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Characterization of the Geology, Geochemistry, and Microbiology of the Radio Frequency Heating Demonstration Site at the Savannah River Site^(U)

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Prepared for the U.S. Department of Energy under contract no. DE-AC09-89SR18035

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Characterization of the Geology, Geochemistry, and Microbiology of the Radio Frequency Heating Demonstration Site at the Savannah River Site

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Objective

The overall objective of the Integrated Demonstration Project for the Remediation of Organics at Nonarid Sites at the Savannah River Site (SRS) is to evaluate innovative remediation, characterization, and monitoring systems to facilitate restoration of contaminated sites. The first phase of the demonstration focused on the application and development of *in situ* air stripping technologies to remediate sediments and groundwater contaminated with volatile organic compounds (VOCs). The second phase focused on the enhancement of the *in situ* air stripping process by adding selected nutrients to stimulate naturally occurring microorganisms that degrade VOCs. The purpose of the third phase was to evaluate the use of heating technologies [radio frequency (RF) and ohmic heating] to enhance the removal of contamination from clay layers where mass transfer is limited.

The objective of this report is to document pretest and post-test data collected in support of the RF heating demonstration. The following data are discussed in this report:

- a general description of the site including piezometers and sensors installed to monitor the remedial process
- stratigraphy, lithology, and a detailed geologic cross section of the study site
- tabulations of pretest and post-test moisture and VOC content of the sediments
- sampling and analysis procedures for sediment samples
- microbial abundance and diversity
- three-dimensional images of pretest and post-test contaminant distribution
- volumetric calculations

The description of the remedial process, detailed modeling and performance evaluation, and results from fiber optic temperature sensor data will be documented in separate reports.

Introduction

Vadose zone characterization data collected previously as part of the Integrated Demonstration Project at SRS have clearly identified a shallow clay layer (30–45 ft deep) located below a portion of the abandoned process sewer line between the M-Area Metal Fabrication Facility and the M-Area Seepage Basin that contains significant quantities of VOCs (WSRC-RP-90-1335 and WSRC-RD-91-22). Analysis of sediment samples collected during installation of characterization wells have identified both trichloroethylene (TCE) and perchloroethylene (PCE) within the clay zone at elevated levels relative to the surrounding sandy sediments. The slow release of solvent from this clay provides a long-term source for groundwater contamination. While vacuum extraction can remove the contaminants from the clay before they reach the groundwater, this method is still limited by mass transfer out of the clay, resulting in unacceptably long remedial campaigns. Heating the clays to increase removal of the VOCs in conjunction with vacuum extraction is one of the most promising *in situ* treatment options. By selectively heating the clays to temperatures at or above 100°C, the release and transport of TCE and PCE will be enhanced as a result of several factors, including the following:

- an increase in the contaminant vapor pressure and diffusivity
- an increase in the effective porosity of the sediment with the release of water vapor and contaminant
- enhanced removal from *in situ* steam stripping by the water vapor generated from heating to temperatures in excess of 100°C

Other methods of subsurface heating (e.g., hot air or steam injection) are poorly suited to heating clay layers because of the low permeability of clay.

The purpose of this field demonstration was to test and evaluate the enhanced removal of chlorinated VOCs from subsurface sediments using *in situ* RF heating. A horizontal well was installed in the clay zone using an innovative directional drilling technique developed by Charles Machine Works (Ditch Witch®). A fiberglass, epoxy line pipe casing, approximately 600 ft long with 300 ft of slotted fiberglass well screen, was installed. The installation procedure and well construction of the horizontal well are described in detail in a separate report (WSRC-TR-93-008). An antenna that emits RF radiation was placed in the horizontal well. The dielectric properties of the contaminated clay zones preferentially capture the RF energy, focusing the applied power precisely in the zones that need to be heated. The RF heating project used a dipole applicator developed and patented by KAI Tech., Inc. The single wand applicator is approximately 17 feet in length and operates at 13.56 MHz with a maximum power output of 25 kW. During the heating, the same horizontal well was used for vacuum extraction.

To assess the effectiveness of the heating technology, pre-demonstration and post-demonstration sediment cores were collected from boreholes within and surrounding the heated zone and in a cold control zone (WSRC-RP-92-1428). Lithologic description of the cores were used to generate cross sections to confirm the location of the targeted clay and to aid in the interpretation of subsurface temperature and pressure patterns. Samples from the cores were analyzed for the following:

- chlorinated volatile organic content to determine changes in the residual contaminant concentrations
- moisture content to determine potential changes in effective permeability to gas flow and to aid in the calculations of RF absorption efficiency
- microbial community population to determine the temperature regimes which accelerate growth or kill subsurface organisms

Three-dimensional images of pre- and post-distribution of PCE and TCE were prepared and contaminant inventories were estimated from the images.

Geology and Stratigraphy

SRS is located on the Atlantic Coastal Plain. The Coastal Plain sediments are approximately 1000 feet thick at SRS, and are dominantly composed of stratified clay, sand, and gravel. In general, these sediments dip gently to the south-east. Brief lithologic descriptions of the stratigraphic units from the surface to a 200-ft depth at the Integrated Demonstration Site (IDS) are available in Eddy Dilek et al. (1993). The unsaturated sediments within the top 60 ft are

of interest to this study. They consist of sands, sandy clays, clayey sands, and clays deposited in Late Eocene to Miocene.

Methods

Core samples were described in the WSRC core logging facility using a standardized procedure for the description of core material. A sample of core material is homogenized over a one-foot interval and described (Procedure ESSOP-2-15: Microscopic Examination of Sediment Cores). Descriptions made using this procedure ignore lithologic features less than a foot in thickness and reflect a "whole-rock" lithologic classification of the sediment. For example, an interval containing 40% sand-sized material and 60% mud-sized material in discrete interbeds would be classified as a sandy clay. An interval containing the same percentage distributions but with the mud fraction dispersed throughout the interval as matrix would also be classified as a sandy clay. These intervals may appear identical on a geologic cross section despite their differences in depositional environment and hydrologic properties.

Two hydrogeologic cross sections across the IDS were constructed along north-south and east-west trends, intersecting at well MHV21. A total of 10 borings was used to construct the cross sections (Table 1). Continuous core description and core samples are available for all of the wells. Geophysical logs were only available for the deepest well MHT16C, which penetrated to a depth of 200 ft. The cross sections presented in this report are tied by well MHT16C to cross sections prepared for earlier phases of the Integrated Demonstration Project (Eddy Dilek 1993).

Individual sediment types represented on the cross sections may appear very different because of symbol and color change; however, the variations in lithology are relatively continuous. Examples of this are common in the Upland Unit, which consists of both sandy clays with a high sand content and clayey sands with a high mud content. A clayey sand composed of 45% mud matrix is very similar to a sandy clay composed of 55% mud matrix. The clayey sand will be yellow on the cross section and the sandy clay will be green. This gives the impression that these sediments have different properties and the boundary represents a sharp lithologic change when in fact the change is gradational.

Because of previous construction projects in the study area, including removal of the process sewer line, the surficial 5–10 ft of sediments have been disturbed. It is difficult to distinguish between this fill material and the sediments because of the coarse texture and massive bed-

ding of the Upland Unit, so correlations in the surficial sediment should be interpreted with caution.

Discussion

Lithostratigraphic units identified during the core-logging process include the Upland Unit and Tobacco Road Sand.

Tobacco Road Sand

The Tobacco Road Sand consists of light grayish purple to moderate grayish purple, medium- to fine-grained sand to clayey sand with approximately 10–15% interstitial mud. The top of the Tobacco Road Sand is marked by a moderate grayish purple clay to clayey sand that varies in thickness from 18 to 6 ft. The sandy portion of the unit tends to contain more clay (up to 30%) at the base. The unconformable contact with the overlying Upland Unit is very irregular, suggesting heavy scouring of the Tobacco Road Sand during deposition of the Upland Unit.

Upland Unit

The Upland Unit is reddish orange to brown to purple with a highly variable lithology. The unit ranges from poorly sorted, gravely sand to clay that contains virtually no sand. The unit has a distinctive speckled appearance in sandier layers. The contact of this unit with the underlying Tobacco Road Sand is unconformable and highly irregular.

Gravel-sized clay balls are common in the Upland Unit. Moderate grayish purple clay balls of boulder size have been observed in core samples. Boulder-sized clay balls in the core material were identified and differentiated from individual clay layers based on the following criteria and observations:

- The clay balls have a light yellowish orange weathering rind.
- The sediment has a relatively coarse texture near the clay balls.
- Numerous cobble and pebble-sized clay balls associated with the boulder size clasts.
- Clay balls at the base of the Upland Unit are commonly seen in outcrop. This outcrop exposing boulder size purple clay balls is found on the north side of Road F just southeast of Upper Three Runs at SRS. These clay balls are probably reworked from a clay layer of similar lithology at the top of the Tobacco Road Sand.

The highly interbedded sediments govern gas and fluid flow in the subsurface at the IDS. The water table is located at an elevation of approximately 230 ft above mean sea level (msl) (a depth of approximately 130–140 ft below surface). The sitewide and local hydrostratigraphy, subsurface hydrologic properties, hydrologic conditions, and vadose zone properties at the IDS are addressed in the pre- and post-test characterization reports (WSRC-RD-91-21, WSRC-TR-93-369). In these reports, four semi-confining/confining zones in the vadose and saturated zone at the IDS are delineated, named for the approximate elevations at which they were found (Eddy et al. 1991). These are, from the surface down, the “325-ft clay”, the “300-ft clay”, the “270-ft clay” (“tan clay”), and the “200-ft clay” (“green clay”) zones. The “325-ft clay” and the “300-ft clay” are in the vadose zone, impacting the flow of gases above the water table and recharge of air and water from the ground surface.

The “325-ft clay” is the unit that was targeted in the RF heating study. It varies in thickness significantly across the RF heating demonstration site from 5.3 to 17.6 ft. It consists of sediments assigned to the Tobacco Road Sand. The majority of the clay and sandy clay in the unit consist of interbedded sand and clay. The estimated porosity (per ESSOP-2-15) ranges from poor in the clay and sandy clay to good in interbedded sand.

There are two contributing factors for the significant variations in thickness of the “325-ft clay”, the erosional unconformity at the top of the Tobacco Road Sand and variations in depositional facies. The variations due to the erosional unconformity at the base of the Upland Unit are minor. However, the combination of the two can greatly reduce the thickness of this unit over a very short distance. This is observed in MHV-22, where this unit is only 5.3 ft in thickness. Core description data shows that the “325-ft clay” comprises layers of clayey sand, sandy clay, and clay, with subordinate sand layers. Hydrostratigraphic picks for these zones determined from the cross sections are summarized in Table 1.

The lithostratigraphy of the IDS is illustrated in detail on two hydrogeologic cross sections (Plates ??). The “325-ft clay” varies greatly in thickness in a relatively short distance, but it is a continuous confining layer across the site. The cross sections illustrate the intercalated geology of the confining zones and demonstrate the overall discontinuity of the individual clayey layers within each zone.

Table 1. Picks for the "325-ft. Clay" Confining Zone Used in Construction of Cross Sections

Well I.D.	Total Core (ft)	Ground Elevation* (ft msl)	Depth Top (ft)	Depth Bottom (ft)	Elevation Top (ft msl)	Elevation Bottom (ft msl)	Unit Thickness (ft)
MHT-16Cb	200	359.1	36.0	47.0	323.1	312.1	11.0
MHV-20a	60	359.3	36.0	46.0	323.3	313.3	10.0
MHV-21a	60	359.2	34.0	46.0	325.2	313.2	12.0
MHV-22a	60	359.2	34.7	40.0	324.5	319.2	5.3
MHV-23a	60	359.2	35.7	46.0	323.5	313.2	10.3
MHV-24a	60	360.0	32.0	43.0	328.0	317.0	11.0
MHV-25a	60	359.0	34.0	46.0	325.0	313.0	12.0
MHV-26a	60	359.4	31.0	46.0	328.4	313.4	15.0
MHV-27a	60	359.5	32.4	50.0	327.1	309.5	17.6
MHV-28a	60	359.5	34.3	45.0	325.2	314.5	10.7

* Ground Elevations used for MHV wells were surveyed stake positions (11/6/92).

Demonstration Site Description

Wells and Borings

The nature and extent of solvent contamination at the IDS was determined by collecting sediment samples from 10 borings (designated by the prefix MHV). Five borings were installed parallel approximately 10 ft away from the horizontal well AMH5 (Figure 1). An additional two locations in line with MHV21 were installed perpendicular to the trend of the horizontal well. Three additional locations were chosen outside the predicted zone of heating to serve as control locations. Since the target clay layer ("325-ft clay") that was heated is located at depths from 30 to 45 ft, the borings were drilled with a hollow stem auger to a nominal 60-ft depth to characterize contamination above, within, and below the clay. Continuous sediment cores were collected with a split-spoon sampler starting at approximately 25 ft to total depth. Samples were collected at selected intervals from the cores in the field for chemical and microbial analysis, and determination of moisture content. Geologic descriptions of the core were prepared in the field (Appendix I).

Multiple characterization and monitoring devices were installed. In each of the 10 locations, a piezometer cluster was installed that consisted of three piezometers, each consisting of 1-inch schedule 40 polyvinyl chloride casing with a 5-ft screened interval at the bottom (Table 2). The tops of 5-ft screens were set at 28, 38, and 48 feet in each cluster to monitor contaminant concentrations and pres-

ures above, within, and below the clay layer. Well construction diagrams for the piezometers are provided in Appendix I.

A second borehole was installed next to each piezometer cluster and an array of thermocouples, fiber optic temperature sensors, and electrodes for electrical resistance tomography were installed (Table 3). These locations are designated by the well number of the associated piezometer cluster and are designated with the suffix T. For example, the temperature sensors adjacent piezometer MHV22 would be MHV22T (Figure 1). Three thermocouples were placed in each location at approximately 28, 38 and 48 feet depth. Well construction details for these installations are given in Appendix I. The installation and operation of fiber optic temperature sensors and electric resistance tomography electrodes will be presented in separate reports.

For the post-test characterization effort, cores were collected, if possible, adjacent to each of the MHV clusters. Figure 1 shows the location of pre- and post-test borings. Three of the cores, one core from the control zone (MHB28V) and two from the heated zone (MHB21V and MHB24V), were collected immediately after the antenna was turned off and the ground was still hot. This was done to collect samples that would have microbial assemblages and VOC contents representative of peak heating conditions. After a 14-day cool-down period, the remaining seven cores were collected to obtain the rest of the sediment samples.

Radio Frequency Heating Demonstration Site Characterization

Table 2. Construction Details for MHV Piezometer Clusters

Well ID	SRS North	SRS East	TOC	Depth Screen	Screen Length	Top of Screen	Bottom of Screen	Pad Elevation
MHV 20A	102418.35	48658.30	361.75	48	4.90	312.35	307.45	359.6
MHV 20B	102418.35	48658.30	361.74	38	4.89	322.14	317.25	359.6
MHV 20C	102418.35	48658.30	361.74	28	4.90	331.94	327.04	359.6
MHV 21A	102433.61	48661.47	361.95	48	4.90	312.45	307.55	359.7
MHV 21B	102433.61	48661.47	361.96	38	4.90	322.36	317.46	359.7
MHV 21C	102433.61	48661.47	361.97	28	4.90	332.27	327.37	359.7
MHV 22A	102443.46	48663.79	361.95	48	4.91	312.45	307.54	359.7
MHV 22B	102443.46	48663.79	361.97	38	4.89	322.27	317.38	359.7
MHV 22C	102443.46	48663.79	361.95	28	4.89	332.25	327.36	359.7
MHV 23A	102458.02	48666.89	361.93	48	4.89	312.46	307.57	359.7
MHV 23B	102458.02	48666.89	361.91	38	4.89	322.34	317.45	359.7
MHV 23C	102458.02	48666.89	361.95	28	4.89	332.32	327.43	359.7
MHV 24A	102439.80	48636.88	362.74	48	4.90	313.34	308.44	360.5
MHV 24B	102439.80	48636.88	362.72	38	4.89	323.12	318.23	360.5
MHV 24C	102439.80	48636.88	362.76	28	4.89	333.06	328.17	360.5
MHV 25A	102428.94	48680.95	361.46	48	4.90	311.96	307.06	359.1
MHV 25B	102428.94	48680.95	361.47	38	4.90	321.87	316.97	359.1
MHV 25C	102428.94	48680.95	361.47	28	4.89	331.77	326.88	359.1
MHV 26A	102404.20	48655.31	362.13	48	4.91	312.53	307.62	359.8
MHV 26B	102404.20	48655.31	362.13	38	4.89	322.53	317.64	359.8
MHV 26C	102404.20	48655.31	362.09	28	4.90	332.39	327.49	359.8
MHV 27A	102374.32	48654.50	362.05	48	4.90	312.45	307.55	359.9
MHV 27B	102374.32	48654.50	362.04	38	4.89	322.44	317.55	359.9
MHV 27C	102374.32	48654.50	362.05	28	4.90	332.35	327.45	359.9
MHV 28A	102366.27	48647.61	362.22	48	4.89	312.72	307.83	359.9
MHV 28B	102366.27	48647.61	362.24	38	4.90	322.64	317.74	359.9
MHV 28C	102366.27	48647.61	362.22	28	4.89	332.52	327.63	359.9
MHV 29A	102362.22	48661.78	361.80	48	4.91	312.30	307.39	359.6
MHV 29B	102362.22	48661.78	361.79	38	4.90	322.19	317.29	359.6
MHV 29C	102362.22	48661.78	361.80	28	4.89	332.00	327.11	359.6

WSRC-RD-93-XXX

Table 3. Construction Details for MHV-T Sensors

Well ID	SRS North	SRS East	Pad elevation	Fiber Optic depth	Thermocouple depth	Electrode depth	Fiber Optic elevation	Thermocouple elevation	Electrode elevation
MHV 20T	102420.47	48649.84	359.9	28.0	28.0	none	331.65	331.70	none
			359.9	33.0	38.0		326.65	321.70	
			359.9	38.0	48.0		321.65	311.70	
			359.9	43.0			316.65		
			359.9	48.0			311.65		
			359.9	53.0			306.65		
MHV 21T	102435.54	48653.51	360.0	28.0	28.0	15.0	331.80	331.75	344.75
			360.0	33.0	38.0	20.0	326.80	321.75	339.75
			360.0	38.0	48.0	25.0	321.80	311.75	334.75
			360.0	43.0		30.0	316.80		329.75
			360.0	48.0		35.0	311.80		324.75
			360.0	53.0		40.0	306.80		319.75
			360.0			45.0			314.75
			360.0			50.0			309.75
			360.0			55.0			304.75
			360.0			60.0			299.75
MHV 22T	102446.01	48657.10	360.0	28.0	28.0	none	331.80	331.75	none
			360.0	33.0	38.0		326.80	321.75	
			360.0	38.0	48.0		321.80	311.75	
			360.0	43.0			316.80		
			360.0	48.0			311.80		
			360.0	53.0			306.80		
MHV 23T	102460.80	48661.00	359.9	28.0	28.0	none	331.70	331.65	none
			359.9	33.0	38.0		326.70	321.65	
			359.9	38.0	48.0		321.70	311.65	
			359.9	43.0			316.70		
			359.9	48.0			311.70		
			359.9	53.0			306.70		
MHV 24T	102442.60	48640.86	360.4	28.0	28.0	15.0	332.20	332.15	345.15
			360.4	33.0	38.0	20.0	327.20	322.15	340.15
			360.4	38.0	48.0	25.0	322.20	312.15	335.15
			360.4	43.0		30.0	317.20		330.15
			360.4	48.0		35.0	312.20		325.15
			360.4	53.0		40.0	307.20		320.15
			360.4			45.0			315.15
			360.4			50.0			310.15
			360.4			55.0			305.15
			360.4			60.0			300.15

Radio Frequency Heating Demonstration Site Characterization

Well ID	SRS North	SRS East	Pad elevation	Fiber Optic depth	Thermocouple depth	Electrode depth	Fiber Optic elevation	Thermocouple elevation	Electrode elevation
MHV 25T	102424.54	48679.01	359.0	28.0	28.0	15.0	330.80	330.75	343.75
			359.0	38.0	38.0	20.0	320.80	320.75	338.75
			359.0	48.0	48.0	25.0	310.80	310.75	333.75
			359.0			30.0			328.75
			359.0			35.0			323.75
			359.0			40.0			318.75
			359.0			45.0			313.75
			359.0			50.0			308.75
			359.0			55.0			303.75
			359.0			60.0			298.75
MHV 26T	102406.07	48647.86	359.9	28.0	28.0	none	331.70	331.65	none
			359.9	38.0	38.0		321.70	321.65	
			359.9	48.0	48.0		311.70	311.65	
MHV 27T	102380.37	48650.30	359.9	28.0	28.0	none	331.70	331.65	none
			359.9	38.0	38.0		321.70	321.65	
			359.9	48.0	48.0		311.70	311.65	
MHV 28T	102367.03	48642.91	360.0	28.0	28.0	none	331.75	331.75	none
			360.0	38.0	38.0		321.75	321.75	
			360.0	48.0	48.0		311.75	311.75	
MHV 29T	102363.75	48656.42	359.8	28.0	none	none	331.60	none	none
			359.8	38.0			321.60		
			359.8	48.0			311.60		

Figure 1. Well and Boring Locations for the Radio Frequency Heating Demonstration

Sampling and Analysis of Sediment Samples

Sediment samples were collected during characterization activities using the same protocols as the pretest characterization summarized below and described in detail in Eddy et al. (1993), Looney et al. (1993), and Looney et al. (in review).

Sediment samples for VOC analysis and moisture content determination were collected from the split spoon as soon as it was opened using a plunger in a syringe with the end cut off. For moisture content samples, the sediment plug was placed in a preweighed vial that was then sealed. In the laboratory, the vials were weighed, opened, and placed into a drying oven and dried at 60°C. The samples were reweighed daily until the variance between the individual weighings was small.

Samples for VOC analysis were packed on ice, taken to the laboratory daily, and stored in a refrigerator until analyzed. VOC analyses were performed on a Hewlett-Packard 5890 Gas Chromatograph with electron capture and flame ionization detectors, an HP 19395A Headspace Sampler, an HP 3392A Networking Integrator, and a 60-m $\times$ 0.75-mm inner-diameter Supelco VOCOL wide-bore capillary column coated with a 1.5-mm film. The instrument was calibrated using samples spiked with standard solution. Analytical techniques used are presented in detail in Eddy et al. (1993) and Looney, Eddy, and Sims (in review).

Core specimens for microbial analyses were obtained directly from the split spoon or barrel. Cores were sectioned into 3-in. lengths with sterile spatulas and the outermost layer (about 1/4 the diameter of the core) was scraped off using sterile techniques. The sample was then placed in a sterile Whirl-Pak® bag for immediate transport to the laboratory for analysis.

In Situ Moisture Content

Moisture content or soil water (Θ_g) was determined for duplicate samples collected from six sediment cores—three from the pretest characterization (MHV21, MHV22, and MHV24) and three collected directly after the RF source was turned off (MHB21, MHB24, and MHB28)—to assess the effects of the heating on the moisture content of the samples (Appendix II).

Methods

Gravimetric moisture content (g water/ g soil) is the most straight-forward expression of soil water content. Gravimetric moisture is the difference in weight between the dry and moist sediment expressed as a fraction of the moist weight. The most commonly used expression of soil moisture is volumetric moisture content. Since the volumes of each sample was not measured in this study, the volumetric moisture content (Θ_v) of the sediments can only be estimated. The following assumptions were made in these calculations:

- 1.6 was used for the bulk density of clay
- 1.65 for the bulk density of sand and gravel
- 48% porosity for the clay fraction
- 35% for the sand fraction
- 2.6 for the density of clay
- 2.65 for the density of sand and gravel

These numbers are based on geotechnical measurements made on nearby cores from the IDS (Eddy et al. 1993). Grain-size distribution were made by microscopic examination of the cores in the laboratory.

Results

Calculated values of volumetric moisture content ranged from 36 to 99% for pretest samples and 34 to 95% for post-test samples. Three samples had moisture contents of above 100%. These samples were collected from a sandy zones where perched water zones had been observed during drilling and may represent true values.

Two observations can be made about distribution of moisture in the study area. First, in any given core, the clay-rich zones have higher moisture contents than the sandy zones. Second, the pretest moisture content of sediments in the target clay zone were substantially reduced during the heating. This is shown in Figure 2; results obtained from pretest boring MHV24 and the adjacent post-test boring MHB24 plotted against depth. In the zone from 33 to 43 ft, where the sediments are classified as clays (Appendix II), both the pretest and post-test moisture contents are higher than in the overlying and underlying sandy zones. In the overlying and underlying zones, the moisture contents vary significantly and a clear relationship between pretest and post-test values is not evident. Deviations from the general trends at nearby depths may also result from sampling a different lithology in the pretest and post-test sampling. The same general trends can be observed for MHV21 and MHB21 (Figure 3). The results from the control zone (MHV28) are very similar to the pretest samples.

Figure 2. Pretest Boring MHV24 and Adjacent Post-test Boring MHB24 Plotted Against Depth

Figure 3. Pretest Boring MHV21 and Adjacent Post-test Boring MHB21 Plotted Against Depth

Microbiology

Sediment samples from MHV21, MHV22T, MHV23, MHV24, MHV25 and MHB21, MHB22, MHB24, and MHB25 were at 5-ft intervals (starting at 35 ft) and evaluated for bacterial and fungal populations prior to and after the RF heating demonstration (Table 4).

Materials and Methods

Microorganisms were extracted from the core samples by vortexing for 60 seconds with homogenizing buffer (pH 7.0), sonicated for 30 seconds, and centrifuged at 2200 RPM for five minutes. This process was repeated three times for each sample, and the supernatant pooled after each extraction. Ten μL of extract was placed into each well of three toxoplasmosis slides for acridine orange direct counts (AODCs) and fluorescent antibody staining. Duplicate Biolog GN Microplates were inoculated with the extract for each sample. The plates were incubated at 25°C. 1% PTYG plates without the antifungal antibiotic cyclohexamide were inoculated with the spread plate technique by plating 10, 100, and 500 μL of the extract in triplicate. One of each was incubated at 25°, 45°, and 60°C. In addition, MHV23 and MHV24 pretest sediment samples were vortexed in pyrophosphate buffer (pH 7.0), diluted in phosphate buffered saline, and plated in triplicate on 1% PTYG plates without cyclohexamide. These plates were also incubated at the three temperatures. Sediment sample was plated directly on 1% PTYG plates, spread with 100 μL homogenizing buffer, and incubated at all three temperatures.

Selected bacterial strains were analyzed because they represented some of the microbial structural components of the ecosystem being investigated. Species specific direct fluorescent antibodies (DFAs) were prepared against the major microbial communities involved in nitrogen transformation in soils and groundwater (i.e., *Azotobacter*, *Nitrosolobus*, *Nitrosomonas*, and *Nitrobacter*), as well as those species of *Nitrosomonas* involved in the production of enzymes capable of degrading TCE; a bacterium that is pathogenic, but widely distributed in nature (*Legionella pneumophila*); a widely distributed bacterium associated with our systems and involved in iron transformations (*Thiobacillus ferrooxidans*); and two organisms that have been involved in the destruction of TCE as well as transformation of methane in the laboratory (SRL-MIIF and *Methanobacterium*). Each of these organisms have been isolated from SRS habitats. The following is a more defined characterization of the bacteria:

- *Azotobacter chroococcum* is a free-living heterotrophic, nitrogen-fixer that lives under aerobic conditions.
- *Nitrosolobus multiformis* and *Nitrosomonas europaea* are morphologically distinct chemolithotrophs that obtain their energy from oxidizing ammonia to nitrite while fixing CO_2 as their sole carbon source.
- *Nitrobacter agilis* and *Nitrobacter winogradskyi* are chemolithotrophs that secure their energy by oxidizing nitrite to nitrate while fixing CO_2 as their sole carbon source.
- SRL-MIIF is a Type II methanotroph isolated from the SRS with TCE-degrading capabilities.
- *Methanobacterium formicicum* is a heterotrophic, strict anaerobe that produces CH_4 from organic compounds such as acetate and cysteine.
- *Thiobacillus ferrooxidans* grows as a chemolithotroph that gets its energy by oxidizing ferrous iron to ferric iron while fixing CO_2 as its carbon source.
- *Legionella pneumophila* Serogroup 1 is a human pathogen and the major etiologic agent of Legionnaires' Disease, as well as an aquatic and terrestrial bacterium.

Results and Discussion

Samples collected prior to the RF heating demonstration indicated that after a two-week incubation period, the 1% PTYG plates incubated at 25°C showed very little microbiological growth (Table 4). Highest 1% PTYG densities for MHV21, MHV22T, and MHV23 were observed at the a depth of 35 ft, the most shallow depth sampled from microbiological analyses. Bacterial densities for the pretest collected at MHV24 and MHV25 indicated the greatest bacterial densities were present at 35 and 50 ft, respectively.

Data collected immediately after the RF heating demonstration indicated that viable bacteria from MHB24 grown on 1% PTYG plates incubated at 25°C were below detectable limits. Data collected from MHB21 during the heating phase indicated that the viable plate counts were elevated for samples from 48 and 55 ft, which experienced 76°F and 70°F temperatures, respectively. This represented a significant increase (3–4 orders of magnitude) from the pretest RF heating conditions. Post-test RF heating analyses indicated that all the samples from MHB22 and MHB25 tested for viable bacteria on 1% PTYG were below detectable limits, except for the sample at 34 ft from MHB22. None of the samples showed any growth at temperatures of incubation except 25°C. Fungal components were not a significant portion of the population observed on the 1% PTYG plates and are thus not reported.

Direct counts were made using acridine-orange staining techniques and the density of bacteria per gram of dry sediments was calculated. The data are reported in Table 4. The highest direct AODCs for pretest data were observed in MHT22T at all depths (25–55 feet). Direct counts from samples collected from cores MHB21 and MHB24 immediately after heating stopped were elevated. Analysis of samples from the post-RF heating samples showed that densities of bacterial cells remained above the pre-RF heating levels. These data indicate that RF heating appeared to cause an increase in cell density as measured by AODC, but that these bacteria were not readily grown on the 1% PTYG used for viable counts.

No Biolog GN plates inoculated with the sediment extract showed any positive (purple) wells after two weeks of incubation at 25°C.

DFA analyses were made for selected bacteria in each of the sediment samples. The organisms were selected in a pragmatic manner in that all of these organisms have been isolated from the IDS and have been characterized during the Integrated Demonstration Project conducted in M Area. The data provide the direct determination of densities of specific organisms without having to culture the organisms. The data indicate that most of the nitrogen transforming organisms (i.e., *Nitrosolobus multiformis*, *Nitrosomonas europaea*, *Nitrobacter agilis*, *Nitrobacter winogradskyi*) demonstrated no appreciable population change over the duration of the RF heating experiment. On the other hand, the densities of *Azotobacter chroococcum*, the nitrogen-fixing bacterium, were reduced by approximately one order of magnitude.

Methanobacterium formicicum, *Thiobacillus ferrooxidans*, and SRL-MIF demonstrated no change over the duration of the heating investigations. A somewhat surprising result was the affect that heating had on the densities of *Legionella pneumophila*. The data in Table 5 indicate that *Legionella pneumophila* densities were near the nondetectable limits in the pre-heating phase of the investigation, but increased dramatically (1–2 orders of magnitude) during the heating phase, only to return to pre-heat levels during the post phase. This is a most surprising result and is somewhat disconcerting. While microorganism respond to a Q10 affect (i.e., a 2–3 fold increase in metabolic activity for each 10 degree rise in temperature until the cardinal temperature is reached), to see this dramatic affect with a pathogen like *Legionella* has not heretofore been observed. *Legionella pneumophila* has properties of a thermophilic bacterium that would allow it to survive and grow under temperatures up to 63°C in aquatic habitats. The temperatures during the RF heating were above such levels where the bacterium was observed.

Isolation of *Legionella pneumophila* has been made from M-Area sediments in the past and currently we are attempting to isolate the organism from samples that were heated.

Clayey regions of the subsurface environment are not only a problem from a remediation point of view but also from a microbiological assessment. It has always been difficult to extract and culture microbial populations from the clay-rich sediments. This is again confirmed by the high AODC/colony forming unit ratio observed in the RF heating samples. The data indicate that microbial populations are present in the clay regions, but they are difficult to culture; the only way to adequately assess their impact is to use direct probing technologies such as DFAs or gene probes.

Contamination Distribution

Sediments sampled from the post-test borings were analyzed for both TCE and PCE content. There was a significant increase in the amount and extent of contamination, especially for PCE. Analytical results for all the post-test borings are reported in Appendix III and are plotted against depth in Appendix IV. Three-dimensional imaging techniques were used to prepare pre- and post-test images of TCE and PCE distribution (Figures 4–7).

Methods

The pre- and post-test values from chemical analysis were entered into a database and three-dimensional representations of the post-test data were prepared using a Silicon Graphics Workstation with Dynamic Graphics Software. The data from the pre- and post-test were modeled using the same parameters. The approach to modeling the data to produce the optimal representation of the data is summarized below and is presented in detail in Eddy and Looney (1993).

Two- and three-dimensional surfaces are used to bound the models to prevent large extrapolation errors in areas where no data control points are present. Second, the effects of important variable parameters (e.g., grid size, grid spacing, and weighting factors) were evaluated (Eddy and Looney 1993). A significant effort was made to use appropriate parameters to calculate the grids for the construction of the three-dimensional models. The grid cell spacing of approximately 5 × 5 × 1 ft was chosen to approximate the spacing between sediment borings. A very low z-influence factor (0.001) was used to enhance the lateral continuity of between-sample zones to mimic the heterogeneity imposed on the contaminant distribution by the strongly layered sediments. Logarithmic transformations, used

prior to gridding, are used to preserve the steep gradients found at the edges of the contaminant plumes. A semi-logarithmic scale was chosen for the contour intervals as it provided the best representation given the distribution of data values.

Volumetric Calculations

Results

The pretest distribution of solvent in the study area was strongly heterogeneous, governed by the location of the contaminant release and migration gradients, and by the interbedded coastal plain sediments (Eddy et al. 1991). Figures 4 and 5 show the pretest distribution of TCE and PCE at concentration of greater than 1 ppm for TCE and PCE. In general, the highest concentrations of TCE and PCE in the study area were found in the clay-rich sediments between 35 and 55 ft that were heated during the remedial demonstration. The pretest images for PCE and TCE show that stratified sediments contribute to the anisotropic distribution of the contamination in the study area. The solvent is distributed in discontinuous lenses that may correspond to clay-rich layers.

In contrast, the post-test models (Figures 6 and 7) also show a reduction in the zone of contamination, and the appearance of the models suggest a more homogeneous distribution of contamination. In addition, preliminary volume calculations indicate the amount of contamination in the modeled area increased during the remedial process. There is more solvent present and the concentrations in the most contaminated zones have increased significantly.

Preliminary conclusions from the modeling suggest that contamination was pulled into the model area during and was not removed by vacuum extraction. The appearance of the models indicates that the distribution of fine-grained sediments more strongly controlled the distribution of contamination prior to the heating experiment than after the demonstration. This suggests that the heating and vacuum extraction was successful in mobilizing and concentrating the sediment in the zone of the horizontal well. Unfortunately, because steam formed in the well, the extraction system was not effective at removing the material. These results in conjunction with detailed volumetric estimates will be investigated and discussed in detail in the future report on the remediation system.

Table 4. Microbiological Results from Sediment Samples Evaluated for Bacterial and Fungal Populations

Still need to
import; see
following pages

PRE Heating

Well ID	Depth (ft.)	Date	Temp °C	% Moisture	AODC#/gdw	CFU#/gdw	L. pneum/ gdw
MHV-21	35	11/20/92	PRE	16.86	0.00E+00	1.27E+02	<4.51E+04
MHV-21	40	11/20/92	PRE	22.22	1.14E+06	<3.70E+01	<3.94E+04
MHV-21	45	11/20/92	PRE	15.52	1.97E+06	<3.10E+01	<3.40E+04
MHV-21	50	11/20/92	PRE	9.23	7.81E+06	6.34E+01	<3.38E+04
MHV 22T	25	1/18/93	PRE	17.37	7.90E+07	3.25E+04	<2.00E+04
MHV 22T	30	1/18/93	PRE	11.84	5.36E+07	<6.56E+02	<2.08E+04
MHV 22T	35	1/18/93	PRE	17.89	1.57E+08	<7.11E+02	<2.18E+04
MHV 22T	40	1/18/93	PRE	15.99	3.29E+07	<5.72E+02	<1.95E+04
MHV 22T	45	1/18/93	PRE	11.11	4.44E+07	<5.81E+02	<1.96E+04
MHV 22T	50	1/18/93	PRE	10.79	4.63E+07	<5.35E+02	<2.18E+04
MHV 22T	55	1/18/93	PRE	13.69	2.14E+08	<5.19E+02	<2.08E+04
MHV-23	35A	11/20/92	PRE	11.42	9.60E+06	2.01E+03	
MHV-23	40A	11/20/92	PRE	21.50	0.00E+00	<8.08E+01	
MHV-23	45A	11/20/92	PRE	15.11	1.10E+06	<5.85E+01	
MHV-23	50A	11/20/92	PRE	8.36	0.00E+00	<5.61E+01	
MHV-23	35	11/20/92	PRE	16.86	1.29E+07	4.84E+02	<3.69E+04
MHV-23	40	11/20/92	PRE	22.22	2.09E+06	<6.17E+01	4.24E+04
MHV-23	45	11/20/92	PRE	15.52	1.06E+07	<3.44E+01	<3.80E+04
MHV-23	50	11/20/92	PRE	9.23	0.00E+00	<2.90E+01	4.05E+04
MHV-24	35	11/17/92	PRE	17.96	1.29E+07	<1.18E+01	1.27E+05
MHV-24	40	11/17/92	PRE	20.84	2.09E+06	8.81E+01	<7.23E+04
MHV-24	45	11/17/92	PRE	9.27	1.06E+07	<9.94E+01	<6.14E+04
MHV-24	50	11/17/92	PRE	9.28	0.00E+00	<7.71E+01	<5.49E+04
MHV-25	35	11/9/92	PRE	13.22	1.29E+06	<4.20E+01	4.47E+05
MHV-25	40	11/9/92	PRE	13.78	0.00E+00	<3.32E+01	7.07E+04
MHV-25	45	11/9/92	PRE	13.76	1.14E+06	1.49E+02	<3.96E+04
MHV-25	50	11/9/92	PRE	6.19	2.40E+06	9.76E+02	<4.16E+04
MHV-25	55	11/9/92	PRE	9.58	ND	4.84E+02	ND

Well ID	SRL/ gdw	Nitros eur/ grw	N. agill/win/ gdw	Ferr/ gdw	Nitrosolb / gdw	Azoto/ gdw	Methano/ gdw
MHV-21	4.51E+04	4.51E+04	4.51E+04	4.51E+04	4.51E+04	4.51E+04	4.51E+04
MHV-21	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04	3.94E+04
MHV-21	3.03E+06	<3.40E+04	<3.40E+04	<3.40E+04	<3.40E+04	<3.40E+04	<3.40E+04
MHV-21	3.38E+04	<3.38E+04	<3.38E+04	<3.37E+04	<3.37E+04	<3.37E+04	<3.37E+04
MHV 22T	2.00E+04	6.20E+05	<2.00E+04	<2.00E+04	<2.00E+04	<2.00E+04	<2.00E+04
MHV 22T	2.08E+04	<2.08E+04	8.54E+05	<2.08E+04	<2.08E+04	1.33E+06	<2.08E+04
MHV 22T	2.18E+04	<2.18E+04	<2.18E+04	<2.18E+04	<2.18E+04	1.99E+06	8.73E+04
MHV 22T	1.95E+04	<1.95E+04	<1.95E+04	<1.95E+04	<1.94E+04	<1.94E+04	<1.94E+04
MHV 22T	9.79E+04	<1.96E+04	<1.95E+04	<1.95E+04	<1.95E+04	<1.95E+04	<1.95E+04
MHV 22T	2.18E+04	<2.18E+04	<2.17E+04	<2.18E+04	<2.17E+04	2.61E+05	<2.18E+04
MHV 22T	2.08E+04	<2.08E+04	<2.08E+04	<2.08E+04	<2.08E+04	2.08E+05	<2.08E+04
MHV-23							
MHV-23							
MHV-23							
MHV-23	3.69E+04	<3.70E+04	<3.69E+04	<3.69E+04	<3.69E+04	<3.69E+04	4.47E+04
MHV-23	1.27E+05	4.24E+04	2.54E+05	4.24E+04	4.24E+04	5.26E+06	<3.53E+04
MHV-23	3.80E+04	<3.80E+04	<3.79E+04	<3.79E+04	<3.79E+04	<3.79E+04	3.96E+04
MHV-23	4.05E+04	4.05E+04	4.05E+04	4.05E+04	4.05E+04	4.05E+04	4.16E+04
MHV-24	6.37E+04	6.37E+04	6.37E+04	6.37E+04	6.37E+04	2.55E+05	6.37E+04
MHV-24	6.51E+05	1.45E+05	7.23E+04	2.17E+05	7.23E+04	1.45E+05	1.45E+05
MHV-24	6.14E+04	6.14E+04	6.14E+04	6.14E+04	6.14E+04	6.14E+04	6.14E+04
MHV-24	5.48E+04	5.48E+04	5.48E+04	5.48E+04	1.64E+05	5.48E+04	5.48E+04
MHV-25	7.34E+06	4.47E+04	4.47E+04	2.24E+05	4.47E+04	4.30E+06	4.47E+04
MHV-25	5.76E+06	<3.53E+04	7.07E+04	7.07E+04	<3.53E+04	1.06E+05	<3.53E+04
MHV-25	3.96E+04	3.96E+04	1.19E+05	7.92E+04	3.96E+04	7.92E+04	3.96E+04
MHV-25	1.25E+05	4.16E+04	4.16E+04	4.16E+04	4.16E+04	4.16E+04	4.16E+04
MHV-25	ND	ND	ND	ND	ND	ND	ND

During Heating

Well ID	Depth (ft.)	Date	Temp °C	% Moisture	AODC#/gdw	CFU#/gdw	L. pneum/gdw
MHB 21	25	4/29/93	*68	11.36	5.61E+07	<6.12E+01	1.68E+06
MHB 21	30	4/29/93	*73	12.05	6.28E+07	<5.35E+01	8.84E+05
MHB 21	34	4/29/93	*83	13.00	5.56E+07	<5.14E+01	8.75E+05
MHB 21	38	4/29/93	88	18.06	1.12E+08	<5.82 E+01	8.86E+05
MHB 21	42	4/29/93	*84	19.95	1.94E+08	<6.32E+01	2.69E+05
MHB 21	48	4/29/93	76	11.15	1.08E+08	1.80E+04	5.91E+05
MHB 21	55	4/29/93	*70	12.59	1.49E+08	9.91E+04	6.12E+05
MHB-24	25	4/28/93	*70	13.36	1.05E+08	<5.09E+01	7.44E+04
MHB-24	30	4/28/93	*85	32.07	6.26E+07	<5.66E+01	3.19E+06
MHB-24	34	4/28/93	*120	19.03	3.93E+07	<5.17E+01	1.72E+06
MHB-24	38	4/28/93	145	19.03	7.49E+07	<5.10E+01	1.72E+06
MHB-24	42	4/28/93	*120	18.32	3.24E+07	<5.74E+01	4.43E+06
MHB-24	48	4/28/93	86	10.67	3.24E+07	<5.02E+01	3.50E+06
MHB-24	55	4/28/93	*70	9.08	3.56E+07	<4.90E+01	3.09E+06

Well ID	SRL/ gdw	Nitros eur/ grw	N. agll/wln/ gdw	Ferr/ gdw	Nitrosolb / gdw	Azoto/ gdw	Methano/ gdw
MHB 21	1.55E+04	<1.55E+04	<1.55E+04	<1.55E+04	<1.55E+04	<1.55E+04	<1.55E+04
MHB 21	1.40E+04	<1.40E+04	<1.40E+04	<1.40E+04	<1.40E+04	<1.40E+04	<1.40E+04
MHB 21	1.23E+04	<1.23E+04	<1.23E+04	<1.23E+04	<1.23E+04	<1.23E+04	<1.23E+04
MHB 21	1.45E+04	<1.45E+04	<1.45E+04	<1.13E+04	<1.45E+04	<1.45E+04	<1.45E+04
MHB 21	1.49E+05	<1.49E+04	<1.49E+04	<1.49E+04	<1.49E+04	4.48E+04	<1.49E+04
MHB 21	1.64E+04	<1.64E+04	<1.64E+04	<1.64E+04	<1.64E+04	1.64E+04	<1.64E+04
MHB 21	1.70E+04	<1.70E+04	<1.70E+04	<1.70E+04	<1.70E+04	<1.70E+04	<1.70E+04
MHB-24	2.68E+05	<1.49E+04	<1.48E+04	<1.48E+04	<1.48E+04	<1.48E+04	<1.48E+04
MHB-24	1.68E+05	<2.09E+04	<2.09E+04	<2.09E+04	<2.09E+04	<2.09E+04	<2.09E+04
MHB-24	1.64E+05	<1.49E+04	<1.49E+04	<1.49E+04	5.98E+04	<1.49E+04	<1.49E+04
MHB-24	1.64E+05	<1.49E+04	<1.49E+04	<1.49E+04	5.98E+04	<1.49E+04	<1.49E+04
MHB-24	2.69E+04	<1.34E+04	<1.34E+04	<1.34E+04	<1.34E+04	<1.34E+04	<1.34E+04
MHB-24	1.56E+04	<1.56E+04	<3.11E+04	<1.56E+04	<1.55E+04	<1.55E+04	<1.55E+04
MHB-24	1.32E+04	<1.32E+04	<1.32E+04	<1.31E+04	<1.31E+04	<1.31E+04	<1.31E+04

Post Heating

Well ID	Depth (ft.)	Date	Temp °C	% Moisture	AODC#/gdw	CFU#/gdw	L. pneum/ gdw
MHB-25	24-26	6/2/92	POST	12.62	3.64E+07	<6.54E+01	<2.43E+04
MHB-25	30-32	6/2/92	POST	11.66	1.13E+08	<6.50E+01	1.89E+05
MHB-25	34-36	6/2/92	POST	19.10	1.07E+08	<7.40E+01	<2.57E+04
MHB-25	38-40	6/2/92	POST	20.19	2.39E+07	<4.34E+01	7.94E+04
MHB-25	42-44	6/2/92	POST	20.92	1.61E+08	<4.45E+01	1.49E+05
MHB-25	48-50	6/2/92	POST	10.01	3.74E+07	<3.93E+01	1.28E+05
MHB-25	54-56	6/2/92	POST	10.97	6.20E+07	<4.66E+01	<1.57E+04
MHB-22	25	6/3/93	POST	12.01	1.49E+08	<3.79E+01	8.92E+04
MHB-22	30	6/3/93	POST	10.60	3.28E+08	<3.85E+01	2.30E+05
MHB-22	34	6/3/93	POST	10.22	1.07E+07	1.84E+04	2.50E+05
MHB-22	38	6/3/93	POST	18.74	2.10E+08	<7.80E+01	<2.77E+04
MHB-22	42	6/3/93	POST	18.71	6.13E+07	<5.65E+01	<3.35E+04
MHB-22	48	6/3/93	POST	11.66	8.78E+07	<4.89E+01	<1.30E+04
MHB-22	55	6/3/93	POST	15.28	1.97E+08	<6.56E+01	5.05E+04

Well ID	SRL/ gdw	Nitros eur/ grw	N. agil/wil/ gdw	Ferr/ gdw	Nitrosolb / gdw	Azoto/ gdw	Methano/ gdw
MHB-25	2.42E+04	<2.42E+04	<2.42E+04	<2.42E+04	<2.42E+04	<2.42E+04	<2.42E+04
MHB-25	2.36E+04	<2.36E+04	<2.36E+04	<2.36E+04	<2.36E+04	<2.36E+04	<2.36E+04
MHB-25	2.57E+04	<2.57E+04	<2.56E+04	7.70E+04	<2.56E+04	<2.56E+04	<2.56E+04
MHB-25	1.59E+04	<1.59E+04	<1.58E+04	<1.58E+04	<1.58E+04	<1.58E+04	<1.58E+04
MHB-25	1.94E+06	<1.86E+04	<1.86E+04	<1.86E+04	<1.86E+04	<1.86E+04	<1.86E+04
MHB-25	1.28E+04	<1.28E+04	<1.28E+04	<1.28E+04	<1.28E+04	<1.28E+04	<1.28E+04
MHB-25	1.57E+04	<1.57E+04	<1.56E+04	<1.56E+04	<1.56E+04	<1.56E+04	<1.56E+04
MHB-22	2.23E+04	6.69E+04	<2.23E+04	<2.23E+04	<2.23E+04	2.23E+04	<2.23E+04
MHB-22	6.91E+04	<2.30E+04	<2.30E+04	<2.30E+04	<2.30E+04	3.91E+05	<2.30E+04
MHB-22	2.28E+04	<2.27E+04	<2.27E+04	<2.27E+04	<2.27E+04	<2.27E+04	<2.27E+04
MHB-22	2.77E+04	<2.77E+04	<2.76E+04	<2.76E+04	<2.76E+04	<2.76E+04	<2.76E+04
MHB-22	1.12E+04	<1.12E+04	<1.12E+04	<1.11E+04	<1.11E+04	<1.11E+04	<1.11E+04
MHB-22	1.30E+04	<1.30E+04	<1.30E+04	<1.30E+04	<1.30E+04	<1.30E+04	<1.30E+04
MHB-22	1.69E+04	<1.69E+04	<1.69E+04	<1.68E+04	<1.68E+04	<1.68E+04	<1.68E+04

Radio Frequency Heating Demonstration Site Characterization

Figure 4. Concentration of Trichloroethylene Prior to the Radio Frequency Heating Demonstration

Figure 5. Concentration of Tetrachloroethylene Prior to the Radio Frequency Heating Demonstration

RF Heating / Pretest Distribution of TCE

RF Heating / Pretest Distribution of PCE

Figure 6. Concentration of Trichloroethylene After the Radio Frequency Heating Demonstration

Figure 7. Concentration of Tetrachloroethylene After the Radio Frequency Heating Demonstration

RF Heating / Post-Test Distribution of TCE

RF Heating / Post-Test Distribution of PCE

References

Eddy, C. A., B. B. Looney, J. M. Dougherty, T. C. Hazen, and D. S. Kaback, 1991, Characterization of the Geology, Geochemistry, Hydrology and Microbiology of the In-Situ Air Stripping Demonstration Site at the Savannah River Site, USDOE Report WSRC-RD-91-21, Westinghouse Savannah River Co., Savannah River Laboratory, Aiken, SC 29808, 118p.

The information in this report was developed during the course of work under Contract No. DE-AC09-89SR18035 with the U. S. Department of Energy.

Appendix I—Core Descriptions

All core descriptions follow the format given in ESSOP-2-15: Microscopic Examination Of Sediment Cores.

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-20A

DRILLER Blake Cabit

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/16/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter 60.0' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Screen~~ Plug Length 0.02'

(b) Screen Length 4.90'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.88'

2) 9.89' 3) 9.88' 4) 9.91'

5) 8.44'

(d) Depth to Top of Screen 48.00'

3) Depths to Centralizers Not required.

4) Total Depth of Installed Well 52.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.4'

6) Depth to Top of Filter Pack 47.6'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 2.4'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-20B

DRILLER Blake Casit

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/20/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce/SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter First Grout stage 45.2' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Sump~~ Plug Length 0.02'

(b) Screen Length 4.89'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.88'
2) 9.88' 3) 9.89' 4) 8.35'

(d) Depth to Top of Screen 38.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 42.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.6'

6) Depth to Top of Filter Pack of 33.6' 36.3'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 2.7'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-20 C

DRILLER Blake Cabit

SRS COORDINATES _____

DATE OF WELL INSTALLATION 12/02/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Dunova

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter Second Grout stage 33.6' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Screen~~ Plug Length 0.02'

(b) Screen Length 4.90'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.92'
2) 9.92' 3) 8.16'

(d) Depth to Top of Screen 28.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 32.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.8'

6) Depth to Top of Filter Pack 26.3'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 26.3'

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G4346
 SUBJECT RF Heating Test - MHV - 20 Piezometers Casing Tally
 BY Bill Joyce DATE 12/02/92 CHECKED BY _____ DATE _____

Casing   Screen
Tally   Zones
A   A
 1) 9.88'
 2) 9.89'
 3) 9.88'
 4) 9.91'
 5) 9.88'
     49.44'
 - 48.00' Top of Casing
     1.44' Stick-up

B   B
 1) 9.88'
 2) 9.88'
 3) 9.89'
 4) 9.91'
     39.56'
 - 38.00' Top of Casing
     1.56' Stick-up

C   C
 1) 9.92'
 2) 9.92'
 3) 9.92'
     29.76'
 - 28.00' Top of Casing
     1.76' Stick-up

Materials
List (A, B, C)

Casing
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen
 1" PVC
 Slotted
 0.010 in. slot
 Flush
 Tri-Loc Threads
 Timco Brand

Sump
 Not required

Plug
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen / Plug
Tally

A

	0.09'
4.90'	4.68'
	0.13'
0.02' Plug	0.02'

B

	0.08'
4.89'	4.68'
	0.13'
0.02' Plug	0.02'

C

	0.10'
4.90'	4.67'
	0.13'
0.02' Plug	0.02'

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G-4346
 SUBJECT RF Heating Test - MHV - 20 Piezometer Well Construction Diagram
 BY Bill Joyce DATE 12/02/92 CHECKED BY _____ DATE _____

From MHV - 20
 Bottom
 Casing

From
 Ground
 Surface

Gravel Pack

Based on Practical
 Application in the Field of
 1 bag Coarse Sand = 1.2 ft³
 1 bag Grout = 0.6 ft³
 1 bag Mixed = 1.3 ft³
 Grout

A. Theoretical

Coarse Sand - 2.0 b
 Grout - 0.6 bags

Actual

Coarse Sand - 2.0 b
 Grout - 1 bag

B. Theoretical

Coarse Sand - 2.4 b
 Grout - 0.6 bags

Actual

Coarse Sand - 3.3 b
 Grout - 0.7 bags

C. Theoretical

Coarse Sand - 2.3 b
 Grout - 7.2 bags

Actual

Coarse Sand - 2.3 b
 Grout - 6.7 bags

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-20T

DRILLER Steve Reese

SRS COORDINATES _____

DATE OF WELL INSTALLATION 1/21/93

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Drive

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter 63.0' / 8"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) Sump & Plug Length Not required

(b) Screen Length Not required

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen)
including threads 1) 10.12'
2) 10.00'
3) 10.00' 4) 10.00' 5) 9.99'
6) 4.89'

(d) Depth to ^{Sensors} Top of Screen Fiber optics: 28.00' 33.00' 38.00' 43.00' 48.00' and 53.00'. Thermocouples: 28.00' 38.00' and 48.00'.

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 55.0'

5) Casing Stick Up (Standard 2.5' A.G.S.) 5.1'

6) Depth to Top of Filter Pack 10.2'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 10.2'

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/16/92</i>	SHEET <i>1</i> OF <i>3</i>
REFERENCE DATUM		DRILLING CONTRACTOR <i>EMTC</i>	
WELL NO. <i>MHV-20</i>	SRP COORDINATES	DRILLER <i>Blike Cabit</i>	
LOGGED BY <i>Bill Joyce</i>	COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-Spoon</i>	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
1	0		85	Upper 0.5' Top soil SAND (silt 10%) med- crse grn, drk yellowish brown, sbrn-sbrn, mod srt'd dry, organic material present	Begin to split-spoon on 11/16/92 at 05:00
	1				3" Split-Spoons
2	2		75	SAND (silt 35-40%, clay trace) med-crse grn with some fn grn, light brown-mod reddish brown, sbrn-sbrn, mod srt'd, dry, frm, gte pocket	Augers 4 1/4" ID 7 1/2" OD Bit 8 1/4" OD Using downhole hammer
	3				
3	4		80		
	5			SAND (silt 40%, clay trace) med-fn grn with some crse grn, mod reddish brown- drk yellowish orange with pale reddish brown - grayish orange - grayish red purple mottled, sbrn-sbrn, mod srt'd, dry, hard frm, trace mang. oxide, gte pockets	
4	6		75		
	7				
5	8		100		
	9			SILT (sand 20-25%, clay 10-15% kaolin- grayish purple) fn - med grn, pale reddish brown-mod reddish brown-drk yellowish bead orange-grayish purple-white, sbrn, well srt'd, dry, hard	
6	10		75		
	1				
7	2		65	SAND (silt 40-45% grading to 15-20%, clay 5% kaolin) med-fn grn grading to med-crse grn, mod reddish brown-pale reddish brown-grayish purple (clayier)- drk yellowish orange-white (kaolin) sbrn- sbrn, mod srt'd, dry, hard, trace mang oxide	
	3				
8	4		65		
	15			SAND (silt 10-15%, clay 5% kaolin speckled throughout) med-crse grn, mod reddish orange-pale reddish brown- white, sbrn-sbrn, mod-ply srt'd, dry, frm, trace mang oxide	
9	6		75		
	7			CLAY grayish red purple-grayish purple silty, mod moist, frm-hard	
10	8		85		
	9			SAND (silt 5-10%, clay(kaolin) 10% speckled throughout) med-fn grn mod reddish orange-white, sbrn-sbrn, mod-well srt'd, dry	
	20				

FIELD GEOLOGIC LOG

PROJECT		DATE		SHEET	
RF Heating Test Integrated Demonstration Site		11/16/92		2 of 3	
WELL NO.		REFERENCE DATUM		DRILLING CONTRACTOR	
MHV-20				EMTC	
LOGGED BY		SRP COORDINATES		DRILLER	
Bill Joyce				Blake Cabit	
		COMPANY		DRILLING METHOD	
		SEC Donohue		Hollow Stem Auger - 3" Split spoon	
RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
11	20		70	SAND (silt 10-15%, clay 10% (kaolin) speckled throughout) coarse - v/coarse grn with some med grn, mod reddish orange - pale reddish brown - white (kaolin) (kaolin), sbrng - sbrnd, prly srtld, dry, trace mang. oxide, occ clay stringers	
12	1		85		
13	25		85	SAND As Above, including granules and gtz pockets, clay pockets	Plug sample (VOC) at 25'
14	6		75	CLAY pale purple - grayish purple with grayish red purple - light brown - drk yellowish orange mottling, silty, trace sand, mod moist, hard	Plug sample at 27'
15	9		85	SAND (silt 5-10% clay 5-10% (kaolin) speckled throughout) coarse - v/coarse grn with granules, pebbles and gtz pockets, mod reddish orange - pale reddish brown - white, sbrng - sbrnd, prly srtld, dry	Plug sample at 29'
16	30		70		Plug sample at 31'
17	2		70	SAND (silt 5-10% clay trace (kaolin) coarse - v/coarse grn with granules and some pebbles, drk yellowish orange - mod yellowish brown - mod reddish orange, sbrng - sbrnd, prly srtld, dry, occ clay thin laminae.	Plug sample at 33'
18	3		85		Plug sample at 35'
19	5		85		Plug sample at 36'
20	7		95	CLAY includes interbedded sands made up of thin laminae, drk yellowish orange grading to grayish purple with grayish red purple mottling, silty, sandy in places, mod moist, slightly malleable, firm - hard	Plug samples at 37' and 38' (37.7')
	8				
	9				Plug samples at 39' and 40' (39.9')
	40				

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration site</i>				DATE <i>11/16/92</i>	SHEET <i>3</i> of <i>3</i>
WELL NO. <i>MHV-20</i>		REFERENCE DATUM	DRILLING CONTRACTOR <i>EMTC</i>		
LOGGED BY <i>Bill Joyce</i>		SAP COORDINATES	DRILLER <i>Blake Cabit</i>		
		COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-spoon</i>		

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
	4 0				
21	1		100		
	2				
22	3		95		
	4				
23	4 5		85		
	6			Intermittent clays and sands	
24	7		90		
	8				
25	9		95		
	5 0				
26	1		100		
	2				
27	3		100		
	4				
28	5 5		90		
	6				
29	7		100		
	8				
30	9		100		
	6 0			Grades siltier 40-45% with a trace of clay	

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-21A

DRILLER Terry Hornsby

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/13/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter 60.0' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Screen~~ Plug Length 0.02'

(b) Screen Length 4.90'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.90'

2) 9.91' 3) 9.91' 4) 9.91'

5) 8.37'

(d) Depth to Top of Screen 48.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 52.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.5'

6) Depth to Top of Filter Pack 46.3'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 2.5'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-21 B

DRILLER Blake Cabit

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/16/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

- 1) Total Drilled Depth/Hole Diameter First Grout Stage 43.8' / 8 1/4"
- 2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)
- (a) ~~Screen~~ Plug Length 0.02'
- (b) Screen Length 4.90'
- (c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen)
- 1) 9.90'
- 2) 9.92' 3) 9.88' 4) 8.30'
- (d) Depth to Top of Screen 38.00'
- 3) Depths to Centralizers Not required
- 4) Total Depth of Installed Well 42.9'
- 5) Casing Stick Up (Standard 2.5' A.G.S.) 1.6'
- 6) Depth to Top of Filter Pack 36.7'
- 7) Depth to Top of Fine Sand Seal Not required
- 8) Depth to Top of Bentonite Seal Not required
- 9) Thickness of Grout _____

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-21C

DRILLER Blake Cabit

SRS COORDINATES _____

DATE OF WELL INSTALLATION 12/03/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce/SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter Second Grout
Stage
34.3' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Screen~~ Plug Length 0.04'

(b) Screen Length 4.90'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.91'
2) 9.90' 3) 8.19'

(d) Depth to Top of Screen 28.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 32.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.7'

6) Depth to Top of Filter Pack 26.5'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 26.5'

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G-4346
 SUBJECT RF Heating Test - MHV - 21 Piezometer Well Construction Diagram
 BY Bill Joyce DATE 12/05/92 CHECKED BY _____ DATE _____

From -
 Bottom
 Casing

MHV - 21

From
 Ground
 Surface

Gravel Pack

Based on Practical
 Application in the Field of
 1 bag Coarse Sand = 1.2 ft³
 1 bag Grout = 0.6 ft³
 1 bag Mixed = 1.3 ft³
 Grout

A B C						Gravel Pack
52.92'	42.92'	32.94'	Initial T.O.C.	Initial T.O.C.	Initial T.O.C.	
44.55'	34.62'	24.75'	1.53'	1.59'	1.71'	A. Theoretical
34.64'	24.74'	14.85'	1.66'	1.66'	1.66'	Coarse Sand - 2.0 bags
24.73'	14.82'	4.94'	1.66'	1.66'	1.66'	Grout - 0.6 bags
14.82'	4.92'	(0.00')	1.66'	1.66'	1.66'	Actual
4.92'	(0.00')		1.66'	1.66'	1.66'	Coarse Sand - 2.5 bags
(0.00')			1.66'	1.66'	1.66'	Grout - 0.7 bags
			1.66'	1.66'	1.66'	
			1.66'	1.66'	1.66'	B. Theoretical
			1.66'	1.66'	1.66'	Coarse Sand - 2.4 bags
			1.66'	1.66'	1.66'	Grout - 0.6 bags
			1.66'	1.66'	1.66'	Actual
			1.66'	1.66'	1.66'	Coarse Sand - 2.5 bags
			1.66'	1.66'	1.66'	Grout - 0.7 bags
			1.66'	1.66'	1.66'	
			1.66'	1.66'	1.66'	C. Theoretical
			1.66'	1.66'	1.66'	Coarse Sand - 2.3 bags
			1.66'	1.66'	1.66'	Grout - 7.2 bags
			1.66'	1.66'	1.66'	Actual
			1.66'	1.66'	1.66'	Coarse Sand - 2 bags
			1.66'	1.66'	1.66'	Grout - 6.7 bags

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SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G4346
 SUBJECT RF Heating Test - MHV - 21 Piezometers Casing Tally
 BY Bill Joyce DATE 12/03/92 CHECKED BY _____ DATE _____

Casing   Screen
Tally   Zones
A   A
 1) 9.90'
 2) 9.91'
 3) 9.91'
 4) 9.91'
 5) 9.90'
49.53'
 - 48.00' Top of Casing
 1.53 Stick-up

B   B
 1) 9.90'
 2) 9.92'
 3) 9.88'
 4) 9.89'
39.59
 - 38.00' Top of Casing
 1.59' Stick-up

C   C
 1) 9.91'
 2) 9.90'
 3) 9.90'
29.71'
 - 28.00' Top of Casing
 1.71' Stick-up

Materials
List (A, B, C)

Casing
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen
 1" PVC
 Slotted
 0.010 in. slot
 Flush
 Tri-Loc Threads
 Timco Brand

Sump
 Not required

Plug
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen / Plug
Tally

A

	0.08'
4.90'	4.68'
	0.14'
0.02' Plug	0.02'

B

	0.09'
4.90'	4.68'
	0.13'
0.02' Plug	0.02'

C

	0.10'
4.90'	4.67'
	0.13'
0.04' Plug	0.04'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-21T

DRILLER Garry Moore

SRS COORDINATES _____

DATE OF WELL INSTALLATION 1/15/93

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME B.II Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

Fiber Optics Temperature Sensors

1) Total Drilled Depth/Hole Diameter 68.0' / 8 1/2"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) Sump & Plug Length Not required

(b) Screen Length Not required

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 10.13'

including threads 2) 10.00'

3) 10.00' 4) 9.99' 5) 9.99'

6) 9.99' 7) 1.90'

(d) Depth to Top of Screen Sensors Thermocouples: 28.00', 38.00', and 48.00'
Fiber optics: 28.00', 33.00', 38.00', 43.00', 48.00', and 53.00'. Lawrence
6.00', 15.00', 20.00', 25.00', 30.00', 35.00', 40.00', 45.00', 50.00', 55.00', and 60.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 62.0'

5) Casing Stick Up (Standard 2.5' A.G.S.) 3.1'

6) Depth to Top of Filter Pack 9.5'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 9.5'

FIELD GEOLOGIC LOG

PROJECT		DATE	SHEET		
RF Heating Test Integrated Demonstration Site		11/11/92	1 of 3		
WELL NO.		REFERENCE DATUM	DRILLING CONTRACTOR		
MHV-21			EMTC.		
LOGGED BY		SAP COORDINATES	DRILLER		
B. H. Joyce			Terry Hornsby		
		COMPANY	DRILLING METHOD		
		SEC Donohue	Hollow Stem Auger - 3" split-spoon		
RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
1	0		75	Upper 0.4' Typ sil sand (silt 10%) med- crs grn drk yellowish brown, sandy-sand, med srd, dry	Begin to split-spoon on 11/11/92 at 13:30
	1			SAND (silt 25% grading to 35-40%, clay- trace) med-crs grn with occ. fn grn, mod reddish brown - pale reddish brown light brown - drk yellowish orange, sandy- sand, dry, fm	3" split-spoon Auger 4 1/4" ID. 7 1/2" OD. B.T. 8 1/4" OD Using donohue hammer
2	2		65		
	3				
3	4		80		
	5				
4	6		95	SAND (silt 40-45%, clay - trace as kaolin) med-fn grn with occ. crs grn, mod reddish brown - pale reddish brown - drk yellowish orange - white (kaolin), mottled, sand-sand, med srd, dry, hard-fm, trace mang oxide, gtz, pebbles	
	7				
5	8		85		
	9				
6	10		90	SILT (sand 25%, clay 10-15% kaolin) fn- med grn, mod reddish brown - pale reddish brown - grayish orange - drk yellowish orange - grayish orange - white sand, well srd, dry, hard	
	1				
7	2		90	SAND (silt 40-45% grading to 15-20%, clay 5% kaolin) med grn grading to med- crs grn, mod reddish brown - pale reddish brown - drk yellowish - white sandy-sand, med-poly srd, dry, hard- fm, trace mang oxide	
	3				
8	4		80		
	15				
9	6		80	SAND (silt 10-15%, clay 5% kaolin speckled throughout) med-crs grn, mod reddish orange - pale reddish brown - grayish orange - white (kaolin), sandy-sand med-poly srd, dry fm, trace mang. oxide	
	7				
10	8		80		
	9				
	20			SAND As Above silt 10%, clay 10-15% as kaolin - dry	

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/11/92</i>	SHEET <i>2 of 3</i>
REFERENCE DATUM		DRILLING CONTRACTOR <i>EMTC</i>	
WELL NO. <i>MHV-21</i>	SAP COORDINATES	DRILLER <i>Terry Hornsby</i>	
LOGGED BY <i>Bill Joyce</i>	COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split Spoon</i>	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
11	20				
	1		80	SAND (silt 10-15% grading to 15-20% clay 5-10% kaolin speckled throughout) coarse med grn with v/crse grn, med reddish orange - pale	
12	2			reddish brown - dk yellowish orange (mottling) - white (kaolin) ssang - sbrad, prly sdtd, dry, trace mang. oxide	
	3		95		
	4			Upper 0.8' not due to weather conditions (rain)	11/12/92
13	25		90	SAND As Above with granules included and gte pockets	
	6				
14	7		100	CLAY pale purple with grayish red purple mottling, silty, trace sand, med moist, hard	
	8				
15	9		90	SAND (silt 5-10% clay trace (kaolin)) v/crse - coarse grn with granules and pebbles med reddish orange - pale reddish br - pale red purple - light brown, ssang - sbrad, prly sdtd, dry, occ clayey stringers	
	30				
16	1		95	SAND (silt 5-10% clay trace (kaolin)) v/crse - coarse grn with granules, pebbles and gte pockets, pale purple - pale red purple - pale yellowish brown - grayish orange with occ. pale reddish brown mottling, ssang - sbrad, prly sdtd, dry	
	2				
17	3		85		
	4				
18	35		100	CLAY grayish purple with grayish red purple and dk yellowish orange mottling, silty, med moist, hard - firm slightly sandy	
	6				
19	7		95	SAND (silt 35-40% clay 12-15% in matrix) fm - med grn with occ. med - coarse pockets, pale purple - grayish red purple - light brown - dk yellowish orange - pale yellowish brown, mottled, occ laminated ssang - sbrad, med - well sdtd, dry	
	8				
20	9		60		
	40			CLAY grayish red purple - grayish purple silty, slightly sandy, med moist, hard - firm	

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/13/92</i>	SHEET <i>3 of 3</i>
WELL NO. <i>MHV-21</i>		REFERENCE DATUM	DILLING CONTRACTOR <i>EMTC</i>
LOGGED BY <i>Bill Joyce</i>		SAP COORDINATES	DILLER <i>Terry Hornsby</i>
		COMPANY <i>S&C Donohue</i>	DILLING METHOD <i>Hollow Stem Auger - 3" Split-Spoon</i>

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
21	0				
	1		95	CLAY includes intermittent sand pockets and varying percentages (10-20%) of sand content, grayish red purple-grayish purple, silty, slightly sandy, is plastic, mod moist, hard - 5 cm mottled	
22	2				
	3		100		
	4				
23	4.5		85	Intermittent clay and sand	
	6				
24	7		75	SAND (silt 10-15% with siltier 15-20% pockets) med - coarse grn w/ o/c v/crse grn, pale red purple - pale purple with light brown and med reddish brown mottling, stage - strand, only silt, dry, trace mang oxide	
25	8				
	9		80		
	50				
26	1		85	SAND (silt 10-15%) med - fa grn, pale purple - pale red purple with o/c med red and dk yellowish orange mottling, stage - strand, mod - well silt, dry, trace mang oxide	
	2				
27	3		100		
	4				
28	5.5		90	SAND As Above with siltier (15-20%) pockets	
	6				
29	7		95		
	8			SAND (silt grades to 35-40%) med - fa grn, pale purple - pale red purple with light brown and dusky red o/c mottling, stage - strand, mod - well silt, dry, trace mang oxide	
30	9		100		
	60				

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-22A

DRILLER Blake Cabot

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/19/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter 60.0' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Screen~~ Plug Length 0.02'

(b) Screen Length 4.91'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen)

1) 9.89'
2) 9.91' 3) 9.89' 4) 9.88'
5) 8.43'

(d) Depth to Top of Screen 48.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 52.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.5'

6) Depth to Top of Filter Pack 46.2'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 2.9'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-22C

DRILLER Blake Cubit

SRS COORDINATES _____

DATE OF WELL INSTALLATION 12/03/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME B.11 Doyle/SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

- 1) Total Drilled Depth/Hole Diameter Second Grot
34.9' / 8 1/4"
- 2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)
  - (a) ~~Screen~~ Plug Length 0.02'
  - (b) Screen Length 4.89'
  - (c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen)
    - 1) 9.88'
    - 2) 9.87'
    - 3) 8.25'
  - (d) Depth to Top of Screen 28.00'
- 3) Depths to Centralizers Not required
- 4) Total Depth of Installed Well 32.9'
- 5) Casing Stick Up (Standard 2.5' A.G.S.) 1.7'
- 6) Depth to Top of Filter Pack 26.2'
- 7) Depth to Top of Fine Sand Seal Not required
- 8) Depth to Top of Bentonite Seal Not required
- 9) Thickness of Grout 26.2'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-22B

DRILLER Blake Cabit

SRS COORDINATES _____

DATE OF WELL INSTALLATION 12/02/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce/SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter First Grout Stage 43.3' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Screen~~ Plug Length 0.02'

(b) Screen Length 4.89'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.91'
2) 9.91' 3) 9.92' 4) 8.26'

(d) Depth to Top of Screen 38.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 42.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.7'

6) Depth to Top of Filter Pack 36.8' (natural soil)

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 1.9'

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G-4346
 SUBJECT RF Heating Test - MHV - 22 Piezometer Well Construction Diagram
 BY Bill Joyce DATE 12/03/92 CHECKED BY _____ DATE _____

From -
 Bottom
 Casing

MHV - 22

From
 Ground
 Surface

Gravel Pack

Based on Practical
 Application in the Field of
 1 bag Coarse Sand = 1.2 ft³
 1 bag ^(dry) Grout = 0.6 ft³
 1 bag Mixed Grout = 1.3 ft³

<u>52.93'</u>	<u>42.91'</u>	<u>32.91'</u>
<u>44.50'</u>	<u>34.65'</u>	<u>24.66'</u>
<u>34.62'</u>	<u>24.73'</u>	<u>14.79'</u>
<u>24.73'</u>	<u>14.82'</u>	<u>4.91'</u>
		<u>0.02'</u>
<u>14.82'</u>	<u>4.91'</u>	<u>(0.00')</u>
	<u>0.02'</u>	
<u>4.93'</u>	<u>(0.00')</u>	
<u>0.02'</u>		
<u>(0.00')</u>		

<u>0.00'</u>	<u>0.00'</u>	<u>0.00'</u>
<u>8.25'</u>	<u>8.26'</u>	<u>8.43'</u>
<u>18.12'</u>	<u>18.18'</u>	<u>18.31'</u>
<u>28.00'</u>	<u>28.09'</u>	<u>28.20'</u>
<u>32.89'</u>		
<u>(32.91')</u>	<u>38.00'</u>	<u>38.11'</u>
	<u>42.89'</u>	
	<u>(42.91')</u>	<u>48.00'</u>
		<u>52.91'</u>
		<u>(52.93')</u>

A. Theoretical

Coarse Sand - 2.3 bags
 Grout - 0.6 bags

Actual

Coarse Sand - 3.5 bags
 Grout - 0.7 bags

B. Theoretical

Coarse Sand - 2.4 bags
 Grout - 0.6 bags

Actual

Coarse Sand - 0 ^{Natural} Fill
 Grout - 0.7 bags

C. Theoretical

Coarse Sand - 2.3 bags
 Grout - 7.2 bags

Actual

Coarse Sand - 2.25 bags
 Grout - 5.7 bags

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G4346
 SUBJECT RF Heating Test - MHV - 22 Piezometers Casing Tally
 BY Bill Joyce DATE 12/03/92 CHECKED BY _____ DATE _____

Casing   Screen
Tally   Zones
A   A
 1) 9.89'
 2) 9.91'
 3) 9.89'
 4) 9.88'
 5) 9.89'
     49.46'
 - 48.00' Top of Casing
     1.46' Stick-up

B   B
 1) 9.91'
 2) 9.91'
 3) 9.92'
 4) 9.91'
     39.65'
 - 38.00' Top of Casing
     1.65' Stick-up

C   C
 1) 9.88'
 2) 9.87'
 3) 9.92'
     29.67'
 - 28.00' Top of Casing
     1.67' Stick-up

Materials
List (A, B, C)
Casing
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen
 1" PVC
 Slotted
 0.010 in. slot
 Flush
 Tri-Loc Threads
 Timco Brand

Sump
 Not required

Plug
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen / Plug
Tally
A

		0.09'
4.91'	—	4.68'
	—	
	—	
	—	
	—	
		0.14'
0.02'	Plug	0.02'

B

		0.08'
4.89'	—	4.68'
	—	
	—	
	—	
	—	
		0.13'
0.02'	Plug	0.02'

C

		0.09'
4.89'	—	4.67'
	—	
	—	
	—	
	—	
		0.13'
0.02'	Plug	0.02'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-22T

DRILLER Steve Reese

SRS COORDINATES _____

DATE OF WELL INSTALLATION 1/21/93

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

Fiber Optics Temperature Sensors

1) Total Drilled Depth/Hole Diameter 63.0' / 8"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) Sump & Plug Length Not required

(b) Screen Length Not required

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 10.12'
including threads 2) 10.00'
3) 10.00' 4) 10.00' 5) 10.00'
6) 4.88'

(d) Depth to ^{Sensors} ~~Top of Screen~~ Fiber optics: 28.00' 33.00'
38.00' 43.00' 48.00' and 53.00'. Thermocouples:
28.00', 38.00' and 48.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 55.0'

5) Casing Stick Up (Standard 2.5' A.G.S.) 5.1'

6) Depth to Top of Filter Pack 9.6'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 9.6'

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/18/92</i>	SHEET <i>1 of 3</i>
REFERENCE DATUM		DRILLING CONTRACTOR <i>EMTC</i>	
WELL NO. <i>MHV-22</i>	SRP COORDINATES	DRILLER <i>Bike Cabit</i>	
LOGGED BY <i>Bill Joyce</i>	COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-spoon</i>	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
1	0		85	Upper 0-1' Top soil and rip-rap SAND (silt 15%) med - coarse grn, drk yellowish brown, shag - strand, mod silt, dry	Begin to split-spoon on 11/18/92 at 08.00
	1				3" split-spoons
2	2		65	SAND (silt 20% grading to 30-35%) med - coarse grn with some fn grn, light brown - mod reddish brown	Augers 4 1/4" ID
	3			shag - strand mod moist - dry, fn	7 1/2" OD
	4			drk yellowish orange coloring included	Bit 8 1/4" OD
3	5		90		Using downhole hammer
	6				
	7				
4	8		95		
	9				
5	10		100		
	11				
6	12		90		
	13				
7	14		90		
	15				
8	16		100		
	17				
9	18		85		
	19				
10	20		95		
	21				

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/18/92</i>	SHEET <i>2 of 3</i>
REFERENCE DATUM		DRILLING CONTRACTOR <i>EMTC</i>	
WELL NO. <i>MHV-22</i>	SRP COORDINATES	DRILLER <i>Blake Cabit</i>	
LOGGED BY <i>Bill Joyce</i>	COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-Spoon</i>	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
11	20		85	SAND (silt 10-15% clay 5-10% as kaolin speckled throughout) coarse - v/coarse grn with some granules, pale reddish brown - med reddish orange - white (kaolin) shag - sbrad, poly srt'd, dry, trace mang. oxide, slight traces of pale purple clay	
12	3		95		
13	25		95	SAND (silt 5-10% clay 10-15% as kaolin speckled throughout) coarse - v/coarse grn with some granules, pale reddish brown - med reddish orange - white (kaolin) shag - sbrad, poly srt'd, dry, trace mang. oxide	
14	7		95		
15	9		95	CLAY pale purple with grayish red purple - pale reddish brown - drk yellowish orange mottling, silty, med moist, hard	
16	1		90	SAND (silt 5-10% clay 5-10% as kaolin pockets) coarse - v/coarse grn with granules, pale purple - grayish orange - pale reddish brown - med reddish orange, mottled, shag - sbrad, poly srt'd, dry	
17	3		95		
18	35		100	CLAY grayish purple with some grayish red purple mottling, silty, slightly sandy, hard - firm, med moist	
19	7		95	Intermittent clean clay with silty/clayey sand	
20	40		95	SAND (silt 35-40% clay 10% in matrix) med to grn, pale red purple - pale purple with grayish red purple mottling shag, well srt'd	

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/18/92</i>	SHEET <i>3</i> of <i>3</i>
REFERENCE DATUM		DRILLING CONTRACTOR <i>EMTC</i>	
WELL NO. <i>MHV-22</i>	SRP COORDINATES	DRILLER <i>Blake Cabit</i>	
LOGGED BY <i>B. H. Joyce</i>	COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-Spoon</i>	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
	40				
21	1		100	<i>SAND (silt 35-40% grading to 5-10% clay, 5-10% as thin laminae and stringers)</i>	
	2			<i>med-fn gra grading to med- cse - c/cse</i>	
22	3		95	<i>gra, grayish purple - pale purple - dk yellowish orange - grayish orange - pale</i>	
	4			<i>reddish brown mottled sbang - sbad mod</i>	
	5			<i>rtid grading to 1/2 prly rtid, dry slight</i>	
23	6		95	<i>trace mang. oxide, laid down in thin</i>	
	7			<i>laminae in places</i>	
	8			<i>CLAY pale red purple with pale purple and</i>	
	9			<i>grayish red purple mottling very sandy</i>	
24	10		95	<i>(c/s pockets throughout) silty, med moist</i>	
	11			<i>fm, slightly malleable</i>	
	12			<i>SAND (silt 10-15% with siltier pockets)</i>	
	13			<i>med-fn gra with occ. cse gra,</i>	
25	14		55	<i>pale red purple - pale purple with grayish</i>	
	15			<i>red purple and med reddish brown</i>	
	16			<i>mottling, sbang - sbad, med - well rtid</i>	
	17			<i>dry, trace mang oxide, includes</i>	
	18			<i>thin clay laminae and stringers</i>	
26	19		100		
	20			<i>SAND (silt 10-15%) med-fn gra, pale</i>	
	21			<i>red purple - pale purple with</i>	
27	22		95	<i>dk red - dk yellowish orange - pale</i>	
	23			<i>yellowish orange mottling, sbang -</i>	
	24			<i>sbad, med - well rtid, dry, trace</i>	
	25			<i>mang. oxide</i>	
28	26		95		
	27			<i>SAND (silt 15-20%) med-fn gra, pale</i>	
	28			<i>red purple - pale purple with med</i>	
	29			<i>red - dk red mottling, sbang -</i>	
29	30		95	<i>sbad, med - well rtid, dry, sbad</i>	
	31			<i>mang. oxide</i>	
	32				
30	33		95	<i>SAND As Above, grades siltier (35-40%)</i>	
	34				
	35				
	36				
	37				
	38				
	39				
	40				

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-23A

DRILLER Blake Cabot

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/20/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donahue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter 60.0' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Sample~~ Plug Length 0.03'

(b) Screen Length 4.89'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen)

1) 9.89'
2) 9.90' 3) 9.90' 4) 9.88'
5) 8.43'

(d) Depth to Top of Screen 48.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 52.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.5'

6) Depth to Top of Filter Pack 46.5'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 2.0'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MAV-27 B

DRILLER Blake Cabot

SRS COORDINATES _____

DATE OF WELL INSTALLATION 12/01/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter First Grout Stage 44.5' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Screen~~ Plug Length 0.02'

(b) Screen Length 4.89'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.89'
2) 9.90' 3) 9.90' 4) 8.31'

(d) Depth to Top of Screen 38.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 42.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.6'

6) Depth to Top of Filter Pack 36.5'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 1.8'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-23C

DRILLER Blake Cubit

SRS COORDINATES _____

DATE OF WELL INSTALLATION 12/03/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME B.II Joyce/SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter Second Grout 37.7' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Screen~~ Plug Length 0.04'

(b) Screen Length 4.89'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.88'
2) 9.87' 3) 8.25'

(d) Depth to Top of Screen 28.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 32.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.63'

6) Depth to Top of Filter Pack 25.9'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 25.9'

CLIENT	LOCATION	JOB NO.	SUBJECT	DATE	CHECKED BY	DATE
WJRC	SRJ	G-4346	RF Heating Test - MHV - 25	12/03/92		BY: Bill Joyce
			Piezometer Well Construction Diagram			

MHV - 23

From
Bottom
Cuttings

From
Ground
Surf face

52.92'	42.91'	32.93'	44.49'	34.60'	24.68'	34.61'	24.70'	14.81'	4.93'	24.71'	14.80'	4.91'	0.07'	14.81'	4.92'	0.03'	(0.00)'
					</												

SEC DONOHUE

CALCULATION SHEET

CLIENT W/SRC LOCATION SRS JOB NO. G 4346
 SUBJECT RF Heating Test - MHV - 23 Piezometers Casing Tally
 BY Bill Joyce DATE 12/03/92 CHECKED BY _____ DATE _____

Casing Tally
A
 1) 9.89'
 2) 9.90'
 3) 9.90'
 4) 9.88'
 5) 9.90'
 49.47'
 - 48.00' Top of Casing
 1.47' Stick-up

B
 1) 9.89'
 2) 9.90'
 3) 9.90'
 4) 9.88'
 39.57'
 - 38.00' Top of Casing
 1.57' Stick-up

C
 1) 9.88'
 2) 9.87'
 3) 9.88'
 29.63'
 - 28.00' Top of Casing
 1.63' Stick-up

Materials List (A, B, C)

Casing
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen
 1" PVC
 Slotted
 0.010 in. slot
 Flush
 Tri-Loc Threads
 Timco Brand

Seal
 Not required

Plug
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen / Plug Tally
A

		0.08'
4.89'	=====	4.68'
		0.13'
0.03'	Plug	0.03'

B

		0.08'
4.89'	=====	4.68'
		0.13'
0.02'	Plug	0.02'

C

		0.08'
4.89'	=====	4.68'
		0.13'
0.04'	Plug	0.04'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-237

DRILLER Steve Reese

SRS COORDINATES _____

DATE OF WELL INSTALLATION 1/21/93

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Tigue/SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT

Fiber Optics Temperature Sensors

1) Total Drilled Depth/Hole Diameter 63.0' / 8 1/2"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) Sump & Plug Length Not required

(b) Screen Length Not required

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 10.12'
including threads 2) 10.00'
3) 10.00' 4) 10.00' 5) 10.00'
6) 4.88'

(d) Depth to ^{Sensors} Top of Screen Fiber optics: 28.00', 33.00', 38.00', 43.00', 48.00' and 53.00'. Thermocouples: 28.00', 38.00' and 48.00'.

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 55.0'

5) Casing Stick Up (Standard 2.5' A.G.S.) 5.1'

6) Depth to Top of Filter Pack 9.1'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 9.1'

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration J. Fe</i>		DATE <i>11/19/92</i>	SHEET <i>1 of 3</i>
REFERENCE DATUM		DRILLING CONTRACTOR <i>EMTC</i>	
WELL NO. <i>MHV-23</i>	SRP COORDINATES	DRILLER <i>Blake Cabif</i>	
LOGGED BY <i>Bill Joyce</i>	COMPANY <i>SEC Dunsmuir</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-Spoon</i>	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
1	0	0-0-0		Upper 0.5' Typ soil and rip rap above (silt 10%) med- coarse grn, dk yellowish brown, shaggy-sbrnd, med silt, dry	Begin to split-spoon on 11/19/92 at 11:15
	1		70		3" Split-Spoon
2	2			SAND (silt 20-25%) med-fn grn with some coarse grn, light brown, shaggy-sbrnd, med moist, firm	Augers 4 1/4" ID 7 1/4" OD B.T. 8 1/4" OD Using Downhole Hammer
3	3		30		
	4			SAND (silt 25-40%) med-fn grn with some coarse grn, dk yellowish orange and reddish brown, mottled, shaggy-sbrnd, med silt, dry, very hard	
4	5		95		
	6			SILT (sand 20-25%, clay 10-15% w/ kaolin) fn-med grn, med reddish brown-greenish orange-dk yellowish orange-white (kaolin) mottled, shaggy, well silt, dry, very hard	
5	7		100		
	8			pochothy of kaolin included	
6	9		100		
	10			SAND (silt 25-40%) med-fn grn with occ. coarse grn, med reddish brown with dk yellowish orange and some grayish purple mottling, shaggy-sbrnd, med silt, dry, hard, trace mang. oxide	
7	11		100		
	12			SAND (silt 15%, clay 5% w/ kaolin speckled throughout) med-coarse grn, med reddish brown-pale reddish brown with dk yellowish orange and white mottling, shaggy-sbrnd, med-silt, dry, hard, trace mang. oxide	
8	13		95		
	14				
9	15		100		
	16			CLAY thin laminae, pale red purple, silty, sandy, med moist, firm	
10	17		75		
	18			SAND (silt 10-15%, clay 10-15% w/ kaolin speckled throughout) med-coarse grn, pale reddish brown-med reddish brown-white (kaolin) with dk yellowish orange mottling, shaggy, med silt, dry, firm	
	19		100		
	20				

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/19/92</i>	SHEET <i>2 of 3</i>
WELL NO. <i>MHV-23</i>		REFERENCE DATUM	DRILLING CONTRACTOR <i>EMTC</i>
LOGGED BY <i>Bill Joyce</i>		SRP COORDINATES	DRILLER <i>Blake Cubitt</i>
		COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Willow Stem Auger - 3" Split-Spoon</i>

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
11	20		90	<i>SAND (silt 10-15%, clay 5-10%, no kaolin speckled throughout) crse - v/crse</i>	
12	1		90	<i>grn, gtz pockets included with granules, pale reddish brown - mod reddish brown - white (kaolin), ssang - sbnd, poly srt'd, dry, slight trace mang. oxide, occ. clay stringers</i>	
	2				
13	3		90		
	4				
14	25		95	<i>CLAY includes pockets of sand, grayish purple with mod reddish brown - pale reddish brown - dark yellowish orange mottling, silty, very sandy, mod moist hard, includes kaolin laminae</i>	<i>Plug sample (VOC) at 25'</i>
	6				
15	7		95	<i>SAND (silt 5-10%, clay 5% as kaolin speckled throughout) crse - v/crse grn with granules, pale reddish brown - mod reddish orange - dark yellowish orange - white, ssang - sbnd, poly srt'd, dry, occ. gtz pockets</i>	<i>Plug sample at 27'</i>
	8				
16	9		95		<i>Plug sample at 29'</i>
	30				
17	1		95	<i>SAND (silt 5-10%, clay trace (kaolin)) crse - v/crse grn with granules, mod reddish orange grading to pale yellowish brown - mod yellowish brown, ssang - sbnd, poly srt'd, dry, occ. clay stringers</i>	<i>Plug sample at 31'</i>
	2				
18	3		90		<i>Plug sample at 33'</i>
	4				
19	35		95	<i>Clay stringers and quartz pockets</i>	<i>11/20/92 Plug samples at 35, 36'</i>
	6				
20	7		100	<i>Intermittent cleaner clays with silty/clayey sand</i>	<i>M. cross sample at 35'</i>
	8				
21	9		95	<i>SAND (silt 35-40%, clay 5% in matrix) in grn with some mod gran, multi-colored including pale yellowish - mod yellowish brown and pale red purple - grayish red purple mottled, thin laminae included, ssang - sbnd, well srt'd, dry, trace mang oxide</i>	<i>Plug samples at 37, 38'</i>
	40				
				<i>CLAY pale purple - pale red purple with grayish red purple and white mottling, silty, mod moist, slightly malleable, hard</i>	

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/20/92</i>	SHEET <i>3</i> OF <i>3</i>
REFERENCE DATUM		DRILLING CONTRACTOR <i>EMTC</i>	
WELL NO. <i>MHV-23</i>	SAP COORDINATES	DRILLER <i>Blake Cabit</i>	
LOGGED BY <i>B.11 Joyce</i>	COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-spore</i>	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
21	40				
	1		95	CLAY with intermittent clayey sand sections	
	2			pale purple - pale red purple with	
	3		95	grayish red purple - white - light brown	
22	4			mottling, etc. pockets included silty,	
	5			sandy, mod moist, hard, includes	
	6			kaolin pocket	
23	45		100	Intermittent silty clays and sand	
	6				
24	7		95	SAND (silt 40-45% grading to 15% clay 5% grading to trace) med-fn -	
	8			often grn grading to med-fn grn,	
	9		90	pale red purple - pale purple with	
25	10			light brown - mod to reddish brown -	
	11			pale yellowish brown mottling, shag-	
	12			strat, mod-well srt'd, dry, trace	
	13			mang. oxide, mica trace in places	
	14			occ. coarse grn	
26	15		100		
	16			SAND (silt 10-15%) fn - med grn	
	17			pale purple - pale red purple with	
	18			light brown - pale reddish brown -	
27	19		100	pale yellowish brown occ. mottling,	
	20			shag - strat, mod-well srt'd, dry,	
	21			abundt mang. oxide	
28	22		100	SAND (silt 10-15% with siltier 15-20% sections) med-fn grn, predominantly	
	23			pale purple - pale red purple with drk	
	24			yellowish orange - mod yellowish brown -	
29	25		75	mod red - pale reddish brown - pale	
	26			yellowish brown, mottled shag - strat,	
	27			mod-well srt'd, dry, trace mang.	
	28			oxide	
30	29		95		
	30			SAND As Above grades siltier 35-40% clay trace - 5%	
	60				

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC.

WELL NUMBER MHV-24A

DRILLER Blake Cabit

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/17/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Denolve

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter 60.0' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Submer~~ Plug Length 0.03'

(b) Screen Length 4.90'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen)
1) 9.87'
2) 9.87' 3) 9.90' 4) 9.89'
5) 8.47'

(d) Depth to Top of Screen 48.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 52.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.4'

6) Depth to Top of Filter Pack 46.3'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 1.9'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-24B

DRILLER Blake Cabit

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/19/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce/SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

- 1) Total Drilled Depth/Hole Diameter First Grout Stage 44.4' / 8 1/4"
- 2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)
- (a) ~~Screen~~ Plug Length 0.02'
- (b) Screen Length 4.89'
- (c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1/ 9.90'
2/ 9.88' 3/ 9.89' 4/ 8.33'
- (d) Depth to Top of Screen 38.00'
- 3) Depths to Centralizers Not required
- 4) Total Depth of Installed Well 42.9'
- 5) Casing Stick Up (Standard 2.5' A.G.S.) 1.6'
- 6) Depth to Top of Filter Pack 36.0'
- 7) Depth to Top of Fine Sand Seal Not required
- 8) Depth to Top of Bentonite Seal Not required
- 9) Thickness of Grout 3.0'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-24C

DRILLER Blake Cabit

SRS COORDINATES _____

DATE OF WELL INSTALLATION 12/01/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce/SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter Second Grout Stage 33.0' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Screen~~ Plug Length 0.04'

(b) Screen Length 4.89'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.88'
2) 9.89' 3) 8.23'

(d) Depth to Top of Screen 28.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 32.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.7'

6) Depth to Top of Filter Pack 26.6'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 26.6'

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G-4346
SUBJECT RF Heating Test - MHV - 24 Piezometer Well Construction Diagram
BY Bill Joyce DATE 12/01/92 CHECKED BY _____ DATE _____

From - MHV-24
Bottom
Casing

From
Ground
Surface

Gravel / Pack
Based on Practical
Application in the Field of
1 bag Coarse Sand = 1.2 ft³
1 bag Grout = 0.6 ft³
1 bag Mixed Grout = 1.3 ft³

A. Theoretical
Coarse Sand - 2.2 bags
Grout - 0.6 bags
Actual
Coarse Sand - 3.3 bags
Grout - 0.7 bags

B. Theoretical
Coarse Sand - 4 bags
Grout - 0.6 bags
Actual
Coarse Sand - 3 bags
Grout - 0.7 bags

C Theoretical
Coarse Sand - 2.3 bags
Grout - 7.2 bags
Actual
Coarse Sand - 2 bags
Grout - 6.7 bags

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G4346
 SUBJECT RF Heating Test - MHV - 24 Piezometers Casing Tally
 BY Bill Joyce DATE 12/01/92 CHECKED BY _____ DATE _____

Casing Tally	Screen Zones
<u>A</u>	<u>A</u>
1) 9.87'	48.0'-53.0'
2) 9.87'	
3) 9.90'	
4) 9.89'	
5) 9.91'	
49.44'	
- 48.00' Top of Casing	
1.44' Stick-up	

Materials List (A, B, C)
Casing
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen
 1" PVC
 Slotted
 0.010 in. slot
 Flush
 Tri-Loc Threads
 Timco Brand

Sump
 Not required

Plug
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

<u>B</u>	<u>B</u>
1) 9.90'	38.0'-43.0'
2) 9.88'	
3) 9.89'	
4) 9.92'	
39.59'	
- 38.00' Top of Casing	
1.59' Stick-up	

<u>C</u>	<u>C</u>
1) 9.88'	28.0'-33.0'
2) 9.89'	
3) 9.91'	
29.68'	
- 28.00' Top of Casing	
1.68' Stick-up	

Screen / Plug Tally	
<u>A</u>	
	0.07'
4.90'	4.69'
	0.14'
0.03' Plug	0.03'

Screen / Plug Tally	
<u>B</u>	
	0.04'
4.89'	4.72'
	0.13'
0.02' Plug	0.02'

Screen / Plug Tally	
<u>C</u>	
	0.08'
4.89'	4.68'
	0.13'
0.04' Plug	0.04'

MONITORING WELL CONSTRUCTION DIAGRAM

WELL NUMBER MHV-24T

SRS COORDINATES _____

SANITARY SEAL ELEVATION _____

DRILLING SUBCONTRACTOR EMTC
 DRILLER Steve Reeve
 DATE OF WELL INSTALLATION 1/18/93
 TECH. O.S./CO. NAME B.II Joyce/JEC Donohue

NOTE: ALL MEASUREMENTS
 ARE FROM GROUND
 SURFACE AT START
 OF BORING - MEASUREMENTS
 TO NEAREST 0.1 FOOT.

Fiber Optic Temperature Sensors

1) Total Drilled Depth/Hole Diameter 68.0' / 8 1/2"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) Sump & Plug Length Not required

(b) Screen Length Not required

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 10.13'

including threads 2) 9.99'

3) 10.00' 4) 10.00' 5) 9.99'

6) 10.00' 7) 1.89'

(d) Depth to Top of Screen 28.00', 33.00', 38.00', 43.00', 48.00', 53.00', 58.00', 63.00', 68.00'
Sensors
Temperature: 28.00', 38.00', 48.00'
Fiber optic: 28.00', 33.00', 38.00', 43.00', 48.00', 53.00', 58.00', 63.00', 68.00'
 (3) Depths to Centralizers Not required

4) Total Depth of Installed Well 62.0'

5) Casing Stick Up (Standard 2.5' A.G.S.) 3.2'

6) Depth to Top of Filter Pack 10.1'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 10.1'

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/17/92</i>	SHEET <i>1 of 3</i>
REFERENCE DATUM		DRILLING CONTRACTOR <i>EMTC</i>	
WELL NO. <i>MHV - 24</i>	SRP COORDINATES	DRILLER <i>Blake Cabit</i>	
LOGGED BY <i>Bill Joyce</i>	COMPANY <i>SEL Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-Spoon</i>	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
1	0		100	Upper 0.7' Top soil and rip-rap SAND (s.H.10%) med-crse grn, drk yellowish brown shag-shad, mud silt, dry	Begin to split-spoon on 11/17/92 at 11:30
2	1		55	SAND (silt 35-40%, clay trace) med-crse grn with some fn grn, light brown and reddish brown (mottling), shag-shad, mud silt, clay, fm, trace mang oxide	3" Split-spoons Augers 4 1/4" ID 7 1/2" OD Bit 8 1/4" OD Using downhole hammer
3	2		80	SAND (silt 40%, clay trace) med-fn grn with some crse grn, med reddish brown-drk yellowish orange with grayish orange, mottled shad-shag, med silt, dry, hard-fm, trace mang oxide, gte patches	
4	3		95		
5	4		80	SAND As Above with some 1/4 crse grn	
6	5		75	SAND (silt 30-35% grading to 15-20%, clay (kaolin) 5% speckled throughout) med-fn grn grading to med-crse grn med reddish brown - pale reddish brown - drk yellowish orange - grayish purple-white (kaolin), shag-shad, mud silt, dry, hard, trace mang, oxide	
7	6		70		
8	7		75	SAND (silt 10-15% grading to 5-10%, clay (kaolin) 5% grading to 10-15% speckled throughout) med-crse grn with some 1/4 crse grn, pale reddish brown - med reddish orange - white (kaolin) shag-shad, med-pale silt, dry, fm, trace mang oxide	
9	8		85		
10	9		75	SAND As Above	
	20				

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/17/92</i>	SHEET <i>2 of 3</i>
WELL NO. <i>MHV-24</i>		REFERENCE DATUM	DILLING CONTRACTOR <i>EMTC</i>
LOGGED BY <i>D. H. Joyce</i>		SRP COORDINATES	DILLER <i>Blake Cabit</i>
		COMPANY <i>SEC Danohue</i>	DILLING METHOD <i>Hollow Stem Auger - 3" Split-Spoon</i>

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DILLING COMMENTS
11	20				
	1		70	<i>SAND (silt 10% clay 10% (knolly) speckled throughout) med - coarse gra with occ. v/coarse gra med reddish orange - pale reddish brown - white, shag - strand, poly sctd, dry, trace mang. oxide</i>	
12	2		95		
	3				
13	25		90	<i>SAND As Above</i>	
	6				
14	7		80	<i>SAND (silt 10-15% clay 10% (knolly) speckled throughout) coarse - v/coarse gra with granules and pebbles med reddish orange - pale reddish brown white (knolly) w/ occ stringers and pockets, shag - strand, poly sctd, dry</i>	
	8				
15	9		70		
	30				
16	1		75	<i>SAND As Above</i>	
	2				
17	3		95	<i>CLAY grayish red purple - grayish purple with dusky yellow mottling, silty, med moist, hard - frm, slightly sandy</i>	
	4				
18	35		95	<i>SAND (silt 35%, clay 20-25% in matrix) fn - med gra, pale purple - pale red purple with grayish red, purple - white mottling, shag - strand, med - well sctd, med dry</i>	
	6				
19	7		100	<i>with intermittent</i>	
	8				
20	9		95	<i>CLAY grayish red purple - grayish purple with some light brown mottling, massive, silty, slightly sandy, hard - frm, med moist</i>	
	40				

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/17/92</i>	SHEET <i>3 of 3</i>
WELL NO. <i>MHV-24</i>		REFERENCE DATUM	DILLING CONTRACTOR <i>EMTC</i>
LOGGED BY <i>Bill Joyce</i>		SRP COORDINATES	DRIER <i>Blake Cabit</i>
COMPANY <i>SEC Dunohue</i>		DILLING METHOD <i>Yellow Stem Auger - 3" split-sp...</i>	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DILLING COMMENTS
	40				
21	1		100	CLAY (intermittent sand pockets of varying percentages (10-20%)	
	2			grayish red purple - grayish purple with med red - light brown - white mottling, silty, slightly sandy in places, med moist, hard - fm, massive	
22	3		75		
	4				
23	45		90	SAND (silt 10-15 % with occ clay - thin laminae) coarse - v-coarse grn with some med grn, pale red purple - pale purple with med red mottling, strong - strand, med silty, dry, pockets are silty (15-20%)	
	6				
24	7		85		
	8				
25	9		95	SAND (silt 10-15 %) med - fn grn, pale red purple - pale purple, strong - strand, med - well silty, dry, trace mang. oxide	
	50				
26	1		100		
	2			SAND (silt 10-15 %) med - fn grn, pale red purple - pale purple with occ. pale reddish brown mottling, strong - strand, med - well silty, dry, trace mang. oxide	
27	3		90		
	4				
28	55		100	SAND (silt 10-15 % with silty pockets (15-20%) med - fn grn, pale red purple - pale purple with pale reddish brown and med red mottling, strong - strand, med - well silty, dry, trace mang. oxide	
	6				
29	7		100		
	8				
	9		90		
	60			Grades silty (35-40%) clay - trace	

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-25A

DRILLER Terry Hornsby

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/10/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce/SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT

- 1) Total Drilled Depth/Hole Diameter 60.0' / 8 1/4"
- 2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)
  - (a) ~~Sum~~ Plug Length 0.04'
  - (b) Screen Length 4.90'
  - (c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen)

<u>1/ 9.89'</u>	<u>2/ 9.89'</u>	<u>3/ 9.90'</u>	<u>4/ 9.90'</u>
<u>5/ 8.42'</u>			
  - (d) Depth to Top of Screen 48.00'
- 3) Depths to Centralizers Not required
- 4) Total Depth of Installed Well 52.9'
- 5) Casing Stick Up (Standard 2.5' A.G.S.) 1.5'
- 6) Depth to Top of Filter Pack 46.6'
- 7) Depth to Top of Fine Sand Seal Not required
- 8) Depth to Top of Bentonite Seal Not required
- 9) Thickness of Grout 2.4'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MNV-25B

DRILLER Terry Hornsby

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/11/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce/SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

- 1) Total Drilled Depth/Hole Diameter First Grout Stage 44.2' / 8 1/4"
- 2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)
- (a) ~~Casing~~ Plug Length 0.03'
- (b) Screen Length 4.90'
- (c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen)
- 1) 9.89' 2) 9.89' 3) 9.88' 4) 8.34'
- (d) Depth to Top of Screen 38.00'
- 3) Depths to Centralizers Not required
- 4) Total Depth of Installed Well 42.9
- 5) Casing Stick Up (Standard 2.5' A.G.S.) 1.6'
- 6) Depth to Top of Filter Pack 36.5'
- 7) Depth to Top of Fine Sand Seal Not required
- 8) Depth to Top of Bentonite Seal Not required
- 9) Thickness of Grout 2.8'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-25C

DRILLER Terry Hornby

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/13/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce/SEL Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

- 1) Total Drilled Depth/Hole Diameter Second Grout 33.7' / 8 1/4"
- 2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)
- (a) ~~Screen~~ Plug Length 0.02'
- (b) Screen Length 4.89'
- (c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.89'
2) 9.89' 3) 8.22'
- (d) Depth to Top of Screen 28.00'
- 3) Depths to Centralizers Not required
- 4) Total Depth of Installed Well 32.9'
- 5) Casing Stick Up (Standard 2.5' A.G.S.) 1.7'
- 6) Depth to Top of Filter Pack 26.7'
- 7) Depth to Top of Fine Sand Seal Not required
- 8) Depth to Top of Bentonite Seal Not required
- 9) Thickness of Grout 26.7'

C Theoretical
Coarse Sand - 2.3 bags
Grout - 7.2 bags
Actual
Coarse Sand - 1 bag
Grout - 5.7 bags

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G4346
 SUBJECT RF Heating Test - MHV - 25 Piezometers Casing Tally
 BY Bill Joyce DATE 11/13/92 CHECKED BY _____ DATE _____

Casing   Screen
Tally   Zones
A   A
 1) 9.89'
 2) 9.89'
 3) 9.90'
 4) 9.90'
 5) 9.89'
     49.47'
 - 48.00' Top of Casing
     1.47' Stick-up

Materials
List (A, B, C)
Casing
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen
 1" PVC
 Slotted
 0.010 in. slot
 Flush
 Tri-Loc Threads
 Timco Brand

Sump
 Not required

Plug
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

B   B
 1) 9.89'
 2) 9.89'
 3) 9.88'
 4) 9.91'
     39.57'
 - 38.00' Top of Casing
     1.57' Stick-up

C   C
 1) 9.89'
 2) 9.89'
 3) 9.91'
     29.69'
 - 28.00' Top of Casing
     1.69' Stick-up

Screen / Plug
Tally
A

	0.08'
4.90'	4.69'
	0.13
0.04' Plug	0.04'

B

	0.07'
4.90'	4.69'
	0.14'
0.03' Plug	0.03'

C

	0.09'
4.89'	4.67'
	0.13'
0.02' Plug	0.02'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC DRILLER Garry Moore DATE OF WELL INSTALLATION 1/15/93 TECH. O.S./CO. NAME B. H. Joyce / SEC Donolue

WELL NUMBER MHV-251 SRS COORDINATES _____ SANITARY SEAL ELEVATION _____

NOTE: ALL MEASUREMENTS ARE FROM GROUND SURFACE AT START OF BORING - MEASUREMENTS TO NEAREST 0.1 FOOT.

Fiber Optic Temperature Sensors

1) Total Drilled Depth/Hole Diameter 68.0' / 8 1/2"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) Sump & Plug Length Not required
(b) Screen Length Not required

(c) Casing Joint Lengths (Measured in Up-hole Sequence from Top of Screen) 1) 10.13'

including threads
2) 10.00' 3) 10.00' 4) 10.00' 5) 10.01' 6) 10.01' 7) 1.85'

(d) Depth to Top of Screen 28.00' 38.00' 48.00' 58.00' 68.00'
Thermocouples: 28.00', 38.00' and 48.00'
Fiber Optic: 28.00', 38.00', 48.00', 58.00', 68.00'
and 48.00' Lawrence Livermore: 15.00', 20.00', 25.00', 30.00', 35.00', 40.00', 45.00', 50.00', 55.00', and 60.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 62.0'

5) Casing Stick Up (Standard 2.5' A.G.S.) 3.2'

6) Depth to Top of Filter Pack 10.0'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 10.0'

FIELD GEOLOGIC LOG

PROJECT RF Healing Test - Integrated Demonstration Site		DATE 11/09/92	SHEET 1 of 3
REFERENCE DATUM		DRILLING CONTRACTOR EMTC	
WELL NO. MHV-25	SRP COORDINATES	DRILLER Terry Hornsby	
LOGGED BY Bill Joyce	COMPANY SEC Donohue	DRILLING METHOD Hollow Stem Auger - 3" Split-Spoon	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
1	0		100	Upper 0-1 The soil sand (silt 10%) med- crse grn drk yellowish brown, shaggy - strand mod satd, dry, some organic material	Ref. to split-spoon on 11/09/92 at 0' 20"
	1				3" split-spoon
	2			SAND (silt 35-40%, clay 5-10% w/ pockets (pale purple - white (kaolin)))	Augers 4 1/4" ID 7 1/2" OD
2	3		100	med-crse - v-crse grn w/ quartz gravel and pebbles, occ cobbles, pale reddish brown - mod reddish brown - drk yellowish orange, strand - shaggy, poly satd	Bit 8 1/4" OD
3	4				
	5		90	dry, very firm - hard Grades to 20-25% silt with abndt gtz cobbles and boulders	
4	6		100	SILT (Sand 25-30%, clay 10-15% kaolin) med-fn grn sand, mod reddish brown - pale reddish brown - drk yellowish orange - white (kaolin), strand - shaggy dry, very hard - firm	
5	7				
	8		100		
	9			SILT As Above	
6	10				
	1		100		
	2			SAND (silt grades to 20-25% clay trace - silt w/ pockets) med-fn grn, mod reddish brown - pale reddish brown - pale yellowish orange - white (kaolin) - pale purple, shaggy - strand, dry, firm	
7	3		100		
	4			SILT (clay 35-40% white (kaolin)) - pale purple - grayish purple, mottled, dry, very hard, slight trace fn sand	
8	15		90		
	6			SAND (silt 30-35%) med grn, mod reddish brown - pale reddish brown - drk yellowish orange - white (kaolin speckled throughout), shaggy - strand, dry trace mang. oxide, pockets of pale purple silt	
9	7		100		
	8				
10	9		100	SAND As Above grading to med-crse grn with some v-crse grn, silt 20-25%	
	20				

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/09/92</i>	SHEET <i>2 of 3</i>
REFERENCE DATUM		DRILLING CONTRACTOR <i>EMTC</i>	
WELL NO. <i>MHV-25</i>	SRP COORDINATES	DRILLER <i>Terry Hornsby</i>	
LOGGED BY <i>Bill Joyce</i>	COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-Spoon</i>	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
11	20		100	CLAY white (kaolin) grading to pale purple silty, slight trace of sand, massive, dry- mod moist	
12	2		75	CLAY As Above with sand pockets	
13	25		90	SAND (silt 10%) med-crse grn, med reddish brown - drk yellowish orange- grayish orange - pale purple, occ banding, shag-sbrd, med-prly srt'd	Using downhole hammer Steam cleaning split-spoons for sampling. Sample at 25'
14	7		85	SAND (silt 10-15%, clay trace as kaolin)	Sample at 27'
15	9		90	med-crse - vcrse grn with gtz granules and pebbles, grayish orange-med reddish orange - pale yellowish brown, shag- sbrd, prly srt'd, dry, gtz pockets	Sample at 29'
16	1		85	SAND As Above grading to drk yellowish orange - med yellowish brown	Sample at 31'
17	3		100	SAND As Above with clay pockets	Sample at 33'
18	35		100	SAND (silt 30-35%, clay 10%) vfn grn, pale purple - pale red purple, sbrd, well srt'd, mod moist	
19	7		100	SAND As Above, slight trace of mica	
20	9		100	SAND As Above, mottled med reddish brown	
	40				

FIELD GEOLOGIC LOG

PROJECT		WELL NO.		LOGGED BY		COMPANY		DILLING METHOD	
RF Heating Test Integrated Denudation Site		MHV-25		B. H. Joyce		SEC Donohue		Hollow Stem Auger - 3" Split-Spoon	
DATE		DILLING CONTRACTOR		SAP COORDINATES		DILLER		DILLING COMMENTS	
11/09/92		EMTC				Terry Horvath			
SHEET 3 OF 3									
DEPTH, FEET	RUN NUMBER	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION		DILLING COMMENTS			
40	21		80	SILT (clay 15-20%, sand 20-25%) v. fine, well sorted, mod. moist, very clayey					
40	22		90	SILT As Above with intermittent sandier areas					
40	23		100	CLAY pale red purple - pale purple, silty, firm - hard, mod. moist					
45	23		100	Intermittent sandy and clayey layers with large 8+ pockets grading to mod reddish orange - pale reddish brown - light brown					
7	24		100	SAND (silt 15%) med - fn grn with o.c.					
8	25		100	fine grn, pale red purple - pale purple with grayish orange and mod reddish brown mottling, sand, mod silt					
50	26		95	SAND As Above with o.c. silty pockets					
3	27		100	SAND As Above					
4	28		95	SAND As Above, little coarse grn sand					
7	29		100	SAND (silt 30% clay - trace) fn - v. fine grading to fn - med grn, pale purple - pale red purple with grayish red purple, mod reddish brown and blk yellowish orange mottling sand - silt					
8	30			med - well sorted, dry, trace manganese oxide					

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER 11MV.26A

DRILLER Terry Horasby

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/11/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter 60.0' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Screen~~ Plug Length 0.02'

(b) Screen Length 4.91'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.90'

2) 9.93' 3) 9.89' 4) 9.92'

5) 8.36'

(d) Depth to Top of Screen 48.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 52.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.6'

6) Depth to Top of Filter Pack 46.6'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Dentonite Seal Not required

9) Thickness of Grout 2.5'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC
 DRILLER Terry Hornsby
 DATE OF WELL INSTALLATION 11/13/92
 TECH. O.S./CO. NAME B.I. Type/SEC Monova

WELL NUMBER MHV-26B
 SRS COORDINATES _____
 SANITARY SEAL ELEVATION _____

NOTE: ALL MEASUREMENTS
 ARE FROM GROUND
 SURFACE AT START
 OF BORING - MEASUREMENTS
 TO NEAREST 0.1 FOOT.

- 1) Total Drilled Depth/Hole Diameter first 60' 44.1' / 8 1/4"
- 2) Casing/Screen Tally (Measured to Nearest 0.01 Foot) 0.04'
- (a) ~~Screen~~ Plug Length _____
- (b) Screen Length 4.89'
- (c) Casing Joint Lengths (Measured in Up-hole Sequence from Top of Screen) 1) 9.90' 2) 9.89' 3) 9.90' 4) 8.31'
- (d) Depth to Top of Screen 38.00'
- 3) Depths to Centralizers Not required
- 4) Total Depth of Installed Well 42.9'
- 5) Casing Stick Up (Standard 2.5' A.G.S.) 1.6'
- 6) Depth to Top of Filter Pack 36.6'
- 7) Depth to Top of Fine Sand Seal Not required
- 8) Depth to Top of Dentritic Seal Not required
- 9) Thickness of Grout 2.7'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-26C

DRILLER Blake Cabot

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/16/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

- 1) Total Drilled Depth/Hole Diameter Second Grout Stage 33.9' / 8 1/4"
- 2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)
- (a) ~~Sample~~ Plug Length 0.02'
- (b) Screen Length 4.90'
- (c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.91'
2) 9.89' 3) 8.20'
- (d) Depth to Top of Screen 28.00'
- 3) Depths to Centralizers Not required
- 4) Total Depth of Installed Well 32.9'
- 5) Casing Stick Up (Standard 2.5' A.G.S.) 1.7'
- 6) Depth to Top of Filter Pack 26.1'
- 7) Depth to Top of Fine Sand Seal Not required
- 8) Depth to Top of Bentonite Seal Not required
- 9) Thickness of Grout 26.1'

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G-4346
 SUBJECT RF Heating Test - MHV - 26 Piezometer Well Construction Diagram
 BY Bill Joyce DATE 11/16/92 CHECKED BY _____ DATE _____

From
Bottom
Casing

MHV - 26

From
Ground
Surface

Gravel Pack

Based on Practical
Application in the Field of
1 bag Coarse Sand = 1.2 ft³
1 bag GROUT = 0.6 ft³
1 bag Mixed GROUT = 1.3 ft³

52.93' 42.93' 32.92'
44.57' 34.62' 24.72'
34.65' 24.72' 14.83'
24.76' 14.83' 4.92'
14.83' 4.93' (0.00')
4.93' (0.00')
0.02'
(0.00')

0.00' 0.00' 0.00'
8.20' 8.31' 8.36'
18.09' 18.21' 18.28'
28.00' 28.10' 28.17'
32.90' 32.92'
38.00' 38.10'
42.89' 42.93'
48.00'
52.91' 52.93'

A. Theoretical

Coarse Sand - 2.3 bags
Grout - 0.6 bags

Actual

Coarse Sand - 3 bags
Grout - 0.7 bags

B. Theoretical

Coarse Sand - 2.4 bags
Grout - 0.6 bags

Actual

Coarse Sand - 2 bags
Grout - 0.7 bags

C. Theoretical

Coarse Sand - 2.3 bags
Grout - 7.2 bags

Actual

Coarse Sand - 2.3 bags
Grout - 5.7 bags

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G4346
 SUBJECT RF Heating Test - MHV - 26 Piezometers Casing Tally
 BY Bill Joyce DATE 11/16/92 CHECKED BY _____ DATE _____

Casing Tally   Screen Zones
A   A
 1) 9.90'   48.0'-53.0'
 2) 9.93'
 3) 9.89'
 4) 9.92'
 5) 9.91'
     49.55'
 - 48.00' Top of Casing
     1.55' Stick-up

B   B
 1) 9.90'   38.0'-43.0'
 2) 9.89'
 3) 9.90'
 4) 9.90'
     39.59'
 - 38.00' Top of Casing
     1.59' Stick-up

C   C
 1) 9.91'   28.0'-33.0'
 2) 9.89'
 3) 9.90'
     29.70'
 - 28.00' Top of Casing
     1.70' Stick-up

Materials List (A, B, C)
Casing
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen
 1" PVC
 Slotted
 0.010 in. slot
 Flush
 Tri-Loc Threads
 Timco Brand

Sump
 Not required

Plug
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen / Plug Tally
A

	0.10'
4.91'	4.68'
	0.13'
0.02' Plug	0.02'

B

	0.07'
4.89'	4.69'
	0.13
0.04 Plug	0.04

C

	0.09'
4.90'	4.68'
	0.13'
0.02' Plug	0.02'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR ENTC

WELL NUMBER M-11-207

DRILLER Garry Moore / Steve Reese

SRS COORDINATES _____

DATE OF WELL INSTALLATION 1/22/93

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Dunova

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

Fiber Optics Temperature Sensors

1) Total Drilled Depth/Hole Diameter 53.0' / 8 1/2"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) Sump & Plug Length Not required

(b) Screen Length Not required

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 10.13'
including threads 2) 10.00'
3) 10.00' 4) 10.00' 5) 9.87'

(d) Depth to ^{Sensors} Top of Screen Fiber optics: 28.00' 38.00'
and 48.00'. Thermocouples: 28.00', 38.00' and
48.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 50.0'

5) Casing Stick Up (Standard 2.5' A.G.S.) 2.7'

6) Depth to Top of Filter Pack 9.1'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 9.1'

FIELD GEOLOGIC LOG

PROJECT RF Heating Test Integrated Demonstration Site		DATE 11/10/92	SHEET 1 of 3
REFERENCE DATUM		DRILLING CONTRACTOR EMTC	
WELL NO. MHV-26	SRP COORDINATES	DRILLER Terry Hornsby	
LOGGED BY Bill Joyce	COMPANY SEC Donohue	DRILLING METHOD Hollow Stem Auger - 3" Split-Spoon	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
1	0		100	Upper 0.5' top soil SAND (silt 10%) med-crse grn, dk yellowish brown, shag-shed, mod silt, dry, grades to a SAND silt 35-40%	Begin to split-spoon on 11/10/92 at 12:35
	1	Organic material (wood) fill		Sampled decaying, moldy wood remnants	3" split-spoon, Augers 4 1/4" OD
2	2	Organic material (wood) fill	65	Sediment fill from above on top of more wood remnants	7 1/2" OD Bit 8 1/4" OD Using downhole hammer
	3				
3	4	Organic material	100	Out of wood remnants at 4.7'	
	5			SAND (silt 35-40%, clay-trace) med-crse grn, med reddish brown - pale reddish brown - dk yellowish orange, shad-shag, dry, fm-hard, gtz pockets	
4	6		100		
	7				
	8			SAND (silt 40-45%, clay-trace, no kaolin) med-fn grn with occ. crse grn, med reddish brown - pale reddish brown - dk yellowish orange - white (kaolin) mottled, shad-shag, mod silt, dry, fm-hard, trace mang oxide	
5	9		90		
	10				
6	1		100	SAND As Above, gtz pockets, very hard, silty	
	2				
7	3		80	SILT (sand 20-25%, clay 10-15% kaolin) fm-med grn, shad med reddish brown - grayish purple - white (kaolin), shad, well silt, dry, hard-fm	
	4				
8	5		90	SAND (silt 15-20%, clay 5% kaolin) med-crse grn, med reddish brown - pale reddish brown - white (kaolin) shag-shad, mod-silt, dry, hard-fm, gtz pockets	
	6				
9	7		85	Trace mang oxide, kaolin speckled throughout	
	8				
10	9		100	Silt content 10%	
	10			CLAY grayish purple, silty, mod moist, hard	
	20				

2 of 2

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/10/92</i>	SHEET <i>3 of 3</i>
WELL NO. <i>MHV-26</i>	REFERENCE DATUM	DRILLING CONTRACTOR <i>EMTC</i>	
LOGGED BY <i>Bill Joyce</i>	SRP COORDINATES	DRILLER <i>Terry Horvath</i>	
	COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-Spoon</i>	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
21	4 0		95	<u>CLAY</u> grayish red purple - pale red purple with dusky red and white mottling, silty, slightly sandy, med moist, hard - firm	
22	3		100	Intermittent clays and sands	
23	4 5		95	<u>CLAY</u> pale purple - pale red purple, silty, slightly sand with sand layering, med moist, hard - firm	
24	7		85		11/11/92
25	5 0		100	<u>SAND</u> (silt 15-20%) med - coarse w/ occ v/coarse granular, pale purple - pale red purple, shag - strand, poorly srt'd, dry, silty, pockets trace mang oxide	
26	1		100	<u>SAND</u> (silt 10%) med - coarse grn, pale red purple with med red mottling, shag - strand, med srt'd, dry, trace mang oxide	
27	2		95	<u>SAND</u> (silt 10%) med - fn grn, pale red purple - pale purple with occ. med red mottling, shag - strand, med - well srt'd, dry, trace mang oxide	
28	5 5		90		
29	6		90	<u>SAND</u> (silt 10-15% with siltier sections) med - fn grn, pale red purple - pale purple with occ. light brown and dusky red mottling, shag - strand, med - well srt'd, dry, trace mang oxide	
30	6 0		100	Gravel siltier (25%)	Total Depth of Boring: 60'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-27A

DRILLER James Fulman

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/25/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Danche

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter 60.0' / 8.4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Blank~~ Plug Length 0.04'

(b) Screen Length 4.90'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen)
1) 9.89'
2) 9.92' 3) 9.89' 4) 9.93'
5) 8.37'

(d) Depth to Top of Screen 48.00"

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 52.9'

5) Casing Stick Up (Standard 2.5 A G.S.) 1.6'

6) Depth to Top of Filter Pack 45.9'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 2.0'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-27B

DRILLER Blake Cabot

SRS COORDINATES _____

DATE OF WELL INSTALLATION 12/02/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

- 1) Total Drilled Depth/Hole Diameter First Grout Stage 43.9' / 8 1/4"
- 2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)
- (a) ~~Screen~~ Plug Length 0.02'
- (b) Screen Length 4.89'
- (c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.92'
2) 9.88' 3) 9.88' 4) 8.32'
- (d) Depth to Top of Screen 38.00'
- 3) Depths to Centralizers Not required
- 4) Total Depth of Installed Well 42.9'
- 5) Casing Stick Up (Standard 2.5' A.G.S.) 1.6'
- 6) Depth to Top of Filter Pack 36.2'
- 7) Depth to Top of Fine Sand Seal Not required
- 9) Depth to Top of Bentonite Seal Not required
- 9) Thickness of Grout 2.3'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR ETC

WELL NUMBER 14 HV-27 C

DRILLER Blake Cubitt

SRS COORDINATES

DATE OF WELL INSTALLATION 12/03/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Conceive

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

- Second Grout
Stage
- 1) Total Drilled Depth/Hole Diameter 33.9' / 8 1/4"
- 2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)
- (a) ~~Sump~~ Plug Length 0.02'
- (b) Screen Length 4.90'
- (c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen)
- 1) 9.88'
- 2) 9.89'
- 3) 8.23'
-
-
-
- (d) Depth to Top of Screen 28.00'
- 3) Depths to Centralizers Not required
-
- 4) Total Depth of Installed Well 32.9'
- 5) Casing Stick Up (Standard 2.5' A.G.S.) 1.7'
- 6) Depth to Top of Filter Pack 26.1'
- 7) Depth to Top of Fine Sand Seal Not required
- 8) Depth to Top of Bentonite Seal Not required
- 9) Thickness of Grout 26.1'

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G-4346
 SUBJECT RF Heating Test - MHV - 27 Piezometer Well Construction Diagram
 BY Bill Joyce DATE 12/03/92 CHECKED BY _____ DATE _____

From -
 Bottom
 Casing

MHV - 27

From
 Ground
 Surface

Gravel Pack

Based on Practical
 Application in the Field of
 1 bag Coarse Sand = 1.2 ft³
 1 bag ^(dry) Grout = 0.6 ft³
 1 bag Mixed Grout = 1.3 ft³

A. Theoretical
 Coarse Sand - 3.8 bags
 Grout - 0.6 bags

Actual
 Coarse Sand - 5.5 bags
 Grout - 0.7 bags

B. Theoretical
 Coarse Sand - 2.4 bags
 Grout - 0.6 bags

Actual
 Coarse Sand - 2 bags
 Grout - 0.7 bags

C. Theoretical
 Coarse Sand - 2.3 bags
 Grout - 7.2 bags

Actual
 Coarse Sand - 2.3 bags
 Grout - 5.7 bags

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G4346
 SUBJECT RF Heating Test - MHV - 27 Piezometers Casing Tally
 BY Bill Joyce DATE 12/03/92 CHECKED BY _____ DATE _____

Casing   Screen
Tally   Zones
A   A
 1) 9.89'
 2) 9.92'
 3) 9.89'
 4) 9.93'
 5) 9.92'
49.55'
 - 48.00' Top of Casing
 1.55' Stick-up

B   B
 1) 9.92'
 2) 9.88'
 3) 9.88'
 4) 9.90'
39.58'
 - 38.00' Top of Casing
 1.58' Stick-up

C   C
 1) 9.88'
 2) 9.89'
 3) 9.90'
29.67'
 - 28.00' Top of Casing
 1.67' Stick-up

Materials
List (A, B, C)

Casing
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen
 1" PVC
 Slotted
 0.010 in. slot
 Flush
 Tri-Loc Threads
 Timco Brand

Sump
 Not required

Plug
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen / Plug
Tally

A

		0.08'
4.90'	—	4.68'
	—	
	—	
	—	
	—	
		0.14'
0.04'	Plug	0.04'

B

		0.09'
4.89'	—	4.67'
	—	
	—	
	—	
	—	
		0.13'
0.02'	Plug	0.02'

C

		0.09'
4.90'	—	4.68'
	—	
	—	
	—	
	—	
		0.13'
0.02'	Plug	0.02'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-27T

DRILLER Garry Moore / Steve Reese

SRS COORDINATES _____

DATE OF WELL INSTALLATION 1/22/93

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

Fiber Optics Temperature Sensors

1) Total Drilled Depth/Hole Diameter 58.0' / 8 1/2"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) Sump & Plug Length Not required

(b) Screen Length Not required

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 10.13'
including threads 2) 10.00'
3) 10.00' 4) 9.99' 5) 9.88'

(d) Depth to ^{Sensors} Top of Screen Fiber optics: 28.00', 38.00'
and 48.00'. Thermocouples: 28.00', 38.00' and 48.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 50.0'

5) Casing Stick Up (Standard 2.5' A.G.S.) 2.6'

6) Depth to Top of Filter Pack 9.5'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 9.5'

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/25/92</i>	SHEET <i>1 of 3</i>
WELL NO. <i>MHV-27</i>		REFERENCE DATUM	DRILLING CONTRACTOR <i>EMTC</i>
LOGGED BY <i>Bill Joyce</i>		SRP COORDINATES	DRILLER <i>James Hallman</i>
		COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-spoon</i>

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERED	SAMPLE DESCRIPTION	DRILLING COMMENTS
1	0			Upper 0.6' Top soil and rip-rap SAND (silt 10%) med-crse grn, dry yellowish brown, shag-sbrnd, mod srtld, dry	Begin to split-spoon on 11/25/92 at 07:35
	1		75		3" split-spoons
2	2			SAND (silt 35-40% clay-trace) med-crse grn, mod reddish brown grading to mod yellowish brown - light brown shag-sbrnd, prly srtld moist from weather (recent rain), trace mang. oxide iron staining	Augers 4 1/4" ID 7 1/2" OD Bit 8 1/4" OD Using downhole hammer
	3		95		
3	4			Trace organic material, quartz pockets	
	5		85		
4	6			SAND (silt 40-45% clay-trace (kaolin) med-fn grn, mod reddish brown - drk yellowish orange - grayish orange - white (kaolin) mottled, shag-sbrnd, dry, fm-hard, trace iron oxide	
	7		100		
5	8				
	9		100	SILT (sand 15% clay 15% (kaolin pockets) fn-med grn, mod reddish brown - red-white (kaolin) - drk yellowish orange, shag-sbrnd, well srtld, dry, hard	
6	10				
	1		100	SILT (sand 5-10% clay 20-25% (kaolin, grayish purple) fn grn, mod reddish brown - grayish purple - white (kaolin) mottled, shag-sbrnd, well srtld, dry, hard	
7	2				
	3		95		
8	4			SAND (silt 20% clay 10-15% as kaolin ² kaolin speckled throughout) med-crse grn, mod reddish orange - pale reddish brown - white (kaolin) sbrnd-shag, mod-well srtld, dry, fm-hard, siltier section	
	15		90		
9	6				
	7		90		
10	8			SAND (silt 5-10% clay 20% as kaolin speckled throughout) med-crse grn, mod reddish orange - pale reddish brown - white (kaolin) sbrnd-shag, mod srtld, dry, clay (kaolin) pocket and stringers	
	9		90		
	20				

FIELD GEOLOGIC LOG

PROJECT		DATE	SHEET
WELL NO.		SRP COORDINATES	DRILLER
LOGGED BY		COMPANY	DRILLING METHOD
RF Heating Test Integrated Demonstration Site		11/25/92	2 of 3
MHV-27			EMTC
Bill Joyce		SEC Donohue	Hollow Stem Auger - 3" Split-spoon

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
11	20		80	SAND (silt 5-10% clay 20% as kaolin speckled throughout) crse-med grn, mod reddish orange - pale reddish brown - pale yellowish brown - grayish orange - white (kaolin), sbang - sbnd, only silt (occ v/crse grn), dry, trace mang. oxide, mica, clay stringers, siltier sections	
12	1		70		
	2				
	3				
	4				
Auger	25		Auger	Driller accidentally augered 2' before interval was sampled	
	6				
13	7		100	SAND As Above	Plug sample (VOC) at 27'
	8				
14	9		85	CLAY with sand laminae and pockets, grayish purple with grayish red, purple - pale purple - white mottling, slightly silty, mod moist, slightly malleable, firm - hard	Plug sample at 29'
	30				
15	1		85	SAND (silt 5% clay 10% (kaolin) crse-med grn with v/crse grn and granules, gtz pockets, mod reddish orange - drk yellowish orange, sbang - sbnd, only silt, dry	Plug sample at 31'
	2				
16	3		95	CLAY grayish purple with grayish red, purple - drk yellowish orange - white mottling, occ. sand sections, silty, mod moist, slightly malleable, massive, hard, trace mica	Plug sample at 33'
	4				
17	35		95	CLAY As Above	Plug samples at 35' and 36' (35.9')
	6				
18	7		95	CLAY grayish red purple grading to pale red purple - pale purple with mod red - white - drk yellowish orange light brown mottling, slightly silty, sandy in part, mod moist, slightly malleable, hard, massive, trace mica	Plug samples at 37' and 38' (37.9')
	8				
19	9		95		Plug samples at 39' and 40' (39.9')
	40				

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/25/92</i>	SHEET <i>3 of 3</i>
WELL NO. <i>MHV-27</i>		REFERENCE DATUM	DRILLING CONTRACTOR <i>EMTC</i>
LOGGED BY <i>Bill Joyce</i>		SRP COORDINATES	DRILLER <i>James Hallman</i>
		COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-spoon</i>

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
20	40		100	CLAY grayish red purple - pale red	plug samples at 41' and 42'
	1			purple - pale purple with mod red and light brown mottling, silty sandy with sandy sections, mod moist, hard, slightly malleable, trace mica, mang. oxide	
	2				
21	3		95		plug samples at 43' and 44' (43.9')
	4			CLAY As Above	
22	45		95	Intermittent clays, sandy clays and sands	plug sample at 45'
	6				
23	7		95	CLAY As Above with high sand and sand pockets	plug sample at 47'
	8			SAND (silt 40%, clay 10-15%) fn grn, pale red purple - pale purple, sheng-sbrd, well srted, mod moist, micaceous	
24	9		95		plug sample at 49'
	50			SAND (silt 10-15%) med - fn grn, pale red purple - pale purple with occ. grayish orange mottling, sheng-sbrd, dry well - mod srted, trace mang. oxide	
25	1		95		plug sample at 51'
	2				
26	3		95	SAND As Above	plug sample at 53'
	4				
27	55		95	SAND (silt 5-10%) med - fn grn, pale red purple - pale purple with mod red - light brown mottling, sheng-sbrd, well - mod srted, dry, trace mang. oxide	plug sample at 55'
	6				
28	7		95		plug sample at 57'
	8				
29	9		90	Grades siltier (15-20%) multi-colored, some thin - thick laminae	plug sample at 59'
	60				
					Total depth of Boring: 60'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER NH-25A

DRILLER Blake Cab.

SRS COORDINATES _____

DATE OF WELL INSTALLATION 12/01/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Doroive

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter 60.0' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Plug~~ Plug Length 0.02'

(b) Screen Length 4.89'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen)
1) 9.90'
2) 9.90' 3) 9.89' 4) 9.88'
5) 8.43'

(d) Depth to Top of Screen 48.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 52.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.5'

6) Depth to Top of Filter Pack 46.2'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 2.3'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-28B

DRILLER Blake Capri

SRS COORDINATES _____

DATE OF WELL INSTALLATION 12/02/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter First Grout Stage 43.9' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Screen~~ Plug Length 0.02'

(b) Screen Length 4.90'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.91'

2) 9.90' 3) 9.90' 4) 8.29'

(d) Depth to Top of Screen 38.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 42.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.6'

6) Depth to Top of Filter Pack 34.9'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 1.5'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-28C

DRILLER Binke Cabit

SRS COORDINATES _____

DATE OF WELL INSTALLATION 12/03/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME B.H. Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

- 1) Total Drilled Depth/Hole Diameter Second Grout Stage 33.4' / 8 1/4"
- 2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)
- (a) ~~Screen~~ Plug Length 0.02'
- (b) Screen Length 4.89'
- (c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.91'
2) 9.89' 3) 8.20'
- (d) Depth to Top of Screen 28.00'
- 3) Depths to Centralizers Not required
- 4) Total Depth of Installed Well 32.9'
- 5) Casing Stick Up (Standard 2.5' A.G.S.) 1.7'
- 6) Depth to Top of Filter Pack 25.6'
- 7) Depth to Top of Fine Sand Seal Not required
- 8) Depth to Top of Bentonite Seal Not required
- 9) Thickness of Grout 25.6'

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G-4346
 SUBJECT RF Heating Test - MHV - 28 Piezometer Well Construction Diagram
 BY Bill Joyce DATE 12/03/92 CHECKED BY _____ DATE _____

From MHV - 28
 Bottom
 Casing

From
 Ground
 Surface

Gravel Pack
 Based on Practical
 Application in the Field of
 1 bag Coarse Sand = 1.2 ft³
 1 bag GROUT = 0.6 ft³
 1 bag Mixed = 1.3 ft³

A. Theoretical
 Coarse Sand - 2.6 bags
 GROUT - 0.6 bags
Actual
 Coarse Sand - 3 bags
 GROUT - 0.7 bags
B. Theoretical
 Coarse Sand - 2.4 bags
 GROUT - 0.6 bags
Actual
 Coarse Sand - 2.3 bags
 GROUT - 0.3 bags

C. Theoretical
 Coarse Sand - 2.3 bags
 GROUT - 7.2 bags
Actual
 Coarse Sand - 2.5 bags
 GROUT - 4.7 bags

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G4346
 SUBJECT RF Heating Test - MHV - 28 Piezometers Casing Tally
 BY Bill Joyce DATE 12/03/92 CHECKED BY _____ DATE _____

Casing Tally   Screen Zones
A   A
 1) 9.90'
 2) 9.90'
 3) 9.89'
 4) 9.88'
 5) 9.88'
49.45'
 - 48.00' Top of Casing
 1.45' Stick-up

B   B
 1) 9.91'
 2) 9.90'
 3) 9.90'
 4) 9.89'
39.60'
 - 38.00' Top of Casing
 1.60' Stick-up

C   C
 1) 9.91'
 2) 9.89'
 3) 9.90'
29.70'
 - 28.00' Top of Casing
 1.70' Stick-up

Materials List (A, B, C)
Casing
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen
 1" PVC
 Slotted
 0.010 in. slot
 Flush
 Tri-Loc Threads
 Timco Brand

Plug
 Not required

Plug
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen / Plug Tally
A

	0.09'
4.89'	4.66'
	0.14'
0.02' Plug	0.02'

B

	0.08'
4.90'	4.69'
	0.13'
0.02' Plug	0.02'

C

	0.07'
4.89'	4.69'
	0.13'
0.02' Plug	0.02'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-28T

DRILLER Garry Moore

SRS COORDINATES _____

DATE OF WELL INSTALLATION 1/13/93

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce/SEL Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

Fiber Optics Temperature Sensors

1) Total Drilled Depth/Hole Diameter 58.0' / 8 1/2"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) Sump & Plug Length Not required

(b) Screen Length Not required

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 10.12'
including threads 2) 10.00'
3) 10.00' 4) 10.00' 5) 9.88'

(d) Depth to ^{Sensors} ~~Top of Screen~~ Fiber optics : 28.00' 38.00'
and 48.00'. Thermocouples : 28.00', 38.00' and
48.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 50.0'

5) Casing Stick Up (Standard 2.5' A.G.S.) 2.6'

6) Depth to Top of Filter Pack 10.5'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 10.5'

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/20/92</i>	SHEET <i>1</i> of <i>3</i>
REFERENCE DATUM		DRILLING CONTRACTOR <i>EMTC</i>	
WELL NO. <i>MHV-28</i>	SRP COORDINATES	DRILLER <i>Blake Casit</i>	
LOGGED BY <i>Bill Joyce</i>	COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-Spoon</i>	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
1	0				<i>Begin to split-spoon on 11/20/92 at 09:25</i>
	1		90	<i>Upper 0.3' p-rap and Top soil SAND (silt 35-40% clay - trace) med - coarse grn, mod reddish brown - mod yellowish brown - occ. dk. yellowish brown, shang-</i>	<i>3" split-spoons Augers 4 1/4" ID 7 1/2" OD Bit 8 1/4" OD Using Donahue hammer</i>
2	2		45	<i>shad, moist (due to weather conditions) trace mang. oxide, occ cobbles, mod srt'd, soft</i>	
	3				
3	4		50	<i>SAND As Above</i>	
	5				
4	6		55	<i>SAND (silt 35-40%) med - coarse grn, mod yellowish brown - mod reddish brown mottled shang - shad, moist (weather conditions) trace mang oxide, mod srt'd, soft, includes cobbles</i>	
	7				
5	8		40		
	9				
6	10		75	<i>SILT (sand 30% grading to 20-25%) (clay 10% w kaolin) med-fn grn, pale reddish brown - mod reddish brown - dk yellowish orange - white, mottled, shang - shad, well - mod srt'd, dry, hard sandier pockets, trace mica, mang. oxide</i>	
	1				
7	2		75		
	3				
8	4		90	<i>SILT As Above</i>	
	15				
9	6		70	<i>SAND (silt 15-20% clay 15-20% w kaolin speckled throughout) med - coarse grn, mod reddish orange - pale reddish brown - white (kaolin) shad - shang, mod srt'd, dry, hard, trace mang. oxide, mica, includes siltier pockets</i>	
	7				
10	8		70		
	9				
	20			<i>SAND As Above with occ. v/coarse grn</i>	

FIELD GEOLOGIC LOG

PROJECT <i>R.R. Heating Test Integrated Demonstration J.T.C.</i>		DATE <i>11/30/82</i>	SHEET <i>2</i> OF <i>3</i>
WELL NO. <i>MHV-28</i>		REFERENCE DATUM	DRILLING CONTRACTOR <i>EMTC</i>
LOGGED BY <i>Bill Joyce</i>		SRP COORDINATES	DRILLER <i>Blake C. b. t</i>
COMPANY <i>SEC Donohue</i>		DRILLING METHOD <i>Hollow Stem Auger - 5" Split-Spoon</i>	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
11	2.0		80	SAND (silt 10%, clay 15-20% as kaolin speckled throughout and clay pockets (grayish purple)) coarse-med grn with some v/crse grn, mod reddish orange-pale reddish brown-pale red purple-white (kaolin), shang-shand, mod silt, dry, trace mang oxide, mica, gtz pocket	
12	1		75		
13	2				
13	2.5		80	SAND As Above, silt 5%, clay 20% as kaolin speckled throughout, some granules and pebbles included	Plug sample (VOC) at 25'
14	6				
14	7		90	SAND (silt 5%, clay 20-25% as kaolin) coarse-v/crse grn, grayish orange-mod reddish orange-pale red purple-white (kaolin), shang-shand, mod silt, dry	Plug sample at 27'
15	8				
15	9		85	SAND As Above with clay (kaolin) 25-30% and occ. clay stringers	Plug sample at 29'
16	30				
16	1		70	SAND (silt 5%, clay 10-15% as kaolin and clay stringers) coarse-v/crse grn with occ. granules, grayish orange-mod reddish orange-pale red purple-white (kaolin), shang-shand, mod-silt, dry, trace mang oxide	Plug sample at 31'
17	2				
17	3		95		Plug sample at 33'
18	4			Grades to silt 25-30%, clay-trace, dark yellowish orange	
18	3.5		95	CLAY grayish purple with dark yellowish orange mottling grading to grayish red purple-grayish purple with light brown-dusky red-white mottling, slightly silty, sandy (trace .5%) in places, moist, slightly malleable, hard massive	Plug samples at 35' and 36' (35.9')
19	6				
19	7		95		Plug samples at 37' and 38' (37.9')
20	8				
20	9		90	CLAY As Above with sandy pockets	Plug samples at 39' and 40' (39.8')
	40				

FIELD GEOLOGIC LOG

PROJECT <i>RF Meeting Test Integrated Demonstration Site</i>		DATE <i>11/30/92</i>	SHEET <i>3</i> of <i>5</i>
WELL NO. <i>MHV-28</i>		REFERENCE DATUM	DRILLING CONTRACTOR <i>EMTC</i>
LOGGED BY <i>Bill Joyce</i>		SRP COORDINATES	DRILLER <i>Bicke Cubitt</i>
		COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-Spoon</i>

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
	40				
21	1		85	CLAY grayish red purple - pale red purple with white - mud red - light brown mottling, slightly silty, sand sections included, moist, slightly malleable, hard, massive in part, trace mang oxide	Plug samples at 41' and 42' (41.7')
22	2		95		
	3				Plug samples at 43' and 44' (43.9')
	4			CLAY As Above	
23	45		95	Intermittent clays and sands with gtz pockets	Plug sample at 45'
	6				
24	7		85	SAND (silt 35-40%, clay trace - 5% with pockets) pale red purple - pale purple, med - coarse grn with some fn grn, shang - strand, prly sctd, dry, trace mang oxide	Plug sample at 47'
	8				
25	9		90	SAND (silt 10-15%) med - coarse grn with some fn grn, pale red purple - pale purple, shang - strand, prly sctd, dry, trace mang oxide, slight trace mica	Plug sample at 49'
	50				
26	1		95	SAND (silt 5-10%) med - fn grn, pale purple - pale red purple with grayish orange - pale yellowish brown - light brown - med red mottling, some thin laminae, shang - strand, well - med sctd, dry, trace mang oxide, ool siltier sections, some iron oxide staining	Plug sample at 51'
	2				
27	3		75		Plug sample at 53'
	4				
28	55		70	SAND As Above	Plug sample at 55'
	6				
29	7		70	SAND (silt 10-15%) med - fn grn, pale red purple - pale purple with pale reddish brown - mud red - grayish orange - drk yellowish orange mottling, shang - strand, med - well sctd, dry, trace mang oxide, iron oxide staining, some thin - thick laminae	Plug sample at 57'
	8				
30	9		85		No plug sample at 59'
	60				Total Depth of Boring: 60'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR ENTC

WELL NUMBER M4V-29A

DRILLER Bike Cabir

SRS COORDINATES _____

DATE OF WELL INSTALLATION 11/24/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyne / SEC Onshore

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter 60.0' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Plug~~ Plug Length 0.02'

(b) Screen Length 4.91'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.89'

2) 9.89' 3) 9.91' 4) 9.92'

5) 8.39'

(d) Depth to Top of Screen 48.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 52.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.5'

6) Depth to Top of Filter Pack 46.7'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 2.2'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER M-1-293

DRILLER Blake Cabot

SRS COORDINATES _____

DATE OF WELL INSTALLATION 12/02/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

1) Total Drilled Depth/Hole Diameter First Grout Stage 44.5' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) ~~Screen~~ Plug Length 0.02'

(b) Screen Length 4.90'

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 9.90'
2) 9.89' 3) 9.88' 4) 8.33'

(d) Depth to Top of Screen 38.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 42.9'

5) Casing Stick Up (Standard 2.5' A.G.S.) 1.6'

6) Depth to Top of Filter Pack 36.3'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 2.2'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EATC

WELL NUMBER M-4V-29C

DRILLER Blake Cabot

SRS COORDINATES _____

DATE OF WELL INSTALLATION 12/03/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

- 1) Total Drilled Depth/Hole Diameter Second Grout stage 34.1' / 8 1/4"
- 2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)
  - (a) ~~Screen~~ Plug Length 0.04'
  - (b) Screen Length 4.89'
  - (c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen)
    - 1) 9.92'
    - 2) 9.92'
    - 3) 8.16'
- (d) Depth to Top of Screen 28.00'
- 3) Depths to Centralizers Not required
- 4) Total Depth of Installed Well 32.9'
- 5) Casing Stick Up (Standard 2.5' A.G.S.) 1.8'
- 6) Depth to Top of Filter Pack 25.8'
- 7) Depth to Top of Fine Sand Seal Not required
- 8) Depth to Top of Bentonite Seal Not required
- 9) Thickness of Grout 25.8'

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SAS JOB NO. G-4346
 SUBJECT RF Heating Test - MHV - 29 Piezometer Well Construction Diagram
 BY Bill Joyce DATE 12/03/92 CHECKED BY _____ DATE _____

From MHV - 29
 Bottom
 Casing

From
 Ground
 Surface

Gravel Pack
 Based on Practical
 Application in the Field of
 1 bag Coarse Sand = 1.2 ft³
 1 bag Grout = 0.6 ft³
 1 bag Mixed Grout = 1.3 ft³

52.93' 42.92' 32.93'
44.54' 34.59' 24.77'
34.62' 24.71' 14.85'
24.71' 14.82' 4.93'
14.82' 4.92' (0.00')
4.93' (0.00')
0.02' (0.00')

0.00' 0.00' 0.00'
8.16' 8.33' 8.39'
18.08' 18.21' 18.31'
28.00' 28.10' 28.22'
32.89' 38.00' 38.11'
(32.93') 42.90' 48.00'
(42.92') 52.91' 52.93'

A. Theoretical
 Coarse Sand - 3.2 bags
 Grout - 0.6 bags
Actual
 Coarse Sand - 4 bags
 Grout - 0.7 bags
B. Theoretical
 Coarse Sand - 2.4 bags
 Grout - 0.6 bags
Actual
 Coarse Sand - 2.8 bags
 Grout - 0.7 bags

C. Theoretical
 Coarse Sand - 2.3 bags
 Grout - 7.2 bags
Actual
 Coarse Sand - 2.8 bags
 Grout - 4.7 bags

SEC DONOHUE

CALCULATION SHEET

CLIENT WSRC LOCATION SRS JOB NO. G4346
 SUBJECT RF Heating Test - MHV - 29 Piezometers Casing Tally
 BY B. H. Joyce DATE 12/03/92 CHECKED BY _____ DATE _____

Casing
Tally
A
 1) 9.89'
 2) 9.89'
 3) 9.91'
 4) 9.92'
 5) 9.91'
49.52'
 - 48.00' Top of Casing
 1.52' Stick-up

B
 1) 9.90'
 2) 9.89'
 3) 9.88'
 4) 9.88'
39.55'
 - 38.00' Top of Casing
 1.55' Stick-up

C
 1) 9.92'
 2) 9.92'
 3) 9.92'
29.76'
 - 28.00' Top of Casing
 1.76' Stick-up

Materials
List (A B C)
Casing
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen
 1" PVC
 Slotted
 0.010 in. slot
 Flush
 Tri-Loc Threads
 Timco Brand

Seep
 Not required

Plug
 1" PVC
 Schedule 40
 Tri-Loc Threads
 Flush
 Timco Brand

Screen / Plug
Tally
A

	0.10'
4.91'	4.67'
	0.14'
0.02' Plug	0.02'

B

	0.10'
4.90'	4.67'
	0.13'
0.02' Plug	0.02'

C

	0.08'
4.89'	4.68'
	0.13'
0.04' Plug	0.04'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR EMTC

WELL NUMBER MHV-29T

DRILLER Brian Cabit

SRS COORDINATES _____

DATE OF WELL INSTALLATION 12/02/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME Bill Joyce / SEC Donohue

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

Fiber Optics Temperature Sensors

1) Total Drilled Depth/Hole Diameter 57.0' / 8 1/4"

2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)

(a) Sump & Plug Length Not required

(b) Screen Length Not required

(c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) 1) 10.16'
with threads 2) 10.02' 3) 10.03'
4) 10.02' 5) 9.77'

(d) Depth to ^{Sensors} Top of Screen 28.00', 38.00', 48.00'

3) Depths to Centralizers Not required

4) Total Depth of Installed Well 50.0'

5) Casing Stick Up (Standard 2.5' A.G.S.) 2.3'

6) Depth to Top of Filter Pack 8.5'

7) Depth to Top of Fine Sand Seal Not required

8) Depth to Top of Bentonite Seal Not required

9) Thickness of Grout 8.5'

FIELD GEOLOGIC LOG

PROJECT		RF Heating Test Integrated Demonstration Site		DATE	11/23/42	SHEET	1 OF 3
REFERENCE DATUM				DRILLING CONTRACTOR EMTC			
WELL NO.		MHV-29		SRP COORDINATES		DRILLER Blake Cusit	
LOGGED BY		Bill Joyle		COMPANY		SEC Donohue	
				DRILLING METHOD		Hollow Stem Auger - 3" Split-spoon	
RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION		DRILLING COMMENTS	
1	0			Upper 0.3' Top soil and some rip-rap SAND		Begin to split-spoon	
	1		60	(silt 10%) med-crse grn, dk yellowish brown, shag-strad, med sdil, dry		on 11/23/42 at 09:45	
2	2			SAND (silt 35-40%, clay-trace) med-crse grn, med reddish brown, grading to med yellowish orange to dk yellowish orange-light brown, shag-strad, dry-moist, firm trace mang oxide, organic material		3" split-spoon Augers 4 1/4" ID 7 1/2" OD Bit 8 1/4" OD Using downhole hammer	
	3		60				
3	4						
	5		80	SAND As Above mottled			
4	6						
	7		100	SAND (silt 40-45%, clay-trace (kaolin)) med-fn grn with occ, crse grn, med reddish brown-dk yellowish orange-white (mottled) shag dry, firm iron oxide			
5	8						
	9		95	SILT (sand 20-25%, clay 10-15% (kaolin)) fn-med grn, med reddish brown-mud red-white (kaolin) shag-strad, well sdil, dry, firm-hard			
6	10						
	1		100	SILT As Above with kaolin pockets and grayish purple-grayish red purple mottling, very hard			
7	2			Clay content 15-20%			
	3		70	Trace mica			
8	4						
	15		80	SAND (silt 15-20%, clay 10% as kaolin speckled throughout) med-fn grn, med reddish orange-pale reddish brown-white (kaolin) shad-shag, med-well sdil, dry, hard, trace mang oxide mica etc pockets			
9	6						
	7		75	Grades to include occ crse grn			
10	8			SAND (silt 5-10%, clay 20-25% as kaolin speckled throughout) med-crse grn, med reddish orange-grayish orange-white (kaolin) with dk yellowish orange mottling, shad, med sdil, dry			
	9		80				
	20						

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/23/92</i>	SHEET <i>2</i> OF <i>3</i>
REFERENCE DATUM		DRILLING CONTRACTOR <i>EMTC</i>	
WELL NO. <i>MHV-29</i>	SRP COORDINATES	DRILLER <i>Blake Cabit</i>	
LOGGED BY <i>Bill Joyle</i>	COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-Spoon</i>	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
	20				
11	1		95	SAND (silt 5%, clay 25-30% as kaolin in matrix speckled throughout) coarse - med gra, pale purple - pale red purple - white (kaolin) shag - strand, med silt, dry, trace mang oxide	
12	2		95		
	3		95	CLAY grayish purple - grayish red purple with occ. light brown mottling, silty, med moist, slightly malleable, massive	
13	4		95		
	25		95	hard - firm, occ. pockets of kaolin, occ sandier sections	Plug sample (VOC) at 25'
	6				
14	7		70	CLAY As Above, with sandy laminae	Plug sample at 27'
	8			SAND (silt 5-10%, clay 5-10% as kaolin in matrix) coarse - v/coarse gra, med reddish orange - dk yellowish orange - grayish orange - white (kaolin), shag - strand, med - ply silt, dry, trace mang oxide, clay content increases to 10-15% as kaolin	
15	9		90		Plug sample at 29'
	30				
16	1		100	SAND As Above, includes granules and gtz pockets, iron staining	Plug sample at 31'
	2				
17	3		95	CLAY grayish red purple - grayish purple with dk yellowish orange mottling, silty, slightly sandy, grades cleaner, med moist, slightly malleable, hard	Plug sample at 33'
	4				
18	35		95	CLAY grades from pale red purple - grayish purple - grayish red purple with some med red, mottled, including light brown, slightly silty, med moist, slightly malleable, hard	Plug sample at 35' and 36' (35.9')
	6				
19	7		95		Plug sample at 37' and 38' (37.9')
	8				
20	9		95	CLAY pale red purple - pale purple with med reddish brown - med red - white - light brown mottling, slightly silty, sandy sections, med moist, slightly malleable, hard.	Plug sample at 39' and 40' (39.9')
	40				

FIELD GEOLOGIC LOG

PROJECT <i>RF Heating Test Integrated Demonstration Site</i>		DATE <i>11/24/92</i>	SHEET <i>3</i> OF <i>3</i>
WELL NO. <i>MNV-29</i>		REFERENCE DATUM	DRILLING CONTRACTOR <i>EMTC</i>
LOGGED BY <i>Bill Joyce</i>		SRP COORDINATES	DRILLER <i>Blake Cabit</i>
		COMPANY <i>SEC Donohue</i>	DRILLING METHOD <i>Hollow Stem Auger - 3" Split-Spoon</i>

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
21	40		95	CLAY grayish red purple - pale red	<i>11/24/92 at 08:30</i> Aug samples at 41' and 42' (41.9')
	1			purple - pale purple with mod red - white - light brown mottling silty, sandy in sections, mod moist, hard, trace mang. oxide, mica	
	2				
22	3		100	Intermittent clays and sands with gtz cobbles	Plug samples at 43' and 44'
	4				
23	45		Auger	lost the downhole hammer in the hole. Augered to 45' to leave a plug in auger before pulling	Retrieved hammer
24	6		95	SAND (silt 20% grading to 10-15%) med-fn gra grading to med-coarse gra with gtz pockets, pale purple - pale red purple with grayish orange - pale yellowish brown - dk yellowish orange mottling, shag - sbrnd, dry, soft, dry, silty pockets, trace mang oxide, mica	Plug sample at 47'
	7				
	8				
25	9		90		Plug sample at 49'
	50				
26	1		85	SAND (silt 5-10%) med-fn gra, pale purple - pale red purple with grayish orange - mod red - light brown mottling, shag - sbrnd, dry, mod-well srtk, trace mang. oxide	Plug sample at 51'
	2				
27	3		90		Plug sample at 53'
	4				
28	5		85	SAND As Above	Plug sample at 55'
	6				
29	7		90	SAND (silt 10%) med-fn gra, pale purple - pale red purple with mod red - light brown - dk yellowish orange mottling, shag - sbrnd, mod-well srtk, dry, trace mang oxide	Plug sample at 57'
	8				
30	9		85		Plug sample at 59'
	60				
				Grades siltier 15-20%	Total Depth of Boring: 60'

MONITORING WELL CONSTRUCTION DIAGRAM

DRILLING SUBCONTRACTOR Graves

WELL NUMBER MHT-16C

DRILLER B. Cunningham

SRS COORDINATES 102,430.85N, 48,672.81E

DATE OF WELL INSTALLATION 05/13/92

SANITARY SEAL ELEVATION _____

TECH. O.S./CO. NAME S. Asquith / SEC
Donohue

LIQUID LEVEL PIPE _____

NOTE: ALL MEASUREMENTS
ARE FROM GROUND
SURFACE AT START
OF BORING - MEASUREMENTS
TO NEAREST 0.1 FOOT.

- 1) Total Drilled Depth/Hole Diameter 210.0' / 12"
- 2) Casing/Screen Tally (Measured to Nearest 0.01 Foot)
  - (a) Sump & Plug Length 4.87' (Between 1st 2 sects below screen (Aug))
  - (b) Screen Length 4.83'
  - (c) Casing Joint Lengths (Measured in Up-hole Sequence From Top of Screen) Below screen:
0.46' (plug), 19.77', 19.77', 4.87'
Above screen: 10.03', 19.74',
19.75', 20.24', 19.75', 19.74',
20.24', 20.24', 6.77'
  - (d) Depth to Top of Screen 154.0'
- 3) Depths to Centralizers 82.7', 152.5',
160.3', 202.2'
- 4) Total Depth of Installed Well 203.7'
- 5) Casing Stick Up (Standard 2.5 A.G.S.) 2.5'
- 6) Depth to Top of Filter Pack 149.2'
- 7) Depth to Top of Fine Sand Seal 147.5'
- 8) Depth to Top of Bentonite Seal 137.4'
- 9) Thickness of Grout 137.0'

Below Screen

Filter Pack: 149.2 to 162.8
Bentonite Seal: 162.8 to 167.7
F550 sand: 167.7 to 210.0

Depths to Top of Tomography Probes:

(Depths in parentheses ~~are~~ were measured when installed on casing. All other depths are calculated from measured intervals between cable splices) (200.0), 186.7, 179.4, 160.1/(159.8), 146.8, 133.5, 120.2, 106.9, 93.6, 80.3, 67.0, 53.7, 40.4, 27.1, 13.8 n.w (n.w)

FIELD GEOLOGIC LOG

PROJECT Horizontal Well Characterization		DATE 5/6/92	SHEET 1 of 10
WELL NO. MHT-16C		REFERENCE DATUM	DRILLING CONTRACTOR Graves
LOGGED BY S. Asquith		SRP COORDINATES	DRILLER G. Wilson / D. Cunningham
		COMPANY SEC Donohue	DRILLING METHOD H.S. Auger / Split-Spoon

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
	0				Start 10:45
1	1		100	SILT 20% clay 30% sand, grayish brown becoming med. reddish brown. crumbly, sand is fine to coarse	B. Cunningham operating rig. All 2" split spoon until 90'
2	2		25	SILT 30% clay, 20% fine sand, mottled med. reddish brown, grayish brown and dark yellow orange crumbly, dry.	
3	3		0		
4	4		0		
5	5		25	CLAY 30% silt, 20% fine sand mottled dark reddish brown with some yellowish gray, v. hard, dry, med. cohesive	
6	6		85	SAND 20% silt, 20% clay, med. reddish brown with yellowish gray speckles, fine to coarse	
7	7		100	SAND 20% silt, 20% clay, mottled med. reddish brown with some pale yellowish orange and white speckles. fine to med.	
8	8		65	CLAY 20% silt, 20% fine sand, med. reddish brown with mottled grayish purple and pale yellowish orange. hard. purple is all clay.	
9	9		100	SAND 40% clay, med reddish brown with abundant white and pale yellowish orange speckles. fine to med. angular	
10	10		90	Same as above	
	20				

FIELD GEOLOGIC LOG

PROJECT		DATE		SHEET	
Horizontal Well Characterization		5/07/92		3 OF 10	
WELL NO.		REFERENCE DATUM		DRILLING CONTRACTOR	
MHT-16C				GRAVES	
LOGGED BY		SRP COORDINATES		DRILLER	
B. Joyce				R. Cunningham	
		COMPANY		DRILLING METHOD	
		SEC Donohue		H.S. Auger / Split-Spoon	
RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
21	40			SAND (silt 25%, clay 15-20% in matrix)	5/07/92
	41		100	vf-fn gra, dk yellowish orange-grayish orange - med reddish brown - pale red purple - white (kaolin), mottled shag - strand, w/ well silt, med dry, trace mica	
22	42				
	43		100	CLAY (silt 15-20% in matrix) grayish purple - grayish red purple, fm, micaceous, med moist	
23	44			grades to more silt 25-40%	
	45		90	w/ some vf-fn gra sand med dry	
24	46			SAND (silt 10% in matrix, clay pockets)	
	47		95	crse - v/crse gra w/ occ granules dk yellowish orange, shag, poly silt dry, trace kaolin	
25	48			SAND (silt 20-25% in matrix) med-crse gra w/ occ v/crse gra	
	49		90	pale purple - pale red purple - med - dk reddish brown, shag - strand, poly silt, dry, tr. mang oxide mottled	
26	50				
	51		85	SAND As above grades finer (med-fn gra)	
27	52				
	53		100	SAND (silt 15% in matrix) med-fn gra, grayish purple - pale purple - dk yellowish orange - grayish orange - dk reddish brown, mottled, shag - strand, well silt, dry	
28	54				
	55		90	Grades siltier (20-25%) tr. mang oxide	
29	56				
	57		100	SAND As above	
30	58				
	59		100	SAND (silt 35-40%, clay trace in matrix) fn - med med gra, pale purple - pale red purple - dk reddish brown - dk yellowish orange, shag - strand, well silt, dry tr. mang oxide	
	60				

FIELD GEOLOGIC LOG

PROJECT				DATE	SHEET
WELL NO.				REFERENCE DATUM	OF
LOGGED BY				DRILLING CONTRACTOR	
COMPANY				DRILLER	
				DRILLING METHOD	
Horizontal Well Characterization				5/7/92	4 OF 10
MHT-16C				Graves	
S. Aquino				George Cunningham	
SEC Donohue				H. S. Auger / Split-Spoon	
RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
31	60			CLAY 20% fine sand, pale red purple, v. soft, micaceous.	S. Aquino (100%) Begin logging
	61		100	SAND 20% clay matrix, bands of pale yellowish orange and light gray, fine, v. well sorted, sub angular	
	62			SAND 20% clay becoming 10% clay	
32	63		85	yellowish gray becoming pale red purple, becoming dark yellowish orange, fine becoming fine to medium, well sorted, angular	
	64			SAND 20 to 35% clay matrix w/ some all clay zones near top, pale to dark yellowish orange w/ yellowish brown zone in middle, fine to med. w/ some coarse, angular, poorly sorted.	
33	65		100	SAND 20% clay becoming 5% clay, dark yellowish orange, fine to v. coarse w/ some fine pebbles.	
	66			v. poorly sorted, sub angular, trace heavies	
34	67		85	SAND trace to 5% clay, light to dark yellowish orange with some yellowish brown, med to v. coarse, v. poorly sorted, angular, trace heavies	
	68			Same as above but med. to coarse.	
35	69		90	SAND 5 to 10% clay matrix, dark yellowish orange to light yellowish brown, fine to coarse with some v. coarse, sub rounded, v. poorly sorted, trace heavies	
	70			Same as above but sub angular	
36	71		70	Same as above	
	72			SAND 5 to 10% clay matrix, dark yellowish orange to light yellowish brown, fine to coarse with some v. coarse, sub rounded, v. poorly sorted, trace heavies	
37	73		85	Same as above but sub angular	
	74			Same as above	
38	75		90	Same as above	
	76			Same as above	
39	77		90	Same as above	
	78			SAND 5% clay matrix, dark yellowish orange, fine to coarse with some v. coarse, v. poorly sorted, sub angular, trace heavies	
40	79		80	Same as above	
	80			Same as above	

FIELD GEOLOGIC LOG

PROJECT Horizontal Well Characterization			DATE 5/7/92	SHEET 5 of 10	
WELL NO. MIT-16C		REFERENCE DATUM	DRILLING CONTRACTOR Graves		
LOGGED BY S. Asquith		SRP COORDINATES	DRILLER B. Cunningham		
		COMPANY SEC Donohue	DRILLING METHOD H.S. Auger/Split-Spoon		
RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
	80			Same as above	
41	51		65		
	82				
42	83		85	SAND 5 to 10% clay matrix, dark to pale yellowish orange, fine to coarse, v. poorly sorted, sub angular, trace heavies.	
	84				
43	85		50	SAND 5 to 10% clay as matrix, dark yellowish orange to yellowish brown, fine to v. coarse w/ occasional pebble, v. poorly sorted, sub angular.	
	86				
44	87		100	SAND 20% clay as matrix, dark yellowish orange, fine to coarse, poorly sorted.	
	88			CLAY 40% fine to v. coarse sand w/ abundant pebbles, dark yellowish orange w/ gray laminae, lignitic.	
45	89		75	SILT 20% v. fine sand 30% clay, dark yellowish orange w/ yellowish gray laminae, soft.	
	90			CLAY pale yellowish orange to yellowish gray, v. hard, v. dense, lignitic.	Hammered 3"
46	91		90	SAND 30% clay as matrix grading to 10%, yellowish gray w/ some orange speckles, fine to v. coarse, v. poorly sorted, lignitic.	spoon. Micro
	92				Bio sample taken.
47	93		100	SAND 20% clay matrix, yellowish gray w/ some dark yellowish orange, fine to v. coarse, lignitic, trace heavies, v. poorly sorted.	
	94			SAND 15% clay matrix, yellowish gray, fine to med, mod. sorted, angular, heavies.	
48	95		80	SAND 20 to 30% clay as matrix, yellowish gray w/ some orange speckles, fine to med, well sorted, angular, trace heavies and lignites.	
	96				
49	97		90	SAND 20 to 30% clay in matrix and pockets, yellowish gray to pale yellowish orange, medium grain, well sorted, sub angular, heavies and lignites.	
	98				
50	99		75	SAND 20 to 30% clay becoming 5% clay, yellowish gray becoming mod. yellowish orange, fine to med, sub angular, well sorted, trace heavies.	
	100				

FIELD GEOLOGIC LOG

PROJECT		DATE	SHEET			
Horizontal well characterization		5/7/92	6 of 10			
WELL NO		REFERENCE DATUM	DRILLING CONTRACTOR			
NHT-16C			Graves			
LOGGED BY		SRP COORDINATES	DRILLER			
S. Asquith			B. Cunningham			
		COMPANY	DRILLING METHOD			
		SEC Donohue	H.S. Auger / split spoon			
RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS	
51	100		100	SAND 20 to 30% clay becoming 10% clay, dark yellowish gray becoming dark yellowish orange, med. grain, med to well sorted, sub angular trace heavies	Hammer 3" split spoon	
	101					Micro bio sample taken.
	102					
52	103		65	SAND 10 to 20% clay as matrix and laminae, mottled dark and light yellowish orange, medium becoming med. to v. coarse w/ some pebbles, lignite.		
	104					
53	105		50	SAND trace clay, light yellowish orange with some gray speckles, med to coarse, v. poorly sorted, trace heavies.	Start 5/8 07:45	
	106			Same as above.	Hammer 2" spoon	
54	107		60		Hammer 2" spoon	
	108					
55	109		100	SAND 5 to 10% clay at top, 40 to 50% middle, 10% at bottom, light yellowish orange at top, dark brown middle, dark yellowish orange bottom, fine to med pebbles top & middle, coarse to v. coarse bottom, v. poor sorting top	Hammer 3"	
	110					
56	111		60	dark middle, med sort bottom, sub angular	split spoon	
	112			SAND trace clay, dark yellowish orange, med to v. coarse, poorly sorted, sub rounded.	Micro bio sample taken.	
57	113		65	SAND 5 to 10% clay in matrix and as matrix, dark yellowish orange to light brown, fine to v. coarse, v. poorly sorted, sub rounded.	Hammer 2" spoon	
	114			Same as above.		
58	115		100	CLAY v. light gray, soft, reddish brown silt laminae, becoming alternating laminae of gray clay and dark yellowish orange silt and v. fine sand.		
	116					
59	117		85	SAND 20% silt, 10% clay as matrix, light gray clay laminae thick near top, dark yellowish orange with some med. brown, fine to v. fine, trace heavies and mica.		
	118					
60	119		65	SAND 5% clay matrix, dark yellowish orange w/ some light brown, fine to coarse, poorly sorted, sub angular		
	120					

FIELD GEOLOGIC LOG

PROJECT		DATE		SHEET	
Horizontal Well Characterization		5/8/92		7 of 10	
WELL NO		REFERENCE DATUM		DRILLING CONTRACTOR	
MHT-16C				Graves	
LOGGED BY		SRP COORDINATES		DRILLER	
S. Asquith				B. Cunningham	
		COMPANY		DRILLING METHOD	
		SEC Donohue		H.S. Auger / Mud Rotary	
RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
61	120		75	SAND 5% clay in matrix w/ occasional median stringers, dark yellowish orange, fine to coarse w/ some well sorted med. zones, poorly sorted, sub angular, trace heavies.	
	121				
	122				
62	123		55	SAND 5% clay matrix, dark yellowish orange, fine to coarse, poorly sorted, sub angular.	
	124				
63	125		60	Same as above SAND 40% clay as thick laminae w/ stringers, light brown, fine to med, med to well sorted, clay is v. pale orange to white, v. soft, sticky	
	126				
64	127		85	SAND 10 to 15% clay in matrix, dark yellowish orange w/ dark reddish brown bands, fine to coarse, poorly sorted w/ some well sorted fine zones, sub angular, heavies.	
	128				
65	129		80	SAND 10% clay in matrix, mostly dark yellowish orange w/ bands of pale red and white and reddish brown, fine to med, mostly well sorted, sub angular	
	130				
66	131		80	SAND 10% clay in matrix and occasional stringers, dark yellowish brown, fine to v. coarse, poorly sorted, sub angular, wet.	
	132				
67	133		95	SAND 10% clay in matrix, dark yellowish orange, fine to coarse, v. poorly sorted, sub angular trace heavies, wet.	
	134				
68	135		43	SAND 10% clay matrix, dark reddish orange to reddish brown, med. to coarse, poorly sorted, sub angular.	Start 5/11/92 10:00 Mud Rotary
	136				
	137				
	138				
69	139		83	SAND 10% clay in matrix, dark yellowish orange, fine to med, well sorted, trace heavies, sub rounded.	
	140				

FIELD GEOLOGIC LOG

PROJECT Horizontal Well Characterization				DATE 5/11/22	SHEET 8 OF 10
WELL NO. MHT-16C				REFERENCE DATUM	DILLING CONTRACTOR GRAVES
LOGGED BY S. Asquith				SRP COORDINATES	DRIILLER B. Cunningham
COMPANY SEC Donohue				DILLING METHOD Mud Rotary	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DILLING COMMENTS
69	140				
	141		83		
70	142			Same as above, but more fine and v. well sorted.	
	143				
	144		60		
	145				
	146				
71	147			SAND 40% clay as matrix and in clay rich zones, alternating bands of dark yellowish orange and light gray, fine to v. coarse, v. poorly sorted, angular, trace heavies	
	148		86		
	149				
	150				
	151				
72	152			SAME AS ABOVE	
	153				
	154		100		
	155			SAND 10 to 20% clay as matrix, dark yellowish orange, med to v. coarse, v. poorly sorted, sub angular, becoming fine to v. fine, well sorted, sub rounded, micaceous, trace heavies.	
	156				
73	157			SAND 50% silt near top (v. micaceous) 10 to 20% clay matrix, dark yellowish orange w/ light gray bands near top, matrix med to fine, well sorted, trace heavies, sub angular.	
	158		100		
	159			zone of fine to coarse in mill's.	
74	160		56	SAND 10 to 20% clay as matrix	

FIELD GEOLOGIC LOG

PROJECT		Horizontal Well Characterization		DATE		SHEET	
WELL NO		MHT-16C		5/11/92		9	
LOGGED BY		M. Smith		DRILLING CONTRACTOR		Graves	
SRP COORDINATES		DRIER		DRILLING METHOD		MHT-16C	
COMPANY		SEC Donohue		DRILLING METHOD		MHT-16C	
RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS		
74	160 - 161			dark yellowish orange w/ some bands of light gray and dark red, fine to med. well sorted, micaceous, trace heavies			
75	164 - 165			CLAY 30% med to fine sand, w/ some rich lacunae, pale to light yellowish orange with beds of light gray clay, speckles of red iron oxide			
76	166 - 168			SAND 30% clay as matrix and in clay rich zones, dark yellowish orange w/ few gray and red bands, mostly med to fine, well sorted with some zones containing coarse and fine v. coarse sub angular, trace heavies			
77	171 - 174			SAND 10% clay in matrix, gray clay laminae abundant at top w/ light red around clay/lane contacts, dark yellowish orange w/ light gray and light brown bands, med to fine, well sorted, trace heavies			
78	176 - 179			SAND 20% clay mostly as fine clay laminae, w/ varying thickness alternating bands of dark yellowish orange, light gray and light brown, med to fine, well sorted, such angular, trace to abundant heavies			

FIELD GEOLOGIC LOG

PROJECT Horizontal Well Characterization				DATE 5/11/92	SHEET 10 OF 12
WELL NO. MHT-16C				DRILLING CONTRACTOR Graves	
LOGGED BY S. A. Quith				DRILLER P. Cunningham	
COMPANY SEC Donohue				DRILLING METHOD 1 1/2" Rotary	

RUN NUMBER	DEPTH, FEET	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS
78	180		90		
	181				
74	182		80	SAME AS ABOVE with abundant thick clay zones at top.	
	183				
80	184		13	CLAY 20% silt, 10% fine sand, light gray and dark yellowish orange, silt.	
	185				
	186				
81	187		76	AND 20% clay as matrix and occasional thick clay zones, dark yellowish orange with light gray bands, med to fine, med to well sorted, sub angular, trace heavies.	
	188				
	189				
	190				
	191				
82	192		44	AND 10 to 20% clay as matrix and occasional thin clay laminae, dark yellowish orange with light gray and light brown bands, fine to med, well sorted, sub angular, trace heavies.	
	193				
	194				
	195				
	196			SAME AS ABOVE	Final Core Run
	197				
83	198		45		
	199				
	200				

Appendix II—Moisture Content or Soil Water from Six Sediment Cores

Well		Depth	Percent	Percent	Percent		FINAL		dry	Initial	vial		Init	n		S	Q	>75%	<75%
I.D.	Date	(feet)	Gravel	Sand	Clay		t1	t2	avg	total	&top	moist	%		bulk	percent	Vw/Vt	sand&	sand&
							g	g	g	g	g	g	Sat		vol	sat.		gravel	gravel
							g	g	g	g	g	g	wgt		cc	%			
MHV 21	11/12	25	1	79	20	SD	32.675	32.402	2.236	32.675	30.303	2.37	6	0.376	1.36	27	0.10	27	S
MHV 21	11/12	25	1	79	20	SD	33.591	33.142	3.059	33.591	30.308	3.28	7	0.376	1.86	32	0.12	32	S
MHV 21	11/12	27	5	80	15	SD	34.922	33.785	4.122	34.922	30.232	4.69	12	0.370	2.47	62	0.23	62	S
MHV 21	11/12	27	5	80	15	SD	36.013	34.649	4.938	36.013	30.393	5.62	12	0.370	2.96	62	0.23	62	S
MHV 21	11/12	29	10	70	20	SD	36.054	35.511	5.308	36.054	30.475	5.58	5	0.376	3.22	22	0.08	22	S
MHV 21	11/12	29	10	70	20	SD	36.507	35.802	5.805	36.507	30.350	6.16	6	0.376	3.52	27	0.10	27	S
MHV 21	11/12	31	5	75	20	SD	35.874	35.332	5.159	35.874	30.444	5.43	5	0.376	3.13	23	0.09	23	S
MHV 21	11/12	31	5	75	20	SD	35.247	34.792	4.479	35.247	30.541	4.71	5	0.376	2.72	22	0.08	22	S
MHV 21	11/12	33	5	80	15	SD	34.496	34.095	4.008	34.496	30.288	4.21	5	0.370	2.41	23	0.08	23	S
MHV 21	11/12	33	5	80	15	SD	36.694	35.979	6.050	36.694	30.287	6.41	6	0.370	3.63	27	0.10	27	S
MHV 21	11/12	35	0	20	80	CL	36.074	34.824	5.065	36.074	30.384	5.69	11	0.454	3.55	39	0.18	NS	39
MHV 21	11/12	35	0	20	80	CL	36.473	35.183	5.462	36.473	30.366	6.11	11	0.454	3.83	37	0.17	NS	37
MHV 21	11/12	36	0	35	65	SDCL	36.695	35.414	5.783	36.695	30.272	6.42	10	0.435	3.91	38	0.16	NS	38
MHV 21	11/12	36	0	35	65	SDCL	35.801	34.733	5.046	35.801	30.221	5.58	10	0.435	3.41	36	0.16	NS	36
MHV 21	11/13	37	0	35	65	SDCL	38.769	37.258	7.442	38.769	30.572	8.20	9	0.435	5.03	35	0.15	NS	35
MHV 21	11/13	37	0	35	65	SDCL	37.267	36.013	6.133	37.267	30.507	6.76	9	0.435	4.14	35	0.15	NS	35
MHV 21	11/13	38	0	30	70	SDCL	36.081	34.842	5.013	36.081	30.449	5.63	11	0.441	3.43	41	0.18	NS	41
MHV 21	11/13	38	0	30	70	SDCL	36.805	35.387	5.674	36.805	30.422	6.38	11	0.441	3.88	41	0.18	NS	41
MHV 21	11/13	39	0	20	80	CL	37.137	35.713	5.709	37.137	30.716	6.42	11	0.454	4.01	39	0.18	NS	39
MHV 21	11/13	39	0	20	80	CL	36.927	35.454	5.906	36.927	30.285	6.64	11	0.454	4.14	39	0.18	NS	39
MHV 21	11/13	40	0	20	80	CL	35.221	34.052	4.284	35.221	30.353	4.87	12	0.454	3.01	43	0.19	NS	43
MHV 21	11/13	40	0	20	80	CL	37.043	35.626	5.981	37.043	30.354	6.69	11	0.454	4.20	37	0.17	NS	37
MHV 21	11/13	41	0	15	85	CL	38.392	36.845	7.262	38.392	30.357	8.04	10	0.461	5.16	33	0.15	NS	33
MHV 21	11/13	41	0	15	85	CL	37.535	36.278	6.376	37.535	30.531	7.00	9	0.461	4.53	30	0.14	NS	30
MHV 21	11/13	42	0	15	85	CL	37.200	35.963	6.205	37.200	30.377	6.82	9	0.461	4.41	30	0.14	NS	30
MHV 21	11/13	42	0	15	85	CL	36.494	35.487	5.696	36.494	30.295	6.20	8	0.461	4.05	27	0.12	NS	27
MHV 21	11/13	43	0	10	90	CL	36.011	34.784	5.075	36.011	30.323	5.69	11	0.467	3.65	36	0.17	NS	36
MHV 21	11/13	43	0	10	90	CL	38.177	36.698	6.887	38.177	30.551	7.63	10	0.467	4.96	32	0.15	NS	32
MHV 21	11/13	44	0	10	90	CL	35.884	34.713	4.906	35.884	30.393	5.49	11	0.467	3.53	35	0.17	NS	35
MHV 21	11/13	44	0	10	90	CL	35.629	34.511	5.001	35.629	30.069	5.56	10	0.467	3.60	33	0.16	NS	33
MHV 21	11/13	45	3	40	57	SDCL	36.948	35.634	6.051	36.948	30.240	6.71	10	0.424	4.01	39	0.16	NS	39
MHV 21	11/13	45	3	40	57	SDCL	36.558	35.476	5.768	36.558	30.249	6.31	9	0.424	3.82	33	0.14	NS	33
MHV 21	11/13	47	0.1	75	25	CLSD	36.425	35.843	5.661	36.425	30.473	5.95	5	0.383	3.47	22	0.08	22	S
MHV 21	11/13	47	0.1	75	25	CLSD	36.055	35.448	5.347	36.055	30.405	5.65	5	0.383	3.28	24	0.09	24	S
MHV 21	11/13	49	0	80	20	SD	36.975	36.270	6.288	36.975	30.335	6.64	5	0.376	3.82	25	0.09	25	S
MHV 21	11/13	49	0	80	20	SD	37.688	36.905	6.409	37.688	30.888	6.80	6	0.376	3.89	27	0.10	27	S
MHV 21	11/13	51	0	90	10	SD	36.427	35.884	5.818	36.427	30.338	6.09	4	0.363	3.45	22	0.08	22	S

Well I.D.	Date	Depth (feet)	Percent Gravel	Percent Sand	Percent Clay		FINAL t1 g	t2 g	dry avg g	Initial total g	vial &top g	moist g	Init % Sat wgt	n	bulk vol cc	S percent sat. %	Q Vw/Vt	>75% sand& gravel	<75 sand& gravel
MHV 21	11/13	51	0	90	10	SD	35.932	35.492	5.283	35.932	30.429	5.50	4	0.363	3.14	19	0.07	19	S
MHV 21	11/13	53	0	90	10	SD	35.916	35.512	5.271	35.916	30.443	5.47	4	0.363	3.13	18	0.06	18	S
MHV 21	11/13	53	0	90	10	SD	36.631	35.998	5.857	36.631	30.458	6.17	5	0.363	3.48	25	0.09	25	S
MHV 22	11/19	25	5	75	20	SD	25.425	25.419	4.285	25.927	21.137	4.79	11	0.376	2.60	52	0.19	52	S
MHV 22	11/19	25	5	75	20	SD	26.034	26.026	4.979	26.690	21.051	5.64	12	0.376	3.02	58	0.22	58	S
MHV 22	11/19	27	5	75	20	SD	26.511	26.502	5.358	27.247	21.149	6.10	12	0.376	3.25	61	0.23	61	S
MHV 22	11/19	27	5	75	20	SD	26.525	26.516	5.361	27.242	21.160	6.08	12	0.376	3.25	59	0.22	59	S
MHV 22	11/19	29	5	75	20	SD	26.493	26.481	5.361	28.226	21.126	7.10	24	0.376	3.25	142	0.53	142	S
MHV 22	11/19	29	5	75	20	SD	25.907	25.897	4.607	27.146	21.295	5.85	21	0.376	2.80	118	0.44	118	S
MHV 22	11/19	31	3	72	25	CLSD	26.184	26.174	5.087	26.763	21.092	5.67	10	0.383	3.12	49	0.19	49	S
MHV 22	11/19	31	3	72	25	CLSD	26.708	26.699	5.639	27.391	21.065	6.33	11	0.383	3.46	52	0.20	52	S
MHV 22	11/19	33	5	75	20	SD	26.597	26.589	5.463	27.366	21.130	6.24	12	0.376	3.32	62	0.23	62	S
MHV 22	11/19	33	5	75	20	SD	26.501	26.496	5.371	27.240	21.128	6.11	12	0.376	3.26	60	0.23	60	S
MHV 22	11/19	35	5	75	20	SD	27.453	27.442	6.329	28.591	21.119	7.47	15	0.376	3.84	79	0.30	79	S
MHV 22	11/19	35	5	75	20	SD	26.616	26.608	5.511	27.951	21.101	6.85	20	0.376	3.35	106	0.40	106	S
MHV 22	11/19	36	0	25	75	SDCL	26.637	26.628	5.507	27.832	21.126	6.71	18	0.448	3.81	70	0.31	NS	70
MHV 22	11/19	36	0	25	75	SDCL	27.799	27.790	6.795	29.354	21.000	8.35	19	0.448	4.71	74	0.33	NS	74
MHV 22	11/19	37	0	25	75	SDCL	27.437	27.428	6.429	28.752	21.004	7.75	17	0.448	4.45	66	0.30	NS	66
MHV 22	11/19	37	0	25	75	SDCL	27.685	27.678	6.724	29.101	20.958	8.14	17	0.448	4.66	68	0.30	NS	68
MHV 22	11/19	38	0	40	60	SDCL	25.832	25.824	4.748	26.876	21.080	5.80	18	0.428	3.17	77	0.33	NS	77
MHV 22	11/19	38	0	40	60	SDCL	26.122	26.110	5.098	27.396	21.018	6.38	20	0.428	3.40	88	0.38	NS	88
MHV 22	11/19	39	0	60	40	CLSD	27.679	27.669	6.489	28.780	21.185	7.60	15	0.402	4.13	67	0.27	NS	67
MHV 22	11/19	39	0	60	40	CLSD	25.584	25.575	4.427	26.378	21.153	5.23	15	0.402	2.81	71	0.28	NS	71
MHV 22	11/19	40	0	60	40	CLSD	27.054	27.043	5.909	28.165	21.140	7.03	16	0.402	3.76	74	0.30	NS	74
MHV 22	11/19	40	0	60	40	CLSD	27.771	27.763	6.603	28.992	21.164	7.83	16	0.402	4.20	73	0.29	NS	73
MHV 22	11/19	41	0	70	30	CLSD	26.970	26.962	5.854	27.948	21.112	6.84	14	0.389	3.64	69	0.27	NS	69
MHV 22	11/19	41	0	70	30	CLSD	27.251	27.239	6.052	28.268	21.193	7.08	14	0.389	3.76	70	0.27	NS	70
MHV 22	11/19	42	0	75	25	CLSD	26.983	26.974	5.865	27.743	21.114	6.63	12	0.383	3.60	56	0.21	56	S
MHV 22	11/19	42	0	75	25	CLSD	25.652	25.643	4.597	26.242	21.051	5.19	11	0.383	2.82	55	0.21	55	S
MHV 22	11/19	43	2	78	20	SD	26.889	26.880	5.656	27.430	21.229	6.20	9	0.376	3.43	42	0.16	42	S
MHV 22	11/19	43	2	78	20	SD	27.062	27.055	5.894	27.793	21.165	6.63	11	0.376	3.58	55	0.21	55	S
MHV 22	11/19	44	2	88	10	SD	26.962	26.954	5.725	27.878	21.233	6.65	14	0.363	3.40	75	0.27	75	S
MHV 22	11/19	44	2	88	10	SD	27.076	27.068	5.907	28.032	21.165	6.87	14	0.363	3.51	75	0.27	75	S
MHV 22	11/19	45	2	73	25	CLSD	26.990	26.980	5.925	28.205	21.060	7.15	17	0.383	3.64	88	0.34	88	S
MHV 22	11/19	45	2	73	25	CLSD	26.910	26.901	5.705	28.235	21.201	7.03	19	0.383	3.50	99	0.38	99	S
MHV 22	11/19	47	0	70	30	CLSD	26.920	26.912	5.993	27.713	20.923	6.79	12	0.389	3.72	55	0.21	NS	55

Well I.D.	Date	Depth (feet)	Percent Gravel	Percent Sand	Percent Clay		FINAL t1 g	FINAL t2 g	dry avg g	Initial total g	vial &top g	moist g	Init % Sat wgt	n	bulk vol cc	S percent sat. %	Q Vw/Vt	>75% sand& gravel	<75 sand& gravel
MHV 22	11/19	47	0	70	30	CLSD	27.398	27.389	6.254	28.035	21.140	6.90	9	0.389	3.88	42	0.17	NS	42
MHV 22	11/19	49	0	60	40	CLSD	26.192	26.185	5.007	26.740	21.182	5.56	10	0.402	3.18	43	0.17	NS	43
MHV 22	11/19	49	0	60	40	CLSD	26.330	26.326	5.189	26.913	21.139	5.77	10	0.402	3.30	44	0.18	NS	44
MHV 22	11/19	51	0	92	8	SD	27.311	27.305	6.080	27.950	21.228	6.72	10	0.360	3.59	50	0.18	50	S
MHV 22	11/19	51	0	92	8	SD	26.949	26.942	5.908	27.575	21.038	6.54	10	0.360	3.49	50	0.18	50	S
MHV 22	11/19	53	0	92	8	SD	26.641	26.635	5.594	27.271	21.044	6.23	10	0.360	3.31	53	0.19	53	S
MHV 22	11/19	53	0	92	8	SD	26.323	26.317	5.149	26.865	21.171	5.69	10	0.360	3.04	50	0.18	50	S
MHV 24	11/17	25	10	70	20	SD	26.642	26.641	5.550	27.502	21.092	6.41	13	0.376	3.37	68	0.26	68	S
MHV 24	11/17	25	10	70	20	SD	26.661	26.657	5.556	27.587	21.103	6.48	14	0.376	3.37	73	0.28	73	S
MHV 24	11/17	27	5	75	20	SD	26.833	26.830	5.783	27.924	21.049	6.88	16	0.376	3.51	83	0.31	83	S
MHV 24	11/17	27	5	75	20	SD	26.365	26.360	5.273	27.380	21.090	6.29	16	0.376	3.20	85	0.32	85	S
MHV 24	11/17	29	10	70	20	SD	26.385	26.380	5.287	27.073	21.096	5.98	12	0.376	3.21	57	0.22	57	S
MHV 24	11/17	29	10	70	20	SD	26.178	26.172	4.966	26.811	21.209	5.60	11	0.376	3.01	56	0.21	56	S
MHV 24	11/17	31	10	75	15	SD	26.665	26.661	5.389	27.353	21.274	6.08	11	0.370	3.23	58	0.21	58	S
MHV 24	11/17	31	10	75	15	SD	26.090	26.083	5.170	26.786	20.917	5.87	12	0.370	3.10	61	0.23	61	S
MHV 24	11/17	33	0	5	95	CL	27.731	27.730	6.515	29.396	21.216	8.18	20	0.474	4.75	74	0.35	NS	74
MHV 24	11/17	33	0	5	95	CL	26.115	26.113	5.065	27.444	21.049	6.40	21	0.474	3.70	76	0.36	NS	76
MHV 24	11/17	35	0	5	95	CL	26.150	26.146	4.998	27.423	21.150	6.27	20	0.474	3.65	74	0.35	NS	74
MHV 24	11/17	35	0	5	95	CL	26.622	26.617	5.538	27.988	21.082	6.91	20	0.474	4.04	72	0.34	NS	72
MHV 24	11/17	36	0	20	80	CL	25.630	25.626	4.541	26.883	21.087	5.80	22	0.454	3.19	87	0.39	NS	87
MHV 24	11/17	36	0	20	80	CL	24.941	24.937	3.749	26.020	21.190	4.83	22	0.454	2.63	91	0.41	NS	91
MHV 24	11/17	37	0	10	90	CL	26.605	26.602	5.411	28.085	21.193	6.89	21	0.467	3.90	81	0.38	NS	81
MHV 24	11/17	37	0	10	90	CL	27.315	27.311	6.080	28.813	21.233	7.58	20	0.467	4.38	73	0.34	NS	73
MHV 24	11/17	38	0	20	80	CL	27.138	27.134	6.052	28.923	21.084	7.84	23	0.454	4.25	93	0.42	NS	93
MHV 24	11/17	38	0	20	80	CL	26.492	26.486	5.423	27.967	21.066	6.90	21	0.454	3.81	86	0.39	NS	86
MHV 24	11/17	39	0	10	90	CL	26.196	26.193	5.081	27.807	21.114	6.69	24	0.467	3.66	94	0.44	NS	94
MHV 24	11/17	39	0	10	90	CL	25.191	25.187	4.017	26.437	21.172	5.27	24	0.467	2.89	92	0.43	NS	92
MHV 24	11/17	40	0	5	95	CL	25.435	25.432	4.311	26.794	21.123	5.67	24	0.474	3.15	91	0.43	NS	91
MHV 24	11/17	40	0	5	95	CL	25.911	25.909	4.787	27.338	21.123	6.22	23	0.474	3.49	86	0.41	NS	86
MHV 24	11/17	41	0	5	95	CL	27.529	27.525	6.372	29.121	21.155	7.97	20	0.474	4.65	72	0.34	NS	72
MHV 24	11/17	41	0	5	95	CL	27.281	27.280	6.160	28.826	21.121	7.71	20	0.474	4.50	73	0.34	NS	73
MHV 24	11/17	42	0	10	90	CL	26.908	26.906	5.813	28.684	21.094	7.59	23	0.467	4.19	91	0.42	NS	91
MHV 24	11/17	42	0	10	90	CL	25.235	25.229	4.164	26.453	21.068	5.39	23	0.467	3.00	87	0.41	NS	87
MHV 24	11/17	43	0.1	15	85	CL	26.941	26.937	5.836	28.308	21.103	7.21	19	0.461	4.15	72	0.33	NS	72
MHV 24	11/17	43	0.1	15	85	CL	26.595	26.590	5.605	27.859	20.988	6.87	18	0.461	3.98	69	0.32	NS	69
MHV 24	11/17	44	2	88	10	SD	26.354	26.348	5.286	26.983	21.065	5.92	11	0.363	3.14	55	0.20	55	S

Well I.D.	Date	Depth (feet)	Percent Gravel	Percent Sand	Percent Clay		FINAL t1	t2	dry avg	Initial total	vial & top	moist	Init % Sat	n	bulk vol cc	S percent sat. %	Q Vw/Vt	>75% sand & gravel	<75 sand & gravel
MHV 24	11/17	44	2	88	10	SD	26.491	26.483	5.337	27.310	21.150	6.16	13	0.363	3.17	72	0.26	72	S
MHV 24	11/17	45	1	89	10	SD	27.371	27.363	6.237	28.060	21.130	6.93	10	0.363	3.70	52	0.19	52	S
MHV 24	11/17	45	1	89	10	SD	26.332	26.327	5.296	26.832	21.034	5.80	9	0.363	3.14	44	0.16	44	S
MHV 24	11/17	47	0	95	5	SD	27.644	27.638	6.523	28.378	21.118	7.26	10	0.357	3.83	54	0.19	54	S
MHV 24	11/17	47	0	95	5	SD	25.365	25.357	4.395	25.833	20.966	4.87	10	0.357	2.58	51	0.18	51	S
MHV 24	11/17	49	0	95	5	SD	26.885	26.879	5.752	27.443	21.130	6.31	9	0.357	3.38	47	0.17	47	S
MHV 24	11/17	49	0	95	5	SD	26.722	26.715	5.664	27.235	21.055	6.18	8	0.357	3.32	44	0.16	44	S
MHV 24	11/17	51	0	85	15	SD	26.607	26.602	5.343	27.108	21.262	5.85	9	0.370	3.21	42	0.16	42	S
MHV 24	11/17	51	0	85	15	SD	27.109	27.103	6.068	27.712	21.038	6.67	9	0.370	3.64	45	0.17	45	S
MHV 24	11/17	53	0	92	8	SD	26.993	26.986	5.742	27.434	21.248	6.19	7	0.360	3.39	36	0.13	36	S
MHV 24	11/17	53	0	92	8	SD	26.872	26.865	5.671	27.353	21.198	6.16	8	0.360	3.35	40	0.14	40	S
MHB-21	4/29	25'	5	80	15	SD	49.170	49.169	17.399	52.830	31.771	21.06	17	0.370	10.44	95	0.35	95	S
MHB-21	4/29	25'	5	80	15	SD	52.194	52.155	19.410	55.902	32.764	23.14	16	0.370	11.65	87	0.32	87	S
MHB-21	4/29	30'	5	80	15	SD	47.552	47.557	15.358	49.606	32.196	17.41	12	0.370	9.22	60	0.22	60	S
MHB-21	4/29	30'	5	80	15	SD	48.503	48.509	15.750	50.642	32.756	17.89	12	0.370	9.45	61	0.23	61	S
MHB-21	4/29	34'	8	67	25	CLSD	53.640	53.596	21.704	57.653	31.914	25.74	16	0.383	13.33	79	0.30	79	S
MHB-21	4/29	34'	8	67	25	CLSD	50.265	50.258	18.108	53.873	32.153	21.72	17	0.383	11.12	85	0.32	85	S
MHB-21	4/29	36'	0	15	85	CL	51.790	51.568	19.264	55.681	32.414	23.27	17	0.461	13.69	63	0.29	NS	63
MHB-21	4/29	36'	0	15	85	CL	54.982	54.667	21.603	59.375	33.221	26.15	17	0.461	15.36	64	0.30	NS	64
MHB-21	4/29	38'	0	2	98	CL	55.997	55.970	23.040	60.891	32.943	27.95	18	0.477	16.95	61	0.29	NS	61
MHB-21	4/29	38'	0	2	98	CL	51.273	51.104	18.660	55.369	32.528	22.84	18	0.477	13.73	64	0.30	NS	64
MHB-21	4/29	40'	0	20	80	CL	52.237	52.094	19.559	56.686	32.607	24.08	19	0.454	13.72	73	0.33	NS	73
MHB-21	4/29	40'	0	20	80	CL	55.010	54.314	22.617	59.778	32.045	27.73	18	0.454	15.87	71	0.32	NS	71
MHB-21	4/29	42'	0	10	90	CL	56.495	55.638	23.697	60.990	32.370	28.62	17	0.467	17.07	62	0.29	NS	62
MHB-21	4/29	42'	0	10	90	CL	51.810	51.713	19.746	56.305	32.015	24.29	19	0.467	14.22	68	0.32	NS	68
MHB-21	4/29	46'	1	69	30	CLSD	56.281	56.281	23.130	59.020	33.151	25.87	11	0.389	14.37	49	0.19	NS	49
MHB-21	4/29	46'	1	69	30	CLSD	54.546	54.511	22.887	57.895	31.641	26.25	13	0.389	14.22	61	0.24	NS	61
MHB-21	4/29	50'	0	85	15	SD	56.746	56.750	24.090	59.436	32.658	26.78	10	0.370	14.46	50	0.19	50	S
MHB-21	4/29	50'	0	85	15	SD	60.137	60.142	27.277	63.057	32.862	30.19	10	0.370	16.37	48	0.18	48	S
MHB-21	4/29	55'	0	85	15	SD	48.600	48.604	17.104	50.991	31.498	19.49	12	0.370	10.27	63	0.23	63	S
MHB-21	4/29	55'	0	85	15	SD	52.679	52.682	20.341	55.298	32.340	22.96	11	0.370	12.21	58	0.21	58	S
MHB-24	4/27	25'	5	70	25	CLSD	50.487	50.489	17.876	53.436	32.612	20.82	14	0.383	10.98	70	0.27	70	S
MHB-24	4/27	25'	5	70	25	CLSD	52.213	52.215	19.498	55.532	32.716	22.82	15	0.383	11.97	72	0.28	72	S
MHB-24	4/28	30'	5	70	25	CLSD	49.025	49.029	16.829	51.573	32.198	19.37	13	0.383	10.33	64	0.25	64	S

Well I.D.	Date	Depth (feet)	Percent Gravel	Percent Sand	Percent Clay		FINAL t1 g	t2 g	dry avg g	Initial total g	vial &top g	moist g	Init % Sat wgt	n	bulk vol cc	S percent sat. %	Q Vw/Vt	>75% sand& gravel	<75 sand& gravel
MHB-24	4/28	30'	5	70	25	CLSD	53.350	53.353	20.445	55.969	32.906	23.06	11	0.383	12.55	55	0.21	55	S
MHB-24	4/28	34'	0	10	90	CL	49.820	49.366	17.489	53.834	32.104	21.73	20	0.467	12.60	72	0.34	NS	72
MHB-24	4/28	34'	0	10	90	CL	50.925	50.822	18.267	55.592	32.607	22.99	21	0.467	13.16	77	0.36	NS	77
MHB-24	4/28	36'	0	5	95	CL	49.722	49.625	16.899	53.721	32.774	20.95	19	0.474	12.33	69	0.33	NS	69
MHB-24	4/28	36'	0	5	95	CL	51.390	51.150	19.198	55.809	32.072	23.74	19	0.474	14.01	68	0.32	NS	68
MHB-24	4/28	38'	0	5	95	CL	54.170	53.874	21.543	58.440	32.479	25.96	17	0.474	15.72	59	0.28	NS	59
MHB-24	4/28	38'	0	5	95	CL	52.214	52.124	19.601	56.369	32.568	23.80	18	0.474	14.31	62	0.29	NS	62
MHB-24	4/28	40'	0	20	80	CL	46.243	46.247	13.592	49.035	32.653	16.38	17	0.454	9.54	64	0.29	NS	64
MHB-24	4/28	40'	0	20	80	CL	46.997	46.987	13.960	50.302	33.032	17.27	19	0.454	9.80	74	0.34	NS	74
MHB-24	4/28	42'	0	45	55	CL	48.926	48.929	15.742	51.496	33.186	18.31	14	0.422	10.38	59	0.25	NS	59
MHB-24	4/28	42'	0	45	55	CL	49.144	49.138	16.369	52.423	32.772	19.65	17	0.422	10.79	72	0.30	NS	72
MHB-24	4/28	46'	0	45	55	SDCL	55.199	55.203	23.535	58.292	31.666	26.63	12	0.422	15.51	47	0.20	NS	47
MHB-24	4/28	46'	0	45	55	SDCL	56.544	56.549	24.756	58.903	31.791	27.11	9	0.422	16.32	34	0.14	NS	34
MHB-24	4/28	50'	0	75	25	CLSD	55.023	55.027	22.188	57.247	32.837	24.41	9	0.383	13.62	43	0.16	43	S
MHB-24	4/28	50'	0	75	25	CLSD	51.098	51.101	18.020	52.694	33.080	19.61	8	0.383	11.06	38	0.14	38	S
MHB-24	4/28	55'	0	80	20	SD	53.255	53.260	20.347	56.375	32.911	23.46	13	0.376	12.35	67	0.25	67	S
MHB-24	4/28	55'	0	80	20	SD	53.049	53.049	20.495	56.055	32.554	23.50	13	0.376	12.44	64	0.24	64	S
MHB-28	4/26	25'	0	15	85	CL	52.467	52.289	19.670	57.541	32.708	24.83	21	0.461	13.98	80	0.37	NS	
MHB-28	4/26	25'	0	15	85	CL	53.055	52.596	19.673	57.890	33.153	24.74	20	0.461	13.98	79	0.36	NS	79
MHB-28	4/26	30'	0	5	95	CL	51.219	51.207	18.357	54.560	32.856	21.70	15	0.474	13.40	53	0.25	NS	53
MHB-28	4/26	30'	0	5	95	CL	50.981	50.929	18.642	54.296	32.313	21.98	15	0.474	13.61	52	0.25	NS	52
MHB-28	4/27	35'	0	20	80	CL	52.481	52.009	19.141	57.907	33.104	24.80	23	0.454	13.43	93	0.42	NS	93
MHB-28	4/27	35'	0	20	80	CL	51.754	51.218	18.610	56.873	32.876	24.00	22	0.454	13.06	91	0.41	NS	91
MHB-28	4/27	37'	0	5	95	CL	55.621	54.729	22.269	60.659	32.905	27.75	20	0.474	16.25	71	0.34	NS	71
MHB-28	4/27	37'	0	5	95	CL	53.755	53.328	20.662	59.015	32.879	26.14	21	0.474	15.08	77	0.36	NS	77
MHB-28	4/27	39'	0	25	75	SDCL	52.154	51.697	20.851	57.178	31.075	26.10	20	0.448	14.45	81	0.36	NS	81
MHB-28	4/27	39'	0	25	75	SDCL	50.778	50.702	18.181	55.963	32.559	23.40	22	0.448	12.60	93	0.41	NS	93
MHB-28	4/27	43'	0	10	90	CL	53.102	53.095	20.904	58.173	32.195	25.98	20	0.467	15.06	72	0.34	NS	72
MHB-28	4/27	43'	0	10	90	CL	54.489	54.453	21.621	60.322	32.850	27.47	21	0.467	15.57	80	0.38	NS	80
MHB-28	4/27	45'	0	45	55	SDCL	57.127	57.132	24.415	60.026	32.715	27.31	11	0.422	16.09	43	0.18	NS	43
MHB-28	4/27	45'	0	45	55	SDCL	54.720	54.725	22.071	57.006	32.652	24.35	9	0.422	14.55	37	0.16	NS	37
MHB-28	4/27	47'	0	65	35	CLSD	52.651	52.653	20.155	54.912	32.497	22.42	10	0.396	12.67	45	0.18	NS	45
MHB-28	4/27	47'	0	65	35	CLSD	52.694	52.696	20.410	54.727	32.285	22.44	9	0.396	12.83	40	0.16	NS	40
MHB-28	4/27	51'	2	63	35	CLSD	52.814	52.817	19.886	54.704	32.930	21.77	9	0.396	12.50	38	0.15	NS	38
MHB-28	4/27	51'	2	63	35	CLSD	51.246	51.251	18.924	52.951	32.324	20.63	8	0.396	11.89	36	0.14	NS	36
MHB-28	4/27	55'	0	92	8	SD	54.750	54.755	22.564	56.451	32.188	24.26	7	0.360	13.33	35	0.13	35	S

Well I.D.	Date	Depth (feet)	Percent Gravel	Percent Sand	Percent Clay		FINAL t1 g	t2 g	dry avg g	Initial total g	vial & top g	moist g	Init % Sat wgt	n	bulk vol cc	S percent sat. %	Q Vw/Vt	>75% sand & gravel	<75 sand & gravel
MHB-28	4/27	55'	0	92	8	SD	54.350	54.356	22.486	56.235	31.867	24.37	8	0.360	13.29	39	0.14	39	S

	AVG CLAY	AVG SAND	SD CLAY	SD SAND
MHV-24	82	56	9	14
MHV-22	66	69	13	25
MHV-21	36	28	4	13
MHB-21	64	69	7	16
MHB-24	63	59	9	9
MHB-28	82	50	9	9

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Appendix III—Tabulated TCE and PCE for Pre- and Post-test Borings

Appendix III

PRETEST				POST TEST			
Well ID	Sample Depth	TCE ppm	PCE ppm	Well ID	Sample Depth	TCE ppm	PCE ppm
MHV-20	25'	0.010	0.010	MHB-20	20'	0.077	0.447
	27'	0.056	0.165		25'	0.049	0.058
	29'	0.010	0.010		30'	0.084	0.138
	31'	0.010	0.010		35'	0.450	1.079
	33'	0.010	0.010		37'	2.974	3.911
	35'	0.010	0.010		39'	5.317	6.341
	36'	0.136	0.305		41'	2.588	4.251
	37'	0.205	0.665		45'	5.177	3.383
	38'	1.136	2.394		47'	0.208	0.158
	39'	4.967	3.300		49'	0.102	0.090
	40'	3.701	2.490		51'	0.055	0.022
	41'	5.413	3.729		55'	0.070	0.050
	42'	2.919	1.245		60'	0.175	0.236
	43'	3.477	1.689				
	44'	10.977	4.620				
	45'	5.281	2.493				
	47'	0.020	0.019				
	49'	0.035	0.015				
	51'	0.010	0.010				
	53'	0.010	0.010				
MHV-21	55'	0.031	0.032	MHB-21	20'	0.043	0.016
	57'	0.024	0.029		25'	0.175	0.114
	59'	0.041	0.037		30'	0.044	0.011
	25'	0.010	0.010		34'	0.060	0.035
	27'	0.021	0.038		36'	1.189	2.248
	29'	0.010	0.012		38'	1.491	2.769
	31'	0.010	0.017		40'	1.276	2.448
	33'	0.010	0.057		42'	1.162	2.067
	35'	1.106	2.779		44'	0.953	1.441
	36'	2.389	1.574		46'	0.168	0.134
	37'	0.011	0.045		48'	0.136	0.125
	38'	2.568	2.055		50'	0.053	0.020
	39'	1.252	0.432		55'	0.123	0.095
	40'	8.226	2.370		60'	0.120	0.101
	41'	12.984	3.837				
	42'	0.185	0.073				
	43'	0.141	0.097				
	44'	0.154	0.115				
	45'	0.020	0.016				
	47'	0.010	0.015				
MHV-22	49'	0.010	0.015	MHB-22	20'	0.009	0.020
	51'	0.010	0.010		25'	0.021	0.033
	53'	0.010	0.015		30'	0.018	0.030
	55'	0.010	0.013		34'	0.022	0.035
	57'	0.010	0.010				
	59'	0.118	0.085				
	25'	0.010	0.010				
	27'	0.010	0.010				
	29'	0.010	0.010				
	31'	0.010	0.010				

Appendix II

Well ID	Sample Depth	TCE ppm	PCE ppm		Well ID	Sample Depth	TCE ppm	PCE ppm
	33'	0.010	0.010			36'	0.160	0.543
	35'	2.664	1.269			38'	0.462	0.409
	36'	0.055	0.043			40'	0.070	0.247
	37'	0.010	0.010			42'	0.020	0.038
	38'	0.010	0.010			44'	0.147	0.188
	39'	0.034	0.040			46'	0.094	0.114
	40'	0.069	0.117			48'	0.073	0.097
	41'	0.010	0.010			50'	0.023	0.028
	42'	0.010	0.010			55'	0.057	0.051
	43'	0.010	0.010			60'	0.121	0.091
	44'	0.010	0.010					
	45'	0.122	0.096					
	47'	0.010	0.010					
	49'	0.010	0.010					
	51'	0.010	0.010					
	53'	0.010	0.010					
	55'	0.016	0.021					
	57'	0.010	0.013					
	59'	0.106	0.160					
MHV-23	25'	0.010	0.030		MHB-23	20'	0.044	0.109
	27'	0.010	0.013			25'	0.060	0.146
	29'	0.010	0.010			30'	0.102	0.317
	31'	0.010	0.010			35'	0.040	0.056
	33'	0.010	0.010			37'	0.075	0.309
	35'	0.010	0.010			39'	0.082	0.340
	36'	0.022	0.097			41'	0.831	2.160
	37'	0.198	0.849			43'	1.935	4.572
	38'	1.082	2.889			45'	0.859	1.713
	39'	0.196	0.330			47'	0.137	0.184
	40'	5.229	5.235			49'	0.055	0.038
	41'	3.474	4.767			51'	0.065	0.052
	42'	3.051	3.611			55'	0.079	0.058
	43'	4.073	4.465			60'	0.226	0.171
	44'	2.528	0.306					
	45'	0.010	0.010					
	47'	0.043	0.043					
	49'	0.010	0.010					
	51'	0.010	0.010					
	53'	0.010	0.010					
	55'	0.080	0.119					
	57'	0.010	0.010					
	59'	0.101	0.133					
MHV-24	25'	0.010	0.010		MHB-24	20'	0.026	0.008
	27'	0.010	0.010			25'	0.043	0.014
	29'	0.010	0.010			30'	0.032	0.010
	31'	0.010	0.010			34'	0.096	0.157
	33'	0.010	0.011			36'	0.300	0.600
	35'	0.230	0.397			38'	0.184	0.232
	36'	0.067	0.073			40'	0.033	0.009
	37'	0.152	0.161			42'	0.204	0.148
	38'	0.058	0.043			44'	0.035	0.013

Appendix II

Well ID	Sample Depth	TCE ppm	PCE ppm		Well ID	Sample Depth	TCE ppm	PCE ppm
	39'	0.010	0.010			46'	0.040	0.017
	40'	0.010	0.010			48'	0.042	0.012
	41'	0.103	0.057			50'	0.031	0.008
	42'	1.877	1.069			55'	0.035	0.009
	43'	0.219	0.181			60'	0.045	0.022
	44'	0.010	0.010					
	45'	0.010	0.010					
	47'	0.010	0.010					
	49'	0.010	0.010					
	51'	0.010	0.010					
	53'	0.010	0.010					
	55'	0.020	0.032					
	57'	0.010	0.010					
	59'	0.053	0.057					
MHV-25	25'	0.010	0.011		MHB-25	20'	0.043	1.342
	27'	0.010	0.102			25'	0.105	0.186
	29'	0.010	0.017			30'	0.046	0.051
	31'	0.010	0.107			34'	2.180	3.647
	33'	0.017	0.122			36'	10.793	11.668
	35'	2.577	1.724			38'	48.509	138.088
	36'	2.067	1.609			40'	39.785	35.856
	37'	5.681	5.559			42'	5.257	6.391
	38'	9.806	7.853			44'	2.021	1.318
	39'	10.102	7.000			46'	0.132	0.143
	40'	9.204	5.548			48'	0.186	0.191
	41'	23.380	10.306			50'	0.080	0.059
	42'	19.199	9.283			55'	0.075	0.062
	43'	17.629	9.915			60'	0.177	0.216
	44'	25.570	13.542					
	45'	1.587	0.401					
	47'	0.111	0.089					
	49'	0.042	0.012					
	51'	0.013	0.015					
	53'	0.022	0.032					
	55'	0.023	0.035					
	57'	0.010	0.037					
	59'	1.120	0.465					
MHV-26	25'	0.010	0.010		MHB-26	20'	0.053	0.053
	27'	0.056	0.067			25'	0.076	0.368
	29'	0.056	0.073			30'	0.044	0.069
	31'	0.013	0.020			35'	0.581	1.780
	32'	0.067	0.401			37'	1.281	2.945
	33'	2.773	1.301			39'	1.893	3.461
	35'	1.099	2.868			41'	0.402	0.828
	36'	0.923	2.267			43'	1.627	1.252
	37'	2.324	3.746			45'	0.317	0.284
	38'	2.314	3.636			47'	0.121	0.104
	39'	3.660	3.372			49'	0.080	0.058
	40'	4.147	3.185			51'	0.057	0.033
	41'	6.211	3.757			55'	0.055	0.044
	42'	4.104	3.064			60'	0.167	0.195
	43'	2.240	2.471					
	44'	2.280	0.413					

Appendix II

Well ID	Sample Depth	TCE ppm	PCE ppm		Well ID	Sample Depth	TCE ppm	PCE ppm
	45'	1.239	0.921					
	47'	0.045	0.046					
	49'	0.039	0.040					
	51'	0.010	0.014					
	53'	0.020	0.025					
	55'	0.053	0.053					
	57'	0.022	0.023					
	59'	0.058	0.053					
MHV-27	27'	0.010	0.010		MHB-27	20'	0.046	0.302
	29'	0.010	0.010			25'	0.051	0.413
	31'	0.010	0.015			30'	0.040	0.147
	33'	0.010	0.070			35'	0.145	1.408
	35'	0.083	0.465			37'	0.280	2.025
	36'	0.229	1.202			39'	0.357	1.620
	37'	0.076	0.521			41'	0.429	1.565
	38'	0.010	0.010			43'	0.265	0.568
	39'	0.152	0.417			45'	0.234	0.428
	40'	1.343	1.112			55'	0.046	0.030
	41'	0.949	1.707			60'	0.072	0.104
	42'	0.170	0.363					
	43'	0.035	0.072					
	44'	2.197	1.747					
	45'	0.010	0.010					
	47'	0.016	0.024					
	49'	0.021	0.045					
	51'	0.017	0.027					
	53'	0.018	0.027					
	55'	0.010	0.015					
	57'	0.010	0.010					
	59'	0.010	0.010					
MHV-28	25'	0.010	0.161		MHB-28	20'	0.050	3.004
	27'	0.010	0.184			25'	0.055	0.390
	29'	0.010	0.011			30'	0.078	0.894
	31'	0.010	0.010			35'	0.090	0.373
	33'	0.010	0.015			37'	0.049	0.208
	35'	0.069	0.728			39'	0.059	0.332
	36'	0.025	0.346			43'	0.045	0.032
	37'	0.015	0.381			45'	0.021	0.003
	38'	0.118	2.597			47'	0.056	0.063
	39'	0.100	2.302			49'	0.049	0.040
	40'	0.126	2.649			51'	0.054	0.052
	41'	0.058	0.139			55'	0.022	0.000
	42'	0.010	0.010			60'	0.091	0.140
	43'	0.123	0.366					
	44'	0.113	0.390					
	45'	0.222	0.395					
	47'	0.010	0.015					
	49'	0.018	0.023					
	51'	0.075	0.085					
	53'	0.010	0.014					
	55'	0.010	0.010					
	57'	0.018	0.022					
MHV-29	25'	0.038	0.575		MHB-29	20'	0.050	0.199

Appendix II

Well ID	Sample Depth	TCE ppm	PCE ppm	Well ID	Sample Depth	TCE ppm	PCE ppm
	27'	0.068	1.015		25'	0.057	0.721
	29'	0.011	0.118		30'	0.079	1.324
	31'	0.024	0.071		35'	0.212	1.056
	33'	0.140	1.830		37'	0.518	1.821
	35'	0.327	1.378		39'	0.965	2.171
	36'	0.871	2.279		41'	1.003	1.076
	37'	0.907	1.480		43'	0.214	0.334
	38'	1.076	1.805		45'	0.149	0.275
	39'	1.736	1.431		47'	0.131	0.236
	40'	2.989	1.906		49'	0.177	0.385
	41'	1.466	1.040		51'	0.053	0.023
	42'	2.604	0.869		55'	0.087	0.152
	43'	0.204	0.354		60'	0.372	1.120
	44'	0.213	0.352				
	47'	0.072	0.073				
	49'	0.010	0.010				
	51'	0.010	0.011				
	53'	0.019	0.020				
	55'	0.018	0.018				
	57'	0.114	0.101				
	59'	0.035	0.026				

Appendix IV—Plots of TCE and PCE vs. Depth

MHV-20 TCE Concentration

MHV-20 PCE Concentration

MHV-21 TCE Concentration

MHV-21 PCE Concentration

MHV-22 TCE Concentration

MHV-22 PCE Concentration

MHV-23 TCE Concentration

MHV-23 PCE Concentration

MHV-24 TCE Concentration

MHV-24 PCE Concentration

MHV-25 TCE Concentration

MHV-25 PCE Concentration

MHV-26 TCE Concentration

MHV-26 PCE Concentration

MHV-27 TCE Concentration

MHV-27 PCE Concentration

MHV-28 TCE Concentration

MHV-28 PCE Concentration

MHV-29 TCE Concentration

MHV-29 PCE Concentration

MHB-20 TCE Concentration

MHB-20 PCE Concentration

MHB-21 TCE Concentration

MHB-21 PCE Concentration

MHB-22 TCE Concentration

MHB-22 PCE Concentration

MHB-23 TCE Concentration

MHB-23 PCE Concentration

MHB-24 TCE Concentration

MHB-24 PCE Concentration

MHB-25 TCE Concentration

MHB-25 PCE Concentration

MHB-26 TCE Concentration

MHB-26 PCE Concentration

MHB-27 TCE Concentration

MHB-27 PCE Concentration

MHB-28 TCE Concentration

MHB-28 PCE Concentration

MHB-29 TCE Concentration

MHV-29 PCE Concentration

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