

BHI-01607
Rev. 0

**Borehole Summary Report
for Boreholes C3103 and
C3104, and Drive Casings
C3340, C3341, C3342,
C3343, and C3344, in the
216-B-38 Trench and 216-
B-7A Crib, 200-TW-2 Tank
Waste Group Operable
Unit**

*Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Environmental Restoration*

Submitted by: Bechtel Hanford, Inc.

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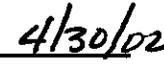


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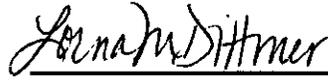


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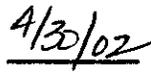


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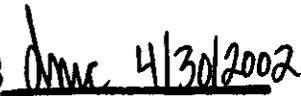
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**Borehole Summary Report for
Boreholes C3103 and C3104, and Drive
Casings C3340, C3341, C3342, C3343,
and C3344, in the 216-B-38 Trench and
216-B-7A Crib, 200-TW-2 Tank Waste
Group Operable Unit**

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April 2002

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ACRONYMS

bgs	below ground surface
ERC	Environmental Restoration Contractor
HEPA	high-efficiency particulate air (filter)
OD	outside diameter
OU	operable unit
RI/FS	remedial investigation/feasibility study
SST	single-shell tank

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
<i>If You Know</i>	<i>Multiply By</i>	<i>To Get</i>	<i>If You Know</i>	<i>Multiply By</i>	<i>To Get</i>
Length			Length		
inches	25.4	millimeters	millimeters	0.039	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	1.609	kilometers	kilometers	0.621	miles
Area			Area		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			Mass (weight)		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			Volume		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			Temperature		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			Radioactivity		
picocuries	37	millibecquerel	millibecquerels	0.027	picocuries

1.0 INTRODUCTION

This report summarizes the characterization activities performed to collect soil samples, to better define stratigraphy, to assess physical properties, and to assess the nature and vertical extent of contamination at the 216-B-38 Trench and the 216-B-7A Crib as part of the remedial investigation (RI) for the 200-TW-2 Tank Waste Group Operable Unit (OU). Characterization was performed in accordance with the *200-TW-1 Scavenged Waste Group Operable Unit and 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan* (DOE-RL 2001). The work plan provides the details for characterizing the vertical extent of chemical and radiological contamination as well as physical conditions beneath the waste sites. Data collection activities and results presented in this report will be used as supporting information to the RI report.

The locations of the 216-B-38 Trench and the 216-B-7A Crib are shown in Figure 1-1. Other documents prepared to support field activities include the following:

- *Preliminary Hazard Classification for Sampling and Characterization Activities to be Conducted at the 216-B-7A Crib, the 216-T-26 Crib, and the 216-B-38 Trench* (BHI 2001e)
- *216-B-7A Crib, 216-T-26 Crib, and 216-B-38 Trench Criticality Evaluation, 0200X-CE-N0002* (BHI 2001b)
- *216-B-7A Crib Criticality Evaluation, 0200X-CE-N0002* (BHI 2001c)
- *Site Specific Health and Safety Plan; 200-TW-1 & TW-2 Site Characterization, 0200X-SSHS-G0003* (BHI 2001i)
- *Radiological Work Permit, GW-136* (BHI 2001f)
- *Radiological Work Permit, GW-138* (BHI 2001g)
- *Environmental Program ALARACT Demonstration for Drilling* (WDOH 2001)
- *200-TW-2 Tank Waste Group Operable Unit Facility Investigation/Corrective Measures Study Waste Control Plan* (BHI 2001a)
- *Remedial Investigation Data Quality Objectives Summary Report for the 200-TW-1 Scavenged Waste Group and 200-TW-2 Tank Waste Group Operable Units* (BHI 2000).
- *Data Quality Objectives Summary Report for 200-TW-1 and 200-TW-2 Waste Designation* (BHI 2001d)
- *Results of the Geophysical Investigations at the 216-T-26 Crib, 216-B-7A Crib, and the 216-B-38 Trench and Associated Burial Ground* (BHI 2001h).

To promote efficient use of resources during the remedial investigation, the Environmental Restoration Contractor (ERC) 200 Area Remedial Action Project teamed with other ERC projects and other Hanford Site contractors to obtain samples in support of several activities. Integration was achieved by identifying vadose zone and groundwater needs in a common work document and conducting the field investigation as a coordinated effort between the core projects of the Groundwater/Vadose Zone Integration Project. The details of the integration effort are specified in Appendix A of the 200-TW-1 and 200-TW-2 RI/FS work plan (DOE-RL 2001), and are summarized in this document.

1.1 BACKGROUND

The 200-TW-2 waste sites received tank waste from first- and second-cycle decontamination processes associated with the bismuth-phosphate process at the B and T Plants. These tank wastes contained inorganic anions and cations as well as low levels of radionuclides (DOE-RL 2001).

The 216-B-38 Trench is an inactive waste site located north of B Plant and west of the 241-BX Tank Farm. The trench, active only in July 1954, received 1,430,000 L (380,000 gal) of high-salt, neutral/basic first-cycle supernatant waste from the 221-B Building via tanks 241-B-110, 241-B-111, and 241-B-112 (Maxfield 1979). The 216-B-38 Trench is 77 m (250 ft) long, 3 m (10 ft) wide, and 3 m (10 ft) deep (Maxfield 1979) and was deactivated by removing the above-ground piping when specific retention was reached (Maxfield 1979). Compounds in the liquid disposed to this site include fluoride, nitrate, nitrite, phosphate, sodium aluminate, sodium hydroxide, sodium silicate, and sulfate-based compounds from the bismuth/phosphate campaign. Radionuclides contained in the waste stream at the time of discharge included 510 Ci of cesium-137, 1,900 Ci of strontium-90, 560 Ci of ruthenium-106, 1.2 g of plutonium, and 42 kg of uranium (Maxfield 1979). In October 1982, the trench was surface stabilized with 0.6 m (2 ft) of clean topsoil and treated with an herbicide.

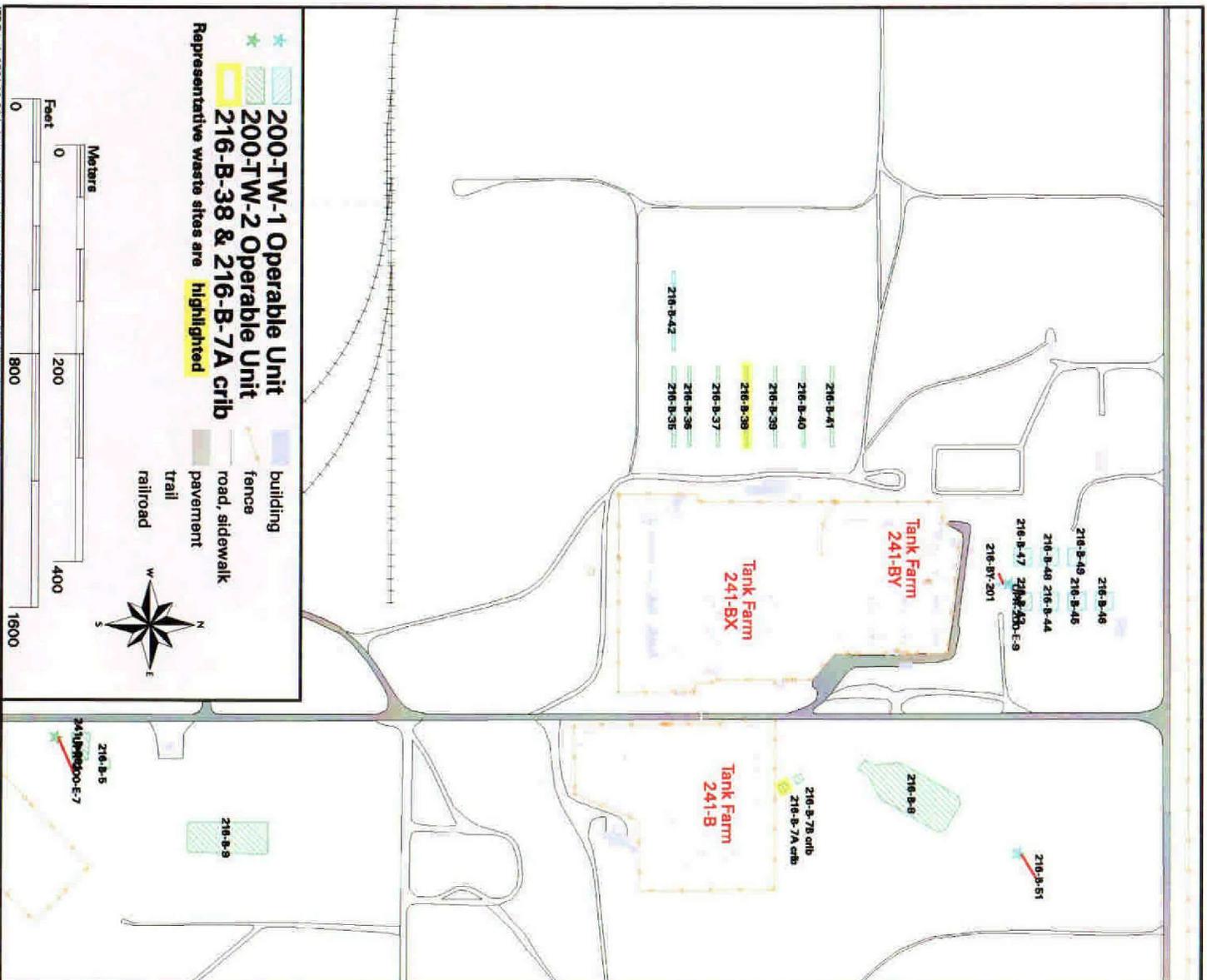
The 216-B-7A&B Cribs consist of two inactive wooden cribs, approximately 6 m (20 ft) apart, located 30 m (100 ft) north of the 241-B Tank Farm. The cribs operated from September 1946 to May 1967 and received a total volume of 43,600,000 L (11,500,000 gal) of waste (Maxfield 1979). From October 1946 to August 1948, these cribs received overflow from single-shell tank (SST) 241-B-201 (a settling tank). The waste included second-cycle waste from the 221-B Building, lanthanum/fluoride process waste from the 224-B Building, and cell drainage and other liquid waste (low salt, alkaline, radioactive liquid) via cells 5 and 6 in the 221-B Building. Tank 241-B-201 was taken out of service in October 1948 because it was nearly filled with sludge from 221-B Building and 224-B Concentration Facility wastes. SSTs 241-B-202 through 241-B-204 were connected in series and began flowing into the cribs in December 1948. After August 1948, lanthanum/fluoride process waste from the 224-B Building was disposed directly to the cribs until October 1961. From December 1954 to October 1961, the unit received cell 5 and 6 drainage and equipment cleanout waste from the 224-B Concentration Facility. From October 1961 to May 1967, material disposed in these cribs consisted of decontamination construction waste from the 221-B Building. The cribs became inactive in 1967 (Brown and Ruppert 1950, WHC 1991).

The 216-B-7A&B Cribs are in line with an 8-cm (3-in.) steel inlet pipe that supplied waste to both cribs simultaneously. Each crib is a 4- by 4- by 1.2-m (12- by 12- by 4-ft) hollow (i.e., not gravel-filled) wooden structure made of 15- by 15-cm (6- by 6-in.) timbers, placed in a 4.2- by 4.2- by 4.2-m (14- by 14- by 14-ft) deep excavation. Figure 2-16 of the work plan illustrates the construction of the cribs. Both cribs are classified as having cave-in potential.

Radionuclides contained within the waste streams discharged to the cribs included cesium-137, ruthenium-106, strontium-90, uranium, plutonium, and americium-241 (potentially at transuranic levels) (Brown et al. 1990). Approximately 22,300,000 L (5,890,000 gal) of waste were jetted to the 241-B-201 through 241-B-204 SSTs between 1947 and 1950 from B Plant. An estimated 10 g of plutonium and 20 g of Ci fission products were sent from the 241-B-201 and 241-B-202 SSTs to the cribs (Brown and Ruppert 1950). Approximately 21,470,000 L (5,670,000 gal) ultimately reached the 216-B-7A&B Cribs. An additional 22,100,000 L (5,800,000 gal) of wastewater were discharged to the cribs after 1950 until they were taken out of service in 1967.

In 1992, the contaminated soil from the unplanned release 200-E-144 surface contamination area was scraped and consolidated on the 216-B-7A&B Cribs. The area was covered with approximately 0.45 to 0.61 m (18 to 24 in.) of clean backfill.

Figure I-1. Location Map of the 216-B-38 Trench and the 216-B-7A Crib.



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2.0 FIELD ACTIVITIES AND SAMPLING

This section describes characterization activities performed as part of the 200-TW-2 RI as defined in the 200-TW-1 and 200-TW-2 RI/FS work plan (DOE-RL 2001). The primary objective of the field effort was to characterize the nature and vertical extent of contamination in the vadose zone underlying the 216-B-7A Crib and the 216-B-38 Trench. Drilling, surface and borehole geophysical surveys, and sampling and analysis of soil samples were conducted during the RI. Five drive casing holes were installed at the 216-B-38 Trench and logged. Two vadose boreholes were drilled (one at each waste site); sampled for nonradiological, radiological, and physical property analyses during the field investigation; and geophysically logged. Field activities commenced June 29, 2001, with the installation of drive casings for geophysical logging at the 216-B-38 Trench. All field activities described in this report were completed by October 2, 2001. Field activities (e.g., drilling, sampling, decontamination) were performed in accordance with BHI-EE-01, *Environmental Investigations Procedures*, unless otherwise stated.

2.1 DRIVE CASING INSTALLATIONS AND DECOMMISSIONING

Five drive casing holes (C3340 through C3344) were installed in the 216-B-38 Trench and logged with a spectral gamma tool to identify the area of highest radiological contamination. The casing were also logged with a neutron-neutron tool to identify areas of high moisture. This information was used to optimize the placement of the borehole in the area of highest contamination. Operations commenced June 29, 2001 with the installation of the drive casings, and were completed August 31, 2001 after the final drive casing was decommissioned. Drive casing installation and decommissioning activities were performed in accordance with *Washington Administrative Code 173-160*.

The five drive casing holes were installed using a diesel hammer drill rig. The 6.625-in. (16.8-cm) outside-diameter (OD) casing was driven to total depth of 60 ft (18.3 m) at each location. The casing was equipped with a specially-constructed drive tip fabricated for this project. The tip was disconnected prior to pulling the casing from the drive casing hole. No drill cuttings were generated. This method allowed the installation of a hole for logging purposes without worker exposure and waste management issues associated with normal drilling where drill cuttings are brought to the surface. Drive casing geophysical logging is described in Section 2.5. No water was added to any of the holes to facilitate the driving of the casing.

The drive casing holes were backfilled with bentonite and cement after total depth was reached. As casing was removed from each borehole, granular bentonite pellets were placed from approximately 3 to 60 ft (0.91 to 18.3 m) below ground surface (bgs). A cement seal was placed from a depth of approximately 2 to 3 ft (0.61 to 0.91 m). A gravel drill pad extends from approximately 2 ft (0.61 m) to the surface. A cement cap with a brass marker showing the well name and decommissioning date marks the location of each of these drive casing holes. A typical as-built drawing of the drive casing holes is shown in Figure 2-1. Drilling information is summarized in Table 2-1.

Field Activities and Sampling

2.2 BOREHOLE DRILLING AND DECOMMISSIONING

2.2.1 216-B-38 Trench

One vadose borehole (C3104) was drilled through the 216-B-38 Trench to a total depth of 263.5 ft (80.3 m) bgs (Figure 2-2). Operations commenced on July 31, 2001 with the initiation of drilling and were completed on September 12, 2001 after the boring was decommissioned. Drilling operations were conducted at night to minimize heat-associated stress to workers. Soil sampling and borehole geophysical logging associated with drilling are described in Sections 2.3 and 2.6, respectively.

Borehole C3104 was drilled using the cable tool method. Drive barrel and split-spoon sampling were used to advance the borehole to total depth. No water was added to the borehole during drilling activities. Temporary threaded carbon steel casings were used to assist in the drilling process. The casings were used to minimize downhole cross contamination, to keep the hole open, and to ream the borehole to a larger size. Temporary telescoping casings were set at depths of 58 ft (17.7 m), 111 ft (33.8 m), and 259.6 ft (79.1 m) bgs. The temporary casings were removed from the borehole during decommissioning. The outside diameter of the three casing strings and size of the borehole were 11.75 in. (29.8 cm), 8.625 in. (21.9 cm), and 6.625 in. (16.8 cm), respectively. Casing was not used in the borehole from 259.6 to 263.5 ft (79.1 to 80.3 m) bgs. In this zone, the size of the borehole (5 in. [11.2 cm]) corresponds to the size of the split-spoon sampler.

Borehole C3104 was decommissioned on September 12, 2001. As the temporary casing was removed, the borehole was filled with the following materials:

- Sand - 262.1 to 252.9 ft (79.9 to 77.1 m) bgs
- Cement - 252.9 to 236.5 ft (77.1 to 72.1 m) bgs
- Bentonite - 236.5 to 2.5 ft (72.1 to 0.76 m) bgs
- Cement - 2.5 to 2.0 ft (0.76 to 0.61 m) bgs.

A cement cap with a brass marker showing the well name and decommissioning date mark the location of this borehole. Drilling information is summarized in Table 2-1. Investigation-derived waste generated during the drilling activities is summarized in Table 2-2. An as-built of the borehole is shown in Figure 2-3.

2.2.2 216-B-7A Crib

One vadose borehole (C3103) was drilled through the 216-B-7A Crib to a total depth of 222.5 ft (67.8 m) bgs (Figure 2-4). The drilling of borehole C3103 commenced on August 21, 2001 with the initiation of drilling, and was completed on October 2, 2001 after the borehole was decommissioned. Drilling operations were conducted at night from August 21, 2001 through September 10, 2001, to minimize heat-associated stress to workers. Day shift drilling commenced on September 11, 2001, when the weather was cooler and the drilling had progressed past the zone of high contamination.

Field Activities and Sampling

Borehole C3103 was drilled with both cable tool and diesel hammer drill rigs. The borehole was drilled to an initial depth of 56.5 ft (17.2 m) with a cable tool rig. The 6.625-in. (16.8-cm) OD casing, split-spoon samplers, and a drive barrel were used to advance the borehole to this depth. This portion of the borehole was backfilled to the surface with silica sand after reaching a depth of 56.5 ft (17.2 m) and the 6.625-in. (16.8-cm) casing was removed. The cable tool rig was moved off the borehole and replaced with a diesel hammer drill rig.

The diesel hammer (i.e., pile driver) was used to drive an outer string of 11.75-in. (29.8-cm) OD casing and an inner string of 4.5-in. (11.4-cm) OD casing with a drive point. This method was used to limit the quantity of highly contaminated soils removed from the borehole (located immediately below the crib) while allowing casing downsizing in accordance with state regulations. The crew attempted to drive the casing strings back to the initial depth of 56.5 ft (17.2 m). Attempts to reach the targeted depth were unsuccessful. The total depth reached with the drive point was 32 ft (9.7 m). At this depth, the 4.5-in. (11.4-cm) OD inner casing string and drive point were removed from the borehole.

The cable tool drill rig was then moved back on site and used to advance the borehole to a total depth of 222.5 ft (67.8 m). The drive barrel and split-spoon samplers were used to advance the borehole to total depth. No water was added to the borehole during drilling activities. Temporary threaded carbon steel casings were used to assist the drilling process. The temporary telescoping casings were set at depths of 50.7 ft (15.4 m), 130.5 ft (39.8 m), and 218.0 ft (66.5 m) bgs with the cable tool rig. The temporary casings were removed during the decommissioning of the borehole. The OD of the three casing strings and size of the borehole were 11.75 in. (29.8 cm), 8.625 in. (21.9 cm), and 6.625 in. (16.8 cm), respectively. Casing was not used in the borehole from 218 to 222.5 ft (66.5 to 67.8 m) bgs. In this zone, the size of the borehole (5 in. [11.2 cm]) corresponds to the size of the split-spoon sampler.

Borehole C3103 was decommissioned on October 2, 2001. As the temporary casing was removed, the borehole was filled with the following materials:

- Bentonite - 222.5 to 3.3 ft (76.8 to 1.0 m) bgs
- Cement - 3.3 to 2.0 ft (1.0 to 0.7 m) bgs.

A cement cap with a brass marker showing the well name and decommissioning date mark the location of this borehole. Drilling information is summarized in Table 2-1. Investigation-derived waste generated during the drilling activities is summarized in Table 2-2. An as-built drawing of the borehole is shown in Figure 2-5.

2.3 SAMPLING AND ANALYSIS

Samples were collected in accordance with the work plan and applicable procedures. Sampling activities are documented in logbooks EL-1518 and 1518-1. Samples from the upper zones of the borehole, where contamination levels were expected to be high, were collected inside a

Field Activities and Sampling

glovebag that was placed inside a contamination-control structure. The glovebag was fitted with a high-efficiency particulate air (HEPA) vacuum unit.

2.3.1 Field Screening and Measurements

Soil samples were screened in the field prior to sample collection for indications of contamination, to assist in selecting sample points, to support worker health and safety, and for shipping documentation. Samples were screened for alpha and beta-gamma activity. Radiological screening was performed by a radiation control technician using an E-600 ratemeter with a SHP380-A/B scintillation probe and a dose meter. Radiological activity greater than two times background was used as an indication of contamination. Background was determined by measuring the activity at ground surface adjacent to the borehole. Mercury was also monitored at the wellhead, in the breathing zone, and on the cuttings and samples to support worker health and safety.

Bulk density measurements were taken in the field according to BHI-EE-05, *Field Screening Procedures*, Procedure 3.9, "Determination of Field Bulk Density Using a Split-Spoon Sampler." Results are presented in Section 3.0.

2.3.2 Borehole Soil Sampling and Analysis

Soil samples were collected from the boreholes and submitted to offsite laboratories for chemical and radiological analysis and determination of physical properties. All soil samples were collected according to BHI-EE-01, Procedure 4.0, "Soil and Sediment Sampling." Split-spoon sampling was the primary sampling method used for borehole sample collection. A total of 18 samples were collected from the 216-B-38 boring and 22 samples from the 216-B-7A boring, including quality assurance/quality control samples and physical property samples. Lionville Laboratory (formerly RECRA) of Lionville, Pennsylvania, and Eberline Services (formerly TMA) of Richmond, California, were the primary chemical and radiological laboratories, respectively. Severn Trent Laboratory of Richland, Washington, and St. Louis, Missouri, was the split laboratory. Laboratory physical property analyses were performed by Maxim Technologies of St. Louis, Missouri. A total of 22 samples were collected from the 216-B-7A Borehole at 10 ft (3 m) intervals in support of the tank farm vadose zone project. These archive samples were primarily collected from the contents of the drive barrel. These samples were relinquished to the PNNL for archive. Five samples were also collected from this borehole in the zone of highest contamination to support the Science and Technology Project.

Sample numbers, depths, and analytes are listed in Tables 2-3 and 2-4. Samples were collected according to the sample schedule identified in Appendix A of the sampling and analysis plan (DOE-RL 2001) with the following exceptions:

- Slight adjustment in sample depth in the field to account for field conditions
- The physical property sample at 216-B-38 Trench in the Hanford formation/Plio-Pleistocene unit (?). Gravel was attempted at 261 to 263.5 ft (79.6 to 80.3 m) bgs but was not collected, due to insufficient recovery in the split-spoon sampler.

Field Activities and Sampling

A surface sample was also collected from 0 to 6 in. (0 to 15 cm) at each borehole location and analyzed for chloro-herbicides to support waste designation.

2.3.3 Air Monitoring/Sampling

Air sampling was conducted in accordance with the *Environmental Program ALARACT Demonstration for Drilling* (WDOH 2001) to verify that contamination did not migrate from the waste site. Existing near-facility stations (N967, N973, and N976) in the 200 East Area were used during the characterization activities. The Washington State Department of Health was notified and agreed to this plan prior to the initiation of the drilling activities as required for high-risk drilling sites in the ALARACT (WDOH 2001). Data from these stations will be included as part of the annual near-field environmental monitoring report.

2.3.4 Integration Sampling

Additional soil samples were collected as specified in the work plan for the Science and Technology Project to support plutonium and other contaminant studies. These samples are listed in Table 2-5. In addition, samples were collected for CH2M Hill Hanford Group, Inc. to support tank farm vadose zone studies. These samples are also identified in Table 2-5.

2.4 BOREHOLE GEOLOGICAL LOGGING

Drill cuttings were logged by a geologist to describe the subsurface soils, identify changes in lithology, support sample collection locations, and provide detailed information for correlation with geophysical logging and analytical results. A detailed description is provided in Section 3.1. The geologic log is provided in Appendix A.

2.5 DRIVE CASING GEOPHYSICAL LOGGING

Borehole geophysical logging was performed in the five drive casing holes at the 216-B-38 Trench. The logging was performed in July 2001. Spectral gamma and neutron-neutron moisture surveys were run. On drive casing holes C3340, C3341, and C3342, the high-rate logging system was used in zones with high contaminant concentrations. A detailed report of logging operations is provided in Appendix B. The report includes a summary of the calibration requirements, processing of the data, and log results.

2.6 BOREHOLE GEOPHYSICAL LOGGING

Borehole geophysical logging (spectral gamma and neutron-neutron moisture) was performed in boreholes C3103 and C3104. The logging was optimized so that data were collected only through a single casing thickness. Logging was performed during August and September. A detailed report of logging operations is provided in Appendix B.

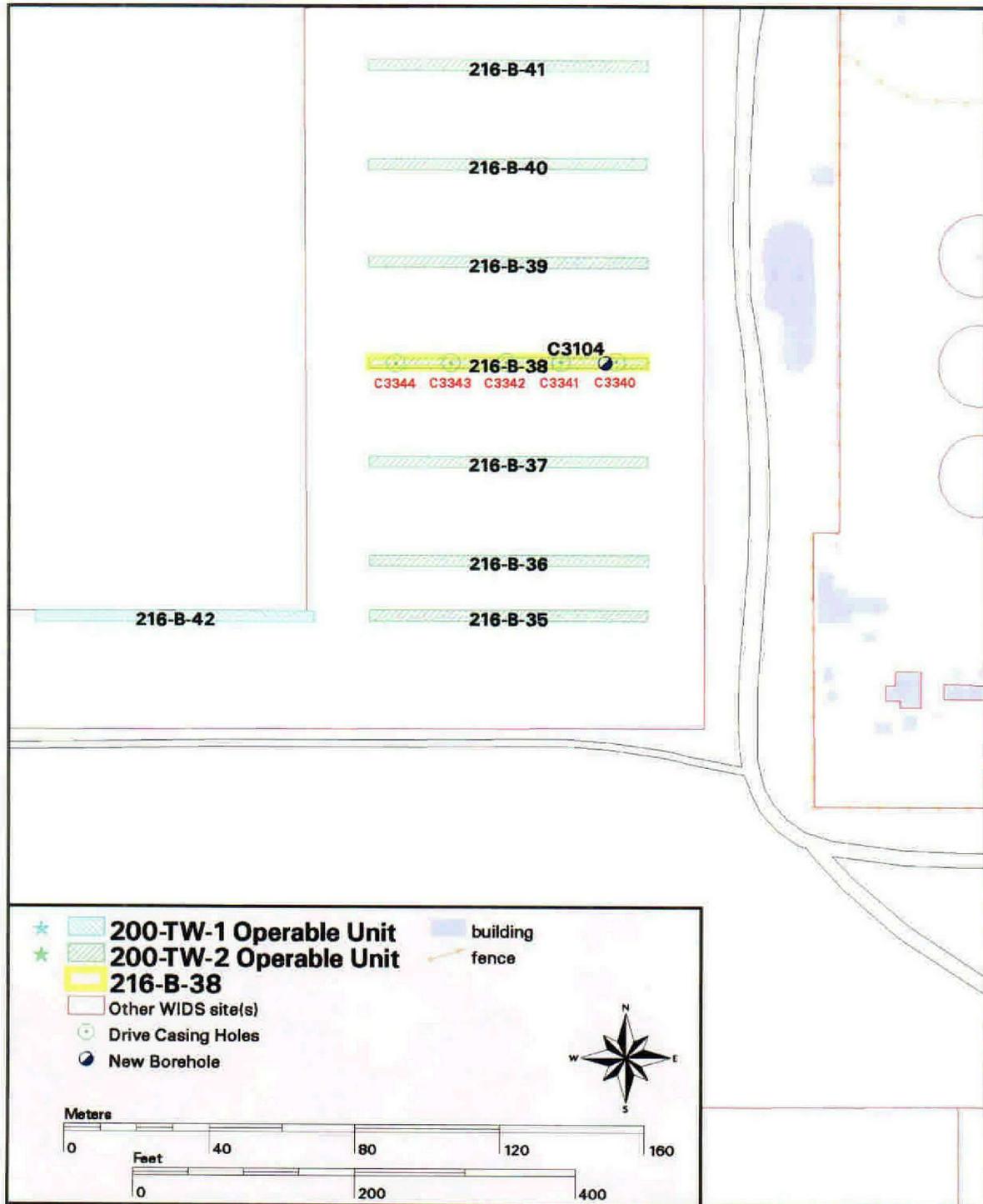
Field Activities and Sampling

2.7 OTHER ACTIVITIES

Surface geophysical surveys were conducted at each site prior to excavation using ground-penetrating radar. The surveys were performed to verify the location of waste sites and identify potential underground hazards prior to excavating. Several sample locations were adjusted based on the findings of these surveys. The surface geophysical survey report is presented in Appendix C.

The borehole locations were surveyed according to BHI-EE-01, Procedure 1.6, "Survey Requirements and Techniques." Coordinates were recorded using the North American Vertical Datum of 1988 (NAVD 1988) and the Washington State Plane (South Zone) North American Datum of 1983 (NAD 1983) with the 1991 adjustment for horizontal coordinates. Survey data are presented in Table 2-1.

Figure 2-2. Location of 216-B-38 Trench Drive Casings and Borehole.



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Figure 2-1. Typical As-Built Drawing of the 216-B-38 Trench Drive Casings (C3340 to C3344).

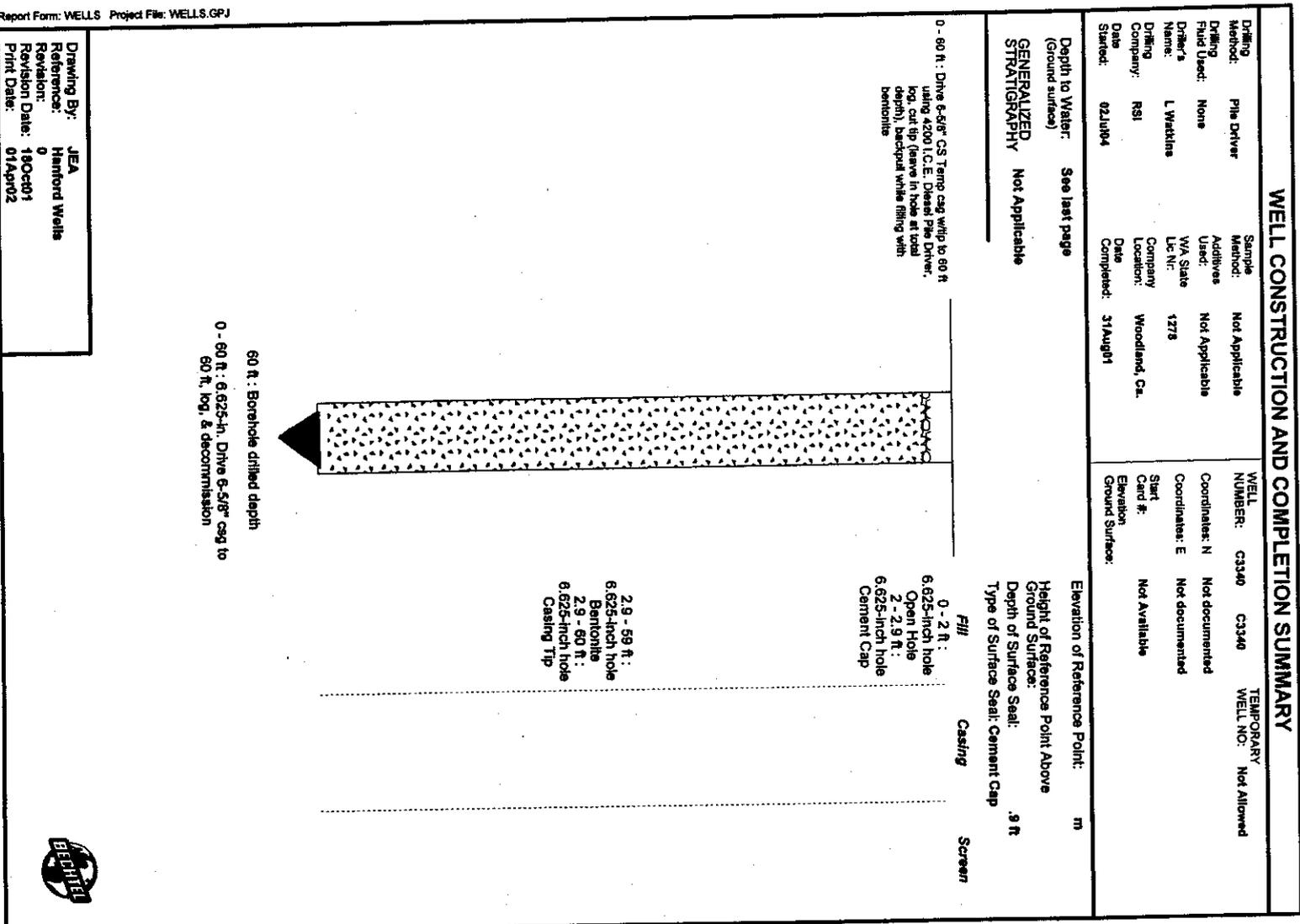
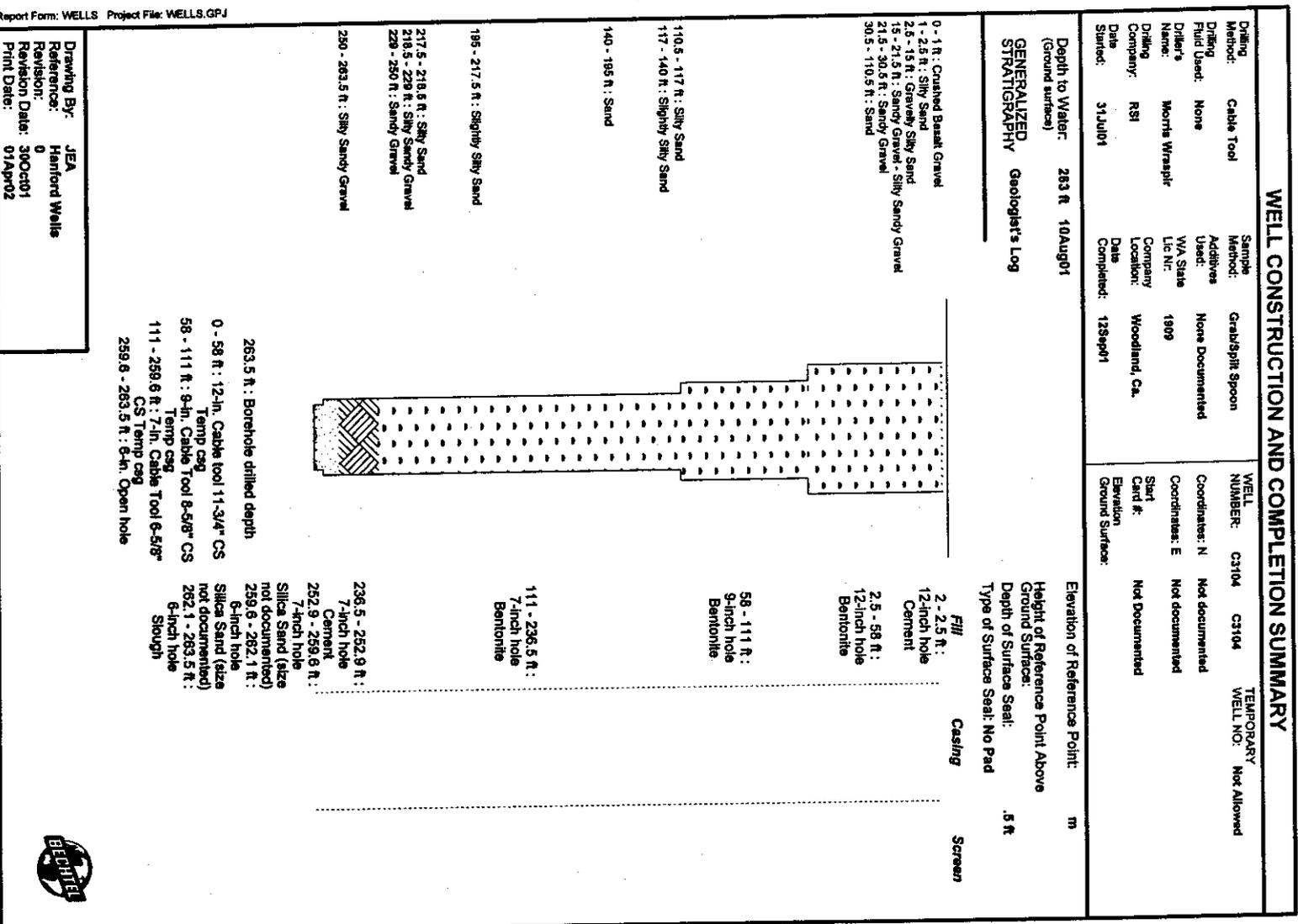


Figure 2-3. As-Built Drawing of the 216-B-38 Trench Borehole (C3104).

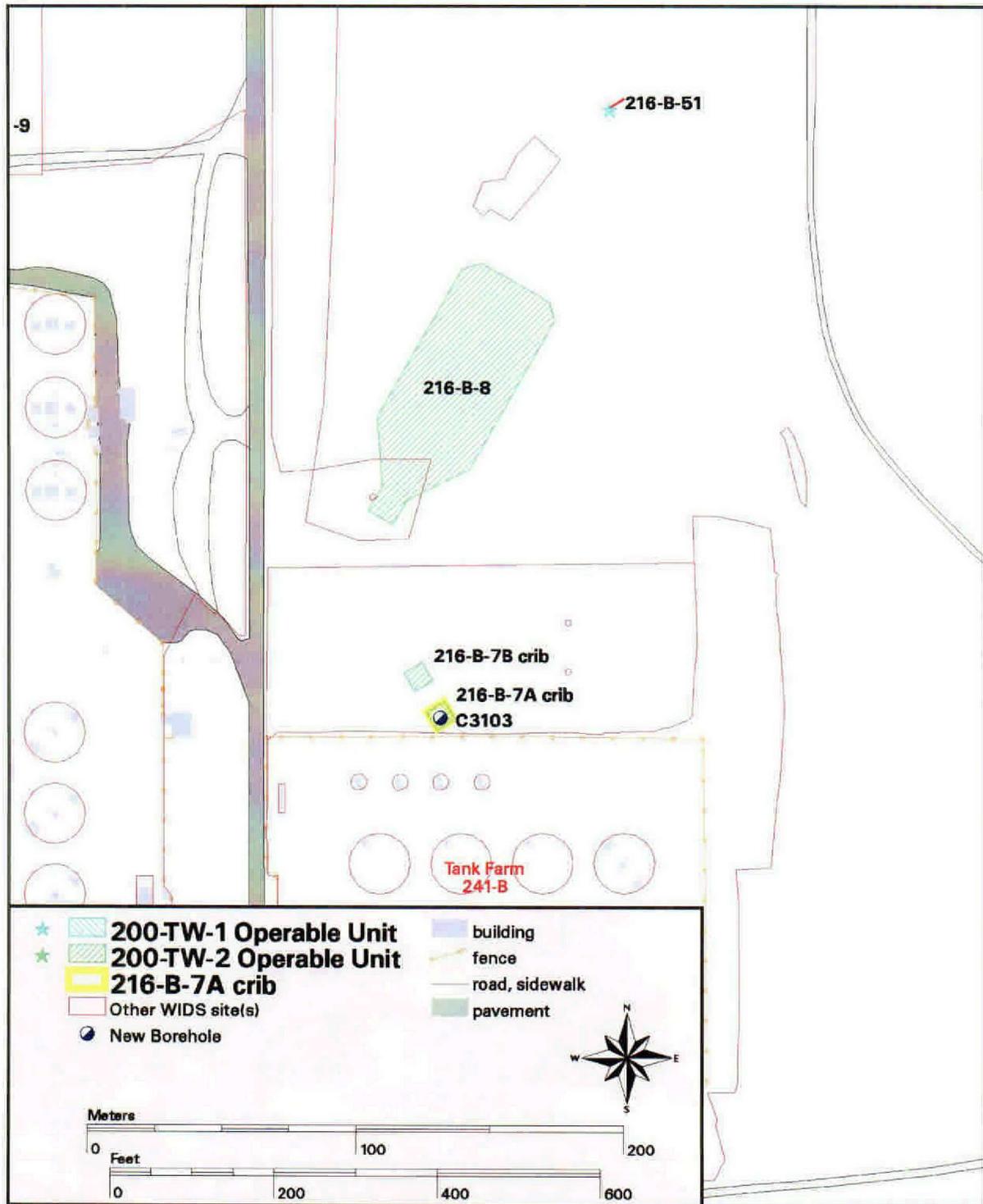


Report Form: WELLS Project File: WELLS.GPJ

Drawing By: JEA
 Reference: Hanford Wells
 Revision: 0
 Revision Date: 30Oct01
 Print Date: 01Apr02



Figure 2-4. Location Map of the 216-B-7A Crib Borehole (C3103).



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Figure 2-5. As-Built Drawing of the 216-B-7A Crib Borehole (C3103).

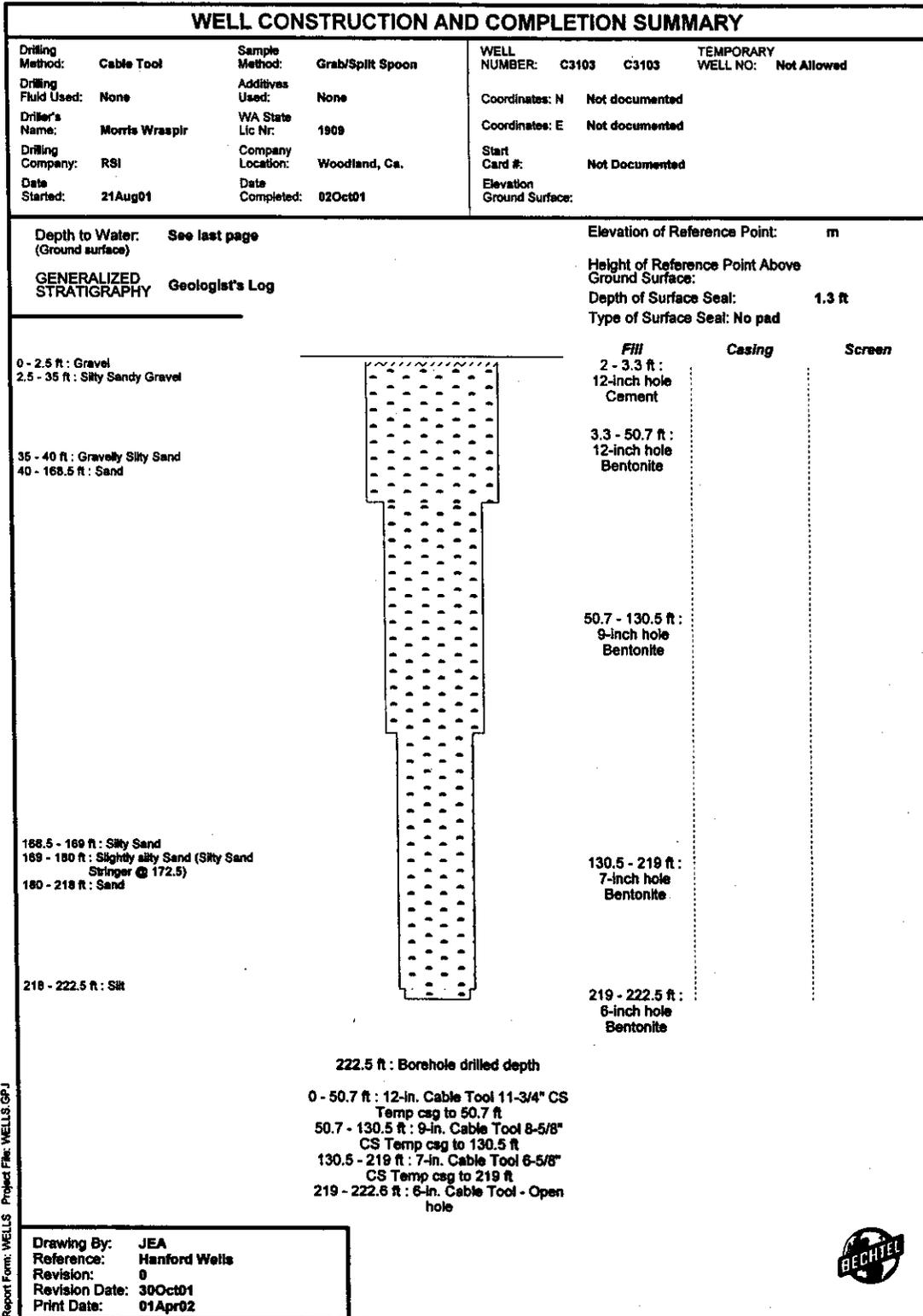


Table 2-1. Summary of Drilling Activities.

Borehole Name/Well Number	216-B-38	216-B-7A Crib
Drilling start date	6/29/01	8/21/01
Drilling end date	9/12/01	9/23/99
Total depth of borehole	18.3 m (60 ft) – drive casing boreholes 80.3 m (263.5 ft) – cable tool boring	67.8 m (222.5 ft)
Static water level, bgs (date)	80.1 m (236 ft) on 8/10/01	NA
Washington Coordinate System of 1983, south zone (1991)	N: 137347.64 m (450615.62 ft) E: 573471.18 m (1881467.13 ft)	N: 137385.58 m (450651.51 ft) E: 573802.55 m (1882554.30 ft)
Elevation of brass cap (NAVD88)	201.990 m (662.70 ft)	198.974 m (652.81 ft)
Decommission/well completion date	9/13/01	10/01/01
Number of investigation-derived waste drums generated	37	46

NA = not applicable

Table 2-2. Summary of Investigation-Derived Waste Generated During the 200-TW-2 Remedial Investigation. (4 Pages)

Drum Number	Package Date	Source ID	Depth Interval, ft bgs	Waste Description
200E-01-0013	07/12/01	216/B-38 Trench	NA	Soils, aggregate, ethylene glycol
200E-01-0014	08/02/01	C3104	NA	Soils and MSW (plastic, cloth)
200E-01-0015	08/03/01	C3104	21 - 26	Soils and MSW (plastic, cloth)
200E-01-0016	08/03/01	C3104	26 - 31.5	Soils and MSW (plastic, cloth)
200E-01-0018	08/02/01	C3104	NA	Soils and MSW (plastic, cloth)
200E-01-0019	08/02/01	C3104	17 - 21	Soils and MSW (plastic, cloth)
200E-01-0020	08/03/01	C3104	31.5 - 36	Soils and MSW (plastic, cloth)
200E-01-0021	08/03/01	C3104	36 - 40	Soils and MSW (plastic, cloth)
200E-01-0022	08/05/01	C3104	28 - 32	Soils and MSW (plastic, cloth)
200E-01-0055	08/06/01	C3104	32 - 36	Soils and MSW (plastic, cloth)
200E-01-0056	08/06/01	C3104	45 - 51.5	Soils and MSW (plastic, cloth)
200E-01-0057	08/06/01	C3104	57 - 67	Soils and MSW (plastic, cloth)
200E-01-0058	08/07/01	C3104	NA	MSW (plastic, paper, cloth, rubber)
200E-01-0059	08/07/01	C3104	67 - 79	Soils
200E-01-0060	08/07/01	C3104	79 - 89	Soils

Field Activities and Sampling

Table 2-2. Summary of Investigation-Derived Waste Generated During the 200-TW-2 Remedial Investigation. (4 Pages)

Drum Number	Package Date	Source ID	Depth Interval, ft bgs	Waste Description
200E-01-0061	08/07/01	C3104	89 - 98	Soils
200E-01-0062	08/07/01	C3104	98 - 106	Soils
200E-01-0063	08/07/01	C3104	106 - 118	Soils and MSW (cloth)
200E-01-0064	08/07/01	C3104	118 - 139	Soils
200E-01-0065	08/08/01	C3104	4139 - 159	Soils
200E-01-0066	08/08/01	C3104	159 - 176	Soils
200E-01-0067	08/09/01	C3104	176 - 198	Soils
200E-01-0068	08/09/01	C3104	198 - 217	Soils
200E-01-0069	08/07/01	C3104	217 - 240	Soils
200E-01-0070	08/09/01	C3104	NA	MSW (cloth, metal, rubber, paper)
200E-01-0071	08/10/01	C3104	240 - 263.5	Soils
200E-01-0073	08/16/01	C3341	NA	MSW (paper, plastic, rubber, cloth)
200E-01-0077	08/08/01	C3104	NA	MSW (plastic, HEPA filter)
200E-01-0100	09/04/01	C3104	NA	MSW (plastic, cloth)
200E-01-0101	08/30/01	C3104	NA	MSW (plastic, cloth)
200E-01-0106	09/18/01	C3104	NA	Carbon steel core barrel/pallet
200E-01-0109	09/18/01	C3104	NA	Carbon steel well casing 4 in. x 5 ft = 9 pieces/ pallet
200E-01-0110	09/18/01	C3104	NA	Carbon steel well casing 4 in. x 5 ft = 9 pieces/ pallet
200E-01-0111	09/18/01	C3104	NA	Carbon steel well casing 4 in. x 5 ft = 9 pieces/ pallet
200E-01-0112	09/18/01	C3104	NA	Carbon steel well casing 4 in. x 5 ft = 9 pieces/ pallet
200E-01-0113	09/18/01	C3104	NA	Carbon steel well casing 4 in. x 5 ft = 9 pieces/ pallet
200W-01-0124	NA	C3104	NA	Purge water
200E-01-0078	08/23/01	C3103	18.5 - 25	Soil and MSW
200E-01-0079	08/23/01	C3103	25 - 35	Soil and MSW (plastic, paper, foil)
200E-01-0080	08/27/01	C3103	35 - 48	Soil and MSW (paper, cloth)
200E-01-0081	08/27/01	C3103	48 - 56	Soil and MSW (paper, cloth)
200E-01-0082	08/27/01	C3103	NA	MSW (plastic, paper, cloth, rubber)
200E-01-0083	08/27/01	C3103	NA	Stainless steel metal split spoons and MSW (paper, rubber, cloth)
200E-01-0084	09/06/01	C3103	NA	MSW from glovebag and HEPA filter (plastic, rubber, cloth)
200E-01-0085	09/06/01	C3103	NA	MSW (paper, plastic, rubber, cloth)

Field Activities and Sampling

Table 2-2. Summary of Investigation-Derived Waste Generated During the 200-TW-2 Remedial Investigation. (4 Pages)

Drum Number	Package Date	Source ID	Depth Interval, ft bgs	Waste Description
200E-01-0086	09/06/01	C3103	NA	MSW (plastic from enclosure)
200E-01-0087	09/06/01	C3103	NA	Plastic stained w/oil and aggregate soil
200E-01-0088	08/21/01	C3103	NA	Container 200E-01-0107 with soil and HEPA debris
200E-01-0089	08/27/01	C3103	NA	MSW (plastic, cloth, paper)
200E-01-0102	08/15/01	C3103	NA	Bulk/pallet - steel drill rig cable
200E-01-0103	08/21/01	C3103	0 - 18.5	Soil and MSW
200E-01-0108	09/06/01	C3103	NA	Bulk/pallet - metal well casing 5 ft x 6 in. = 11 pieces
200E-01-0090	09/10/01	C3103	NA	MSW (plastic, cloth, paper, HEPA filter)
200E-01-0091	09/13/01	C3103	NA	MSW (paper, plastic, rubber, cloth)
200E-01-0092	09/13/01	C3103	NA	HEPA filter and MSW (paper, plastic, cloth, metal)
200E-01-0093	09/17/01	C3103	NA	MSW (plastic and cloth stained with hydraulic fluid)
200E-01-0094	09/19/01	C3103	31 - 36	Soil and MSW (plastic, metal)
200E-01-0095	09/20/01	C3103	39 - 44	Soil and MSW (plastic)
200E-01-0096	09/19/01	C3103	136 - 39	Soil and MSW (plastic)
200E-01-0097	09/20/01	C3103	44 - 46	Soil and MSW (plastic)
200E-01-0098	09/20/01	C3103	46 - 51	Soil and MSW (plastic)
200E-01-0099	09/20/01	C3103	151 - 54	Soil and MSW (plastic)
200E-01-0114	09/18/01	C3103	NA	Carbon steel (madrell, jar and drill stem) 4 in. x 16 ft
200E-01-0115	09/19/01	C3103	NA	Metal well casing and boring probe 4 in. x 5.5 ft = 6 pieces
200E-01-0116	09/20/01	C3103	NA	MSW (plastic, cloth, paper, rubber)
200E-01-0117	09/20/01	C3103	NA	MSW (plastic, cloth, paper)
200E-01-0118	09/21/01	C3103	66 - 80	Soils
200E-01-0119	09/21/01	C3103	53 - 66	Soils
200E-01-0120	09/21/01	C3103	80 - 93	Soils
200E-01-0121	09/21/01	C3103	93.5 - 104.5	Soils
200E-01-0122	09/20/01	C3103	104.5 - 114	Soils
200E-01-0123	09/24/01	C3103	114 - 127	Soils
200E-01-0124	09/24/01	C3103	127 - 137.5	Soils
200E-01-0125	09/25/01	C3103	4162 - 182	Soils
200E-01-0126	09/25/01	C3103	182 - 202	Soils

Field Activities and Sampling

Table 2-2. Summary of Investigation-Derived Waste Generated During the 200-TW-2 Remedial Investigation. (4 Pages)

Drum Number	Package Date	Source ID	Depth Interval, ft bgs	Waste Description
200E-01-0127	09/25/01	C3103	137 - 162	Soils
200E-01-0128	09/26/01	C3103	202 - 222.5	Soils and MSW
200E-01-0129	09/27/01	C3103	NA	Metal/HEPA vacuum
200E-01-0130	10/02/01	C3103	NA	MSW (cloth, rubber, plastic)
200E-01-0133	10/03/01	C3103	NA	MSW (cloth, rubber, plastic)
200E-01-0139	10/10/01	C3103	NA	Bulk/pallet – carbon steel well casing 12 in. x 5 ft = 4 pieces
200E-01-0140	10/10/01	C3103	NA	Bulk/pallet – carbon steel well casing 12 in. x 5 ft = 6 pieces
200E-01-0141	10/10/01	C3103	NA	Carbon steel well casing 8 in. x 5 ft = 2 pieces

MSW = miscellaneous solid waste

NA = not applicable

Table 2-3. Soil Samples at Borehole C3104 (216-B-38 Trench). (2 Pages)

Sample Interval		HEIS Number	Date Sampled	Analytes
Top (ft bgs)	Bottom (ft bgs)			
<i>Physical Property Samples</i>				
3.0	5.5	B12CB7	08/01/01	Moisture content, particle size
97.5	100.0	B12CB8	08/07/01	Moisture content, particle size
<i>Soil Samples</i>				
0	0.5	B12684	07/18/01	Chloro-herbicides
3.0	5.5	B12C67	08/01/01	Metals, anions, radionuclides
9.5	12.0	B12C68	08/02/01	Metals, anions, radionuclides
13.0	15.5	B12C63	08/02/01	Radionuclides
13.0	15.5	B12C63-A	08/02/01	Metals, anions
18.0	20.5	B12C64	08/02/01	Radionuclides
18.0	20.5	B12C64-A	08/02/01	Metals, anions
22.5	25.0	B12DB8	08/03/01	Radionuclides
22.5	25.0	B12DB8-A	08/03/01	Metals, anions
29.0	31.5	B12DB9	08/03/01	Radionuclides
29.0	31.5	B12DB9-A	08/03/01	Metals, anions
37.5	40.0	B12C88	08/05/01	Radionuclides
37.5	40.0	B12C88-A	08/05/01	Metals, anions
52.0	54.5	B12C69	08/06/01	Metals, anions, radionuclides

Field Activities and Sampling

Table 2-3. Soil Samples at Borehole C3104 (216-B-38 Trench). (2 Pages)

Sample Interval		HEIS Number	Date Sampled	Analytes
Top (ft bgs)	Bottom (ft bgs)			
97.5	100.0	B12C71	08/07/01	Metals, anions, radionuclides
147.5	150.0	B12C72	08/08/01	Metals, anions, radionuclides
197.5	200.0	B12C73	08/09/01	Metals, anions, radionuclides
261.0	263.5	B12C74	08/10/01	Metals, anions, radionuclides
Duplicate Samples				
52.0	54.5	B12C70	08/05/01	Metals, anions, radionuclides
37.5	40.0	B12DC0	08/05/01	Radionuclides
37.5	40.0	B12DC0-A	08/05/01	Metals, anions
Equipment Blank				
3.0	5.5	B12BW6	07/18/01	Metals, anions, VOA, semi-VOAs, gross alpha, gross beta, radionuclides; tied to B12C67

HEIS = Hanford Environmental Information System

VOA = volatile organic analyte

Table 2-4. Soil Samples at Borehole C3103 (216-B-7A Crib). (2 Pages)

Sample Interval		HEIS Number	Date Sampled	Comments
Top (ft bgs)	Bottom (ft bgs)			
Physical Properties Samples				
2.5	5.0	B12BR7	08/22/01	Moisture content, particle size
97.5	100	B12BR8	09/21/01	Moisture content, particle size
219	221.5	B12BR9	09/26/01	Moisture content, particle size
Soil Samples				
0	0.5	B12683	06/19/01	Chloro-herbicide
2.5	5.0	B12MH5	08/22/01	Metals, anions, radionuclides
5.5	8.0	B12MH6	08/22/01	Metals, anions, radionuclides
10.0	12.5	B12MH7	08/22/01	Metals, anions, radionuclides
12.5	15.0	B12MH4	08/23/01	Metals, anions, radionuclides
18.5	21.0	B12C89	08/23/01	Metals, anions, radionuclides
18.5	21.0	B12C89-A	08/23/01	Metals, anions, radionuclides
22.5	25.0	B12DC1	08/24/01	Metals, anions, radionuclides
22.5	25.0	B12DC1-A	08/24/01	Metals, anions, radionuclides
25.0	27.5	B12ML4	08/26/01	Radionuclides
25.0	27.5	B12ML4-A	08/26/01	Metals, anions
30.0	32.5	B12ML5	08/27/01	Radionuclides

Table 2-4. Soil Samples at Borehole C3103 (216-B-7A Crib). (2 Pages)

Sample Interval		HEIS Number	Date Sampled	Comments
Top (ft bgs)	Bottom (ft bgs)			
30.0	32.5	B12ML5-A	08/27/01	Metals, anions
35.0	37.5	B12ML6	08/27/01	Radionuclides
35.0	37.5	B12ML6-A	08/27/01	Metals, anions
48.0	50.5	B12ML7	08/28/01	Metals, anions, radionuclides
72.5	75.0	B12MH8	09/21/01	Metals, anions, radionuclides
97.5	100	B12MJ0	09/21/01	Metals, anions, radionuclides
147.5	150	B12MJ1	09/25/01	Metals, anions, semi-VOA, VOA, radionuclides
219	221.5	B12MJ2	09/26/01	Metals, anions, semi-VOA, VOA, radionuclides
Duplicate Sample				
72.5	75.0	B12MH9	09/21/01	Metals, anions, semi-VOA, VOA, radionuclides; replicate of B12MH5
Split Sample				
48.0	50.5	B12C91 (Sample)	08/28/01	Metals, anions, radionuclides
Equipment Blank				
264.0	265.5	B12DB4	08/10/01	Metals, anions, VOA, semi-VOA, radionuclides, gross alpha, gross beta; tied to B12MH5

Table 2-5. Summary of Integration Samples. (2 Pages)

Sample Number	Interval (ft)	Date
7A-22.0'	22	08/24/01
7A-25.0	25	08/26/01
7A-30.0	30	08/27/01
7A-35.0	35	08/27/01
7A-48	48	08/28/01
B10024 ^b	60	09/21/01
B10025	70	09/21/01
B10026	80	09/21/01
B10027	90	09/21/01
B10028	100	09/21/01
B10031	110	09/21/01
B10032	120	09/24/01
B10033	130	09/24/01
B10034	140	09/25/01
B10035	150	09/25/01

Table 2-5. Summary of PNNL Samples. (2 Pages)

Sample Number	Interval (ft)	Date
B10036	160	09/25/01
B10037	168	09/25/01
B10038	170	09/25/01
B10039	172.5	09/25/01
B10040	180	09/25/01
B10041	190	09/25/01
B10042	200	09/26/01
B10043	210	09/26/01
B10044	218	09/26/01
B10045	221.5	09/26/01
B10046	219	09/26/01
B10047	221.5	09/26/01

^a Samples collected for the Science and Technology Project.

^b Samples collected for the Tank Farm Vadose Zone Project.

PNNL = Pacific Northwest National Laboratory

3.0 RESULTS

This section describes the geology encountered during the drilling activities and presents the results of field screening and geophysical logging activities.

3.1 GEOLOGY

3.1.1 216-B-38 Trench

Borehole cuttings were logged by a geologist. Soils described as backfill material form the uppermost soil horizon at the trench. Backfill was identified from 0 to 15 ft (0 to 4.6 m) bgs and consisted mainly of crushed basalt gravel, sand, and silty sandy gravel. The trench bottom was estimated to be at 15 ft (4.6 m) bgs. Soils typical of Hanford sand- and gravel-dominated sequences lie beneath the backfill. The following stratigraphy was identified in the borehole:

- Hanford formation gravel-dominated sequence from 15 to 30.5 ft (4.6 to 9.3 m) bgs
- Hanford formation sand-dominated sequence from 30.5 to 218.5 ft (9.3 to 66.6 m) bgs
- Hanford formation/Plio-Pleistocene unit (?) from 218.5 ft (66.6 m) bgs to the bottom of the borehole (263.5 ft [80.3 m] bgs).

The water table was encountered at 263 ft (80.2 m) bgs. Figure 3-1 shows the stratigraphy for the C3104 borehole.

3.1.2 216-B-7A Crib

Borehole cuttings were logged by a geologist. Soils described as backfill material form the uppermost soil horizon at the crib. Backfill was identified from 0 to 23 ft (0 to 7 m) bgs and consisted mainly of crushed basalt gravel, sand, and silty sandy gravel. The wooden crib structure was encountered at 21 ft (6.4 m) bgs and the crib bottom is estimated to be at 23 ft (7 m) bgs. Soils typical of Hanford sand- and gravel-dominated sequences lie beneath the backfill. The following stratigraphy was identified in the borehole:

- Hanford formation gravel-dominated sequence from 23 to 35 ft (7 to 10.7 m) bgs
- Hanford formation sand-dominated sequence ranged from 35 to 218 ft (10.7 to 66.5 m) bgs
- Hanford formation/Plio-Pleistocene unit (?) silt from 218 ft (66.5 m) to the bottom of the borehole (222.5 ft [67.8 m] bgs).

The water table was not encountered in this borehole; however, drilling was suspended when nearly saturated soils were encountered at approximately 219 ft (66.8 m) bgs. Figure 3-2 shows the stratigraphy for the C3103 borehole.

Results

3.2 FIELD SCREENING RESULTS

The radiological field screening results from the drill cuttings are presented in Figures 3-1 and 3-2. Results of alpha and beta-gamma screening of the split-spoon samplers and the mercury screening are presented in Table 3-1. Mercury was detected at the 216-B-38 borehole at the top of the drill casing in the 3 to 5.5 ft (0.9 to 1.7 m) interval. Work was stopped so the health and safety implications could be assessed. Work was resumed with respirators until mercury readings were below the action level.

The radiological field screening at the 216-B-38 borehole showed elevated beta-gamma counts at samples B12C63, B12C64, B12DB8, and B12DB9 (14.5 to 25 ft [4.4 to 7.6 m] bgs). The readings were significantly elevated through this zone with dose readings as high as 6 mrem/hr of beta and 8 mrem/hr of gamma radiation. Radiological field screening is consistent with the geophysical logging results at these depths. The remainder of the field screening basically showed background levels.

The radiological field screening at the 216-B-7A borehole showed elevated beta-gamma counts at samples B12C89, B12DC1, B12ML4, B12ML5, and B12ML6 (18 to 37.5 ft [5.5 to 11.4 m] bgs). The readings were significantly elevated through this zone with dose readings as high as 1,500 mrem/hr beta and 20 mrem/hr gamma. Elevated alpha contamination was identified in samples B12ML4, B12ML5, and B12ML6 (22.5 to 37.5 ft [6.6 to 11.4 m] bgs). Readings as high as 100 mrem/hr were detected in this zone.

3.3 GEOPHYSICAL LOGGING RESULTS

3.3.1 216-B-38 Drive Casings

Cesium-137 was the only man-made radionuclide detected in the five drive casings. In drive casing C3340, cesium-137 was detected from 15 to 32 ft (4.6 to 9.8 m) bgs with the maximum of 180,000 pCi/g occurring at 23.5 ft (7.2 m) bgs.

In drive casing C3341, the highest concentrations of cesium-137 occurred between 12.5 and 28 ft (3.8 and 8.5 m) bgs with a maximum concentration of 56,186 pCi/g at 17 ft (5.2 m) bgs. A second interval of cesium-137 contamination was encountered from 29.5 to 33 ft (9.0 to 10.0 m) bgs with a maximum concentration of 6,356 pCi/g at 31.5 ft (9.6 m). Minor cesium-137 contamination was noted from 4 to 5.5 ft (1.2 to 1.7 m) with a maximum concentration of 2.57 pCi/g. Cobalt-60 was detected from 33 to 57 ft (10.0 to 17.4 m) with a maximum concentration of 0.16 pCi/g at 53 ft (16 m). The neutron moisture increased slightly between 15 and 35 ft (4.6 and 10.7 m) bgs. This corresponds to the area of high cesium-137, but also may be a result of interference with the tool from the high gamma.

In drive casing C3342, the highest concentrations of cesium-137 occurred between 13 and 33.5 ft (4.0 and 10.2 m) with a maximum concentration of 195,000 pCi/g at 16.5 ft (5.0 m) bgs. From 17.5 to 28.5 ft (5.3 to 8.7 m) bgs, the concentrations decreased to the 20,000 to 100,000 pCi/g

Results

range. From 33.5 ft (10.2 m) to the total depth of 59.5 ft (18.1 m), the concentrations decreased from over 2,000 pCi/g to about 15 pCi/g. Cobalt-60 was detected from 34 to 42 ft (10.4 to 12.8 m) bgs with a maximum concentration of 0.29 pCi/g. The neutron moisture increased slightly in the zone of high cesium-137.

In 3343, only minor cesium-137 concentrations were detected from 4.5 to 5.5 ft (1.4 to 1.7 m) bgs with a maximum of 1.2 pCi/g. Moisture increased slightly from 22 to 29 ft (6.7 to 8.8 m) bgs and below 35 ft (10.7 m) bgs. These increases correspond to an increase in concentration of naturally occurring radionuclides and may indicate a stratigraphic change with higher fines content.

In 3344, only minor cesium-137 concentrations were detected from 4.5 to 5.0 ft (1.4 to 1.5 m) bgs with a maximum of 0.8 pCi/g. Moisture increased slightly from 38 to 39 ft (11.6 to 11.9 m) bgs. This increase corresponds to an increase in concentration of naturally occurring radionuclides and may indicate a stratigraphic change with higher fines content.

3.3.2 216-B-38 Borehole

The man-made radionuclides cesium-137 and cobalt-60 were detected in borehole C3104. The high-gamma activity between 13 and 45 ft (4.0 and 13.7 m) bgs is attributed to cesium-137 activities greater than 1,000 pCi/g. High-rate logging indicates that cesium-137 reaches activities of about 100,000 pCi/g between 18 and 35 ft (5.5 and 10.7 m) bgs. In addition, cobalt-60 was observed in the intervals from 44 ft (13.4 m) through 71.5 ft (21.8 m) and at 115 ft (35.1 m) bgs at about 0.1 pCi/g. Cobalt-60 may also be present higher in the borehole but was not detected due to saturation from the high levels of cesium-137 activity. Deeper in the borehole, cesium-137 activity was observed at 217.5 ft (66.3 m) with a measured activity of about 0.2 pCi/g.

Other than the zones containing man-made radionuclides, the changes in gross gamma counts depend primarily upon changes in potassium-40 activities. There is an increase in potassium-40 from about 14 pCi/g above 12 ft (3.7 m) to about 19 pCi/g below 43 ft (13.1 m) bgs. This increase in apparent potassium-40 activity occurred within the interval of high dead time, which was due to high cesium-137 activity. The increase in gross gamma counts from 130 to 145 cps at a log depth of 217 through 220 ft (66.2 through 67.1 m) bgs corresponds to an increase in gross neutron counts per second. Cesium-137 was detected within this zone at 217.5 ft (66.3 m) with an activity of 0.2 pCi/g. Below 220 ft (67.1 m), gross gamma counts average about 25 cps less than that measured above 215 ft (65.5 m) bgs.

Elevated neutron counts at 115 ft and 219 ft (35.1 and 66.8 m) bgs corresponded with intervals of man-made radionuclides. At 115 ft (35.1 m), cobalt-60 was detected at 0.1 pCi/g; cesium-137 was not detected at this depth. Cesium-137 was detected at 217.5 ft (66.3 m) at approximately 0.5 pCi/g. The natural radionuclides do not show any apparent changes in these intervals. The elevated neutron count rate at 109 through 111 ft (33.2 through 33.8 m) bgs is probably related to the bottom of the second casing string.

3.3.3 216-B-7A Borehole

The man-made radionuclides detected in borehole C3103 were cesium-137 and europium-154. Cesium-137 was detected continuously from near the ground surface to about 56 ft (17.1 m) in depth with the highest concentration of about 300,000 pCi/g measured at about 23 ft (7.0 m) bgs. Europium-154 was detected between 16 and 18 ft (4.9 and 5.5 m) and probably exists at some depth intervals within the high-rate zone between 18 and 27 ft (5.5 and 8.2 m) bgs. No other man-made radionuclides were detected in this borehole, including plutonium-239, for which longer counting times were employed to enhance the possibility of detection.

The potassium/uranium/thorium logs do not delineate any definitive lithologic units. Changes in the potassium-40 concentrations from about 12 pCi/g at about 18 ft (5.5 m) to about 17 pCi/g near 37 ft (11.3 m) suggest a lithologic change occurs in the high-rate interval. A thin bed with relatively high thorium-232 concentrations occurs at about 107 ft (32.6 m) and may be useful to correlate in nearby boreholes.

Relatively higher moisture content appears to exist in the interval from 18 to 37 ft (5.5 to 11.3 m) bgs. The highest moisture content occurs at 20 ft (6.1 m) in depth, just above the depth where the highest cesium-137 concentrations were measured. An interval between about 80 and 100 ft (24.4 and 30.5 m) indicates slightly higher moisture that corresponds with finer grained soil as indicated by slightly higher concentrations of potassium-40 and thorium-232. The remainder of the borehole exhibits consistent moisture content in the soils. The moisture content is increasing near the bottom of the borehole, and the final data point at 218 ft (66.5 m) indicates the detector is in close proximity to groundwater but has not fully entered the saturated interval.

3.4 BULK DENSITY RESULTS

Bulk density measurements were computed from data collected in the field. Samples of a known volume were weighed and moisture was compensated for in the calculation. Table 3-1 provides the bulk densities associated with the physical property samples.

3.5 CONCLUSIONS

This report summarizes the drilling, sampling, and geophysical logging activities for the 200-TW-2 OU at the 216-B-38 Trench and the 216-B-7A Crib. An RI report will be prepared for this OU that will summarize and evaluate the laboratory and other results from the RI. The RI will include evaluations of risk and fate and transport of contaminants. The RI is to be submitted to the U.S. Environmental Protection Agency by September 30, 2002, under *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1998) Milestone M-15-42b.

Figure 3-1. 216-B-38 Crib Stratigraphy, Sample Locations, Radiological Field Screening Data, and Geophysical Logging Results.

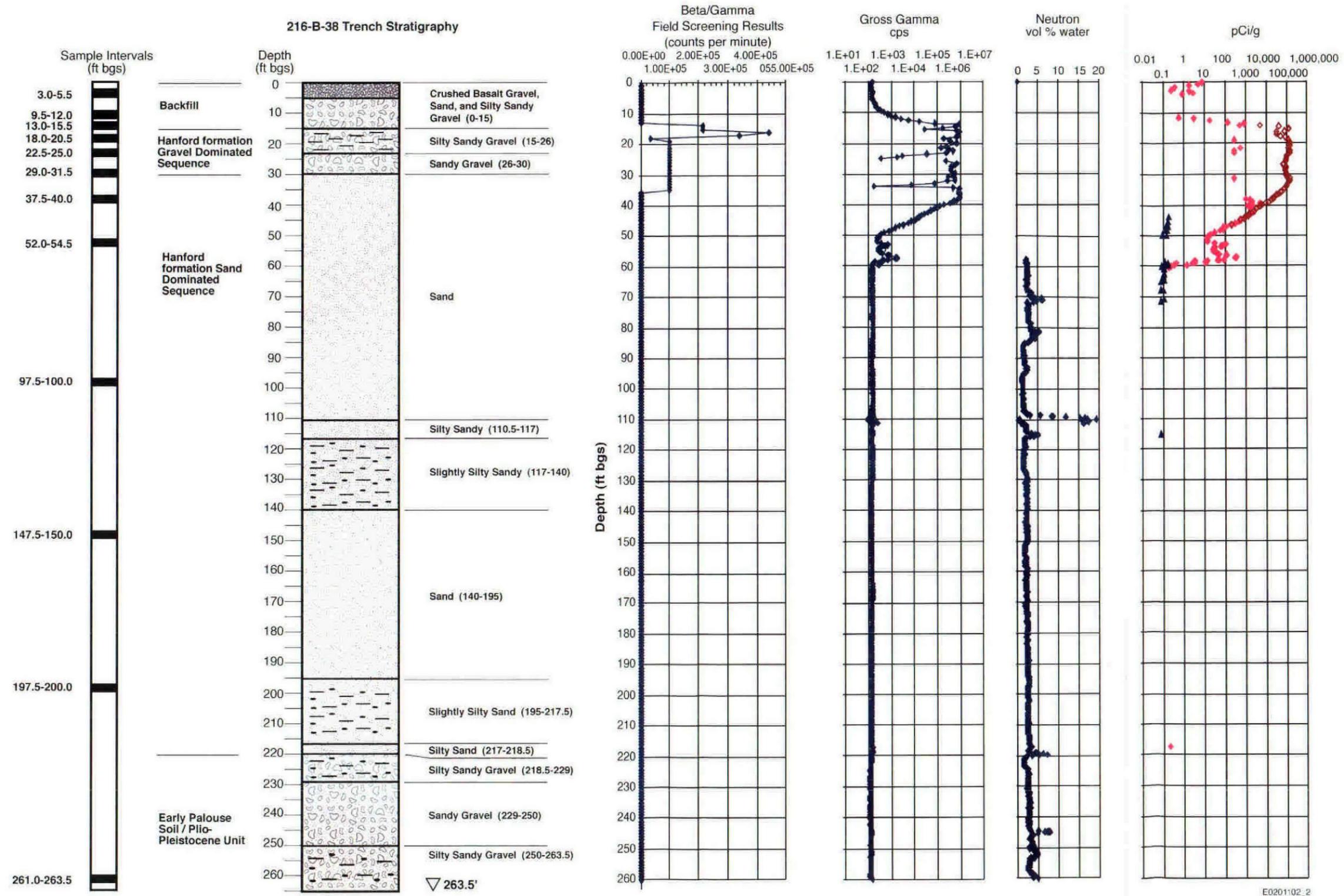
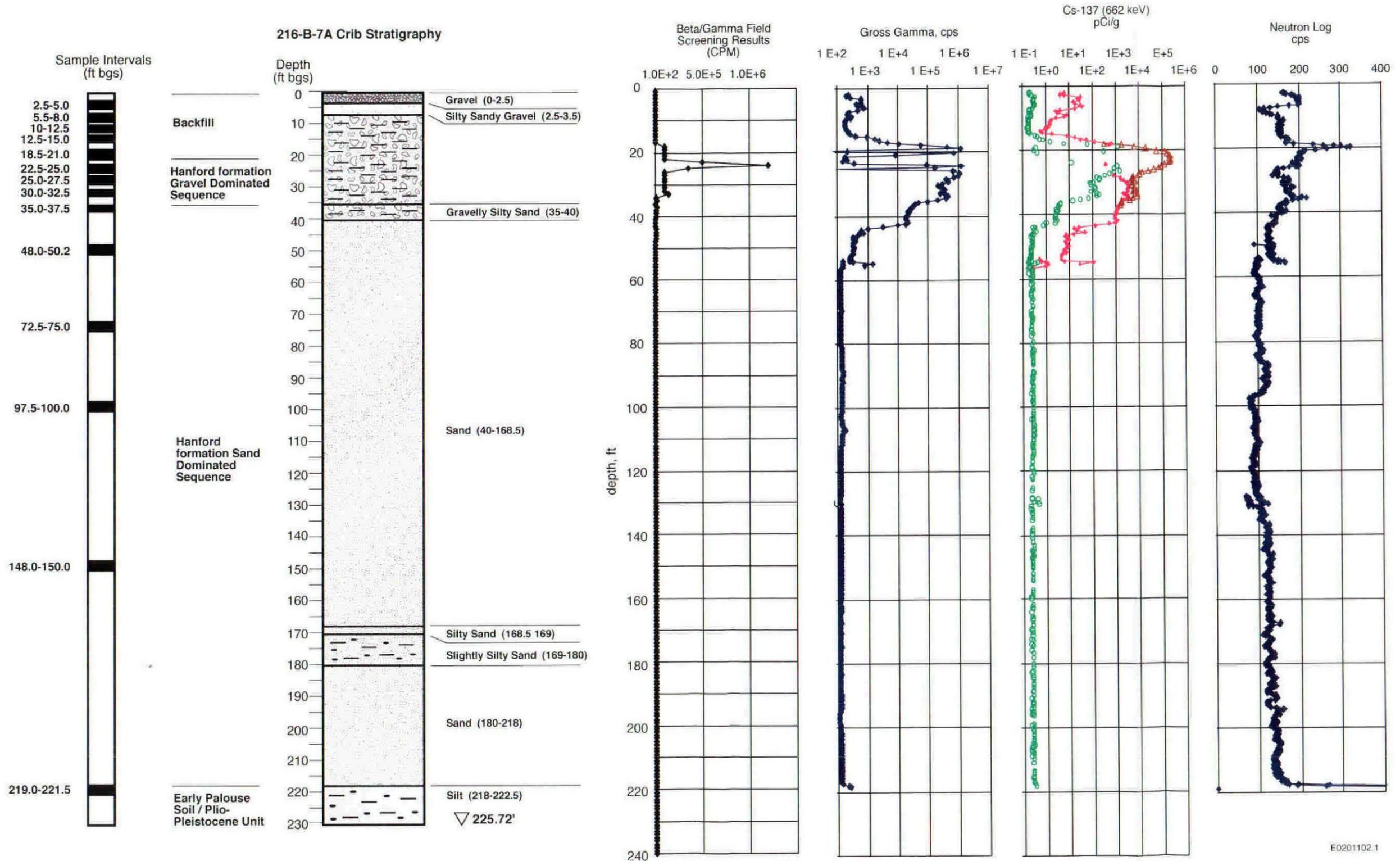


Figure 3-2. 216-B-7A Crib Stratigraphy, Sample Locations, Radiological Field Screening Data, and Geophysical Logging Results.



E0201102.1

Results**Table 3-1. Field-Screening Data. (2 Pages)**

Sample Number	Depth (ft bgs)	Alpha Field Screening	Beta-Gamma Field Screening	Mercury Field Screening	Bulk Density	Formation
C3103						
B12MH5	2.5 - 5.0	BG	BG	ND	2.01 g/cc	Backfill
B12MH6	5.5 - 8.0	BG	BG	ND	NA	Backfill
B12MH7	10.0 - 12.5	BG	BG	ND	NA	Backfill
B12MH4	12.5 - 15.0	BG	BG	ND	NA	Backfill
B12C89	18.5 - 21.0	BG	3 mrem/hr beta <0.5 mrem gamma	ND	NA	Backfill
B12DC1	22.5 - 25.0	BG	1.5 mrem/hr beta <0.5 mrem gamma	ND	2.06 g/cc	Backfill/ Hanford formation – gravel-dominated sequence
B12ML4	25.0 - 27.5	100 mrem	1500 mrem/hr beta 20 mrem/hr gamma	ND	1.88 g/cc	Hanford formation – gravel-dominated sequence
B12ML5	30.0 - 32.5	100 mrem	100 mrem/hr beta 20 mrem/hr gamma	ND	NA	Hanford formation – gravel-dominated sequence
B12ML6	35.0 - 37.5	20 mrem	1 mrem/hr beta <0.5 mrem/hr gamma	ND	NA	Hanford formation – sand-dominated sequence
B12ML7	48.0 - 50.5	BG	BG	ND	NA	Hanford formation – sand-dominated sequence
B12C91	48.0 - 50.5	BG	BG	ND	NA	Hanford formation – sand-dominated sequence
B12MH8	72.5 - 75.0	BG	BG	ND	NA	Hanford formation – sand-dominated sequence
B12MH9	72.5 - 75.0	BG	BG	ND	NA	Hanford formation – sand-dominated sequence
B12MJ0	97.5 - 100.0	BG	BG	ND	1.61 g/cc	Hanford formation – sand-dominated sequence
B12MJ1	147.5 - 150.0	BG	BG	ND	NA	Hanford formation – sand-dominated sequence
B12MJ2	219.0 - 221.5	BG	BG	ND	1.56 g/cc	Early Palouse soil/ Plio-Pleistocene unit
C3104						
B12C67	3.0 - 5.5	BG	BG	0.598 ppm	1.40 g/cc	Backfill
B12C68	9.5 - 12.0	BG	BG	ND	NA	Backfill
B12C63	14.5 - 15.5	BG	5 mrem/hr	ND	NA	Backfill
B12C64	18.0 - 20.5	BG	6 mrem/hr beta 8 mrem/hr gamma	ND	1.98 g/cc	Hanford formation – gravel-dominated sequence
B12DB8	22.5 - 25.0	BG	5 mrem/hr	ND	NA	Hanford formation – gravel-dominated sequence
B12DB9	14.5 - 15.5	BG	3 mrem/hr	ND	NA	Backfill

Results**Table 3-1. Field-Screening Data. (2 Pages)**

Sample Number	Depth (ft bgs)	Alpha Field Screening	Beta-Gamma Field Screening	Mercury Field Screening	Bulk Density	Formation
B12DC0	37.5 - 40.0	BG	BG	ND	NA	Hanford formation – sand-dominated sequence
B12C88	37.5 - 40.0	BG	BG	ND	NA	Hanford formation – sand-dominated sequence
B12C69	52.0 - 54.5	BG	BG	ND	NA	Hanford formation – sand-dominated sequence
B12C70	52.0 - 54.5	BG	BG	ND	NA	Hanford formation – sand-dominated sequence
B12C71	97.5 - 100.0	BG	BG	ND	1.69 g/cc	Hanford formation – sand-dominated sequence
B12C72	147.5 - 150.0	BG	BG	ND	NA	Hanford formation – sand-dominated sequence
B12C73	197.5 - 200.0	BG	BG	ND	NA	Hanford formation – sand-dominated sequence
B12C74	261.0 - 263.5	BG	BG	ND	1.91 g/cc	Early Palouse soil/ Plio-Pleistocene unit

BG = background

NA = not applicable – bulk density measure not taken at this sample location

ND = not detected

4.0 REFERENCES

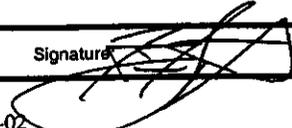
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APPENDIX A
BOREHOLE GEOLOGIC LOGS

Appendix A - Borehole Geologic Logs

WELL CONSTRUCTION SUMMARY REPORT				Start Date: 7-31-01			
				Finish Date: 9-12-01			
				Page 1 of 1			
Well ID: C3104		Well Name: C3104		Approximate Location: 200 East 216-B-38			
Project: 200-TW-2		Other Companies: CHI					
Drilling Company: R.S.I		Geologist(s): Kevin Singleton L.D. Walker					
Driller: Morris Wraspice		License #: 1909					
TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD	HOLE DIAMETER (in) / INTERVAL (ft)			
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D.A.D.	Auger:	Diameter 11 3/4" From 0 to 60.5			
11 3/4" O.D. Thread	0 - 58.0	-	Cable Tool: <input checked="" type="checkbox"/>	Diameter 9" From 60.5 to 112			
8 5/8" O.D. Thread	0 - 111	9"	Air Rotary:	Diameter 7" From 112 to 263.5			
6 5/8" O.D. Thread	0 - 259.6	7"	A.R. w/Sonic:	Diameter _____ From _____ to _____			
				Diameter _____ From _____ to _____			
				Diameter _____ From _____ to _____			
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter _____ From _____ to _____			
			Drilling Fluid: None Used				
Total Drilled Depth: 263.5'	Hole Dia @ TD: 7"	Total Amt. Of Water Added During Drilling: None Used					
Well Straightness Test Results: NA		Static Water Level: 263'		Date: 26 8-10-01			
GEOPHYSICAL LOGGING							
Sondes (type)		Interval	Date	Sondes (type)			
Spectral Gamma		0 - 58.0	8-6-01	NA			
Spectral Gamma/Mudstone/Misc		58.05 - 112	8-7-01				
Spectral Gamma/Mudstone/Misc		112 - 263.5	8-10-01				
COMPLETED WELL							
Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
				NA			
OTHER ACTIVITIES							
Aquifer Test: NA		Date:		Well Decommission: Yes: <input checked="" type="checkbox"/> No: <input type="checkbox"/>		Date: 9-12-01	
Description: NA				Description: SAND 252.9'-262.1', Cement 236.5'-252.9'		Bentonite 2.5'-236.5', Cement 2.0'-2.5'	
WELL SURVEY DATA (if applicable)							
Washington State Plane Coordinates: NA				Protective Casing Elevation: NA		Brass Survey Marker Elevation: NA	
COMMENTS/REMARKS							
Reported By: Kevin Singleton		Title: Geologist		Signature: 		Date: 10-12-01	

Original to: Document & Information Services, H0-09/HWIS
 Distribution by DIS: Environmental Technologies Well Coordinator, H0-02

Appendix A - Borehole Geologic Logs

BOREHOLE LOG					Page <u>1</u> of <u>9</u>	
Well ID: <u>200-TW-2</u>		Well Name: <u>C3104</u>		Location: <u>200 East 214-B-3B</u>		
Project: <u>200-TW-2</u>		Reference Measuring Point: <u>Ground surface</u>				
Depth (Fl.)	Sample		Graphic Log	Sample Description	Comments:	
	Type No.	Blows Recovery				
0	DB	0-11' <u>100%</u>		0-1' Crushed basalt v.c.p. (Gravel)		
				1-2.5' SILTY SAND, 10% RSL, light olive brown, dry, No RK	Bottom Trench @ -15'	
	SS	RCY 95%			mud sorted, 70% SAND, 30% Silt, Sand mainly VFS-FS, 30-40% ms; others sub round to ANG 70% Qtz, 30% mafic MPS 1mm	
5	DB				2.5-15' GRAVELLY SILTY SAND, 10% RSL to 10% RSL, light olive brown to olive brown, moist weak RK to acid, poorly sorted, 70% SAND, 10-20% Gravel, 10% Silt, mainly VFS to ms, little ms ANG to subrd, mainly mp to vsp, Round, 60-70 % Qtz, 30-40% other, MPS 136 Gravel size & # increasing with depth.	
	SS	RCY 66%			15'-21.5' SANDY GRAVEL to SILTY SANDY GRAVEL	
15	DB	100% Blows 105			10% RSL, moist, very dark grayish brown 40-55 Gravel, 35-40% SAND 5-10% Silt	
	SS	RCY 100%			No to weak RK, mainly mp to vsp, Round, ms-vcs, MPS MPS 55mm, 70% Basalt 30% others	
20	DB				21.5-30.5' SANDY GRAVEL, 10% RSL dark grayish brown, moist, poorly sorted	
	SS	RCY 283 blows sand			No RK, 65% SAND, 27% Gravel, 3% Silt	Gravel to micromes to 60% SAND
25	DB				Basalt, 20% other, MPS. 60mm	~37% @ 29.5'
	SS				30.5-45' SAND, 10% RSL, dark grayish brown moist, weak to med sorted, No RK, 90% SAND 7% Gravel 3% Silt, mainly MS-VCS, Round-ANG v.c.p. Round 80% Round, 20% other MPS 20mm	SANDY GRAVEL

Reported By: Kevin Singleton Title: Geologist Signature: [Signature] Date: 8-6-01

Reviewed By: DC Weekes Title: Geologist Signature: [Signature] Date: 10/19/01

BHI-EE-183 (12/97)

Appendix A - Borehole Geologic Logs

BOREHOLE LOG				Page 3 of 9	
				Date: 8-6-01	
Well ID: C3104		Well Name: NA C3104		Location: 200 East 216-B-38	
Project: 200-TW-2 O.U.			Reference Measuring Point: Ground		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl					
Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level					
60	DB	NA		45'-77' SAND, 10R4/2, dark grayish brown, (see page 2)	
65				@ 72' Silty SAND Stringer 6" mainly ves ms No RX 20-30% silt	
70				77'-87' SAND, 10R4/2, dark grayish brown, well sorted, NO RX moist, very consolidated, 95% SAND 5% others, mainly ms, 20-80% Brantt Qtz & Feld 20-30% other, MPS thin	look like Ringold SAND
75				87'-89' SAND, 10R4/2, dark grayish brown moist, well sorted, No RX, 95% SAND, 4% Silt, 1% other, mainly coarse sand 50% Brantt, 50% other MPS thin	
80				89'-110.5' SAND, 10R4/2, dark grayish brown moist, well sorted, 4% No, 97% SAND, 3% other, mainly coarse & med sand 50% mafic / 50% Felac & Qtz. MPS thin	
85					
Reported By: Kevin Singleton			Reviewed By: DC Weekes		
Title: Geologist			Title: Geologist		
Signature:		Date: 8-8-01	Signature:		Date: 10/19/01

BHI-EE-183 (12/97)

Appendix A - Borehole Geologic Logs

BOREHOLE LOG					Page 4 of 9
Well ID: C3104		Well Name: 200-TW-2 C3104		Location: 200 EAST 216-B-38	
Project: 200-TW-2 O.U.		Reference Measuring Point: Ground		Date: 8-7-01	
Depth (Fl.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
90	DB			89-110.5 SAND, 10YR 4/2 dark grayish brown moist, No RX, well sorted, mostly CS, 50% Basalt/min Fe, 50% Felsic Qtz MPS 4mm	
95				@ 95' mainly ms	
97.5-100	DB	125 Blows 100% RCY		@ 97.5 mainly ms	Split spoon
105					
110				110.5-113.5 SILTY SAND, 10YR 7/2, light gray dry, Strong RX, poorly sorted, 60% Sand 40% Silt, mainly ms-CS, Silt is non-plastic (white CaCO3) 30-40% Basalt, 60% Qtz some Felsic MPS 2mm, Friable, weakly consolidated	
115				113.5-117 SILTY SAND, 10YR 5/3, brown moist, No RX, 80% Sand, 20% Silt mainly VES-FS, 30% Basalt, 70% others MPS 2mm	

Reported By: Kevin Singletary	Reviewed By: DC Weekes
Title: Geologist	Title: Geologist
Signature:	Signature:
Date: 8-7-01	Date: 10/19/01

BHI-EE-183 (12/97)

Appendix A - Borehole Geologic Logs

BOREHOLE LOG					Page 5 of 9
Well ID: C3104		Well Name: 200 TW-2 C3104		Date: 8-8-01	
Project: 200-TW-2 O.U.			Reference Measuring Point: Ground		
Depth (FL)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
120	BB DB 10/19/01	NA		117-130 SLIGHTLY SILTY SAND	
				10YR4/2, dark grayish brown, moist, weak R _X	
				85% SAND, 15% Silt, mainly ms-cs	
				50% Basalt, 40-50% Qtz & Feld, weakly cemented, MPS 2mm well sorted	
125				130-140 Slightly Silty SAND	
				10YR4/2, dark grayish brown, moist No-weak	
				R _X , 85% SAND, 15% Silt mainly ms-cs	
				70% Qtz & Feld, 30% Basalt MPS 2mm	
130				140-159 SAND, 10YR4/2, dark grayish brown	
				moist, well sorted No to weak	
135			R _X , mainly ms, 70-80% Basalt 60% other		
140			MPS < 3mm		
145					
	147.5 150	103 110.5 23%			

Reported By: <i>J. Singleton</i>	Reviewed By: <i>DC Weekes</i>
Title: <i>Geologist</i>	Title: <i>Geologist</i>
Signature: <i>[Signature]</i>	Signature: <i>[Signature]</i>
Date: 8-9-01	Date: 10/19/01

BHI-EE-183 (12/97)

Appendix A - Borehole Geologic Logs

BOREHOLE LOG					Page <u>6</u> of <u>9</u>
Well ID: <u>C3104</u>			Well Name: <u>C3104</u>		Date: <u>8-08-01</u>
Project: <u>200-TW2</u>			Location: <u>200 East 216-B-38</u>		
Reference Measuring Point: <u>Ground</u>					
Depth (Fl.)	Sample		Graphic Log	Sample Description	Comments
	Type No.	Blows Recovery			
150	PB	NA	[Dotted pattern]	140-159 SAND, 10YR 4/2, dark grayish brown. (See page 5)	
				159-162 SAND, 10YR 4/2, dark grayish brown, moist, poorly sorted	
155				No RL, mainly VCS-MS, 95% SAND	
				5% Silt, MPS 4mm 70% Basalt, 30% others	
				162-187 SAND, 10YR 5/2, grayish brown moist	
160				mod-poorly sorted, Weak RL weakly cemented, 90% SAND 10% Silt & others,	
				mainly MS-CS, 70% Basalt, 30% others MPS < 3mm; weakly cemented	
				~65' Mod to strong RL to acid <u>8-08-01</u>	
165				weakly cemented	
				~70' Weak to mod RL to acid	
170					
175					
Reported By: <u>Kevin Singleton</u>				Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>				Title: <u>Geologist</u>	
Signature: <u>[Signature]</u>			Date: <u>8-9-01</u>	Signature: <u>[Signature]</u>	
				Date: <u>10/19/01</u>	

BHI-EE-183(1297)

Appendix A – Borehole Geologic Logs

BOREHOLE LOG					Page <u>7</u> of <u>7</u>
					Date: <u>8-9-01</u>
Well ID: <u>C3104</u>		Well Name: <u>200-TW-2</u>		Location: <u>200 East 26-B-38</u>	
Project: <u>200-TW-2</u>			Reference Measuring Point: <u>Ground</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
180	28	NA		162-187 SAND, 10% RSP grayish brown moist, med-poorly sorted Weak RX to acid, weakly cemented, 90% SAND, 10% silt & others, main ms-cs, 20% Basalt, 30% others MFS 3mm	
185				187-195 SAND, 10% RSP, dry, poorly sorted Weak RX, weakly cemented, 90% SAND, mainly ms to vcs, basalt subround to subang, Qtz & Feld ANG, 10% others, 70% Basalt, 30% others MFS 3mm	
190				195-211' Slightly Silty SAND, 10% RSP GRAY dry, poorly sorted, weak RX, weakly cemented 80% SAND, mainly ms to vcs, 20% silt 60-70% Basalt, 30-40% others MFS 3mm	
195					
200	55 97.5 200	85% 191 Blows			
205		NA			

Reported By: <u>Kevin Singleton</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>		Title: <u>Geologist</u>	
Signature:	Date: <u>8-09-01</u>	Signature:	Date: <u>10/19/01</u>

BHI-EE-183 (12/97)

Appendix A - Borehole Geologic Logs

BOREHOLE LOG					Page <u>2</u> of <u>2</u>
Well ID: <u>C3104</u>		Well Name: <u>1049/01 NA C3104</u>		Location: <u>200 East 216-B-38</u>	
Project: <u>200-TW-2</u>			Reference Measuring Point: <u>Ground</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
210	DB	NA		195-211 Slightly SILTY SAND 104R611, gray, dry, poorly sorted, weak to med. cementation, weakly cemented 80% SAND, mainly ms-vc5, ~20% silt 60-70% Basalt, 30-40% other MPS < 3mm	Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
215				211'-217.5' Slightly SILTY SAND 104R612 light brownish gray, poorly sorted, weak to med. cementation, weakly cemented 85% SAND mainly ms-cs, ~15% silt 60-70% matrix 30% other MPS 3mm ~2% Gravel	
220				217.5'-218.5' SILTY SAND, 104R613 pale brown, dry, well sorted, weak cementation, 70% vps-fs 30% silt, 60% Basalt 30-40% other MPS 2mm	
225				218.5'-229' SILTY SANDY GRAVEL, H.F./PPP(?) 218.5' 104R512, grayish brown, dry, very poorly sorted Also slightly attenuated weak cementation, oxide brown staining, 65% Gravel 30% SAND, 5% silt, mainly vep-cp Round, mainly ms-vc5, 90% Basalt, 10% other MPS 30mm # moist zone of silty vcs c. ~20'	
230				229'-235' SANDY GRAVEL, 104R512, grayish brown dry, poorly sorted, weak to med. cementation, 75% Gravel (mainly vep-fp) 23% SAND (mainly ms-vc5) 90% Basalt, 10% other MPS 20mm	
235					

Reported By: Kevin Singleton

Reviewed By: DC Weekes

Title: Geologist

Title: Geologist

Signature: [Signature]

Date: 8-10-01

Signature: [Signature]

Date: 10/19/01

BHI-EE-183 (12/97)

Appendix A – Borehole Geologic Logs

BOREHOLE LOG					Page <u>9</u> of <u>9</u>		
Well ID: <u>C3104</u>		Well Name: <u>C3104</u>		Location: <u>200 East 216-B-38</u>			
Project: <u>200-TW-2</u>			Reference Measuring Point: <u>Ground</u>				
Depth (Fl.)	Sample		Graphic Log	Sample Description	Comments:		
	Type No.	Blows Recovery					
240	DB			235-250' SANDY GRAVEL, 10% S&S, grayish brown, dry, poorly sorted, weak to med BK, 75% Gravel, 23% Sand, 2% Silt mainly v-f-m, Round, 6 ms-vc3, 90% Bratt 10% others MPS. 25mm			
245				Small clast sometimes altered			
				@ 250' clast size max = 60mm with some silty altered cores			
250				250' Silty SANDY GRAVEL, 10% S&S dark brown, moist dry poorly sorted, weak BK, 75% Gravel, 20% Sand 5% Silt, mainly v-f-cp, Round, 6 ms-vc5 85% Bratt, 15% others MPS 90mm			
255				Small cobbles @ 255			
260							
				53 61- 63.5	75% dry		▽ ~263' END HOLE 263.5
265							
Reported By: <u>Kevin Singletary</u>			Reviewed By: <u>DC Weekes</u>				
Title: <u>Geologist</u>			Title: <u>Geologist</u>				
Signature:		Date: <u>8-10-01</u>	Signature:		Date: <u>10/19/01</u>		

BHI-EE-183 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT NO. 1		Page <u>1</u> of <u>2</u>	
DRILLING PLAN		Date: <u>7-31-01</u>	
Use additional pages if req'd.			
Purpose: <u>Characterization by soil sampling</u>		Location: <u>200-EAST C3104 / 216-B-38</u>	
Well Name: <u>NO 19121 C3104</u>		Well ID: <u>C3104</u>	
Drig. Co.: <u>RST</u>		Rig No.: <u>HO-22</u> ⁵³⁰⁹	Rig Make/Mod.: <u>Wellmaster 1250</u>
Casing String No. <u>① 2 3 4</u>	Drilling Method	Circulation	D.H. Hammer
Casing Size <u>0.8750</u>	Auger <u>NA</u>	Air <u>NA</u> Water/Mud <u>NA</u>	Make <u>NA</u>
Grade <u>NA</u>	Rotary <u>NA</u>	Reverse <u>Direct</u>	Model <u>NA</u>
Lbs. Per Ft. <u>NA</u>	Tubex <u>NA</u>	Vol: cfm <u>NA</u>	Choke <u>NA</u>
Material <u>Carbon Steel</u>	Cable Tool <u>✓</u>	gpm <u>NA</u>	Casing Hammer
Type:	Sonic <u>NA</u>	Pressure <u>NA</u> psi	Make <u>NA</u>
Welded <u>Thd. ✓</u>	A.R. w/Sonic _____	Drill Pipe O.D. <u>NA</u>	Model <u>NA</u>
Planned/Actual	Other: _____	Tool Joint Size <u>NA</u>	Bit Size
Set At: <u>60.5 / 60</u>		Additives <u>NA</u>	Type <u>NA</u>
Shoe OD/ID <u>0.8750 / 0.8000</u>			Nozzles <u>NA</u>
Reference Measuring Point:			
GROUND LEVEL			
Drig. Co. <u>RST</u>		Rig No.: <u>HO-5309 HO-22</u>	Rig Make/Mod.: <u>Wellmaster 1250</u>
Casing String No. <u>③ 3 4</u>	Drilling Method	Circulation	D.H. Hammer
Casing Size <u>0.6350</u>	Auger <u>NA</u>	Air <u>NA</u> Water/Mud <u>NA</u>	Make <u>NA</u>
Grade <u>NA</u>	Rotary <u>NA</u>	Reverse <u>Direct</u>	Model <u>NA</u>
Lbs. Per Ft. <u>NA</u>	Tubex <u>NA</u>	Vol: cfm <u>NA</u>	Choke <u>NA</u>
Material <u>Carbon Steel</u>	Cable Tool <u>✓</u>	gpm <u>NA</u>	Casing Hammer
Type:	Sonic <u>NA</u>	Pressure <u>NA</u> psi	Make <u>NA</u>
Welded <u>Thd.</u>	A.R. w/Sonic <u>NA</u>	Drill Pipe O.D. <u>NA</u>	Model <u>NA</u>
Planned/Actual	Other: _____	Tool Joint Size <u>NA</u>	Bit Size
Set At: <u>100 / 111</u>		Additives <u>NA</u>	Type <u>NA</u>
Shoe OD/ID <u>0.6350 / 0.7260</u>			Nozzles <u>NA</u>
Reference Measuring Point:			
Comments/Remarks:			Estimated Depth to Water
<u>All measurements are in tenths of a Foot.</u>			<u>~ 265.57 Ft</u>
Reported By: <u>Kevin S. Smith</u>		Reviewed By: <u>D. C. Weeks</u>	
Name/Title: <u>Geologist</u>		Name/Title: <u>Geologist</u>	
Signature: <u>[Signature]</u>	Date: <u>8-1-01</u>	Signature: <u>[Signature]</u>	Date: <u>10/19/01</u>

BHI-EE-017 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT- DAILY DRILLING		Page 2 of 2	
Continuation Page		Date: 7-31-01	
Well Name: <i>NA C3104</i>		Well ID: <i>C3104</i>	
Location: <i>200 EAST</i>		Continuation of Report No.: <i>1</i>	
Time / Depth		Description of Activities/Operations with Depth	
From	To		
<i>2130</i>		<p>Crew on site @ 2130hrs by Ed RaFuse. RaFuse review several safety topics; Safety attitude, job readiness, insect bites, minor minor injuries, house keeping, managing time, reduce chances of injury, others; POD @ 2130 to 2200hrs. Move equipment, move drill rig, drill collect samples. Preparing to drill @ 2200hrs. Dug thru gravel drill pad @ 0045hrs with shovel to ~6' set first joint of casing 0.38 Hole + 0.82 shoe + 4.00 = Total 9.8" 5.20' of 9.8" O.D. casing. Ready drill @ ~ 0125hrs. Short pre job safety meeting @ 0125hrs in office trailers. Meeting over @ 0145hrs Lunch. Drilling @ 0230hrs. Cae barrel to 2' @ 0245hrs. HPT noted 650cpm on soil; also background is ~300cpm; however 3000cpm of non-smearable contamination is in the top of the drive barrel. The elevated levels of contamination may be from the Fixed contamination or radon. HPT recounted soil @ ~0305hrs ~300cpm. Concern was raised regarding using the drive barrel with fixed contamination. Issues addressed per Mary Todd, CHT. Drilling continues @ 0350hrs Hg vapors exceed action levels of 0.1. Reading of .588 and 0.234 for 1 minute. Work stopped by T H Tech. Crew leaves zone. Crew may need to work in respirator on next shift. Crew off site @ 0500hrs. Will re group on next shift.</p> <p>Note collected chemical sample from 3-5.5' @ 0245hrs.</p>	
		<i>NA</i>	
Reported By: <i>Kevin Singleton</i>		Reviewed By: <i>DC Weekes</i>	
Title: <i>Geologist</i>	Date: <i>8-1-01</i>	Title: <i>Geologist</i>	Date: <i>10/19/01</i>
Signature: <i>[Signature]</i>		Signature: <i>[Signature]</i>	

BHI-EE-018 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING		Page <u>1</u> of <u>1</u>
Well Name: <u>10-11-01 10-11-01 C3104</u>		Well ID: <u>C3104</u>
Location: <u>200 EAST</u>		Report No.: <u>2</u>
Start Time: <u>2130</u>	Finish Time: <u>0700</u>	Total Time: <u>9</u>
Hole/Depth/Csg: <u>6 15.2</u>	Hole/Depth/Csg: <u>20.5 19</u>	Hole/Depth/Csg: <u>14.5 118.8</u>
Reference Measuring Point: GROUND SURFACE	Casing String No. <u>① 2 3 4</u> See Report No. 1	
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To	
2130		Crew on site @ 2130hrs. Plan of the day and meeting conducted by Russ Fabian. Russ complimented the crew on emergency evacuation procedure regarding detection of H ₂ vapor above the action level on last shift. Russ requested that each crew member provide a narrative regarding body location prior to the detection. All narratives were submitted to Russ.
2145		Many visitors on site; see plan of the day sign in sheet 8-1-A. Safety topics, report injuries, personal canned, exhaust from equipment. The RWP was reviewed by Ryden (HPT). A secondary meeting was held with Sheldon to discuss details of the timeline of the H ₂ vapor detection on 8-1-01 AM. RWP reviewed again @ 2231 hrs. by HPT. Ed Rafuse review emergency evacuation procedure. Added 5.01' of casing; Total string is 10.21. Drilling @ 0040hrs; Collecting 'spec from 9.5-12 @ 0110hrs. Adding 5.00' of casing @ 0130hrs. Total string is 15.21. Note: Team entered zone in Anti-C ₂ with respirators with H ₂ can to. All mask was removed / later off @ 0145hrs.
		Collecting spec 13-15.5' - Blow counts 105; 5 Mr on bottom of tube. Lunch @ 0230hrs. @ 0310hrs short safety meeting. Waiting on paperwork for and needed Fin pink ring. Drill @ 0330hrs. Adding 5.00' @ 0505hrs; total string is 20.21. @ 0505hrs; 18-20.5' Limits of
0625		RWP exceeded @ 0625hrs; max 27 m R/hr? @ end of shift; should be no greater than 10 m R/hr. Sample indicate zero flow/negative pressure
0700		in glass box @ 0635hrs. Crew stopped work; have sample @ H ₂ in zone; off site 0700hrs
Reported By: <u>Kevin Singleton</u>	Reviewed By: <u>D. C. Weber</u>	
Title: <u>Geologist</u>	Date: <u>8/20/01</u>	Title: <u>Geologist</u> Date: <u>10/19/01</u>
Signature: <u>[Signature]</u>	Signature: <u>[Signature]</u>	

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Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING		Page <u>1</u> of <u>1</u>
Well Name: <u>C3104-NA 10-11-01</u>		Well ID: <u>C3104</u>
Location: <u>200 EAST 216-B-38</u>		Report No.: <u>3</u>
Start Time <u>2130</u>	Finish Time <u>0710</u>	Total Time <u>9 hrs 10 min</u>
Hole/Depth/Csg <u>20.5 19</u>	Hole/Depth/Csg <u>36 136.8</u>	Hole/Depth/Csg <u>15.5 17.8</u>
Reference Measuring Point: GROUND SURFACE		Casing String No. <u>① 2 3 4</u> See Report No. 1
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To	
2130		Crew on site @ 2130 hrs. Plan of the day @ ~ 2132 hrs by Ed RaFus. Topics - operation of HEPA VAC; Mercury vapor monitoring; management review of work @ C3104 - good effort; evacuation plan. Todd returns the RWP. Waiting on JH Tech; he is having problems calibrating equipment. JH Tech on site @ 2224 hrs. Dressing and preparing to drill @ 2225 hrs. Samples and HPT in zone @ ~ 2300 hrs to move soil/clean out
2315		g hole log. Drilling @ ~ 2315 hrs Total string is 20.21'
2330		@ 2330 hrs wind out of the west 5-8 mph; Temp ~ 72°F. Adding 5.02'
0023		@ 0023 hrs; total casing string is 25.23'. Hole @ 225' @ 0047 hrs
0048		Preparing to spoon. Spoon at of lde ~ 0104 hrs 22.5-25.0' 100% RCT. Adding 5.02' of casing; Total string 30.25 @ 0210 hrs. Crew preparing to leave zone @ ~ 0215 hrs. Lunch 0230 hrs. Preparing to drill moving down equipment & hot soil samples. Drilling @
		0345 hrs. @ 0445 hrs. Preparing to drive spoon 29-31.5.
8-3-01		Adding 5.02' of casing @ 0540 hrs. Total string 35.27'. Adding 5.00' of casing total string is 40.27'. Hanford SAND & great drilling
0450		Depth is 36" @ 0650 hrs. Contact between H1 & H2 in 30.5.
0700		Crew leaving zone @ ~ 0700 hrs.
NA		
Reported By: <u>Kevin Singleton</u>		Reviewed By: <u>DC Weekes</u>
Title: <u>Geologist</u>	Date: <u>8-3-01</u>	Title: <u>Geologist</u>
Signature: <u>[Signature]</u>		Signature: <u>[Signature]</u>

BHI-EE-018 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING		Page <u>1</u> of <u>1</u>
Well Name: <u>NA C3104 5 10-11-01</u>		Date: <u>8-5-01</u>
Location: <u>200 East 216-B-38</u>		Well ID: <u>C3104</u>
Report No.: <u>4</u>		
Start	Finish	Total
Time <u>2130</u>	Time <u>0530</u>	Time <u>6.5</u>
Hole/Depth/Csg <u>36 136.8</u>	Hole/Depth/Csg <u>60.5 1 58</u>	Hole/Depth/Csg <u>245 1 212</u>
Reference Measuring Point: GROUND SURFACE		Casing String No. <u>(1) 2 3 4</u> See Report No. 1
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To	
2130		Crew onsite @ 2130hrs. Plan of the day @ 2131 hrs. by Ed RaFuse. Safety topic - A SAFE WORK PLACE; employees are valuable resources. Preparing to drill, moving equipment, dress in Anti-C's @ 2200hrs. T.H. Tech has equipment problem. Drilling delayed ~ 30min. Drilling @ ~ 2240hrs. Drilling SS @ 1100
	1100	1100hrs. Windout of West 1-5mph @ 2302 hrs; Temp ~ 70°F. Total casing string in 4027'. Wind 0-1 mph from north @ 2355
	2355	2320hrs. Adding 433' of casing @ 2355hrs. Total string in 4460'
	0030	Drilled to 45' @ 0030hrs. Contaminate level are declining
	0035	therefore, HPT may dampen the CA. Crew surveying out @ 0035 HPT's down posting site. Lunch @ 0245hrs. Site down posted and drilling continues @ 0330hrs. Adding 467' of casing @ 0400hrs. Total string is 4927'. Drilling SS @ 520' @ 0415hrs. Adding two joints of casing @ 0445hrs; 437' + 463' = total string
	0515	@ 58.27'. First casing string set @ 58.00' @ 0515; Hole @ 60.5'. The hole will be geophysically logged with the special permea tool later today. The logging truck is expected
	0521	out @ 0700hrs
		NA
Reported By: <u>Kevin Singleton</u>		Reviewed By: <u>DC Weekes</u>
Title: <u>Geologist</u>	Date: <u>8-5-01</u>	Title: <u>Geologist</u> Date: <u>10/19/01</u>
Signature: <u>[Signature]</u>		Signature: <u>[Signature]</u>

BHI-EE-018 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING		Page <u>1</u> of <u>1</u>
Well Name: <u>NA C3104 8-10-01</u>		Well ID: <u>C3104</u>
Location: <u>200 East 216-B-38</u>		Report No.: <u>5</u>
Start Time: <u>2130</u>	Finish Time: <u>0800</u>	Total Time: <u>10</u>
Hole/Depth/Csg: <u>60.510</u>	Hole/Depth/Csg: <u>112.111</u>	Hole/Depth/Csg: <u>515.111</u>
Reference Measuring Point: GROUND SURFACE		Casing String No. 1 <u>2</u> 3 4 See Report No. 1
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To	
2130		Crew onsite @ 2130hrs. Plan of the day @ 2136hrs by Ed RaFuz
		Geophysical logging of the 1 st string (casing) was completed during today's shift - set @ 5B. Ed reviewed job and responsibilities for site worker's
		Run casing - string #2, H.E.S. Monitoring, change drive barrel, decor,
2145		drill, sample. Preparing to drill @ 2145hrs. Down sized hole's casing - completed @ 2340hrs. 2 nd string is 8" ID (0.631 ID 0.72' O.D.). Total string is 1.08' Head + 100 shoe + 10.02 10.01 + 10.01 + 10.01 + 10.00 + 10.00 + 3.01 = 67.11' Drilling commenced @ 2345hrs. Wind out of the north 15-20 mph, Temp ~ 70°F. Adding 5.00' of 8" ID casing @ 0001hrs. Total string is 72.14. Adding 5.00' @ 0025hrs, Total string is 77.14. Adding
0047		5.00' @ 0047hrs, total string is 82.14, hole @ 72. Adding 5.00', total string is 87.14 @ 0130hrs. Adding 5.0' of 8" casing 0155' Total string is 92.14, hole @ 90' @ 0225hrs. - Unach- Drilling @ 0315hrs. @ 0330hrs adding 5.0' of 8" ID, Total string is 97.14. Collecting split-Spoon sample (97.5-100 @ 0340hrs. Adding 5.0' of casing @ 0415hrs, Total string is 102.14 Adding 5.0' of casing @ 0445hrs, Total string is 107.14. Setting casing with last 8" joint (5.0'); Total string is 112.14 Hole @ 112.0 0555 hrs - most of the crew is out of the zone. Geophysical logging is scheduled @ 0600hrs Logging crew in zone @ 0630 hrs (Steve Los). Singleton witness logging pre-check - for moisture tool until 0900hrs. OFF-site @ 0900hrs
0900		@ 0900hrs
Reported By: <u>Kevin Singleton</u>		Reviewed By: <u>DC Weekes</u>
Title: <u>Geologist</u>	Date: <u>8-7-01</u>	Title: <u>Geologist</u> Date: <u>10/19/01</u>
Signature: <u>[Signature]</u>		Signature: <u>[Signature]</u>

BHI-EE-018 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING		Page <u>1</u> of <u>1</u>
		Date: <u>8-7-01</u>
Well Name: <u>HA C 3104 10-11-01</u>		Well ID: <u>C3104</u>
Location: <u>200 EAST 216-B-38</u>		Report No.: <u>6</u>
Start	Finish	Total
Time <u>2130</u>	Time <u>0800</u>	Time <u>10</u>
Hole/Depth/Csg <u>112 1 0</u>	Hole/Depth/Csg <u>177 1 175.5</u>	Hole/Depth/Csg <u>65 1 175.5</u>
Reference Measuring Point: GROUND SURFACE		Casing String No. 1 2 <u>(3)</u> 4 See Report No. 1
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To	
2130		Crew onsite @ 2130hrs. Plans of the day @ 2140hrs by Ed RaFuse, delay by HPTs, Job scope covered by Ed, other topics extension cord safety. Crew preparing to run/down size to 6" casing
		Downsizing @ ~2210hrs - Drilling commences @ 2320hrs. Total 6" TD casing is 116.80'. Adding 5.00' of 6" casing @ 2355hrs; Total string is 121.80'. Adding 5.0' @ 0022hrs. - Total casing is 126.80'. Adding
0050		5.00' of 6" casing; Total casing is 131.80'. Hole @ ~127' @ 0050hrs
		Adding pipe @ 0130hrs (5.00'); Total string is 137.80'. Total casing is 141.80' - Added 5.00' of pipe. Hole @ 138' - 0200hrs. Addy 5.00' of 6"; total string is 146.80 @ 0225hrs; hole @ 143' - Lunch.
		Drilling continues @ 0310hrs. Collecting split spm 147.5-150 @
0300hrs		0330hrs. Adding 5' of 6" casing @ 0340hrs; string is 154.80'. Adding 5.0' @ 0405hrs; total string is 156.80'. + 5' of casing @ 0430 hrs. total string is 161.80'. + 5' of 0500hrs; total string is 166.80'. + 5" of casing; total string is 171.80'. @ 0700hrs hole @ 176'; adding 5.00' of 6"; Total string is 176.80'.
0720		Crew completed drill during shift @ 0720hrs. Moving equipment
		NA
Reported By: <u>Kevin Singlet</u>		Reviewed By: <u>DC Weekes</u>
Title: <u>Geologist</u>	Date: <u>08-8-01</u>	Title: <u>Geologist</u> Date: <u>10/19/01</u>
Signature: <u>[Signature]</u>		Signature: <u>[Signature]</u>

BHI-EE-018 (12/97)

Appendix A - Borehole Geologic Logs

BHI-01607

Rev. 0

FIELD ACTIVITY REPORT DAILY DRILLING				Page <u>1</u> of <u>1</u>					
				Date: <u>8-9-01</u>					
Well Name: <u>C3104</u>			Well ID: <u>C3104</u>						
Location: <u>200 East 216-B-38</u>			Report No.: <u>7</u>						
Start		Finish		Total					
Time <u>2130</u>		Time <u>0900</u>		Time <u>10</u>					
Hole/Depth/Csg <u>175.5</u> ¹⁷⁷ <u>175.5</u>		Hole/Depth/Csg <u>224</u> <u>1222.5</u>		Hole/Depth/Csg <u>42</u> <u>1 42</u>					
Reference Measuring Point: GROUND SURFACE			Casing String No. 1 2 <u>3</u> 4 _ See Report No. 1						
Time / Depth		Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)							
From	To								
2130		<p>Crew onsite @ 2130. Plan of the day conducted by Ed RaFue. Job scope include: drilling, sampling, decon, measure water level in nearby wells. Safety topics, weather, beat stroke. Drilling commenced @ 2150 hrs. Drilling stopped @ 2152 hrs by K.M. Singleton as directed by Ed RaFue. Drilling stopped as I H Tech having equipment problems (lacking spacers). Ed provides the OK to proceed with drilling with AM-PM I H coverage. Drilling @ 2257 hrs. Adding 5.00' of 6" casing; Total string is 181.80. I H Tech onsite @ 0002 hrs. Depth @ 185' @ 0012 hrs; adding 5.00' casing - total string is 186.80. @ 0110 hrs adding 5.00' casing; total string is 191.80. @ 0150 adding 5.00' casing; total string is 196.80. 0230 hrs Lunch - Drilling continues @ 0303 hrs. Drill split spacers for chem. sample @ 0310 hrs. Adding 5.00' @ 0330 hrs. Total string is 201.80. Adding more pipe (5.00') @ 0415 hrs total string is 206.80. Adding more pipe (5.00') @ 0500 hrs; total string is 211.80. Hole in @ 207' Hole @ 215 @ 0605 hrs; add 5.00' of 6" casing; Total string is 216.80' @ 0650 hole to 217.5; adding 5.00' casing; Total string is 221.80. Adding 5.00' casing @ 0745 hrs; Total string is 226.80. Hole @ 227'</p> <p style="text-align: center;">NA</p>							
2145									
2255									
0650									
0745									
						NA			
						NA			
						NA			
						NA			
						NA			
Reported By: <u>Kevin Singleton</u>			Reviewed By: <u>DCWeekes</u>						
Title: <u>Geologist</u>		Date: <u>8-9-01</u>		Title: <u>Geologist</u>					
Signature: <u>[Signature]</u>		Date: <u>10/19/01</u>		Signature: <u>[Signature]</u>					

BHI-EE-018 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING		Page <u>1</u> of <u>2</u>	
		Date: <u>8-9th 10-01</u>	
Well Name: <u>NA C3104</u>		Well ID: <u>C3104</u>	
Location: <u>200 East 216-13-38</u>		Report No.: <u>8</u>	
Start	Finish	Total	
Time <u>2130hrs</u>	Time <u>0700</u>	Time <u>9</u>	
Hole/Depth/Csg <u>224 2225</u>	Hole/Depth/Csg <u>263.5 258.6</u>	Hole/Depth/Csg <u>39.5 32.1</u>	
Reference Measuring Point: GROUND SURFACE		Casing String No. 1 2 <u>3</u> 4 _ See Report No. 1	
Time / Depth		Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To		
<u>2130</u>		<u>Crew onsite @ 2130hrs. Ed Rafine presented the plan of the day. Scope includes, drilling, sampling, measuring, inventory sampling equipment. Ed reviewed changes to the H&S Plan. Preparing to</u>	
<u>2146</u>		<u>drill @ 2146hrs. Drilling @ 2200hrs. Borehole to 228' @ 2250hrs - adding 5.00' of 6" casing; total casing string is 231.80. Hole to 34.5' @ 2330hrs. Adding 5.00' of 6" casing. Total string is 236.80</u>	
		<u>Borehole to 240' @ 0034hrs; adding 5.0' of 6" casing; total string is 241.80</u>	
		<u>Borehole to 246' @ 0145hrs; adding 5.0' of 6" casing; Total string is 246.80'. Lunch @ 0230hrs. Drilling continues @ 0305hrs.</u>	
<u>0320</u>		<u>Hole to 250' @ 0330hrs. Add 5.0' casing; Total casing</u>	
<u>0430</u>		<u>string is 251.80. Hole @ 255'; Adding 5.00' @ 0430hrs. Total string is 256.80. Hole to 260' @ 0530hrs. Adding</u>	
		<u>5.00' of casing; Total string is 261.80. Driving split spoon</u>	
<u>0600</u>		<u>@ 0600 hrs. From 261.0-263.5. End of shoe is wet. Drilling is done. Great job team. Water table @ 263'</u>	
		<u>Note: Geology Backfill 0-15'</u>	
		<u>Hanford Gravel 15-30.5'</u>	
		<u>Hanford Sand 30.5-218.5</u>	
		<u>HF/PPH? 218.5</u>	
		<u>water table 263' below ground surface.</u>	
		<u>NA</u>	
Reported By: <u>Kevin Singleton</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>	Date: <u>8-10-01</u>	Title: <u>Geologist</u>	Date: <u>10/19/01</u>
Signature: <u>[Signature]</u>		Signature: <u>[Signature]</u>	

BHI-EE-018 (12/97)

Appendix A - Borehole Geologic Logs

BHI-01607

Rev. 0

FIELD ACTIVITY REPORT											Page 2 of 2	
TUBULAR GOODS TALLY											Date: 8-10-01	
Well Name: <i>HA C3104 8" ID</i>						Well I.D.: <i>C3104</i>						
String #1 TEMPORARY		String #2		String #3 PERMANENT		TEMPORARY		SCREEN/GAP				
Jt.#	Length (ft.)	Jt.#	Length (ft.)	Jt.#	Length (ft.)	C	Jt.#	Length (ft.)	C	Jt.#	Length (ft.)	Jt.#
1	0.38 head	21	1.08 head	1	0.55 100 head		21	5.00		1	5.00	
2	0.87 shoe	22	1.06 shoe	2	1.00 shoe		22	5.00		2	5.00	20.00
3	4.00	23	10.07	3	9.95		23	5.00		3	5.00	
4	5.01	24	10.01	4	9.94		24	5.00		4		
5	5.00	25	10.01	5	9.92		25	5.00		5		
6	5.00	26	10.01	6	10.00		26	5.00		6		
7	5.02	27	10.00	7	10.00		27	5.00	18.8	7		
8	5.02	28	10.00	8	9.95		28	5.00		8		
9	5.02	29	5.01	9	10.00		29	5.00		9		
10	5.00	30	5.00	10	10.00		30	5.00		10		
11	4.33	31	5.00	11	10.02		31	5.00		11		
12	4.67	32	5.00	12	10.00		32	5.00		12		
13	4.37	33	5.00	13	10.00		33	5.00	24.80	13		
14	4.63	34	5.00	14	5.02		34	5.00		14		
15		35	5.00	15	5.00		35	5.00		15		
16		36	5.00	16	5.00		36	5.00	22.8	16		
17		37	5.00	17	5.00		37	5.00		17		
18		38	5.00	18	5.00		38	5.00		18		
19		39		19	5.00		39	5.00		19		
20		40		20	5.00		40	5.00	24.80	20		
Tot	58.27	Tot	112.14	Tot	→		Tot	246.80		Tot	761	80

*Indicate those joints with centralizers with a C in the available box.
 ALL casing length shall be measured to the nearest 0.01 ft.

Comments/Remarks:
None

Temporary: O.D./I.D. <i>?</i>	Permanent: O.D./I.D. <i>NA</i>	Screen: O.D./I.D. <i>NA</i>
<i>String #1</i>	<i>0.87' ID, 0.98' O.D</i>	
<i>String #2</i>	<i>0.63' ID, 0.72' O.D</i>	
<i>String #3</i>	<i>0.55' ID, 0.55' O.D</i>	<i>800</i>
<i>NA</i>		

Reported By: <i>Kevin Singleton</i>	Reviewed By: <i>DC Coker</i>
Title: <i>Geologist</i>	Date: <i>8-10-01</i>
Signature: <i>[Signature]</i>	Title: <i>Geologist</i>
	Date: <i>10/19/01</i>
	Signature: <i>[Signature]</i>

BHI-EE-182 (12/97)

Appendix A – Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING		Page <u>1</u> of <u>1</u>
		Date: <u>8/13</u> → <u>8/14/01</u>
Well Name: <u>NA C3104</u> 10-11-01		Well ID: <u>C 3104</u>
Location: <u>200 East / 216-B-38</u>		Report No.: <u>109</u> 10/19/01
Start Time: <u>2130</u>	Finish Time: <u>0800</u>	Total Time: <u>10 hrs</u>
Hole/Depth/Csg: <u>NA -</u>	Hole/Depth/Csg: <u>NA -</u>	Hole/Depth/Csg: <u>NA -</u>
Reference Measuring Point: GROUND SURFACE		Casing String No: <u>B②③ 4</u> See Report No. 1 <u>NA</u> Borehole Abandonment
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To	
2130	2150	Plan ^w of the Day held at the site trailer. Led by E. Refuse, BHI-STR.
2150		Resume backpull of the 6" temporary casing, and backfilling with bentonite chips. See Well Completion Log sheets for details. Shift begins with 6" casing shoe 228 feet below ground surface.
2230 1024		Switch from bentonite chips (medium) to bentonite crumbles (Cetco granular bentonite crumbles #8)
2-11 0125		All 6" temporary casing out of the ground. Bentonite crumbles up into the 8" temp. casing, which is set 111' bgs.
0200		Begin backpulling the 8" casing, backfilling with bentonite crumbles.
0230	0300	Lunch break.
	0500	All 8" temp. casing is out of the ground. The granular bentonite is at 57.9' bgs - the 12" casing is set at 58' bgs.
		Drill crew secures the drill site. The crew then works to set up the drill rig at the next TW-2 borehole (a different rig than is set up at C3104)
	0600	Walker leaving site. The crew will continue setting up to 0800.
<u>NA</u> →		
Reported By: <u>L.D. Walker</u>		Reviewed By: <u>Kevin Singleton</u>
Title: <u>Geologist</u>	Date: <u>8-14-01</u>	Title: <u>Geologist</u>
Signature: <u>[Signature]</u>		Signature: <u>[Signature]</u>

BHI-EE-018 (12/97)

Appendix A – Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING			Page <u>1</u> of <u>1</u>
			Date: <u>9/6 & 7/01</u>
Well Name: <u>C3104</u>		Well ID: <u>C3104</u>	
Location: <u>214-B-38 Trench</u>		Report No.: <u>H 10 per 10/19/01</u>	
Start	Finish	Total	
Time <u>2130</u>	Time <u>0340</u>	Time <u>~ 7.0</u>	
Hole/Depth/Csg <u>57.8 / 57.77</u>	Hole/Depth/Csg <u>NA / NA</u>	Hole/Depth/Csg <u>46.3 / 53.14</u>	
Reference Measuring Point: GROUND SURFACE		Casing String No. <u>1 2 3 4</u> <u>NA 10-1101</u>	
		See Report No. 1	
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)		
From	To	Weather <u>50's</u> , Wind <u>30's mph</u>	
2130	2200	POD. Work for Saturday Possible. Ed working details. Back Pull B-38 12" casing tonight.	
2200	2355	Prep for back pulling: Reposition drill rig, bentonite chips, pallets for casing, slewing for casing, rags from 7A CA zone, Assemble knocker head	
2355	0215	Begin back pulling & continue back pulling	
0215	0255	Lunch	
0310	0340	Continue Back Pulling	
0340		Stop work due to chipped clutch on Spudding Arm. Causing dangerous work environment and not able to pull casing.	
Summary			
1) Pull 4.63' of casing			
2) Back filled 11.5' with Bentonite Chips			
3) Work cut short by unsafe mechanical equipment & unable to continue to pull casing effectively.			
<u>NA</u>			
Reported By: <u>Greg Thomas</u>		Reviewed By: <u>Kevin Singletor</u>	
Title: <u>Geologist</u>	Date: <u>9/7/01</u>	Title: <u>Geologist</u>	Date: <u>10-11-01</u>
Signature: <u>Greg Thomas</u>		Signature: <u>[Signature]</u>	

WELL COMPLETION LOG											Page 2 of 4	Date: 8-13-01
Well Name: <u>NA C3104 10-11-01</u>						Well ID: <u>C3104</u>				Drilling Contractor: <u>RST</u>		
Project: <u>200-TW-2</u>				Location: <u>200 East 216-B-38</u>				Fill Material: <u>NA</u>				
1. Time	2. Total Casing	3. Stkup	4. Btm Csg	5. Tape Reading	6. Correction	7. Cor Tape Reading	8. Fill Depth	9. Overlap	Type	Amt	Unit	Comments
2350	266.80	7.3	259.5	269.4	NA	NA	262.1 264.4	2.6	SAND 10-40	1	1 Bag	Water Table c. 263
0000	266.8	7.3	259.5	263.0			255.7	11.1				263-2529 Fill c. SAND
-5 0006	266.8	9.0	257.8 256.6	265.6			256.6	1.20	SAND	1	Bag	
0012	261.8			254.2								
-5 0020	261.8	9.0	252.8	241.9			252.9	0.1	cement	6	Bags	Casing added @ 0440hrs
0510	256.8	4.0	252.8	235.5			231.5	21.3				Running Time
0557	241.8	5.4	236.4	-			-	-	scumbls	1/2	Bag	
-5 0605	241.8	5.4	236.4	232.10			233.7	2.7	scumbls	1/2	Bag	
0640	236.8	4.0	232.8	237.0			233	0.2	-	-	-	
0705	236.8	7.0	229.8	237.0			230	0.2	-	-	-	
0715	236.8	8.7	228.1	237.1 236.8			228.4 226.4	0.3 0.6	-	-	-	
082155	236.8	8.7	228.1	233.9			225.2	2.9	Bentonite chips	1	50-lb bag	Add bentonite
2200	236.8	9.5	227.3	236.1			226.6	0.7	NA			Pull casing
2210	231.8	5.2	226.6	221.9			216.7	9.9	Bent. chips	4	50-lb. bag	Remove 5.0' casing / Add bent
2225	226.8	5.5	221.3	230.0			224.5	3.2	NA			Pull/remove 5.0'
2235	226.8	5.5	221.3	203.2			197.7	23.6	bent. crumbles	10	50-lb bag	Add bentonite
2240	221.8	5.6	216.2	208.9			203.3	12.9	NA			Pull/remove 5.0' casing
2248	216.8	5.2	211.6	210.2			205.0	6.6	NA			Pull/remove 5.0'
2310	216.8	5.2	211.6	190.8	✓	✓	185.6	26.0	bent. crumbles	5	50-lb bag	Add bentonite

Note: Col. 2 - Col. 3 = Col. 4 - Col. 5 - weight and attachments = Col. 7; Col. 7 - Col. 3 = Col. 8; Col. 4 - Col. 8 = Col. 9

Reported By: <u>L. D. Walker</u>	Reviewed By: <u>Kevin Singleton</u>
Title: <u>Geologist</u>	Date: <u>8-13-01</u>
Signature: <u>[Signature]</u>	Signature: <u>[Signature]</u>
Date: <u>10-11-01</u>	

WELL COMPLETION LOG											Page <u>25</u> of <u>4</u>	
Well Name: <u>NA C3104 #10-401</u>											Well ID: <u>C3104</u>	Date: <u>8-13-01</u>
Project: <u>200-TW-2</u>				Location: <u>200 East; 216-B-38 trench</u>				Drilling Contractor: <u>RSI</u>				
1.	2.	3.	4.	5.	6.	7.	8.	9.	Fill Material			Comments
Time	Total Casing	Stkup	Btm Csg	Tape Reading	Correction	Cor Tape Reading	Fill Depth	Overlap	Type	Amt	Unit	
2320	201.8	5.6	196.2	195.9	NA	NA	190.3	5.9	NA			Pull/remove 15.0' casing
2325	201.8	5.6	196.2	172.2			166.6	29.6	bent. crumbles	6	50-lbs bag	Add bentonite
2335	186.8	5.5	176.3	178.1			172.6	3.7	NA			Pull/remove 20.0'
2341	181.8	5.5	176.3	146.7			141.2	35.1	bent. crumb.	8	50-lb bag	Add bentonite
2355	161.8	5.5	156.3	153.3			147.8	8.5	NA			Pull/remove 20.0'
8-14-01 0015	161.8	5.5	156.3	132.8			127.3	29.0	bent. crumb.	5	50-lbs bag	Add bentonite
0025	141.8	5.7	136.1	139.0			133.3	2.8	NA			Pull/remove 20.0'
0030	141.8	5.7	136.1	107.3			101.6	34.5	bent. crumbles	8	50-lbs bag	Add bentonite
0041	121.8	5.6	116.2	117.0			111.4	4.8	NA			Pull/remove 20.0'
0045	121.8	5.6	116.2	92.4			86.8	29.4	bent. crumb.	6	50-lbs bag	Add bentonite
0125	All	6" out of borehole.										Pull/remove all 6" casing
0200	112.1	1.1	111.0	99.7			98.6	12.4	NA			8" casing
0202	112.1	1.1	111.0	94.5			93.4	17.6	bent. crumble	2 1/2	50-lbs bag	Add bentonite
0214	102.1	2.6	99.5	99.0			96.4	3.1	NA			Pull/remove ^{10.0' w} 5.0' casing
0310	102.1	2.6	99.5	77.3			74.7	24.8	bent. crumbles	10	50-lbs bag	Add bentonite
0330	92.1	4.2	87.9	85.5			81.3	6.6	NA			Pull/remove 10.0'
0336	92.1	4.2	87.9	63.7			59.5	28.4	bent. crumb.	10	50-lbs bag	Add bentonite
0345	82.1	3.0	79.1	66.7			63.7	15.4	NA			Pull/remove 10.0'
0355	77.1	3.3	73.8	68.0			64.7	9.1	NA			Pull/remove 5.0'

Note: Col. 2 - Col. 3 = Col. 4 - Col. 5 - weight and attachments = Col. 7; Col. 7 - Col. 3 = Col. 8; Col. 4 - Col. 8 = Col. 9

Reported By: <u>L.D. Walker</u>				Reviewed By: <u>Kevin Singletta</u>			
Title: <u>Geologist</u>		Date: <u>8-14-01</u>		Title: <u>Geologist</u>		Date: <u>10-11-01</u>	
Signature: <u>[Signature]</u>				Signature: <u>[Signature]</u>			

Borehole Summary Report (C3103, C3104, C3340 to C3344), 200-TW-2 OU
April 2002

A-27

WELL COMPLETION LOG												
Well Name: C3104										Well ID: C3104		
Project: 200-TW-2-					Location: 200 E 216-B-3B				Drilling Contractor: RSI			
1.	2.	3.	4.	5.	6.	7.	8.	9.	Fill Material			
Time	Total Casing	Stkup	Btm Csg	Tape Reading	Correction	Cor Tape Reading	Fill Depth	Overlap	Type	Amt	Unit	Comments
0019	63.27	5.5	57.77	63.3		63.3	57.8					
0028	63.27	6.5	57.77	50.0		50.0	44.5	13.27	bentonite chips	12	bags	
0130	53.64	.3	53.64	46.1		46.1	45.8	7.84				Removed ^{4.63'} casing & knockerhead 5'
0340	53.64	4.0	49.64	50.3		50.3	46.3	3.34				
End of Shift Friday AM the 7 th September												
0720	53.64	4.0	49.64	42.7		42.7	38.7	10.9	bentonite chips	8	bags	
0745	49.19	0.2	48.99	39.7		39.7	39.5	9.2				
2340	44.12	0.2	43.92	40.4		40.4	40.2	3.72	bentonite chips	33	bags	972-01 2312 backpulling
0000	44.12	0.2	43.92	1.2		1.2	1.0	4.292		1	bag	
0002	44.12	0.6	43.52	1.2		1.2	0.6	4.292		3	bags	9-13-01 0002ars
0015	44.12	2.0	42.12	0.4	press. bot.	0.4	0.4	4.372				Fill 150.4' below top of casing
0030	39.12	0.2	38.92	-		-	-	-				
0035	34.12	0.3	33.82	-		-	-	-				
0041	29.12	0.5	28.62	2.5		2.5	2.0	26.62				
0054	24.12	0.3	23.82	-		-	-	-				
0100	19.12	0.3	18.82	-		-	-	-				
0110	14.12	0.3	13.82	6.3		6.3	6.0	7.82'				
0120	9.12	0.4	8.72	7.1		7.1	6.7	2.02	bentonite chips	4	bags	

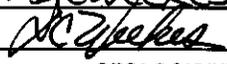
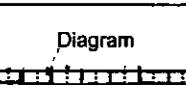
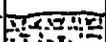
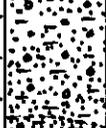
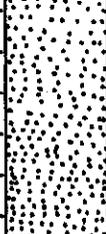
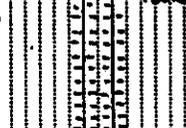
Note: Col. 2 - Col. 3 = Col. 4 - Col. 5 - weight and attachments = Col. 7; Col. 7 - Col. 3 = Col. 8; Col. 4 - Col. 8 = Col. 9

Reported By: Greg Thomas	Reviewed By: Kevin Simola
Title: Geologist	Title: Geologist
Date: 9/7/01	Date: 10-11-01
Signature: Greg Thomas	Signature: [Signature]

2.5/5.8
 9-11
 4.45
 -5.00
 -5.00
 -5.00
 -5.00
 -5.00
 -5.00
 -5.00
 -5.00

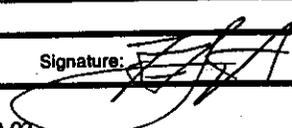
WELL COMPLETION LOG												
Well Name: 200-TW-2 <i>C3104</i>						Well ID: <i>C3104</i>			Page <i>5</i> of <i>7</i> Date: <i>9-13-01</i>			
Project: <i>200-TW-2</i>				Location: <i>200 East 216-B-38</i>				Drilling Contractor: <i>RSI</i>				
1.	2.	3.	4.	5.	6.	7.	8.	9.	Fill Material		Comments	
Time	Total Casing	Stkup	Btm Csg	Tape Reading	Correction	Cor Tape Reading	Fill Depth	Overlap	Type	Amt		Unit
<i>0129</i>	<i>9.12</i>	<i>.04</i>	<i>8.72</i>	<i>2.9</i>		<i>2.9</i>	<i>2.5</i>	<i>6.62</i>				
<i>0131</i>	<i>4.12</i>	<i>0.3</i>	<i>3.8</i>	-	-	-	-	-	<i>bentonite chips</i>	<i>1</i>	<i>bag</i>	
<i>0140</i>	<i>4.12</i>	<i>0.3</i>	<i>3.8</i>	<i>4.0</i>	-	<i>4.0</i>	<i>3.7</i>	<i>0.1</i>	<i>bentonite</i>	<i>1</i>	<i>bag</i>	
<i>0145</i>	<i>0</i>	<i>0</i>	<i>0</i>	-	-	-	<i>-3.7</i>	-	<i>concreat</i>	<i>1</i>	<i>bag</i>	
<i>0150</i>	-	-	-	-	-	-	<i>-2.5</i>	-				
<i>0155</i>	-	-	-	-	-	-	<i>2.0</i>	-				
												<i>Cement to 2' below ground surface, survey marker also add. 2' of gravel drill pad will be removed later in the year. The survey mark for C3104 will be at the surface</i>
Note: Col. 2 - Col. 3 = Col. 4 - Col. 5 - weight and attachments = Col. 7; Col. 7 - Col. 3 = Col. 8; Col. 4 - Col. 8 = Col. 9												
Reported By: <i>Kevin Singleton</i>						Reviewed By: <i>DC Wecker</i>			Date: <i>10/19/01</i>			
Title: <i>Geologist</i>				Date: <i>9-13-01</i>		Title: <i>Geologist</i>			Date: <i>10/19/01</i>			
Signature: <i>[Signature]</i>						Signature: <i>[Signature]</i>						

Appendix A - Borehole Geologic Logs

WELL SUMMARY SHEET				Page <u>1</u> of <u>1</u>	
				Date: <u>10-02-01</u>	
Well ID: <u>C3103</u>		Well Name: <u>C3103</u>			
Location: <u>200 East 216-B-7A</u>		Project: <u>200-TW-2</u>			
Prepared By: <u>Kevin Singleton</u>		Date: <u>10-20-01</u>		Reviewed By: <u>DC Weekes</u>	
Signature: 		Date: <u>10-20-01</u>		Signature: 	
CONSTRUCTION DATA			GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description	
10-40' ^{10-34'} cement		0		0-2.5 GRAVEL	
12" ID, 12.5' OD to 50.7' 8" ID, 8.9' OD casing to 130.5' with shoe hole is 9"		0-23		2.5-35 Silty SANDY GRAVEL	
6" ID, 6.5' OD casing to 218' 6.5' hole to 219' 4" hole 219-222.5'		23-35		35-40 Gravelly Silty SAND	
All casing was removed from hole. 0-23' Backfill		50		40-168.5 SAND	
23-35 Hanford Formation SAND GRAVEL Dominated Sequence		100			
35-218' Hanford Formation SAND Dominated Sequence		150			
218-222.5' Hanford Formation Plio-Pleistocene Unit - Silt		200			
Hole backfill with bentonite from 222.5'-26' 3.3'		218		172.5 Silty SAND STRINGER	
Cement from 3.3'-26' 2.0'		220		168.5-168.0 Silty SAND	
Gravel 0'-2.0'		220		168.0-180 Slightly Silty SAND	
		220		180-218 SAND	
		220		218-222.5 Silt	
		222.5		END OF HOLE = 222.5' 9/26/01	
All depths in feet below ground surface.					

BHI-EE-189 (12/97)

Appendix A - Borehole Geologic Logs

WELL CONSTRUCTION SUMMARY REPORT				Start Date: 8-21-01			
				Finish Date: 10-2-01			
				Page 1 of 1			
Well ID: C3103		Well Name: C3103		Approximate Location: 200 East 216-B-7A Crib			
Project: 200-TW-2		Other Companies: CHI					
Drilling Company: R.S.I.		Geologist(s): Kevin Singleton					
Driller: Morris Weaspir License #: 1909		Greg Thomas					
TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD	HOLE DIAMETER (in) / INTERVAL (ft)			
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger Cable-tool	Diameter 7" From 0 to 56.5			
6 5/8 OD Thread	0 - 56.5	7" OD	Cable Tool: ✓	Diameter 9" From 56.5 to 137.5			
1 1/4" OD Thread	0 - 50.7'		Air Rotary: Cable-tool	Diameter 7" From 137.5 to 222.5			
8 5/8 OD Thread	0 - 130.5'	9" OD	A.P. Sonic: Cable-tool	Diameter 4" From 218' to 222.5'			
6 5/8 OD Thread	0 - 218'	7" OD	Diesel hammer →	Diameter 1 3/4" From 0 to 50.75			
				Diameter _____ From _____ to _____			
				Diameter _____ From _____ to _____			
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design							
Drilling Fluid: None Used							
Total Drilled Depth: 222.5		Hole Dia @ TD: 7"		Total Amt. Of Water Added During Drilling: None Used			
Well Straightness Test Results: NA		Static Water Level: NA		Date: NA			
GEOPHYSICAL LOGGING							
Sondes (type)	Interval	Date	Sondes (type)	Interval	Date		
Spectral Gamma/Neutron Moisture	0 - 56.5	8-28-01	NA				
Spectral Gamma/Neutron Moisture	56.5 - 137.5	9-24-01	NA				
Spectral Gamma/Neutron Moisture	137.5 - 222.5	9-27-01	NA				
COMPLETED WELL							
Size/WL/Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
NA							
OTHER ACTIVITIES							
Aquifer Test: NA		Date:	Well Decommission:	Yes: ✓	No:	Date: 10-2-01	
Description:			Description: 222.5' - 3.3' Bentonite, 3.3' - 2.0' Cement				
WELL SURVEY DATA (if applicable)							
Washington State Plane Coordinates:			Protective Casing Elevation: NA				
			Brass Survey Marker Elevation: NA				
COMMENTS/REMARKS							
* 6 5/8" Drilled to 56.5' and removed. Used diesel hammer as a core push to advance borehole to 50.7' with 1 1/4" casing. All casing was removed from borehole after reaching total depth.							
Reported By: Kevin Singleton		Title: Geologist		Signature: 			
Date: 9-12-01							

BHI-EE-181 (07/27/2001)

Appendix A – Borehole Geologic Logs

BOREHOLE LOG				0540402	Page 1 of 8
Well ID: C3103		Well Name: C3103 NA 192361		Location: 200 EAST 216-B-7A	Date: 8-22-01
Project: 200-TW-2			Reference Measuring Point: ground		
Depth (ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
0	DB		0-0.5	0-0.5 Crushed Basalt Gravel - cp-ang	Soil adjacent to boulder is SSG
	SS 2.5-5.0	100% RCY		0.5-2.5 Basalt Boulder >600mm	
5	DB			2.5-7.0 Silty Sandy Gravel 10YR5/3	
	SS 5.5-8.0	100% RCY		strong RX, very poorly sorted, 50% Gravel	
	SS			40% Sand, 10% Silt, mainly mp-vc, ms-cs-basalt	
	DB			MPS, 5.5mm	
10	DB			7.0-12.0 Slightly Silty Gravelly Sand	
	SS 10-12.5	109 Blows 50% RCY		10YR5/3, brown, moist, strong RX, mod sorted	
	SS 12.5-15.0	73 Blows 50% RCY		80% Sand, 10% Gravel, 10% Silt, mainly ms-cs; vcp to fp; 60-70% Basalt, 30-40% others	
	DB			MPS 30mm.	
15	DB			12-21 Silty Sandy Gravel, 10YR5/5	
	SS 18.5-21.0	50% RCY		poorly sorted, moist	
	SS			strong RX, 60% Sand, 25% Gravel, 15% Silt	
	DB			FS-CS; mp-cp, round, mainly basalt (80%)	
20	DB			Wood @ 21'	
	SS 22.5-25.0	100% RCY		2.1-2.5 Silty Sandy Gravel, 10YR3/2	Backfill 0-23'
	SS 25.0-27.5	100% RCY		very dark grayish	Hanford Gravel @ 23'
	SS			brown, vps, wood from 21-23, very moist, < saturated, wood is wet, RX none @ 23, occas-	
25	DB			white-non carbonate in matrix, 50% Sand	DB - Drive barrel
	SS			30-35% Gravel, 15-20% Silt, ms-vc;	SS - Split spoon
				FP-MP, MPS 50mm	

Reported By: Kevin Singleton Reviewed By: DC Weekes
 Title: Geologist Title: Geologist
 Signature: *[Signature]* Date: 8-24-01 Signature: *[Signature]* Date: 10/23/01

BHI-EE-183 (12/97)

Appendix A - Borehole Geologic Logs

BOREHOLE LOG					Page 2 of 2
Well ID: C3103		Well Name: ^{Mod} AIA C3103		Location: 200-East 216-B-7A	
Project: 200-TW-2				Reference Measuring Point: Ground	
Depth (FL)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
30	OB	50% RCY		25-27.5 SILTY SANDY GRAVEL, 10YR3/2, very dark grayish brown, vps, wet 25-26, sample make from ml H ₂ O	
30.0				No RX, 50% SAND, 30-35% GRAVEL, 15-20% Silt, mostly ms-vcs; Fp-mp, MPS 50mm, mainly basalt?	
32.5	SS				
OB					
35	35.0	75% RCY		27.5-35 SILTY SANDY GRAVEL, 10YR3/2, very dark grayish brown	
	37.5 SS			vps, moist, 65% SAND, 25-30% GRAVEL	
	OB			5-10% Silt, Weak RX, mainly ms-cs; Fp-mp MPS 40mm; Mainly Basalt	
40				35-40 GRAVELLY SILTY SAND, 10YR5/3	
				brown, moist, 75% SAND, 13% GRAVEL, 12% Silt, fs-ms; cp MPS 50mm	
45				40-45 SAND, 10YR5/3, brown, moist	
				mod. sorted, 90% SAND, 10% other	
				mostly ms-cs, No RX, MPS 10mm	
50	48.0			45-50 SAND, 10YR5/2, grayish brown	
	50.2			mod to poorly sorted, No RX, dry	
	SS			90% SAND, 10% others, mainly ms-vcs;	
	OB			Fp, MPS, 10mm	
55					

BHI-EE-183 (12/97)

Appendix A - Borehole Geologic Logs

BOREHOLE LOG					Page 3 of 8
Well ID: C3103					Date: 8-27-01
Well Name: 111 C3103					Location: 200E-216-B-7A
Project: 200-TW-2					Reference Measuring Point: ground
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
60	PINAC Grab DB			50-56.5 SAND, 10YR4/2, dark grayish brown, weak-strong RX, moist well-med sorted, 90-95% SAND, 5-10% other 80-90% Basalt, 10-20% other, very loose, weakly cemented, ms-cs, MPS 6mm	
65				56.5-87 SAND, 10YR4/2, dark grayish brown, weak-med RX, dry-moist, med sorted, 90-95% SAND, mostly UCS-ms, 5% other, MPS 7mm, weakly cemented, 60-70% mafic, 30-40% other	9-21-01 start
70	PINAC Grab DB				
75	SS 72.5-75.0 DB	100% RCY			
80	PINAC Grab DB				
85					

Reported By: Kevin Singleton	Reviewed By: DCubekes
Title: Geologist	Title: Geologist
Signature:	Signature:
Date: 9-22-01	Date: 10/27/01

Appendix A - Borehole Geologic Logs

BOREHOLE LOG					Page <u>4</u> of <u>8</u>
Well ID: <u>C3103</u>		Well Name: <u>N/A</u> <u>C3103</u>		Location: <u>200 E 216-B-7A</u>	
Project: <u>200-TW-2</u>			Reference Measuring Point: <u>Ground</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
80	<u>PNWL</u>			<u>87-116 SAND, 10X R 4/2 dark grayish brown</u> <u>Swack R.V. moist, med sorted, 95%</u> <u>SAND, cs-ms, 5% othrs MPS 4mm</u> <u>60% Brentt - 40% othrs, MPS 4mm</u>	
85					
90	<u>PNWL</u> <u>sample</u>				
95					
97.5		<u>100%</u>			
100	<u>100</u>	<u>RCY</u> <u>85 blows</u> <u>count</u>			
105					
Reported By: <u>Kevin Singleton</u>			Reviewed By: <u>DC Weekes</u>		
Title: <u>Geologist</u>			Title: <u>Geologist</u>		
Signature: <u>[Signature]</u>		Date: <u>9-21-01</u>	Signature: <u>[Signature]</u>		Date: <u>10/23/01</u>

BHI-EE-183 (12/97)

Appendix A - Borehole Geologic Logs

BOREHOLE LOG					Page 6 of 8
Well ID: C3103		Well Name: ^{REV} 417 ¹⁹⁸³⁴ C3103		Location: 200 East	
Project: 200-TW-2		Reference Measuring Point: Ground			
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
140	PNNL GRAB			116-150' SAND, 10F 4/2, dark grayish brown	
145				Weakly cemented @ 145'	
				Cemented zone SAND, 10YR 6/3, dry, ^{-moist} poorly sorted, strong RX, 90% SAND, 10% other, mainly MS-CS-FS, MPS 2mm, 40%-50% gravel	
	148-150			40-50% others	
150				Weakly cement @ 150'	
				150-168.5 SAND, 10YR 6/3 dry, ^{moist} poorly sorted, weakly cemented, weak RX, 90% SAND, most CS-FS, 10-5% Silt	
				MPS 2mm, interstratified ^{with} MS VCS to MS.	
160	PNNL GRAB				
165				168.5-169.0 SILTY SAND, 10YR 5/3 brown, moist	
				poorly sorted, weakly cemented, strong RX to acid	
				75% SAND, mostly MS-VCS, 25% Silt, ← 25-35% Silt	
				Non plastic MPS 2mm	
Reported By: Kevin Singleton			Reviewed By: D. Weekes		
Title: Geologist			Title: Geologist		
Signature: <i>[Signature]</i>		Date: 9-25-01	Signature: <i>[Signature]</i>		Date: 10/23/01

BHI-EE-183 (12/97)

Appendix A - Borehole Geologic Logs

BOREHOLE LOG					Page 7 of 8
Well ID: C3103		Well Name: ^{draw} NA C3103		Location: 200-East 216-B-7A	
Project: 200-TW-2		Reference Measuring Point: Ground		Date: 9-25-01	
Depth (FL)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
170	P/NAL Grab			169-180 Silty SAND Silty ^{SILTY} 7A 9-25-01	
175				10YR 4/3, brown, moist, poorly sorted, weak RX, 85% SAND, CS-VES, 15-10% Silt, 60% matrix - 40% other MPS 3mm, very weakly cemented. Silty SAND stringer @ 172.5	
180	P/NAL Grab			180-190 SAND, 10YR 4/3, brown, moist, poorly sorted, weak RX, 90% SAND, VES-VES, 40% Silt, 60% matrix - 40% other MPS 4mm, weakly cemented	
185				190- SAND, 10YR 5/3, brown, moist, poorly sorted 198 weak RX, 90% SAND, CS-VES, 10% Silt, 60% matrix, 40% other, 7mm, weakly cemented.	
190	P/NAL Grab			198-200 SAND, 10YR 4/3, moist, med sorted weak to no RX, 95% SAND, VES-VES 5% Silt, very few gravel 70% Basalt 30% other MPS 15mm - General 0% Feils	
195					END 9-25-01 @ 195 Slough in hole on 9-24-01 @ 194. Very moist in this zone due to heavy rain last night
Reported By: Kevin Singleton			Reviewed By: DC Weetes		
Title: Geologist			Title: Geologist		
Signature: <i>Kevin Singleton</i>		Date: 10/23/01	Signature: <i>DC Weetes</i>		Date: 10/23/01

BHI-EE-183 (12/97)

Appendix A - Borehole Geologic Logs

BOREHOLE LOG					Page 8 of 8
Well ID: C3103		Well Name: NA C3103		Location: 216-B-7A 200 East	
Project: 200-TW-2		Reference Measuring Point: Ground		Date: 9-26-01	
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type No.	Blows Recovery			
200	PWWL Grab			200- SAND, 10YR6/2, light brownish	
				218.0 gray, moist to nearly dry, med-well sorted, very weak to med RX 90-95% SAND	
				VFS - ms mostly, 5-10% silt, MPS 0.5mm (8.000g)	
				very compacted; also occas. thin clumps with strong RX - indicating this zone is partially weak cemented - 40% small - 60% at fields	
205					
210				@ 210 No to weak RX & uncemented	
215				@ 216 Strong RX to acid, silt content increasing to 12%	
220	219 221.5 35 PWWL 85	100% RCY		@ 26.5-18' 2 mm silt stringers	
				218.0 SILT 10YR6/2, light grayish brown	
				222.5 Very well sorted strong RX	
				Non-plastic, massive bedded, moist	END 9-26-01
					Total depth 222.5'
225				219-219.5 Water saturated sediments	6' casing @ 218'
					SS = split spoon
Reported By: Kevin Singleton			Reviewed By: DC Weekes		
Title: Geologist			Title: Geologist		
Signature:		Date: 9-26-01	Signature:		Date: 10/11/01

BHI-EE-183 (12/97)

Appendix A - Borehole Geologic Logs

BHI-01607
Rev. 0

FIELD ACTIVITY REPORT NO. 1		Page <u>1</u> of <u>2</u>	
DRILLING PLAN		Date: <u>8-21-01</u>	
Use additional pages if req'd.			
Purpose: <u>Drill & sample beneath crib</u>		Location: <u>200 East 216-13-7A</u>	
Well Name: <u>NA^{NEW} C3103</u>		Well ID: <u>C3103</u>	
Drig. Co.: <u>RST</u>		Rig No.: <u>40-22-521</u> Rig Make/Mod.: <u>Buc Cyrus</u>	
Casing String No. <u>(1) 2 3 4</u>	Drilling Method	Circulation	D.H. Hammer
Casing Size <u>5 5/8 ID</u> <u>6 5/8 OD</u>	Auger <u>NA</u>	Air <u>NA</u> Water/Mud <u>NA</u>	Make <u>NA</u>
Grade <u>6 5/8 OD</u>	Rotary <u>NA</u>	Reverse <u>Direct</u>	Model <u>NA</u>
Lbs. Per Ft. <u>NA</u>	Tubex <u>NA</u>	Vol: cfm <u>NA</u>	Choke <u>NA</u>
Material <u>Carbon Steel</u>	Cable Tool <u>✓</u>	gpm <u>NA</u>	Casing Hammer
Type:	Sonic <u>NA</u>	Pressure <u>NA</u> psi	Make <u>NA</u>
Welded <u>Thd.</u>	A.R. w/Sonic <u>NA</u>	Drill Pipe O.D. <u>NA</u>	Model <u>NA</u>
Planned/Actual	Other: _____	Tool Joint Size <u>NA</u>	Bit Size
Set At: <u>60 156.5</u>		Additives <u>NA</u>	Type <u>NA</u>
Shoe OD/ID <u>—</u>			Nozzles <u>NA</u>
Reference Measuring Point:			
GROUND LEVEL			
Drig. Co. <u>RST</u>		Rig No.: <u>40-22-521</u> Rig Make/Mod.: <u>Buc Cyrus</u>	
Casing String No. <u>1 2 3 4</u>	Drilling Method	Circulation	D.H. Hammer
Casing Size <u>11 3/4 8 5/8, 6 5/8</u>	Auger <u>NA</u>	Air <u>NA</u> Water/Mud <u>NA</u>	Make <u>XT 70T</u>
Grade <u>—</u>	Rotary <u>NA</u>	Reverse <u>Direct</u>	Model <u>Environmental</u>
Lbs. Per Ft. <u>—</u>	Tubex <u>NA</u>	Vol: cfm <u>NA</u>	Choke <u>Hammer</u>
Material <u>Carbon Steel</u>	Cable Tool <u>✓</u>	gpm <u>NA</u>	Casing Hammer
Type:	Sonic <u>NA</u>	Pressure <u>NA</u> psi	Make <u>NA</u>
Welded <u>Thd.</u>	A.R. w/Sonic <u>NA</u>	Drill Pipe O.D. <u>NA</u>	Model <u>NA</u>
Planned/Actual	Other: <u>NA</u>	Tool Joint Size <u>NA</u>	Bit Size
Set At: <u>— 50.7, 120.5</u> <u>218.0</u>		Additives <u>NA</u>	Type <u>11 3/4" OD</u>
Shoe OD/ID <u>8 5/8" with 9" shoe</u>			Nozzles <u>Casing</u>
Reference Measuring Point:			<u>Pushed 11 3/4" to 50.7</u>
GROUND LEVEL			
Comments/Remarks:			Estimated Depth to Water
<u>Drilled to 56.5' with 6 5/8" casing. Then 6 5/8" casing removed. ~252'</u>			
<u>hole back fill with sand. Core pushed 11 3/4" ID casing (inter casing 4.5" OD casing (inner and casing) to 50.75'. 8" ID, 8 5/8" OD casing to 130'. 6" ID, 6 5/8" OD. to 218'.</u>			
Reported By: <u>Kevin Singleton</u>		Reviewed By: <u>D. C. Weeks</u>	
Name/Title: <u>Geologist</u>		Name/Title: <u>Geologist</u>	
Signature: <u>[Signature]</u>	Date: <u>8-22-01</u>	Signature: <u>[Signature]</u>	Date: <u>10/23/01</u>

BHI-EE-017 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING			Page <u>1</u> of <u>1</u>
Well Name: <u>NA</u> C3103		Well ID: C3103	
Location: <u>200 EAST 216-B-7A</u>		Report No.: <u>5</u>	
Start Time <u>2130</u>	Finish Time <u>0800</u>	Total Time <u>10</u>	
Hole/Depth/Csg <u>48 47</u>	Hole/Depth/Csg <u>56.5 56.5</u>	Hole/Depth/Csg <u>8.5 9.5</u>	
Reference Measuring Point: GROUND SURFACE		Casing String No. <u>① 2 3 4</u> See Report No. 1	
Time / Depth		Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To		
2130		Crew on site @ 2130 hrs. Site visitors are Jeff Groover & Chuck Hedel (CHI). POD @ 2145 hrs. Wind out of west 5-10 mph; temperature ~ 70°F. Ed Lafuse identified staging area, evacuation procedure, 1st aid procedure. Covered holes and responsibilities for all - drillers, samplers, HPTs, IH.	
		Reviewed G.W.-RWP-138. PPE includes Anti-Cs respirators. Note: Recognition lunch was provided by BHI prior to the POD. Preparing to drill @ ~ 2230 hrs - moving equipment, drums contaminated split spools. Drilling spool 48-50.5 @ 0008 hrs.	
	0110	Adding 5.0' casing @ 0020 hrs, total string is 52'. Drill to 52' @ 0110 hrs. Adding 5.0' casing @ 0125 hrs. Total string is 57'. To total depth / 6" casing to 56.5' @ 0200 hrs.	
	0200	Most of the crew except driller out of zone. Will log hole during the day shift with the moisture and spectral gamma tool.	
		NA	
Reported By: <u>Kenn Singleton</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>	Date: <u>8-28-01</u>	Title: <u>Geologist</u>	Date: <u>10/23/01</u>
Signature: <u>[Signature]</u>		Signature: <u>[Signature]</u>	

BHI-EE-018 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT		Page <u>1</u> of <u>2</u> pages	
DAILY DRILLING		Date: <u>9/5/01</u>	
Well Name: <u>C3103</u>		Well ID: <u>C3103</u>	
Location: <u>B-7A / 200 E</u>		Report No.: <u>6</u>	
Start Time: <u>2130</u>	Finish Time: <u>0206</u>	Total Time: <u>4.5</u>	
Hole/Depth/Csg: <u>56.5' / 52.5'</u>	Hole/Depth/Csg: <u>0 1 0</u>	Hole/Depth/Csg: <u>NA NA</u>	
Reference Measuring Point: <u>GROUND SURFACE</u>		Casing String No. <u>① 2 3 4</u> See Report No. 1	
Time / Depth		Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To	Weather <u>5-35 mph, 7 cloudy, CO'S</u>	
		<u>Pull 6" casing</u>	
<u>2130</u>	<u>2155</u>	<u>POD. weather. Carpenter removed wood, PAPER, a zone. Go with regs for contamination on casing. Drilling equipment wrenches, knocker head from B-3B site. Need new drive plate</u>	
<u>2155</u>	<u>2220</u>	<u>Drillings to other site</u>	
<u>2220</u>	<u>2345</u>	<u>Prep. Go over RSP. Dress</u>	
<u>2345</u>	<u>0000</u>	<u>Prep / cut sleaving, remove equipment from bags, put in place 16 5' gallon buckets of 10/20 silica sand, pallet for casing in RBA zone. Note 5 gallon bucket = 150 lb bag</u>	
<u>0001</u>	<u>0206</u>	<u>Pull casing - See page 2</u>	
Reported By: <u>G Thomas</u>		Reviewed By: <u>K.M. Singleton</u>	
Title: <u>Geologist</u>	Date: <u>9/6/01</u>	Title: <u>Geologist</u>	Date: <u>10-11-01</u>
Signature: <u>[Signature]</u>		Signature: <u>[Signature]</u>	

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Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING		Page <u>1</u> of <u>3</u>
Well Name: <u>NA</u>		Well ID: <u>C3103</u>
Location: <u>R-211a-7A/200E</u>		Report No.: <u>7</u>
Start Time: <u>0600</u>	Finish Time: <u>1430</u>	Total Time: <u>10</u>
Hole/Depth/Csg: <u>0 1 0</u>	Hole/Depth/Csg: <u>3' 1 3'</u>	Hole/Depth/Csg: <u>3' 1 3</u>
Reference Measuring Point: <u>GROUND SURFACE</u>	Casing String No. <u>① 2 3 4</u>	See Report No. 1 <u>79 not 01</u>
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To	
0600	0640	POD, DISCUSS HASP with Drillers (Kelly Olson, Mike Gomez, Darwin Tenney and Theresa Curry Area working in RBA and training requirements Rad Worker T. Survey out tube blocking. Prep 1/2. weather calm & clear. Darwin wants an appropriate seal to stop dust emissions. Discuss Geology Gravels with boulders to 25', sandy gravel to 35' sand to 56.5'. Mike will use visqueen around jacks. Discuss pmcl point. Plan to go to 56' bgs with 12" casing.
0700	0715	Ed Refuse off site to get rags
0715		Prep site. Remove visqueen from wood and form part hole of tent and place in drum 200E-01-0089, position Rig & set blocks & jacks, transport casing measurements on 12" casing Point 2.8' Casing 5.0', 1 x 5.1', Shoe .75' Point Assembly 2.0' 75' Not measured (Decon report on 12" casing) 731-5425 Darwin Call Monday Morning from Darwin
0845		Set point and point assembly 1.0' + 1.0' + 4.8'
0908		Add 5.0' casing Total casing plus Point 5.8'
0915		Add centralizer on inner casing. Took off centralizer.
0923		Set point on Ground Surface.
0931		Add drive head
0934		Add wet Rags around point
Reported By: <u>Greg Thomas</u>	Reviewed By: <u>Kevin Singleton</u>	
Title: <u>Geologist</u>	Date: <u>9/8/01</u>	Title: <u>Geologist</u> Date: <u>10-11-01</u>
Signature: <u>Greg Thomas</u>	Signature: <u>[Signature]</u>	

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Appendix A - Borehole Geologic Logs

BHI-01607

Rev. 0

Time / Depth		Description of Activities/Operations with Depth
From	To	
FIELD ACTIVITY REPORT- DAILY DRILLING		Page <u>2</u> of <u>3</u>
Continuation Page		Date: <u>9/8/01</u>
Well Name: <u>NA-1020</u> <u>C3103</u>		Well ID: <u>C3103</u>
Location: <u>216-B3-7A/200E</u>		Continuation of Report No.: <u>7</u>
0935	0950	Break & Drillers dress in Coveralls
0950		Connect drive head to diesel hammer
0958		Begin pushing casing
1001		Level casing
1008	1042	Realign casing
1042		Continue pushing casing
1052	1102	Work on pump
1103	1104	Continue push (drove 3') 2 cups
1104	1107	hydraulic leak. Clean up. 2 cups leaked (all contained)
1107	1150	Add 5.0' inner & outer casing Total outer casing 10.8'
1150	1155	Prime Diesel Hammer
1150	1156	Diesel Hammer started 3 blows before leak.
1156		Final leak 1 minute free flow ~ 1 Gallon
		Fuel Filter screen ruptured
		Mike (driller) stops leak & works to repair
		Crew contains & absorbs leak. All contained on viscosity of absorbed within 12 minutes. Fluid on casing & drill rig
		Brace on hammer is cracked also.
1210		Darwin calls Rob Debusch to inform of spill.
		Ed Rafuse calls Bruce Ford and leaves message regarding spill
		Ed Rafuse calls Chris Kemp Soil Coordinator No answer
		Ed Rafuse calls Russ Ekbre.
1225	1320	Team discussion on plan for problem: Possible solutions 1) Need to get RWP to pull pile and drill initial 10' for starter for the push with 13 7/8" casing. With that depth of initial hole driller feels confident that any boulders could be pushed out of path. Team believes boulders pushing casing off to side. Plan for the remainder of day is to clean up & call it a day
Reported By: <u>Greg Thomas</u>		Reviewed By: <u>Kevin Singletan</u>
Title: <u>Geologist</u>	Date: <u>9/8/01</u>	Title: <u>Geologist</u> Date: <u>10-11-01</u>
Signature: <u>Greg Thomas</u>		Signature: <u>Kevin Singletan</u>

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Appendix A - Borehole Geologic Logs

BHI-01607

Rev. 0

FIELD ACTIVITY REPORT DAILY DRILLING		Page <u>1</u> of <u>3</u>	
		Date: <u>9/9 & 10/01</u>	
Well Name: <u>NA</u>		Well ID: <u>C 3103</u>	
Location: <u>216-B-7A/200 E</u>		Report No.: <u>8</u>	
Start	Finish	Total	
Time <u>2130</u>	Time _____	Time _____	
Hole/Depth/Csg <u>3' 10³'</u>	Hole/Depth/Csg <u>27' 27'</u>	Hole/Depth/Csg <u>24 24'</u>	
Reference Measuring Point: <u>GROUND SURFACE</u>		Casing String No. <u>(12) 3 4</u>	
		See Report No. 1 <u>79 10-10-01</u>	
Time /Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)		
From	To		
		<i>Site Personnel: Ed Rafuse, Mark Hasey, Mo Wasmer, Dan Curry, Bill Murre, Bryan Rader, Greg Thomas</i>	
2130	2210	POD. Pull B-3B casing & try pushing casing at C3103	
2215		Remove jibs from Rig Cable tool Rig at C3103. Survey 5600 cpm at the top end of the ^{mandrell} drill . Decision to cut cable ~ 20' above ^{mandrell} jibs (2318). Change, new plan decon wire rope, mandrell, drill string and jibs.	
	0100	Complete decon of smearable contamination.	
0130		Drum Containment plastic into 200E-01-0082.	
0145	0655	Stand by	
0655	0735	Prep Mike Gomez, Jerry Beck	
0735	0745	Remove 5.0' outer 11 3/4" casing & Drive head. Also Remove 5.0' inner casing.	
0745	0855	Repair Bent Brace (Not work). Heat alignment Brace for Hammer with torch & pound into place. Weld on support brace.	
0855	0905	Add 5.0' inner, 5.0' outer & Drive head [Total Casing 10.8']	
0905	0933	Set chains on top & bottom of casing to align	
0934		Soft hit & tighten chains	
0937	0950	Prime hammer	
0951		Drive hammer 4 Blows	
0945		Mary Todd & Kevin Singleton Call. Talk to Ed Rafuse regarding work completed Saturday & Sunday. Ask about clean up of diesel leak	
1003	1028	Drive casing & adjust cam along (finish 7 hrs)	
1028		Add 5.0' inner & Outer casing [Total Casing 15.8']	
RCT Coverage Bill Murrex until 11:30, 2 nd RCT 12:30-3:30, 3 rd RCT			
Reported By: <u>Greg Thomas</u>		Reviewed By: <u>Kevin Singleton</u>	
Title: <u>Geologist</u>	Date: <u>9/10/01</u>	Title: <u>Geologist</u>	Date: <u>10-11-01</u>
Signature: <u>Greg Thomas</u>		Signature: <u>[Signature]</u>	

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Appendix A - Borehole Geologic Logs

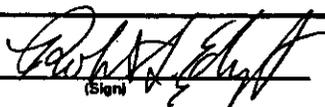
FIELD ACTIVITY REPORT- DAILY DRILLING		Page <u>2</u> of <u>3</u>	
Continuation Page		Date: <u>9/10/01</u>	
Well Name: <u>NA</u>		Well ID: <u>C3103</u>	
Location: <u>216-B-714/200E</u>		Continuation of Report No.: <u>8</u>	
Time / Depth	Description of Activities/Operations with Depth		
From	To		
		4:15 until shut down. Drilling crew can go into RBA without PCT if they desire (ie enter 12:00 prior to 12:30 shift PCT).	
<u>1051</u>		(This according to Bob Demers)	
<u>1035</u>		Mo Whispiv & Dave Curry off site	
<u>1057</u>		Bob Edrington on site	
<u>1108</u>		DRIVE CASING	
<u>1115</u>		Break for lunch - PCT surveys crew out of zone.	
<u>1140</u>		Loud "Bang" noise comes from area of Rig. Driller comes out of lunch trailer, investigates to find that the out back passenger-side tire has blown. Rupture is on top on the outer top edge. This will not affect drilling, as back end of rig is on jacks.	
<u>1152</u>		Driller + Helper back in zone starting ^{up} rig.	
<u>1154</u>		Remove cap, start to add casing 5' inner casing.	
<u>1208</u>		Adding outer casing. Total Casing 20.8'	
<u>1223</u>		Driving casing (10 strokes)	
<u>1225</u>		Pulling cap to add more casing.	
<u>1228</u>		Adding 5' inner	
<u>1232</u>		Adding 5' outer casing. Total Casing 25.8'	
<u>1240</u>		Drive casing (70 strokes)	
<u>1242</u>		Pulling cap to add more casing	
<u>1243</u>		As helper prepares inner casing w/ centralizer, Driller and PSE personnel prepare to bring more casing into zone	
<u>1259</u>		Casing in zone; PCT surveys fork lift forks, Driller adding 5.0' inner casing w/ centralizer.	
<u>1303</u>		Add 5.0' outer casing (~31' casing) Total Casing 30.8'	
<u>1311</u>		Drive casing (375 strokes)	
Reported By: <u>Guy Thomas</u>		Reviewed By: <u>Kevin Singleton</u>	
Title: <u>Geologist</u>	Date: <u>9/10/01</u>	Title: <u>Geologist</u>	Date: <u>10-11-01</u>
Signature: <u>[Signature]</u>		Signature: <u>[Signature]</u>	

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Appendix A - Borehole Geologic Logs

BHI-01607

Rev. 0

FIELD ACTIVITY REPORT SHIFT CONTINUATION SHEET		Continuation of Report No. <hr/> Page <u>3</u> of <u>3</u>
Continuation of Shift <u>9/10/01</u> <small>(Date)</small>	Well/Excavation No. <u>C3103</u>	Operable Unit No. <u>200-TW-2</u>
Description of Operations/Remarks		
<p>1325 - While removing cap, driller notice cracks BRING welder over to repair crack</p> <p>1345 - It is also discovered that the adjustment nut is broken, ^{REF} this means that the cone point has most likely ^{SET} most likely shifted up into the casing</p> <p>1355 - PSI personnel takes adjustment nut into town for repair</p> <p>1400 - Driller welding cracks in drive cap. Russ Faber on site.</p> <p>1416 - finished with welding cap. Driller goes to get jacks</p> <p>1511 - PSI personnel returns w/ adjustment nut, not</p> <p>1525 - Find out new game plan, adjustment nut cant be fixed so, driller is going to back pull casing and try to reset drive point. At that time he will phone the shop the dimensions needed and they will fabricate a solid piece to replace the adjustment nut. They will then send it out to us here and the driller will drive ^{REF} drive casing. PCT Support ENDS at 1545.</p> <p>1540 - LC Swanson calls, I am to return to home base (signature) Russ Faber will supervise operation</p> <p style="text-align: center; font-size: 2em;">NA</p>		
Report By: <u>Robert S. Edrington</u> <small>(Print)</small>	 <small>(Sign)</small>	Date: <u>9/10/01</u>
Title: <u>Geologist</u>		

A-8001-123.1 (03/93)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING		Page <u>1</u> of <u>2</u>
Well Name: <u>AA^{key} C3103</u>		Well ID: <u>C3103</u>
Location: <u>200 East - 216-B-7A</u>		Report No.: <u>11</u>
Start Time: <u>0600</u>	Finish Time: <u>1630</u>	Total Time: <u>10</u>
Hole/Depth/Csg: <u>32' x 32.5</u>	Hole/Depth/Csg: <u>36.5' - 36.5</u>	Hole/Depth/Csg: <u>AA + 111</u>
Reference Measuring Point: <u>GROUND SURFACE</u>	Casing String No. <u>① 2 3 4</u>	<u>4.5' / 4.5</u>
	See Report No. 1 <u>9-18-01</u>	<u>10-11-01</u>
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To	
0600		Crew on site @ 0600 hrs. Ed Rofar conducted the POD. Temperature - 58°F; Wind 07 mph. Plan: Backpull inner wall casing, set 10 3/4" @ 70' center casing. Reduce casing size to 8", drill to 100'. POD completed @ 0630 hrs. Driller gathering tools when ready (driller); all tools are obtained the HPT will review the RWP. HPT reviewing RWP GW-152
0635		Rev 0 @ 0635 hrs. Driller, helper and HPT in gear in ant C's
0815		PAPER @ 0815 hrs. Backpulling inner casing. Wind out of the west @ 0816 hrs 6-9 mph. Removing 1 st joint of casing @ 0829 hrs. [5.00']. Removed Joint #2 @ 0840 hrs [5.00']; note inner casing only is being removed. 2 nd joint is contaminated. 3 rd joint out @ 0850 hrs [5.00']. 4 th joint out @ 0855 hrs [5.00'] - 15K spm @ 86'. 5 th joint out @ 0912 hrs. [5.00']; remaining last joint including sub & drive point @ 0926 hrs. Four centralizers also removed with 4" inner wall casing.
0932		@ 0932 hrs hole @ 32'; casing @ 35.10' - 3.10' of overlap in casing. Crew leaving zone @ 0940 hrs. Casing tally correction; Total string is 30.75 - stickup 0.6 = 30.15 (Bottom of casing). Holes @ 32' 1.85' in open hole. HPT having instrument problems. Sounding equipment may not be functioning properly. Sounding instrument are being replaced. Waiting for new instrumentation. Reviewing RWP GW 138-Rev. 3 @ 1215 hrs. @ - Putting putting on drive head / changing tools. New survey equipment also on site & operational. Wind out of the east @ 2-1 mph @ 1311 hrs. - gust to 8 mph. Adding 5.00' + .58 drive head
1341		Total string is 36.33. Driving casing @ 1341 hrs.
Reported By: <u>Kevin Singleton</u>	Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>	Date: <u>9-19-01</u>	Title: <u>Geologist</u>
Signature: <u>[Signature]</u>		Date: <u>10/2/01</u>
		Signature: <u>[Signature]</u>

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Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT- DAILY DRILLING		Page 2 of 2	
Continuation Page			
Well Name: ^{new} NA C3103		Well ID: C3103	
Location: 200 East ^{10/23/01} 216-B-7A		Continuation of Report No.: 11	
Time / Depth		Description of Activities/Operations with Depth	
From	To		
1345		Total string is 36.33' @ 1345. @ 1400 hrs 1 st drive barrel after completing core push out of hole. 0% soil recovered in drive barrel. 60,000 cpm 8,000 cpm BF and 15 cpm δ on drive barrel (smearable). 12 cpm BF & 12 cpm δ on drive barrel @ ~ 32' (smearable). 100 ml on material in drive barrel (window open) 2.5 m R window close - material in drive barrel is 20-40 SAND. No readings provided from HPT in regards to alpha, beta, gamma - material	
1430		to hot - a 20-40 SAND in drive barrel. @ 34.5 1 cpm alpha, 20,000 cpm BF. @ 36' 0 cpm alpha, 20,000 cpm BF. Hole to 36.5'	
1550	1550	Casing to 36.5. 12K beta gamma on soil 0 cpm alpha. Crew undressing @ 1600.	
NA			
Reported By: Kevin Singleton		Reviewed By: DC Weekes	
Title: Geologist	Date: 9-19-01	Title: Geologist	Date: 10/23/01
Signature: <i>[Signature]</i>		Signature: <i>[Signature]</i>	

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Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING		Page <u>1</u> of <u>1</u>
Well Name: <u>C3103</u>		Well ID: <u>C3103</u>
Location: <u>200 East-216-B-7A</u>		Report No.: <u>12</u>
Start Time <u>0600</u>	Finish Time <u>1430</u>	Total Time <u>10</u>
Hole/Depth/Csg <u>36.5 36.5</u>	Hole/Depth/Csg <u>50.75 54</u>	Hole/Depth/Csg <u>17.5 14.25</u>
Reference Measuring Point: GROUND SURFACE	Casing String No. <u>0 2 3 4</u> <u>75 9-14-01</u> See Report No. 1	
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To	
0600		Crew on site @ 0600 hrs. Ed Refuse conducting PDD @ 0605 hrs. Temp: 55°F; Wind 0-1 mph. Topics - parking lot restrictions @ Federal building, housekeeping, moving wood around in the CA. Plan drill to ~40' with 12" casing, downpost, telescope with 8" and drill to ~100'. RWP-6W-13B, Rev 3 new seal by
0630		HPT. Dressing @ 0630 hrs - Full anti Cs - no respirator. Drilling @ 0715 hrs. Wind out of the east. Drive barrel #1 open alpha, 30 Kcpm @ Adding 5.00' of 12" casing; Total string is <u>41.33'</u> measurable contamination detected around the borehole - on ground - the area is being covered in plastic @ 0815 hrs. Redrill to 38.5' @ 0825 hrs. Note: Drilling with rig # 140-22-5211 (Cable tool). Hole to 40' @ 0845 hrs - Open alpha, 5 Kcpm @ on soil. ~0.5 m Rad. Crew out of zone @ 0925 hrs for water; other. Temperature ~70°F - wind 0-3 mph. Crew dressing @
0940		0940 hrs. Drilling continues @ 1000 hrs. Adding 5.00' of casing @
1040		1040 hrs; total string is 46.33. Lunch @ 1130 hrs - Drilling
1230		continues @ 1230 hrs. Turn in anti Cs - no respirator. Adding 5.00' of 12" @ 1320 hrs; Total string is 51.33. Preparing to downsize & down post; hole @ 54' casing @ 50.75. Removing drive
1430		barrel @ 1410 hrs. 1430 hrs single ton off site. Crew down posting.
		NA
Reported By: <u>Kevin Singleton</u>	Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>	Date: <u>9-20-01</u>	Title: <u>Geologist</u> Date: <u>10/23/01</u>
Signature: <u>[Signature]</u>	Signature: <u>[Signature]</u>	

BHI-FR-01A (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING		Page <u>1</u> of <u>1</u>
Well Name: <u>Jeff C3103</u>		Well ID: <u>C3103</u>
Location: <u>200 East 216-B7-A</u>		Report No.: <u>13</u>
Start Time: <u>0600</u>	Finish Time: <u>1630</u>	Total Time: <u>10</u>
Hole/Depth/Csg: <u>57.38' 1 0</u>	Hole/Depth/Csg: <u>114 1 110</u>	Hole/Depth/Csg: <u>60 1 110</u>
Reference Measuring Point: <u>GROUND SURFACE</u>		Casing String No. 1 <u>2</u> 3 4 <u>—</u> See Report No. 1
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To	
0600		Crew on site @ 0600 hrs. P.O.D. presented by Bob Jones @ 0600 hrs. Temp ~ 53°F, Wind - calm. Topics reviewed, 1" thick decontamination facilities, mark safe (i.e. no need to rush, body position, emergency number (376-3800), stay focused. Plan: Reduce hole & casing size to 9" & 8" respectively, drill & sample soils. Crew preparing to
0635		drill @ 0635 hrs. @ 0750 hrs crew telescoping 8" TD casing. Total casing string is 57.33 @ 0827 hrs. - Moving equipment into RBA casing (additional) tables, chairs, drums. Drilling commences @ 0945 hrs
0945		Adding 5.00' of casing @ 0945 hrs - Total string is 62.38. Hole to 62.5' @ 1020 hrs. Adding 5.00' @ 1025 hrs. Total string is 67.38. The hole is clean @ 70.5' @ 1055 hrs. Adding 5.00' of 8" TD casing total string is <u>72.38</u> . Lunch @ 1100 hrs. Drilling continues
1145		@ 1145 hrs. Collecting split spoon 72.5-75 @ 1210 hrs. Add 5.00' of 8" casing @ 1220 hrs. Total string is <u>77.38</u> . Hole to 80' @
1235		1235 hrs. Adding 5.00' of 8" @ 1245 hrs. Total string is <u>82.38</u> . Adding 5.00' of casing @ 1305 hrs. Total string is <u>87.38</u> . Hole to 93.5'
1350		@ 1350 hrs. Adding 5.0' of 8" Total string is <u>92.38</u> . Adding
1410		5.00' of 8" @ 1410 hrs - Total string is <u>97.38</u> . Collecting split spoon sample 97.5-100' @ 1430 hrs. Adding 5.00' of 8" casing @ 1445 hrs. Total string is <u>102.38</u> . Hole to 103 @
1445		1505 hrs. Adding 5.0' of 8" - Total string is <u>107.38</u> @ 1515. Adding 5.00' of 8" casing @ 1530 hrs. Total string is <u>112.38</u> . Hole @ 110'. Crew closing site down for week
		NA NA
Reported By: <u>Kevin Singleton</u>		Reviewed By: <u>DC Weefoes</u>
Title: <u>Geologist</u>	Date: <u>9-21-01</u>	Title: <u>Geologist</u> Date: <u>10/23/01</u>
Signature: <u>[Signature]</u>		Signature: <u>[Signature]</u>

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Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING			Page <u>1</u> of <u>2</u>
Well Name: <u>C3103</u>		Well ID: <u>C3103</u>	
Location: <u>200 EAST - 216-B-7A</u>		Report No.: <u>14</u>	
Start Time: <u>0600hrs</u>	Finish Time: <u>1630</u>	Total Time: <u>10</u>	
Hole/Depth/Csg: <u>114 1110</u>	Hole/Depth/Csg: <u>137.5 1 130.5</u>	Hole/Depth/Csg: <u>23.5 1 30.5</u>	
Reference Measuring Point: GROUND SURFACE		Casing String No. <u>1 3 4</u> See Report No. 1	
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)		
From	To		
0600		Crew on site @ 0600 hrs, except HPT. PDCP 0630hrs. by Ed RaFase. HPT on site @ 0640hrs. Temp. -60°F - Wind - calm. Waiting on cross over sub to run additional 8" casing. Planning to down size within the next 30min @ possible perching horizon / Drill 5' sample - log borehole. Crew in zone @ 0745 preparing to drill. Using different drive head (-0.4)'. Total casing string is 111.98 + 5.00' = <u>117.08'</u> .	
0810		Drilling @ 0810hrs. Collecting MNUG sample @ 0840hrs (Gravel). Adding casing 5.00' @ 0845hrs. Total casing string is 122.08.	
0905		Hole to 126' @ 0905hrs. Adding 5.00' of casing @ 0925hrs. Total string (casing) is 127.08. Hole to 130' @ 0954hrs. Hole	
1002		To 132' @ 1002hrs. Adding 5.00' of casing, total string is 132' (casing). Hole to 134' @ 1025hrs. Hole @ 136.5' @ 1031hrs.	
1037		End drilling & sampling activities @ 1037hrs. Formation saws dominated sequence of the Great Falls Formation. Preparing to geophysically log borehole with spectral gamma & muonstone tool. Logger warming tools up @ 1030hrs.	
NA			
Reported By: <u>Kevin Singleton</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>	Date: <u>9-24-01</u>	Title: <u>Geologist</u>	Date: <u>10/23/01</u>
Signature: <u>[Signature]</u>		Signature: <u>[Signature]</u>	

BHI-EE-018 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT TUBULAR GOODS TALLY										Page 2 of 2			
Well Name: <i>ACV C3103</i>										Well I.D.: <i>C3103</i>			
TEMPORARY <i>10/23/01</i>										PERMANENT		SCREEN/CAP*	
Jt.#	Length (ft.)	Jt.#	Length (ft.)	Jt.#	Length (ft.)	C	Jt.#	Length (ft.)	C	Jt.#	Length (ft.)	Jt.#	
1	50' + .75'	21		1	Point LD		21	6.16 head		1	5.00	112.08	
2	5.0'	22		2	Point LD		22	11.04		2	5.00		
3	5.0'	23		3	4.8	C	23	10.04		3	5.00		
4	5.0'	24		4	5.0		24	10.03		4			
5	5.0'	25		5	5.0	C	25	10.03		5			
6	5.0'	26	drive head	6	5.0		26	5.02		6			
7	5.0' + .58'	27	removed	7	5.0	C	27	5.02		7			
8	5.0'	28	removed	8	5.0		28	5.08		8			
9	5.0'	29	removed	9			29	5.05	112.38	9			
10	5.0'	30		10			30	5.00		10			
11		31		11			31	5.00		11			
12		32		12	Inner casing removed		32	5.00		12			
13		33		13			33	5.00	112.38	13			
14		34		14			34	5.00		14			
15		35		15			35	5.00		15			
16		36		16			36	5.00		16			
17		37		17			37	5.00	112.38	17			
18		38		18			38	5.00		18			
19		39		19			39	5.00	112.38	19			
20		40		20			40	5.00	112.38	20			
Tot	51.33	Tot		Tot	0		Tot	111.98		Tot			

*Indicate those joints with centralizers with a C in the available box.
ALL casing length shall be measured to the nearest 0.01 ft.

Comments/Remarks:
Shoe .75'

Temporary: O.D./I.D.	Permanent: O.D./I.D.	Screen: O.D./I.D.
<i>Inner wall 4.5" OD - inner wall removed from broken on 9-19-01</i>		
<i>outer casing 10 3/4" / 10 3/4"</i>		
<i>8" ID 8 3/4" OD casing 9" shoe</i>		

Reported By: <i>Kevin Singleton</i>	Reviewed By: <i>DC Weekes</i>
Title: <i>Geologist</i>	Title: <i>Geologist</i>
Date: <i>9-24-01</i>	Date: <i>10/23/01</i>
Signature: <i>[Signature]</i>	Signature: <i>[Signature]</i>

BHI-EE-182 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING		Page <u>1</u> of <u>2</u>
		Date: <u>9-25-01</u>
Well Name: <u>27A C3103</u>		Well ID: <u>C3103</u>
Location: <u>200 East - 216-B-7A</u>		Report No.: <u>15</u>
Start Time: <u>0600hrs</u>	Finish Time: <u>1600hrs</u>	Total Time: <u>9</u>
Hole/Depth/Csg: <u>137.5 1-1385</u>	Hole/Depth/Csg: <u>195 1 194</u>	Hole/Depth/Csg: <u>57.5 1 194</u>
Reference Measuring Point: <u>GROUND SURFACE</u>		Casing String No. <u>1 2 3 4</u> See Report No. 1
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To	
0600		Crew onsite @ 0600hrs. PDD presented by Ed RaFuso. Safety topic: First Aid procedures. Plan run 6" drill & sample. Preparing to drill @ 0610hrs. Running 6" casing @ 0850 ~0700hrs. Drilling @ ~0850hrs. Total 6" casing string is 142.29'. Adding 5.0' of casing @ 0910hrs. Total string is 147.29'. Collecting split spoon sample from 148-150 @ ~0945hrs.
1000		Adding 5.00' of 6" @ 1000hrs. Total string (casing) is 152.29'. Adding 5.00' of 6" @ 1025hrs. Total string is 157.29'. Hole to 157 @ 1100hrs. Lunch. Drilling continues @ 1135hrs.
1140		Adding 5.00' @ 1140hrs. Total string is 162.29'. Wind out of the East ~10mph. Temp - 65°F @ 1150hrs. Adding 5.0' of casing @ 1205 @ 1205 hrs. Total string is 167.29'. Adding 5.0' of casing @ 1230 hrs. Total string is 172.29'. Adding 5.00' of casing @ 1330 hrs. total string is 177.29'. To 182.5 @ 1430hrs. Adding 5.00' of 6" casing @ 1429hrs. total string is 182.29'. plus 5.00' of casing @ 1455hrs. Total string is 187.29'. Borehole to 190' @ 1517 hrs. + 5.00' of casing. total string is 192.29'. @ 195' (Hole) @ 1545hrs HPT hrs to leave.
1545		Adding 5.0' of 6" - Total string is 197.29'.
		Not used McAfee 10/23/01
Reported By: <u>Kevin Singleton</u>		Reviewed By: <u>DC Weekes</u>
Title: <u>Geologist</u>	Date: <u>9-25-01</u>	Title: <u>Geologist</u> Date: <u>10/23/01</u>
Signature: <u>[Signature]</u>		Signature: <u>[Signature]</u>

BHI-EE-018 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT TUBULAR GOODS TALLY										Page <u>4</u> of <u>2</u>		
Well Name: <u>AA C3103</u>										Date: <u>9-25-01</u>		
Well I.D.: <u>C31043</u>										Report # <u>15</u>		
TEMPORARY				PERMANENT*				SCREEN/CAP*				
Jt.#	Length (ft.)	Jt.#	Length (ft.)	Jt.#	Length (ft.)	C	Jt.#	Length (ft.)	C	Jt.#	Length (ft.)	Jt.#
1	1.00	1	5.00	1			21			1		
2	1.00	2	5.00	2			22			2		
3	10.02	23	5.00	3			23			3		
4	9.98	24	5.00	4			24			4		
5	10.02	25	5.00	5			25			5		
6	10.04	26	5.00	6			26			6		
7	10.04	27	5.00	7			27			7		
8	9.98	28	5.00	8			28			8		
9	9.96	29	5.00	9			29			9		
10	9.99	30	5.00	10			30			10		
11	10.02	31	5.00	11			31			11		
12	10.05	32	5.00	12			32			12		
13	10.02	33	5.00	13			33			13		
14	5.02	34	5.00	14			34			14		
15	5.03	35	5.00	15			35			15		
16	5.03	36		16			36			16		
17	5.02	37		17			37			17		
18	5.04	38		18			38			18		
19	5.03	39		19			39			19		
20	5.02	40		20			40			20		
Tot	147.29	Tot		Tot			Tot			Tot		

*Indicate those joints with centralizers with a C in the available box.
ALL casing length shall be measured to the nearest 0.01 ft.

Comments/Remarks:
NA

Temporary: O.D./I.D.	Permanent: O.D./I.D.	Screen: O.D./I.D.
<u>6" ID 6 7/8" O.D.</u>		

Reported By: <u>Kevin Singleton</u>	Reviewed By: <u>DC Weekes</u>
Title: <u>Geologist</u>	Date: <u>9-26-01</u>
Signature: <u>[Signature]</u>	Date: <u>10/23/01</u>
Signature: <u>[Signature]</u>	Signature: <u>[Signature]</u>

BHI-EE-162 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING			Page <u>1</u> of <u>2</u> <small>pages</small>
			Date: <u>9-26-01</u>
Well Name: <u>NA C3103</u>		Well ID: <u>C3103</u>	
Location: <u>200-EAST-216-B-7A</u>		Report No.: <u>16</u>	
Start	Finish	Total	
Time <u>0600</u>	Time <u>1600 hrs</u>	Time <u>9.5</u>	
Hole/Depth/Csg <u>195 194</u>	Hole/Depth/Csg <u>222.5 218.0</u>	Hole/Depth/Csg <u>22.5 </u>	
Reference Measuring Point GROUND SURFACE		Casing String No. <u>1 2 3 4</u> See Report No. <u>1</u>	
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)		
From	To		
0600		Crew onsite @ 0600 hrs. POD presented by Ed Rafuse. Plan lubricate rig, drill & sample soil, ~ 60' to total depth. Other topics - dosimeters, data to completion. Preparing to dull	
0630		@ 0630 hrs Drilling @ 0710 hrs. Note heavy rain last night. 1" core barrel out of hole w/ist. Appears the rains from last night enter the borehole. Adding 5.00' of 6" - Total string is	
0742		[202.29] @ 0740 hrs. Fuel truck onsite @ 0742 hrs Drilling is stopped for Fueling. Drilling @ 0800 hrs. Hole to 206' @ 0853 hrs; adding 5.0' of 6" casing total string is [207.29]. JH Tech onsite for AM check @ ~ 0905 hrs. Hole to 210' @ 0940 hrs. Adding 5.0' of 6" @ 0940 hrs. Total string is [212.29]. Adding 5.0' of 6" casing @ 1036 hrs. Total string is 217.29; hole @ 216'	
0940		Lunch @ 1100 hrs. Drilling continues @ 1145. Drill to 118' - Sit - driller having problem retrieving sit. Clutches smoking @ 1225 hrs. Break - to let clutch cool @ 1225 hrs. Cleaned out hole - Drive split spoon 219-221.5. Clutches burning after ~ 7min of back pulling. Break to let clutches cool. Back pulling @ 1320 hrs. Spoon out of hole @ 1330. Top of sample very wet (saturated.) Pulling tools out of hole. Hole will sit ~ 45min to determine if water will accumulate. No water. Driving second split spoon @ 1500 hrs. Hole @ total depth.	
		NA	
Reported By: <u>Kevin Singleton</u>		Reviewed By: <u>DC Weekes</u>	
Title: <u>Geologist</u>	Date: <u>9-26-01</u>	Title: <u>Geologist</u>	Date: <u>10/23/01</u>
Signature: <u>[Signature]</u>		Signature: <u>[Signature]</u>	

BHI-EE-018 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT DAILY DRILLING			Page <u>1</u> of <u>1</u>
Well Name: <u>NA C3103</u>		Well ID: <u>NA C3103</u>	
Location: <u>200 East 216-B-7A</u>		Report No.: <u>17</u>	
Start Time: <u>0600</u>	Finish Time: <u>0635</u>	Total Time: <u>NA</u>	
Hole/Depth/Csg: <u>222.5 218.0</u>	Hole/Depth/Csg: <u>NA NA</u>	Hole/Depth/Csg: <u>NA NA</u>	
Reference Measuring Point: <u>GROUND SURFACE</u>		Casing String No. <u>1 2 ③ 4</u>	
		See Report No. <u>1</u>	
Time / Depth		Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)	
From	To		
0600		Crew onsite @ 0600hrs. Ed RaFase presenting the POD. Plan: Tag water, collect water sample if possible, log borehole with radionuclide logging system & moisture tool; Safety	
0611		topres - body position, continue to work safely. POD over @ 0611hrs	
0620		Moving casing out of RBA @ 0620hrs. E-Tape in hole @ 0630hrs - result is negative - no water in the borehole. Bottom of hole is 220.83, currently 17' of sluff in borehole. Logging	
0635		truck moving into work zone @ 0635hrs.	
		NA	
Reported By: <u>Kevin Singleton</u>		Reviewed By: <u>DCWeekes</u>	
Title: <u>Geologist</u>	Date: <u>9-27-01</u>	Title: <u>Geologist</u>	Date: <u>10/23/01</u>
Signature: <u>[Signature]</u>		Signature: <u>[Signature]</u>	

BHI-EE-018 (12/97)

Appendix A - Borehole Geologic Logs

Time / Depth		Description of Activities/Operations with Depth
From	To	
		FIELD ACTIVITY REPORT- DAILY DRILLING
		- Continuation Page <u>2</u>
		Page <u>1</u> of <u>3</u>
		Date: <u>9-28-01</u>
Well Name: <u>C3103</u>		Well ID: <u>C3103</u>
Location: <u>200 East - 216-B-7A</u>		Continuation of Report No.: <u>18</u>
0600		Crew on site @ 0600hrs. Geophysical logging still in progress
		POD @ 0625 by Ed RaFuse. Safety topic, tripping hazards, body position, new HPT on site. Current temperature ~53°F, Wind 0-1mph. PLAN: survey logging truck & equipment out of hole/zone, check for water in hole, and sample H ₂ O if possible, change drilling tools, and back pull 6" casing.
0635		Geophysical logging completed @ 0700hrs. Tagged bottom of well with E Tape @ ~0715 - No measurable water. Drilling split spoon to get/sample sluff in bottom of borehole - Driving spoon from 218-223' @ 0740hrs. Preparing to back pull 6" casing @ 0750hrs - The sluff/sample will be stored in the drum storage area. Note: 200E-01- 528 0128 see this drum for sluff sample. Drum*. Back pulling @ 0930hrs.
1445		Lunch @ 110hrs. All 6" casing out of hole @ 144hrs - shoe is present. Bentonite crumbles placed from ~223' to 1455
1455		126.5. Driller moving 6" casing out of RBA @ 1455hrs. Additional equipment is needed to pull 8" casing. Drilling planning to go to 100N pipe yard.
		NA
Reported By: <u>Kevin Singletor</u>		Reviewed By: <u>DC Weekes</u>
Title: <u>Geophys</u>	Date: <u>9-28-01</u>	Title: <u>Geologist</u>
Signature: <u>[Signature]</u>		Date: <u>10/23/01</u>
		Signature: <u>[Signature]</u>

BHI-EE-018 (12/97)

Appendix A - Borehole Geologic Logs

FIELD ACTIVITY REPORT - DAILY DRILLING				Page 1 of 1	
				Date: 10-20-01	
Well ID: C3103		Well Name: NA C3103			
Location: 200 East - 216-B-7A		Report No.: 20			
Start Time: 0600		Finish Time: 1530		Total Time: 1530 9	
Hole Depth/Csg: NA NA		Hole Depth/Csg: NA NA		Hole Depth/Csg: NA NA	
Reference Measuring Point: GROUND SURFACE		Casing String No. 1 2 3 4 _____ Rod Size: See Report No. 1			
Time / Depth		Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)			
From	To				
0600		Crew on site @ 0600hrs, exception = HPT & geologist. Geologist on site @ 0610hrs - HPT on site @ 0625hrs. Safety Topic - emergency contacts & numbers - 376-3800, First Aids, Plan: Backpull 12" casing/demonstration with bentonite. P.O.D ends @ 0752hrs. HPT leaving to pick up equipment.			
0945		Moving equipment - pasting CA until 0945hrs. Reversing P.W.P @ 0946hrs. Crew dressing in Anti-Cs. Backpulling 12" @ 1020hrs. Lunch @ 1200hrs. 20' of 12" cut off the hole. Backpulling @ 1300hrs. Backpulling complete @ 1530hrs.			
1530		See page 2 - well completion log.			
Not used DCWeekes 10/23/01					
Reported By: Kevin Singleton		Reviewed By: DCWeekes			
Title: Geologist		Date: 10-20-01		Title: Geologist	
Signature: <i>[Signature]</i>		Signature: <i>[Signature]</i>			
Original to: Document and Information Services, H0-09/HWIS					

BHI-EE-018 (07/27/2001)

Appendix A - Borehole Geologic Logs

BHI-01607

Rev. 0

Page 1 of 2
Date: 9/15/01

WELL COMPLETION LOG

Well Name: <u>AA-C3103</u>		Well ID: <u>C3103</u>		Drilling Contractor: <u>RSL</u>							
Project: <u>B-70/200 E</u>		Location: <u>200 TW 2 - Soil Sampling</u>		Fill Material							
1.	2.	3.	4.	5.	6.	7.	8.	9.	Fill Material	Unit	Comments
Time	Total Casing	Stkup	Btm Csg	Tape Reading	Correction	Cor Tape Reading	Fill Depth	Overlap	Type	Amt	
0005	57.2	0.7	56.5	57.2		57.2			silica	2	1 bucket = 1 50lb bag
0008	57.2	0.7	56.5	49.4		49.4	48.4	8.1	silica	2	Remove 5' casing SK Field
0022	57.2	.7	51.5	50.6		50.6	49.9	1.6		3	
0030	57.2	.7	51.5	41.1		41.1	40.4	11.1			Remove 5' casing
0039	47.2	1.0	46.2								Remove 5' casing
0045	42.2	1.0	41.2								Remove 5' casing
0056	37.2	1.5	35.7								Remove 5' casing
0103	32.2	2.0	30.2	44.5		43.5	41.5		silica	11	
0112	32.2	2.0	30.2	7.0		7.0	5.0	25.2	silica		
0120	27.2	2.5	24.7								Remove 5' casing
0128	22.2	2.0	20.2								Remove 5' casing
0135	17.2	2.5	14.7						silica	5	
0139	17.2	2.5	14.7	+2.0		+2.0	+2.0	16.7	silica		
0144	12.2	2.5	9.7						silica	2	
0157	7.2	2.5	4.7								Remove 5' casing
0206	0										Remove 5' casing
											1' silice, 1' puller band

Note: Col. 2 - Col. 3 = Col. 4 - Col. 5 - weight and attachments = Col. 7; Col. 7 - Col. 3 = Col. 8; Col. 4 - Col. 8 = Col. 9

Reported By: G Thomas Date: 9/15/01 Reviewed By: Kevin Singleton Date: 10-11-01
 Title: Geologist Signature: [Signature]
 Signature: [Signature]

Appendix A - Borehole Geologic Logs

BHI-01607

Rev. 0

WELL COMPLETION LOG										
Well Name: <u>200-TW-2</u>		Well ID: <u>C3103</u>		Location: <u>B-7A/200E</u>		Drilling Contractor: <u>RST</u>		Page <u>4</u> of <u>7</u> pages Date: <u>9-28-01</u>		
1.	2.	3.	4.	5.	6.	7.	8.	9.	Fill Material	Comments
Time	Total Casing	Stkup	Btm Csg	Tape Reading	Correction	Cor Tape Reading	Fill Depth	Overlap	Type	Unit
0935	222.28	5.0	217.28			220.5	215.5	1.7.8	Bentonite	2 Bags
0941	222.28	7.0	215.2			222.3	215.3	0.1	Bentonite	1 Bag
0945	222.28	8.0	214.28			219.6	211.6	2.6.8		
0948	222.28	9.0	213.28			221.3	212.3	0.9.8		
0950	217.28	5.0	212.28	<u>BA 9.230'</u>					Bentonite	1 Bag
0955	217.28	5.5	211.78			213.8	208.3	3.5		
1001	217.28	9.0	208.28			217.4	208.4	0.12	Bent	1 Bag
1003	217.28	4	208.28			208.6	204.6	3.8	Bent	2 Bags
1012	217.28	7	205.28			204.4	197.4	7.8.8		
1016	212.28	10	202.28			209	199	3.2.8	Bent	2 Bags
1020	202.28	5.0	202.28			195.8	190.8	12.2		
1030	202.28	5.7	196.6			197.8	192.1	4.5	Bent	2 Bag
1032	202.28	5.7	196.6			194.0	188.3	8.3		
1034	197.28	5.0	192.28			194.6	189.6	2.7	Bent	2 Bags
1037	197.28	5.0	192.28			186.4	181.4	10.9		
1046	197.28	5.0	187.28			181.4	176.4	10.9		
1100	192.28	7.0	185.28			191.1	184.1	1.1.8		
1200	187.28	6.0	181.28			188.8	182.8	-1.5	Bent.	1.3 Bag
1205	187.28	6.0	181.28			172.5	177.28	8.4		

Note: Col. 2 - Col. 3 = Col. 4 - Col. 5 - weight and attachments = Col. 7; Col. 7 - Col. 8; Col. 8 - Col. 9 = Col. 9

Reported By: Kevin Singletary Title: Geologist Date: 9-28-01
 Signature: [Signature] Reviewed By: DC Meekes Date: 10/27/01
 Signature: [Signature] Title: Geologist

BHI-EE-179 (12/97)

Appendix A - Borehole Geologic Logs

BHI-01607

Rev. 0

4 6

Page 2 of 2
Date: 10-1-01

WELL COMPLETION LOG

Well Name: <u>200-TW-2</u>		Well ID: <u>C3103</u>		Drilling Contractor: <u>RST</u>								
Project: <u>200-TW-2</u>		Location: <u>216-B-7A</u>		Fill Material								
1.	2.	3.	4.	5.	6.	7.	8.	9.	Type	Amt	Unit	Comments
Time	Total Casing	Skip	Btm Csg	Tape Reading	Correction	Cor Tape Reading	Fill Depth	Overlap				
0905	130.8	5.5	130.8	132.7		132.7	12.6	4.7	Bent	3	Bags	Adding 5.00' casing to pull with 4" slip jacks
0915	136.3	5.5	130.8	125.7		125.7	10.6	10.6	Bent	2	Bags	
0920	131.3	5.6	125.7	125.1		125.1	6.2	6.2	Bent			
0925	131.3	5.6	125.7	118.7		118.7	12.6	12.6				(-5) Denotes sleeved because of contamination
0928	133.3	4.3	122.0									
0930	131.3	4.3	117.0			120.8	116.5	0.5	Bent	10	Bags	Adding 0.7' head
0935	121.3	4.3	117.0			99.8	95.5	2.5				
0945	111.3					103.3	98.3	8.7				
0946	112.0	5.0	107.0			104.5	99.5	2.5	Bent	10	Bags	
0948	107.0	5.0	102.0			83.1	78.1	23.9				
1015	107.0	5.0	102.0			89.6	84.6	2.4	Bent	10	Bags	TOC in hole / 1st joint with 8.2' in hole.
1026	92	5.0	87.0			68.3	63.3	23.7				
1030	92	5.0	87.0			72.2	67.2	5.0	Bent	10	Bags	
1040	77	5.0	72.0			50.9	45.9	26.1				
1210	77	5.0	72.0			49.0	42.0	23.0				Pipe hanging in hole when measured
1341	67	2.0	65.0			44.2	42.2	22.8				
1356	62	2.0	60.0			51.3	49.3	10.7				Bent = Bentonite crumbles
1406	57	2.0	55.0			54.0	51.0	3.0	Bent	2	Bags	

Note: Col. 2 - Col. 3 = Col. 4 - Col. 5 - weight and attachments = Col. 7; Col. 7 - Col. 8; Col. 4 - Col. 8 = Col. 9

Reported By: Kevin Singleten Title: Geologist Date: 10-1-01
 Signature: [Signature] Signature: [Signature] Date: 10/23/01
 Reviewed By: DC Weekes

APPENDIX B
BOREHOLE GEOPHYSICAL LOGGING REPORTS



C3340

Log Data Report

Borehole Information:

Borehole: C3340		Site: 216-B-38			
Coordinates		GWL' (ft): none		GWL Date:	
North N/A ³	East N/A	Drill Date June 2001	TOC ⁴ Elevation N/A	Total Depth (ft) 60	Type push

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
steel threaded	0.5	6.625	5.625	0.5	0	60

Borehole Notes:

This is a temporary borehole pushed to a depth of approximately 60 ft. There is a gravel pad approximately 1 ft thick, and the top of casing sticks up approximately 0.5 ft above the gravel surface. The zero reference point for the log data is the ground surface.

Logging Equipment Information:

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

Logging System: RLS	Type: NMLS (Moisture)
Calibration Date: 05/01	Calibration Reference: GJO-2001-247-TAR
Logging Procedure: MAC-HGLP 1.6.5	

Logging System: Gamma 1C	Type: HRLS
Calibration Date: 09/00	Calibration Reference: GJO-2001-244-TAR
Logging Procedure: MAC-HGLP 1.6.5	

Appendix B – Borehole Geophysical Logging Reports

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	
Date	7/11/01	7/11/01	7/12/01	7/12/01	
Logging Engineer	Spatz/Musial	Spatz/Musial	Kos/Musial	Kos/Musial	
Start Depth	0	12.5	22.5	35.0	
Finish Depth	13.5	23.5	34.5	35.0	
Count Time (sec)	180	30	30	180	
Live/Real	L	R	R	L	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
ft/min	n/a ⁴	n/a	n/a	n/a	
Pre-Verification	B0017CAB	B0017CAB	B0019CAB	B0019CAB	
Start File	B0018000	B0018028	B0019000	B0019024	
Finish File	B0018027	B0018050	B0019023	B0019024	
Post-Verification	B0018CAA	B0018CAA	None	None	

High Rate Logging System (HRLS) Log Run Information:

Log Run	5				
Date	7/20/01				
Logging Engineer	A. Pearson				
Start Depth	13.5				
Finish Depth	36.0				
Count Time (sec)	300				
Live/Real	R				
Shield (Y/N)	N				
MSA Interval (ft)	0.5				
ft/min	n/a				
Pre-Verification	D0000CAB				
Start File	D0000000				
Finish File	D0000045				
Post-Verification	D0002CAA				

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	6	7 (repeat)			
Date	7/23/01	7/23/01			
Logging Engineer	Kos/Spatz	Kos/Spatz			
Start Depth	0.0	40.0			
Finish Depth	59.0	33.25			
Count Time (sec)	n/a	n/a			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	n/a	n/a			
ft/min	1.0	1.0			
Pre-Verification	C0042CAB	C0042CAB			
Start File	C0052000	C0052237			
Finish File	C0052236	C0052264			
Post-Verification	C0062CAA	C0062CAA			

Logging Operation Notes:

Log depths are relative to ground surface. The NMLS and HRLS data are relative to top of casing, which represents an offset of about 0.5 ft. Multiple SGLS log runs were made to adjust count times in response to high dead time intervals. In areas of excessive dead time, the count time was reduced to 30 seconds to provide a log record where spectra were not anticipated to contain reliable full energy peaks. No fine-gain adjustments were made. SGLS log run four was terminated early due to a water-pump failure in the logging truck, and no post-run verification spectrum was recorded. No SGLS logs were recorded below a depth of 35 ft.

Internal contamination (inside the casing) was reported by the HPT on July 11, 2001. A reading of approximately 12,000 dpm was reported. The radionuclide responsible for this contamination was not identified.

Analysis Notes:

Analyst:	McCain	Date:	07/27/01	Reference:	MAC-VZCP 1.7.9, Rev. 2
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Pre-run and post-run verification spectra were evaluated and found to be within acceptance criteria. Individual spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL. Corrections were applied for casing thickness and dead time. Because of high dead time and detector saturation, maximum gross count rates and ¹³⁷Cs concentrations are not considered reliable, and are probably significantly higher than reported values. Where dead time exceeds about 40 percent, pulse pileup and peak spreading effects may result in underestimation of peak count rates. The ²¹⁴Bi peak at 1764 keV was used to determine ²³⁸U concentrations instead of the ²¹⁴Pb peak at 609 keV to avoid interference from the ¹³⁷Cs peak at 662 keV.

The high rate data were processed for the ¹³⁷Cs count rate at 662 keV using APTEC supervisor. Concentrations were calculated in EXCEL. A casing correction factor of 1.37 was applied to the high rate data to account for the increased attenuation in the 0.5-inch steel casing, relative to 0.28-inch casing.

The neutron moisture log was processed using the calibration relationship developed for a 6-inch diameter borehole with 0.28-inch thick casing. A correction factor of 1.20 was applied to account for the effects of the thicker casing, which is based on an equivalent casing correction for 8-inch diameter developed by Randall.

Log Plot Notes:

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

Appendix B – Borehole Geophysical Logging Reports

Results and Interpretations:

¹³⁷Cs was detected. The greatest ¹³⁷Cs concentration occurs between 15 and 32 ft. High dead times and detector saturation occurs between 13 and 36 ft. The maximum measured ¹³⁷Cs concentration is about 180,000 pCi/g, at 23.5 ft.

Detector saturation in the region of high ¹³⁷Cs effectively obscures the natural radionuclides.

¹ GWL – groundwater level

² TOC – top of casing

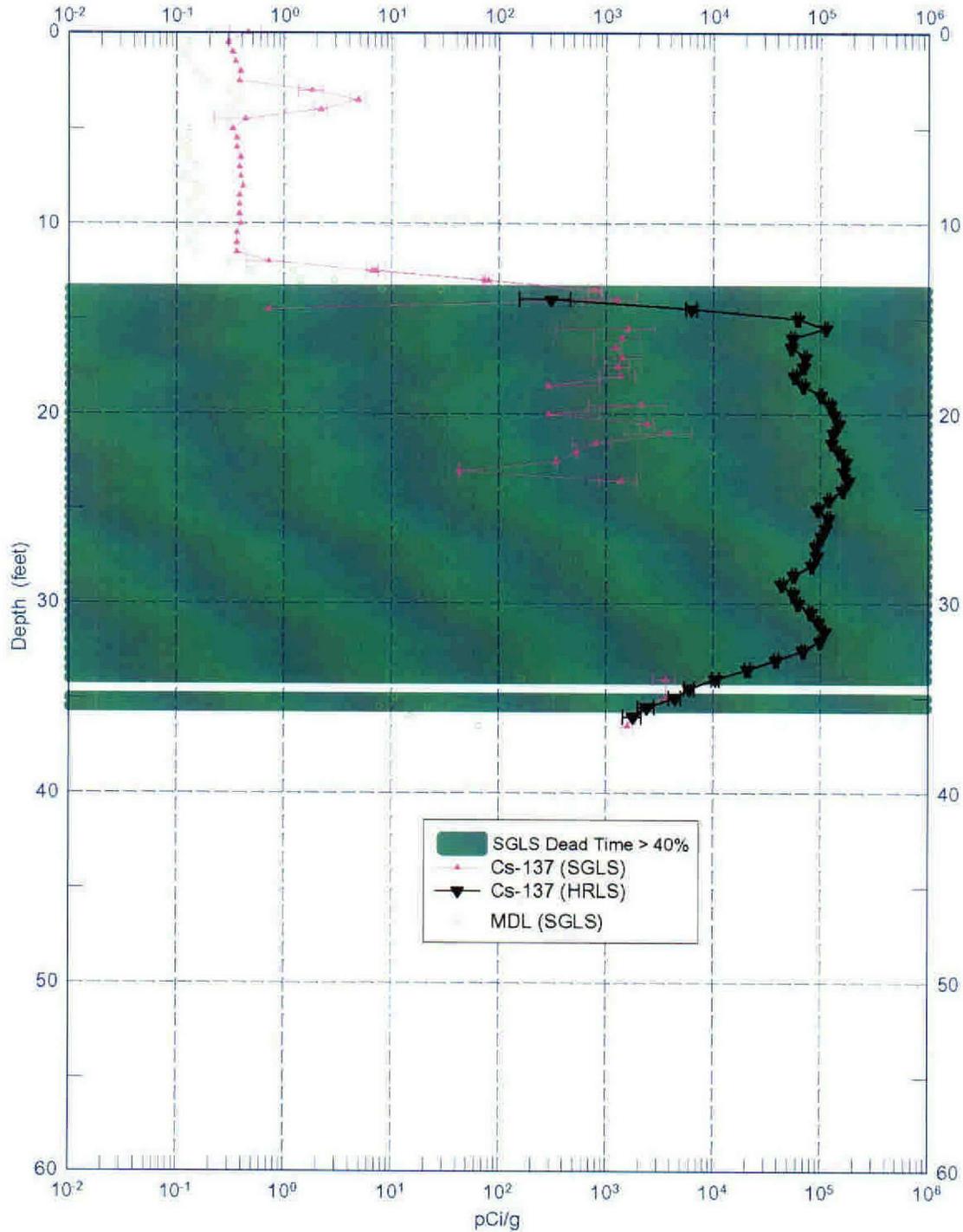
³ N/A – not available

⁴ n/a – not applicable

C3340

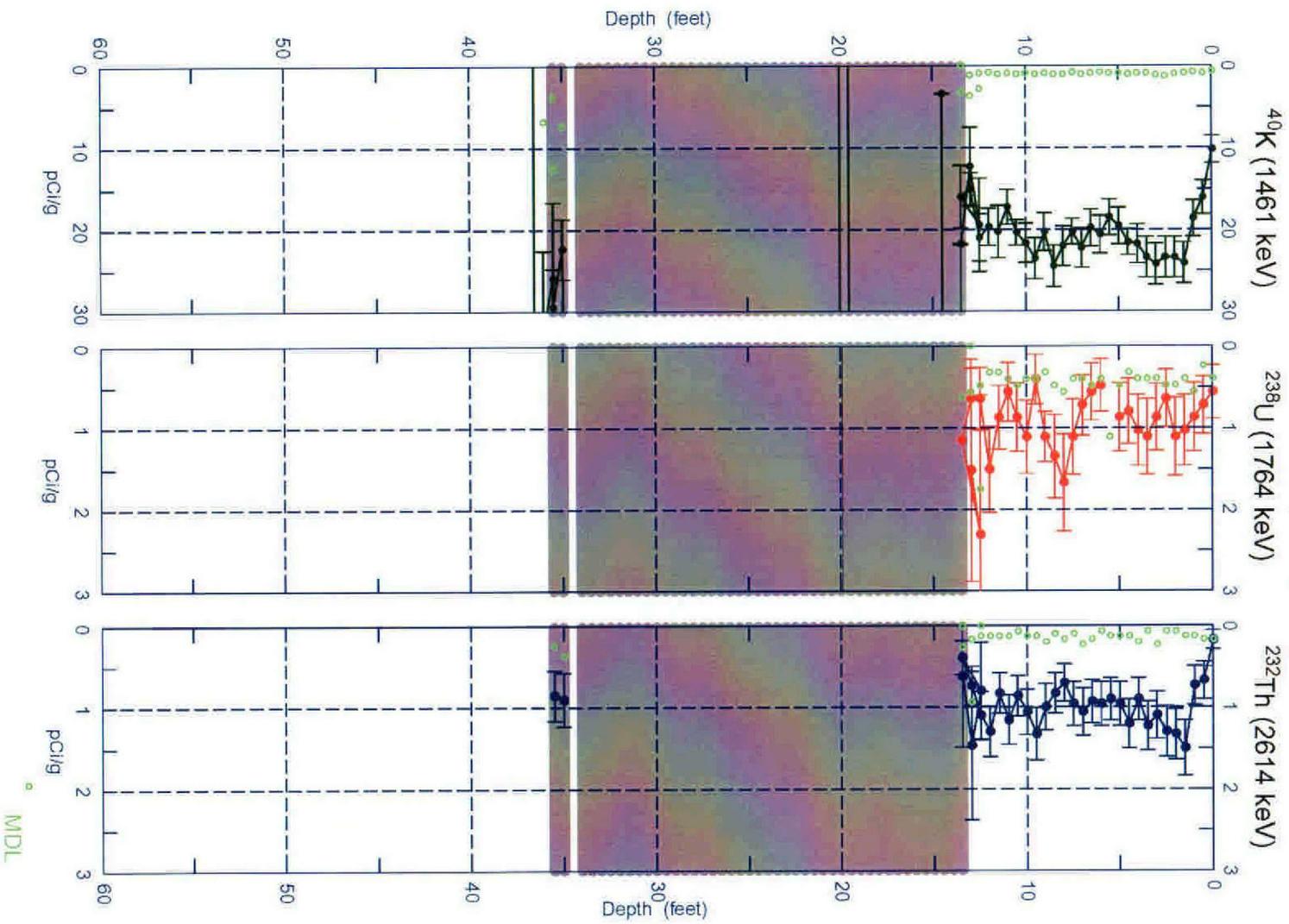
Man-Made Radionuclides

¹³⁷Cs (662 keV)

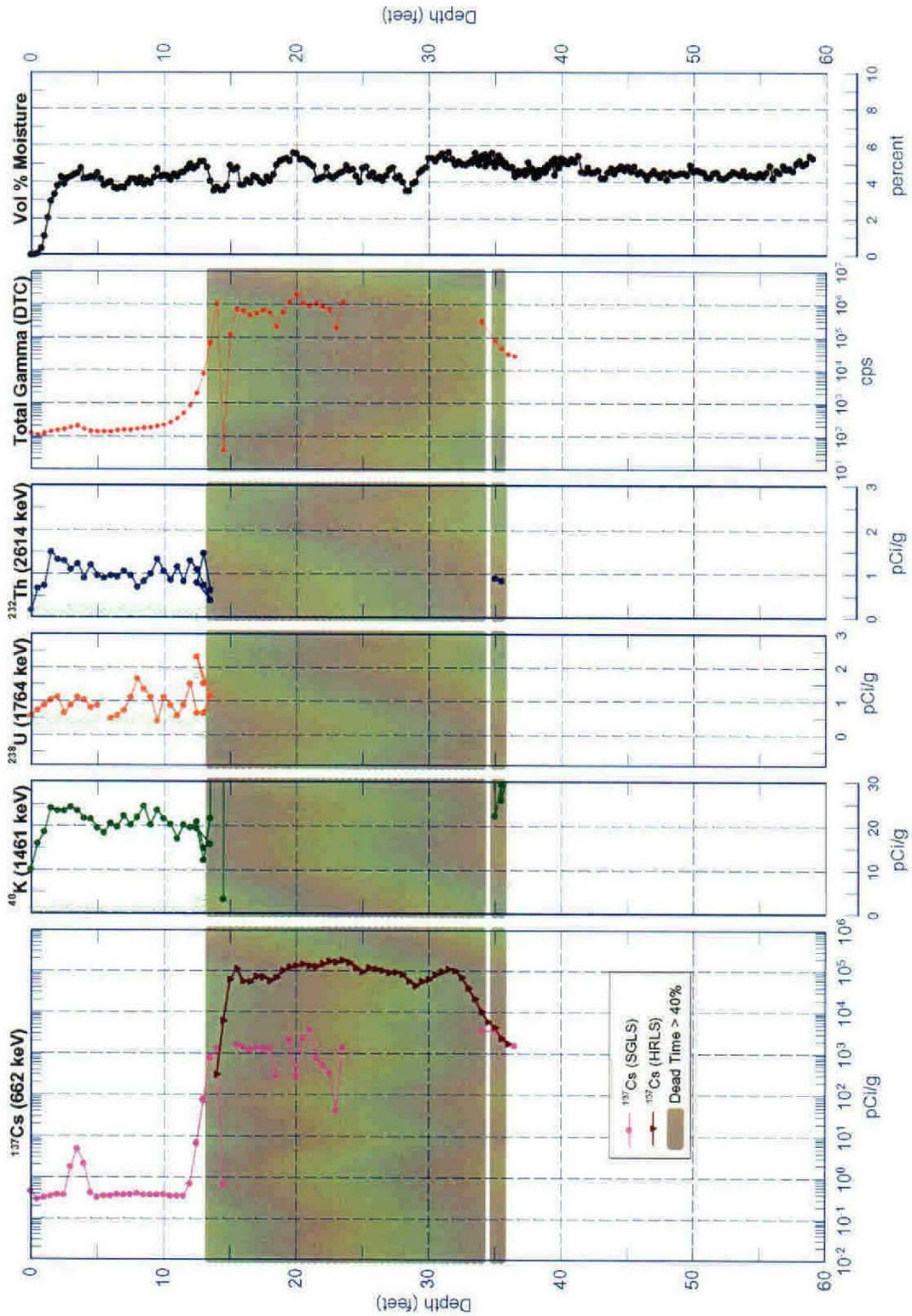


C3340

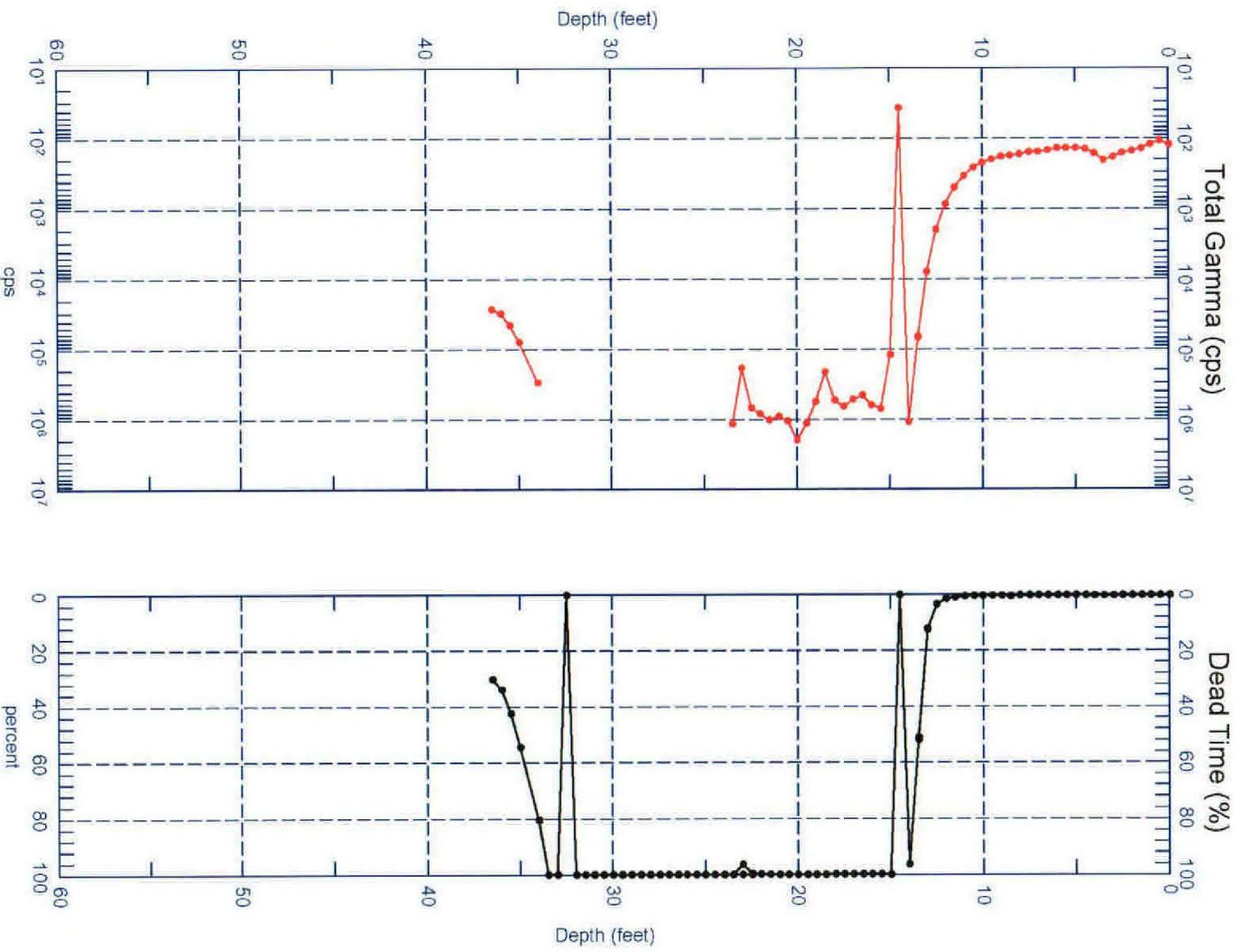
Natural Gamma (KUT) Logs



C3340
Combination Plots



C3340 Total Gamma and Dead Time





C3341

Log Data Report

Borehole Information:

Borehole: C3341		Site: 216-B-38			
Coordinates		GWL (ft): N/A		GWL Date:	
North	East	Drill Date	TOC Elevation	Total Depth (ft)	Type
N/A	N/A	June 2001	N/A	60	push

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
steel threaded	0.5	6.625	5.625	0.5	0	59.5

Borehole Notes:

This temporary borehole was pushed to a depth of approximately 60 ft. There is a gravel pad approximately 1 ft thick, and the top of casing sticks up approximately 0.5 ft above the gravel surface. The zero reference point for the log data is the ground surface.

Logging Equipment Information:

Logging System:	Gamma 2B	Type:	SGLS (35%)
Calibration Date:	09/00	Calibration Reference:	GJO-2001-245-TAR
		Logging Procedure:	MAC-HGLP 1.8.5

Logging System:	RLS1	Type:	NMLS (Moisture)
Calibration Date:	05/01	Calibration Reference:	GJO-2001-247-TAR
		Logging Procedure:	MAC-HGLP 1.8.5

Logging System:	Gamma 1C	Type:	HRLS
Calibration Date:	09/00	Calibration Reference:	GJO-2001-244-TAR
		Logging Procedure:	MAC-HGLP 1.8.5

Appendix B – Borehole Geophysical Logging Reports

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	5
Date	7/10/01	7/10/01	7/10/01	7/10/01	7/10/01
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth	59.5	33.0	30.5	20.0	19.0
Finish Depth	32.0	29.5	19.0	18.0	13.0
Count Time (sec)	180	180	180	180	30
Live/Real	L	R	L	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5
ft/min	n/a ²	n/a	n/a	n/a	n/a
Pre-Verification	B0016CAB	B0016CAB	B0016CAB	B0016CAB	B0016CAB
Start File	B0016000	B0016056	B0016064	B0016088	B0016093
Finish File	B0016055	B0016063	B0016087	B0016092	B0016105
Post-Verification	B0016CAA	B0016CAA	B0016CAA	B0016CAA	B0016CAA

Log Run	6	7	8 (repeat)		
Date	7/10/01	7/11/01	7/11/01		
Logging Engineer	Spatz	Musial/Spatz	Musial/Spatz		
Start Depth	14.0	8.0	14.0		
Finish Depth	7.0	1.0	8.0		
Count Time (sec)	180	180	180		
Live/Real	L	L	L		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	0.5	0.5	0.5		
ft/min	n/a	n/a	n/a		
Pre-Verification	B0016CAB	B0017CAB	B0017CAB		
Start File	B0016106	B0017000	B0017015		
Finish File	B0016120	B0017014	B0017027		
Post-Verification	B0016CAA	B0017CAA	B0017CAA		

High Rate Logging System (HRLS) Log Run Information:

Log Run	9	10			
Date	7/20/01	7/20/01			
Logging Engineer	Pearson /Musial	Pearson /Musial			
Start Depth	13.5	29.0			
Finish Depth	24.0	34.0			
Count Time (sec)	300	300			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.5	0.5			
ft/min	n/a	n/a			
Pre-Verification	D0000CAB	D0000CAB			
Start File	D0001000	D0001022			
Finish File	D0001021	D0001032			
Post-Verification	D0002CAA	D0002CAA			

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	11	12 (repeat)		
Date	7/24/01	7/24/01		
Logging Engineer	Kos/Spatz	Kos/Spatz		
Start Depth	0.0	42.0		
Finish Depth	59.5	35.75		
Count Time (sec)	n/a	n/a		
Live/Real	n/a	n/a		
Shield (Y/N)	N	N		
MSA Interval (ft)	0.25	0.25		
ft/min	1.0	1.0		
Pre-Verification	C0042CAB	C0042CAB		
Start File	C0062000	C0062239		
Finish File	C0062238	C0062264		
Post-Verification	C0062CAA	C0062CAA		

Logging Operation Notes:

Log depths are relative to ground surface. Multiple SGLS log runs were made to adjust count times in response to high dead time intervals. Measurement mode was switched from live time to real time in intervals with high count rates to expedite logging operations. In areas of excessive dead time, the count time was reduced to 30 seconds to provide a log record where spectra are not anticipated to contain reliable full energy peaks. No fine-gain adjustments were made. The post-run verification spectrum B0017CAA was collected over a 500-second count time instead of 1,000 seconds.

The HRLS data are relative to top of casing. To account for the 0.5-ft stickup, depths for the HRLS should be reduced by 0.5 ft.

Analysis Notes:

Analyst:	McCain	Date:	07/27/01	Reference:	MAC-VZCP 1.7.9, Rev. 2
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Pre-run and post run verification spectra were evaluated and found to be within acceptance criteria. Individual spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL. Corrections were applied for casing thickness and dead time. Water correction was not required. Because of high dead time and detector saturation, maximum gross count rates and ¹³⁷Cs concentrations are not considered reliable, and are probably significantly higher than reported values. Where dead time exceeds about 40 percent, pulse pileup and peak spreading effects may result in underestimation of peak count rates. The ²¹⁴Bi peak at 1764 keV was used to determine ²³⁸U concentrations instead of the ²¹⁴Bi peak at 609 keV to avoid interference from the ¹³⁷Cs peak at 662 keV.

The high rate data were processed for ¹³⁷Cs count rate at 662-keV energy level using APTEC supervisor. Concentrations were calculated in EXCEL. A casing correction factor of 1.37 was applied to the high rate data to account for the increased attenuation in the 0.5-inch steel casing, relative to 0.28-inch casing, for which the system was calibrated. No shield corrections were required.

The neutron moisture log was processed using the calibration relationship developed for a 6-inch-diameter borehole with 0.28-inch-thick casing. A correction factor of 1.20 was applied to account for the effects of

Appendix B – Borehole Geophysical Logging Reports

the thicker casing, which is based on an equivalent casing correction for 8-inch diameter developed by Randall.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K , and decay progeny of ^{232}Th and ^{238}U), man-made radionuclides, and moisture content. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing and water corrections. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. Intervals where SGLS dead time exceeds 40% are shaded. The total gamma log is plotted at both logarithmic and linear scales. The logarithmic scale shows the full range of variation, while the linear scale shows subtle variation in low count intervals.

A repeat log plot is also shown. The repeat plot indicates good agreement between successive log runs. This demonstrates good repeatability in both depth and radionuclide measurement.

Results and Interpretations:

^{137}Cs and ^{60}Co were detected. The highest ^{137}Cs concentrations occur between 12.5 and 28 ft. High dead times and detector saturation occurs between 14.5 and 19 ft. The maximum measured ^{137}Cs concentration is about 56,186 pCi/g at 17 ft. A second interval of ^{137}Cs occurs between 29.5 and 33 ft, with concentrations as high as 6356 pCi/g at 31.5 ft. Minor ^{137}Cs also occurs between 4.0 and 5.5 ft, with a maximum concentration of 2.57 pCi/g.

^{60}Co was detected intermittently between 33 and 57 ft, with a maximum concentration of 0.16 pCi/g at 33 ft.

^{40}K concentrations increase gradually from about 10 pCi/g at 19 ft to about 20 pCi/g at 33 ft. This increase may indicate a gradational change, with increasing fines in the material below 32.5 ft.

Moisture content appears to increase slightly between about 15 and 35 ft. This corresponds to the interval of high ^{137}Cs concentration, but it is not clear if the neutron log is responding to an increased moisture content or to interference from the high gamma flux in this interval.

¹ GWL – groundwater level

² TOC – top of casing

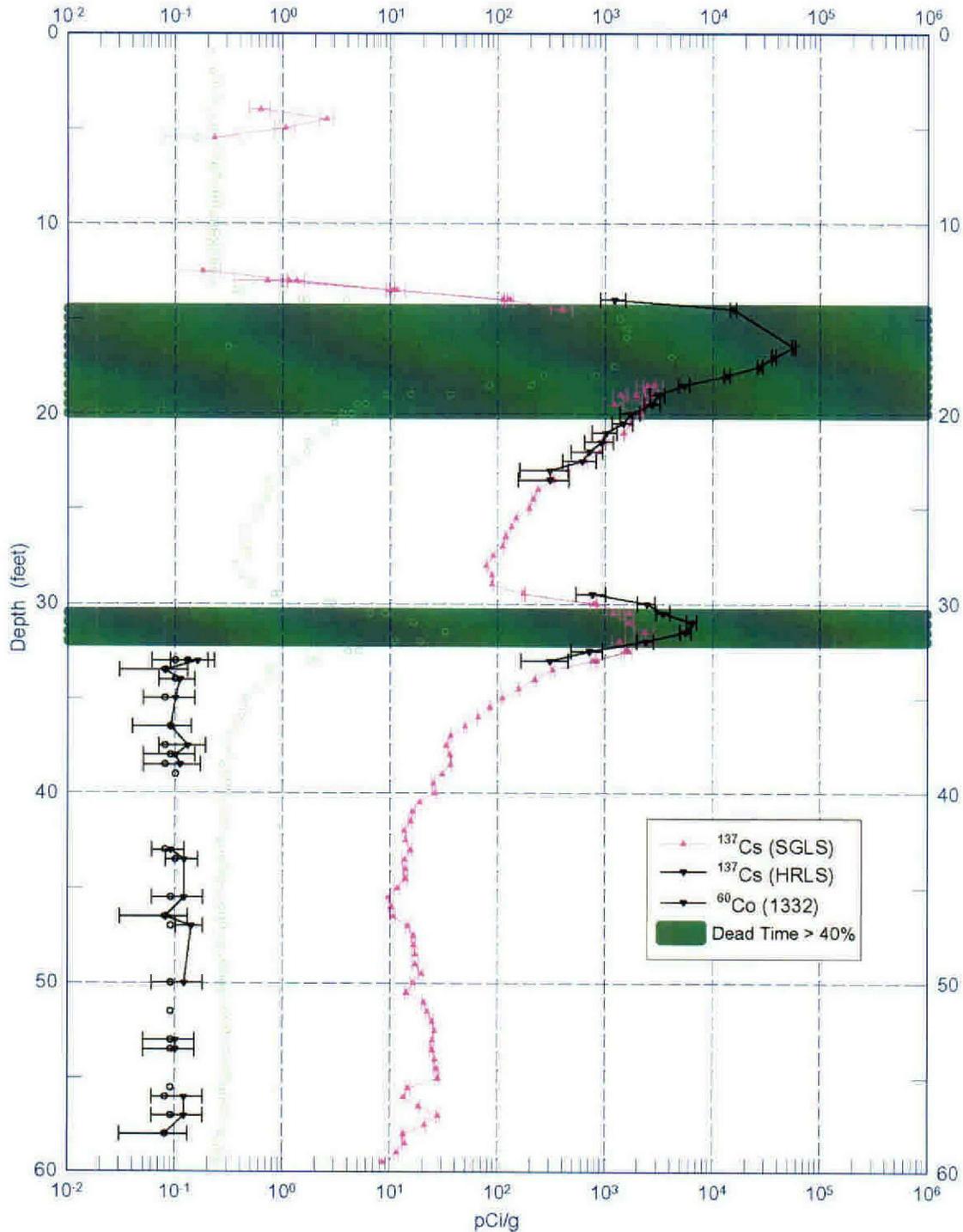
³ N/A – not available

⁴ n/a – not applicable

C3341

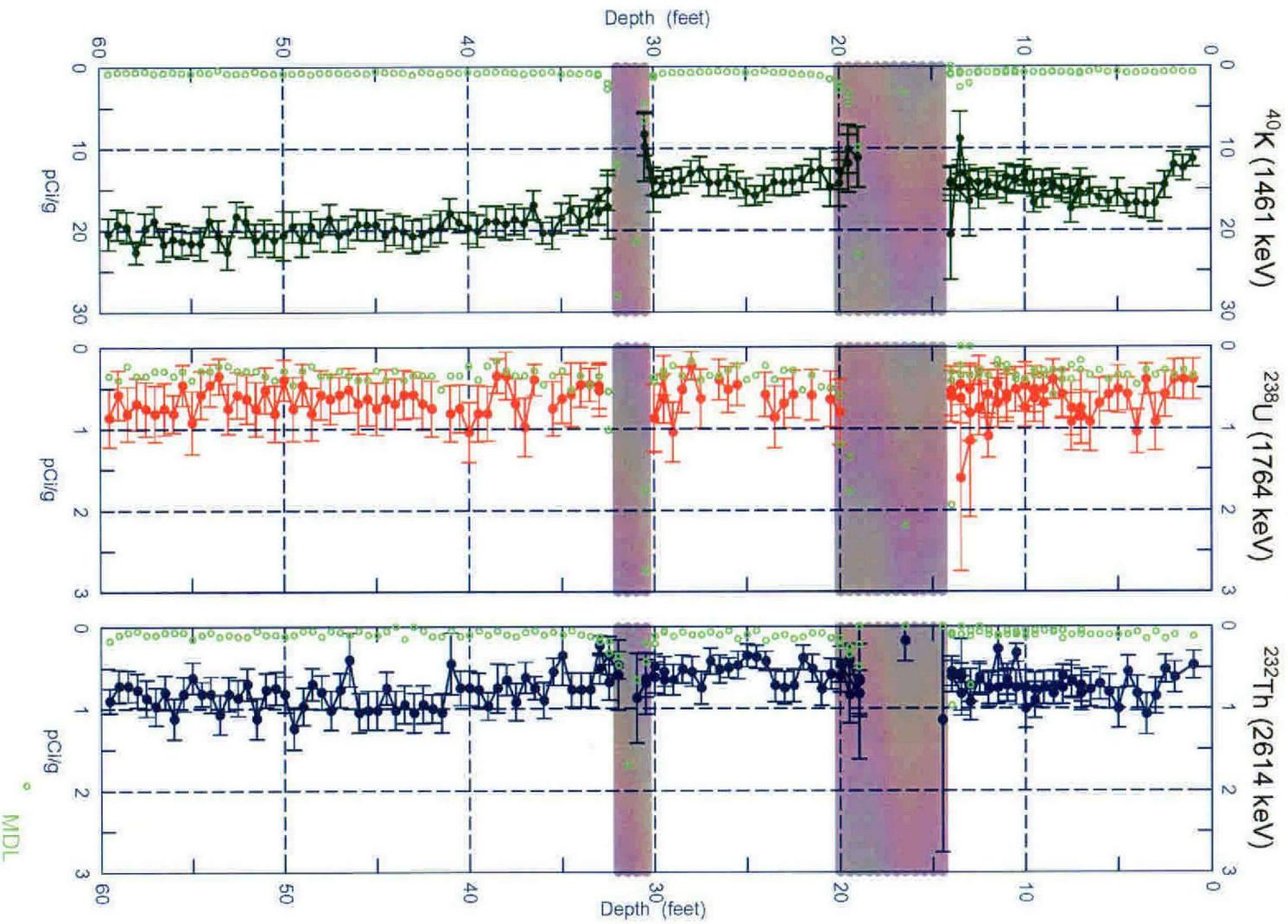
Man-Made Radionuclides

¹³⁷Cs (662 keV)

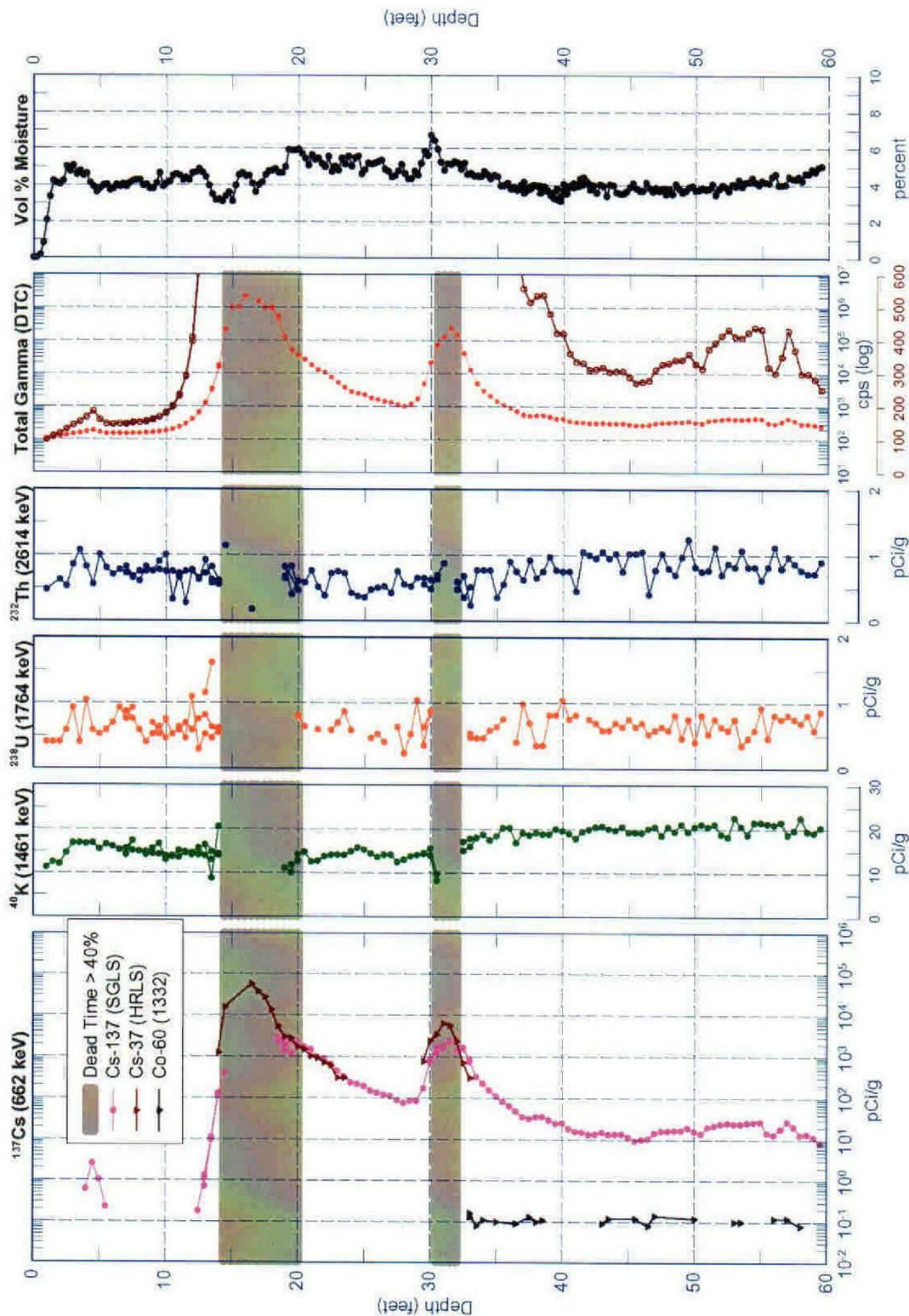


C3341

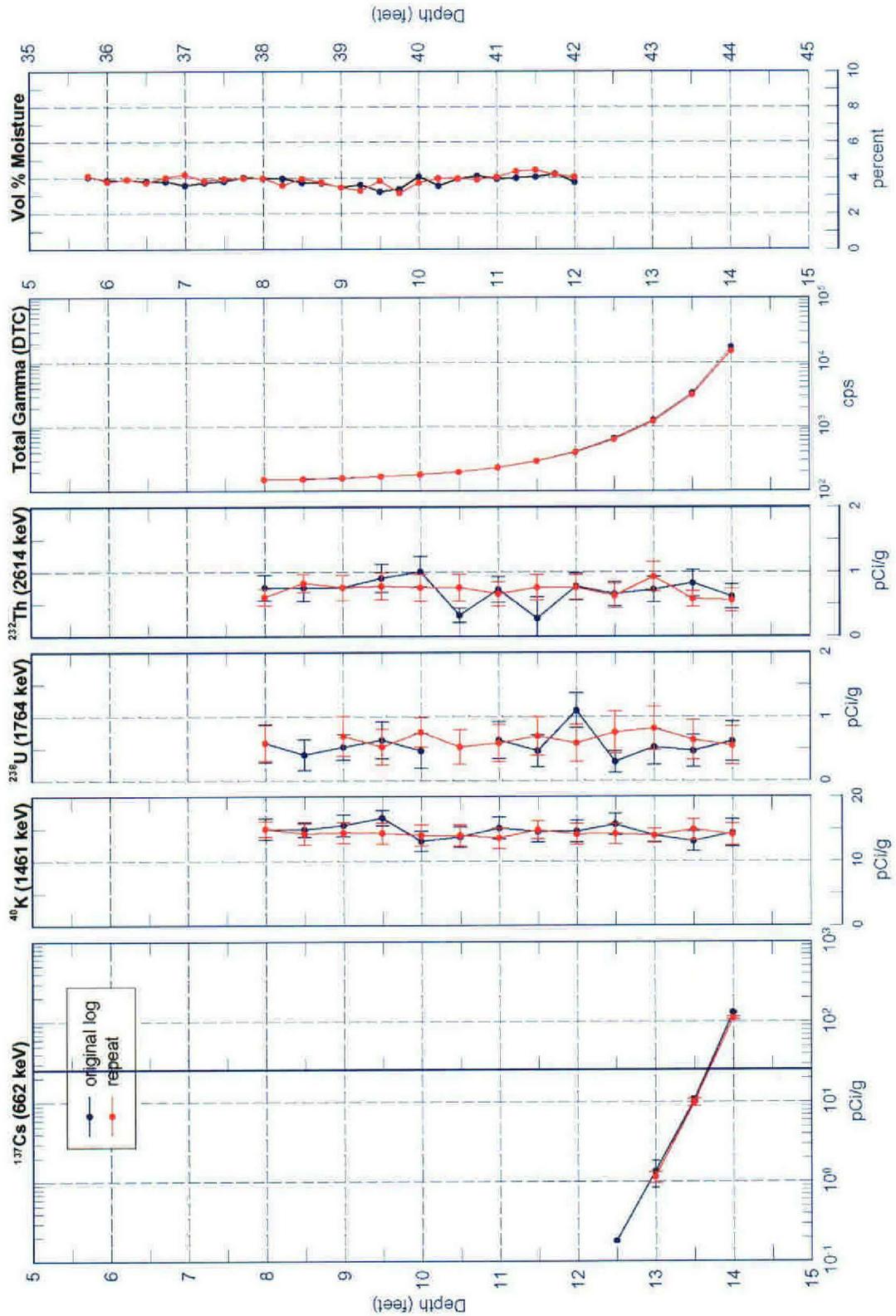
Natural Gamma (KUT) Logs



**C3341
Combination Plots**

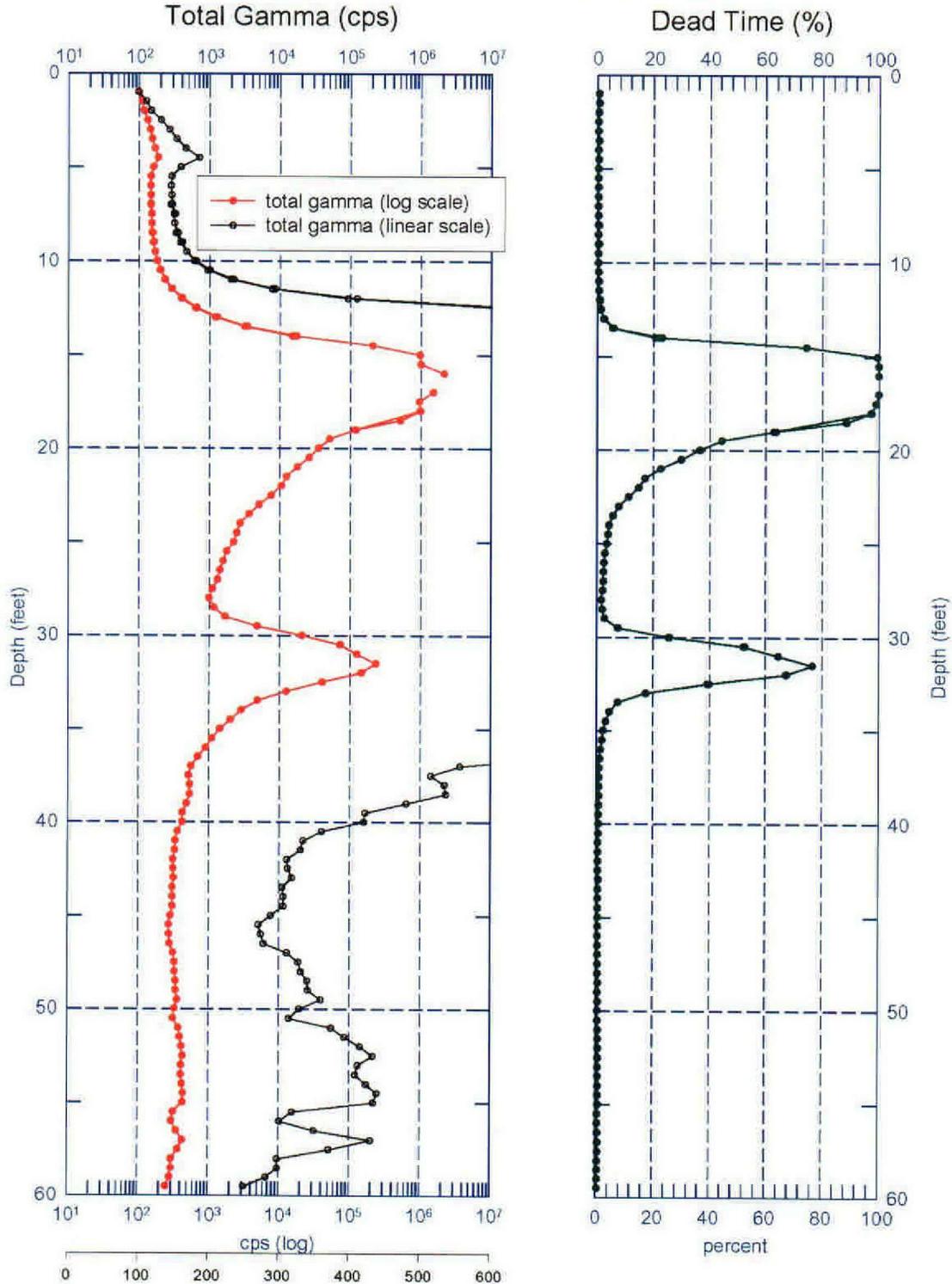


C3341
Repeat Plots



C3341

Total Gamma and Dead Time



Appendix B – Borehole Geophysical Logging Reports**C3342****Log Data Report****Borehole Information**

Borehole: C3342		Site: 216-B-38			
Coordinates		GWL' (ft): N/A ^c		GWL Date:	
North N/A	East N/A	Drill Date June 2001	TOC^a Elevation N/A	Total Depth (ft) 60	Type push

Casing Information

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
steel threaded	0.5	6.625	5.625	0.5	0	59.5

Borehole Notes:

This is a temporary borehole pushed to a depth of approximately 60 ft. There is a gravel pad approximately 1 ft thick, and the top of casing sticks up approximately 0.5 ft above the gravel surface.

Logging Equipment Information:

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

Logging System: NMLS	Type: NMLS (Moisture)
Calibration Date: 05/01	Calibration Reference: GJO-2001-247-TAR
Logging Procedure: MAC-HGLP 1.6.5	

Logging System: Gamma 1C	Type: HRLS
Calibration Date: 09/00	Calibration Reference: GJO-2001-244-TAR
Logging Procedure: MAC-HGLP 1.6.5	

Appendix B – Borehole Geophysical Logging Reports

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	5 (repeat)
Date	7/09/01	7/09/01	7/09/01	7/09/01	7/09/01
Logging Engineer	Spatz/Musial	Spatz/Musial	Spatz/Musial	Spatz/Musial	Spatz/Musial
Start Depth	59.5	34.0	29.5	14.0	14.0
Finish Depth	33.0	28.5	13.0	1.0	8.0
Count Time (sec)	180	180	30	180	180
Live/Real	L	R	R	L	L
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5
ft/min	n/a ⁴	n/a	n/a	n/a	n/a
Pre-Verification	B0015CAB	B0015CAB	B0015CAB	B0015CAB	B0015CAB
Start File	B0015000	B0015054	B0015066	B0015100	B0015127
Finish File	B0015053	B0015065	B0015099	B0015126	B0015139
Post-Verification	B0015CAA	B0015CAA	B0015CAA	B0015CAA	B0015CAA

High Rate Logging System (HRLS) Log Run Information:

Log Run	6				
Date	7/20/01				
Logging Engineer	Pearson				
Start Depth	13.5				
Finish Depth	35.0				
Count Time (sec)	300				
Live/Real	R				
Shield (Y/N)	N				
MSA Interval (ft)	0.5				
ft/min	n/a				
Pre-Verification	D0000CAB				
Start File	D0002000				
Finish File	D0002043				
Post-Verification	D0002CAA				

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	7				
Date	7/20/01				
Logging Engineer	Spatz/Musial				
Start Depth	0.0				
Finish Depth	59.5				
Count Time (sec)	n/a				
Live/Real	n/a				
Shield (Y/N)	N				
MSA Interval (ft)	0.25				
ft/min	1.0				
Pre-Verification	C0002CAB				
Start File	C0002000				
Finish File	C0062238				
Post-Verification					

Logging Operation Notes:

The zero reference point for all log data is the top of casing. Depths have been adjusted to ground surface, which is taken as the top of the gravel pad. Multiple SGLS log runs were made to adjust count times in response to high dead time intervals. Measurement mode was switched from live time to real time in intervals with high count rates to expedite logging operations. In areas of excessive dead time, the count time was reduced to 30 seconds to provide a log record where spectra were not anticipated to contain reliable full energy peaks. Fine-gain adjustments were made in run 1 after B0015031 (44.0 ft), and in run 4 after B0015103 (12.5 ft).

Analysis Notes:

Analyst:	McCain	Date:	07/27/01	Reference:	MAC-VZCP 1.7.9, Rev. 2
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Pre-run and post-run verification spectra were evaluated and found to be within acceptance criteria. Individual spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL. Corrections were applied for casing thickness and dead time. Water correction was not required. Where SGLS dead time exceeds about 40 percent, pulse pileup and peak spreading effects may result in underestimation of peak count rates. The ²¹⁴Bi peak at 1764 keV was used to determine ²³⁸U concentrations instead of the ²¹⁴Bi peak at 609 keV to avoid interference from the ¹³⁷Cs peak at 662 keV.

The high rate data were processed for ¹³⁷Cs count rate at 662-keV energy level using APTEC supervisor. Concentrations were calculated in EXCEL. A casing correction factor of 1.37 was applied to the high rate data to account for the increased attenuation in the 0.5-inch steel casing, relative to 0.28-inch casing, for which the system was calibrated. No shield corrections were required.

The neutron moisture log was processed using the calibration relationship developed for a 6-inch-diameter borehole with 0.28-inch-thick casing. A correction factor of 1.20 was applied to account for the effects of the thicker casing, which is based on an equivalent casing correction for 8-inch-diameter casing developed by Randall.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (⁴⁰K, and associated decay progeny of ²³²Th and ²³⁸U), man-made radionuclides, and moisture content. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing and water corrections. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. Intervals where SGLS dead time exceeds 40 percent are shaded. The total gamma log is plotted at both logarithmic and linear scales. The logarithmic scale shows the full range of variation, while the linear scale shows subtle variation in low count intervals.

A repeat log plot is also shown. The repeat plot indicates good agreement between successive log runs. This demonstrates good repeatability in both depth and radionuclide measurement.

Results and Interpretations:

¹³⁷Cs and ⁶⁰Co were detected. The greatest ¹³⁷Cs concentration occurs between 13 and 33.5 ft. High dead times and detector saturation occur between 14.5 and 29 ft. The maximum measured ¹³⁷Cs concentration is about 195,000 pCi/g at 16.5 ft. Between 17.5 and 28.5 ft, the ¹³⁷Cs concentration falls between 20,000 and

100,000 pCi/g. From 33.5 ft to TD at 59.5 ft the ^{137}Cs concentration gradually decreases from more than 2,000 pCi/g to about 15 pCi/g.

^{60}Co was detected intermittently between 34 and 42 ft, with a maximum concentration of 0.29 pCi/g at 34 ft.

The neutron moisture log indicates a slightly higher moisture content corresponding with the interval of high ^{137}Cs , but it is not clear if this is related to higher moisture content, or to interference from the high gamma flux. There is a relatively thin interval from about 26.5 to 28.5 ft where the moisture content increases from about 5 percent to 8 percent. This zone occurs near the bottom of the interval of maximum contamination, and does not appear to be related to changes in gamma intensity. There is also a zone of elevated moisture content at about 1 to 5 ft with a maximum of 5.5 percent at 3 ft.

¹ GWL – groundwater level

² N/A – not available

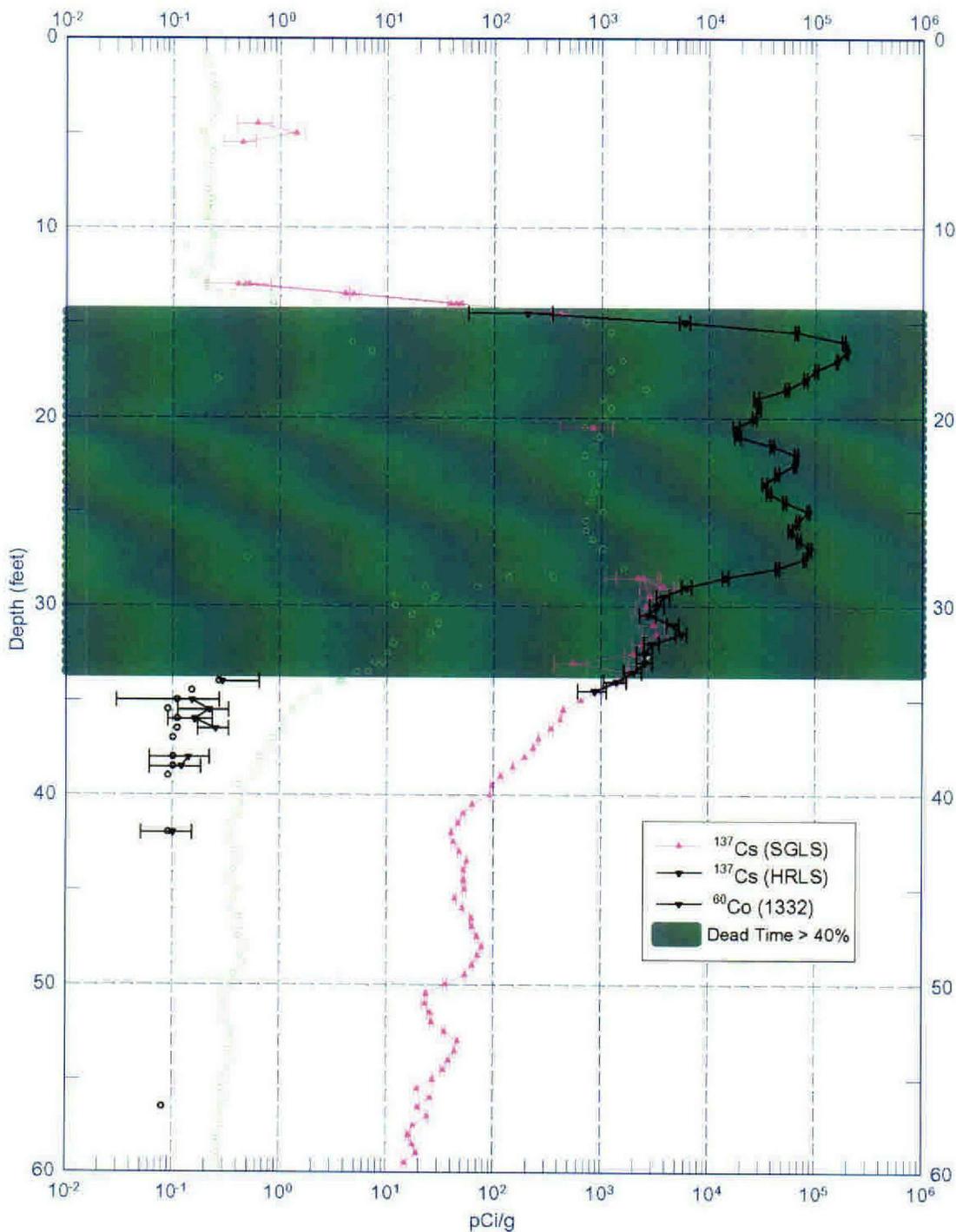
³ TOC – top of casing

⁴ n/a – not applicable

C3342

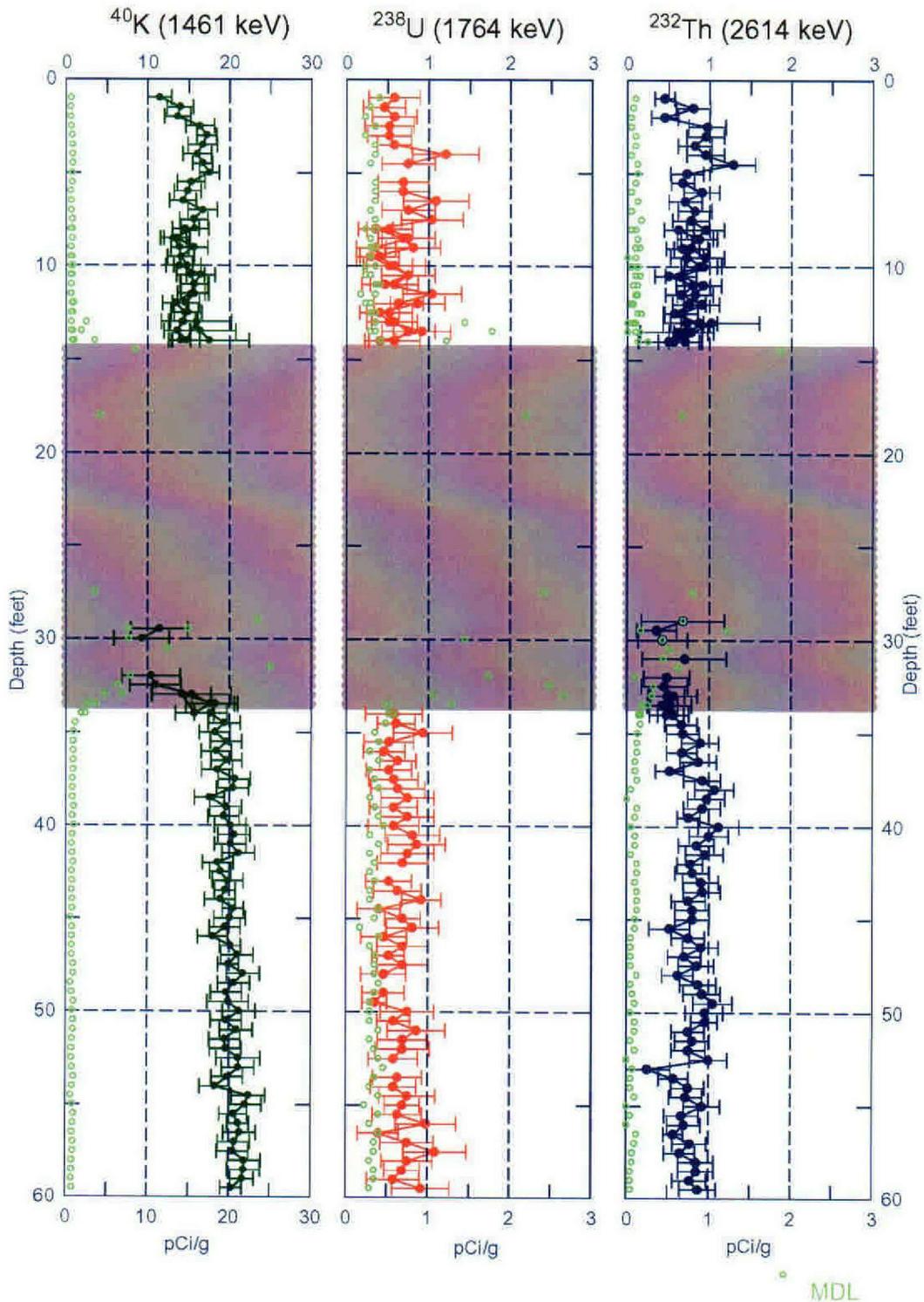
Man-Made Radionuclides

¹³⁷Cs (662 keV)

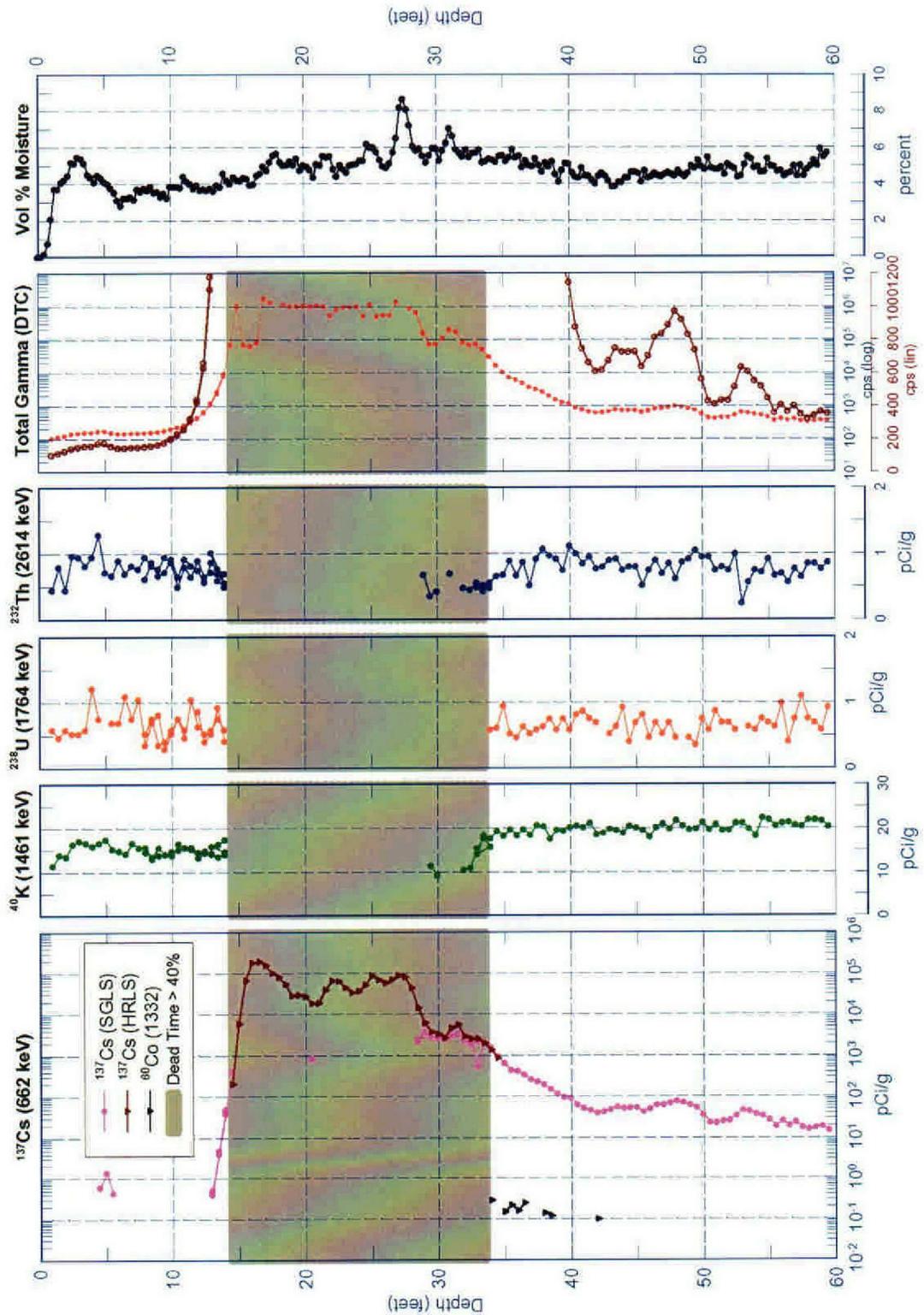


C3342

Natural Gamma (KUT) Logs



**C3342
Combination Plots**

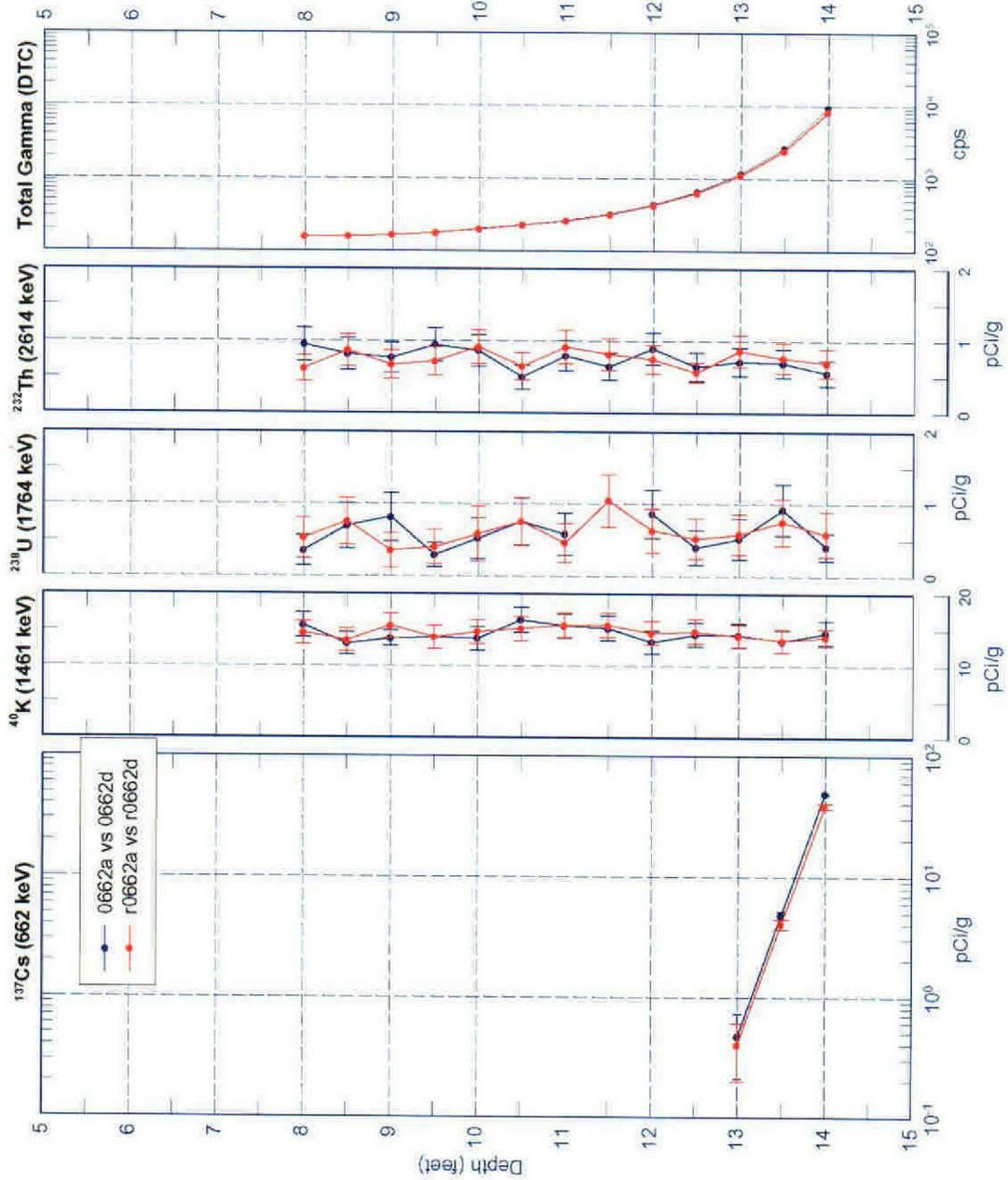


Appendix B – Borehole Geophysical Logging Reports

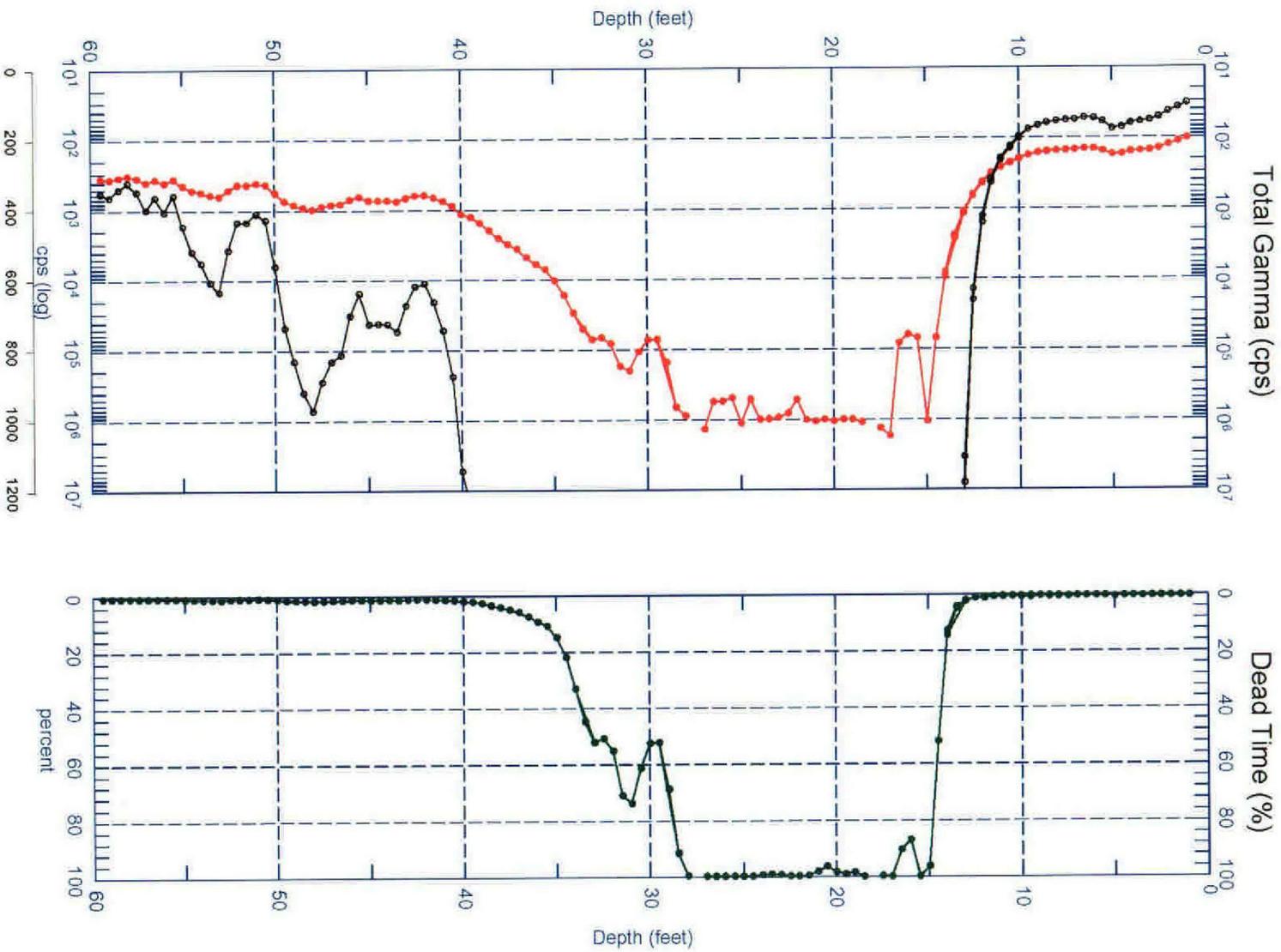
BHI-01607

Rev. 0

C3342 Repeat Plots



C3342 Total Gamma and Dead Time





C3343

Log Data Report

Borehole Information:

Borehole: C3343		Site: 216-B-38			
Coordinates		GWL (ft): N/A		GWL Date:	
North	East	Drill Date	TOC ³ Elevation	Total Depth (ft)	Type
N/A	N/A	June 2001	N/A	60	push

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
steel threaded	0.5	6.625	5.625	0.5	0	59.5

Borehole Notes:

This is a temporary borehole pushed to a depth of approximately 60 ft. There is a gravel pad approximately 1 ft thick, and the top of casing sticks up approximately 0.5 ft above the gravel surface.

Logging Equipment Information:

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

Logging System: NMLS	Type: NMLS (Moisture)
Calibration Date: 05/01	Calibration Reference: GJO-2001-247-TAR
Logging Procedure: MAC-HGLP 1.6.5	

Appendix B – Borehole Geophysical Logging Reports

Spectra Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 (repeat)			
Date	7/05/01	7/05/01			
Logging Engineer	Spatz	Spatz			
Start Depth	59.5	3.0			
Finish Depth	1	9.0			
Count Time (sec)	180	180			
Live/Real	L	L			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.5	0.5			
ft/min	n/a ⁴	n/a			
Pre-Verification	B0014CAB	B0014CAB			
Start File	B0014000	B0014118			
Finish File	B0014117	B0014130			
Post-Verification	B0014CAA	B0014CAA			

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	7				
Date	7/20/01				
Logging Engineer	Spatz/Musial				
Start Depth	0.0				
Finish Depth	59.5				
Count Time (sec)	n/a				
Live/Real	n/a				
Shield (Y/N)	N				
MSA Interval (ft)	0.25				
ft/min	1.0				
Pre-Verification	C0002CAB				
Start File	C0003000				
Finish File	C0003238				
Post-Verification	C0003CAA				

Logging Operation Notes:

The zero reference point for all log data is the top of casing. Depths have been adjusted to ground surface, which is taken as the top of the gravel pad. Fine-gain adjustments were made in run 1 after file B0014033 (43.0 ft).

Analysis Notes:

Analyst:	McCain	Date:	07/27/01	Reference:	MAC-VZCP 1.7.9, Rev. 2
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The pre-run verification spectrum was found to be within acceptance criteria. The post-run verification spectrum was below the lower warning limit for all three peak intensities (609, 1461, and 2615 keV). FWHM values were within verification criteria. Comparison of the two spectra indicates the tool appears to be functioning properly. Individual spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL. Corrections were applied for casing thickness. Water correction was not required. Dead time was less than 1 percent over the entire borehole, and no dead time corrections were required. The ²¹⁴Bi peak at 1764 keV

was used to determine ^{238}U concentrations instead of the ^{214}Bi peak at 609 keV. This was done for consistency with boreholes C3340, C3341, and C3342, where interference from the ^{137}Cs peak at 662 keV affected the ^{214}Bi peak at 609 keV.

The neutron moisture log was processed using the calibration relationship developed for a 6-inch-diameter borehole with 0.28-inch-thick casing. A correction factor of 1.20 was applied to account for the effects of the thicker casing, which is based on an equivalent casing correction for 8-inch diameter developed by Randall.

Log Plot Notes:

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

A repeat log plot is also shown. The repeat plot indicates good agreement between successive log runs, demonstrating good repeatability in both depth and radionuclide measurement.

Results and Interpretations:

Only minor amounts of Cs-137 were detected by the SGLS between 4.5 and 5.5 ft. The maximum concentration of 1.2 pCi/g occurred at 5.5 ft.

Increases in gamma counts at 22 to 29 ft and below 35 ft are attributed to increases in natural radionuclides, primarily K-40. This may be an indication of a stratigraphic change associated with an increase in fines.

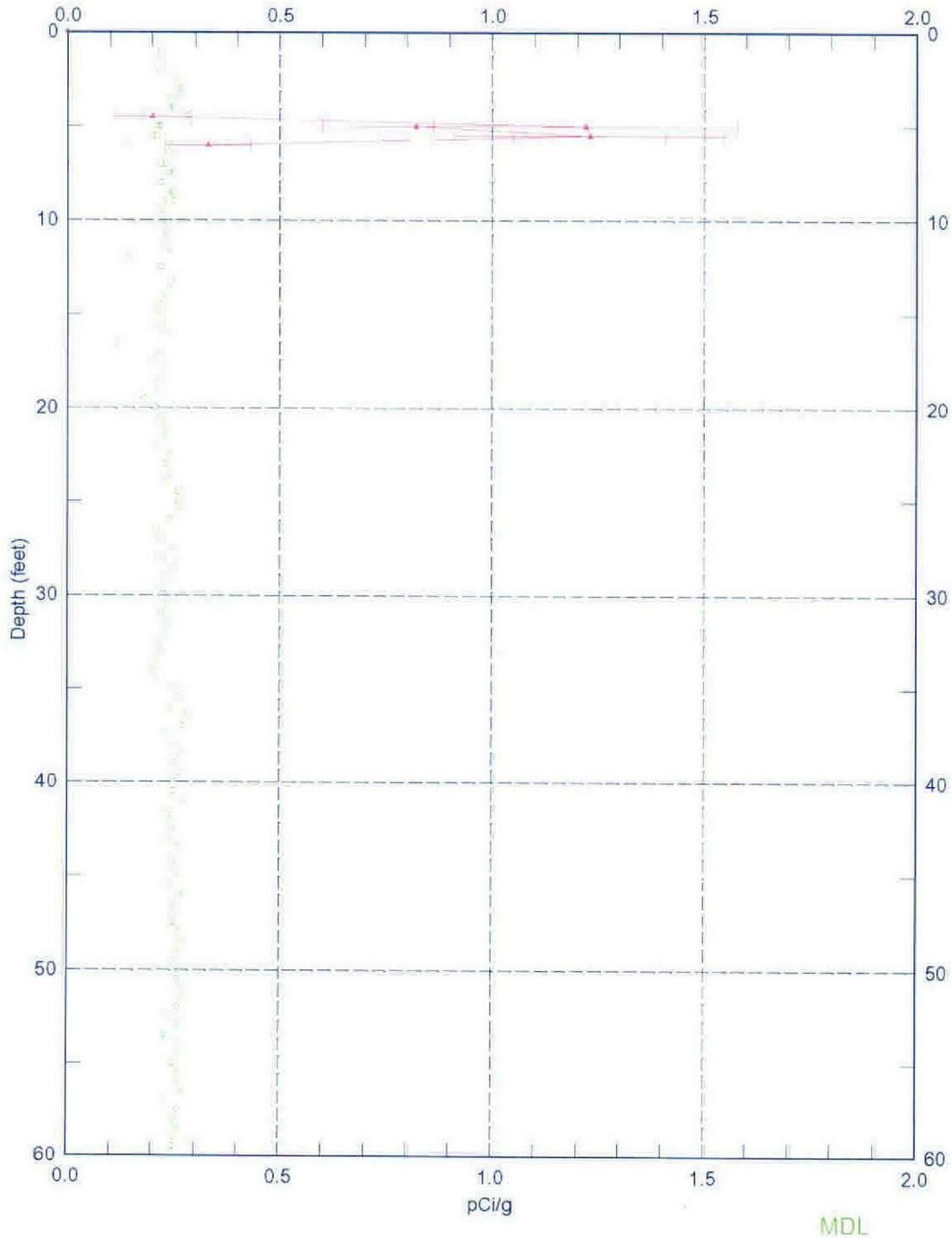
¹ GWL – groundwater level

² N/A – not available

³ TOC – top of casing

⁴ n/a – not applicable

C3343 Man-Made Radionuclides ¹³⁷Cs (662 keV)



Appendix B – Borehole Geophysical Logging Reports

was used to determine ^{238}U concentrations instead of the ^{214}Bi peak at 609 keV. This was done for consistency with boreholes C3340, C3341, and C3342, where interference from the ^{137}Cs peak at 662 keV affected the ^{214}Bi peak at 609 keV.

The neutron moisture log was processed using the calibration relationship developed for a 6-inch-diameter borehole with 0.28-inch-thick casing. A correction factor of 1.20 was applied to account for the effects of the thicker casing, which is based on an equivalent casing correction for 8-inch diameter developed by Randall.

Log Plot Notes:

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

A repeat log plot is also shown. The repeat plot indicates good agreement between successive log runs, demonstrating good repeatability in both depth and radionuclide measurement.

Results and Interpretations:

Only minor amounts of Cs-137 were detected by the SGLS between 4.5 and 5.5 ft. The maximum concentration of 1.2 pCi/g occurred at 5.5 ft.

Increases in gamma counts at 22 to 29 ft and below 35 ft are attributed to increases in natural radionuclides, primarily K-40. This may be an indication of a stratigraphic change associated with an increase in fines.

¹ GWL – groundwater level

² N/A – not available

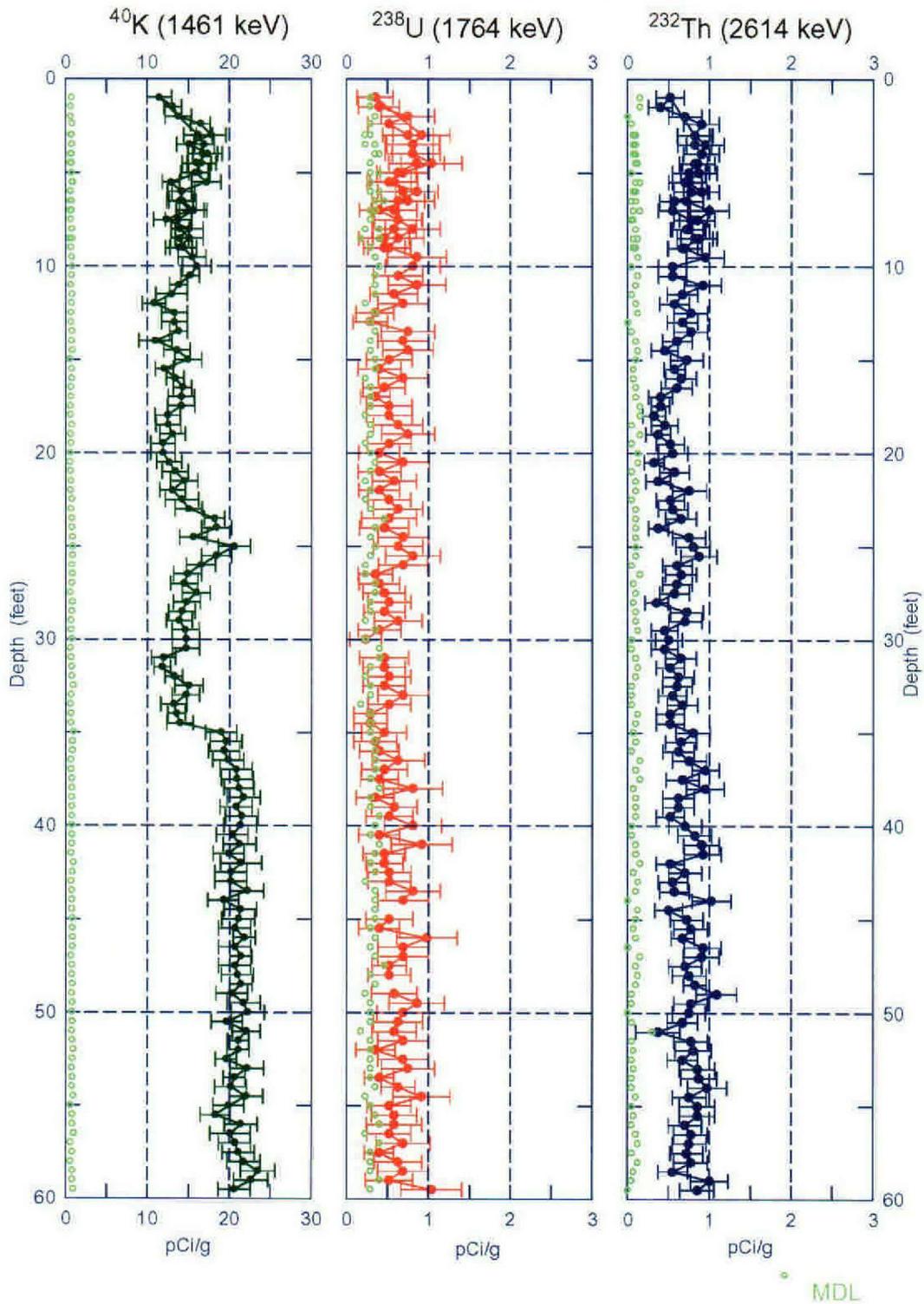
³ TOC – top of casing

⁴ n/a – not applicable

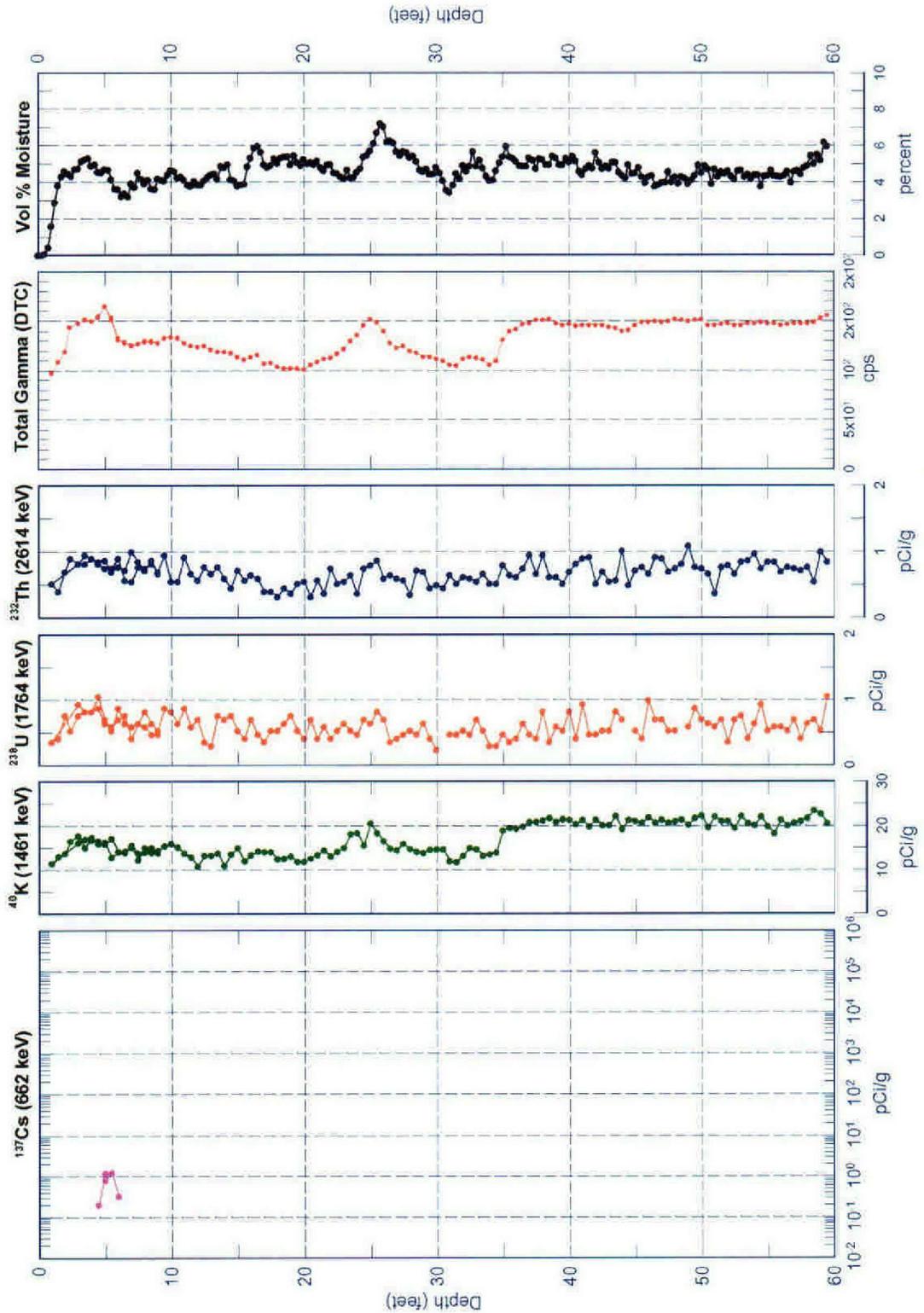
Appendix B – Borehole Geophysical Logging Reports

C3343

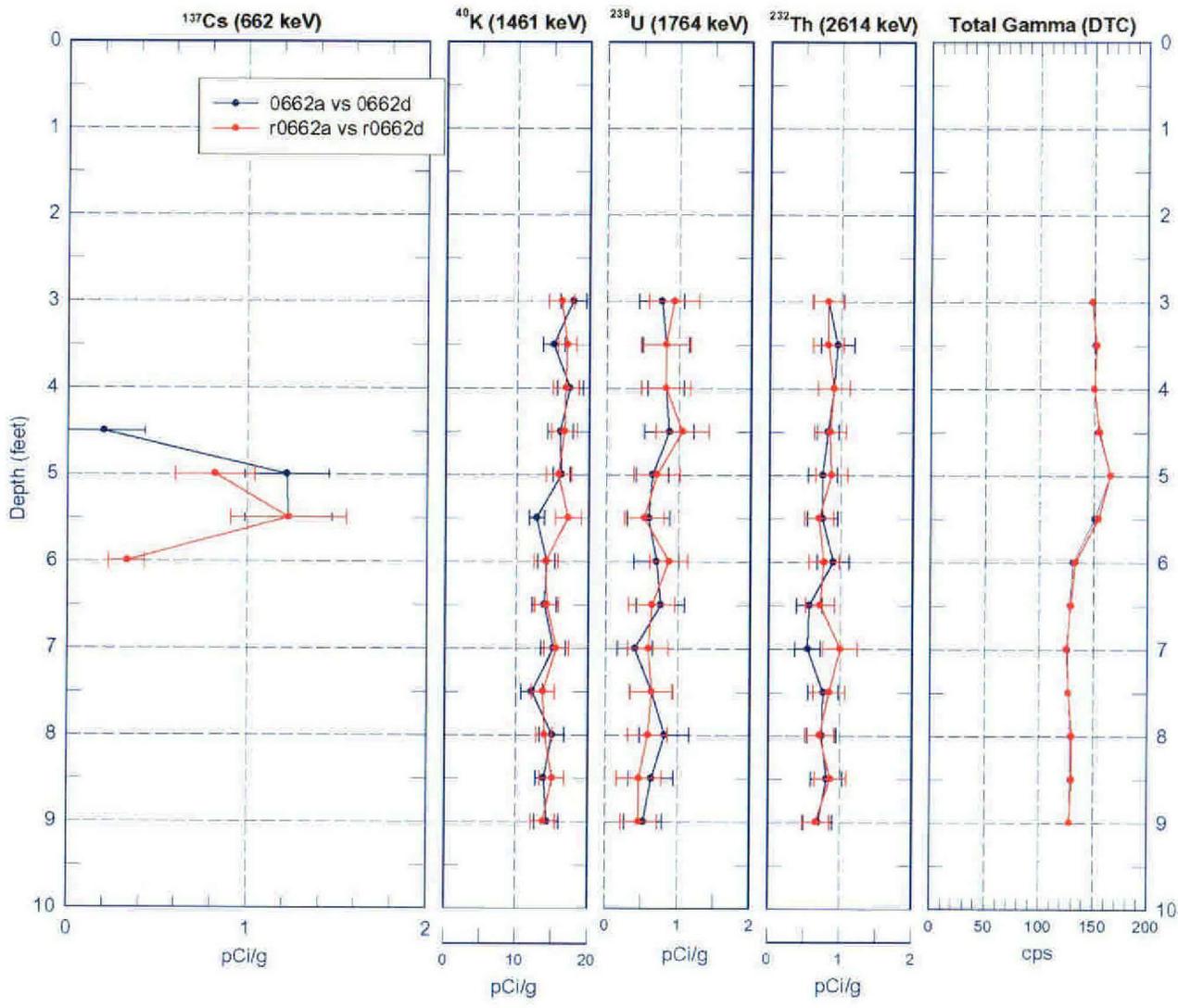
Natural Gamma (KUT) Logs



**C3343
Combination Plots**

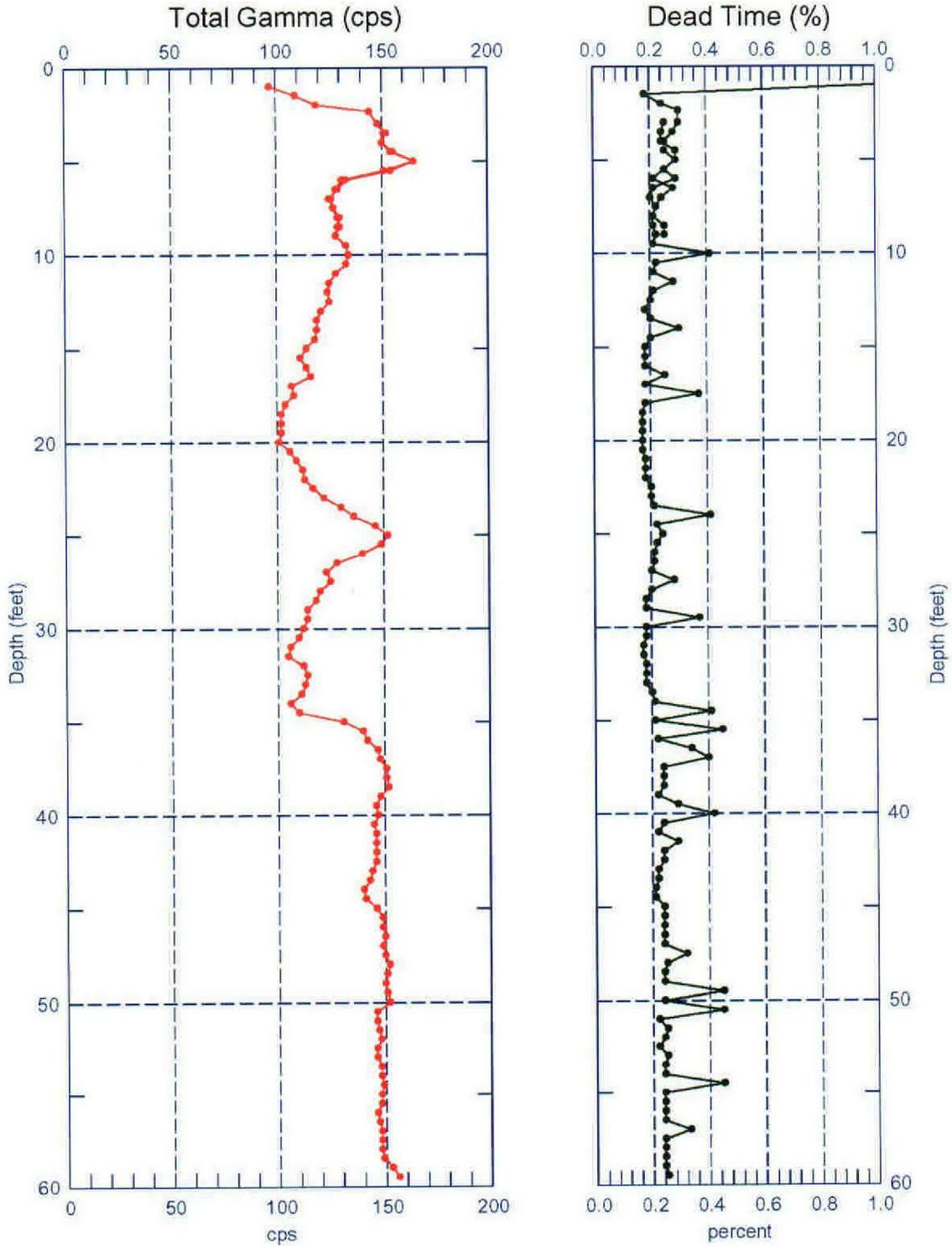


C3343 Repeat Plots



C3343

Total Gamma and Dead Time



Appendix B – Borehole Geophysical Logging Reports



C3344

Log Data Report

Borehole Information:

Borehole: C3344		Site: 218-B-38			
Coordinates		GWL' (ft): N/A		GWL Date:	
North	East	Drill Date	TOC ³ Elevation	Total Depth (ft)	Type
N/A	N/A	June 2001	N/A	60	push

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
steel threaded	0.5	6.625	5.625	0.5	0	59.5

Borehole Notes:

This is a temporary borehole pushed to a depth of approximately 60 ft. There is a gravel pad approximately 1 ft thick, and the top of casing sticks up approximately 0.5 ft above the gravel surface.

Logging Equipment Information:

Logging System:	Gamma 2B	Type:	SGLS (35%)
Calibration Date:	09/00	Calibration Reference:	GJO-HAN-245-TAR
		Logging Procedure:	MAC-HGLP 1.8.5

Logging System:	RLS	Type:	NMLS (Moisture)
Calibration Date:	05/01	Calibration Reference:	GJO-HAN-247-TAR
		Logging Procedure:	MAC-HGLP 1.8.5

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 (repeat)			
Date	7/02/01	7/02/01			
Logging Engineer	Musial/Spatz	Musial/Spatz			
Start Depth	59.5	10.0			
Finish Depth	1	4.0			
Count Time (sec)	150	150			
Live/Real	L	L			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.5	0.5			
ft/min	n/a*	n/a			
Pre-Verification	B0012CAB	B0012CAB			
Start File	B0012000	B0012118			
Finish File	B0012117	B0012130			
Post-Verification	B0012CAA	B0012CAA			

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	3	4 (repeat)			
Date	7/23/01	7/23/01			
Logging Engineer	Kos/Spatz	Kos/Spatz			
Start Depth	0.0	36.0			
Finish Depth	59.5	29.5			
Count Time (sec)	n/a	n/a			
Live/Real	n/a	n/a			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
ft/min	1.0	1.0			
Pre-Verification	C0042CAB	C0042CAB			
Start File	C0042000	C0042239			
Finish File	C0042238	C0042264			
Post-Verification	C0062CAA	C0062CAA			

Logging Operation Notes:

The zero reference point for all log data is the top of casing. Depths have been adjusted to ground surface, which is taken as the top of the gravel pad. Fine-gain adjustments were made in run 1 after file B0012094 (12.5 ft).

Analysis Notes:

Analyst:	McCain	Date:	07/27/01	Reference:	MAC-VZCP 1.7.9, Rev. 2
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The pre-run verification spectrum was found to be within acceptance criteria. The post-run verification spectrum was below the lower warning limit for all three peak intensities (609, 1461, and 2615 keV). FWHM values were within verification criteria. Comparison of the two spectra indicates the tool appears to be functioning properly. Individual spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL. Corrections were applied for casing thickness. Water correction was not required. Dead time was less than 1 percent over the entire borehole, and no dead time corrections were required. The ²¹⁴Bi peak at 1764 keV

Appendix B – Borehole Geophysical Logging Reports

was used to determine ^{238}U concentrations instead of the ^{214}Bi peak at 609 keV. This was done for consistency with boreholes C3340, C3341, and C3342, where interference from the ^{137}Cs peak at 662 keV affected the ^{214}Bi peak at 609 keV.

The neutron moisture log was processed using the calibration relationship developed for a 6-inch-diameter borehole with 0.28-inch-thick casing. A correction factor of 1.20 was applied to account for the effects of the thicker casing, which is based on an equivalent casing correction for 8-inch diameter developed by Randall.

Log Plot Notes:

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

A repeat log plot is also shown. The repeat plot indicates good agreement between successive log runs, demonstrating good repeatability in both depth and radionuclide measurement.

Results and Interpretations:

Only minor amounts of Cs-137 were detected by the SLGS between 4.5 and 5 ft. The maximum concentration of 0.8 pCi/g occurred at 4.5 ft.

Increases in gamma counts at 38 to 39 ft are attributed to increases in natural radionuclides. This may be an indication of a stratigraphic change associated with an increase in fines.

¹ GWL – groundwater level

² N/A – not available

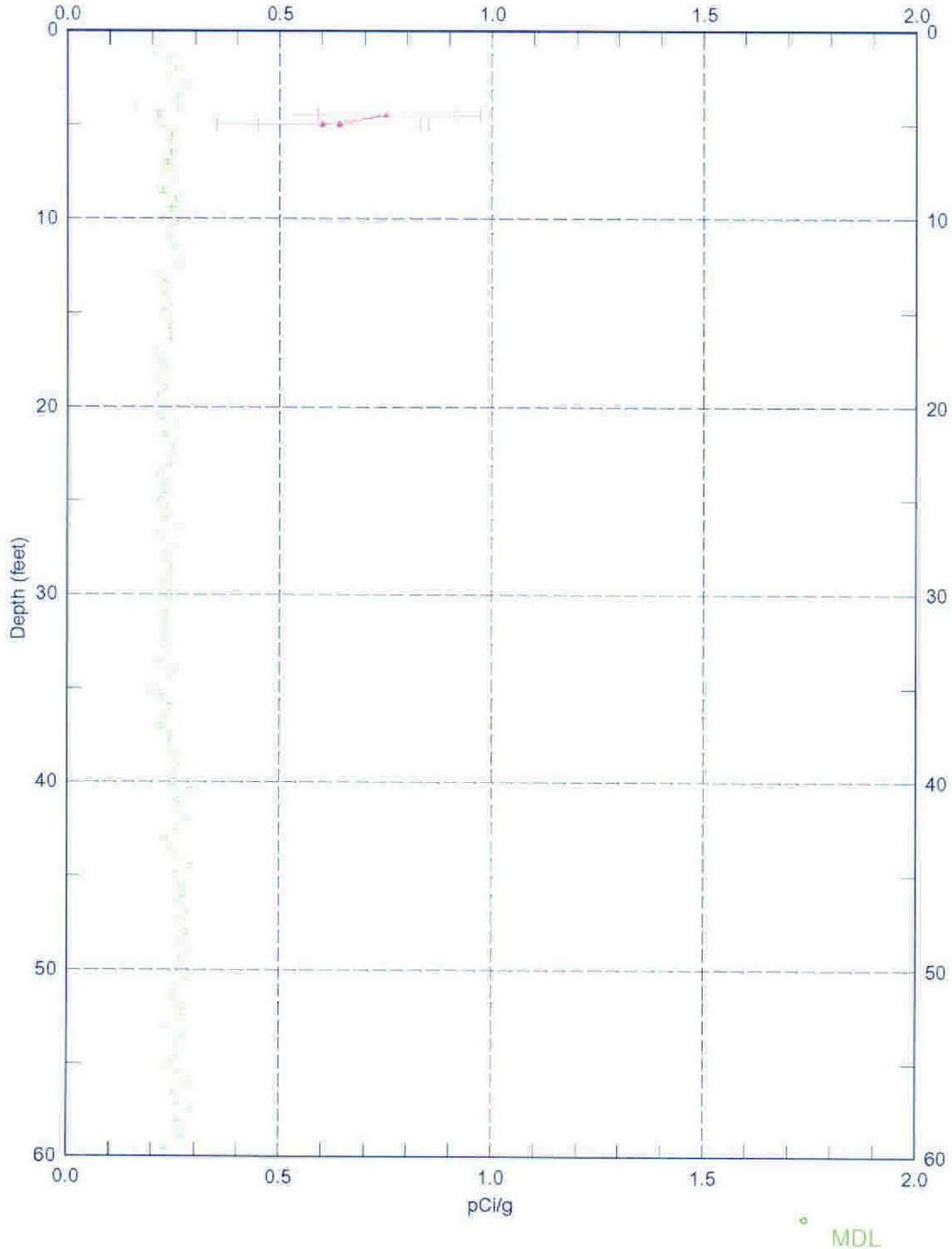
³ TOC – top of casing

⁴ n/a – not applicable

C3344

Man-Made Radionuclides

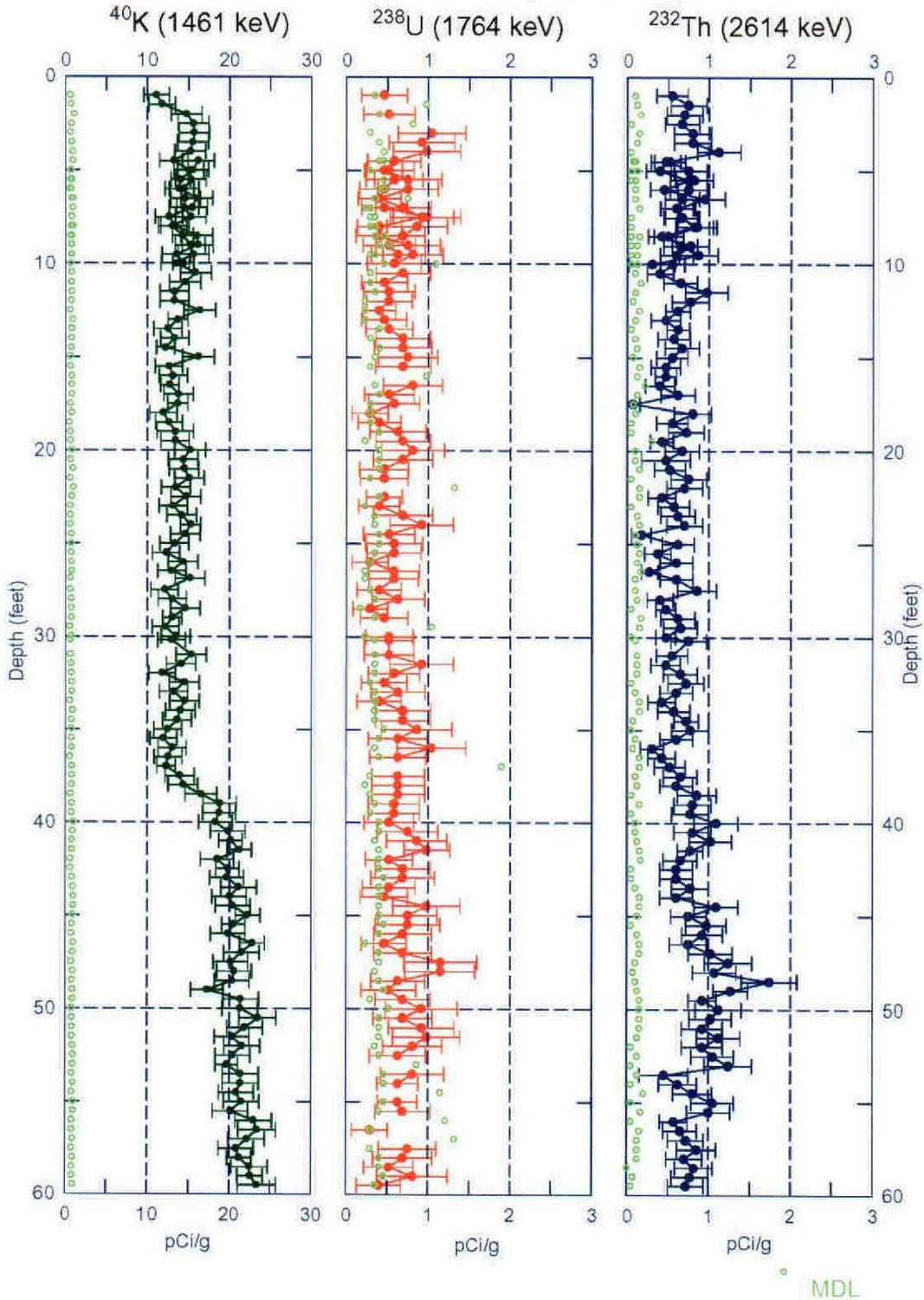
¹³⁷Cs (662 keV)



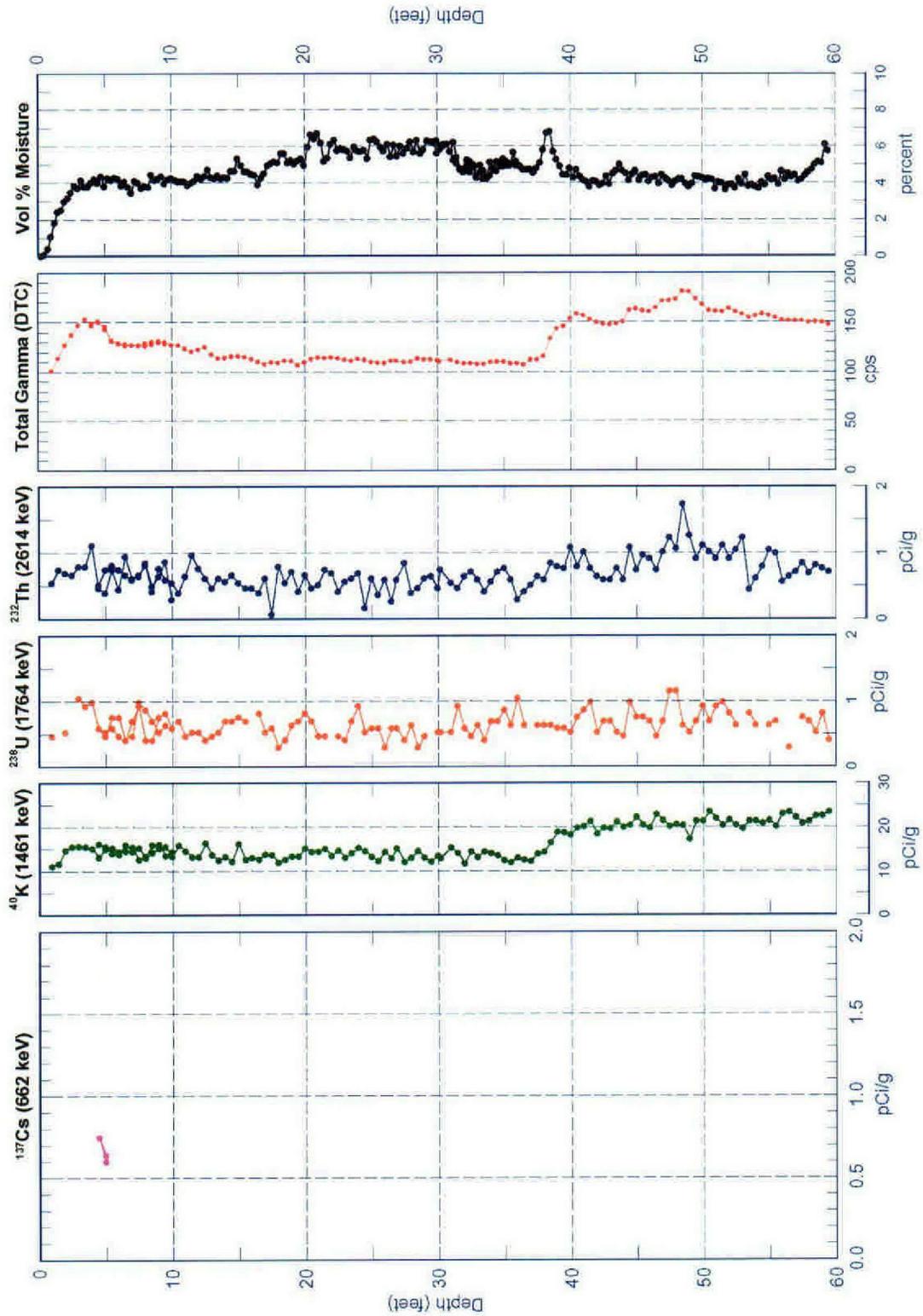
Appendix B – Borehole Geophysical Logging Reports

C3344

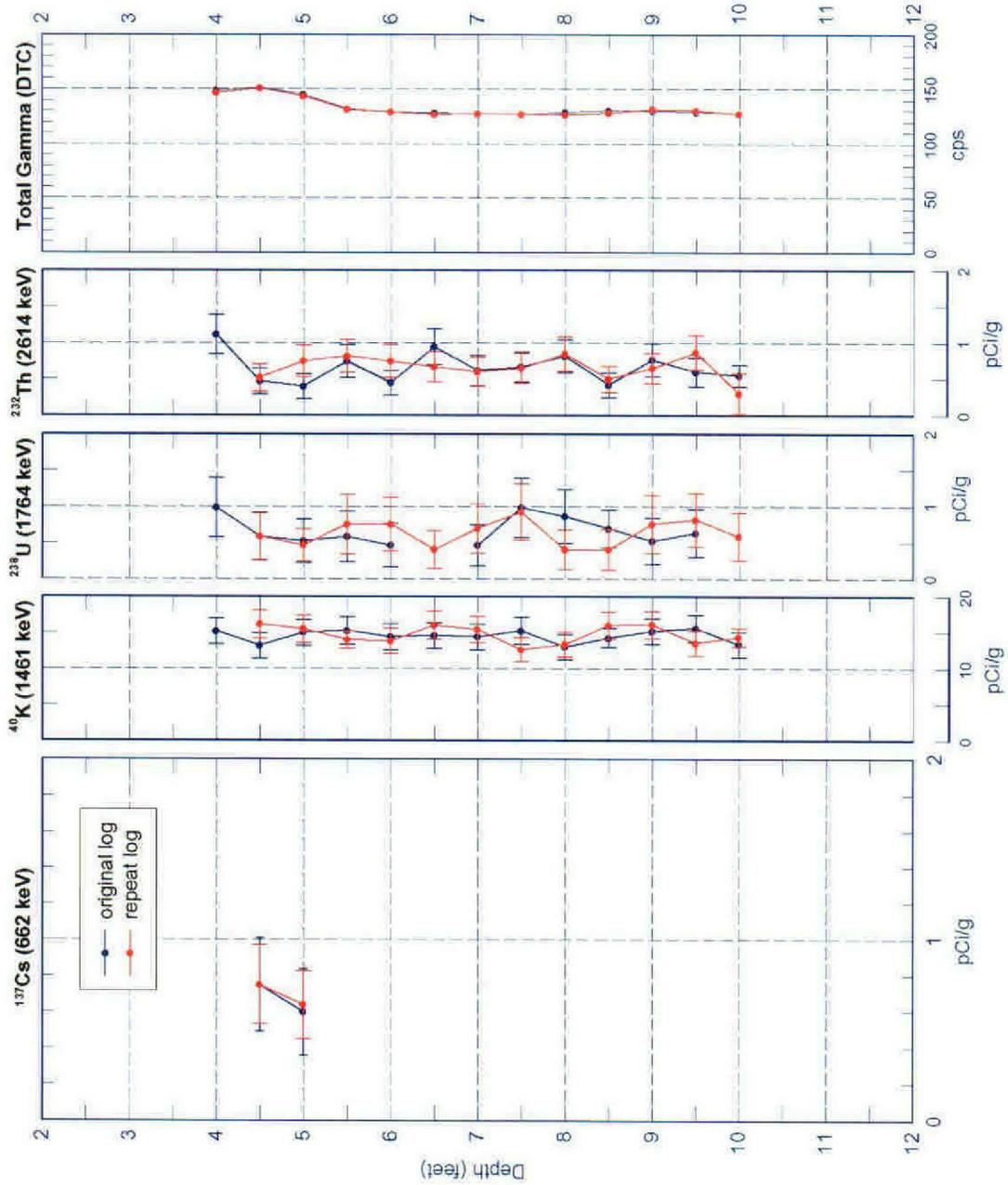
Natural Gamma (KUT) Logs



**C3344
Combination Plots**

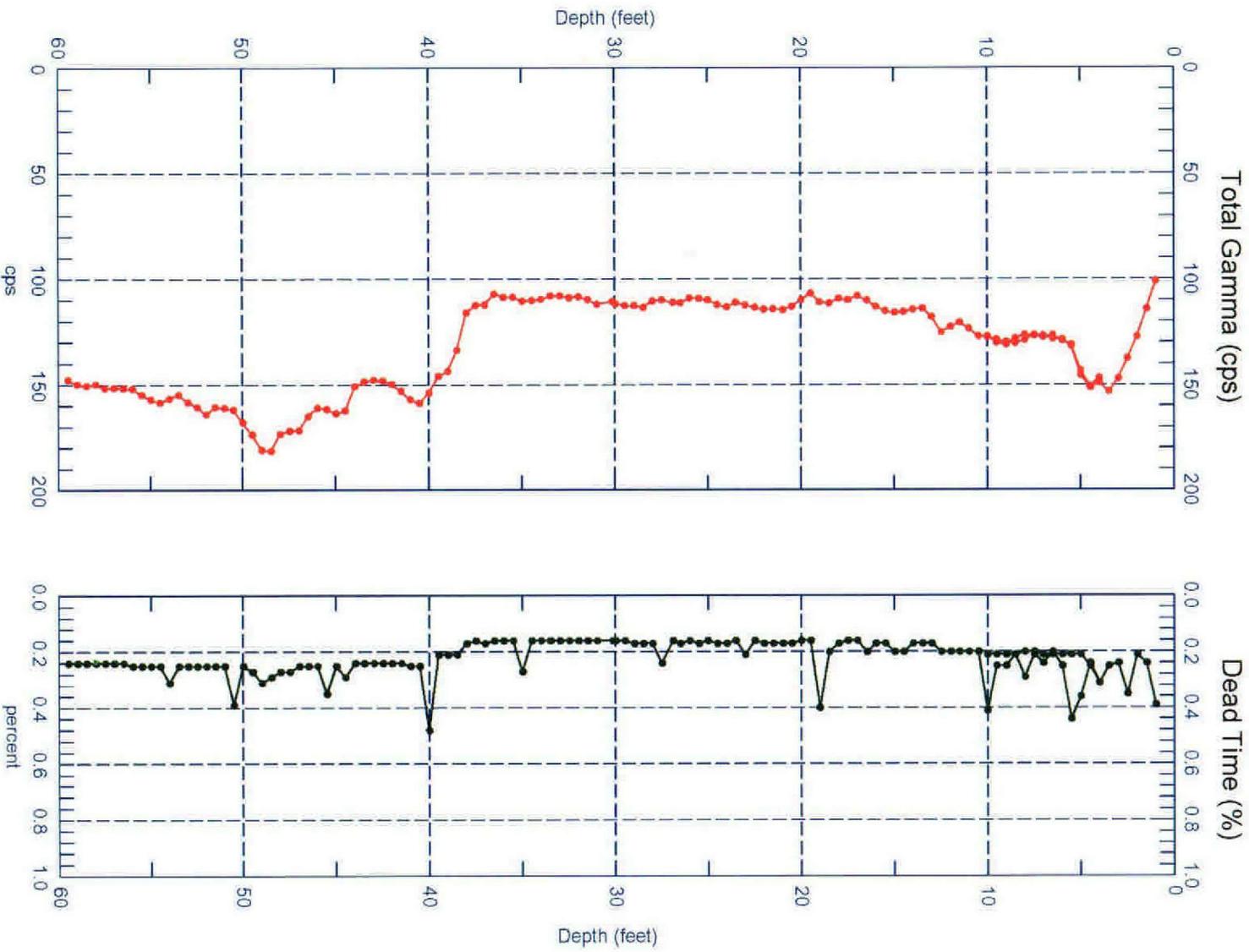


C3344
Repeat Plots



C3344

Total Gamma and Dead Time





C3104

Log Data Report

Borehole Information:

Borehole: C3104		Site: 216-B-38 Trench			
Coordinates		GWL' (ft): Not reached		GWL Date:	
North N/A	East n/a	Drill Date 8/01/01	TOC* Elevation n/a	Total Depth (ft) 259.6	Type Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
CS threaded steel pipe	5 in.	10.75	9.25	0.75	0	58
CS threaded steel pipe	17 in.	8.375	7.825	0.5	0	111
CS threaded steel pipe	26.5	6.687	5.6785	0.5	0	259.6

Borehole Notes:

Ground surface is a gravel pad 1.5 to 2.0 ft thick.
This borehole is located 5.0 ft west of the "push" borehole C3340.

Logging Equipment Information:

Logging System:	Gamma 2B	Type:	SGLS (35%)
Calibration Date:	9/00	Calibration Reference:	GJO-2001-245-TAR
		Logging Procedure:	MAC-HGLP 1.6.5
Logging System:	RLS 1	Type:	Moisture
Calibration Date:	5/01	Calibration Reference:	RLSM00.0
		Logging Procedure:	MAC-HGLP 1.6.5
Logging System:	Gamma 1C	Type:	HRLS
Calibration Date:	9/00	Calibration Reference:	GJO-2001-244-TAR
		Logging Procedure:	MAC-HGLP 1.6.5

Appendix B – Borehole Geophysical Logging Reports

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4/Repeat	5
Date	8/06/01	8/06/01	8/06/01	8/06/01	8/07/01
Logging Engineer	Musial	Musial	Musial	Musial	Musial/Kos
Start Depth (ft)	0	18.5	42	53	58
Finish Depth (ft)	18	41.5	59.5	59	111.5
Count Time (sec)	200	30	200	200	200
Live/Real	R	R	R	R	R
Shield	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	1.0	0.5
ft/min	n/a*	n/a	n/a	n/a	n/a
Pre-Verification	B00029CAB	B00029CAB	B00029CAB	B00029CAB	B00030CAB
Start File	B0029000	B0029037	B0029084	B0029120	B0030000
Finish File	B0029036	B0029083	B0029119	B0029132	B0030107
Post-Verification	B00029CAA	B00029CAA	B00029CAA	B00029CAA	B00030CAA

Log Run	6/Repeat	7	8	9	10/Repeat
Date	8/07/01	8/10/01	8/10/01	8/11/01	8/11/01
Logging Engineer	Musial	Musial	Pearson	Musial	Musial
Start Depth (ft)	106	110	173.0	219.5	115
Finish Depth (ft)	111.0	174	222.0	260	130
Count Time (sec)	200	200	200	100	100
Live/Real	R	R	R	R	R
Shield	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5
ft/min	n/a	n/a	n/a	n/a	n/a
Pre-Verification	B00030CAB	B00032CAB	B00032CAB	B00033CAB	B00033CAB
Start File	B0030108	B0032000	B0032129	B0033000	B0033082
Finish File	B0030118	B0032128	B0032227	B0033081	B0033112
Post-Verification	B00030CAA	B00032CAA	B00032CAA	B00033CAA	B00033CAA

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2/Repeat	3	4/Repeat	
Date	8/07/01	8/07/01	8/11/01	8/11/01	
Logging Engineer	Musial/Kos	Musial/Kos	Musial	Musial	
Start Depth (ft)	58.0	105	110	230	
Finish Depth (ft)	111.25	110	260	245	
Count Time (sec)	n/a	n/a	n/a	n/a	
Live/Real	n/a	n/a	n/a	n/a	
Shield	N	N	N	N	
MSA Interval (ft)	0.25	0.25	0.25	0.25	
ft/min	1.0	1.0	1.0	1.0	
Pre-Verification	C009CAB	C009CAB	C0010CAB	C0010CAB	
Start File	C009000	C009214	C0010000	C0010601	
Finish File	C009213	C009234	C0010600	C0010661	
Post-Verification	C009CAA	C009CAA	C0010CAA	C0010CAA	

High Rate Logging System (HRLS) Log Run Information:

Log Run	1	2/Repeat			
Date	8/16/01	8/16/01			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	12.0	25.0			
Finish Depth (ft)	47.0	20.0			
Count Time (sec)	300	n/a			
Live/Real	R	n/a			
Shield	N	N			
MSA Interval (ft)	0.5	0.25			
ft/min	n/a	n/a			
Pre-Verification	D003CAB	D003CAB			
Start File	D003000	D003071			
Finish File	D003070	D003081			
Post-Verification	D003CAA	D003CAA			

Logging Operation Notes:

Spectral gamma data were collected in three surveys, one in each casing string as the borehole was advanced. The final SGLS survey was conducted on August 11, 2001.

SGLS log depths are relative to ground level. During logging run 3, a fine gain adjustment occurred at file B0029089 (45 ft). During logging run 4, a fine gain adjustment occurred at file B0029120 (53 ft). During logging run 8, fine gain adjustments occurred at files B0032111 (165.5 ft) and B0032125 (172.5 ft). SGLS surveys conducted on 8/11/01 (log runs 9 and 10) were erroneously conducted at an acquisition rate of 100 seconds real time.

Neutron moisture logs were run on 8/07/01 and 8/11/01 using the RLS 1 through one string of drill pipe. Log depths are relative to ground level. The neutron moisture tool was run centralized.

Two strings of casing were removed from the borehole prior to running the HRLS. High rate logging was not performed in this casing string when it was initially installed because the inside of this casing string has the potential for internal contamination. The HRLS tool was covered with a plastic bag, because this borehole has a potential for internal contamination. The outside temperature was extremely hot (>100 °F) during logging, which appears to have caused some minor gain drift during the pre-run verification and spectra collected early in the log run. Fine-gain amplifier adjustment after files: D003003 at 13 ft; D003008 at 16 ft; D003013 at 18.5 ft; D003048 at 36 ft.

Analysis Notes:

Analyst: Sobczyk	Date: 08/22/01	Reference: MAC-VZCP 1.79, Rev.2
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Pre-run and post-run verification spectra for the SGLS were evaluated. All of the pre-survey verification spectra were within the control limits. The post-survey verification spectrum for logging run 1 (file B00030CAA) was the only post-survey verification spectrum that was outside of the control limits. The full width half maximum (FWHM) for the 1461-keV peak and the 2614-keV peak were above the upper control limits for this post-run verification spectra. Examinations of spectra indicate that the detector appears to have functioned normally during the log run. Individual spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL. Corrections were applied for a casing thickness of 0.75 inches from the surface to 58 ft and for a casing thickness of 0.50 inch from 58 to 260 ft. A correction for

water in the borehole was necessary. Dead time corrections were necessary in portions of the borehole above 47 ft. The hole was open at the end of each drill string at 58, 111, and 259.6 ft, and the change in drill strings is apparent in the logs as a slight increase at the end of the drill string and a decrease at the beginning of the log run while in double casing.

The first and second reruns of the SGLS show good repeatability. On the third rerun of the SGLS, data collected using a 100-second count time (rerun) compares well with data collected using a 200-second count time (original log run) except on the ^{40}K curve at 122.5, 124, 126.5, 127, and 129.5 ft. These discrepancies may be related to the shorter counting time used on the repeat log.

The High Rate Logging System (HRLS) was run in the interval from 12 to 47 ft. Data were collected in the interval of the SGLS high dead time (> 40%) and indicates that ^{137}Cs reaches activities of about 100,000 pCi/g between 18 and 35 ft. This high rate zone contains activities of ^{137}Cs that are beyond the operating range of the SGLS. At lower activities of ^{137}Cs , there is good agreement between the SGLS and HRLS in the interval between 42 and 47 ft.

Moisture calibration models at Hanford for 6-inch-diameter casing with 1/2-inch thickness have not been established; however, calibration models have been established for 8-inch-diameter casing with 0.322-inch thickness and 6-inch-diameter casing with 0.28 inch thickness. A casing thickness correction (relative to 8-inch) casing can be estimated. Thus, the neutron log was processed for the portion of the hole with 6-inch casing to estimate volumetric moisture content with the established 6-inch hole-size correction and the 0.50-inch casing thickness for 8-inch diameter casing. A casing correction factor of 1.2 was applied to account for casing thickness. Neutron data are also presented as gross counts. In general, an increase in neutron count is indicative of an increase in moisture content.

The first rerun of the neutron-moisture tool shows good repeatability. On the second rerun of the neutron-moisture tool, the rerun appears to read about 10 cps higher on the rerun than the original run.

Log Plot Notes:

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

Results and Interpretations:

The man-made radionuclides ^{137}Cs and ^{60}Co were detected in this borehole. The high gamma activity between 13 and 45 ft is attributed to ^{137}Cs activities greater than 1,000 pCi/g. High rate logging indicates that ^{137}Cs reaches activities of about 100,000 pCi/g between 18 and 35 ft. In addition, ^{60}Co was observed in the intervals from 44 ft through 71.5 ft and at 115 ft at about 0.1 pCi/g. ^{60}Co may also be present higher in the borehole but was not observed due to the high recorded dead time due to the high levels of ^{137}Cs activity. Deeper in the borehole, ^{137}Cs activity was observed at 217.5 ft with a measured ^{137}Cs activity of about 0.2 pCi/g.

Other than the zones containing man-made radionuclides, the changes in gross gamma counts depend primarily upon changes in ^{40}K activities. There is an increase in ^{40}K from about 14 pCi/g above 12 ft to about 19 pCi/g below 43 ft. This increase in apparent ^{40}K activity occurred within the interval of high dead time, which was due to high ^{137}Cs activity. The increase in gross gamma counts from 130 to 145 cps at a

log depth of 217 through 220 ft corresponds to an increase in gross neutron counts per second. ^{137}Cs was detected within this zone at 217.5 ft with an activity of 0.2 pCi/g. Below 220 ft, gross gamma counts average about 25 cps less than that measured above 215 ft.

The elevated neutron counts per second that occur at about 115 ft and 219 ft correspond with intervals of man-made radionuclides. At 115 ft, ^{60}Co was detected at 0.1 pCi/g. ^{137}Cs was detected at 217.5 ft. The natural radionuclides do not show any apparent changes in these intervals. The elevated neutron count rate at 109 through 111 ft is probably related to the bottom of the second casing string.

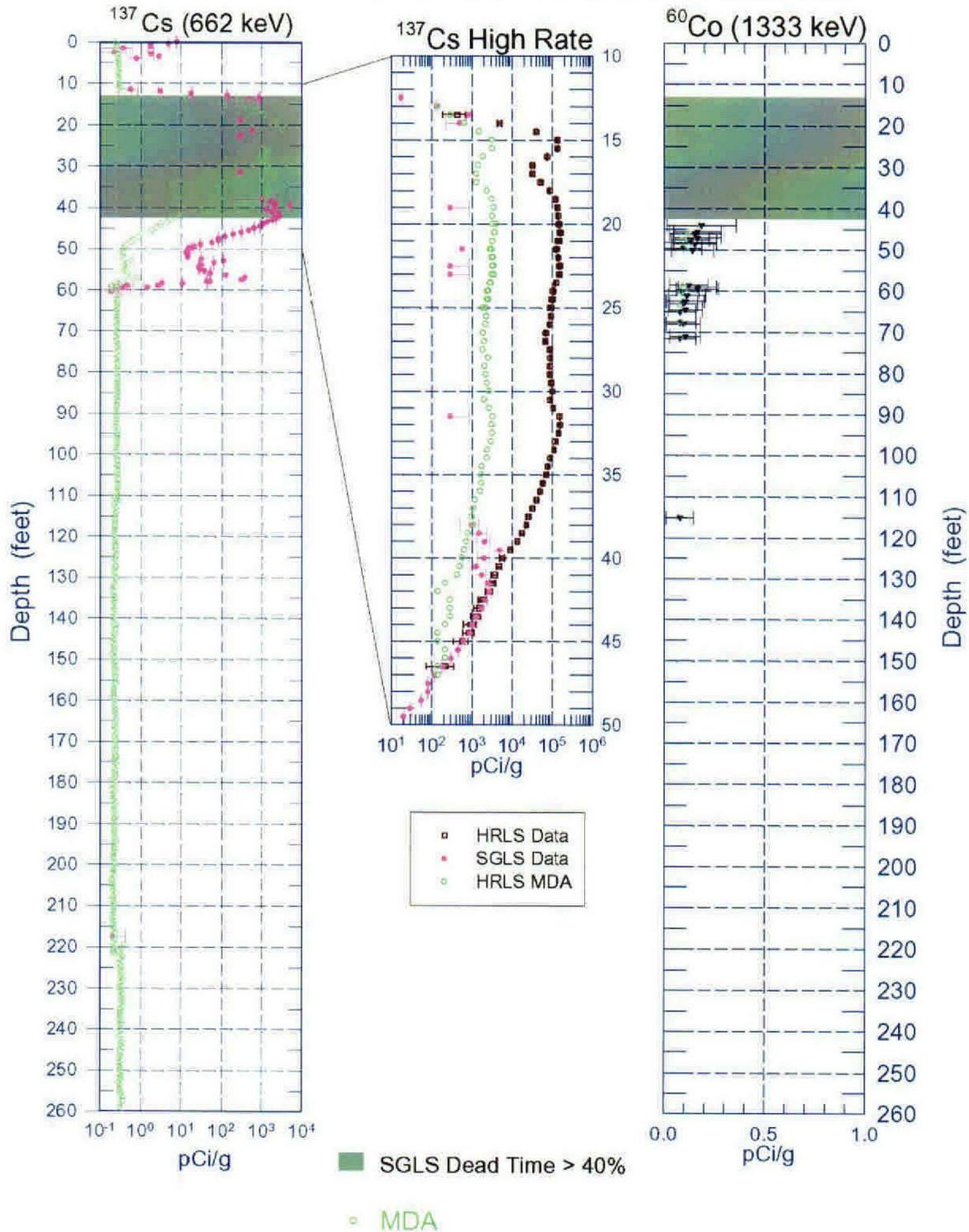
¹ GWL – groundwater level

² TOC – top of casing

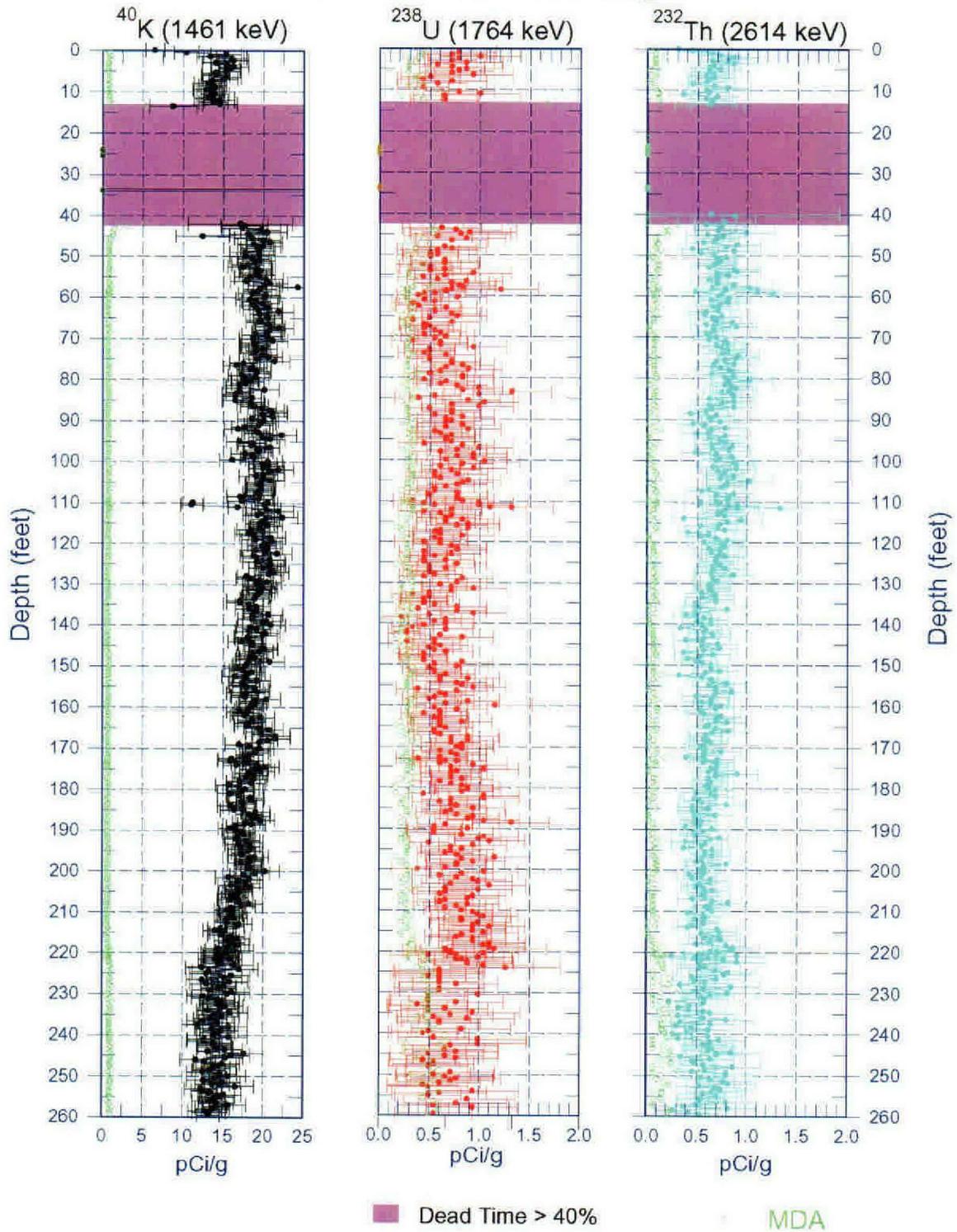
³ N/A – not available

⁴ n/a – not applicable

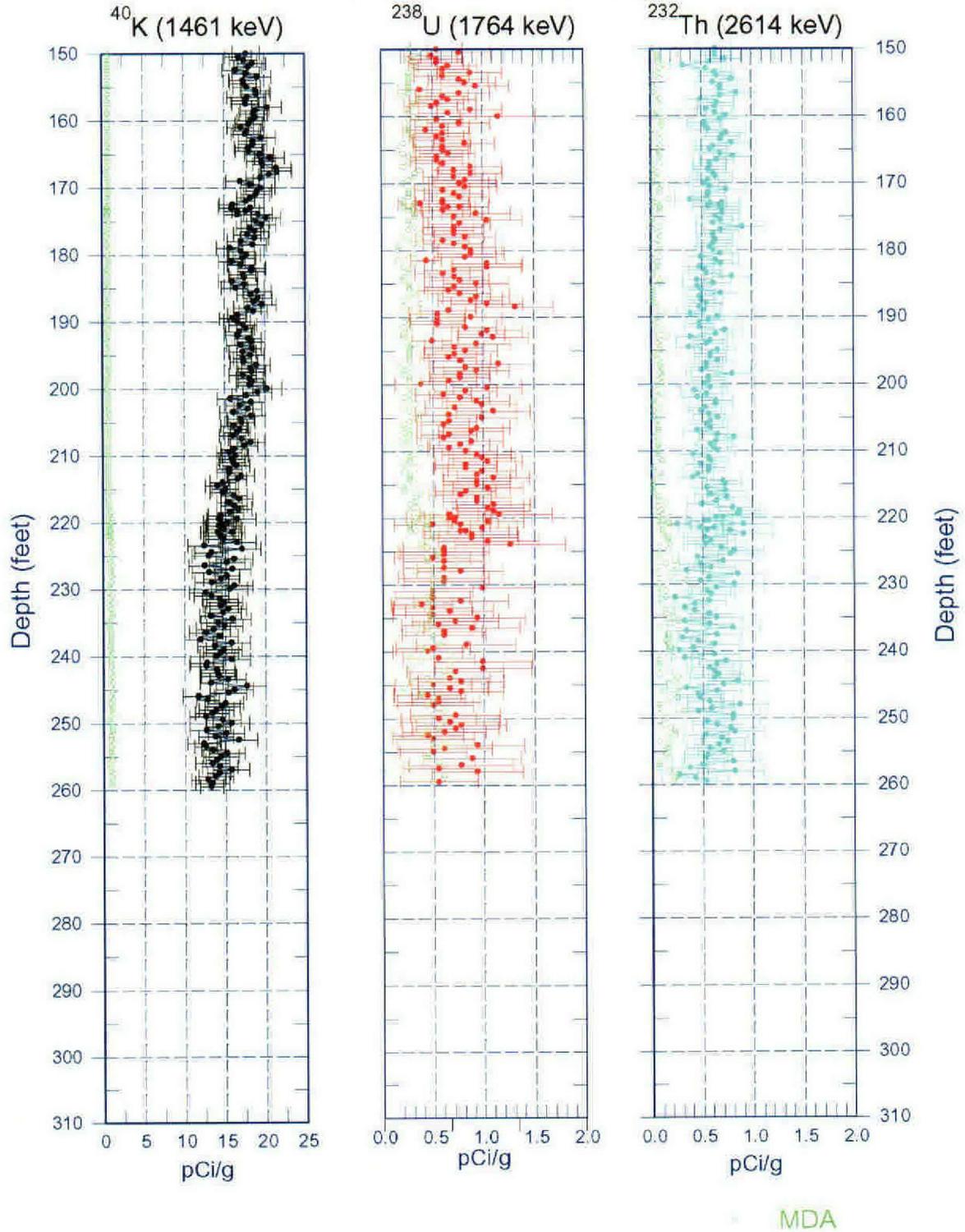
C3104 Man-Made Radionuclide Concentrations



C3104 Natural Gamma Logs



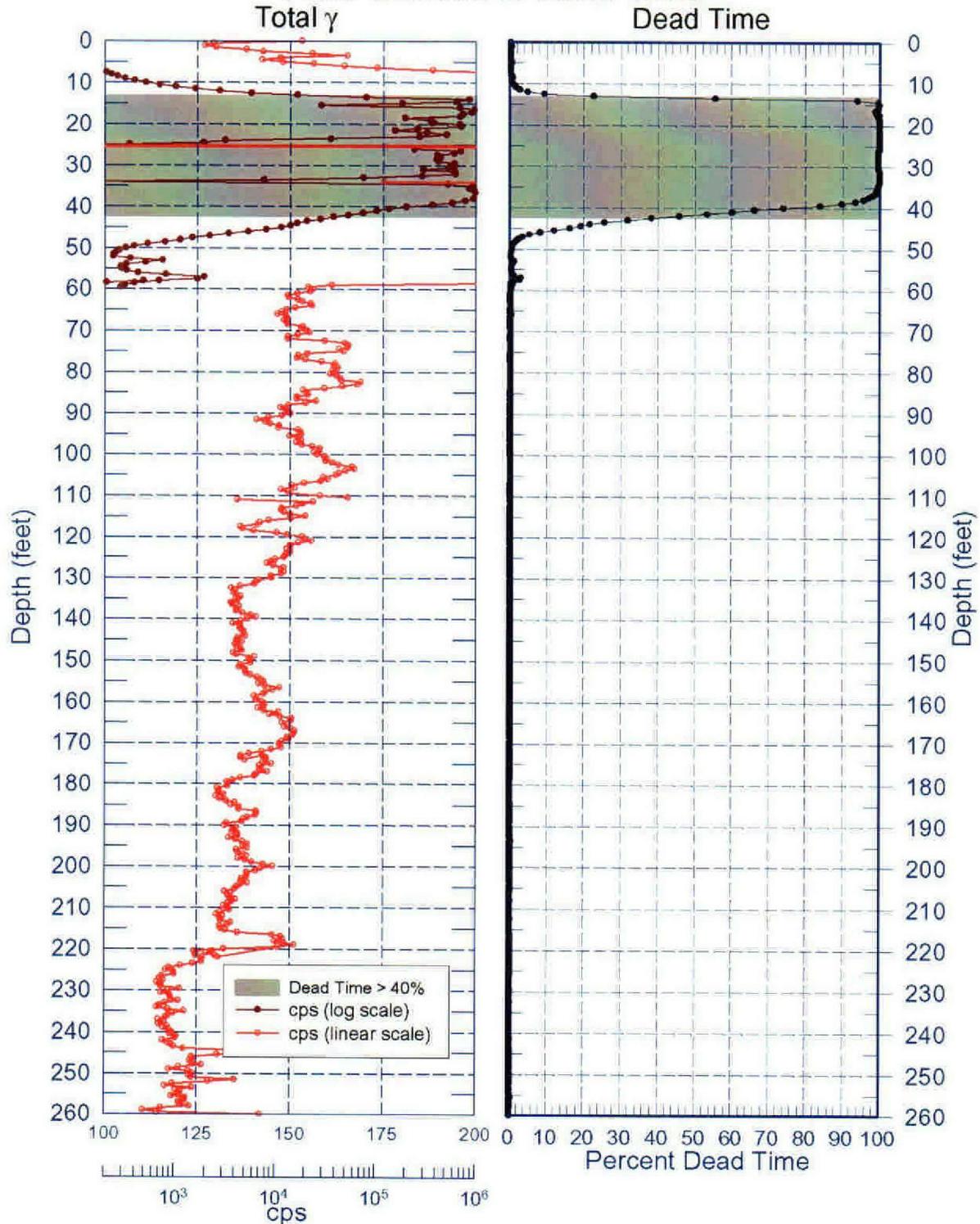
C3104 Natural Gamma Logs



Appendix B – Borehole Geophysical Logging Reports

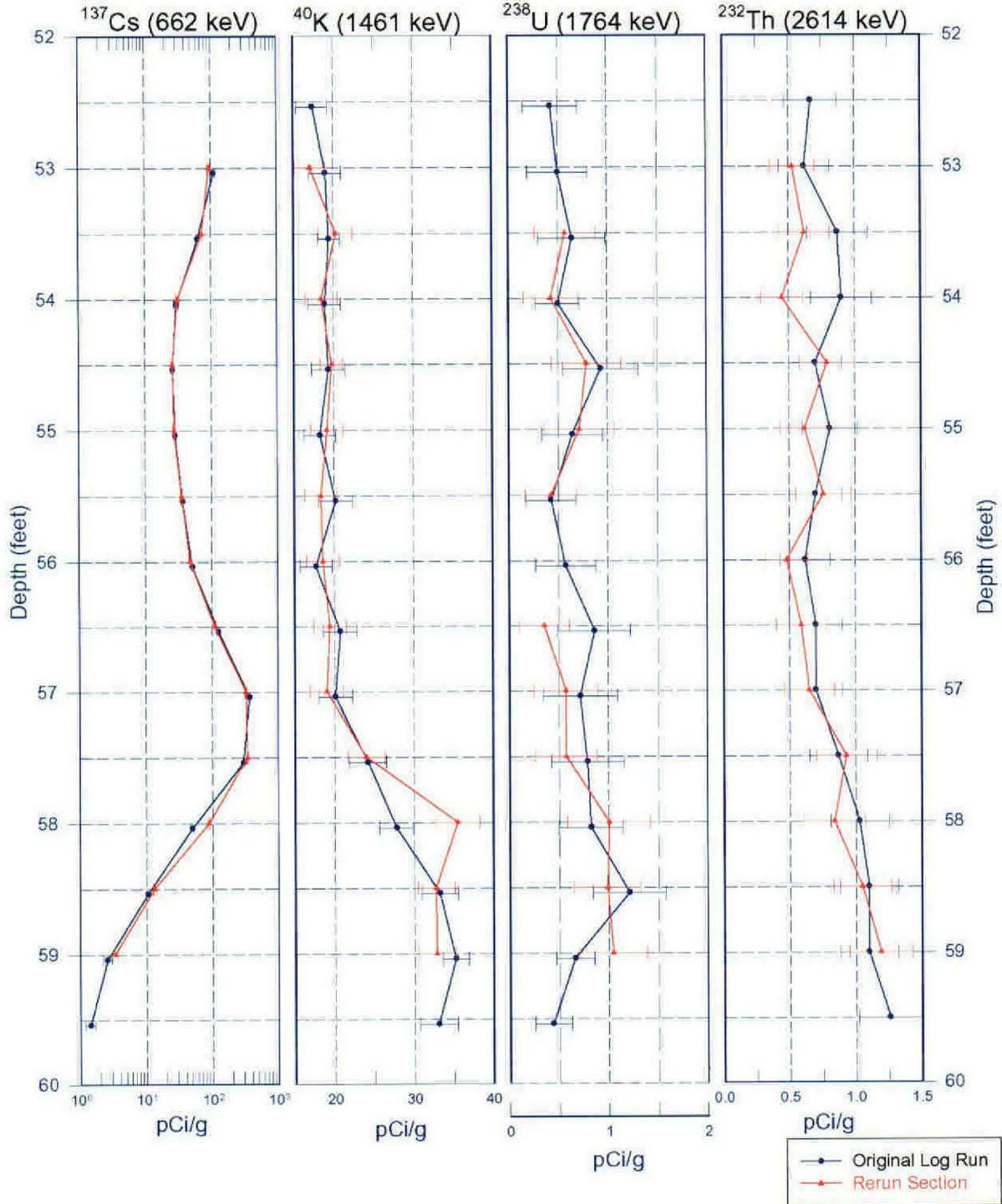
C3104

Total Gamma & Dead Time



C3104

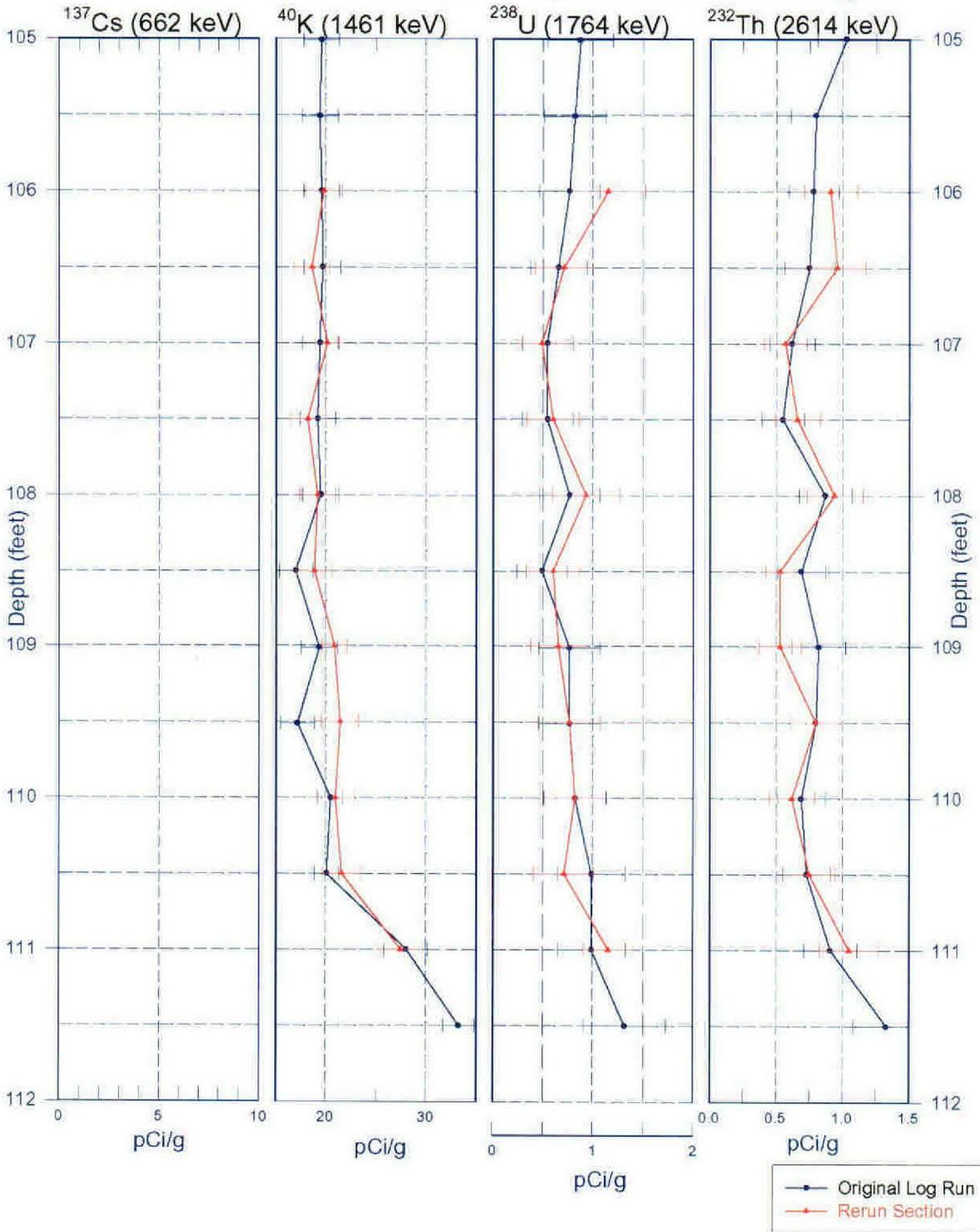
First Rerun Section of Spectral Gamma Logs



Appendix B – Borehole Geophysical Logging Reports

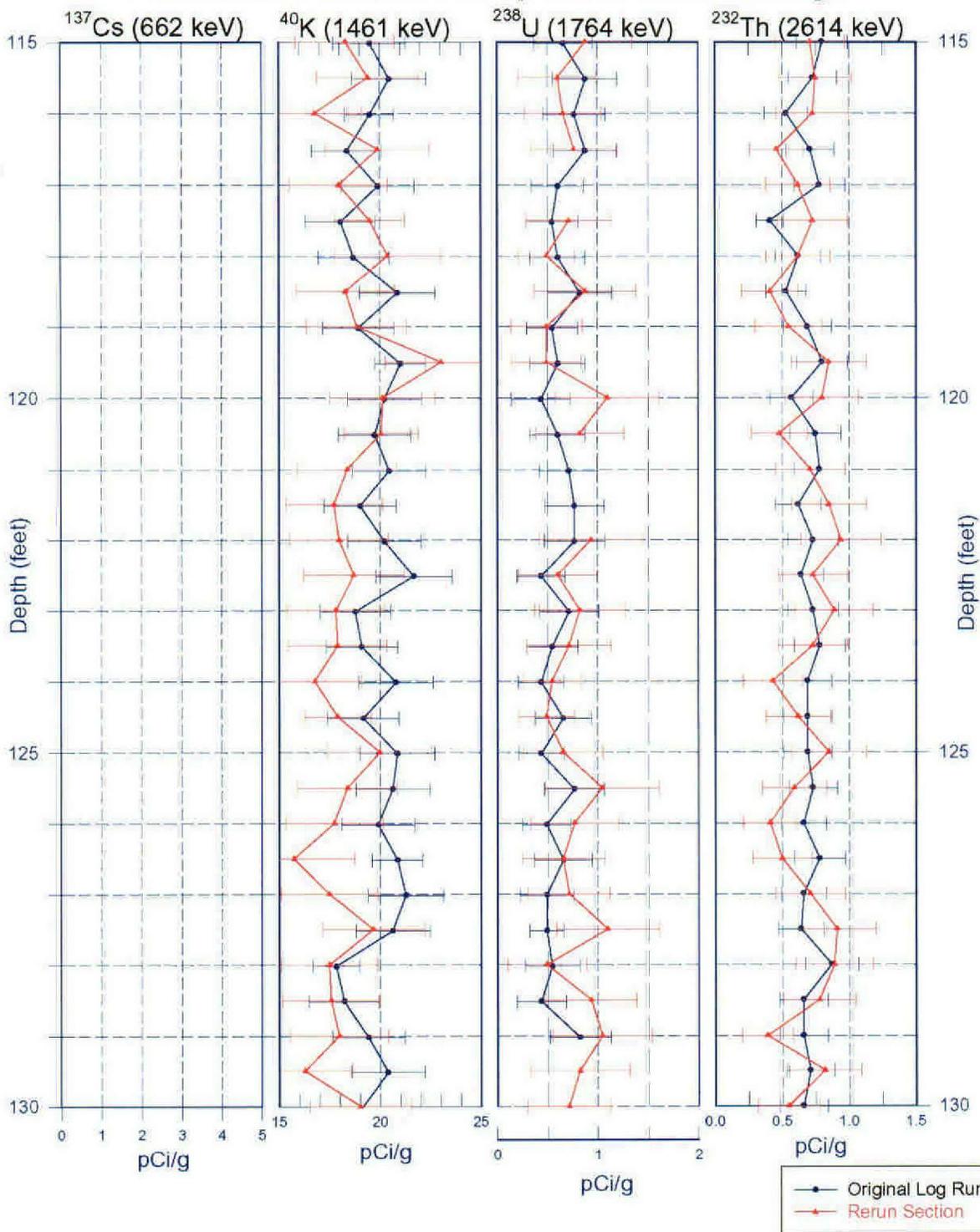
C3104

Second Rerun Section of Spectral Gamma Logs

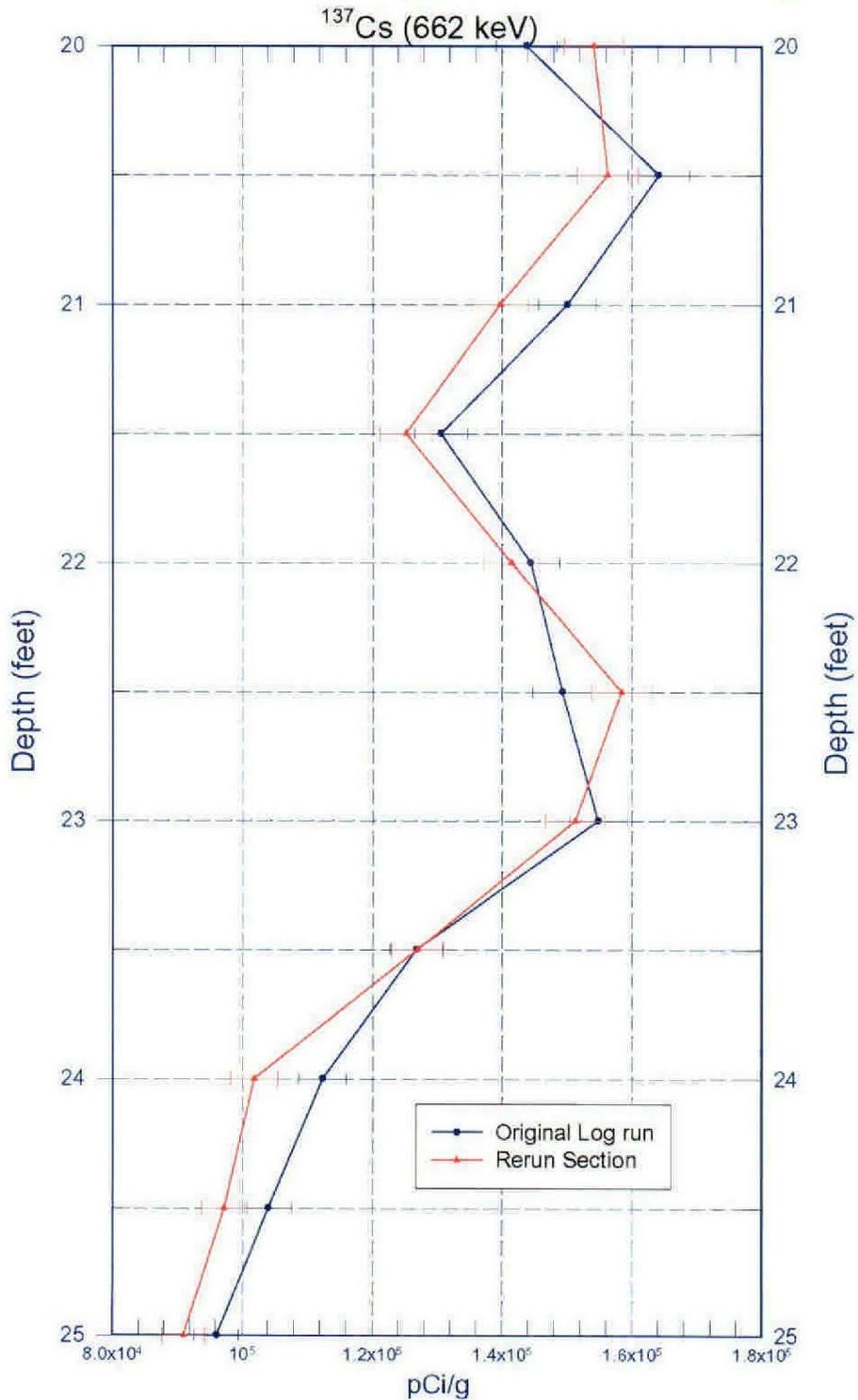


C3104

Third Rerun Section of Spectral Gamma Logs

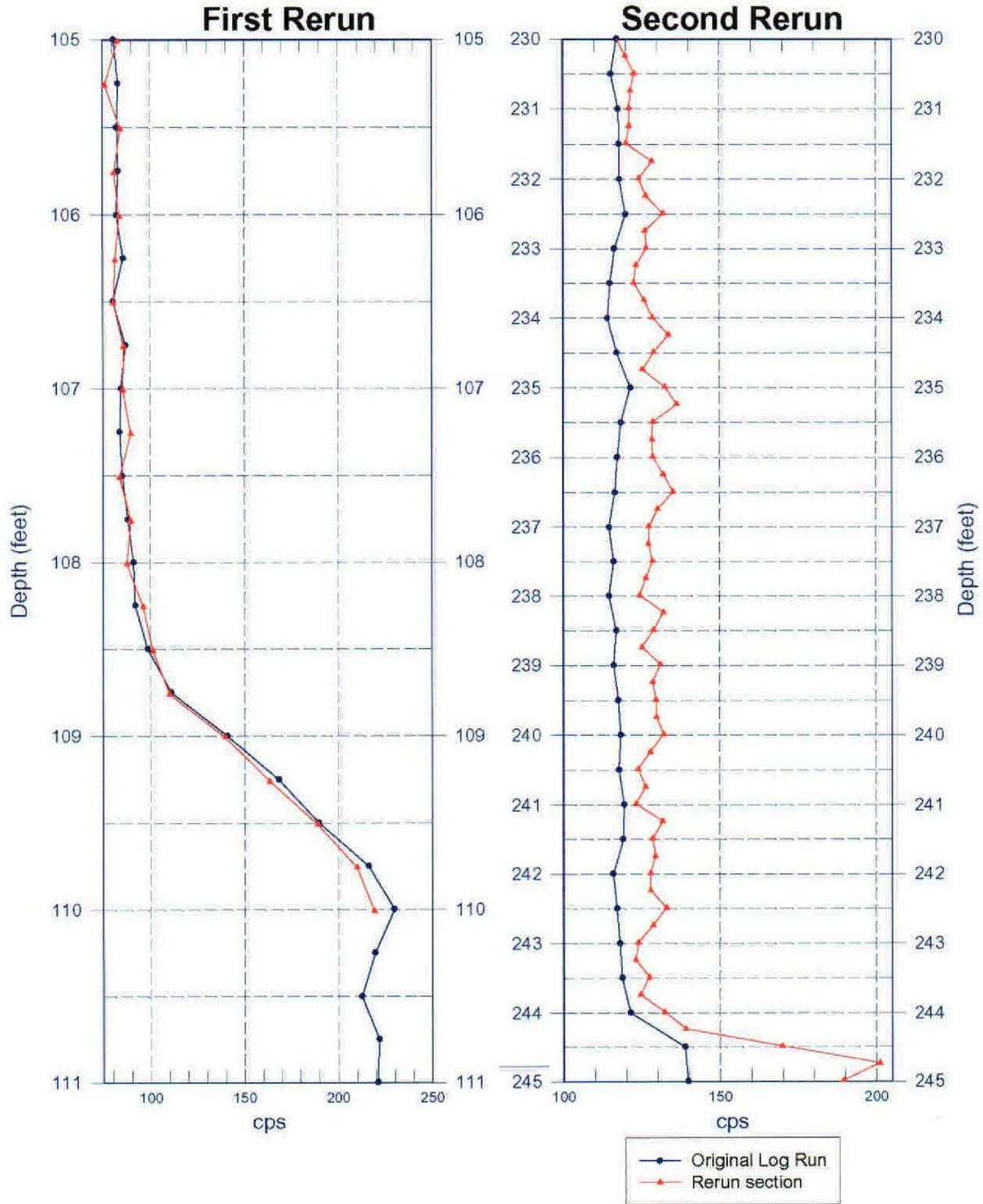


C3104 Rerun Section of High Rate Gamma Logs



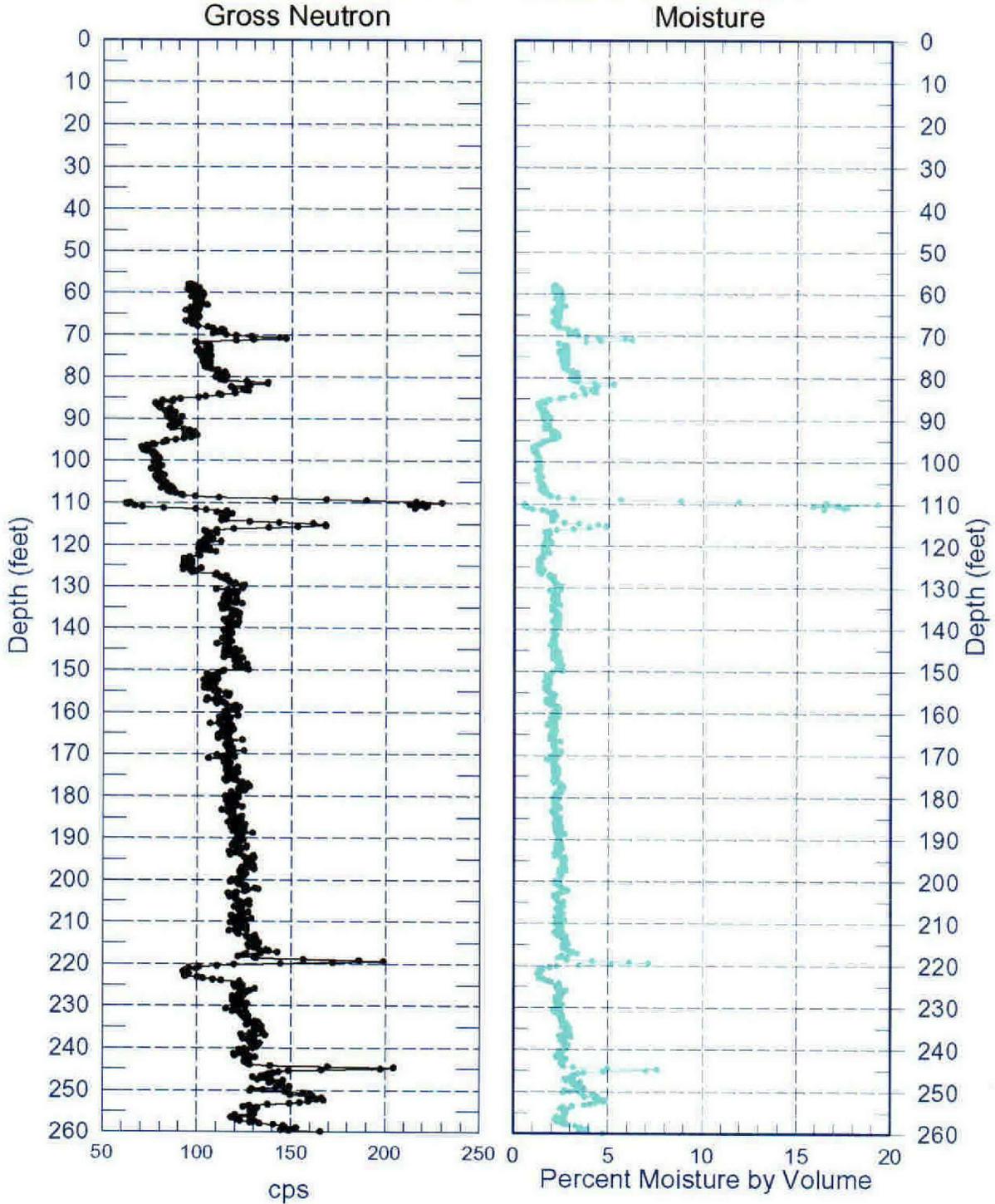
C3104

Rerun of Neutron Logs

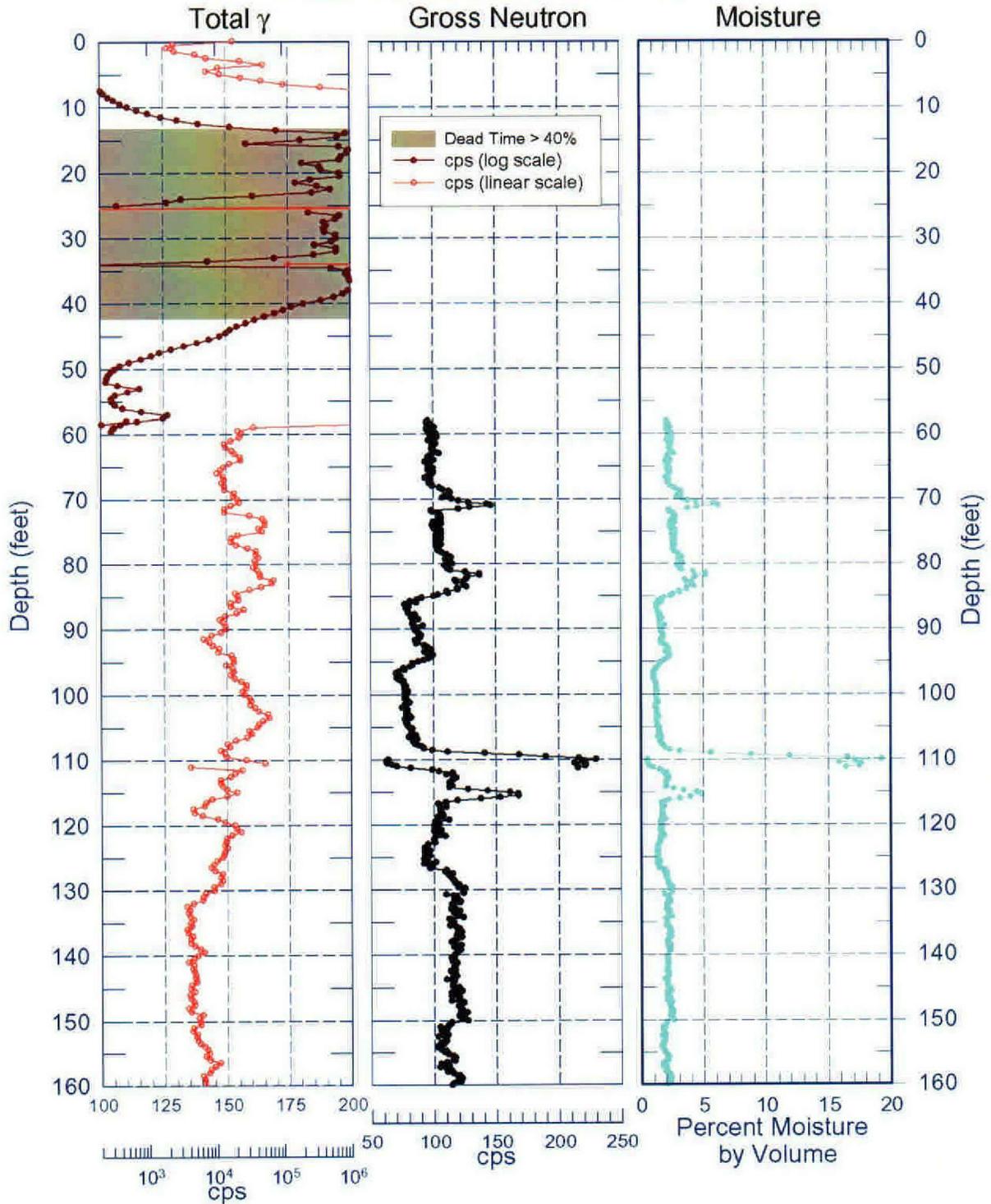


C3104

Gross Neutron & Volumetric Moisture

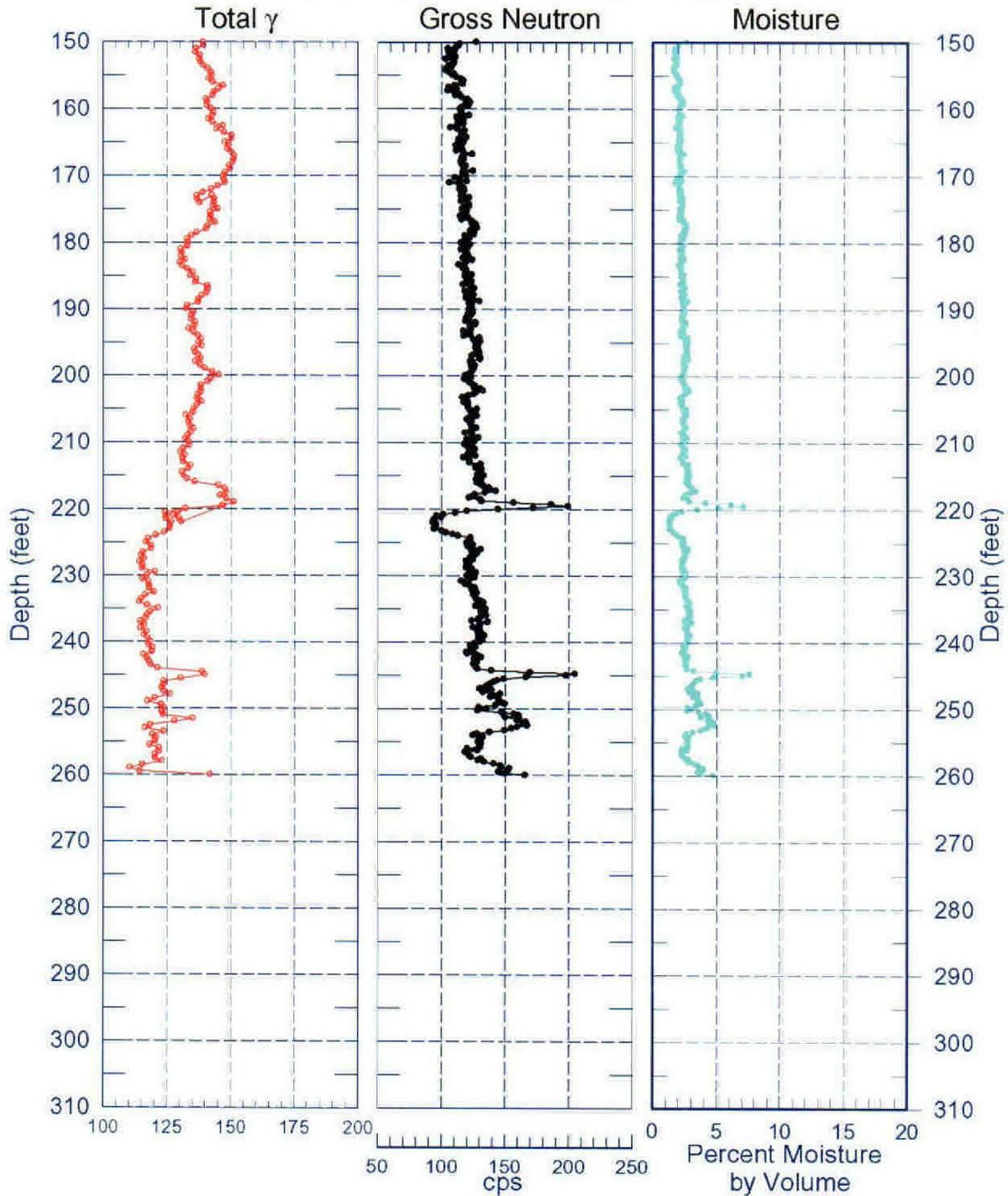


C3104 Total Gamma & Gross Neutron

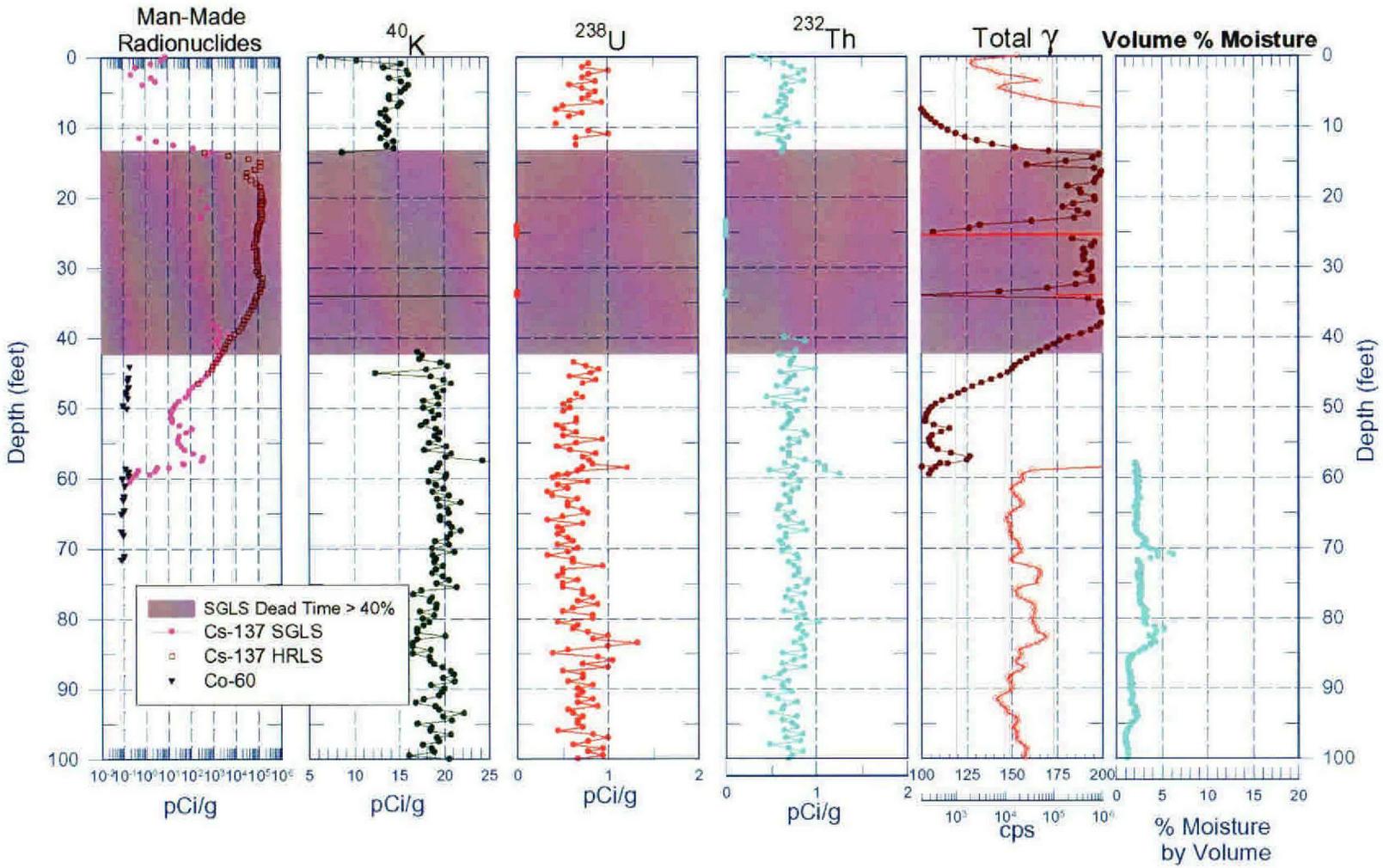


Appendix B – Borehole Geophysical Logging Reports

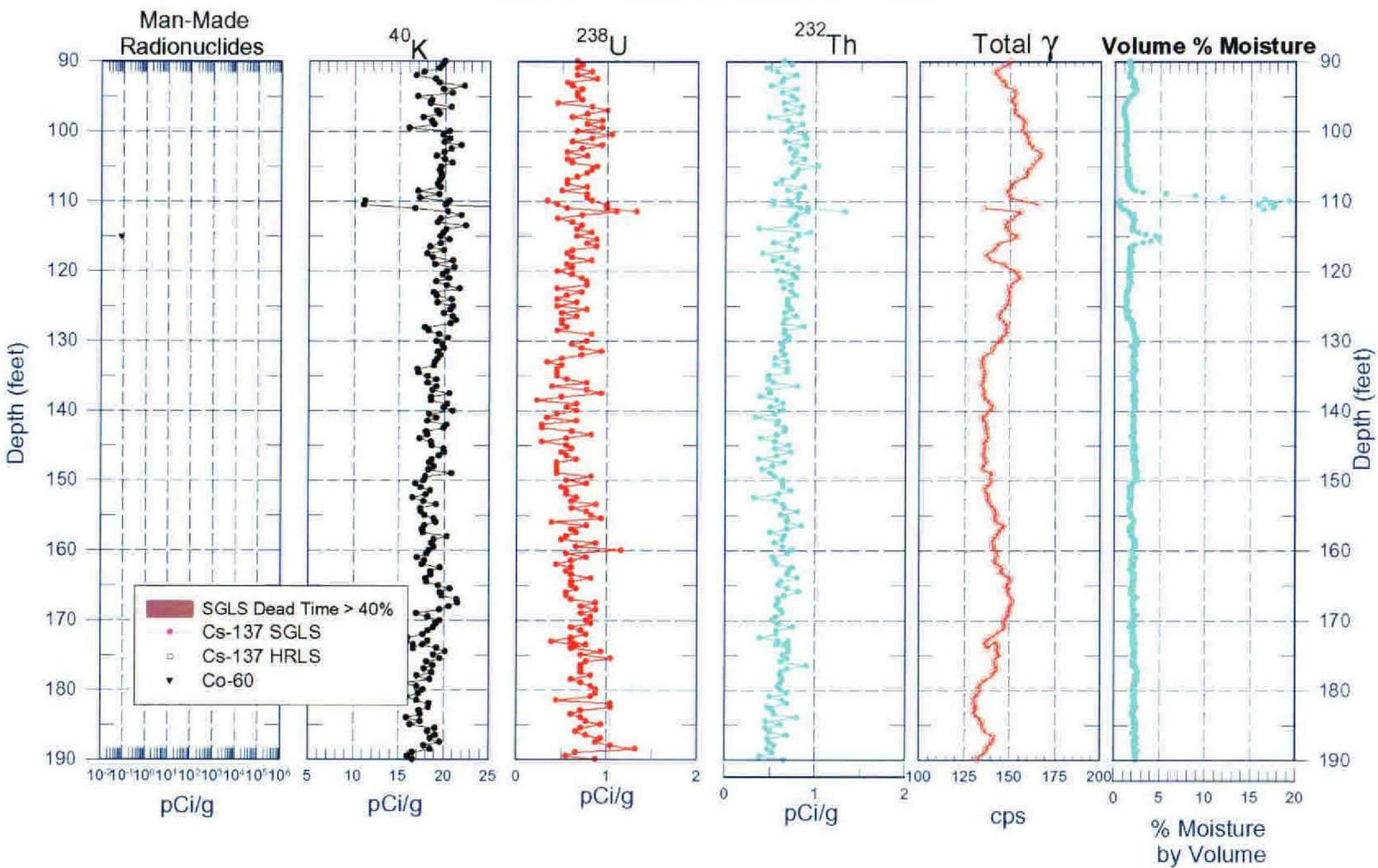
**C3104
Total Gamma & Gross Neutron**



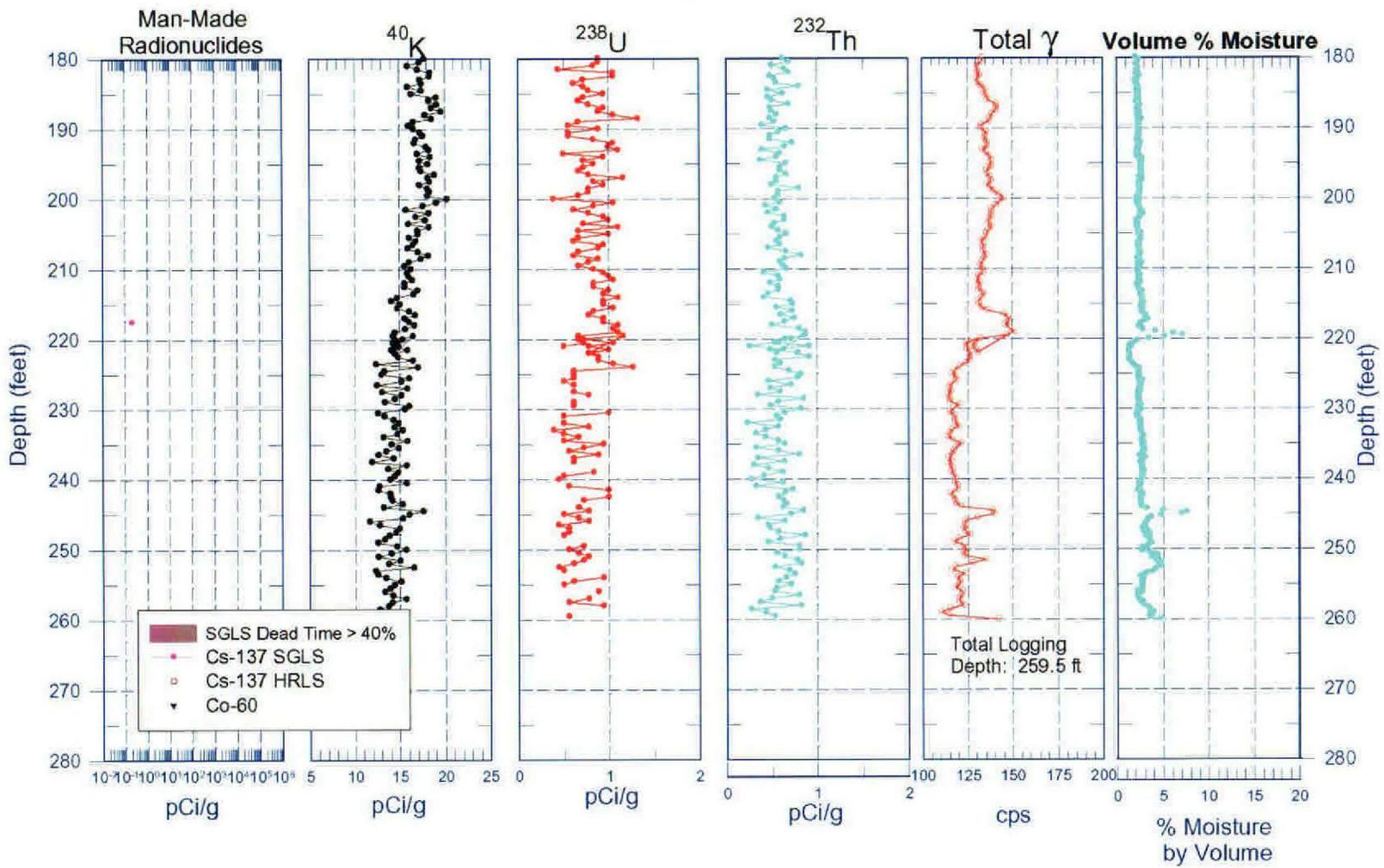
C3104 Combination Plot



C3104 Combination Plot



C3104 Combination Plot





C-3103

Log Data Report

Borehole Information:

Borehole: C-3103		Site: 216-B-7A Crnb			
Coordinates (Plant)		GWL ¹ (ft): n/a ²		GWL Date: n/a	
North	East	Drill Date	TOC ³ Elevation	Total Depth (ft)	Type
137385.743	573803.238	09/01	199.049	219.0	cable tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel (threaded)	1.0	6.625	5.625	0.5	0	56.5
Steel (threaded)	0.7	11.75	10.75	0.5	0	50.75
Steel (threaded)	1.4	8.75	7.75	0.5	0	130.5
Steel (threaded)	3.5	6.625	5.625	0.5	0	218.0

Borehole Notes:

The casing depth information provided above is derived from personal communication with the Bechtel Hanford Incorporated site representative. The casing size information is derived from caliper measurements collected in the field by MACTEC-ERS personnel. Logging measurements are referenced to ground surface. The original 6-in. casing in place from 0 to 56.5 ft was removed and replaced with the 11-in. casing from 0 to 50.75 ft. Drilling was stopped at about 220 ft where perched groundwater was encountered.

Logging Equipment Information:

Logging System: Gamma 1C	Type: HRLS
Calibration Date: 09/00	Calibration Reference: GJO-2001-244-TAR
	Logging Procedure: MAC-HGLP 1.6.5

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

Logging System: Gamma 2A	Type: SGLS (35%)
Calibration Date: 09/00	Calibration Reference: GJO-2001-248-TAR
	Logging Procedure: MAC-HGLP 1.6.5

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

Appendix B – Borehole Geophysical Logging Reports

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

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

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4 (Repeat)	5
Date	08/29/01	08/29/01	08/29/01	08/29/01	09/24/01
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth	2.0	19.0	36.5	55.0	54.0
Finish Depth	18.5	36.0	55.5	49.0	130.5
Count Time (sec)	200	30	200	200	200
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5
ft/min	n/a	n/a	n/a	n/a	n/a
Pre-Verification	B0041CAB	B0041CAB	B0041CAB	B0041CAB	B0057CAB
Start File	B0042000	B0042034	B0042069	B0042108	B0057000
Finish File	B0042033	B0042068	B0042107	B0042120	B0057153
Post-Verification	B0042CAA	B0042CAA	B0042CAA	B0042CAA	B0057CAA

Log Run	6 (Repeat)	7	8	9 (Repeat)	
Date	09/24/01	09/27/01	09/27/01	09/27/01	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth	130.5	129.0	147.0	218.5	
Finish Depth	122.5	148.0	218.5	209.5	
Count Time (sec)	200	200	200	200	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
ft/min	n/a	n/a	n/a	n/a	
Pre-Verification	B0057CAB	A0003CAB	A0003CAB	A0003CAB	
Start File	B0057154	A0003000	A0003039	A0003183	
Finish File	B0057170	A0003038	A0003182	A0003201	
Post-Verification	B0057CAA	A0003CAA	A0003CAA	A0003CAA	

High Rate Logging System (HRLS) Log Run Information:

Log Run	10	11 (Repeat)	12		
Date	08/30/01	08/30/01	08/30/01		
Logging Engineer	Musial	Musial	Musial		
Start Depth	17.5	37.0	24.0		
Finish Depth	37.0	33.0	22.0		
Count Time (sec)	300	300	1200		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	0.5	0.5	1.0		
ft/min	n/a	n/a	n/a		
Pre-Verification	D0004CAB	D0004CAB	D0004CAB		
Start File	D0004000	D0004040	D0004049		

Appendix B – Borehole Geophysical Logging Reports

Log Run	10	11 (Repeat)	12		
Finish File	D0004039	D0004048	D0004051		
Post-Verification	D0004CAA	D0004CAA	D0004CAA		

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	13	14 (Repeat)	15	16 (Repeat)	
Date	08/29/01	08/29/01	09/24/01	09/24/01	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth	3.5	55.25	54.0	130.5	
Finish Depth	55.55	49.73	130.5	122.5	
Count Time (sec)	n/a	n/a	15	15	
Live/Real	n/a	n/a	L	L	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	n/a	n/a	0.25	0.25	
ft/min	1.0	1.0	n/a	n/a	
Pre-Verification	C0013CAB	C0013CAB	C0018CAB	C0018CAB	
Start File	C0013000	C0013213	C0018000	C0018307	
Finish File	C0013212	C0013235	C0018306	C0018339	
Post-Verification	C0013CAA	C0013CAA	C0018CAA	C0018CAA	

Radionuclide Logging System (RLS) Moisture Log Run Information:

Log Run	17	18 (Repeat)			
Date	09/27/01	09/27/01			
Logging Engineer	Spatz	Spatz			
Start Depth	128.0	219.0			
Finish Depth	219.0	210.0			
Count Time (sec)	n/a	n/a			
Live/Real	n/a	n/a			
Shield (Y/N)	N	N			
MSA Interval (ft)	n/a	n/a			
ft/min	1.0	1.0			
Pre-Verification	C0192CAB	C0192CAB			
Start File	C0192000	C0192365			
Finish File	C0192364	C0192401			
Post-Verification	C0192CAA	C0192CAA			

Logging Operation Notes:

SGLS, HRLS, NMLS, and RLS logging were performed in this borehole between August and September 2001 on three separate days. The logging occurred inside three different casing configurations as the borehole was drilled. A longer count time (200 sec) than usual (100 sec) was required with the SGLS because of the relatively thick casing and to possibly detect plutonium that was thought to exist in the area. The HRLS was utilized to collect data in a high gamma flux zone between 17.5 and 37 ft where high SGLS dead times were encountered. In addition, test spectra were collected with the HRLS between 22 and 24 ft using a 1,200 second counting time. Because the HRLS planar detector is more sensitive to lower energy gamma photons than high-energy photons, it was believed low-yield plutonium-239 (^{239}Pu) energy peaks between about 59 and 414 keV might be observed in the spectra. Neutron moisture log data were also collected in this borehole. Data repeat sections for each logging system were collected to measure the systems' performance.

Analysis Notes:

Analyst:	Henwood	Date:	10/16/01	Reference:	MAC-VZCP 1.7.9 Rev. 2
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Pre-run and post-run verifications of the logging tools were performed for each day's log event. Acceptance criteria were met for the SGLS and HRLS. The post-verification spectra were used for the energy and resolution calibration for the data processing.

Verification measurements were also collected for the NMLS and RLS moisture systems. Acceptance criteria have not yet been established for the logging systems. However, the pre- and post-run total count rate measurements agree within about 5%, suggesting the logging systems were operating properly during data collection.

Each spectrum collected during a log run was processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL using an efficiency function and corrections for casing as appropriate. Dead time corrections are applied to log data, including the total gamma data, where the dead time is in excess of 10 percent. In zones of high dead time (> 40%) gross count rates and radionuclide concentrations are not considered reliable, and may be significantly higher than the reported values. The HRLS is utilized when high dead times are encountered. The ²¹⁴Bi peak at 1764 keV was used to determine the naturally occurring ²³⁸U concentrations rather than the ²¹⁴Bi peak at 609 keV. The 609-keV energy peak cannot be distinguished as a result of interference from the ¹³⁷Cs peak at 662 keV in higher concentration zones.

For the neutron moisture logs, calibration functions are available for 6-in. and 8-in.-diameter boreholes with conventional ASTM schedule-40 steel casing. The calibration function converts total neutron count rate to volume percent moisture content. Neutron moisture data from the interval between 54 and 130.5 ft were analyzed using the calibration function for an 8-in. borehole. Neutron moisture data from the intervals between 3.5 and 55.5 ft and 128 and 219 ft were analyzed using the calibration function for a 6-in. borehole. A correction factor developed from data provided by Meisner, Price, and Randall (WHC-SD-EN-TI-306) was applied to the data in the 8-in. interval to account for the 0.5-in. casing thickness. This factor increased the calculated moisture content by approximately 17 percent. No such correction factor was available for a 6-in. borehole; therefore, the same correction factor was also applied over depth intervals where a 6-in., 0.5-in.-thick casing was present.

Repeat log plots at selected depth intervals for spectral gamma concentrations and neutron moisture measurements were evaluated. The spectral gamma plots indicate good agreement between successive log runs, demonstrating repeatability in both depth and concentration measurement. The moisture plots also indicate good agreement for log data collected within the same casing configuration. Repeatability of calculated volumetric moisture content is not good in depth intervals where log data were collected in different sized casings (e.g., see moisture repeat section from 50 to 55 ft). As noted above, the correction applied to the 6-in. casing is the same as that applied to the 8-in. casing even though a correction for 6-in. casing has not been experimentally derived. It appears this casing thickness correction causes an overestimation of the volumetric moisture in 6-in. boreholes, particularly where the moisture content is less than 5 percent by volume; calibration data are not collected for curve fitting between zero and 5 percent moisture.

Log Plot Notes:

Separate log plots are provided for the man-made radionuclides (¹³⁷Cs and ¹⁵⁴Eu), naturally occurring radionuclides (⁴⁰K, ²³²Th, ²³⁸U [KUT]), a combination of man-made, KUT, total gamma and moisture, total gamma plotted with dead time, and repeat section plots for spectral gamma and moisture measurements. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead

Appendix B – Borehole Geophysical Logging Reports

time correction, casing corrections, or water corrections. These errors are discussed in the calibration report.

Results and Interpretations:

The man-made radionuclides detected in this borehole were ^{137}Cs and ^{154}Eu . ^{137}Cs is detected continuously from near the ground surface to about 56 ft in depth with the highest concentration of about 300,000 pCi/g measured at about 23 ft. ^{154}Eu is detected between 16 and 18 ft and probably exists at some depth intervals within the high rate zone between 18 and 27 ft. The HRLS detector is less efficient than the SGLS in detecting higher energy peaks such as the 1274-keV ^{154}Eu peak. No other man-made radionuclide was detected in this borehole, including ^{239}Pu , for which longer counting times were employed to enhance the possibility of detection.

SGLS measurements were collected between 54 and 55.5 ft in both log run 3 and log run 5 (see man-made radionuclide plot). A 6-in. casing was in place at this depth interval during log run 3. When log data were collected during log run 5, the original 6-in. casing had been removed and an 8-in. casing existed in the depth interval. The calculated ^{137}Cs concentrations from log run 5 were much lower than in log run 3. The discrepancy in concentrations between the two log runs suggests contaminated material had been dragged down from the high-rate interval to lower depths during the drilling process or the original casing was contaminated. Once the casing was removed and the borehole was drilled to a larger diameter, the ^{137}Cs concentrations measured about 1 pCi/g. Most of the ^{137}Cs contamination measured during log run 3 below about 43 ft is likely the result of borehole contamination.

The KUT logs do not delineate any definitive lithologic units. Changes in the ^{40}K concentrations from about 12 pCi/g at about 18 ft to about 17 pCi/g near 37 ft suggest a lithologic change occurs in the high rate interval. A thin bed with relatively high ^{232}Th concentrations occurs at about 107 ft and may be useful to correlate in nearby boreholes.

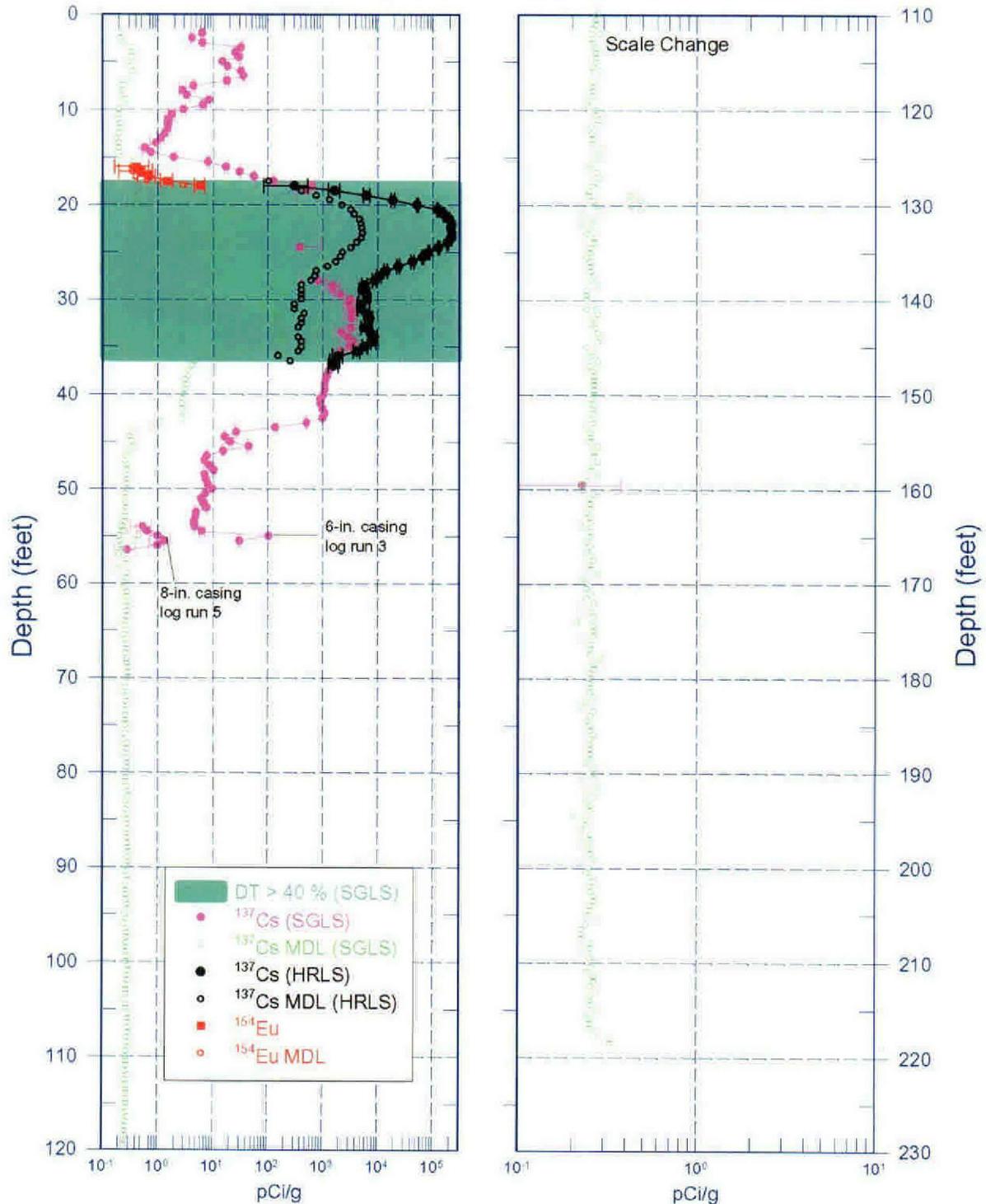
Relatively higher moisture content appears to exist in the interval from 18 to 37 ft. The highest moisture content occurs at 20 ft in depth, just above the depth where the highest ^{137}Cs concentrations were measured. An interval between about 80 and 100 ft indicates slightly higher moisture that corresponds with finer grained soil as indicated by slightly higher concentrations of ^{40}K and ^{232}Th . The remainder of the borehole exhibits consistent moisture content in the soils. The moisture content is increasing near the bottom of the borehole and the final data point at 218 ft indicates the detector is in close proximity to groundwater but has not fully entered the saturated interval.

¹ GWL – groundwater level

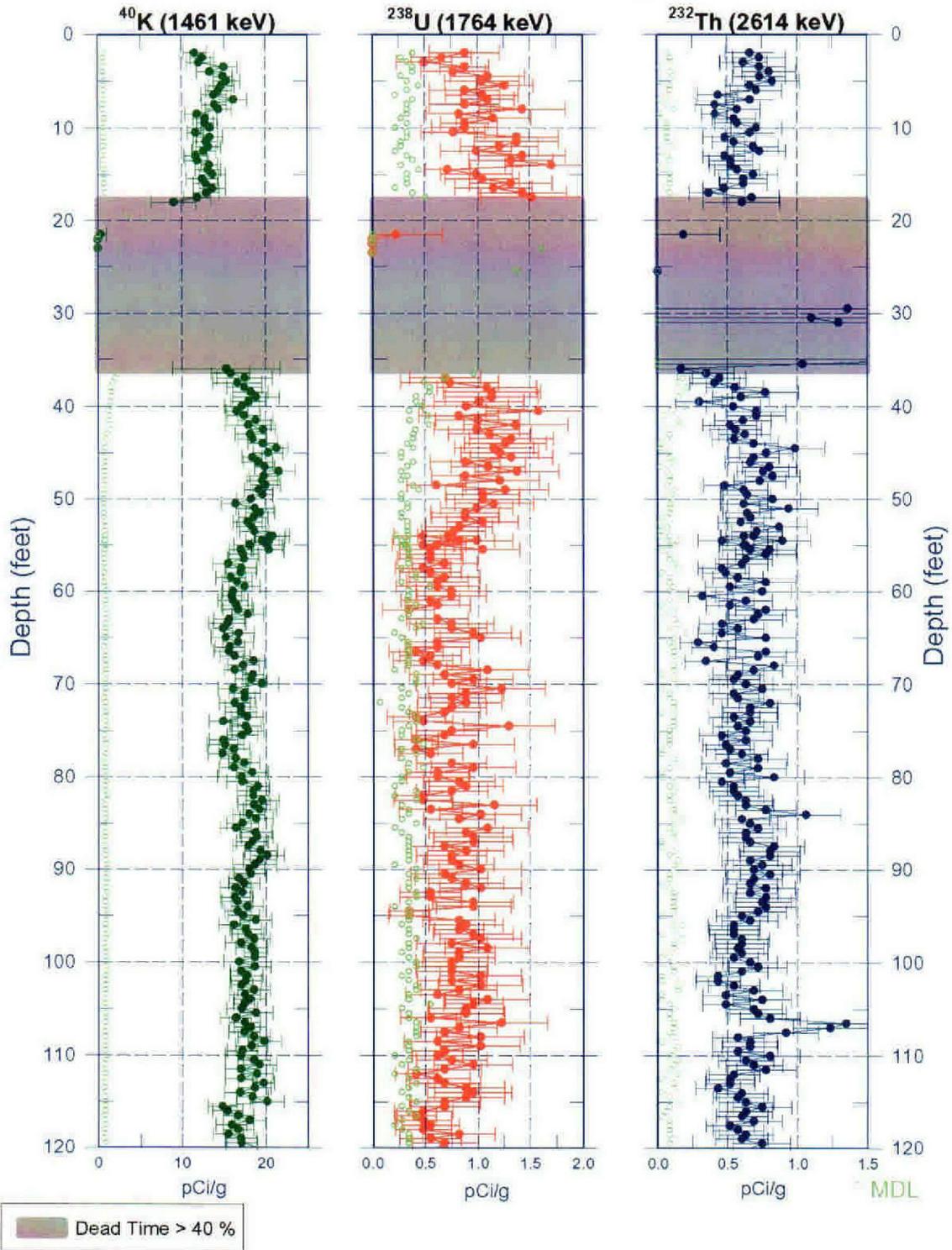
² n/a – not applicable

³ TOC – top of casing

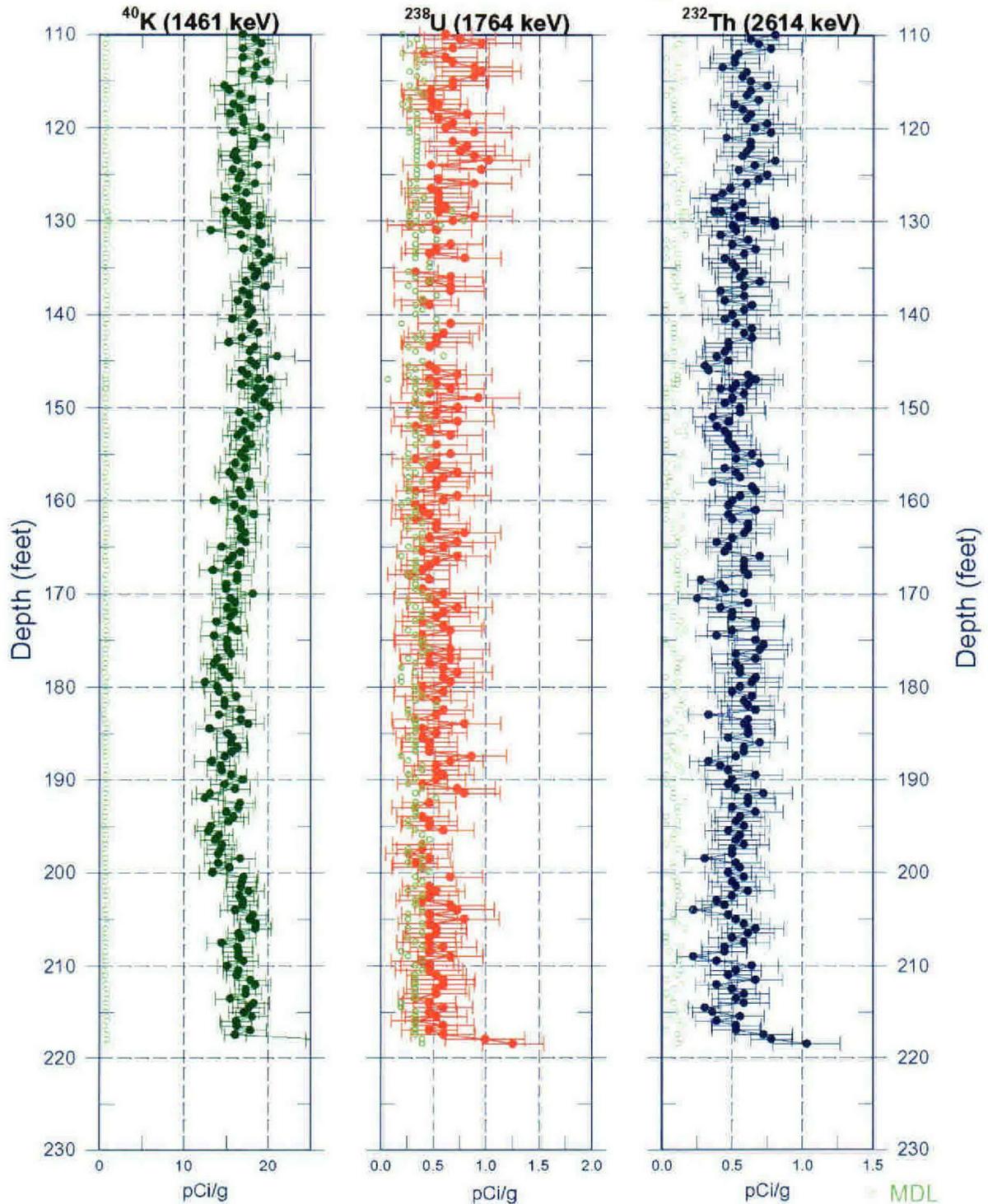
C-3103 Man-Made Radionuclide Concentrations



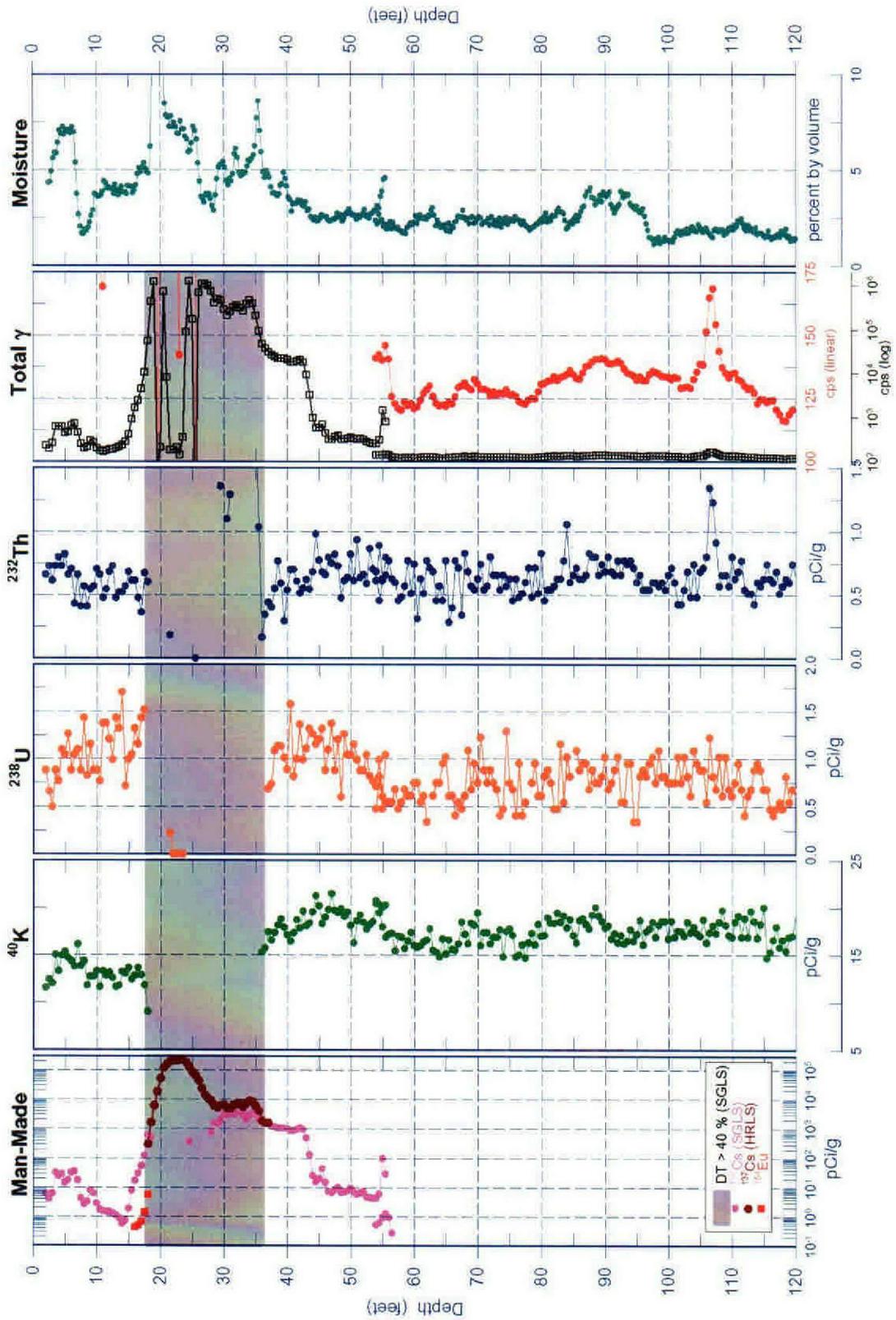
C-3103 Natural Gamma Logs



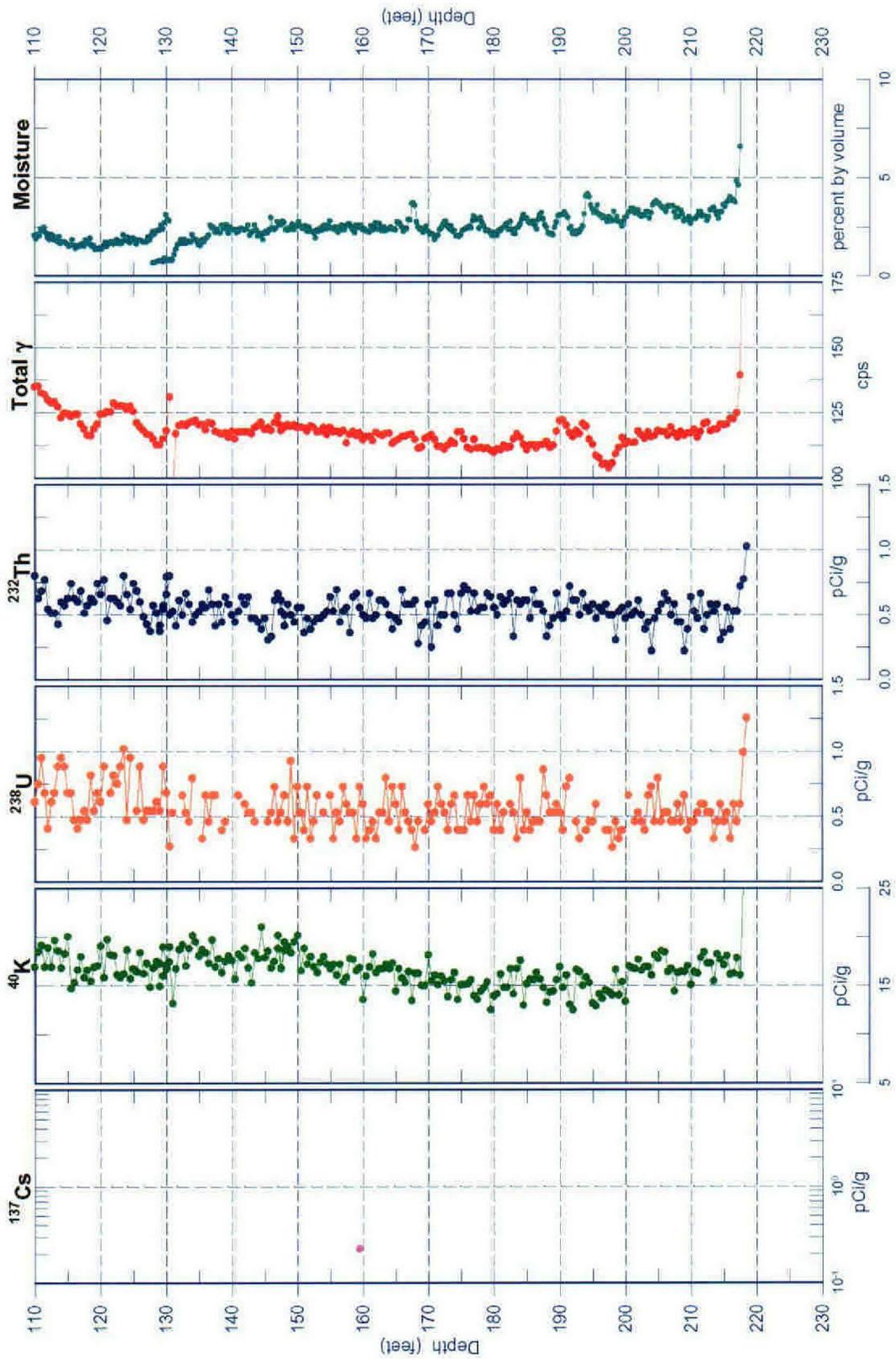
C-3103 Natural Gamma Logs



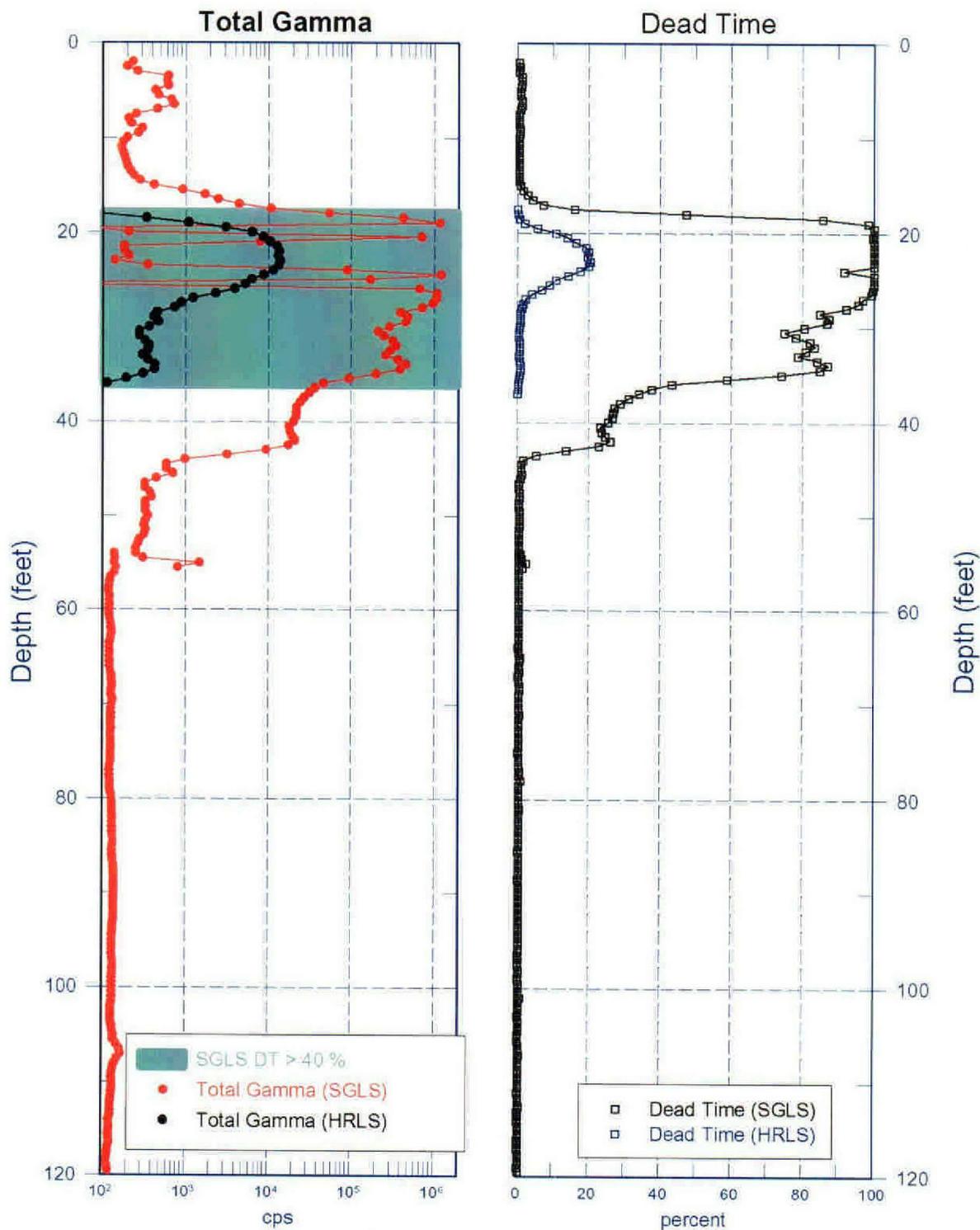
C-3103 Combination Plot



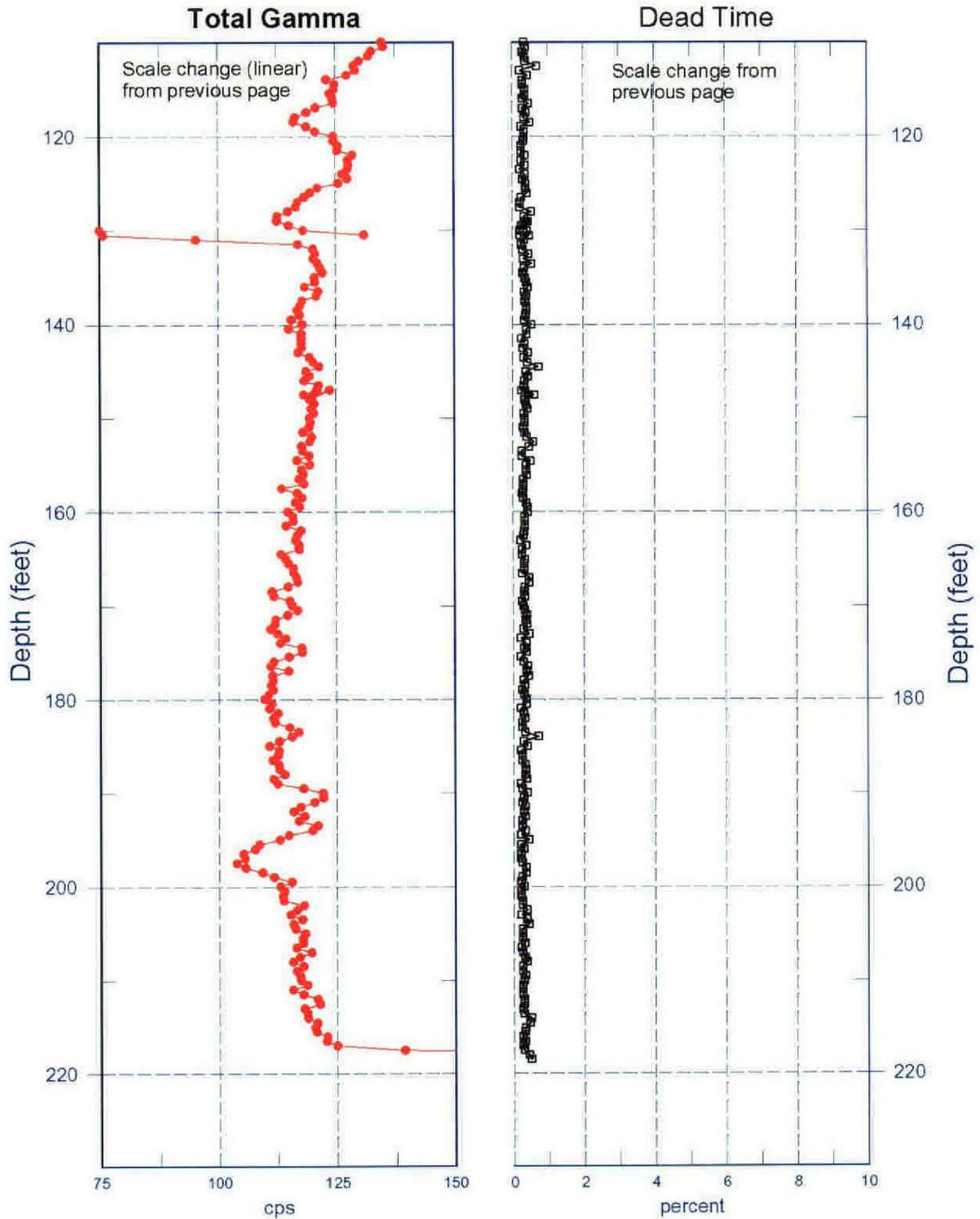
C-3103 Combination Plot (continued)



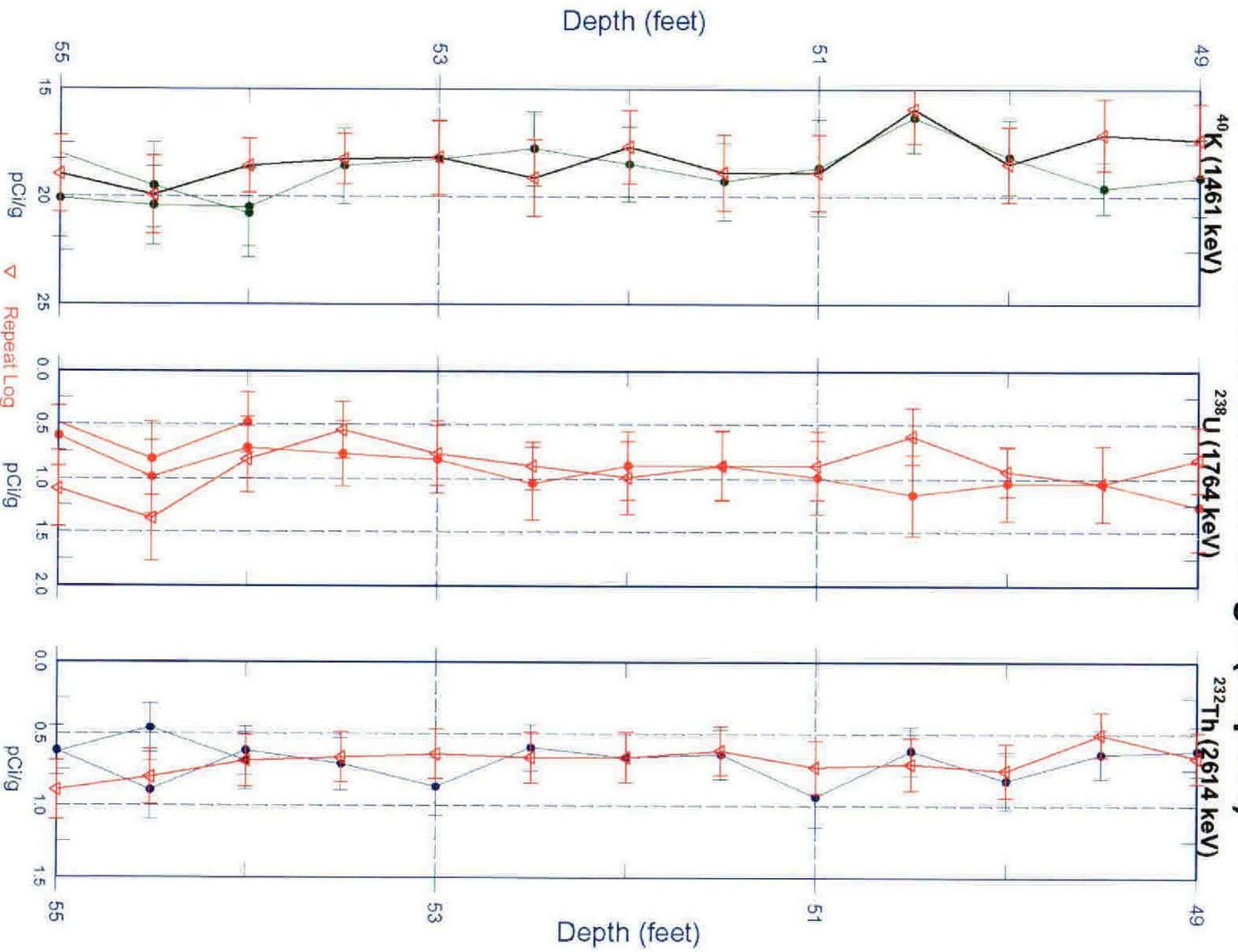
C-3103



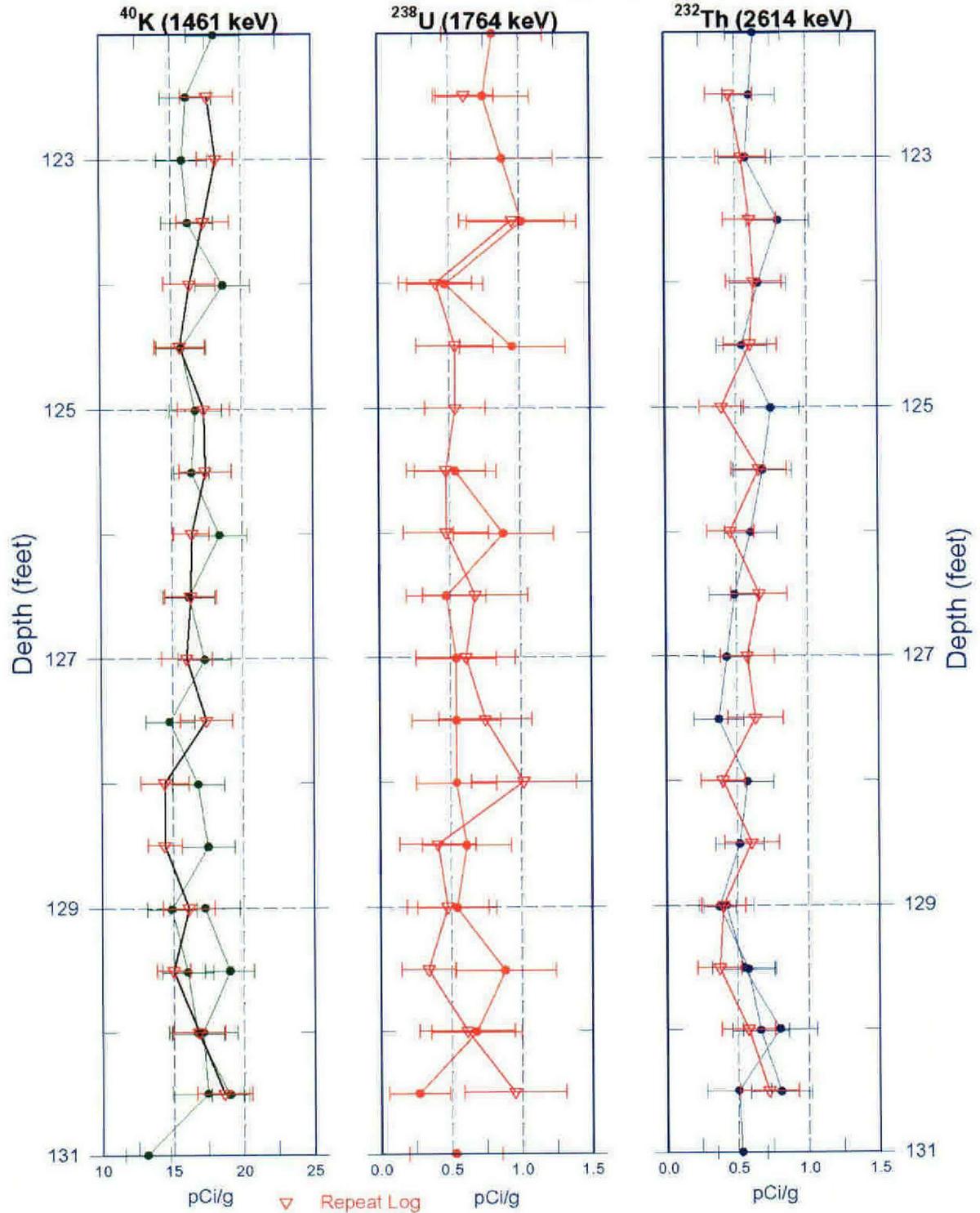
C-3103 (continued)



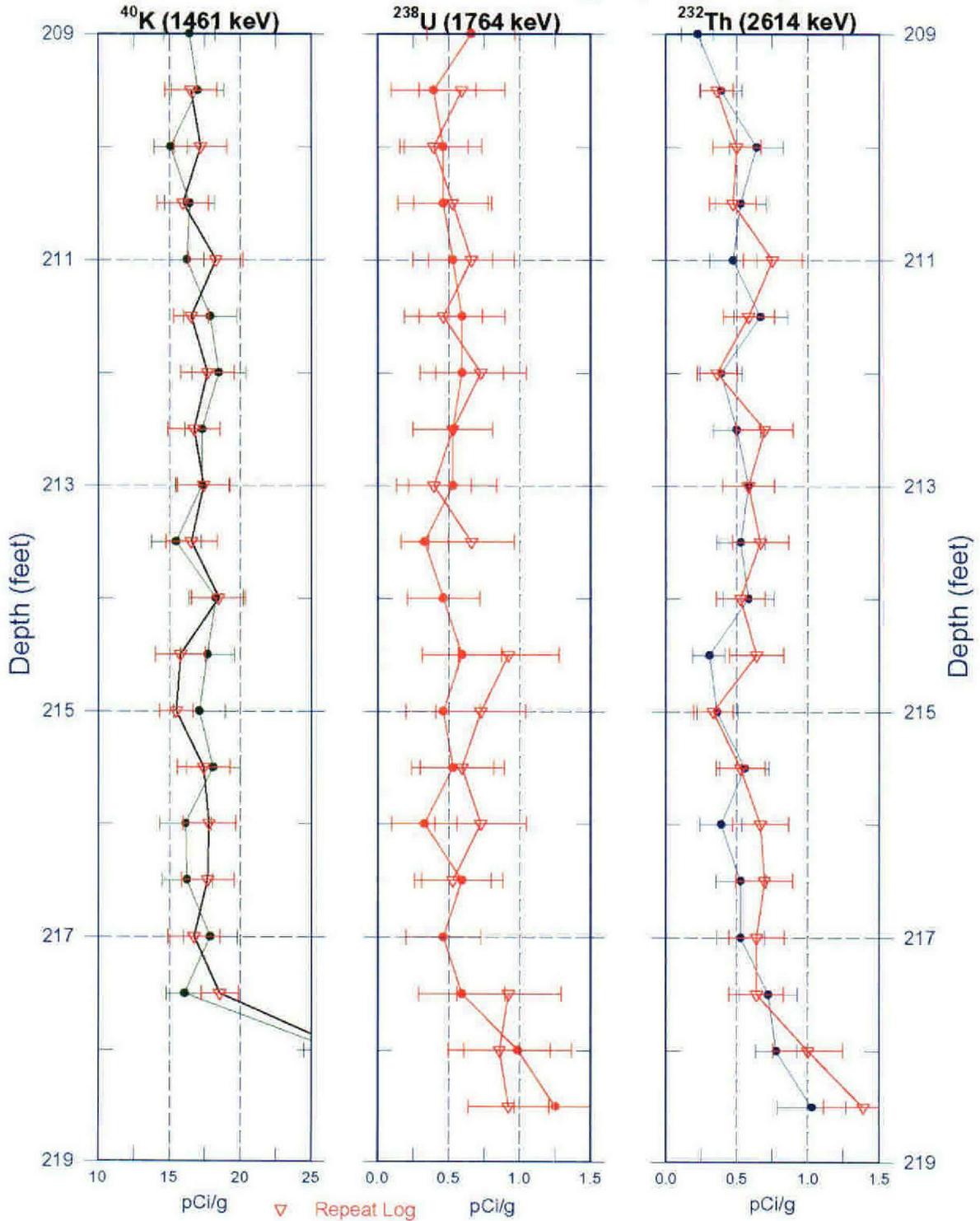
C-3103 Natural Gamma Logs (Repeat)



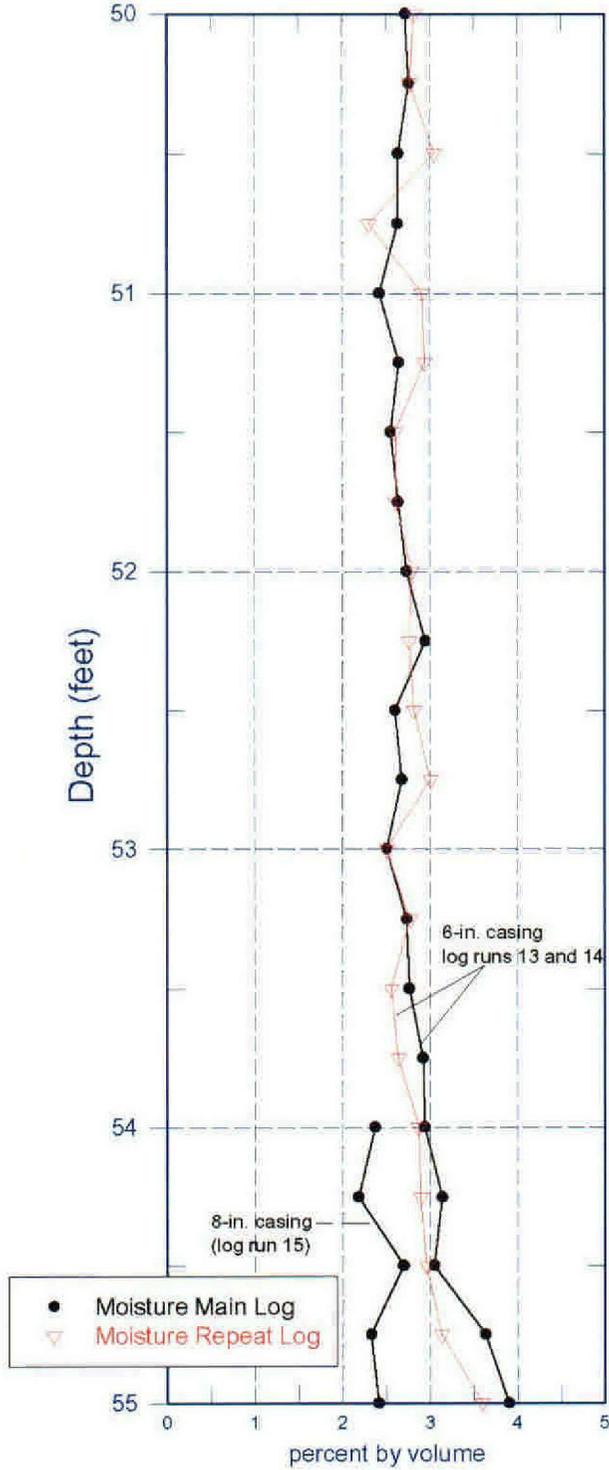
C-3103 Natural Gamma Logs (Repeat)



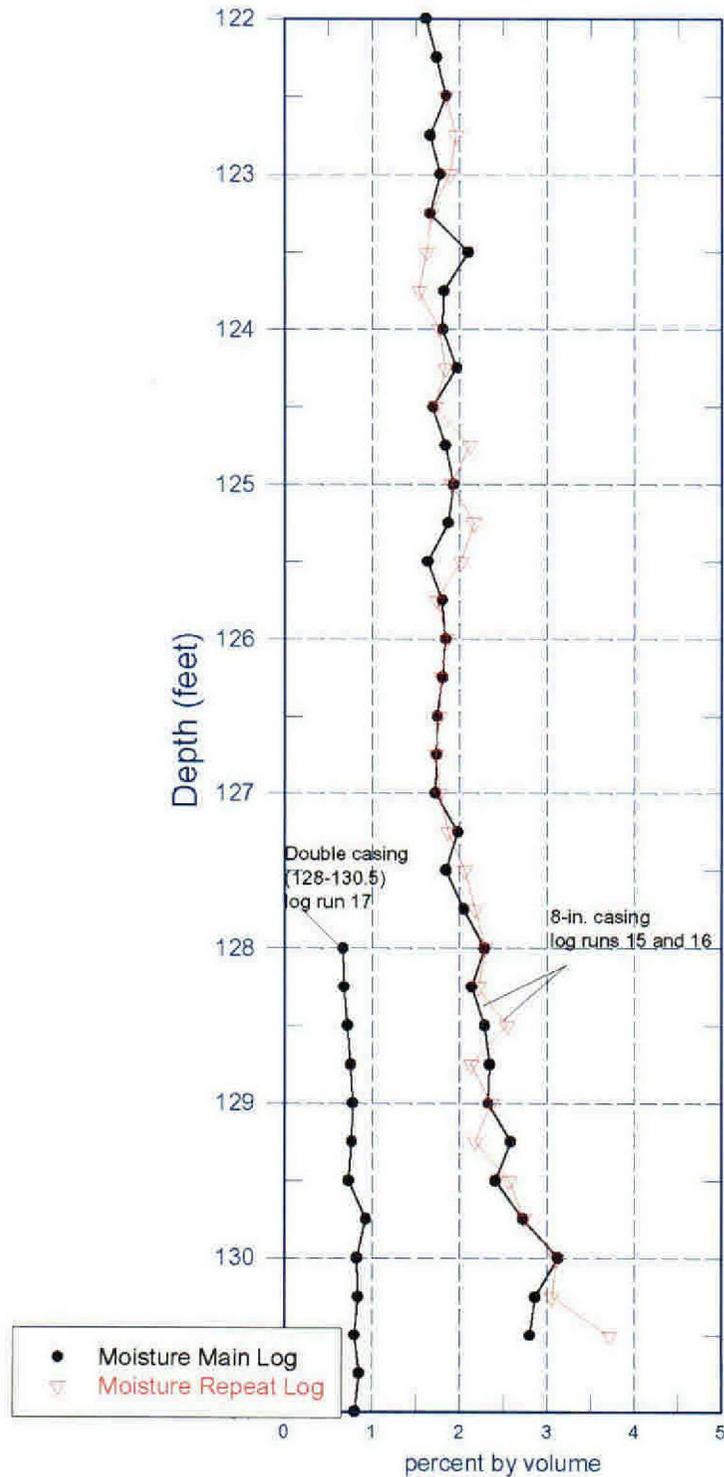
C-3103 Natural Gamma Logs (Repeat)



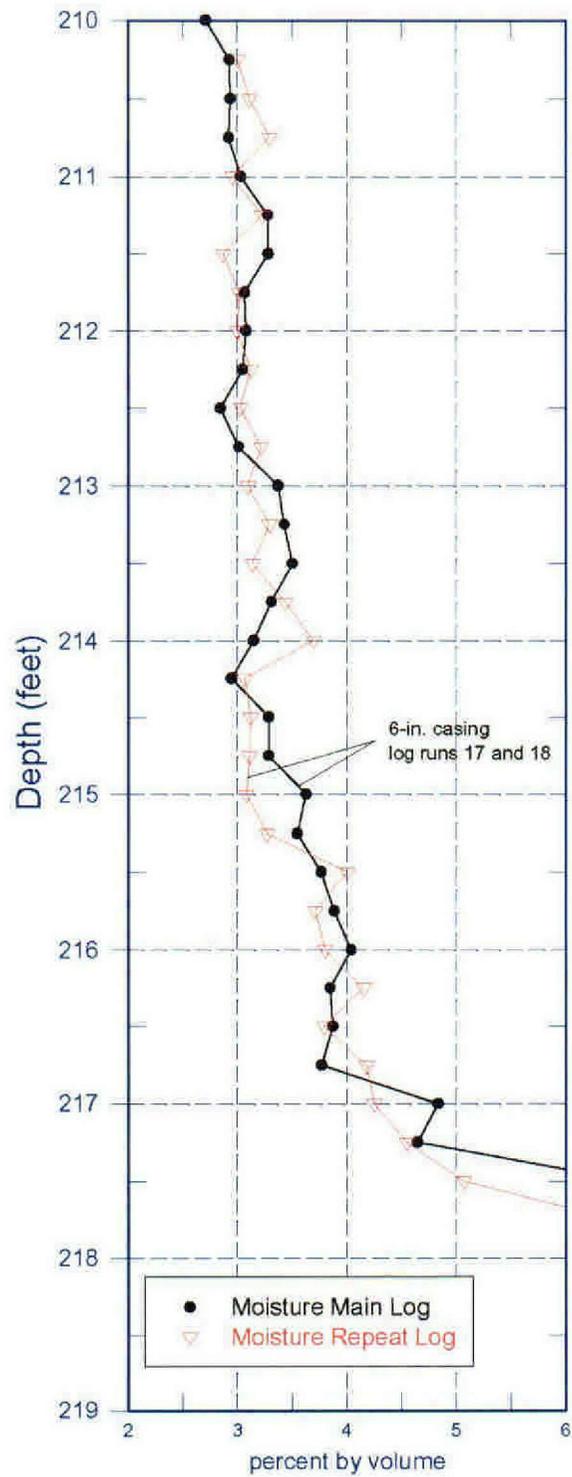
C-3103 Moisture Repeat Section



C-3103 Moisture Repeat Section



C-3103 Moisture Repeat Section



APPENDIX C

**SURFACE GEOPHYSICAL SURVEY REPORT—
GROUND PENETRATING RADAR**

Environmental
Restoration
Contractor

ERC Team

Interoffice Memorandum

085931

Job No. 22192
Written Response Required: NO
Due Date: N/A
Actionee: N/A
Closes CCN: N/A
OU:
TSD:
ERA:
Subject Code: 8280

TO: C. Cearlock/H9-0

COPIES: M. E. Todd H9-03
L. A. Dietz H0-20
C. D. Wittreich H9-03
Document and Info Services H0-09

DATE: January 30, 2001

FROM: T. H. Mitchell/K. A. Bergstrom
Design and Geoscience
H9-02/372-9690/372-9591

Kevin Bergstrom
1/30/01

SUBJECT: **RESULTS OF THE GEOPHYSICAL INVESTIGATIONS AT THE 216-T-26 CRIB, 216-B-7A CRIB AND THE 216-B-38 TRENCH AND ASSOCIATED BURIAL GROUND.**

Geophysical investigations were conducted at three waste sites in the 200 Areas, the 216-T-26 Crib in 200 West and the 216-B-7A Crib and 216-B-38 Trench in 200 East. Ground Penetrating Radar and Electromagnetic Induction were the geophysical methods used for the investigations.

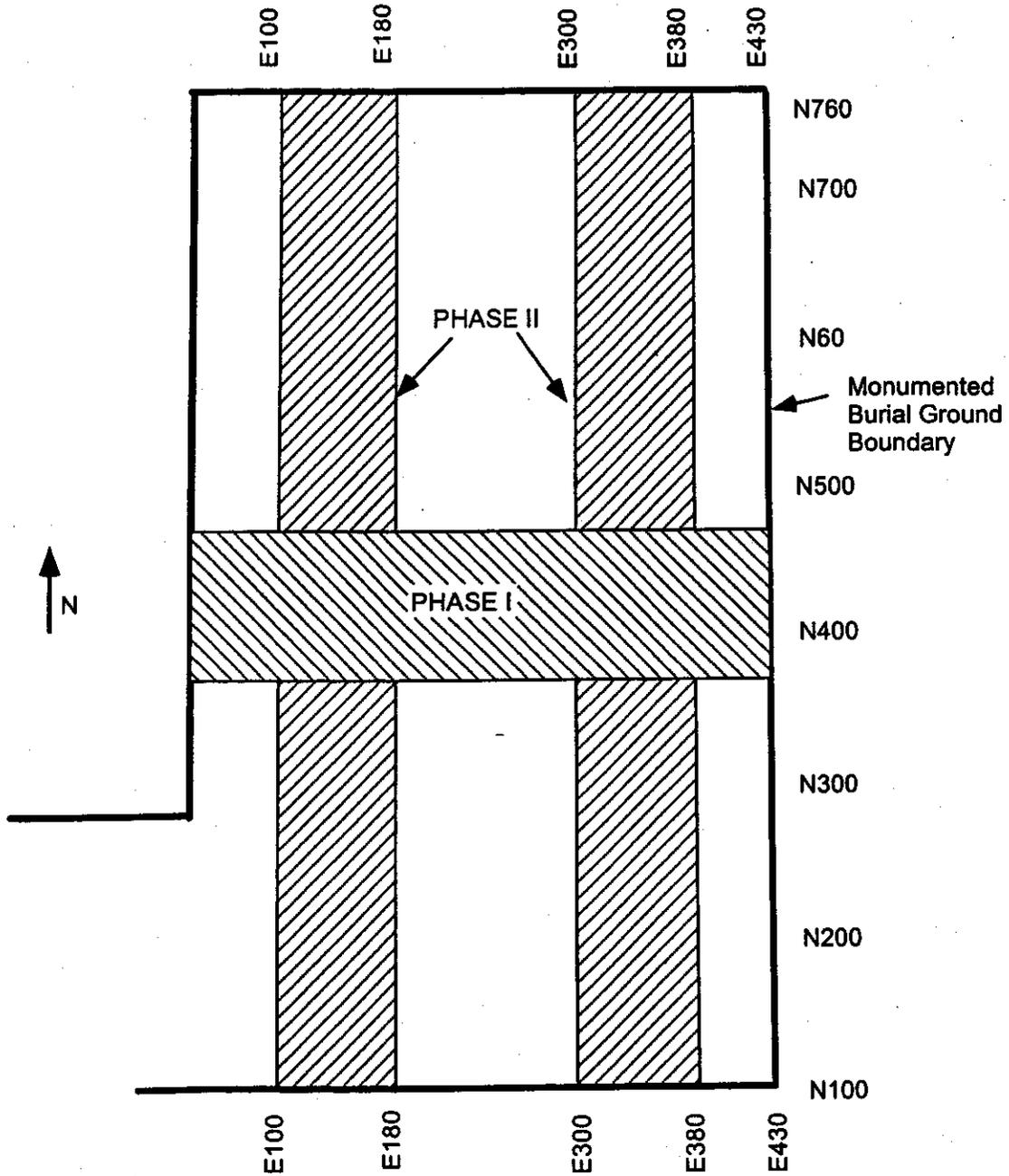
Attached are the results from the three investigations. If there are any questions contact Tom Mitchell at 372-9691 or Kevin Bergstrom at 372-9591.

KAB:mrc

Attachment: Investigation Results

H:\Coy. Michelle\ERC\ERC IOMS\216-IOM.doc

Bechtel Hanford, Inc. – CH2M Hill Hanford, Inc. – Thermo Hanford, Inc.



General Layout of the Geophysical Surveys at
the 216-B-38 Trench.

GEOPHYSICAL SITE INVESTIGATION SUMMARY FORM

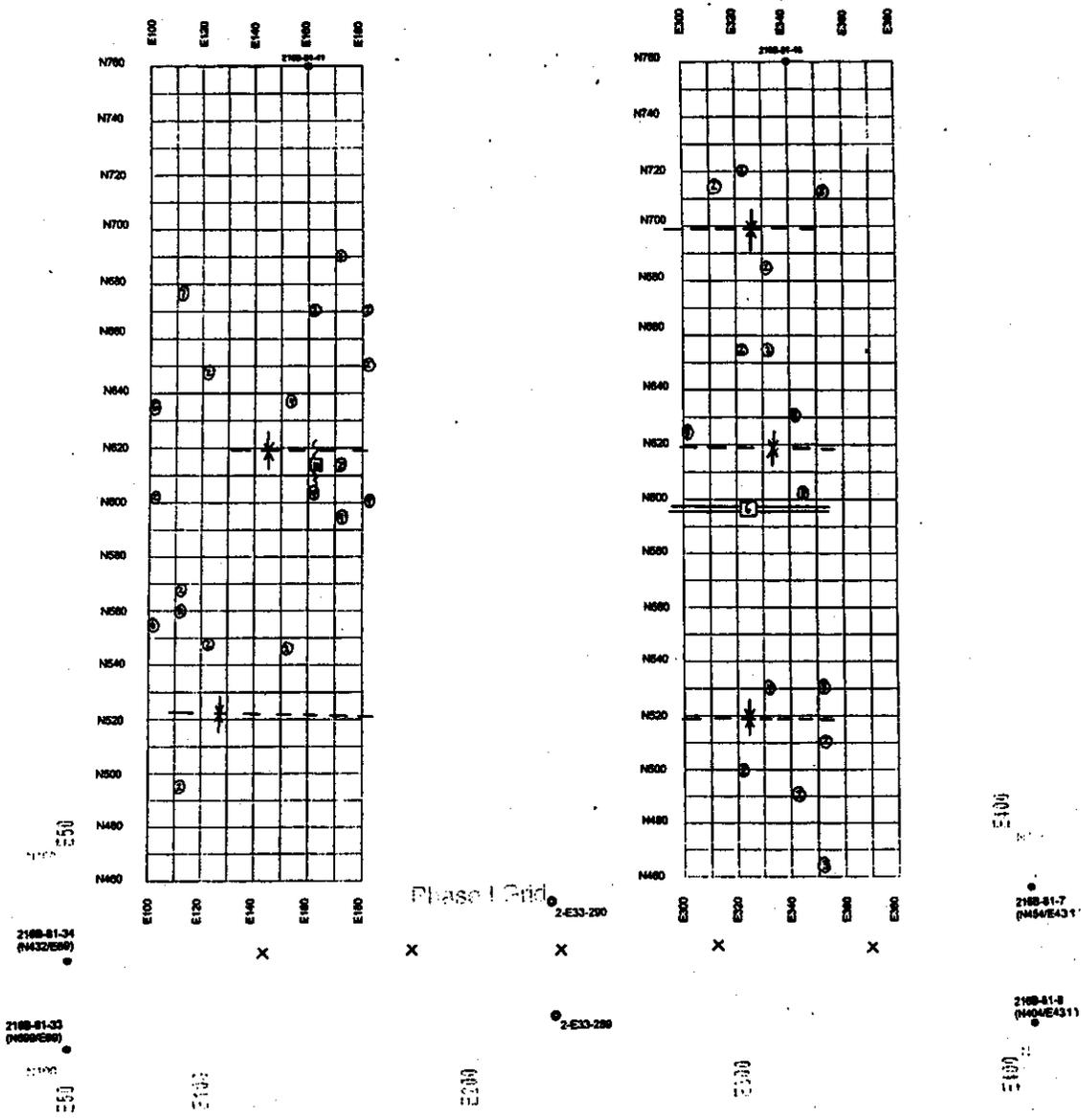
Site: 216-B-38 trench	Document Number: IOM#085931	Date: 1/2001
Sponsor/Contact: Mary Todd, Chris Cearlock	Phone: 372-9631	
Location: 200 East Area, North side of 241-B Tank Farm, East side of Baltimore Ave.		
Objectives: To confirm location of trench.		
Investigators		
Name: Tom Mitchell	Company: CHI	
Phone: 372-9690	E-Mail: Thmitche@bhi-erc.com	
Name: Kevin Bergstrom	Company: CHI	
Phone: 372-9591	E-Mail: Kabergst@bhi-erc.com	
Site Description		
Cultural Resource Setting: NA		
Terrain: Gently slopes from south to north		
Vegetation: Bunch grass used to stabilize cover over burial ground.		
Soil/sediments/rock type: Fill material, gravel, sand and silt at surface. Subsurface unknown		
Anticipated Bedrock: Depth: None Type: NA		
Hydro properties*: Soil was dry during data collection		
Obstacles**: None		
Site Limitations: None		
Overall assessment of site for geophysical investigations: Soil showed minimal lateral variations/character across site thus limiting the effectiveness of GPR.		
Equipment		
Type/Model: Ground Penetrating Radar GSSI SIR10A system, 300 Mhz antenna model 3105 pulled by ATV EMI: EM-31 Geonics ground conductivity meter.		
Data Format:	Disk <input checked="" type="checkbox"/>	Tape <input type="checkbox"/> Hardcopy <input checked="" type="checkbox"/>
Data Collection/Processing Parameters		
Survey Parameters/Grid:	Data collected in three segments. The initial segment was a 10 x 10-ft grid over an area 350 feet long (east-west) by 80 feet wide (north-south). The survey was expanded to include two long north-south segments, 660 feet long by 80 feet wide. GPR data were collected along north-south profiles spaced 10 feet apart (i.e. perpendicular to the trenches). EMI data were also collected along north-south profiles spaced 10 feet apart with data recorded at 5 foot intervals.	
Equipment Settings:	Data collected in continuous mode with 2x stacking of scans. 108 ns data recording window. Filters and gains were set in the field to match local soil conditions. Both in-phase and quadrature EMI data were collected with the boom parallel to the profiles at ~ 3 feet above the ground.	
Summary of Results (Data quality, types of information, etc.)		
The GPR data suggests that there are at least seven trenches across the site. In addition several linears (i.e. suspect pipes) were detected across the site. It is not clear if the linears area associated with the trenches. The proposed sample locations appear to be within trench 216-B-38.		
Lessons Learned (None)		

*water table, moisture, etc:

** rocks, trees, buildings, etc.

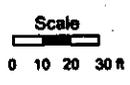
Note: To use the check box electronically - double click on box and change default value to checked.

BHI-EE-259 (09/29/2000)

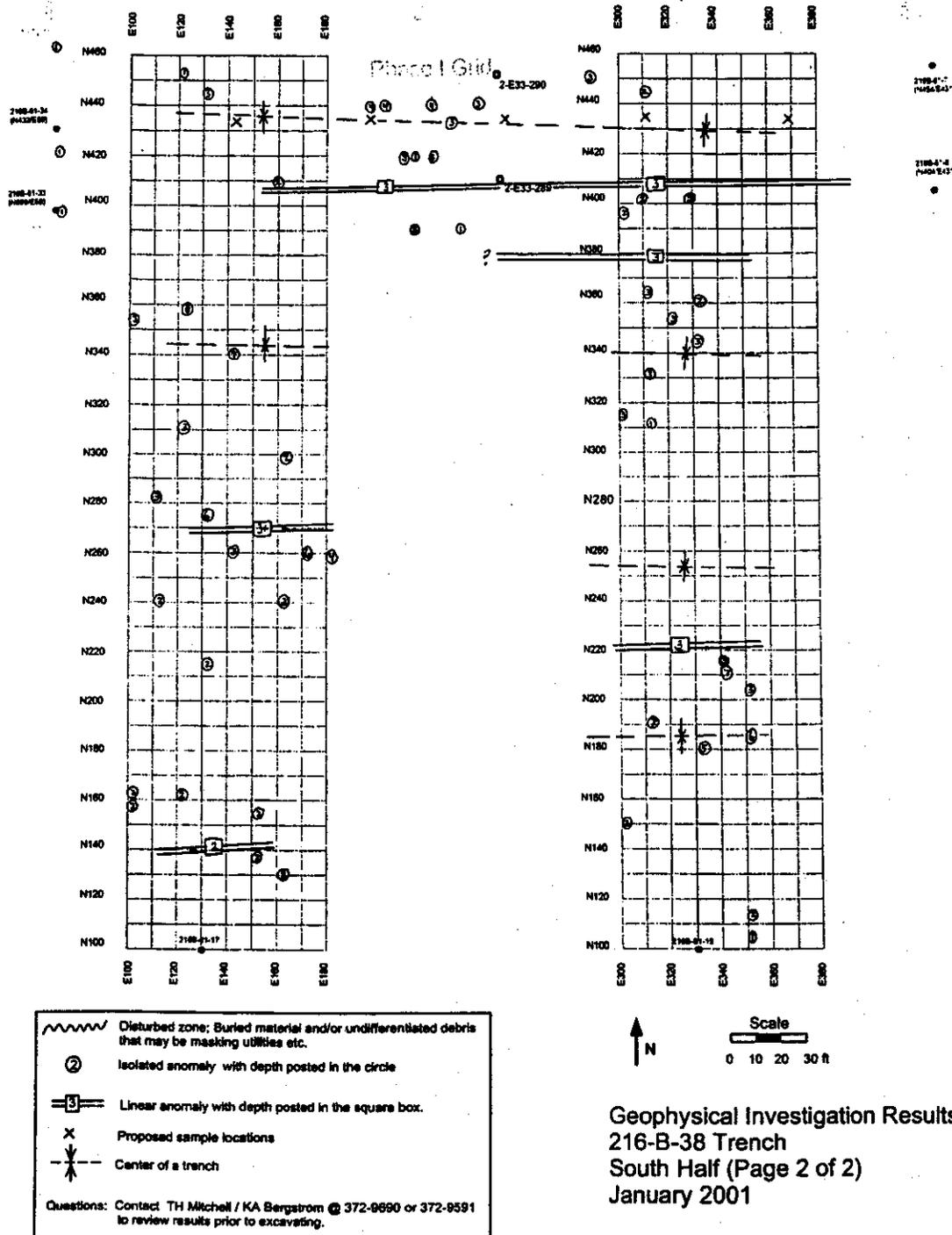


	Disturbed zone; Buried material and/or undifferentiated debris that may be masking utilities etc.
	Isolated anomaly with depth posted in the circle
	Linear anomaly with depth posted in the square box.
	Proposed sample locations
	Center of a trench

Questions: Contact TH Mitchell / KA Bergstrom @ 372-9890 or 372-9591 to review results prior to excavating.



Geophysical Investigation Results
 216-B-38 Trench
 North Half (Page 1 of 2)
 January 2001

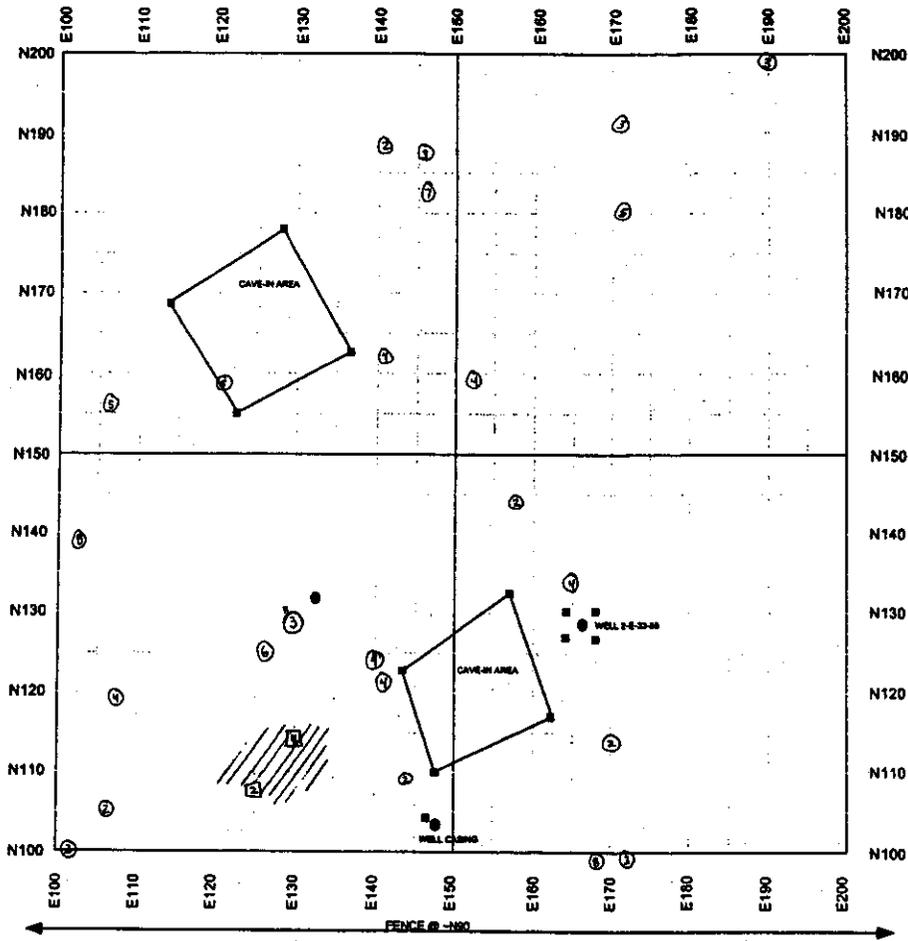


GEOPHYSICAL SITE INVESTIGATION SUMMARY FORM

Site:	216-B-7A Crib	Document Number:	IOM#085931	Date:	1/2001
Sponsor/Contact:	Mary Todd, Chris Cearlock	Phone:	372-9631		
Location:	200 East Area, North side of 241-B Tank Farm, East side of Baltimore Ave.				
Objectives:	To confirm location of crib and locate associated underground piping.				
Investigators					
Name:	Tom Mitchell	Company:	CHI		
Phone:	372-9690	E-Mail:	Tmitch@bhi-erc.com		
Name:	Kevin Bergstrom	Company:	CHI		
Phone:	372-9591	E-Mail:	Kabergst@bhi-erc.com		
Site Description					
Cultural Resource Setting:	NA				
Terrain:	Slopes from north to south from N130 to N100 with ~ 10-ft of relief. Flat between N130 to N200				
Vegetation:	None				
Soil/sediments/rock type:	Fill material, gravel and cobbles at surface. Subsurface unknown				
Anticipated Bedrock:	Depth:	None	Type:	NA	
Hydro properties*:	Soil was dry during data collection				
Obstacles**:	CA (contamination area between N100 and perimeter fence at N90.				
Site Limitations:	None				
Overall assessment of site for geophysical investigations:	GPR did not penetrate deep enough to locate and map crib and associated piping.				
Equipment					
Type/Model:	Ground Penetrating Radar GSSI SIR10A system, 200 Mhz antennat model 5106 EMI: EM-31 Geonics ground conductivity meter.				
Data Format:	Disk <input checked="" type="checkbox"/>	Tape <input type="checkbox"/>	Hardcopy <input checked="" type="checkbox"/>		
Data Collection/Processing Parameters					
Survey Parameters/Grid:	5 x 5-ft grid over a 100 x 100-ft area. GPR data were collected along profiles spaced 5 feet apart in both the north-south and east-west direction. EMI data were collected along north-south profiles spaced 5 feet apart with data recorded at 5 foot intervals.				
Equipment Settings:	GPR data collected in continuous mode with 2x stacking of scans. 150 ns data recording window. Filters and gains were set in the field to match local soil conditions. GSSI RADAN software used for post processing, with no improvement in locating features of interest. Both in-phase and quadrature EMI data were collected with the boom parallel to the profiles at ~ 3 feet above the ground.				
Summary of Results (Data quality, types of information, etc.)					
The cribs and piping were not located. An anomalous zone was detected with both the EMI and GPR data to the west of the anticipated location of the crib. None of the available historical drawing indicated the presence of a buried anthropogenic feature in that area thus it is not clear what the source of the anomalous zone is.					
Lessons Learned					
Neither GPR and EMI were effective at locating 3 inch steel pipes at depth of ~16-ft. Thickness of fill material over original land surface too deep to locate original excavation boundaries of crib.					

*water table, moisture, etc.
** rocks, trees, buildings, etc.

Note: To use the check box electronically - double click on box and change default value to checked.
BHI-EE-259 (09/29/2000)



	Isolated anomaly with depth posted in the circle
	Linear anomaly (None detected).
	Zone dominated with strong reflective horizon
	Well casing
	Metal fence post

Questions: Contact TH Mitchell / KA Bergstrom @ 372-9690 or 372-9691 to review results prior to excavating.

Ground Penetrating Radar Results
 216-B-7A Crib, 200 East
 January, 2001

GEOPHYSICAL SITE INVESTIGATION SUMMARY FORM

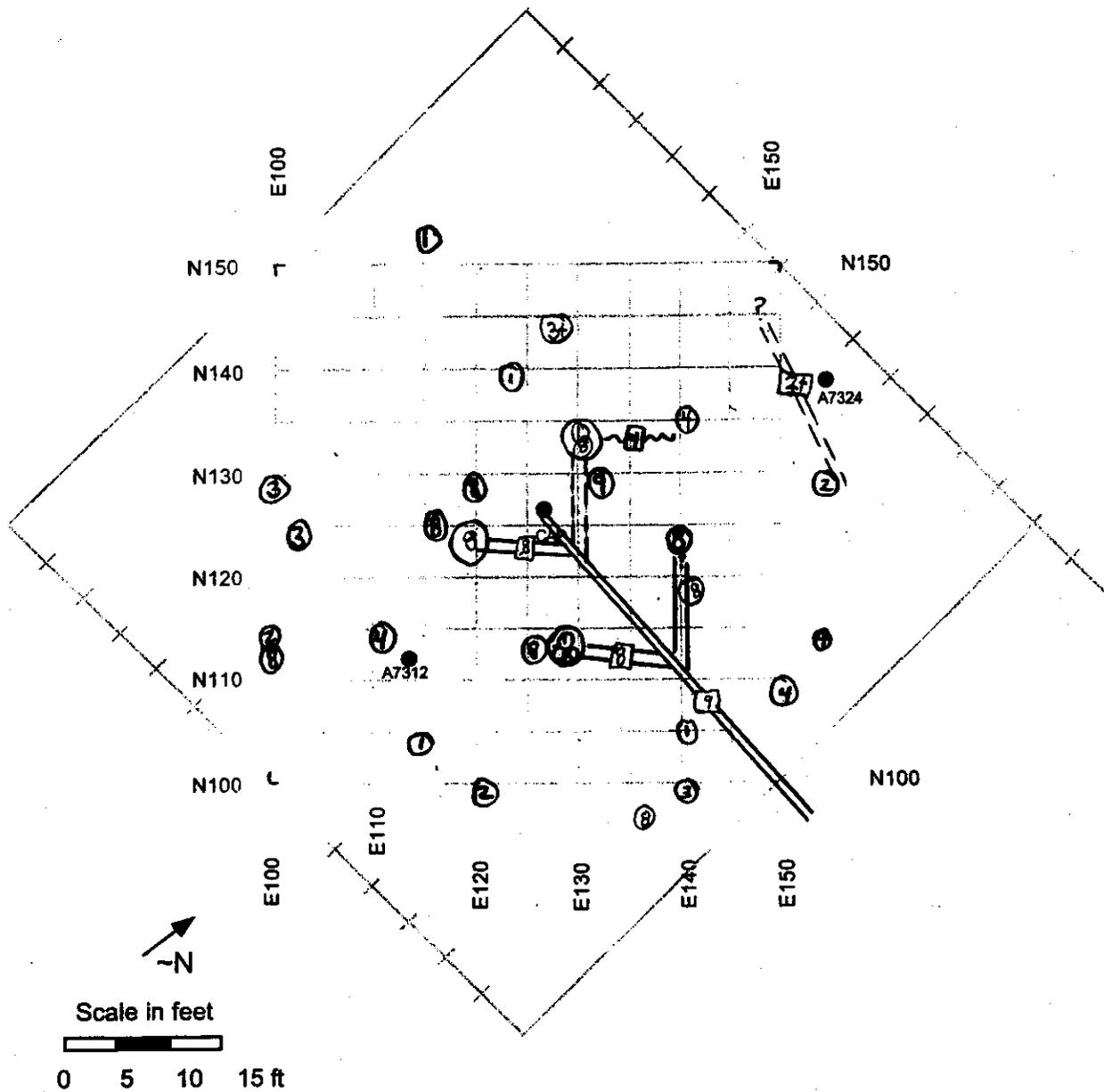
Site: 216-T-26 Crib	Document Number: IOM#085931	Date: Jan. 2001
Sponsor/Contact: Mary Todd (CHI)	Phone: 372-9631	
Location: 200 West, East Side of Camden Rd across from TY Tank Farm		
Objectives: To locate and map the distribution piping within the crib and find a location within the crib for a borehole.		
Investigators		
Name: Kevin Bergstrom	Company: CHI	
Phone: 372-9591	E-Mail: Kabergst@bhi-erc.com	
Name: Tom Mitchell	Company: CHI	
Phone: 372-9690	E-Mail: Thmitche@bhi-erc.com	
Site Description		
Cultural Resource Setting: NA		
Terrain: Flat		
Vegetation: Scattered bunch grass used to stabilize site.		
Soil/sediments/rock type: Sand, silt and cobbles (fill material)		
Anticipated Bedrock: Depth: NA Type: NA		
Hydro properties*: Relatively moist		
Obstacles**: Wells		
Site Limitations: The antenna "bounced" around due to the bunch grass effecting data quality along some profiles.		
Overall assessment of site for geophysical investigations: GPR was effective down to ~14 feet.		
Equipment		
Type/Model: Ground Penetrating Radar: GSSI SIR10A, 300 MHz antenna		
Data Format: Disk <input checked="" type="checkbox"/> Tape <input type="checkbox"/> Hardcopy <input checked="" type="checkbox"/>		
Data Collection/Processing Parameters		
Survey Parameters/Grid: 5 x 5 ft grid over a 50 x 50 ft area		
Equipment Settings: Data were stacked @ 2x; 108 ns window, gains and filters set in field to match soil conditions.		
Summary of Results (Data quality, types of information, etc.)		
The data were sufficient to locate and map the pipes within the crib with the aid of the drawings.		
Lessons Learned		
The drawings that were provided significantly enhanced the interpretation.		

*water table, moisture, etc:

** rocks, trees, buildings, etc.

Note: To use the check box electronically - double click on box and change default value to checked.

BHI-EE-259 (09/29/2000)



	Disturbed zone; Buried material and/or undifferentiated debris that may be masking utilities etc.
	Isolated anomaly with depth posted in the circle
	Linear anomaly with depth posted in the square box.
	Surface Obstruction

Questions: Contact TH Mitchell / KA Bergstrom @ 372-9690 or 372-9591 to review results prior to excavating.

**GPR Survey Results
216-T-26, Crib
200 East
1/5/2001**

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