 1 ft; PS; A-R; A≤CP≤R; 60% felsic. Caliche coating.	sm boulders: 0.5-1.5'
				Sand: VF-VC, 50% VF-F, 50% C-VC; PS; A-R; A≥C≥R; 80% felsic. Sediment is dry; 2.5Y 7/1,	*@300' bgs, gravels are multilithic
295	G	4/13/15 DTW= 296.9 ▼		light grey; Mod rxn to HCl; trace mica.	
				@295' bgs; same sediment as above, only there	@295' Add 2 gal H_2O
				is clear evidence of weathering, clay rinds,	@297' Add 2 gal H_2O
	G			gravel clasts crumble with mod pressure,	Medium compaction @297
				some iron oxidation (staining)	@298'; moist/saturated?
300	G			@298' bgs; saturated sediment	sediment. Driller comments
				298'-300' bgs; SILTY SANDY GRAVEL (msG)	drilling feels different - as
				70% gravel, 19% Sand, 11% Silt	it would in saturated sed.
				Gravel is VFP-LC, 30% VFP-MP, 70% LP-LC;	DTW on 4/9 = 297.05' bgs (not
				PS; A-R; A≤MP≤R. Sand is VF-VC,	representative)
305	G			40% VF-M, 60% C-VC; PS; SA-SR; 30% basalt.	@302' bgs; New drive
	GW I-001			Gravel is 30% basalt. Sediment is 2.5Y 3/1, very dk grey,	barrel: 8 5/8" x 3.12' with
	I-001dup			mod-strg HCl rxn; wet; trace mica; clay rinds.	brushes
				300'-315' bgs; GRAVEL (G); 90% G, 10% S	@307' bgs; drive barrel
				Gravel: VFP-VCP, 40% FP-MP; Max 120mm; PS;	coming up empty - driller
310				A-R; A≤MP≤R; 30% basalt. Clean river gravels.	comments we are advancing
				Sand: M-C; PS; SA-SR; 30% basalt. No HCl rxn.	and pushing boulders out of
				@305'; sample contains more sand, but large cobbles	the way - use sand
	Waste G I-001			and boulders are pushed out of the way, thus not represented.	pump; some return of finer
				@310; no return from drive barrel from 307-313'	sediments. Drill rate ↓↓
315	G			@313'; color is 2.5Y 3/3 Dk. Olive braun	@313'; collect sample for waste
				@315'; 60% G, 32% S, 8% Silt; SANDY GRAVEL	characterization
	G			Gravel: 40% FP-MP, 60% CP-SC, max 100mm; MS;	@315: moderate dry strength,
				SA-SR; multi-lithic, 20% basalt. Sand: 80% VF-M,	slightly micaceous
				20% C-VC; MS; WR; 80% qtz fld; 2.5Y 6/2 light brownish gray (dry); slight rxn HCl	

Reported By: Kira Murray & Janine Carter | Reviewed By: Kevin Bergstrom
Title: Geologist (s) | Title: Sr. Geologist
Signature: Kira Murray, Janine Carter | Date: 4/9/15 | Signature: Kevin Bergstrom | Date: 7/20/15

A-6003-642 (03/03)

9 KS 5/13/15 x3 5/13/15

BOREHOLE LOG

Page 8 of 10
Date: 4/15/15

Well ID: C9447 | Well Name: 299-E28-31 | Location: 300m N of B-Plant
Project: 8 M24 TPA GW Monitoring Wells | 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
320	G			315-325' bgs; SANDY GRAVEL (sG)	Drilling w/Cable Tool: DB
	GW I-002			@317.5' bgs distinct change, sharp	Grab samples every 5' &
				Gravel: 50%, Sand: 45%, Silt: 5%	at lithology changes
	G			Gravel: MP-SC; MS; SR; 30% Basalt; 100mm max	@320' water is rusty,
325	G			Sand: VF-C, 75% M, 15% VF-F; WS; WR; 80% 32 1/4s 90% felsic. 10YR 6/3, pale brown	coats all drilling tools
				No HCl rxn; micaceous; moist/wet	@323' heaving sands
				@320' bgs; 2.5Y 5/2 grayish brown; wet	"drilling" w/ sand pump
				@324' bgs: 65% G, 27% S, 8% M.	sands heave ~5' at a
				Gravel: MP-SC, 60% CP-SC, max 70mm; A-SR;	time. Progress is slow.
330	G			MS; 60% basalt. Sand: A-R; VF-VC, 50% M-C;	@330' heaving sands still
	G			80% felsic; MS. Weak rxn to HCl.	Water became clear @325'
				325-330.5 bgs; GRAVELLY SAND (gS)	Possible Ringold A (9B) encountered? KS 4/22/15
				20% G, 75% S, 5% M. Gravel: CP-SC;	@332' begin hard-tool drilling
				R; MS; 60% basalt. Sand: VF-C, 80% VF-M;	w/10" bit
335				MS-WS; 30% basalt. No rxn to HCl.	
				@330' MS; F-VC, 60% C-VC; 50% basalt. 10YR 4/3 brown	
				330.5-337 Silty Sandy GRAVEL (msG)	Difficult to drive KS 4/22/15
				50% gravel, 30% Sand, 20% Silt. Gravel:	casing 332-338' (335'
				m-CP, 20% CP, R, 90% felsics. 80% MP	DTW 4/23/15 = 297.7')
340				A, 40% basalt. Ocnl SC, R, 80% felsics	HT mud was very
	W 341'			Max = 90mm. Sand: VFS-VCS, 30% mafics	thick 5Y 4/2 olive gray
				80% VF-FS, WS, SA. 2.5Y 4/2	Slow drilling = 5hr/2' shell
				dark grayish brown, no rxn w/HCl,	producing water ~2.5gpm
				moist. Tightly compacted w/ ~~trace~~ KS 4/22/15 clay	(~30% of silt is clay)
345				Ocnl iron-oxide staining, black	unable to determine
				clay skin around some gravels	plasticity, cemented (weak)
				337-344 Sandy GRAVEL (sG)	335-342 drilling/drive
	W 347'			60% gravel, 35% Sand, 5% Silt. Gravel:	casing easier = ~1'/hr
				cuttings from HT; unable to determine	cuttings/mud (337-344')
350				angularity or size distribution but	are ~~runny~~ KS 4/22/15 thinner
				can see 70% felsics. Sand: VFS-MS	than previous grab.
				mod. Sorted, 70% VF-FS. 5Y 4/2 olive	Driller thinks formation
				gray, wet no rxn w/HCl	is loose w/cobbles +
				344-353 Silty Sandy GRAVEL	possibly heaving sand.
355				(msG) 50% gravel, 30% sand, 20% Silt.	Difficult to drive casing
				Gravel: recovered few intact F-MP, WR	@342.8', drill rate ↓
				Quartz/Quartzite, few 15mm chunks	@347' few clay nodules
				of broken basalt. Sand: VF-M, ave	2.5Y 5/2 grayish brown
				VF/F (70%), 2.5Y 5/2 grayish brown, wet no rxn w/HCl,	wet, @350' no clay nodules

Hard Tool Drilling

HT grab from bailer: washed and unwashed; washed and unwashed; washed and unwashed; washed and unwashed

@~340' add 40 gal H2O
@345' add 35 gal H2O
@~150' add 290 gallons H2O

Reported By: Janine Carter / Kim Schuyler
Title: Geologist
Signature: Janine Carter / Kim Schuyler Date: 4/15/15

Reviewed By: Kevin Bergstrom
Title: Sr. Geologist
Signature: Kevin Bergstrom Date: 7/20/15

A-6003-642 (03/03)

10 vs 5/13/15 vs 5/13/15

BOREHOLE LOG

Page 9 of 9 10
Date: 4/27/15

Well ID: C9447 | Well Name: 299-E28-31 | Location: 300m N of B-Plant
Project: 8 M24 TPA GW Monitoring Wells | 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
350	(repeat)	Washed and unwashed HT grab from bailer Hard too		344-353 Silty Sandy GRAVEL (msG) 50% gravel, 30% Sand, 20% Silt. Gravel: recovered few intact → gravels 40% basalt F-MP, WR, quartz/quartzite, few 15mm chunks of broken basalt	Drilling w/cable tool (Hard tool) DTW=299.0' 4/28/15
355	(repeat)			Sand: VF-M, 70% VF/F, 2.5Y 5/2 grayish brown, wet no rxn w/HCl 353-362.0 Basalt	driller thinks basalt was encountered @ 353' bgs, difficult to advance casing
	G	WASHED AS RECEIVED		Grab from 350-355 had ↑↑ in basalt, cuttings are 5YR 4/1 to 4/1 dark gray. Gravels ~70% basalt	
360	G	WASHED AS RECEIVED		GRAB FROM 356-357 CUTTINGS ARE 100% BASALT. APPEARS TO BE VESICULAR FLOW TOP WITH ABUNDANT (≈10%) SECONDARY MINERALIZATION	WASHED THROUGH 10 MESH SCREEN >80% PASSED THROUGH SCREEN DURING WASH.
365				COLORS OF FRAGMENTS RANGE FROM 10YR 3/1 V.DK GRAY TO 10YR 2/1 (BLACK) HARD TOOL DRILLING RESULTS IN SIZE RANGE ≤ MED PEBBLE (100%) WITH VF PEBBLE AS DOMINANT SIZE	TD=362.0' bgs 5/11/15 casing=359.4' bgs
				362' T.D. AS ABOVE WITH ↑ SECONDARY MINERALS, FEW ANGULAR COARSE PEBBLE SIZE FRAGMENTS RECOVERED FROM BAILED CUTTINGS. ALL CUTTINGS BASALT OR ASSOCIATED VESICLE FILL SECONDARY MINERALIZATION	

Reported By: Kim Schuyler Greg Rasla | Reviewed By: Kevin Bergstrom
Title: Geologist 5/11/15 | Title: Sr. Geologist
Signature: Kim Schuyler | Date: 4/28/15 | Signature: [illegible] | Date: 7/20/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

299-E28-31 (C9447)
Log Data Report

Borehole Information:

Log Date:	2015-05-12	Filename:	C9447_HG-NM_2015-05-12	Site:	200 BP-5
Coordinates (WA St Plane)		DTW[1] (ft) :	298.5	DTW Date:	05/11/15
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	05/11/15	N/A	362	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Threaded Steel	1.0	13 3/8	12 3/8	0.5	1.0	139
Threaded Steel	1.5	12	10 3/4	5/8	1.5	359.4

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.). Water inside the casing was interpreted to exist at 298.5 ft based on the total gamma count rate; the e-tape is not long enough to reach this depth. The maximum logging depth achieved was 361 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

Logging System:	Gamma 5P	Type:	NMLS
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	5	6	7 Repeat
HEIS Number	1018710	1018711	1018712	1018713	1018714
Date	04/01/15	04/01/15	05/11/15	05/12/15	05/12/15
Logging Engineer	Spatz	Spatz	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	1	2 Repeat	5	6	7 Repeat
Start Depth (ft)	0.0	70.0	361.0	140.0	256.0
Finish Depth (ft)	141.0	85.0	256.0	255.0	278.0
Count Time (sec)	100	100	100	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
Log Speed (ft/min)	N/A	N/A	N/A	N/A	N/A
Pre-Verification	AL242CAB	AL242CAB	AL253CAB	AL254CAB	AL254CAB
Start File	AL242000	AL242142	AL253000	AL254000	AL254116
Finish File	AL242141	AL242157	AL253105	AL254115	AL254138
Post-Verification	AL242CAA	AL242CAA	AL253CAA	AL254CAA	AL254CAA
Depth Return Error (in.)	N/A	0	1.0 low	N/A	0.0
Comments	No fine gain adjustments made	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	3	4 Repeat	8	9 Repeat	
HEIS Number	1018715	1018716	1018717	1018718	
Date	04/01/15	04/01/15	05/12/15	05/12/15	
Logging Engineer	Spatz	Spatz	Felt	Felt	
Start Depth (ft)	0.0	55.0	140.0	150.0	
Finish Depth (ft)	140.25	70.0	297.0	152.0	
Count Time (sec)	15	15	15	15	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.25	0.25	0.25	0.25	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	AH201CAB	AH201CAB	C9447FP201551 2AV00CAB1	C9447FP201551 2AV00CAB1	
Start File	AH201000	AH201562	DO14000	DO15000	
Finish File	AH201561	AH201622	DO29701	DO15200	
Post-Verification	AH201CAA	AH201CAA	C9447FP201551 2RV00CAA1	C9447FP201551 2RV00CAA1	
Depth Return Error (in.)	N/A	1.0 high	N/A	2.0 high	
Comments	None	None	None	Unable to collect full 10% repeat due to software problem	

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:	06/10/15	Reference:	HGLP-MAN-003, Rev. 0

A casing correction for a 1/2-in. thick casing was applied to the log data to 139 ft. Below 139 ft a casing correction for a 5/8-in. thick casing was applied.

A correction for water was applied below 298 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 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 are plotted for the entire borehole.

Elevated U-238 concentrations are indicated from approximately 350 to 355 ft. The spectra indicate the uranium is naturally occurring as evidenced by the daughters, e.g., Bi-214, that occurs late in the U-238 decay chain. There is no detection of Pa234m, which in the relative absence of daughters lower in the decay chain, is considered to be evidence of processed uranium. It is not known if the enhanced U-238 is related to a sedimentary layer or is the result of radon accumulation.

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 relatively high moisture count rate at approximately 64 ft may be the result of the driller adding approximately 120 gallons of water at this depth to facilitate drilling.

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 (0-380 ft)
Natural Gamma Logs (0-160 ft)
Natural Gamma Logs (150-310 ft)
Natural Gamma Logs (300-460 ft)
Combination Plot (0-120 ft)
Combination Plot (110-230 ft)
Combination Plot (220-340 ft)
Combination Plot (330-450 ft)
Combination Plot (0-380 ft)
Total Gamma & Moisture (0-190 ft)
Total Gamma & Moisture (180-370 ft)
Total Gamma & Hanford Gamma Unit (0-380 ft)
Repeat Section of Natural Gamma Logs (70 to 85 ft)
Repeat Section of Natural Gamma Logs (256 to 278 ft)
Moisture Repeat Section (55 to 70 ft)
Moisture Repeat Section (150 to 152 ft)

[5] Hanford Gamma Unit

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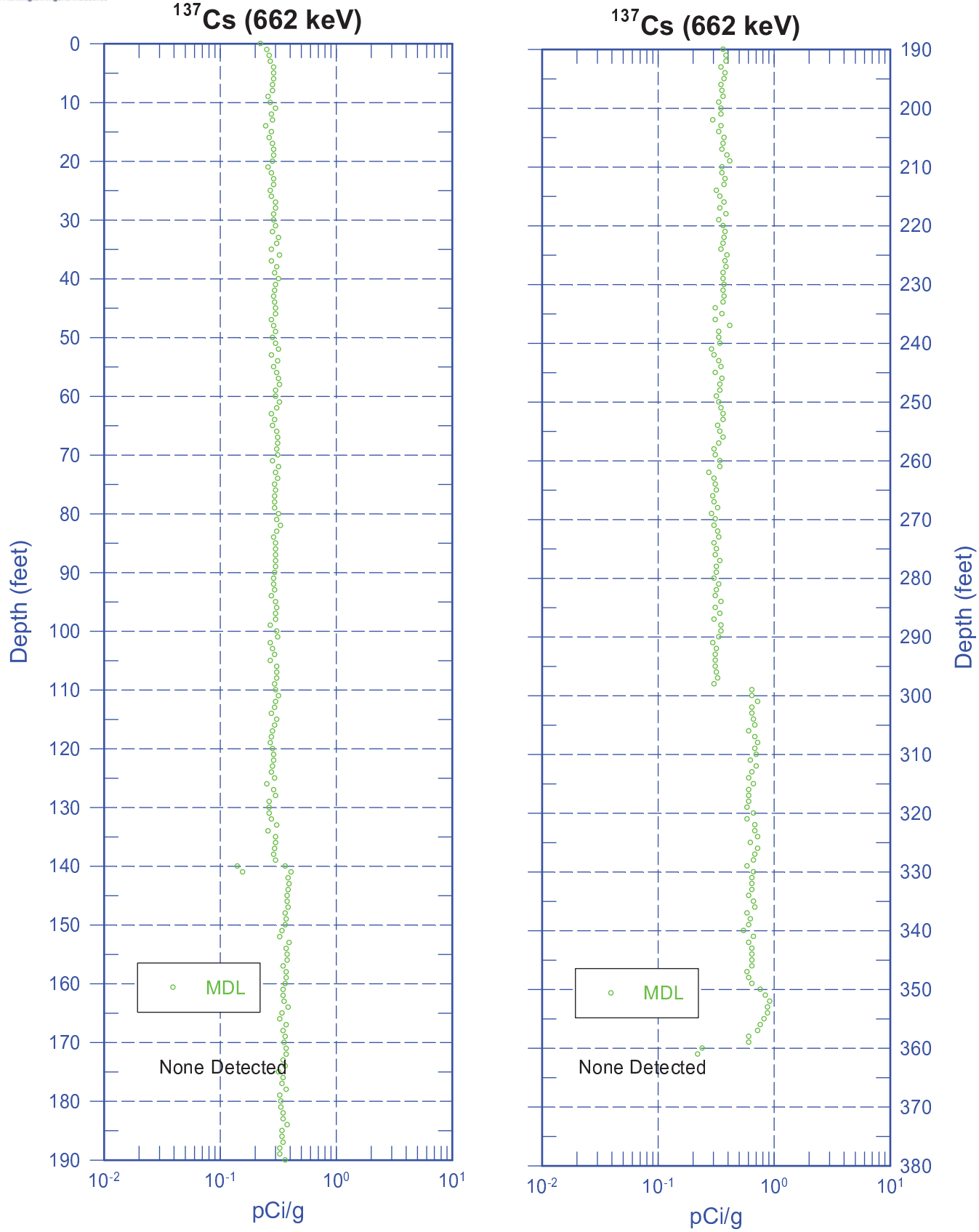
299-E28-31 (C9447)
Manmade Radionuclides



Zero Reference - Ground Surface

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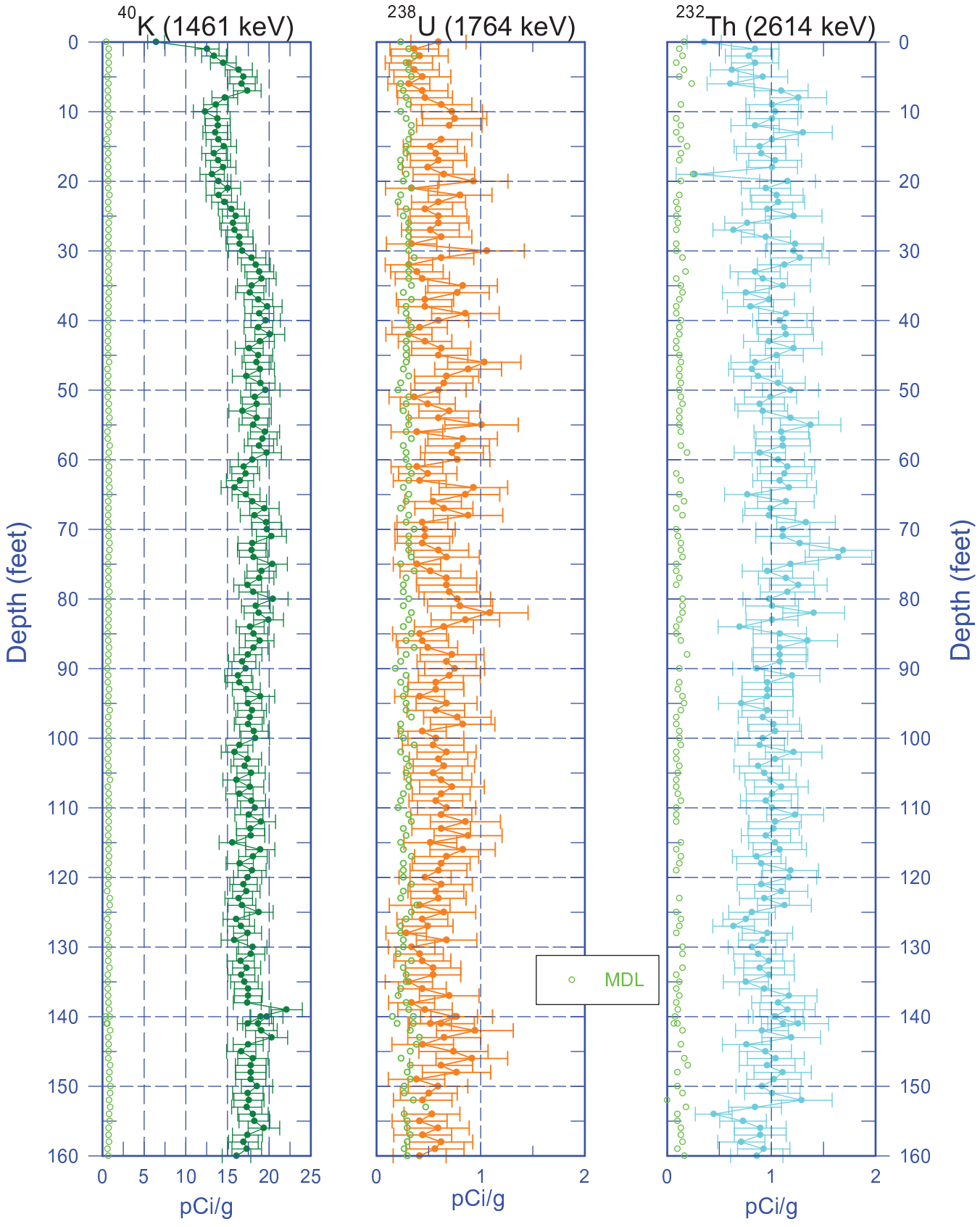
299-E28-31 (C9447)
Natural Gamma Logs



Zero Reference - Ground Surface

Stoller Newport News Nuclear
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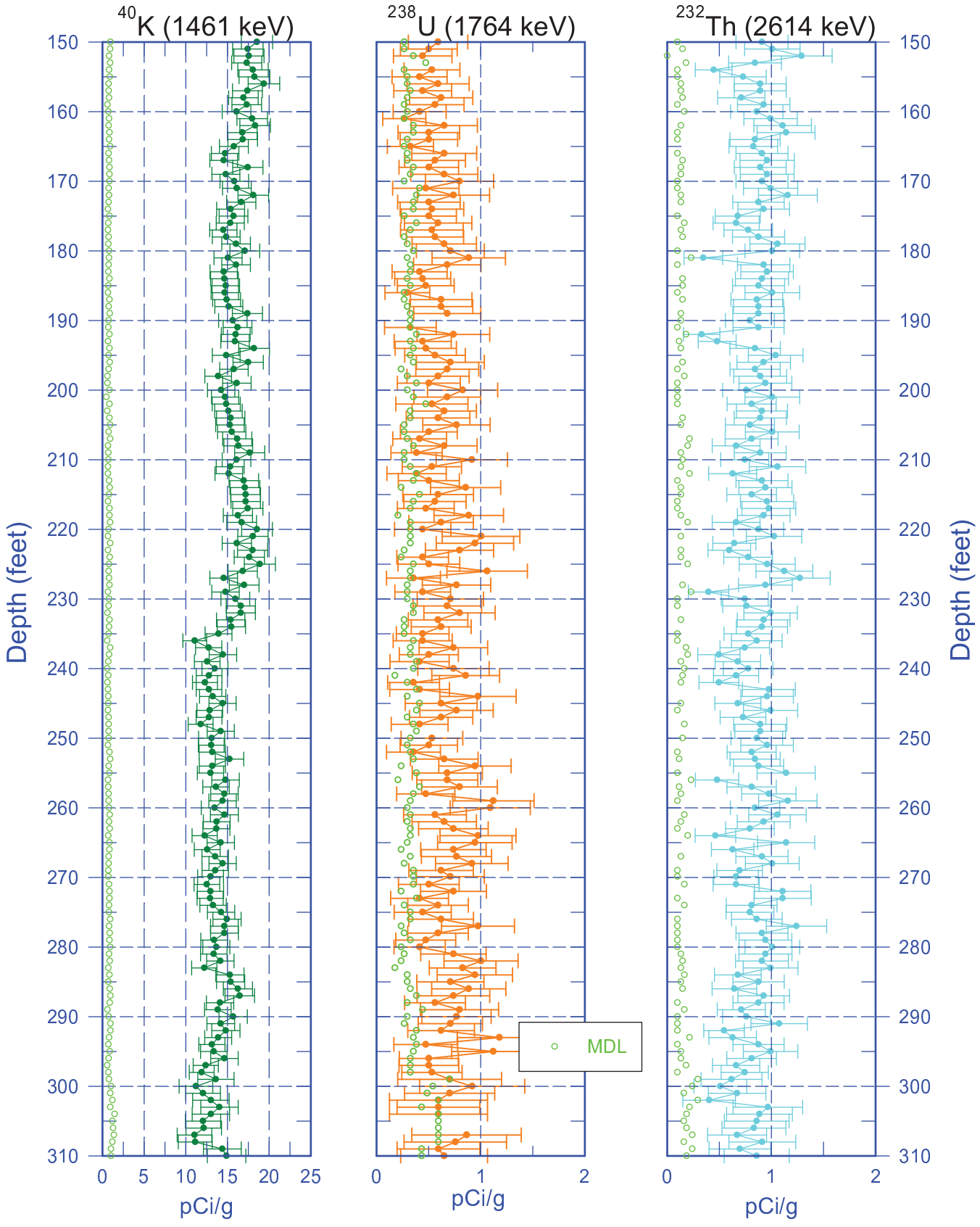
299-E28-31 (C9447)
Natural Gamma Logs



Zero Reference - Ground Surface

Stoller Newport News Nuclear
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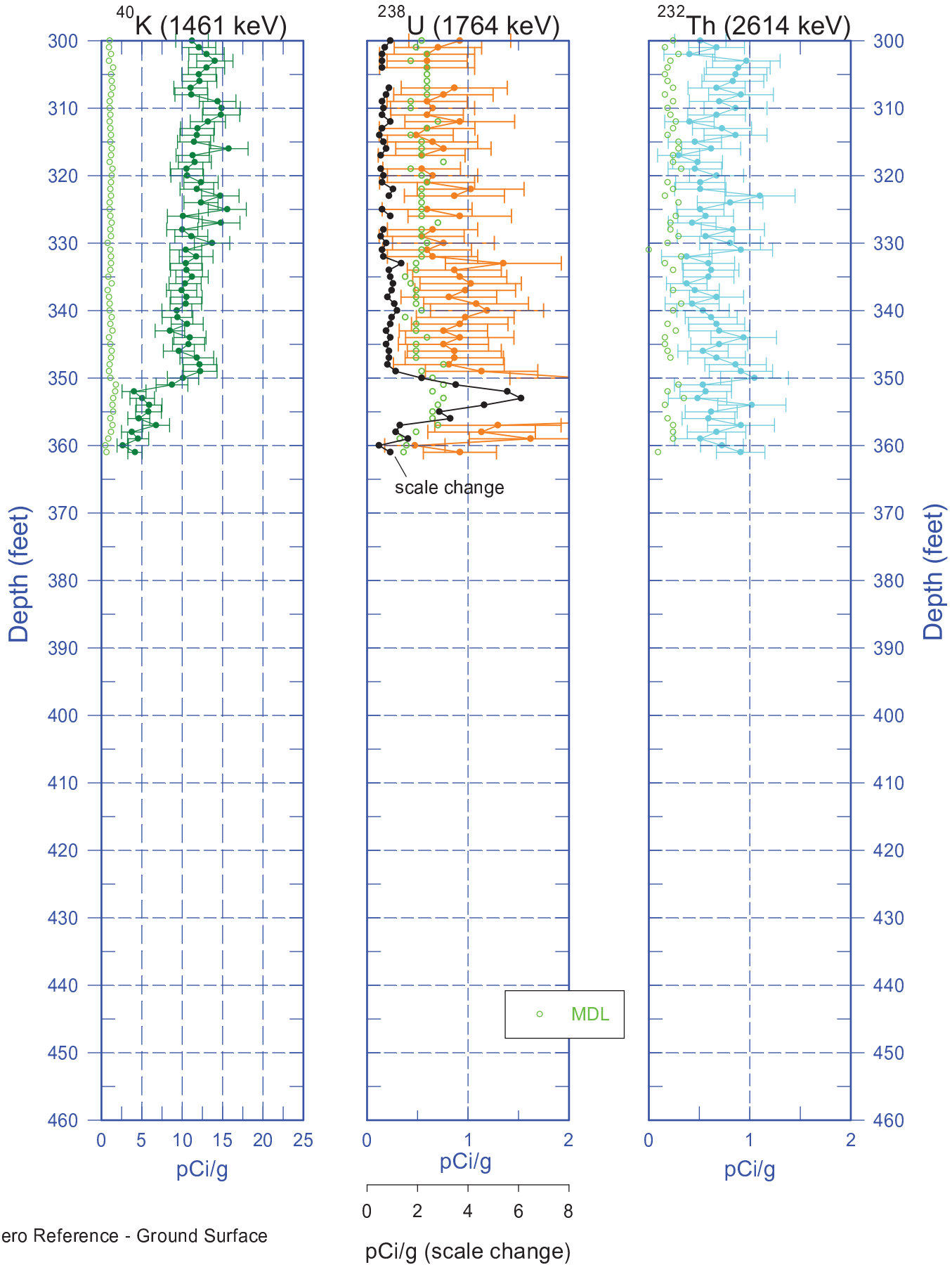
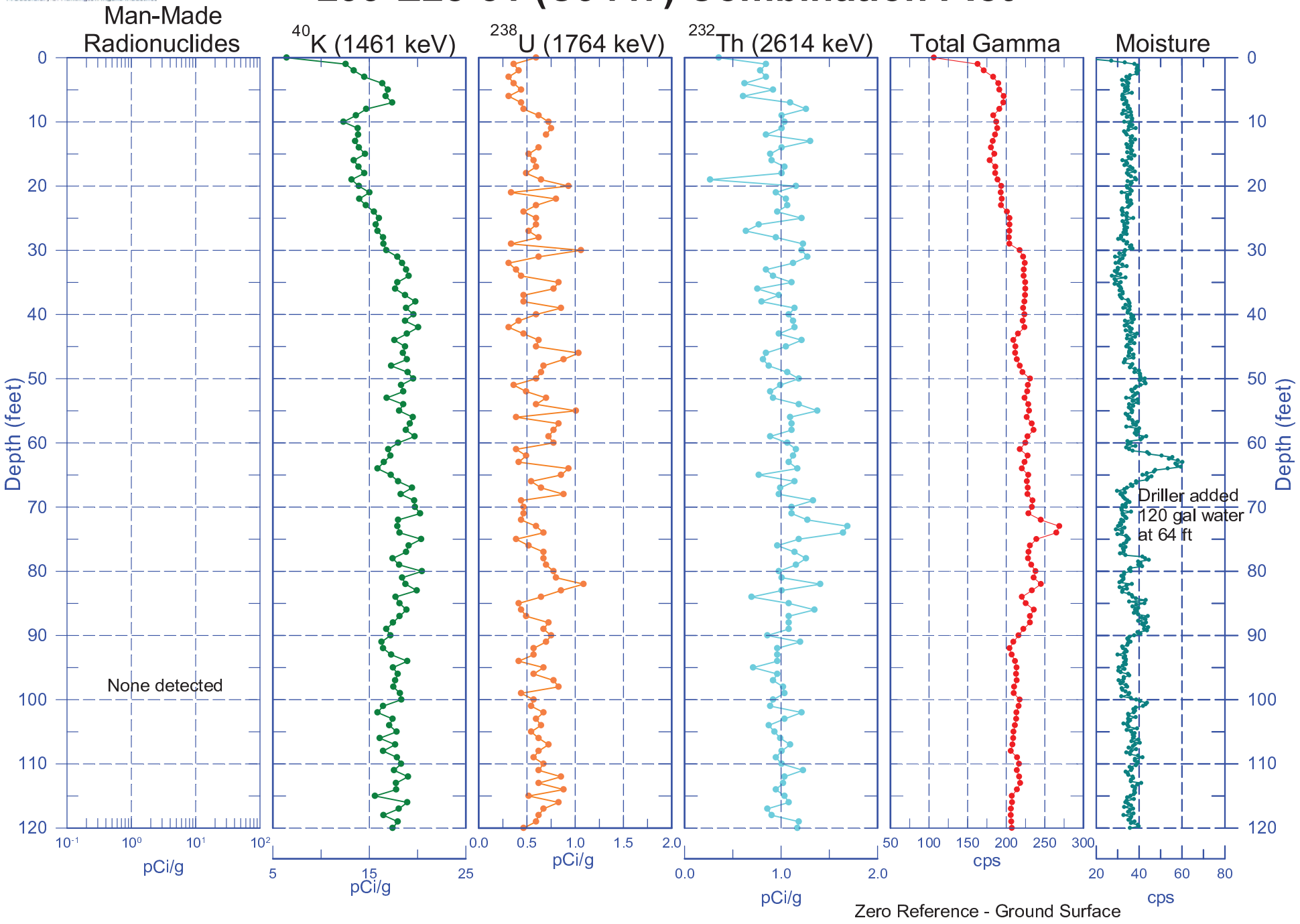
299-E28-31 (C9447)
Natural Gamma Logs



Zero Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E28-31 (C9447) Combination Plot



Stoller Newport News Nuclear
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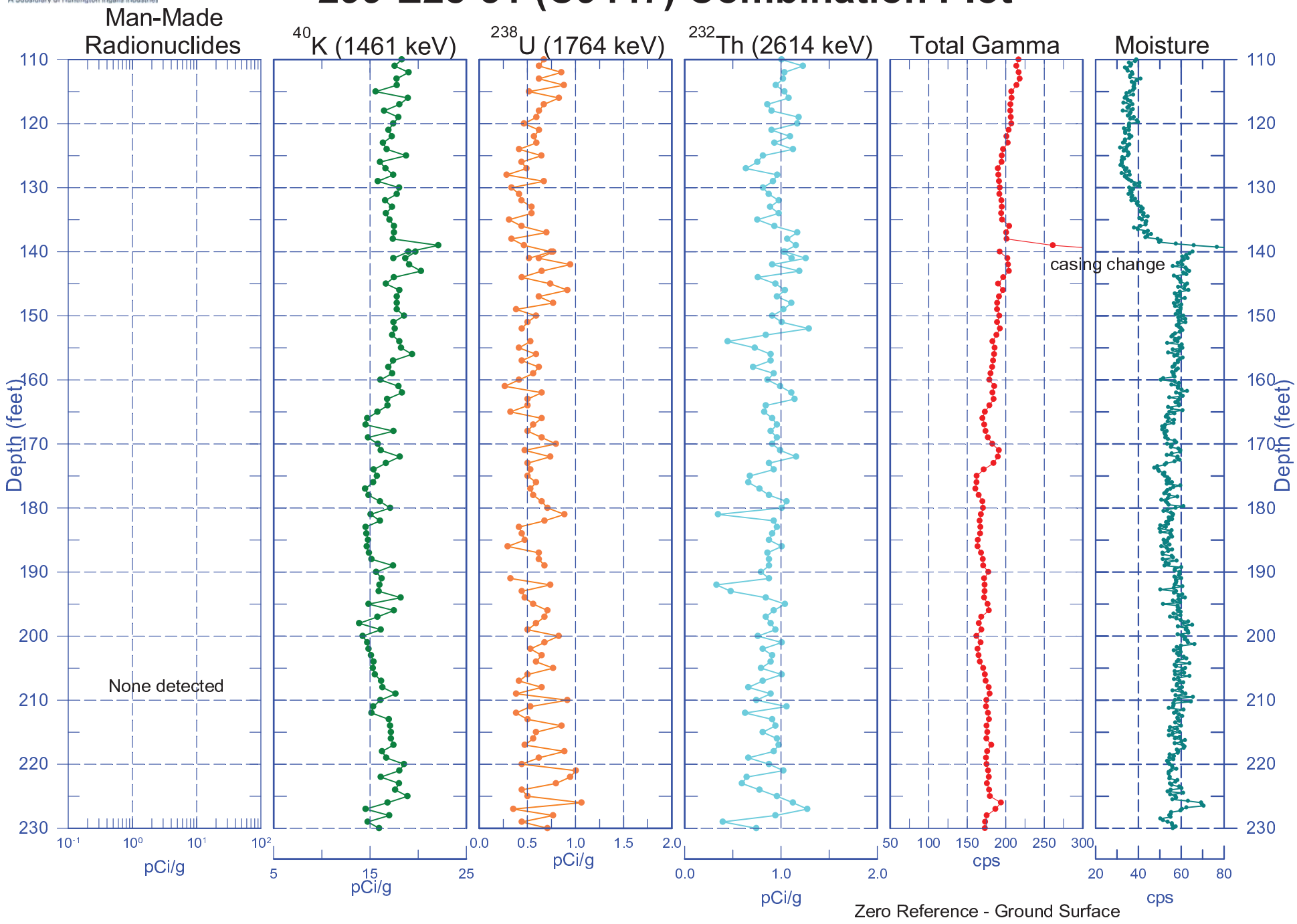
299-E28-31 (C9447) Combination Plot



Stoller Newport News Nuclear
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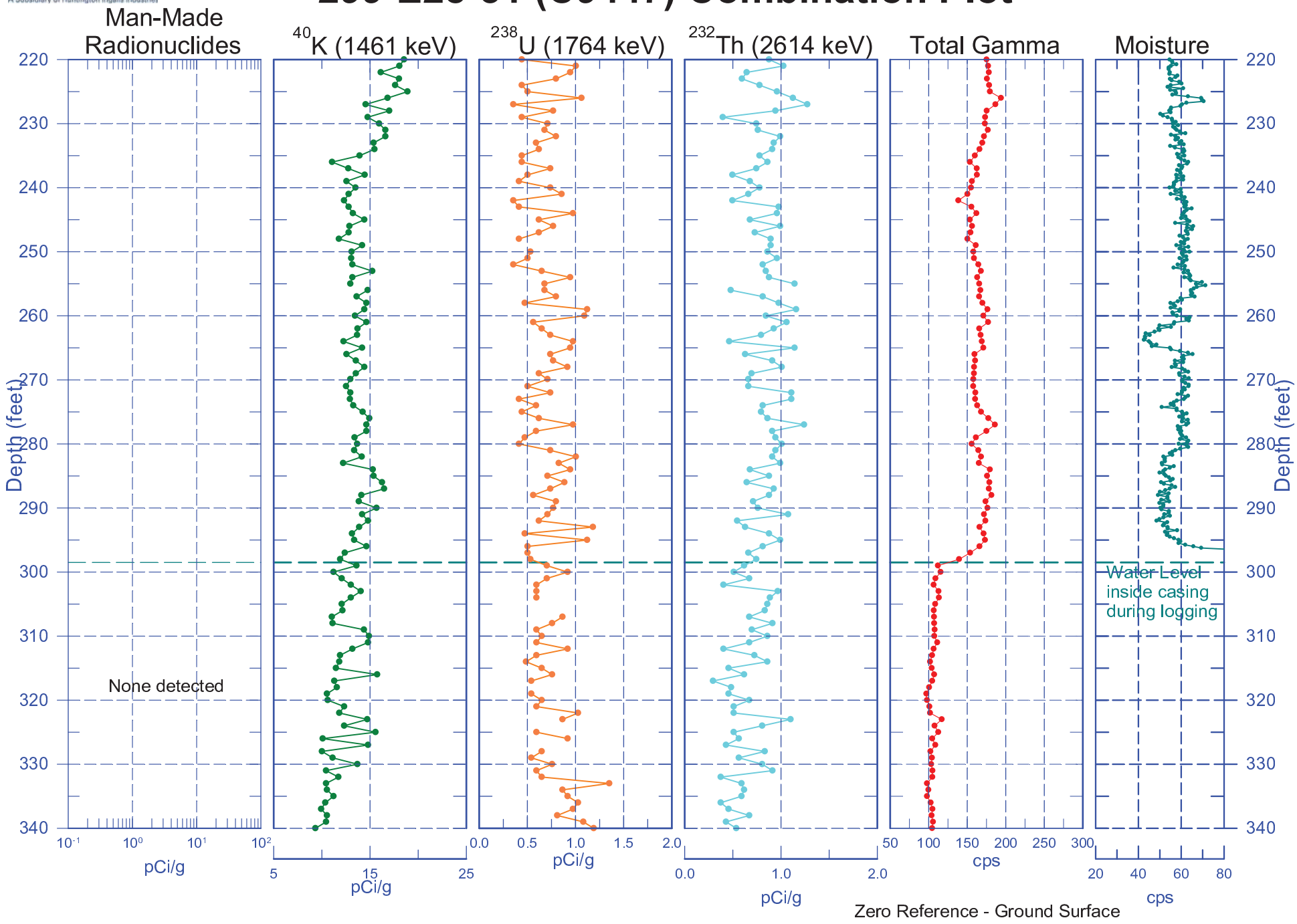
299-E28-31 (C9447) Combination Plot



Stoller Newport News Nuclear
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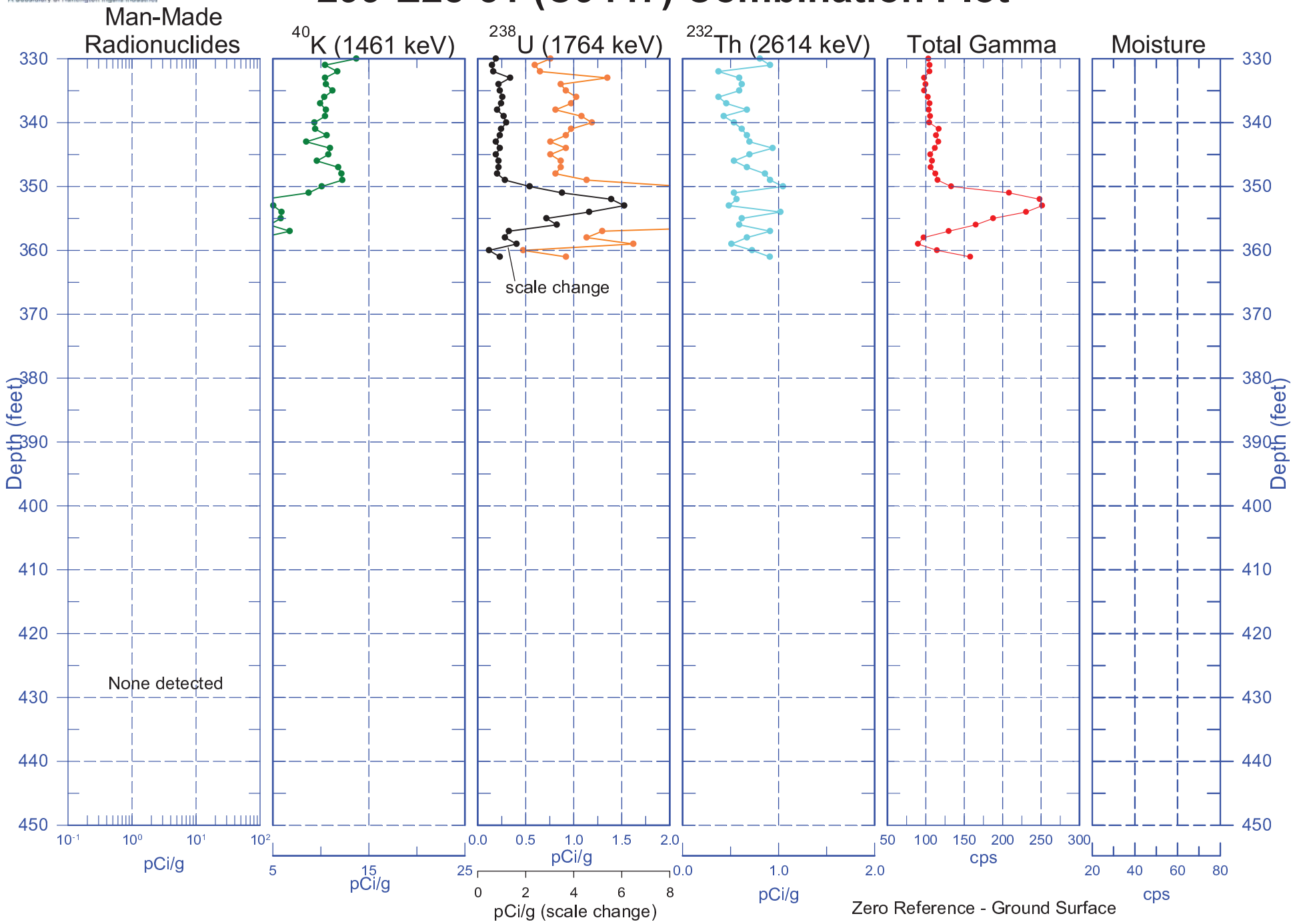
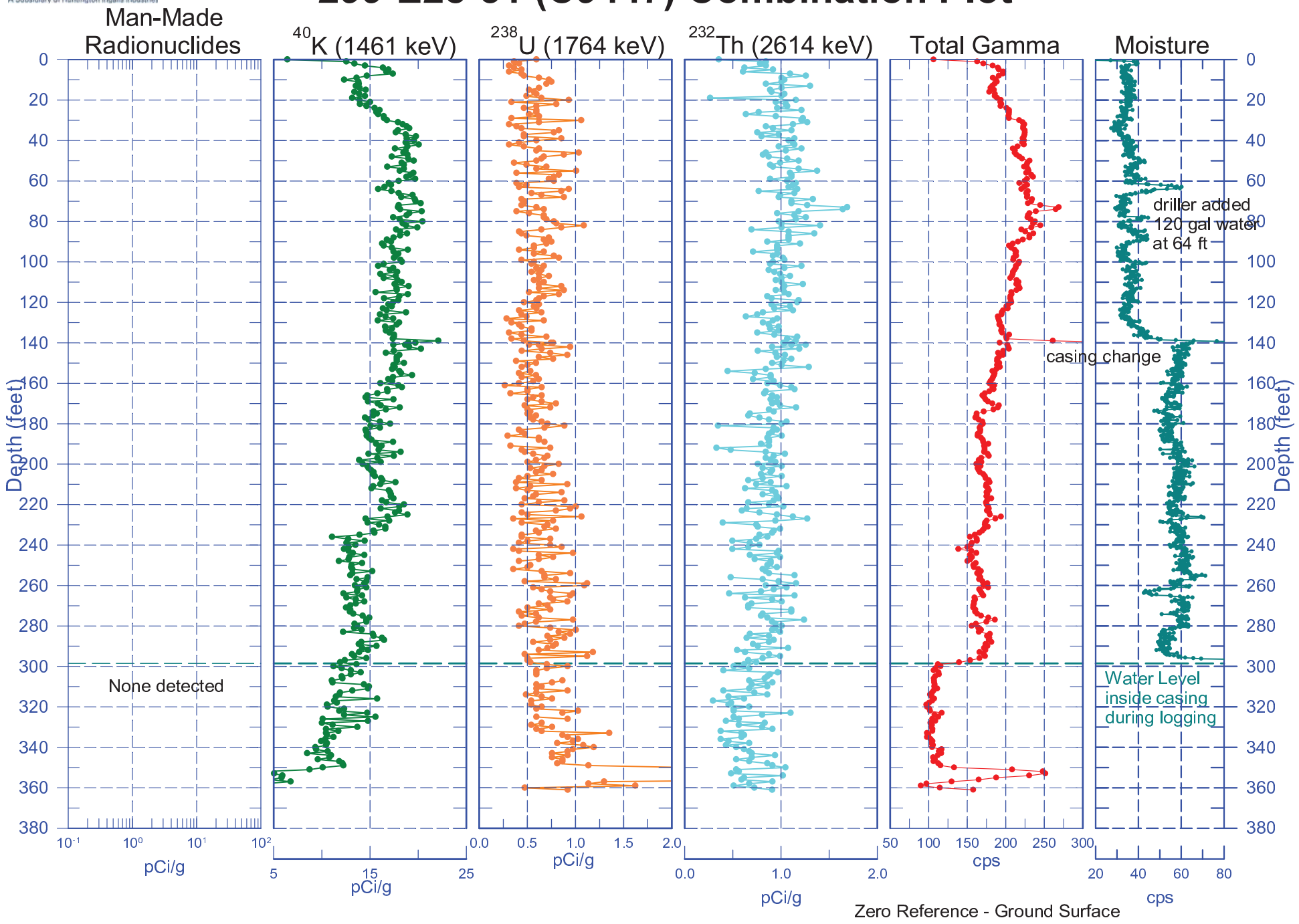
299-E28-31 (C9447) Combination Plot



Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E28-31 (C9447) Combination Plot



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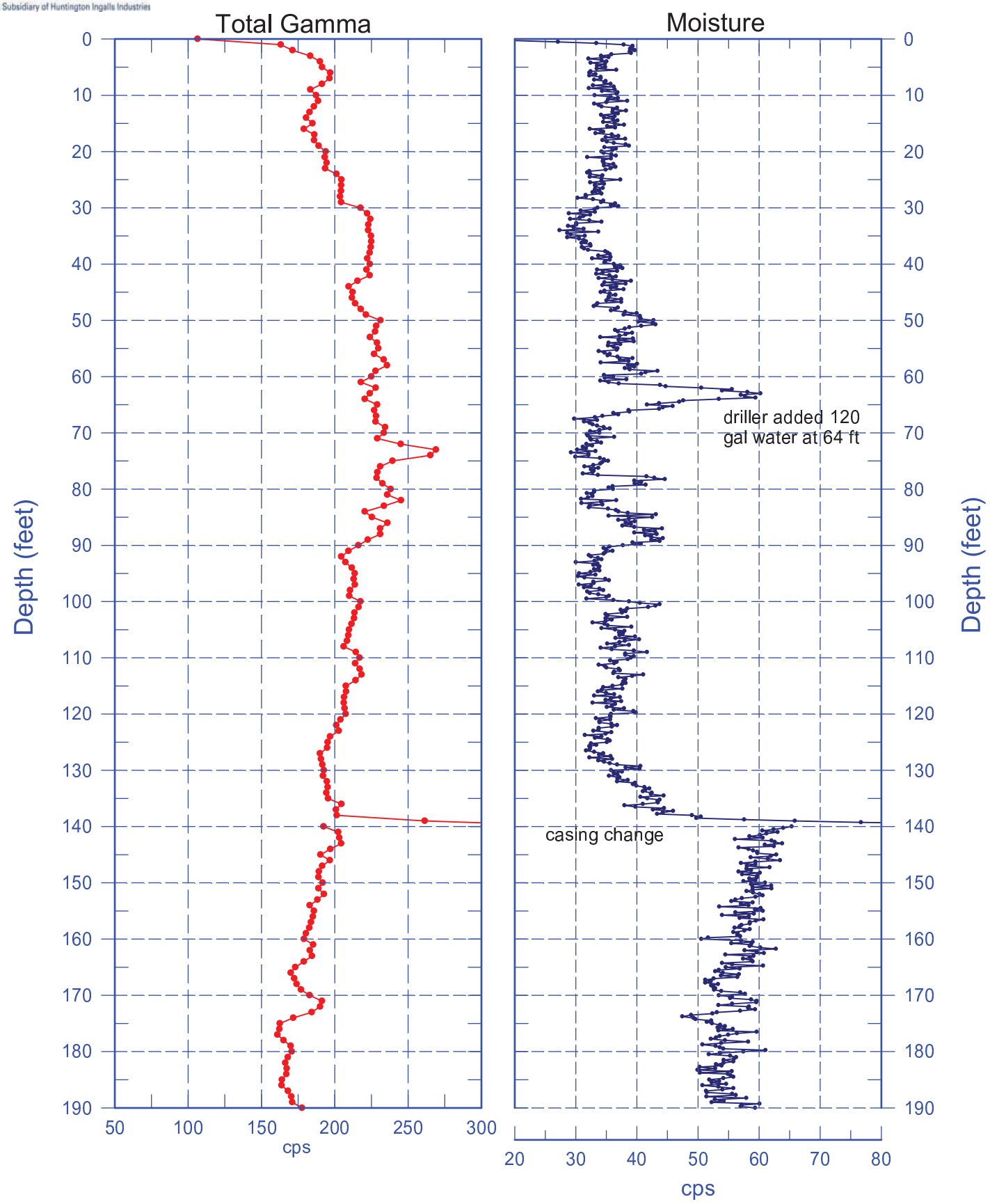
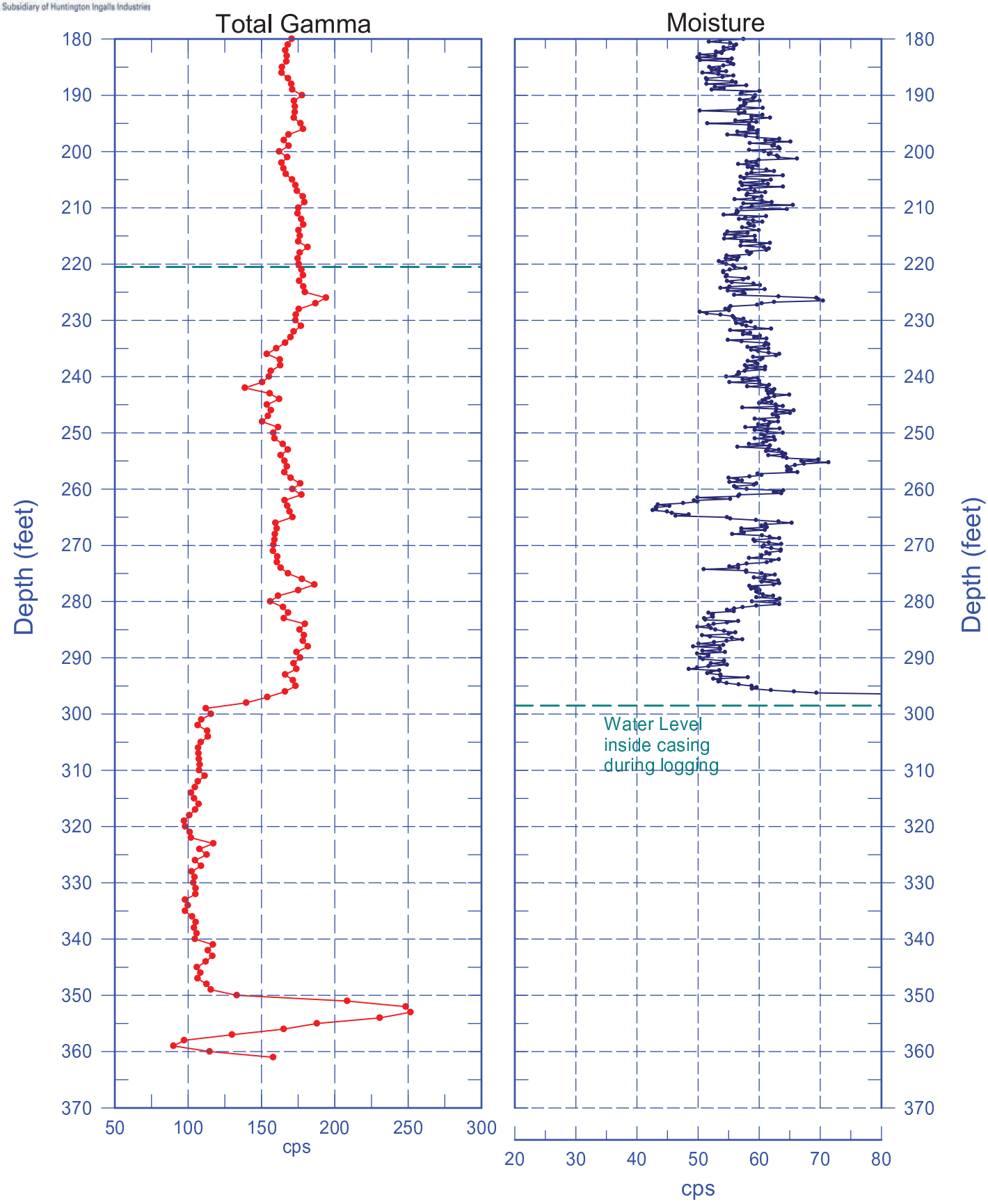
299-E28-31 (C9447)
Total Gamma & Moisture



Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E28-31 (C9447)
Total Gamma & Moisture



Reference - Ground Surface

Stoller Newport News Nuclear
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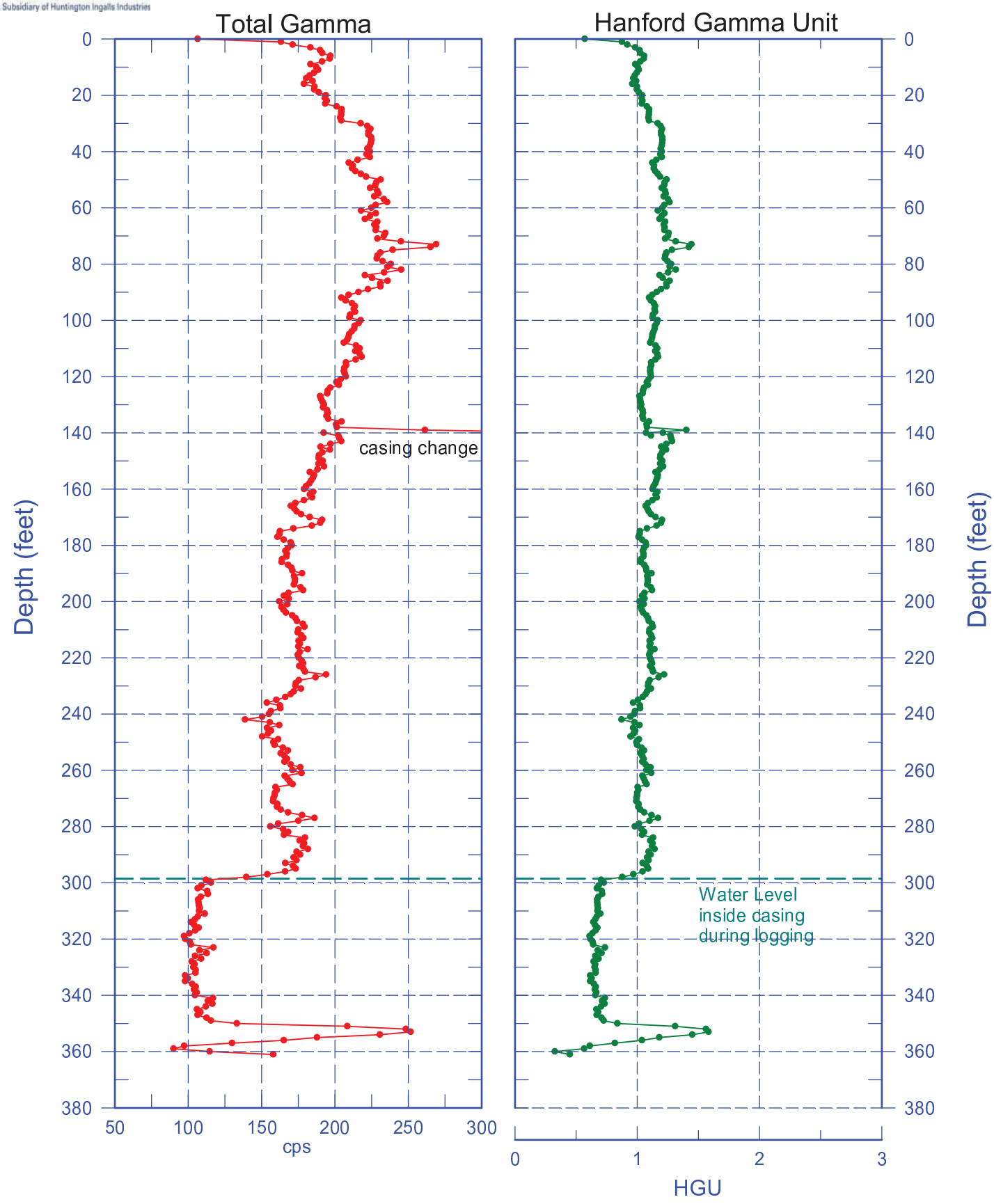
299-E28-31 (C9447)

Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

Stoller Newport News Nuclear
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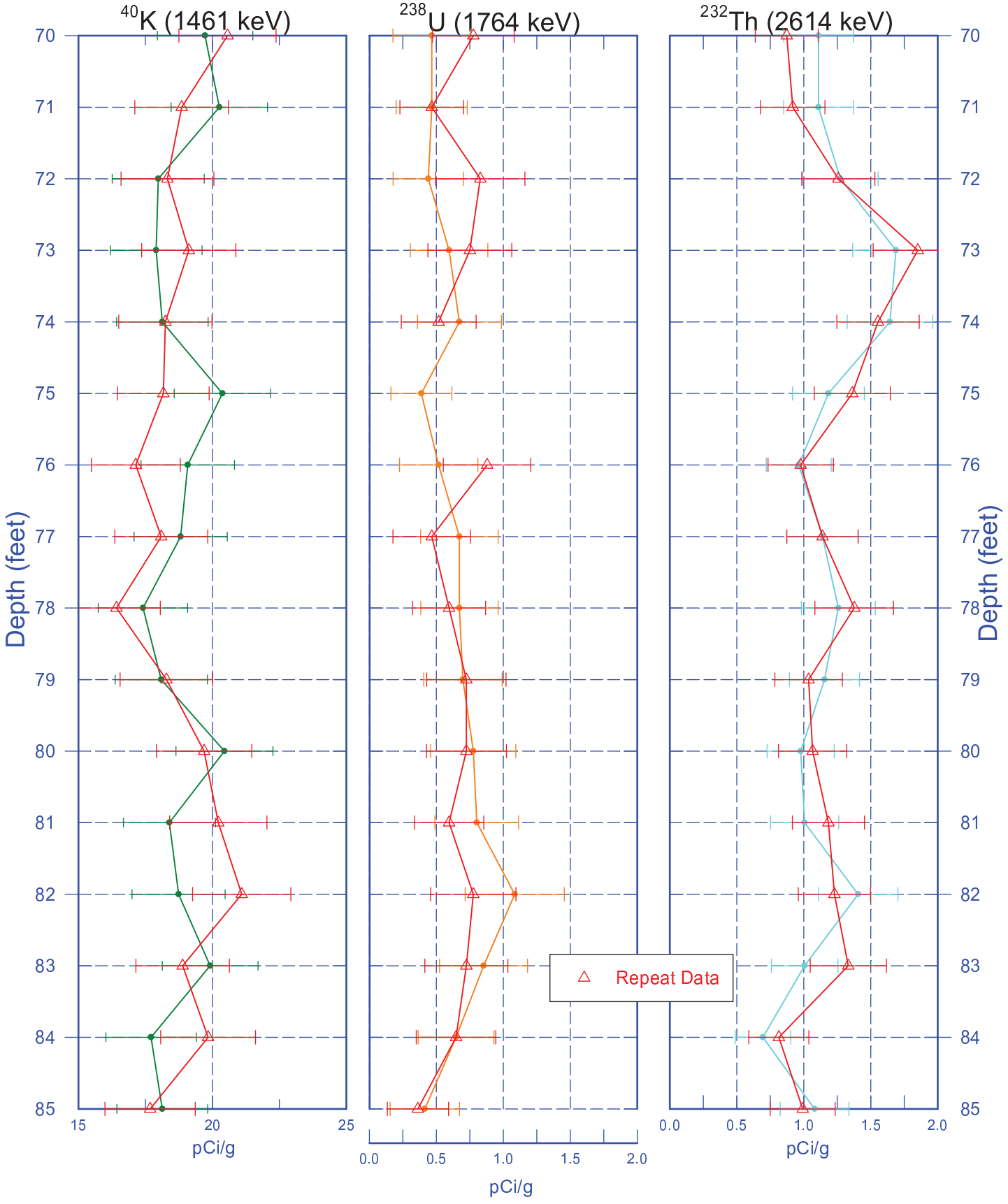
299-E28-31 (C9447)

Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

Stoller Newport News Nuclear
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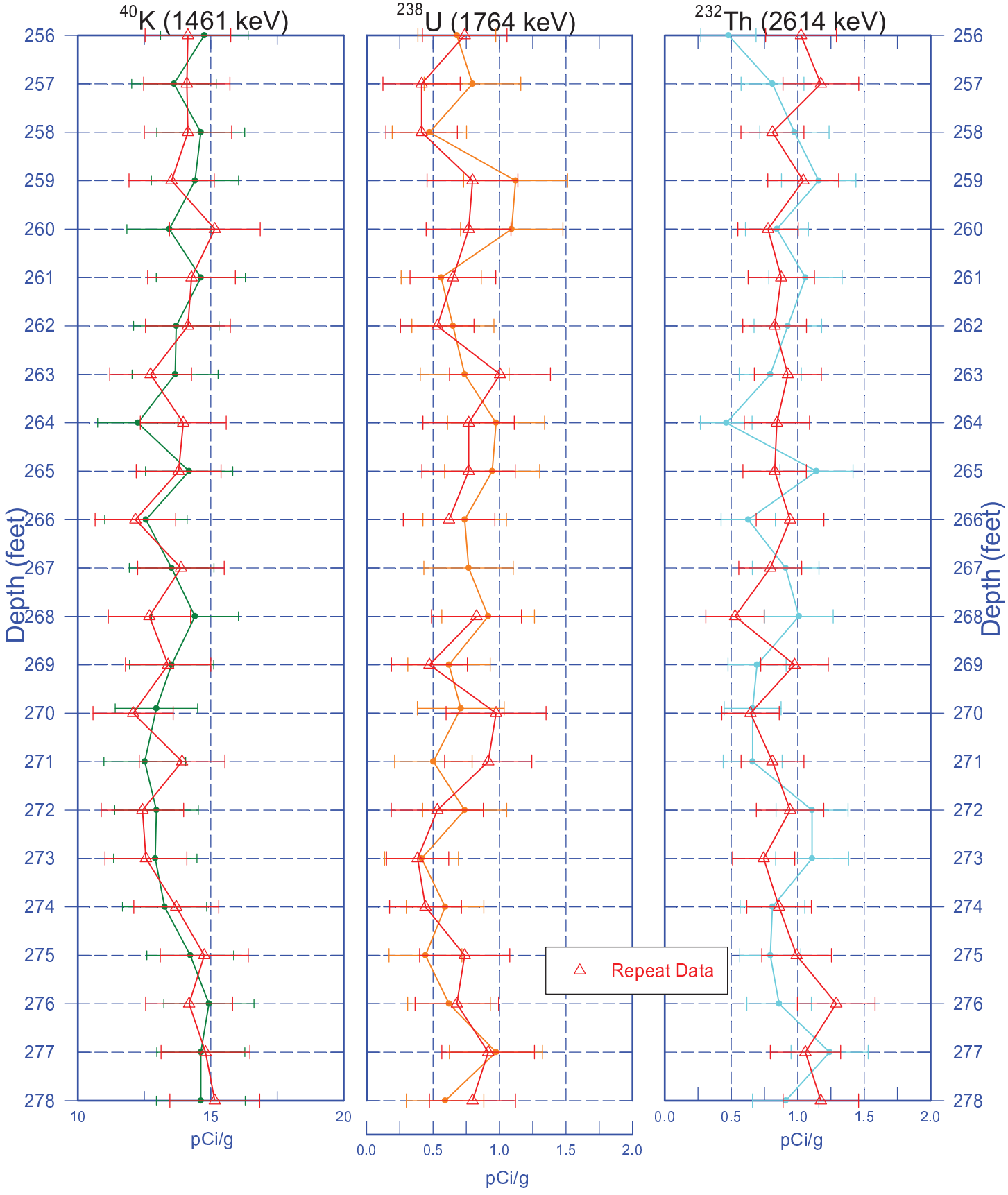
299-E28-31 (C9447)

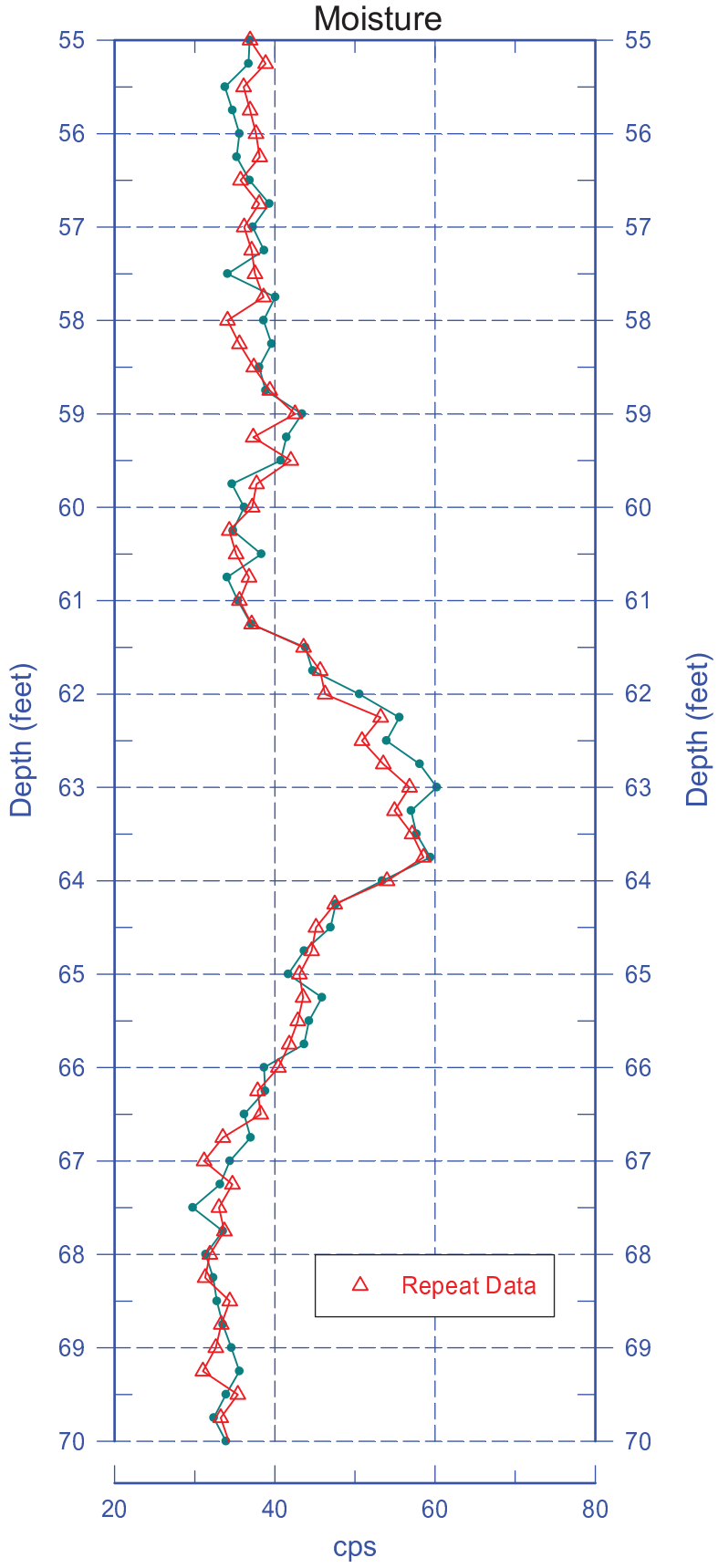
Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

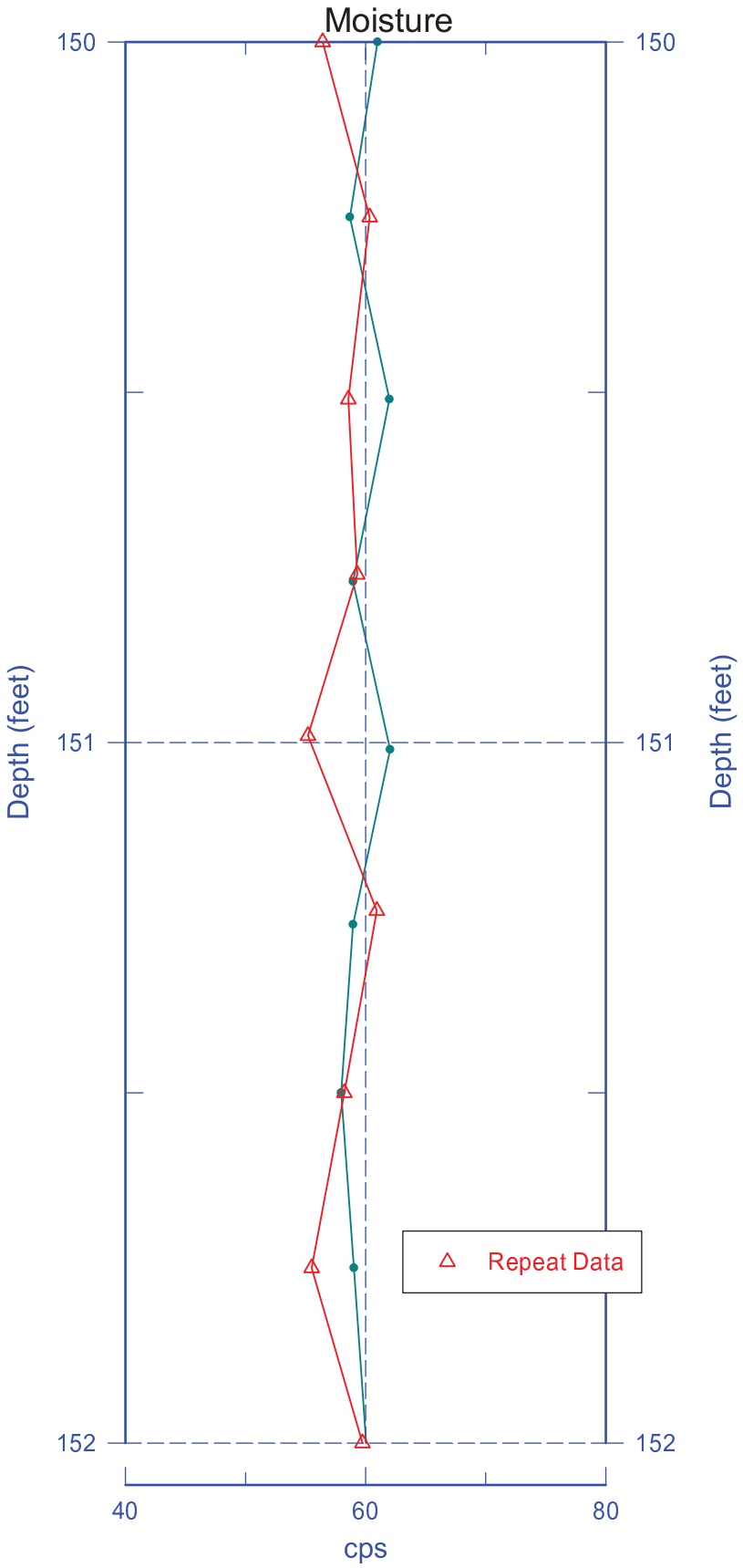
299-E28-31 (C9447)
Moisture Repeat Section



Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E28-31 (C9447)
Moisture Repeat Section



Reference - Ground Surface

cm
C9447 5 ft

cm
C9447 10 ft

cm
C9447 15 ft

cm
C9447 20 ft

cm
C9447 25 ft

cm
C9447 30 ft

cm
C9447 35 ft

cm
C9447 40 ft

cm
C9447 45 ft

cm
C9447 50 ft

cm
C9447 55 ft

cm
C9447 60 ft

cm
C9447 65 ft

cm
C9447 70 ft

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C9447 75 ft

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C9447 80 ft

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C9447 85 ft

cm
C9447 90 ft

cm
C9447 95 ft

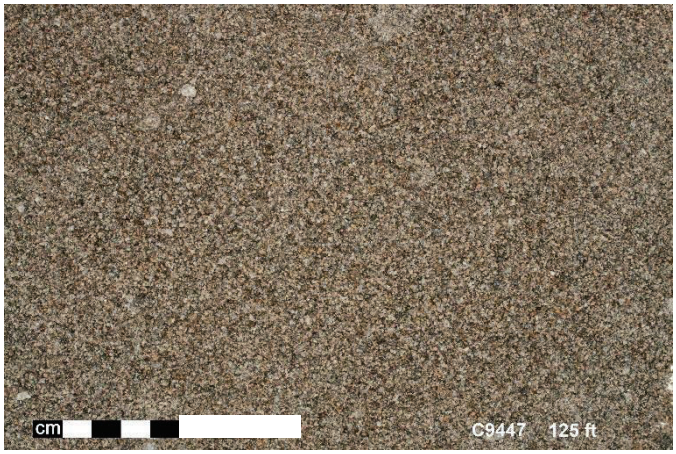
cm
C9447 100 ft

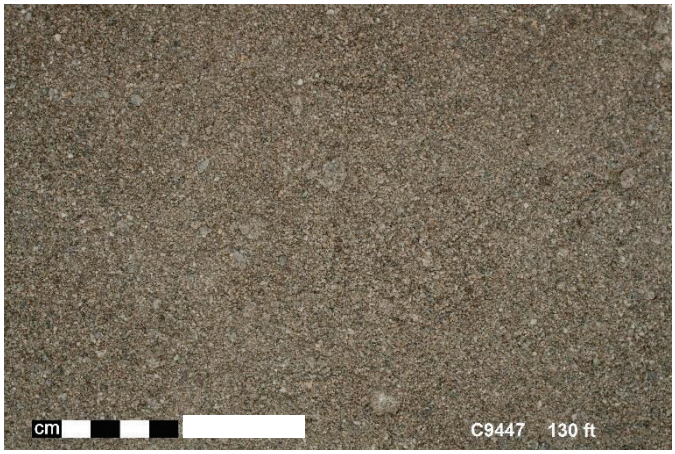
cm
C9447 105 ft

cm
C9447 110 ft

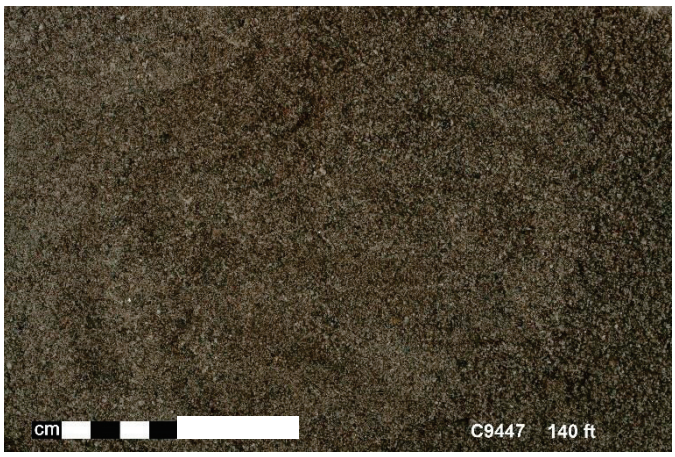
cm
C9447 115 ft

cm
C9447 120 ft


cm
C9447 125 ft


cm
C9447 130 ft

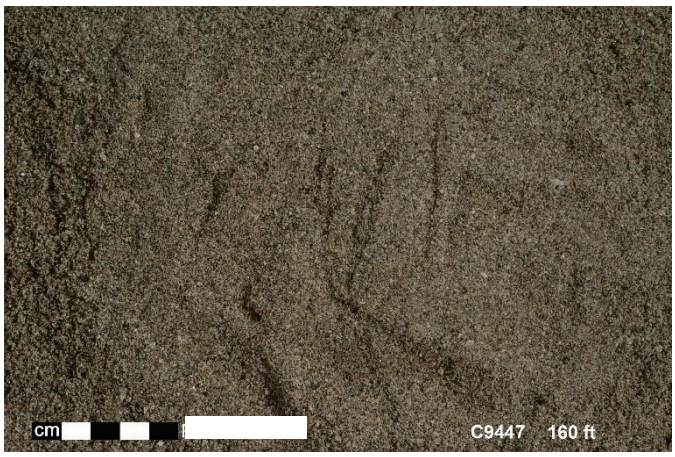
cm
C9447 135 ft


cm
C9447 140 ft

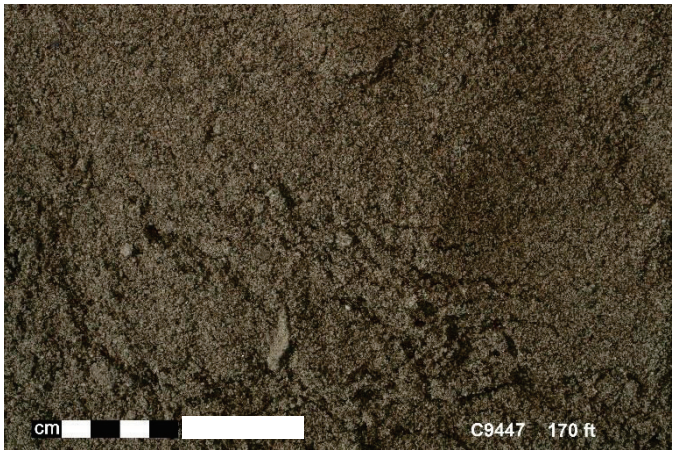
cm
C9447 145 ft

cm
C9447 150 ft

cm
C9447 155 ft


cm
C9447 160 ft

cm
C9447 165 ft

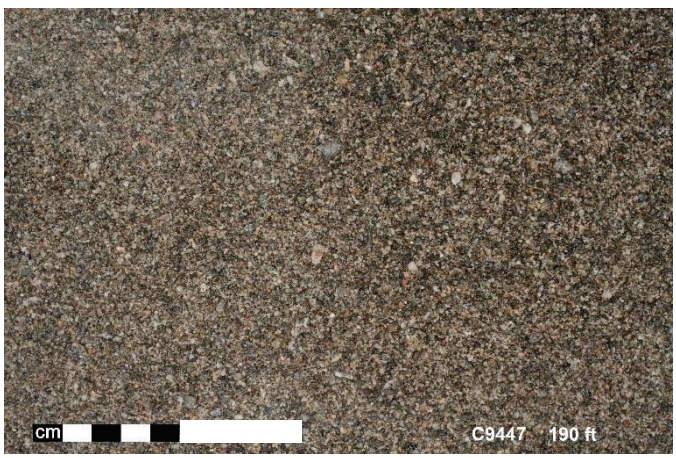

cm
C9447 170 ft

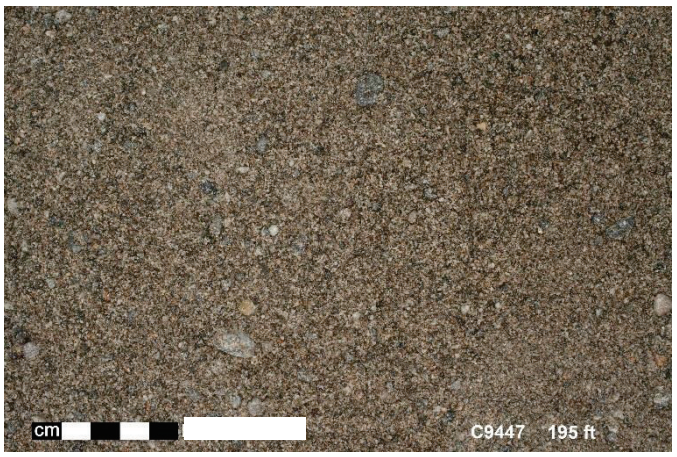
cm
C9447 173 ft

cm
C9447 175 ft

cm
C9447 180 ft

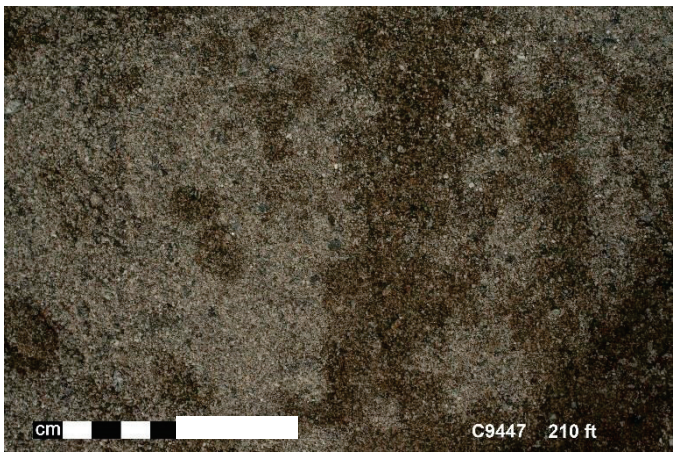
cm
C9447 185 ft


cm
C9447 190 ft


cm
C9447 195 ft

cm
C9447 200 ft

cm
C9447 205 ft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C9447 220 ft

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C9447 225 ft

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C9447 230 ft

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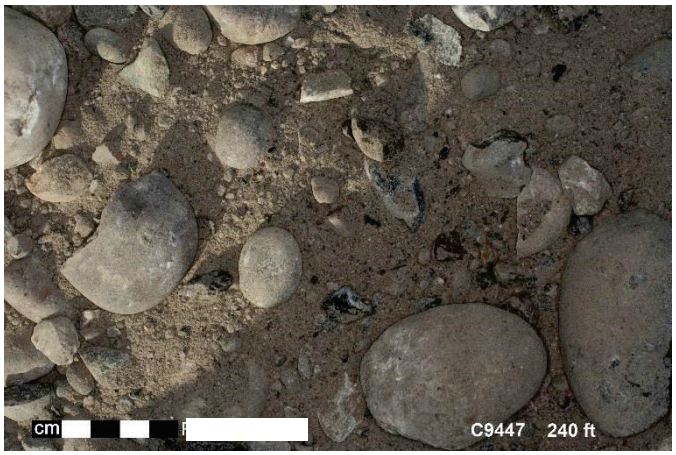
C9447 231 ft

cm
C9447 235 ft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cm
C9447 245 ft

cm
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cm
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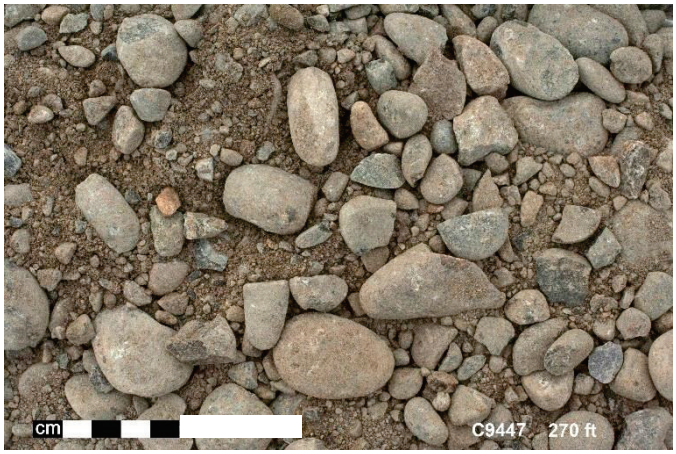
cm
C9447 265 ft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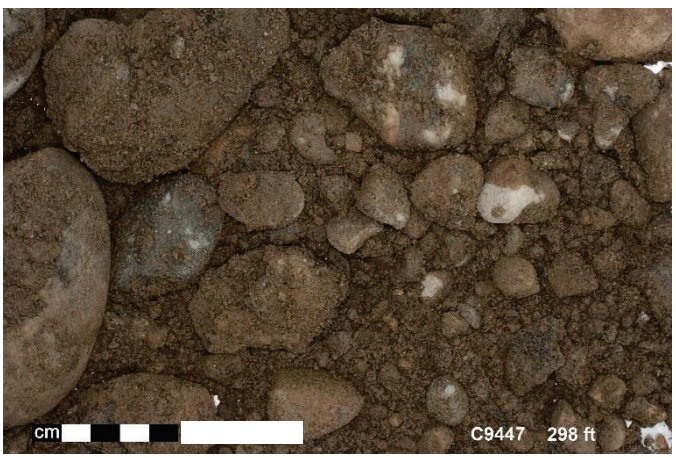
cm
C9447 275 ft

cm
C9447 280 ft

cm
C9447 285 ft

cm
C9447 290 ft

cm
C9447 295 ft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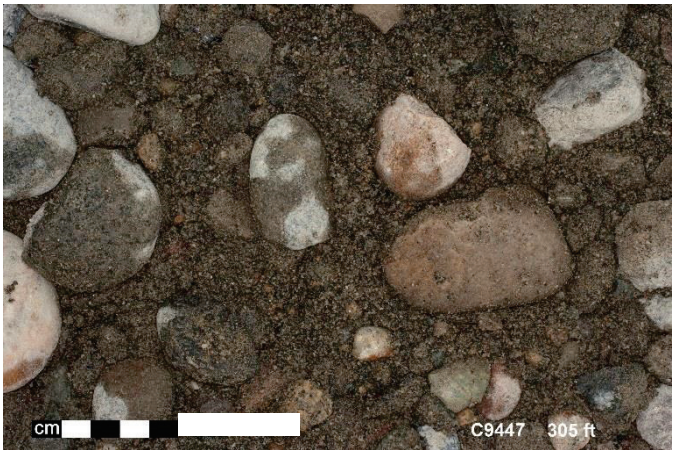
C9447 298 ft

cm
C9447 300 ft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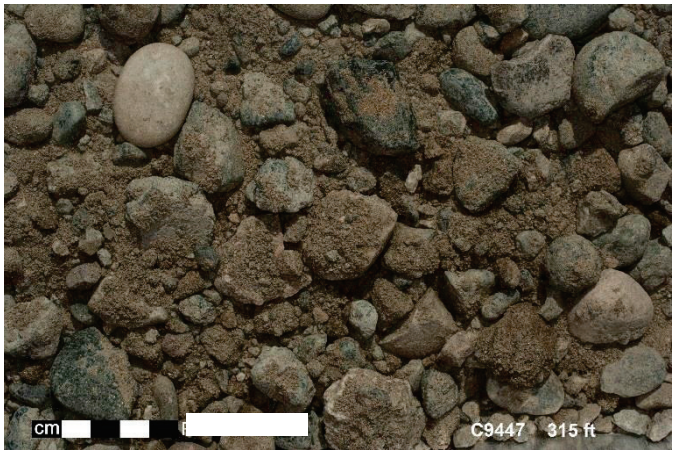
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cm
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cm
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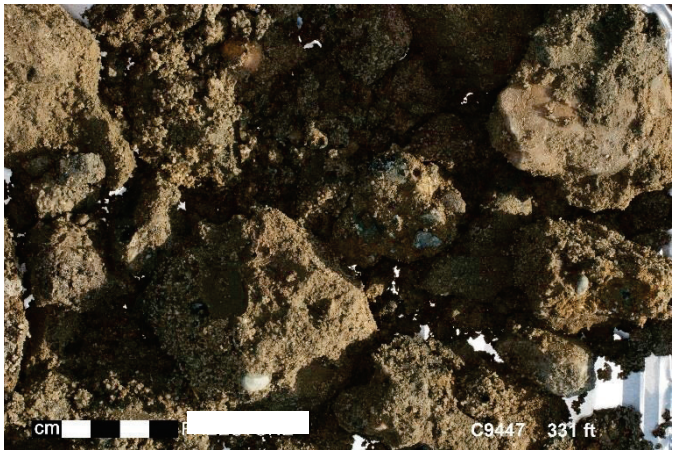
cm
C9447 324 ft

cm
C9447 325 ft

cm
C9447 330 ft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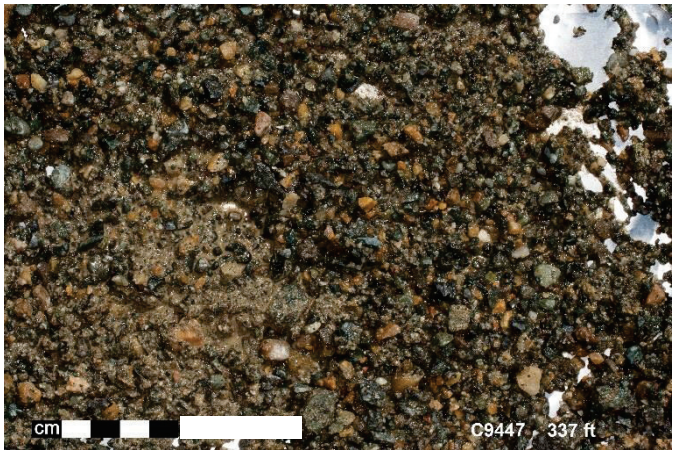
C9447 331 ft

cm
C9447 337 ft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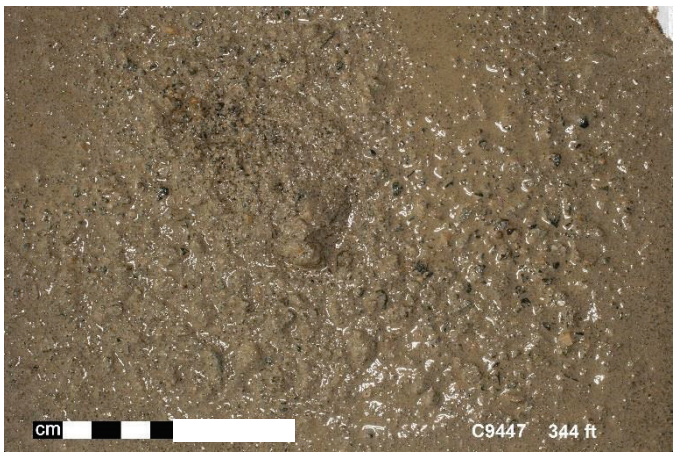
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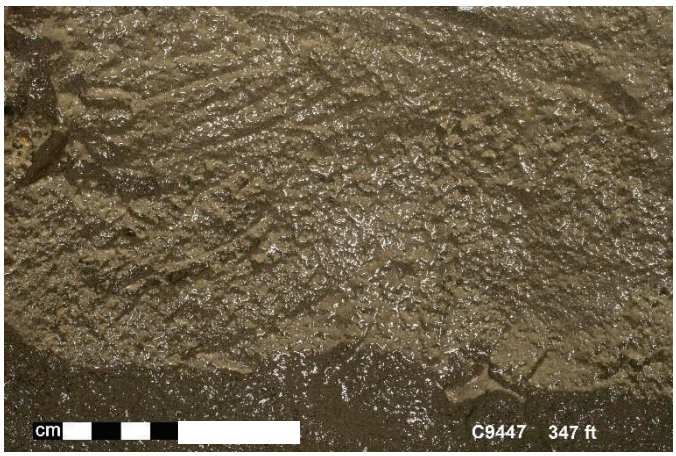
C9447 344 ft

cm
C9447 344 ft


cm
C9447 347 ft

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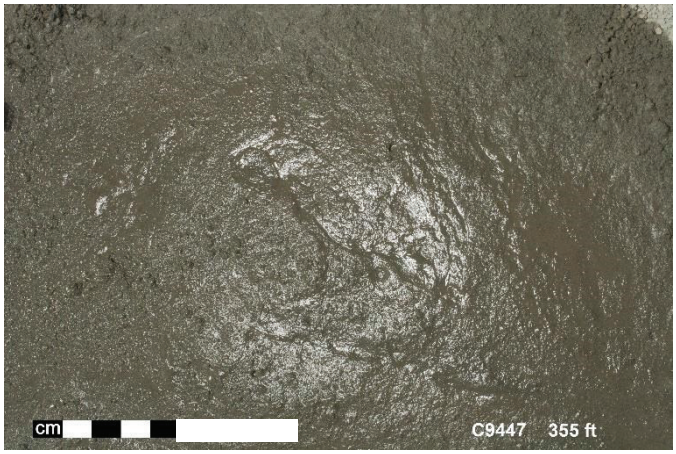
C9447 347 ft

cm
C9447 350 ft

cm
C9447 350 ft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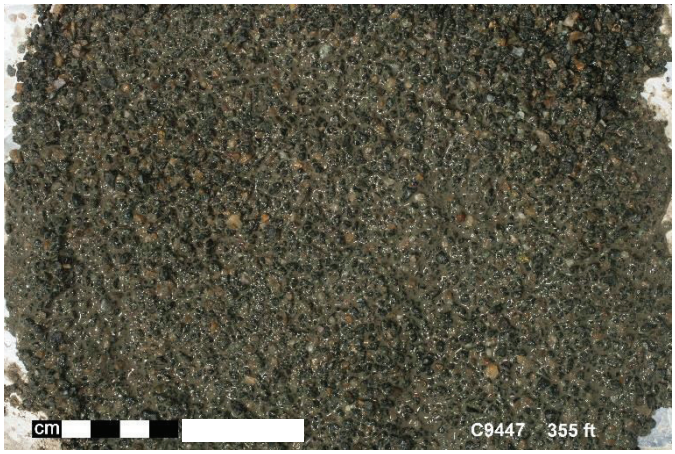
C9447 355 ft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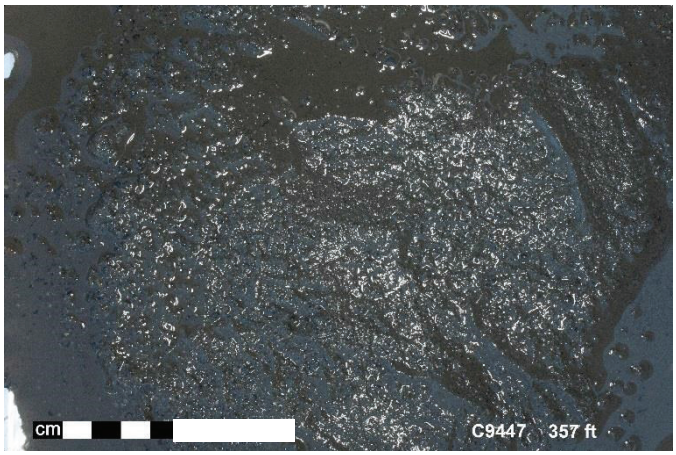
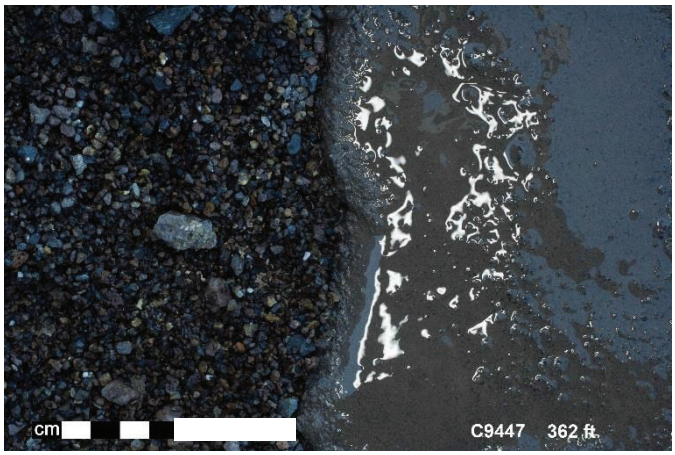
C9447 355 ft


cm
C9447 357 ft


cm
C9447 362 ft

SURVEY DATA REPORT			Request No. 153-133
Project No.	Title: 200W M-24 Wells C8913 and C9447 Final Surveys		File No. 2ET12R26
Job. No. CACN: 303595-JPRC	Prepared By: N.P. Fastabend	Date: 6/22/15	Reviewer: LBM

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casings) and elevations of completed M-24 Wells C8913 (299-E26-15) and C9447 (299-E28-31) in 200E 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: 06/13/15	Requestor: Jim Mehrer (CHPRC)
Date of Survey: 06/22/15	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 M-24 Well C9447 (299-E28-31) located on north side of B-Plant in 200E Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 200E

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
2E-123 (CHPRC) and 2E-124 (CHPRC)

Well ID	Well Name	Easting	Northing	Elevation	
C9447	299-E28-31	573358.37	136608.90		Center of Casing
				213.129	"X" on Rim
				212.400	Brass Survey Marker

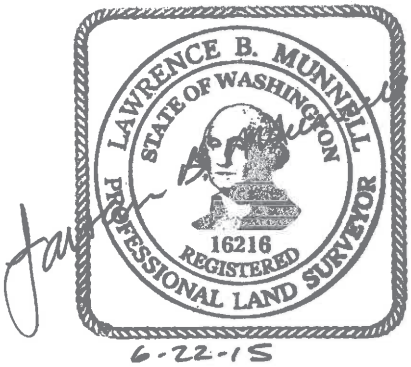
Notes:

212.838 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.



6-22-15

A-6003-659 (04/03)

Appendix G

Well Documentation for C9448 (299-E28-32)

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

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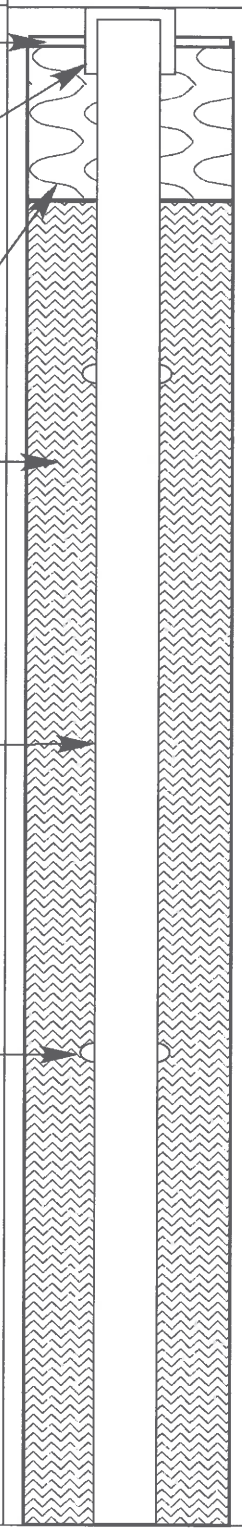
WELL SUMMARY SHEET

Start Date: 5/28/15
Finish Date: 7/23/2015
Page 1 of 5

Well ID: C9448
Well Name: 299-E28-32
Location: 70 m South of B-Plant
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Cameron Penner-Ash Date: 7/13/15
Reviewed By: J.D. MEHRER Date: 8-4-15
Signature:
Signature:

CONSTRUCTION DATA

Description	Diagram
Concrete Pad: 0.5 ft above ground surface (ags)	
Protective Permanent Monument: 2.49 ags - 1.01 bgs	
Type I/II Portland Cement Grout: 0 - 15.3 ft bgs	
Cetco Medium Bentonite Chips / #8 Cetco Bentonite Crumbles: 15.3 - 305.4 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.0 ft ags - 361.53 ft bgs	
Stainless steel centralizers installed from the top of the sump at 40 ft intervals	
Depths are in ft below ground surface.	
Borehole drilled with 13 1/2-inch and 12-inch OD casing from 0.0 - 372.4 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 - 11 Sandy Gravel (sG)
10		11 - 11.5 Silt (M)
		11.5 - 20 Sandy Gravel (sG)
20		20 - 25 Gravelly Sand (gS)
		25 - 76 Sand (S)
30		
40		
50		
60		
70		
		76 - 80 Silt (M)
80		80 - 85 Silty Sand (mS)
		85 - 175.5 Sand (S)

A-6003-643 (REV 1)

WELL SUMMARY SHEET	Start Date: 5/28/15 Finish Date: 7/23/2015	Page 2 of 5

Well ID: C9448	Well Name: 299-E28-32
Location: 70 m South of B-Plant	Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Cameron Penner-Ash Date: 7/13/15	Reviewed By: J.D. MEHRER Date: 8-4-15
Signature: Cameron Penner-Ash	Signature: J.D. Mehrer

CONSTRUCTION DATA

Description	Diagram
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.0 ft ags - 361.53 ft bgs	
Stainless steel centralizer installed from the top of the sump at 40 ft intervals	
Cetco Medium Bentonite Chips / #8 Cetco Bentonite Crumbles: 15.3 - 305.4 ft bgs	
Depths are in ft below ground surface.	
Borehole drilled with 13 1/2-inch and 12-inch OD casing from 0.0 - 372.4 ft bgs	
All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
90		85 - 175 Sand (S)
100		
110		
120		
130		
140		@ 138' bgs Temp. Casing Downsized to 12 " OD.
150		
160		
170		175.5 - 180 Sandy Silt (sM)

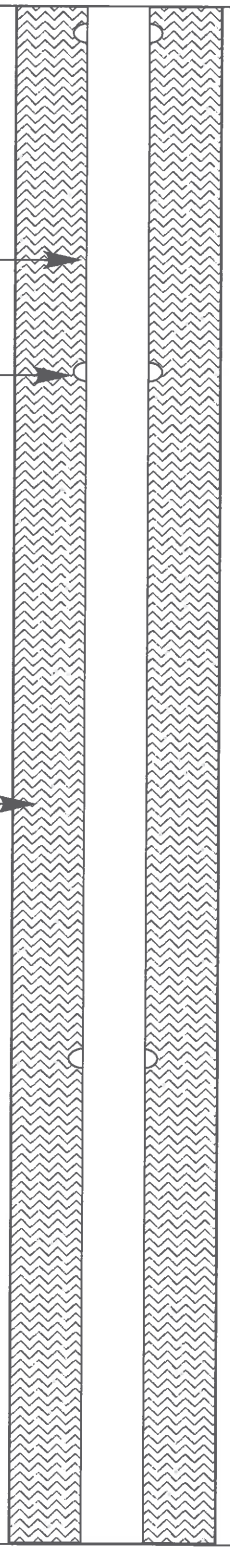
A-6003-643 (REV 1)

WELL SUMMARY SHEET

Start Date: 5/28/2015
Finish Date: 7/23/2015

Well ID: C9448
Well Name: 299-E28-32
Location: 70 m South of B-Plant
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Cameron Penner-Ash Date: 7/13/15
Reviewed By: J.D. MEHRER Date: 8-4-15
Signature: Cameron Penner-Ash
Signature: J.D. Mehrer

CONSTRUCTION DATA

Description	Diagram
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.0 ft ags - 361.53 ft bgs	
Stainless steel centralizers installed from the top of the sump at 40 ft intervals	
Cetco Medium Bentonite Chips / #8 Cetco Bentonite Crumbles: 15.3 - 305.4 ft bgs	
Depths are in ft below ground surface. Borehole drilled with 13 1/2-inch and 12-inch OD casing from 0.0 - 372.4 ft bgs. All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
180		175.5 - 180 Sandy Silt (sM)
		180 - 200 Gravelly Sand (gS)
190		
200		200 - 205 Sand (S)
		205 - 210 Sandy Gravel (sG)
210		210 - 215 Gravelly Sand (gS)
		215 - 217 Sand (S)
		217 - 220 Silt (M)
220		220 - 225 Sand (S)
		225 - 235 Gravelly Sand (gS)
230		
		235 - 244 Sand (S)
240		
		244 - 255 Sandy Gravel (sG)
250		
		255 - 265 Gravel (G)
260		
		265 - 270Gravelly Sand (gS)

A-6003-643 (REV 1)

WELL SUMMARY SHEET

Start Date: 5/28/2015
Finish Date: 7/23/2015
Page 4 of 5

Well ID: C9448
Well Name: 299-E28-32
Location: 70 m South of B-Plant
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Cameron Penner-Ash Date: 7/13/15
Reviewed By: J.D. MEHRER Date: 8-4-15
Signature: Cameron Penner-Ash
Signature: J.D. Mehrer

CONSTRUCTION DATA

Description	Diagram
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.0 ft ags - 361.53 ft bgs	
Cetco Medium Bentonite Chips / #8 Cetco Bentonite Crumbles: 15.3 - 305.4 ft bgs	
Type I/II Portland Cement Grout: 305.4 - 350.1 ft bgs	
Stainless steel centralizers installed from the top of the sump at 40 ft intervals	
3/8-in Cetco Bentonite Pellets: 350.1 - 358.0 ft bgs	

Depths are in ft below ground surface.

Borehole drilled with 13 1/2-inch and 12-inch OD casing from 0.0 - 372.4 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
270		265 - 270 Gravelly Sand (gS)
		270 - 285 Sandy Gravel (sG)
280		
		285 - 295 Silty Sandy Gravel (msG)
290		
		295 - 316 Sandy Gravel (sG)
300		
		Static Water Level: 306.0' bgs (7/8/15)
310		
		316 - 317.5 Sandy Gravel (sG)
		317.5 - 322 Gravelly Sand (gS)
320		
		322 - 331 Sandy Gravel (sG)
330		
		331 - 335 Sand (S)
		335 - 342 Silty Gravel (mG)
340		
		342 - 350 Silty Sandy Gravel (msG)
350		
		350 - 372 Sandy Gravel (sG)

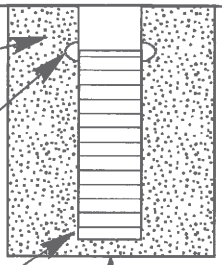
A-6003-643 (REV 1)

WELL SUMMARY SHEET

Start Date: 5/28/2015
Finish Date: 7/23/2015
Page 5 of 5

Well ID: C9448
Well Name: 299-E28-32
Location: 70 m South of B-Plant
Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Cameron Penner-Ash Date: 7/13/15
Reviewed By: J.D. MEHRER Date: 8-4-15
Signature:
Signature:

CONSTRUCTION DATA

Description	Diagram
Premier Silica Primary Filter Pack (10-20 mesh Silica Sand): 358.0 - 372.4 ft bgs Stainless steel centralizers installed from the top of the sump at 40 ft intervals 4-in I.D. Schedule 10, Type 304/304L, Stainless Steel 20 Slot Screen: 361.53 - 371.53 ft bgs 4-in I.D. Schedule 10, Type 304/304L, Stainless Steel End Cap: 371.53 - 371.83 ft bgs	

Depths are in ft below ground surface.

Borehole drilled with 13 1/2-inch and 12-inch OD casing from 0.0 - 372.4 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
360		350 - 372 Sandy Gravel (sG)
370		@ 372 Basalt
380		Total Depth: 372.4' bgs (7/9/15)
390		
400		
410		
420		
430		
440		

A-6003-643 (REV 1)

BOREHOLE LOG

Page 1 of 10
Date: 5-28-15

Well ID: C9448 | Well Name: 299-E28-32 | Location: 70m South of B-Plant

Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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				0-11' Sandy Gravel (sG) 30% gravel, 60% Sand, 10% Silt, Gravel: VCP-FP, poorly sorted, max: 70mm, 90% mafic, angular. Sand: CS-FS, poorly sorted, 90% mafic, angular. 2.5yr 3/3, dark olive brown, strong HCl rxn, moist.	• Cable Tool drilling w/ drive barrel. • 13.5" OD Temp casing • Samples every 5' or change in lith. • 0-140' Drillers add ~2.5 gals of water every 5'.
5	6			11-11.5' Silt(M) 90% Silt, 10% Sand. Sand: VF well sorted, 90% mafic. Silt: well laminated, ~4mm laminations, gravely contacts at base, low plasticity 7.5yr 3/3 dark olive brown. weak HCl rxn, moist.	
				11.5'	
10	6			11.5-20' Sandy Gravel (sG) 50% gravel, 50%	
	6			Sand. Gravel: FP-VFP, well sorted, max: 70mm, 70% mafic, angular. Sand: CS-FS, mod. sorting, 90% mafic, angular. 2.5yr 5/1, gray. No HCl rxn. dry.	Occ'l small cobbles
15	6			@15' ↓Gravel 40%, ↑Sand 60%, Sand: FS 50%, CS 50%, poorly sorted, ↓ mafic 50%. 2.5yr 4/1 dark gray.	
				20-25' Gravelly Sand (GS) 15% gravel, 85%	
20	6			Sand, trace silt. Gravel: FP, well sorted, 5mm max, 50% mafic, angular, Sand: CS-FS, 50% CS, 50% FS, poorly sorted, 40% mafic, angular. 2.5yr grayish brown no HCl rxn, moist. Slightly cemented	
25	6			25-26' Sand (S) 95% Sand, 5% gravel, Gravel: VFP, well sorted, max: 3mm, 50% mafic, angular. Sand: CS-FS, 90% CS, well sorted, angular, 2.5yr 5/2 grayish brown, no HCl rxns, dry.	
30	6			@35' ↑ Sand 100%, ↓ mafic 20%, 2.5yr 5/1 gray, Sand size becomes CS.	
35	6				

Reported By: Cameron Penner-Ash | Reviewed By: Kevin Bergstrom

Title: Geologist | Title: Sr. Geologist

Signature: [signature] | Date: 5-28-15 | Signature: [signature] | Date: 8/10/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 10
Date: 6-2-15

Well ID: C9448 | Well Name: 299-E28-32 | Location: 70 m South of B-Plant
Project: 8 M24 TPA GW Monitoring Wells | 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			27-76' Sand (S) 100% Sand. Sand: CS, V. well sorted, 20% mafic, angular. 2.5yr 5/1, gray. dry; no rxn w/HCl	· Cable Tool drilling w/ drive barrel. · 13.5" OD Temp. casing. · Samples collected every 5' or change in lith. · 0-140' Drillers add ~2.5 gals of water every 5'.
45	G			@ 45' ↑ gravel 5%, ↑ Silt trace, Gravel: VFP-FP, poorly sorted, 50% FP, 50% VFP, max: 8mm, angular, 10% mafic, slight HCl rxn	
50	G			@ 50' ↓ gravel 0%, no HCl rxn	
55	G			@ Noticeable poorly cemented sand pieces	
60	G			@ ↑ gravel 2%, Gravel: FP, 95% well sorted, max: 10mm, angular. Sand: ↑ mafic 50%, 2.5yr 5/2, grayish brown, Slightly moist.	
65	G			@ 66' ↑ gravel 5%, max gravel: 8mm	
70	G			@ 74' ↑ Sand 100%	
75	G			76-80 Silt (M) 95% Silt, 5% Sand. Sand: VFS-MS, poorly sorted. Silt: Slight (2-4mm) laminations, Sand interlayered, some oxidation Slight low plasticity. 10yr 3/3, dark brown. No HCl rxn. moist.	

Reported By: Cameron Penner-Ash | Title: Geologist | Signature: [signature] | Date: 6-2-15
Reviewed By: Kevin Bergstrom | Title: Sr. Geologist | Signature: [signature] | Date: 8/10/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 10
Date: 6-2-15

Well ID: C9448 | Well Name: 299-E28-32 | Location: 70m South of B-Plant
Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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			80-85' Silty Sand (mS) 60% sand, 40% Silt. Sand: CS, very well sorted, 20% mafic, angular. Silt: Silt stringers, ~~5/3/2015~~ slight low plasticity intermixing w/ sand layers. 2.5 yr 3/3, dark olive brown, no HCl rxn, moist.	· Cable Tool drilling w/ drive barrel · 13.5" OD Temp. casing · Samples collected every 5' or change in lith. · 0-140' Drillers add ~2.5gals every 5'.
85	G			85-175.5' Sand (S) 95% Sand, 5% Silt. Sand: CS-FS, CS 50%, FS 50%, poorly sorted, 10% mafic, angular. 2.5yr 3/3, dark olive brown, no rxn HCl. moist.	
90	G			@ 91' ↓ Silt Trace	
95	G			@ ~~96~~ COA 6-3-15	
100	G			@ 100' ↑ Silt 5%, ↑ Gravel Trace, Gravel: FP, well sorted, max: 4mm, 50% mafic, angular. 2.5yr 4/3, olive brown.	
105	G			@ 105' ↓ gravel 0%, ↓ silt 0%, Sand: CS-FS, CS-80%, moderate sorting	
110	G			@ 110' ↑ Silt 5%, Sand: UFS, well sorted, 5% mafic, 2.5yr 3/3, dark olive brown	
115	G			@ 116' ↓ Silt 0%, Sand: CS-FS, CS 60% FS 40%, 20% mafic, angular	

Reported By: Cameron Penner-Ash | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: [signature] | Date: 6-2-15 | Signature: [signature] | Date: 8/10/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 4 of 10
Date: 6-4-15

Well ID: C4448 | Well Name: 299-E28-32 | Location: 70 m South of B-Plant
Project: 8 MZA TPA GW Monitoring Wells FY2015 | Reference Measuring Point: ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120	G			85-175.5' Sand(s) 100% Sand, Trace gravel. Gravel: VCP-FP, max: 40mm, 90% FP, well sorted, angular. Sand: CS-FS, 60% CS, 40% FS, poorly sorted, 20% mafic, angular. 2.5yr 3/3, dark olive brown, no HCl rxn. moist. Small chunks of organic material.	• Cable Tool drilling w/ drive barrel. • 13.5" OD Temp casing • Samples collected every 5' or change in lith. • 0-140' Drillers add ~25 gals every 5'.
125	G			@ 126' ↓ gravel 0%, Sand: 70% FS, 30% CS.	
130	G			@ 130' ↑ gravel 2%, Gravel: FP, well sorted, max: 4mm, 70% mafic, angular. Sand: CS 90%, FS 10%, well sorted, 50% mafic.	
135	G			@ 135' ↓ gravel Trace	@ 138.8' bgs Downsized temp casing to 12" OD
140	G				• No water added to the borehole after 140' bgs.
145	G			@ 145' ↓ CS 80%; 2.5y 4/2, dark grayish brown	
150	G			@ 150' ↑ Gravel Trace; Gravel: VFP, well sorted, 50% mafic, max: 2mm, angular.	
155	G			@ 155' ↑ Gravel max: 5mm; 2.5, 3/3, dark olive brown	

Reported By: Cameron Penner-Ash | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: [signature] Date: 6-4-15 | Signature: [signature] Date: 8/10/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 5 of 10
Date:

Well ID: C9448 | Well Name: 299-E28-32 | Location: 70m South of B-Plant
Project: SM24 GW Monitoring Wells FY2015 | 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
160	G			85-175.5' Sand (S) 100% Sand, Trace gravel. Gravel: VFP-FP, well sorted, max: 5mm, 50% mafic, angular. Sand: CS-FS, 80% CS, well sorted, 40% mafic, angular. 2.5yr 3/3, dark olive brown, no HCl rxn, slightly moist. @165' ↑ FS 80%	·Cable tool drilling w/ drive barrel. ·12" OD Temp casing. ·Samples collected every 5' or change in lith.
165	G				
170	G			@170' ↑ CS 80%	
175	G			@175' ↑ CS 90% @175.5'-180 Sandy Silt (sM) 60% Silt, 35% Sand, 5% gravel. Gravel: VFP, well sorted, 80% mafic, angular. Sand: CS-VFS, poor sorting, 50% mafic, angular. Silt: 10cm thick, some laminations. 2.5yr 4/3, Olive brown, no HCl rxn, moist.	
180	G			180-200' Gravelly Sand (gS) 90% Sand, 10% gravel. Gravel: FP, well sorted, 8mm: max, 80% mafic, angular. Sand: VCS-CS, well sorted, 60% mafic, angular. 2.5yr 4/2, dark grayish brown, no HCl rxn, moist	
185	G			@186' Gravel: ↓ max: 6mm	
190	G			@190' ↑ Gravel 15%, ↓ Sand 85%, ↑ Sand: mafic 70%.	
195	G			@195' ↑ max gravel: 30mm, ↓ Sand mafic 60%	

Reported By: Cameron Penner-Ash | Title: Geologist | Signature: [signature] | Date: 6-12-15
Reviewed By: Kevin Bergstrom | Title: Sr. Geologist | Signature: [signature] | Date: 8/10/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 6 of 10
Date: 6-12-15

Well ID: C4448 | Well Name: 299-E28-32 | Location: 70m South of B-Plant
Project: 8M24 GW Monitoring Wells FY2015 | 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
200	6			200-205' Sand (S) 100% Sand, Trace gravel. Gravel: FP, well sorted, max: 6mm, 80% mafic, angular. Sand: CS-FS, well sorted, 40% mafic, angular. 2.5yr 4/3, olive brown, no HCl rxn, moist.	Cable Tool drilling w/ drive barrel. 12" OD Temp Casing. Samples collected every 5' or change in lith.
205	6			205-210' Sandy Gravel (sG) 40% gravel, 60% Sand. Gravel: FP-MP, poorly sorted, max: 30mm, 80% mafic, angular. Sand: CS v. well sorted, 80% mafic, angular. 2.5yr 3/3, dark grayish brown, no HCl rxn, moist	
210	6			210-215' Gravelly Sand (gS) 10% gravel, 90% Sand. Gravel: FP, v. well sorted, max: 5mm, 90% mafic, angular. Sand: CS, v. well sorted, 80% mafic, angular. 2.5yr 4/2, dark grayish brown, no HCl rxn, slightly moist.	@ 210' Multiple drive barrel loads lost due to loose sediments.
215	6			215-217' Sand (S) ~~10~~ 5% gravel, 95% sand, trace Silt. Gravel: VFP, well sorted, max: 4mm, 80% mafic, angular. Sand: CS-VFS, poor sorting, 80% mafic, angular, 2.5yr 4/2, dark grayish brown, No HCl rxn, slightly moist, 200mm cobble.	
220	6			@ 217+2" Silt (M) 90% Silt, 10% Sand. Sand: VFS, v. well sorted, 80% mafic. Silt: 5mm laminations, gravelly contacts, some grading, ~~slight~~ low plasticity. 2.5yr 4/4, Olive brown, weak HCl rxn, moist.	
225	6			220-225' Sand (S) 5% gravel, 95% Sand, Trace Silt, Gravel: VFP, v. well sorted, max: 4mm, 90% mafic, angular. Sand: CS-FS, well sorted, 80% mafic, angular. 2.5yr 4/3 dark olive brown, no HCl rxn, moist	
230	6			225-235 Gravelly Sand (gS) 10% gravel, 90% Sand, Trace Silt. Gravel: FP, well sorted, max: 5mm, 80% mafic, angular. Sand: CS, v. well sorted, 80% mafic, angular. 2.5yr 4/3, Olive brown, no HCl rxn, moist.	
235	6			235-244' Sand (S) 2% Gravel, 98% Sand. Gravel: FP, v. well sorted, max: 5mm, 90% mafic, angular, Sand: CS-FS, well sorted, 80% CS, 80% mafic, angular. 2.5yr 3/3, dark olive brown, no HCl rxn, moist.	

Reported By: Cameron Penner-Ash		Reviewed By: Kevin Bergstrom	
Title: Geologist		Title: Sr. Geologist	
Signature: [signature]	Date: 6-12-15	Signature: [signature]	Date: 8/10/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 7 of 10
Date: 6/15/15

Well ID: C9448 | Well Name: 299-E28-32 | Location: 70m South of B-Plant
Project: 8 M24 TPA GW Monitoring Wells FY2015 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
240	6			235-244' Sand(s) Trace Gravel, 100% Sand. Gravel: VFP, V. well sorted, max: 3mm, 90% mafic, angular. Sand: CS-FS, well sorted, 90% CS, 80% mafic, angular. 2.5yr 3/3, dark olive brown, no HCl rxn, moist. @ 243' 150mm rounded granite cobble	· Cable tool drilling w/ drive barrel. · 12" OD Temp Casing · Samples collected every 5' or change in lith.
245	6			244-255' Sandy Gravel (sG) 50% gravel, 30% Sand. Gravel: MP-FP, well sorted, only VCP max: 50mm, 80% mafic, angular. Sand: CS-FS, well sorted, 90% CS, angular. 2.5yr 3/3, dark olive brown. No rxn HCl, moist. @ 248' ↑ Gravel 60%, Gravel: UCP-FP, poor sorting, max: 60mm, 90% mafic, larg pebbles = rounded, sm. = angular. ↓ Sand 40%, Sand: CS-UFS, poor sorting, 90% mafic, angular. ↑ Silt Trace. 2.5yr 4/3, olive brown. Slight HCl rxn, slightly moist @ 250' ↓ Gravel to 50%, ↑ Sand to 50% 2.5yr, 3/3, dark olive brown	@ 244' ~~Proposed contact between Hanford Fm & the Cold Creek Unit, based on Lithology, ↑ in gravel~~ 7/30/15
250	6				
255	6			255-265' Gravel (G) 80% Gravel, 20% Sand, trace silt. Gravel: UCP-UFP, very poor sorting, max: 80mm, 60% mafic, lrg = rounded, sm. = angular. Sand: CS-UFS, poor sorting, 80% mafic, angular. 2.5yr 3/3, dark olive brown, slight HCl rxn, slightly moist. @ 260' ↓ Sand 15%, ↑ Silt 5%. Sand: mafic ↑ 90%. 2.5yr 3/2, very dark grayish brown, dry no HCl rxn.	
260	6				
265	6			265-270' Gravelly Sand (gS) 20% gravel, 80% Sand, trace silt. Gravel: MP-FP, well sorted, max: 30mm 90% mafic, sm: angular, lrg = rounded. Sand: CS-FS, well sorted, 90% CS, 80% mafic, angular. 2.5yr 3/3 dark olive brown, slight HCl rxn on cemented sections, slightly moist. @ 267' Cobbles inc. to 200mm	
270	6			270-285' Sandy Gravel (sG) 65% Gravel, 30% Sand, 5% Silt. Gravel: UCP-VFP v. poor sorting, max: 200mm, 60% mafic, angular. Sand: MS-UFS, poor sorting, 80% mafic. 2.5 5/2, grayish brown, weak HCl rxn, dry. @ 275' ↓ Gravel 60%, ↑ Sand 35% Gravel: ↓ mafic 50%, Sand: CS-UFS, slightly moist.	@ 275' Drilling is slowed due to cobbles
275	6				

Reported By: Cameron Penner-Ash
Title: Geologist
Signature: Cam, Schuyler for Cameron Penner-Ash Date: 6/16/15

Reviewed By: Kevin Bergstrom
Title: Sr. Geologist
Signature: Kevin Bergstrom Date: 8/10/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 8 of 10
Date: 6-26-15

Well ID: C9448 | Well Name: 299-E28-32 | Location: 70m South of B-Plant
Project: 8M24 GW Monitoring Wells FY2015 | 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
280	G			270-285' Sandy Gravel (sG) 60% Gravel, 35% Sand 5% Silt. Gravel: UCP-VFP, poor sorting, 100mm: max, 50% mafic, lrg: rounded, sm: angular. Sand: CS-VFS, CS 70%, mod. Sorting, 80% mafic, angular. 2.5yr 4/3, olive brown, weak HCl rxn, slightly moist.	· Cable tool drilling w/ drive barrel. · 12" OD temp casing · Samples every 5' or change in lith.
285	G			285-295' Silty Sandy Gravel (msG) 70% Gravel, 18% Sand, 12% Silt Gravel: UCP-VFP, poor sorting, max: 300mm, 90% mafic, sm: angular, lrg: rounded. Sand: CS-VFS, poor sorting, 80% mafic, angular. 2.5yr 5/2, grayish brown, mod. HCl rxn, dry. @ 290' ↑ moisture to moist/wet.	
295	G			295-316' Sandy Gravel (sG) 75% gravel, 20% Sand, 5% silt. Gravel: UCP-VFP, poor sorting, max: 250mm, 40% mafic, lrg: rounded, sm: angular, Sand: CS-VFS, 80% VFS, well sorted, angular, 2.5yr 4/3, olive brown, slight HCl rxn on cemented pieces, slightly moist. @ 300' inc moisture to moist	@ 295' Drilling speed is slow due to cobbles. Drive barrels are received every fourth try. @ 295' proposed contact w/ Ringold A (US 7/16/15) based on an increase in felsic content VFS well sorted, color change. oxn well-polished gravel @ 304.7' static water level is encountered on 6/17/15
300	G				
305	G			@ 305' Gravel: ↑ mafic 60%, ↓ max: 125mm, Sand: ↓ VFS 40%, ~~2.5yr~~ EPA 6/26/15	DTW: 306.0' bgs 7/8/15
310	G			@ 312' Gravel: ↓ max: 40mm, ↑ mafic 60%, Sand: ↑ sorting to well, 80% CS, 2.5yr 3/2, dark grayish brown, wet. @ 313' ↑ Silt 10%, ↓ Sand 15%	
315	W			316-317.5' ~~Silty~~ Sandy Gravel (~~msG~~ sG) 70% Gravel, 20% Sand, 10% silt. Gravel: UCP-VFP, poor sorting, max: 100mm, 30% mafic, lrg: rounded, sm: angular. Sand: CS-FS, FS 80%, well sorted, 40% mafic, angular. Silt: slight plasticity, micaceous. 2.5 4/3, olive brown, no HCl rxn, wet.	Water Sample: 314' on 6/22/15. HEIS # B30T43, B30T44, B30T65, B30T45, B30T46, B30T66
	G			317.5-320 Gravelly Sand (gS) Full Description on Next Page.	
	G				

Reported By: Cameron Penner-Ash | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: [signature] | Date: 6-26-15 | Signature: [signature] | Date: 8/10/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 9 of 10
Date: 6-26-15

Well ID: 69448 | Well Name: 299-E28-32 | Location: 70m South of B-Plant
Project: 8 M24 GW Monitoring Wells FY2015 | 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
320	6 KS 7/13/15			317.5-322' Gravelly Sand (gS) 25% Gravel, 70% Sand,	· Cable Tool drilling w/
	6 7/13/15 KS			5% Silt. Gravel: UCP-UFP, poor sorting, max: 30mm,	drive barrel.
				20% mafic, lrg: rounded, sm: angular, Sand: CS-UFS,	· 12" OD Temp casing
				FS 90%, well sorted, 10% mafic, extremly micaous, 2.5yr	· Samples collected every
	6			4/3, olive brown, no HCl rxn, wet.	5' or change in lith.
325				322-331' Sandy Gravel (sG) 35% Gravel, 60% Sand,	
				10% Silt, Gravel: UCP-UFP, poor sorting, max: 30mm,	
				20% mafic, lrg: rounded, sm: angular, Sand: CS-UFS,	320-340' Many issues
				FS 90% well sorted, 10% mafic, extremly micaous, 2.5yr	with drive barrel recovery
	W			4/3 Olive brown, no HCl rxn, wet	Sediment is extremly compact
330	6			@ 324' Gravel: ↑ max: 250mm, Sand: ↑ mafic:	and silty.
	6			30% Slight plasticity	Water sample: 329.0' bgs
				@ 330' Color: 2.5yr, very dark grayish brown	6/25/15, HEIS #B30T56
				Sections of Cemented, Burnt orange, brown, green	B30T47, B30T48, B30T67
				and blue clay nodules.	
335	6			331-335' Sand (S) 5% gravel, 90% sand, 5% silt.	
				Gravel: FP-UCP, poor sorting, 50% mafic, angular → rounded.	
				Sand: CS-UFS, 80% MS, well sorted, angular. 2.5yr, 3/3,	
				dark olive brown, no HCl rxn, wet. Slightly plastic	
				Silt stringers. Sand alternates with cemented gravels.	
340	6			335-342' Silty Gravel (msG) 50% gravel, 20% Sand,	Silty sandy gravel (msG)
				30% Silt. Gravel: UCP-UFP, poor sorting, max: 70mm, 20%	
	6			mafic, rounded. Sand: MS-UFS, 80% =UFS, well sorted, 20%	
				mafic, angular. 2.5 3/2, very dark grayish brown. no HCl rxn.	
				Moist. Extremly well cemented, Some chem. alterations,	
345				Intermittent sandy layers.	
				@ 340' ↑ Sand 25%, ↓ Silt 25%. Wet.	
	6			342-346' Silty Sandy Gravel (msG) 60% gravel, 25% Sand,	
	W			15% Silt. Gravel: UCP-VFP, poor sorting, max: 100mm, 30% mafic	Water sample: 348' bgs
				rounded. Sand: CS-UFS, poor sorting, 40% mafic, angular. 2.5yr	7/1/15, HEIS #
350	6			5/3 Light olive brown, no HCl rxn. Slight plasticity, wet	
				346-350' Silty Gravel (sG) 50% gravel, 25% Sand, 25% Silt.	Silty Sandy Gravel (msG)
				Gravel: UCP-VFP, poor sorting, 150mm = max, 30% mafic,	
				rounded. Sand: MS-UFS, well sorted, 30% mafic, angular.	
				2.5yr 5/3, Light olive brown, no HCl rxn, moist. Colorful	
355	6			clay nodules reappear.	
				350-372' Sandy Gravel (sG) Full description	
				on the next page.	

Reported By: Cameron Penner-Ash | Reviewed By: Kevin Bergstrom
Title: Geologist | Title: Sr. Geologist
Signature: [signature] Date: 8-9-15 | Signature: [signature] Date: 8/10/15

A-6003-642 (03/03)

BOREHOLE LOG

Page 10 of 10
Date: 7-9-15

Well ID: C9448 | Well Name: 299-E28-32 | Location: 70 m South of B-Plant

Project: 8 M24 TPA GW Monitoring Wells FY2015 | 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
360	G			350-372' Sandy Gravel (sG) 70% gravel, 25% Sand, 5% silt. Gravel: vCP-vFP, poor sorting. max: 60mm, 30% mafic, angular → rounded. Sand: CS-vFS, vFS-80%, wellsorted, 40% mafic, angular. 2.5y, 4/3 Olive brown. no HCl rxn	· Cable tool drilling w/ drive barrel. · 12" OD Temp casing. · Samples collected every 5' or change in lith.
365	G			Very wet. Occasional cemented gravels. @ 355' ↓ Gravel 50%, ↑ Sand 40%, ↑ Silt 10%, Gravel: ↑ max: 80mm, ↓ mafic 20%, Sand: ↓ mafic 10%	
	W			@ 360' ↑ Gravel 60%, ↓ Sand 35%, ↓ Silt 5%. ↑ mafic 25%, ↑ vFP 50%. Sand: ↑ CS 50%, poor sorting. 2.5yr 4/3, olive brown.	Water Sample: 367.0' bgs on 7/8/15, HEIS #B30T58, B30T53, B30T54, B30T70
370	G			@ 365' ↑ Gravel 70%, ↓ Sand 25%. Gravel: max: 100mm, ↑ mafic 35%, Sand: ↑ CS 80%, wellsorted, small Sand/silt nodules.	
	G			@ 370' Slight HCl rxn.	
375				372-372.4' Weathered Basalt Flow Top. Well compacted, rounded exotics mixed with angular basalt clasts, moderatly plastic silt fills pore spaces, Orange → yellow zones of weathered clasts, HCl rxns in areas but not universal throughout.	
380				@ 372.4' Basalt, Aphanitic, black when wet, stretched vesicles, sm. vugs of white min, angular cuttings range from 40mm - 300mm	TD: 372.4' bgs, 7-9-15 casing: 371.8' bgs PTW = 304.9' bgs 7-23-15
385				not used KS 7/30/15	
390					
395					

Reported By: Cameron Penner-Ash | Title: Geologist | Signature: Cam Penner | Date: 7-9-15

Reviewed By: Kevin Bergstrom | Title: Sr. Geologist | Signature: Kevin Bergstrom | Date: 8/10/15

A-6003-642 (03/03)

Stoller Newport News Nuclear

299-E28-32 (C9448)
Log Data Report

Borehole Information:

Log Date:	2015-07-14	Filename:	C9448_HG-NM_2015-07-14	Site:	M-24
Coordinates (WA St Plane)		DTW[1] (ft) :	~305.25	DTW Date:	07/13/2015
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	07/09/2015	N/A	372	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Threaded Steel	1.0	13 3/8	12 3/8	1/2	-1.0	138.79
Threaded Steel	3.4	12	10 3/4	5/8	-3.4	372

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.). Water inside the casing was estimated at ~305.25 ft by the logging engineer using observations from NMLS logging. The maximum logging depth achieved was 371.7 ft where the sonde unweighted.

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. 2a

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. 2a

Logging System:	Gamma 4N	Type:	60% HPGe SGLS
Effective Calibration Date:	01/08/15	Serial No.:	47-TP22010A
Calibration Reference:	HGLP-CC-113, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 2a

SGLS Log Run Information:

Log Run	3	4 Repeat	8	9	10 Repeat
HEIS Number	1018815	1018816	1018817	1018818	1018819
Date	06/08/15	06/08/15	07/13/15	07/14/15	07/14/15
Logging Engineer	Spatz	Spatz	Spatz	Pope	Pope

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

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Log Run	3	4 Repeat	8	9	10 Repeat
Start Depth (ft)	0.0	10.0	139.0	240.0	250.0
Finish Depth (ft)	140.0	25.0	241.0	371.0	273.0
Count Time (sec)	100	100	100	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
Log Speed (ft/min)	N/A	N/A	N/A	N/A	N/A
Pre-Verification	AL258CAB	AL258CAB	AL263CAB	DNM41CAB	DNM41CAB
Start File	AL258000	AL258141	AL263000	DNM41000	DNM41132
Finish File	AL258140	AL258156	AL263102	DNM41131	DNM41155
Post-Verification	AL258CAA	AL258CAA	AL263CAA	DNM41CAA	DNM41CAA
Depth Return Error (in.)	N/A	0.0	LOW 2.0	NA	LOW 3.0
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	Fine gain adjustments made after files 012 and 119.	Fine gain adjustments made before files 132 and 151.

NMLS Log Run Information:

Log Run	1	2 Repeat	5	6	7 Repeat
HEIS Number	1018810	1018811	1018812	1018813	1018814
Date	06/04/15	06/04/15	07/09/15	07/13/15	07/13/15
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	0.0	70.0	139.0	189.0	210.0
Finish Depth (ft)	140.0	84.0	190.0	305.0	227.0
Count Time (sec)	15	15	15	15	15
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	0.25	0.25	0.25	0.25	0.25
Log Speed (ft/min)	N/A	N/A	N/A	N/A	N/A
Pre-Verification	AH211CAB	AH211CAB	AH216CAB	AH217CAB	AH217CAB
Start File	AH211000	AH211561	AH216000	AH217000	AH217465
Finish File	AH211560	AH211617	AH216204	AH217464	AH217533
Post-Verification	AH211CAA	AH211CAA	AH216CAA	AH217CAA	AH217CAA
Depth Return Error (in.)	N/A	0.0	LOW 1	NA	LOW 2
Comments	None	None	None	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 in all but one log run. The AL258CAB (Log Run 3) pre-verification measurement indicated the logging system was working, however, the count rate for the 2615 keV peak slightly exceeded the HAZQARD (+20%) limit. Following logging that day, the resulting post-verification spectrum (AL258CAA) indicated the logging system was functioning properly, as verification criteria were met.

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Analysis Notes:

Analyst:	K.J. Felt	Date:	08/31/15	Reference:	HGLP-MAN-003, Rev. 1a

A casing correction for a 1/2-in. thick casing was applied to the log data from 0 to 138.79 ft. A casing correction for a 5/8-in. thick casing was applied to the log data from 139 to 372 ft.

A correction for water was applied below 305.25 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 the EXCEL template identified as 1L20141112 for data collected with the Gamma 1L logging system. Template DN20150108 was used for data collected with the Gamma 4N logging system. Calculations were completed using an efficiency function and corrections for casing and dead time as determined by annual calibration.

NMLS data are represented in counts per second because no calibration data exist for 10-3/4 or 12-3/8 inch inner 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 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 (0-380 ft)
Natural Gamma Logs (0-160 ft)
Natural Gamma Logs (150-310 ft)
Natural Gamma Logs (300-460 ft)
Combination Plot (0-120 ft)
Combination Plot (110-230 ft)
Combination Plot (220-340 ft)
Combination Plot (330-450 ft)
Combination Plot (0-380 ft)
Total Gamma & Moisture (0-380 ft)
Total Gamma & Hanford Gamma Unit (0-380 ft)
Repeat Section of Natural Gamma Logs (10 to 25 ft)
Repeat Section of Natural Gamma Logs (250 to 273 ft)
Moisture Repeat Section (70 to 84 ft)
Moisture Repeat Section (210 to 227 ft)

[5] Hanford Gamma Unit

Stoller Newport News Nuclear
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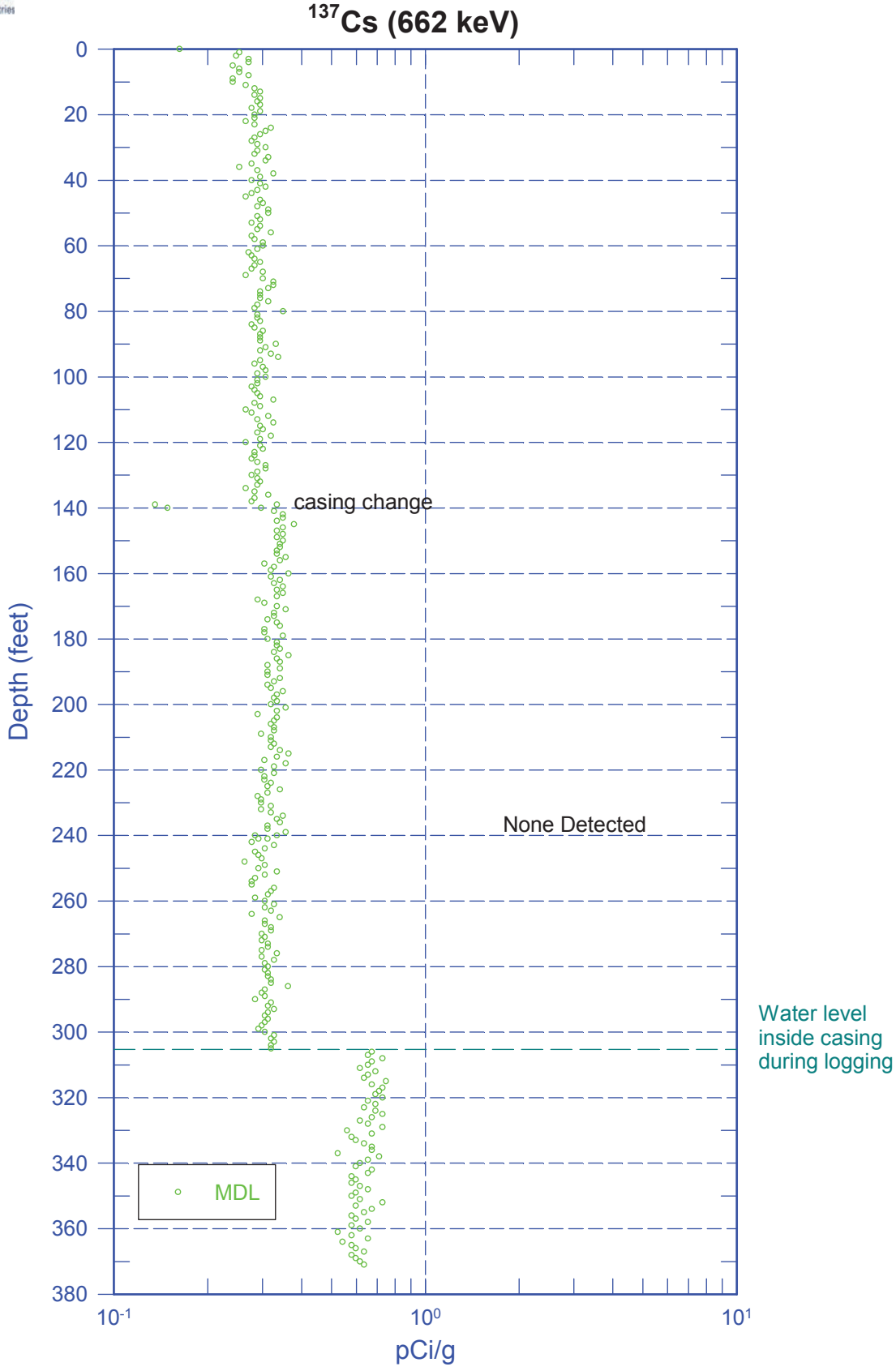
299-E28-32 (C9448)
Manmade Radionuclides



Zero Reference - Ground Surface

Stoller Newport News Nuclear
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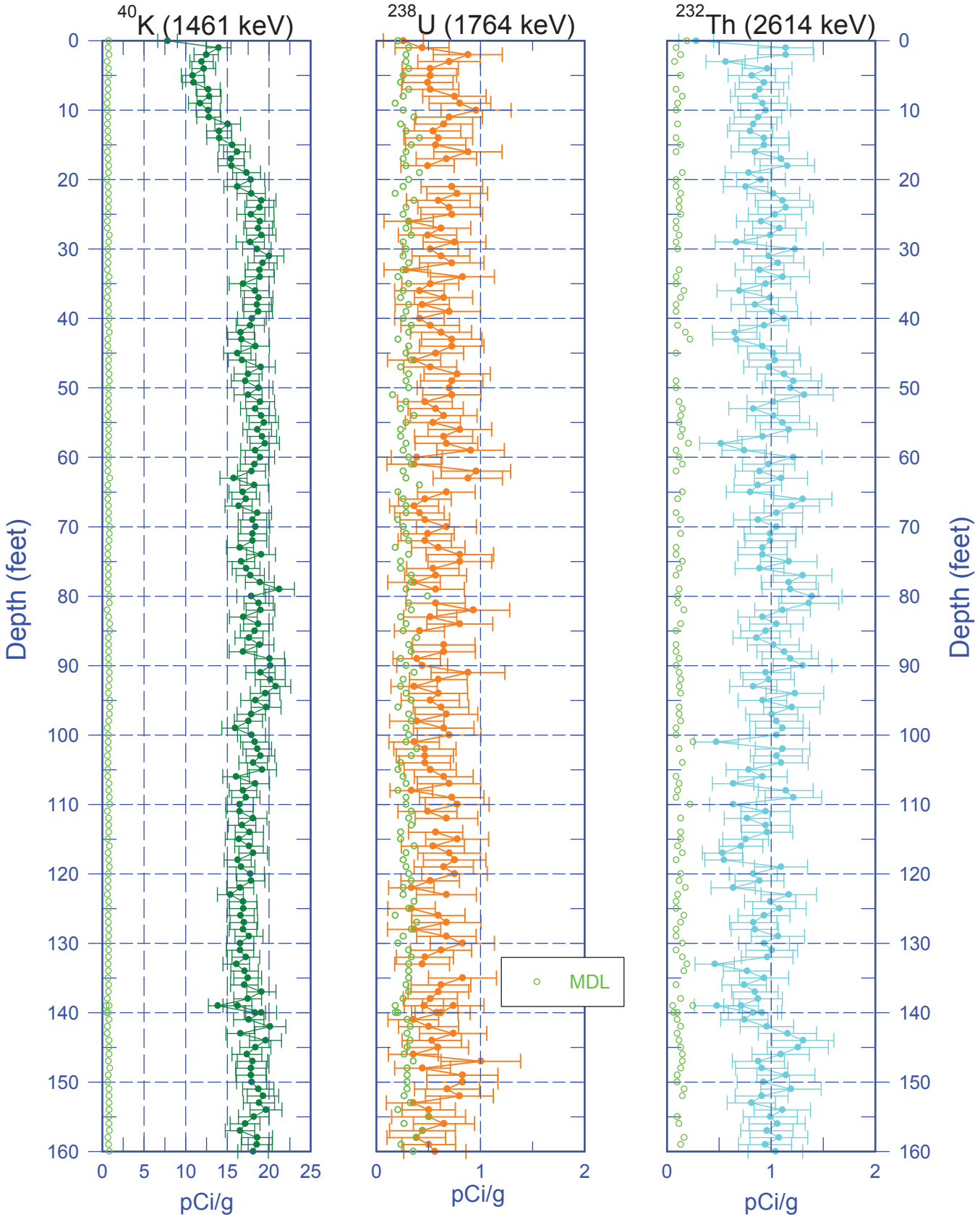
299-E28-32 (C9448)
Natural Gamma Logs



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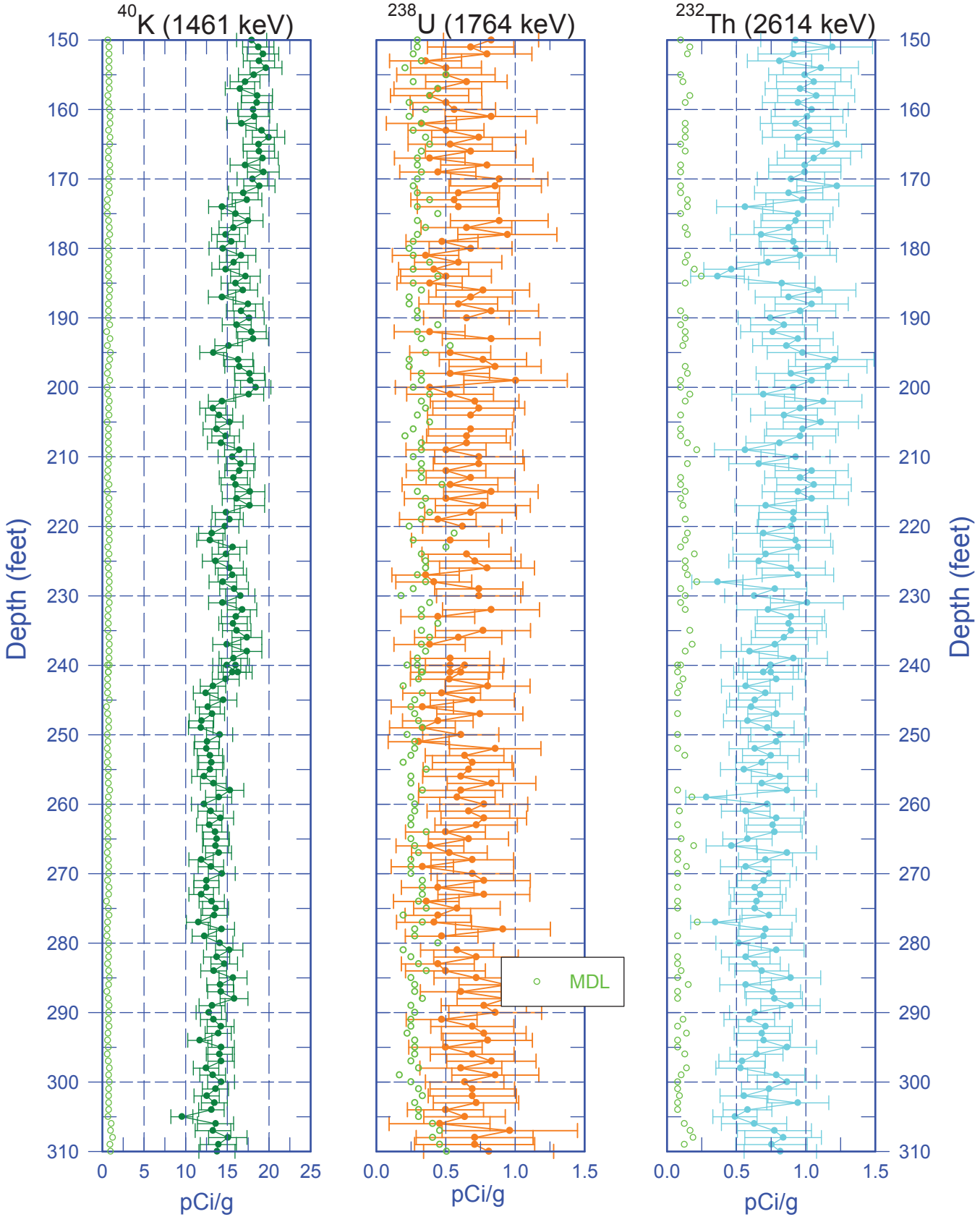
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E28-32 (C9448)
Natural Gamma Logs



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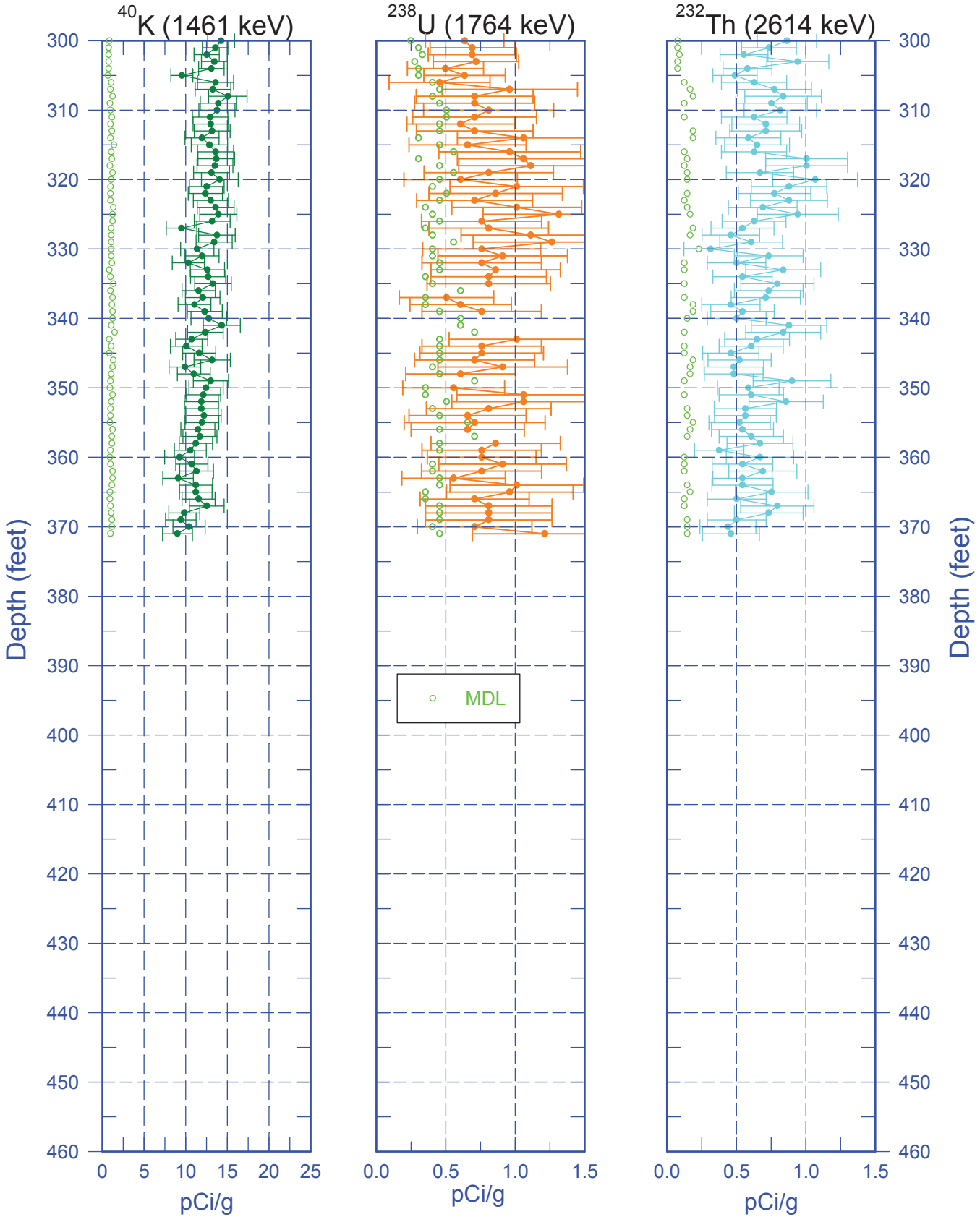
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

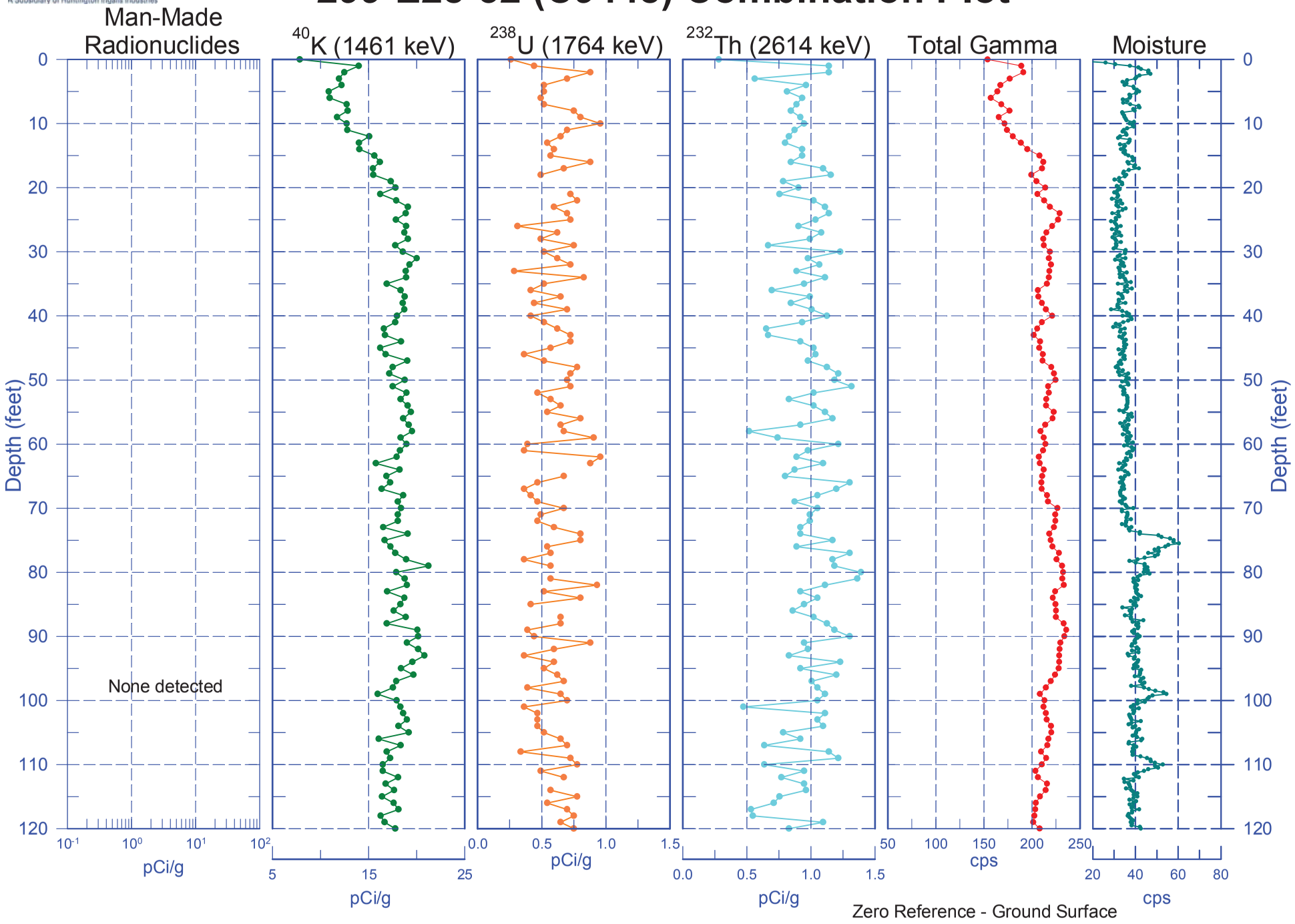
299-E28-32 (C9448)
Natural Gamma Logs



Zero Reference - Ground Surface

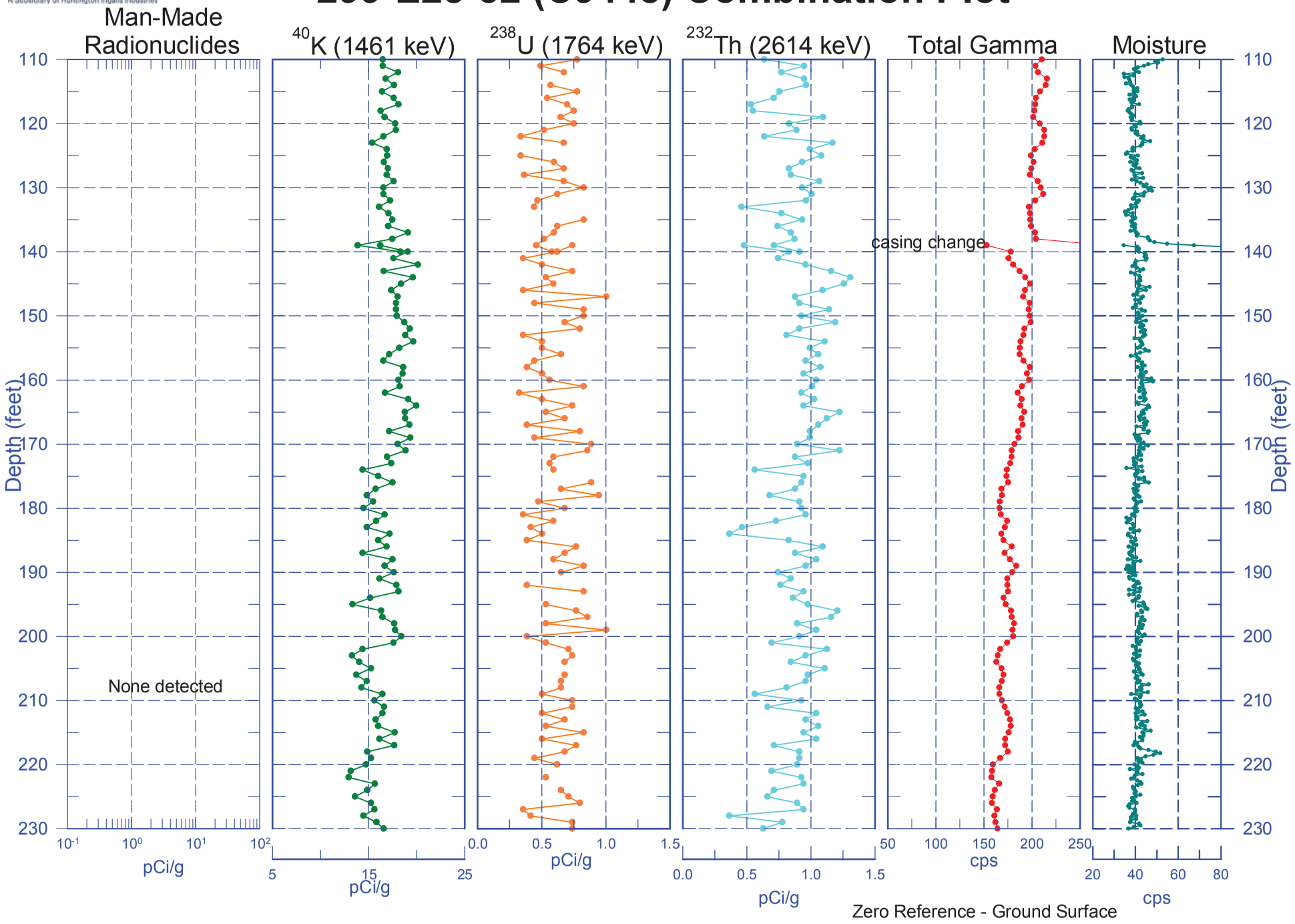
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E28-32 (C9448) Combination Plot



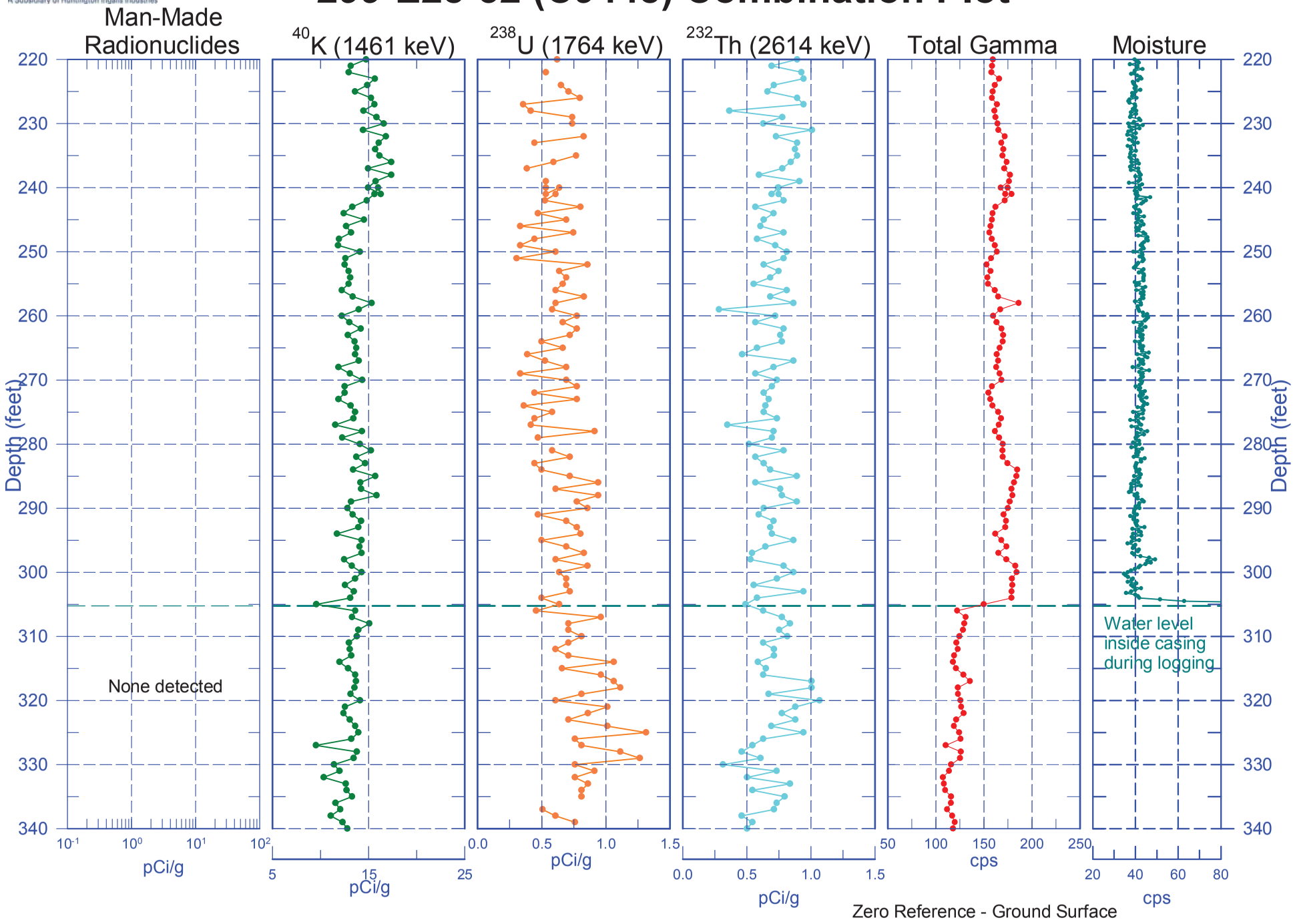
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E28-32 (C9448) Combination Plot



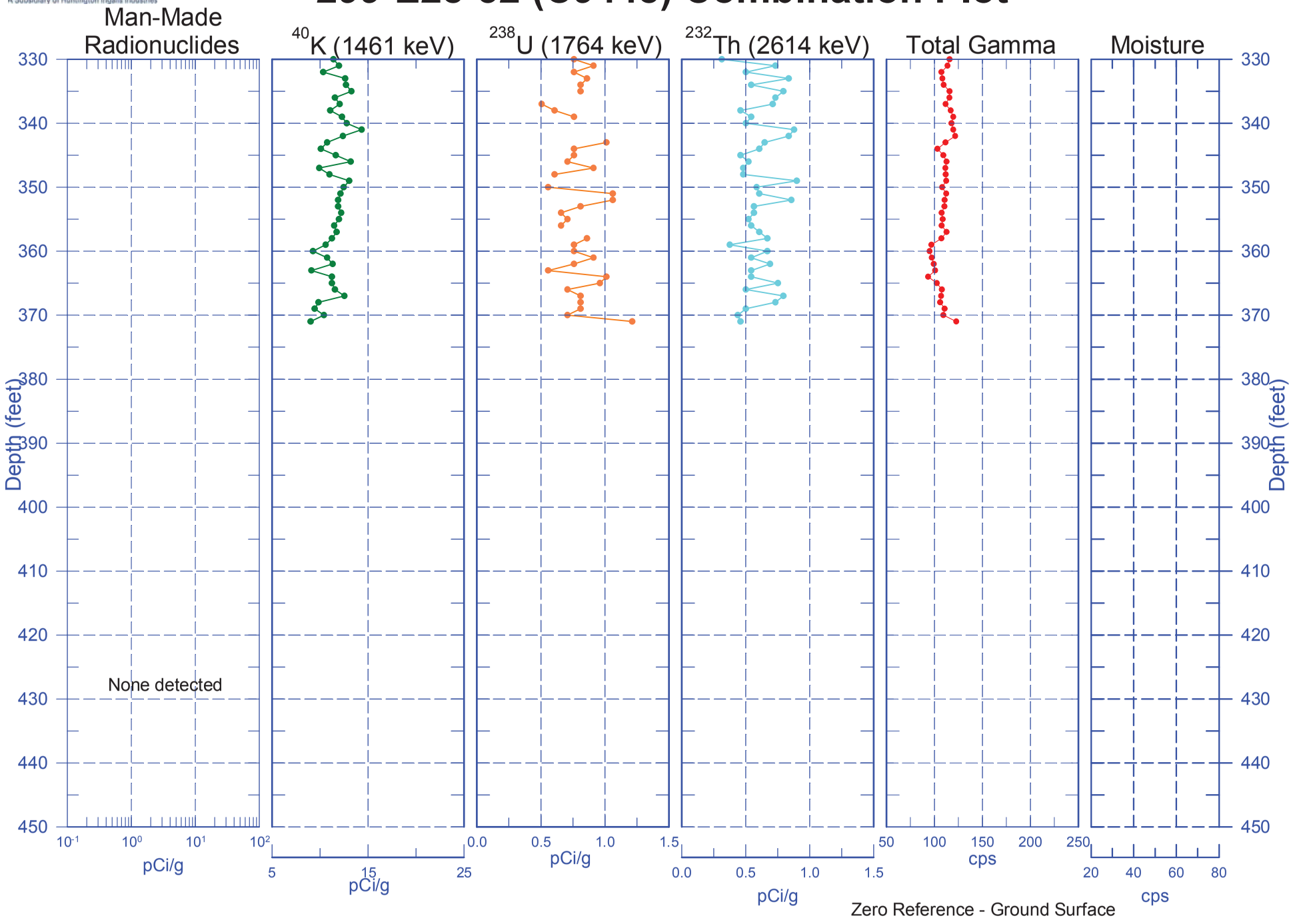
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E28-32 (C9448) Combination Plot



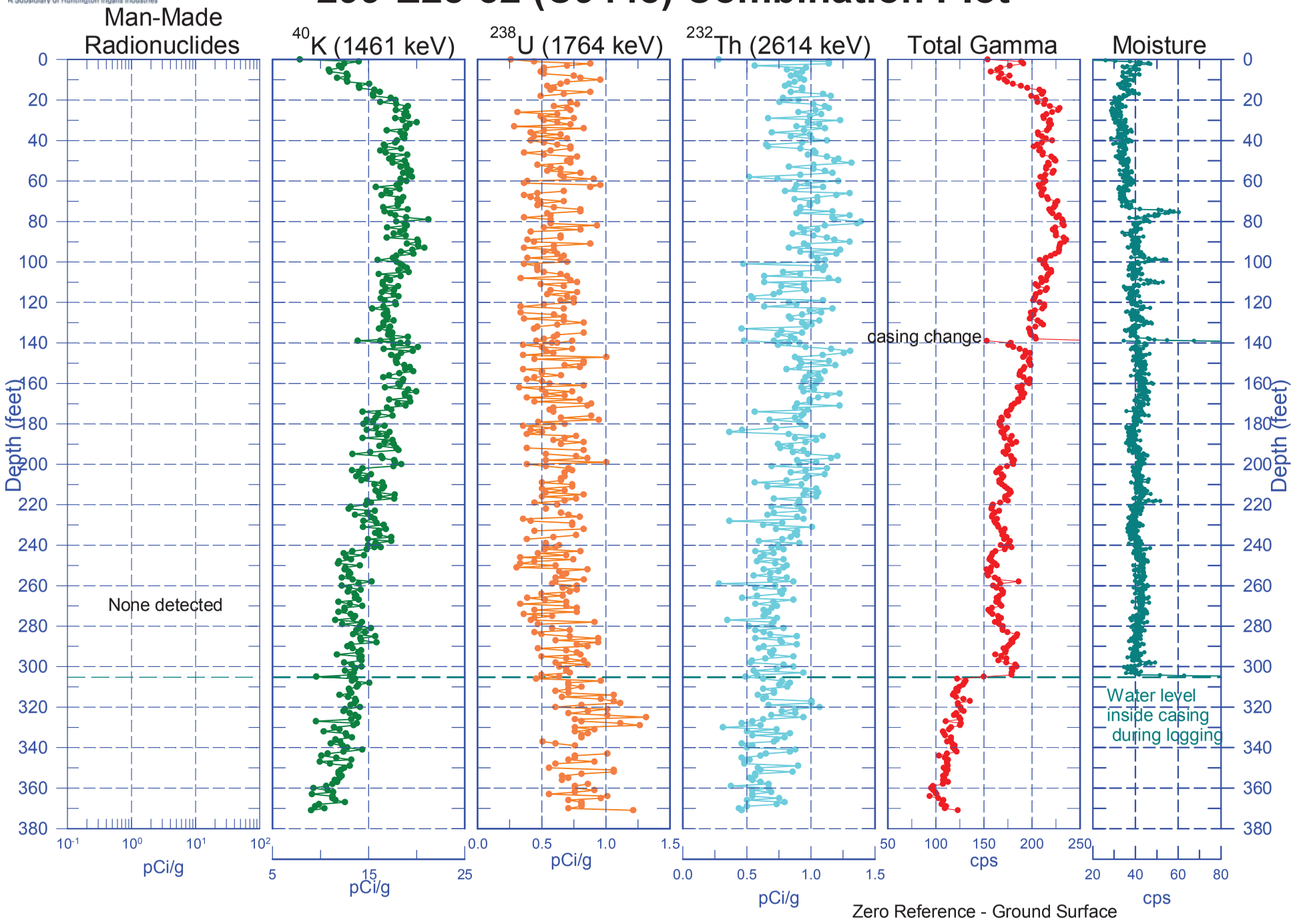
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E28-32 (C9448) Combination Plot



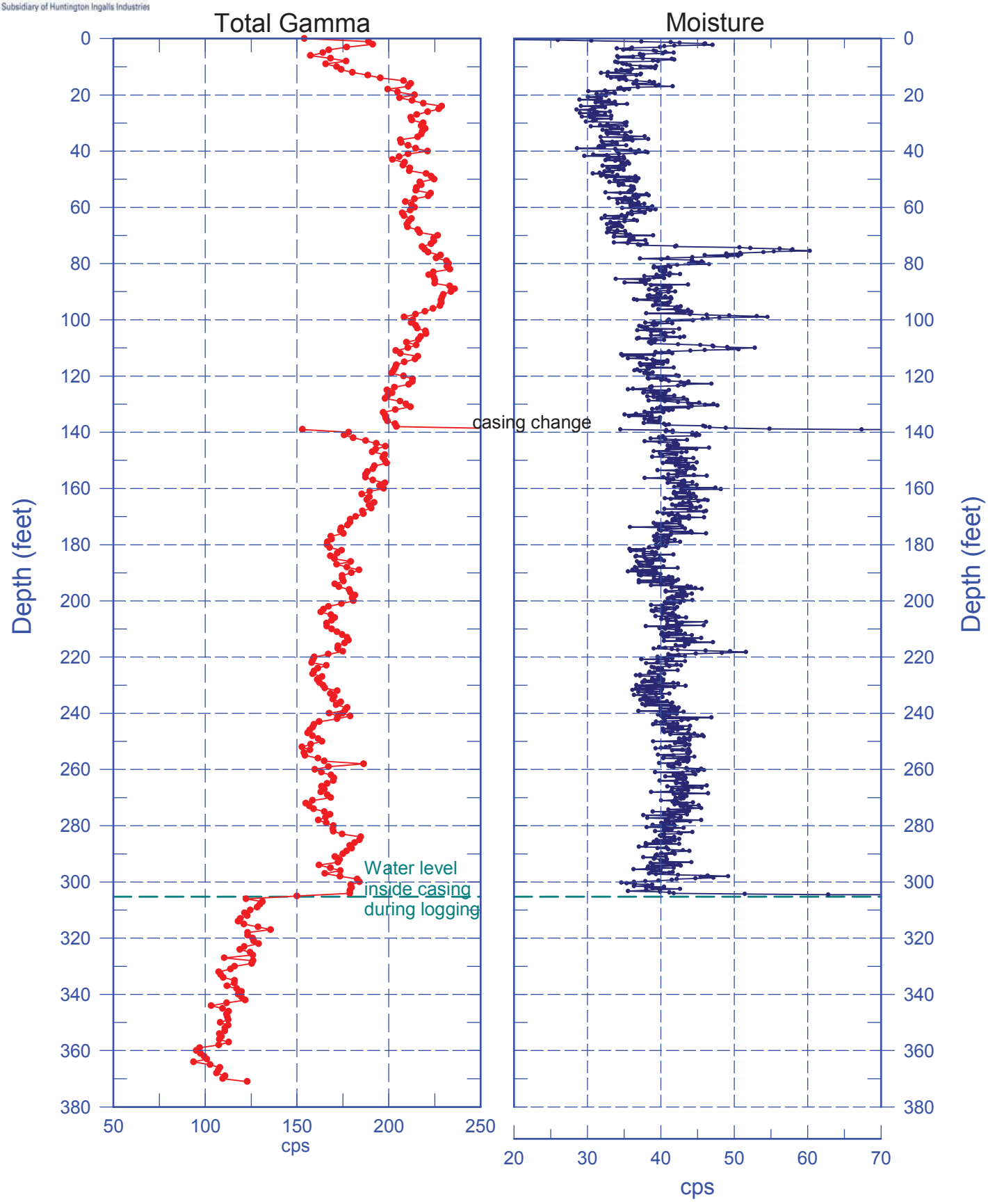
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E28-32 (C9448) Combination Plot



Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

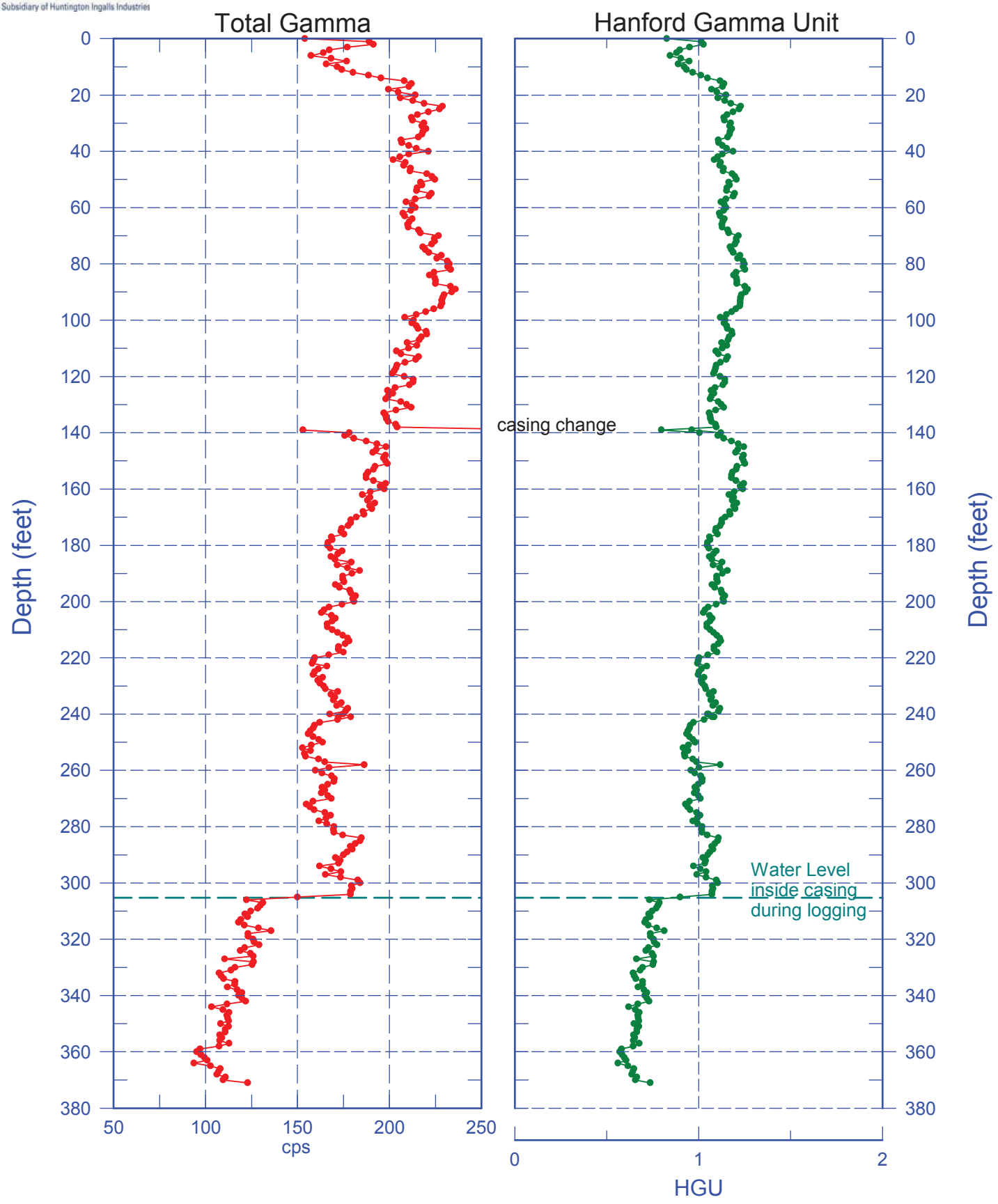
299-E28-32 (C9448)
Total Gamma & Moisture



Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E28-32 (C9448)
Total Gamma & Hanford Gamma Unit

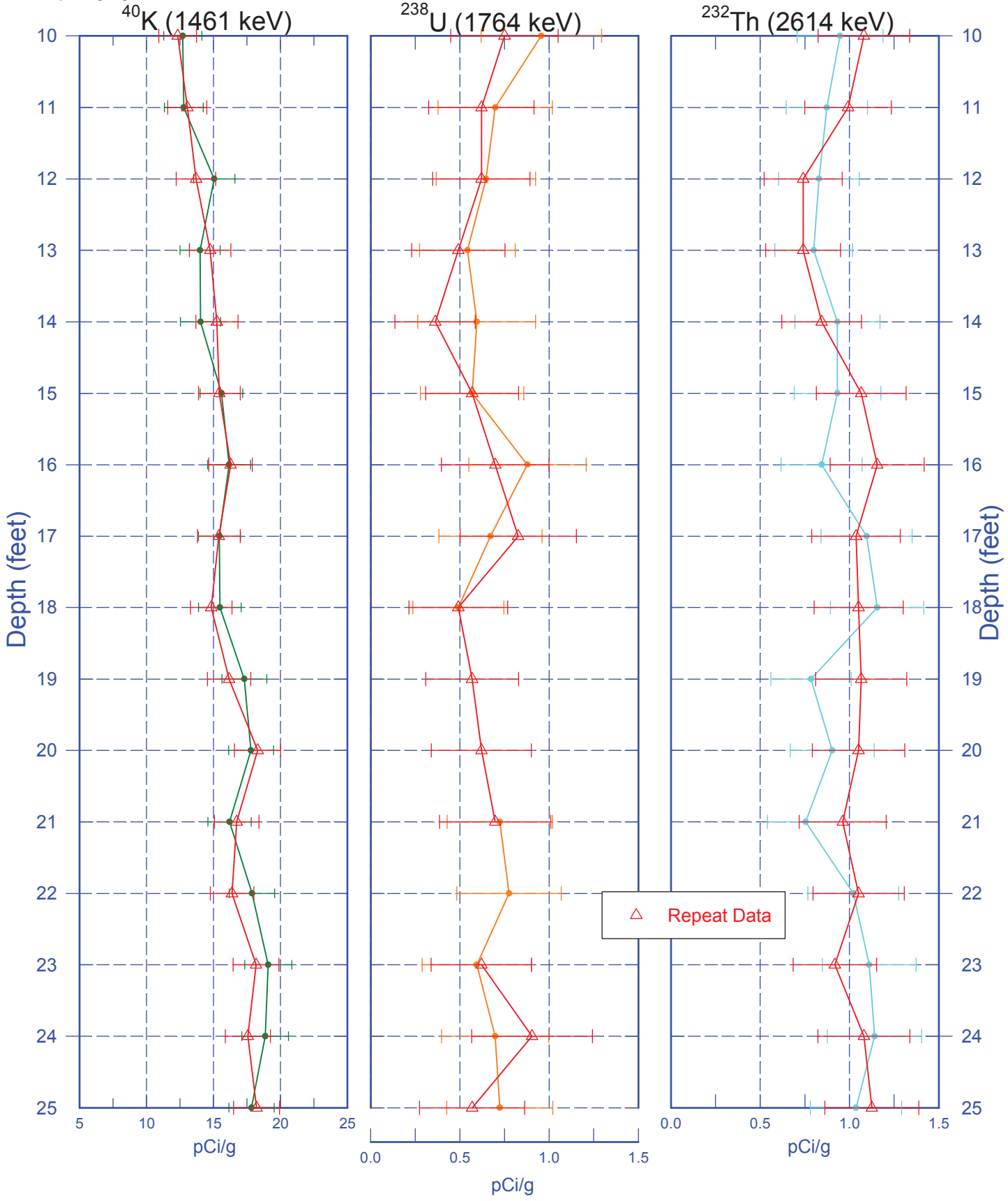


Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E28-32 (C9448)

Repeat Section of Natural Gamma Logs

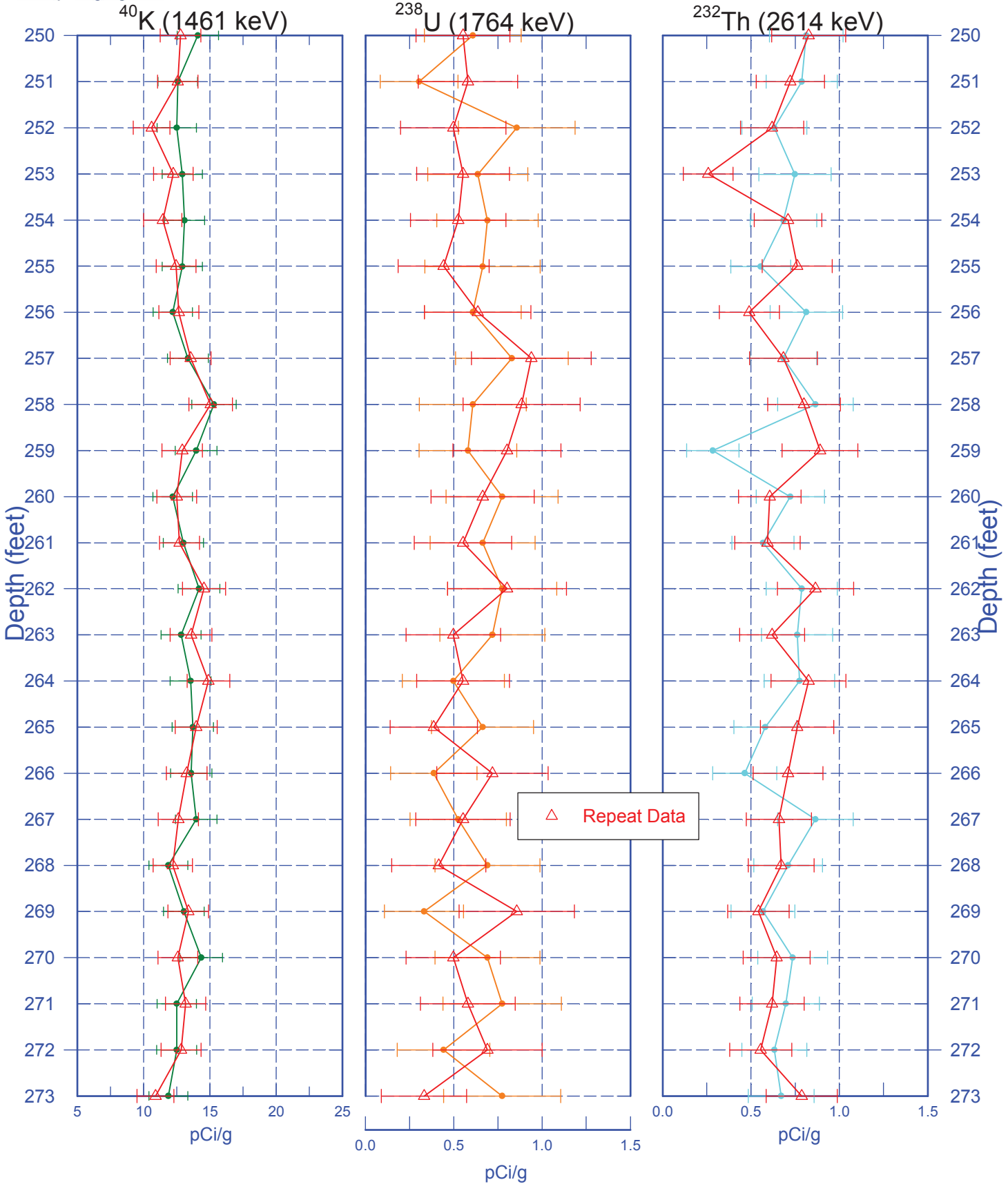


Zero Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

299-E28-32 (C9448)

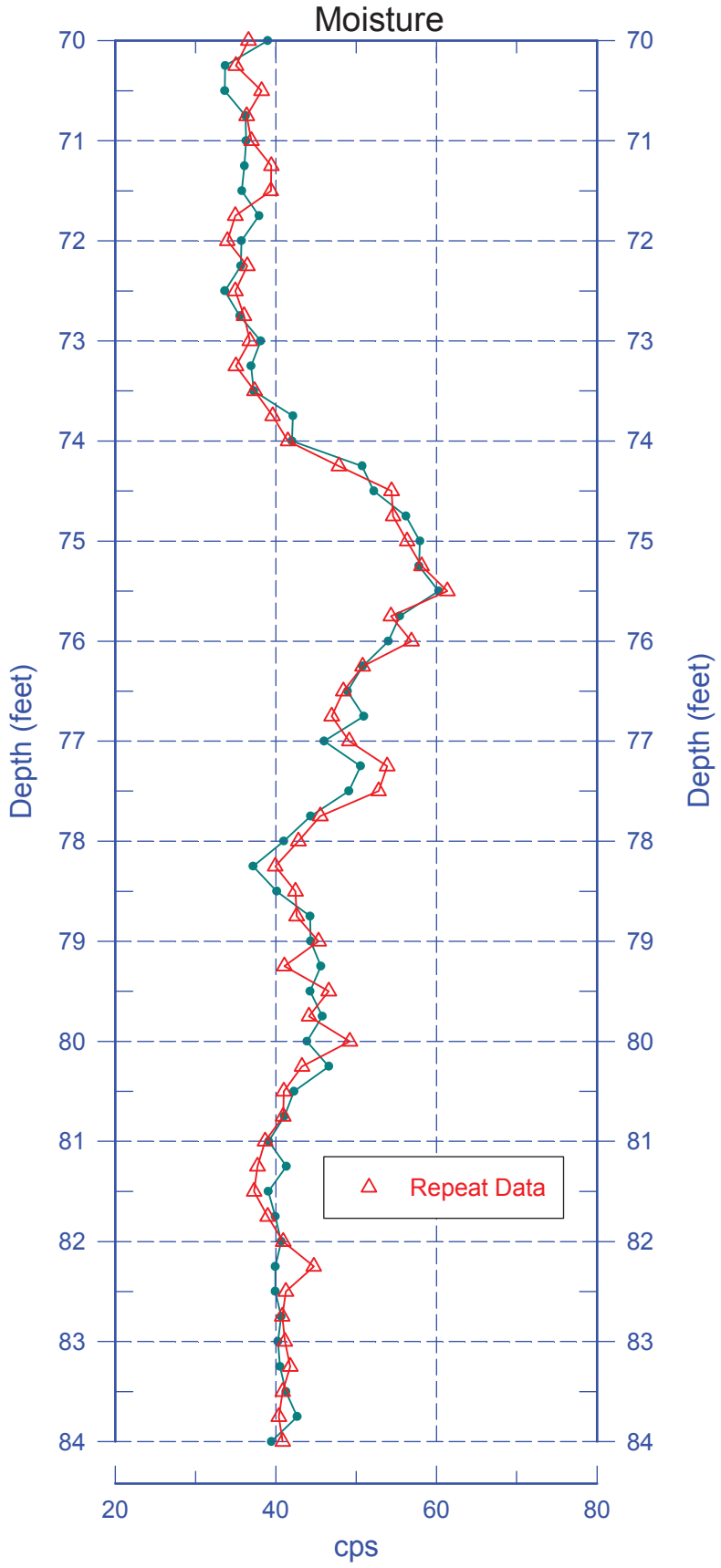
Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

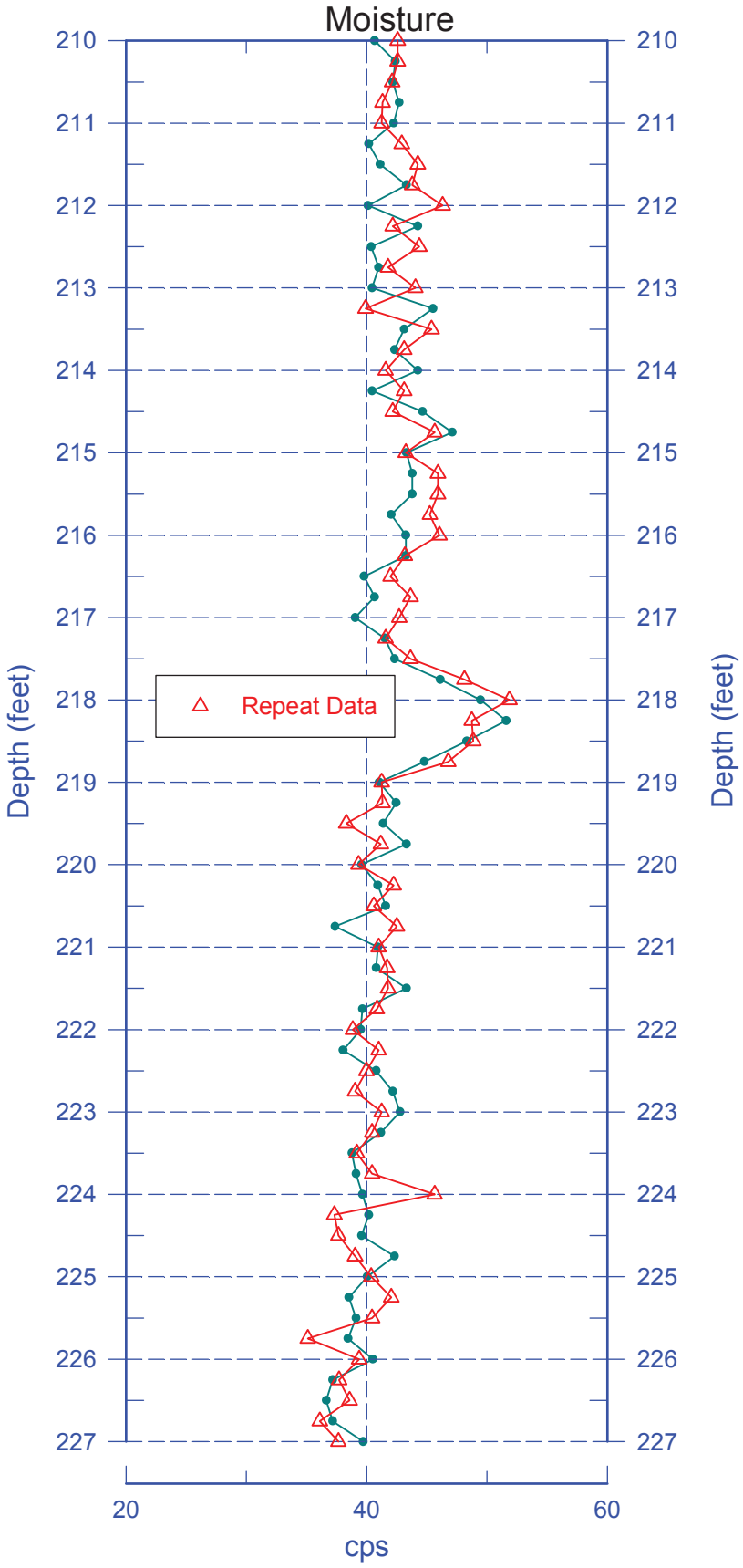
299-E28-32 (C9448)
Moisture Repeat Section



Reference - Ground Surface

Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

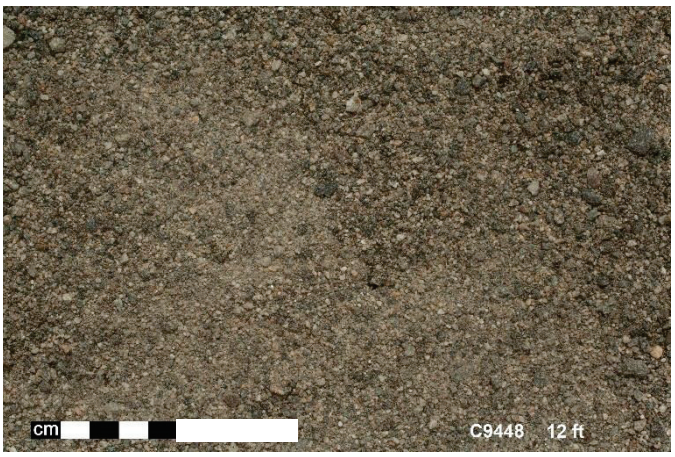
299-E28-32 (C9448)
Moisture Repeat Section

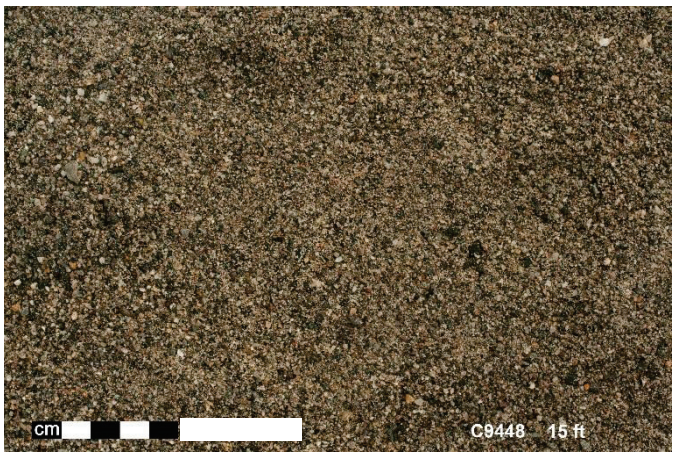


Reference - Ground Surface

cm
C9448 6 ft

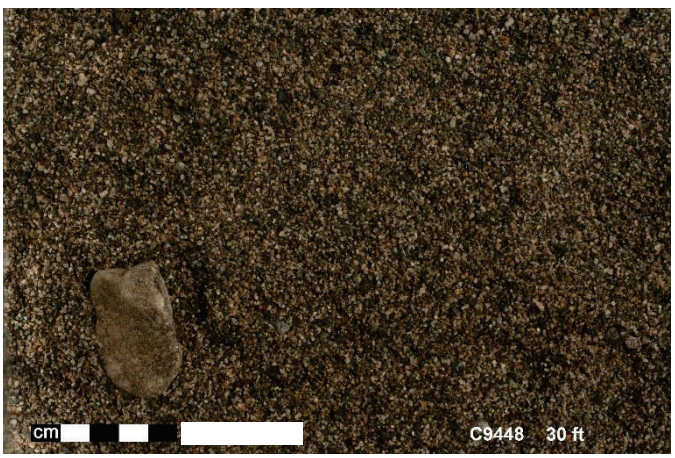
cm
C9448 11 ft

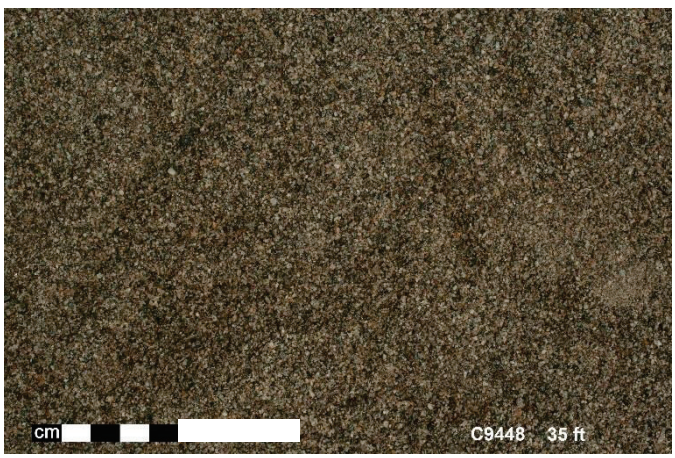

cm
C9448 12 ft


cm
C9448 15 ft

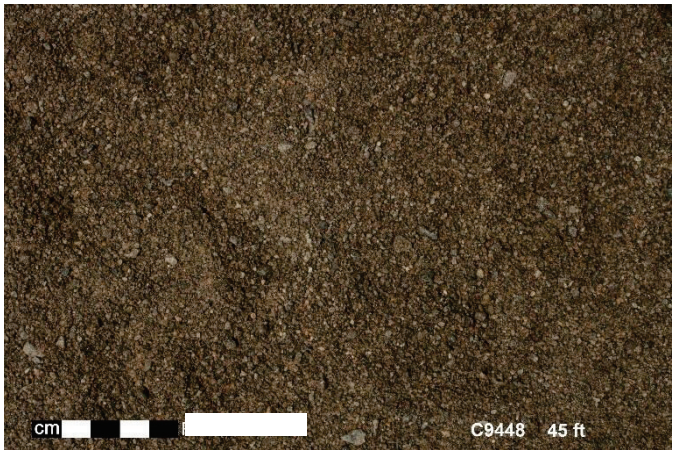
cm
C9448 20 ft

cm
C9448 25 ft


cm
C9448 30 ft


cm
C9448 35 ft

cm
C9448 40 ft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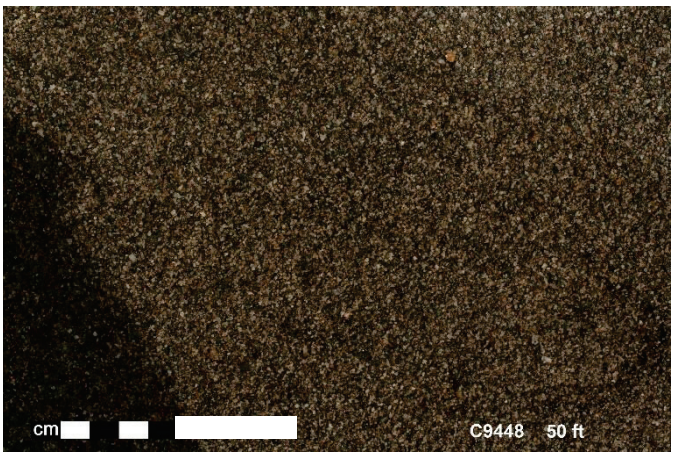
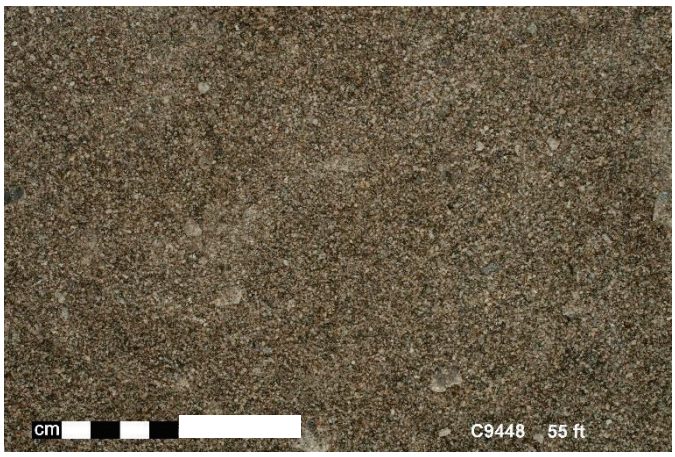
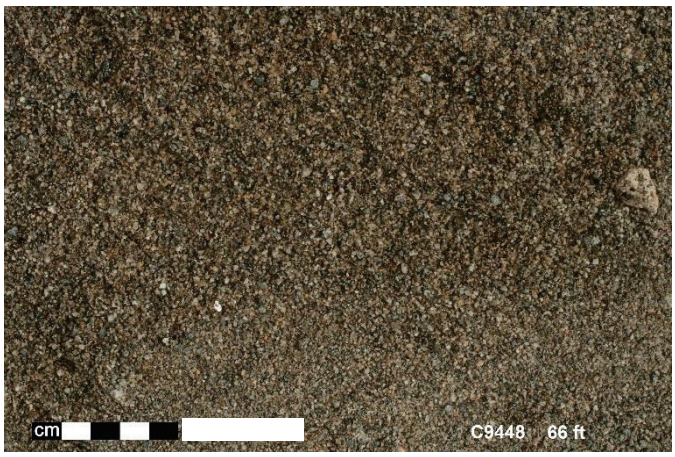
C9448 45 ft


cm
C9448 50 ft


cm
C9448 55 ft

cm
C9448 60 ft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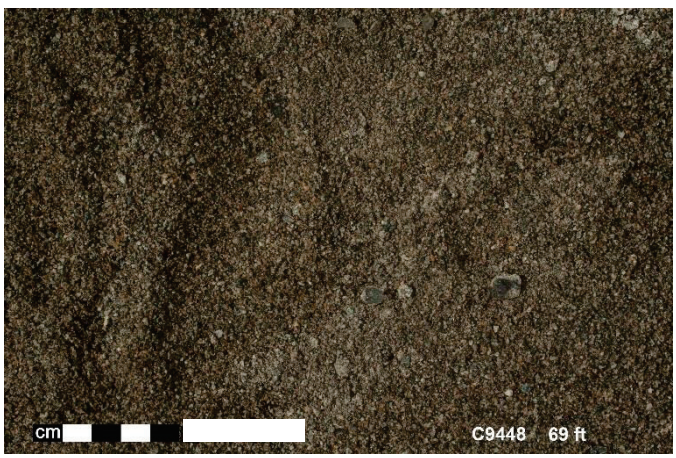
C9448 66 ft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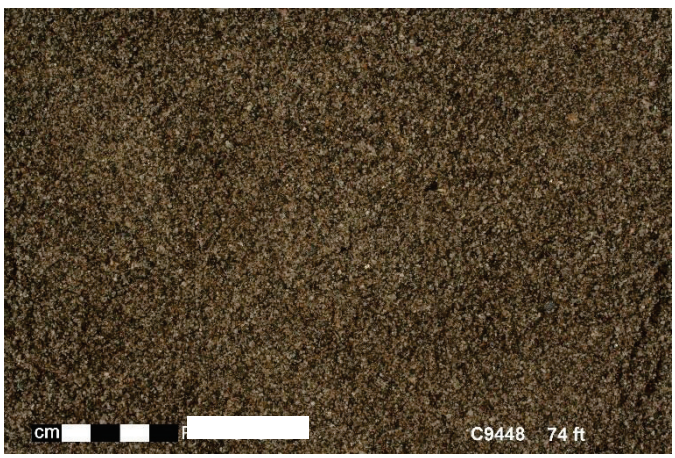
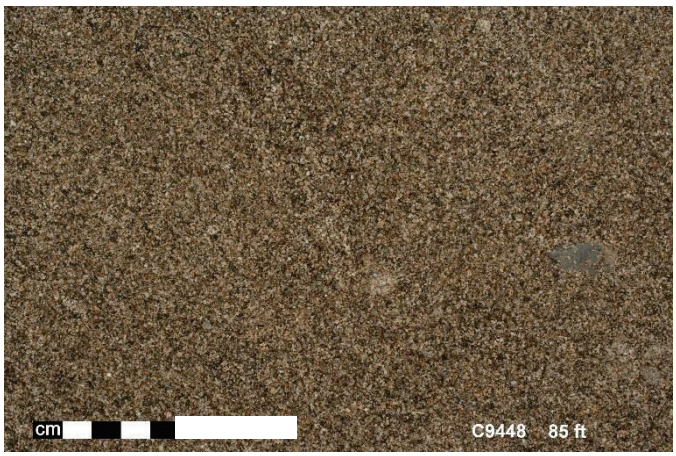
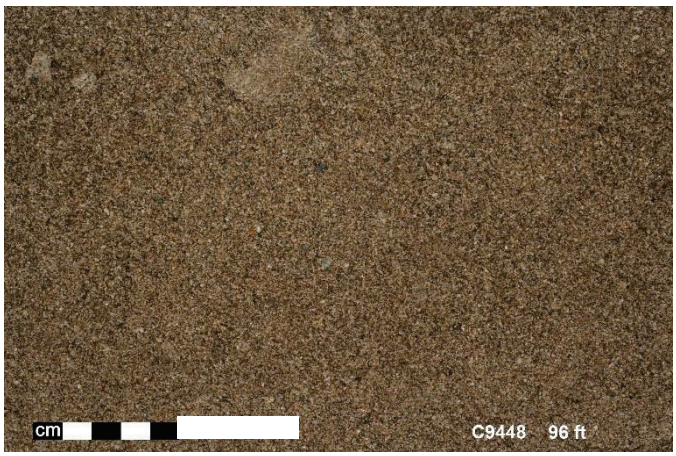

cm
C9448 74 ft

cm
C9448 76 ft

cm
C9448 80 ft


cm
C9448 85 ft

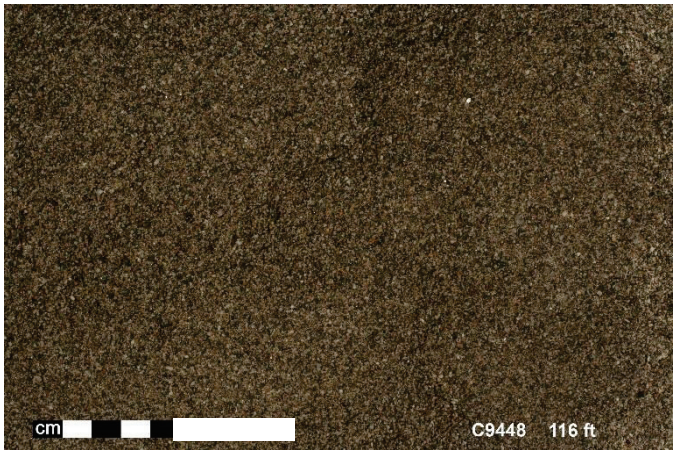
cm
C9448 91 ft


cm
C9448 96 ft

cm
C9448 100 ft

cm
C9448 105 ft

cm
C9448 110 ft


cm
C9448 116 ft

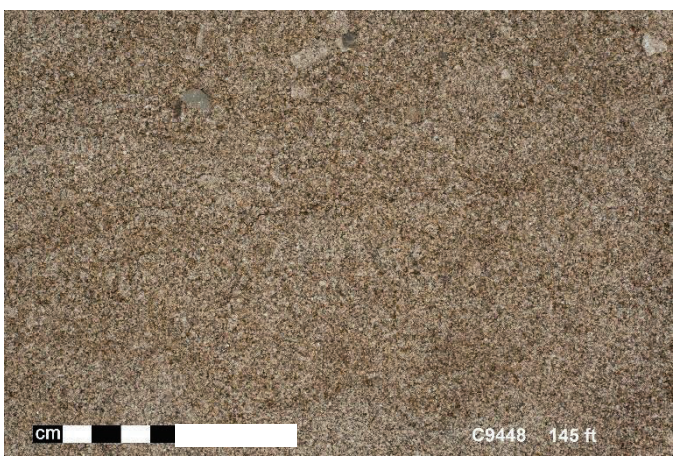
cm
C9448 121 ft

cm
C9448 126 ft

cm
C9448 130 ft

cm
C9448 135 ft

cm
C9448 140 ft


cm
C9448 145 ft

cm
C9448 150 ft

cm
C9448 155 ft

cm
C9448 160 ft

cm
C9448 166 ft

cm
C9448 170 ft

cm
C9448 175 ft

cm
C9448 176 ft

cm
C9448 180 ft

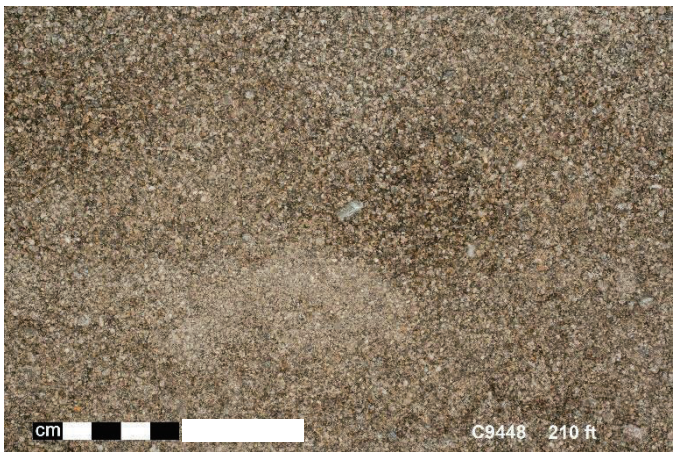
cm
C9448 186 ft

cm
C9448 190 ft

cm
C9448 195 ft

cm
C9448 200 ft

cm
C9448 205 ft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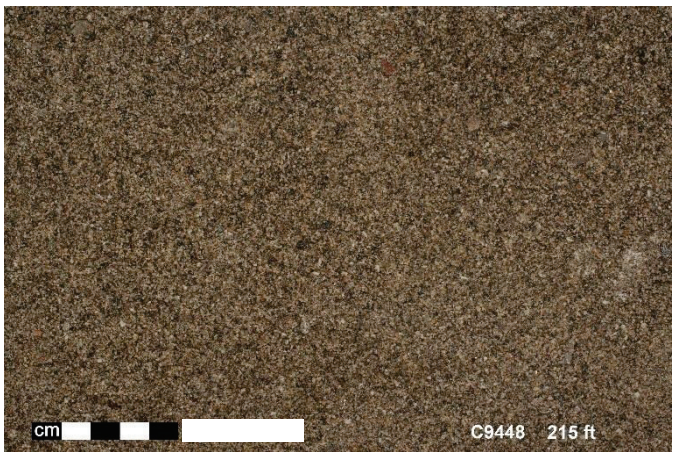
C9448 210 ft


cm
C9448 215 ft

cm
C9448 217 ft

cm
C9448 220 ft

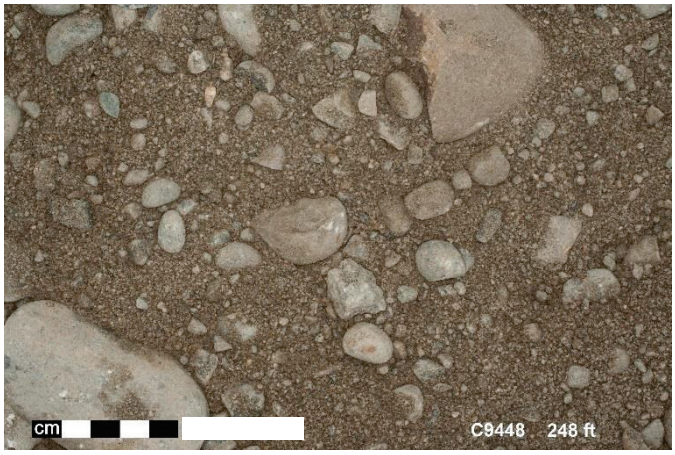
cm
C9448 225 ft

cm
C9448 230 ft

cm
C9448 235 ft

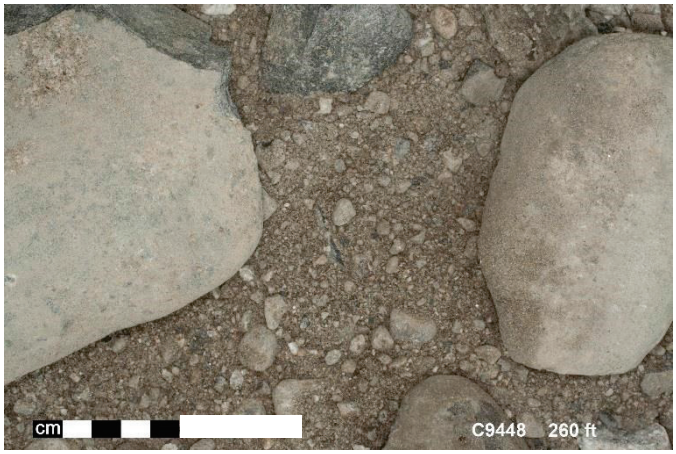
cm
C9448 240 ft

cm
C9448 244 ft

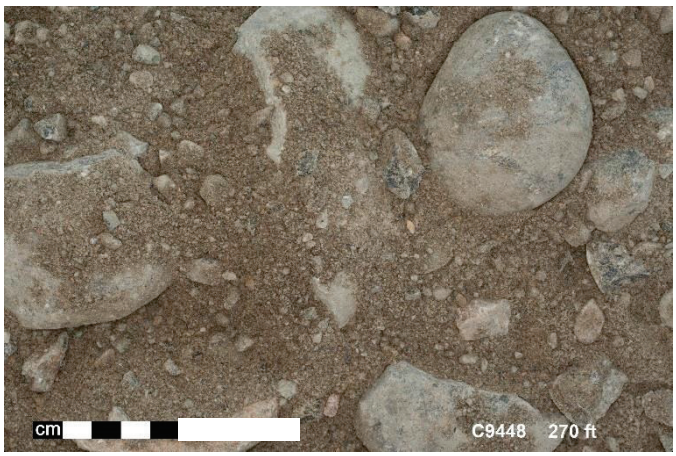

cm
C9448 248 ft

cm
C9448 250 ft

cm
C9448 255 ft


cm
C9448 260 ft

cm
C9448 265 ft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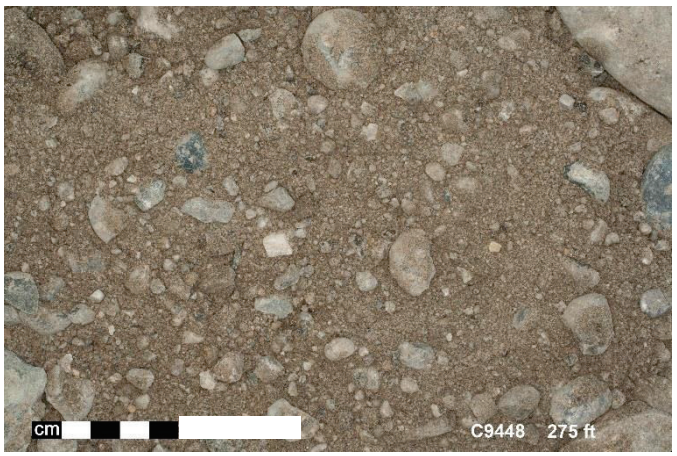
C9448 270 ft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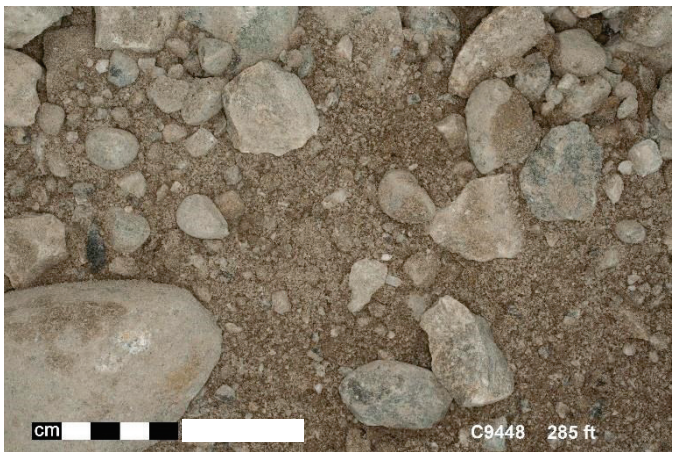
C9448 275 ft

cm
C9448 280 ft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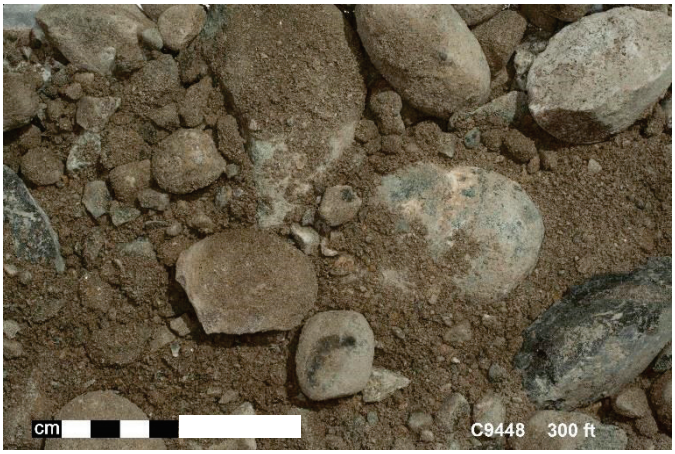
C9448 285 ft

cm
C9448 290 ft

cm
C9448 295 ft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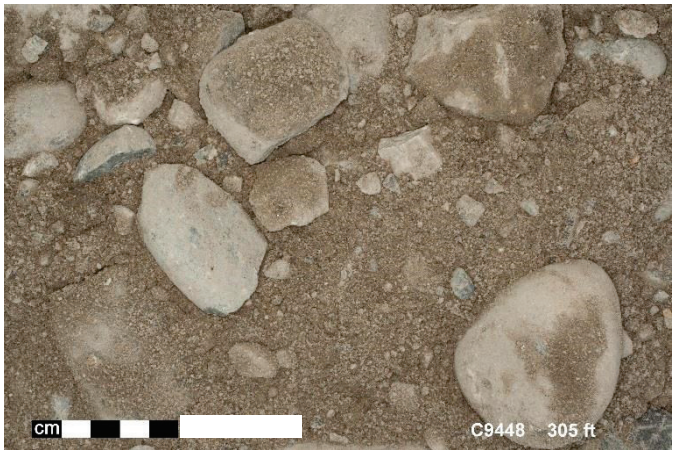
C9448 300 ft

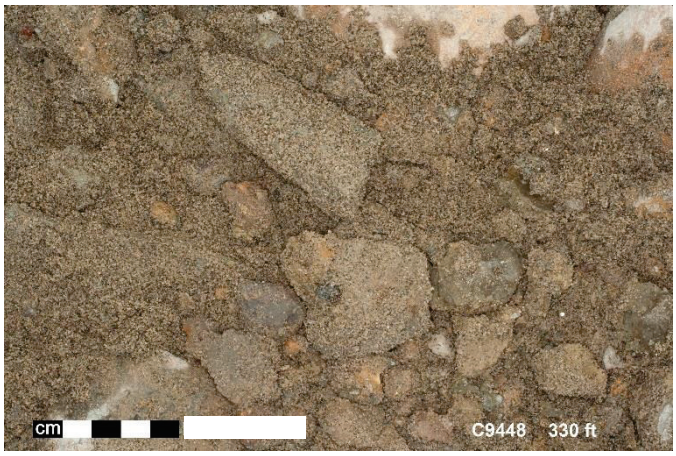

cm
C9448 305 ft

cm
C9448 312 ft

cm
C9448 316 ft

cm
C9448 318 ft

cm
C9448 324 ft


cm
C9448 330 ft

cm
C9448 331 ft

cm
C9448 335 ft

cm
C9448 340 ft

cm
C9448 342 ft

cm
C9448 346 ft

cm
C9448 350 ft

cm
C9448 355 ft

cm
C9448 360 ft

cm
C9448 365 ft

cm
C9448 370 ft

cm
C9448 371 ft

C9448 372 ft

SURVEY DATA REPORT			Request No. 154-155
Project No.	Title 200E M-24 Well C9448 (299-E28-32) Final Survey		File No. 2ET12R26
Job. No. CACN: 303595-JPRC	Prepared By N.P. Fastabend	Date 7/29/15	Reviewer UBM

DESCRIPTION OF WORK	DISTRIBUTION	SDR	PLOT	DWG
Obtained final coordinates (C/L Casing) and elevations of completed M-24 Well C9448 (299-E28-32) located on south side of B-Plant in 200E 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: 07/27/15	Requestor: Jim Mehrer (CHPRC)
Date of Survey: 07/29/15	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 M-24 Well C9448 (299-E28-32) located on south side of B-Plant in 200E Area.	Horizontal Datum: NAD83(91) Vertical Datum: NAVD88 Units: Meters Hanford Area Designation: 200E

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
2E-8 (CHPRC) and 2E-124 (CHPRC)

Well ID	Well Name	Easting	Northing	Elevation	
C9448	299-E28-32	573449.93·	136392.19·		Center of Casing
				215.512·	"X" on Rim
				214.761·	Brass Survey Marker

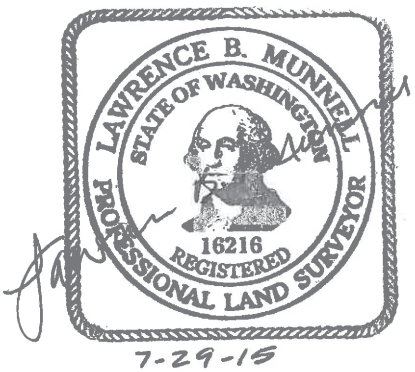
Notes:

215.214· 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.



7-29-15

A-6003-659 (04/03)

Distribution

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	D.P. Capelle	R3-60
	W.R. Faught	R3-50
	J.B. Geiger	R3-60
	A.J. Green	R3-60
	J.P. McDonald	R3-50
	G.S. Thomas	R3-50
	K.M. Whitley	R3-50
	B.A. Williams	H8-51