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EXECUTIVE SUMMARY

This report provides the status and accomplishments from fiscal year 1993 site characterization activities conducted as part of the 200 West Area Carbon Tetrachloride Expedited Response Action and the Volatile Organic Compounds - Arid Integrated Demonstration. The report includes or references all available raw data collected as part of these tasks. During fiscal year 1993, the 200 West Area Carbon Tetrachloride Expedited Response Action and the Volatile Organic Compounds - Arid Integrated Demonstration programs focused on the carbon tetrachloride plume in the unsaturated zone underlying the 200 West Area at the Hanford Site in southeast Washington.

The 200 West Area Carbon Tetrachloride Expedite Response Action is an environmental restoration program to remove carbon tetrachloride from the unsaturated soils in the 200 West Area by using soil vapor extraction followed by aboveground vapor treatment. Implementation of this expedited response action was based on concerns that carbon tetrachloride residing in the soils was continuing to spread to the groundwater and, if left unchecked, would significantly increase the area of groundwater contamination.

The Volatile Organic Compounds - Arid Integrated Demonstration is a technology development program to acquire, develop, demonstrate, and deploy technologies for evaluation and cleanup of volatile organic compounds and associated contaminants in soils and groundwater of arid U.S. Department of Energy sites. The area of carbon tetrachloride contamination in the 200 West Area was selected as the initial demonstration site.

Site characterization activities in support of the two programs have been fully integrated throughout planning and implementation because of their similar objectives and scope. The primary objective of this unified characterization program is to further refine the conceptual model of the site, both to aid development and testing of new technologies and to optimize removal of the carbon tetrachloride.

The activities planned for fiscal year 1993 were described in site characterization workplans and test plans. The site characterization tasks undertaken during fiscal year 1993 were:

- Evaluate the integrity of effluent pipelines
- Investigate the source of the secondary groundwater maximum
- Estimate the vapor flux from soils
- Conduct geophysical surveys
- Conduct borehole geophysical logging
- Remediate wells
- Measure water levels
- Drill and sample crib boreholes and vapor extraction wells
- Drill and sample technology demonstration boreholes
- Sample groundwater.

Full interpretation and integration of the data collected during these tasks, and an updated site conceptual model, will be reported in a separate document during fiscal year 1994.

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1.0 PURPOSE

This report provides the status of the fiscal year (FY) 1993 characterization tasks conducted as part of the 200 West Area Carbon Tetrachloride Expedited Response Action (ERA) and the Volatile Organic Compounds - Arid Integrated Demonstration (VOC-Arid ID) (Rohay et al. 1993). The FY 1993 site evaluation tasks focused on the unsaturated zone in the vicinity of the carbon tetrachloride disposal sites. The primary objective of the site characterization tasks were to further refine the conceptual model of the site, both to aid development and testing of new technologies and to optimize removal of the carbon tetrachloride. Other objectives of the site characterization work include monitoring the performance of remedial actions; providing samples to support technology demonstrations; and demonstrating and using new characterization and monitoring technologies.

2.0 BACKGROUND

2.1 PROGRAMMATIC BACKGROUND

An ERA is a provision included in the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) that allows accelerated cleanup activities to be undertaken at waste sites to abate imminent hazards or to prevent significantly increased degradation that might occur if action were delayed until completion of the remedial investigation/feasibility study and the record of decision. The ERA is implemented according to the requirements outlined in the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989, Part 3, Article XIII, Section 38), and in accordance with 40 CFR Part 300, Subpart E.

In December 1990, the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology) requested the U.S. Department of Energy (DOE), Richland Operations Office, to proceed with detailed planning, including nonintrusive field work, required to implement the ERA for carbon tetrachloride contamination located in the unsaturated soils beneath certain disposal sites in the 200 West Area of the Hanford Site (Figure 1). The request was made based on concerns that the carbon tetrachloride residing in the soils was continuing to spread to the groundwater and, if left unchecked, would significantly increase the area of groundwater contamination. The purpose of this ERA is to minimize or stabilize carbon tetrachloride migration within the unsaturated zone beneath and away from the carbon tetrachloride disposal sites in the 200 West Area.

The first site evaluations were conducted at this site from January through April 1991 as part of the ERA to refine the preliminary conceptual model and to collect data in support of the selection and design of an initial remedial action (Hagood and Rohay 1991). The results of the initial ERA site evaluations were summarized in June 1991 (DOE-RL 1991, Appendix B). Based on this work and on the engineering evaluation and cost assessment, the preferred alternative for removal of the carbon tetrachloride from the unsaturated zone was identified as soil vapor extraction followed by aboveground vapor

Figure 1. Location Map of the ERA/VOC-Arid ID Site.

collection on granular activated carbon (DOE-RL 1991). The second phase of ERA site evaluation activities, which began in September 1991, were described in the phase II (FY 1992) workplan (Rohay 1991). In January 1992, the EPA and Ecology authorized DOE to initiate soil vapor extraction for cleanup of the carbon tetrachloride.

The VOC-Arid ID is a DOE program funded by the Office of Technology Development that is targeted at the acquisition, development, demonstration, and deployment of technologies for evaluation and cleanup of volatile organic compounds (VOC) and associated contaminants in soils and groundwaters of arid DOE sites. The DOE contractors, national laboratories, universities, and industry are participants in the program. New technologies are being demonstrated in the areas of site characterization; performance prediction, monitoring, and evaluation; contaminant extraction and ex situ treatment; in situ remediation; and site closure and monitoring. The performance of these demonstrated technologies will be compared to baseline (i.e., conventional) technologies and documented to promote the transfer of new technologies to industry for use at Hanford and other DOE sites.

The initial demonstration site selected for the VOC-Arid ID was also the area of carbon tetrachloride contamination in the 200 West Area. Last et al. (1991) summarized the physical and chemical characteristics of this site for the principal investigators of candidate new technologies. The initial phase of site characterization activities was described in the FY 1992 workplan issued in November 1991 (Last and Rohay 1991).

Because of the similar objectives and scope of the two site characterization programs, the FY 1992 tasks of the VOC-Arid ID characterization effort were fully integrated with the ongoing characterization activities of the ERA throughout the planning and implementation. This coordination was designed to maximize efficient use of time and resources and to ensure that each activity and resulting product achieved the maximum usefulness to both programs. The summary and status of these tasks, and the data collected, were reported at the end of the fiscal year (Rohay et al. 1992). The data were then used to produce a refined conceptual model of the site (Last and Rohay 1993).

Site characterization tasks to support both the ERA and VOC-Arid ID programs during FY 1993 were fully coordinated and presented in a single workplan (Rohay et al. 1993). The status and accomplishments of these FY 1993 tasks are provided in this report. Full interpretation and integration of the data collected during these tasks, and an updated site conceptual model, will be reported in a separate document during FY 1994.

Site activities planned for FY 1993 to optimize the wellfield for vapor extraction operations were described in the FY 1993 wellfield workplan (Rohay and Cameron 1992). The status and accomplishments of these tasks will be the subject of a separate report. However, the characterization and wellfield tasks were closely coordinated, and characterization data collected in conjunction with wellfield enhancements tasks (e.g., drilling of new extraction wells) will be presented in this report.

2.2 SITE CHARACTERISTICS

This section provides a brief summary of site characteristics as background for this report. More detailed discussions of site characteristics are included in Rohay and Johnson (DOE-RL 1991, Appendix B), Last et al. (1991), and Last and Rohay (1993).

2.2.1 Site Operations

In the 200 West Area, carbon tetrachloride was used at Z Plant (currently called the Plutonium Finishing Plant) (Figure 2). No other plant in the 200 West Area is known to have used carbon tetrachloride.

Z Plant was designed to process plutonium to a final product form using three process lines. Each of these process lines generated side streams that contained recoverable quantities of plutonium. The Recuplex facility and the Plutonium Reclamation Facility (PRF) were established to recover plutonium from these streams and were the primary contributors of carbon tetrachloride to 200 West Area soils.

Carbon tetrachloride was used, in mixtures with other organics, to recover plutonium from aqueous streams at Z Plant. The aqueous waste stream, characterized as a high-salt aqueous waste, was primarily a concentrated nitrate solution that had a pH of 1 (neutralized to a pH of 2.5 prior to discharge). The chemical processes used to recover plutonium resulted in the production of actinide-bearing aqueous and organic waste liquids. The primary radionuclide components of these liquids were plutonium-239/240 and americium-241.

Both the aqueous and organic phases were discharged to the same liquid waste disposal sites. The solvent was periodically discharged batch-wise and was also a minor (<1%) component of the aqueous phase.

Organic liquids discharged to the disposal sites consisted of carbon tetrachloride in mixtures with tributyl phosphate (TBP), dibutyl butyl phosphonate (DBBP), or lard oil. Degradation products of carbon tetrachloride include chloroform and methylene chloride. Breakdown products of TBP include dibutyl phosphate (DBP) and monobutyl phosphate (MBP). In addition to the plutonium and americium, co-contaminants discharged to the sites include aluminum, cadmium, calcium, chromium, fluoride, chloride, iron, iodine, magnesium, nickel, nitrate, rubidium, sodium, sulfate, sulfamate, cesium-137, cobalt-60, uranium, ruthenium-106, and strontium-90.

The carbon tetrachloride disposal sites, located near Z Plant in the 200 West Area, are the 216-Z-9 Trench, 216-Z-1A Tile Field, and 216-Z-18 Crib (Figure 2). The 216-Z-9 Trench was used from 1955 to 1962 to receive all organic and aqueous waste from the Recuplex facility. Organic and aqueous waste from the PRF was discharged to 216-Z-1A Tile Field from 1964 to 1969 and to 216-Z-18 Crib from 1969 to 1973. Discharge of carbon tetrachloride to the soil column was discontinued in 1973.

Figure 2. Site Map of the 200 West Area.

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Estimates of the volumes and quantities of various liquids and contaminants discharged to the three carbon tetrachloride disposal sites are summarized in Table 1. A total of 363,000 to 580,000 L of carbon tetrachloride is estimated to have been discharged to the soil column between 1955 and 1973.

Table 1. Contaminant Inventory in Carbon Tetrachloride Liquid Waste Disposal Sites.

Contaminant	216-Z-9	216-Z-1A ^a	216-Z-18
Carbon tetrachloride (L)	83,000-300,000	170,000	110,000
Plutonium (kg)	106 ^b	57	23
Americium (kg)	2.5	1	~0.4
Total liquid (L)	4.09×10^6	5.2×10^6	3.86×10^6
Period of use	1955-1962	1964-1969	1969-1973

^aFrom 1949 to 1959, the 216-Z-1A Tile Field received approximately 1×10^6 L of slightly basic, aqueous waste via overflow from associated 216-Z-1, -2, and -3 Cribs prior to disposal of Plutonium Reclamation Facility waste. From 1964 to 1969, Plutonium Reclamation Facility wastes were discharged directly to 216-Z-1A.

^b58 kg was later removed.

Boreholes were drilled from 1949 to 1978 to characterize/monitor the three carbon tetrachloride disposal sites, primarily with regard to the radionuclide concentrations. Six boreholes were installed in FY 1992 and six were installed in FY 1993 as part of the ERA/VOC-Arid ID characterization program. Fifty-eight boreholes are potentially available for additional characterization, monitoring, and remediation (Figure 3). Construction details for these boreholes are summarized in the ERA proposal (DOE-RL 1991, Appendix C), in the FY 1992 characterization status report (Rohay et al. 1992), and in this report.

2.2.2 Conceptual Models

2.2.2.1 Hydrogeology. The geology of the 200 West Area consists primarily of fluvial and glaciofluvial sediments underlain by basalts. The sediments are, from youngest to oldest (Figure 4):

- Hanford formation - glaciofluvial gravels, sands, and silts deposited by Pleistocene cataclysmic flood waters
- Early "Palouse" soil - silt and fine sand. Previously considered to be an eolian deposit, its origin is now being re-evaluated; may be fluvial or fluviolacustrine
- Plio-Pleistocene unit - basaltic detritus and a carbonate-rich paleosol, often referred to as the caliche layer
- Ringold Formation - a series of alluvial sands and gravels, and overbank and lacustrine deposits, of late Miocene to Pliocene age
- Saddle Mountains Basalt Formation - a series of Miocene tholeiitic basalt flows.

Figure 4. Generalized Hydrostratigraphic Column for the Z Plant Area.

The unsaturated zone, which consists of sediments of the Ringold Formation, Plio-Pleistocene unit, early "Palouse" soil, and Hanford formation, ranges in thickness from 58 to 82 m across the 200 West Area and from 60 to 66 m beneath the carbon tetrachloride disposal sites. Because the Plio-Pleistocene unit is less permeable than the other units, it may temporarily divert or perch liquids and/or dense vapors. The top of this unit occurs approximately 40 m below ground surface. The topography of the Plio-Pleistocene surface suggests that it locally forms a ridge that extends south-southwest beneath the three carbon tetrachloride disposal sites.

The uppermost aquifer in the 200 West Area is unconfined and located within the Ringold Formation. The saturated thickness of the uppermost aquifer ranges from 67 to 113 m. Groundwater flow directions are generally radial outward from the southwest portion of the 200 West Area primarily because of the continuing influence of the residual groundwater mound underlying the decommissioned 216-U-10 Pond (Figure 2). Recharge to the aquifer is primarily artificial recharge from waste disposal activities.

2.2.2.2 Carbon Tetrachloride Distribution. Results of FY 1991 and FY 1992 characterization activities for the ERA and VOC-Arid ID were used to refine the site conceptual model of the carbon tetrachloride behavior and distribution (Last and Rohay 1993). In this refined conceptual model, the highest concentrations of carbon tetrachloride are located in the vicinity of the 216-Z-9 Trench; concentrations in the vicinity of the 216-Z-1A Tile Field and 216-Z-18 Crib are typically one to two orders of magnitude lower.

At the 216-Z-9 Trench, the carbon tetrachloride concentrations appear to be highest adjacent to and north of the disposal facility. The soil-gas survey results indicate that the highest near-surface soil-gas concentrations of carbon tetrachloride (72 ppm) and chloroform are located just north of the 216-Z-9 Trench. The highest subsurface carbon tetrachloride vapor concentrations (over 10,000 ppm) were measured in wells and deep soil-gas ports near the trench. Higher carbon tetrachloride concentrations (up to 37.8 ppm) were detected in sediment samples from a well drilled adjacent to the trench in 1992 (299-W15-217). Concentrations of carbon tetrachloride extracted from wells in the 216-Z-1A/Z-18 wellfield during vapor extraction operations typically range from 200 to 1000 ppm; concentrations extracted from wells in the 216-Z-9 wellfield have been as high as 28,500 ppm.

Sediment and subsurface soil-gas samples indicate that the highest concentrations of carbon tetrachloride in the unsaturated zone are associated with the early "Palouse" soil and the top of the Plio-Pleistocene unit, located at a depth of approximately 35 to 40 m. The early "Palouse" soil is a fine-grained unit with high porosity, small pore-size distribution, and relatively low hydraulic conductivity; the Plio-Pleistocene unit is a calcium carbonate-cemented horizon with very low hydraulic conductivity. Numerical flow simulations appear to support the contention that the early "Palouse" soil is the primary repository for carbon tetrachloride and other VOCs.

Total VOC vapor concentrations (found to consist predominantly of carbon tetrachloride) measured in existing boreholes and deep soil-gas ports suggest a correlation with barometric pressure changes. Air flow measurements in the boreholes indicate that barometric pressure fluctuations may constitute a significant release mechanism for VOCs out of the unsaturated zone (through boreholes) into the atmosphere, and could account for 3% of the carbon

tetrachloride inventory estimated to have been discharged to the soil column. Ambient soil-surface flux measurements suggest natural fluxes of carbon tetrachloride from the unsaturated zone, on the order of $0.25 \text{ g/m}^2/\text{yr}$, based on a rough estimate that 18% of the estimated discharged inventory may have been released to the atmosphere via natural flux from the soil surface.

Well construction and wastewater disposal histories suggest that some of the older existing wells, including deep groundwater wells, had the potential to provide a vertical conduit for the downward migration of carbon tetrachloride and other contaminants directly to the aquifer. However, column pore volume estimates and numerical model simulations suggest that, at the 216-Z-9 Trench, the wastes likely reached the water table irrespective of whether poorly sealed wells provided a preferential pathway.

Perched water has been encountered at the 216-Z-9 Trench above the Plio-Pleistocene unit. The source of this perched water is probably the currently active 216-Z-21 disposal facility southeast of the trench.

Concentrations of dissolved carbon tetrachloride detected in the upper 10 m of the unconfined aquifer (as defined by the 10-p/b contour) have accounted for approximately 2% of the total carbon tetrachloride inventory (DOE-RL 1991, Appendix B). The dissolved plume is estimated to cover an area of 13 km^2 and appears to be emanating from the area of the disposal sites and extends primarily to the north.

Sampling data from one well (299-W15-6) also suggest that carbon tetrachloride occurs deep within the aquifer, at least near the 216-Z-9 Trench, where dissolved carbon tetrachloride was detected 52 m below the water table. However, the well itself may have provided the preferential pathway for the vertically distributed contaminants.

3.0 STATUS OF FY 1993 FIELD INVESTIGATION TASKS

Nineteen field investigation tasks were proposed by the combined ERA and VOC-Arid ID site characterization program (Rohay et al. 1992). This section provides a brief description of each task and its status at the end of FY 1993. The relative timing the duration of these tasks is shown in Figure 5. Detailed results for each task conducted during FY 1993 are provided in Section 4.0.

SOURCE TERM CHARACTERIZATION

1. Evaluate Effluent Pipeline Integrity. The objective of this task is to estimate the location and quantity of any leaks from the carbon tetrachloride effluent pipelines to estimate how much organic and aqueous effluent discharged from Z Plant from 1955 to 1973 actually went to the three carbon tetrachloride disposal cribs as intended. The investigation focused on the effluent pipelines to 216-Z-9 Trench, which was used from 1955 to 1962. The in-pipe investigations were conducted

Figure 5. Schedule of ERA/VOC-Arid ID Site Characterization Field Investigation Tasks Conducted During FY 1993.

February 2 - 11, 1993 by pushing a forward-looking color camera assembly through the pipelines to look for areas of potential leaks. The final report was completed August 23, 1993. (NOTE: This work was initiated in September 1991, and detailed planning and purchase of equipment was accomplished in FY 1992.)

2. Investigate Source of Secondary Groundwater Maximum. The objective of this task is to determine the source of the secondary concentration maximum in the dissolved groundwater plume. Research and evaluation of historical waste management practices, interpreted using chemical and engineering process knowledge, was conducted between January and June 1993 and reported in a Westinghouse Hanford Company (WHC) internal memo.
3. Assess Artificial Recharge. The objective of this task is to evaluate the possible impacts of artificial recharge on the unsaturated zone and groundwater hydrogeology and on the distribution and redistribution of carbon tetrachloride wastes. Information on the miscellaneous effluent stream discharge volumes/rates and locations is being compiled by the WHC liquid waste management group. Assessing the current and historic impact of these discharges was postponed to FY 1994.

SOIL-GAS SURVEYS

4. Map Lateral Distribution of VOCs. The objective of this task is to map the lateral distribution of carbon tetrachloride and other selected VOCs in the vicinity of and away from the three disposal sites. The intent was to install additional near-surface (1.2-m-deep) soil-gas probes to complement an existing soil-gas survey network. After reviewing the workplan, the Characterization and Monitoring Technical Support Group to the VOC-Arid ID recommended that this mapping be conducted using passive soil-gas sampling methods rather than the conventional grab sampling method outlined in this task. For this reason, this task was not conducted.
5. Estimate VOC Vapor Flux from Ambient Soil Surface. The objective of this task is to use passive soil-gas sampling to estimate the vapor flux from the soil-air surface and to indicate the lateral distribution of carbon tetrachloride vapor. The sampling was conducted using Quadrel Services, Inc. EMFLUX (a registered trademark of Quadrel Services, Inc.) technology. Samplers were deployed between July 24 and July 31, 1993, and sent to Quadrel for analysis. A report containing the analytical results was prepared by Quadrel Services on August 20, 1993.
6. Map Vertical Distribution of VOCs. The objective of this task is to investigate the vertical distribution of carbon tetrachloride and other VOCs by accessing the subsurface using existing wells and the cone penetrometer. Wells were sampled throughout the fiscal year in conjunction with the ERA wellfield enhancement activities, ERA baseline monitoring for soil gas, and the liquid effluent program. VOC vapor sampling with depth using the cone penetrometer was conducted from May 6 to 13, 1993. These data are included in the forthcoming FY 1993 wellfield status and data package report.

CONDUCT GEOPHYSICAL SURVEYS

7. Conduct Geophysical Surveys. The objective of this task is to collect geophysical data at the carbon tetrachloride site using multiple surface geophysical techniques to support a demonstration of a data fusion workstation being developed by Coleman Research Corporation. From December 10 to 16, 1992, an initial test phase was conducted to evaluate techniques and equipment for use at the site. Based on the results of this initial testing, a production phase was conducted from February 10 to March 8, 1993 using seismic refraction, seismic reflection, frequency domain electromagnetics, and direct current resistivity. Results were provided by Coleman Research Corporation on July 13, 1993.

EXISTING WELL EVALUATIONS

8. Conduct Borehole Geophysical Logging. The objective of this task is to use existing boreholes to delineate intervals of radiological contamination, marker lithologic units, zones of perched water, and/or intervals of carbon tetrachloride contamination via detection of chlorine. Gross gamma logging was conducted in seven wells between February 9 and July 23, 1993 to identify any zones of radiological contamination. Additional borehole geophysical logging, using a prompt fission neutron probe to search for fissionable isotopes (primarily plutonium-239 and uranium-235) and a thermal decay time probe to search for significant quantities of carbon tetrachloride, is planned for mid-September 1993.
9. Measure Wellhead Vapor Emissions. The objective of this task is to collect data on wellhead concentrations and fluxes of VOC vapor that can be used to estimate the quantity of carbon tetrachloride that has been vented from boreholes since 1955. Wellhead concentrations and borehole vapor flux have been measured at selected wells throughout the fiscal year as part of wellfield enhancement activities for the ERA. These data are included in the forthcoming FY 1993 wellfield status and data package report.
10. Remediate Wells. The objective of this task was to remove any known preferential pathways provided by old wells, to convert existing wells for vapor extraction/monitoring or groundwater investigations, and to obtain accurate survey data for wells. Several attempts, all unsuccessful, were made to sample an old well (299-W15-5) suspected of providing a preferential pathway, prior to proceeding with its remediation. Four existing wells at the 216-Z-9 Trench were perforated on April 27, 1993 to facilitate vapor extraction. Most of the wells associated with the carbon tetrachloride site were resurveyed by the U.S. Army Corps of Engineers from September 1992 to May 8, 1993.
11. Measure Water Levels. The objective of this task was to establish an accurate and current water table map and to confirm the rate of water table decline. Water level data were collected throughout FY 1993; however, an updated water table map for the carbon tetrachloride site has not yet been generated. Data to determine the short-term variability of the water table elevation were collected every 30 min in well 299-W15-6 between July 15 and August 9 and in well 299-W15-4 between July 19 and August 9.

12. Evaluate Archived Borehole Samples. The objective of this task is to establish a consistent database of geologic contacts by relogging existing wells according to the current protocol. In addition, geologic samples collected during FY 1992 were to be sieved and analyzed for clay content. This task was postponed because of funding constraints.

NEW WELL INVESTIGATIONS

13. Drill and Sample Crib Boreholes. The objective of this activity is to obtain data on the nature, distribution, transport pathways, and behavior of contaminants immediately below each of the carbon tetrachloride disposal facilities. Existing well 299-W18-96 in the 216-Z-18 Crib was deepened from 80 ft to 147 ft and completed as a vapor extraction well between February 10 and March 5. Existing well 299-W18-174 in the 216-Z-1A Tile Field was deepened from 46 ft to 131.5 ft and completed as a vapor extraction well between March 17 and April 26. Samples were collected for physical analyses (lithology, moisture and calcium carbonate contents, particle size distribution, porosity and bulk density, and air permeability), chemical analyses (volatile organics analysis, semivolatile organics analysis, ions and selected metals), microbial analyses, soil-gas analyses, and for principal investigators from the VOC-Arid ID. Drilling of a new, angled well, 299-W15-223, beneath the parking lot north of the 216-Z-9 Trench is scheduled to begin in mid-September 1993.
14. Drill and Sample Vapor Extraction Wells. The objective of this activity is to collect characterization data during installation of vapor extraction wells for the carbon tetrachloride ERA. The well locations were selected as part of the vapor extraction system wellfield design, and the field sampling activities are described in the FY 1993 Wellfield Enhancement Workplan for the ERA (Rohay and Cameron 1993). The geologic and volatile organics analysis data and well construction data are included in this report to provide a complete data package in one document. Four wells were drilled using cable tool drilling technology in FY 1993: 299-W15-218, on the north side of the 216-Z-9 Trench, was installed between February 3 and April 26; 299-W15-219, northwest of the 216-Z-9 Trench, was installed from April 26 to July 19; 299-W15-220, east of 216-Z-9, was installed between June 2 and August 25; and 299-W18-252, midway between 216-Z-1A and 216-Z-12, was installed between May 3 and August 6. All four were drilled to groundwater but completed as unsaturated zone wells with two screened intervals.
15. Drill and Sample Deep Groundwater Well. The objective of this task is to obtain data on the nature and distribution of contaminants in the aquifer in the vicinity of the disposal facilities and to obtain data on the lithology, geochemistry, hydrology, and microbiology of the aquifer materials. Drilling of this well was deferred to the fieldwork conducted by the Interim Remedial Measures for the 200-ZP-2 Operable Unit. It is anticipated that the well will be drilled in FY 1994.
16. Drill and Sample Technology Demonstration Boreholes. The objective of this task was to drill boreholes required to support technology demonstrations conducted by the VOC-Arid ID. Drilling of one bioremediation borehole at the in situ bioremediation demonstration

field site between 241-T Tank Farm and 221-T Plant began May 3, 1993, and reached total depth of 310 ft on September 1, 1993. Completion activities began September 9, 1993. Drilling of one 15-m-deep borehole in support of the in situ heating/corona destruction demonstration was tentatively planned for FY 1993 but was not installed.

17. Sample Groundwater. The objective of this task is to monitor concentrations of VOCs in groundwater from wells in and around the three carbon tetrachloride disposal sites and at the perimeter of the carbon tetrachloride groundwater plume. Groundwater samples were collected from 19 existing wells between November 10 and November 23, 1992; between January 4 and January 12, 1993; and between June 16 and July 20, 1993. The vertical distribution of VOC within the aquifer will be investigated at well 299-W15-6, which is perforated to a depth of 170 ft below the water table, in late September 1993. Groundwater samples were collected from the four new vapor extraction wells drilled to the water table in FY 1993.

4.0 RESULTS FROM FY 1993 FIELD INVESTIGATION TASKS

4.1 EVALUATE EFFLUENT PIPELINE INTEGRITY

This task was designed to provide information to guide remediation of the unsaturated zone carbon tetrachloride plume. The wellfield design for vapor extraction operations will be guided by knowing whether the effluent streams entered the soil only at the cribs as intended or whether contaminant sources exist along the effluent pipelines because of pipeline leaks. In keeping with this objective, only substantial breaching of the pipelines is significant; minor cracks and fractures would not allow sufficient liquid to leak out to influence remediation strategies. Because "wet" carbon tetrachloride (carbon tetrachloride in contact with water) is known to be corrosive, it is considered quite possible that the pipelines conveying carbon tetrachloride and aqueous waste developed breaches during use.

Five retired process effluent drain lines were used to transport aqueous and organic waste containing carbon tetrachloride for disposal to the soil column (Figure 6). Lines 840 and 840D, routed from the Recuplex facility in the 234-5Z Building to the 216-Z-9 Trench, operated from 1955 to 1962. Lines 1035 and 1036, routed from the 242-Z Building to the 216-Z-1A Tile Field and 216-Z-18 Crib, were used from 1964 to 1973.

The scope of work for this task included determining accessibility of the pipelines, identifying the most viable method of investigation, acquiring the appropriate equipment, writing a workplan for conducting the work, determining the locations and sizes of any breaches, and transmitting the results in a report to the ERA. Work on this task was initiated in September 1991 by the Engineering Surveillance and Testing (ES&T) group within WHC. Results of the FY 1992 work were reported in the FY 1992 Site Characterization Status Report and Data Package (Rohay et al. 1992).

Figure 6. Map of Effluent Pipelines Used to Convey Carbon Tetrachloride to Disposal Sites 1955 - 1973.

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During FY 1992, ES&T determined that remote, internal closed-circuit television camera examination is the most viable method of initial investigation; conducted design and fabrication of equipment to conduct the remote examination; and completed the workplan to guide the remote camera examination of the pipelines, *Plan for Closed Circuit TeleVision (CCTV) Examination of Process Liquid Effluent Drain Lines in Support of the 200 West Carbon Tetrachloride Expedited Response Action* (WHC 1992), in September 1992.

Two highly specialized miniature color video camera systems were developed by ES&T for the in-pipe survey of lines 840 and 840D. These cameras, nicknamed "weasels", are 1-1/4 in. in diameter, 13 in. in length, and are designed to negotiate up to 45° transitions inside of 1-1/2-in.-diameter stainless steel piping. The weasel's camera optics are contained in a forward stainless steel housing, and the circuitry is contained in a separate module joined to the camera by a flexible conduit. This arrangement allows the weasels to negotiate anticipated bends in the piping. Each weasel also includes an array of eight high-intensity variable lights mounted around the camera lens. This system is light enough to be pushed through small-diameter piping for distances in excess of 700 ft, if conditions permit. Several large rolls, each containing 750 ft of 3/8-in.-diameter fiberglass pushrod material, were procured for pushing the weasel cameras through the full lengths of lines 840 and 840D. Previous in-pipe video surveys in small-diameter piping had only accomplished distances in the 200- to 300-ft range.

Three additional miniature color cameras, nicknamed "gophers", were developed for projected use in these abandoned effluent lines 1035 and 1036 from Z Plant to the 216-Z-1A and 216-Z-18 site (Figure 6). These cameras are identical to the weasel cameras except that the camera optics and circuitry are contained in one stainless steel housing. The examination of lines 1035 and 1036 was subsequently cancelled; however, one of the gopher cameras was used in line 840.

In consultation with ERA staff, it was decided that lines 840 and 840D, routed from the Recuplex facility in the 234-5Z Building to the 216-Z-9 Trench, would be the first to be examined (Figure 6). These lines are postulated to present the "worst case" for drain pipe condition because they were earliest in operation, longest in retirement, and can be accessed without requiring excavation. ES&T conducted the survey of lines 840 and 840D in February 1993. The *Final Report for the Remote CCTV Survey of the Abandoned Effluent Drain Lines 840 and 840D in Support of the 200 West Area Carbon Tetrachloride ERA* (Pedersen 1993) describes the methodology and results of an in-pipe camera survey of these two retired effluent lines.

Access to drain lines 840 and 840D was accomplished in January 1993 when a section was removed from each line in the basement of the 234-5Z Building. A small hole was drilled in each line, and the atmosphere contained within the lines was sampled for residual carbon tetrachloride and/or explosive gases. The gas tests were negative, allowing a short piece to be removed from each line. The remaining ends were threaded to accept pipe caps. The weasel cameras were pushed through the lines as far as possible with the aid of fiberglass pushrods. The images from within the lines were recorded on videotape at the control station. An encoding system was used during the survey to accurately determine the location of each weasel camera within the piping. The encoder produces a footage measurement that was recorded on the videotapes along with the camera images.

Both pipes are made up of 20-ft lengths of 1-1/2-in.-diameter, schedule 40, type 304L stainless steel piping. Each section is welded pipe (i.e., it is made from rolled plate that was longitudinally welded by the manufacturer). These 20-ft-long sections of pipe were welded together in the field.

The lines are buried and run essentially parallel to one another through their entire length. The construction drawings indicate that the pipe slope is 1% inside the 234-5Z Building. Outside, where the pipe emerges from the east side of the building, the pipe elevation is 669.5 ft. Where the pipe enters the 216-Z-9 Trench, the elevation is 656.0 ft. The pipe slope outside the 234-5Z Building is therefore approximately 1.9%. The construction drawings indicate the required minimum depth of burial was 6 ft. Because of the surface contours in the vicinity, the depth of burial is likely to vary from 6 to 10 ft along the piping route.

On February 2, a weasel camera was placed into the open end of line 840D in the 234-5Z basement. At this location, the encoding system was set to zero. All further footage distances are referenced for line 840D from this location. The exterior of the 234-5Z Building is approximately 27 in. from the zero location. Video information was obtained in line 840D for a total distance of 347.9 ft. This is approximately half of the total pipe length. At that point, the camera could not be pushed any further, apparently because the severe corrosion and inside surface roughness of the piping produced a friction load that could not be overcome.

On February 11, a second weasel camera was placed into the open end of line 840 and the encoding system set to zero. Video information was obtained for a distance of 63.3 ft. At that location, the camera lens became obscured by a thick sludge-like material in the pipe. On February 23, the weasel camera was retracted from line 840 in an attempt to clean off the lens. However, when the camera was pulled from the line several camera lights were found to be shorted out. Rather than attempt repairs to the weasel camera, a gopher camera was substituted. This camera was pushed through the line to 63 ft, at which point it too was obscured by the sludge. Contamination levels on the weasel camera withdrawn from line 840 were found to be 2.5 million disintegrations per minute (dpm) alpha by the Health Physics Technician (HPT).

The examination of abandoned carbon tetrachloride lines 840 and 840D was discontinued for ALARA and personnel safety reasons because of the high levels of contamination encountered in line 840. Cameras and cabling, along with the fiberglass pushrods, were subsequently left in the pipes. It is unclear at this time whether these materials will be permanently left inside of the abandoned pipes. At this time, there are no plans to proceed with the examination of lines 1035 and 1036.

No pipe breaks or major cracks were detected in either line 840 or 840D. However, both lines exhibited areas of severe pitting and corrosion throughout the lengths examined. Line 840 appears to be in the more deteriorated condition of the two pipes. Numerous pits are evident with apparent significant depth. However, it cannot be determined from the video footage if any of the pitting is through-wall.

4.2 INVESTIGATE SOURCE OF SECONDARY GROUNDWATER MAXIMUM

A secondary concentration maximum in the dissolved groundwater plume appears to underlie the 241-T Tank Farm, approximately 900 m north of the core of the dissolved plume (Figure 7). The primary concentration maximum, in the vicinity of Z Plant, is related to soil column discharge of carbon tetrachloride between 1955 and 1973. The objective of this task was to investigate the source of this secondary maximum. Research and evaluation of historical waste management practices, interpreted using chemical and engineering process knowledge, was conducted by the WHC Waste Characterization Analysis group and reported in an internal WHC memo. The following is a brief summary of that work.

Prior to May 1973, aqueous and organic liquid wastes containing carbon tetrachloride were intermittently discharged from Z Plant to the soil column through cribs in the vicinity of Z Plant. After discharge to these disposal facilities ceased in May 1973, the organic solvent was either recycled within the PRF at Z Plant or loaded out in drums. Although routine solvent discharges from PRF ceased, an aqueous waste stream continued to be generated.

All of the liquid waste discharged (through pipes) from PRF after May 1973 was aqueous and sent to the 242-T evaporator for blending, treatment, temporary storage, and/or volume reduction. However, most of this aqueous waste had been in intimate contact with the PRF organic solvent and thus was saturated with carbon tetrachloride. The waste did not contain a separate organic solvent phase.

The 242-T evaporator was a pot boiler powered by steam. The steam condensate joined the condensed overhead and was sent exclusively to the 216-T-19 Crib throughout the operating history of the evaporator, including the period from January 1966 to April 1976 (Figure 7).

Because of a component failure in 1976, the 242-T evaporator was shut down for repairs. In light of the fact that the 242-A evaporator (with an order-of-magnitude larger capacity) would be coming on line in 1977, repairs to the 242-T evaporator were postponed indefinitely. From 1976 until 1980, acidic Z Plant waste was blended in the 242-T evaporator feed system tanks, but was evaporated by either the 242-A or 242-S evaporator.

As long as the 242-T evaporator feed system tanks were in use, the 216-T-19 Crib was needed to accept any drainage from the vessel vent system at the 242-T evaporator complex. In 1980, a new underground vessel was installed near 242-T and began operation in 1981, eliminating the need for any portion of the 242-T evaporation system. The dilute waste was subsequently sent to the 242-A evaporator. In 1980, the 216-T-19 Crib became inactive.

In an aqueous evaporation process, the carbon tetrachloride reports to the overhead essentially quantitatively. Therefore, the mass of carbon tetrachloride that was discharged to the soil at the 216-T-19 Crib can be estimated as equal to all dissolved carbon tetrachloride transferred from Z Plant to 242-T for evaporation during the 3-year period from May 1973 to April 1976.

Figure 7. Location of Secondary Groundwater Maximum and 216-T-19 Crib.

A total of 460,000 gal of carbon tetrachloride-saturated waste was sent to the 242-T evaporator from May 1973 to April 1976. The solubility of carbon tetrachloride in the Z Plant aqueous waste is conservatively estimated to be the solubility in water, which is 800 ppm. Using these figures, the amount of carbon tetrachloride in the waste sent to the 242-T evaporator is estimated to be 3,100 lb, or 1.4 metric tons.

- The 242-A evaporator has processed a considerable amount of PRF waste since its startup in 1977. The 242-S evaporator may also have been used to evaporate PRF effluents. If the mode of carbon tetrachloride groundwater contamination described above is correct, additional plumes might be expected in the vicinities of these evaporators.

4.3 ESTIMATE VAPOR FLUX FROM SOILS

The EMFLUX soil-gas collection system is a passive, surface-based system owned and operated by Quadrel Services, Inc., of Ijamsville, Maryland (Quadrel). This system employs a variety of sorbent collectors, depending on the nature and number of target contaminants. Once retrieved, the contaminants are thermally desorbed from the sorbent collectors and analyzed using a gas chromatograph/mass spectrometer. The results are used to calculate a flux rate out of the soil for each contaminant. The field sampling period for deployment of the EMFLUX system is selected based on Quadrel's belief that gravitational forces, which produce earth tides, are the primary forces governing changes in vertical gas-migration rates.

The FY 1993 sampling locations (Figure 8) were selected by WHC to expand on a similar, but more limited, EMFLUX survey conducted in FY 1992 in the vicinity of the 216-Z-9 Trench (Last and Rohay 1993). The primary period of sample collection, July 28 to July 31, 1993, was selected by Quadrel as the optimal time for sampling based on the predicted earth-tide effects. A report on the EMFLUX soil-gas survey was prepared by Quadrel and is included as Appendix A.

WHC deployed the EMFLUX sampling devices provided by Quadrel at 34 sample locations on July 28, 1993 (Figure 8). Only standard site preparation activities were required, which entailed clearing a small area of the soil (30-cm diameter) free from loose organic debris and near-surface rocks, which required removal of the top 2 to 3 cm of soil. A small wire hanger was then inserted in the soil surface and the sorbent collector hung just above the soil. A stainless steel container was then placed over the sorbent collector and wire hanger and forced into the top soil to a depth of approximately 2 cm.

After the EMFLUX devices were retrieved by WHC on July 31, 1993, they were shipped to Quadrel for analysis at Quadrel's contract laboratory. The sorbent collectors were analyzed for the EPA Target Compound List of contaminants. Laboratory procedures included standards, surrogates, and blanks appropriate to the modified EPA Method 8240 used by the laboratory to analyze the collectors. The collectors were delivered to the laboratory on August 9; Quadrel received the laboratory report on August 11, 1993.

Figure 8. Location of EMFLUX Soil-Gas Vapor Collection Sites.

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Laboratory results were expressed in nanograms of specific contaminant recovered per collector. These results were converted to average emission flux rates, using the subtended area of the stainless steel container and the period of exposure for each sample. The final values, expressed in nanograms per square meter per minute ($\text{ng}/\text{m}^2/\text{min}$), are listed in Table 2. (NOTE: No emission flux values were computed for methylene chloride because laboratory contamination is suspected for this contaminant and Quadrel believes that all measurements of this compound should be disregarded).

Carbon tetrachloride was detected at 25 of the 34 sample locations (Table 2). The highest emission rate ($251.7 \text{ ng}/\text{m}^2/\text{min}$) was found at location 7, on the west side of the 216-Z-9 Trench. Samples locations 2 and 3, approximately 275 ft north of the trench, also exhibited high emission rates (188.0 and $186.1 \text{ ng}/\text{m}^2/\text{min}$, respectively). Low-level tetrachloroethane (PCE) emissions were observed at 8 of the 34 sample locations. Acetone, toluene, and/or xylene were also detected at low levels at a few locations. Chloroform was below reported quantitation levels in every one of the 34 samples.

4.4 CONDUCT GEOPHYSICAL SURVEYS

Multiple surface geophysical techniques were used at the carbon tetrachloride site to support a demonstration of a data fusion workstation being developed by Coleman Research Corporation (Coleman Research). The statistical technique utilized by the workstation performs best when data points have relatively uniform areal extent such as obtained with geophysical techniques. The target of the copious existing Hanford geophysical surveys was the basalt basement and deeper horizons and thus, for the suprabasalt sediments, this type of data is lacking. Therefore, the Blackhawk Geosciences division of Coleman Research (Blackhawk) conducted a series of preliminary surface geophysical surveys targeting the suprabasalt sediments to collect data for testing the workstation. As such, this work does not constitute a test of the applicability or usefulness of these techniques for use on the Hanford Site to delineate subsurface horizons.

Testing and data collection was conducted in accordance with the *Integrated Test Plan for Demonstration of Surface Geophysics at the VOC-Arid ID Host Site* (WHC 1993a). Data was collected in two phases. An initial test phase was conducted from December 10 to 16, 1992, to evaluate techniques and equipment for use at the carbon tetrachloride site. The following techniques were used during the testing phase: seismic refraction, seismic reflection, frequency domain electromagnetics (FDEM), time domain electromagnetics (TDEM), direct current (D.C.) resistivity, induced polarization (IP), and ground-penetrating radar (GPR). All data were collected by Blackhawk with the exception of the GPR data, which were collected by WHC.

The test results for TDEM were ambiguous, apparently due to the presence of near-surface metal scrap. Therefore, this technique, although reasonably powerful, was not included in the final survey. Although GPR can be an excellent technique for delineating very near-surface features, especially when combined with shallow FDEM, it was not included because this method has

Table 2. EMFLUX Emission Flux Rates.

Sample location	Contaminants (ng/m ² /min)				
	Acetone	Carbon tetra-chloride	Tetrachloro-ethene	Toluene	Xylene
1	--	34.4	--	--	--
2	--	188.0	--	--	--
3	--	186.1	1.2	1.1	--
4	--	128.5	1.5	1.0	--
5	--	181.7	2.6	--	--
6	3.5	4.0	--	--	--
7	--	251.7	1.4	--	--
8	--	111.2	5.2	--	--
9	--	96.1	3.9	--	--
10	3.0	--	--	1.8	--
11	--	8.6	--	--	--
12	--	106.2	2.1	1.4	--
13	--	12.5	--	--	--
14	--	145.4	5.6	--	--
15	--	32.8	--	--	--
16	--	18.5	--	--	--
17	--	--	--	--	--
18	--	69.6	--	--	--
19	--	19.9	--	--	--
20	2.0	12.6	--	1.7	1.4
21	--	5.0	--	--	--
22	1.9	17.5	--	--	--
23	--	--	--	--	1.1
24	--	2.0	--	--	--
25	--	--	--	--	--
26	--	--	--	--	--
27	--	--	--	--	--
28	--	--	--	--	--
29	--	1.4	--	--	--
30	--	--	--	--	--
31	--	--	--	--	--
32	--	2.2	--	--	--
33	--	2.8	--	--	--
34	2.6	3.5	--	--	--

NOTE: "--" denotes value below the reported quantitation level.

very shallow penetration (generally <20 ft) at the Hanford Site. To demonstrate the abilities of the data fusion technique, it is better if the data sets are all sampling the same horizons. Results of the IP survey are not yet available.

Based on results of the test phase, four techniques were chosen for the production survey conducted from February 10 to March 8, 1993. Seismic reflection, seismic refraction, and FDEM were collected along survey lines 1, 2, 3, and 4, while D.C. resistivity was collected across the lines (Figure 9).

The seismic reflection and refraction surveys resulted in the most useful data to demonstrate the data fusion process. An example of the seismic reflection data collected during a noise walkaway is shown in Figure 10. Examples of the results of the refraction surveys and the D.C. resistivity surveys are shown in Figures 11 and 12, respectively. Sets of geophysical data such as these are being interpreted by Coleman Research using data fusion modeling. The results of this demonstration with a limited interpretation will be included in a separate publication.

4.5 CONDUCT BOREHOLE GEOPHYSICAL LOGGING

Borehole geophysical logging using a gross gamma ray logging tool was conducted in support of the ERA and VOC-Arid ID site characterization between February 9 and July 23, 1993. This work was performed according to WHC-CM-7-7, EII 11.1, Rev. 2, Appendix A, "Gross Gamma Ray Logging" (WHC 1989). A total of seven wells were logged during FY 1993. Each well was logged after placement of successive temporary casing strings. The well numbers, depth intervals, dates, and any zones of gamma activity >200 cps are listed in Table 3.

Wells 299-W18-96 and 299-W18-174 were drilled through cribs used for disposal of radioactive wastes. The zones of high gamma activity in these wells are likely due to the presence of manmade radionuclides within the cribs. All other wells showed no evidence of contamination.

4.6 REMEDIATE WELLS

Four wells at the 216-Z-9 Trench were remediated on April 27, 1993, for use as vapor extraction wells. All four wells are 8-in.-diameter carbon steel wells that are open at the bottom. The perforated interval in each well consists of four equally spaced (every 90°) vertical, 15-ft-long rows of perforations. There are six perforations per foot. Each perforation is 5/8 in. by 3/8 in. The following perforated intervals are given in depths relative to the ground surface:

<u>Well Number</u>	<u>Perforated Interval</u>
299-W15-84	75 to 90 ft
299-W15-82	73 to 88 ft
299-W15-85	83 to 98 ft
299-W15-95	83 to 98 ft

Figure 9. Map of Survey Lines Used for Geophysical Data Collection at the Carbon Tetrachloride Site During FY 1993.

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Figure 10. Seismic Reflection Raw Data. The horizontal axis is distance in feet and the vertical axis is two-way travel time in milliseconds. The source is at the origin and the geophones are 2.5 ft apart. The arrows with the labels indicate the possible caliche reflector and high amplitude interfering noise. The data were collected with an analog 100 Hz lowcut filter.

Figure 11. Results of Refraction Survey Using a High-Resolution Rollalong Method of Data Acquisition. The horizontal axis is distance along line 4 (Figure 9). The upper graph displays the time picks from the data, the middle graph shows the results in depth from the surface, and the lower display is a model of the subsurface velocity structure.

Figure 12. Results of the D.C. Resistivity Survey. The results of the D.C. resistivity survey are plotted on the left of this diagram while the interpreted resistivity model is shown on the right with the depth interval given in meters.

Table 3. Results of Gross Gamma Logging at ERA/VOC-Arid ID Boreholes.

Well number	Depth interval (ft)	Date	Gamma activity zones >200 cps
299-W15-218	38.6 - 4.0	February 9, 1993	None
299-W15-218	117.1 - 2.6	February 25, 1993	None
299-W15-218	205.1 - 80.0	March 19, 1993	None
299-W18-96	148.7 - 1.7	March 1, 1993	33 - 35 ft
299-W18-174	130.8 - 3.1	April 9, 1993	46 - 47 ft
299-W15-219	34.9 - 4.5	April 26, 1993	None
299-W15-219	118.1 - 2.4	May 6, 1993	None
299-W15-219	209.8 - 80.0	May 25, 1993	None
299-W18-252	39.0 - 4.5	May 5, 1993	None
299-W18-252	137.5 - 3.3	May 21, 1993	None
299-W18-252	227.0 - 100.0	June 11, 1993	None
299-W15-220	38.8 - 4.7	June 8, 1993	None
299-W15-220	110.5 - 3.6	June 21, 1993	None
299-W15-220	199.7 - 80.0	July 23, 1993	None
299-W11-32	156.5 - 2.6	June 9, 1993	None

The U.S. Army Corps of Engineers performed well location and elevation surveys during FY 1993. Field work was performed from September 1992 to May 8, 1993. The results were issued in three reports. The phase one report was issued on December 16, 1992; the phase two report was issued on February 24, 1993; and the phase three report was issued on August 1, 1993. Selected results covering wells of interest for the carbon tetrachloride site are given in Appendix H.

Wells 299-W18-96 and 299-W18-174 were deepened this year after they were surveyed by the U.S. Army Corps of Engineers. The existing well casings were altered during completion. Thus, the U.S. Army Corps of Engineer elevations for these two wells are no longer correct, because they were measured to top of casing.

4.7 MEASURE WATER LEVELS

Groundwater levels were measured in two wells every 30 min during a 3-wk period that included the interval of EMFLUX sample collection (Section 4.3) in July and August. A transducer was installed to record water levels in well 299-W15-6 from July 15 to August 9 and in well 299-W15-4 from July 19 to August 9. Preliminary review of the data (Figure 13) indicates that the recorded water level fluctuations are similar in both wells and that the water level varied by as much as 0.5 ft during this period. Barometric pressure was measured using a barometric pressure transducer installed at well 299-W15-6.

4.8 DRILL AND SAMPLE CRIB BOREHOLES AND VAPOR EXTRACTION WELLS

Six unsaturated zone monitoring/vapor extraction wells were drilled between February and August 1993 (Figure 14). Two of these (299-W18-96 and 299-W18-174) were existing wells, located in disposal cribs, that were deepened and completed with a screen above the Plio-Pleistocene unit. The other four new wells (299-W15-218, 299-W15-219, 299-W15-220, and 299-W18-252), located in the vicinity of disposal cribs, were drilled approximately 5 ft (1.5 m) into the saturated zone, sampled for groundwater, backfilled into the unsaturated zone, and completed with dual screens, one above and one below the potentially perching Plio-Pleistocene unit. All wells were drilled with the cable tool method. Well construction details are summarized in Table 4.

One well, 299-W15-220, penetrated perched water. Approximately 2.9 ft of water is perched on caliche within the Plio-Pleistocene unit. The water was sampled and analyzed, and the well was constructed to prevent the perched water from penetrating the perching unit. The 219-Z-21 Trench is the suspected source of the perched water.

Borehole logs are included in Appendix C. These logs, along with the borehole logs from FY 1992 drilling, were used to prepare cross sections of the ERA site. These cross sections are included in Appendix D. Certain aspects of the FY 1992 logs have been re-interpreted. In particular, the unit that was classified as early Palouse soil in previous studies (Tallman et al. 1979, Bjornstad 1984, DOE 1988, Last et al. 1989) was found to commonly consist of laminated and interbedded silt and sand. Lithologies such as these are more typical of the sand-dominated and silt-dominated facies of the Hanford formation rather than the massive bedded, loess-dominated early Palouse soil. Consequently, these interbedded sands and silts are reassigned to the Hanford formation.

During drilling and completion of all wells, HPTs performed periodic field screening for alpha and beta/gamma radiation, using a proportional alpha monitors (PAM) and Geiger-Mueller counters with P-11 probes (GM) respectively.

During drilling and completion of each well, a Site Safety Officer (SSO) performed periodic field screening to detect and monitor hazardous conditions. The SSO screened at the wellhead for VOCs using a photoionization detector (PID), carbon tetrachloride using colorimetric tubes, and combustible gasses using a combustible gas analyzer (CGA). The SSO also screened wet cuttings for pH. Work was performed under protection levels B or D as directed by the SSO. Complete field screening data are included in Appendix D.

Figure 13. Water Level and Barometric Pressure Data in Wells 299-W15-4 and 299-W15-6.

Figure 14. Location of FY 1993 ERA and VOC-Arid ID Boreholes.

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Table 4. Summary of FY 1993 Well Construction Details.

Well number	Plant coordinates		Outer casing elevation (ft)	Pad elevation (ft)	Total depth (ft)	Completed depth (ft)	Depth to water (ft)	Well diameter (in.)	Screened interval (ft)	Date completed
	North	West								
299-W18-96	38825	76970	682.62 ^a	NA	149.2	132.31	NA	2	122.29-131.88	March 3, 1993
299-W18-174	39117	76565	672.03 ^a	NA	131.5	126.45	NA	4	106.45-126.45	
299-W18-252	39269.16	76930.99	681.98	680.59	228.5	210.3	215.83	4	113.24-133.21 165.13-185.00	August 6, 1993
299-W15-218	40026.78	75865.91	668.35	665.36	206.1	195.3	198.97	4	98.5-113.5 180.4-195.3	April 28, 1993
299-W15-219	40003.71	76004.2	669.58	668.02	212	182.5	201.6	4	87.2-102.2 167.2-182.2	July 16, 1993
299-W15-220	39886.06	75656.57	660.28	657.73	201	185.3	191.58 ^b	4	80-95.10 170.02-185.3	August 25, 1993

NA = not applicable.

^aElevation of inner casing.^bPerched water encountered at 106.10 ft.

The Well Site Geologist performed periodic field screening with an Organic Vapor Monitor (OVM) to characterize occurrences of VOCs. These field screening results are included in Appendix D. The OVM is a particular brand of PID, and in the text of this report, both the SSO's and geologist's screening results are referred to as PID results. In Appendix D, the screening results are called out according to instrument and sampling method.

The geologist also collected soil-gas samples with the SEAMIST (tradename of Eastman Cherrington Environmental, Santa Fe, New Mexico) soil-gas sampling system. These soil-gas samples were screened with an OVM and analyzed with a gas chromatograph with an electron capture detector (GC/ECD). Results of soil-gas sampling are included in Appendix F.

Barometric pressure has a strong influence on venting and detection of carbon tetrachloride and other VOCs. High downhole pressures have been measured with the SEAMIST air permeability apparatus during periods of low barometric pressure. Boreholes vent VOCs freely under these conditions, and VOCs are detected readily at the wellhead during low pressure periods. Negative downhole pressures have been measured during periods of high barometric pressure. Atmospheric air enters the formation through well screens under these conditions. This borehole effect dilutes soil-gas concentrations and diminishes wellhead detection of VOCs. Thus, detected concentrations or non-detections may not indicate equilibrium conditions and accurate VOC concentrations in the vicinity of the sampling point.

4.8.1 Well 299-W18-96

Well 299-W18-96, located in the 216-Z-18 Crib, is an existing well that was deepened to the Plio-Pleistocene unit (Figure 14). This well was initially drilled to 83 ft in 1972, with 6-in.-diameter carbon steel casing advanced to 80 ft, beneath the zone of field-detectable radioactive contamination. A bentonite slurry plug was set from 76.3 to 83 ft. Drilling this year commenced on February 10. The well was completed on March 5.

The well was drilled to a total depth of 149.2 ft. No water was encountered during drilling. From 83 to approximately 104 ft, the borehole penetrated sands assigned to the Hanford formation fine unit. From 104 to 124 ft, the sands grade into gravels of the Hanford formation lower coarse unit, which extend to 127.9 ft. At 127.9 ft, there is a sharp contact with interbedded silt and sandy silt (sand-dominated and silt-dominated facies) assigned to the Hanford formation lower fine unit. Minor silty gravel occurs at 129.5 to 131 ft. Silt, tentatively correlated to the early Palouse soil, is found at 137 ft. This silt overlies the pedogenic calcium carbonate rich Plio-Pleistocene unit, with a sharp contact at 146.6 ft.

No elevated alpha or beta/gamma radiation was detected with field screening instruments while drilling and completing well 299-W18-96.

Significant concentrations of carbon tetrachloride and/or VOCs were detected at 124 and 149 ft. At 124 ft, PID results indicated up to 92 ppm VOC, colorimetric tube results indicated >60 ppm carbon tetrachloride, and a GC/ECD analysis of wellhead vapor indicated 98 ppm carbon tetrachloride. PID and GC/ECD analyses of a soil-gas sample collected at total depth (149.15 ft) indicated 55 ppm VOC and 23 ppm carbon tetrachloride respectively.

Complete field screening data are included in Appendix D. Complete soil-gas results are included in Appendix E.

Five-inch threaded temporary casing was advanced to 146.7 ft, 0.1 ft into the Plio-Pleistocene unit. The borehole was advanced 2.6 ft into the Plio-Pleistocene. The borehole was backfilled with bentonite to a depth of 134.9 ft. A 2-in.-diameter stainless steel permanent well casing was installed to a completed depth of 132.31 ft, with a .020 slot louvered stainless steel screen set from 122.29 to 132.31 ft. The screened interval was chosen to straddle the Hanford formation lower coarse/lower fine unit contact. Filter pack was installed from 118.95 to 134.9 ft. A bentonite annular seal was installed from 10.0 to 118.95 ft.

The existing 6-in. carbon steel casing penetrated a high radiation zone. WHC planned to leave this casing in place to minimize worker exposure to radiation. Ecology agreed and granted a variance prior to commencement of drilling. The bentonite annular seal was installed between this casing and the 2-in.-diameter permanent casing up to 10.0 ft. A portland cement surface seal was installed from ground surface to 10.0 ft between the 2-in. stainless steel casing and 6-in. casing.

4.8.2 Well 299-W18-174

Well 299-W18-174, located in the 216-Z-1A Crib, is an existing well that was deepened to the Plio-Pleistocene unit (Figure 14). This well was initially drilled to 49.5 ft in 1977, with 8-in. carbon steel casing advanced to 47 ft, beneath the zone of field-detectable radioactive contamination. A portland cement grout plug was set from 47.3 to 49.5 ft. Drilling this year commenced on March 17. The well was completed on April 26.

The well was drilled to a total depth of 131.5 ft. No water was encountered during drilling. From 49.5 to approximately 84.5 ft, the borehole penetrated sands assigned to the Hanford formation fine unit. The sand overlies sandy gravel of the Hanford formation lower coarse unit, which is 22.5 ft thick. At 107 ft, there is a sharp contact with interbedded silt and sandy silt (sand-dominated and silt-dominated facies) assigned to the Hanford formation lower fine unit. Silt, tentatively correlated to the early Palouse soil, is found at 119.5 ft. This silt overlies the pedogenic calcium carbonate rich Plio-Pleistocene unit, with a sharp contact at 130 ft.

HPTs performed periodic field screening for alpha and beta/gamma radiation, using a PAM and GM respectively. At 48.0 ft, 700 dpm alpha radiation was detected on the drilling tools while drilling out the existing concrete plug. Laboratory analysis confirmed the presence of 1,920 pCi/g americium-241, 40 pCi/g neptunium-237, 34.7 pCi/g protactinium-233, and <0.66 pCi/g cesium-137 (Appendix F). No elevated alpha or beta/gamma radiation was detected below the 49-ft depth while drilling well 299-W18-174.

Field screening with a colorimetric tube at 90 ft indicated >60 ppm carbon tetrachloride. Lesser concentrations (3 to 20 ppm) were detected at various depths from spoils, headspace sample, and wellhead screening with a PID or colorimetric tube. Complete field screening data are included in Appendix D.

During the drilling and sampling of 299-W18-174, the 216-Z-1A vapor extraction system was operating. Wells that were within 125 ft (estimated radius of influence) were disconnected from the extraction system for the duration of drilling. A comparison of the extraction system operating schedule and monitoring results while drilling show that the extraction system operation had no influence on VOC concentrations at the borehole.

No soil-gas samples were collected in well 299-W18-174 due to potential radionuclide contamination.

Six-inch threaded temporary casing was advanced to 129.0 ft, 1 ft above the Plio-Pleistocene unit. The borehole was advanced 1.5 ft into the Plio-Pleistocene. The borehole was backfilled to the top of the Plio-Pleistocene unit with bentonite. A 4-in.-diameter stainless steel permanent well casing was installed to a completed depth of 126.45 ft, with a .020 slot louvered stainless steel screen set from 106.45 ft to 126.45 ft. This interval was chosen to straddle the contact of the lower fine unit of the Hanford formation (interbedded sands and silts) and the underlying silt unit (tentatively correlated to the early Palouse soil). Filter pack was installed from 106 to 130 ft. A bentonite annular seal was installed from 18.3 to 106 ft.

The existing 8-in. carbon steel casing penetrated a high radiation zone. WHC planned to leave this casing in place to minimize worker exposure to radiation. Ecology agreed and granted a variance prior to commencement of drilling. The bentonite annular seal was installed between this casing and the 4-in.-diameter permanent casing up to 18.3 ft. A portland cement surface seal was installed from ground surface to 18.3 ft between the 4-in. stainless steel casing and 8-in. casing. A portland cement surface seal was installed from ground surface to 18.3 ft between the 4-in. stainless steel casing and the 8-in. casing.

4.8.3 Well 299-W15-218

Well 299-W15-218 is located approximately 45 m north of the 216-Z-9 Crib (Figure 14). This well was started on February 3 and completed on April 28, 1993.

Well 299-W15-218 was drilled to a depth of 206.1 ft. Static water level (SWL) was measured at 198.97 ft. From ground surface to 7.5 ft, the borehole penetrated fill and reworked eolian sand. Undisturbed Holocene eolian sand extended from 7.5 to 13.5 ft. The contact between the Holocene deposits and underlying Hanford formation is at 13.5 ft.

The uppermost Hanford formation strata in the borehole are the gravelly and slightly gravelly sands of the upper fine unit extending from 13.5 to 22 ft. Underlying the upper fine unit are generally open framework gravels and minor interbedded sands typical of the gravel-dominated facies. These deposits comprise the upper coarse unit which extends from 22 to 54.5 ft. Well stratified sand and minor gravel of the sand-dominated or transitional facies comprising the Hanford formation fine unit are found between 54.5 and 107 ft. From 107 to 115 ft, interstratified deposits of the sand-dominated and silt-dominated facies occur, forming the lower fine unit. The borehole intersected a clastic dike intermittently from 52.5 to 57 ft. The base of the Hanford formation occurs at 115 ft.

Five feet (from 115 to 120 ft) of the calcium carbonate rich Plio-Pleistocene unit underlies the Hanford formation. Carbonate in this interval consists of interstitial cement overprinted on gravelly sands. The lowermost interval penetrated in the borehole consists of the consolidated to cemented, massive to stratified, pebble to cobble gravel and minor sand of Ringold Formation unit E. These gravels extend to total depth at 206.1 ft. A sand interval occurs within these gravels at 136 to 149 ft.

No elevated alpha or beta/gamma radiation was detected while drilling and completing well 299-W15-218.

The GPR survey performed prior to drilling delineated the location of buried construction debris in the vicinity of well 299-W15-218. Also, fragments of asbestos-bearing transite pipe were found near this location. Because of the potential presence of buried asbestos, all cuttings from the top 25 ft of the borehole were contained and screened for asbestos-containing materials. The Hanford Environmental Health Foundation laboratory determined that a pipe fragment found at 6 to 7.5 ft consisted of transite. Kaiser Engineers Hanford (KEH) disposed of all suspect cuttings as asbestos-contaminated materials.

Significant concentrations of carbon tetrachloride and/or VOCs were detected throughout borehole advancement. Concentrations of >10 ppm were detected from 11 to 190 ft with field screening instruments. From 100 to 120 ft, VOC concentrations of approximately 150 to 500 ppm were detected. GC/ECD analyses of two soil-gas samples collected at 111.8 ft indicated 16,660 and 20,910 ppm carbon tetrachloride. GC/ECD analyses of soil-gas samples collected at 178.5 and 191 ft indicated 778 and 10,380 ppm carbon tetrachloride respectively. Complete field screening data are included in Appendix D. Complete soil-gas results are included in Appendix E.

A 16-in. temporary welded casing was installed to a depth of 38.87 ft. A 12-in. temporary welded casing was set at 118.1 ft, 3.1 ft into the potentially perching Plio-Pleistocene unit. The borehole was advanced to a total depth of 206.1 ft, approximately 7 ft below SWL. An 8-in. threaded temporary casing was advanced to 205.04 ft. After a groundwater sample was collected, the borehole was backfilled through the saturated zone with sand and a bentonite plug was installed from 197.1 to 198.8 ft. A 4-in. stainless steel permanent well casing was installed to a completed depth of 195.7 ft, with two louvered .020 slot screened intervals from 180.4 to 195.3 ft and from 98.5 to 113.5 ft. Filter packs were installed from 174.9 to 197.1 ft and from 97.9 to 115.0 ft.

Three pressure transducer vent lines, consisting of 1/8-in.-diameter stainless steel tubing, were strapped to the exterior of the permanent well casing during completion. These were open ended, terminating at 85.5, 124, and 152 ft. Each open tube end was filter packed with approximately 3 ft of filter pack to provide continuity with the formation.

The transducer tube and screen filter packs were isolated from each other by installing portland cement grout annular seals and bentonite annular seals between the filter packs. A portland cement grout annular seal was also installed across the Plio-Pleistocene unit to prevent contaminant transport across the confining unit.

The cement grout lifts were installed through a tremie pipe. The tremie pipe was dropped as it was being lowered into the borehole annulus for installation of the Plio-Pleistocene seal. During retrieval of the broken tremie, the two lower transducer vent lines were inadvertently broken. A downhole camera survey verified the successful retrieval of the broken tremie pipe and the location of the breaks in the transducer tubes. The cement grout and bentonite annular seals were installed at depths to seal the broken transducer tubes.

A bentonite annular seal was installed from 10.5 ft to the top of the upper transducer cement grout seal at 72.8 ft. A cement grout seal was installed from ground surface to 10.5 ft. The upper ends of the two destroyed tubes were sealed in this grout lift. A locking cover, concrete surface pad, and protective posts were installed at the wellhead.

An inflatable packer will be installed between the two screened intervals to prevent migration of gaseous phase contamination through the well bore.

4.8.4 Well 299-W15-219

Well 299-W15-219 is located approximately 30 m north west of the 216-Z-9 Crib (Figure 14). This well was started on April 20 and completed on July 16, 1993.

Well 299-W15-219 was drilled to a depth of 212.0 ft. SWL was measured at 201.6 ft. From ground surface to 6.0 ft, the borehole penetrated fill and reworked eolian sand. Undisturbed Holocene eolian sand extended from 6.0 to 13.0 ft. The contact between the Holocene deposits and underlying Hanford formation is at 13.0 ft.

The uppermost Hanford formation strata in the borehole are the gravelly and slightly gravelly sands of the upper fine unit, extending from 13.0 to 20.5 ft. Underlying the upper fine unit are generally open framework gravels and minor interbedded sands typical of the gravel-dominated facies. These deposits comprise the upper coarse unit, which extends from 20.5 to 44.5 ft. Well stratified sand and minor gravel of the sand-dominated or transitional facies comprising the Hanford formation fine unit are found between 44.5 and 107.8 ft. From 107.8 to 119.5 ft, interstratified deposits of the sand-dominated and silt-dominated facies occur, forming the lower fine unit. This unit contains poorly developed carbonate stringers from 116.5 to 119.5 ft. The base of the Hanford formation occurs at 119.5 ft.

A carbonate-rich sandy gravel, correlated with the Plio-Pleistocene unit, extends from 119.5 to 121 ft. Carbonate in this interval consists of interstitial cement binding the gravel. The Hanford formation lower fine unit and underlying Plio-Pleistocene unit are damp to wet from approximately 112 to 121 ft, although not saturated. The lowermost interval penetrated in the borehole consists of the consolidated to cemented, massive to stratified, pebble to cobble gravel and minor sand of Ringold Formation unit E. These gravels extend to total depth at 212.0 ft.

No elevated alpha or beta/gamma radiation was detected while drilling and completing well 299-W15-219.

Because of the potential presence of buried asbestos, all cuttings from the top 25 ft of the borehole were contained and screened for asbestos-containing materials. A fragment of suspected transite pipe was encountered at 5 ft. KEH disposed of all suspect cuttings as asbestos-contaminated materials.

Significant concentrations of carbon tetrachloride and/or VOCs were detected throughout borehole advancement. Concentrations of >10 ppm were detected from 36 to 184 ft with field screening instruments. From 70 to 76 ft, VOC concentrations of approximately 15 to 150 ppm were detected. From 87 to 92 ft, VOC concentrations of approximately 50 to 120 ppm were detected. From 117 to 137 ft, VOC concentrations of approximately 20 to 200 ppm were detected. From approximately 160 to 180 ft, VOC concentrations of >60 ppm were detected with colorimetric tubes. Complete field screening data are included in Appendix D.

The PNL BoreSampler, an in situ soil-gas sampling device, was field tested in accordance with the test plan (WHC 1993b) while drilling well 299-W15-219. The results of this test will be contained in a separate report. SEAMIST sampling was not performed at 299-W15-219.

A 16-in. temporary welded casing was installed to a depth of 35.57 ft. A 12-in. temporary welded casing was set at 120.11 ft, 3.5 ft into the potentially perching Plio-Pleistocene unit. The Hanford formation lower fine unit and the Plio-Pleistocene unit were damp to wet, but no free water accumulated in the borehole. The borehole was advanced to a total depth of 212.0 ft, 10.4 ft below SWL. A 10-in. threaded temporary casing was advanced to 210.00 ft. After a groundwater sample was collected, the borehole was backfilled through the saturated zone with sand and a bentonite plug was installed from 187.2 to 201.9 ft. A 4-in. stainless steel permanent well casing was installed to a completed depth of 182.5 ft, with two louvered .020 slot screened intervals from 167.2 to 182.2 ft and from 87.2 to 102.2 ft. Filter packs were installed from 166.8 to 187.2 ft and from 84.3 to 104.2 ft.

Three pressure transducer vent lines, consisting of 1/8-in.-diameter stainless steel tubing, were strapped to the exterior of the permanent well casing during completion. These were open ended, terminating at 66.7, 126.7, and 152.2 ft. Each open tube end was filter packed with approximately 3 to 4 ft of filter pack to provide continuity with the formation.

The transducer tube and screen filter packs were isolated from each other by installing portland cement grout annular seals and bentonite annular seals between the filter packs. A portland cement grout annular seal was also installed across the Plio-Pleistocene unit to prevent contaminant transport across the confining unit.

The cement grout lifts were installed through a tremie pipe. Because of a miscalculation of the temporary casing depth, the drive shoe of the 10-in. casing was cemented in the grout lift above the lower screen at 159 ft. Before this error was discovered, the lower transducer line was sheared off and pinched shut while trying to pull the cemented in casing. The 10-in. drive shoe was freed by lowering an 8-in. casing string between the 10-in. string and the 4-in. permanent casing, and breaking up the cement bridge by driving the 8-in. casing with a 2,100-lb casing hammer. A downhole camera survey inside the permanent stainless steel casing indicated that the

permanent casing had bulged, but had not split, at 157 to 158 ft while trying to pull the cemented 10-in. casing. A downhole camera survey run in the annulus indicated that the upper two transducer lines were intact and that the lower line was pinched shut at its lower end. A replacement transducer line was attached to a stainless steel weight and lowered to 152.2 ft.

A bentonite annular seal was installed from 9.3 ft to the top of the upper transducer cement grout seal at 57.0 ft. A cement grout seal was installed from ground surface to 9.3 ft. The upper end of the destroyed transducer tube was sealed in this grout lift. A locking cover, concrete surface pad, and protective posts were installed at the wellhead.

An inflatable packer will be installed between the two screened intervals to prevent migration of gaseous phase contamination through the well bore.

4.0.5 Well 299-W18-252

Well 299-W18-252 is located approximately 65 m west of the 216-Z-1A Tile Field and 105 m north of the 216-Z-18 Crib (Figure 14). This well was started on May 3 and completed on August 6, 1993.

Well 299-W18-252 was drilled to a depth of 228.5 ft. SWL was measured at 215.83 ft. From ground surface to 5 ft, the borehole penetrated fill and Holocene eolian sand. The contact between the Holocene deposits and underlying Hanford formation is at 5 ft.

The uppermost Hanford formation strata in the borehole are the gravelly and slightly gravelly sands of the upper fine unit, extending from 5 to 11.5 ft. Underlying the upper fine unit are gravels and interbedded sands of the gravel-dominated facies. These deposits comprise the upper coarse unit, which extends from 11.5 to 51 ft. Well stratified sand and minor gravel of the sand-dominated or transitional facies comprising the Hanford formation fine unit are found between 51 and 101 ft. Sandy gravel of the Hanford formation lower coarse unit extends from 101 to 125 ft. From 125 to 137.5 ft, interstratified deposits of the sand-dominated and silt-dominated facies occur, forming the lower fine unit. The lower fine unit silty sands at 137 ft were very moist, although not saturated. The base of the Hanford formation occurs at 137.5 ft.

Two feet (from 137.5 to 139.5 ft) of the calcium carbonate rich Plio-Pleistocene unit underlies the Hanford formation. Carbonate in this interval consists of lenticular carbonate stringers in sandy gravel. The lowermost interval penetrated in the borehole consists of the consolidated to cemented, massive to stratified, pebble to cobble gravel, sand, and silty gravels of Ringold Formation unit E. These gravels extend to total depth at 228.5 ft.

No elevated alpha or beta/gamma radiation was detected while drilling and completing well 299-W18-252.

Minor concentrations of carbon tetrachloride and/or VOCs were detected throughout advancement of this borehole. Concentrations of <10 ppm were detected during field screening from 65 to 225 ft (approximately 10 ft below SWL). GC/ECD analyses of soil-gas samples collected at 137 and 205 ft

indicated 36.4 and 169.7 ppm carbon tetrachloride respectively. PID and GC/ECD analyses of a soil-gas sample collected at 160 ft indicated 26 ppm VOC and 1,419 ppm carbon tetrachloride respectively. Complete field screening data are included in Appendix D. Complete soil-gas results are included in Appendix E.

A 16-in. temporary welded casing was installed to a depth of 38.71 ft. A 12-in. temporary welded casing was set at 138.28 ft, 3.1 ft into the potentially perching Plio-Pleistocene unit. The borehole was advanced to a total depth of 228.5 ft, approximately 13 ft below SWL. A 10-in. welded temporary casing was advanced to 227.38 ft. After a groundwater sample was collected, the borehole was backfilled through the saturated zone with sand and a bentonite plug was installed from 212.3 to 217.3 ft. A 4-in. stainless steel permanent well casing was installed to a completed depth of 210.3 ft, with two louvered .020 slot screened intervals from 165.13 to 185.09 ft and from 113.24 to 133.21 ft. Filter packs were installed from 163.0 to 187.2 ft and from 111.0 to 134.7 ft.

Three pressure transducer vent lines, consisting of 1/8-in.-diameter stainless steel tubing, were strapped to the exterior of the permanent well casing during completion. These were open ended, terminating at 100.0, 145.2, and 210.0 ft. Each open tube end was filter packed with approximately 3 to 4 ft of filter pack to provide continuity with the formation.

The transducer tube and screen filter packs were isolated from each other by installing portland cement grout annular seals and bentonite annular seals between the filter packs. A portland cement grout annular seal was also installed across the Plio-Pleistocene unit to prevent contaminant transport across the confining unit. The cement grout lifts were installed through a tremie pipe.

A bentonite annular seal was installed from 9.0 ft to the top of the upper transducer cement grout seal at 90.2 ft. A cement grout seal was installed from ground surface to 9.0 ft. A locking cover, concrete surface pad, and protective posts were installed at the wellhead.

An inflatable packer will be installed between the two screened intervals to prevent migration of gaseous phase contamination through the well bore.

4.8.6 Well 299-W18-220

Well 299-W18-220 is located approximately 65 m east of the 216-Z-9 Crib (Figure 14). This well was started on June 1 and completed on August 25, 1993.

Well 299-W15-219 was drilled to a depth of 201.0 ft. SWL was measured at 191.58 ft. From ground surface to 5.5 ft, the borehole penetrated fill, reworked, and undisturbed Holocene eolian sand. The contact between the Holocene deposits and underlying Hanford formation is at 10.0 ft.

The uppermost Hanford formation strata in the borehole are the gravelly and slightly gravelly sands of the upper fine unit, extending from 10.0 to 20.0 ft. Underlying the upper fine unit are generally open framework gravels

and minor interbedded sands typical of the gravel-dominated facies. These deposits comprise the upper coarse unit, which extends from 20.0 to 44.0 ft. Well stratified sand and minor gravel of the sand-dominated or transitional facies comprising the Hanford formation fine unit are found between 44.0 and 103 ft. From 103 to 109 ft, interstratified deposits of the sand-dominated and silt-dominated facies occur, forming the lower fine unit. The lower fine unit is saturated at 106.1 ft, with approximately 2.9 ft of water perched on the Plio-Pleistocene carbonate. The base of the Hanford formation occurs at 109 ft.

The calcium carbonate rich Plio-Pleistocene unit underlies the Hanford formation, extending from 109 to 113.5 ft. Carbonate in this interval consists of interstitial cement and carbonate nodules in sandy gravel. The Plio-Pleistocene unit is dry beneath the saturated sediments of the Hanford lower fine unit. The lowermost interval penetrated in the borehole consists of the consolidated to cemented, massive to stratified, pebble to cobble gravel and minor sand of Ringold Formation unit E. These gravels extend to total depth at 201.0 ft.

HPTs performed periodic field screening for alpha and beta/gamma radiation, using a PAM and GM respectively. No elevated alpha radiation was detected while drilling well 299-W15-220. A 4,000 dpm beta/gamma radiation hot spot was detected in the surface soils beneath the stabilization fill. This hot spot was located approximately 15 ft south of the borehole. Other than causing a 1-day delay, this had no effect on drilling, sampling, or completion of the well. After completion of the well, the hot spot was excavated for analysis and removal. The hot spot consisted of an old (degraded) 250-mL plastic sample bottle containing a liquid. Results of field screening indicate that the bottle contains strontium/cesium contamination with a dose rate of 100 mrem/h. The results of the laboratory analysis have not been received yet. The bottle had leaked, contaminating approximately 20 L of soil. The contaminated soil was drummed for disposal.

Because of the potential presence of buried asbestos, all cuttings from the top 25 ft of the borehole were contained and screened for asbestos-containing materials. A fragment of suspected transite pipe was encountered at 5 ft. KEH disposed of all suspect cuttings as asbestos-contaminated materials.

Significant concentrations of carbon tetrachloride and/or VOCs were detected throughout borehole advancement. Concentrations of >10 ppm were detected from 30 to 95 ft with field screening instruments. Field screens with colorimeter tubes at 126 and 182 ft indicated carbon tetrachloride concentrations of >60 and 50 ppm respectively. A PID screen of soils collected approximately 3.5 ft below SWL at 195 ft indicated a VOC concentration of 59 ppm. GC/ECD analyses of soil-gas samples indicated 16,660 and 20,910 ppm carbon tetrachloride. GC/ECD analyses of soil-gas samples indicated significant concentrations of carbon tetrachloride throughout advancement of this borehole. The highest detected concentration was 1,511.6 ppm at 90 ft. Complete field screening data are included in Appendix D. Complete soil-gas results are included in Appendix E.

A 16-in. temporary welded casing was installed to a depth of 39.72 ft. A 12-in. temporary welded casing was set at 111.09 ft, 2.1 ft into the perching Plio-Pleistocene unit. A 4.1-ft bentonite seal installed at the

bottom of the 12-in. casing. A 10-in. welded temporary casing was set through the bentonite seal at 113.14 ft. This method of telescoping through two casing strings was designed to seal the perching Plio-Pleistocene unit. An 8-in.-diameter welded temporary casing was advanced through the seal. The borehole was drilled to a total depth of 201.0 ft, approximately 9.5 ft below SWL. The 8-in. casing was advanced to 200.02 ft. After obtaining a groundwater sample, the borehole was backfilled through the saturated zone with sand and a bentonite plug was installed from 187.0 to 191.9 ft. A 4-in. stainless steel permanent well casing was installed to a completed depth of 185.3 ft, with two louvered .020 slot screened intervals from 155.0 to 170.0 ft and from 80.0 to 95.1 ft. Filter packs were installed from 152.9 to 171.9 ft and from 78.0 to 96.9 ft.

Three pressure transducer vent lines, consisting of 1/8-in.-diameter stainless steel tubing, were strapped to the exterior of the permanent well casing during completion. These were open ended, terminating at 52.0, 118.0, and 185.0 ft. Each open tube end was filter packed with approximately 4 ft of filter pack to provide continuity with the formation.

The transducer tube and screen filter packs were isolated from each other by installing portland cement grout annular seals and bentonite annular seals between the filter packs. A portland cement grout annular seal was also installed across the Plio-Pleistocene unit to prevent perched water and contaminant transport across the confining unit. The cement grout lifts were installed through a tremie pipe.

A bentonite annular seal was installed from 9.7 ft to the top of the upper transducer cement grout seal at 35.1 ft. A cement grout seal was installed from ground surface to 9.7 ft. A locking cover, concrete surface pad, and protective posts were installed at the wellhead.

An inflatable packer will be installed between the two screened intervals to prevent migration of gaseous phase contamination through the well bore.

4.8.7 Chemical Analyses

Soil samples collected from each crib borehole were analyzed for volatile, semivolatile, and other organic compounds; metals; cations; anions; and radionuclides. Soil and groundwater samples collected during the drilling of vapor extraction wells were analyzed for VOCs. The results received to date are provided in Appendix F.

The highest soil concentrations of carbon tetrachloride were found in well 299-W15-218 (15,794 ppb) and well 299-W15-219 (11,688 ppb), at depths of 33.5 m and 34.9 m, respectively.

4.8.8 Physical Analyses

Samples were obtained at an approximate 5-ft sample interval from all six boreholes for moisture and calcium carbonate content analysis. Samples were obtained at an approximate 5-ft sample interval from boreholes 299-W18-96 and 299-W18-174 for particle size analysis. Some particle size samples were also obtained from boreholes 299-W15-218 and 299-W15-219. Samples were also

obtained from from boreholes 299-W18-96 and 299-W18-174 for porosity/bulk density and air permeability analyses. These analyses were performed by the WHC Geotechnical Laboratory. One saturated hydraulic conductivity and one moisture retention sample was collected from both 299-W15-218 and 299-W18-96 for analysis at the WHC Geotechnical Laboratory. The results are included in Appendix G.

Samples were obtained at an approximate 20-ft sample interval from boreholes 299-W18-96 and 299-W18-174 for unsaturated hydraulic conductivity, saturated hydraulic conductivity, and pore water chemistry analyses. These analyses were performed by Washington State University (WSU) Tri-Cities and will be included in a separate report.

Nine samples were obtained at an approximate 10-ft sample interval from borehole 299-W15-220 for vapor phase partitioning coefficient analyses. These analyses were performed by WSU Pullman and will be included in a separate report.

4.9 DRILL AND SAMPLE TECHNOLOGY DEMONSTRATION BOREHOLES

One in situ bioremediation borehole is being installed during FY 1993 in support of technology demonstrations for in situ treatment tasks of the VOC-Arid ID. The approach to in situ bioremediation is to stimulate native anaerobic microorganisms that are capable of degrading carbon tetrachloride in the subsurface to allow biodegradation to occur in the aquifer beneath the 200 West Area. The in situ bioremediation demonstration field site is between 241-T Tank Farm and 221-T Plant, where two bioremediation wells, 299-W11-29 and 299-W11-30, have already been installed (Figure 15). Dissolved carbon tetrachloride concentrations in the underlying aquifer range from approximately 10 to 3,000 ppb. The demonstration will be carried out by stimulating native microorganisms with the addition of "nutrients" to the groundwater and dispersing them into the aquifer using a withdrawal and injection circulation system in a single well.

To better understand in situ biodegradation of carbon tetrachloride and thereby design an efficient remediation system the hydrogeologic system, the subsurface geochemistry and the microbiologic populations are currently being characterized. In addition, the kinetics of the potential circulation and nutrient distribution systems and the microbiologic response (biodegradation) is being simulated with a numerical model.

Wells 299-W11-29 and 299-W11-30 were installed in 1992 to collect data about the subsurface environment in which the demonstration will be conducted and to monitor the progress of the actual demonstration. During the well installations, data were collected about the microorganisms present, the chemistry of the groundwater and sediments, the physical properties of the sediments, and the hydraulics of the groundwater flow system at the demonstration location.

Well 299-W11-32, in which the circulation system will be implemented, was started on May 3. Total depth (310 ft) was reached September 1, and completion began September 9. Sample collection during the well installation was coordinated to allow evaluation and comparison of a variety of subsurface parameters. Aquifer heterogeneity with respect to laboratory-determined

Figure 15. Location of the FY 1993 In Situ Bioremediation Borehole

hydraulic conductivity and porosity and field hydrologic testing is under way. Sediment and groundwater samples were collected in selected intervals to study the relationship between the sediment and groundwater chemistry and the in situ microbiologic populations. Aseptic sediment samples were collected for studies of the capability of in situ microorganisms to degrade carbon tetrachloride and the conditions under which the degradation occurs and the kinetics of that chemical reaction.

The BoreSampler, an in situ soil-gas sampling device, was field tested in accordance with the test plan (WHC 1993b) while drilling well 299-W11-32. The results of this testing will be contained in a separate report.

4.9.1 In Situ Microorganism Characterization

Various microbiological analyses are being conducted to determine the number of microorganisms in the sediment and to characterize the different groups those microorganisms constitute. Aseptic core samples collected in lexan liners are opened under anaerobic conditions and sediment is placed aseptically in sterile whirlpak bags. Measurement of denitrifier enzyme concentrations will be conducted to determine the denitrification potential. The following tests will also be performed for enumeration of microorganisms:

- Most Probable Number (MPN) of denitrifying bacteria
- MPN of sulfate-reducing bacteria
- MPN of iron-reducing bacteria
- Plate count of aerobic heterotrophs.

Samples were collected through the month of August 1993. The tests require an incubation period before the results will be available. Consequently, results are not available for presentation in this report from the sediment samples that have been collected during FY 1993.

Microbiologic analyses will also be performed at partner universities on samples collected from the 1993 well installation. Approximately 100 g of sediment will be shipped to WSU for coliform tests. Also 100 g of sediment will be shipped to Oak Ridge National Laboratory for phenol toluene degraders test. Oregon State University will receive an intact core sample on which microbiologic degradation of carbon tetrachloride will be tested.

4.9.2 In Situ Carbon Tetrachloride Biodegradation

Methods for biodegrading carbon tetrachloride *in situ* are also being developed. For example, carbon tetrachloride can be degraded by a bacterium strain, BrY, that grows by reducing ferric iron in sedimentary and subsurface media.

To assess the degradation of carbon tetrachloride by BrY in the native material from well 299-W11-32, triplicate sets of vials containing native material obtained from a depth of 277 to 278 ft were amended with simulated groundwater (SGW), lactate, BrY, and carbon tetrachloride. SGW was designed to include the major ionic constituents of the Hanford Site groundwater. BrY was added to a density of 10^6 cells/mL of SGW and each vial was spiked with

carbon tetrachloride to achieve an aqueous concentration of 0.5 ppm. Lactate was present at a concentration of approximately 20 mM. Each vial was immediately crimp sealed after the addition of carbon tetrachloride using a Teflon-lined butyl rubber septa with an aluminum seal. Vials were then incubated at 30°C and sets were sacrificed periodically for analysis of volatile chlorinated hydrocarbons by gas chromatography.

After 14 days of incubation, approximately 40 ppb of carbon tetrachloride had been converted to chloroform in sediment amended with BrY. The degradation of carbon tetrachloride in sediments amended with BrY appears to be at least four times faster than in sediment not amended with BrY. At this time it is unclear as to the exact mechanism responsible for the degradation of carbon tetrachloride, although it is evident that a biological factor is at least in part playing a key role.

The experiments described above will be repeated using native groundwater in lieu of SGW and incubating the experiments at the in situ temperature of 17°C. The full report will be provided elsewhere.

4.10 SAMPLE GROUNDWATER

Groundwater samples were collected from 19 existing wells in the vicinity of the three carbon tetrachloride disposal sites and at the perimeter of the groundwater plume. The list of wells sampled (Table 5) was chosen based on sampling conducted during FY 1991 and FY 1992 and in coordination with other groundwater monitoring programs. Sampling occurred twice, once in late November to mid-January, and once in mid- to late June. The sampling is in support of both ERA/VOC-Arid ID site characterization and also baseline monitoring for ERA vapor extraction operations.

Ongoing Hanford Site groundwater monitoring programs that include 200 West Area wells are (1) the Operational Groundwater Monitoring Network, (2) the RCRA program, (3) the 200 West Aggregate Area Management Study under CERCLA, (4) any groundwater monitoring required by liquid waste discharge permits, and (5) Pacific Northwest Laboratory site-wide monitoring. The various sampling efforts are coordinated by the Operational Groundwater Program. The 19 wells sampled for the carbon tetrachloride ERA were selected to complement the sampling being conducted by other programs. Nine wells in Table 5 were not being sampled by other programs in the two sampling periods originally targeted (November 1992 and May 1993). Sampling for VOCs was added to other sampling already being conducted at 10 RCRA wells (Table 5).

Groundwater samples were analyzed for VOCs using either a gas chromatograph/mass spectrometer (GC/MS) (analytical method 8240) or using a gas chromatograph (GC) (analytical method 8010), which provides a lower detection limit. The lower detection limit allows better definition of the areal distribution of the lower concentrations in the dissolved carbon tetrachloride groundwater plume.

Analytical results for all the sampling indicated in Table 5 have not yet been received but will be available on HEIS.

Table 5. Groundwater Wells Sampled for Volatile Organic Compounds.

Well	Program	Sample date	Sample type	Analytical method
299-W10-4	CC14 ERA	January 7, 1993 June 17, 1993	Submersible	GC/MS GC
299-W10-15	RCRA	November 10, 1992 June 21, 1993	Hydrostar	GC/MS GC
299-W10-17	RCRA	June 23, 1993	Hydrostar	GC
299-W10-18	RCRA	June 23, 1993	Hydrostar	GC
299-W11-27	RCRA	June 22, 1993	Hydrostar	GC
299-W14-12	RCRA	June 23, 1993	Hydrostar	GC
299-W15-12	CC14 ERA	January 6, 1993 June 24, 1993	Bailer	GC/MS GC
299-W15-16	CC14 ERA	January 12, 1993 June 16, 1993	Hydrostar	GC/MS GC
299-W15-22	RCRA	June 23, 1993	Hydrostar	GC
299-W18-2	CC14 ERA	January 12, 1993 June 17, 1993	Hydrostar	GC/MS GC
299-W18-9	CC14 ERA	January 6, 1993 July 1, 1993	Bailer	GC/MS GC
299-W18-25	RCRA	June 21, 1993	Hydrostar	GC
299-W18-30	RCRA	June 22, 1993	Hydrostar	GC
299-W19-32	RCRA	November 13, 1992 July 20, 1993	Hydrostar	GC/MS GC
299-W23-13	RCRA	November 23, 1992 June 24, 1993	Hydrostar	GC/MS GC
699-38-70	CC14 ERA	January 5, 1993 June 22, 1993	Submersible Bailer	GC/MS GC
699-39-79	CC14 ERA	January 5, 1993 June 18, 1993	Submersible	GC/MS GC
699-43-88	CC14 ERA	January 5, 1993 June 21, 1993	Submersible	GC/MS GC
699-49-79	CC14 ERA	January 4, 1993 June 21, 1993	Submersible	GC/MS GC

5.0 DATA MANAGEMENT AND EVALUATION TASKS

5.1 DATA MANAGEMENT, INTEGRATION, AND PRESENTATION

The purpose of this task was to establish an interactive database/graphics retrieval and display capability, using the Hanford Environmental Information System (HEIS) and Geographical Information System (GIS) as the backbone for all data storage and retrieval.

This task was to be accomplished through data entry, data manipulation and display, support to data fusion efforts, and issuance of the U Pond Characterization Report.

5.1.1 Data Entry

The objective was to enter all VOC-Arid ID and ERA site data into HEIS. This was to include existing data (e.g., drillers logs, geophysical logs, chemical analyses), the acquisition/modification of field computers and macros for direct data entry, and HEIS support for preparation of new data fields and loader programs.

Data entry efforts have been limited to direct (automated) entry of groundwater analytical data into HEIS, hand entry of VOC data (groundwater and soil) into HEIS, and spreadsheet entry of soil analytical data. Automated data entry of soil analytical data into HEIS has been prevented by the lack of a "loader" program to load the data into specified data fields. Currently, this loader program has been written and is in the testing phase.

Entry of previously existing data into HEIS and further development/use of field computers were not conducted due to funding constraints.

5.1.2 Data Manipulation and Display

The HEIS/GIS was to be used to generate concentration contour maps, geologic cross sections, isopach maps, and structural contour maps. Some software modifications were anticipated to develop new HEIS/GIS capabilities. This task was also to support preparation of report tables, maps, and graphs.

Efforts were made early in the fiscal year to prepare soil-gas concentration contour maps and to display selected types of geologic data (e.g., calcium carbonate content, percent mud). However, the graphics capabilities and lack of complete data sets made immediate use of the HEIS/GIS for preparation of report graphics and tables inappropriate. Funding constraints prohibited continued efforts to use the HEIS/GIS for data manipulation and display.

5.1.3 Support Data Fusion Efforts

This effort was aimed at providing support to Coleman Research Corporation (Coleman Research) on the development of an environmental data fusion workstation. This support was aimed at providing technical guidance,

available site-specific data and interpreted data sets, field and laboratory support to geophysical data collection efforts, and testing of the prototype workstation.

Technical guidance was provided via numerous meetings, both at the Hanford Site and at Coleman Research facilities in Maryland. Complete data sets were provided either electronically and/or by hard copy. These data sets consisted of borehole geophysical logs, driller's and/or geologist's well logs, moisture content, calcium carbonate contents, grain size data, and chemical analysis data. Interpreted data sets consisted of geologic contacts and conceptual model reports (DOE-RL 1991, Last et al. 1991, Rohay et al. 1992, Last and Rohay 1993).

Field and laboratory support was provided during a two-phase surface geophysical data collection effort (Section 4.4).

The prototype workstation hardware and initial software was delivered to Pacific Northwest Laboratory the week of June 14, 1993. Coleman Research staff set up the workstation during the week of June 21, 1993. This initial phase of the workstation consists primarily of a "Onyx" engineering workstation (tradename of Silicon Graphics Inc.), EarthVision software (a tradename of Dynamic Graphics, Inc.), and a Tektronix Phaser III printer (a tradename of Tektronics, Inc.). The final phase of software installation and training on the use of the data fusion software was conducted September 2 through 9, 1993. Due to late delivery of the data fusion and other software, testing of the workstation has been delayed and will be reduced in scope to accommodate the shortened performance period.

5.1.4 Issue U Pond Characterization Report

The objective of this task was to revise and document the U Pond characterization report drafted in 1981. This document contains maps and sampling results that will be useful to planning and remediation efforts in 200 West Area. The document (consisting of approximately 450 pages) was retyped, after which a second, more up-to-date version of the document was discovered, which precipitated additional extensive retyping of the document. Currently this document is undergoing editorial revision and figure preparation and will be issued in FY 1994.

5.2 NUMERICAL MODELING

The objective of this task was to simulate the behavior of the multiphase system--carbon tetrachloride/water/vapor--in the unsaturated and saturated zones to aid in the design and monitoring of remedial activities.

During FY 1993 a report was issued (Piepho et al. 1993) reporting on the application of the two-dimensional multiphase model SAMFT2D (Single-phase And Multi-phase Flow and Transport in 2-Dimensions) to the disposal of carbon tetrachloride to the 216-Z-9 Trench.

The developer of the SAMFT2D code, HydroGeoLogic, Inc., completed the three-dimensional version of the multiphase code, referred to as MAGNAS3 (Multi-phase Analysis of Ground Water, Non-Aqueous Phase Liquid, and Soluble

Component in 3 Dimensions), and WHC then purchased this code. Additionally, arrangements were made to have an adaptive solver incorporated into the code to improve its efficiency for modeling large-domain problems.

Upon receipt of the MAGNAS3 code during the latter part of the fiscal year, the code was tested by using the two-dimensional input data developed for SAMFT2D in MAGNAS3. The results proved to be satisfactory.

To assess the capabilities of MAGNAS3, the size of the problem domain was increased (while still maintaining a two-dimensional representation) to deal with a greater number of nodes and also to address a more significant problem, that of disposal of water to facilities near the 216-Z-9 Trench. In order for comparisons to be made with previous SAMFT2D modeling, the geohydrologic and fluid properties were not changed. The adaptive solver for MAGNAS3 was implemented so that large domain grids could be simulated with minimum computer time. Currently, the grid domain has been increased to about 15,000 nodes with no computer problems. Simulated results suggest that the liquid carbon tetrachloride may reach the bottom of the aquifer in less than 8 years. The 216-Z-20 Crib water source was then included in the model, and indicated a minimal effect on the carbon tetrachloride plume from the 216-Z-9 Trench. This work has been accomplished considering the carbon tetrachloride to be only a free-phase liquid.

The next steps in the application of MAGNAS3, planned for FY 1994, will be the incorporation of recently determined and more realistic fluid properties, revision of site stratigraphy and geohydrologic properties, consideration of carbon tetrachloride vapor as well as the free liquid carbon tetrachloride, and extension of the model domain to include other water and carbon tetrachloride disposal sites in a three-dimensional representation. The approach being followed in this investigation is to advance one step at a time in order to gain a better understanding of what is happening in the subsurface and also how the code is treating the movement of the carbon tetrachloride in the subsurface environment. Completion of the tasks mentioned in the beginning of this paragraph should provide a reasonable picture of where the carbon tetrachloride is in the subsurface and what phase, free liquid or vapor, it is in. It is anticipated however that some parameters will require adjustment as additional field information is obtained; this is known as model calibration and is an integral part of the modeling process.

5.3 DATA EVALUATION

The purpose of this task was to further refine the conceptual models of the site hydrogeology and carbon tetrachloride distribution and behavior. Site data collected in FY 1992 were evaluated and integrated into the hydrogeologic and carbon tetrachloride conceptual models. The result of this task was reported March 1993 in Last and Rohay (1993). The refined conceptual models are briefly summarized in Section 2.2.2 of this report.

6.0 REFERENCES

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APPENDIX A
EMFLUX SOIL-GAS SURVEY REPORT

Quadrel Report Number QS1149

EMFLUX[®] SOIL-GAS SURVEY

of

HANFORD 200 WEST CARBON TETRACHLORIDE SITE
HANFORD, WASHINGTON

Prepared for

Westinghouse Hanford Company
P.O. Box 1970
Richland, WA 99352

by

Quadrel Services, Inc.
10075 Tyler Place #9
Ijamsville, MD 21754

August 20, 1993

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APPENDICES

- A. Targeted Compounds
- B. Quadrel Field Procedures
- C. Laboratory Procedures
- D. MSS Laboratory Report

EMFLUX[®] SOIL-GAS SURVEY
of
HANFORD 200 WEST CARBON TETRACHLORIDE SITE
HANFORD, WASHINGTON

The following EMFLUX[®] Soil-Gas Survey Report has been prepared for Westinghouse Hanford Company (Westinghouse) by Quadrel Services, Inc. (Quadrel) in accordance with the terms of Purchase Order No. MLR-SVV-321603 dated June 23, 1993. Quadrel's principal contact at Westinghouse for this project has been Mr. Jon Fancher.

1.0 BACKGROUND

The Hanford 200 West Carbon Tetrachloride Site addressed in this survey ("the Site") is shown in Figure 1, which is based on a site map provided by Westinghouse. Quadrel understands that previous investigations have indicated potentially widespread carbon tetrachloride contamination, and current efforts are directed at developing a greater understanding of the extent and magnitude of that contamination.

According to information provided to Quadrel, ground water is approximately 210 feet below grade and generally flows in an easterly direction. Quadrel has no data pertaining to local geology or subsoil composition.

2.0 OBJECTIVES

The purpose of this EMFLUX[®] soil-gas survey was to investigate the Site to determine the presence, identities, and relative source strengths of subsurface volatile organic compounds (VOCs) including, but not limited to, carbon tetrachloride. It is understood that the results of this survey are to be used in further characterizing the survey area.

3.0 WORK PLAN

The subparagraphs below describe the work carried out, the schedule followed, and the overall quality-assurance and quality-control (QA/QC) procedures used.

3.1 Target Compounds

The EMFLUX[®] investigation of the Site encompassed the EPA Target Compound List (TCL) contaminants listed in Appendix A.

3.2 Site Survey Plan

Westinghouse personnel requested and Quadrel provided EMFLUX[®] sampling equipment for 34 sample locations. Westinghouse determined the specific locations of the field-collection devices. The survey plan for this investigation (with approximate sample-point locations provided by Westinghouse) is illustrated in Figure 1.

3.3 Site Preparation

Quadrel understands from Westinghouse personnel that only standard site preparation activities were required, including the removal of surface vegetation and the scraping and leveling of the top half-inch of soil prior to field-collection-device installation.

3.4 Field Work

Westinghouse personnel deployed EMFLUX[®] collection devices at two different periods. Samples "A" and "B" were deployed at locations 6 and 5, respectively (see Figure 1) on July 24, 1993 and recovered on July 28, 1993. The remaining devices were deployed at locations 1 to 34 on July 28, 1993 and recovered on July 31, 1993. Westinghouse personnel report that both deployment and retrieval of EMFLUX[®] devices were accomplished in conformity with Quadrel's established Field Procedures (see Appendix B).

3.5 Laboratory Analysis

Quadrel's contract laboratory, Maryland Spectral Services (MSS), analyzed all EMFLUX[®] sample cartridges with gas chromatography/mass spectrometry (GC/MS) equipment, using a modified EPA Method 8240 (see Appendix C). The cartridges were delivered to the laboratory on Wednesday, August 4, 1993; MSS analyses were completed on Monday, August 9, 1993; and Quadrel received the laboratory report on Wednesday, August 11, 1993.

3.6 Quality Assurance/Quality Control (General)

This survey involved 36 field samples, three control samples, and one trip blank, a total of 40 adsorbent cartridges. Laboratory procedures included standards, surrogates, and blanks appropriate to the modified EPA Method 8240 employed by MSS to analyze EMFLUX[®] cartridges. Field work and reporting were done under Quadrel's Quality Assurance Program Plan, while MSS analyses were performed under the laboratory's Quality Assurance Plan.

EMFLUX Passive Soil-Gas Sampling Test Locations

WHC-SD-EN-TI-202 Rev. 0

A-7

-3-

△

11

△ EMFLUX Soil-Gas Collectors
Drawing Date: 7/21/93

4.0 FINDINGS

This section outlines pertinent laboratory procedures and results of the EMFLUX[®] soil-gas investigation of the Site.

4.1 EMFLUX[®] Cartridge Analysis

As noted above, MSS analyzed 40 EMFLUX[®] cartridges for those compounds listed in Appendix A. Laboratory results are expressed in nanograms of specific contaminant recovered per cartridge and are included as Appendix D. The laboratory designated each cartridge (or trap) with the last two digits of the appropriate Westinghouse "HEIS" number assigned to each sample.

Laboratory contaminant findings were converted to average emission flux rates, using the subtended area of the collector shell and the period of exposure for each sample. The final values, expressed in nanograms per square meter per minute ($\text{ng}/\text{m}^2/\text{min}$), are given in Tables 1 (samples 1 - 34) and Table 2 (samples A and B). These tables list the samples by both location number and Westinghouse HEIS number designator.

4.2 Quality Assurance/Quality Control (Specific)

The following information is germane to any evaluation of the results of this EMFLUX[®] survey.

4.2.1 Integrity of Samplers

Westinghouse personnel reported no evidence of disturbance of any collection device.

4.2.2 Suspected Laboratory Contamination

Every sample analyzed by MSS for this project exhibited various levels of methylene chloride contamination, including trip blank, field control samples, and background sample (see below). Although the MSS methods blanks analyzed in connection with this task revealed no contamination, the laboratory manager suspects contamination in the laboratory air. While methods blanks detect contamination in the analytical system itself (e.g. thermal desorber, gas chromatograph, and mass spectroscope), they do not discern ambient-air contamination to which EMFLUX[®] adsorbent traps may be exposed while being transferred to the thermal desorption unit. Further, laboratory personnel have traced the likely source of contamination to improperly conditioned charcoal filters installed in the laboratory's air handling system shortly before analyses of these traps began.

Table 2

Emission Flux Rates (ng/m2/min)
Hanford 200 West Carbon Tetrachloride Site
Richland, WA

=====		
SAMPLE LOCATION	A	B
HEIS#	B08YS7	B08YS8
=====		
CONTAMINANTS		
Acetone	5.0	2.5
Benzene	---	0.9
Carbon Tetrachloride	2.5	130.8
Chloroethane	---	4.0
Chloroform	---	107.3
Chloromethane	---	8.7
1,1-Dichloroethene	---	0.9
Tetrachloroethene	---	2.3
=====		

NOTE: "----" denotes value below the
reported quantitation level.

In light of the laboratory's review and the fact that all quality control samples, including the background sample, exhibit varying levels of methylene chloride contamination, Quadrel believes that all measurements of this compound should be disregarded. Accordingly, no emission flux values were computed for methylene chloride.

4.2.4 Trip Blank

As noted in Section 4.2.3, the trip blank (trap X3 in Appendix D), a cartridge carried to the site but not intentionally exposed, was contaminated with 52 nanograms of methylene chloride, which is attributed to laboratory contamination.

4.2.5 Control Samples

The function of the control samples (traps X4, X5, and X6 in Appendix D) is to detect contamination in ambient air captured during deployment of EMFLUX[®] collection devices (as distinct from subsurface soil contamination); measurements of any such contaminants on the control sample are subtracted from measurements of the same compounds at other sample points. As noted in Section 4.2.3, all control samples exhibited various levels of methylene chloride contamination, but, for reasons given above, Quadrel does not believe this contaminant was in the ambient air at the Site.

5.0 DISCUSSION

The comments below highlight survey findings and provide an overall view of the Site with respect to compounds detected by EMFLUX[®]. For reference, Tables 1 and 2 list contaminant emission flux rates by sample location number and corresponding HEIS number; Figure 2 shows carbon tetrachloride emission-flux-rate distributions across the Site. Interpretation of contamination levels (i.e., as low, moderate, or high) are relative solely to the findings of the present survey and, except where noted, should not be compared with results of other EMFLUX[®] surveys.

5.1 Sample Locations 1 to 34

5.1.1 Carbon Tetrachloride

Carbon tetrachloride, an industrial solvent and degreaser, was detected at 25 of the 34 sample

locations (74 percent). Figure 2 is an isopleth map illustrating likely contaminant migration patterns based on the relative strengths of the observed emission flux rates at the Site.

A review of Table 1 and Figure 2 strongly suggests that carbon tetrachloride contamination has spread: i) from a source at or near sample location 7, which exhibited the highest emission rate found in the survey (251.7 ng/m²/min); and (ii) from an area beneath sample locations 2 and 3, approximately 275 feet northeast of the Z-9 Crib which also exhibited high emission rates (188.0 and 186.1 ng/m²/min, respectively). The absence of any significant emissions at sample location 6 (4.0 ng/m²/min) suggests a dual-source and double-migration hypothesis (see Figure 2). The northern half of the site is generally devoid of carbon tetrachloride emissions, except along the southern and eastern boundaries (sample locations 21, 22, 29, 32, 33, and 34). The relatively modest emissions at these points indicate a narrow, northerly migration pathway along the eastern boundary of the upper portion of the Site.

5.1.2 Tetrachloroethene (Perchloroethene/PCE)

PCE is a compound most commonly used for metal degreasing and commercial drycleaning. Low-level PCE emissions (1.2 to 5.6 ng/m²/min) were observed at eight of the 34 sample locations (see Table 1). Although no definitive pattern is discernible, five of these locations (4, 5, 7, 8, and 9) are in proximity to the Z-9 Crib. One point, sample 3, is co-located with one of the high carbon tetrachloride emission sites, and the remaining two, samples 12 and 14, are co-located with two moderate carbon tetrachloride emission sites south of the Z-9 Crib. This suggests that any solvents containing carbon tetrachloride used at this site in the past may have contained a small percentage of PCE as well.

5.1.3 Acetone, Toluene, and Xylene

Acetone, a ubiquitous compound (produced in nature by bacterial action) is used in industrial solvents. It was detected at five sample locations, at low levels (1.9-3.5 ng/m²/min). The sample locations (6, 10, 20, 22, and 34) have no discernible pattern, but instead are scattered over the study area (including

EMFLUX Passive Soil-Gas Sampling Test Locations

background location 10, several hundred yards east of the main study area). As with PCE, it is conceivable that carbon tetrachloride solvents formerly used on this site may have contained a small percentage of acetone as well. Alternatively, these five low-level detections may simply reflect a residual of animal waste and prove insignificant.

Toluene emissions were detected at low levels (1.0-1.8 ng/m²/min) at five locations (3, 4, 10, 12, and 20). Three of these are co-located with areas of relatively high (locations 3 and 4) and moderate (location 12) carbon tetrachloride emissions. The other two, location 10, (the background sample) and location 20, on the eastern boundary of the Site, are not associated with carbon tetrachloride detections. While toluene is commonly used as a paint solvent and is a gasoline component, it is also produced by decaying vegetation. Because the foregoing detections are quite low and the locations do not suggest a pattern of contamination, Quadrel believes these emissions to be of little significance.

Xylene emissions of 1.4 ng/m²/min were detected at sample location 20, on the eastern boundary of the Site. Although toluene also was detected at this location, the absence of benzene and/or ethylbenzene appears to rule out the presence of gasoline. Hence, Quadrel judges this single emission to be an isolated event of little importance.

5.2 Sample Locations 6 and 5, Samples A and B

Samples A and B (see Appendix D and Table 2) were deployed at locations 6 and 5, respectively, approximately 85 hours before the main body of samples were deployed at locations 1 to 34. At time of removal, they were replaced by samples 6 and 5, respectively (see Table 1). Analysis of sample A revealed contaminants and emission rates comparable to sample location 6 values, especially when adjusted for the difference in exposure time (85 hours for sample A, and 72 hours for sample 6). Sample B, on the other hand, produced curious results. While both sample B and sample 5 detected similar emissions of carbon tetrachloride and PCE, analysis of sample B also revealed major chloroform emissions and small amounts of chloroethane, chloromethane, and 1,1-dichloroethene. This is the only sample location to report such contaminants and Quadrel has no ready explanation for the occurrence.

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Appendix A

TARGETED COMPOUNDS

Appendix A

Target Compound List (TCL) for
EPA Contract Laboratory Program (CLP)

Acetone	1,2-Dichloropropane
Benzene	trans-1,3-Dichloropropene
Bromodichloromethane	cis-1,3-Dichloropropene
Bromoform	Ethylbenzene
Bromomethane	2-Hexanone
2-Butanone	4-Methyl-2-pentanone
Carbon Disulfide	Methylene Chloride
Carbon Tetrachloride	Styrene
Chlorobenzene	1,1,2,2-Tetrachloroethane
Chloroethane	Tetrachloroethene
Chloroform	Toluene
Chloromethane	1,1,1-Trichloroethane
Dibromochloromethane	1,1,2-Trichloroethane
1,2-Dichloroethane	Trichloroethene
1,1-Dichloroethane	Vinyl Acetate
1,1-Dichloroethene	Vinyl Chloride
1,2-Dichloroethene (total)	Xylene (total)

Appendix B

QUADREL FIELD PROCEDURES
FOR EMFLUX[®] SOIL-GAS SURVEYS

Quadrel routinely follows the field procedures outlined below in performing EMFLUX[®] soil gas surveys, although modifications can be and are incorporated from time to time in response to requirements of individual projects. In all instances, Quadrel or other designated personnel adhere to EPA-approved Quality Assurance and Quality Control practices.

- A. One or more two-person teams, the specific number dependent upon scope and schedule of the project, transport EMFLUX[®] system components and support equipment to the site and deploy samplers in accordance with a prearranged survey pattern. One member of each team is designated "clean" and given exclusive responsibility for procedures involving components which must be protected from contamination.
- B. At each survey point, the team clears vegetation as necessary, removes a laboratory-prepared sampler cartridge containing a standardized adsorbent from an air-tight vial, affixes it to a support stake, and secures this sampler assembly to the ground at the specified point. The sampler shell is immediately placed on the ground, open end down, over the sampler assembly and surrounded with a collar of sand or local soil (to minimize effects of ambient airflow). The shell is then covered with camouflage cloth which is secured with a small additional amount of sand or soil. Finally, the team records the survey point location code, cartridge number, date and time of emplacement, and other relevant information.
- C. At intervals during the emplacement phase, as a quality control check, the team draws ambient air through control samples and records the date, time, and location of collection. (One or more trip blanks are also carried to and from the site in air-tight vials as part of the quality control program.)
- D. Once the predetermined number of EMFLUX[®] sampling devices are in the field the team sets the time for sampler recovery (generally not less than 72 hours after emplacement) and leaves the area, taking with it all equipment except the detection devices.

- E. The team returns to retrieve the sampling devices when the exposure period has elapsed. The "clean" person of the team recovers the cartridge at each point and returns it to its air-tight vial, while the other person collects the remaining equipment. Again, location codes, cartridge numbers, dates, times, etc. are recorded.
- F. The field team carries or ships re-sealed vials containing exposed cartridges to analytical laboratories under contract to Quadrel for processing. The remaining equipment is returned to Quadrel's preparation facility for cleaning and reuse.

Appendix C

LABORATORY PROCEDURES FOR EMFLUX[®] ADSORBENT CARTRIDGES

After exposure, EMFLUX[®] cartridges are analyzed as follows:

- A. The gas chromatography/mass spectrometry (GC/MS) equipment to be used is calibrated in accordance with the EPA Contract Laboratory (CLP) method for low waters.
- B. The exposed cartridge is placed in a Tekmar Autosampler stainless-steel chamber where it is desorbed at 300°C for 11 minutes at 40 ml/min helium, through a sparging vessel containing five (5) ml of water with internal standards and surrogates into a three-component trap on a Tekmar Liquid Sample Concentrator. The three components in the secondary trap are Tenax, silica gel, and coconut charcoal. ,
- C. The secondary trap is thermally desorbed at 220°C into a Restek 502.2 capillary column, per the EPA CLP Statement of Work (SOW).
- D. Following the SOW, the GC/MS is scanned between 35 and 260 Atomic Mass Units (AMU) at two (2) seconds per scan.
- E. The internal standard method is used to determine the amounts of analytes found.
- F. The compounds found are measured against five (5) ml of aqueous standard analyzed previously.

Appendix D

MSS LABORATORY REPORT

WHC-SD-EN-TI-202, Rev. 0
MARYLAND SPECTRAL SERVICES, INC.
1500 Caton Center Drive Baltimore, MD 21227

VOLATILE ORGANICS BY EPA GC/MS METHOD MODIFIED 8240

CLIENT SAMPLE ID:	TRAP-A	TRAP-B	TRAP-S9	TRAP-T0	TRAP-T1	TRAP-T2
	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W
LAB SAMPLE ID:	93080411	93080412	93080419	93080420	93080421	93080422
RECEIVED DATE:	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93
ANALYSIS DATE:	08/07/93	08/07/93	08/07/93	08/07/93	08/07/93	08/07/93
FILE NAME:	080411	080412	080419	080420	080421	080422
INSTRUMENT ID:	MSD	MSD	MSD	MSD	MSD	MSD
UNITS:	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP
VOLATILE COMPOUNDS						
Acetone	183	89	73	50 U	50 U	50 U
Benzene	25 U	32	25 U	25 U	25 U	25 U
Bromodichloromethane	25 U	25 U	25 U	25 U	25 U	25 U
Bromoform	25 U	25 U	25 U	25 U	25 U	25 U
Bromomethane	50 U	50 U	50 U	50 U	50 U	50 U
2-Butanone	50 U	50 U	50 U	50 U	50 U	50 U
Carbon Disulfide	25 U	25 U	25 U	25 U	25 U	25 U
Carbon Tetrachloride	89	4740	25 U	208	2560	302
Chlorobenzene	25 U	25 U	25 U	25 U	25 U	25 U
Chloroethane	50 U	146	50 U	50 U	50 U	50 U
Chloroform	25 U	3890	25 U	25 U	25 U	25 U
Chloromethane	50 U	316	50 U	50 U	50 U	50 U
Dibromochloromethane	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethene	25 U	34	25 U	25 U	25 U	25 U
1,2-Dichloroethene (total)	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloropropane	25 U	25 U	25 U	25 U	25 U	25 U
trans-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
cis-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
Ethylbenzene	25 U	25 U	25 U	25 U	25 U	25 U
2-Hexanone	50 U	50 U	50 U	50 U	50 U	50 U
4-Methyl-2-Pentanone	50 U	50 U	50 U	50 U	50 U	50 U
* Methylene Chloride	46	565	192	255	198	184
Styrene	25 U	25 U	25 U	25 U	25 U	25 U
1,1,2,2-Tetrachloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Tetrachloroethene	25 U	84	25 U	25 U	50	25 U
Toluene	25 U	25 U	43	25 U	33	25 U
1,1,1-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1,2-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Trichloroethene	25 U	25 U	25 U	25 U	25 U	25 U
Vinyl Chloride	50 U	50 U	50 U	50 U	50 U	50 U
Xylene (total)	25 U	25 U	25 U	25 U	25 U	25 U

* Suspected Laboratory Contaminant

B - Detected in Lab Blank. U - Below Reported Quantitation Level. J - Estimated Value.

WHC-SD-EN-TI-202, Rev. 0
MARYLAND SPECTRAL SERVICES, INC.
1500 Caton Center Drive Baltimore, MD 21227

VOLATILE ORGANICS BY EPA GC/MS METHOD MODIFIED 8240

CLIENT SAMPLE ID:	TRAP-T3	TRAP-T4	TRAP-T5	TRAP-T6	TRAP-T7	TRAP-T8
	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W
LAB SAMPLE ID:	93080423	93080424	93080425	93080426	93080427	93080428
RECEIVED DATE:	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93
ANALYSIS DATE:	08/07/93	08/07/93	08/07/93	08/07/93	08/07/93	08/07/93
FILE NAME:	080423	080424	080425	080426	080427	080428
INSTRUMENT ID:	MSD	MSD	MSD	MSD	MSD	MSD
UNITS:	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP
VOLATILE COMPOUNDS						
Acetone	50 U	50 U	50 U	50 U	50 U	50 U
Benzene	25 U	25 U	25 U	25 U	25 U	25 U
Bromodichloromethane	25 U	25 U	25 U	25 U	25 U	25 U
Bromoform	25 U	25 U	25 U	25 U	25 U	25 U
Bromomethane	50 U	50 U	50 U	50 U	50 U	50 U
2-Butanone	50 U	50 U	50 U	50 U	50 U	50 U
Carbon Disulfide	25 U	25 U	25 U	25 U	25 U	25 U
Carbon Tetrachloride	3500	790	444	2310	6050	2670
Chlorobenzene	25 U	25 U	25 U	25 U	25 U	25 U
Chloroethane	50 U	50 U	50 U	50 U	50 U	50 U
Chloroform	25 U	25 U	25 U	25 U	25 U	25 U
Chloromethane	50 U	50 U	50 U	50 U	50 U	50 U
Dibromochloromethane	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethene	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethene (total)	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloropropane	25 U	25 U	25 U	25 U	25 U	25 U
trans-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
cis-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
Ethylbenzene	25 U	25 U	25 U	25 U	25 U	25 U
2-Hexanone	50 U	50 U	50 U	50 U	50 U	50 U
4-Methyl-2-Pentanone	50 U	50 U	50 U	50 U	50 U	50 U
* Methylene Chloride	153	155	137	126	78	50
Styrene	25 U	25 U	25 U	25 U	25 U	25 U
1,1,2,2-Tetrachloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Tetrachloroethene	134	25 U	25 U	93	34	124
Toluene	25 U	25 U	25 U	25 U	25 U	25 U
1,1,1-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1,2-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Trichloroethene	25 U	25 U	25 U	25 U	25 U	25 U
Vinyl Chloride	50 U	50 U	50 U	50 U	50 U	50 U
Xylene (total)	25 U	25 U	25 U	25 U	25 U	25 U

* Suspected Laboratory Contaminant

B - Detected in Lab Blank. U - Below Reported Quantitation Level. J - Estimated Value.

WHC-SD-EN-11-202, Rev. U
MARYLAND SPECTRAL SERVICES, INC.
1500 Clanton Center Drive Baltimore, MD 21227

VOLATILE ORGANICS BY EPA GC/MS METHOD MODIFIED 8240

CLIENT SAMPLE ID:	TRAP-T9	TRAP-V0	TRAP-V1	TRAP-V2	TRAP-V3	TRAP-V6
	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W
LAB SAMPLE ID:	93080429	93080430	93080431	93080432	93080433	93080434
RECEIVED DATE:	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93
ANALYSIS DATE:	08/07/93	08/07/93	08/08/93	08/08/93	08/08/93	08/08/93
FILE NAME:	080429	080430	080431	080432	080433	080434
INSTRUMENT ID:	MSD	MSD	MSD	MSD	MSD	MSD
UNITS:	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP
VOLATILE COMPOUNDS						
Acetone	50 U	85	50 U	50 U	50 U	50 U
Benzene	25 U	25 U	25 U	25 U	25 U	25 U
Bromodichloromethane	25 U	25 U	25 U	25 U	25 U	25 U
Bromoform	25 U	25 U	25 U	25 U	25 U	25 U
Bromomethane	50 U	50 U	50 U	50 U	50 U	50 U
2-Butanone	50 U	50 U	50 U	50 U	50 U	50 U
Carbon Disulfide	25 U	25 U	25 U	25 U	25 U	25 U
Carbon Tetrachloride	1670	96	4340	3070	25 U	471
Chlorobenzene	25 U	25 U	25 U	25 U	25 U	25 U
Chloroethane	50 U	50 U	50 U	50 U	50 U	50 U
Chloroform	25 U	25 U	25 U	25 U	25 U	25 U
Chloromethane	50 U	50 U	50 U	50 U	50 U	50 U
Dibromochloromethane	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethene	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethene (total)	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloropropane	25 U	25 U	25 U	25 U	25 U	25 U
trans-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
cis-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
Ethylbenzene	25 U	25 U	25 U	25 U	25 U	25 U
2-Hexanone	50 U	50 U	50 U	50 U	50 U	50 U
4-Methyl-2-Pentanone	50 U	50 U	50 U	50 U	50 U	50 U
* Methylene Chloride	167	25 U	56	215	117	88
Styrene	25 U	25 U	25 U	25 U	25 U	25 U
1,1,2,2-Tetrachloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Tetrachloroethene	25 U	25 U	62	37	25 U	25 U
Toluene	25 U	25 U	25 U	25	25 U	25 U
1,1,1-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1,2-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Trichloroethene	25 U	25 U	25 U	25 U	25 U	25 U
Vinyl Chloride	50 U	50 U	50 U	50 U	50 U	50 U
Xylene (total)	25 U	25 U	25 U	25 U	25 U	25 U

* Suspected Laboratory Contaminant

B - Detected in Lab Blank. U - Below Reported Quantitation Level. J - Estimated Value.

WHC-SD-EN-TI-202, Rev. 0
MARYLAND SPECTRAL SERVICES, INC.
1500 Caton Center Drive Baltimore, MD 21227

VOLATILE ORGANICS BY EPA GC/MS METHOD MODIFIED 8240

CLIENT SAMPLE ID:	TRAP-V5	TRAP-V6	TRAP-V7	TRAP-V8	TRAP-V9	TRAP-W0
	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W
LAB SAMPLE ID:	93080435	93080436	93080437	93080438	93080439	93080440
RECEIVED DATE:	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93
ANALYSIS DATE:	08/08/93	08/08/93	08/08/93	08/08/93	08/08/93	08/08/93
FILE NAME:	080435	080436	080437	080438	080439	080440
INSTRUMENT ID:	MSD	MSD	MSD	MSD	MSD	MSD
UNITS:	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP
VOLATILE COMPOUNDS						
Acetone	50 U	50 U	50 U	55	50 U	50 U
Benzene	25 U	25 U	25 U	25 U	25 U	25 U
Bromodichloromethane	25 U	25 U	25 U	25 U	25 U	25 U
Bromoform	25 U	25 U	25 U	25 U	25 U	25 U
Bromomethane	50 U	50 U	50 U	50 U	50 U	50 U
2-Butanone	50 U	50 U	50 U	50 U	50 U	50 U
Carbon Disulfide	25 U	25 U	25 U	25 U	25 U	25 U
Carbon Tetrachloride	815	4450	4400	354	48	25 U
Chlorobenzene	25 U	25 U	25 U	25 U	25 U	25 U
Chloroethane	50 U	50 U	50 U	50 U	50 U	50 U
Chloroform	25 U	25 U	25 U	25 U	25 U	25 U
Chloromethane	50 U	50 U	50 U	50 U	50 U	50 U
Dibromochloromethane	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethene	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethene (total)	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloropropane	25 U	25 U	25 U	25 U	25 U	25 U
trans-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
cis-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
Ethylbenzene	25 U	25 U	25 U	25 U	25 U	25 U
2-Hexanone	50 U	50 U	50 U	50 U	50 U	50 U
4-Methyl-2-Pentanone	50 U	50 U	50 U	50 U	50 U	50 U
* Methylene Chloride	97	54	100	70	70	98
Styrene	25 U	25 U	25 U	25 U	25 U	25 U
1,1,2,2-Tetrachloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Tetrachloroethene	25 U	25 U	29	25 U	25 U	25 U
Toluene	25 U	25 U	27	47	25 U	25 U
1,1,1-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1,2-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Vinyl Chloride	50 U	50 U	50 U	50 U	50 U	50 U
Xylene (total)	25 U	25 U	25 U	40	25 U	27

* Suspected Laboratory Contaminant

B - Detected in Lab Blank. U - Below Reported Quantitation Level. J - Estimated Value.

WHL-SU-EN-11-202, Rev. U
MARYLAND SPECTRAL SERVICES, INC.
1500 Caton Center Drive Baltimore, MD 21227

VOLATILE ORGANICS BY EPA GC/MS METHOD MODIFIED 8240

CLIENT SAMPLE ID:	TRAP-W1	TRAP-W2	TRAP-W3	TRAP-W4	TRAP-W5	TRAP-W6
	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W
LAB SAMPLE ID:	93080441	93080442	93080443	93080444	93080445	93080446
RECEIVED DATE:	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93
ANALYSIS DATE:	08/08/93	08/08/93	08/08/93	08/08/93	08/08/93	08/08/93
FILE NAME:	080441	080442	080443	080444	080445	080446
INSTRUMENT ID:	MSD	MSD	MSD	MSD	MSD	MSD
UNITS:	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP
VOLATILE COMPOUNDS						
Acetone	52	50 U	50 U	50 U	50 U	50 U
Benzene	25 U	25 U	25 U	25 U	25 U	25 U
Bromodichloromethane	25 U	25 U	25 U	25 U	25 U	25 U
Bromoform	25 U	25 U	25 U	25 U	25 U	25 U
Bromomethane	50 U	50 U	50 U	50 U	50 U	50 U
2-Butanone	50 U	50 U	50 U	50 U	50 U	50 U
Carbon Disulfide	25 U	25 U	25 U	25 U	25 U	25 U
Carbon Tetrachloride	479	118	25 U	25 U	25 U	25 U
Chlorobenzene	25 U	25 U	25 U	25 U	25 U	25 U
Chloroethane	50 U	50 U	50 U	50 U	50 U	50 U
Chloroform	25 U	25 U	25 U	25 U	25 U	25 U
Chloromethane	50 U	50 U	50 U	50 U	50 U	50 U
Dibromochloromethane	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethene	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethene (total)	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloropropane	25 U	25 U	25 U	25 U	25 U	25 U
trans-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
cis-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
Ethylbenzene	25 U	25 U	25 U	25 U	25 U	25 U
2-Hexanone	50 U	50 U	50 U	50 U	50 U	50 U
4-Methyl-2-Pentanone	50 U	50 U	50 U	50 U	50 U	50 U
* Methylene Chloride	139	77	44	88	80	120
Styrene	25 U	25 U	25 U	25 U	25 U	25 U
1,1,2,2-Tetrachloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Tetrachloroethene	25 U	25 U	25 U	25 U	25 U	25 U
Toluene	25 U	25 U	25 U	25 U	25 U	25 U
1,1,1-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1,2-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Trichloroethene	25 U	25 U	25 U	25 U	25 U	25 U
Vinyl Chloride	50 U	50 U	50 U	50 U	50 U	50 U
Xylene (total)	25 U	25 U	25 U	25 U	25 U	25 U

* Suspected Laboratory Contaminant

B - Detected in Lab Blank. U - Below Reported Quantitation Level. J - Estimated Value.

WHC-SD-EN-TI-202, Rev. 0
MARYLAND SPECTRAL SERVICES, INC.
1500 Caton Center Drive Baltimore, MD 21227

VOLATILE ORGANICS BY EPA GC/MS METHOD MODIFIED 8240

CLIENT SAMPLE ID:	TRAP-W7	TRAP-W8	TRAP-W9	TRAP-X0	TRAP-X1	TRAP-X2
	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W
LAB SAMPLE ID:	93080447	93080448	93080449	93080450	93080451	93080452
RECEIVED DATE:	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93	08/04/93
ANALYSIS DATE:	08/08/93	08/08/93	08/08/93	08/08/93	08/09/93	08/09/93
FILE NAME:	080447	080448	080449	080450	080451	080452
INSTRUMENT ID:	MSD	MSD	MSD	MSD	MSD	MSD
UNITS:	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP
VOLATILE COMPOUNDS						
Acetone	50 U	50 U	50 U	50 U	50 U	60
Benzene	25 U	25 U	25 U	25 U	25 U	25 U
Bromodichloromethane	25 U	25 U	25 U	25 U	25 U	25 U
Bromoform	25 U	25 U	25 U	25 U	25 U	25 U
Bromomethane	50 U	50 U	50 U	50 U	50 U	50 U
2-Butanone	50 U	50 U	50 U	50 U	50 U	50 U
Carbon Disulfide	25 U	25 U	25 U	25 U	25 U	25 U
Carbon Tetrachloride	32	25 U	25 U	51	64	82
Chlorobenzene	25 U	25 U	25 U	25 U	25 U	25 U
Chloroethane	50 U	50 U	50 U	50 U	50 U	50 U
Chloroform	25 U	25 U	25 U	25 U	25 U	25 U
Chloromethane	50 U	50 U	50 U	50 U	50 U	50 U
Dibromochloromethane	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethene	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethene (total)	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloropropane	25 U	25 U	25 U	25 U	25 U	25 U
trans-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
cis-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
Ethylbenzene	25 U	25 U	25 U	25 U	25 U	25 U
2-Hexanone	50 U	50 U	50 U	50 U	50 U	50 U
4-Methyl-2-Pentanone	50 U	50 U	50 U	50 U	50 U	50 U
* Methylene Chloride	84	150	103	123	83	162
Styrene	25 U	25 U	25 U	25 U	25 U	25 U
1,1,2,2-Tetrachloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Tetrachloroethene	25 U	25 U	25 U	25 U	25 U	25 U
Toluene	25 U	25 U	25 U	25 U	25 U	25 U
1,1,1-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1,2-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Trichloroethene	25 U	25 U	25 U	25 U	25 U	25 U
Vinyl Chloride	50 U	50 U	50 U	50 U	50 U	50 U
Xylene (total)	25 U	25 U	25 U	25 U	25 U	25 U

* Suspected Laboratory Contaminant

B - Detected in Lab Blank. U - Below Reported Quantitation Level. J - Estimated Value.

WHC-SD-EN-TI-202, Rev. 0
MARYLAND SPECTRAL SERVICES, INC.
1500 Caton Center Drive Baltimore, MD 21227

VOLATILE ORGANICS BY EPA GC/MS METHOD MODIFIED 8240

CLIENT SAMPLE ID:	TRAP-X3	TRAP-X4	TRAP-X5	TRAP-X6	VBLK0806D1	VBLK0807D1
	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W	HANFORD-200-W		
LAB SAMPLE ID:	93080453	93080454	93080455	93080456	METHOD_BLANK	METHOD_BLA.
RECEIVED DATE:	08/04/93	08/04/93	08/04/93	08/04/93		
ANALYSIS DATE:	08/09/93	08/09/93	08/09/93	08/07/93	08/06/93	08/07/93
FILE NAME:	080453	080454	080455	080456	0806VBLK01	0807VBLK01
INSTRUMENT ID:	MSD	MSD	MSD	MSD	MSD	MSD
UNITS:	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP
VOLATILE COMPOUNDS						

Acetone	50 U	50 U	50 U	50 U	50 U	50 U
Benzene	25 U	25 U	25 U	25 U	25 U	25 U
Bromodichloromethane	25 U	25 U	25 U	25 U	25 U	25 U
Bromoform	25 U	25 U	25 U	25 U	25 U	25 U
Bromomethane	50 U	50 U	50 U	50 U	50 U	50 U
2-Butanone	50 U	50 U	50 U	50 U	50 U	50 U
Carbon Disulfide	25 U	25 U	25 U	25 U	25 U	25 U
Carbon Tetrachloride	25 U	25 U	25 U	25 U	25 U	25 U
Chlorobenzene	25 U	25 U	25 U	25 U	25 U	25 U
Chloroethane	50 U	50 U	50 U	50 U	50 U	50 U
Chloroform	25 U	25 U	25 U	25 U	25 U	25 U
Chloromethane	50 U	50 U	50 U	50 U	50 U	50 U
Dibromochloromethane	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethene	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethene (total)	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloropropane	25 U	25 U	25 U	25 U	25 U	25 U
trans-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
cis-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
Ethylbenzene	25 U	25 U	25 U	25 U	25 U	25 U
2-Hexanone	50 U	50 U	50 U	50 U	50 U	50 U
4-Methyl-2-Pentanone	50 U	50 U	50 U	50 U	50 U	50 U
* Methylene Chloride	52	78	27	86	25 U	25 U
Styrene	25 U	25 U	25 U	25 U	25 U	25 U
1,1,2,2-Tetrachloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Tetrachloroethene	25 U	25 U	25 U	25 U	25 U	25 U
Toluene	25 U	25 U	25 U	25 U	25 U	25 U
1,1,1-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1,2-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Trichloroethene	25 U	25 U	25 U	25 U	25 U	25 U
Vinyl Chloride	50 U	50 U	50 U	50 U	50 U	50 U
Xylene (total)	25 U	25 U	25 U	25 U	25 U	25 U

* Suspected Laboratory Contaminant

B - Detected in Lab Blank. U - Below Reported Quantitation Level. J - Estimated Value.

MARYLAND SPECTRAL SERVICES, INC.
1500 Caton Center Drive Baltimore, MD 21227
WHC-SD-EN-TI-202, Rev. 0
VOLATILE ORGANICS BY EPA GC/MS METHOD MODIFIED 8240

CLIENT SAMPLE ID: VBLK080801

LAB SAMPLE ID: METHOD_BLANK

RECEIVED DATE:

ANALYSIS DATE: 08/08/93

FILE NAME: 0808VBLK01

INSTRUMENT ID: MSD

UNITS: NG/TRAP

VOLATILE COMPOUNDS

Acetone	50	U
Benzene	25	U
Bromodichloromethane	25	U
Bromoform	25	U
Bromomethane	50	U
2-Butanone	50	U
Carbon Disulfide	25	U
Carbon Tetrachloride	25	U
Chlorobenzene	25	U
Chloroethane	50	U
Chloroform	25	U
Chloromethane	50	U
Dibromochloromethane	25	U
1,2-Dichloroethane	25	U
1,1-Dichloroethane	25	U
1,1-Dichloroethene	25	U
1,2-Dichloroethene (total)	25	U
1,2-Dichloropropane	25	U
trans-1,3-Dichloropropene	25	U
cis-1,3-Dichloropropene	25	U
Ethylbenzene	25	U
2-Hexanone	50	U
4-Methyl-2-Pentanone	50	U
Methylene Chloride	25	U
Styrene	25	U
1,1,2,2-Tetrachloroethane	25	U
Tetrachloroethene	25	U
Toluene	25	U
1,1,1-Trichloroethane	25	U
1,1,2-Trichloroethane	25	U
Trichloroethene	25	U
Vinyl Chloride	50	U
Xylene (total)	25	U

B - Detected in Lab Blank. U - Below Reported Quantitation Level. J - Estimated Value.

APPENDIX B
LITHOLOGIC AND CONSTRUCTION DATA FOR NEW WELLS

APPENDIX B.1
BOREHOLE LOGS

BOREHOLE LOG

Boring or Well No. 299-W15-218Sheet 1 of 14Location 200W - N of Z-9 TrenchProject CC14 ERAElevation NGVD '29 665.3' Brass CapDrilling Contractor KEHDriller M. WaspiyDrilling Method and Equipment Cable Tool BE22WPrepared By John Flinn (Sign/Print Name)Date 2/4/93Reviewed By KS. Smith (Sign/Print Name) Date 2-19-93

Depth (Feet)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
5	RAD Asbestos	Drive Barrel		0-1' Sandy GRAVEL (Stabilization Fill) 75% Gravel 25% Sand 20% lc 40% vcs 20% sc 40% cs 20% vcp-cp 20% fs-vfs 20% mp Dry 10 YR 7/6 20% fp-vfp Wet 10 YR 4/6 Slightly moist, poorly sorted, rounded to subangular, subdisoidal to subprismatic 40% Basalt, 30% Qtz Andesite, 30% feldspar	Advancing 16" Casing with Drive Shoe Note: Construction debris @ 4 ft (Nails, wood)
				1' SAND (Fill) 95% Sand, 5% silt 50% ms Dry 10 YR 5/3 50% fs-vfs Wet 10 YR 4/3 Slightly moist, well sorted	Start 2/4/93 at 0735 Casing 4.13'; Hole 5.0 ft VOA Sample at 0820 2/4/93 PUL HEIS # B01 MT6
	VOA RAD			7.5' SAND 95% Sand, 5% silt 75% Fine sand, 20% Very fine sand, 5% silt Moist from condensation; very well sorted	VOA Sample 0915 9.0-10.0 2/4/93 # B01 MT7
10	VOA RAD			55% Qtz, 40% Basalt, 5% Mica (Biotite, Muscovite) Flaky; Qtz and Basalt subrounded to subangular, iron staining present on some grains, No cementation present	Lah results from HEHP indicate no asbestos Trace of cellulose (wood)
13				10' 100% SAND 8% fine sand 20% very fine sand, trace of silt very well sorted Color 10 YR 5/2, Slightly moist due to condensation 60% Qtz, subrounded to sub- angular 35% Basalt subrounded to subangular	No Hazards indicated
				5% flaky mica (biotite, muscovite) and iron stained Quartz. No cementation present.	End of day 2/4/93 Hole = 11.0 ft
				11' SAND 50% Medium sand 30% ^{fine sand} fine sand, 20% very fine sand, Slightly moist, well sorted, subrounded to subangular 60% Quartz (Quartzite), 30% Basalt, 10% K Feldspar (white prismatic) and mica, subhedral shape (biotite and muscovite) Color 10 YR 5/3 (Wet)	Depth 11.0 ft

BOREHOLE LOG

Boring or Well No. 299-W15-218

Sheet 2 of 14

Location 200W-N of Z-9 Trench

Project CCL4 ERA

Elevation NAVD '29 665.36' Bore Cap

Drilling Contractor KEH

Driller M. W. Caspir

Drilling Method and Equipment Cable Tool BE27W

Prepared By John Flinn Date 2/8/93

Reviewed By K. J. Smith Date 3-19-93

(Sign/Print Name)

(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
10'				13' Same as above (SAND)	OVM = 5 ppm
				13.5' Gravelly SAND (85% Sand, 15% Gravel)	OVM = 0 ppm
				50% mp 5% VCS-CS	No dry color or HCl test due
				50% Fp-Vp 10% MS	to containment for possibility
				wet-2.5.4.4/2 85% FS-VFS	of asbestos content. We are
				Slightly moist, moderately sorted, subrounded	drilling through fill and possible
				to subangular, mostly spherical, some micromodal	construction debris. No
	2 VOA			40% Basalt, 40% Qtz, 20% Felsics, occasional beds	asbestos has been encountered.
15	1 Rad			of slightly silty Gravelly SAND. CaCO ₃ rinds present	
				on few pebbles	SAMPLE B01MT8 B01MT9
				15' Same as above	2/5/93, 0900, VOA & Rad (14'-15')
				17' Same as above	
				18' Decreasing gravel, mostly medium	
				to coarse sand	
	1 VOA			20' Slightly Gravelly SAND (90% Sand, 10% Gravel)	SAMPLE B01MV1
20'	1 Rad			40% VCS-CS	2/5/93, 1025, VOA & Rad (19'-20')
				20% MP 30% MS wet-2.5.4.4/2	
				80% Fp-Vp 30% FS-VFS	CaCO ₃ rinds present on
				Slightly moist, moderately sorted, subround	few pebbles.
				to subangular, spherical, 50% Basalt.	Most CS & VCS is basalt, most
				40% Qtz, 10% Felsics	MS, FS, & VFS is Qtz.
				22' Sand GRAVEL (60% Gravel, 40% Sand)	No CaCO ₃ rinds
				2% MP 80% CS-VCS wet-10.4/2/1	No Stratification
				98% Fp-Vp 20% MS	
25'	1 VOA			Moist, well sorted, angular to subangular,	
	1 Rad			spherical, 90% Basalt, 10% Qtz & Felsics	
				25' Same as above. Less moist	SAMPLE B01MV3
					2/8/93, 1005, VOA, Rad (25'-26')
30'	1 VOA				
	1 Rad				

B.1-4

30' sample - see next page

2-0000-182 0490)

BOREHOLE LOG

Boring or Well No. 299-W15-218Sheet 3 of 14Location 200 W - N of Z-9 TrenchProject CC14 ERAElevation NGVD '29 665.36' Brass CapDrilling Contractor KEHDriller M. W. CaspirDrilling Method and Equipment Cable Tool - BEZZWPrepared By John Flinn
(Sign/Print Name)Date 2/10/93Reviewed By K.S. Smith
(Sign/Print Name) Date 3-19-93

Depth (Feet)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
30'				30' Gravelly SAND (70% Sand, 30% Gravel) 5% Vcp-Cp 20% Vp-cs wet 5.43/1 30% Mp 30% Ms Dry 10.4R 5.5/1 65% Sp-vfp 50% Ps-vfs Slightly moist, moderately sorted, subangular to rounded, subdiscoidal to subprismatic 80% Basalt 20% Qtz & Felsics, Tr. Micas Weak reaction to HCl	No Stratification observed SAMPLE B01 MV5 2/18/93, 1105 VOA Rad, CaCO ₃ Moisture (29'-30' (see previous page)) End Shift 2/9/93 - 31'
35'	VOA, RAD CaCO ₃ Moisture			35' Slightly Gravelly SAND (90% Sand, 10% Gravel) 2% Sc - 18" Qtzite cobble 2% Cp-Vcp 20% Cs-Vcs 20% Mp 60% Ms 76% Sp-vfp 20% Ps-vfs Wet - 10.4R 3/3, Dry 2.54 7/10 Moist, Moderately sorted, sand is angular to subangular, pebbles and cobbles are subround to round. Sand & Sp - 60% Basalt 20% Qtz, 20% Felsics Prismatic to spherical to discoidal. Trace Muscovite, No reaction to HCl	SAMPLE B01 MV 7 35' 2/19/93, 0905, VOA, Rad, Moisture, CaCO ₃ (34'-35')
40'	VOA RAD CaCO ₃ Moisture			37' Formation is coarsening - higher proportion of pebbles	END shift 2/9/93 - 40'
45'	Rad CaCO ₃ Moisture			40' Sandy GRAVEL (60% Gravel, 40% Sand) 42' GRAVEL (90% Gravel, 10% Sand) 5% lc Wet 10.4R 4/1 5% Sc Dry 10.4R 8/1 30% Vcp-Cp 75% Cs-Vcs 30% Mp 20% Ms 30% Sp-vfp 5% Ps-vfs - trace silt Moist - Very poorly sorted, subround to subangular, subprismatic to subdiscoidal Sand - 20% Basalt 20% Qtz & Felsics Gravel - 90% Basalt - Moderate reaction to HCl	SAMPLE B01 MW1 42' 2/10/93, 1100, VOA, Rad, CaCO ₃ , Moisture (41'-43') Some clumps of weakly cemented material - strong reaction to HCl Interbedded Sand & Gravel SAMPLE B08433-45' 2/10/93, 1107 Rad CaCO ₃ , Moisture (43'-45.5')
50'				B.1-5 45' Same as above	

BOREHOLE LOG

Boring or Well No. 299-W15-218Sheet 4 of 14

Location 200W-N of B-9 Trench Project CCly ERA
 Elevation NGVD '29 665.36' Brass Cap Drilling Contractor KEH
 Driller M. Wraspik Drilling Method and Equipment Cable Tool - BE 22W
 Prepared By John Flinn Date 2/11/93 Reviewed By R.J. Snott Date 3-19-93
 (Sign/Print Name) (Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
48.5'				Formation becoming sandier	
49'-50'				Few lumps of silt, possibly little clay	
50'				51' Sandy GRAVEL (75% Gravel, 25% Sand) 5% lc Wet - 5.4 2.5/1 15% sc Dry - 2.5 4 6/10 23% CP-VCS 50% CS-VCS 24% MP 30% MS 22% FS-VFS 20% FS-VFS Moist - Very poorly sorted, sand is subangular gravel is subround, subdiscoidal to sub- prismatic, Sand - 60% Basalt, 40% Qtz & felsics, gravel same w/ some metamorphics. Weak reaction to HCl	SAMPLE B01MW2 51' 2/10/93, 1400 VOA, Rad, CaCO ₃ Moisture (50.5-58.5)
52.5'	VOA, Rad CaCO ₃ Moisture VOA Rad			52.5' Drive Barrel contains large size fragment of Clastic Dike, vertical irregularly bedded silty clay, silt and medium to fine sand. Other material in DB is sand & gravel.	SAMPLE B01MW3 52.5' 2/11/93, 0855 VOA, Rad CaCO ₃ , Moisture (51.5-52.5) QWL Headspace: 8.6 ppm
53.5'				53.5' DB contains ~0.5' of well- sorted sand - fine & medium. Upper 1.0' to 0.5' is sand and gravel	
55'	VOA Rad CaCO ₃ Moisture			55' SAND (100% Sand) 20% CS-VCS Wet 2.5 4 6/13 60% MS Dry 2.5 4 7/3 20% FS-VFS Moist, very well sorted, angular to sub- angular, subdiscoidal to subprismatic, 90% Qtz, 10% Basalt. Also - Clastic Dike present in DB, ~20cm wide, vertically laminated, silt, clayey silt, silty clay, runs for 2' length of DB. Also - 2cm to 20cm lumps of fines similar to Clastic Dike Material. Weak reaction to HCl	SAMPLE B01MW4 55' 2/11/93, 0930 VOA, Rad, CaCO ₃ , Moisture (53.5-55') QWL Headspace: 6.2 ppm Material is stratified. No CaCO ₃ cementation
				B.1-6	
57'				Same as above - No clastic Dike	

BOREHOLE LOG

Boring or Well No. 299-W15-213

Sheet 5 of 14

Location 200W-N of Z9 Trench

Project CCL4 ERA

Elevation NGVD'29 665.36 Brass Cap

Drilling Contractor KEH

Driller M. Wragg

Drilling Method and Equipment Cable Tool, BEZZW

Prepared By J. R. / John Flinn

Date 2/2/93

Reviewed By K. Smith

Date 3-19-93

(Sign/Print Name)

(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
				59' Same as above (SAND)	
				60' SAND (95% Sand, 5% Gravel)	SAMPLE B01NV5 60'
				100% FS-VFS	2/11/93, 1055, VOA Rad.
				70% CS-VCS Wet - 10 GR 5/3	CaCO ₃ Moisture (59.9' - 60.5')
				20% MS Dry - 10 GR 7/2	OVH Headspace: 0 ppm
				10% FS-VFS	
				Moist, well sorted, angular to subangular,	Few small clumps of CaCO ₃
				subdiscoidal to subprismatic, VCS & larger	Cemented sand, no CaCO ₃
				is 90% Basalt CS & smaller is 80% Qtz, iron gravel	
				& felsic, 20% Basalt, weak reaction to HCl.	
				Above material is interbedded w/ ~0.3' Coarse material is non-cohesive	
				thick layer of SAND (100% Sand trace silt)	Finer material is slightly cohesive
				5% CS wet - 10 GR 5/6	
				60% MS Dry - 10 GR 7/2	
				35% FS-VFS	
				Moist, very well sorted angular to sub-	
				angular, subdiscoidal to subprismatic	
				90% Qtz, 10% basalt basalt is mostly	END Shift 2/11/93 - 61'
				coarser fraction. Moderate reaction to HCl.	
				62' Same as above - trace gravel	
				64' Formation appears stratified - more	
				coarse sand.	
				65' SAND (100% Sand)	SAMPLE B01NV7 65'
				20% CS-VCS wet - 10 GR 6/4	2/12/93, 0955, VOA Rad.
				60% MS Dry - 10 GR 8/2	CaCO ₃ Moisture (64.5' - 65.5')
				20% FS-VFS	OVH Headspace: 0 ppm
				Moist, Very well sorted, angular to sub-	
				angular, subdiscoidal to subprismatic	
				90% Qtz, 10% Basalt, trace muscovite	Interbedded w/ ~1cm bed of
				and magnetite, weak reaction to HCl	medium sand.

Seamist OVM = 14.2 ppm @ 59.9'

BOREHOLE LOG

Boring or Well No. 299-W15-218

Sheet 6 of 14

Location 200W-N of Z-9 Trench Project CC14
 Elevation NGVD '29 645.36 Brass Cap Drilling Contractor KEH
 Driller M. Waspir Drilling Method and Equipment Cable Tool - BEZZW
 Prepared By John Flinn Date 2/12/93 Reviewed By KJ Snott Date 3-19-93
 (Sign/Print Name) (Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
70'	VOA, Rad CaCO ₃ Moisture			70' SAND (95% Sand, 5% Gravel) 100% Sp-vfp 20% CS-VCS Wet- 10YR 6/4 50% MS Dry- 10YR 7/2 30% fs-vfs Moist, well sorted, angular to subangular, (some gravel subrounded) subdiscoidal to subprismatic, 70% Qtz, 30% Basalt (most basalt is coarse fraction) No micas observed, trace magnetite. Weak reaction to HCl	SAMPLE B01NV3 70' 2/12/93 1035, VOA, Rad. CaCO ₃ , Moisture (69.5-70.5') OVM Headspace = 0ppm No observed stratification
				74' Silt layer ~ 4 cm thick, 4 beds 1.5 to 0.5 cm thick	
75'	VOA, Rad CaCO ₃ Moisture			75' SAND (99% Sand, 1% Gravel) 100% Sp-vfp 30% CS-VCS Wet- 10YR 7/4 40% MS Dry 10YR 6/2 30% fs-vfs Moist, Very well sorted, subangular to angular, subprismatic to subdiscoidal, 80% Qtz, 20% Basalt, trace mica & magnetite, moderate reaction to HCl	SAMPLE B01NV9 75' 2/12/93, 1100, VOA, Rad CaCO ₃ , Moisture (74.5-75.5') Sand contains small lumps of silt.
80'	VOA Rad CaCO ₃ Moisture			80' SAND (99% Sand, 1% Gravel) 100% vfp 50% CS-VCS Wet- 10YR 6/6 30% MS Dry- 10YR 7/2 20% fs-vfs Moist, very well sorted, subangular to angular subprismatic to subdiscoidal, 80% Qtz, 20% Basalt, trace micas & magnetite, weak reaction to HCl	SAMPLE B01NV6 (80') 2/12/93-1124, VOA, RAD CaCO ₃ , Moisture (78.5-80') OVM Headspace = 0ppm Contains lumps of medium & fine sand, some are tabular coarse portion not cohesive, fine portion slightly cohesive
				81' Stratified silty fine SAND below ~ 80.5', to ~ 82'	OVM - 0ppm 1' above cuttings

BOREHOLE LOG

Boring or Well No. 299-W15-218

Sheet 7 of 14

Location 200W-N of Z-9 Trench Project CC14 ERA
Elevation NGVD '29 665.36' Brass Cap Drilling Contractor KEH
Driller M. Wraspir Drilling Method and Equipment Cable Tool BEZZW
Prepared By John Flinn Date 2/16/93 Reviewed By K.J. Smith Date 3-19-93
(Sign/Print Name) (Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
85'	VOA Rad. CaCO ₃ Moisture			85' SAND (100% Sand) 10% CS-VCS 40% MS Wet 10.4R 6/4 50% FS-VFS Dry 10.4R 8/1 Moist, very well sorted, angular to sub- angular, subprismatic to subdiscoidal, 95% Qtz, 5% Basalt Trace mica & magnetite, No reaction to HCl	SAMPLE B01NW0 85' 2/16/93 0747 110H Rad. CaCO ₃ Moisture (83.5-95') OVM Headspace = 0 ppm
90'	VOA Rad. CaCO ₃ Moisture			90' SAND (100% Sand) 5% CS-VCS 20% MS Wet 10.4R 7/6 75% FS-VFS Dry 10.4R 7/1 Moist, Very well sorted, subangular to angular, subdiscoidal to subprismatic 95% Qtz, 5% Basalt, trace mica & magnetite, STRATIFIED ~ 90.5' Fine and very fine sand very well sorted, coarser fraction is not cohesive and has no reaction to HCl, finer fraction is slightly cohesive & has weak reaction to HCl.	SAMPLE B01NW1 90' 2/16/93 0815 VOA RAD. CaCO ₃ Moisture (89.5-91') OVM Headspace = 82.9 ppm
92'				92' Same as above, with 5% to 10% medium to fine pebbles, stratification observed including 0.5 to 2.0 cm, medium sand interbedded w/ fine sand	END Shift - 92'
95'	VOA Rad. CaCO ₃ Moisture			95' S Gravelly SAND (95% Sand, 5% Gravel) 20% MS 80% FS-VFS Wet 10.4R 6/6 30% CS-VCS Dry 10.4R 7/3 40% MS 30% FS-VFS Moist, well sorted angular to subangular, subdiscoidal to subprismatic (some is subrounded) Sand: 80% Qtz, 20% Basalt, Gravel: 75% Basalt, 25% Quartzite, Armitonite, Metamorphics, Trace mica & Magnetite, No reaction to HCl	SAMPLE B01NW3 95' 2/17/93 0742 T/M Mazoni VOA Rad. CaCO ₃ Moisture (93.8'-95.5') OVM Headspace = 2.4.7 ppm Vertical stratification observed. Medium & coarse sand fine sand layer ~ 1cm thick, silty sand layer ~ 3cm thick. Few silt skins on gravel.

BOREHOLE LOG

Boring or Well No. 299-W15-218Sheet 8 of 14Location 200W-N of Z-9 TrenchProject CC14 ERAElevation NGVD '29 645.36' Brass CapDrilling Contractor KEHDriller M. WaspirDrilling Method and Equipment Cable Tool - BE22WPrepared By John Flinn
(Sign/Print Name)Date 2/17/93Reviewed By R.J. Short
(Sign/Print Name)Date 3-19-93

Depth (Feet)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
100'	VOA, Rad Moisture CaCO ₃			100' Gravelly SAND (80% Sand, 20% Gravel) 100% Fp Wet 104R 4/3 50% CS-VCS Dry 104R 7/3 30% MS 20% FS-VFS Very Moist, Moderately sorted, Sand, subangular to angular, Gravel; subround to subangular, both subangular, subdiscoidal to subprismatic, Sand; 80% Qtz, 15% Basalt Gravel; 75% Basalt, 15% Qtzite & Granitoids, Weak reaction to HCl	100' Sample B01 NW2 (985' 100.5') VOA, Rad, CaCO ₃ , Moisture, 2/17/93 1020 Contains lumps of finer material - No stratification obs.
105'	VOA Rad CaCO ₃ Moisture			101' - Stratified; Medium sand & Fine sand 101.5-103 Alternating moist/drier beds, Silt layers up to 3cm thick, mostly Sand	SIP reading - 2.5 ppm - cuttings OVM Headspace - 14.2 ppm OVM - 2.5 ppm @ 1" above cuttings
110'	VOA Rad CaCO ₃ Moisture			104.5 SAND (98% Sand, 2% Gravel) 100% Fp 50% CS-VCS Wet 104R 6/3 30% MS Dry 104R 7/2 20% FS-VFS Moist, well sorted, angular to subangular subprismatic to subdiscoidal, 75% Qtz & Felsics, 25% Basalt, trace micas. No reaction to HCl	104.5' Sample B01 NW5 (103'-104.8') VOA, Rad, Moisture CaCO ₃ , 2/17/93 1345 OVM Headspace = 1.2 ppm
115'				107' Sharp Contact - Very fine & fine sand below 107' 110' Silty SAND 66% Sand 34% Silt 100% FS-VFS wet - 104R 5/3 trace MS Dry 104R 8/2 Moist, very well sorted, angular to subangular, subprismatic to subdiscoidal, 98% Qtz, 2% Basalt Dilatancy - Rapid; Thread - weak and soft Slight Plasticity - Moderate reaction to HCl	Touchet Beds Stratified - Silty sand and very fine and fine sand OVM Headspace = 58.6 ppm 110' Sample B01 NW4 (109'-110.5') VOA Rad, CaCO ₃ , Moisture 2/17/93 - 1415 OVM Headspace = 58.6 ppm End Shift - Hole to 111', Casing to 97' 2/17/93
				Contact w/ Caliche at 115' - sharp contact. Sandy SILT w/ intercalated beds of fine and very fine SAND above 115'	

OVM = 590 ppm @ 111.8'

BOREHOLE LOG

Boring or Well No. 299-W15-218Sheet 9 of 14Location 200 West N. of Z-9 TrenchProject CC14 ERAElevation NAD 83 165.36' Bench CapDrilling Contractor KEHDriller M. WaspirDrilling Method and Equipment Cable Tool - BE22WPrepared By John Flinn (Sign/Print Name)Date 3/8/93Reviewed By KJ Swift (Sign/Print Name) Date 3-19-93

Depth (Feet)	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery		Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
115'				116' CATCHE Gravelly SAND (30% CaCO ₃ , 50% Sand, 20% Gravel) Wet 10 YR 7h. Cementation inter-faces w/ grain size estimate. Moist, poorly sorted, gravel is subround, 100% basalt. Very strong reaction to HCl	SAMPLE B08434 (116.3-117.3) 2/23/94-1430 Split Spoon Sample for physical properties SAMPLE B01P75 & B01P76 116.5' (115-117') 2/24/93-1450 VOA (dup) Rad, CaCO ₃ , Moisture OVM Headspace = 148 ppm
				120' Sandy GRAVEL (60% Gravel, 38% Sand, 2% Silt) Wet 10 YR 5/3	Gradational contact ~ 119.5' (118.5)
	2 VOA Rad CaCO ₃ Moisture	Drive Barrel Split Spoon 1, 2, 9, 99, 258		25% SC 33% s-s Dry 10 YR 7/3 25% CP 34% ms 25% MP 33% fs-ufs 25% f p	SAMPLE B01P77 - 120' (119.5' - 120') 2/25/93 @ 1370 VOA Rad, CaCO ₃ , Moisture OVM Headspace = 0.7
	Physical Characteristics			Slightly Moist, very poorly sorted, Sand - angular to subangular, subprismatic to sub- discoidal, Gravel angular to rounded, sub- discoidal to subprismatic. Sand - 60% Qtz 40% Basalt, Gravel - 33% Basalt, 33% Qtzite 34% Metamorphics Strong reaction to HCl	Some CaCO ₃ rinds on Gravel END Shift 2/25/93 120'
	VOA, Rad Moisture, CaCO ₃	Drive Barrel		122' Cuttings contain many broken cobbles, probably up to 10" dia. - Discoidal to subdiscoidal, subrounded. Very Hard Drilling	END Shift 3/2/93 123'
120'				125' Silty Sandy GRAVEL (Hard tool) (80% Gravel, 15% Sand, 5% silt) Wet 10 YR 5/2 Dry 10 YR 7/1 Gravel - 50% Basalt, 20% Metamorphics, 20% Qtzite, 10% Gneissoids. Sand, same Weak reaction to HCl	End Drive Barrel, Begin Hard tool 123' SAMPLE B08435-125' (123 to 125') Hard Tool 3/9/93 0915. VOA, Rad, CaCO ₃ OVM Headspace = 10.7 ppm Ringold Formation Driller reports abundant cobbles, very hard drilling
125'	VOA Rad CaCO ₃	Hard Tool			

B.1-11

Seamist OVM = 15.6ppm @ 126.6

BOREHOLE LOG

Boring or Well No. 299-W15-218Sheet 10 of 14Location 200 W. Naf Z-9 TrenchProject CC14 ERAElevation NGVD '29 165.36' Brass CapDrilling Contractor KEHDriller M. WrasperDrilling Method and Equipment Cable Tool - BE22WPrepared By John FlinnDate 3/10/93Reviewed By John FlinnDate 3-19-93

(Sign/Print Name)

(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
130	VOA Rad CaCO ₃	Hard Tool Drive Rate Blows Recovery		130' Same as above - More Qtz	SAMPLE B08436 - 130' (128.5' to 130') 3/8/93 - 1350
				134' Driller reports Sand - Sharp Contact	VOA, Rad, CaCO ₃ OVM Headspace: 25.3 ppm END Shift 3/8/93 - 131'
				135' SAND (From Hand Tool slurry)	
				10 YR 5/3, contains some gravel, probably cuttings chips from above.	SAMPLE B08437 - 135' (134' to 135') 3/9/93 - 1115
				136' SAND (100% Sand)	VOA, Rad, CaCO ₃ OVM Headspace: 30.2 ppm
				20% cs-vc's wet 10 YR 5/3	
				60% ms Dry 10 YR 8/1	
				20% fs-vc's	Change to Drive Barrel @ 135'
				Slightly Moist, very well sorted, angular to subangular, subdisoidal to subprismatic,	136' OVM Headspace: 6.1 ppm appears stratified - 2 cm layer fs & vc's w/ some silt
				85% Qtz, 15% Basalt, Trace Micras. Weak reaction to HCl.	139' OVM Headspace: 0 ppm
135	VOA Rad CaCO ₃	Drive Barrel		139' Same as above.	
				140' Same as above - Stratified with Sandy GRAVEL, Layer 40 to 20 cm thick, 80% Mps & P, 80% Granitoids & metamorphics 10% Qtzite, 10% Basalt.	SAMPLE B01P79 - 140' (139' to 141') 3/9/93 - 1418 VOA, Rad, CaCO ₃ , Moisture OVM Headspace: 3 ppm
				rounded to subrounded, subprismatic to sub- disoidal. Strong reaction to HCl	Sand cemented to gravel - strong reaction to HCl END Shift 3/9/93 - 141'
				143' Slightly Silty SAND (97% Sand, 3% silt)	Sharp Contact at 143' Contact has 30 cm layer of cemented sand - strong reaction to HCl
140	VOA Rad CaCO ₃ Moisture	Drive Barrel		100% fs & vc's Dry 10 YR 7/2	Intercalated with silty SAND layers, 5 to 10 cm bedding
				Slightly moist, very well sorted, subangular to angular, subprismatic to subdisoidal,	
				99% Qtz, 2% Basalt, Strong reaction to HCl	

BOREHOLE LOG

Boring or Well No. 299-W15-218Sheet 11 of 14Location 200 West. N of Z-9 TrenchProject CC14 ERAElevation NAD '29 1465.34' Brass CapDrilling Contractor KEHDriller M. WaspirDrilling Method and Equipment Cable Tool BE22WPrepared By Jol. Al. / John Flinn Date 3/10/93Reviewed By KEH KJ. Smith Date 3-19-93

(Sign/Print Name)

(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description		Comments
	Type and No.	Blows or Recovery		Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level	
145'	VOA Rad CaCO ₃ Moisture			145' SAND (100% Sand) 15% cs-vcs wet-104R6/4 50% ms Dry-104R7/1 35% fs-vfs Slightly moist, very well sorted, angular to subangular, subprismatic to subdiscoidal 98% Qtz, & felsics, 2% Basalt, Trace micros. Strong reaction to HCl.	SAMPLE BOIP80-145' (144.5' to 145.3') 3/10/93 1050 VOA, Rad, CaCO ₃ , Moisture OVM Headspace = 117 ppm	Moderately cemented. Cohesive Coarsening downward
				Sharp Contact at 148'		
149'	VOA Rad CaCO ₃ Moisture			149' Sandy GRAVEL (50% Sand, 50% Gravel) Color: Salt & Pepper wet-104R4/1 50% MP 70% cs-vcs Dry 104R6/1 50% SP 20% ms 10% fs-vfs Trace silt Almost dry, poorly sorted, Sand angular to subangular, Gravel subangular to sub- rounded. Subdiscoidal to Subprismatic. Gravel 98% Basalt, 2% Qtzite. Sand 70% Basalt, 30% Qtz. & felsics. Strong reaction to HCl.	Gravel has rinds of cemented Sand. Will not rub off, strong reaction to HCl	
150'	VOA Rad CaCO ₃ Moisture			150' Same as above	SAMPLE BOIP81-150' (149' to 150') 3/10/93 1250	
				153' Coarsening downward. More & larger Gravel.	VOA, Rad, CaCO ₃ , Moisture OVM Headspace = 1.2 ppm	
155'	VOA Rad CaCO ₃ Moisture			155' Slightly Silty, Sandy, GRAVEL (80% Gravel, 18% Sand, 2% Silt) 30% CP 40% vcs-cs wet-104R 5/3 30% MP 30% ms Dry-104R 7/1 40% fs 30% fs-vfs Dry, very poorly sorted, Sand subangular to angular, Gravel subangular to subround subdiscoidal to subprismatic, Gravel- 60% Basalt, 20% Qtzite, 20% Granitoids & Metamorphics, Sand 40% Basalt, 60% Qtz & felsics. Weak reaction to HCl	SAMPLE BOIP82-155' (154.5-155.5) 3/10/93 1430 VOA, Rad, CaCO ₃ , Moisture OVM Headspace = 0 ppm	
160'	VOA Rad CaCO ₃ Moisture			156' Continues to coarsen downward	End Shift 156', 3/10/93	

OVM = 0.0 ppm @ 120.1

BOREHOLE LOG

Boring or Well No. 299-W15-218Sheet 12 of 14Location 200W-N of Z-9 TrenchProject CC14 ERAElevation NAVD'29 465.36' Braid OpDrilling Contractor KEHDriller M. WraspirDrilling Method and Equipment Cable Tool- BEZZWPrepared By John Flian
(Sign/Print Name)Date 3/12/93Reviewed By K.J. Smith
(Sign/Print Name) Date 3-19-93

Depth (Feet)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
160'				158' continues to coarsen, silt proportion also increases	Very hard drilling.
				160' Same as above	SAMPLE B01P23 - 160' (159' to 160') 3/11/93 - 0835
				165' Same as above - increasing finer is pulverized cobbles, some cementing material has strong reaction to HCl	VOA, Rad, CaCO ₃ , Moisture OVM Headspace = 0 ppm
165'	VOA Rad CaCO ₃ Moisture			High proportion of gravel is Quartzite.	SAMPLE B01P34 165' (164' to 165') 3/11/93 - 1350
				170' - Same as above	VOA, Rad, CaCO ₃ , Moisture OVM Headspace = 0 ppm
				171.5 SAND (100%) dry 109R 7/2 wet 109R 4/3	END Shift 3/11/93 - 1600
				20% MS	Begin Shift 3/12/93
				80% fs-ufs	SAMPLE B01P35 170' (168' to 170') 3/12/93 - 0811
				Dry - very well sorted, subround to subangular, subdisoidal to subprismatic	VOA, Rad, CaCO ₃ , Moisture
170'	VOA Rad CaCO ₃ Moisture			98% Qtz, 2% basalt, trace micas.	OVM Headspace = 0
				No reaction to HCl	Sharp Contact @ 171.5'
				172 becomes sandy GRAVEL - sand is same as above - gradational contact	sand is calcareous/cemented, but does not react to HCl
				173 becomes Gravelly SAND	SAMPLE B01P36 175' (174.5' - 175') 3/11/93 @ 0935
				175 Sandy GRAVEL (60% sand, 40% gravel)	VOA, Rad, CaCO ₃ , Moisture
				40% MS 40% fs-ufs wet 109R 5/4	OVM Headspace = 16 ppm
				60% ss 40% ms Dry 109R 8/2	
175'	VOA, Rad CaCO ₃ , Moisture			30% fs-ufs	
				Dry, poorly sorted, sand similar to subrounded gravel subrounded, both subprismatic to subdisoidal, Gravel - 33%	No 175' Archive or character box due to 5 ppm CCly
				Qtz to 33% basalt 34% metamorphics	End of shift 3/12/93
				Sand - 95% Qtz & feldspar, 5% Basalt	175.5' still fairly hard drilling in Sand & Sandy Gravel
				No reaction to HCl	
				178 - larger gravel present - some LP	END Shift 3/17/93 - 178.5'
180'	VOA, Rad CaCO ₃ , Moisture				

BOREHOLE LOG

Borehole No. 209-W15-218

Depth 13 of 14

Location 200 West - N of Z-9 Trench

Project CCL4 ERA

Elevation NVD '29 665.36' Brass Cap

Drilling Contractor KEH

Driller M. Wrasnik

Drilling Method and Equipment Cable Tool - BE27W

Prepared By John Flinn Date 3/18/93

Reviewed By [Signature] Date 3-19-93

(Sign/Print Name)

(Sign/Print Name)

Depth (feet)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
180'				180' Same as above - Sandy GRAVEL	SAMPLE B01P87 - 180' (175.180) 3/15/93 - 0835 VOA Rad, CaCO ₃ , Moisture OVM Headspace = 1.3 ppm
				180.75 Back to sand, same as 171.5	
				Gradational change	END Shift 3/15/93 - 181.5'
				182 Back to Sandy GRAVEL, up to small cobbles	Driller reports Hard Drilling 3/16/93
185'	VOA Rad Cells Moisture			185 Sandy GRAVEL (40% sand, 60% Gravel)	SAMPLE B01P88 - 185' B01 P89 3/16/93 - 1037 185.5 - 186' .
				25% sc 33% ves - Dry - 10 YR 7/1	
				25% sp 34% ves Wet - 10 YR 6/2	VOA Rad, CaCO ₃ , Moisture
				25% mp 23% ves	OVM Headspace = 0.3 ppm
				25% p Rock crushed by DB into pieces of grain size	
				Dry, poorly sorted, subangular to subround, subdiscoidal to subprismatic	Very Hard drilling
190'	VOA Rad Cells Moisture			Equal proportions Basalt, Granite (some red) Metamorphics, Gneiss, etc. Weak reaction to HCl	Driller reports clasts up to small boulder size fragments present in cutting
				190 - Same as above	SAMPLE B01P90 - 190' (189.5 - 190') 3/16/93 - 1347
				195 Same as above - with moist patches, oxide stains on some gravel.	Driller, Heavy Cor. C ₂ , Moisture OVM Headspace = 2 ppm
				199' intermediate - Same as above Moist - small patches appear saturated	END Shift 3/16/93 - 191'
195'	VOA Rad Cells Moisture QA - Trip, Transfer, Field Blank			200' Same as above - Saturated, patches, mostly color variable, mottled.	SAMPLE B01NXU 195' (194.5 - 195) 3/16/93 - 0500
				Unaltered wet color appears to be 10 YR 7/4	VOA Rad, CaCO ₃ , Moisture, Al ₂ O ₃
				also, wet - 10 YR 4/3 to 10 YR 4/1	QA - Trip, transfer & Equipment Blanks.
				Dry - 10 YR 7/1	OVM Headspace = 2.7 ppm
				205 Sandy GRAVEL - 90% sand, 10% gravel	199 OVM HS = 2 ppm
				ex. 5 - 11 - 12 - same as 199	SAMPLE B01S438 200' (195.5 - 200.2) 3/18/93 - 0845 1055
				Saturated	VOA Rad, CaCO ₃ , Moisture
200'	VOA Rad Cells Moisture			Static water level measured @ 198.97' BGS 2/19/93 - 0730	OVM Headspace = 2.7 ppm Water measured @ 200.22' hrs 3/18/93 @ 11:00

Seamist OVM = 104 ppm @ 11:00

BOREHOLE LOG

Boring or Well No. 299-W15-218

Sheet 14 of 14

Location 200W - N of Z-9 Trench

Project CC14 ERA

Elevation NGVD '29 665.36' Brass Cap

Drilling Contractor KEH

Driller M. L. Wraspik

Drilling Method and Equipment Cable Tool RE 2211

Prepared By Col. R. John Fian
(Sign/Print Name)

Date 3/18/93

Reviewed By AK/Enc K.J. Smith Date 3-19-93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
200		Drive Barrel		205' Sand GRAVEL - 8% Gravel, 15% Sand, 5% Silt, Same as above	SAMPLE 205 - B08439 204'-205' - 3/18/93 - 1300 VOA, Rad, C, CO ₂ , Moisture CUM. Hard Spare = 2.7 ppm
205	VOA Rad C, CO ₂ Moisture			B04 = 206.10'	

BOREHOLE LOG				Boring or Well No. <u>299-W75-219</u>	
				Sheet <u>1</u> of <u>27</u>	
Location <u>200 W. AREA, NW OF Z-9 TRENCH</u>			Project <u>CCI, ERA VAPOR EXTRACTION WELL</u>		
Prepared By <u>Roy D. Deen / Roy D. Deen</u> Date <u>4/21/93</u> <small>(Sign/Print Name)</small>			Reviewed By <u>William N. Johnson / W.N. Johnson</u> Date <u>5/24/93</u> <small>(Sign/Print Name)</small>		

Depth (FEET)	Sample Type and No.	Blows or Recovery	Graphic Log	Sample Description <small>Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl</small>	Comments <small>Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level</small>
1	DB	0	0	FILL MATERIAL;	START SHIFT 4/21/93
				UNCONSOLIDATED, SIZED	16" CS CASING
				SAND WITH ABOUT 10% GRAVEL.	812' LONG, INCL.
					SHOE, INSTALLED.
					SHOE 1.36' DIAMETER
					(JT. #1)
					OVM NOT AVAILABLE
					TODAY SO NO OVM
					READINGS TAKEN
2	DB	0	0		
3	DB	0	0		
4	DB	0	0		
5	DB	0	0	ASBESTOS FRAGMENT.	
				AT 5.0'	
6	DB	0	0	FILL MATERIAL, UNCONSOLIDATED,	
				SIZED SAND, NO GRAVEL.	
7	DB	0	0		
8	DB	0	0		(JT. #2)
					16" CS CASING;
					9.34' LONG, INSTALLED.

BOREHOLE LOG				Boring or Well No. <u>299-W15-219</u>	
				Sheet <u>2</u> of <u>27</u>	
Location <u>200W AREA, NW OF Z-9 TRENCH</u>			Project <u>CC14 ERA VAPOR EXTRACTION WELL</u>		
Prepared By <u>Roy D. Deen</u> <small>(Sign/Print Name)</small> Date <u>4/21/93</u>			Reviewed By <u>Richard H. Johnson</u> <small>(Sign/Print Name)</small> Date <u>5/24/93</u>		

Depth (FEET)	Sample		Graphic Log	Sample Description	Comments		
	Type and No.	Blows or Recovery		Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level		
8	SPOILS SLEEVED THROUGH THIS INTERVAL; NO SAMPLES	DB	[Dotted Pattern]	FILL, CLEAN SIZED SAND	INSTALLED 9.34' LONG		
				WELL-SORTED FINE TO	WT. OF 16" CASING		
				MEDIUM SAND	(LOT #2, TOTAL 17.63')		
				S. SAND.			
9							
10							
				END OF SHIFT 4/21/93			
			BEGINNING SHIFT 4/22/93	BORING 10.5'			
11				CASING 9.5' ABOUT			
				10' OF STICK UP.			
12				FINE-MEDIUM SAND, WELL			
				SORTED; SIZED (SEIVED).			
13				GRADATIONAL CONTACT			
				CONSOLIDATED MATERIAL, LAYERING			
				OBSERVED; CALLING IT			
				"IN SITU" OR "NATIVE" SOIL.			
				SOME GRAVEL (<5%) IN SAND.			
				GRADATIONAL CONTACT.			
14							
				INSTALLED 12" X 8.75'			
				WT OF CASING (3RD WT)			
15	ARCHIVE, MOISTURE, CASING SAMPLE BOB #96	DB	[Dotted Pattern]	(55) GRAVELLY SAND; FINE	SAMPLE TAKEN @ 0850		
				TO MEDIUM SAND WITH POORLY	USED OVM #23 TO G.		
				DEFINED LAYERS, BEDDING, 2	HEADSPACE, CUTTINGS		
				A LITTLE (<5%) GRAVEL.	READINGS.		
				STRONG REACTION WITH HCL	CUTTINGS: 0.0 ppm		
16					HEADSPACE: 1.3 ppm		

BOREHOLE LOG				Boring or Well No. <u>299-WIS-219</u>	
				Sheet <u>3</u> of <u>27</u>	
Location <u>200 W. AREA; NW OF Z-9 TRENCH</u>			Project <u>CC19 ERA VAPOR EXTRACTION WELL</u>		
Prepared By <u>Ray D. Deen / RAY D. DEEN</u> <small>(Sign/Print Name)</small>			Reviewed By <u>William H. Johnson / W. H. JOHNSON</u> <small>(Sign/Print Name)</small>		
Date <u>4/22/93</u>			Date <u>5/24/93</u>		

Depth <u>FEET</u>	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery		Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
16		DB		SAND, S; FINE TO MED SAND WITH LESS THAN 5% GRAVELS, SAND WELL-SORTED, COLOR (DRY) 2.5Y 6/3 LT. YELLOWISH BROWN.	USING OVM #023 FOR BOREHOLE, CUTTINGS HEADSPACE READINGS, ETC.
17				GRADATIONAL CONTACT TO GRAVELLY SAND, g S; GRAVELS, COBBLES IN SAND @ 17 FEET. ABOUT 10-20%	RDD 12" x 5/16" x 3/16"
18				GRAVELS, INCLUDING MEDIUM- COARSE GRAVELS, COBBLES & PEBBLES.	
19				TRENDING (GRADATIONAL CONTACT TO SILTY SANDY GRAVEL @ 20.5'	
20					
21	UOA, SUOA, ARCHIVES, MISTHAB, POINT 4	DB		SLIGHTLY SILTY SANDY GRAVEL, ^{RDD} (m) S G 40% GRAVEL (MAX 1/4") 30% FINE SAND 30% MEDIUM SAND GRAVEL COMPOSITION: 70% BASALT PEBBLES 30% QTZ PEBBLES	SAMPLE POINT 4 TAKEN @ 1310. OVM QUIT, NO FURTHER READINGS TAKEN TODAY.
22		DB		SAND COMPOSITION: 40% QTZ 40% FELDSPARS 20% BASALT GRAINS ALL PARTICLES SUBANGULAR TO SUBROUNDED. THERE IS ALSO ABOUT 10% SILT. SAMPLE POORLY SORTED. COLOR (DRY) 2.5Y 5/4, LT. OLIVE BROWN (VARIGATED) 10% SILT.	
23					
24					

BOREHOLE LOG

Boring or Well No. 299-W15-219

Sheet 4 of 27

Location 200 W. AREA, NW OF Z-9 TRENCH

Project CCI4 VAPOR EXTRACTION WELL

Prepared By Roy D. Deen / Roy D. Deen Date 4/23/93
(Sign/Print Name)Reviewed By Victor H. Hanson / Victor H. Hanson Date 5/24/93
(Sign/Print Name)

Depth FEET	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
24		DB		GRADATIONAL CONTACT	
25	VIA, MOISTURE CACO ₃ , ARCHIVE BOINT 5	DB		SANDY GRAVEL, SG 50% SAND, 50% GRAVEL GRAVEL POORLY SORTED, RANGES IN SIZE FROM $< 1/16$ TO < 1.5 " GRAVEL SUBROUNDED TO ANGULAR SAND POORLY SORTED, RANGES FROM FINE SAND TO COARSE SAND; SUBANGULAR TO SUBROUNDED. GRAVEL; PEBBLE TO COBBLE SIZE	SAMPLE BOINT 5 TAKEN @ 14 HRS. @ 25.9 FEET. INSTALLED 16" X 9.44 JT. OF CASING (JT#4). END OF SHIFT, 4/22/93 BOREHOLE: 26.0' CASING: 24.0' BEGIN SHIFT 4/23/93
26		DB		40% BASALT GRAINS, 30% FELSIC GRAINS, 20% QTZ, GRAINS 10% OTHER, INCLUDING MICA, OLIVINE GRANITE GRAINS	AT 26.0' ABOUT 1.5 GALS RAW WATER ADDED TO BOREHOLE. C928 SSOCK'D BOREHOLE; 1.2 ppm (PID)
27				SAND; FINE TO COARSE SIZE 30% BASALT 40% QTZ 20% FELSIC GRAINS 10% OTHERS, INCLUDING MICA, OLIVINE, AND OTHER GREEN MINERAL.	
28					
29	VIA, MOISTURE CACO ₃ , ARCHIVE BOINT 7	DB		COLORS (DRY) GRAVEL; 5Y 5/4 OLIVE SAND; 2.5Y 4/3 OLIVE BRN. NO REACTION TO HCL.	1000 HRS SAMPLE BOINT 7 SAMPLE AT 30' SAME DESCRIPTION AS AT 25'. SAME MATERIAL.
30		DB			
31					
32					

BOREHOLE LOG

Boring or Well No. 299-W15-219

Sheet 5 of 27

Location 200 W. AREA, NW OF Z-9 TRENCH

Project CCl₄ VAPOR EXTRACTION WELLPrepared By Roy D. Deen / Roy D. Deen Date 4/23/93
(Sign/Print Name)Reviewed By [Signature] Date 5/24/93
(Sign/Print Name)

Depth (FEET)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
32		DB	Δ O	SANDY GRAVEL, SG	
			Δ O	50% SAND, 50% GRAVEL	
			Δ O	GRAVEL POORLY SORTED,	
			Δ O	RANGING IN SIZE FROM	
33			Δ O	< 1/16" ≤ 1.5"; ANGULAR	
			Δ O	TO ROUNDED; ≈ 40% SUBANGULAR	
			Δ O	GRAVEL: 40% BASALT	
			Δ O	30% FELSIC GRAIN	
			Δ O	20% QTZ	
			Δ O	10% OTHERS	
34			Δ O	INCL. MICA, OLIVINE	
			Δ O	GREEN MINERAL	
			Δ O	GRANITE	
			Δ O	SAND: FINE TO COARSE,	
			Δ O	POORLY SORTED,	
35		DB	Δ O	SUBANGULAR TO ROUNDED	SAMPLE POINT 8
			Δ O	30% BASALT	TAKEN 1106/4/23/93
			Δ O	40% QTZ	GROSS-GAMMA LOGGING
			Δ O	20% FELSIC MATERIAL	TIME: 0930-1010
			Δ O	10% OTHERS, INCL.	INTERVAL: 0' - 37.5'
36		DB	Δ O	MICA, OLIVINE	END SHIFT 4/23/93
			Δ O	GREEN MINERAL	CASING: 33.0'
			Δ O	COLORS (DRY)	HOLE: 36.0'
			Δ O	GRAVEL: 5 Y 5/4, OLIVE	BEGIN SHIFT 4/24/93
37			Δ O	SAND: 2.5 Y 4/3, OLIVE BRN.	CONDUCTED GROSS-
			Δ O		GAMMA LOGGING
			Δ O	GRADATIONAL CONTACT	IN BOREHOLE;
			Δ O	AT 37.5' GRAVEL TRENDS TO	DOWN SIZED TO
			Δ O	SUBANGULAR TO SUBROUND;	12" CASING.
38			Δ O	PERCENTAGE GRANITE GRAVEL	END SHIFT 4/26/93
			Δ O	INCREASES TO 15%; HOWEVER,	BEGIN SHIFT 4/27/93
			Δ O	OVERALL GRAVEL PERCENTAGE	
			Δ O	DECREASES	USING OVM # 024
			Δ O		CAL TO 101.0 / SPAN 102.0
39			Δ O	GRADATIONAL CONTACT @ 39.5'	THIS AM,
			Δ O		ADDING 3RD FT. OF
			Δ O	GRAVELLY SAND, GS	CASING 12" X 10.17'
			Δ O	@ 39.5' SAND / GRAVEL	SAMPLE POINT 6
			Δ O	RATIO CHANGES TO	TAKEN @ 0905/4/26/93
40		DB	Δ O	30% GRAVEL, 70% SAND	SEE DESCRIPTION NEXT P.

BOREHOLE LOG

Boring or Well No. 299-W15-219Sheet 6 of 27Location 200W AREA; NW OF Z-9 TRENCHProject CCl₄ VAPOR EXTRACTION WELLPrepared By Ray D. Deen / Roy D. Deen Date 4/26/93
(Sign/Print Name)Reviewed By Victor H. Johnson / Victor H. Johnson Date 5/4/93
(Sign/Print Name)

Depth Feet	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
40		DB		GRAVELLY SAND, S; ABOUT 40% GRAVEL, 60% SAND. SAND & GRAVEL POORLY SORTED, SUBROUNDED TO ROUNDED, SUBANGULAR. MAX. GRAVEL SIZE 1.5" SAND FINE TO COARSE; MINERAL COMPOSITION AS PREVIOUSLY DESCRIBED. COLOR (DRY) SAND - 2.5 Y 5/4, LT. OLIVE BROWN. GRAVEL GRADATIONALLY INCREASES TO SANDY GRAVEL TO CONTACT AT 44.6', HOWEVER SAND CONTACT IS SHARP.	SAMPLE POINT 6, VOA, ARCHIVE, CaCO ₃ MOISTURE TAKEN @ 39.5'-40.0'
41					
42					
43					SOCKED CUTTINGS AT 43.0-44.0' INTERVAL - GOT NO DETECTABLE GOT 0.5 ppm, HOW- EVER NO DETECTABLE AT BORE HOLE.
44	VOA, ARCHIVES MOISTURE / CaCO ₃ POINT 9	DB			SAMPLE POINT 9 TAKEN @ 1220 / 4/27/93
45				FINE TO MED SAND, S, POORLY SORTED, COLOR (DRY) 2.5 Y 5/4 TO 5/6, LT. OLIVE BRN., VARIGATED. SAMPLE DRY, GRAINS ANGULAR TO SUBROUNDED, COMPOSITION: 15% BASALT GRAINS 30% RTZ GRAINS 30% FELDER GRAINS 10% OLIVINE 10% COLORED FELDSPARS 5% MICA. NO REACTION TO HCL.	SHARP CONTACT BET'N SANDY GRAVEL SG, AND FINE TO MEDIUM SAND, S
46		DB			
47					
48					

BOREHOLE LOG				Boring or Well No	2901-W15-219	
				Sheet	7 of 27	
Location			200 W AREA, NW OF Z-9-TRENCH			
Project			CCL/VAPOR EXTRACTION WELL			
Prepared By			Roy D. Deen / Roy D. Deen		Date 4/27/93	
			(Sign/Print Name)			
Reviewed By			[Signature]		Date 5/2/93	
			(Sign/Print Name)			
Depth FEET	Sample Type and No.	Blows or Recovery	Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level	
48		DB		FINE TO MEDIUM SAND, S	SSO CK'D BOREHOLE	
		↓		WITH A LITTLE (1.5%)	49.0'-50.0' INTERVAL,	
				SMALL GRAVEL SCATTERED	NO DETECTABLE	
				THROUGH IT. MINERALOGY	HAZARDS	
49		DB		AS PREVIOUSLY DESCRIBED.		
	VOA, ARCHIVES MOISTURE, CALC. BOINVO			SAME MATERIAL AS ABOVE.	SAMPLE BOINVO	
					COLLECTED 1300/4/27/93	
50		DB			TRIMMED 3RD JT.	
					OF CASING BY 0.07';	
					ADDED 4TH JT. CASING	
					12" X 10.15'	
51						
52					END OF SHIFT 4/27/93	
					CASING 50.85'	
				GRAVEL INCREASING TO >10%	HOLE 52.0'	
				GRADATIONAL CONTACT	START SHIFT 4/28/93	
53		DB		FINE TO MEDIUM SAND, ^{red} S	USING OVM #024.	
	VOA, PART. DIST. MUSTIES ARCHIVE, BOINVI			WITH ABOUT 10% GRAVEL,	SSO GOT 10. PM	
				GRAVELLY SAND, G S, POORLY	ON PID, SO WENT	
				SORTED, COLOR VARIGATED,	(ON SUPPLIED AIR)	
				DAMP, 2.5Y4/3, OLIVE BRN,	SAMPLE BOINVI	
54		DB		ANGULAR TO SUBROUNDED;	TAKEN @ 1215/4/28/93	
	VOA, BOIPNG PART. DIST. HDSPACE BO7B79			COMPOSITION:	BORE SAMPLER PART. DIST.	
				20% BASALT GRAINS	VOA, # BOIPNG, AND	
				40% RTZ GRAINS	BORE SAMPLER HD SPACE,	
				15% FELSIC GRAINS	BO7B79, TAKEN AT	
55		BS		20% DARKER-COLORED	1245/4/28/93. OVM	
	BORE SAMPLER HDSPACE BO7B79			FELDSPARS	READING, 62 PM AT	
				5% OLIVINE	SAMPLE PORT.	
56				NO REACTION WITH HCL	BORE SAMPLER,	
					SAMPLE TAKEN AT	
					1355/4/28/93	

BOREHOLE LOG

Boring or Well No. 299-W15-219Sheet 8 of 27Location 200 W AREA, NW OF Z-9 TRENCHProject CCIA VAPOR EXTRACTION WELLPrepared By Roy D. Deem / Roy D. DEEM Date 4/28/93
(Sign/Print Name)Reviewed By William H. Pharo / W. H. Pharo Date 5/21/93
(Sign/Print Name)

Depth <u>FEET</u>	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
56	BORE SAMPLER	BS	0.0	FINE TO MEDIUM SAND	BORE SAMPLER TO
				WITH <15% LARGER	56.3 (DESCRIBED
	BOIPW7	DB	0.0	GRAVELS; GRAVELLY SAND	ON PREVIOUS PAGE)
	HEADSPACE		0.0	9.5. SAMPLE DAMP. MINERAL	BS SEDIMENT SAMPLES
	BO7B80		0.0	COMPOSITION AS PREVIOUSLY	TAKEN WITH DRIVE BAR
57	VOA		0.0	DESCRIBED	DB @ 1444/4/28/93
	BOIPW7		0.0	END SHIFT, 4/28/93	SAMPLES BOIPW7 & BO7B80
	HEADSPACE		0.0	CASING 57.0', HOLE 57.05'	INTERVAL 56.05'-57.05'
	BOINV2	DB	0.0	BEGIN SHIFT 4/29/93, OVM #24	SAMPLE BOINV2
58	VOA, ARCHIVE;		0.0	FINE TO MEDIUM SAND, WITH	TAKEN 0754/4/29/93
	MOISTURE, CACO3		0.0	<15% GRAVEL, 9.5;	INTERVAL 57.05'-58.4'
	RND		0.0	INCREASED FELSIC GRAINS,	SSO CK'D BOREHOLE, NO
		DB	0.0	LESS QTZ. GRADATIONAL CONTACT	DETECTABLE.
			0.0	20% FELSIC GRAINS	USING OVM #024,
59			0.0	35% QTZ GRAINS	READINGS 0.0
			0.0	5% MICA	WITH SAMPLE
			0.0	30% FINE SAND	BOINV2.
60			0.0		
61			0.0		
62			0.0	UNCHANGED, 9.5	DRIVE BARREL
			0.0		OBSERVATION.
			0.0		SSO CK'D BOREHOLE,
			0.0		NO DETECTABLE
63			0.0		CK'D BOREHOLE
			0.0		WITH OVM, NONE
			0.0		DETECTED
64			0.0		

BOREHOLE LOG

Boring or Well No. 2019-1015-219Sheet 9 of 27Location 200 W AREA, NW OF 29 TRENCHProject CC14 VAPOR EXTRACTION WELLPrepared By Roy D. Deen / Roy D. Deen Date 4/29/93
(Sign/Print Name)Reviewed By James H. Pharis - M/J/UISL Date 5/24/97
(Sign/Print Name)

Depth (FEET)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
64		DB ↓	0	GRAVELLY SAND, 95% FINE TO MED. SAND WITH ^{AND} 15% ^{<15%}	USING OVM #24
65	VDA, ARCHIVES MOISTURE, CALO, ICHO BO1PR8	DB	0	GRAVEL; HOWEVER, MORE BASALT GRAINS IN GRAVEL	DB OUT OF HOLE 0830 BUT HAD "CRITICALITY"
			0	(ABOUT 40%) AND MORE MICA (ABOUT 10%).	DRILL (PFP) & HAD TO EVACUATE AREA
66		DB	0	GRAVEL; POORLY SORTED ANGULAR TO SUBANGULAR; 40% BASALT 30% FELSIC GRAINS 20% QTZ 10% MICA	UNTIL ABOUT 0900 AT WHICH TIME SAMPLES WERE POORLY TAKEN. ACTUALLY TAKEN
67			0	SAND: POORLY SORTED; 50% FINE SAND	WEATHER RAINY, SO ACCURACY, STABILITY OF OVM IS QUESTIONABLE.
			0	50% MED. SAND 20% SILT ^{AND SILT}	SAMPLE BO1PR8, OVM READINGS
68			0	SAND ANGULAR-SUBANGULAR 40% BASALT 40% QTZ 10% FELSIC GRAINS 10% MICA	WELL HEAD 0.0 SAMPLE POINT 0.0 CUTTINGS 0.0
69			0		
70			0	GRADATIONAL CONTACT	ADDED 12" X 9.80' CASING (5TH JT.)
			0	SLIGHTLY SILTY ^{AND SILT}	SAMPLE BO1PR9
71	VDA, ARCHIVE MOISTURE BO1PR9	DB	0	GRAVELLY SAND, 95% (mgs) SAND GETTING FINER WITH SOME LAYERING OCCURRING	TAKEN @ 0949/4/29/93 CC14 VENTING @ 70.0 ppm (SSO PID) SO CREW HAD
		DB	0	GRAVEL; SMALLER AND LESS (ABOUT 10%), MORE MICA (15%), ^{AND SILT} 0.1%	TO GO ON SUPPLIED AIR.
72			0	SOME CHUNKS OF CARBONACEOUS MATERIAL, ~10% SILT, SILT, CARBONACEOUS MATERIAL	SSO PICKED UP 145 ppm ON PID 40 ppm ON C-TUBE
			0	HAVE STRONG REACTION TO HCL	

BOREHOLE LOG

Boring or Well No. 299-W15-219Sheet 10 of 27Location 200W AREA; NW OF Z-9 TRENCHProject CCl₄ VAPOR EXTRACTION WELLPrepared By Roy D. Deen / Roy D. Deen Date 4/30/93
(Sign/Print Name)Reviewed By Victor H. Plaso / VHP Date 5/24/93
(Sign/Print Name)

Depth (FEET)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
72		DB		SLIGHTLY SILTY GRAVELLY SAND (M) G S. SAND FINER WITH SOME LAYERING, HOWEVER GRAVEL GETTING LARGER AND INCREASING GRADUALLY TO ABOUT 15% TO 20%. SILT DECREASING. SILT, CARBONACEOUS MATERIAL STILL HAS STRONG REACTION TO HCL.	ADDED 12" ROD 5/13/93 SSO CRID BOREHOLE @ 1303, PICKED UP 25 ppm ON P.D. CREW STILL ON SUPPLY AIR CREW DECONATED 12" DRIVE BARREL FOR USE @ ANOTHER SITE.
73					
74					
75	VOA, ARCHIVE MOISTURE, CLOG BOIPSO	DB		GRADATIONAL CONTACT GRAVELLY SAND, G.S. SAND, IN GENERAL, COARSER THAN THAT DESCRIBED ABOVE, WITH MUCH MORE BASALT PEBBLES ($\approx 40\%$), ABOUT 10% LARGER BASALT PEBBLES, CORBLES. ALSO MORE FELSIC PARTICLES ($\approx 25\%$), BASALT PEBBLES, CORBLES SUBANGULAR TO SUBROUNDED. COLOR (DRY) 2.5 Y 5/2, DK. GRAYISH BRN.	SAMPLE BOIPSO TAKEN @ 1345 / 4/29/93 ADDING CASING 12" X 8.49' (6TH JT.) 1430 SSO PICKED UP AT BOREHOLE 15 ppm ON P.D. 10 ppm ON C-TUBE 0 ppm ON CGA END OF SHIFT: 4/29/93 CASING: 68.5' HOLE: 76.0' BEGIN SHIFT: 4/30/93 USING DVM #18, CAL. THIS AM. (4/30/93)
76		DB			
77					
78					
79	VOA, CLOG MOISTURE BOIPSI	DB		VERY FINE TO FINE SAND, S; DAMP, WITH LAYER OF FINE- GRAIN MATERIAL ABOUT 0.2' THICK AT TOP OF INTERVAL Cuor (Damp), 2.5 Y 5/2, LT. OLIVE BRN.	SAMPLE # BOIPSI TAKEN @ 0935 / 4/30/93 SEE COMPLETE DESCRIPTION ON NEXT PAGE.
80					

BOREHOLE LOG

Boring or Well No. 299-WT5-219Sheet 11 of 22Location 200W. AREA, NW OF 29 TRENCHProject CCl₄ VAPOR EXTRACTION WELLPrepared By Roy D. Deen / Roy D. DEEN Date 4/30/93
(Sign/Print Name)Reviewed By Richard M. [Signature] / Richard M. [Signature] Date 5/24/93
(Sign/Print Name)

Depth Feet	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
80		DB		VERY FINE TO FINE SAND, FS, WITH ABOUT 10% COARSE SAND IN IT. SAND IS DAMP. COLOR (DAMP) 2.5 Y 5/6 LT. OLIVE BROWN. OTHER CONSTITUENTS INCLUDE; 5-10% MICA 10% BASALT 40% QTZ 20% FELDSPARS 10% COLORED FELDSPARS 1-2 5% OLIVINE 5% GRAINS ARE ANGULAR SUBANGULAR, WELL- SORTED, FINE-GRAINED LAYERED MATERIAL AT TOP HAS SOME CARBONATE IN IT, AS INDICATED BY MILD HCL REACTION. LAYERED MATERIAL IS VERY FINE SAND WITH <10% SILT IN IT. VFS-FS AT 84.0-85.0' BUT IS DAMPER THAN THAT ABOVE AND HAS MORE CONSOLIDATION. ALSO MORE FINE SAND. MINERALOGY SAME AS PREVIOUSLY DESCRIBED.	USING OVM #18, SSO CK'D BOREHOLE @ 0710, NO DETECTABLE HPT CK'D SITE @ 0900, NO DETECTABLE
81					
82					
83					
84	VOA, AIRSUTURE CAGE, RAD BOIP52	DB			SAMPLE BOIP52 TAKEN @ 1005 / 4/30/93 END SHIFT
85		DB			SSO CK'D BOREHOLE, 1 AM ADDING 12" X 9.76" CASING (7TH JT) WELDING CASING CLEANED OUT HOLE FOR BORE SAMPLER DEMONSTRATION ON MONDAY 5/3/93 BEGIN SHIFT 5/3/93; OVM #18; CAL THIS AM, 102.3" CCl ₄ VENTING; CREW ON FRESH AIR BOREHOLE 54" DIA (PID) (SSO) 15" DIA (C-TUBE) ST SAMPLES BOIPW8 & BO7B81 (ALT @ 0954
86	BS VOA VON BOIPW8 HEADSPACE	ST			
87		DB			
88					

BOREHOLE LOG

Boring or Well No. 294-WIS-219

Sheet 12 of 22

Location 200 W AREA, NW OF Z-9 TRENCH

Project CC19 VAPOR EXTRACTION WELL

Prepared By Roy D. Deen / Roy D. Deen Date 5/3/93
(Sign/Print Name)Reviewed By William M. Hansen / William M. Hansen Date 5/4/93
(Sign/Print Name)

Depth Feet	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
88	BORE SAMPLER BS1 SOIL GAS BO7BC1	50 BS Blows, 20"		VERY FINE TO FINE SAND, SS, WITH 10% COARSE SAND IN IT. SAND IS DAMP. COLOR (DAMP) 2.5 Y 5% LT. OLIVE BRN.	SSO CKD BOREHOLE @ 1037. 120 ppm PID 500 ppm C-TUBE
89	BORE SAMPLER BS1 SOIL GAS BO7BC1	PULLED BACK 3"		CONSTITUENTS INCLUDE 5-10% MICA 20% BASALT 30% QTZ.	CREW ON SUPPLIED AIR, BORE SAMPLER SOIL GAS SAMPLE, BO7BC1, TAKEN AT 116/5/3/93
90	VOR, BOIPW9 HANDSPACE BO7B82 BORE SAMPLER SENTINEL	DB		20% FELDSPARS 10% OTHER COLORED MINERALS 5% OLIVINE	DB VOA SAMPLE BOIPW9 TAKEN @ 1245/5/3/93
91	VOR, BOIPW9 HANDSPACE BO7B82 BORE SAMPLER SENTINEL	ST		GRAINS ANGULAR - SUBANGULAR, WELL SORTED. MATRIX HAS MORE CARBONATE IN IT. AS INDICATED BY MUCH STRONGER REACTION WITH HCL, GENERALLY MORE FINER SAND; LESS SILT (ONLY ABOUT 5%.	ST BS SOIL SEDIMENTS SAMPLES BOIPW9 & BO7B82 TAKEN @ 1300/5/3/93 BORE SAMPLER SOIL GAS SAMPLE BO7BC3 TAKEN @ 1414/5/3/93
92	CLEANED HOLE	DB			1500 ppm FROM BO7BC3
93	BORE SAMPLER SOIL GAS BO7BC3	BS			SSO CKD BOREHOLE @ 1103, 49 ppm on PID 500 ppm on C-TUBE CREW STILL ON SUPPLIED AIR.
94	CLEANED HOLE	DB			ENDS SHIFT 5/3/93 HOLE: 94.0, CASING: 87.0 BEGIN SHIFT 5/4/93
95	VOR, BOIPXD (ALSO HANDSPACE BO7B83) BORE SAMPLER SENTINEL	ST 185 BLOWS 100% RECOV. IN A & B LINERS.		FINE SAND, fU-fL; POORLY SORTED (ABOUT <5% ML MIXED IN); GRAINS ANGULAR TO SUBANGULAR. SAND TOO FINE TO DETERMINE MIN COMPOSITION PERCENTAGES HOWEVER DOES HAVE BASALT, QTZ., FELDSPARS, MICA, OTHER COLORED MINERALS IN IT. COLOR (DRY) 2.5 Y 5% LT. OLIVE BRN.	NO OVM AVAILABLE TODAY. SSO CKD BOREHOLE, CREW ST SAMPLE BOIPXD, BO7B83 TAKEN @ 0802. DB VOA, MAISTURE, CaCO3 SAMPLES TAKEN IN THIS INTERVAL AT 0910. DB VOA * BOIPXD ADDED 12" x 9.74" CASING (STH) SSO CKD BOREHOLE, CLEAR
96	VOR, BOIPXD (ALSO HANDSPACE BO7B83) BORE SAMPLER SENTINEL				

BOREHOLE LOG

Boring or Well No. 294-W15-219Sheet 13 of 27Location 200 W. AREA, NW OF Z-9 TRENCHProject CCl₄ VAPOR EXTRACTION WELLPrepared By Roy D. Deen / Roy D. Deen Date 5/4/93
(Sign/Print Name)Reviewed By William H. Hanson / W. H. Hanson Date 5/14/93
(Sign/Print Name)

Depth (FEET)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
96		DB		FINE SAND, f u - f L; POORLY SORTED WITH ABOUT 10% M L MIXED IN, MAKING IT (M) S; SLIGHTLY SILTY SAND. HAS BASALT, RTZ, FELDSPARS MICA & OTHER COLORED MINERALS IN IT. COLOR (DRY) 2.5 Y 5/6, LT. OLIVE BRN SOME CHUNKS OF CONSOLIDATED FINE-GRAIN MATERIAL IN THE SAMPLE, BUT THE CONSOLIDATIONS HAVE VERY POOR CEMENTATION. WEAK REACTION TO HCL, SO NOT AS MUCH CARBONACEOUS MATERIAL IN IT.	SSO CK'D BOREHOLE @ 0715, 0848 & 0954 NO DETECTABLE. CLUST NO OVM AVAILABLE TODAY.
97					
98					
99					
100	VOA, MOISTURE, CACO ₃ , RAB BOIP55	DB		MEDIUM SAND, MU - ML, COLOR (DRY) 2.5 Y 4/3 OLIVE BRN. SAMPLE DRY; GRAINS ANGULAR TO SUBANGULAR. COMPOSITION: 20% BASALT 40% RTZ 10% FELDSPARS 10% DK. COLORED FELSPARS 5% MICA 5% OTHERS; INCL. OLIVINE; GREEN MINERAL; DK. RD. MINERAL (JASPER?). GRAINS WELL-SORTED. NO REACTION WITH HCL.	VOA SAMPLE BOIP55 TAKEN @ 1125/5/4/93 SSO CK'D BOREHOLE @ 1200; NO DETECTABLE
101		DB			
102					
103					
104					

BOREHOLE LOG

Boring or Well No. 294-W15-219

Sheet 14 of 27

Location 200 W. AREA, NW OF Z-9 TRENCH Project CCLV VAPOR EXTRACTION WELL

Prepared By Roy W. Deem / R.D. Deem Date 5/5/93 Reviewed By Victor M. (Ginsburg) / Victor M. (Ginsburg) Date 5/24/93
(Sign/Print Name) (Sign/Print Name)

Depth FEET	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
104	VOA, MOISTURE, CaCO ₃ BOIP56	DB		FINE TO MED SAND; FL-ML; COLOR (DRY) 2.5Y 5/6, LT. OLIVE BRN., SMALL AMT. OF COARSE SAND (5-15%)	SSO CK'D BOREHOLE, CUTTINGS @ 1229'; NO DETECTABLE VOA SAMPLE BOIP56 TAKEN @ 1225/5/4/93
105				COMPOSITION OF COARSE SAND: 200% BASALT 40% QTZ. 15% FELDSPARS 10% COLORED FELDSPARS 15% OTHER MINERALS	CREW WELDED CASING MOST OF AFTERNOON; ADDED
106				INCL. MICA, OLIVINE UNIDENT. MINERALS, WEAK REACTION WITH HCL.	12" x 9.54 (8TH JT.) 12" x 10.02 (9TH JT.)
107					
108				GRADATIONAL CONTACT ALT. LAYERS OF GRAVELLY SAND, QS, AND FINE SAND, FL MATRIX SAME AS DESCRIBED AT 104.0'	
109	VOA, MOISTURE, CaCO ₃ , RAD BOIP57	DB		ALT. LAYERS GETTING THICKER.	VOA SAMPLE BOIP57 TAKEN AT 1245/5/4/93 OVM READINGS ON BOIPX1, BO7B83, 6 PM @ WELL HEAD EST.
110					
111	VOA, BOIPX1 (HEADSPACE) BO7B83 BORE SAMPLES SEDIMENTS A&B.	ST 61 Blows 100% RECOV. IN LINERS		FINE SAND WITH CHUNKS OF CONSOLIDATED MATERIAL IN IT. TRANSITIONAL FORMATION. GRADATIONAL CONTACT VERY FINE SANDS WITH CHUNKS OF CONSOLIDATED MATERIAL AND SILT IN IT.	END SHIFT 5/4/93 HOLE 110.0', CASING 105.0' BEGIN SHIFT 5/5/93 CLEAN OUT 109-110 INTERVAL ADDED CASING 12" x 8.45' (10TH JT) ST SAMPLE BOIPX1, TAKEN @ 1035; HEADSPACE SAMPLE BO7B83 ALSO @ 1035
112				CONSOLIDATED VERY FINE SAND AND SILT M.S.	

BOREHOLE LOG

Boring or Well No. 299-W15-219

Sheet 15 of 27

Location 200 W. AREA, NW OF Z-9 TRENCH

Project CCL VAPOR EXTRACTION WELL

Prepared By Roy D. Deen / Roy D. Deen Date 5/5/93
(Sign/Print Name)Reviewed By [Signature] / [Signature] Date 5/24/93
(Sign/Print Name)

Depth FEET	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
112	BORE SAMPLER SOIL GAS. BO7 BC4	BS 33		VERY FINE SAND, SILT; S.	BS OPERATORS
		BLOWS, DROVE		SILT CLAY < 10%	QUESTIONED ACCURACY
		1.5'		GRAINS WELL SORTED	OF UVM # 27.
113	BORE SAMPLER SEDIMENT SAMPLE BOIPX2; BOIPX3	ADV. 20"		SAMPLE DAMP; GRAINS ANGULAR TO SUBANGULAR	INTERFERED WITH BS SAMPLING
		PULLED BACK 6"		COLOR (DAY); 2.5 Y 5G, LT.	BS SAMPLE @ 1242
				OLIVE BROWN. MUCH CARBONATE IN SOIL, AS IT HAS STRONG REACTION WITH HCL. SAMPLE	ST SAMPLE @ 1351
114	BORE SAMPLER SEDIMENT SAMPLE BOIPX2; BOIPX3	HEADSPICE BO7 BS5; BO7 BS6 (DUPLICATES)		MODERATELY CONSOLIDATED INTO THIN BEDS	
				PROBABLY TOP OF "TOUCHET" BEDS. F.M.D. ADD 5/5/93	DB VUA, MOISTURE, RAD SAMPLE BOIPX8;
				AS ABOVE, EXCEPT MUCH MORE CONSOLIDATED;	THROUGH 114.5' - 115.4', TAKEN @ 1405
115	SFE SAMPLE BO8 F97			HARDER. THIN LAYERING APPARENT. STRONG REACTION WITH HCL. SOME FREE WATER IN SEDIMENTS.	END OF SHIFT 5/5/93 HOLE DEPTH; 115.4 CASING DEPTH; 111.75
116				116.5 - 118.5 CONSOLIDATED SEDIMENTS, CALICHE	"SFE" SAMPLES BO8 F97 115.0 - 116.5'
117				STRINGERS, HOWEVER MINERALIZATION, MATRIX GRAIN SIZE AS ABOVE.	BO8 F98 116.5 - 118.5 BO8 F99 118.5 - 119.5 BO8 F97 TAKEN 1006 BO8 F98 11 1018 BO8 F99 11 1036
118	SFE SAMPLE BO8 F98				
119	SFE SAMPLE BO8 F99				
120	SFE SAMPLE BO8 F99			CALICHE, COBBLES SAND, GRAVEL, SILT COLOR (REV) 2.5 Y 7/2; YELLOW	ADDED 5.07' UT. OF 12" CASING (11TH UT.) END OF SHIFT 5/6/93 HOLE 121.0', CASING 119.8'

BOREHOLE LOG

Boring or Well No. 240-1015-216

Sheet 16 of 27

Location 200 W AREA, MW OF Z-9 TRENCH

Project CCL VAPOR EXTRACTION WELL

Prepared By R. J. D. / R. W. D. Date 5/16/93
(Sign/Print Name)Reviewed By [Signature] Date 5/14/93
(Sign/Print Name)

Depth FEET	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
120				COBBLES, COARSE GRAVELS, SAND, A LITTLE SILT. SOME COBBLES SURROUNDING COATED WITH CALCITE OR CaCO ₃	DOWN-SIZING TO 10" THREADED CASING. BAN IN 31.77' OF 10" CASING USING POWER TONGS SET @
121				COBBLES, PEBBLES SANDY GRAVEL WITH SOME FREE WATER IN IT, COBBLES PEBBLES BASALT, MATRIX GRAVELLY SAND. COATING ON COBBLES, PEBBLES HAS STRONG REACTION WITH HCL.	6.50 MIN. END SHIFT 5/17/93 HOLE 121.0'; CASING 19.47' BEGIN SHIFT 5/16/93 SSD PID SHOWS NO SP DETECTABLE GELIGIT
122		DB		MATRIX IN GENERAL HAS STRONG REACTION WITH HCL. MAX. COBBLE SIZE 3", MAX PEBBLE SIZE 1/2". SAMPLE POORLY SORTED. MATRIX COAR (DRY) 2.5V 8/4, YELLOW (GENERALLY) @ 122, SOME RTZ COBBLES, PEBBLES (<10%) RTZ PEBBLES ABT 1" - 3". SUBROUND	USING DVM #027, DVM READINGS AT 122.0 SH NONE ABOVE RACKG. HPT ON SITE @ 125.6 NO DETECTABLE, 5" COBBLE AT 122.0' 122.5' FMN. IN GENERAL CEMENTED GRAVELS. HARD DRILL, POOR RECOVERY, SSD @ 135.0' 20% MD 15% C-TR COLOR (DRY) @ 123, 2.5V 4/4
123		HT		TO ROUNDED. @ 122.0, MORE PEBBLES (~20%) THAN COBBLES START OF 5/11/93 SHIFT AT 125.2', HT SLURRY, SEIVED, SHOWED ~40% SAND; 60% GRAVEL; SAND VERY FINE - COARSE, POORLY SORTED; GRAVEL POORLY SORTED, ANGULAR - SUBROUND	OLIVE BRN. NO DETAIL CUTTINGS. (SSD) VDA SAMPLE BOIPTC CACO ₃ SAMPLE, BAD SAMPLE @ 0923 PH OF SLURRY ~7
124	BOIPTC VDA, CACO ₃ RAD	HT SLURRY		GRAVEL; 60% BASALT 10% FELSIC PEBBLES 10% GREEN MINERAL (OLIVINE?) 10% FELDSPARS 10% RTZ SAND; 70% FINE } POORLY 40% MED. } SORTED 30% COARSE 10% SILT	
125		HT			
126					
127					
128					

BOREHOLE LOG				Boring or Well No. <u>299-415-219</u>	
				Sheet <u>17</u> of <u>27</u>	
Location <u>200 WEST - NW OF 2-9 TRENCH</u>			Project <u>CCM - Vapor Extraction Well</u>		
Prepared By <u>E.A. Johnson / E.A. Johnson</u> Date <u>5/11/93</u>			Reviewed By <u>Victor H. Johnson / Victor H. Johnson</u> Date <u>6/1/93</u>		
<small>(Signature Name)</small>			<small>(Signature Name)</small>		

Depth (Feet)	Sample		Graphic Log	Sample Description <small>Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl</small>	Comments <small>Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level</small>
	Type and No.	Blows or Recovery			
128		Hard Tool	0.0		
129	1 UOA 1 AAO 1 MAST 1 Hard spare 1 chip iron		0.0	loosely sand - transitional contact loosely sand = 40% / 60% loosely = basalt - 40%, 25, 30%, Feldspar - 10%, Fines Pbbles 10% sand = silt - 10% fine loosely = 70%, medium graded 20%	Sample 130' @ 1254 PM BOPTI, From Hard Tool Shavings
130			0.0		
131	1 UOA 1 AAO 1 MAST 1 Hard spare 1 chip iron	Drive Barrel	0.0		
132			0.0	5/11/93 Sandy loose sand Sand contains frags of consolidated sand in it. - Basalt - 20% Quartz 40%, Feldspar - 20%	Sample collected here Due to change in lith. END SHEET 5/11/93 Casing 131.0, Hole 132.0 START SHEET 5/12/93 OVM = 27, 99.9/100.00mm
133			0.0		
134			0.0		
135			0.0	Slightly silty, loosely sand 20% loosely, 80% sand, loosely to 2" dia. Sand are 20% loose loosely 20% medium graded, 30% fine graded 50% silt 5% clay color 5Y 4/2, olive gray	
136			0.0		

BOREHOLE LOG

Boring or Well No. 249-WIS-219Sheet 18 of 27Location 200 W. AREA, NW OF 29-TRENCHProject CLL4, EPA, VAPOR EXTRACTION WELLPrepared By E.A. Johnson E.A. JOHNSON Date 5/12/93
(Sign/Print Name)Reviewed By Victor H. Johnson VM Johnson Date 5/24/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
136				Boulder - Basalt?	
137					STOP SHIFT 5/12/93, 137'
				SANDY GRAVELS - (FROM HARD TOOL SLURRIES) 80% BASALT	START SHIFT, 5/13/93, 0745
				FRAGS - 20% FELSIC FRAGS -	QUM #027, 99.9/100.0
				FELSIC FRAGS - 50% QUARTZITE,	137' - HARD TOOL
				50% MAFIC + FELSIC W/ CANALS	SLURRIES - 0.0 ppm
					NO VAPORS AT COLLAR
138					
139					139' - 550 REPEATS
				SANDY GRAVELS - SAME AS ABOVE - DRILLER NOTES SANDY INTERBEDS, ± 1/2" THICK.	60 ppm on Collar Tube
					LEL - 0.07%
					* VOA SAMPLE TAKEN @ 140.0'
					@ 0225 VOA #B01PT3, MOIST!
					CO2 #B01PT3 RAD #B01PT3.
					SAMPLE WAS TAKEN BY HT
					SWIRLY BRILL.
140	* Samples *				
141				SANDY GRAVELS - SAME AS ABOVE, DRILLER REPEATS LESS INTERBEDDING	
142					
143					143' - 550 REPEATS, AT
					Hole Collar, PID 2.0 ppm
					Collar Tube 3.0 ppm, LEL 0.07%
144				GRADATIONAL CONTACT GRAVELY SAND, 646 - 3" DIA	USED 17 GALL. Lubrication
					RAW WATER W/ HARD TOOL

BOREHOLE LOG

Boring or Well No. 299-W15-219

Sheet 19 of 27

Location 200 W. AREA, NW OF 37 TRENCH

Project VOC. Liquid 201, 202, WCC4, EPH

Prepared By E. A. Johnson / E. A. JOHNSON Date 5/13/73

Reviewed By [Signature] Date 5/24/93

K.J. Snett 26/June

10/27/1916

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
144		DRIVE BARREL		144.0- SAND, 50% CL, 30% MED LR, 20% FG, MOD	
145	1 VOA 1 MMT 1 AD 1 NOST 1 GRINDING	DRIVE BARREL		144.1 Slightly Sub Rounded, 30% Basalt, 70% Felsic Quartz, Feldspar, Dry 1mm Carbonaceous	Sampled 145.0' at 1345 PM
146		DRIVE BARREL		Lenses, Wx. Lenses Cement, 2.54 1/2, LT. BAN. Lany	30 IPTM, OVM-0.0 PM,
147					
148					
149	1 VOA 1 MMT 1 AD 1 NOST 1 GRINDING			147.0 - Sandy GRAVEL (50% Grav.) 50% Sand) SE 30% SC 50% US-ES 20% LG 30% MS 30% NA 20% FS-ES 10% FG 5% 4 1/2 olive gray	HAT-NO RAD CONTAMINATION
150	split spoon 1 VOA, 1 LG, 1 MMT, 1 AD, 1 NOST, 1 GRINDING	25 Blows per 18"		Sl. moist, poorly sorted, subangular to rounded, subplasmoidal to subdiscoidal 33% Qtz, 33% Basalt, 33% Felsic (Granite, Gneiss, etc., other than Qtzite) strong rxn to HCl	END SHIRT, 5/15/93, 1500 PM
151				149.0 SAND 95% Sand 5% silt, trace sm. subangular gravel 30% med sand, 70% fine & fine sand, well sorted subrounded, 40% Qtz, 20% Basalt 20% other Felsics	149-149.5 30 IPTS 5-14-93 @ 0827
152				2.54 5/3 lt. olive br. st. rxn to HCl	

BOREHOLE LOG

Boring or Well No. 299-215-219Sheet 20 of 27Location 200 W AREA, NW OF 29 TRENCHProject CCM, E.P.A. VAPOR EXTRACTION WELLPrepared By E.A. Johnson
(Sign/Print Name)Date 5/17/93Reviewed By W. J. Johnson
(Sign/Print Name)Date 5/24/93

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
152		DRIVE BARREL		Sand - 70% Fine Gr, 30% Med	
				1-R. 2.54 5/16, LT Olive Brown,	START SHIFT, 5/17/93
				Wet Saturated, Slightly Moist,	SPLIT SPOON SAMPLE, 0755
					BOI PX5
153	SPLIT TUBE SAMPLE 152.4-153.7 1.5'	100 Blows 1.5' Sample			Field Screening
				Slightly Moist	WV to Reaction: Hal
					QUM #27, 0.0 ppm
154				Sharp Contact	
				153.8 Sand, 80% CL, 20% Med Gr,	153'
				104R71, LT Gray, Sub rounded	HCL - No Reaction
				154.5 - Sandy GRAVEL, 40%	QUM - 0.0 ppm
				GRAVEL, 60% Sand, Gravel -	Add 5.02' - 10" casing
				50% bobbles to 4" DIA, 60%	
155	VQA Sample * 1 INCH RAD 1 HEADS 1 CHIRTS	DRIVE BARREL		Basalt, 40% Felsic - Mafic - Flow	154' - HCL - Weak Reaction
				Rock, Tan Brown Quartzite, Sands	QUM - 0.0 ppm,
				107% CL, 30% ML, 107% FL,	HPT - NO RAD ON TUBES
				104R4/2, LT Brown Gray, Slightly	OR SAMPLE
				MOIST.	155' - Sample at 293.5 ppm
156					QUM + P10 0.0 ppm, BOI PTH
					Switch to Hard tool - 156'
157					
				Sandy Gravel - Hard tool shatters	
				60% Basalt - 40% Felsic/Mafic	Add 5.02' - 10" casing
158				Flow, Tan Brown - Gt, tex	
				2.54 5/16 LT Olive Brown	
159				Sandy Gravel - SAME AS	SSO REPORTS - P10 - 0.0 ppm
				Above - Hard tool shatters	5.0 ppm on C-Tube
160					

BOREHOLE LOG

Boring or Well No. 109-44-219Sheet 21 of 27Location 200' W AREA, NW OF 29 TRENCHProject CCM EIA LINDOR EXTRACTION WELLPrepared By E.A. JOHNSON Date 5/17/93
(Sign/Print Name)Reviewed By (Signature) Date 5/17/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
160	1 VOA 1 RAD 1 Hard SAND 1 CHITAM 1 CACOS	HARD TOOL	0.0	SANDY GRAVEL - AS BEFORE	Sampled at 160' - 1245 PM BOI PT
161			0.0		550 - 40 ppm in C-Tube 25 ppm - PID, at collar
162			0.0		
163			0.0	SANDY GRAVEL, AS BEFORE, 40% BASALT, 40% FELSIC - FELSIC A MIX OF ELONG, High GRADE Metamorphics, Quartzites, 1 Piece - FLINT, 545/3, OLIVE BROWN or HT SLURRY	550 - PID - 0 ppm, C-Tube + 40 ppm HPT - NO RAD - cutting - SLURRY
164			0.0		164' END SHIFT 5/17/93 Casing 163.5' Hole 164' START SHIFT 5/18/93 QUM #37 100.0 ppm wing
165	1 MOIST 1 RAD 1 Hard SAND 1 VOA 1 CHIP TRAM	DRIVE BIT	0.0	SANDY GRAVEL, AS BEFORE - Slightly Moist - Heterogeneous From Hard Drilling, GRAVEL - 50% Well Rounded Pebbles, 50% Well Rounded Cobbles to 2" DIA, SANDS - 40% MMd GRAINED, 35% FINE GRAINED, 5% Silt, ALL Subangular, color WHEN Slight Moist - 545/3, OLIVE BROWN	100.0 SPAN GAS END 5/18/93 165' - Sampled at 165' + 30 BOI PT QUM - 0.0 and 100.0 ppm + collar 6.8 ppm ON HARD SANDS - HCL - NO REACTION
166		HARD TOOL	0.0		
167			0.0		550 - COLLAR, PID - 22.7 ppm C-Tube + 40 ppm PH - 7.0
168			0.0		

BOREHOLE LOG				Boring or Well No. <u>249-415-219</u>	
				Sheet <u>22</u> of <u>27</u>	
Location <u>200' W. AREA, NW OF 29 TRENCH</u>			Project <u>CCW/ EPA, Vapor Extraction Well</u>		
Prepared By <u>E.A. Johnson / E.A. Johnson</u> Date <u>5/18/93</u>			Reviewed By <u>William M. Johnson</u> Date <u>5/11/93</u>		
Depth (Feet)	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery		Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
168		HARD TOOL	0.0		
			0.0		
			0.0		
169			0.0		
	1 UOA		0.0		
	1 CAIS		0.0		
	1 RAD		0.0		
	1 HEAD		0.0		
	1 SPARE		0.0		
170	1 Chat		0.0	SANDY GRAVEL - SAME AS AT 168' - Basalt 40% Fines	* Sample 170' at 1335'
			0.0	40% From Hard tool	QUM - 0.00mm
			0.0	SLURRIES	Celling - HCL -
			0.0		No Reaction
			0.0		(BOLETS)
171			0.0		HPT - NO RAD CONTAMINATION
			0.0		Add 5.00' - 10" casing
172			0.0		
			0.0		
			0.0		
173			0.0		SSO REPORTS PID 22.2ppm
			0.0		C-Tube +60, -170'
			0.0		
			0.0		
174			0.0	SANDY GRAVEL - SAME AS ABOVE	
	1 UOA		0.0	Sample Homogenized From	
	1 CAIS		0.0	HARD TOOL SLURRIES	Collect Samples - 175', 1445mm
	1 RAD		0.0		Field Screening - QUM - 0.00mm
	1 HEAD		0.0		HCL - NO Reaction (BOLETS)
	1 SPARE		0.0		
175	1 Chat		0.0		END SHIFT 5/18/93
		5/18/93	0.0		Casing 175', Hole 175'
			0.0		START SHIFT 5/19/93
			0.0		QUM #27
176			0.0		

BOREHOLE LOG

Boring or Well No. 290-VIS-219Sheet 23 of 27Location 200 W. AREA, NW OF 29 TRENCHProject CEMERA, LITHO EXTRACTION WELLSPrepared By E.A. Johnson / E.A. Johnson Date 5/19/93
(Sign/Print Name)Reviewed By Victoria M. Johnson / Victoria M. Johnson Date 5/19/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
176		Hard Tool			550-798 ppm P10 at Collar HPT- No Rad Contamination
177				Sandy Gravel, 30% Basalt 70% Felsic Flows, Metaseds. FROM HARD TOOL SHUVERS, SAME AS AT 165', FEWER pebbles, more pebbles 177'	Add 5.02'-10" casing
178					177' - Over 2.0 ppm on shuvers
179					
180	100A 100B 100C 100D 100E			Sandy Gravel, 70% Sand, 30% Gravel, Gravel is 70% pebbles, 30% pebbles, Sand is 40% coarse Gravel, 40% Med. Gravel, 20% Fine Gravel, Pebbles and pebbles well rounded, Sand - Sub rounded, Gravel is 35% Basalt, 65% Felsic Flows and Metasediments, Slurry Color is 5YR/4.3, Reddish Brown	(BOIRVI) Sample 180, 1040 AM Over - Collar 0.0 ppm From Buys Collar - 30 ppm 550 NOTES C-Tube + 0 ppm From Collar
181					HCL - No Reaction
182					Add 5.03'-10" casing
183					FIELD SCREENING - 183.5' OVER - Shuvers - 0.0 ppm HCL - No Reaction
184					

Sheet 24 of 27

Project CE64 FERN L'APAR EXTRACTION WELL

Reviewed By Wanda M. Johnson Date 5/24/87

B.1-40

BOREHOLE LOG

Boring or Well No. 299-W-5-219Sheet 25 of 27Location 200 W. AREA / NW OF 29 TRENCHProject CCCN, ERM, WASTE EXTRACTION WELLPrepared By E.H. Johnson Date 5/20/93
(Sign/Print Name)Reviewed By William M. Johnson Date 5/24/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
192	DRIVE #40 STAINLESS BARREL		0-0	Silty Sandy Gravel 40% Gravel 35% Sand 15% Silt and Clay Gravel 50% Labeled to 4" Dia. 50% Pebbles 30% Basalt 70% Felsic Flows Metamorphic, Quartz, etc. Dry, somewhat pulverized due to hard drilling, 104 R/L Pale Brown	550 Rpm - No Vapors in Hole, Red - 0.0 ppm, C-100 0.0 ppm, 100-0.0% CUM Add - 5.01' 10" casing
193			0-0		
194			0-0		140 - No Rad. in instrument to 194.5'
195	1 RAD 1 UOA 1 Head Space 1 Moist 1 chipam		0-0	Silty Sandy Gravel - Same as 192' but slightly moist, Gravel/Sand - 60/40% Labeled to 5" Dia. Wall Rounded.	Sampled 195' - 1310 rpm CUM 0.0 exultinas 550 - 500 rpm 664 on L-Tube From Casing Annulus HCL - No Reaction (BOURVIS)
196			0-0		
197			0-0		STOP SHIFT 5/20/93 Casing 197', Hole 197' START SHIFT 5/21/93 CUM #27, 100 rpm, 100 rpm Add 5.01' - 10" casing
198			0-0	Silty Sandy Gravel - Same as above but moist - later Note Brown - 104 R/L 1/3	Field Screening - 198' - CUM - 0.0 ppm HCL - No Reaction
199	1 RAD 1 UOA 1 Head Space 1 Moist 1 chipam		0-0	199' - same but dry	199' - Field Screening CUM - 0.0 ppm HCL - No Reaction 550 - 0.0 ppm, CUM Tube 0.0, 100 rpm Sample 200' - 1020 rpm, 0.0 ppm CUM - 0.0 ppm, 100-0.0%
200			0-0		

BOREHOLE LOG

Boring or Well No. 299-W15-219Sheet 26 of 27Location 200 WEST - NW OF 2-9 TRAMMProject CCCL, EPR/Vapor Extraction WellPrepared By E.A. Johnson / E.A. Johnson Date 5/21/93Reviewed By Victor M. Johnson / Victor M. Johnson Date 6/1/93

(Sign/Print Name)

(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
200			0. - 0.0	Silty Sandy loams, Same as at 192'. 1 Frag. of Unconsolidated Basalt - Faintly as Amorphous Silica in Vugs	Field Scanning - 201' QUM - 0.0 gpm Hcl - No Reaction
201			0.0 - 0.0		Soil Shift - 5/21/93 1130 Casing 201.0', Hole 201.5'
202			0.0 - 0.0	Silty Sandy loams, Same as before, Capillary Fracture - 201' Moist at 202'. Color - Moist - 10YR3/3, Dark Brown	Start Shift - 5/24/93 0815 QUM = #27, 96.6 / 100.0 gpm Field Scanning 202.5'- QUM - 0.0 gpm Hcl - No Reaction
203			0.0 - 0.0		Add - 5.02' - 10" casing
204	1 UGA 1 AAD 1 H2O 1 SPN 1 AMST 1 H2O		0.0 - 0.0		HPT Reports - No Rad Contamination or tools or fittings
205			0.0 - 0.0		H2O - 202-203' Samples at 205', 0955 am BOIPV7 Field Scannings - QUM - 0.0 gpm, Hcl - No Reaction, pH - 7.0 SSO Reports - No Vapor in Hole No Amorphous
206			0.0 - 0.0	Silty Sandy loams - As above.	HPT Reports - No Rad Contamination Detected Add - 5.02' - 10" casing
207			0.0 - 0.0		
208			0.0 - 0.0		

BOREHOLE LOG				Boring or Well No. <u>299-WIS-219</u>	
				Sheet <u>27</u> of <u>27</u>	
Location <u>200 W. AREA / NW OF 22 TRENCH</u>			Project <u>CLM, ERA, Upper Extraction Well</u>		
Prepared By <u>E. Johnson / E. JOHNSON</u> <small>(Sign/Print Name)</small>			Reviewed By <u>Victoria Johnson / Johnson</u> <small>(Sign/Print Name)</small>		
Date <u>5/24/93</u>			Date <u>6/1/93</u>		

Depth (Feet)	Sample		Graphic Log	Sample Description <small>Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl</small>	Comments <small>Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level</small>
	Type and No.	Blows or Recovery			
208		DRIVE BARREL	0	Silty Sandy Gravel - Hs BEFORE	Hard drilling - Drive Barrel crushing cobbles + pebbles to pea gravel size
209			0		
			0		STOP SHIFT 5/24/93
			0		Casing - 208.5 Hole - 209.5
			0		START Shift - 5/25/93
210	1 UOA 1 RAD 1 Head 1 Sand 1 Moist 1 Chert		0	Silty Sandy Gravel, Gravel 60%, Sand 30%, Silt + Clay 10%, Gravel - pebbles to 4" dia, 50%, Pebbles - 50%, well rounded, Quartzite, Metamorphic - 70%, Basalt - 30%, Sand - 60%	210.5' - Sampled - 0750 DUM - 0.0 ppm G.H. H ₂ O BOL PV8
211			0	Coarse Grained - 30% Med. Gravel, 10% Fine Grained, Sample Moist but not saturated, color (Moist) 10YR 3/3 / Dark Brown	211.0 Field Scanning - DUM - 0.0 ppm, HCL - No Reaction, pH - 7.0 SSA - P10 - 0.0 ppm - Yellow CLM - 0.0 ppm, LEL - 0.0%
212			0	Hole TO - 212.0'	212.0 - TO Hole at 212.0' 10" casing Set AT 212.06' 0.7' Slough in Hole.
213					
214					
215					
216					

BOREHOLE LOG

Boring or Well No. 299-1115-220

Sheet 1 of 11

Location 200 WEST, EAST OF 2-9 TRENCH

Project CCLH VOC/ARID TOLERA

Prepared By E.A. Johnson (Signature) Date 6/1/93

Reviewed By E.A. Johnson (Signature) Date 7/27/93

Depth (FEET)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
0		DRIVE BARREL	0.0-0.0	0'-0.5' SANDY GRAVEL, DRILL PAD FILL SHARP CONTACT	START 6/1/93, 12:30 DUM #27, 99.9/100ppm
			0.0-0.5	0.5'-5.5', HULOGAN SURFACE DEPOSIT GRAVELLY SAND 15/25%, MOIST, REDDISH BROWN, 54R5/4, PEBBLES TO 1.5" DIA, SAND IS 60% MED. GRAINED, 40% FINE GRAINED. NO CONSTRUCTION DEBRIS NOTED.	13" OD DRIVE BARREL ALL SPIKES SKEWED IN PLASTIC - DUE TO POSSIBLE ASBESTOS CONTAMINATION NO FIELD SCREENING POSSIBLE
5			0.0-5.0	GRADATIONAL CONTACT 5.5' TO 10', HULOGAN SURFACE DEPOSIT SAND, OCCASIONAL PEBBLES TO 1.5" DIA, ROUNDED SAND IS 60% MED. GRAINED, 40% FINE GR. REDDISH BROWN, 54R5/4 - 7.54R5/4 - BROWN, SLIGHTLY MOIST	SSO REPORTS NO VAPORS IN HOLE ADD 9.93'-16" CASING W/SHOE, SHOE - 1.4' OD HPT - NO RAD DETECTED
10			0.0-10.0	10.0' - HANFORD FORMATION SHARP CONTACT 10.0-12.5, HANFORD FM., BROWN 7.54R5/4, SALT + PEPPER GRAIN GRAINED SAND. GRADATIONAL INTO SANDY GRAVEL 12.0-12.5. GRADATIONAL INTO GRAVELLY SAND 20/20%, BROWN-7.54R5/4, SLIGHTLY MOIST, SANDS ARE SALT + PEPPER LARGE, GRAVEL ARE ROUNDED PEBBLES TO 1" DIA, LARGER TO 3" DIA	END SHIFT, 6/1/93 14:50 CASING 9.0' HOLE 11.0' START SHIFT 6/2/93 0710 DUM #27, 103.7/100ppm SSO - NO VAPORS DETECTED
15			0.0-15.0	GRADATIONAL CONTACT 16.5 - 20.0', GRAVELLY SAND, 30/70%, SAME AS BEFORE BUT HIGHER GRAVEL CONTENT LARGE - DARK BROWN 7.54R4/2	ADD 10.6'-16" CASING HPT - NO RAD DETECTED NO FIELD SCREENING - ALL SPIKES SKEWED
20			0.0-20.0		SSO - 17' NO VAPORS DETECTED IN HOLE ADD 10.04'-16" CASING

BOREHOLE LOG				Boring or Well No. <u>299-1115-220</u>		
				Sheet <u>2</u> of <u>11</u>		
Location <u>200 WEST, EAST OF 29 TRENCH</u>			Project <u>CCLN UDC/ARID FO/ERA</u>			
Prepared By <u>E.A. Johnson</u> <u>E.A. Johnson</u> Date <u>6/2/93</u>			Reviewed By <u>Victoria M. Johnson</u> <u>VM Johnson</u> Date <u>7/27/93</u>			
Depth (Feet)		Sample Type and No.	Blows or Recovery	Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
20		DRIVE BARREL		0.0	20.0 - 24.0 SANDY GRAVEL, 60/40%	
				0.0	SANDS - 60% COARSE GRAINED, 40%	
				0.0	MEDIUM GRAINED, 7.54R 4/12	
				0.0	GRAVELS ARE SUB-ANGULAR	END SHIFT 6/2/93 1500 PM
				0.0		Casing - 18", Hole 22.0'
				0.0		START SHIFT 6/3/93 0715 AM
				0.0	GRADATIONAL CONTACT	NUM = #027, 103.4/100 ppm
				0.0	24.0 - 33.0 SANDY GRAVEL, 40% 60%	SSD - NO VAPORS DETECTED
				0.0	PINK BROWN BROWN, 104R 4/12, SANDS	HPT - NO RADIATION
				0.0	ARE COARSE GRAINED, SUB-ANGULAR	STOP RAPPING SPEARS AT 25'
25				0.0	GRAVELS ARE 50% LAKES, 50% RIBBON	Collect Samples, 25.2', 104 ppm
				0.0	LOBBIES TO 4" DIA, PEBBLES TO 2" DIA	FIELD SCREENING - NUM
				0.0	SUB-ANGULAR, SANDS AND GRAVELS	0.0 ppm, HCL - NO REACTION
				0.0	ARE 70% BASALT, 30% FELSIC	END SHIFT 6/3/93 1230 PM
				0.0		Casing - 27", Hole - 27'
				0.0		START SHIFT 6/4/93 1215 PM
				0.0		NUM = #027, 103.4/100 ppm
				0.0		Sample 30' AT 1235 PM
				0.0		NUM - 0.0 ppm -
				0.0		LEAK - 8.0 ppm -
				0.0		SSD - AT 61.0 - P10 - 41.5 ppm
				0.0		CCLN TUBE - + 6.0 ppm
				0.0	SANDY GRAVELS, AS BEFORE BUT	END SHIFT - 1510, 6/4/93
				0.0	SLIGHTLY MOIST, OLIVE BROWN, 2.54R 4/12	Casing - 28.5', Hole - 31.0'
				0.0	SHARP CONTACT	START SHIFT, 6/7/93 0730
				0.0	33' - SANDY SILTY GRAVELS - AS	NUM = #027, 103.4/100 ppm
				0.0	BEFORE BUT VERY MOIST, 10%	Add 7.55 - 16" Casing
				0.0	SILT AND CLAY, MATRIX IS BROWN	32.0' - OVER CAPPING, SSD -
				0.0	7.54R 5/14 TO OLIVE BROWN 544/12	NO VAPORS DETECTED
				0.0	SILTY SANDY GRAVEL, 15/15/70%	Sample 35' - 1240 PM
				0.0	GRAVELS ARE 50% LAKES TO 6" DIA,	FIELD SCREENING - NUM -
				0.0	50% PEBBLES TO 2.5", SANDS ARE 50%	0.0 ppm, HCL - WEAK REACTION
				0.0	MEDIUM GRAINED, 50% FINE GRAINED	END SHIFT 6/7/93 1505 PM
				0.0	MOIST, GRAVELS ARE ROUNDED	Casing 38.5', Hole 38.5'
				0.0	UNIT IS 70% BASALT, 30% FELSIC	START SHIFT 6/8/93 0730
				0.0		FIELD SCREENING - 38.5' -
				0.0		NUM - 0.0 ppm, PH - 8.0
				0.0		HCL - NO REACTION, NO
				0.0		STANDING WATER IN HOLE
				0.0		Sample 40' AT 0830

BOREHOLE LOG

Boring or Well No. 299-W15-220Sheet 3 of 11Location 200 WEST, EAST OF E-9 TRENCHProject CEL4 WAC/ARID ID/ERAPrepared By E. Johnson
(Sign/Print Name)Date 6/8/93Reviewed By William M. Johnson
(Sign/Print Name) Date 7/27/93

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
40		DRIVE BARREL	0-10	Silty, Sandy GRAVEL, As BEFORE, MOIST, colors VARY FROM 10YR 6/4 Brownish Yellow to 10YR 4/4, DARK Yellowish BROWN. Medium PLASTICITY, ONE pebble - 6" Dia. Rounded, TRAC - Organic Debris	40' FIELD SCREENING - CUM 0.0 ppm. HCL - STRONG REACTION 16" CASING SET - 59.72' - 0.4' SL. Adding 41.6' - 12" casing with Add 8.25' - 12" casing END SHIFT 6/9/93 1500 PM Casing 40.5' Hole 40.5'
45	1 RAD 1 UOA 1 MOIST	807878	0-10	Sharp Contact 44' Sand, Moist, Yellowish BROWN, 10YR 5/4, 20% COARSE GRAINED, 40% MED GRAINED, 40% FINE GRAINED, WELL Sorted, Sub angular 85% Quartz, Feldspars, 85% BASALT. Occasional BASALT pebbles to 1" Dia - Well Rounded	START SHIFT 6/9/93 0745 CUM = 0.07, 99.9/100 ppm Sampled 45' AT 0840 SSO - 40 ppm - 6-Tube UGARS Sample Part on RB
50	1 RAD 1 UOA 1 MOIST	807879	0-10	3" Silty Interbed at 48' 48.5' Silty Sand, 80% FINE GRAINED SAND, 20% SILT, MOIST - Yellowish BROWN 10YR 5/4 90% Quartz and Feldspars, 10% BASALT, Gradational Contact at 48.5'	42' - CUM - 0.0 ppm Sampled 50' AT 0955 CUM - 0.0 on Cuttings - 110 HEADSPACE HCL - WEAK REACTION SEAMIST @ 50' 1200
55	1 RAD 1 UOA 1 MOIST	807880	0-10	Sharp Contact 54' Sand, Slightly Moist, 10YR 6/4 Light Yellowish BROWN 60% COARSE GRAINED, 20% MED. GRAINED, 20% FINE GRAINED, 80% Quartz and Feldspars, 20% BASALT	53' FIELD SCREENING - HCL - WEAK REACTION, CUM - 0.0 ppm on Spills Sampled 55' AT 1345 CUM - 0.0 at wellhead, Soils, SSO - 15 P10 - 30 F-Tube Add 10.49' - 12" casing END SHIFT 6/9/93 1500 Casing 48.0' Hole 58.0'
60	1 RAD 1 UOA 1 MOIST	807881	0-10	58' FINE GRAINED Silty Sand Interbeds	START SHIFT 6/10/93 SSO - No Vapors Detected HPT - No Rad Detected CUM #027 - 103.2 ppm = 100

BOREHOLE LOG

Boring or Well No. 244-WIS-220Sheet 4 of 11Location 200 WEST, EAST OF E-9 TRENCHProject CCLN VOC/ARID TO/ERRPrepared By E.A. Johnson B.A. JOHNSON Date 4/10/93
(Sign/Print Name)Reviewed By William Johnson W. JOHNSON Date 7/27/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCL	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
60		DRIVE BARREL		59' - Slightly Gravelly Sand, Moist, 7.54 R 1/4, Light Brown, 107% Pebbles 107% Coarse Grained Sand w/ granules, Pebbles + granules - 407% Basalt, 407% Felsite, Rest of Sand - 307% Med. Grained, 807% Quartz, Feldspar, Micas, 207% Basalt Gravels ARE ROUNDED.	Sampled 60' AT 07:35 OUM on Spills - 0.0 ppm 11 ppm - Sample Port HCL - Weak Reaction 64' - OUM - 0.0 ppm in Spills
65	1 RAD 1 UOA 1 MOIST	807BV2			Sample 65' AT 12:35 SSO - 210 ppm, + 40 ppm at Well head, OUM - 0.0 ppm on Spills, 21 ppm at Well head, HCL - No Reaction, HPT - No RAD Detected
70	1 RAD 1 UOA 1 MOIST	807BV3		67' Silty F.G. Sand Interbed, 0.5'	Add 9.60' - 12" casing END SHIFT 4/10/93 1505 Casing 67.0, Hole 67.5'
70				70' Slightly Gravelly Sand, Same As Before, One Large Gravel - 4" Dia - Well Rounded GRADATIONAL CONTACT	START SHIFT 4/11/93 0800 OUM = 027 100/100 ppm SSO - 110.0, C-10.0 0.0 ppm at Well head
70				71' Sand - Same as Above but no pebbles, 107% Granules - All granules - Basalt	Sampled 70' AT 0830 OUM - 0.0 on Spills, 21 ppm on Sample Port (Drive Barrel)
70	15 FE 1 RAD 1 MOIST 1 UOA	807BV4		72' Sand - Silty - Fine Grained, 7.54 R 5/4, Brown, Interbed	HCL - WEAK REACTION Add 9.36' - 12" casing END SHIFT 4/11/93 1415
75				Sample 75' AT 0930, Field Screening - OUM, 0.0 ppm HCL - WEAK REACTION	Hole 70.0, Casing 68.5' Sample 75' - 70' START SHIFT 4/14/93 0815 OUM = 027, 22.5/100 ppm
75				72.5' - Sand, As At 70' No Pebbles, Occasional Pebbles Sand Remains Coarse Grained, Slightly Moist, 7.54 R 5/4, Brown	HPT - NO RAD DETECTED, SSO - 1.5 ppm - PID - 10.0 ppm Both at 75'
75	15 FE 1 RAD 1 MOIST 1 UOA	807BV5		78.5' Fine Grained Silty Sand	Sample 80' AT 1055 Field Screening - OUM - 0.0 ppm - Spills, HCL - No Reaction
80				79.0 Sand, As Before but not as coarse, 1 Basalt Gravel - 3" Dia	

BOREHOLE LOG

Boring or Well No. 299-015-220

Sheet 5 of 11

Location 200 - WEST, EAST OF E-9 TRENCH

Project CCL4 VOG/ARID TQ/ERR

Prepared By E.A. Johnson / E.A. Johnson Date 4/14/93
(Sign/Print Name)Reviewed By William M. Johnson / W.M. Johnson Date 7/27/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bt Size, Water Level
	Type and No.	Blows or Recovery			
80		DRIVE BARREL		81' Sand, Moist, 104R6/4, Brownish yellow, 40% Med. Grained, 40% Fine Grained, Well Sorted, Sub Angular, 20% Basalt, 80% Quartz, Feldspar, Micas	Add 10.78'-12" casing SSD - + 64 ppm - PID - Colloidal 83'-OUM - 0.0 ppm - Spills HCL - WEAK REACTION
	1SFE 1RAD 1UOA 1MOIST	807BVC			END SHIFT 4/14/93 1450 Hole - 84', casing - 84' START SHIFT 6/15/93 0800
85				85' Sand, Same as Above Coarse Grained - 20% Med. Gr. 40%, Fine Gr - 40%, Grained - 80% Basalt, 20% Feldspar	OUM - #027, 104.3/100 ppm Sample 85' AT 0810 FIELD SCREEN - OUM - 0.0 ppm on Spills, HCL - WEAK REACT
	1SFE 1RAD 1UOA 1MOIST	807BUT		87.5' - Silty Fine Gr. Sand Interbed. 89' - Sand Same as Above, As AT 85'	SSD - 87' - Colloidal - 5 ppm PID - 6-Tube 10 ppm
90					Sample 90' AT 0915 FIELD SCREEN - OUM - Spills 0.0 ppm - HEADSPACE 17 ppm, HCL - MOD REACT.
	3WSL 1RAD 1UOA 1MOIST	807BVS		91' - Sand, Same as Above, Slightly Moist, 104R6/3 Pale Brown, 15% Grained, 20% Coarse Gr, 40% Med. Grained, 25% Fine Grained, 15% Basalt, 85% Feldspar - Quartz, Feldspar, Micas, Subangular, Moderately Sorted,	Add 10.48'-12" casing END SHIFT 6/15/93 1505 Casing - 92.0, Hole - 92.0 START SHIFT 4/14/93 0715 OUM - #027, 99.9/100 ppm SSD - NO VAPORS IN COLLOID
95	1SFE	807BV1		94' + 97', 0.5' Sandy Silty Interbeds	Sample 95' AT 0800, Field Screen - Spills - 0.0 ppm OUM Headspace - 50 ppm, HCL - WEAK REACTION - Silty Interbed.
	1SFE 1UOA 1RAD 1MOIST	807BV1		97.5' Sand - Same as AT 91', Slight Yellow Change to 104R6/4 Light Yellowish Brown	HPT - NO RAD DETECTED Sample 100' - 09:45 OUM - 0.0 ppm Spills - Headspace 0.0 HCL - WEAK REACTION
100					

BOREHOLE LOG

Boring or Well No. 299-115-220

Sheet 6 of 11

Location 200 WEST, EAST OF 2-4 TRANCE

Project CCLN - VOC/ARID - FO/ERN

Prepared By S.P. Johnson / E.A. Johnson Date 6/16/93
(Sign/Print Name)Reviewed By Victoria M. Johnson / M. Johnson Date 7/27/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
100		DRUM BARREL		101' - SAND - SAME AS AT 97.5'	550 - 102' - 0.0 PLO CALICHE, OUM - SPILLS - 0.0 ppm
				SHARP CONTACT - PALUZE SOILS	
	3WSH 1RAD 1UOA 1MNST 1SFE	BO7BW0		103.0 - Slightly Sandy Silt to Sandy Silt - MOIST, 2.545/3	HPT - No Rad Detected
				Light Olive Brown, 30% FINE SAND, 30% VEL SAND, 40% SILT, BROWN	Sample 105' AT 12:35 PM
105				Spurters - oxidized sulfides? WEAK concretal fracture across bedding	Field Screen - OUM - 0.0 ppm UN Spills + HeadSpace
				Well Sorted,	HCL - Moderate Reaction Add 9.01' - 12" casing
				107' - Slightly Sandy Silt, Same As Before, Very Moist,	END SHIFT 6/16/93 1500
				considerable - Hackly - Fractures	Casing 103.5', Hole 105.0'
	1SFE 1RAD 1UOA 1MNST	BO7BW1		Across bedding - Micaceous sh. on	START SHIFT, 6/17/93 0745
				Along bedding - Saturated at 106.1'	OUM = #027, 97.9/100.0 ppm
				SHARP CONTACT - CALICHE	550 - No Vapors - 105'
				109' - Sandy GRAVEL - cemented	HPT - No Rad - 107'
				w/ Caliche. Cobbles to 3" dia, SANDS - PRE Dominately coarse gr.	Sampled 110' AT 10:40 AM
				Carbonaceous nodules, Dry -	Field Screen - OUM - 0.0
				0707/4, Very Pale Brown to Yellow, Caliche Filled openings,	ppm - HCL - Strong Reaction
				Caliche cement.	END SHIFT 6/17/93 1510
110				112.0 Sandy GRAVEL - Caliche, same As Above, crushed cobbles of	Hole 110.0 Casing 107.8'
	1RAD 1SFE 1UOA 1MNST	BO7BW2		Oxidized Iron ore - Org. Yellow	START SHIFT 6/18/93 0700
				113.5' - Weak Caliche cement.	OUM = #027, 104.3/100.0 ppm
				* 6/18/93 Tag H2O 106.1', Hole 107.7', Drive	PH on Packed H2O - 7.0
				12" casing to 110.9', cleanout hole to 112.0,	110' Field Screen - OUM -
				H2O now 109.3', Hole 110.0, Rail H2O	0.0 ppm - HCL - Strong React.
				6/21/93 H2O 110.0, Hole 110.9, Set	Packed H2O AT 106.1'
				12" casing to 110.9', Drive to 113.5'	END SHIFT 6/18/93 14:00
				Hole 112.0, Add Bentonite Plug 112.0' - 114.8'	Hole 113.0 - 12" casing 116.0
	3WSH 1RAD 1MNST 1UOA	BO7BW3		6/22/93 SET 10" casing AT 113.14'	6/21/93 SET 12" casing 111.09
				6/23/93 Place 8" casing to 110.0', Drive	Drive Hole to 113.5'
				Casing to 112.5', Cleanout hole to 113.5'	6/22/93, Add 10" casing - 113.14
120					6/23/93, Add 8" casing to 112.5'
					6/24/93 START SHIFT, 0700
					OUM = #027, 104.3/100.0 ppm
					Sample 115' AT 17:30, Collings
					0.0 ppm, HeadSpace - 8.6 ppm

BOREHOLE LOG

Boring or Well No. 299-415-220

Sheet 7 of 11

Location 200 WEST E. OF 3-9 TRENCH

Project CCLW - VOA/BRID - ID/ERR

Prepared By E. Johnson Date 4/25/93
(Sign/Print Name)

Reviewed By ALDO H. GONZALEZ VM/TWISA Date 7/27/93
(Sign/Print Name)

[illegible]

BOREHOLE LOG

Boring or Well No. 299-WIS-220Sheet 8 of 11Location 200 WEST, E. OF E-9 TrenchProject CLLH - UOC/ARIA - TO/SPAPrepared By E.A. Johnson Date 4/27/93
(Sign/Print Name)Reviewed By Victor M. Johnson Date 7/27/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
140		Draw Recover		141.0' - Same as at 137'. Sandy Gravel - but 10% Fk sand and silt. Also silt - clayey - interbedded. Lobbies to 1" dia. Lobbies + pebbles - rounded. Gradational contact into - 144.0' Silt. Sandy Gravel - 40% Gravel, 20% Sand, 40% Silt + clay, Heavy Slightly Moist. 2.54/4, Dark brown Brown 145.5 Silt. Interbedded 146.0 Silt. Sandy Gravel, Same as before but 10% RSL 4 yellowish brown 148' - Trace Caliche, 1" thick, weak 151' - Gradational contact with Sand, Slightly Moist, 2.54/4 Light yellowish brown, 80% Med. Grained, 10% Fk sand, 10% Coarse Grained, well sorted, Angular to sub-angular, 50% ch, 50% Plug + path Fk sand, Med. Fabric debris - slight Fox stain 153.5' - Gradational contact - Sandy Gravel - Same Sand as at 151' - Gravel 40% 154.5 Gradational contact - Silt. Sandy Gravel - Dry - 2.54/4 4% fine brown, Gravel - 40% 50/50 Lobbies to 4" dia, pebbles to 2" dia - Both well rounded Sand 20%, Silt + clay 20% Gravels 20% MARC plus Fk sand, Interbedded, white sand, 30% Basalt - crystalline, 1 frag - Oxidized G.C. In fracture.	140' - OUM 0.0 ppm - HCL - No Reaction. END SHIFT 6/30/93 14:30 Hole - 143.0 (399 141.4 START SHIFT 6/30/93 07:00 OUM = 027, 77.7 ppm / 100 ppm Sample 142' at 14:30 Add 9.83' - 8" casing SSO - NO VAPORS DETECTED END SHIFT - 6/30/93 12:10 Casing - 144.0', Hole 144.0' No Drilling 7/1, 7/6, 7/7, 7/8 - KEN Big Improvements START SHIFT 7/9/93 13:00 OUM = 027, 77.4 / 100 ppm Sample 146' at 13:05 HeadSpace 0.0 ppm HCL - No Reaction SSO - NO VAPORS DETECTED - 147' HPT - NO RAD DETECTED - 148' END SHIFT 7/9/93 14:30 Casing - 148.5', Hole 149.0' START SHIFT 7/12/93 07:45 OUM = 026, 77.7 / 100 ppm Sample 150' at 08:05, OUM 0.0 - HeadSpace, HCL - MODERATE REACTION Add 9.83' - 8" casing SSO - NO VAPORS - 153' 53' - HPT - NO RAD FOUND Sample 1550' at 11:15 OUM - HeadSpace - 0.0 ppm, HCL - NO REACTION 158' - SSO - NO VAPORS HPT - No Rad Found Sample 160' at 14:30 OUM - HeadSpace 0.0 ppm HCL - NO REACTION END SHIFT 7/12/93 15:05 Hole - 160.0', Casing 159.5'
145	1RAD 1UOA 1MOIST	607013			
150	3WSH 1RAD 1MOIST 1UOA	607017			
155	1UOA 1RAD 1MOIST	607010			
160	3WSH 1RAD 1UOA 1MOIST	607011			

BOREHOLE LOG

Boring or Well No. 249-W15-320

Sheet 9 of 10

Location 200 WAST. E. OF 2-9 TRENCH

Project CC/N-VOC/ARID-IO/ERR

Prepared By E.A. Johnson / E.A. Johnson Date 7/12/75
(Sign/Print Name)

Reviewed By Robert M. Johnson VM Johnson Date 7/28/93
(Sign/Print Name)

Depth (FEET)	Sam.		Graphic Log	Sample Description		Comments
	Type and No.	Blows or Recovery		Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level	
160		DRIVE BARREL		158.5' - Silty Sandy GRAVEL, SAME AS BEFORE - No Clay, Less Silty Sand - 30% G.G., 40% Med. G., 30% F. GRAVEL.	START SHIFT 7/13/93 0700 QUM#027, 99.9/100ppm SSD - NO VAPORS DETECTED HPT - NO RAD DETECTED.	
	1 RAD	807 BX2		161.5' - Silty Sandy GRAVEL - SAME AS BEFORE BUT W/ SILT-CLAY LENSES	SERMIST SAMPLE AT 08:30 QUM - RAD SAMPLES - 22.0ppm	
	1 UOA			162.0' SANDY GRAVEL - 40% Pkls + Cbcls - 60% Sand, Silty Moist,	Add 9.14' - 8" CASING END SHIFT 7/13/93	
	1 MOIST			2546/3, LT. YELLOW BROWN, pebbles to 3" Dia. Sand is 20% G.G., 80% MG.	CASING 163.5' Hole 164.0'	
165				40% MG., 20% FG. GRAVEL - Rounded 164.0' - Gradational Contact - Gravelly Sand - 15% GRAVEL / 85% Sand Sand is 60% Med. G., 20% Coarse G., 20% Fine G., Slightly Moist 2546/4, Olive Yellow	START SHIFT 7/14/93 0700 QUM#026, 101.1ppm/100ppm 164' - SSD - NO VAPORS Sampled 164.5' - 10:30 - ON - HEADSPACE - 0.0ppm - HCL - - NO REACTION 167' - SSD - NO VAPORS HPT - NO RAD FOUND	
	3 WSH	807 BX3		165.5' GRADATIONAL CONTACT with Sandy GRAVEL, 40/60 SAND SAME AS BEFORE, GRAVEL ARE PKLS + Cbcls to 3" Dia. Well Rounded - 20% FINE - 20% BASALT	Sampled 170' AT 14:15, QUM 0.0 - HEADSPACE - HCL - NO REACTION END SHIFT 7/14/93 14:45 CASING 171.0' Hole 171.0'	
170				173' GRADATIONAL CONTACT with Silty Sandy GRAVEL - 50% Pebbles + Lenses to 4" Dia, Rounded, 20% BASALT SANDS ARE 30% G.G., 30% MG - 30% FG, 10% SILT + CLAY, 30% QUARTZ, 20% FINE SANDS + MICA, RY, 1048/6/4, LT. YELLOWISH BROWN	START SHIFT 7/15/93 0700 QUM#026, 101.2ppm/100 175' - QUM - 0.0ppm - SPECKS - HCL - NO REACTION SSD - NO VAPORS DETECTED Sampled 175' AT 08:55 QUM - 0.0ppm - HEADSPACE HCL - NO REACTION Add 7.52' - 8" CASING	
	1 UOA	807 BX4		178.5' Silty Sandy GRAVEL - AS BEFORE BUT Slightly Moist	178' - QUM - 0.0 - G.WINGS HCL - NO REACTION SSD - NO VAPORS FOUND HPT - NO REPORT Sampled 180.5' AT 13:45 QUM - HEADSPACE 0.0ppm HCL - NO REACTION	
	3 WSH	807 BX5				
	1 UOA					
	1 RAD					
180						

BOREHOLE LOG

Boring or Well No. 299-WIS-220

Sheet 10 of 11

Location 200 WEST, E. OF 3-7 TRENCH

Project CCLM-VOC/ARID-20/ERR

Prepared By S.A. Johnson / B.A. Johnson Date 7/15/93
(Signature Name)Reviewed By William M. Johnson Date 7/27/93
(Signature Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
180				Silty Sandy GRAVEL - AS BEFORE - Vary Slightly Moist	181' - SSU - NO VAPORS FOUND HPT - NO REACTION END SHIFT 7/15/93 14:45
				181.0 Silty Sandy GRAVEL, AS BEFORE BUT 90% Phs to 1" DIA, 10% Gravel To 3" DIA, SAND/GRAVEL 40/60	CASING - 180.7' Hole 181.2' 7/16/93 START SHIFT 0700 QUM = #026 101.3/100 ppm STARTIST 182' AT 0740
	1 RAD 1 UOA 1 MOIST	607 BX6		184' - Silty Sandy GRAVEL SAME AS BEFORE BUT Gravel to 4" DIA, Slightly Moist 104R5/4 Yellowish BROWN, 50% GRAVELS - Pebbles & Gravel to 3" DIA, Well Rounded, 80% Folice, Meta Minerals, Flints, Meta Sands - 20% Basalts - Very Filled w/ Gravel Size, Sands - 40% 60% MG, 30% FG, 10% CG, 10% Silt + Clay	END SHIFT 7/16/93 13:00 CASING 180.7' Hole 181.2' START SHIFT 7/19/93 0715 QUM = #026, 101.5/100 ppm Add 9.97' - 8" casing Sample 185' AT 14:25 QUM - HANDSOME 0.0 ppm HCL - No Reaction END SHIFT 7/19/93 14:45 Casing 184.5' Hole 185.0'
185				188' - Silty Sandy GRAVEL SAME AS BEFORE BUT later changed to 107R4/4, Dark Yellowish BROWN, DRY	START SHIFT 7/20/93 0730 QUM = #026, 98.4 ppm/100 ppm SSU SWIFFS Hole - 0.0 P.O - ANALYSIS 20 ppm - C-766 Sample 190' - 10:30 QUM - HANDSOME - GRAPES HCL - No Reaction
	3 WSU 1 RAD 1 MOIST 1 UOA	607 BX7		191' - Silty Sandy GRAVEL - SAME AS BEFORE BUT SAND is 20% CG 60% MG, 10% FG, 10% Silt + Clay - DRY	ADD 8.97' - 8" casing END SHIFT 7/20/93 14:45 Casing - 191.5' Hole - 19.1 START SHIFT 7/21/93 0700 QUM = #026, 101.6/100 ppm 194' - SSU - NO VAPORS
190				192.5 Slightly Moist w/ WET SPOTS, Top of Capillary Fringe	
	3 WSU 1 RAD 1 MOIST 1 UOA	607 BX8		193.0 Silty Sandy GRAVEL - AS BEFORE - Moist. 7.543/4 Dark BROWN	QUM - HANDSOME 0.0 ppm Sample 195' AT 08:35 QUM - HANDSOME 0.0 ppm HCL - No Reaction PH - 7.0, Sands 197.5 - QUM - 0.0 ppm - SANDS
195				(191.58 STATIC LEVEL 7/22/93 12:40) (Sampled 7/22/93 08:45) 197.0 Silty Sandy GRAVEL - SAME AS BEFORE - Vary Moist to Saturated.	
	1 RAD 1 UOA 1 MOIST	607 BX7			
200					

BOREHOLE LOG

Boring or Well No. 299-1415-220

Sheet 11 of 11

Location 200 WEST E. OF 2-9 TRENCH

Project CC44-VEG/ARID-IO/ERR

Prepared By E. D. Johnson / E. B. Johnson Date 7/21/93
(Print Name)

Reviewed By LICHA M. STURM, RN / PHN SA Date 7/27/20
(Signature/Print Name)

Depth <i>(Feet)</i>	Sample		Graphic Log	Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blow or Recovery			
200		DRIVE BAMEL	U=O D=D	200' silty sandy GRAVEL - SOME AS BEFORE. Td = 201.0' 7/31/93 14:30 8" CASING SET AT 200.02', 7/32/93	197.5-HCL-NO REACTION - IN V. SLIGHT SPIRITS 199.0' SSR-BEAR Q.D. PPM-PID-" $\frac{8}{16}$ " AUGERUS" SSPMM-G-TUBE SAMPLES 100' AT 13140 OVER-SPPMM-MOOD/SPPMM HCL-NO REACTION-SPIRITS SSQ-WATER BEAR-Q.D.PID +SSPMM G-Tube - RUGULUS 8"/16"
205					END SHIFT 7/31/93 15:00 Hold 201.0'; casing 202.0'
210					

BOREHOLE LOG

Boring or Well No 299.W18.96Sheet 1 of 10Location 216.218 Crb. South of E. plantProject VOC And TO CCL4 DrillingElevation 682.52' Outer casingDrilling Contractor KaiserDriller G. HowellDrilling Method and Equipment Cable Tool Walker-NeerPrepared By William H. Johnson / W.H. Johnson
(Sign/Print Name)Date 2-10-93Reviewed By D. Smith Old
(Sign/Print Name)Date 2-20-93

Depth (FEET)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCL	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
76				Water on top of bentonite plug. Came out of hole in top of drive bore as wet mud like bentonite. Dark in color. Bottom of drive bore was dry, light grey bentonite pinkish plug - Approximately 6 in water on top of plug.	210.93 Bottom of original casing 80.0 ft. Top of hole in hole (top of bentonite) Lower 76.3 ft original casing 6 in 76.3' - 79.6' PH=8 did 00 PAM < 10 No ORM available to use.
77					
78					
79				Cased to 80.0 ft with air casing	
80				82.0' - 83.0' Bentonite / formation mix	Bottom of original air casing 80.0 ft. High pressure in oxidation on drive barrel.
81					
82				SPLIT TUBE 82'-84.5'	82.0' - 84.5' No hasards detected with FID CGA, in PAM. No ORM used.
83				82'-83.0' Oxidized, muddy on top bentonite unconsolidated with formation. Moist dark formation that is very undisturbed combined with dry, light grey chunks. Relatively sharp contact at 83.0 ft between formation and bottom of bentonite. Shows oxidation just 83.0 ft SAND 100% sand: 90% fine grain sand, 20% medium grain, trace of very fine sand. Bed of	Split tube at 1357 ft: VOC # B01NW7; Bulk Density 120 lbs/cu ft - Align B08094; Bulk Density 120 lbs/cu ft - Align B08092; Physical Incep- Align B08093; Chem/Red- Align # B01NW7
84					

BOREHOLE LOG

Boring or Well No 299.W/8.96

Sheet 2 of 10

Location 216-2.12 Dib South of 2. West

Project VOC And TD CCL Drilling

Elevation 482.52' Outer casing

Drilling Contractor Kaiser

Driller G. Howell, Helper J. Carpenter

Drilling Method and Equipment Walker New

Prepared By (John H. Johnson)

Date 2-10-93

Reviewed By D. Swett

Date 2-20-93

(Sign/Print Name)

(Sign/Print Name)

Depth (FEET)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
84				dominant medium grains. Color overall 104% silt, grayish brown; clay; very well sorted; sandy, ranges from subrounded to subangular 80% sample subangular 20% sample subrounded; 65% quartz, quartzite quartzite ranges from milky white to asch. yellowish color. 3.5% basalt basalt amp. fine grain, black possible quartz rich and silty; 5% mica all muscovite with trace of hematophiles Strong reaction with HCl.	2000 samples at 125 ft. 2-10-93 End shift hole 84.5 ft. Start shift 2-11-93 Bottom of hole 84.5 ft.
85	2 VOA's # BOINX1, # BOINX3 2.5 VOA's # BOINX1, # BOINX3 CHEN 180, 80 C LINS ARCHIVE, NHT RAD	SPLIT TUBE 370 Blows counts 84.5'-87.0'		14.5'-87.0' alternating layers of silt and fine grain to mid sand coarsening downwards to 87.5' to a large grain sand and very coarse sand.	125 ft. 2 inch. particle size distribution, CaCO ₃ , and moisture from drive berry 82.0'-84.5'
86				SAND 100% 85.0'-86.0' 80% fine grain, 20% very fine grain with trace of silt 104% 1/2 dry; very well sorted; subrounded- subangular. 50% quartz, quartzite; 40% basalt, andesite volcanics; 10% plagioclase feldspar, muscovite, oxidized and weathered minerals, moderate reaction to HCl; very fine grain/silt layers inter- bedded color 104% 1/2 moist. 86.0'-87.0' coarsening sand 100% 90% mud to predominantly coarse grain, 10% very coarse grain, 104% 1/2 dry, well sorted, subangular, coarse grain mostly quartz and basalt volcanics, 55% quartz, quartzite 43% basalt, volcanic, 2% muscovite and weathered metamorphics	End shift 2-11-93 casing end 85.3 ft mud end 87.0 ft total footage 2.5 ft No hazardous detected. casing 5 in. to 5.5 in.
87				87.0' Sand 100% 20% mid sand, 80% fine sand to very fine sand; 104% 1/2 natural, moisture; slightly moist; well sorted; subangular to subrounded; spherical some divided mica 75% quartz and quartzite; 20% basalt; 5% clays. Some very fine sand beds ~ 0.1 ft thick.	90 ft sample 2-12-92 J0845 VOA, SVOA = BOINW9 VOA = BOINW8
88				91.0' Sand 100% 20% mid sand, 80% fine sand to very fine sand; 104% 1/2 natural, moisture; slightly moist; well sorted; subangular to subrounded; spherical some divided mica 75% quartz and quartzite; 20% basalt; 5% clays. Some very fine sand beds ~ 0.1 ft thick.	91.85' - 92.85' Split tube 2-12-92 @ 0710 Sump BOINX5 = VOA, SVOA Rad BOINX7 = VOA Core Biter 92.35' - 92.85'
89				90 ft same as above	

BOREHOLE LOG

Boring or Well No. 299-W18-96Sheet 3 of 10Location 216-Z-18 CRIB SOUTH OF Z-PLANTProject VOC-ARID ID CCl₄ DRILLINGElevation 682.52' WATER CASINGDrilling Contractor KAISERDriller G. HOWELL; HELPER J. CARPENTERDrilling Method and Equipment CABLE TOOL (WALKER-NFER)Prepared By Roy D. Deen / Roy D. Deen
(Sign/Print Name)Date 2/12/93Reviewed By K.J. Smith
(Sign/Print Name)Date 2-20-93

Depth (Feet)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
92				AS ABOVE	
93					
94					
95					
96	1 VOA 1 SVOA	SCOOP		COARSE TO FINE SAND, CL-FH,	95 FOOT SAMPLE 2/12/93
				20% COARSE SAND	1005 HRS.
	2 LITH 1 EACD 1 PERM	SCOOP		40% MEDIUM SAND	VOA, SVOA BDINX8 (SCOOP)
				30% FINE SAND	HEADSPACE D.D. APPROX
97				COLOR (DRY) 5Y 5/3, OLIVE	
				SAMPLE DAMP, POORLY SORTED,	
				ANGULAR TO SUBROUNDED,	
				15% BASALT FRAGMENTS	
				30% QUARTZ	
98				55% FELSICS	
				10% SILT COATING THE	
				LARGER GRAINS.	
99	SPLIT-SPoon LINER D → B080418 LINER C → B080419 LINER E → B080417	210 Blows 100% RECOVERY		AS ABOVE	SPLIT-SPoon SAMPLE
					LINER A USED AS
					CHEM-RAD SAMPLE BY
				B.1-57	PNL, # B01NX9
100					B01NY0

BOREHOLE LOG

Boring or Well No. 299-W18-96

Sheet 4 of 10

Location 216-Z-18 CRIB SOUTH OF Z-PLANT Project VOC-ARID ID CCL₂ DRILLING

Elevation 1082.52' Outer casing

Drilling Contractor KAISER

Driller G. HOWELL; HELPER J. CARPENTER

Drilling Method and Equipment CABLE TOOL (WALKER NEED)

Prepared By Roy D. Deen / Roy D. DEEN
(Sign/Print Name)

Date 2/12/93

Reviewed By KD-Swett
(Sign/Print Name)

Date 2-20-93

(Sign/Print Name)

(Sign/Print Name)

[illegible]

BOREHOLE LOG

Boring or Well No. 299-W18-96

Sheet 5 of 10

Location 216-Z-18 CRIB SOUTH OF Z-PLANT Project VOC-ARID ID CCLH DRILLING
Elevation 682.52' Outer casing Drilling Contractor KALSER
Driller G. HOWELL; HELPER J. CARPENTER Drilling Method and Equipment CABLE-TOOL: (WALKER-NEER)
Prepared By Ray D. Deen / Ray D. DEEN Date 2/16/93 Reviewed By KJ. SWATT Phil Deen Date 2-20-93
(Sign/Print Name) (Sign/Print Name)

Depth (FEET)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
109				GRADATIONAL CONTACT GRAVELLY SAND, INCREASING AMOUNTS OF LGE. GRAVEL, PEBBLES, COARSE GRAVEL, OTHERWISE, SAME AS ABOVE.	WEATHER AT 0715, 18°F, WINDS 11-15 MPH NNE, BAROM: 29.51, WINDCHILL 0°F.
109					NOTHING DETECTED ON SSD'S PID OR GGM
110	2 VOA 1 SVOA	CORK BOKER, SCOOP		GRADATIONAL CONTACT GRAVELLY SAND, 10% COARSE GRAVEL, 15% PEBBLES, 20% COARSE GRAVEL	VOA, SVOA SAMPLES FROM DB
	2 LITH 1 CA CO ₃ 1 PERM	FROM DRIVE BARREL		30% COARSE GRAVEL 30% COARSE SAND, 20% MEDIUM SAND 10% FINE SAND 5% SILT COATING LGR. GRAINS.	BOINY4, BOINY5 (PNL NOS)
111				COLOR (DRY) 2.5Y5/4, LIGHT OLIVE BROWN, SAMPLE DAMP, POORLY SORTED, SUBANGULAR TO SUBROUNDED, 40% BASALT FRAGMENTS	
112				20% FELSICS 30% QUARTZ 10% DARK MINERALS.	
113					
114					
115					
116					

BOREHOLE LOG

Boring or Well No. 299.W18.96Sheet 6 of 10Location 216.3.18 CurbProject VOC And TO CCL4 DrillingElevation 682.52' over casingDrilling Contractor KEHDriller G. Johnson / J. JohnsonDrilling Method and Equipment Cable Tool WalkerPrepared By J. Johnson
(Sign/Print Name)Date 2-17-93Reviewed By K.S. Shett
(Sign/Print Name)Date 2-20-93

Depth <u>FEET</u>	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery			
116	1 VOA 1 SVOA 2 LITH 1 CACOS 1 PERM		0.0.0	SAMPLE HAS MUCH MORE COARSER GRAVEL, ABOUT 30% COBBLES 20% PEBBLES 50% COARSE TO MEDIUM SAND.	VOA, SVOA SAMPLES PNL # B01NY6 Start Shift 2-17-93 Bikony - hole 117.24' Bokomb casing 119.0' OVM # 022 DO NOT HAVE calibration gas for OVM.
117					
118	1 VOA 1 SVOA 2 LITH 1 CACOS 1 PERM	DRIVE BARREL 117.24' - 119.34'		INCREASING LG. PEBBLES, SMALL COBBLES. 117.24-119.34 Sandy GRAVEL 75% gravel 25% SAND: gravel ranges in size from small cobble to very fine pebble; mid-large pebble to small cobble makes up 40% of sample; remainder gravel fraction; very fine pebble to mid pebble 40%; SAND: 40% very coarse grain, 60% med-coarse grain; 10% silt dry; 10% silt wet; dry from hole; very poorly sorted; pebbles to cobbles subangular to intermediately subrounded; SAND mostly angular to subangular; 65% basalt, andesite, and volcanics, 40% quartz, quartzite with very few feldspars and mica; pebble to cobble 95% basalt 5% quartzite and intrusive, matrix present between grains and on grains. Grains to be powder-like. Shows a moderate to strong reaction to HCL.	*2-17-93 SVOA and VOA DA at 0920 hrs. # B01NY9 40 mL and 125 mL, 2 1st MASON jars for archive (lightage, 1 CACOS, moisture tin No hazards have been detected with PID or PAM. VOA @ 0920 hrs # B01N20
119	1 VOA 1 SVOA 2 LITH 1 CACOS 1 PERM	SPLIT TUBE 119.34-120.54 75% Recovery			*2-17-93 SVOA and VOA ST at 1049 hrs VOA 5, 40 mLs # B01NY8 and # B01NY7 119.34/120.54': - Chem/Rad B01NY7 - VOA B01NY7 listed above - SVOA B01NY7 - VOA B01NY8 listed above Remainder of samples not taken due to poor recovery
120	1 VOA 1 SVOA 2 LITH 1 CACOS 1 PERM	SPLIT TUBE 120.54-124.0' 55% Recovery * top section 5' long		119.34-122.54 At 119.64' there exists a relatively gradual contact which shows a finer downward of small to mid cobble to a mid pebble sand dominated matrix. Strong cementation present from 120.0' - 120.54'. Within same there is a rusty, limed thin layer CACOS shows a very strong reaction to HCL. Sandy GRAVEL 60% gravel 40% sand, 10% silt gray; Dry, poor representation Sample highly pulverized 20% med cobble - small cobble; 40% med- v coarse sand	119.64' grades to sharp contact. OVM # 022 Calibrated at 1200 hrs 101 ppm = 108 ppm. No hazards detected with PID or PAM
121	1 VOA 1 SVOA 2 LITH 1 CACOS 1 PERM				
122					
123					
124					

BOREHOLE LOG

Boring or Well No 299. W18. 96Sheet 7 of 10Location 216.218 Crib. S. of E. plantProject VOC Mid. In CCL DrillingElevation 682.52' outer casingDrilling Contractor Kaiser EngineersDriller G. Howell, Driller; D. Hutchins, HelperDrilling Method and Equipment Cable Tool; Walker NuePrepared By (Signature) V.M. Johnson
(Sign/Print Name)Date 2-23-93Reviewed By (Signature) R.S. Smith
(Sign/Print Name)Date 3-8-93

Depth (FEET)	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery		Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCL.	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
124	CHEM/RAD-124.5'-126.5'-B.C. BOIN 2 2 VOA-126.5'-B.OIP 91 SVOA-126.5'-B.OIP 91 1 Rad (NPT)	SPLIT TUBE 225 BLOWS 75% Recovery 124.5'-126.5'		40% small pebbles or very fine pebbles to very coarse pebbles; v. poorly sorted; angular; 90% basalt, andesite, volcanics; 10% quartz; quartzite; weak reaction to HCL; very compact	Split to be driven to 124.0 ft; after ST was pulled, hole started venting approx 124.0 60ppm CCL indicated by colorimetric tube; OVM kicks of 3.2ppm; time 1254 hrs.) at 1410 hrs. colorimetric tube at 124.0' wellhead was 60ppm; power lock syringe was 98.6ppm CCL.
125				122.0'-124.0' GRAVEL: 80% gravel; 40% M-L pebble, 60% v.f. M pebble; same color as above; Dry; v. poorly sorted; sub- rounded; 80% basalt, volcanic, 20% felsics, quartz (etc); coarsening down- ward; compact	End Shift 2-17-93
126				123.5'-124.0' Subrounded coarse pebbles - small, med. broken pebbles; CaCO ₃ covering pebbles, cobbles 98% basalt, 2% quartzite; 10% sand, 20% c. grain sand, 30% M. grain, 50% v.f. grain; 10% silt; Fins rxn to HCL	Bottom of hole 124.0' Bottom of casing 119.55' Start Shift 2-19-93 Culbath OVM 98.8ppm = 102ppm at 124.0', 92ppm CCL m PID, 910 or.
127	CHEM/RAD-126.5'-128.5'-B.OIN 2 2 VOA-128.5'-B.OIP 91 SVOA-128.5'-B.OIP 91 1 Rad (NPT)	SPLIT TUBE 225 BLOWS 75% Recovery 124.5'-126.5'		124.5'-126.5' Same as above, but under- silt; color: Dry 104 & 4/1; CaCO ₃ coating on larger pebbles, cobbles	End Shift 2-18-93 Challenger OVM 111 ppm
128				127.94' Top of Touchit Beds 97% SILT 3% v. fine grain sand; sharp contact; stems rxn to HCL; dry; 104 & 4/2 dry; 104 & 4/2 wet; v. well sorted; 30% mafics, 60% quartz (etc), 10% felsics; subrounded- angular	Bottom of hole 124.0' Start Shift 2-22-93 NO OVM avail to use Bottom of hole and casing 124.0' SVOA, VOA at 129.0' @ 1664 hrs SVOA, VOA at 129.5'-131' @
129				129.5'- Gradational contact. Silt to Silty gravel; 104 & 7/2 dry; 60% basalt, volcanics; 40% metamorphics; 40% very fine-v. coarse pebbles, 10% small-med cobble, 20% coarse pebbles, 30% silt.	1245 hrs. *Chem/Rad 129.5'-131.0'-BOIN 26 Chem/Rad 129.5'-129.5'-BOIN 25 No backwash/pneumatics re air permeability due to 55% recovery
130	CHEM/RAD-128.5'-130.5'-B.OIN 2 2 VOA-130.5'-B.OIP 91 SVOA-130.5'-B.OIP 91 1 Rad (NPT)	SPLIT TUBE 225 BLOWS 55% Recovery 129.5'-131.0'		129.5'-131.0' Silty GRAVEL. 70% gravel; 40% silt. Gradational contact at 130.2' grades to sandy silt	
131					
132					

B.1-61

BOREHOLE LOG

Boring or Well No 299.W18.96Sheet 8 of 10Location 214.3.18 S. of 2. plantProject VOC (incl. 10 CCL4 DrillingElevation 182.52' meter casingDrilling Contractor Kaiser EngineersDriller G. Howell, Driller; D. Hutchins, HelperDrilling Method and Equipment Cable Tool Walker TurbPrepared By William H. Johnson/V.M. JohnsonDate 2-25-93Reviewed By KS SmithDate 3-8-93

(Sign/Print Name)

(Sign/Print Name)

Depth (FEET)	Sample		Gr. Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
132			DRIVE	Sandy SILT 75% silt, 25% sand. Sand: 100% v.f. grain; 104 R5/3, comp fin grain pebbles noticed, well sorted. 60% quartz (wt), metamorphics. Weak reaction to HCl.	No hazards detected with PID and colorimetric tube. No α or CCL4 detected.
133	ART LITH-132.5 1 HPT (RAD)-132.5	DRIVE BARREL 132.5'-134.0'			End Shift 2-22-93 7:04 PM SVOA, VOA taken at 1430 hrs at depth of 134.5'
134	CAG 1 HPT 20 RCH/LITH 134 Part. Size C. in SFB 27 w/s	DRIVE BARREL 134.0'-135.0'			End Shift 2-22-93 7:04 PM SVOA, VOA taken at 1430 hrs at depth of 134.5'
135	VOA-134.5'-135.0' P03 V0A-134.5'-135.0' P03 SV0A-134.5'-135.0' P03 CHEM/RAD-134.5'-135.0' P03 PHYS P03-134.5'-135.0' P03	DRIVE BARREL 134.0'-135.0'			End Shift 2-22-93 7:04 PM SVOA, VOA taken at 1430 hrs at depth of 134.5'
136	VOA-135.5'-136.0' P03 V0A-135.5'-136.0' P03 SV0A-135.5'-136.0' P03 CHEM/RAD-135.5'-136.0' P03 PHYS P03-135.5'-136.0' P03	SPLIT TUBE 158 BLOWS 100% Recovery 135'-137'		135'-137.0' sandy SILT 60% silt, 40% v.f. grain sand; 104 R6/2 dry; 104 R silt wet; dry sample; v. well sorted. Weak reaction to HCl.	Casing sit 134.3' Start Shift 2-23-93 Cable tool OVM No α or CCL4 detected. Casing 134.3', hole 135.0' OVM 2.0 ppm at 135.0' 1210 hrs 2.5 ppm CCL4 on colorimetric tube, 1.6 ppm CCL4 on PID
137	VOA-136.5'-137.0' P03 V0A-136.5'-137.0' P03 SV0A-136.5'-137.0' P03 CHEM/RAD-136.5'-137.0' P03 PHYS P03-136.5'-137.0' P03	SPLIT TUBE 158 BLOWS 100% Recovery 135'-137'		137.0'-137.5' SILT 95% silt, 5% sand. Sand: 100% v.f. grain; 104 R6/2; dry; very well sorted; 60% quartz (wt), 25% mafics, 15% felsics, morphic, flakes of mica; weak reaction to HCl.	0920 hrs 135'-137, VOA, SVOA, HPT (RAD), Air (CRM-135'-136' * B080A2, B080A3, B080A4, B080A5 135.5'-137.0' VOA, SVOA End Shift 2/23/93 Start Shift 2/24/93 Cable tool OVM 1.2=101.3, NO α or CCL4 detected, casing 139.1, B0H, 139.0' OVM battery fails last half of day Start Shift 2-25-93
138	VOA-137.5'-138.0' P03 V0A-137.5'-138.0' P03 SV0A-137.5'-138.0' P03 CHEM/RAD-137.5'-138.0' P03 PHYS P03-137.5'-138.0' P03	SPLIT TUBE 158 BLOWS 100% Recovery 135'-137'			
139	VOA-138.5'-139.0' P03 V0A-138.5'-139.0' P03 SV0A-138.5'-139.0' P03 CHEM/RAD-138.5'-139.0' P03 PHYS P03-138.5'-139.0' P03	SPLIT TUBE 158 BLOWS 100% Recovery 135'-137'			
140					

B.1-62

BOREHOLE LOG

Boring or Well No. 299.1118.96

Sheet 9 of 10

Location 214.7-18 Crib S. of E-plant

Project 1100-Grid-2D C.C. Drilling, VEX

Elevation 682.52' outer casing

Drilling Contractor Kaiser

Driller G. Howell; 761 per D. Hutchins

Drilling Method and Equipment Cable Tool Walker Neer

Prepared By Victoria H. Johnson V.H. Johnson

Date 2-25-93

Reviewed By K.D. Smith K.D. Smith

Date 3-8-93

(Sign/Print Name)

(Sign/Print Name)

Depth (FEET)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
140				SILT 95% silt, 5% sand; sand: 100% very fine grain; dry; very well sorted; moderate reaction to HCl. No distinct bedding noticed color dry 10yr 5/3, Brown	No α or C.C. detected at 141.69'
141					
142				141.69'-144.34' SILT 100% silt few v.f. grains quartz (lt), color 10yr 5/3 Brown, dry; very well sorted. Strong reaction to HCl, few oxidized spots noticed with bottom of shoe.	VOA, SVOA-143.94'-1110hrs No hazard detected with OVM. 0.0 ppm OVM @ 141.69'- 144.34'
143					0.0 ppm on PID No α detected w/ PAM 143.7'-145' Triaxial measure- ment shaft on top, cautious drilling.
144				143.7'-145.0' SILT same as above.	* 1305 PSI 143.7-145: VOA, BOIPB0; VOA, BOIPB1; SVOH, BOIPB1; Phys. Prop. BOIPB5; Air Perm, BOIPB4; Bulk Dens./porosity, BOIPB3; Chem/Rad. BOIPB5; PAC02/moisture, BOIPB6 CAC02 moisture 142.69'-143.19'-BOIPB5 145'-147' did not obtain Bulk L, Dens./porosity sample due to lack of recovery.
145					
146					No hazards detected on PID or colorimetric tube at 146.0'
147				-146.55' Top of Mio-Pleistocene Unit (caliche layer). color 10yr 7/3-8/2 very pale brown; strong reaction to HCl (calcium carbonate indicated) few basalt pebbles noticed at contact between pale and caliche bed; Sharp contact; dry, mineralogy: Caliche, Calcium Carbonate Secondary precipitate.	No α detected on tube or casing 145'-147' VOA SVOH and samples taken at 1450 hrs.
148					

BOREHOLE LOG

Boring or Well No. 299-W18.96

Sheet 10 of 10

Location 26.2.18 Crib S. of Z. D/W

Project ROC Arc4-2D CCL shellline VEX

Elevation 682.52' outer casing

Drilling Contractor KaiserDriller G. Howell; Helper: D. Hutchins

Drilling Method and Equipment Cable Tool / Valley View

Prepared By Michael H. Johnson V.M. Johnson Dated 2.26.23
(Sign/Print Name)

Reviewed By HS. Smith Date 8-2-93
(Sign/Print Name)

[illegible]

BOREHOLE LOG

Boring or Well No. 299.W18.174Sheet 2 of 11Location 21W E1A Oib ; 200WProject VOC Grid 20/200W ERA DrillingElevation NAD 83 672.29' Outer CasingDrilling Contractor Kaiser Engineers & ConstructorsDriller G Howell ; Helper: D. HutchinsDrilling Method and Equipment Cable Tool, Walker Nier No. 22.530Prepared By John J. JohnsonDate 3/24/13Reviewed By K.J. SmithDate 4-2-13

(Sign/Print Name)

(Sign/Print Name)

Depth (FEET)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCL	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
53	ST	ST			End Shift 7:45 PM 3/24/13
	DB	DB			Bottom of casing 53.8'
54					Start Shift 3/24/13
				54.0'-56.5' SAND, 100% SAND.	OVM Calibration 102ppm=88
				Interbedded mid grain sand & silt	ST samples 1019 hrs 54'-56.5'
				to coarse grain sand, 70% med coarse	VOA # B01PK4, SVOA, VOA #
				grain sand, 15% fine grain, 15% coarse	B01PK5, B01PK6, B01PK7, B01PK8
				grain, 1/2 damp from humidity; well	Particle size # B01PK9, TAG
				sorted, coarse grain downward; subangular	# B01PK8, # B01PK9, # B01PK10
				subrounded; 55% quartzite, 30%	5.5ppm.
				basalt matrix, 15% silts, mica, mica	550 duhls 1 ppm on PID, 5ppm
				in matrix. Unable to do HCL test	indication tube at 58.0'
				due to glove box work.	
				56.5'-58.0' SAND 100% sand sample	according to HET fill instrument
				taken from drive barrel, 70% M. grain	
				10% coarse grain, 20% fine grain; well	End Shift 3/24/13
				sorted. No lith changes, uniform	Start Shift 3/24/13
				mineralogy. Damp from humidity; 1/2	OVM Calibration 102ppm=109
				1/2 damp from humidity; subangular	#014.
				subrounded; moderate reaction to HCL.	*Samples 56.5'-58.0' taken
					2090 hrs VOA # B01PK8,
					VOA, SVOA # B01PK9, 2 archives
					# B01PK9, MOIS/CAO2 # B01PK9,
					Particle size # B01PK9, TAG
					# B01PK8, # B01PK9, # B01PK10
					5.5ppm.
					550 duhls 1 ppm on PID, 5ppm
					indication tube at 58.0'
					*Samples 60.0'-61.5' taken
				60.0'-61.5' SAND 100% sand 40% M. coarse	1010 hrs VOA # B01PK10, SVOA
				grain, 10% coarse grain, 50% fine grain;	VOA # B01PK11, 2 archives # B01
				1/2 slightly damp from humidity,	PK1, MOIS/CAO2 # B01PK11,
				1/2 slightly damp from humidity; dry;	Particle size # B01PK11, TAG
				subangular-subrounded; 70% quartzite,	# B01PK10, # B01PK11. No HCL
				30% basalt, matrix, trace of mica. Strong	detected. 102ppm 3.7ppm

BOREHOLE LOG

Boring or Well No. 299-W18-174

Sheet 9 of 11

Location 214-21-A Crib; 200 W

Project VOC. On 10/20/2000 WERA Drilling

Elevation 1660' 29 672.29' MSL casing

Drilling Contractor Kaiser Engineers Hartford

Driller G. Howell, Helper D. Hutchins

Drilling Method and Equipment Cable Tool Walker New

Prepared By Victoria Johnson Date 3/25/93
(Sign/Print Name)Reviewed By K.J. Swett Date 4-12-93
(Sign/Print Name)

Depth (FEET)	Sample		Graphic Log	Sample Description Soil Classification, Particle Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Reaction to HCl.	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
61	4 SEG DOWNHOLE	DB 6'-4.5'		Reaction to HCl. CaCO ₃ coating on smaller grains & sand. No significant change in lithology Uniform	End Shift 3/24/93 OVM End Churn 100.3 ppm Casing set at 57.9' Hole 53.0' Start Shift 3/25/93 OVM Calibration 102 ppm 107.3
62					
63	DB	DB			Unable to determine lithology between sampling intervals due to SCA drilling conditions
64					
65	4 SEG COMMENTS	DRIVE 65'-66.5'		45.0'-46.5' SAND 100% sand 70% medium - 1 grain sand, 20% v. fine sand, 10% coarse grain; 10% clay; clay; subangular subangular 70% quartzite, 20% matrix, 10% mica, 10% mica, feldspar. Strong reaction to HCl; CaCO ₃ coating on smaller grains; well sorted.	Samples 45'-46.5' taken at 0848 hrs. VOA = 601 PL2, VOA SVOA = 601 PL3, 2 analyses AOI PL3, Moisture (H ₂ O) = 601 PL3 Particle Size = 601 PL3, RAD (TAL) PL2 PL3, Headpack 13.0 ppm No horizons radiologically or chemically detected at field instruments from 65'-66.5'
66					
67					
68	DB	DB			
69					

BOREHOLE LOG

Boring or Well No. 244 W18.174

Sheet 4 of 11

Location 214-A Crib; 200W

Project 200 W CFA / VOC (Mid 20)

Prepared By Victoria H. Johnson, V.H. Johnson
(Sign/Print Name) Date 3/27/93

Reviewed By K.D. Swett, K.D. Swett
(Sign/Print Name) Date 4-12-93

Depth (FEET)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCL	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
69					
70	DB	DB			
71	*SEE COMMENTS	DRIVE BARREL 70.5'-72.0'		70.5'-72.0' SAND 100% SAND; 80% MID- grain-fine grain sand, 20% v. fine sand; 100% light brownish gray; dry; well sorted; subangular-subrounded; most quartz grains subrounded; 70% quartz (1.75) 5% mica: biotite, phlogopite, and muscovite. 5% matrix: basalt; quartz grains coated with CaCO ₃ which is producing a strong reaction with HCL. Max. particle size is mid grain quartz sand.	* Drive Barrel Sample 70.5'-72.0' taken @ 1310 hrs VOA #BO1PF2 SVOA, VOA #BO1PF3, 2 archives #BO1PF3, CaCO ₃ /MOISTURE #BO1 PF3, Particle Size #BO1PF3, Rad (TAC) #BO1PF2 #BO1PF3, headspace 0.0 ppm.
72	DB	DB			No chemical analysis has been detected from 70.5'-72.0'
73	*SEE COMMENTS	SPUT TUBE 95% recovery 73'-75'		73'-75' SAND 100% SAND; 80% mid grain fine grain sand, 20% v. fine sand. No significant lith change noticed as observed looking through glass of split tube. Uniform, similar mineralogic composition is expected since uniform.	*ST samples 73'-75' @ 1406 hrs VOA #BO1PH6, VOA, SVOA #BO1PH7, BO1PH8, #BO1PH9, Air Perm #BO1PH10, Phys. Props #BO1PH11, Chemical #BO1PH12, Rad (TAC) #BO1PH13, Mat'l Props #BO1PH14, TOC #BO1PH15. As above, HCL is shallow. BO1PH16, #BO1PH17, Air Perm #BO1PH18, Phys. Props #BO1PH19
74	*SEE COMMENTS	DRIVE BARREL 75'-76.6'		75'-76.6' SAND 100% SAND; 80% mid- fine grain sand, 20% v. fine sand; 100% light brownish gray; dry; well sorted; subangular-subrounded. Quartz grains mostly subrounded; 75% quartz (1.75) 100% mica: biotite, muscovite, phlogopite, 5% matrix: basalt; Max particle size is mid grain quartz sand. Quartz grains have high amount of CaCO ₃ coating. Strong reaction produced w/ HCL. No lithologic change noticed.	75.0'-75.6' Gt well head spm on colorimetric tube. 0.0 ppm in PID & CHA End Shift 3/25/93 Casing at 72.7' hole 75.0' Start Shift 3/26/93 Calibrated OVM #214 102.87 ppm 102.87 ppm 75'-76.6' spm 10.1 ppm ccl off spm
77				B.1-68	

BOREHOLE LOG

Boring or Well No. 299-WB-174Sheet 5 of 11Location 210-21-A Crib; 200 WestProject VOC Grid 20/200W CCL EEA DrillingPrepared By Victoria Johnson VM Johnson Date 3/30/93Reviewed By OK/Ken H. Smith Date 4-2-93

(Sign/Print Name)

(Sign/Print Name)

Depth (FEET)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
77					*DB Sample 75'-76.6' taken 20910 hrs VOA # A01PL4, VOA 5 VOA # A01PL5 2 archins # A01PL5, Moisture, CaCO ₃ , #A01PL5 Particle size #A01PL5, Red (TAC) #A01PL5, fluid spay 3.1 ppm cutting PID 10.1 ppm 77.2 3.0 ppm in 150 mm tube
78	DB	DB			
79					End Shift 3/24/93 Casing 78.1' hole 79.9' OVM Challenge 102.9 Start Shift 3/29/93
80				80.0'-81.1' SAND 100% sand: 60% medium grain, 30% f-v.f. grain, 10% coarse grain; 10% w/2; clay; well sorted; subangular - subrounded; 70% quartz (f.v.f.), 20% mica: biotite, muscovite, chlorite, 10% Mg f.l.s.; basalt. Maximum particle size up quartz and grain, strong reaction to HCl. No lithologic changes observed	OVM #014 Challenge 102ppm = 102.9ppm *DB Sample 80.0'-81.1' taken 21040 hrs VOA # A01PL6, VOA 2 VOA # A01PL7, 2 archins #A01PL7 Moist/CaCO ₃ #A01PL7, Particle Size #A01PL7, Red #A01PL7, fluid spay 4 ppm
81	DB	DB			
82					
83	DB	DB			
84					
85					

BOREHOLE LOG

Boring or Well No. 299.018.174Sheet 6 of 11Location 216.2.1A Crib 200 WestProject VOC. (WIL) 20/2 W/PL4 ERAPrepared By Victoria H. Hanson (Sign/Print Name)Date 3/31/93Reviewed By D. Smith (Sign/Print Name)Date 4-12-93

Dept. (FEET)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
85				85.1'-87.1' Sandy GRAVEL. 45% gravel / 55% sand 45%. Gravel: 40% fine-mid, 40% coarse, 20% v. coarse, 20% v. coarse pebble; 10% r.s./s.; Dry; v. poorly sorted; pebbles not submerged & rounded. Sand ranges from subangular to sub-rounded. Sand: 60% quartz (1H), 35% basalt, volcanics, 5% mica; biotite, muscovite, phlogopite. More particle size is basalt pebble. Strong reaction to HCl.	*DA Sample 85.1'-87.1' taken @ 1313 hrs VOA # B01PL8 SVOA, VOA # B01PL9, 20th min # B01PL9, Moist / CaCO ₃ # B01PL9, Pmt. Sub. Dist # B01PL9, Red # B01PL9, hand spec 5.4 ppm
86	*SEE COMMENTS	DRIVE BARREL 85.1'-87.1'			
87					
88					
89	DB	DB			*DA Sample 89.7'-91.2' taken @ 1435 hrs VOA # B01PF4, SVOA, VOA # B01PF5, Moist / CaCO ₃ # B01PF5, Pmt. Sub. # B01PF5, Red # B01PF4F5, hand spec 5.6 ppm. No archives taken.
90	*SEE COMMENTS	DRIVE BARREL 89.7'-91.2'		89.7'-91.2' Sandy GRAVEL 50% gravel / 50% sand 50% Gravel: 40% fine-mid pebble, 40% coarse pebble, 20% v. coarse pebble; Sand: 10% mid grain, 40% f-v. fine grain, trace of silt on pebbles 10% r.s./s.; Dry; pebble submerged - rounded; sand: subangular - subrounded. Pebbles: basalt, andesite. Sand: 60% quartz, 35% basalt, 5% mica, strong rxn w/ HCl. pebble max. size.	@ 90.0' 60 ppm Colormetric tube. End Shift 3/29/93 OVM Challenge 102.9 ppm Note 91.2'
91	DB	DB			Casing 89.5'
92	*SEE COMMENTS	TUBE 94.0' Recovery		92.0'-94.0' Sandy GRAVEL 55% gravel / 45% sand; Gravel: 50% coarse & coarse pebble, 40% v. fine-mid pebble, 10% small cobble; Sand: 50% v. coarse-coarse, 40% mid grain, 10% f-v. fine grain. CaCO ₃ color 10% r.s./s. 10% r.s./s.	Start 3/30/93 OVM Calibration 102 ppm = 1
93					

BOREHOLE LOG

Boring or Well No. 299.W18.174

Sheet 7 of 11

Location 214 E. 1A Crib; 200 West

Project Vac. (ind. 20/200 W) CCL/ EBA Drilling

Prepared By [Signature] VM Johnson Date 4/10/13

Reviewed By [Signature] Date 4-12-13

Depth (FEET)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
93	*SEE COMMENTS	SPLIT 92.0' 100%		Color of remaining sample: dry, very poorly sorted. Basalt pebbles sub- rounded-angulated. Sand grain sub- angular-subrounded. Pebbles 100% basalt, volcanic. Pebbles are coated with fine layer of CaCO ₃ . Sand: 100% quartz (-1#), 30% basalt, 5% mica, 5% metamorphics. Max. parti- cle size is basalt pebble. Basalt pebbles show some pyritization within smaller cavities. CaCO ₃ becoming more present in small chunks within basalt pebbles.	No hazards detected w/ PAM in PAM.
94		DB			*92.0'-94.0' ST sample taken @ 2937 hrs. VOA # B01PH8, SVA, VOA # B01PH9, B01PH10, SVA # B08D26, CUS, permeability # B08D25, physical properties # B08D24, chemical # B01PH9, metallurgy # B01PH9, TOC # B01PH9, Rad (TAC) # B01PH9
95	*SEE COMMENTS	DRIVE BARREL 95.2'-96.7'			No hazards detected w/ OVM in PAM. ST-364 Blows.
96	*SEE COMMENTS	DB		95.2'-96.7' Sandy GRAVEL gran/ 100% sand 40% Gravel: 20% coarse pebble 40% med. pebble, 40% fine- v. fine pebble. Sand: 30% med-v. coarse sand, 40% f. sand, 30% v. fine; 104.6/2 light brownish gray; dry; very poorly sorted; pebbles subrounded, sand subrounded- subangular. Pebbles 100% basalt Sand: 50% quartz (1.4), 40% basalt, 5% mica, 5% metamorphics strong reaction to HCl. Sand and pebbles slightly coated w/ CaCO ₃ . noticed a couple of quartz pebbles. Max. particle size is basalt pebble.	*95.2'-96.7' DB Sample taken @ 1100 hrs VOA # B01PH10, SVA, VOA # B01PH1, 2 GACHES # B01PH1, Moist/CaCO ₃ # B01PH1, Dnt. Spt. Dist. # B01PH1, Rad (TAC) # B01 PH10, 7.46dspa 5.6ppm. Both, VOA's were skipped. No hazards detected w/ PAM, GM, or PID.
97	DB	DB			End Shift 3/30/13 Casing 98.5' hole 99.4' Start Shift 4/1/13 Calibrate OVM 102ppm = 102.8 ppm.
98					No hazards detected w/ PAM, GM, or OVM.
99					
100	*SEE COMMENTS	DRIVE BARREL 99.6'-102.7'			
101					

BOREHOLE LOG

Boring or Well No. 299. W18.174Sheet 8 of 11Location 216.3.1A Crib; 200WProject Voc Oxid 20/2WCL4 EPA DrillingPrepared By William M Johnson Date 4/4/93
(Sign/Print Name)Reviewed By Old Lane KS-Swett Date 4/2/93
(Sign/Print Name)

Depth (FEET)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
101	*SEE COMMENTS	DRIVE BARREL 99.6'-102.7'		99.6'-102.7' Sandy GRAVEL gravel 60% SAND 40%, GRAVEL: 70% coarse pebble - v. coarse pebble, 40% f-mid. pebble, 40% f-v. fine pebble; SAND: 40% coarse- v. coarse sand, 35% mid. sand, 5% f. sand; 10 yr 4/1 dark gray, moist, very poorly sorted; pebbles: rounded-subround sand: subangular-subrounded; Max. particle size is basalt pebble; pebbles 100% basalt, sand	*DB Sample 99.6'-102.7' taken D 1338 hrs VOA# BOIPF6; SVA, VOA# BOIPF7, 2 archives #BOIPF7 MOIST/CO2 #BOIPF7, Put. Sig. Dist. #BOIPF7, Rel (TAC) #BOIPF6F7 Hand spec sample 13.3 ppm, sample may have interference from condensate.
102					End Shift Casing 102.0' hole 103.0' End Challenge OVM = 102.8' Start Shift 4/2/93
103					OVM calibration, 103 ppm = 101.9 ppm.
104	*SEE COMMENTS	DRIVE BARREL 104.0'-106.0'		104.0'-106.0' Sandy GRAVEL gravel 50% sand 50% gravel; 40% coarse pebble, 40% f-mid. pebble, 20% v. fine pebble; Sand: 40% coarse-very coarse sand, 30% mid. sand, 30% f-v. fine sand; dry; v. poorly sorted; pebble: subangular; sand: subangular-sub- rounded; 10 yr 5/2 grayish brown; pebbles 100% basalt, volcanics; sand: coarse-v. coarse sand predominantly basalt ~ 60% basalt, 35% quartz (v. f.), 5% mica and metamorphics; Moderate inclination to HCL; appears to be grading to fines.	*DB Sample 104'-106' taken D 0815 hrs: VOA# BOIPM2, SVA, VOA# BOIPM3, 2 arch- ives #BOIPM3, Moist/CO2 #BOIPM3, Put. Sig. Dist. #BOIPM3, Rel (TAC) #BOIP- M2M3. Hand spec 0.0 ppm. No hazards detected w/ PAN, GM, PID, COLUMBIUM tube, or OVM.
105					
106					
107	DB	DB		107.0' SAND 100% sand sand: 55% mid. sand, 40% f-v. fine sand, 5% coarse-v. coarse sand; well sorted; 10 yr 6/2 light brownish gray; 40% quartz, 30% basalt	
108					
109					

B 1-72

BOREHOLE LOG

Boring or Well No. 299.W18.174

Sheet 9 of 11

Location 2147-1A Culp; 200 W

Project VOC (Mid 90/200 CCL) EPA Drilling

Prepared By Victor M. Johnson Date 4/10/93Reviewed By R. S. Smith Date 4-12-93

(Sign/Print Name)

(Sign/Print Name)

Depth (FEET)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
109	DB	DB			*110.0'-112.0' DB samples taken @ 1010 hrs VOA #B-
110	DB	DB		110.0'-112.0' SAND 90% sand, 10% silt; sand: 80% med-f. sand, 20% v. fine sand; 10% silt; 10% clay light brownish gray; dry; well sorted; subangular-subrounded	01PM4; 5VOA, VOA #BOIPM5; 2 archives #BOIPM5; Moist CaCO ₃ #BOIPM5; Dist. #BOIPM5; Rad (TAC) #BOIPM4M5; headspace
111	*SEE COMMENTS	DRIVE BARREL 110.0'-112.0'		75% quartz (4H), 15% basalt; 5% mica; 2% illite, muscovite, phlogopite, 5% metamorphics; strong reaction to HCl. CaCO ₃ present within silt coated grains; Max particle size quartz 1/4" sand; sand is fine grained	0.0 ppm @ 111.0' 20 ppm indicated on calimetric tube off of soils. End Shift 4/2/93 hole: 112.0' Casing: 107.4' Start Shift 4/5/93
112	DB	DB		112.7'-114.7' Silty SAND sand 75% silt; sand: 40% M. grain, 60% f - v. fine sand; 10% clay dry; clay; well sorted; subangular subrounded; 80% quartz (4H) 15% basalt; 5% mica; high illite muscovite; trace of metamorphics Some basalt shows pitting in cavities. Max. particle size basalt	No OVM available @ 0800 hrs. 0800 hrs: No hazards detected w/ param. pin on calimetric tube. 0920: OVM #24 delivered to site. calibrated @ 101.9 ppm.
113	*SEE COMMENTS	SPLIT TUBE 112.7'-114.7' 100% Recovery		115.0'-116.6' Sandy SILT sand 30% silt 60% sand; 60% med-f. fine grain, 40% v. fine grain; 2.54 1/2; slightly moist; well sorted; subangular-subrounded; 70% quartz (4H); 30% basalt, volcanics trace of mica and metamorphics Max particle size is quartz sand. strong rxn to HCl	*112.7'-114.7' ST samples taken @ 1008 hrs: VOA # BOIP10; 5VOA VOA #BOIP11; BOIP10SIL #BOIP029; Air pin #BOIP028; Phys prop #BOIP027; Chemical #BOIP1 Metal ions #BOIP1, TOC #BOIP1; Rad (TAC) #BOIP 1110; 126 Blows; No hazards detected.
114	DB	DB		115.0'-116.6'	115.0'-116.6' DB sample taken @ 1245 hrs VOA #BOIPM6; 5VOA VOA #BOIPM7 2 archives #BOIPM7 MOIST/CaCO ₃ #BOIPM7; TAC # BOIPM7; Rad #BOIPM6M7; Head- space 12.0 ppm. Cutting @ 0.0 ppm No hazards detected w/ param.
115	*SEE COMMENTS	DRIVE BARREL 115.0'-116.6'			
116	DB	DB			
117	DB	DB			

BOREHOLE LOG

Boring or Well No. 299-W18-174

Sheet 10 of 11

Location 216 E 1A Crib; 200 West

Project VOC-Grid 30/21W CCL/ERA Drilling

Prepared By Victor A. Johnson Date 4/8/93
(Sign/Print Name)Reviewed By K.S. Surt Date 4-12-93
(Sign/Print Name)

Depth (FEET)	Sample		Graphic Log	Sample Description	Comments			
	Type and No.	Blows or Recovery		Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level			
117	* SEE COMMENTS	SPLIT TUBE 100% Recovery 117.0'-119.0'		117.0'-119.0' Silty SAND sand 70%, silt 30%, Sand: 60% M-V. coarse grain, 40% v. fine-fine sand; 2.54 g/2 dry; Moderately well sorted; silty- angular-subrounded. 60% < 75 (-14), 5% mica; 30% basalt, 5% metamor- phics. Max particle size v. coarse sand. Strong reaction to HCl.	* ST sample taken @ 117'-119' 1350 hrs VOA #BO1P12; SVOA VOA #BO1P13; Bulk Density 1 Density #BO8D32, Air Den #BO8D31, Phys. Prop. #BO8D30 Chemical #BO1P13, METALLIONS. #BO1P13, TOC #BO1P13, Rad (TAC) #BO1P12 3, 197 Blows End Shift 4/5/93 Casing: 117.9' Twist 119.5' Start Shift 4/6/93			
118								
119				-DB	-DB			
120				PNL MICROBIAL SAMPLE	SPLIT TUBE 100% Recovery 119.5'-121.5'		119.5'-121.5' SILT 100% silt 100% 5/3; MOIST; very well sorted. Strong reaction to HCl. (PALOUSE)	QVM #24 Calibration 1020 = 101.9 ppm. * ST sample 119.5'-121.5' taken @ 0852 hrs: PNL Microbial #BO8D33, Rad (TAC) #BO8D34 109 blows * DB SFE Sample taken @ 0930 hrs * DB Sample 121.5'-122.7' taken @ 0952 hrs: VOA #BO1P18, SVOA, VOA #BO1P19, MOIST (CCL) #BO1P19, Pinitilic #BO1P19, Rad (TAC) #Rad (TAC) #BO1P19 4 duplicates: Not obtained; Dupl- icates: VOA #BO1P14, #BO1P15 * DB SFE Sample 120'-121.5', Rad (TAC) #BO8D34 * DB SFE Sample 122.7'-123.4' Rad (TAC) #BO8D35 * ST sample 123.4'-125.4' taken @ 1405 hrs: VOA #BO1P14, SVOA, VOA #BO1P15, Air Den # BO8D36, Aspic #1 #BO8D37, Aspic #2 #BO8D38, Chem #BO1P15, METALLIONS #BO1P15 TOC #BO1P15, Rad (TAC) #BO1P14 -15; Duplicates: VOA #BO1P12, VOA #BO1P13, SVOA #BO1P16
121								
122	* SEECOMMENTS	DRIVE BARREL 121.5'-122.7'					121.5'-122.7' SILT 100% silt 100% 5/3 Brown; MOIST; very well sorted. Strong reaction to HCl.	
123	SFE Sample	DRIVE BARREL 122.7'-123.4'					122.7'-123.4' SILT 100% silt. No changes from above.	
124	* SEE COMMENTS	SPLIT TUBE 100% Recovery 123.4'-125.4'		123.4'-125.4' SILT 100% silt. No changes from above.				
125								

B.1-74

BOREHOLE LOG

Boring or Well No. 299. W18.174Sheet 11 of 11Location 216 E 14th 200 WestProject VOC. And 20/2W CCL4 ERAPrepared By Vicki M. Johnson Date 4/8/93
(Sign/Print Name)Reviewed By K. J. Smith Date 4-12-93
(Sign/Print Name)

Depth (FEET)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
125	ST	ST		125.9'-127.6' SILT 100% silt, 104.25% Moist. v. well sorted, strong reaction to HCL	Mud logs #801P16, 120 Blows *DB SEE Sample 124.1'-125.4' @ 1455 hrs Rad(TAC) #808039 End Shift 4/6/93
126	*SEE COMMENTS	DB			Casing: 124.1' hole: 125.9' Start Shift 4/7/93 OVM Calibration #24 102ppm = 101.9 ppm
127	*SEE COMMENTS	DRIVE BARREL 125.4'-127.6'			*DB Sample 125.9'-127.4' taken 0.934 hrs: VOA #801P60, SVOA VOA #801P61, 200 chips #801P61
128	*SEE COMMENTS	SPLIT TUBE 100% Recovery 127.6'-129.4'		127.6'-129.4' SILT 100% silt. No change from above.	Moist/CuCO ₃ #801P61, Part Size #801P61, Rad(TAC) #801P60 G1, headspace 10.1 ppm, Cuttings 15 ppm. Blanks: 2.40 ml toasters, 2.40 ml trip blanks, 2.40 ml equipment blanks
129	*SEE COMMENTS				*ST sample 127.6'-129.4' taken @ 1252 hrs: VOA #801P16, SVOA, VOA #801P17, Bulk Density/Density #808040, Air Perm #808041, Phys. Props #808042, Chemical #801P17, Mud logs #801P17, TOC #801P17
130	*SEE COMMENTS	DRIVE BARREL 129.4'-131.5'		130.0' CALICHE 104.27% Very pale brown, very strong reaction to HCL. Sharp contact at 130.0' w/ wellhead 0.0 ppm. headspace @ 130.0' 13.0 ppm w/ OVM, colorimetric: 60+ ppm.	Rad(TAC) #801P17, head up ST 11 ppm, Shw 13 ppm, 133 blows
131	*SEE COMMENTS				End Shift 4/7/93 OVM Challenge 101.9 Casing 129.0' hole: 129.4' Start Shift 4/8/93 OVM Calibration #24 102ppm = 101.9
132					*DB Sample 129.4'-131.5' 0843 hrs: VOA #801P62, SVOA, VOA #801P63 200 chips #801P63, Moist/CuCO ₃ # 801P63, Part Size #801P63, Rad (TAC) #801P62 G3. End Shift 4/8/93 OVM Challenge 101.9 ppm hole 131.5' casing 129.0' *TD!

B.1-75

BOREHOLE LOG

Boring or Well No. 299-W18-252

Sheet 1 of 14

Location 200W-S of Z-Plant

Project CCLH ERA

Prepared By John Flinn Date 5/3/93

Reviewed By Victoria M. Johnson Date 6/14/93

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name; Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
0				0' Stabilization Fill	
				5' SAND S (100% Sand)	SAMPLE BOIPH2
				20% cs, vcs	5/3/93-1000 (3'-5')
				40% ms 104R3/4	VOA, TAC, CaCO ₃ Moisture
				40% fs, vfs	OVM Headspace = 0ppm (STP)
	VOA TAC CaCO ₃ Moisture			Moist, Very well sorted, angular to subangular, 80% Qtz, 20% Basalt, Max size = 2 mm, Moderate oxidation staining No reaction to HCl	
5'				10' Gravely SAND gs (75% Sand, 25% Gravel)	SAMPLE BOIPH3
				33% vcp-cp 30% cs, vcs	5/3/93-1045 (8'-10')
				34% mp 30% ms 104R6/2	VOA, TAC, CaCO ₃ Moisture
				33% fp, vfp 40% fs, vfs	OVM Headspace = 0ppm (STP)
	VOA TAC CaCO ₃ Moisture			Dry, Poorly sorted, subangular to subrounded, Subdiscoidal to subprismatic, 90% Basalt, Easy drilling 10% Meta & Granitoids, S-40% Basalt, 60% Qtz Max = 2", No reaction to HCl.	Sharp contact @ 11.5'
10'				12' Sandy GRAVEL G (65% Gravel, 35% Sand)	More difficult drilling
				50% mp 80% cs, vcs	
				50% fp, vfp 20% ms	
				Max size = 4"	
				15' Sandy GRAVEL sg (60% Gravel, 40% Sand)	SAMPLE BOIPG5
				20% cp, vcp 60% cs, vcs	5/3/93-1420 (13.5'-16')
				30% mp 25% ms 104R6/1	VOA, TAC, CaCO ₃ Moisture
				50% fp, vfp 15% fs, vfs	OVM Headspace = 0ppm (STP)
	VOA TAC CaCO ₃ Moisture			Dry, poorly sorted, G-Angular to rounded, Subdiscoidal to subprismatic, 35% Basalt, 15% Qtzite, Granitoids & Meta, S-Subangular to subrounded, Subdiscoidal to subprismatic 60% Basalt, 40% Qtz & felsics, Max = 2" Weak reaction to HCl	
15'					
	VOA TAC CaCO ₃ Moisture				Driller reports sharp contact @ 16.5' - Sand
20'					

B.1-76

BOREHOLE LOG

Boring or Well No. 299-W18-252

Sheet 2 of 14

Location 200W-S of E Plant

Project CCW ERA

Prepared By John Flinn Date 5/5/93
(Sign/Print Name)Reviewed By William Johnson Date 6/14/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
20'				20' SAND S (99% Sand, 1% Gravel) 100% vfp 20% cs-vcs 65% ms 104R4/1 15% fs, vfs Dry, Very well sorted, Angular to rounded, discoidal to subprismoidal, 50% Basalt, 50% Qtz., Max = 2mm, No reaction to HCl	SAMPLE BOIPG4 VOA TAC, CaCO ₃ , Moisture 5/3/93: 1455 (18'-20') OVM Headspace = 0 ppm
25'	VOA, TAC CaCO ₃ Moisture			25' Gravelly SAND gs (80% Sand, 20% Gravel) 100% sp, vfp 60% cs, vcs 30% ms 104R5/1 10% fs, vfs Moist, Moderately sorted, Angular to Subangular, Subprismoidal to Subdiscoidal, 90% Basalt, 10% Qtz & felsics. Max = 5mm No reaction to HCl	SAMPLE BOIPG6 VOA TAC, CaCO ₃ , Moisture 5/4/93: 1025 (24'-25') OVM Headspace = 0 ppm (STP) Start. bed. med. sand. Fine gravel & coarse sand to 0.5' bedding - 22' to 24' coarsening downward - medium sand to medium gravel, sand.
30'	VOA, TAC CaCO ₃ Moisture			30' Gravelly SAND gs (75% Sand, 25% Gravel) Same as above. Max = 2 cm	Thin bedded (~2mm) ~27' Layers total ~1.5cm fine & med. sand. 2 gal low water added @ 28.5'
35'	VOA TAC CaCO ₃ Moisture				SAMPLE BOIPG7 VOA TAC, CaCO ₃ , Moisture 5/4/93: 1440' (30'-30.6') OVM Headspace = 0 ppm Poorly consolidated - difficult recovery END Shift 5/4/93 BH: 34' CS: 34'

B.1-77

BOREHOLE LOG

Boring or Well No. 299.W18-252

Sheet 3 of 14

Location 200 W. S of Z Plant

Project CCl₄ ERA

Prepared By John Flynn Date 5/6/93
(Sign/Print Name)

Reviewed By Victoria Johnson Date 6/8/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery		Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
35'				35' SAND S (99% Sand, 1% Gravel)	35' SAMPLE · B01PG8
				60% CS, vcs 100% fp, vfp	VOA, TAC, CaCO ₃ , Moisture
				20% ms 104R3/L	5/5/93 · 0745 (33.5' - 35.5')
				20% fs, vfs	OVM Headspace = Ø ppm
				Slightly Moist, Well Sorted, Angular to Subround, Subdiscoidal to Subprismoidal,	Very poorly consolidated
				85% Basalt, 15% Qtz & felsics, Max size = 6mm, No reaction to HCl	No stratification
40'	VOA, TAC, Moisture, CaCO ₃			37.5 sG Clasts to large Cobble size	37' Sharp Contact
				Gravel: 75% Qtzite, 25% Basalt	Cobble layer 1' thick
				Sand is mostly medium	
				40' Sand S (95% Sand, 5% Gravel)	40' SAMPLE · B01PG9
			Trace CP 33% fs, vfs trace silt	VOA, TAC, Moisture, CaCO ₃	
			50% MP 34% ms 104R6/L	5/5/93 · 0845 (39' - 40')	
			50% fp, vfp 33% cs, vcs	OVM Head space = Ø ppm	
	VOA, TAC, Moisture, CaCO ₃		Slightly Moist, Poorly Sorted, G-Subrounded to Rounded, Subdiscoidal, 90% Qtzite, 10% Basalt.		
45'			S-Subangular to Subrounded, Subdiscoidal to Subprismoidal, 60% Qtz & felsics, 40%		
			Basalt, Max = 50 mm. Weak reaction to HCl on gravel surfaces, sand stuck to gravel.	End Shift 5/5/93	
				BH-38.58' Cs-38.71'	
				End 11" drilling, begin 12" drilling	
			42.5' Sandy GRAVEL sG (80% Gravel, 20% Sand)		
			Abundant Small Cobbles (to ~4" dia.)	Gradational Change	
			75% Qtzite, 25% Basalt, Matrix same as above	Driller reports difficult drilling	
			45' Sandy GRAVEL sG (75% Gravel, 25% Sand)		
			50% LC 33% cp, vcp 20% fs, vfs		
			50% SC 34% MP 50% ms 104RLS/L	45' SAMPLE · B01PHI	
			33% fp, vfp 30% fs, vfs	VOA, TAC, Moisture, CaCO ₃	
			Moist, very poorly sorted, G-Rounded to Subrounded, Subdiscoidal, 45% Basalt,	5/6/93 · 1245 (43.7' - 44.7')	
			45% Qtzite, 10% Meta, S-Angular to Subangular, Subdiscoidal to Subprismoidal	OVM Headspace = Ø ppm	
			50% Basalt, 50% Qtz. Max = 8" (~20cm).	Encl Shift 5/6/93	
			Weak reaction to HCl.	BH=48.6'	
50'					

B.1-78

BOREHOLE LOG

Boring or Well No. 299-W18-252

Sheet 4 of 14

Location 200 W - S of Z Plant

Project CC 4 ERA

Prepared By _____ (Sign/Print Name)

Reviewed By VICTOR M. JOHNSON Date 6/8/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery		Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
45'				50' Same as above	50' SAMPLE · B07BD5
					VOA, TAC, CaCO ₃ , Moisture
				51' Stratified, Medium Sand; Coarse Sand and Fine Gravel	5/10/93: 1300 (48.5'-50.0') OVM Headspace: ∅ ppm
				52' SAND S (98% Sand, 2% Gravel) 2% CS, VCS 100% fs, vfp 50% ms trace silt 48% fs, vfs 104R5/6 Moist, well sorted, max = fp, 80% Qtz, 20% Basalt, Weak reaction to HCl	Sharp contact @ 51' cs:fp/ MS to 51.5', fs to 52.5', then as described @ 55'. Continues variable w/ gradational contacts.
50'				55' SAND S (99% Sand, 1% Gravel) 10% CS, VCS 100% fs, vfp 60% ms 104R3/4 30% fs, vfs Moist, well sorted, S = angular to subangular, subprismatic to subdiscoidal, 30% Qtz, 70% Basalt. G = subrounded, subprismatic, 100% Basalt. Max = 1cm No reaction to HCl.	55' SAMPLE · B07BD6 VOA, TAC, CaCO ₃ , Moisture 5/10/93: 1405 (49.0'-50.0') (54'-55') OVM Headspace: ∅ ppm Sand contains tabular lumps of moderately cohesive sand, weak reaction to HCl.
55'				60' SAND S (100% Sand) 50% CS, VCS 40% ms 104R5/3 10% fs, vfs Moist, very well sorted, angular to subangular, subdiscoidal to subprismatic, 50% Qtz, 50% Basalt, trace Muscovite. Max = 2mm, No reaction to HCl	END Shift 5/10/93 BH: 58', CS: 54.5' 60' SAMPLE · B07BD7 VOA, TAC, Moisture, CaCO ₃ 5/11/93: 0930 (59.0'-60.0') OVM Headspace: ∅ ppm
60'				62'-63' Stratified, 10 to 30 cm layers, fs, ms, MA VCS. Color, grain size, Basalt & Qtz content varies gradationally over short intervals.	

BOREHOLE LOG

Boring or Well No. 299-W18-252

Sheet 5 of 14

Location 200W-S of Z Plant

Project CCHERA

Prepared By

John Flann

Date

5/12/93

Reviewed By

Victoria Johnson

Date

6/8/93

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
60'				65' SAND S (100% Sand) 3% CS, VCS trace silt 75% MS 104R6/3 22% FS, VFS Moist, Very well sorted, Angular, subdiscoidal to discoidal, 100% of CS, VCS is Muscovite, MS: 75% Qtz, 25% Basalt. No reaction to HCl	65' SAMPLE: B07BDB VOA, TAC, CaCO ₃ , Moisture 5/11/93 - 1100 (64.5'-65.5') OVM Headspace = 0 ppm Contains lumps of slightly cohesive sand. Weak reaction to HCl END Shift - 5/11/93 - BH - 66', CS - 63.8'
65'	VOA, TAC CaCO ₃ Moisture			70' SAND S (95% Sand, 5% Silt) 10% CS, VCS 30% MS 104R6/2 60% FS, VFS Moist, Very well sorted, Angular, discoidal to subprismatic, 3% Muscovite, 60% Qtz, 37% Basalt, No reaction to HCl	70' SAMPLE: B07BD9 VOA, TAC, CaCO ₃ , Moisture 5/12/93 - 1100 (70.0'-71.0') OVM Headspace = 1.9 ppm Weakly cohesive, thinly laminated.
70'	VOA, TAC CaCO ₃ Moisture			75' SAND S (90% Sand, 10% Gravel) 5% MP 15% CS, VCS 95% FS, VFS 25% MS 104R5/2 60% FS, VFS Moist, Well sorted, Angular to Subangular, Discoidal to subprismatic, S: 50% Basalt, 48% Qtz, 2% Muscovite, G: 75% Basalt, 20% Qtz & Quartzite, 5% Meta & Granitoids. Max size = ~12.8mm mus No reaction to HCl	75' SAMPLE: B07BFO VOA, TAC, CaCO ₃ , Moisture 5/12/93 - 1230 (75'-76') OVM Headspace = 1.5 ppm Contains lumps of cohesive sand - medium to coarse.
75'	VOA, TAC CaCO ₃ Moisture			80' SAND S (98% Sand, 2% Silt) 5% CS, VCS 30% MS 104R5/3 65% FS, VFS Moist, Very well sorted, Angular to Subangular, discoidal to subprismatic, CS, VCS: 30% Muscovite, 40% Qtz, 30% Basalt. Max size = 1.5mm Muscovite. No reaction to HCl	80' SAMPLE: B07BF1 VOA, TAC, CaCO ₃ , Moisture 5/12/93 - 1440 (79'-80.6') OVM Headspace = 1.1 ppm END Shift - 5/12/93 BH = 84.5', CS = 84'
80'	VOA, TAC CaCO ₃ Moisture			B.1-80	

BOREHOLE LOG

Boring or Well No. 299-W18-252

Sheet 6 of 14

Location 200W-S of Z Plant

Project C.C. L. ERA

Prepared By John Flinn Date 5/14/93
(Sign/Print Name)Reviewed By Victor Johnson Date 6/8/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery		Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
80'	See pg 5			85' SAND S (98% Sand, 1% Gravel, 5% cs, vcs 1% Silt) 70% ms 100% fs, vps 20% fs, vps 104R5/6 Moist Very Well Sorted, Angular to Subangular, Discoidal (Muscovite) to subprismatic, 70% Qtz, 30% Basalt, Max = 4mm, Weak Reaction to HCl	85' SAMPLE B07BF2 VOA, TAC, CaCO ₃ , Moisture 5/13/93 - 0800 (84.5' - 86') OVM Headspace = 2.0 ppm
85'	VOA TAC CaCO ₃ Moisture			90' SAND S (100% Sand) 15% cs, vcs Trace Silt 70% ms 104R 6/1 15% fs, vps Moist Very Well Sorted, Angular to Subangular, Discoidal to subprismatic, 75% Qtz, 23% Basalt, 2% Muscovite, Max = 2mm, No Reaction to HCl	90' SAMPLE B07BF3 VOA, TAC, CaCO ₃ , Moisture 5/13/93 - 1045 (88' - 90.2') OVM Headspace = 0 ppm
90'	VOA TAC CaCO ₃ Moisture			95' SAND S (97% Sand, 3% Silt) 2% cs, vcs 40% ms 104R 6/4 58% fs, vps Moist Very Well Sorted, Angular, Discoidal, CS = 90% Muscovite, 10% Qtz, MS = 90% Qtz, 10% END Silt 5/13/93 Basalt, trace Muscovite, Max = 2mm, Weak Reaction to HCl	95' SAMPLE B07BF4 VOA, TAC, CaCO ₃ , Moisture 5/13/93 - 1355 (95.5' - 96.5') OVM Headspace = 0 ppm
95'				100' SAND S (99% Sand, 1% Silt) 10% cs, vcs Trace Vp 70% ms 104R 6/6 20% fs, vps Moist Very Well Sorted, Angular to Subangular 70% Qtz, 30% Basalt, trace Muscovite, Max = 5mm, No Reaction to HCl	100' SAMPLE B07BF5 VOA, TAC, CaCO ₃ , Moisture 5/14/93 - 0740 (99' - 100') OVM Headspace = 2.4 ppm
100'	VOA, TAC CaCO ₃ Moisture				Sharp Contact @ 101' S above G/G below

B. I-81

BOREHOLE LOG

Boring or Well No. 299-W18-252Sheet 7 of 14Location 200W-S of Z PlantProject CCJ4 ERAPrepared By John Flinn Date 5/18/93
(Sign/Print Name)Reviewed By John H. Chinn Date 6/8/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
100'				103' Sandy GRAVEL sg (70% Gravel, 28% Sand, 2% Silt) 20% mp 75% cs, vcs 5% fs, vfs 80% fs, vfs 20% ms 104R4/3 Very Moist, Poorly Sorted, G-Subangular, Sub- disoidal to Subprismatic, 50% Basalt, 50% Qtzite. S-Subangular to Subangular, Subdisoidal to Subprismatic, 60% Basalt 40% Qtz. Max Size: 10cm subdis, Weak Reaction to HCl	Sharp contact @ 101' S/G, sg Sharp contact @ 104'
105'	VOA, TAC CaCO ₃ Moisture			105' Sandy GRAVEL sg (75% Gravel, 25% Sand) 2% cp, vcp 60% cs, vcs 49% mp 30% ms 104R5/2 49% fs, vfs 10% fs, vfs trace silt Moist, Poorly Sorted, G-Subangular, Subdisoidal to Subprismatic, 50% Basalt, 50% Qtzite S-Subangular to Subangular, Subdisoidal to Subprismatic, 60% Basalt 40% Qtz. Max size: 10cm, Weak Reaction to HCl	105' SAMPLE B07BF6 VOA, TAC, CaCO ₃ , Moisture 5/14/93, 0840 (105'-105.5') OVM Headspace: 0 ppm Silt skins on Gravel Sharp contact @ 105.4', sg above, below is ms-mp, almost dry, much better sorted than above contact.
110'				107'-109' sg, varies dry to moist 111' GRAVEL G (95% Gravel, 3% Sand, 2% Silt) Moist, Very Poorly Sorted, G-Rounded to Subangular, Subdisoidal to Subprismatic, 75% Basalt, 25% Qtzite Max size: 10cm	107'-109' sg, varies dry to moist 115' SAMPLE B07BF7 VOA, TAC, CaCO ₃ - No Moisture 5/17/93 - 1325 (115'-115.5') OVM Headspace: 2.9 ppm (possibly due to added moisture) END Shift 5/17/93 BH-116', CS-115.5'
115'	VOA, TAC CaCO ₃			118.5' Trace CALICHE in cuttings 121' Sandy GRAVEL sg (70% Gravel, 27% Sand, 3% Silt) 33% cp, vcp 33% cs, vcs 34% mp 34% ms 104R3/2 33% fs, vfs 33% fs, vfs Moist, Very Poorly Sorted, G-Subangular, Sub- disoidal to Subprismatic, 90% Basalt, 10% Qtzite S-Angular to Subangular, Subdisoidal to Subprismatic, 80% Basalt 20% Qtz. Max size = 3", Weak Reaction to HCl. Trace fragments of Caliche B.J-82	121' Driller Reports "Red Cinders" in Cuttings - Oxidized Qtz? Silt skins on Gravel 120' Sample B07BF8 VOA, TAC, CaCO ₃ Moisture 5/18/93, 0845 (121'-121.5') OVM Headspace: 0 ppm Moisture content probably affected by water added @ 115.5'
120'					

BOREHOLE LOG

Boring or Well No. 299-W18-252

Sheet 8 of 14

Location 200W-S of Z Plant

Project CCL4 ERA

Prepared By John Flinn Date 5/20/93
(Sign/Print Name)Reviewed By William M. Johnson / Virginia M. Johnson Date 6/8/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
120'	VOA TAC CaCO ₃ Moisture			121' See page 7	Sharp Contact @ 125' Touched Bobs 1 cm stratification: vfs/vfs, m
				126' Silty SAND mS (60% Sand, 40% silt)	
				Moist, Very Well sorted, Max: 1/8", 104R5/4	127' SAMPLE: B07BF9
				Non-Plastic, medium dilatancy, gritty smear	VOA TAC, CaCO ₃ , Moisture
				Very low dry strength, 98% Qtz, 2% Basalt	5/19/93: 0755 (125.5'-127')
				Trace Muscovite, Strong Reaction to HCl	OVN Headspace: 6.4 ppm
				130' Sandy SILT sM (80% silt, 20% sand)	130' SAMPLE: B073G0
125'	VOA TAC CaCO ₃ Moisture			100% fs, vfs trace fgs 104R5/6	VOA TAC, CaCO ₃ , Moisture
				Moist, Very Well Sorted, Non-Plastic, medium	5/19/93: 1110 (129'-130')
				Dilatancy, very slightly gritty smear, G-subangular	OVN Headspace: 0.8 ppm
				100% Basalt, 5-40% Qtz, 10% Basalt, Max:	
				15mm. Strong Reaction to HCl	Stratified: mS/sM
				135' Silty SAND mS (70% Sand, 30% silt)	135' SAMPLE: B07BG1
				100% fs, vfs Trace Gravel 104R5/3	VOA TAC, CaCO ₃ , Moisture
				Moist, Very Well Sorted, Non-Plastic, medium	5/19/93: 1315 (133.5'-135.3')
				Dilatancy, Gritty Smear, Medium dry crush strength	OVN Headspace: 1.8 ppm
				Max: 5mm basalt gravel, Strong Reaction to HCl	
				137' Slightly Silty SAND mS (80% Sand	Stratified sM/mS
				40% MS 20% silt)	END Shift 5/19/93
				60% fs, vfs 104R4/3	BH-135.3' - CS-132.8'
				Very Moist (Free water appeared while hammering	137' OVN Headspace: 5.4 ppm
				sample out of DB) Non-Plastic, Angular,	SPS
				85% Qtz, 15% Basalt, Max: 1mm, Strong	Triangular, Sharp Contact w/
				Reaction to HCl	CALICHE @ 137.5' No
					PALOUSE Soil present.
				138' CALICHE - Sandy GRAVEL sG	
135'	VOA TAC CaCO ₃ Moisture			104R8/2, 104R6/6	
				(60% Gravel, 25% Sand, 15% CaCO ₃)	
				25% SC	
				25% CP, VCP	
				25% MP	
				25% fs, vfs	Gradational Contact - CALICHE
				G-subangular, subprismatic to sub-	ends ~ 139.5'
				discoidal, 30% Qtzite, 70% Basalt.	
				Strong Reaction to HCl	END Shift 5/20/93
140'				B.1-83	BH-139.6'

BOREHOLE LOG

Boring or Well No. 299-W18-252

Sheet 9 of 14

Location 200 W. S of Z Plant

Project CC14 ERA

Prepared By John Flinn Date 5/26/93

Reviewed By [Signature] Date 6/8/93

(Sign/Print Name)

(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
140'	VOA TAC CaCO ₃ Moisture			142' Sandy GRAVEL sG (60% Gravel, 38% Sand, 2% Silt) 33% CP, VCP 50% CS, VCS 34% MP 30% MS 104R5/2 33% SP, VSP 20% TS, VTS Slightly Moist, Poorly Sorted, G-Subround, Subdiscoidal to Subprismatic, 60% Basalt, 30% Qtzite, 10% Meta. S-Subround to Subangular, Subdiscoidal to Subprismatic 60% Qtz, 40% Basalt, Max: 2.5", Strong Reaction to HCl	142' SAMPLE: BO7BG1, 2 VOA, TAC, CaCO ₃ , Moisture 5/25/93: 1100 (141.6' - 142.6') OVM Headspace: 0.4 ppm
145'	VOA, TAC CaCO ₃ Moisture			145' Sandy GRAVEL sG (75% Gravel, 21% Sand, 4% Silt) 104R6/2 50% LC 33% CP, VCP 60% CS, VCS 50% SL 34% MP 30% MS 33% SP, VSP 10% TS, VTS Dry, Very Poorly Sorted, G-Rounded to Sub- Angular, Subdiscoidal to Subprismatic, 50% Qtzite, 50% Basalt, S-Angular to Subangular, Subdiscoidal to Subprismatic, 60% Qtz, 40% Basalt, Max: 8". No Reaction to HCl.	145' SAMPLE: BO7BG3 VOA, TAC, CaCO ₃ , Moisture 5/25/93: 1433 (145' - 145.5') OVM Headspace = 1.4 ppm Sharp contact @ 149'
150'	VOA TAC CaCO ₃ Moisture			150' SAND S (90% Sand, 10% Gravel) 50% LC 104R5/6 50% SL 60% CS, VCS 33% CP, VCP 30% MS 34% MP 10% TS, VTS 33% SP, VSP Trace Silt Moist Well Sorted, G-Subround to Subangular, Subdiscoidal to Subprismatic, 50% Basalt, 40% Qtzite, 10% Granitoid & Meta. S-Angular to Subangular, Subdiscoidal to Subprismatic, 60% Qtz, 40% Basalt, Max: 1/8". No Reaction to HCl. Sand is slightly Oxidized.	END Shift 5/25/93 BH-149' CS-148.6' 150' SAMPLE: BO7BG4 VOA, TAC, CaCO ₃ , Moisture 5/26/93: 0830 (149' - 150.2') OVM Headspace: 0.4 ppm (may be due to moisture) Sharp contact @ 151'-ms Grades into sG (s: same as @ 150' @ 152' Varying sG, gS, S
155'	VOA TAC CaCO ₃ Moisture				
160'	VOA, TAC CaCO ₃ Moisture				

B.1-84

BOREHOLE LOG

Boring or Well No. 299.W18.252Sheet 10 of 14Location 200W-S of Z PlantProject CCIA ERAPrepared By John Flinn Date 5/28/93
(Sign/Print Name)Reviewed By Victor H. Vano Date 6/6/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
155'				155' SAND S (95% Sand, 5% Gravel) Same as 150' G- 50% mp, 50% fp, vfp	155' SAMPLE BO7BG5 VOA, TAC, CaCO ₃ , Moisture 5/26/93-1040 (153.5'-155') OVM Headspace = 0.4 ppm
				160' Sandy GRAVEL sg (60% Sand, 40% Gravel) 10% s 30% CPVCP 50% CS, VCS 104R5/6 30% mp 30% ms 30% fp, vfp 20% fs, vfs Trace Silt	Grades to sG @ 159' 160' SAMPLE BO7BG6 VOA, TAC, CaCO ₃ , Moisture 5/26/93-1225 (159'-160') OVM Headspace = 0.4 ppm
160'	VOA, TAC CaCO ₃ Moisture			Moist, Poorly Sorted, G-Subangular, Subdisoidal to Subprismatic, 30% Basalt, 40% Qtzite, 20% Granitoid, 10% Meta. S-Subangular, sub- disoidal to Subprismatic, 60% Qtz, 40% Basalt Max = 4", No Reaction to HCl	END Shift 5/26/93 BH-160', CS 158.9'
				165' Gravelly SAND sg (15% Gravel, 84% Sand, 1% Silt) 25% sc 104R4/6 25% CPVCP 60% CS, VCS 25% mp 30% ms 25% fp, vfp 10% fs, vfs	165' SAMPLE BO7BG7 d BO7BG8 (Duplicate for VOA only) VOA(2), TAC, Moisture CaCO ₃ 5/27/93-1315 (164'-165') OVM Headspace = 0 ppm
165'	VOA (Dup) TAC CaCO ₃ Moisture			Moist, Moderately Sorted, G-Subangular (larger) to Subangular (smaller), Subdisoidal to Sub- prismatic, 40% Basalt, 40% Qtzite, 10% Meta, 10% Granitoid, S-Subangular to Angular, Subdisoidal to Subprismatic, 50% Basalt, 50% Qtz. Max = 3", No Reaction to HCl	END Shift 5/27/93 BH-168', CS-165'
				170' Silty Sandy GRAVEL msG (50% Gravel, 35% Sand, 15% Silt) 20% CPVCP 20% CS, VCS 30% mp 40% ms 50% fp, vfp 40% fs, vfs	Sharp contact Dry fine med sand & silt (Ash?) @ 169'. Grades into msG @ 170' Moisture effluent by added water
170'	VOA, TAC CaCO ₃ Moisture			Very Poorly sorted, G-Subangular to Subangular, sub- disoidal to Subprismatic, 80% Basalt, 10% Qtzite, 10% Igneous & Meta. S-50% Basalt, 50% Qtz.	173' SAMPLE BO7BG9 VOA, TAC, CaCO ₃ , Moisture 5/28/93-1425 (172'-173') OVM Headspace = 0 ppm
				B.I-85	

BOREHOLE LOG				Boring or Well No. <u>299-W18-252</u>	
				Sheet <u>11</u> of <u>14</u>	
Location <u>200W-S of Z Plant</u>			Project <u>CQ14 ERA</u>		
Prepared By <u>Jel M. Kim Flim</u> Date <u>6/1/93</u> <small>(Sign/Print Name)</small>			Reviewed By <u>William Johnson</u> Date <u>6/8/93</u> <small>(Sign/Print Name)</small>		
Depth (Feet)	Sample Type and No.	Blows or Recovery	Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
170'			Drive Barrel	173' GRAVEL G (80% Gravel, 15% Sand, 5% Silt)	173' Sample - see pg 10
				50% CP, VCP 70% CS, VCS	Difficult recovery - non-cohesive
				40% MP 20% MS 104R5/6	
	See pg 10			10% Fp, Vfp 10% Fs, Vfs	Water added - 170' & 171' - total 3 gal.
				Moist, Very poorly sorted, G-Subrounded to	
				Subangular, subdiscoidal to subprismoidal, 60%	
				Basalt, 30% Qtzite, 10% Igneous & Meta.	
				G-Angular to Subangular, subdiscoidal to	
				Subprismoidal, 60% Basalt, 40% Qtz, Qtzite.	END Shift 5/28/93
175'	VOA, TAC CaCO ₃ Moisture			Non-Plastic, Max=4", No Reaction to HCl	BH-174.2' CS-173'
			176' Sandy GRAVEL sg (50% Sand, 50% Gravel)	SAMPLE - BO7BH0	
			30% CP, VCP 50% CS, VCS	VOA, TAC, CaCO ₃ , Moisture	
			30% M 30% MS 104R4/2	6/1/93 - 0840 (175.2' - 176')	
			40% Fp, Vfp 20% Fs, Vfs Trace silt	OVM Headspace = 0 ppm	
			Moist, Poorly Sorted, G-Subangular to Sub-		
			rounded, subdiscoidal, 60% Basalt, 40%		
			Qtzite, S-Angular to Subangular,		
			subdiscoidal to subprismoidal, 60% Qtz,		
180'			40% Basalt, Max=3", No Reaction to HCl	180' material appears cemented - No reaction to HCl	
			182' GRAVEL G (85% Gravel, 12% Sand, 3% Silt)	SAMPLE - BO7BH1	
	VOA, TAC CaCO ₃ Moisture		10% LC	VOA, TAC, CaCO ₃ , Moisture	
			20% SC 20% CS, VCS 104R7/2	6/1/93, 1315 (181.5' - 182')	
			20% CP, VCP 30% MS	OVM Headspace = 2.4 ppm	
			30% MP 50% Fs, Vfs		
			20% Fp, Vfp	Very difficult recovery	
			Moist, Very Poorly Sorted, G-Rounded to		
			Subrounded, subdiscoidal to subprismoidal,		
185'	VOA, TAC CaCO ₃ Moisture		50% Qtzite, 25% Basalt, 25% Igneous		
			S-Subangular to Angular, subdiscoidal to Sub-		
			Prismoidal, 80% Qtz, 20% Basalt, Max =		
			8", No Reaction to HCl.	Sharp Contact @ 184'	
			184' SAND S (96% Sand, 4% Gravel)		
			20% MP 10% CS, VCS		
			80% Fp, Vfp 20% MS 104R7/3		
			70% Fs, Vfs		

BOREHOLE LOG

Boring or Well No. 299-W18-252Sheet 12 of 14Location 200W-S of Z PlantProject CC14 ERAPrepared By J.P. K. / John Flinn Date 6/3/93
(Sign/Print Name)Reviewed By Victoria M. Johnson VJ/Johnson Date 6/14/93
(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
185'	VOA, TAC CaCO ₃ Moisture			185 SAND S (99% Sand, 1% Gravel) 100% fs, vfp 10% cs, vcs 40% ms 104R 7/3 50% fs, vfs Trace Silt Moist, Very Well Sorted, G-Angular to Sub- angular, Subdiscoidal to Subprismatic 60% Basalt 40% Quartz, S-Angular to Subangular, discoidal to Subprismatic, 95% Qtz, 4% Basalt, 1% Muscovite, Max = 8mm No Reaction to HCl	SAMPLE BO7BH2 VOA, TAC, CaCO ₃ , Moisture 6/1/93-1435 (184.5'-185.6') OVM Headspace = 1.4 ppm END Shift 6/1/93 BH-187.6, CS-184.7
190'	VOA TAC CaCO ₃ Moisture			192' Sandy GRAVEL sg 104R 6/4 (60% Gravel, 39% Sand, 1% Silt) 25% SC 25% cp, vcp 30% cs, vcs 25% mp 40% ms 25% fp, vfp 30% fs, vfs Moist, Very poorly sorted, G-Rounded to Subrounded, Subdiscoidal to Subprismatic 60% Quartz, 20% Basalt, 20% Igneous Meta, S-Angular, Subdiscoidal to Subprismatic, 89% Qtz, 10% Basalt, 1% Muscovite Max = 4", No Reaction to HCl	Gradational Contact ~ 189' SAMPLE BO7BH3 VOA, TAC, CaCO ₃ , Moisture 6/2/93-1305 (190.5'-192') OVM Headspace = 0 ppm 194'-195' ~ 15% Silt, Non-Plastic END Shift 6/2/93 BH-195' CS-194'
195'	VOA, TAC CaCO ₃ Moisture			196' Sandy GRAVEL sg (60% Gravel, 35% Sand, 5% Silt) 20% cp, vcp 10% cs, vcs 30% mp 30% ms 104R 4/3 50% fp, vfp 60% fs, vfs Moist, Poorly sorted, Non-plastic, G-Rounded, to Subrounded, Subdiscoidal to Subprismatic, Quartz 30%, Meta 40%, Igneous 30%, S-Angular, to Subangular, Subdiscoidal to Subprismatic, 95% Qtz, 5% Basalt, Max = 3" No Reaction to HCl	SAMPLE BO7BH4 VOA, TAC, CaCO ₃ , Moisture 6/3/93-1310 (195.5'-196) OVM Headspace = 2.0 ppm Bimodal - little coarse sand SAMPLE BO7BH5 VOA, TAC, CaCO ₃ , Moisture 6/3/93-1310 (199'-200')
200'	VOA, TAC CaCO ₃ Moisture			200' Same as above - Dry 104R 7/2 202' Same as above - Slightly Moist	END Shift 6/3/93 BH-203.5' CS 201.7'
205'					

BOREHOLE LOG

Boring or Well No. 299-W18-252

Sheet 13 of 14

Location 200W-S of Z Plant

Project CCI4 ERA

Prepared By John Flinn Date 6/8/93Reviewed By Victoria H. Johnson Date 6/14/93

(Sign/Print Name)

(Sign/Print Name)

Depth (Feet)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
200'				205' SAND S (99% Sand, 1% Gravel) 10% CS, VCS G:VCP 50% MS 104R 6/4 40% FS, VFS Trace Silt Moist, Very well sorted, S-Angular to Subangular, Subdiscoidal to Subprismatic, 99% Qtz, 1% Basalt. G-Subround, Subprismatic 50% Qtz, 50% Gran. Max = 5cm, No reaction to HCl.	Sharp Contact @ 204' SAMPLE B07BH6 VOA, TAC, CaCO ₃ , Moisture 6/7/93-0830 (205'-206.6') OVM Headspace = 2.0 ppm Gradational contact to GS-207'
205'	VOA TAC CaCO ₃ Moisture			209'-5G 211' Silty GRAVEL mG 104R 6/2 (60% Gravel, 10% Sand, 30% Silt) 20% lc 20% sc 15% CS, VCS 20% CP, VCP 40% MS 20% mp 45% FS, VFS 20% fp, Vfp Slightly moist, Very poorly sorted, G-Subround to Subangular, Subdiscoidal to Subprismatic, 40% Basalt, 40% Qtzite, 20% Targous & Meta. S-Subangular to angular, Subdiscoidal to Subprismatic, 50% Basalt, 50% Qtzite. Max = 8", No reaction to HCl.	209'-5G SAMPLE B07C87 VOA, TAC, CaCO ₃ , Moisture 6/7/93-1350 (210.5'-211.2') OVM Headspace = 0 ppm Difficult drilling - Bi Modal grain size distribution - very little coarse sand Fines probably increased by over- driving drive barrel. Varies - almost dry - moist. Gravel encrusted w/ Silt.
210'	VOA, TAC CaCO ₃ Moisture			213' Same as above - heavily oxidized, mottled dark red, black.	END Shift 6/7/93 BH 213.6' CS-212.9'
215'	VOA, TAC CaCO ₃ Moisture			215' Same as above 215.5' Very moist 216' Almost saturated 217' Alternating - almost dry - very moist 218' Small amount of saturated material	SAMPLE B07C88 VOA, TAC, CaCO ₃ , Moisture 6/8/93-0820 (214.3'-215') OVM Headspace = 0.5 ppm Begin Hard Tool drilling @ 218' END Shift 6/8/93
220'					Water level measured @ 216.91 BGS - 6/9/93 OTB

B.1-88

BOREHOLE LOG

Boring or Well No. 299-W18-252

Sheet 1 of 4

Location 200W. S of Z Plant

Project CCl₄ ERA

Prepared By John Flynn Date 6/9/93
(Sign/Print Name)

Reviewed By Walter H. Johnson VM Johnson Date 6/14/93
(Sign/Print Name)

[illegible]

APPENDIX B.2
WELL CONSTRUCTION REPORTS

WELL CONSTRUCTION REPORT

Page 1 of 2
517193Specification No. WHC-S-014¹ Rev No. 7
150145Project 200W CCL₄ ERALocation 200W - N. of E-9 TrenchDrilling Company KEHDriller M. WraspirOther (Companies) PULGeologist(s) K. Swett J. FlinnV. JohnsonR. DeenWell No. 299-WIS-219 Temp. Well No. WEX-1Coordinates N: 40,026.78 E: 75,865.91Casing Elev. 668.35' Ground Elev. 664.86

Drilling Method

Verification Method Visual ObservationCriteria WHC-S-014 5.2, 5.3, 7.5Rotary Air N/A Mud N/A Initials N/A Date N/ACable Tool 0'-123' D 135'-206.1' H 123'-135' Initials F Date 3/19/93Drilling Fluid Raw Water 59 gal Initials F Date 4/30/93Other N/A N/A N/A N/A

Geophysical Logging

Strides	Interval	Date
Gross Gamma (unavailable)	4.0' - 38.6'	2-9-93
Gross Gamma	2.6' - 117.1'	2-25-93
Gross Gamma	80' - 205.1'	3-19-93
Gamma log	0' - 200'	3-19-93
N/A	N/A - N/A	N/A

Completion Data

Drilled Depth 206.10'
Completed Depth 197.1' 195.71'
Date Started 2-3-93
Date Completed 4-28-93
Static Water Level/Date 198.97' hys
3/19/93

Aquifer Testing

Type N/A
Flow Meter I.D. No. N/A
Cal. Due Date N/A
Length of Test N/A
Volume Pumped N/A
Drawdown N/A
Date of Test N/A

Completion Results

Cleaning

Verification Method Visual inspection & observation
Criteria WHC-S-014 7.6, 4.2, 2, 7.7

	Initials	Date
Drilling Tools/Rig	<u>KSS</u>	<u>2-2-93</u>
Temporary Materials	<u>KSS</u>	<u>2-2-93</u>
Permanent Materials	<u>F</u>	<u>4-30-93</u>

Material Storage/Packing

Verification Method Visual inspection
Criteria WHC-S-014 4.2, 2, 7.3

	Initials	Date
Mtl. Handling/Storage	<u>KSS</u>	<u>4-28-93</u>
Material Packing	<u>KSS</u>	<u>4-28-93</u>

Lubricants/Additives

Verification Method Visual observation
Criteria WHC-S-014 7.2

	Identify	Initials	Date
Additives	<u>Raw Water</u>	<u>F</u>	<u>4/30/93</u>
Lubricants	<u>Well Guard</u>	<u>KSS</u>	<u>2-3-93</u>

Screen

Type	Length	Slot Size
<u>Stainless steel banded</u>	<u>15'</u>	<u>0.020"</u>
<u>Stainless steel banded</u>	<u>15'</u>	<u>0.070"</u>
Depth(s)	<u>98.5'</u>	<u>113.5'</u>
	<u>180.4'</u>	<u>195.3'</u>

Verification Method Steel tapeCriteria WHC-S-014 4.2, 3, 4.2, 1, 4.2, 5, 12.2, 1Initials F Date 4/30/93

Straightness Test

Verification Method Visual observationCriteria WHC-S-014 5.2Initials F Date 4/30/93

WELL CONSTRUCTION REPORT

(continuation sheet)

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2

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Type	Casing (permanent) Size	Placement	Well Protection	
4" Stainless Steel	4"	15' Ag - 98.5'	Verification Method	Visual inspection
4" Stainless Steel	4"	113.5' - 120.4'	Criteria	WHC-S-014 4.2.9, 4.2.10, 11.0
NA	NA	NA - NA	Protective Posts	Initials <u>F</u> Date <u>4/23/93</u>
NA	NA	NA - NA	Protective Casing	Initials <u>F</u> Date <u>4/23/93</u>
Verification Method	Steel tape		Site Restored	Initials <u>VMJ</u> Date <u>8/25/93</u>
Criteria	WHC-S-014 4.2.1, 4.2.4, 4.2.5, 12.2.1		Cap, Hasp and Lock	Initials <u>F</u> Date <u>4/23/93</u>
Initials	<u>F</u> Date <u>4/15/93</u>		Surface Pad	Initials <u>F</u> Date <u>4/23/93</u>

Annular Seal/Filter Pack

Type	Interval	Volume (ft ³)	Initials	Date
Portland Cement Grout	2.5' - 10.5'	15.42	<u>F</u>	<u>4/26/93</u>
Bentonite Crambles	10.5' - 72.3'	61.29	<u>F</u>	<u>4/26/93</u>
Portland Cement Grout	72.3' - 82.3'	12.8	<u>F</u>	<u>4/23/93</u>
Bentonite Crambles (2)	82.3' - 84.6'	1.42	<u>F</u>	<u>4/23/93</u>

Well Survey/Labeling

Initials	Date
Measurement Point/Surveyed	<u>VMJ</u> <u>9/10/93</u>
Protective Casing/Brass Cap Surveyed	<u>VMJ</u> <u>9/10/93</u>
Well Number Stenciled	<u>VMJ</u> <u>9/10/93</u>
Brass Cap Labeled	<u>VMJ</u> <u>9/10/93</u>

Pump Installation

Initials	Date
Pump Decon/Prep	<u>NA</u> <u>NA</u>
Installed	<u>NA</u> <u>NA</u>
Pump Tested	<u>NA</u> <u>NA</u>

Other (initial if performed)

<u>NA</u> Well Abandonment	<u>VMJ</u> Downhole TV Inspection	<u>F</u> Complete As-Built Diagram, Driller's/Geologist's Logs
<u>NA</u> Well Development		

Comments/Remarks: (1) Also specific procedures as referenced in WHC-SD-EN-AP-114 Rev'd and LOI-EP56-FY93-002

(2) Annular Seal / Filter Pack description continued on attached page.

Completion includes 1/8" dia. stainless steel pressure transducer tube set in sand pack at 85.45' bgs, upper end inside protective casing, strapped to outside of well casing.

Reviewed By (Sign/Print Name) J. M. Jimenez / J. M. Jimenez Date 09-10-93

WELL CONSTRUCTION SUMMARY REPORT

Page 1 of 2

Well No. WHC-S-014^L Rev. No. 7Well No. 299-WIS-219 Temp. Well No. N/AECNs 169883, 150145Approximate Location 200 W. AREA, NW OF 29 TRENCHProject SC14 VOC-ARID ID & ERA WORK PLANDrill Method CABLE TOOLDrilling Company KAKER ENGR.Drilling Fluid * WATER (WHEN USING HT)Driller M. WRASPIRTotal Amount of Water Added During Drilling 175 GALOther (Companies) PNL, W.H.C.Comments * Raw Columbia River WaterGeologist(s) ROY D. DEENE.A. JOHNSONV.M. JOHNSONK. SWETTJ. FLINNDate Drilling Started 4/20/93

Geophysical Logging

Sondes (type)

Interval

Date

GROSS-GAMMA 4.5' - 34.9' 4/26/93GROSS-GAMMA 2.4' - 118.1' NAGROSS-GAMMA 24.95' - 118.1' 5/6/93GROSS-GAMMA 207.8' - 30.0' 5/25/93

Temporary Casings and Drilled Depth

Casing Type and Size

Interval

Shoe OD

CS, TEMP., 16" 0 - 35.57' 1.36'CS, TEMP., 12" 0 - 120.61' 1.1'CS, TEMP, THREADED, 10" 0 - 310.06' 0.92'NA - -Drilled Depth 212.0' Hole Diameter at TD 0.92'Static Water Level/Date 201.6' 5/25/93

Comments

Completion Activity

Date Started 6/15/93

Casing and Screen (Permanent)

Type

Depths

Length

Slot Size

4" stainless steel 0' - 87.2' 87.2' NA4" stainless steel 87.2' - 102.2' 15' 0.020"4" stainless steel 102.2' - 167.2' 65' NA4" stainless steel 167.2' - 182.2' 15' 0.020"4" stainless steel 182.2' - 192.5' 0.3' NA

Annular Seal/Filter Pack *

Type

Interval

Volume

Mesh Size

Cement Grout - 9.3' 19.29 cu ft NABentonite Cements 9.3' - 57' 53.3 NACement Grout 57' - 62.7' 6.4 NABentonite Cements 62.7' - 64.6' 1.8 NASilica Sand 64.6' - 68.8' 4.6 10-20

Other Activity

Aquifer Test Performed? NAType NA Date NAWell Abandoned? NADate NA

Well Survey Data

Date 9/10/93 Survey Report Date 9/3/93Washington State Prime Coordinates N: 135 654.033 E: 506 728.897Protective Casing Elevation N 6VD'29 669.58'Brass Cap Elevation N 6VD'29 668.02'

Comments/Remarks 1/8" O.D. stainless steel transducer tubes attached to outside of permanent casing & screen at 2' intervals, w/ 3/8" stainless steel bands. Bottoms of tubes set @ 66.7', 126.7', & 152.2' BGS.

* - Annular Seal/Filter Pack continued on next page.

† Also specific procedures referred in WHC-SD-EN-TI-114 Rev 0 & COT-EFS6-E493-002, Rev 1.

FIELD ACTIVITY REPORT -
TEXT CONTINUATION PAGEPage 2 of 2Date 7/19/93 Well No 299-W15-219 Continuation of Report No NA

DESCRIPTION OF OPERATIONS/REMARKS

Annular Seal / Filter Pack - Continued

Type	Interval	Volume (ft ³)	Mesh Size
Bentonite Crumbles	68.8' - 73.3'	3.6	NA
Cement Grout	73.3' - 80.1'	8.6	NA
Bentonite Crumbles	80.1' - 84.3'	3.6	NA
Silica Sand	84.3' - 104.2'	17.7	10-20
Sand Bentonite Crumbles	104.2' - 117.1'	9.8	NA
Cement Grout	117.1' - 124.7'	8.5	NA
Bentonite Crumbles	124.7' - 125.9'	0.7	NA
Silica Sand	125.9' - 128.7'	1.3	10-20
Bentonite Crumbles	128.7' - 136.4'	6.7	NA
Cement Grout	136.4' - 145.2'	6.4	NA
Bentonite Crumbles	145.2' - 151.5'	3.6	NA
Silica Sand	151.5' - 155.4'	2.8	10-20
Cement Grout	155.4' - 163.8'	4.5	NA
Bentonite Pellets	163.8' - 166.8'	1.6	NA
Silica Sand	166.8' - 187.2'	17.9	10-20
Bentonite Hole Plug	187.2' - 201.9'	11.0	NA
Silica Sand	201.9' - 210.4'	5.9	10-20
Slough	210.4' - 212'	NA	NA

NA

Report By Sohn FlinnTitle GeologistSignature [Signature]

Reviewed By _____

Title _____

Date _____

Signature _____

WELL CONSTRUCTION SUMMARY REPORT

Page 1 of 2

Classification No. <u>WHC-5-014</u> Rev. No. <u>7</u>		Well No. <u>299-WIS-220</u> Temp. Well No. <u>NONE</u>	
EC No. <u>150145, 169883, 169857</u>		Approximate Location <u>200 W. AREA, E. OF 29 TRENCH</u>	
Project <u>CC64, VOC/ARID, FOL/ERR</u>		Drill Method	
Drilling Company <u>KEH</u>		Type <u>Cable Tool</u>	
Driller <u>G. Thomas, #0867,</u>		Drilling Fluid <u>Columbia River - Raw Water</u>	
Other (Companies)		Total Amount of Water Added During Drilling <u>21.0 gal.</u>	
Geologist(s) <u>E. JOHNSON</u>		Comments <u>ENTIRE Hole Drilled using</u>	
<u>J. Fliin</u>		<u>DRIVE BARRELS.</u>	
<u>K. S. S. S. S.</u>			
Date Drilling Started <u>6/1/93</u>		Temporary Casings and Drilled Depth	
Geophysical Logging		Casing Type and Size Interval <u>AGL</u> Shoe OD	
Sonde (type)	Interval	Date	
<u>CROSS Gamma</u>	<u>4.7' - 38.8'</u>	<u>6/8/93</u>	<u>0 - 39.72' 1.4'</u>
<u>CROSS Gamma</u>	<u>3.6' - 110.5'</u>	<u>6/21/93</u>	<u>0 - 116.09' 1.12'</u>
<u>CROSS Gamma</u>	<u>80.0' - 199.7'</u>	<u>7/21/93</u>	<u>0 - 113.14' 0.95'</u>
<u>N/A</u>			<u>0 - 200.02' 0.77'</u>
<u>N/A</u>			
		Drilled Depth <u>201.0'</u>	Hole Diameter at TD <u>0.77'</u>
		Static Water Level/Date <u>191.58' AGL, 7/22/93</u>	
		Comments <u>perched water @ 106.10' 6/18/93</u>	
Completion Activity Date Started <u>8/9/93</u>			
Casing and Screen (Permanent)		Annular Seal/Filter Pack *	
Type	Depth	Length	Slot Size
<u>4" Stainless Steel</u>	<u>0 - 80.00</u>	<u>80.00</u>	<u>N/A</u>
<u>4" Stainless Steel</u>	<u>80.00 - 95.10</u>	<u>15.10</u>	<u>0.020" Covered</u>
<u>4" Stainless Steel</u>	<u>95.10 - 155.03</u>	<u>59.93</u>	<u>N/A</u>
<u>4" Stainless Steel</u>	<u>155.03 - 170.02</u>	<u>14.99</u>	<u>0.020" Covered</u>
<u>4" Stainless Steel</u>	<u>170.02 - 185.30</u>	<u>15.28</u>	<u>N/A</u>
Other Activity		Well Survey Data	
Aquifer Test Performed? <u>N/A</u>		Date <u>Survey Data Report 9/3/93</u>	
Type <u>N/A</u>	Date <u>NA</u>	Washington State Prime Coordinates <u>N: 135,618.444 E: 506,834.927</u>	
Well Abandoned? <u>NA</u>		Protective Casing Elevation <u>NGVD'29 140.28'</u>	
Date <u>NA</u>		Brace Cap Elevation <u>NGVD'29 657.73'</u>	
Comments/Remarks <u>* Annular Seal/Filter Pack description continued on page 2</u>			
<u>This well completed above water table as a Vapor Extraction Well</u>			
<u>There are 3, 1/8" OD. Stainless Steel transducer tubes attached to the outside of the 4.25" stainless steel well materials w/ 3/8" stainless steel banding. The transducers are set @ 52', 119', & 185' BGL.</u>			

Well Construction Summary Report

FIELD ACTIVITY REPORT -
TEXT CONTINUATION PAGE

Page 2 of 2

Date 8/25/93	Well No 299-W15-220	Continuation of Report No NA	
-----------------	------------------------	---------------------------------	--

DESCRIPTION OF OPERATIONS/REMARKS

Annular Seal / Filter Pack - continued

Type	Interval	Volume (ft ³)	Mesh
Bentonite Crumbles	54.0 - 58.7	4.26	N/A
Cement Grout	58.7 - 75.0	23.1	N/A
Bentonite Crumbles	75.0 - 78.0	2.6	N/A
Silica Sand	78.0 - 96.9	15.0	10-20
Bentonite Crumbles	96.9 - 104.0	5.9	N/A
Cement Grout	104.0 - 113.9	9.3	N/A
Bentonite Crumbles	113.9 - 115.7	0.7	N/A
Silica Sand	115.7 - 119.9	1.3	10-20
Bentonite Crumbles	119.9 - 122.9	0.9	N/A
Cement Grout	122.9 - 124.9	1.0	N/A
Bentonite Crumbles	124.9 - 142.5	5.5	N/A
Cement Grout	142.5 - 150.0	3.9	N/A
Bentonite Crumbles	150.0 - 152.9	0.9	N/A
Silica Sand	152.9 - 171.9	6.3	10-20
Bentonite Crumbles	171.9 - 177.1	1.6	N/A
Cement Grout	177.1 - 180.8	2.2	N/A
Bentonite Crumbles	180.8 - 183.0	0.7	N/A
Silica Sand	183.0 - 187.0	1.6	10-20
Bentonite Crumbles	187.0 - 191.9	1.9	N/A
Silica Sand	191.9 - 200.1	3.7	10-20

N/A

Report By John Flinn
 Title Geologist
 Signature [Signature]

Reviewed By _____
 Title _____ Date _____
 Signature _____

WELL CONSTRUCTION REPORT

Page 1 of 2

Location No. WHC-5-014 (1) Rev No. 7
 ECNs 150145
 Project ROC - Drill SD 200 West
 Location 200 West; 216.2-18 Crib
 Drilling Company Kaiser Engineers Hanford
 Driller Gary Howell
 Other (Companies) PNL
 Geologist(s) K. Smith (WHC)
V. Johnson (WHC)
R. Dean (Hepco)

Well No. 299-WL-96 Temp. Well No. NA
 Coordinates N 38.825 W 76.290 76.970
 Casing Elev. (3) SEC COMMENTS Ground Elev NA

Drilling Method
 Verification Method Visual Observation
 Criteria WHC-5-014 5.2.5.3.7.5

	Rotary	Air	Mud	Initials	Date
Rotary	NA	NA	NA	NA	NA
Cable Tool	D	149.2'	H	NA	2/25/93
Drilling Fluid	NA	NA	NA	NA	NA
Other	NA	NA	NA	NA	NA

Geophysical Logging

Sondes	Interval	Date
Gamma Gamma	1.7' - 148.7'	3/1/93
Spectral Gamma	72.5' - 145.16'	3/1/93
X		

Completion Data

Drilled Depth 149.2'
 Completed Depth 132.31'
 Date Started 2/10/93
 Date Completed 3/5/93
 Static Water Level/Date NA

Aquifer Testing

Type NA
 Flow Meter I.D. No. NA
 Cal Due Date NA
 Length of Test NA
 Volume Pumped NA
 Drawdown NA
 Date of Test NA

Completion Results

Cleaning

Verification Method Visual Inspection and Observation
 Criteria WHC-5-014 7.6, 4.2.2, 7.7

	Initials	Date
Drilling Tools/Rig	2/10/93 VMJ	2/10/93
Temporary Materials	VMJ	2/10/93
Permanent Materials	VMJ	3/3/93

Material Storage/Packing

Verification Method Visual Observation
 Criteria WHC-5-014 4.2.2, 7.3

	Initials	Date
Mtl. Handling/Storage	VMJ	3/3/93
Material Packing	VMJ	3/3/93

Lubricants/Additives

Verification Method Visual Observation
 Criteria WHC-5-014 7.2

	Identify	Initials	Date
Additives	NA	NA	NA
Lubricants	Well Guard	VMJ	2/10/93

Straightness Test

Verification Method Visual Observation
 Criteria WHC-5-014 8.2

	Initials	Date
	VMJ	2/25/93

Screen

Type	Length	Slot Size
T-304 S.S. 2" Lined	9.77'	.020

Depth(s) 122.29' - 132.31' w/shore
122.29' - 131.88' w/o shore
 Installation Method Verify using steel tape
 Criteria WHC-5-014 4.2.3, 4.2.1, 4.2.5, 12.2.1
 Initials VMJ Date 3/5/93

WELL CONSTRUCTION REPORT

(continuation sheet)

Page 2 of 2

Casing (permanent)			Well Protection	
Type	Size	Placement	Verification Method	Criteria
T. 304 S.S. Sch. 5	2"	2.4' - 122.29'	Visual inspection, measure w/ tape	WHC-S-014 4.2.9, 4.2.1, 11.0
			Initials	Date
			Protective Posts	NA
			Protective Casing	KSS 3-24-93
			Site Restored	KSS 3-24-93
			Cap, Hasp and Lock	NA KSS 3-24-93
			Surface Pad	NA NA
Verification Method <u>Verify w/ Steel Tape</u> Criteria <u>WHC-S-014 4.2.1, 4.2.4, 4.2.5, 12.2.1</u> Initials <u>VMT</u> Date <u>3/5/93</u>				

Annular Seal/Filter Pack

Verification Method		Criteria	
<u>Measurement w/ Steel Tape</u>		<u>WHC-S-014 4.2.6 - 4.2.9, 5.3.1</u>	
Type	Interval	Volume	Date
<u>Drift and Gravel Type I, II</u>	<u>9.90' - 10.4'</u>	<u>2.57 cu ft</u>	<u>3/5/93</u>
<u>Bentonite Gravel</u>	<u>113.5' - 9.90'</u>	<u>17.57 cu ft</u>	<u>3/5/93</u>
<u>1/4" Bentonite Pellets</u>	<u>118.95' - 113.5'</u>	<u>.47 cu ft</u>	<u>3/5/93</u>
<u>10-20 Silica Sand</u>	<u>134.9' - 118.95'</u>	<u>3.83 cu ft</u>	<u>3/4/93</u>
<u>Bentonite Plug</u>	<u>179.2' - 134.9'</u>	<u>2.24 cu ft</u>	<u>3/4/93</u>

Well Survey/Labeling		Pump Installation	
Verification Method <u>Document Review</u>		Verification Method <u>NA</u>	
Criteria <u>WHC-S-014 3.4, 4.2.10</u>		Criteria <u>NA</u>	
Measurement Point/Surveyed	Initials <u>KSS</u> Date <u>5-28-93</u>	Pump Decon/Prep	Initials <u>NA</u> Date <u>NA</u>
Protective Casing/Brass Cap Surveyed	<u>NA</u> <u>NA</u>	Installed	<u>NA</u> <u>NA</u>
Well Number Stenciled	<u>NA</u> <u>NA</u>	Pump Tested	<u>NA</u> <u>NA</u>
Brass Cap Labeled	<u>NA</u> <u>NA</u>		

Other (initial if performed)

NA Well Abandonment NA Downhole TV Inspection KSS Complete As-Built Diagram, Driller's/Geologist's Logs
NA Well Development

Comments/Remarks (1) Also specific procedures as referenced in WHC-SD-EN-AP-109 Rev. 0 and L.O.I. EFSG-FY-93-002.
(2) Top outer casing: north side: 209.064 meters, 682.52 ft
Top inner casing: north side: 209.095 meters, 682.62 ft (Top of welded lid)

Reviewed By (Sign/Print Name)

Keith J. Snell

Date

7-7-93

Page 1 of 1

Drill Method

Temporary Casings and Drilled Depth

Casing Type and Size	Interval	Shoe OD
----------------------	----------	---------

Drilled Depth 131.5' Hole Diameter at TD .6'

Static Water Level/Date NA

Comments: NA

Geophysical Logging

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

Spectral Gamma 0' - 44.5' 2/22/13

Gross Gamma. 3.1' - 130.8' 4/9/93

Spectral Gamma 425' ± 128.5' 4/13/93

Completion Activity

Date Started 4/19/93

Casing and Screen (Permanent)

Type	Depth	Length	Slot Size
7-304 Sch. 5	71.1 - 106.45'	107.6'	NA

4" casing _____

T. 304.50 m 106.45' - 126.45' 20.0' .020

Annular Seal/Filter Pack

Type	Interval	Volume	Mesh Size
Cl. med. I & II	18.3' - +1.0'	3.96 cu/ft	
g-70 MUSH Curculio	41.9' - 18.3'	5.68 cu/ft	8-20

correl 76 ft 50.5' - 41.9' 2.57 m/ft _____

820 MESH DIMENSIONS 47.1' - 50.5' 8.52 cu/ft 8-20 MESH

2nd from 11/17/51'4" 104.5 - 104.1' .31 cu/ft 1/4"

10-20 Silica Sand 130.0' - 106.0' 30 cu/ft 10-20 MESH

Other Activity

Aquifer Test Performed? NA

Type NA Date NA

Well Abandoned? _____

Date _____

Well Survey Data

Date 5-28-93

Washington State Prime Coordinates N 39.117 W 76.565

Protective Casing Elevation (1) _____

Brass Cap Elevation 214

Measurements/Remarks

(1) Top of outer casing north side:	205.944 meters, 672.29 Ft
Top of outer ^{inner} casing north side:	205.867 meters, 672.03 Ft
RSS 7793	

WELL CONSTRUCTION SUMMARY REPORT

Page 1 of 2

Specification No. <u>WHC-S-014¹</u> Rev. No. <u>7</u> ECNs <u>150145, 169883, 169857</u> Project <u>200W CCLERA</u> Drilling Company <u>KEH</u> Driller <u>C. Howell</u> Other (Companies) <u>PNL</u> Geologist(s) <u>J. Flinn</u> <u>K. Smet</u>	Well No. <u>299-WIS-252</u> Temp. Well No. <u>VEX-7</u> Approximate Location <u>200W. S of 3-Plant</u> Drill Method Type <u>Cable Tool - Walker Noor WS-31</u> Drilling Fluid <u>Raw Water</u> Total Amount of Water Added During Drilling <u>141 gal.</u> Comments <u>Drive Barrel 0'-218'</u> <u>Hard Tool 218'-228.5'</u>																		
Temporary Casings and Drilled Depth <table border="1" style="width:100%"> <thead> <tr> <th>Casing Type and Size</th> <th>Interval</th> <th>Shoe OD</th> </tr> </thead> <tbody> <tr> <td>16" CS</td> <td>0' - 38.71'</td> <td>16 1/2"</td> </tr> <tr> <td>12" CS</td> <td>38.71' - 138.28'</td> <td>13 5/16"</td> </tr> <tr> <td>10" CS</td> <td>138.28' - 227.38'</td> <td>11 5/8"</td> </tr> <tr> <td>N/A</td> <td>-</td> <td>-</td> </tr> </tbody> </table> Drilled Depth <u>228.5'</u> Hole Diameter at TD <u>10"</u>		Casing Type and Size	Interval	Shoe OD	16" CS	0' - 38.71'	16 1/2"	12" CS	38.71' - 138.28'	13 5/16"	10" CS	138.28' - 227.38'	11 5/8"	N/A	-	-			
Casing Type and Size	Interval	Shoe OD																	
16" CS	0' - 38.71'	16 1/2"																	
12" CS	38.71' - 138.28'	13 5/16"																	
10" CS	138.28' - 227.38'	11 5/8"																	
N/A	-	-																	
Date Drilling Started <u>5/13/93</u> Geophysical Logging <table border="1" style="width:100%"> <thead> <tr> <th>Sondes (type)</th> <th>Interval</th> <th>Date</th> </tr> </thead> <tbody> <tr> <td>Gross Gamma</td> <td>29.0' - 4.5'</td> <td>5/5/93</td> </tr> <tr> <td>Gross Gamma</td> <td>137.5' - 3.3'</td> <td>5/21/93</td> </tr> <tr> <td>Spectral Gamma</td> <td>136.5' - 0'</td> <td>5/21/93</td> </tr> <tr> <td>N/A</td> <td>-</td> <td>-</td> </tr> <tr> <td>N/A</td> <td>-</td> <td>-</td> </tr> </tbody> </table>		Sondes (type)	Interval	Date	Gross Gamma	29.0' - 4.5'	5/5/93	Gross Gamma	137.5' - 3.3'	5/21/93	Spectral Gamma	136.5' - 0'	5/21/93	N/A	-	-	N/A	-	-
Sondes (type)	Interval	Date																	
Gross Gamma	29.0' - 4.5'	5/5/93																	
Gross Gamma	137.5' - 3.3'	5/21/93																	
Spectral Gamma	136.5' - 0'	5/21/93																	
N/A	-	-																	
N/A	-	-																	
Static Water Level/Date <u>215.83' 6/10/93</u> Comments <u>Well Dr. to TD on 6/9/93</u>																			

Completion Activity				Date Started <u>7-20-93</u>			
Casing and Screen (Permanent)				Annular Seal/Filter Pack			
Type	Depths	Length	Slot Size	Type	Interval	Volume (ft ³)	Mesh Size
4" Stainless Steel	0' - 113.24	113.24	N/A	Cement Grout	1.5 - 9.0	15.4	N/A
4" Stainless Steel	113.24' - 133.21	19.97'	0.020"	Bentonite Crumbles	9.0 - 90.2	86.3	N/A
4" Stainless Steel	133.21' - 165.13	31.92'	N/A	Cement Grout	90.2 - 95.6	6.4	N/A
4" Stainless Steel	165.13' - 195.04'	19.96'	0.020"	Bentonite Crumbles	95.6 - 97.9	1.8	N/A
4" Stainless Steel	185.09' - 210.30'	25.21'	N/A	Silica Sand	97.9 - 101.9	3.6	10-20
Other Activity				Well Survey Data			
Aquifer Test Performed? <u>N/A</u> Type <u>N/A</u> Date <u>N/A</u> Well Abandoned? <u>N/A</u> Date <u>N/A</u>				Date <u>Survey Data Report 9/3/93</u> Washington State Prime Coordinates <u>N 135.429 477 E: 5466 447.220</u> Protective Casing Elevation <u>NAD'29 1681.93'</u> Brass Cap Elevation <u>NAD'29 482.5'</u>			

Comments/Remarks 1 Also specific procedures followed in WHC-SD-EN-TI-202 & LCI-EP-55-F-93-002 Rev 1
* Annular Seal / Filter Pack continued on next page
1/8" O.D. Stainless Steel transducer tubes attached to outside of permanent casing & screen @
2' intervals w/ 3/8" stainless steel bands. Bottom of tubes set @ 100.00', 145.19', & 210.00' BGS.

Well construction summary Report

FIELD ACTIVITY REPORT -
TEXT CONTINUATION PAGE

KJS 9-2-93

Page 2 of 2

ite 8/24/93

Well No 299-1115

Continuations of Report No

N/A

DESCRIPTION OF OPERATIONS/REMARKS

Annular Seal / Filter Pack - Continued

Type	Interval	Volume (ft ³)	Mesh
Bentonite Crumbles	101.9 - 102.5	0.4	NA
Cement Grout	102.5 - 109.2	5.8	NA
Bentonite Crumbles	109.2 - 111.0	1.8	NA
Silica Sand	111.0 - 134.7	23.9	10-20
Bentonite Crumbles	134.7 - 135.7	0.7	NA
Cement Grout	135.7 - 141.0	6.7	NA
Bentonite Crumbles	141.0 - 142.9	3.2	NA
Silica Sand	142.9 - 146.9	2.9	10-20
Bentonite Crumbles	146.9 - 157.2	5.9	NA
Cement Grout	157.2 - 161.2	6.7 3.9	NA
Bentonite Crumbles	161.2 - 163.0	1.2	NA
Silica Sand	163.0 - 187.2	15.8	NA 10-20
Bentonite Crumbles	187.2 - 194.1	4.3	NA
Cement Grout	194.1 - 206.1	8.4	NA
Bentonite Crumbles	206.1 - 208.1	1.1	NA
Silica Sand	208.1 - 212.3	2.7	10-20
Bentonite Holeplug	212.3 - 217.3	4.8	NA
Silica Sand	217.3 - 227.6	6.7	10-20

N/A

Report By John Flinn

Title Geologist

Signature

Reviewed By

Title

Date

Signature

APPENDIX B.3
WELL SUMMARY SHEETS

WELL SUMMARY SHEET

Boring or Well No. **299-W15-218**

Northing 135661.17

Easting 566771.02

Sheet 1 of 3Location 200 WestProject VOC/Arid IDElevation 665.36'Drilling Contractor Kaiser Engineers HanfordDriller M. WraspirDrilling Method and Equipment Cable Tool Bucyrus Erie 22WPrepared by J. Flinn

(Sign/Print Name)

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Well Construction		Graphic Log	Lithologic Description
CEMENT (2.5'-10.5')				0.0'-1.0' Sandy GRAVEL (Stabilization). 1.0'-13.5' SAND NOTE: Construction debris at 4.0' (nails, wood)
16" TEMPORARY CARBON STEEL CASING SET AT 38.87'		10		13.5'-20.0' Gravelly SAND
		20		20.0'-22.0' Slightly Gravelly SAND 22.0'-30.0' Sandy GRAVEL
		30		30.0'-33.0' Gravelly SAND 33.0'-37.0' Slightly Gravelly SAND
8-20 MESH BENTONITE CRUMBLES (10.5'-72.8')		40		37.0'-41.0' Sandy GRAVEL 41.0'-50.0' GRAVEL 42.0'-51.0' GRAVEL
		50		50.0'-54.5' Sandy GRAVEL 52.5' Drive Barrel contains large cobble-size fragments of Clastic Dike. Vertical, irregularly bedded silty clay, silt, and med-fine Sand.
		60		54.5'-92.0' SAND 55.0' Clastic Dike present in drive barrel; approx. 20 cm wide; vertically laminated silt, clayey silt, silty clay; runs 2.0' length of drive barrel.
		70		
CEMENT (72.8'-82.3')		80		

Inches

28 20 12 8 4 0 4 8 12 20 28

8.3-3

C/Z S P C/B

WELL SUMMARY SHEET

Boring or Well No. **299-W15-218**

Northing 135661.17

Easting 566771.02

Sheet 2 of 3Location 200 WestProject VOC/Arid IDElevation 665.36'Drilling Contractor Kaiser Engineers HanfordDriller M. WraspirDrilling Method and Equipment Cable Tool Bucyrus Erie 22WPrepared by J. Flinn

(Sign/Print Name)

CONSTRUCTION DATA

Depth
in
Feet

GEOLOGIC/HYDROLOGIC DATA

Description

Well Construction

Graphic Log

Lithologic Description

8-20 MESH BENTONITE CRUMBLES
(82.3'-84.6')10-20 MESH SILICA SAND
(84.6'-87.7')1/8" STAINLESS STEEL TUBE SET
AT 85.5'8-20 MESH BENTONITE CRUMBLES
(87.7'-92.1')

CEMENT (92.1'-97.1')

8-20 MESH BENTONITE CRUMBLES
(97.1'-97.9')10-20 MESH SILICA SAND
(97.9'-115.0')4" DIAM 15.0' 20-SLOT LOUVERED
SS SCREEN (98.5'-113.5')

CEMENT (115.0'-119.3')

12" TEMPORARY CARBON STEEL
CASING SET AT 118.10'

SLOUGH (119.3'-120.1')

8-20 MESH BENTONITE CRUMBLES
(120.1'-123.0')10-20 MESH SILICA SAND
(123.0'-125.8')8-20 MESH BENTONITE CRUMBLES
(125.8'-132.5')

CEMENT (132.5'-149.0')

8-20 MESH BENTONITE CRUMBLES
(149.0'-150.7')10-20 MESH SILICA SAND
(150.7'-153.5')8-20 MESH BENTONITE CRUMBLES
(153.5'-162.3')

Inches

20 20 12 8 4 0 4 8 12 20 20

C/Z S P C/B

WELL SUMMARY SHEET

Boring or Well No. **299-W15-218**

Northing 135661.17

Easting 566771.02

Sheet 3 of 3Location 200 WestProject VOC/Arid IDElevation 665.36'Drilling Contractor Kaiser Engineers HanfordDriller M. WraspirDrilling Method and Equipment Cable Tool Bucyrus Erie 22WPrepared by J. Flinn

(Sign/Print Name)

CONSTRUCTION DATA

Depth
in
Feet

GEOLOGIC/HYDROLOGIC DATA

Description

Well Construction

Graphic Log

Lithologic Description

CEMENT (162.3'-170.0')

8-20 MESH BENTONITE CRUMBLES
(170.0'-174.9')10-20 MESH SILICA SAND
(174.9'-197.1')4" DIAM 15.0' .020-SLOT
LOUVERED SS SCREEN
(180.4'-195.3')8-20 MESH BENTONITE CRUMBLES
(197.1'-198.8')10-20 MESH SILICA SAND
(198.8'-205.5')8" TEMPORARY CARBON STEEL
CASING SET AT 205.04'
SLOUGH (205.5'-206.1')
BOTTOM OF BOREHOLE 206.10'

170

180

190

200

210

220

230

240

165.0' Coarsening downward with high
percentage of quartzite gravel.171.5'-172.0' SAND
172.0'-173.0' Sandy GRAVEL.
173.0'-175.0' Gravelly SAND
175.0'-180.75' Sand & GRAVEL180.75'-182.0' SAND
182.0'-206.1' Sandy GRAVEL195.0' Moist patches with oxide stains on
gravel.Static Water Level @ 198.97' BGS
(2/19/93).

Inches

28 20 12 8 4 0 4 8 12 20 28

C/Z S P C/B

WELL SUMMARY SHEET

Boring or Well No. **299-W15-219**

Northing 135654.03

Easting 566728.90

Sheet 1 of 3Location 200 WestProject VOC/Arid IDElevation 668.02Drilling Contractor Kaiser Engineers HanfordDriller M. WraspirDrilling Method and Equipment Cable Tool Bucyrus EriePrepared by R.D. Deen, E.A. Johnson

(Sign/Print Name)

CONSTRUCTION DATA

Depth
in
Feet

GEOLOGIC/HYDROLOGIC DATA

Description

Well Construction

Graphic Log

Lithologic Description

CEMENT (1.0'-9.3')

16" TEMPORARY CARBON STEEL
CASING SET AT 35.57'8-20 MESH BENTONITE CRUMBLES
(9.3'-57.0')

CEMENT (57.0'-62.7')

8-20 MESH BENTONITE CRUMBLES
(62.7'-64.6')10-20 MESH SILICA SAND
(64.6'-68.3')

TRANSDUCER SET @ 66.7'

8-20 MESH BENTONITE CRUMBLES
(68.3'-73.3')

CEMENT (73.3'-80.1')

10

20

30

40

50

60

70

80

0.0'-6.0' Stabilization (fill).
Construction debris mixed into Aeolian
Sand?

6.0'-13.0' SAND

13.0'-20.5' Gravelly SAND

20.5'-25.0' Silty Sandy GRAVEL.

25.0'-44.5' Sandy GRAVEL

44.5'-53.0' Gravelly SAND

53.0'-70.0' Gravelly SAND

70.0'-75.0' Slightly Silty Gravelly SAND

75.0'-79.0' Gravelly Sand

Inches

28 20 12 8 4 0 4 8 12 20 28

C/Z S P C/B

WELL SUMMARY SHEET

Boring or Well No. **299-W15-219**

Northing 135854.03

Easting 566728.90

Sheet 2 of 3Location 200 WestProject VOC/Arid IDElevation 668.02Drilling Contractor Kaiser Engineers HanfordDriller M. WraspirDrilling Method and Equipment Cable Tool Bucyrus EriePrepared by R.D. Deen, E.A. Johnson

(Sign/Print Name)

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Well Construction		Graphic Log	Lithologic Description
8-20 MESH BENTONITE CRUMBLES (80.1'-84.3')		90		79.0'-112.0' SAND
10-20 MESH SILICA SAND (84.3'-104.2')				
4" DIAM 15.0' 0.20-SLOT SS LOUVERED WELL SCREEN (87.2'-102.2')		100		
8-20 MESH BENTONITE CRUMBLES (104.2'-117.1')		110		107.8' Alternating layers of fine grained SAND and gravelly SAND.
CEMENT (117.1'-124.7')		120		119.5'-121.0' CALICHE-Gravelly SAND 121.0'-132.0' Silty Sandy GRAVEL
12" TEMPORARY CARBON STEEL CASING SET AT 120.11'		130		
8-20 MESH BENTONITE CRUMBLES (124.7'-125.9')		140		132.0'-134.0' SAND 134.0'-137.0' Gravelly SAND 137.0'-140.0' Sandy GRAVEL 140.0'-147.0' SAND
10-20 MESH SILICA SAND (125.9'-128.7')				
TRANSDUCER SET @ 126.7'		150		147.0'-149.0' Sandy GRAVEL 149.0'-154.0' SAND
8-20 MESH BENTONITE CRUMBLES (128.7'-136.6')		160		154.0'-184.0' Sandy GRAVEL
CEMENT (136.6'-145.2')				
8-20 MESH BENTONITE CRUMBLES (145.2'-151.5')				
10-20 MESH SILICA SAND (151.5'-155.4')				
TRANSDUCER SET @ 152.2'				
CEMENT (155.4'-163.8')				

Inches

20 20 12 8 4 0 4 8 12 20 20

C/Z S P C/B

WELL SUMMARY SHEETBoring or Well No. **299-W15-219**

Northing 135654.03

Easting 566728.90

Sheet 3 of 3Location 200 WestProject VOC/Arid IDElevation 668.02Drilling Contractor Kaiser Engineers HanfordDriller M. WraspirDrilling Method and Equipment Cable Tool Bucyrus EriePrepared by R.D. Deen, E.A. Johnson

(Sign/Print Name)

CONSTRUCTION DATADepth
in
Feet**GEOLOGIC/HYDROLOGIC DATA**

Description

Well Construction

Graphic Log

Lithologic Description

8-20 MESH BENTONITE CRUMBLES
(163.8'-166.8')10-20 MESH SILICA SAND
(166.8'-187.2')4" DIAM 15.0' 0.020-SLOT SS
LOUVERED SCREEN
(167.2'-182.2')

HOLE PLUG (187.2'-201.9')

10-20 MESH SILICA SAND
(201.9'-210.4')SLOUGH (210.4'-211.0')
BOTTOM OF BOREHOLE 212.0'

184.0'-212.0' Silty Sandy GRAVEL

Static Water Level @ 201.6' BGS (5/25/93)

Inches
28 20 12 8 4 0 4 8 12 20 28

C/Z S P C/B

WELL SUMMARY SHEET

Boring or Well No. **299-W15-220**

Northing 135618.44

Easting 566834.93

Sheet 1 of 3Location 200 WestProject VOC/Arid IDElevation 657.73Drilling Contractor Kaiser Engineers HanfordDriller G. ThomasDrilling Method and Equipment Cable Tool Bucyrus Erie 22-14102Prepared by E.A. Johnson

(Sign/Print Name)

CONSTRUCTION DATA

Depth
in
Feet

GEOLOGIC/HYDROLOGIC DATA

Description

Well Construction

Graphic Log

Lithologic Description

CEMENT (0.0'-9.7')

16" TEMPORARY CARBON STEEL
CASING SET AT 39.72'
8-20 MESH BENTONITE CRUMBLES
(9.7'-35.1')

CEMENT (35.1'-47.0')

8-20 MESH BENTONITE CRUMBLES
(47.0'-50.0')
10-20 MESH SILICA SAND
(50.0'-54.0')
1/8" STAINLESS STEEL
TRANSDUCER SET AT 52.0'
8-20 MESH BENTONITE CRUMBLES
(54.0'-58.7')
CEMENT (58.7'-75.0')8-20 MESH BENTONITE CRUMBLES
(75.0'-78.0')
10-20 MESH SILICA SAND

10

20

30

40

50

60

70

80

0.0'-0.5' Sandy GRAVEL (Stabilization)
0.5'-5.5' Gravelly SAND

5.5'-10.0' SAND

10.0'-12.0' SAND
12.0'-12.5' Sandy GRAVEL
12.5'-20.0' Gravelly SAND

20.0'-33.0' Sandy GRAVEL

33.0'-44.0' Silty Sandy GRAVEL

44.0'-48.5' SAND

48.5'-54.0' Silty SAND

54.0'-59.0' SAND

Fine grained Silty Sand interbeds @ 58.0'
59.0'-71.0' Slightly Gravelly SAND

71.0'-78.5' SAND

78.5'-79.0' Silty SAND

Inches

28 20 12 8 4 0 4 8 12 20 28

C/Z S P C/B

WELL SUMMARY SHEET

Boring or Well No. **299-W15-220**

Northing 135618.44

Easting 566834.93

Sheet 2 of 3Location 200 WestProject VOC/Arid IDElevation 657.73Drilling Contractor Kaiser Engineers HanfordDriller G. ThomasDrilling Method and Equipment Cable Tool Bucyrus Erie 22-141u2Prepared by E.A. Johnson

(Sign/Print Name)

CONSTRUCTION DATA

Depth
in
Feet

GEOLOGIC/HYDROLOGIC DATA

Description

Well Constructor.

Graphic Log

Lithologic Description

(78.0'-96.9')

4" DIAM 15.0' .020-SLOT

LOUVERED SS SCREEN

(80.0'-95.1')

79.0'-103.0' SAND

90

0.5' Sandy Silty interbeds @ 94.0' and 97.0'.

8-20 MESH BENTONITE CRUMBLES
(96.9'-104.0')

100

CEMENT (104.0'-113.9')

103.0'-109.0' Sandy SILT

Perched water encountered at 106.10'.

110

109.0'-112.0' CALICHE-Sandy GRAVEL

12" TEMPORARY CARBON STEEL
CASING SET AT 111.09'10" TEMPORARY CARBON STEEL
CASING SET AT 113.14'8-20 MESH BENTONITE CRUMBLES
(113.9'-115.7')10-20 MESH SILICA SAND
(115.7'-119.9')1/8" STAINLESS STEEL
TRANSDUCER SET AT 118.0'
8-20 MESH BENTONITE CRUMBLES
(119.9'-122.9')

CEMENT (122.9'-124.9')

8-20 MESH BENTONITE CRUMBLES
(124.9'-142.5')

120

122.0'-128.0' Sandy GRAVEL

130

128.0'-130.0' Gravelly SAND
130.0'-135.0' Sandy GRAVEL

140

135.0'-137.0' Silty Sandy GRAVEL
137.0'-144.0' Sandy GRAVEL

CEMENT (142.5'-150.0')

144.0'-151.0' Silty Sandy GRAVEL

@ 148.0' trace CALICHE, 1" thick, weak.

150

151.0'-153.5' SAND

8-20 MESH BENTONITE CRUMBLES
(150.0'-152.9')10-20 MESH SILICA SAND
(152.9'-171.9')4" DIAM 15.0' .020-SLOT
LOUVERED SS SCREEN
(155.03'-170.02')

160

153.5'-154.5' Sandy GRAVEL
154.5'-162.0' Silty Sandy GRAVEL

Inches

20 20 12 8 4 0 4 8 12 20 20

C/Z S P C/B

WELL SUMMARY SHEETBoring or Well No. **299-W15-220**

Northing 135618.44

Easting 566834.93

Sheet 3 of 3Location 200 WestProject VOC/Arid IDElevation 657.73Drilling Contractor Kaiser Engineers HanfordDriller G. ThomasDrilling Method and Equipment Cable Tool Bucyrus Erie 22-14102Prepared by E.A. Johnson

(Sign/Print Name)

CONSTRUCTION DATADepth
in
Feet**GEOLOGIC/HYDROLOGIC DATA**

Description

Well Construction

Graphic Log

Lithologic Description

8-20 MESH BENTONITE CRUMBLES
(171.9'-177.1')

CEMENT (177.1'-180.8')

8-20 MESH BENTONITE CRUMBLES
(180.8'-183.0')10-20 MESH SILICA SAND
(183.0'-187.0')1/8" STAINLESS STEEL
TRANSDUCER SET AT 185.0'8-20 MESH BENTONITE CRUMBLES
(187.0'-191.9')10-20 MESH SILICA SAND
(191.9'-200.1')8" TEMPORARY CARBON STEEL
CASING SET AT 200.02'
SLOUGH (200.1'-201.0')
BOTTOM OF BOREHOLE 201.0'

170

180

190

200

210

220

230

240

162.0'-164.0' Sandy GRAVEL

164.0'-165.5' Gravelly SAND

165.5'-173.0' Sandy GRAVEL

173.0'-201.0' Silty Sandy GRAVEL

Static Water Level @ 191.58' BGS
(7/22/93)

Inches

20 20 12 8 4 0 4 8 12 20 20

C/Z S P C/B

WELL SUMMARY SHEETBoring or Well No. **299-W18-96**

Northing 135293.83

Easting 566435.23

Sheet 1 of 2Location 200 WestProject VOC/Arid IDElevation 681.92Drilling Contractor Kaiser Engineers HanfordDriller G. HowellDrilling Method and Equipment Cable Tool Walker NeerPrepared by V.M. Johnson

(Sign/Print Name)

CONSTRUCTION DATADepth
in
Feet**GEOLOGIC/HYDROLOGIC DATA**

Description

Well Construction

Graphic Log

Lithologic Description

LOCATED WITHIN THE 216-Z-18
CRIB

CEMENT (0.0'-9.90')

8-20 MESH BENTONITE CRUMBLES
(9.90'-113.5')2" DIAM PERMANENT STAINLESS
STEEL CASING W/ CENTRALIZERS6" PERMANENT CARBON STEEL
CASING SET AT 80.0'Borehole was previously drilled prior
to being redrilled; therefore, no lithologic
description exists between 0'-80.0'.

10

20

30

40

50

60

70

80

inches

20 20 12 8 4 0 4 8 12 20 20

C/Z S P C/B

WELL SUMMARY SHEET

Boring or Well No. **299-W18-96**

Northing 135293.83

Easting 566435.23

Sheet 2 of 2Location 200 WestProject VOC/Arid IDElevation 681.92Drilling Contractor Kaiser Engineers HanfordDriller G. HowellDrilling Method and Equipment Cable Tool Walker NeerPrepared by V.M. Johnson

(Sign/Print Name)

CONSTRUCTION DATA

Depth
in
Feet

GEOLOGIC/HYDROLOGIC DATA

Description

Well Construction

Graphic Log

Lithologic Description

5" TEMPORARY CARBON STEEL
CASING SET AT 146.7'1/4" BENTONITE PELLETS
(113.5'-118.95')10-20 MESH SILICA SAND
(118.95'-134.9')2" DIAM .020-SLOT T-304
LOUVERED SS SCREEN
(122.29'-131.88')BENTONITE CHUNKS
(134.9'-149.2')5" TEMPORARY CARBON STEEL
CASING SET AT 146.7'
BOTTOM OF BOREHOLE 149.2'

90

100

110

120

130

140

150

160

80.0'-104.0' SAND

Interbedded silt/sand between 84.0'-86.0'.

104.0'-117.0' Gravelly SAND

117.0'-122.0' Sandy GRAVEL

122.0'-127.9' GRAVEL

127.9'-129.5' SILT
129.5'-131.0' Silty GRAVEL
131.0'-137.0' Sandy SILT

137.0'-146.5' SILT

146.5'-149.2' Plio-Pleistocene/CALICHE

Inches

28 20 12 8 4 0 4 8 12 20 28

C/Z S P C/B

WELL SUMMARY SHEET

Boring or Well No. **299-W18-174**

Northing 135437.38

Easting 566558.21

Sheet 1 of 2Location 200 WestProject VOC/Arid IDElevation 672.29'Drilling Contractor Kaiser Engineers HanfordDriller G. Howell M. WraspirDrilling Method and Equipment Cable Tool Walker Neer
Ho-22-5300Prepared by V.M. Johnson

(Sign/Print Name)

CONSTRUCTION DATA

Depth
in
Feet

GEOLOGIC/HYDROLOGIC DATA

Description

Well Construction

Graphic Log

Lithologic Description

LOCATED WITHIN THE 216-Z-1A
TILE FIELD

CEMENT (+1.0-18.3')

4" DIAM T-304 SCH 5 STAINLESS
STEEL PERM CASING W/
CENTRALIZERS8" PERMANENT CARBON STEEL
CASING SET AT 47.0'8-20 MESH BENTONITE CRUMBLES
(18.3'-41.9')

CEMENT (41.9'-50.45')

8-20 MESH BENTONITE CRUMBLES
(50.45'-97.1')Borehole was previously drilled prior
to redrilling; therefore, no lithologic
description exists between 0.0'-49.5'.

49.5'-84.5' SAND

Inches
20 20 12 8 4 0 4 8 12 20 20

C/Z S P C/B

WELL SUMMARY SHEET

Boring or Well No. **299-W18-174**

Northing 135437.38

Easting 566558.21

Sheet 2 of 2Location 200 WestProject VOC/Arid IDElevation 672.29'Drilling Contractor Kaiser Engineers HanfordDriller G. Howell M. WraspirDrilling Method and Equipment Cable Tool Walker NeerPrepared by V.M. JohnsonHo-22-5300

(Sign/Print Name)

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Well Construction		Graphic Log	Lithologic Description
6" TEMPORARY CARBON STEEL CASING SET AT 129.0'		84.5		84.5'-107.0' Sandy GRAVEL
1/2" BENTONITE PELLETS (97.1'-104.1')		90		
1/4" BENTONITE PELLETS (104.1'-106.0')		100		107.0'-112.7' SAND
4" DIAM 20.0' 0.020-SLOT SS LOUVERED SCREEN (106.45'-126.45')		110		
10-20 MESH SILICA SAND (106.0'-130.0')		120		112.7'-115.0' Silty SAND 115.0'-116.6' Sandy SILT 116.6'-119.5' Silty SAND 119.5'-130.0' SILT
6" TEMPORARY CARBON STEEL CASING SET AT 129.0'		130		130.0'-131.5' Plio-Pleistocene/CALICHE
1/4" BENTONITE PELLETS (130.0'-131.5')		140		
BOTTOM OF BOREHOLE 131.5'		150		
		160		

Inches

28 20 12 8 4 0 4 8 12 20 28

C/Z S P C/B

WELL SUMMARY SHEET

Boring or Well No. **299-W18-252**

Northing 135429.48

Easting 566447.02

Sheet 1 of 3

Location **200 West**

Project **VOC/Arid ID**

Elevation **680.59**

Drilling Contractor **Kaiser Engineers Hanford**

Driller **G. Howell**

Drilling Method and Equipment **Cable Tool Walker Neer WS-31**

Prepared by **J. Flinn**

(Sign/Print Name)

CONSTRUCTION DATA

Depth
in
Feet

GEOLOGIC/HYDROLOGIC DATA

Description

Well Construction

Graphic Log

Lithologic Description

CEMENT (0.0' to 9.0')

16" TEMPORARY CARBON STEEL
CASING SET AT 38.71'

4" DIAM T-304 SCH 5 STAINLESS
STEEL CASING
W/ CENTRALIZERS TO 113.2'

8-20 MESH BENTONITE CRUMBLES
(9.0'-90.2')

0'-1' Stabilization (Fill)
1.0'-7.0' SAND

7.0'-11.5' Gravelly SAND

11.5'-16.5' Sandy GRAVEL

16.5'-22.0' SAND

22.0'-33.5' Gravelly SAND

33.5'-37.0' SAND

37.0'-38.0' GRAVEL
38.0'-42.5' SAND

42.5'-51.0' Sandy GRAVEL

51.0'-101.0' SAND
51.0'-52.5' Stratified medium sand, coarse
sand, and fine gravel.

Inches

20 20 12 8 4 0 4 8 12 20 20

C/Z S P C/B

WELL SUMMARY SHEET

Boring or Well No. **299-W18-252**

Northing 135429.48

Easting 566447.02

Sheet 2 of 3Location 200 WestProject VOC/Arid IDElevation 680.59Drilling Contractor Kaiser Engineers HanfordDriller G. HowellDrilling Method and Equipment Cable Tool Walker Neer WS-31Prepared by J. Flinn

(Sign/Print Name)

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Well Construction		Graphic Log	Lithologic Description
12" TEMPORARY CARBON STEEL CASING SET AT 138.28'				
CEMENT (90.2'-95.6')		90		
8-20 MESH BENTONITE CRUMBLES (95.6'-97.9')				
10-20 MESH SILICA SAND (97.9'-101.9')		100		
TRANSDUCER SET @ 100.0'				
8-20 MESH BENTONITE CRUMBLES (101.9'-102.5')				101.0'-109.0' Sandy GRAVEL
CEMENT (102.5'-109.2')				
8-20 MESH BENTONITE CRUMBLES (109.2'-110.0')		110		109.0'-120.0' GRAVEL
10-20 MESH SILICA SAND (111.0'-134.7')				
4" DIAM 20.0' 0.020-SLOT LOUVERED SS SCREEN (113.2'-133.2')		120		118.5' Trace of CALICHE in cuttings. 120.0'-125.0' Sandy GRAVEL
				125.0'-137.5' Silty SAND Sharp Contact @ 125.0'.
		130		130.0' Sandy SILT (80% SILT 20% SAND)
8-20 MESH BENTONITE CRUMBLES (134.7'-135.7')				
CEMENT (135.7'-141.0')		140		137.0' Slightly Silty SAND (80% SAND 20% SILT) 137.5'-139.5' CALICHE-Sandy GRAVEL 137.5' Irregular, sharp contact w/ CALICHE. 139.5'-149.0' Sandy GRAVEL
8-20 MESH BENTONITE CRUMBLES (141.0'-142.9')				
10-20 MESH SILICA SAND (142.9'-146.9')		150		149.0'-159.0' SAND
TRANSDUCER SET @ 145.2'				
8-20 MESH BENTONITE CRUMBLES (146.9'-157.2')				
4" DIAM T-304 SCH 5 STAINLESS STEEL CASING W/ CENTRALIZERS (133.2'-165.1')		160		
CEMENT (157.2'-161.2')				

Inches
20 20 12 8 4 0 4 8 12 20 20

C/Z S P C/B

WELL SUMMARY SHEET

Boring or Well No. **299-W18-252**

Northing 135429.48

Easting 566447.02

Sheet 3 of 3Location 200 WestProject VOC/Arid IDElevation 680.59Drilling Contractor Kaiser Engineers HanfordDriller G. HowellDrilling Method and Equipment Cable Tool Walker Neer WS-31Prepared by J. Flinn

(Sign/Print Name)

CONSTRUCTION DATA

Depth
in
Feet

GEOLOGIC/HYDROLOGIC DATA

Description

Well Construction

Graphic Log

Lithologic Description

8-20 MESH BENTONITE CRUMBLES
(161.2'-163.0')
10-20 MESH SILICA SAND
(163.0'-167.2')
4" DIAM 20.0' .020-SLOT SS
LOUVERED SCREEN (165.1'-185.1')

10" DIAM TEMPORARY CARBON
STEEL CASING SET AT 227.38'
8-20 MESH BENTONITE CRUMBLES
(187.2'-194.1')

CEMENT (194.1'-206.1')
4" DIAM T-304 SCH 5 STAINLESS
STEEL CASING
W/ CENTRALIZERS (185.1'-210.3')

8-20 MESH BENTONITE CRUMBLES
(206.1'-208.1')
10-20 MESH SILICA SAND
(208.1'-212.3')
TRANSDUCER SET @ 210.0'
BENTONITE HOLEPLUG
(212.3'-217.3')

10-20 MESH SILICA SAND
(217.3'-227.3')

SLOUGH (227.3'-228.5')
BOTTOM OF BOREHOLE 228.5'

170

180

190

200

210

220

230

240

159.0'-162.5' Sandy GRAVEL

162.5'-169.0' Gravelly SAND

169.0'-171.0' Silty Sandy GRAVEL

171.0'-173.0' GRAVEL

173.0'-179.0' Sandy GRAVEL

179.0'-184.0' GRAVEL

184.0'-189.0' SAND

189.0'-204.0' Sandy GRAVEL

204.0'-209.0' SAND

209.0'-228.5' Silty GRAVEL

213' Heavily oxidized

Static Water Level @ 217.3' BGS (7/20/93)

inches
78 20 12 8 4 0 4 8 12 20 78

C/Z S P C/B

APPENDIX B.4
SAMPLE SUMMARIES

Site Characterization Samples Collected from Well 299-W15-218
(see pg. B.4-9 for legend)

Collection Date	Time	Mid-Point Depth (ft)	Mid-Point Depth (m)	HEIS Sample Number	Samp Meth	Arch Lith	Moist and/or Ca-CO ₃	WHC Phys Props	SEA MIST	VOC
02/04/93	0810	7.3	2.2	B01MT6	DB					1
02/04/93	0915	9.5	2.9	B01MT7	DB					1
02/05/93	0900	14.8	4.5	B01MT9	DB					1
	0900	14.8	4.5	B01MV0	DB					1
	1014	19.8	6.0	B01MV1	DB					1
02/08/93	1010	24.3	7.4	B01MV3	DB					1
	1027	27.0	8.2	B01MV4	DB					1
	1037	29.5	9.0	B01MV5	DB					1
	1057	29.5	9.0	B01MV6	DB					1
02/09/93	0901	34.8	10.6	B01MV7	DB		1			1
	0901	34.8	10.6	B01MV8	DB					1
	0901	34.8	10.6	B01MV9	DB					1
	0901	34.8	10.6	B01MW0	DB					1
02/10/93	0901	34.8	10.6	B08432	DB	1				1
	1040	42.5	13.0	B01MW1	DB	1	1			1
	1117	44.3	13.5	B08433	DB		1			1
	1400	51.0	15.5	B01MW2	DB		1			1
02/11/93	0838	52.0	15.8	B01NV3	DB					1
	0920	54.3	16.5	B01NV4	DB		1			1
	1052	59.8	18.2	B01NV5	DB		1			1
	1142	59.9	18.3	n/a	n/a				1	
02/12/93	0950	65.0	19.8	B01NV7	DB		1			1
	1035	70.0	21.3	B01NV8	DB		1			1
	1052	75.0	22.9	B01NV9	DB		1			1
	1120	79.3	24.2	B01NW6	DB		1			1
02/16/93	0743	84.5	25.8	B01NW0	DB		1			1
	0812	90.3	27.5	B01NW1	DB		1			1
	1426	92.0	28.0	n/a	n/a				1	
02/17/93	0742	94.7	28.8	B01NW3	DB		1			1
	1019	99.5	30.3	B01NW2	DB		1			1
	1338	103.9	31.7	B01NW5	DB					1
	1412	109.8	33.5	B01NW4	DB					1
02/23/93	0939	111.8	34.1	n/a	n/a				1	
	1430	116.3	35.4	B08434	SB		1	1		
02/24/93	1442	116.5	35.5	B01P75	DB		1			1
	1442	116.5	35.5	B01P76	DB					1
	1309	119.8	36.5	B01P77	DB		1			1
03/04/93	1103	122.5	37.3	n/a	n/a				1	
03/08/93	0908	124.0	37.8	B08435	HT		1			1
	1344	128.5	39.2	B08436	HT		1			1
03/09/93	1115	134.0	40.8	B08437	HT		1			1
	1415	140.0	42.7	B01P79	DB		1			1
03/10/93	0923	139.5	42.5	n/a	n/a				1	
	1050	144.9	44.2	B01P80	DB		1			1
	1245	149.5	45.6	B01P81	DB		1			1
	1425	155.0	47.2	B01P82	DB		1			1
03/11/93	0827	159.5	48.6	B01P83	DB		1			1
	0944	161.5	49.2	n/a	n/a				1	
	1346	164.8	50.2	B01P84	DB		1			1
03/12/93	0807	169.5	51.7	B01P85	DB		1			1
	0931	174.8	53.3	B01P86	DB		1			1
03/15/93	0831	179.8	54.8	B01P87	DB		1			1
	1331	178.5	54.4	n/a	n/a				1	
03/16/93	1030	185.0	56.4	B01P89	DB		1			1
	1334	189.8	57.8	B01P90	DB		1			1
03/17/93	1040	191.0	58.2	n/a	n/a				1	
03/18/93	0753	195.0	59.4	B01NX0	DB		1			1
	1053	199.9	60.9	B08438	DB		1			1
	1330	204.5	62.3	B08439	DB		1			1
03/19/93	1035	205.0	62.5	B01NQ8	DB				(ground water)	1
Total Number of Samples					2	34	1	8	49	

Site Characterization Samples Collected from Well 299-W15-219
(see pg. B.4-9 for legend)

Collection Date	Time	Mid-Point Depth (ft)	Mid-Point Depth (m)	HEIS Sample Number	Samp Meth	Arch Lith	Moist and/or Ca-CO ₃	SFE	Part Size Dist	PNL Head-Space	Bore Sampler	VOC
04/22/93	0850	15.5	4.7	B08P96	DB	2	1					
	1310	21.0	6.4	B01NT4	DB	2	1					
	1411	25.9	7.9	B01NT5	DB	2	1					
04/23/93	1000	29.5	9.0	B01NT7	DB	2	1					
	1106	35.5	10.8	B01NT8	DB	2	1					
04/27/93	0900	39.8	12.1	B01NT6	DB	2	1					
	1220	44.8	13.6	B01NT9	DB	2	1					
	1300	49.5	15.1	B01NV0	DB	2	1					
04/28/93	1215	53.5	16.3	B01NV1	DB	2	1					
	1245	54.3	16.6	B01PW6	DB *				1			
	1245	54.3	16.6	B07B79	DB *					1		
	1355	56.0	17.1	B07BC0	BS *						1	
	1444	56.6	17.2	B01PW7	DB *				1			
	1444	56.6	17.2	B07B80	DB *					1		
04/29/93	0754	57.9	17.6	B01NV2	DB	2	1					
	0830	65.0	19.8	B01PR8	DB	2	1					
	0949	70.0	21.3	B01PR9	DB	2	1					
	1345	75.5	23.0	B01PS0	DB	2	1					
04/30/93	0935	79.5	24.2	B01PS1	DB		1					
	1005	84.5	25.8	B01PS2	DB		1					
05/03/93	0954	87.0	26.5	B01PW8	SB *				1			
	0954	87.0	26.5	B07B81	SB *					1		
	1120	89.7	27.3	B07BC1	BS *						1	
	1245	89.5	27.3	B01PS3	DB		1					
	1300	91.0	27.7	B01PW9	SB *				1			
	1300	91.0	27.7	B07B82	SB *					1		
	1414	93.3	28.4	B07BC3	BS *						1	
05/04/93	0802	95.5	29.1	B01PX0	SB *				1			
	0802	95.5	29.1	B07B83	SB *					1		
	0810	96.5	29.4	B01PS4	DB		1					
	1125	100.0	30.5	B01PS5	DB		1					
	1225	105.5	32.2	B01PS6	DB		1					
	1245	109.5	33.4	B01PS7	DB							
05/05/93	1035	111.1	33.9	B01PX1	SB *				1			
	1035	111.1	33.9	B07B84	SB *					1		
	1307	113.4	34.5	B07BC4	BS *						1	
	1350	114.5	34.9	B01PX2	SB *				1			
	1350	114.5	34.9	B01PX3	SB *							
	1350	114.5	34.9	B07B85	SB *					1		
	1350	114.5	34.9	B07B86	SB *					1		
	1405	114.9	35.0	B01PS8	DB		1					
05/06/93	1006	115.8	35.3	B08P97	DB			1				
	1018	117.5	35.8	B08P98	DB			1				
	1340	120.0	36.6	B01PS9	DB		1					
05/11/93	0923	124.5	37.9	B01PT0	HT		1					
	1254	129.5	39.5	B01PT1	HT		1					
	1446	131.5	40.1	B01PT2	DB		1					
05/13/93	0925	140.0	42.7	B01PT3	HT		1					
	1345	145.0	44.2	B01PT4	DB		1					
05/14/93	0827	149.0	45.4	B01PT5	DB		1					
	0915	150.3	45.8	B01PX4	SB *				1			
	0915	150.3	45.8	B07B87	SB *					1		
	1012	152.1	46.4	B07BC7	BS *						1	
05/17/93	0805	153.4	46.8	B01PX5	SB *				1			
	0805	153.4	46.8	B07B88	SB *					1		
	0935	155.0	47.2	B01PT6	DB		1					
	1245	160.0	48.8	B01PT7	HT		1					
05/18/93	0830	165.0	50.3	B01PT8	DB		1					
	1235	170.0	51.8	B01PT9	HT		1					
	1445	175.0	53.3	B01PV0	HT		1					
05/19/93	1040	180.0	54.9	B01PV1	KT		1					
	1325	185.0	56.4	B01PV2	HT		1					
	1445	187.0	57.0	B01PV3	DB		1					
05/20/93	0920	190.3	58.0	B01PV4	DB		1					
	1310	195.0	59.4	B01PV5	DB		1					
05/21/93	1020	200.0	61.0	B01PV6	DB		1					
05/24/93	0955	205.0	62.5	B01PV7	DB		1					
05/25/93	0750	210.5	64.2	B01PV8	DB		1					
	1250	211.0	64.3	B07BS6	DB						(ground water)	
Total Number of Samples						26	40	2	9	10	5	51

* Collected as part of the Bore Sampler Test Demonstration.

Site Characterization Samples Collected from Well 299-W15-220
(see pg. B.4-9 for legend)

Collection		Mid-Point	Mid-Point	HRIS	Moist	WSU			
Date	Time	Depth (ft)	Depth (m)	Sample Number	Samp Meth	Ca-CO3	SFE	Head-space	SEA MIST VOC
06/03/93	1038	24.8	7.6	B07BT4	DB	1			1
06/05/93	1235	29.7	9.1	B07BT5	DB	1			1
06/07/93	1240	34.7	10.6	B07BT6	DB	1			1
06/08/93	0830	40.0	12.2	B07BT7	DB	1			1
06/09/93	0840	45.0	13.7	B07BT8	DB	1			1
	0955	50.0	15.2	B07BT9	DB	1			1
	1139	50.5	15.4	n/a	n/a				1
	1340	55.0	16.8	B07BV0	DB	1			1
06/10/93	0930	60.0	18.3	B07BV1	DB	1			1
	1235	64.8	19.8	B07BV2	DB	1			1
06/11/93	0850	69.6	21.2	B07BV3	DB	1			1
	1254	70.0	21.3	n/a	n/a				1
06/14/93	0925	75.0	22.9	B07BV4	DB	1	1		1
	1055	79.8	24.3	B07BV5	DB	1	1		1
06/23/93	0805	84.6	25.8	B07BV6	DB	1	1		1
	0915	90.5	27.6	B07BV7	DB	1	1		1
	1205	89.8	27.4	n/a	n/a				1
06/16/93	0800	94.6	28.8	B07BV8	DB	1	1	3	1
	0945	100.5	30.6	B07BV9	DB	1	1		1
	1230	104.5	31.9	B07BW0	DB	1	1	3	1
06/17/93	1040	109.6	33.4	B07BW1	DB	1			1
	1350	107.8	32.9	B07BT3	n/a			(parched water)	1
06/24/93	0730	114.8	35.0	B07BW2	DB	1	1		1
06/25/93	0905	120.0	36.6	B07BW3	DB	1	1	3	1
	1030	123.0	37.5	B07BW4	DB	1			1
06/28/93	0830	127.0	38.7	B07BW5	DB	1		3	1
	1100	133.0	40.5	B07BW6	DB	1			1
06/29/93	1025	138.5	42.2	B07BW7	DB	1		3	1
06/30/93	0820	142.3	43.4	n/a	n/a				2
07/09/93	1305	146.0	44.5	B07BW8	DB	1			1
07/12/93	0805	150.0	45.7	B07BW9	DB	1		3	1
	1115	155.0	47.2	B07BX0	DB	1			1
	1430	160.0	48.8	B07BX1	DB	1		3	1
07/13/93	1023	162.1	49.4	n/a	n/a				2
07/14/93	1030	164.5	50.1	B07BX2	DB	1			1
	1415	170.0	51.8	B07BX3	DB	1		3	1
07/15/93	0855	175.0	53.3	B07BX4	DB	1			1
	1345	180.5	55.0	B07BX5	DB	1		3	1
07/16/93	0845	181.7	55.4	n/a	n/a				3
07/19/93	1425	185.0	56.4	B07BX6	DB	1			1
07/20/93	1030	190.0	57.9	B07BX7	DB	1		3	1
07/21/93	0835	195.0	59.4	B07BX8	DB	1		3	1
	1340	200.0	61.0	B07BX9	DB	1			1
07/23/93	0845	200.0	61.0	B07CF4	n/a			(ground water)	1
Total Number of Samples						36	9	33	10 38

Site Characterization Samples Collected from Well 299-W18-252
(see pg. B.4-9 for legend)

Collection		HEMU				Moist and/or		WSU	SEA	VOC	
Date	Time	(ft)	(m)	Sample Number	Samp Meth	Arch Lith	Ca-CO3	SFB	Head-space	MIST	
05/03/93	1000	4.5	1.4	B01PH2	DB						
	1045	9.5	2.9	B01PH3	DB		1			1	
	1420	15.0	4.6	B01PG5	DB		1			1	
	1455	20.0	6.1	B01PG4	DB		1			1	
05/04/93	1025	25.0	7.6	B01PG6	DB		1			1	
	1440	30.6	9.3	B01PG7	DB		1			1	
05/05/93	0745	35.0	10.7	B01PG8	DB		1			1	
	0845	39.5	12.0	B01PG9	DB		1			1	
05/06/93	1245	44.7	13.6	B01PH1	DB		1			1	
05/07/93	0947	48.8	14.9	n/a	n/a					1	
05/10/93	1253	49.5	15.1	B07BD5	DB		1			1	
	1359	55.0	16.8	B07BD6	DB		1			1	
05/11/93	0923	59.5	18.1	B07BD7	DB		1			1	
	1055	65.5	20.0	B07BD8	DB		1			1	
	1470	64.6	19.7	OVM and Dragger Tube - GC not operational					(1)		
05/12/93	1055	70.5	21.5	B07BD9	DB		1			1	
	1220	75.5	23.0	B07BF0	DB		1			1	
	1435	80.2	24.4	B07BF1	DB		1			1	
05/13/93	0757	85.5	26.1	B07BF2	DB		1			1	
	0950	85.7	26.1	n/a	n/a				1		
	1040	89.7	27.3	B07BF3	DB		1			1	
	1350	96.0	29.3	B07BF4	DB		1			1	
05/14/93	0737	99.5	30.3	B07BF5	DB		1			1	
	0835	105.0	32.0	B07BF6	DB		1			1	
	1034	104.4	31.8	n/a	n/a				1		
05/17/93	1320	115.0	35.1	B07BF7	DB		1			1	
05/18/93	0843	121.3	37.0	B07BF8	DB		1			1	
	1359	123.2	37.6	n/a	n/a				1		
05/19/93	0745	126.5	38.6	B07BF9	DB		1			1	
	1107	129.5	39.5	B07BG0	DB		1	1		1	
	1310	134.8	41.1	B07BG1	DB		1	1		1	
05/20/93	0825	138.0	42.1	B07BS7	DB		1			1	
	1100	138.0	42.1	n/a	n/a				1		
05/25/93	1056	142.1	43.3	B07BG2	DB					1	
	1430	145.5	44.3	B07BG3	DB					1	
05/26/93	0822	149.7	45.6	B07BG4	DB					1	
	1034	154.5	47.1	B07BG5	DB					1	
	1220	159.5	48.6	B07BG6	DB					1	
	1432	159.4	48.6	n/a	n/a				1		
05/27/93	1312	164.5	50.1	B07BG7	DB		1			1	
	1312	164.5	50.1	B07BG8	DB					1	
05/28/93	1422	172.0	52.4	B07BG9	DB		1			1	
06/01/93	0836	175.5	53.5	B07BH0	DB		1			1	
	1311	182.0	55.5	B07BH1	DB		1			1	
	1435	185.1	56.4	B07BH2	DB		1			1	
	1452	187.3	57.1	B08M54				1			
	1452	187.3	57.1	B08M55				1			
	1452	187.3	57.1	B08M56				1			
	1452	187.3	57.1	B08M57				1			
06/02/93	0914	185.8	56.6	n/a	n/a				1		
	1300	191.7	58.4	B07BH3	DB		1			1	
06/03/93	0801	195.8	59.7	B07BH4	DB		1			1	
	1303	199.5	60.8	B07BH5	DB		1			1	
06/04/93	1128	202.2	61.6	n/a	n/a				1		
06/07/93	0823	206.1	62.8	B07BH6	DB		1			1	
	1347	211.1	64.3	B07C87	DB		1			1	
06/08/93	0811	214.7	65.4	B07C88	DB		1			1	
	1435	220.2	67.1	B07C89	HT		1			1	
06/09/93	0853	225.6	68.8	B07C90	HT		1			1	
06/11/93	1125	227.4	69.3	B07BS5	HT				(ground water)	1	
Total Number of Samples						0	40	2	4	8	46

Site Characterization Samples Collected from Well 299-W18-96
(see pg. B.4-9 for legend)

Collection Date	Time	Mid-Point Depth (ft)	Mid-Point Depth (m)	HEIS Sample Number	Samp Meth	Arch Lith	Moist and/or Ca-CO3	Part Size Dist	SFB	Micro	SEA MIST	Bulk Den/ Por Liner	Air Perm Liner	WSU Phys Prop Liner	Chem Rad Liner	CER-CLA PP Liner	VOC	ABN	ICP Ions CYN Hg,Pb	TOC	α,β	γ	Sr-90	PUIS Am-241	
02/10/93	1257	82.8	25.2	B08094	SB			1				1													
		83.3	25.4	B08095																					
		83.3	25.4	B08096				1																	
		83.3	25.4	B08092										1											
		83.8	25.5	B08093											1										
02/11/93	1351	84.0	25.6	B01NW7		2	1	1								1		1	1	1	1	1	1	1	1
		86.0	26.2	B01NX2	SB												1								
		86.5	26.4	B01NX4													1								
		86.5	26.4	B01NX1		1													1	1					
		86.5	26.4	B01NX3															1	1					
02/11/93	1308	87.0	26.5	n/a	n/a																				
02/12/93	0843	90.0	27.4	B01NW8	DB													1							
		90.0	27.4	B01NW9				1	1										1	1					
02/12/93	0900	91.4	27.8	B01NX6	SB											1							1	1	1
		92.4	28.1	B01NX5															1	1					
		92.4	28.1	B01NX7																1					
02/12/93	1005	93.0	29.0	B01NX8	DB	2	1	1										1	1						
02/12/93	1048	98.0	29.9	B01NY1	DB		1												1	1					
		98.0	29.9	B01NY2																1					
02/12/93	1100	99.3	30.3	B08099	SB								1												
		99.8	30.4	B08098										1											
		100.3	30.6	B08097											1										
		100.5	30.6	B01NX9															1	1	1	1	1	1	1
		100.5	30.6	B01NY0																1					
02/12/93	1209	101.0	30.8	n/a	n/a								1												
02/12/93	1348	104.0	31.7	B01NY3	DB														1	1					
02/16/93	0954	110.2	33.6	B01NY4	DB	2	1	1												1	1				
		110.2	33.6	B01NY5																	1				
02/16/93	1040	116.0	35.4	B01NY6	DB	2	1	1												1	1				
02/17/93	0930	119.0	36.3	B01NY9	DB	2	1	1												1	1				
02/17/93	1052	120.0	36.6	B01NY7	SB											1				1	1	1	1	1	1
		120.0	36.6	B01NY8																1					
02/17/93	1430	123.5	37.6	B01NZ1	SB											1				1	1	1	1	1	1
		123.5	37.6	B01NZ2																1					
02/18/93	1038	124.0	37.8	n/a	n/a								1												
02/18/93	1346	125.5	38.3	B01P91	SB															1	1	1	1	1	1
		125.5	38.3	B01P92																1					
		125.5	38.3	B01P93																1	1				
		125.5	38.3	B01P94																1					
02/22/93	0920	127.9	39.0	n/a		1																			
02/22/93	1004	129.0	39.3	B01NZ9	DB		1													1	1				
		129.0	39.3	B01P00																	1				
		129.0	39.3	B01P01																	1				
		129.0	39.3	B01P02																	1				
02/22/93	1243	130.5	39.8	B01NZ3	SB	2										1			1	1	1	1	1	1	1
		130.5	39.8	B01NZ6													1			1	1	1	1	1	1
		130.5	39.8	B01NZ7																1					
		130.5	39.8	B01NZ8																1					
02/22/93	n/r	132.5	40.4	n/a	DB	1																			
02/22/93	1430	134.5	41.0	B01P03	DB															1	1				
		134.5	41.0	B01P06		2		1	2											1					
		134.5	41.0	B080B5			1																		
02/23/93	0920	135.3	41.2	B080B3	SB								1												
		135.8	41.4	B080B2										1											
		136.3	41.5	B080B1											1										
		136.5	41.6	B01P03												1			1	1	1	1	1	1	1
		136.5	41.6	B01P04																1					
02/24/93	1350	137.3	41.8	B080B6	SB	1																			
		137.8	42.0	B080B7																					
		138.3	42.1	B080B8													1								
		138.5	42.2	B01NZ3					1										1	1					
		138.5	42.2	B01NZ4																1					
		138.8	42.3	B084R6				1																	
02/25/93	1030	140.0	42.7	n/a	SB							1													
02/25/93	1110	141.9	43.3	B080C0	SB								1												
		142.4	43.4	B080C1										1											
		142.9	43.6	P046C2											1										
		143.2	43.6	B080C3					1																
		143.8	43.8	B01P95												1			1	1	1	1	1	1	1
		143.8	43.8	B01P96															1						
		143.8	43.8	B01P98															1						
02/25/93	1305	143.2	43.6	B080C3	SB								1												
		143.7	43.8	B080C4										1											
		144.2	44.0	B080C5											1										
		144.5	44.0	B080C6					1																
		144.5	44.0	B01PB0						1										1					
		144.5	44.0	B01PB1																	1	1			
		144.7	44.1	B01PB0						1															
02/25/93	1400	145.3	44.3	B084R8	SB		1																		
		145.8	44.4	B084R7										1											
		146.3	44.6	B084R6											1										
		146.5	44.7	B01P99												1			1	1	1	1	1	1	1
		146.5	44.7	B01PB2															1						
Total Number of Samples						20	14	8	5	1	3	5	5	5	13	2	46	26	10	10	12	12	12	12	

Site Characterization Samples Collected from Well 299-W18-174
(see pg. B.4-9 for legend)

Collection Date	Time	Mid-Point Depth (ft)	Mid-Point Depth (m)	HEIS Sample Number	Samp Meth	Arch Lith	Molten and/or Ca-CO ₃	Part Size Dist	SFE	Micro	Bulk Den/ Por Liner	Air Perm Liner	WSU Phys Prop Liner	Chem Rad Liner	VOC	ABN	ICP Ions CYN Hg,Pb	TOC
03/22/93	1010	53.0	16.2	B01PF0	DB													
		53.0	16.2	B01PF1	↓	2	1	1										
03/22/93	1019	54.9	16.7	B08D20	SB						1							
		53.3	16.8	B08D19	↓							1						
		55.8	17.0	B08D18	↓								1					
		56.0	17.1	B01PH4	↓										1			
		56.0	17.1	B01PH5	↓										1	1	1	1
03/24/93	0900	57.3	17.3	B01PK8	DB													
		57.5	17.5	B01PK9	↓	2	1	1										
03/24/93	1010	61.0	18.6	B01PL0	DB													
		61.0	18.6	B01PL1	↓	2	1	1										
03/25/93	0848	65.8	20.0	B01PL2	DB													
		66.0	20.1	B01PL3	↓	2	1	1										
03/25/93	1310	71.3	21.7	B01PP2	DB													
		71.5	21.8	B01PP3	↓	2	1	1										
03/25/93	1406	73.3	22.3	B08D23	SB						1							
		73.8	22.5	B08D22	↓							1						
		74.3	22.6	B08D21	↓								1					
		74.5	22.7	B01PH6	↓										1			
		74.5	22.7	B01PH7	↓										1	1	1	1
03/26/93	0910	75.8	23.1	B01PL4	DB													
		76.0	23.2	B01PL5	↓	2	1	1										
03/29/93	1040	80.5	24.5	B01PL6	DB													
		80.6	24.6	B01PL7	↓	2	1	1										
03/29/93	1313	86.1	26.2	B01PL8	DB													
		86.6	26.4	B01PL9	↓	2	1	1										
03/29/93	1435	90.5	27.6	B01PP4	DB													
		90.5	27.6	B01PP5	↓		1	1										
03/30/93	0937	92.3	28.1	B08D26	SB						1							
		92.8	28.3	B08D25	↓							1						
		93.3	28.4	B08D24	↓								1					
		93.5	28.5	B01PH8	↓										1			
		93.5	28.5	B01PH9	↓										1	1	1	1
03/30/93	1100	96.0	29.2	B01PM0	DB													
		96.0	29.2	B01PM1	↓	2	1	1										
04/01/93	1338	101.1	30.8	B01PP6	DB													
		101.1	30.8	B01PP7	↓	2	1	1										
04/02/93	0815	105.0	32.0	B01PM2	DB													
		105.0	32.0	B01PM3	↓	2	1	1										
04/02/93	1010	111.5	34.0	B01PM4	DB													
		111.5	34.0	B01PM5	↓	2	1	1										
04/05/93	1008	113.0	34.4	B08D29	SB						1							
		113.5	34.6	B08D28	↓							1						
		114.0	34.7	B08D27	↓								1					
		114.2	34.8	B01PJ0	↓										1			
		114.2	34.8	B01PJ1	↓										1	1	1	1
04/05/93	1245	115.8	35.3	B01PM6	DB													
		116.1	35.4	B01PM7	↓	2	1	1										
04/05/93	1350	117.3	35.7	B08D32	SB						1							
		117.8	35.9	B08D31	↓							1						
		118.3	36.0	B08D30	↓								1					
		118.5	36.1	B01PJ2	↓										1			
		118.5	36.1	B01PJ3	↓										1	1	1	1
04/06/93	0852	120.5	36.7	B08D33	SB													
04/06/93	0930	120.8	36.8	n/a	DB				1									
04/06/93	0952	122.1	37.2	B01PP8	DB													
		122.1	37.2	B01PN4	↓										1			
		122.2	37.2	B01PP9	↓	2	1	1							1	1		
		122.2	37.2	B01PN5	↓										1			
04/06/93	1024	123.1	37.5	n/a	DB				2									
04/06/93	1405	123.7	37.7	B08D36	SB							1						
		124.2	37.8	B08D37	↓													
		124.7	38.0	B08D38	↓													
		124.9	38.1	B01PJ4	↓										1			
		124.9	38.1	B01PN2	↓										1			
		124.9	38.1	B01PJ5	↓										1	1	1	1
		124.9	38.1	B01PN3	↓										1			
		124.9	38.1	B01PN6	↓										1	1	1	
04/06/93	1455	125.0	38.1	n/a	DB				1									
04/07/93	0934	126.8	38.6	B01PG0	DB													
		127.1	38.7	B01PG1	↓	2	1	1										
04/07/93	1252	127.7	38.9	B08D40	SB						1							
		128.2	39.1	B08D41	↓							1						
		128.7	39.2	B08D42	↓								1					
		128.9	39.3	B01PJ6	↓										1			
		128.9	39.3	B01PJ7	↓										1	1	1	1
04/08/93	0843	130.4	39.7	B01PG2	DB													
		131.0	39.9	B01PG3	↓	2	1	1										
Total Number of Samples						32	17	17	4	3	6	7	6	8	52	25	8	7

<u>Sample/Analysis Abbreviation</u>	<u>Description</u>
a	Alpha Radiation
ABN	Semi-Volatile Compound
Air Perm Liner	Air Permeability Liner
Am-241	Americium-241
Arch Lith	Archive Lithologic
b	Beta Radiation
Bore Sampler	Bore Sampler
Bulk Den/Por Liner	Bulk Density/Porosity Liner
CERCLA PP Liner	Additional liner for CERCLA Physical Property analyses
Chem Rad Liner	Chemical and Radionuclide constituents Liner
CYN	Cyanide
DB	Drive Barrel
g	Gamma Emitters
Hg	Mercury
ICP	ICP Metals
Ions	Anions
Micro	Microbiologic
Moist and/of CaCO ₃	Moisture Content and/or CaCO ₃ Content
Part Size Dist	Particle Size Distribution
Pb	Lead
PNL Headspace	Headspace associated with Bore Sampler
PUIS	Plutonium/Uranium Isotopes
SB	Split-Barrel
SEAMIST	SEAMIST™
SFE	Supercritical Fluid Extraction Matrix Characterization
Sr-90	Strontium-90
TOC	Total Organic Carbon
VOC	Volatile Organic Compound
WSU Headspace	WSU-Pullman Headspace
WSU Headspace	Special samples for analysis by WSU Pullman
WSU Phys Prop Liner	WSU-Tri Cities Physical Properties Liner

APPENDIX C
UNSATURATED ZONE LITHOLOGIC CROSS SECTIONS

LEGEND

Fill - Backfill and reworked surficial material
Eo - Holocene eolian material
Huf - Hanford formation upper fine unit
Huc - Hanford formation upper coarse unit
Hf - Hanford formation fine unit
Hlc - Hanford formation lower coarse unit
Hlf - Hanford formation lower fine unit
Ep - Tentatively correlated with early "Palouse" soil
PP - Plio-Pleistocene unit
RE - Ringold formation unit E

GEOSCI\082293A2

Vertical Exaggeration 2X
GEOSCI/081783-A

GEOSCI\081793-B

GEOSCI\091793-C

D
North

W18-252
(678.0 ft)

W18-249
(679.4 ft)

GEOSCI\091793-D

- (1) Interpretation from drillers logs dated 2/16-18, 1972
 (2) Screened Intervals

GEOSCI\091793-E

APPENDIX D
SCREENING DATA FOR NEW WELLS

PID, Colorimetric Tube, and OVM Monitoring Results for FY 93 Wells

Well No.		299-W18-96			
Depth (ft)	PID (ppm)	Colorimetric (ppm)	OVM (ppm)		
76.3-79.6	0				
82-84.5	0.0 (d)				
87	0	0			
95			0.0 (e)		
101.1	0		0.0 (e)		
104.43			0.0 (e)		
110			16.0 (e)		
117.2-119.3	0.0 (e)				
120.54	0				
124		20	3.2	1254 hrs	2/17/93
124		> 60		1410 hrs	2/17/93
124	92				2/18/93
132.5	0	0			
135	0	0	0		
137	0.6	2.5		1210 hrs	2/23/93
137	0	0		0700 hrs	2/24/93
141.69	0.0 (d)	0			
141.7-144	0.0 (d)		0.0 (d)		
146	0.0 (d)	0.0 (d)			

(a) Annulus (b) Soil Cuttings (c) Drive Barrel (d) Split Tube (e) Headspace

Note: Maximum detection limit of colorimetric tube is 60 ppm.

(PID) Photoionization Detector (OVM) Organic Vapor Monitor

PID, Colorimetric Tube, and OVM Monitoring Results for FY 93 Wells

Well No.		299-W18-174			
Depth (ft)	PID (ppm)	Colorimetric Tube (ppm)	OVM (ppm)		
47.3	0			0730 hrs	3/17/93
47.3		10		1330 hrs	3/17/93
50	0	0			
52-53.5	0	0	3.7 (e)		
53.5	2.5	5			
54-56.5	0	0			
56.5	5				
56.5-58			5.5 (e)		
58	1	5			
60-61.5	0	0	3.7 (e)		
61.5	0	0			
63	0	0			
65-66.5			13.0 (e)		
66.5	0	0			
70.5-72.0	0	0	0.0 (e)		
73-75.0	0	5			
75-76.6	10.1 (b)		3.1 (e)		
77		20			
79.9	0	0			
80-81.1			9.0 (e)		
81.1	0	0			
85.1-87.1			5.4 (e)		
87.1	0	0			
89.7-91.2			5.6 (e)		
91.2		>60	12.6	1435 hrs	3/29/93
91.2	0	0		0715 hrs	3/30/93
92-94			0.0 (d)		
95.2-96.7	0		5.6 (e)		
99.6	10	20		0740 hrs	3/31/93
99.6	0.94	45		1230 hrs	3/31/93
99.6	0	0		0945 hrs	4/1/93
99.6-102.7			13.3 (e)		
104-106	0	0	0.0 (e)		
110-112	0	20.0 (b)	0.0 (e)		
112.7-114.7	0	0			
125.9-127.6			10.1 (e) 150 (b)		
127.6-129			13.0 (d)		
129-131.5		>60			
130	0	>60 (e)	13.0 (e)		

(a) Annulus (b) Soil Cuttings (c) Drive Barrel (d) Split Tube (e) Headspace

Note: Maximum detection limit of colorimetric tube is 60 ppm.

PID (Photoionization Detector) (OVM) Organic Vapor Monitor

PID, Colorimetric Tube, and OVM Monitoring Results for FY 93 Wells

<u>Well No.</u> 299-W18-252			
Depth (ft)	PID (ppm)	Colorimetric Tube (ppm)	OVM (ppm)
3-5	0.0 (e)		
8-10	0.0 (e)		
13.5-16	0.0 (e)		
18-20			0.0 (e)
24-25	0.0 (e)		
28.4	0		
30-30.6			0.0 (e)
33.5-35.5			0.0 (e)
39-40		2	0.0 (e)
43.7-44.7			0.0 (e)
48.6	5	30	
48.86		>60	
48.5-50			0.0 (e)
52.6	2		
54-55			0.0 (e)
58	0		
59-60			0.0 (e)
64.5-65.5			0.0 (e)
70-71	0		1.9 (e)
75-76			1.5 (e)
79-80.6			1.1 (e)
84	0		
84.5-86			2.0 (e)
88-90.2			0.0 (e)
95.5-96.5			0.0 (e)
99-100			2.4 (e)
105-105.5			0.0 (e)
115-115.5			2.9 (e)
121-121.5			0.0 (e)
125.5-127			6.4 (e) .8 (b)
129-130	1.5 (b)		0.8 (e)
133.5-135.3			1.8 (e)
137			5.4 (e)
139.6	0	0	
141.6-142.6			0.4 (e)
144.9		>60	
145-145.5			1.4 (e)
149	0	0	
149-150.2	0	0	.4 (e)
153.5-155			.4 (e)
159-160		40	.4 (e)
160	225, 235 (a)	>60	

Depth (ft)	PID (ppm)	Colorimetric Tube (ppm)	OVM (ppm)		
164-165			0.0 (e)		
168	235				
172-173			0.0 (e)		
175.2-176			0.0 (e)		
181.5-182			0.0 (e)		
184.5-185.6			1.4 (e)		
187.8	0				
190.5-192			0.0 (e)		
195	0				
195.5-196			2.0 (e)		
200			1.0 (e)		
203.5	40 (a)			0710 hrs	6/4/93
203.5		> 60		0800 hrs	6/4/93
205-206.6			2.0 (e)		
210.5-211.2			0.0 (e)		
214.3-215			0.5 (e)		
220-220.5			1.5 (e)		
224.6-226.6			1.0 (e)		

(a) Annulus (b) Soil Cuttings (c) Drive Barrel (d) Split Tube (e) Headspace

Note: Maximum detection limit of colorimetric tube is 60 ppm.

(PID) Photoionization Detector (OVM) Organic Vapor Monitor

PID, Colorimetric Tube, and OVM Monitoring Results for FY 93 Wells

Well No.		299-W15-218			
Depth (ft)	PID (ppm)	Colorimetric Tube (ppm)	OVM (ppm)		
5	0				
11	0				
13	0	0	5		
13.5			0		
20.5			0.0 (e)		
21	2			Dräger 10 ppm	
24			0		
29	0				
31	10	35		1205 hrs	2/8/93
31	25	>60.0		1333 hrs	2/8/93
31	0	0		0730 hrs	2/9/93
32.8	0	0			
34	0				
40.5	0	0			
45.5	0	0			
48.5	0	0			
51.5	0	0		1420 hrs	2/10/93
51.5	3	7			
52.5			8.6 (e)	0855 hrs	2/11/93
55			6.2 (e)	0940 hrs	2/11/93
58.5	2	0			
60			0.0 (e)	1105 hrs	2/11/93
60.5	3			1055 hrs	2/11/93
60.5	5	10		1210 hrs	2/11/93
61	0	0		1250 hrs	2/11/93
61	20	25		1500 hrs	2/11/93
65			0.0 (e)		
70			0.0 (e)		
75			0.0 (e)		
80			0.0 (e)		
81			0.0 (b)		
85			0.0 (e)		
88	0.5 (e), 0.3 (b)				
90			82.9 (e)		
95			24.7 (e)		
95.5	2.7 (b)				
98.5			0.0 (b)		
100	2.5 (b)		14.2 (e) 25 (b)		
104.5			1.2 (e)		
110			58.6 (e)		
111	250	>60			
111-111.5			4.5 (b)		

Depth (ft)	PID (ppm)	Colorimetric Tube (ppm)	OVM (ppm)		
112.5-113			20.0 (b)		
114	2.6	5		0800 hrs	2/22/93
114	1.2	2.5		0925 hrs	2/22/93
114	115 (a), 3	18		0955 hrs	2/22/93
114	21	25		1020 hrs	2/22/93
114	10.7	10		1220 hrs	2/22/93
114	.7, 12 (a)	40 (a)		0810 hrs	2/23/93
114	60 (a)	> 60 (a)		1205 hrs	2/23/93
115.3	0.7			0710 hrs	2/24/93
115.3	0.675			0830 hrs	2/24/93
115.3	0.2			1415 hrs	2/24/93
116			14 (b)		
116.5			148 (a)		
117	0.5				
118	1.2	2	2 (b)		
120			.2 (a)	1320 hrs	2/25/93
120	14	> 60		0710 hrs	3/1/93
120	22	> 60		0930 hrs	3/1/93
120	85	> 60		1045 hrs	3/1/93
120	480	> 60		1215 hrs	3/1/93
120	5			1310 hrs	3/1/93
120	27 (a)	> 60		1450 hrs	3/1/93
123	207	> 60		0740 hrs	3/3/93
123	70	> 60		1100 hrs	3/3/93
123	3.5, 1.5 (a)	10		0915 hrs	3/4/93
123	3.5, 488(a)	> 60		0710 hrs	3/8/93
123	4.5, 498(a)	5, > 60		0825 hrs	3/8/93
125			10.7 (a)	0915 hrs	3/8/93
125	1.3, 507(a)			1030 hrs	3/8/93
125	28, 225(a)	> 60		1200 hrs	3/8/93
127.7	432, 540(a)	> 60		1320 hrs	3/8/93
130			25.3 (a)		
130.03	74, 174(a)			1415 hrs	3/8/93
131	25	> 60		0710 hrs	3/9/93
131.3	104	> 60		0826 hrs	3/9/93
133	194	> 60		0930 hrs	3/9/93
135			30.2 (a)	1115 hrs	3/9/93
135	.7, .75 (a)			1215 hrs	3/9/93
136	6.7		6.1 (a)	1335 hrs	3/9/93
139			0.0 (a)		
140			3.0 (a)	1418 hrs	3/9/93
141	0			0715 hrs	3/10/93
145			117 (a)	1050 hrs	3/10/93
150			1.2 (a)	1250 hrs	3/10/93
152.2	16 (a)			1410 hrs	3/10/93

Depth	PID	Colorimetric Tube	OVM		
(ft)	(ppm)	(ppm)	(ppm)		
155			0.0 (e)	1430 hrs	3/10/93
156	0				
160			0.0 (e)	0835 hrs	3/11/93
162	0				
165			0.0 (e)	1350 hrs	3/11/93
168	0				
170			0.0 (e)	0810 hrs	3/12/93
172.5	8 (b)				
173	0.5				
175		50 (a)	16 (e)		
176	4 (b)				
178.5	288,638(a)	> 60		0710 hrs	3/15/93
180			1.3 (e)	0835 hrs	3/15/93
181.5	0				
184.1	0				
185			.3 (e)	1030 hrs	3/16/93
189	5 (a)	22 (a)			
190			2 (e)	1340 hrs	3/16/93
191	36 (a)	> 60 (a)			
191		> 60	PID-8" .11 ppm, 12" 315 ppm, 16" 25 ppm		
191	PID-8" 52 ppm, 12" 85 ppm				
192	PID-8" 150 ppm, 12" 503 ppm, 16" 120 ppm				
192	PID-8" 74 ppm, 12" 174, 16" 120 ppm.				
194.5	PID-8" 114 ppm, 12" 5 ppm, 16" 0.0 ppm.				
195			2.7 (e)	0800 hrs	3/18/93
197		25 (a)			
199.5	0				
200			8 (e)	1055 hrs	3/18/93
205			2.7 (e)	1300 hrs	3/18/93

(a) Annulus (b) Soil Cuttings (c) Drive Barrel (d) Split Tube (e) Headspace

Note: Maximum detection limit of colorimetric tube is 60 ppm.

(PID) Photoionization Detector (OVM) Organic Vapor Monitor

PID, Colorimetric Tube, and OVM Monitoring Results for FY 93 Wells

<u>Well No.</u>	<u>299-W15-219</u>				
<u>Depth</u> <u>(ft)</u>	<u>PID</u> <u>(ppm)</u>	<u>Colorimetric Tube</u> <u>(ppm)</u>	<u>OVM</u> <u>(ppm)</u>		
15			0.0 (b) 1.3 (e)		
25	0.1				
26	0.2				
26.5	1.2				
30	5	5			
34	2				
35	20	40			
50	4	4			
50	50	20		0830 hrs	4/28/93
50	10	5		0930 hrs	4/28/93
50	0.2			1030 hrs	4/28/93
54	0.2				
55			62 (e)		
57	0.8	10			
59	5				
61	7				
62	8				
64	140	40			
70	25				
75	200	> 50			
76	10	10			
84	0.5				
85	25	30			
86	54	> 15			
90	120	> 50			
92	36	> 50		1310 hrs	5/3/93
92	67	> 50		1400 hrs	5/3/93
98	5				
116	0.2	3			
119	20 (b)				
121	1			1230 hrs	5/7/93
121	0.5	5		1315 hrs	5/7/93
121	2.5			1330 hrs	5/7/93
121	2.5	5		1400 hrs	5/7/93
121	9	> 15		0710 hrs	5/9/93
121	8	5		0800 hrs	5/9/93
121	2	5		0900 hrs	5/9/93
122	25	> 15			
124	5	> 15			
125	20	> 15			
126	28	> 15			
127	798	> 15		1030 hrs	5/11/93

Depth (ft)	PID (ppm)	Colorimetric Tube (ppm)	OVM (ppm)		
127	450	> 15		1200 hrs	5/11/93
130	52	> 15			
135	76.0, 220 (a)	> 15		1400 hrs	5/11/93
135	200	> 15		1500 hrs	5/11/93
135	12.1	> 60		0720 hrs	5/12/93
135	8.5			0815 hrs	5/12/93
137			0 (b)		
140	94.5	> 60			
145	> 200				
145	65	> 60			
146.5			0		
153			0		
154			0		
158	1	5			
160	0.5	5		1200 hrs	5/17/93
160	5			1225 hrs	5/17/93
160	25	40		1300 hrs	5/17/93
162	10	> 60			
165			6.8 (e)		
167	30.6	> 60		1000 hrs	5/18/93
167	22.7	> 60		1220 hrs	5/18/93
170	26.5	> 60	0.0 (b)		
175	20		0.0 (e)		
176	79.8				
177			0.0 (b)		
178	22.8	> 60			
180			0 (b) 30 (a)		
181	43.7	> 60			
183	30.5	> 60	0.0 (b)		
185	13.5		0.0 (b)		
185.5	3.2	25			
187-187.5			0.0 (b)		
189			0		
191	3	50			
191.5			0		
192.5	0	0	0		
195		5 (a)	0 (b)		
198			0		
199	0	0	0		
200			0		
201			0		
202.5			0		
205			0		
210.5			0		
211	0	0	0		
212	0.5			1350 hrs	5/25/93

Depth	PID	Colorimetric Tube	OVM		
<u>(ft)</u>	<u>(ppm)</u>	<u>(ppm)</u>	<u>(ppm)</u>		
212	9	5		1425 hrs	5/25/93
212	15	>60		1500 hrs	5/25/93

(a) Annulus (b) Soil Cuttings (c) Drive Barrel (d) Split Tube (e) Headspace

Note : Maximum detection limit of colorimetric tube is 50 ppm.

(PID) Photoionization Detector (OVM) Organic Vapor Monitor

PID, Colorimetric Tube, and OVM Monitoring Results for FY 93 Wells

Well No. 299-W15-220			
Depth (ft)	PID (ppm)	Colorimetric Tube (ppm)	OVM (ppm)
5	0		
11	0		
15	0		
17	0		
22	0		
25.2			0
30	41.5 (a)	>60	0.0 (b) 8.0 (a)
32	0		0
35			0
38.5			0
40			0
45	40 (c)		0.0 (b)
48			0
50			0.0 (b) 11 (e)
53			0.0 (b)
55	15	30	0.0 (b)
58	0		
65	210	>60	0.0 (b) 21
70			21 (c)
75	1.5	1.5	
80	64		
83			0.0 (b)
85			0.0 (b)
87	5	10	
90		>60	0.0 (b) 17 (e)
95			0.0 (b) 50 (e)
100			0.0 (b) 0.0 (e)
102	0	0	
105			0.0 (b) 0.0 (e)
110			0
111			0
115	0		0.0 (b) 8.6 (e)
118			0
120			0.0 (e)
123			0.0 (e)
127	0	0	0.0 (e)
127	0	0	0.0 (e)
133			0
138.5	0	0	0.0 (e)
140	0	0	0
146	0	0	0.0 (e)
150			0.0 (e)

Depth <u>(ft)</u>	PID <u>(ppm)</u>	Colorimetric Tube <u>(ppm)</u>	OVM <u>(ppm)</u>
153	0	0	
155			0.0 (e)
158	0	0	
160			0.0 (e)
164	0	0	0.0 (e)
167	0	0	
170			0.0 (e)
173	0	0	0.0 (b)
175			0.0 (e)
178	0	0	0.0 (b)
180.5			0.0 (e)
181	0	0	
185	0.0 (a)	20	0.0 (e)
190			0.0 (e)
192	0	5	
194	0	0	
195			0.0 (e) 59 (c)
197.5			0.0 (b)
199		25 (a)	
200	0	> 20 (a)	0.0 (e)

(a) Annulus (b) Soil Cuttings (c) Drive Barrel (d) Split Tube (e) Headspace

Note: Maximum detection limit of colorimetric tube is 60 ppm.

(PID) Photoionization Detector (OVM) Organic Vapor Monitor

APPENDIX E
SOIL-GAS ANALYSES

Soil Gas Results for FY 93 Wells

Well No. 299-W18-96

Depth (ft)	GC/ECD (ppm)	OVN (ppm)
86.7	8.1 CCL4	3.9
101.1	8.31 CCL4	5.5
121.8	98.09 CCL4	28.6
148.15	*	29.7

Well No. 299-W15-218

Depth (ft)	GC/ECD (ppm)	OVN (ppm)
59.9	45.39 CCL4	16.5
92	102.85 CCL4	46.6
111.8	16,660 CCL4	590
	18.7 CHCL3	
111.8	20,910 CCL4	602
	96.6 CHCL3	
	2.89 CH2CL2	
126.6	29.75 CCL4	73.6
139.5	10.2 CCL4	30.1
	7.905 CCL4	
158.9	155.04 CCL4	3.1
178.5	778.6 CCL4	0
189.7	10,380 CCL4	489
	0.68 CHCL3	

Well No. 299-W18-252

Depth (ft)	GC/ECD (ppm)	OVN (ppm)
48.86	0.83 Unk	0
	1.72 Unk	0
	.70 Unk	0
	1.73 CCL4	0
	1.48 Unk	0
64.6	*	3.5
85.68	1.19 Unk	0
	6.12 Unk	
	16.32 CCL4	
	7.82 Unk	
	1.02 Unk	
	4.08 Unk	
104.42	*	0
123.2	5.251 CCL4	0
138	36.410 CCL4	1.8
	5.133 Unk	
	0.177 CHCL3	
159.4	1419.61 CCL4	26
	3.057 Unk	
	0.134 Unk	
	1.623 Unk	
	0.074 Unk	
185.8	8.918 CCL4	0
202.24	0.475 Unk	2.5
	0.123 Unk	
	169.708 CCL4	
	14.818 Unk	
	0.012 CH2CL2	
	0.683 Unk	
	0.511 CHCL3	
	1.660 Unk	

Well No. 299-W15-220

Depth (ft)	GC/ECD (ppm)	OVN (ppm)
50.5	853.66 CCL4	174
70	*	76
90	1,511.6 CCL4	121.7
	11.09 CHCL3	
	11.16 Unk	
	0.14 1-2 DCA	
115	633.02 CCL4	121.7
	0.99 CHCL3	
	0.54 Unk	
	0.09 1-2 DCA	
142	149.0 CCL4	18.1
	0.97 CHCL3	
	2.12 Unk	
	0.12 Unk	
	0.10 Unk	
142	167.2 CCL4	18.1
	0.45 CHCL3	
	0.10 Unk	
	0.03 Unk	
160	108.356 CCL4	22.2
	0.045 Unk	
	1.305 CHCL3	
	0.022 1-2 DCA	
182	49.368 CCL4	8.2
	1.551 CHCL3	
	0.450 1-2 DCA	
182	50.160 CCL4	8.2
	0.020 Unk	
	1.435 CHCL3	
	0.006 1-2 DCA	

(GC/ECD) Gas Chromatograph/Electron Capture Detector

(OVN) Organic Vapor Monitor

* Results not received from laboratory.

Unk=Unknown

APPENDIX F
ANALYTICAL RESULTS FOR CHEMICAL SAMPLES FROM NEW WELLS

APPENDIX F.1
VOC ANALYTICAL RESULTS

Analytical Results

Depth	Sample	Drill / Sub-Sample Method	Approx. Lab #	HEIS Sample Number	Meth.ylene chloride (ppb)	trans-1,2-Dichloroethylene (ppb)	1,1-Dichloroethane (ppb)	cis-1,2-Dichloroethylene (ppb)	Chloroform (ppb)	1,1,1-Trichloroethane (ppb)	CCl4 (ppb)	1,2-Dichloroethane (ppb)	Benzene (ppb)	Trichloroethylene (ppb)	Toluene (ppb)	Tetra-chloroethylene (ppb)	Ethylbenzene (ppb)	m,p-Xylene (ppb)	o-Xylene (ppb)	Acetone (ppb)	n-Butyl Benzene (ppb)
7.0	2.1	Sed	NR	B01MT6	<300	<20	<80	<20	<80	<80	82	<80	<30	<20	<20	<20	<20	<20	<20	<20	ND
10.0	3.0	Sed	NR	B01MT7	307 (6)	<30	<100	<30	<100	<100	<34 (6)	<100	<30	<30	<30	<30	<30	<30	<30	<30	ND
15.0	4.6	Sed	NR	B01MT9	<300	<40	<100	<40	<100	<100	<100 (6)	<100	<40	<40	<40	<40	<40	<40	<40	<40	ND
15.0	4.6	Sed	NR	B01MV0	<300	<50	<150	<50	<150	<150	<150 (6)	<150	<50	<50	<50	<50	<50	<50	<50	<50	ND
20.0	6.1	Sed	NR	B01MV1	<300	<50	<150	<50	<150	<150	<150 (6)	<150	<50	<50	<50	<50	<50	<50	<50	<50	ND
25.0	7.6	Sed	NR	B01MV3	<100	<10	<25	<10	<25	<25	36	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND
27.0	8.2	Sed	NR	B01MV4	<100	<10	<25	<10	<25	<25	96	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND
30.0	9.1	Sed	NR	B01MV5	<100	<10	<25	<10	<25	<25	96	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND
30.0	9.1	Sed	NR	B01MV6	<100	<10	<25	<10	<25	<25	112	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND
35.0	10.7	Sed	NR	B01MV7	<50	<5	<10	<5	<10	<10	9	<10	<5	<5	<5	<5	<5	<5	<5	<5	-100 (6)
35.0	10.7	Sed	NR	B01MV8	<100	<10	<25	<10	<25	<25	7 (6)	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND
35.0	10.7	Sed	NR	B01MV9	<100	<10	<25	<10	<25	<25	11 (6)	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND
35.0	10.7	Sed	NR	B01MVC	<100	<10	<25	<10	<25	<25	16 (6)	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND
42.0	12.8	Sed	NR	B01MW1	<150	<15	<30	<15	<30	<30	40	<30	<15	<15	<15	<15	<15	<15	<15	<15	ND
51.0	15.5	Sed	NR	B01MW2	<150	<15	<30	<15	<30	<30	40	<30	<15	<15	<15	<15	<15	<15	<15	<15	ND
52.5	16.0	Sed	NR	B01NV3	<300	<30	<60	<30	<60	<60	1876	<60	<30	<30	<30	<30	<30	<30	<30	<30	ND
55.0	16.8	Sed	NR	B01NV4	<200	<20	<40	<20	<40	<40	198	<40	<20	<20	<20	<20	<20	<20	<20	<20	ND
60.0	18.3	Sed	NR	B01NV5	<200	<20	<40	<20	<40	<40	354	<40	<20	<20	<20	<20	<20	<20	<20	<20	ND
65.0	19.8	Sed	NR	B01NV7	<200	<20	<40	<20	<40	<40	75	<40	<20	<20	<20	<20	<20	<20	<20	<20	ND
70.0	21.3	Sed	NR	B01NV8	<150	<15	<30	<15	<30	<30	175	<30	<15	<15	<15	<15	<15	<15	<15	<15	ND
75.0	22.9	Sed	NR	B01NV9	<150	<15	<30	<15	<30	<30	309	<30	<15	<15	<15	<15	<15	<15	<15	<15	ND
80.0	24.4	Sed	NR	B01NV6	<125	<10	<25	<10	<25 (6)	<25	1334	<25	<15	<15	<15	<15	<15	<15	<15	<15	ND
85.0	25.9	Sed	NR	B01NV0	<100	<10	<20	<10	<20 (6)	<20	206	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
90.0	27.4	Sed	NR	B01NW1	<100	<10	<20	<10	<20 (6)	<20	810	<20	<10	<10	<10	<10 (6)	<10	<10	<10	<10	ND
95.0	29.0	Sed	NR	B01NW3	<100	<10	<20	<10	<20 (6)	<20	11804 (6)	<20	<10	<10	<10	<10 (6)	<10	<10	<10	<10	ND
100.0	30.5	Sed	NR	B01NW2	<100	<15	<30	<15	<30 (6)	<30	1182	<30	<15	<15	<15	<15 (6)	<15	<15	<15	<15	ND
104.5	31.9	Sed	NR	B01NW5	<250	<25	<50	<25	<50 (6)	<50	2600	<50	<25	<25	<25	<25 (6)	<25	<25	<25	<25	ND
110.0	33.5	Sed	NR	B01NW4	<100	<10	<30	<10	<30	<30	15794 (6)	<30	<10	<10	<10	<10 (6)	<10	<10	<10	<10	ND
116.5	35.5	Sed	NR	B01P75	<100	<10	<30	<10	<30	<30	6816 (6)	<30	<10	<10	<10	<10 (6)	<10	<10	<10	<10	ND
116.5	35.5	Sed	NR	B01P76	<100	<10	<30	<10	<30	<30	9932 (6)	<30	<10	<10	<10	<10 (6)	<10	<10	<10	<10	ND
120.0	36.6	Sed	NR	B01P77	<100	<10	<30	<10	<30	<30	31	<30	<10	<10	<10	<10	<10	<10	<10	<10	ND
125.0	38.1	Sed	NR	B01P77	<100	<10	<30	<10	<30	<30	<25	<30	<10	<10	<10	<10	<10	<10	<10	<10	ND
130.0	39.6	Sed	NR	B01P77	<100	<10	<30	<10	<30	<30	<25	<30	<10	<10	<10	<10	<10	<10	<10	<10	ND
135.0	41.1	Sed	NR	B01P77	<100	<10	<30	<10	<30	<30	19	<30	<10	<10	<10	<10	<10	<10	<10	<10	ND
140.0	42.7	Sed	NR	B01P79	<100	<10	<30	<10	<30	<30	244	<30	<10	<10	<10	<10	<10	<10	<10	<10	ND
145.0	44.2	Sed	NR	B01P80	<100	<10	<30	<10	<30	<30	3915 (6)	<30	<10	<10	<10	<10	<10	<10	<10	<10	ND
150.0	45.7	Sed	NR	B01P81	<200	<20	<75	<20	<75	<75	81	<75	<20	<20	<20	<20	<20	<20	<20	<20	ND
155.0	47.2	Sed	NR	B01P82	<100	<10	<25	<10	<25	<25	54	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND
160.0	48.8	Sed	NR	B01P83	<100	<10	<25	<10	<25	<25	37 (6)	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND
165.0	50.3	Sed	NR	B01P84	<100	<15	<40	<15	<40 (6)	<40	175	<40	<15	<15	<15	<15	<15	<15	<15	<15	ND
170.0	51.8	Sed	NR	B01P85	<50	<5	<15	<5	<15	<15	<15 (6)	<15	<5	<5	<5	<5	<5	<5	<5	<5	ND
175.0	53.3	Sed	NR	B01P86	<100	<15	<45	<15	<45	<45	<45 (6)	<45	<15	<15	<15	<15	<15	<15	<15	<15	ND
180.0	54.9	Sed	NR	B01P87	<100	<50	<20	<50	<20	<50	<50	<50	<20	<20	<20	<20	<20	<20	<20	<20	ND
185.0	56.4	Sed	NR	B01P89	<30	<15	<15	<15	<15	<15	<15 (6)	<15	<15	<15	<15	<15	<15	<15	<15	<15	ND
190.0	57.9	Sed	NR	B01P90	<50	<10	<15	<10	<15	<15	<15 (6)	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND
195.0	59.4	Sed	NR	B01N30	412 (6)	<15	<15	<15	<15	<15	38	<15	<15	<15	<15	<15	<15	<15	<15	<15	ND
200.0	61.0	Sed	NR	B01N30	<60	<5	<15	<5	<15	<15	33	<15	<15	<15	<15	<15	<15	<15	<15	<15	ND
205.0	62.5	Sed	NR	B01N30	<60	<10	<15	<10	<15	<15	33	<15	<15	<15	<15	<15	<15	<15	<15	<15	ND
205.0	62.5	Water	NR	B01N30	16	<16	<16	<16	<16	<16	499 (6)	<16	<16	<16	<16	<16	<16	<16	<16	<16	ND

Analytical Results VOLATILE ORGANIC COMPOUNDS 209-W15-218 (VEX-1)

Sample/Subsample Methods	Lab Notes	Analytical Notes	
DB = Drive Barrel	(1) Methanol leaked from container in field.	(a) Poor value because of the large amount observed in the methanol blank and dilution volume caused by the sample weight.	(s) -8 ave. from both detectors, but below LDM's.
CB = Core Borer	(2) Observed large peak at n-Butylbenzene retention time.	(b) -84 observed, but below LDM's.	(t) -12 observed, but below LDM's.
S = Scoopula	(3) Total sediment weight was estimated. Container not weighed initially.	(c) -15 observed, but below LDM's.	(u) Non-calibrated estimate.
TB = Teflon Bailor	(4) Slurry, sediment around container thresholds causing vital to leak.	(d) -23 observed. Below linear detection limits -3.5 gms of sediment needed in 10 ml. of Methanol to lower < value.	(v) -4 observed, but below LDM's.
ND = Not Detected	(5) Some methanol leaked from vial.	(e) -17 observed, but below LDM's.	(w) -11 observed, but below LDM's.
NR = Not Reported	(6) Poor seal on septum. Sample exposed to atmosphere.		(x) -3 observed, but below LDM's.
N/A = Not Applicable			(y) Estimated background control.
			(z) -6 observed, but below LDM's.

299-W15-319 (VEX-3)

ANALYTICAL RESULTS

Volatile Organic Compounds

Depth (ft)	Sample Matrix	Drill / Sub-Sample Method	Approx. Lab. #	HEIS Sample Number	Method	1,1-Dichloroethane (ppb)	1,1,1-Trichloroethane (ppb)	1,2-Dichloroethane (ppb)	Benzene (ppb)	Trichloroethylene (ppb)	Toluene (ppb)	Tetra-chloroethylene (ppb)	Ethylbenzene (ppb)	m,p-Xylene (ppb)	o-Xylene (ppb)	Acetone (ppb)	n-Butyl Benzene (ppb)
21.0	6.4	Sed	DB	B01NT4	Container broken in Lab - No Analysis	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
25.9	7.9	Sed	DB	B01NT5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
29.5	9.0	Sed	DB	B01NT7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
35.5	10.8	Sed	DB	B01NT8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
39.8	12.1	Sed	DB	B01NT6	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
44.8	13.6	Sed	DB	B01NT9	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
49.5	15.1	Sed	DB	B01NV0	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
53.5	16.3	Sed	DB	B01NV1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
54.3	16.6	Sed	DB	B01PW6	<15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
56.6	17.2	Sed	DB	B01PW7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
57.9	17.6	Sed	DB	B01NV2	<15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
65.0	19.8	Sed	DB	B01PW8	<30	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
70.5	21.3	Sed	DB	B01PW9	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
75.5	23.0	Sed	DB	B01PS0	<40	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
79.5	24.2	Sed	DB	B01PS1	<40	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
84.5	25.8	Sed	DB	B01PS2	<40	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
87.0	26.5	Sed	DB	B01PW8	<30	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
89.5	27.3	Sed	DB	B01PS3	<60	<15	<30	<15	<30	<15	<30	<15	<30	<15	<30	<15	<30
91.0	27.7	Sed	DB	B01PW9	<30	<15	<30	<15	<30	<15	<30	<15	<30	<15	<30	<15	<30
95.5	29.1	Sed	DB	B01PX0	<30	<10	<15	<10	<15	<10	<15	<10	<15	<10	<15	<10	<15
96.5	29.4	Sed	DB	B01PS4	<40	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
100.0	30.5	Sed	DB	B01PS5	<40	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
105.5	32.2	Sed	DB	B01PS6	(a)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
109.5	33.4	Sed	DB	B01PS7	(a)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
111.1	33.9	Sed	DB	B01PX1	<25	<15	<25	<15	<25	<15	<25	<15	<25	<15	<25	<15	<25
114.5	34.9	Sed	DB	B01PX2	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
114.5	34.9	Sed	DB	B01PX3	<15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
114.9	35.0	Sed	DB	B01PS8	<25	<15	<25	<15	<25	<15	<25	<15	<25	<15	<25	<15	<25
120.0	36.6	Sed	DB	B01PS9	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
124.5	37.9	Sed	HT	B01PT0	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
129.5	39.5	Sed	HT	B01PT1	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
131.5	40.1	Sed	DB	B01PT2	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
140.0	42.7	Sed	HT	B01PT3	<40	<15	<30	<15	<30	<15	<30	<15	<30	<15	<30	<15	<30
145.0	44.2	Sed	DB	B01PT4	<30	<15	<30	<15	<30	<15	<30	<15	<30	<15	<30	<15	<30
149.0	45.4	Sed	DB	B01PT5	<30	<15	<30	<15	<30	<15	<30	<15	<30	<15	<30	<15	<30
150.3	45.8	Sed	DB	B01PX4	<30	<15	<30	<15	<30	<15	<30	<15	<30	<15	<30	<15	<30
153.4	46.8	Sed	DB	B01PX5	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
155.0	47.2	Sed	DB	B01PT6	<25	<15	<25	<15	<25	<15	<25	<15	<25	<15	<25	<15	<25
160.0	48.8	Sed	HT	B01PT7	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
165.0	50.3	Sed	DB	B01PT8	<30	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
170.0	51.8	Sed	HT	B01PT9	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
175.0	53.3	Sed	HT	B01PV0	<20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
180.0	54.9	Sed	HT	B01PV1	<20	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
185.0	56.4	Sed	HT	B01PV2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
187.0	57.0	Sed	DB	B01PV3	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
190.3	58.0	Sed	DB	B01PV4	<40	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
195.0	59.4	Sed	DB	B01PV5	<30	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
200.0	61.0	Sed	DB	B01PV6	<60	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
205.0	62.5	Sed	DB	B01PV7	<30	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
210.5	64.2	Sed	DB	B01PV8	<30	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15
211.0	64.3	Water	DB	B07BS6	38	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15

299-W15-219 (VEX-3)

VOLATILE ORGANIC COMPOUNDS

Analytical Results

Sample/Subsample Methods

DB = Drive Barrel
HT = Hard Tool
SB = Split-Barrel
CB = Core borer
S = Scoopula
TB = Teflon Bailor

Lab Notes

(1) Turbid sample.
ND = Not Detected
NR = Not Reported
N/A = Not Applicable

Analysis Notes

(a) -12 observed, but below LDL's.
(b) -3 observed, but below LDL's.
(c) -6 observed, but below LDL's.
(d) -4 observed, but below LDL's.
(e) -8 observed, but below LDL's.
(f) 1:100 dilution necessary for CCM analysis.
(g) -5 observed, but below LDL's.

(h) -7 observed, but below LDL's.
(i) 1:200 dilution necessary for CCM analysis.
(j) -9 observed, but below LDL's.
(k) -10 observed, but below LDL's.
(l) -13 observed, but below LDL's.
(m) -11 observed, but below LDL's.
(n) CH2Cl2 impurity in lab.

(o) -18 observed, but below LDL's.
(p) Above range. Could be slightly higher.
(q) Above range, but no other dilution run.

Analytical Results VOLATILE ORGANIC COMPOUNDS 299-W15-228 (VEX-2)

Depth	Sample	Drill / Sub- Sample	Approx. Lab % Fine: Z % Coarse: R	HEIS Sample Number	Meth- ylene Chloride (ppb)	trans-1,2- Dichloro- ethylene (ppb)	1,1- Dichloro- ethane (ppb)	cis-1,2- Dichloro- ethylene (ppb)	Chloro- form (ppb)	1,1,1-Tri- chloro- ethane (ppb)	CC14 (ppb)	1,2-Di- chloro- ethane (ppb)	Benzene (ppb)	Trichloro- ethylene (ppb)	Toluene (ppb)	Tetra- chloro- ethylene (ppb)	Ethyl- benzene (ppb)	M+P- Xylene (ppb)	O-Xylene (ppb)	Acetone (ppb)	n-Butyl Benzene (ppb)
24.8	7.6	Soil	S	5:95:0	B07BT4	<20	<10	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
29.7	9.1	Soil	S	15:85:0	B07BT5	<20	<20	<20	<20	<20	29	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
34.7	10.6	Soil	S	15:85:0 (1)	B07BT6	<120	<120	<120	<120	<120	<120 (a)	<120	<60	<60	<60	<60	<60	<60	<60	<60	ND
40.0	12.2	Soil	S	50:50:0 (1)	B07BT7	<30	<30	<30	<30	<30	<30	<30	<15	<15	<15	<15	<15	<15	<15	<15	ND
45.0	13.7	Soil	CB	5:95:0 (1)	B07BT8	<120	<120	<120	<120	<120	<120	<120	<60	<60	<60	<60	<60	<60	<60	<60	ND
50.0	15.2	Soil	CB	100:0:0 (1)	B07BT9	<60	<60	<60	<60	<60	1052	<60	<30	<30	<30	<30	<30	<30	<30	<30	ND
55.0	16.8	Soil	CB	0:100:0 (1)	B07BV0	<60	<60	<60	<60	<60	772	<60	<30	<30	<30	<30	<30	<30	<30	<30	ND
60.0	18.3	Soil	CB	5:95:0	B07BV1	<25	<25	<25	<25	<25	296	<25	<15	<15	<15	<15	<15	<15	<15	<15	ND
64.8	19.8	Soil	CB	5:95:0	B07BV2	<20	<20	<20	<20	<20	544	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
69.6	21.2	Soil	CB	20:80:0	B07BV3	<15	<15	<15	17	<15	729	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND
75.0	22.9	Soil	CB	80:20:0	B07BV4	<20	<20	<20	<20	<20	261	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
79.8	24.3	Soil	S	80:20:0	B07BV5	<20	<20	<20	<20	<20	174	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
84.6	25.8	Soil	S	80:20:0	B07BV6	<20	<20	<20	<20	<20	107	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
90.5	27.6	Soil	S	95:5:0	B07BV7	<20	<20	<20	<20	<20	1132	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
94.6	28.8	Soil	CB	50:50:0	B07BV8	<20	<20	<20	<20	<20	699	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
100.5	30.6	Soil	CB	100:0:0	B07BV9	1171	<25	<25	<25	<25	545	<25	<15	<15	<15	<15	<15	<15	<15	<15	ND
104.5	31.9	Soil	CB	100:0:0	B07BW0	86	<25	<25	<25	<25	56	<25	<15	<15	<15	<15	<15	<15	<15	<15	ND
107.8	32.9	Water	PJ	Muddy	B07BT3	<5 (e)	<0.5	<0.5	20	<2	200 (f)	<2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	ND
109.6	33.4	Soil	CB	100:0:0	B07BW1	380	<25	<25	<25	<25	109	<25	<15	<15	<15	<15	<15	<15	<15	<15	ND
114.8	35.0	Soil	S	100:0:0 (2)	B07BW2	<20	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
120.0	36.6	Soil	S	95:5:0	B07BW3	<20	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
123.0	37.5	Soil	S	95:5:0	B07BW4	<20	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
127.0	38.7	Soil	S	50:50:0	B07BW5	<40	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
133.0	40.5	Soil	CB	80:20:0	B07BW6	<20	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
138.5	42.2	Soil	CB	30:70:0	B07BW7	<40	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
146.0	44.5	Soil	S	95:5:0	B07BW8	<40	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
150.0	45.7	Soil	S	95:5:0	B07BW9	<40	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
155.0	47.2	Soil	S	95:5:0	B07BX0	<20	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
160.0	48.8	Soil	S	95:5:0	B07BX1	<20	<15	<15	<15	<15	<15	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND
164.5	50.1	Soil	S	100:0:0	B07BX2	<20	<15	<15	<15	<15	51	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND
170.0	51.8	Soil	S	95:0:5	B07BX3	<25	<25	<25	<25	<25	25	<25	<15	<15	<15	<15	<15	<15	<15	<15	ND
175.0	53.3	Soil	S	90:0:10	B07BX4	<20	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
180.5	55.0	Soil	S	95:0:5	B07BX5	<20	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
185.0	56.4	Soil	S	90:10:0	B07BX6	<25	<25	<25	<25	<25	<25	<25	<15	<15	<15	<15	<15	<15	<15	<15	ND
190.0	57.9	Soil	S	50:45:5	B07BX7	<25	<25	<25	<25	<25	<25	<25	<15	<15	<15	<15	<15	<15	<15	<15	ND
195.0	59.4	Soil	S	50:25:25	B07BX8	<15	<15	<15	<15	<15	<15	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND
200.0	61.0	Soil	S	50:25:25	B07BX9	<10 (c)	<10	<10	32	<10	101	<10	<5	<5	6	<5	<5	<5	<5	<5	ND
200.0	61.0	Water	TB	N/A	B07CT4	32	<0.5	<0.5	459	<2 (g)	915	<2	<0.5	0.6	<0.5 (g)	1.1	<0.5	<0.5	<0.5	<0.5	ND

Sample/Subsample Methods

DB = Drive Barrel
CB = Core Bore
S = Scoopula
PJ = Plastic Jug
TB = Teflon Bailor

Lab Notes

(1) Power outage - sample rerun - required larger dilution volume.
(2) Turbid sample.

Analysis Notes

(a) Trace (-8), but below LDL's.
(b) Slightly below LDL's.
(c) -4 observed, but below LDL's.
(d) -12 observed, but below LDL's.
(e) -1.6 observed, but below LDL's.

(f) 1:200 dilution necessary for CCM analysis.
(g) -10 observed, but below LDL's.
(h) -18 observed, but below LDL's.
(i) -6 observed, but below LDL's.
(j) Non-calibrated suspect.

(k) -5 observed, but below LDL's.
(l) -8 observed, but below LDL's.
(m) -2 observed, but below LDL's.
(n) -0.3 observed, but below LDL's.
(o) -0.4 observed, but below LDL's.

Analytical Results

VOLATILE ORGANIC COMPOUNDS

299-W15-252 (VEX-7)

Depth (ft)	Sample Matrix	Drill / Sample Method	Sub- sample Method	Approx. %Fine %Coarse %Rock	Lab Z #	HELS Sample Number	Meth- ylene Chloride (ppb)	trans-1,2- Dichloro- ethylene (ppb)	1,1- Dichloro- ethane (ppb)	cis-1,2- Dichloro- ethylene (ppb)	Chloro- form (ppb)	1,1,1-Tri- chloro- ethane (ppb)	CC14 (ppb)	1,2-Di- chloro- ethane (ppb)	Benzene (ppb)	Trichloro- ethylene (ppb)	Toluene (ppb)	Tetra- chloro- ethylene (ppb)	Ethyl- benzene (ppb)	M+P- Xylene (ppb)	O-Xylene (ppb)	Acetone (ppb)	n-Butyl Benzene (ppb)	
4.5	1.4	Soil	DB	100:0:0		B01PH2	<40	<10	<20	<10	<20	<20	<20 (a)	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
9.5	2.9	Soil	DB	100:0:0		B01PH3	<30	<10	<15	<10	<15	<15	<15 (b)	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
15.0	4.6	Soil	DB	10:90:0		B01PG5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND	ND
20.0	6.1	Soil	DB	90:10:0		B01PG4	<30	<10	<15	<10	<15	<15	15	<10	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
25.0	7.6	Soil	DB	NR		B01PG6	<10	<5	<10	<5	<10	<10	<10 (e)	<10	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
30.6	9.3	Soil	DB	NR		B01PG7	<15	<10	<15	<10	<15	<15	<15 (e)	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
35.0	10.7	Soil	DB	NR		B01PG8	<10	<5	<10	<5	<10	<10	<10 (d)	<10	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
39.5	12.0	Soil	DB	NR		B01PG9	<15	<10	<15	<10	<15	<15	57	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
44.7	13.6	Soil	DB	90:10:0		B01PH1	NR	<30	<30	<30	<30	<30	<30 (e)	<30	<15	<10	<10	<10	<10	<10	<10	<10	ND	ND
49.5	15.1	Soil	DB	100:0:0		B07BD5	<20	<20	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
55.0	16.8	Soil	DB	20:80:0		B07BD6	<40	<20	<20	<20	<20	<20	<20 (f)	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
59.5	18.1	Soil	DB	NR		B07BD7	<30	<15	<30	<15	<30	<30	<30 (e)	<30	<15	<10	<10	<10	<10	<10	<10	<10	ND	ND
65.5	20.0	Soil	DB	NR		B07BD8	<40	<20	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
70.5	21.5	Soil	DB	NR		B07BD9	<20	<10	<20	<10	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
75.5	23.0	Soil	DB	NR		B07BF0	<20	<10	<20	<10	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
80.2	24.4	Soil	DB	NR		B07BF1	<35	<20	<35	<20	<35	<35	62	<35	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
85.5	26.1	Soil	DB	NR		B07BF2	<30	<15	<30	<15	<30	<30	84	<35	<20	<20	<20	<20	<20	<20	<20	<20	ND	ND
89.7	27.3	Soil	DB	NR		B07BF3	<20	<10	<20	<10	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
96.0	29.3	Soil	DB	NR		B07BF4	<30	<15	<30	<15	<30	<30	<30 (a)	<30	<15	<10	<10	<10	<10	<10	<10	<10	ND	ND
105.0	30.3	Soil	DB	100:0:0		B07BF5	<20	<10	<20	<10	<20	<20	101	<30	<15	<10	<10	<10	<10	<10	<10	<10	ND	ND
109.5	32.0	Soil	DB	80:20:0		B07BF6	<30	<15	<30	<15	<30	<30	<30 (b)	<30	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
115.0	35.1	Soil	DB	50:50:0		B07BF7	<15	<10	<15	<10	<15	<15	<15	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
121.3	37.0	Soil	DB	60:40:0		B07BF8	<10	<10	<15	<10	<15	<15	<15	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
126.5	38.6	Soil	DB	NR		B07BF9	<25	<25	<25	<25	<25	<25	<25 (b)	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
129.5	39.5	Soil	DB	100:0:0		B07BG0	<25	<25	<25	<25	<25	<25	74	<25	<15	<15	<15	<15	<15	<15	<15	<15	ND	ND
134.8	41.1	Soil	DB	100:0:0		B07BG1	<20	<20	<20	<20	<20	<20	307	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
142.1	43.3	Soil	DB	90:10:0		B07BG2	NR	<30	<30	<30	<30	<30	140	<30	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
145.5	44.3	Soil	DB	75:25:0		B07BG3	NR	<68	<68	<68	<68	<68	53	<20	<15	<15	<15	<15	<15	<15	<15	<15	ND	ND
149.7	45.6	Soil	DB	50:50:0		B07BG4	NR	<35	<35	<35	<35	<35	<35	<35	<15	<15	<15	<15	<15	<15	<15	<15	ND	ND
154.5	47.1	Soil	DB	50:50:0		B07BG5	<50	<25	<25	<25	<25	<25	56	<25	<15	<15	<15	<15	<15	<15	<15	<15	ND	ND
159.5	48.6	Soil	DB	10:90:0		B07BG6	NR	<30	<30	<30	<30	<30	281	<30	<15	<15	<15	<15	<15	<15	<15	<15	ND	ND
164.5	50.1	Soil	DB	0:100:0		B07BG7	NR	<35	<35	<35	<35	<35	205	<35	<15	<15	<15	<15	<15	<15	<15	<15	ND	ND
164.5	50.1	Soil	DB	0:100:0		B07BG8	NR	<30	<30	<30	<30	<30	177	<35	<15	<15	<15	<15	<15	<15	<15	<15	ND	ND
172.0	52.4	Soil	DB	10:90:0		B07BG9	<20	<10	<20	<10	<20	<20	<20 (a)	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
175.5	53.5	Soil	DB	NR		B07BH0	<20	<20	<20	<20	<20	<20	116	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
182.0	55.5	Soil	DB	50:50:0	(1)	B07BH1	<30	<15	<15	<15	<15	<15	<15	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
185.1	56.4	Soil	DB	100:0:0		B07BH2	<20	<20	<20	<20	<20	<20	159	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
191.7	58.4	Soil	DB	100:0:0		B07BH3	<25	<15	<15	<15	<15	<15	<25 (f)	<25	<15	<15	<15	<15	<15	<15	<15	<15	ND	ND
195.8	59.7	Soil	DB	100:0:0		B07BH4	<15	<15	<15	<15	<15	<15	<15	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
199.5	60.8	Soil	DB	100:0:0		B07BH5	68	<30	<30	<30	<30	<30	130	<35	<20	<20	<20	<20	<20	<20	<20	<20	ND	ND
206.1	62.8	Soil	DB	100:0:0		B07BH6	<30	<30	<30	<30	<30	<30	<30 (m)	<30	<15	<15	<15	<15	<15	<15	<15	<15	ND	ND
211.1	64.3	Soil	DB	95:5:0		B07C87	<25	<25	<25	<25	<25	<25	<25	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
214.7	65.4	Soil	DB	95:5:0		B07C88	<40	<20	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
220.2	67.1	Soil	HT	100:0:0		B07C89	<20	<15	<15	<15	<15	<15	<15	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
225.6	68.8	Soil	HT	95:5:0		B07C90	<20	<20	<20	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND	ND
227.4	69.3	Water	HT	N/A		B07BSS	<5	<0.5	<2	<0.5	46	<2	1130 (n)	<2	<0.5	2.2	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	ND

F.1-8

Sample/Subsample Methods

DB = Drive Barrel

CB = Core Borer

S = Scoopula

TB = Teflon Bailor

Lab Notes

(1) No tare weight - so weight was estimated.

(2) Turbid sample.

ND = Not Detected

NR = Not Recorded

N/A = Not Applicable

Analysis Notes

(a) -6 observed, but below LDL's.

(b) -2

(c) None observed.

(d) -7 observed, but below LDL's.

(e) -18 observed, but below LDL's.

(f) -16

(g) -25 observed.

(h) -9 observed, but below LDL's.

(i) -12 observed, but below LDL's.

(j) -11 observed, but below LDL's.

(k) -10 observed, but below LDL's.

(l) -8 observed, but below LDL's.

(m) -24 observed, but below LDL's.

(n) 1:200 dilution necessary for CCM Analysis

Analytical Results VOLATILE ORGANIC COMPOUNDS 299-W18-96 (ID-4)

Depth (ft)	Sample Matrix	Drill / Sample Method	Sub- sample Method	Approx. Lab % Fine: $\geq$ 60 μ m % Coarse: $\geq$ 60 μ m % Rock	HEIS Sample Number	Meth- ylene Chloride (ppb)	trans-1,2- Dichloro- ethylene (ppb)	1,1- Dichloro- ethane (ppb)	cis-1,2- Dichloro- ethylene (ppb)	Chloro- form (ppb)	1,1,1-Tri- chloro- ethane (ppb)	CC14 (ppb)	1,2-Di- chloro- ethane (ppb)	Benzene (ppb)	Trichloro- ethylene (ppb)	Toluene (ppb)	Tetra- chloro- ethylene (ppb)	Ethyl- benzene (ppb)	M+P- Xylene (ppb)	O-Xylene (ppb)	n-Butyl Benzene (ppb)
84.0	25.6	Sed	SB	NR	B01NW7	<300	<10	<50	<10	<50	<50	89	<50	<10	<10	<10	<10	<10	<10	<10	ND
86.5	26.4	Sed	SB	NR	B01NX1	<400	<25	<70	<25	<70	<70	79	<70	<25	<25	94	<25	<25	<25	<25	ND
86.5	26.4	Sed	SB	NR	B01NX3	<250	<15	<50	<15	<50	<50	93	<50	<15	<15	<15	<15	<15	<15	<15	ND
90.0	27.4	Sed	DB	NR	B01NW8	<150	<10	<25	<10	<25 (a)	<25 (a)	332	<25	<10	<10	<10	<10	<10	<10	<10	ND
90.0	27.4	Sed	DB	NR	B01NW9	<150	<30	<30	<30	<30 (b)	<30 (b)	440	<30	<15	<15	<15	<15	<15	<15	<15	ND
92.4	28.1	Sed	SB	NR	B01NX5	<100	<10	<25	<10	<25	<25	99	<25	<10	<10	<10	<10	<10	<10	<10	ND
92.4	28.1	Sed	SB	NR	B01NX7	<100	<10	<25	<10	<25	<25	56	<25	<10	<10	<10	<10	<10	<10	<10	ND
95.0	29.0	Sed	DB	NR	B01NX8	<100	<10	<25	<10	<25	<25	124	<25	<10	<10	<10	<10	<10	<10	<10	ND
98.0	29.9	Sed	DB	NR	B01NY1	<150	<10	<25	<10	<25	<25	111	<25	<10	<10	<10	<10	<10	<10	<10	ND
98.0	29.9	Sed	DB	NR	B01NY2	150.0	<10	<25	<10	<25	<25	193	<25	<10	<10	<10	<10	<10	<10	<10	ND
100.5	30.6	Sed	SB	NR	B01NX9	<100	<10	<25	<10	<25	<25	242	<25	<10	<10	<10	<10	<10	<10	<10	ND
100.5	30.6	Sed	SB	NR	B01NY0	<70	<10	<20	<10	<20	<20	177	<20	<10	<10	<10	<10	<10	<10	<10	ND
104.0	31.7	Sed	DB	NR	B01NY3	<100	<10	<20	<10	<20	<20	140	<20	<10	<10	<10	<10	<10	<10	<10	ND
110.2	33.6	Sed	DB	NR	B01NY4	<100	<10	<20	<10	<20	<20	20 (e)	<20	<10	<10	<10	<10	<10	<10	<10	ND
110.2	33.6	Sed	DB	NR	B01NY5	<70	<10	<15	<10	<15	<15	12	<15	<10	<10	<10	<10	<10	<10	<10	ND
116.0	35.4	Sed	DB	NR	B01NY6	<40	<5	<10	<5	<10	<10	15 (e)	<15	<5	<5	<5	<5	<5	<5	<5	ND
119.0	36.3	Sed	DB	NR	B01NY9	<40	<5	<15	<5	<15	<15	15 (f)	<15	<5	<5	<5	<5	<5	<5	<5	ND
120.0	36.6	Sed	SB	NR	B01NY7	<40	<5	<15	<5	<15	<15	15 (f)	<15	<5	<5	<5	<5	<5	<5	<5	ND
120.0	36.6	Sed	SB	NR	B01NY8	<70	<5	<15	<5	<15	<15	15 (f)	<15	<5	<5	<5	<5	<5	<5	<5	ND
123.5	37.6	Sed	SB	NR	B01NZ1	<40	<5	<10	<5	<10	<10	41	<10	<5	<5	<5	<5	<5	<5	<5	ND
123.5	37.6	Sed	SB	NR	B01NZ2	<70	<5	<15	<5	<15	<15	52	<15	<5	<5	<5	<5	<5	<5	<5	ND
125.5	38.3	Sed	SB	NR	B01P91	61.0	<5	<10	<5	<10	<10	41	<10	<5	<5	<5	<5	<5	<5	<5	ND
125.5	38.3	Sed	SB	NR	B01P92	<50	<5	<10	<5	<10	<10	68	<10	<5	<5	<5	<5	<5	<5	<5	ND
125.5	38.3	Sed	SB	NR	B01P93	<75	<5	<15	<5	<15	<15	15 (g)	<15	<5	<5	<5	<5	<5	<5	<5	ND
125.5	38.3	Sed	SB	NR	B01P94	85.0	<5	<15	<5	<15	<15	15 (g)	<15	<5	<5	<5	<5	<5	<5	<5	ND
129.0	39.3	Sed	DB	NR	B01NZ9	<100	<10	<20	<10	<20	<20	65	<20	<10	<10	<10	<10	<10	<10	<10	ND
129.0	39.3	Sed	DB	NR	B01P00	<140	<10	<30	<10	<30	<30	43	<30	<10	<10	<10	<10	<10	<10	<10	ND
129.0	39.3	Sed	DB	NR	B01P01	<70	<5	<15	<5	<15	<15	28	<15	<5	<5	<5	<5	<5	<5	<5	ND
129.0	39.3	Sed	DB	NR	B01P02	<50	<5	<10	<5	<10	<10	39	<10	<5	<5	<5	<5	<5	<5	<5	ND
130.5	39.8	Sed	SB	NR	B01NZ5	<60	<5	<15	<5	<15	<15	16	<15	<5	<5	<5	<5	<5	<5	<5	ND
130.5	39.8	Sed	SB	NR	B01NZ6	<50	<5	<10	<5	<10	<10	14	<10	<5	<5	<5	<5	<5	<5	<5	ND
130.5	39.8	Sed	SB	NR	B01NZ7	182.0	<5	<15	<5	<15	<15	15 (h)	<15	<5	<5	<5	<5	<5	<5	<5	ND
134.5	41.0	Sed	DB	NR	B01NZ8	<100	<10	<20	<10	<20	<20	20	<20	<10	<10	<10	<10	<10	<10	<10	ND
134.5	41.0	Sed	DB	NR	B01P05	<120	<10	<25	<10	<25	<25	111	<25	<10	<10	<10	<10	<10	<10	<10	ND
134.5	41.0	Sed	DB	NR	B01P06	<100	<15	<40	<15	<40	<40	786	<40	<15	<15	<15	<15	<15	<15	<15	ND
136.5	41.6	Sed	SB	NR	B01P03	<100	<10	<20	<10	<20	<20	759	<20	<10	<10	<10	<10	<10	<10	<10	ND
136.5	41.6	Sed	SB	NR	B01P04	<70	<5	<15	<5	<15	<15	334	<15	<5	<5	<5	<5	<5	<5	<5	ND
138.5	42.2	Sed	SB	NR	B01NZ3	<100	<10	<30	<10	<30	<30	494	<30	<10	<10	<10	<10	<10	<10	<10	ND
138.5	42.2	Sed	SB	NR	B01NZ4	<70	<5	<15	<5	<15	<15	861	<15	<5	<5	<5	<5	<5	<5	<5	ND
143.8	43.8	Sed	SB	NR	B01P95	<100	<10	<25	<10	<25	<25	714	<25	<10	<10	<10	<10	<10	<10	<10	ND
143.8	43.8	Sed	SB	NR	B01P96	<100	<10	<20	<10	<20	<20	626	<20	<10	<10	<10	<10	<10	<10	<10	ND
143.8	43.8	Sed	SB	NR	B01P98	<75	<5	<15	<5	<15	<15	25 (m)	<15	<5	<5	<5	<5	<5	<5	<5	ND
144.5	44.0	Sed	SB	NR	B01P80	<100	<10	<25	<10	<25	<25	28	<25	<10	<10	<10	<10	<10	<10	<10	ND
144.5	44.0	Sed	SB	NR	B01P81	<100	<10	<20	<10	<20	<20	33	<20	<10	<10	<10	<10	<10	<10	<10	ND
146.5	44.7	Sed	SB	NR	B01P99	<100	<10	<20	<10	<20	<20	33	<20	<10	<10	<10	<10	<10	<10	<10	ND
146.5	44.7	Sed	SB	NR	B01P82	<75	<5	<15	<5	<15	<15	33	<15	<5	<5	<5	<5	<5	<5	<5	ND

F.1-9

(k) -8 observed, but below LDL's.
 (l) -17 observed, but below LDL's.
 (m) -24 observed, but below LDL's.
 (n) -3 observed, but below LDL's.

(i) -7 observed, but below LDL's.
 (j) -2 observed, but below LDL's.
 (k) Possibly n-Butyl Benzene.
 (l) Non-calibrated estimate.
 (m) -5 observed, but below LDL's.

(a) -16 observed, but below LDL's.
 (b) -21 observed, but below LDL's.
 (c) -10 observed, but below LDL's.
 (d) -4 observed, but below LDL's.
 (e) -6 observed, but below LDL's.

Analysis Notes

Lab Notes

(1) Possibly clay.

ND = Not Detected

NR = Not Reported

Sample/Subsample Methods

DB = Drive Barrel

SB = Split-Barrel

CB = Core borer

S = Scoopula

299-W18-174 (ID-5)

VOLATILE ORGANIC COMPOUNDS

Analytical Results

Depth (ft)	Sample Matrix	Drill / Sample Method	Sub- Sample Method	Approx. Lab %Fine: Z %Roc: g	HEIS Sample Number	Meth- ylene Chloride (ppb)	trans-1,2- Dichloro- ethylene (ppb)	1,1- Dichloro- ethane (ppb)	cis-1,2- Dichloro- ethylene (ppb)	Chloro- form (ppb)	1,1,1-Tri- chloro- ethane (ppb)	CC14 (ppb)	1,2-Di- chloro- ethane (ppb)	Benzene (ppb)	Trichloro- ethylene (ppb)	Toluene (ppb)	Tetra- chloro- ethylene (ppb)	Ethyl- benzene (ppb)	M+P- Xylene (ppb)	O-Xylene (ppb)	Methyl Ethyl Ketone (ppb)	Methyl Iso Butyl Ketone (ppb)
53.0	16.2	Sed	DB	S	100:0:0	B01PF0	<60	<10	<10	<10	<30	31	<30	<10	<10	<10	<10	<10	<10	<10	<10	ND
53.0	16.2	Sed	DB	CB	100:0:0	B01PF1	<80	<10	<10	<10	<40	<40 (b)	<40	<10	<10	<10	<10	<10	<10	<10	<10	-165 (a)
56.0	17.1	Sed	SB	SB	100:0:0	B01PH4	<80	<15	<15	<15	<40	41	<40	<15	<15	<15	<15	<15	<15	<15	<15	ND
56.0	17.1	Sed	SB	CB	100:0:0	B01PH5	<80	<15	<15	<15	<40	95	<40	<15	<15	<15	<15	<15	<15	<15	<15	ND
57.5	17.5	Sed	DB	S	see note (1)	B01PK8	<30	<5	<10	<10	<10	75	<10	<5	<5	<5	<5	<5	<5	<5	<5	ND
57.5	17.5	Sed	DB	CB	100:0:0	B01PK9	<30	<5	<15	<15	<15	143	<15	<5	<5	<5	<5	<5	<5	<5	<5	ND
61.0	18.6	Sed	DB	S	NR	B01PL0	<30	<5	<15	<15	<15	83	<15	<5	<5	<5	<5	<5	<5	<5	<5	ND
61.0	18.6	Sed	DB	CB	100:0:0	B01PL1	<30	<5	<15	<15	<15	126	<15	<5	<5	<5	<5	<5	<5	<5	<5	ND
65.8	20.0	Sed	DB	S	100:0:0	B01PL2	<30	<5	<15	<15	<15	69	<15	<5	<5	<5	<5	<5	<5	<5	<5	ND
66.0	20.1	Sed	DB	CB	100:0:0	B01PL3	<40	<10	<10	<10	<20	150	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
71.3	21.7	Sed	DB	S	100:0:0	B01PF2	<30	<5	<15	<15	<15	52	<15	<5	<5	<5	<5	<5	<5	<5	<5	ND
71.5	21.8	Sed	DB	CB	100:0:0	B01PF3	<30	<5	<15	<15	<15	349	<15	<5	<5	<5	<5	<5	<5	<5	<5	ND
74.5	22.7	Sed	SB	SB	100:0:0	B01PH6	<50	<10	<15	<15	<25	151	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND
74.5	22.7	Sed	SB	CB	100:0:0	B01PH7	<70	<15	<15	<15	<35	337	<35	<15	<15	<15	<15	<15	<15	<15	<15	ND
75.8	23.1	Sed	DB	S	see note (2)	B01PL4	<20	<5	<10	<10	<10	67	<10	<5	<5	<5	<5	<5	<5	<5	<5	ND
75.8	23.1	Sed	DB	CB	100:0:0	B01PL5	<20	<5	<10	<10	<10	73	<10	<5	<5	<5	<5	<5	<5	<5	<5	ND
80.5	24.5	Sed	DB	S	95:5:0	B01PL6	<80	<15	<15	<15	<40	56	<40	<15	<15	<15	<15	<15	<15	<15	<15	ND
86.1	26.2	Sed	DB	CB	90:10:0	B01PL7	<80	<15	<15	<15	<40	51	<40	<15	<15	<15	<15	<15	<15	<15	<15	ND
86.6	26.4	Sed	DB	S	100:0:0	B01PL8	<70	<10	<15	<15	<35	35	<35	<10	<10	<10	<10	<10	<10	<10	<10	ND
90.5	27.6	Sed	DB	CB	100:0:0	B01PL9	<50	<10	<10	<10	<20	60	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
90.5	27.6	Sed	DB	S	80:10:10 (2)	B01PF4	<40	<10	<10	<10	<20	<20 (g)	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
93.5	28.5	Sed	SB	S	80:10:10 (2)	B01PF5	<50	<10	<10	<10	<20	<25 (e)	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND
93.5	28.5	Sed	SB	CB	10:90:0	B01PH9	(h)	<15	<30	<30	<30 (h)	<30 (h)	<30	<15	<15	<15	<15	<15	<15	<15	<15	ND
96.0	29.2	Sed	DB	S	80:20:0	B01PM0	(h)	<15	<30	<30	<30 (h)	<30 (h)	<30	<15	<15	<15	<15	<15	<15	<15	<15	ND
96.0	29.2	Sed	DB	CB	80:20:0	B01PM1	(h)	<20	<40	<40	<40 (h)	<40 (h)	<40	<15	<15	<15	<15	<15	<15	<15	<15	ND
101.1	30.8	Sed	DB	S	see note (1)	B01PF6	<20	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND
101.1	30.8	Sed	DB	CB	see note (1)	B01PF7	<20	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ND
105.0	32.0	Sed	DB	S	80:20:0	B01PM2	<40	<10	<10	<10	<20	<20 (f)	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
105.0	32.0	Sed	DB	CB	80:20:0	B01PM3	<50	<10	<10	<10	<25	<25 (g)	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND
111.5	34.0	Sed	DB	S	100:0:0	B01PM4	<100 (e)	<15	<15	<15	<30	<30 (g)	<30	<15	<15	<15	<15	<15	<15	<15	<15	ND
111.5	34.0	Sed	DB	CB	100:0:0	B01PM5	<150 (g)	<15	<15	<15	<30	<30 (g)	<30	<15	<15	<15	<15	<15	<15	<15	<15	ND
114.2	34.8	Sed	SB	S	100:0:0	B01P10	<200 (g)	<10	<10	<10	<20	103	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
114.2	34.8	Sed	SB	CB	100:0:0	B01P11	<200 (g)	<10	<10	<10	<20	<20 (g)	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
115.8	35.3	Sed	DB	S	100:0:0	B01PM6	<225 (g)	<10	<10	<10	<20	498	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
116.1	35.4	Sed	DB	CB	100:0:0	B01PM7	<225 (g)	<10	<10	<10	<20	34	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
118.5	36.1	Sed	SB	S	50:50:0	B01P12	<150 (g)	<10	<10	<10	<20	230	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
118.5	36.1	Sed	SB	CB	50:50:0	B01P13	<120	<5	<10	<10	<15	68	<10	<10	<10	<10	<10	<10	<10	<10	<10	ND
122.1	37.2	Sed	DB	S	100:0:0	B01PF8	<40	<10	<10	<10	<20	20	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
122.1	37.2	Sed	DB	CB	100:0:0	B01PN4	<100 (g)	<10	<10	<10	<20	26	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
122.2	37.2	Sed	DB	S	95:0:5	B01PF9	<50	<10	<10	<10	<25	427	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND
124.9	38.1	Sed	DB	CB	95:0:5	B01PN5	<150 (g)	<15	<15	<15	<40	357	<40	<15	<15	<15	<15	<15	<15	<15	<15	ND
124.9	38.1	Sed	SB	S	80:0:20	B01PN4	<100 (g)	<10	<10	<10	<25	789	<25	<10	<10	<10	<10	<10	<10	<10	<10	ND
124.9	38.1	Sed	SB	CB	80:0:20	B01PN2	<100 (g)	<10	<10	<10	<15	796	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND
124.9	38.1	Sed	SB	S	95:0:5	B01PN5	<100 (g)	<15	<15	<15	<25	1247	<25	<15	<15	<15	<15	<15	<15	<15	<15	ND
124.9	38.1	Sed	SB	CB	95:0:5	B01PN3	<100 (g)	<15	<15	<15	<25	890	<25	<15	<15	<15	<15	<15	<15	<15	<15	ND
126.8	38.6	Sed	DB	S	40:60:0	B01PG0	<40	<10	<10	<10	<20	749	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
127.1	38.7	Sed	DB	CB	100:0:0	B01PG1	<40	<10	<10	<10	<20	6561 (f)	<20	<10	<10	<10	<10	<10	<10	<10	<10	ND
128.9	39.3	Sed	SB	S	100:0:0	B01PG6	<200 (g)	<5	<15	<15	<63 (g)	3088 (f)	<15	<10	<10	<10	<10	<10	<10	<10	<10	ND
128.9	39.3	Sed	SB	CB	100:0:0	B01P77	<200 (g)	<10	<10	<10	<95 (g)	4124 (f)	<10	<20	<20	<20	<20	<20	<20	<20	<20	ND
130.4	39.7	Sed	DB	S	50:50:0	B01PG2	<40	<10	<10	<10	<50	374	<50	<10	<10	<10	<10	<10	<10	<10	<10	ND
131.0	39.9	Sed	DB	CB	50:50:0	B01PG3	<60	<10	<10	<10	<135	317	<135	<10	<10	<10	<10	<10	<10	<10	<10	ND

Analytical Results VOLATILE ORGANIC COMPOUNDS 299-W18-174 (ID-5)

Sample/Subsample Method	Lab Notes	Analytical Results	Analysis Notes
DB = Drive Barrel SB = Split-Barrel CB = Core Borer S = Scoopula	(1) Too much soil added / turbid. (2) Turbid (3) Possibly fines. Too much sample (soil). ND = Not Detected NR = Not Reported N/A = Not Applicable		
			(a) None observed. (c) High CH3Cl2, benzene, and toluene in purge & trap grade Methanol. (f) ~24 observed, but below LDL's. (g) Observed higher organic impurities in this Methanol batch. (Reordered) (h) 200:1 dilution required.
			(b) Problem's with purge & trap grade Methanol for 03/17/93 batch. (i) ~13 observed, but below LDL's. (j) ~15 observed, but below LDL's. (k) ~19 observed, but below LDL's. (l) ~2 observed, but below LDL's. (m) MEK impurity in purge & trap Methanol - 1/2 amount observed in sample.
			(e) Non-calibrated estimate. Suspect. (b) ~28 observed, but below LDL's. (c) ~8 observed, but below LDL's. (d) ~4 observed, but below LDL's. (e) ~6 observed, but below LDL's. (f) ~3 observed, but below LDL's. (g) ~18 observed, but below LDL's.

APPENDIX F.2
CHEMICAL ANALYSES

Depth (ft)	Depth (m)	HHS Sample Number	Fluoride (F) (µg/Kg)	Chloride (Cl) (µg/Kg)	Nitrate Ion (NO3) (µg/Kg)	Nitrite Ion (NO2) (µg/Kg)	Bromide (Br) (µg/Kg)	Phosphate Ion (PO4) (µg/Kg)	Sulfate (SO4) (µg/Kg)	Cyanide (CN) (µg/Kg)	Mercury (Hg) (µg/Kg)	Lead (Pb) (µg/Kg)	o-cresol (µg/Kg)	m-cresol (µg/Kg)	p-cresol (µg/Kg)	Dodecane (µg/Kg)	Dodecane (µg/Kg)
Limit of Detection =>			200	400	400	400	300	800	1000	3000	400	300	660	660	660	660	660
84.0	25.6	B01NW7	4700	22000	4400000	1900	ND	ND	22000	ND	ND	3300	ND	ND	ND	ND	ND
86.5	26.4	B01NX1	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
86.5	26.4	B01NX3	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
90.0	27.4	B01NW9	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
92.4	28.1	B01NX5	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
95.0	29.0	B01NX8	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
98.0	29.9	B01NY1	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
100.5	30.6	B01NX9	1000	6300	990000	ND	ND	ND	8000	ND	ND	4900	ND	ND	ND	ND	ND
104.0	31.7	B01NY3	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
110.2	33.6	B01NY4	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
116.0	35.4	B01NY6	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
119.0	36.3	B01NY9	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
120.0	36.6	B01NY7	1000	3600	12000	ND	ND	ND	19000	ND	ND	2900	ND	ND	ND	ND	ND
125.5	38.3	B01P91	900	3400	6000	ND	ND	ND	18000	ND	ND	1800	ND	ND	ND	ND	ND
125.5	38.3	B01P93	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
129.0	39.3	B01NZ9	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
129.0	39.3	B01P00	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
130.5	39.8	B01NZ5	700	1800	2400	ND	ND	ND	8000	ND	ND	3200	ND	ND	ND	ND	ND
130.5	39.8	B01NZ6	700	1800	1800	ND	600	ND	8000	ND	ND	6100	ND	ND	ND	ND	ND
134.5	41.0	B01P05	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
136.5	41.6	B01P03	300	900	1200	ND	ND	ND	3000	ND	ND	12000	ND	ND	ND	ND	ND
138.5	42.2	B01NZ3	Data unavailable at this time.														
143.8	43.8	B01P95	Data unavailable at this time.														
144.5	44.0	B01PB1	Data unavailable at this time.														
146.5	44.7	B01P99	Data unavailable at this time.														

Depth (ft)	Depth (m)	HHS Sample Number	Tetra- decanoic (µg/Kg)	Naph- thalenoic (µg/Kg)	Phenyl- chloro- phenol (µg/Kg)	Phenol (µg/Kg)	Triphenyl Phosphine (µg/Kg)	2-Phenoxy- phenol (µg/Kg)	Phenol, d6 (µg/Kg)	Nitro- benzene (µg/Kg)	Phenyl- Biphenyl (µg/Kg)	2,4,6- Tribromo- phenol (µg/Kg)	Terphenyl d14 (µg/Kg)	Antimony (Sb) (µg/Kg)	Barium (Ba) (µg/Kg)	Beryllium (Be) (µg/Kg)	Cadmium (Cd) (µg/Kg)
Limit of Detection =>			660	660	3300	660	660	660	660	660	660	660	660	20000	20000	300	1000
84.0	25.6	B01NW7	ND	ND	ND	ND	ND	5900	6300	2900	2900	4900	3400	ND	87000	400	ND
86.5	26.4	B01NX1	ND	ND	ND	ND	ND	5900	6000	2900	2600	3800	3100	.	.	.	.
86.5	26.4	B01NX3	ND	ND	ND	ND	ND	7100	7000	3300	3100	4600	3200	.	.	.	.
90.0	27.4	B01NW9	ND	ND	ND	ND	ND	6400	6200	3000	2800	4200	3100	.	.	.	.
92.4	28.1	B01NX5	ND	ND	ND	ND	ND	8700	8400	4100	3600	5900	3900	.	.	.	.
95.0	29.0	B01NX8	ND	ND	ND	ND	ND	7500	7300	3700	3100	4300	3500	.	.	.	.
98.0	29.9	B01NY1	ND	ND	ND	ND	ND	7300	7000	3400	3000	4600	3500	.	.	.	.
100.5	30.6	B01NX9	ND	ND	ND	ND	ND	6100	6200	3000	2900	4900	3300	ND	73000	400	ND
104.0	31.7	B01NY3	ND	ND	ND	ND	ND	7200	6800	3200	2900	4400	3000	.	.	.	.
110.2	33.6	B01NY4	ND	ND	ND	ND	ND	7200	7300	3600	3200	5100	3200	.	.	.	.
116.0	35.4	B01NY6	ND	ND	ND	ND	ND	7300	6900	3300	2900	4200	3000	.	.	.	.
119.0	36.3	B01NY9	ND	ND	ND	ND	ND	6000	6300	3100	2900	4600	3200	.	.	.	.
120.0	36.6	B01NY7	ND	ND	ND	ND	ND	6700	6900	3400	3100	4900	3200	ND	87000	300	ND
125.5	38.3	B01P91	ND	ND	ND	ND	ND	6800	7200	3400	3100	4800	3100	ND	70000	ND	ND
125.5	38.3	B01P93	ND	ND	ND	ND	ND	7200	7200	3600	3300	5400	3300	.	.	.	.
129.0	39.3	B01NZ9	ND	ND	ND	ND	ND	6700	7100	3400	3200	4900	3300	.	.	.	.
129.0	39.3	B01P00	ND	ND	ND	ND	ND	7400	7600	3600	3300	5300	3400	.	.	.	.
130.5	39.8	B01NZ5	ND	ND	ND	ND	ND	6200	6600	3300	3000	4600	3300	ND	86000	300	ND
130.5	39.8	B01NZ6	ND	ND	ND	ND	ND	7000	7200	3600	3300	5200	3200	ND	84000	400	ND
134.5	41.0	B01P05	ND	ND	ND	ND	ND	7300	7600	3600	3300	5300	3400	.	.	.	.
136.5	41.6	B01P03	ND	ND	ND	ND	ND	8100	8400	3900	3700	6100	3900	ND	110000	600	ND
138.5	42.2	B01NZ3	Data unavailable at this time.														
143.8	43.8	B01P95	Data unavailable at this time.														
144.5	44.0	B01PB1	Data unavailable at this time.														
146.5	44.7	B01P99	Data unavailable at this time.														

Depth (ft)	Depth (m)	HHS Sample Number	Calcium (Ca) (µg/Kg)	Chromium (Cr) (µg/Kg)	Cobalt (Co) (µg/Kg)	Copper (Cu) (µg/Kg)	Iron (Fe) (µg/Kg)	Magnesium (Mg) (µg/Kg)	Manganese (Mn) (µg/Kg)	Nickel (Ni) (µg/Kg)	Potassium (K) (µg/Kg)	Silver (Ag) (µg/Kg)	Sodium (Na) (µg/Kg)	Tin (Sn) (µg/Kg)	Vanadium (V) (µg/Kg)	Zinc (Zn) (µg/Kg)
Limit of Detection =>			10000	2000	2000	2000	2000	10000	1000	3000	30000	2000	30000	10000	3000	1000
84.0	25.6	B01NW7	ND	12000	9000	16000	ND	5000000	420000	14000	1400000	ND	1300000	ND	54000	39000
86.5	26.4	B01NX1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
86.5	26.4	B01NX3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
90.0	27.4	B01NW9	.	.	.	.	.	.	.	.	.	.	.	.	.	.
92.4	28.1	B01NX5	.	.	.	.	.	.	.	.	.	.	.	.	.	.
95.0	29.0	B01NX8	.	.	.	.	.	.	.	.	.	.	.	.	.	.
98.0	29.9	B01NY1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
100.5	30.6	B01NX9	8600000	13000	7000	13000	ND	5300000	330000	12000	2000000	ND	170000	ND	30000	37000
104.0	31.7	B01NY3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
110.2	33.6	B01NY4	.	.	.	.	.	.	.	.	.	.	.	.	.	.
116.0	35.4	B01NY6	.	.	.	.	.	.	.	.	.	.	.	.	.	.
119.0	36.3	B01NY9	.	.	.	.	.	.	.	.	.	.	.	.	.	.
120.0	36.6	B01NY7	9500000	14000	9000	14000	ND	4600000	270000	12000	900000	ND	440000	ND	57000	43000
125.5	38.3	B01P91	6300000	10000	9000	14000	ND	3800000	220000	16000	630000	ND	450000	ND	47000	31000
125.5	38.3	B01P93	.	.	.	.	.	.	.	.	.	.	.	.	.	.
129.0	39.3	B01NZ9	.	.	.	.	.	.	.	.	.	.	.	.	.	.
129.0	39.3	B01P00	.	.	.	.	.	.	.	.	.	.	.	.	.	.
130.5	39.8	B01NZ5	8600000	13000	7000	13000	ND	3800000	230000	13000	790000	ND	420000	ND	49000	36000
130.5	39.8	B01NZ6	8800000	16000	7000	13000	ND	5600000	330000	20000	1900000	ND	200000	ND	37000	42000
134.5	41.0	B01P05	.	.	.	.	.	.	.	.	.	.	.	.	.	.
136.5	41.6	B01P03	ND	17000	9000	20000	ND	7000000	330000	17000	2100000	ND	170000	ND	33000	54000
138.5	42.2	B01NZ3	Data unavailable at this time.													
143.8	43.8	B01P95	Data unavailable at this time.													
144.5	44.0	B01PB1	Data unavailable at this time.													
146.5	44.7	B01P99	Data unavailable at this time.													

ND = Not Detected

. = Not Analyzed

Depth (ft)	Depth (m)	HRIS Sample Number	Fluoride (F) (µg/Kg)	Chloride (Cl) (µg/Kg)	Nitrate Ion (NO3) (µg/Kg)	Nitrite Ion (NO2) (µg/Kg)	Bromide (Br) (µg/Kg)	Phosphate Ion (PO4) (µg/Kg)	Sulfate (SO4) (µg/Kg)	Cyanide (CN) (µg/Kg)	Mercury (Hg) (µg/Kg)	Lead (Pb) (µg/Kg)	o-cresol (µg/Kg)	m-cresol (µg/Kg)	p-cresol (µg/Kg)	Dioxins (µg/Kg)	Dibenzos (µg/Kg)
Limit of Detection =			200	400	400	400	500	800	1000	3000	400	300	600	600	600	60000	60000
53.0	16.2	B01PF1	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
56.0	17.1	B01PH5	15000	6300	250000	600	ND	1000	10000	ND	ND	6000	ND	ND	ND	ND	ND
57.5	17.5	B01PK9	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
61.0	18.6	B01PL1	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
66.0	20.1	B01PL3	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
71.5	21.8	B01PF3	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
74.5	22.7	B01PH7	3300	1000	4500	ND	ND	ND	2600	ND	ND	3300	ND	ND	ND	ND	ND
76.0	23.2	B01PL5	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
80.6	24.6	B01PL7	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
86.6	26.4	B01PL9	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
90.5	27.6	B01PF5	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
93.5	28.5	B01PH9	7900	1500	7200	500	ND	ND	5900	ND	ND	1800	ND	ND	ND	ND	ND
96.0	29.2	B01PM1	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
101.1	30.8	B01PF7	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
105.0	32.0	B01PM3	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
111.5	34.0	B01PM5	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
114.2	34.8	B01P71	7900	700	3300	ND	ND	ND	3000	ND	ND	6300	ND	ND	ND	ND	ND
116.1	35.4	B01PM7	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
118.5	36.1	B01P73	7500	600	13000	ND	ND	ND	1600	ND	ND	4100	ND	ND	ND	ND	ND
122.2	37.2	B01PF9	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
124.9	38.1	B01P75	16000	3400	8800	ND	ND	ND	7700	ND	ND	5900	ND	ND	ND	ND	ND
124.9	38.1	B01PN6	15000	3100	8100	ND	ND	ND	6900	ND	ND	11000	ND	ND	ND	ND	ND
127.1	38.7	B01PQ1	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND
128.9	39.3	B01P77	16000	2300	7500	ND	ND	ND	8300	ND	ND	4600	ND	ND	ND	ND	ND
131.0	39.9	B01PQ3	.	.	.	.	.	.	.	.	.	.	ND	ND	ND	ND	ND

Depth (ft)	Depth (m)	HRIS Sample Number	Tri-n-butyltin (TBS) (µg/Kg)	Naphthalene (NAP) (µg/Kg)	Polychlorinated biphenyls (PCB) (µg/Kg)	Phenol (µg/Kg)	Triphenyl phosphine (TPP) (µg/Kg)	2-Fluorophenol (2-FP) (µg/Kg)	Phenol, d6 (µg/Kg)	Nitrobenzene d5 (µg/Kg)	Fluorobiphenyl (FB) (µg/Kg)	2,4,6-Trichlorophenol (2,4,6-TCP) (µg/Kg)	Terphenyl, d14 (µg/Kg)	Antimony (Sb) (µg/Kg)	Barium (Ba) (µg/Kg)	Beryllium (Be) (µg/Kg)	Cadmium (Cd) (µg/Kg)
Limit of Detection =			66000	660	3300	660	660	660	660	660	660	660	660	20000	2000	300	1000
53.0	16.2	B01PF1	ND	ND	ND	48	ND	4700	4700	2400	2400	4000	3400	.	.	.	.
56.0	17.1	B01PH5	ND	ND	ND	ND	ND	4600	4800	2500	2600	3400	3400	ND	120000	700	ND
57.5	17.5	B01PK9	ND	ND	ND	ND	ND	5000	4900	2800	3100	4300	3900	.	.	.	.
61.0	18.6	B01PL1	ND	ND	ND	ND	ND	5500	5100	2800	3000	4400	3700	.	.	.	.
66.0	20.1	B01PL3	ND	ND	ND	ND	ND	5000	4800	2600	3100	4100	3300	.	.	.	.
71.5	21.8	B01PF3	ND	ND	ND	ND	ND	5500	5100	2700	3000	4600	3700	.	.	.	.
74.5	22.7	B01PH7	ND	ND	ND	ND	ND	5400	5000	2600	3200	4000	3600	ND	93000	600	ND
76.0	23.2	B01PL5	ND	ND	ND	ND	ND	5100	4800	2700	3100	4000	3900	.	.	.	.
80.6	24.6	B01PL7	ND	ND	ND	ND	ND	4900	4600	2500	2900	4000	3200	.	.	.	.
86.6	26.4	B01PL9	ND	ND	ND	ND	ND	4800	4500	2300	2700	3800	3300	.	.	.	.
90.5	27.6	B01PF5	ND	ND	ND	ND	ND	4800	4500	2500	2900	4000	3500	.	.	.	.
93.5	28.5	B01PH9	ND	ND	ND	ND	ND	5300	4900	2500	3000	4100	3300	ND	63000	500	ND
96.0	29.2	B01PM1	ND	ND	ND	ND	ND	5600	5000	2500	3000	3900	3300	.	.	.	.
101.1	30.8	B01PF7	ND	ND	ND	ND	ND	5100	4700	2300	2700	4200	3200	.	.	.	.
105.0	32.0	B01PM3	ND	ND	ND	ND	ND	4700	4600	2500	2800	4500	3200	.	.	.	.
111.5	34.0	B01PM5	ND	ND	ND	ND	ND	4800	4600	2400	2900	4100	2700	.	.	.	.
114.2	34.8	B01P71	ND	ND	ND	ND	ND	5100	4800	2600	2900	4700	3100	ND	79000	600	ND
116.1	35.4	B01PM7	ND	ND	ND	ND	ND	5100	5000	2700	2900	4700	3200	.	.	.	.
118.5	36.1	B01P73	ND	ND	ND	ND	ND	4100	3900	2100	2400	3800	2600	ND	160000	600	ND
122.2	37.2	B01PF9	ND	ND	ND	ND	ND	4600	4600	2400	2700	4500	3100	.	.	.	.
124.9	38.1	B01P75	ND	ND	ND	ND	ND	5400	5300	2800	3100	5300	3400	ND	110000	700	ND
124.9	38.1	B01PN6	ND	ND	ND	ND	ND	5500	5300	2900	3000	5200	3400	ND	110000	700	ND
127.1	38.7	B01PQ1	ND	ND	ND	ND	ND	5400	5500	2900	3200	5400	3600	.	.	.	.
128.9	39.3	B01P77	ND	ND	ND	ND	ND	5500	5500	2700	3300	4900	3200	ND	79000	500	ND
131.0	39.9	B01PQ3	ND	ND	ND	ND	ND	5000	4900	2600	2900	4400	3000	.	.	.	.

Depth (ft)	Depth (m)	HRIS Sample Number	Calcium (Ca) (µg/Kg)	Chromium (Cr) (µg/Kg)	Cobalt (Co) (µg/Kg)	Copper (Cu) (µg/Kg)	Iron (Fe) (µg/Kg)	Magnesium (Mg) (µg/Kg)	Manganese (Mn) (µg/Kg)	Nickel (Ni) (µg/Kg)	Potassium (K) (µg/Kg)	Silver (Ag) (µg/Kg)	Sodium (Na) (µg/Kg)	Tin (Sn) (µg/Kg)	Vanadium (V) (µg/Kg)	Zinc (Zn) (µg/Kg)
Limit of Detection =			10000	2000	2000	2000	2000	10000	1000	3000	30000	2000	30000	10000	3000	1000
53.0	16.2	B01PF1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
56.0	17.1	B01PH5	11000000	15000	9000	24000	21000000	6500000	430000	13000	2700000	ND	1300000	ND	40000	52000
57.5	17.5	B01PK9	.	.	.	.	.	.	.	.	.	.	.	.	.	.
61.0	18.6	B01PL1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
66.0	20.1	B01PL3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
71.5	21.8	B01PF3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
74.5	22.7	B01PH7	9500000	10000	7000	10000	18000000	4900000	340000	9000	1400000	ND	550000	ND	40000	38000
76.0	23.2	B01PL5	.	.	.	.	.	.	.	.	.	.	.	.	.	.
80.6	24.6	B01PL7	.	.	.	.	.	.	.	.	.	.	.	.	.	.
86.6	26.4	B01PL9	.	.	.	.	.	.	.	.	.	.	.	.	.	.
90.5	27.6	B01PF5	.	.	.	.	.	.	.	.	.	.	.	.	.	.
93.5	28.5	B01PH9	11000000	11000	10000	23000	23000000	5400000	270000	15000	1100000	ND	1600000	ND	52000	42000
96.0	29.2	B01PM1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
101.1	30.8	B01PF7	.	.	.	.	.	.	.	.	.	.	.	.	.	.
105.0	32.0	B01PM3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
111.5	34.0	B01PM5	.	.	.	.	.	.	.	.	.	.	.	.	.	.
114.2	34.8	B01P71	9900000	14000	7000	21000	17000000	5400000	320000	14000	1600000	ND	510000	ND	36000	41000
116.1	35.4	B01PM7	.	.	.	.	.	.	.	.	.	.	.	.	.	.
118.5	36.1	B01P73	12000000	19000	7000	16000	19000000	5900000	340000	12000	1800000	ND	590000	ND	43000	42000
122.2	37.2	B01PF9	.	.	.	.	.	.	.	.	.	.	.	.	.	.
124.9	38.1	B01P75	13000000	16000	9000	18000	19000000	7400000	330000	15000	2200000	ND	600000	ND	31000	47000
124.9	38.1	B01PN6	13000000	15000	8000	17000	19000000	7200000	310000	15000	2100000	ND	580000	ND	30000	45000
127.1	38.7	B01PQ1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
128.9	39.3	B01P77	18000000	17000	9000	16000	15000000	6100000	240000	16000	1500000	ND	410000	ND	28000	35000
131.0	39.9	B01PQ3	.	.	.	.	.	.	.	.	.	.	.	.	.	.

ND = Not Detected . = Not Analyzed

APPENDIX F.3
RADIOLOGICAL ANALYSES

WHC-SD-EN-TI-202, Rev. 0

RADIONUCLIDE ANALYSES FOR SOILS FROM WELL NO. 299-W18-96 (ID-4)

HEIS																
Depth (ft)	Depth (m)	Sample Number	Alpha (pci/g)	Beta (pci/g)	Co-60 (pci/g)	Ru-106 (pci/g)	Sb-125 (pci/g)	Cs-137 (pci/g)	Pb-212 (pci/g)	Pb-214 (pci/g)	Ra-226 (pci/g)	Ra-224 (pci/g)	U-238 (pci/g)	U-239/40 (pci/g)	Sr-90 (pci/g)	Am-241 (pci/g)
84.0	25.6	B01NW7	7.73	3.79	-0.00526	0.11	0.0177	-0.0113	0.864	0.693	0.669	0.899	0.0000419	0.00187	0.0039	0.000199
86.0	26.2	B01NX2	4.53	22.10	-0.014	-0.592	-0.0497	-0.0387	1.76	1.45	1.31	1.83	-0.000161	0.000492	0.00731	0.0016
88.5	26.4	B01NX4	9.35	17.10	-0.00163	-0.164	0.0632	0.00647	0.953	0.731	0.85	0.993	-8.39E-05	0.000336	0.00582	0.000246
91.4	27.9	B01NX6	4.61	18.90	0.017	0.038	0.0382	0.00757	0.761	0.611	0.638	0.791	0.0000451	0.000194	0.00802	0.000557
100.5	30.6	B01NX9	2.04	21.60	0.00302	-0.127	-0.034	-0.00352	0.719	0.585	0.544	0.747	-1.46E-06	0.000132	-0.0018	-0.0000649
120.0	36.6	B01NY7	7.94	13.70	0.00945	-0.389	0.00413	-0.00914	0.636	0.475	0.607	0.658	-5.33E-05	0.000588	-8.22E-05	0.000468
123.5	37.6	B01NZ1	1.30	2.31	0.00351	0.228	0.11	-0.00461	0.381	0.39	0.448	0.394	0.0000547	0.000913	-0.00585	0.0000319
125.5	38.3	B01P91	6.44	13.70	-0.0175	-0.125	0.0515	-0.0295	0.391	0.27	0.377	0.404	-2.86E-05	0.000233	-0.00372	0.0129
130.5	39.8	B01NZ3	1.53	13.80	0.00228	-0.34	-0.0102	-0.0174	0.523	0.477	0.472	0.539	0.0000164	0.00379	-0.00513	0.000718
136.5	41.6	B01P03	7.68	6.89	0.0348	-0.0106	0.00217	-0.000873	1.22	1.12	0.839	1.25	-2.87E-05	0.000242	-0.000278	-0.000219
143.8	43.8	B01P95	10.40	27.10	-0.00828	-0.0414	0.00293	0.00144	1.29	0.975	0.863	1.53	No data available at this time			
146.5	44.7	B01P99	12.50	15.80	0.0073	0.0756	-0.0483	-0.00353	1.03	0.758	0.745	1.22	No data available at this time			

APPENDIX F.4
RADIOLOGICAL ANALYSES FROM WELL 299-W18-174

299-W18-174 47.3 ft

SAMPLE STATUS REPORT FOR E 8232. E-BLANK B08484 TIME: 3/29/93 8:40
 DISPATCHED: 3/26/93 8:11 SAMPLE HAS NOT BEEN SLURPED
 RECEIVED: 3/26/93 10:23

EXT.	DETER.	RESULTS OR STATUS	OUT OF RANGE?	GOOD ANS?	CHARGE CODE
****	*****	*****	***	***	*****
2172	GEA-SOIL	7.53000E 02 pCi/gWETwt Am-241	N	Y	VOGEL
2172	GEA-SOIL	3.00000E 01 pCi/gWETwt Np-237	N	Y	VOGEL
2172	GEA-SOIL	3.12000E 01 pCi/gWETwt Pa-233	N	Y	VOGEL
2172	GEA-SOIL	< 5.57000E-01 pCi/gWETwt Cs-137	N	Y	VOGEL
4271	TOT-ACT	< 5.00000E 01 pCi/G	N	Y	VOGEL

END OF REPORT

299-W18-174 48.0 ft

SAMPLE STATUS REPORT FOR E 8233. E-BLANK B08485 TIME: 3/29/93
 DISPATCHED: 3/26/93 8:11 SAMPLE HAS NOT BEEN SLURPED
 RECEIVED: 3/26/93 10:23

EXT.	DETER.	RESULTS OR STATUS	OUT OF RANGE?	GOOD ANS?	CHARGE CODE
****	*****	*****	***	***	*****
2172	GEA-SOIL	1.92000E 03 pCi/gWETwt Am-241	N	Y	VOGEL
2172	GEA-SOIL	4.00000E 01 pCi/gWETwt Np-237	N	Y	VOGEL
2172	GEA-SOIL	3.67000E 01 pCi/gWETwt Pa-233	N	Y	VOGEL
2172	GEA-SOIL	< 6.56000E-01 pCi/gWETwt Cs-137	N	Y	VOGEL
4271	TOT-ACT	1.71850E 02 pCi/G	N	Y	VOGEL

END OF REPORT

APPENDIX G
ANALYTICAL RESULTS FOR GEOTECHNICAL SAMPLES FROM NEW WELLS

APPENDIX G.1
MOISTURE CONTENT/CACO₃ RESULTS

Moisture Content and CaCO3 Content Results for FY93 Wells

Well No. 299-W18-174			
Depth (ft)	HEIS No.	Moisture (%)	CaCO3 (%)
52.0 - 53.5	B01PF1	3.0	.9
54.5 - 55.0	B08D20	6.3	1.2
56.5 - 58.0	B01PK9	9.43	<1
60.0 - 61.5	B01PL1	5.84	<1
65.0 - 66.5	B01PL3	7.99	1.5
70.5 - 72.0	B01PF3	4.24	1.0
73 - 75	B08D23	10.83	1.3
75.0 - 76.6	B01PL5	6.88	<1
80.0 - 81.1	B01PL7	3.79	<1
85.1 - 87.1	B01PL9	5.65	<1
89.7 - 91.2	B01PF5	2.22	<1
92 - 94	B08D26	2.43	1.0
95.2 - 96.7	B01PM1	2.27	<1
99.6-102.7	B01PF7	4.29	<1
104-106	B01PM3	2.22	<1
110-112	B01PM5	5.26	<1
112.7-113.2	B08D29	4.11	n/r
115-116.6	B01PM7	7.88	1.3
117-119	B08D32	7.28	n/r
121.5-122.7	B01PF9	12.66	<1
125.9-127.6	B01PG1	22.29	2.8
127.6-129.4	B08D40	16.92	n/r
129.4-131.5	B01PG3	14.46	9.8

Well No. 299-W18-96			
Depth (ft)	HEIS No.	Moisture (%)	CaCO3 (%)
82.0 - 84.5	B08096	8.54	0.8
90.0	B01NW9	6.00	<1.0
95.0	B01NX8	4.70	<1.0
99.01	B01NY1	7.64	1.0
104.43	B01NY3	3.19	<1.0
110.15	B01NY4	3.21	<1.0
116.03	B01NY6	2.72	<1.0
118-120	B01NY9	7.11	<1.0
129.0	B080B4	8.26	.01
135.0	B080B5	9.01	1.8
137 - 139	B084R9	17.95	1.8
138.0 - 138.5	B080B8	12.0	1.8
142.69 - 143.19	B080B9	20.94	2.8
142.95 - 144.95	B080C6	10.78	2.0
145 - 147	B084R8	13.12	1.3

Moisture Content and CaCO₃ Content Results for FY93 Wells

Well No.	299-W15-218		
Depth (ft)	HEIS No.	Moisture (%)	CaCO ₃ (%)
25.0	B01MV3	2.96	<1.0
30.0	B01MV5	3.66	<1.0
35.0	B01MV7	4.14	<1.0
42.0	B01MW1	3.21	<1.0
45.0	B08433	2.61	<1.0
51.0	B01MW2	2.86	<1.0
55.0	B01NV4	6.98	<1.0
60.0	B01NV5	3.05	<1.0
65.0	B01NV7	5.22	<1.0
70.0	B01NV8	3.49	<1.0
75.0	B01NV9	4.49	<1.0
80.0	B01NW6	3.36	<1.0
85.0	B01NW0	10.38	<1.0
90.0	B01NW1	17.23	<1.0
95.0	B01NW3	6.06	<1.0
100.0	B01NW2	7.04	<1.0
104.5	B01NW5	4.57	<1.0
110.0	B01NW4	22.26	2.0
116.8 - 117.3	B08434	15.12	9.3
120.00	B01P77	7.23	7.0
125.0	B08435	n/r	<1.0
130.0	B08436	n/r	<1.0
135.0	B08437	n/r	<1.0
140.0	B01P79	6.5	<1.0
150.0	B01P81	3.5	2.6
155.0	B01P82	4.2	<1.0
160.0	B01P83	2.8	<1.0
145.0	B01P80	10.1	1.6
165.0	B01P84	3.6	<1
170.0	B01P85	3.0	<1
175.0	B01P86	3.3	<1
180.0	B01P87	3.5	<1
185.0	B01P89	2.8	<1
190.0	B01P90	3.7	<1
195.0	B01NX0	9.2	0
200.0	B08438	9.3	0
205.0	B08439	4.4	0

Well No.	299-W15-219		
Depth (ft)	HEIS No.	Moisture (%)	CaCO ₃ (%)
15-16	B08F96	3.11	1.0
20.5-21.5	B01NT4	2.75	<1
25.9	B01NT5	3.29	<1
29-30	B01NT7	3.04	<1
35-36	B01NT8	3.84	<1
39.5-40	B01NT6	2.81	<1
44.0-45.0	B01NT9	5.18	<1
49.0-50.0	B01NV0	2.68	<1
53.0-54.0	B01NV1	2.78	<1
57.05-58.4	B01NV2	2.94	<1
64.5-65.5	B01PR8	2.99	<1
70.0-70.5	B01PR9	5.63	<1
75.0-76.0	B01PS0	2.92	<1
79.0-80.0	B01PS1	6.75	<1
84.0-85.0	B01PS2	2.97	<1
89.5-90.0	B01PS3	6.55	<1
94.0-96.0	B01PX0	7.78	<1
95.0-96.0	B01PS4	5.61	<1
99.5-100.5	B01PS5	3.93	<1
109.9-110.0	B01PS7	4.56	<1
110.5-112.0	B01PX1	6.90	1.0
113.75-115.25	B01PX2	10.21	1.0
114.5-115.0	B01PS8	19.42	1.8
119.5-120.0	B01PS9	13.98	5.0
124.0-125.0	B01PT0	15.13	<1
129.0-130.0	B01PT1	16.66	<1
131.0-132.0	B01PT2	9.40	<1
140	B01PT3	12.76	<1
145	B01PT4	4.52	<1
149-149.5	B01PT5	15.46	1.3
150.25	B01PX4	12.94	1.0
153.4	B01PX5	17.21	<1
155	B01PT6	2.85	<1
160	B01PT7	13.84	<1
165	B01PT8	5.42	<1
170	B01PT9	15.22	<1
175	B01PV0	14.89	<1
180	B01PV1	15.69	<1
185	B01PV2	14.25	<1
187.5	B01PV3	9.47	<1
190.3	B01PV4	2.77	<1
195	B01PV5	3.77	<1
200	B01PV6	2.14	<1
205	B01PV7	8.44	<1
210.5	B01PV8	11.50	<1

Moisture Content and CaCO₃ Content Results for FY93 Wells

Well No. 299-W15-220			
Depth (ft)	HEIS No.	Moisture (%)	CaCO ₃ (%)
25	B07BT4	3.24	<1
30	B07BT5	2.96	<1
35	B07BT6	6.32	1.0
40	B07BT7	5.76	<1
45	B07BT8	9.39	<1
50	B07BT9	19.74	1.4
55	B07BV0	3.20	<1
60	B07BV1	2.90	<1
65	B07BV2	3.28	<1
70	B07BV3	5.46	<1
75	B07BV4	4.94	<1
80	B07BV5	4.92	<1
85	B07BV6	4.94	<1
90	B07BV7	4.98	<1
95	B07BV8	19.73	1.1
100	B07BV9	17.49	<1
105	B07BW0	15.86	1.3
110	B07BW1	16.58	9.3
115	B07BW2	8.77	3.8
120	B07BW3	3.10	<1
123	B07BW4	5.71	<1
127'	B07BW5	8.11	<1
133	B07BW6	4.15	3.3
138.5	B07BW7	2.69	<1
146	B07BW8	3.34	-0.5
150	B07BW9	3.47	1.2
155	B07BX0	2.8	-0.1
160	B07BX1	1.87	-0.2
170	B07BX3	3.45	-0.5
175	B07BX4	2.15	-0.4
180.5	B07BX5	2.52	-0.4
164.5	B07BX2	9.01	-0.5
185	B07BX6	3.7	-0.4
190	B07BX7	2.8	-0.4
195	B07BX8	7.27	-0.5
200	B07BX9	9.28	-0.4

Well No. 299-W18-252			
Depth (ft)	HEIS No.	Moisture (%)	CaCO ₃ (%)
5	B01PH2	7.45	<1
10	B01PH2	2.74	<1
15	B01PG5	2.32	<1
20	B01PG4	3.13	<1
24-25	B01PG6	2.33	<1
30-30.6	B01PG7	2.51	<1
33.5-35.5	B01PG8	2.72	<1
39.0-40.0	B01PG9	5.03	<1
43.7-44.7	B01PH1	4.21	<1
48.5-50.0	B07BD5	4.55	<1
54.0-55.0	B07BD6	4.20	<1
59-60	B07BD7	5.88	<1
64.5-65.5	B07BD8	4.57	<1
70-71	B07BD9	9.39	<1
75-76	B07BF0	3.12	<1
79-80.6	B07BF1	9.95	1.0
84.5-86	B07BF2	5.57	<1
88-90.2	B07BF3	3.23	<1
95.5-96.5	B07BF4	7.02	<1
99-100	B07BF5	6.11	<1
105-105.5	B07BF6	3.77	<1
115-115.5	B07BF7	n/r	<1
121-121.5	B07BF8	6.96	<1
125.5-127	B07BF9	14.64	1.5
129-130	B07BG0	13.21	1.5
133.5-135.3	B07BG1	15.87	1.0
138	B07BS7	20.24	9.3
141.6-142.6	B07BG2	5.07	<1
145-145.5	B07BG3	3.32	<1
149-150.2	B07BG4	3.84	<1
153.5-155	B07BG5	4.14	<1
159-160	B07BG6	3.87	<1
164-165	B07BG7	3.72	<1
175.2-176	B07BH0	3.72	<1
181.5-182	B07BH1	5.59	<1
184.5-185.6	B07BH2	4.17	<1
172-173	B07BG9	3.08	<1
190.5-192	B07BH3	3.44	<1
195.5-196	B07BH4	10.28	<1
199-200	B07BH5	3.38	<1
205-206.6	B07BH6	4.32	<1
210.5-211.2	B07C87	5.87	<1
214.3-215	B07C88	4.85	<1
220-220.5	B07C89	19.55	<1
224.6-226.6	B07C90	18.51	<1

APPENDIX G.2

BULK DENSITY/POROSITY RESULTS

Bulk Density and Porosity Results for FY 93 Wells

299-W18-96					299-W18-174				
Well No.	Depth (ft)	HEIS No.	Porosity %	Bulk Density (g/cc)	Well No.	Depth (ft)	HEIS No.	Porosity (%)	Bulk Density (g/cc)
	82.8	B08094	63.92	1.33		54.5-55	B08D20	NR	NR
	99.3	B08099	39.05	1.65		73.3	B08D23	53.3	1.27
	135.3	B080B3	43.31	1.56		92.3	B08D26	20.4	2.17
	138-138.5	B080B8 (1)	39.04	1.66		113	B08D29	38.64	1.65
	141.9	B080C0	40.94	1.61		117.3	B08D32	46.89	1.43
	143.2	B080B3	37.38	1.7		127.7	B08D40	47.26	1.44
	146-146.5	B084R7 (2)	45.02	1.5					

(1) Originally collected as special sample for CERCLA Physical Properties analyses.

(2) Originally collected for Air Permeability analyses.

NR = No Results.

APPENDIX G.3
SATURATED HYDRAULIC CONDUCTIVITY RESULTS

Saturated Conductivity Results for FY 93 Wells

<u>Well No.</u>	299-W18-96	<u>Well No.</u>	299-W15-218
	Saturated		Saturated
Depth	Conductivity	Depth	Conductivity
<u>(ft)</u>	<u>(cm/s)</u>	<u>(ft)</u>	<u>(cm/s)</u>
141.7-142.7	1.26E-04	116.3-117.3	5.23E-06

APPENDIX G.4
MOISTURE RETENTION

Tempe Drying Curve
 Kettle Drying Curve
 Tempe Wetting Curve
 Kettle Wetting Curve

299-W15-218 116.3 ft (35.4 m)

ATLANTIC OIL

APPENDIX G.5
AIR PERMEABILITY RESULTS

WHC-SD-EN-TI-202, Rev. 0
299-W 18-96 83.3 ft (25.4 m)

SAMPLE NUMBER 3-0631

Roto.Rdng	0.9 0.0 to 1.0	Roto.Rdng	0.6 0.0 to 1.0	Roto.Rdng	0.3 0.0 to 1.0
Q	90 cm3/sec	Q	60 cm3/sec	Q	30 cm3/sec
n	1.84E-04 poise	n	1.84E-04 poise	n	1.84E-04 poise
L	15.1 cm	L	15.1 cm	L	15.1 cm
rho	1 g/cm3	rho	1 g/cm3	rho	1 g/cm3
g	981 cm/sec2	g	981 cm/sec2	g	981 cm/sec2
Hi	56.23 inches	Hi	28.9 inches	Hi	13 inches
Ho	6.60 inches	Ho	3.30 inches	Ho	1.50 inches
Delta H	126.1 cm	Delta H	65.0 cm	Delta H	29.2 cm
A	70.88 cm2	A	70.88 cm2	A	70.88 cm2
$K=Q*n*L/(rho*g*h*A)$		$K=Q*n*L/(rho*g*h*A)$		$K=Q*n*L/(rho*g*h*A)$	
K= 2.85E-08 cm2		K= 3.69E-08 cm2		K= 4.10E-08 cm2	

Linearity test

Hi inches	Ho inches	Recip. H c	Calc. K	Regrsn K.
56.23	6.6	0.012532	2.85E-08	3.07E-08
28.9	3.3	0.024453	3.69E-08	3.39E-08
13	1.5	0.054304	4.10E-08	4.19E-08
		0		2.73E-08

slope = 2.69E-07
intercept = 2.73E-08 Coefficient of liquid permeability
 $r^2 = 0.8238$

SAMPLE NUMBER 3-0634

Roto.Rdng	0.9 0.0 to 1.0	Roto.Rdng	0.6 0.0 to 1.0	Roto.Rdng	0.35 0.0 to 1.0
Q	90 cm3/sec	Q	60 cm3/sec	Q	35 cm3/sec
n	1.84E-04 poise	n	1.84E-04 poise	n	1.84E-04 poise
L	14.57 cm	L	14.57 cm	L	14.57 cm
rho	1 g/cm3	rho	1 g/cm3	rho	1 g/cm3
g	981 cm/sec2	g	981 cm/sec2	g	981 cm/sec2
Hi	72.3 inches	Hi	48.2 inches	Hi	24.1 inches
Ho	7.25 inches	Ho	4.00 inches	Ho	1.50 inches
Delta H	165.2 cm	Delta H	112.3 cm	Delta H	57.4 cm
A	45.01 cm2	A	45.01 cm2	A	45.01 cm2
K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)	
K= 3.31E-08 cm2		K= 3.24E-08 cm2		K= 3.70E-08 cm2	

Linearity test

Hi inches	Ho inches	Recip. H c	Calc. K	Regrsn K.
72.3	7.25	0.009898	3.31E-08	3.23E-08
48.2	4	0.015084	3.24E-08	3.34E-08
24.1	1.5	0.030758	3.70E-08	3.68E-08
		0		3.02E-08

slope = 2.13E-07

intercept = 3.02E-08 Coefficient of liquid permeability

r^2 = 0.8711

SAMPLE NUMBER 3-0637

Roto.Rdng	0.9 0.0 to 1.0	Roto.Rdng	0.6 0.0 to 1.0	Roto.Rdng	0.3 0.0 to 1.0
Q	90 cm3/sec	Q	60 cm3/sec	Q	30 cm3/sec
n	1.84E-04 poise	n	1.84E-04 poise	n	1.84E-04 poise
L	15.14 cm	L	15.14 cm	L	15.14 cm
rho	1 g/cm3	rho	1 g/cm3	rho	1 g/cm3
g	981 cm/sec2	g	981 cm/sec2	g	981 cm/sec2
Hi	200.82 inches	Hi	128.53 inches	Hi	48.2 inches
Ho	6.90 inches	Ho	3.60 inches	Ho	1.80 inches
Delta H	492.6 cm	Delta H	317.3 cm	Delta H	117.9 cm
A	44.65 cm2	A	44.65 cm2	A	44.65 cm2
$K=Q*n*L/(rho*g*h*A)$		$K=Q*n*L/(rho*g*h*A)$		$K=Q*n*L/(rho*g*h*A)$	
K= 1.16E-08 cm2		K= 1.20E-08 cm2		K= 1.62E-08 cm2	

Linearity test

Hi inches	Ho inches	Recip. H c	Calc. K	Regrsn K
200.82	6.9	0.003791	1.16E-08	1.14E-08
128.53	3.6	0.005959	1.20E-08	1.23E-08
48.2	1.8	0.015748	1.62E-08	1.61E-08
		0		9.92E-09

slope = 3.95E-07

intercept = 9.92E-09 Coefficient of liquid permeability

r^2 = 0.9918

WHC-SD-EN-TI-202, Rev. 0
299-W18-96 137.8 ft (42.0 m)

SAMPLE NUMBER 3-0666

Roto.Rdng	0.9 0.0 to 1.0	Roto.Rdng	0.6 0.0 to 1.0	Roto.Rdng	0.4 0.0 to 1.0
Q	90 cm3/sec	Q	60 cm3/sec	Q	40 cm3/sec
n	1.84E-04 poise	n	1.84E-04 poise	n	1.84E-04 poise
L	14.64 cm	L	14.64 cm	L	14.64 cm
rho	1 g/cm3	rho	1 g/cm3	rho	1 g/cm3
g	981 cm/sec2	g	981 cm/sec2	g	981 cm/sec2
Hi	30.3 inches	Hi	18 inches	Hi	10.8 inches
Ho	6.60 inches	Ho	3.70 inches	Ho	2.10 inches
Delta H	60.2 cm	Delta H	36.3 cm	Delta H	22.1 cm
A	44.3 cm2	A	44.3 cm2	A	44.3 cm2
K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)	
K= 9.27E-08 cm2		K= 1.02E-07 cm2		K= 1.12E-07 cm2	

Linearity test

Hi inches	Ho inches	Recip. H c	Calc. K	Regsn K.
30.3	6.6	0.021339	9.27E-08	9.36E-08
18	3.7	0.036286	1.02E-07	1.01E-07
10.8	2.1	0.061039	1.12E-07	1.13E-07
		0	8.33E-08	

slope = 4.82E-07
intercept = 8.33E-08 Coefficient of liquid permeability
r^2 = 0.9808

WHC-SD-EN-TI-202, Rev. 0
299-W18-96 143.7 ft (43.8 m)

SAMPLE NUMBER 3-0636

Roto.Rdng	0.9 0.0 to 1.0	Roto.Rdng	0.6 0.0 to 1.0	Roto.Rdng	0.4 0.0 to 1.0
Q	90 cm3/sec	Q	60 cm3/sec	Q	40 cm3/sec
n	1.84E-04 poise	n	1.84E-04 poise	n	1.84E-04 poise
L	14.32 cm	L	14.32 cm	L	14.32 cm
rho	1 g/cm3	rho	1 g/cm3	rho	1 g/cm3
g	981 cm/sec2	g	981 cm/sec2	g	981 cm/sec2
Hi	104.43 inches	Hi	64.27 inches	Hi	40.17 inches
Ho	6.70 inches	Ho	3.50 inches	Ho	2.10 inches
Delta H	248.2 cm	Delta H	154.4 cm	Delta H	96.7 cm
A	44.65 cm2	A	44.65 cm2	A	44.65 cm2
K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)	
K= 2.18E-08 cm2		K= 2.34E-08 cm2		K= 2.49E-08 cm2	

Linearity test

Hi inches	Ho inches	Recip. H c	Calc. K	Regrsn K.
104.43	6.7	0.007085	2.18E-08	2.2E-08
64.27	3.5	0.011619	2.34E-08	2.31E-08
40.17	2.1	0.018628	2.49E-08	2.5E-08
		0		2.01E-08

slope = 2.62E-07
intercept = 2.01E-08 Coefficient of liquid permeability
r^2 = 0.9814

WHC-SD-EN-TI-202, Rev. 0
299-W18-174 55.3 ft (16.8 m)

SAMPLE NUMBER 3-0678

Roto.Rdng	0.9 0.0 to 1.0	Roto.Rdng	0.6 0.0 to 1.0	Roto.Rdng	0.3 0.0 to 1.0
Q	90 cm3/sec	Q	60 cm3/sec	Q	30 cm3/sec
n	1.84E-04 poise	n	1.84E-04 poise	n	1.84E-04 poise
L	15 cm	L	15 cm	L	15 cm
rho	1 g/cm3	rho	1 g/cm3	rho	1 g/cm3
g	981 cm/sec2	g	981 cm/sec2	g	981 cm/sec2
Hi	23.8 inches	Hi	12.9 inches	Hi	5.4 inches
Ho	7.00 inches	Ho	3.60 inches	Ho	1.80 inches
Delta H	42.7 cm	Delta H	23.6 cm	Delta H	9.1 cm
A	71.63 cm2	A	71.63 cm2	A	71.63 cm2
K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)	
K= 8.28E-08 cm2		K= 9.98E-08 cm2		K= 1.29E-07 cm2	

Linearity test

Hi inches	Ho inches	Recip. H c	Calc. K	Regrsn K.
23.8	7	0.025565	8.28E-08	8.5E-08
12.9	3.6	0.047721	9.98E-08	9.68E-08
5.4	1.8	0.109361	1.29E-07	1.3E-07
	0		7.14E-08	

slope = 5.33E-07
intercept = 7.14E-08 Coefficient of liquid permeability
r^2 = 0.9870

SAMPLE NUMBER 3-0707

Roto.Rdng	0.9 0.0 to 1.0	Roto.Rdng	0.6 0.0 to 1.0	Roto.Rdng	0.3 0.0 to 1.0
Q	90 cm3/sec	Q	60 cm3/sec	Q	30 cm3/sec
n	1.84E-04 poise	n	1.84E-04 poise	n	1.84E-04 poise
L	14.6 cm	L	14.6 cm	L	14.6 cm
rho	1 g/cm3	rho	1 g/cm3	rho	1 g/cm3
g	981 cm/sec2	g	981 cm/sec2	g	981 cm/sec2
Hi	14.8 inches	Hi	8.6 inches	Hi	3.9 inches
Ho	6.80 inches	Ho	3.70 inches	Ho	1.80 inches
Delta H	20.3 cm	Delta H	12.4 cm	Delta H	5.3 cm
A	70.88 cm2	A	70.88 cm2	A	44.65 cm2
K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)	
K= 1.71E-07 cm2		K= 1.86E-07 cm2		K= 3.45E-07 cm2	

Linearity test

Hi inches	Ho inches	Recip. H c	Calc. K	Regsn K.
14.8	6.8	0.036454	1.71E-07	1.57E-07
8.6	3.7	0.064016	1.86E-07	2.06E-07
3.9	1.8	0.138141	3.45E-07	3.4E-07
		0		9.1E-08

slope = 1.80E-06
intercept = 9.10E-08 Coefficient of liquid permeability
r^2 = 0.9656

SAMPLE NUMBER 3-0708

Roto.Rang	0.9 0.0 to 1.0	Roto.Rang	0.6 0.0 to 1.0	Roto.Rang	0.3 0.0 to 1.0
Q	90 cm3/sec	Q	60 cm3/sec	Q	30 cm3/sec
n	1.84E-04 poise	n	1.84E-04 poise	n	1.84E-04 poise
L	14.74 cm	L	14.74 cm	L	14.74 cm
rho	1 g/cm3	rho	1 g/cm3	rho	1 g/cm3
g	981 cm/sec2	g	981 cm/sec2	g	981 cm/sec2
Hi	8.8 inches	Hi	4.7 inches	Hi	2.3 inches
Ho	6.90 inches	Ho	3.60 inches	Ho	1.80 inches
Delta H	4.8 cm	Delta H	2.8 cm	Delta H	1.3 cm
A	71.63 cm2	A	71.63 cm2	A	71.63 cm2
$K=Q*n*L/(rho*g*h*A)$		$K=Q*n*L/(rho*g*h*A)$		$K=Q*n*L/(rho*g*h*A)$	
K= 7.20E-07 cm2		K= 8.29E-07 cm2		K= 9.12E-07 cm2	

Linearity test

Hi inches	Ho inches	Recip. H c	Calc. K	Regsn K.
8.8	6.9	0.050153	7.20E-07	7.41E-07
4.7	3.6	0.094868	8.29E-07	7.98E-07
2.3	1.8	0.192049	9.12E-07	9.21E-07
		0		6.77E-07

slope = 1.27E-06

intercept = 6.77E-07 Coefficient of liquid permeability

r^2 = 0.9188

SAMPLE NUMBER 3-0709

Roto.Rdng	0.9 0.0 to 1.0	Roto.Rdng	0.6 0.0 to 1.0	Roto.Rdng	0.4 0.0 to 1.0
Q	90 cm3/sec	Q	60 cm3/sec	Q	40 cm3/sec
n	1.84E-04 poise	n	1.84E-04 poise	n	1.84E-04 poise
L	15.1 cm	L	15.1 cm	L	15.1 cm
rho	1 g/cm3	rho	1 g/cm3	rho	1 g/cm3
g	981 cm/sec2	g	981 cm/sec2	g	981 cm/sec2
Hi	56.23 inches	Hi	28.2 inches	Hi	17.7 inches
Ho	6.50 inches	Ho	3.30 inches	Ho	2.00 inches
Delta H	126.3 cm	Delta H	63.2 cm	Delta H	39.9 cm
A	70.88 cm2	A	70.88 cm2	A	70.88 cm2
K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)	
K= 2.85E-08 cm2		K= 3.79E-08 cm2		K= 4.01E-08 cm2	

Linearity test

Hi inches	Ho inches	Recip. H c	Calc. K	Regsn K.
56.23	6.5	0.012552	2.85E-08	3E-08
28.2	3.3	0.024997	3.79E-08	3.51E-08
17.7	2	0.03997	4.01E-08	4.13E-08
		0		2.48E-08

slope = 4.14E-07
intercept = 2.48E-08 Coefficient of liquid permeability
r^2 = 0.8485

SAMPLE NUMBER 3-0710

Roto.Rdng	0.9 0.0 to 1.0	Roto.Rdng	0.6 0.0 to 1.0	Roto.Rdng	0.3 0.0 to 1.0
Q	90 cm3/sec	Q	60 cm3/sec	Q	30 cm3/sec
n	1.84E-04 poise	n	1.84E-04 poise	n	1.84E-04 poise
L	14.81 cm	L	14.81 cm	L	14.81 cm
rho	1 g/cm3	rho	1 g/cm3	rho	1 g/cm3
g	981 cm/sec2	g	981 cm/sec2	g	981 cm/sec2
Hi	20 inches	Hi	11.5 inches	Hi	5.1 inches
Ho	7.00 inches	Ho	3.70 inches	Ho	1.80 inches
Delta H	33.0 cm	Delta H	19.8 cm	Delta H	8.4 cm
A	71.48 cm2	A	71.48 cm2	A	71.48 cm2
K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)	
K= 1.06E-07 cm2		K= 1.18E-07 cm2		K= 1.39E-07 cm2	

Linearity test

Hi inches	Ho inches	Recip. H c	Calc. K	Regrsn K.
20	7	0.029163	1.06E-07	1.07E-07
11.5	3.7	0.051803	1.18E-07	1.16E-07
5.1	1.8	0.114116	1.39E-07	1.4E-07
		0	9.62E-08	

slope = 3.80E-07
intercept = 9.62E-08 Coefficient of liquid permeability
r^2 = 0.9906

SAMPLE NUMBER 3-0742 (Damaged Sample)

Roto.Rdng	0.9 0.0 to 1.0	Roto.Rdng	0.6 0.0 to 1.0	Roto.Rdng	0.3 0.0 to 1.0
Q	90 cm3/sec	Q	60 cm3/sec	Q	30 cm3/sec
n	1.84E-04 poise	n	1.84E-04 poise	n	1.84E-04 poise
L	13.96 cm	L	13.96 cm	L	13.96 cm
rho	1 g/cm3	rho	1 g/cm3	rho	1 g/cm3
g	981 cm/sec2	g	981 cm/sec2	g	981 cm/sec2
Hi	7.3 inches	Hi	4 inches	Hi	1.5 inches
Ho	7.30 inches	Ho	4.00 inches	Ho	1.50 inches
Delta H	0.0 cm	Delta H	0.0 cm	Delta H	0.0 cm
A	71.63 cm2	A	71.63 cm2	A	71.63 cm2
$K=Q*n*L/(rho*g*h*A)$		$K=Q*n*L/(rho*g*h*A)$		$K=Q*n*L/(rho*g*h*A)$	
K= #DIV/0! cm2		K= #DIV/0! cm2		K= #DIV/0! cm2	

Linearity test

Hi inches	Ho inches	Recip. H c	Calc. K	Regsn K
7.3	7.3	0.053932	#DIV/0!	#DIV/0!
4	4	0.098425	#DIV/0!	#DIV/0!
1.5	1.5	0.262467	#DIV/0!	#DIV/0!
		0	#DIV/0!	

slope = #DIV/0!
intercept = #DIV/0! Coefficient of liquid permeability
r^2 = #DIV/0!

SAMPLE NUMBER 3-0743

Roto.Rdng	0.9 0.0 to 1.0	Roto.Rdng	0.6 0.0 to 1.0	Roto.Rdng	0.4 0.0 to 1.0
Q	90 cm3/sec	Q	60 cm3/sec	Q	40 cm3/sec
n	1.84E-04 poise	n	1.84E-04 poise	n	1.84E-04 poise
L	15.1 cm	L	15.1 cm	L	15.1 cm
rho	1 g/cm3	rho	1 g/cm3	rho	1 g/cm3
g	981 cm/sec2	g	981 cm/sec2	g	981 cm/sec2
Hi	281.16 inches	Hi	192.8 inches	Hi	112.46 inches
Ho	7.30 inches	Ho	4.00 inches	Ho	2.60 inches
Delta H	695.6 cm	Delta H	479.6 cm	Delta H	279.0 cm
A	71.63 cm2	A	71.63 cm2	A	71.63 cm2
K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)		K=Q*n*L/(rho*g*h*A)	
K= 5.12E-09 cm2		K= 4.95E-09 cm2		K= 5.67E-09 cm2	

Linearity test

Hi inches	Ho inches	Recip. H c	Calc. K	Regrn K.
281.16	7.3	0.00273	5.12E-09	4.97E-09
192.8	4	0.004001	4.95E-09	5.16E-09
112.46	2.6	0.006843	5.67E-09	5.6E-09
		0	4.55E-09	

slope = 1.54E-07
intercept = 4.55E-09 Coefficient of liquid permeability
r^2 = 0.7425

APPENDIX G.6
GRAIN SIZE ANALYSIS RESULTS

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No.

3-0629

Page

2 of 5

299-W15-218 116.6 ft (35.4 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted By *L.D. Bruggeman*

Date 3-18-93

Plot Checked By *R. T. McCallister*

Date 3/18/93

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0860

Page 2 of 2

299-W15-219 53.5 ft (16.3 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plot

Date

Plot Checked By

Date

1/9/2

PD 00000000 10 10 00

Sample No. 3-0861

Page 2 of 2

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W15-219 54.3 ft (16.6 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted By

Date

Plot Checked By

Date

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 0862
3-5682
Page 2 of 2

299-W15-219 56.6 ft (17.2 m)

Remarks

Hydrometer Analysis

Number of Mesh Per Inch

Size of Opening in Inches

Date: 1/23

Plot Checked By: P. T. M. H. D.

Date

Plot

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W15-219 87.0 ft (26.5 m)

Remarks

Size of Opening In Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted By

Date

Plot Checked By

Date 5/11/93

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 828
3-06886

Page 2 of 2

299-W15-219 89.5 ft (27.3 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plot

Date

Plot Checked By R. T. M. [Signature]

Date 4/1/03

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0584

Page 2 of 2

299-W15-219 91.0 ft (27.7 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W15-219 95.5 ft (29.1 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plot

Date

Plot Checked By

Date

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-06877

Page 2 of 2

299-W15-219 114.5 ft (34.9 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted By

Date

Plot Checked By

Date

PD FORM 799 (11-79)

Sample No.
3-0969-2
Page **2** of **2**

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W15-219 150.3 ft (45.8 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plot

Date

Plot Checked By

Date 5/13/12

Sample No

3-0970-2

Page 2 of 2

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W15-219 153.4 ft (46.8 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted By

Date

Plot Checked By

Date

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W18-96 83.3 ft (25.4 m)

3-0615

Page 2 of 2

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

G-6-14

1000000

Date 3-3-96

Plot Checked By

1000000

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W18-96 90 ft (27.4 m)

Sample No.

3-0616

Page

2 of 2

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted By

Date

Plot Checked By

Date

3/3/94

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0617

Page 2 of 2

299-W18-96 95.0 ft (29.0 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

LD Bruggeman

Date 3-3-9

Plot Checked By

Date 3-3-9

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W18-96 104.0 ft (31.7 m)

Sample No. 3-0618

Page 2 of 2

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

G.6-17

Plotted By LD Pungeman

Date 3-3-93

Plot Checked By R. J. McE...

Date 3/3/93

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W18-96 110.2 ft (33.6 m)

3-0619

Page 2 of 2

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plt

by L.D. Bruggeman

Date 3-3-91

Plot Checked By R.P. McClinton

Date 3-3-91

GEL-07 GRAIN SIZE ANALYSIS PLOI

299-W18-96 116.0 ft (35.4 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

G.6-19

Plotted By

W. Bruggeman

Date

3-3-93

Plot Checked By

R. L. H. S. L. L. L.

Date

3/3/93

in mm 100 mm

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. J-0621

Page 2 of 2

299-W18-96 119.0 ft (36.3 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

By 10 Brinson

Date 3/3/96

Plot Checked By

Plot Checked By

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No.

3-0622

Page

2 of 2

299-W18-96 134.5 ft (41.0 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted By

L.D. Bruggeman

Date

3/2/93

Plot Checked By

R. J. [Signature]

Date

3/2/93

Sample No.
3-0665

Page _____ of _____

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W18-96 138.3 ft (42.1 m)

Remarks _____

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

4/21/1997

Date

Plot Checked By *R.T. McIntosh*

4/21/1997

Date

R.T. McIntosh

Plotted

NO 399 414371

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0635

Page 2 of 5

299-W18-96 141.9 ft (43.3 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Date 3-17-93

Plotted By L.D. Bragg

Plt Checked By Richard J. McLeod

Date 3/17/93

Sample No. 3-0815

Page 2 of 2

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W18-174 53.0 ft (16.2 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted By

Date

Plot Checked By

Date

RD

33 04/921

GEL-07 GRAIN SIZE ANALYSIS PLOT	
Sample No. <u>3-0696</u> Page <u>2</u> of <u>2</u>	Remarks: _____ _____ _____
Size of Opening in Inches _____ _____ _____	Hydrometer Analysis _____ _____ _____

299-W18-174 57.5 ft (17.5 m)

Plotted By _____ Date _____	Plot Checked By <u>R. A. McLeod</u> Date <u>4/20/93</u>
--------------------------------	--

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No.

3-0697

Page

2 of 2

299-W18-174 61.0 ft (18.6 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

G.6-26

ted By

Date

Plot Checked By

R. J. M. C. T. P. 11/17/73

NOTED FOR 11/17/73

Sample No. 3-0688

Page 2 of 2

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W 18-174 66.0 ft (20.1 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

G.6-27

Printed By

Date

Plot Checked By

Date

R. M. [Signature] 4/20/82

Sample No. 3-0699

Page 2 of 2

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W18-174 71.5 ft (21.8 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

G.6-28

Plot By

Date

Plot Checked By

Date

000 799 004/921

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0700-1

Page 2 of 2

299-W18-174 76.0 ft (23.2 m)

Remarks _____

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

GRAIN SIZE IN MILLIMETERS

Plotted By _____

Date _____

Plot Checked By _____

Date _____

APR 22 1993

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0701-1

Page 2 of 2

299-W18-174 80.6 ft (24.6 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analyze

Plotted By

Date APR 22 1993

Checked By

Date

4/23

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No.

3-0702-1

Page

2 of 2

299-W18-174 86.6 ft (26.4 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted By

[Signature]

Date

5/15/72 1993

Plot Checked By

[Signature]

Date

5/15/72 1993

Sample No.

3-0703-1

Page 2 of 2

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W18-174 90.5 ft (27.6 m)

Remarks

Size of Opening In Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted By

Date

10/1/03

Checked By

Richard H. M. Stoltz

Date

APR 2

Sample No. 3-0706

Page of

GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W18-174 92.3 ft (28.1 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted By

Date

Plot Checked By

Date

APR 22 1993

IN 1000 200 300 400 500 600 700 800 900 1000

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0704-1

Page 2 of 2

299-W18-174 96.0 ft (29.2 m)

Remarks

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted By

Date

APR 7 1993

Checked By

R. J. M. G. G. G.

Date

APR 7 1993

RD 5000 1/92

442 : 2 1991

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 5-0713
Page of

Remarks Re-Ran Sieve & Hydrometer 299-W18-174 101.1 ft (30.8 m)

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted by

Date

Plot Checked By

Date

RI.

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No.

3-0714

Page of

299-W18-174 105.0 ft (32.0 m)

Remarks X-X-X miniature tin plot.

○-○-○ master for plot - ○-○-○ hydrometer plot.

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted By

Date 4/14/2003

Plot Checked By

Date

Eff. 1/2/03

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No.
3-0714

Page _____ of _____

Remarks *Re-Run of Sieve & Hydrometer* - 299-W18-174 105.0 ft (32.0 m)

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plotted By

Date 4/28/92

Plot Checked By R. T. M. Smith

Date 11/25/93

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No.

3-0715

Page of

Remarks X-X-X *aluminum tin* 299-W18-174 111.5 ft (34.0 m)

0-0-0 Mason Jar *--- hydrometer plot*

Size of Opening in Inches

1 1/2

1

3/4

1/2

3/8

1/4

1/8

1/16

1/32

1/64

1/128

1/256

1/512

1/1024

1/2048

1/4096

1/8192

1/16384

1/32768

1/65536

1/131072

1/262144

1/524288

1/1048576

1/2097152

1/4194304

1/8388608

1/16777216

1/33554432

1/67108864

1/134217728

1/268435456

1/536870912

1/1073741824

1/2147483648

1/4294967296

1/8589934592

1/17179869184

1/34359738368

1/68719476736

1/137438953472

1/274877906944

1/549755813888

1/1099511627776

1/2199023255552

1/4398046511104

1/8796093022208

1/17592186044416

Number of Mesh Per Inch

200

100

50

25

12.5

6.25

3.125

1.5625

0.78125

0.390625

0.1953125

0.09765625

0.048828125

0.0244140625

0.01220703125

0.006103515625

0.0030517578125

0.00152587890625

0.000762939453125

0.0003814697265625

0.00019073486328125

9.5367431640625E-05

4.76837158203125E-05

2.384185791015625E-05

1.1920928955078125E-05

5.9604644775390625E-06

2.98023223876953125E-06

1.4901161193847656E-06

7.450580596923828E-07

3.725290298461914E-07

1.862645149230957E-07

9.313225746154785E-08

4.656612873077392E-08

2.328306436538696E-08

1.164153218269348E-08

5.82076609134674E-09

2.91038304567337E-09

1.455191522836685E-09

7.275957614183425E-10

3.637978807091712E-10

1.818989403545856E-10

9.09494701772928E-11

4.54747350886464E-11

2.27373675443232E-11

1.13686837721616E-11

5.6843418860808E-12

Plotted By

Date 4/10/72

Plot Checked By

Date APR 22 1972

Page 3 of 3

GEL-07 GELAIN SIZE ANALYSIS PLOT
299-W18-174 122.2 ft (37.2 m)

[illegible]

Number of Mesh Per Inch

Hydrometer Analysis

Sept 11/11

Sample No. 3-0739

Page 3 of 5

GEL-07 GRAIN SIZE ANALYSIS PLOT 299-W18-174 127.1 ft (38.7 m)

Remarks JAR Plot x - x - x Moisture
Combined Sieve & Hydrometer Plot O - O - O X See Comments on back.

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

Plot By

Date

Plot Checked By

Date

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 3-0740

Page of

Remarks 3-0740 = Mason for Sample 299-W18-174 131.0 ft (39.9 m)

2 x x x = Main Test for Sample

Size of Opening in Inches

Number of Mesh Per Inch

Hydrometer Analysis

G.6-43

Plotted By

RM

Date

APR 1 1963

Plot Checked By

R. T. M. [Signature]

Date APR 1 1963

APPENDIX H
U.S. ARMY CORPS OF ENGINEERS DATA

5/25/93

PHASE 1 & 2 ACOE SURVEY RESULTS

Well	Northing	Easting	Ngvd29 (ft)
2-E32-2	137467.51	572648.02	670.25
2-E32-5	137285.13	572599.70	682.35
2-E33-1	137614.03	573632.34	632.06
2-E33-12	137632.22	573780.53	623.41
2-E33-13	137584.39	573706.49	628.34
2-E33-14	137567.22	573985.61	622.03
2-E33-15	137540.70	573810.29	627.25
2-E33-18	137386.06	573779.17	651.84
2-E33-24	137578.53	573493.54	637.93
2-E33-26	137681.47	573333.35	632.72
2-E33-28	137375.02	573226.37	664.45
2-E33-29	137231.19	573227.86	673.98
2-E33-3	137666.04	573633.13	630.58
2-E33-30	137467.78	572923.80	663.90
2-E33-31	137491.44	573524.98	647.48
2-E33-32	137354.02	573524.83	660.02
2-E33-33	137301.93	574080.14	640.39
2-E33-34	137740.43	573104.46	633.57
2-E33-35	137605.10	573220.80	643.22
2-E33-38	137594.49	573591.16	631.90
2-E33-39	137637.37	573843.52	623.29
2-E33-4	137693.11	573616.75	629.80
2-E33-40	137723.10	573546.23	624.54
2-E33-5	137606.42	573574.23	634.65
2-E33-7	137695.97	573574.03	627.77
2-E34-1	137238.17	574642.67	629.41
2-E34-2	137220.69	574634.81	631.01
2-E34-5	137743.33	574643.81	590.99
2-W10-17	136491.25	566775.44	670.82
2-W10-18	136396.29	566846.87	670.91
2-W15-16	135733.60	566307.03	685.14
2-W15-22	136110.93	566683.04	670.75
2-W15-6	135654.40	566801.51	661.53
2-W15-8	135576.70	566757.69	668.25
2-W15-82	135610.37	566786.42	662.04
2-W15-84	135609.77	566728.61	669.76
2-W15-85	135643.71	566757.45	664.06
2-W15-86	135592.16	566742.84	663.63
2-W15-9	135631.36	566763.35	661.24
2-W15-95	135631.35	566752.75	662.25
2-W18-10	135300.69	566485.91	681.89
2-W18-11	135265.62	566439.60	683.85
2-W18-12	135308.00	566439.77	683.38
2-W18-149	135447.52	566547.01	672.79
2-W18-150	135370.30	566547.47	670.09
2-W18-158	135428.19	566532.34	672.84

Northing and Easting are in meters using NAD83(1991) Zone is WCS83S/1991
 Ngvd29 is the elevation of the top of casing in ft calculated from ACOE values
 originally reported in meters (converted using 39.37/12)

5/25/93

PHASE 1 & 2 ACOE SURVEY RESULTS

Well	Northing	Easting	Ngvd29 (ft)
2-W18-159	135416.93	566547.04	671.07
2-W18-163	135433.97	566562.21	672.78
2-W18-164	135359.47	566547.21	678.46
2-W18-165	135402.40	566532.43	672.37
2-W18-166	135380.21	566532.32	671.40
2-W18-167	135412.56	566562.19	673.12
2-W18-168	135391.14	566562.57	671.94
2-W18-169	135369.79	566562.41	671.91
2-W18-17	135425.24	566702.76	672.86
2-W18-170	135394.26	566547.12	672.56
2-W18-171	135350.50	566546.53	677.86
2-W18-172	135479.82	566548.93	678.25
2-W18-173	135440.70	566554.64	673.54
2-W18-174	135437.38	566558.21	673.45
2-W18-175	135392.14	566547.08	671.73
2-W18-18	135317.38	566650.14	670.76
2-W18-19	135202.53	566610.49	671.08
2-W18-2	135383.59	566380.16	683.45
2-W18-20	135081.76	566590.09	670.30
2-W18-24	135346.30	566370.87	684.60
2-W18-6	135412.83	566513.08	679.43
2-W18-65	135461.16	566550.69	678.11
2-W18-7	135409.80	566580.97	678.43
2-W18-76	135441.91	566544.32	671.34
2-W18-77	135431.16	566544.97	670.40
2-W18-78	135441.80	566548.71	671.17
2-W18-79	135431.64	566549.44	670.40
2-W18-80	135425.93	566548.77	670.06
2-W18-81	135434.17	566546.24	673.12
2-W18-82	135216.03	566395.55	684.21
2-W18-85	135343.99	566512.13	679.96
2-W18-86	135379.64	566504.41	683.69
2-W18-87	135341.16	566546.83	677.45
2-W18-88	135438.24	566598.68	679.98
2-W18-89	135456.98	566501.08	681.53
2-W18-9	135302.12	566472.96	682.68
2-W18-93	135269.39	566454.95	683.45
2-W18-94	135244.01	566462.69	682.60
2-W18-95	135244.99	566435.27	683.72
2-W18-96	135293.83	566435.23	683.77
2-W18-97	135269.49	566490.24	681.84
2-W18-98	135328.93	566462.51	682.70
2-W18-99	135331.72	566496.31	682.01
2-W7-4	137308.24	566408.77	671.92
2-W7-5	137635.69	566476.03	673.23
3-1-1	116588.84	594359.99	376.66

Northing and Easting are in meters using NAD83(1991) Zone is WCS83S/1991
 Ngvd29 is the elevation of the top of casing in ft calculated from ACOE values
 originally reported in meters (converted using 39.37/12)

**Supplementary Horizontal Well Ties - Phase III
U.S. Department of Energy Hanford Site**

Datum: NAD83(1991)

Zone: Washington Coordinate System of 1983

South Zone (WCS83S/1991)

Units: Meters

Well Number	Well Designation	Latitude	Longitude	Northing	Easting	Convergence	Scale factor
801	199-K-10	46°38'56.35046" N	119°35'58.93216" W	146628.096	568912.763	0°39'14.298"	0.999915218
802	199-K-21	46°39'38.26071" N	119°35'17.91438" W	147932.060	569769.902	0°30'44.093"	0.999915464
803	2-E13-1	46°32'18.67295" N	119°32'22.88406" W	134404.512	573655.723	0°41'51.234"	0.999914927
804	2-E13-3	46°32'17.28066" N	119°32'24.02454" W	134361.232	573631.949	0°41'50.406"	0.999914932
805	2-E17-3	46°32'50.00499" N	119°31'11.68192" W	135390.495	575160.625	0°42'42.955"	0.999914815
806	2-E24-160	46°32'52.56833" N	119°31'19.79918" W	135467.488	574986.738	0°42'37.059"	0.999914807
807	2-E25-191	46°32'54.63493" N	119°30'35.28269" W	135543.121	575934.171	0°43'09.395"	0.999914801
808	2-E25-24	46°32'53.80767" N	119°30'23.10547" W	135520.843	576193.873	0°43'18.241"	0.999914803
809	2-E25-27	46°32'57.49273" N	119°30'25.73377" W	135633.908	576136.456	0°43'16.331"	0.999914792
810	2-E25-5	46°33'15.52303" N	119°30'46.77835" W	136184.937	575681.237	0°43'01.045"	0.999914741
811	2-E25-7	46°33'15.91573" N	119°30'43.74903" W	136197.868	575745.605	0°43'03.245"	0.999914740
812	2-E26-53	46°33'22.07517" N	119°30'46.33404" W	136387.341	575688.169	0°43'01.367"	0.999914725
813	2-E27-1	46°33'27.38775" N	119°31'41.31917" W	136536.816	574515.100	0°42'21.427"	0.999914712
814	2-E28-61	46°33'36.85615" N	119°32'12.09084" W	136821.099	573856.186	0°41'59.074"	0.999914691
815	2-E33-2	46°34'03.51224" N	119°32'22.85162" W	137641.271	573617.005	0°41'51.258"	0.999914644
816	2-E33-22	46°34'04.14139" N	119°32'22.47700" W	137660.792	573624.745	0°41'51.530"	0.999914643
817	2-E33-23	46°34'05.25675" N	119°32'22.81817" W	137695.139	573617.061	0°41'51.282"	0.999914641
818	2-E33-36	46°33'50.33771" N	119°32'01.87990" W	137239.981	574068.540	0°42'06.491"	0.999914665
819	2-E33-37	46°33'48.56165" N	119°32'00.83429" W	137185.421	574091.477	0°42'07.251"	0.999914668
820	2-E33-58	46°33'55.25416" N	119°32'14.53067" W	137388.475	573797.295	0°41'57.302"	0.999914657
821	2-E34-8	46°33'50.59518" N	119°31'55.39956" W	137249.622	574206.438	0°42'11.199"	0.999914665
822	2-W11-61	46°33'34.08592" N	119°37'25.20986" W	136657.806	567188.917	0°38'11.626"	0.999914697
823	2-W11-70	46°33'25.57322" N	119°37'37.40250" W	136392.107	566932.165	0°38'02.769"	0.999914716
824	2-W11-81	46°33'38.81001" N	119°37'32.86840" W	136801.847	567024.200	0°38'06.063"	0.999914687
825	2-W11-82	46°33'26.07170" N	119°37'37.31526" W	136407.518	566933.853	0°38'02.832"	0.999914715

**Supplementary Horizontal Well Ties
U.S. Department of Energy Hanford Site - Phase III**

Datum: NAD83(1991)

Zone: Washington Coordinate System of 1983

South Zone (WCS83S/1991)

Units: Meters

Well Number	Well Designation	Latitude	Longitude	Northing	Easting	Convergence	Scale factor
826	2-W14-1	46°33'22.94469" N	119°37'36.45148" W	136311.178	566953.318	0°38'03.460"	0.999914723
827	2-W14-3	46°33'23.97875" N	119°37'37.04100" W	136342.965	566940.409	0°38'03.032"	0.999914720
828	2-W14-53	46°33'24.73350" N	119°37'37.40642" W	136366.242	566932.368	0°38'02.766"	0.999914718
829	2-W14-62	46°33'24.98329" N	119°37'36.98106" W	136373.993	566941.342	0°38'03.075"	0.999914718
830	2-W15-63	46°33'11.32979" N	119°37'48.34833" W	135949.782	566703.896	0°37'54.818"	0.999914752
831	2-W19-89	46°32'36.91201" N	119°36'55.94926" W	134899.587	567831.861	0°38'32.881"	0.999914859
832	2-W19-90	46°32'37.22894" N	119°36'55.23724" W	134909.542	567846.919	0°38'33.398"	0.999914858
833	2-W22-74	46°32'05.48845" N	119°37'09.78737" W	133926.126	567547.903	0°38'22.829"	0.999914981
834	2-W22-75	46°32'23.74697" N	119°37'07.31923" W	134490.421	567594.191	0°38'24.621"	0.999914907
835	2-W26-1	46°31'50.01598" N	119°38'02.33274" W	133436.036	566433.606	0°37'44.660"	0.999915049
836	2-W26-51	46°31'55.06666" N	119°38'12.54653" W	133589.584	566214.265	0°37'37.241"	0.999915026
837	299-W14-9	46°33'01.52515" N	119°37'33.11356" W	135650.662	567031.737	0°38'05.885"	0.999914780
838	299-W27-1	46°31'59.78579" N	119°37'08.60222" W	133750.345	567575.120	0°38'23.689"	0.999915005
839	699-19-58	46°29'33.91293" N	119°33'37.18078" W	129298.752	572133.468	0°40'57.265"	0.999915891
840	699-22-70	46°30'03.24793" N	119°36'13.11339" W	130165.727	568798.297	0°39'03.996"	0.999915673
841	699-25-55	46°30'35.50856" N	119°32'51.28805" W	131212.146	573089.050	0°41'30.601"	0.999915456
842	699-25-70	46°30'35.92112" N	119°36'24.46542" W	131171.718	568544.855	0°38'55.750"	0.999915454
843	699-28-52A	46°31'04.13129" N	119°31'59.24159" W	132109.320	574187.625	0°42'08.408"	0.999915284
844	699-28-52B	46°31'04.27676" N	119°31'59.35405" W	132113.781	574185.173	0°42'08.326"	0.999915284
845	699-28-55	46°31'01.35911" N	119°32'48.52100" W	132010.950	573138.387	0°41'32.611"	0.999915300
846	699-29-70A	46°31'08.02162" N	119°36'27.66818" W	132162.002	568465.373	0°38'53.424"	0.999915262
847	699-29-70C	46°31'10.75183" N	119°36'26.27876" W	132246.629	568494.031	0°38'54.433"	0.999915247
848	699-29-70D	46°31'09.90937" N	119°36'24.52350" W	132221.042	568531.734	0°38'55.708"	0.999915252
849	699-29-78	46°31'16.98223" N	119°38'13.27572" W	132413.605	566211.593	0°37'36.711"	0.999915213
850	699-30-55	46°31'21.13469" N	119°32'48.16947" W	132621.578	573138.500	0°41'32.867"	0.999915191

SUPPLEMENTAL VERTICAL CONTROL
VERTICAL WELL LOCATIONS PHASE III
TERTIARY TIE ELEVATION LISTING

WELL #	WELL DESIGNATION	WELL IS MARKED	DISK/PLATE IS MARKED	HANFORD AREA	TERTIARY TIE	TERTIARY ELEVATION (METERS) NAVD 88	NGVD 29
801	189-K-10	K-10	N/A	100-K	N/A		
802	199-K-21	K-21	N/A	100-K	N/A		
803	2-E13-1	E13-1	N/A	200-E	N/A		
804	2-E13-3	E13-3	N/A	200-E	N/A		
805	2-E17-3	E17-3	N/A	200-E	N/A		
806	2-E24-160	01-10-01-160	N/A	200-E	N/A		
807	2-E25-191	E-25-191	299-E25-191	200-E	BRASS CAP	208.219	207.188
808	2-E25-24	E-25-24	N/A	200-E	N/A		
809	2-E25-27	E-25-27	E25-27	200-E	BRASS CAP	206.534	205.503
810	2-E25-5	E25-5	N/A	200-E	N/A		
811	2-E25-7	E-25-7	N/A	200-E	N/A		
812	2-E26-53	E26-53	E-26-53	200-E	X ON N RIM OF 8" OUTER CASING	201.322	200.291
813	2-E27-1	E27-1	299-E27-01	200-E	BRASS CAP	197.978	196.947
814	2-E28-61	B12	N/A	200-E	BRASS C/P	208.296	207.265
815	2-E33-2	E33-2	N/A	200-E	N/A		
816	2-E33-22	E33-22	N/A	200-E	X ON N RIM OF 4" PIEZOMETER	193.561	192.530
817	2-E33-23	E33-23	N/A	200-E	X ON N RIM OF 4" PIEZOMETER	193.365	192.334
818	2-E33-36	299-E33-36	299-E33-36	200-E	X ON N RIM OF 4" PIEZOMETER	192.793	191.762
819	2-E33-37	299-E33-37	299-E33-37	200-E	BRASS CAP	197.279	196.248
820	2-E33-58	E33-58	N/A	200-E	BRASS CAP	199.188	198.157
821	2-E34-8	299-E34-8	299-E34-8	200-E	N/A		
822	2-W11-61	T-9	N/A	200-E	BRASS CAP	195.414	194.383
823	2-W11-70	11-70	N/A	200-W	N/A		
824	2-W11-81	W-11-81	N/A	200-W	N/A		
825	2-W11-82	11-82	N/A	200-W	N/A		
826	2-W14-1	W14-1	N/A	200-W	N/A		
827	2-W14-3	14-3	N/A	200-W	N/A		
828	2-W14-53	14-53	N/A	200-W	N/A		
829	2-W14-62	14-62	N/A	200-W	N/A		
830	2-W15-63	63	N/A	200-W	N/A		
831	2-W19-89	W-19-89	W19-89	200-W	BRASS PLUG	212.073	211.041
832	2-W19-90	W-19-90	W19-90	200-W	BRASS PLUG	211.882	210.850
833	2-W22-74	W-22-74	NOT MARKED	200-W	BRASS PLUG	208.280	207.248
834	2-W22-75	W-22-75	N/A	200-W	NORTH RIM OF 8" STEEL BASE PIPE	211.301	210.269
835	2-W26-1	W26-1	N/A	200-W	N/A		
836	2-W26-51	2-W26-51	N/A	200-W	N/A		
837	299-W14-9	W14-9	NOT MARKED	200-W	BRASS PLUG	207.475	206.443
838	299-W27-1	W-27-1	W27-1	200-W	BRASS PLUG	206.192	205.160
839	699-19-58	19-58	N/A	600	NORTH RIM 1" STEEL PIPE	175.648	174.617
840	699-22-70	22-70	N/A	600	NORTH RIM OF S.E. 2" STEEL PIPE	188.469	187.437
840	699-22-70	22-70	N/A	600	NORTH RIM OF S.W. 2" STEEL PIPE	188.469	187.437
841	699-25-55	25-55	N/A	600	TOP OF STANDARD FAUCET	188.469	187.465
842	699-25-70	25-70	N/A	600	SOUTH RIM 3/4" STEEL PIPE	207.263	206.232
842	699-25-70	25-70	699-25-70	600	BRASS PLUG	192.555	191.523
843	699-28-52A	28-52A	699-25-70	600	NORTH RIM 3/4" STEEL PIPE	192.978	191.896
844	699-28-52B	6 28 52B	N/A	600	N/A		
845	699-28-55	699-28-55	N/A	600	X ON N RIM OF 8" OUTER CASING	209.643	208.612

WHC-SO-EN-TI-202 REV. 0

END

**DATE
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12/02/93