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Borehole Data Package for RCRA Wells 299-E25-93 and 299-E24-22 at Single-Shell Tank Waste Management Area A-AX, Hanford Site, Washington

B. A. WilliamsS. M. Narbutovskih

December 2003



Prepared for the U.S. Department of Energy under Contract DE-AC06-76RL01830

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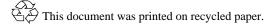
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Pacific Northwest National Laboratory Richland, Washington 99352

Summary

Two new Resource Conservation and Recovery Act (RCRA) groundwater monitoring wells were installed at single-shell tank Waste Management Area (WMA) A-AX in fiscal year 2003 to fulfill commitments for well installations proposed in the draft *Hanford Federal Facility Agreement and Consent Order M-24-00*. Well 299-E24-22 has been installed upgradient and well 299-E25-93 downgradient of the WMA. Specific objectives for these wells include monitoring the impact, if any, that potential releases from inside the WMA may have on current groundwater conditions (i.e., improved network coverage); differentiating upgradient groundwater flow direction (i.e., improved water table determinations).

This report supplies the information obtained during drilling, characterization, and installation of the two new groundwater monitoring wells, 299-E25-93 and 299-E24-22. This document also provides a compilation of hydrogeologic and well construction information obtained during drilling, well construction, well development, pump installation, aquifer testing, and sample collection/analysis activities.

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1.0 Introduction

Two new Resource Conservation and Recovery Act (RCRA) groundwater monitoring wells were installed at single-shell tank Waste Management Area (WMA) A-AX in fiscal year 2003 to fulfill commitments for well installations proposed in draft *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement; Ecology et al. 1998) Milestone M-24-57 (Murphy-Fitch 2003).^(a) The need for increased monitoring capability was identified in Narbutovskih and Horton (2001) and during a data quality objectives process for establishing an RCRA/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/Atomic Energy Act of 1954 (AEA) integrated 200 West and 200 East Area Groundwater Monitoring Network (Byrnes and Williams 2003).

One outcome of the data quality objective process was a requirement to install additional groundwater monitoring wells in the immediate vicinity of WMA A-AX. Two wells have been installed; one located upgradient and one downgradient of the WMA (Figure 1). Specific objectives for these wells include monitoring the impact, if any, that potential releases from the WMA may have on current groundwater conditions (i.e., improved network coverage); differentiating upgradient groundwater flow direction from contaminants released at the WMA; and improving the determination of groundwater flow direction (i.e., improved water table determinations). This report provides the information obtained during drilling, characterization, and installation of the two new groundwater monitoring wells at the single-shell tank WMA A-AX.

1.1 New Groundwater Monitoring Wells

The two new groundwater monitoring wells were installed between July and September 2003. The wells are identified as 299-E25-93 (well ID C4122) and 299-E24-22 (well ID C4123) and shown on a location map in Figure 1. The new wells were constructed to the specifications and requirements described in Washington Administrative Code (WAC) 173-160, and the groundwater monitoring description of work for drilling and installation (Williams 2003) and specifications used by Fluor Hanford, Inc. (FHI) for well drilling and construction. During drilling and construction of the wells, sampling and analysis activities were conducted to support screening for radiological contaminants and to collect sediment grab samples for geologic descriptions and for archiving in the Hanford Geotechnical Sample Library located at Building 3718A/B in the 300 Area.

This document provides a compilation of hydrogeologic and well construction information obtained during drilling, well construction, well development, pump installation, aquifer testing, and sample collection/analysis activities. Appendix A contains the Well Summary Sheets (as-built diagrams), the Well Construction Summary Report, the geologist's borehole log, well development and pump installation reports, and the well survey records. Appendix B contains results of field and/or laboratory determinations of physical properties of sediment samples. Appendix C contains borehole geophysical logs and borehole deviation survey results. Additional well construction documentation is on file with FHI in

⁽a) Letter from EJ Murphy-Fitch (Fluor Hanford Inc., Richland, Washington) to Distribution, "Tentative Agreement on Tri-Party Agreement Negotiations on the Overall Strategy and Approach for Hanford Groundwater Protection, Monitoring, and Remediation (M-024)," dated September 22, 2003.

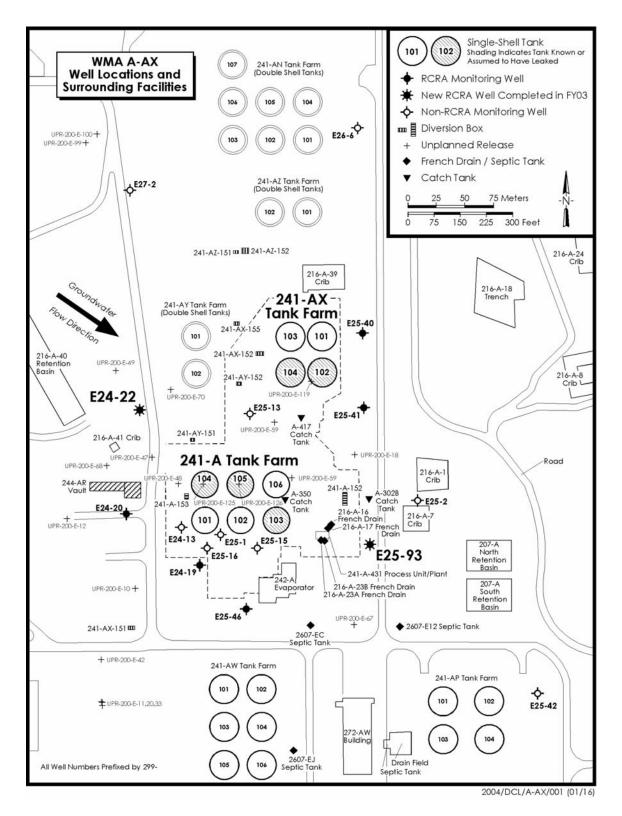


Figure 1. Map of Single-Shell Tank Waste Management Area A-AX and Locations of New and Existing Wells in the Groundwater Monitoring Network

Richland, Washington. The Records Management Information System and the Hanford Well Information System [http://apweb02/cfroot/rapidweb/phmc/cp/hwisapp/] are two electronic databases that also contain the drilling and construction records for these two wells.

English units are used in this report to describe drilling and well completion activities because that is the system of units used by drillers to measure and report depths and well construction measurements. Conversion to metric can be done by multiplying feet by 0.3048 to obtain meters or by multiplying inches by 2.54 to obtain centimeters.

2.0 Well 299-E25-93

Well 299-E25-93 is located along the southeast side of the 241-A tank farm (Figure 1). The well is downgradient of WMA A-AX and will help determine if contaminants are released from the WMA.

2.1 Drilling and Sampling

Well 299-E25-93 (well ID C4122) was drilled with a dual wall percussion rig (Becker-hammer) from surface to a total depth of 320 feet below ground surface (bgs). Temporary 9-inch-outside-diameter, dual-wall casing was used during drilling from the surface to total depth. Borehole drilling began on July 1 and total depth was reached on July 2, 2003.

Grab samples of sediment for geologic description and archive were collected at approximately 5-foot intervals from ground surface to total depth. Also, one 2-foot-long, 4-inch-diameter split spoon sample was attempted from the proposed screen interval for physical property analysis (sieve analysis) to confirm screen selection. The split spoon attempt was unsuccessful, so grab samples from the drill cuttings return line were collected from the screen interval (at ~281 feet bgs and ~316 feet bgs).

Sediments encountered during drilling consisted of backfill material and recent sediments (Holocene) deposited to a depth of approximately 10 feet bgs, Hanford formation sediments composed of sand to gravelly sand to sandy gravel from 10 feet bgs to about 266 feet bgs, and the sandy gravel of the lower Hanford formation and/or the mainstream alluvial facies of the Cold Creek unit from 266 feet bgs to approximately 317 feet bgs. Ringold Formation silty sandy gravel is indicated from 317 to 320 feet bgs total depth. The wellsite geologist's detailed lithologic borehole log and 5-foot depth interval sediment descriptions are included in Appendix A. A more complete hydrogeologic interpretation of the borehole sediments is included in Chapter 7.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants (i.e., for alpha, beta, and gamma). Organics were not detected. The well was geophysically logged on July 7, 2003, by Stoller Corporation. Geophysical logging indicated that a slight amount of manmade cesium-137 was detected near ground surface (4.9 pCi/g maximum concentration) and at scattered intervals down to 195 feet bgs (Appendix C). Chapter 5 provides more details of geophysical logging.

2.2 Well Completion

The permanent casing and screen was installed in well 299-E25-93 in July 2003. A 35-foot-long, 4-inch-inner-diameter, stainless steel, continuous wire-wrap (0.02-inch slot) screen was set from 278.23 to 313.26 feet bgs. Below the screen interval there is a 2-foot-long stainless steel sump placed from 313.26 to 315.26 feet bgs. The permanent well casing is 4-inch-inside-diameter, stainless steel from 278.23 feet bgs to 2 feet above ground surface.

The screen filter pack is 10-20 mesh silica sand placed from 273.1 to 320 feet bgs. The sand pack was settled and initial development completed using a dual-flange surge block. The annular seal is composed of bentonite pellets from 268.5 to 273.1 feet bgs and bentonite crumbles from 10.5 to 268.5 feet bgs. The surface seal is composed of Portland cement grout from 10.5 feet bgs to ground surface. A 4-foot by 4-foot by 6-inch concrete pad was placed around the well at the surface. A protective well head casing with locking cap, four protective steel posts, and a brass marker stamped with the well ID number and Hanford well number were set into the concrete pad. The Well Construction Summary Report and Well Summary Sheet (as-built) are included in Appendix A.

A vertical borehole deviation survey was conducted utilizing a downhole gyroscope in the completed well to determine the well bottom location relative to a vertical borehole projection. Survey results are discussed in Chapter 6 and located in Appendix C.

The elevation and geographic coordinates of the well were surveyed by Fluor Federal Services on October 31, 2003. The horizontal position of the well was referenced to horizontal control stations established by the U.S. Army Corps of Engineers (USACE). The coordinates are Washington State Plane Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD88 and is based on existing USACE bench marks. Survey data are included in Table 1 and Appendix C. The static water level was 278.04 feet bgs on July 15, 2003.

2.3 Well Development and Pump Installation

Well 299-E25-93 was developed on August 14, 2003. Well development was performed at three different intervals. A temporary, 5-horsepower submersible pump was used for development. Depth-to-

Well Name (Well ID)	Easting (m)	Northing (m)	Elevation (m)	Comments
299-E25-93	575,471.51	136,022.09		Center of casing
(C4122)			208.040	Top of casing, N. edge
			207.265	Brass survey marker
			208.046	Top pump base plate, N. edge
299-E24-22	575,262.68	136,142.82		Center of casing
(C4123)			210.285	Top of casing, N. edge
			209.553	Brass survey marker
			210.291	Top pump base plate, N. edge
NOTES: Horizonta	l Datum is NAD83(91); Vertical Datum is	s NAVD88; Wasl	hington State Plane Coordinates (South
Zone); surveyed Oc	tober 2003.			

Table 1.Survey Data for Wells 299-E25-93 and 299-E24-22

water level was measured at 281.26 feet below top of casing (btc) prior to development. A pressure transducer was installed above the pump and connected to a Hermit datalogger to monitor water level during development. Table 2 contains the results of final well development, including pump intake depth, pump rate, pump run time, drawdown, recovery time, final turbidity (NTU), and stabilized conductivity and temperature readings. A total of 4,547 gallons of water was pumped.

A dedicated Redi-Flo-3, 0.7-horsepower GrundfosTM submersible sampling pump was installed in well 299-E25-93 on September 16, 2003. The sampling pump intake was set at 286.1 feet btc, approximately 5 feet below the water table, and connected to the surface with 3/4-inch-diameter stainless steel riser pipe.

Pump Rate	Pump Intake Depth (ft btc)	Pumping Run Time (min)	Drawdown (ft)	Final Readings	Recovery Test Time (min)
25.5 gpm	316.1	59	0.2	1.26 NTU, 564 µs/cm, 20.4 C	11 (99.8%)
26 gpm	306	64	< 0.1	0.83 NTU, 550 μs/cm, 21.6 C	14 (100%)
26 gpm	296	53	< 0.1	1.19 NTU, 555 μs/cm, 20.6 C	10 (100%)
gpm = Ga min = Mi NTU = Ne	et below top of cas allons per minute. inutes. ephelometric turbic cro siemen per cen	lity unit.			

 Table 2.
 Well Development Information for Well 299-E25-93

3.0 Well 299-E24-22

Well 299-E24-22 is located on the west side of the tank farm (Figure 1). The well is upgradient of the WMA A-AX and will help differentiate upgradient groundwater contamination from contaminants released at the WMA.

3.1 Drilling and Sampling

Well 299-E24-22 (well ID C4123) was also drilled with a Becker -hammer rig from surface to a total depth of 330 feet bgs. Temporary 9-inch-outside-diameter, dual-wall casing was used for drilling throughout the borehole to total depth. Borehole drilling began on July 10 and reached total depth on July 11, 2003.

Grab samples of sediment for geologic description and archive were collected at approximately 5-foot intervals from ground surface to total depth. Also, one 2-foot-long, 4-inch-diameter split spoon sample was attempted from the proposed screen interval for sieve analysis to confirm screen selection. The split spoon retrieved 100% of sample from 286 to 288.5 feet bgs; a grab sample was also collected from the drill cuttings return line at ~321 feet bgs for sieve analysis.

Sediments encountered during drilling consist of backfill and recent sediments (Holocene) deposited to a depth of approximately 8 feet bgs, Hanford formation sediments composed of sand to gravelly sand to sandy gravel from 8 feet bgs to about 300 feet bgs, and the sandy gravel of the lower Hanford formation and/or the Cold Creek unit from 300 feet bgs to total depth (330 feet bgs). A distinct silt/clay layer was encountered from 267 to 272 feet bgs. A more complete hydrogeologic interpretation of the borehole sediments is included in Chapter 7. A detailed lithologic borehole log is provided in Appendix A.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants (i.e., for alpha, beta, and gamma). Organic vapor analysis detected 3.6 to 3.8 parts per million organics in the borehole at 300 feet bgs. The well was geophysically logged between July 12 and July 15, 2003, by Stoller Corporation. Geophysical logging indicated that a slight amount of manmade cesium-137 was detected at scattered intervals down to 125 feet bgs (Appendix C). Chapter 5 provides more details of geophysical logging.

3.2 Well Completion

The permanent casing and screen was installed in well 299-E24-22 in July 2003. A 35-foot-long, 4-inch-inner-diameter, stainless steel, continuous wire-wrap (0.02-inch slot) screen was set from 321.26 to 286.21 feet bgs. Below the screen interval, there is a 2-foot long stainless steel sump placed from 323.68 to 321.26 feet bgs. The permanent well casing is 4-inch-inside-diameter, stainless steel from 286.21 feet bgs to 2 feet above ground surface.

The screen filter pack is 10-20 mesh silica sand placed from 330 to 281.1 feet bgs total depth. The sand pack was settled and initial development completed using a dual-flange surge block. The annular seal is composed of bentonite pellets from 281.1 to 276.1 feet bgs and bentonite crumbles from 276.1 to 10 feet bgs. The surface seal is composed of Portland cement from 10 feet bgs to ground surface. A 4-foot by 4-foot by 6-inch concrete pad was placed around the well at the surface. A protective well head casing with locking cap, four protective steel posts, and a brass marker stamped with the well ID number and Hanford well number were set into the concrete pad. The Well Construction Summary Report and Well Summary Sheet (as-built) are included in Appendix A.

A vertical borehole deviation survey was conducted in the completed well to determine the well bottom location relative to a vertical projection. Survey results are discussed in Chapter 6 and located in Appendix C.

The vertical and horizontal coordinates of the well were surveyed by Fluor Federal Services in October 2003. The horizontal position of the well was referenced to horizontal control stations established by the U.S. Army Corps of Engineers. The coordinates are Washington State Plane Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD88 and is based on existing USACE bench marks. Survey data are included in Table 1 and Appendix C. The static water level was 286.02 feet bgs on July 17, 2003.

3.3 Well Development and Pump Installation

Well 299-E24-22 was developed on September 8, 2003. Well development was performed at three different intervals. A temporary, 5-horsepower submersible pump was used for development. Depth to water level was measured at 288.94 feet btc prior to development. A pressure transducer was installed above the pump and connected to a Hermit[™] datalogger to monitor water level during development. Table 3 contains the results of final well development, including pump intake depth, pump rate, pump run time, drawdown, recovery time, final turbidity, and stabilized conductivity and temperature readings. A total of 4,087 gallons of water was pumped.

A dedicated Redi-Flo-3, 0.7-horsepower, GrundfosTM submersible sampling pump was installed in well 299-E24-22 on September 8, 2003. The sampling pump intake was set ~7 feet below the water table at 296 feet btc and connected to the surface with 3/4-inch-diameter stainless steel riser pipe.

Pump Ra (gpm)		Pump Intake Depth (ft btc)	Pumping Run Time (min)	Drawdown (ft)	Final Readings	Recovery Test Time (min)
22.5		324.2	80	0.2	2.31 NTU, 519 μs/cm, 18.2 C	24 (99.9%)
24		314.2	63	< 0.1	2.25 NTU, 366 µs/cm, 18.4 C	16 (100%)
25		303.1	31	< 0.1	3.14 NTU, 370 µs/cm, 18.5 C	Not available
gpm Min NTU	= = = =	Feet below top of Gallons per minut Minutes. Nephelometric tur micro siemens per	te. rbidity unit.			

 Table 3.
 Well Development Information for Well 299-E24-22

4.0 Sampling and Analysis During Drilling

This section describes the collection and analysis of sediment samples collected during drilling from wells 299-E25-93 and 299-E24-22.

4.1 Field Screening

Sediment samples were screened in the field prior to sample collection for indications of contamination. The drill cuttings and samples were screened for volatile organic contamination, beta-gamma activity, and alpha activity by radiation control technicians and safety staff. All radiation activity levels were at or below background for wells 299-E25-93 and 299-E24-22. Volatile organic screening was performed with a photo-ionization detector. No volatile organics were detected during drilling in well 299-E25-93, but 3.6 to 3.8 parts per million concentration was detected in the well 299-E24-22 at a depth of 300 feet bgs. No action was taken, and monitoring and drilling continued.

4.2 Borehole Sampling

Sediment samples of drill cuttings were collected for geologic description (documented in the geologic borehole log) and archival from both boreholes at 5-foot intervals from ground surface to total depth. The geologic borehole logs are included in Appendix A. One-pint sediment samples collected in glass jars are archived in the Hanford Geotechnical Sample Library which is located at Building 3718A/B in the 300 Area.

Two split spoon samples were attempted from the interval to be screened at each borehole. In some cases, soil grab samples were used in lieu of split spoon samples because of incomplete sample recoveries or because the formation was not conducive to split spoon sampling. These samples were sieved for particle size distribution to provide data for screen slot size confirmation/selection. Sieve data and distribution curves are available in Appendix B.

All sediment sample depths are documented in the geologic borehole log for each well (located in Appendix A).

5.0 Geophysical Logging

A spectral gamma-ray borehole geophysical survey was conducted in both boreholes by Stoller Corporation. The spectral gamma-ray tool was used to determine the presence and concentration of manmade and naturally occurring gamma-emitting radionuclides in the boreholes. The geophysical logs have also been correlated with the geologic log data and the results are presented in Chapter 7. The full suite of logs for both wells and detailed geophysical logging reports for the two wells are provided in Appendix C. The reports also describe calibration requirements, data processing, and log plots.

Well 299-E25-93 was logged on July 7, 2003 using high resolution, spectral gamma-ray instrumentation from ground surface to 320 feet bgs inside temporary dual-wall carbon steel casing with an approximate outside diameter of 9 inches. A repeat section was run from 320 to 288 feet bgs. Measurements were made at a "move-stop-acquire" mode and at a rate of 100 seconds per foot. Cesium-137 was the only gamma-emitting manmade radionuclide detected during geophysical logging. Cesium-137 was detected at ground surface with a maximum concentration of 4.9 pCi/g. Cesium-137 was also detected sporadically at a few other depths throughout the borehole near the 0.3 pCi/g minimum detection limit. The geophysical logs are in Appendix C. Neutron-moisture logging was not completed because a dualwall casing was used and the casing diameter was too large for the calibrated neutron moisture tool.

In well 299-E24-22, logged between July 12 and 15, the spectral gamma-ray tool was run from ground surface to a depth of 328 feet bgs within the nominal 9-inch-diameter dual-wall temporary carbon steel casing. A repeat section was run from 105 to 72 feet bgs. Measurements were made at a "move-stop-acquire" mode and at a rate of 200 seconds per foot. Cesium-137, a manmade radionuclide, was detected at a few depths throughout the borehole near the method detection limit (0.3 pCi/g). Neutron-moisture logging was not completed because a dual-wall casing was used and the casing diameter was too large for the calibrated tool.

6.0 Borehole Gyroscope Survey

Downhole deviation (gyroscopic) surveys were performed in both wells following construction to determine the vertical and horizontal location coordinates of the screened interval (i.e., water table) relative to the borehole surface location and to determine the vertical dimension of the overall well. These data are used to determine the extent of borehole deviations created during drilling. The data can also be used to correct water-level elevations from depth-to-water measurements taken in the completed wells. Refer to Appendix C for the results of these surveys.

In well 299-E25-93, results indicate that at a measured cable depth of 305 feet, the true vertical depth of the well is 304.99 feet. (Note: This is not the drilled total depth). Figure 2 illustrates the vertical and horizontal offsets from the surface projection of well 299-E25-93. The correction factor for determining the true vertical elevation of the water table is ~0.01 foot. This distance should be subtracted from the depth-to-water measurements to obtain true depth.

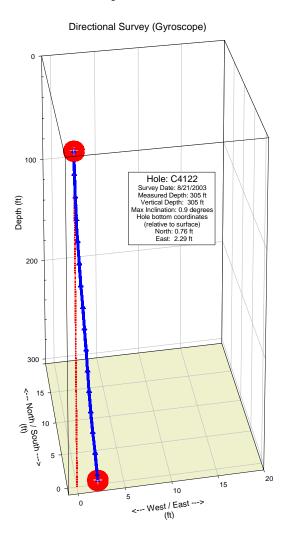


Figure 2. Vertical Profile and Bottom Hole Projections of Well 299-E25-93

In well 299-E24-22, results indicate that at a measured cable depth of 312 feet, the true vertical depth of the well is 311.65 feet. (Note: This is not the drilled total depth). Figure 3 illustrates the vertical and horizontal offsets from the surface projection of well 299-E24-22. The measured depth-to-water table is approximately 286 ft bgs and the correction factor at this depth for determining the true vertical elevation of the water table is ~0.27 foot. This distance should be subtracted from the depth-to-water measurements to obtain true depth.

7.0 Subsurface Characterization Results and Interpretation

Results from the sediment sampling, physical property analysis, geologic log, geophysical logs, well development, and aquifer testing from each borehole are correlated to provide an interpretation of the hydrogeology at each borehole. This section includes a discussion of the criteria used to evaluate and interpret the data. The composite logs in Figures 4 and 5 illustrate the interpreted hydrogeology developed for each well.

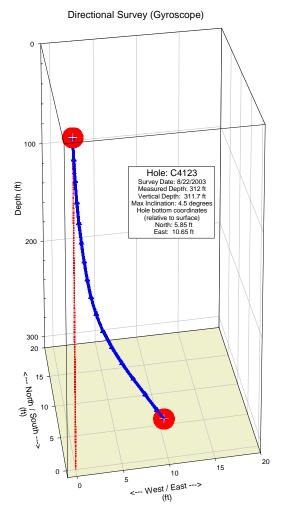


Figure 3. Vertical Profile and Bottom Hole Projections of Well 299-E24-22

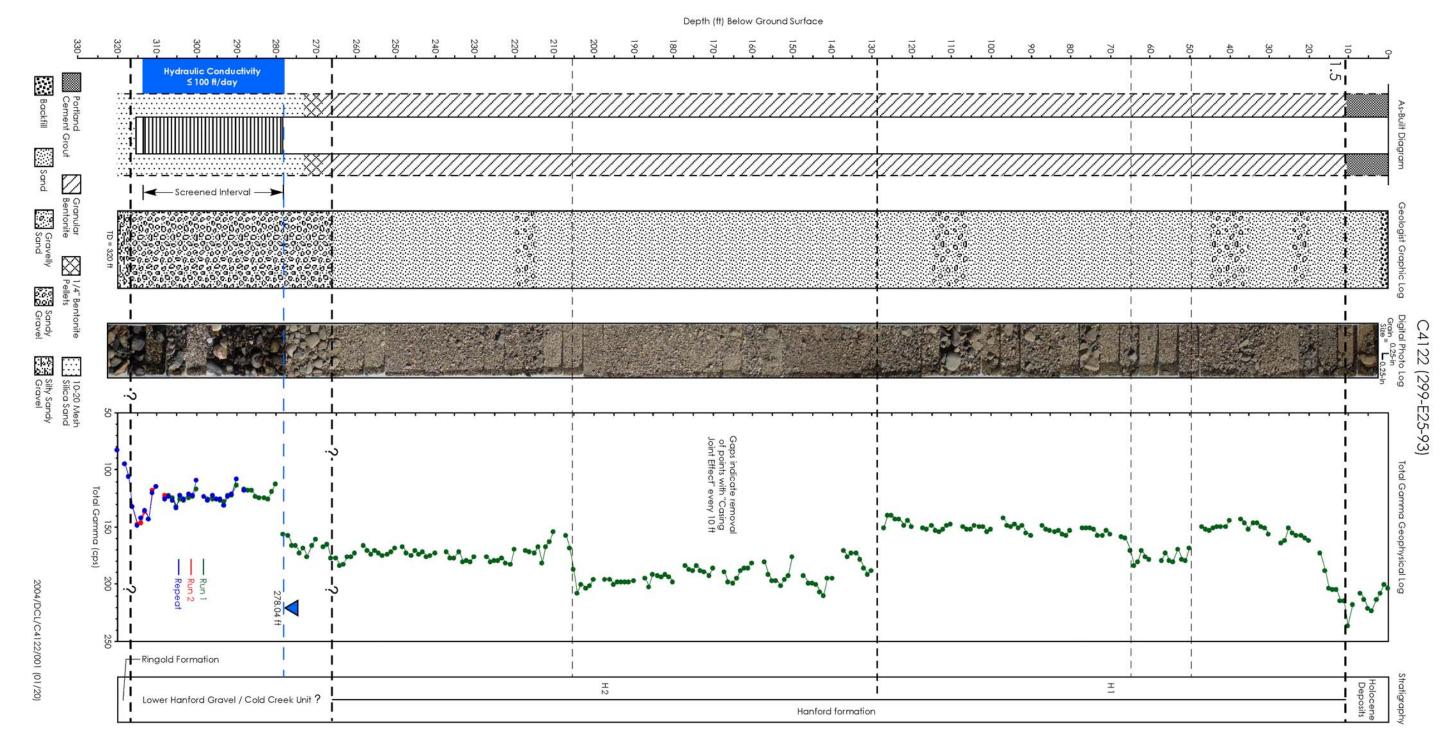


Figure 4. Hydrogeologic Interpretation for Well 299-E25-93 near Single-Shell Tank Farm WMA A-AX

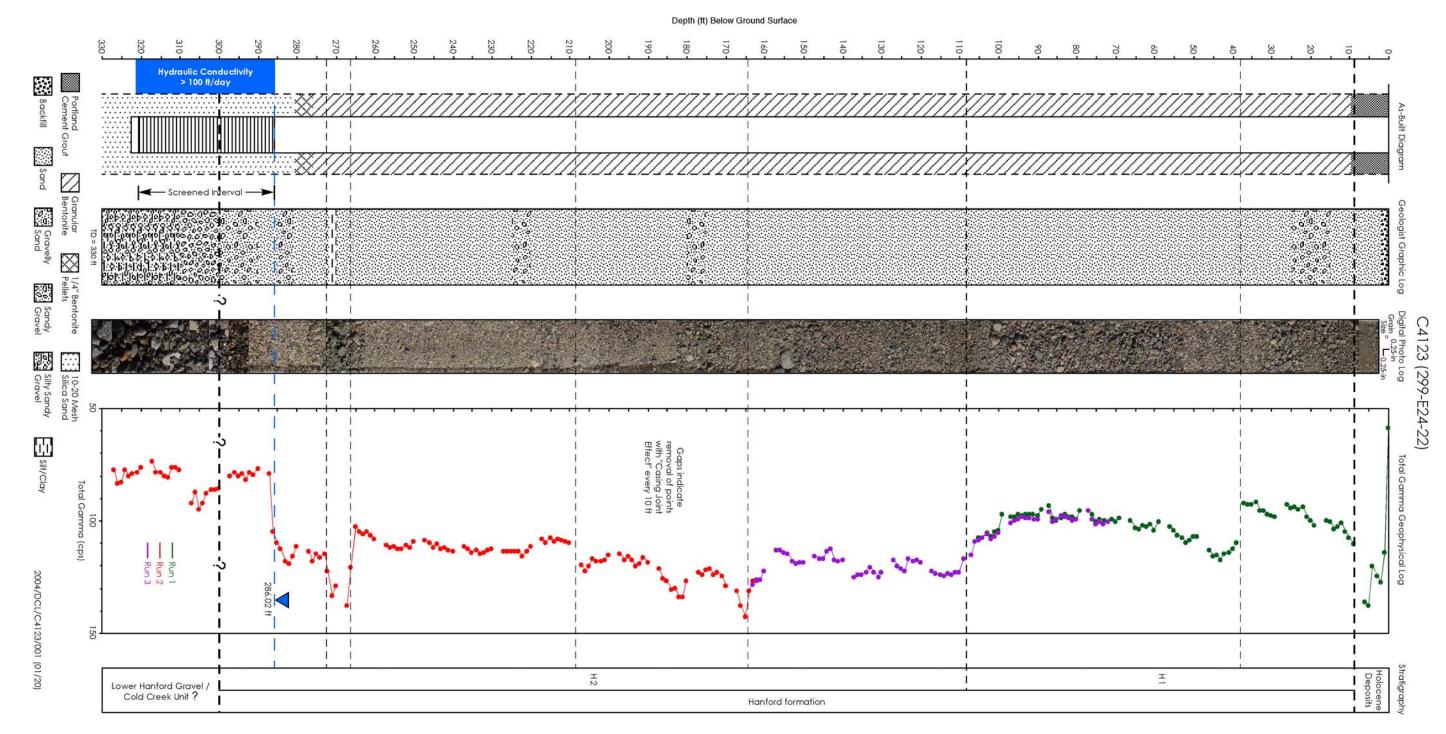


Figure 5. Hydrogeologic Interpretation for Well 299-E24-22 near Single-Shell Tank Farm WMA A-AX

7.1 **Physical Properties**

There was no analysis for physical properties conducted on samples from these wells except sieve analysis of sediment samples (grab or split spoon) collected from the screen interval for particle size distribution. Particle size distribution results (sieve results) are provided in Appendix B.

Grab samples collected at 5-foot-depth intervals are described on the geologist's borehole log located in Appendix A. The wellsite geologist's graphic representation of the borehole logs for both wells are illustrated in composite logs (Figures 4 and 5). The sample quality and formation representativeness of the grab samples, and thus the borehole log descriptions, are limited due to the nature of the drilling. Drill rates were very fast (>250 feet per day) and the airlifted cuttings return process, which causes gravity separation of sediments based on grain size and density, most likely mixed a lot of the sediment cuttings from different depth intervals before the cuttings reached the surface. When thin beds or sharp contacts were drilled, the returned sediments that were collected could not be easily evaluated or confidently correlated to their representative depth intervals.

The spectral gamma geophysical logs do indicate the presence of sharp contacts and/or thin bed intervals which can not always be differentiated in the returned cuttings. These changes are not documented in the geologic borehole log for these wells but evidence they exist can be seen in core data collected in a nearby well. Vadose-zone core recovered from well C4124 (299-E27-22) at single-shell tank WMA C provides evidence of these contacts and the thin, sharp lithologic changes that are seldom recognized when only evaluating drill cuttings returns from the Becker-Hammer drilling method.

7.2 Sediment Digital Photographic Log

A digital photographic log is included in each composite log for the wells (Figures 4 and 5). Grab samples from the cuttings return line (cyclone) were collected for lithologic descriptions, documented in the borehole log in Appendix A archives, and for digital photography of the sediments. These photographic log presentations, compiled from 1-inch chip tray samples collected at 5-foot-depth intervals, provide a qualitative visual tool that reveals changes in major lithologic intervals (i.e., grain size, color, and relative moisture). The digital photographic logs provide a means to illustrate subsurface lithologic and related hydrogeologic features. The interpretative value of these logs is also limited by the sample collection technique and sample container site.

7.3 Geophysical Logging

Cesium-137 was the only manmade radionuclide detected in both wells. This contaminant is mainly at the surface but there are a few sporadic detects at the minimum detectable level throughout the boreholes. Appendix C provides more details about the cesium detected in the boreholes.

For well 299-E25-93, geophysical log plots of the naturally occurring gamma emitting radionuclides (potassium, uranium, and thorium) indicate there are several distinct activity changes (inflection points) at depths of ~50, 65, 130, 205, and 279 feet bgs. These major changes correlate to lithologic features (i.e., contacts and/or thin contrasting lithologic intervals) and the water table (Figure 4). The inflections at

~50, 65, 130 and 205 feet bgs probably correspond to distinct changes in lithology (i.e., grain size, clast mineralogy, or both). As discussed in the section above, these changes are not documented in the geologic borehole log for this well but evidence they exist can be seen in core data collected in a nearby well.

For well 299-E24-22, geophysical log plots of naturally occurring radionuclides indicate there are several distinct activity changes (inflection points) at depths of ~38, 108, 165, 208, 267, 272, and 286 feet bgs. The inflections at 38, 108, 165, and 208 bgs probably correspond to unrecognized changes in lithology similar to those discussed in the previous sections. The inflections at 267 and 272 feet bgs and high gamma peaks (~268 and 271 feet bgs) correspond to a ~5 foot thick silt/clay interval that is recognized in the borehole and as clay clumps in the digital photographic logs (Figure 5). The water table is indicated at 286 feet bgs.

No attempt has been made to correlate specific units of facies between these two wells, although evaluation of the logs does suggest some continuity may exist.

7.4 Aquifer Tests

Slug testing was performed in both wells following construction and development. The slug tests are performed to provide semi-quantitative calculation of hydraulic conductivity in the unconfined aquifer (i.e., the screen interval). The slug testing results provide an objective method to evaluate the hydraulic properties of the formation and support interpretation of the hydrogeology of the aquifer system.

Highly permeable conditions are indicated from well screen development drawdown data collected during constant rate pumping in both wells. Drawdowns were less than 0.11 feet (22.5 gallons-perminute pump rate) and 0.16 feet (25.5 gallons-perminute pump rate) in wells 299-E24-22 and 299-E25-93, respectively. During slug testing, both wells exhibited highly permeable screened test intervals with test recovery within 10 seconds. Well 299-E24-22 exhibits an oscillatory, underdamped slug test response, while well 299-E25-93 displays a rapid, exponential decay (overdamped) test response. An oscillatory response indicates a higher permeability test interval (all other test parameters being similar, e.g., well-screen length). Preliminary average hydraulic conductivity values for the two wells are: well 299-E24-22 > 100 feet per day and well 299-E25-93 \leq 100 feet per day. Quantitative analysis results for these two well sites will be documented in a subsequent PNNL technical report that presents hydrologic test results for slug tests conducted during fiscal year 2003.

7.5 Composite Logs

Composite logs have been assembled for each well using the well as-builts, aquifer testing results, the geologic graphic log description of the sediments, the digital photographic log, and the geophysical logs. Stratigraphic interpretation contacts and key lithologic changes are identified where possible. The composite logs for new wells 299-E25-93 and 299-E24-22 are illustrated in Figures 4 and 5, respectively. These interpretations are also consistent with Woods et al. (2003) and Williams et al. (2000).

The Hanford formation comprises most of the thick vadose zone in both wells, composed mostly of sand to silty sandy gravel. There are several distinct contacts and thin fine grain lithologic intervals (e.g.,

silt or soil horizons) within the Hanford formation, implied by the inflections on the geophysical logs. The most significant inflections are dashed on the composite log to imply a contact.

The uppermost unconfined aquifer is composed mostly of uncemented, loose, gravel to silty sandy gravel and appears characteristic of the more permeable lower Hanford formation and/or the Cold Creek unit (formerly called "reworked Ringold Formation sediments" or the "Pre-Missoula Gravel"). The contact between the lower Hanford formation and the Cold Creek unit is gradational and not easy to distinguish. The lower Hanford formation and/or Cold Creek unit upper contact is approximately located at 266 and 300 feet bgs in wells 299-E25-93 and 299-E24-22, respectively (Figures 4 and 5). Criteria for designating the Cold Creek unit sediments include dominantly gravel deposition, samples composed of less than 50% basalt, and hydraulic conductivity values (> 55 feet per day) greater than published results for known Ringold Formation sediments.^(b) However, distinguishing this unit based on hydraulic conductivity values from lower Hanford formation gravel is not possible in this area.

In well 299-E25-93, the very bottom 3 feet from 317 to 320 ft bgs (total depth) comprises a portion of the Ringold Formation Unit 9. This unit is characterized by silty sandy gravel that is less than 25% basalt, has moderate cementation, contains iron staining, micaceous material, and is described in daily drilling logs as difficult slower drilling. The interpretation of the lower Ringold Formation Unit 9 at the bottom of this well is consistent with interpretations described in Williams et al. 2000.

8.0 References

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NAD83 (91) North American Datum of 1983 (1991 adjustment).

⁽b) Letter report from FA Spane to VG Johnson (Pacific Northwest National Laboratory, Richland, Washington), "Summary of Hydraulic Conductivity Estimates Obtained From Recent Hydrologic Characterization Tests Conducted in the WMA S-SX," 2002.

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Appendix A

Well Construction and Completion Documentation

WELL SUMMAI	RY SHE	ET			Date: 01/01/03	Page 1_of _2
·					sh Date: 07/09/03	
Well ID: CHI22					- 825-93	
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Signature: Charten marting			Signature	: Á	Dille	
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Signature: charles martine		Signature		B Walk
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Aquifer Test: Well development Date:081/2403 Well Decommission: Yes: No: Date: Description: 5 HP Franklin submersiblequump: Developed 3 Description: Secription: Secription: Secription: Stages: Intake set@ 316.1, 306.0, 296.0, 10mp rate 26 Description: Secription: Secription: Stages: Intake set@ 316.1, 306.0, 296.0, 10mp rate 26 Description: Description: Secription: Stages: Intake set@ 316.1, 306.0, 296.0, 10mp rate 26 Well Decommission: Description: Secription: Stages: Intake set@ 316.1, 306.0, 296.0, 10mp rate 26 Well Decommission: Description: Secription: Well Decommon reserve to a secription: Well Decommon reserve to a secription: Well Decommon reserve to a secription: Well Decommon reserve to a secription: Well Decommon reserve to a secription: Well Decommon reserve to a secription: Well Decommon reserve to a secription: Well Decommon reserve to a secription: Well Decommon reserve to a secription: Brass Survey Marker Elevation: Washington State Plane Coordinates: Brass Survey Marker Elevation: Comments / REMARKS Vol cales: f.c., 6 begas frage 7:71 Ft is consulted, 30 bags frage 10 cos ft is cos frage 20 cos ft is cos frage 20 cos ft i				071150.4	0711/17/50			-	
Description: <u>SHP</u> Franklin <u>submersible gump. Developed 3</u> Description: <u>Stages</u> : Intake set@ 314.1, 304.0, 244.0, 1ump rate 26 <u>appm. Final turbidity</u> : <u>1.24 nTu 0.83 nTu 1.19 nTu.</u> <u>WELL SURVEY DATA (if applicable)</u> <u>Protective Casing Elevation:</u> <u>Brass Survey Marker Elevation:</u> <u>COMMENTS / REMARKS</u> <u>Vol calcs: f.C., 6 bags + 1.285 bag = 7.71 fc²: Granules, 132 bags + 0.71 bag = 93.72 fc²; pellets, <u>3 buckets + 0.62 bucket = 1.86 fc²: 10-20 sand, 30 bags + 0.535 bag = 16.05 fc²</u> <u>Reported By:</u> Title: Signature: Date: <u>Charlene Martinez</u> Geologist <u>Concluse Marker</u> Oflocios</u>								Detai	
Stages : Intake set@ 314.1, 306.0, 294.0, 14mp rate 26 gem. Final turbidity 2) 1.24 nT u 10.83 nT u 1.14 nT u. WELL SURVEY DATA (if applicable) Protective Casing Elevation: Washington State Plane Coordinates: Brass Survey Marker Elevation: COMMENTS / REMARKS Vol cales: f.c., 6 bags# 1.285 bag= 7.71 ft23: Granules, 132 bags # 0.71 ft23 g = 93.72 ft23; pellets, J buckets # 0.62 ft2 Reported By: Title: Signature: Date: OPloy:st	•			00		Yes	s: No:	Date:	
Reported By: Title: Signature: OPIC Colspan="2">OPIC COLSPAN="2"	Description: SHP Franklin	submersible pur	ne Deve	Loped 3	Description:				
WELL SURVEY DATA (if applicable) Protective Casing Elevation: Washington State Plane Coordinates: Brass Survey Marker Elevation: COMMENTS / REMARKS Vol colss: P.C., & bags # 1-285 bag = 7.71 Ft2 : Granules, 132 bags # 0.71 ft2 : gellets, 3 buckets # 0.62 ft2 Brass Survey Marker Elevation: COMMENTS / REMARKS Vol colss # 1-285 bag = 7.71 Ft2 : Granules, 132 bags # 0.71 ft2 : gellets, 3 buckets # 0.62 ft2 Brass Survey Marker Elevation: COMMENTS / REMARKS Vol colss # 0.71 ft2 : gellets, 3 buckets # 0.62 ft2 Brass Survey Marker Elevation: Date: Date: Option: Date: Option: Date: Option: Date: Option: Date: Option: Date: Option: Date: Option: <tr< td=""><td>~ <u>a</u></td><td>· \ m</td><td>, Pump</td><td>note 26</td><td></td><td></td><td></td><td></td><td></td></tr<>	~ <u>a</u>	· \ m	, Pump	note 26					
Protective Casing Elevation: Protective Casing Elevation: Brass Survey Marker Elevation: COMMENTS / REMARKS Vol colspan="2">COMMENTS / REMARKS Vol colspan="2">COMMENTS / REMARKS Vol colspan="2">Protective Casing Elevation: COMMENTS / REMARKS Vol colspan="2">Colspan="2">Protective Casing Elevation: COMMENTS / REMARKS Vol colspan="2">Protective Casing Elevation: OMMENTS / REMARKS Vol colspan= 2 Protective Casing Elevation: OMENTS / REMARKS Protective Casing Elevation: OMENTS / REMARKS Protective Casing Elevation: Develop: State Protective: Protecting to the protecting to the protecting to the protecting to the pr	gem. Final turbidity =) 1.	24 nT 4 0.83 NTU							
Washington State Plane Coordinates: Brass Survey Marker Elevation: COMMENTS / REMARKS Vol colspan="2">COMMENTS / REMARKS Vol colspan="2">COMMENTS / REMARKS Vol colspan="2">COMMENTS / REMARKS Vol colspan="2">COMMENTS / REMARKS Vol colspan="2">Colspan="2">COMMENTS / REMARKS Vol colspan="2">Contines, 132 bogs # 0.71 for g = 93.72 for g = 93.72 for g = 10.05 for g	N		WELL S	URVEY D	1				
COMMENTS/REMARKS Vol calcs: P.C., & bags # 1.285 bag= 7.71 Fz ³ : Granules, 132 bags # 0.71 fz ³ cg=93.72 fz ³ ; pellets, 					Protective Casing Elevation:				
Vol calcs: P.C., & bags # 1.285 bag = 7.71 Ft2 : Granules, 132 bags # 0.71 ft2 bag = 93.72 ft2; pellets,	Washington State Plane Coordina	tes:				on:			
<u>3 buckets # 0.62</u> <u>Buckets # 0.62 <u>Buckets # 0.62 <u>Buckets #</u></u></u>	-	~1	co	OMMENTS	S / REMARKS	C+2			
Reported By: Title: Signature: Date: Charlene Mertinez Geologist Charlene Morting 09106103	Vol cales: P.C., 6 bags	* 1.285 Eng= 1	7.71 62	:Gran	ules, 132 bags + at	u š	1g = 93.72 FZ	pellets	
Charlene Martinez Geologist Charlene martine 09/06/03	3 buckets + 0.62	bucket = 1.810	ee3: 10	-20 59	nd, 30 bags # 0.53	5 5 6	g= 1605 f	د*	
Charlene Martinez Geologist Charlene martine 09/06/03					`		7		
Charlene Martinez Geologist Charlene martine 09/06/03									
	· · .				-				
→ A-6003-658 (04/0	Charlene Martinez	<u> </u>	t.			<u>.</u>			

			BORE	EHOLE LO	G			Page 1_ of 3_
								Date: 2010103
Nell ID: ๛ุนเว				9-625-93		East of 2		
Project: CH03	RCRA D	n Illin	٩		Reference	Measuring Point:	Ground	Surface
Sam	ple		4	Sample	Description			Comments
Oepth (Ft.) Type No. F			Color, Mois		Sorting, Angul	oil Classification, arity, Mineralogy, o HCI	Method o Sam	Casing, Drilling Metho of Driving Sampling Too oler Size, Water Level
	NIA		-1 B	ac.kfill m	aterial. C.	cushed	Becker	Hammer using
9'60		<u>j</u>	asaltic	gravel.			dual w	ball casing a o
				sand (s)				sands @ 2' bgs.
5 - Erab			o yrsl.			non basalt.	- F	S'archive same
-84			der.					
		28 - L	1-20 S			nd, 5 /2 site	. Hartfor	rd formation Q/11's
		1.1.1	v. peorly	85 10 ba		in et zlother	Collect 1	or archive sample
- Bt	50.000		byr3	12. very	dark gray			•
			moist)	med. ren	Hel.			-
			20-25	1 onavelle	SANDLA	\$) 15°10		
		1.00146	gravel,				, collect	15 archive sample
-BH		8-260 T	nod. sor	ved, Ry b		Sand, v. poor go"(o basa t		
		33730.1		zl other.		HCL LOYR3		
-1			v. dark		brewn (moist)		
- BH		0	25- 3	5 39000	3) 100'10	Poorly	collect	20'archive same
- 1		ээ:	sorted,		grained,	SK-SA, 45	0	
-				55 10 gt		$\frac{104R412}{micaceou}$	s.	
s t	O.	SC ST	no nxn	HCI.				25 a chive same
-BH			35-45	/	50.D(.	5)1-04		
-		500 S F	<u>35'- 45</u> 55'10 391	5 4	1 SHADLA	5) 10% grav		
		2516-77			ic. Sand.	poorly sorter	4	
0 1			B-30.	ven-ves	Inning.	90'10 benett.		
- 8 H			0 10 gt	zlother, L	04×312,1	1. dark grayis	sh Collect	30 archive same
		e E	0.0000		Do ran HC			
,]		-				oarly some	4	
-BH		<u> </u>		zlother			is collec	I 35 archive same
-11					no nxn H			
-1		- O						
eported By:	variance y	mart	inez		Reviewed	By: 6, D. U	Valker	
itle: Geolo					Title:	Geologi	st	
Signature: 🔥	•			Date: Date:	Signature:	18 11	2 ph	Date: 10/1/0

			Page 2_ of
	BOREHOLE LOG		Date:07/01/03
	Vell Name: ۵۹۹-۶۵-93	Location: East of 241	
roject: CYD3 RCRA Drill:	29	Reference Measuring Point:	
Sample Graphic	Sample D	Description	Comments
(Ft.) Type Blows Log No. Recovery	Color, Moisture Content, So Max Particle Size	istribution, Soil Classification, orting, Angularity, Mineralogy, e. Reaction to HCI	Depth of Casing, Drilling Method Method of Driving Sampling Tool Sampler Size. Water Level
O BH NIA O O	@ 55' 45% basal	t, 55 in at 2/other_	Becker Hammer using
- BHQU	(still sand) IOYR 4		And wall casing. 4" ob
-	micaceous. SR-SA.	poorly sorted. NO	Collect 40 archive
	mon HCI.		collect 45 orchive
5 Grab	8. S		
-Btiq	3		
	k		
	ä		Collect 50' archive
- Britt	&		
	ä		
	å		
	<u> </u>		
6	<u>\$</u>		collect 55' archive
- BHan	<u> </u>		A.M.RCT ck.
- 1	ž.		K. 3. 312 background
	<u>.</u>		
	ě.		collect 60' archive
O Grab	200		
- B#9*	8		
	@ 70' sand grad	ding to mod-sorted	4
6	SR-R, micaseous. M	med-ucre grained.	
-BHA"			collect 65 archive
	<u> </u>		
	<u></u>		
0 Gmb			Collect 70 'archive
-BH 9	<u> </u>		Lawer In growing
- 🕅	8		
	8		-
	a 75. Sand 95'	10. gravel < 5 "10,	collect 75' archive.
15 Grab	trace sitt. Grav.		
	morted mos ~ 0	. 5 ". Sand, poorly	
	sorted sR-sn. VS	En-ucae, 55 10 gt 2/2	Lar,
	45% besatt. IDYRY		
Reported By: charlen 1	martinez	Reviewed By: 1.D.W.	h /Ker
Title: Geoleci ST		Title: Geologisz	t
0		10	<i>nn</i> / /
Signature: concere m	Date:07/01/0	Signature: AS Wal	Date: /0/1/0:

			BOREHOLE LOG			Page <u>3</u> of <u>8</u>
			BOREHOLE LOG			Date: orloilo3
Well ID	: C4122	We	ell Name: 299-625-93	Location: East of 2	41-A T	ank Form
Project	: CHO3 RO	CRA dri	Ning	Reference Measuring Point:	Groun	d surface
	Sample			Description		Comments
Depth (Ft.)	Type Blow No. Recov		Group Name, Grain Size D Color, Moisture Content, So Max Particle Siz	istribution, Soil Classification, orting, Angularity, Mineralogy, e. Reaction to HCI	Depth of Method o Samp	Casing, Drilling Metho of Driving Sampling To oler Size, Water Level
ස ව	BHAN NIF) [Selige		sorted (vfn-med		r Hammer usin
-	6mb 8H 9"		other no rxb HCl	micaczeus.	Colles	t 80'archive
- - 85					collect	- 85' archive
80 	BH9"					
- - 20			Q 90' the trace	of pea-sized, R	Collert	r go' archivy
. –	Grab BH9"		poorly sorted. vfr	Till sand. Sand,		
- - %			45-56 10 basals	maist. no ran HC		as'archive
	6 rab 8 H a 11			· · · ·		
– – 			2.100 sand grad in	to mod. served	نه مارم	t wo'archive
- -	BH 9		Sand, m-Vise grain Basalt increasing - brown, meist	ned. no gravel. to 60 %. 104R313, dar	Ł	
- کە	E mb BH 9 ⁴		basaltic, Sand, po	orted growel @ 105'		t 105' archive
_		o O	104R313, dark b			
·10	Grab BHq 4		106- 115' gravel gravel, 80 % san	4 SAND(95) 20%	Collec	t 110'archiv-
-				2 lother 40 %.		-
	Rup Bright		10YR 312, v. dark No rxn Aci	grayish breen (mois	t) c.o llec	t us archive
				······		
Report	ted By: Char	lene m	artinez	Reviewed By: L.D.U	lalker	
	Geologis			Title: Geologis		
	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			Signature: Ald lu	, 11	Date: 10/1/

		BOREHOLE LOG			Page <u>4</u> of <u>8</u>
		BORENOLL LOG	·		Date: 07/01/03
Well ID: C 4122	We	ell Name: 299-2225-93	Location: East of a	41-AT	ank Farm
Project: CY03 RCR	A dri	Ning	Reference Measuring Point:	Ground	Surface
Sample		★ Sample D	escription		Comments
(Ft.) Type Blows No. Recovery	Graphic Log	Group Name, Grain Size Di Color, Moisture Content, Sc Max Particle Size	istribution, Soil Classification, orting, Angularity, Mineralogy, e. Reaction to HCI	Method o	Casing, Drilling Method f Driving Sampling Tool ler Size, Water Level
20 BHAN NIA		45-215'sand (3) 1	00 10, poorly sorted	Becker	- Hammer wing
- BH 9"		A	grained 60-656	chunt w	all casing. 9"00
		V. dark grayish bro		Coller	120 or chive
		N. dark grayish bro no ran HCL.	wh chuist micace		
-BH74				Collect	t25 archive
					+ 130'archive
30-Greb			101	Colle C	riso archiva
- BH9"					
35		Q135' trace bas	attic gravel ( < 5%)	collec	+ 135 archiv-
-BHQ "					ţn.
	64 - S				1 - 1 - 1 - 1
-					
		Q140' sand gradi	ng to mod-well	collec	+ 140'orchive
Grah			coe grained.		
-BHR "	10.57		0		
45 6000			well sorted, SR-R,	collect	t 145' archive
-BHa"		vfn-med graines	1, basalt 30%,		
			owish brown (moist)		
			5-150)		
50 1					
Brab.		@ 150' back to be	esaltic, poorly	Collect	risp'archive
		Serted send as	described above.		
-1 $ $ $ $ $ $		(150-155-)			
155 V			layer of ven-med	levilec	t 155 archive
-BH 94		grained, well sorted	sand as described		
Reported By: Charle	ne m	lertine 2		Ja lker	
Title: Geologist			Title: Geologi's	:t	······
			Signature: AS UL		Date: 10/1/

				BORE	HOLE LOG	•			Page <u>5</u> of <u>8</u>
				BORE			13		Date: 02/01/03
/ell IC	):C412	22	We	ell Name:29	-625-93	Location: 20	SE OF	241-12	tank form
roject	: 2403	BRCRA	drillin	9		Reference Me	easuring Point:	Fround	Surface
		mple		a	Sample D	escription			Comments
epth Ft.)	Type No.	Blows Recovery	Graphic Log	Group Name Color, Moistu M	e, Grain Size D ure Content, Sc ax Particle Size	stribution, Soil orting, Angularit e, Reaction to I	Classification, y, Mineralogy, ICl	Method c	Casing, Drilling Methor f Driving Sampling Too ler Size, Water Level
o	BHax	NA	200 200 200			Vese are		Becker	Hammer using
	BHa	1				to b atzlo			pall casing 9"00
_	I I			poorly sor	ted, SR-SF	a. Lovie 413	dark	collect	160' archive
-				grayish k	0-1651)	552) no no	n HCl.		
<u>б</u> —	Grab			DVIE CON	1 110-0-1-	ed grainet,	usell-sedet.	Collect	165 erchivy
-	BH4 K			SR-12, 20"	(a + z) = 0	Rr. 30 6 5	weatt.		
-	1 \	· .	2355			lowish brou			
-	1 1			no ron H					
~	1 1								
	BHA"							collect	170' archive
_	001			poorly so	nted, SR-	s A sand.	104Rul3		
_				dark gra	ish brow	n (moist)	Au ran HCL		
					•				
5	<u> </u>		1.00						
-	Grab BH9."	1						Collect	t 175' archive
-				ļ					
-	4 1								
-									
80-	6 - 20	4							180'archive
-	BH "	T I						COLLECT	too archive
-	- 1		100						·
-	+								
					-				
5_	Grab							Collect	185' archive
-	BH a "		555.55						
-	1 [								
-	1								
<u> </u>	1 1								
-0	Grab	1						collect	r 190' rohive
	-		41.						-
3	1			a 195'	Sand, no	t as coarse	e. silt	0110-2	+ 195 archive
95	6 - 2 b			increase	<u>~ +0 5°</u>	10. Basala	tic, SR - SP		
					- <b>.</b>				
epo	rted By:	Sheet In	1055205561 ng 400	2 a mb/ of 7		Reviewed B	y: L.D.U	a/ker	
						Title:	Geologis		
	Geolo	•		,			•		Data: In /
Signa	ture: C	narles	e mai	the	Dateorloilo	3 Signature:	a du	alle	Date: 10 / 1

			BOREHOLE LOG	1		Page 🖉 of 📕
			BORENOLE LOG	·		Date: orlolo3
Vell ID: C4		We	ell Name: 299-625-93	Location: East of	241-A T	ank Farm
roject: CH o	3 RCRF	A Drilli	na	Reference Measuring Point:	Ground	+ Surface
	ample		Sample L	Description		Comments
epth Ft.) Type No.	Blows Recovery		Color, Moisture Content, So Max Particle Siz	istribution, Soil Classification, orting, Angularity, Mineralogy, e. Reaction to HCl	Depth of Method o Samp	Casing, Drilling Methor f Driving Sampling To ler Size, Water Level
OB BHO	ALA ,		@ 200 Sand ( 95" 10	) s; 1t (5 %) sand,		Hammer usin
-BH 9"	1			ell sorted. SR-SA,		all casing 9"01
- 1				o atzlother.	Collec	+ 200' archiv
-1			micacyous LOYRY	13, brown, moist		
_ +			no run Hel.		C = 11 = = +	- 205' archive
S Grab					Am IH	
BHA						s L detect.
		6. S.				
-						
o L.V.	$\downarrow$	<b>.</b>			collect	210'archiv
-BH.9						
- 1						
-						
			215-220' oravella	SAND(05) 10/10	0.00.0	- 215 archiv-
5 Grab	4	- 8 A	Quarel, 85% sand	5 10 stite. Gravel.	Lawer	
- 64 9 "		5	<i>d</i> . , , , , , , , , , , , , , , , , , , ,	predominately sea-		
		$\sim 0.5$	Size gravely mes, a	CO.5 ", basaltic.		
- 1			Sand, v. poorly sor	ted, SR-SA, wfn-vest	l	
a decab	4	0.0	grained. us " basa	12, 40°10 ot 2 lother.		, , , , , , , , , , , , , , , , , , , ,
BHA		1.0.1.4		() brown (muist)	Collect	t 220 archive
-			No rxn HCL.			1 1
- 1			220- 2005 SAND (5)	95% sand, 5% sire		· · · · ·
			trace state aravel.	Sand. v. poorly sorte	J	
5 V Gran			SR-SA. ufn-ucse		7	- 225' erchive
ואייי			40 % gtz lother. 10	VR413 prown(moist)		
			no man HCI.		L	
-						
so v	4					
- 84,9"					Collect	230' archive
11					1	
-					<b> </b>	
		9				
Grab					collect	235' archive
BHA						
4 1.						
	L Ý				1.14	
		ne m	lartine 2		<u>Jalker</u> 1	
	logist		•		10	
ignature:	horles	, mai	time Date: rlo la	Signature: The Wa	the	Date: 10/1/

				BOF	REHOL	E LOG					Page	<u>_7_</u> of	8
											Date:	071	01103
	: C 41			ell Name:	299-62	5-93	Location: g	ast c	f zui	- A Tan	k Fa	cm	
roject	:040	3 RC	RAdri	Ming			Reference N	Measurin	g Point:	Groun	d Su	r faa	e
	Sar	mple				•	escription				Comn		
Depth (Ft.)	Type No.	Blows Recovery	Graphic Log	Group N Color, M	ame, Grai oisture Co Max Pa	in Size Di ontent, So article Size	stribution, So orting, Angula e. Reaction to	il Classi rity, Mine HCl	fication, eralogy,	Depth of Method o Samp	Casing, of Driving ler Size	Drillin Sam Wate	g Methoo pling Too r Level
	BH9"	614	Silver	D 240'	Sand.	tract	gravel.	Trace	SIT.	Becker	Ham	mer u	sing
4	Grab BHa"			sand. v.	peorly	sorted	rfn-ve		alned,		ll cas		
-	T			SR-SA,	60-0			30-35		دەدامح	1 240	arch	10-4
-				other.	10YR4	13 600	wn(moist	1) <u>()</u> ()	in hici.		~		
-			100							Collect	245	0.4.1	1.1.0
	Grah		10									ares	1142
-	BH 9"			-									
		·											
]									• .				
50	V.			I						Co llect	t 250	ars	hive
_	BAR												
_													
-													
-										collect		-	1. 1. 0
55	Grab									Conco	255	arc.	h.v.C
-	BHA"			1						·			
_	1			/			3						
			0.7	ъ.									
	V		5							Collect	່າກເປ	9-0	hive_
_	Grab BH 9		18.40	266-	317 5	andy G	RAVEL (	<u>sG)</u>	45 °/0	Cont	, RCI		verage
-			500	grave	50 6	sand.	5 % 5:10	<u>. 60</u>		betwe			180-1
-				mods			ed to me			R. 3.X	<u>@</u> \ <u>b</u>	reg	round
-				SA-R.	sand,	Poorly			med-				
5-	Grap			no rx	grained	1. 104	e 513 hr	own (	moist)	Collect	22.5		م د ز ه
_	BH 9"		04.0								205	ערנ	N. C. L.
	1		$\mathcal{P}_{\mathcal{A}}^{O}$						÷				
			$\mathcal{C} \subset \mathcal{O}$									1	
	V		D				•**			ellect	270	í ar	chine
	BHqu	1 1	$O_{2}$										
_			208					· · · · · · · · · · · · · · · · · · · ·					
-			$\mathcal{E}O^{\circ}$										
_	J	-	XQX								22/		
75-	Grab		50		•					Collect FMIH		arch	1.0.
	BHAU		800	Tagge	à •	62	18.04 b	~ ( ) ~	115/03)			etest	
-		4	A O B	10040	~ <u>1. m</u>			83/00			<u>ລຸ</u> 280	bee.	Ortoilo
-		= 1	202							STarte			
Report	ed By: c	Narla	me Tra	artinez	,		Reviewed E	By:	L.D.U	hlker			
	Geolog							Seo lo					
		4		-	Data				9/12	.00		Date	10/1
Jynau		naner	mart	mg	Date.	01101103	Signature:	100	wa	en			-642 (03/0

				BOREHOLE LOO	3		Page <u>8</u> of <u>8</u>
					-		Date: 07101103
Nell ID	): ૯૫ા	22	W	ell Name: 299-625-93	Location: Ensz of 2	41- A T	ankFarm
Project	t: CY	03 RC	RA dr.	lling	Reference Measuring Point:	Ground	d surface
		mple		Sample	Description		Comments
Depth (Ft.)	Type No.	Blows Recovery	Graphic Log	Group Name, Grain Size I Color, Moisture Content, S Max Particle Si	Distribution, Soil Classification, orting, Angularity, Mineralogy, ze, Reaction to HCl	Samp	Casing, Drilling Metho of Driving Sampling Too ler Size, Water Level
80	BH 9"	nIA				Becker	Hammer using
_	35#	005 05	600	·		dualwo	lasing 9 00
-	١	o's rec				SS 1	280 - 282.5 693
	BH	nIA	9 Oo	· · · · · · · · · · · · · · · · · · ·			CONSLA
	12	1	O			Collect	285 archiv-
	Grab BH9		0 PASO			Ame	et ek
_	1		2 Õa			4.0.00	2 background
-			30 Q				*
-			$O_{O_{4}}$				
90-	Gmb		$\mathcal{D}_{0}^{O}$			Collect	290 archive
-	BH94		0.5	• • • •			
_	11		8 Q4P	· •			
~			$O^{\circ}O^{\circ}$				
-6	L		*0 <u>2</u>				
-	BHQ		O			Collec	1 295' archive
-	i		DASI				
-			3.00			+	
-			0.5 0			Caller	t 300 archive
0	Grab	1	$O$ $\delta$ $O$			100110	a soo areative
_	Bther "		$O_{2}$				
			200				
-			OOO				
d5	Grab		ЪÔ				305' archiv-
_	BH 9'	1	٩Ŋ٥			AM IT	
-	11		0.29			organics	s < detect.
-			ROX				
-	1.		$\sum O$			Collos	t 310 anchiv
10-	BHAT	t	OQS				
_			080	317- 820 Silty 2	iandy GRAVEL (msG)		
_			USA	60% gravel, 30%	6 sand, 10 % s! 14.		
-	$\left  \right\rangle$		o U	Gravel, poorly sort			
5	Grato			basalt, 30 10 gtz 1	other. Sand, poorly		315 archive
-	55#	15% RC.	$\approx$	Sorted, SR-SA, VE	n- ucse, 25% basalt,	Ringold	1 fmtn @ 312 bgs
-			072-0		erate cementation,	Callert	320'archive
-	8790	nin	20.5-2	Fe oxide staining. mis	accons. Sample- wet		320'bas.
Report	ted By:	- harly	3-0-	lertinez	Reviewed By: L.D.W		
	Geola		in vy	19111140	Title: Geologist	4(NCP	
		0		T Data al al	-0 -11	nl.	Data: In / 1
ignat	ure: C	have	2 m	Date: 07/09	Bolghature. May Way	m	Date: /0/1/2 A-6003-642 (03/2

WELL D	DEVELOPMENT AND TESTING DATA
Well Name: Well ID: 	Well Location: Date: East of 241-4 Tank Farm 08/14/03
Reference Measuring Poir	nt (unless otherwise noted): TOP OF OUTER CASING (TOC)
Has the well been surveyed?  Yes	
PART 1	PART 4
STATIC WATER LEVEL:	
Start of Job 281.26 100	Last Recorded Current
End of Job ~	Measurements Measurements
DEPTH TO BOTTOM:	Date: 08/06/03
Start of Job 318.82' TOC	cl ∏ ↓c'
End of Job -	
PART 2	
WELL DEVELOPMENT DATA	
Pump Model Frankline SHP submersible	В В'
Intake Depth Big.1 306 296	Ground Level
	-1
Pump Start Stop Flow Rate	te A = <u>2.58</u> A' = <u>2.58</u>
(59 mins) (1504.5gd15) 1041 (140 25.5 gpm	B= 1.47 B'=47
(44m n3) (1444 ggg) N	
(52 miles) (13788845) (52 miles) (13788845) (1437 1530 240 gp	
1504.5+ 1464+ 1378= 454 6.58915	1 101
1204.97 100 14 13 10 - 13 16. 380	Are there any reference marks on the casing strings?  Yes No
Total Pumped 4547 gals	PART 5
Final Turbidity 1.24 0.83 1.19	COMMENTS: DBSO Tagged g.w. =>281.21 from 300
XD SN/Range (PSI)	0852 Tagged bettom => 318.82 from toc. no fill
PART 3	0852 Pump setting rig on site. Setting up.
INSTANTANEOUS SLUG TEST	0906 measured pump: motor=2.3. Intaka@2.3-2.5
Static Water Level (TOC)	(0.2' long). upper portion of pump => 2.35' long. Total
Transducer Depth *	pump = 4.65' long. Franklin SHP submersible electric
Baseline Start	0907 Assembling pump, testing, works.
Injection Start	0929 Tripping in pump   tremmie pipe.
Baseline Start	0938 runge water truck on site.
Withdrawal Start	0940 Instruments calibrated.
Slug Volume V	1025 Pump teremmie pipe installed. Pump@ 3161 TOC
XD SN/Range (PSI)	1030 Setting transducer.
spared by (print name):	Signature: Date:
Charlene Martinez	Charles martine 08/14/03
Reviewed by (print name):	Signature: Date:
L.D. Walker	A-6003-644 (03

-		FIELD ACTIVIT	Y REPORT - DAIL	Y DRILLING		Page of	
				T		Date: 08/14/03	
Well ID: c	-4122			Well Name: 299-625-93			
ocation:	East	of 241-A Ta	nk Farm	Report No.: 3 ( us	ell develor	pmenz)	
	St	art	Fin	lish		Total	
Time	084	15		D	Time	25 hrs	
Hole Depth	n/Csa		Hole Depth/Csg		Hole Depth/Csg	/	
Reference		SURFACE		2 3 4 Ro			
Time/[		SURFACE		Well Develor	1		
From	To	u u	Description Attach applicable draw	of Activities/Operation		t results)	
FIOIII	10						
1040		4	al head (Bot		,		
1041			ted. Flow met	<b>N</b> ,			
1046			surements: pH	8.111, Turb	126 ATU ,	T= 20.8; cond t	
1059		pH mater qu	2				
		met met	er Readings	(46)	terval		
	Time	cond Turb	ax JT	(Fe) drawdow,	n		
	1059	559 3.47	20.5 32.5	97 0.107	110 100 100		
	1111	565 1.68	21.2 32.58	35 0.119			
	1130	558 1.35	22.2 325	84 0,12			
	1138	564 426	20.4 32.54				
11 40		End test * 1	. Start recove	ery trest (# 2	) XD= 32.	625	
	1151	Final XD =>	32.649'; 99.1	8°10 recovery.	Stop test	<u>*</u>	
1156		Benowing 21	of tremmie pipe.	Tripping in 10	to reset	the pump.	
		Dew intake	depth @ 306'	bas.			
1203	1235	Purge water tri	uck off. site.	Back on site			
1238	1342	Begintest =	3 (initial head	3, 22.598 / b	fore test		
		Initial rea	dings: midd	le interval (30	6 Intake	depth)	
		X0 22.5	85. cond 55	2 m = 24.2 °C	Turb. 109	11 nJy. 25 gr	
		from flowma	ter.				
		meter R.	eadings (midd)	le interval)			
	Time	cond Tun	T'C XD	(FZ) drauda	on (4)		
	1250	548 1.75	23.6 22.5	99 -			
	1324	554 0.75	20,6 22.53	31 0.00	)		
	1338	550 0.83	21.6 22.6	15 <del>0</del>			
1342	1350	Start recou	ery test (#	4) Final X	D= 27.608 .	100 TO RELEVEN	
eported	By: cha	riene martin	4	Reviewed By:			
	plogist		Date: 08/14/0	J Title:		Date:	
	•						
Signature	Char	les martin	ez	Signature:			

		FIELD ACTIVITY REP	ORT - DAILY	( DRILLING	Page <u>3</u> of <u>3</u>
	-	Continua	ation Page	·······	Date: 08/14/03
Well Name	: 299-1	E25-93		Well ID: c u(22	
		f 241-A Tank Farm		Continuation of Report No.: 3 ( well	1 development)
Time/	Depth		Description of	Activities/Operations with Depth	
From	То				
1359	1432	Purge water truck	oft- 5148. (	Back	
1400				set intake of pump @	) 296 bga, for
	1405	3rd development is	nterval.	TOP interval	
1437	1530	Initial readings:	12.651 XD	· Begin test # 5 f	or 3rd interval
		Readings: x	0=12.570	2'; 26 gpm, T=22.4°	C, turb 6.14 mu
		cond: 554 cm			
		meter re	ntyl 31	dinterval (TOP)	
	Time	KD(E=) T C	Turb	(D nd Orawdown	
		122021 20.9			
	1517	12630 21.4		551 0.021	
		12.615 20.6			°(
1530	1540			Stop recovery. Final XD	
1550				· Tremmie pipe + pump	st: 11 in well.
<b>Ö</b>		Unable to tag bo			
1553		Geologist off Sil	he to com	plete sieve analyses.	
$\searrow$					
	$\leftarrow$				
	$\vdash$				
		Ch n		······································	
		- Conce	45.1		
			these	· · · · · · · · · · · · · · · · · · ·	
			- may	08.	
				8114103	
Reported	By: Chart	chene, martinez		Reviewed By:	
itle: G			Date: orligios	Title:	Date:
	2	. <u> </u>			
Signature	Charl	the marking		Signature:	A-6003-652 (04/03)

				CTIVITY REI				Page _1_ of _1_	
Date 09/146103	Well No. C		Rig Type/		Rig No.	Contra	act/Work Order No.	Report No.	
				etting rig RCER wells.	· · · · · · · · · · · · · · · · · · ·	Refer	ance .	Location East of 241-A Tank Farm	
	HISTORICA	L DATA			PUM	P SYSTE	M CONFIGURATION		
Construction	Depth 315		9. <b>5</b>				Pre-Maintenance	Post-Maintenano	
Casing Size		Туре	Set At	Pump Type	٥,	א די	Grundfos Redif	103	
	304, sch. 1			Pump Model			made A		
Casing Perfo	orations Sch		Interval	Tubing Size/Typ	•		50.75 DD 55 30	4	
Well Screen	(s) Type	278.2	13 - 313.26 Interval	Length-Bottom	of Tubing to Purns	o Intake	1.11		
	4,50,10,	0.020		Tubing Length			286.0'		
Last Red	corded	Last I	Recorded	Length-Top of T	ubing to Reference	e Point			
Depth-to	1	J 18 .5	-to-Bottom	Pump Intake Se	t at (Depth)		284.1 70		
Curr	ent		urrent	Reference/Mean			1 404.1 70		
Depth-to		Depth- 3\B.4	-to-Bottom	Top of	casing				
		1	Personnel	<u> </u>		Mate	erials Used		
	me <u>1315</u>		FH - fro:	s (T. Hottell	)		und-fos Redif		
	me		CH6 geole	ristensen dr	( ) crews			le 40, 55304	
Contract Ti	me		Layne Cr	and		+	emmie pipe. 28 => 10° sec	tions= 280'	
Total Ti	me 4,5	hrs		en Paul	. •		i => 5' see		
				Descriptio	n of Operations/R	emarks			
0845	On-site	. Fw	S (T. Hoth	ell) + dr:11	crew Q 10	angon	n yard test	ing pump.	
0900					SP.BIE) OT 6		~	et ' '.	
1038	Pump 3	ettine	6 + pin	cill crews	on site,				
1039	Setting	~							
1050	0	A .	2		A. (1-3 0		+ 0.75 OD	h-0	
		9			Partios P	ump	÷ 0.73 00	and mail bibes	
			286.17	,	1.00	<u>`</u> !e			
1300	•	- ·			~			easing crew	
	9:200	ered i	wine on	pump h	ad broken	· CwJ	~ 1 044	wines wine	
	-	•	in town						
1315	6e0100	zist.	release	Nina.b.	HID off	. 511	e to deco	n more trem	
	p:per c	<i>ا\</i> : عر	repair .	oirs in	A.m.				
			off sit						
,		<u> </u>	00	not u	sed				
				more to	nartine	0911	403		
					4				
					1		L.D.Wal	Kat	
Report By	charle	ene 1	martin	ez	Review	ed By	210.0001	rer	
			martin	ez					
TitleG	<u>zologis</u>	Τ	martin		Reviews	G	eologist		

DISTRIBUTION: White-Field File Custodian Yellow-Group Files Pink-Project Coordinator Goldenrod-Team Leader BC-6000-278 (04/91)

	W		/EY	DATA REPO	ORT		
Project:			Prepared By:Neil P. FastabendCompany:Fluor Federal Services				
Date Reques	sted: 9/29/03		Re	questor: C	hris S. Wright	(FH)	
Date of Survey: 10/31/03				•	or Federal Ser vey Dept.	vices	
ERC Point of Contact:				•	nt of Contact ant F. Brazil, P		
Description	of Work:		Ho	orizontal Date	um: NAD83(9	1)	
Civil Survey of Groundwater Monitoring				rtical Datum	: NAVD88		
Well C4122 (299-E25-93).				its:	Meters		
			Ha	nford Area [	Designation:	200E	
Coordinate S	System: Washi	ngton State	Pla	ane Coordina	tes (South Zor	ne)	
Horizontal Co	ntrol Monuments 2E-1		nd 2	2E-134 (FFS)			
Vertical Cont	rol Monuments: 2E-1	8 (FFS) an	id 21	E-38 (FFS)			
Well ID	Well Name	Easting		Northing	Elevation		
C4122	299-E25-93	575471.5	51	136022.09		Center of Casing	
					208.040	Top Casing, N. Edge	
					207.265	Brass Survey Marker	
					208.046 -	Top Pump Base- plate, N. Edge	
in the State of W certify that this r October, 2003 u	atement: I, a Professional Lar Vashington (Registra eport is based on a inder my direct supe is true and correct.	ation No. 223 field survey p	26), l perfoi	ered hereby rmed in	208.046	ED JUNE	

Original to: Distribution by DIS:

WELL SUMMA	RY SHEET		Start Date: 0110103 Page 1 of Finish Date: 011103	<u>٦</u>
Well ID: CHI23		Well Nam	10: 299-E24-22	
Location: west of 241-AY Tank	6		CY03 RCRA drilling	
Prepared By: Charlene Martinez		1		10
		Signature	101101	
Signature: Construction	ΤΔ	Cignatare	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram	Depth in Feet	Graphic Log Lithologic Description	
9 00 dual wall temponery carbon steel casing.		· o	0-2' Backfill material (gravel 2-15' SAND (S) 15-25' gravelly SAND (gs	
6"ID protective casing set + 1.0 'above permanent	1777	-  40	25-175 SAND (s)	
$\frac{4^{H} \pm D}{4^{2} \times D} \frac{55304.5ched.10}{526.21} \xrightarrow{10} 286.21$				
or 10.0		80 —		
Granular bentonite : 10.0'	17777777	- - 120 -		
			175 - 180 gravelly SAND (9	1
All temporary casing removed from ground:		- - - مەد	5 (S) (S) (S)	
All depths are in feet below ground surface.		-	0140 225 - 225 gravelly SAN 0140 225 - 270 SAND (S)	.0(

A-6003-643 (03/03)

WELL SUMMA	RY SHEET			Date: Page h Date: סוניוסס Page	e <u>2_</u> of <u>2</u>
Well ID: CHI23		Well Name: 299-624-22			
Location: west of 241- AY	Tank Farm	Project:	403	RCRA drilling	
Prepared By: Charlene markinez	Date: 08/06/03	Reviewed	By:	L.D. Walker Dat	te:8/11/0
Signature: charles martin		Signature:	Â	Walk	
CONSTRUCTION DAT	A	D	GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description	'n
276.1'> 281.1'		340 — -			
10-20 mesh silica sand:		_		270-272 SILTICO	<u>iy (m)</u>
281.1 330		280		ברבר (sAnd (s)	
0.020" slot cont. wire-wrap		7	7 <b>-07-0</b> 33 218(330)	281-285 gravelly	SANDG
286.21				285-290' SAND(5) 290'-300' gravelly 5	Anolas
				300-310 sandy GRAI 310-320 si 1ty sandy	
tally endcap:		— ٥د3		310-320 si 14 sandu (ms6)	GRAVE
321.20 323.68	15M/1777385/14/17/24				
		-		TD = 330 bgs	,
				static water => 286.0	3 693
		340-		(07117103)	
All temperary casing temperat from ground:					
All depths are in feet					
below ground surface					
		-			
		-		·	·

A-6003-643 (03/03)

							Start Date:	07/10/0	3
WELL	CONSTRUCT	ION SL	JMMA	RY REPORT			Finish Date: 09/08/03		
							Page	__ of	)
11D: C4123	Well Name: 299-6	24-22		Approximate Location: صعد	20	9241-	AY Tan	K Farm	
Project: eyos BCRA dri				Other Companies: FH. C	HG				
Drilling Company: Layne Chr				Geologist(s): c. martinez	m.3	. Hock	ing		
Driller: Paul (" Derry") Lodd		#: \629	ଟ						
	SING AND DRILL DEP	тн		DRILLING METHOD	н	OLE DIA	METER (in.)	/ INTERVA	L (ft)
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O	.D./I.D.	Auger:	Diam	neter	From	to _	
Dual-wall, carbon steel,	<u>0' - 320'</u>	۹"		Cable Tool:	Diam	neter	From	to _	
FJ. a "op (enter)				Air Rotary:	Diam	neter	From	to	
7" ] 6" (inner)				A.R. w/Sonic:	Diam	neter	From _	to _	
	·			Reverse Air (Recker	Diam	neter <u>9</u>	<u></u> From	<u>o′</u> to	330'
					Diam	neter	From _	to _	
*Indicate Welded (W) - Flush Jo	oint (FJ) Coupled (C)	& Thread	Design		Diam	neter	From	to	
	a de a décense é								
				Drilling Fluid: れいわ					
Total Drilled Depth: 330	Hole Dia @ TD: 🤨			Total Amt. Of Water Added D	During	Drilling:			
Well Straightness Test Results: २		0.00.4	long	Static Water Level: 284.02 Date: 07/17/03					
on 07/15/03.		GE		AL LOGGING					
Sondes (type)	Interval		ate	Sondes (type)		Int	terval	Da	te
Spectral Gamma	<u>5 - 328.0'</u>	07/12/1	+07/4 5,2003						
1							·		
	··		COMPLE	ED WELL					
Size/Wt./Material		Thread	Slot Size	Туре		Annular S	terval eal/Filter Pack	Volume	Mesh Size
Size/Wt./Material	 Depth <u>+ع.م`</u> - <u>ع8ه ع أ</u>	1	Slot Size		₹)	Annular S	terval eal/Filter Pack	Volume 5 bags	Size
si.		Thread	Slot Size	Туре	#\	Annular S	eal/Filter Pack - <u>10.0</u> - <u>274.1</u>	5 bags	Size nlA nlA
4 10 55 204, Sch. 10 casing 4 10 56 204 sch. 10 wellswern	+2.0286.21	Thread F4স্বত	Slot Size ດ.ເA ວ.ວວວ	Type	*)	Annular S  10.0' 	eal/Filter Pack - <u>10.0</u> - <u>274.1</u> - <u>281.1</u>	5 bage	Size nIA nIA
41D 55 204, Sch. 10 Casing	+2.0286.21 286.21 -321.26	Thread F4ชอ เเ	Slot Size ດ.ເA ວ.ວວວ	Type Portland cement (94 Granular Bentenite(ST	≢) ₽)	Annular S  10.0' 	eal/Filter Pack - <u>10.0</u> - <u>274.1</u>	5 bags	Size
4 10 55 204, Sch. 10 casing 4 10 56 204 sch. 10 wellswern	+2.0286.21 286.21 -321.26	Thread F4&D u u	Slot Size ก.เค อ.อ.เว" ก.เค	Type Portland Cement (94 ³ Granular Bentoniste(St Bentoniste Reliets(St SeloradoSilitca Sand (	≢) ₽)	Annular S  10.0' 	eal/Filter Pack - <u>10.0</u> - <u>274.1</u> - <u>281.1</u>	5 bags 114 bags 2.5 buck	Size
4 10 55 204, Sch. 10 casing 4 10 56 204 sch. 10 wellswern	+2.0286.21 286.21 -321.26	Thread F4&D u u	Slot Size ก.เค อ.อ.เว" ก.เค	Type fortland cement (94 ³ Granular Bentenise(ST Bentenise Reviews(ST	≢) ₽)	Annular S  10.0' 	eal/Filter Pack - <u>10.0</u> - <u>274.1</u> - <u>281.1</u>	5 bags 114 bags 2.5 buck 33 bags	Size
4 10 55 204, Sch. 10 casing 4 10 56 204 sch. 10 wellswern	+2.0286.21 286.21 -321.26	Thread F4&D u u	Slot Size ก.เค อ.อ.เว" ก.เค	Type Portland Cement (94 ³ Granular Bentoniste(St Bentoniste Reliets(St SeloradoSilitca Sand (	≢) ₽)	Annular S  10.0' 	eal/Filter Pack - <u>10.0</u> - <u>274.1</u> - <u>281.1</u>	5 bags 114 bags 2.5 buck	Size
4"ID 55 204, Sch. 10 casing 4"ID 55 204 sch. 10 wellswon 4"ID 55 204 sch. 10 sump.	+2.0286.21 286.21 -321.26	Thread F 4-ช-อ เง น	Slot Size ก.เค อ.อ.เว" ก.เค	Type Portland Cement (94 Granular Benteniste(St Benteniste Reliets(St CeloradoSt (tra Sand ( CTIVITIES	≢) ₽)	Annular S 0 ⁻¹ 10.0 ⁻ 274.1 ⁻ 281.1 ⁻	eal/Filter Pack - <u>10.0</u> - <u>234.1</u> - <u>281.1</u> - <u>380.0</u>	5 bags 114 bags 2.5 buck 33 bags	Size
4 ⁴ 2D 55 204, seh. 10 casing 4 ⁴ 20 55 204 seh. 10 wellsereen 4 ⁴ 20 55 304 seh. 10 sump. 4 ⁴ 20 55 304 seh. 10 sump.	+2.0286.21 286.21 -321.26	Thread F 4-ช-อ เง น	Slot Size ก.เค อ.อ.เว" ก.เค	Type fortland cement (94 ³ Granwlar Bentenise(ST Bentenise Reviets(SO SeloradoSillica Sand ( CTIVITIES Well Decommission:	≢) ₽)	Annular S 0 ⁻¹ 10.0 ⁻ 274.1 ⁻ 281.1 ⁻	eal/Filter Pack - <u>10.0</u> - <u>234.1</u> - <u>281.1</u> - <u>380.0</u>	5 bags 114 bags 2.5 buck 33 bags	Size
4 ⁴ 2D 55 204, seh. 10 casing 4 ⁴ 20 55 204 seh. 10 wellsereen 4 ⁴ 20 55 304 seh. 10 sump. 4 ⁴ 20 55 304 seh. 10 sump.	+2.0286.21 286.21 -321.26	Thread F 4.90 u Date:	Slot Size ALA ALA OTHER A	Type fortland cement (94 Granwlar Bentenite(ST Bentenite Reliets(SO Selorado St Utra Sand ( CTIVITIES Well Decommission: Description:	≢) ₽)	Annular S 0 ⁻¹ 10.0 ⁻ 274.1 ⁻ 281.1 ⁻	eal/Filter Pack - <u>10.0</u> - <u>234.1</u> - <u>281.1</u> - <u>380.0</u>	5 bags 114 bags 2.5 buck 33 bags	Size
4 ⁴ 2D 55 204, seh. 10 casing 4 ⁴ 20 55 204 seh. 10 wellsereen 4 ⁴ 20 55 304 seh. 10 sump. 4 ⁴ 20 55 304 seh. 10 sump.	+2.0286.21 286.21 -321.26	Thread F 4.90 u Date:	Slot Size ALA ALA OTHER A	Type fortland cement (94 ³ Granwlar Bentenise(ST Bentenise Reviets(SO SeloradoSillica Sand ( CTIVITIES Well Decommission:	≢) ₽)	Annular S 0 ⁻¹ 10.0 ⁻ 274.1 ⁻ 281.1 ⁻	eal/Filter Pack - <u>10.0</u> - <u>234.1</u> - <u>281.1</u> - <u>380.0</u>	5 bags 114 bags 2.5 buck 33 bags	Size
4 ⁴ 2D 55 204, seh. 10 casing 4 ⁴ 20 55 204 seh. 10 wellsereen 4 ⁴ 20 55 204 seh. 10 sump. 4 ⁴ 20 55 204 seh. 10 sump.	+2.0286.21 286.21 -321.26	Thread F 4.90 u Date:	Slot Size ALA ALA OTHER A	Type fortland cement (94 Granwlar Bentenite(ST Bentenite Reliets(SO Selorado St Utra Sand ( CTIVITIES Well Decommission: Description:	₩) **) **) **) **) **) **) **) *	Annular S 0 ⁻¹ 10.0 ⁻ 274.1 ⁻ 281.1 ⁻	eal/Filter Pack - <u>10.0</u> - <u>234.1</u> - <u>281.1</u> - <u>380.0</u>	5 bags 114 bags 2.5 buck 33 bags	Size
4 ⁴ 2D 55 204, seh. 10 casing 4 ⁴ 20 55 204 seh. 10 wellsereen 4 ⁴ 20 55 204 seh. 10 sump. 4 ⁴ 20 55 204 seh. 10 sump.	<u>+2.0</u> - <u>286.21</u> <u>286.21</u> - <u>521.26</u> <u>323.68</u> 	Thread F 4.90 u Date:	Slot Size ALA ALA OTHER A	Type fortland cement (94 Granular Benteniste(St Benteniste Reliet & So Selorado St Utra Sand ( CTIVITIES Well Decommission: Description: ATA (if applicable)	*) *) *)	Annular S 0 ⁻¹ 10.0 ⁻ 274.1 ⁻ 281.1 ⁻	eal/Filter Pack - <u>10.0</u> - <u>234.1</u> - <u>281.1</u> - <u>380.0</u>	5 bags 114 bags 2.5 buck 33 bags	Size
4 ⁴ ID 55 204, seh. 10 casing 4 ⁴ ID 55 204 sch. 10 wellswein 4 ⁴ ID 55 204 sch. 10 Swmp. 4 ⁴ ID 55 204 sch. 10 Swmp. Aquifer Test: Description:	<u>+ ک. م علامی ا ا</u> <u>علامی ا - بالا یا ا</u> <u>علامی ا - بالا یا ا</u> <u>علامی ا </u>	Thread F 4.40 u Date: WELL S	Slot Size ດູເກີ ດູເລ ດູເລ ດູເລ ດູເລ OTHER A	Type fortiand cement (94 ³ Granular Bentenise(ST Bentenise Reviews So Solorado St Utca Sand ( CTIVITIES Well Decommission: Description: ATA (if applicable) Protective Casing Elevation:	*) *) *)	Annular S 0 ⁻¹ 10.0 ⁻ 274.1 ⁻ 281.1 ⁻	eal/Filter Pack - <u>10.0</u> - <u>274.1</u> - <u>281.1</u> - <u>380.0</u> No:	5 bags 114 bags 2.5 buck 33 bags Date:	Size
4 ⁴ ID 55 204, seh. 10 casing 4 ⁴ ID 55 204 sch. 10 wellswein 4 ⁴ ID 55 204 sch. 10 Swmp. 4 ⁴ ID 55 204 sch. 10 Swmp. Aquifer Test: Description:	<u>+2.0</u> - <u>286.21</u> <u>286.21</u> - <u>521.26</u> <u>323.68</u> 	Thread F 4.40 u Date: WELL S	Slot Size ດູເກີ ດູເລ ດູເລ ດູເລ ດູເລ OTHER A	Type fortland cement (94 Granular Bentenise(ST Bentenise Reviet So Solorado St Utra Sand ( CTIVITIES Well Decommission: Description: ATA (if applicable) Protective Casing Elevation: Brass Survey Marker Elevat	**) **) 57 57	Annular S 0 ⁻¹ 10.0 ⁻ 274.1 ⁻ 281.1 ⁻	eal/Filter Pack - <u>10.0</u> - <u>274.1</u> - <u>281.1</u> - <u>380.0</u> No:	5 bags 114 bags 2.5 buck 33 bags	Size
4 ⁴ ID 55 204, seh. 10 casing 4 ⁴ ID 55 204 sch. 10 wellswein 4 ⁴ ID 55 204 sch. 10 Swmp. 4 ⁴ ID 55 204 sch. 10 Swmp. Aquifer Test: Description:	<u>+ ک. ۲</u> - <u>کلایک اُ</u> <u>علایت - الدیکا اُ <u>علایت - الدیک</u> <u>علایت - الدیک</u> <u> </u></u>	Thread F 4.90 	Slot Size ດູເກີ ດູເລ ດູເລ ດູເລ ດູເລ OTHER A	Type <u>fortiand cement (94</u> <u>Granular Bentenise(57</u> <u>Bentenise Reviews(57</u> <u>Selorado Sillica Sand (</u> <u>CTIVITIES</u> Well Decommission: Description: Description: <u>Protective Casing Elevation</u> : Brass Survey Marker Elevation: Brass Survey Marker Elev	**) **) 57 57	Annular S <u>0</u> ⁻¹ <u>10.0</u> <u>2</u> <u>2</u> <u>4.1</u> <u>2</u> <u>8</u> <u>1.1</u> Yes: <u>7</u> <u>8</u> <u>-</u> <u>8</u> <u>-</u>	eal/Filter Pack - <u>10.0</u> - <u>274.1</u> - <u>281.1</u> - <u>380.0</u> No:	5 bags 114 bags 2.5 buck 33 bags Date:	Size
4 ⁴ ID 55 204, seh. 10 casing 4 ⁴ ID 55 204 sch. 10 wellswein 4 ⁴ ID 55 204 sch. 10 Swmp. 4 ⁴ ID 55 204 sch. 10 Swmp. Aquifer Test: Description:	+3.0 286.21 186.21 - 321.26 321.26 - 323.68 	Thread F 4.90 	Slot Size ດູເກີ ດູເລ ດູເລ ດູເລ ດູເລ OTHER A	Type <u>fortiand cement (94</u> <u>Granular Bentenise(57</u> <u>Bentenise Reviews(57</u> <u>Selorado Sillica Sand (</u> <u>CTIVITIES</u> Well Decommission: Description: Description: <u>Protective Casing Elevation</u> : Brass Survey Marker Elevation: Brass Survey Marker Elev	₩) #) 50 	Annular S <u>0</u> ⁻¹ <u>10.0</u> <u>2</u> <u>2</u> <u>4.1</u> <u>2</u> <u>8</u> <u>1.1</u> Yes: <u>7</u> <u>8</u> <u>-</u> <u>8</u> <u>-</u>	eal/Filter Pack - <u>10.0</u> - <u>274.1</u> - <u>281.1</u> - <u>380.0</u> No:	5 bags 114 bags 2.5 buck 33 bags Date:	Size
4 ⁴ ID 55 204, seh. 10 casing 4 ⁴ ID 55 204 sch. 10 wellswein 4 ⁴ ID 55 204 sch. 10 Swmp. 4 ⁴ ID 55 204 sch. 10 Swmp. Aquifer Test: Description:	+3.0 286.21 186.21 - 321.26 321.26 - 323.68 	Thread F 4.90 	Slot Size ດູເກີ ດູເລ ດູເລ ດູເລ ດູເລ OTHER A	Type <u>fortiand cement (94</u> <u>Granular Bentenise(57</u> <u>Bentenise Reviews(57</u> <u>Selorado Sillica Sand (</u> <u>CTIVITIES</u> Well Decommission: Description: Description: <u>Protective Casing Elevation</u> : Brass Survey Marker Elevation: Brass Survey Marker Elev	₩) #) 50 	Annular S <u>0</u> ⁻¹ <u>10.0</u> <u>2</u> <u>2</u> <u>4.1</u> <u>2</u> <u>8</u> <u>1.1</u> Yes: <u>7</u> <u>8</u> <u>-</u> <u>8</u> <u>-</u>	eal/Filter Pack - <u>10.0</u> - <u>274.1</u> - <u>281.1</u> - <u>380.0</u> No:	5 bags 114 bags 2.5 buck 33 bags Date:	Size

A-6003-658 (04/03)

		BOREHOLE LOG			Page <u></u> of <u>9</u>
Well ID: C4123	W	ell Name: 299-624-22	Location: n. w. of 24	241-6	Date: 07/10/03
			Reference Measuring Point:	-A Tai	
Project: CN 03 RCT Sample	ZADA	പ്	escription	Groun	<u>d</u> surface
Depth	Graphic		stribution, Soil Classification,	Depth of	Casing, Drilling Method
(Ft.) Type Blows No. Recovery อหจุ ^ง กเล	Log	Color, Moisture Content, So Max Particle Size	rting, Angularity, Mineralogy, e. Reaction to HCI	Method o Samp	f Driving Sampling Tool ler Size. Water Level
0-BH9 niA	3220	D-2 Backfill m	aterial. Crushed gravel	Dualw 9"00!	all casing
		2- 15 SAND(S)	100%0. 11. we W		r Hammer dr: 11 rig
			grained, SR_R.	0	
		our HCL. non- bas	K	Collect	an sand 2-10 S'archive
5 treb -BHA"			basaltic, (105 m)		m fmtn @ 10 bas
			oorly sorded, SR-SA		
		104R312 v. dark	- Trace mica.		
LO GOR		(moist) Strong	Trxn HCI	لصالعط	to archive
- BH9"		15-25 gravelly	5AND (05) 15 20		
		gravel, 30 to sam	1, 5°10 51 17. Grave		
		mod-sorted, SA-R	, basaltic. Sand		
15-600		arained. 80% has	sA, usn - uco c	Collect	15' archive
-34,9"	Q. Q.	7.5 1R3/1 N. dark			
	$^{\circ}$ $O'$	mps~1"	a duad current		
	22				
20 Grab	0* P	25-175 Sand(s)	5°Co gravel, 95°Co	collect	20' archive
-349"	- N	sand, trace silt.	Scavel, basaltic,		Vadar di s'inana
	o	mod-sonted, SR-R.	Sand. 40 10 basalt,		
	5-0	40 10 gtz lother, pe			
	ð	no r×n HCI.	ayish brownimbre	C -lle -t	25' archive
25 Grab		@ 30 pasalt a	ontent increasing		25 44041770
		to ~ 20° 10.	N		
			ling to well-sorted,		
	2019	med- v. car. grain			
30 Grab		104R512 gravish 1	micaceous SR-SA	C - Llo T	30' archive
-18H40		min IACI.	Srown (moise / m)	Collect	so archive
	4. S. S. S				
35- 5reb	88997d.				
-G+12"	53.57			204102	135 archive
		· · · · · · · · · · · · · · · · · · ·			
		· · · · ·			
Reported By: Charler	ne tr	actinez	Reviewed By: L.D. L	Va I Ker	<b>`</b>
Title: ( eologisz			Title: Geologi		
Clanatura	. ma	Date: 0710/03		lk.	Date: 10/1/03
		2			A-6003-642 (03/03

		BOREHOLE LOG			Page <u>2</u> of <u>9</u> Date: 010103
Well ID: C 4123	w	ell Name: 299-624-22	درمانی Location: n. درم	- of 241- AY	Tank Farm
Project: C ¥ 03	BERAdail	120		ring Point: Ground	
Samp	le	Sample D	escription		Comments
Depth (Ft.) Type E No. Re	Blows Log covery	Group Name, Grain Size Dis Color, Moisture Content, So Max Particle Size	stribution, Soil Clas	ineralogy.   Method o	Casing, Drilling Method f Driving Sampling Tool ler Size, Water Level
1.00 11 1	IA N	Q40' sand grad:	ng to vfn.		Hammer rig usin
-BH9		grained, 20°ro ba	salt. 30 %	gtz] 9"000	walwall casing.
- 1		other, poorly sont	ed, SR-SA	Colle	LT 40' anchive
		moist V			
15 Grab				Lollect	45 archive
-BH9"					
-					
-BH9*				Collect	50 archive
- 1.		sand is increasing		content	
55 Grab		(~ 80°10) moisz la	55		
BHQ"				<u>Collect</u>	rss'archive
-					
-					
Grab				t allo	60'archive
-GHQU				Solleo	
5-0-					
- BHO "		·		Collect	65'archive
		· · · · · · · · · · · · · · · · · · ·			
		· · · · · · · · · · · · · · · · · · ·			
O Grab					- 1 - 1 -
- BH 9 "				Collect	20' archive
-1					
-					
75-4-4-					
- BH QI				Collect	75 archive
			1		
Reported By: Ch	artene ma	rtinez.	Reviewed By:	L.D. Walker	
Fitle: Geologis	τ		Title: G	eologist	
Signature:					

		BOREHOLE LOG	ì		Page <u>3</u> of <u>9</u>	
Well ID: دوري	<b>.</b> w	ell Name: 299-E24-22	Location: n.w. of 241-A Tank Farm			
Project: 2403			Reference Measuring Point			
Sample		Sample	Description		Comments	
Depth	Graphic		istribution, Soil Classification,	Depth of		
No. Red	ows Log	Color, Moisture Content, So	orting, Angularity, Mineralogy e. Reaction to HCI		Casing, Drilling Method of Driving Sampling Tool oler Size, Water Level	
80 BH9" N	IA A	@ 80 traces of 1	vell sorted SR-R	Becker	Hammer using 90	
-G49 u		gravel, baseltic m	25 - 0.5". Sand	dualw	all casing	
-		continues to be 30	perore maiss	Colled	3 80 archive	
-	8823	poorly ported as k	secore, maiss			
85				Collect	85 archive	
Grab 24011						
				_		
Trab				collect	90'archive	
BH,9						
-						
-	10055					
75				Collect	195' antive	
BHQU						
				_		
- 1, 1						
Grab	8 D 0	@ 100 gravel inche	asing to 5 %.	Collect	100 archive	
-GHA"		Bazaltic, well sort	ed mps < 1". SR-R	<u> </u>		
-1		sand, basaltic, rf	ucise, SR-SA			
05-14	See S			Collect	105 orchive	
O POO	2014					
819 "						
10		@ 110' sand, med-u	se grained, well-			
-BH9"			"10 basant, 55 "0	IH CK	Organics < delet.	
-	25000		nica. 7.54R.513		-	
-		brown (moise) Do	rkn Hcl			
			4 back to 100%		and another	
115 Crah		Que sand gradin basalz, 40 % gtz		- Jollee	t 115' archive.	
- GH 9			Orver SR-SP,	1		
		2.5 YR412 brown	N N	. 1.		
	V					
Reported By:	rtene Mo	artinez	Reviewed By: L.D.	Uh/Ker	r	
Title: Geolog:	52		Title: Geologis	4		
	rlene mo	· ·				

		BOF		OG			Page <u>4</u> of <u>9</u>		
							Date: 07/10/03		
Well ID: CHI23	5 W	ell Name:	99-224-22		Location: WEST of 241-AY Tank Farm				
Project: CYO	BRCRAdri	lling		Reference	Measuring Point:	Ground	Surface		
Samp		A	Samp	le Description			Comments		
	Blows Log Bcovery	Group Na Color, Mo	ame, Grain Siz oisture Content Max Particle	e Distribution, S t, Sorting, Angula Size, Reaction t	oil Classification, arity, Mineralogy, o HCl	Depth of Method o Samo	Casing, Drilling Method of Driving Sampling Too oler Size, Water Level		
	AIA	@120'		c. as 115'.			Hammer using a "oc		
-BHQU				. '			Il easing		
						Colle	et 120' arch: 42		
125 V	<b></b>			F well son	ted, pea -	Collect	125 archive		
- BH9"		<u>size</u> b	asaltic o	gcavel, so	-R ('C5 /0	}	· · · · · · · · · · · · · · · · · · ·		
							30' archive		
- 849 U						Collect	Go archive		
35 Grab -BHQ"	<b>a</b> . <b>p</b>	@ 135 4	race of p	ea-size bo	saltic grave	1 Coller	+ 135 archive		
40 Grab BH 9ª		med	sand grad vese grain gezlothe	ing to well ned, sr-sA (, LOYR 51	<b>0</b>	t, Collo,	t 140' archive		
15		gravel	. <u>No rxn</u>	HCI. Trac	e pea-5:20	4			
- BH9"	D. O.	Q (45 )		in pra-si %)	ze basultic	Collect	145 archive		
50						collect	150' archive		
-BH R"						Collect	155' archive.		
	arlene the	antine 7		Reviewed B	By: / D	Wa /ke	~		
itle: Geolog				Title:	Geologis	4	· .		
100 (DOD 100					000,04/3				

			BOREHOLE LOG			Page <u>5</u> of <u>9</u>
						Date: 0 7110103
Vell ID: OHAZ	3	We	Il Name: 299-624-22	Location: west of 2		
Project: CY03	RCRA	Irillin	<u>ng</u>	Reference Measuring Point: (	Fround 3	Surface
	nple		Sample D	escription		Comments
	Blows Recovery	Fraphic Log	Group Name, Grain Size Di Color, Moisture Content, So Max Particle Size	stribution, Soil Classification, rting, Angularity, Mineralogy, a. Reaction to HCl	Method o	Casing, Drilling Metho f Driving Sampling Too ler Size, Water Level
60 Gran	NLA		Q wo' sand grading	to well-sorted, SE-SA	Becker	Hammer using 9"0
- BHAT			<u> </u>	ace mica, 40%0	dualina	v casing.
			basalt, 60 % oft	lother.	Collect	160'archive
5 Grab					Collect	165' archive
- 849 ^v -			· · · · · · · · · · · · · · · · · · ·			*
				to poorly sorted,	collect	170' archive
-Btay			w5 10 basate 35%	e gtzl other, SR-SA		
	an lea					
5 Brake -BH9"	60	0. 0	175-180 gravelly	SAND (95) 10%0	collect	175' archive
-		52.5	Sand, reporty sonter busate, 35%/0 atz	4. SR-SA, 65%		
0	994 See		grain. 7.5 YR412 mrn HCI.	brown (moist) no	collect	180' archive
			180'- 200'SAND(S	) 100° lo. v poorly grained, SR-SA,		
5 V - 84 90				"10 gt2lother my (moist). no rxnHcl	Collect 1	85 archive
	1000		2185 basalt conte			
Grab			~ 40° lo. gt2 other		collect	190' archine
- 6# 9 •  			skish, mod- v cse	grained.		
5 Grab - Grab - Bria"	S	T	Dias traces of p	ea-sized gravel.	Collect	- 195'archive
				·		
eported By: c	hadaaa		410.91	Reviewed By: L. D. Uka	1Ker	
tle: Geolog				Title: Geologist		
ignature:			he Date: 07/10/03	Signature:	00	Date: 10/1/0

				BOREHOLE LOG	3		Page <u>6</u> of <u>9</u>
				DORENOLE LOG			Date: 07110103
Well ID	): C4(	22	We	ell Name: 299-E24-22	Location: west of a		
Project	: 0403	RCKA	drilli	ng	Reference Measuring Point:	Snound	Surface
	1	mple			Description		Comments
Depth (Ft.)	.Type No.	Blows Recovery	Graphic Log	Color, Moisture Content, So	istribution, Soil Classification, orting, Angularity, Mineralogy, e. Reaction to HCl	Method of	Casing, Drilling Metho f Driving Sampling To ler Size, Water Level
200	BHa	nia	0	- / .	ne to poorly sorted,	Beckert	ammer using 9"0
	BHQV		° •		grained 40 20 basathe		all casing.
_	1			40 % oft 2 lother. T	race gravel. Trace		at 200 archive
`				mica		RCTCK	a 3 3 Decken
256—	V		0.0	@ 2505 sand grading	to mod-well sorted	Collect	205 archive
-	BH9		0	med-vise grained.			
·				Basalt content 40	10, gtzlother 40°10,		
01	Grab					Collec	t 210' archive
• -	BHA"		10000				
-		· · ·	5064				
-							
215				215' sand grading	to poorly sorted	collect	215 archive
<u> </u>	Grab BH9		0	vfn-vcce. grainer. T			
	רויפן			a	0 -		
_			3.56				
-							
220-	Grab		100	220-225 gravelly	SAND(25) 15%	Collect	t 220' archive
-	Greb Bit 9		0	gravel, 85 To sand	- Gravel, poorly sorted		
-			ð.	sk-A, peo-size to atzlother, 65% bas	1		
-				Sand, SR-SA, poorly			
~ -	V		0	40% gtz. lother, vi		Collect	225 archive
אג	Grab		70535		au ish brown, moist.		
-	8#9"			no man Hel. Trace		i i	
-							
_	.			225- 270 SAUDO			
230	V			mod- well sorted , r		Collect	230' orchive
_	BHQI			Trace mica. 55° /	o basate, 45 / otc		
. –					live brown, moist.		
-				No ran HCI.	a still annatada a a statut sa		
~ -	1		s stad			Collect	235' archive
J36	Grab		W\$\$\$\$\$		· · · · · · · · · · · · · · · · · · ·	Cours	
-	BHI9"				· · · · · · · · · · · · · · · · · · ·		
				1			
	V	Ų.					
			ar the	dinez.	Reviewed By: L.D.U	alker	
Title:	Geolo	9'SE		· · · · · · · · · · · · · · · · · · ·	Title: Geologist		
	ure: O	•	marti	Date: 07110/03	Signature: 75 11/2	11	Date: 10/1/0

				BOR	EHOLE L	OG				Р	age <u>7</u>	of <u>9</u>
				DON						D	ate: O	110103
Vell ID:	CHIZ	2	We	ell Name: 20	19-824-2	<u>a</u> Lo	ocation: ر	lest of	241-1	ay Tan	K Far	m
roject:	CYO!	3 RCR	A drilli	ng		R	eference N	leasuring P	oint: Go	round :	Surfa	د هر
		nple		$\mathbf{+}$	Sam	ple Des	cription			C	ommen	ts
epth (Ft.)		Blows Recovery	Graphic Log	Group Nar Color, Moi	me, Grain Si sture Conter Max Particle	ize Distri nt, Sortir e Size, F	bution, Soing, Angular Reaction to	l Classificat ity, Mineral HCl	ogy, M	ethod of D Sampler	riving Sa Size, W	Iling Metho ampling To ater Level
· · · · · ·	349"	nIA		Q 240' 5	Same as	quevi	us des	cription (a				using 9"0
	3490								d,		casin	-
-										ollect		irchi ue
	1 3 ft q n								<u></u>	ilect 2	ts' ar	chine
4												
	2500 3494						· · · · · · · · · · · · · · · · · · ·		Co	(lect 2	<i>\$</i> 0' ar	chive.
-												
	shab 34 a "					~				5/1ect 2	55_0	rchiv
	V								C	illect 2	.60 a	rchive
-6	279 P P								-		10103	
				ufn-res	A.	basa	Itic. Tr	ace of		tart c	ę. l	oz
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	eolog					т	itle: 6	eologi	54			
ignatu	re:	arle.	man	theo	Date: Jli	dozs	ignature:	AD L	lall	2	Da	ate: 10/1/

				BOR	EHOLE	LOG					8_ of _	
							Location				071	
	: 0412			ell Name: 29	9-224			52 of 24			rain	<u>`</u>
Project	: CY03	s rcra	drilling	<b>j</b>			Reference Meas	uring Point:	6 round			
Depth	Sar	nple	Graphic	<b>`</b>		•	scription			Comm		
(Ft.)		Blows Recovery	Log	Color, Mois	sture Conte	ent. Sor	tribution, Soil Cla ting, Angularity, I Reaction to HC	Mineralogy.	Depth of Method o Samp	Casing, f Driving ler Size,	Sampli	ng Too
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-	BHQU		AP SAME	of pea-si	re grave		<u>usaltic), Ja</u> Cse anained	nd, SR-SH,	Collect	<u>ll costi</u> t 280	a	
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_	Grab BH9		<b>79</b> 0	gravet	25%	sand,	5% 3:10.	Gravel,	collec	t 310	arch	1. 0-4
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Report	ed By: c	harler	ne mar	tinez			Reviewed By:	L.D. l	Walker	-		
	Geolo						Title: Ge	ologist				
		arley	mar	i	Date: ວາ	تعمليا	Signature:	D Ula	the		Date: (	0/1/0
		and and			1			- mu				

				BORF	HOLE LOG				Page 9_of 9_
									Date: 07/103
Well ID	): C412	3	w	ell Name: 🚗	2-624-22				Tank Farm
Project	t: CNO:	BRCRA	a drill	ing		Reference M	easuring Point:	Ground	surface
	Sa	mple				escription			Comments
Depth (Ft.)		Blows Recovery		Group Nan Color, Mois	ne, Grain Size Di sture Content, So Max Particle Size	stribution, Soil rting, Angularit e. Reaction to l	Classification, y, Mineralogy, ICI	Samp	Casing, Drilling Method f Driving Sampling Tool ler Size, Water Level
300-	Bt a "	nia	0+0- a.J.0	310-330		LY GRAVEL	(ms6)	1.	tammer using 9"OD
-	Bad a	analasis	$O_{1}O_{1}$	70 % or	avel, 20 /	sand, le	<u>(n si 17</u> 200-size th	dual-u	ated 320 archive
	BHAU	nin	80°	med cob	bles (mas ~	6 55 10	69.50 TC.	Collect	sample @ 321 bes
	] ( .		$O^{\mu}$	45 10 gt	elother. Sa	nd, mod-s	oded, SR-R,	for si	eve analysis (cyclone
ಷ್ —	V.		95 Y	10 10 0	asalt, 30%	e gtzlothe			
-	6mb Bt/9#		$\succ_{\mathcal{O}} \mathcal{O}$	rfn-med	0			Collect	325 archive
-		· (	$S = O^{u}$	micaceo wet.	us. Fe oxic	e. stainir	g. Sample		
	1.)								
330-	Grab	L	<i>b</i> O₽						
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			ne m	antinez		Reviewed By		Walker	<u> </u>
Title:	Geolo	gist		,	1	Title:	Geolog is	<del>f</del>	····· / · · · · · · · · · · · · · · · ·
Signat	ture: O	hard	mar	line	Date: 02/11/03	Signature:	TA W	alle	Date: 10/1/03
				~					A-6003-642 (03/03

Well Name:	Well ID:		Well Location:		<u>, Page 1 of 2</u> Date:
299-624-22	C4123		West of 241-AY	Tank Farm	09108103
Referen	ce Measuring Poi	nt (unless othe	rwise noted): TOP OF	OUTER CASING	(TOC)
Has the well been survey	/ed? 🗌 Yes	🖾 No	Does the well have a	cement pad?	Yes 🗋 No
PART 1		PART 4			
STATIC WATER LEVEL	:			Г	
Start of Job 288,94	1 Toc	Last Reco			Current Measurements
End of Job 288,9		Date:			Date: 09/08/03
DEPTH TO BOTTOM:		┨└───	· · · · · · · · · · · · · · · · · · ·	L	0 (108103
Start of Job 3 24	6' TOC			л	L C'
End of Job				┨┍╤┙╴┈	↑
PART 2		<b>-</b>	· →	1ni	<b>↑</b>
WELL DEVELOP	MENT DATA				A'
Pump Model Franklin	5 HP Submersible	-	В		В'
Intelia Denth B . )	314.3' 303.1	,	Ground Level		<b>_</b>
Starting Turbidity	50.8 14.4	-			
Pump Start Sto		A =		A' =	2.38
(80 mins) (1802 0850 1010		B =		B'=	+.46
(13mm3) (151)	29915) 24 9pm	C=	-	C' =	0,92'
1059 1202 (31mino) 37 1229 1387		- T		HI - T	0, 0
1800 + 1512-1725=	वा	-			
		Are there an	ny reference marks on th	e casing strings?	🗋 Yes 😡 No
Total Pumped	tosz gals	PART 5			
Final Turbidity 2.31	2.25 3.14	COMMENT	S:0600 P.O.D.] =	Sector proset	*
XD SN/Range (PSI)			0000 P.0.0.1 -	The market	a a
PART 3			hopment activities		1 <u></u>
WSTANTANEOU	S SLUG TEST	0620 on	3	or pump setti	ngrig
Static Water Level (TO			288 Q. 10. @ 288.		
Transducer Depth	- /		3000 TD @ 326 5 (	100)	
Baseline Start	· · · · · · · · · · · · · · · · · · ·	1	q en site		
Injection Start	×u.	0710 Set	ting up rig.		· · · · · · · · · · · · · · · · · · ·
Baseline Start	e h		pping in Rump of t		
Withdrawal Start	- Contraction		ibrating instrume	<u> </u>	·····
Slug Volume	- it		ering transducer	(	
XD SN/Range (PSI)			1:+10 xD=> 32.688	Con C TUU	18. 1 32.583
spared by (print nam	e):		ature:	94:497 134-3	18.7 \32.583' Date:
Lebachene mart	-	_			09108102
Reviewed by (print nam	iner		alene martine		Date:
	. Walker		Allala		10-1-03

A-6003-644 (03/03

							DRILLING		Page 🔔 of 🥆			
		HELD	ACTIVI		JKT - D.		DIVIELING		Date: 09/08/03			
Vell ID:	C4123					W	Vell Name: 299-6	824-22				
ocation:	west	of ayı	-AY TO	ank far	~	F	Report No.: 1 ( w	ell Develo	pment)			
		art				Finist	n		Total			
Time	0600	)		Time .				Time				
			_		epth/Csg .	_	- / -	Hole Depth/Csg	- / -			
Hole Dept	uivosy	/			spurcosy .							
Reference	e Measuring GROUND		E	-	String No. port No. 1	12	3 4 Roo	d Size:				
Time	/Depth				Descript	ion of	Activities/Operation	ns with Depth				
From	То	1		(Attach ap	plicable	drawin	gs and document	straightness tes	t results)			
<b>08</b> 50	start	Read:	105: D	AT 1 ( 2	24.2 1	· · · · ·	22.5 gpm					
	Time	xp	TWEB	Cond	ΓÌ							
	0932	32.640		515	12.9							
	0944	32,058		508	17.8							
	0959	32.46		521	17.9							
	100 8	32.647	2.3,	519	18.2							
		Sale of	1 4.01				(+or =)	Stratest X	N= 32.101.7' 99.9%			
1010	1034		rut off pump start recovery (test =). Stop test. XD = 32.667. 99.9%									
1016	1054	Parge wooder truck off site (roc), moving pump up 10°. Intake @ 314.2°. Ready for test "3										
1036	1040	moor	ng pu	nphp #		ntal	e (al sig	menoy tor	) Initial XD=23.311			
		1	1			1		206 105	1201410120-03.31			
	Time	20 -04	50.8	378			1 gpm avebun					
	1101	-3. 284			18.3		227					
	h18	1	5.00		18.1		45					
	1132		3. 29	362	18.2	1						
	way		3 2.72	364	18.1	0.0						
	1200	23,28	912.25	346	118.4	10.0	·27	1.				
1202	1218							Stop test	246601 CE.PG = 0X.			
+219	1225	move	pump 1	p 10. I	Intake	<u>@ 3</u>	03.1 (TOC.	<u>، ۱</u>	( ) )			
1229		Bendin	gs: rest	5 (30	3.1 Toc	<u>), T</u>	nitialx D= H	182 Start	25 (1239) 25 gpm			
	Pime.		DARB	Cono	- Γ				Begin recovery (# 6			
	1232	11.993	14.4	374	185				t on recovery test			
<b></b>	12215	11.999	4-36	371	18,4			~ ~	XD=12/044 100 10 Hec.			
	1253	11.999	3.30	348	18.5		1310 Stop	test. Recou	very test didn't work			
	1300	12002	3.14	370	18.5		Herm	st blitzed.	Install perm. pump.			
1						1314		noducer, 7#	monie pipe + pump.			
eported	By:	-lene -	marti	n-8.7			Reviewed By:					
Title: G	cologist				Date:09/1	8103	Title:		Date:			
Signatur	e: char	<u>م</u>	÷				Signature:					
e.g. a.g	- SNO-	the m	Jarrice						A-6003-651 (04/03)			

		ACTIVITY RE				Pa	ge _1 of
Date   Well No. 0	4-22 Pume	pe/Model	Rig No.	Contra	act/Work Order No.	Report	No.
Purpose Install RCRA w	sompling mon	itaring pump	in croz	Refere	ence		
HISTORIC	AL DATA		PUM	P SYSTE	M CONFIGURATION	Nork Order No. Nork Order No. 1 De Location West e DUI-AY Tark f CONFIGURATION Pre-Meintenance Post-Meinter MindfDS edi Flo 3 .75" \\$5 30 44 Dug 295 .75" \\$5 30 44 Dug 295 .75" \\$5 30 44 Dug 295 .75" \\$5 30 44 	
Construction Depth 3	23.28 (693)	Statistic		8.888 S			Post-Maintenance
Casing Size	Type Set A	t Pump Type m	Edel Hisenia	0.000	Grundfos	-	
<b>చి</b> ≖ం 5:	+2.00-		HP (0.7)		Red: Flo 3	1	
Casing Perforations Sci			pe		0.75" 53 302	14	
B.O 20 " CONT. Well Screen(s) Type Sa	S Joy Inter	Length-Bottom	of Tubing to Pump	Inteke	0.9		
206.21 - 32		Tubing Length				-	•
Lest Recorded	Lest Recorded	Length-Top of	Tubing to Reference	e Point	<b>x</b> 10		
Depth-to-Water	Depth-to-Bottom				2000 01		
288.9' TOC	326.5 TOC Current	Reference/Mea			275.4		
Depth-to-Water	Depth-to-Bottom	Tor of	casing ( Too	-)			
288,9' TOC	326.45 TOC	- 1		:	data thead are a		
Start Time <u>1400</u> End Time <u>1600</u> Time	O Layne	Christensens Tim Hottell	missiensen =) Dave Dews 10 0.75" tremmie pipe + 35 onew ni couplers. m Hottell ENP 6 rundfos Rediflo3 pump.				
Total Time 2.0	<u></u> ch G ≈	, Charlene M	artinez	5.7	I BRUTTIS		
bottomof pu	mp=1.62	Descriptio	on of Operations/Re	marks			
Intaka = D.2-	Te Te	stal= 2.74	·				
Fop = 0.9'							
	ng in 5 HP		Red: f10 3 f	ump;	¥ 0.75 50	30	4L, schedule
1524 Puma	••••••						
LEGE RE	- FIFT INDER						
1525 Riggin	of armen brow	e sering rig			1		· · · · · · · · · · · · · · · · · · ·
	TOI DOX NOT	c programmor	+or pum	<u>q.</u> 6	estogist re	-293-2	0
			09/10	203	Pump teste	d. L	Jorks
1	Ch	noz		and	09/19/03		
		when and					
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		ma	- ang 0910	28/-	<hr/>		<u></u>
		Ma	- 2 0910 - 10 0910	08/03		_	
		hia		08/03			
		hia					
Report By Charle				od By	L.D. Walk	Tet -	
Report By <u>Chart</u>		ha		od By			Dete 10/1/

DISTRIBUTION: White-Field File Custodian Yellow-Group Files Pink-Project Coordinator Goldenrod-Team Leader BC-6000-278 (04/91)

	w	ELL SURV	/EY	DATA REPO	RT			
Project:			Pr	epared By:	Neil P. Fastab	end		
					Fluor Federal			
Date Reques	ted: 9/29/03				nris S. Wright (			
Date of Surve	ey: 10/31/03		Sı		or Federal Ser vey Dept.	vices		
ERC Point of	Contact:		Sı	•	nt of Contact int F. Brazil, P			
Description of	of Work:		Horizontal Datum: NAD83(91)					
Civil Survey o	f Groundwater N	Ionitoring	Ve	ertical Datum	NAVD88			
Well C4123 (2				nits:	Meters			
					Designation:			
	<b>System:</b> Washi		e Pl	ane Coordinat	tes (South Zor	1e)		
Horizontal Co	ntrol Monuments 2E-1		and	2E-134 (FFS)				
Vertical Contr	ol Monuments: 2E-1	8 (FFS) an	nd 2	E-38 (FFS)				
Well ID	Well Name	Easting		Northing	Elevation			
C4123	299-E24-22	575262.6	58	136142.82		Center of Casing		
					210.285	Top Casing, N. Edge		
					209.553	Brass Survey Marker		
					210.291	Top Pump Base- plate, N. Edge		
in the State of W certify that this re	<b>Itement:</b> I, a Professional Lar /ashington (Registra eport is based on a nder my direct supe	ation No. 223 field survey p	26), perfo	stered hereby prmed in	209.553 210.291. 200.291. 210.291. 210.291. 210.291. 210.291. 210.291. 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 22326 23326 22326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 2332 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23326 23357 23357 235757 23577 235777 2357777777777	A DUPLE		
Contained here in Original to: Distribution by D	s true and correct.			<u> </u>				

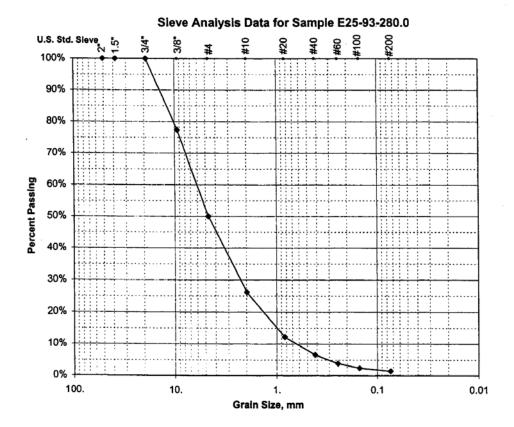
Original to: Distribution by DIS:

# Appendix B

**Sediment Samples Physical Properties Data** 

#### SIEVE ANALYSIS

				•			
WELL NAME	299-E25-93	DEPTH	280.0-282.5	SAMPLE#	E25-93-280.0	WELL ID#	C4122
TESTED BY	CRM	CONTACT	Dave Weekes	PHONE	372-9350	DATE	07/07/2003
SAMPLE	SIEVE	CUMULATIVE	% WEIGHT	%	Grain Size	COMMEN	TS
WT (g)	SIZE IN.	WEIGHT(g)	RETAINED	PASSING	(mm)		
1307.00	2"	0.0	0.0	100.0	50.80		
	1.5"	0.0	0.0	100.0	38.10		
	3/4"	0.0	0.0	100.0	19.05		
	3/8"	296.0	22.6	77.4	9.42		
	#4	653.8	50.0	50.0	4.70		
	#10	965.0	73.8	26.2	1.98		
	#20	1147.7	87.8	12.2	0.83		
	#40	1220.6	93.4	6.6	0.42		
	#60	1256.5	96.1	3.9	0.25		
	#100	1275.9	97.6	2.4	0.150		
	#200	1288.4	98.6	1.4	0.074		



 Comments:
 Gravel - Field geologist collected sample from cyclone. Split spoon had 0% recovery.

 Sieve analysis may not be representative of formation due to collection method.

 All data are accurately and completely recorded.

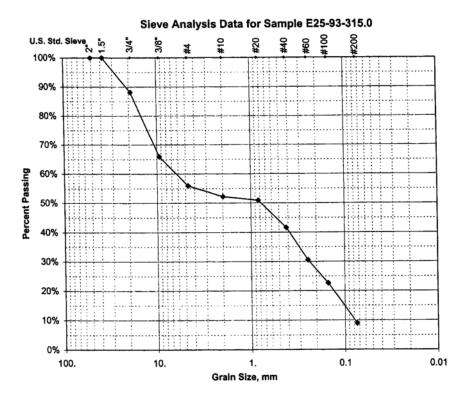
 Checked By:
 L. D. Walker

 Date:
 10~1~03

#### SIEVE ANALYSIS

WELL NAME	299-E25-93	DEPTH	315.0-317.5	SAMPLE#	E25-93-315.0	WELL ID#	C4122
TESTED BY	CRM	CONTACT	Dave Weekes		372-9350	DATE	07/07/2003

SAMPLE	SIEVE	CUMULATIVE	% WEIGHT	%	Grain Size	COMMENTS
WT (g)	SIZE IN.	WEIGHT(g)	RETAINED	PASSING	(mm)	
1067.40	2*	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	· 0.0	11.9	88.1	19.05	
	3/8"	127.5	34.1	65.9	9.42	
	#4	363.9	44.1	55.9	4.70	
	#10	471.1	47.8	52.2	1.98	
	#20	510.2	49.1	50.9	0.83	
	#40	523.9	58.4	41.6	0.42	
	#60	623.1	69.5	30.5	0.25	
	#100	741.9	77.4	22.6	0.150	
	#200	1288.4	91.1	8.9	0.074	



 Comments:
 Gravel - Field geologist collected sample from cyclone. Split spoon had 0% recovery.

 Sieve analysis may not be representative of formation due to collection method.

 All data are accurately and completely recorded.

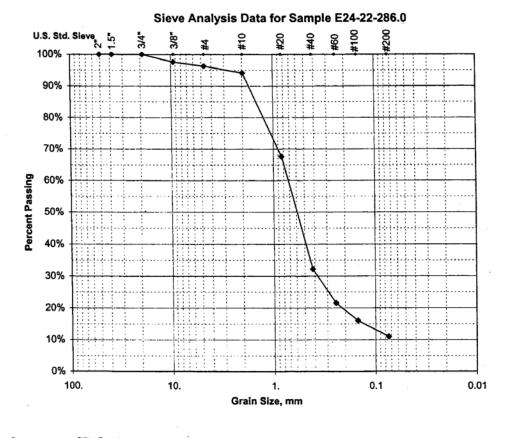
 Checked By:
 1.D. Wa (kcr

 Date:
 10 - 1 - 03

#### SIEVE ANALYSIS

WELL NAME	299-E24-22	DEPTH	286.0-288.5	SAMPLE#	E24-22-286.0	WELL ID#	C4123
TESTED BY	CRM	CONTACT	Dave Weekes	PHONE	372-9350	DATE	07/14/2003

SAMPLE	SIEVE	CUMULATIVE	% WEIGHT	%	Grain Size	COMMENTS
WT (g)	SIZE IN.	WEIGHT(g)	RETAINED	PASSING	(mm)	
1262.60	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
[	3/4*	0.0	0.0	100.0	19.05	
[	3/8"	30.9	2.4	97.6	9.42	
Í	#4	47.2	3.7	96.3	4.70	
	#10	74.6	5.9	94.1	1.98	
	#20	409.0	32.4	67.6	0.83	
[	#40	856.6	67.8	32.2	0.42	
	#60	990.9	78.5	21.5	0.25	
	#100	1060.3	84.0	16.0	0.150	
	#200	1124.1	89.0	11.0	0.074	



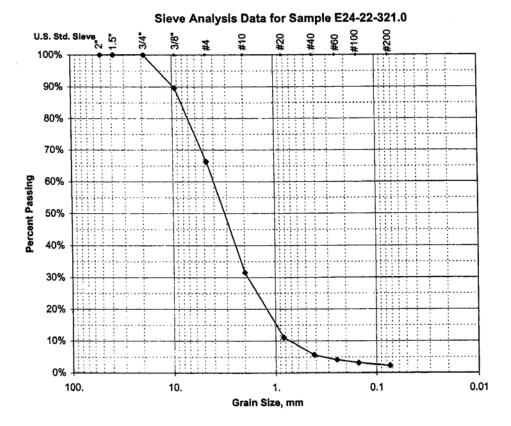
Comme	nts:	Silty	San	d

All data are accurat	ely and completely recorded.			
Checked By:	L.D. Harker	Date:	10-1-03	

#### SIEVE ANALYSIS

WELL NAME	299-E24-22	DEPTH	321 SAMPLE#	E24-22-321.0	WELL ID#	C4123
TESTED BY	CRM	CONTACT	Dave Weekes PHONE	372-9350	DATE	07/14/2003

SAMPLE	SIEVE	CUMULATIVE	% WEIGHT	%	Grain Size	COMMENTS
WT (g)	SIZE IN.	WEIGHT(g)	RETAINED	PASSING	(mm)	
1047.70	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	0.0	0.0	100.0	19.05	
	3/8"	109.2	10.4	89.6	9.42	
	#4	353.6	33.8	66.2	4.70	
	#10	718.0	68.5	31.5	1.98	
	#20	931.3	88.9	11.1	0.83	
	#40	989.1	94.4	5.6	0.42	
	#60	1005.4	96.0	4.0	0.25	
	#100	1015.1	96.9	3.1	0.150	
	#200	1024.6	97.8	2.2	0.074	



Comments:	Gravel. Sa	mple collected from	cyclone. Fine	s washed away.	
Sample not r	epresentative	of formation.			
All data are ac	curately and co	mpletely recorded.			
Checked By:	L.D.	Walker	Date:	10-1-03	

# Appendix C

**Borehole Geophysical Logs Gyroscope Surveys** 



C-4122 Log Data Report

### **Borehole Information:**

Borehole: C-4122		Site:	East of A Tank Far	m
Coordinates (WA St Plane)	GWL' (ft) :	281	GWL Date:	07/02/03
North East (estimated) (estimated) 136020 575460	Drill Date 07/03	Ground Level Elevation Not available	Total Depth (ft) 319.5	<b>Type</b> Becker

# **Casing Information:**

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	4.0	9.0	8.0	0.50	+4.0	319.5
Steel Tubing	4.5	6.24	6.0	0.125	+4.5	319.5

#### **Borehole Notes:**

The casing dimensions are derived from published values for Becker drill casing. Casing thicknesses at the joints are 0.875-in. and 0.240-in. for the 8-in. and 6-in. casings, respectively. The total depth of the borehole was provided by the driller. Total logging depth was 321 ft, 1.5 ft deeper than reported by the driller. The well site geologist provided the depth to water. Borehole coordinates were provided by Fluor Hanford's person in charge and are estimates. Ground level elevation was not available. Logging data acquisition is referenced to the ground surface.

# Logging Equipment Information:

Logging System:	Gamma 2E		Type: SGLS (70%) SN: 34TP40587A	
Calibration Date:	03/03	Calibration Reference:	GJO-2003-430-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

# Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3 Repeat	
Date	07/07/03	07/07/03	07/07/03	
Logging Engineer	Spatz	Spatz	Spatz	
Start Depth (ft)	0.0	308.0	320.0	
Finish Depth (ft)	309.0	321.0	288.0	
Count Time (sec)	100	100	100	
Live/Real	R	R	R	
Shield (Y/N)	N	N	N	
MSA Interval (ft)	1.0	1.0	1.0	
ft/min	N/A ²	N/A	N/A	
Pre-Verification	BE055CAB	BE055CAB	BE055CAB	
Start File	BE055000	BE055310	BE055324	

Log Run	1	2	3 Repeat	
Finish File	BE055309	BE055323	BE055356	
Post-Verification	BE055CAA	BE055CAA	BE055CAA	
Depth Return Error	-1.5	N/A	0	
(in.)				
Comments	Log run stopped to refill sonde with liquid nitrogen.	Fine-gain adjustment made before resuming logging.	No fine gain adjustment.	

#### **Logging Operation Notes:**

Spectral gamma logging was performed in this borehole on July 7, 2003. Logging was conducted with a centralizer on the sonde, and measurements are referenced to ground surface. A repeat section was collected in this borehole to evaluate system performance.

#### Analysis Notes:

Analyst: Henwood	Date:	07/11/03	Reference:	GJO-HGLP 1.6.3, Rev. 0
Analyst. I norwood	Duto.			

Pre-run and post-run verifications for the logging system were performed before and after data acquisition. The acceptance criteria were met.

A combined casing correction for 0.625-in.-thick casing was applied throughout the borehole for both casings. The combined thickness at casing joints is 1.115 in. This thickness results in a significant reduction in gamma activity detection as the detector passes by a casing joint. However, it is not practical to correct individual data points for the effect of casing joints. The influence of the thick joints is apparent on the total gamma and ⁴⁰K logs where reduced count rates and concentrations are exhibited at approximately 10-ft depth intervals.

SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with an EXCEL worksheet template identified as G2EMar03.xls using efficiency functions and corrections for casing, water, and dead time as determined from annual calibrations. Dead time corrections are applied where dead times exceed 10.5 percent; no dead times in excess of 10.5 percent were encountered. Correction for water was applied to the data below 281 ft.

#### Log Plot Notes:

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

# **Results and Interpretations:**

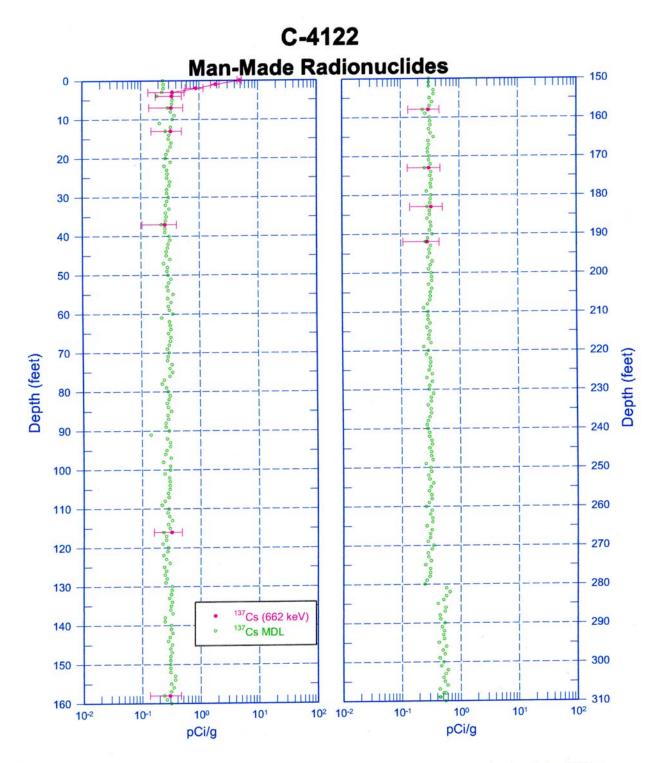
¹³⁷Cs was the only man-made radionuclide detected in this borehole. ¹³⁷Cs was detected near the ground surface with the maximum concentration of 4.9 pCi/g detected at 0-ft depth. ¹³⁷Cs was also detected at a few sporadic locations throughout the borehole near its MDL of approximately 0.3 pCi/g.

The repeat sections indicated good agreement of the naturally occurring KUT.

¹ GWL – groundwater level

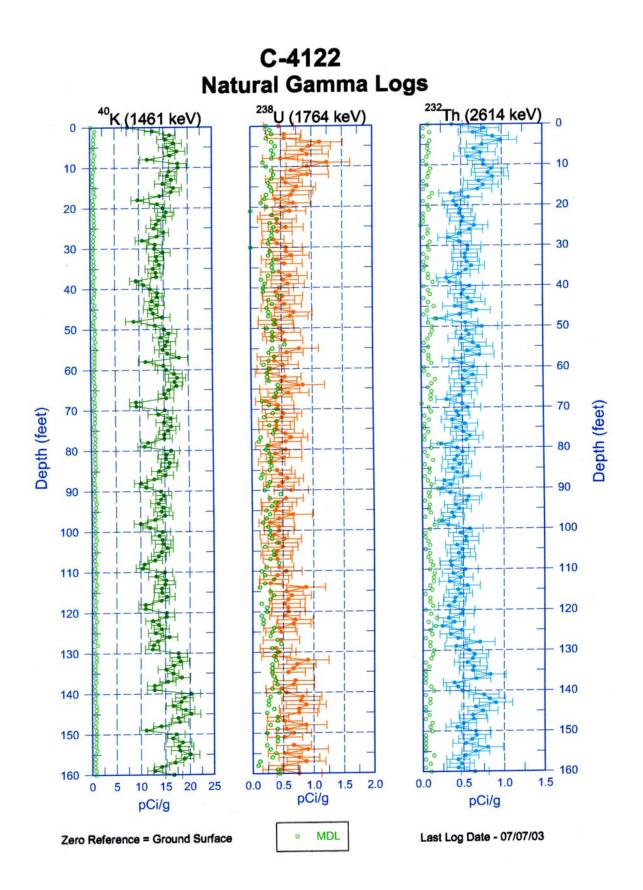
² N/A – not applicable

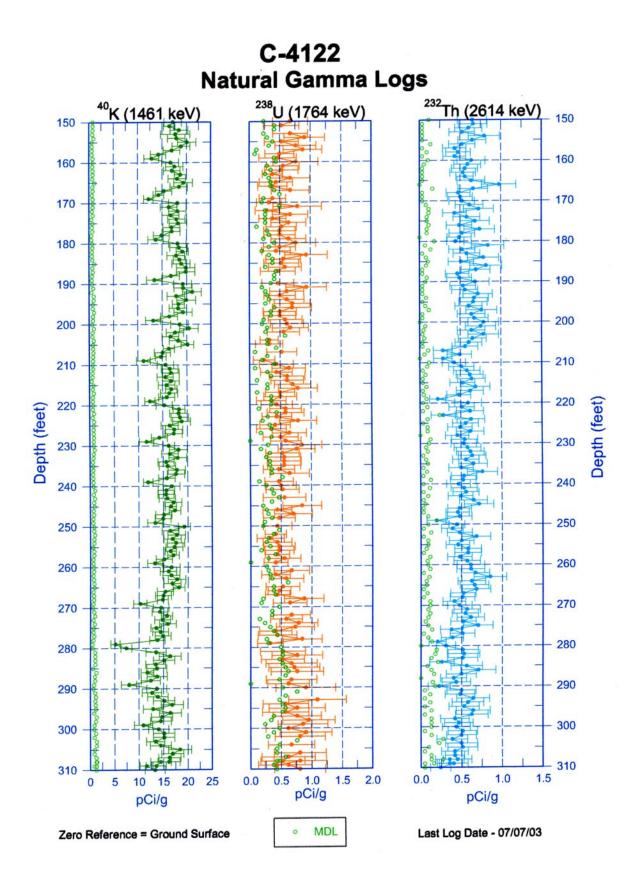
Page 3

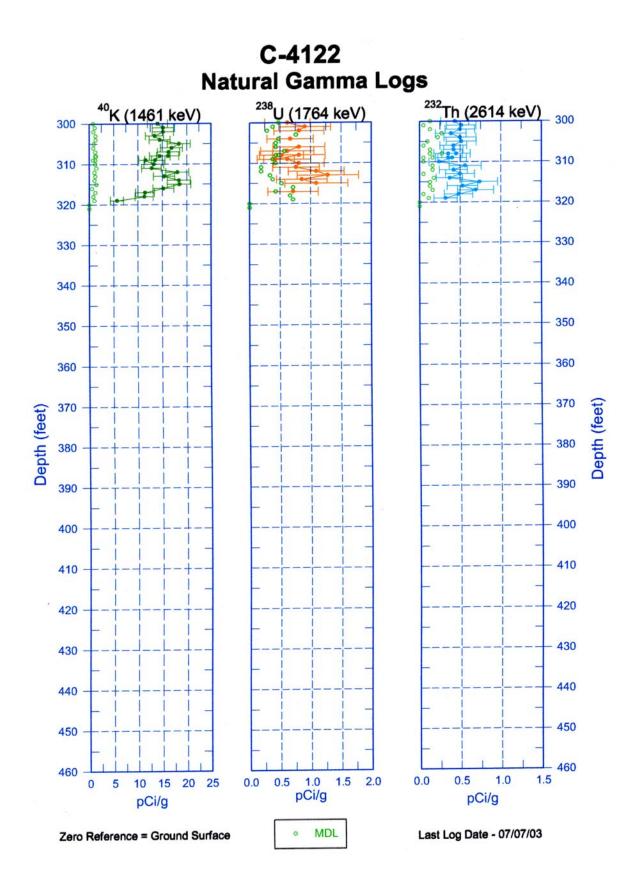


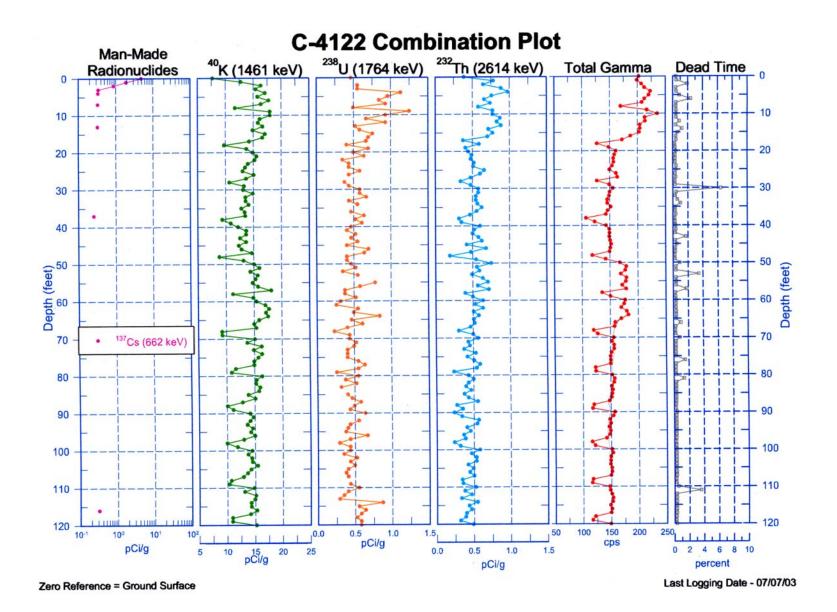
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Last Log Date - 07/07/03

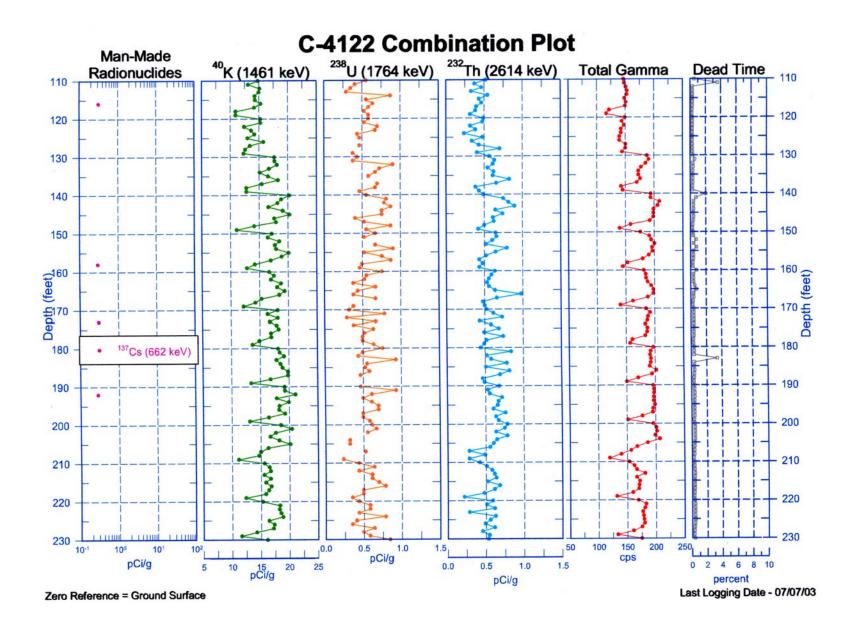




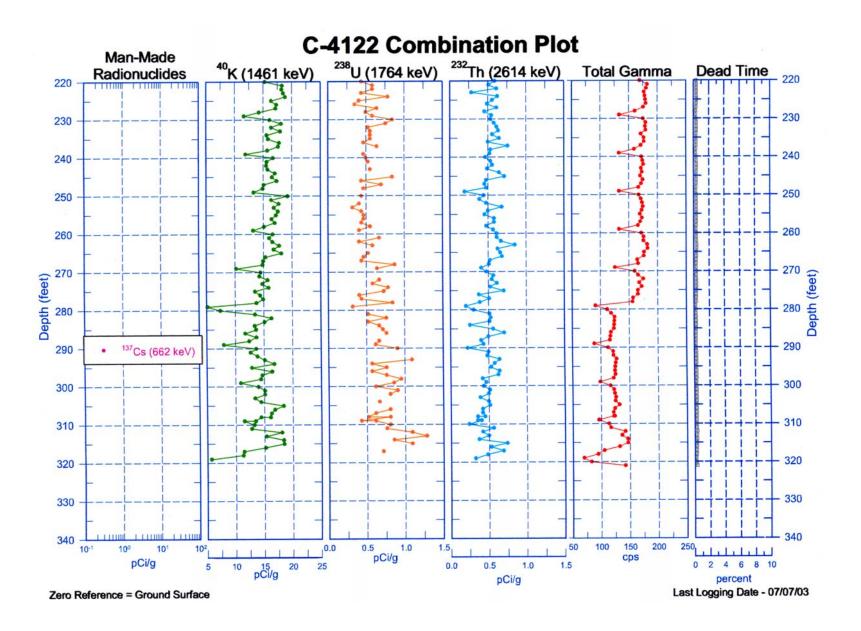




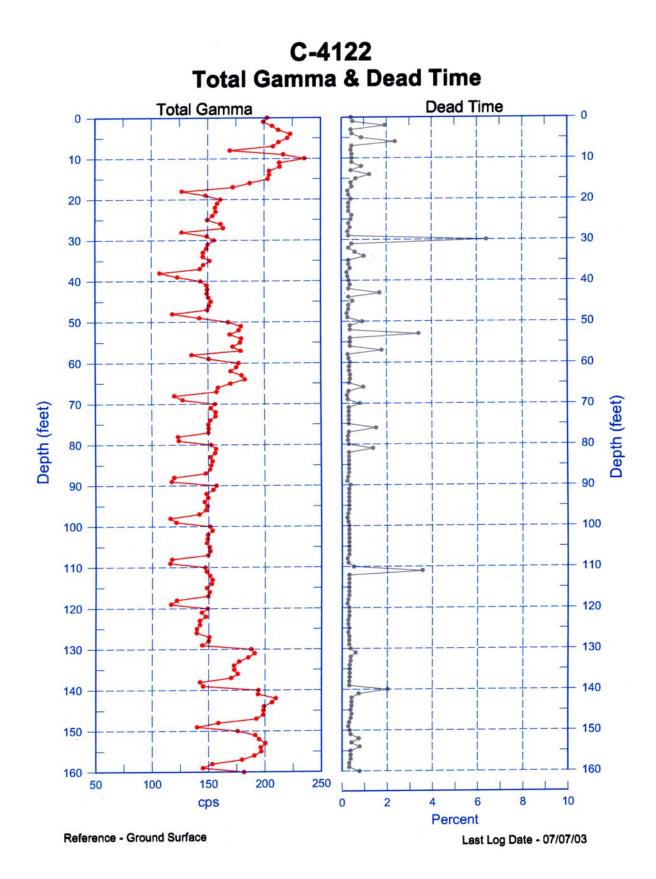




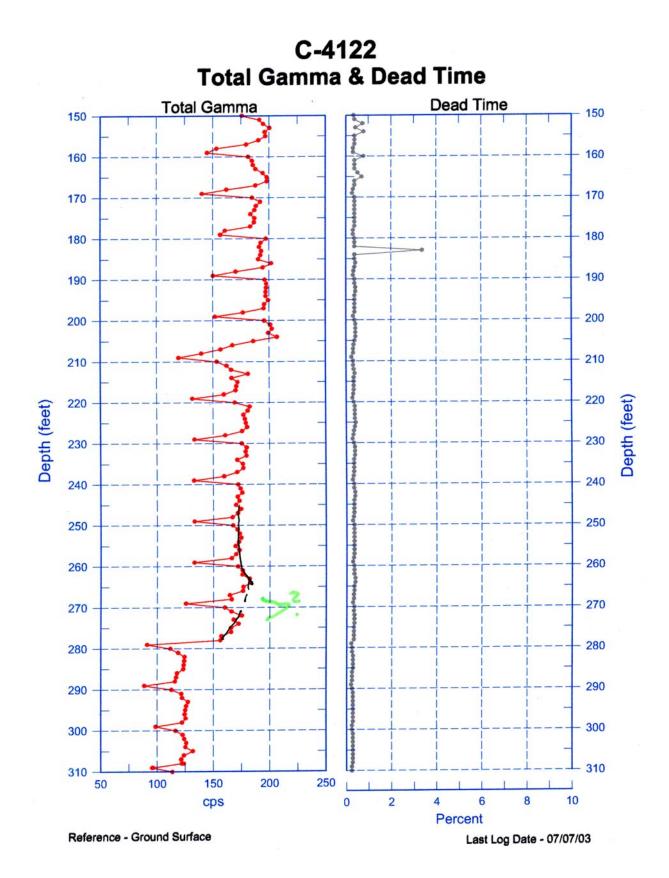
C.9



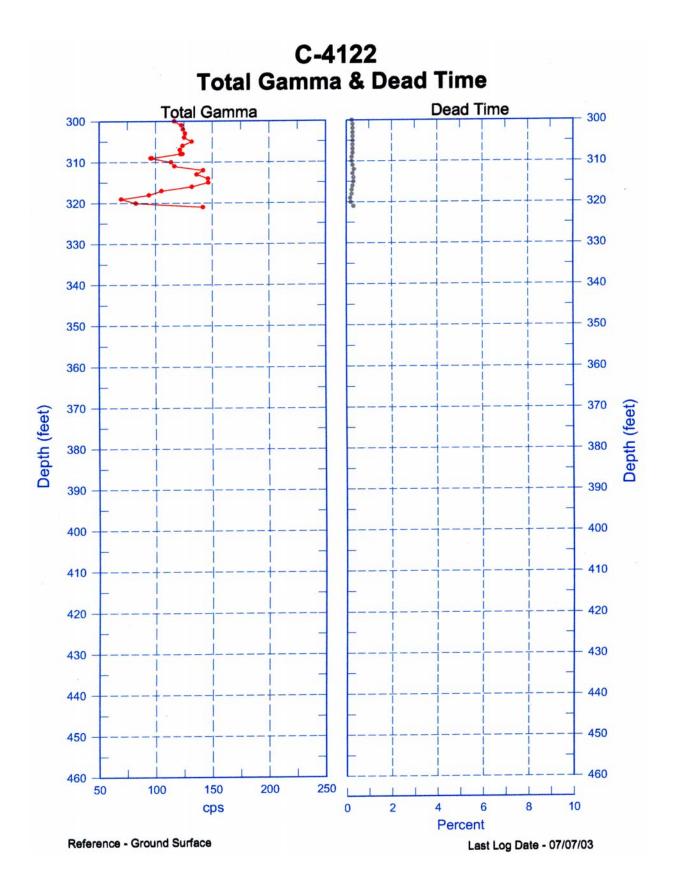
C.10

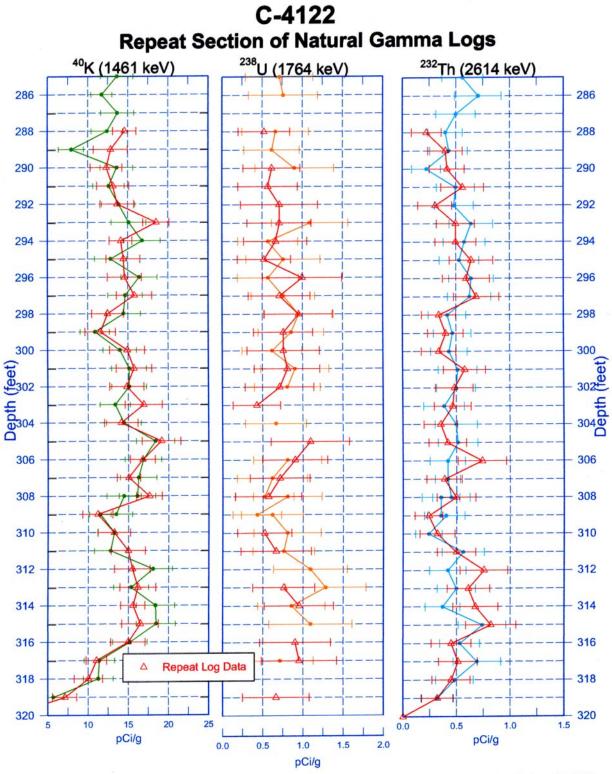


C.11



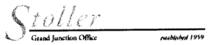






Zero Reference = Ground Surface

Last Log Date - 07/07/03



C-4123 Log Data Report

# **Borehole Information:**

Borehole: C-4123		Site:	West of A Tank Fa	m
Coordinates (WA St Plane)	GWL' (ft) :	288	GWL Date:	07/11/03
North East (estimated) (estimated) 136140 572265	Drill Date 07/03	Ground Level Elevation Not available	Total Depth (ft) 328.0	<b>Type</b> Becker

# **Casing Information:**

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	2.65	9.0	8.0	0.50	+2.65	328.0
Steel Tubing	3.1	6.24	6.0	0.125	+3.1	328.0

# **Borehole Notes:**

The casing dimensions are derived from published values for Becker drill casing. Casing thicknesses at the joints are 0.875 in. and 0.240 in. for the 8-in. and 6-in. casings, respectively. The total depth of the borehole was provided by the driller. The well site geologist provided the depth to water. Borehole coordinates were provided by Fluor Hanford's person in charge and are estimates. Ground level elevation was not available. Logging data acquisition is referenced to the ground surface.

### Logging Equipment Information:

Logging System:	Gamma 2A		Type: SGLS (35%) SN: 34TP11019B
Calibration Date:	01/03	Calibration Reference:	GJO-2003-418-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

# Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4 Repeat	
Date	07/12/03	07/14/03	07/15/03	07/15/03	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	105.0	328.0	163.0	105.0	
Finish Depth (ft)	0.0	162.0	104.0	72.0	
Count Time (sec)	200	200	200	200	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	N/A ²	N/A	N/A	N/A	
Pre-Verification	BA209CAA	BA210CAB	BA211CAB	BA211CAB	
Start File	BA209000	BA210000	BA211000	BA211058	

#### Page 1

Log Run	1	2	3	4 Repeat	
Finish File	BA209105	BA210166	BA211059	BA211091	
Post-Verification	BA209CAA	BA210AA	BA211CAA	BA211CAA	
Depth Return Error (in.)	0	0	Not applicable	+1	
Comments	Fine-gain adjustment made after files -076 and -095.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	

#### **Logging Operation Notes:**

Spectral gamma logging was performed in this borehole between July 12 and 15, 2003. Logging was conducted with a centralizer on the sonde and measurements are referenced to ground surface. A repeat section was collected in this borehole to evaluate system performance.

#### Analysis Notes:

Analyst: Henwood	Date: 07/21/03	Reference:	GJO-HGLP 1.6.3, Rev. 0
Analyst. Therewood	Duto. On Eneo		

Pre-run and post-run verifications for the logging system were performed before and after data acquisition. Acceptance criteria were met except for file numbers BA209CAB and BA210CAB. The total counts per second (cps) were exceeded for the 2614- and 1461-keV energy peaks for files BA209CAB and BA210CAB, respectively. The percent change between the before and after verification (i.e., files BA211CAB and BA211CAA, log runs 3 and 4) for the 2614-keV energy peak was 22 percent, which exceeds the criterion of 10 percent. After examination of individual spectra, the logging sonde appeared to have functioned normally and the data are provisionally accepted.

A combined casing correction for 0.625-in.-thick casing was applied throughout the borehole for both casings. The combined thickness at casing joints is 1.115 in. This thickness results in a significant reduction in gamma activity detection as the detector passes by a casing joint. However, it is not practical to correct individual data points for the effect of casing joints. The influence of the thick joints is apparent on the total gamma and ⁴⁰K logs where reduced count rates and concentrations are exhibited at approximately 10-ft depth intervals.

SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with an EXCEL worksheet template identified as G2AFEB03.xls using efficiency functions and corrections for casing, water, and dead time as determined from annual calibrations. Dead time corrections are applied where dead times exceed 10.5 percent; no dead times in excess of 10.5 percent were encountered. Correction for water was applied to the data below 288 ft.

#### Log Plot Notes:

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

Page 2

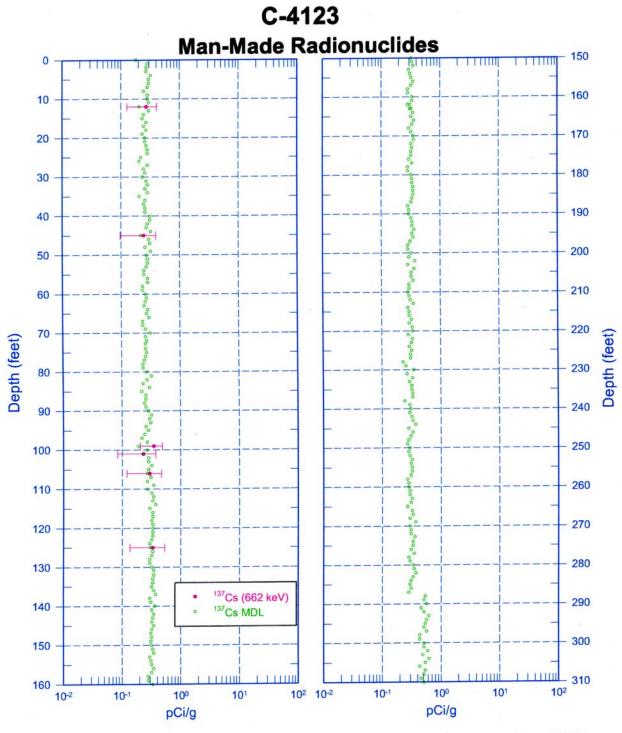
# **Results and Interpretations:**

 137 Cs was the only man-made radionuclide detected in this borehole.  137 Cs was detected at a few sporadic locations throughout the borehole near its MDL of approximately 0.2 pCi/g.

The repeat sections indicated good agreement of the naturally occurring KUT.

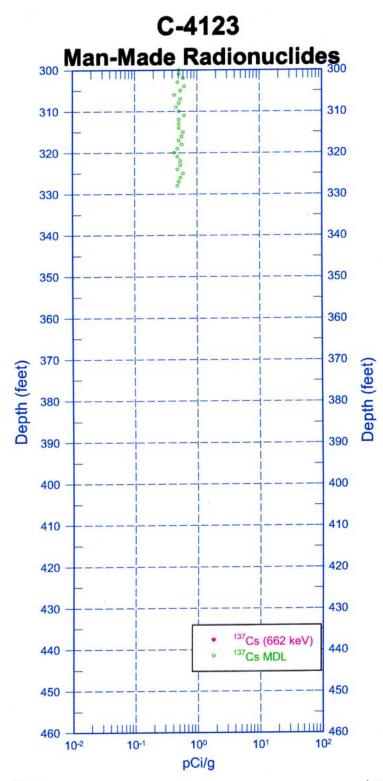
¹ GWL – groundwater level ² N/A – not applicable

Page 3



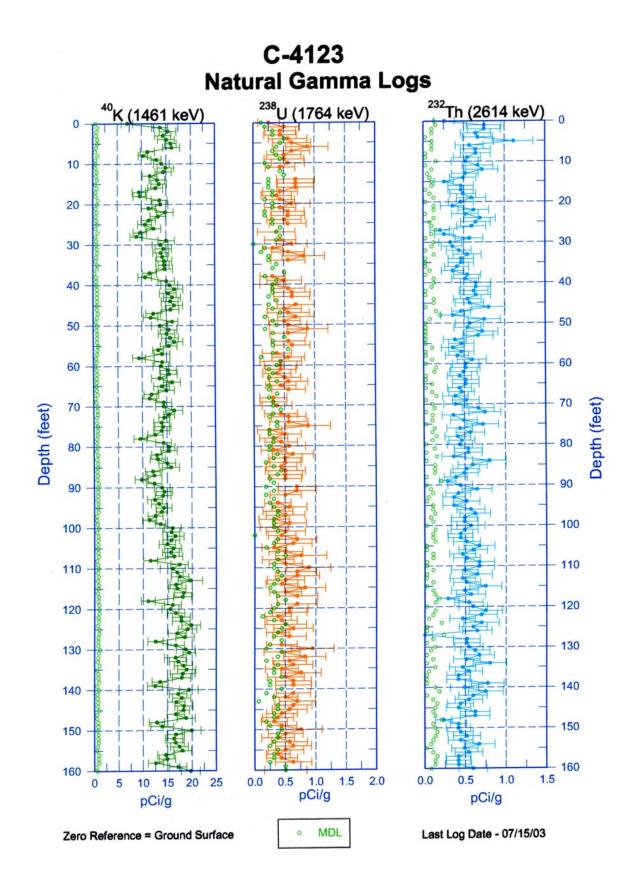
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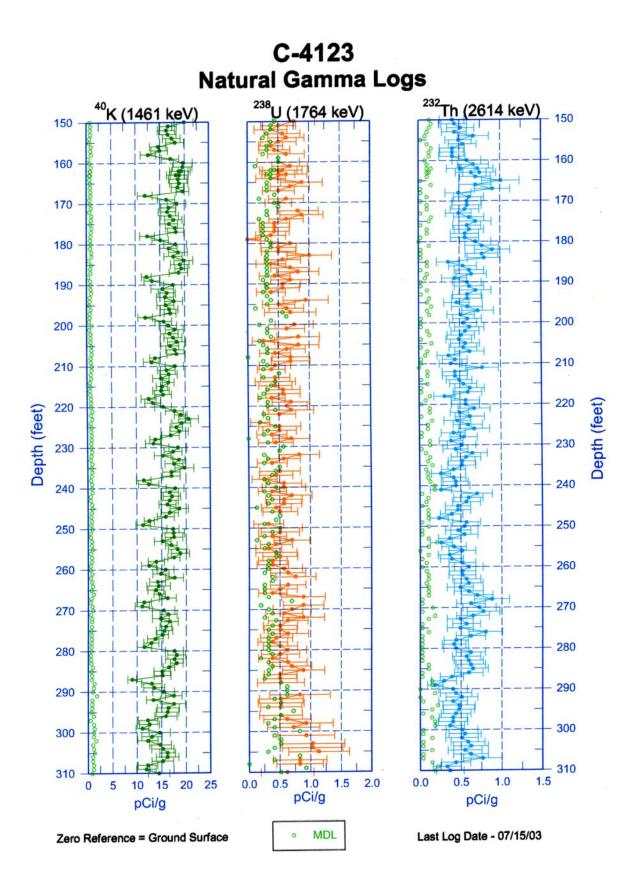
Last Log Date - 07/15/03

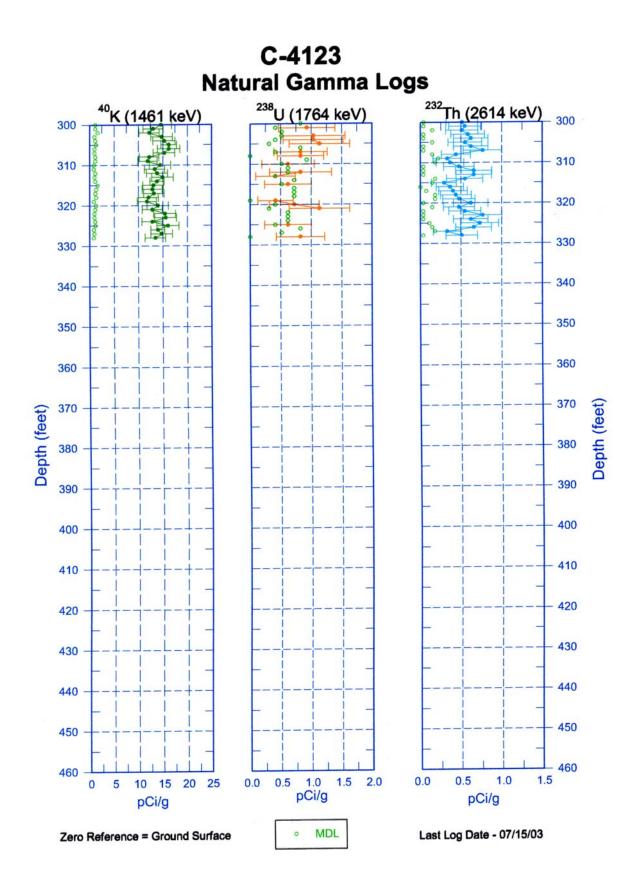


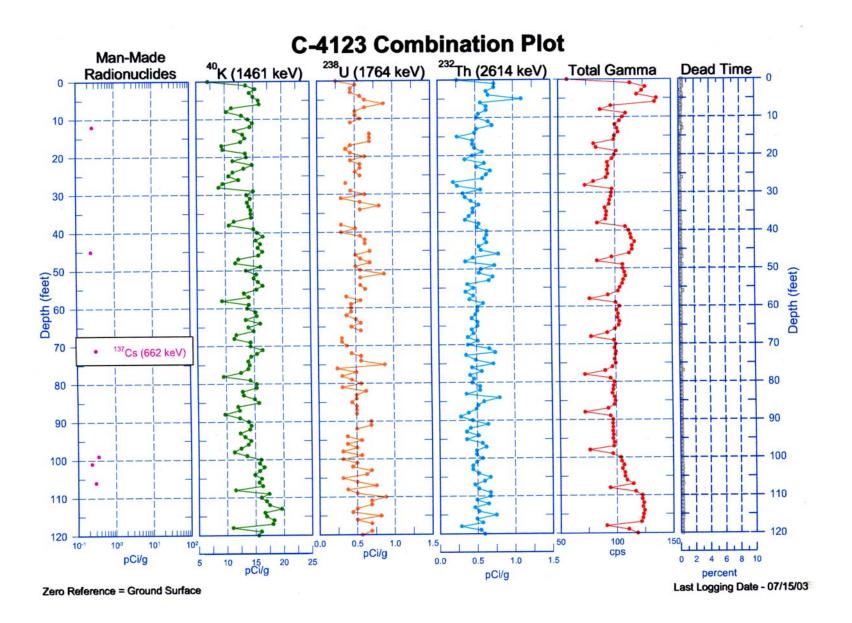
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Last Log Date - 07/15/03

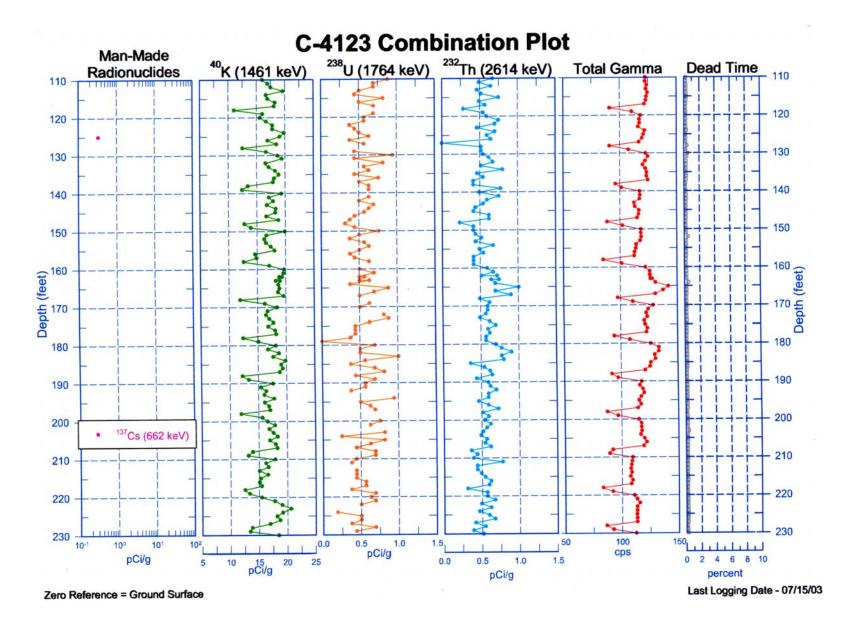




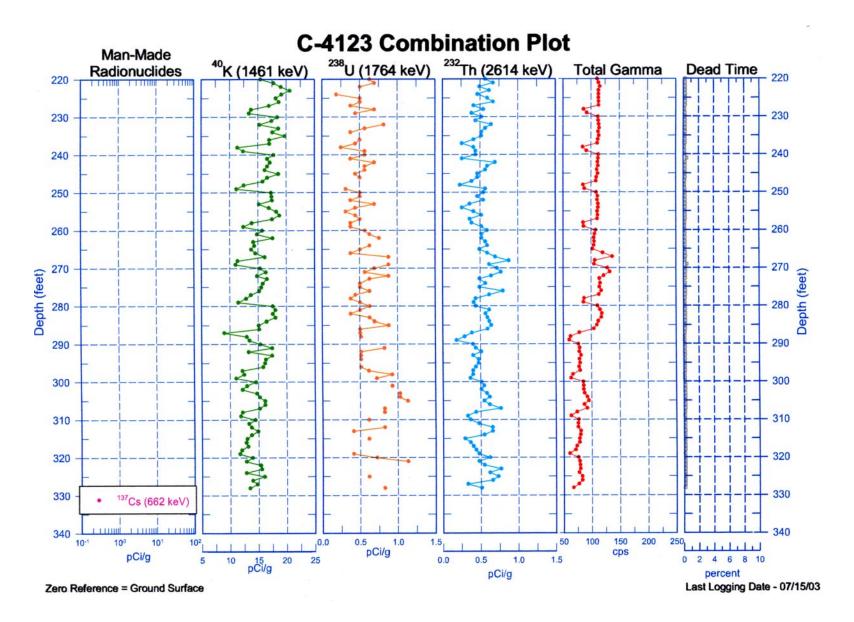




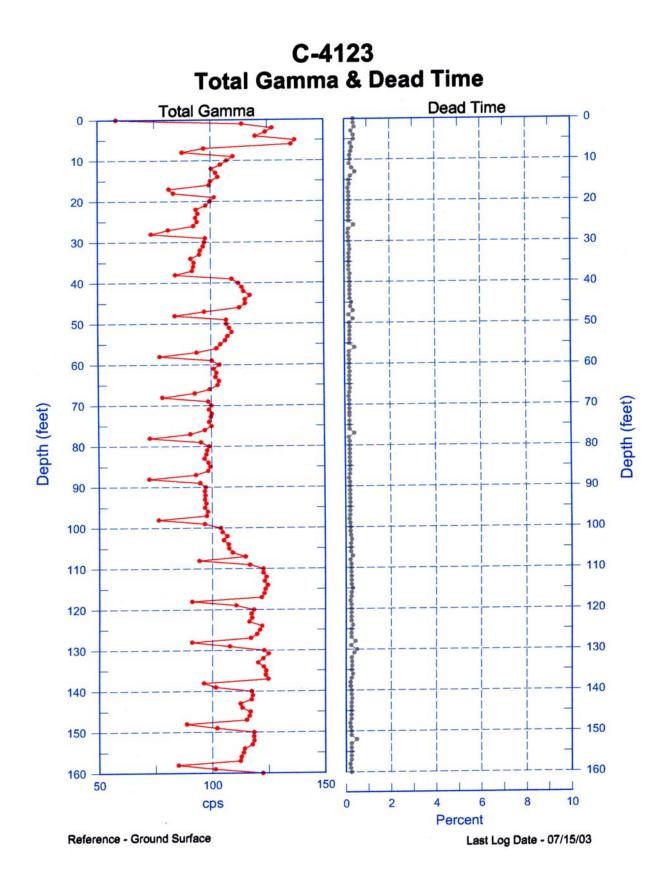
C.23

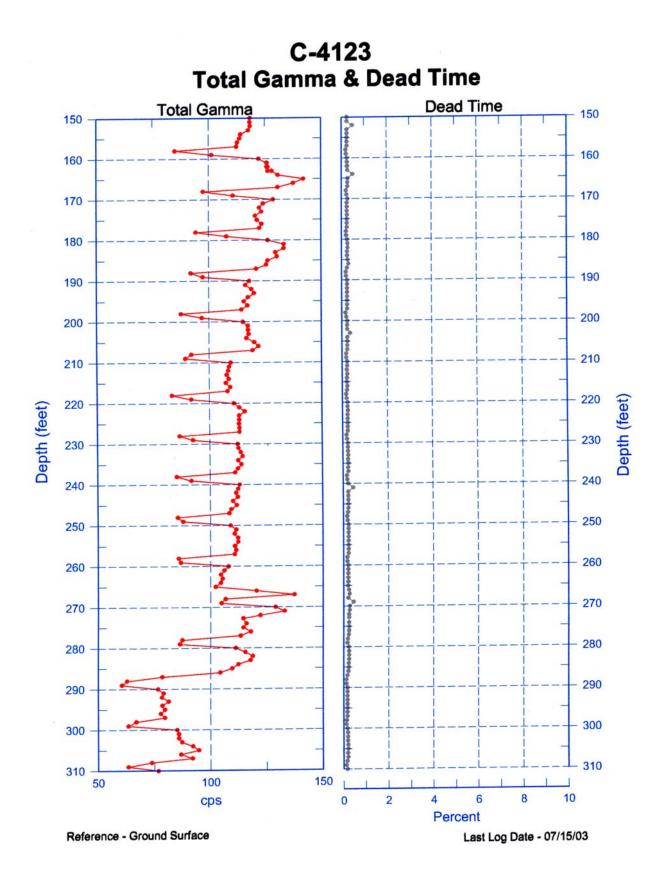


C.24

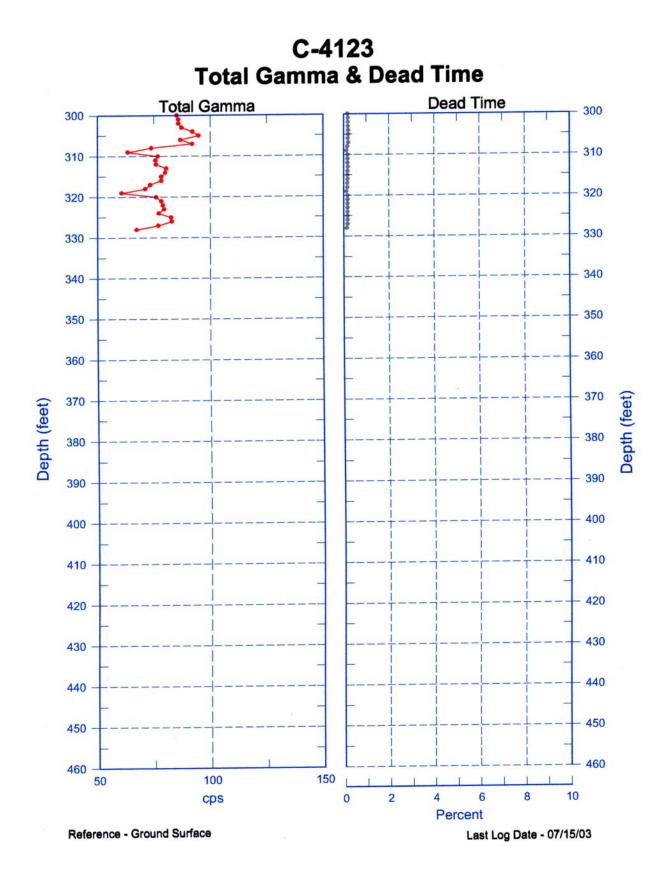


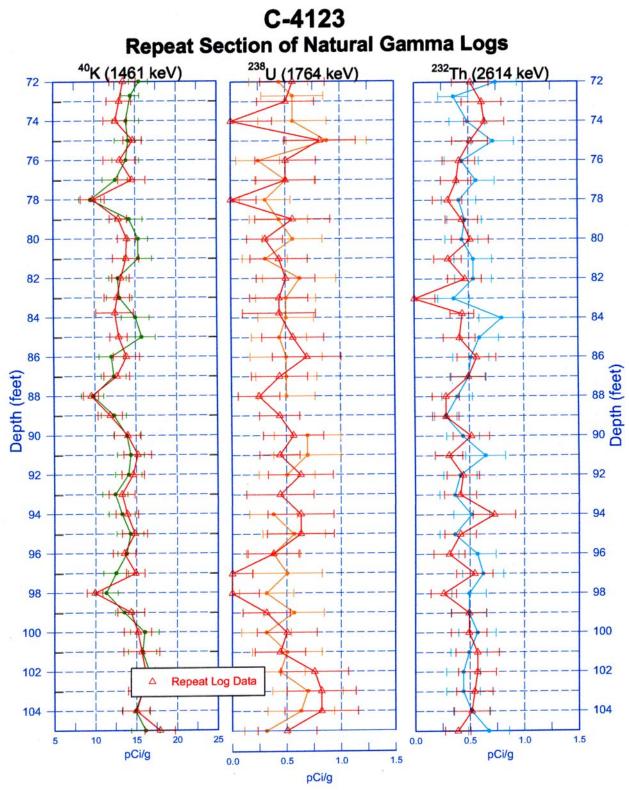
C.25





C.27





Zero Reference = Ground Surface

Last Log Date - 07/15/03

Hole: C4122	Time	CabLength (feet)	Inclination (fromVert.)	TF Gyro	TFHighSide	CourseDir (0°360°)	Rec.ID (17)	ClosureDir (0°360°)	ClosureDist (feet)	TVD (+feet)	+N/-S (feet)	+E/-W (feet)	Dogleg °/ 100f
2 S	3.18	0	0.13	34.1	333	214	2 S	0	0	0	0	0	0
3 S	4.33	20	0.17	301	0	94.2	3 S	142	0.03	20	-0	0.02	1.3
4 S	5.18	40	0.23	313	14.4	92.3	4 S	106	0.09	40	-0	0.09	0.3
5 S	5.98	60	0.34	267	355	65.4	5 S	90.4	0.18	60	0	0.18	0.8
6 S	6.67	80	0.47	297	14.2	76.8	6 S	82.3	0.32	80	0.04	0.31	0.8
7 S	7.28	100	0.36	356	62.2	87.6	7 S	82.1	0.46	100	0.06	0.45	0.7
8 S	7.98	120	0.48	50.1	125	78.5	8 S	82.1	0.6	120	0.08	0.6	0.7
9 S	8.7	140	0.62	64.1	141	77.3	9 S	81.1	0.8	140	0.12	0.79	0.7
10 S	9.24	160	0.34	85.8	175	64.5	10 S	79.7	0.96	160	0.17	0.95	1.5
11 S	9.88	180	0.76	110	202	62.3	11 S	76.9	1.15	180	0.26	1.12	2.1
12 S	10.4	200	0.35	120	235	39.3	12 S	73.9	1.33	199.99	0.37	1.27	2.3
13 S	11.2	220	0.76	165	268	50.9	13 S	70.6	1.5	219.99	0.5	1.42	2.2
14 S	11.9	240	0.66	213	314	53.3	14 S	68	1.74	239.99	0.65	1.61	0.6
15 S	12.8	260	0.66	244	317	81.5	15 S	67.9	1.96	259.99	0.74	1.82	1.6
16 S	13.5	280	0.68	249	318	84.7	16 S	69.5	2.19	279.99	0.76	2.05	0.2
17 S	14.1	300	0.9	284	290	148	17 S	74.1	2.34	299.99	0.64	2.25	4.3
18 S	17.2	305	0.96	264	265	153	18 S	76	2.36	304.99	0.57	2.29	2

 Table C.1. Gyroscope Data Report for Borehole C4122

Hole: C4122	Time	CabLength (feet)	Inclination (fromVert.)	TF Gyro	TFHighSide	CourseDir (0°360°)	Rec.ID (17)	ClosureDir (0°360°)	ClosureDist (feet)	TVD (+feet)	+N/-S (feet)	+E/-W (feet)	Dogleg °/ 100f
2 S	3.18	0	0.13	34.1	333	214	2 S	0	0	0	0	0	0
3 S	4.33	20	0.17	301	0	94.2	3 S	142	0.03	20	-0	0.02	1.3
4 S	5.18	40	0.23	313	14.4	92.3	4 S	106	0.09	40	-0	0.09	0.3
5 S	5.98	60	0.34	267	355	65.4	5 S	90.4	0.18	60	0	0.18	0.8
6 S	6.67	80	0.47	297	14.2	76.8	6 S	82.3	0.32	80	0.04	0.31	0.8
7 S	7.28	100	0.36	356	62.2	87.6	7 S	82.1	0.46	100	0.06	0.45	0.7
8 S	7.98	120	0.48	50.1	125	78.5	8 S	82.1	0.6	120	0.08	0.6	0.7
9 S	8.7	140	0.62	64.1	141	77.3	9 S	81.1	0.8	140	0.12	0.79	0.7
10 S	9.24	160	0.34	85.8	175	64.5	10 S	79.7	0.96	160	0.17	0.95	1.5
11 S	9.88	180	0.76	110	202	62.3	11 S	76.9	1.15	180	0.26	1.12	2.1
12 S	10.4	200	0.35	120	235	39.3	12 S	73.9	1.33	199.99	0.37	1.27	2.3
13 S	11.2	220	0.76	165	268	50.9	13 S	70.6	1.5	219.99	0.5	1.42	2.2
14 S	11.9	240	0.66	213	314	53.3	14 S	68	1.74	239.99	0.65	1.61	0.6
15 S	12.8	260	0.66	244	317	81.5	15 S	67.9	1.96	259.99	0.74	1.82	1.6
16 S	13.5	280	0.68	249	318	84.7	16 S	69.5	2.19	279.99	0.76	2.05	0.2
17 S	14.1	300	0.9	284	290	148	17 S	74.1	2.34	299.99	0.64	2.25	4.3
18 S	17.2	305	0.96	264	265	153	18 S	76	2.36	304.99	0.57	2.29	2

 Table C.2. Gyroscope Data Report for Borehole C4123