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Rev. 0

River Corridor Closure Contract

Bioremediation Well Borehole Soil Sampling and Data Analysis Summary Report for the 100-N Area Bioremediation Project (UPR-100-N-17)

September 2009

For Public Release

Washington Closure Hanford

Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Assistant Manager for River Corridor

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ACRONYMS

asl	above sea level
bgs	below ground surface
CHPRC	CH2MHill Plateau Remediation Company
CFU/g	colony forming units per gram
COC	contaminant of concern
ERDF	Environmental Restoration Disposal Facility
MDL	minimum detection limit
mw	moisture by weight
O&G	oil and grease
PRZ	periodically rewetted zone
RAO	remedial action objective
RCRA	*Resource Conservation and Recovery Act*
SAI	sampling and analysis instruction
TKN	Total Kjeldahl Nitrogen
TPH	total petroleum hydrocarbons
VOC	volatile organic compound
WCH	Washington Closure Hanford

1.0 INTRODUCTION

The U.S. Environmental Protection Agency and the Washington State Department of Ecology have selected bioremediation as the technology for remediation of the petroleum-contaminated sites in the 100-N Area. This decision is discussed in the *Interim Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington* (EPA 1999) and the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (DOE-RL 2006).

1.1 PURPOSE

The purpose of this report is to present data and findings acquired during the drilling and construction of seven bioremediation wells in the 100-N Area in conjunction with remediation of the UPR-100-N-17 petroleum waste site (Figure 1). This report is to be the basis of the UPR-100-N-17 site conceptual model and is intended to support closeout planning for the UPR-100-N-17 site, if in situ bioremediation technology is successful in reducing contaminant levels below the required cleanup criteria.

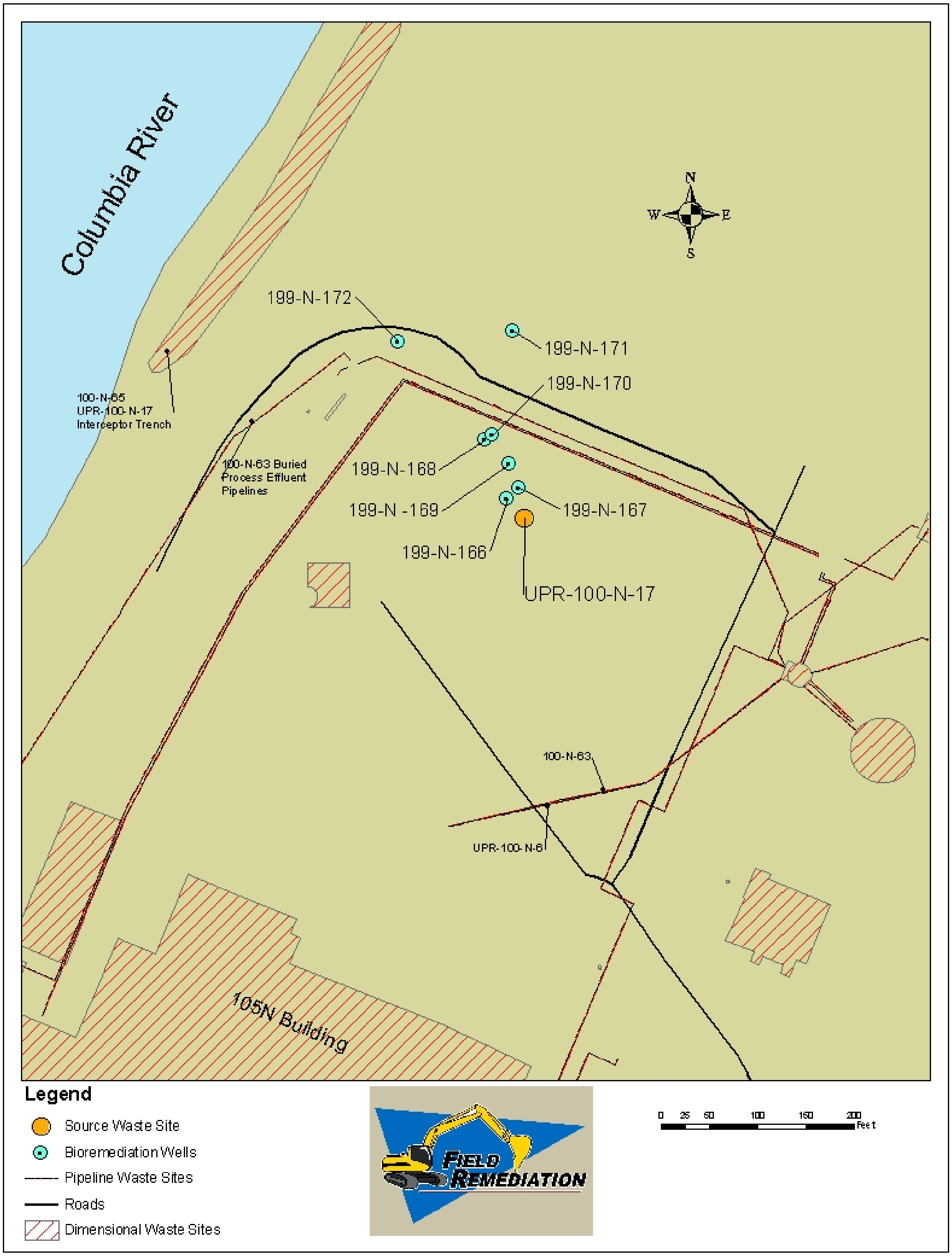
The acquired data have been analyzed; findings presented in relevant sections of this report consist of the following parameters:

- Hydrogeology of the vadose zone
- Lithology of the vadose zone
- Depths to groundwater in the unconfined aquifer
- Determination of the periodically rewetted zone (PRZ) that defines the boundary between the (WCH) Field Remediation's Closure Project's and another contractor's (Groundwater Project) scopes of work
- Soil, chemical, and microbial properties of the vadose zone
- Location of the contaminants of concern (COCs) in the vadose zone
- Concentration of the COCs in the vadose zone
- Area and volume of contamination in the vadose zone.

1.2 PREVIOUS STUDY OF THE WASTE SITE AREA

An engineering study of the petroleum waste sites at 100-N Area was previously completed (WCH 2007) that provides for a historical background of the waste site area, historical document references, project description, regulatory context, remedial design approach, etc. WCH (2007) addressed all the petroleum waste sites at 100-N Area, whereas this report focuses on efforts to date at the UPR-100-N-17 site.

Figure 1. 100-N Area Bioremediation Wells.



1.3 WCH FIELD REMEDIATION SCOPE OF WORK

The scope of work for the UPR-100-N-17 site is to remediate total petroleum hydrocarbon (TPH) contamination in the vadose zone using in situ bioremediation (bioventing) technology as described in WCH scope of work and technical specification documents (WCH 2009a, 2009b).

In situ bioremediation will consist of adding nutrients, bacteria, and oxygen to treat deep petroleum-contaminated soils through the use of injection wells to be constructed at various locations within the contamination zone. Nutrients and bacteria will continue to be added until characterization data collected from injection wells and from nearby monitoring wells indicate groundwater and Columbia River remedial action objectives (RAOs) have been achieved. Residues and miscellaneous waste resulting from the bioremediation activities will be disposed in the Environmental Restoration Disposal Facility (ERDF) if the ERDF waste acceptance criteria are met; otherwise, disposal will be at an approved offsite facility (DOE-RL 2006).

1.4 WCH BIOREMEDIATION WELL DRILLING AND CONSTRUCTION

In early 2009, WCH contracted to have seven bioremediation wells drilled and constructed at the UPR-100-N-17 site (Figure 1). Five of the wells were drilled deep into the vadose zone and two were drilled into the shallow vadose zone. Table 1 shows the well construction details and data for the seven wells. Appendix A presents borehole logs and well summary sheets for each bioremediation well.

Table 1. Bioremediation Well Construction Details.

Well Number	Construction Date	Total Depth (ft bgs)	Screen Top (ft bgs)	Bottom of Screen (ft bgs)	Screen Interval (ft)	Well Elevation (ft asl)	Groundwater Elevation[a] (ft asl)	Depth to Water (ft bgs)
199-N-166	01/29/2009	33	10	30	20	461.69	388.53 [b]	73.16
199-N-167	02/09/2009	83	53	78	25	461.33	388.17	73.16
199-N-168	02/25/2009	33	10	30	20	462.02	387.92 [b]	74.10
199-N-169	02/20/2009	83	53	78	25	461.48	387.88	73.60
199-N-170	03/05/2009	83.5	54	79	25	461.66	387.56	74.10
199-N-171	03/13/2009	82.4	55	80	25	462.35	386.85	75.50
199-N-172	01/23/2009	82	57	77	20	461.05	389.15	71.90

a. Groundwater elevation values represent the construction dates time frame and are not assumed to be static through time.
b. Wells 199-N-166 and 199-N-168 were not completed into the water table. Water elevations are estimated using adjacent deeper well water level measurements.
asl = above sea level
bgs = below ground surface

1.5 SAMPLING AND ANALYSIS INSTRUCTIONS FOR BOREHOLE DRILLING AND SAMPLING

The *Sampling and Analysis Instruction for Installation of UPR-100-N-17 Bioremediation Wells and Performance of Bioventing Pilot Tests* (SAI) (WCH 2008) was prepared and followed during borehole drilling and sampling.

This report describes the sample collection, handling, and analytical requirements that will be used for the in situ bioremediation pilot study for remediation of petroleum hydrocarbon-impacted soil at the UPR-100-N-17 site. Sample results from borehole drilling are presented in proceeding sections and in Appendix B.

2.0 FIELD DATA SUMMARY

This section presents data collected during the borehole drilling and well construction phase and includes hydrogeology of the vadose zone (using borehole logs and referenced material), lithology of the vadose zone (using borehole log descriptions), discussion of the general groundwater elevations of the unconfined aquifer at the UPR-100-N-17 site encountered during drilling, and a discussion for determination of the PRZ that defines the groundwater table for this scope of work.

2.1 SITE HYDROGEOLOGY

Prior to drilling, historical borehole lithologic logs were reviewed and correlated to existing hydrogeologic reference material such as *Hydrogeology of the 100-N Area Hanford Site, Washington* (WHC 1993). The Site is located approximately 122 to 152 m (400 to 500 ft) from the edge of the Columbia River. The two major hydrogeologic units, in descending order, are the Hanford formation and the Upper Ringold Formation. These two units make up the vadose zone and the unconfined aquifer.

WHC (1993) describes the Hanford formation in the 100-N Area as predominantly consisting of two main lithologies that comprise this gravel-dominated facies: (1) a pebble-cobble unit and (2) a cobble-boulder unit.

WHC (1993) describes the uppermost portion of the Ringold Formation in the 100-N Area as fluvial gravel deposits. These gravel deposits consist of pebble-to-cobble clasts with a sand matrix. Some silt and clay content exists and can exceed 10% of total matrix locally.

The Hanford-Ringold contact is irregular and was formed by post-Ringold erosion probably associated with Pleistocene cataclysmic flooding. Several criteria are used to differentiate the two units (WHC 1993):

1. The sand fraction in Hanford formation gravels generally contains greater than 40% basalt; Ringold Formation deposits generally contain less than 25% basalt.

2. Hanford formation gravels may display salt and pepper and gray coloring, while Ringold Formation gravels are generally more oxidized and red-brown to yellow-red in color.

3. Ringold Formation gravels generally are consolidated and cementation may be well developed locally. Consequently, drilling rates tend to be slower in the Ringold Formation than in the Hanford formation.

A review of borehole logs completed during the recent drilling of the seven bioremediation wells correlates adequately to previously described hydrogeology of the area. Gravels and sandy gravels dominated the borehole log descriptions. Some borehole intervals contain silts and clays mixed with the gravels. Descriptions of finer grained deposits were more scrutinized in the lithology section as they might have impeded the flow of TPH after it was released into the vadose zone. If a fine-grained deposit has a large surface area, some of the TPH could have been “perched” above it and not reached the groundwater table. Perched zones within the vadose zone will be incorporated into the UPR-100-N-17 site conceptual model if applicable.

2.2 LITHOLOGY OF THE SITE’S VADOSE ZONE

Borehole logs were recorded in the field by a WCH geologist and reviewed by a CH2MHill Plateau Remediation Company (CHPRC) geologist. The CHPRC was contracted via a work order to perform the actual drilling and well construction scope of work.

The WCH Bioremediation Project resident engineer reviewed the borehole logs while developing the UPR-100-N-17 site conceptual model and cross section (Figure 2). Appendix A presents the borehole logs and well summary sheets completed during the drilling and well construction scope of work.

A summary of pertinent lithologic properties for the UPR-100-N-17 site is as follows:

1. The Hanford formation is approximately 45 ft thick throughout the drilling area and contacted with the Ringold Formation as anticipated in an unconformable manner.

2. Minor stringers of clay and silt were noted in the drill cuttings of both formations.

3. A 1-ft bed or lens of silt was noted from 53 to 54 ft bgs in the borehole for well 199-N-171. This silt bed or lens was located within the Ringold Formation.

4. A 6-in. “stringer” of silt was noted at 51 ft bgs in the borehole for well 199-N-172 and was located in the Ringold Formation. Another thin bed of silt was encountered at 59 ft bgs.

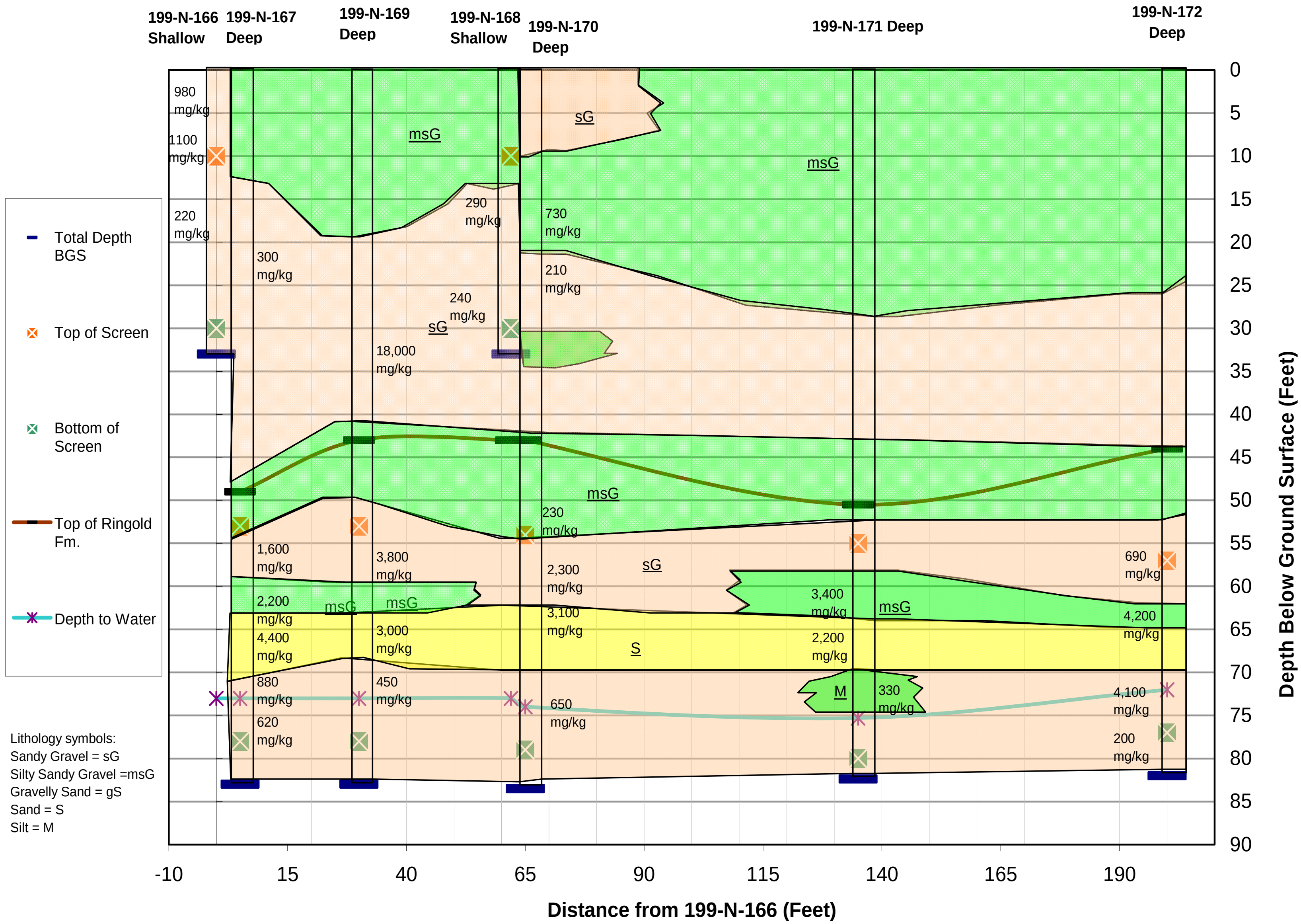


Figure 2. Cross Section of Bioremediation Well Construction with TPH and Oil and Grease Results.

5. In the Hanford and Ringold Formations zones of caliche and carbonate deposits were noted intermittently in drill cuttings. This was confirmed by positive reactions with hydrochloric acid field tests.

6. Zones of cementation were noted in boreholes as drilling progressed into the Ringold Formation. Depths encountered were random and were noted in intervals from 45 to 78 ft bgs.

7. A 5- to 7-ft-thick bed of fine to coarse-grained sand was contiguous and ranged in depth from approximately 63 to 70.5 ft bgs. This sand bed is located in the Ringold Formation.

Overall the lithology in the drilling area was dominated by silty sandy gravels in the upper vadose zone and sandy gravels, silty sandy gravels, and sand in the lower portion of the vadose zone. Most lithologies noted during logging were contiguous from borehole to borehole, but some interfingering or lensmatic deposits were noted.

The lithologies encountered during drilling indicate a depositional environment of high-energy fluvial channel systems that evolved over time and correlate to interpretations from previous studies.

2.3 SITE DEPTH TO GROUNDWATER DATA

2.3.1 Surface Water/Groundwater Interface

Normally late winter, early spring, and summer runoff releases from Priest Rapids Dam increase river flow and stage, which have been documented to affect groundwater wells near the shoreline. WHC (1993) states a study demonstrated that the effects of seasonal river stage changes were noticeable up to 1,000 ft inland. Daily river-level fluctuations affected groundwater levels up to 750 ft inland. One of the studies referenced is documented in *Evaluations of the Effects of the Columbia River on the Unconfined Aquifer Beneath the 1301-N Liquid Waste Disposal Facility* (PNL 1991). The study reported that in 1990 the groundwater levels were affected most from June to July by long-term high river stage. Groundwater levels raised an annual maximum of approximately 10 ft in monitored well 199-N-8S, which is located 80 ft inland from the river. Annual fluctuations in two other representative wells, 199-N-20 (190 ft inland) and 199-N-3 (300 ft inland), due to daily, seasonal, and regional influences were approximately 6 ft. Well 199-N-3 was located in the same general area as the current bioremediation project wells but has since been decommissioned.

The fluctuations of the river are regulated immediately upstream of the Hanford Site by the Priest Rapids Dam. River level fluctuations are reflective of a number of cyclical factors including daily, weekly, seasonal, and annual cycles. Daily and weekly cycles are related to hydroelectric energy needs. Seasonal cycles are influenced largely by the spring runoff, along with fish and wildlife management activities. In January and February, in preparation for the spring runoff, the reservoir system is lowered, creating higher river levels. In mid-April, there is another large release of water, which lasts over a month, to facilitate the salmon migration downstream. The largest release of water from the system occurs from May to the end of June, which represents the release of spring runoff (PNL 1990).

2.3.2 Groundwater Depths Encountered During Drilling (2009)

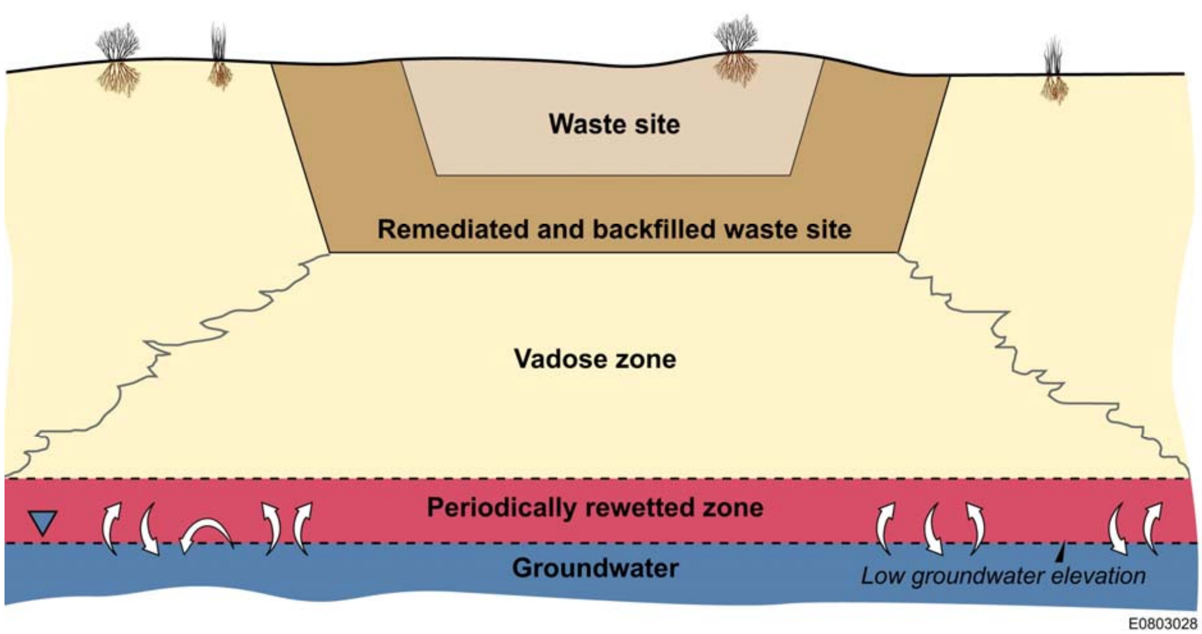
Depth to groundwater encountered during the drilling period from January to early March 2009 ranged from 71.9 to 75.5 ft bgs. These groundwater depth measurements were converted to groundwater elevations using well completion survey data (see Table 1). The elevations were then compared to river stage and discharge daily mean measurement data for the same time period in 2008 (2009 records are not available to the public at this time).

Since drilling occurred from late January to early March 2009, the 2.3-ft differential between groundwater elevations in the bioremediation wells could be actual groundwater table fluctuations caused by short-term (daily or weekly) increases and decreases in river discharge. As described above, drilling of the bioremediation wells was occurring during periods of planned releases at Priest Rapids Dam in order to create storage capacity behind the dam in anticipation of the spring runoff releases.

2.4 DETERMINATION OF THE PERIODICALLY REWETTED ZONE

In a 2008 letter to WCH, the U.S. Department of Energy, Richland Operations Office stated the River Corridor Project (WCH) is responsible for characterizing the vadose zone above the PRZ (DOE-RL 2008). Figure 1 of that letter shows the PRZ to consist of a zone of sediment that is periodically saturated with groundwater when groundwater levels are high and unsaturated at times when the groundwater levels are low (Figure 3).

Figure 3. Periodically Rewetted Zone.



For the purpose of this report, an additional 2 ft will be added to the highest groundwater elevation measured during drilling and assumed as the top of the PRZ. This maximum groundwater elevation would then be 391.15 ft above seal level (asl). This value may change based on future discussions and determinations by WCH or other interested parties.

3.0 SOIL SAMPLING ANALYTICAL RESULTS

3.1 BOREHOLE SOIL SAMPLING PURPOSE

The purpose of sampling soils from the borehole during drilling was to support the design and implementation of the bioventing system and to characterize the vadose zone with regards to current physical and chemical conditions and how these conditions might affect bioremediation.

Two main goals were met during the drilling and sampling project. Petroleum contamination was located in the vadose zone, and soil analysis verified the existence of a microbial population within the vadose zone that is necessary for the bioremediation process to move forward.

3.2 DATA REQUIREMENTS FOR BIOVENTING PILOT TEST

Although much is known about the hydrogeologic conditions of the vadose zone in the 100-N Area, some of the physical and chemical parameters important to successful implementation of bioremediation and bioventing were not available and needed to be collected during well construction and performance of pilot testing. Specifically, data concerning the concentrations of indigenous microbes and nutrients in the subsurface and quantitative site-specific data concerning the nature and extent of petroleum contamination were needed. Table 2 provides a summary of the data parameters collected during well installation and to be collected during performance of pilot testing (WCH 2008).

Table 2. Characterization Parameters for Bioremediation/Bioventing.

Parameter	Purpose	Methodology
TPH-diesel	Determine concentration of target constituent and toxicity to microbial population.	Collect soil samples during well drilling.
TPH-gasoline	Determine concentration of target constituent and toxicity to microbial population.	Collect soil samples during well drilling.
TPH-motor oil	Determine concentration of target constituent and toxicity to microbial population.	Collect soil samples during well drilling.
Oil and grease	Determine concentration of target constituent and toxicity to microbial population.	Collect soil samples during well drilling.
Total nitrogen	Determine mineral nutrient requirements.	Collect soil samples during well drilling.
Orthophosphate	Determine mineral nutrient requirements.	Collect soil samples during well drilling.
VOCs	Determine concentration of benzene, toluene, ethylbenzene, and xylenes	Collect soil samples during well drilling.
Total organic carbon	Determine presence of organic matter and adsorption characteristics of soil.	Collect soil samples during well drilling.
RCRA metals	Identify contaminants that may inhibit microbial metabolism.	Collect soil samples during well drilling.
Hexavalent chromium	Evaluate hexavalent chromium in vadose zone.	Collect soil samples during well drilling.
Strontium-90	Determine if strontium-90 has been introduced into the deep vadose soil from historical fluctuations of the groundwater table.	Collect soil samples during well drilling.
Heterotrophic bacterial plate count	Determine indigenous/adapted microbial population densities in soil.	Collect soil samples during well drilling.
pH	Verify pH suitable for microbial metabolism.	Collect soil samples during well drilling.
Moisture content	Determine conditions suitable for microbial metabolism; influences air permeability.	Collect soil samples during well drilling; perform geophysical logging.
Depth to groundwater	Determine depth to set well screen for deep vadose wells.	Measure depth to groundwater for deep vadose wells.
Permeability	Determine ability to deliver oxygen to the contaminated zone.	Calculated from air injection tests; supplemented with existing data for hydraulic conductivity, bulk density, grain-size distribution; and porosity.
O_2 content in soil gas	Evaluate biodegradation rates.	Field measurements during drilling and during pilot tests.
CO_2 content in soil gas	Evaluate biodegradation rates.	Field measurements during drilling and during pilot tests.
VOC in soil gas	Evaluate biodegradation rates.	Field measurements during drilling and during pilot tests.
Pressure measurements	Evaluate radius of influence of oxygen injection in vadose zone.	Pressure measurements collected during pilot tests.

TPH = total petroleum
VOC = volatile organic compound
RCRA = *Resource Conservation and Recovery Act of 1976*

3.3 SUMMARY OF SAMPLING RESULTS

Appendix B presents tables of the sampling results for the analytes outlined in the SAI (WCH 2008). Tables of applicable sample results are presented as follows:

- Microbes (results table is not included in Appendix B as results were presented in report format only and paraphrased in Section 3.3.1)
- TPH/oil and grease
- Organics
- Wet chemistry
- Inorganics
- Radionuclides.

Below are summaries of the sample result data and relevant highlights or interpretations.

3.3.1 Microbes

All boreholes were sampled for heterotrophic bacteria as per the SAI (WCH 2008). The purpose was to enumerate the microorganisms in soil samples collected from boreholes at the UPR-100-N-17 site. Heterotrophic microorganisms in the soil include bacteria and fungi that obtain their energy and carbon source for growth and reproduction from organic compounds. This portion of the microbial community can be responsible for degradation of xenobiotic compounds such as diesel. Two approaches were proposed to be used to enumerate (or estimate) the number of live microorganisms in the soil samples. First was to estimate total heterotrophic microorganisms using a plate count technique with soil extract agar. The second approach was based on the outcome of the first approach, and that approach would estimate total diesel-degrading microorganisms using a plate count technique with soil extract agar amended with 10 mg/L diesel No. 2 fuel.

A total of 17 soil samples were provided for analysis. These samples ranged in depth with relation to the periodically rewetted zone, soil moisture, and apparent petroleum odor. All of the soil samples collected at the Site exhibited microbial growth. Because of the heavy fungal growth on the initial dilution samples and no growth on plates with the serially diluted samples, the estimate of the soil community is between 100 and 1000 colony forming units per gram of soil (CFU/g).

3.3.2 TPH/Oil and Grease

All boreholes were sampled for TPH (diesel and gasoline range) and oil and grease (O&G) as per the SAI. TPH and O&G were detected in all boreholes and at levels over the current cleanup level of 200 mg/kg.

The overall trend was to encounter higher concentrations at depths of 55 ft bgs or greater. Then the contamination was pervasive to groundwater. High concentrations ranging from approximately 3,000 to 4,400 mg/kg were detected in each of the deep boreholes (Figure 4).

O&G was detected in the shallow well 199-N-166 at depths less than 15 ft bgs and at concentrations of approximately 1,000 mg/kg. Some samples collected in the shallow to middle depths had results at or slightly above the cleanup level of 200 mg/kg (Figure 4).

One sample from well 199-N-169 at 35 ft bgs reported a result of 18,000 mg/kg (Figure 4). This result is probably erroneous based on the sample results from 30 ft bgs (140 mg/kg) and 40 ft bgs (88 mg/kg), which was the minimum detection limit (MDL) and causes doubt as to the accuracy of the 35 ft bgs, sample results. The lithology does not indicate the potential for a perched layer of TPH at or near 35 ft bgs and the sample results from borehole samples taken from the other wells did not have high concentrations of TPH at or near the 35 ft bgs sample interval. Figure 5 shows TPH and O&G concentrations at depth without the probable erroneous value from well 199-N-169 to show concentrations with higher resolution.

3.3.3 Moisture Content

All boreholes were sampled to determine moisture content of the soil as per the SAI (WCH 2008). Some general trends of moisture content correlating from borehole to borehole was noted, which suggest some zones within the UPR-100-N-17 site's lithology retain moisture better than other lithologic zones (i.e., silty soil versus sandy soils). Disparity from trends could indicate localized lithologic changes in some boreholes (lenses or stringers of finer grained sediments) or other factors. Moisture contents increased overall as sample depths approached the groundwater table and as higher concentrations of TPH were encountered (Figure 6).

The minimum result was 0.2% moisture by weight (mw) and the maximum result was 10% mw. The average moisture content of all samples was 4.59% mw. The 0.2% mw result may be an erroneous result based on surrounding samples' results that have higher result values. The next minimum result was 2.1% mw, and using this value the average moisture content for all samples was 4.63% mw. These average values fall within the range for bioremediation to occur (EPA 1995).

3.3.4 Organics

All boreholes were sampled for volatile and semivolatile organic compounds as per the SAI (WCH 2008). All sample results were below the current 100-N Area cleanup levels for direct exposure, protection of groundwater, and protection of the Columbia River. This indicates that most or all of the volatile and semivolatile compounds may have volatilized or degraded over time in the UPR-100-N-17 site's vadose zone.

Figure 4. Chart of 100-N Bioremediation Wells Borehole TPH and Oil and Grease Sample Results.

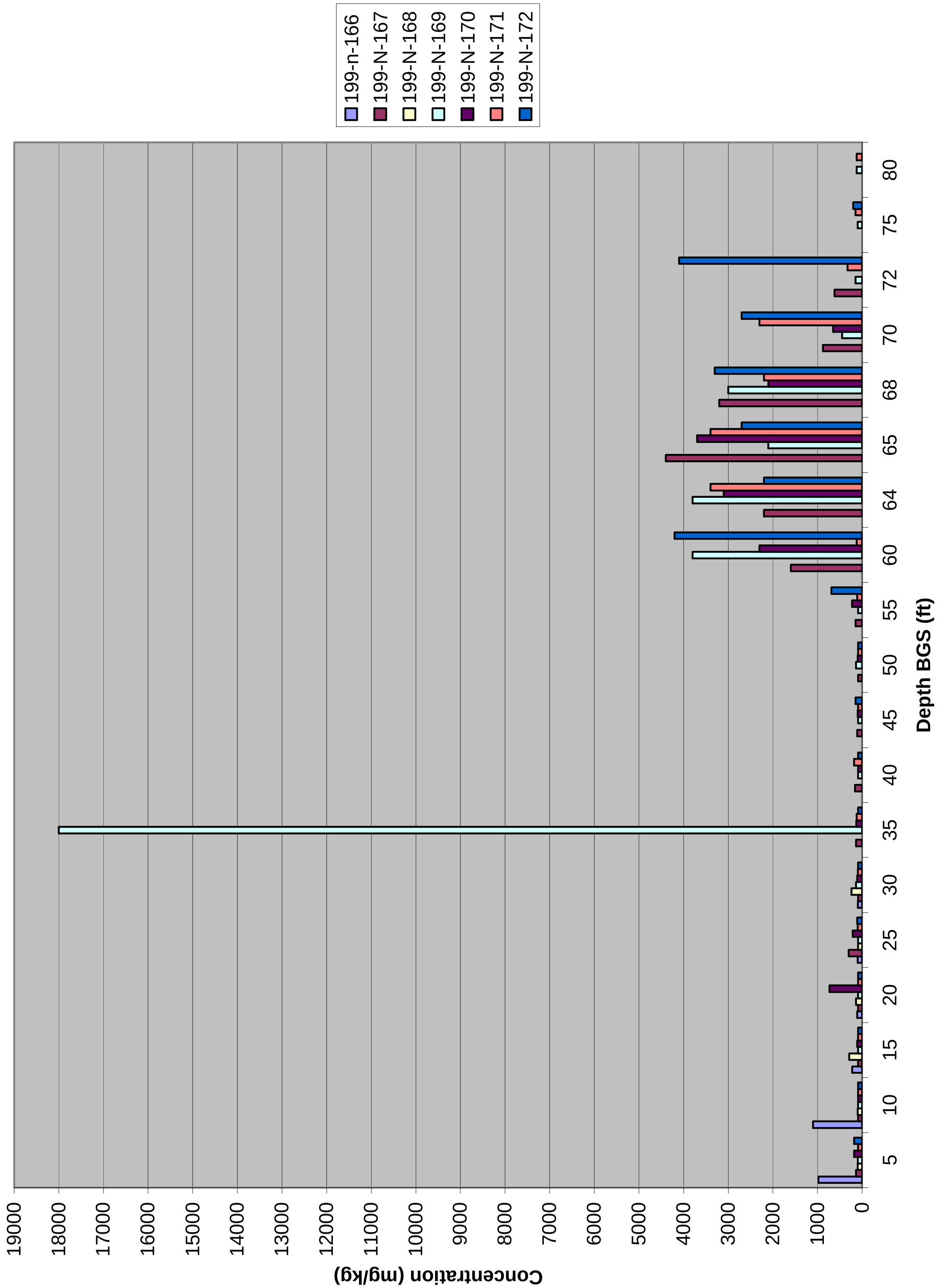


Figure 5. Chart of Bioremediation Wells Borehole TPH and Oil and Grease Sample Results Without Anomalous Concentration at Well 199-N-169.

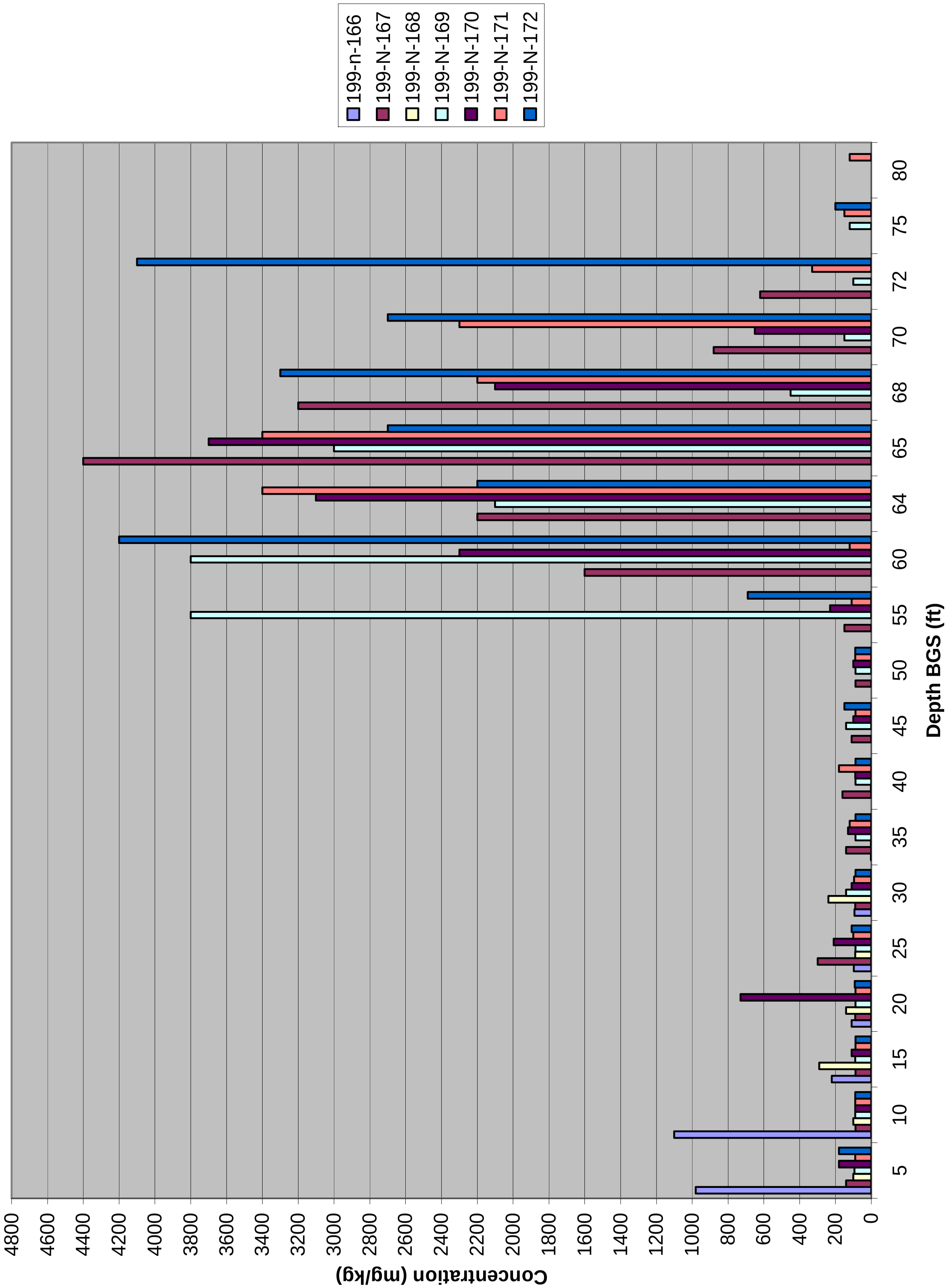
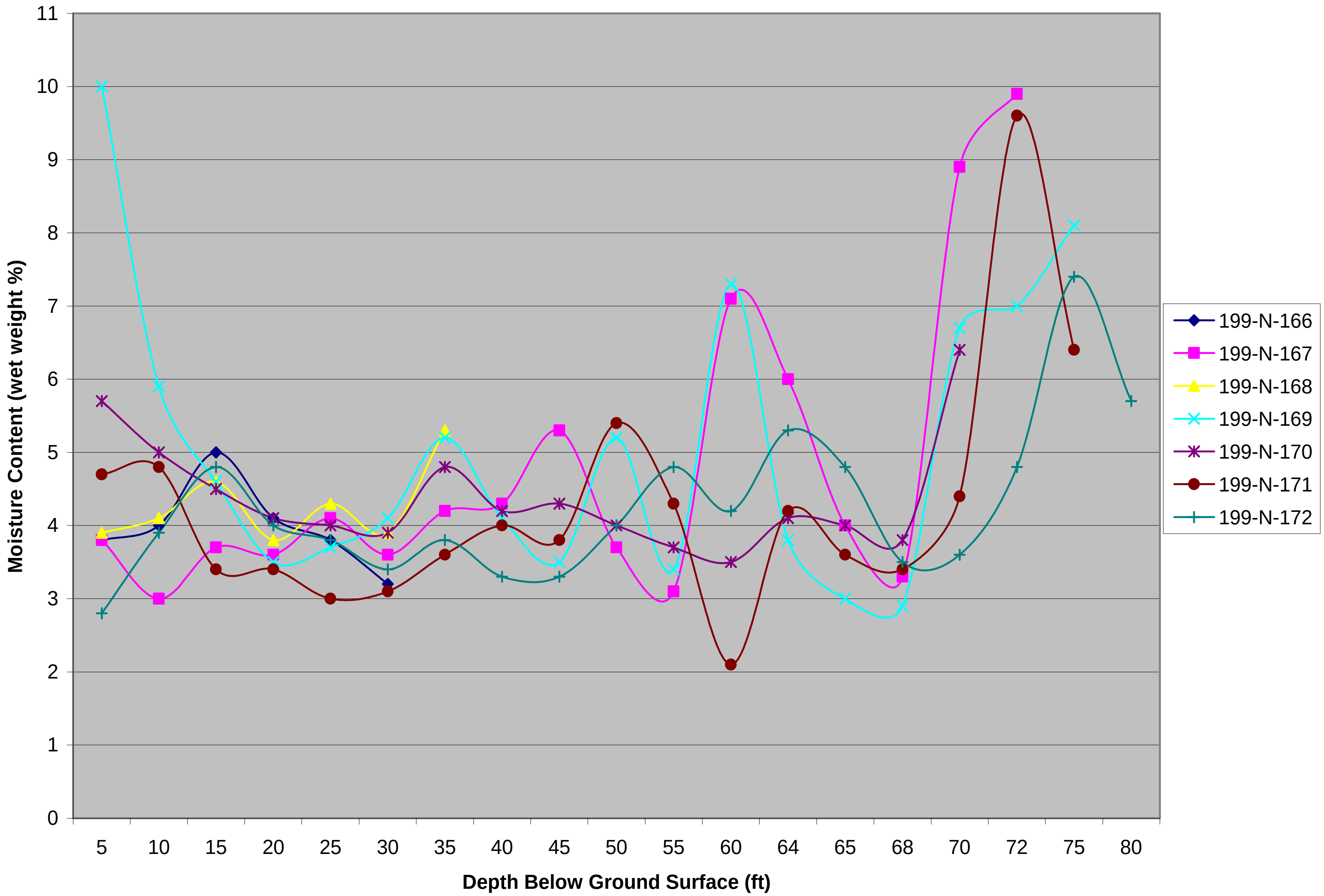


Figure 6. Chart of Bioremediation Wells Borehole Moisture Content Values at Depth.



3.3.5 Nitrogen

The Total Kjeldahl Nitrogen (TKN) method has been reported to be the most reliable method for determining total nitrogen available, which is a valuable nutrient to support microbial growth processes. All boreholes were sampled to determine total nitrogen content in the soil as per the SAI (WCH 2008). TKN results detected nitrogen in most of the samples collected. The average TKN concentration of the sample results was 28 mg/kg. This is a relatively low value, but a value that has been reported as adequate to support bioremediation (EPA 1995).

3.3.6 Phosphorus

Phosphorus has been found to be a valuable nutrient that supports microbial growth processes. All boreholes were sampled to determine total phosphorus content in the soil as per the SAI. Phosphorus, as an element, was detected in all samples collected with an average concentration of 543 mg/kg. Phosphorus in this mineralogical form may not be the best available form as a nutrient for the bacteria to metabolize. However, some microbial communities have adapted to uptake phosphorus.

Phosphorus in anion form, as a phosphate ion, was analyzed for and the results were nondetected for all boreholes. The phosphate ion is the more bio-available form of the nutrient used by the bacteria. These low concentrations of the phosphate ion in the vadose zone could be a limiting factor for maximum rates of bioremediation to occur during bioventing (WSRC 1997).

3.3.7 pH

All boreholes were sampled to determine pH content of the soil as per the SAI (WCH 2008). Results had a range of 6.6 to 9.2 and an average value of 8.6. This average is near the upper range of optimal pH for bioremediation to occur and correlates to previous studies' interpretations of 100-N Area soils as being alkaline.

3.3.8 Metals

All boreholes were sampled to determine *Resource Conservation and Recovery Act of 1976* (RCRA) metals content in the soil as per the SAI (WCH 2008). Soil samples were analyzed for metals as high concentrations may be toxic to bacterial processes. Metal toxicity to microorganisms is a complex subject and beyond the scope of this report. Generally the presence of metals has very little direct effect on the bioremediation process as the microbial population frequently adapts to the concentrations present (Norris et al.1994).

The sample results will be used as a baseline and for future reference if problems occur with the bioventing process and metal toxicity needs to be investigated as a limiting factor.

3.3.9 Radionuclides

All boreholes were sampled as per the SAI (WCH 2008) to determine if radionuclides (man-made and naturally occurring background) are in the soil. These analyses were necessary to characterize the vadose zone for radiological hazards that might cause worker safety issues or affect the presence of microbial activity in the soil. Radionuclides have been detected in the groundwater at the 100-N Area historically due to reactor processes that occurred during operations.

Well 199-N-172 was the first well drilled and constructed. In accordance with the SAI (WCH 2008) it was decided to sample for a full range of radionuclides using gamma spectrum analysis. All results were for nondetected concentrations except for potassium-40, radium-226, and thorium-232. Potassium-40, radium-226, and thorium-232 were detected in samples collected at the site but are not related to the operational history of the site, and all were detected at levels below statistical background activities (based on an assumption of secular equilibrium, the background activities for radium-228 and thorium-228 are equal to the statistical background activity of 1.32 pCi/g for thorium-232 provided in DOE-RL 1996).

Therefore, further borehole soil samples were analyzed for total beta radiostrontium only, as strontium-90 is a known groundwater contaminant at the 100-N Area. All samples collected had results below the cleanup level of 4.5 pCi/g for total beta radiostrontium. The highest sample result was 1.8 pCi/g and was taken from well 199-N-171.

Geophysical logs were run to detect the presence of man-made and naturally occurring radionuclides in the soil. Boreholes for wells 199-N-167, 199-N-169, 199-N-170, 199-N-171, and 199-N-172 were logged by Stoller Company. Appendix C presents the logs and results in the summary report for each borehole that was logged. Boreholes for 199-N-167 and 199-N-169 had minor detections for cobalt-60 below the cleanup levels.

3.4 CONCLUSION

The sample result data were helpful in constructing an initial conceptual model for the UPR-100-N-17 site. Microbial samples results show that there are colonies of bacteria and other microorganisms living in the vadose zone. Therefore, bioventing pilot testing is expected to be successful to some degree. Further data will be collected during pilot testing to track performance of the bioremediation system and determine the level of bioremediation that is occurring within the contaminated zone affected by the system. These data will consist of oxygen (O_2) content in soil gas, carbon dioxide (CO_2) in soil gas, volatile organic compounds (VOCs) in soil gas samples, and pressure measurements to evaluate biodegradation rates and the radius of oxygen injection in the vadose zone, respectively. As more data are collected they will be incorporated into the conceptual model of the UPR-100-N-17 site.

Zones of TPH contamination were identified based on sample results. All wells had high concentrations of TPH in a zone starting about 55 ft bgs and extended to the groundwater table in the unconfined aquifer. The distance from well 199-N-166 to the bioremediation well closest to the river (199-N-172) is approximately 200 ft. Well 199-N-172 is located on the approximate azimuth as the currently accepted direction of the hydraulic gradient for groundwater in the unconfined aquifer. Since the TPH concentration did not noticeably decrease from wells 199-N-166 to 199-N-172, it may be assumed the zone of TPH contamination extends beyond 200 ft and may extend to the river. Currently the sampling data do not assist in fully defining the lateral and upgradient boundaries of the TPH diesel contamination zone.

However, well 199-N-171 was constructed to the right (north) of the initially planned straight line of wells following the estimated hydraulic gradient. This was due to underground interferences discovered to exist in the originally planned location for 199-N-171 causing its final location to be moved to a safer area. Currently well 199-N-171 is approximately 100 ft perpendicular to the originally planned straight line of wells. Well 199-N-171 sampling results indicate lateral contamination in its general area and at levels consistent with the other wells' results (see Figure 4).

Analysis methods 9071b (O&G) and 8015b (TPH C10-C36) were used by the contracted laboratories for sample analysis. The two laboratory methods used for analysis of petroleum contaminants target the same type of constituents and, when low concentrations of VOCs exist, the results of each method are similar and can be used together for characterization purposes. Where TPH samples were not collected in the boreholes but O&G samples were collected, the data showed a strong correlation between O&G and TPH result values. For example, in the borehole for well 199-N-172 an O&G sample was collected at 70 ft bgs and had a result of 3,300 mg/kg. A TPH sample was collected in the same borehole at 72 ft bgs and had a result of 2,700 mg/kg for TPH. At 75 ft bgs another O&G sample was collected and had a result of 4,100 mg/kg. Therefore, it is assumed that sample values for O&G can be used to estimate the TPH values in those areas of the vadose zone.

Sample results for nutrients such as nitrogen and phosphorus in bio-available forms had low concentrations. However, previous studies referenced in AFCEE (2004) indicate some sites with low or less than ideal concentrations of nutrients still exhibited adequate levels of microbial activity during bioremediation projects. Other references mention that microbial systems may adapt and use other forms of nutrients to assist with petroleum biodegradation. Several references mention that a low carbon to nitrogen to phosphorus (C:N:P) ratio can become a limiting factor and result in less than optimal rates of biodegradation. More analysis and study may be given to the C:N:P ratios at the UPR-100-N-17 site after the bioremediation system is operating and more sampling data are collected and processed. If the system does not perform at optimum levels, the C:N:P ratios might be evaluated to determine a limiting factor(s) affecting the bioventing system's performance.

Based on the data collected and summarized in this report, the minimum positive criterion for field implementation of a bioventing system is assumed to exist at the UPR-100-N-17 site. Installation of the bioventing system and pilot testing is expected to begin in October or November 2009.

4.0 REFERENCES

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APPENDIX A

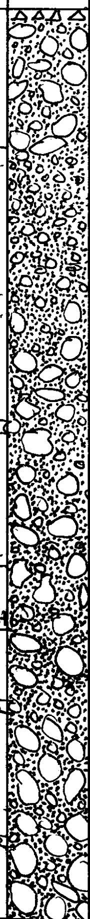
BOREHOLE LOGS AND WELL SUMMARY SHEETS

BOREHOLE LOG

Page 1 of 1
Date: 01/27/09

Well ID: C7031 | Well Name: 199-N-166 | Location: 100-N Area (UPR-100-N-17)

Project: 100-N Bioremediation Wells | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description (Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level)
0				0–0.5′ Crushed gravel (fill)	9½" OD DB 0′-2′ bgs.
					7" OD DB 2′-TD bgs.
				0.5′–33′ Sandy Gravel (SG). v. poorly	8⅝"\ 7⅝" CS casing
				sorted. 60% basalt, 40% qtz/felsics.	Hanford formation
				SR-SA. sand vfn-vcse grained.	
5	5′ archive			max particle size ~8". no rxn	collect 5′ archive\
				to HCl. 10YR5/2 grayish brown.	chip tray.
				65% gravel, 30% sand, <5%	
				silt.	
				@7′ mod sorted sandy gravel.	
10	10′ archive			mps ~3", trace caliche, mod. rxn	collect 10′ archive\
				HCl, sand vfn-med, SR-A	chip tray.
				75% basalt, 25% qtz/felsics.	
				10YR3/3, dark brown. 60% gravel,	
				35% sand, 5% silt.	collect 15′ archive\
15	15′ archive			@10′ sandy gravel. sand content	chip tray.
				increasing. Gravel 50%, sand 45%,	large rock @ 16′ bgs
				silt 5%. weak to mod rxn Hcl.	
				@15′ Gravel increase to 65%, sand	
				30%, silt 5%. Gravel, basaltic,	
20	20′ archive			SR-A, fragmented, poorly sorted.	collect 20′ archive\
	SS#1	100% recovery		mps ~5". weak rxn Hcl.	chip tray.
	J18116 J180Y5			@18′ Gravel 70%, Sand 25%,	SS#1 20-20.5′ bgs
	J18116			silt <5%. mps ~3", 80% basalt,	J18116: J180Y5
				20% felsics, poorly sorted. SA-R	E.O.S. @ 23′ bgs.
25	25′ archive			7.5YR3/1 very dark gray. no	Start 01/28/09
				rxn Hcl.	collect 25′ archive\
					chip tray
				TD @ 33′ bgs.	
30	30′ archive				
	SS#2	100%			collect 30′ archive\
	J18117				chip tray.
	J180Y6				SS#2 30-32.5′
	TD @ 33′ bgs				J18117 & J180Y6
35					

Reported By: Charlene Martinez | Reviewed By: L.D. Walker
Title: Geologist \ P.A.L. | Title: Geologist
Signature: Charlene Martinez | Date: 01/27/09 | Signature: L D Walker | Date: 3/26/09

A-6003-642 (03/03)

WELL SUMMARY SHEET

Start Date: 01\27\09
Finish Date: 01\29\09
Page 1 of 1

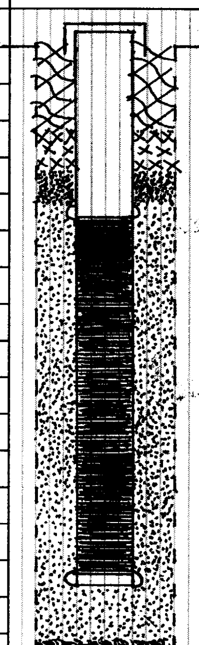
Well ID: C7031	Well Name: 199-N-166
Location: 100-N Area (UPR-100-N-17)	Project: 100-N Bioremediation Wells
Prepared By: Charlene Martinez Date: 02\06\09	Reviewed By: L. D. Walker Date: 3/26/09
Signature: Charlene Martinez	Signature:

CONSTRUCTION DATA			GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description

CONSTRUCTION DATA – Description

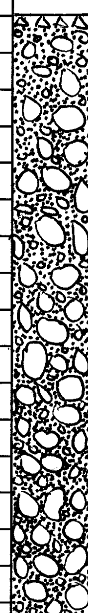
- $8^{5/8}$"\ $7^{5/8}$" c.s. temp. casing.
- Portland Cement 0' – 4.85'
- 4" PVC perm. casing +0.5' —— 9.53'
- 3/8" Bentonite Pellets 4.85' – 6.55'
- 20-40 mesh silica sand 6.55' – 8.32'
- 8-12 mesh silica sand 8.32' – 32.75'
- muddy fill 32.75' – 33.0'
- 4" PVC screen (0.04" slot) 9.53' —— 29.54'
- 4" PVC endcap 29.54' —— 29.89'
- All temp. casing removed from ground.
- All depths in ft below ground surface

Diagram



Depth in Feet: 0, 10, 20, 30, 40, 50

Graphic Log



Lithologic Description

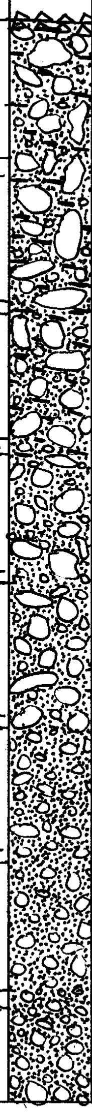
Hanford formation
0 – 0.5' Crushed gravel (fill)
0.5' – 33' Sandy Gravel (sG)
TD = 33' bgs.
GW not reached.

A-6003-643 (03/03)

BOREHOLE LOG

Page 1 of 3
Date: 01/30/09

Well ID: C7032	Well Name: 199-N-167	Location: 100-N-Area (UPR-100-N-17)
Project: 100-N Bioremediation well Drilling		Reference Measuring Point: Ground Surface



Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Sample Description (Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level)
0	9 5/8" DB		0-0.5' Crushed Gravel (fill)	9 1/2" OD d.b. 8 5/8" / 7 5/8" temp C.S. casing.
			0.5'-14' Silty Sandy Gravel (msG). G 65%, sand 25%, silt 10%. Very poorly sorted, SR-A, 60% basalt, 40% felsics.	Hanford formation 0-5' had 9 1/2" D.B. 5'-TD had 7" D.B.
5	5' archive		Sand vfn-cse grained. mps ~ 9.5". Slight rxn to HCl. 10YR5/2 grayish brown. Gravel (more basalt) sand (less basalt).	collect 5' archive/chip tray.
10	10' archive		@ 10' msG w/ strong rxn HCl.	collect 10' archive/chip tray.
			14'-49' Sandy Gravel (sG) Gravel 65%, sand 30%, silt <5%. Poorly sorted SR-A. 75-80% basalt, 20-25% felsics.	
15	15' archive		Sand vfn-cse grained, mps ~ 6". no rxn HCl. 10YR3/1, very dark gray.	collect 15' archive/chip tray. E.O.S. @ 15' bgs. start 02/02/09
20	20' archive			collect 20' archive/chip tray.
25	25' archive			collect 25' archive/chip tray.
			@ 28' gravel 55%, sand 40%, silt 5%. mps ~ 3".	
30	30' archive		@ 32' bgs. formation not as consolidated. Easier drilling.	collect 30' archive/chip tray.
35	35' archive		@ 35' increased moisture. Gravel size from pea-sized to < 2". mod. sorted, basaltic 90%, 10% felsics, sand, med-vcse. no rxn HCl.	collect 35' archive/chip tray.

Reported By: Charlene Martinez		Reviewed By: L.D. Walker	
Title: Geologist / P.A.L.		Title: Geologist	
Signature: Charlene Martinez	Date: 01/30/09	Signature: [illegible]	Date: 3/26/09

A-6003-642 (03/03)

BOREHOLE LOG				Page 2 of 3	
				Date: 02/02/09	
Well ID: C7032	Well Name: 199-N-167			Location: 100-N Area (UPR-100-N-17)	
Project: 100-N Bioremediation Wells				Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample: Type No.	Sample: Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
40	40' archive			increased moisture @ 40' bgs. Gravel	7" D.B.\ 8 5/8"\ 7 5/8"
				65%, sand 35%, Trace silt. no	temp. c.s. casing.
				rxn HCl. SR-A, basaltic. Sand med-vcse	collect 40' archive\
					chip tray
45	45' archive.			increased moisture @ 45' bgs.	collect 45' archive.
				49'-55' Silty Sandy Gravel (msG)	Ringold Formation at 49' bgs.
50	50' archive			60% gravel, 30% sand, 10% silt.	collect 50' archive\
				75% qtz\felsics, 25% basalt.	chip tray.
				SR-A, v. poorly sorted. mps ~ 6".	
				Sand vfn-vcse grained. Strong	
				rxn HCl. Increased moisture.	collect 55' archive\
55	55' archive			10YR 6/2 light brownish gray.	chip tray.
				55'-59' Sandy Gravel (sG)	
				50% gravel, 45% sand, 5% silt.	
				SR-A, mps ~ 4". Sand vfn-vcse	
60	60' archive			grained. 75% felsics\qtz, 25%	Collect 60' archive\
				basalt. decreased moisture. no rxn	chip tray.
				HCl. 10YR 6/2 light brownish gray.	
				Trace mica.	
				59'-60' Silty Sandy Gravel (msG)	Very strong diesel
65	65' archive			65% gravel, 25% sand, 10% silt.	odor at 59' bgs.
				v. poorly sorted, SR-A, 75% felsics	Some cementation in
				qtz, 25% basalt. Sand, vfn-vcse	formation.
				No rxn HCl. 10YR 5/1, gray.	E.O.S. @ 60' bgs.
	SS #1	100% recovery			start 02/03/09
70	70' archive			60'-61' silty sandy gravel.	Collect 65' archive\
				(msG). cemented, 60% gravel,	chip tray.
				25% sand, 15% silt. v-poorly sorted.	
				no rxn HCl. 75% qtz\ 25% basalt.	collect 70' archive\
	SS #2	90% recovery		10YR 4/1, dark gray.	chip tray.
75	75' archive			61'-64.5' Sandy Gravel (sG). 55%	
				gravel, 50% sand 5% silt. SR-A,	Collect 75' archive\
				poorly sorted, 80% qtz\felsics, 20%	chip tray
				basalt. no rxn HCl. 10YR 7/1	
				light gray.	

Reported By: Charlene Martinez		Reviewed By: L.D. Walker	
Title: Geologist\P.A.L.		Title: Geologist	
Signature: Charlene Martinez	Date: 02/02/09	Signature: [signature]	Date: 3/26/09

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 3
Date: 02/03/09

Well ID: C7032 | Well Name: 199-N-167 | Location: 100-N Area (UPR-100-N-17)

Project: 100-N Bioremediation Wells | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
80	~~80' archive~~			64.5'-70' SAND (S), well-sorted, fine-med grained, SR-SA, 85% qtz/felsics, 15% basalt. no rxn HCl. ~~10~~ 7.5 YR 6/1, gray.	7" DB \ 8 5/8" \ 7 5/8" temp. c.s. casing. collect 80' archive / chip tray
	TD	at 83'	bgs		
				70'-72' Gravelly sand (gS) 20% gravel, 80% sand, mod-sorted ~~SR~~ SA-R. 15% basalt, 85% qtz/felsics. no rxn HCl. 7.5 YR 6/1, gray.	SS#1 68'-70.5' bgs. J18047 + J18118
					SS#2 73'-75.5' bgs. J18048 + J18119
				72'-83' Sandy Gravel (sG) 60% gravel, 35% sand, 5% silt Poorly sorted, mps ~ 3". Sand, fn-vcse grained, SR-A. 75% qtz/felsics, 25% basalt. no rxn HCl. 10YR 5/1 gray. Moist. large rock at 83' bgs.	no rad detected through entire borehole.
					IH - max readings were 37 ppm ~ 59' bgs. OVM was instrument used.

Reported By: Charlene Martinez
Title: Geologist / P.A.C.
Signature: Charlene Martinez
Date: 02/03/09

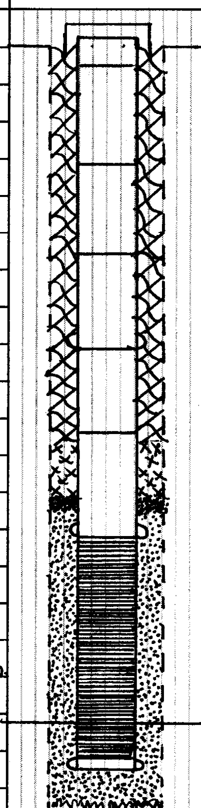
Reviewed By: L. D. Walker
Title: Geologist
Signature: [signature]
Date: 3/26/09

A-6003-642 (03/03)

WELL SUMMARY SHEET	Start Date: 01/30/09 Finish Date: 02/09/09	Page 1 of 1
Well ID: C7032	Well Name: 199-N-167	
Location: 100-N-Area (UPR-100-N-17)	Project: 100-N Bioremediation Wells	
Prepared By: Charlene Martinez Date: 02/09/09	Reviewed By: L. D. Walker	Date: 3/27/09
Signature: Charlene Martinez	Signature: L D Walker	

CONSTRUCTION DATA

Description	Depth in Feet
8 5/8" / 7 5/8" C.S. temp. casing	0
4" PVC Permanent Casing. +0.3' — 52.91'	
Portland Cement Grout 0'–42.5'	20
3/8" Bentonite Pellets 42.5'–49.0'	
20-40 mesh silica sand 49'–50.7'	40
8-12 mesh silica sand 50.7'–81.4'	60
4" PVC 0.040-in slot screen 52.91' — 77.86'	
4" PVC endcap 77.86' — 78.18'	80
muddy fill 81.4' — 83.0'	
All temp casing removed from ground.	100
All depths in feet below ground surface	

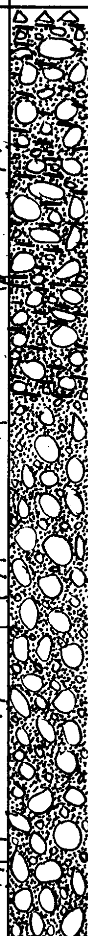


GEOLOGIC/HYDROLOGIC DATA

Lithologic Description
0–0.5' Crushed gravel (fill)
Hanford Formation
0.5'–14' Silty Sandy Gravel (msG)
14'–49' Sandy Gravel (sG)
Ringold Formation at 49' bgs.
49'–55' Silty Sandy Gravel (msG)
55'–59' Sandy Gravel (sG)
59'–61' Silty Sandy Gravel (msG)
61'–64.5' Sandy Gravel (sG)
64.5'–70' Sand (S)
70'–72' gravelly Sand (gS)
72'–83' Sandy Gravel (sG)
Static water at 73.16' bgs (02/09/09)

A-6003-643 (03/03)

BOREHOLE LOG		Page 1 of 1
		Date: 02/23/09
Well ID: C7033	Well Name: 199-N-168	Location: 100-N-Area (UPR-100-N-17)
Project: 100-N Bioremediation Wells		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description (Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level)
0	9½" db			0'–0.5' Crushed gravel (fill)	8 5/8" \ 7 5/8" OD/ID temp. casing
	7" db			0.5'–14' Silty Sandy Gravel (msG) 65% gravel, 25% sand, 10% silt. SR-SA, v. poorly sorted. MPS ~9". Sand, vfn-med grained. WK rxn HCl, 2.5Y 3/3, dark olive brown, moist.	9½" db 0'–3' bgs Hanford formation; 7" db 3'–TD
5	5' archive				collect 5' archive
				@4' chg in msG. 60% gravel, 30% sand, 10% silt. Dry. Strong rxn HCl. Poorly sorted. 75% basalt, 25% qtz/felsics. 10YR 7.5/5/1 gray. MPS ~6".	
10	10' archive				collect 10' archive
				14'–33' Sandy Gravel (sG) 70% gravel, 25% sand, 5% silt. Poorly sorted. 80% basalt, 20% qtz/felsics. SR-SA. Gravel, pea-size to ~4". Sand, vfn-coarse grained. No rxn HCl. 10YR 4/1 dark gray. Increased moisture.	
15	15' archive				collect 15' archive
20	20' archive; SS#1 318100 318122	75% rec			collect 20' archive; E.O.S. @ 20' bgs 02/23/09; SS#1 20'–22.5' bgs
25	25' archive				collect 25' archive
30	30' archive; SS#2 318101 318123	100% rec			collect 30' archive; SS#2 31'–33.5' bgs
	TD = 33' bgs				
35					

Reported By: Charlene Martinez	Reviewed By: L.D. Walker
Title: Geologist \ P.A.L.	Title: Geologist
Signature: Charlene Martinez Date: 02/23/09	Signature: [signature] Date: 3/27/09

A-6003-642 (03/03)

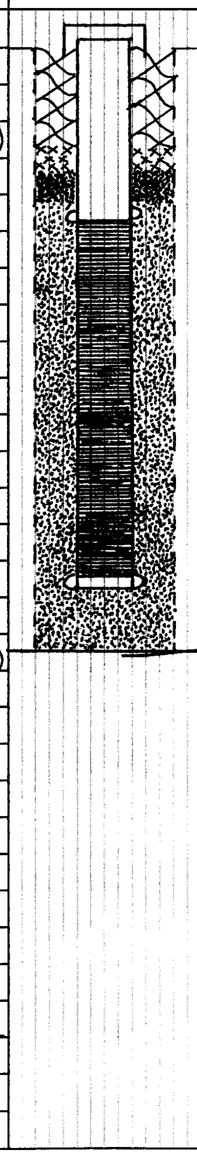
WELL SUMMARY SHEET

Start Date: 02\23\09	Finish Date: 02\25\09	Page 1 of 1	
Well ID: C7033		Well Name: 199-N-168	
Location: 100-N Area (UPR-100-N-17)		Project: 100-N Bioremediation Wells	
Prepared By: Charlene Martinez	Date: 03\05\09	Reviewed By: L. D. Walker	Date: 3/27/09
Signature: Charlene Martinez		Signature: L D Walker	

CONSTRUCTION DATA

Description
8 5/8" \ 7 5/8" temp. casing.
2" PVC permanent casing +0.3' — 9.75' (sch. 40)
Portland Cement Grout 0' — 5.9'
Bentonite Pellets (3/8") 5.9' — 6.9'
20-40 mesh silica sand 6.9' — 8.5'
8-12 mesh silica sand 8.5' — 33.0'
2" PVC screen (0.04" slot) 9.75' — 29.75'
2" PVC endcap 29.75' — 29.95'
All temporary casing removed from ground
All depths recorded in ft below ground surface

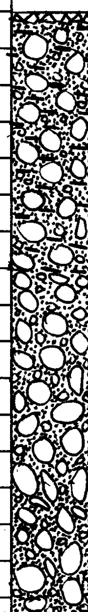
Diagram



Depth in Feet: 0, 10, 20, 30, 40, 50

GEOLOGIC/HYDROLOGIC DATA

Graphic Log



	Lithologic Description
0 – 0.5'	Crushed Gravel (fill)
	Hanford formation
0.5' – 14'	Silty Sandy Gravel (msG)
14' – 33'	Sandy Gravel (sG)
	TD = 33' bgs.
	GW = n/A

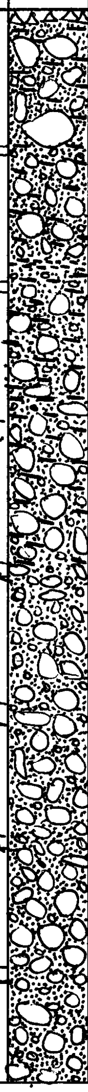
A-6003-643 (03/03)

BOREHOLE LOG

Page 1 of 3
Date: 02/12/09

Well ID: C7034 | Well Name: 199-N-169 | Location: 100-N Area (UPR-100-N-17)

Project: 100-N Bioremediation Wells | Reference Measuring Point: Ground surface.

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0'-0.5' Crushed gravel (fill)	8 5/8" | 7 5/8" c.s.
					temp. casing.
				0.5'-20' Silty sandy Gravel (msG)	9 1/2" d.b.: 0'-3'
				v. poorly sorted. Gravel 65%, sand,	7 1/2" d.b.: 3'-TD
				25%, silt 10%. mps >12". SR-A,	Hanford formation
5	5' archive			basaltic. 70% basalt, 30% qtz/felsics,	large rocks visible
				sand vfn-vcse grained, no rxn HCl.	in sides (>12")
				@ 7' msG w/strong rxn HCl.	large rock @ 4' bgs.
				7.5YR 5/1 gray.	collect 5' archive/
				@ 9' trace of silt stringer. Mod.	chip tray.
10	10' archive			rxn HCl. 10YR 6/3, pale brown.	collect 10' archive/
				@ 10' trace caliche. strong rxn	chip tray.
				HCl. 10YR 6/3 pale brown.	
				@ 13' increased moisture, more	
				caliche.	collect 15' archive/
15	15' archive			@ 15' (dry) msG. weak to no rxn HCl.	chip tray.
				poorly sorted. Basaltic (80%), felsics	E.O.S. @ 19' bgs.
				20%. 10YR 5/1 gray.	start 02/13/09
20	20' archive			20'-43' Sandy Gravel (sG) 70%	collect 20' archive.
				gravel, 25% sand, 5% silt. Poorly	easy drilling @ 20' bgs.
				sorted, gravel ranges from pea-size	unconsolidated material
				to mps of ~3", sand vfn-vcse	
				SR-SA. Basalt 90%, felsics 10%.	
25	25' archive			10YR 4/1 dark gray. No rxn HCl	collect 25' archive/
					chip tray
30	30' archive				still easy drilling @ 30'
					Collect 30' archive/
					chip tray.
35	35' archive				collect 35' archive/
					chip tray.
					increased moisture
					@ 35' bgs.

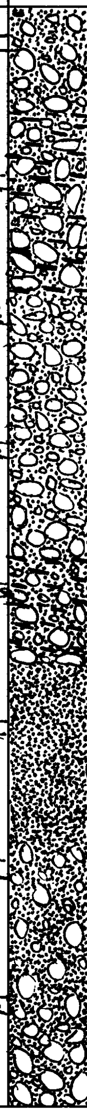
Reported By: Charlene Martinez | Reviewed By: L. D. Walker

Title: Geologist/P.A.L. | Title: Geologist

Signature: Charlene Martinez | Date: 02/12/09 | Signature: L D Walker | Date: 3/27/09

A-6003-642 (03/03)

BOREHOLE LOG				Page 2 of 3	
				Date: 02/13/09	
Well ID: C7034	Well Name: 199-N-169	Location: 100-N-Area (UPR-100-N-17)			
Project: 100-N Bioremediation Well Drilling		Reference Measuring Point: Ground Surface			

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
40	40' archive			43'-49' Silty Sandy Gravel (msG) 60% gravel, 30% sand, 10% silt. Poorly sorted, SR-A, 90% qtz/felsics, 10% basalt. Gravel - pea sized to mps ~4". sand vfn - vcse grained. mod. rxn HCl 2.5Y 7/1, light gray	8 5/8" / 7 5/8" temp. 7" D.B. collect 40' archive\ chip tray. Ringold @ 43' bgs.
45	45' archive				collect 46' archive\ chip tray.
				49'-59' Sandy Gravel (sG) 65% gravel, 30% sand, 5% silt. Poorly sorted, moist, SR-A, mps ~ 4". sand vfn - vcse. 90% felsics, 10% basalt. 10YR 6/3 pale brown no rxn HCl.	increased moisture @ 49' bgs
50	50' archive				collect 50' archive
				@ 55' bgs, increase in sand. Gravel 55%, sand 40%, silt 5%	
55	55' archive			@ 57' bgs, discolored sandy gravel w/ strong diesel odor. 10YR 2/1 black. moist, 6"-1' thick.	Collect 55' archive\ chip tray. Diesel odor became noticeable at 57' bgs through
60	60' archive			59'-63' Silty sandy Gravel (msG) Poorly sorted. mps ~4", 85% felsics, 15% basaltic, SA-SR, sand vfn-vcse. mod. rxn HCl. 10YR 7/1 light gray.	Collect 60' archive\ chip tray. E.O.S. @ 60' bgs. Start 02/13/09
65	65' archive			@ 66' hit discolored layer w/ strong diesel odor	Collect 65' archive\ chip tray.
70	70' archive			63'-69.5' Sand (S) 100%. SR-SA, fn-cse grained. mod. sorted. 90% qtz/felsics, 10% Basalt. No rxn HCl. 2.5Y 8/1 white	Collect 70' archive\ chip tray
75	75' archive			69.5'-83' Sandy Gravel (SG) 50% gravel, 45% sand, 5% silt. SR-SA, mod. sorted, 85% felsics/qtz, 15% basalt, mps ~ 3". Sand vfn - cse. no rxn HCl. 10YR 5/1, gray.	Collect 75' archive\ chip tray

Reported By: Charlene Martinez		Reviewed By: L.D. Walker		
Title: Geologist\P.A.L.		Title: Geologist		
Signature: Charlene Martinez	Date: 02/13/09	Signature: L.D. Walker		Date: 3/27/09

A-6003-642 (03/03)

BOREHOLE LOG			Page 3 of 3 Date: 02/17/09
Well ID: C7034	Well Name: 199-N-169	Location: 100-N-Area (UPR-100-N-17)	
Project: 100-N Bioremediation Wells		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
80	80' archive			at 76' sandy gravel is moderately sorted w/increased gravel content. Gravel 60%, sand 35%, silt 5%. SR-SA, 80% qtz/felsics, 20% basalt. moist.	8 5/8" / 7 5/8" temp. casing. 7" drive barrel.
	TD	= 83'	bgs.		Collect 80' archive / chip tray.
				at 78' sandy gravel is poorly sorted. Gravel 65-70%, sand 25-30%, silt 5%. moist.	
				TD = 83' bgs.	
				Water (ground) ~ 73' bgs.	

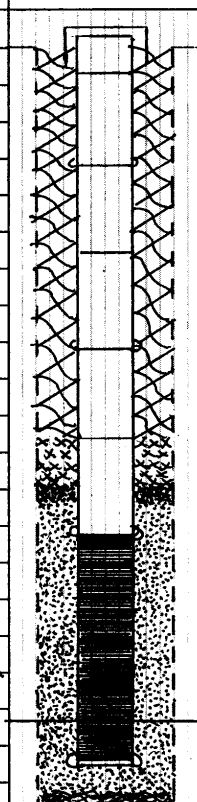
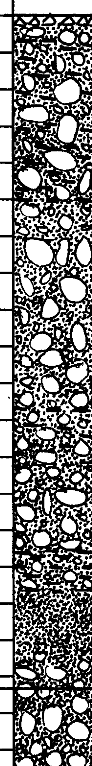
Reported By: Charlene Martinez		Reviewed By: L.D. Walker	
Title: Geologist / P.A.L.		Title: Geologist	
Signature: Charlene Martinez	Date: 02/20/09	Signature: [signature]	Date: 3/27/09

A-6003-642 (03/03)

WELL SUMMARY SHEET

WELL SUMMARY SHEET	Start Date: 02/12/09 Finish Date: 02/20/09	Page 1 of 1

Well ID: C7034		Well Name: 199-N-169	
Location: 100-N Area (UPR-100-N-17)		Project: 100-N Bioremediation Wells	
Prepared By: Charlene Martinez	Date: 02/23/09	Reviewed By: L. D. Walker	Date: 3/27/09
Signature: Charlene Martinez		Signature: LDWalker	

CONSTRUCTION DATA			GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
8 5/8" \ 7 5/8" temp. casing		0		0'- 0.5' crushed gravel (fill)
				Hanford formation
2" PVC Permanent casing				0.5'- 20' Silty Sandy Gravel
+ 0.2' — 53.47'				(msG)
(sched. 40)				
Portland Cement		20		20'- 43' Sandy Gravel (sG)
0' - 43'				
3/8" Bentonite Pellets				
43' - 48'				
		40		Ringold Formation @ 43' bgs.
20-40 mesh silica sand				43'- 49' Silty Sandy Gravel
48' - 49.4'				(msG)
				49'-59' Sandy Gravel (sG)
8-12 mesh silica sand				
49.4' - 81.8'		60		59'-63' Silty Sandy Gravel
				(msG)
2" PVC 0.04-slot-screen				63'-69.5' Sand (S)
53.47' — 78.4'				69.5'- 83' Sandy Gravel (sG)
		▽		
2" PVC Endcap		80		
78.4' — 78.6'				
				TD = 83' bgs.
muddy fill				Static GW = 73.6' bgs
81.8' — 83'				(02/20/09)
		100		
All depths in feet below				
ground surface				
All temporary casing removed				
from ground				

A-6003-643 (03/03)

BOREHOLE LOG

Page 1 of 3
Date: 02/26/09

Well ID: C7035	Well Name: 199-N-170	Location: 100-N-Area (UPR-100-N-17)
Project: 100-N Bioremediation Wells		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample: Type No.	Sample: Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
				0′–0.5′, crushed gravel (fill)	8 5/8" \ 7 5/8" Temp.
0	9½" d.b.			0.5′–8′ ~~silty~~ sandy Gravel (~~msG~~ sG).	casing.
				poorly sorted. mps ~ 7". moist.	9½" d.b. 0′–5′ bgs.
				Sand, vfn grn – med, 75% qtz/felsic	7" d.b. 5′–
				25% basalt. 55% gravel, 45%	Hanford formation
5	5′ archive			sand. no rxn HCl. 10YR 6/3	Collect 5′ archive
	7" d.b.			pale brown	
				8′–22′ Silty sandy Gravel (msG)	
				v. poorly sorted. Gravel 65%, sand	
10	10′ archive			25%, silt 10%. 75% basalt, 25%	Collect 10′ archive.
				qtz/felsics, SR–SA, mps ~ 7". Sand–	
				vfn–cse grained. Strong rxn HCl.	
				10YR 4/2 dark grayish brown. moist.	
				@12′ basalt content increase to 90%.	
15	15′ archive			no rxn HCl. 10YR 3/1, very dark	
				gray.	collect 15′ archive
				22′–31′ sandy GRAVEL (sG) Gravel	
				70%, Sand 25%, silt 5%. V.	
20	20′ archive			poorly sorted, SR–SA, mps ~ 6".	collect 20′ archive
				90% basalt, 10% qtz/felsics.	
				Sand – med–cse grained. no rxn HCl.	
				7.5YR 4/1 dark gray.	
25	25′ archive				collect 25′ archive
				31′–35′ Silty Sandy Gravel (msG)	
				60% gravel, 30% sand, 10% silt.	
				Poorly sorted, gravel pea-sized to mps	
				of 2". Sand vfn–cse grained. 90%	
30	30′ archive			basaltic, 10% qtz/felsic. SR–A.	collect 30′ archive
				wk rxn HCl. 10YR 4/1 dark gray.	
					Increased moisture
					at 33′ bgs.
35	35′ archive			35′–42′ Sandy Gravel (sG) 70%	
				gravel, 25% sand, 5% silt. 90%	Collect 35′ archive
				basalt, 10% qtz/felsics, SR–SA. very	E.O.S. @ 37′ bgs.
				moist. mod sorted. pea sized – ≤ 1".	start 02/27/09
				sand, fn–vcse. 10YR 3/1, very dark gray.	

Reported By: Charlene Martinez		Reviewed By: L. D. Walker	
Title: Geologist/P.A.L.		Title: Geologist	
Signature: Charlene Martinez	Date: 02/26/09	Signature: L. D. Walker	Date: 3/27/09

A-6003-642 (03/03)

BOREHOLE LOG			Page 2 of 3 Date: 02/27/09
Well ID: C7035	Well Name: 199-N-170	Location: 100-N Area (UPR-100-N-17)	
Project: 100-N Bioremediation Wells		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
	7" db			@ 39' gravel content decreased to	8 5/8" \ 7 5/8" temp casing
40	40' archive			45%, sand 50%, silt 5%. mod.	7" drive barrel
				sorted, SR-R. Gravel mps < 1".	collect 40' archive \
				sand med-vcse grained, 90% basalt,	chip tray.
				10% felsics \ qtz. moist. 10YR 3/2,	Ringold Formation at
				v. dark grayish brown.	42' bgs.
45	45' archive			@ 41' gravel content increased to	collect 45' archive\chip tray
				55%, poorly sorted, mps ~ 2.5". dry.	IH: DVM 0.00 ppm
				42–45' @ 42' Encountered Ringold. Sandy	@ 42' bgs.
				Gravel (sG) 95% qtz \ felsics,	
50	50' archive			5% basalt. Gravel 60%, sand	collect 50' archive.
				35%, silt < 5%. Poorly sorted.	
				mps ~ 3". Sand, vfn-vcse grained.	
				SR-SA. WK rxn HCl. 2.5Y 7/1,	
				light gray.	
55	55' archive				
				45'– 55' Silty Sandy Gravel (msG)	collect 55' archive \
				Gravel 65%, Sand 25%, silt 10%.	chip tray. DIESEL
				v. poorly sorted, SR-SA, mps ~ 4".	odor noticeable
				sand. vfn-cse grained. 95% qtz \	
60	60' archive			felsics, 5% basalt. Strong rxn HCl.	@ 59' discolored soil
				2.5Y 7/1, light gray.	w/ strong diesel odor.
				@ 50' mod. sorted, gravel size	10YR 4/1 dark gray.
				to < 1", SR-R.	collect 60' archive.
65	65' archive			55'– 61' sandy Gravel (sG). 65%	collect 65' archive
				gravel, 30% sand 5% silt. SR-SA,	
				mps ~ 4". Sand vfn-vcse, poorly	E.O.S. @ 48' bgs.
				sorted. 90% qtz/felsics, 10% basalt.	Start 03/02/09
	SS#1	70% recovery		weak to no rxn HCl. 2.5Y 7/1	SS#1 68'-70.5' bgs.
70	70' archive			light gray.	collect 70' archive
				61'-63.5' silty sandy Gravel (msG)	
				Poorly sorted, mps ~ 5". SR-SA.	collect 75' archive.
				sand, vfn-med grained. 90% qtz \	SS#2. 75'-77.5' bgs.
75	~~75' archive~~			felsics, 10% basalt. no rxn HCl.	
	SS#2	100% recovery		10YR 4/1, dark gray.	

Reported By: Charlene Martinez	Reviewed By: L.D. Walker	
Title: Geologist \ P.A.L.	Title: Geologist	
Signature: Charlene Martinez — Date: 02/27/09	Signature: [signature]	Date: 3/27/09

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 3
Date: 02/27/09

Well ID: C7035	Well Name: 199-N-170	Location: 100-N Area (UPR-100-N-17)
Project: 100-N Bioremediation Wells		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
	7" dia			63.5'-69.5' Sand (S) 100%, SR-A,	8 5/8" \ 7 5/8" temp. casing
80	80' archive			vfn-med grained, mod. sorted.	7" drive barrel.
				95% qtz/felsics, 5% basalt.	Collect 80' archive.
				No rxn HCl, 10YR 7/1 light gray	
	TD=	83.5'	bgs		
85				69.5'-83.5' Sandy Gravel (sG)	
				Poorly sorted. SR-SA. 60% gravel,	
				35% sand, 5% silt. 95% qtz/	
				felsics, 5% basalt, mps ~ 5".	
				sand fn-cse grained. 2.5Y 6/1	
				gray. Wk to no rxn HCl.	
				V. hard drilling starting at 73'	
				bgs. Returns indicate some	
				cementation.	
				Cemented formation 73'-78' bgs.	
				Easier drilling ~ 78' bgs although	
				rocks (mps 6") are encountered.	
				Still sandy gravel.	
				TD at 83.5' bgs.	

Reported By: Charlene Martinez		Reviewed By: L.D. Walker	
Title: Geologist \ P.A.L.		Title: Geologist	
Signature: Charlene Martinez	Date: 02/27/09	Signature: LD Walker	Date: 3/27/09

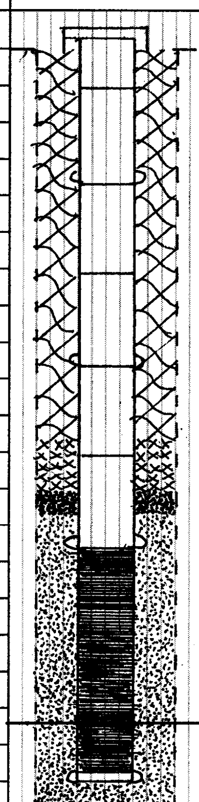
A-6003-642 (03/03)

WELL SUMMARY SHEET	Start Date: 02/26/09 Finish Date: 03/05/09	Page 1 of 1

Well ID: C7035	Well Name: 199-N-170
Location: 100-N Area (UPR-100-N-17)	Project: 100-N Bioremediation wells
Prepared By: Charlene Martinez Date: 03/06/09	Reviewed By: L.D. Walker Date: 3/27/09
Signature: Charlene Martinez	Signature: [signature]

CONSTRUCTION DATA | **GEOLOGIC/HYDROLOGIC DATA**

Description	Depth in Feet	Lithologic Description
9 5/8" 17 5/8 temporary casing	0	0' - 0.5' crushed gravel (fill)
		Hanford formation
2" PVC permanent casing		.5' - 8' Sandy Gravel (sG)
+0.3' — 54.87'		8' - 22' Silty Sandy Gravel (msG)
Portland Cement Grout	20	22' - 31' Sandy Gravel (sG)
0' — 43.4'		
3/8" Bentonite Pellets		31' - 35' Silty Sandy Gravel (msG)
43.4' — 48.6'		35' - 42' Sandy Gravel (sG)
	40	42' - Ringold Formation
20-40 mesh silica sand		42' - 45' Sandy Gravel (sG)
48.6' — 51'		45' - 55' Silty Sandy Gravel (msG)
		55' - 61' Sandy Gravel (sG)
8-12 mesh silica sand		61' - 63.5' Silty Sandy Gravel (msG)
51' — 83.5'		
	60	63.5' - 69.5' Sand (S)
2" PVC (0.04-in) screen		69.5' - 83.5' Sandy Gravel (sG)
54.87' — 79.84'		
		TD = 83.5' bgs
2" PVC Endcap	80	G.W. = 74.1' bgs (03/05/09)
79.84' — 80.04'		
All depths recorded in feet		
below ground surface		
	100	
All temporary casing		
removed from ground		

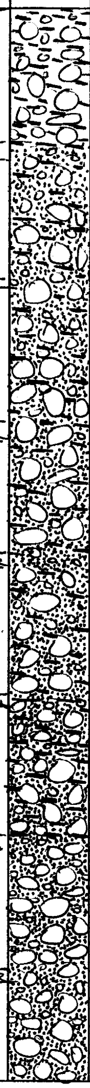


A-6003-643 (03/03)

BOREHOLE LOG

Page 1 of 3
Date: 03\06\09

Well ID: C7036	Well Name: 199-N-171	Location: 100-N Area (UPR-100-N-17)
Project: 100-N Bioremediation Wells		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description (Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level)
0	9 1/2" d.b.			0'-5' Silty Gravel (mG). 60% gravel, 35% silt, 5% sand. V poorly sorted. mps ~ 2". SR-SA. Gravel is basaltic no rxn HCl. 10YR5/4 yellowish brown.	8 5/8"\7 5/8" temp. casing 9 1/2" d.b. 0'-5' Hanford formation 7" d.b. 5'-TD Collect 5' archive AM/PM IH ck (nothing detected) 3' & 8' bgs.
5	7" d.b. 5' archive			5'-30' Silty Sandy Gravel (msG) Gravel 65%, sand 25%, silt 10% SR-A. 85% basalt, 15% qtz/felsics mps ~ 4.5". Fragmented basalt from drilling. Strong rxn HCl. Some caliche. 10YR4/2 dark grayish brown.	
10	10' archive				Collect 10' archive.
15	15' archive				Collect 15' archive.
20	20' archive				Collect 20' archive. E.O.S. @ 22' bgs. Start 03/09/09
25	25' archive				Collect 25' archive Very unconsolidated. Easy drilling (23'-28')
30	30' archive			30'-45' Sandy Gravel (sG) 65% gravel, 30% sand, 5% silt. SR-A. 90% basalt, 10% qtz/felsics. Sand vfn-vcse grained. Poorly sorted. mps ~ 3.5". No rxn HCl. 7.5YR3/1 very dark gray	Collect 30' archive.
35	35' archive				Collect 35' archive A.M. IH ck. nothing detected (35' bgs).

Reported By: Charlene Martinez		Reviewed By: L.D. Walker	
Title: Geologist\P.A.L.		Title: Geologist	
Signature: Charlene Martinez	Date: 03\06\09	Signature: LD Walker	Date: 3/27/09

A-6003-642 (03/03)

BOREHOLE LOG	Page 2 of 3
	Date: 03/09/09

Well ID: C7036	Well Name: 199-N-171	Location: 100-N Area (UPR-100-N-17)
Project: 100-N Bioremediation Wells		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
	7½B				8 5/8" \ 7 5/8" temp casing
40	40' archive				collect 40' archive
				45'-50.5' Silty Sandy Gravel (msG)	
45	45' archive			65% gravel, 25% sand, 10% silt.	collect 45' archive
				SR-A, 50% basalt, 50% qtz/other.	Harder drilling from
				mps ~3", sand vfn-vcsc. weak to	46' bgs. - 50' bgs.
				no rxn HCl. 7.5Y5/1 gray.	
50	50' archive				collect 50' archive.
				50.5'-53' Silty Sandy Gravel (msG)	Ringold Formation
				60% gravel, 25% sand 15% silt.	@ 50.5' bgs.
				SR-SA, poorly sorted. Sand, vfn-med	
				grained. 90% qtz/felsics, 10%	
55	55' archive			basalt. Strong rxn HCl. 2.5Y6/1	collect 55' archive.
				gray. mps ~4".	E.O.S. @ 56' bgs
					Start 03/10/09
				53'-54' Silt (m) 100%. non-	
				plastic, compact, laminated. Strong	
60	60' archive			rxn HCl. 10YR6/3, pale brown.	collect 60' archive.
					very hard drilling
				54'-57' Sandy Gravel (sG) 60%	57'-65' bgs.
				gravel, 35% sand, 5% silt, poorly	
				sorted, SR-SA. sand vfn-vcse grained	
65				95% qtz/felsics, 5% basalt. no	Diesel odor at 64' bgs.
	65' archive			rxn HCl. 2.5Y5/2 grayish brown.	Collect 65' archive.
				57'-65' silty sandy Gravel (msG)	
				60% gravel, 30% sand, 10% silt.	
				Poorly sorted, mps ~4". SR-SA.	
70	70' archive			90% qtz/felsics, 10% basalt. Sand	collect 20' archive
				vfn-med grained. no rxn HCl. 10YR6/1	
				gray. Dry.	E.O.S. @ 73.5' bgs
					start 03/11/09
				65'-69.5' Sand (S) 100%. SA-R, mod.	
75	75' archive			sorted. 95% qtz/felsics, 5% basalt	collect 75' archive
				fn-med grained. no rxn HCl.	
				Gley 7/N, light gray. Strong diesel	
				odor.	

Reported By: Charlene Martinez	Reviewed By: L.D. Walker
Title: Geologist \ P.A.L.	Title: Geologist
Signature: Charlene Martinez Date: 03/09/09	Signature: LD Walker Date: 3/27/09

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 3
Date: 03/10/09

Well ID: C7036 | Well Name: 199-N-171 | Location: 100-N Area (UPR-100-N-17)

Project: 100-N Bioremediation Wells | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample: Type No.	Sample: Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
80	~~80'~~ archive			69.5'-74' Silty Sandy Gravel (msG)	8 5/8" / 7 5/8" temp. casing
				Gravel 45%, sand 45%, silt 10%	7" d.b.
				Poorly sorted SA-R. 90% qtz/felsics,	collect 80' archive.
				10% basalt. compacted w/ silt stringers.	
				Laminated. no rxn HCl. Silt, non-	
85	TD = 84' bgs			plastic. Overall color Gley	
				10Y 6/1 greenish gray. Silt	
				Gley 5G 6/1 greenish grey.	
				Strong diesel odor. visible cementation	
90				74'-84' sandy Gravel (sG) 65%	
				gravel, 30% sand, 5% silt.	
				Poorly sorted. mps ~ 3.5". 90%	
				qtz/felsics, 10% basalt, SR-SA.	
				Sand, vfn - vcse grained. moist.	
				strong diesel odor. no rxn HCl.	
				2.5Y 6/1 gray.	
				increase in rock size. Lots	
				of broken/fragmented rock @	
				75' bgs.	
				@ 78' v. poorly sorted. mps	
				~ 6".	
				TD = 84' bgs	

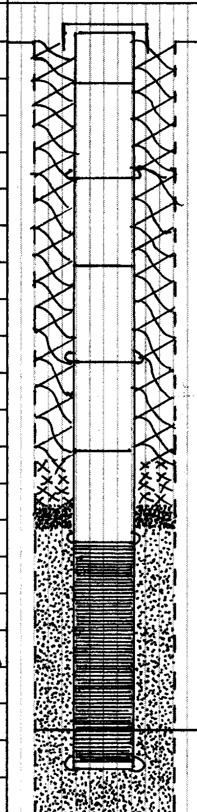
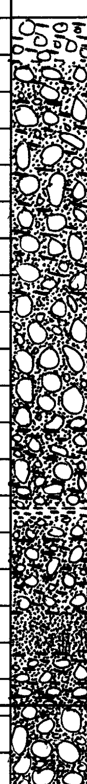
Reported By: Charlene Martinez | Reviewed By: L.D. Walker

Title: Geologist / P.A.L. | Title: Geologist

Signature: Charlene Martinez | Date: 03/10/09 | Signature: LD Walker | Date: 3/27/09

A-6003-642 (03/03)

WELL SUMMARY SHEET		Start Date: 03/06/09 Finish Date: 03/13/09	Page 1 of 1
Well ID: C7036	Well Name: 199-N-171		
Location: 100-N Area (UPR-100-N-17)	Project: 100-N Bioremediation Well Drilling		
Prepared By: Charlene Martinez — Date: 03/18/09	Reviewed By: L. D. Walker — Date: 3/27/09		
Signature: Charlene Martinez	Signature: LD Walker		

CONSTRUCTION DATA — Description	Diagram	Depth in Feet	Graphic Log	GEOLOGIC/HYDROLOGIC DATA — Lithologic Description
8 5/8" \ 7 5/8" temp. casing		0		Hanford formation
2" PVC Permanent Casing +0.3' — 54.79'				0'-5' Silty Gravel (mG)
Portland cement Grout 0'-46'		20		5'-30' Silty Sandy Gravel (msG)
3/8" Bentonite Pellets 46'-50.7'				30'-45' Sandy Gravel (sG)
20-40 mesh silica sand 50.7'-53.4'		40		45'-50.5' Silty Sandy Gravel (msG)
8-12 mesh silica sand 53.4'-84'				Ringold Formation at 50.5'
2" PVC 0.04-in. slot screen 54.79' — 79.68'		60		50.5'-53' silty sandy Gravel (msG)
2" PVC End Cap 79.68' — 79.88'				53'-54' Silt (m)
				54'-57' Sandy Gravel (sG)
				57'-65' silty sandy Gravel (msG)
				65'-69.5' sand (s)
		80		69.5'-74' silty sandy Gravel (msG)
				74'-84' Sandy Gravel (sG)
				TD = 84' bgs.
				static G.W. @ 75.5' bgs (03/13/09)
All temporary casing removed from ground		100		
All depths in feet below ground surface				

A-6003-643 (03/03)

BOREHOLE LOG

Page 1 of 3
Date: 01/13/09

Well ID: C7037 | Well Name: 199-N-172 | Location: 100-N Area (UPR-100-N-17)

Project: UPR-100-N-17 Bioremediation wells | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample: Type No.	Sample: Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0	9½" DB	N/A		0 - 0.5'. Fill material crushed	Starter d.b. = 9.5" OD
				gravel from drill pad.	0-2' Bgs.
	7" DB				7" OD drive barrel
				0.5' - 25' Silty Sandy Gravel (msG)	2' - ~~8~~ 82'
				G 60%, S 25%, M 15%.	large boulder @ 3' bgs.
5		Archival chip tray		Gravel is R - A, many fragments,	IH monitored cuttings
				basaltic, ~~pea-size~~ to ~6". Sand,	@ 5' bgs. 0.000 ppm
				v-f to med, SR - A, basaltic. Grayish	E.O.S. @ 8' bgs.
				brown. 80% basalt, 20% qtz & other	01/15/09
				felsics. 7.5YR 4/1 dark gray.	IH monitored cuttings
10		Archival chip		5' silt content decreased	0.000 ppm.
				to 10%, sand 25%, gravel 65%	RCT ≤ bkg readings
				v. poorly sorted. Gravel to 6" dia.	collect 10' archive
				Sand SR-SA, fine - coarse grained.	
				80% basalt, 20% felsics.	collect 15' archive
15		Archival chip		13' thin layer of silt. V compact.	
				med. plasticity.	
				15' trace silt stringer.	
				25' - 44' Sandy GRAVEL (SG)	
20		Archival chip		Gravel 65%, sand 30%, silt 5%	Collect 20' archive
				80% Basalt, 20% qtz/felsics.	
				SR - A, mps 5.5". Sand vf - vcse	
				grained. Increased moisture.	
				10YR 3/1 very dark gray.	
25		Archival chip		lg. rock @ 26' bgs. Basalt	collect 25' archive
				content increasing to 85-90%	
					collect 30' archive
					E.O.S. @ 30' bgs
					start 01/16/09
30		Archival chip			IH monitoring < detect.
					0.000 ppm. on PID
					RCT ≤ bkg readings
				@ 35' several thin (<6") sand	
35		Archival chip		layers encountered. Basalt content	collect 35' archive
				90+%. 2.5YR 2.5/1 Reddish	
				black.	
				@ 37' Gravel 65%, sand 27%,	
				silt 8%. Basalt 80%. 7.5YR 3/1 very dark gray.	

Reported By: Charlene Martinez | Reviewed By: L.D. Walker

Title: Geologist/P.A.L. | Title: Geologist

Signature: Charlene Martinez | Date: 01/13/09 | Signature: L.D. Walker | Date: 3/27/09

A-6003-642 (03/03)

BOREHOLE LOG			Page 2 of 3 Date: 01/16/09
Well ID: C7037	Well Name: 199-N-172	Location: 100-N-Area (UPR-100-N-17)	
Project: UPR-100-N-17 Bioremediation wells		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
40	7½" OD OB	Archive chip		@ 39' Gravel 50%, sand 40%, silt 10%. Basalt 80%, qtz/felsic 20%, SR-A, moderately sorted. mps ~5"	8 5/8" / 7 5/8" temp. casing. 7" OD drive barrel. Collect 40' archive
					collect 45' archive
45		Archive chip		@ 40' increase in moisture & basalt content to ~90%. 10YR3/1 very dark gray.	
				@ 42' gravel 45%, sand 45%, silt 10%. moderately sorted. Gravel pea-size to <2" diam.	collect 50' archive
50		Archive chip + tray			
				@ 42.5' increase in felsics, some cementation. Trace caliche.	
55		Archive chip		color chg. ranged from 10YR7/1 (light gray) to 10YR5/1 (gray). Gravel SR-A, poorly sorted.	collect 55' archive
				44'-52' silty sandy GRAVEL (msG)	Ringold formation observed ~44' bgs.
60		Archive chip (diesel odor)		Gravel 50%, sand 35%, silt 15%. Gravel, SR-A, poorly sorted, sand SR-SA, vfn-csp 70% basalt, 30% qtz/felsics. Pea-size to 3" mps. 10YR6/1 gray	@ 59' thin layer of compact silt non-plastic.
65 archive (diesel odor)	SS#1 rec. (diesel odor)	100%		@ 45' basalt <20%, felsics 80%. 10YR6/2 light brownish gray. trace caliche + cementation @ 46' bgs.	Gley 5'5PB(5/1) chart 2. Bluish gray. SS#1, HEIS#s J18OY0, J18OY1, J18111, J18112. depth 64.5'-67' bgs.
70 archive	SS#2 recovery (diesel odor)	100%		@ 51' bgs, 6" silt stringer. mod. plasticity, very compact. 2.5Y5/3 light olive brown.	SS#2 HEIS#s J18OY2 & J18113. Depth 68'-70.5' bgs.
	75' bgs IH: PID max	8 13ppm		52'-62' Sandy Gravel (sG)	
75	archive chip + tray (strong diesel odor)			Gravel 60%, sand 35%, silt 5%. SR-SA, ~~basaltic~~ gravel mps 3". non-basaltic (<10%), sand, vfn-vcsd, SR-A. 2.5Y5/3 light olive brown. Slight increase in moisture.	Static g.w. 72.1 bgs. Grab sample 72' bgs. HEIS#s J18OY3 & J18114

Reported By: Charlene Martinez	Reviewed By: L.D. Walker
Title: Geologist \ P.A.2.	Title: Geologist
Signature: Charlene Martinez — Date: 01/16/09	Signature: [signature] — Date: 3/27/09

A-6003-642 (03/03)

BOREHOLE LOG

BOREHOLE LOG		Page 3 of 3
		Date: 01/19/09
Well ID: C7037	Well Name: 199-N-172	Location: 100-N Area: (UPR-100-N-17)
Project: 100-N Bioremediation Wells.		Reference Measuring Point: Ground surface

Depth (Ft.)	Sample: Type No.	Sample: Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
80	chip	archive		62′ - 63′ Silty Sandy Gravel (msG)	Temp. casing 8 5/8″
	7 1/2″ OD			Gravel 60%, Sand 30%, silt 10%.	7 5/8″
	D.B.	TD = 82′ bgs		Poorly sorted, SR-SA, mps ~ 6″.	Collect 80′ archive\
				20-25% basalt, 75-80% qtz\	chip tray
				felsics. sand, SR-SA, vfn-med.	
85				10YR 6\1, gray.	
				63′ - 68′ sand ~~fine~~ well	
				sorted, SR-SA, 20% basalt,	
				80% qtz\felsics. 10YR 7\1	
				light gray, vfn - med grain.	
				68′ - Sandy Gravel (sG).	
				65% gravel, 30% sand, 5% silt.	
				v. poorly sorted. SR - A, 15% basalt,	
				85% qtz/felsics. sand fine -	
				coarse grained. 10YR 7/1, light	
				gray.	
				@ 70′ more cementation. notable	
				diesel smell.	
				@ 72′ increased moisture. Increase	
				in cementation. Very strong diesel	
				smell.	
				@ 75′ IH P.I.D. reading (max.) on	
				spoils pile was 13 ppm. Breathing	
				zone < 2 ppm.	
				TD at 82′ bgs.	

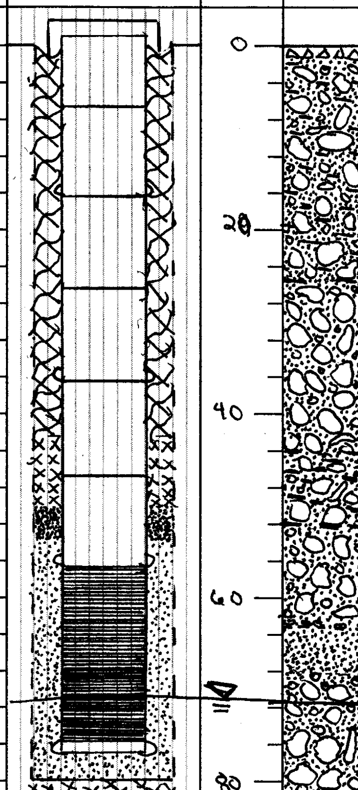
Reported By: Charlene Martinez		Reviewed By: L.D. Walker	
Title: Geologist \ P.A.L.		Title: Geologist	
Signature: Charlene Martinez	Date: 01/19/09	Signature: LD Walker	Date: 3/27/09

A-6003-642 (03/03)

WELL SUMMARY SHEET

Start Date: 01/14/09 | Finish Date: 01/23/09 | Page 1 of 1

Well ID: C7037	Well Name: 199-N-172
Location: 100-N-Area (UPR-100-N-17)	Project: 100-N Bioremediation Wells
Prepared By: Charlene Martinez Date: 02/05/09	Reviewed By: L. D. Walker Date: 3/27/09
Signature: Charlene Martinez	Signature: LD Walker

CONSTRUCTION DATA: Description	Diagram	Depth in Feet	Graphic Log	GEOLOGIC/HYDROLOGIC DATA: Lithologic Description
8 5/8" 17 5/8" temp. c.s. casing.		0		0-0.5' Fill (crushed gravel)
4" PVC perm. casing.				Hanford formation
Portland cement 0'— 43'				0.5'-25' Silty Sandy Gravel (msG)
Bentonite Pellets 43.0'— 51.0'		20		25'-44' Sandy Gravel (sG)
20-40 mesh silica sand 51.0'— 54.4'		40		Ringold Formation @ 44' bgs.
8-12 mesh silica sand 54.4'— 80.6'				44'-52' Silty Sandy Gravel (msG)
				52'-62' Sandy Gravel (sG)
muddy fill 80.6'-82.0'		60		62'-63' Silty Sandy Gravel (msG)
				63'-68' Sand (S)
4" PVC permanent casing. 0.3'— 57.17'				68'-82' Sandy Gravel (sG)
4" PVC 0.040" screen 57.17'-77.14'		80		TD = 82' bgs
				Static water 71.9' bgs (01/23/09)
4" PVC Endcap 77.14'-77.44'		100		
All depths recorded in feet below ground surface.				
All temp. casing removed				

A-6003-643 (03/03)

APPENDIX B

SOIL SAMPLE ANALYTICAL RESULTS

Lookup Table for Wells by Sample Number and Sample Depths

Well ID	Sample No.	Sample Depth (bgs ft)
199-N-166	J188W2	5
199-N-166	J188W3	10
199-N-166	J188W4	15
199-N-166	J188W5	20
199-N-166	J188W6	25
199-N-166	J18117	30
199-N-166	J188W7	30
199-N-166	J180Y6	30
199-N-167	J188W8	5
199-N-167	J188W9	10
199-N-167	J188X0	15
199-N-167	J188X1	20
199-N-167	J188X2	25
199-N-167	J188X3	30
199-N-167	J188X4	35
199-N-167	J188X5	40
199-N-167	J188X6	45
199-N-167	J188X7	50
199-N-167	J188X8	55
199-N-167	J188X9	60
199-N-167	J188Y0	65
199-N-167	J18118	68
199-N-167	J180Y7	68
199-N-167	J188Y1	70
199-N-167	J18119	73
199-N-167	J180Y8	73
199-N-167	J188Y2	75
199-N-168	J188R7	5
199-N-168	J188R8	10
199-N-168	J188R9	15
199-N-168	J188T0	20
199-N-168	J188T1	25
199-N-168	J188T2	30
199-N-168	J18122	31
199-N-168	J18123	31
199-N-168	J18101	31
199-N-168	J18100	31

Well ID	Sample No.	Sample Depth (bgs ft)
199-N-169	J188Y4	5
199-N-169	J188Y5	10
199-N-169	J188Y6	15
199-N-169	J188Y7	20
199-N-169	J188Y8	25
199-N-169	J188Y9	30
199-N-169	J18900	35
199-N-169	J18901	40
199-N-169	J188V3	45
199-N-169	J188V4	50
199-N-169	J188V5	55
199-N-169	J188V6	60
199-N-169	J188V7	65
199-N-169	J18115	68
199-N-169	J180Y4	68
199-N-169	J188V8	70
199-N-169	J18120	73
199-N-169	J18121	73
199-N-169	J180Y9	73
199-N-169	J188W0	75
199-N-169	J188W1	80
199-N-169	J188Y3	80
199-N-170	J18JW6	5
199-N-170	J18JW7	10
199-N-170	J18JW8	15
199-N-170	J18JW9	20
199-N-170	J18JX0	25
199-N-170	J18JX1	30
199-N-170	J18JX2	35
199-N-170	J18JX3	40
199-N-170	J18JX4	45
199-N-170	J18JX5	50
199-N-170	J18JX6	55
199-N-170	J18JX7	60
199-N-170	J18JX8	65
199-N-170	J18124	68
199-N-170	J18102	68
199-N-170	J18JX9	70
199-N-170	J18125	75
199-N-170	J18JY0	75
199-N-170	J18103	75

Well ID	Sample No.	Sample Depth (bgs ft)
199-N-171	J18JY2	5
199-N-171	J18JY3	10
199-N-171	J18JY4	15
199-N-171	J18JY5	20
199-N-171	J18JY6	25
199-N-171	J18JY7	30
199-N-171	J18JY8	35
199-N-171	J18JY9	40
199-N-171	J18K00	45
199-N-171	J18K01	50
199-N-171	J18K02	55
199-N-171	J18K03	60
199-N-171	J18K04	65
199-N-171	J18126	68
199-N-171	J18105	68
199-N-171	J18K05	70
199-N-171	J18K06	75
199-N-171	J18127	76
199-N-171	J18108	76
199-N-171	J18JY1	80
199-N-171	J18K07	80
199-N-172	J187T5	5
199-N-172	J187T6	10
199-N-172	J187T7	15
199-N-172	J187T8	20
199-N-172	J187T9	25
199-N-172	J187V0	30
199-N-172	J187V1	35
199-N-172	J187V2	40
199-N-172	J187V3	45
199-N-172	J187V4	50
199-N-172	J187V5	55
199-N-172	J187V6	60
199-N-172	J18111	64.5
199-N-172	J18112	64.5
199-N-172	J180Y0	64.5
199-N-172	J180Y1	64.5
199-N-172	J187V7	65
199-N-172	J18113	68
199-N-172	J180Y2	68
199-N-172	J187V8	70
199-N-172	J18114	72
199-N-172	J180Y3	72
199-N-172	J187V9	75
199-N-172	J187W0	80

TPH DIESEL RANGE RESULTS

sample location	HEIS Number	Sample Date	TPH - diesel range	QUAL	PQL	TPH - diesel C36	QUAL	PQL	Units
199-N-166	J180Y6	1/28/09 9:00	710	U	710	1000	U	1000	ug/kg
199-N-167	J180Y7	2/3/09 9:20	4400000	D	3400	4400000	D	5000	ug/kg
199-N-167	J180Y8	2/3/09 10:40	880000		740	880000		1100	ug/kg
199-N-168	J18100	2/24/09 7:35	1500	J	700	1600	J	1000	ug/kg
199-N-168	J18101	2/24/09 9:00	1400	J	690	1500	J	1000	ug/kg
199-N-169	J180Y4	2/17/09 10:20	2100000	D	3500	2000000	D	5100	ug/kg
199-N-169	J180Y9	2/17/09 11:25	450000	N	720	450000	N	1100	ug/kg
199-N-170	J18102	3/2/09 7:45	3700000	D	6800	3700000	D	10000	ug/kg
199-N-170	J18103	3/2/09 10:32	22000		700	22000		1000	ug/kg
199-N-171	J18105	3/10/09 13:15	3400000	D	6600	3300000	D	9800	ug/kg
199-N-171	J18108	3/11/09 9:40	330000		750	330000		1100	ug/kg
199-N-172	J180Y0	1/19/09 10:30	4200000	D	7100	4200000	D	10000	ug/kg
199-N-172	J180Y1	1/19/09 10:30	3700000	D	6800	3700000	D	10000	ug/kg
199-N-172	J180Y2	1/19/09 11:40	2700000	D	3500	2700000	D	5100	ug/kg
199-N-172	J180Y3	1/19/09 13:00	2700000	D	3500	2700000	D	5100	ug/kg
199-N-172	J180Y5	1/27/09 14:45	700	U	700	1000	U	1000	ug/kg
199-N-172	J18106	1/19/09 9:55	640	U	640	940	U	940	ug/kg

sample location	HEIS Number	Sample Date	TPH - gasoline range	QUAL	PQL	Units
199-N-166	J180Y6	1/28/09 9:00	1000	JBC	340	ug/kg
199-N-167	J180Y7	2/3/09 9:20	110000	BD	3400	ug/kg
199-N-167	J180Y8	2/3/09 10:40	16000	B	350	ug/kg
199-N-168	J18100	2/24/09 7:35	770	JB	340	ug/kg
199-N-168	J18101	2/24/09 9:00	720	JB	340	ug/kg
199-N-169	J180Y4	2/17/09 10:20	39000	BD	660	ug/kg

199-N-169	J180Y9	2/17/09 11:25	2700	B	340	ug/kg
199-N-170	J18102	3/2/09 7:45	46000	BDN	1700	ug/kg
199-N-170	J18103	3/2/09 10:32	1300	B	350	ug/kg
199-N-171	J18105	3/10/09 13:15	110000	BD	3300	ug/kg
199-N-171	J18108	3/11/09 9:40	15000	B	360	ug/kg
199-N-172	J180Y0	1/19/09 10:30	51000	BD	3400	ug/kg
199-N-172	J180Y1	1/19/09 10:30	81000	BD	3400	ug/kg
199-N-172	J180Y2	1/19/09 11:40	73000	BD	3300	ug/kg
199-N-172	J180Y3	1/19/09 13:00	37000	BD	670	ug/kg
199-N-172	J180Y5	1/27/09 14:45	800	JBC	330	ug/kg
199-N-172	J18106	1/19/09 9:55	4300	B	320	ug/kg

WET CHEMISTRY RESULTS

sample location	HEIS Number	Sample Date	pH	Bromide	QUAL	PQL	Chloride	QUAL	PQL	Units
199-N-166	J180Y6	1/28/09 9:00	8.8	0.41	U	0.41	2.1	U	2.1	mg/kg
199-N-167	J180Y7	2/3/09 9:20	9	0.4	U	0.4	4.6	B	2.1	mg/kg
199-N-167	J180Y8	2/3/09 10:40	8.8	0.43	U	0.43	13	M	2.2	mg/kg
199-N-168	J18100	2/24/09 7:35	9.2	0.41	U	0.41	5.3		2.1	mg/kg
199-N-168	J18101	2/24/09 9:00	8.8	0.41	U	0.41	7.1	M	2.1	mg/kg
199-N-169	J180Y4	2/17/09 10:20	9.1	0.4	U	0.4	2	U	2	mg/kg
199-N-169	J180Y9	2/17/09 11:25	9.2	0.42	U	0.42	3.7	B	2.1	mg/kg
199-N-170	J18102	3/2/09 7:45	8.8	0.4	U	0.4	2.1	U	2.1	mg/kg
199-N-170	J18103	3/2/09 10:32	8.9	0.43	U	0.43	4.2	B	2.2	mg/kg
199-N-171	J18105	3/10/09 13:15	8	0.4	U	0.4	12	M	2	mg/kg
199-N-171	J18108	3/11/09 9:40	8.8	0.43	U	0.43	4.6	B	2.2	mg/kg
199-N-172	J180Y0	1/19/09 10:30	6.6	0.41	U	0.41	5.1	BM	2.1	mg/kg
199-N-172	J180Y1	1/19/09 10:30	6.7	0.41	U	0.41	9.1		2.1	mg/kg
199-N-172	J180Y2	1/19/09 11:40	8.8	0.4	U	0.4	10		2	mg/kg
199-N-172	J180Y3	1/19/09 13:00	9.1	0.41	U	0.41	9.7		2.1	mg/kg
199-N-172	J180Y5	1/27/09 14:45	8.8	0.4	U	0.4	3.3	BM	2	mg/kg

sample location	HEIS Number	Sample Date	Fluoride	QUAL	PQL	N in ammonia	QUAL	PQL	Units
199-N-166	J180Y6	1/28/09 9:00	0.97	BM	0.86	2		0.17	mg/kg
199-N-167	J180Y7	2/3/09 9:20	1.5	B	0.86	1.2	M	0.17	mg/kg
199-N-167	J180Y8	2/3/09 10:40	1.3	BM	0.9	1.6		0.17	mg/kg
199-N-168	J18100	2/24/09 7:35	0.87	U	0.87	0.68		0.17	mg/kg
199-N-168	J18101	2/24/09 9:00	0.87	U	0.87	0.56		0.17	mg/kg
199-N-169	J180Y4	2/17/09 10:20	0.85	U	0.85	0.82	M	0.16	mg/kg
199-N-169	J180Y9	2/17/09 11:25	0.88	U	0.88	1.4		0.17	mg/kg
199-N-170	J18102	3/2/09 7:45	0.86	U	0.86	0.84		0.17	mg/kg

199-N-170	J18103	3/2/09 10:32	0.91	U	0.91	0.57		0.18	mg/kg
199-N-171	J18105	3/10/09 13:15	0.85	U	0.85	0.99	M	0.16	mg/kg
199-N-171	J18108	3/11/09 9:40	0.91	U	0.91	0.34	B	0.18	mg/kg
199-N-172	J180Y0	1/19/09 10:30	0.87	U	0.87	0.47	BM	0.17	mg/kg
199-N-172	J180Y1	1/19/09 10:30	0.87	U	0.87	0.67		0.17	mg/kg
199-N-172	J180Y2	1/19/09 11:40	0.85	U	0.85	0.61		0.16	mg/kg
199-N-172	J180Y3	1/19/09 13:00	0.86	U	0.86	0.19	B	0.17	mg/kg
199-N-172	J180Y5	1/27/09 14:45	1.1	BM	0.85	1.9		0.17	mg/kg
sample location	HEIS Number	Sample Date	N in Nitrate	QUAL	PQL	N in Nitrite	QUAL	PQL	Units
199-N-166	J180Y6	1/28/09 9:00	0.82	BM	0.33	0.35	U	0.35	mg/kg
199-N-167	J180Y7	2/3/09 9:20	0.33	U	0.33	0.35	U	0.35	mg/kg
199-N-167	J180Y8	2/3/09 10:40	0.34	U	0.34	0.37	U	0.37	mg/kg
199-N-168	J18100	2/24/09 7:35	0.33	U	0.33	0.36	U	0.36	mg/kg
199-N-168	J18101	2/24/09 9:00	1.2	B	0.33	0.35	U	0.35	mg/kg
199-N-169	J180Y4	2/17/09 10:20	0.32	U	0.32	0.35	U	0.35	mg/kg
199-N-169	J180Y9	2/17/09 11:25	0.34	U	0.34	0.36	UN	0.36	mg/kg
199-N-170	J18102	3/2/09 7:45	0.33	U	0.33	0.35	U	0.35	mg/kg
199-N-170	J18103	3/2/09 10:32	0.42	B	0.35	0.37	U	0.37	mg/kg
199-N-171	J18105	3/10/09 13:15	0.38	BM	0.33	0.35	U	0.35	mg/kg
199-N-171	J18108	3/11/09 9:40	0.41	B	0.35	0.37	U	0.37	mg/kg
199-N-172	J180Y0	1/19/09 10:30	0.33	U	0.33	0.35	U	0.35	mg/kg
199-N-172	J180Y1	1/19/09 10:30	0.33	U	0.33	0.36	U	0.36	mg/kg
199-N-172	J180Y2	1/19/09 11:40	0.33	U	0.33	0.35	U	0.35	mg/kg
199-N-172	J180Y3	1/19/09 13:00	0.33	U	0.33	0.35	U	0.35	mg/kg
199-N-172	J180Y5	1/27/09 14:45	0.85	B	0.33	0.35	U	0.35	mg/kg
sample location	HEIS Number	Sample Date	N, Kjeldahl total	QUAL	PQL	P in phosphate	QUAL	PQL	Units

199-N-166	J180Y6	1/28/09 9:00	15	B	13	0.52	U	0.52	mg/kg
199-N-167	J180Y7	2/3/09 9:20	43	B	12	0.52	U	0.52	mg/kg
199-N-167	J180Y8	2/3/09 10:40	20	B	13	0.55	U	0.55	mg/kg
199-N-168	J18100	2/24/09 7:35	14	B	13	1.3	U	1.3	mg/kg
199-N-168	J18101	2/24/09 9:00	17	B	13	1.3	U	1.3	mg/kg
199-N-169	J180Y4	2/17/09 10:20	35	B	12	1.3	U	1.3	mg/kg
199-N-169	J180Y9	2/17/09 11:25	32	B	13	1.3	U	1.3	mg/kg
199-N-170	J18102	3/2/09 7:45	21	B	13	1.3	U	1.3	mg/kg
199-N-170	J18103	3/2/09 10:32	13	U	13	1.4	U	1.4	mg/kg
199-N-171	J18105	3/10/09 13:15	22	B	12	1.3	U	1.3	mg/kg
199-N-171	J18108	3/11/09 9:40	13	U	13	1.4	U	1.4	mg/kg
199-N-172	J180Y0	1/19/09 10:30	30	B	13	0.53	U	0.53	mg/kg
199-N-172	J180Y1	1/19/09 10:30	53		13	0.53	U	0.53	mg/kg
199-N-172	J180Y2	1/19/09 11:40	52		12	0.52	U	0.52	mg/kg
199-N-172	J180Y3	1/19/09 13:00	39	B	13	0.53	U	0.53	mg/kg
199-N-172	J180Y5	1/27/09 14:45	36	B	12	0.52	UM	0.52	mg/kg

sample location	HEIS Number	Sample Date	Sulfate	QUAL	PQL	Total organic carbon	QUAL	PQL	Units
199-N-166	J180Y6	1/28/09 9:00	23		1.8	750	B	65	mg/kg
199-N-167	J180Y7	2/3/09 9:20	3	B	1.8	2400		680	mg/kg
199-N-167	J180Y8	2/3/09 10:40	7.3	M	1.9	2900		680	mg/kg
199-N-168	J18100	2/24/09 7:35	14		1.8	680	U	680	mg/kg
199-N-168	J18101	2/24/09 9:00	13		1.8	680	UM	680	mg/kg
199-N-169	J180Y4	2/17/09 10:20	8.1		1.8	2800		680	mg/kg
199-N-169	J180Y9	2/17/09 11:25	6.8		1.9	3000		680	mg/kg
199-N-170	J18102	3/2/09 7:45	6.2		1.8	2600	M	680	mg/kg
199-N-170	J18103	3/2/09 10:32	11		1.9	1400	B	680	mg/kg

199-N-171	J18105	3/10/09 13:15	1.8	U	1.8	1200	BM	680	mg/kg
199-N-171	J18108	3/11/09 9:40	5.5		1.9	1600	B	680	mg/kg
199-N-172	J180Y0	1/19/09 10:30	1.8	U	1.8	1100	BM	65	mg/kg
199-N-172	J180Y1	1/19/09 10:30	1.8	U	1.8	1400	B	65	mg/kg
199-N-172	J180Y2	1/19/09 11:40	2.8	B	1.8	1600	B	65	mg/kg
199-N-172	J180Y3	1/19/09 13:00	6.1		1.8	2100		65	mg/kg
199-N-172	J180Y5	1/27/09 14:45	27		1.8	1500	B	65	mg/kg

INORGANIC RESULTS

Well No.	HEIS No.	Date	Aluminum	QUAL	Antimony	QUAL	Arsenic	QUAL	Units
199-N-166	J180Y6	1/28/09 9:00	3900	L	0.4	U	0.73	BM	mg/kg
199-N-167	J180Y7	2/3/09 9:20	3600		0.4	U	0.91	BM	mg/kg
199-N-167	J180Y8	2/3/09 10:40	5100		0.42	U	1	B	mg/kg
199-N-168	J18100	2/24/09 7:35	4400	L	0.4	U	1.7	B	mg/kg
199-N-168	J18101	2/24/09 9:00	4600	L	0.4	U	1.6	B	mg/kg
199-N-169	J180Y4	2/17/09 10:20	3600		0.39	U	1.2	B	mg/kg
199-N-169	J180Y9	2/17/09 11:25	5400		0.41	U	0.95	B	mg/kg
199-N-170	J18102	3/2/09 7:45	4100		0.4	U	0.87	B	mg/kg
199-N-170	J18103	3/2/09 10:32	9000		3.9		50		mg/kg
199-N-171	J18105	3/10/09 13:15	3900		0.39	U	1.4	BM	mg/kg
199-N-171	J18108	3/11/09 9:40	4500		0.42	U	1.3	B	mg/kg
199-N-172	J180Y0	1/19/09 10:30	4600		0.4	U	0.78	BM	mg/kg
199-N-172	J180Y1	1/19/09 10:30	4400		0.89	B	1.3	B	mg/kg
199-N-172	J180Y2	1/19/09 11:40	5000		0.52	B	0.93	B	mg/kg
199-N-172	J180Y3	1/19/09 13:00	5700		0.99	B	0.78	B	mg/kg
199-N-172	J180Y5	1/27/09 14:45	3900	L	0.4	U	1.3	B	mg/kg
199-N-172	J18106	1/19/09 9:55	170		0.38	U	0.66	U	mg/kg

Well No.	HEIS No.	Sample Date	Barium	QUAL	Beryllium	QUAL	Bismuth	QUAL	Units
199-N-166	J180Y6	1/28/09 9:00	52	L	0.45	B	2.1	B	mg/kg
199-N-167	J180Y7	2/3/09 9:20	29		0.13	B	0.53	U	mg/kg
199-N-167	J180Y8	2/3/09 10:40	42		0.24	B	0.91	B	mg/kg
199-N-168	J18100	2/24/09 7:35	46	L	1.5		2.5	B	mg/kg
199-N-168	J18101	2/24/09 9:00	55	L	1.8		2.9	B	mg/kg
199-N-169	J180Y4	2/17/09 10:20	27		0.33	B	0.52	U	mg/kg
199-N-169	J180Y9	2/17/09 11:25	77	M	0.77		0.78	BM	mg/kg

199-N-170	J18102	3/2/09 7:45	31		0.14	B	0.53	U	mg/kg
199-N-170	J18103	3/2/09 10:32	35		0.15	B	3.3	B	mg/kg
199-N-171	J18105	3/10/09 13:15	37		0.15	B	0.65	BN	mg/kg
199-N-171	J18108	3/11/09 9:40	47		0.67		0.93	BM	mg/kg
199-N-172	J180Y0	1/19/09 10:30	32		0.26	B	0.54	U	mg/kg
199-N-172	J180Y1	1/19/09 10:30	34		0.23	B	0.54	U	mg/kg
199-N-172	J180Y2	1/19/09 11:40	41		0.32	B	0.52	U	mg/kg
199-N-172	J180Y3	1/19/09 13:00	53		0.66		0.53	U	mg/kg
199-N-172	J180Y5	1/27/09 14:45	57	L	0.47	B	2	BN	mg/kg
199-N-172	J18106	1/19/09 9:55	1.7		0.033	U	0.51	U	mg/kg

Well No.	HEIS No.	Sample Date	Boron	QUAL	Cadmium	QUAL	Calcium	QUAL	Units
199-N-166	J180Y6	1/28/09 9:00	1	U	0.35	BM	9500	M	mg/kg
199-N-167	J180Y7	2/3/09 9:20	1	U	0.094	B	6700		mg/kg
199-N-167	J180Y8	2/3/09 10:40	1.1	U	0.13	B	5100		mg/kg
199-N-168	J18100	2/24/09 7:35	1	U	0.043	U	5600	L	mg/kg
199-N-168	J18101	2/24/09 9:00	1	U	0.043	U	5500	L	mg/kg
199-N-169	J180Y4	2/17/09 10:20	1	U	0.042	U	3200		mg/kg
199-N-169	J180Y9	2/17/09 11:25	1.1	U	0.044	U	5300		mg/kg
199-N-170	J18102	3/2/09 7:45	1	U	0.049	BM	5300		mg/kg
199-N-170	J18103	3/2/09 10:32	1.1	U	0.045	U	7100		mg/kg
199-N-171	J18105	3/10/09 13:15	1	U	0.043	U	1700		mg/kg
199-N-171	J18108	3/11/09 9:40	1.1	U	0.045	U	3300		mg/kg
199-N-172	J180Y0	1/19/09 10:30	1	U	0.043	U	1600		mg/kg
199-N-172	J180Y1	1/19/09 10:30	1	U	0.043	U	1700		mg/kg
199-N-172	J180Y2	1/19/09 11:40	1	U	0.042	U	2300		mg/kg
199-N-172	J180Y3	1/19/09 13:00	1	U	0.043	U	4000		mg/kg
199-N-	J180Y5	1/27/09	1	U	0.15	BM	5700		mg/kg

172		14:45							
199-N-172	J18106	1/19/09 9:55	0.98	U	0.041	U	52	C	mg/kg
Well No.	**HEIS No.**	**Sample Date**	**Chromium**	**QUAL**	**Cobalt**	**QUAL**	**Copper**	**QUAL**	**Units**
199-N-166	J180Y6	1/28/09 9:00	5.6	LM	10	L	14		mg/kg
199-N-167	J180Y7	2/3/09 9:20	11		3.2		4.9		mg/kg
199-N-167	J180Y8	2/3/09 10:40	13		4.4		9.7		mg/kg
199-N-168	J18100	2/24/09 7:35	6.6	LM	11	L	18	L	mg/kg
199-N-168	J18101	2/24/09 9:00	6.4	L	12	L	15	L	mg/kg
199-N-169	J180Y4	2/17/09 10:20	12		3.3		6.1		mg/kg
199-N-169	J180Y9	2/17/09 11:25	14		4.8		11		mg/kg
199-N-170	J18102	3/2/09 7:45	13		3.3		6.4		mg/kg
199-N-170	J18103	3/2/09 10:32	4900		17		35		mg/kg
199-N-171	J18105	3/10/09 13:15	11		3.5		6.3		mg/kg
199-N-171	J18108	3/11/09 9:40	48	NM	5.3	L	14		mg/kg
199-N-172	J180Y0	1/19/09 10:30	12		4		6.2		mg/kg
199-N-172	J180Y1	1/19/09 10:30	12		3.9		6.6		mg/kg
199-N-172	J180Y2	1/19/09 11:40	14		4.2		8.6		mg/kg
199-N-172	J180Y3	1/19/09 13:00	8		5.5		11		mg/kg
199-N-172	J180Y5	1/27/09 14:45	10	M	11		14	L	mg/kg
199-N-172	J18106	1/19/09 9:55	0.18	B	0.1	U	0.22	U	mg/kg
Well No.	**HEIS No.**	**Sample Date**	**Hexavalent Chromium**	**QUAL**	**Iron**	**QUAL**	**Lead**	**QUAL**	**Units**
199-N-166	J180Y6	1/28/09 9:00	0.155	U	24000	L	1.6		mg/kg
199-N-167	J180Y7	2/3/09 9:20	0.155	U	6500		2.3		mg/kg
199-N-167	J180Y8	2/3/09 10:40	0.155	U	13000		2.9		mg/kg
199-N-168	J18100	2/24/09 7:35	0.155	U	28000	L	2.2		mg/kg
199-N-168	J18101	2/24/09 9:00	0.153	U	23000	L	2.7		mg/kg
199-N-169	J180Y4	2/17/09 10:20	0.155	U	6600		3		mg/kg

199-N-169	J180Y9	2/17/09 11:25	0.155	U	12000		2.6		mg/kg
199-N-170	J18102	3/2/09 7:45	0.154	U	7700		2.7		mg/kg
199-N-170	J18103	3/2/09 10:32	0.15	U	26000		1.4		mg/kg
199-N-171	J18105	3/10/09 13:15	0.155	U	8100		2.7		mg/kg
199-N-171	J18108	3/11/09 9:40	0.154	U	12000		2.5		mg/kg
199-N-172	J180Y0	1/19/09 10:30	0.366		8000		3.4		mg/kg
199-N-172	J180Y1	1/19/09 10:30	0.155	U	8300		3		mg/kg
199-N-172	J180Y2	1/19/09 11:40	0.499		10000		2.5		mg/kg
199-N-172	J180Y3	1/19/09 13:00	0.349		12000		3		mg/kg
199-N-172	J180Y5	1/27/09 14:45	0.155	U	28000	L	1.6		mg/kg
199-N-172	J18106	1/19/09 9:55			190		0.27	U	mg/kg
Well No.	HEIS No.	Sample Date	Lithium	QUAL	Magnesium	QUAL	Manganese	QUAL	Units
199-N-166	J180Y6	1/28/09 9:00	2.7		4100		280		mg/kg
199-N-167	J180Y7	2/3/09 9:20	5.8		2500		150		mg/kg
199-N-167	J180Y8	2/3/09 10:40	11		2800		210		mg/kg
199-N-168	J18100	2/24/09 7:35	3.3		4500	L	310	L	mg/kg
199-N-168	J18101	2/24/09 9:00	3.6		3900	L	360	L	mg/kg
199-N-169	J180Y4	2/17/09 10:20	6.1		2800		140		mg/kg
199-N-169	J180Y9	2/17/09 11:25	6.5		3100		210		mg/kg
199-N-170	J18102	3/2/09 7:45	6.4		2600		140		mg/kg
199-N-170	J18103	3/2/09 10:32	4.8		2900		640		mg/kg
199-N-171	J18105	3/10/09 13:15	6.5		2600		150		mg/kg
199-N-171	J18108	3/11/09 9:40	5.1	N	2800	L	160		mg/kg
199-N-172	J180Y0	1/19/09 10:30	9.4		2700		110		mg/kg
199-N-172	J180Y1	1/19/09 10:30	8.4		2700		110		mg/kg
199-N-172	J180Y2	1/19/09 11:40	8.1		3100		150		mg/kg
199-N-	J180Y3	1/19/09	6.2		2800		210		mg/kg

172		13:00							
199-N-172	J180Y5	1/27/09 14:45	3.3		4300		350	L	mg/kg
199-N-172	J18106	1/19/09 9:55	0.79	BC	28		3.3		mg/kg
Well No.	**HEIS No.**	**Sample Date**	**Molybdenum**	**QUAL**	**Nickel**	**QUAL**	**Phosphorus**	**QUAL**	**Units**
199-N-166	J180Y6	1/28/09 9:00	0.88	BM	8	M	1100	L	mg/kg
199-N-167	J180Y7	2/3/09 9:20	0.27	UM	11		260		mg/kg
199-N-167	J180Y8	2/3/09 10:40	0.39	B	11		430		mg/kg
199-N-168	J18100	2/24/09 7:35	0.46	BM	9.5	L	1400	N	mg/kg
199-N-168	J18101	2/24/09 9:00	0.29	B	12	L	1200		mg/kg
199-N-169	J180Y4	2/17/09 10:20	0.27	U	13		250		mg/kg
199-N-169	J180Y9	2/17/09 11:25	0.28	UM	11		390		mg/kg
199-N-170	J18102	3/2/09 7:45	0.27	U	11		280		mg/kg
199-N-170	J18103	3/2/09 10:32	42		2600		300		mg/kg
199-N-171	J18105	3/10/09 13:15	0.27	U	11		280		mg/kg
199-N-171	J18108	3/11/09 9:40	0.63	BM	31	NM	640	N	mg/kg
199-N-172	J180Y0	1/19/09 10:30	0.27	U	12		270		mg/kg
199-N-172	J180Y1	1/19/09 10:30	0.28	U	12		360		mg/kg
199-N-172	J180Y2	1/19/09 11:40	0.35	B	12		320		mg/kg
199-N-172	J180Y3	1/19/09 13:00	0.27	U	8.6		340		mg/kg
199-N-172	J180Y5	1/27/09 14:45	0.93	B	10		1400	L	mg/kg
199-N-172	J18106	1/19/09 9:55	0.26	U	0.12	U	5		mg/kg
Well No.	**HEIS No.**	**Sample Date**	**Potassium**	**QUAL**	**Selenium**	**QUAL**	**Silicon**	**QUAL**	**Units**
199-N-166	J180Y6	1/28/09 9:00	520		0.9	U	290	L	mg/kg
199-N-167	J180Y7	2/3/09 9:20	680		0.9	U	140	L	mg/kg
199-N-167	J180Y8	2/3/09 10:40	940		0.94	U	140	L	mg/kg
199-N-168	J18100	2/24/09 7:35	620		0.91	U	370	L	mg/kg
199-N-168	J18101	2/24/09 9:00	680		0.91	U	270	L	mg/kg

199-N-169	J180Y4	2/17/09 10:20	630		0.89	U	440		mg/kg
199-N-169	J180Y9	2/17/09 11:25	820		0.92	U	340		mg/kg
199-N-170	J18102	3/2/09 7:45	760		0.9	U	240		mg/kg
199-N-170	J18103	3/2/09 10:32	470		0.95	U	380		mg/kg
199-N-171	J18105	3/10/09 13:15	740		0.89	U	200	L	mg/kg
199-N-171	J18108	3/11/09 9:40	610		0.95	U	290		mg/kg
199-N-172	J180Y0	1/19/09 10:30	730		0.91	U	170		mg/kg
199-N-172	J180Y1	1/19/09 10:30	720		0.91	U	180		mg/kg
199-N-172	J180Y2	1/19/09 11:40	850		0.89	U	170		mg/kg
199-N-172	J180Y3	1/19/09 13:00	520		0.9	U	170		mg/kg
199-N-172	J180Y5	1/27/09 14:45	590		0.89	U	180	L	mg/kg
199-N-172	J18106	1/19/09 9:55	41	U	0.86	U	140		mg/kg

Well No.	HEIS No.	Sample Date	Silver	QUAL	Sodium	QUAL	Strontium	QUAL	Units
199-N-166	J180Y6	1/28/09 9:00	0.17	U	400		27	L	mg/kg
199-N-167	J180Y7	2/3/09 9:20	0.17	U	150		24		mg/kg
199-N-167	J180Y8	2/3/09 10:40	0.18	U	210		19		mg/kg
199-N-168	J18100	2/24/09 7:35	0.17	U	580	L	21	L	mg/kg
199-N-168	J18101	2/24/09 9:00	0.17	U	420	L	20	L	mg/kg
199-N-169	J180Y4	2/17/09 10:20	0.16	U	150		19		mg/kg
199-N-169	J180Y9	2/17/09 11:25	0.17	U	310		23		mg/kg
199-N-170	J18102	3/2/09 7:45	0.17	U	160		22		mg/kg
199-N-170	J18103	3/2/09 10:32	0.18	U	400		21		mg/kg
199-N-171	J18105	3/10/09 13:15	0.17	U	160		17		mg/kg
199-N-171	J18108	3/11/09 9:40	0.18	U	330		16		mg/kg
199-N-172	J180Y0	1/19/09 10:30	0.17	U	140		13		mg/kg
199-N-172	J180Y1	1/19/09 10:30	0.26	BC	140		13		mg/kg
199-N-	J180Y2	1/19/09	0.37	BC	280		16		mg/kg

172		11:40							
199-N-172	J180Y3	1/19/09 13:00	0.17	U	490		22		mg/kg
199-N-172	J180Y5	1/27/09 14:45	0.17	UM	380		19	L	mg/kg
199-N-172	J18106	1/19/09 9:55	0.29	BC	59	U	0.52	B	mg/kg

Well No.	HEIS No.	Sample Date	Thallium	QUAL	Tin	QUAL	Uranium	QUAL	Units
199-N-166	J180Y6	1/28/09 9:00	1.8		4.5	BC	2.6	UM	mg/kg
199-N-167	J180Y7	2/3/09 9:20	0.68	U	1.2	BCM	2.6	U	mg/kg
199-N-167	J180Y8	2/3/09 10:40	0.71	U	2.2	BC	2.7	U	mg/kg
199-N-168	J18100	2/24/09 7:35	0.83	B	1.6	B	2.6	U	mg/kg
199-N-168	J18101	2/24/09 9:00	1	B	1.5	B	2.9	B	mg/kg
199-N-169	J180Y4	2/17/09 10:20	0.67	U	0.94	U	2.6	U	mg/kg
199-N-169	J180Y9	2/17/09 11:25	0.7	U	0.98	U	2.7	U	mg/kg
199-N-170	J18102	3/2/09 7:45	0.68	U	0.95	U	4	B	mg/kg
199-N-170	J18103	3/2/09 10:32	1.8		2	B	7.2	B	mg/kg
199-N-171	J18105	3/10/09 13:15	1	B	0.95	U	2.6	U	mg/kg
199-N-171	J18108	3/11/09 9:40	0.72	U	1.3	BC	2.8	U	mg/kg
199-N-172	J180Y0	1/19/09 10:30	0.69	U	0.96	U	2.6	U	mg/kg
199-N-172	J180Y1	1/19/09 10:30	0.69	U	0.97	U	2.6	U	mg/kg
199-N-172	J180Y2	1/19/09 11:40	0.67	U	0.94	U	2.6	U	mg/kg
199-N-172	J180Y3	1/19/09 13:00	0.68	U	0.96	U	2.6	U	mg/kg
199-N-172	J180Y5	1/27/09 14:45	1.6		3.4	BC	2.6	U	mg/kg
199-N-172	J18106	1/19/09 9:55	0.65	U	0.91	U	2.5	U	mg/kg

Well No.	HEIS No.	Sample Date	Vanadium	QUAL	Zinc	QUAL	Units
199-N-166	J180Y6	1/28/09 9:00	72		43		mg/kg
199-N-167	J180Y7	2/3/09 9:20	11		14		mg/kg
199-N-167	J180Y8	2/3/09 10:40	32		31		mg/kg
199-N-168	J18100	2/24/09 7:35	61	L	48	L	mg/kg

199-N-168	J18101	2/24/09 9:00	69	L	47	L	mg/kg
199-N-169	J180Y4	2/17/09 10:20	13		18	L	mg/kg
199-N-169	J180Y9	2/17/09 11:25	32		25	L	mg/kg
199-N-170	J18102	3/2/09 7:45	14		20		mg/kg
199-N-170	J18103	3/2/09 10:32	38		18		mg/kg
199-N-171	J18105	3/10/09 13:15	15		19		mg/kg
199-N-171	J18108	3/11/09 9:40	32		22	LN	mg/kg
199-N-172	J180Y0	1/19/09 10:30	13		21	L	mg/kg
199-N-172	J180Y1	1/19/09 10:30	13		20	L	mg/kg
199-N-172	J180Y2	1/19/09 11:40	18		21	L	mg/kg
199-N-172	J180Y3	1/19/09 13:00	29		23	L	mg/kg
199-N-172	J180Y5	1/27/09 14:45	73		48	L	mg/kg
199-N-172	J18106	1/19/09 9:55	0.3	B	1.1	L	mg/kg

ORGANICS SAMPLE RESULTS

WELL NUMBER		J180Y0			J180Y1			
199-N-166								
199-N-167								
199-N-168								
199-N-169								
199-N-170								
199-N-171								
199-N-172		1/19/09 10:30			1/19/09 10:30	R		
CONSTITUENT	CLASS		Qual	PQL		Qual	PQL	Units
1,1,1-Trichloroethane	VOA	21	U	21	21	U	21	ug/kg
1,1,2,2-Tetrachloroethane	VOA	31	U	31	31	U	31	ug/kg
1,1,2-Trichloroethane	VOA	29	U	29	29	U	29	ug/kg
1,1-Dichloroethane	VOA	53	U	53	53	U	53	ug/kg
1,1-Dichloroethene	VOA	53	U	53	53	U	53	ug/kg
1,2-Dichloroethane	VOA	26	U	26	26	U	26	ug/kg
1,2-Dichloroethene(Total)	VOA	23	U	23	23	U	23	ug/kg
1,2-Dichloropropane	VOA	49	U	49	49	U	49	ug/kg
2-Butanone	VOA	310	U	310	310	U	310	ug/kg
2-Hexanone	VOA	230	U	230	230	U	230	ug/kg
4-Methyl-2-Pentanone	VOA	240	U	240	240	U	240	ug/kg
Acetone	VOA	420	U	420	420	U	420	ug/kg
Benzene	VOA	48	U	48	48	U	48	ug/kg
Bromodichloromethane	VOA	42	U	42	42	U	42	ug/kg
Bromoform	VOA	31	U	31	31	U	31	ug/kg
Bromomethane	VOA	46	U	46	47	U	47	ug/kg
Carbon disulfide	VOA	68	U	68	68	U	68	ug/kg
Carbon tetrachloride	VOA	18	U	18	18	U	18	ug/kg
Chlorobenzene	VOA	32	U	32	32	U	32	ug/kg
Chloroethane	VOA	46	U	46	47	U	47	ug/kg
Chloroform	VOA	49	U	49	49	U	49	ug/kg
Chloromethane	VOA	53	U	53	53	U	53	ug/kg
cis-1,3-Dichloropropene	VOA	29	U	29	29	U	29	ug/kg
Dibromochloromethane	VOA	35	U	35	35	U	35	ug/kg
Ethylbenzene	VOA	36	U	36	36	U	36	ug/kg
Methylenechloride	VOA	73	U	73	73	U	73	ug/kg
Styrene	VOA	27	U	27	28	U	28	ug/kg
Tetrachloroethene	VOA	29	U	29	29	U	29	ug/kg
Toluene	VOA	41	U	41	41	U	41	ug/kg
trans-1,3-Dichloropropene	VOA	44	U	44	44	U	44	ug/kg
Trichloroethene	VOA	24	U	24	24	U	24	ug/kg
Vinyl chloride	VOA	29	U	29	29	U	29	ug/kg

Xylenes (total)	VOA	100	J	37	37	U	37	ug/kg
WELL NUMBER		J180Y2			J180Y3			
199-N-166								
199-N-167								
199-N-168								
199-N-169								
199-N-170								
199-N-171								
199-N-172		1/19/09 11:40			1/19/09 13:00			
CONSTITUENT	CLASS		Qual	PQL		Qual	PQL	Units
1,1,1-Trichloroethane	VOA	21	U	21	21	U	21	ug/kg
1,1,2,2-Tetrachloroethane	VOA	30	U	30	30	U	30	ug/kg
1,1,2-Trichloroethane	VOA	28	U	28	28	U	28	ug/kg
1,1-Dichloroethane	VOA	52	U	52	53	U	53	ug/kg
1,1-Dichloroethene	VOA	52	U	52	53	U	53	ug/kg
1,2-Dichloroethane	VOA	26	U	26	26	U	26	ug/kg
1,2-Dichloroethene(Total)	VOA	23	U	23	23	U	23	ug/kg
1,2-Dichloropropane	VOA	48	U	48	49	U	49	ug/kg
2-Butanone	VOA	310	U	310	310	U	310	ug/kg
2-Hexanone	VOA	220	U	220	230	U	230	ug/kg
4-Methyl-2-Pentanone	VOA	230	U	230	240	U	240	ug/kg
Acetone	VOA	410	U	410	420	U	420	ug/kg
Benzene	VOA	47	U	47	47	U	47	ug/kg
Bromodichloromethane	VOA	41	U	41	42	U	42	ug/kg
Bromoform	VOA	30	U	30	30	U	30	ug/kg
Bromomethane	VOA	46	U	46	46	U	46	ug/kg
Carbon disulfide	VOA	66	U	66	67	U	67	ug/kg
Carbon tetrachloride	VOA	18	U	18	18	U	18	ug/kg
Chlorobenzene	VOA	31	U	31	31	U	31	ug/kg
Chloroethane	VOA	46	U	46	46	U	46	ug/kg
Chloroform	VOA	48	U	48	48	U	48	ug/kg
Chloromethane	VOA	52	U	52	52	U	52	ug/kg
cis-1,3-Dichloropropene	VOA	28	U	28	28	U	28	ug/kg
Dibromochloromethane	VOA	34	U	34	35	U	35	ug/kg
Ethylbenzene	VOA	35	U	35	36	U	36	ug/kg
Methylenechloride	VOA	71	U	71	72	U	72	ug/kg
Styrene	VOA	27	U	27	27	U	27	ug/kg
Tetrachloroethene	VOA	28	U	28	28	U	28	ug/kg
Toluene	VOA	40	U	40	41	U	41	ug/kg
trans-1,3-Dichloropropene	VOA	43	U	43	43	U	43	ug/kg
Trichloroethene	VOA	24	U	24	24	U	24	ug/kg
Vinyl chloride	VOA	28	U	28	28	U	28	ug/kg
Xylenes (total)	VOA	36	U	36	37	U	37	ug/kg
WELL NUMBER		J180Y4			J180Y5			

199-N-166								
199-N-167								
199-N-168								
199-N-169		2/17/09 10:20						
199-N-170								
199-N-171								
199-N-172					1/27/09 14:45			
CONSTITUENT	CLASS		Qual	PQL		Qual	PQL	Units
1,1,1-Trichloroethane	VOA	0.54	U	0.54	0.54	U	0.54	ug/kg
1,1,2,2-Tetrachloroethane	VOA	0.63	U	0.63	0.63	U	0.63	ug/kg
1,1,2-Trichloroethane	VOA	0.91	U	0.91	0.92	U	0.92	ug/kg
1,1-Dichloroethane	VOA	0.22	U	0.22	0.22	U	0.22	ug/kg
1,1-Dichloroethene	VOA	0.61	U	0.61	0.61	U	0.61	ug/kg
1,2-Dichloroethane	VOA	0.72	U	0.72	0.73	U	0.73	ug/kg
1,2-Dichloroethene(Total)	VOA	0.4	U	0.4	0.41	U	0.41	ug/kg
1,2-Dichloropropane	VOA	0.57	U	0.57	0.57	U	0.57	ug/kg
2-Butanone	VOA	1.9	U	1.9	1.9	U	1.9	ug/kg
2-Hexanone	VOA	5	U	5	5.1	U	5.1	ug/kg
4-Methyl-2-Pentanone	VOA	4.5	U	4.5	4.5	U	4.5	ug/kg
Acetone	VOA	12	JB	5.5	5.6	U	5.6	ug/kg
Benzene	VOA	0.48	U	0.48	0.49	U	0.49	ug/kg
Bromodichloromethane	VOA	0.23	U	0.23	0.23	U	0.23	ug/kg
Bromoform	VOA	0.24	U	0.24	0.24	U	0.24	ug/kg
Bromomethane	VOA	0.52	U	0.52	0.52	U	0.52	ug/kg
Carbon disulfide	VOA	0.43	U	0.43	0.44	U	0.44	ug/kg
Carbon tetrachloride	VOA	0.65	U	0.65	0.66	U	0.66	ug/kg
Chlorobenzene	VOA	0.56	U	0.56	0.56	U	0.56	ug/kg
Chloroethane	VOA	0.92	U	0.92	0.93	U	0.93	ug/kg
Chloroform	VOA	0.3	U	0.3	0.3	U	0.3	ug/kg
Chloromethane	VOA	0.79	U	0.79	0.8	U	0.8	ug/kg
cis-1,3-Dichloropropene	VOA	1.3	U	1.3	1.3	U	1.3	ug/kg
Dibromochloromethane	VOA	0.59	U	0.59	0.59	U	0.59	ug/kg
Ethylbenzene	VOA	2.8	J	0.69	0.7	U	0.7	ug/kg
Methylenechloride	VOA	0.77	U	0.77	0.78	U	0.78	ug/kg
Styrene	VOA	0.65	U	0.65	0.66	U	0.66	ug/kg
Tetrachloroethene	VOA	0.61	U	0.61	0.61	U	0.61	ug/kg
Toluene	VOA	0.71	U	0.71	0.72	U	0.72	ug/kg
trans-1,3-Dichloropropene	VOA	0.69	U	0.69	0.7	U	0.7	ug/kg
Trichloroethene	VOA	0.24	U	0.24	0.24	U	0.24	ug/kg
Vinyl chloride	VOA	1.4	U	1.4	1.4	U	1.4	ug/kg
Xylenes (total)	VOA	3.9		0.63	0.63	U	0.63	ug/kg
WELL NUMBER		J180Y6			J180Y7			
199-N-166		1/28/09 9:00						
199-N-167					2/3/09 9:20			

199-N-168								
199-N-169								
199-N-170								
199-N-171								
199-N-172								
CONSTITUENT	CLASS		Qual	PQL		Qual	PQL	Units
1,1,1-Trichloroethane	VOA	0.54	U	0.54	21	U	21	ug/kg
1,1,2,2-Tetrachloroethane	VOA	0.64	U	0.64	30	U	30	ug/kg
1,1,2-Trichloroethane	VOA	0.92	U	0.92	28	U	28	ug/kg
1,1-Dichloroethane	VOA	0.22	U	0.22	53	U	53	ug/kg
1,1-Dichloroethene	VOA	0.62	U	0.62	53	U	53	ug/kg
1,2-Dichloroethane	VOA	0.73	U	0.73	26	U	26	ug/kg
1,2-Dichloroethene(Total)	VOA	0.41	U	0.41	23	U	23	ug/kg
1,2-Dichloropropane	VOA	0.57	U	0.57	48	U	48	ug/kg
2-Butanone	VOA	1.9	U	1.9	310	U	310	ug/kg
2-Hexanone	VOA	5.1	U	5.1	230	U	230	ug/kg
4-Methyl-2-Pentanone	VOA	4.6	U	4.6	230	U	230	ug/kg
Acetone	VOA	12	J	5.6	420	U	420	ug/kg
Benzene	VOA	0.49	U	0.49	47	U	47	ug/kg
Bromodichloromethane	VOA	0.23	U	0.23	41	U	41	ug/kg
Bromoform	VOA	0.24	U	0.24	30	U	30	ug/kg
Bromomethane	VOA	0.52	U	0.52	46	U	46	ug/kg
Carbon disulfide	VOA	0.44	U	0.44	67	U	67	ug/kg
Carbon tetrachloride	VOA	0.66	U	0.66	18	U	18	ug/kg
Chlorobenzene	VOA	0.56	U	0.56	31	U	31	ug/kg
Chloroethane	VOA	0.93	U	0.93	46	U	46	ug/kg
Chloroform	VOA	0.3	U	0.3	48	U	48	ug/kg
Chloromethane	VOA	0.8	U	0.8	52	U	52	ug/kg
cis-1,3-Dichloropropene	VOA	1.3	U	1.3	28	U	28	ug/kg
Dibromochloromethane	VOA	0.6	U	0.6	34	U	34	ug/kg
Ethylbenzene	VOA	0.7	U	0.7	63	J	35	ug/kg
Methylenechloride	VOA	0.78	U	0.78	72	U	72	ug/kg
Styrene	VOA	0.66	U	0.66	27	U	27	ug/kg
Tetrachloroethene	VOA	0.62	U	0.62	28	U	28	ug/kg
Toluene	VOA	0.72	U	0.72	41	U	41	ug/kg
trans-1,3-Dichloropropene	VOA	0.7	U	0.7	43	U	43	ug/kg
Trichloroethene	VOA	0.24	U	0.24	24	U	24	ug/kg
Vinyl chloride	VOA	1.4	U	1.4	28	U	28	ug/kg
Xylenes (total)	VOA	0.64	U	0.64	36	U	36	ug/kg
WELL NUMBER		J180Y6			J180Y7			
199-N-166		1/28/09 9:00						
199-N-167					2/3/09 9:20			
199-N-168								
199-N-169								
199-N-170								

199-N-171								
199-N-172								
CONSTITUENT	CLASS		Qual	PQL		Qual	PQL	Units
1,1,1-Trichloroethane	VOA	0.54	U	0.54	21	U	21	ug/kg
1,1,2,2-Tetrachloroethane	VOA	0.64	U	0.64	30	U	30	ug/kg
1,1,2-Trichloroethane	VOA	0.92	U	0.92	28	U	28	ug/kg
1,1-Dichloroethane	VOA	0.22	U	0.22	53	U	53	ug/kg
1,1-Dichloroethene	VOA	0.62	U	0.62	53	U	53	ug/kg
1,2-Dichloroethane	VOA	0.73	U	0.73	26	U	26	ug/kg
1,2-Dichloroethene(Total)	VOA	0.41	U	0.41	23	U	23	ug/kg
1,2-Dichloropropane	VOA	0.57	U	0.57	48	U	48	ug/kg
2-Butanone	VOA	1.9	U	1.9	310	U	310	ug/kg
2-Hexanone	VOA	5.1	U	5.1	230	U	230	ug/kg
4-Methyl-2-Pentanone	VOA	4.6	U	4.6	230	U	230	ug/kg
Acetone	VOA	12	J	5.6	420	U	420	ug/kg
Benzene	VOA	0.49	U	0.49	47	U	47	ug/kg
Bromodichloromethane	VOA	0.23	U	0.23	41	U	41	ug/kg
Bromoform	VOA	0.24	U	0.24	30	U	30	ug/kg
Bromomethane	VOA	0.52	U	0.52	46	U	46	ug/kg
Carbon disulfide	VOA	0.44	U	0.44	67	U	67	ug/kg
Carbon tetrachloride	VOA	0.66	U	0.66	18	U	18	ug/kg
Chlorobenzene	VOA	0.56	U	0.56	31	U	31	ug/kg
Chloroethane	VOA	0.93	U	0.93	46	U	46	ug/kg
Chloroform	VOA	0.3	U	0.3	48	U	48	ug/kg
Chloromethane	VOA	0.8	U	0.8	52	U	52	ug/kg
cis-1,3-Dichloropropene	VOA	1.3	U	1.3	28	U	28	ug/kg
Dibromochloromethane	VOA	0.6	U	0.6	34	U	34	ug/kg
Ethylbenzene	VOA	0.7	U	0.7	63	J	35	ug/kg
Methylenechloride	VOA	0.78	U	0.78	72	U	72	ug/kg
Styrene	VOA	0.66	U	0.66	27	U	27	ug/kg
Tetrachloroethene	VOA	0.62	U	0.62	28	U	28	ug/kg
Toluene	VOA	0.72	U	0.72	41	U	41	ug/kg
trans-1,3-Dichloropropene	VOA	0.7	U	0.7	43	U	43	ug/kg
Trichloroethene	VOA	0.24	U	0.24	24	U	24	ug/kg
Vinyl chloride	VOA	1.4	U	1.4	28	U	28	ug/kg
Xylenes (total)	VOA	0.64	U	0.64	36	U	36	ug/kg
WELL NUMBER		J180Y8			J180Y9			
199-N-166								
199-N-167		2/3/09 10:40						
199-N-168								
199-N-169					2/17/09 11:25			
199-N-170								
199-N-171								
199-N-172								

CONSTITUENT	CLASS		Qual	PQL		Qual	PQL	Units
1,1,1-Trichloroethane	VOA	22	U	22	0.56	U	0.56	ug/kg
1,1,2,2-Tetrachloroethane	VOA	32	U	32	0.65	U	0.65	ug/kg
1,1,2-Trichloroethane	VOA	30	U	30	0.94	U	0.94	ug/kg
1,1-Dichloroethane	VOA	55	U	55	0.23	U	0.23	ug/kg
1,1-Dichloroethene	VOA	55	UX	55	0.63	U	0.63	ug/kg
1,2-Dichloroethane	VOA	27	U	27	0.75	U	0.75	ug/kg
1,2-Dichloroethene(Total)	VOA	24	U	24	0.42	U	0.42	ug/kg
1,2-Dichloropropane	VOA	51	U	51	0.59	U	0.59	ug/kg
2-Butanone	VOA	320	U	320	2	U	2	ug/kg
2-Hexanone	VOA	610	J	240	7.7	J	5.2	ug/kg
4-Methyl-2-Pentanone	VOA	250	U	250	4.7	U	4.7	ug/kg
Acetone	VOA	440	U	440	11	J	5.8	ug/kg
Benzene	VOA	50	U	50	0.5	U	0.5	ug/kg
Bromodichloromethane	VOA	43	U	43	0.24	U	0.24	ug/kg
Bromoform	VOA	32	U	32	0.25	U	0.25	ug/kg
Bromomethane	VOA	48	U	48	0.54	U	0.54	ug/kg
Carbon disulfide	VOA	70	U	70	0.76	J	0.45	ug/kg
Carbon tetrachloride	VOA	19	U	19	0.68	U	0.68	ug/kg
Chlorobenzene	VOA	33	U	33	0.58	U	0.58	ug/kg
Chloroethane	VOA	48	U	48	0.95	U	0.95	ug/kg
Chloroform	VOA	51	U	51	0.31	U	0.31	ug/kg
Chloromethane	VOA	55	U	55	0.83	U	0.83	ug/kg
cis-1,3-Dichloropropene	VOA	30	U	30	1.4	U	1.4	ug/kg
Dibromochloromethane	VOA	36	U	36	0.61	U	0.61	ug/kg
Ethylbenzene	VOA	37	U	37	0.72	U	0.72	ug/kg
Methylenechloride	VOA	76	U	76	4.5	J	0.8	ug/kg
Styrene	VOA	29	U	29	0.68	U	0.68	ug/kg
Tetrachloroethene	VOA	30	U	30	0.63	U	0.63	ug/kg
Toluene	VOA	43	UX	43	0.74	U	0.74	ug/kg
trans-1,3-Dichloropropene	VOA	45	U	45	0.72	U	0.72	ug/kg
Trichloroethene	VOA	25	U	25	0.25	U	0.25	ug/kg
Vinyl chloride	VOA	30	U	30	1.4	U	1.4	ug/kg
Xylenes (total)	VOA	38	U	38	0.65	U	0.65	ug/kg
WELL NUMBER		J18100			J18101			
199-N-166								
199-N-167								
199-N-168		2/24/09 7:35			2/24/09 9:00			
199-N-169								
199-N-170								
199-N-171								
199-N-172								
CONSTITUENT	CLASS		Qual	PQL		Qual	PQL	Units
1,1,1-Trichloroethane	VOA	0.55	U	0.55	0.55	U	0.55	ug/kg

1,1,2,2-Tetrachloroethane	VOA	0.65	U	0.65	0.64	U	0.64	ug/kg
1,1,2-Trichloroethane	VOA	0.93	U	0.93	0.93	U	0.93	ug/kg
1,1-Dichloroethane	VOA	0.22	U	0.22	0.22	U	0.22	ug/kg
1,1-Dichloroethene	VOA	0.62	U	0.62	0.62	U	0.62	ug/kg
1,2-Dichloroethane	VOA	0.74	U	0.74	0.74	U	0.74	ug/kg
1,2-Dichloroethene(Total)	VOA	0.41	U	0.41	0.41	U	0.41	ug/kg
1,2-Dichloropropane	VOA	0.58	U	0.58	0.58	U	0.58	ug/kg
2-Butanone	VOA	1.9	U	1.9	1.9	U	1.9	ug/kg
2-Hexanone	VOA	5.2	U	5.2	5.2	U	5.2	ug/kg
4-Methyl-2-Pentanone	VOA	4.6	U	4.6	4.6	U	4.6	ug/kg
Acetone	VOA	7.2	JB	5.7	5.8	JB	5.7	ug/kg
Benzene	VOA	0.5	U	0.5	0.5	U	0.5	ug/kg
Bromodichloromethane	VOA	0.23	U	0.23	0.23	U	0.23	ug/kg
Bromoform	VOA	0.24	U	0.24	0.24	U	0.24	ug/kg
Bromomethane	VOA	0.53	U	0.53	0.53	U	0.53	ug/kg
Carbon disulfide	VOA	1	J	0.44	0.44	U	0.44	ug/kg
Carbon tetrachloride	VOA	0.67	U	0.67	0.67	U	0.67	ug/kg
Chlorobenzene	VOA	0.57	U	0.57	0.57	U	0.57	ug/kg
Chloroethane	VOA	0.94	U	0.94	0.94	U	0.94	ug/kg
Chloroform	VOA	0.31	U	0.31	0.31	U	0.31	ug/kg
Chloromethane	VOA	0.81	U	0.81	0.81	U	0.81	ug/kg
cis-1,3-Dichloropropene	VOA	1.4	U	1.4	1.4	U	1.4	ug/kg
Dibromochloromethane	VOA	0.6	U	0.6	0.6	U	0.6	ug/kg
Ethylbenzene	VOA	0.71	U	0.71	0.71	U	0.71	ug/kg
Methylenechloride	VOA	0.79	U	0.79	0.79	U	0.79	ug/kg
Styrene	VOA	0.67	U	0.67	0.67	U	0.67	ug/kg
Tetrachloroethene	VOA	0.62	U	0.62	0.62	U	0.62	ug/kg
Toluene	VOA	0.73	U	0.73	0.73	U	0.73	ug/kg
trans-1,3-Dichloropropene	VOA	0.71	U	0.71	0.71	U	0.71	ug/kg
Trichloroethene	VOA	0.24	U	0.24	0.24	U	0.24	ug/kg
Vinyl chloride	VOA	1.4	U	1.4	1.4	U	1.4	ug/kg
Xylenes (total)	VOA	0.65	U	0.65	0.64	U	0.64	ug/kg
WELL NUMBER		J18102			J18103			
199-N-166								
199-N-167								
199-N-168								
199-N-169								
199-N-170		3/2/09 7:45			3/2/09 10:32			
199-N-171								
199-N-172								
CONSTITUENT	CLASS		Qual	PQL		Qual	PQL	Units
1,1,1-Trichloroethane	VOA	21	U	21	22	U	22	ug/kg
1,1,2,2-Tetrachloroethane	VOA	30	U	30	32	U	32	ug/kg
1,1,2-Trichloroethane	VOA	28	U	28	30	U	30	ug/kg

1,1-Dichloroethane	VOA	53	U	53	56	U	56	ug/kg
1,1-Dichloroethene	VOA	53	U	53	56	UZ	56	ug/kg
1,2-Dichloroethane	VOA	26	U	26	28	U	28	ug/kg
1,2-Dichloroethene(Total)	VOA	23	U	23	24	U	24	ug/kg
1,2-Dichloropropane	VOA	48	U	48	51	U	51	ug/kg
2-Butanone	VOA	310	U	310	330	U	330	ug/kg
2-Hexanone	VOA	230	U	230	240	U	240	ug/kg
4-Methyl-2-Pentanone	VOA	230	U	230	250	U	250	ug/kg
Acetone	VOA	420	U	420	440	U	440	ug/kg
Benzene	VOA	47	U	47	50	U	50	ug/kg
Bromodichloromethane	VOA	41	U	41	44	U	44	ug/kg
Bromoform	VOA	30	U	30	32	U	32	ug/kg
Bromomethane	VOA	46	U	46	49	U	49	ug/kg
Carbon disulfide	VOA	67	U	67	71	U	71	ug/kg
Carbon tetrachloride	VOA	18	U	18	19	U	19	ug/kg
Chlorobenzene	VOA	31	U	31	33	UZ	33	ug/kg
Chloroethane	VOA	46	U	46	49	U	49	ug/kg
Chloroform	VOA	48	U	48	51	U	51	ug/kg
Chloromethane	VOA	52	U	52	55	U	55	ug/kg
cis-1,3-Dichloropropene	VOA	28	U	28	30	U	30	ug/kg
Dibromochloromethane	VOA	34	U	34	36	U	36	ug/kg
Ethylbenzene	VOA	450		35	38	U	38	ug/kg
Methylenechloride	VOA	72	U	72	76	U	76	ug/kg
Styrene	VOA	27	U	27	29	U	29	ug/kg
Tetrachloroethene	VOA	28	U	28	30	UZ	30	ug/kg
Toluene	VOA	41	U	41	43	U	43	ug/kg
trans-1,3-Dichloropropene	VOA	43	U	43	46	U	46	ug/kg
Trichloroethene	VOA	24	U	24	25	U	25	ug/kg
Vinyl chloride	VOA	28	U	28	30	U	30	ug/kg
Xylenes (total)	VOA	450		36	39	U	39	ug/kg
WELL NUMBER		J18105			J18106			
199-N-166								
199-N-167								
199-N-168								
199-N-169								
199-N-170								
199-N-171		3/10/09 13:15						
199-N-172					1/19/09 9:55	E		
CONSTITUENT	CLASS		Qual	PQL		Qual	PQL	Units
1,1,1-Trichloroethane	VOA	21	U	21	20	U	20	ug/kg
1,1,2,2-Tetrachloroethane	VOA	30	U	30	29	U	29	ug/kg
1,1,2-Trichloroethane	VOA	28	U	28	27	U	27	ug/kg
1,1-Dichloroethane	VOA	52	U	52	51	U	51	ug/kg
1,1-Dichloroethene	VOA	52	U	52	51	U	51	ug/kg
1,2-Dichloroethane	VOA	26	U	26	25	U	25	ug/kg

1,2-Dichloroethene(Total)	VOA	23	U	23	22	U	22	ug/kg
1,2-Dichloropropane	VOA	48	U	48	46	U	46	ug/kg
2-Butanone	VOA	310	U	310	300	U	300	ug/kg
2-Hexanone	VOA	230	U	230	220	U	220	ug/kg
4-Methyl-2-Pentanone	VOA	230	U	230	230	U	230	ug/kg
Acetone	VOA	410	U	410	400	U	400	ug/kg
Benzene	VOA	47	U	47	45	U	45	ug/kg
Bromodichloromethane	VOA	41	U	41	40	U	40	ug/kg
Bromoform	VOA	30	U	30	29	U	29	ug/kg
Bromomethane	VOA	46	U	46	44	U	44	ug/kg
Carbon disulfide	VOA	66	U	66	64	U	64	ug/kg
Carbon tetrachloride	VOA	18	U	18	17	U	17	ug/kg
Chlorobenzene	VOA	31	U	31	30	U	30	ug/kg
Chloroethane	VOA	46	U	46	44	U	44	ug/kg
Chloroform	VOA	48	U	48	46	U	46	ug/kg
Chloromethane	VOA	52	U	52	50	U	50	ug/kg
cis-1,3-Dichloropropene	VOA	28	U	28	27	U	27	ug/kg
Dibromochloromethane	VOA	34	U	34	33	U	33	ug/kg
Ethylbenzene	VOA	70	J	35	34	U	34	ug/kg
Methylenechloride	VOA	72	U	72	69	U	69	ug/kg
Styrene	VOA	27	U	27	26	U	26	ug/kg
Tetrachloroethene	VOA	28	U	28	27	U	27	ug/kg
Toluene	VOA	40	U	40	39	U	39	ug/kg
trans-1,3-Dichloropropene	VOA	43	U	43	41	U	41	ug/kg
Trichloroethene	VOA	24	U	24	23	U	23	ug/kg
Vinyl chloride	VOA	28	U	28	27	U	27	ug/kg
Xylenes (total)	VOA	72	J	36	35	U	35	ug/kg

WELL NUMBER		J18108			
199-N-166					
199-N-167					
199-N-168					
199-N-169					
199-N-170					
199-N-171		3/11/09 9:40			
199-N-172					
CONSTITUENT	CLASS		Qual	PQL	Units
1,1,1-Trichloroethane	VOA	0.57	U	0.57	ug/kg
1,1,2,2-Tetrachloroethane	VOA	0.67	U	0.67	ug/kg
1,1,2-Trichloroethane	VOA	0.97	U	0.97	ug/kg
1,1-Dichloroethane	VOA	0.23	U	0.23	ug/kg
1,1-Dichloroethene	VOA	0.65	U	0.65	ug/kg
1,2-Dichloroethane	VOA	0.77	U	0.77	ug/kg
1,2-Dichloroethene(Total)	VOA	0.43	U	0.43	ug/kg
1,2-Dichloropropane	VOA	0.61	U	0.61	ug/kg

2-Butanone	VOA	3.3	J	2	ug/kg
2-Hexanone	VOA	5.4	U	5.4	ug/kg
4-Methyl-2-Pentanone	VOA	4.8	U	4.8	ug/kg
Acetone	VOA	13	J	5.9	ug/kg
Benzene	VOA	0.52	U	0.52	ug/kg
Bromodichloromethane	VOA	0.24	U	0.24	ug/kg
Bromoform	VOA	0.25	U	0.25	ug/kg
Bromomethane	VOA	0.55	U	0.55	ug/kg
Carbon disulfide	VOA	1.1	J	0.46	ug/kg
Carbon tetrachloride	VOA	0.7	U	0.7	ug/kg
Chlorobenzene	VOA	0.6	U	0.6	ug/kg
Chloroethane	VOA	0.98	U	0.98	ug/kg
Chloroform	VOA	0.32	U	0.32	ug/kg
Chloromethane	VOA	0.85	U	0.85	ug/kg
cis-1,3-Dichloropropene	VOA	1.4	U	1.4	ug/kg
Dibromochloromethane	VOA	0.63	U	0.63	ug/kg
Ethylbenzene	VOA	2.7	J	0.74	ug/kg
Methylenechloride	VOA	2	JB	0.83	ug/kg
Styrene	VOA	0.7	U	0.7	ug/kg
Tetrachloroethene	VOA	0.65	U	0.65	ug/kg
Toluene	VOA	0.76	U	0.76	ug/kg
trans-1,3-Dichloropropene	VOA	0.74	U	0.74	ug/kg
Trichloroethene	VOA	0.25	U	0.25	ug/kg
Vinyl chloride	VOA	1.5	U	1.5	ug/kg
Xylenes (total)	VOA	2.2	J	0.67	ug/kg

RADIOLOGICAL SAMPLE RESULTS

sample location	HEIS Number	Sample Date	Relationship	Americium-241 GEA	QUAL	MDA	Units
199-N-172	J18110	1/14/09 13:40	SCREEN	0.0124	U	0.0716	pCi/g
				Cesium-137	QUAL	MDA	pCi/g
				0.0725	U	0.153	pCi/g
				Cobalt-60	QUAL	MDA	pCi/g
				0.0295	U	0.183	pCi/g
				Curium-243	QUAL	MDA	pCi/g
				0.114	U	0.152	pCi/g
				Curium-245	QUAL	MDA	pCi/g
				0.0775	U	0.104	pCi/g
				Europium-152	QUAL	MDA	pCi/g
				0.0103	U	0.0984	pCi/g
				Europium-154	QUAL	MDA	pCi/g
				-0.0365	U	0.106	pCi/g
				Europium-155	QUAL	MDA	pCi/g
				0.148	U	0.143	pCi/g
				Lead-212	QUAL	MDA	pCi/g
				0.748	U	0.322	pCi/g
				Niobium-94	QUAL	MDA	pCi/g
				-0.0662	U	0.121	pCi/g
				Potassium-40	QUAL	MDA	pCi/g
				13.2		1.03	pCi/g
				Radium-226	QUAL	MDA	pCi/g
				0.458		0.25	pCi/g
				Silver-108m	QUAL	MDA	pCi/g
				-0.0427	U	0.109	pCi/g
				Thorium-232	QUAL	MDA	pCi/g
				0.376		0.229	pCi/g
				Uranium-235 GEA	QUAL	MDA	pCi/g
				0.495	U	0.141	pCi/g
				Uranium-238	QUAL	MDA	pCi/g
				0.446	U	0.827	pCi/g

sample location	HEIS Number	Sample Date	Relationship	Total beta radiostrontium	QUAL	MDA	Units
199-N-166	J180Y6	1/28/09 9:00		0.14	U	0.142	pCi/g
199-N-167	J180Y7	2/3/09 9:20		0.743		0.155	pCi/g
199-N-167	J180Y8	2/3/09 10:40		0.853		0.136	pCi/g
199-N-168	J18100	2/24/09 7:35		0.0357	U	0.183	pCi/g
199-N-168	J18101	2/24/09 9:00		0.0736	U	0.205	pCi/g
199-N-169	J180Y4	2/17/09 10:20		0.743		0.133	pCi/g
199-N-169	J180Y9	2/17/09 11:25		1.06		0.149	pCi/g
199-N-170	J18102	3/2/09 7:45		0.719		0.133	pCi/g
199-N-170	J18103	3/2/09 10:32		0.672		0.139	pCi/g
199-N-171	J18105	3/10/09		1.8		0.134	pCi/g

		13:15					
199-N-171	J18108	3/11/09 9:40		0.88		0.13	pCi/g
199-N-172	J180Y0-A	1/19/09 10:30		-0.004	U	0.345	pCi/g
199-N-172	J180Y1-A	1/19/09 10:30	R	-0.05	U	0.314	pCi/g
199-N-172	J180Y2-A	1/19/09 11:40		0.149	U	0.33	pCi/g
199-N-172	J180Y3-A	1/19/09 13:00		0.5		0.271	pCi/g
199-N-172	J180Y5	1/27/09 14:45		0.0896	U	0.146	pCi/g

APPENDIX C

GEOPHYSICAL LOG REPORTS

Stoller
Hanford Office
established 1959

HGLP-LDR-367, Rev. 0

199-N-167 (C7032)
Log Data Report

Borehole Information:

Borehole:	199-N-167 (C7032)		Site	100-NR-2	
Coordinates (WA St Plane)		GWL[1] (ft):	72.8	GWL Date:	02/04/09
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
Unknown	Unknown	02/03/09	Unknown	81.6	Cable tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (inch)	Inside Diameter (inch)	Thickness (inch)	Top (ft)	Bottom (ft)
Welded steel	-1.5	8 5/8	7 5/8	1/2	-1.5	81.6

Borehole Notes:

The logging engineer measured depth to water and the casing diameter, rounding to the nearest 1/16 inch.

This borehole is part of a bioventing pilot test for remediation of hydrocarbon-impacted soils.

Logging Equipment Information:

Logging System:	Gamma 1 L		Type: Serial No.:	SGLS (60%) 47TP32211A
Effective Calibration Date:	04/17/2008	Calibration Reference:	HGLP-CC-030, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	

Logging System:	Gamma 1 M		Type: Serial No.:	NMLS H240207279
Effective Calibration Date:	05/06/2008	Calibration Reference:	HGLP-CC-032, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 Repeat			
Date	02/04/09	02/04/09			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	81.0	70.0			
Finish Depth (ft)	0.0	59.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	NA	NA			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	NA	NA			
Pre-Verification	AL033CAB	AL033CAB			
Start File	AL033000	AL033082			
Finish File	AL033081	AL033093			
Post-Verification	AL033CAA	AL033CAA			
Depth Return Error (inch)	NA	NA			
Comments	No Fine gain adjustments made	No Fine gain adjustments made			

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Stoller
Hanford Office
established 1959

HGLP-LDR-367, Rev. 0

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	3	4 Repeat			
Date	02/04/09	2/04/09			
Logging Engineer	Spatz/ Pearson	Spatz/ Pearson			
Start Depth (ft)	0.0	55.0			
Finish Depth (ft)	72.5	62.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	NA	NA			
Pre-Verification	AMO55CAB	AM055CAB			
Start File	AM055000	AM055291			
Finish File	AM055290	AM055319			
Post-Verification	AM055CAA	AM055CAA			
Depth Return Error (inch)	NA	NA			
Comments	None	None			

Logging Operation Notes:

Data were collected using Gamma 1 HO 68B-3574 for both logs. Pre- and post-survey verification measurements were acquired in the Amersham KUTh-082 field verifier for the SGLS and the AmBe standard for the NMLS. A centralizer was installed on the sondes. For the SGLS, the maximum logging depth achieved was 81.03 ft, before the sonde un-weighted. The maximum logging depth for the NMLS was 72.5 ft, just above the reported water depth. The zero reference was the ground surface.

Analysis Notes:

Analyst:	HOLLOWAY	Date:	03/03/09	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre- and post-survey verification spectra for the SGLS and NMLS met the acceptance criteria for the established systems.

SGLS spectra were processed in batch mode using APTEC Supervisor to identify individual peaks and count rates. Concentrations were calculated using an EXCEL template identified as G1LApr08.xls using an efficiency function and corrections for casing, dead time and water as determined by annual calibrations.

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

The NMLS data were processed to identify count rates. Count rates were converted to percent volumetric moisture using an EXCEL template identified as G1MMay08.xls, using calibration for an 8-inch diameter borehole.

Results and Interpretations:

Co-60 was detected intermittently from 59-66 feet. The maximum concentration of 0.7 pCi/g was measured at 60 feet.

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HGLP-LDR-367, Rev. 0

Moisture indicates some variability. The neutron moisture sonde bombards the formation with neutrons and detects the back-scattered neutrons. In geologic media, the dominant mechanism for neutron scattering is interaction with hydrogen atoms. In the vadose zone, hydrogen content is usually related to water (moisture) content. With the source-detector configuration used in the moisture log, count rate increases with increasing moisture. However, the logging system responds to all hydrogen and does not discriminate between "free" water, "bound" water, water of hydration, or other hydrogenous compounds. Because this site has possible hydrocarbon contamination, the logging sonde may be responding to hydrocarbon contamination, as well as moisture, at some depth locations.

KUT, Co-60 and moisture show good repeatability.

List of Log Plots:

Depth Reference is ground surface.

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

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

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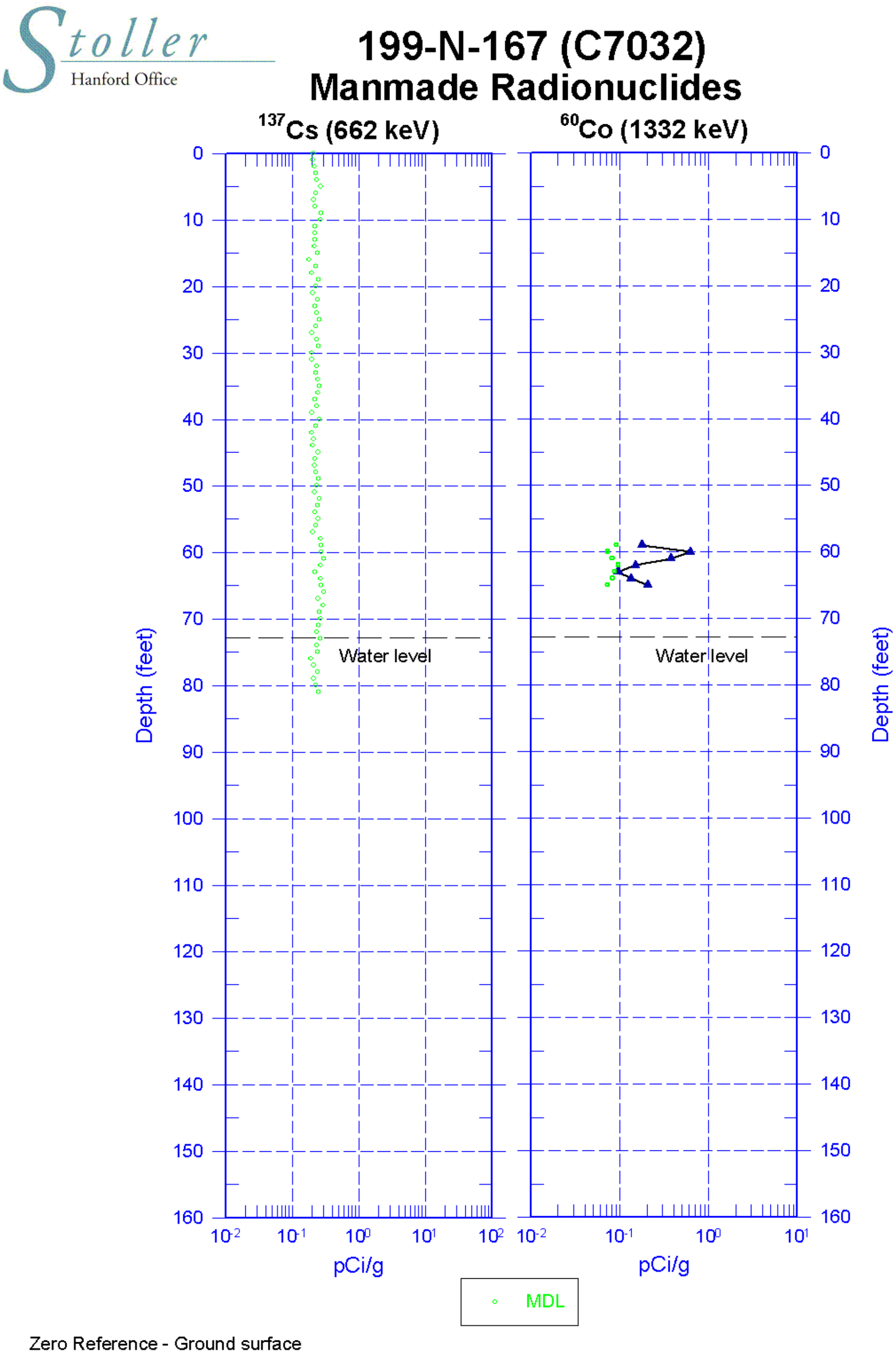
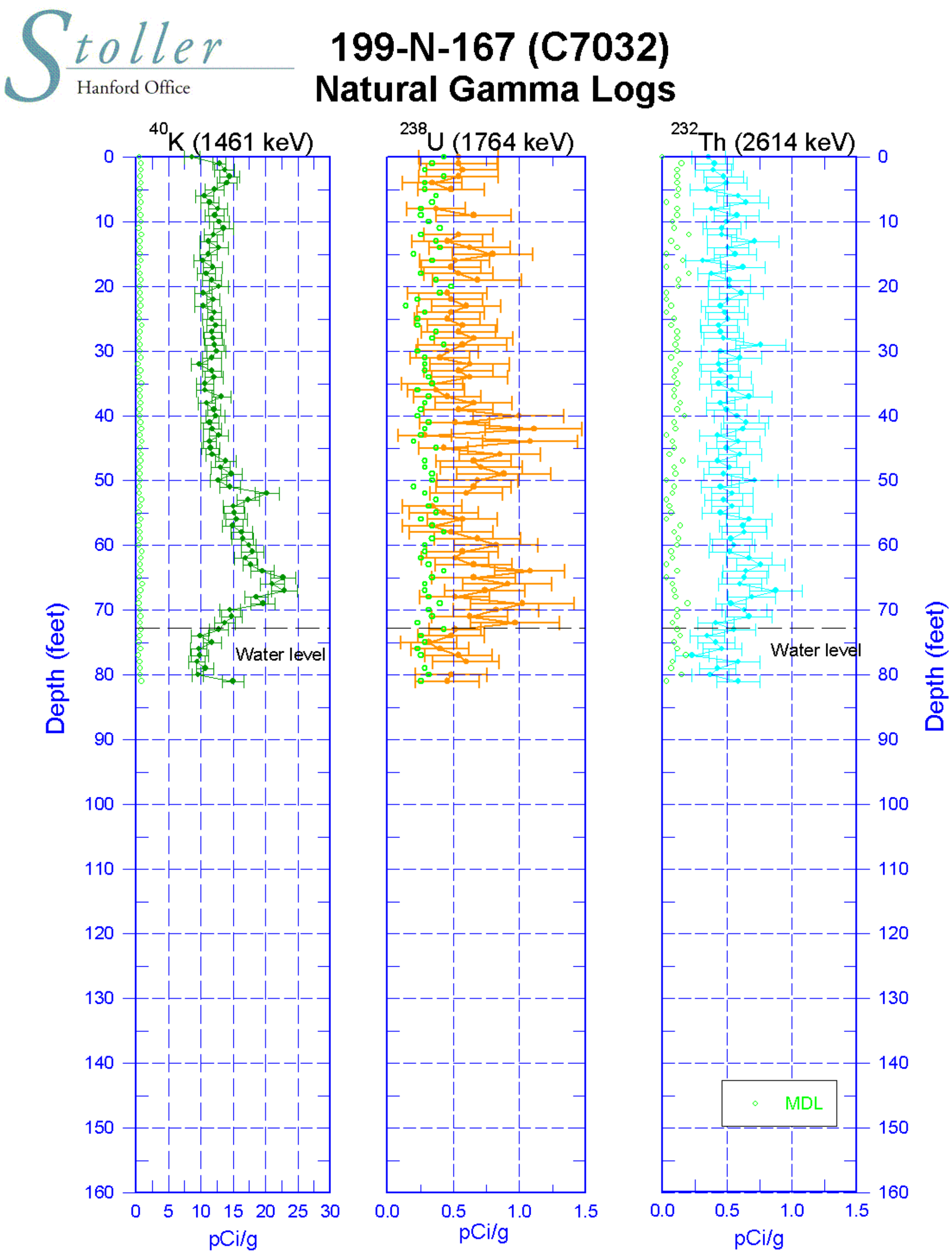
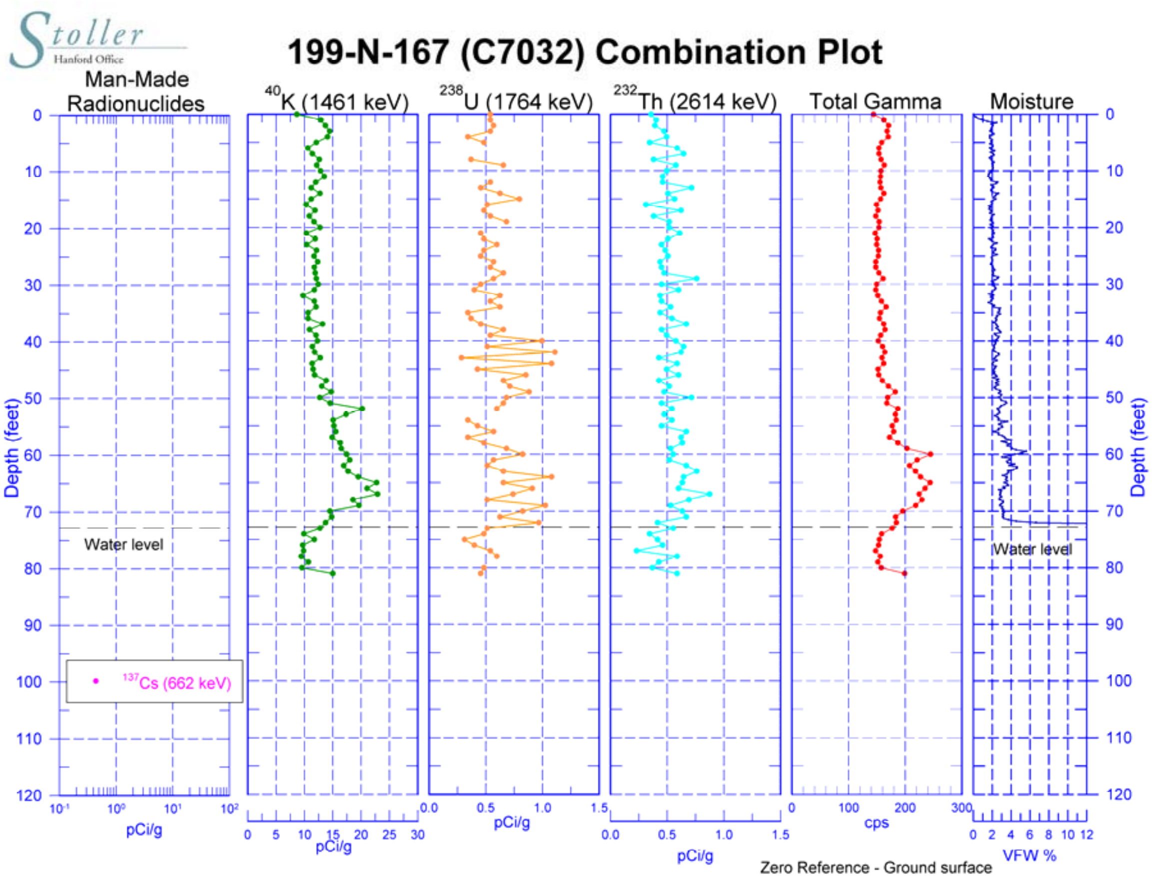
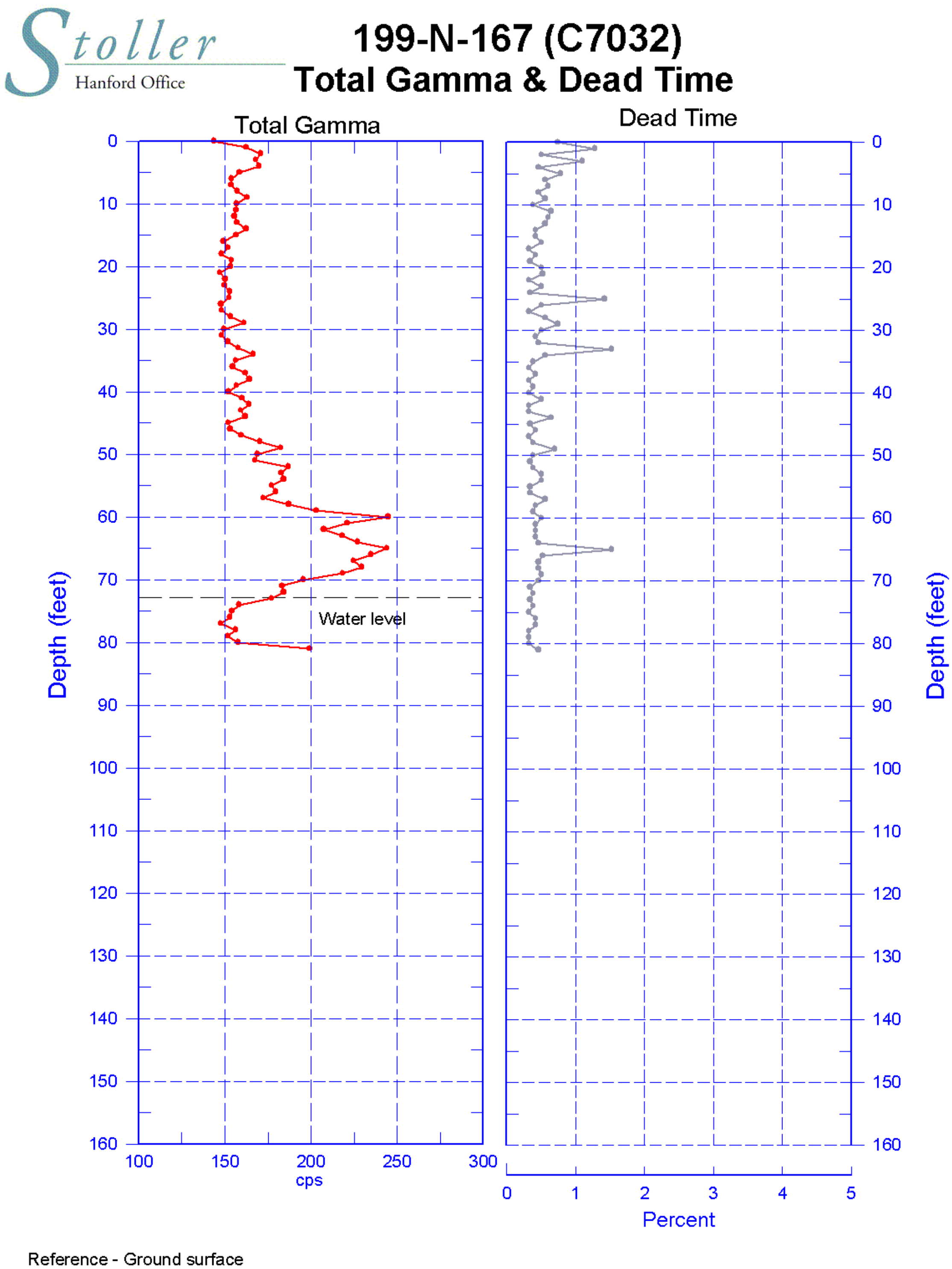

Stoller
Hanford Office
199-N-167 (C7032)
Manmade Radionuclides
137Cs (662 keV)
60Co (1332 keV)
Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
Water level
10-2
10-1
100
101
102
pCi/g
MDL
Zero Reference - Ground surface

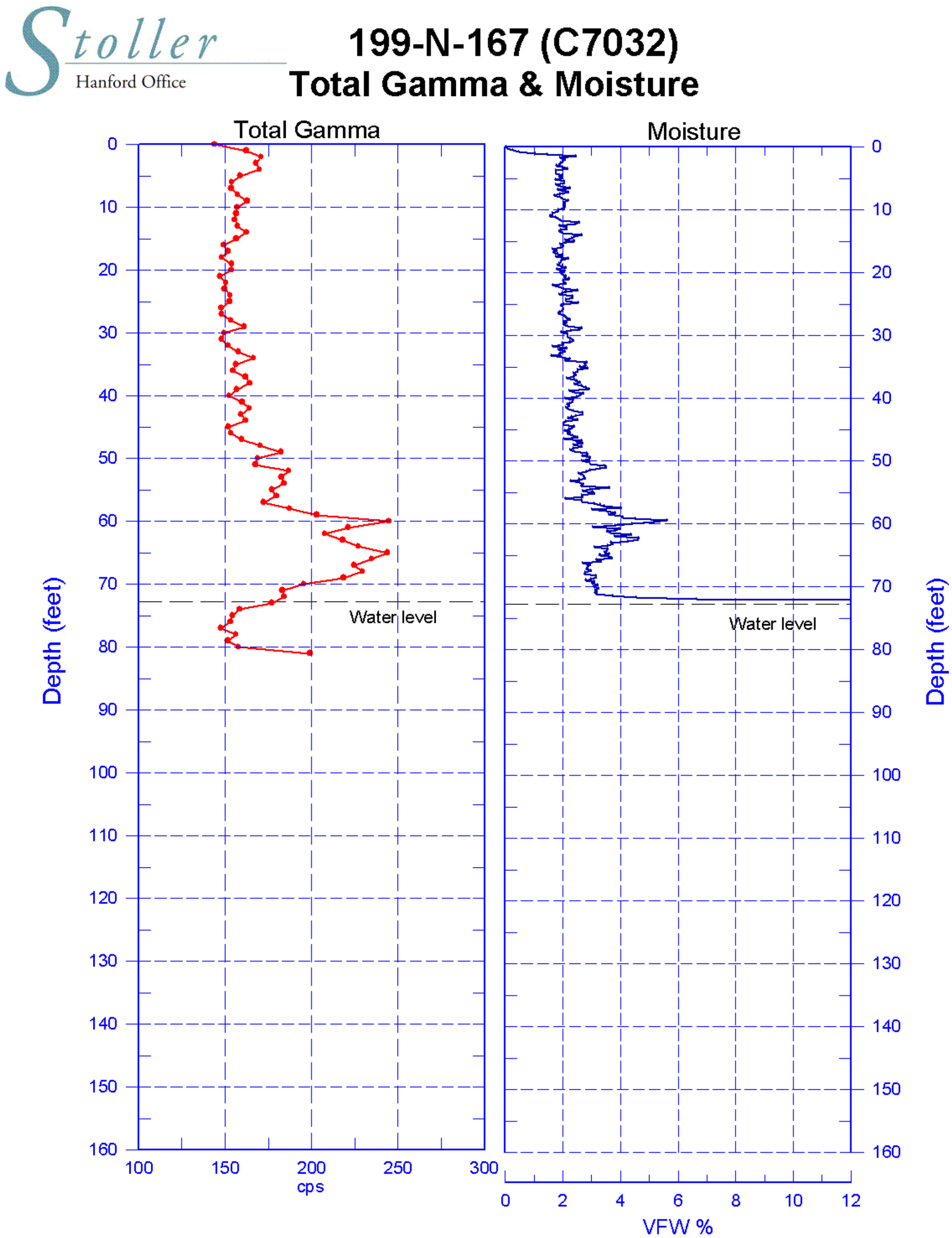
199-N-167 (C7032)
Natural Gamma Logs



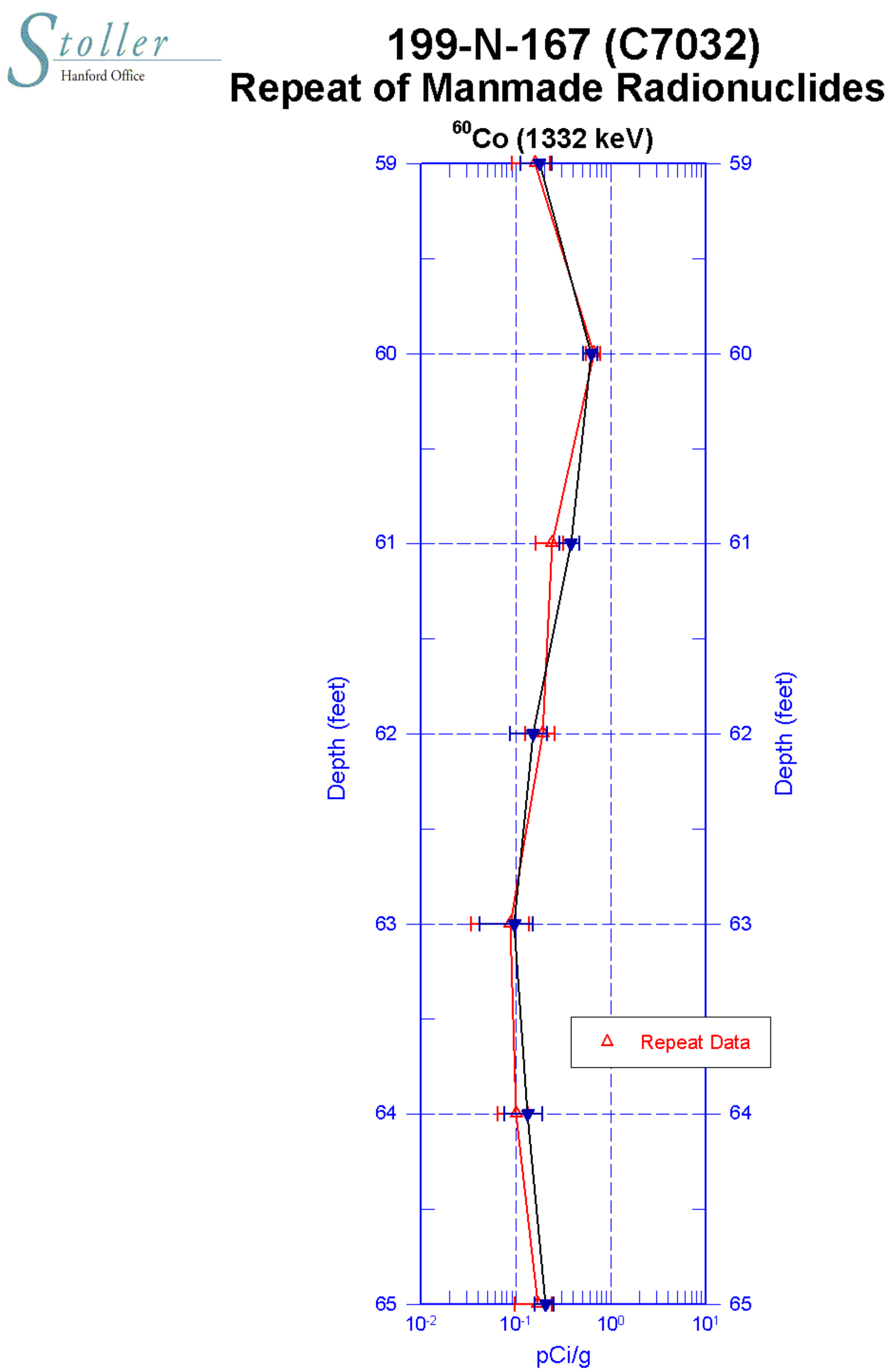
Zero Reference - Ground surface


Stoller
Hanford Office
199-N-167 (C7032) Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Moisture
Depth (feet)
Water level
137Cs (662 keV)
pCi/g
cps
VFW %
Zero Reference - Ground surface

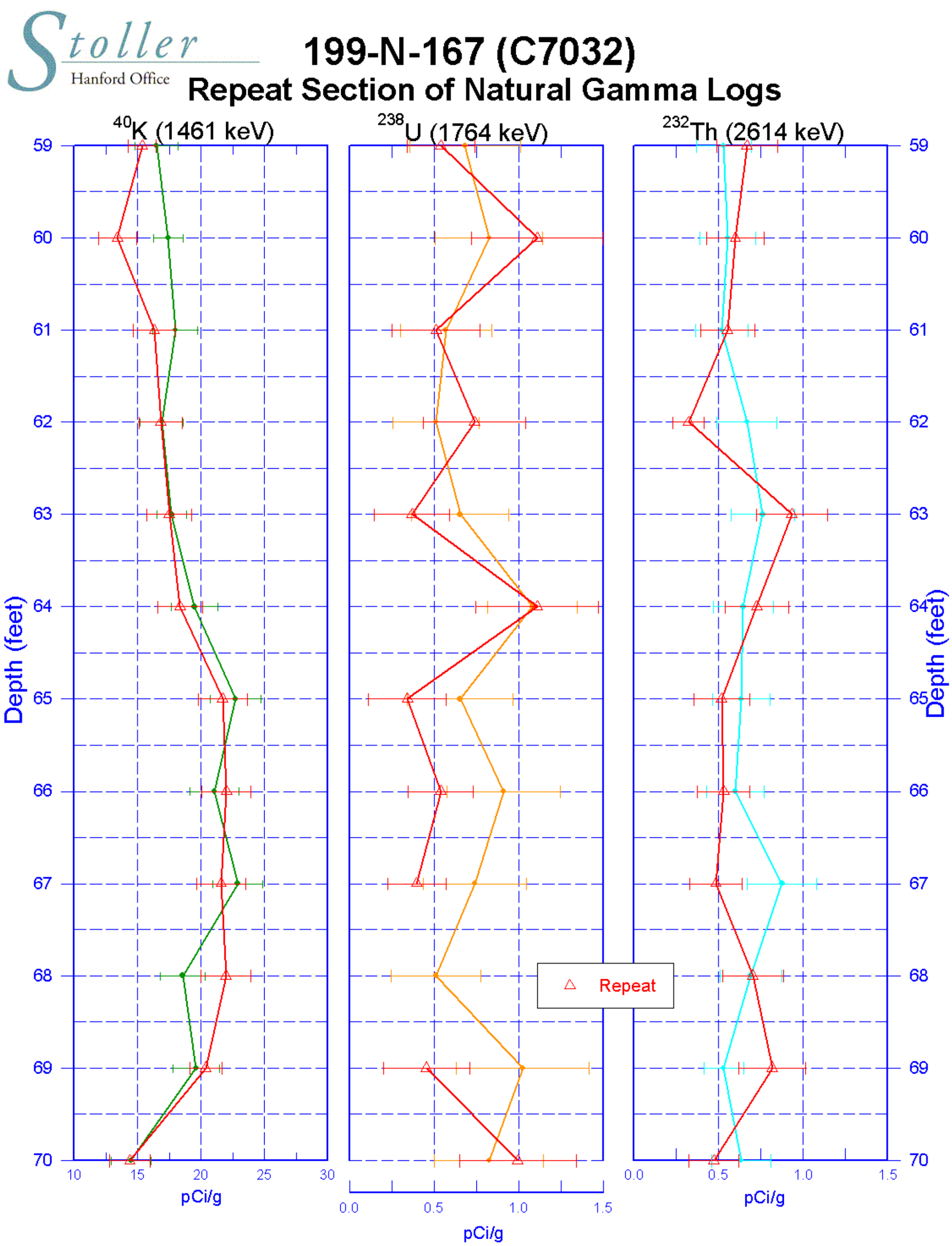

Stoller
Hanford Office
199-N-167 (C7032)
Total Gamma & Dead Time
Total Gamma
Dead Time
Depth (feet)
Water level
cps
Percent
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
100
150
200
250
300
1
2
3
4
5
Reference - Ground surface



Reference - Ground surface

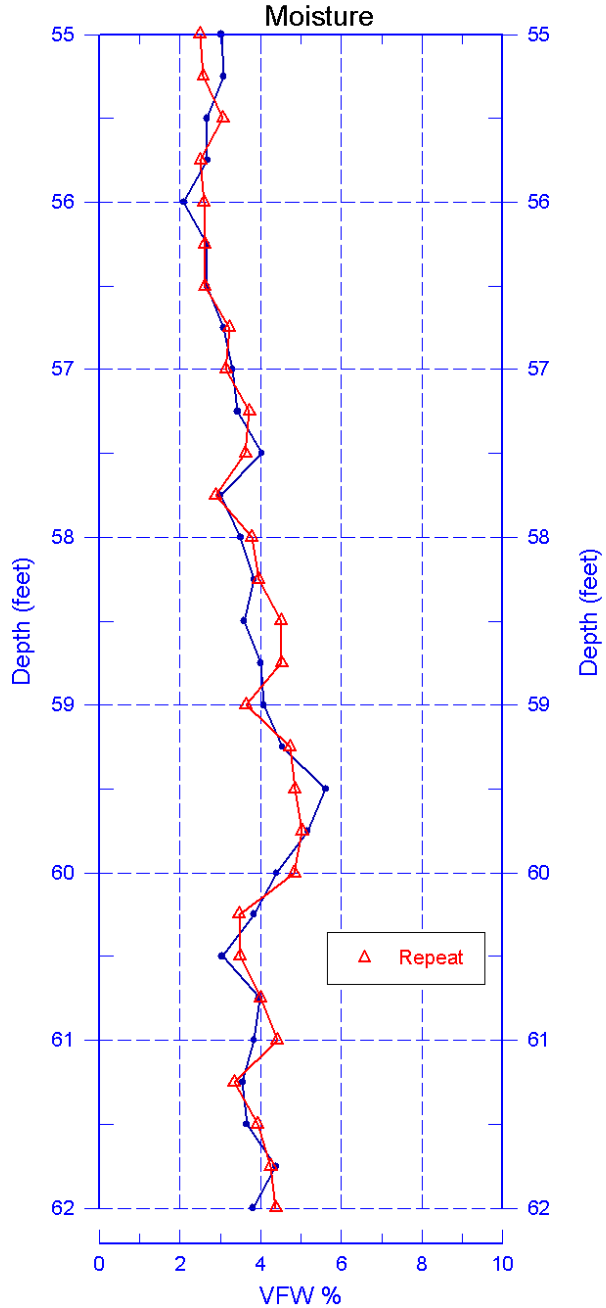


Zero Reference - Ground surface



Zero Reference - Ground surface

199-N-167 (C7032)
Moisture Repeat Section



Reference - Ground surface

Stoller
Hanford Office
established 1959

HGLP-LDR-346, Rev. 0

199-N-169 (C7034)
Log Data Report

Borehole Information:

Borehole:	199-N-169 (C7034)		Site	100-NR-2	
Coordinates (WA St Plane)		GWL[1] (ft):	73.9	GWL Date:	02/18/09
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
Unknown	Unknown	02/17/09	Unknown	82.5	Cable tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (inch)	Inside Diameter (inch)	Thickness (inch)	Top (ft)	Bottom (ft)
Welded steel	-1.3	8 5/8	7 5/8	1/2	-1.3	82

Borehole Notes:

The logging engineer measured depth to water and the inner casing diameter, rounding to nearest 1/16 inch.

This borehole is part of a bioventing pilot test for remediation of hydrocarbon-impacted soils.

Logging Equipment Information:

Logging System:	Gamma 1 L		**Type:** **Serial No.:**	SGLS (60%) 47TP32211A
Effective Calibration Date:	04/17/2008	**Calibration Reference:**	HGLP-CC-030, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	
Logging System:	Gamma 1 M		**Type:** **Serial No.:**	NMLS H240207279
Effective Calibration Date:	05/06/2008	**Calibration Reference:**	HGLP-CC-032, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 Repeat			
Date	02/18/09	02/18/09			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	81.0	70.0			
Finish Depth (ft)	0.0	60.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	NA	NA			
Pre-Verification	AL034CAB	AL034CAB			
Start File	AL034000	AL034082			
Finish File	AL034081	AL034092			
Post-Verification	AL034CAA	AL034CAA			
Depth Return Error (inch)	NA	NA			
Comments	No fine gain adjustments made	No fine gain adjustments made			

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HGLP-LDR-346, Rev. 0

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	3	4 Repeat			
Date	02/18/09	02/18/09			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	0.0	55.0			
Finish Depth (ft)	73.75	62.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N	N			
Pre-Verification	AMO56CAB	AM056CAB			
Start File	AM056000	AM056296			
Finish File	AM056295	AM056336			
Post-Verification	AM056CAA	AM056CAA			
Depth Return Error (inch)	NA	NA			
Comments	None	None			

Logging Operation Notes:

Data were collected using Gamma 1 HO 68B-3574 for both logs. Pre- and post-survey verification measurements were acquired in the Amersham KUTh-082 field verifier for the SGLS and the AmBe standard for the NMLS. A centralizer was installed on the sondes. For the SGLS, the maximum logging depth achieved was 81.03 ft, before the sonde un-weighted. The maximum logging depth for the NMLS was 73.5 ft, just above the reported water depth. The zero reference was the ground surface.

Analysis Notes:

Analyst:	HOLLOWAY	Date:	03/03/09	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre- and post-survey verification spectra for the SGLS and NMLS met the acceptance criteria for the established systems.

SGLS spectra were processed in batch mode using APTEC Supervisor to identify individual peaks and count rates. Concentrations were calculated using an EXCEL template identified as G1LApr08.xls using an efficiency function and corrections for casing, dead time and water as determined by annual calibrations.

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

The NMLS data were processed to identify count rates. Count rates were converted to percent volumetric moisture using an EXCEL template identified as G1Mmay08.xls using calibration for an 8-inch diameter borehole.

Results and Interpretations:

Co-60 was detected intermittently from 59-68 feet. The maximum concentration of 0.61 pCi/g was measured at 60 feet.

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HGLP-LDR-346, Rev. 0

Moisture data indicated some variability. The neutron moisture sonde bombards the formation with neutrons and detects the back-scattered neutrons. In geologic media, the dominant mechanism for neutron scattering is interaction with hydrogen atoms. In the vadose zone, hydrogen content is usually related to water (moisture) content. With the source-detector configuration used in the moisture log, count rate increases with increasing moisture. However, the logging system responds to all hydrogen and does not discriminate between "free" water, "bound" water, water of hydration, or other hydrogenous compounds. Because this site has possible hydrocarbon contamination, the logging sonde may be responding to hydrocarbon contamination, as well as moisture, at some depth locations.

KUT, NMLS and Co-60 data shows good repeatability.

List of Log Plots:

Depth Reference is ground surface.

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

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

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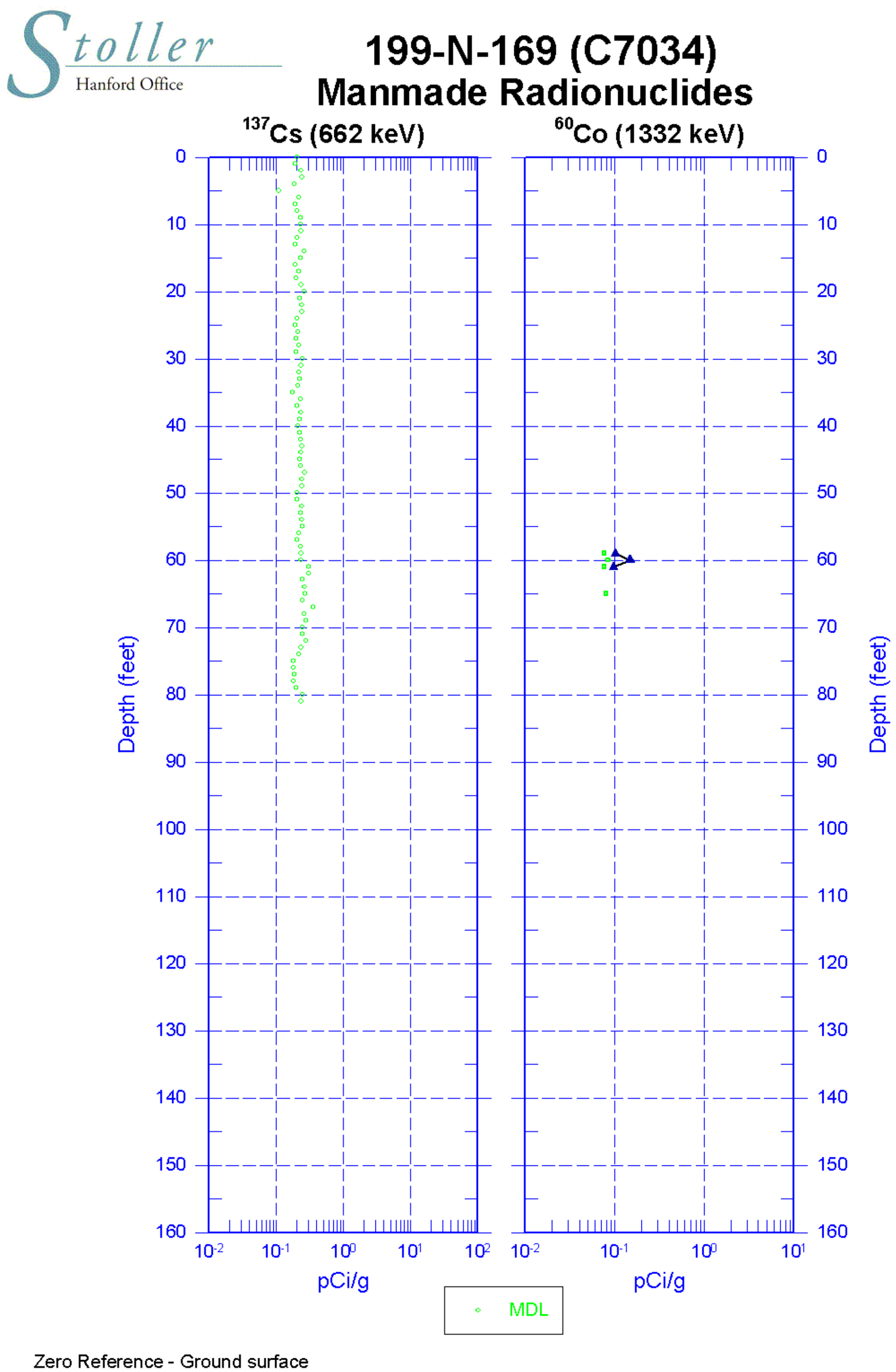
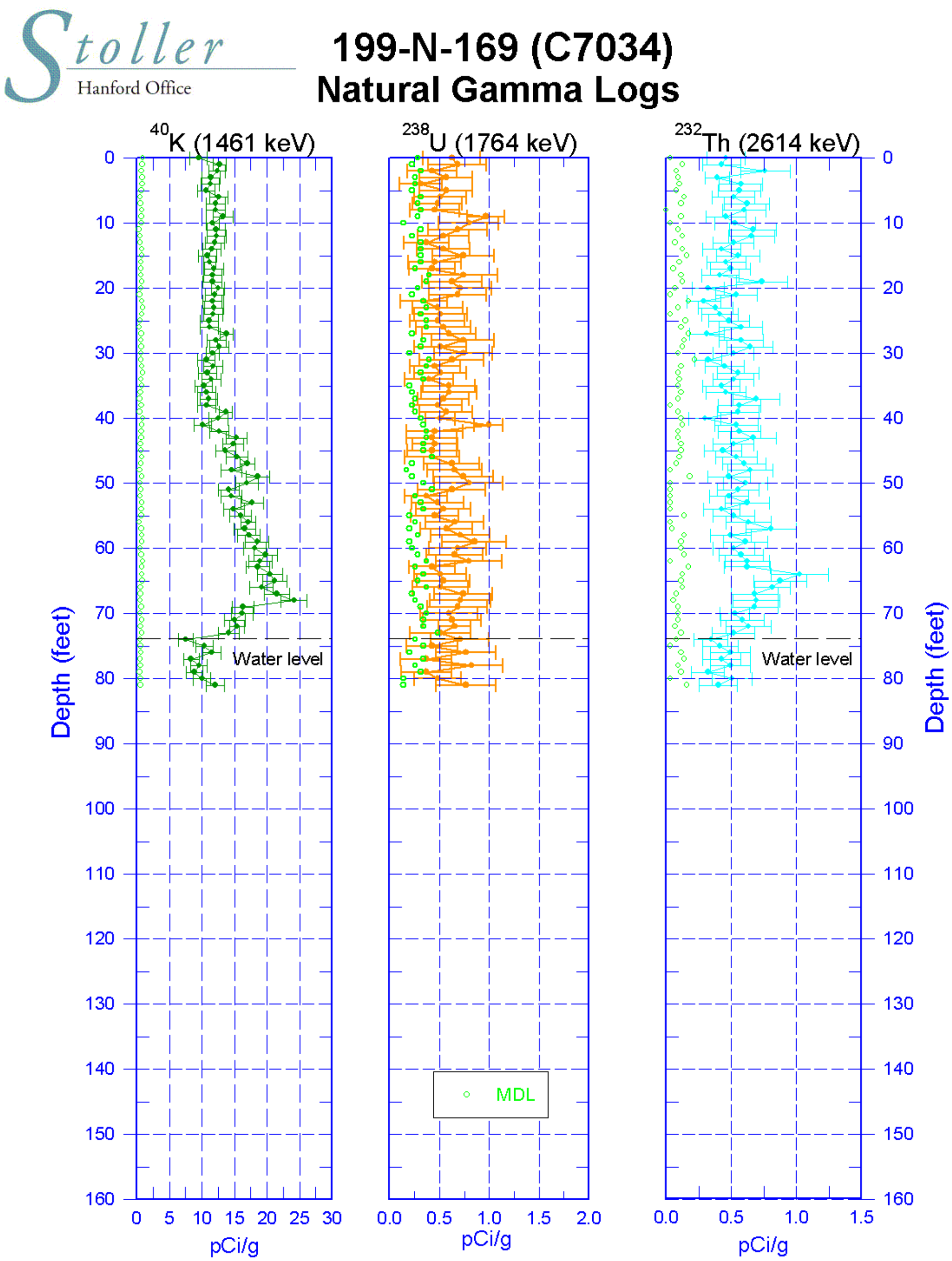
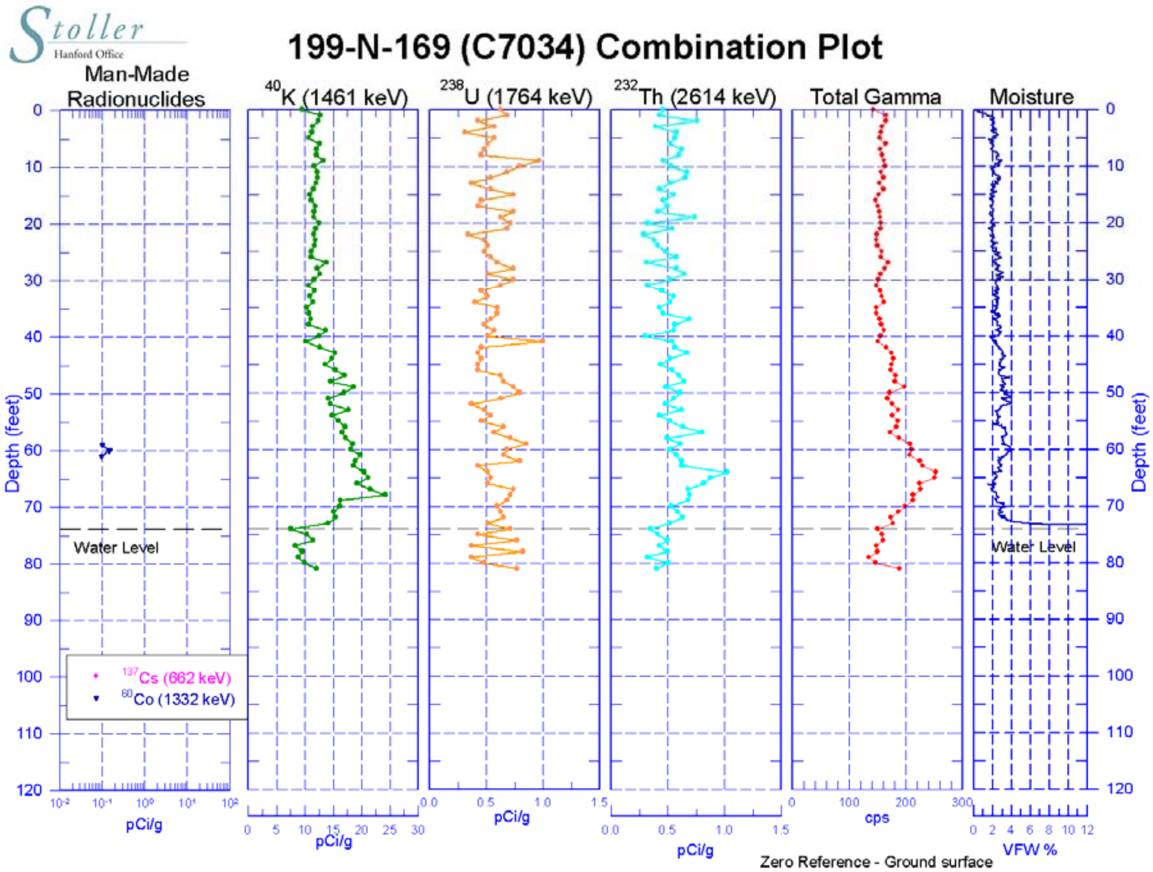
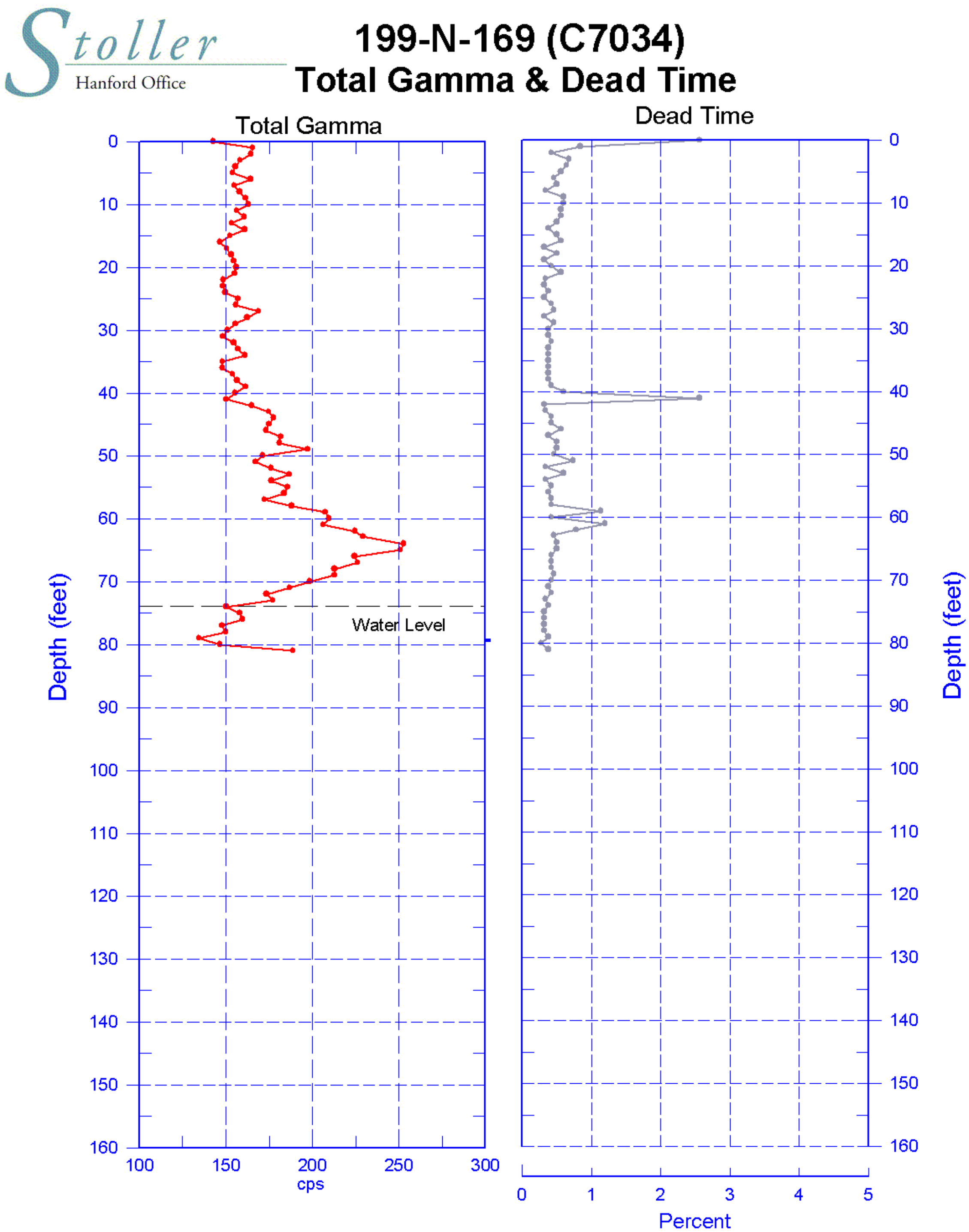

Stoller
Hanford Office
199-N-169 (C7034)
Manmade Radionuclides
137Cs (662 keV)
60Co (1332 keV)
Depth (feet)
pCi/g
MDL
Zero Reference - Ground surface



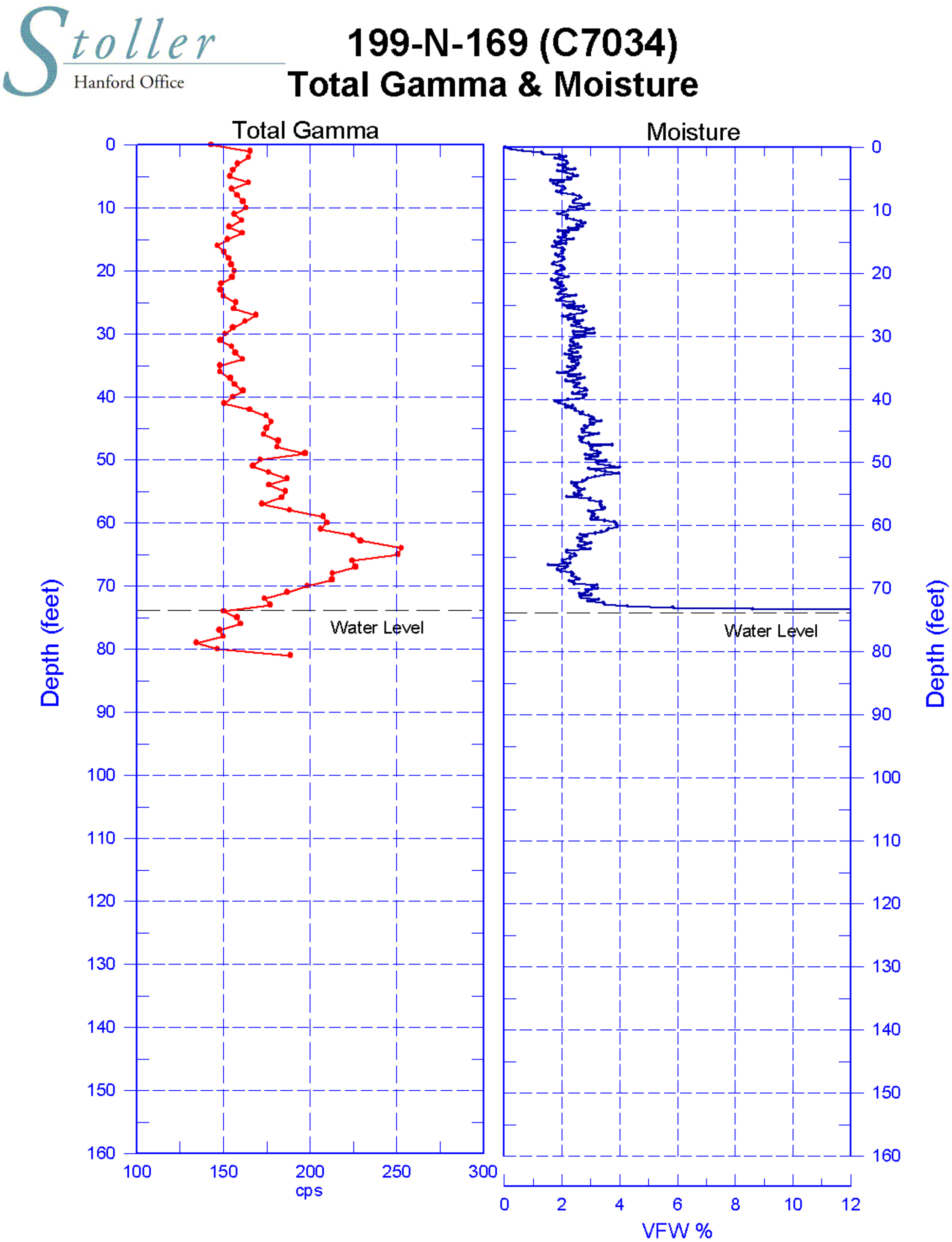
Zero Reference - Ground surface


Stoller
Hanford Office
199-N-169 (C7034) Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Moisture
Depth (feet)
Water Level
137Cs (662 keV)
60Co (1332 keV)
pCi/g
cps
VFW %
Zero Reference - Ground surface

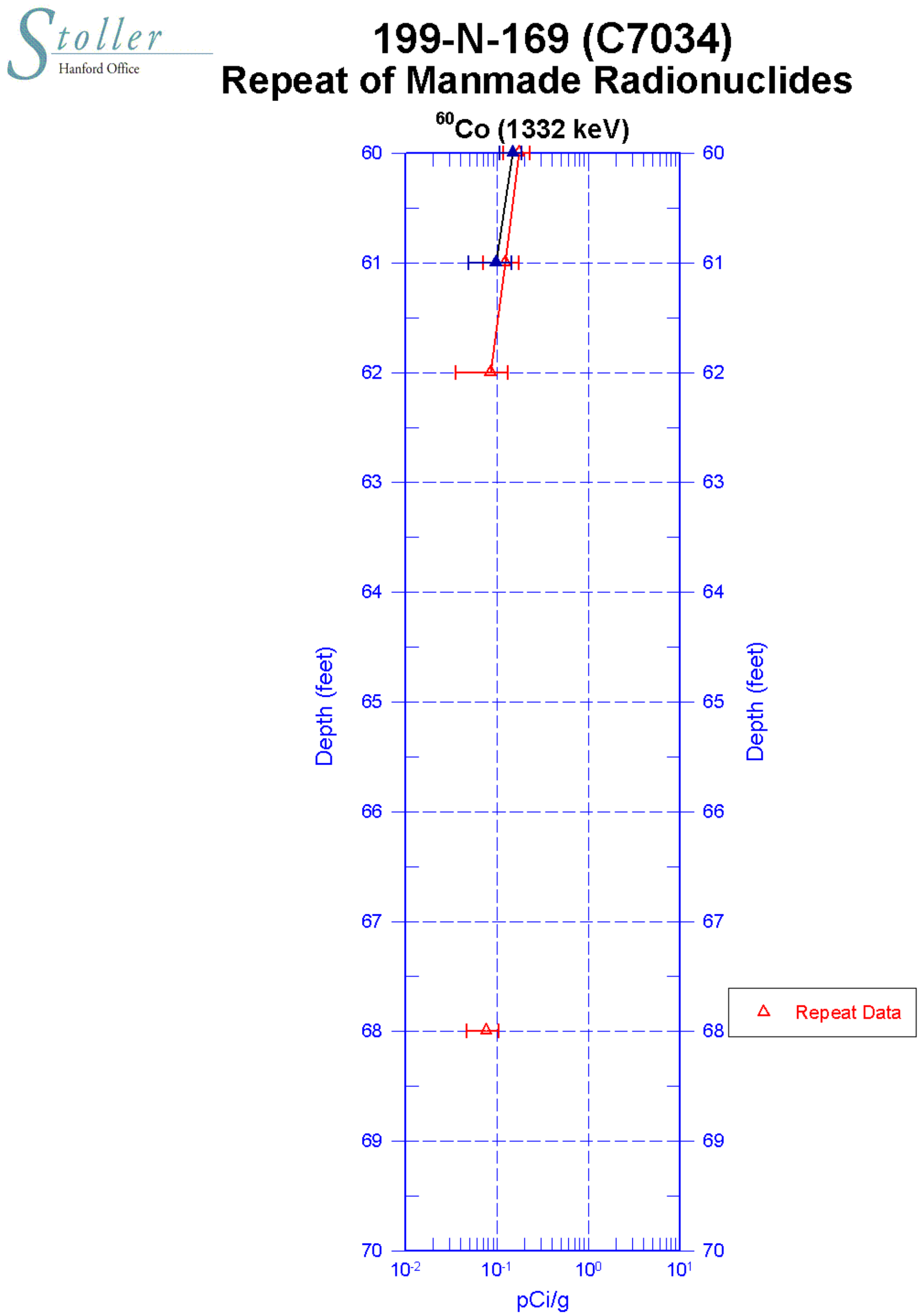


Reference - Ground surface

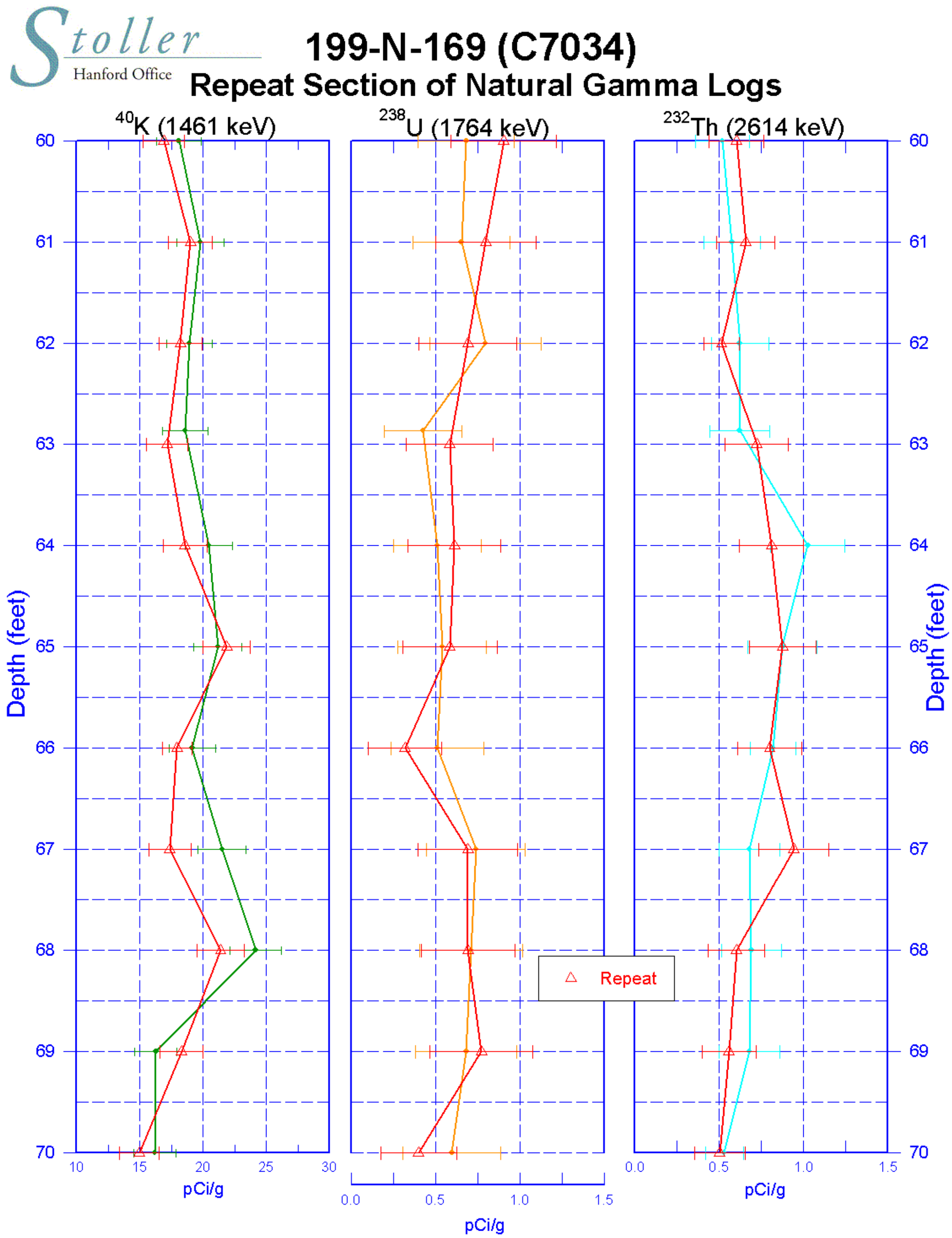
199-N-169 (C7034)
Total Gamma & Moisture



Reference - Ground surface

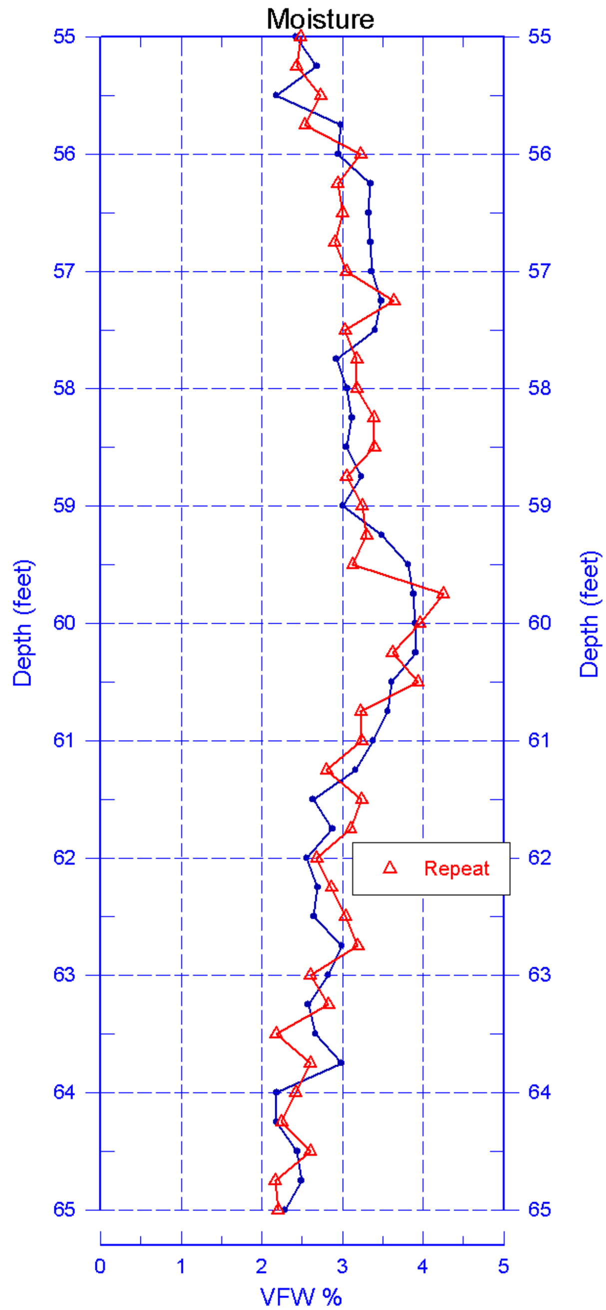


Zero Reference - Ground surface



Zero Reference - Ground surface

199-N-169 (C7034)
Moisture Repeat Section



Reference - Ground surface

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established 1959

HGLP-LDR-348, Rev. 0

199-N-170 (C7035)
Log Data Report

Borehole Information:

Borehole:	199-N-170 (C7035)		Site:	100-NR-2	
Coordinates (WA St Plane)		GWL[1] (ft):	74.6	GWL Date:	03/03/09
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
Unknown	Unknown	03/02/09	Unknown	83.5	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (inch)	Inside Diameter (inch)	Thickness (inch)	Top (ft)	Bottom (ft)
Welded Steel	-0.75	8 5/8	7 5/8	1/2	-0.75	82.0

Borehole Notes:

The logging engineer measured depth to water and the casing diameter, rounding to the nearest 1/16 inch.

This borehole is part of a bioventing pilot test for remediation of hydrocarbon-impacted soil.

Logging Equipment Information:

Logging System:	Gamma 1 L		Type: Serial No.:	60% HPGe SGLS 45TP22010A
Effective Calibration Date:	03/28/08	Calibration Reference:	HGLP-CC-031, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	

Logging System:	Gamma 1 M		Type: Serial No.:	NMLS H340207279
Effective Calibration Date:	05/06/08	Calibration Reference:	HGLP-CC-032	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 Repeat			
Date	03/03/09	03/03/09			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	82.0	70.0			
Finish Depth (ft)	0.0	60.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	NA	NA			
Pre-Verification	AN121CAB	AN121CAB			
Start File	AN121000	AN121083			
Finish File	AN121082	AN121093			
Post-Verification	AN121CAA	AN121CAA			
Depth Return Error (inch)	Low 1	0			
Comments	No fine gain adjustment made.	No fine gain adjustment made			

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HGLP-LDR-348, Rev. 0

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	3	4 Repeat			
Date	03/03/09	03/03/09			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	0.0	35.0			
Finish Depth (ft)	74.5	45.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	NA	NA			
Pre-Verification	AM057CAB	AM057CAB			
Start File	AM057000	AM057299			
Finish File	AM057298	AM057339			
Post-Verification	AM057CAA	AM057CAA			
Depth Return Error (inch)	NA	0			
Comments	None	None			

Logging Operation Notes:

Data were collected using Gamma 1, HO 68B-3574. SGLS pre- and post-survey verification measurements were acquired in the Amersham KUTh-118 field verifier. NMLS pre- and post-survey verification measurements were acquired in the AmBe standard. Maximum logging depth for the SGLS was 82.0 ft before the sonde un-weighted. A centralizer was installed on the sondes. The zero reference is the ground surface.

Analysis Notes:

Analyst:	LEGLER	Date:	03/25/09	Reference:	GJO-HGLP 1.6.3, Rev. 0

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

A casing correction for a 1/2-inch thick casing was applied during analysis. A water correction was also applied from 74.6 ft to total logged depth of borehole.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual peaks and count rates. Concentrations for SGLS were calculated using an EXCEL template identified as G1LMar08.xls using an efficiency function and corrections for casing, dead time and water as determined by annual calibrations.

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

NMLS spectra were processed in batch mode in APTEC SUPERVISOR to identify counts. NMLS count rates were calculated using an EXCEL template identified as G1MMay08.xls.

Results and Interpretations:

No manmade radionuclides were detected in this borehole.

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Stoller
Hanford Office
established 1959

HGLP-LDR-348, Rev. 0

Moisture indicates some variability. The neutron moisture sonde bombards the formation with neutrons and detects the back-scattered neutrons. In geologic media, the dominant mechanism for neutron scattering is interaction with hydrogen atoms. In the vadose zone, hydrogen content is usually related to water (moisture) content. With the source-detector configuration used in the moisture log, count rate increases with increasing moisture. However, the logging system responds to all hydrogen and does not discriminate between "free" water, "bound" water, water of hydration or other hydrogenous compounds. Because this site has possible hydrocarbon contamination, the logging sonde may be responding to hydrocarbon contamination, as well as moisture, at some depth locations.

KUT and Moisture repeat plots indicate good repeatability.

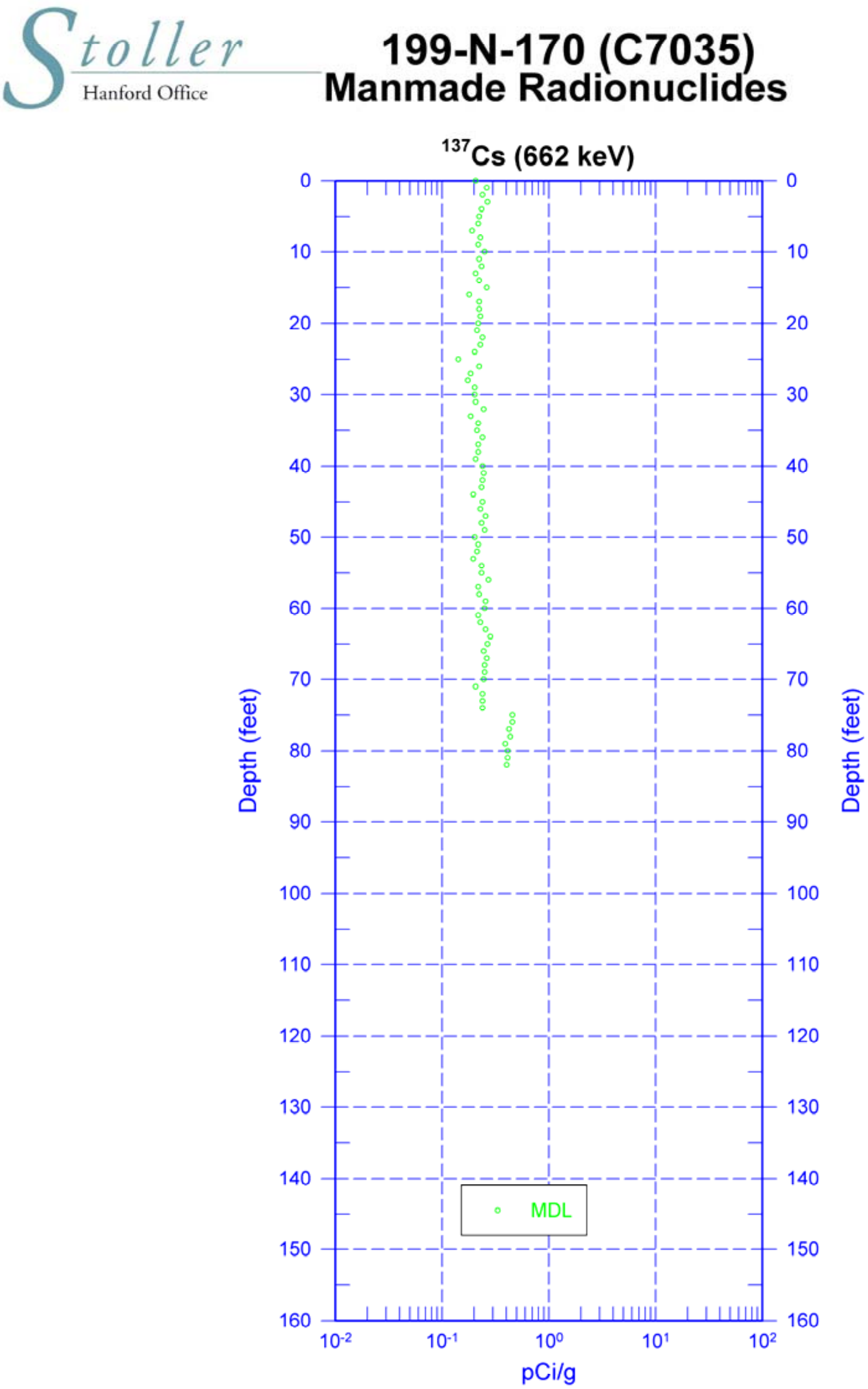
List of Log Plots:

Depth Reference is the Ground Surface

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

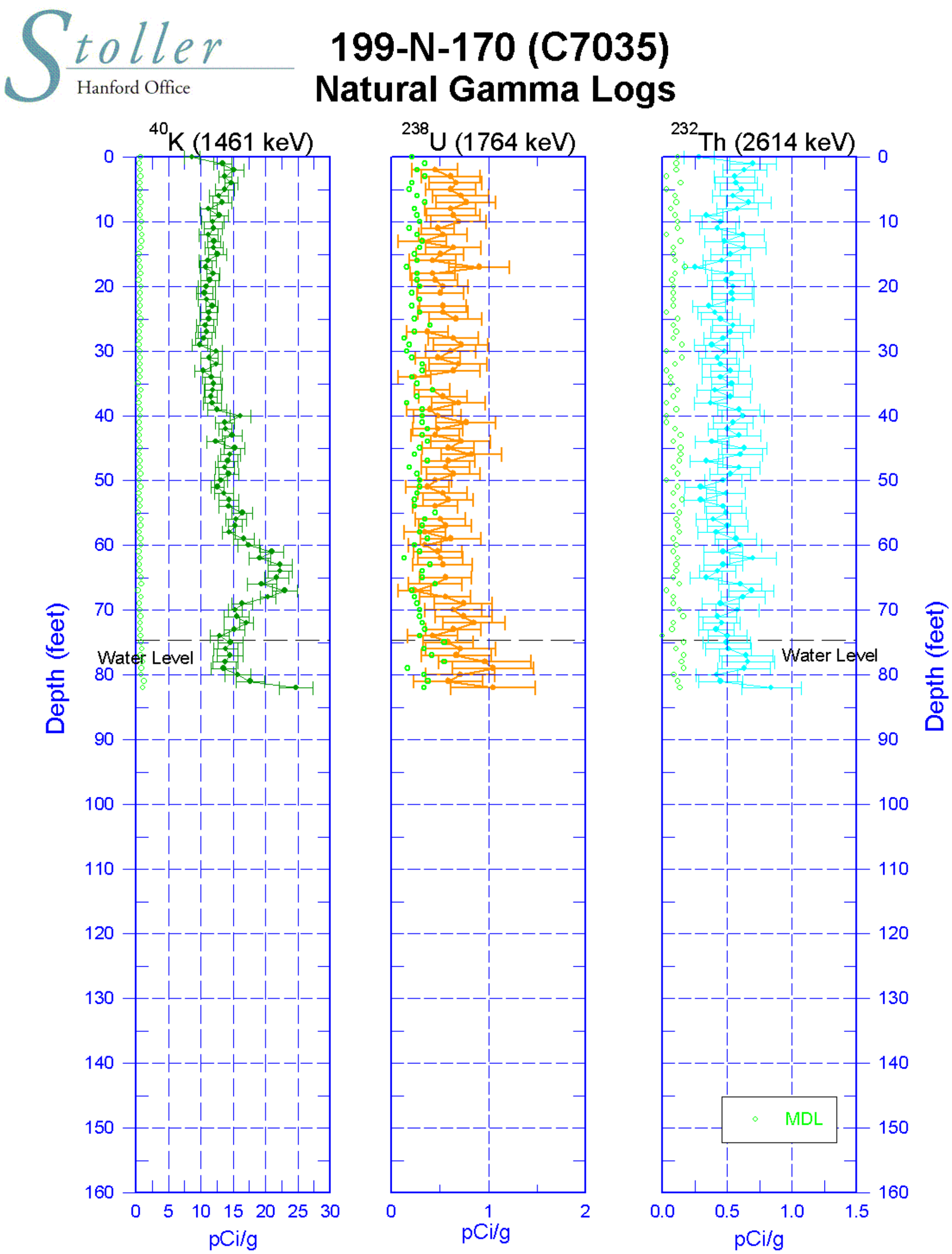
[1] GWL – groundwater level
[2] TOC – top of casing

199-N-170 (C7035)
Manmade Radionuclides

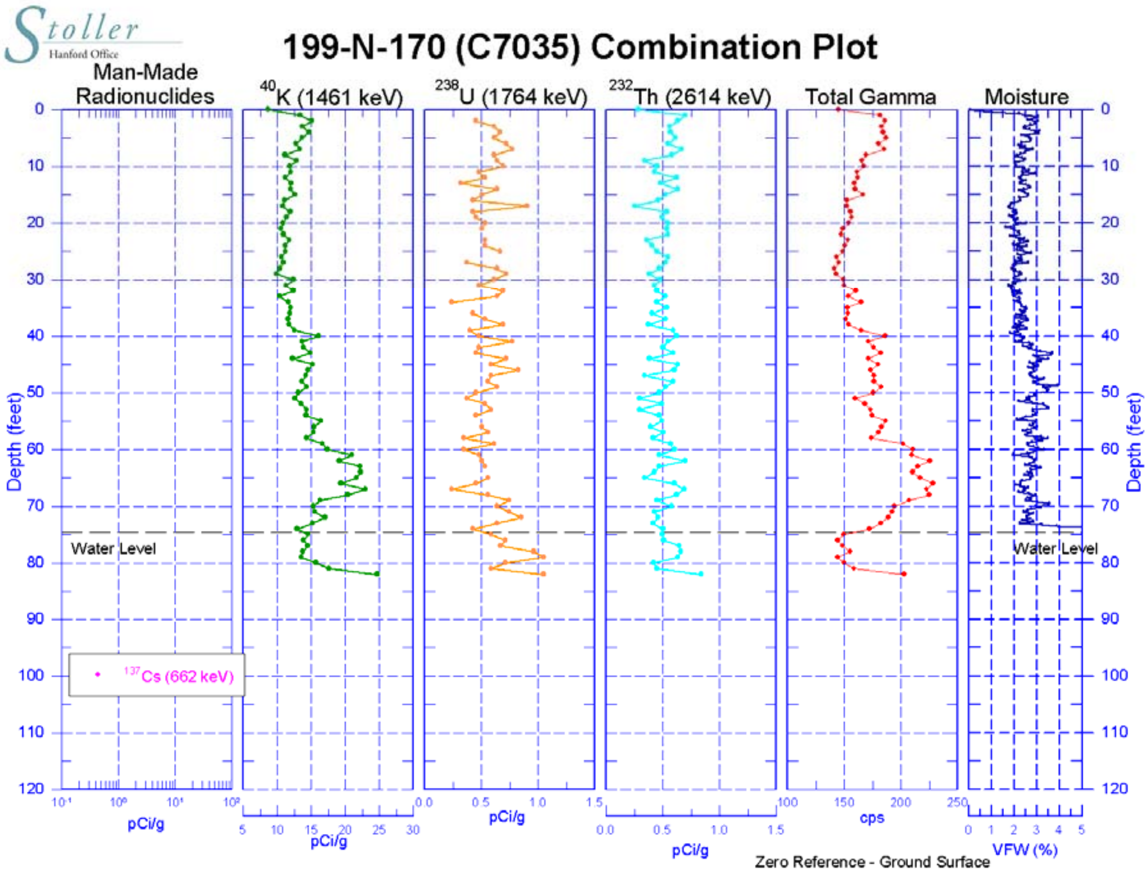


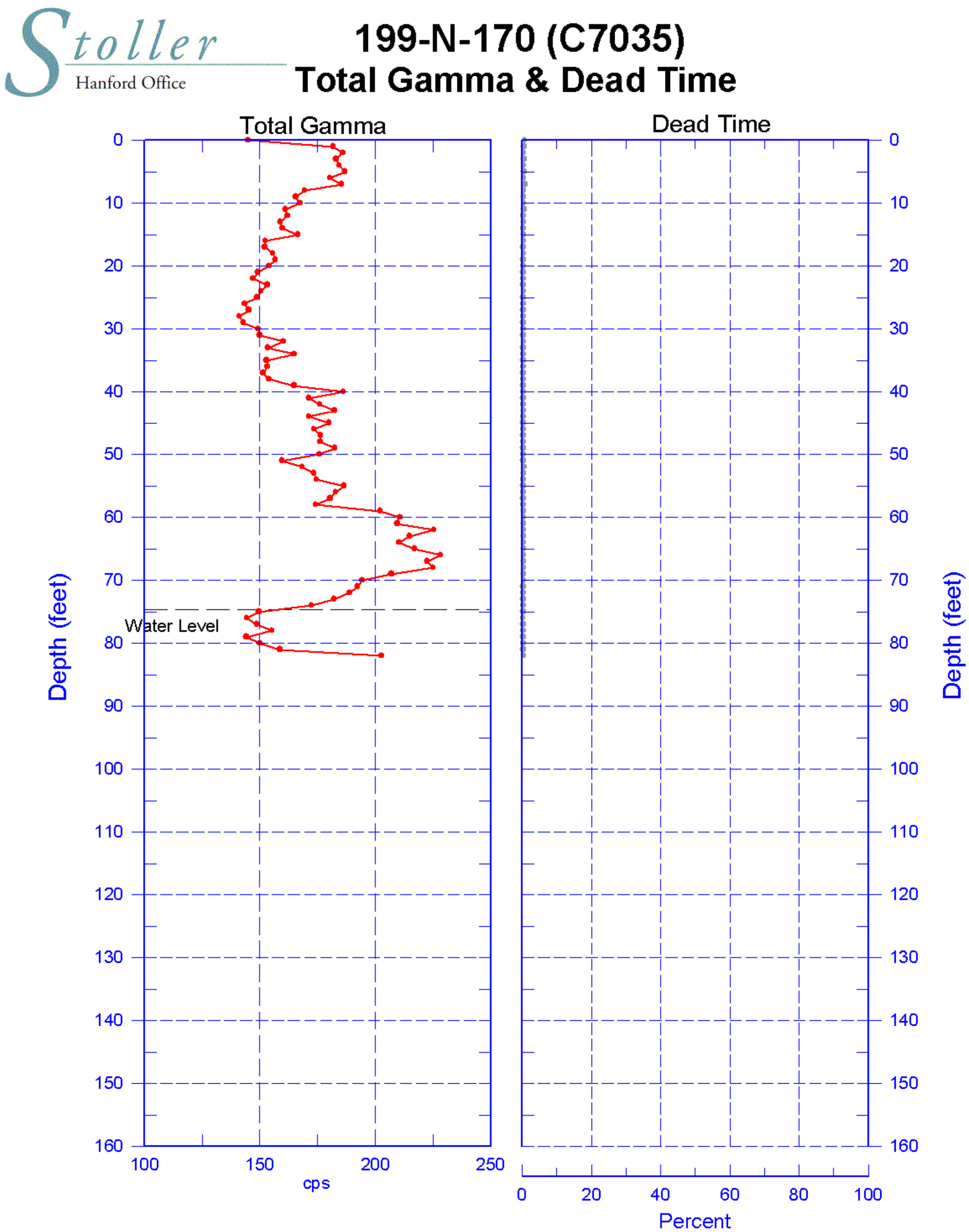
Zero Reference - Ground Surface

199-N-170 (C7035)
Natural Gamma Logs

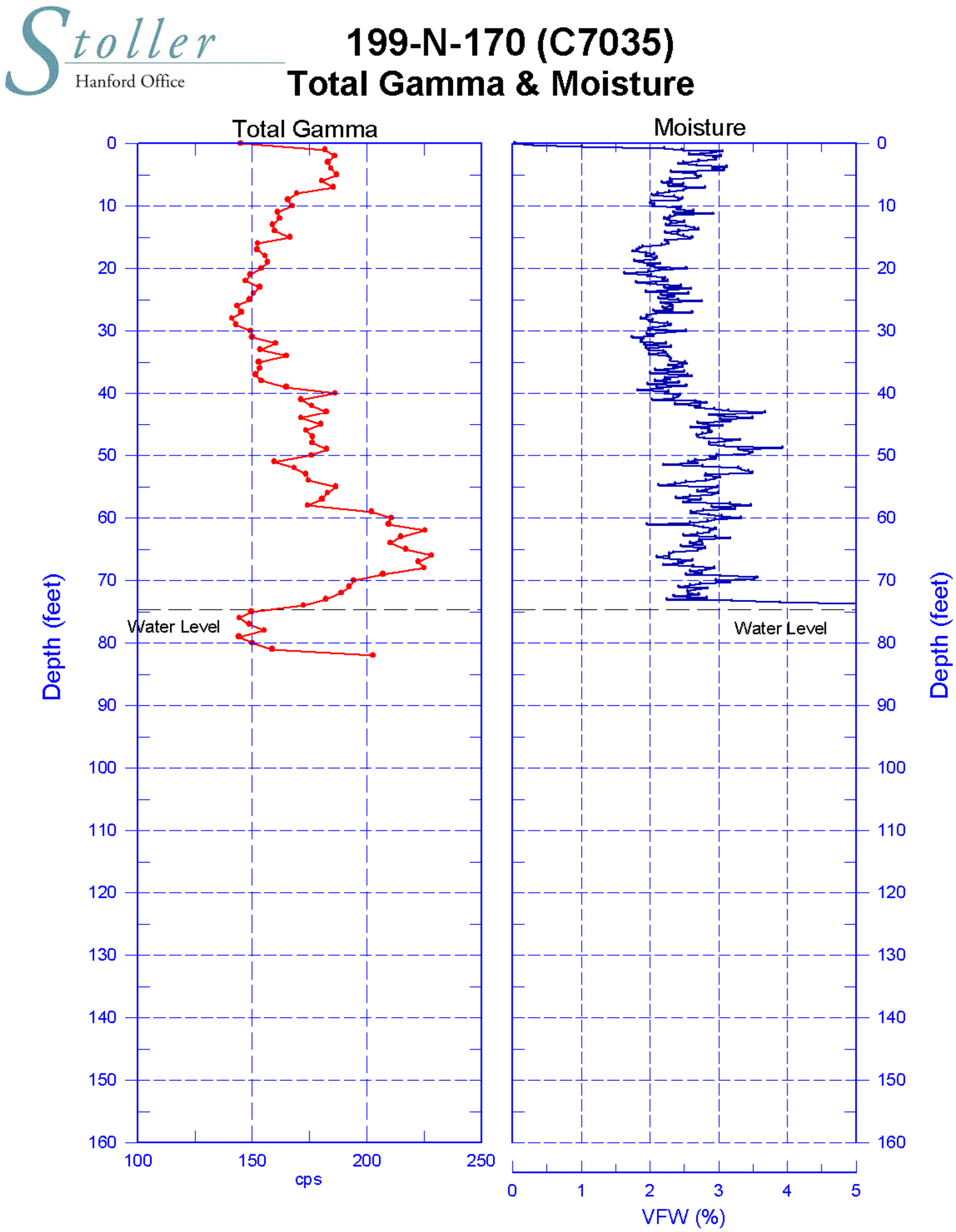


Zero Reference - Ground Surface

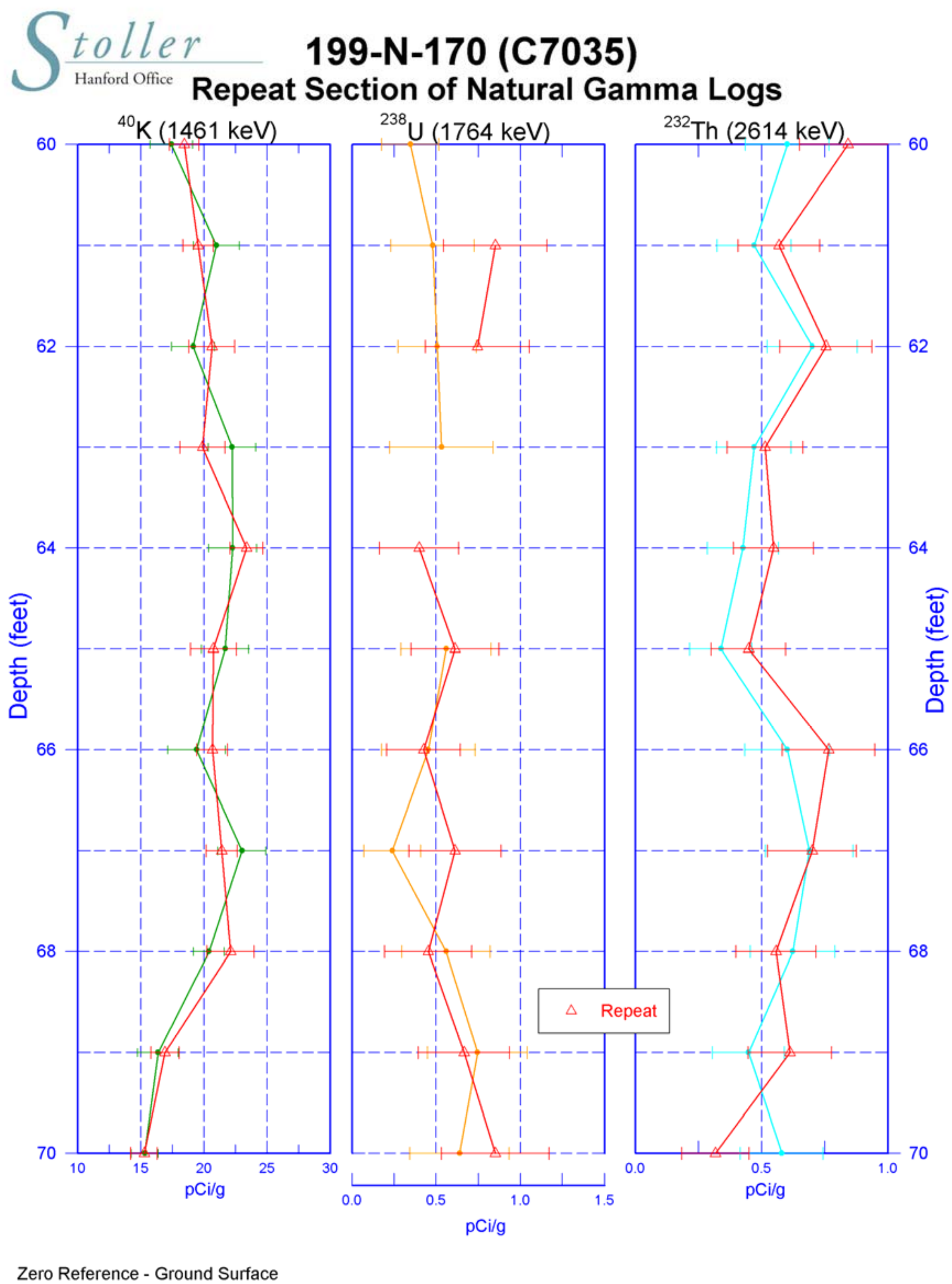

Stoller
Hanford Office
199-N-170 (C7035) Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Moisture
Depth (feet)
Water Level
137Cs (662 keV)
pCi/g
cps
VFW (%)
Zero Reference - Ground Surface

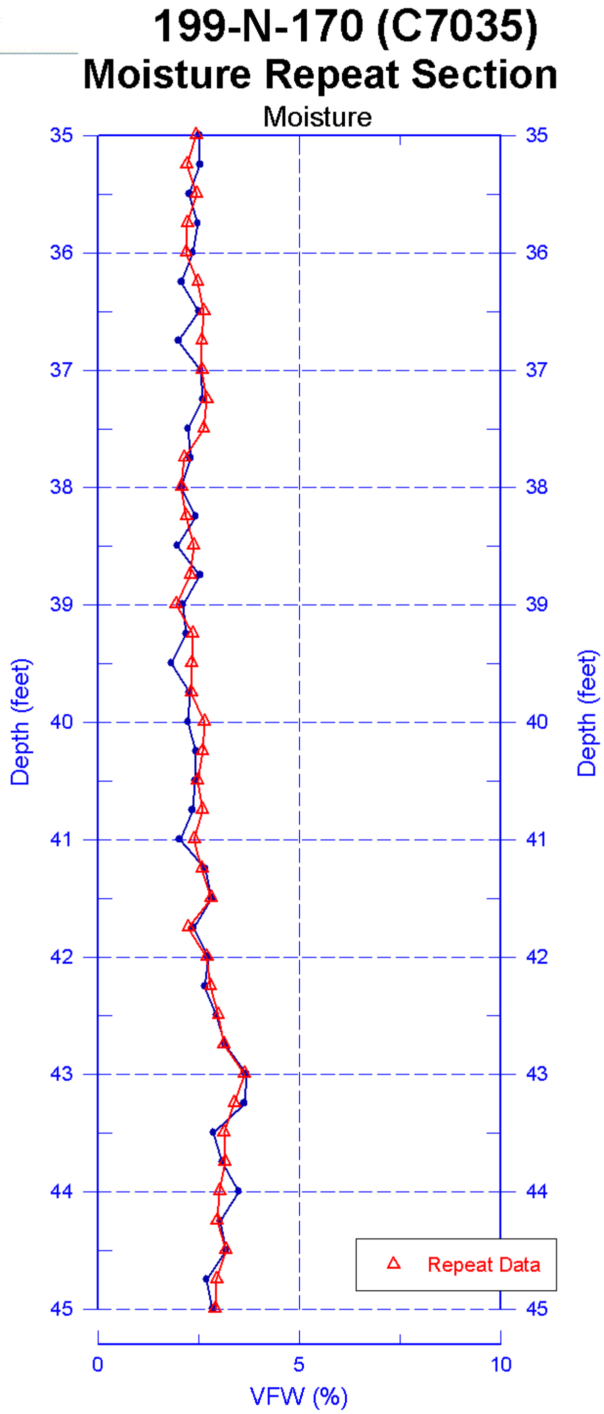


Reference - Ground Surface



Reference - Ground Surface


Stoller
Hanford Office
199-N-170 (C7035)
Repeat Section of Natural Gamma Logs
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Depth (feet)
60
62
64
66
68
70
10
15
20
25
30
pCi/g
0.0
0.5
1.0
1.5
pCi/g
0.0
0.5
1.0
pCi/g
Repeat
Zero Reference - Ground Surface



Reference - Ground Surface

Stoller
Hanford Office
established 1959

HGLP-LDR-344, Rev. 0

199-N-171 (C7036)
Log Data Report

Borehole Information:

Borehole:	199-N-171 (C7036)		**Site**	100-NR-2	
Coordinates (WA St Plane)		**GWL[1] (ft):**	75.3	**GWL Date:**	03/11/09
North (m)	**East (m)**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
Unknown	Unknown	03/11/09	Unknown	82.4	Cable tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (inch)	Inside Diameter (inch)	Thickness (inch)	Top (ft)	Bottom (ft)
Welded steel	-0.8	8 5/8	7 5/8	1/2	-0.8	82

Borehole Notes:

The logging engineer measured depth to water and the inner casing diameter, rounding to nearest 1/16 inch.

This borehole is part of a bioventing pilot test for remediation of hydrocarbon-impacted soils.

Logging Equipment Information:

Logging System:	Gamma 1 N		**Type:** **Serial No.:**	SGLS (60%) 47TP32211A
Effective Calibration Date:	04/17/2008	**Calibration Reference:**	HGLP-CC-031, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	
Logging System:	Gamma 1 M		**Type:** **Serial No.:**	NMLS H240207279
Effective Calibration Date:	05/06/2008	**Calibration Reference:**	HGLP-CC-032, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	**1**	**2 Repeat**			
Date	03/11/09	03/11/09			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	81.0	56.0			
Finish Depth (ft)	0.0	49.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	NA	NA			
Pre-Verification	AN123CAB	AN123CAB			
Start File	AN123000	AN123082			
Finish File	AN123081	AN123089			
Post-Verification	AN123CAA	AN123CAA			
Depth Return Error (inch)	½" Low	0			
Comments	No fine gain adjustments made	No fine gain adjustments made			

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HGLP-LDR-344, Rev. 0

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	3	4 Repeat			
Date	03/11/09	03/11/09			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	49.0			
Finish Depth (ft)	75.25	56.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	NA	NA			
Pre-Verification	AMO59CAB	AM059CAB			
Start File	AM059000	AM059302			
Finish File	AM059301	AM059330			
Post-Verification	AM059CAA	AM059CAA			
Depth Return Error (inch)	NA	¼ " high			
Comments	None	None			

Logging Operation Notes:

Data were collected using Gamma 1 HO 68B-3574 for both logs. Pre- and post-survey verification measurements were acquired in the Amersham KUTh-082 field verifier for the SGLS and the AmBe standard for the NMLS. A centralizer was installed on the sondes. For the SGLS, the maximum logging depth achieved was 81.0 ft, before the sonde un-weighted. Logging depth for the NMLS was 75.25 ft, just above groundwater level. The zero reference was the ground surface.

Analysis Notes:

Analyst:	HOLLOWAY	Date:	04/01/09	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre- and post-survey verification spectra for the SGLS and NMLS met the acceptance criteria for the established systems.

SGLS spectra were processed in batch mode using APTEC Supervisor to identify individual peaks and count rates. Concentrations were calculated using an EXCEL template identified as G1MApr08.xls using an efficiency function and corrections for casing, dead time and water as determined by annual calibrations.

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

The NMLS data were processed to identify count rates. Count rates were converted to percent volumetric moisture using an EXCEL template identified as G1MMay08.xls, using calibration for an 8-inch diameter borehole.

Results and Interpretations:

No manmade radionuclides were detected in this borehole.

Moisture indicates some variability. The neutron moisture sonde bombards the formation with neutrons and detects the back-scattered neutrons. In geologic media, the dominant mechanism for neutron scattering is interaction with

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hydrogen atoms. In the vadose zone, hydrogen content is usually related to water (moisture) content. With the source-detector configuration used in the moisture log, count rate increases with increasing moisture. However, the logging system responds to all hydrogen and does not discriminate between "free" water, "bound" water, water of hydration, or other hydrogenous compounds. Because this site has possible hydrocarbon contamination, the logging sonde may be responding to hydrocarbon contamination, as well as moisture, at some depth locations. The relatively high apparent moisture at approximately 52.5 ft may reflect the presence of hydrocarbons.

KUT and moisture show good repeatability.

List of Log Plots:

Depth Reference is ground surface.

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

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

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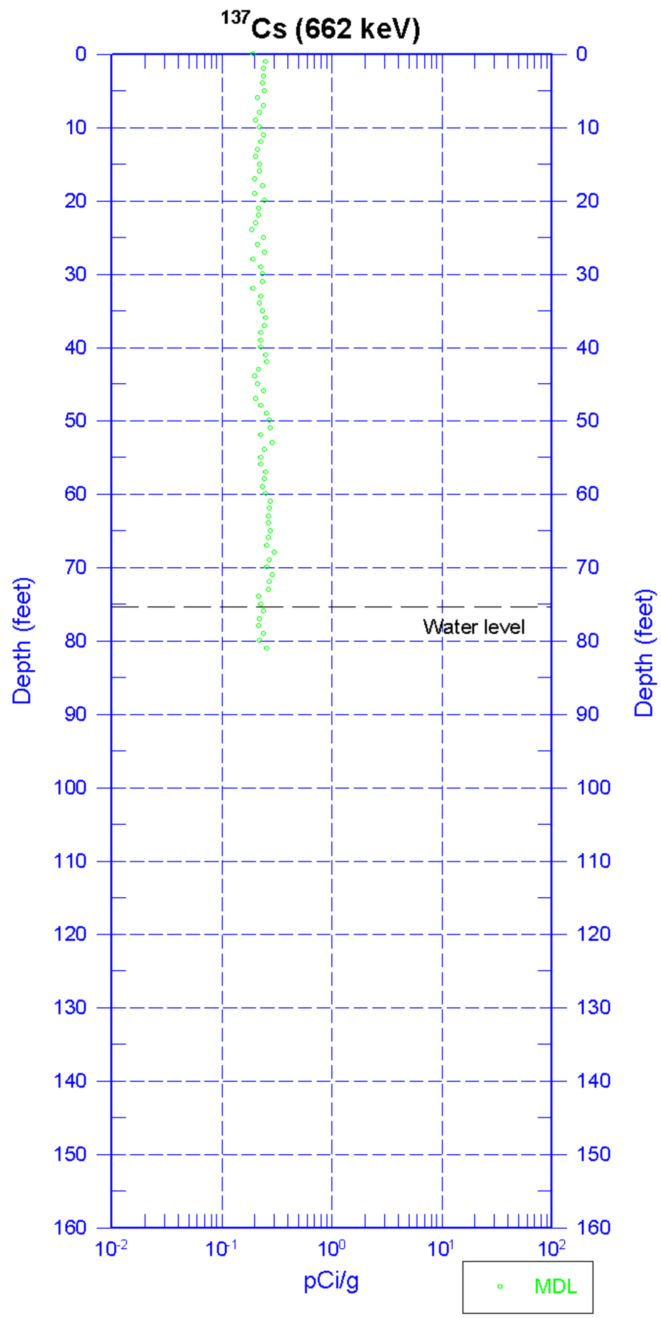
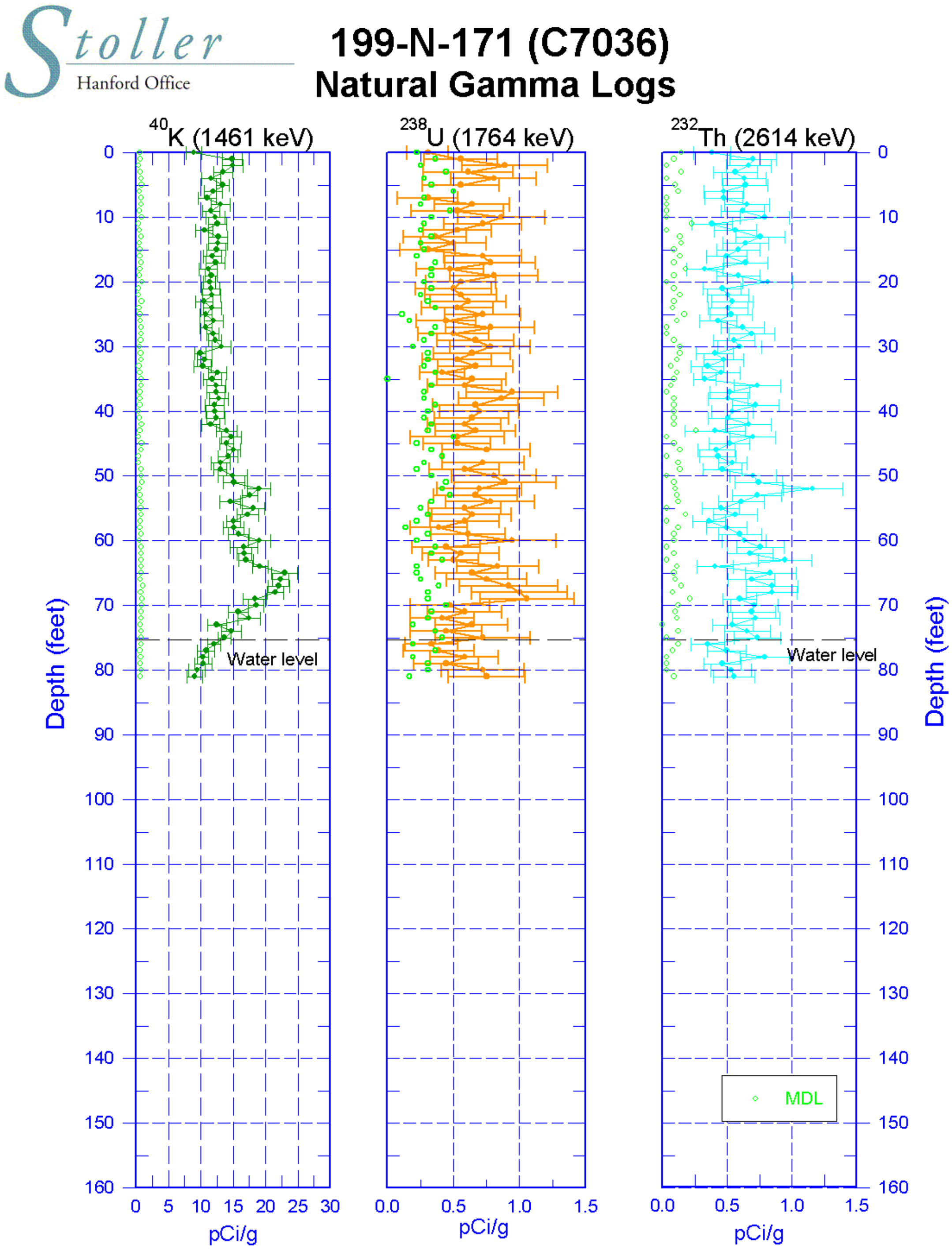
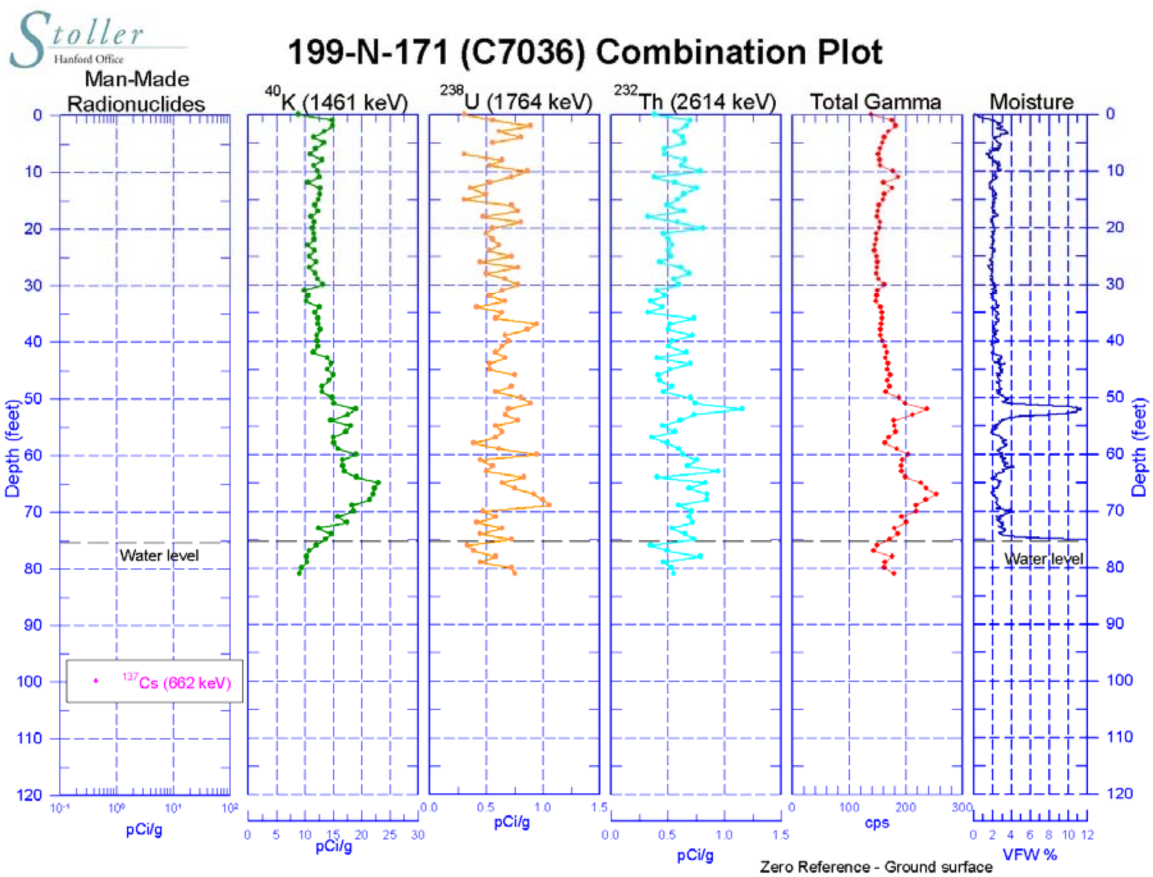
199-N-171 (C7036)
Manmade Radionuclides



Zero Reference - Ground surface



Zero Reference - Ground surface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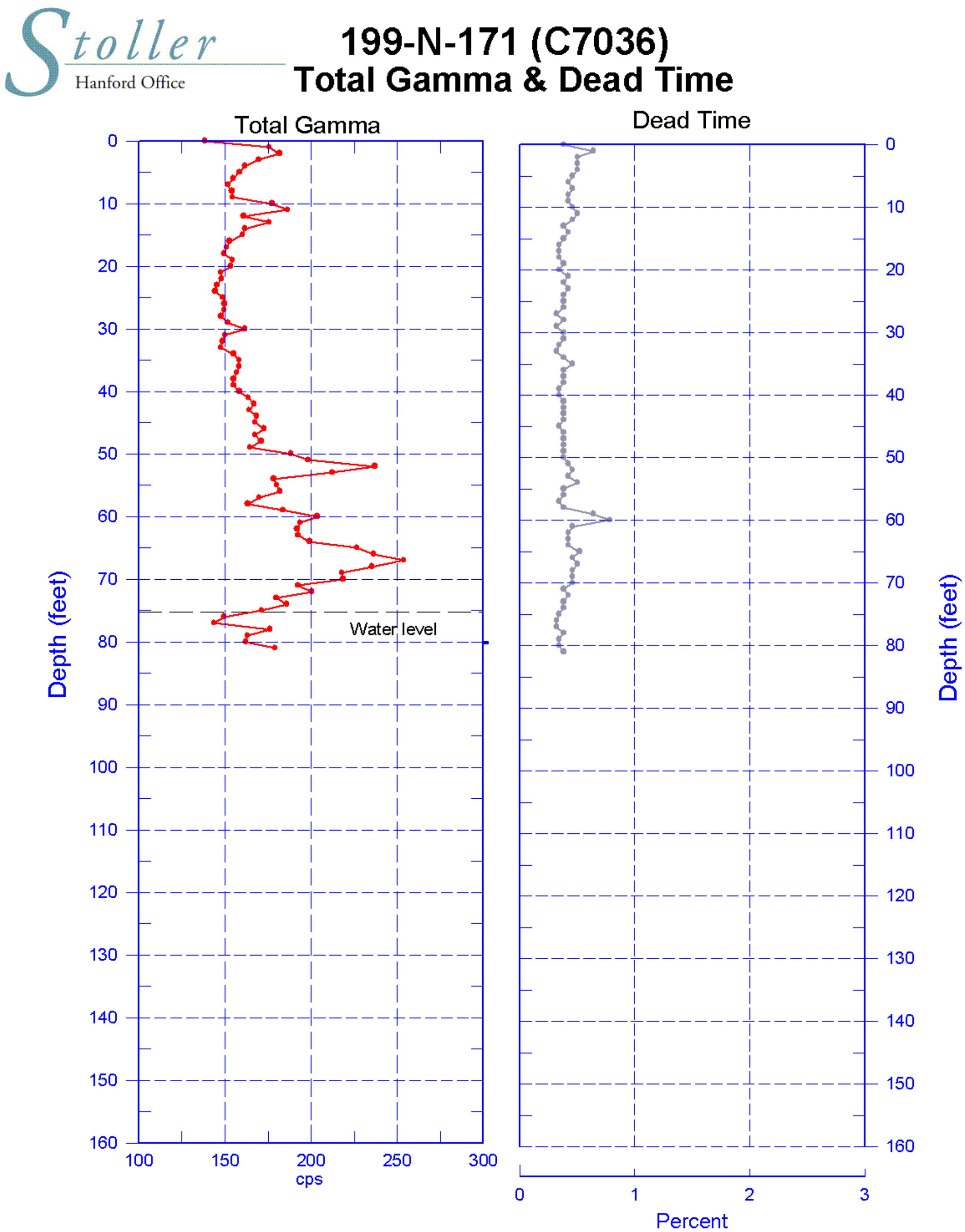
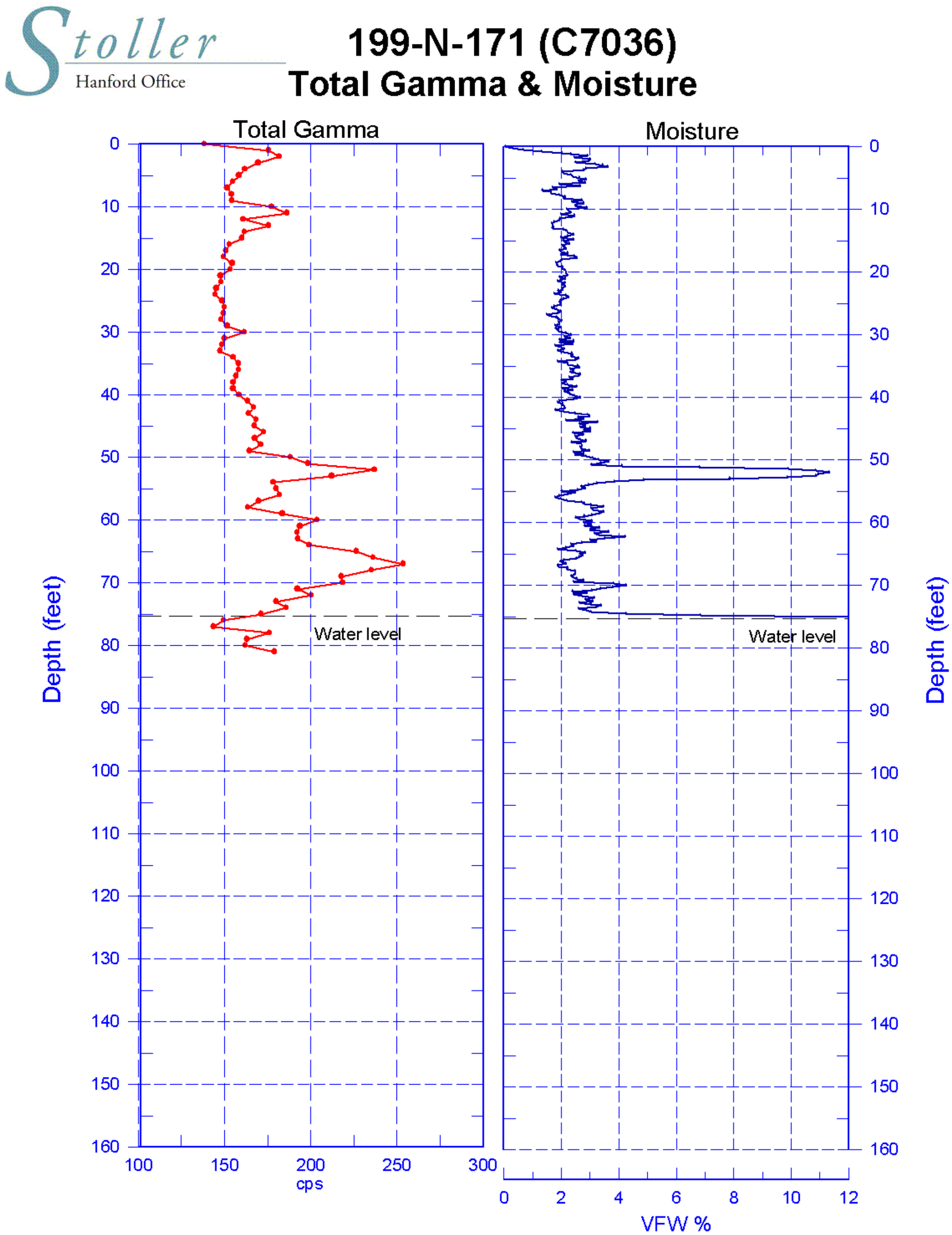
199-N-171 (C7036) Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Moisture
Depth (feet)
Water level
137Cs (662 keV)
pCi/g
cps
VFW %
Zero Reference - Ground surface

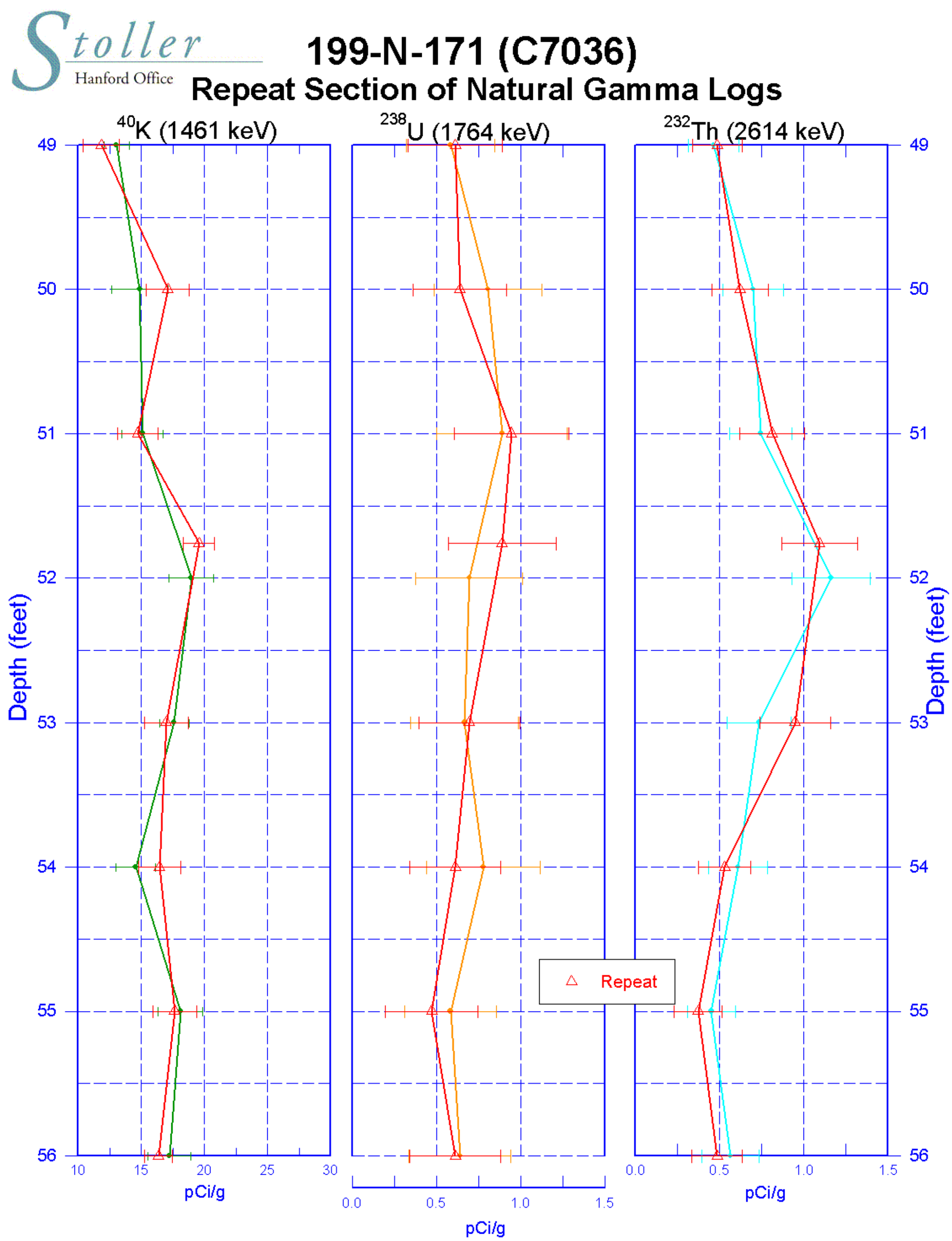


Reference - Ground surface

199-N-171 (C7036)
Total Gamma & Moisture



Reference - Ground surface



Zero Reference - Ground surface

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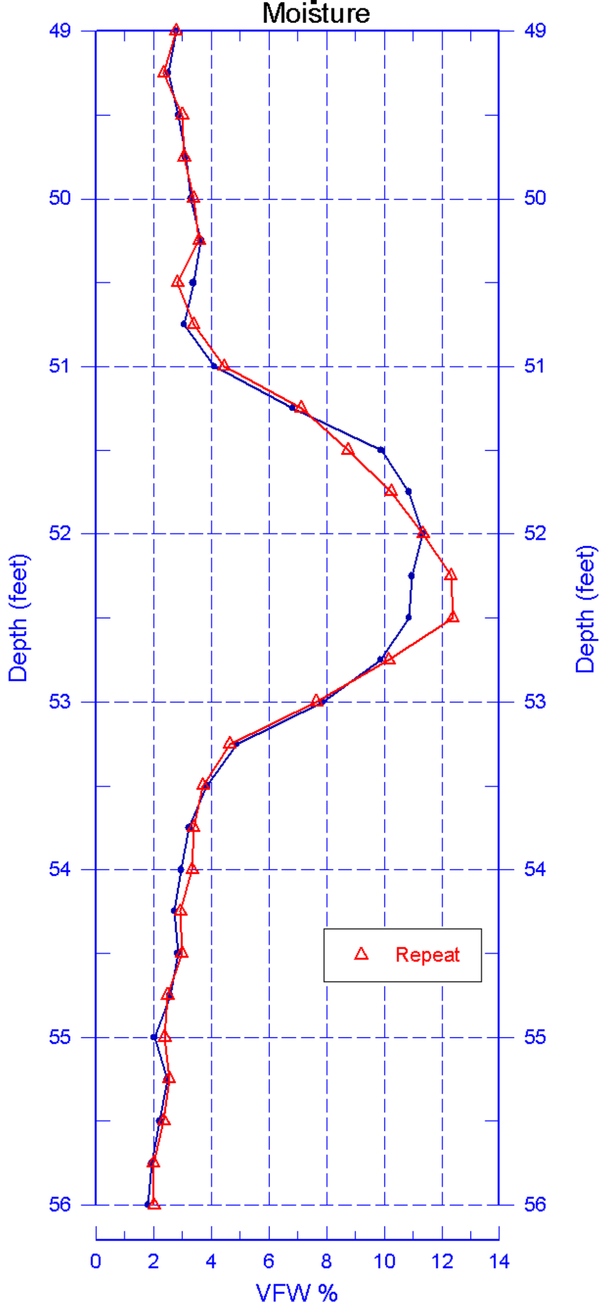
199-N-171 (C7036)
Moisture Repeat Section



Reference - Ground surface

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HGLP-LDR-368, Rev. 0

199-N-172 (C7037)
Log Data Report

Borehole Information:

Borehole:	199-N-172 (C7037)		**Site**	UPR-100-N-17	
Coordinates (WA St Plane)		**GWL[1] (ft):**	72.1	**GWL Date:**	01/20/09
North (m)	**East (m)**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
Unknown	Unknown	01/19/09	Unknown	82	Cable tool

Casing Information:

Casing Type	**Stickup (ft)**	**Outer Diameter (inch)**	**Inside Diameter (inch)**	**Thickness (inch)**	**Top (ft)**	**Bottom (ft)**
Welded steel	-3.7	8 5/8	7 5/8	1/2	-3.7	80

Borehole Notes:

The logging engineer measured depth to water and the inner casing diameter, rounding to the nearest 1/16 inch.

This borehole is part of a bioventing pilot test for remediation of hydrocarbon-impacted soils.

Logging Equipment Information:

Logging System:	Gamma 1 L		**Type:** **Serial No.:**	SGLS (60%) 47TP32211A
Effective Calibration Date:	04/17/2008	**Calibration Reference:**	HGLP-CC-030, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	
Logging System:	Gamma 1 M		**Type:** **Serial No.:**	NMLS H240207279
Effective Calibration Date:	05/06/2008	**Calibration Reference:**	HGLP-CC-032, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	**1**	**2 Repeat**			
Date	1/20/09	1/20/09			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	80.0	70.0			
Finish Depth (ft)	0.0	60.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	NA	NA			
Pre-Verification	AL032CAB	AL032CAB			
Start File	AL032000	AL032081			
Finish File	AL032080	AL032091			
Post-Verification	AL032CAA	AL032CAA			
Depth Return Error (inch)	NA	NA			
Comments	Fine gain adjustment made after file -23	No fine gain adjustments made			

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Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	3	4 Repeat			
Date	1/20/09	1/20/09			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	0.0	30.00			
Finish Depth (ft)	71.75	40.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	NA	NA			
Pre-Verification	AM054CAB	AM054CAB			
Start File	AM054000	AM054291			
Finish File	AM054290	AM054328			
Post-Verification	AM054CAA	AM054CAA			
Depth Return Error (inch)	0	0			
Comments	None	None			

Logging Operation Notes:

Data were collected using Gamma 1 HO 68B-3574 for both logs. Pre- and post-survey verification measurements were acquired in the Amersham KUTh-082 field verifier for the SGLS and the AmBe standard for the NMLS. A centralizer was installed on the sondes. For the SGLS, the maximum logging depth achieved was 80.0 ft before the sonde un-weighted. The maximum logging depth for the NMLS was 71.75 ft, just above the reported water depth. The zero reference was the ground surface.

Analysis Notes:

Analyst:	HOLLOWAY	Date:	02/25/09	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre- and post-survey verification spectra for the SGLS and NMLS met the acceptance criteria for the established systems.

SGLS spectra were processed in batch mode using APTEC Supervisor to identify individual peaks and count rates. Concentrations were calculated using an EXCEL template identified as G1LApr08.xls using an efficiency function and corrections for casing, dead time and water as determined by annual calibrations.

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

The NMLS data were processed to identify count rates. Count rates were converted to percent volumetric moisture using an EXCEL template identified as G1MMay08.xls, using calibration for an 8-inch diameter borehole.

Results and Interpretations:

No manmade radionuclides were detected.

Moisture indicates some variability. The neutron moisture sonde bombards the formation with neutrons and detects the back-scattered neutrons. In geologic media, the dominant mechanism for neutron scattering is interaction with

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hydrogen atoms. In the vadose zone, hydrogen content is usually related to water (moisture) content. With the source-detector configuration used in the moisture log, count rate increases with increasing moisture. However, the logging system responds to all hydrogen and does not discriminate between “free” water, “bound” water, water of hydration, or other hydrogenous compounds. Because this site has possible hydrocarbon contamination, the logging sonde may be responding to hydrocarbon contamination, as well as moisture, at some depth locations. The relatively high apparent moisture at approximately 50 ft may reflect the presence of hydrocarbons.

The logging engineer noticed a potential neutron moisture tool malfunction between 30 and 40 ft where the moisture appeared to increase. This interval was re-logged to check the data for repeatability. The repeat log indicated the increase in moisture was not valid. The repeat data are considered reliable and consistent with moisture content in other nearby boreholes. The post-verification measurement was within acceptance limits. For the purposes of this log data report, the repeat data for moisture are plotted as main log data.

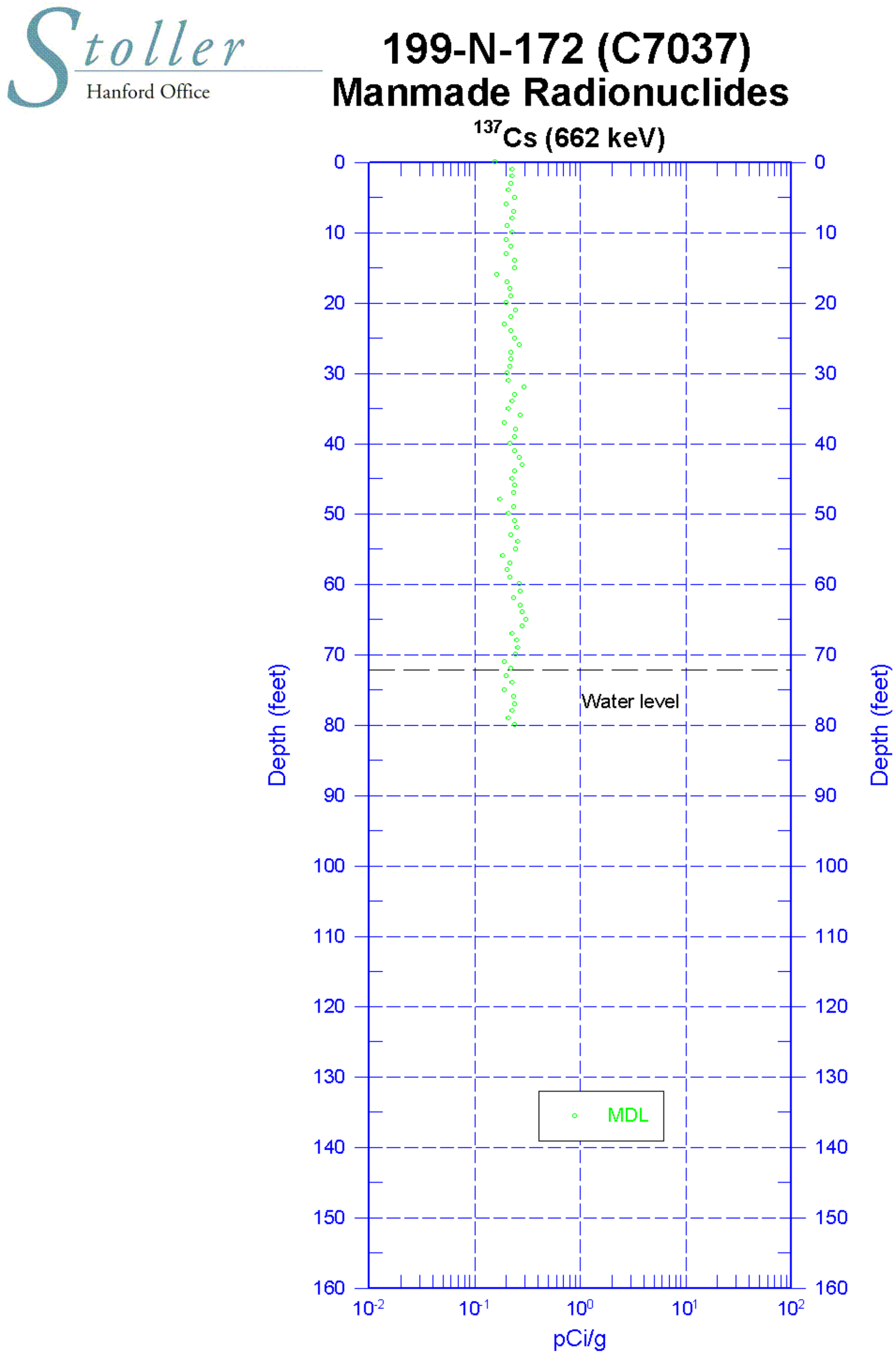
KUT and NMLS data shows good repeatability.

List of Log Plots:

Depth Reference is ground surface.

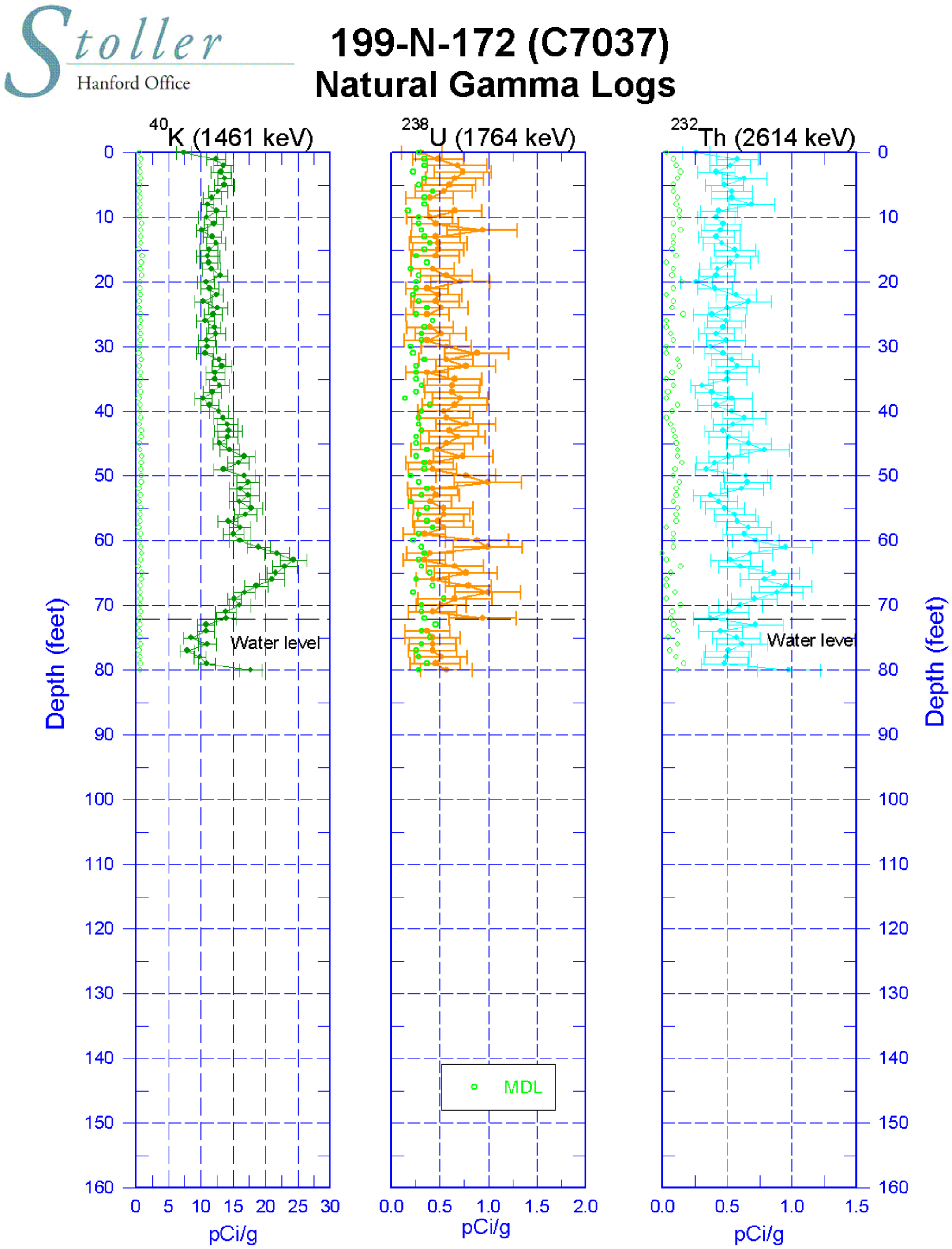
Manmade Radionuclides
Natural Gamma Logs
Combination Plot
Total Gamma & Dead Time
Total Gamma and Moisture
Repeat Section of Natural Gamma Logs
Moisture Repeat Section

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

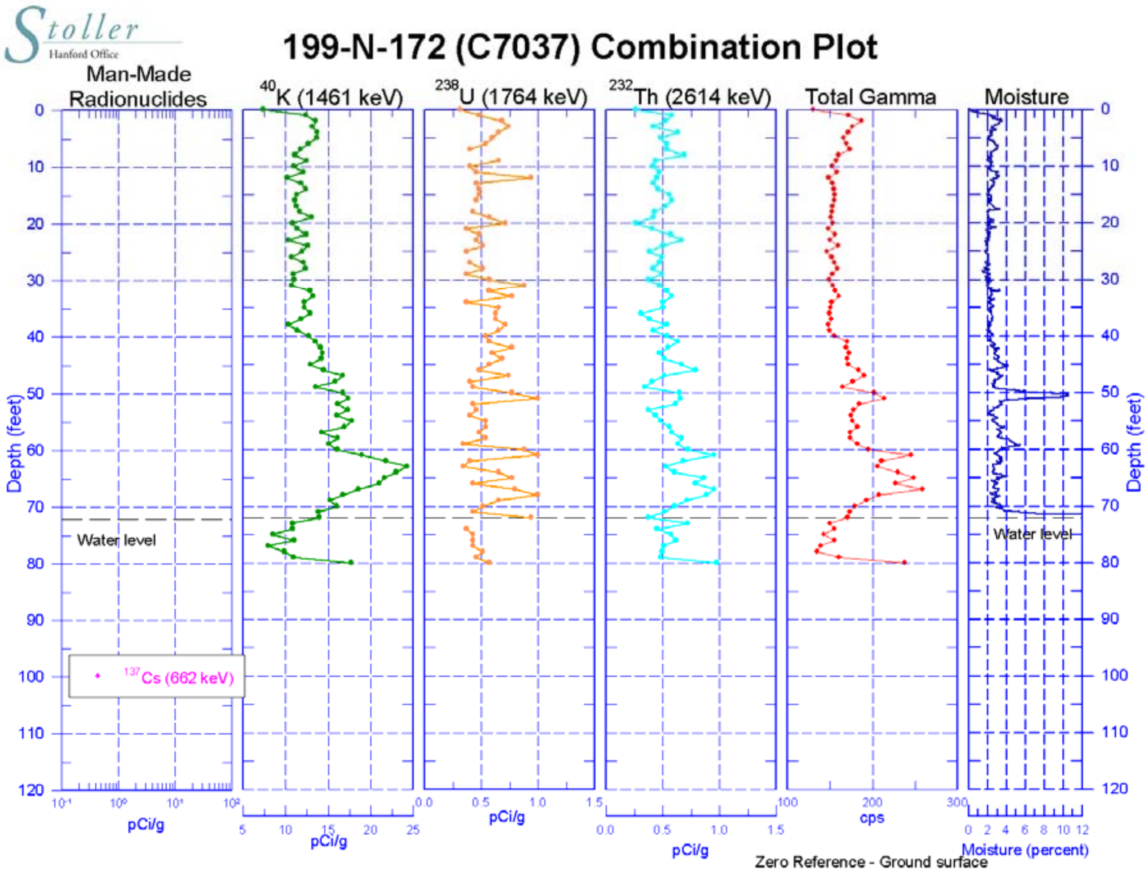


Zero Reference - Ground surface

199-N-172 (C7037)
Natural Gamma Logs



Zero Reference - Ground surface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199-N-172 (C7037) Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Moisture
Depth (feet)
Water level
137Cs (662 keV)
pCi/g
cps
Moisture (percent)
Zero Reference - Ground surface

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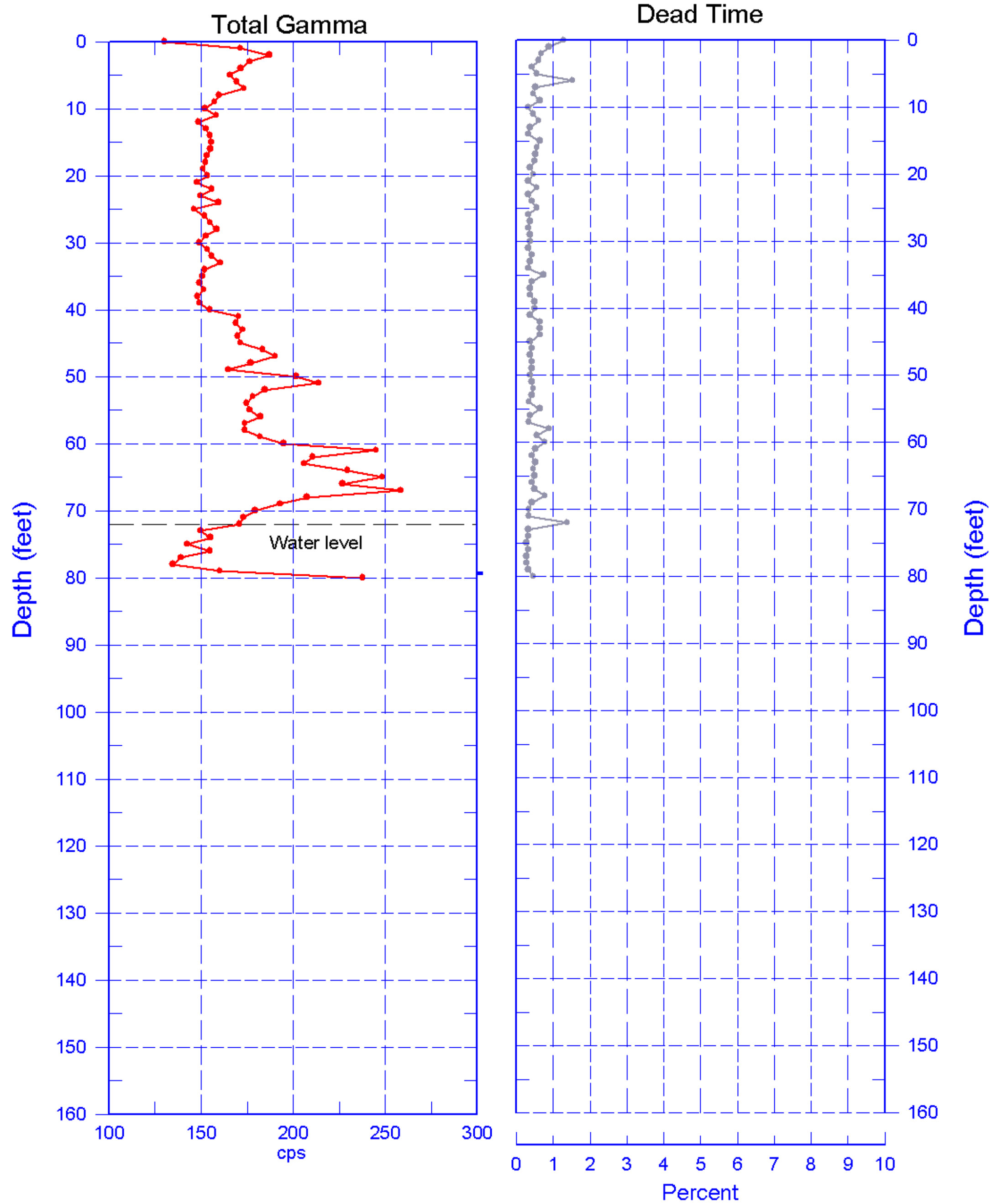
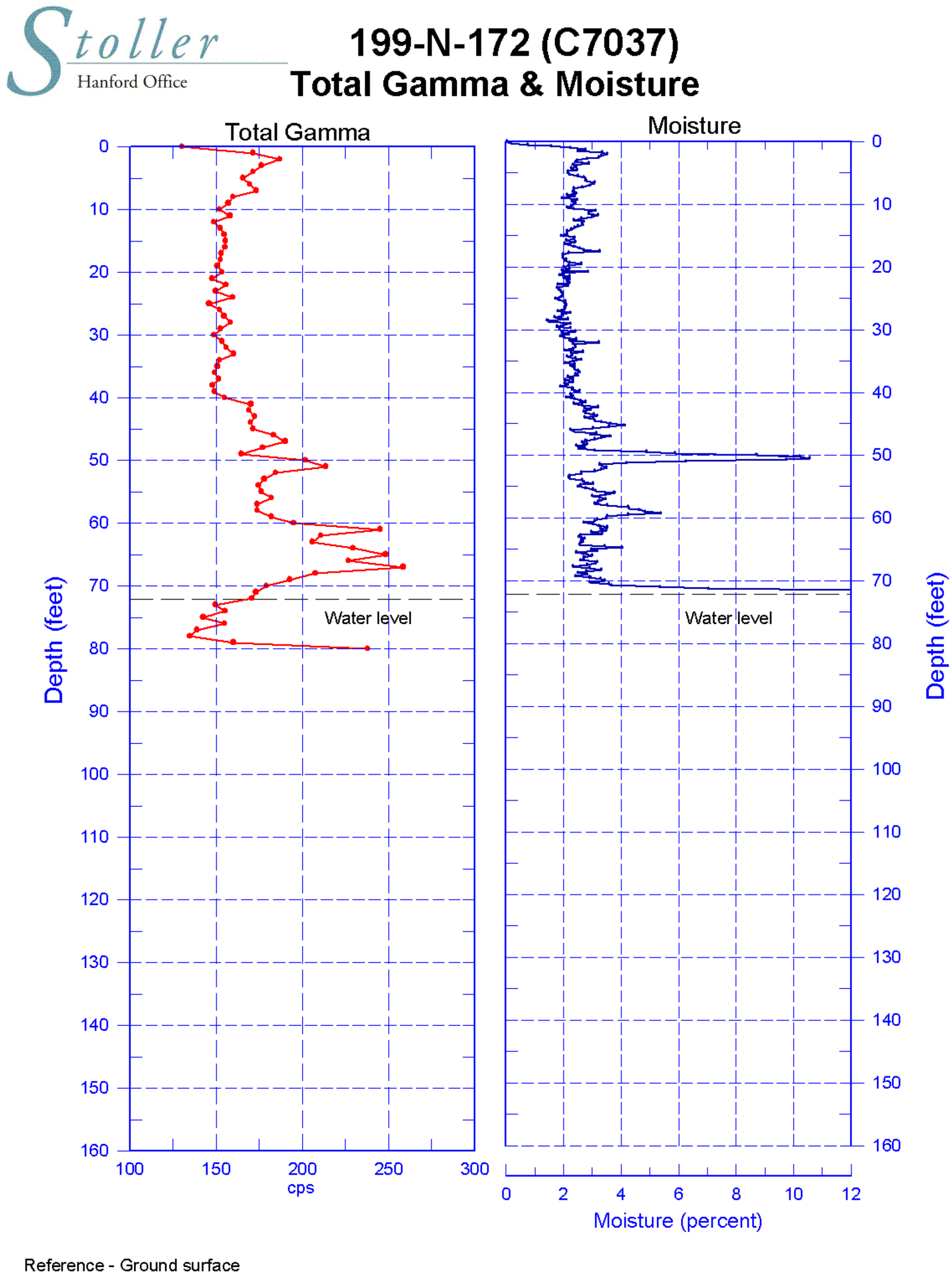
199-N-172 (C7037)
Total Gamma & Dead Time



Zero reference- Ground surface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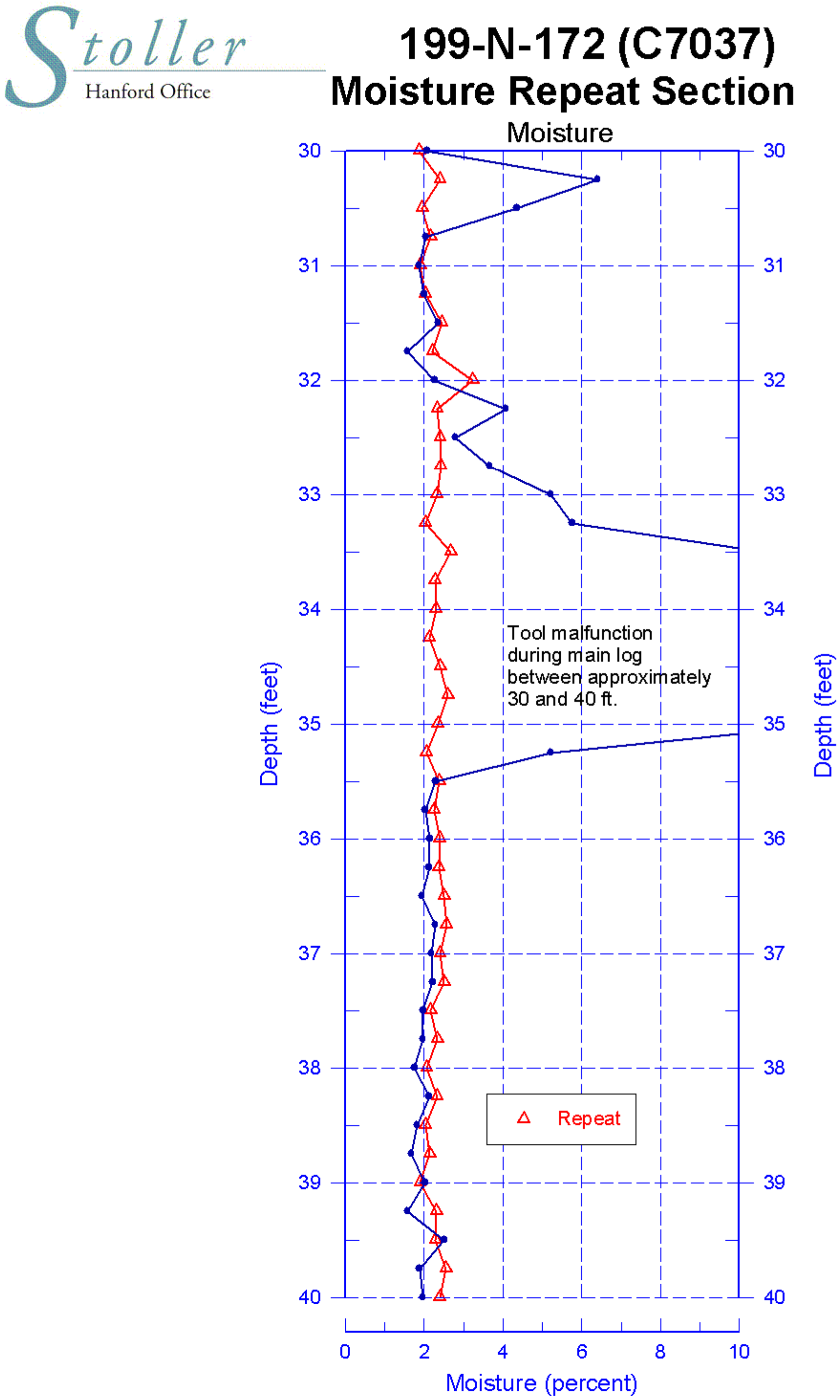
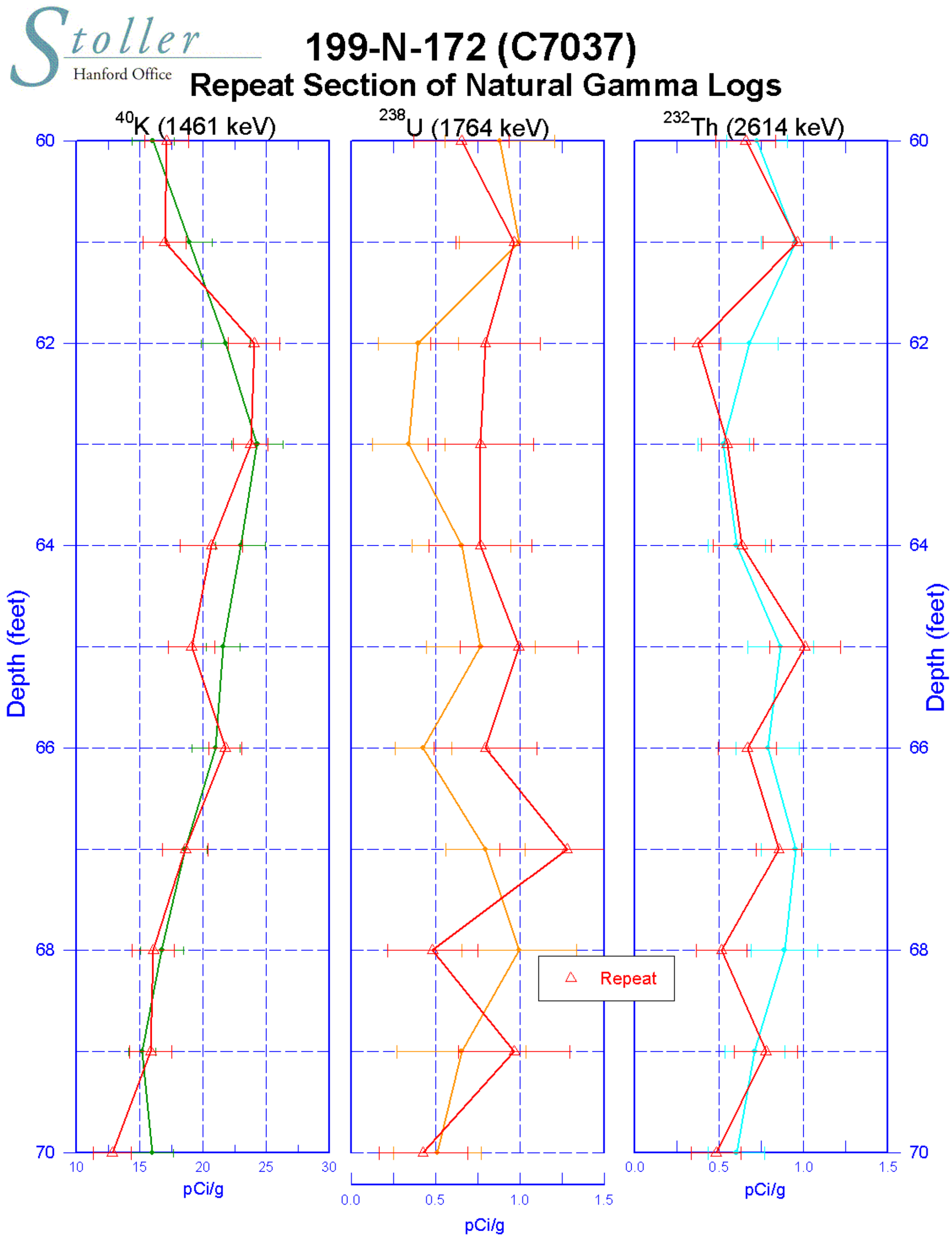
199-N-172 (C7037)
Total Gamma & Moisture
Total Gamma
Moisture
Depth (feet)
Water level
cps
Moisture (percent)
Reference - Ground surface

199-N-172 (C7037)
Moisture Repeat Section



Reference - Ground surface



Zero reference-Ground surface

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