

Submitted to: The Alabama Department of Environmental Management Montgomery, Alabama



The following Scope of Work is an addendum to the Work Plan for Rapid Response, Interim Corrective Measures, and Comprehensive Site Assessment (Work Plan) that was approved by the Alabama Department of Environmental Management (ADEM) on June 8, 2001. In addition, this addendum further modifies the approved Addendum 06 regarding the installation of monitoring wells to assess the geologic and groundwater characteristics across the site referred to as the Coliseum Boulevard Plume (CBP) site.

This addendum addresses the installation of deep monitoring wells using sonic drilling techniques. Sonic drilling methods are not specifically referenced in the EPA Region 4 Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM) dated May 1996 and includes 1997 revisions. Although not specifically referenced in the manual, we have discussed the procedure with US EPA Region IV, and have discussed the procedure with consultants that have used this method at Wright-Patterson Air Force Base, under approval from the Ohio EPA and the US EPA Region V. This addendum will be limited to the four deep wells proposed herein. Based on the information obtained from this work, procedures for installing future deep wells at the CBP site may be modified in subsequent addendums.

Four deep borings and four monitoring wells have been proposed and approved by ADEM to investigate the saturated zone beneath the first distinct clay, but above the Gordo Formation (See Figure 1). The location of these "deep" zone borings and monitoring wells is based on: 1) water quality data for the saturated zone above the first distinct clay, and 2) initially bounding the perimeter of the investigation area. The four boring/monitoring well locations are shown on Figure 1 attached with this addendum.

## **Technical Specifications**

## General

Four deep borings and four deep groundwater monitoring wells will be installed near the perimeter of the presently identified area of shallow groundwater containing TCE associated with the CBP site. These borings and monitoring wells will be drilled to a depth beneath the first distinct clay but above the Gordo Formation. Installation of these borings/wells will include:

• Evaluation of four soil conductivity logs to estimate the thickness and the depth to the first distinct clay layer and the depth to the clay layer beneath the second saturated zone. At present, the soil conductivity investigation has been completed and these results are included in Attachment 1. Note that the soil conductivity probe hit refusal before



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reaching a clay layer underlying a second saturated zone, however, the conductivity logs will be useful during drilling the exploratory borings.

- Drilling four exploratory borings to the top of the clay beneath the second saturated zone.
- Collecting continuous soil samples for geologic logging and PID screening.
- Tremie grouting the exploratory boreholes immediately following the borehole completion.
- Installing a two-inch diameter deep monitor well within 15 feet of the exploratory boring location.
- Installing an aboveground or flush-mount protective casing/shroud.
- Developing the completed wells.

## **Exploratory Borings**

- All borings will be advanced using sonic drilling techniques (see Figure 2, Diagrams 1 through 4). A nominal four-inch core barrel will be advanced in 10-foot or lesser intervals to collect undisturbed soil samples. The length of coring will be based on the lithology observed in the preceding core run and the results of the preceding conductivity probe. Following each soil sample core advancement, an override casing will be advanced to the depth of the sample. This method of boring advancement will continue to the designated boring depth.
- The test borings will extend to the top of the clay beneath the second saturated zone, but • will not penetrate through the top of the Gordo Formation.
- Soil samples will be collected continuously from ground surface to the total depth in clear • plastic sleeves to be provided by the subcontractor using a nominal four-inch diameter sonic inner core barrel.
- Following the completion of the exploratory soil boring, the borehole will be tremiegrouted from the base of the boring to the ground surface using Pure Gold® bentonite. The bentonite grout will contain approximately 27% solids.

## Sample Collection

The core samples will be field screened using a photo-ionization detector (PID) or comparable instrument. At each boring location, samples of the core exhibiting the highest PID reading in the first saturated zone and second saturated zone will



be collected for laboratory analysis. In addition, soil samples from the top of the first distinct clay and the clay unit beneath the second saturated zone will be collected. If PID readings are not elevated in comparison to background values in the first or second saturated zone, a laboratory sample will not be collected from these zones. However, a sample from the top of each clay unit will be submitted for laboratory analysis regardless of the PID reading. All samples will be analyzed for volatile organic compounds.

• The actual number of soil samples may be increased based on field screening results.

## Monitoring Well Installation

Four deep zone monitoring wells will be installed within 15 feet of each exploratory boring location using sonic drill methods. Information obtained from the exploratory borings will be used to identify the depth and thickness of the first distinct clay layer and the second saturated zone interval. The deep monitoring wells will be constructed to minimize the potential for cross contamination between the first and second saturated zones, as described in the following sections.

Two construction procedures for the deep wells are proposed based on the thickness of the first distinct clay layer and detectable presence of TCE in the first water bearing zone. These construction methods are as follows:

# **Deep Well Construction Method 1 (DWCM1):**

A temporary override casing will be used if the thickness of the first distinct clay is:

- at least four (4) feet, OR
- less than four (4) feet and TCE was not detected in groundwater samples from adjacent shallow monitoring wells or probeholes.

## **Deep Well Construction Method 2 (DWCM2):**

A permanent casing will be used if the first distinct clay is:

- less than four (4) feet, AND
- groundwater samples from adjacent shallow monitoring wells or probeholes contained TCE.



DWCM1 Installation Description (see Figure 3, Diagrams 5-7)

- A borehole will be completed using conventional sonic drilling methods to a depth of at least two feet below the top of the first distinct clay unit. The depth and thickness of the first distinct clay unit will be verified as a part of the exploratory boring phase of work.
- After the target depth of the boring is reached, a clean 8-inch diameter temporary override metal casing will be set into the top two (2) feet of the first distinct clay.
- Accumulated water in the open borehole will be evacuated.
- Approximately three to four feet of Pure Gold bentonite slurry consisting of 30% solids will be pressure grouted into the bottom of the borehole through the 8-inch diameter casing.
- The 8-inch diameter casing will be raised approximately two feet and slowly lowered to the original depth to form a bentonite seal around the bottom of the 8-inch casing.
- The bentonite slurry will be allowed to set for approximately one hour.
- A 6-inch core barrel sampler then will be inserted into the base of the borehole to remove the accumulated bentonite from the base of the borehole.
- Approximately 5 feet of potable water will be added to the borehole.
- Water level measurements will be made immediately after addition of the potable water and, again, after 1 hour.
- If the water level measurements are within 0.1 foot after 1 hour, drilling will continue. If the water level is not stable, additional bentonite will be added inside the temporary protective casing and the above steps will be repeated.
- Following completion of the bentonite seal in the first distinct clay unit, sonic drilling will continue using the 4-inch diameter soil sampler and 6-inch diameter override casing through the first distinct clay and inside the 8-inch temporary protective casing. The borehole will be advanced into the second saturated zone to the total depth of the monitoring well.

# Filter Pack

- The material used as a filter pack shall consist of clean, well-rounded, quartz sand graded to the size range appropriate for the screened interval.
- The filter pack shall extend from the bottom of the well screen to two feet above the top of the well screen. In no instance will the filter pack extend to an elevation above the bottom of the first distinct clay.



Bentonite Seal and Grouting (see Figure 4, Diagrams 8-9)

- Pure Gold® bentonite consisting of 30% solids will be tremied into the annulus above the filter pack to a thickness of two-feet.
- A grout mixture containing 95% Portland Cement to 5% bentonite will be tremied into the monitoring well annulus coincident with the retraction of the 6-inch protective override casing. This coincident method of tremie grouting and retraction of the 6-inch sonic override casing will continue until the grout has been emplaced to the top of the first distinct clay. Tremie grouting then will continue coincident with the retraction of both the 6- and 8-inch protective override casings until the grout has been emplaced to within about six inches of the land surface.

### DWCM2 Installation Description

- A borehole will be completed using conventional sonic drilling methods to a depth of at least two feet below the top of the first distinct clay unit. The depth and thickness of the first distinct clay unit will be verified as a part of the exploratory boring phase of work.
- After the target depth of the boring is reached, a clean 10-inch diameter temporary override casing will be set into the top two (2) feet of the first restrictive clay.
- A clean 8-inch diameter permanent casing will be placed inside the 10-inch diameter metal casing to the same depth. See Diagram 10 (Figure 4).
- A mixture of 95% Portland Cement to 5% bentonite will be pressure grouted (Halliburton Method) into the annulus between the 8- and 10-inch diameter casings.
- The 10-inch diameter override casing will be slowly retracted during the grouting process.
- The grout will be allowed to set for approximately 24 hours.
- Following completion of the permanent 8-inch casing in the first saturated zone, sonic drilling will continue using the 4-inch diameter soil sampler and 6-inch diameter override casing through the first distinct clay and inside the 8-inch temporary protective casing. The borehole will be advanced into the second saturated zone.



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- The grout will extend to two feet below ground surface.

#### **Site-specific well constructions**

Pertinent geologic and water quality data in the first water bearing zone at the proposed deep boring/monitor well locations are provided in Table 1. Soil conductivity logs were used to estimate the thickness of the first distinct clay beneath the water table at the four proposed deep wells locations (DZ1 through DZ4). The thickness of the first distinct clay beneath the water table at locations DZ1/MW311 (Christian Laboratory) and DZ3/MW322 (Alabama Department of Environmental Management) ranges from 2 to 4 feet. Ground-water samples from monitoring wells 111 and 211 at location DZ1 contained 12.0 and 22.4 micrograms per liter TCE, respectively. Deep-Well Construction Method 1 will be used to construct the monitoring well at location DZ1 because the clay is probably less than four (4) feet thick and the groundwater samples from the adjacent monitoring wells contained TCE. Thus, a permanent 8-inch steel casing will be installed through the first saturated zone and into the upper two feet of the first distinct clay at location DZ1.



TCE was not detected in ground-water samples from monitoring wells 122 and 222 at location DZ3. An 8-inch temporary override casing will be used through the first saturated zone and within the upper two feet of the first distinct clay at location DZ3. At locations DZ2/MW319 (Coliseum Boulevard) and DZ4/MW316 (Emory Folmar Boulevard) the first distinct clay beneath the water table is about 17 and 15 feet thick, respectively. TCE was not detected in a ground-water sample from monitoring well 219 at location DZ2. Ground-water samples from monitoring wells 116 and 216 at location DZ4 contained 8.7 and 12.8 micrograms per liter TCE, respectively. Deep-Well Construction Method 2 will used to construct the monitoring wells at locations DZ2, DZ3, and DZ4 because of the thickness of the first distinct clay (at least 15 feet) at these two locations. Thus, an 8-inch temporary protective override casing will be sonically driven into the upper 2 feet of the first distinct clay at locations DZ2, DZ3, and DZ4.

## Monitoring Well Identification

• All deep zone monitoring wells will be labeled with a 300-series number to indicate that they monitor the first zone of groundwater beneath the first distinct clay layer.

# Casing and Screen

- All casing and screen shall consist of two-inch diameter Schedule 40 flush-threaded PVC.
- The screen shall be five or 10 feet in length with a 0.01-inch slot size. The length of the screen shall be determined based on the results of the exploratory borings. If the interval of the second saturated zone is greater than 15 feet, a 10 foot screen will be used; however, if the second saturated zone interval is less than 15 feet, a five foot screen will be used to construct the well.
- The top of the screened interval shall be below the bottom of the <u>first</u> distinct clay and allow for sufficient spacing for the filter pack so that it does not extend to an elevation above the bottom of the first distinct clay.

## Well Protection

- Locking caps with lock and key.
- A two-foot by two-foot concrete pad with a new 8-inch or larger watertight flush mount manhole protector (shroud).



## Well Development

• After completion, the wells will be developed either by pumping or surge block methods until the turbidity of the purged water is less than 25 Nephelometric Turbidity Units (NTUs) or until the clarity of the water removed during development has stabilized.

## Surveying

• At each monitoring well location, a Professional Land Surveyor will survey the land surface and top of casing to the nearest 0.01 foot.

#### Schedule

• The deep exploratory borings and installation of the groundwater monitoring wells will begin on January 21, 2002. It is anticipated that the worked described in this addendum will be completed within three weeks of the start date.

**Table 1**. Casings for deep well construction based on thicknesses of the first distinct clay and the concentrations of trichloroethylene (TCE) in ground-water samples from monitoring wells.

Well ID	Location	Adjacent Well ID - TCE Concentration (μg/l) <sup>1</sup>	Depth to Clay <sup>2</sup> (ft BLS) <sup>3</sup>	Clay Thickness <sup>4</sup> (ft)	Double Casing Method
DZ1/MW 311	Christian Lab	MW 111 - 12.0 MW 211 - 22.4	82	3	Permanent - 8" Diameter Steel <sup>5</sup>
DZ2/MW319	Coliseum Boulevard	MW 219 - ND <sup>6</sup>	22	17	Temporary - 8" Diameter Override Casing <sup>7</sup>
DZ3/MW 322	ADEM	MW 122 - ND MW 222 - ND	58	2-4	Temporary - 8" Diameter Override Casing <sup>7</sup>
DZ4/MW 316	Emory Folmar	MW 116 - 8.7 MW 216 - 12.8	42	15	Temporary - 8" Diameter Override Casing <sup>7</sup>

Notes:

 $^{1}$  Concentrations expressed in micrograms per liter (µg/l)

<sup>2</sup> Depth to first distinct clay beneath water table

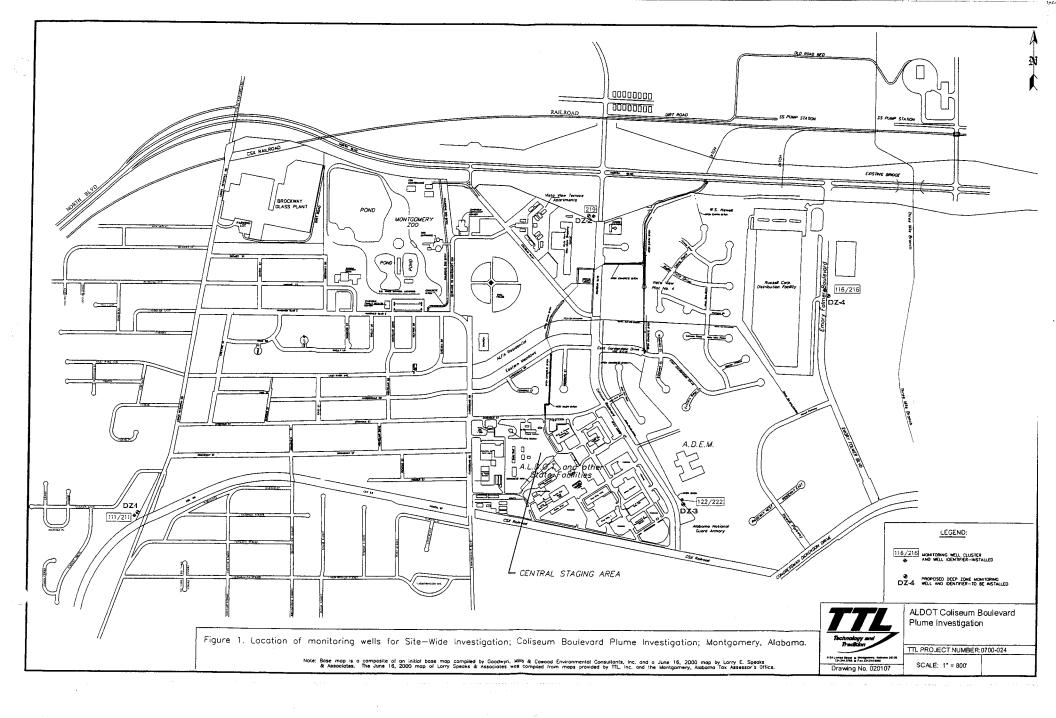
<sup>3</sup> ft BLS - feet Below Land Surface

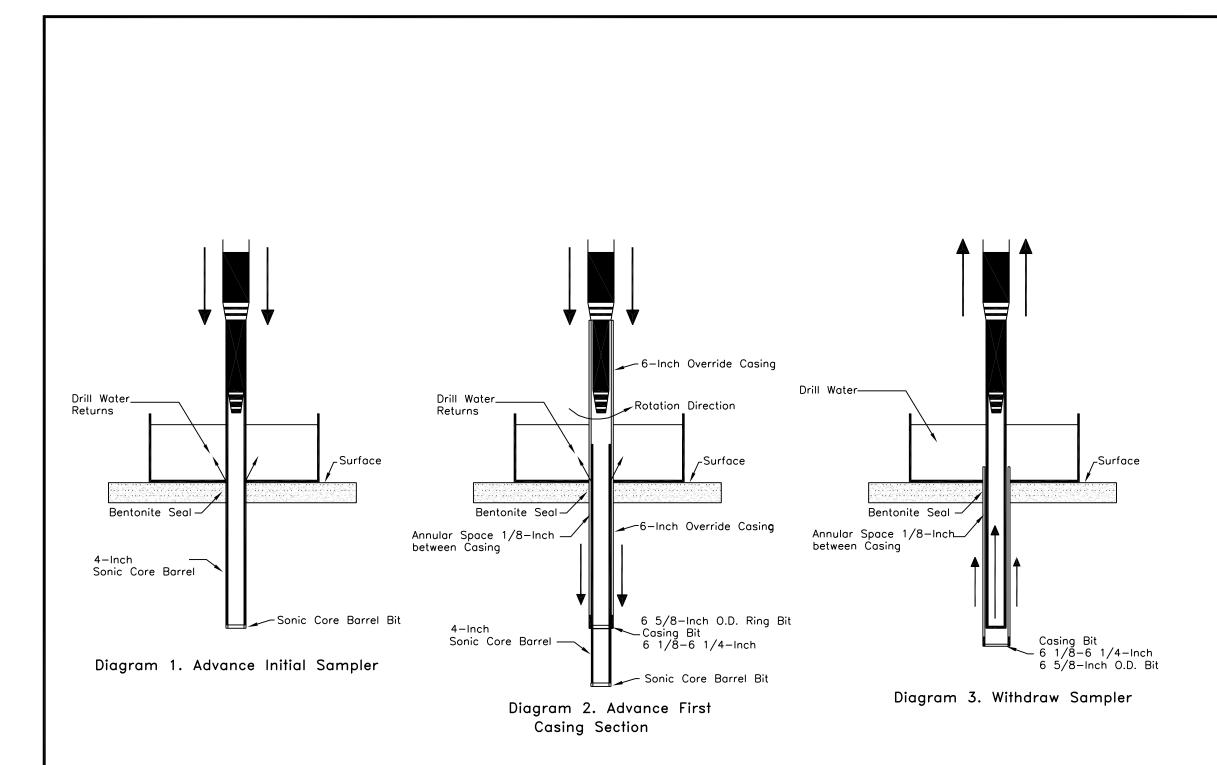
<sup>4</sup> Based on soil conductivity logs

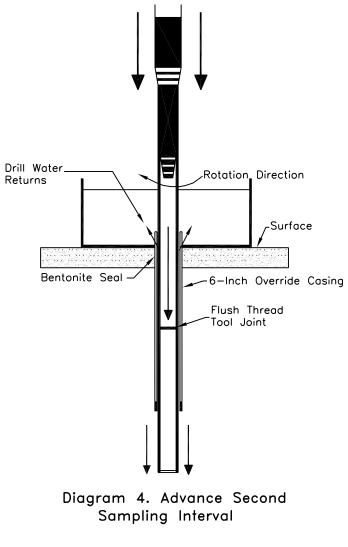
<sup>5</sup> See Diagram 10 (Figure 4)

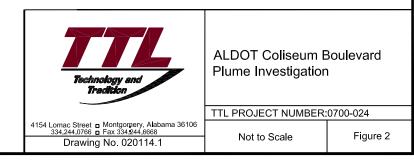
<sup>6</sup> ND - Not Detected

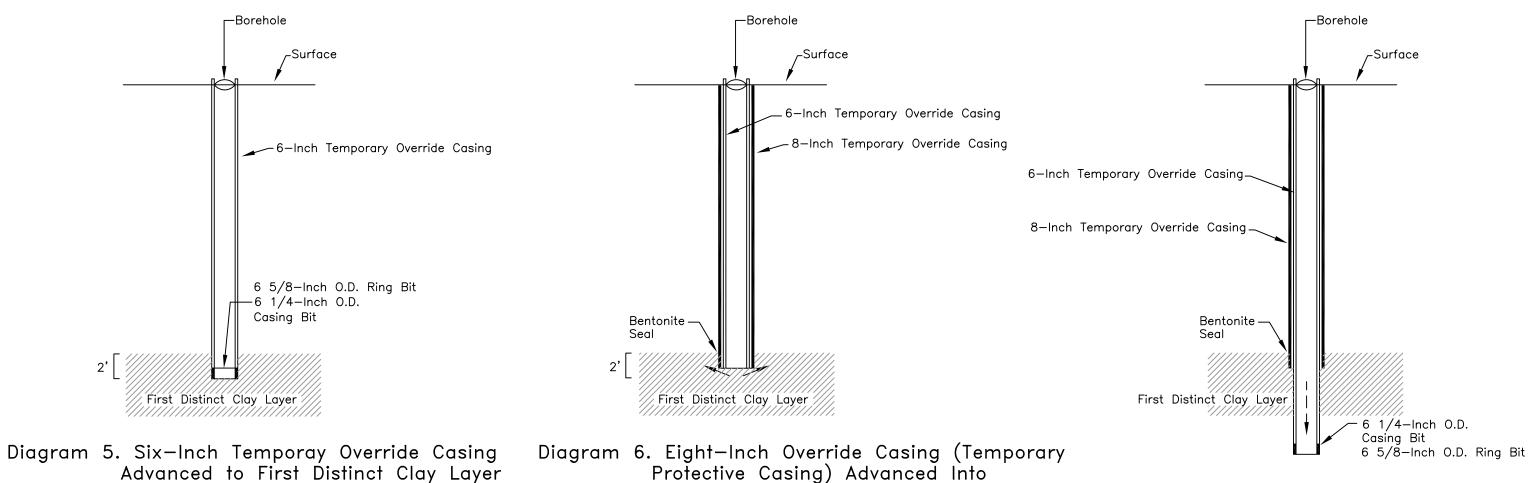
<sup>7</sup> See Diagrams 6 & 7 (Figure 3) and Diagrams 8 & 9 (Figure 4)





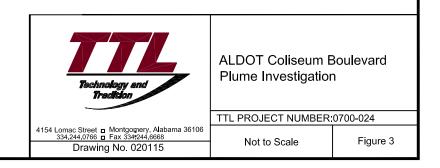


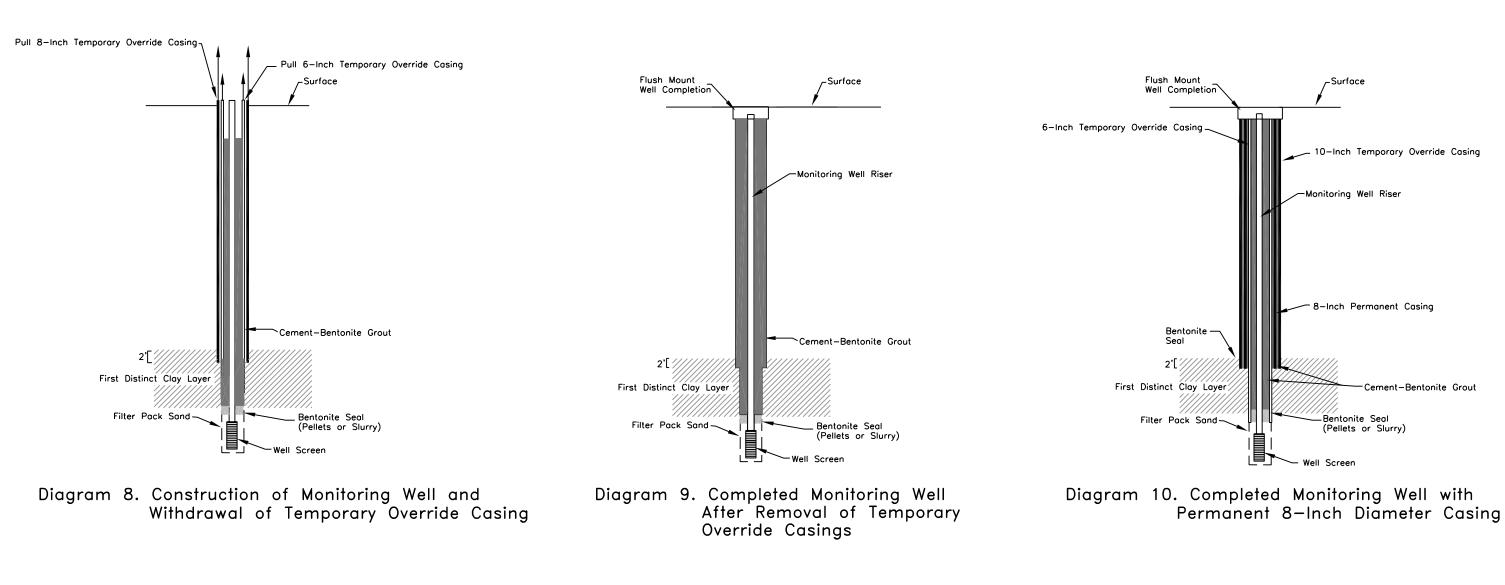


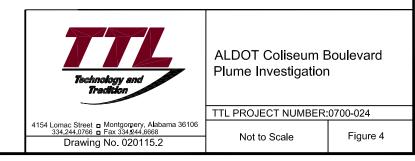


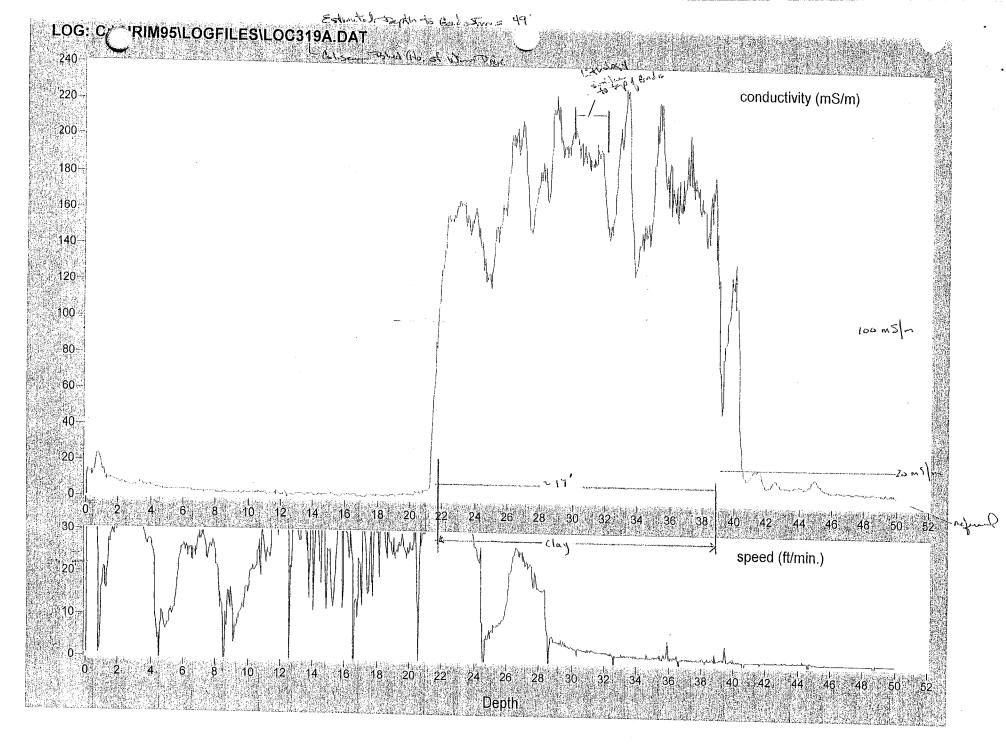
First Distinct Clay Layer

Diagram 7. Advance Six—Inch Temporary Overide Casing to Total Depth for Monitoring Well

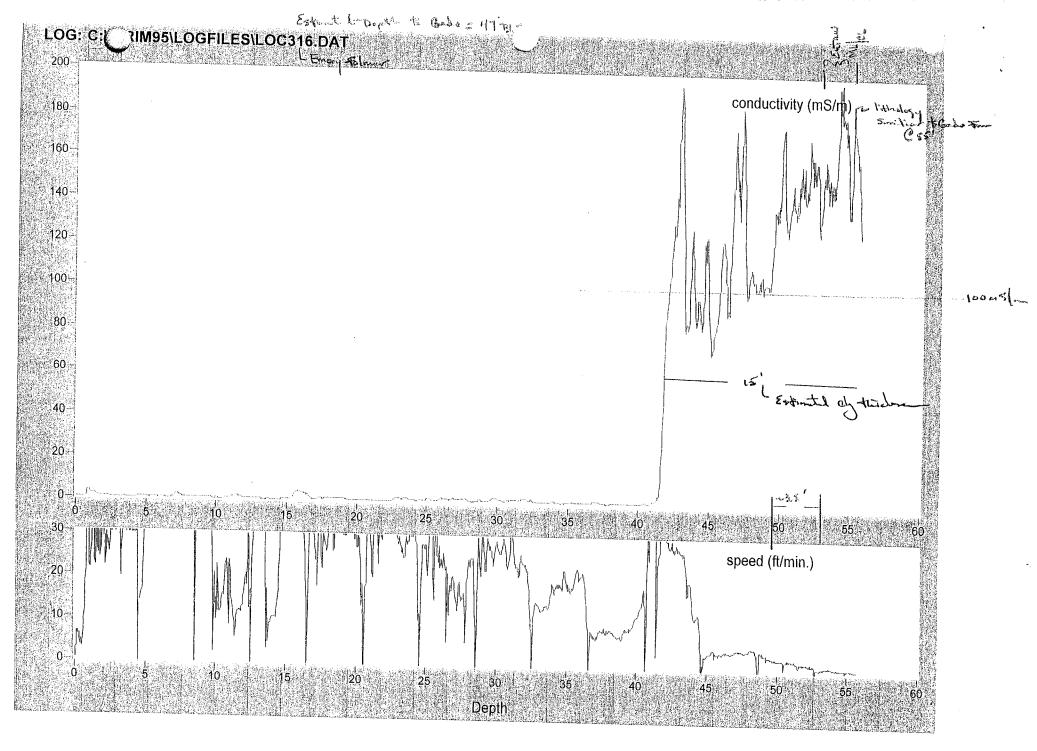




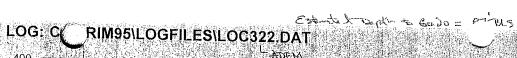


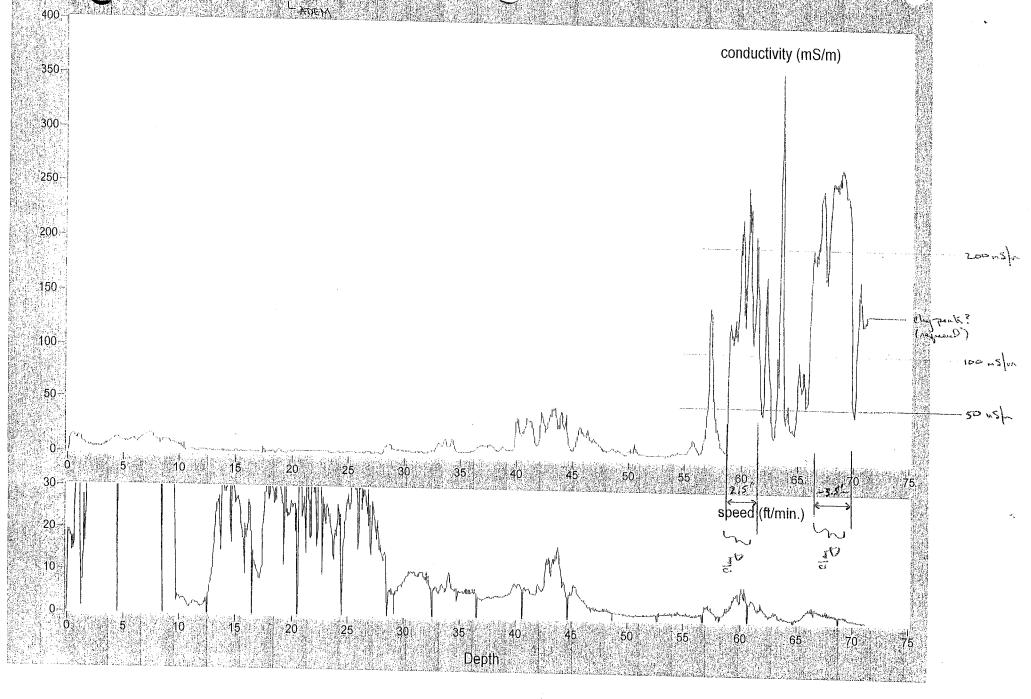


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