SGW-50130
Revision 0

Borehole Summary Report for the Installation of 2 Temporary Monitoring Wells and 1 Characterization Borehole within the 100-FR-3 Area in Support of the Integrated 100 Area Remedial Investigation/ Feasibility Study, FY2010-2011

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

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

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Terms

ags	above ground surface
ARRA	*American Recovery and Reinvestment Act of 2009*
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CHPRC	CH2M Hill Plateau Remediation Company
EPA	U.S. Environmental Protection Agency
DOE	U.S. Department of Energy
DOW	Description of Work
DQO	Data Quality Objective
Fm.	Formation (formal name)
fm.	formation (informal name)
ft	feet
HCl	hydrochloric acid
HEIS	*Hanford Environmental Information System*
Hg	Mercury
hp	Horse Power
IH	industrial hygiene
ID	identification
in.	inch
ISRM	*In-situ Redox Manipulation*
MSW	miscellaneous solid waste
NTU	nephelometric turbidity units
OU	operable unit
ppm	parts per million
PNNL	Pacific Northwest National Laboratory
RCRA	*Resource Conservation and Recovery Act of 1976*
RCT	radiological control technician
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPO	Remedial Process Optimization
RUM	Ringold Formation, Upper Mud Unit
SAP	Sampling and Analysis Plan
TD	total depth
TOC	top of casing
VOA	volatile organic analyte
VOC	volatile organic compound
WP/LIS	Waste Packaging /Labeling Instruction Sheet

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 (statute)
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 (avoir)
pounds	0.454	kilograms	kilograms	2.205	pounds (avoir)
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			
Temperature			**Temperature**		
Fahrenheit	(°F-32)*5/9	Centigrade	Centigrade	(°C*9/5)+32	Fahrenheit
Radioactivity			**Radioactivity**		
picocurie	37	millibecquerel	millibecquerel	0.027	picocurie

1 Intoduction/Scope

This borehole summary report supports the Remedial Investigation (RI)/Feasibility Study (FS) process for the 100-FR-3 operable unit (OU). It includes summary of all activities and general information common to the installation of 2 Temporary Monitoring Wells and the Drilling of 1 Characterization Borehole; C7970, C7972 and C7971 respectively, see Table 1 below. These wells and borehole support the RI/FS process for the 100-FR-3 OU. The well drilling activities were completed in compliance with *Washington State Administrative Code* 173-160, "Minimum Standards for Construction and Maintenance of Wells" (WAC-173-160). Well site activities and geologic logging were performed in accordance with CH2M Hill Plateau Remediation Company (CHPRC) procedure GRP-EE-01-7.0, *"Geologic Logging."*

Table 1: Borehole Information

Well Name	Borehole ID#	Dept. of Ecology ID#	Dates		Final Civil Survey Data			Total Depth (ft bgs)
			Start	Finish	Easting (m)[a]	Northing (m)[a]	Elevation of Brass Marker (m)[b]	
199-F5-55	C7970	AAO 516	02/09/2011	02/18/2011	581076.10	147797.57	126.811	50.0
-	C7971	-	02/10/2011	02/11/2011	580158.59	147192.84	122.14	33.5
199-F5-56	C7972	AAO 513	02/15/2011	02/22/2011	580440.62	147556.36	127.215	50.9

Notes:
[a] Measured at the center of the borehole/well in Washington State Plane Coordinates, NAD83(91), North American Datum of 1983.

[b] Measured at the Brass Survey Marker associated with the borehole/well in NAVD88, North American Vertical Datum of 1988.

bgs = below ground surface.
ft bgs = feet below ground surface
ID# = (borehole) identification number.
m = meters

The 100-FR-3 OU is the closest of the old Hanford Site production reactor areas upstream from Richland. The 100-FR-3 OU encompasses an area of approximately 2.8 sq. km (1.1 sq. mi). It lies predominantly in the north, northeastern portion of the Hanford Site, see Figure 1. Borehole locations are identified in Figure 2.

These boreholes were installed and sampled under the direction of the following driving documentation:

- DOE/RL-2009-43, *Sampling and Analysis Plan for the100-FR-I, 100-FR-2, 100-FR-3,100-IU-2, and 100-IU-6 Operable Units Remedial Investigation/Feasibility Study, Rev. 0*(DOE/RL-2009-43, 2010)
- DOE/RL-2008-46, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* (DOE/RL-2008-46, 2009)
- DOE/RL-2008-46-ADD4, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan Addendum 4: 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* (DOE/RL-2008-46-ADD4, 2010).
- SGW-46025, *Description of Work for the Installation of 21 Boreholes and 2 Temporary Wells in the 100-Area of the Hanford Site in Fiscal Year 2010 and Fiscal Year 2011*(SGW-46025, 2010)

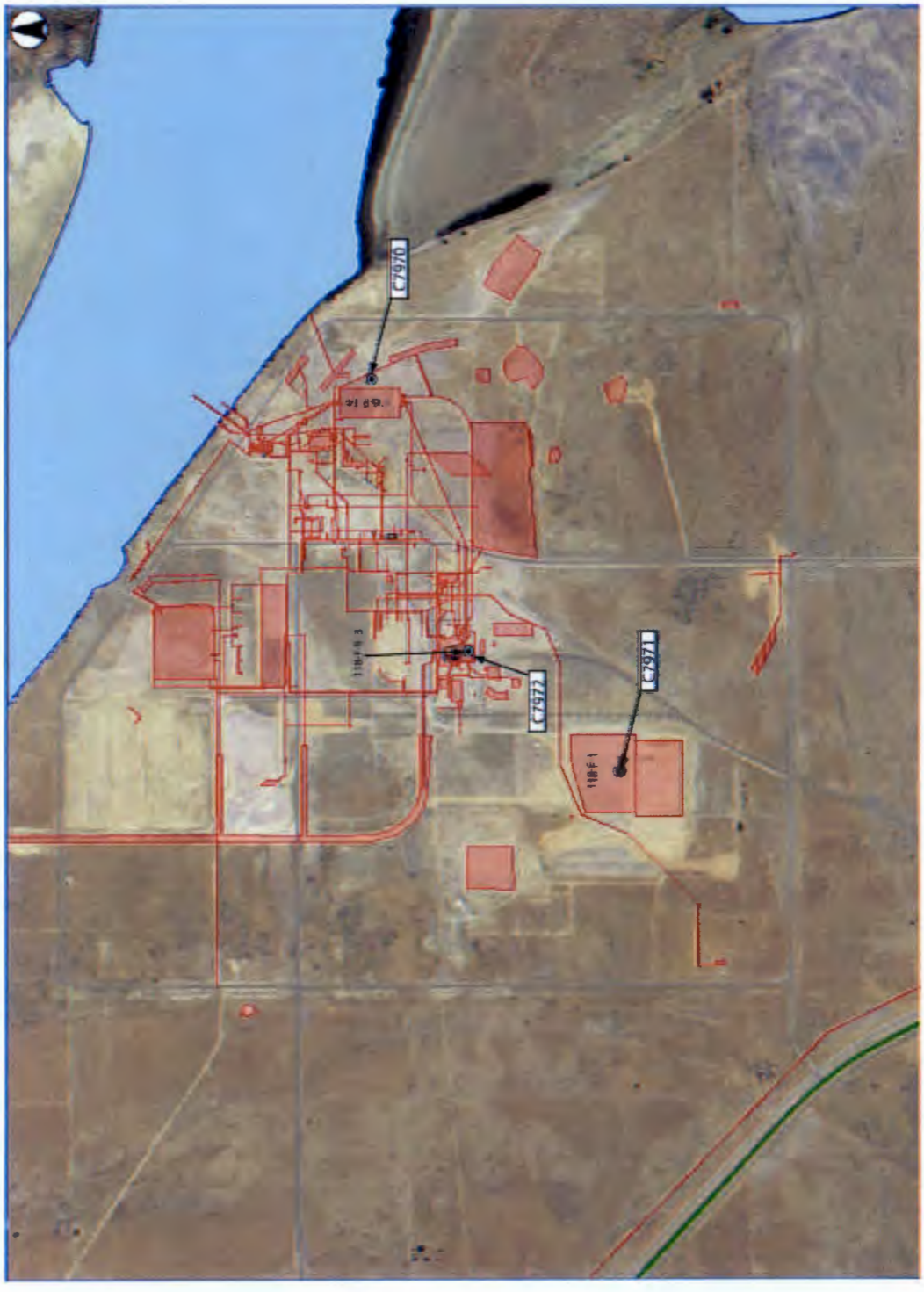
This project is being carried out to close data gaps and address uncertainties in interim record of decisions (RODs) for the 100 Areas National Priority Listing sites; except the 300 Area which is addressed separately. Data gap closure will support final remedial selections under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA). This RI/FS work will also address corrective actions for interlaying *Resource Conservation and Recovery Act of 19-76* (RCRA) areas of concern.

Figure 1. River Corridor Decision Units

River Corridor Areas

Areas	Acres	Hectares	Sq. Mi.	Sq. Km.
100-BC	2850.79	1153.68	4.45	11.54
100-D/H	5016.89	2030.27	7.84	20.30
100-F/ IU2/IU6	92945.73	37613.95	145.23	376.16
100-K	2218.16	897.66	3.47	8.98
100-N	2197.47	889.29	3.43	8.89
300	36663.19	14594.31	56.35	145.95

Figure 2. RI/FS Temporary Well and Borehole Locations for 100-FR-3 Area



1.1 Background

Portions of the Hanford Site are designated numerically, with the location of production reactors being the 100 Area. The 100 Area is located in the northern part of the Hanford Site along the south shore of the Columbia River. The 100 Area is divided into five groundwater OUs. Environmental setting information common to the 100 Area is provided in detail in DOE/RL-2008-46. The environmental setting dictates much of the behavior of contamination within the vadose zone and groundwater.

1.1.1 Initial Evaluation

The primary sources of contamination at the 100-F Area are the water-cooled nuclear reactor (105-F) and the structures (e.g., fuel storage basins [FSB]) and processes (e.g., sodium dichromate process) associated with reactor operations. The reactor was built to irradiate uranium-enriched fuel rods from which plutonium and other special nuclear materials could be extracted (in the 200 Area process plants). The processes associated with reactor operations generated large quantities of liquid and solid wastes. Liquid and solid wastes from reactor operations and associated facilities, as well as from the Experimental Animal Farm (EAF), were released to the soil column and the Columbia River. Sources of contamination include spills, leaks, and past liquid and solid waste disposal sites.

1.2 Conceptual Site Model

The Conceptual Site Model (CSM) is a description of the site that organizes the available information and provides a summary of the site conditions. The CSM is developed to depict what is known about the site history (including process history), concentrations and location of contamination, and information needed to support decisions on remediation. The CSM is used to identify data and information gaps, establish data needs, and design a field program to address the gaps.

1.2.1 Geologic Overview of the 100-FR-3 OU

The following is a geologic overview of geology encountered in the boreholes at the 100-FR-3 OU. The only geologic units that were encountered on this project were the Hanford formation and the Ringold upper mud unit. The overview includes geologic information from WHC-SD-EN-TI-221, Geology of the 100-FR-3 Operable Unit, Hanford Site South-Central Washington (WHC-SD-EN-TI-221, 1994). Geologic descriptions of the sediments encountered at each borehole are included in Section 3 "Technical Data".

Throughout 100-FR-3, the Hanford formation overlies the Ringold Formation. The Hanford formation is characterized by large to very large cobble to boulder size clasts in open framework gravels that include discrete sand lenses, with minor to no silt and clay material. The grains typically are sub-round to round gravel and sub-angular to round in the sand grain fraction. The gravel-dominated facies is typically well stratified and contains little to no cementation (WHC-SD-EN-TI-132, Geologic Setting of the 100-HR-3 Operable Unit, Hanford Site, South-Central Washington). The Hanford formation is divided into three facies: (1) gravel-dominated, (2) sand-dominated, and (3) silt-dominated (DOE/RL-2002-39). The Hanford formation comprises the dominant material throughout the 100 Area vadose zone where numerous contaminant sources either have been remediated or await remediation.
Ringold upper mud material was encountered only in borehole C7971 while drilling activities were conducted. In addition to the Hanford formation, some drilling activities encountered eolian surface

sediments. Eolian surface sediments encountered during drilling exhibited anthropogenic influence to depths no greater than 17 ft bgs. The eolian surface sediments were characterized by relatively undisturbed surface sediments typically consist of silty sand to sandy silt.

2 Technical Data

2.1 Temporary Well 199-F5-55 (C7970)

Temporary Well 199-F5-55 (C7970) is located east of 105-F Reactor on the east side of the 116-F-14 Retention Basin along the Columbia River. Well installation operations began on February 9, 2011 and were concluded on February 18, 2011. All drilling activities were done in compliance to WAC 173-160.

2.1.1 Drilling

Drilling C7970 was done with 10 ¾ -in outer diameter (OD), and 9 ½ -in. inner diameter (ID) rope-thread, carbon steel temporary casing. A Bucyrus Erie 22-W truck mounted cable tool rig using a 4-in drive barrel was used to advance the casing, advance the borehole and collect split spoon samples. The borehole was advanced to a total depth (TD) of 50.0 feet below ground surface (ft bgs). Water was encountered at this borehole at 42.3 ft bgs. Upon reaching TD a straightness test was completed using 20-ft piece carbon steel with welded steel wings with a diameter 8 ½-in.

2.1.2 Borehole Geology

The only unit encountered throughout the drilling of this well was the Hanford formation (fm.). The Hanford fm. at this location extends from ground surface to 50.0 ft bgs, the TD of the borehole.

From ground surface to 10 ft bgs the material was represented by 60% sand, 40% gravel, and5% silt and is classified as sandy gravel. The sand ranged from very fine to very coarse, sub-rounded to sub-angular. The vast majority (90%) of the gravels ranged from 2 mm to 30 mm (very fine to coarse pebbles) while a small amount (10%) of the gravels were large cobbles (> 126 mm). The bulk (80%) of the material was mafic and the remaining material (20%) was felsic. The dominant color was brown and there was no reaction with hydrochloric acid (HCl). At 10 ft bgs there was a color change to dark grayish brown (10 YR 4/2). While 10% of the material was still large cobbles (i.e., > 126 mm), 30% of the material ranged from 2mm to 22 mm (i.e., very fine to coarse pebbles), 5% was observed to be silt, and the remaining 55% was sand; the sand at this depth has a weak reaction to HCl.

From 20 ft bgs to 48.4 ft bgs silty sandy gravel dominated. Gravel consistency ranged from 50% to 60% and from 2 mm to 50 mm (i.e., very fine to very coarse pebbles). The sand content ranged from 35% to 45% displaying no discernable percentage trend. The sand ranged from sub-rounded to sub-angular. The silt percentage held consistent near 10%. The dominate color of the material varied from a red-brown at 20 ft bgs grading to a dark grey at 25 ft bgs, and finally grading to a dark grey at 40 ft bgs. At 20 ft bgs, 90% of the material was felsic and the remaining 10% was mafic. The felsic to mafic ratio gradated with depth recording: 80% felsic and20% mafic at 25 ft bgs; 50% felsic and 50% mafic at 30 ft bgs; and 20% felsic and 80% mafic at 40 ft bgs. HCl did not react with the material in this range, except weakly at 20 ft bgs. The static water table was encountered at 42.3 ft bgs.

2.1.3 Borehole Geophysical Logging

Geophysical logging for C7970 was performed by The S.M. Stoller Corporation (Stoller) after TD was reached. Spectral Gamma Logging System (SGLS) was performed from ground surface to 46.0 ft bgs and neutron moisture logging (NMLS) was performed from ground surface to 40.75 ft bgs on February *15th, 2011. See Appendix* C for the specific geophysical logging results.

2.1.4 Well Completion

Installation of the temporary well at borehole C7970 took place on February 16, 2011. Installation began by tripping in a 4-in PVC sump (0.30 ft), a 0.020-in. (20-slot) screen (10.0 ft) and blank riser casing (40.06 ft) for a total of 50.36 ft of material. Well installation continued by removing all temporary casing while simultaneously back filling with 16.7 ft of 10-20 mesh Colorado Silica® sand. The remaining annular space was filled using 3.1 ft of 3/8-in bentonite pellets, and 27.9 ft of #8 bentonite crumbles. The final 2.3 ft of annular space was poured with Portland type I-II cement, and brass marker placed. Details for well completion are shown below in Table 2.

Table 2: Construction Summary, Well 199-F5-55 (C7970)

Borehole Total Depth (ft bgs)	Static Water Level (ft bgs)	4-inch Diameter, SCH 40 PVC Well Materials			Annular Materials		
		Material	Interval (ft bgs)	Slot Size (in.)	Material	Interval (ft bgs)	Mesh Size
50.0	41.0	Casing	0.0 – 39.7	Solid	Neat Grout Cement	0.0-2.3	Slurry
		Screen	39.7 – 49.7	0.020	Bentonite Seal (Crumbles)	2.3 – 30.2	#8
		Casing	49.7 – 50.0	Sump	Bentonite Pellets	30.2 – 33.3	3/8"
					Filter Sand Pack	33.3 – 50.0	10-20

Notes:
ft bgs = feet below ground surface
in. = inches

2.1.5 Well Development

Development at C7970 was carried out on February 18, 2011 using a Grundfos® X-MS402 submersible pump. The pump was run for 2 hours, 50 minutes at a rate of 10 gallons per minute (1,700 gallons pumped) with a drawdown of 2.35 ft. Specific sampling information is shown below in Table 3.

Table 3: Development Overview for 199-F5-55 (C7970)

Time	Temp (°C)	xD (feet)	Conductivity (µS/cm)	pH	Turbidity (NTU)
1220	17.2	2.87	760	7.18	>1000
1235	17.2	1.35	568	7.35	148
1250	15.8	1.35	558	7.52	45.6
1330	19.5	1.29	534	7.58	12.70
1350	19.8	1.27	528	7.50	9.15
1405	18.9	1.26	519	7.46	9.58

Table 3: Development Overview for 199-F5-55 (C7970)

Time	Temp (°C)	xD (feet)	Conductivity (µS/cm)	pH	Turbidity (NTU)
1430	19.3	1.25	523	7.46	6.68
1445	19.4	1.25	511	7.40	5.43
1500	18.6	1.25	522	7.38	4.98
1505	18.3	1.25	520	7.38	4.85
1507	18.1	1.24	521	7.40	4.92

Notes:
xD = Change in hydraulic head
µS/cm = micro-Siemens per centimeter
NTU = Nephelometric Turbidity Units

2.1.6 Sampling for Laboratory Analysis

Sampling at this borehole included geologic archive sampling and split spoon soil sampling. Geologic archive samples were collected at 5 ft intervals throughout the depth of the borehole. Split spoon samples were collected on a semi-continuous basis (approximately 2 ft between split spoons) starting at 15.4 ft bgs until groundwater was reached. At the groundwater horizon (42.3 ft bgs) continuous split spoons were taken through the boundary. At TD a water sample was collected. Samples and depths are summarized in Table 4 below.

Table 4: Sample Table Summary for 199-F5-55 (C7970)

Sample Acquisition Information					Sample HEIS # and Laboratory Identification			
Sample Interval (ft bgs)	Sample Interval #	Collection Date	Sample Type	Sample Method	WSCF	Eberline	LVL	TARL
15.4-17.9	I-001	2/9/2011	Soil	Split Spoon	B28NV9	B28NT6	B28NM7, B28NP0, B28NR3, B28NM3	--
20.2-22.7	I-002 (DUP=[d])	2/9/2011	Soil	Split Spoon	B2BXR1	B28NW7, B28NT7, B28NX0[d]	B28NW6, B28NW8, B28NM8, B28NP1, B28NR4, B28NW9[d], B28NX1[d]	--
24.6-27.1	I-003	2/10/2011	Soil	Split Spoon	B28NW0	B28NT8	B28NM9, B28NP2, B28NR5	--

Table 4: Sample Table Summary for 199-F5-55 (C7970)

Sample Acquisition Information					Sample HEIS # and Laboratory Identification			
Sample Interval (ft bgs)	Sample Interval #	Collection Date	Sample Type	Sample Method	WSCF	Eberline	LVL	TARL
29.4-31.9	I-004	2/10/2011	Soil	Split Spoon	--	B28NT9	B28NM4, B28NN0, B28NP3, B28NR6	--
34.4-36.9	I-005	2/10/2011	Soil	Split Spoon	B28NW1	B28NV0	B28NN1, B28NP4, B28NR7	--
37.5-40.0	I-006	2/11/2011	Soil	Split Spoon	B2BXR3	B28NV1	B28NN2, B28NP5, B28NR8	--
39.5-42.0	I-007	2/11/2011	Soil	Split Spoon	B28NW2	B28NV2	B28NN3, B28NP6, B28NR9	--
42.2-43.7	I-014	2/11/2011	Soil	Split Spoon	B28NW5	B28NV8	B28NN9, B28NR2, B28NT5	--
46.4-48.4	I-015 (DUP=[d])	2/11/2011	Water, Soil (Soil=[s])	Pump, Split Spoon	--	B28NX2[s], B28NX5, B28NX6[d]	B28NM6[s], B28NX3, B28NX4[d]	B28NX7, B28NX8[d]

Notes:

ft bgs = feet below ground surface
HEIS = *Hanford Environmental Information System* (database)
LVL = Lionville Laboratory
TARL = Test America - Richland Laboratory
WSCF= Waste Sampling and Characterization Facility

2.1.7 Environmental Monitoring

Radiological monitoring was provided on a morning and afternoon (i.e., "AM/PM") basis throughout vadose zone drilling activities and was also provided on an intermittent basis (i.e., frequent checks throughout the day) during drilling that took place below the water table and when extracting casing during well construction. Radiological Control Technicians (RCTs) conducted surveys of drill cuttings, drilling tools, sampling equipment, personal protective equipment, and sediment storage containers using several radiation detection meters; to detect levels of beta, gamma and alpha radiation particles. All radiological contamination encountered at well sites was attributed by RCTs performing periodic checks as naturally occurring Radon gas. All gamma and alpha contamination detected was below the threshold limit of elevated radiological permitting.

Air quality monitoring for organic vapors was provided on an "AM/PM" basis by an industrial hygienist (IH) while drilling through the aquifer. The industrial hygienist measured air quality above the borehole opening, above the drill cuttings (when present) and within the general breathing space around the work area. The Industrial hygienist reported all sustainable readings to be between zero and 3 parts per million

(ppm); which according to the IH were well below the sustainable permissible exposure limit of all suspect contaminants of concern.

2.2 Characterization Borehole C7971

Borehole C7971 is located south west of the 100-F Reactor. Drilling activities began on February 10, 2011 and were concluded on February 24, 2011. All drilling activities were done in compliance with WAC 173-160.

2.2.1 Drilling

Drilling C7971 was done with 10 ¾ -in OD, and 9 ½ -in. ID rope-thread, carbon steel temporary casing. A Bucyrus Erie 22-W truck mounted cable tool rig using a 4-in drive barrel was used to advance the casing, advance the borehole and collect split spoon samples. The borehole was advanced to a TD of 33.5 ft bgs. Water was encountered at this borehole at 26.2 ft bgs.

2.2.2 Borehole Geology

The units encountered throughout the drilling of this borehole were the eolian sands, Hanford fm., and clay and silt of the Ringold upper mud unit. The eolian sands extended from ground surface to 13 ft bgs, the Hanford fm. extended from 13 ft bgs to 29 ft bgs. High plasticity clay was encountered at 29 ft bgs and extended to TD of 33.5 ft bgs.

From ground surface to 13 ft bgs eolian sandy gravel was present. The sandy gravel was represented by 60% sand and 40% gravel. The sand consistently ranged medium grained and was sub-rounded. The gravels ranged from 8 mm to 256 mm (i.e., medium pebbles to large cobbles) and sub-rounded to rounded. The mineralogy of sandy gravel was 15% of the material was mafic and 85% felsic. The dominant color of the sandy gravel was dark gray and there was a weak reaction to HCl.

The Hanford formation was present from 13 ft bgs to 29 ft bgs. From 13 ft bgs to 22 ft bgs gravelly sandy silt was present. The material in the gravelly sandy silt was represented by 20% sand, 20% gravel, and 60% silt. The sand ranged from fine to medium grained. The gravel ranged from 4 mm to 16 mm (i.e., fine to medium pebbles) and sub-rounded to sub-angular. The mineralogy of the gravelly sandy silt was 85% of the material was mafic and 15% felsic. The dominant color was gray and there was a moderate reaction to HCl. From 22 ft bgs to 25 ft bgs slightly silty sandy gravel was present. The sand ranged from medium to coarse grained and sub-rounded to rounded. The gravel ranged from 4 mm to 32 mm (i.e., fine to coarse pebbles) and sub-angular to sub-rounded. The mineralogy of the gravel was 80% of the material was mafic and 20% felsic. The dominant color was dark gray and there was no reaction to HCl. From 25 ft bgs to 29 ft bgs sandy gravel was present. The sand was consistently course grained and sub-rounded. The gravel was 4 mm to 64 mm (i.e., fine to very coarse pebbles) and sub-rounded. The dominant color was very dark gray. From 29 ft bgs to a TD of 33.5 ft bgs clay was present interpreted to be the Ringold upper mud unit. The clay showed high levels of plasticity and the dominant color was gray.

2.2.3 Borehole Geophysical Logging

Geophysical logging for C7971 was performed by Stoller after TD was reached. SGLS was performed from ground surface to 28.0 ft bgs and NMLS was performed from ground surface to 26.0 ft bgs on February 19th, 2011. See Appendix C for the specific geophysical logging results.

2.2.4 Borehole Decommissioning

No well was installed at this borehole. The borehole was decommissioned in accordance with GRP-EE-02-14.1, *Drilling, Remediating, and Decommissioning Resource Protection Wells and Geotechnical Soil Borings* and WAC 173-160. The decommissioning of C7971 took place on February 24, 2011. The borehole was decommissioned by removing all temporary casing while simultaneously back filling with Colorado Silica® sand, bentonite crumbles and Portland cement. From TD to 21.6 ft bgs the borehole was backfilled with 10/20 mesh Colorado Silica® sand. Decommissioning continued from 21.6 ft bgs to 3.0 ft bgs using Cetco® #8 bentonite crumbles. The remainder of the borehole was decommissioned using Portland cement from a depth of 3.0 ft bgs to ground surface. The surface seal has a 1.05 inch diameter. A brass survey marker was placed on the north side of the seal. The brass marker has the borehole identification number (C7971) and the date the borehole was fully decommissioned (February 24, 2011). An overview of well decommissioning can be seen below in Table 5.

Table 5: Borehole Decommissioning, Borehole C7971

Borehole Total Depth (ft bgs)	Static Water Level (ft bgs)	4-inch Diameter, SCH 40 PVC Well Materials			Annular Materials		
33.5	26.2	Material	Interval (ft bgs)	Slot Size (in.)	Material	Interval (ft bgs)	Mesh Size
		NA	NA	NA	Neat Grout Cement	0.0 3.0	Slurry
					Bentonite Seal (Crumbles)	3.0 - 21.6	#8
					Colorado Silica Sand	21.6 -30.2	10-20
					Natural Fill	30.2 – 33.5	N/A

Notes:
ft bgs = feet below ground surface
in. = inches

2.2.5 Sampling for Laboratory Analysis

Sampling at this borehole included geologic archive sampling and split spoon soil sampling. Geologic archive samples were collected at 5 ft intervals throughout the depth of the borehole. Split spoon samples were collected on a semi-continuous basis (approximately 2 ft between split spoons) starting at 17.3 ft bgs until groundwater was reached. At the groundwater horizon (26.2 ft bgs) continuous split spoons were taken through the boundary. At TD a water sample was collected. Samples and depths are summarized in Table 6 below.

Table 6: Sample Table C7971

Sample Acquisition Information					Sample HEIS # and Laboratory Identification			
Sample Interval (ft bgs)	Sample Interval #	Collection Date	Sample Type	Sample Method	WSCF	Eberline	LVL	TARL
17.3-19.8	I-001	2/11/2011	Soil	Split Spoon	B28VL5	B28VL6	B28VL7 B28VL8 B28VL9	-
19.7-22.2	I-002	2/11/2011	Soil	Split Spoon	-	B28VM1	B28VM2 B28VM3 B28VM4	-
25.3-27.8	I-003 (DUP=[d])	2/11/2011	Soil	Split Spoon	B28VN1	B28VN2 B28VM5[d]	B28VN3 B28VN4 B28VN5 B28VM6[d] B28VM7[d]	-
26-28.5	I-012	2/11/2011	Soil	Split Spoon	-	B2B6M3	B28VV0 B28VV1 B28VV3	-
29-31.5	I-013S	2/11/2011	Soil	Split Spoon	-	B28VV3	B28VV4 B28VT9	-
28.1	I-013 (DUP=[d])	2/15/2011	Water	Pump	-	B28VV9 B28VW2[d]	B28WV0 B28VW3[d]	B28VV8 B28VW1[d]

Notes:

ft bgs = feet below ground surface

HEIS = *Hanford Environmental Information System* (database)

LVL = Lionville Laboratory

TARL = Test America - Richland Laboratory

WSCF= Waste Sampling and Characterization Facility

2.2.6 Environmental Monitoring

Radiological monitoring was provided on a "AM/PM" basis throughout vadose zone drilling activities and was also provided on an intermittent basis (i.e., frequent checks throughout the day) during drilling that took place below the water table and when extracting casing during well construction. Radiological Control Technicians (RCTs) conducted surveys of drill cuttings, drilling tools, sampling equipment, personal protective equipment, and sediment storage containers using several radiation detection meters, to detect levels of beta, gamma and alpha radiation particles. All radiological contamination encountered at well sites was attributed by RCTs performing periodic checks as naturally occurring Radon gas. All gamma and alpha contamination detected was below the threshold limit of elevated radiological permitting.

Air quality monitoring for organic vapors was provided on a morning and afternoon basis by an IH while drilling through the aquifer. The IH measured air quality above the borehole opening, above the drill cuttings (when present) and within the general breathing space around the work area. The IH reported all sustainable readings to be between zero and 3 ppm; well below the sustainable permissible exposure limit of all suspect contaminants of concern.

2.3 Temporary Well 199-F5-56 (C7972)

Temporary Well 199-F5-56 (C7972) is located south of the 100-F Reactor. Well installation operations began on February 15, 2011 and were concluded on February 23, 2011. All drilling activities were done in compliance with WAC 173-160.

2.3.1 Drilling

Drilling C7972 was done with 10 ¾ -in OD, and 9 ½ -in. ID rope-thread, carbon steel temporary casing. A Bucyrus Erie 22-W truck mounted cable tool rig using a 4-in drive barrel was used to advance the casing, advance the borehole and collect split spoon samples. The borehole was advanced to a TD of 50.9 ft bgs. Water was encountered at this borehole at 43.45 ft bgs. Upon reaching TD a straightness test was not completed.

2.3.2 Borehole Geology

The only unit encountered throughout the drilling of this borehole was the Hanford fm. The Hanford fm. extends from ground surface to the TD of 50.9 ft bgs.

From ground surface to 19 ft bgs sandy gravel was present. The material in the sandy gravel was represented by 40% sand, 55% gravel, and 5% silt. The sand ranged from very fine to very coarse grained and sub-rounded to sub-angular. The gravels ranged from 2 mm to 55 mm (i.e., very fine to very coarse pebbles) and were dominantly sub-rounded. The mineralogy of sandy gravel was 70% of the material was mafic and 30% felsic. The dominant color of the sandy gravel was brown and there was no reaction with HCl.

From 19 ft bgs to 23 ft bgs gravelly sand was present. The material in the gravelly sand was represented by 85% sand, 10% gravel, and 5% silt. The sand ranged from very fine to coarse grained. The gravel ranged from 2mm to 20mm (i.e., very fine to coarse pebbles) and was sub-rounded. The dominant color was brown and there was no reaction to HCl.

From 23 ft bgs to 27 ft bgs sandy gravel was present. The material in the sandy gravel was represented by 40% sand, 55% gravel, and 5% silt. The sand ranged from very fine to very coarse grained and sub-rounded to sub-angular. The gravel ranged from 2 mm to 40 mm (i.e., very fine to very coarse pebbles) and was dominantly sub-rounded. The mineralogy of the sandy gravel was 50% of the material was mafic and 50% felsic. The dominant color of the sandy gravel was grayish brown and there was a moderate reaction to HCl.

From 27 ft bgs to 32 ft bgs silty sandy gravel was present. The material in the silty sandy gravel was represented by 30% sand, 40% gravel, and 30% silt. The sand ranged from very fine to coarse grained sand. The gravel ranged from 2 mm to 40 mm (i.e., very fine to very coarse pebbles) and sub-rounded to

sub-angular. The mineralogy of the silty sandy gravel was 50% of the material was mafic and 50% felsic. The dominant color of the silty sandy gravel was light brownish gray.

From 32 ft bgs to a TD of 50.9 ft bgs sandy gravel dominated. The gravel consistency ranged from 50% to 55% and from 2 mm to 30 mm (i.e., very fine to coarse pebbles). The sand content was a consistent 40% and ranged from very fine to coarse grained. The silt consistency ranged from 5% to 10%. The dominant color was brown. The mafic to felsic ratio gradated with depth, starting at 75% mafic, 25% felsic and ending at TD with 60% mafic, 40% felsic. HCl did not react with the material in this range except for strong reaction at 37 ft bgs. The static water table was encountered at 43.45 ft bgs.

2.3.3 Borehole Geophysical Logging

Geophysical logging for C7972 was performed by Stoller after TD was reached. SGLS was performed from ground surface to 46.0 ft bgs and NMLS was performed from ground surface to 43.25 ft bgs on February 19th, 2011. See Appendix C for the specific geophysical logging results.

2.3.4 Well Completion

Installation of temporary well 199-F5-56 (C7972) took place on February 22, 2011. Installation began by tripping in a 4-in PVC sump (0.30 ft), 0.020-in. (20-slot) screen (10.0 ft) and blank riser casing (39.15 ft) for a total of 49.45 ft of material. Well installation continued by removing all temporary casing while simultaneously back filling with 13.55 ft of Colorado Silica® sand. The remainder of the annular space was filled using 32.9 ft of bentonite crumbles. The final 2.7 ft was filled using Portland cement. From TD to 35.6 ft bgs the borehole was backfilled with 10/20 mesh Colorado Silica® sand. Construction continued from 35.6 ft bgs to 2.7 ft bgs using Cetco® #8 bentonite crumbles. The remainder of the borehole was filled using Portland cement from a depth of 2.7 ft bgs to ground surface. The surface seal is 1.05- in diameter. A brass survey marker was placed on the north side of the seal. An overview of well constructions details can be found in Table 7 below.

Table 7: Construction Summary for Well 199-F5-56 (C7972)

Borehole Total Depth (ft bgs)	Static Water Level (ft bgs)	4-Inch Diameter, SCH 40 PVC Well Materials			Annular Materials		
50.9	43.45	Material	Interval (ft bgs)	Slot Size (In.)	Material	Interval (ft bgs)	Mesh Size
		Casing	0.0-39.15	Solid	Neat Grout Cement	0.0-2.7	Slurry
		Screen	39.15-49.15	0.020	Bentonite Seal (Crumbles)	2.7-35.6	#8
		Casing	49.15-49.45	Sump	Filter Sand Pack	35.6-49.15	[10-20]
					Natural Fill	49.15-50.9	NA

Table 7: Construction Summary for Well 199-F5-56 (C7972)

Borehole Total Depth (ft bgs)	Static Water Level (ft bgs)	4-Inch Diameter, SCH 40 PVC Well Materials			Annular Materials		
		Material	Interval (ft bgs)	Slot Size (in.)	Material	Interval (ft bgs)	Mesh Size
50.9	43.45						

Notes:
ft bgs = feet below ground surface
in. = inches

2.3.5 Well Development

Development at C7972 was carried out on February 23, 2011 using a Grundfos® X-MS402 submersible pump. The pump was run for 2 hours, 50 minutes at a rate of 7 gallons per minute (1,190 gallons pumped) with a drawdown of 1.18 ft. Specific sampling information is present in Table 8 below.

Table 8: Development Overview for 199-F5-56 (C7972)

Time	Temp (°C)	XD (feet)	Conductivity (µS/cm)	pH	Turbidity (NTU)
930	12.1	1.07	1104	7.26	>1000
1030	15.4	1.01	1112	7.96	24.0
1115	15.3	1.15	1121	7.83	13.0
1200	15.5	1.12	1113	7.61	26.7
1230	15.2	1.15	1105	7.59	5.88
1245	16.1	1.15	1069	7.63	5.38
1300	18.0	1.18	1069	7.61	4.27
1305	17.5	1.18	1054	7.66	4.89
1310	17.9	1.15	1058	7.65	4.98

Notes:
xD = Change in hydraulic head
µS/cm = micro-Siemens per centimeter
NTU = Nephelometric Turbidity Units

2.3.6 Sampling for Laboratory Analysis

Sampling at this borehole included geologic archive sampling and split spoon soil sampling. Geologic archive samples were collected at 5 ft intervals throughout the depth of the borehole. Split spoon samples were collected on a semi-continuous basis (approximately 2 ft between split spoons) starting at 21.1 ft bgs until groundwater was reached. At the groundwater horizon (43.45 ft bgs) split spoon samples were taken at the water table as well as five feet below the static water level. At TD a water sample was collected. Samples and depths are summarized in Table 9 below.

Table 9: Sample Summary Table for 199-F5-56 (C7972)

Sample Acquisition Information					Sample HEIS # and Laboratory Identification				
Sample Interval (ft bgs)	Sample Interval #	Collection Date	Sample Type	Sample Method	WSCF	Eberline	LVL	TARL	TASL
21.1 – 23.6	I-001	2/16/2011	Soil	Split Spoon	B29386	B29387	B29388 B29390	-	-
25.3 – 26.8	I-002	2/16/2011	Soil	Split Spoon	-	B29391	B29392 B29394 B29395	-	-
30.4 – 31.4	I-003 (Split=[sp])	2/16/2011	Soil	Split Spoon	B29396	B29397	B29398 B293B0 B29399	B293B1[sp]	B293B2[sp] B293P4[sp]
35.1 – 36.1	I-004	2/17/2011	Soil	Split Spoon	-	B293B7	B293B8 B293C0	-	-
37.6 – 38.6	I-005	2/17/2011	Soil	Split Spoon	B293C1	B293C2	B293C3 B293C5	-	-
40.5 – 42.0	I-006 (DUP=[d])	2/17/2011	Soil	Split Spoon	-	B293C6 B293D0[d]	B293C9 B293D2[d]	-	-
42.5 – 45.0	I-008	2/17/2011	Soil	Split Spoon	-	B293D9	B293F0 B293F2	-	- -
48.4 – 50.9	I-013S	2/17/2011	Soil	Split Spoon	-	B293H8	B293H9	-	-
47.8	I-013 (DUP=[d])	2/18/2011	Water	Pump	-	B293J1 B293J4[d]	B293J2 B293J5[d]	B293J0 B293J3[d]	-

Notes:

ft bgs = feet below ground surface

HEIS = *Hanford Environmental Information System* (database)

LVL = Lionville Laboratory

TARL = Test America - Richland Laboratory

WSCF = Waste Sampling and Characterization Facility

2.3.7 Environmental Monitoring

Radiological monitoring was provided on a "AM/PM" basis throughout vadose zone drilling activities and was also provided on an intermittent basis (i.e., frequent checks throughout the day) during drilling that took place below the water table and when extracting casing during well construction. Radiological Control Technicians (RCTs) conducted surveys of drill cuttings, drilling tools, sampling equipment, personal protective equipment, and sediment storage containers using several radiation detection meters, to detect levels of beta, gamma and alpha radiation particles. All radiological contamination encountered at well sites was attributed by RCTs performing periodic checks as naturally occurring Radon gas. All gamma and alpha contamination detected was below the threshold limit of elevated radiological permitting.

Air quality monitoring for organic vapors was provided on a morning and afternoon basis by an IH while drilling through the aquifer. The IH measured air quality above the borehole opening, above the drill cuttings (when present) and within the general breathing space around the work area. The IH reported all sustainable readings to be between zero and 3 ppm; well below the sustainable permissible exposure limit of all suspect contaminants of concern.

3 Waste Management

Waste generated during well installation and borehole drilling/decommissioning activities described in this document was managed according to the DOE/RL-2004-31, *Waste Control Plan for the100-FR-3 Operable Unit*, DOE/RL-2009-43, and a site-specific Waste Packaging/Labeling Instruction Sheet (WP/LIS). The CHPRC Waste Management Specialist provided final waste management instructions for the project.

3.1 Vadose Zone Waste

Vadose zone cuttings were placed on plastic sheeting near the well head and periodically surveyed for radiological contamination. No detection of contamination occurred while drilling. The soil was sampled and analyzed prior to disposition and was released to the environment by spreading it near the well head in accordance with the site-specific WP/LIS. Vadose zone miscellaneous solid waste (MSW) was to be placed in containers and disposed of based on field-screening results as stated in the site-specific WP/LIS.

3.2 Groundwater-Contacted Waste

Groundwater-contacted waste, defined as any cuttings below the historic high water mark for each well, was containerized in drums and periodically surveyed in order to verify that the cuttings were not contaminated at levels greater than the instrument(s) sensitivity. The saturated soils were sampled and analyzed prior to disposition in accordance with the site-specific WP/LIS. All MSW was placed in containers and disposed of as stated in the site-specific WP/LIS.

3.3 Purge water

Purgewater was handled based on process knowledge and collected and contained at the well head until it was either transported to the modular storage units, or, if waste acceptance criteria can be met, the Effluent Treatment Facility (ETF). Purgewater from containerized cuttings was decanted and stored on the drill site until transported to the modular storage units. Purgewater, groundwater samples, and decontamination fluids generated during well drilling, sample screening, and analysis were all managed as Purgewater in accordance with the guidance provided in 90-ERB-040, *Strategy for Handling and Disposing of Purgewater at the Hanford Site, Washington.*

4 Civil Survey

Final civil surveys were performed on March 14th, 2011 and March 17th, 2011 on the two temporary monitoring wells and single characterization borehole. The survey was performed under the supervision of a licensed professional land surveyor registered in the state of Washington. The following table was compiled from information obtained from the survey data report from this survey, File No. 1FT14R27.

Final Survey For One Decommissioned Characterization Borehole

Well ID	Northing	Easting	Elevation	Description
C7971	147192.84	580158.59	122.14	Brass Marker

Final Survey For Two Installed Temporary Wells

Well ID	Well Name	Northing	Easting	Elevation	Description
C7970	199-F5-55	147797.57	581076.10	126.811	Brass Marker
C7972	199-F5-56	147556.36	580440.62	127.215	Brass Marker

The Description of Work (DOW SGW-46025, Rev. 1) added these three boreholes in the 100 FR-3 OU to drill, sample and decommission in accordance with Department of Ecology approved Decommissioning Profile. The Description of Work also describes possible field changes to complete boreholes as 4-inch PVC pipe temporary flush mount wells if required by sampling conditions. Boreholes C7970 and C7972 were completed as 4-inch PVC temporary wells and a borehole-specific well design was generated to document the field changes. The final walk-down was performed on 3/15/11 by the BTR, Well Management, Field Geology Lead and QA. All wells were subsequently surveyed by a licensed Land Surveyor. During each final walk-down, acceptability of the following was confirmed: For the 4-inch PVC Temporary Wells – flush mount metal monument with water tight locking expansion well caps, brass survey marker with well name, well number and completion date embedded into surface grout, Department of Ecology tags attached to temporary PVC wells and site clean-up. The water level was measured in the temporary PVC wells during the walk-down to demonstrate the functionality of the wells. For the Decommissioned Borehole – brass survey marker with well number and completion date imbedded into surface grout (SGRP-2011-SURV-10662).

5 References

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DOE/RL-2008-46-ADD4, 2010, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan Addendum 4: 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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GRP-EE-02-14.5, *Drilling, Remediating, and Decommissioning Resource Protection Wells, and Geotechnical Borings*, CH2M Hill Plateau Remediation Company

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SGW-46025, 2010, *Description of Work for the Installation of 21 Boreholes and 2 Temporary Wells in the 100-Area of the Hanford Site in Fiscal Year 2010 and Fiscal Year 2011,* CH2M Hill Plateau Remediation Company

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

WHC-SD-EN-TI-132, 1993, *Geologic Setting of the 100-HR-3 Operable Unit, Hanford Site, South-Central Washington,* Westinghouse Hanford Company, Richland, Washington.

WHC-SD-EN-TI-221, 1994, *Geology of the 100-FR-3 Operable Unit, Hanford Site South-Central Washington*, Rev 0, Westinghouse Hanford Company, Richland, Washington.

WHC-SD-ER-TI-003, 1991, *Geology and Hydrology of the Hanford Site: A Standardized Text for Use in Westinghouse Hanford Company Documents and Reports*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Appendix A

Well Summary Sheets (Asbuilts)

And

Construction Summary Sheets

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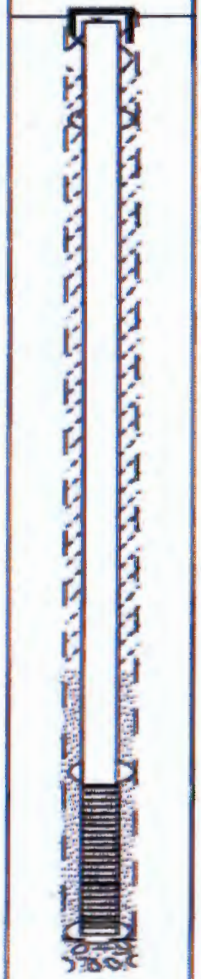
WELL SUMMARY SHEET

Start Date: 2/15/2011
Finish Date: 2/23/2011
Page 1 of 1

Well ID: C7972
Well Name: 199-F5-56
Location: S of 100-F Reactor
Project: FR3 WCH RI/FS Characterization Boreholes
Prepared by: J. Osborn
Date: 3/1/2011
Reviewed by: L.B. Walker
Date: 3/8/11
Signature: Joseph A Osborn
Signature: L.B. Walker

CONSTRUCTION DATA

Description	Diagram
Ground surface circular concrete seal with Brass well marker: 0-2.7 ft bgs Well monument 0.0-1.0 ft bgs 4-in. SCH 40 PVC blank 0.00-39.15 ft bgs #8 bentonite crumbles: 35.6-2.7 ft bgs Temporary Casing: 10 3/4-in. Carbon Steel: 0-47.8 ft bgs 4-in. 20 slot PVC Screen 49.15-39.15 ft bgs 10-20 slot silica sand 49.15-35.6 ft bgs bgs 4-in. PVC cap 49.45-49.15 ft bgs Natural Fill 50.9-49.45 ft bgs Note: All temporary casing was removed during well construction. Centralizers were placed just above and below the screen. One centralizer was placed approximately 5 ft bgs.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0-19' Sandy Gravel (sG)
		0-19 ft bgs was backfill from previous remediation
10		
		19-23 ft. bgs Gravelly Sand (gS)
20		
		23-27 ft. bgs Sandy Gravel (sG)
		27-50.9 ft. bgs Silty Sandy Gravel (msG)
30		
40		Static water at 43.45 ft bgs. Tagged on 2-18-11
		T.D 50.9 ft bgs on 2-17-11
50		

WELL SUMMARY SHEET

Start Date: 2/9/2011
Finish Date: 2/18/2011
Page 1 of 1

Well ID: C7970
Well Name: 199-F5-55
Location: E of 100-F Reactor
Project: FR3 WCH RI/FS Characterization Boreholes
Prepared by: J. Osborn Date: 3/2/2011
Reviewed by: L.D. Walker Date: 3-8-11
Signature: Jay D Osborn
Signature: L D Walker

CONSTRUCTION DATA

Description	Diagram
Ground surface circular concrete seal with Brass well marker 0-2.3 ft bgs Well monument 0.0-1.0 ft bgs 4-in. SCH 40 PVC blank 0.0-38.7 ft bgs #8 bentonite crumbles 30.2-23 ft bgs 3/8" bentonite Pellets 33.3-30.2 ft bgs Temporary Casing 10 3/4-in. Carbon Steel: 0-50.0 ft bgs 4-in. 20 slot PVC Screen 48.7-38.7 ft bgs 10-20 slot silica sand 53.0-33.3 ft bgs bgs 4-in. PVC cap 53.0-48.7 ft bgs Note: All temporary casing was removed during well construction. Centralizers were placed just above and below the screen. One centralizer was placed approximately 10 ft bgs.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0-20 Sandy Gravel (sG)
		0-20 ft bgs was backfill from previous remediation.
10		
20		20-50.0 ft. bgs Silty Sandy Gravel (msG)
30		
40		Static water at 42.3 ft bgs. Tagged on 2-11-11
		T.D 50.0 ft bgs on 2-15-11
50		

WELL SUMMARY SHEET		Start Date: 2/10/2011 Finish Date: 2/24/2011	Page 1 of 1
Well ID: C7971		Well Name: N/A	
Location: SW of 100-F Reactor		Project: FR3 WCH RI/FS Characterization Boreholes	
Prepared by: J. Osborn	Date: 3/2/2011	Reviewed by: L.D. Walker	Date: 3-8-11
Signature: Joyce D Osborn		Signature: LD Walker	

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
Surface monument: Brass Marker labeled C7971 2-24-11 set at ground surface facing approximately North Cement (3.5'-0.5' bgs) Granular bentonite (21.0'bgs-3.5'bgs) 10-20 mesh Colorado silica sand (33.5'bgs-21.0'bgs) TD: 33.5 ft bgs Borehole drilled with 10 3/4-in OD casing (completely removed) All depths in feet below ground surface (ft bgs) No horizontal scale		0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0		0 - 13: Sandy Gravel (sG) 13 - 25: Silty Sandy Gravel (msG) 25 - 29: Sandy Gravel (sG) Water logging at 26.2 ft BGS on 2/11/2011 29 - 33.5: Clay-silty-M, wet, stiff

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 2-9-11
Finish Date: 2/18/11
Page 1 of 1

Well ID: C7970	Well Name: 199-F5-55
Project: 100 Areas Irrigated RI/FS	Approximate Location: E. of 105-F Reactor @ 116-F-11 Waste Site
Drilling Company: Stillwater L.L.C.	Other Companies: GRAM Inc./CHPRC
Driller: Dean Petersen License #: 2928	Geologist(s): J. Osborn/A. Lenton/C. Barnette

TEMPORARY CASING AND DRILL DEPTH

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.
10¾"/Drive/77#.	0.0 - 50.0	10¾"/9¾"
	-	
	-	
	-	
	-	

*Indicate Welded (W) - Flush Joint (F.J) Coupled (C) & Thread Design

Threaded Tapered Box

DRILLING METHOD / HOLE DIAMETER (in.) / INTERVAL (ft)

Auger:	Diameter 10¾ From 0.0 to 60.0
Cable Tool: X	Diameter ____ From ____ to ____
Air Rotary:	Diameter ____ From ____ to ____
A.R. w/Sonic:	Diameter ____ From ____ to ____
	Diameter ____ From ____ to ____
	Diameter ____ From ____ to ____

Drilling Fluid: N/A

Total Drilled Depth: 50.0	Hole Dia @ TD: 10 ¾
Total Amt. Of Water Added During Drilling: N/A	
Well Straightness Test Results: Pass 2-16-11 CB	Static Water Level: 42.3 Date: 2-11-11

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
	-			-	
	-			-	
	-			-	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
PVC cap	50.0 - 49.7	Rope	Sump	Concrete silica sand	50.0 - 33.3	9.07ft³	10-20
PVC Screen 4½"/4"	49.9 - 39.7	Rope	20	⅜" Bentonite pellets	33.3 - 28.2	1.38ft³	⅜"
PVC Blank sch. 40	39.7 - 0	Rope	Blank	⅜" Bentonite crumbles	30.2 - 2.3	19.91ft³	8-20
	-			Cement	2.3 - 0	Slurry	Slurry
	-				-	125ft³	

OTHER ACTIVITIES

Aquifer Test: Single Pump Drawdown	Date: 2/18/11	Well Decommission:	Yes:	No: X	Date:
Description: Well pumped until NTU 45; 1700 Gallons pumped		Description:			

WELL SURVEY DATA (if applicable) Not yet surveyed at this time (3/8/11)

Washington State Plane Coordinates:	Protective Casing Elevation:
	Brass Survey Marker Elevation: LW

COMMENTS / REMARKS

Drill & Sample to water & Collect water sample to verify nature & extent of contaminants & presence of contaminants.

Reported By:	Title:	Signature:	Date:
J. Osborn	Env. Engr	Joseph Osborn	3/2/11

A-6003-656 (04/03)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 2/10/11
Finish Date: 2/24/11
Page 1 of 1

Well ID: C7971 — Well Name: NA	Approximate Location: SW of F reactor
Project: WCH Characterization Boreholes	Other Companies: GRAM, Inc.
Drilling Company: Stillwater.	Geologist(s): Candice Burnette
Driller: Brian Heinlen — License #: 3090	

TEMPORARY CASING AND DRILL DEPTH

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.
10 3/4 / Carbon Steel / Ft	30.07 - 0	~~11 3/4 / 10 ...~~ 10 3/4 / 9 ...
	-	
	-	
	-	
	-	

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

Box thread 6' sticks

DRILLING METHOD

Auger: -
Cable Tool: X
Air Rotary:
A.R. w/Sonic:

HOLE DIAMETER (in.) / INTERVAL (ft)

Diameter	From	to
~~10 5/8~~	~~0~~	~~30.07~~ → 10 3/4 / well
10 3/4	0	30.07

Total Drilled Depth: 33.6
Hole Dia @ TD: ~~10 5/8~~ 10 3/4 (30 3/4/11)
Well Straightness Test Results: NONE
Drilling Fluid: None
Total Amt. Of Water Added During Drilling: Ø
Static Water Level: 26.2 — Date: 2-11-11

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
	-			-	
	-			-	
	-			-	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
	-				-		
	-				-		
	-				-		
	-		NA		-		
	-		30 3/4/11		-		

OTHER ACTIVITIES

Aquifer Test:	Date:	Well Decommission: Yes: X No:	Date: 2/24/11
Description: N/A		Description: Back filled w/ 10-20 silica to 21.6' BGS; w/ Bentonite #8 Crumbles 21.6' BGS → 3.0' BGS; Cement 3.0' BGS - 0' BGS	

WELL SURVEY DATA (if applicable) not yet surveyed at this time (3/8/11) cw

	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Survey Marker Elevation:

COMMENTS / REMARKS

Reported By:	Title:	Signature:	Date:
Candice Burnette	Geologist	[signature]	3/2/2011
J. Osborn	Env. Engr	[signature]	3/2/2011

A-6003-658 (04/03)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 2/15/2011
Finish Date: 2/23/2011
Page 1 of 1

Well ID: C7972	Well Name: 199-F5-56	Approximate Location: S OF 100-F REACTOR	
Project: 100 Integrated; FR3 pWFS Unmn. Bldg		Other Companies: GRAM INC.	
Drilling Company: STILL WATER		Geologist(s): Joe Osborn, ~~Candace Burnette~~ JO 3/1/2011	
Driller: UKIAH PETERSEN License #R.P.: 2928			

TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD	HOLE DIAMETER (in.) / INTERVAL (ft)
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger:	Diameter ____ From ____ to ____
10¾"/Carbon Steel/??#/ft	0 - 47.8	10¾/9½	Cable Tool: X	Diameter 10¾ From 0 to 47.8
	____ - ____		Air Rotary:	Diameter 4" From 47.8 to 50.9
	____ - ____		A.R. w/Sonic:	Diameter ____ From ____ to ____
	____ - ____			Diameter ____ From ____ to ____
	____ - ____			Diameter ____ From ____ to ____
*Indicate Welded (W) - Flush Joint (F.J) Coupled (C) & Thread Design				Diameter ____ From ____ to ____
FJ, ~~BOX~~ JO 3/1/2011				
Pin Pile/Rope Thread				
			Drilling Fluid: NONE	
Total Drilled Depth: 50.9	Hole Dia @ TD: 4"		Total Amt. Of Water Added During Drilling: 0	
Well Straightness Test Results: NONE			Static Water Level: 93.45' BGS Date: 2/18/2011	

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
	____ - ____			____ - ____	
	____ - ____			____ - ____	
	____ - ____			____ - ____	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
4"/PVC casing	49.45 - 49.15	Pin Pile	Sump	Natural Fill	50.9 - 49.45	N/A	N/A
4"/PVC Screen	49.15 - 39.15	Pin Pile	20	Silica Sand	49.15 - 35.6	756 ft³	10-20
4"/PVC Sch. 40	39.15 - 0	Pin Pile	Solid	#8 Bentonite Crumbles	35.6 - 2.7	9.99 ft³	8-20
	____ - ____			Cement	2.7 - 0	1.47 ft³	Slurry
	____ - ____				____ - ____		

OTHER ACTIVITIES

Aquifer Test: Single Well Drawdown	Date: 2/23/11	Well Decommission:	Yes:	No: X	Date:
Description: Well pumped to a low Turbidity of 4.27 NTU		Description:			

WELL SURVEY DATA (if applicable)

not yet surveyed at this time (3-8-11 LW)

	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Survey Marker Elevation:

COMMENTS / REMARKS

Reported By:	Title:	Signature:	Date:
J. Osborn	Environmental Engineer	Joseph Osborn	3/1/11

A-6003-658 (04/08)

Appendix B

Borehole Logs

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BOREHOLE LOG

[illegible] 199-F5-56

Page 1 of 2 | Date: 2/9/2011

Well ID: C7970 | Well Name: [illegible] | Location: E of KF REACTOR

Project: 100-FR-3 RI/FS [illegible] | 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 60% Sand 5% (GS) silt, 40% gravel; no rxn w/HCl	DRIVE BARREL/[illegible] [illegible] to [illegible]
				sand V.fine to V.coarse, sub rnd	[illegible] to 325' [illegible]
				to sub angular; gravels: 90%	
				2mm: 30 mm; 10% Lrg Cobbles	
5	G.S.			mostly sub rnd, ~ [illegible] Basalt	Archive @ 5' BGS
				20% Felsic 10YR 7/3 Brown	
				@ 10' BGS 10YR 4/2 dark [illegible] Brown	
10	G.S.			10% Large Cobbles 30% pebble [illegible];	Archive @ 10' BGS
				22 mm, 5% silt, 55% Sand	
				[illegible] rxn w/HCl. Sands [illegible]	
				to V.coarse; sub rnd to sub angular	
				gravels mostly sub rnd, 55% mafic	
15	G.S.				Archive @ 15' BGS
				@ 15' BGS 80% mafic	I-001 Split Spoon
		[illegible]			[illegible]
					2/9/11 SEE PAR FOR [illegible]
				@ 18' BGS Color change Grayish	@ 18' BGS AND COUNT
				Brown, ↑ in felsic material to ~	[illegible]
20	S.S. [illegible]	S.S. [illegible] Recovery		50% NO GS DUE TO RAD	I-002 & [illegible] Split Spoon
				10% silt, 40% Gravel, 50% Sand	20.2 → 22.7 SEE PAR 2/9/11
				@ 20' BGS → [illegible] Sand[illegible]	@ 22.6 S.S. I-003
		[illegible]		Gravel. 60% Gravels [illegible] 50 mm	22.6-27.[illegible] SEE PAR [illegible]
25	[illegible]	100%		90% Felsic, 5% silt; 35% sand	Archive @ 25' BGS
	[illegible]	Recovery		[illegible] V.fine to V.coarse, [illegible]	
				w/HCl; gravels Sub angular	
		[illegible]		@ 25' BGS [illegible]	I-004 Split Spoon [illegible]
				Sand; 45% Gravels: [illegible]: 50 mm	[illegible] SEE PAR 2/9/11
30	S.S.	100%		sub rnd to sub angular. 80% Felsic [illegible]	Archive @ 30' BGS
	I-004	Recovery		@ 30' BGS [illegible] 35% sand: mostly	
				sub angular, 35% Gravel: sub rnd	
		[illegible]		to sub angular, 50% felsic 50% mafic	
				NO Rxn w/HCl, 2.5YR 4/1 DARK GREY	[illegible]
35	[illegible]	[illegible]		MAX [illegible] ~ 40 mm [illegible]	[illegible] Split Spoon.
				-35: Sandy Gravel [illegible] 45-50% [illegible], 55-50% [illegible]	[illegible]
				[illegible]	[illegible] Archive.
		[illegible]		[illegible]	37.5-40: Split Spoon Archive
	[illegible]	[illegible]		[illegible]	SEE PAR 2/9/11

Reported By: I. Osborn / [illegible]		Reviewed By: L. A. Walker	
Title: Env. Engr. / Geologist		Title: Geologist	
Signature: [illegible]	Date: 2-9-11	Signature: [illegible]	Date: 2/9/11

A-6000-642 (03/08)

BOREHOLE LOG

Page 2 of 2
Date: 2/11/11

Well ID: C7970 | Well Name: 199-F5-55 | Location: E of 100-F-REACTOR
Project: 100-FR-3 RI/FS @ 116-F-14 | Reference Measuring Point: GROUND SURFACE

Depth (FL)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description	Comments
40	SS-3	100% Rec		Sandy gravel (SG) 5% silt	Archive @ 40' BGS
	1	100% Rec		45% sand vfine to coarse, sub rnd	(DR4)
42	1-004	50% rec		to sub angular, 50% gravels 80% mafic	I-007 39.5-42'
				sub rnd to sub angular, no RXN w/	SEE FAR 2/14/11
				HCL, 10YR 4/1 DARK Grey, MAX 35mm	I-014 42.2-43.7
45	SS			@45 Same as above	SEE FAR 2/14/11
				H2O TAKEN @ 42.3' BGS 2/11/11	Archive @ 45' BGS
	H2O	I-015 75% Rec			I-015 SS 46.4-48.4
				@ 48.4 Same as Above	SEE FAR 2/11/11
					I-015 H2O, I-015 DUP
50				TD = 50.0' bgs (2/16/11)	@ 47.0' BGS SEE
					FAR 2/14/11
					H2O @ 42.3 on 2-11-11

Reported By: I. Osborn | Reviewed By: L.J. Walker
Title: Engr, Engr | Title: Geologist
Signature: Joseph D Osborn | Date: 2/11/11 | Signature: [signature] | Date: 3/8/11

A-6003-642 (03/03)

BOREHOLE LOG

Page 1 of 2
Date: 2-10-11

Well ID: C7971	Well Name: NA	Location: SW of F reactor
Project: WCH characterization boreholes	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, Sample Size, Water Level)
0				0-17' bgs	All drilling will be conducted
				Sandy Gravel (sG)	with a single barrel fig.
				[illegible] rich ~ [illegible] sub-rounded, Sand:	[illegible]
				medium grain, well sorted.	[illegible] Casing, 10" [illegible]
				Medium to large? [illegible]	2-10-11
				[illegible]	[illegible] Samples ([illegible])
5				Sand 60% Gravel 40-35% 5% [illegible]	taken @ 4' 9' 12'
				and silt. [illegible] to HCl. Sample	2-11-11
				Color is 2.5Y 4/1 dark gray. Sample	SS taken from 17.5-19.5
				is moist.	[illegible]
				@ 11' [illegible]	[illegible]
10				[illegible] from	SS taken from 19.7-22.2
				[illegible]	[illegible]
				[illegible] @ 15' bgs	[illegible]
				@ 15' [illegible]	SS taken from 22.5-25
					[illegible]
15				17-22	[illegible]
				Silty Sandy Gravel (msG)	[illegible]
				[illegible] to medium grain sand moderately	[illegible]
		100%		sorted, silica rich ~ [illegible]	SS taken from 26-28.5
				Gravel to medium [illegible]	[illegible]
20		100%		[illegible] 25% [illegible]	[illegible] Top of water
				[illegible] to HCl. Color [illegible]	table [illegible]
				gray. Dry Sample	
				[illegible] silt 20% sand 30% Gravel	[illegible] bgs [illegible]
25				22-35	SS taken from 25-28.5
		100%		[illegible] Silty Sandy Gravel ([illegible])	[illegible]
		[illegible]		[illegible] to sand and small gravel.	[illegible]
				Silica rich ~ [illegible]	[illegible]
		100%		Coarse grain to medium grain sand	[illegible] sample
30				sub round to well rounded.	taken @ 28.5 ft bgs
				Gravel to larger [illegible] to sub round	on 2-15-11
				[illegible] 5Y 4/1 dark gray	[illegible]
				[illegible]	[illegible]
35					[illegible]
				35-38	[illegible]
				Sandy Gravel (sG) 5Y 3/1 very dark gray	[illegible] cond [illegible]
				Coarse [illegible]	[illegible]
				Gravel to large [illegible]	

Reported By: Candice Burnette	Reviewed By: L.A. Walker	
Title: Geologist	Title: Geologist	
Signature: [signature] Date: 2-10-11	Signature: [signature]	Date: 3/?/11

A-6003-643 (03/03)

BOREHOLE LOG

Page 2 of 2
Date: 2-11-11

Well ID: C7971 | Well Name: ~~C4971~~ NA | Location: SW of F reactor
Project: Well Characterization boreholes | Reference Measuring Point: Ground Surface

Depth (FL)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
				29-33.5	All drilling was conducted
				Clay.	with a Cable tool
				High plasticity. Color 2YR 5/1 Grey	rig. Casing OD 10 3/4"
				mostly fum.	Shoe OD 11" ID 10"
				T.D 33.5' 2-11-11	
				Tag after water sample 30.2'	

Reported By: Candice Burnette | Title: Geologist | Signature: [signature] | Date: 2-14-11
Reviewed By: L.B. Walker | Title: Geologist | Signature: [signature] | Date: 3/8/11

A-6003-642 (03/03)

BOREHOLE LOG

Page 1 of 2
Date: 2/15/11

Well ID: C7972 | Well Name: 199-F5-56 | Location: South of 100-F REACTOR

Project: 100 Integrated, FR-3 Chrom Boreholes | 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 → 19 Sandy Gravel (sG)	DRIVE BARREL
				5% Silt, 40% Sand vfine to coarse,	Cable tool
				sub rnd to sub angular; 55% gravel	
				[illegible] sub rnd; max ~ 50mm	
				[illegible] [illegible], [illegible], Brown, no	
5	G.S.			rxn w/ HCL	Archive @ 5' BGS
10	G.S.	G.S.		@ 10' BGS 35% Gravel, 5% silt	
				60% Sand, Brown, no rxn w/HCL	Archive @ 10' BGS
				max clast ~ 35 mm; [illegible] mostly [illegible]	
15	G.S.			@ 15' BGS 45% Gravel max ~50mm	Archive @ 15' BGS
				5% silt, 50% Sand	
	G.S.			19 → 23 Gravelly Sand (gS)	Archive @ 19'
20				5% silt 10% Gravel mostly	21.1 → 23.6' BGS
				sub rnd mafic 2 → 20 mm	I-001 S.S. SEE
	S.S.	100% recovery		85% sand, vfine to [illegible] coarse	FAR 2/15/11
				Brown, no rxn w/ HCL	@ 23' RAD ~150 cpm [illegible]
				23 → 27 Sandy Gravel (sG)	
25				5% silt 40% Sand vfine to coarse	
	S.S.	100% recovery		[illegible] to sub angular, 55% Gravel	25.3 → 26.8
				mostly sub rnd [illegible], [illegible]	I-002 S.S. SEE FAR
				moderate rxn w/ HCL max ~ [illegible]	2/16/11; ARCHIVE @ [illegible]
				27 → 38.9 silty Sandy Gravel (msG)	
30				20% silt, 30% Sand vfine to coarse	I-003 SS, 30.4 → 31.9
	S.S.	100% recovery		40% gravel: sub rnded to sub	SEE FAR 2/16/11
				angular; [illegible]	Archive @ 32' BGS
				[illegible], moderate rxn w/ HCL, Max ~ [illegible]	@ 30' No R.O
				@ 32 [illegible] [illegible] [illegible] [illegible] [illegible] Gravel	
35				60% mafic [illegible] rxn w/ HCL	35.1 - 36.1 I-004 S.S.
	S.S.	100% recovery		@ 37' 75% mafic 25% Felsic	SEE FAR 2/17/11
				Max ~ 30 mm Strong rxn w/ HCl	Archive @ 37' BGS
	S.S.	[illegible]			37.6 → 38.6 I-005 S.S.
					SEE FAR 2/18/11

Reported By: J. Osborn	Reviewed By: L.D. Walker
Title: Env. Engr.	Title: Geologist
Signature: [signature] Date: 2/22/11	Signature: [signature] Date: 3/8/11

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 2
Date: 2/17/11

Well ID: C7972 | Well Name: 199-F5-52 | Location: S of 100-F REACTOR
Project: 100 Integrated FR-3 Boreholes | Reference Measuring Point: Ground Surface

Depth (FL)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
40				Sandy Gravel (SG) 5% silt	Drive Barrel
	42.5-43	2.5ft Recovery		40% Sand 65% Gravel sub rnd to sub angular, 60% mafic, 40% felsic	I-006 @ 40# 40.5-42 SEE FAR 2/17/11
	SS			Brown, Max ~ 30 mm, No rxn w/ HCl	@ 42 "WET"
				H2O @ 43.45' BGS 2/16/11	Archive @ 42
45				@ 47 same as above	I-008 SS 42.5-45
	4.3				SEE FAR 2/17/11
					Archive @ 47' BGS
				@ 50 Same as above	I-013 SS 48.4→50.9'
50				TD = 50.9' BGS.	SEE FAR 2/17/11
					I-013 H2O Sample @ 47.5' BGS SEE FAR 2/17/11
					TAG H2O @ 43.45 on 2/18/11

Reported By: J. Osborn | Title: Env. Engr. | Signature: Joseph D Osborn | Date: 2/22/11
Reviewed By: L. S. Walker | Title: Geologist | Signature: [signature] | Date: 3/8/11

A-6003-642 (03/03)

Appendix C

Geophysical Logging Reports

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Stoller
Hanford Office

established 1959

HGLP-LDR-597, Rev. 0

C7970
Log Data Report

Borehole Information:

Log Date:	2011-02-15	Filename:	C7970_HG-NM_2011-02-15	Site:	100-FR-3, 116-F-14 Retention Basin	
Coordinates (WA St Plane)		GWL[1] (ft):	41.0		GWL Date:	2/15/11
North (m)	East (m)	Drill Date	TOC[2] Elevation		Total Depth (ft)	Type
Unknown	Unknown	2/14/11	Unknown		47.5	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Threaded Steel	3.5	10 3/4	9 3/4	1/2	3.5	47.0

Borehole Notes:

The driller provided the depth of the borehole and depth of the casing. The logging engineer measured casing diameters (rounded to the nearest 1/16-in.) and depth to water.

Zero reference is ground surface.

Logging Equipment Information:

Logging System:	Gamma 1N	Type:	60% HPGe SGLS[3]	Serial No.:	45-TP22010A
Effective Calibration Date:	12/21/10	Calibration Reference:		HGLP-CC-066, Rev. 0	
		Logging Procedure:		HGLP-MAN-002, Rev. 1	

Logging System:	Gamma 1H	Type:	NMLS[4]	Serial No.:	H310700352
Effective Calibration Date:	5/17/10	Calibration Reference:		HGLP-CC-058, Rev. 0	
		Logging Procedure:		HGLP-MAN-002, Rev. 1	

SGLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1017619	1017620			
Date	2/15/11	2/15/11			
Logging Engineer	Holloway/ Pearson	Holloway/ Pearson			
Start Depth (ft)	46.0	24.0			
Finish Depth (ft)	0.0	15.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			

[1] ground water level
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

Stoller Hanford Office established 1959

Log Run	1	2 Repeat			
MSA Interval (ft)	1.0	0.5			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AN196CAB	AN196CAB			
Start File	AN196000	AN196047			
Finish File	AN196046	AN196065			
Post-Verification	AN196CAA	AN196CAA			
Depth Return Error (in.)	N/A	1/2 low			
Comments	No fine gain adjustments made	No fine gain adjustments made			

NMLS Log Run Information:

Log Run	3	4 Repeat			
HEIS Number	1017621	1017622			
Date	2/15/11	2/15/11			
Logging Engineer	Holloway/ Pearson	Holloway/ Pearson			
Start Depth (ft)	0.0	40.0			
Finish Depth (ft)	40.75	35.0			
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	AH071CAB	AH071CAB			
Start File	AH071000	AH071164			
Finish File	AH071163	AH071184			
Post-Verification	AH071CAA	AH071CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	None	None			

Logging Operation Notes:

SGLS data were collected using Gamma 1, HO 68B-3574. Pre- and post-survey verification measurements were acquired in the Amersham KUTh-118 field verifier. A centralizer was installed on the sonde.

NMLS data were collected using Gamma 1, HO 68B-3574. Pre and post-survey verification measurements were acquired in the AmBe standard field verifier. A centralizer was installed on the sonde.

Analysis Notes:

Analyst:	C. Nelson	Date:	3/7/11	Reference:	HGLP-MAN-003, Rev. 0

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

A casing correction for 1/2-in. thick casing was applied during analysis. A water correction was applied from 41 ft to the total logged depth of the borehole.

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 AN20101221, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[5] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

The NMLS data are presented in counts per second because no calibration data exist for a 9 3/4-in. inner diameter casing.

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

The repeat log data interval was used in place of main log data, because the 0.5 ft MSA interval provides greater depth resolution of the logged section.

Results and Interpretations:

Cs-137, Co-60, Eu-152, and Eu-154 were the manmade radionuclides detected in this borehole.

Cs-137 was detected from 17.5-33 ft with a maximum concentration of approximately 3.2 pCi/g at 20 ft.

Co-60 was detected from 16.5-25 ft with a maximum concentration of approximately 2.0 pCi/g at 20.5 ft.

Eu-152 was detected from 15.5-26 ft with a maximum concentration of approximately 205 pCi/g at 19 ft.

Eu-154 was detected from 16.5-23.5 ft with a maximum concentration of approximately 14.3 pCi/g at 19 ft.

Although not detected, MDLs for Pu-239 are plotted on the manmade radionuclides plot.

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 (2 pages)
Natural Gamma Logs
Combination Plot
Total Gamma & Dead Time
Total Gamma & Moisture
Total Gamma & Hanford Gamma Unit
Manmade Repeat Section
Repeat Section of Natural Gamma Logs
Moisture Repeat Section

[5] minimum detection level
[6] Hanford Gamma Unit

HGLP-LDR-597, Rev. 0

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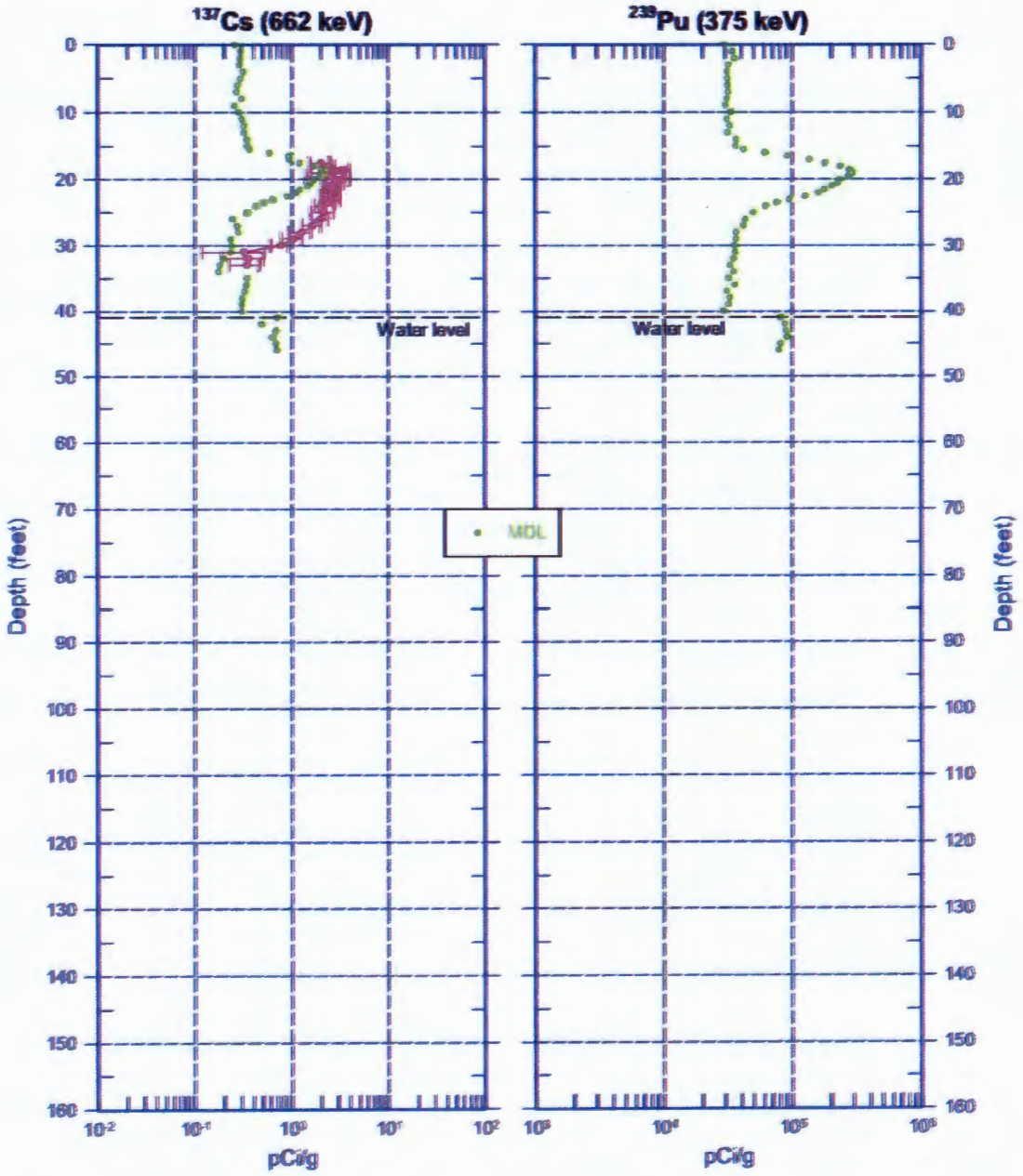
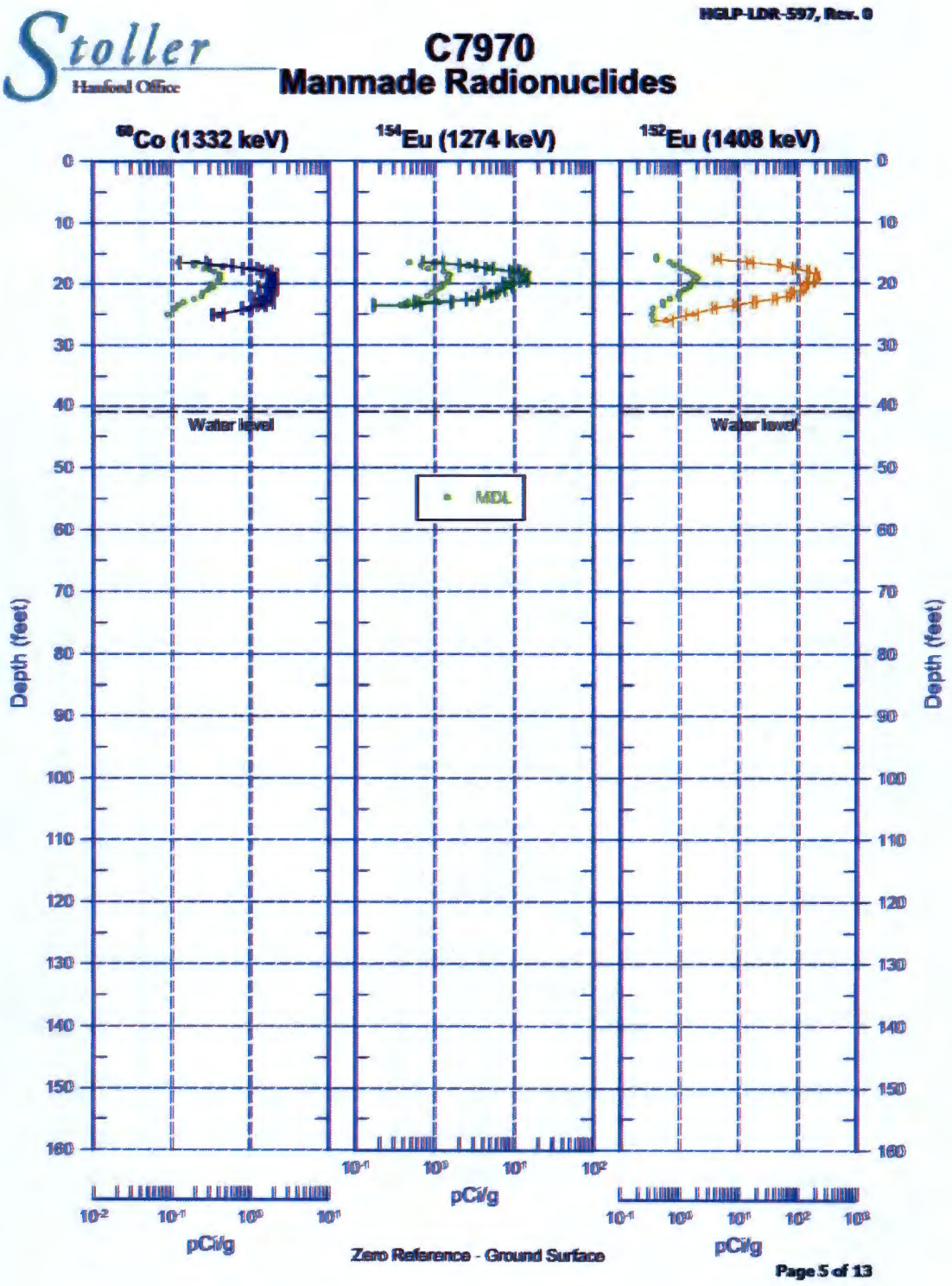
C7970
Manmade Radionuclides



Zero Reference - Ground Surface

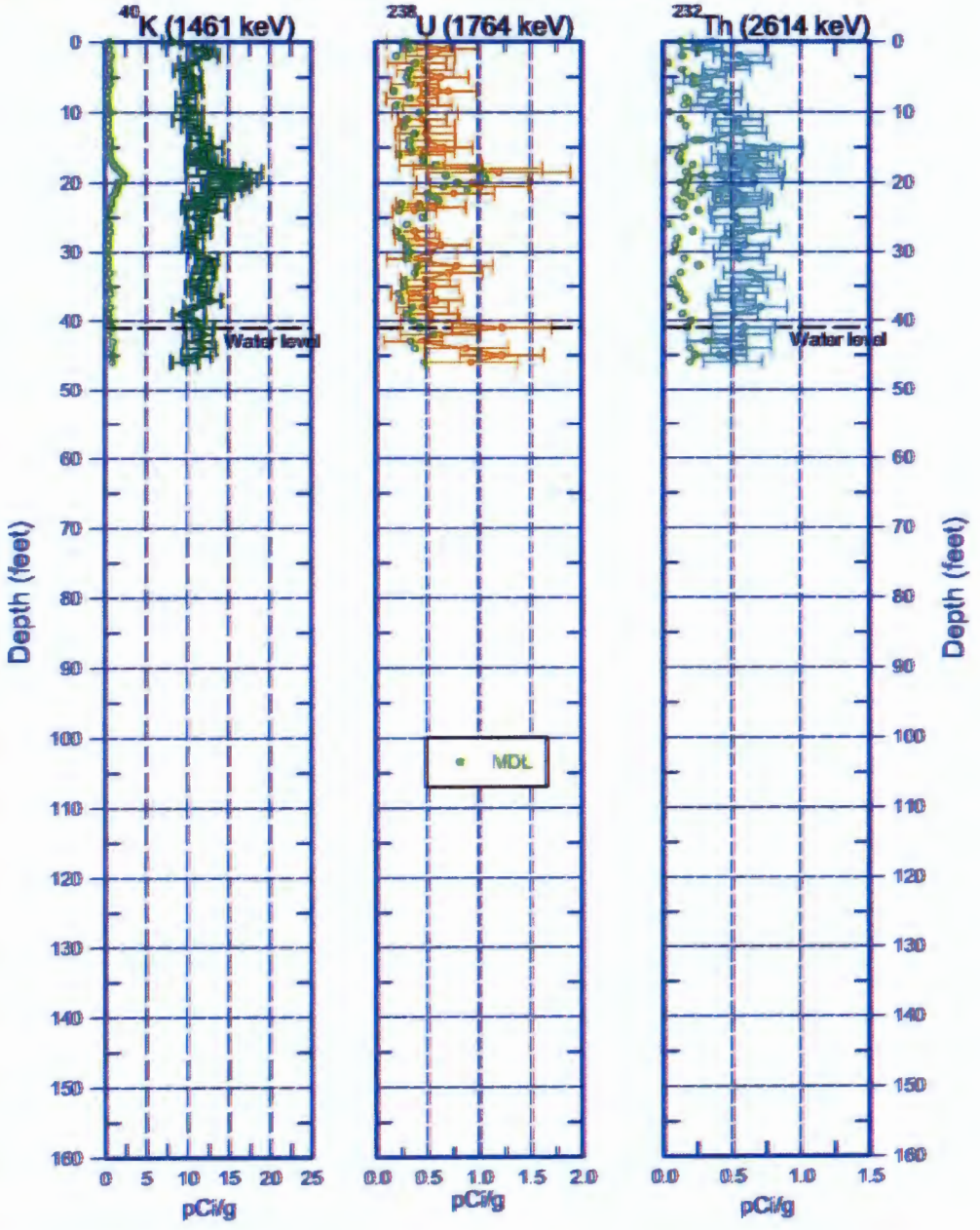
Page 4 of 13


HGLP-LDR-597, Rev. 0
Stoller
Hanford Office
C7970
Manmade Radionuclides
60Co (1332 keV)
154Eu (1274 keV)
152Eu (1408 keV)
Water level
Water level
MDL
Depth (feet)
Depth (feet)
pCi/g
pCi/g
pCi/g
Zero Reference - Ground Surface
Page 5 of 13

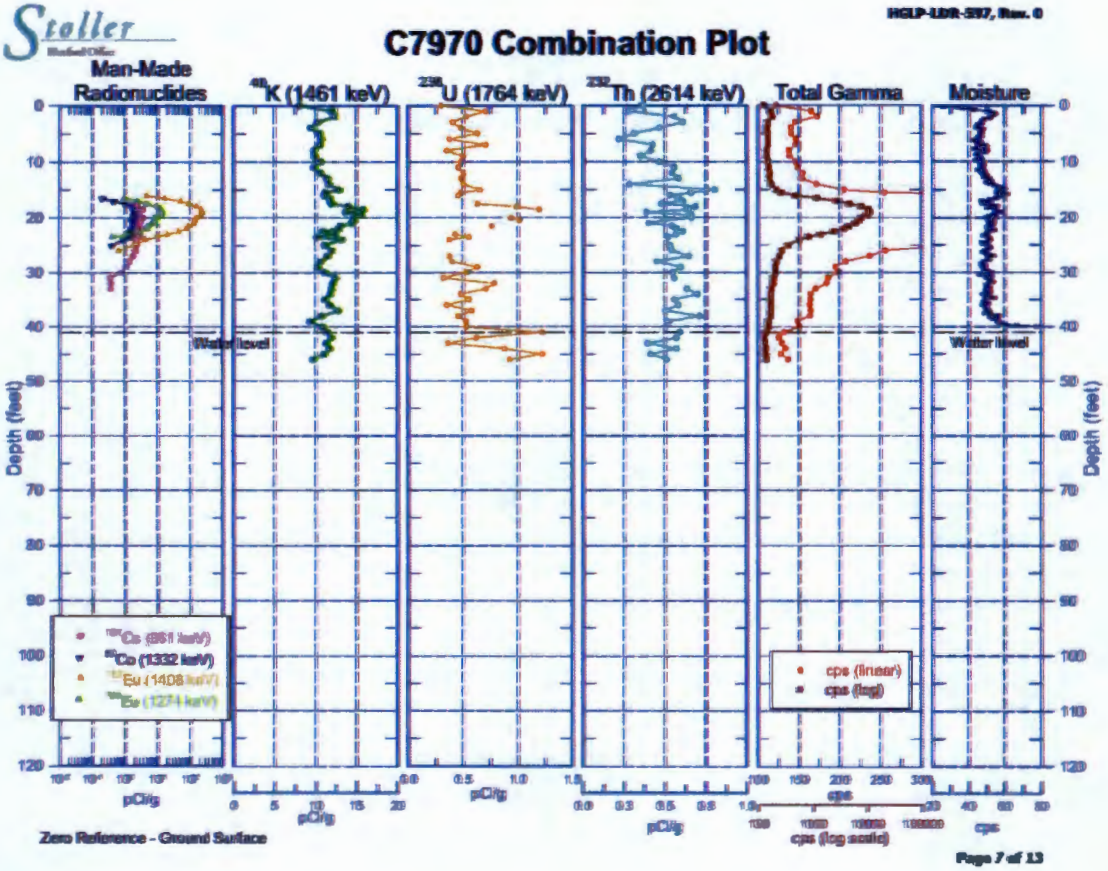
Stoller
Hanford Office

HGLP-LDR-597, Rev. 0

C7970
Natural Gamma Logs



Zero Reference - Ground Surface


Stoller
HGLP-LDR-297, Rev. 0
C7970 Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Moisture
Water level
Depth (feet)
137Cs (661 keV)
60Co (1332 keV)
152Eu (1408 keV)
154Eu (1274 keV)
cps (linear)
cps (log)
pCi/g
cps
cps (log scale)
Zero Reference - Ground Surface
Page 7 of 13

HGLP-LDR-597, Rev. 0

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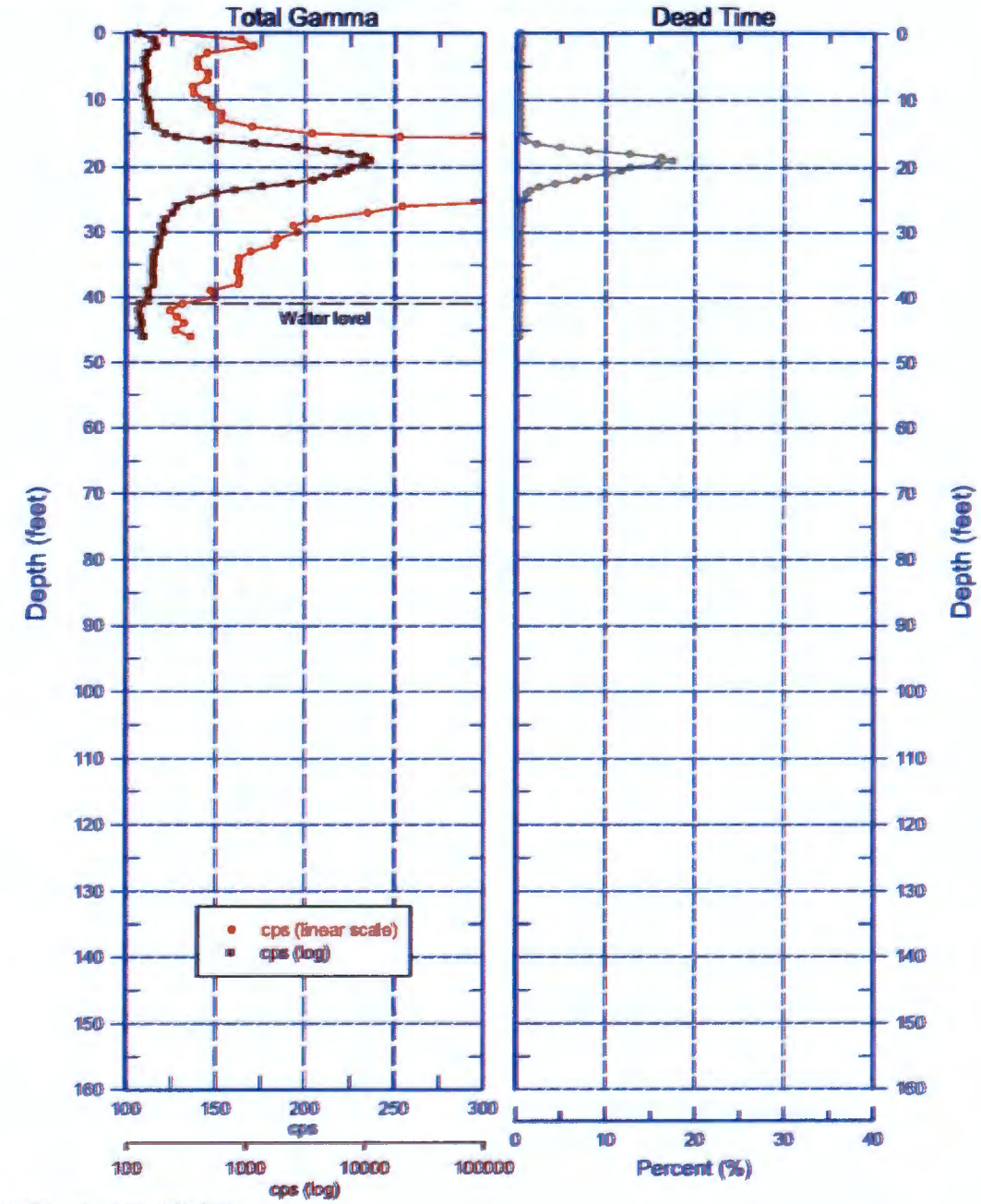
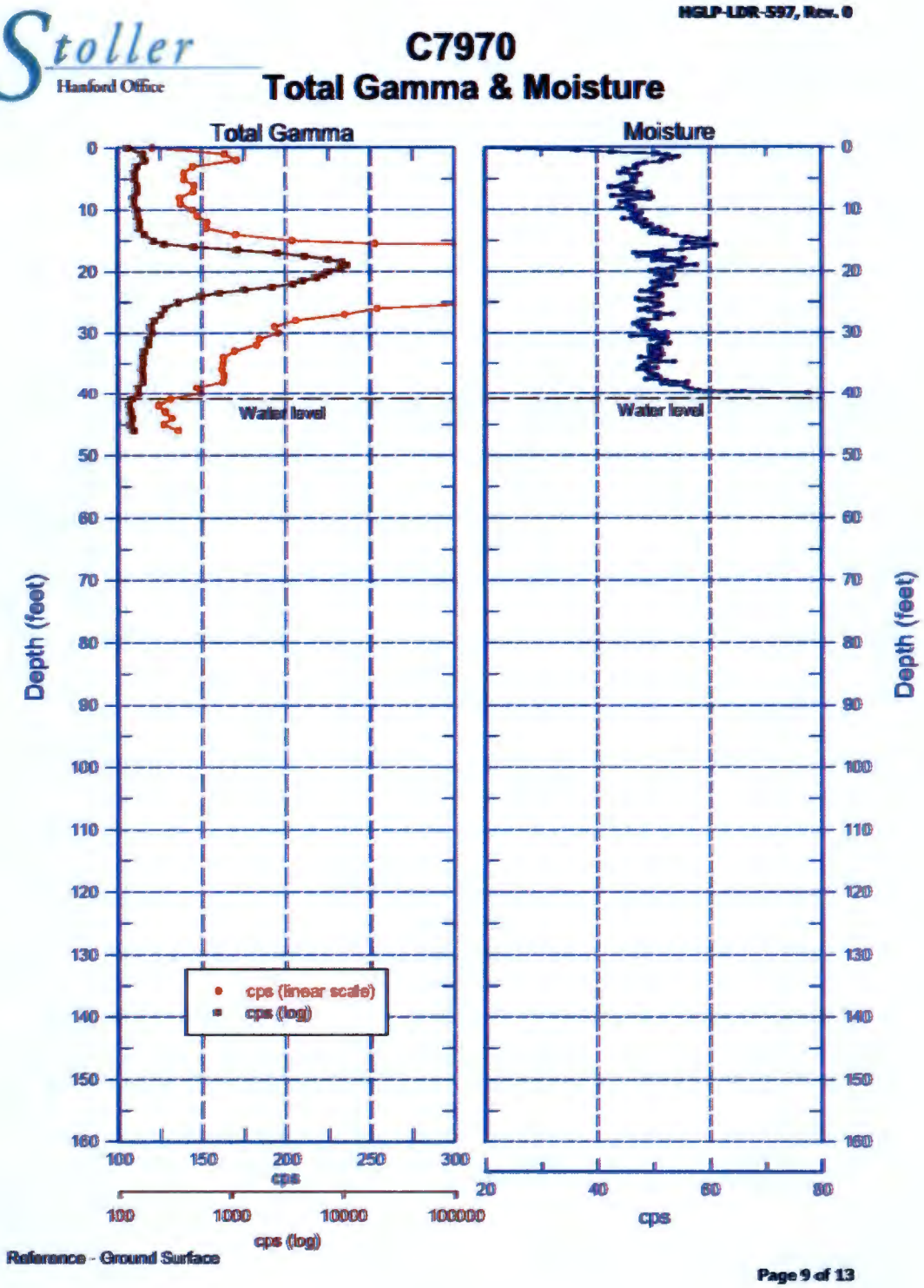
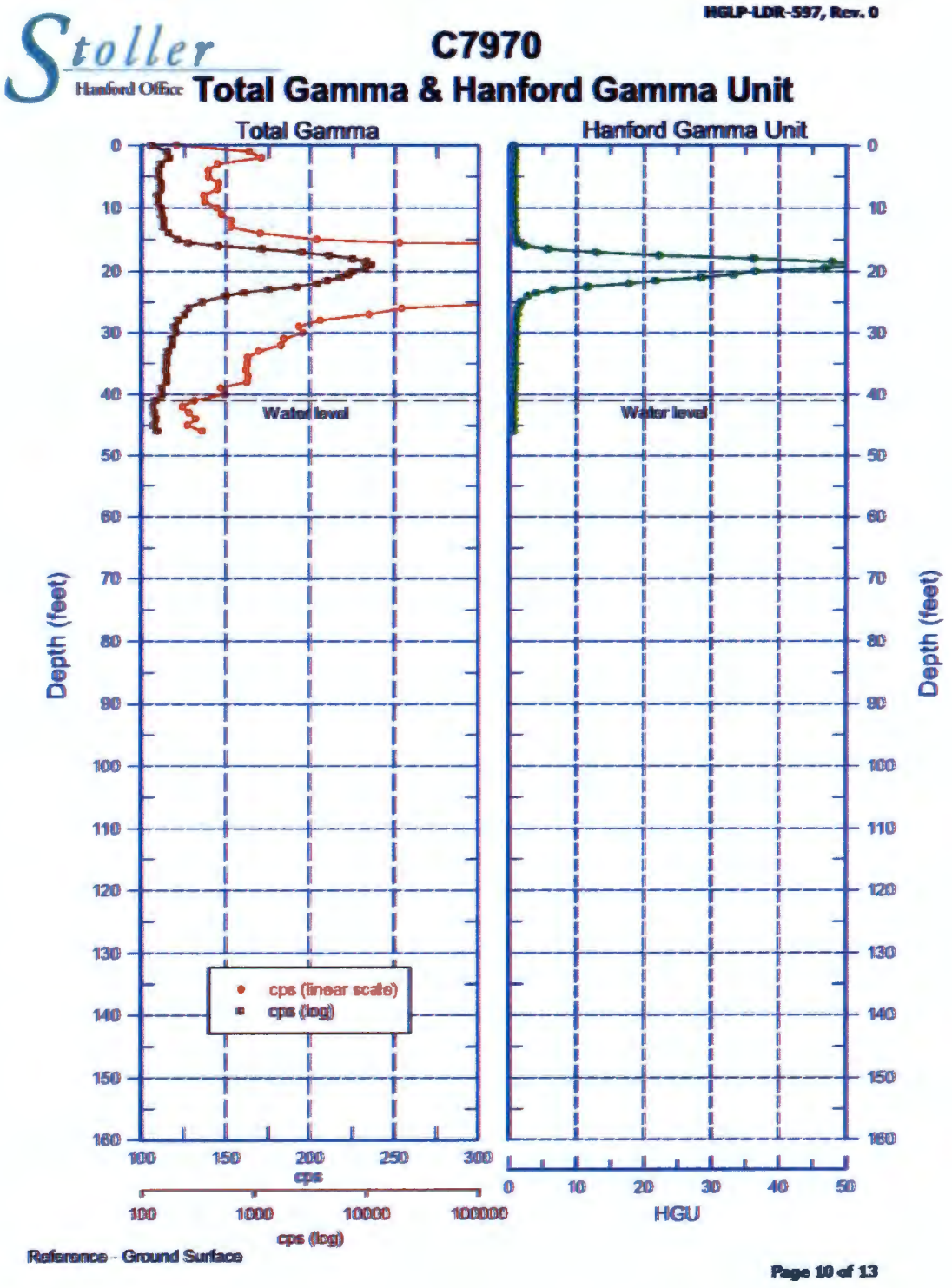
C7970
Total Gamma & Dead Time

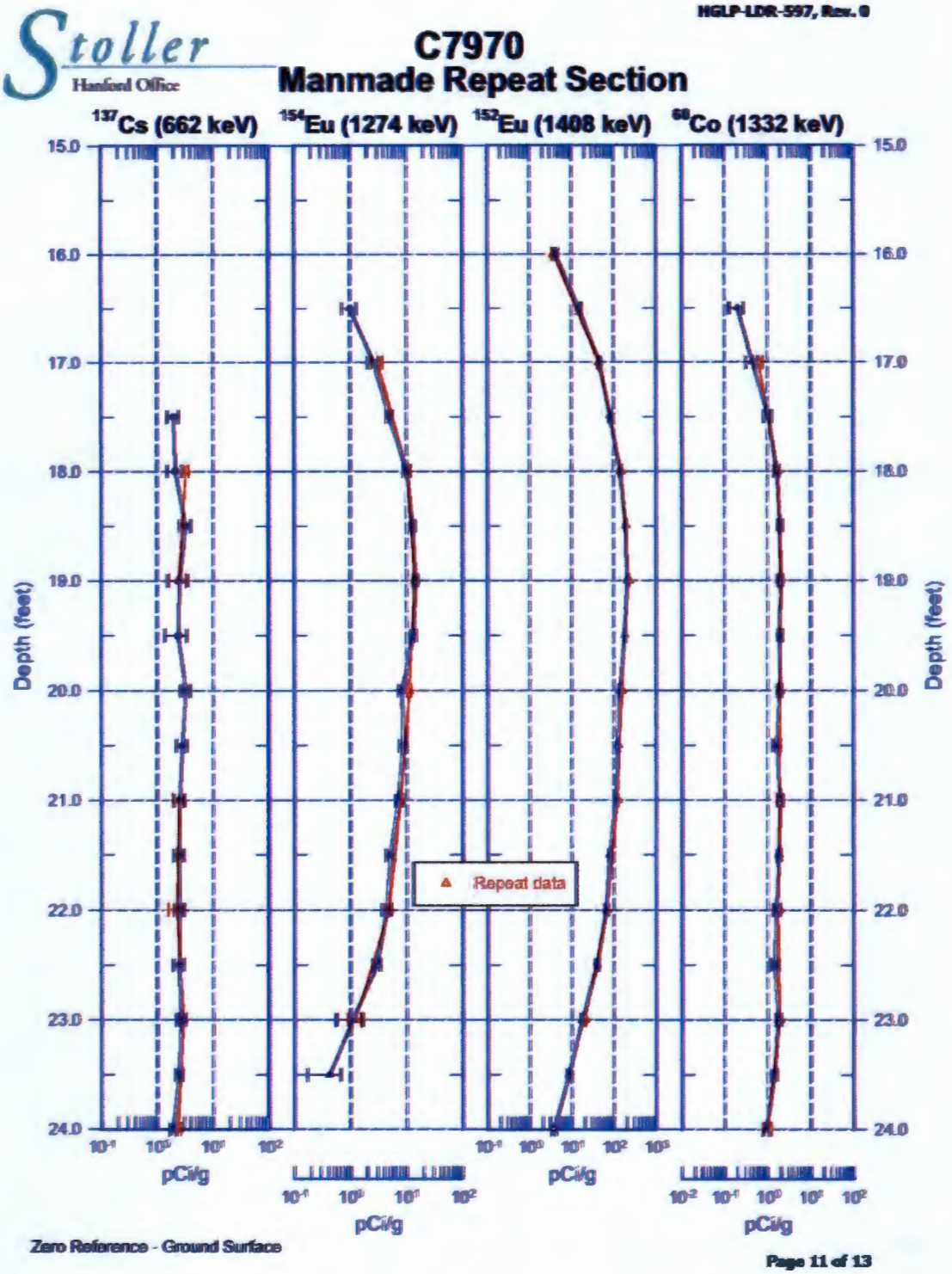


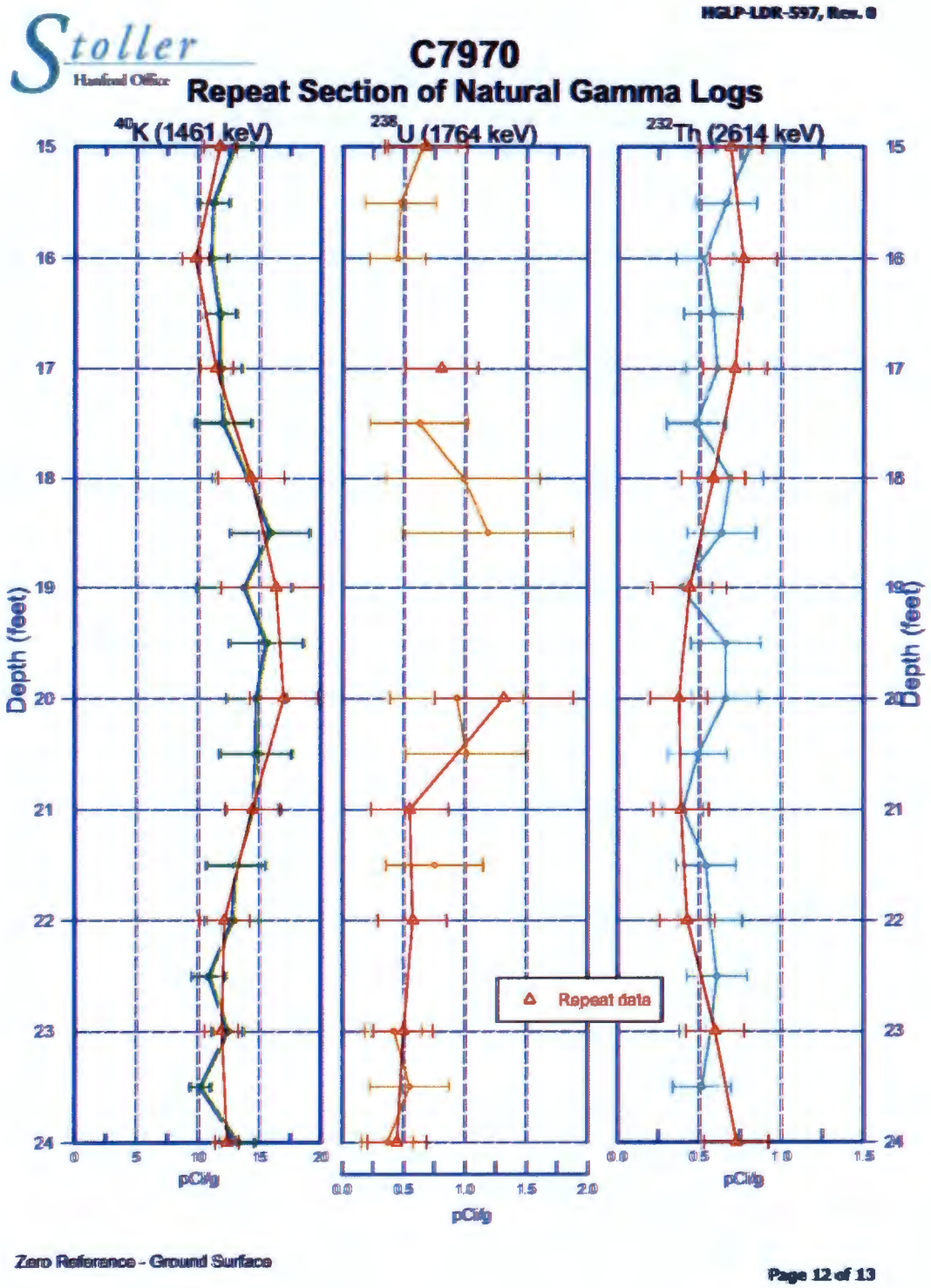
Reference - Ground Surface

Page 8 of 13


HSLP-LDR-597, Rev. 0
Stoller
Hanford Office
C7970
Total Gamma & Moisture
Total Gamma
Moisture
Water level
Water level
Depth (feet)
Depth (feet)
cps (linear scale)
cps (log)
cps
cps (log)
Reference - Ground Surface
Page 9 of 13

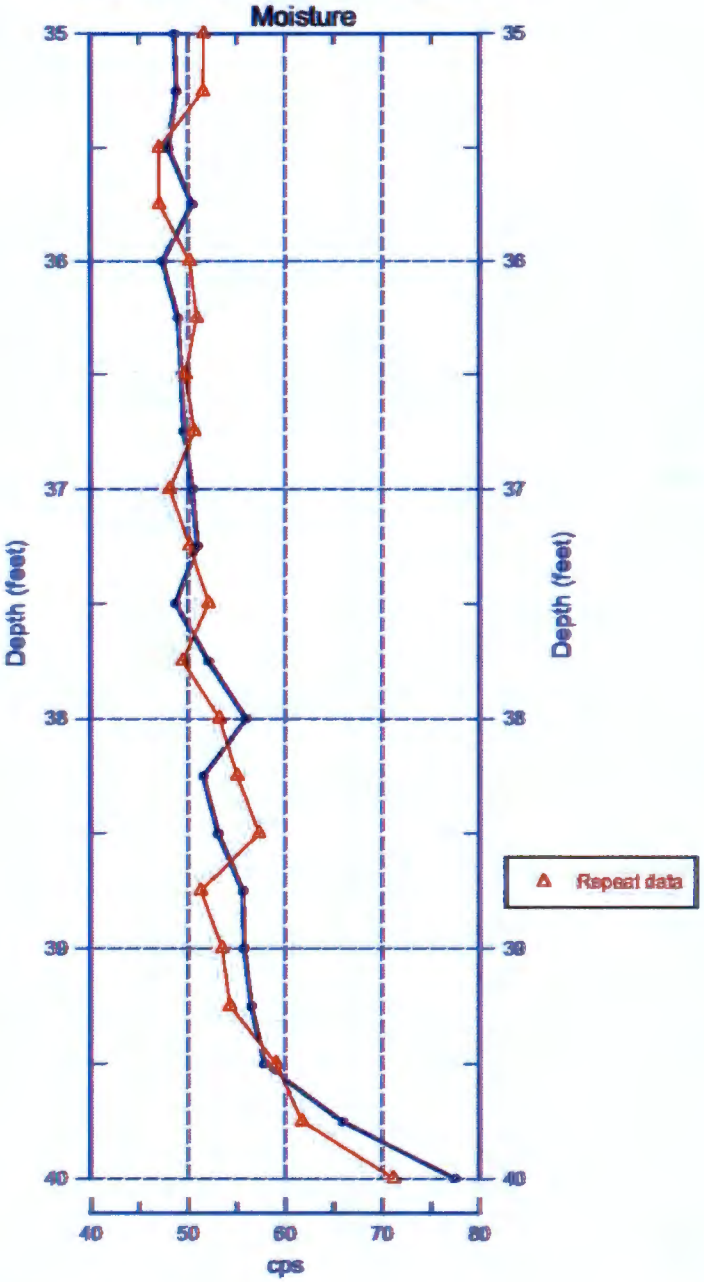

HGLP-LDR-597, Rev. 0
Stoller
Hanford Office
C7970
Total Gamma & Hanford Gamma Unit
Total Gamma
Hanford Gamma Unit
Water level
Water level
Depth (feet)
Depth (feet)
cps (linear scale)
cps (log)
cps
cps (log)
HGU
Reference - Ground Surface
Page 10 of 13


HGLP-LDR-597, Rev. 0
Stoller
Hanford Office
C7970
Manmade Repeat Section
137Cs (662 keV)
154Eu (1274 keV)
152Eu (1408 keV)
60Co (1332 keV)
Depth (feet)
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
Repeat data
pCi/g
Zero Reference - Ground Surface
Page 11 of 13


HGLP-LDR-597, Rev. 0
Stoller
Hanford Office
C7970
Repeat Section of Natural Gamma Logs
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Depth (feet)
15
16
17
18
19
20
21
22
23
24
0
5
10
15
20
pCi/g
0.0
0.5
1.0
1.5
2.0
pCi/g
0.0
0.5
1.0
1.5
pCi/g
Repeat data
Zero Reference - Ground Surface
Page 12 of 13

Stoller
Hanford Office

C7970
Moisture Repeat Section



Reference - Ground Surface

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Hanford Office

HGLP-LDR-557, Rev. 0

C7971
Log Data Report

Borehole Information:

Borehole:	C7971		Site:	100-FR-3, 118-F-1	
Coordinates (WA St Plane)		GWL[1] (ft):	26.0	GWL Date:	2/15/11
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
Unknown	Unknown	2/14/11	Unknown	32	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	1.8	10 3/4	9 3/4	1/2	1.8	32.0

Borehole Notes:

The drilling contractor provided the depth of casing and total depth of borehole. The logging engineer measured casing stick-up, casing diameters (rounded to the nearest 1/16-in.), and depth to water.

The zero reference is the ground surface.

Logging Equipment Information:

Logging System:	Gamma 1 N		Type:	60% HPGe SGLS
			Serial No.:	45-TP22010A
Effective Calibration Date:	12/21/10	Calibration Reference:	HGLP-CC-066, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 1	

Logging System:	Gamma 1 H		Type:	NMLS
			Serial No.:	H310700352
Effective Calibration Date:	5/17/10	Calibration Reference:	HGLP-CC-058	
		Logging Procedure:	HGLP-MAN-002, Rev. 1	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1017547	1017548			
Date	2/19/11	2/19/11			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	28.0	3.0			
Finish Depth (ft)	0.0	0.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AN199CAB	AN199CAB			
Start File	AN199000	AN199029			
Finish File	AN199028	AN199032			
Post-Verification	AN199CAA	AN199CAA			
Depth Return Error (in.)	1/2 low	1/2 low			
Comments	No fine gain	No fine gain			

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Hanford Office
established 1959

HGLP-LDR-557, Rev. 0

Log Run	1	2 Repeat			
	adjustments made.	adjustments made.			

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	3	4 Repeat			
HEIS Number	1017549	1017550			
Date	2/19/11	2/19/11			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	0.0			
Finish Depth (ft)	26.0	3.0			
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	AH073CAB	AH073CAB			
Start File	AH073000	AH073105			
Finish File	AH073104	AH073117			
Post-Verification	AH073CAA	AH073CAA			
Depth Return Error (in.)	0.0	0.0			
Comments	None	None			

Logging Operation Notes:

SGLS data were collected using Gamma 1, HO 68B-3574. Pre- and post-survey verification measurements were acquired in the standard field verifier. A centralizer was installed on the sonde.

NMLS data were collected using Gamma 1, HO 68B-3574. Pre- and post-survey verification measurements were acquired in the standard field verifier. A centralizer was installed on the sonde.

Analysis Notes:

Analyst:	LEGLER	Date:	3/7/2011	Reference:	HGLP-MAN-003, Rev. 0

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

A casing correction for 1/2-in. thick casing was applied during analysis.

A water correction was applied from 26 ft to the total logged depth of the borehole.

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 AN20101221, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the minimum detection level (MDL) resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

The NMLS data are presented in counts per second (cps) because no calibration data exist for a 9 3/4-in. inner diameter casing.

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Hanford Office
established 1959

HGLP-LDR-557, Rev. 0

The Hanford Gamma Unit (HGU) 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 this borehole. Although not detected, MDLs for Cs-137 and Pu-239 were plotted on the manmade radionuclides plot.

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 repeat plots indicate that the respective systems were working properly.

List of Log Plots:

Depth Reference is ground surface

Manmade Radionuclides
Natural Gamma Logs
Combination Plot
Total Gamma & Dead Time
Total Gamma & Moisture
Total Gamma & Hanford Gamma Unit
Repeat Section of Natural Gamma Logs
Moisture Repeat Section

[1] GWL – groundwater level
[2] TOC – top of casing

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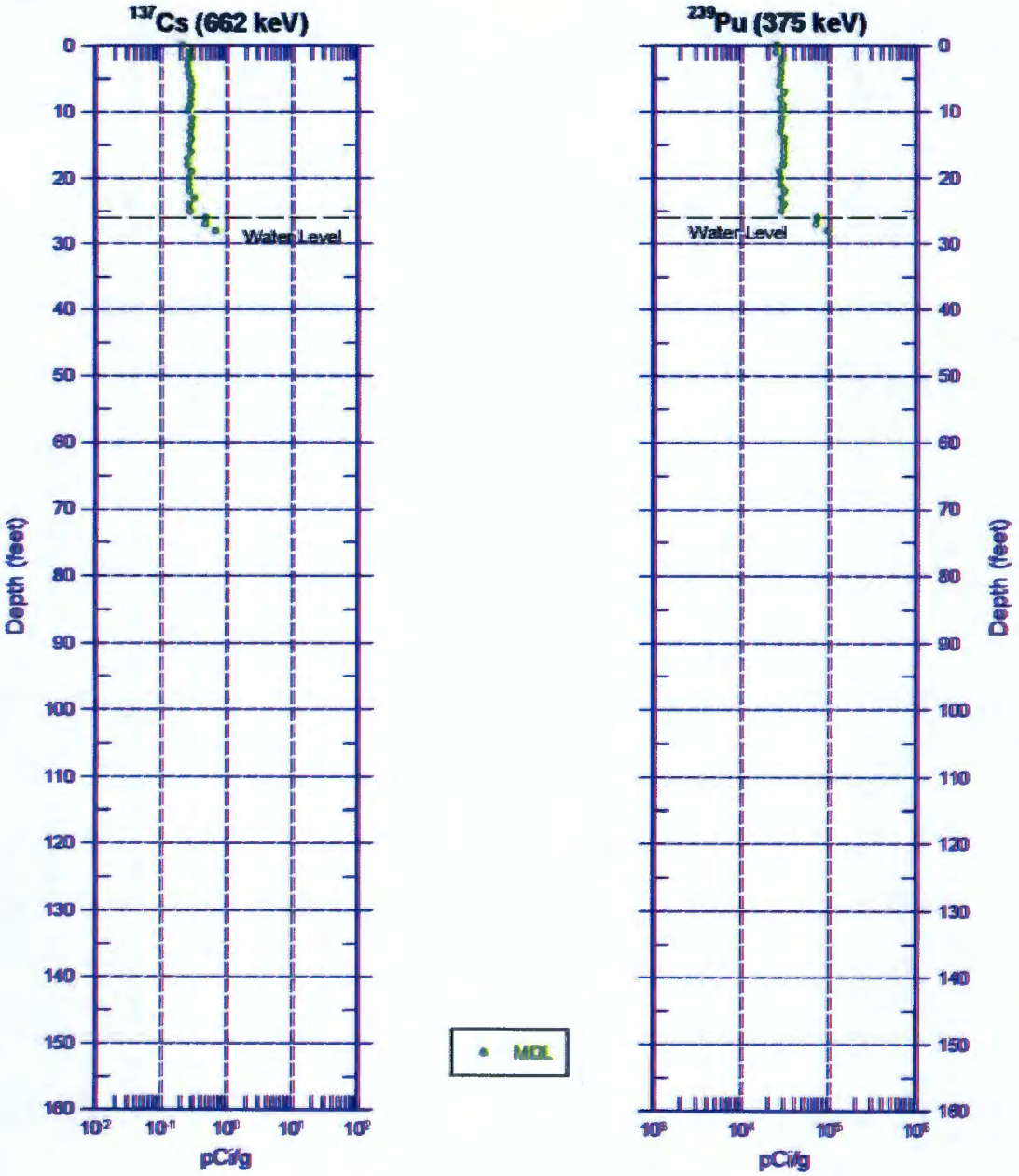
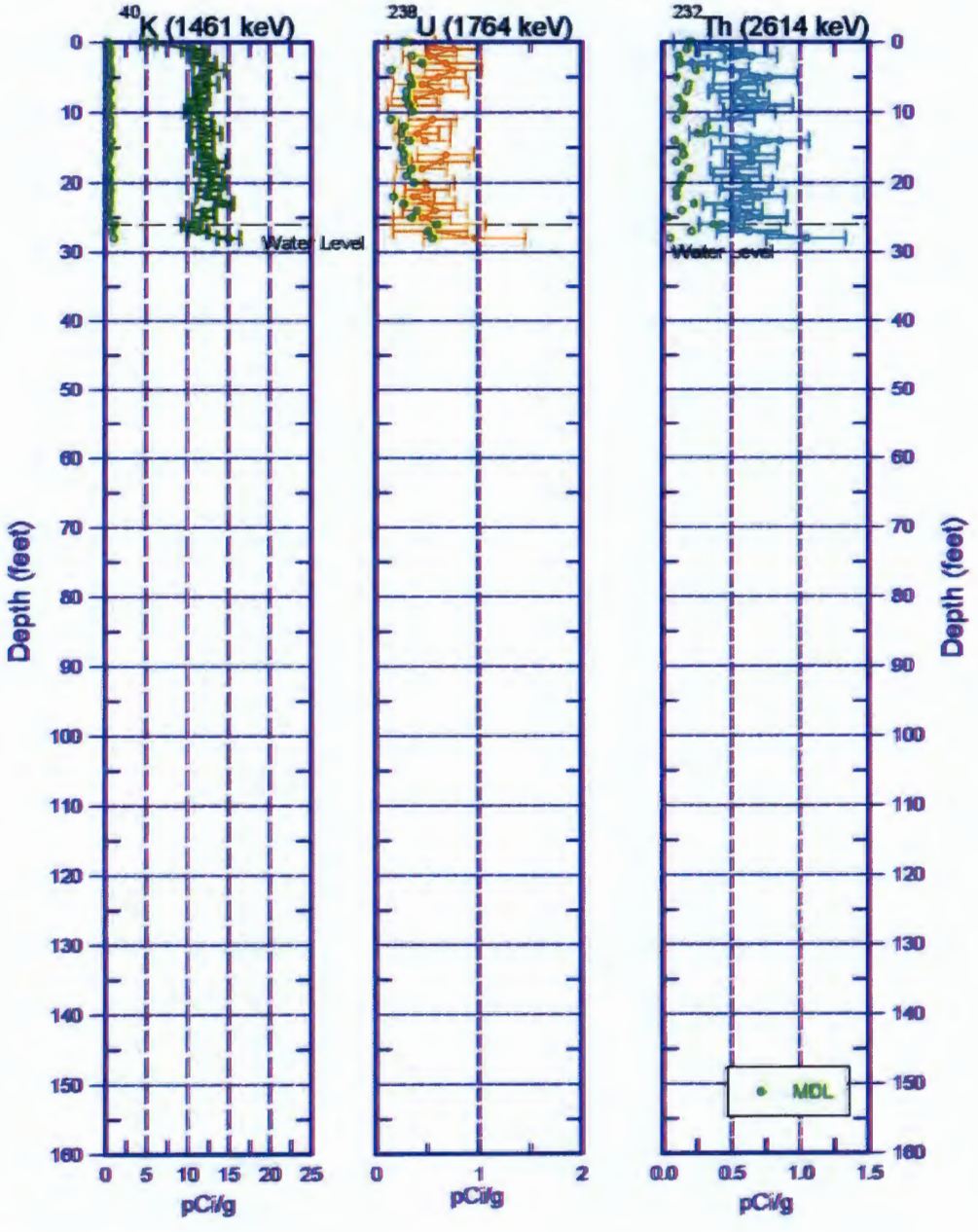
Hanford Office

C7971
Manmade Radionuclides



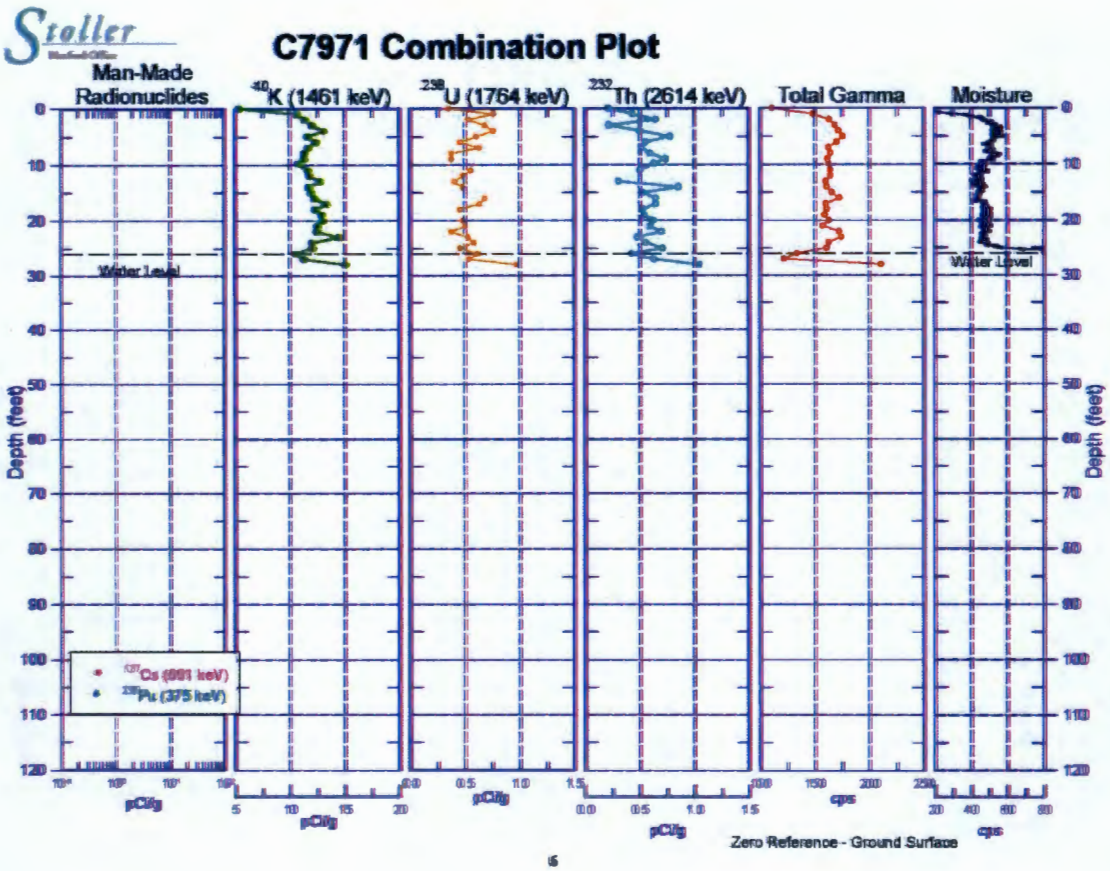
Stoller
Hanford Office

C7971
Natural Gamma Logs



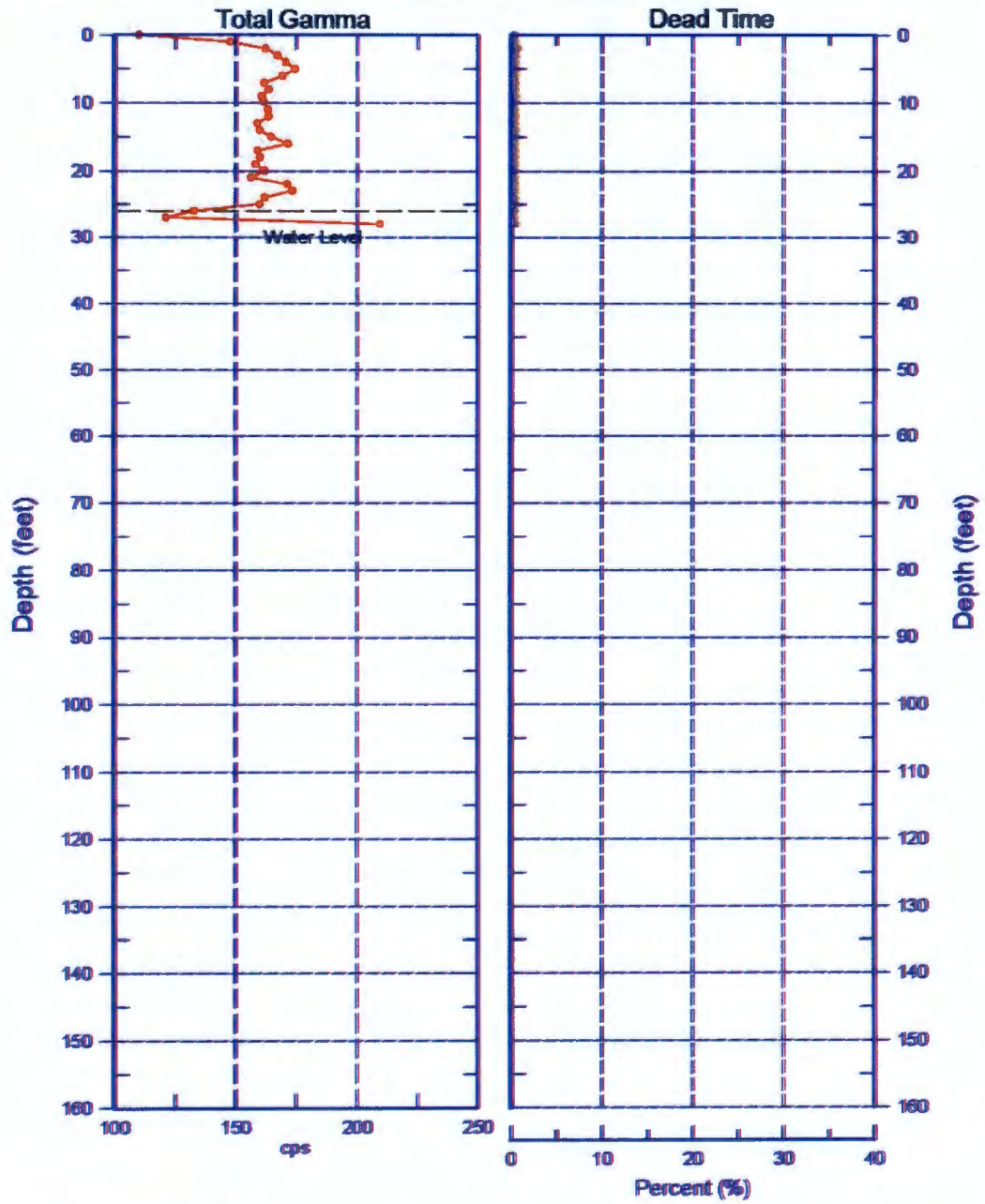
Zero Reference - Ground Surface

5


Stoller
C7971 Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Moisture
Water Level
Water Level
Depth (feet)
Depth (feet)
137Cs (661 keV)
235U (375 keV)
pCi/g
pCi/g
pCi/g
pCi/g
cps
cps
Zero Reference - Ground Surface

Stoller
Hanford Office

C7971
Total Gamma & Dead Time

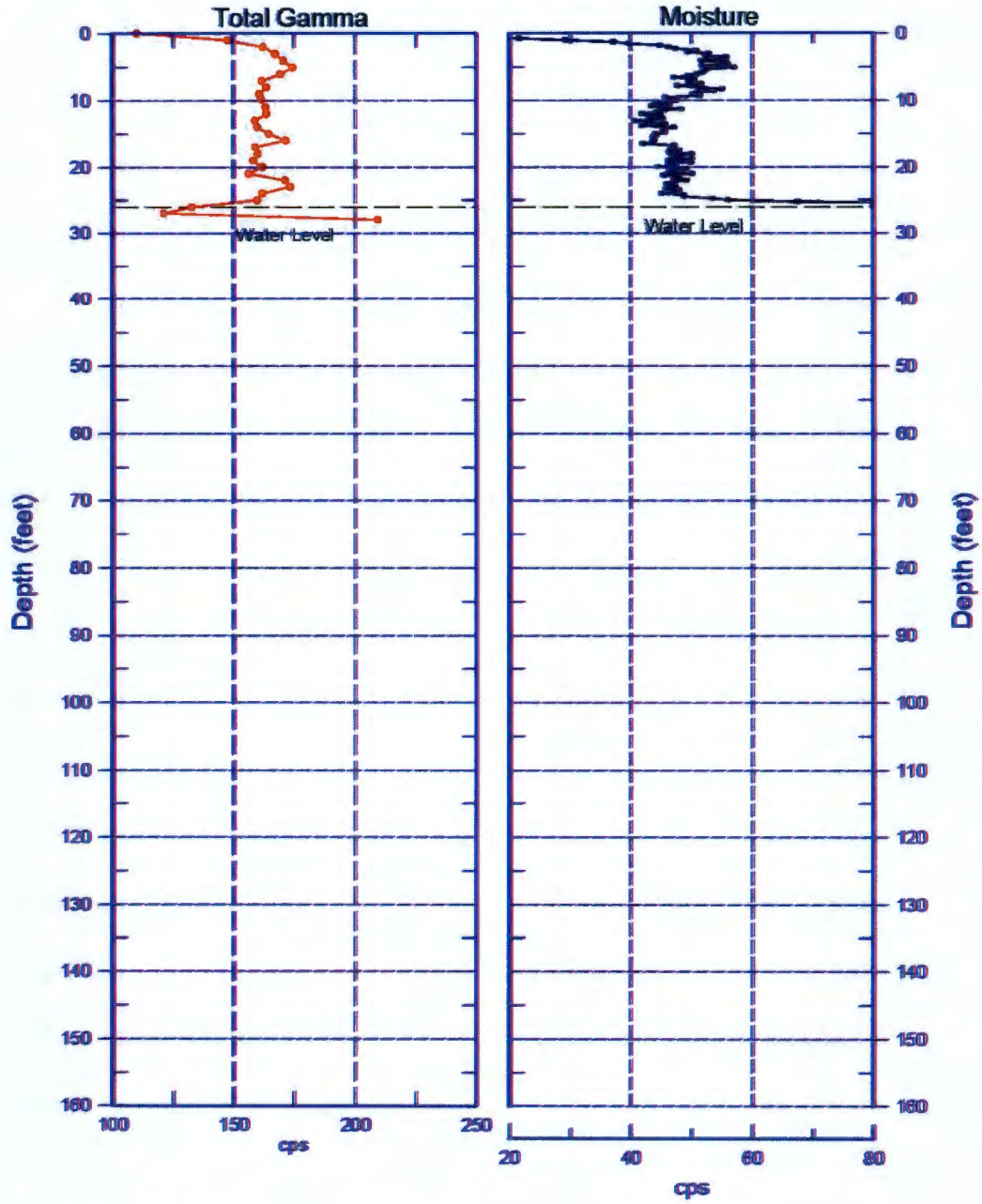


Reference - Ground Surface

7

Stoller
Hanford Office

C7971
Total Gamma & Moisture



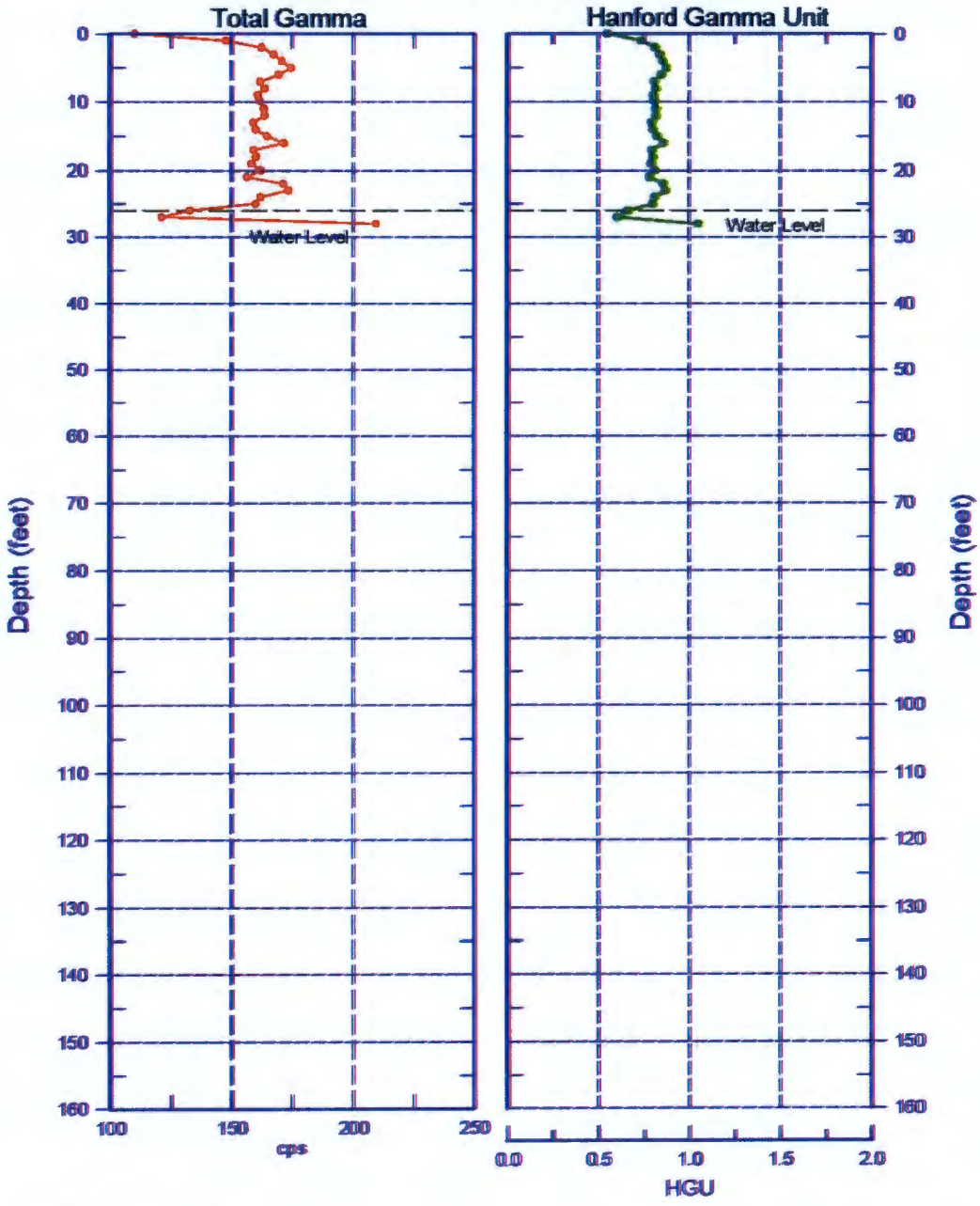
Reference - Ground Surface

8

Stoller
Hanford Office

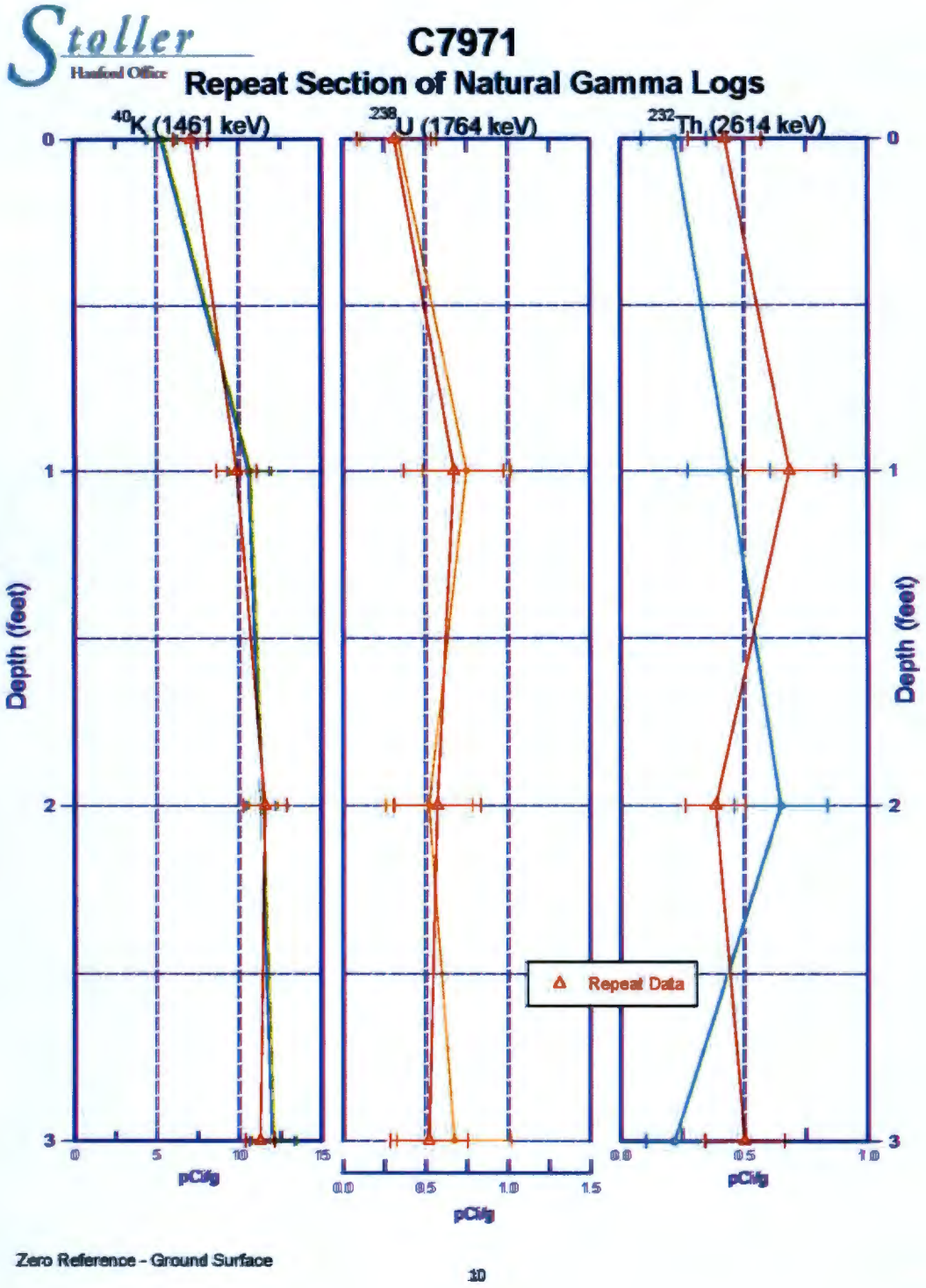
C7971

Total Gamma & Hanford Gamma Unit



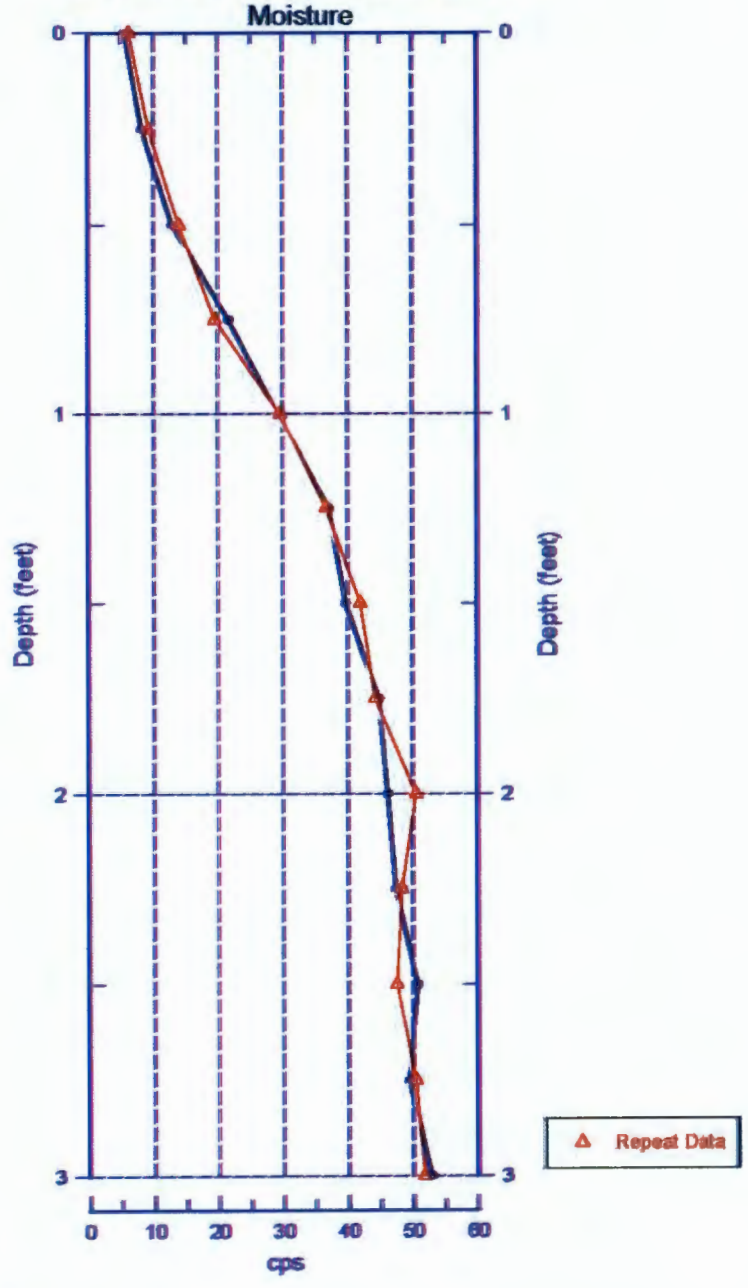
Reference - Ground Surface

9


Stoller
Hanford Office
C7971
Repeat Section of Natural Gamma Logs
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Depth (feet)
Depth (feet)
0
1
2
3
0
5
10
15
pCi/g
0.0
0.5
1.0
1.5
pCi/g
0.0
0.5
1.0
pCi/g
Repeat Data
Zero Reference - Ground Surface

Stoller
Hanford Office

C7971
Moisture Repeat Section

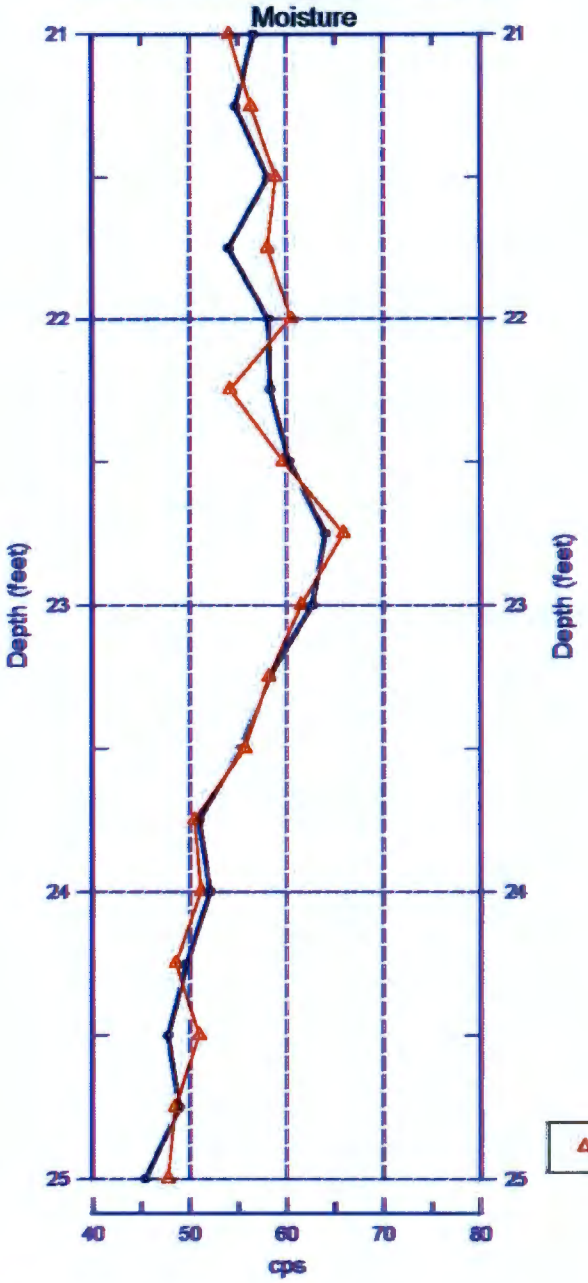


Reference - Ground Surface

11

Stoller
Hanford Office

C7972
Moisture Repeat Section



Reference - Ground Surface

Stoller
Hanford Office
established 1959

HGLP-LDR-579, Rev. 0

C7972
Log Data Report

Borehole Information:

Log Date:	2011-02-19	Filename:	C7972_HG-NM_2011-02-19	Site:	100-FR-3, 118-F-8:3 Retention Basin
Coordinates (WA St Plane)		GWL[1] (ft):	43.3	GWL Date:	2/19/11
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
Unknown	Unknown	2/18/11	Unknown	48.1	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	2.2	10 3/4	9 5/8	1/2	2.2	47.8

Borehole Notes:

The drilling contractor provided the depth of casing and total depth. The logging engineer measured casing stick-up, casing diameters (rounded to the nearest 1/16-in.), and depth to water.

The zero reference is the ground surface.

Logging Equipment Information:

Logging System:	Gamma 1 N		Type: Serial No.:	60% HPGe SGLS[3] 45-TP22010A
Effective Calibration Date:	12/21/10	Calibration Reference:	HGLP-CC-066, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 1	

Logging System:	Gamma 1 H		Type: Serial No.:	NMLS[4] H310700352
Effective Calibration Date:	5/17/10	Calibration Reference:	HGLP-CC-058, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 1	

SGLS Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1017551	1017552			
Date	2/19/11	2/19/11			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	46.0	26.0			
Finish Depth (ft)	0.0	22.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	0.5			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AN200CAB	AN200CAB			

[1] ground water level
[2] top of casing
[3] Spectral Gamma Logging System
[4] Neutron Moisture Logging System

Log Run	1	2 Repeat			
Start File	AN200000	AN200047			
Finish File	AN200046	AN200055			
Post-Verification	AN200CAA	AN200CAA			
Depth Return Error (in.)	1/2 low	1/2 low			
Comments	No fine gain adjustments made	No fine gain adjustments made			

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	3	4 Repeat			
HEIS Number	1017553	1017554			
Date	2/19/11	2/19/11			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	21.0			
Finish Depth (ft)	43.25	25.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AH074CAB	AH074CAB			
Start File	AH074000	AH074174			
Finish File	AH074173	AH074190			
Post-Verification	AH074CAA	AH074CAA			
Depth Return Error (in.)	N/A	1/2 high			
Comments	None	None			

Logging Operation Notes:

SGLS data were collected using Gamma 1, HO 68B-3574. Pre- and post-survey verification measurements were acquired in the KUTh-118 field verifier. A centralizer was installed on the sonde.

NMLS data were collected using Gamma 1, HO 68B-3574. Pre- and post-survey verification measurements were acquired in the AmBe standard field verifier. A centralizer was installed on the sonde.

Analysis Notes:

Analyst:	LEGLER	Date:	3/9/11	Reference:	HGLP-MAN-003, Rev. 0

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

A casing correction for 1/2-in. thick casing was applied during analysis.

A water correction was applied from 44 ft to the total logged depth of the borehole.

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 AN20101221, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the minimum detection level resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not

detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

The NMLS data are presented in counts per second because no calibration data exist for a 9 5/8-in. inner diameter casing.

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).

The repeat log data interval was used in place of main log data, because the 0.5 ft MSA interval provides greater depth resolution of the logged section.

Results and Interpretations:

Cs-137, Co-60, Eu-154, and Eu-152 were the manmade radionuclides that were detected in this borehole.

Cs-137 was detected from 18 to 26 ft with a maximum concentration of approximately 29 pCi/g at 24 ft.

Co-60 was detected at 23 - 24 ft with a maximum concentration of approximately 0.3 pCi/g at 23.5 ft.

Eu-154 was detected at 23.5 ft with an approximate concentration of 0.6 pCi/g.

Eu-152 was detected from 21 – 25 ft with a maximum concentration of approximately 8 pCi/g at 24 ft.

Although not detected, MDLs for Pu-239 are plotted on the manmade radionuclides plot.

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.

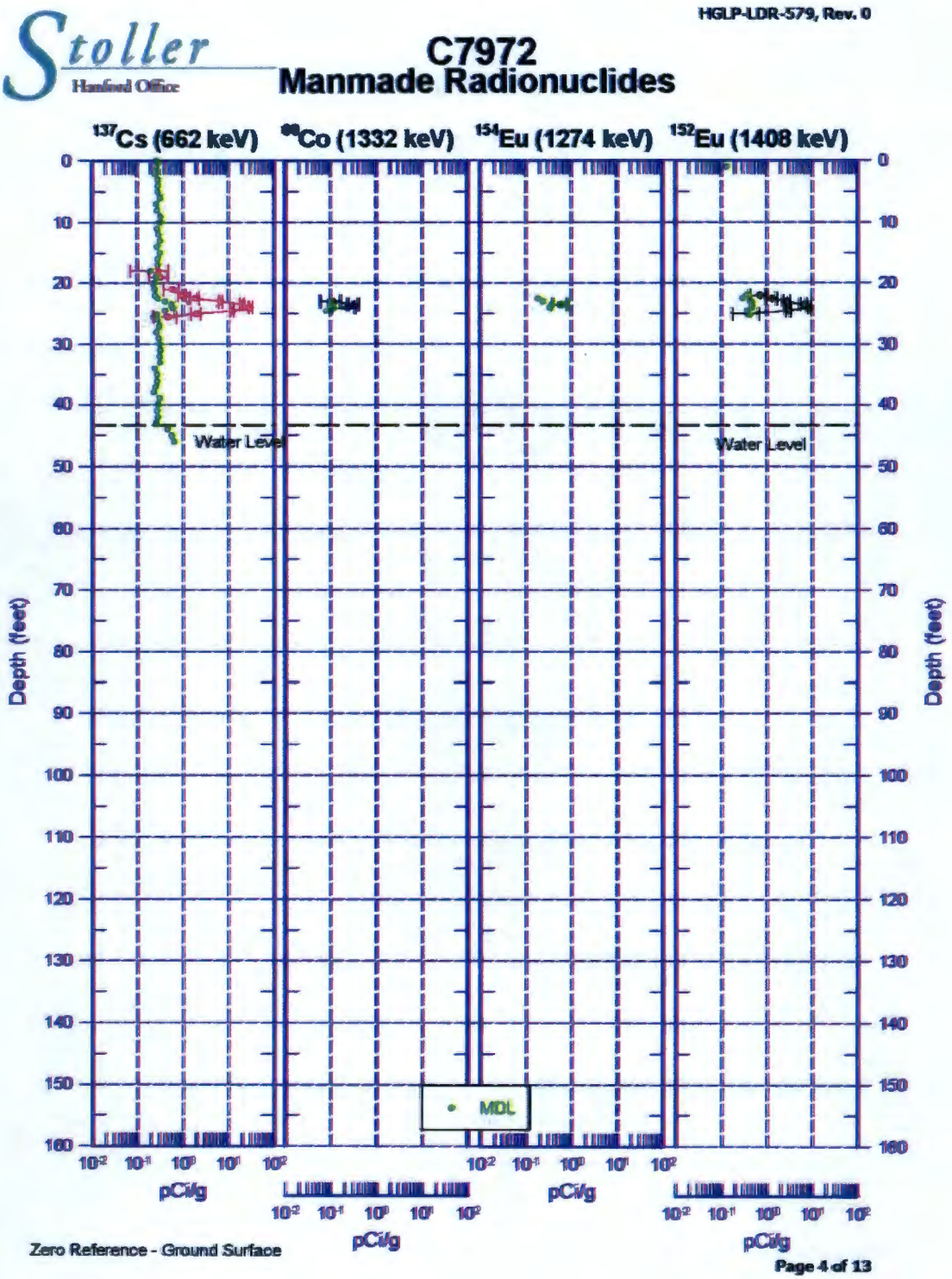
The repeat plots indicate that respective systems were working properly.

List of Log Plots:

Depth Reference is ground surface

Manmade Radionuclides (2 pages)
Natural Gamma Logs
Combination Plot
Total Gamma & Dead Time
Total Gamma & Moisture
Total Gamma & Hanford Gamma Unit
Manmade Repeat Section
Repeat Section of Natural Gamma Logs
Moisture Repeat Section

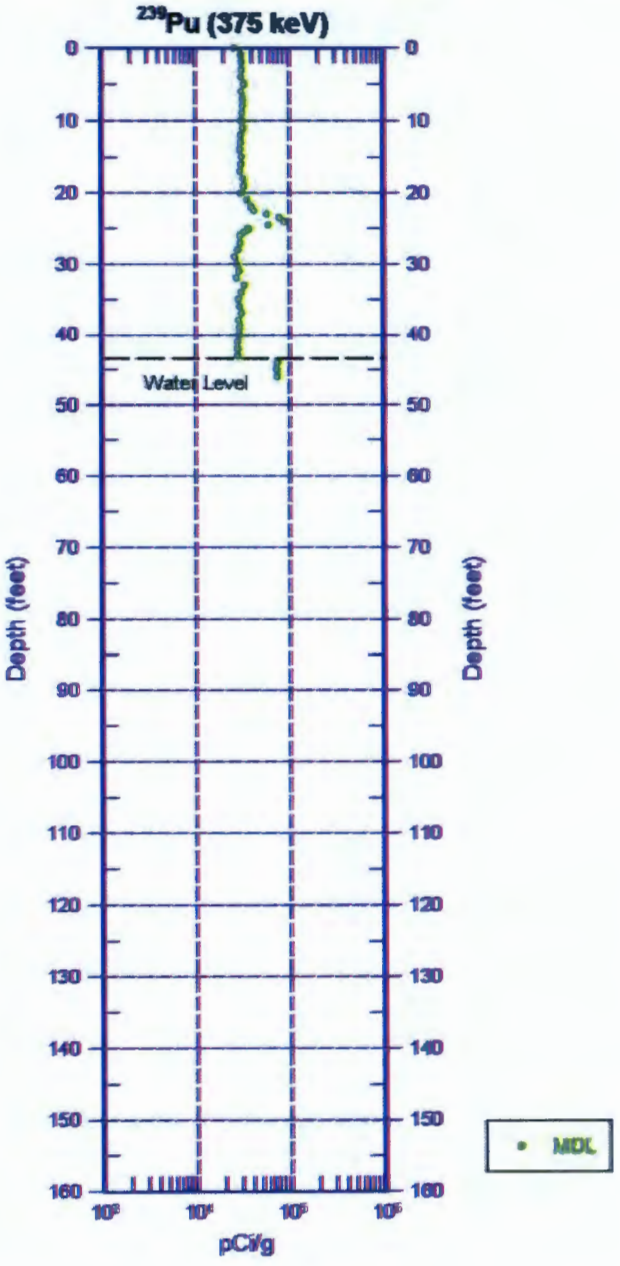
[5] Hanford Gamma Unit


HGLP-LDR-579, Rev. 0
Stoller
Hanford Office
C7972
Manmade Radionuclides
137Cs (662 keV)
60Co (1332 keV)
154Eu (1274 keV)
152Eu (1408 keV)
Water Level
Water Level
MDL
Depth (feet)
Depth (feet)
pCi/g
pCi/g
pCi/g
pCi/g
Zero Reference - Ground Surface
Page 4 of 13

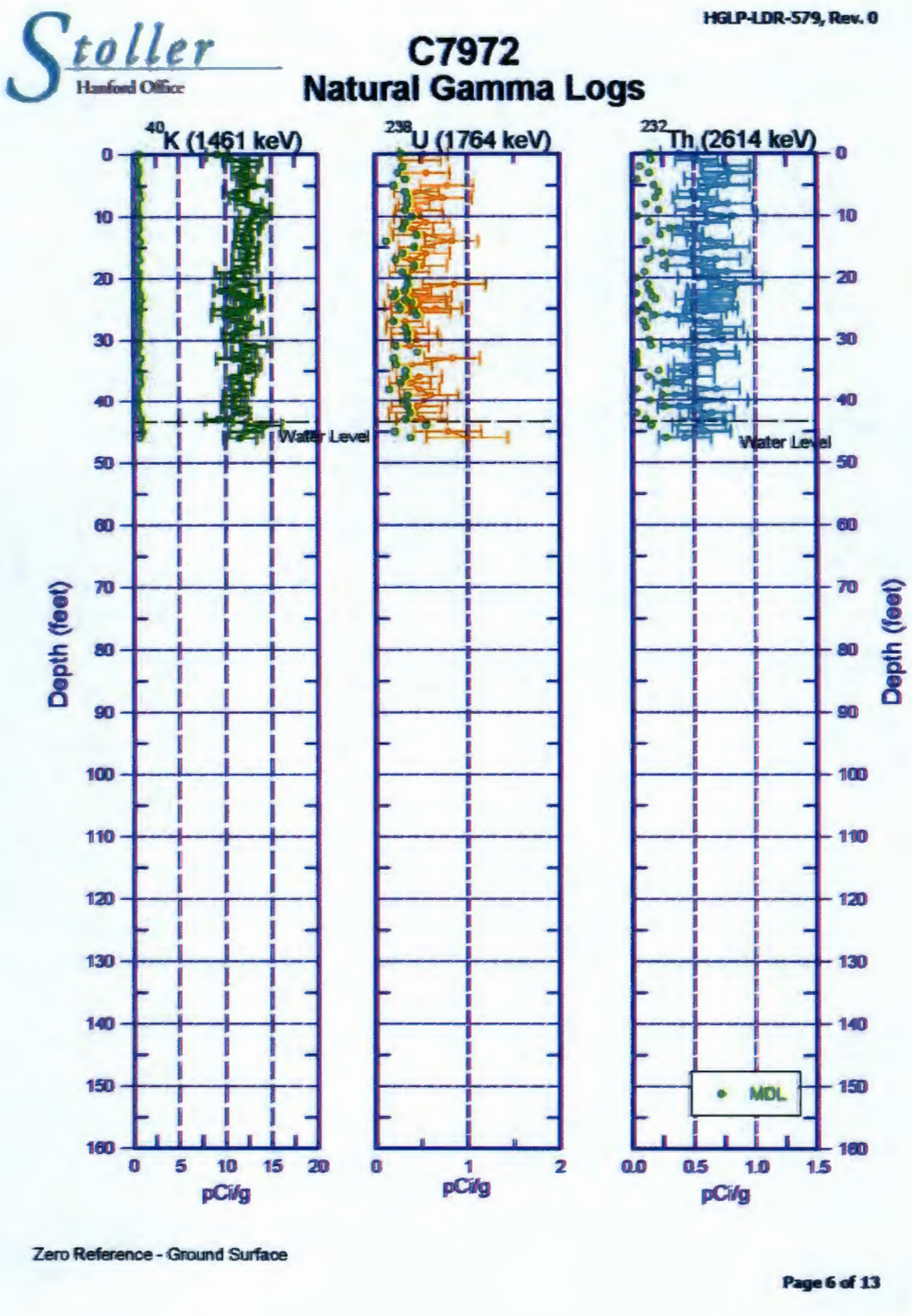
Stoller Hanford Office

HGLP-LDR-579, Rev. 0

C7972
Manmade Radionuclides



Zero Reference - Ground Surface


Stoller
Hanford Office
HGLP-LDR-579, Rev. 0
C7972
Natural Gamma Logs
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Water Level
Water Level
Depth (feet)
Depth (feet)
0 5 10 15 20
pCi/g
0 1 2
pCi/g
0.0 0.5 1.0 1.5
pCi/g
MDL
Zero Reference - Ground Surface
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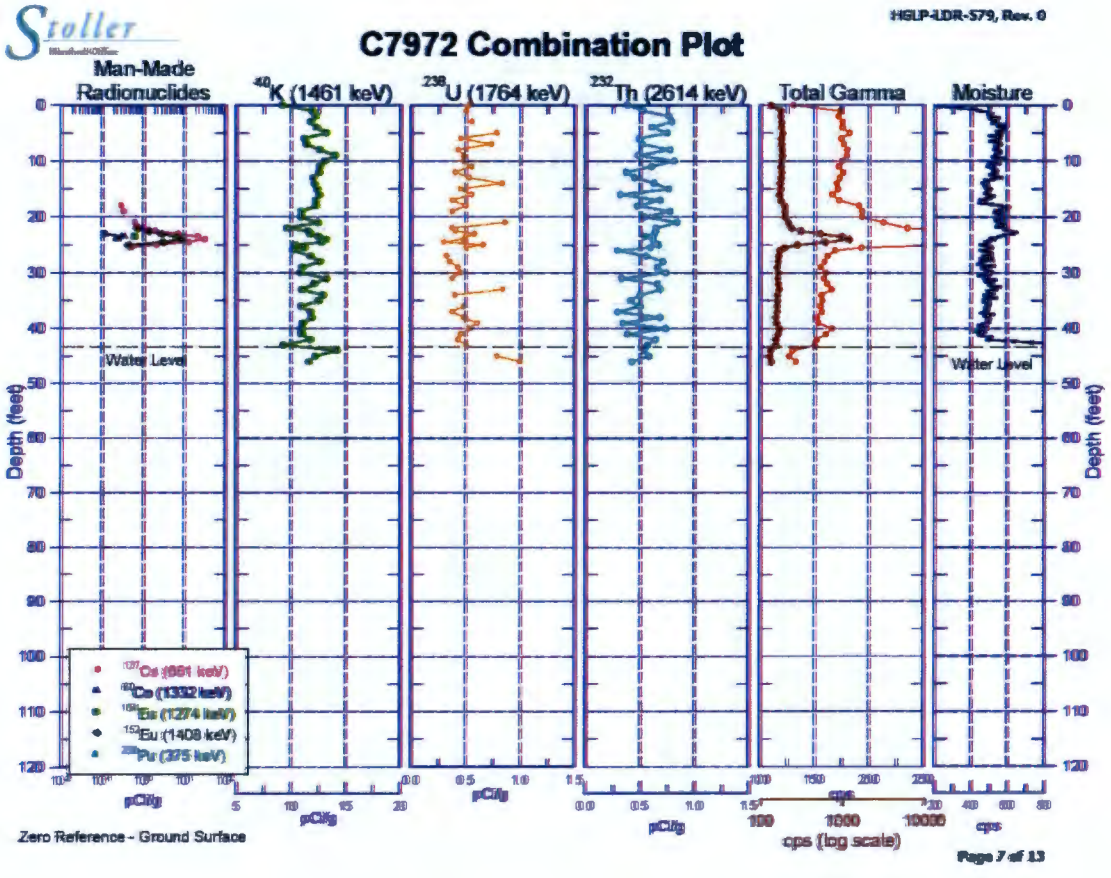
Stoller
HGLP-LDR-S79, Rev. 0
C7972 Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Moisture
Water Level
Water Level
Depth (feet)
Depth (feet)
137Cs (661 keV)
60Co (1332 keV)
154Eu (1274 keV)
152Eu (1408 keV)
239Pu (375 keV)
pCi/g
pCi/g
pCi/g
cps
cps (log scale)
cps
Zero Reference - Ground Surface
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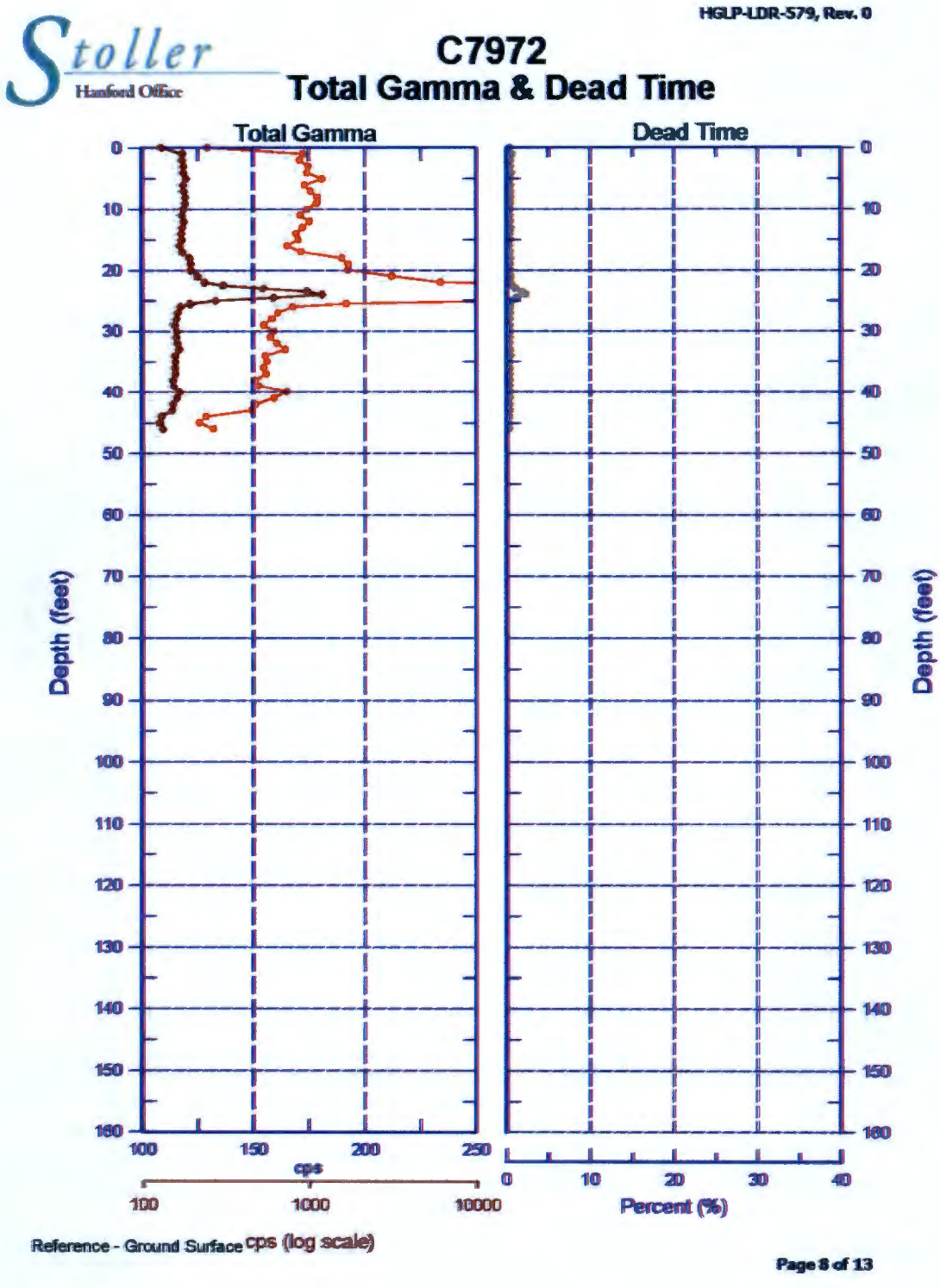
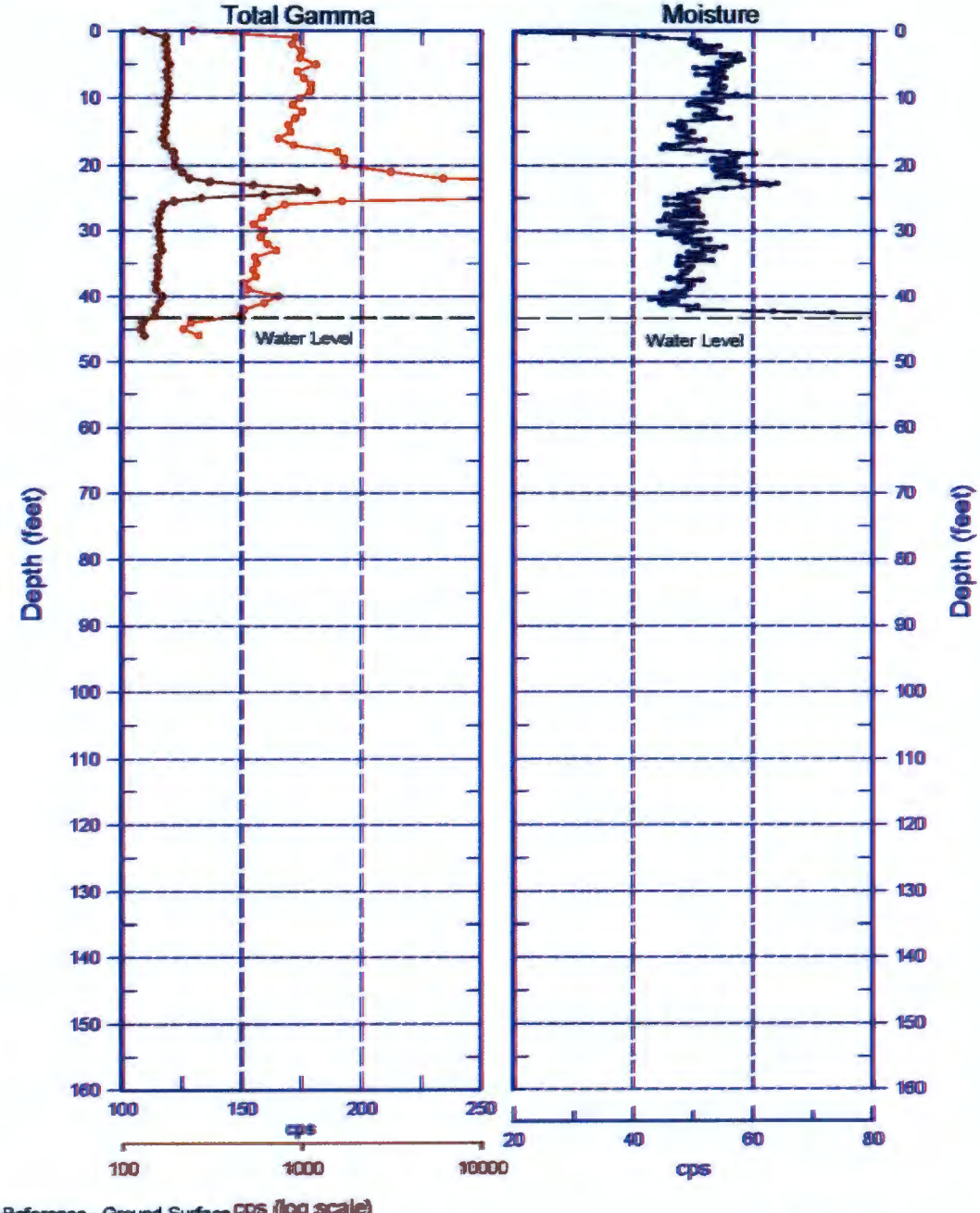

HGLP-LDR-579, Rev. 0
Stoller
Hanford Office
C7972
Total Gamma & Dead Time
Total Gamma
Dead Time
Depth (feet)
Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
100
150
200
250
cps
100
1000
10000
0
10
20
30
40
Percent (%)
Reference - Ground Surface
cps (log scale)
Page 8 of 13

HGLP-LDR-579, Rev. 0

Stoller
Hanford Office

C7972
Total Gamma & Moisture



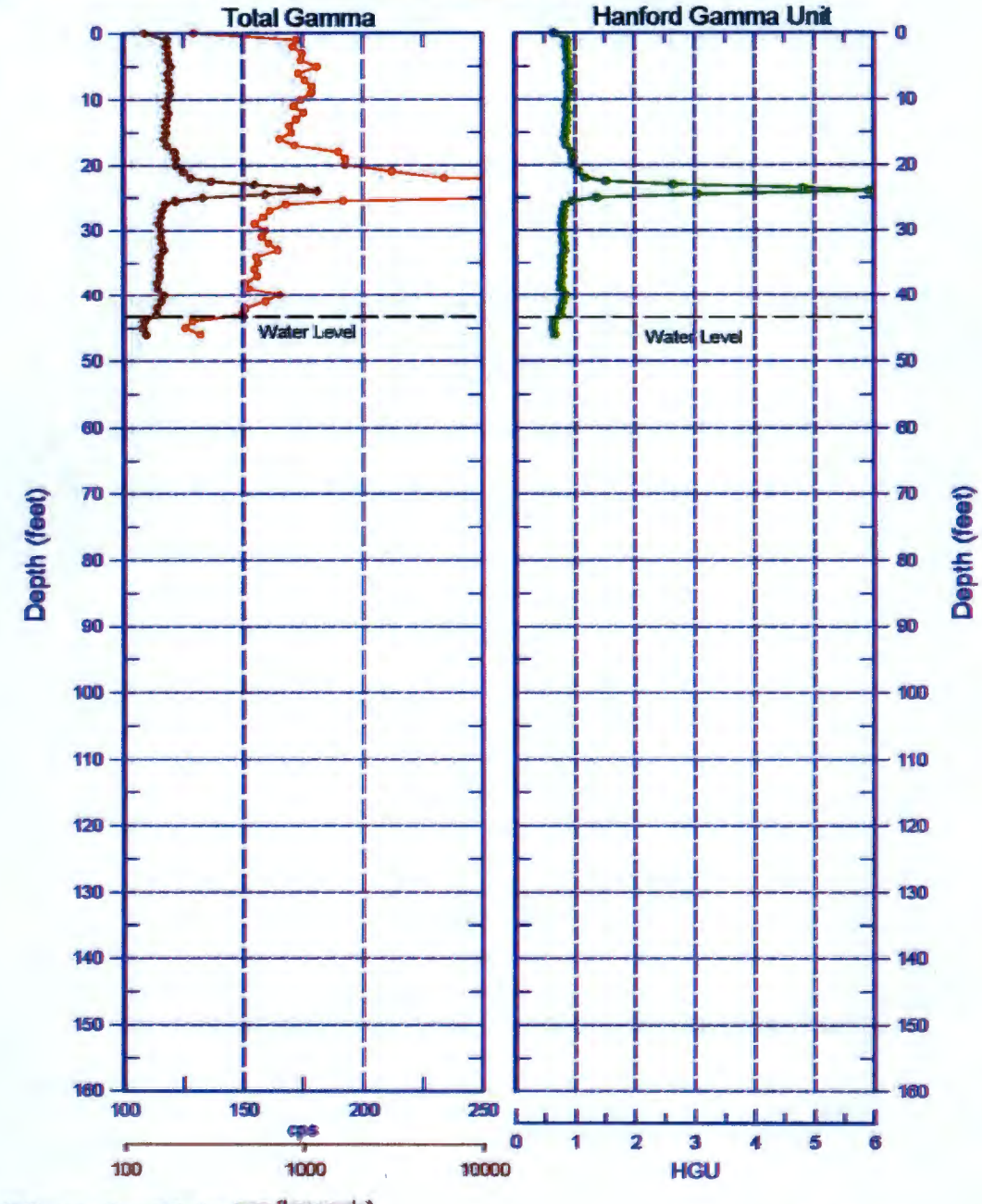
Reference - Ground Surface cps (log scale)

HGLP-LDR-579, Rev. 0

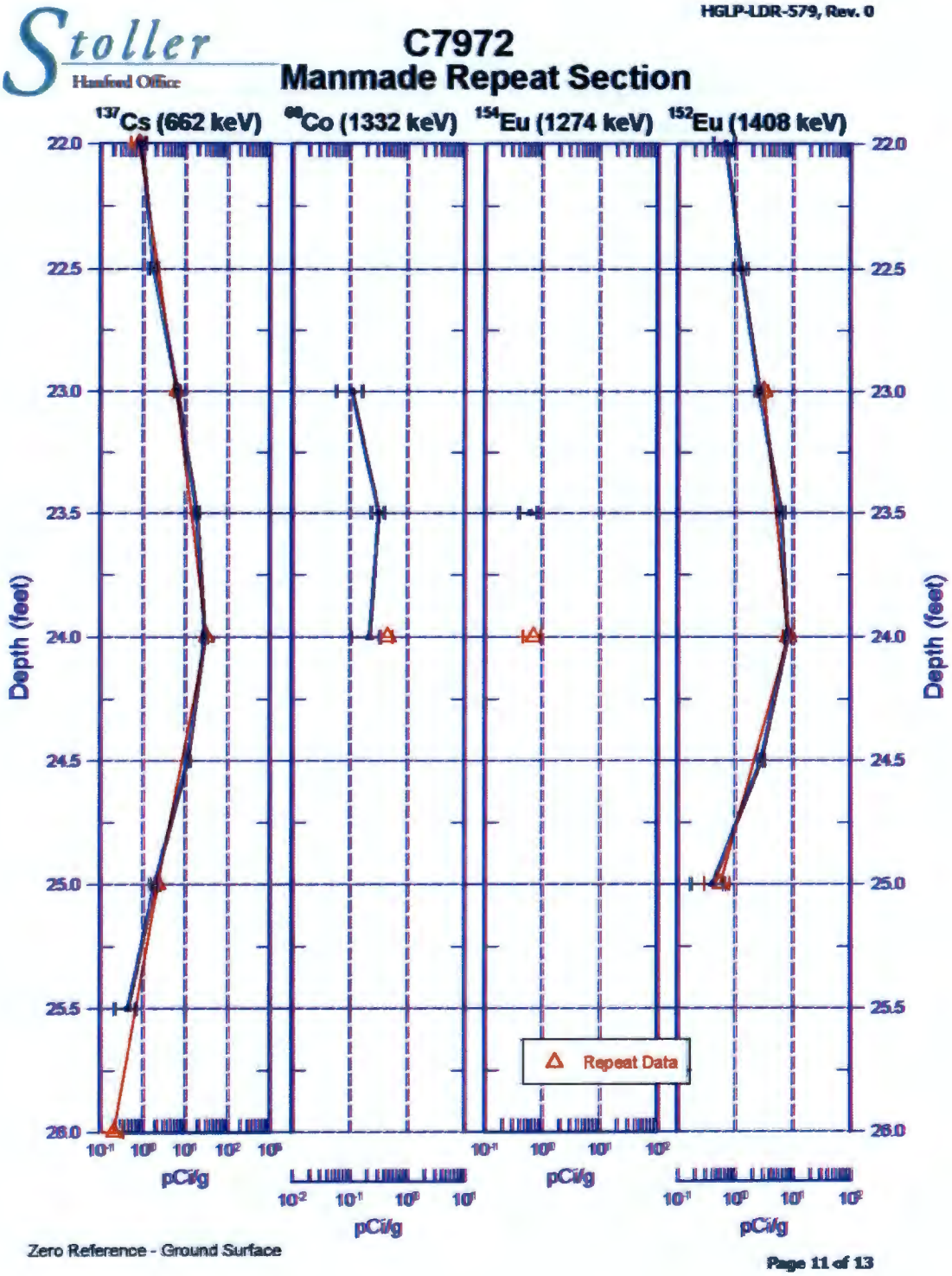
Stoller Hanford Office

C7972

Total Gamma & Hanford Gamma Unit



Reference - Ground Surface cps (log scale)


HGLP-LDR-579, Rev. 0
Stoller
Hanford Office
C7972
Manmade Repeat Section
137Cs (662 keV)
60Co (1332 keV)
154Eu (1274 keV)
152Eu (1408 keV)
Depth (feet)
22.0
22.5
23.0
23.5
24.0
24.5
25.0
25.5
26.0
pCi/g
Repeat Data
Zero Reference - Ground Surface
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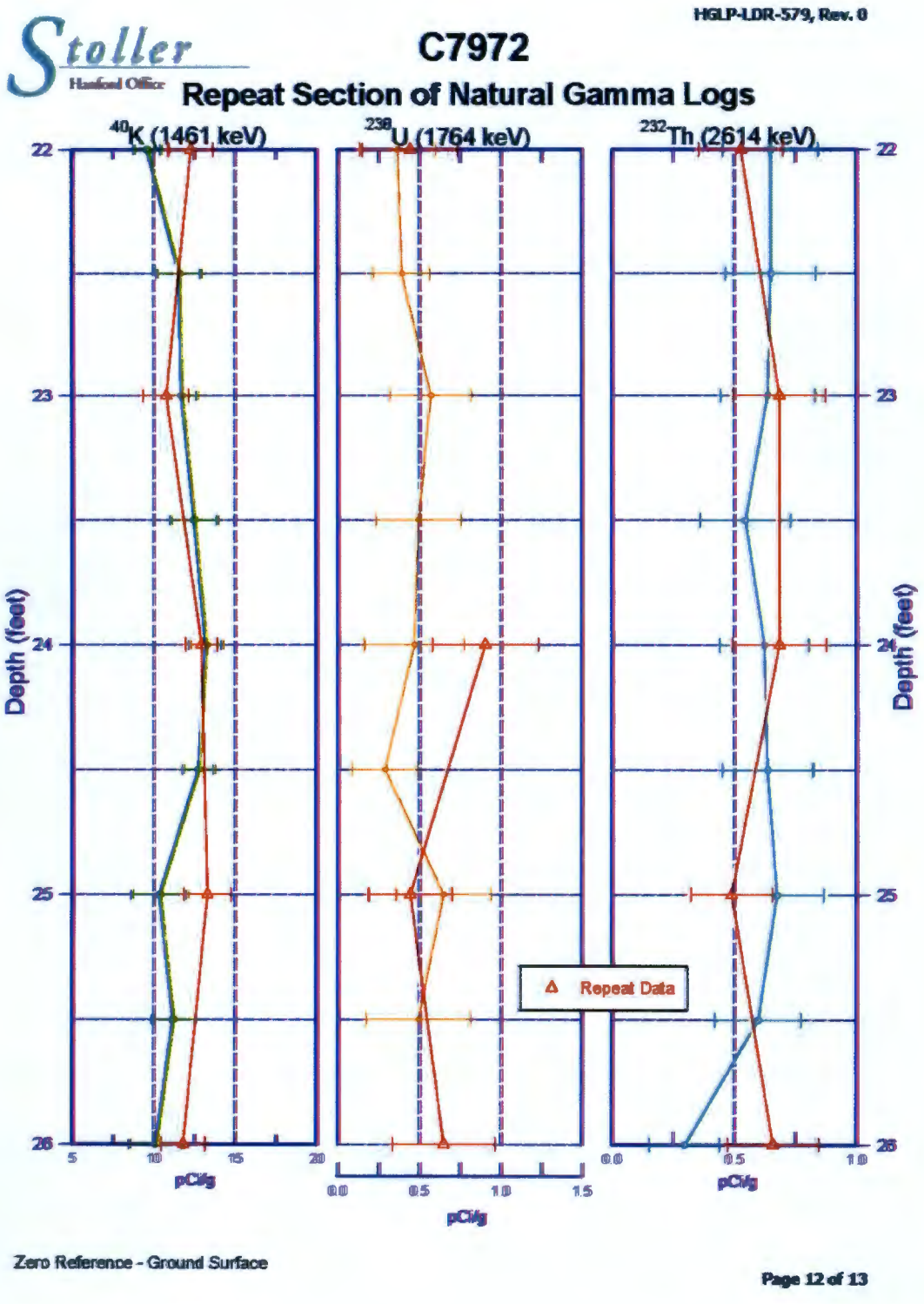
HGLP-LDR-579, Rev. 0
Stoller
Hanford Office
C7972
Repeat Section of Natural Gamma Logs
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Depth (feet)
22
23
24
25
26
5
10
15
20
0.0
0.5
1.0
1.5
pCi/g
Repeat Data
Zero Reference - Ground Surface
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