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Technical Memorandum #2, Environmental Management Disposal Facility Phase 1 Monitoring Oak Ridge, Tennessee

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Technical Memorandum #2, Environmental Management Disposal Facility Phase 1 Monitoring Oak Ridge, Tennessee

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ACRONYMS

amsl	above mean sea level
BCV	Bear Creek Valley
bgs	below ground surface
CBCV	Central Bear Creek Valley
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
D	Drainage
DOE	U.S. Department of Energy
DTW	depth to water
EC	electrical conductivity
EMDF	Environmental Management Disposal Facility
EMWMF	Environmental Management Waste Management Facility
EPA	U.S. Environmental Protection Agency
FLUTe™	Flexible Liner Underground Technologies, LLC
FS	Feasibility Study
FSP	Field Sampling Plan
NT	North Tributary
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation
SME	Subject Matter Expert
SU	standard unit
T	transmissivity
TDEC	Tennessee Department of Environment and Conservation
TDS	total dissolved solids
TM	Technical Memorandum
UPF	Uranium Processing Facility
USGS	U.S. Geological Survey
W	West

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EXECUTIVE SUMMARY

An estimated 2.2 million cubic yards of disposal facility capacity beyond what is already available in the existing Environmental Management Waste Management Facility (EMWMF) is needed for the disposal of wastes from continuing Comprehensive Environmental Response, Compensation, and Liability Act of 1980 cleanup actions on the Oak Ridge Reservation. Additional capacity will be provided by the Environmental Management Disposal Facility, which is proposed to be located in Central Bear Creek Valley (CBCV), approximately 1.5 miles southwest of the existing EMWMF (Fig. ES.1).

Characterization of the CBCV site began in February 2018 as described in the *Phase 1 Field Sampling Plan for the Proposed Environmental Management Disposal Facility for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal, Oak Ridge, Tennessee* (Field Sampling Plan) [U.S. Department of Energy (DOE) 2018a]. Technical Memorandum (TM) #1 was issued in July 2018 (DOE 2018b) describing the Phase 1 field activities that had been completed and presenting the surface water and groundwater data that had been collected over the first 90 days of monitoring through May 8, 2018, for groundwater and through June 4, 2018, for surface water. This document, TM #2, contains a full year of surface water and groundwater data through March 8, 2019, including that reported on in TM #1. These initial characterization results have confirmed the CBCV site is acceptable for a new, low-level waste landfill.

ES.1 SETTING

The CBCV site is located on the southern flank of Pine Ridge between two streams, North Tributary (NT)-10 and NT-11. A smaller stream at the site, Drainage (D)-10 West (W), is located just west of NT-10 (Fig. ES.2). The area is mostly forested, except for a cleared area with a large soil pile and two constructed wetlands for the Y-12 National Security Complex. The Haul Road and Bear Creek Road cross the southern edge of the site and will need to be rerouted prior to CBCV site construction.

The proposed landfill would overlie steeply angled bedrock consisting of shales, siltstones, and mudstones with some limestone layers. Recent stream deposits are present on the valley floors, particularly along D-10W at the eastern side of the site. Karst features, such as sinkholes, sinking streams, and resurgent springs, are not present beneath the proposed footprint of the CBCV site, but are present along Bear Creek south of the site.

Precipitation primarily runs off as surface water and shallow groundwater in the stormflow zone. During the summer/fall growing season, the streams within the CBCV site may dry up, although there is still flow during significant rainfall events. However, there is continuous surface water flow in Bear Creek located south of the proposed landfill.

ES.2 PHASE 1 INVESTIGATION APPROACH AND RESULTS

Bear Creek Valley (BCV) has been extensively investigated and monitored over the years, although not specifically at the proposed CBCV location. The Phase 1 investigation has provided site-specific information for the proposed CBCV site.

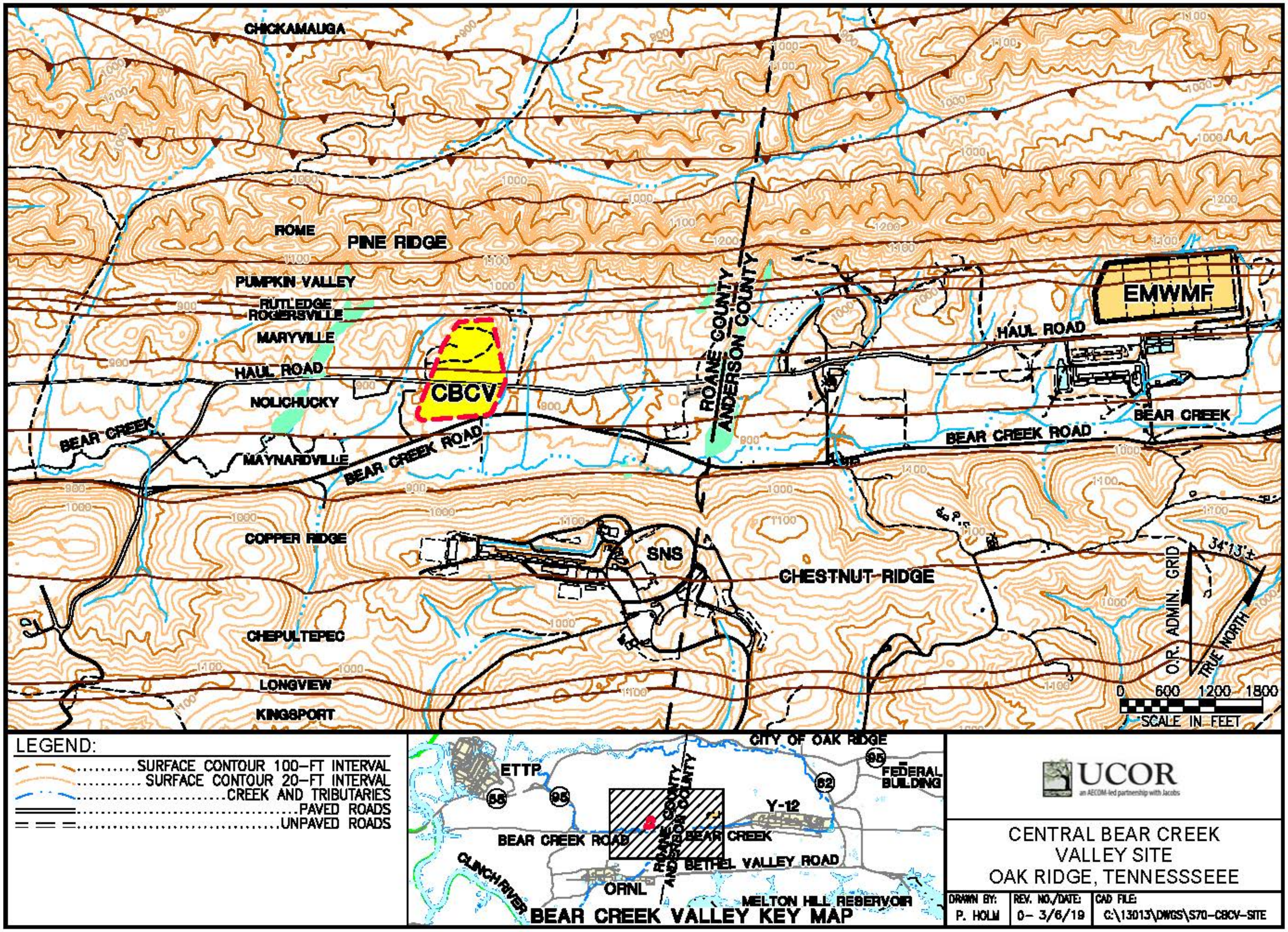


Fig. ES.1. Location of the proposed CBCV site.

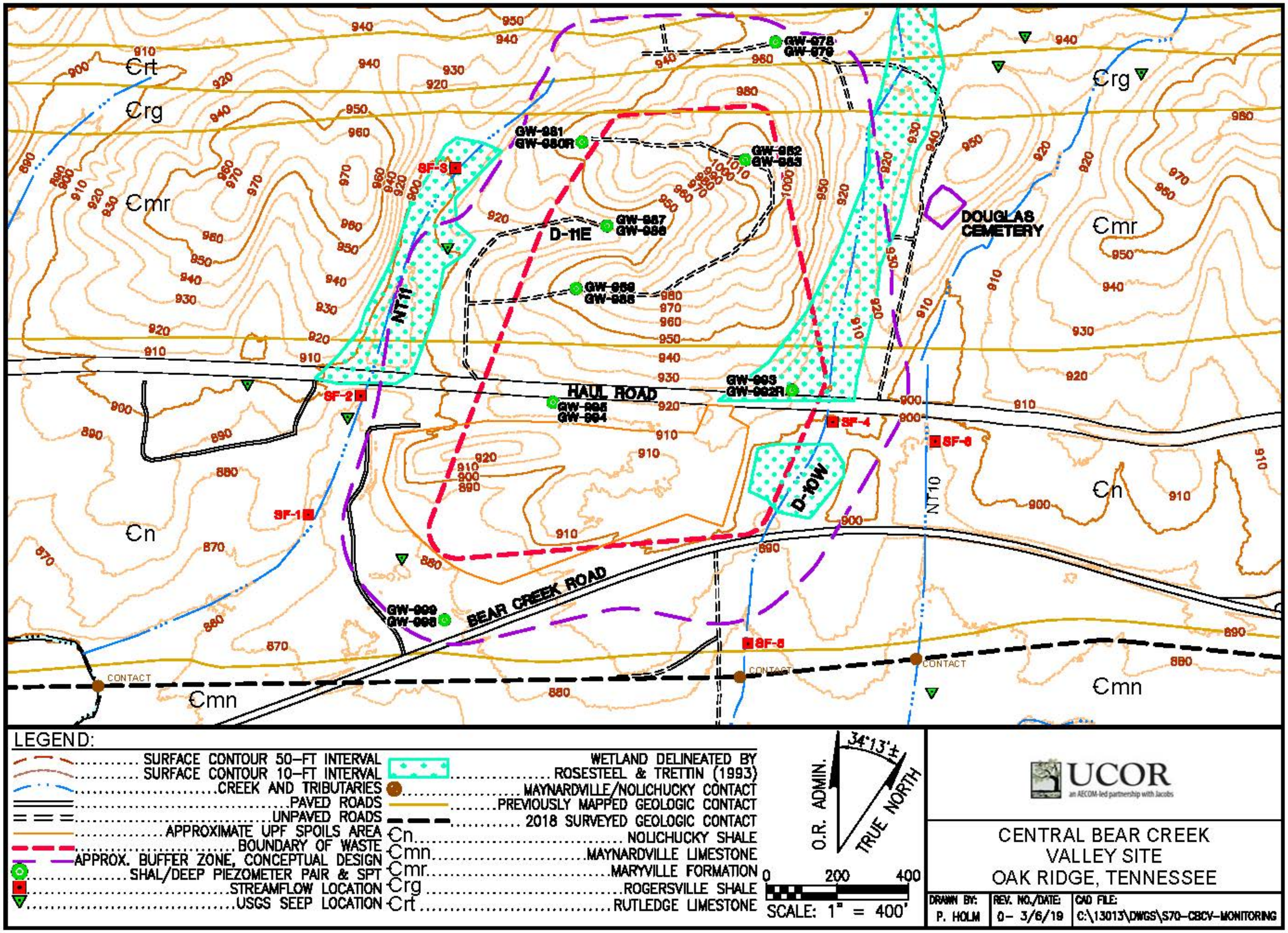


Fig. ES.2. Monitoring locations at the CBCV site.

The investigation approach for the CBCV site was developed in cooperation with the U.S. Environmental Protection Agency and Tennessee Department of Environment and Conservation (TDEC). The characterization effort consisted of the following tasks:

- Perform surface water walkdowns to continue to evaluate streams and identify seeps, springs, and other expressions of shallow groundwater.
- Locate the contact with the Maynardville Limestone, the type of bedrock most prone to contain karst features.
- Monitor surface water flow by utilizing flumes installed to measure flow, and select water quality parameters in NT-10, D-10W, and NT-11.
- Drill and install piezometers to measure groundwater surfaces and to obtain detailed subsurface information. Measure piezometric surfaces/elevations and select water quality parameters in Phase 1 piezometers.
- Test subsurface materials to obtain design data to develop the engineering design for the proposed landfill.

The acquired data are used to verify the CBCV site is appropriate for siting a landfill and will be used to develop the engineering design.

ES.2.1 Surface Water Walkdown

Two detailed site walkdowns were performed during the wet season (January 30 and February 27, 2018) to further characterize surface geology and hydrology; identify geotechnical areas of interest; and identify seeps, springs, and other expressions of shallow groundwater (Fig. ES.2). Three additional walkdowns, representing drier conditions (May 1, June 4, and October 10, 2018) were also completed to further characterize surface water hydrology; monitor geotechnical areas of interest; and confirm and monitor seeps, springs, and other expressions of shallow groundwater that had been identified during previous walkdowns. TDEC personnel participated in all of the surface water walkdowns.

Field data collected during the walkdowns are provided in Appendix A. In general, pH and specific conductivity of the surface water in these tributaries increase from north to south. Temperature remains relatively consistent throughout each tributary with minor fluctuations.

ES.2.2 Locate the Maynardville Limestone

The Maynardville Limestone is the type of bedrock most prone to contain karst features in BCV. The contact between the Maynardville and Nolichucky Shale was previously mapped by a regional investigation about 300 ft south of the planned landfill footprint. The January 2018 surface walkdown with Subject Matter Experts (SMEs) and TDEC geologists examined this location and revised the Maynardville Limestone contact in CBCV based on observations within NT-10 and D-10W streambeds. The contact location within the NT-11 streambed was found later by the same SME. The contact was confirmed to be approximately 50 ft further south of the proposed landfill location than was originally mapped (Fig. ES.2).

ES.2.3 Determine Surface Water Flow

Six surface water flow measurement stations have been installed at the CBCV site to determine surface water flow along the stream channels of NT-10, D-10W, and NT-11 (Fig. ES.2). The stations were placed to evaluate surface water flow, particularly close to the proposed landfill location. TDEC personnel participated in the initial walkdown and discussion to determine flume placement.

Three flumes were installed along NT-11, two along D-10W, and one at NT-10 (Fig. ES-2). The flumes were sized to accommodate the reasonably expected flow rates based on historical information and additional field observations. The flumes were equipped to measure surface water flow, pH, specific conductivity, and temperature at 30-min intervals. These data are automatically recorded and downloaded by characterization personnel every two weeks for one year. The surface water flow data will be used to design surface water controls for the landfill.

As expected, flow rates generally increase downstream, from north to south, and increase quickly in response to rainfall. The maximum flow rates were recorded on February 23, 2019, when the Y-12 National Security Complex area received from 4 to 5 in. of rainfall during a wet period in February 2019. Minimum to no flow rates were observed at all flumes during dry periods.

ES.2.4 Drill and Install Piezometers

Eight pairs of bedrock and shallow piezometers were installed within the proposed landfill area to monitor the shallow and intermediate piezometric surface within the cell boundary (Fig. ES.2). First, boreholes were drilled and sampled using split-spoon samplers from the surface through the complete soil column to obtain soil samples and geotechnical data, and once rock was encountered, the boreholes were cored to the total depth to obtain representative rock cores. These cores were photographed and described at the drill site. Next, subsurface testing was conducted in the bedrock holes to estimate the hydraulic properties. Piezometers were constructed with well screens placed to monitor groundwater bearing zones.

Following piezometer construction, the shallow piezometers were tested to estimate the hydraulic properties. After testing was completed, downhole monitors were installed to measure piezometric surface, temperature, pH, and specific conductivity at 30-min intervals. In general, the CBCV site wells show typical fluctuations in specifc conductivity and pH in response to precipitation events. Piezometric surface data show responses to precipitation events, as would be expected, with more subdued responses at the well pairs located at the higher elevations (i.e., GW-980R/GW-981 and GW-982/GW-983).

This TM includes a full year of data from the continuous monitoring of these 16 piezometers from March 2018 to early April 2019. Monitoring of the CBCV site piezometric surface is expected to continue for at least one more year for continued evaluation in the design of a disposal facility at the CBCV site.

ES.2.5 Test Subsurface Materials

The laboratory testing program was directed toward determining the general soil classification, physical properties, shear strength, and compressibility of the soil for the engineering analysis and design of the CBCV site. Limited permeability testing was also conducted on both relatively undisturbed samples (tube samples) and from recompacted bulk samples taken during piezometer drilling. All laboratory testing was performed in accordance with applicable American Society for Testing and Materials standards. In total, 18 thin-walled (i.e., Shelby tube) samples, 69 split-spoon soil samples, 10 bulk soil samples, and 10 rock core samples were shipped to laboratories for testing. Appendix E provides the laboratory reports for geotechnical laboratory testing. The collected data will be used to develop the engineering design.

ES.3 PHASE 1 CHARACTERIZATION CONCLUSIONS

Results of the Phase 1 site monitoring continue to validate acceptability of the CBCV site for a new, low-level waste landfill and support final site selection based on the following conclusions.

Walkdowns confirmed the location of existing seeps and did not locate additional seeps in the CBCV area. The contact with the Maynardville Limestone was located approximately 50 ft further south of the currently proposed CBCV footprint than previously mapped.

Precipitation primarily runs off as surface water and as shallow groundwater in the stormflow zone. Site walkdowns conducted in January, February, May, June, September, and October 2018 found numerous cases where surface water entered and exited the soil through decayed trees and other types of features. Flumes record higher stream flows following precipitation, indicating that a large portion of precipitation is running off as stormwater. Flow rates rapidly decrease when precipitation is over, indicating a smaller influence from groundwater.

Piezometric surface elevations are typical of other BCV wells in similar settings and were similar to the piezometric surface elevations predicted in the Remedial Investigation/Feasibility Study (DOE 2017). Piezometric surface elevations measured in both intermediate and shallow piezometers during the Phase 1 characterization confirmed that the piezometric surface generally mirrors topography (i.e., is higher topographically beneath knolls/ridges and lower near the tributaries). The piezometric surface responds to rainfall events, indicating recharge is occurring on the site.

Evaluation of the downhole and surface water data in the CBCV site knoll area determined that the primary groundwater flow gradients are lateral and towards the nearby drainages. Strong upward gradients within the knoll area which could affect the landfill are not present.

1. INTRODUCTION

The mission of the U.S. Department of Energy (DOE) Oak Ridge Office of Environmental Management is to decommission and demolish numerous facilities and conduct remedial actions under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) on the Oak Ridge Reservation (ORR) in Oak Ridge, Tennessee. This effort requires an estimated 2.2 million cubic yards of landfill disposal capacity beyond what is available in the existing Environmental Management Waste Management Facility (EMWMF) for the disposal of wastes from CERCLA cleanup actions. The *Remedial Investigation/Feasibility Study for the Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal, Oak Ridge, Tennessee* (RI/FS) [DOE 2017], evaluated several alternatives for the disposal of this waste, including no action, off-site disposal, and on-site disposal.

The proposed Central Bear Creek Valley (CBCV) site on the ORR is located approximately 1.5 miles southwest of the existing EMWMF. The approximately 70-acre tract was identified as the best alternative for development of the disposal facility based on available capacity and location (Fig. 1.1). The Phase 1 site characterization activities are focused on the CBCV site.

The Phase 1 site characterization activities have been ongoing since January 2018. All activities are conducted in accordance with the *Phase 1 Field Sampling Plan for the Proposed Environmental Management Disposal Facility for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal, Oak Ridge, Tennessee* (Field Sampling Plan [FSP]) [DOE 2018a], which includes the project-specific Quality Assurance Project Plan (QAPP). The QAPP identifies the procedures that are to be followed in the collection, custody, sample handling, data management, and quality control activities for all anticipated CBCV investigation activities.

The objective of Phase 1 site characterization of the proposed CBCV site was to validate key assumptions regarding the hydrogeologic setting (groundwater and surface water conditions) at the site. These key assumptions were validated and were used to confirm the acceptability of the CBCV for a new, low-level waste landfill and to support a final site selection. The key validated assumptions for the Phase 1 characterization are:

- Geology is typical of Bear Creek Valley (BCV) with steeply dipping, fractured bedrock, and there are no major karstic features in the Maryville, Nolichucky, or Rogersville formations underlying the CBCV site.
- The contact with the Maynardville Limestone is located south of the proposed CBCV footprint.
- Precipitation primarily runs off as surface water and shallow groundwater in the stormflow zone.
- Potentiometric surface elevations are typical of other BCV wells in similar settings.
- Water level extrapolations presented in Technical Memorandum (TM) #1 (DOE 2018b) based on other BCV wells are found to be relatively consistent with observations at the CBCV site.

This TM #2 presents the additional data collected during the continued monitoring of the CBCV site since TM #1 was issued. Also included in this TM is the analysis of the data in relation to the geologic and hydrologic properties associated with the CBCV site. All of these data have been provided to the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and

Conservation (TDEC). The data are available as text files on the DOE Oak Ridge Environmental Information System (http://oreis.ettp.energy.gov).

The hydrologic data presented herein must be considered within the context of the climatological conditions for the period of record. Figure 1.2 shows the average annual precipitation for the years from 1989 to 2018. Also shown is the 30-yr average precipitation from 1981 to 2010 as reported on the Oak Ridge National Laboratory (ORNL) meteorology webpage (https://metweb.ornl.gov/page5.htm). These data are based on the National Oceanic and Atmospheric Administration records for Oak Ridge, Tennessee, and available on the ORNL meteorology webpage (https://metweb.ornl.gov/page5.htm). Calendar year 2018 was one of the wetter years of record for the Oak Ridge area, and nearly 9 in. above the 1981 to 2010 30-yr average. A total of 64.73 inches of precipitation was recorded at the Y-12 Tower W station for calendar year 2018. The wet conditions continued throughout the 1-yr monitoring period of record for TM #2. The wet conditions are demonstrated by the total precipitation of 73.15 inches recorded at Tower W over the monitoring period of March 2018 through February 2019.

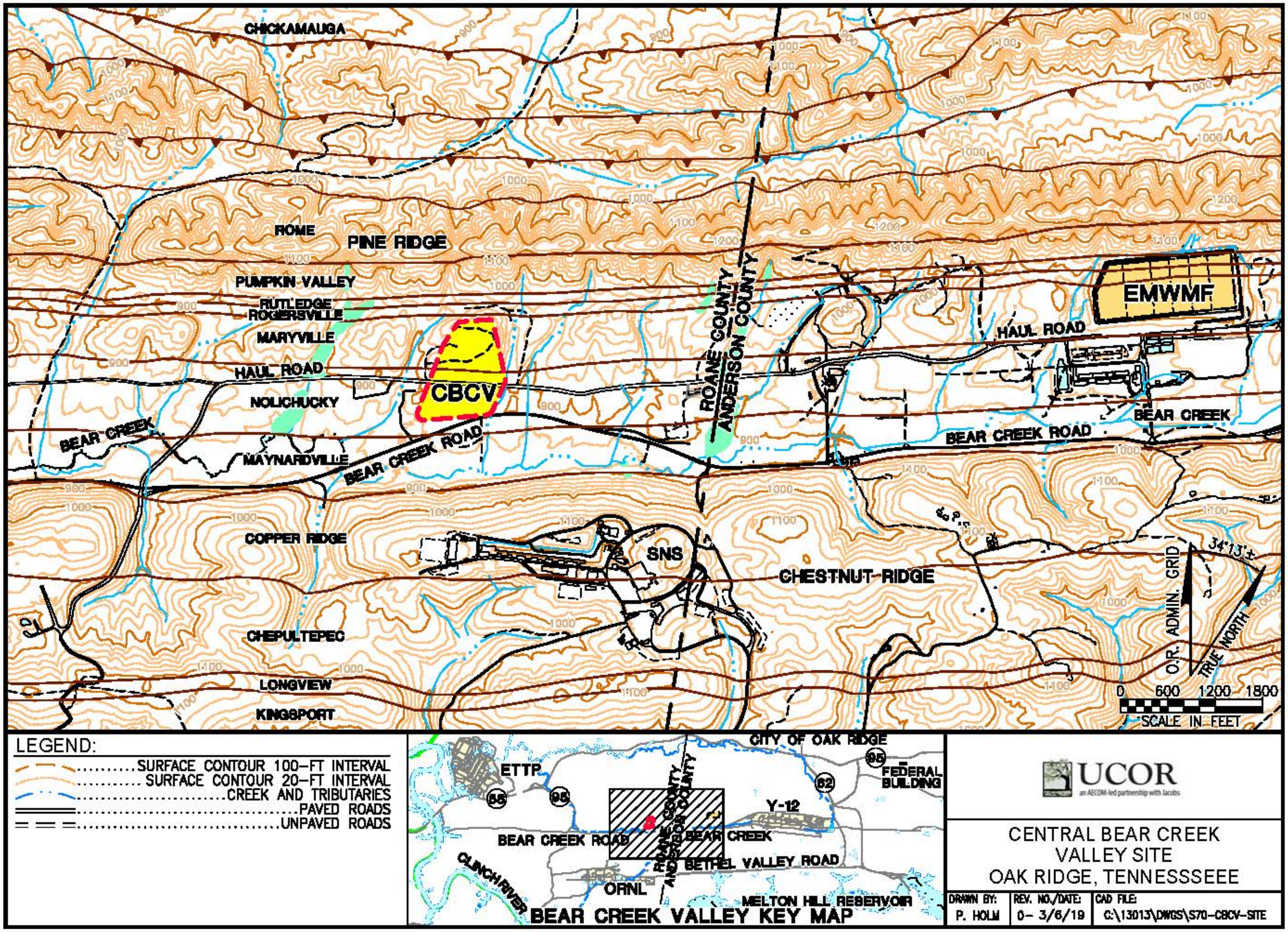
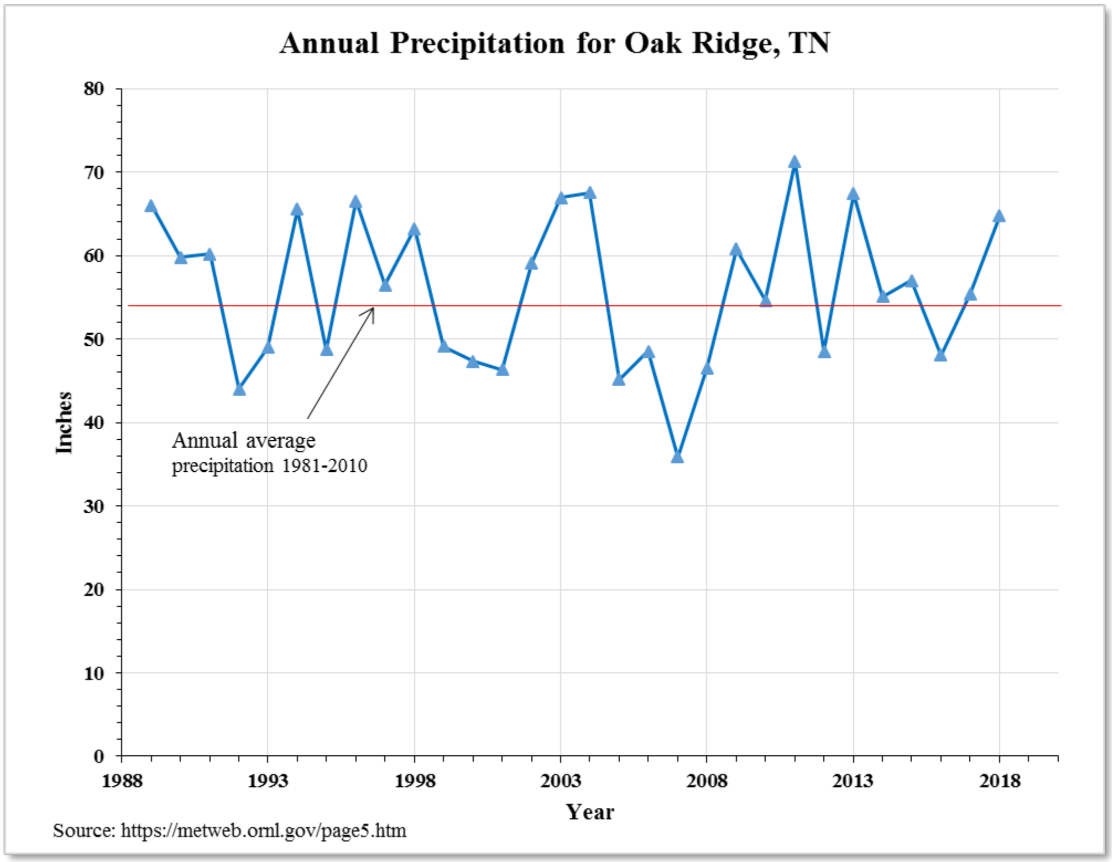


Fig. 1.1. Location of the proposed CBCV site.



Source: https://metweb.ornl.gov/page5.htm

Fig. 1.2. Annual precipitation records for Oak Ridge, TN.

2. BACKGROUND

2.1 GENERAL SITE LOCATION

The CBCV site is situated within an upland area located between north–south trending valleys of North Tributary (NT)-10 and NT-11 in BCV. The southern boundary of the site extends to just north of Bear Creek Road (Fig. 2.1). The site and surrounding areas are forested, except for areas along the south side between the Haul Road and Bear Creek Road, where the area has been cleared. The cleared area includes a recent soil staging area along the southern margin and two wetland basins completed in 2015 for the Y-12 National Security Complex compensatory wetland mitigation. The Haul Road and Bear Creek Road are located at the southern edge of the site and will need to be rerouted prior to CBCV site construction.

The larger surface water conveyances within the site are Drainage (D)-10 West (W), parallel to and just west of NT-10, and D-11 East (E), an east–west trending feature that drains westward into NT-11 near the center of the site (Fig. 2.1). An additional shallow east–west trending drainage was present in the southern part of the area prior to construction of the Uranium Processing Facility (UPF) wet spoils pile. This drainage was noted as dry when observed prior to the Phase 1 investigation, and is now covered by the UPF wet spoils pile; however, there was a seep within this drainage area downgradient of the wet spoils pile that is now covered by a sediment basin. (Note: The figures in this TM illustrating a disposal facility boundary have used the boundary information from the 2017 RI/FS.)

The BCV has been extensively investigated over the years. Geologic, hydrogeologic, and groundwater contamination conditions have been characterized, and there is routine monitoring of surface water conditions and groundwater conditions in specific areas. In addition, other investigations have been conducted to identify wetlands, ecological species of concern, and cultural resources. This Phase 1 site characterization provides additional site-specific hydrogeologic information for the proposed CBCV site. The monitoring that is being reported in this TM is a continuation of the Phase 1 site characterization, which was initially provided in TM #1.

2.2 HYDROGEOLOGY

The available hydrogeologic data for various potential disposal sites in BCV are described in the RI/FS (DOE 2017). The general subsurface hydrogeological conditions at the CBCV site are known from previous characterization performed of the BCV watershed summarized in the *Groundwater Strategy for the U.S. Department of Energy, Oak Ridge Reservation, Oak Ridge, Tennessee* (DOE 2014).

The CBCV site overlies bedrock formations of the Conasauga Group (Fig. 2.2), which include (from oldest to youngest): Pumpkin Valley Shale, Rutledge Limestone (Friendship Formation), Rogersville Shale, Maryville Limestone (Dismal Gap Formation), Nolichucky Shale, and Maynardville Limestone. The bedrock formations consist predominantly of shales, siltstones, and mudstones, with some interbedded limestones. There is little limestone present in the bedrock lying directly beneath the proposed CBCV site, even in the Maryville Formation. There are no major karstic features in the formations underlying the CBCV site (DOE 2018b). Detailed descriptions of the geologic units that make up the Conasauga Group can be found in *Status Report on the Geology of the Oak Ridge Reservation* (Hatcher et al. 1992).

In BCV the average dip of the bedrock formations is approximately 45°, to the southeast (Fig. 2.3); a similar dip was assumed for the formations lying directly underneath the CBCV site. Folds and fractures are present within the bedrock and exert substantial control on the location of the tributaries to Bear Creek. The fractures and macro/micropores within the remaining soils/saprolite and bedrock provide the primary routes for groundwater flow (and contaminant transport) as documented in the *2016 Remediation Effectiveness Report for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee* (DOE 2016). A key assumption was that the geology is typical of BCV with steeply dipping, fractured bedrock, and there are no major karstic features in the Maryville, Nolichucky, or Rogersville formations underlying the CBCV site.

Thin layers of alluvial and colluvial soils may be present along streams, drainage ways, and the base of steeper slopes. These soils may be looser, more compressible, and more permeable than the underlying residual soils or saprolite. As noted in *Geology of the West Bear Creek Site* (ORNL 1989):

> "The soils are underlain by a comparatively thick saprolite zone which varies from 10 to 20 ft thick. The saprolite is composed of weathered bedrock which has lost its rock cement but retained its bedding features. Its upper portions can be readily penetrated with a hand auger. The saprolite/bedrock contact is gradational due to decreasing weathering with depth but is typically defined as the depth of machine auger refusal."

The saprolite zone includes all materials that overlay unweathered (competent) bedrock, corresponding to the overburden in engineering terminology. Depending on the site topography and local conditions, the saprolite zone at the Environmental Management Disposal Facility (EMDF) site may include surficial soils (organic-rich topsoil and clayey residual subsoils), colluvium and alluvium along flanks and floors of the NT valleys, and the underlying saprolite, which is bedrock that has been completely chemically weathered but remains otherwise undisturbed. Saprolite transitions to less weathered or unweathered bedrock. For practical purposes, the depth of the saprolite zone may be considered as auger refusal drilling depth, which typically ranges from 10 to 30 ft, but can exceed 50 ft in some locations. Saprolite retains the fabric and structure of the parent sedimentary rocks, including fracture sets. Beneath the saprolite zone lies a bedrock zone that comprises less weathered and fractured bedrock. In general, the degree of weathering, average aperture and density of fractures, porosity, and permeability decrease with increasing depth below the surface. Materials near the saprolite-bedrock boundary are transitional and can include less weathered rock fragments (mostly shale and siltstone) in a fine-grained saprolite matrix.

The thin topsoil layer of organic-rich soil varies from a few inches to < 1 ft thick. The zone of fine-grained residual soil varies from < 2 ft up to 10 ft in thickness. The thickness of these intervals and the underlying saprolite varies, and downward transition from one to the next may be rapid, or gradual, depending on the topographic position and history of profile development. Pore structure within the clayey residuum reflects surface soil formation processes, including macropore structures related to root growth and bioturbation (e.g., earthworm activity). Structural features of the underlying saprolite reflect the bedding and fracture geometry of the parent sedimentary rocks. As documented in Driese et al. 2001, there is extensive filling in saprolite fractures at the base of the residual soil due to translocation of clays. These clays and associated iron and manganese deposits contribute to the decrease in permeability with depth within the regolith.

Along the valley floors of Bear Creek tributaries, the soil and saprolite upper portion of the subsurface profile may be replaced with alluvial sediment deposits that vary in width and thickness. Colluvial deposits may occur along the lower slopes of these valleys. A thicker belt of alluvial deposits occurs within the floodplain of BCV. Colluvial or alluvial deposits also may occur in places outside of the current stream valleys as demonstrated by detailed site soil surveys completed for a waste disposal demonstration project in West Bear Creek Valley [Lietzke et al. 1988].

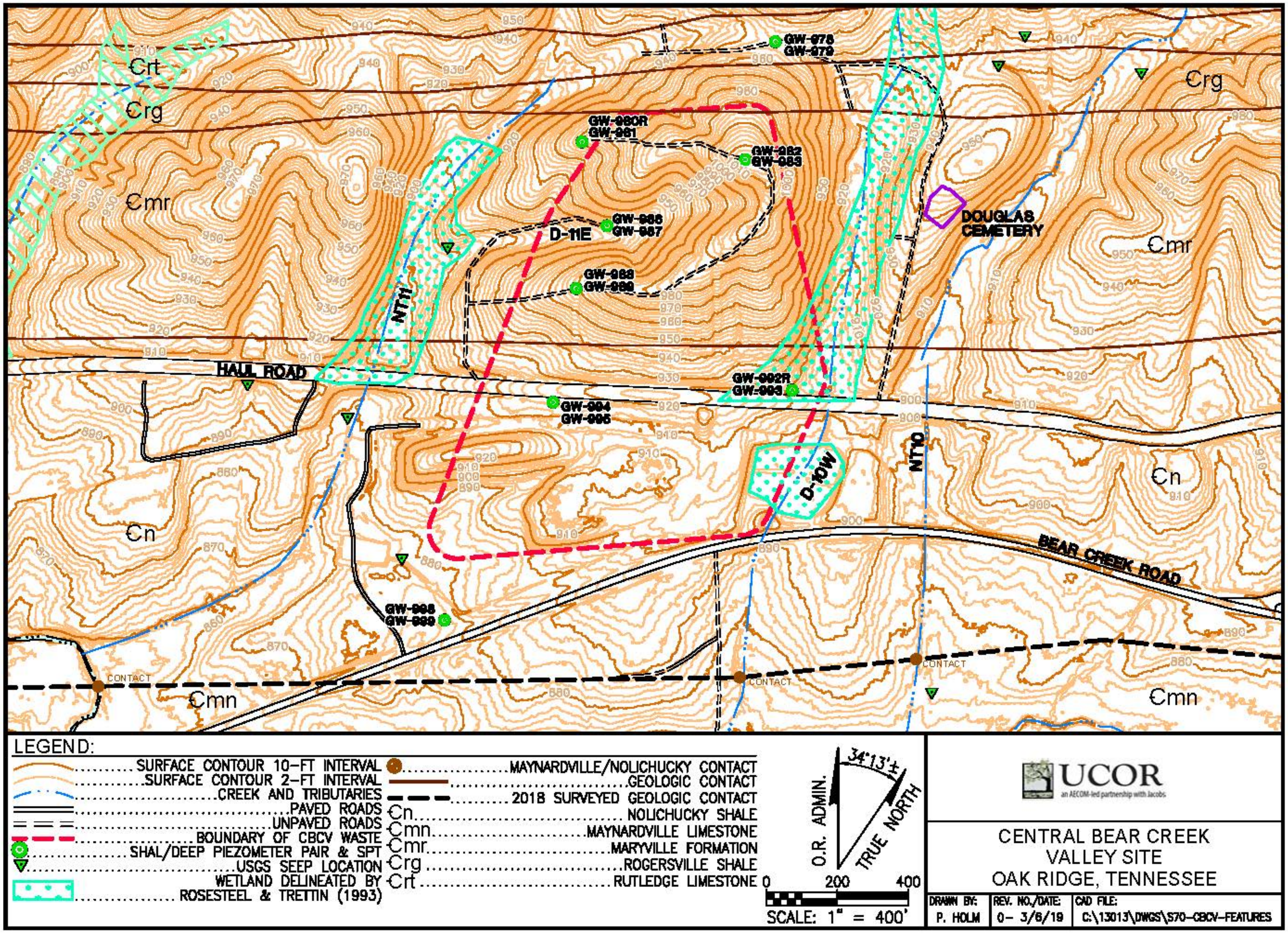


Fig. 2.1. General features of the CBCV site.

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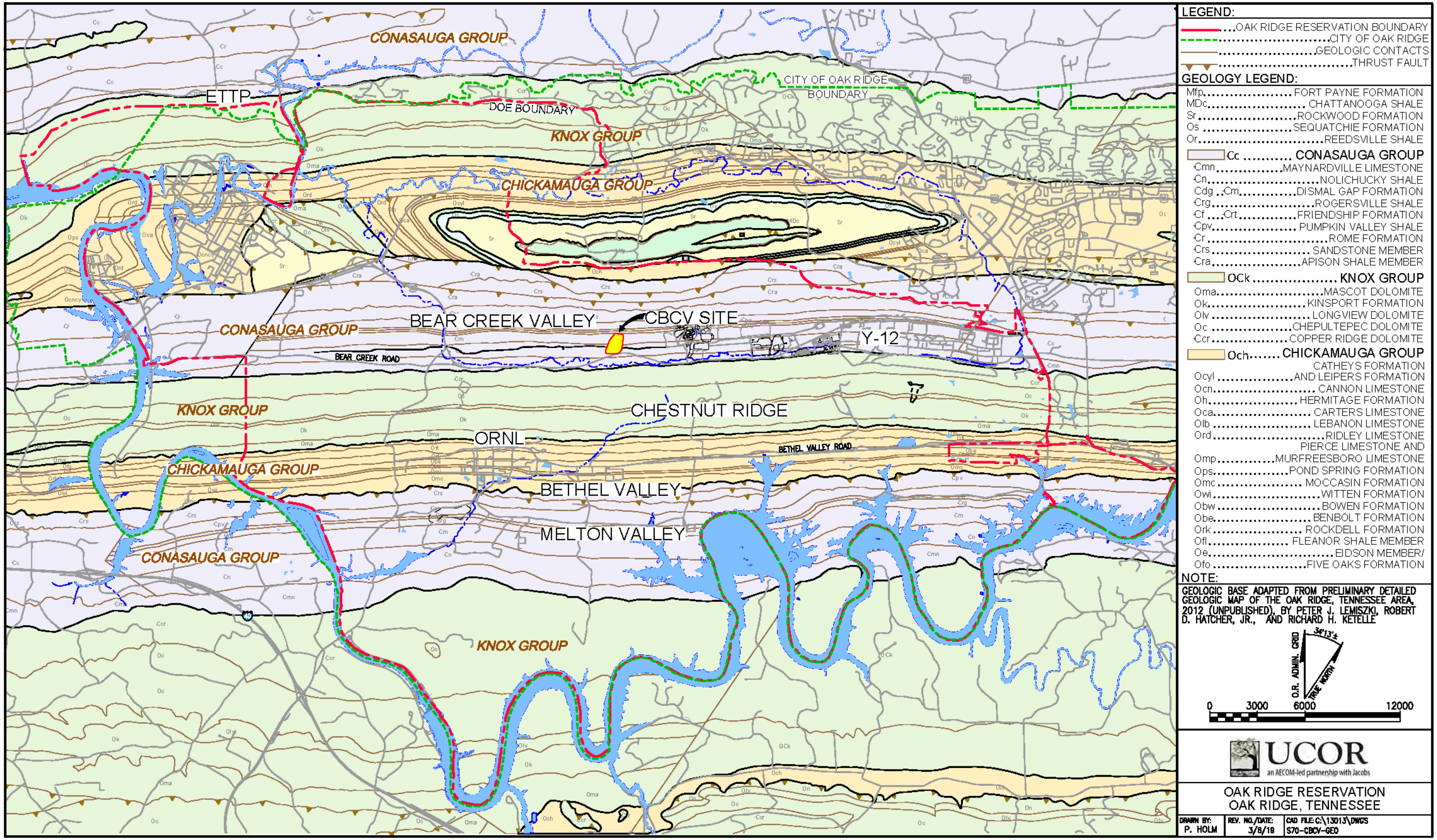

Fig. 2.2. Geologic map of CBCV and the surrounding area.

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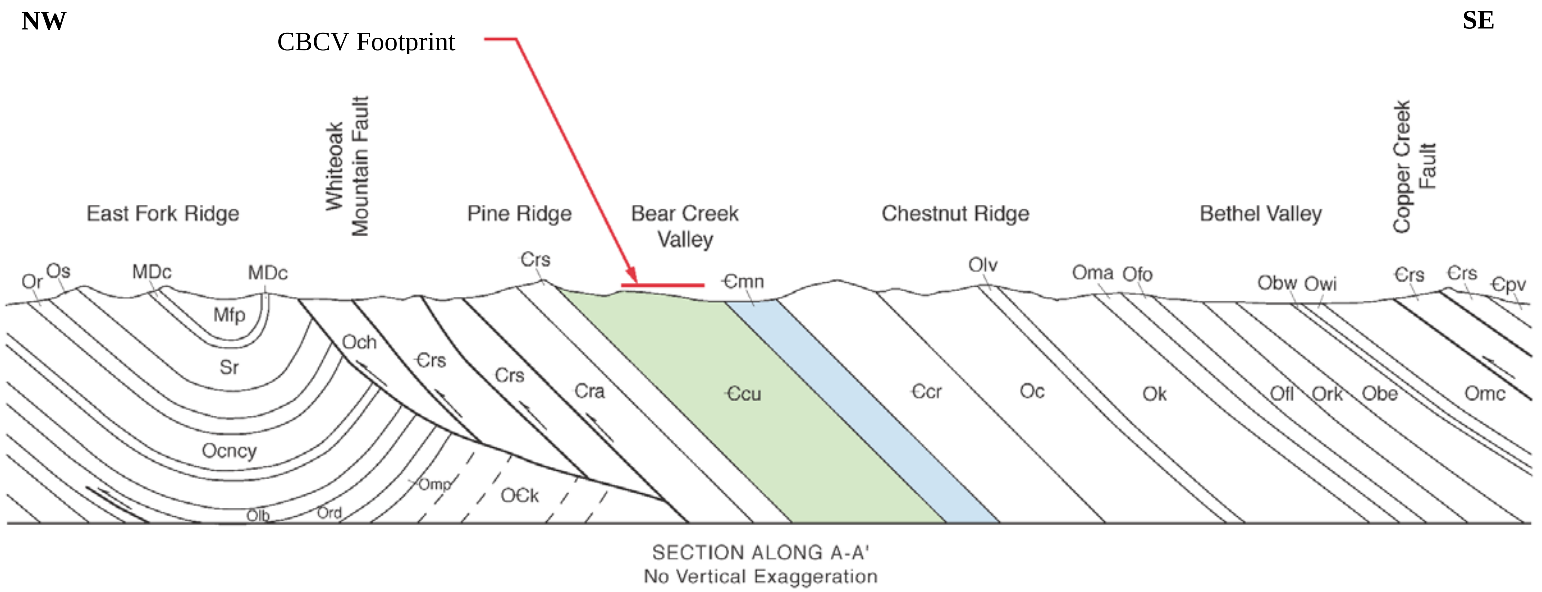


Cra/Crs – Lower Cambrian Rome Formation; Apison Shale Member and Sandstone Member.
Ccu – Middle Cambrian Conasauga Shale Undivided (including the Nolichucky Shale).
Cmn – Upper Cambrian Maynardville Limestone.
Ccr – Upper Cambrian Copper Ridge Dolomite.

Fig. 2.3. General geologic cross-section of the CBCV site.

2.3 SURFACE WATER HYDROLOGY

The CBCV site surface water systems are fed by precipitation, surface runoff and shallow stormflow, and both shallow and deeper groundwater that discharges via springs and seeps (DOE 2018b). In areas underlain by Conasauga Group shales, as much as 90 percent of the water entering the groundwater system flows rapidly through highly porous, shallow soil. In areas underlain by soluble, massive carbonate bedrock of the Maynardville Limestone, a larger percentage of the available water enters the groundwater system by conduit flow through deeper flow pathways (DOE 2016). A key assumption for the CBCV site was that precipitation primarily runs off as surface water and shallow groundwater in the stormflow zone.

Historical continuous flow monitoring data were not previously available for NT-10, NT-11, or D-10W. The available U.S. Geological Survey (USGS) base flow data indicated that base flow was present along the NT-10, D-10W, and NT-11 stream channels during the winter/spring non-growing wet season. During the summer/fall growing season with warm and often dry conditions, base flow is negligible and limited to pulsed flow associated with significant storm rainfall events. Flow monitoring for Bear Creek downstream of the CBCV site indicates continuous flow in Bear Creek (DOE 2017).

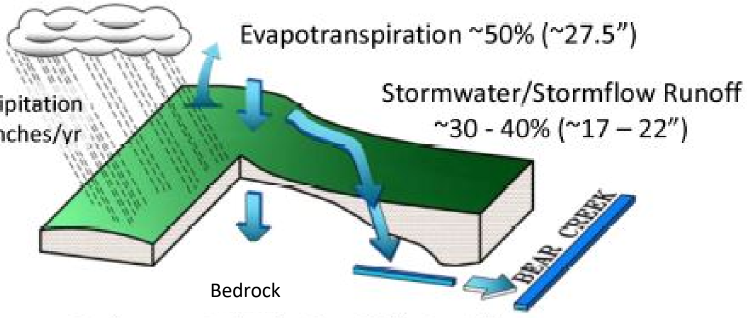
2.4 GROUNDWATER

The BCV RI (DOE 1997) provided the first comprehensive assessment of the environmental setting and hydrogeological conceptual model encompassing the entire length of BCV. The report incorporates the hydrologic framework for the ORR developed by ORNL researchers (Solomon et al. 1992; Moore and Toran 1992; Hatcher et al. 1992), includes a comprehensive assessment of historical waste sites and groundwater contaminant plumes, and presents human health and ecological risk assessments for BCV.

Hydrologic subsystems for areas underlain by predominantly clastic (non-carbonate) rocks were defined in *Status Report: A Hydrologic Framework for the Oak Ridge Reservation* (Solomon et al. 1992); likewise, the technical basis for these subsystems is described in detail in the status report and in *Supplement to a Hydrogeologic Framework for the Oak Ridge Reservation* (Moore and Toran 1992). The subsystems include a shallow subsurface stormflow zone, the vadose zone, three intervals within the saturated zone (shallow, intermediate, and deep intervals), and an aquiclude at great depth where minimal water flux is presumed to occur. The stormflow and vadose zones and the uppermost saturated zone (shallow interval) generally occur within materials of the saprolite zone (Fig. 2.4). A majority of the estimated subsurface water flux occurs within these uppermost parts of the subsurface hydrogeologic profile (Solomon et al. 1992). In general, the seasonal range of potentiometric surface elevations tends to span the transition between the saprolite zone and the underlying bedrock, suggesting that the weathering profile reflects the complexity of variably-saturated flow dynamics.

Subsurface flow within the saprolite zone is directed downward and laterally from higher elevations toward stream valleys where shallow groundwater discharge occurs. Water flux through the lower part of the vadose zone is primarily vertically downward. The vertical component of flow below the water table varies according to topographic position (recharge versus discharge areas). Shallow subsurface flux in the uppermost saprolite zone and lateral flux near the saprolite-bedrock interface respond rapidly to heavier precipitation events and contribute much of the quickflow component of storm-period runoff. At increasing depths (on the order of 100 ft or more), flow within the saturated zone contributes proportionally less to the overall subsurface flux, reflecting the decrease in porosity and permeability with increasing depth. A complete description of research methods, locations, interpretations, and findings completed in the headwaters areas of Melton Branch, underlain by the same Conasauga Group formations present in BCV, is documented in Solomon et al. 1992. Subsequent watershed studies (Clapp 1997) indicated the proportion

Annual Average Groundwater Mass Balance



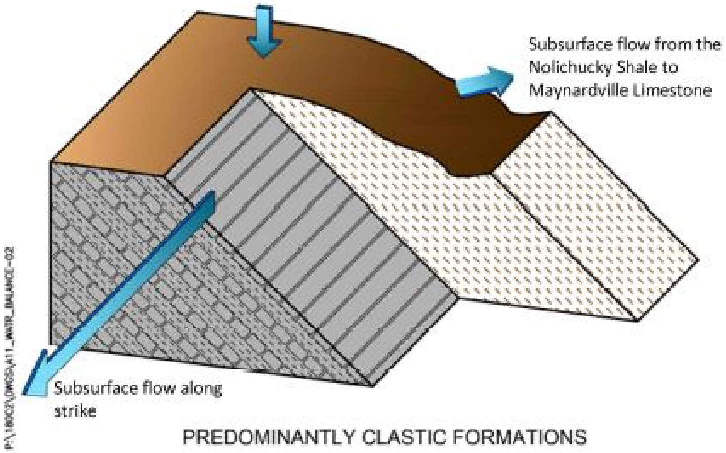
Precipitation
55 inches/yr

Evapotranspiration ~50% (~27.5")

Stormwater/Stormflow Runoff
~30 - 40% (~17 – 22")

Recharge to Bedrock ~10 – 20% (~5 – 11")

- Recharge to shallow groundwater then discharge to surface water



Subsurface flow from the
Nolichucky Shale to
Maynardville Limestone

Subsurface flow along
strike

PREDOMINANTLY CLASTIC FORMATIONS

Soil
macropore/
stormflow
channel
discharge
points

UCOR
an AECOM-led partnership with Jacobs

DRAWN BY: P. HOLM
REV. NO./DATE: 0– 4/22/19
CAD FILE: C:\13013\DWGS S80–EMDF–GW

Fig. 2.4. Annual average groundwater mass balance based on the CBCV Model.

of flux via the uppermost saprolite zone may be less than reported by Solomon et al. 1992, but generally confirmed that most of the active groundwater flux occurs in the saprolite zone.

The depth to the water table or unsaturated zone thickness varies across a relatively wide range from upland to lowland areas. Vadose zone thickness is greatest below upland areas such as those along Pine Ridge and along the subsidiary ridges underlying the Maryville outcrop belt. In these topographic positions, the water table can lie within the bedrock zone (Fig. 2.4), at depths exceeding 30 ft below the surface. Away from these upland areas of groundwater recharge, the vadose zone thins along the transition to groundwater discharge areas in valley floors where the water table is at, or near, the ground surface. In most lower elevation areas, the water table lies within the saprolite zone materials at depths less than 20 ft below the surface.

Groundwater within the saturated zone converges and discharges into stream channels along the tributary valley floors, supporting dry-weather base flow, primarily during the wetter portions of the year. During drier periods, groundwater may support little or no stream base flow, but may continue to slowly migrate southward toward Bear Creek along the tributary valley floor areas within alluvium, saprolite, and bedrock fractures below the active stream channels. Deeper groundwater that does not discharge to the tributaries moves southward toward Bear Creek along pathways through the bedrock zone. Most of the groundwater flux within the saturated zone has been demonstrated to occur via the saprolite zone with progressively less flux occurring at greater depth. The flux decreases in proportion to a general decrease in saturated hydraulic conductivity (K_{sat}) with depth that is associated with smaller fracture apertures and an overall decrease in the number and density of interconnected fractures capable of transmitting groundwater (Fig. 2.5).

Shallow groundwater also discharges to springs in narrow headwater ravines of Pine Ridge and across broader seepage faces along portions of the tributary valleys. Groundwater from these discharge locations contributes to stream channel base flow, particularly during the wet season. Water level hydrographs indicate that recharge to the water table occurs rapidly in response to significant rainfall events in most areas, but the response may be subdued and delayed in wells below upland areas where the water table is at greater depth and recharge rates are slower (DOE 2017). In general, water table elevations are several feet higher, on average, during the wet season (approximately December through March or April) compared to the remainder of the year.

Unsaturated flow in undisturbed areas will migrate to the potentiometric surface through the typical sequence of topsoil, silty/clayey residuum, and saprolite as described in Sect. 2.2 which may also include veneers of alluvial and colluvial materials along the flanks and floors of the tributary valleys. According to research (Solomon et al. 1992; Moore and Toran 1992), most of the water infiltrating the surface during and immediately after storm events travels laterally and relatively quickly through the uppermost part of the soil profile to discharge along stream channels.

Research on the ORR (Solomon et al. 1992; Moore and Toran 1992; Clapp 1997) has demonstrated that recharge through the unsaturated zone in undisturbed natural settings is episodic and occurs along discrete permeable features that may become saturated during storm events, even though surrounding macro- and micropores remain unsaturated and contain trapped air. During recharge events, flow paths in the unsaturated zone are complex, controlled to a large degree by the nature and orientation of structures such as relict fractures in saprolite (Solomon et al. 1992).

Due to the abundant precipitation and shallow water tables in BCV, surface and groundwater hydrology are closely related in BCV. In BCV the major components of groundwater flow include movement through unconsolidated material, weathered bedrock, and fill under unconfined conditions, and flow along bedding planes, fractures, and solution channels in the competent bedrock, generally under confined conditions (Kamp 1985). Bear Creek flows primarily over non-karst bedrock but loses flow to subsurface conduits

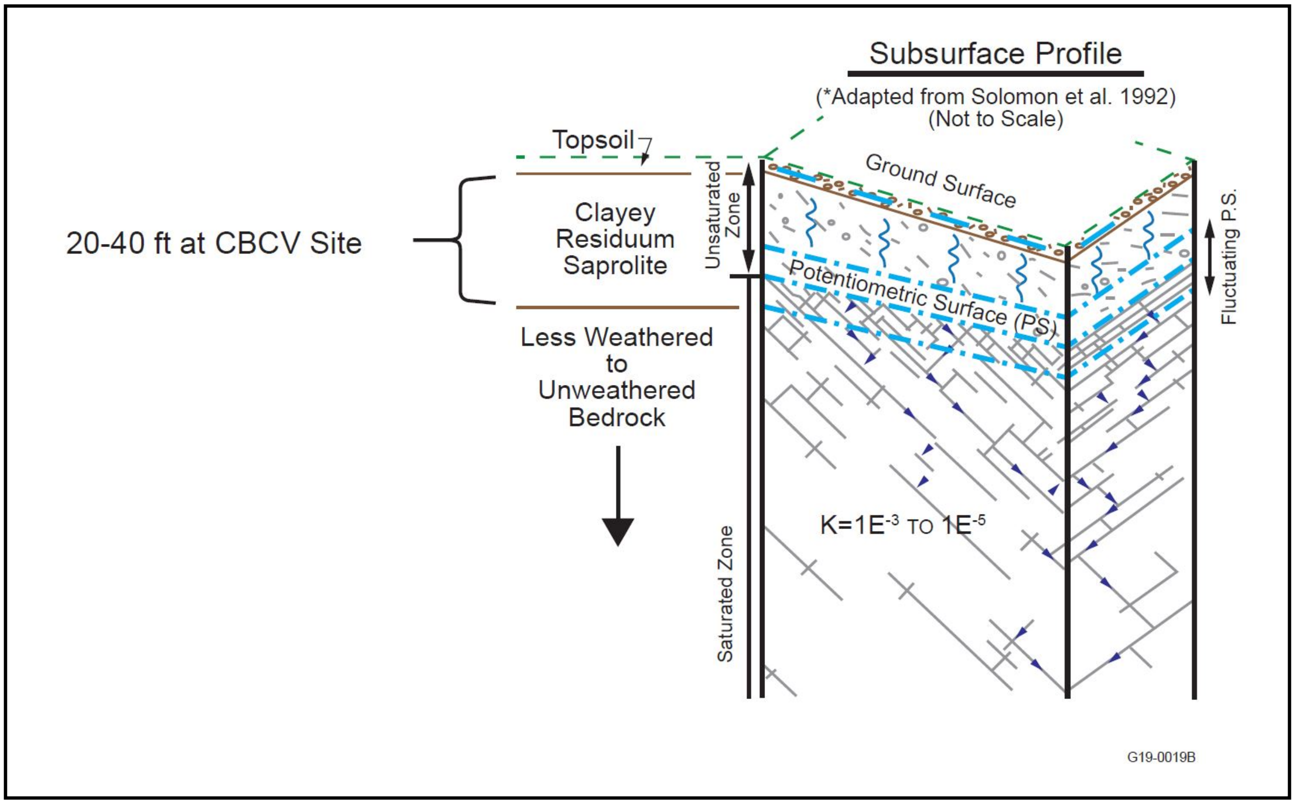


Fig. 2.5. Typical subsurface profile - upland areas.

where it crosses karst features in the Maynardville Limestone. Karst features and fractures within the Maynardville Limestone provide the principal conduits for groundwater movement within BCV.

Hydraulic gradients mirror the topography and are much higher within the clastic rocks north of Bear Creek than gradients along the valley floor and Maynardville limestone outcrop (Fig. 2.6).

There were no previous potentiometric surface elevation data available for the CBCV site prior to this investigation. Available data were projected to this site from adjacent areas with similar hydrogeologic conditions to plan the Phase 1 investigation. A key assumption going into this investigation was that potentiometric surface elevations are typical of other BCV wells in similar settings. As the landfill is constructed, the current surface water and groundwater flow regime will be modified due to regrading of the site and installation of impermeable barriers that eliminate recharge, and adjustments to surface runoff.

2.5 SITE CONCEPTUAL MODEL

The BCV hydrogeologic conceptual model differentiates between the surface water and groundwater flow within and across the predominantly clastic lithology underlying most of the valley floor and the flow along Bear Creek, including groundwater flow within the karstic carbonate rocks along the southern margin of BCV (Fig. 2.3).

An important aspect of the conceptual model relates to groundwater flow paths and rates that are dominant along fractures that trend parallel to geologic strike. Tracer tests and investigations of groundwater contaminant plumes on the ORR and in BCV demonstrate that groundwater tends to move more rapidly along fracture flow paths that are parallel to geologic strike versus flow paths that are perpendicular to strike. This is particularly true for the shallower portions of the saturated zone where most groundwater flux occurs (Fig. 2.7).

The distinction between the shallower parts of the saturated zone and deeper levels is based on variation in groundwater chemical composition with depth thought to be related to water residence time. The approximate boundary between mixed-cation-HCO_3 water and Na-HCO_3 water was defined at depths ranging from 30 to 50 m (approximately 100 to 165 ft) for the predominantly clastic rocks on the ORR such as those at the CBCV site. The deep "aquiclude," composed of saline water having total dissolved solids ranging from 2,000 to 275,000 mg/L lies beneath the deep interval at depths in portions of BCV believed to be greater than 300 m (approximately 1,000 ft) [Solomon et al. 1992 for details].

Across the clastic outcrop belts, groundwater at shallow to intermediate depth tends to flow south to southwest, whereas flow within the Maynardville and along Bear Creek tends to more closely parallel the geologic strike toward the southwest. Hydraulic gradients mirror the topography and are much higher within the clastic rocks north of Bear Creek than gradients along the valley floor and Maynardville limestone outcrop.

The majority of water flow from upland areas is directed toward the valley axis by the NTs where they discharge to Bear Creek. Bear Creek is located south of the proposed CBCV and flows more or less continuously over non-karst bedrock but loses flow to subsurface conduits where it crosses karst features in the Maynardville Limestone. Underflow conduits in the Maynardville Limestone continuously convey base flow, while overflow conduits and Bear Creek carry high flows during the wet season and heavy rainfall events.

The CBCV site area slopes to the south–southeast. As described in the *Oak Ridge Reservation Physical Characteristics and Natural Resources* (ORNL 2006), sloping land surfaces on the ORR exhibit the characteristics of hillslope hydrology. In undisturbed, naturally vegetated areas such as the CBCV site, an estimated 80 to 90 percent of precipitation is captured and discharged from the 1- to 2-m (3- to 6.5-ft) storm-flow zone/root zone and does not infiltrate into the subsurface. During November through March when plants are not consuming water and shallow soils are saturated, lateral drainage of water occurs on slopes through macropores (e.g., holes left by the decay of dead plant roots and animal burrows) as well as through vertical seepage to the potentiometric surface through pervious zones (Clapp 1997).

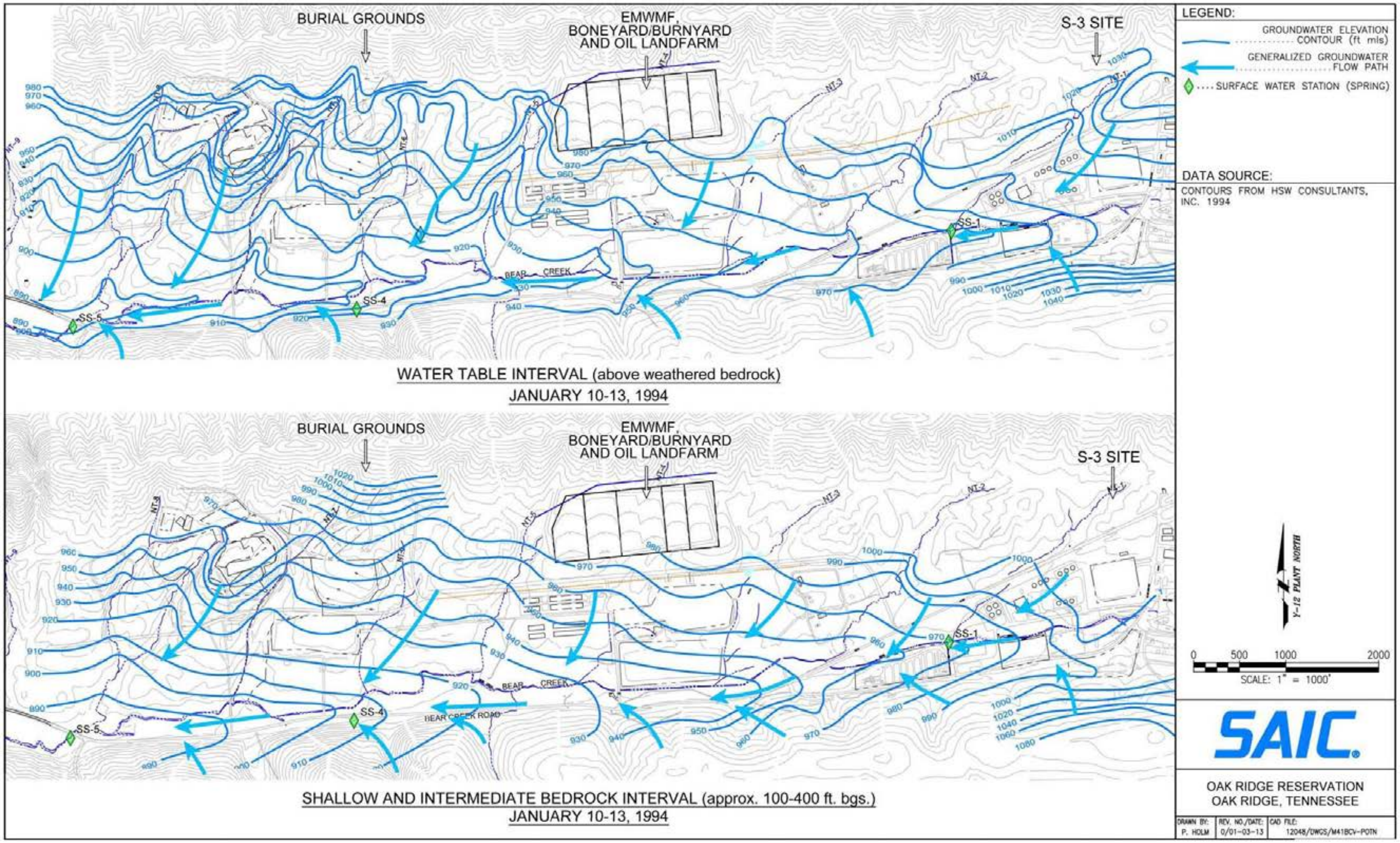


Fig. 2.6. BCV Groundwater flow patterns.

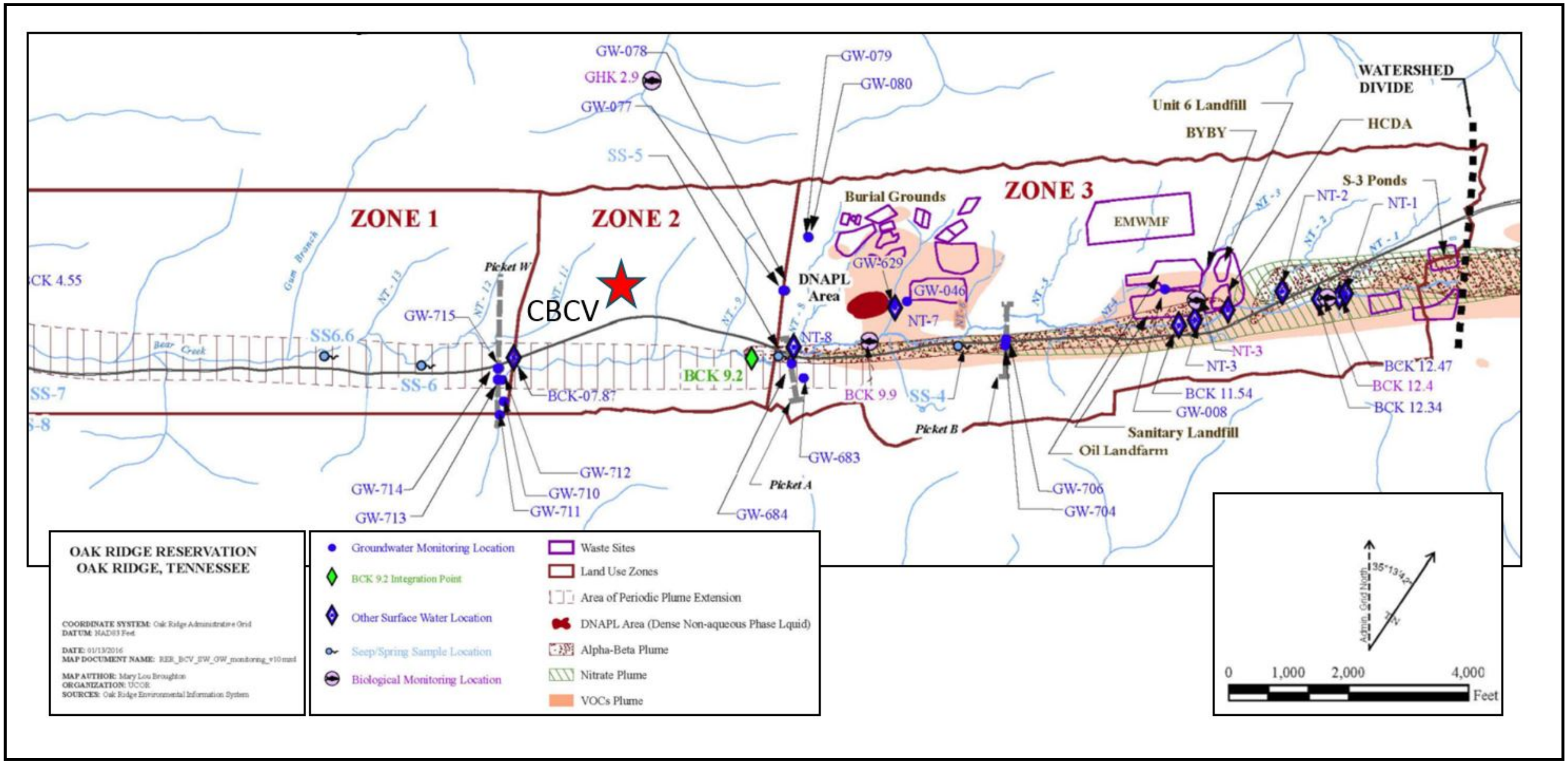


Fig. 2.7. BCV plumes.

3. SURFACE WATER WALKDOWN EVALUATION

3.1 APPROACH

Two detailed site walkdowns were performed during the wet season (January 30 and February 27, 2018), and three walkdowns, representing drier conditions (May 1, June 4, and October 10, 2018) were also completed to further characterize surface geology; examine hydrogeologic areas of interest; and identify seeps, springs, and other expressions of shallow groundwater in NT-10, D-10W, D-11E, and NT-11. The initial walkdowns were conducted by a qualified hydrologic professional, as defined in TDEC 0400-40-17. TDEC personnel also participated in all of the walkdowns. Additional information on these walkdowns is provided in Appendix A.

The walkdowns included a description at every 50 ft along NT-10, D-10W, and NT-11 (as safe access allowed) as well as field measurements of temperature, specific conductivity, and pH (Fig. 3.1). The walkdown of October 10, 2018, also included observations of flow in macropores and similar features to determine potential impacts on facility design.

3.2 RESULTS

The site walkdowns identified several noteworthy soil macropore and channel features in the upper 3 ft of soil in the Nolichucky Shale in the CBCV area. A shallow macropore/soil channel transmits percolation water from soils to the NT-11 stream channel in the Nolichucky Shale outcrop area. Overland surface water flow into a soil macropore/channel was also observed, and that subsurface channel is daylighted a short distance downstream due to collapse and downstream transport of shallow soils. A small amount of water flow emanating from the channel has been observed at this location. This feature joins another branch of subsurface flow from an unnamed western valley. These types of soil drainage features are typical in undisturbed ORR soils and are a part of the stormflow system that rapidly conducts percolation water laterally downslope to stream channels.

The site walkdowns determined that D-11E, the east–west valley draining to NT-11, located on the western slope of the high knoll in the Maryville Formation, contained no defined surface water channel.

A well-established surface channel approximately 1 ft wide by 1 ft deep was encountered in the D-10W valley. Variable flow conditions were present throughout the channel during the walkdowns. Most of the northern portion of D-10W was either dry or too shallow for measurement collection during the dry period of the September and October 2018 walkdowns. The D-10W valley is approximately 50 percent less incised than the adjacent NT-10 and NT-11 valleys and has a much narrower headwater basin.

The surface water field measurenment locations are shown on Fig. 3.1. The results of the surface water field measurements are illustrated on maps included in Appendix A.

3.2.1 Parameter Results

The field data collected during the walkdown surveys conducted in January, February, May, June, September, and October 2018 are included in Appendix A (Figs. A.21 to A.26). Based on the number of dry data points or areas of low flow observed during the dry season walkdowns, it can be concluded that groundwater influence is minimal in the tributaries and drainages, especially in D-10W and NT-10 along the eastern side of the site. Flow in NT-11, which has a broader, more defined stream channel than many of the other tributaries at the CBCV site, was more consistent year round; however, the two USGS seeps

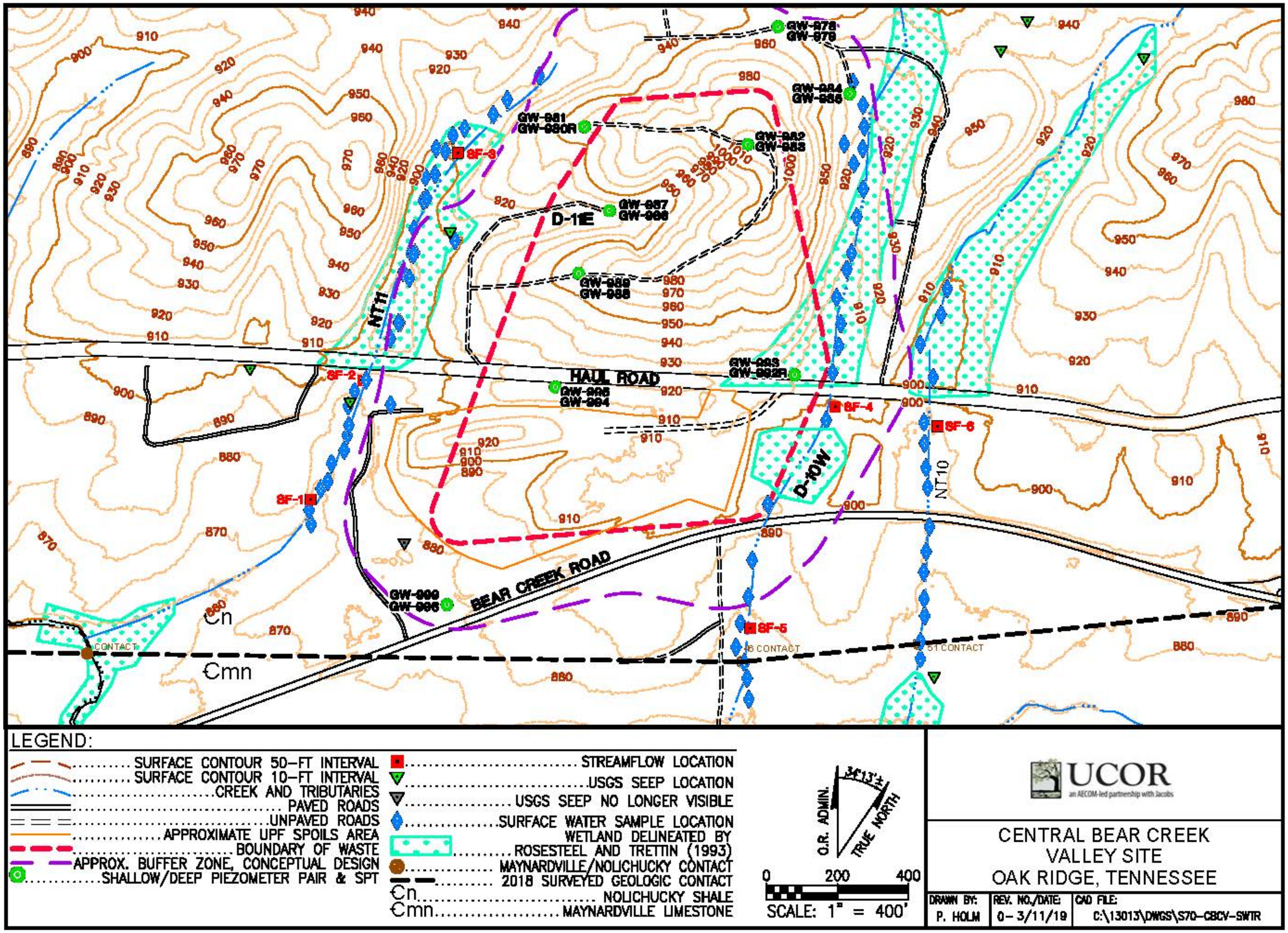


Fig. 3.1. Surface water measurement locations in the vicinity of the CBCV site.

on NT-11 (Fig. 3.1) were dry during all six walkdowns, suggesting the stream relies primarily on surface water for recharge. The D-11E macropore, which feeds into NT-11, also had less water when conditions were dry.

In general, pH and specific conductivity of the surface water in these tributaries increase from north to south. Downstream sampling locations showed more consistency in pH values than those located further upstream, suggesting that more carbonate is present in the lower reaches as one approaches the Maynardville contact.

The data collected during the walkdowns exhibited seasonal fluctuations, as would be expected. Conductivity was highest and showed the most variability during the dry season due to the number of low to no flow locations. Temperature also fluctuated seasonally, with water temperatures increasing as the year progressed. Values for pH were highest during the May walkdown when stream conditions were transitioning from spring to summer, causing more particulate matter to be present in the system.

Although the measured flows indicate NT-11 prirmarily relies on surface water for sustaining flow, the increase in pH in the downstream direction indicates that there is some influx of groundwater in the lower reaches.

3.2.2 Seep Locations

Seep locations at the CBCV site are identified on Fig. 3.1. All but one of the previously identified seeps were located and no additional seeps were located during the site walkdowns. One seep was previously located in an area covered during placement of clean spoils from the UPF and could not be located during the walkdowns.

3.2.3 Conclusions

As a result of the walkdowns, several conclusions can be drawn in terms of groundwater influence and seasonal fluctuations. Based on the number of dry data points or areas of low flow observed during the dry season walkdowns, it can be concluded that groundwater influence is minimal in many of the tributaries and drainages, especially in D-10W and NT-10 along the eastern side of the site. Flow in NT-11, which has a broader, more defined stream channel than many of the other locations, was more consistent year round; however, NT11-SEEP1 and NT11-SEEP2 (the seeps identified in the past by the USGS) were dry during all six walkdowns, suggesting the stream relies primarily on surface water for recharge. The D-11E macropore, which feeds into NT-11, also had less water when conditions were dry. Downstream sampling locations showed more consistency in pH values than those located further upstream, suggesting that more carbonate is present nearer to the Maynardville contact, and supporting the absence of carbonate beneath the CBCV site.

These walkdowns should be interpreted as trend data and used to set a baseline for what can be expected seasonally. The data fluctuated seasonally, as expected. Conductivity was highest and showed the most variability during the dry season due to the number of low- to no-flow locations. Temperature also fluctuated seasonally, with water temperatures increasing as the year progressed. Values for pH were highest during the May transitional walkdown when stream conditions were shifting from spring to summer, causing more particulate matter to be present in the system.

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4. MAYNARDVILLE CONTACT EVALUATION

Previous mapping of BCV indicated that the contact between the Nolichucky Shale and Maynardville Limestone was located approximately 300 ft south of the proposed southernmost waste limit (DOE 2017).

4.1 APPROACH

The Nolichucky/Maynardville geologic contact in the NT-10 and D-10W stream channels was located during the first surface water walkdown in January 2018. Participants included a hydrogeologist/Subject Matter Expert from UCOR, an AECOM-led partnership with Jacobs, Water Resources Restoration group, and TDEC geologists. The walkdown used observations of bedrock outcrops in the stream channels and observations of weathered bedrock material to more precisely identify the geologic contact. Coordinates for these contact locations were obtained using Global Positioning System equipment.

4.2 FINDINGS

The Maynardville/Nolichucky geologic contact was observed in the field at three locations. The contact was located in the drainage channel of NT 10, D-10W, and near the confluence of NT-11 and Bear Creek (Fig. 4.1). The location of the Maynardville/Nolichucky geologic contacts observed in the field were approximately 50 ft further south than represented on the geologic maps prior to the field mapping effort.

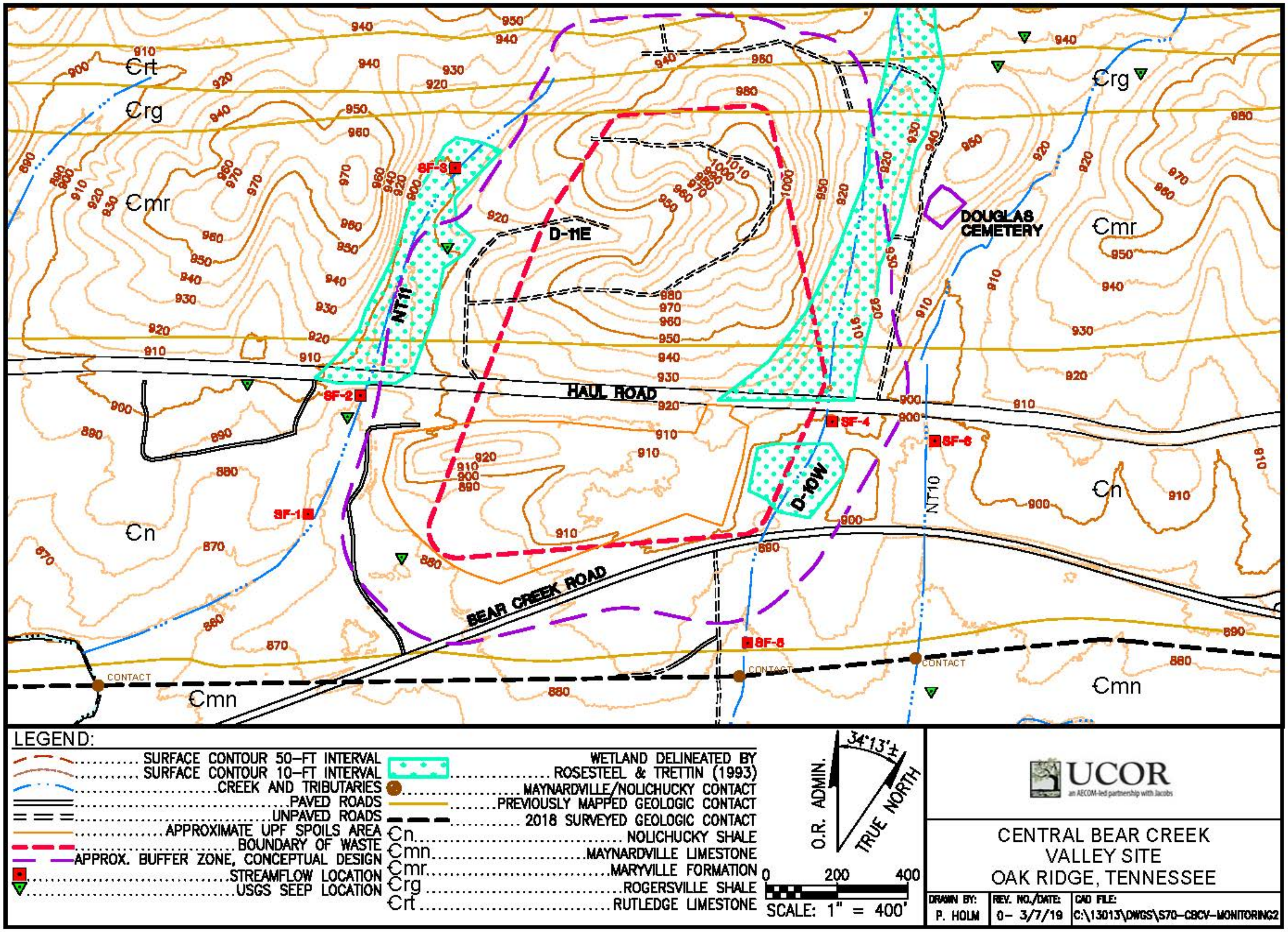

Fig. 4.1. Surface water monitoring locations and field-verified contact for Maynardville Limestone at the CBCV site.

5. SURFACE WATER FLOW EVALUATION

5.1 APPROACH

The areas of the three surface water basins between the crest of Pine Ridge on the northwest and the geologic contact between the Maynardville Limestone and the Nolichucky Shale on the southeast are shown in Fig. 4.1. The Maynardville/Nolichucky geologic contact is the most downstream flow measurement location because further downstream surface water tends to sink into the Maynardville karst, causing a low bias to the flow data.

A total of six surface water flow measurement stations (flumes) were installed at locations identified during the January (2018) surface water walkdown survey (Fig. 5.1). The flumes were located in the Nolichucky Shale and Maryville Formation outcrop areas in NT-10, D-10W, and NT-11 (Fig. 5.1). TDEC personnel participated in the walkdown including discussion of flume placement. Flow readings obtained at the CBCV site flumes are measured to < 1 gpm. At low flow conditions, small changes in the flume environment could result in a perceived increase or decrease in flow at the flume.

Three measurement flumes were installed in NT-11 at locations identified during the site walkdown (SF-1, -2, and -3; Fig. 5.1). For the D-10W valley, a surface water flow measurement station was installed downstream of the Haul Road (SF-4) and another downstream of Bear Creek Road near the Nolichucky Shale/Maynardville Limestone geologic contact (SF-5). Surface water flow measurement station (SF-6) was placed on the downstream side of the culvert under Haul Road in NT-10, the northernmost location within NT-10 with a well-defined stream channel. The flumes were installed during March 2018.

The flumes were sized based on historical flow information and measurements of the stream width, depth, and bankfull dimensions collected during the site walkdown. Based on this information, 2.0-ft H-flumes and 1.5-ft H-flumes were sized for installation at the site. The 1.5-ft H-flumes were installed at upstream locations, where the stream channels, size of the catchment basins, and associated runoff are smaller. The 2.0-ft H-flumes were installed downstream, where higher flows are expected due to larger drainage areas as well as the influence of runoff from the Haul Road, Bear Creek Road, UPF Spoils Area, and other disturbed areas. In total, three 2.0-ft H-flumes and three 1.5-ft H-flumes were installed within the three primary tributaries at the CBCV site.

All of the surface water flumes were equipped with a flow meter and water quality analyzer and controller system to provide monitoring of water flow through the flumes. Final surveying of all locations occurred upon completion of monitoring station installation. The coordinates and elevations of the locations of each monitoring site and positions and elevations of the base of each flow control section were surveyed to an accuracy of 0.1 ft horizontal and 0.01 ft vertical. Figure 4.1 also indicates the locations of the three surface water basins (wetlands, identified by Rosensteel and Trettin, 1993) that occupy the valleys of NT-11 and D-10W and the surface expression of the geologic contact between the Maynardville Limestone and the Nolichucky Shale. The wetlands delineation available at the time FSPs were developed are shown instead of the newer boundaries to illustrate the information available when the sample locations were set.

5.2 FLUME DATA FINDINGS

Surface water flow measurements were performed as described in the Phase 1 FSP (DOE 2018a) at the six flumes and include continuous flow, temperature pH, and specific conductivity measurements collected at 30-min intervals.

Surface water flow data collected from April 2018 to April 2019 at the flow measurement stations at the CBCV site are illustrated in Fig. 5.1. As expected, flow rates increase downstream, from north to south, and increase quickly in response to rainfall. Flow rates for NT-11 ranged from 0.1 to 6,810 gpm. The flow rate for NT-10 during this period had a range of 0.1 to 4,426 gpm. D-10W is a smaller stream and generally has a lower flow rate. However, the peak flow rate during the wet February 2019 period at SF-5 did exceed the flow rate recorded at flume SF-6 on NT-10 during the same period. The flow rates at SF-5 have ranged from 0.1 to 5,273 gpm (Fig. 5.2). There have been periods where flumes SF-1 and SF-3 on NT-11 recorded no flow. However, SF-2, located between SF-1 and SF-3, showed low flows during those same periods. The SF-4 and SF-5 locations on D-10W showed periods of no flow in May, June, July, August, September, and October. The SF-6 location on NT-10 also showed periods of no flow in June, July, August, and September.

Table 5.1 provides a summary of the flow rates recorded from April 2018 to April 2019 at the CBCV weirs. Appendix A contains the individual measurements collected in the field during the surface water walkdowns.

Figures 5.2 through 5.4 provide graphs of the measurements recorded for pH, temperature, and specific conductivity at all of the CBCV site flume installations. The low readings of pH (Fig. 5.2) below 4 standard units (SUs) are suspected to be artifacts of the monitoring equipment as these generally occur as either the initial reading at the re-start of the data collection following a gap in the data collection, or the final reading before a gap in data collection. The average pH ranged from 7.00 SU at SF-5 to 7.58 SU at SF-4. The average pH for all six flumes at the CBCV was 7.25 SU.

Temperature follows a pattern similar to pH with the extreme low values occurring at the start or the end of a period of data collection between periods of no data collection. These temperatures are usually a single reading which deviates substantially from the rteadings prior to, or after, the extereme reading. Average temperature readings at the six CBCV site flumes ranged from 14.2°C at SF-1 to 18.4°C at SF-2.

Specific conductivity readings for surface water at the CBCV flumes also exhibited some extreme readings suspected to be a function of the equipment. This is especially true for the single readings that are extremely low or high compared to preceding or subsequent readings. The average specific conductivity readings ranged from 75.6 µS/cm at SF-3 to 204.7 µS/cm at SF-5. It can be seen in Fig. 5.4 that specific conductivity measurements at SF-3 are significantly lower than the other five CBCV site flume locations. The SF-3 flume is located in the northern upstream portion of NT-11 near the headwater for this stream. The lower conductivity at this flume location suggests that precipitation provides the majority of the observed flow at this flume location.

The flume data show expected responses to precipitation with high flow occurring during high precipitation events. Less flow occurs in D-10W in response to the same precipitation events. Stormflow bypass flow through macropores (see Fig. 2.4) is assumed to be contributing to surface water flow at the CBCV site.

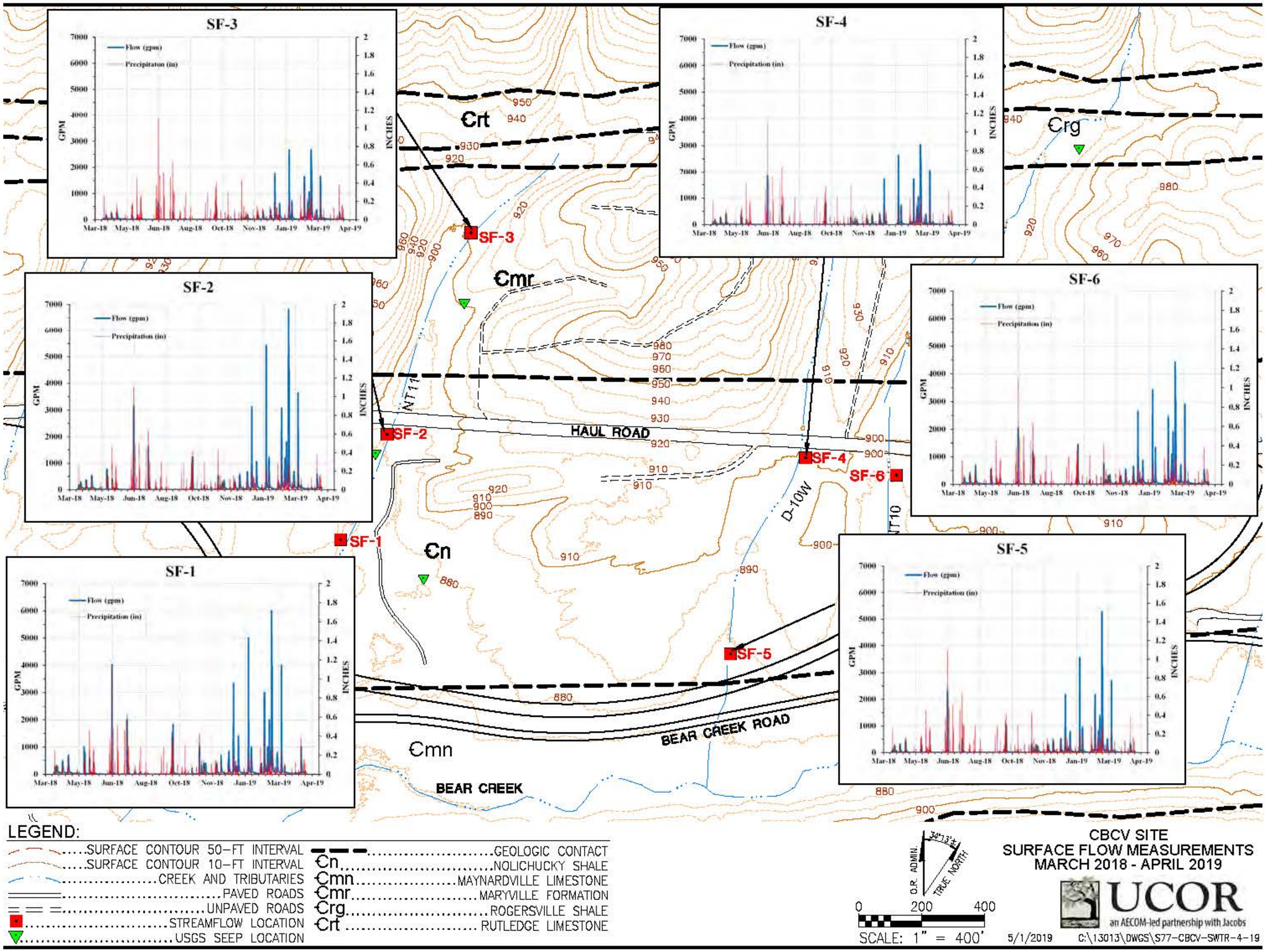

Fig. 5.1. Surface water flow measurement flumes at the CBCV site.

Table 5.1. Minimum and maximum flow rates for the CBCV site flumes, April 2018 to April 2019

Tributary measured	Flume	Minimum flow rate (gpm)	Date of minimum flow rate	Maximum flow rate (gpm)	Date of maximum flow rate
NT-11	SF-1	0.3	9/18–19/2018	5,612	2/23/2019
NT-11	SF-2	0.7	9/05/2018 9/09/2018 9/12/2018	6,810	2/23/2019
NT-11	SF-3	0.1[a]	9/01/2018 9/03/2018 9/05–09/2018 9/12–16/2018 9/18–19/2018 9/22–23/2018	2,678	2/23/2019
D-10W	SF-4	0.1[a]	9/01–10/2018 9/13–24/2018	3,042	2/23/2019
D-10W	SF-5	0.1[a]	9/10/2018 9/13/2018 9/24–25/2018	5,273	2/23/2019
NT-10	SF-6	0.1[a]	9/01/2018 9/10/2018 9/14/2018 9/17/2018 9/24/2018 9/28/2018	4,426	2/23/2019

[a] Essentially no flow periods.

D = drainage.
CBCV = Central Bear Creek Valley.
NT = North Tributary.
W = West.

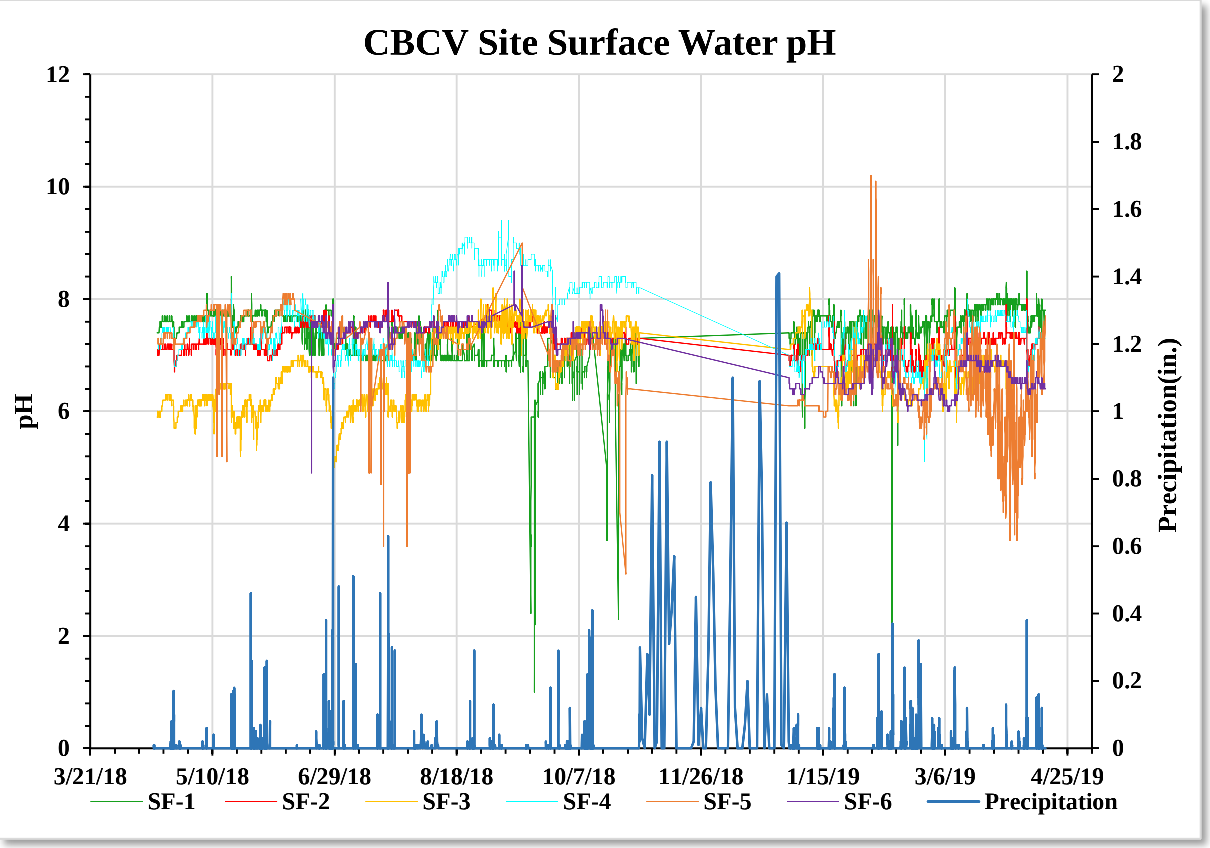

Fig. 5.2. Surface water pH at the CBCV site.

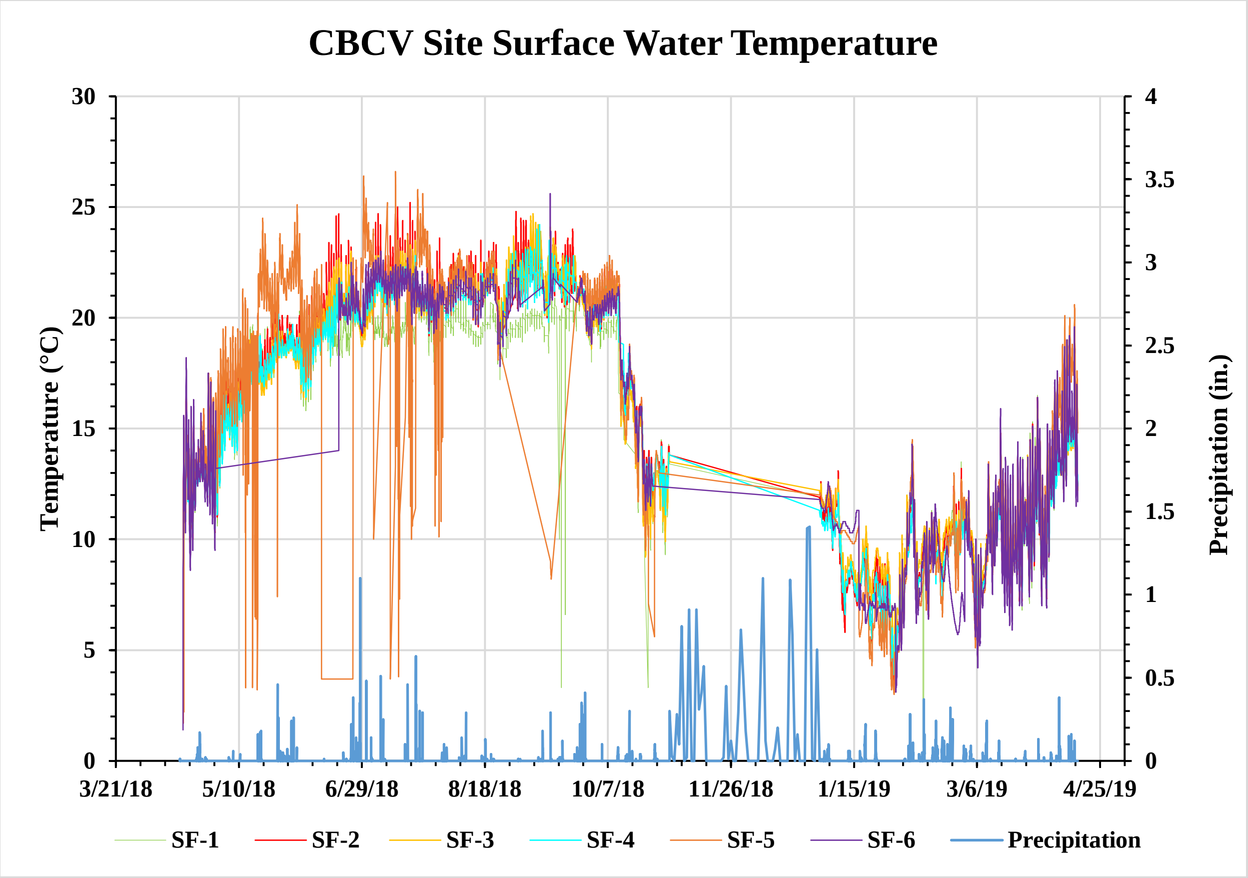

Fig. 5.3. Surface water temperature at the CBCV site.

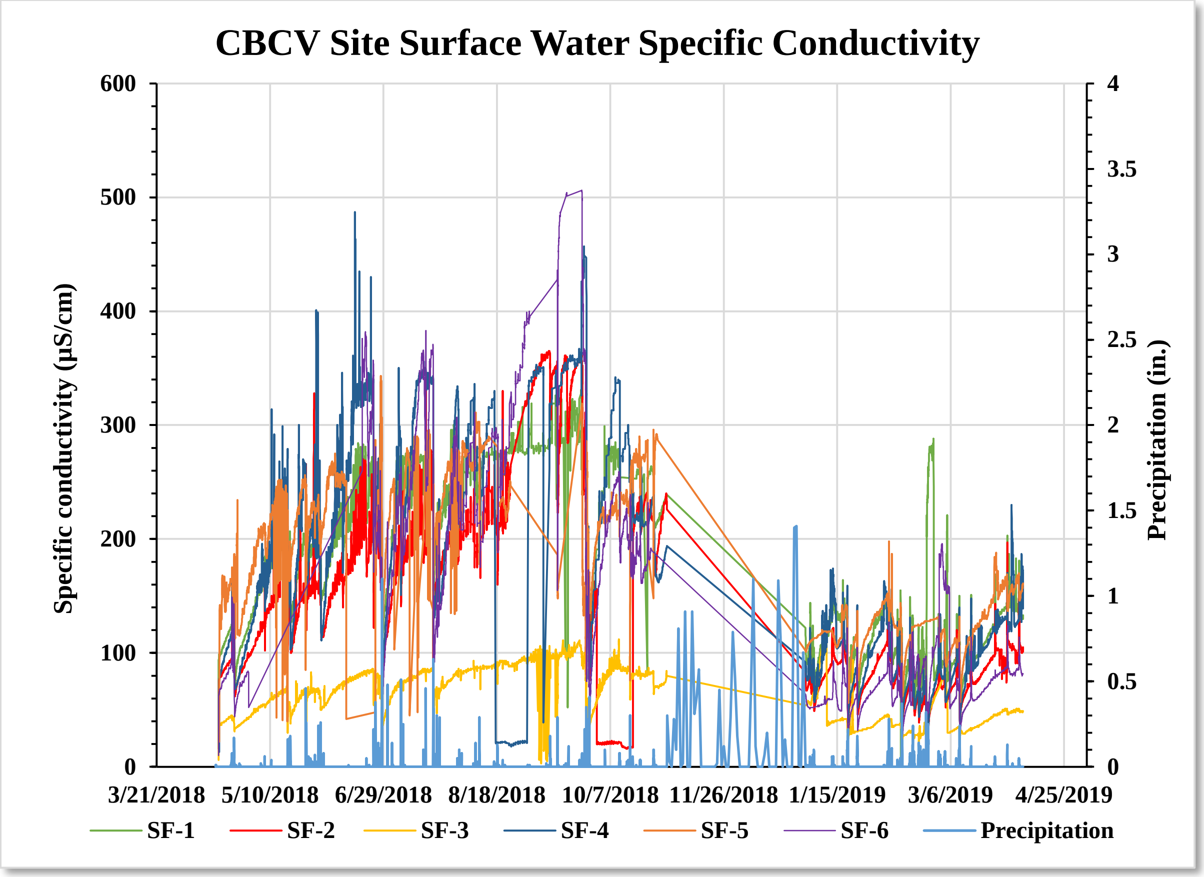

Fig. 5.4. Surface water specific conductivity at the CBCV site.

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6. GROUNDWATER PIEZOMETER EVALUATION

The following describes the installation and testing of the piezometers installed at the CBCV site during the Phase 1 site characterization. The locations of the piezometers are shown on Fig. 6.1.

6.1 HYDRAULIC CONDUCTIVITY TESTING APPROACH

Flexible Liner Underground Technologies, LLC (FLUTe™)[1] tests (bedrock piezometers) and slug tests (shallow piezometers) were conducted to develop a more complete picture of the *in situ* hydraulic conductivity. Hydraulic conductivity (horizontal) was measured by performing slug tests for piezometers completed in the residuum, and FLUTe™ testing was performed for bedrock intervals to maximize the amount and precision of hydraulic conductivity information obtained.

6.1.1 FLUTe™ Tests

FLUTe™ testing was performed in each open, intermediate borehole prior to piezometer installation. The results from the FLUTe™ testing and interpretation of the borehole logs, relative to identifying target intervals of permeable water-bearing bedrock, were used to determine screen and sand-pack intervals for both the intermediate and shallow piezometers at each location. In addition, interval hydraulic conductivity values were determined. During FLUTe™ testing, a flexible borehole liner made of a water-tight, urethane-coated, nylon fabric is lowered into the borehole. Each flexible liner is custom made for each borehole and shipped from the FLUTe™ manufacturing facility in New Mexico to the field site on a reel. Tests were performed in accordance with the manufacturer's guidelines. The rate of water addition to the liner during installation is carefully controlled to create a nearly constant applied head differential between the inside of the liner and the water level in the formation outside the liner. The rate at which water is added to the liner is governed mostly by the rate at which the water can escape into the permeable features in the open hole below the descending liner as it forces the water out into the permeable zones in the formation. About 1 percent of the transmissivity (T) remaining below the descending liner at any depth in the hole is the limit of resolution. For that reason, the resolution in the bottom portion of the hole is better than in the upper portion of the hole.

6.1.2 Slug Tests

Hydraulic conductivity (horizontal) was measured by performing slug tests for piezometers completed in the residuum. Slug tests were performed after well development in shallow piezometers GW-979, GW-981, GW-983, GW-987, GW-989, GW-993, GW-995, and GW-999 (Table 6.1). The slug tests were conducted by monitoring water-level changes after displacement of a volume of water. Water was displaced by the insertion of a 4-ft by 1.25-in. stainless steel slug bar into the well just below the static water level. Steady but rapid insertion of the slug bar was employed to create as rapid a displacement of the water as possible while creating minimal splash in the piezometer. A second test was performed by displacing water downward with the sudden removal of the slug bar. Slug test results are summarized in Table 6.1 and presented in Appendix C.

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[1] Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

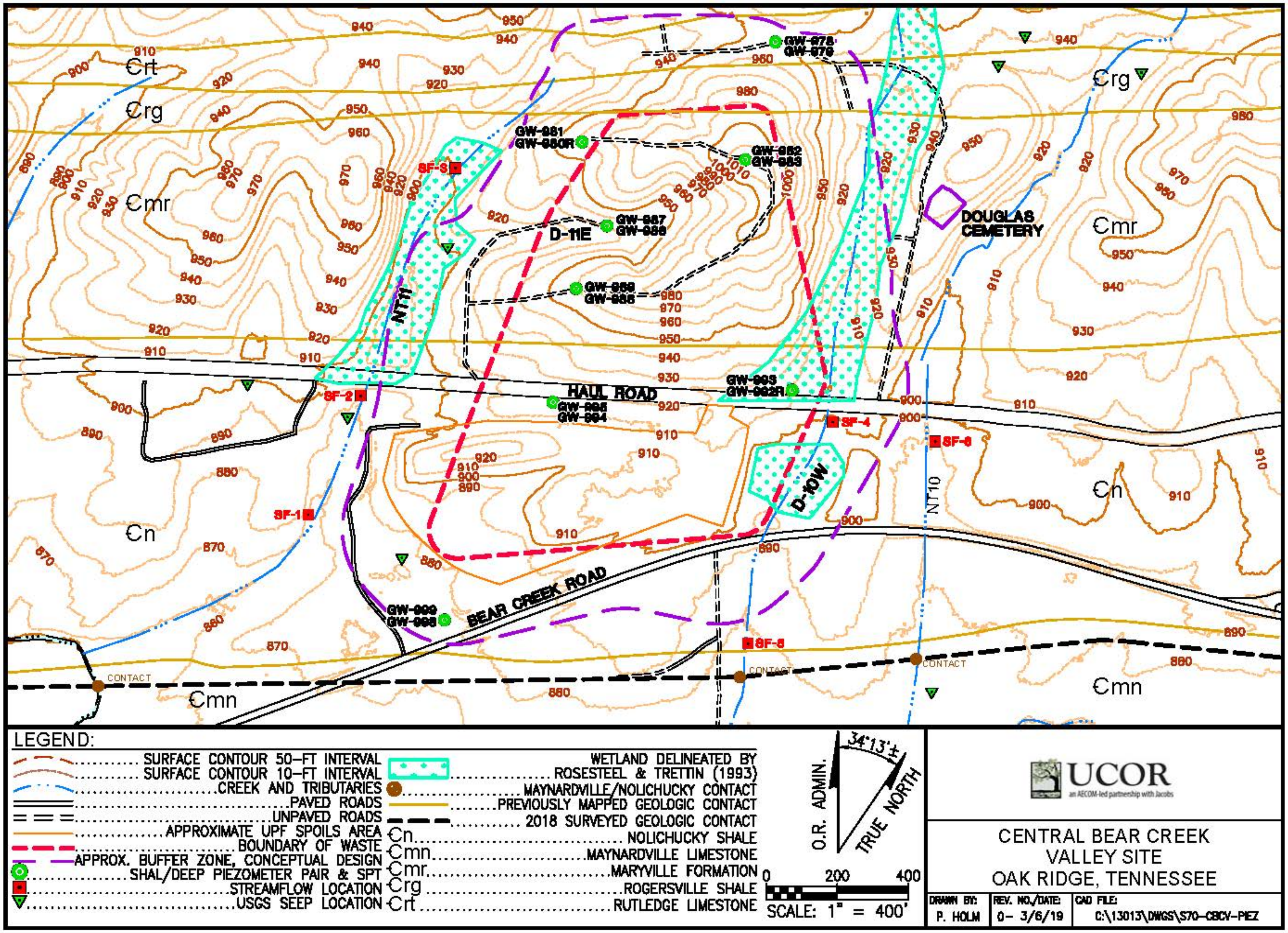

Fig. 6.1. Phase 1 piezometer locations at the CBCV site.

Table 6.1. Slug test results for the CBCV site shallow piezometers

Well ID	Screen depth (ft bgs)	Saturated thickness (ft)	Type of test	Initial displacement (ft)	Static water column height (ft)	Bouwer-Rice hydraulic conductivity (cm/sec)
GW-979	26.3–36.3	9.7	Slug in	1.44	21.24	4.17E-04
			Slug out	1.55	21.27	4.96E-04
			Average			4.56E-04
GW-981	22.1–32.1	9.7	Slug in	1.01	10.96	6.39E-05
			Slug out	1.2	11.03	4.61E-05
			Average			5.50E-05
GW-983	79.1–89.2	9.7	Slug in	0.67	26.14	5.04E-03
			Slug out	1.28	26.16	4.96E-03
			Average			5.00E-03
GW-987	16.1–26.1	9.7	Slug in	1.43	19.45	9.52E-05
			Slug out	1.45	18.84	9.75E-05
			Average			9.64E-05
GW-989	33.6–43.6	9.7	Slug in	1.35	31.59	1.42E-04
			Slug out	1.49	31.61	6.68E-05
			Geometric mean			9.74E-05
GW-993	23.0–33.0	9.7	Slug in	0.63	28.46	5.88E-04
			Slug out	0.68	28.51	6.98E-04
			Average			6.43E-04
GW-995	22.1–32.1	9.8	Slug in	1.44	24.05	1.85E-04
			Slug out	1.45	24.07	1.84E-04
			Average			1.85E-04
GW-999	10.3–20.3	9.7	Slug in	1.31	18.3	5.14E-04
			Slug out	1.43	18.33	4.54E-04
			Average			4.84E-04

bgs = below ground surface.
CBCV = Central Bear Creek Valley.
ID = identification.

Water-level data were collected during the slug tests using a pressure transducer data logger. Static water levels were measured manually and recorded prior to setting the transducer into the piezometer. The pressure transducer was then lowered into the well. The transducer was set at a depth below the water table appropriate for the pressure range of the transducer and deep enough to be below the inserted slug bar during the test. After setting the transducer, the water level was allowed to equilibrate to static conditions prior to starting the test. The transducer was set to logarithmic data collection mode so that rapid water-level changes in the early part of the slug test could be monitored accurately. The slug bar, transducer, cable, and water-level tape were decontaminated using a non-phosphate detergent solution followed by a distilled water wash, prior to insertion in each well.

6.2 PHASE 1 PIEZOMETERS

Eight pairs of piezometers were installed to monitor the shallow and intermediate groundwater within the cell boundary (Fig. 6.1). Piezometers were installed in each designated borehole by Tennessee qualified monitoring well drillers in accordance with ORR requirements as described in Appendix B, Sect. B.3, of the FSP (DOE 2018a). Depths and testing requirements for each piezometer are provided in Table 6.2. Piezometers were developed no sooner than 24 hr after installation, and development continued until the piezometer responded to water-level changes and produced clear, sediment-free water to the extent possible.

Boreholes were drilled and sampled using split-spoon samplers from the surface through the complete soil column to obtain soil samples and geotechnical data, and once rock was encountered, the boreholes were cored to the total depth to obtain representative lithologic data from across the site and in representative formations. The cores were described and logged at the drillsite. The borehole logs are provided in Appendix B. The boreholes were placed to obtain representative lithologic and groundwater data from across the site and in representative formations. Because these piezometers could be preferential pathways to groundwater, all piezometers within the footprint of the disposal cells will be plugged and abandoned as per UCOR procedures prior to construction of the EMDF (DOE 2018a).

Monitoring wells were constructed with 2-in.-diameter, 0.010-in. slot, schedule 40 polyvinyl chloride (PVC) screen and schedule 40 flush-threaded PVC riser pipe. The installed screen sections were either 5 or 10 ft in length depending on the length of the target interval. The installed intermediate piezometer screen sections were 10-ft lengths with the exception of GW-986 and GW-992R, which were completed with 5-ft screen sections (Table 6.2). All shallow piezometers were constructed with 10-ft screens. Screen caps were constructed of schedule 40 PVC threaded end caps along with a 1-ft section of blank schedule 40 PVC riser pipe. The screen and riser sections are Silver-Line Plastics, Enviro Pure brand and arrived at the site in factory packaging. Packaging was only removed immediately prior to well installation, and casing and screen sections were handled while wearing clean, disposable, nitrile gloves during installation. All well screen and riser components were measured to the nearest 0.01 in., assembled, and lowered into the borehole. The length of casing extending above ground level relative to total screen and casing riser length was calculated to properly position the monitoring well screen. The sand pack consisted of DSI “GP#2” gravel pack specifically packaged for use in the environmental industry. The sand pack was gravity placed into the annular space between the piezometer screen and the borehole wall from the bottom of the well screen to a minimum of 2 ft and a maximum of 5 ft above the top of the screen.

Following sand-pack installation, at least 2 ft of coated bentonite pellets were added as a seal above the sand pack. In the boreholes that required centralizers, the pellets also were installed and measured through the 1-in. tremie pipe, as described above for the sand pack. In the auger boreholes, augers were pulled back exposing the borehole wall as the bentonite pellets were added. The depth to the sand pack and bentonite pellet seal was periodically checked with a sounding tape to verify proper placement. Per application instructions, the bentonite pellet seal requires a minimum of 8 hr to hydrate prior to grouting. In the field, the bentonite pellet seal was given 16 to 24 hr to hydrate, exceeding this requirement. The remainder of the annular space was sealed with a cement-bentonite grout mixed to specifications outlined in the statement of work.

Table 6.2. CBCV site piezometer construction summary

Location ID	Date well development completed	Drilling method[1]	Location coordinates		Boring depth (ft)	Ground elev. (ft-amsl)	Casing ID (in.)	Elevation at top of casing (ft-amsl)	Elevation at bottom of casing (ft-amsl)	Casing stick-up (ft)	Depth of screened interval (ft-bgs)	Top of screen elev. (ft-amsl)	Bottom of screen elev. (ft-amsl)	Sand pack interval (ft-bgs)	Bentonite pellet seal interval (ft-bgs)	Grout interval (ft-bgs)	Total depth of well (ft-TOC)	Depth of water at completion (ft-TOC)
			Northing	Easting														
Intermediate Piezometers																		
GW-978	2/27/2018	HSA/HQ/R	30656.68	38643.59	80.0	953.5	2.0	955.97	882.6	2.5	59.5 – 69.6	894.0	883.9	56.1 – 71.5	53.0 – 56.1	0.5 – 53.0	73.37	10.63
GW-980R[2]	3/5/2018	R	30379.90	38138.34	74.4	963.5	2.0	965.63	892.2	2.1	59.9 – 70.0	903.6	893.5	55.0 – 72.3	51.5 – 54.9	0.5 – 51.5	73.43	28.27
GW-982	3/5/2018	HSA/HQ/R	30317.82	38617.04	126.5	1015.6	2.0	1018.02	902.2	2.4	102.1 – 112.1	913.5	903.5	99.2 – 114.5	95.9 – 99.2	0.5 – 95.9	115.82	66.39
GW-986	3/1/2018	HSA/HQ/R	30130.30	38191.80	59.6	930.2	2.0	932.37	882.7	2.2	41.0 – 46.0	889.2	884.2	38.6 – 48.0	35.8 – 38.6	0.5 – 35.8	49.67	6.38
GW-988	3/1/2018	HSA/HQ/R	29952.47	38091.14	78.5	957.0	2.0	958.95	883.8	2.0	61.9 – 71.9	895.1	885.1	59.6 – 74.0	55.1 – 59.6	0.5 – 55.1	75.15	13.56
GW-992R[2]	3/3/2018	R	29698.29	38737.35	55.5	908.9	2.0	911.40	863.2	2.5	39.3 – 44.4	869.6	864.5	37.2 – 48.2	33.8 – 37.2	0.5 – 33.8	48.20	4.88
GW-994	3/1/2018	HSA/HQ/R	29644.99	38051.04	55.0	916.7	2.0	918.89	863.4	2.2	42.0 – 52.0	874.7	864.7	37.0 – 54.6	32.3 – 37.0	0.5 – 32.3	55.549	6.98
GW-998	2/27/2018	HSA/HQ/R	29021.82	37742.36	45.0	877.7	2.0	880.18	839.8	2.5	26.6 – 36.6	851.1	841.1	24.0 – 40.0	21.7 – 24.0	0.5 – 21.7	40.38	4.55
Shallow Piezometers																		
GW-979	2/27/2018	HSA/HQ/R	30656.61	38653.90	37.8	953.7	2.0	955.99	916.1	2.3	26.3 – 36.3	927.4	917.4	21.2 – 37.8	19.0 – 21.2	0.5 – 19.0	39.89	14.70
GW-981	3/6/2018	HSA/HQ	30396.70	38148.33	34.0	963.2	2.0	965.74	929.8	2.5	22.1 – 32.1	941.1	931.1	20.0 – 34.0	17.9 – 20.0	0.5 – 17.9	35.94	22.20
GW-983	3/6/2018	HSA/HQ	30325.62	38606.49	92.2	1015.6	2.0	1018.07	925.1	2.5	79.1 – 89.2	936.5	926.4	74.1 – 91.5	70.2 – 74.1	0.5 – 70.2	92.97	65.92
GW-987	3/3/2018	HSA/HQ	30138.34	38194.40	27.9	930.5	2.0	932.94	903.1	2.4	16.1 – 26.1	914.4	904.4	13.3 – 27.9	10.9 – 13.3	0.5 – 10.9	29.84	9.49
GW-989	3/6/2018	HSA/HQ	29950.44	38082.67	45.0	955.7	2.0	957.86	910.8	2.3	33.6 – 43.6	922.1	912.1	30.0 – 45.0	25.7 – 30.0	0.5 – 25.7	47.06	14.03
GW-993	3/3/2018	HSA/HQ/R	29690.50	38724.90	35.5	909.7	2.0	911.76	875.4	2.1	23.0 – 33.0	886.7	876.7	19.8 – 35.5	14.5 – 19.8	0.5 – 14.5	36.36	5.45
GW-995	3/3/2018	HSA/HQ	29646.82	38039.32	34.0	916.3	2.0	918.76	882.9	2.5	22.1 – 32.1	894.2	884.2	19.2 – 34.0	17.0 – 19.2	0.5 – 17.0	35.86	11.93
GW-999	3/5/2018	HSA/HQ	29025.01	37750.58	22.0	877.6	2.0	880.11	856.0	2.5	10.3 – 20.3	867.3	857.3	8.3 – 21.6	1.0 – 8.3	--	24.11	3.41

[1] HSA = Hollow Stem Augers; HQ = HQ Rock Core; and R = Rotary.
[2] Replacement borehole - original borehole abandoned and sealed.

amsl = above mean sea level.
bgs = below ground surface.
CBCV = Central Bear Creek Valley.
ID = identification.
TOC = top of casing.

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6.3 HYDRAULIC CONDUCTIVITY FINDINGS

Hydraulic conductivity tests were performed in both the shallow and intermediate piezometers. FLUTe™ testing was performed within the open, uncased boreholes in each of the intermediate piezometer pairs and slug testing was performed in the shallow piezometers following piezometer installation.

6.3.1 FLUTe™ Test Results

FLUTe™ testing was performed within the open, uncased boreholes in each of the intermediate piezometer pairs (GW-978, GW-980R, GW-982, GW-986, GW-988, GW-992R, GW-994, and GW-998) to determine T (and/or hydraulic conductivity) values within the bedrock (Table 6.3). See Appendix D for a summary of FLUTe™ testing results. It should be noted that GW-982 was nearly impermeable below 54 ft below ground surface (bgs), and GW-980R had permeability too low to conduct profiling.

The liner descent-rate or velocity is a measure of T of the entire borehole. As the liner continues down the borehole and seals each permeable feature, changes in the liner velocity indicate the position of each feature and an estimate of T is provided using the Thiem equation (Wenzel and Fishel 1942) for steady radial flow. After the liner reaches the bottom of the hole, the liner acts as a seal preventing borehole cross-connection between transmissive features at different depths.

FLUTe™ testing results indicate that the total borehole transmissivity ranged from 0.052 cm^2/sec to 0.198 cm^2/sec with the average for the seven tested boreholes being 0.118 cm^2/sec. The flow rate per unit driving pressure measured during the FLUTe™ tests ranged from 0.0022 gal/min/ft to 0.0335 gal/min/ft with an average of 0.0195 gal/min/ft. These results show decreasing hydraulic conductivity with depth.

6.3.2 Slug Test Results

Slug tests were performed in shallow piezometers GW-979, GW-981, GW-983, GW-987, GW-989, GW-993, GW-995, and GW-999 (Table 6.1). Slug-test data were analyzed using the Bouwer-Rice method (Bouwer and Rice 1976; Bouwer 1989) within the AQTESOLV software.[2] Water-level recovery data are plotted semi-logarithmically versus time. The slope of a line defined by the recovery data is then used, along with data on well geometry, to calculate hydraulic conductivity.

The results shown in Table 6.1 indicate that hydraulic conductivity ranged from 4.6E-05 to 5.0E-03 cm/sec in the shallow piezometers. The average/mean hydraulic conductivity determined for the two individual tests for each piezometer ranged from 5.5E-05 to 5.0E-03 cm/sec.

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[2] AQTESOLV (AQuifer TEst SOLVer) is a software used for the design and analysis of aquifer tests (pumping tests, slug tests, constant-head tests, groundwater mounding, etc.) in confined, leaky, unconfined, and fractured aquifers.

Table 6.3. FLUTe™ test result summary for the CBCV site piezometers

Well ID	Depth to water (ft)	Borehole depth (ft bgs)	Casing depth (ft bgs)	Depth of FLUTe™ profile (ft bgs)	Flow rate per unit driving pressure (gal/min/ft)	Length of borehole remaining (ft)	Transmissivity of remaining borehole (cm^2/sec)	Average hydraulic conductivity for remaining borehole (cm/sec)	Total borehole transmissivity (cm^2/sec)
GW-978	10.75	80.0	27	76.85	0.01	5.24	0.02705	1.30E-04	0.16164
GW-980R	28.27	74.4	27	--	--	--	--	--	--
GW-982	52.38	126.5	50	53.74	0.00217	71.56	0.0045	2.06E-06	0.05181
GW-986	5.00	59.6	20	49.17	0.01538	10.25	0.01538	1.02E-04	0.09862
GW-988	13.9	78.5	36.5	75.37	0.02739	3.64	0.056714	5.12E-04	0.10648
GW-992R	1.5	55.5	31	51.12	0.02047	3.71	0.04239	3.75E-04	0.10757
GW-994	7.06	55	35	52.02	0.03347	2.73	0.06932	8.34E-04	0.09845
GW-998	1.45	45.0	20	39.92	0.02745	5.16	0.05684	3.62E-04	0.19806

Note: Permeabilty of the GW-980R borehole was too low to adequately measure flow into the bedrock using the FLUTe™ technology.
bgs = below ground surface.
CBCV = Central Bear Creek Valley.
FLUTe™ = Flexible Liner Underground Technologies, LLC.
ID = identification.
R = replacement borehole.
-- = not available/applicable.

7. LONG-TERM MONITORING RESULTS FROM PHASE 1 WELLS – THROUGH APRIL 2019

Understanding the expected seasonal high groundwater levels is a key element to designing a landfill. The FS phase (DOE 2017) provided conceptual landfill base elevations that would ensure long-term protection from groundwater intrusion based on informed assumptions regarding local conditions at the CBCV site. The purpose of the FS was to determine the plausibility of constructing an on-site disposal facility, based on meeting CERCLA criteria.

The intent of the engineering design will be to establish the lowest allowable elevation of the CBCV site landfill bottom and still maintain a minimum 10-ft buffer between the bottom of the liner system and the estimated seasonal high piezometric surface. It is anticipated that the post-construction piezometric surface will be lower than the current lowest piezometric surface observed in the shallow piezometers due to the elimination of groundwater recharge over the footprint of the landfill because of the placement of the impermeable barriers in the bottom of the landfill. This lack of recharge will also reduce the degree of response in the piezometric surface to precipitation events and seasonal fluctuations from what is currently observed at the site.

Cut and fill will be required for site construction. Fill is necessary to raise the bottom of the waste to maintain the appropriate minimum buffer between the waste and the potentiometric surface, and provide a level footprint, while cuts are necessary in some areas to also provide a level footprint.

7.1 DESCRIPTION OF DOWNHOLE MONITOR ISSUES

Several of the downhole monitors installed to continuously measure depth to water (DTW), temperature, pH, and conductivity experienced problems over the monitoring period, resulting in several data gaps. The manufacturer was consulted and downhole monitors were repaired or replaced. The manufacturer also visited the project site to view how the monitors were installed, and verified that these were appropriately installed.

In a few instances, less complicated downhole monitors were installed to collect DTW and temperature data while the original downhole monitors were evaluated and replaced or repaired to bridge data gaps. In addition, overlapping data from the paired piezometers have been used to aid interpretation of water levels during periods when limited data were available. Table 7.1 provides a summary of the groundwater monitoring data gaps during the year-long monitoring period.

7.2 POTENTIOMETRIC SURFACE FLUCTUATIONS OVER TIME

Existing condition profiles based on the CBCV site boreholes have been constructed at the locations shown on Fig. 7.1 based on the piezometer data. The existing conditions profiles are provided in Figs. 7.2 through 7.4. The profiles include the geology, completed screen depths for the piezometers, and the peak high potentiometric surface measured on February 24, 2019, the average seasonal high potentiometric surface (February 2019), and the average seasonal low potentiometric surface (late August to early September 2018). These profiles demonstrate the potentiometric surfaces are influenced by topography and local recharge from precipitation. Groundwater flow is both toward Bear Creek, and laterally toward the adjacent drainages. As projected onto the profiles from other BCV sources, the deep groundwater (greater than 400 ft bgs) has a lateral flow component along strike of the bedding, but ultimately discharges to the Maynardville Limestone and Bear Creek.

Table 7.1. Phase 1 groundwater monitoring data gaps

Location	Data gap dates		Affected parameter(s)	Explanation
	Start	End		
GW-979	6/13/2018	7/17/2018	All	Downhole monitor failure
GW-981	7/10/2018	7/17/2018	Conductivity	Conductivity probe calibration error
GW-982	7/10/2018	7/17/2018	Conductivity	Conductivity probe calibration error
GW-983	6/13/2018	7/2/2018	All	Downhole monitor failure
	7/2/2018	7/12/2018	pH Conductivity	Replacement monitor installed measuring only DTW and temperature
	7/12/2018	7/17/2018	All	Downhole monitor failure
GW-987*	6/8/2018	8/7/2018	DTW	Pressure sensor failure
	8/7/2018	8/13/2018	All	Downhole monitor failure
GW-989	6/13/2018	7/2/2018	All	Downhole monitor failure
	7/2/2018	7/17/2018	Temperature pH Conductivity	Replacement monitor installed measuring only DTW and temperature
GW-992R	8/10/2018	8/17/2018	pH Conductivity	Battery failure
	8/17/2018	10/2/2018	All	Downhole monitor could not download data
	10/2/2018	10/25/2018	pH Conductivity	Replacement monitor installed measuring only DTW and temperature
GW-999	6/13/2018	10/9/2018	All	Downhole monitor failure

*On November 6, 2018, a tree fell near well pair GW-986/987; however, this event did not impact the wells or data collection.

DTW = depth to water.
GW = groundwater well.
R = replacement borehole.

As indicated in TM #1, potentiometric surface elevations in the CBCV site piezometers are typical of other BCV wells in similar settings and were similar to the elevations predicted in the RI/FS. Intermediate and shallow piezometer measurements during the Phase 1 characterization confirmed that the potentiometric surface generally mirrors topography (i.e., is higher topographically beneath knolls/ridges and lower near the tributaries). Potentiometric surface measurements respond to rainfall events, indicating some recharge is occurring on the site. Table 7.2 summarizes the potentiometric surfaces measured at the Phase 1 piezometers. The minimum and maximum potentiometric surface elevations in Table 7.2 represent the minimum and maximum over the entire monitoring period for the CBCV piezometers.

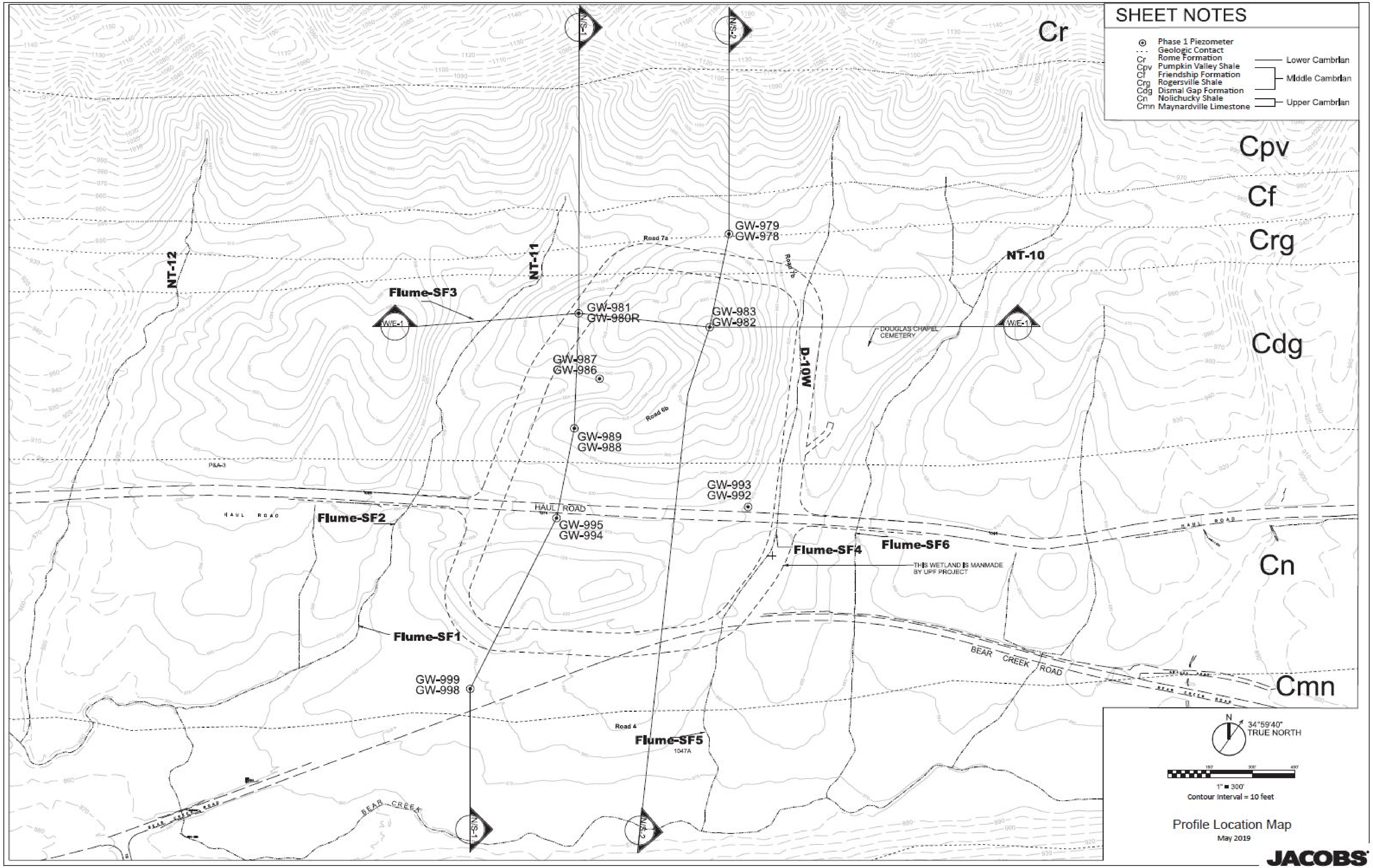
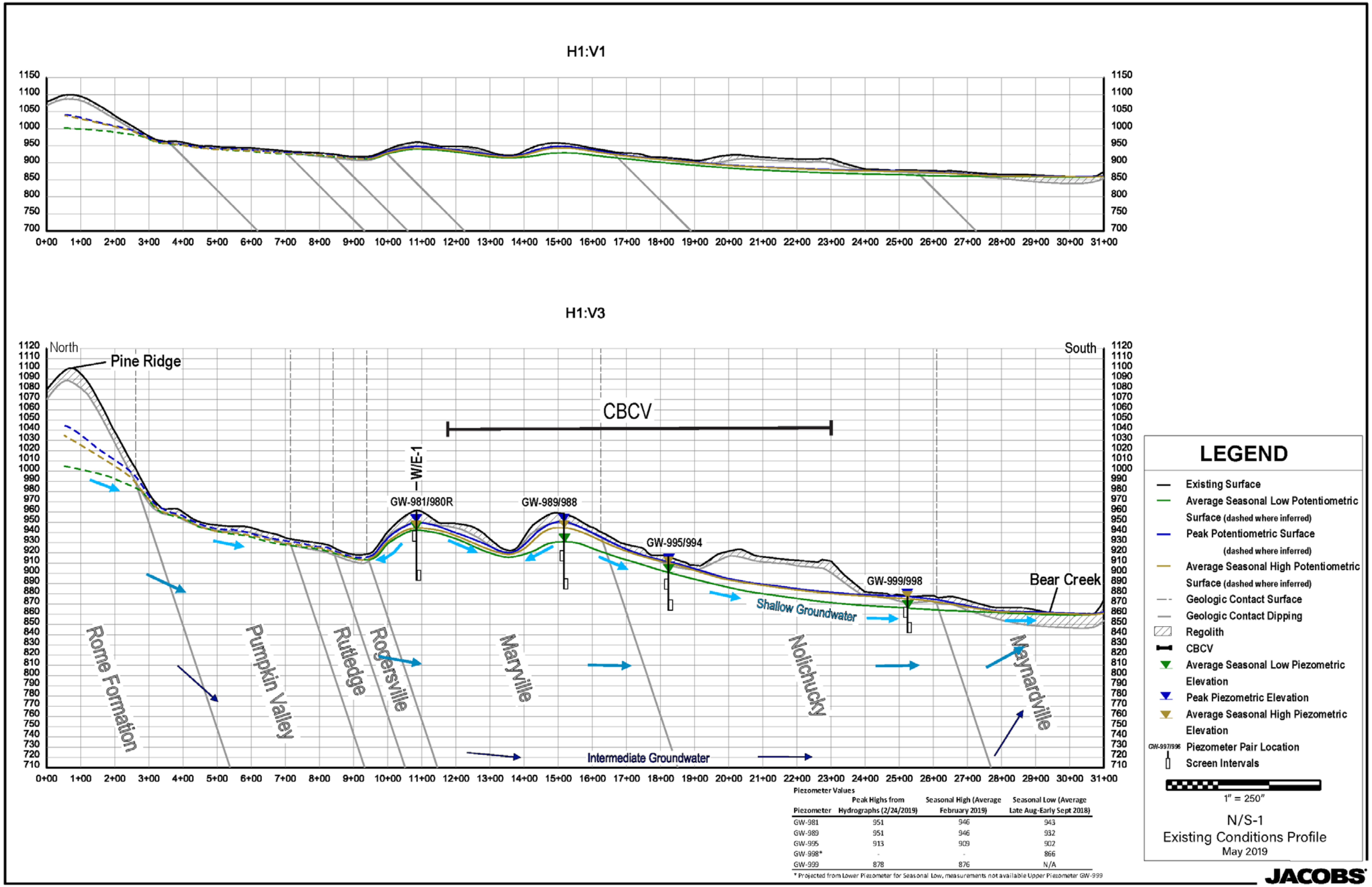


Fig. 7.1. Existing conditions profile location map.

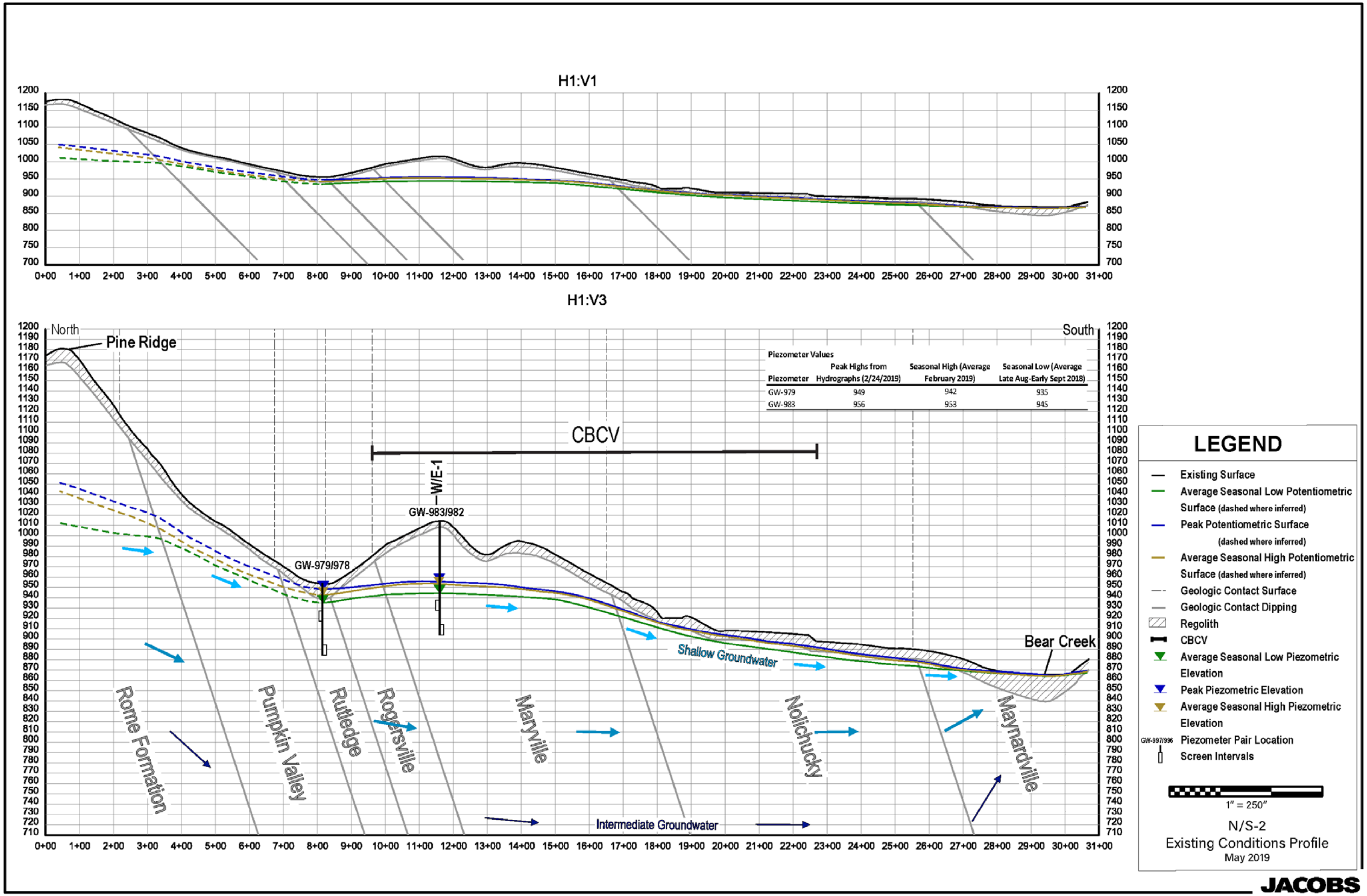


Piezometer Values

Piezometer	Peak Highs from Hydrographs (2/24/2019)	Seasonal High (Average February 2019)	Seasonal Low (Average Late Aug-Early Sept 2018)
GW-981	951	946	943
GW-989	951	946	932
GW-995	913	909	902
GW-998*	-	-	866
GW-999	878	876	N/A

* Projected from Lower Piezometer for Seasonal Low, measurements not available Upper Piezometer GW-999

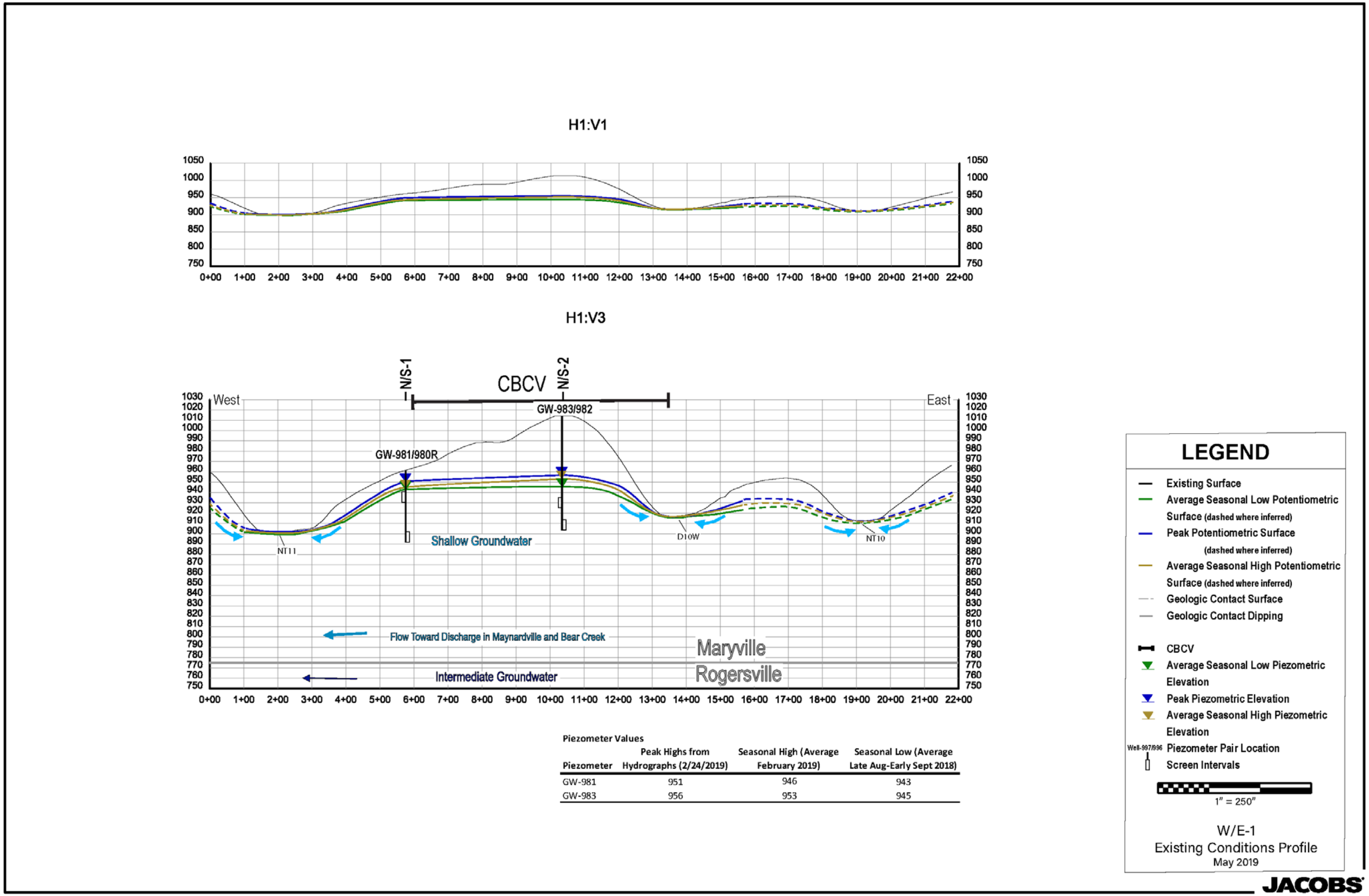
Fig. 7.2. North–south existing conditions profile 1 of the CBCV site.



Piezometer Values

Piezometer	Peak Highs from Hydrographs (2/24/2019)	Seasonal High (Average February 2019)	Seasonal Low (Average Late Aug-Early Sept 2018)
GW-979	949	942	935
GW-983	956	953	945

Fig. 7.3. North–south existing conditions profile 2 of the CBCV site.



Piezometer Values

Piezometer	Peak Highs from Hydrographs (2/24/2019)	Seasonal High (Average February 2019)	Seasonal Low (Average Late Aug-Early Sept 2018)
GW-981	951	946	943
GW-983	956	953	945

Fig. 7.4. West–east existing conditions profile of the CBCV site.

Table 7.2. Potentiometric surface variations at the CBCV site piezometers, March 2018 to April 2019

Piezometer	Mid-point of screen (ft-bgs)	Total depth (ft-bgs)	Minimum potentiometric surface (ft-amsl)	Maximum potentiometric surface (ft-amsl)	Difference from min to max (ft)
GW-978	64.5	80.0	934.78	948.72	13.94
GW-979	31.3	37.8	934.74	948.86	14.09
GW-980R	64.95	74.4	935.55	940.81	5.21
GW-981	27.1	34.0	942.76	951.04	8.26
GW-982	107.1	126.5	943.41	955.90	12.49
GW-983	84.2	92.2	943.35	956.23	12.89
GW-986	43.5	59.6	918.75	929.76	11.01
GW-987	21.1	27.9	918.43	929.17	10.75
GW-988	66.9	78.5	928.78	949.16	20.38
GW-989	38.6	45.0	929.26	951.30	22.04
GW-992R	41.85	55.5	901.38	909.16	7.77
GW-993	28.0	35.5	901.06	908.24	7.17
GW-994	47.0	55.0	901.69	913.47	11.79
GW-995	27.1	34.0	901.60	912.71	11.11
GW-998	31.6	45.0	865.42	878.76	13.34
GW-999	15.3	22.0	865.35	878.27	12.92

amsl = above mean sea level.
bgs = below ground surface.
CBCV = Central Bear Creek Valley.
GW = groundwater well
R = replacement borehole.

Potentiometric surface fluctuations over time in the CBCV piezometers are shown in Figs. 7.5 through 7.12. These figures show the potentiometric surfaces for the paired shallow and intermediate wells at the eight locations, the peak high potentiometric surface elevation, and the average seasonal high and average seasonal low potentiometric surfaces for the shallow well. The average seasonal high elevation is based on the average of the February 2019 potentiometric levels for the shallow well in the pair. The February 2019 data represent the period with the highest water levels recorded over the past 12 months of water level monitoring. The average seasonal low potentiometric surface is based on the average of the late August to early September water level data, which represents the period with the lowest water levels measured during the 12-month monitoring period. Depth to water measurements are recorded approximately every 30 min using downhole monitors.

The response to precipitation events is evident in the piezometer water level graphs (Figs. 7.5 through 7.12), although only a subdued response occurs at the piezometer pair of GW-982/GW-983 (Fig. 7.7). The widest fluctuations in potentiometric surface elevations occurred at the piezometer pair of GW-988 and GW-989, with changes in piezometric surface of 20.38 ft and 22.04 ft, respectively, over the period of March 2018 through April 2019. The following paragraphs provide some of the key observations from the piezometric data for each of the piezometer pairs the CBCV site.

The piezometer pair of GW-978/GW-979, located north of, and outside of, the conceptual design waste boundary, is at an elevation of approximately 954 ft above mean sea level (amsl). The piezometric surface in both the shallow and intermediate zones shows a gradual decline over the late spring, summer, and early fall months and then begins to increase during the late fall and winter months (Fig. 7.5). An overall fluctuation in the piezometric surface of approximately 14 ft has occurred over the year-long monitoring period. Piezometric surface response to precipitation events in both the shallow and intermediate zone piezometers is more subdued in the drier months of summer and early fall than in the wetter months of winter and early spring when a much greater response is evident to individual precipitation events. In general, the piezometric response in both the shallow and intermediate zones tracks closely with no significant lag in time of response between the two zones, and the slight downward vertical hydraulic gradient between the shallow and intermediate zones is maintained throughout the responses to precipitation.

The piezometer pair of GW-980R/GW-981, located at the northwest corner, just outside of the conceptual design waste boundary, is at an elevation of approximately 964 ft amsl. The piezometric surface in both the shallow and intermediate zones shows little fluctuation with only a slight overall decline in the late summer and early fall months, and then a slight increase during the late fall and winter months (Fig. 7.6). Fluctuation in the shallow piezometric surface of approximately 5.2 ft and in the intermediate piezometric surface of approximately 8.2 ft have occurred over the year-long monitoring period. The piezometric surface response to precipitation events in both the shallow and intermediate zone piezometers is more subdued in the drier months of summer and early fall than in the wetter months of winter and early spring when a more active response to individual precipitation events is evident. In general, the piezometric response in both the shallow and intermediate zones tracks closely with no significant lag in time of response between the two zones, and the significant downward vertical hydraulic gradient between the shallow and intermediate zones is maintained throughout the monitoring period.

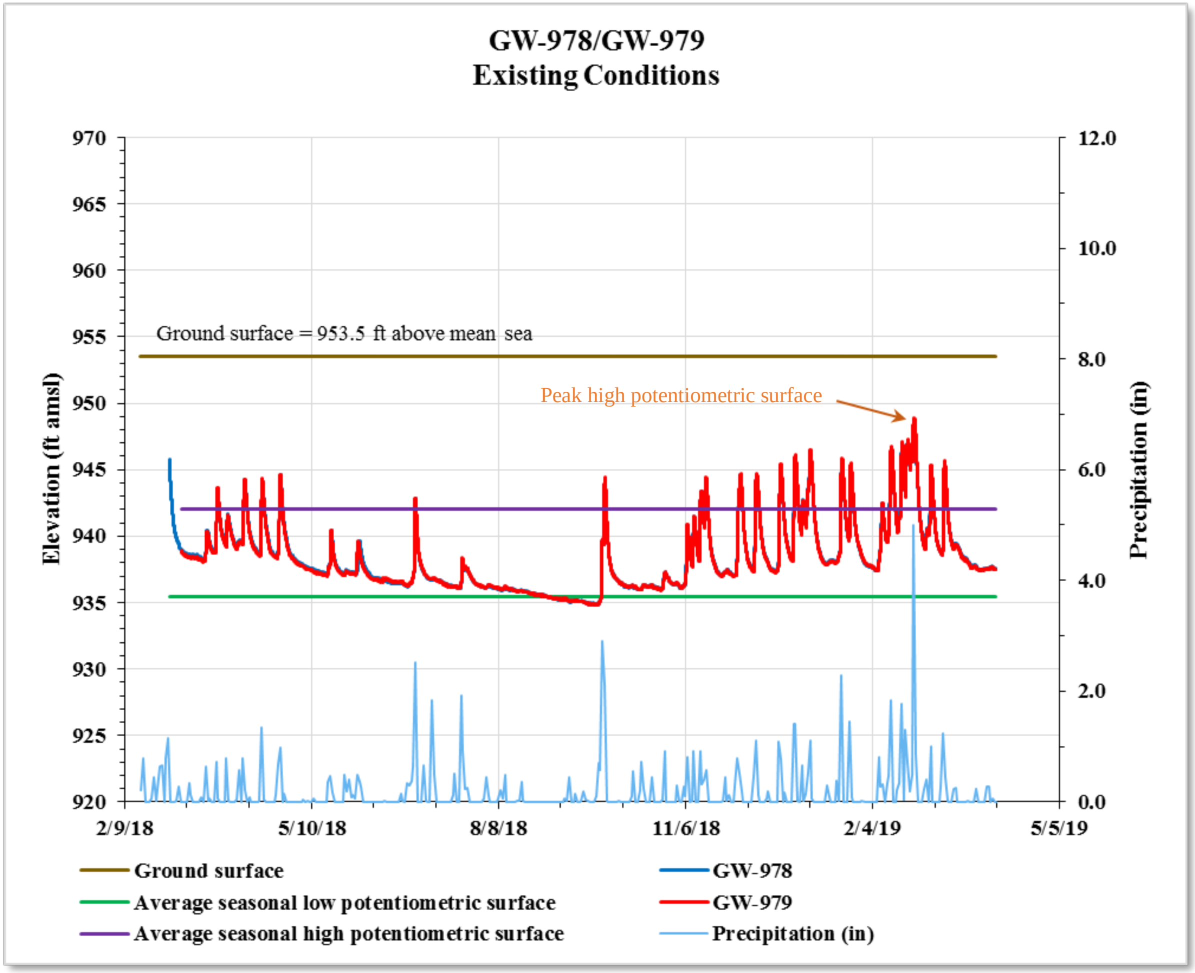


Fig. 7.5. Water levels at paired wells GW-978 and GW-979.

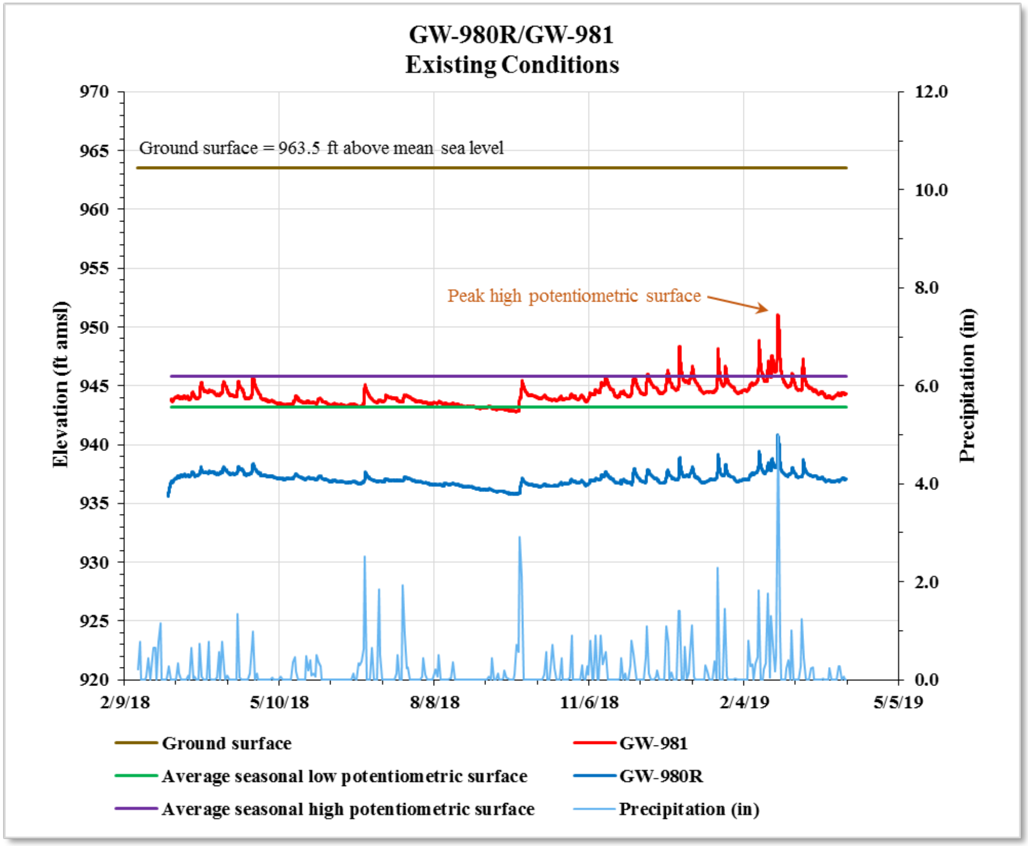


Fig. 7.6. Water levels at paired wells GW-980R and GW-981.

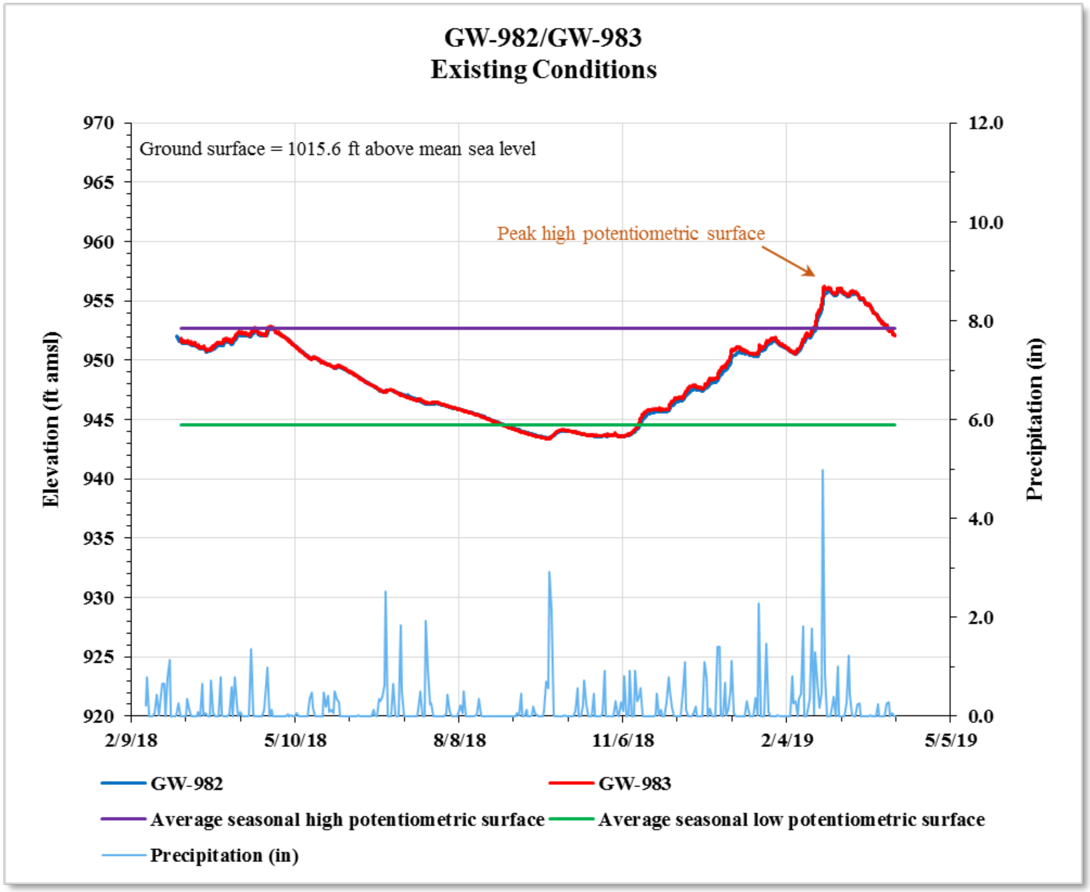


Fig. 7.7. Water levels at paired wells GW-982 and GW-983.

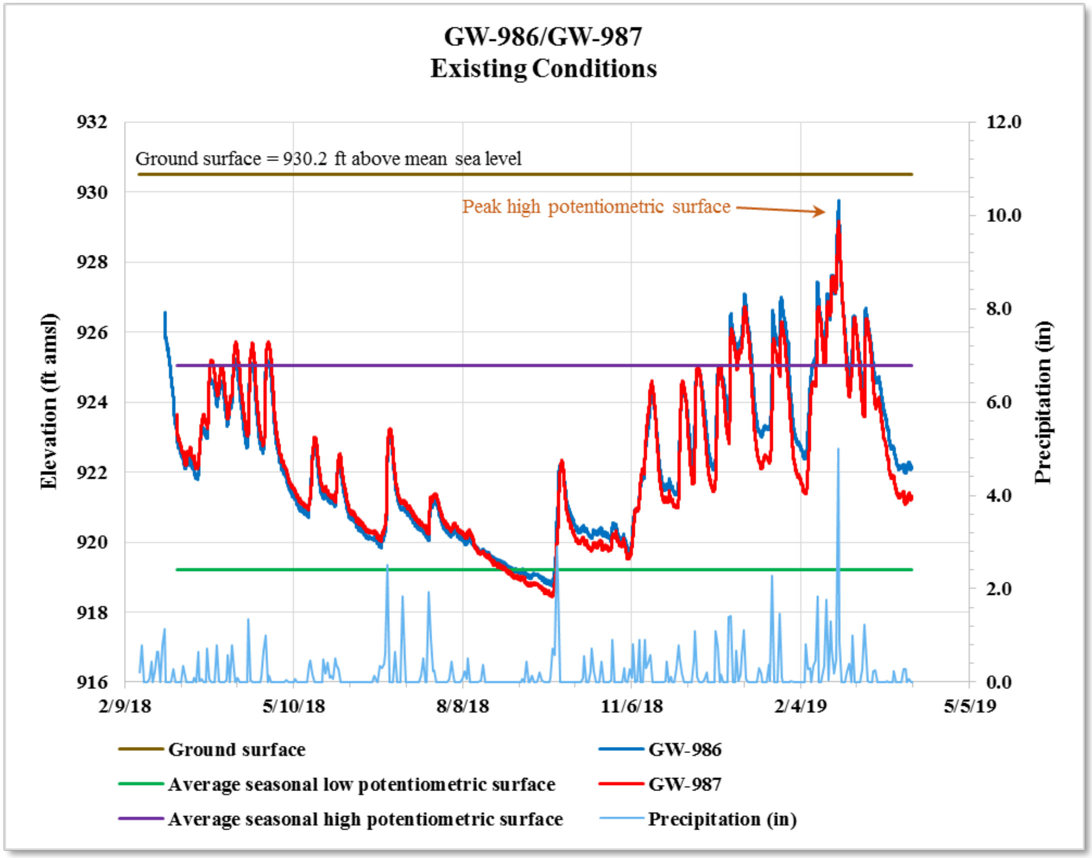


Fig. 7.8. Water levels at paired wells GW-986 and GW-987.

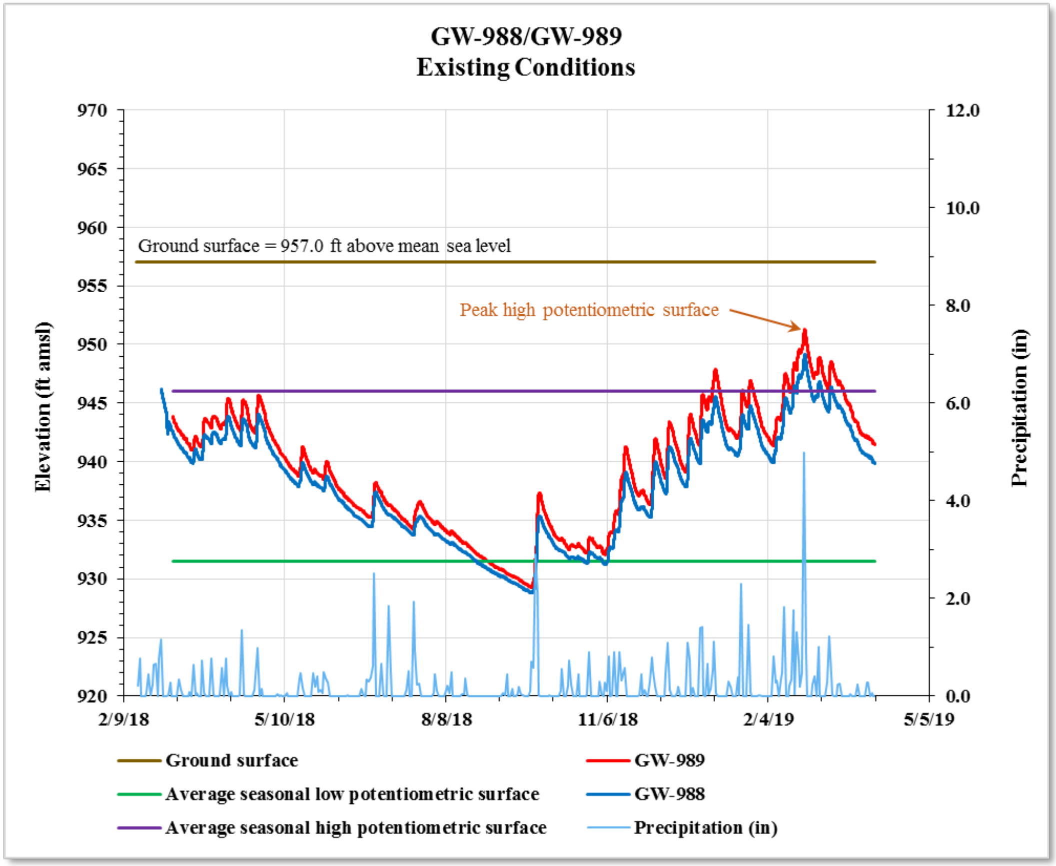


Fig. 7.9. Water levels at paired wells GW-988 and GW-989.

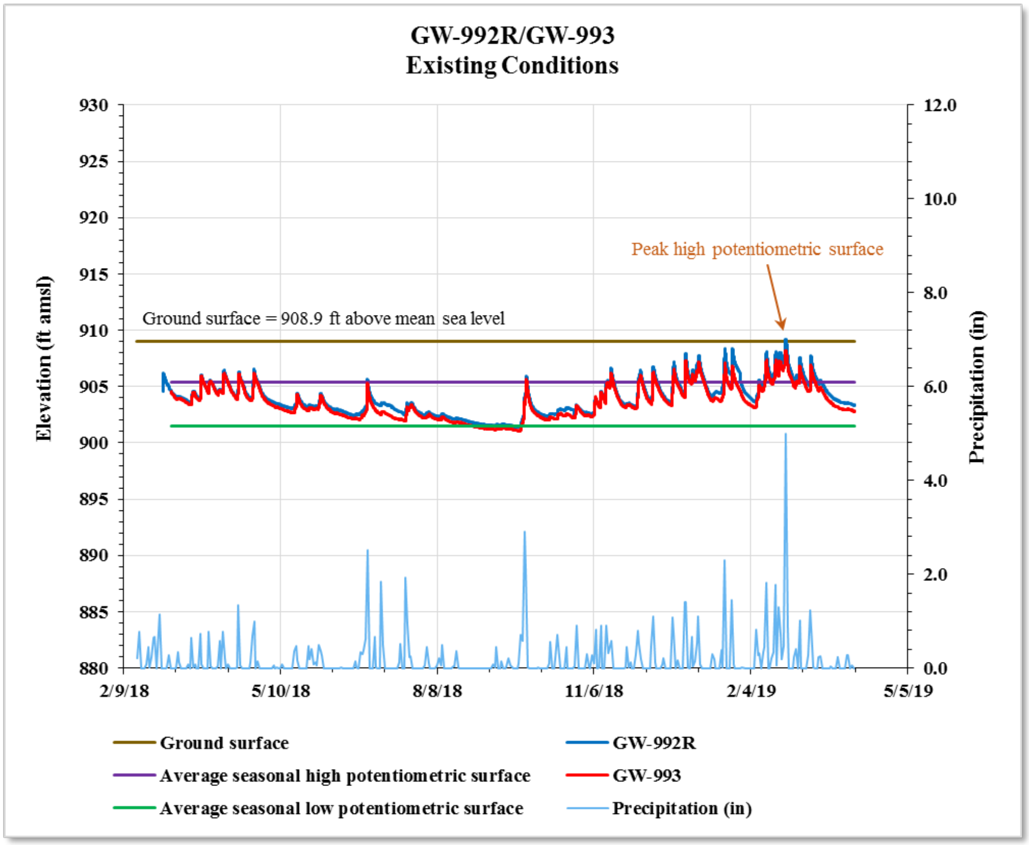


Fig. 7.10. Water levels at paired wells GW-992R and GW-993.

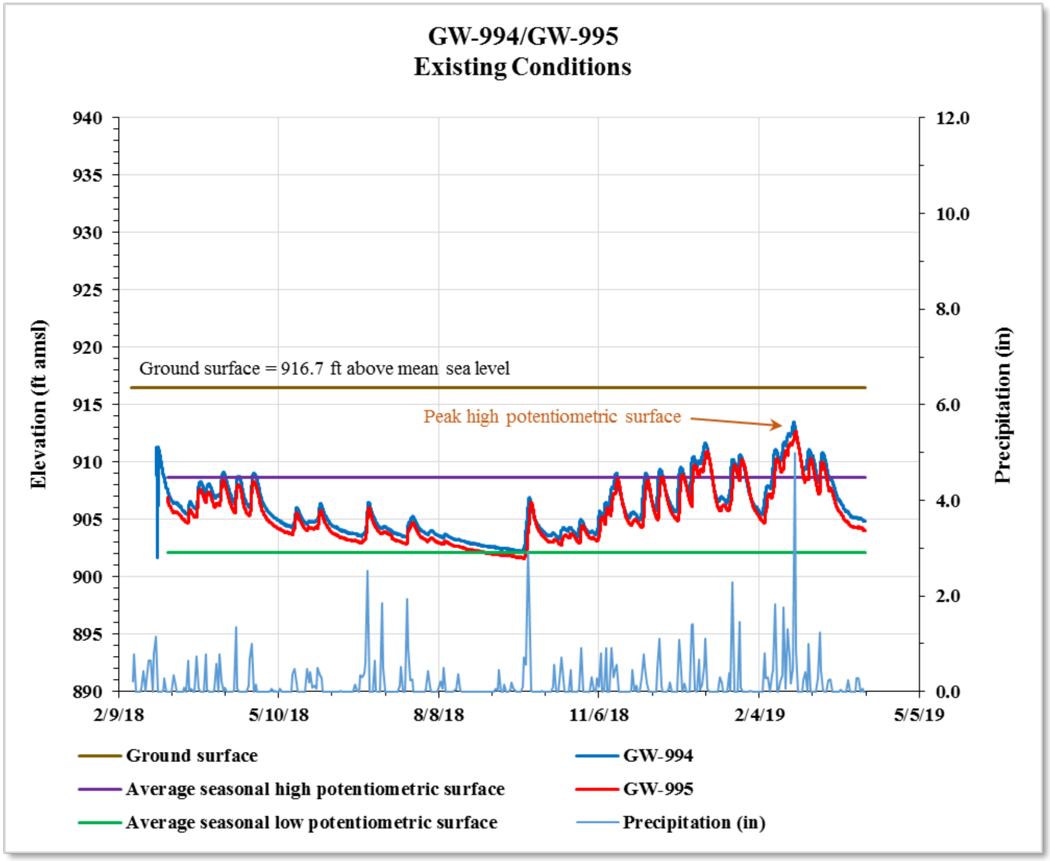


Fig. 7.11. Water levels at paired wells GW-994 and GW-995.

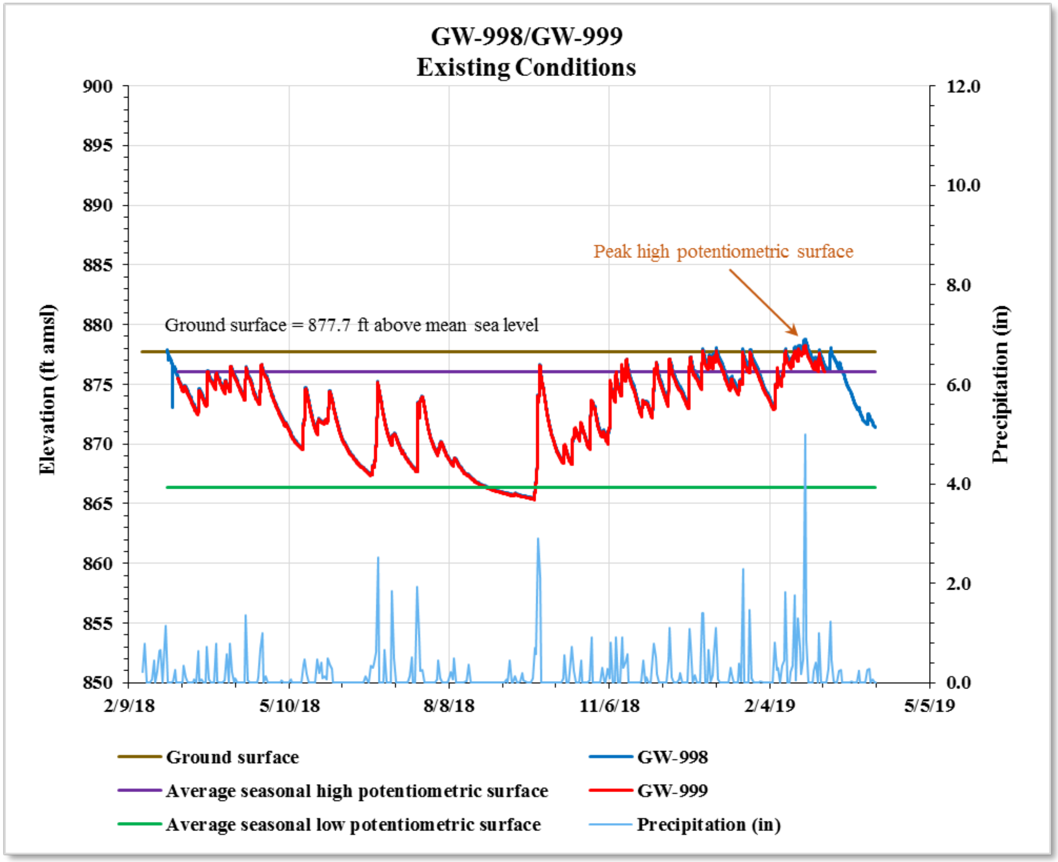


Fig. 7.12. Water levels at paired wells GW-998 and GW-999.

The piezometer pair of GW-982/GW-983, located within the northeast corner of the conceptual design waste boundary and on top of the knoll, is at an elevation of approximately 1,016 ft amsl. The piezometric surface in both the shallow and intermediate zones shows an overall decline starting in the spring and continuing through the summer and early fall months, and then a relatively significant increase starting in the late fall and continuing during the winter months (Fig. 7.7). An overall fluctuation in both the shallow and intermediate piezometric surface of approximately 12.5 ft has occurred over the year-long monitoring period. The piezometric surface response to precipitation events in both the shallow and intermediate zone piezometers is relatively subdued throughout the monitoring period; however, the response is even more subdued in the drier months of summer and early fall than in the wetter months of winter and early spring, when a response to precipitation events is more evident. In general, the piezometric response in both the shallow and intermediate zones tracks closely with no significant lag in time of response between the two zones. There appears to be little to no vertical gradient between the piezometric surfaces during the declining period, but a slight downward vertical gradient is present as the piezometric surface increases in the winter months.

The piezometer pair of GW-986/GW-987, located in the drainage that runs to the west to NT-11, within the upper reach of the D-11E drainage, is at a ground level elevation of approximately 930 ft amsl. The piezometric surface in both the shallow and intermediate zones shows a gradual overall decline from the late spring, through the summer and early fall months, and then an increasing level during the late fall and winter months (Fig. 7.8). An overall fluctuation in both the shallow and intermediate piezometric surface of approximately 11 ft has occurred over the year-long monitoring period. The piezometric surface response to precipitation events in both the shallow and intermediate zone piezometers is more subdued in the drier months of summer and early fall than in the wetter months of winter and early spring when a more active response to individual precipitation events is evident. In general, the piezometric response in both the shallow and intermediate zones tracks closely together with no significant lag in time of response between the two zones. The vertical hydraulic gradient between the shallow and intermediate zones is generally upward as the piezometric surface returns to static conditions; however, in response to precipitation events, the vertical gradients temporarily reverse to downward from the shallow to the intermediate zone around the peak of the response.

The piezometer pair of GW-988/GW-989, located near the west-central portion of the conceptual design waste boundary, is at a ground level elevation of approximately 957 ft amsl. The piezometric surface in both the shallow and intermediate zones shows a substantial overall decline from the late spring, through the summer and early fall months, and then a corresponding significant increase in level during the late fall and winter months (Fig. 7.9). An overall fluctuation in the shallow piezometric surface of approximately 22 ft has occurred, and an overall fluctuation of approximately 20.4 ft has occurred in the intermediate zone over the year-long monitoring period. The piezometric surface response to precipitation events in both the shallow and intermediate zone piezometers is more subdued in the drier months of summer and early fall than in the wetter months of winter and early spring when a more active response to individual precipitation events is evident. In general, the piezometric response in both the shallow and intermediate zones tracks closely together with no significant lag in time of response between the two zones. The vertical hydraulic gradient between the shallow and intermediate zones is generally downward throughout the year.

The piezometer pair of GW-992R/GW-993, located near the crossing of D-10W with Haul Road, in the east-central portion of the conceptual design waste boundary, is at a ground level elevation of approximately 910 ft amsl. The piezometric surface in both the shallow and intermediate zones shows a gradual overall decline from the late spring, through the summer and early fall months, and then a gradual increase in level during the late fall and winter months (Fig. 7.10). Overall, the piezometric surface has fluctuated approximately 7 ft in the shallow piezometer, and approximately 7.8 ft in the intermediate zone over the year-long monitoring period. The piezometric surface response to precipitation events in both the shallow and intermediate zone piezometers is slightly more subdued in the drier months of summer and early fall than in the wetter months of winter and early spring when a more active response to individual precipitation events is evident. In general, the piezometric response in both the shallow and intermediate zones tracks closely together with no significant lag in time of response between the two zones. The vertical hydraulic gradient between the shallow and intermediate zones is slightly upward from the intermediate to the shallow zone during static conditions and this upward vertical gradient is maintained during precipitation events.

The piezometer pair of GW-994/GW-995, located near Haul Road in the center of the southwestern quadrant of the conceptual design waste boundary, is at a ground level elevation of approximately 917 ft amsl. The piezometric surface in both the shallow and intermediate zones shows a gradual overall decline from the late spring, through the summer and early fall months, and then a corresponding gradual increase in level during the late fall and winter months (Fig. 7.11). An overall fluctuation in the shallow piezometric surface of approximately 11.1 ft has occurred, and an overall fluctuation of approximately 11.8 ft has occurred in the intermediate zone over the year-long monitoring period. The piezometric surface response to precipitation events in both the shallow and intermediate zone piezometers is generally more subdued in the drier months of summer and early fall than in the wetter months of winter and early spring when a more active response to individual precipitation events is evident. In general, the piezometric response in both the shallow and intermediate zones tracks closely together with no significant lag in time of response between the two zones. The vertical hydraulic gradient between the shallow and intermediate zones is upward during static conditions and throughout the response to precipitation events.

The piezometer pair of GW-998/GW-999, located southwest and outside of the conceptual design waste boundary in the lower elevation of the valley, is at a ground level elevation of approximately 878 ft amsl. The piezometric surface in both the shallow and intermediate zones, although a substantial portion of the summer and early fall data for the shallow piezometer (GW-999) are unavailable due to equipment malfunction, shows a relatively significant overall decline from the late spring, through the summer and early fall months, and then a corresponding significant increase in level during the late fall and winter months (Fig. 7.12). An overall fluctuation in the shallow piezometric surface of approximately 12.9 ft has occurred, and an overall fluctuation of approximately 113.3 ft has occurred in the intermediate zone over the year-long monitoring period. Unlike the other piezometers at the CBCV site that are located up the slope from the GW-998/GW-999 location, the piezometric surface response to precipitation events in both the shallow and intermediate zone piezometers is relatively active to individual precipitation events, even in the drier months of summer and early fall. In general, the piezometric response in both the shallow and intermediate zones tracks closely together with no significant lag in time of response between the two zones. The vertical hydraulic gradient between the shallow and intermediate zones is slightly upward during both static conditions and throughout the response to precipitation events.

Measurements of pH, temperature, and specific conductivity are also collected, in addition to water levels, at the CBCV piezometers. Groundwater temperatures from March 2018 to April 2019 ranged from 13.9°C to 19.3°C in the shallow piezometers and 13.0°C to 18.8°C in the intermediate piezometers. Measurements of pH ranged from 6.05 to 11.8 in the shallow piezometers and 6.72 to 11.47 in the intermediate piezometers. Specific conductivity measurements ranged from 106 µS/cm to 1,266 µS/cm in the shallow piezometers. As would be expected, the intermediate zone piezometers showed less fluctuation in specific conductivity with a range of 252 µS/cm to 894 µS/cm. Figures 7.13 to 7.15 provide graphs of the data for pH, temperature, and specific conductivity for all 16 of the CBCV site piezometers. In general, pH and temperature show minor fluctuations, with specific conductivity exhibiting the greatest degree of fluctuation. High initial readings of temperature, pH, and specific conductivity at some piezometers (e.g., GW-978 and GW-998) may reflect impacts from piezometer installation, as these elevated readings dropped off rapidly and have not recurred. Overall, the CBCV piezometers show typical fluctuations in specifc conductivity and pH in response to precipitation events. However, of particular interest is the behavior at piezometer GW-993 (Fig. 7.15). This is the shallow piezometer paired with the intermediate piezometer GW-992R. GW-993 monitors the shallow potentiometric surface in the D-10W

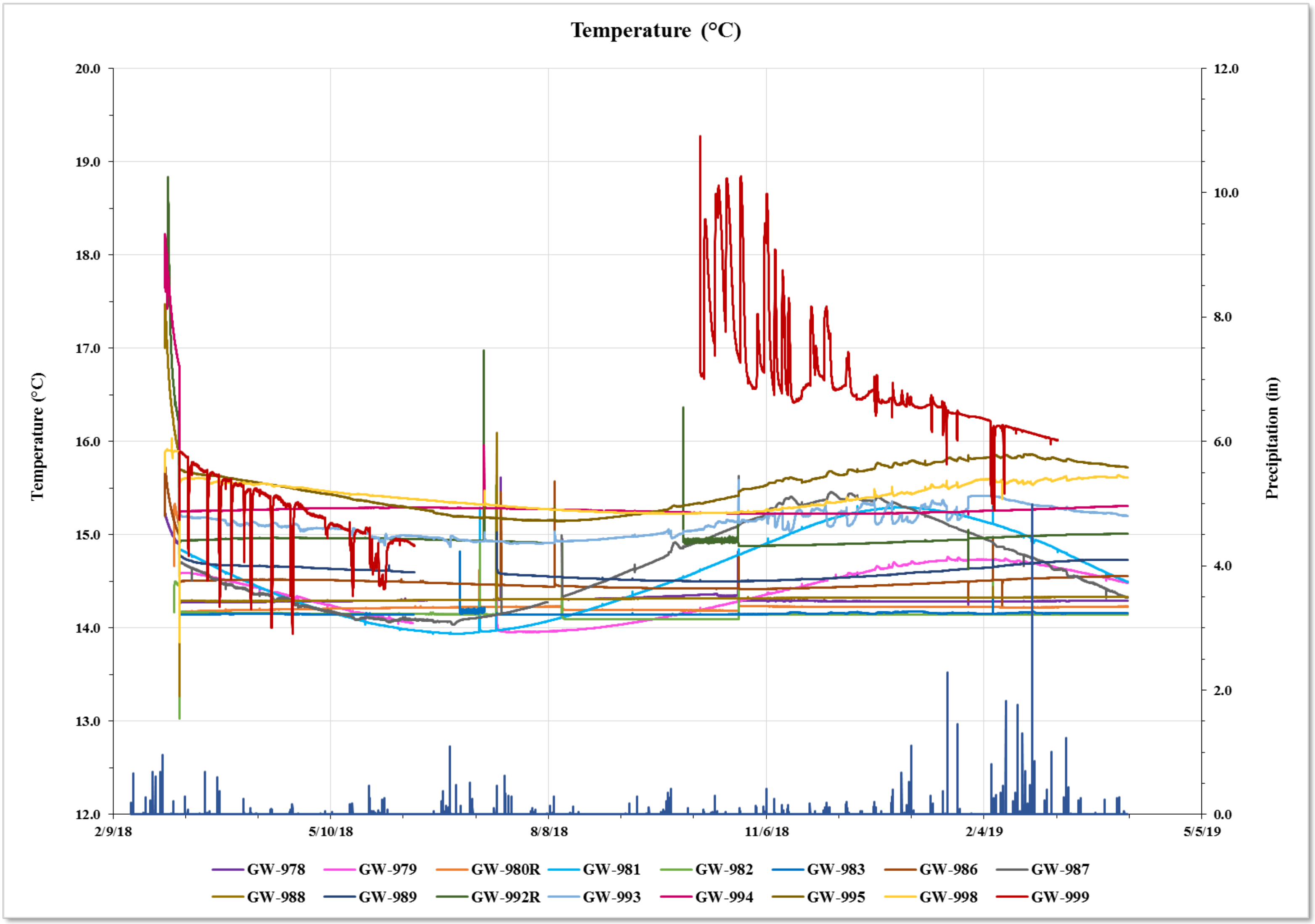


Fig. 7.13. Measurements of temperature at the CBCV site piezometers.

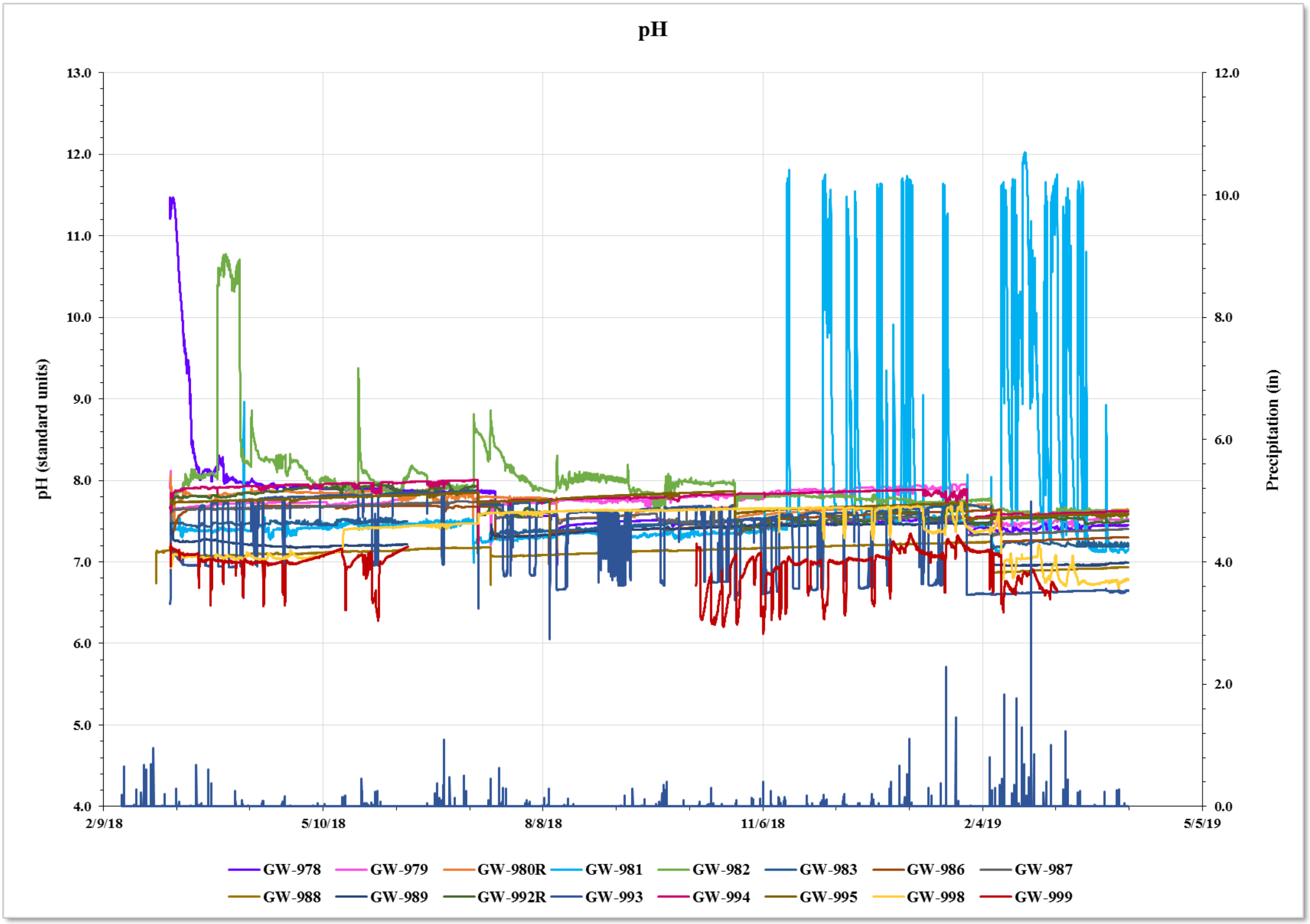


Fig. 7.14. Measurements of pH at the CBCV site piezometers.

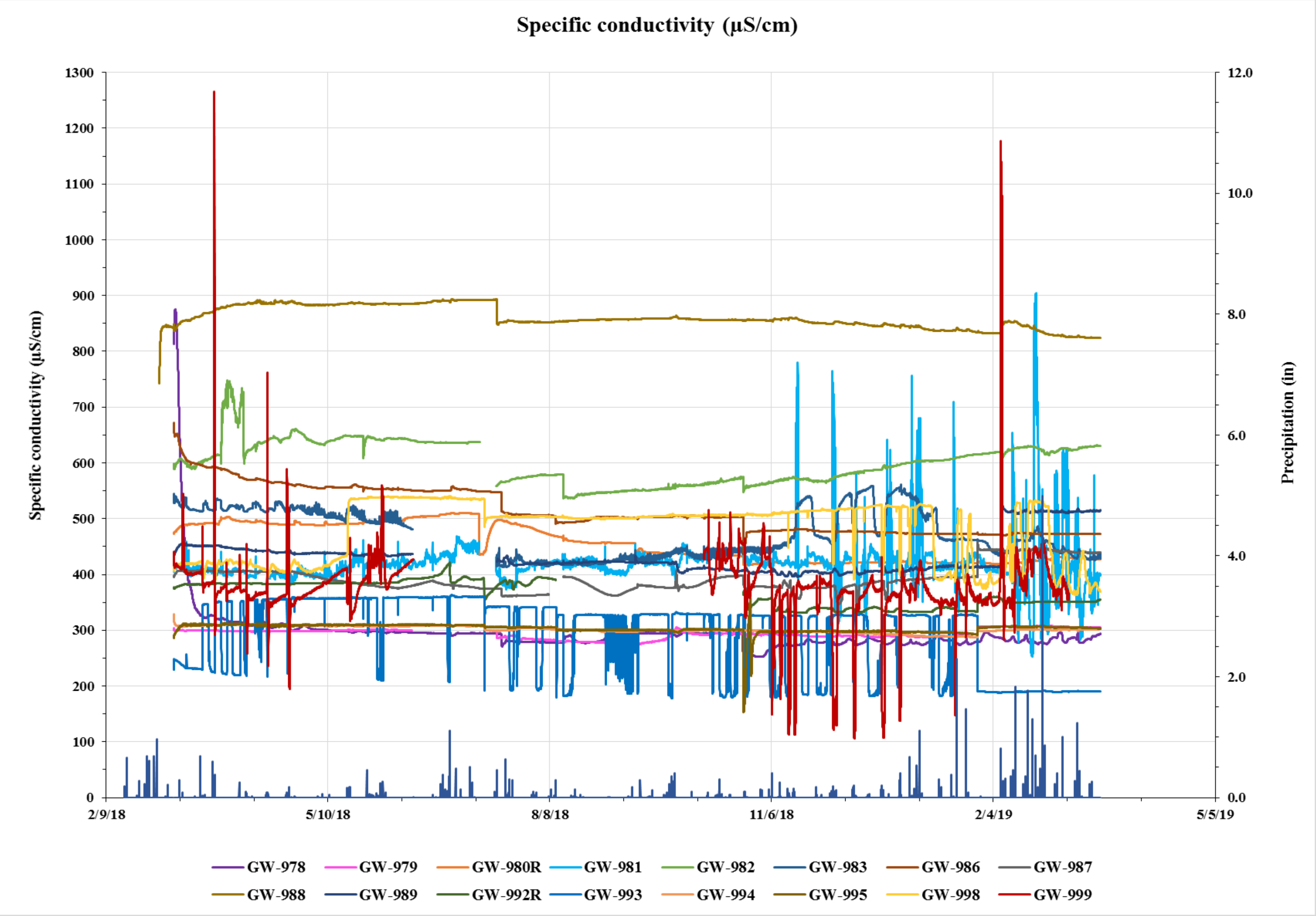


Fig. 7.15. Measurements of specific conductivity at the CBCV site piezometers.

drainage. The behavior of the monitored parameters at GW-993 appears to indicate that the rising groundwater from bedrock into the shallow well has higher specific conductivity and higher pH that dissipates when the shallow alluvial groundwater enters the screen during a precipitation event decline cycle. Thus, GW-993 appears to monitor exactly on the hydrogeochemical interface between bedrock and the unconsolidated alluvial zone groundwater.

The sudden increase in both pH and specific conductivity over approximately 10 days in late March and early April at GW-982 does not appear to be related to precipitation, but the initial increase does correspond to a field adjustment of the transducer. Since the second week of April, the pH at GW-982 has ranged from 7.9 to 8.9.

Rapid, large fluctuations in temperature at GW-999, located in the lower elevations near the valley floor, suggest that contributions from surface water may be impacting the observed temperatures. Spikes in pH greater than 11 at GW-981 in the wet season may indicate impacts from grout used for piezometer construction. The spikes in pH also correspond to spikes in specific conductivity at this piezometer occurring during November, December, and early January. In general, the shallow piezometers show a more flashy response of all three parameters to precipitation events than occurs in the intermediate zone piezometers.

Comparison of Phase 1 Piezometers with Initial Extrapolation

Included in TM #1 were extrapolated potentiometric surfaces for the wet season (February) for the CBCV site piezometers, which were based on the water levels for wells located elsewhere in BCV (Fig. 7.16), but having similar water level response to precipitation events as the CBCV piezometers. However, with wet season data now available for the CBCV piezometers, extrapolation of water levels is no longer necessary.

The water level comparison included in TM #1 showed similar piezometric fluctuations between most of the CBCV piezometers and other wells within BCV. An example is the graph in Fig. 7.17 showing GW-994 (CBCV) and GW-078 (BCV). Although there are minor differences in the fluctuations, and magnitude of the fluctuations, there is good correlation between these two piezometers/wells, despite a distance of approximately 3,000 ft between these two locations. Figure 7.18 shows a comparison between GW-980R (CBCV) and GW-080 (BCV), which did not show a good correlation of water level responses. However, the piezometer pair of GW-980R/GW-981 exhibits significantly less response to precipitation events, with the exception of GW-982/GW-983, than the other CBCV piezometers. Thus, the extrapolated water levels for the GW-980R/GW-981 piezometers may not correlate as well with the continuing data being collected.

It should be noted that, as discussed in Sect. 1, precipitation for 2018 and early 2019 was significantly higher than the average, and water level fluctuations may vary somewhat from historical behavior.

7.3 POTENTIOMETRIC SURFACE MAPS, GRADIENTS, AND FLOW RATE

Figures 7.19, 7.20, and 7.21 show the piezometric surface for the peak high conditions at the CBCV site, from February 24, 2019, the average seasonal high potentiometric surface from February 2019, and the average seasonal low potentiometric surface from the period of late August to early September 2018 in the shallow CBCV site piezometers. The potentiometric surface represented in Fig. 7.19 is based on the potentiometric surface measured in the CBCV piezometers on September 24, 2018, with the exception of GW-999, which did not have data collected on that date. The potentiometric surface for GW-999 is represented by the lowest potentiometric surface measured in that piezometer which occurred on October 15, 2018.

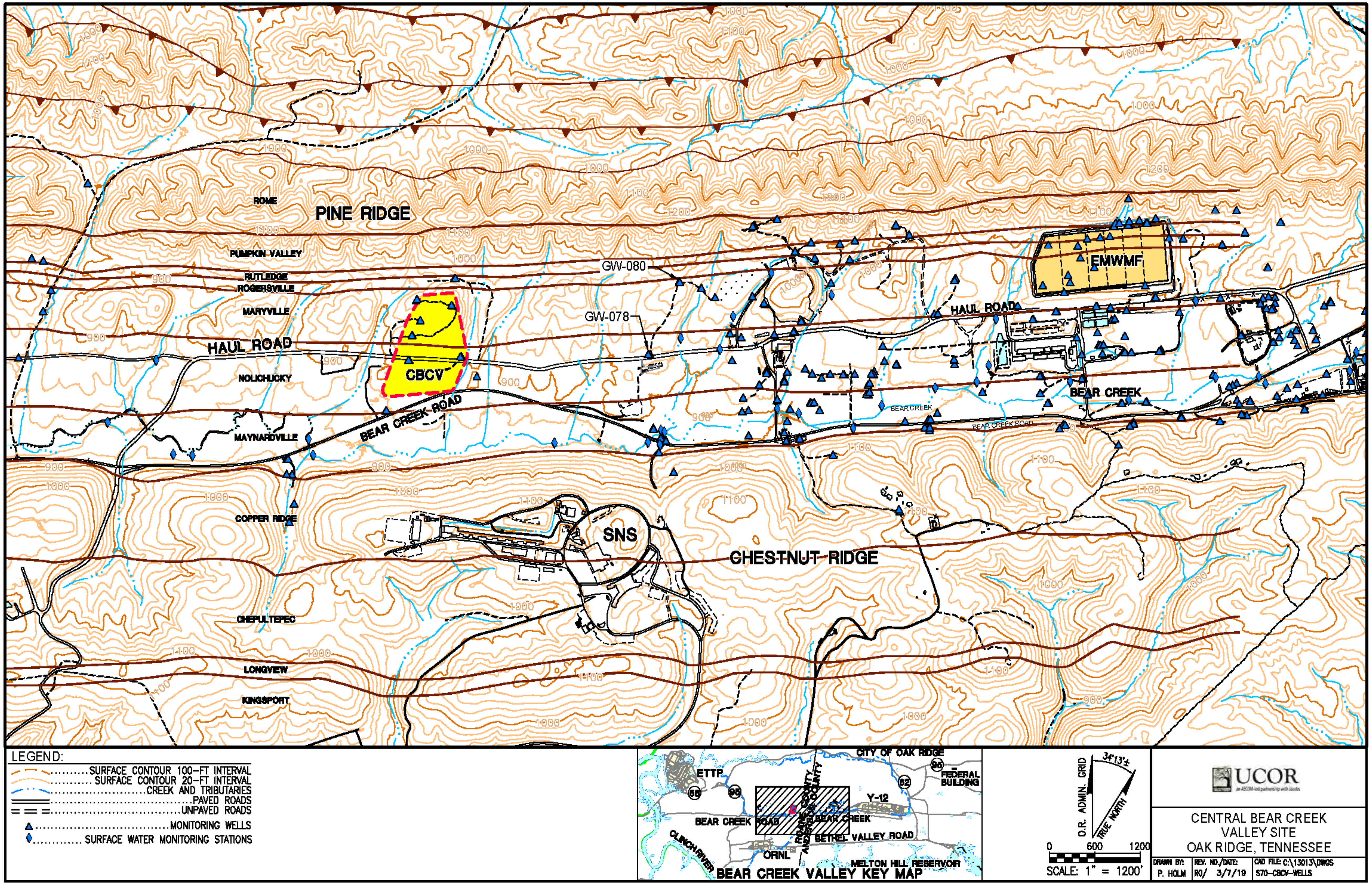


Fig. 7.16. Bear Creek Valley well locations.

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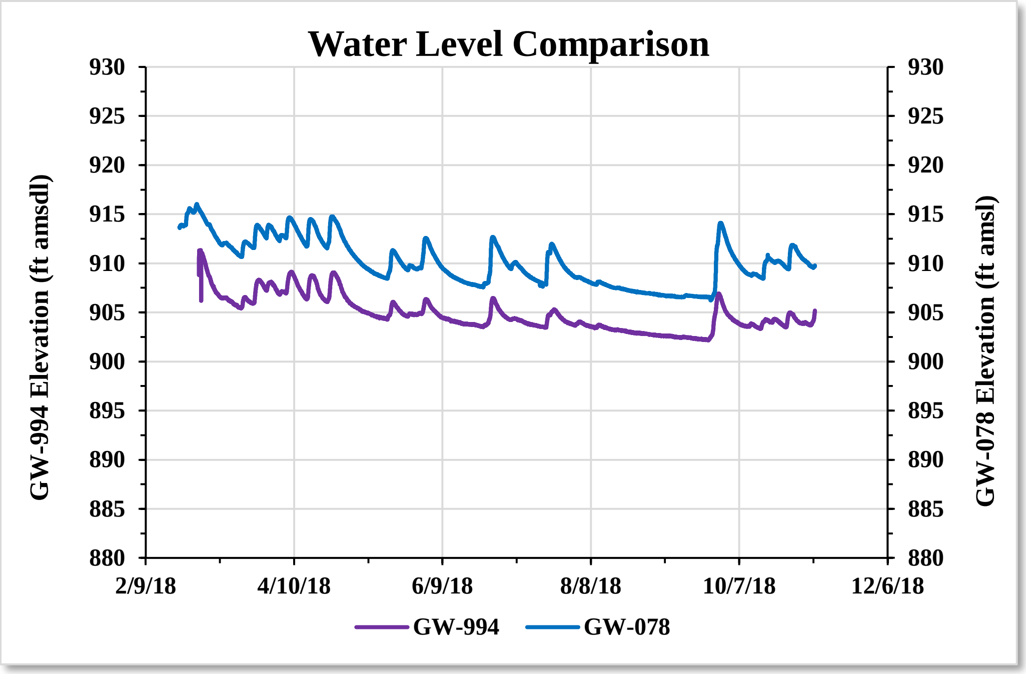


Fig. 7.17. Water level comparison for GW-994 (CBCV) and GW-078 (BCV).

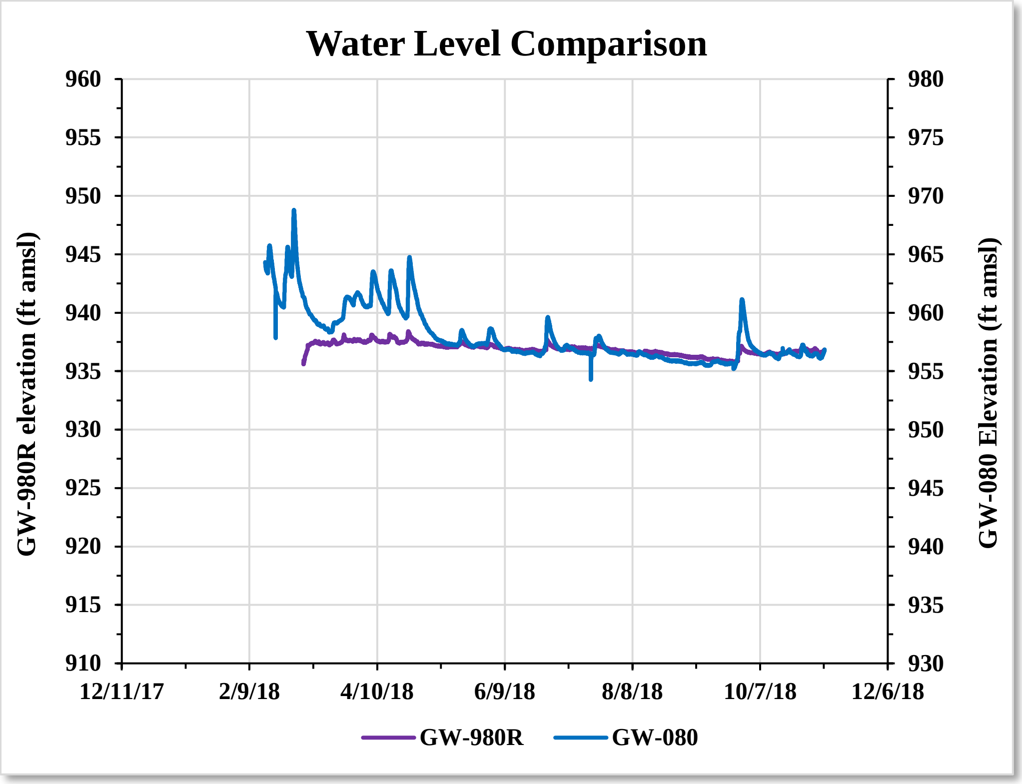


Fig. 7.18. Water level comparison for GW-980R (CBCV) and GW-080 (BCV).

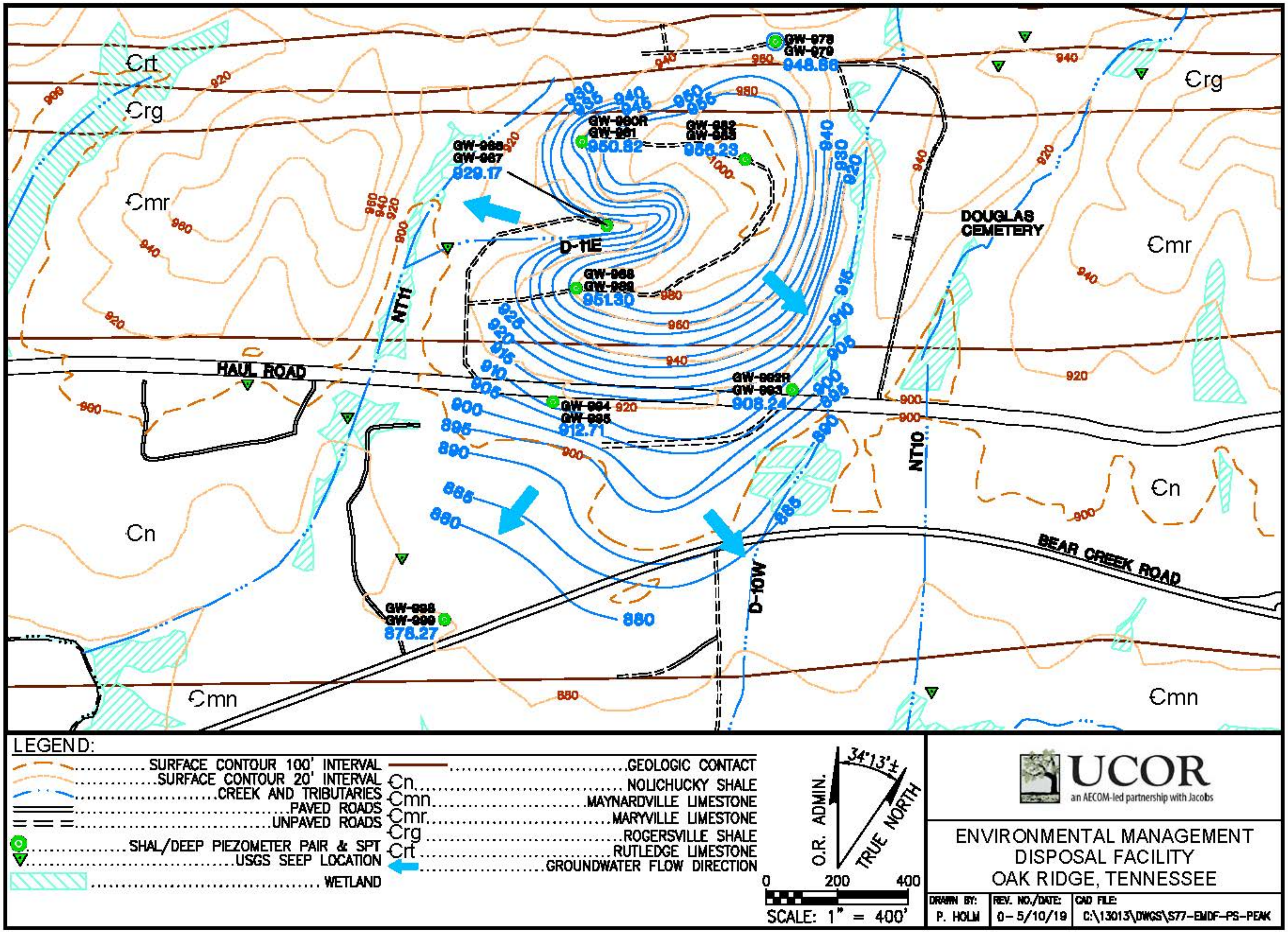


Fig. 7.19. Piezometric surface map of the peak high conditions at the CBCV site, February 24, 2019.

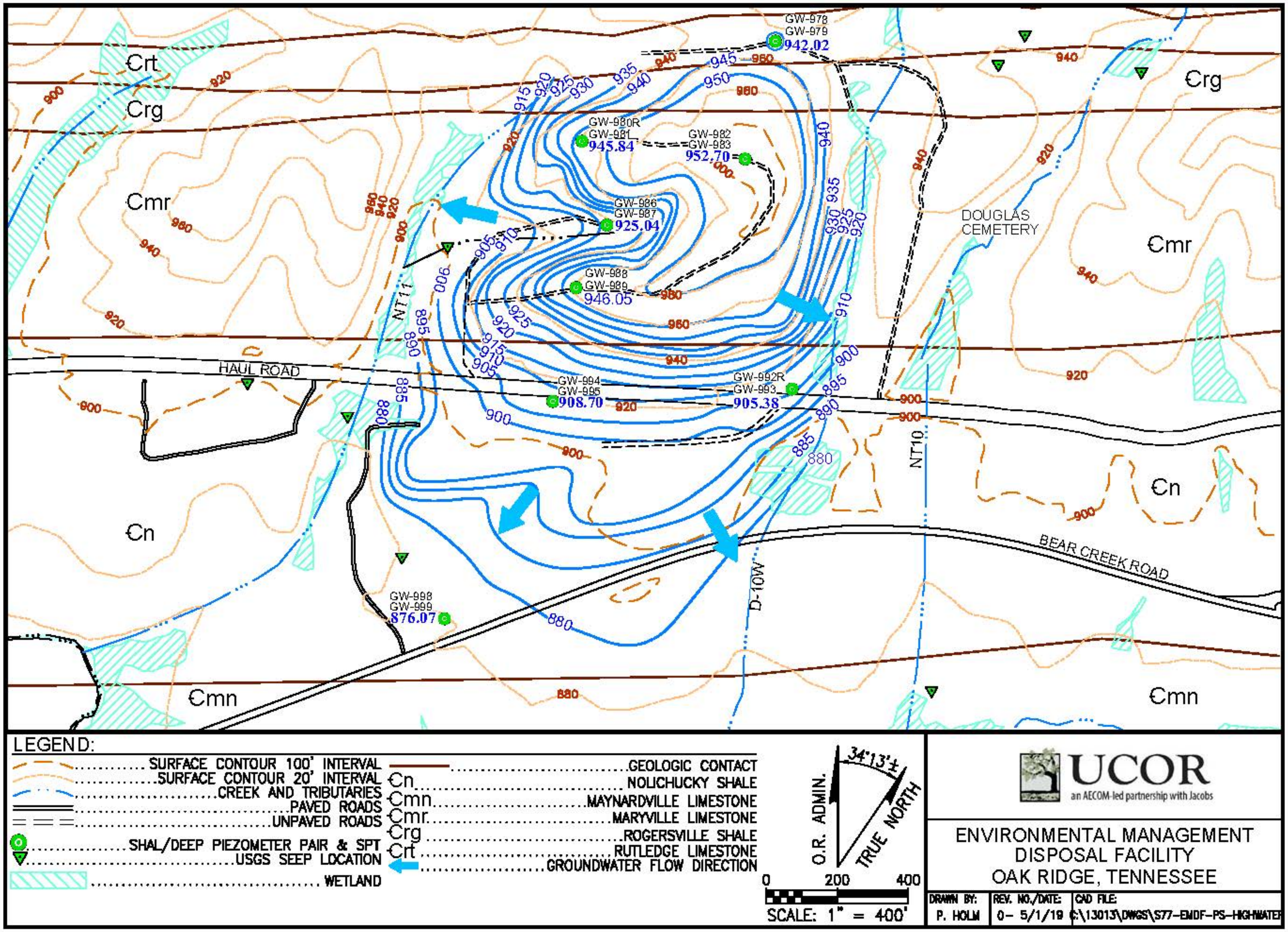


Fig. 7.20. Piezometric surface map of the average seasonal high conditions at the CBCV site, February 2019.

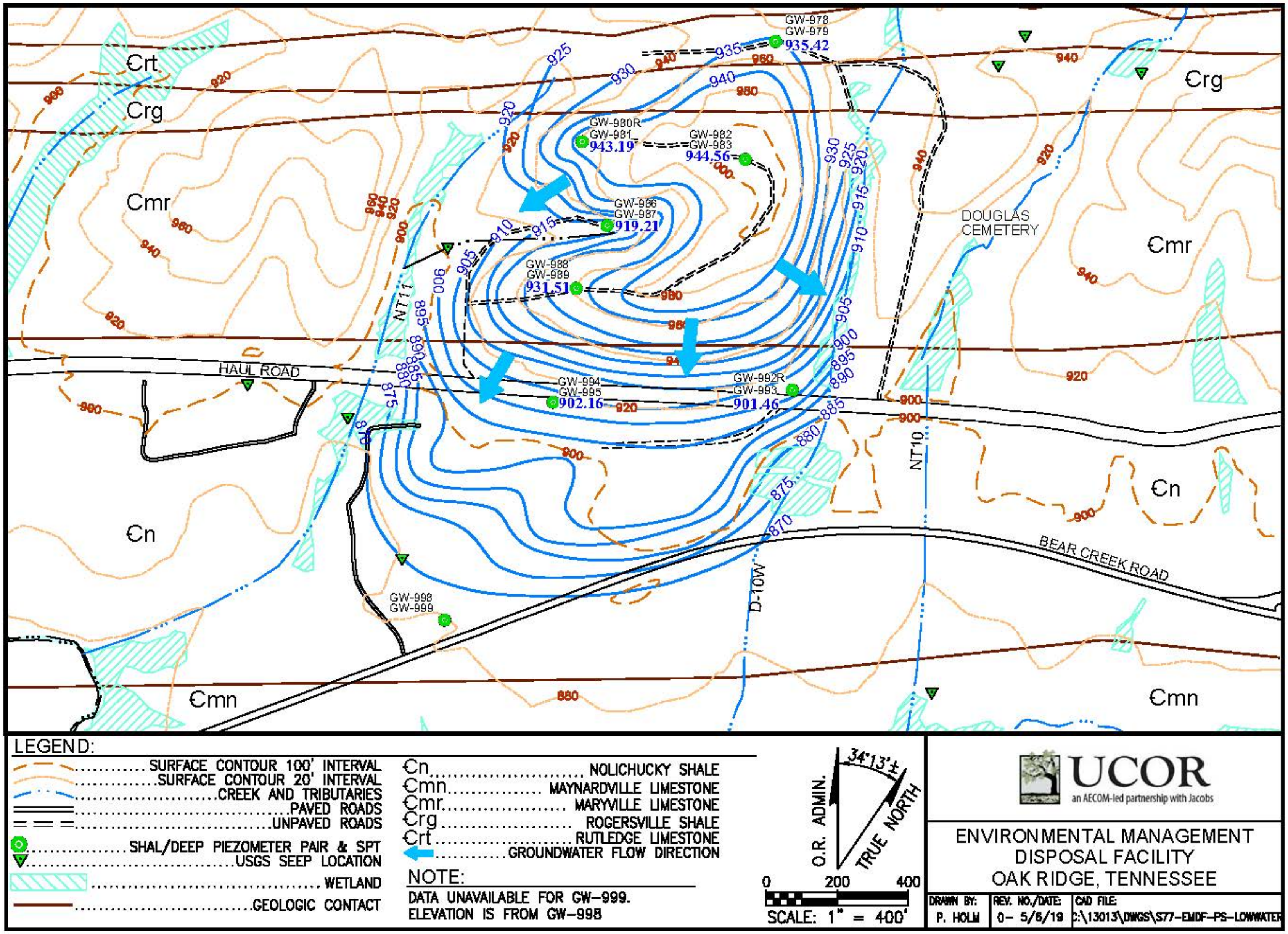


Fig. 7.21. Piezometric surface map of the average seasonal low conditions at the CBCV site, August to September 2018.

Horizontal hydraulic gradients are variable over the site as can be seen in the potentiometric maps (Figs. 7.19 and 7.20). Using the potentiometric map in Fig. 7.20, the average hydraulic conductivity from the shallow piezometers, and an effective porosity of 0.2, a linear groundwater velocity of approximately 0.58 ft/day is obtained for the slopes in the central portion of the site between GW-989 and GW-995 based on the January 2019 water levels. A linear groundwater velocity of 0.25 ft/day is obtained for the southern portion of the site between GW-995 and GW-999 based on the January water levels.

Vertical hydraulic gradients between the shallow and intermediate zones at the CBCV site were determined based on piezometric surfaces from September 2018 and February 2019. The vertical gradients were calculated using the mid-point of the screen for both paired piezometers and determining the difference in the vertical distance between these two points. The difference between the piezometric surface for the shallow piezometer and the intermediate piezometer was then determined and the result divided by the difference between the mid-point of the screens to derive the vertical gradient (EPA 2019). The vertical gradients calculated for the CBCV piezometers indicate that five of the eight well pairs exhibited upward vertical gradients during September 2018, with the exception that the piezometric data for October 15 were used for the well pair of GW-998/GW-999 due to no September data being available for GW-999. The other three well pairs exhibited downward vertical gradients in September 2018. Vertical gradients determined for February 2019 indicate that the well pair of GW-982/GW-983 exhibited a reversal of the vertical gradient with a downward gradient instead of an upward gradient that was observed in September 2018. The remaining well pairs exhibited identical vertical gradient directions as in September 2018. The mid-point of the well screens, total depth of the well, and the vertical gradients from September 24, 2018, and February 24, 2019, are shown in Table 7.3. The September 24 date was selected as this represents the date of the lowest potentiometric surfaces at most of the CBCV site piezometers and follows a period in late August and early September of little, to no, precipitation. The February 24, 2019, date was selected as this represents a period of minimal evapotranspiration and the highest potentiometric surface recorded at the CBCV piezometers during the year-long monitoring period.

Table 7.3. Vertical gradients at the CBCV site, September 2018 and February 2019

Piezometer	Mid-point of screen (ft bgs)	Total depth (ft bgs)	Vertical gradient during dry conditions, September 2018 (ft/ft)	Vertical gradient direction during dry conditions, September 2018	Vertical gradient during wet conditions, February 2019 (ft/ft)	Vertical gradient direction during wet conditions, February 2019
GW-978	64.5	80.0	0.12	Down	<0.01	Down
GW-979	31.3	37.8				
GW-980R	64.95	74.4	0.19	Down	0.28	Down
GW-981	27.1	34.0				
GW-982	107.1	126.5	<-0.01	Up	0.03	Down
GW-983	84.2	92.2				
GW-986	43.5	59.6	-0.01	Up	-0.02	Up
GW-987	21.1	27.9				
GW-988	66.9	78.5	0.02	Down	0.08	Down
GW-989	38.6	45.0				
GW-992R	41.85	55.5	-0.02	Up	-0.07	Up
GW-993	28.0	35.5				
GW-994	47.0	55.0	-0.07	Up	<-0.01	Up
GW-995	27.1	34.0				
GW-998	31.6	45.0	-0.01	Up	-0.03	Up
GW-999	15.3	22.0				

CBCV = Central Bear Creek Valley.
ft bgs = feet below ground surface.
GW = groundwater well.
R = replacement borehole.

7.4 POTENTIAL FOR UPWELLING BENEATH THE KNOLL

Hydrographs and groundwater electrical conductivity (EC) were evaluated for the four piezometer pairs constructed in the Maryville Limestone beneath the knoll area on the southern flank of Pine Ridge to determine the potential for groundwater upwelling (Fig. 6.1, GW-980R/981, GW-982/983, GW-986/987, and GW-988/989). As part of the groundwater evaluation, the piezometer data were compared to observations and measurements of the flow characteristics and EC for the adjacent CBCV site drainages.

7.4.1 Piezometer Pair GW-982/GW-983

This piezometer pair is located at the highest part of the knoll (Fig. 6.1). The location of this piezometer pair, along with GW-980R/981, is shown on the west/east profile section (Fig. 7.4). The section shows the elevation of the screened intervals, surface topography, slopes, and elevations of adjacent drainages.

The changes in the potentiometric surface with time and the screened intervals are shown on Fig. 7.22. The intermediate (GW-982) and shallow (GW-983) piezometers in this pair generally demonstrate a neutral to weakly downward gradient (Fig. 7.22).

Both piezometers demonstrate a slow infiltration rate after rain events, with infiltration into the intermediate piezometer slightly slower. The shallow piezometer drains more quickly than the intermediate piezometer, resulting in a slight upward gradient during the dry periods.

As expected, the EC for the intermediate piezometer is higher than the shallow piezometer, reflecting groundwater in contact with the bedrock for a longer period of time, with limited response to precipitation events. The slow infiltration of precipitation during rain events results in subdued changes in potentiometric surface. The largest changes in EC are associated with the greatest increases in potentiometric surface.

Comparison of the vertical gradient between the piezometer pairs with the lateral gradient to the nearest surface water drainage (D-10W) found that the lateral gradient to the D-10W is 5 to 10 times steeper than the vertical gradient for the piezometer pair. This steeper lateral gradient, in combination with aquifer hydraulic conductivity anisotropy caused by dipping beds having contrasting properties, indicates that beneath the knoll, there is more lateral flow toward the drainages than vertically downward and deeper into the bedrock. The very weak upward gradient, when present, is far less than the lateral gradient.

7.4.2 Piezometer Pair GW-980R/GW-981

This piezometer pair is located on the northwestern side of the knoll and the ground surface drops steeply on three sides (south, west, and north) toward NT-11 (see Fig. 6.1). The changes in the potentiometric surface with time are shown on Fig. 7.23. The location of this piezometer pair, along with GW-982/983, is shown on the west/east profile section (Fig. 7.4). The section shows the elevation of the screened intervals, surface topography, slopes, and elevations of adjacent drainages. As shown in Fig. 7.23, a consistently strong downward gradient is present, consistent with the surrounding topography.

This piezometer pair shows a typically higher EC for the intermediate piezometer, reflecting more contact time with bedrock, but declining to levels more consistent to the shallow piezometer (Fig. 7.23). This change may reflect flushing of the groundwater with the increased precipitation during the 2018 very high precipitation year. The shallow piezometer potentiometric surface and EC is very responsive to precipitation, indicating a good infiltration pathway for precipitation.

The strong vertical downgradient at this location is greater than the lateral gradient toward NT-11 although the groundwater elevations in this well pair remain about 25 to about 35 ft higher than the nearby NT-11 headwater stream elevation. The gradient is influenced by the topography and nearby drainages. Therefore, precipitation that infiltrates in the subsurface tends to move downward into the bedrock and then laterally to discharge toward NT-11. This conclusion is supported by similar EC values in groundwater from both the shallow and intermediate piezometers, reflecting similar groundwater travel paths and residence time. However, the shallow piezometer is more responsive to precipitation events, indicating somewhat higher infiltration in the shallow potentiometric surface as compared to the intermediate potentiometric surface.

Grout contamination may be influencing the shallow piezometer to some extent because both pH and EC rise with the increases in the potentiometric surface.

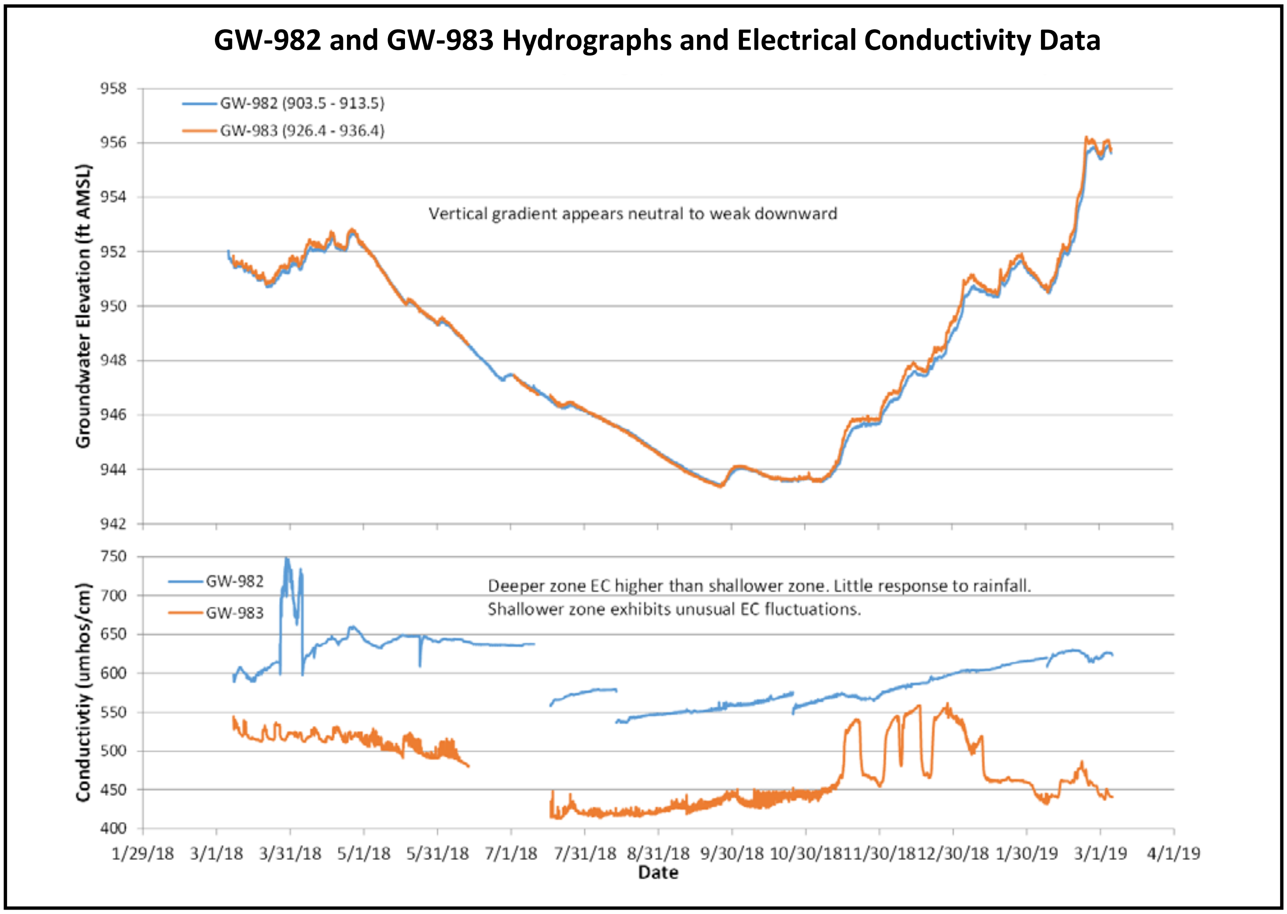


Fig. 7.22. GW-982/983 comparisons.

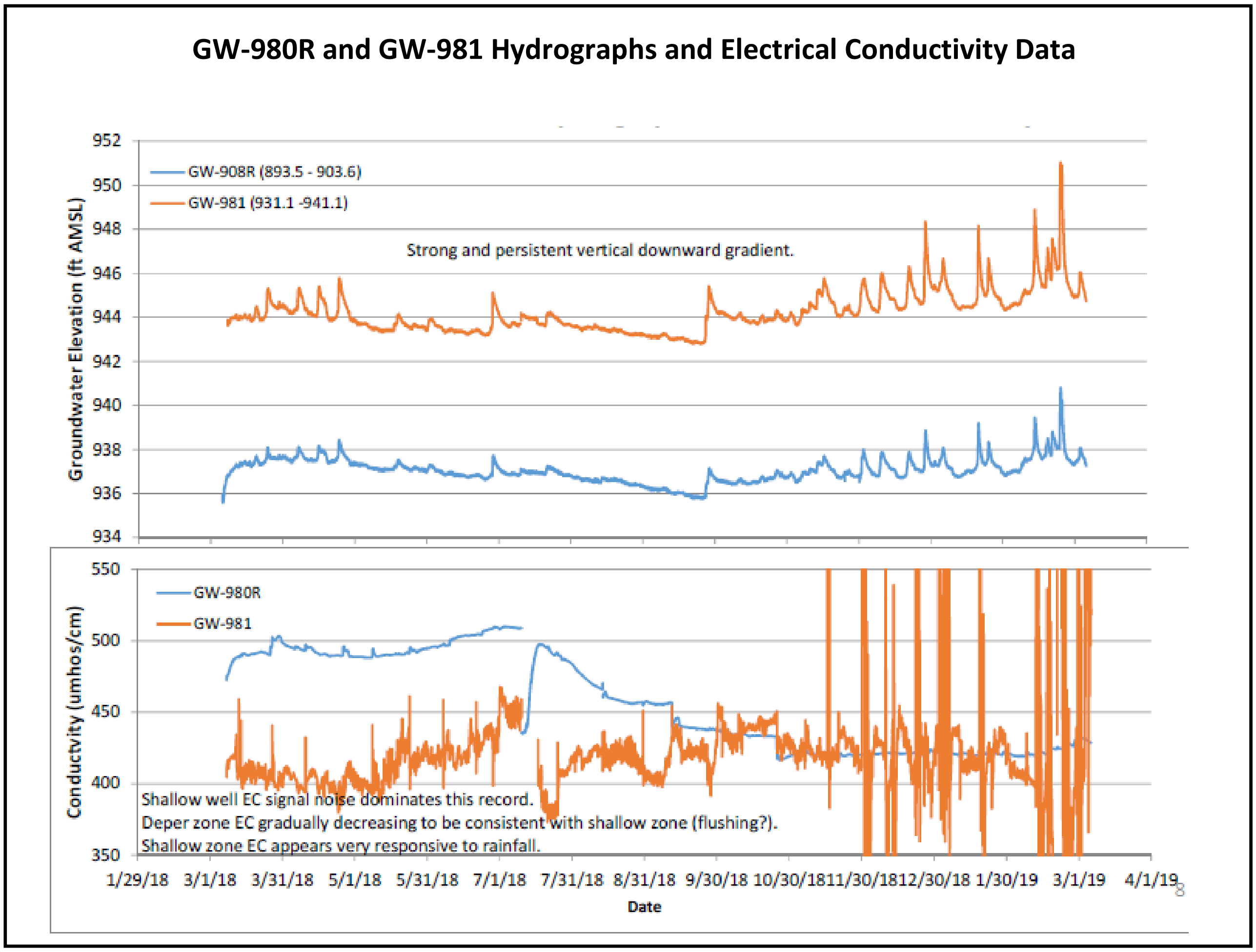


Fig. 7.23. GW-980R/981 comparisons.

7.4.3 Piezometer Pair GW-986/GW-987

This piezometer pair is located within the steep-sided, east-west drainage D-11E that feeds into NT-11 (Fig. 6.1). Surface flow within D-11E is not common, generally present only following heavy precipitation events.

The depths of the screened intervals and changes in the potentiometric surface with time are shown on Fig. 7.24. As shown in Fig. 7.24, the vertical gradient changed over time from primarily weakly downward during much of 2018, to neutral or weakly upward beginning around September 2018. The shallow piezometer drains more quickly than the intermediate piezometer, contributing to the upward gradient.

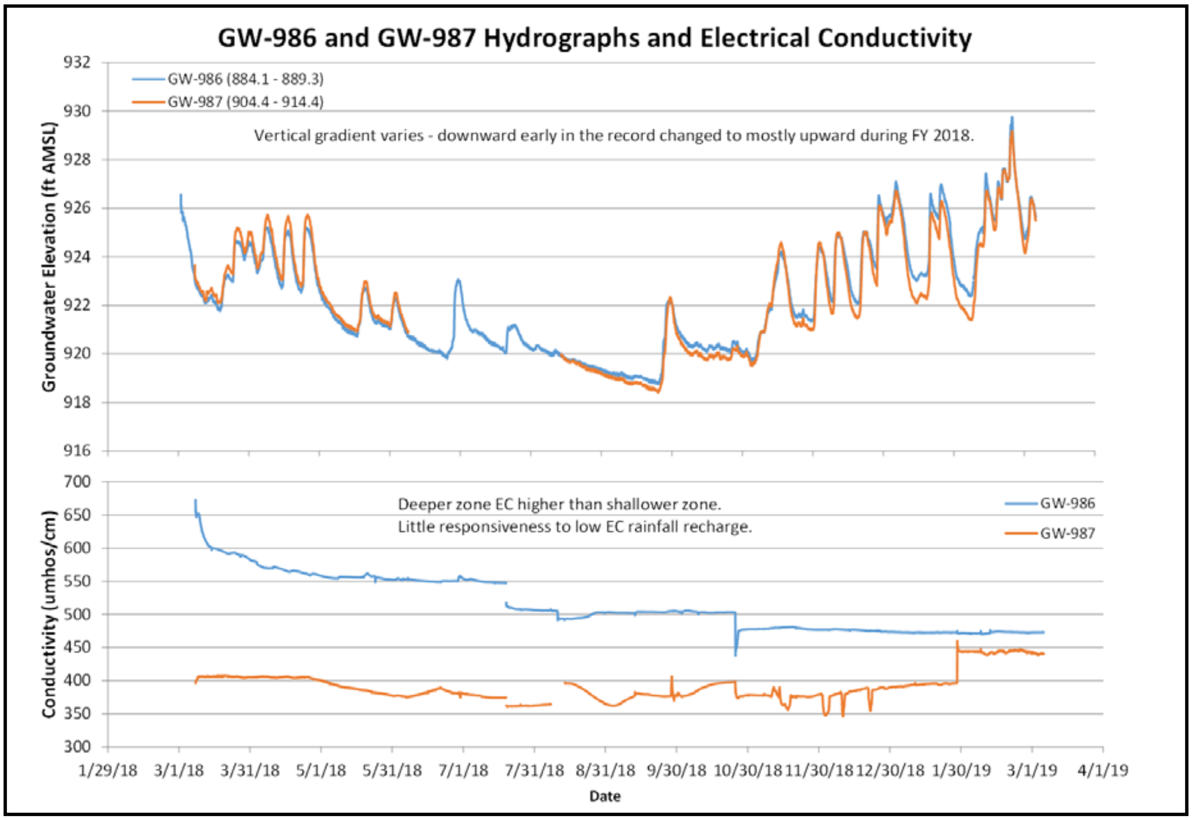
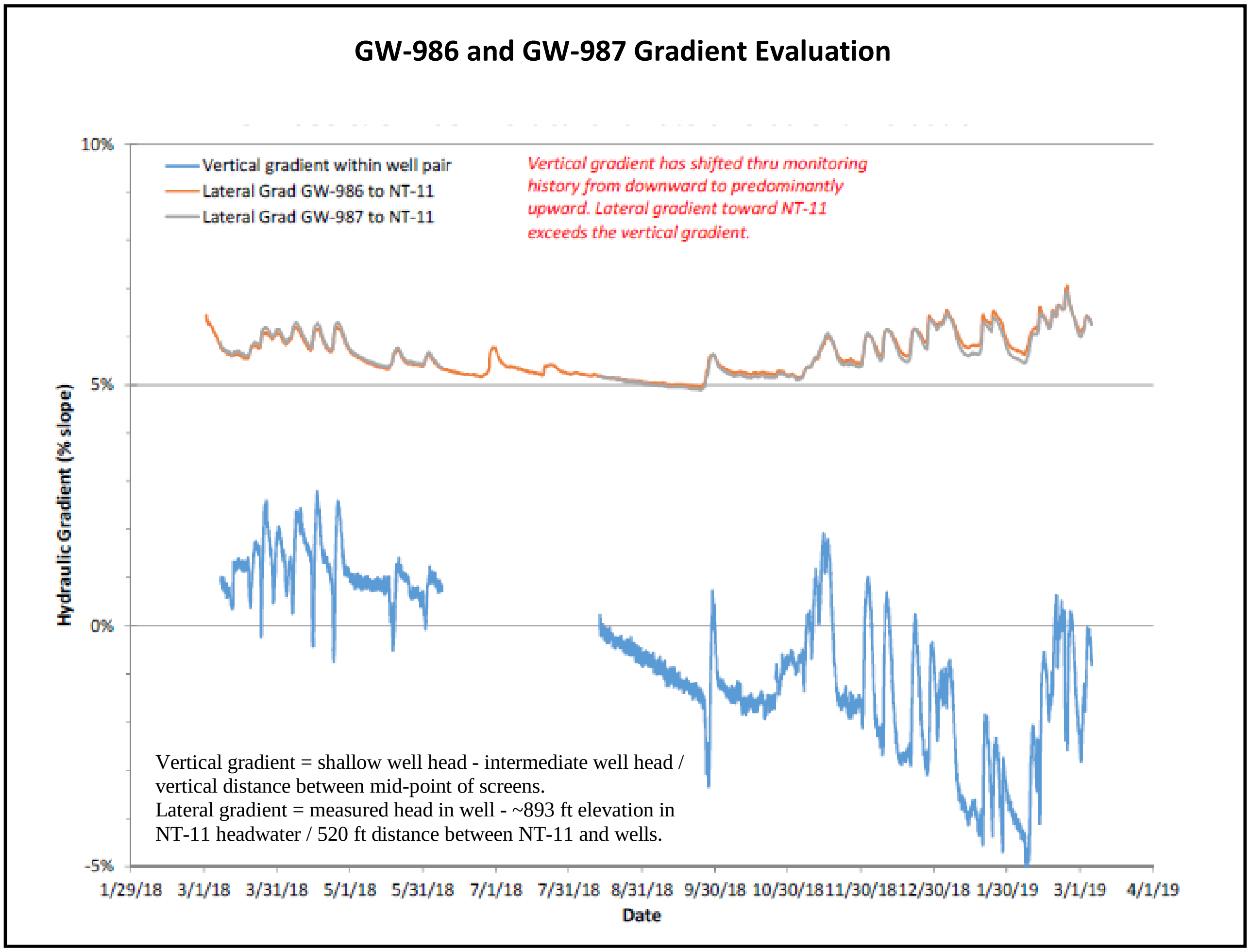


Fig. 7.24. GW-986/987 comparisons.

The EC measurements in this piezometer pair show changes attributed to removal and replacement of the downhole monitors, including possible small changes in the monitors' downhole positions. The EC measurements for the intermediate piezometer are slightly higher, indicating a somewhat longer residence time for groundwater in contact with bedrock and shows no response to precipitation. The shallow piezometer EC measurements do not exhibit a response to precipitation prior to October 2018. Starting around October 2018, infiltration of low EC precipitation corresponds to potentiometric surface increases. However, in the 2018 high precipitation year, higher precipitation amounts caused a shift in both the shallow and intermediate piezometer measurements toward a common EC value.

The lateral gradient toward NT-11 was calculated by comparing the potentiometric surfaces in the piezometers against the stream surface in NT-11, then dividing by the distance from the piezometers to NT-11. For both piezometers, the lateral gradient exceeds the vertical gradient in all cases, demonstrating groundwater flow is primarily lateral toward NT-11 at this location (Fig. 7.25).



Vertical gradient has shifted thru monitoring history from downward to predominantly upward. Lateral gradient toward NT-11 exceeds the vertical gradient.

Vertical gradient = shallow well head - intermediate well head / vertical distance between mid-point of screens.
Lateral gradient = measured head in well - ~893 ft elevation in NT-11 headwater / 520 ft distance between NT-11 and wells.

Fig. 7.25. GW-986/987 gradient evaluation.

7.4.4 Piezometer Pair GW-988/GW-989

This piezometer pair is located along the southwestern side of the knoll and the ground surface drops steeply to the south and north (Fig. 6.1). The depths of the screened intervals and changes in the potentiometric surface with time are shown on Fig. 7.26. As shown on Fig. 7.26, there is a consistent, moderate downward gradient at this location.

The intermediate piezometer exhibits higher EC as expected, with some response to periods of higher precipitation. The shallow piezometer exhibits very muted response to precipitation that could be caused by minor influence of lower EC precipitation reaching groundwater. The step change in EC could be from the observed rise in the intermediate groundwater; however, the steep, sharp step change could also be caused by an issue with the downhole monitor.

The vertical gradient for this piezometer pair is consistently downward at values about half for less than the lateral gradient toward NT-11. These results indicate that groundwater flow is mostly lateral toward NT-11 at this location.

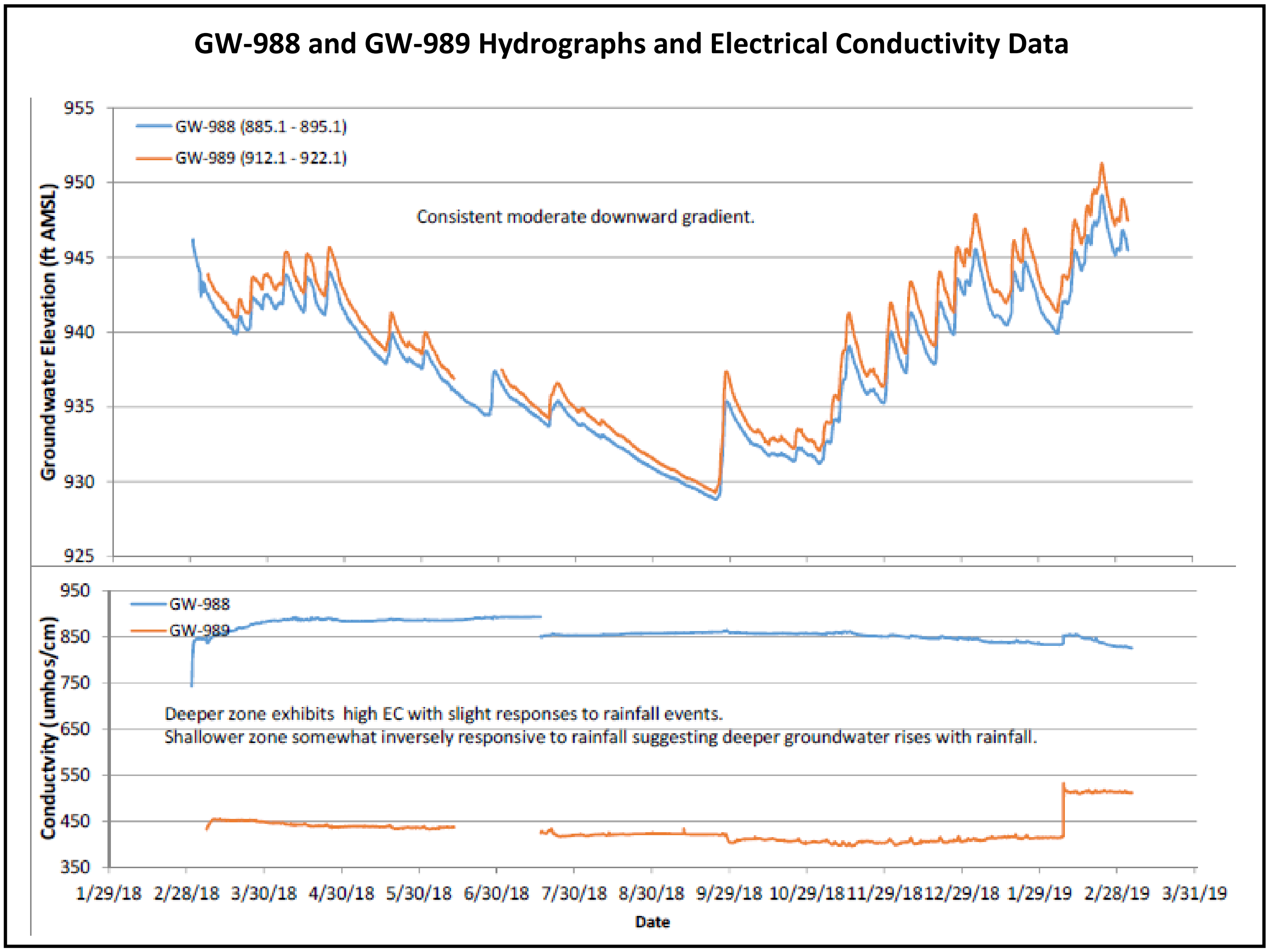


Fig. 7.26. GW-988/989 comparisons.

7.4.5 Summary and Conclusion

Groundwater EC values generally increase with depth beneath the knoll and across the CBCV site. This condition is a result of increasing groundwater residence time in contact with geologic materials subject to dissolution. In addition, EC values tend to vary in response to hydrologic stresses at the monitoring point. Shallow piezometers may exhibit rapid and significant decreases in EC following rainfall events that recharge the shallow groundwater with very low EC rainwater. In the knoll area, the intermediate piezometers in the pairs similarly exhibit recharge induce decreases in EC or no EC response to rainfall.

However, GW-982, the piezometer installed at the greatest depth, exhibits small to slight inverse response to precipitation that suggests a small upward movement of deeper groundwater or a lateral inflow of slightly higher EC groundwater from an adjacent area.

Evaluation of the hydrographs, EC, and drainages in the CBCV site knoll area determined that the primary gradients are lateral and toward the nearby drainages. Where present, upward gradients within piezometer pairs are weaker than the lateral gradients that drive water toward the streams. As a result, if upwelling of very deep groundwater were present, it would be expected to drain laterally to drainages through fractures or weathered rock zones and not rise into the intermediate or shallow knoll area.

This conclusion is supported by the surface water data that demonstrate a small groundwater flow component accounted for by lateral flow from the knoll. If upwelling into the intermediate and shallow groundwater was taking place, this deeper bedrock flow component would be reflected in increased surface water flows, and higher EC.

8. SUMMARY AND CONCLUSIONS

BCV has been extensively studied as part of several regional studies and the regional geology is well understood. The geologic structure of the BCV area is a fundamental aspect of the region that dictates the topographic and hydrogeologic conditions. Bedrock beneath all the stratigraphic units that underlie Pine Ridge and BCV dip at an attitude of approximately 45 degrees to the southeast with geologic strike, or the direction that individual rock beds intersect the ground surface, being northeast to southwest in a direction approximately 55 degrees east of true north.

Pine Ridge forms the northern boundary of BCV and is underlain by the erosion-resistant sandstones and siliceous shales of the Rome Formation. The CBCV site is located nearly 1,000 ft southeast of, and about 200 ft lower than, the Pine Ridge crest. A topographic saddle coincident with the outcrop area of the Rutledge Limestone separates the CBCV site from the main slope of Pine Ridge and from the knoll formed by the Maryville Limestone (Fig. 2.1).

Geologically, the CBCV site is separated from the Rome Formation by bedrock of the Pumpkin Valley Shale and the Rutledge Limestone. The Pumpkin Valley Shale consists of two locally recognized members including a lower siltstone unit and an upper siliceous shale unit. As determined by previous site investigations conducted both northeast and southwest of the CBCV site, in the BCV strike belt, the Rutledge Limestone is predominantly a calcareous shale with discontinuous, thin limestone beds. The Pumpkin Valley and Rutledge formations provide a low hydraulic conductivity separation between the sandstone of the Rome Formation and the primarily shale bedrock formations that directly underlie the CBCV site. These lower permeability shales effectively confine groundwater in the Rome Formation.

The CBCV site is located over steeply dipping siltstones, shales, and minor limestone bedrock of the Conasauga Group, including the Rogersville Shale, the Maryville Limestone, and the Nolichucky Shale. Overlying the bedrock is a highly weathered, clay-rich saprolite layer of varying thickness. The permeability of both the saprolite and the bedrock is approximately 1×10^{-3} to 1×10^{-5} cm/sec, resulting in slow groundwater movement. Fractures are present in the bedrock and decrease with depth, resulting in decreased permeability and slower groundwater movement with depth (Fig. 2.5).

In contrast to the lower, more clastic-rich rock formations in the Conasauga Group, the Maynardville Limestone is a relatively pure limestone that, due to chemical weathering and formation of karst, is much more permeable than the Conasauga Group formations. However, because of the regionally imposed southeastward dip of bedrock in BCV, the Maynardville Limestone is not present under the CBCV site. The EMDF design planning approach will maintain a separation of at least 350 ft between the southernmost landfill footprint and the Maynardville Limestone outcrop area. The separation between the Maynardville and the proposed landfill provides adequate space for monitoring and other operational activities (Fig. 2.1). The location of Bear Creek is in part controlled by the presence of the Maynardville Limestone.

Annual precipitation in this area is approximately 55 in. per year with the area’s topography and near-surface geology reflecting steep erosional channels (northern tributaries) generally aligned with bedrock cross bedding fracture system to accommodate precipitation from storm events. As shown in the (Fig. 2.4), evapotranspiration returns about 50 percent (27.5 in.) of the precipitation back into the environment as humidity, clouds, and/or precipitation. Based on conditions in clastic formations along Bear Creek, 30 to 40 percent of the precipitation exits as stormwater and stormflow zone runoff (equivalent to 17 to 22 in.) and immediately exits to surface water through the abundant macropores and other shallow subsurface features (decayed roots, trees, animal burrows, and the like). An additional 10 to 20 percent (4.5 to 10.5 in.) of the precipitation enters into the shallow groundwater and discharges to the surface water streams and Bear Creek. An estimated less than 1 percent (less than 0.5 to 0.6 in.) of the precipitation enters the deeper groundwater system.

At the CBCV site, as with most other areas studied on the ORR, there is one interconnected groundwater zone at shallow and intermediate depths, not distinct aquifers separated by unsaturated bedrock zones. The distinction between shallow and intermediate groundwater is largely subjective and is based primarily on the consideration of the physical characteristics of the groundwater host materials (e.g., degree of weathering and unconsolidated materials versus competent bedrock). The higher the degree of rock weathering, or the more fractures that are present, the more similar to a porous media the matrix material becomes with observed groundwater flow similar to porous media flow (Darcy flow).

In zones with less weathering, or where interbedded bedrock layers have a significant contrast in permeability such as Rome Sandstone contact with the Pumpkin Valley Shale, the saturated zone retains anisotropy that “steers” groundwater flow parallel to the beds. In competent, shale-rich bedrock zones, groundwater flow occurs primarily through fractures because the rock matrix has extremely low permeability. Fractures in competent bedrock tend to form within individual beds at varying orientation with sparse through cutting fractures at orientations caused by the tectonic evolution of the region. Groundwater migration in competent bedrock beneath the CBCV site would be expected to occur through the fracture network and exhibits a low degree of interconnections compared to the highly connected fracture and weathering porosity in the overlying unconsolidated aquifer zone.

As described in Sect. 2, BCV shallow potentiometric surface generally mimics topography. The potentiometric surface demonstrates a general gradient from higher elevations on Pine Ridge toward Bear Creek and the Maynardville Limestone outcrop band. The potentiometric gradients also demonstrate local groundwater movement down slopes toward the northern tributaries that dissect the mid-valley topography at fairly regular intervals. There is a slight, western offset in the potentiometric surface caused by groundwater exiting at the northern tributaries. The intermediate bedrock flow is similar but demonstrates a more subdued topographic influence and greater southwest orientation due to decreased number of fractures for flow and alignment. Shallow and bedrock groundwater shows a strong, westward component in the Maynardville Limestone, the dominant groundwater drain for the valley (Fig. 2.6).

The distribution of contaminant plumes resulting from previous disposal practices reflects the groundwater flow within BCV. The plume associated with the nearby Bear Creek Burial Grounds shows the primary groundwater flow direction to the south, with minor westerly flow into the northern tributaries. In contrast, plumes from the S-3 Ponds and other up-valley sources closer to Bear Creek, show a primarily westerly groundwater flow direction associated with the Maynardville Limestone and Bear Creek (Fig. 2.7).

The Phase 1 hydrogeological investigation was conducted to validate and refine the original key assumptions, and to provide hydrogeological data supporting the engineering design. The investigation included installing eight shallow and intermediate depth pairs of piezometers, six surface water flumes, and conducting seven walkdowns (both wet and dry season) of surface water drainages within the CBCV site. In addition, the location of the Maynardville contact was field identified to confirm the separation from the planned landfill. The piezometers and surface water flumes were equipped with continuous monitoring equipment that measured pH, electrical conductivity, and temperature along with water levels (piezometers only) and flow rates (surface water flumes only). Piezometers and flumes were monitored for a year following installation (February/April 2018 through February/April 2019), a high precipitation year. Precipitation in 2018 was 64.73 in., about 10 in. above the average annual precipitation. For the monitored year March 2018 through February 2019, 73 in. of precipitation fell, almost 20 in. above the average annual amount. The higher-than-average precipitation resulted in monitoring over a very wet period.

Bedrock and saprolite cores were collected during piezometer installation that confirmed the presence of primarily siltstones and shales with minor limestone interbeds and the lack of major karst features (Sect. 2). As expected, fractures were present, particularly in the shallow bedrock core. Testing was performed and confirmed the presence of low-permeability bedrock, with permeability decreasing with depth.

The piezometer monitoring results showed that the potentiometric surfaces are primarily influenced by topography and local recharge. There is subdued mounding of the potentiometric surface under the knoll. Generally, piezometer measurements respond quickly during precipitation events then decrease rapidly to average conditions within days. A seasonal variation was also noted, with higher potentiometric surfaces in February 2019 when abundant precipitation occurred and vegetation was dormant. The lowest potentiometric surface elevations were measured in September 2018 when precipitation was low and plants were growing. Comparison of the shallow and intermediate piezometer pairs (Figs. 7.5 through 7.12) demonstrates a downward-to-flat gradient in the knoll area, and slight upward gradients in areas away from the knoll. These gradients and the immediate response to precipitation show that the shallow groundwater on the knoll is locally recharged by infiltration of precipitation.

The monitoring also confirmed the overall groundwater flow direction from Pine Ridge toward Bear Creek and the Maynardville limestone, with lateral flow to the NT-10, D-10W, and NT-11 drainages (Fig. 7.18). Figure 7.2 provides the low and high potentiometric surfaces, showing seasonal variation in potentiometric surfaces and the overall flow direction from Pine Ridge toward Bear Creek. While not observed during the investigation, other investigations in BCV indicate deep groundwater flow from Pine Ridge to Bear Creek and the Maynardville Limestone across bedding planes and geologic contacts, and may have higher potentiometric surfaces (upward gradients) at greater depths (below the investigation depths). However, flow conditions at depth discharge primarily to the Maynardville Limestone and are not found at elevations corresponding to the proposed landfill.

As noted in Sect. 5, the higher surface water flow rates are associated with precipitation events, declining rapidly afterward. Lower flow rates result from the contributions from shallow groundwater. Some surface water flow likely bypasses the upper flumes, through macropores. However, flumes at SF-2, SF-4, and SF-6 are located at the downstream end of culverts under the Haul Road with most, if not all, surface water flow captured. D-10W has less flow than NT-10 or NT-11, and exhibits no flow approximately 25 percent of the year. However, all drainages had periods of no flow during the dry season.

As demonstrated by the pH and EC measured at the flumes (Sect. 5) and during the seven surface water walkovers (Sect. 3), shallow groundwater locally discharges to adjacent NT-10, NT-11, and seasonally to D-10W, demonstrating some lateral flow into these drainages. The shallow groundwater chemistry contribution to surface flow is relatively unnoticed during wet periods when the groundwater contribution is masked by the greater surface water flow, but can be observed during dry times of the year. These measurements support the conclusion that shallow groundwater is recharged locally and discharges laterally into drainages as indicated by the potentiometric surfaces (Sect. 7.3).

The Phase 1 monitoring confirmed that upward gradients found in the deeper bedrock 100 to 400 ft bgs were not observed in the shallow and intermediate potentiometric surfaces at the CBCV site, and therefore are not responsible for the mounding observed in the knoll area. If significant upward groundwater gradients were present, continuous surface water flow would be expected in NT-10, NT-11, and D-10W even during dry seasons, and the surface water base flow water chemistry would be similar to deep groundwater. The quality of deep groundwater has been characterized in other Bear Creek Valley wells with total dissolved solids (TDS) greater than 400 mg/L and pH up to 9. However, the shallow groundwater in Bear Creek Valley generally has TDS concentrations less than 300 mg/L and lower pH values. The higher TDS and pH in the deeper groundwater is a result of the longer groundwater travel distances, and the longer duration for groundwater to interact with bedrock.

In contrast, the water chemistry observed during low flow conditions in the adjacent streams demonstrates that the base flow in the tributaries is from shallow groundwater (Sect. 7.4). As noted above and in Sect. 7.4, mounding of the potentiometric surface under the knoll is due to recharge from precipitation rather than from deep groundwater flowing up into knoll area (Sect. 7.4).

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APPENDIX A

SURFACE WATER WALKDOWN RESULTS

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CONTENTS

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FIGURES

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ACRONYMS

CBCV	Central Bear Creek Valley
D	Drainage
DOE	U.S. Department of Energy
E	East
EMDF	Environmental Management Disposal Facility
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
GPS	Global Positioning System
NT	North Tributary
ORNL	Oak Ridge National Laboratory
SOW	Statement of Work
TDEC	Tennessee Department of Environment and Conservation
W	West

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Beginning in January 2018, a series of surface water walkdowns were conducted to characterize stream flow at the Environmental Management Disposal Facility (EMDF) Central Bear Creek Valley (CBCV) site and address a requirement in the August 2017 U.S. Environmental Protection Agency (EPA)/Tennessee Department of Environment and Conservation (TDEC) Statement of Work (SOW) for Phase 1 sampling. As part of the December 2017 Dispute Resolution Agreement, a TDEC/EPA-approved Field Sampling Plan (FSP) reflecting data collection identified in the SOW was to be presented in the Proposed Plan. The FSP, *Phase 1 Field Sampling Plan for the Proposed Environmental Management Disposal Facility for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal, Oak Ridge, Tennessee* (U.S. Department of Energy [DOE] 2018), was approved in May of 2018.

The primary objectives of the surface water walkdowns were to locate seeps and springs during the wet season within the disposal area and buffer zone. Streams and drainages within the area included North Tributary (NT)-10, Drainage (D)-10 West (W), NT-11, and D-11 East (E). Sampling locations were established approximately every 50 ft along each of the streams and drainages, with pH, conductivity, and temperature measured at each of the sampling locations during both the wet and dry seasons. The spacing was adjusted as necessary, based on low flow and stagnant water in some areas; however, sampling locations were established within the 50-ft range.

The initial wet season walkdown to establish sampling locations and identify wet season seeps and springs occurred on January 30, 2018, followed by a second wet season walkdown on February 27, 2018. Intermediate walkdowns were performed on May 1, 2018, and on June 4, 2018, during the transitional period between the wet and dry seasons. Dry season walkdowns were completed on September 12, 2018, and October 10, 2018.

Participants in the walkdowns included members of the DOE; UCOR, an AECOM-led partnership with Jacobs; the Oak Ridge National Laboratory (ORNL); and TDEC.

WALKDOWN #1: JANUARY 30, 2018

On January 30, 2018, members of UCOR, ORNL, and TDEC met to perform a wet season walkdown of the EMDF site to identify seeps and springs while establishing sampling points along NT-10, D-10W, NT-11, and D-11E. In addition, flume locations were established, and the contact between the Maynardville and Nolichucky formations was identified.

Once established, measurements of pH, temperature, and conductivity were taken at each sampling location, and Global Positioning System (GPS) coordinates were collected. The weather was cold and sunny, with sparse vegetation present along the drainages. While no precipitation occurred during the walkdown, almost an inch of precipitation occurred during the prior week. Participants in the walkdown included:

- UCOR: Annette Primrose, Dick Ketelle, Eddie Arnold, and Tim Herrell
- ORNL: Trent Jett
- TDEC: Brad Stephenson and Don Gilmore

After meeting at the Environmental Management Waste Management Facility (EMWMF), the team proceeded to the first assessment point on NT-11, which was also identified as a likely flume location (SF-1) for the lower end of NT-11. Measurements were recorded approximately every 50 ft upstream of the potential flume site, from NT11-PF1 to NT11-11, before crossing the Haul Road. Another likely flume location (SF-2) was identified at NT11-11 below the Haul Road culvert, and seep NT11-SEEP1 was identified just south of the Haul Road. This seep is in the same area as a historically identified seep.

Upon crossing the Haul Road, the team continued upstream, marking sampling locations and collecting data from NT11-12 through NT11-24. No surface flow was present in D-11E; however, groundwater was visible within a soil macropore, D11E-1, that was established as a sampling location. Standing water was present in the area, indicating that at that time, surface water was equivalent to shallow groundwater. No other surface water locations could be established in D-11E due to lack of surface water flow.

Sampling locations NT11-16a and NT11-16b were established at the confluence of NT-11 and D-11E, shown in Fig. A.1. A likely flume location (SF-3), known as NT11-HW STATION, was identified between NT11-20 and NT11-21 at the headwaters of NT-11. In addition, iron staining was present along the east fork of the tributary (sampling locations NT11-EF1 and NT11-EF2), indicating a possible change from reduced conditions in groundwater to oxidized conditions where the groundwater daylighted.

The team then continued across the saddle to D-10W. A likely upgradient D-10W flume location (SF-4) was identified on the portion of the tributary downstream of the Haul Road above sampling location D10W-14; however, no flume locations were identified north of the Haul Road due to poorly defined stream channels, as shown in Fig. A.2, caused by macropores in the area.

The team proceeded to the southern portion of D-10W below the Haul Road. The likely flume location for the upgradient D-10W flume (SF-5) was identified above D10W-20.

Measurements were then taken along NT-10 located east of D-10W. The Maynardville/Nolichucky contact was approximated near NT10-1 and NT10-2 on the southern portion of the tributary. South of the Haul Road near NT10-11, another likely upgradient NT-10 flume location was identified. The walkdown concluded at NT10-15.

Fig. A.1. Confluence of NT-11 and D-11E.

Fig. A.2. Poorly defined channels in D-10W.

WALKDOWN #2: FEBRUARY 27, 2018

The second wet season surface water walkdown was performed on February 27, 2018. Measurements of pH, temperature, and conductivity were taken at the previously established sampling points along NT-10, D-10W, NT-11, and D-11E. GPS coordinates were also recorded for sampling locations for which GPS coordinates could not be established in the January walkdown. The weather was cold and sunny, and vegetation was sparsely distributed. Although there was no precipitation during the walkdown, a little over 2 in. of precipitation occurred in the previous week. Participants in the walkdown included:

- UCOR: Annette Primrose, Eddie Arnold, Daniel Craze, and Chelsea West
- TDEC: Don Gilmore and Rebecca Lenz

The group traveled to NT-11 and began the assessment. Measurements were taken along the southern portion of the tributary from sampling location NT11-PF1 to NT11-11, shown in Fig. A.3. No measurements were taken at NT11-SEEP1.

After crossing the Haul Road, samples were taken from the northern portion of the tributary (NT11-12 through NT11-24). NT11-SEEP2 and NT11-16 could not be measured; however, sufficient water was available for the measurement at macropore D11E-1, shown in Fig. A.4.

Measurements were then taken along D-10W across the saddle. All sampling locations (D10W-1 through D10W-14) were sufficiently sampled.

The team then proceeded east toward NT-10 to collect samples at NT10-15 toward NT10-1 on the south side of Bear Creek Road. The pin flag at sampling location NT10-2 had been transported downstream in the precipitation event prior to the walkdown; therefore, the flag was placed approximately in the original sampling location, and coordinates were taken with a GPS.

Sampling locations along the southern portion of D-10W, D10W-22 through D10W-15, were then measured. The walkdown concluded at D10W-15, located adjacent to the constructed wetland north of Bear Creek Road.

Fig. A.3. Collecting measurements along the southern portion of NT-11.

Fig. A.4. Presence of groundwater at the D11E-1 macropore.

WALKDOWN #3: MAY 1, 2018

The third surface water walkdown was performed on May 1, 2018, during the transitional period between the wet and dry seasons. Measurements of pH, temperature, and conductivity were taken at the previously established sampling points along NT-10, D-10W, and NT-11; however, D-11E was too shallow for measurement collection. GPS coordinates were also taken at sites where coordinates were not previously identified. The weather was warm and sunny, with vegetation becoming increasingly denser in the spring climate, as shown in Fig. A.5. Approximately 1 in. of precipitation occurred during the week prior to the walkdown. Participants in the walkdown included:

- UCOR: Annette Primrose, Daniel Craze, Chelsea West, Stacey Goss, and Michael Fleming
- DOE: Aaron White
- TDEC: Don Gilmore and Rebecca Lenz

The surface water walkdown began with NT-11. Measurements were recorded at NT11-PF1 through NT11-11 along the southern portion of the tributary; however, no measurements were taken at NT11-SEEP1 due to insufficient water depth.

Next, the team continued across the Haul Road to the northern portion of the tributary to collect measurements at NT11-12 through NT11-24. Measurements could not be taken at NT11-18b and NT11-SEEP2 due to lack of water; however, all other locations were sufficiently measured. Locations along the east fork of the tributary (NT11-18b, NT11-EF1, and NT11-EF2) exhibited iron staining, shown in Fig. A.6.

Measurements were collected across the saddle along D-10W at D10W-1 through D10W-14. All sites were measured; however, D10W-SEEP1 was very shallow with low flow.

The team continued east toward NT-10. Samples were collected at NT10-15 through NT10-12 on the north side of the Haul Road, then continued south toward NT10-11 through NT10-8, crossing Bear Creek Road to collect measurements at NT10-7 through NT10-1.

The assessment continued east toward the southern portion of D-10W, with measurements taken at D10W-22 through D10W-15. The walkdown concluded at D10W-15 located below the constructed wetland north of Bear Creek Road.

Fig. A.5. Dense vegetation surrounding NT-11.

Fig. A.6. Iron staining along the east fork of NT-11.

WALKDOWN #4: JUNE 4, 2018

The first dry season surface water walkdown was performed on June 4, 2018. Measurements of pH, temperature, and conductivity were taken at the previously established sampling points along NT-10, D-10W, NT-11, and D-11E. The weather was very warm and sunny, and vegetation was extremely dense, making it hard to locate sampling locations, which were marked with pin flags, in some areas. Less than an inch of rain occurred the weekend prior to the walkdown. Participants in the walkdown included:

- UCOR: Annette Primrose, Chelsea West, and Michael Fleming
- DOE: Jim Daffron
- TDEC: Hannah Klein and Heather Lutz

The team proceeded to the first assessment point on NT-11. Measurements were taken along the portion of NT-11 below the Haul Road from NT11-PF1 through NT11-11; however, there was no flow at NT11-SEEP1.

After completing the southern portion of NT-11, team members continued across the Haul Road to collect measurements from NT11-12 through NT11-24. Of these locations, measurements were not able to be collected at NT11-SEEP2 and NT11-16. Although lack of flow at NT11-18b only allowed about 50% coverage of the YSI probe, measurements were still recorded. Both NT11-EF1 and NT11-EF2 exhibited iron staining. At macropore D11E-1, the probe was about 25% covered; however, measurements were taken despite the lack of water at the collection point.

Next, measurement collection along D-10W across the saddle began, with measurement collection occurring every 50 ft from D10W-1 through D10W-14 located south of the Haul Road. Vegetation was very dense, as shown in Fig. A.7, making it hard to follow the channel. No flow was present at D10W-SEEP1.

The group continued east to NT-10, beginning with NT10-15 north of the Haul Road and continuing to NT10-1 south of Bear Creek Road. Fish surveys were being conducted upstream of the assessment points, causing increased turbidity in the stream from NT10-15 to NT10-12.

Measurements were then taken along D-10W, located west of NT-10, at D10W-22 through D10W-15. No flow was present at D10W-22, as shown in Fig. A.8; however, all other sampling locations were sufficiently measured. The walkdown concluded at D10W-15 south of the constructed wetland on the north side of Bear Creek Road.

Fig. A.7. Dense vegetation along D-10W.

Fig. A.8. Dry stream channel at D10W-22.

WALKDOWN #5: SEPTEMBER 12, 2018

The second dry season surface water walkdown occurred on September 12, 2018. Measurements of pH, temperature, and conductivity were taken at the previously established sampling points along NT-10, D-10W, and NT-11. D-11E was dry; therefore, no measurements were taken at the macropore. The weather was warm and sunny, and the dense vegetation often made it hard to locate pin flags at the designated sampling locations. There was less than half an inch of rain during the previous week, so conditions were very dry. Participants in the walkdown included:

- UCOR: Chelsea West and Michael Fleming
- TDEC: Don Gilmore, Courtney Thomason, and Dana Wright

The team began the walkdown with NT-11. Samples were collected along the portion of the tributary south of the Haul Road from NT11-PF1 to NT11-11; however, NT11-SEEP1 could not be sampled.

After proceeding across the Haul Road to the northern portion of the tributary, samples were collected at NT11-12 through NT11-24. Of these locations, NT11-13 and NT11-18b were too shallow for measurement collection, and NT11-SEEP2 and NT11-EF2 were dry.

Most of the northern portion of D-10W across the saddle was either dry or too shallow for measurement collection. D10W-10 and D10W-14 were the only locations that could be sufficiently measured. Figure A.9 is representative of the debris present in most of the northern portion of the drainage channel where little to no flow was present.

East along NT-10, NT10-13 through NT10-10 and NT10-4 through NT10-1 were dry. Both NT10-14 and NT10-6 had very little water present; however, measurements were still collected.

West toward the southern portion of D-10W below Bear Creek Road, D10W-22 through D10W-16 were all dry. The assessment concluded with sufficient measurement collection at D10W-15 below the constructed wetland north of Bear Creek Road.

Fig. A.9. Logs and other vegetation located in the northern portion of D-10W.

WALKDOWN #6: OCTOBER 10, 2018

The final dry season surface water walkdown was conducted on October 10, 2018. Measurements of pH, temperature, and conductivity were taken at the previously established sampling points along NT-10, D-10W, and NT-11, as the D-11E macropore was dry. The weather was warm and sunny, and the vegetation was dense, but slightly thinning, in the transition from summer to fall. There was less than half an inch of rain during the prior week. Participants in the walkdown included:

- UCOR: Chelsea West and Michael Fleming
- TDEC: Don Gilmore

The assessment began at sampling location NT11-PF1 along NT-11. Measurements were collected approximately every 50 ft from the flume through NT-11. No water was observed at NT11-SEEP1.

After crossing the Haul Road, measurements were collected along the remaining portion of NT-11 from NT11-12 through NT11-24. NT11-SEEP2 and NT11-EF2, shown in Fig. A.10, on the east fork were dry, while NT11-18b, located at a fork in the stream, was too shallow to sample.

The team then continued across the saddle to the head of D-10W. Samples were collected at the previously established downstream sampling locations from D10W-1 to D10W-13 and across the Haul Road to D10W-14. Of these locations, D10W-1, D10W-SEEP1, and D10W-12 were dry, and D10W-5 was too shallow to sample, shown in Fig. A.11.

After returning to the Haul Road, the team traveled east toward the Cemetery Road to NT-10. Measurements were taken from NT10-15 through NT10-12 north of the Haul Road then continued south of the Haul Road to NT10-11 through NT10-8. Once reaching Bear Creek Road, the team continued south to collect measurements from NT10-7 through NT10-1. Measurements were collected at all sampling locations along this tributary as flow was sufficient.

Once completing measurements along NT-10, the team traveled west through a pine stand toward the final stretch of D-10W (D10W-22 through D10W-15), moving north toward Bear Creek Road from D10W-22. D10W-21 and D10W-22 were dry, and D10W-19 was too shallow for measurement collection with the YSI probe; however, all other locations were sufficiently measured. The trip concluded with the measurement of D10W-15 below the constructed wetland along Bear Creek Road.

Fig. A.10. Dry stream channel at NT11-EF2.

Fig. A.11. Low flow at D10W-5.

CONCLUSIONS

Summary data for each drainage is provided in Figs. A.12 through A.20. Figures A.21 through A.26 provide the measurements obtained during each of the six walkdowns conducted at the CBCV site. As a result of the walkdowns, several conclusions can be drawn in terms of groundwater influence and seasonal fluctuations. Based on the number of dry data points or areas of low flow observed during the dry season walkdowns, it can be concluded that groundwater influence is minimal in many of the tributaries and drainages, especially in D-10W and NT-10 along the eastern side of the site. Flow in NT-11, which has a broader, more defined stream channel than many of the other locations, was more consistent year round; however, NT11-SEEP1 and NT11-SEEP2 were dry during all six walkdowns, suggesting the stream relies primarily on surface water for recharge. The D-11E macropore, which feeds into NT-11, also had less water when conditions were dry.

Downstream sampling locations showed more consistency in pH values than those located further upstream, suggesting that more carbonate is present nearer to the Maynardville contact.

These walkdowns should be interpreted as trend data and used to set a baseline for what can be expected seasonally. The data fluctuated seasonally, as expected. Conductivity was highest and showed the most variability during the dry season due to the number of low to no flow locations. Temperature also fluctuated seasonally, with water temperatures increasing as the year progressed. Values for pH were highest during the May transitional walkdown when stream conditions were shifting from spring to summer, causing more particulate matter to be present in the system. It is expected that designers use the data to predict surface water patterns that may be encountered both during and after construction.

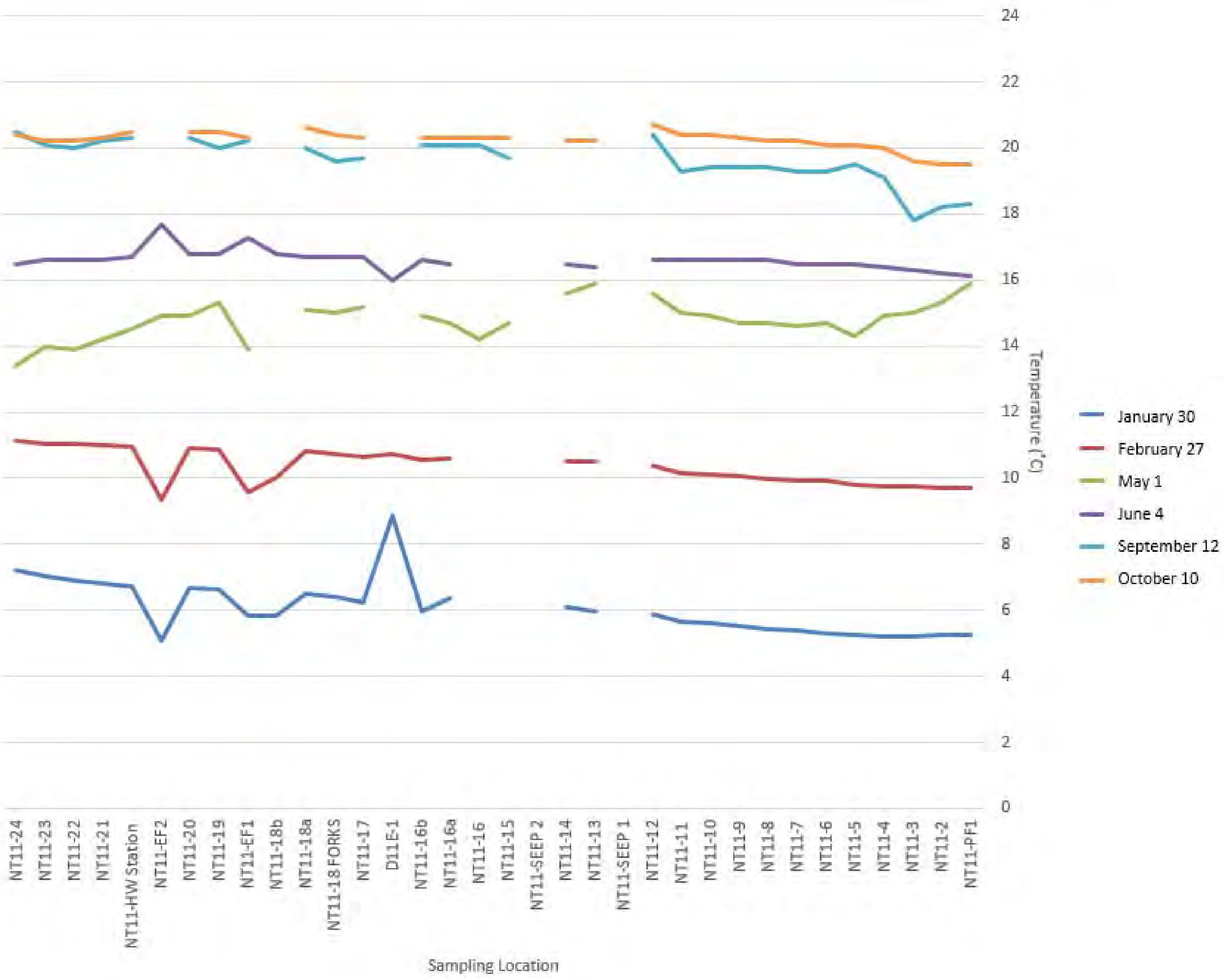


Fig. A.12. Temperature comparison along NT-11.

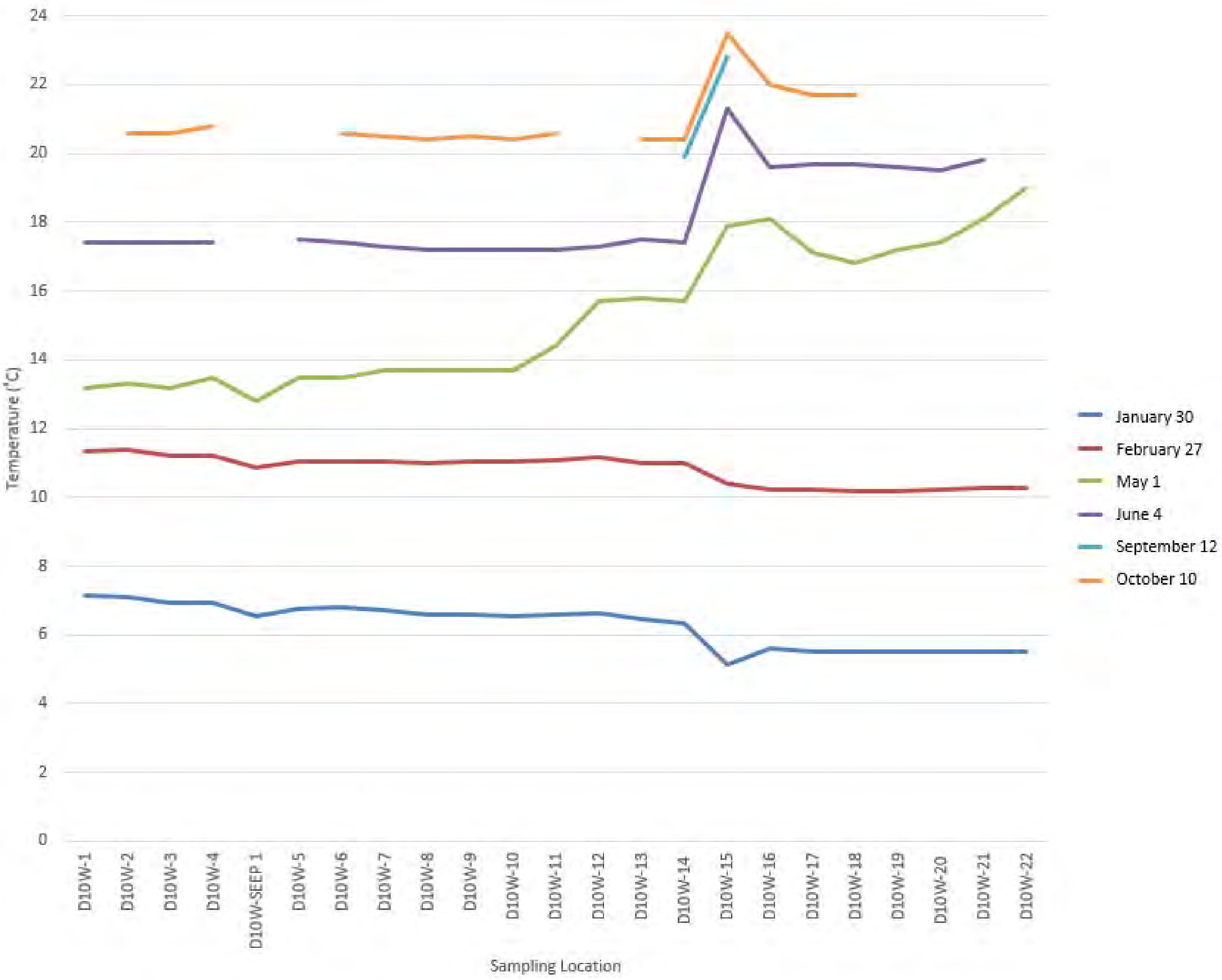


Fig. A.13. Temperature comparison along D-10W.

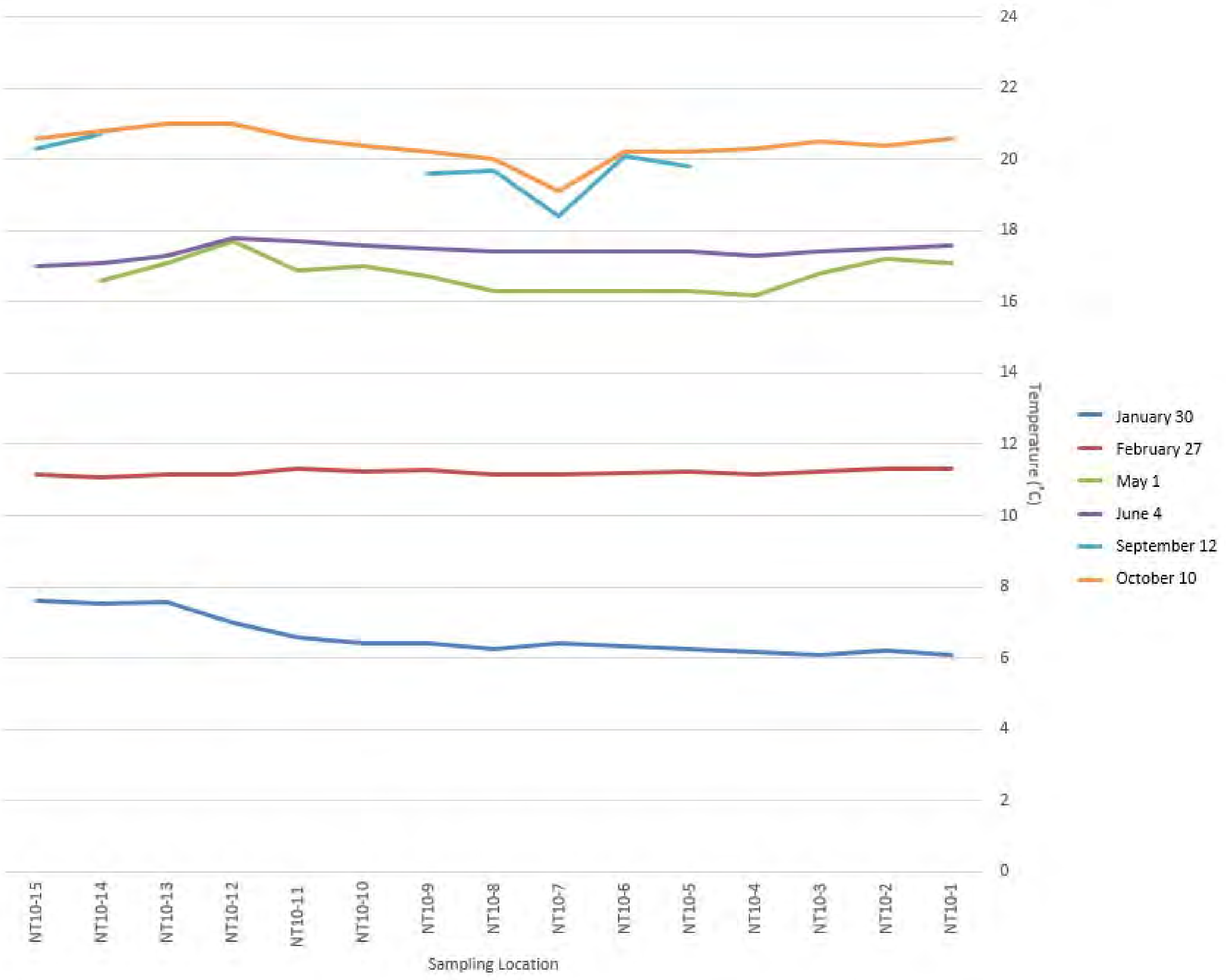


Fig. A.14. Temperature comparison along NT-10.

Fig. A.15. pH comparison along NT-11.

Fig. A.16. pH comparison along D-10W.

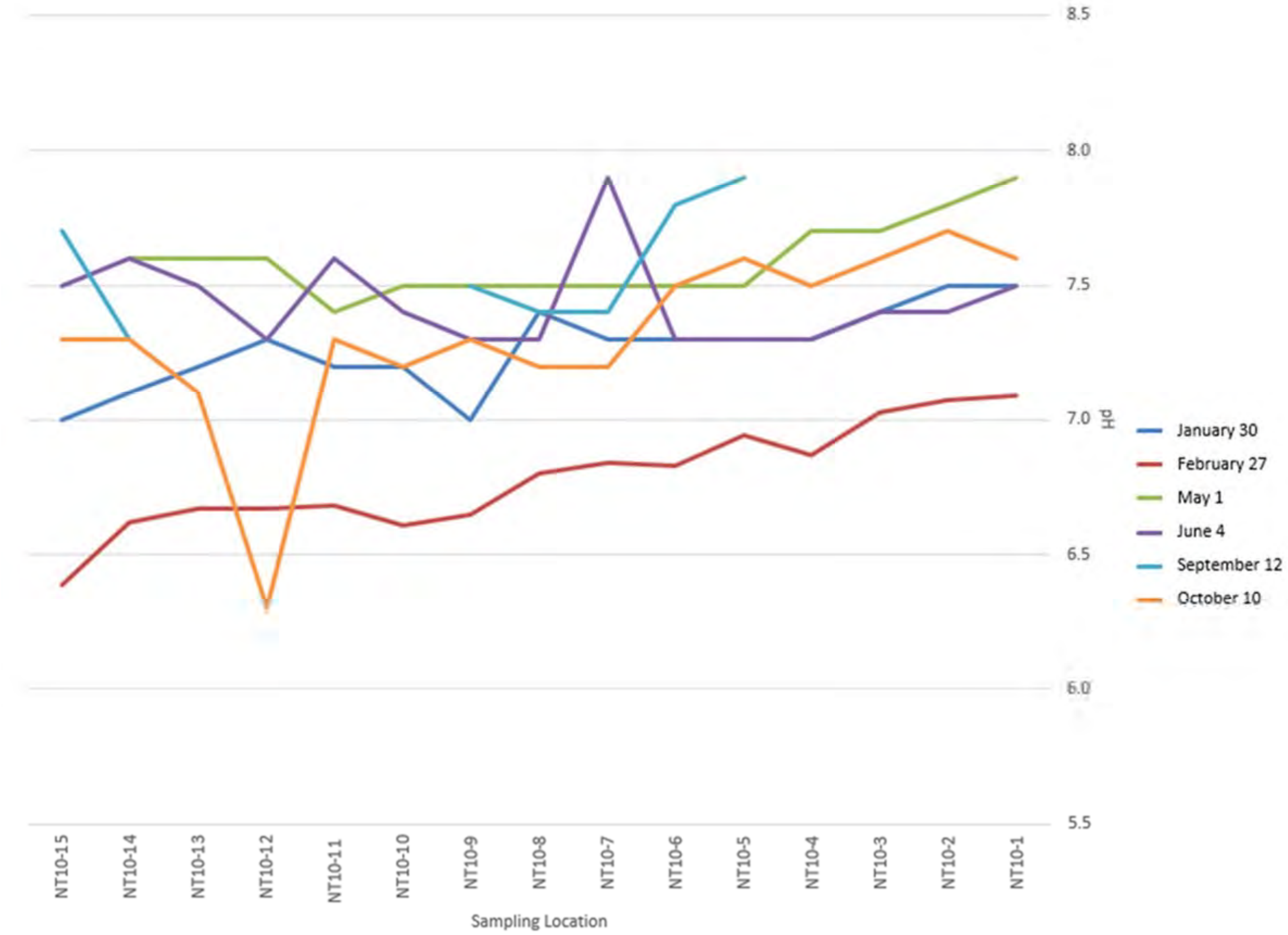


Fig. A.17. pH comparison along NT-10.

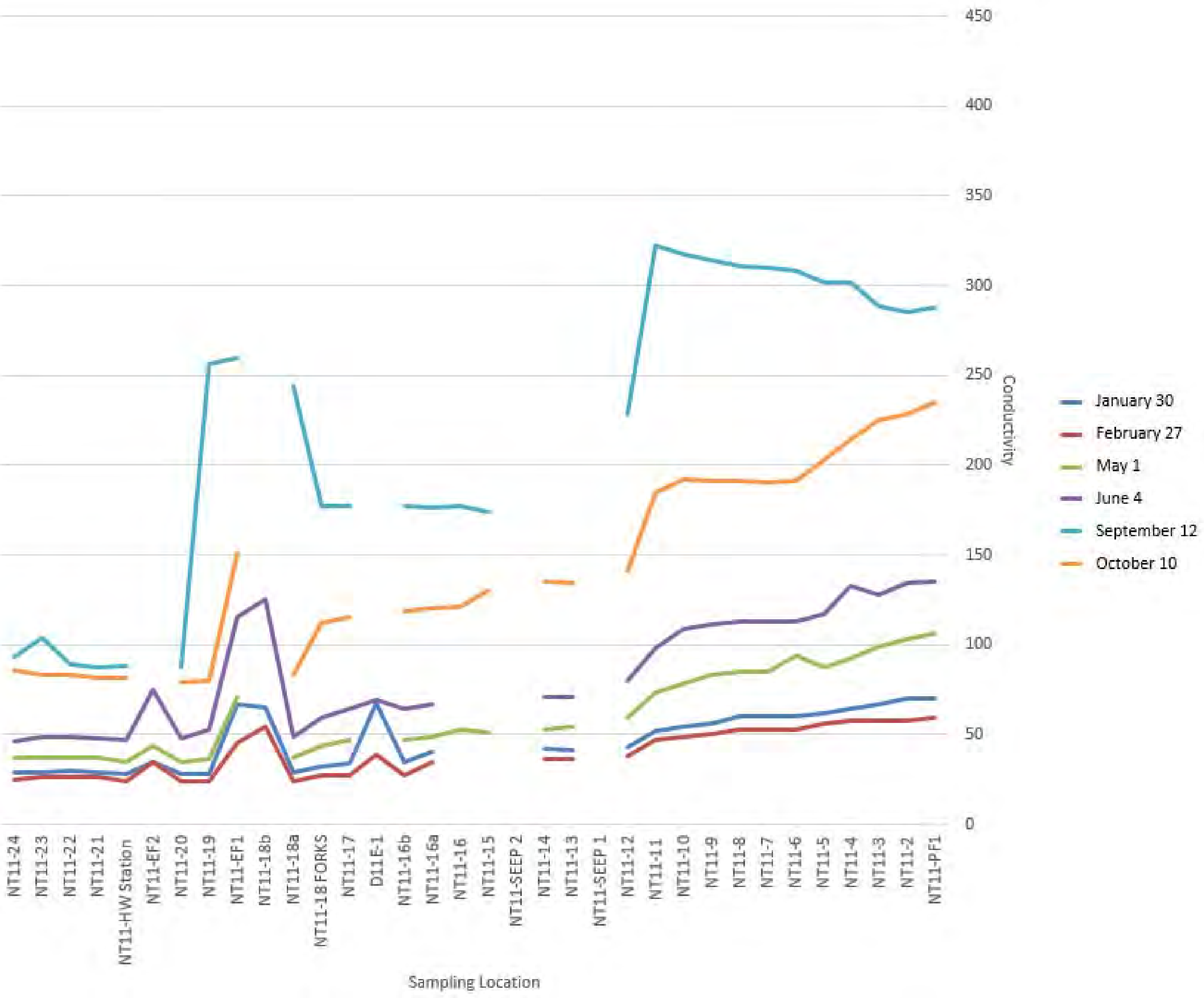


Fig. A.18. Conductivity comparison along NT-11.

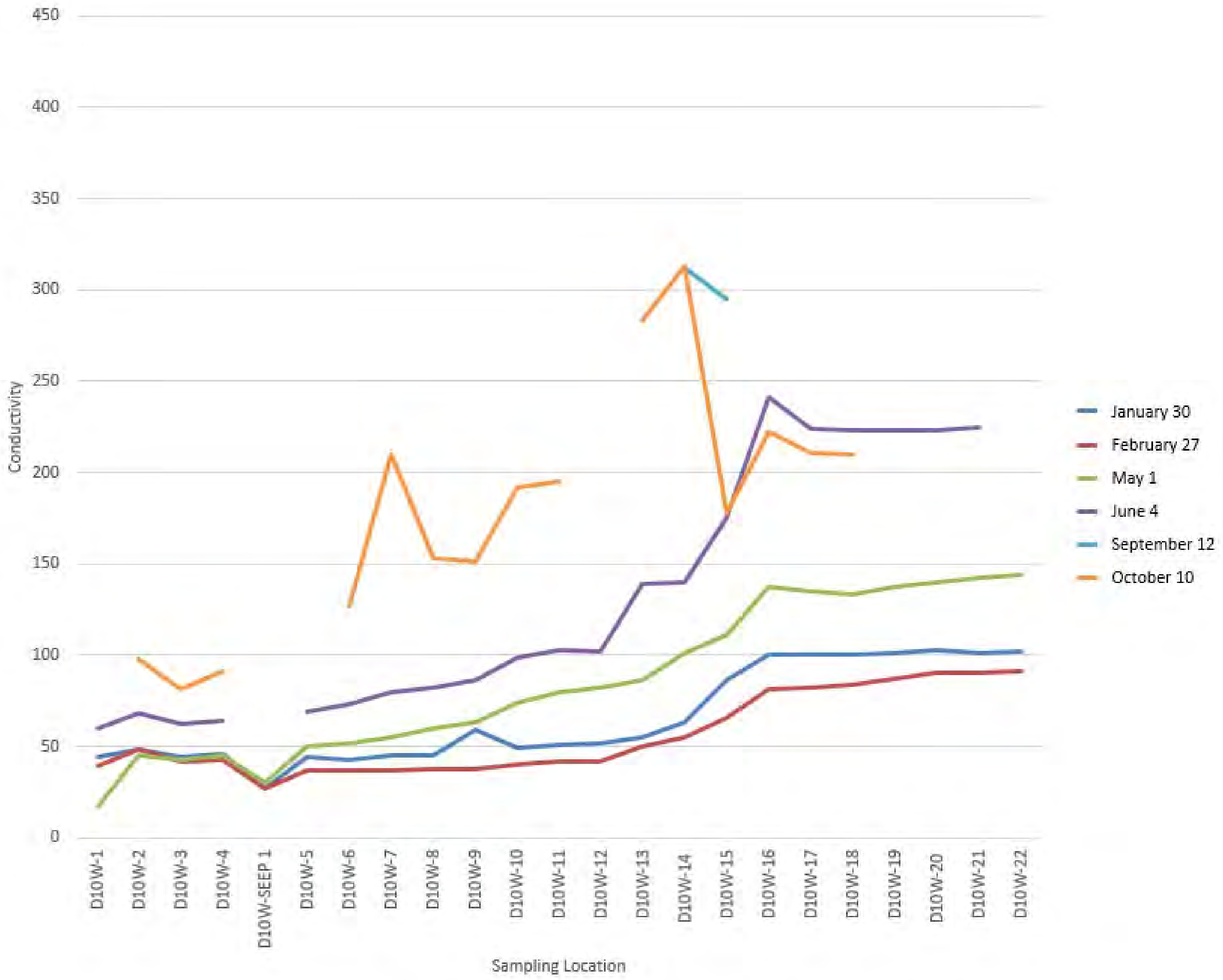


Fig. A.19. Conductivity comparison along D-10W.

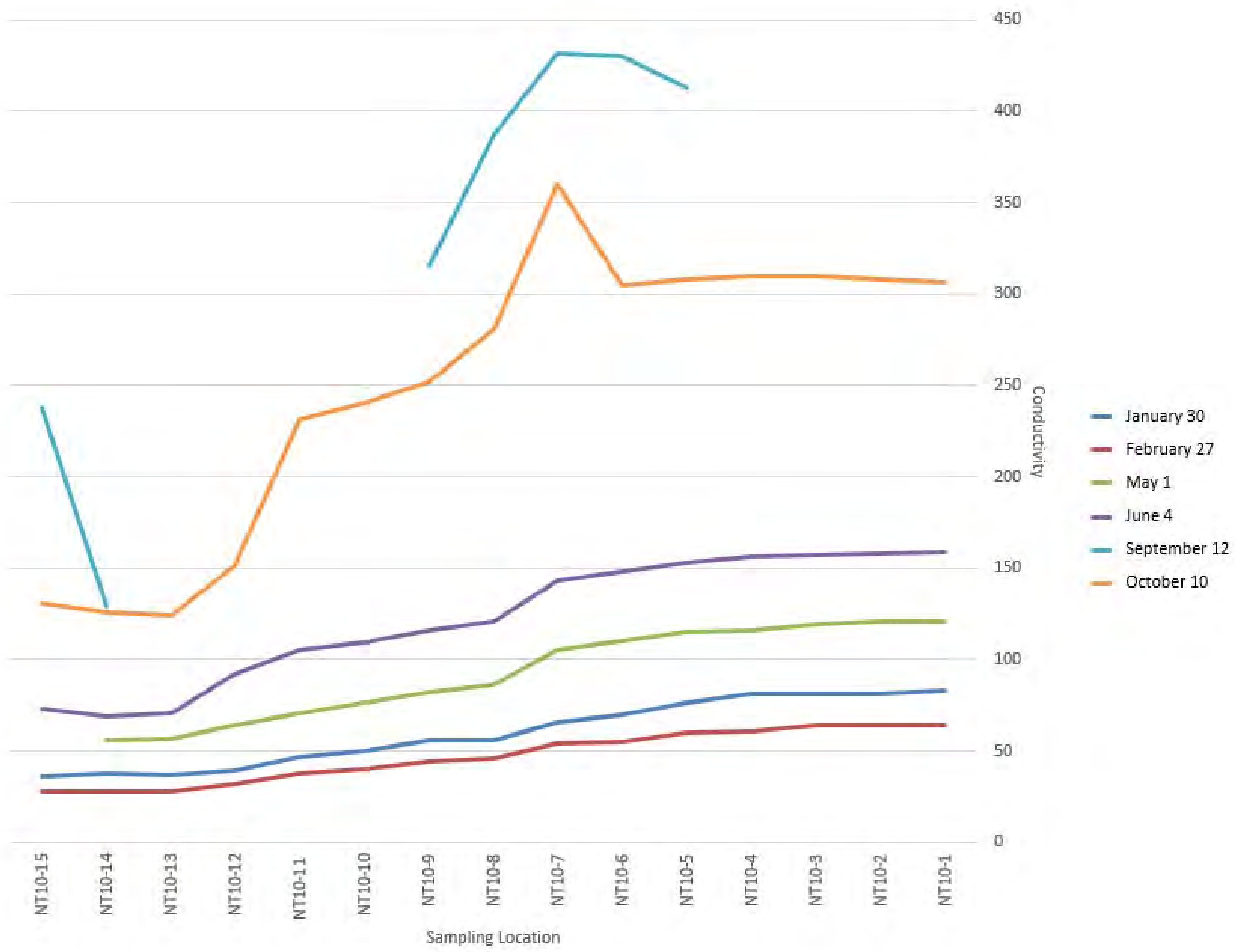


Fig. A.20. Conductivity comparison along NT-10.

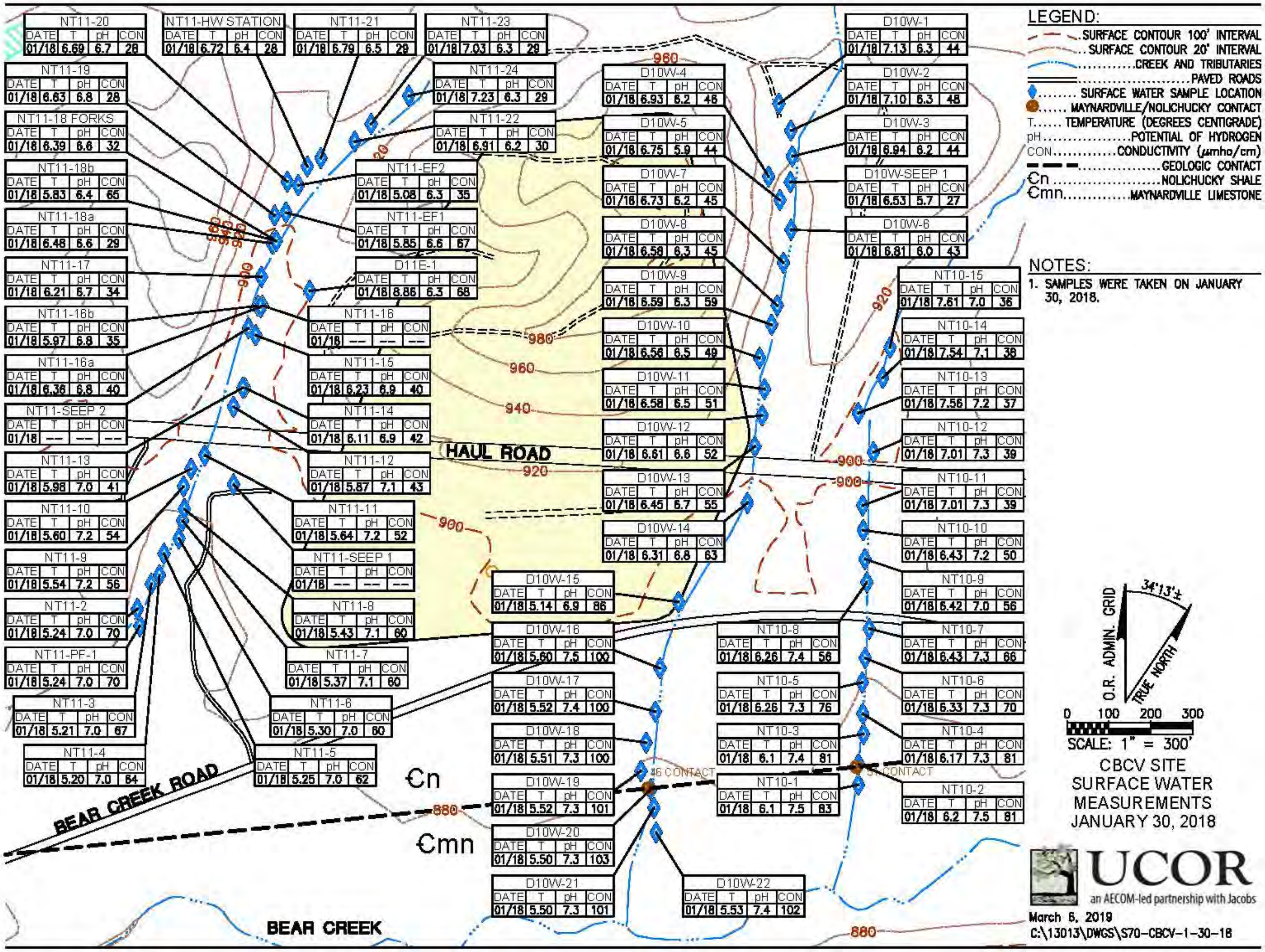


Fig. A.21. January 30, 2018, walkdown results.

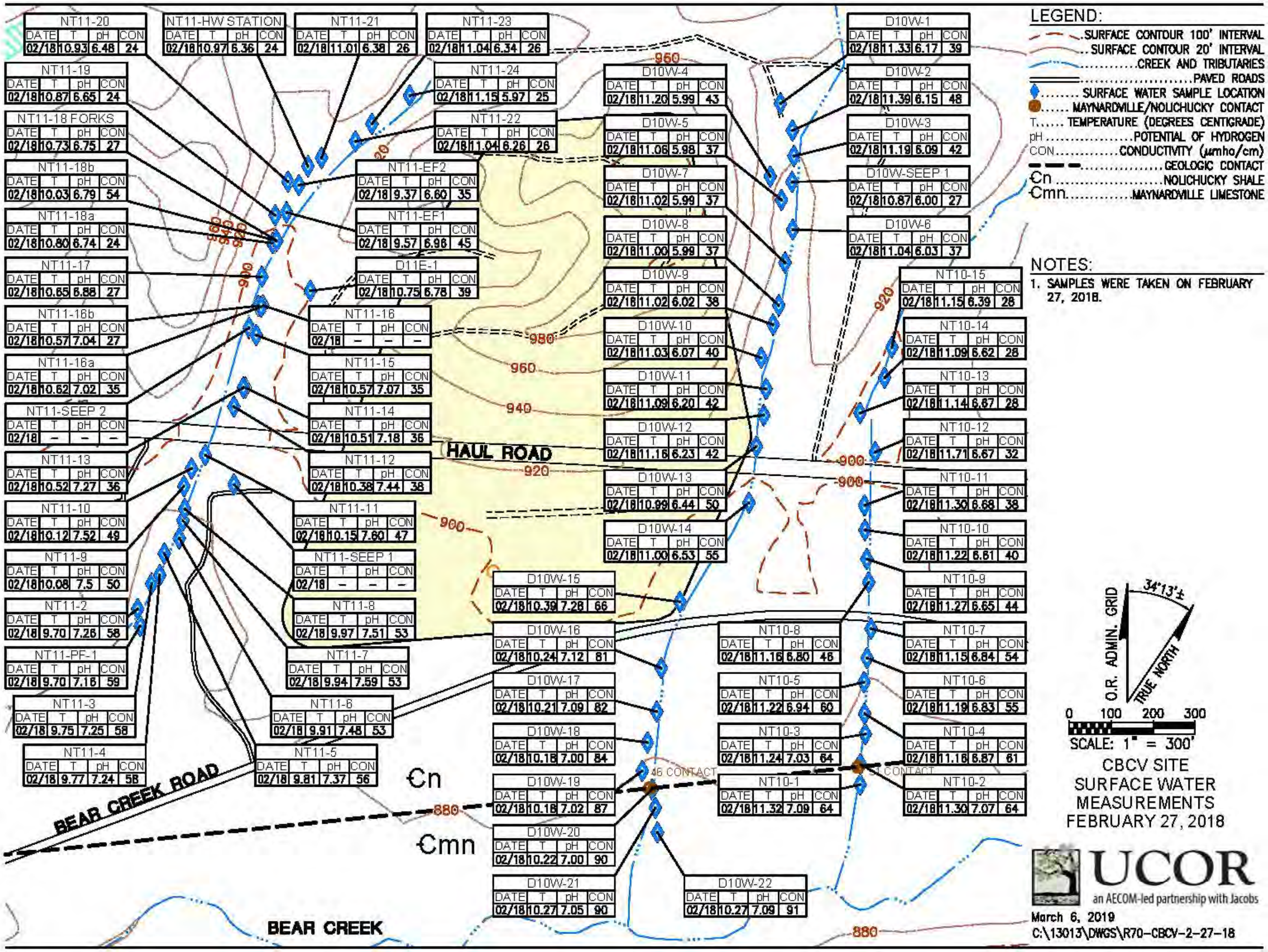


Fig. A.22. February 27, 2018, walkdown results.

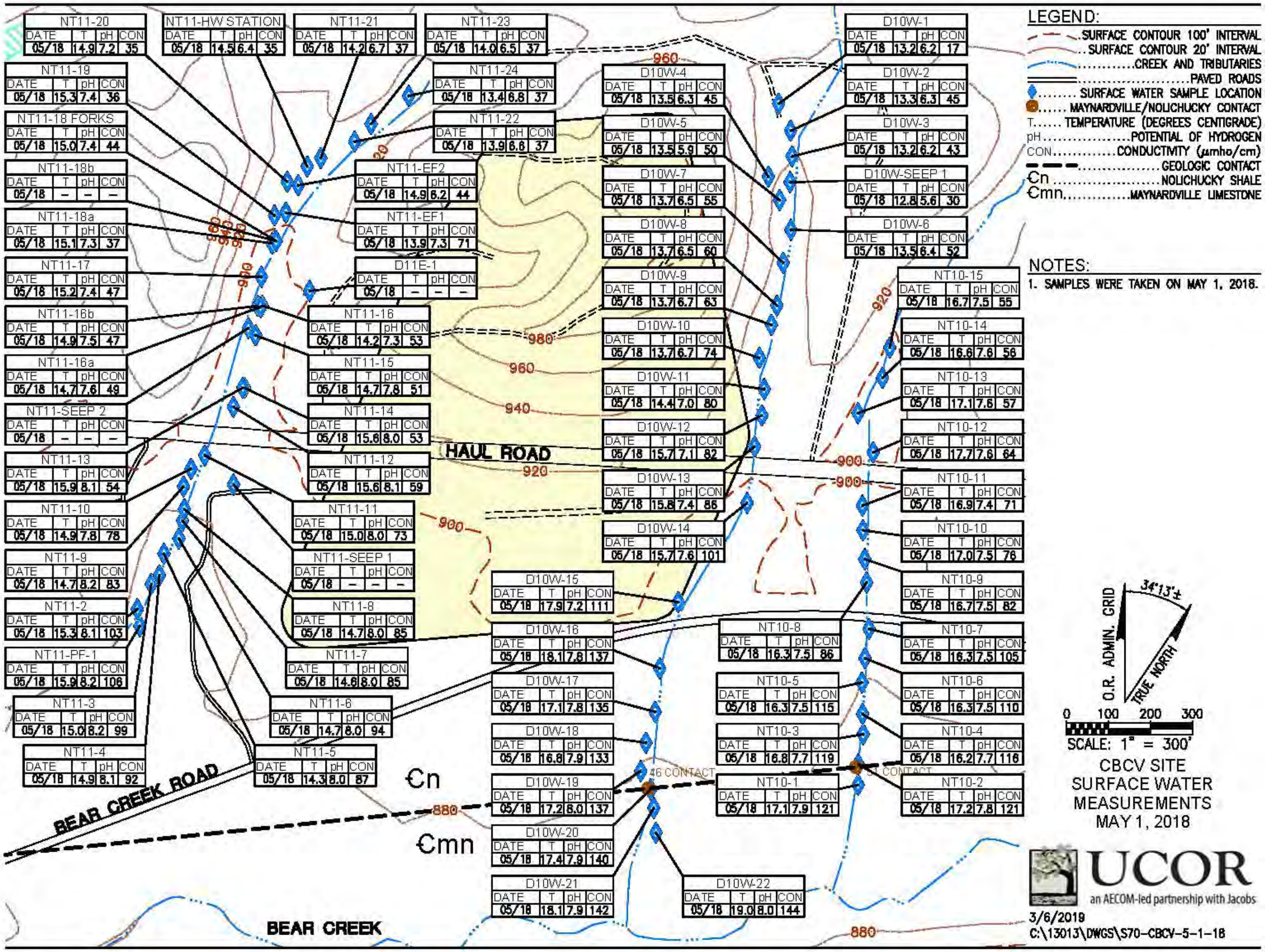


Fig. A.23. May 1, 2018, walkdown results.

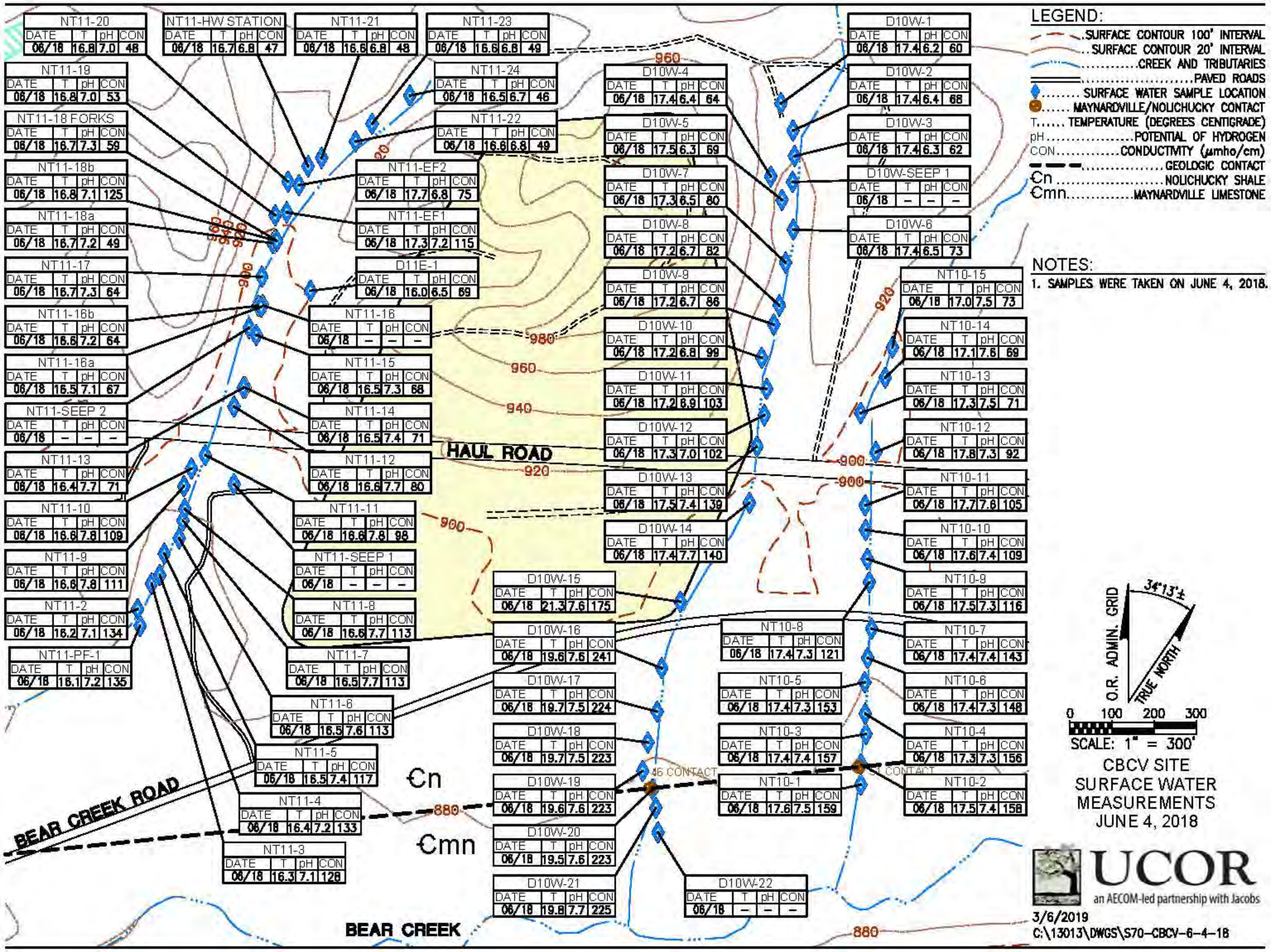
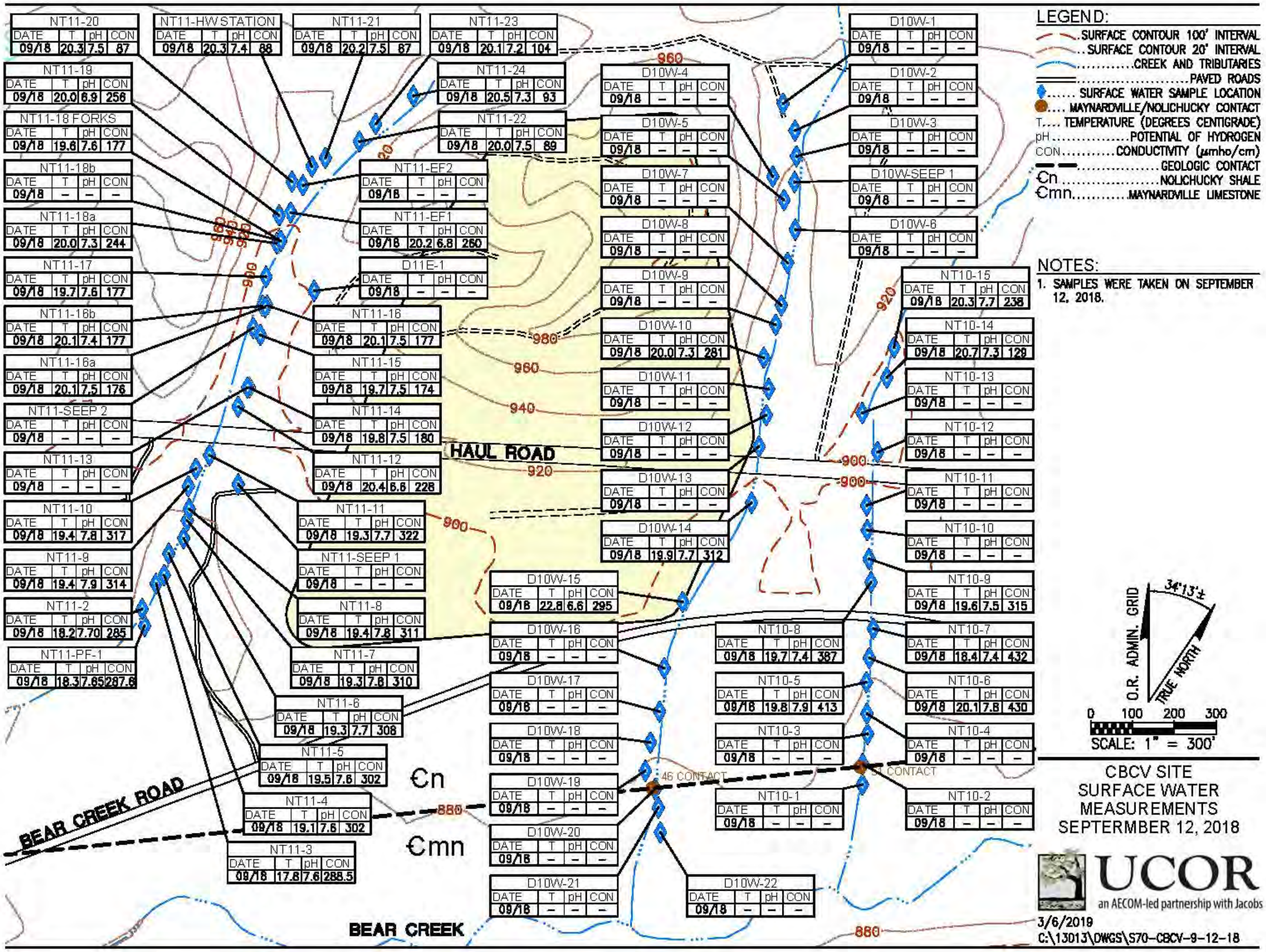


Fig. A.24. June 4, 2018, walkdown results.



LEGEND:

- .SURFACE CONTOUR 100' INTERVAL
- ..SURFACE CONTOUR 20' INTERVAL
- ....CREEK AND TRIBUTARIES
- ....PAVED ROADS
- ...... SURFACE WATER SAMPLE LOCATION
- .... MAYNARDVILLE/NOLICHUCKY CONTACT

T.... TEMPERATURE (DEGREES CENTIGRADE)
pH ....POTENTIAL OF HYDROGEN
CON...........CONDUCTIVITY (μmho/cm)
..................GEOLOGIC CONTACT
Ꞓn ....NOLICHUCKY SHALE
Ꞓmn............MAYNARDVILLE LIMESTONE

NOTES:

1. SAMPLES WERE TAKEN ON SEPTEMBER 12, 2018.

CBCV SITE
SURFACE WATER
MEASUREMENTS
SEPTERMBER 12, 2018

UCOR
an AECOM-led partnership with Jacobs

3/6/2019
C:\13013\DWGS\S70-CBCV-9-12-18

Fig. A.25. September 12, 2018, walkdown results.

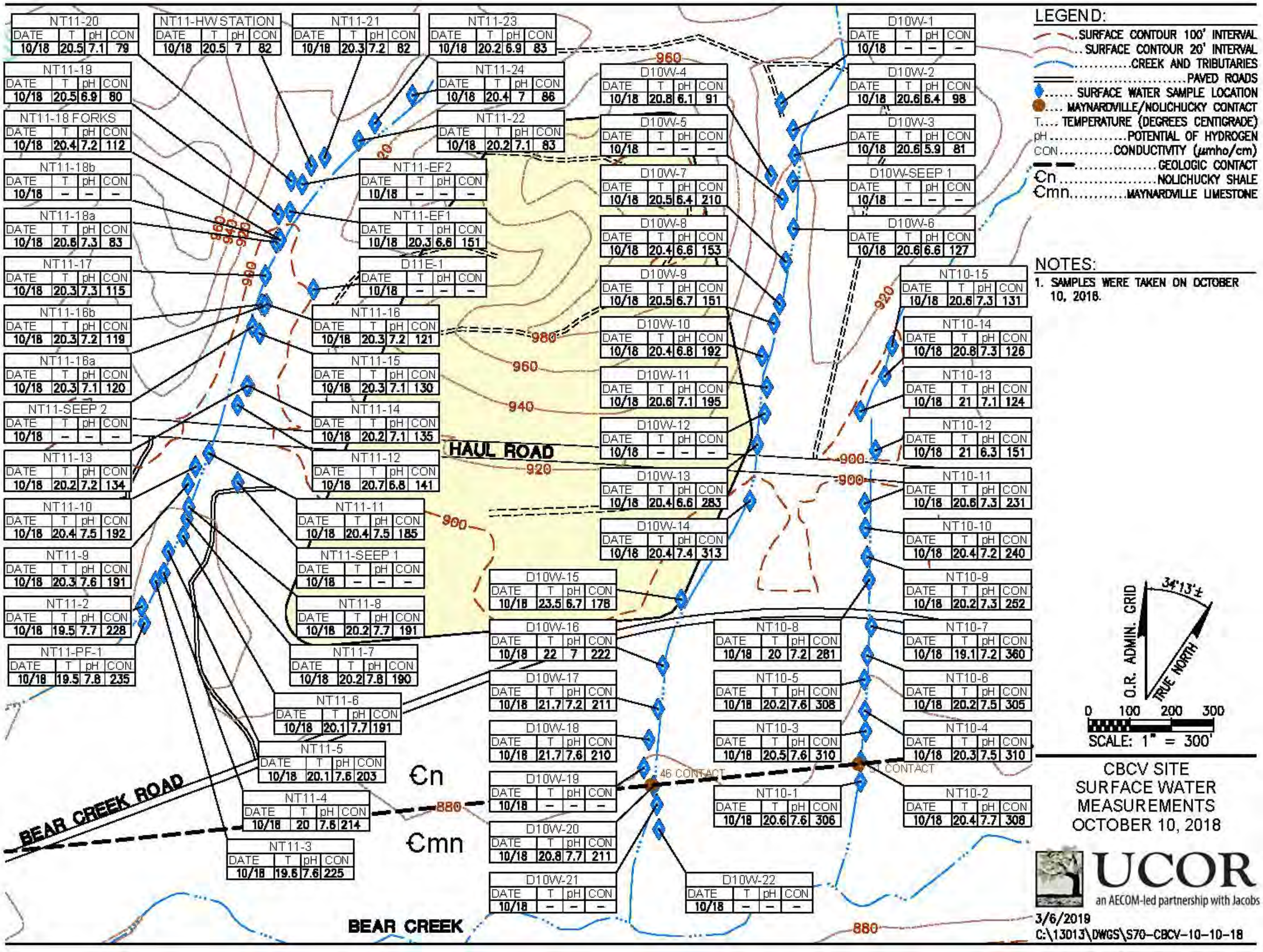


Fig. A.26. October 10, 2018, walkdown results.

REFERENCES

DOE 2018. *Phase 1 Field Sampling Plan for the Proposed Environmental Management Disposal Facility for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal, Oak Ridge, Tennessee*, DOE/OR/01-2739&D2, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

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APPENDIX B

BORING LOGS

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BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project Oak Ridge, TN**	Drilling Methods: 2 1/4" HSA, HQ3 Core w/water, 10" hammer bit w/air, 5 7/8" tricone bit w/water/air.				Boring Number: GW-978
Drilling Firm: *Tri-State Drilling*	DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)	
Driller / Rig: *Fred Reynolds/Mobile 42C*	2/12/18	0910	18.3	9.81	*Page 1 of 4*
Logged by: *Ryan Hansel*	Sampling Methods: ST = Shelby Tube WS = Waxed Sample SP = Sand Pump GP or DP = Direct Push CT = Cuttings		SS = Split Spoon CS = Continuous Sampler C = Coring NS = Not Sampled B = Bailer		Start / Finish
Coordinates: *30656.68N 38643.59E*					*Time 0849* / *Time 1658*
Surface Elevation: *953.5 ft/MSL*					*Date 2/10/18* / *Date 2/18/18*
Surface Conditions / Weather: *Gravel road base, wet / 45°F, Cloudy, calm*					
Remarks:					

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
1	NS			ROAD BASE.	▩	Ran 2 1/4" HSA (7" OD) w/center plug while augering. Continuous 2" OD, 2' drive split spoons, 140 lb hydraulic hammer. HQ3 Core (3 7/8" OD) w/water.	
2 3	SS-1	1.0' 66.7%	2 2 3	Yellowish brown to dark yellowish brown (10YR 5/6 - 4/6) CLAYEY SILT. Trace fine grained sand. Trace angular shale clasts, 1" - 1/2" diameter. Medium to high plasticity. Cohesive. Mottled appearance. Stiff to very stiff. High dry strength. No dilatancy. Weathering present with iron oxide and manganese oxide on surfaces of shale clasts. No reaction with HCl. Moist. RESIDUAL SOIL.	▨	SS-1 Lab results: Moisture Content (MC) 21.8%.	CL
4 5	SS-2	1.9' 95%	3 5 6 7		▨	On 2/15/18, used Ingersoll-Rand T3W rotary rig to ream borehole to 26.5' using 10" air hammer bit and set permanent 6" ID PVC casing. Casing sealed with cement bentonite grout.	
6 7	SS-3	2.0' 100%	5 7 9 11	Below 5' roots (trace). Siltstone clasts present, trace, up to 1" diameter. Clay content increasing with depth. Underlying contact is transitional. Change at 7.4'.	▨	SS-3 Lab results: MC 19.3%.	
8 9	SS-4	1.9' 95%	4 7 9 11	Pale yellow to pale gray (5Y 8/2 - 7/2) to strong brown (7.5YR 5/6 - 4/6) SILTY CLAY. Trace fine grained sand. Trace angular shale and siltstone clasts. Medium to high plasticity. Cohesive. Color gives mottled appearance. Very stiff. High dry strength. Weathered. Iron and/or manganese oxide throughout. No reaction with HCl. Shale clasts becoming oriented in same direction. Moist. COLLUVIUM. Change at 9.9'.	▨	SS-4 Lab results: MC 24%; 0.5% Gravel; 34.2% Sand; 65.3% Fines.	CL
10 11	SS-5	2.0' 100%	4 8 16 19	Gray to dark gray (10YR 5/1 - 4/1) completely weathered SHALE (SAPROLITE). Trace fine grained sand. Laminated to thinly bedded. Shale clasts are comprised mostly of silt and clay. Some shale broken into angular/subangular gravel-sized pieces with iron oxide and manganese oxide on shale surface. Shale bedding is at ~40°-50° angle. Very stiff to hard. Cohesive. High plasticity. Highly decomposed. No dilatancy. Weathered. No reaction with HCl. Dry to moist. SAPROLITE.	☰	SS-5 Lab results: MC 21%.	CL
12 13	SS-6	1.7' 85%	9 20 34 40	Below 12.1' some silt beds and partings present .	☰		
14	SS-7	0.9' 100%	14 50/5	13.7' - 13.9' Color is olive gray to olive (5Y 5/2 - 4/3).	☰		
15	NS			Below 13.7' becomes moderately to highly decomposed. Shale is becoming more intact. Slickensided features along shale bedding planes. Dry to moist.	☰		
16	SS-8	1.0' 100%	46 50/6		☰	SS-8 Lab results: MC 11.5%.	
17	NS			Becoming less weathered with depth.	☰		
18	SS-9	1.3' 100%	24 45 50/3		☰	SS-9 Lab results: MC 11.7%. 2/12/18 at 0910 DTW=9.81 BGS.	
19	NS				☰		
	SS-10	0.7' 100%	40 50/2	No reaction with HCl.	☰	SS-10 Lab results: MC 11.1%.	

BOREHOLE LOG

Boring Number
GW-978

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	USCS
	NS			CL
21	SS-11	0.2' 100%	50/2	
22	NS			
23	SS-12	0	50/2	
24	NS			
25	SS-13	0	50/2	
	C-1	0.9' 100%	0%	
26–31	C-2	3.1' 62%	0%	
31–34	C-3	3.6' 100%	28.9%	
35	C-4	1.4' 100%	38.6%	
36–38	C-5	2.6' 93%	29.6%	
39–40	C-6	2.1' 95.5%	45.5%	
41–44	C-7	5.0' 100%	33.8%	

SAMPLE DESCRIPTION

Gray to dark gray (10YR 5/1 - 4/1) completely weathered SHALE (SAPROLITE). (Cont'd.)

Below 21.0' shale is mostly intact. Iron oxide and manganese oxide become trace. Sample is mostly pulverized due to sample technique and high blow counts. Color becomes gray to dark gray (N 5/ - 4/). Shale clasts are difficult to be broken by hand. Dry to moist.

Underlying contact may be as high as 17.0'.

Change at 25.1'.

Overall structure is a laminated to thinly INTERBEDDED LIMESTONE and SHALE. The shale is very dusky red (10R 2/2). The limestone is dark reddish gray (10GY 4/1). The shale is laminated to thinly bedded. Abundant with slickensides, most along bedding plane. Strong field strength. The limestone is laminated in parts with glauconite grains. Has a strong reaction with HCl. The overall structure is fresh to slightly decomposed. Slightly disintegrated. Intensely to very intensely fractured. Most fractures are along the 45° bedding plane and mechanically induced. Some fractures are completely healed with white to pink/orange calcite and dusky red mudstone. Soft sediment deformation and cross-bedding is present throughout and along shale/limestone bedding contact.
26.0' - 27.3' Multiple horizontal and vertical breaks and fractures. Some are healed with calcite. Most are mechanically induced.
At 27.3, iron oxide on fracture perpendicular to the bedding plane.
Below 27.3' sample is very intensely fractured (pulverized). Probably mechanically induced.
Change at 31.0'.

Dusky red to very dusky red (10R 3/2 - 2.5/2) SHALE. Laminated to thinly bedded. Strong field strength. Trace limestone beds and partings. Abundant slickensides mostly along bedding plane. Bedding is ~40°-50°. Trace glauconite grains and stringers. Fresh. Slightly disintegrated. Moderately to intensely fractured. Most breaks/fractures are mechanically induced. Trace to little fractures are healed with calcite. No reaction with HCl in shale. Strong reaction on limestone beds and calcite veins.
31.6', 31.85' - 32.0' Fracture perpendicular to bedding plane.
32.3' Fracture along bedding plane with slickensides and brittle calcite.
32.5' - 33.0' Very intensely fractured. Multiple fractures/breaks along and perpendicular to bedding planes.

37.5' - 37.6' Dark greenish gray limestone parting. Limestone contains angular clasts of limestone (interclasting limestone).

37.6' - 38.8' Shale is pulverized. Dark greenish gray in color.

Below 38.8' becoming moderately fractured.

38.9' - 39.1' Calcite healed fracture perpendicular to bedding.

39.1' - 39.4' Fracture along bedding plane, slickensided with thin calcite precipitate.

39.4' - 40.2' Trace siltstone/mudstone partings. Irregular breaks in core. Horizontal to core axis. Same color as shale. Strong to moderate reaction with HCl.
40.2' - 40.4' Fracture along bedding plane with thin calcite precipitate.

Below 41.0' limestone beds and partings become trace to little.

41.4' - 41.5' Fracture perpendicular to bedding plane with brittle calcite.

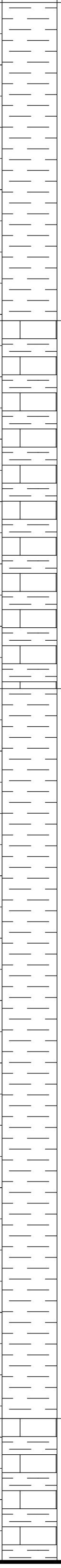
41.7' Fracture horizontal to core axis with brittle calcite.

42.5' Bedding plane fracture with brittle calcite.

Below 42.6' shale becomes very dark greenish gray (10Y 3/1). Limestone beds and partings increasing with depth. Limestone beds present with bioturbidation.
42.6' - 42.9 Fracture perpendicular to bedding plane with calcite.
Change at 42.7'. (Transitional).

Laminated to thinly INTERBEDDED SHALE and LIMESTONE. The shale is dark reddish gray to reddish black (2.5YR 3/1 - 2.5/1). Laminated to thinly bedded. Strong field strength. Abundant slickensides. The limestone is gray to dark gray (N 5/ - 4/). Bioturbidation and soft sediment

Graphic Log



Remarks

Water on AW rods when pulling SS-10. Water in hole may be from surface. ~4" rain over weekend.

SS-12 No return. Very hard sampling and augering.

SS-13 No return. Switching to core to attempt better sample recovery. DTW = 17.85' BGS on 2/12/18 at 1055. Added 1/2 bag 3/8" bentonite chips to hole. Lowered 4" ID temporary surface casing to 25.0'.

C-1 25.1' - 26.0' 1256-1311.

C-2 26.0' - 31.0' 1326-1429. (Stopped run from 1340 - 1345 to switch water tanks.)

C-3 31.0' - 34.6' 1442-1550. 1526-1540 Change water/break.

33.0' Fracture perpendicular to bedding plane.
35.6' Fracture along bedding plane healed with calcite.
33.6' - 33.8' Vertical fracture.

C-4 34.6' - 36.0' 1608-1627.

C-5 36.0' - 38.8' 1640-1714. 1649-1655 Change water.

2/12/18 at 1719 DTW = 5.65' BGS. 2/13/18 at 0810 DTW = 9.19' BGS.

C-6 38.8' - 41.0' 0830-0856.

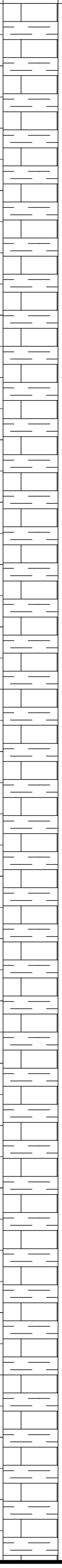
42.0' Water circulation becomes light gray.

C-7 41.0' - 46.0' 0905-0956. 0914-0919 Change water.

Eagon & Associates, Inc.

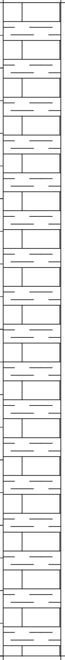
EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-978

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
	C-7	5.0' 100%	33.8%	deformation. Strong field strength. Trace glauconite grains. The contact between the shale and limestone is in most part deformed. Trace glauconite veins/stringers. Fresh to slightly decomposed. Intensely to moderately fractured. Most fractures are along bedding planes and probably mechanically induced. Trace to some fractures are completely healed with calcite.		At ~45' water circulation turned brown. ~45.5' Water circulation dark to light gray.	
46 47 48 49 50	C-8	4.9' 98%	36.6%	44.6' - 45.1' Multiple fractures with and against bedding plane. Iron oxide and manganese oxide present on all fracture surfaces. Iron oxide halo from 44.6' - 44.9'. 45.0' - 45.3' Multiple fracture with and against bedding plane. Iron oxide and manganese oxide on each fracture face. Iron oxide halo ~0.01' around fractures. 47.2' Fracture along bedding plane with Iron and manganese oxide. 49.0' and 49.2' Fracture horizontal to core axis with iron and manganese oxide.		C-8 46.0' - 51.0' 1020-1200. 46.5' Water brown. 47.0' Water light gray.	
51 52 53 54 55	C-9	4.7' 94%	35.8%	Below 51.0' becomes moderately fractured. Most to all mechanically induced. 52.2' - 53.2' Fracture perpendicular to bedding plane completely healed with calcite. Below 52.5' trace to little glauconite stringers/veins/partings. Limestone has fine grains of glauconite. Limestone and shale interbeds are mostly wavy and deformed. There are some subrounded, reworked limestone clasts oriented with bedding (40° - 50°). Below 54.0' bedding becomes mostly planar with some soft sediment deformation. Shale has a very dark greenish gray color (10GY 3/1).		On C-8 ran out of water at 50.8'. Finish run after lunch. Lunch 1100-1155. C-9 51.0' - 56.0' 1210-1320. 1237-1309 Stop - out of water.	
56 57 58	C-10	2.7' 90%	0%	Below 56.0' becomes intensely fractured to very intensely fractured. Multiple fracture/breaks are along calcite healed fractures or bedding planes. Shale becomes dark reddish brown (5YR 3/2). 56.2' - 56.4' Fracture perpendicular to bedding plane healed with calcite. 57.2' - 59.0' Very intensely fractured. Most/all are mechanical breaks along bedding planes/calcite healed fractures. 59.0' - 59.2' Vertical fracture (mechanical break) healed with calcite. 59.0' - 59.6' Shale is very dark greenish gray (10GY 3/1).		C-10 56.0' - 59.0' 1330-1424. 1356-1413 Change water.	
59 60	C-11	1.9' 95%	0%	Below 59.6' soft sediment deformation becomes trace to little. 61.4' - 61.6' Shale is very dark greenish gray (10GY 3/1). Shale beds becoming dominant.		At 59.0' driller noted spike in water pressure. Stopped run at 59.0'. C-11 59.0' - 61.0' 1435-1450.	
61 62 63 64	C-12	3.4' 74%	0%	61.8' - 62.0' Fracture along bedding plane healed with calcite. 62.6' Mechanical break perpendicular to bedding. 63.0' - Mechanical break perpendicular to bedding. Below 63.6' shale becomes dark greenish gray (10GY 3/1). Shale and limestone beds become 50/50. Soft sediment deformation becomes few to little. 64.1' - 64.2' Fracture perpendicular to bedding plane healed with calcite.		C-12 61.0' - 65.6' 1502-1536. 65.0' Driller noted spike in water pressure. Pulled run, thinks lost from bottom of C-12.	
65	C-13	0.7' 77.8%	37.8%	Below 65.1' shale becomes dark reddish brown (5YR 3/2). Fractures healed with calcite become trace to rare.		C-13 65.6' - 66.0' 1545-1557.	
66 67	C-14	1.3' 81.3%	0%	66.6' Horizontal fracture healed with calcite. 67.9' Horizontal fracture with calcite. Multiple fractures along bedding plane are mechanically induced.		C-14 66.0' - 67.6' 1608-1628. Spike in water pressure blocked tip. Pulled run at 67.6'. Lost from bottom of run.	
68 69	C-15	3.2' 94.1%	0%	69.9' - 70.2' Fracture perpendicular to bedding plane healed with calcite.		C-15 67.6' - 71.0' 1636-1714. 1643-1650 Change water.	

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-978

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
	C-15	3.2'	0%	Gray to dark gary (N 5/ - 4/) to dark reddish brown (5YR 3/2) INTERBEDDED SANDSTONE and SHALE. (Cont'd.)		2/13/18 at 1710 DTW=21.51 BGS. 2/14/18 at 0802 DTW=18.05 BGS.	
71	C-16	2.7	0%	71.0 - 71.5' Highly broken zone. Mechanically induced. Some fractures completely healed with calcite. 71.9' Fracture horizontal to core axis healed with calcite. Glauconite veins and stringers become little.			
72						C-16 71.0' - 73.9' 0922-0948.	
73				Most breaks are along bedding plane and mechanically induced.			
74	C-17	1.1	0%			C-17 73.9' - 75.0' 0957-1006.	
75	NS					2/14/18 at 1021 DTW=33.96 BGS.	
76							
77							
78							
79							
80				Bottom of Borehole = 80.0'. Piezometer GW-978 installed in borehole. See Monitoring Well Installation Report GW-978 for details.		2/18/18 Reamed borehole and advanced borehole to 80.0' using Ingersoll-Rand T3W rotary rig with 5 7/8" tricone bit with water and air circulation. Completed at 1658.	
81							
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Eagon & Associates, Inc.

Well Number
GW-978

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*

Completion Date: *3/8/18*

Coordinates: *30656.68N 38643.59E*

Borehole Depth (ft): *80.0*

Elevation Top of Casing (ft/MSL): *955.97*

Borehole Diameter (in):*10" (0'-26.5'), 5 7/8" (26.5'-80.0')*

Elevation Ground Surface (ft/MSL): *953.5*

Drilling Methods: *2 1/4" HSA, HQ3 Core w/water, 10" hammer bit w/air, 5 7/8" tricone bit w/water/air.*

Installed By: *Fred Reynolds/Tri-State Drilling*

Completed Drilling: *2/18/18*

Supervised By: *Shay Beanland/Eagon & Associates, Inc.*

Drilling Water Used (gals):

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel Protector w/Locking Lid	-2.8 - 2.2	956.3 - 951.3
Riser	2" ID Schedule 40 PVC	-2.3 - 59.5	955.8 - 894.0
Surface Seal	3' x 3' Concrete Pad	-0.5 - 0.5	954.0 - 953.0
Conductor Casing	6" ID PVC Schedule 40, Flush Threaded	-0.4 - 26.5	953.9 - 927.0
Cement Grout	Cement Bentonite Grout	0.5 - 53.0	953.0 - 900.5
Bentonite Seal	Pel Plug 1/4" Coated Bentonite Pellets	53.0 - 56.1	900.5 - 897.4
Sand Pack	DSI "GP #2" Gravel Pack	56.1 - 70.9	897.4 - 882.6
Screen	2" ID Schedule 40 PVC, 10-Slot	59.5 - 69.6	894.0 - 883.9
Well Point Blank	2" ID Sch. 40 PVC Cap & Riser Section	69.6 - 70.9	883.9 - 882.6
Sand Pack Bottom	DSI "GP #2" Gravel Pack	70.9 - 71.5	882.6 - 882.0
Bentonite Seal	Pel Plug 1/4" Coated Bentonite Pellets	71.5 - 80.0	882.0 - 873.5

Well Development

Well Depth (ft,TOC): *73.18*

Depth to Water (ft,TOC): *10.63*

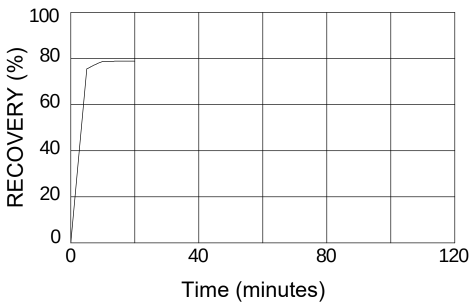
Well Volume (gals): *10.2*

Volume Purged (gals): *467.5*

Development Method:
Bailer, surge block, Tornado pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (µmhos/cm)	pH (S.U.)	Turbidity (NTU)
2/26/18	1700	125	--	--	--	--
2/27/18	0810	145	14.1	372	8.29	3.6
2/27/18	1304	250	14.8	351	7.56	2.7
2/27/18	1314	265	14.8	342	7.57	6.0
2/27/18	1344	310	14.8	334	7.52	1.8
2/27/18	1555	467.5	15.1	340	7.48	2.0

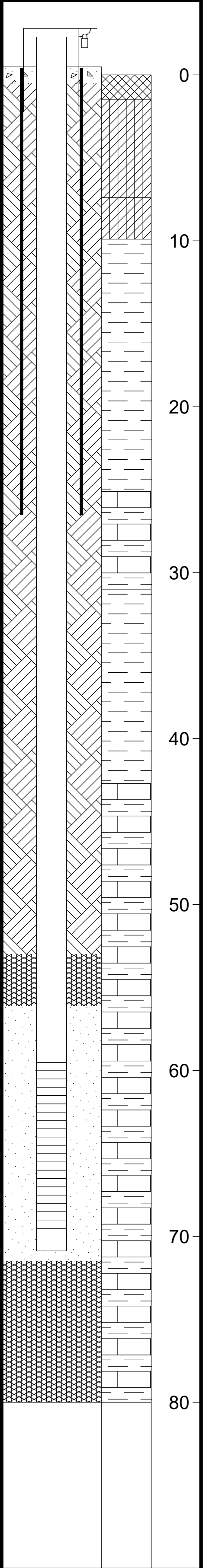
Recovery Data



Sampling Equipment:

Comments:

Stainless steel centralizers set at 52' and 27' from ground surface. Washed sand pack and pellets in using tremie pipe. Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 59.8 - 69.5 bgs.



Boring depth=80.0 ft.

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Eagon & Associates, Inc.

BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project**
Oak Ridge, TN

Drilling Methods:
3 1/4" ID HSA, HQ Core with water, 5 7/8" air hammer bit.

Boring Number:
GW-979

Page 1 of 2

Drilling Firm: *Tri-State Drilling*

Driller / Rig: *Fred Reynolds/Mobile Drill B42C*

Logged by: *Shay Beanland*

Coordinates: *30656.61N 38653.90E*

Surface Elevation: *953.7 ft/MSL*

Surface Conditions / Weather: *Gravel road base, wet / 70°F, Overcast, light sprinkle*

DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)

Sampling Methods:

ST = Shelby Tube
WS = Waxed Sample
SP = Sand Pump
GP or DP = Direct Push
CT = Cuttings
SS = Split Spoon
CS = Continuous Sampler
C = Coring
NS = Not Sampled
B = Bailer

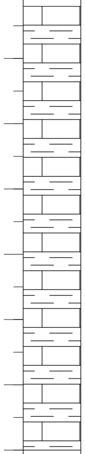
Start	Finish
Time 1112	*Time 1358*
Date 2/21/18	*Date 2/22/18*

Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
1 2	NS			See Borehole Log GW-978 for detailed lithologic description and stratigraphic interpretation.		Ran 3 1/4" ID HSA with center plug while augering. 7" OD borehole.	
3 4	ST-1	2.0	700 PSI 700 PSI 750 PSI 850 PSI	At base of tube, sample was light brown to strong brown (7.5YR 6/4 - 5/6) SANDY SILTY CLAY. Sand is fine grained. Sample is mottled. Moist.		Pushed Shelby tube from 3.0' - 5.0'. Let Shelby tube (ST-1) set from 1119 to 1132.	
5 6 7	NS					Bucket Sample BS-1 collected from 4.0' - 5.0' at 1140. Bucket Sample BS-2 collected from 5.0' - 6.0' at 1141.	
8	ST-2	1.25	900 PSI 900 PSI 1000/3 PSI				
9	NS			At base of tube, sample was reddish brown (5YR 5/3 - 4/4) SAPROLITE (SHALE). Highly weathered. Easily crumbled with hand. Moist.		Pushed Shelby tube (ST-2) from 7.5' - 8.75', which is where refusal was. Let Shelby tube set from 1144 to 1154.	
10	ST-3	1.6	850 PSI 1100 PSI 1500/4 PSI	At base of tube, sample was light yellowish brown to light olive brown (2.5Y 4/3 - 5/3) SHALE (SAPROLITE). Weathered. Easily crumbled with hand. Iron oxide and manganese oxide on bedding plane surfaces.		Pushed Shelby tube (ST-3) from 9.5' - 10.8'. Let tube set from 1201 to 1208.	
11 12 13 14 15 16 17 18 19	NS						

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-979

Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
21	C-1	0.4' 44.4%	0%	Dark gray to very dark green gray (N 4/ - 5GY 3/1) INTERBEDDED SHALE and LIMESTONE. Limestone tends to be lighter in color - gray to greenish gray (N 5/ - 5GY 5/1). Laminated in places with glauconite grains. Overall structure of interbeds is laminated to medium bedded. Shale is laminated. Slickensides observed on bedding plane surfaces due to soft sediment deformation. Bioturbation and other soft sediment deformation features observed. Bedding is at 40° to 50° angles. No iron staining observed. Field strength is strong. Core is fresh and competent to slightly disintegrated where trace fractures have been healed with calcite. Some fractures that are healed with calcite are at 45° angles and opposite direction of bedding. Intensely to very intensely fractured in part, but breaks are along bedding planes and are likely mechanical.		Auger refusal at 20.2'. Switch to HQ core barrel and start coring and pulled augers at 1359 - 1421 went to get casing. 1421 Attempting to install PVC casing. 1424 WL at 18.55', TD = 20'. 1643 WL at 5.8', TD = 27.1'. 25.6' - 26.0' Calcite present along fracture face. C-1 Run: recovery has been highly disturbed. Limestone beds intact, shale has been pulverized and did not feed into barrel. Sample destroyed. C1: 20.2 - 21.1' 1445-1455. C2: 26.1' - 25.0' 1500-1522. 21.1' - 21.3' Very intensely broken along bedding planes and some at an angle perpendicular to bedding direction. Iron staining throughout. No iron staining present below 21.3'. C3: 25.0' - 27.0' 1528-1548.	
22 23 24 25	C-2	3.9' 100%	26.1%				
26 27	C-3	2.1' 100%	0%				
28 29 30 31 32 33 34 35 36 37	NS						
38 39 40 41 42 43 44				Bottom of Borehole = 37.6'. Piezometer GW-979 installed in borehole. See Monitoring Well Installation Report GW-979 for details.		On 2/22/18 used Ingersoll-Rand T3W rotary rig to ream corehole and advance borehole to 37.6' using 5 7/8" hammer bit. Completed drilling at 1358.	

Well Number
GW-979

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*

Completion Date: *3/8/18*

Coordinates: *30656.61N 38653.90E*

Borehole Depth (ft): *37.8*

Elevation Top of Casing (ft/MSL): *955.99*

Borehole Diameter (in):*5 7/8" (0'-37.75')*

Elevation Ground Surface (ft/MSL): *953.7*

Drilling Methods: *3 1/4" ID HSA, HQ Core with water, 5 7/8" air hammer bit.*

Installed By: *Fred Reynolds/Tri-State Drilling*

Completed Drilling: *2/22/18*

Supervised By: *Shay Beanland/Eagon & Associates, Inc.*

Drilling Water Used (gals):

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel Protector w/Locking Lid	-2.6 - 2.4	956.3 - 951.3
Riser	2" ID Schedule 40 PVC	-2.3 - 26.3	956.0 - 927.5
Surface Seal	3' x 3' Concrete Pad	-0.5 - 0.5	954.2 - 953.2
Cement Grout	Cement Bentonite Grout	0.5 - 19.0	953.2 - 934.7
Bentonite Seal	Pel Plug 1/4" Coated Bentonite Pellets	19.0 - 21.2	934.7 - 932.6
Sand Pack	DSI "GP #2" Gravel Pack	21.2 - 37.6	932.6 - 916.1
Screen	2" ID Schedule 40 PVC, 10-Slot	26.3 - 36.3	927.5 - 917.4
Well Point Blank	2" ID Sch. 40 PVC Cap & Riser Section	36.3 - 37.6	917.4 - 916.1
Sand Pack Bottom	DSI "GP #2" Gravel Pack	37.6 - 37.8	916.1 - 916.0

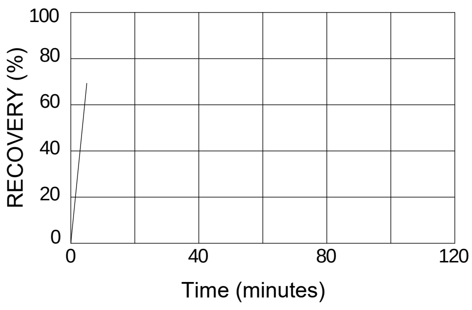
Well Development

Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
39.88	*14.70*	*4.1*	*236.0*

Development Method:
Surge block, bailer, Tornado pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (µmhos/cm)	pH (S.U.)	Turbidity (NTU)
2/27/18	1100	108.5	14.4	311	7.35	41.9
2/27/18	1110	123.5	14.4	306	7.44	13.1
2/27/18	1150	183.5	14.5	304	7.35	1.0
2/27/18	1200	198.5	14.5	304	7.30	1.9
2/27/18	1210	213.5	14.5	301	7.38	0.9
2/27/18	1225	236.0	14.5	303	7.32	0.7

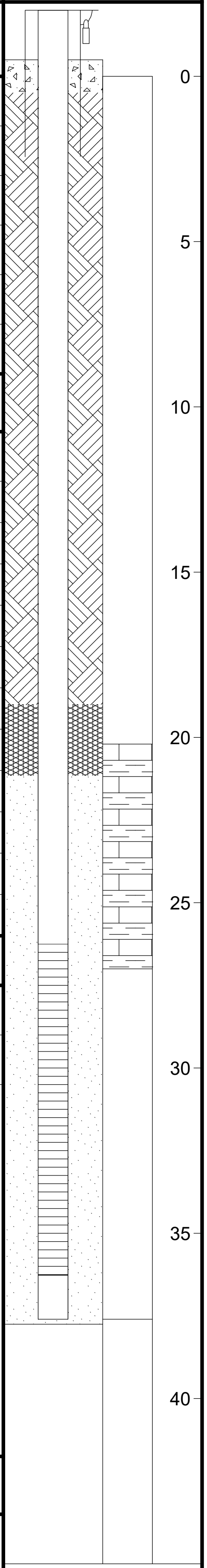
Recovery Data



Sampling Equipment:

Comments:

Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 26.5 - 36.2 bgs.



Boring depth=37.8 ft.

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Eagon & Associates, Inc.

BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project Oak Ridge, TN**	Drilling Methods: 3 1/4" ID HSA, HQ3 Core with water circulation, 10" air hammer bit, 5 7/8" tricone bit with air/water.				Boring Number: GW-980
Drilling Firm: *Tri-State Drilling*	DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)	
Driller / Rig: *Shannon Snow/CME-550*					*Page 1 of 4*
Logged by: *David J. Sugar*	Sampling Methods: ST = Shelby Tube WS = Waxed Sample SP = Sand Pump GP or DP = Direct Push CT = Cuttings		SS = Split Spoon CS = Continuous Sampler C = Coring NS = Not Sampled B = Bailer		
Coordinates: *30388.00N 38138.34E*					Start: *Time 1525* *Date 2/13/18*
Surface Elevation: *963.4 ft/MSL*					Finish: *Time 1202* *Date 2/17/18*
Surface Conditions / Weather: *Gravel pad, moist, slopping / 51°F, Overcast*					

Remarks:

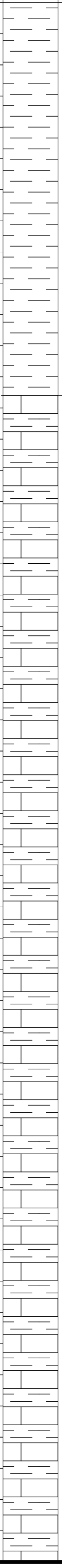
Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
	NS			Road bed/pad. Gravel.		3 1/4" ID HSA, 7 1/2" OD, ran center bit while augering. Continuous 2" OD, 2' drive split spoons 140 lb automatic hammer.	
1				Dark yellowish brown (10YR 4/4 - 4/6) SANDY SILT. Few clay. Few to some gravel clasts, up to 1 3/8" shale/sandstone fragments. Unsorted, generally jumbled fabric (no dominant orientation of clasts). Low to medium plasticity. Low to medium toughness. Weathered. Moist to slightly moist. RESIDUUM/COLLUVIUM.			ML
2	SS-1	0.5' 83%	4			Possibly ML-CL classification. Trace to some iron oxide coatings on rock fragments. Does not appear to follow soil fractures, isolated to rock fragments.	
3	SS-2	1.6' 80%	5 10 12 17				
4 5	SS-3	2.0' 100%	6 21 29 30	Trace to some very grayish green (5GY 3/2) zones. Possibly highly weathered glauconitic rock fragments.		No reaction with HCl. On 2/15/18 used Ingersoll-Rand T3W rotary rig to ream corehole to 26.5' using 10" air hammer bit. Set permanent 6" PVC casing and sealed with cement bentonite grout.	
6 7	SS-4	2.0' 100%	43 68 73 70	Below 6.9' primarily slightly moist. Color is lighter light brownish gray, brown to yellowish brown (10YR 5/2 - 5/6).		SS-2 Lab results: Moisture Content (MC) 13.8%; 45% Gravel; 32% Sand; 23% Fines.	
8 9	SS-5	2.0' 100%	16 25 49 42				
10 11	SS-6	2.0' 100%	6 25 78 100	11.1' - 11.2' grayish green glauconitic sandstone fragment.		Possibly ML-CL classification. SS-3 Lab results: MC 15.1%.	
12 13	SS-7	1.4' 70%	11 39 100/4	Light yellowish brown to brownish yellow (10YR 6/4 - 6/8) and greenish gray (5G 5/1). Highly to completely weathered SHALE. Thinly bedded. Considerable yellowish brown iron oxide coatings. Trace manganese oxide.		Zone with rock structure. Possibly large rock fragment. SS-4 Lab results: MC 15%.	
14	NS					SS-6 Lab results: MC 12.6%. SS-8 Lab results: MC 14.5%. No reaction with HCl.	
15	SS-8	2.0' 100%	39 54 66 51	Continues to have low to medium plasticity, low to possibly medium toughness. Possibly ML-CL classification.		Appears saprolitic in places, may be large flat rock fragments. Slightly moist.	
16 17	SS-9	1.9' 95%	20 63 57 100/5	Underlying contact is gradational from 17.2' - 17.5'. Change at 17.4'.		SS-9 Lab results: MC 10.2%. SS-10 Lab results: MC 4.3%.	
				Gray to greenish gray (N 5/ - 10Y 5/1) SHALE. Soft. Sample structure is generally destroyed by sampling process. Trace yellowish brown iron oxide, fracture coatings. Appears thinly bedded with relatively high bedding angle.		No reaction with HCl. Unweathered to slightly weathered.	
18	SS-10	0.7' 100%	92 100/2				
19	NS			Below 18.0' primarily gray (N 5/) color. Trace yellowish brown iron oxide near 18.6'.		Slightly moist to dry structure is mostly disturbed by the	

EMDF Characterization Project Oak Ridge, TN	BOREHOLE LOG	Boring Number GW-980

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Remarks	USCS
	SS-11	0.5'/100%	100/5	Very dark gray to black (N3/ - N2.5/) SHALE. (Cont'd.)	sampling process. SS-11 Sample is wet, ~1' of cutter sampler was also wet. After taking SS-11 (1700) measured WL at 19.22' (1705).	
21	NS			Trace yellowish brown iron oxide from 20.2' to 20.3'.		
22	SS-12	0.9' 90%	69 100/2	Trace white precipitate (?) does not react with HCl. Trace amount associated with bedding planes.	SS-12 Lab results: MC 11.7%. SS-13 Lab results: MC 12.3%.	
23	NS			Below 22.0' oxidation not present. Formation is soft but relatively unweathered.	SS-11 and SS-12 Recovery is broken due to the sampling process. Bedding appears to	
24	SS-13	0.8' 80%	40 100/3	SS-13 Sample has relatively intact bedding. 40° - 45° Bedding angle, appears thinly bedded.	be angled but gradation is not apparent. End 2/13/18, 1735, at 25.0'.	
25 26	NS			Change at 26.3'.	1746 WL = 20.72' from GS. Begin 2/14/18, 0830, 45°-50°F, light rain. 0808 WL = 14.12' from GS.	
27 28 29	C-1	2.6 87%	0%	Interbedded dark reddish gray/weak red to dark red (2.5 4/1 - 4/2 and 3/1 - 3/2) SHALE and dark gray to very dark gray (N4/ - N3/) LIMESTONE or calcareous SILTSTONE. Thinly bedded to banded, beds are generally less than 0.1', and up to 0.2'. Trace to few dark green/greenish black glauconitic beds and partings. Bedding is typically irregular, showing soft sediment deformation features. Limestone content generally varies between 30 to 40%. Healed fractures with white calcite infilling are generally present, but seldom exceed 2mm in width and are often hairline. The formation is moderately to intensely fractured, however most of the breaks are associated with bedding plane breaks and are mechanical breaks at planes of weakness. Some surfaces are slickenside, but appear to be depositional, associated with lithification. Limestone beds are moderately hard to hard and shale beds are soft. The formation is unweathered, fresh.	Auger SS-13 interval and advance augers to 26.0'. Not refusal but formation appears competent to core. Installed 4" temporary casing to 26.3'. Start HQ3 coring at 1053, water circulation.	
30 31 32	C-2	2.5' 81%	13%	27.2' - 27.8' Glauconitic limestone seam. Interclastic, with clasts up to 1/2" diameter, irregular elliptical shape with reddish brown hematitic halo. At 31.2' and 31.3' fracture, orientation is approximately 35° to the bedding angle. Face is heavily striated (slickenside) with red clay or hematite on fracture face. Ferrous oxide.	Bedding generally varies between 35° and 40°. C-1 26.3' - 29.3' 1033-1056. C-2 29.3' - 32.9' 1101-1115. C-3 32.9' - 33.1' 1125-1130. 27.2' - 27.8' Fracture or fracture set, rough face. Secondary clear crystals on face, relatively flat crystals, does not react with HCL - possibly gypsum or celestite.	
33	C-3	0.6' 100%	0%		C-3 Run picked up 0.4' from C-2 run.	
34 35 36 37	C-4	3.9' 81%	31%	Below 32.9' the reddish color hue changes to dark reddish gray/reddish black (7.5R 3/1 - 2.5/1) Below 34.6' generally becoming more competent, moderately fractured with most core breaks attributed to mechanical drilling breaks.	29.9' - 30.0' Calcite filled fractures perpendicular to bedding. 31.1' and 33.5' Bedding breaks with slickenside surfaces, no mineralization present, probably mechanical. C-4 33.1' - 37.9' 1132-1152.	
38 39 40 41 42	C-5	4.7' 94%	9%	Below 37.9' healed fractures with white calcite infilling are relatively rare and usually less than 1 to 2 mm wide. Limestone/limey siltstone content is probably closer to 25-30%.	37.9' - 39.2' Broken zone, several breaks along bedding planes with slickenside surfaces. At 38.7' bedding break with slickenside and very fine secondary pyrite crystals on fracture face. C-5 37.9' - 42.9' 1249-1314. C-6 42.9' - 47.9' 1323-1339.	
43 44	C-6	5.0' 100%	56%	Below 42.9' deformation of limestone/limey siltstone appears slightly more pronounced. Most bedding breaks are associated with depositional slickenside surfaces. Most have trace to full thin coatings of calcite. Bedding angle is approximately 40°.	43.2' - 44.2' Several bedding breaks (0.1' - 0.4' intervals) faces are generally slickensided (appears depositional) with trace to full carbonate coatings (calcite).	

Graphic Log

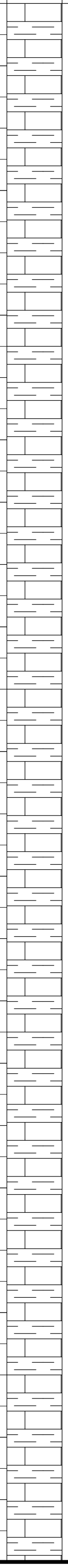


EMDF Characterization Project
Oak Ridge, TN

BOREHOLE LOG

Boring Number
GW-980

Remarks:

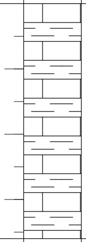


Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Remarks	USCS
46 47	C-6	5.0' 100%	56%	Interbedded dark reddish gray to reddish black (7.5R 3/1 - 2.5/1) SHALE and dark gray to very dark gray LIMESTONE to LIMEY SILTSTONE. (Cont'd.)	Moderate to slightly fractured.	
48 49 50 51 52	C-7	5.0' 100%	77%	Continues to be fresh, no observed oxidation. Thinly bedded and competent. Bedding contacts are deformed, wavey structure.	Bedding angle is approximately 45°. Fracture at 49.8' has a white calcite coating. C-7 47.9' - 52.9' 1347-1358.	
53 54 55 56 57	C-8	5.0' 100%	65%	Bedding angle approximately 47°.	C-8 52.9' - 57.9' 1405-1417.	
58	C-9	1.0' 100%	71%	Bedding angle varies between 35° - 40°.	C-9 57.9' - 58.9' 1428-1440.	
59 60 61 62	C-10	3.2' 80%	28%	59.2' - 64.3' Moderate to intensely broken. Most breaks correspond with bedding breaks/depositional slickenside surfaces. Slightly higher concentration of calcite healed fractures are perpendicular to bedding. By 60.5' bedding angle is approximately 50°. 62.2' - 63.5' Bedding turns (deformed) to vertical and back to normal (~45°) bedding angle.	59.2' - 60.1' Zone with healed (calcite filled) fractures, generally oriented perpendicular to bedding angle. At 59.2', 59.5', and 59.8' fractures are open but appear broken by the drilling process. C-10 58.9' - 62.9' 1445-1457. No weathering or oxidation observed. C-10 recovery loss appears associated with this zone.	
63 64 65 66 67	C-11	4.8' 96%	39%	Below 64.3' slightly fractured to unfractured. Continues to be fresh, no oxidation, competent. Bedding angle is approximately 45°.	C-11 62.9' - 67.9' 1503-1517. 67.0' - 67.3' Bedding plane break with apparent depositional slickensides. Trace calcite coating and fine pyrite crystals.	
68 69	C-12	5.0' 100%	86%	Bedding angle is approximately 50°. 68.0' - 68.2' Bedding plane break, weak slickenside surface, calcite generally coats face. Probably mechanical break.	C-12 67.9' - 72.9' 1529-1540.	

BOREHOLE LOG V.2 OAK RIDGE .GPJ CONTAINER CRAFT TEMPLATE WITH PID.GDT 4/4/18

EMDF Characterization Project Oak Ridge, TN	BOREHOLE LOG	Boring Number GW-980

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
71 72	C-12	5.0' 100%	86%	Interbedded dark reddish gray to reddish black (7.5R 3/1 - 2.5/1) SHALE and dark gray to very dark gray LIMESTONE to LIMEY SILTSTONE. (Cont'd.)		Continues to be very competent, fresh, relatively unfractured. Bedding angle is approximately 50°. 72.4' - 72.5' Bedding plane break, weak slickensides (depositional). Trace calcite on face.	
73	NS						
74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94				Bottom of Borehole = 73.6'. Borehole sealed with cement bentonite grout due to damage to the surface casing at the beginning of reaming activities. Installation borehole for piezometer GW-980 installed approximately 7' north of original borehole.		Finished coring at 1540, 2/14/18. Prior to removing core from C-12 run, flushed borehole from 1540 to 1550. Returns were free of cuttings. On 2/17/18 used Ingersoll-Rand T3W rotary rig to ream corehole and advance borehole to 73.6' using 5 7/8" hammer bit. Finished at 1202.	

BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project**
Oak Ridge, TN

Drilling Methods: 10" Air Hammer, 5 7/8" tricone bit with water and air.

Boring Number: GW-980R

Page 1 of 4

Drilling Firm: *Tri-State Drilling*

Driller / Rig: *Travis Morgan/Ingersoll-Rand T3W*

Logged by: *Nelson Novak*

Coordinates: *30379.90N 38138.34E*

Surface Elevation: *963.5 ft/MSL*

DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)

Sampling Methods:

ST = Shelby Tube	SS = Split Spoon
WS = Waxed Sample	CS = Continuous Sampler
SP = Sand Pump	C = Coring
GP or DP = Direct Push	NS = Not Sampled
CT = Cuttings	B = Bailer

	Start	Finish
Time	*1525*	*1152*
Date	*2/22/18*	*2/27/18*

Surface Conditions / Weather: *Damp gravel road / 55°F, Cloudy*

Remarks: Drilled approximately 7' north of borehole GW-980.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
				GW-980R is a replacement well and was straight drilled. See Borehole Log GW-980 for detailed lithologic description and stratigraphic interpretation.		Straight drilled using 10" hammer bit to 27.0'. Set permanent 6" PVC casing and sealed with cement bentonite grout.	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10	NS						
11							
12							
13							
14							
15							
16							
17							
18							
19							

BOREHOLE LOG V.2 OAK RIDGE .GPJ CONTAINER CRAFT TEMPLATE WITH PID.GDT 4/4/18

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-980R

Remarks: Drilled approximately 7' north of borehole GW-980.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
21							
22							
23							
24							
25							
26							
27						Below 27.0', straight drilled to 74.4' using 5 7/8" tricone bit with air and water circulation.	
28							
29							
30							
31							
32	NS						
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-980R

Remarks: Drilled approximately 7' north of borehole GW-980.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
46							
47							
48							
49							
50							
51							
52							
53							
54							
55							
56							
57							
	NS						
58							
59							
60							
61							
62							
63							
64							
65							
66							
67							
68							
69							

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-980R

Remarks: Drilled approximately 7' north of borehole GW-980.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
71							
72	NS						
73							
74							
75				Bottom of Borehole = 74.4'. Piezometer GW-980R installed in borehole. See Monitoring Well Installation Report GW-980R for details.			
76							
77							
78							
79							
80							
81							
82							
83							
84							
85							
86							
87							
88							
89							
90							
91							
92							
93							
94							

Eagon & Associates, Inc.

Well Number GW-980R

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*	Completion Date: *3/8/18*
Coordinates: *30379.90N 38138.34E*	Borehole Depth (ft): *74.4*
Elevation Top of Casing (ft/MSL): *965.63*	Borehole Diameter (in): *10" (0'-27.0'), 5 7/8" (27.0'-74.4')*
Elevation Ground Surface (ft/MSL): *963.5*	Drilling Methods: *10" Air Hammer, 5 7/8" tricone bit with water and air.*
Installed By: *Fred Reynolds/Tri-State Drilling*	Completed Drilling: *2/27/18*
Supervised By: *Shay Beanland/Eagon & Associates, Inc.*	Drilling Water Used (gals):

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel Protector w/Locking Lid	-2.4 - 2.6	965.9 - 960.9
Riser	2" ID Schedule 40 PVC	-2.1 - 59.9	965.6 - 903.6
Cement Grout	Cement Bentonite Grout	-0.5 - 51.5	964.0 - 912.0
Surface Seal	3' x 3' Concrete Pad	-0.5 - 0.5	964.0 - 963.0
Conductor Casing	6" ID Sch. 40 PVC, Flush Threaded	-0.4 - 27.0	963.9 - 936.5
Bentonite Seal	Pel Plug 1/4" Coated Bentonite Pellets	51.5 - 54.9	912.0 - 908.6
Sand Pack	DSI "GP #2" Gravel Pack	55.0 - 71.3	908.5 - 892.2
Screen	2" ID Schedule 40, 10-Slot	59.9 - 70.0	903.6 - 893.5
Well Point Blank	2" ID Sch. 40 PVC Cap & Riser Section	70.0 - 71.3	893.5 - 892.2
Sand Pack Bottom	DSI "GP #2" Gravel Pack	71.3 - 72.3	892.2 - 891.2
Bentonite Seal	Enviro Plug Medium Chips	72.3 - 74.4	891.2 - 889.1

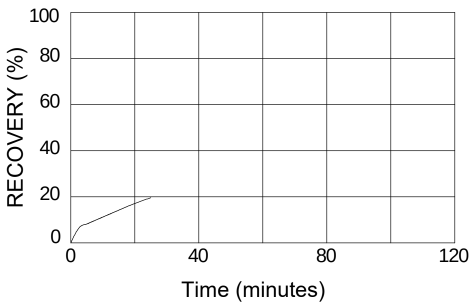
Well Development

Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
73.44	*28.27*	*7.4*	*61.0*

Development Method:
Bailer, surge block, Tornado pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (µmhos/cm)	pH (S.U.)	Turbidity (NTU)
3/5/18	0908	27	14.6	324.7	8.50	17.4
3/5/18	1025	35	13.9	325.1	8.78	15.3
3/5/18	1340	46	14.9	317.6	8.23	7.2
3/5/18	1532	54.5	14.6	330.2	8.48	7.3
3/5/18	1535	57	14.7	328.5	8.37	9.7
3/5/18	1537	59	14.4	328.0	8.45	12.1

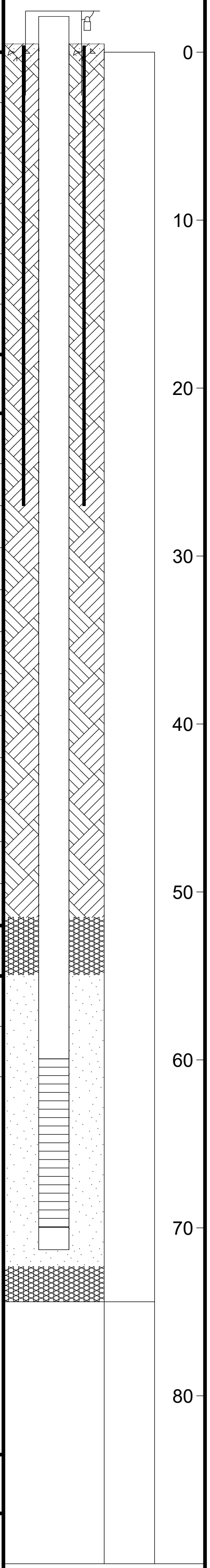
Recovery Data



Sampling Equipment:

Comments:

Stainless steel centralizers set at 49 and 24.5 from ground surface. Washed sand pack and pellets in using tremie pipe. Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 60.2 - 69.9 bgs.



Boring depth=74.4 ft.

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Eagon & Associates, Inc.

BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project**
Oak Ridge, TN

Drilling Methods:
4 1/4" ID HSA, HQ3 Core with water.

Boring Number: **GW-981**

Drilling Firm: *Tri-State Drilling*

Driller / Rig: *Shannon Snow/CME-550*

DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)

Page 1 of 2

Logged by: *David J. Sugar*

Coordinates: *30396.70N 38148.33E*

Surface Elevation: *963.2 ft/MSL*

Sampling Methods:

ST = Shelby Tube	SS = Split Spoon
WS = Waxed Sample	CS = Continuous Sampler
SP = Sand Pump	C = Coring
GP or DP = Direct Push	NS = Not Sampled
CT = Cuttings	B = Bailer

Start	Finish
Time *1455*	*Time* *0955*
Date *2/23/18*	*Date* *2/26/18*

Surface Conditions / Weather: *Gravel pad, relatively flat / 79°F, Mostly sunny*

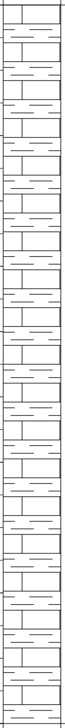
Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
				See Borehole Log GW-980 for detailed lithologic description and stratigraphic interpretation.		4 1/4" ID HSA, ran auger plug while augering. 7 1/2" OD borehole.	
1	NS						
				RESIDUUM/COLLUVIUM.			
2							
3	ST-1	1.65	1200 PSI				
4				Description based on inspection of bottom of ST-1 recovery. Dark yellowish brown (10YR 4/4 - 4/6) highly (completely) weathered SHALE. ~45° Bedding angle. Appears in place, but may be a large rock fragment.		Auger cuttings bucket sample; BS-1 collected from 4.0' - 6.0'.	
5							
6							
						Auger cuttings bucket sample; BS-2 collected from 6.0' - 8.0'.	
7							
8							
9							
10							
11							
12	NS						
13							
14							
15							
16							
17							
18							
19							

BOREHOLE LOG V.2 OAK RIDGE .GPJ CONTAINER CRAFT TEMPLATE WITH PID.GDT 4/4/18

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-981

Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
21 22	NS			Based on C-1 recovery, contact with overlying saprolite is above 23.0'. Change at 23.0'.		End 2/23/18, 1536 at 20.5'. Begin 2/24/18, 0915. 0900 Augers measured dry.	
23 24	C-1	2.0' 100%	0%	Interbedded dark reddish gray to weak red/dusky red (2.5YR 4/1, 4/2 - 3/2) SHALE and dark gray to very dark gray (N 4/ - N 3/) LIMESTONE to calcareous SILTSTONE. Thinly bedded, generally less than 0.1' intervals, partings are not uncommon. Bedding angle is approximately 45°. Limestone beds are generally less than 1/2" thick and have wavey deformed bedding contacts, comprises approximately 40% of formation. Fresh, no indication of weathering. Limestone beds are hard (strong) and shale beds are soft (very weak to weak). Moderate to intensely fractured. Trace glauconite partings and thin seams. 24.0' - 24.9' Broken zone, fractures oriented perpendicular to bedding (possibly associated with healed fractures where the calcite infilling has been removed). Trace thin secondary calcite on fracture faces. 25.5' - 26.7' Bedding is horizontal. Becomes very deformed from 26.4' - 26.7'. Possible breaks near top and bottom of zone. Below zone 26.7' - 27.0' bedding transitions back to 45° angle. 27.0' - 27.2' Calcite filled fracture along bedding plane. Face is striated. No oxidation. May be healed. Possibly depositional slump (slickensides). At 27.7' 1/2" glauconitic seam. 28.1' - 28.4' Broken zone. Appears mechanical, but there is no obvious change in rock to explain breakage. Several slickenside surfaces (not all appear oriented with bedding). No apparent secondary mineralization. Below 28.7' all breaks appear mechanical. Trace very fine mica on some of the mechanical breaks.		Trace (rare) calcite filled/healed fractures below 26.0'. Very thin, less than 1 mm to hairline. Limestone reacts strongly to HCl, shale does not react. C-1: 23' - 25.0' 0930-0941. Top of C-2 run 25.0' - 25.4' is highly broken, probable mechanical. Mechanical breaks along bedding planes are common. C-2: 25.0' - 30.0' 0959-1015. 25.4' - 26.3 High angle fracture, jagged/rough face. Trace secondary calcite and possibly celestite. 25.9' - 26.0' Limestone seam fractured roughly 90° to bedding. Trace glauconite nodules (<1 mm). At 27.4' bedding break, face has slickensides. Trace calcite and pyrite on face. Finished coring at 1015, 2/24/18. Overdrilled corehole with HSA and advanced borehole to 33.5'. End 2/24/18, 1113 at 33.5'. 2/26/18, 0921, WL = 14.77'. Finished drilling 2/26/18 at 0955, advanced borehole to 34.0'.	
25 26 27 28 29	C-2	5.0' 100%	39%				
30 31 32 33	NS						
34 35 36 37 38 39 40 41 42 43 44				Bottom of Borehole = 34.0'. Piezometer GW-981 installed in borehole. See Monitoring Well Installation Report GW-981 for details.		2/24/18 at 1247 WL = 12.0'.	

Eagon & Associates, Inc.

Well Number GW-981

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*	Completion Date: *3/8/18*
Coordinates: *30396.70N 38148.33E*	Borehole Depth (ft): *34.0*
Elevation Top of Casing (ft/MSL): *965.74*	Borehole Diameter (in):*7 1/2"*
Elevation Ground Surface (ft/MSL): *963.2*	Drilling Methods: *4 1/4" ID HSA, HQ3 Core with water.*
Installed By: *Shannon Snow/Tri-State Drilling*	Completed Drilling: *2/26/18*
Supervised By: *David J. Sugar/Eagon & Associates, Inc.*	Drilling Water Used (gals): *~500*

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel w/Locking Lid	-2.8 - 2.2	966.0 - 961.0
Riser	2" ID Schedule 40 PVC	-2.5 - 22.1	965.7 - 941.1
Surface Seal	3' x 3' Concrete	-0.5 - 0.5	963.7 - 962.7
Cement Grout	Cement Bentonite Grout	0.5 - 17.9	962.7 - 945.3
Bentonite Seal	Pel-Plug 1/4" Coated Bentonite Pellets	17.9 - 20.0	945.3 - 943.2
Sand Pack	DSI "GP #2" Gravel Pack	20.0 - 33.4	943.2 - 929.8
Screen	2" ID Schedule 40 PVC, 10-Slot	22.1 - 32.1	941.1 - 931.1
Well Point Blank	2" ID Sch. 40 PVC Cap & Riser Section	32.1 - 33.4	931.1 - 929.8
Sand Pack Bottom	DSI "GP #2" Gravel Pack	33.4 - 34.0	929.8 - 929.2

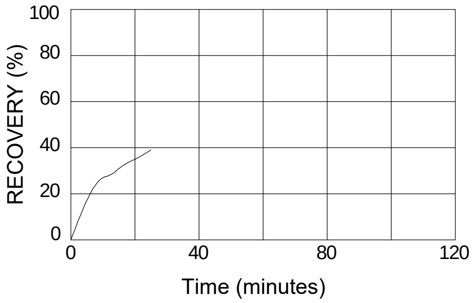
Well Development

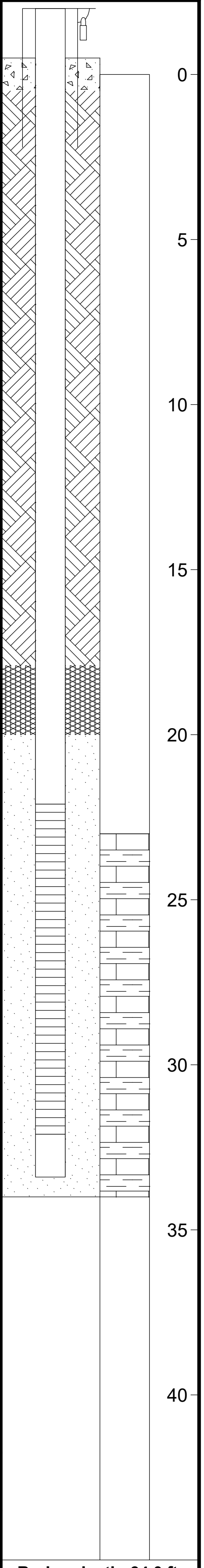
Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
35.85	*22.20*	*2.2*	*89.0*

Development Method:
Bailer, surge block, Tornado pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (μmhos/cm)	pH (S.U.)	Turbidity (NTU)
3/2/18	1655	15	15.2	322.7	8.14	>1000
3/3/18	1224	25	14.8	271.9	8.50	>1000
3/5/18	1624	60.5	14.8	302.0	7.99	185.0
3/6/18	1550	82.0	15.2	257.9	7.88	163.0
3/6/18	1553	85.0	15.5	271.8	7.90	-
3/6/18	1632	88.0	15.1	255.2	7.79	153.0

Recovery Data





Boring depth=34.0 ft.

Sampling Equipment:

Comments:

Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 22.3 - 32.0 bgs.

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Eagon & Associates, Inc.

BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project Oak Ridge, TN**

Drilling Methods: 3 1/4" ID HSA, HQ3 Core with water circulation, 10" air hammer bit, 5 7/8" tricone bit with air/water.

Boring Number: GW-982

Drilling Firm: *Tri-State Drilling*

DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)

Driller / Rig: *Shannon Snow/CME-550*

Page 1 of 6

Logged by: *David J. Sugar*

Coordinates: *30317.82N 38617.04E*

Surface Elevation: *1,015.6 ft/MSL*

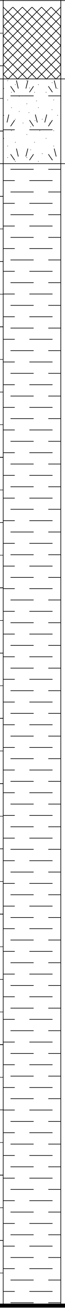
Sampling Methods:

ST = Shelby Tube
WS = Waxed Sample
SP = Sand Pump
GP or DP = Direct Push
CT = Cuttings
SS = Split Spoon
CS = Continuous Sampler
C = Coring
NS = Not Sampled
B = Bailer

Start	Finish
Time 1135	*Time 0945*
Date 2/7/18	*Date 2/18/18*

Surface Conditions / Weather: *Gravel road bed, relatively flat, moist / Overcast, ~45°F*

Remarks:



Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Remarks	USCS
1	NS			Gravel road bed. Topsoil removed during road construction. Change at 1.2'.	3 1/4" ID HSA, 7 1/2" OD. Continuous 2" OD, 2' drive split spoons, 140 lb automatic hammer. Ran center bit while augering to sample depth. On 2/15/18 used Intersoll-Rand T3W rotary rig to ream borehole to 50.3' using 10 air hammer bit and set permanent 10" PVC casing. Casing sealed with cement bentonite grout.	
	SS-1	0.8' 100%	1, 4	Brown to yellowish brown (10YR 5/3 - 5/6) SANDY SILT to SILT. Trace clay. Trace to some gravel size (fine to coarse) shale fragments, angular, increasing content with increasing depth. Unsorted, jumbled fabric. Does not appear to have preferred orientation. Becomes mottled near lower contact. Low plasticity. Low toughness. Low dry strength. Rapid dilatancy. Very stiff. Moist. Weathered. SOIL/SUBSOIL.		ML
2 3	SS-2	1.85' 92.5%	6 11 15 21	Change at 2.5'.		CL
4 5	SS-3	1.35' 67.5%	12 20 29 39	Light yellowish brown (2.5Y 6/3 - 6/4) and light olive brown (2.5Y 5/3 - 5/6) highly weathered to completely weathered SHALE (SAPROLITE). Shale structure is intact, does not appear disturbed. Thinly bedded (generally less than 1/2"), 40°-50° bedding angle (disturbed by sampling process in some areas). Sample can be molded with hand pressure. Primarily clay to silty clay composition. Trace to few fine sand. High plasticity, toughness, and dry strength. No dilatancy with added water. Hard. Slightly moist to moist. Highly weathered. SAPROLITE.	1.2' - 1.6' Trace roots. No reaction with HCl. SS-2 Lab results: Moisture Content (MC) 11%. SS-3 Lab results: MC 13.1%. SS-4 Lab results: MC 12.5%. No reaction with HCl.	
6 7	SS-4	2.0' 100%	28 38 44 48	At 6.9' and 8.0' - 8.4' Trace light gray incorporations and deformed partings. Fine sandstone/silty sandstone partings and/or incorporations.	Trace dark brown/reddish brown to black iron and manganese oxide precipitates follow fracture plates and bedding breaks. Fracture traces are generally not well defined or difficult to follow over distance.	
8 9	SS-5	2.0' 100%	28 56 71 60	Bedding angle appears to be fairly consistent, between 40° to 50° and continues to be thinly bedded.	SS-5 Lab results: MC 12.3%; 2.2% Gravel; 47% Sand; 50.8% Fines.	
10 11	SS-6	1.7' 85%	10 32 41 48	Below 10.0' dark brown/black manganese oxide deposition increases, continues to be associated with bedding breaks and fractures oriented perpendicular to bedding. Traces are generally not well developed or destroyed by the sampling process.	4.2' - 4.4' High angle fracture with iron oxide coating. Below 5.1' increase in black to dark brown iron/manganese oxide, generally 0.2' to 0.3' intervals.	
12 13	SS-7	2.0' 100%	12 18 20 26	12.1' - 14.4' Zone with mottling, dark brown/black iron/manganese oxide and light gray/greenish gray inclusions or irregular partings (deformed sandy zones).	Sample continues to be broken at intervals less than 1/2". 12.1' - 14.4' Slightly higher moisture content, still moist with no visible water.	
14 15	SS-8	1.75' 87.5%	11 23 33 68	13.5' - 13.8' Zone with very high clay content, light yellowish brown and olive gray (weak mottled appearance). Rock structure is not prominent. Moist. 14.6' - 15.0' Dark gray brown to black sandy zone, probable fine silty sandstone or sandy siltstone remnant. May be a highly weathered glauconite bed.	0.0' - 20.0' No indication of water. Sample is consistently slightly moist to moist. No free water observed on drill rods or sampler.	
16 17	SS-9	2.0' 100%	29 66 89 80/4	Below 16.5', trace reddish brown iron oxide, less manganese oxide.	SS-8 Lab results: MC 13.9%; 4.8% Gravel; 65.9% Sand; 29.3% Fines. SS-10 Lab results: MC 10.8%.	
18 19	SS-10	2.0 100%	41 42 71 100	18.4' - 19.0' Dark brownish gray to black seams, not well defined, sandy saprolite.	Becoming difficult to mold sample. Gravel/sand sized rock fragments within molded sample. No reaction with HCl.	

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-982

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
	SS-11	1.5	62 100/5	Light yellowish brown (2.5Y 6/3 - 6/4) and light olive brown (2.5Y 5/3 - 5/6) highly weathered SHALE (SAPROLITE). (Cont'd.)		No reaction with HCl. SS-11, SS-12, SS-13, and SS-14 greater recovery than, all looked in-place. Slightly less weathered, becoming more competent. Still appears to be saprolite. Continues to be thinly bedded, broken <0.05' (1/2"). Sampling process is altering/disturbing the rock structure.	CL
21	NS						
22 23	SS-12	1.4	30 38 50/1	Below 19.0' trace (light) reddish brown and black iron oxide and manganese oxide.			
	NS						
24 25	SS-13	1.4	20 71 73/2	Below 24.0' iron oxide not apparent, considerable dark brownish gray to black manganese oxide. Trace to few sand, probably associated with sandy partings and seams.		SS-13 Lab results: MC 11.9%. End 2/7/18, 1440, at 27.0' while augering below 26.0', stopped to repair a hydraulic line on the drill rig. 2/7/18, 1610 Borehole measured dry.	
	NS						
26	SS-14	1.0	37 50/2				
27	NS					2/8/18 Borehole sounded dry at 0808. 0900 Start augering below 26.0'. No reaction with HCl.	
28	SS-15	1.35	63 100/5				
29	NS			Difficult to mold sample with added water, becoming more competent with depth. High plasticity, toughness, and dry strength. Continues to be highly weathered shale (saprolite). Dry to slightly moist.		Below 28.0' sample is generally disturbed from sample process. Bedding appears to still be in the range of 40° - 50°.	
30	SS-16	0.8	100				
31	NS					SS-16 Lab results: MC 4.7%.	
32	SS-17	1.0	82 100/4				
33	NS						
34	SS-18	1.1	32 100/6			SS-18 Lab results: MC 8.9%.	
35	NS						
36 37	SS-19	1.8	41 65 70 55	Below 36.0' slightly higher degree of weathering. Continues to be highly weathered shale, saprolite. Continues to have trace manganese oxide, bedding is mostly disturbed by the sampling process.			
38 39	SS-20	1.6	32 84 100/5				
	NS						
40	SS-21	1.3	40 100/5			SS-21 Lab results: MC 7%; 14.7% Gravel; 56.8% Sand; 28.5% Fines.	
41	NS						
42	SS-22	1.0	28 100/4				
43	NS			Trace iron and manganese oxide. Sample continues to be mostly pulverized/broken from the sampling process.		Continues to be dry to slightly moist. No reaction with HCl.	
44	SS-23	1.0	60 100/3			SS-23 Lab results: MC 5.5%.	

EMDF Characterization Project Oak Ridge, TN	BOREHOLE LOG	Boring Number GW-982

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
	NS			Light yellowish brown (2.5Y 6/3 - 6/4) and light olive brown (2.5Y 5/3 - 5/6) highly weathered SHALE (SAPROLITE). (Cont'd.)		No indication of water on drilling rods or sampler to 47.3'.	CL
46	SS-24	0.2	50/1	Trace calcite appears to be 1 to 5 mm fracture infilling. Sample is pulverized.		SS-24 Strong reaction with HCl.	
47	NS			Change at 47.3'.			
48 49 50 51	C-1	1.5' 32%	0%	Olive gray to dark olive gray (5Y 4/2 - 3/2) and gray dark gray (5Y 5/1 - 4/1) SHALE and LIMESTONE. Limestone beds appear silty in places and may classify as a calcareous siltstone. Thinly bedded, sample is very broken (40° bedding angle). Trace white calcite veins (up to 5 mm). Trace black and brownish yellow iron/manganese oxide precipitate along bedding breaks and possible fractures. Gray-grayish beds are limestone. Olive colored beds are generally shale. Highly weathered. Moderate to very strong strength. Most of the lost recovery is expected to be within shale beds that have low field strength. C-1 recovery, bottom piece has reddish brown interbeds (<0.05'). Beds appear deformed with slight displacement along healed fractures (white calcite in-fill). Bottom of recovery has a fracture face that is perpendicular to bedding.		1128, 2/8/18, Auger refusal at 47.3'. 1308 Borehole measured dry at 46.2'. Set up to core. Set temporary 4 1/2" steel flush threaded casing, HQ3 core, water circulation. 1425 Start washing core bit to depth. C-1 47.3' - 52.0' 1450-1536. Cannot position C-1 core loss, sample is too broken. No reaction with HCl within shale, strong reaction with calcite fracture infilling and within limestone beds.	
52 53 54	C-2	2.8' 100%	0%	Below 52.0' higher percentage of shale, mostly shale. Limestone beds generally have calcite veins or healed fractures. Continues to be highly weathered. Predominate olive gray to dark olive color. Trace thin limestone interbeds below 54.1'.		C-2 Run, fractured throughout, faces are coated with iron and/or manganese oxide. C-2 52.0' - 54.8' 1555-1655. C-3 54.8' - 55.8' 1710-1730.	
55	C-3	1.0' 100%	0%			End 2/8/18, 1730 at 55.8'. Water level at 10.1', 1745 most if not all drilling water was recirculated during drilling.	
56	C-4	1.1' 92%	0%	Below 55.8 slight increase in brown color. Some dark olive gray to olive gray (5Y 4/2 - 3/2). Primarily shale or mudstone composition. Bedding angle is approximately 40°. Continues to be thinly bedded with limestone partings and thin seams (<0.05'). Moderate field strength. Limestone layers are strong to very strong. Moderately decomposed/weathered.		Begin 2/9/18 0830, driller changing out bit style, HQ3 still. Start coring at 0955. 0840, WL: 16.82 from GS.	
57 58 59 60 61	C-5	2.7' 54%	0%	Below 57.4' Trace to few dark greenish gray to very dark greenish gray (5GY 4/1 - 3/1) layers. Becoming less weathered. Stronger olive color associated with weathered areas. Core is very broken from 58.0' - 59.7'. Lost core probably from bottom of run. Below 58.4' limestone interbeds are deformed (soft sediment) irregular surfaces and thickness, generally less than 0.1' thick. Near 59.7', trace pink calcite, up to 5mm thick, appears to be fracture infilling.		No reaction with HCl. Continues to be highly fractured with iron oxide precipitates on fracture faces. Breaks along bedding planes and angular fractures. Intensely to moderately fractured. Sample is generally very broken and fracture orientation and fracture traces are hard to follow.	
62 63 64 65 66	C-6	4.5' 90%	0%	Below 62.4' predominately dark gray to very dark gray (N 4/ - 3/) with trace olive gray/dark olive gray (5Y 4/2 - 3/2) zones associated with weathered areas. Trace gray (5Y 6/1 - 5/1) partings/thin limestone seams. Continues to be intensely fractured. 64.6' - 64.8', 65.2' - 65.4', 65.6' - 65.8' bedding plane fractures/breaks with iron oxide and trace calcite. 65.6' - 65.8' Fracture is polished (slickenside). 65.9' - 66.5' Recovery is very broken, some angular pieces with slickenside surfaces.		C-6 Run, bedding angle varies between 45° to 50° limestone seams are typically deformed and have wavy surfaces/contacts. 62.9' - 63.4' Oxidized bedding break, 3/4" olive gray weathering have faces coated with iron oxide. 63.6' - 64.0' Bedding break, calcite coating on face, no oxidation . Possible indication of saturation. Broken oxidized fractures above and below.	
67 68 69	C-7	2.3' 46%	0%	Below 67.0' primarily limestone and siltstone recovery. Few shale seams. Lost recovery (C-7 run) may be mostly shale. Highly broken interval, intensely fractured/broken. Fracture/bedding break faces are all oxidized with mostly iron oxide coatings; trace black manganese oxide. Mostly olive gray to dark olive gray (5Y 4/2 - 3/2). Some dark gray to very dark gray areas.		C-4 55.8' - 57.0' 0955-1010. C-5 57.0' - 62.0' 1018-1124. C-6 62.0' - 67.0' 1133-1220. C-7 67.0' - 72.0' 1429-1541.	

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD
71	C-7	2.3' 46%	0%
72	C-8	1.2' 100%	0%
73			
74			
75	C-9	3.8' 100%	16%
76			
77			
78	C-10	2.9' 100%	35%
79			
80			
81	C-11	1.5' 71%	0%
82			
83			
84	C-12	4.2' 84%	38%
85			
86			
87			
88			
89	C-13	3.2' 64%	35%
90			
91			
92			
93	C-14	4.0' 100%	10%
94			

SAMPLE DESCRIPTION

Interbedded olive gray to dark olive gray (5Y 4/2 - 3/2), dark gray to very dark gray (N 4/ - 3/) SHALE and LIMESTONE. (Cont'd.)
Trace to few limestone seams (<0.2' thick).

72.7' - 73.1', 0.15' Thick silty limestone seam. Strong reaction with HCl.

Highly fractured and broken. Generally has associated iron oxide coatings. Trace calcite precipitates.

Change at 73.3'.

Dusky red (5R 3/3) OOLITIC LIMESTONE. Trace to few glauconite nodules (~1mm). Red color possibly associated with hematite. Massive. Field strength is strong, competent. Trace white calcite healed fractures. Fresh to slightly weathered.
Change at 74.0'.

Very dark gray to black (N 3/ - 2 1/2/) SHALE. Thinly bedded, ~45° - 50° angle. Trace gray ~1mm siltstone partings. Fresh. Intensely fractured or broken, mostly along bedding planes (some may be mechanical). Unweathered/no oxidation.
Below 77.0' bedding angle is between 55° - 60°. Moderately to intensely fractured.
77.0' - 77.3' Bedding break, slickenside surface. No weathering or precipitates.
77.7' - 77.9' Bedding break surface has white noncarbonate precipitate, trace fine (<1mm) pyrite. Slickenside surface.
77.9' - 78.2' Bedding break, slightly polished surface. Trace thin (<1mm) calcite and clay (maybe from drilling) on face. No oxidation. Maybe open.
79.0' - 79.3' Set of bedding breaks, polished (slickenside) surfaces. Within interval, perpendicular fracture appears healed with white noncarbonate infilling (hairline).
Change at 79.9'.

Interbedded gray to very dark gray (N5/ to N3/) SHALE and LIMESTONE. Thinly bedded, generally between 0.1' - 0.3'. Limestone and shale partings are common. Shale beds are typically darker gray and soft while limestone beds are lighter gray and hard. Bedding appears to vary between 50° to 60°. Trace healed fractures, while calcite filled, generally oriented perpendicular to bedding, hairline to 2 mm width. Unweathered to slightly weathered (fresh). Mostly shale, 20 - 30% limestone.

Below 82.0' primarily shale, trace lighter (gray) limestone or siltstone partings (<1/4").
85.0' - 85.9' Bluish gray to dark bluish gray (5PB 5/1 to 4/1) Interclastic Limestone Seam - elongated elliptical, clasts oriented parallel with bedding (long axis), up to 1" high and 1 3/4" wide. 45° - 50° bedding angle. Hard, unweathered except for lower contact which is oxidized yellowish brown. Trace fine (<1 mm) glauconite nodules.

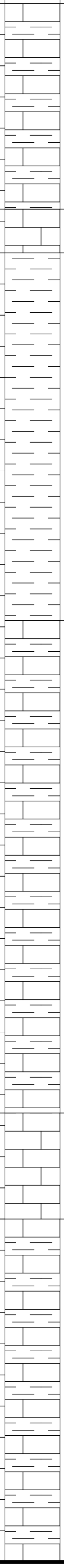
Below 87.8' becomes interbedded limestone and shale, thinly bedded, somewhat deformed. Trace glauconitic beds/partings.
Change at 87.8'.

Bluish gray to dark bluish gray (5PB 5/1 - 4/1) LIMESTONE. Fine grained. Few 1 mm or less glauconite nodules. Trace stylolites, dark gray to black, jagged, trace. Thinly bedded. Fresh.
Basal contact has rip up clasts, elliptical and elongated with bedding. Becoming interclastic.
Change at 89.5'.

Interbedded very dark gray to black (N 3/ - N 2 1/2) SHALE and gray to dark gray (N 5/ - 4/) LIMESTONE. Generally thinly bedded (0.1' or less). Trace white calcite filled fractures (healed). Limestone seams are generally deformed, wavey, uneven bedding. Fresh, no oxidation. Intensely broken along bedding planes, most are mechanical. Limestone is hard to moderately hard. Shale is soft.
92.0' - 93.7' Predominately shale, trace limestone partings.

Below 93.7' trace bioturbation.

Graphic Log



Remarks

Lost recovery in C-7 run is assumed to be shale.

Bedding angle is between 45° - 50°.

Most of C-8 recovery is shale.

C-8 72.0' - 73.2' 1555-1621.

73.3' - 73.5; fracture oriented perpendicular to bedding. Face appears oxidized.

End 2/9/18, 0710 at 77.0' WL at 1724 = 23.72' from ground.
C-9 73.2' - 77.0' 1633-1710.
2/10/18, 0805, WL = 63.0'.
Begin 2/10/18, 0830, 45°F, overcast, tract light rain.
Continue HQ core, using core barrel liner.
C-10 77.0' - 79.9' 0833-0920.
Broken zones are identified fractures in C-10 interval appear to be mechanical, probably associated with wedging and difficulty with sample. Feeding, typically core wear indicates core was turning. Bottom of C-10 recovery mechanically fractured (broken), bit plugged at end of run. End 2/10/18, 1004, rain, at 80.2'.

Begin 2/12/18, 0920 continue C-11 run. 0907 WL = 35.05' from GS. 45°F, Overcast, wet.
C-11 Run, lost recovery mostly from bottom of run.
~55° - 60° bedding angle
At 81.4' fracture at 90° to bedding, iron oxide on face. Adjacent rock is not oxidized.
83.1' - 83.5' Broken zone, probable fracture or fractures, no oxidation.
83.3' - 83.5' 1/4" to 1/2" thick pink calcite filled fracture.
84.7' - 84.9' Set of fractures 45° to bedding angle, surfaces have slickensides. No precipitate or oxidation.
C-11 79.9' - 82.0' 0920-0935.
C-12 ~50° bedding angle.

At 87.8' oxidized (iron oxide) bedding contact.
Strong reaction with HCl.
At 88.0' fracture, 45° to bedding, oxidized (iron oxide on face).

Limestone reacts strong with HCl. Shale has no reaction.

92.0' - 92.3', 93.1' - 93.4', and 93.4' - 93.7' Bedding plane breaks, slickenside surface. No oxidation or precipitates.

92.85' - 92.95' ~45° fracture, slickenside surface. No oxidation or precipitates.
45° - 50° Bedding angle.
C-12 82.0' - 87.0' 1044-1105.
C-13 87.0' - 92.0' 1140-1159.

USCS

EMDF Characterization Project
Oak Ridge, TN

BOREHOLE LOG

Boring Number
GW-982

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
	C-14	4.0' 100%	10%	Interbedded very dark gray to black (N 3/ - N 2 1/2) SHALE and gray to very dark gray (N 5/ - 4/) LIMESTONE. (Cont'd.)		C-14 92.0' - 95.9' 1342-1356. C-15 95.9' - 97.0' 1436-1445. C-16 97.0' - 98.2' 1451-1505. C-17 98.2' - 102.0' 1524-1545.	
96	C-15	0.6' 55%	46%	95.9' - 96.5' Bluish gray to dark bluish gray (5PB 5/1 - 4/1) Interclastic LIMESTONE. Clasts up to 0.2', generally less than 0.1', elongated and elliptical. Clasts oriented parallel with bedding. Hard. Fresh.			
97	C-16	0.7' 58%	0%			C-16 Run highly broken, fractured faces with slickenside surfaces, too broken to determine position. No oxidation or precipitation.	
98 99 100 101	C-17	3.1' 81%	33%	Change at 98.9'. Bluish gray to dark bluish gray (5PB 5/1 - 4/1) LIMESTONE. Fine crystalline. Trace glauconite nodules (up to 1mm). Trace stylolites. Fresh, unweathered. Hard. Trace pyrite. 98.5' - 98.9' Rip up clasts or deformation, up to 0.1' diameter, elongated. Change at 100.6'. Interbedded very dark gray to black (N 3/ - N 2 1/2) SHALE and gray to very dark gray (N 5/ - 4/) LIMESTONE. Thinly bedded. Shale is soft, limestone is hard. Generally fresh, unweathered. Limestone beds are generally thin (<0.1' thick). Shale beds are up to 0.3' thick. Limestone is hard, fresh, unweathered. Shale is soft, fresh, unweathered. 20 to 40% limestone. Continues to be intensely fractured. Bedding angle is near 45°.		Strong reaction with HCl. 99.6' - 99.8' and 100.0' - 100.3' bedding breaks, no oxidation or precipitates. Shale does not react with HCl. Limestone has a strong reaction. 45-50° Bedding angle.	
102 103 104 105	C-18	1.2' 31%	0%	102.0' - 102.3' Fracture zone/bedding breaks. Faces are oxidized with iron oxide coatings. Trace very dark greenish gray (10GY 3/1) thin seams, less than 0.1' thick, possibly glauconitic.		C-18 Recovery is poor, appears to have started run in a fracture zone cannot position lost recovery interval. C-18 102.0' - 105.9' 1617-1649. C-19 105.9' - 106.8' 1705-1710. C-20 106.8' - 107.0' 1720-1722. C-21 107.0' - 108.3 0847-0900.	
106	C-19	0.8' 89%	0%	Bedding angle ~45°.		End 2/12/18, 1720 at 107.0'. 1730 WL = 14.02' from GS. Begin 2/13/18, 0847, 40°F, overcast, light rain. 2/13/18, 0830 WL = 21.65' GS.	
107	C-20	0.2	0%				
108	C-21	1.3' 100%	0%	107.6' - 107.9' Fracture 90° to bedding plane. Face has thin coating of calcite. No oxidation. Underlying contact is relatively sharp color change.			
109	C-22	0.9' 100%	40%	Change at 109.2'.		Continues to be intensely fractured. Most bedding breaks have slickenside surfaces. No oxidation or weathering.	
110 111	C-23	2.8' 100%	22%	Dark reddish gray (2.5YR 3/1 - 4/1) SHALE. Trace gray to very dark gray shale partings (generally <2mm). Soft. Thinly bedded, 40-45° angle, beds generally <0.1'. Fresh, unweathered. Moderately fractured. Breaks appear to be mechanical. Trace glauconitic partings (greenish color, no reaction with HCl.) Change at 112.0'.		No reaction with HCl. 109.9' - 110.1'. 110.1' - 110.3' Bedding break with gray precipitate/clay on face. Below 110.5' broken along bedding contacts at 0.3' to 0.4' intervals. Face of break has slickensides, no oxidation or precipitates/mineralization.	
112 113 114 115 116	C-24	4.9' 98%	54%	Interbedded very dark gray to black (N 3/1 - N 2-1/2/) and dark reddish gray (2.5YR 3/1 - 4/1) SHALE and LIMESTONE. Noticeable change to reddish color hues. Thinly bedded, color variation, highlights thinly bedded character. Limestone beds typically have stronger gray color hues, are hard and react strongly with HCl. Shale beds are soft, generally have stronger red color hues. Bedding is generally 0.1' or less, partings are common. Bedding contacts are generally wavy, have a deformed appearance. May in part be due to bioturbation. Beds or partings with green color hues are also present, appear to be glauconitic. Unweathered/fresh. Commonly broken along bedding, but generally attributed to mechanical breaks. 112.4' - 112.6' Limestone seam. Trace fine glauconite nodules, trace rare pyrite. Below 113.5' thinly bedded. Limestone and shale beds are generally 0.1' or less. Limestone beds are hard, typically gray to dark gray and shale beds are reddish gray, soft. Most limestone beds have deformed upper and lower surfaces, convoluted bedding.		Most if not all breaks below 112' appear mechanical. Trace slickenside surfaces, but no oxidation or mineralization observed. Possibly depositional. C-22 108.3' - 109.2' 0913-0920. C-23 109.2' - 112.0' 0934-0951.	
117 118 119	C-25	5.0' 100%	63%			C-24 112.0' - 117.0' 1000-1022. C-25 117.0' - 122.0' 1033-1048.	

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-982

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
121	C-25	5.0' 100%	63%	Interbedded dark reddish gray (2.5YR 3/1 - 4/1) SHALE and gray to very dark gray (N 3/ - N 2 1/2/) LIMESTONE. Thinly bedded. (Cont'd.)		Unweathered. Core breaks are along bedding planes. Most if not all appear mechanical.	
122							
123							
124	NS						
125							
126							
127				Bottom of Borehole = 126.5'. Piezometer GW-982 installed in borehole. See Monitoring Well Installation Report GW-982 for details.		2/13/18, 1156 WL = above GS. Probably drilling water. 2/13/18 1247 WL = 12.51'. 1250 Start pulling drill rods. 1320 Drill rods removed. 1326 WL = 33.43' GS. On 2/18/18 used Intersoll Rand T3W rotary rig to ream corehole and advance borehole to 126.5' using 5 7/8" tricone bit with air and water circulation. Finished drilling at 0945.	
128							
129							
130							
131							
132							
133							
134							
135							
136							
137							
138							
139							
140							
141							
142							
143							
144							

Eagon & Associates, Inc.

Well Number
GW-982

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*	Completion Date: *3/8/18*
Coordinates: *30317.82N 38617.04E*	Borehole Depth (ft): *126.5*
Elevation Top of Casing (ft/MSL): *1,018.02*	Borehole Diameter (in):*10" (0'-50.3'); 5 7/8" (50.3'-126.5')*
Elevation Ground Surface (ft/MSL): *1,015.6*	Drilling Methods: *3 1/4" ID HSA, HQ3 Core with water circulation, 10" air hammer bit, 5 7/8" tricone bit with air/water.*
Installed By: *Shannon Snow/Tri-State Drilling*	Completed Drilling: *2/18/18*
Supervised By: *David J. Sugar/Eagon & Associates, Inc.*	Drilling Water Used (gals): *~2000*

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel w/Locking Lid	-2.7 - 2.3	1018.3 - 1013.3
Riser	2" ID Schedule 40 PVC	-2.4 - 102.1	1018.0 - 913.5
Surface Seal	3' x 3' Concrete	-0.5 - 0.5	1016.1 - 1015.1
Conductor Casing	6" ID Sch. 40 PVC, Flush Threaded	-0.4 - 50.3	1016.0 - 965.3
Cement Grout	Cement Bentonite Grout	0.5 - 95.9	1015.1 - 919.7
Bentonite Seal	Pel-Plug 1/4" Coated Bentonite Pellets	95.9 - 99.2	919.7 - 916.4
Sand Pack	DSI GP #2 Gravel Pack	99.2 - 113.4	916.4 - 902.2
Screen	2" ID Schedule 40 PVC, 10-Slot	102.1 - 112.1	913.5 - 903.5
Well Point Blank	2" ID Sch. 40 PVC Cap & Riser Section	112.1 - 113.4	903.5 - 902.2
Sand Pack Bottom	DSI GP #2 Gravel Pack	113.4 - 114.5	902.2 - 901.1
Bentonite Seal	Pel-Plug 1/4" Coated Bentonite Pellets	114.5 - 126.5	901.1 - 889.1

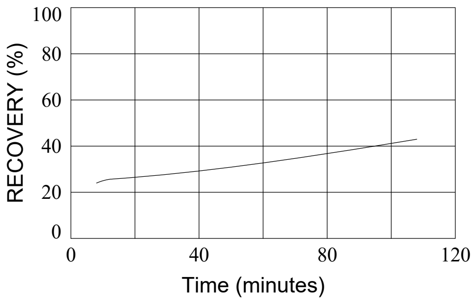
Well Development

Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
115.82	*66.39*	*8*	*64.5*

Development Method:
Surge block, bailer, Tornado pump, bladder pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (µmhos/cm)	pH (S.U.)	Turbidity (NTU)
3/3/18	0858	39.0	12.2	374	10.38	41.0
3/3/18	1408	50.0	15.8	354.3	9.35	24.8
3/5/18	0837	51.0	12.7	414.2	8.37	397.0
3/5/18	1257	61.5	15.1	359.9	9.17	29.0
3/5/18	1415	63.5	15.3	391.2	8.92	21.0
3/5/18	1455	64.5	14.5	395.6	8.87	17.5

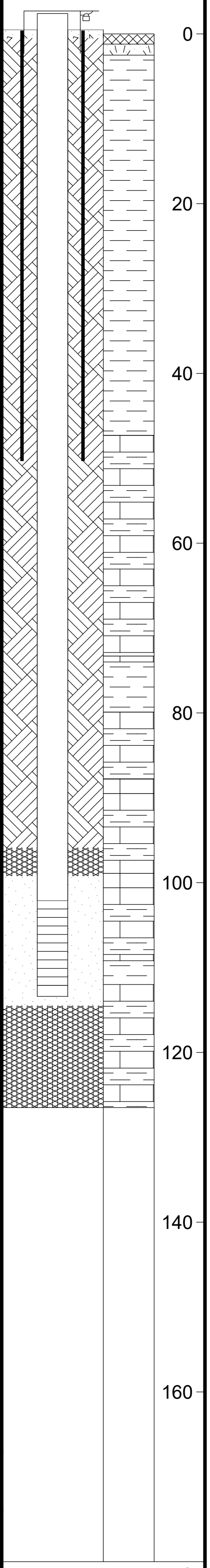
Recovery Data



Sampling Equipment:

Comments:

Stainless steel centralizers set at 95.0' and 45.0'. Washed sand pack and pellets in using tremie pipe. Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 102.3 - 112.0 bgs.



Boring depth=126.5 ft.

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Eagon & Associates, Inc.

BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project**
Oak Ridge, TN

Drilling Methods:
4 1/4" ID HSA, HQ3 Core with water circulation, 5 7/8" hammer bit.

Boring Number: **GW-983**

Page 1 of 4

Drilling Firm: *Tri-State Drilling*

Driller / Rig: *Shannon Snow/CME-550*

Logged by: *David J. Sugar*

Coordinates: *30325.62N 38606.49E*

Surface Elevation: *1,015.6 ft/MSL*

Surface Conditions / Weather: *Flat, gravel road bed / 74°F, Mostly sunny*

DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)

Sampling Methods:

ST = Shelby Tube
WS = Waxed Sample
SP = Sand Pump
GP or DP = Direct Push
CT = Cuttings
SS = Split Spoon
CS = Continuous Sampler
C = Coring
NS = Not Sampled
B = Bailer

Start	Finish
Time *1030*	*Time* *1257*
Date *2/21/18*	*Date* *2/27/18*

Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
				See adjacent Borehole Log GW-982 for detailed lithologic description and stratigraphic interpretation.		Ran 4 1/4" ID HSA, ran center bit while augering.	
1	NS						
2							
3	ST-1	1.7	1200 PSI				
4				Description from bottom of ST-1. Brown to yellowish brown (10YR 5/3 - 5/6) SANDY SILT. Trace little clay. Mostly gravel size rock (shale) fragments, appears in-place, highly (completely) weathered shale. Slightly moist.		Auger cutting Bucket Sample BS-1 collected from 4.0' to 6.5'.	
5							
6							
7							
8						Auger cutting Bucket Sample BS-2 collected from 6.5' to 8.5'.	
9							
10							
11						Cutting returns are slightly moist to moist.	
12	NS						
13							
14							
15							
16							
17							
18							
19						Cutting returns are slightly moist to dry.	

Eagon & Associates, Inc.

EMDF Characterization Project
Oak Ridge, TN

BOREHOLE LOG

Boring Number
GW-983

Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
				Augered without sampling, see adjacent Borehole Log GW-982 for detailed stratigraphic interpretation.		No indication of water with cutting returns.	
21							
22							
23						End 2/21/18 at 23.5', 1700.	
24				Cutting returns are damp (slightly moist) to dry. Augered relatively smooth and consistent.		Begin 2/22/18, 0855. Borehole measured dry.	
25							
26						Auger cuttings continue to be slightly moist to dry.	
27							
28							
29							
30							
31							
32	NS						
33							
34							
35							
36							
37							
38							
39							
40							
41							
42						No indication of water in cutting returns (damp to dry) to 45.0'.	
43							
44				At 45.0' augered hard and rough, probable limestone or siltstone seam.		Below 45.0' switch over to HQ3 core, water circulation.	

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-983

Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
46 47 48 49	C-1	3.7	0%	Interbedded olive gray to dark olive gray to olive (5Y 4/2 - 4/3 and 3/2) SHALE and LIMESTONE to CALCAREOUS SILTSTONE. Limestone seams have stronger gray color hues (5Y 4/1 - 4/2). Thinly bedded, generally less than 0.2' beds, with common partings and seams less than 0.1' thick. Limestone content estimated at 30%. Shale seams are soft, moderately to highly decomposed. Limestone seams are hard, moderately decomposed. Considerable iron oxide precipitates/coatings along fractures (bedding breaks and fractures oriented perpendicular to bedding). Weathered bedrock. Limestone/calcareous siltstone beds react strong with HCl. Shale has no reaction with HCl.		HQ3 core, water circulation. C-1 45.0' - 49.3' 1047-1129. Highly fractured, broken along bedding planes and perpendicular to bedding. All fractures are oxidized with iron oxide/manganese oxide coatings. Approximate 45° bedding angle. Sample (core) is relatively broken. At 46.8' probable glauconitic seam ~ 1/4" - 1/2".	
50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69	NS					Finished coring at 1129. WL = 1.98' at 1157, 2/21. Removed augers. On 2/27/18, Ingersoll-Rand T4 rotary rig reamed corehole and advanced borehole to 92.2' using 5 7/8" hammer bit.	

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-983

Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
71							
72							
73							
74							
75							
76							
77							
78							
79							
80						Driller noted borehole making water between 80' - 81'.	
81	NS						
82							
83							
84							
85							
86							
87							
88							
89							
90							
91							
92				Bottom of Borehole = 92.2'. Piezometer GW-983 installed in borehole. See Monitoring Well Installation Report GW-983 for details.		Finished drilling to 92.2' at 1257.	
93							
94							

Eagon & Associates, Inc.

Well Number
GW-983

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*	Completion Date: *3/8/18*
Coordinates: *30325.62N 38606.49E*	Borehole Depth (ft): *92.2*
Elevation Top of Casing (ft/MSL): *1,018.07*	Borehole Diameter (in):*5 7/8" (0'-92.2')*
Elevation Ground Surface (ft/MSL): *1,015.6*	Drilling Methods: *4 1/4" ID HSA, HQ3 Core with water circulation, 5 7/8" hammer bit.*
Installed By: *Fred Reynolds/Tri-State Drilling*	Completed Drilling: *2/27/18*
Supervised By: *Shay Beanland/Eagon & Associates, Inc.*	Drilling Water Used (gals):

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel Protector w/Locking Lid	-2.8 - 2.2	1018.4 - 1013.4
Riser	2" ID Schedule 40 PVC	-2.5 - 79.2	1018.1 - 936.4
Surface Seal	3' x 3' Concrete Pad	-0.5 - 0.5	1016.1 - 1015.1
Cement Grout	Cement Bentonite Grout	0.5 - 70.2	1015.1 - 945.4
Bentonite Seal	Pel Plug 1/4" Coated Bentonite Pellets	70.2 - 74.1	945.4 - 941.4
Sand Pack	DSI "GP #2" Gravel Pack	74.1 - 90.5	941.4 - 925.1
Screen	2" ID Schedule 40 PVC, 10-Slot	79.2 - 89.2	936.4 - 926.4
Well Point Blank	2" ID Sch. 40 PVC Cap & Riser Section	89.2 - 90.5	926.4 - 925.1
Sand Pack Bottom	DSI "GP #2" Gravel Pack	90.5 - 91.5	925.1 - 924.1
Natural Fill	Natural Fill	91.5 - 92.2	924.1 - 923.4

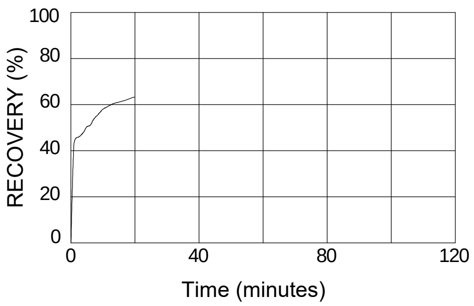
Well Development

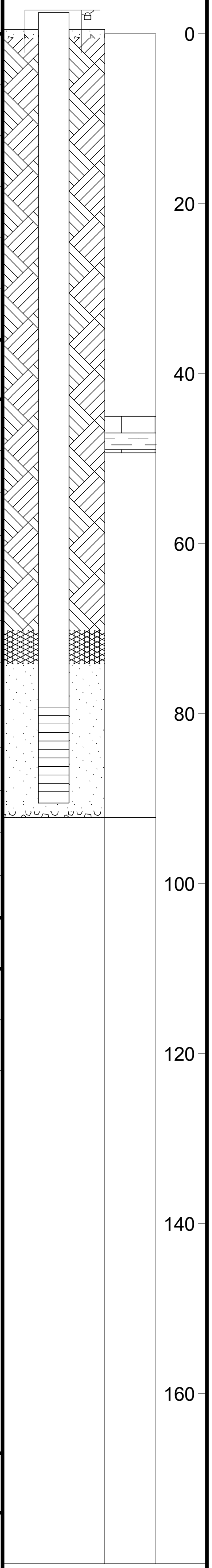
Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
92.99	*65.92*	*4.4*	*50.0*

Development Method:
Tornado pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (µmhos/cm)	pH (S.U.)	Turbidity (NTU)
3/6/18	1059	5	14.4	402.6	7.21	127.0
3/6/18	1113	15	14.3	410.5	7.13	97.8
3/6/18	1126	25	14.3	408.4	7.11	44.2
3/6/18	1133	30	14.3	406.9	7.12	22.7
3/6/18	1139	35	14.2	406.5	7.12	14.7
3/6/18	1201	50	14.5	405.7	7.11	3.1

Recovery Data





Boring depth=92.2 ft.

Sampling Equipment:

Comments:

Stainless steel centralizers set at 69' and 34' from ground surface. Washed sand pack and pellets in using tremie pipe. Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 79.4 - 89.1 bgs.

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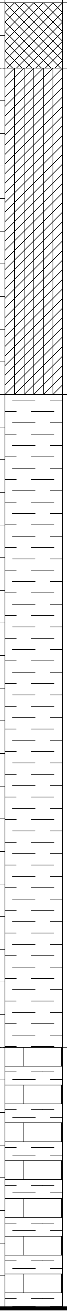
Eagon & Associates, Inc.

BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project Oak Ridge, TN**	Drilling Methods: 3 1/4" ID HSA, HQ3 Core with water circulation, 10" air hammer bit, 5 7/8" tricone bit with air/water.				Boring Number: GW-986
Drilling Firm: *Tri-State Drilling*	DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)	
Driller / Rig: *Shannon Snow/CME-550*					*Page 1 of 3*
Logged by: *David J. Sugar*	Sampling Methods:				
Coordinates: *30130.30N 38191.80E*	ST = Shelby Tube WS = Waxed Sample SP = Sand Pump GP or DP = Direct Push CT = Cuttings		SS = Split Spoon CS = Continuous Sampler C = Coring NS = Not Sampled B = Bailer		Start: *Time 1050* / Finish: *Time 1240*
Surface Elevation: *930.2 ft/MSL*					
Surface Conditions / Weather: *Flat gravel drilling pad / 57°F, Overcast*					Start: *Date 2/15/18* / Finish: *Date 2/20/18*

Remarks:



Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Remarks	USCS
	NS			GRAVEL. Road bed/drilling pad. Change at 1.0'.	3 1/4" ID HSA, ran center plug while augering. Continuous 2" OD, 2' drive split spoons. 140 lb automatic hammer.	
1	SS-1	0.0	3 1	Brown to strong brown (7.5 YR 5/4, 5/6, 4/4 - 4/6) SILTY CLAY. Trace highly weathered shale and sandstone fragments, up to 1/2" diameter, subrounded to subangular. Unsorted, weak mottled appearance. Trace dark reddish brown to black manganese oxide/iron oxide. Trace roots. High plasticity and toughness. No dilatancy. High dry strength. Moist. Weathered. SUBSOIL.	No reaction with HCL. 1.0' - 2.0' Sample tip blocked with root fragment.	CL
2 3	SS-2	1.6' 80%	2 3 4 4		SS-2 Lab results: Moisture Content (MC) 20.4%.	
4 5	SS-3	1.15' 57.5%	5 4 5 4	Change at 6.0'.	SS-3 Lab results: MC 21.1%. Underlying contact is sharp. On 2/19/18 used Ingersoll-Rand T3W rotary rig to ream borehole to 20.0' using 10" air hammer bit and set permanent 6" PVC casing. Casing sealed with cement bentonite grout.	
6 7	SS-4	1.8' 90%	3 9 19 23	Light yellowish brown, olive yellow, and light olive brown (2.5Y 6/4 - 6/6 and 5/4 - 6/6) highly to completely weathered SHALE (SAPROLITE). Trace bluish gray (5G 6/1 - 10GY 6/1) and light greenish gray to light bluish gray (10Y 7/1 - 10GY 7/1) zones. Trace to few dark reddish brown to black iron/manganese oxide coatings, appear associated with fractures, but are difficult to follow. Sample is moldable with added water. Low to medium plasticity and toughness. Dry strength. No dilatancy. Thinly bedded. Very hard when classified as soil. Slightly moist to dry. Highly to completely weathered. SAPROLITE.	No reaction with HCl. Remnant bedding angle is approximately 45°. Possibly ML-CL in part.	ML
8 9	SS-5	2.0' 100%	39 47 51 70		Carbonates leached from formation.	
10 11	SS-6	1.8' 90%	6 24 56 100		SS-4 Lab results: MC 14.6%; 7.8% Gravel; 52.8% Sand; 39.4% Fines. SS-6 Lab results: MC 8.4%. SS-7 Lab results: MC 8.7%.	
12 13	SS-7	1.4' 70%	16 52 44 84	Below 11.5' color is primarily bluish gray (5G 6/1 - 10GY 6/1) to light bluish gray/light greenish gray (10Y 7/1 - 10GY 7/1). Highly weathered. Transitioning into weathered bedrock with depth.	SS-8 No reaction with HCl. Trace wet on SS-8 sampler tip and within sample. SS-9 Lab results: MC 4.3%.	
14	SS-8	0.3'/100%	100/5	SS-8 recovery is wet.	After augering to 20.0' WL measured at 13.94' from GS at 1341 (1 hr. 31 mins after drilling stopped). WL = 10.85' at 1445, TD = 20.0'.	
15	NS			Underlying contact may be as high as 14.3'. Change at 16.0		
16 17	SS-9	1.3' 92.3%	21 89 100/4	Interbedded greenish gray to dark greenish gray (5BG 5/1 - 4/1 and 10BG 5/1 - 4/1) SHALE and LIMESTONE. Some limestone seams may classify as calcareous siltstone. Trace to some reddish brown iron oxide, associated with fractures with poorly defined trace. Structure is also lost with the sampling process. Soft to medium hard. Thinly bedded. Highly weathered. At least partially wet (SS-9 recovery, bottom of sample was moist, SS-10 recovery was wet).	SS-9 1.5' of split barrel was wet. 16.0' - 16.5' is wet.	
	NS					
18	SS-10	0.2'/100%	100/2		Strong reaction with HCL.	
19	NS				End 2/15/18, 1210, sampled to 18.2'. Augered to 20.0' on 2/17/18 and switch over to HQ3 core, water circulation.	

EMDF Characterization Project
Oak Ridge, TN

BOREHOLE LOG

Boring Number
GW-986

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD
20 - 22	C-1	1.3' 65%	0%
22 - 27	C-2	2.3' 46%	0%
27 - 32	C-3	0.0' 0%	0%
32 - 32.9	C-4	0.0' 0%	0%
32.9 - 34.6	C-5	1.5' 88.2%	0%
34.6 - 36.1	C-6	1.5' 100%	0%
36.1 - 37.0	C-7	1.2' 100%	0%
37.0 - 39.8	C-8	2.4' 86%	0%
39.8 - 42.0	C-9	2.2' 100%	54.1%
42.0 - 44.6	C-10	2.6' 100%	0%
44.6 -	C-11	2.4'	0%

SAMPLE DESCRIPTION

Interbedded dark gray to very dark gray (N 5/ - 4/) SHALE and gray to dark gray (N 4/ - N 3/) LIMESTONE. Thinly bedded, beds generally less than 0.2', partings and very thin seams <1/4". Trace, healed, calcite (white) filled (<2 mm) fractures oriented perpendicular to bedding. Medium hard to hard limestone. Field strength is moderate to strong, but core generally breaks easily along bedding contacts between shale and limestone beds. Soft shale. Generally fresh with oxidation on some broken bedding contacts. Highly fractured, but most appear to be bedding breaks. Mechanical breaks along bedding is common. Bedding is deformed, wavey contacts between beds. Some thin limestone beds have discontinuous beds. Trace bioturbidation along some bedding breaks.

C-3 Run, core barrel did not latch. No recovery.

Oxidation/weathering not observed below 33.0'.

33.0' - 33.2' Limestone seam. Unweathered.

Below 34.6' approximately 50% limestone, 50% shale. Thinly interbedded. Soft sediment deformation. Wavey to discontinuous bedding is more prominent.

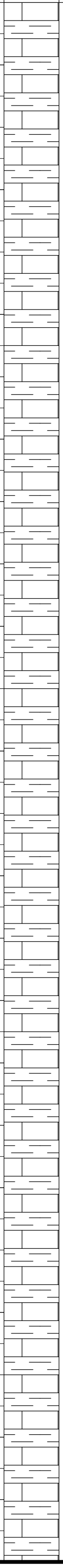
35.1' - 35.4' Gray to dark gray interclastic limestone. Elongated clasts oriented with bedding angle, up to 1 1/4" long by 3/4" high. Trace calcite filled/healed fracture, oriented perpendicular to bedding. Trace, very fine (<1 mm) pyrite and possibly glauconite nodules.

Below 37.9' primarily dark bluish gray to very dark bluish gray (5B 4/1 - 3/1) to greenish black (5GY 2/1) shale with gray to dark gray (N 5/ - N 4/1) limestone partings. Approx. 45° bedding angle. Continues to be thinly bedded. Trace bioturbidation. Bedding continues to be deformed, wavey, and discontinuous in places.

40.7' - 41.8' Shale seam. Trace white calcite filled/healed fractures, perpendicular to bedding.

Below 42.6' bedding changes from 45° to 70° by 42.8'. By 43.2' bedding angle changes back to 45°-50°.

Graphic Log



Remarks

Shale, no reaction with HCl. Limestone, strong reaction with HCl. Bedding angle is approximately 45° (very broken sample). Below 22.0' bedding angle is approx. 40°.

22.25' - 22.35, 22.7' - 22.85', and 22.9' - 23.05' Bedding breaks with reddish brown to yellowish brown oxidation on bedding plane. Iron oxide precipitate.
C-1 20.0' - 22.0' 1030-1040.
C-2 22.0' - 27.0' 1058-1134.
23.6' - 24.3' Highly broken gravel size fragments. Trace iron oxide faces.

C-2 Lost recovery, most likely from bottom of run.

C-3 27.0' - 32.0' 1157-1232.
C-4 32.0' - 32.9' 0914-0930.
C-5 32.9' - 34.6' 1010-1027.
C-6 34.6' - 36.1' 1113-1119.
C-3 and C-4 runs cutting returns were gray.

End 2/17/18, 1232 at 32.0'. Stopped due to rain.
Begin 2/18/18, 35°F, sunny, 0800. WL = 2.15' at 0801. Start coring at 0914.

Below 35.1' healed (white calcite filled) fractures are more prominent, generally less than 1 mm width. Often the fractures are associated with limestone seams and terminate in shale beds.
C-6 Recovered 0.3' of C-5 run.

Bedding angle ~45°.

Core breaks easily along bedding contacts between shale and limestone.

Bedding angle ~45°.

C-7 36.1' - 37.0' 1127-1131.
C-8 37.0' - 39.8' 1250-1305.
C-9 39.8' - 42.0' 1314-1324.
C-10 42.0' - 44.6' 1330-1344.
C-11 44.6' - 47.0' 1355-1406.

USCS

EMDF Characterization Project
Oak Ridge, TN

BOREHOLE LOG

Boring Number
GW-986

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
46 47	C-11	2.4' 100%	0%	Interbedded dark bluish gray to very dark bluish gray (5B 4/1 - 3/1) and greenish black (5G 2/1) SHALE and gray to dark gray (N 5/ - N 4/) LIMESTONE. (Cont'd.)		Continues to be broken along bedding planes. Calcite precipitates are usually present, and generally the surfaces have depositional slickenside surfaces. Breaks appear to be mechanical, typically at intervals between 0.3' to less than 0.1'.	
48 49	C-12	2.3' 100%	0%	47.8' - 48.1' Interclastic limestone seam. Trace to few glauconite nodules (<1 mm). Trace (rare) pyrite nodules (<1 mm). Clasts elongated and oriented with bedding.		C-12 47.0' - 49.3' 1412-1423.	
50 51 52	C-13	2.7' 100%	13%	At 49.8' fracture (appears mechanically broken), 2 mm calcite filled, broken face is striated at an orientation 30° from the fracture angle. At 50.2' fracture following bedding plane, face is polished with very fine pyrite on face. At 50.5' horizontal break, rough face. Trace pyrite.		C-13 49.3' - 52.0' 1431-1502. Stopped for water from 1430' - 1454'.	
53 54 55	C-14	2.9' 97%	0%			C-14 52.0' - 55.0' 1508-1520. 45° Bedding angle. 52.7' - 53.3' ~50° Bedding angle.	
56 57 58 59	NS					Finished coring 2/18/18 at 1520. WL = 10.5' from GS at 1534.	
60 61 62 63 64 65 66 67 68 69				Bottom of Borehole = 59.6'. Piezometer GW-986 installed in borehole. See Monitoring Well Installation Report GW-986 for details.		On 2/20/18 using Ingersoll-Rand T3W rotary rig, reamed corehole and advanced borehole using 5 7/8" tricone bit with air and water circulation. Finished at 1240.	

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Eagon & Associates, Inc.

Well Number GW-986

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*	Completion Date: *3/8/18*
Coordinates: *30130.30N 38191.80E*	Borehole Depth (ft): *59.6*
Elevation Top of Casing (ft/MSL): *932.37*	Borehole Diameter (in): *10" (0'-20.0'), 5 7/8 (20.0'-59.6')*
Elevation Ground Surface (ft/MSL): *930.2*	Drilling Methods: *3 1/4" ID HSA, HQ3 Core with water circulation, 10" air hammer bit, 5 7/8" tricone bit with air/water.*
Installed By: *Fred Reynolds/Tri-State Drilling*	Completed Drilling: *2/20/18*
Supervised By: *Shay Beanland/Eagon & Associates, Inc.*	Drilling Water Used (gals):

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel Protector	-2.5 - 2.6	932.7 - 927.7
Riser	2" ID Schedule 40 PVC	-2.2 - 41.0	932.4 - 889.3
Surface Seal	3' x 3' Concrete Pad	-0.5 - 0.5	930.7 - 929.7
Conductor Casing	6" ID Sch. 40 PVC, Flush Threaded	-0.4 - 20.0	930.6 - 910.2
Cement Grout	Cement Bentonite Grout	0.5 - 35.8	929.7 - 894.4
Bentonite Seal	Pel Plug 1/4" Coated Bentonite Pellets	35.8 - 38.6	894.4 - 891.6
Sand Pack	DSI "GP #2" Gravel Pack	38.6 - 47.6	891.6 - 882.7
Screen	2" ID Schedule 40 PVC, 10-Slot	41.0 - 46.0	889.3 - 884.2
Well Point Blank	2" ID Sch. 40 PVC Cap & Riser Section	46.0 - 47.6	884.2 - 882.7
Sand Pack Bottom	DSI "GP #2" Gravel Pack	47.6 - 48.0	882.7 - 882.2
Bentonite Seal	Pel Plug 1/4" Coated Bentonite Pellets	48.0 - 59.6	882.2 - 870.6

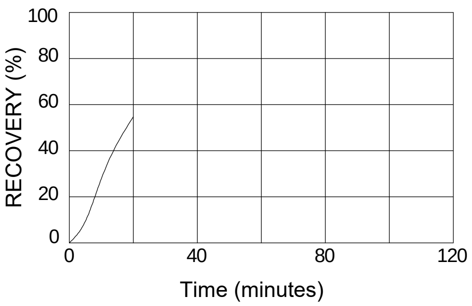
Well Development

Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
49.70	*6.38*	*7.1*	*156.0*

Development Method:
Surge block, bailer, mega purger whale pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (µmhos/cm)	pH (S.U.)	Turbidity (NTU)
3/1/18	0848	89	15.4	520	7.42	24.8
3/1/18	1422	97	14.9	560	7.37	210.0
3/1/18	1557	139	14.6	486	7.41	229.0
3/1/18	1612	145	15.1	494.6	7.43	82.2
3/1/18	1627	149	15.0	495	7.44	119.0
3/1/18	1652	156	14.8	488	7.45	28.2

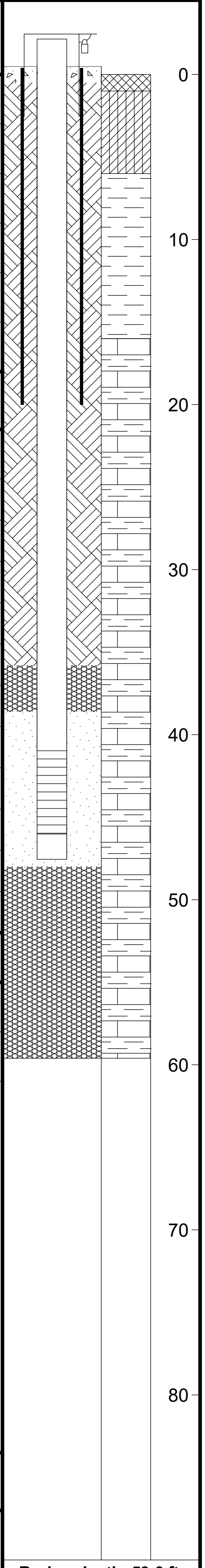
Recovery Data



Sampling Equipment:

Comments:

Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval from 41.1 - 45.9 bgs.



Boring depth=59.6 ft.

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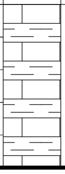
Eagon & Associates, Inc.

BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project Oak Ridge, TN**	Drilling Methods: 4 1/4" ID HSA, HQ3 Core with water circulation, 10" air hammer bit, 5 7/8" tricone bit with air/water.				Boring Number: **GW-987**
Drilling Firm: *Tri-State Drilling*	DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)	
Driller / Rig: *Shannon Snow/CME-550*					*Page 1 of 2*
Logged by: *David J. Sugar*	Sampling Methods: ST = Shelby Tube WS = Waxed Sample SP = Sand Pump GP or DP = Direct Push CT = Cuttings	SS = Split Spoon CS = Continuous Sampler C = Coring NS = Not Sampled B = Bailer			Start / Finish
Coordinates: *30138.34N 38194.40E*					*Time 1410* / *Time 1102*
Surface Elevation: *930.5 ft/MSL*					*Date 2/20/18* / *Date 2/21/18*
Surface Conditions / Weather: *Flat, gravel pad / 65°F, Mostly sunny*					

Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
1	NS			See adjacent Borehole Log GW-986 for detailed lithologic description and stratigraphic interpretation.		4 1/4" ID HSA, ran auger plug while augering. 8 1/2" Borehole.	CL
2 3	ST-1	0.90	700	Description based on bottom of ST-1 recovery. Brown to strong brown (7.5YR 5/4 - 4/6) SILTY CLAY. Trace highly to completely weathered shale fragments, coarse sand to gravel size. Unsorted. high plasticity, toughness, and dry strength. Moist. Weathered. SUBSOIL. No reaction with HCl.		ST-1 recovery was partially blocked, not usable. Discarded.	
4 5	NS			ST-3 Collected after completing GW-987; moved rig 3' off of GW-987 and pressed sample from 2.0' - 4.0'. Recovered 2.1', 700 PSI press. Change at 6.0'.		Auger cuttings, bucket sample, BS-1 collected from 4.0' - 6.0'.	
6 7	ST-2	1.75	1000	Description based on bottom of ST-2 recovery: Light yellowish brown, yellowish brown to light olive brown (2.5Y 6/4 - 6/6) highly weathered to completely weathered SHALE (SAPROLITE). Thinly bedded (<1/2") high bedding angle. Highly fractured with black iron oxide precipitate/coatings. Moist.		Auger cuttings bucket sample BS-2 collected from 6.0' - 8.5'. No reaction with HCl. Difficult to mold sample with added water.	ML
8 9 10 11 12 13 14 15 16 17	NS			Change at 17.5'.		Below 17.5' switch to HQ3 core, water circulation.	
18 19	C-1	1.8' 72%	0%	Interbedded dark gray to olive gray (5Y 4/1 - 4/2) SHALE and LIMESTONE to CALCAREOUS SILTSTONE. Trace white calcite filled fractures, oriented perpendicular to bedding, <2 mm width. Thinly bedded, generally less than 0.1' thick, oriented at a relatively high angle. Moderate to highly decomposed. Shale seams are soft. Limestone seams are hard. Weathered. Below 20.0' color changes to dark gray, very dark gray (N 4/ - N 3/) and		Highly fractured. Primarily along bedding, trace fractures oriented perpendicular to bedding. Fracture faces are generally coated with manganese oxide precipitates. C-1 17.5' - 20.0' 1554-1615.	

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-987

Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
21	C-2	1.2' 32%	0%	gray-dark gray (N 5/ - 4/). Interbedded dark gray to very dark gray (N 4/ - N 3/) SHALE and gray to dark gray (N 5/ - 4/) LIMESTONE. Below 20.3' relatively unweathered. Thinly bedded and generally broken along bedding planes. Breaks appear mechanical. At 21.4' and 21.7' dark yellowish brown to black iron oxide/manganese oxide on bedding breaks. Below 21.7' unweathered, oxidation not observed. Consistent dark gray to very dark gray. Trace bioturbidation burrows present along some bedding contacts. Trace glauconite nodules, generally associated with limestone seams. Continues to be thinly bedded (<0.1' beds). Bedding contacts generally are deformed and have bioturbidation. At 23.2' secondary calcite on bedding break, thin coating. Consistent thinly bedded shale and limestone, ~40% limestone, 60% shale.		Becoming unweathered. Limestone reacts strong with HCl. Shale does not react. 20.0' - 20.3' Trace yellowish brown oxidation. Highly broken. ~45° Bedding angle. End 2/20/18, 1707 at 21.3'. Begin 2/21/18, 0909. WL at 0835 = 1.2' from GS. 65°F, light rain. 22.4' - 22.8' Several bedding breaks with oxidized (yellowish brown) faces. Fracture perpendicular to bedding angle is also oxidized. Below 22.8' oxidation/weathering not observed. C-2 20.0' - 21.3' 1640-1707. C-3 21.3' - 22.0' 0909-0926. C-4 22.0' - 26.5' 0932-0952.	
22	C-3	0.7'/100%	0%				
23 24 25 26	C-4	4.0' 89%	16%				
27	NS						
28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44				Bottom of Borehole = 27.9'. Piezometer GW-987 installed in borehole. See monitoring well installation report GW-987 for details.		Finished coring at 0952, 2/21/18. Overdrilled corehole with HSA and advanced borehole to 27.9'. Finished auger drilling at 1102.	

Eagon & Associates, Inc.

Well Number
GW-987

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*	Completion Date: *3/8/18*
Coordinates: *30138.34N 38194.40E*	Borehole Depth (ft): *27.9*
Elevation Top of Casing (ft/MSL): *932.94*	Borehole Diameter (in):*7 1/2"*
Elevation Ground Surface (ft/MSL): *930.5*	Drilling Methods: *4 1/4" ID HSA, HQ3 Core with water circulation, 10" air hammer bit, 5 7/8" tricone bit with air/water.*
Installed By: *Shannon Snow/Tri-State Drilling*	Completed Drilling: *2/21/18*
Supervised By: *David J. Sugar/Eagon & Associates, Inc.*	Drilling Water Used (gals): *750*

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel w/Locking Lid	-2.7 - 2.3	933.2 - 928.2
Riser	2" ID Schedule 40 PVC	-2.4 - 16.1	932.9 - 914.4
Surface Seal	3' x 3' Concrete	-0.5 - 0.5	931.0 - 930.0
Cement Grout	Cement Bentonite Grout	0.5 - 10.9	930.0 - 919.6
Bentonite Seal	Pel-Plug 1/4" Coated Bentonite Pellets	10.9 - 13.3	919.6 - 917.2
Sand Pack	DSI GP #2 Gravel Pack	13.3 - 27.4	917.2 - 903.1
Screen	2" ID Schedule 40 PVC, 10-Slot	16.1 - 26.1	914.4 - 904.4
Well Point Blank	2" ID Schedule 40 PVC Cap and Riser	26.1 - 27.4	904.4 - 903.1
Sand Pack Bottom	DSI GP #2 Gravel Pack	27.4 - 27.9	903.1 - 902.6

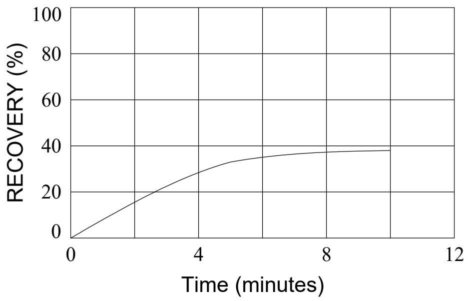
Well Development

Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
29.77	*9.49*	*3.3*	*110.0*

Development Method:
Bailer, surge block, Tornado pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (μmhos/cm)	pH (S.U.)	Turbidity (NTU)
2/23/18	1510	10.0	16.3	364	7.48	>1000
2/27/18	1652	17.5	15.6	380	7.57	>1000
2/28/18	1620	56.0	15.0	411	7.63	810.0
3/1/18	0859	66	14.8	422	7.55	>1000
3/2/18	1635	99	14.4	433	7.52	129.0
3/3/18	0850	110	14.8	437	7.49	68.8

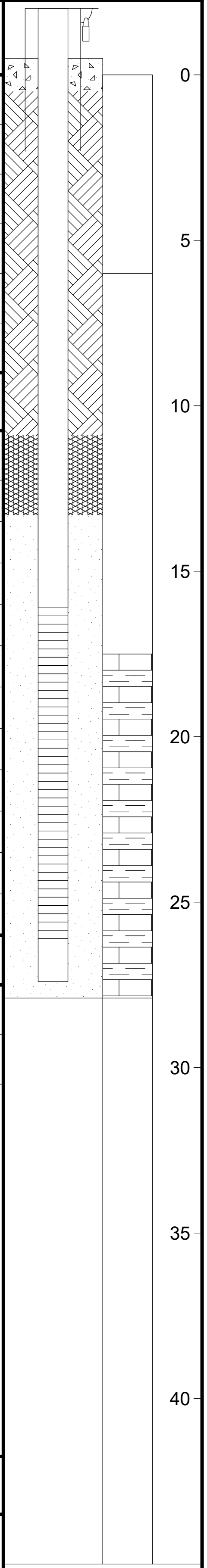
Recovery Data



Sampling Equipment:

Comments:

Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 16.3 - 26.1 bgs.



Boring depth=27.9 ft.

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Eagon & Associates, Inc.

BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project Oak Ridge, TN**	Drilling Methods: 2 1/4" HSA, HQ3 Core w/water, 10" air hammer bit, 5 7/8" tricone bit w/air/water.				Boring Number: GW-988
Drilling Firm: *Tri-State Drilling*	DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)	
Driller / Rig: *Fred Reynolds/Mobile 42C*	2/8/18	1719	51.6	19.45	*Page 1 of 4*

Logged by: *Ryan Hansel/Nelson Novak*

Coordinates: *29952.47N 38091.14E*

Surface Elevation: *957.0 ft/MSL*

Sampling Methods:

ST = Shelby Tube	SS = Split Spoon
WS = Waxed Sample	CS = Continuous Sampler
SP = Sand Pump	C = Coring
GP or DP = Direct Push	NS = Not Sampled
CT = Cuttings	B = Bailer

Start	Finish
Time 1135	*Time 1120*
Date 2/7/18	*Date 2/22/18*

Surface Conditions / Weather: *Gravel pad on 10° slope, damp ground / 40°, Cloudy, 0-5 MPH SW*

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
1 2	SS-1	1.4' 70%	1 2 2 2	Reddish yellow to strong brown (7.5YR 7/6 - 5/6) SAND. Few silt. Some gravel. Sand is fine grained, subangular to subrounded, loose, massive. Low dry strength, slow to rapid dilatancy. Moist. Road base. Below 1.2' becomes gray in color. Strong reaction to HCl. ROAD BASE. Change at 1.4'.		Ran 2 1/4" ID Hollow Stem Augers (7" OD) w/center plug while augering. Ran 2" (OD) by 2' drive split-spoon sampler driven by 140 lb hydraulic hammer/HQ3 core w/ water. SS-1 Lost return at top compaction of road base.	ML CL
3 4	SS-2	2.0' 100%	3 4 5 8	Yellow to olive yellow (2.5Y 7/6 - 6/6) to reddish yellow to strong brown (7.5YR 6/8 - 5/8) CLAYEY SILT. Trace fine grained sand. Trace shale fragments that have been weathered to gravel, subangular to angular. Thinly bedded with a mottled appearance, very stiff, low plasticity. Moderate strength, slow to rapid dilatancy. Weathered. Moist. RESIDUUM/COLLUVIUM.		On 2/20/18 used Intersoll-Rand T3W rotary rig to ream borehole to 36.0' using 10" hammer bit. Set permanent 6" conductor casing and sealed with cement bentonite grout.	
5 6	SS-3	2.0' 100%	4 6 8 9	Below 5.2' silt lenses and partings present. Iron and manganese oxide present along shale fragments. No reaction with HCl.		SS-2 Lab results: Moisture Content (MC) 34.6%. SS-3 Lab results: MC 25.1%.	
7 8	SS-4	2.0' 100%	4 8 12 17			SS-4 Lab results: MC 33.6%; 0.6% Gravel; 42% Sand; 57.4 Fines.	
9 10	SS-5	2.0' 100%	3 13 16 19	Shale becoming more competent with depth. Shale bedding and structure becoming more defined/intact with depth. Bedding is at 45°.			
11 12	SS-6	2.0' 100%	7 11 11 12	11.5' - 11.6' Strong reaction HCl. Underlying contact is transitional. Change at 11.6'.		SS-6 Lab results: MC 29.8%.	
13 14	SS-7	2.0' 100%	10 14 11 15	Grayish brown to olive brown (2.5Y 5/2 - 4/3) highly weathered SHALE (SAPROLITE). Shale is mostly reduced to a silty clay. Trace fine grained sand. Some shale has been reduced to gravel, subangular to angular, thinly bedded (~45°), very stiff. Low to medium plasticity. Moderate dry strength. No dilatancy. Weathered with iron and manganese oxide present along clast surfaces. No reaction with HCl. SAPROLITE.			CL ML
15 16	SS-8	2.0' 100%	7 11 13 15	Below 13.8' silt lenses and partings present. Silt has rapid dilatancy. Shale fragments up to 1" diameter.		SS-8 Lab results: MC 26.2%.	
17 18	SS-9	1.6' 80%	7 9 10 14				
19	SS-10	1.6' 80%	6 12 14 16				

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-988

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
21	SS-11	1.8' 90%	5 11 15 17	From 20.0' - 20.6' wet.		On SS-11 wet at top of spoon. SS-11 Lab results: MC 21.5%.	CL ML
22 23	SS-12	1.0' 50%	7 11 21 32	Below 22.0' shale is becoming more competent, harder, becoming brown to dark brown (7.5YR 4/2 - 3/2). Degree of weathering decreasing with depth. SAPROLITE.		After augering to 26', visible wet in cuttings after 45 min break.	
24 25	SS-13	1.5' 75%	17 29 32 46			SS-13 Lab results: MC 16%.	
26 27	SS-14	1.4' 100%	18 49 50/4	Below 26.0' shale clasts become light olive gray to olive gray (5Y 7/2 - 6/2). Iron oxide on clasts becomes trace to none. Some manganese oxide present on clasts surface. SAPROLITE.		Refusal at 27.4', augered to 28'.	
	NS						
28 29	SS-15	1.8' 90%	28 22 32 45	Below 28.7' shale clasts become brown to dark brown (7.5YR 4/2 - 3/2). Manganese oxide becomes trace to little on shale surfaces.			
30 31	SS-16	1.4' 100%	22 49 50/4	Below 30.0' becomes dry. Color becomes light olive gray to olive gray (5Y 6/2 - 4/2). Some iron oxide to manganese oxide on clast surfaces.		SS-16 Lab results: MC 9.9%; 3.3% Gravel; 66.9% Sand; 29.8% Fines.	
	NS					Refusal at 31.4', augered to 32.0'.	
32 33	SS-17	1.2' 60%	20 23 11 19	Shale structure becoming more defined, less weathered with depth.			
34	SS-18	0.9' 100%	40 50/5			SS-18 Lab results: MC 9.9%. Auger refusal @ 35.6' @ 1625. 2/7/18 @ 1533 DTW - 25.3 BGS.	
35	NS			Change at 35.2'.		2/8/18 @ 0801 DTW = 13.11 BGS.	
36	C-1	1.0' 71.4%	0%	Overall structure is a laminated to thinly INTERBEDDED LIMESTONE and SHALE. The limestone is medium gray to medium dark gray (N 5/ - N 4/). The shale is dark gray to grayish black (N 3/ - N 2/). The limestone is massive, siliceous, very strong field strength. The shale is laminated to thinly bedded, strong field strength. The overall structure has a 45° bedding angle. Present with soft sediment deformation, bioturbidation, and cross bedding. The top portion (top 1/2') is present with iron staining on fracture traces.		Set PVC temporary surface casing to 35' in hole plug. Cleaned out hole to 35.2'. Start HQ3 core with water at 1140. Drilling water is being recirculated. C-1: 35.2' - 36.6', 1140-1150. 35.2' - 35.4' highly fractured zone with iron staining and calcite on surface	
37 38	C-2	2.2' 88%	0%	Below 35.4' the limestone and shale are fresh to slightly decomposed. Fracturing is moderate to very intense. Fractures along bedding planes are fresh and probably mechanically induced. Slickensides are observed along shale bedding planes. Multiple horizontal and vertical fractures are present that have been completely healed with calcite. Trace vertical and horizontal fractures have been healed with mudstone. Calcite veins have strong reaction with HCl.		C-2: 36.6' - 39.1', 1305-1320. 36.6' - 36.8' Fracture perpendicular to bedding plane healed with calcite.	
39 40 41	C-3	1.1' 44%	0%	38.6' - 38.8' Vertical fracture. Probably mechanically induced. 38.9' - 40.0' Multiple horizontal and vertical fractures. Some are healed with calcite. Most breaks are probably mechanically induced.		C-3: 39.1' - 41.6', 1334-1345. Vertical fracture wedged and blocked tip. Lost return from bottom.	
42	C-4	0.6' 85.7%	0%	40.0' - 40.2' Fracture along core axis that has been healed with mudstone.		C-4: 41.6' - 42.3', 1520-1526. Driller noted blocked tip on run due to vertical fracture.	
43 44	C-5	2.3' 100%	17.4%	41.6' - 42.3' Multiple horizontal and vertical fractures, iron and manganese oxide on fracture face. Some healed with calcite. 42.3' - 44.6' Very intensely fractured. 42.7' - 43.1' Vertical fracture healed with mudstone. Rip-up clasts present. Multiple horizontal and vertical fractures healed with calcite.		C-5: 42.3' - 44.6', 1535-1549. 43.9' Horizontal fracture with iron.	
	C-6	2.0	27.5%				

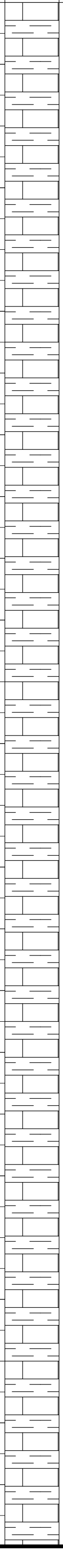
EMDF Characterization Project
Oak Ridge, TN

BOREHOLE LOG

Boring Number
GW-988

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
46	C-6	2.0' 100%	27.5%	Medium gray to medium dark gray (N5 - N4) to dark gray to grayish black (N3 - N2) INTERBEDDED LIMESTONE and SHALE. (Cont'd.) 46.2' Horizontal fracture (~1 inch thick) healed with calcite.		C-6: 44.6' - 46.6', 1559-1610. 44.6' - 46.6' Multiple hairline fractures healed with calcite.	
47 48 49 50	C-7	3.0' 85.7%	12.9%	Shale beds becoming dominant with depth. Contacts between shale and limestone are deformed, have a wavy appearance.		47.3' Fracture perpendicular to bedding plan healed with calcite. C-7: 46.6' - 50.1', 1620-1642. Driller noted no loss of water/circulation while drilling.	
51	C-8	1.5' 100%	0%	Below 50.0' shale and limestone content is approximately 50%. Rock is fresh, moderately to very intensely fractured. Fractures along bedding planes (45°) are mechanically induced. Multiple thin horizontal and vertical fractures that are healed with calcite. Shale has abundant slickensided surfaces along bedding planes.		C-8: 50.1' - 51.6', 1650-1710. 2/8/18 @ 1719 WL = 19.45 BGS. 2/9/18 @ 0835 DTW - 15.58 BGS.	
52 53 54 55 56	C-9	4.0' 80%	36.4%	52.8' Fracture along bedding plane healed with calcite. 53.2' - 53.4' Multiple hairline fractures perpendicular to bedding planes completely healed with calcite. Trace pyrite nodules and stringers within shale. 54.6' Fracture perpendicular to bedding plane healed with calcite.		C-9: 51.6' - 56.6', 0933-1012.	
57 58 59 60 61	C-10	5.0' 100%	17.2%	56.8' - 57.1' Shale and limestone are deformed with turbidation, approaching a brecciated appearance. Below 57.0' bedding varies between 45° and 60°. 59.0' - 59.1' Fracture perpendicular to bedding plane healed with calcite. 61.2' - 61.5' Hairline fractures perpendicular to bedding plane healed with calcite.		C-10: 56.6' - 61.6', 1029-1055.	
62 63 64 65 66	C-11	3.8' 76%	0%	61.7' - 61.8' Fracture perpendicular to bedding plane healed with calcite. From 62.2' - 62.3' fine glauconite nodules oriented along bedding plane. Only found in layers of limestone. 63.6' - 63.8' Fine glauconite nodules oriented along bedding planes only within limestone. Pyrite nodules associated near glauconite grains/nodules. 63.9' - 64.1' Fracture perpendicular to bedding plane healed with calcite. 64.4' - 64.7' Fracture perpendicular to bedding plane healed with calcite. Below 65.0' limestone beds are up to 3" thick. Slickensides present perpendicular to bedding plane in shale. Shale beds becoming dominant.		C-11: 61.6' - 66.6'. 1108-1150. Driller noted pressure fluctuations while drilling. No loss of water/circulation during drilling.	
67 68 69	C-12	2.3' 92%	14.8%	66.6' - 67.0' Multiple fractures along bedding plane healed with calcite. 67.2' - 67.4' 1/4" thick fracture healed with calcite. Calcite is mostly white, some pink/orange in color. 68.2' - 68.5' Multiple horizontal and vertical hairline fractures filled with calcite.		C-12: 66.6' - 69.1', 1358-1417. Driller noted rock feeding poorly. Pulled run.	
	C-13	1.5' 100%	0%				



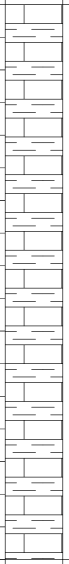
Eagon & Associates, Inc.

EMDF Characterization Project
Oak Ridge, TN

BOREHOLE LOG

Boring Number
GW-988

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
	C-13	1.5' 100%	0%	At 69.7' bedding turns near vertical with a fracture going from 69.9' to 72.3'. Fracture is healed with mudstone and calcite. Some limestone and shale rip-up clasts present within the mudstone. Highly deformed along bedding planes with some small-scale folds observed. Abundant horizontal fractures healed with calcite. Most breaks were probably mechanically induced. From 71.8' - 72.3' very intensely fractured zone. Healed with mudstone. Some healed with calcite. Below 72.3' bedding turns back to 40° to 50°.		C-13: 69.1' - 70.6', 1428-1444.	
71	C-14	1.0' 100%	0%			C-14: 70.6' - 71.6', 1454-1504.	
72	C-15	2.0' 100%	0%			C-15: 71.6' - 73.6', 1513-1531. Driller noted approximately 5% water loss in circulation.	
73							
74	C-16	1.3' 92.9%	0%			C-16: 73.6' - 75.0', 1542 - 1552. 2/9/18 at 1600 DTW = 6.79 BGS. 2/10/18 @ 0755, DTW = 4.88'.	
75							
76							
77	NS						
78							
79				Bottom of Borehole = 78.5'. Piezometer GW-988 installed in borehole. See Monitoring Well Installation Report GW-988 for details.		On 2/22/18 used T3W rotary rig to ream corehole and advance borehole to 78.5' using 5 7/8" tricone bit with air and water circulation. Finished drilling at 1120.	
80							
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Eagon & Associates, Inc.

Well Number GW-988

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*	Completion Date: *3/8/18*
Coordinates: *29952.47N 38091.14E*	Borehole Depth (ft): *78.5*
Elevation Top of Casing (ft/MSL): *958.95*	Borehole Diameter (in):*10" (0'-36.0'), 5 7/8" (36.0'-78.5')*
Elevation Ground Surface (ft/MSL): *957.0*	Drilling Methods: *2 1/4" HSA, HQ3 Core w/water, 10" air hammer bit, 5 7/8" tricone bit w/air/water.*
Installed By: *Fred Reynolds/Tri-State Drilling*	Completed Drilling: *2/22/18*
Supervised By: *Shay Beanland/Eagon & Associates, Inc.*	Drilling Water Used (gals):

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel Protector w/Locking Lid	-2.3 - 2.7	959.3 - 954.3
Riser	2" ID Schedule 40 PVC	-2.0 - 61.9	959.0 - 895.1
Surface Seal	3' x 3' Concrete Pad	-0.5 - 0.5	957.5 - 956.5
Conductor Casing	6" ID PVC Schedule 40, Flush Threaded	-0.4 - 36.0	957.4 - 921.0
Cement Grout	Cement Bentonite Grout	0.5 - 55.1	956.5 - 901.9
Bentonite Seal	Pel Plug 1/4" Coated Bentonite Pellets	55.1 - 59.6	901.9 - 897.4
Sand Pack	DSI "GP #2" Gravel Pack	59.6 - 73.2	897.4 - 883.8
Screen	2" ID Schedule 40 PVC, 10-Slot	61.9 - 71.9	895.1 - 885.1
Well Point Blank	2" ID Sch. 40 PVC Cap & Riser Section	71.9 - 73.2	885.1 - 883.8
Sand Pack Bottom	DSI "GP #2" Gravel Pack	73.2 - 74.0	883.8 - 883.0
Bentonite Seal	Pel Plug 1/4" Coated Bentonite Pellets	74.0 - 78.5	883.0 - 878.5

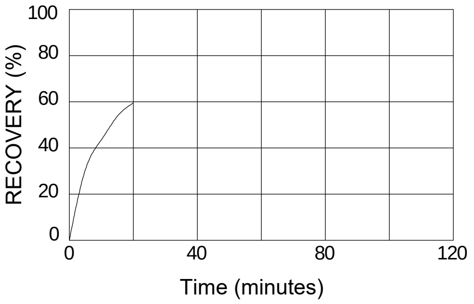
Well Development

Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
75.20	*13.56*	*10*	*132.5*

Development Method:
Surge block, bailer, mega purger whale pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (μmhos/cm)	pH (S.U.)	Turbidity (NTU)
3/1/18	1240	42.5	15.1	647	7.54	134.0
3/1/18	1305	57.5	14.9	759	7.25	29.0
3/1/18	1325	87.5	14.8	761	7.12	3.9
3/1/18	1335	102.5	14.9	768	7.10	3.5
3/1/18	1345	117.5	14.7	766	7.07	2.2
3/1/18	1400	132.5	14.7	769	7.05	2.4

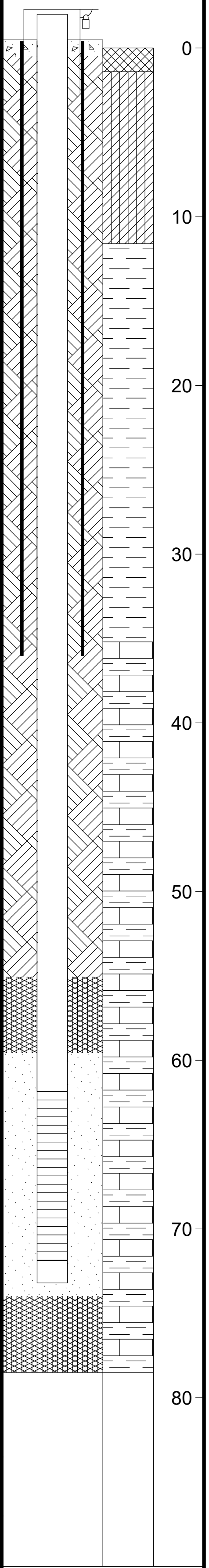
Recovery Data



Sampling Equipment:

Comments:

Stainless steel centralizers installed at 27.5' and 55.5' below ground surface. Washed sand pack and pellets in using tremie pipe. Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 62.1 - 71.8 bgs.



Boring depth=78.5 ft.

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BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project**
Oak Ridge, TN

Drilling Methods:
4 1/4" ID HSA, HQ3 Core with water circulation.

Boring Number: GW-989

Drilling Firm: *Tri-State Drilling*

Driller / Rig: *Shannon Snow/CME-550*

Logged by: *David J. Sugar*

Coordinates: *29950.44N 38082.67E*

Surface Elevation: *955.7 ft/MSL*

DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)

Page 1 of 3

Sampling Methods:

ST = Shelby Tube
WS = Waxed Sample
SP = Sand Pump
GP or DP = Direct Push
CT = Cuttings
SS = Split Spoon
CS = Continuous Sampler
C = Coring
NS = Not Sampled
B = Bailer

	Start	Finish
Time	1429	1645
Date	2/27/18	2/28/18

Surface Conditions / Weather: *Slopped surface, gravel pad / 60°-65°F, Sunny*

Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
1 2	NS			See Borehole Log for adjacent boring GW-988 for detailed lithologic description and stratigraphic interpretation.		4 1/4" ID HSA, ran auger plug while augering.	
3 4	ST-1	1.85	1200 PSI	Description based on inspection of bottom of ST-1 recovery: Strong brown (7.5YR 5/6 - 5/8 and 4/6) and pale brown (2.5Y 7/3 - 7/4) mottled SILTY CLAY. Trace to some black mottling. Trace highly weathered fragments. Moist. high plasticity and toughness. SUBSOIL.		Auger cutting bucket sample BS-1 collected from 4.0' - 6.0'.	
5 6	NS						
7 8	ST-2	1.85	1000 PSI	Description based on inspection of bottom of ST-2 recovery: Thinly bedded yellow to olive yellow (7.5Y 7/6 - 6/6) SHALE (SAPROLITE). Completely weathered. Some dark grayish brown to very dark grayish brown (2.5Y 4/2 - 3/2) beds. Appears intact remnant bedding. Underlying contact may be higher or bottom of ST-2 may be a large rock fragment.		Plasticity and toughness are variable, generally low to medium.	
9 10	NS					Auger cutting bucket sample BS-2 collected from 8.0' - 10.0'.	
11 12	ST-3	1.9	1500 PSI	SHALE (SAPROLITE). Highly/completely weathered. Damp to moist.			
13 14	NS			Description based on inspection of bottom of ST-3 recovery: Light olive brown (2.5Y 5/3 - 5/4) highly weathered SHALE (SAPROLITE). Low bedding angle (may not be in place) or slightly disturbed sample at sampler tip.			
15 16	ST-4	1.95	1300 PSI	Description based on inspection of bottom of ST-4 recovery: Olive gray to olive (5Y 4/2 - 4/3 and 5/3 - 5/4) highly weathered SHALE (SAPROLITE). Relatively low bedding angle. Thinly bedded with dark reddish brown/black iron oxide on bedding surfaces. Moist.			
17 18 19	NS						

EMDF Characterization Project
Oak Ridge, TN

BOREHOLE LOG

Boring Number
GW-989

Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	USCS
21 22 23 24 25 26 27 28 29 30 31	NS			
32 33 34 35	C-1	2.9' 80%	13%	
36	C-2	1.1' 100%	0%	
37 38 39	C-3	1.5' 45%	30%	
40 41 42 43 44	C-4	3.2' 64%	0%	

SAMPLE DESCRIPTION

SHALE (SAPROLITE). (Cont'd.)

Below 22.0' auger cutting returns are very moist. No free water.

Below 30.0' auger cutting returns are wet.

Contact with underlying interbedded shale and limestone is higher than 32.0'.

Change at 32.0'.

Interbedded dark gray to olive gray (5Y 4/1 - 4/2) SHALE and LIMESTONE. Some of the limestone seams may actually classify as calcareous siltstone. Thinly bedded, generally <0.1' beds and partings are not uncommon. Bedding angle is 45°. Limestone seams are hard and react strongly with HCl. Microcrystalline to fine crystalline. Shale seams are soft, do not react with HCl. Moderate to highly decomposed. Intensely fractured.

With depth picking up gray color hues, becoming unweathered.
Below 33.3' consistent gray to very dark gray (N 5/ - N 3/) color. Fresh to slightly decomposed. Limestone seams have lighter gray color hues. Becoming unweathered/competent.

33.5' - 34.4' Primarily limestone, trace shale partings and thin seams. Bedding contacts are deformed and bioturbated.

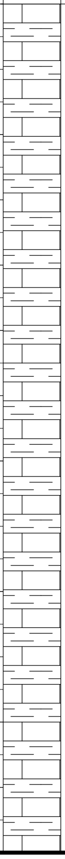
Below 35.6' oxidized zones/fractures are rare and called out where observed. Continues to be thinly bedded with common mechanical breaks at shale/limestone bedding contacts. Secondary mineralization along breaks is generally not observed.

Below 36.0' bedding angle increases to 65° - 70°. Healed fractures (white calcite filled) increase, up to 1/4" width, generally oriented perpendicular to bedding, often more prominent within limestone beds and typically dissipate or terminate within shale beds.
By 41.0' bedding is approaching vertical. Healed (calcite filled) fractures oriented perpendicular to bedding are prominent within limestone beds. Local deformation, contorted bedding (small scale folds) are present.
Below 41.5' beds may be slightly overturned.

Below 42.3' some limestone beds are almost brecciated. At a minimum, highly deformed.

Below 42.8' considerable white calcite filled fractures, highly deformed.

Graphic Log



Remarks

C-1 32.0' - 35.6' 1630-1701.

C-2 35.6 - 36.7' 0930-0941.

C-3 36.7' - 40.0' 0952-1050.

C-4 40.0' - 45.0' 1108-1130.

Contacts between limestone and shale beds are wavey/deformed. Soft sediment deformation trace bioturbidation.
Approximately 40% to 60% limestone.

32.0' - 33.6' Most bedding breaks are oxidized with iron oxide precipitates on fracture surfaces.

34.1' - 34.3' Broken zone, bedding break and fracture perpendicular to bedding. Oxidized with iron oxide precipitates on fracture faces.
End 2-27-18, 1701 at 35.6'.
2/28/18, 0810 WL = 5.4', 49°F, Light rain. Start coring at 0930.
The increase in white calcite filled fractures below 36.0' appears to correlate with the increase in the bedding angle.
41.9' - 42.3' Broken zone with iron oxide along bedding planes and perpendicular fractures. Secondary calcite does not appear to be present. Zone may account for some C-4 lost recovery.
The core bit/lifter was stuffed, indicating that the majority of lost C-4 recovery was most likely from the bottom of the run.
Overdrilled corehole with 4 1/4" ID HSA.

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-989

Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
				Bottom of Borehole = 45.0'.			
46				Piezometer GW-989 installed in borehole. See Monitoring Well Installation Report GW-989 for details.			
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Eagon & Associates, Inc.

Well Number
GW-989

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*	Completion Date: *3/8/18*
Coordinates: *29950.44N 38082.67E*	Borehole Depth (ft): *45.0*
Elevation Top of Casing (ft/MSL): *957.86*	Borehole Diameter (in): *7 1/2"*
Elevation Ground Surface (ft/MSL): *955.7*	Drilling Methods: *4 1/4" ID HSA, HQ3 Core with water circulation.*
Installed By: *Shannon Snow/Tri-State Drilling*	Completed Drilling: *2/28/18*
Supervised By: *David J. Sugar/Eagon & Associates, Inc.*	Drilling Water Used (gals): *~600*

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel w/Locking Lid	-2.6 - 2.4	958.3 - 953.3
Riser	2" ID Schedule 40 PVC	-2.3 - 33.6	958.0 - 922.1
Surface Seal	3' x 3' Concrete	-0.5 - 0.5	956.2 - 955.2
Cement Grout	Cement Bentonite Grout	0.5 - 25.7	955.2 - 930.0
Bentonite Seal	Pel-Plug 1/4" Coated Bentonite Pellets	25.7 - 30.0	930.0 - 925.7
Sand Pack	DSI GP #2 Gravel Pack	30.0 - 44.9	925.7 - 910.8
Screen	2" ID Schedule 40 PVC, 10-Slot	33.6 - 43.6	922.1 - 912.1
Well Point Blank	2" ID Sch. 40 PVC Cap & Riser Section	43.6 - 44.9	912.1 - 910.8
Sand Pack Bottom	DSI GP #2 Gravel Pack	44.9 - 45.0	910.8 - 910.7

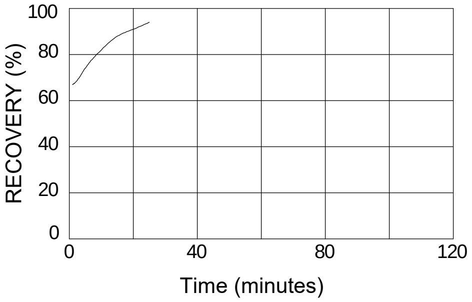
Well Development

Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
47.21	*14.03*	*5.4*	*151.0*

Development Method:
Surge block, bailer, mega purger whale pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (µmhos/cm)	pH (S.U.)	Turbidity (NTU)
3/5/18	0900	17.0	14.8	534	7.28	>1000
3/5/18	1126	49.5	14.8	341.3	8.10	351.0
3/5/18	1400	80.5	14.6	508	7.51	383.0
3/6/18	0904	124.0	14.5	323.8	7.72	142.0
3/6/18	1402	135.5	15.3	326.6	7.78	24.6
3/6/18	1459	151.0	15.6	329.3	7.79	8.1

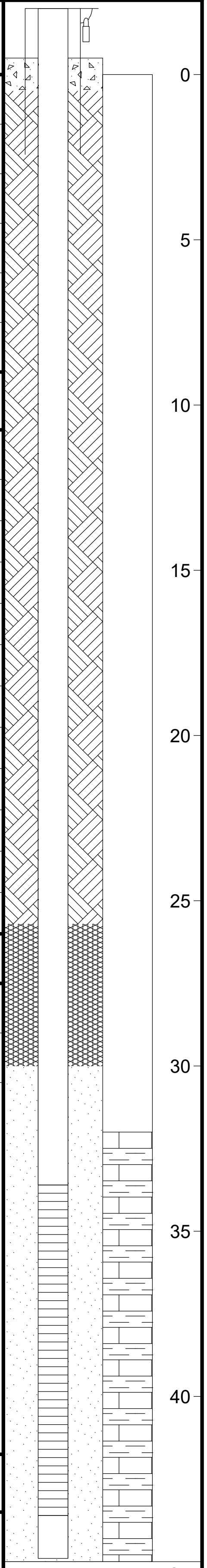
Recovery Data



Sampling Equipment:

Comments:

Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 33.8 - 43.5 bgs.



Boring depth=45.0 ft.

MONITOR WELL INSTALLATION 2 OAK RIDGE.GPJ EAGON.GDT 4/4/18

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Eagon & Associates, Inc.

BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project Oak Ridge, TN**	Drilling Methods: 2 1/4" HSA, HQ3 Core w/water, 10" air hammer bit, 5 7/8" tricone bit with air/water.				Boring Number: GW-992
Drilling Firm: *Tri-State Drilling*	DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)	
Driller / Rig: *Fred Reynolds/Mobile 42C*	2/16/18	1725	36.4	4.57	*Page 1 of 3*
Logged by: *Ryan Hansel*	Sampling Methods:				Start / Finish
Coordinates: *29698.29N 38749.00E*	ST = Shelby Tube WS = Waxed Sample SP = Sand Pump GP or DP = Direct Push CT = Cuttings		SS = Split Spoon CS = Continuous Sampler C = Coring NS = Not Sampled B = Bailer		*Time 0855* / *Time 1515*
Surface Elevation: *910.0 ft/MSL*					*Date 2/16/18* / *Date 2/17/18*
Surface Conditions / Weather:					
Remarks:					

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
	NS			ROAD BASE. Change at 1.0'.		Ran 2 1/4" HSA (7" OD) w/center plug while augering. Continuous 2" OD, 2' drive split spoons, 140 lb hydraulic hammer.	
1 2	SS-1	1.3' 65%	3 4 5 3	Brown (7.5YR 5/4 - 4/4) CLAYEY SILT. Trace fine grained sand. Trace to little shale fragments (up to 1" diameter). Iron and manganese oxide on shale fragments. Massive. Shale fragments are oriented in same direction. Low plasticity. Slow to no dilatancy. Medium dry strength. Moist. Cohesive. No reaction with HCl. Very soft to soft. Weathered. RESIDUAL SOIL/COLLUVIUM.		On 2/18/18, used Ingersoll-Rand T3W rotary rig to ream borehole to 31.0' using 10" air hammer bit. Set permanent 6" PVC casing and sealed with cement bentonite grout. SS-1 Lab results: Moisture Content 29.3%.	ML
3 4	SS-2	1.3' 65%	3 2 2 2	Below 4.3' shale clasts become trace to rare. Becomes moist to wet. No to slow dilatancy. Fine grained sand becomes few to little. Clay content decreases slightly.		SS-2 Lab results: MC 23.9%; 7% Gravel; 36% Sand; 57% Fines.	
5 6	SS-3	2.0' 100%	WH 1 1 1			WH = weight of hammer.	
7 8	SS-4	1.4' 70%	WH WH 4 6	Below 7.0' clay content increases. Change at 8.0'. Olive (5Y 5/4 - 4/4) highly weathered SHALE (SAPROLITE). Shale clasts are highly weathered and comprised of silt and clay. Laminated to thinly bedded with iron and manganese oxide along bedding planes. Bedding planes are at 40°-50° angles. Very stiff to hard. Medium plasticity. High dry strength. Cohesive. No reaction with HCl. Dry to moist. SAPROLITE.		SS-4 Lab results: MC 37.1%.	CL
9 10	SS-5	1.3' 65%	4 10 19 17			SS-5 Lab results: MC 13.4%.	
11 12	SS-6	1.3' 65%	5 10 10 9	Below 11.0' becomes wet. Trace to few siltstone beds/clasts. Shale is becoming more competent with depth. All shale and siltstone has iron and manganese oxide. Wet. 11.7' - 11.9' Broken siltstone beds with manganese oxide on clast surfaces.			
13 14	SS-7	1.1' 55%	4 6 5 2			SS-7 Lab results: MC 21.3%. Water on spoon.	
15 16	SS-8	1.6' 80%	7 16 18 29	15.0' - 15.5' Shale is grayish blue green (5BG 5/2). Trace iron and manganese oxide. Below 15.0' shale clasts can barely be broken by hand. Dry.		SS-8 Lab results: MC 16.2%.	
17 18	SS-9	1.6' 80%	8 19 18 19				
19	SS-10	1.5' 75%	9 13			SS-10 Lab results: MC 15.5%; 1% Gravel; 62% Sand; 37% Fines.	

Eagon & Associates, Inc.

EMDF Characterization Project
Oak Ridge, TN

BOREHOLE LOG

Boring Number
GW-992

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Remarks	USCS
21	SS-10	1.5' 75%	11 9	Olive (5Y 5/4 - 4/4) highly weathered SHALE (SAPROLITE). (Cont'd.)		CL
22 23	SS-11	1.3' 65%	10 10 10 6	Below 20.0' shale (saprolite) becomes more weathered. Shale clasts are easily broken by hand. Abundant iron and manganese oxide on shale clasts. No reaction with HCl. Below 23.0' trace limestone clasts with calcite veins. Strong reaction with HCl.		
24	SS-12	1.7' 94.4%	2 8 23 50/3	24.0' - 24.8' Sandstone clasts completely decomposed to sand, abundant with iron and manganese oxide. Saturated. Below 25.0' shale (saprolite) becomes olive gray (5Y 5/2 - 4). Trace iron and manganese oxide on clast surfaces.	SS-12 Lab results: MC 17.6%.	
25	NS					
26 27	SS-13	1.3' 65%	30 28 30 29	Below 25.5' color becomes grayish blue green (5BG 5/2). Below 26.8' color becomes light olive gray (5Y 6/2).	SS-13 Lab results: MC 10.8%.	
28	SS-14	0.8' 80%	8 50/5	Change at 28.0'.		
29 30 31	C-1	2.6' 76.5%	22.9%	Gray to dark gray (N 5/ - 4/) INTERCLASTIC LIMESTONE. Strong. Thinly bedded. Clasts are made up of limestone and are elongated. Clast orientation is parallel to bedding planes. The matrix material is limestone with trace glauconite grains within matrix. Some soft sediment deformation of the limestone clasts and cross bedding. Slightly decomposed. Strong reaction with HCl. Moderate to intensely fractured. Multiple horizontal and vertical fractures that have been completely healed with calcite. Below 31.0' shale beds and partings that are increasing with depth. Change at 31.4'.	Auger refusal at 1052 at 28.0'. Pull augers and install temporary PQ surface casing. 28.0' - 28.2' Fracture perpendicular to bedding and a near vertical fracture with iron oxide. C-1: 28.0' - 31.4' 1407-1448. Weathered at top. Probably where return was lost. Measure C-1 from bottom.	
32	C-2	0.9' 90%	0%	Dark gray to very dark gray (N 4/ - 3/) SHALE. Trace glauconite. Laminated to thinly bedded. Strong. Fresh. Slightly disintegrated. Intense to very intensely fractured. Most breaks are along bedding planes and probably mechanically induced. Some fractures are shear with glauconite grains and striations along fracture. No reaction with HCl.	31.4' - 33.1' Vertical fracture with slickensides. Glauconite. C-2: 31.4' - 32.4' 1456-1509. Blocking in tip/pull run.	
33	C-3	0.7' 100%	0%		C-3: 32.4' - 33.1' 1515-1530. Blocked tip. Pull run.	
34 35 36	C-4	3.3' 100%	18.8%	33.1' - 33.4' Shale is very intensely fractured. Probably due to sampling/mechanically induced. 33.4' - 34.1' Interclastic limestone bed. Clasts are elongated. Matrix is made up of shale and limestone. Clasts are oriented parallel to the bedding planes. Some iron oxide staining along bedding planes associated with limestone beds. 34.1' - 34.4' Shale is dark greenish gray 10GY (4/1). Shale is becoming less fractured with depth.	34.6' Vertical fracture with iron oxide. 33.7' - 34.0' Fracture perpendicular to bedding plane with iron oxide. C-4: 33.1' - 36.4' 1538-1615. 2/16/18 at 1725 DTW = 4.57 BGS. 2/17/18 at 0803 DTW = 4.32 BGS.	
37 38 39	C-5	2.3' 74.1%	0%	36.4' - 37.4' Trace limestone and glauconite beds and partings. Very intensely fractured. Some healed with calcite. Most are mechanically induced. Limestone bed from 37.5' - 38.2'. 37.5' - 37.9' and 38.0' - 38.2' Interclastic limestone beds. Clasts are elongated and oriented parallel to bedding planes. Matrix material is limestone with glauconite. Some soft sediment deformation and cross-bedding observed. Trace horizontal and vertical fractures healed with calcite. Shale beds near the limestone beds are dark greenish gray (10GY 4/1).	C-5: 36.4' - 39.5' 0819-0853. Driller noted tip blocked. Pulled run. 39.3' Fracture perpendicular to bedding plane healed with calcite.	
40 41	C-6	1.9' 100%	0%	Below 39.5' shale is fresh. Competent. Slightly to moderately fractured. Limestone beds and partings become trace to rare. Multiple breaks along bedding planes with slickensides. Breaks are probably drilling induced. 40.4' - 40.7' Vertical break with slickensides.	C-6: 39.5' - 41.4' 0900-0929.	
42 43 44	C-7	3.2' 88.9%	0%	41.8' - 44.3' Very intensely fractured. Multiple breaks along and perpendicular to the bedding planes. Some with slickensides. Probably mechanically induced. 44.3' - 45.0' Limestone bed with some soft sediment deformation. Trace shale beds within limestone. Moderately fractured with fracture healed by calcite.	C-7: 41.4' - 45.0' 0939-1033. 1046 Drillers get water.	

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-992

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
46 47 48 49	C-8	1.3' 28.9%	0%	Dark gray to very dark gray (N 4/ - 3/) SHALE. (Cont'd.) Below 45.0' trace limestone beds and partings. Limestone present with multiple horizontal and vertical fractures healed with calcite.		C-8: 45.0' - 49.5' 1104-1210. On start of C-8 cutting returns turned from light gray to brown. 1135 Drillers to get water. On C-8 inner core barrel did not lock in. Core in bottom of hole. Trip out to attempt core recovery at 1223. Low recovery on C-8. Makes difficulty in logging. C-9: 49.5' - 50.0' 1250-1859. DTW = 11.57 BGS.	
	C-9	0.3'/60%	0%				
50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69				Bottom of Borehole = 50.0'. Borehole sealed with cement bentonite grout due to damage to the surface casing at the beginning of reaming activities. Installation borehole for Piezometer GW-992 installed approximately 8' east of original borehole.		On 2/19/18, used Ingersoll-Rand T3W rotary rig to ream corehole to 50.0' using 5 7/8" tricone bit. Finished drilling at 1515.	

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BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project** **Oak Ridge, TN**	Drilling Methods: 10" Air Hammer, 5 7/8" and 5 5/8" Tricone.				Boring Number: GW-992R
Drilling Firm: *Tri-State Drilling*	DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)	
Driller / Rig: *Travis Morgan/Ingersoll-Rand T3W*	2/26/18	1730	54.2	24.22	*Page 1 of 3*
Logged by: *Nelson Novak*	Sampling Methods:				
Coordinates: *29698.29N 38737.35E*					
Surface Elevation: *908.9 ft/MSL*					
Surface Conditions / Weather: *Damp gravel road / 60°F, Sunny*					

Sampling Methods:

ST = Shelby Tube
WS = Waxed Sample
SP = Sand Pump
GP or DP = Direct Push
CT = Cuttings
SS = Split Spoon
CS = Continuous Sampler
C = Coring
NS = Not Sampled
B = Bailer

Start	Finish
Time 1422	*Time 1635*
Date 2/20/18	*Date 2/26/18*

Remarks: Drilled approximately 8' east of borehole GW-992.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
				GW-992R is a replacement well and was straight drilled. See Borehole Log GW-992 for a detailed lithologic description and stratigraphic interpretation.		Straight drilled to 32.0' using 10" hammer bit. Set permanent 6" PVC casing and sealed with cement bentonite grout.	
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10	NS						
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18							
19							

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-992R

Remarks: Drilled approximately 8' east of borehole GW-992.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
21							
22							
23							
24							
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27							
28							
29							
30							
31							
32	NS						
33							
34							
35						Straight drilled to 34.6' with 5 5/8" tricone bit to get through permanent 6" casing. Once below 6" PVC casing, switched tricone bit to a larger size bit (5 7/8") and straight drilled to 55.5'.	
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42							
43							
44							

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-992R

Remarks: Drilled approximately 8' east of borehole GW-992.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
46							
47							
48							
49							
50	NS						
51							
52							
53							
54							
55							
56				Bottom of Borehole = 55.5'. Piezometer GW-992R installed in borehole. See Monitoring Well Installation Report GW-992R for details.			
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Eagon & Associates, Inc.

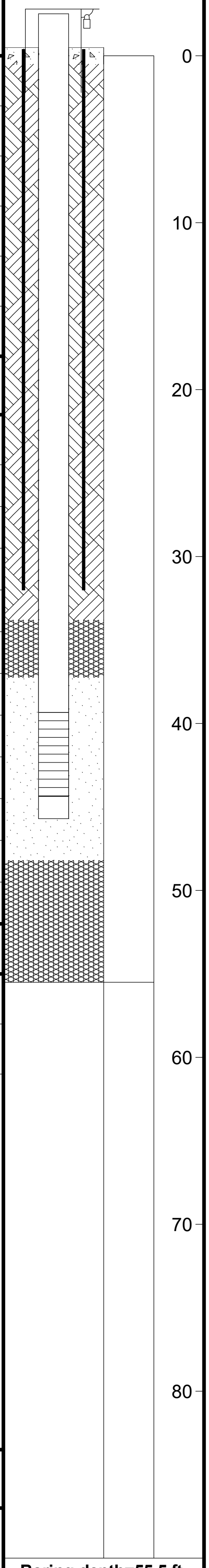
Well Number
GW-992R

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*	Completion Date: *3/8/18*
Coordinates: *29698.29N 38737.35E*	Borehole Depth (ft): *55.5*
Elevation Top of Casing (ft/MSL): *911.40*	Borehole Diameter (in):*10" (0'-32.0'), 5 7/8" (32.0'-55.5')*
Elevation Ground Surface (ft/MSL): *908.9*	Drilling Methods: *10" Air Hammer, 5 7/8" and 5 5/8" Tricone.*
Installed By: *Fred Reynolds/Tri-State Drilling*	Completed Drilling: *2/26/18*
Supervised By: *Shay Beanland/Eagon & Associates, Inc.*	Drilling Water Used (gals):

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel Protector	-2.8 - 2.2	911.7 - 906.7
Riser	2" ID Schedule 40 PVC	-2.5 - 39.3	911.4 - 869.6
Surface Seal	3' x 3' Concrete Pad	-0.5 - 0.5	909.4 - 908.4
Conductor Casing	6" ID PVC Sch. 40 PVC, Flush Threaded	-0.4 - 32.0	909.3 - 876.9
Cement Grout	Cement Bentonite Grout	0.5 - 33.8	908.4 - 875.1
Bentonite Seal	Pel Plug 1/4" Coated Bentonite Pellets	33.8 - 37.2	875.1 - 871.7
Sand Pack	DSI "GP #2" Gravel Pack	37.2 - 45.7	871.7 - 863.2
Screen	2" ID Schedule 40 PVC, 10-Slot	39.3 - 44.4	869.6 - 864.5
Well Point Blank	2" ID Sch. 40 PVC Cap & Riser Section	44.4 - 45.7	864.5 - 863.2
Sand Pack Bottom	DSI "GP #2" Gravel Pack	45.7 - 48.2	863.2 - 860.7
Bentonite Seal	Enviro Plug Medium Chips	48.2 - 55.5	860.7 - 853.4



Boring depth=55.5 ft.

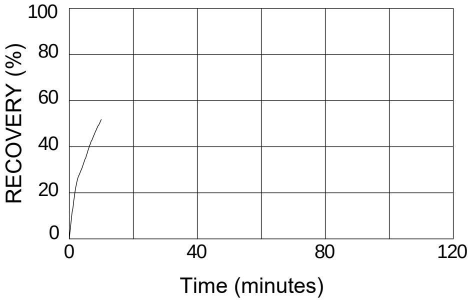
Well Development

Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
48.21	*4.88*	*7.1*	*74.5*

Development Method:
Surge block, bailer, mega purger whale pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (μmhos/cm)	pH (S.U.)	Turbidity (NTU)
3/3/18	1305	17.0	15.5	387	7.49	62.7
3/3/18	1320	32.0	15.1	380	7.57	7.0
3/3/18	1350	42.0	15.0	380	7.49	6.3
3/3/18	1405	57	15.1	375	7.52	6.8
3/3/18	1415	67	15.0	369	7.46	8.3
3/3/18	1430	74.5	15.2	368	7.46	6.0

Recovery Data



Sampling Equipment:

Comments:

Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 39.4 - 44.2 bgs.

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BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project Oak Ridge, TN**

Drilling Methods: 4 1/4" ID HSA, HQ Core with water, 5 7/8" hammer bit.

Boring Number: GW-993

Page 1 of 2

Drilling Firm: *Tri-State Drilling*

Driller / Rig: *Fred Reynolds/Mobile B42C*

DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)

Logged by: *Shay Beanland*

Coordinates: *29690.50N 38724.90E*

Surface Elevation: *909.7 ft/MSL*

Sampling Methods:

ST = Shelby Tube	SS = Split Spoon
WS = Waxed Sample	CS = Continuous Sampler
SP = Sand Pump	C = Coring
GP or DP = Direct Push	NS = Not Sampled
CT = Cuttings	B = Bailer

	Start	Finish
Time	0000	0818
Date	2/22/18	2/27/18

Surface Conditions / Weather: *Gravel pad, dry / 70°F, Partly cloudy*

Remarks: Boring installed for collection of geotech samples and for installation of shallow piezometers.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
1 2	HSA			See Borehole Log for adjacent boring GW-992 for detailed lithologic description and stratigraphic interpretation.		Ran 4 1/4" ID HSA with center plug to target depths of Shelby tube samples. Pushed Shelby tubes. Advanced augers to target depth and switched to HQ Core with water. Cored to target depth, then reamed borehole with 5 7/8" hammer bit to depth.	
3 4	ST-1	1.6	700 PSI 750 PSI 750 PSI 750 PSI	Bottom of tube, sample is brown to strong brown (7.5YR 5/4 - 4/6) CLAYEY SILT. Few to little fine to coarse grained sand, primarily medium to coarse grained. Abundant shale fragments. Moist.		Pushed ST-1 from 3.0' - 5.0'. Let tube set in borehole from 940 to 945. Bulk Bucket Sample (BS-1) collected from 4.0' - 5.0' at 0952. Auger cuttings collected.	
5 6	ST-2	2.0	600 PSI 600 PSI 600 PSI 600 PSI	Bottom of tube, same material as above, but decrease in sand content to trace. Increase in moisture content to wet.		Pushed ST-2 from 5.0' - 7.0'. Let tube set in borehole from 0954 to 1003. Tube is wet. Bulk Bucket Sample (BS-2) collected from 6.0' - 7.0' at 1000. Auger cuttings collected.	
7 8 9 10	HSA						
11	ST-3	0.5	900 PSI 1000/1 PSI	At bottom of tube, sample is olive (5Y 5/4 - 4/4) SHALE (SAPROLITE). Highly weathered. No reaction with HCl.		Pushed ST-3 from 10.5' - 11.1' until refusal. Let tube set in borehole from 1019 to 1025.	
12 13 14 15 16 17 18 19	HSA						

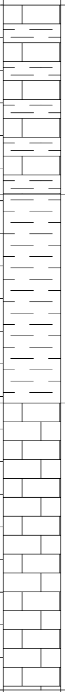
BOREHOLE LOG V.2 OAK RIDGE .GPJ CONTAINER CRAFT TEMPLATE WITH PID.GDT 4/4/18

EMDF Characterization Project
Oak Ridge, TN

BOREHOLE LOG

Boring Number
GW-993

Remarks: Boring installed for collection of geotech samples and for installation of shallow piezometers.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
21 22 23 24	HSA						
25 26 27	C-1	2.1' 67.7%	0%	Interbedded gray (N 5/) LIMESTONE and dark gray (N 4/) SHALE. Overall interbedded structure is thinly to medium bedded. Shale is laminated where present. Limestone is interclastic above 27.0' and microcrystalline below 27.0'. Clasts are elongated and aligned parallel to bedding planes, which are at an 80° angle. Limestone is strong and shale weak Slickenside surfaces (depositional) along bedding plane breaks at 60° - 70° angles. Slightly decomposed, moderately disintegrated at top of core but becomes slightly disintegrated with depth. Very intensely to intensely fractured but some breaks are mechanically induced. Bedding plane angles range from 80°-90° to 40°-50° with depth. Fractures healed with calcite also are observed throughout limestone zones run perpendicular to bedding planes ranging in thickness from less than 1mm up to 8mm. Iron staining, iron oxide, and manganese oxide observed on several fracture surfaces and bedding planes, as noted in remarks. Change at 27.9'.		1110 - Switching over to core. C-1 25.0' - 25.0' 1239-1306. 1231 WL = 4.30 from ground surface, TD = 25.0'. C1 - Recovery lost is probably shale mainly from top of core run but within limestone beds too. Driller noted that it felt very soft when coring. 26.0' - 26.5' Multiple high angle fractures (>75° angles) with iron staining, iron and manganese oxide along fracture face. 26.0' - 26.2' limestone is slightly to moderately disintegrated along fracture face. 27.3' - 27.5' 40°-50° fractures, not along bedding planes, iron staining present.	
28 29 30	C-2	2.8' 100%	0%	Dark gray (N 4/) SHALE. Laminated bedding. Trace limestone beds. Abundant slickenside surfaces (depositional). Upper 1' has iron oxide, manganese oxide, and calcite precipitate observed along fracture faces. Slightly to moderately decomposed becoming fresh and competent with depth. Weak to moderate field strength. Very intensely fractured along bedding plane surfaces, likely mechanical induced. Does not react with HCl. Change at 31.1'.		27.8' - 28.1' Core is highly broken due to composition mudstone/shale and is likely due to coring. Iron staining along fractures, along bedding planes, and along fractures that are perpendicular to bedding angles. C2 Core is very intensely fractured and reduced to rubble in places due to drilling process. C2 28.0' - 31.0' 1310-1350. 28.1' - 28.6' Rubble zone, very intensely fractured, all pieces rounded. Iron staining, iron oxide, and manganese oxide observed along surfaces. Calcite precipitate also observed along fracture faces.	
31 32 33 34	C-3	2.5' 73.5%	35.9%	Gray (N 5/) INTERCLASTIC to MICROCRYSTALLINE LIMESTONE. Interclastic limestone changing to microcrystalline with depth; clasts decreasing to none at 32.0'. Clasts aligned parallel to bedding planes. Bedding planes are at 40°-60° angles. Little shale beds within limestone, up to 10mm thick, predominately less than 5mm. Bioturbation observed in shales. Fresh and competent. Strong field strength. Intensely to moderately fractured along bedding plane breaks likely mechanically induced. Some calcite precipitate observed along bedding planes. Breaks in beds are along bedding contacts of limestone and shale with slickenside surfaces observed along contacts (depositional). Calcite healed fractures running perpendicular to bedding planes. Soft sediment deformation observed. Reacts strongly with HCl.			
35	NS						
36 37 38 39 40 41 42 43 44				Bottom of Borehole = 35.5'. Piezometer GW-993 installed in borehole. See Monitoring Well Installation Report GW-993 for details.		On 2/27/18 used Ingersoll-Rand T4 rig to ream corehole and advance borehole to 35.5' using 5 7/8" hammer bit. Finished drilling at 0818.	

Eagon & Associates, Inc.

Well Number
GW-993

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*	Completion Date: *3/8/18*
Coordinates: *29690.50N 38724.90E*	Borehole Depth (ft): *35.5*
Elevation Top of Casing (ft/MSL): *911.76*	Borehole Diameter (in):*5 7/8" (0'-35.5')*
Elevation Ground Surface (ft/MSL): *909.7*	Drilling Methods: *4 1/4" ID HSA, HQ Core with water, 5 7/8" hammer bit.*
Installed By: *Travis Morgan/Tri-State Drilling*	Completed Drilling: *2/27/18*
Supervised By: *Shay Beanland/Eagon & Associates, Inc.*	Drilling Water Used (gals):

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel Protector w/Locking Lid	-2.4 - 2.6	912.1 - 907.1
Riser	2" ID Schedule 40 PVC	-2.1 - 23.0	911.8 - 886.8
Surface Seal	3' x 3' Concrete Pad	-0.5 - 0.5	910.2 - 909.2
Cement Grout	Cement Bentonite Grout	0.5 - 14.5	909.2 - 895.2
Bentonite Seal	Pel Plug 1/4" Coated Bentonite Pellets	14.5 - 19.8	895.2 - 889.9
Sand Pack	DSI "GP #2" Gravel Pack	19.8 - 34.3	889.9 - 875.4
Screen	2" ID Schedule 40 PVC, 10-Slot	23.0 - 33.0	886.8 - 876.7
Well Point Blank	2" ID Sch. 40 PVC Cap & Riser Section	33.0 - 34.3	876.7 - 875.4
Sand Pack Bottom	DSI "GP #2" Gravel Pack	34.3 - 35.5	875.4 - 874.2

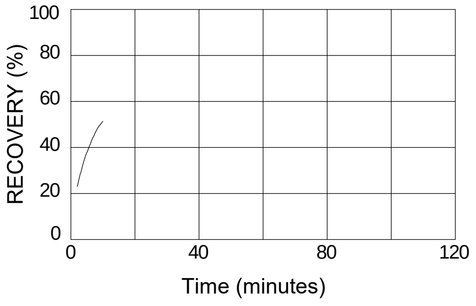
Well Development

Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
36.37	*5.45*	*5.3*	*89.5*

Development Method:
Surge block, bailer, mega purger whale pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (µmhos/cm)	pH (S.U.)	Turbidity (NTU)
3/3/18	1425	79.5	15.2	308	7.29	80.4
3/3/18	1330	9.5	15.1	310	7.34	>1000
3/3/18	1340	24.5	14.9	292	7.27	269.0
3/3/18	1350	39.5	15.1	297	7.30	165.0
3/3/18	1400	54.5	15.2	295	7.26	141.0
3/3/18	1435	89.5	15.2	292	7.23	48.4

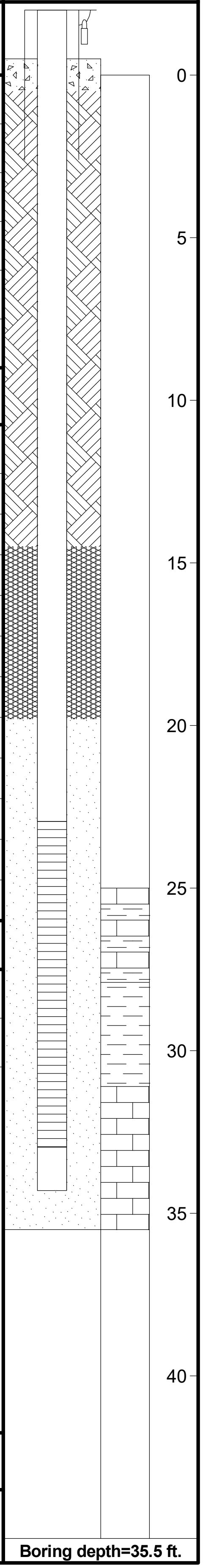
Recovery Data



Sampling Equipment:

Comments:

Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 23.2 - 32.9 bgs.



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Eagon & Associates, Inc.

BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project**
Oak Ridge, TN

Drilling Methods: 3 1/4" ID HSA, HQ3 Core with water circulation, 10" air hammer bit, 5 7/8" tricone bit with air/water.

Boring Number: **GW-994**

Page 1 of 3

Drilling Firm: *Tri-State Drilling*

Driller / Rig: *Shannon Snow/CME-550*

Logged by: *David J. Sugar*

Coordinates: *29644.99N 38051.04E*

Surface Elevation: *916.7 ft/MSL*

Surface Conditions / Weather: *Flat gravel pad adjacent to haul road / 64°F, Light rain*

Remarks:

DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)

Sampling Methods:

ST = Shelby Tube	SS = Split Spoon
WS = Waxed Sample	CS = Continuous Sampler
SP = Sand Pump	C = Coring
GP or DP = Direct Push	NS = Not Sampled
CT = Cuttings	B = Bailer

Start	Finish
Time 0857	*Time 1253*
Date 2/16/18	*Date 2/19/18*

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
	NS			Gravel drilling pad.	▩	3 1/4" ID HSA, continuous 2" OD, 2' drive split spoon, automatic 140 lb hammer. Ran center plug while augering.	
1	SS-1	0.7' 70%	2 3	Strong brown (7.5YR 5/6 - 5/8 and 4/6) CLAYEY SILT to SILTY CLAY. Trace medium to coarse sand. Trace fine gravel with depth, subrounded to subangular. Unsorted, massive to mottled appearance. High plasticity, toughness and dry strength. No dilatancy. Moist. Weathered. SUBSOIL.	▥	No reaction with HCl. Trace roots.	CL
2 3	SS-2	1.1' 55%	3 3 6 6		▥	SS-2 Lab results: Moisture Content (MC) 22.8%. 1.0' - 1.3' Appears disturbed, probable soil fill associated with adjacent road.	
4 5	SS-3	1.6' 80%	3 5 11 16	Below 4.3' mottled appearance with pale brown (2.5Y 7/3 - 7/4) areas, probably reduction associated with desiccation fractures. Below 5.1' slightly higher sand content, trace fine gravel, subangular to angular. Chert fragments. No roots observed below 5.1'.	▥	On 2/18 used Ingersoll-Rand T-4 rotary rig to ream borehole to 35.0' using 10" hammer bit. Set permanent 6" conductor casing and sealed with cement-bentonite grout. SS-3 Lab results: MC 23.6%.	
6 7	SS-4	1.4' 70%	5 9 16 18	Below 6.0' color changes to brown yellowish brown (10YR 5/3 - 5/6) consistent silty clay composition. 1/4" Diameter root at 8.1'. Change at 8.2'.	▥	No reaction with HCl. SS-4 Lab results: MC 21.7%; 0.6% Gravel; 9.4% Sand; 90% Fines.	
8 9	SS-5	2.0' 100%	10 16 19 29	Brown/grayish brown to dark grayish brown (10YR 5/2, 5/3 - 4/2) highly to completely weathered SHALE (SAPROLITE). Thinly bedded, approximate 45° bedding angle. Highly fractured with reddish to yellowish brown iron oxide coatings on fracture faces. Rock is easily pulverized and is moldable with added water. Low to medium plasticity. Low toughness, dilatancy. Soft rock classification/hard soil classification. Highly to completely weathered. Slightly moist to dry.	▤	No reaction with HCl. Possibly ML-CL classification. Highly fractured.	ML
10 11	SS-6	2.0' 100%	13 15 12 20		▤	Below 10.0' black manganese oxide precipitate on fracture faces. SS-6 Lab results: MC 39.2%. 10.9' - 11.4' Yellowish brown to light yellowish brown (10YR 6/4 - 6/6) silty clay to clay seam, no rock structure, completely weathered limestone (?). Moist.	
12 13	SS-7	2.0' 100%	26 29 39 33	Below 12.0' color is highly variable but generally 10YR with the majority of the color in the grayish brown/dark grayish brown to yellowish brown/dark yellowish brown range (10YR 5/2 - 4/4 and 4/2 - 4/4) and light brownish gray/pale brown (10YR 6/2 - 6/3).	▤		
14 15	SS-8	1.7' 85%	9 23 15 16	14.6' - 14.8' Yellowish brown (10YR 6/4) silty clay to clay seam. No structure. Completely weathered limestone seam(?).	▤	Below 12.0' fractures have yellowish/reddish brown iron oxide precipitates. SS-8 Lab results: MC 24.4%.	
16 17	SS-9	2.0' 100%	19 25 39 27	16.7' - 16.8' Yellowish brown to black (10YR 6/4 - 2/1) silty clay seam. Completely weathered limestone seam (?).	▤	SS-10 Lab results: MC 16.6%. Bedding angle ~45°.	
18 19	SS-10	1.4' 70%	9 28 51 29	Below 20.0' primarily light brownish gray, pale brown to grayish brown/brown (10YR 6/2 - 6/3 and 5/2 - 5/3) color.	▤	Iron oxide continues to be associated with fractures and bedding breaks.	

EMDF Characterization Project Oak Ridge, TN	BOREHOLE LOG	Boring Number GW-994

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Remarks	USCS
21	SS-11	2.0' 100%	27 32 36 37	Light brownish gray/pale brown to grayish brown/brown (10YR 6/2 - 6/3 and 5/2 - 5/3) highly to completely weathered SHALE (SAPROLITE). (Cont'd.)	No reaction with HCl. ~45° Bedding angle. Continues to be damp to slightly moist.	ML
22 23	SS-12	1.3' 65%	6 9 3 5	22.8' - ~23.3' Dark grayish brown/olive brown (2.5Y 4/2 - 4/3) sandy zone. Structure is not apparent. Possible weathered glauconitic zone or sandy siltstone. Wet. First wet zone observed. Soft zone.	SS-12: Water on bottom 1.5' of split spoon sampler. Sample is very moist to wet.	
24 25	SS-13	1.5' 75%	14 24 50 100	24.8' - 25.0' Reddish orange iron oxide, pronounced color, iron oxide precipitate/oxidation on fractures. Below 25.0' becomes layered with color variation greenish gray to dark greenish gray (N 6/ - N 4/) grayish brown to light olive brown (2.5Y 5/2 - 5/4) and very dark brown to very dark grayish brown (10YR 3/2 - 2/2).	Below 24.0' split spoon sampler was wet/muddy on retrieval.	
26 27	SS-14	1.6' 80%	49 49 46 48	Underlying contact is transitional and subjective. May be as high as 25.0'. Change at 28.0'.	SS-12 Lab results: MC 18.7%. SS-14 Lab results: MC 13.6%; 9.2% Gravel; 56.9% Sand; 33.9% Fines.	
28 29	SS-15	1.4' 70%	19 52 100	Interbedded dark greenish gray (N 5/), grayish brown to light olive brown (2.5Y 5/2 - 5/4) and very dark brown to very dark grayish brown (10YR 3/2 - 2/2) SHALE and LIMESTONE. Some limestone seams may classify as calcareous siltstone. Thinly bedded. Soft to medium hard. Apparent bedding angle around 45° (disturbed from sampling process). Highly weathered and fractured. Carbonate not leached from interval. Limestone content is about 30%.	Limestone seam at contact (strong reaction with HCl). SS-15 Lab results: MC 13.3%. 28.3' - 28.6 Wet zone in weathered shale. Generally sample looks moist to very slightly moist.	
	NS					
30	SS-16	0.3'/100%	100/2	SS-16 Split spoon drove on limestone seam. Sample is broken from the sampling process.		
31	NS				SS-17 Lab results: MC 15.9%.	
32 33	SS-17	1.5' 100%	17 83 100/4	SS-18 Recovery is mostly broken limestone with iron oxide possibly manganese oxide (dark brownish black).	1121 Finish split-spoon sampling. Bottom of augers at 34.0'. 1436 Start HQ3 core water circulation at 34.0'	
	NS			C-1 Core run from 34.0' - 34.6', overdrilled SS-18 interval. 0.6' Recovered, very broken sample, mostly limestone.	(cored over SS-18 interval	
34	SS-18	0.6' 100%	73 100/1		C-1).	
35 36	C-2	1.3' 62%	0%	Dark gray to very dark gray (N 4/ - 3/) SHALE and gray to dark gray (N 6/ - N 4/) LIMESTONE. Thinly bedded, beds are generally less than 0.2'. Core is highly broken, most correspond with bedding planes and are most likely mechanically induced. Moderate to intensely fractured. Moderate to strong field strength. Fresh to slightly decomposed. Trace healed calcite filled fractures oriented perpendicular to bedding.	Bedding is generally deformed, wavey. Shale does not react with HCl. Limestone has a strong reaction with HCl.	
37 38 39 40 41	C-3	5.0' 100%	0%	35.5' - 35.65' Gray to dark gray Interclastic Limestone seam. 37.4' - 38.1' Gray to dark gray (N 6/ - N 4/) Interclastic Limestone seam. Clasts are elliptical oriented along bedding, up to 1" along long axis, generally less than 1/2" on short axis. Strong reaction with HCl. Hard. Matrix is unweathered.	SS-18 Lab results: MC 14.6%. C-2 34.6' - 36.7' 1454-1510. C-3 36.7' - 41.7' 1514-1545. 37.6' - 38.1' Fracture, oriented 40° to bedding angle. Face has iron oxide weathering (yellow/reddish brown). Bedding angle ~45° - 50°. 41.8' - 42.6' Sample is highly broken, trace iron oxide on fracture faces. Too disturbed to determine orientation.	
42 43 44	C-4	4.5' 90%	9%	42.2' - 43.2' Thinly interbedded limestone and shale, mostly limestone, ~60° bedding angle, but orientation may be off. 44.5' - 44.7' Gray to dark gray limestone seam. Trace stylolites. Calcite filled fractures up to 2 mm width oriented perpendicular to bedding angle.	At 42.8' fracture oriented perpendicular to bedding. Face is oxidized with iron oxide precipitates. 44.9' - 45.4' Bedding breaks and fracture oriented perpendicular to bedding angle, faces are oxidized with iron oxide precipitate. C-4 41.7' - 46.7' 1553-1610.	

Eagon & Associates, Inc.

EMDF Characterization Project Oak Ridge, TN	BOREHOLE LOG	Boring Number GW-994

Remarks:

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
46	C-4	4.5' 90%	9%	Interbedded dark gray to very dark gray (N 4/ - 3/) SHALE and gray to dark gray (N 6/ - N 4/) LIMESTONE. (Cont'd.) 44.8' - 46.0' Shale bed, unweathered/fresh. Trace calcite filled fractures oriented perpendicular to bedding.		Limestone reacts strong with HCl. Shale does not react. 45° Bedding angle.	
47 48 49	C-5	2.3' 70%	0%	Below 46.7' thinly bedded, broken along bedding planes. No weathering/iron oxide observed. Limestone beds, generally less than 0.1' with calcite filled fractures oriented perpendicular to bedding.		C-5 46.7' - 50.0' 1624-1656.	
50 51 52 53 54	NS						
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69				Bottom of Borehole = 55.0'. Piezometer GW-994 installed in borehole. See Monitoring Well Installation Report GW-994 for details.		Finish drilling at 1656, 2/16/18. WL = 10.22 from GS at 1700 on 2/16/18. 2/17/18 WL = 6.25' from GS at 0830. On 2/19 used T3W rotary rig to ream corehole and advance borehole to 55.0' using 5 7/8" tricone bit with air and water circulation. Finished drilling at 1253.	

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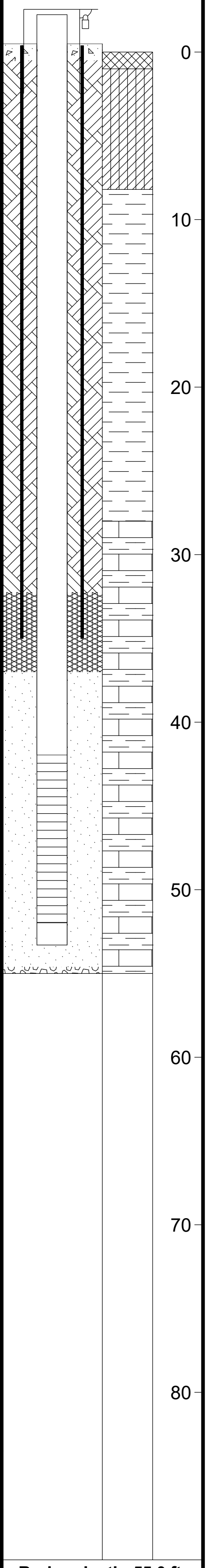
Eagon & Associates, Inc.

Well Number
GW-994

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*	Completion Date: *3/8/18*
Coordinates: *29644.99N 38051.04E*	Borehole Depth (ft): *55.0*
Elevation Top of Casing (ft/MSL): *918.89*	Borehole Diameter (in): *10" (0'-35.0'), 5 7/8" (35.0'-55')*
Elevation Ground Surface (ft/MSL): *916.7*	Drilling Methods: *3 1/4" ID HSA, HQ3 Core with water circulation, 10" air hammer bit, 5 7/8" tricone bit with air/water.*
Installed By: *Fred Reynolds/Tri-State Drilling*	Completed Drilling: *2/19/18*
Supervised By: *Shay Beanland/Eagon & Associates, Inc.*	Drilling Water Used (gals):



Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel Protector w/Locking Lid	-2.5 - 2.5	919.2 - 914.2
Riser	2" ID Schedule 40	-2.2 - 42.0	918.9 - 874.7
Surface Seal	3' x 3' Concrete Pad	-0.5 - 0.5	917.2 - 916.2
Conductor Casing	6" ID Sch. 40 PVC, Flush Threaded	-0.4 - 35.0	917.1 - 881.7
Cement Grout	Cement Bentonite Grout	0.5 - 32.3	916.2 - 884.4
Bentonite Seal	Pel Plug 1/4" Coated Bentonite Pellets	32.3 - 37.0	884.4 - 879.7
Sand Pack	DSI "GP #2" Gravel Pack	37.0 - 53.3	879.7 - 863.4
Screen	2" ID Schedule 40, 10-Slot	42.0 - 52.0	874.7 - 864.7
Well Point Blank	2" ID Sch. 40 PVC Cap & Riser Section	52.0 - 53.3	864.7 - 863.4
Sand Pack Bottom	DSI "GP #2" Gravel Pack	53.3 - 54.6	863.4 - 862.1
Natural Fill	Natural Fill	54.6 - 55.0	862.1 - 861.7

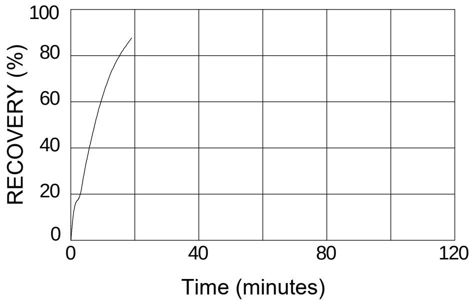
Well Development

Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
55.54	*6.98*	*7.9*	*86.0*

Development Method:
Bailer, surge block, Tornado pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (µmhos/cm)	pH (S.U.)	Turbidity (NTU)
3/1/18	1046	15.0	15.8	539.1	9.29	340.0
3/1/18	1107	40.0	15.5	315.9	8.53	92.1
3/1/18	1125	66.0	15.5	317.0	8.87	3.0
3/1/18	1137	76.0	15.6	312.5	8.73	1.9
3/1/18	1144	81.0	15.7	312.5	8.68	2.0
3/1/18	1152	86.0	15.6	310.5	8.63	4.3

Recovery Data



Sampling Equipment:

Comments:

Stainless steel centralizers set at 17' and 34' from ground surface. Washed sand pack and pellets in using tremie pipe. Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 42.2 - 51.9 bgs.

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Eagon & Associates, Inc.

BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project**
Oak Ridge, TN

Drilling Methods: 4 1/4" ID Hollow Stem Auger, HQ3 Core with water circulation.

Boring Number: GW-995

Drilling Firm: *Tri-State Drilling*

Driller / Rig: *Shannon Snow/CME-550*

Logged by: *David J. Sugar*

Coordinates: *29646.82N 38039.32E*

Surface Elevation: *916.3 ft/MSL*

DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)

Page 1 of 2

Sampling Methods:

ST = Shelby Tube	SS = Split Spoon
WS = Waxed Sample	CS = Continuous Sampler
SP = Sand Pump	C = Coring
GP or DP = Direct Push	NS = Not Sampled
CT = Cuttings	B = Bailer

Start	Finish
Time 1435	*Time* 0935
Date 2/26/18	*Date* 2/27/18

Surface Conditions / Weather: *Moist/wet gravel pad / 53°F, Partly cloudy*

Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
1 2	NS			See adjacent Borehole Log GW-994 for detailed lithologic descriptions and stratigraphic interpretations.		4 1/4" ID HSA, ran auger plug while augering.	CL
3 4	ST-1	1.95	900 PSI	Description based on inspection of bottom of ST-1 recovery. Strong brown (7.5 YR 5/6 - 5/8 and 4/6) and pale brown (2.5Y 7/3 - 7/4) mottled SILTY CLAY. Trace subangular to subrounded rock fragments. Highly weathered. Moist. High plasticity, toughness, and dry strength. SUBSOIL.		No reaction with HCl. Auger cutting bucket sample BS-1 collected from 4.0' - 6.0'.	
5 6	NS						
7 8	ST-2	2.0	1200 PSI	Description based on inspection of bottom of ST-2 recovery. Brown/grayish brown to dark grayish brown (10YR 5/2, 5/3 to 4/2). Highly to completely weathered SHALE (SAPROLITE). Approx. 45° angle bedding, appears in place. Reddish to yellowish brown iron oxide coats bedding breaks and fracture faces.		Auger cutting bucket sample BS-2 collected from 6.0' - 8.0'. No reaction with HCl. When crushed with water, does not completely come apart/crush. High plasticity and toughness is apparent.	
9 10 11 12 13 14 15 16 17 18 19	NS						

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-995

Remarks: Borehole installed for the collection of geotech samples and installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
21 22 23 24	NS			Light brownish gray/pale brown to grayish brown/brown (10YR 6/2 - 6/3 and 5/2 - 5/3) highly to completely weathered SHALE (SAPROLITE). (Cont'd.) Below 25.0' grayish brown/dark grayish brown to light olive brown (2.5Y 5/2 - 4/2, 4/3) SHALE (SAPROLITE). Highly broken sample (gravel size). Generally have iron/manganese oxide coatings on most faces. Highly disturbed. Below 25.5' relatively intact core, very weathered, broken along bedding planes, thinly bedded, iron oxide on bedding contacts.		Limestone not present from 25.0' - 25.5'. No reaction with HCl. Below 25.0' switch to HQ3 core, water circulation. Start coring at 1540. C-1 Lost recovery is from the top and bottom of the run. First 0.5' of recovery is gravel size (brown) rock fragments. Core barrel tip (lifter) was stuffed.	CL
25 26 27 28 29	C-1	2.9' 58%	0%	Below 25.9' mostly unweathered, fractures are typically oxidized. Change at 25.9'. Gray to very dark gray (N 4/ - N 6/) and (5YR 4/1 - 3/1) INTERBEDDED SHALE and LIMESTONE. Thinly bedded, generally <0.1' beds, ~45° bedding angle. Approximately 30% limestone or calcareous siltstone (generally lighter gray color hues (N 6/ and N 5/). Below 26.0' most bedding breaks (generally at 0.1' - 0.2' intervals have secondary calcite on bedding surfaces. Breaks perpendicular to bedding are also common and most have secondary calcite on fracture surfaces. 26.5' - 27.0' Trace yellowish/reddish brown iron oxide on fracture surfaces. Oxidation not observed below 27.0', but continues to be highly fractured and broken with secondary calcite along breaks.	▨	Highly/intensely fractured. Shale does not react with HCl. Limestone reacts stronger with HCl. Finish coring at 1608. Advance HSA over corehole to completion depth. C-1 25.0' - 30.0' 1540-1608. End 2/26/18, 1700 at 33.0'. Begin 2/27/18, 0925, 38°F, sunny.	
30 31 32 33	NS						
34 35 36 37 38 39 40 41 42 43 44				Bottom of Borehole = 34.0'. Piezometer GW-995 installed in borehole. See Monitoring Well Installation Report GW-995 for details.		2/27/18 Completed drilling at 0935.	

Eagon & Associates, Inc.

Well Number
GW-995

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*	Completion Date: *3/8/18*
Coordinates: *29646.82N 38039.32E*	Borehole Depth (ft): *34.0*
Elevation Top of Casing (ft/MSL): *918.76*	Borehole Diameter (in): *7 1/2"*
Elevation Ground Surface (ft/MSL): *916.3*	Drilling Methods: *4 1/4" ID Hollow Stem Auger, HQ3 Core with water circulation.*
Installed By: *Shannon Snow/Tri-State Drilling*	Completed Drilling: *2/27/18*
Supervised By: *David J. Sugar/Eagon & Associates, Inc.*	Drilling Water Used (gals): *~750*

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel w/Locking Lid	-2.8 - 2.2	919.1 - 914.1
Riser	2" ID Schedule 40 PVC	-2.5 - 22.1	918.8 - 894.2
Surface Seal	3' x 3' Concrete	-0.5 - 0.5	916.8 - 915.8
Cement Grout	Cement Bentonite Grout	0.5 - 17.0	915.8 - 899.3
Bentonite Seal	Pel-Plug 1/4" Coated Bentonite Pellets	17.0 - 19.2	899.3 - 897.1
Sand Pack	DSI GP #2 Gravel Pack	19.2 - 33.4	897.1 - 882.9
Screen	2" ID Schedule 40 PVC, 10-Slot	22.1 - 32.1	894.2 - 884.2
Well Point Blank	2" ID Sch. 40 PVC Cap & Riser Section	32.1 - 33.4	884.2 - 882.9
Sand Pack Bottom	DSI GP #2 Gravel Pack	33.4 - 34.0	882.9 - 882.3

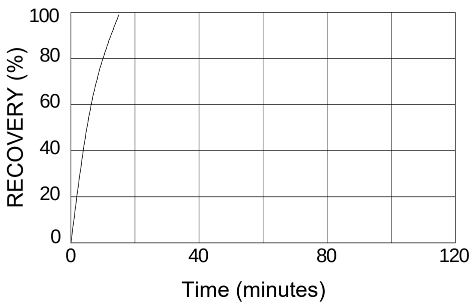
Well Development

Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
35.85	*11.93*	*3.9*	*156.0*

Development Method:
Surge block, bailer, mega purger whale pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (µmhos/cm)	pH (S.U.)	Turbidity (NTU)
3/2/18	0900	10.5	15.7	345	7.11	>1000
3/2/18	0940	33.0	15.0	342	7.12	>1000
3/2/18	1510	63.0	15.5	318	7.20	>1000
3/2/18	1610	96.0	15.2	320	7.16	273.0
3/2/18	1705	126.0	15.1	324	7.21	60.4
3/3/18	0815	156.0	15.1	317	7.15	5.6

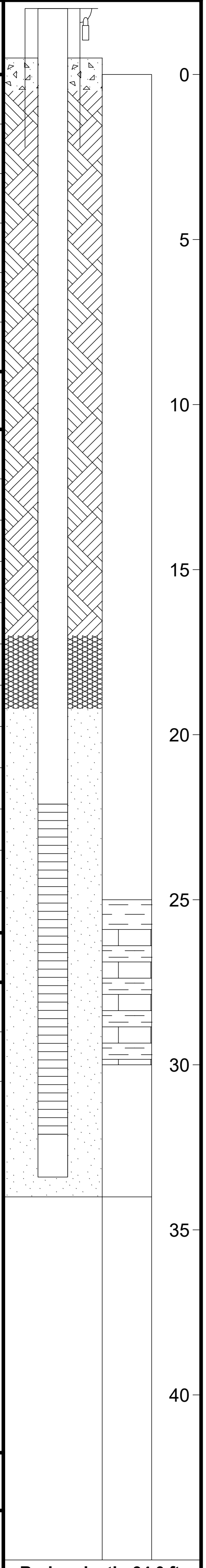
Recovery Data



Sampling Equipment:

Comments:

Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 22.2 - 32.0 bgs.



Boring depth=34.0 ft.

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Eagon & Associates, Inc.

BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project Oak Ridge, TN**	Drilling Methods: 2 1/4" HSA, HQ3 Core w/water, 10" air hammer bit, 5 7/8" tricone bit w/air/water.				Boring Number: **GW-998**
Drilling Firm: *Tri-State Drilling*	DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)	
Driller / Rig: *Fred Reynolds/Mobile 42C*	2/14/18	1654	19.0	1.41	*Page 1 of 2*
Logged by: *Ryan Hansel*	Sampling Methods: ST = Shelby Tube WS = Waxed Sample SP = Sand Pump GP or DP = Direct Push CT = Cuttings		SS = Split Spoon CS = Continuous Sampler C = Coring NS = Not Sampled B = Bailer		Start / Finish
Coordinates: *29021.82N 37742.36E*					Time *1355* / Time *0919*
Surface Elevation: *877.7 ft/MSL*					Date *2/14/18* / Date *2/20/18*
Surface Conditions / Weather: *Gravel pad, moist / 50°F, Cloudy, 0-5 SW*					

Remarks: Set up on cone located ~6' south of staked location.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
	NS			ROAD BASE. Change at 1.0'.		Ran 2 1/4" HSA (7" OD) w/center plug while augering. Continuous 2" OD, 2' drive split spoon, 140 lb hydraulic hammer.	
1 2	SS-1	1.2' 60%	3 3 4 6	Light olive brown to olive brown (2.5Y 5/3 - 4/2) CLAYEY SILT. Trace fine to coarse grained sand. Trace to little angular shale fragments (up to 1" diameter). Medium to stiff. Massive. Cohesive. Low plasticity. No dilatancy. Weathered. Iron and manganese oxide on surface of shale clasts. Moist. No reaction with HCl. RESIDUAL SOIL. Trace silt partings 3.2' - 3.3'. Strong reaction with HCl. Roots present.		On 2/18/18, used Ingersoll-Rand T3W rotary rig to ream borehole to 22.0' using 10" air hammer bit. Set permanent 6" PVC casing and sealed with cement bentonite grout.	ML/CL
3 4	SS-2	2.0' 100%	3 6 10 15	Shale clasts are becoming oriented in same direction. Underlying contact is transitional. Change at 4.0'. Grayish brown to dark grayish brown highly weathered SHALE (SAPROLITE). Shale fragments are weathered to silt and clay. Shale fragments have trace to little iron and manganese oxide on bedding surface. Laminated to thinly bedded (beds are 40°-50°). Very Stiff. Cohesive. Medium plasticity. No dilatancy. Weathered. Dry to moist. Moisture content decreasing with depth. SAPROLITE.			CL
5 6	SS-3	2.0' 100%	9 11 12 16	5.7' - 6.0' Saprolite has been weathered down to a silty clay. Abundant with iron and manganese oxide. Reddish brown to strong brown in color. (CL).			
7 8	SS-4	1.8' 90%	7 11 10 10	Shale is becoming harder with depth. Iron and manganese oxide present along bedding surfaces.		SS-1 Lab results: Moisture Content (MC) 18.9%. SS-2 Lab results: MC 22%.	
9 10	SS-5	1.6' 80%	6 12 12 9	9.0' - 9.4' Shale (saprolite) has been weathered completely to a silty clay. Abundant with iron and manganese oxide. Reddish brown to strong brown in color. (CL). 9.4' - 9.6' Iron oxide present on bedding surfaces. Below 9.6' shale becomes brown (7.5YR 5/2 - 4/2) in color. Iron oxide becomes trace. Abundant manganese oxide staining on bedding surfaces.		SS-3 Lab results: MC 27.4%. SS-4 Lab results: MC 18.6%; 4.3% Gravel; 58.4% Sand; 37.3% Fines.	
11 12	SS-6	1.5' 75%	2 4 3 10	Below 11.0' saprolite (shale) becomes grayish olive (10Y 5/2). Trace to few yellow fine grained silty sand partings. Saprolite is almost completely weathered to a silty clay. Little to some iron and manganese oxide along bedding surfaces. Wet.		SS-5 Lab results: MC 26%.	
13 14	SS-7	1.5' 75%	3 16 9 9	Below 13.2' saprolite (shale) becomes harder. Sampling process has almost destroyed bedding structure. Below 14.0' becomes dark gray to very dark gray (N 4/ - 3/). Iron oxide becomes trace. Manganese oxide becomes trace. Trace subrounded siltstone clasts. Sampling method has partially destroyed structure.		SS-7 Lab results: MC 23.8%. After SS-8 driller noted ~12' of water on rods.	
15 16	SS-8	1.5' 75%	7 11 9 6	Below 15.5' trace subrounded limestone clasts. Iron and manganese oxide on clast surfaces. Strong reaction with HCl. Limestone clasts are increasing with depth.		SS-9 Lab results: MC 15.4%. Measured contact from bottom of SS-9 due to high blow counts.	
17 18	SS-9	1.6' 80%	4 7 48 50	Change at 18.6'.		Switch to HQ3 core with water.	
19	C-1	2.0' 95.2%	0%	Dark brown to very dark brown (7.5YR 3/2 - 2.5/2) SHALE. Laminated to thinly bedded. Trace limestone beds and partings. Soft sediment deformation along shale and limestone. Intact. Moderate field strength. Moderately decomposed. Moderately disintegrated.		1525 Auger refusal 19.0'. 1654 DTW = 1.41 BGS. Added 1/2 bag 3/8" bentonite chips to hole and installed PVC	

Eagon & Associates, Inc.

EMDF Characterization Project Oak Ridge, TN	BOREHOLE LOG	Boring Number GW-998

Remarks: Set up on cone located ~6' south of staked location.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD
21	C-1	2.0' 95.2%	0%
22–26	C-2	4.8' 96%	13.6%
26–31	C-3	4.2' 91.3%	12.6%
31	C-4	0.4'/100%	0%
31–36	C-5	5.0' 100%	13.8%
36–40	C-6	3.0'	37.7%
40–44	NS		

Strong reaction with HCl after scratched with knife. Intensely to very intensely fractured, most are along bedding planes and healed with calcite. Calcite veins are stained with iron and manganese oxide. Bedding is between 40° and 50°.
20.3' - 20.6' Fracture perpendicular to bedding plane healed with calcite, iron and manganese oxide.
20.6' - 20.8' Fracture perpendicular to bedding plane with iron and manganese oxide.
Change at 22.2'.

Greenish gray (10Y 6/1 - 5/1) LIMESTONE. Trace to few thin beds of shale. Contacts with shale are wavy with soft sediment deformation. Thinly bedded, with beds at 40°-50° angles. Strong. Slightly decomposed. Slightly disintegrated. Intensely to moderately fractured. Most breaks are along bedding planes, probably mechanically induced.
22.5' - 22.6' Multiple breaks along and perpendicular to bedding plane with iron and manganese oxide.
Change at 23.8'.

Laminated to thinly INTERBEDDED SHALE and LIMESTONE. Limestone is greenish gray (10Y 6/1 - 5/1). Massive. Microcrystalline. Strong. Shale is dark gray to very dark gray (N 4/ - 3/). Laminated to thinly bedded. Strong. Shale and limestone beds are wavy with soft sediment deformation and cross bedding. Slightly disintegrated. Slightly decomposed. Moderately to intensely fractured along bedding planes with some completely healed with calcite.
Change at 26.2'.

Greenish gray (10Y 6/1 - 5/1) LIMESTONE. Trace glauconite grains. Trace mudstone stringers. Massive. Microcrystalline. 26.8' - 27.0' subangular limestone clasts incorporated into limestone matrix. Strong. Slightly decomposed. Slightly disintegrated. Moderately fractured with some iron and manganese oxide on fracture faces.
Below 28.0' shale beds present and increasing with depth.
Change at 28.2'.

Dark brown to very dark brown (7.5YR 3/2 - 2.5/2) SHALE. Trace to few limestone beds and partings. Laminated to thinly bedded, with beds at 40°-50° angles. Soft sediment deformation and turbidation. Abundant slickensides along bedding plane. Strong. Fresh to slightly decomposed. Moderately fractured with little calcite healing of fractures. Most breaks are along bedding planes. Strong reaction with HCl when scratched. Below 31.1' shale becomes olive green in color due to weathering. Iron oxide present.
Change at 31.5'.

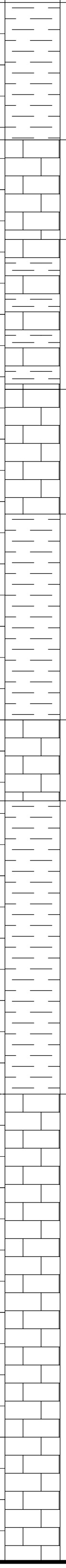
Gray to very dark gray (N 5/ - 3/) LIMESTONE. Massive with trace angular (40°-50°) shale beds and partings with soft sediment deformation. Trace glauconite grains. 31.6' - 32.0' limestone is oolitic. Oolites are round (~1mm diameter). Strong. Slightly decomposed. Very intensely fractured. Multiple fractures along and perpendicular to bedding plane. Some fractures are healed with mudstone.
Change at 32.8'.

Dark reddish brown (5YR 3/2 - 2.5/2) SHALE. Trace limestone beds and partings. Laminated to thinly bedded. Abundant slickensides along bedding plane. Fresh to slightly decomposed. Moderately to intensely fractured. Most breaks are along bedding plane and mechanically induced. Some are perpendicular to bedding and healed with calcite. Strong reaction with HCl when scratched.
Below 37.0' limestone clasts/inclusions oriented with bedding and increasing with depth. Underlying contact is transitional.
Change at 37.5'.

Light brownish gray to grayish brown (10YR 4/2 - 5/2) LIMESTONE. Thinly bedded. Trace shale beds and partings. Trace marine fossils present along shale bedding breaks. Soft sediment deformation. Moderately decomposed. Slightly to moderately fractured. Most fractures along bedding plane have iron oxide on fracture faces. Strong reaction with HCl.
38.3' Fracture with iron oxide.
38.3' - 38.8' Fracture vertical along core axis with iron oxide.
39.6' Fracture perpendicular to bedding plane with iron and manganese oxide.

Bottom of Borehole at 45.0'.

Piezometer GW-998 installed in borehole. See Monitoring Well Installation Report GW-998 for details.



Remarks:

temporary surface casing to 19.0'.
2/15/18 at 0840 DTW=2.51 BGS.
C-1 19.0' - 21.1', 1041-1119.
21.1' - 22.2' Multiple breaks along bedding plane. All have iron and manganese oxide. Strong reaction with HCl on limestone (shale when scratched).

22.6' Fracture perpendicular to bedding plan with iron and manganese oxide.
23.6 - 23.9' Horizontal fractures with iron and manganese oxide. Shale beds increasing with size and quantity with depth.
C-2 21.1' - 26.1', 1041-1119.
Becoming less weathered with depth.

26.0' Horizontal fracture with iron oxide.
26.8' - 27.2' Vertical fracture with iron and manganese oxide.
C-3 26.1' - 30.7', 1140-1220.
Driller noted blocked tip in barrel. Pull run at 30.7'.
27.4' Fracture perpendicular to bedding plane with iron oxide.
28.0', 28.1', 28.2' Fracture along bedding plane with iron and manganese oxide.
C-4 30.7' - 31.1', 1225-1236.

31.6' Fracture along bedding plane with iron oxide. 0.05" Iron halo on each side.
C-5 31.1' - 36.1', 1349-1425.

31.7' - 32.2' Multiple fractures along and perpendicular to bedding planes. Iron oxide present on all fractures. 31.7' - 31.9' Fracture healed with mudstone.
32.8' Break along bedding plane with iron and manganese oxide.
32.8' - 33.0' Shale is iron stained and discolored.
C-6 36.1' - 40.0', 1435-1504.

36.2' Break along bedding plane with iron oxide.
38.0' - 38.4' Limestone is iron stained and discolored.

2/15/18, 1515, DTW = 11.70 BGS.

On 2/20/18, used T3W rotary rig to ream corehole and advance to 45.0' using 5 7/8" tricone bit with water and air circulation. Finished drilling at 0919.

BOREHOLE LOG V.2 OAK RIDGE .GPJ CONTAINER CRAFT TEMPLATE WITH PID.GDT 4/4/18

Eagon & Associates, Inc.

Well Number
GW-998

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*	Completion Date: *3/8/18*
Coordinates: *29021.82N 37742.36E*	Borehole Depth (ft): *45.0*
Elevation Top of Casing (ft/MSL): *880.18*	Borehole Diameter (in):*10" (0'-22.0'), 5 7/8" (22.0'-45.0')*
Elevation Ground Surface (ft/MSL): *877.7*	Drilling Methods: *2 1/4" HSA, HQ3 Core w/water, 10" air hammer bit, 5 7/8" tricone bit w/air/water.*
Installed By: *Shannon Snow/Tri-State Drilling*	Completed Drilling: *2/20/18*
Supervised By: *David J. Sugar/Eagon & Associates, Inc.*	Drilling Water Used (gals): *~1500*

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel w/Locking Lid	-2.8 - 2.2	880.5 - 875.5
Riser	2" ID Schedule 40 PVC	-2.5 - 26.6	880.2 - 851.1
Surface Seal	3' x 3' Concrete	-0.5 - 0.5	878.2 - 877.2
Conductor Casing	6" ID Schedule 40 PVC, Flush Threaded	-0.4 - 22.0	878.1 - 855.7
Cement Grout	Cement Bentonite Grout	0.5 - 21.7	877.2 - 856.0
Bentonite Seal	Pel-Plug 1/4" Coated Bentonite Pellets	21.7 - 24.0	856.0 - 853.7
Sand Pack	DSI GP #2 Gravel Pack	24.0 - 37.9	853.7 - 839.8
Screen	2" ID Schedule 40 PVC, 10-Slot	26.6 - 36.6	851.1 - 841.1
Well Point Blank	2" ID Sch. 40 PVC Cap & Riser Section	36.6 - 37.9	841.1 - 839.8
Sand Pack Bottom	DSI GP #2 Gravel Pack	37.9 - 40.0	839.8 - 837.7
Bentonite Seal	Pel-Plug 1/4" Coated Bentonite Pellets	40.0 - 45.0	837.7 - 832.7

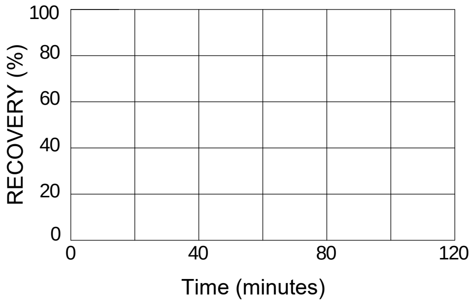
Well Development

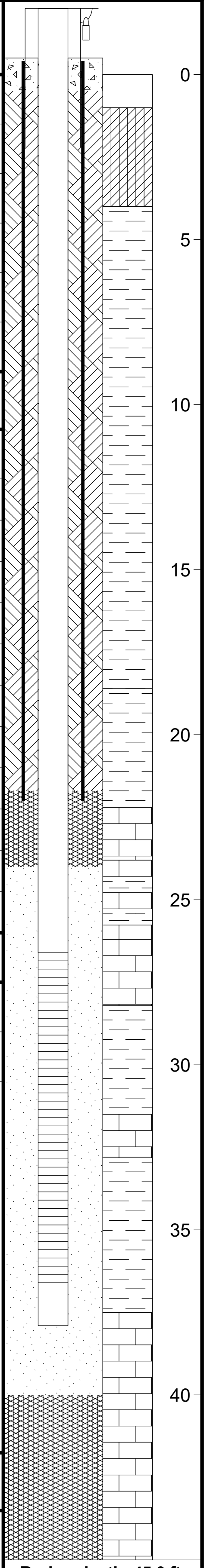
Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
40.37	*4.55*	*5.8*	*405.0*

Development Method:
Bailer, surge block, Tornado pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (µmhos/cm)	pH (S.U.)	Turbidity (NTU)
2/26/18	1001	5	15.0	962	7.23	>1000
2/26/18	1020	30	15.7	412	7.09	>1000
2/26/18	1050	105	15.8	364	6.86	104.0
2/26/18	1130	205	15.7	356	6.81	80.6
2/26/18	1210	305	15.8	351	6.79	56.2
2/26/18	1250	405	15.8	345	6.87	33.8

Recovery Data





Sampling Equipment:

Comments:

Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 26.8 - 36.5 bgs.

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Eagon & Associates, Inc.

BOREHOLE LOG

Site Name and Location: **EMDF Characterization Project**
Oak Ridge, TN

Drilling Methods: 4 1/4" ID HSA, HQ Core w/water.

Boring Number: GW-999

Drilling Firm: *Tri-State Drilling*

Driller / Rig: *Fred Reynolds/Mobile B42C*

Logged by: *Shay Beanland*

Coordinates: *29025.01N 37750.58E*

Surface Elevation: *877.6 ft/MSL*

Surface Conditions / Weather: *Gravel pad, dry / 70°F, Sunny*

DATE	TIME	DEPTH DRILLED (ft)	WATER LEVEL (ft)

Page 1 of 2

Start	Finish
Time *1050*	*Time* *1045*
Date *2/20/18*	*Date* *3/2/18*

Sampling Methods:

ST = Shelby Tube	SS = Split Spoon
WS = Waxed Sample	CS = Continuous Sampler
SP = Sand Pump	C = Coring
GP or DP = Direct Push	NS = Not Sampled
CT = Cuttings	B = Bailer

Remarks: Boring installed for collection of geotech samples and for installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
1 2	HSA			See Borehole Log for adjacent boring GW-998 for detailed lithologic description and stratigraphic interpretation.		Ran 4 1/4" ID HSA with center plug to target depths of Shelby tube and bucket samples. Pushed Shelby tubes. Advanced augers to target depth and switched to HQ Core with water. Then reamed borehole with 4 1/4" ID HSA using CME 550. Pushed Shelby tube 2.0' down. Pressure noted in 'blows/6 in' column.	
3 4	ST-1	1.7	800 PSI 900 PSI 900 PSI 1300 PSI				
	HSA			At 4.5' sample was light bluish gray SHALE (SAPROLITE). Fracture noted on bottom of sample with iron oxide and manganese oxide on surface, could be bedding plane surface.			
5	ST-2	0.85	1100 PSI	At 5.85' sample was gray (7.5YR 6/1 - 5/1) SAPROLITE. Iron and manganese oxide noted on bedding plane surfaces. Micaceous.		Pushed Shelby tube 0.85' before refusal.	
6 7 8 9 10	HSA		1500 PSI/ 0.35'			Bulk sample collected from 4.0' - 4.5' of cuttings from augers. Bulk sample (BS-2) collected from 5.0' - 6.0'.	
11 12	ST-3	2.0	850 PSI 900 PSI 1000 PSI			Pushed Shelby tube (ST-3) 2.0' from 10.5' to 12.5'. Shelby tube is wet.	
13 14 15 16	HSA		1000 PSI	At 12.5' sample was light brownish gray to grayish brown (2.5Y 6/2 - 5/2) SHALE (SAPROLITE). Iron and manganese oxide observed in bedding plane surfaces. Wet.			
17 18	SS-1	1.2	15 41 50/3	Gray to grayish brown (2.5Y 5/1 - 5/2) highly weathered SHALE (SAPROLITE). Laminated bedding structure. Easily crumbled with hand. Iron staining and precipitate throughout bedding planes. Weathered. Low to medium plasticity and toughness. Moist.		Below 17.0' reacts with HCl. Auger refusal at 19.1'.	
	HSA			Change at 18.5'.		Spoon was bent when retrieved.	
19	SS-2	0.9	7 15 50/3.5	Gray to olive gray (5Y 5/1 - 4/2) SHALE. Laminated bedding. Decrease in iron and manganese oxide along bedding planes to little. Below 19.0' olive gray (5Y 5/2 - 4/2) limestone. Very intensely fractured. Calcite precipitate/crystals along fracture surfaces. Wet.		1430-1500 Went for water to start coring. WL = 5.85 at 1511, TD = 19.1.	

EMDF Characterization Project Oak Ridge, TN	**BOREHOLE LOG**	Boring Number GW-999

Remarks: Boring installed for collection of geotech samples and for installation of shallow piezometer.

Depth (feet)	Sample Method	Sample Recovery (feet or %)	Blows/6 in or RQD	SAMPLE DESCRIPTION	Graphic Log	Remarks	USCS
21	C-1	2.2' 100%	56.4%	Light gray to greenish gray (N 7/ - 10Y 6/1) LIMESTONE. Microcrystalline. Trace to few thin beds of shale. Shale beds are wavey with soft sediment deformation and bioturbation. Beds are at 40°-50° angles. Shale beds range in thickness from less than 1mm to up to 5mm in thickness. Trace glauconite crystals. Trace calcite seams/stringers along bedding planes. Trace calcite crystals. Field strength is strong. Slightly decomposed. Sightly disintegrated. Intensely to moderately fractured with iron and manganese oxide and calcite precipitate. 20.45' - 20.65' Shale bed. 20.75' - 21.1' Shale bed. Very intensely fractured along bedding plane/fracture surfaces. Trace iron staining observed throughout core, predominately along shale beds. Below 21.1' limestone becomes clastic with clasts elongated and oriented parallel to bedding plane. Bottom of Borehole = 22.0'. Piezometer GW-999 installed in borehole. See Monitoring Well Installation Report GW-999 for details.		Auger refusal at 19.1', split spoon sampled to 19.3'. Switching over to HQ Core. C-1: 19.3' - 21.5' 1645-1711. 19.7' - 19.9' 45° angle fracture with iron staining present on surface. 20.2' - 20.4' 40° angle fracture with iron staining along bedding plane. 20.45' - 20.6' 40° angle fracture along bedding plane. 20.6' - 20.75' 30° angle fracture, iron and manganese oxide along face, fractures along bedding plane. 21.1' - 21.25' 60° angle fracture. 2/20/18 Done for day at 1711. 2/21/18 at 0810 WL = 0.90', TD = 21.5'. Start augering hole at 0834 from 19.1'. 0855 Stopped augering, had only gone 2" with rig. Pulling rig off hole and setting temporary 6" casing to 19.0'. On 3/2/18 used CME-55 to overdrill corehole and advance borehole to 22.0' using 4 1/4" ID HSA augers. Completed drilling at 1045.	
	NS						
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Eagon & Associates, Inc.

Well Number
GW-999

Monitoring Well Installation Report

Site Name and Location: *EMDF Characterization Project, Oak Ridge, TN*

Completion Date: *3/8/18*

Coordinates: *29025.01N 37750.58E*

Borehole Depth (ft): *22.0*

Elevation Top of Casing (ft/MSL): *880.11*

Borehole Diameter (in):*7 1/2" (0'-22.0')*

Elevation Ground Surface (ft/MSL): *877.6*

Drilling Methods: *4 1/4" ID HSA, HQ Core w/water.*

Installed By: *Shannon Snow/Tri-State Drilling*

Completed Drilling: *3/2/18*

Supervised By: *Shay Beanland/Eagon & Associates, Inc.*

Drilling Water Used (gals):

Well Design

Component	Materials	Depth (LSD)	Elevation
Well Protector	4" Square Steel Protector w/Locking Lid	-2.8 - 2.2	880.4 - 875.4
Riser	2" ID Schedule 40	-2.5 - 10.3	880.1 - 867.4
Surface Seal	3' x 3' Concrete Pad	-0.5 - 1.0	878.1 - 876.6
Bentonite Seal	Enviro Plug Medium Chips	1.0 - 4.8	876.6 - 872.8
Bentonite Seal	Pel Plug 1/4" Coated Bentonite Pellets	4.8 - 8.3	872.8 - 869.4
Sand Pack	DSI "GP #2" Gravel Pack	8.3 - 21.6	869.4 - 856.0
Screen	2" ID Schedule 40, 10-Slot	10.3 - 20.3	867.4 - 857.3
Well Point Blank	2" ID Schedule 40 Cap & Riser Section	20.3 - 21.6	857.3 - 856.0
Natural Fill	Natural Fill	21.6 - 22.0	856.0 - 855.6

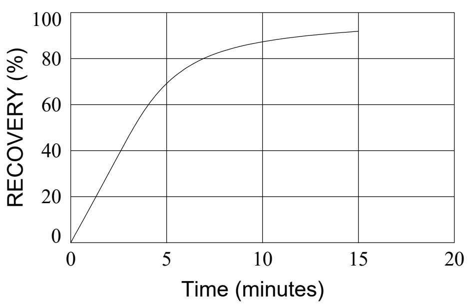
Well Development

Well Depth (ft,TOC):	Depth to Water (ft,TOC):	Well Volume (gals):	Volume Purged (gals):
24.10	*3.41*	*3.4*	*114.5*

Development Method:
Surge block, bailer, mega purger whale pump

Date	Time	Cumulative Volume Removed (gals)	Temp (°C)	Specific Conductivity (µmhos/cm)	pH (S.U.)	Turbidity (NTU)
3/5/18	1005	12.0	14.7	546	7.15	>1000
3/5/18	1015	24.5	15.3	461	7.13	>1000
3/5/18	1040	44.5	15.1	440	7.15	>1000
3/5/18	1100	64.5	15.1	432	7.08	97.4
3/5/18	1140	94.5	15.4	425	6.98	27.9
3/5/18	1200	114.5	15.6	422	6.95	23.4

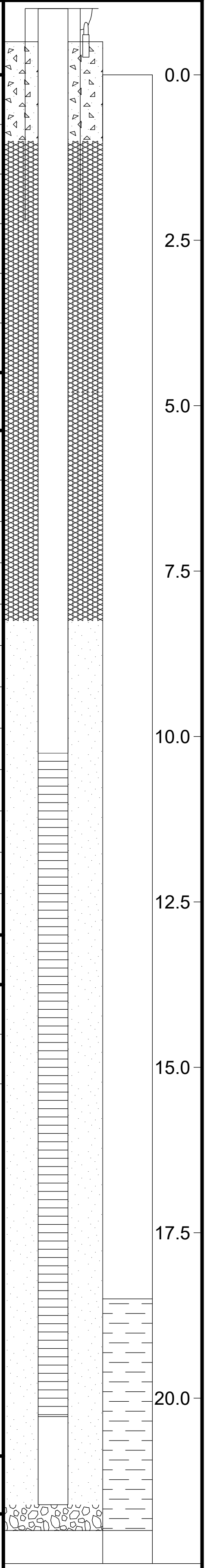
Recovery Data



Sampling Equipment:

Comments:

Grout mixing and placement information provided by Tri-State Drilling. Screen slot interval 10.4 - 20.1 bgs.



Boring depth=22.0 ft.

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PHASE I CHARACTERIZATION
ENVIRONMENTAL MANAGEMENT DISPOSAL FACILITY
CENTRAL BEAR CREEK VALLEY SITE (7c)

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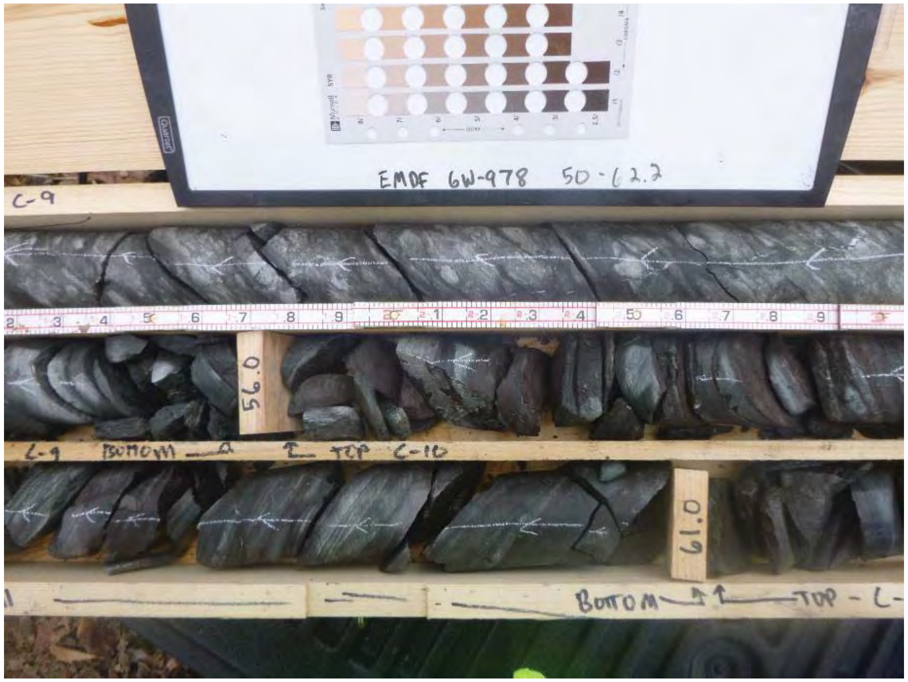
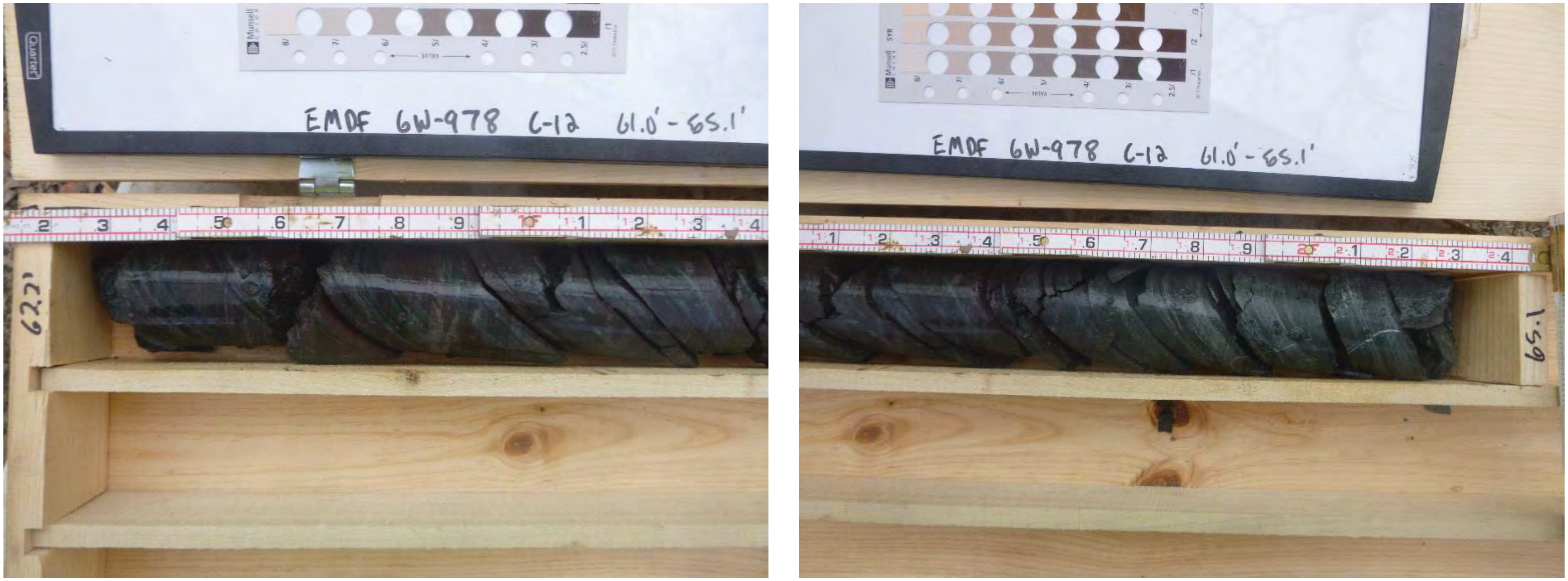
GW-978



GW-978 56.1’ – 71.5’ Sand Pack Interval
59.5’ – 69.6’ Screened Interval

GW-978



GW-978 56.1' – 71.5' Sand Pack Interval
59.5' – 69.6' Screened Interval

GW-979

GW-979 21.2’ – 37.8’ Sand Pack Interval
26.3’ – 36.3’ Screened Interval

21.1’- 21.3’ Very intensely fractured along bedding planes and some at an angle perpendicular to bedding direction. Iron staining throughout.

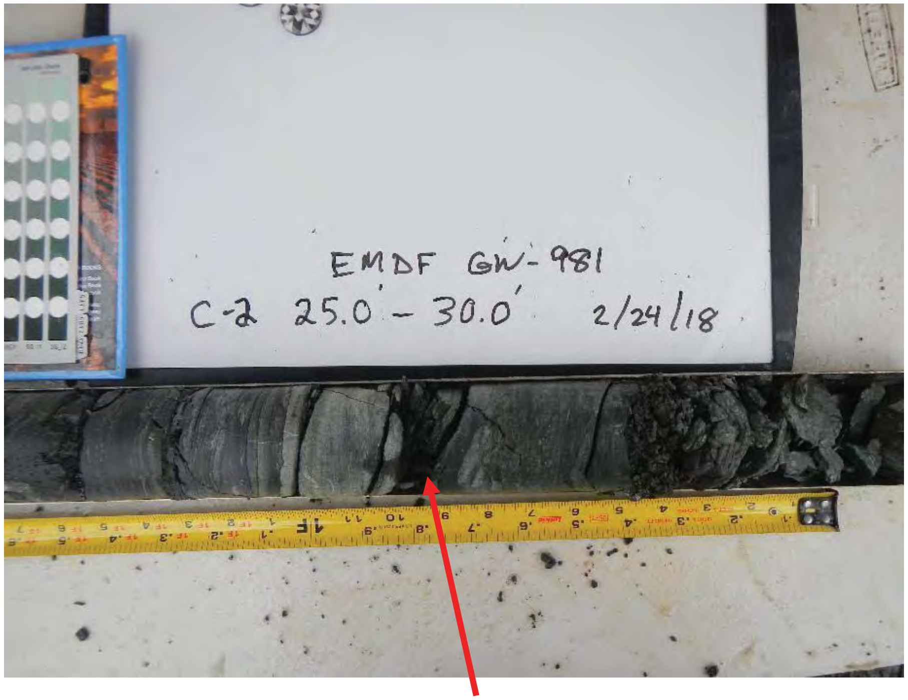
GW-980

GW-980R 55.0' – 72.3' Sand Pack Interval
59.9' – 70.0' Screened Interval

67.0'- 67.3' Bedding plane break with apparent depositional slickensides. Trace calcite coating and fine pyrite crystals

59.2'- 60.1' Zone with healed (calcite filled) fractures, generally oriented perpendicular to bedding angle. At 59.2', 59.5', and 59.8' fractures are open but appear broken by the drilling process

GW-981

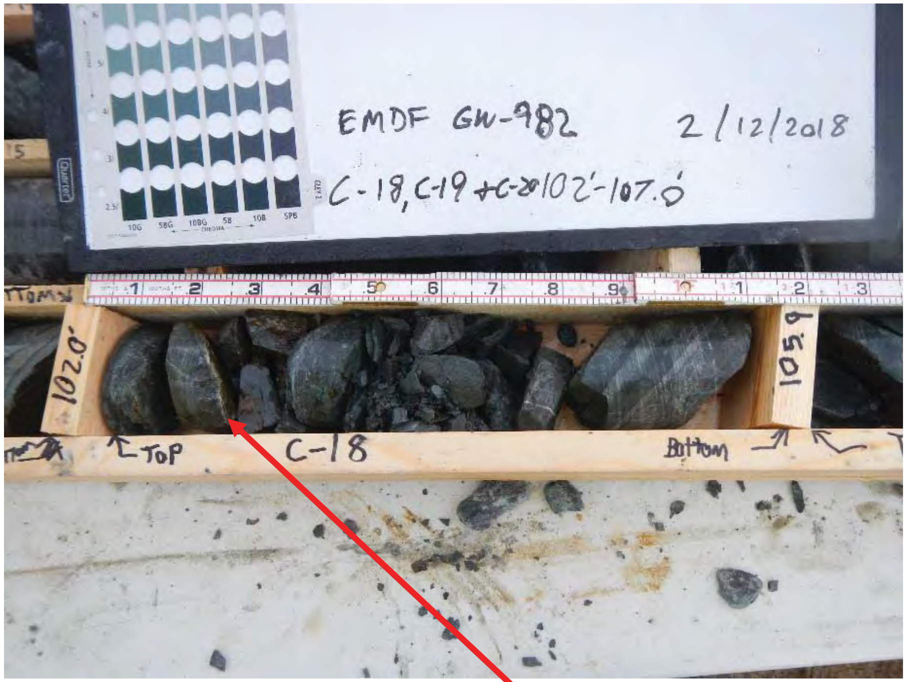


GW-981 20.0' – 34.0' Sand Pack Interval
22.1' – 32.1' Screened Interval

24.0'- 24.9' Broken zone, fractures oriented perpendicular to bedding (possibly associated with healed fractures where the calcite infilling has been removed). Trace thin secondary calcite on fracture faces.

25.4'- 26.3' High angle fracture, jagged/rough face. Trace secondary calcite and possibly celestite.

GW-982



102.0' – 102.3' Fracture zone/bedding breaks. Faces are oxidized with iron oxide coatings. Continues to be intensely fractured. Bedding angle is near 45°.

107.6' – 107.9' Fracture 90° to bedding plane. Face has thin coating of calcite. No oxidation.

GW-982 99.2' – 114.5' Sand Pack Interval
102.1' – 112.1' Screened Interval

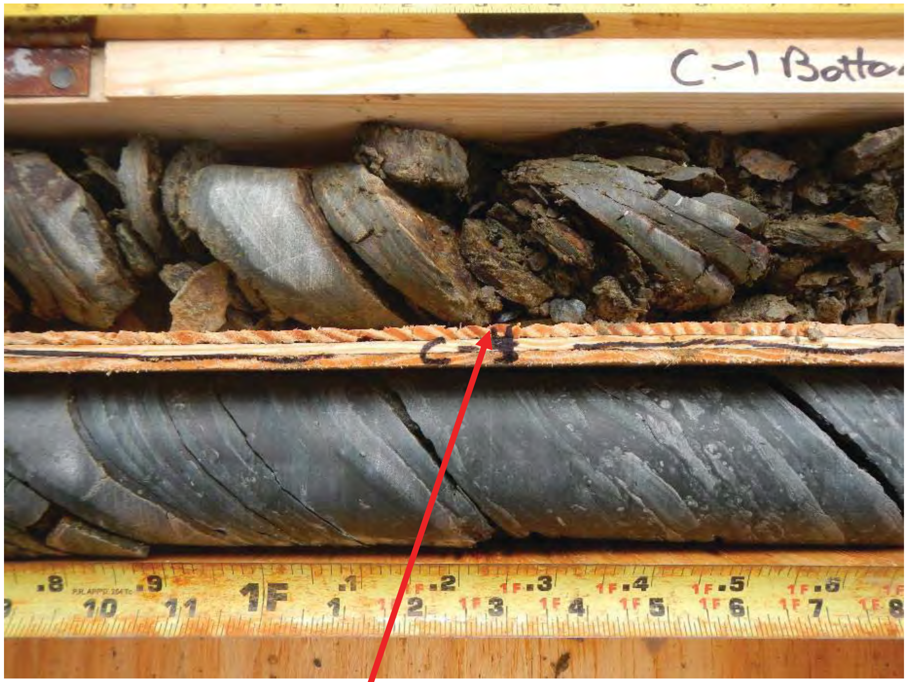
GW-986

GW-986 38.6' – 48.0' Sand Pack Interval
41.0' – 46.0' Screened Interval

At 49.8' Fracture (appears mechanically broken) ~ 2mm calcite filled, broken face is striated at orientation of 30° from the fracture angle

At 50.5' Horizontal break, rough face. Trace pyrite.

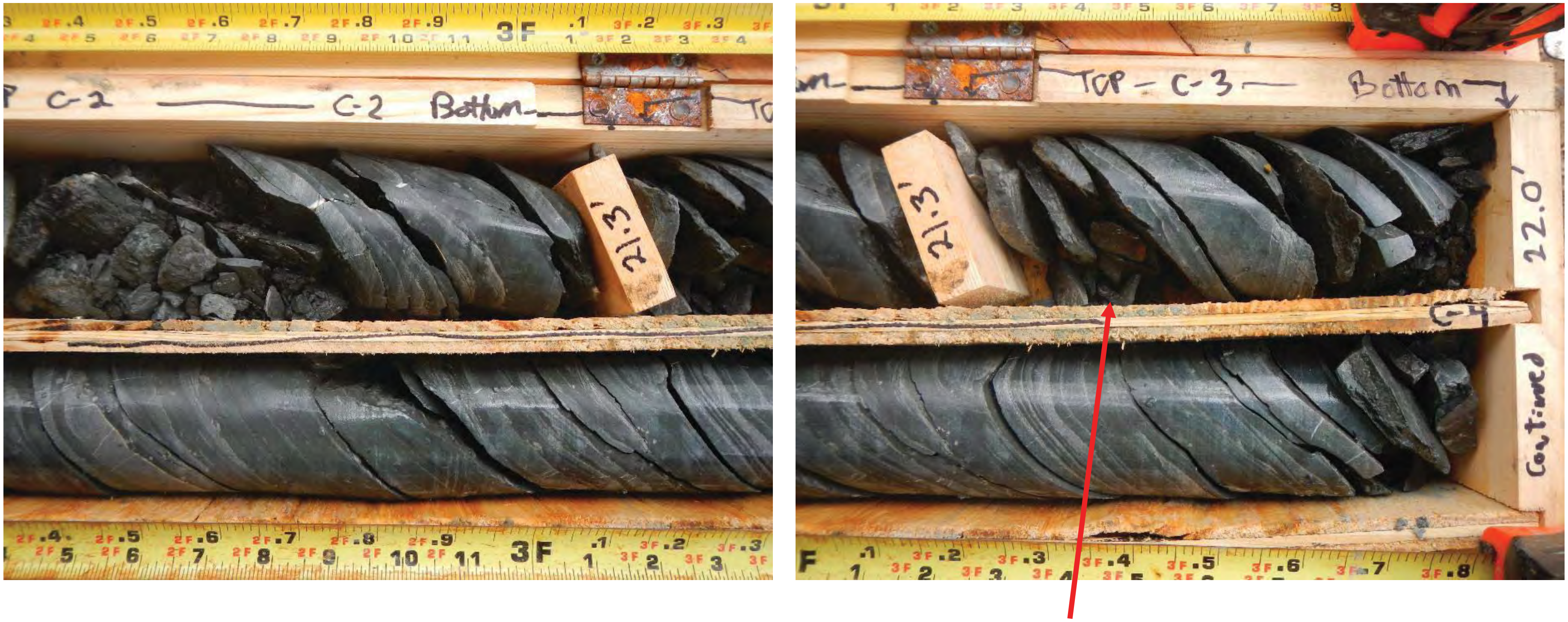
GW-987



GW-987 13.3’ – 27.9’ Sand Pack Interval
16.1’ – 26.1’ Screened Interval

17.5’ – 20.0’ Interval highly fractured. Primarily along bedding planes, trace fractures oriented perpendicular to bedding. Fracture faces are generally coated with manganese oxide precipitates.

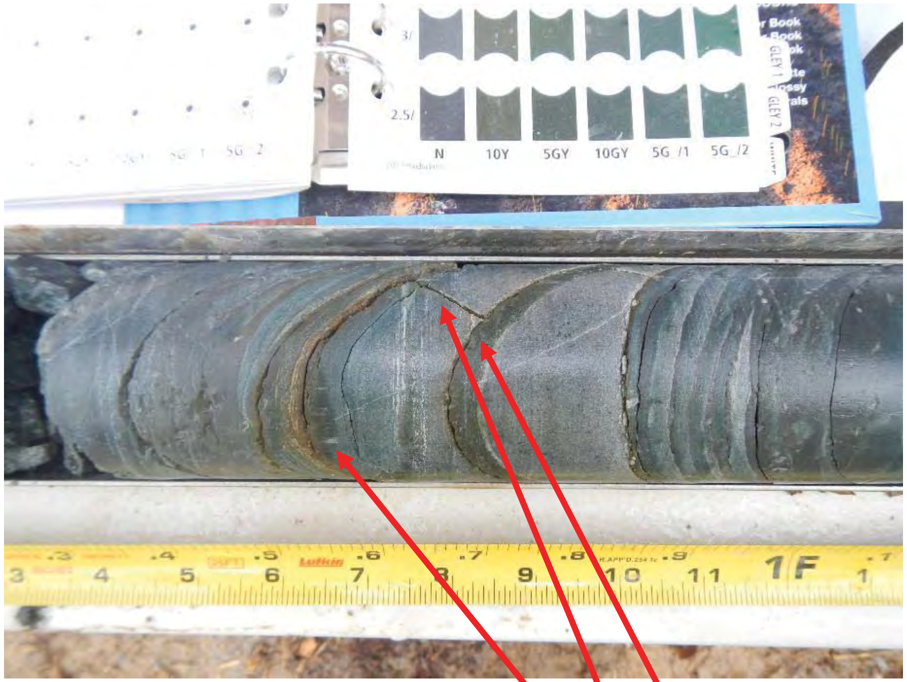
GW-987

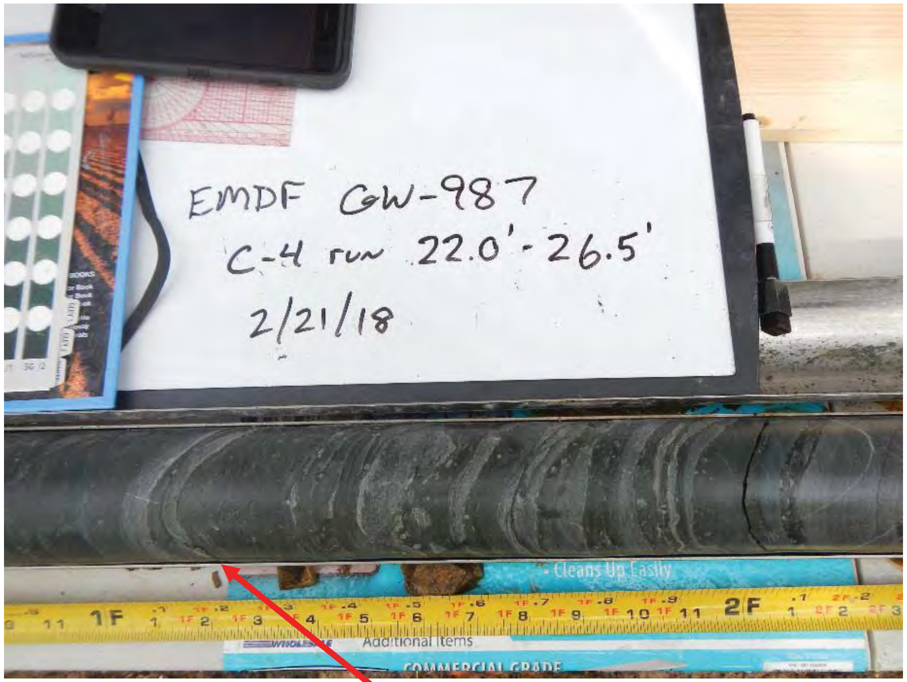


GW-987 13.3’ – 27.9’ Sand Pack Interval
16.1’ – 26.1’ Screened Interval

21.4’ – 21.7’ Dark yellowish brown to black iron oxide/manganese oxide on bedding breaks

GW-987





GW-987 13.3' – 27.9' Sand Pack Interval
16.1' – 26.1' Screened Interval

22.4' – 22.8' Several bedding breaks with oxidation (yellowish brown) faces. Fracture perpendicular to bedding angle is also oxidized

At 23.2' Secondary calcite on bedding break, thin coating.

GW-988

GW-988 59.6' – 74.0' Sand Pack Interval
61.9' – 71.9' Screened Interval

70.0' – 70.6' Vertical fracture along the bedding plane that appears to turn from 60° to near vertical. Fractures are fresh.

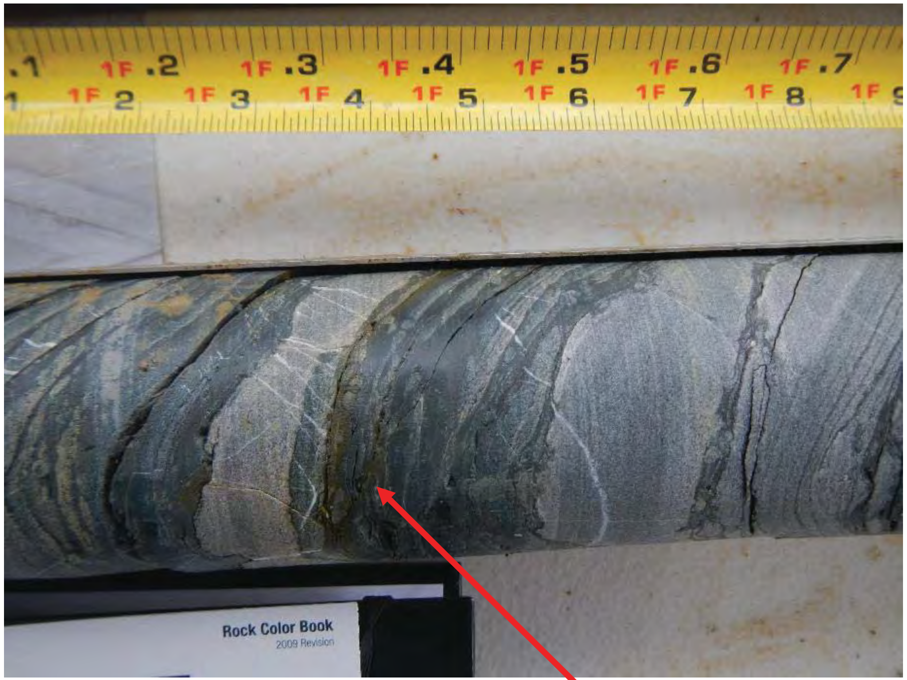
GW-989

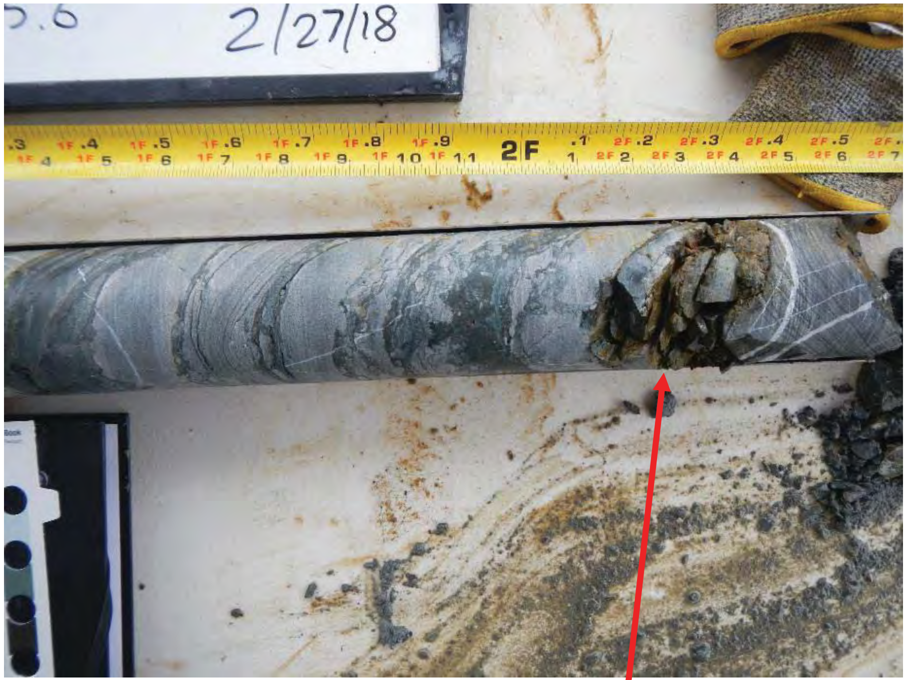
34.1' – 34.3' Broken zone, bedding breaks and fractures perpendicular to bedding. Oxidized with iron oxide precipitates on fracture faces.

GW-989 30.0' – 45.0' Sand Pack Interval
33.6' – 43.6' Screened Interval

32.0' – 33.6' Most bedding breaks are oxidized with iron oxide precipitates on fracture surfaces.

GW-989



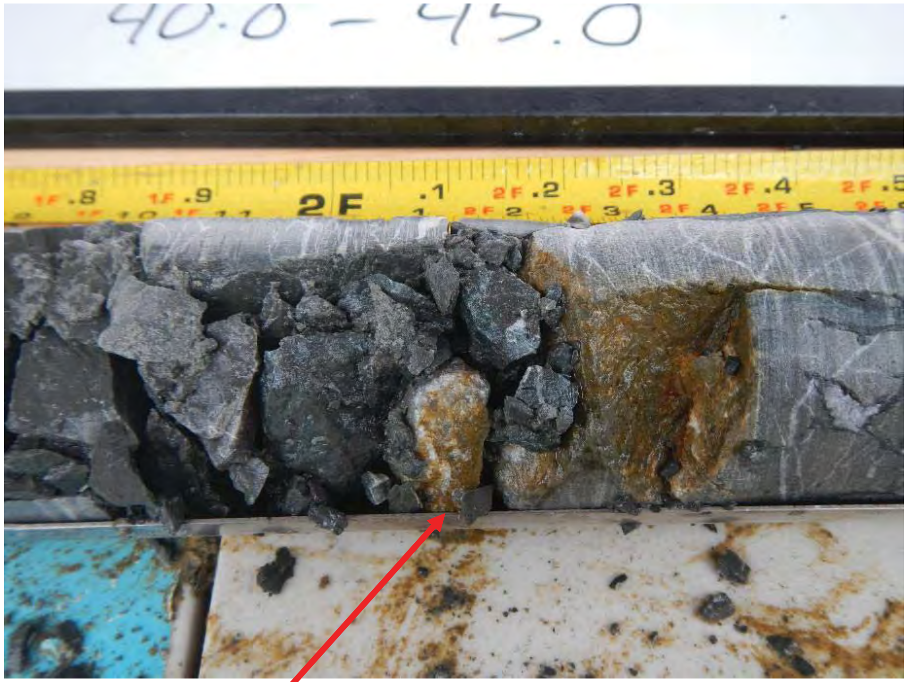


GW-989 30.0' – 45.0' Sand Pack Interval
33.6' – 43.6' Screened Interval

32.0' – 33.6' Most bedding breaks are oxidized with iron oxide precipitates on fracture surfaces.

34.1' – 34.3' Broken zone, bedding breaks and fractures perpendicular to bedding. Oxidized with iron oxide precipitates on fracture faces.

GW-989



GW-989 30.0' – 45.0' Sand Pack Interval
33.6' – 43.6' Screened Interval

41.9' – 42.3' Broken zone with iron oxide along bedding planes and perpendicular fractures. Oxidized with iron oxide precipitates on fracture faces.

GW-993

GW-993 19.8' – 35.5' Sand Pack Interval
23.0' – 33.0' Screened Interval

26.0' – 26.7' Multiple high angle fractures with iron and manganese oxide precipitate.

27.3' – 27.5' 40-50 degree fracture, iron staining present.

GW-993

GW-993 19.8' – 35.5' Sand Pack Interval
23.0' – 33.0' Screened Interval

27.8' – 28.1' Core is highly broken due to composition (mudstone/shale) and sampling procedure. Iron staining along fractures, along bedding planes, and along fractures perpendicular to bedding angles.

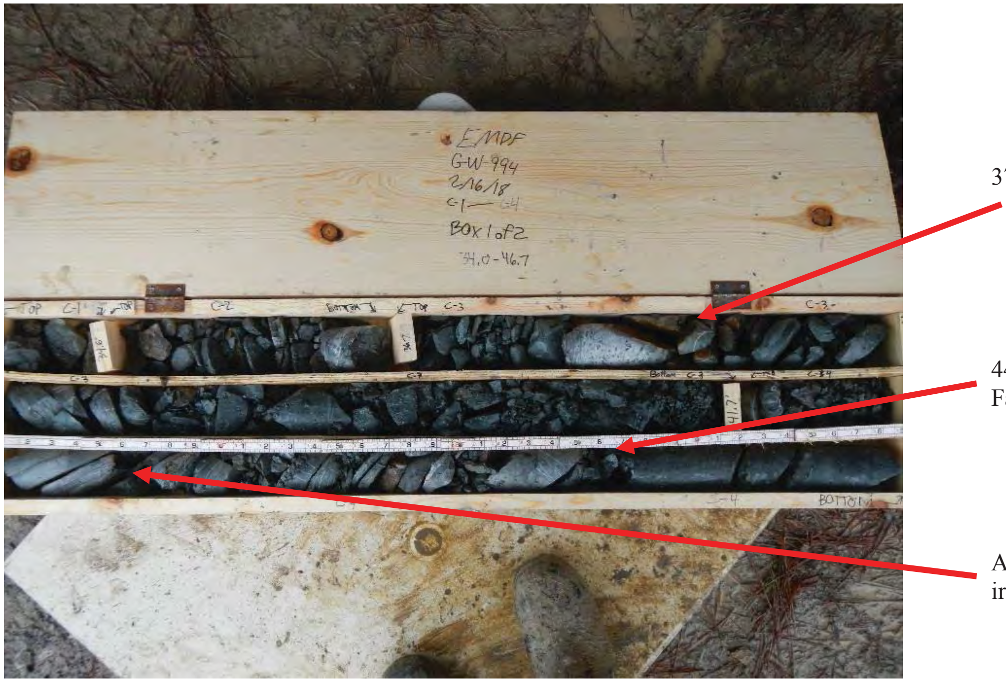
28.1' – 28.6' Rubble zone, very intensely fractured, all pieces rounded due to composition and sampling procedure. Iron staining, iron oxide, and manganese oxide observed along fracture faces. Calcite precipitate also observed along fracture faces.

GW-994

GW-994 37.0' – 54.6' Sand Pack Interval
42.0' – 52.0' Screened Interval

37.6' – 38.1' Fracture oriented 90° to bedding angle. Face has iron oxide weathering

GW-994



37.6’ – 38.1’ Fracture oriented 90° to bedding angle. Face has iron oxide weathering

44.9’ – 45.4’ Bedding breaks and fractures oriented perpendicular to bedding angle. Faces oxidized with iron oxide precipitates.

At 42.8 fracture oriented perpendicular to bedding. Face is oxidized with iron oxide precipitates.

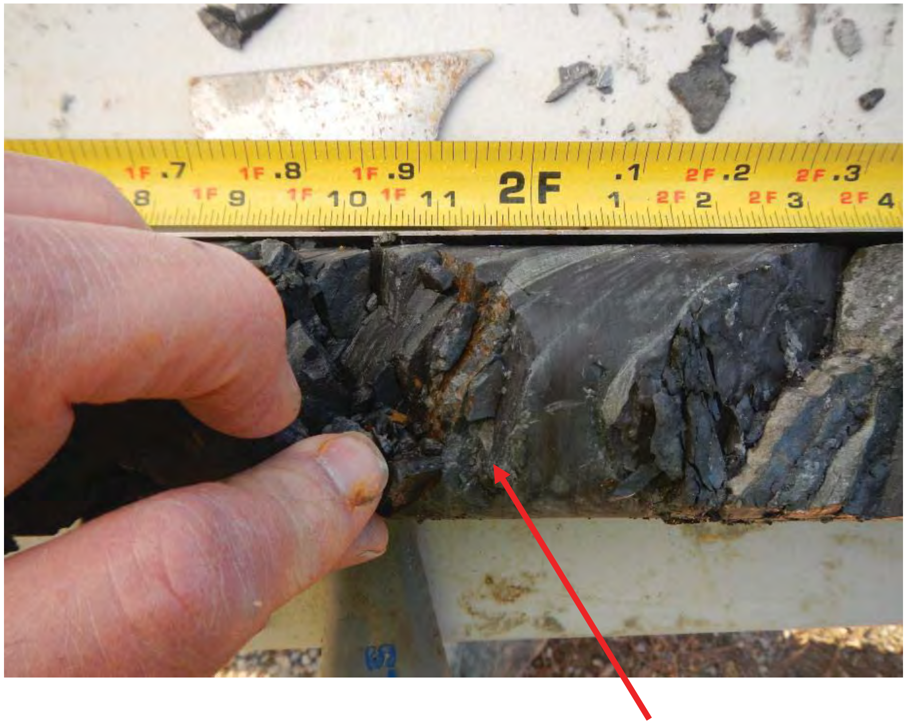
GW-994 37.0’ – 54.6’ Sand Pack Interval
42.0’ – 52.0’ Screened Interval

GW-995

GW-995 19.2' – 34.0' Sand Pack Interval
22.1' – 32.1' Screened Interval

Below 25.5' Core is very weathered, broken along bedding planes, iron oxide on bedding planes

GW-995



GW-995 19.2’ – 34.0’ Sand Pack Interval
22.1’ – 32.1’ Screened Interval

26.5’ – 27.0’ Trace yellowish/reddish brown iron oxide on fracture surfaces

GW-998

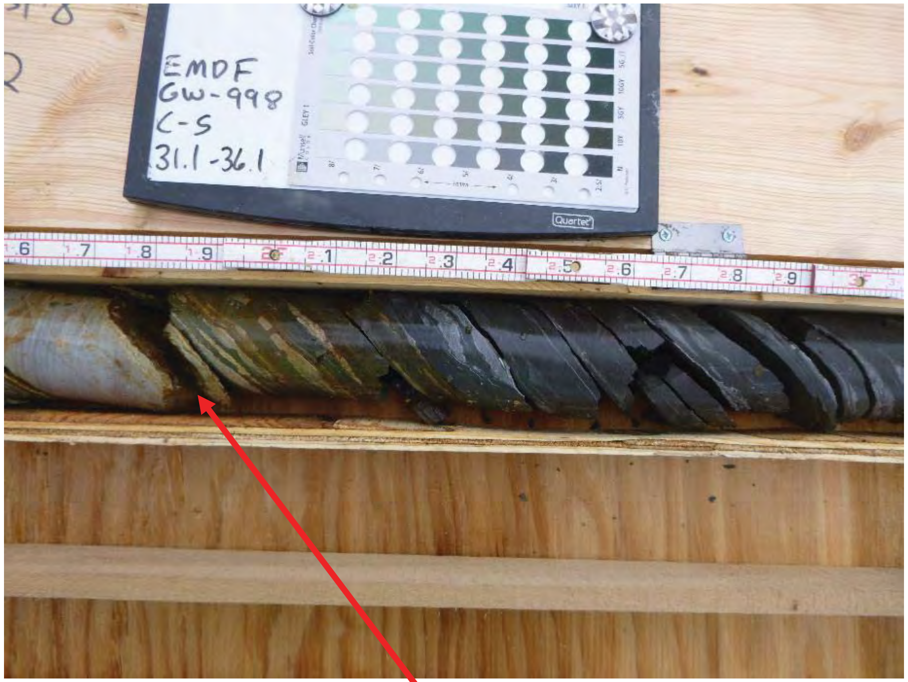
GW-998 24.0' – 40.0' Sand Pack Interval
26.6' – 36.6' Screened Interval

26.8' – 27.2' Vertical fracture with iron and manganese oxide precipitates.

At 27.4' Fracture perpendicular to bedding plane with iron and manganese oxide precipitates.

At 28.0', 28.1', and 28.2' Fractures along bedding planes with iron and manganese oxide precipitates.

GW-998



GW-998 24.0’ – 40.0’ Sand Pack Interval
26.6’ – 36.6’ Screened Interval

At 31.6’ Fracture along bedding plane with iron oxide precipitates.

31.7’ -32.2’ Multiple fractures along and perpendicular to bedding plane with iron oxide present on all fractures.

At 32.8’ Break along bedding plane with iron and manganese oxide precipitates.

GW-998

GW-998 24.0' – 40.0' Sand Pack Interval
26.6' – 36.6' Screened Interval

At 36.2' Break along bedding plane with iron oxide precipitate.

38.0' and 38.4' Limestone is iron stained and discolored.

38.3' and 38.8' Fracture vertical along core axis with iron oxide.

GW-998

GW-998 24.0' – 40.0' Sand Pack Interval
26.6' – 36.6' Screened Interval

At 39.6' Fracture perpendicular to bedding plane with iron and manganese oxide.

GW-999

GW-999 8.3’ – 21.6’ Sand Pack Interval
10.3’ – 20.3’ Screened Interval

19.7’ - 19.9’ 45 deg. fracture with iron staining.

20.2’ – 20.4’ 40 deg. fracture with iron staining.

20.6’ – 20.75’ 30 deg. fracture with iron and manganese oxide.

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APPENDIX C

SLUG TEST DATA

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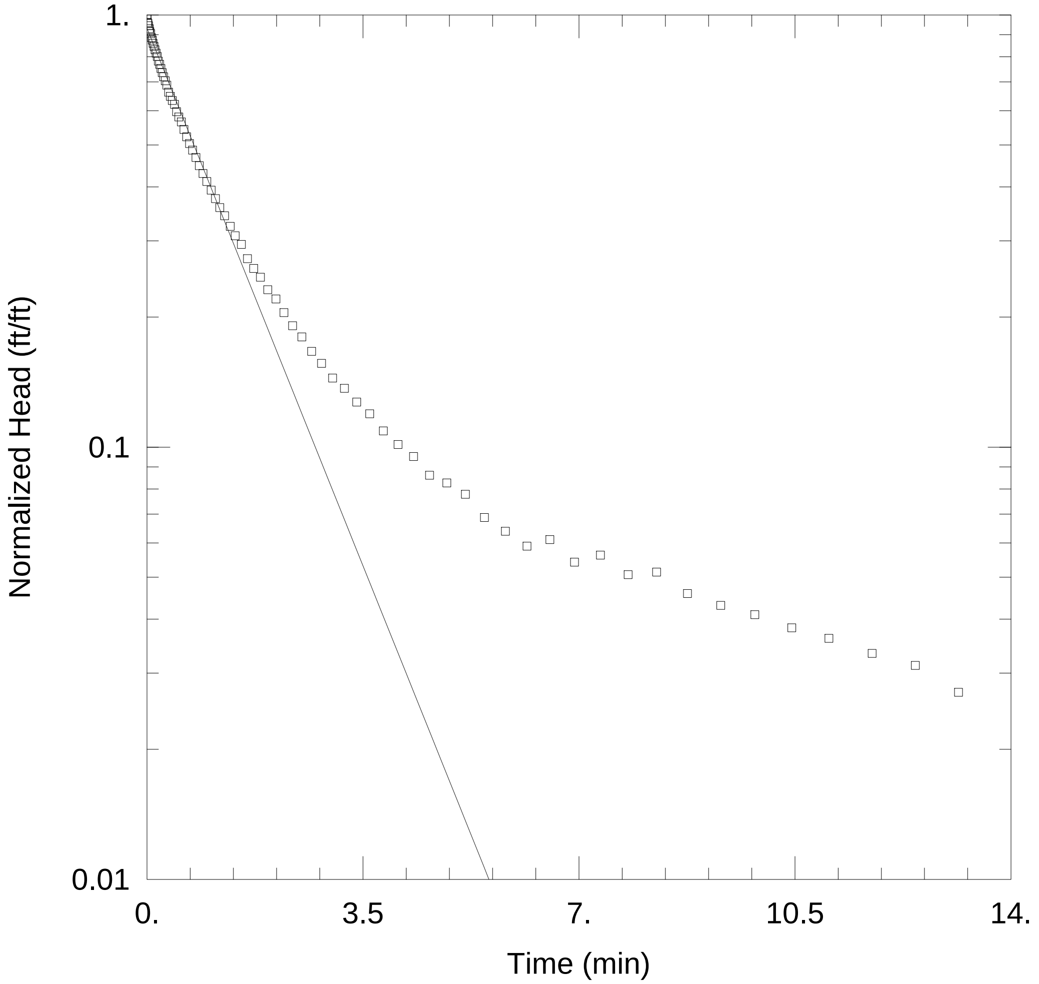
TABLE C.1.
SUMMARY OF SLUG TESTING RESULTS
PHASE I CHARACTERIZATION ENVIRONMENTAL MANAGEMENT DISPOSAL FACILITY
CENTRAL BEAR CREEK VALLEY SITE (7c)

Well No.	Screen Depth (feet)	Saturated Thickness[2] (feet)	Type of Test	Bouwer-Rice Calculated Hydraulic Conductvity cm/sec
GW-979	26.3 - 36.3	9.7	Bar In	4.17×10^{-4}
			Bar Out	4.96×10^{-4}
			Average	4.56×10^{-4}
GW-981	22.1 - 32.1	9.7	Bar In	6.39×10^{-5}
			Bar Out	4.61×10^{-5}
			Average	5.50×10^{-5}
GW-983	79.2 - 89.2	9.7	Bar In	5.04×10^{-3}
			Bar Out	4.96×10^{-3}
			Average	5.00×10^{-3}
GW-987	16.1 - 26.1	9.7	Bar In	9.52×10^{-5}
			Bar Out	9.75×10^{-5}
			Average	9.64×10^{-5}
GW-989	33.6 - 43.6	9.7	Bar In	1.42×10^{-4}
			Bar Out	6.68×10^{-5}
			Geometric Mean	9.74×10^{-5}
GW-993[1]	23.0 - 33.0	9.7	Bar In	5.88×10^{-4}
			Bar Out	6.98×10^{-4}
			Average	6.43×10^{-4}
GW-995	22.1 - 32.1	9.8	Bar In	1.85×10^{-4}
			Bar Out	1.84×10^{-4}
			Average	1.85×10^{-4}
GW-999	10.3 - 20.3	9.7	Bar In	5.14×10^{-4}
			Bar Out	4.54×10^{-4}
			Average	4.84×10^{-4}

[1] Average borehole radius of screened interval in GW-993 assumed to be 17.4 inches based on volume of sand pack required.

[2] Saturated thickness equals the actual measured slotted interval of 10-foot screen section. Length of filter pack disregarded.



GW-979 FALLING HEAD SLUG TEST

Data Set: F:\Aqtesolve\Oak Ridge\GW-979 Bar In.aqt
Date: 04/02/18 Time: 13:50:32

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-979
Test Date: 3/6/18

AQUIFER DATA

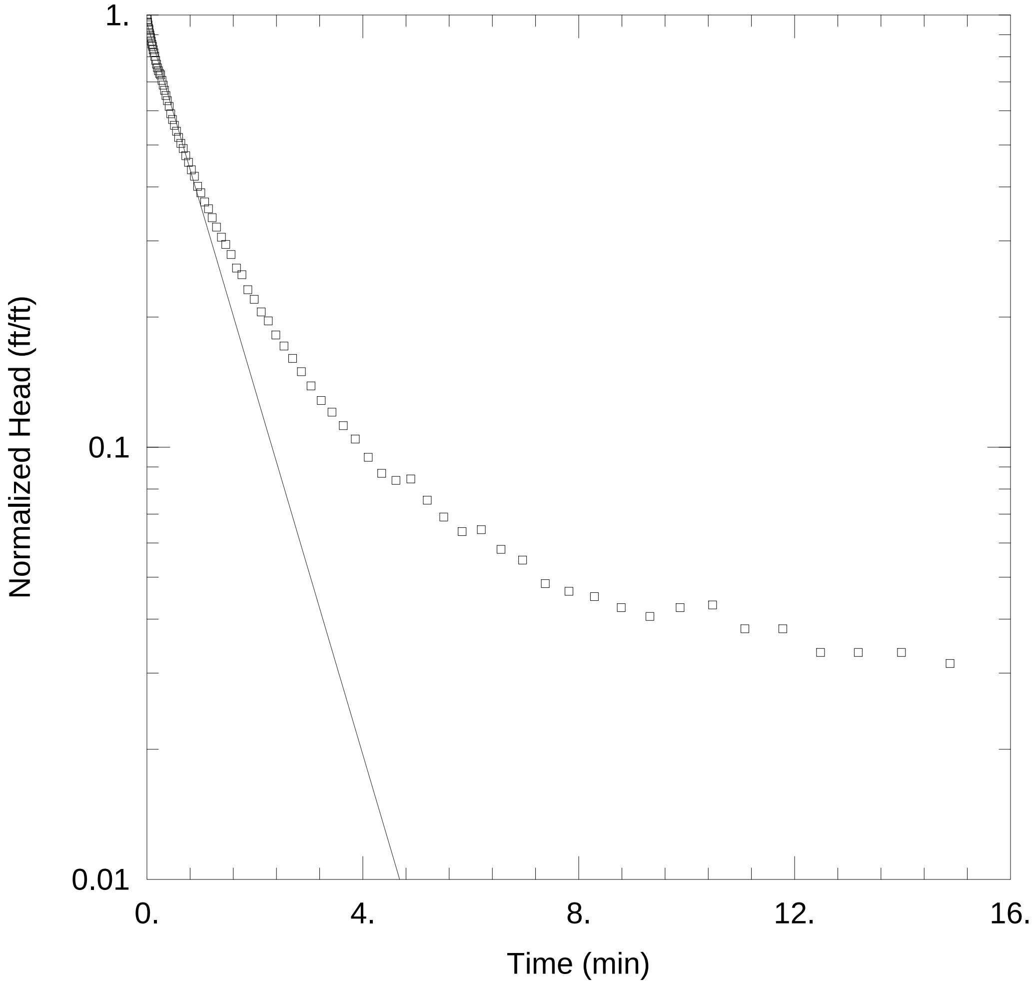
Saturated Thickness: 9.7 ft
Anisotropy Ratio (Kz/Kr): 0.5

WELL DATA (GW-979)

Initial Displacement: 1.44 ft
Static Water Column Height: 21.24 ft
Total Well Penetration Depth: 9.7 ft
Screen Length: 9.7 ft
Casing Radius: 0.0833 ft
Well Radius: 0.2448 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.0004169 cm/sec
y0 = 1.341 ft



GW-979 RISING HEAD SLUG TEST

Data Set: F:\Aqtesolve\Oak Ridge\GW-979 Bar Out.aqt
Date: 04/02/18 Time: 13:54:13

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-979
Test Date: 3/6/18

AQUIFER DATA

Saturated Thickness: 9.7 ft
Anisotropy Ratio (Kz/Kr): 0.5

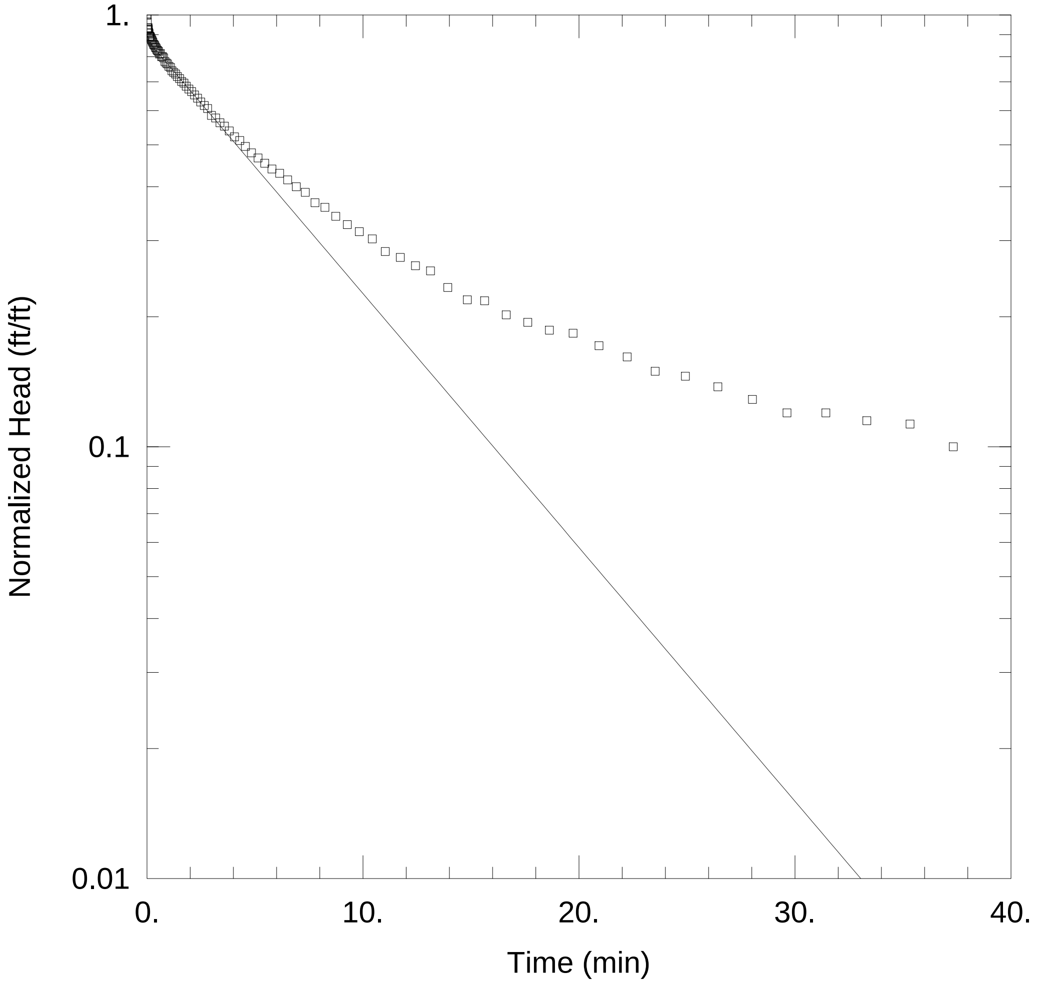
WELL DATA (GW-979)

Initial Displacement: 1.552 ft
Static Water Column Height: 21.27 ft
Total Well Penetration Depth: 9.7 ft
Screen Length: 9.7 ft
Casing Radius: 0.0833 ft
Well Radius: 0.2448 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.0004963 cm/sec
y0 = 1.485 ft



GW-981 FALLING HEAD SLUG TEST

Data Set: F:\Aqtesolve\Oak Ridge\GW-981 Bar In.aqt
Date: 04/02/18 Time: 13:55:39

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-981
Test Date: 3/7/18

AQUIFER DATA

Saturated Thickness: 9.7 ft
Anisotropy Ratio (Kz/Kr): 0.5

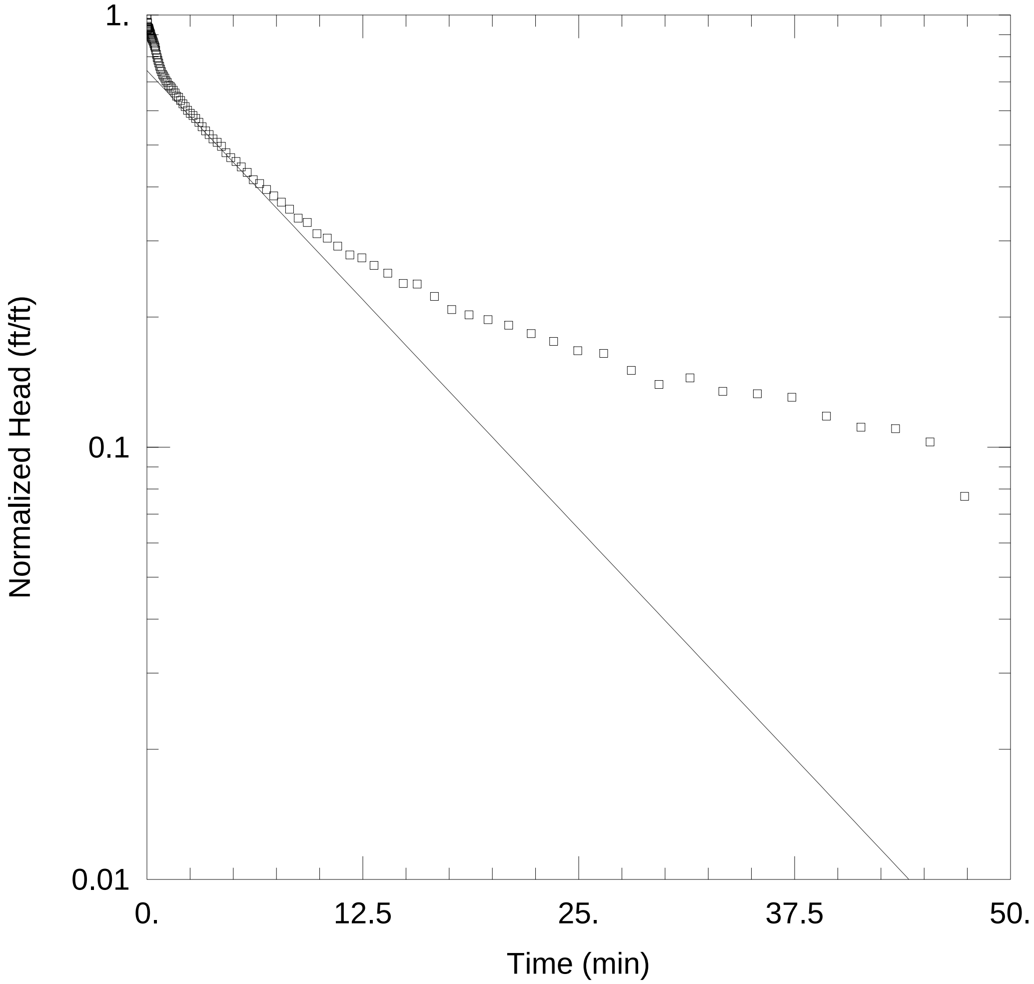
WELL DATA (GW-981)

Initial Displacement: 1.01 ft
Static Water Column Height: 10.96 ft
Total Well Penetration Depth: 9.7 ft
Screen Length: 9.7 ft
Casing Radius: 0.0833 ft
Well Radius: 0.3125 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 6.392E-5 cm/sec
y0 = 0.8843 ft



GW-981 RISING HEAD SLUG TEST

Data Set: F:\Aqtesolve\Oak Ridge\GW-981 Bar Out.aqt
Date: 04/02/18 Time: 13:56:17

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-981
Test Date: 3/7/18

AQUIFER DATA

Saturated Thickness: 9.7 ft
Anisotropy Ratio (Kz/Kr): 0.5

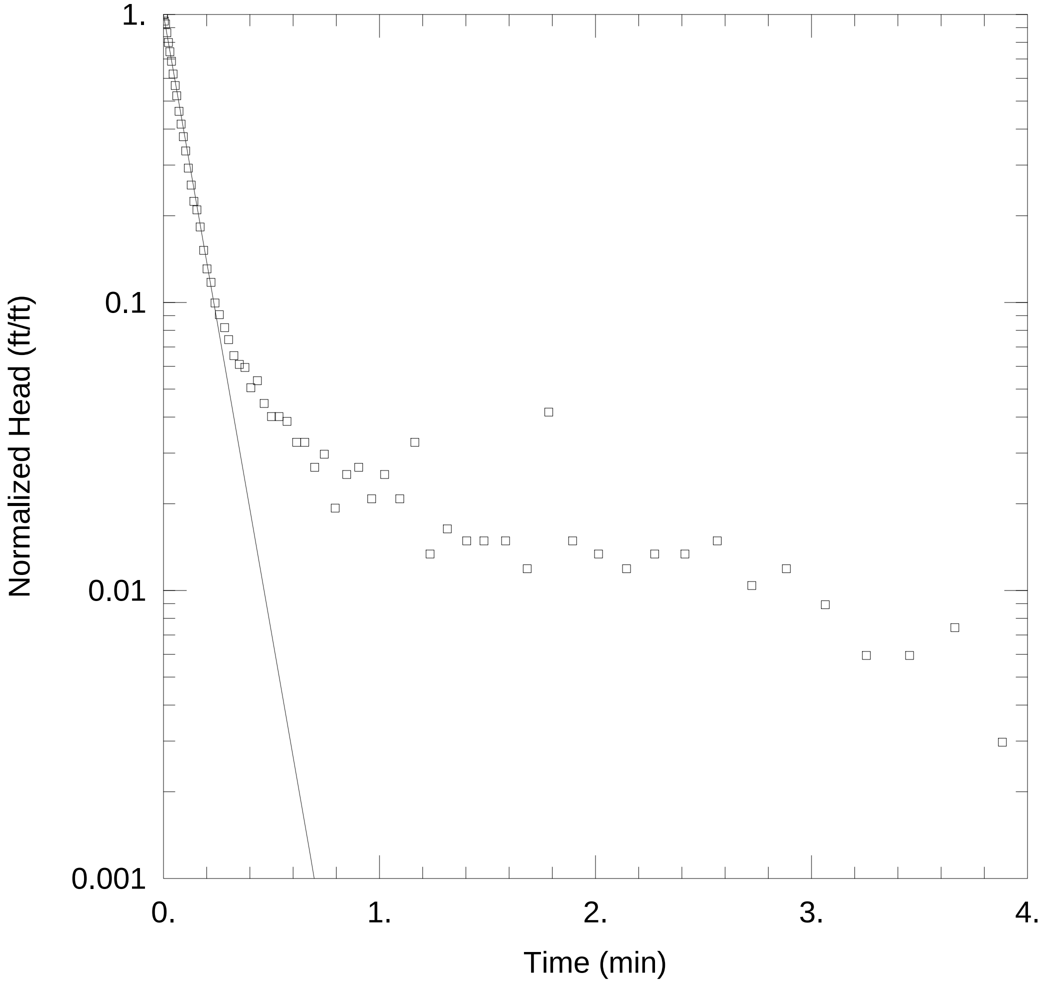
WELL DATA (GW-981)

Initial Displacement: 1.196 ft
Static Water Column Height: 11.03 ft
Total Well Penetration Depth: 9.7 ft
Screen Length: 9.7 ft
Casing Radius: 0.0833 ft
Well Radius: 0.3125 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 4.613E-5 cm/sec
y0 = 0.8893 ft



GW-983 FALLING HEAD SLUG TEST

Data Set: F:\Aqtesolve\Oak Ridge\GW-983 Bar In.aqt
Date: 04/02/18 Time: 13:56:48

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-983
Test Date: 3/6/18

AQUIFER DATA

Saturated Thickness: 9.7 ft
Anisotropy Ratio (Kz/Kr): 0.5

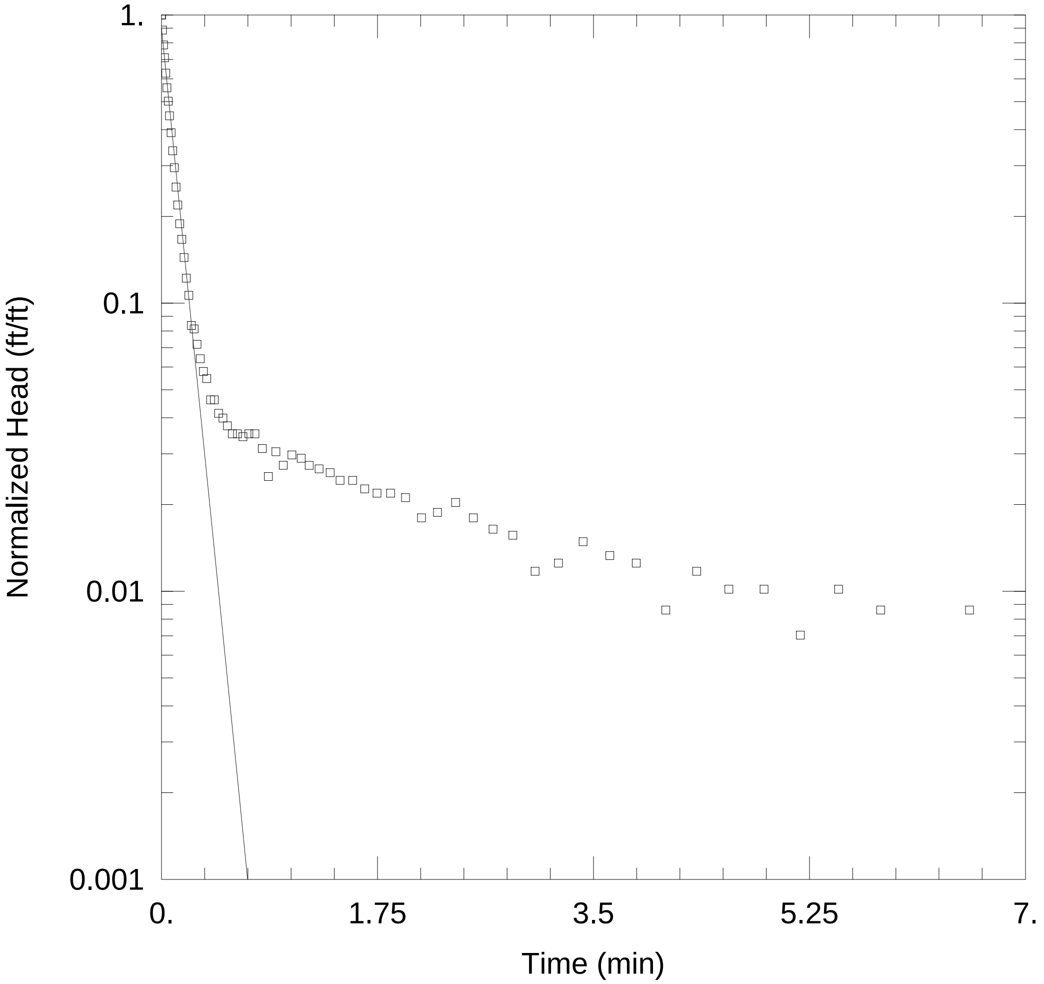
WELL DATA (GW-983)

Initial Displacement: 0.673 ft
Static Water Column Height: 26.14 ft
Total Well Penetration Depth: 9.7 ft
Screen Length: 9.7 ft
Casing Radius: 0.0833 ft
Well Radius: 0.2447 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.005039 cm/sec
y0 = 0.6725 ft



GW-983 RISING HEAD SLUG TEST

Data Set: F:\Aqtesolve\Oak Ridge\GW-983 Bar Out.aqt
Date: 04/02/18 Time: 13:57:24

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-983
Test Date: 3/6/18

AQUIFER DATA

Saturated Thickness: 9.7 ft
Anisotropy Ratio (Kz/Kr): 0.5

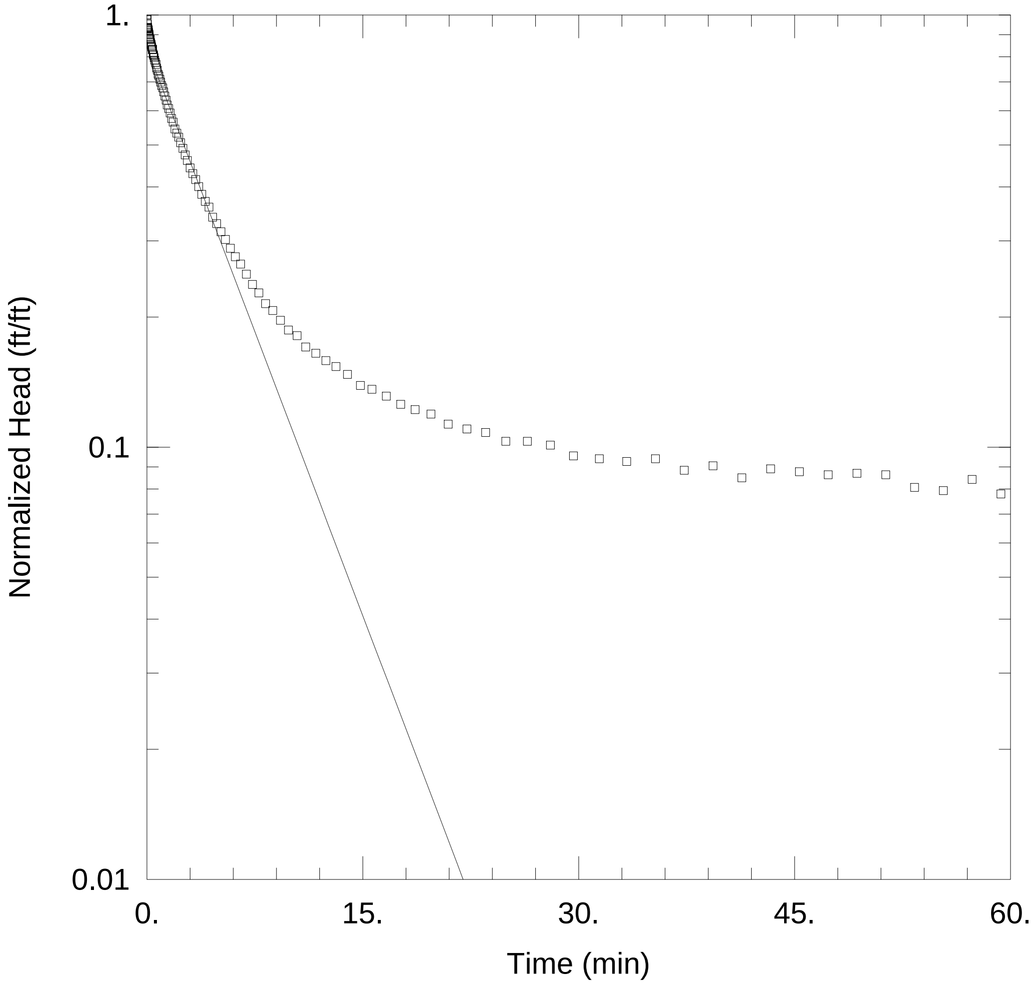
WELL DATA (GW-983)

Initial Displacement: 1.279 ft
Static Water Column Height: 26.16 ft
Total Well Penetration Depth: 9.7 ft
Screen Length: 9.7 ft
Casing Radius: 0.0833 ft
Well Radius: 0.2447 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.004961 cm/sec
y0 = 1.15 ft



GW-987 FALLING HEAD SLUG TEST

Data Set: F:\Aqtesolve\Oak Ridge\GW-987 Bar In.aqt
Date: 04/02/18 Time: 10:37:23

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-987
Test Date: 3/6/18

AQUIFER DATA

Saturated Thickness: 9.7 ft
Anisotropy Ratio (Kz/Kr): 0.5

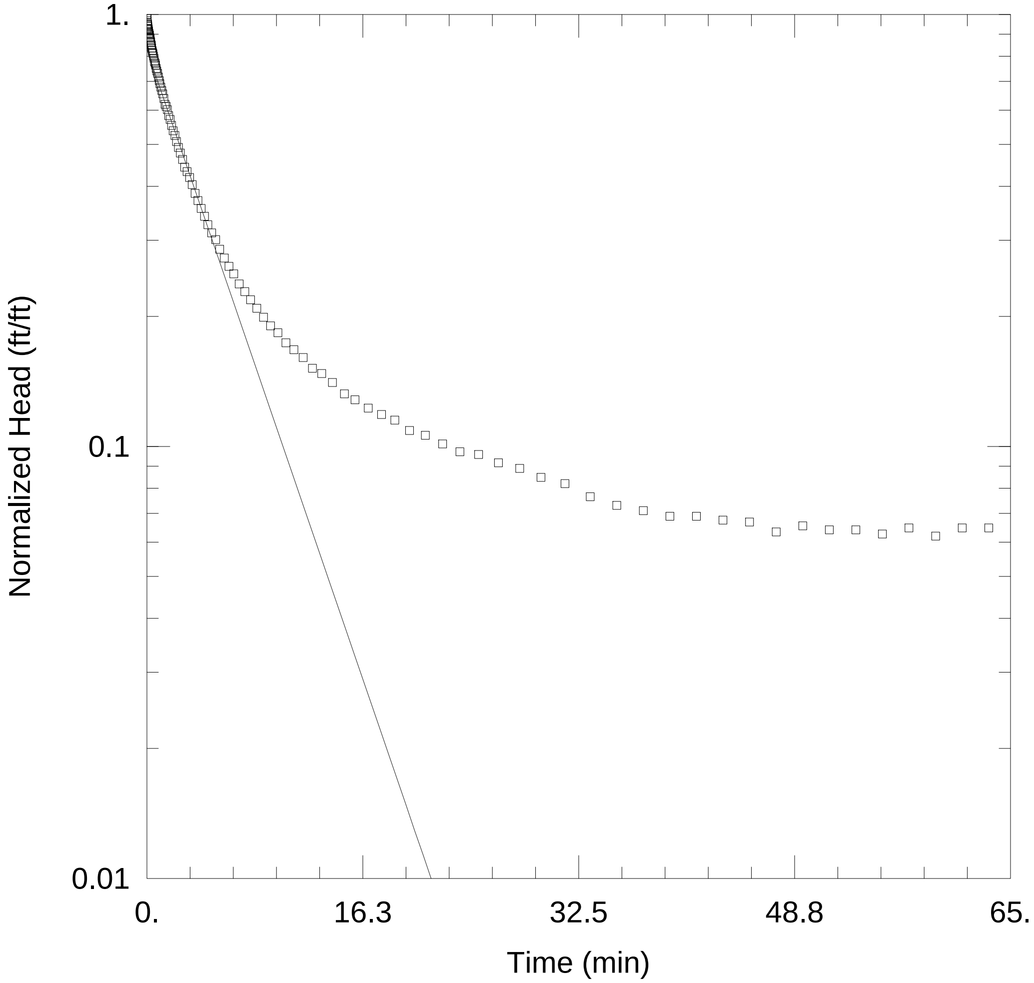
WELL DATA (GW-987)

Initial Displacement: 1.425 ft
Static Water Column Height: 19.45 ft
Total Well Penetration Depth: 9.7 ft
Screen Length: 9.7 ft
Casing Radius: 0.0833 ft
Well Radius: 0.3125 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 9.52E-5 cm/sec
y0 = 1.195 ft



GW-987 RISING HEAD SLUG TEST

Data Set: F:\Aqtesolve\Oak Ridge\GW-987 Bar Out.aqt
Date: 04/02/18 Time: 10:37:25

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-987
Test Date: 3/7/18

AQUIFER DATA

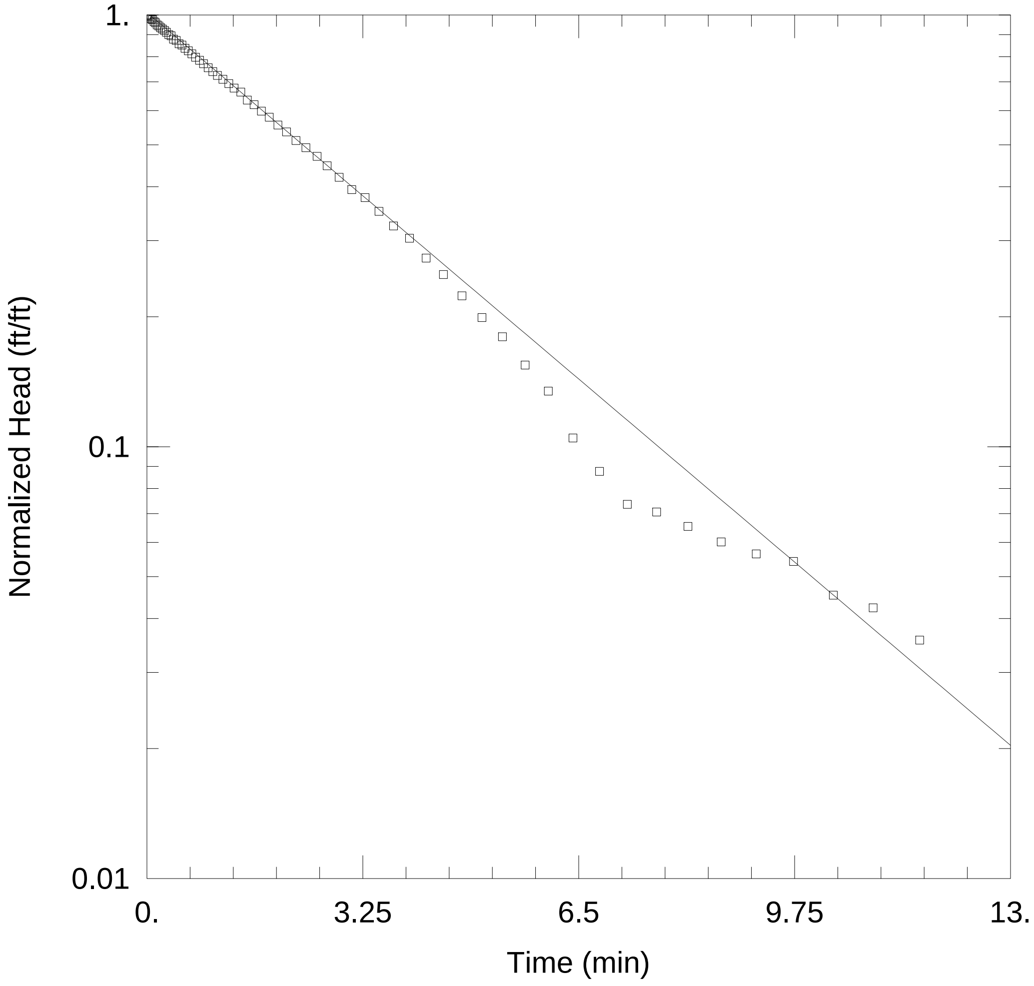
Saturated Thickness: 9.7 ft
Anisotropy Ratio (Kz/Kr): 0.5

WELL DATA (GW-987)

Initial Displacement: 1.451 ft
Static Water Column Height: 18.84 ft
Total Well Penetration Depth: 9.7 ft
Screen Length: 9.7 ft
Casing Radius: 0.0833 ft
Well Radius: 0.3125 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 9.748E-5 cm/sec
y0 = 1.201 ft



GW-989 FALLING HEAD SLUG TEST

Data Set: F:\Aqtesolve\Oak Ridge\GW-989 Bar In.aqt
Date: 04/02/18 Time: 10:37:28

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-989
Test Date: 3/7/18

AQUIFER DATA

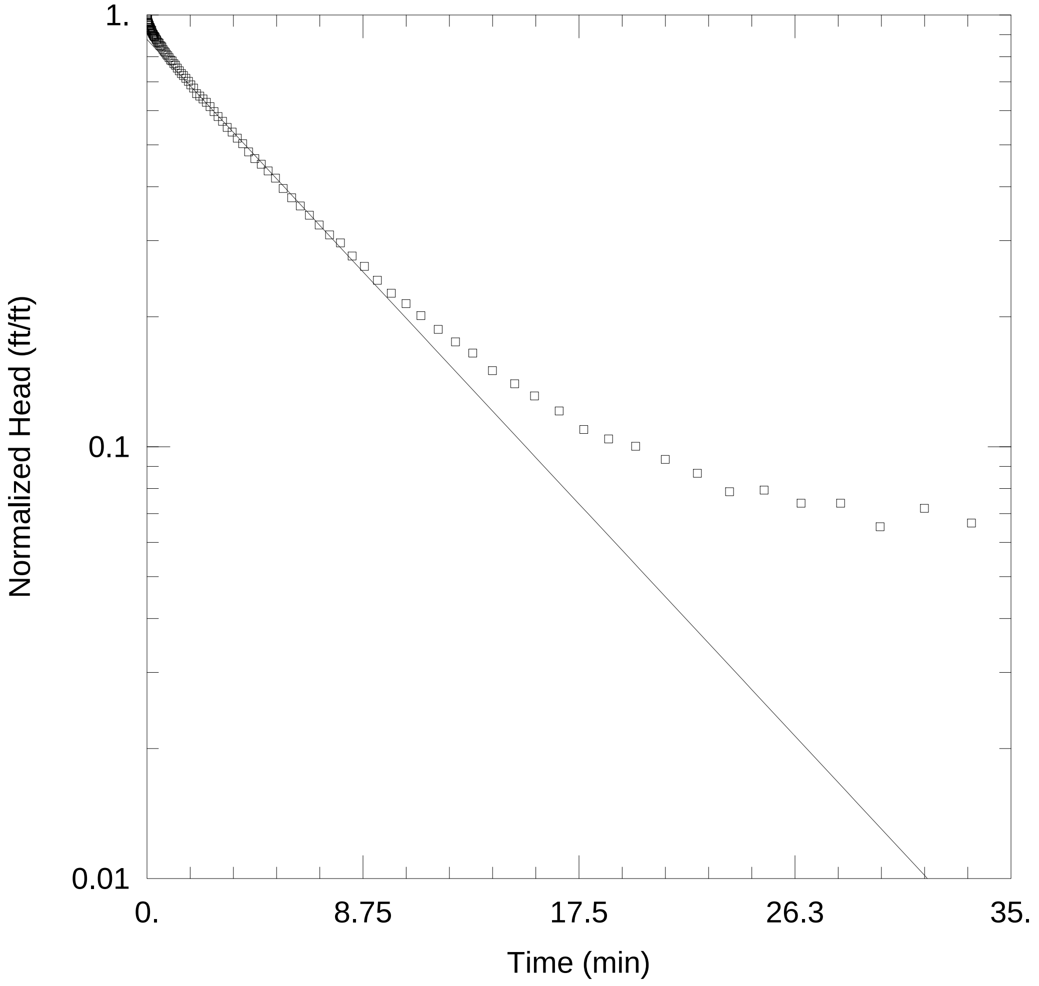
Saturated Thickness: 9.7 ft
Anisotropy Ratio (Kz/Kr): 0.5

WELL DATA (GW-989)

Initial Displacement: 1.346 ft
Static Water Column Height: 31.59 ft
Total Well Penetration Depth: 9.7 ft
Screen Length: 9.7 ft
Casing Radius: 0.0833 ft
Well Radius: 0.3125 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.000142 cm/sec
y0 = 1.364 ft



GW-989 RISING HEAD SLUG TEST

Data Set: F:\Aqtesolve\Oak Ridge\GW-989 Bar Out.aqt
Date: 04/02/18 Time: 10:40:11

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-989
Test Date: 3/7/18

AQUIFER DATA

Saturated Thickness: 9.7 ft
Anisotropy Ratio (Kz/Kr): 0.5

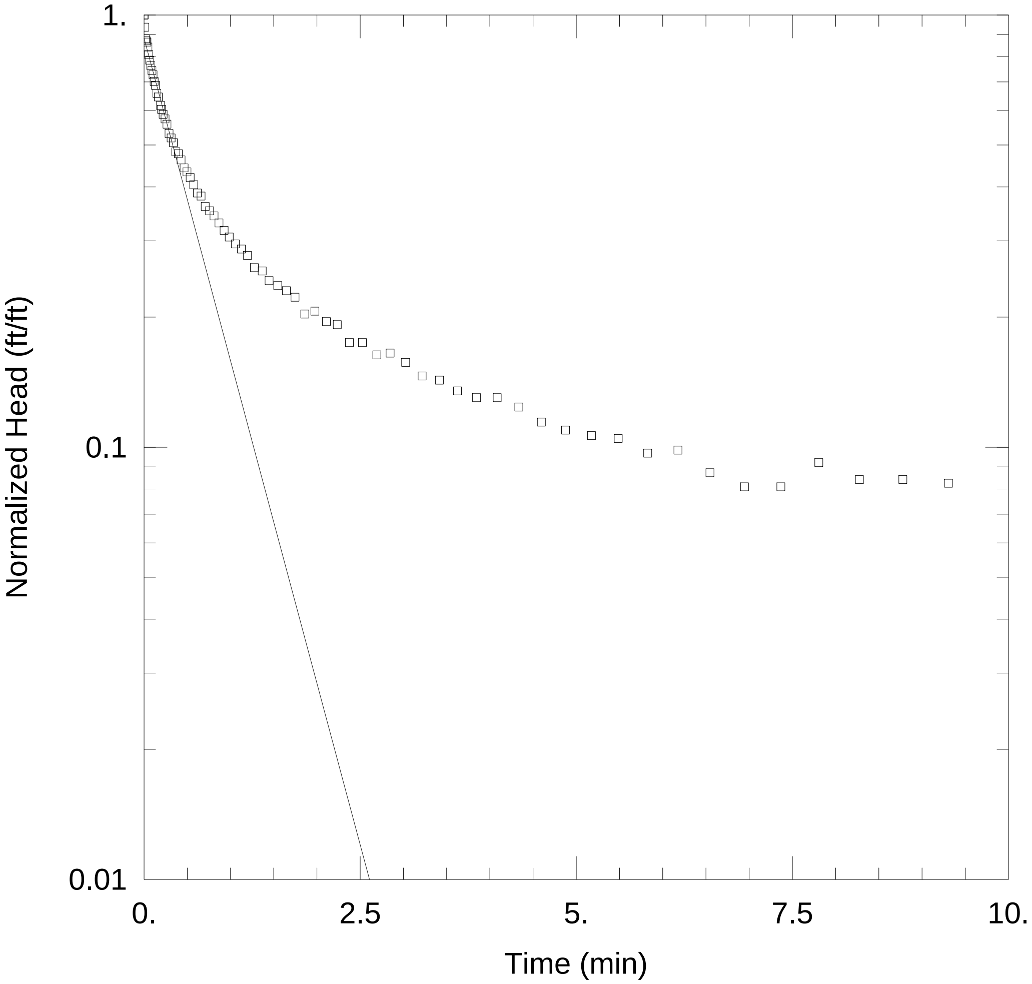
WELL DATA (GW-989)

Initial Displacement: 1.487 ft
Static Water Column Height: 31.61 ft
Total Well Penetration Depth: 9.7 ft
Screen Length: 9.7 ft
Casing Radius: 0.0833 ft
Well Radius: 0.3125 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 6.684E-5 cm/sec
y0 = 1.305 ft



GW-993 FALLING HEAD SLUG TEST R(W) = 0.725

Data Set: F:\Aqtesolve\Oak Ridge\GW-993 Bar In r(w) = 0.725.aqt
Date: 04/02/18 Time: 13:58:11

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-993
Test Date: 3/7/18

AQUIFER DATA

Saturated Thickness: 9.7 ft
Anisotropy Ratio (Kz/Kr): 0.5

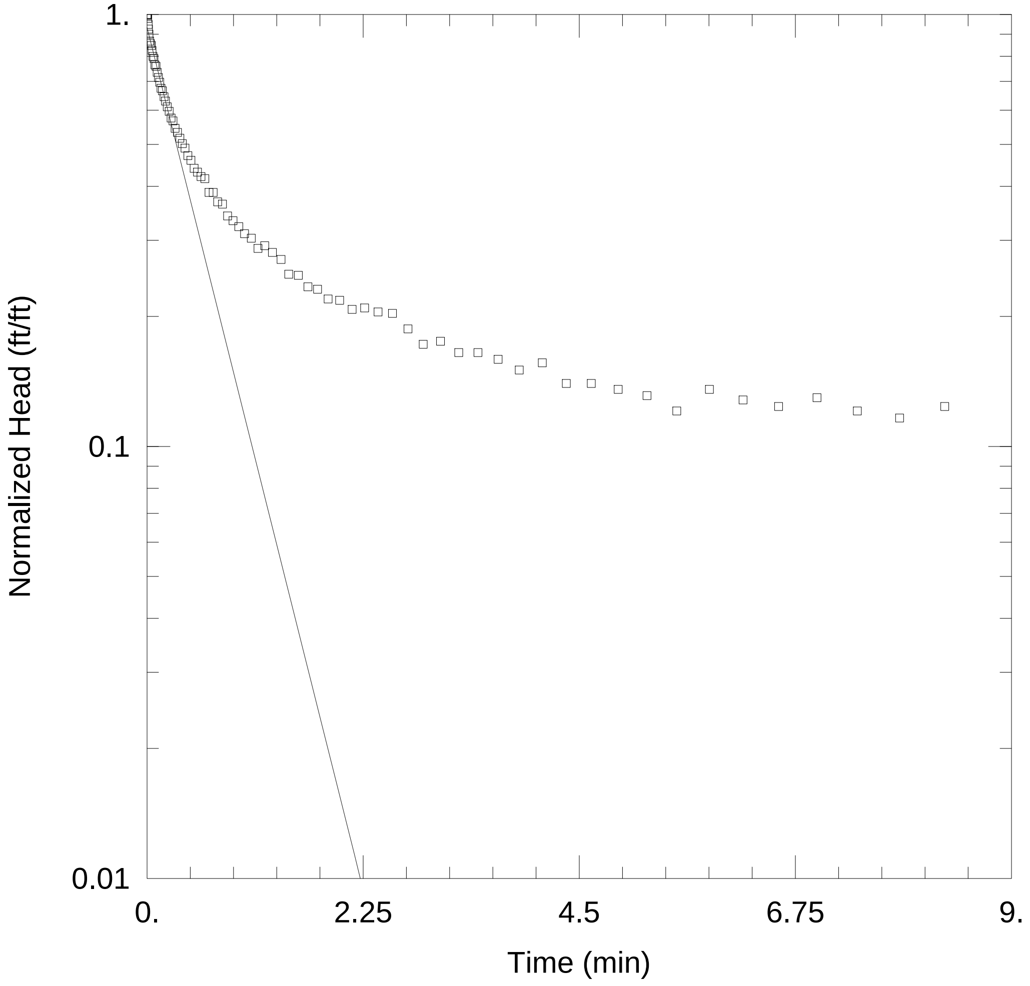
WELL DATA (GW-993)

Initial Displacement: 0.63 ft
Static Water Column Height: 28.46 ft
Total Well Penetration Depth: 9.7 ft
Screen Length: 9.7 ft
Casing Radius: 0.0833 ft
Well Radius: 0.725 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.0005875 cm/sec
y0 = 0.5567 ft



GW-993 RISING HEAD SLUG TEST R(W) = 0.725

Data Set: F:\Aqtesolve\Oak Ridge\GW-993 Bar Out r(w) = 0.725.aqt
Date: 04/02/18 Time: 13:58:47

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-993
Test Date: 3/7/18

AQUIFER DATA

Saturated Thickness: 9.7 ft
Anisotropy Ratio (Kz/Kr): 0.5

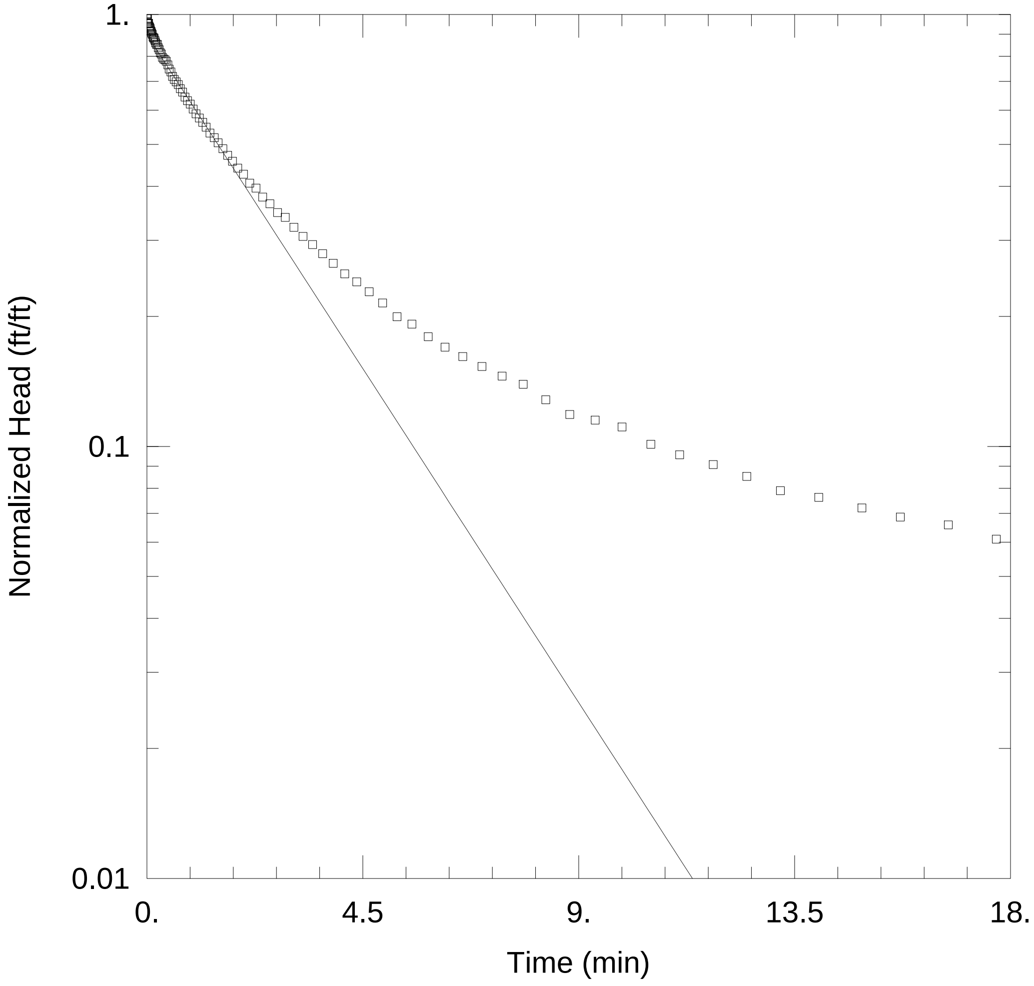
WELL DATA (GW-993)

Initial Displacement: 0.679 ft
Static Water Column Height: 28.51 ft
Total Well Penetration Depth: 9.7 ft
Screen Length: 9.7 ft
Casing Radius: 0.0833 ft
Well Radius: 0.725 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.0006977 cm/sec
y0 = 0.6329 ft



GW-995 FALLING HEAD SLUG TEST

Data Set: F:\Aqtesolve\Oak Ridge\GW-995 Bar In.aqt
Date: 04/02/18 Time: 10:40:40

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-995
Test Date: 3/5/18

AQUIFER DATA

Saturated Thickness: 9.8 ft
Anisotropy Ratio (Kz/Kr): 0.5

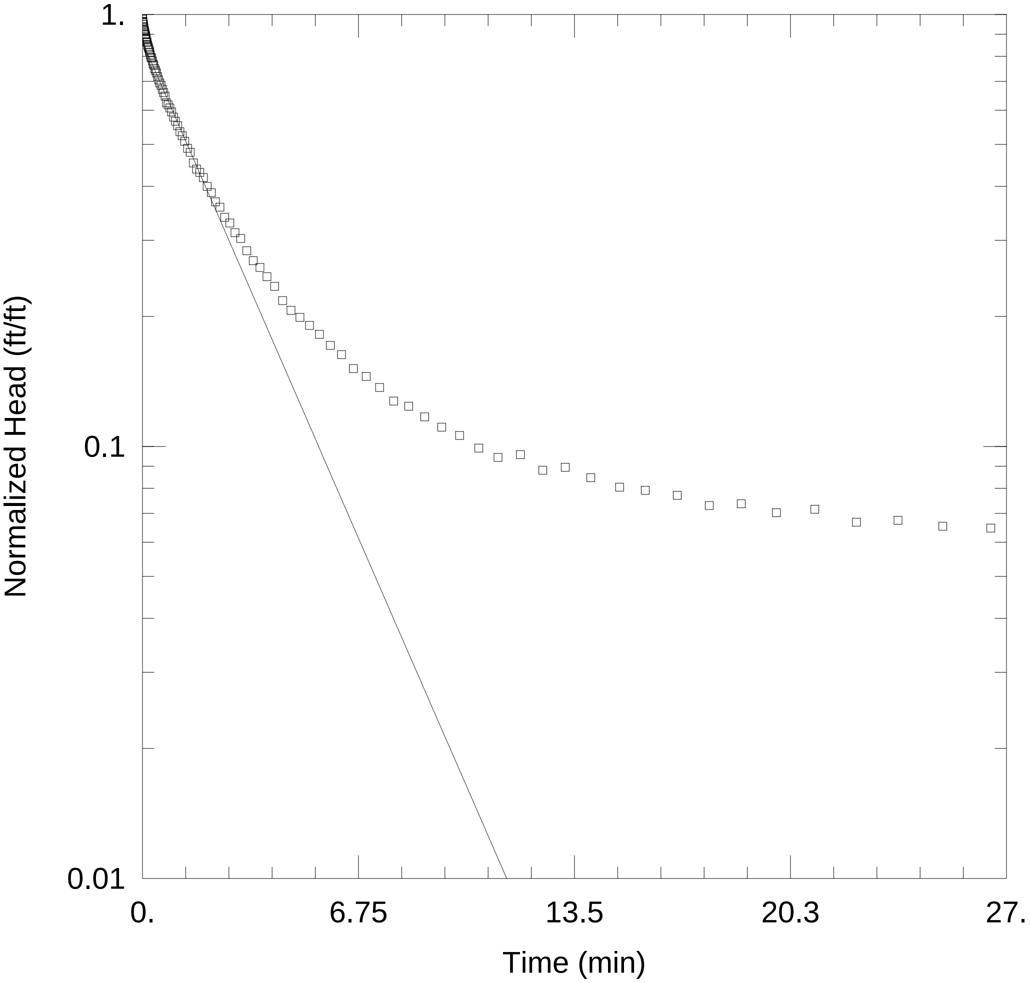
WELL DATA (GW-995)

Initial Displacement: 1.443 ft
Static Water Column Height: 24.05 ft
Total Well Penetration Depth: 9.8 ft
Screen Length: 9.8 ft
Casing Radius: 0.0833 ft
Well Radius: 0.3125 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.0001854 cm/sec
y0 = 1.295 ft



GW-995 RISING HEAD SLUG TEST

Data Set: F:\Aqtesolve\Oak Ridge\GW-995 Bar Out.aqt
Date: 04/02/18 Time: 10:40:43

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-995
Test Date: 3/5/18

AQUIFER DATA

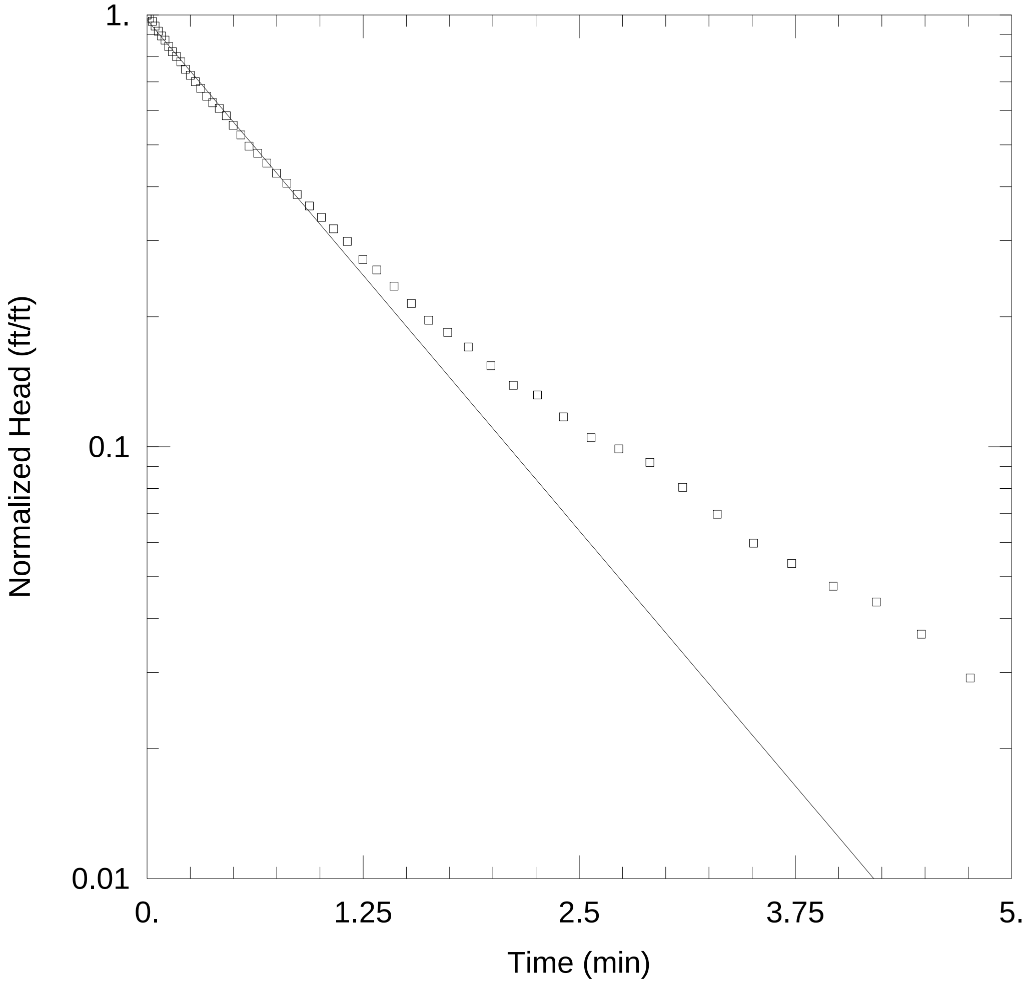
Saturated Thickness: 9.8 ft
Anisotropy Ratio (Kz/Kr): 0.5

WELL DATA (GW-995)

Initial Displacement: 1.453 ft
Static Water Column Height: 24.07 ft
Total Well Penetration Depth: 9.8 ft
Screen Length: 9.8 ft
Casing Radius: 0.0833 ft
Well Radius: 0.3125 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.0001837 cm/sec
y0 = 1.256 ft



GW-999 FALLING HEAD SLUG TEST

Data Set: F:\Aqtesolve\Oak Ridge\GW-999 Bar In.aqt
Date: 04/02/18 Time: 14:00:42

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-999
Test Date: 3/6/18

AQUIFER DATA

Saturated Thickness: 9.7 ft
Anisotropy Ratio (Kz/Kr): 0.5

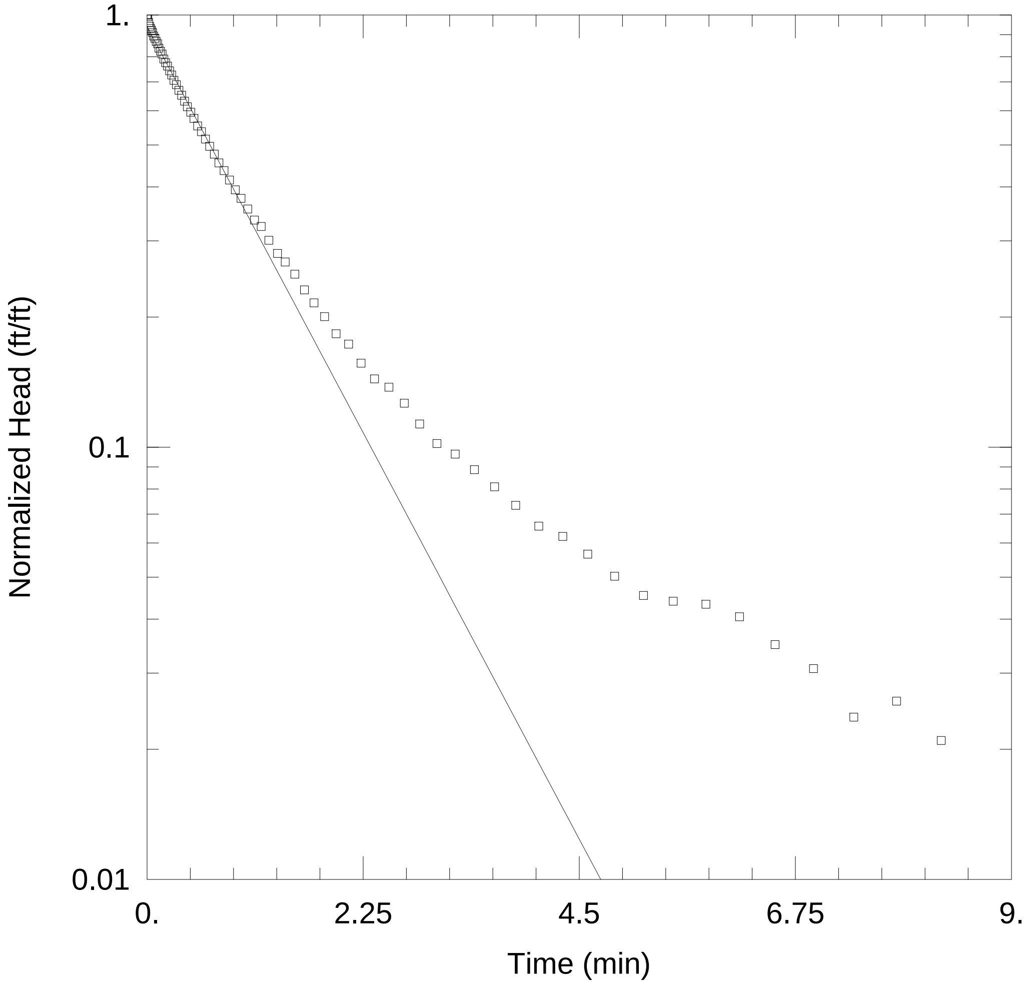
WELL DATA (GW-999)

Initial Displacement: 1.305 ft
Static Water Column Height: 18.3 ft
Total Well Penetration Depth: 9.7 ft
Screen Length: 9.7 ft
Casing Radius: 0.0833 ft
Well Radius: 0.3125 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.0005143 cm/sec
y0 = 1.27 ft



GW-999 RISING HEAD SLUG TEST

Data Set: F:\Aqtesolve\Oak Ridge\GW-999 Bar Out.aqt
Date: 04/02/18 Time: 14:01:31

PROJECT INFORMATION

Company: EAGON & ASSOCIATES, INC.
Client: EMDF Characterization Project
Location: Oak Ridge, TN
Test Well: GW-999
Test Date: 3/6/18

AQUIFER DATA

Saturated Thickness: 9.7 ft
Anisotropy Ratio (Kz/Kr): 0.5

WELL DATA (GW-999)

Initial Displacement: 1.432 ft
Static Water Column Height: 18.33 ft
Total Well Penetration Depth: 9.7 ft
Screen Length: 9.7 ft
Casing Radius: 0.0833 ft
Well Radius: 0.3125 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.0004542 cm/sec
y0 = 1.346 ft

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APPENDIX D

FLUTe™ TESTS

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APPENDIX D

FLUTe Tests

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GW-978

Results of FLUTe profiling for hole no. GW-978 for *Strata-G Oak Ridge*

Water Table depth	10.75	ft BGS
Hole depth	82.08	ft BGS
liner length	85	ft BGS
casing depth	27	ft BGS
hole diameter	6	inches
liner diameter	0	inches
date of measurement	2/19/2018	

The profile was measured to a depth of 76.845 ft

The flow rate per unit driving pressure was 0.01 **gal/min/ft**

The transmissivity for the remainder of the hole is: 0.020705 cm sq./sec

The average conductivity for the remaining 5.2346 ft of the hole is 1.30E-04 cm/sec

Total borehole transmissivity is 0.161636 cm2/s

Comments:

Contact for questions about data or reduction

carl Keller

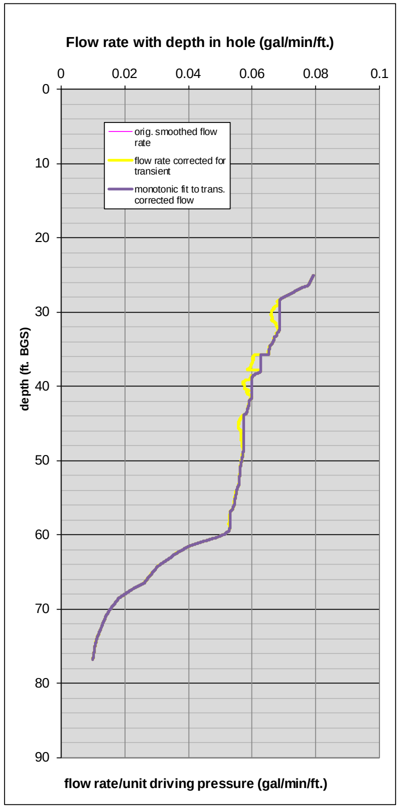
Phone: 505-455-1300

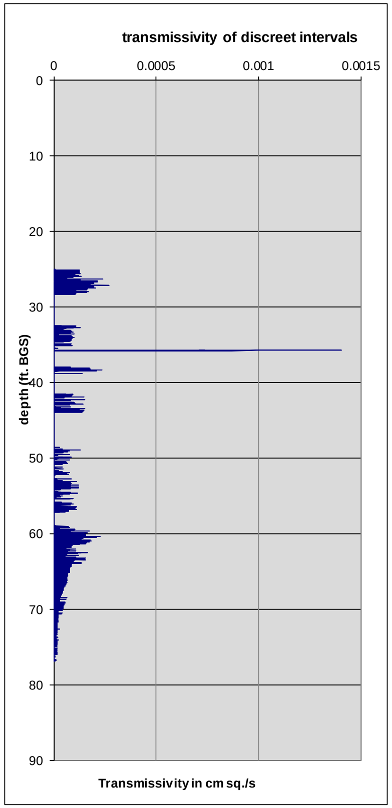
Note: the flow rate curve is the liner velocity multiplied by the borehole cross section

A drop in flow rate is usually associated with loss into the hole wall.
The magnitude of the drop in velocity is a direct measure of the loss into the hole wall.
The agreement between the black monotonic fit and the yellow smoothed flow/velocity curve of the first graph is an indication of the data reliability.
The transmissivity curve of the second graph is calculated from the monotonic flow rate curve.

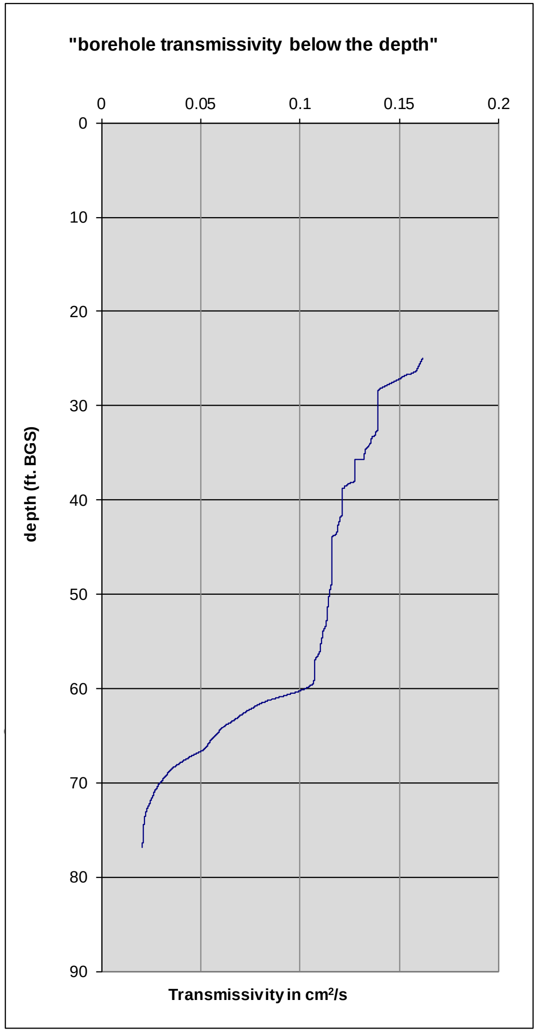
GW-978

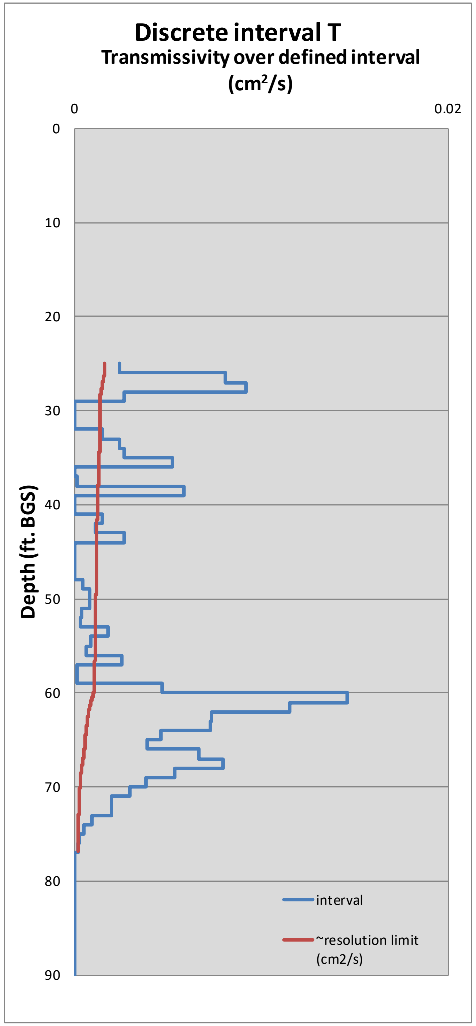
Monotonic curve (black over yellow) is corrected for the transient

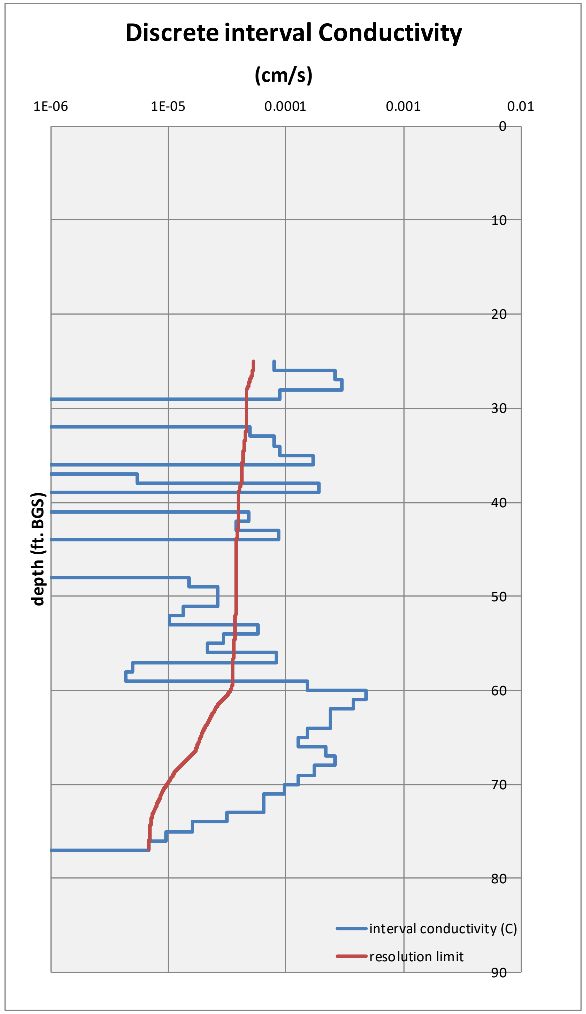




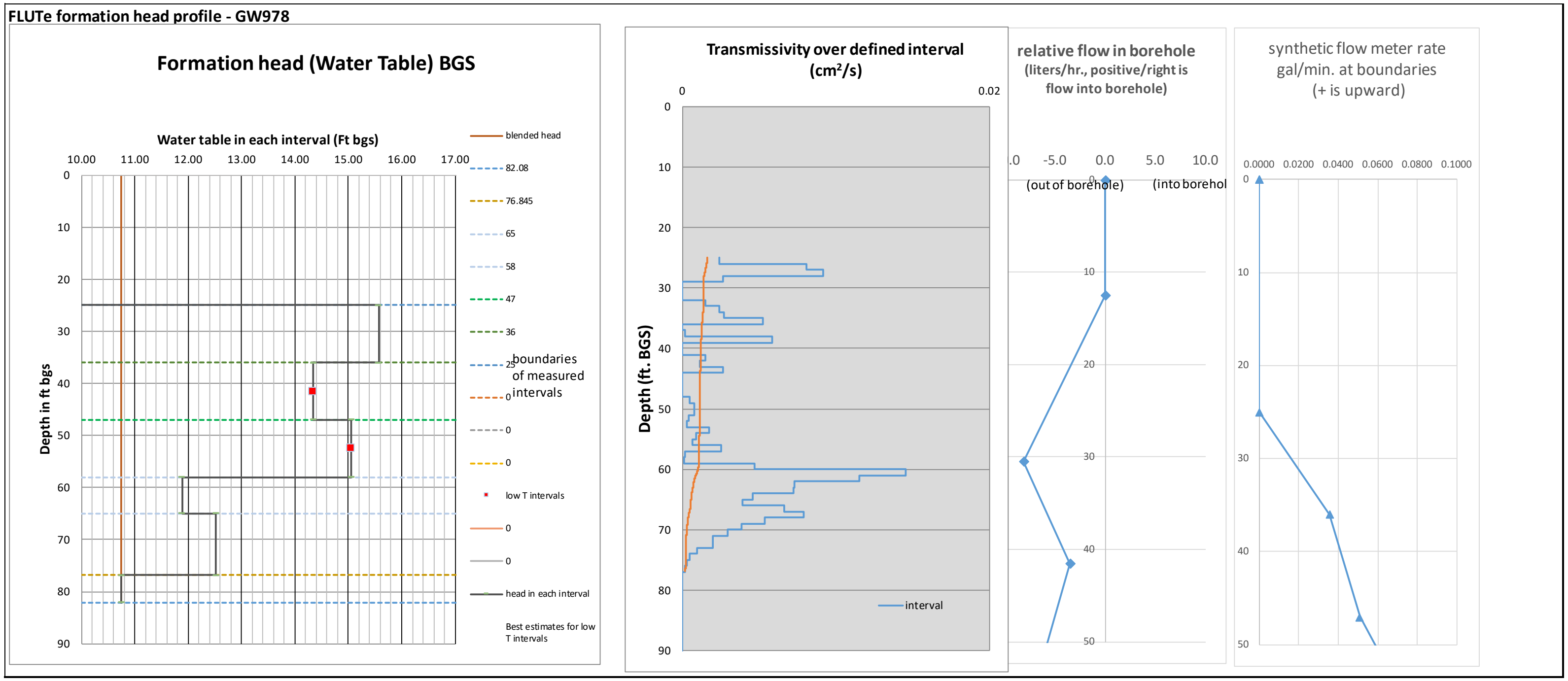
GW-978


"borehole transmissivity below the depth"


Discrete interval T
Transmissivity over defined interval (cm²/s)


Discrete interval Conductivity
(cm/s)

GW-978



The first graph shows the head profile calculated over the interval of measurement. The assumption is that the head is constant between the "stopping elevations", the depth at which the liner is stopped to allow equilibration below the liner.

The bold red squares indicate that the calculation is unreliable because it depends of the measurement of a very low transmissivity in the measurement interval. That is because the FLUTe transmissivity profiling method does not measure the transmissivity to better than 1% of the transmissvity below the depth of the liner.

The estimated heads for the red square intervals are based on the either the equilibrium heads measured or assumed to lie between the more reliable head in the higher flow zone above and below the low transmissivity interval. It is reasonable to assume that the head in the low T interval with be between the higher flow zones above and below the low T interval.

The first, and deepest, interval is very reliable because the transducer is allowed to equilibrate in that interval totally isolated by the bottom of the borehole and the liner above. It is also a low transmissivity interval because the liner is halted with only a low remaining transmissivity.

The Second graph is the transmissivity distribution from the FLUTe T profile which is used in the head profile.
The Third graph is the flow calculated into and out of the open borehole using the transmissivity of each interval, the head calculated, and the open hole blended head.
The Fourth graph is the a synthetic flow log based on the third graph data. The flow is plotted at the boundaries of the measurement intervals.

GW-978

Reverse head profile Borehole no. GW-978 Oak Ridge Strata G date: **2/19/2018**

interval depths (ft)	head in the interval (ft bgs)	blended head	top of interval	bottom of interval	Water table in formation (ft bgs)	interval	mid point of intervals (ft)	flow into/out of hole (liters/hr)	synthetic flow meter rate gal/min at boundaries	low T intervals	boundries of meas. i		range of plot		DTi used in the calculation (cm2/s)	If below not equal to 1.0, DTi was modified	Best estimates for low T intervals
82.08	10.75	10.75	76.845	82.08	10.75	1	80.46	6.03709585	0.0265	0	82.08	82.08	0	100	0.020705418	1	
76.845	10.75	10.75	65	76.845	12.5196905	2	70.9225	3.561968762	0.0421	0	76.845	76.845	0	100	0.036575691	1	13.1617324
76.845	12.51969	10.75	58	65	11.8847998	3	61.5	8.367427113	0.0788	0	65	65	0	100	0.050088902	1	13.1617324
65	12.51969	10.75	47	58	15.0609197	4	52.5	-6.35009474	0.0509	15.06091965	58	58	0	100	0.034994892	4	13.1617324
65	11.8848	10.75	36	47	14.34278	5	41.5	-3.49309741	0.0356	14.34277995	47	47	0	100	0.034026639	3	13.1617324
58	11.8848	10.75	25	36	15.5734649	6	30.5	-8.12329957	0.0000	0	36	36	0	100	0.034174829	1	
58	15.06092	10.75	0	25	#DIV/0!	7	12.5	#DIV/0!	#DIV/0!	#DIV/0!	25	25	0	100	0	1	
47	15.06092	10.75	0	0	#DIV/0!	8	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
47	14.34278	10.75	0	0	#DIV/0!	9	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
36	14.34278	10.75	0	0	#DIV/0!	10	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
36	15.57346	10.75	0	0	#DIV/0!	11	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
25	15.57346	10.75	0	0	#DIV/0!	12	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
25	#DIV/0!	10.75	0	0	#DIV/0!	13	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	14	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	15	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	16	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	17	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	18	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	19	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	20	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	21	0	#DIV/0!	0.0000	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!																
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0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																

total hole depth	82.08	ft bgs
hole diameter	0	in.
casing depth	0	ft bgs
casing diam.	0	in.

integral of hole flow
is 0?? **#DIV/0!**

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GW-982

Results of FLUTe profiling for hole

no. GW-982 for ***Strata-G Oak Ridge***

Water Table depth	52.375	ft BGS
Hole depth	125.3	ft BGS
liner length	130	ft BGS
casing depth	50	ft BGS
hole diameter	6	inches
liner diameter	6.5	inches
date of measurement	2/19/2019	

The profile was measured to a depth of 53.741 ft

The flow rate per unit driving pressure was 0.00217 **gal/min/ft**

The transmissivity for the remainder of the hole is: 0.0045 cm sq./sec

The average conductivity for the remaining 71.559 ft of the hole is 2.06E-06 cm/sec

Total borehole transmissivity is 0.051813 cm2/s

Comments:

Contact for questions about data or reduction

carl Keller

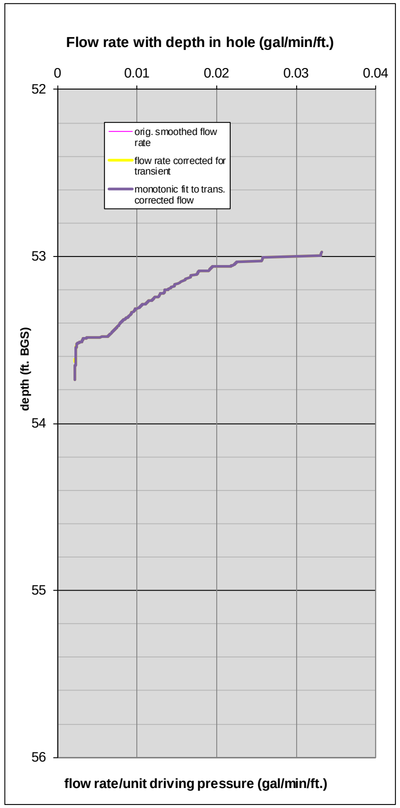
Phone: 505-455-1300

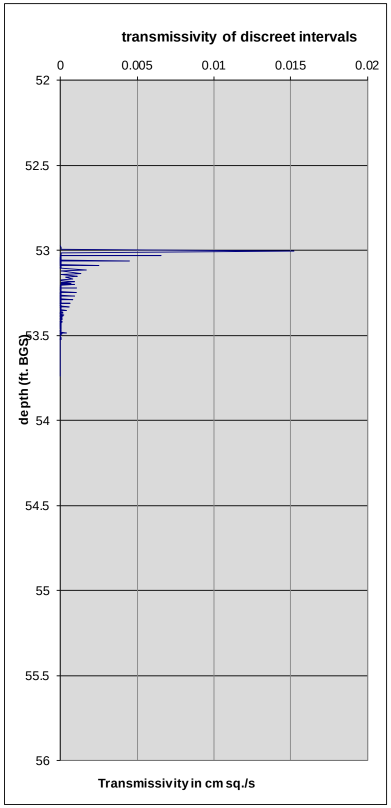
Note: the flow rate curve is the liner velocity multiplied by the borehole cross section

A drop in flow rate is usually associated with loss into the hole wall.
The magnitude of the drop in velocity is a direct measure of the loss into the hole wall.
The agreement between the black monotonic fit and the yellow smoothed flow/velocity curve of the first graph is an indication of the data reliability.
The transmissivity curve of the second graph is calculated from the monotonic flow rate curve.

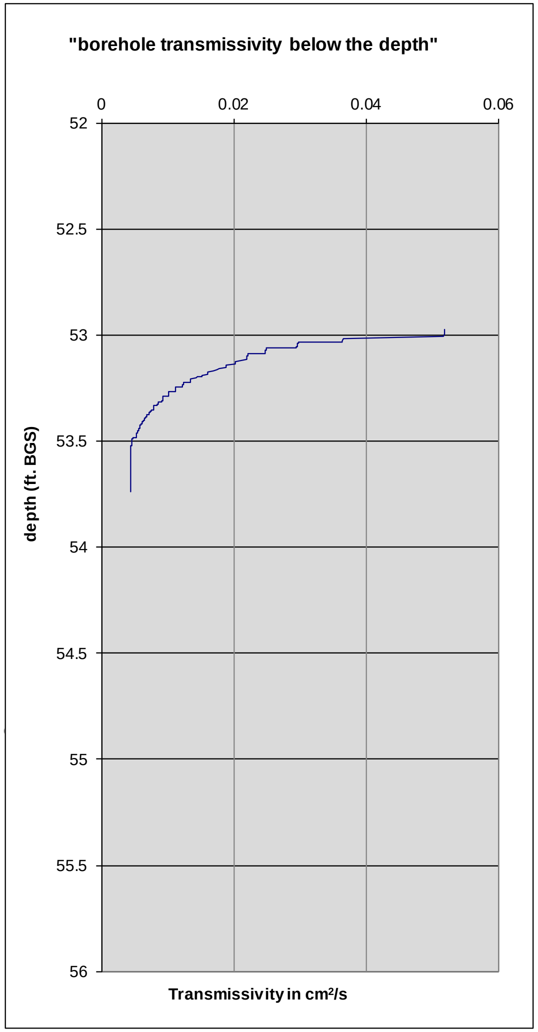
GW-982

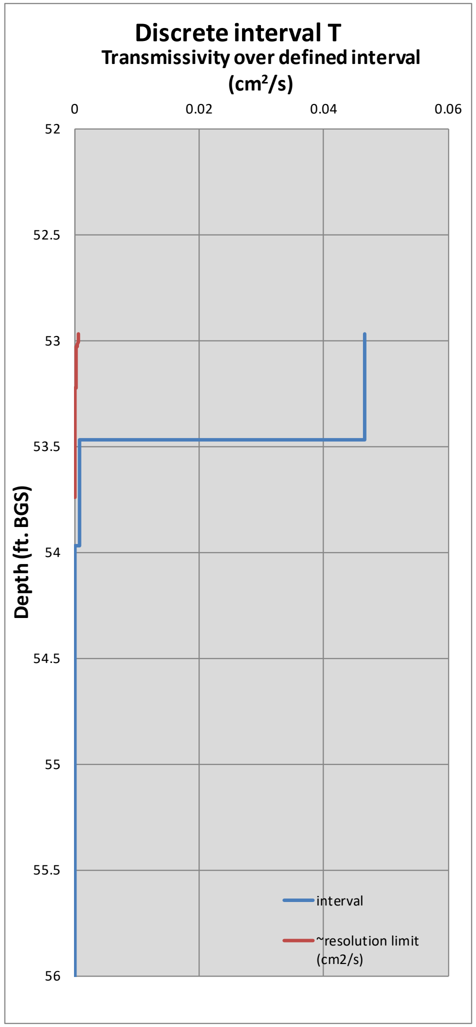
Monotonic curve (black over yellow) is corrected for the transient

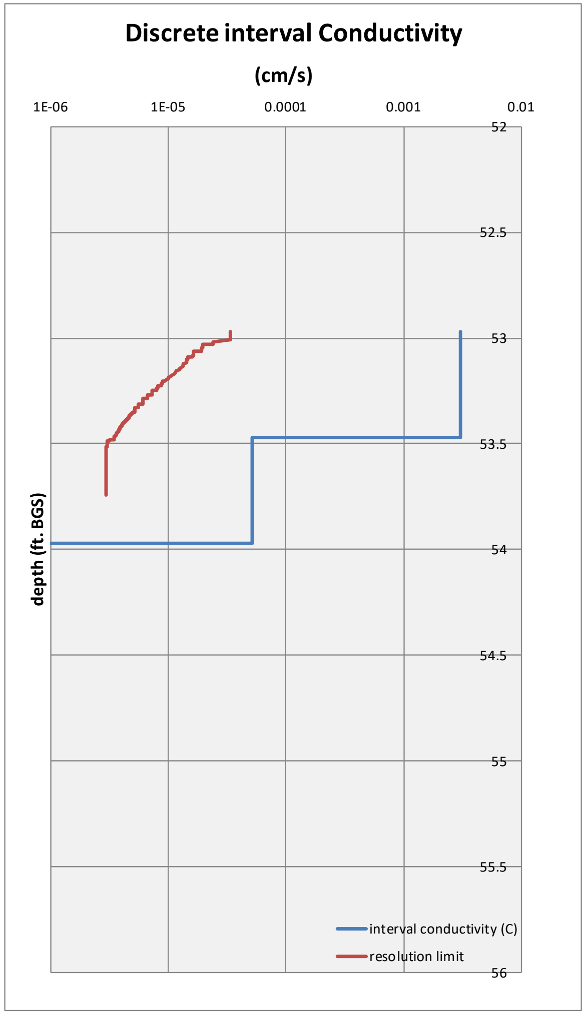




GW-982


"borehole transmissivity below the depth"


Discrete interval T
Transmissivity over defined interval
(cm²/s)


Discrete interval Conductivity
(cm/s)

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GW-986

Results of FLUTe profiling for hole no. GW-986 for ***Strata-G Oak Ridge***

Water Table depth	5	ft BGS
Hole depth	59.42	ft BGS
liner length	65	ft BGS
casing depth	20	ft BGS
hole diameter	6	inches
liner diameter	6.5	inches
date of measurement	2/23/2018	

The profile was measured to a depth of 49.173 ft

The flow rate per unit driving pressure was 0.01538 **gal/min/ft**

The transmissivity for the remainder of the hole is: 0.031841 cm sq./sec

The average conductivity for the remaining 10.247 ft of the hole is 1.02E-04 cm/sec

Total borehole transmissivity is 0.098617 cm2/s

Comments:

Contact for questions about data or reduction

carl Keller	
Phone:	505-455-1300

Note: the flow rate curve is the liner velocity multiplied by the borehole cross section

A drop in flow rate is usually associated with loss into the hole wall.

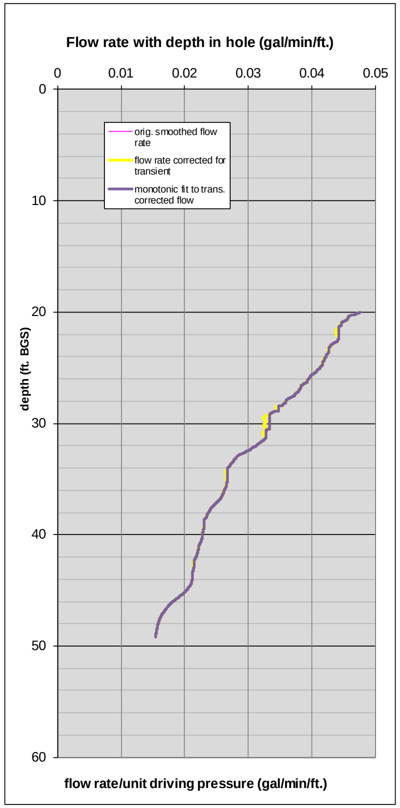
The magnitude of the drop in velocity is a direct measure of the loss into the hole wall.

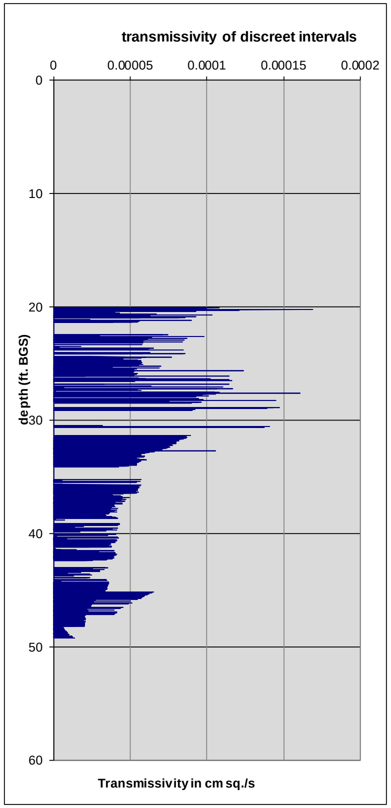
The agreement between the black monotonic fit and the yellow smoothed flow/velocity curve of the first graph is an indication of the data reliability.

The transmissivity curve of the second graph is calculated from the monotonic flow rate curve.

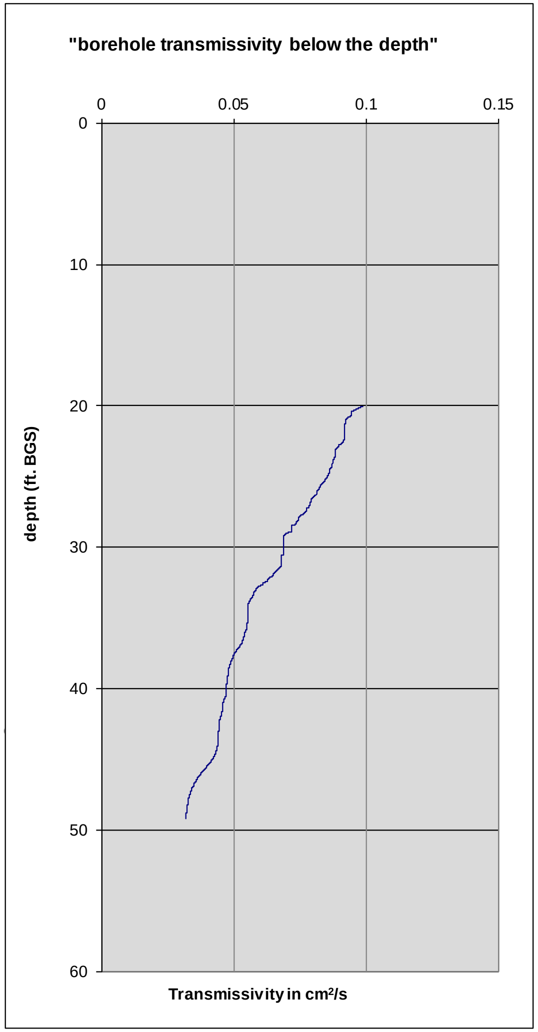
GW-986

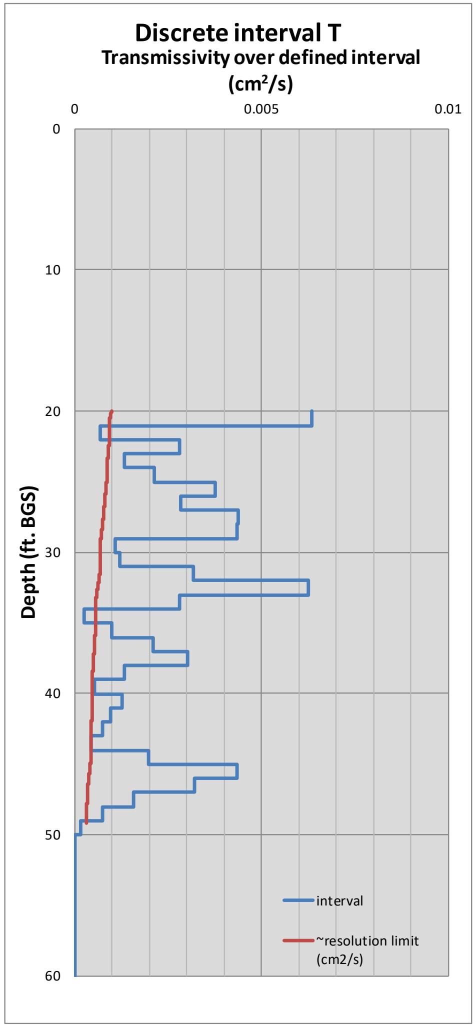
Monotonic curve (black over yellow) is corrected for the transient

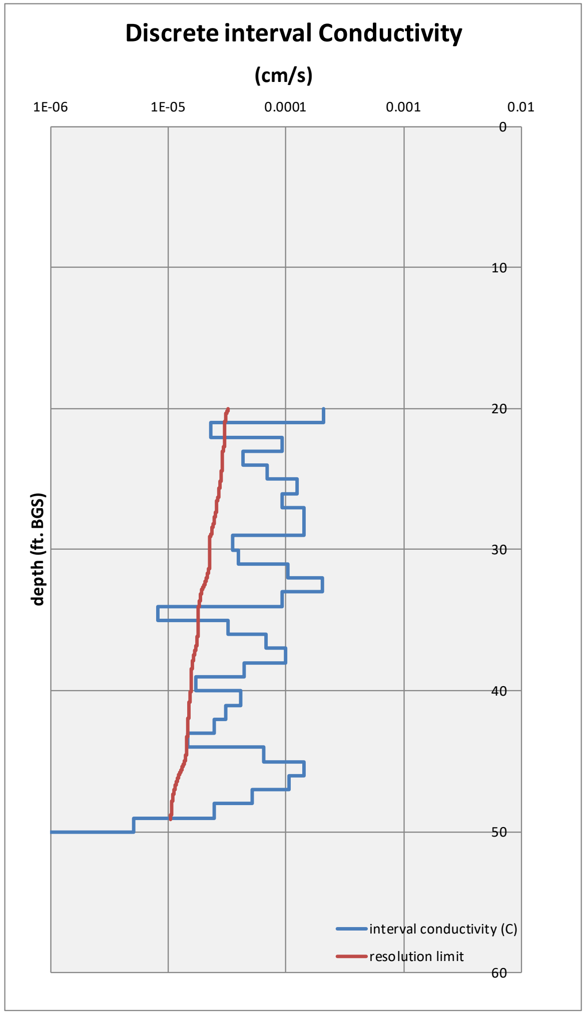




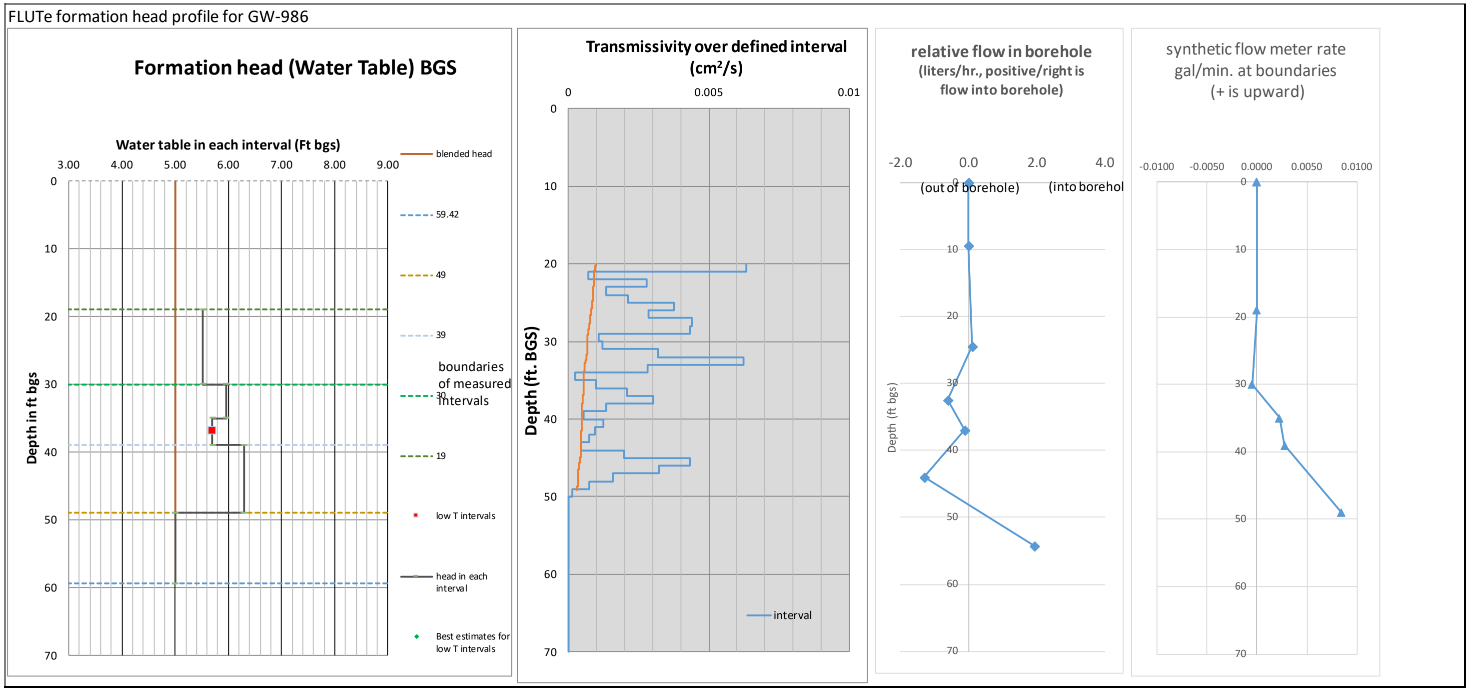
GW-986


"borehole transmissivity below the depth"
0
0.05
0.1
0.15
depth (ft. BGS)
0
10
20
30
40
50
60
Transmissivity in cm²/s


Discrete interval T
Transmissivity over defined interval
(cm²/s)
0
0.005
0.01
Depth (ft. BGS)
0
10
20
30
40
50
60
interval
~resolution limit
(cm2/s)


Discrete interval Conductivity
(cm/s)
1E-06
1E-05
0.0001
0.001
0.01
depth (ft. BGS)
0
10
20
30
40
50
60
interval conductivity (C)
resolution limit

GW-986



FLUTe formation head profile for GW-986

The first graph shows the head profile calculated over the interval of measurement. The assumption is that the head is constant between the "stopping elevations", the depth at which the liner is stopped to allow equilibration below the liner.

The bold red squares indicate that the calculation is unreliable because it depends of the measurement of a very low transmissivity in the measurement interval. That is because the FLUTe transmissivity profiling method does not measure the transmissivity to better than 1% of the transmissvity below the depth of the liner.

The estimated heads for the red square intervals are based on the either the equilibrium heads measured or assumed to lie between the more reliable head in the higher flow zone above and below the low transmissivity interval. It is reasonable to assume that the head in the low T interval with be between the higher flow zones above and below the low T interval.

The first, and deepest, interval is very reliable because the transducer is allowed to equilibrate in that interval totally isolated by the bottom of the borehole and the liner above. It is also a low transmissivity interval because the liner is halted with only a low remaining transmissivity.

The Second graph is the transmissivity distribution from the FLUTe T profile which is used in the head profile.
The Third graph is the flow calculated into and out of the open borehole using the transmissivity of each interval, the head calculated, and the open hole blended head.
The Fourth graph is the a synthetic flow log based on the third graph data. The flow is plotted at the boundaries of the measurement intervals.

GW-986

Reverse head profile Borehole no. GW-986 O. Ridge date: **2/23/2018**

interval depths (ft)	head in the interval (ft bgs)	blended head	top of interval	bottom of interval	Water table in formation (ft bgs)	interval	mid point of intervals (ft)	flow into/out of hole (liters/hr)	synthetic flow meter rate gal/min at boundaries	low T intervals	boundries of meas. i		range of plot		DTi used in the calculation (cm2/s)	If below not equal to 1.0, DTi was modified	Best estimates for low T intervals
59.42	5	5	49	59.42	5	1	54.295	1.927215	0.0085	0	59.42	59.42	0	100	0.031840557	1	
49	5	5	39	49	6.29331233	2	44	-1.2967647	0.0028	0	49	49	0	100	0.015933604	1	#DIV/0!
49	6.293312	5	35	39	5.70049765	3	37	-0.1215002	0.0022	5.700497648	39	39	0	100	0.007437049	1	#DIV/0!
39	6.293312	5	30	35	5.95886618	4	32.5	-0.6129673	-0.0005	0	35	35	0	100	0.013716775	1	#DIV/0!
39	5.700498	5	19	30	5.51968049	5	24.5	0.10401723	0.0000	0	30	30	0	100	0.029689104	1	#DIV/0!
35	5.700498	5	0	19	#DIV/0!	6	9.5	#DIV/0!	#DIV/0!	#DIV/0!	19	19	0	100	0	1	
35	5.958866	5	0	0	#DIV/0!	7	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
30	5.958866	5	0	0	#DIV/0!	8	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
30	5.51968	5	0	0	#DIV/0!	9	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
19	5.51968	5	0	0	#DIV/0!	10	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
19	5.51968	5	0	0	#DIV/0!	11	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	5	0	0	#DIV/0!	12	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	5	0	0	#DIV/0!	13	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	14	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	15	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	16	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	17	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	18	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	19	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	20	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	21	0	#DIV/0!	0.0000	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																

total hole depth	59.42	ft bgs
hole diameter	0	in.
casing depth	0	ft bgs
casing diam.	0	in.

integral of hole flow
is 0?? **#DIV/0!**

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GW-988

Results of FLUTe profiling for hole

no. GW-988 for ***Strata-G Oak Ridge***

Water Table depth	13.9	ft BGS
Hole depth	79	ft BGS
liner length	85	ft BGS
casing depth	36.5	ft BGS
hole diameter	6	inches
liner diameter	6.5	inches
date of measurement	2/22/2018	

The profile was measured to a depth of 75.365 ft

The flow rate per unit driving pressure was 0.02739 **gal/min/ft**

The transmissivity for the remainder of the hole is: 0.056714 cm sq./sec

The average conductivity for the remaining 3.6346 ft of the hole is 5.12E-04 cm/sec

Total borehole transmissivity is 0.106479 cm2/s

Comments:

Contact for questions about data or reduction

carl Keller	
Phone:	505-455-1300

Note: the flow rate curve is the liner velocity multiplied by the borehole cross section

A drop in flow rate is usually associated with loss into the hole wall.

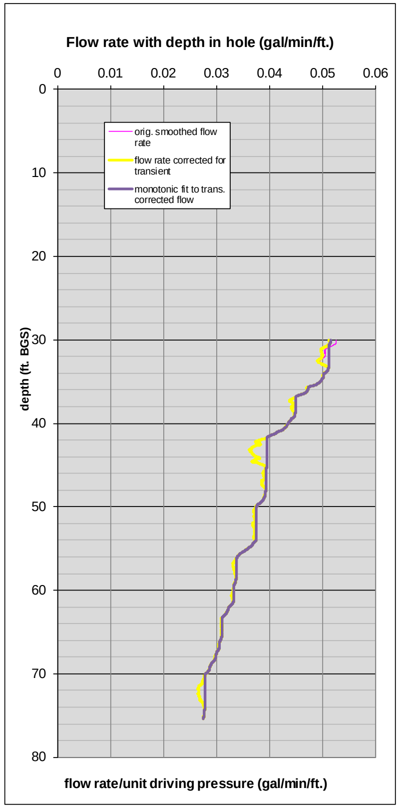
The magnitude of the drop in velocity is a direct measure of the loss into the hole wall.

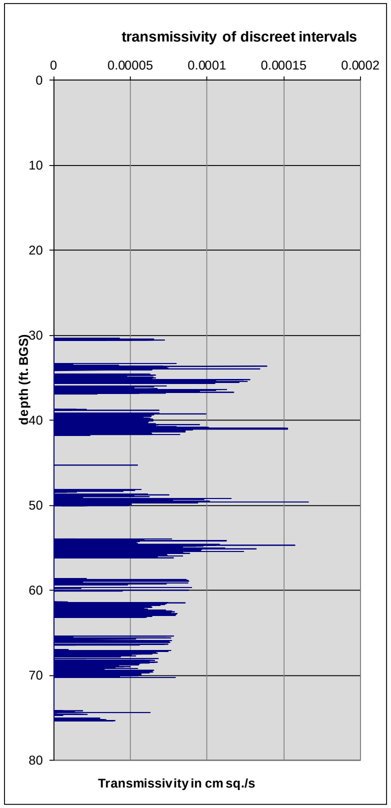
The agreement between the black monotonic fit and the yellow smoothed flow/velocity curve of the first graph is an indication of the data reliability.

The transmissivity curve of the second graph is calculated from the monotonic flow rate curve.

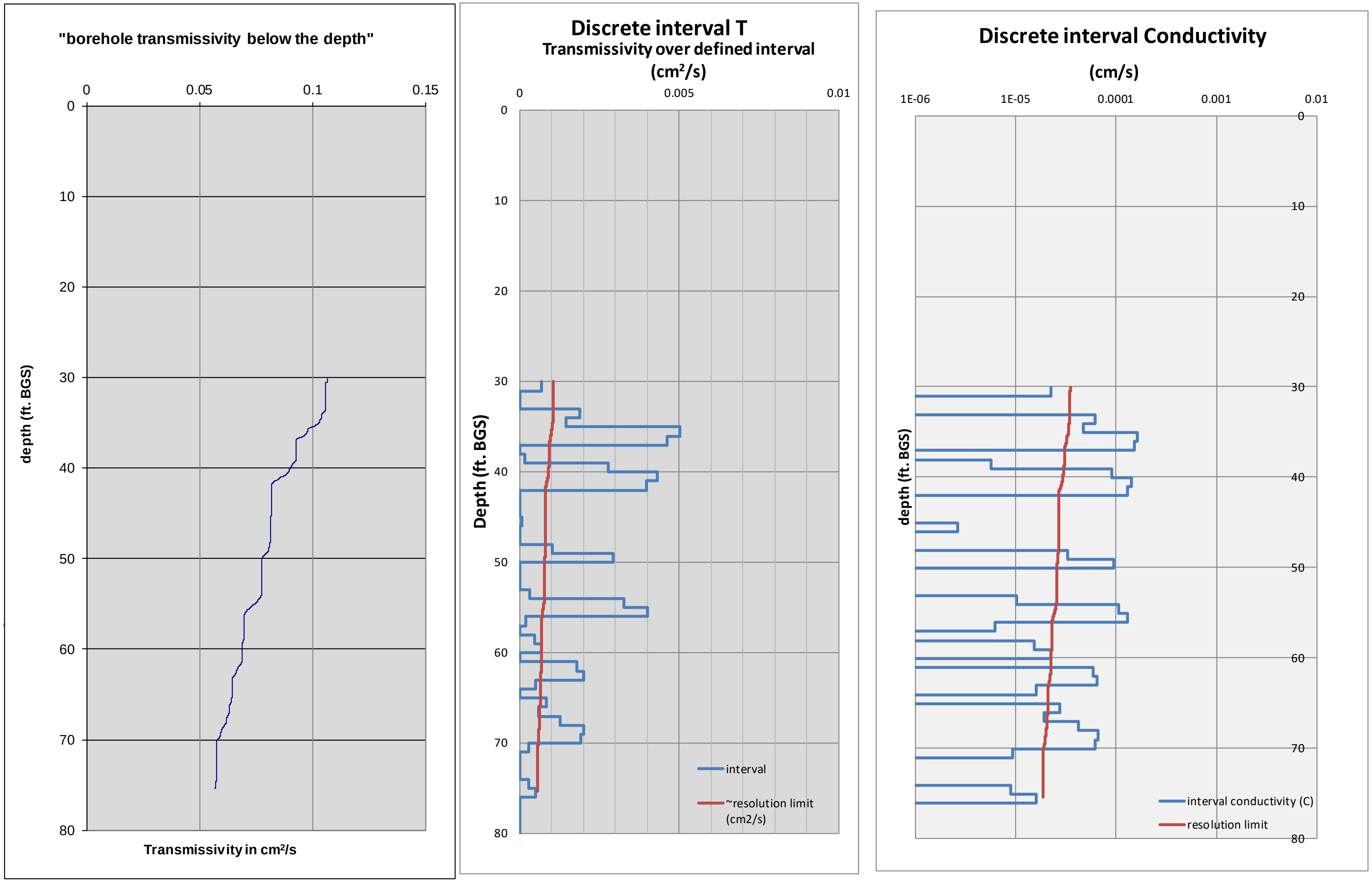
GW-988

Monotonic curve (black over yellow) is corrected for the transient

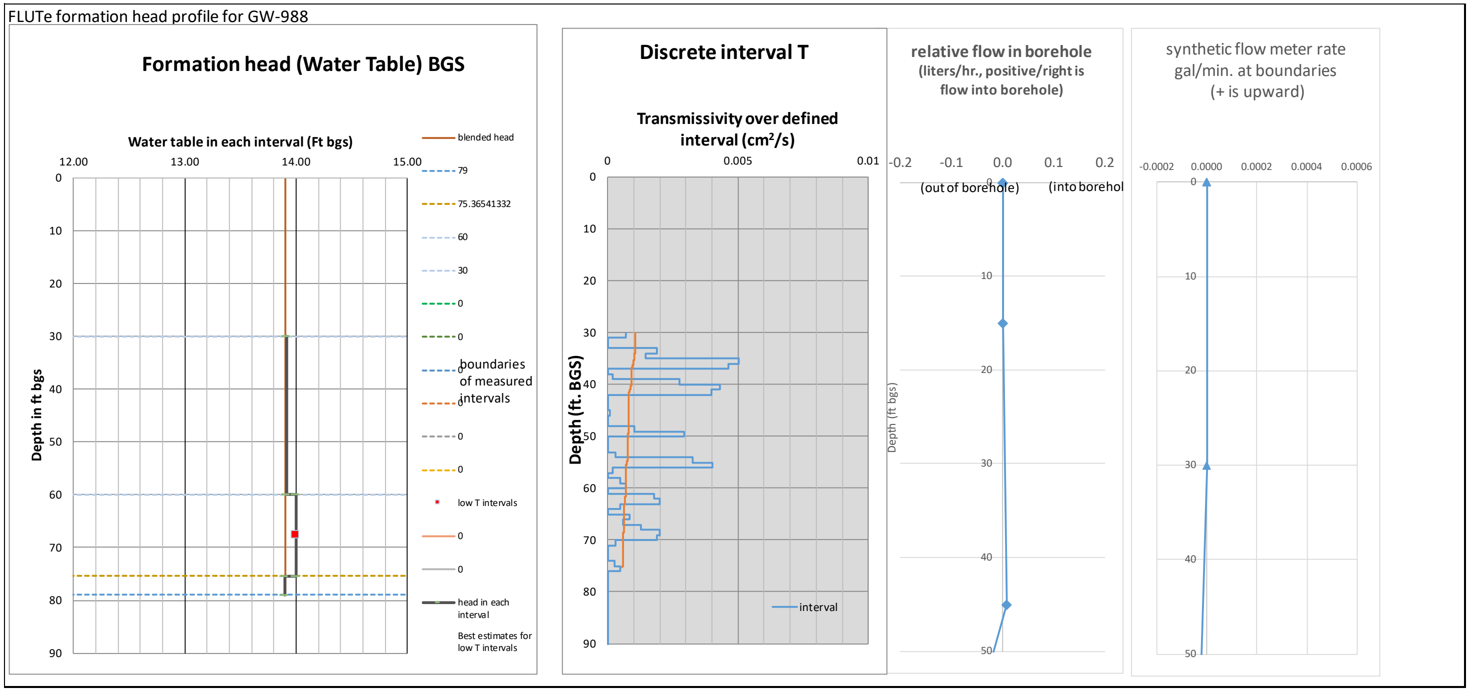




GW-988


"borehole transmissivity below the depth"
0
0.05
0.1
0.15
0
10
20
30
40
50
60
70
80
depth (ft. BGS)
Transmissivity in cm²/s
Discrete interval T
Transmissivity over defined interval
(cm²/s)
0
0.005
0.01
0
10
20
30
40
50
60
70
80
Depth (ft. BGS)
interval
~resolution limit
(cm2/s)
Discrete interval Conductivity
(cm/s)
1E-06
1E-05
0.0001
0.001
0.01
0
10
20
30
40
50
60
70
80
depth (ft. BGS)
interval conductivity (C)
resolution limit

GW-988



FLUTe formation head profile for GW-988

The first graph shows the head profile calculated over the interval of measurement. The assumption is that the head is constant between the "stopping elevations", the depth at which the liner is stopped to allow equilibration below the liner.

The bold red squares indicate that the calculation is unreliable because it depends of the measurement of a very low transmissivity in the measurement interval. That is because the FLUTe transmissivity profiling method does not measure the transmissivity to better than 1% of the transmissvity below the depth of the liner.

The estimated heads for the red square intervals are based on the either the equilibrium heads measured or assumed to lie between the more reliable head in the higher flow zone above and below the low transmissivity interval. It is reasonable to assume that the head in the low T interval with be between the higher flow zones above and below the low T interval.

The first, and deepest, interval is very reliable because the transducer is allowed to equilibrate in that interval totally isolated by the bottom of the borehole and the liner above. It is also a low transmissivity interval because the liner is halted with only a low remaining transmissivity.

The Second graph is the transmissivity distribution from the FLUTe T profile which is used in the head profile.
The Third graph is the flow calculated into and out of the open borehole using the transmissivity of each interval, the head calculated, and the open hole blended head.
The Fourth graph is the a synthetic flow log based on the third graph data. The flow is plotted at the boundaries of the measurement intervals.

GW-988

Reverse head profile Borehole no. GW-988 Oak Ridge Strata G date: **2/22/2018**

interval depths (ft)	head in the interval (ft bgs)	blended head	top of interval	bottom of interval	Water table in formation (ft bgs)	interval	mid point of intervals (ft)	flow into/out of hole (liters/hr)	synthetic flow meter rate gal/min at boundaries	low T intervals	boundries of meas. i		range of plot		DTi used in the calculation (cm2/s)	If below not equal to 1.0, DTi was modified	Best estimates for low T intervals
79	13.9	13.9	75.36541	79	13.9	1	77.1825	0.099569377	0.0004	0	79	79	0	100	0.056713747	1	
75.36541	13.9	13.9	60	75.36541	13.996706	2	67.68271	-0.10711975	0.0000	13.99670602	75.36541	75.36541	0	100	0.012096122	1	#DIV/0!
75.36541	13.99671	13.9	30	60	13.9141733	3	45	0.007550369	0.0000	0	60	60	0	100	0.037669134	1	#DIV/0!
60	13.99671	13.9	0	30	#DIV/0!	4	15	#DIV/0!	#DIV/0!	#DIV/0!	30	30	0	100	0	1	#DIV/0!
60	13.91417	13.9	0	0	#DIV/0!	5	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	#DIV/0!
30	13.91417	13.9	0	0	#DIV/0!	6	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
30	#DIV/0!	13.9	0	0	#DIV/0!	7	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	13.9	0	0	#DIV/0!	8	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	13.9	0	0	#DIV/0!	9	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	13.9	0	0	#DIV/0!	10	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	13.9	0	0	#DIV/0!	11	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	13.9	0	0	#DIV/0!	12	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	13.9	0	0	#DIV/0!	13	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	14	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	15	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	16	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	17	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	18	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	19	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	20	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	21	0	#DIV/0!	0.0000	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																

total hole depth	79	ft bgs
hole diameter	0	in.
casing depth	0	ft bgs
casing diam.	0	in.

integral of hole flow
is 0?? **#DIV/0!**

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GW-992

Results of FLUTe pr+O1:Y40ofiling for hole

no. GW-992 for ***Strata G Oak Ridge***

Water Table depth	1.5	ft BGS
Hole depth	54.833	ft BGS
liner length	60	ft BGS
casing depth	31	ft BGS
hole diameter	6	inches
liner diameter	6.5	inches
date of measurement	2/27/2018	

The profile was measured to a depth of 51.124 ft

The flow rate per unit driving pressure was 0.02047 **gal/min/ft**

The transmissivity for the remainder of the hole is: 0.042393 cm sq./sec

The average conductivity for the remaining 3.7092 ft of the hole is 3.75E-04 cm/sec

Total borehole transmissivity is 0.107572 cm2/s

Comments:

Contact for questions about data or reduction

carl Keller

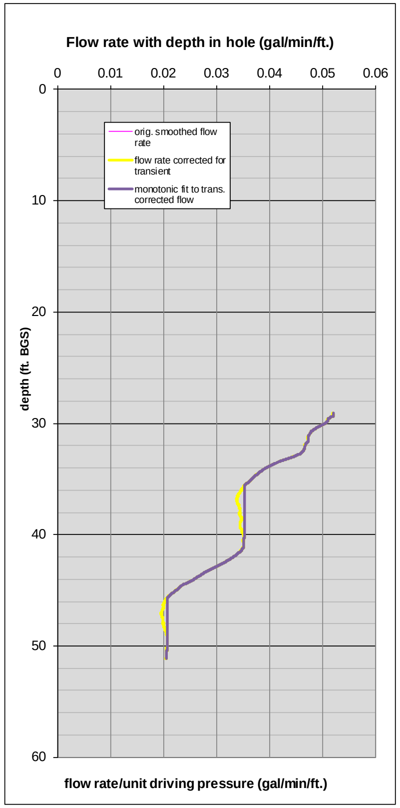
Phone: 505-455-1300

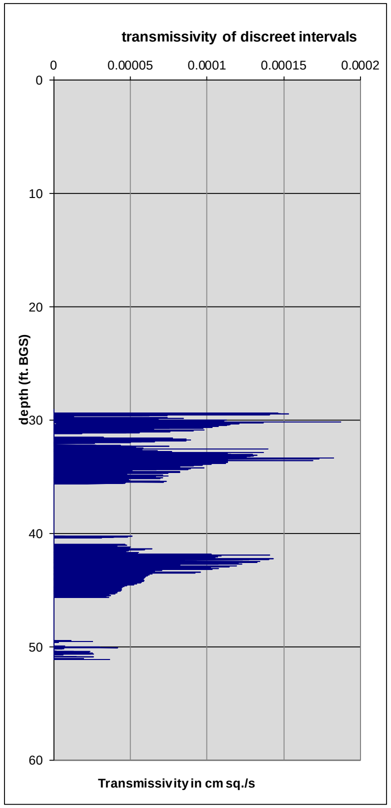
Note: the flow rate curve is the liner velocity multiplied by the borehole cross section

A drop in flow rate is usually associated with loss into the hole wall.
The magnitude of the drop in velocity is a direct measure of the loss into the hole wall.
The agreement between the black monotonic fit and the yellow smoothed flow/velocity curve of the first graph is an indication of the data reliability.
The transmissivity curve of the second graph is calculated from the monotonic flow rate curve.

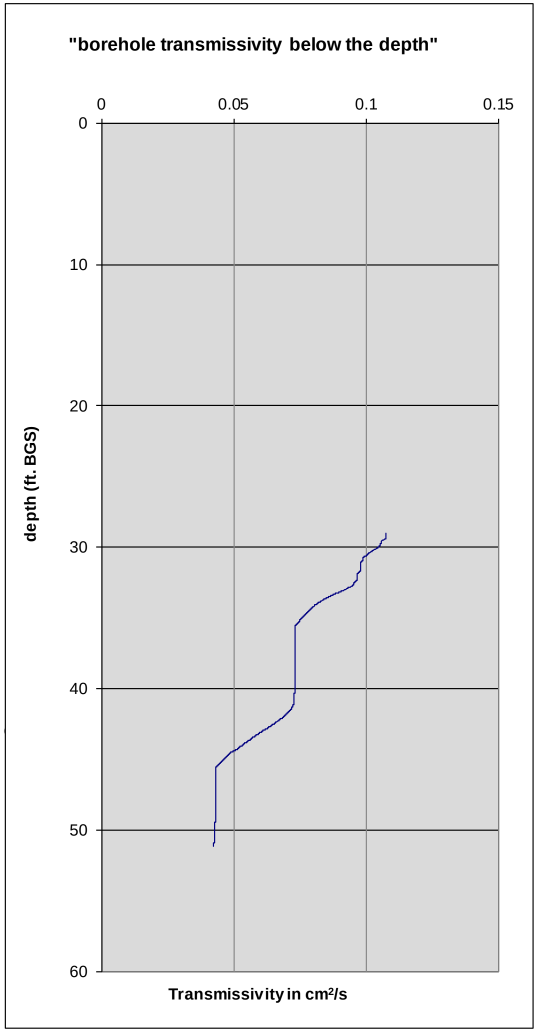
GW-992

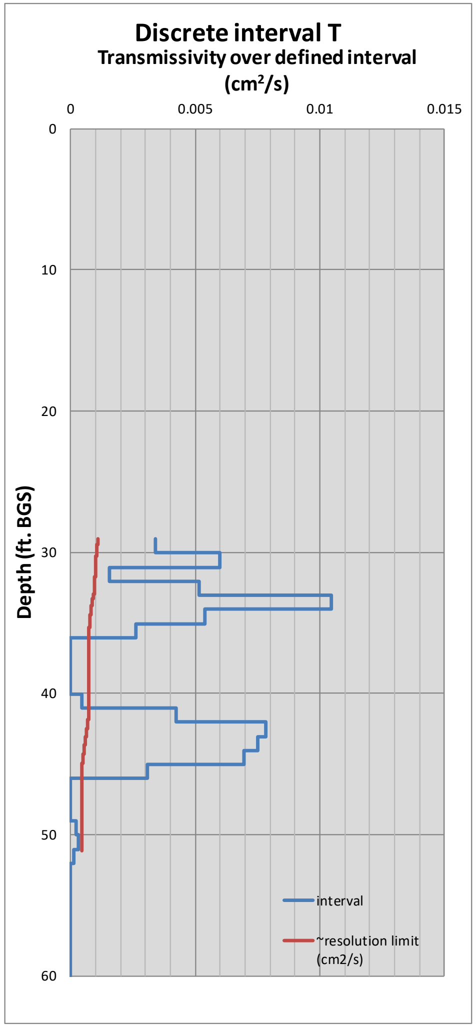
Monotonic curve (black over yellow) is corrected for the transient

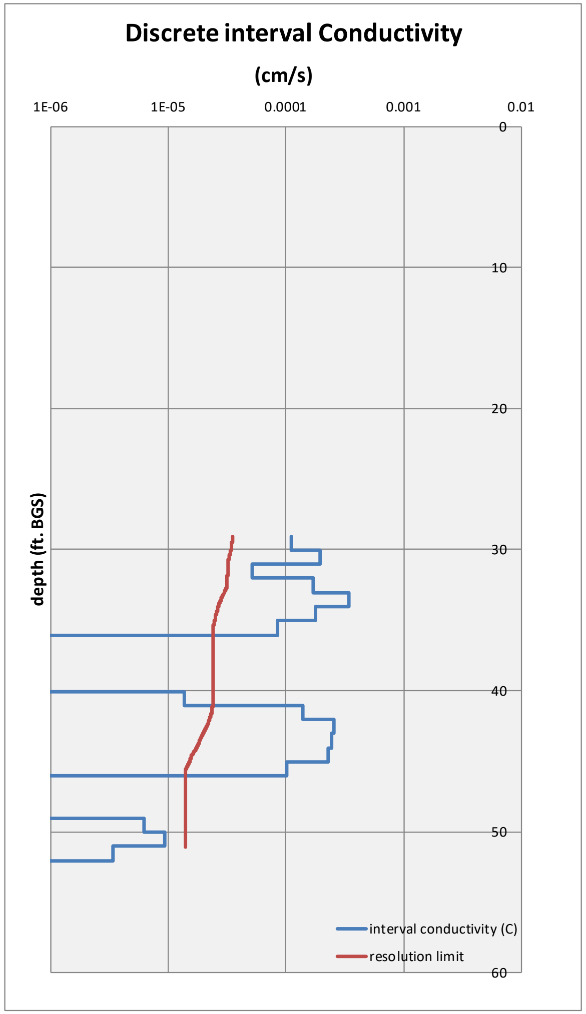

Flow rate with depth in hole (gal/min/ft.)


transmissivity of discreet intervals

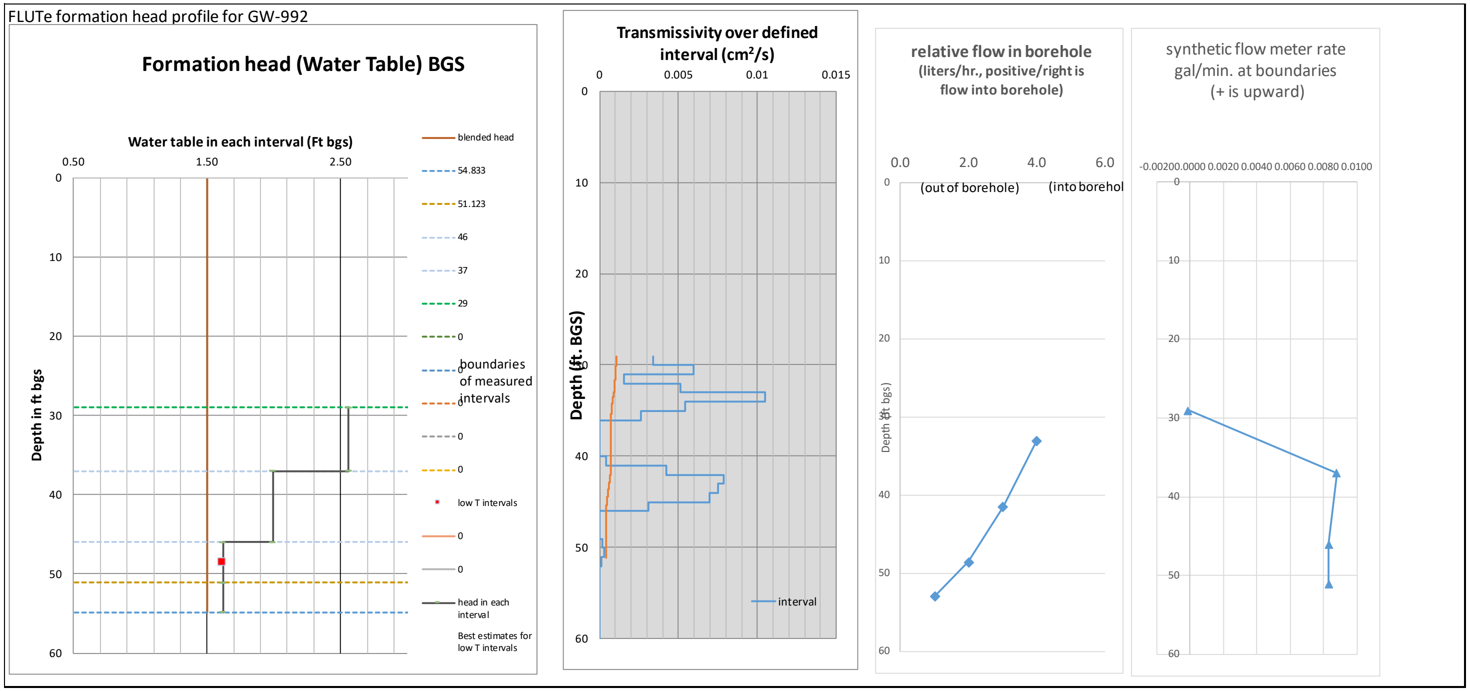
GW-992


"borehole transmissivity below the depth"


Discrete interval T
Transmissivity over defined interval (cm²/s)


Discrete interval Conductivity
(cm/s)

GW-992



The first graph shows the head profile calculated over the interval of measurement. The assumption is that the head is constant between the "stopping elevations", the depth at which the liner is stopped to allow equilibration below the liner.

The bold red squares indicate that the calculation is unreliable because it depends of the measurement of a very low transmissivity in the measurement interval. That is because the FLUTe transmissivity profiling method does not measure the transmissivity to better than 1% of the transmissvity below the depth of the liner.

The estimated heads for the red square intervals are based on the either the equilibrium heads measured or assumed to lie between the more reliable head in the higher flow zone above and below the low transmissivity interval. It is reasonable to assume that the head in the low T interval with be between the higher flow zones above and below the low T interval.

The first, and deepest, interval is very reliable because the transducer is allowed to equilibrate in that interval totally isolated by the bottom of the borehole and the liner above. It is also a low transmissivity interval because the liner is halted with only a low remaining transmissivity.

The Second graph is the transmissivity distribution from the FLUTe T profile which is used in the head profile.
The Third graph is the flow calculated into and out of the open borehole using the transmissivity of each interval, the head calculated, and the open hole blended head.
The Fourth graph is the a synthetic flow log based on the third graph data. The flow is plotted at the boundaries of the measurement intervals.

GW-992

Reverse head profile Borehole no. GW-992 RHP profle Oak Ridg date: **2/27/2018**

interval depths (ft)	head in the interval (ft bgs)	blended head	top of interval	bottom of interval	Water table in formation (ft bgs)	interval	mid point of intervals (ft)	flow into/out of hole (liters/hr)	synthetic flow meter rate gal/min at boundaries	low T intervals	boundries	of meas. i	range of	plot	DTi used in the calculation (cm2/s)	If below not equal to 1.0, DTi was modified	Best estimates for low T intervals
54.833	1.6185	1.5	51.123	54.833	1.6185	1	52.978	1.89554973	0.0083	0	54.833	54.833	0	100	0.04239261	1	
51.123	1.6185	1.5	46	51.123	1.6185	2	48.5615	e	0.0083	1.6185	51.123	51.123	0	100	0.00058122	1	#DIV/0!
51.123	1.6185	1.5	37	46	1.99391215	3	41.5	0.1058208	0.0088	0	46	46	0	100	0.03005474	1	#DIV/0!
46	1.6185	1.5	29	37	2.56087528	4	33	-2.0273595	-0.0001	0	37	37	0	100	0.03454306	1	#DIV/0!
46	1.993912	1.5	0	29	#DIV/0!	5	14.5	#DIV/0!	#DIV/0!	#DIV/0!	29	29	0	100	0	1	#DIV/0!
37	1.993912	1.5	0	0	#DIV/0!	6	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
37	2.560875	1.5	0	0	#DIV/0!	7	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
29	2.560875	1.5	0	0	#DIV/0!	8	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
29	#DIV/0!	1.5	0	0	#DIV/0!	9	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	1.5	0	0	#DIV/0!	10	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	1.5	0	0	#DIV/0!	11	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	1.5	0	0	#DIV/0!	12	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	1.5	0	0	#DIV/0!	13	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	14	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	15	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	16	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	17	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	18	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	19	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	20	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	21	0	#DIV/0!	0.0000	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																

total hole depth	54.833	ft bgs
hole diameter	0	in.
casing depth	0	ft bgs
casing diam.	0	in.

integral of hole flow
is 0?? **#DIV/0!**

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GW-994

Results of FLUTe profiling for hole

no. GW-994 for ***Strata-G Oak Ridge***

Water Table depth 7.06 ft BGS
Hole depth 54.75 ft BGS
liner length 60 ft BGS
casing depth 35 ft BGS
hole diameter 6 inches
liner diameter 6.5 inches
date of measurement 2/21/1987

The profile was measured to a depth of 52.024 ft
The flow rate per unit driving pressure was 0.03347 **gal/min/ft**
The transmissivity for the remainder of the hole is: 0.069317 cm sq./sec
The average conductivity for the remaining 2.7264 ft of the hole is 8.34E-04 cm/sec
Total borehole transmissivity is 0.098448 cm2/s

Comments:

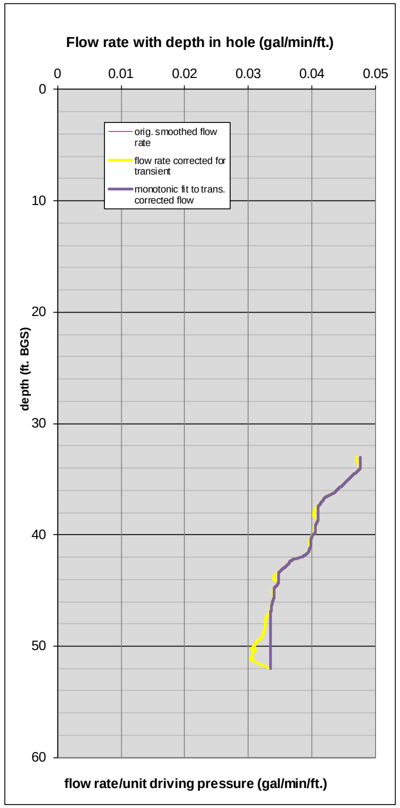
Contact for questions about data or reduction
carl Keller
Phone: 505-455-1300

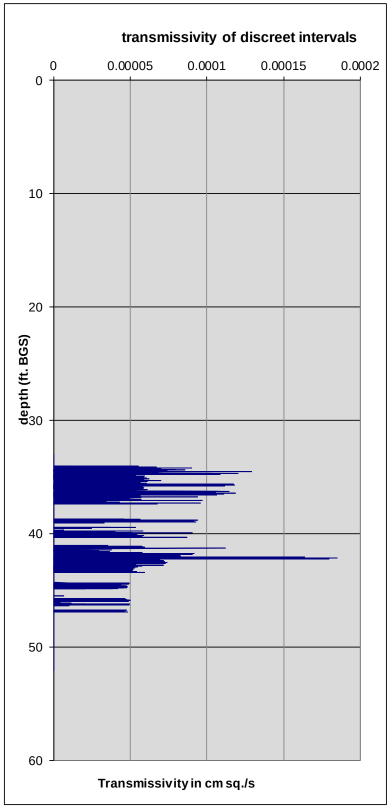
Note: the flow rate curve is the liner velocity multiplied by the borehole cross section

A drop in flow rate is usually associated with loss into the hole wall.
The magnitude of the drop in velocity is a direct measure of the loss into the hole wall.
The agreement between the black monotonic fit and the yellow smoothed flow/velocity curve of the first graph is an indication of the data reliability.
The transmissivity curve of the second graph is calculated from the monotonic flow rate curve.

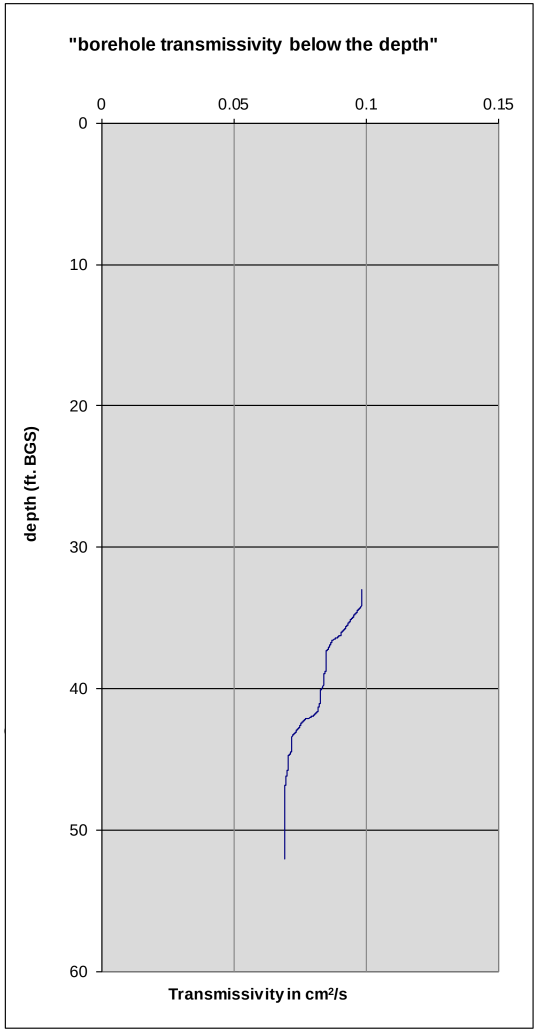
GW-994

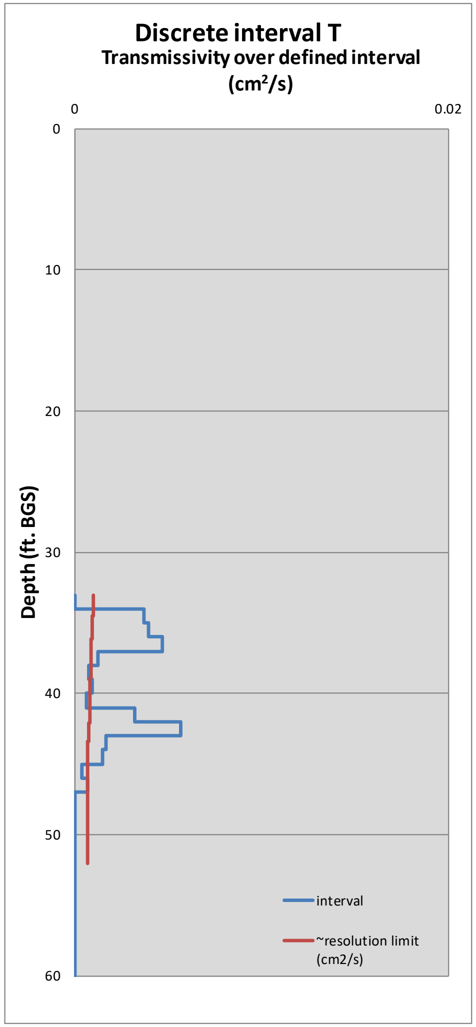
Monotonic curve (black over yellow) is corrected for the transient

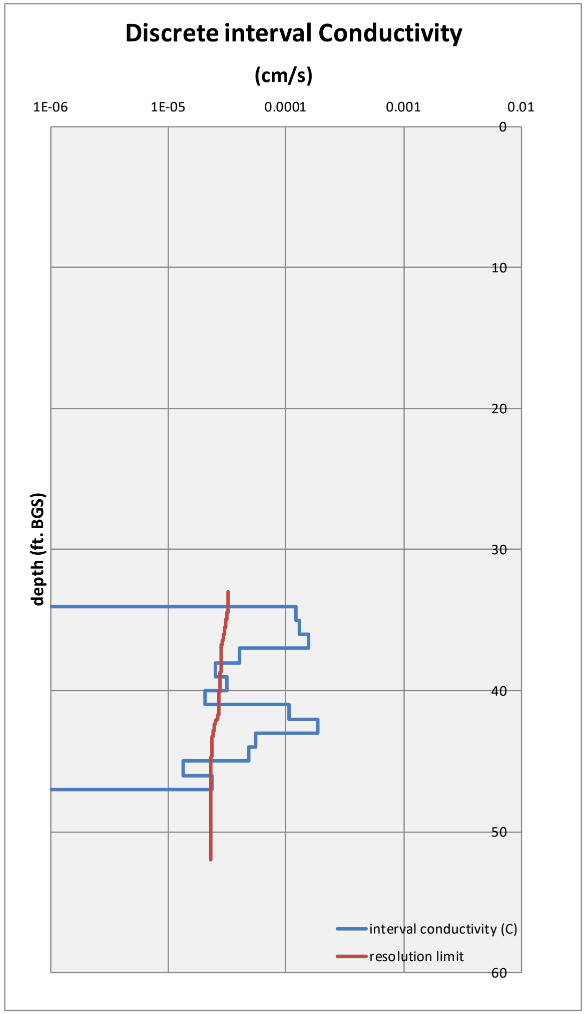




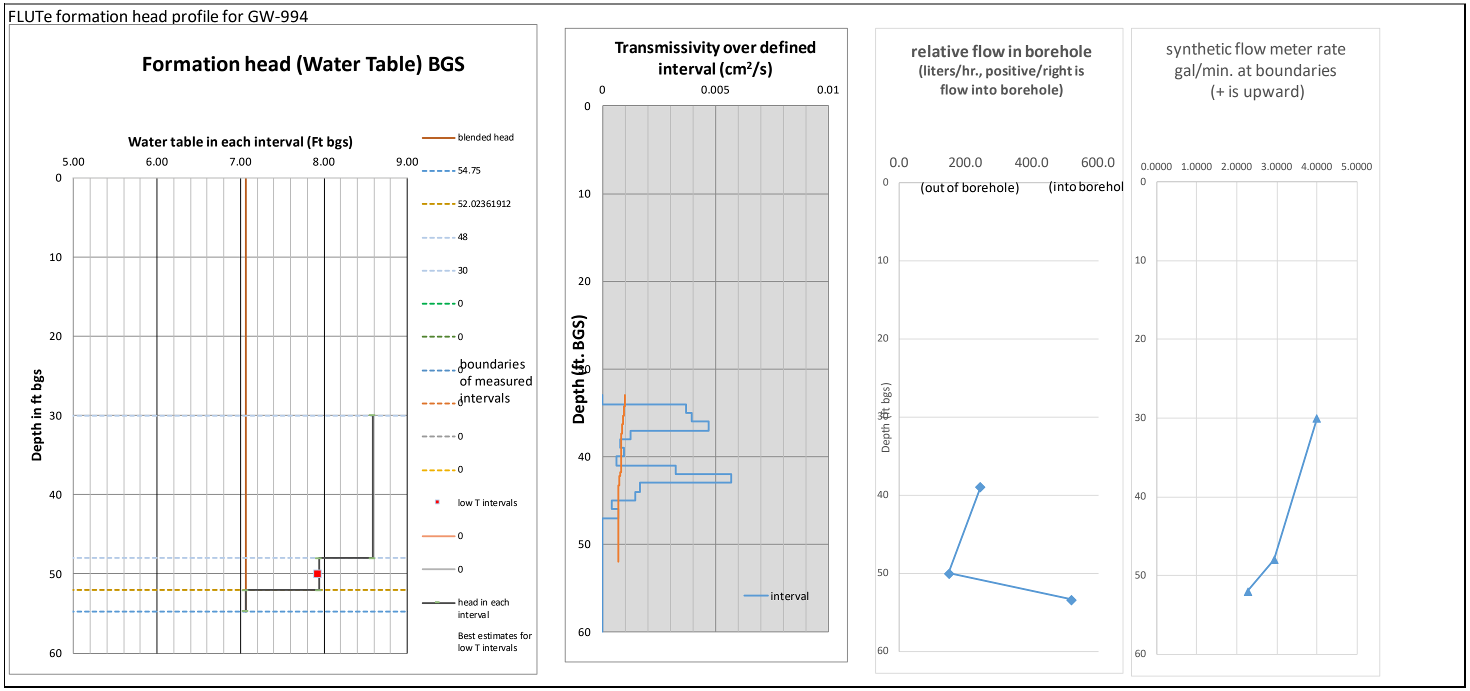
GW-994


"borehole transmissivity below the depth"


Discrete interval T
Transmissivity over defined interval
(cm²/s)


Discrete interval Conductivity
(cm/s)

GW-994


FLUTe formation head profile for GW-994

The first graph shows the head profile calculated over the interval of measurement. The assumption is that the head is constant between the "stopping elevations", the depth at which the liner is stopped to allow equilibration below the liner.

The bold red squares indicate that the calculation is unreliable because it depends of the measurement of a very low transmissivity in the measurement interval. That is because the FLUTe transmissivity profiling method does not measure the transmissivity to better than 1% of the transmissvity below the depth of the liner.

The estimated heads for the red square intervals are based on the either the equilibrium heads measured or assumed to lie between the more reliable head in the higher flow zone above and below the low transmissivity interval. It is reasonable to assume that the head in the low T interval with be between the higher flow zones above and below the low T interval.

The first, and deepest, interval is very reliable because the transducer is allowed to equilibrate in that interval totally isolated by the bottom of the borehole and the liner above. It is also a low transmissivity interval because the liner is halted with only a low remaining transmissivity.

The Second graph is the transmissivity distribution from the FLUTe T profile which is used in the head profile.
The Third graph is the flow calculated into and out of the open borehole using the transmissivity of each interval, the head calculated, and the open hole blended head.
The Fourth graph is the a synthetic flow log based on the third graph data. The flow is plotted at the boundaries of the measurement intervals.

GW-994

Reverse head profile Borehole no. GW-994 Oak Ridge Strata G date: **2/22/2018**

interval depths (ft)	head in the interval (ft bgs)	blended head	top of interval	bottom of interval	Water table in formation (ft bgs)	interval	mid point of intervals (ft)	flow into/out of hole (liters/hr)	synthetic flow meter rate gal/min at boundaries	low T intervals	boundries	of meas. i	range of	plot	DTi used in the calculation (cm2/s)	If below not equal to 1.0, DTi was modified	Best estimates for low T intervals
54.75	7.06	7.06	52.02362	54.75	7.06	1	53.38681	519.1099214	2.2768	0	54.75	54.75	0	100	0.060535883	1	
52.02362	7.06	7.06	48	52.02362	7.94175274	2	50.01181	148.9073127	2.9299	7.941752744	52.02362	52.02362	0	100	0.017562951	2	#DIV/0!
52.02362	7.941753	7.06	30	48	8.58422717	3	39	244.9294767	4.0042	0	48	48	0	100	0.029130553	1	#DIV/0!
48	7.941753	7.06	0	30	#DIV/0!	4	15	#DIV/0!	#DIV/0!	#DIV/0!	30	30	0	100	0	1	#DIV/0!
48	8.584227	7.06	0	0	#DIV/0!	5	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	#DIV/0!
30	8.584227	7.06	0	0	#DIV/0!	6	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
30	#DIV/0!	7.06	0	0	#DIV/0!	7	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	7.06	0	0	#DIV/0!	8	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	7.06	0	0	#DIV/0!	9	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	7.06	0	0	#DIV/0!	10	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	7.06	0	0	#DIV/0!	11	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	7.06	0	0	#DIV/0!	12	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	7.06	0	0	#DIV/0!	13	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	14	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	15	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	16	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	17	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	18	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	19	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	20	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	21	0	#DIV/0!	0.0000	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!																

total hole depth	54.75	ft bgs
hole diameter	6	in.
casing depth	0	ft bgs
casing diam.	6	in.

integral of hole flow
is 0?? **#DIV/0!**

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GW-998

Results of FLUTe profiling for hole

no. GW-998 for ***Strata-G Oak Ridge***

Water Table depth	1.45	ft BGS
Hole depth	45.08	ft BGS
liner length	50	ft BGS
casing depth	20	ft BGS
hole diameter	6	inches
liner diameter	6.5	inches
date of measurement	2/21/2018	

The profile was measured to a depth of 39.922 ft

The flow rate per unit driving pressure was 0.02745 **gal/min/ft**

The transmissivity for the remainder of the hole is: 0.05684 cm sq./sec

The average conductivity for the remaining 5.1581 ft of the hole is 3.62E-04 cm/sec

Total borehole transmissivity is 0.19806 cm2/s

Comments:

large flow zone at 21-24 ft

Contact for questions about data or reduction

carl Keller

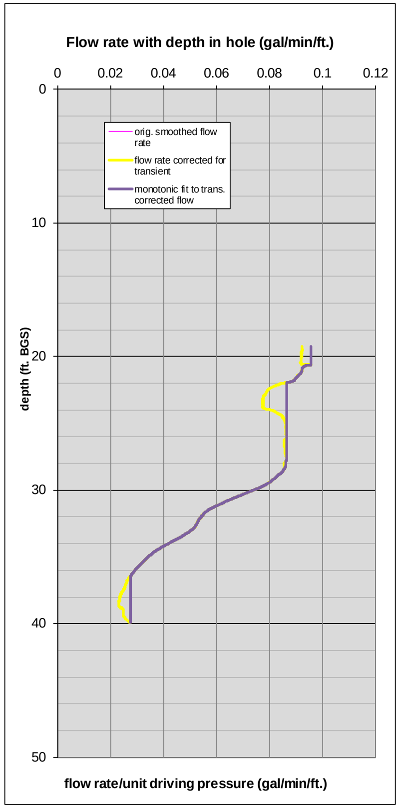
Phone: 505-455-1300

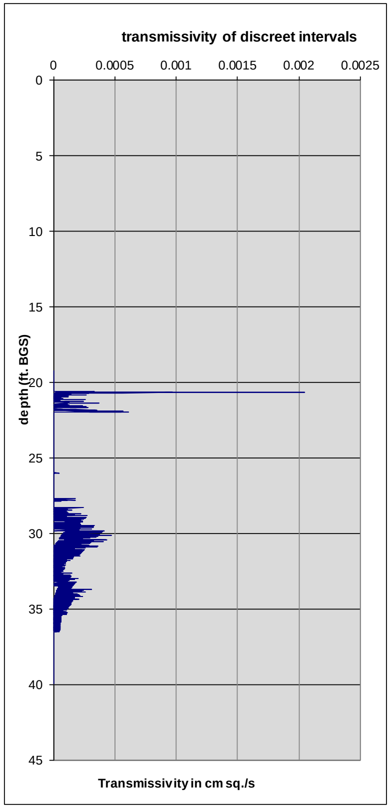
Note: the flow rate curve is the liner velocity multiplied by the borehole cross section

A drop in flow rate is usually associated with loss into the hole wall.
The magnitude of the drop in velocity is a direct measure of the loss into the hole wall.
The agreement between the black monotonic fit and the yellow smoothed flow/velocity curve of the first graph is an indication of the data reliability.
The transmissivity curve of the second graph is calculated from the monotonic flow rate curve.

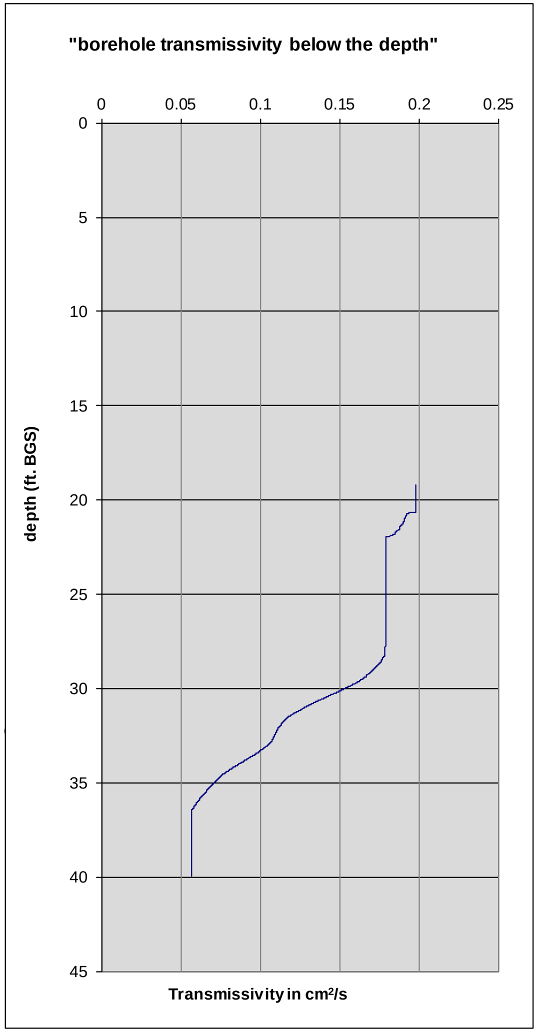
GW-998

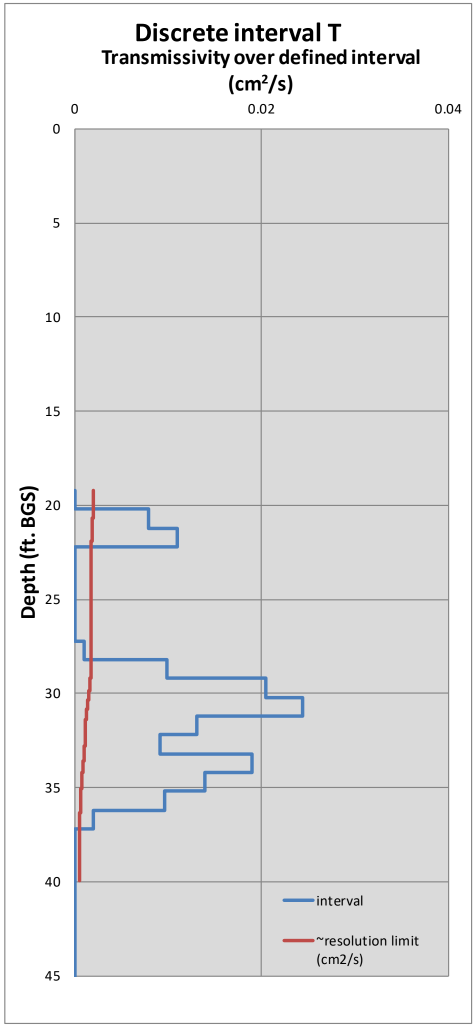
Monotonic curve (black over yellow) is corrected for the transient

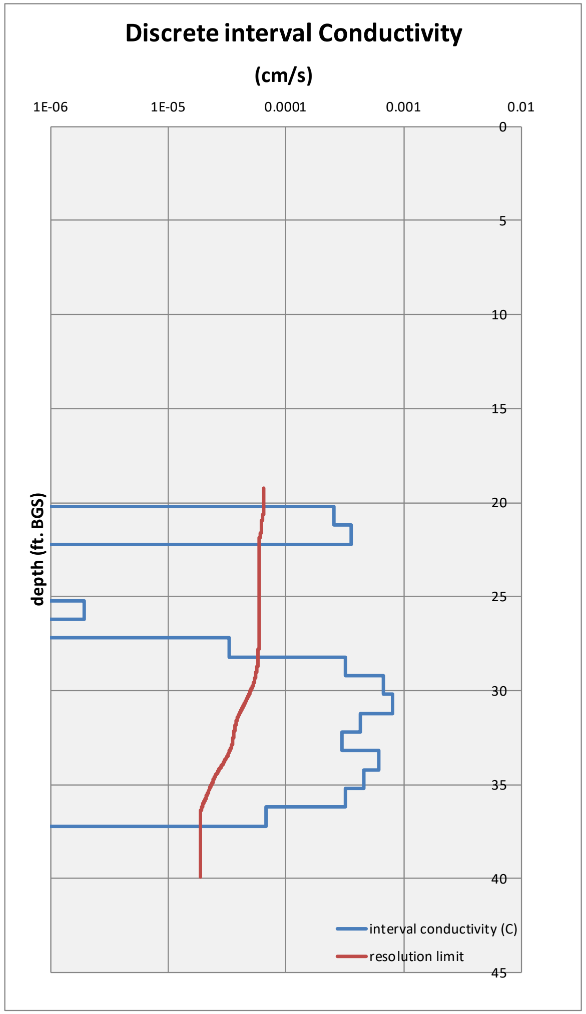




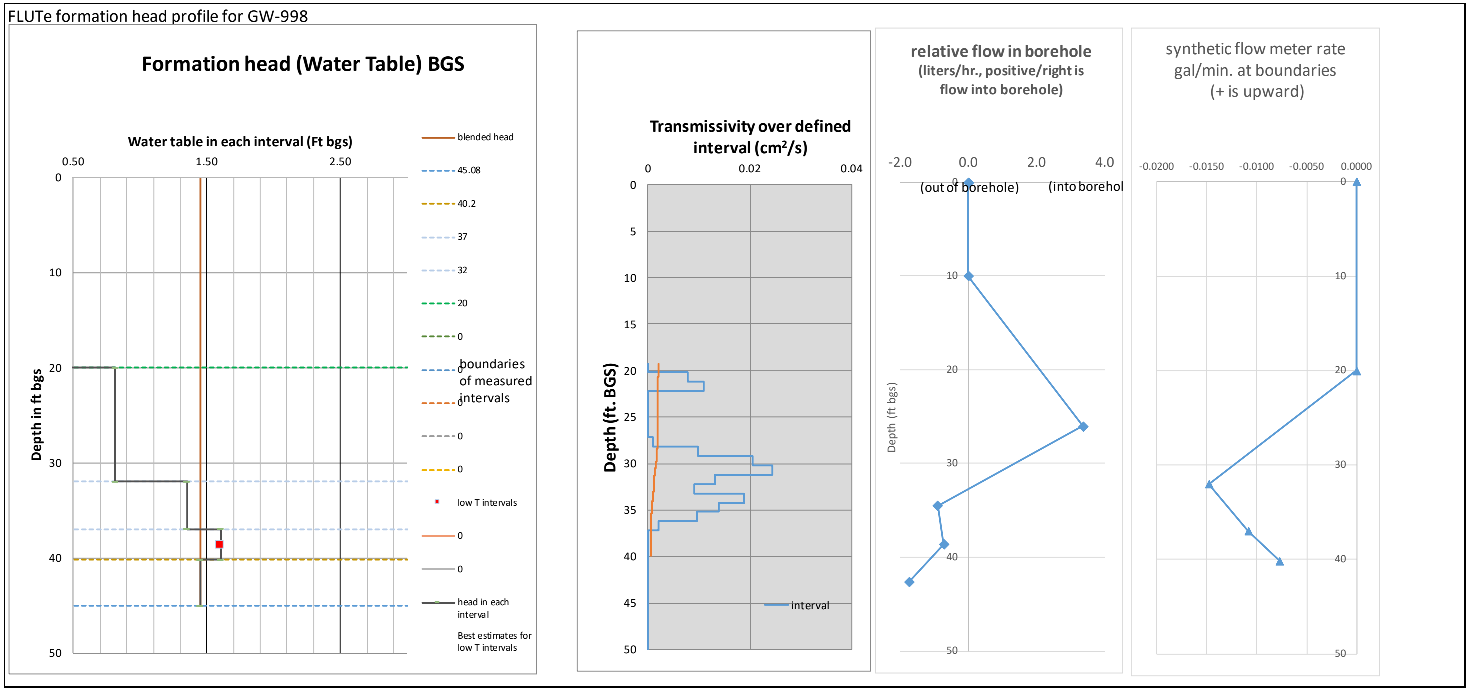
GW-998


"borehole transmissivity below the depth"
0
0.05
0.1
0.15
0.2
0.25
0
5
10
15
20
25
30
35
40
45
depth (ft. BGS)
Transmissivity in cm²/s


Discrete interval T
Transmissivity over defined interval
(cm²/s)
0
0.02
0.04
0
5
10
15
20
25
30
35
40
45
Depth (ft. BGS)
interval
~resolution limit (cm2/s)


Discrete interval Conductivity
(cm/s)
1E-06
1E-05
0.0001
0.001
0.01
0
5
10
15
20
25
30
35
40
45
depth (ft. BGS)
interval conductivity (C)
resolution limit

GW-998



The first graph shows the head profile calculated over the interval of measurement. The assumption is that the head is constant between the "stopping elevations", the depth at which the liner is stopped to allow equilibration below the liner.

The bold red squares indicate that the calculation is unreliable because it depends of the measurement of a very low transmissivity in the measurement interval. That is because the FLUTe transmissivity profiling method does not measure the transmissivity to better than 1% of the transmissvity below the depth of the liner.

The estimated heads for the red square intervals are based on the either the equilibrium heads measured or assumed to lie between the more reliable head in the higher flow zone above and below the low transmissivity interval. It is reasonable to assume that the head in the low T interval with be between the higher flow zones above and below the low T interval.

The first, and deepest, interval is very reliable because the transducer is allowed to equilibrate in that interval totally isolated by the bottom of the borehole and the liner above. It is also a low transmissivity interval because the liner is halted with only a low remaining transmissivity.

The Second graph is the transmissivity distribution from the FLUTe T profile which is used in the head profile.
The Third graph is the flow calculated into and out of the open borehole using the transmissivity of each interval, the head calculated, and the open hole blended head.
The Fourth graph is the a synthetic flow log based on the third graph data. The flow is plotted at the boundaries of the measurement intervals.

GW-998

Reverse head profile Borehole no. GW-998 Oak Ridge Strata G date: **2/21/2018**

interval depths (ft)	head in the interval (ft bgs)	blended head	top of interval	bottom of interval	Water table in formation (ft bgs)	interval	mid point of intervals (ft)	flow into/out of hole (liters/hr)	synthetic flow meter rate gal/min at boundaries	low T intervals	boundries of meas. i		range of	plot	DTi used in the calculation (cm2/s)	If below not equal to 1.0, DTi was modified	Best estimates for low T intervals
45.08	1.45	1.45	40.2	45.08	1.45	1	42.64	-1.74266785	-0.0076	0	45.08	45.08	0	100	0.056839968	1	
40.2	1.45	1.45	37	40.2	1.60586612	2	38.6	-0.71643114	-0.0108	1.605866123	40.2	40.2	0	100	0.015	1.5	#DIV/0!
40.2	1.605866	1.45	32	37	1.35262602	3	34.5	-0.90525555	-0.0148	0	37	37	0	100	0.045320456	1	#DIV/0!
37	1.605866	1.45	20	32	0.81364878	4	26	3.36435454	0.0000	0	32	32	0	100	0.085899113	1	#DIV/0!
37	1.352626	1.45	0	20	#DIV/0!	5	10	#DIV/0!	#DIV/0!	#DIV/0!	20	20	0	100	0	1	#DIV/0!
32	1.352626	1.45	0	0	#DIV/0!	6	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
32	0.813649	1.45	0	0	#DIV/0!	7	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
20	0.813649	1.45	0	0	#DIV/0!	8	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
20	#DIV/0!	1.45	0	0	#DIV/0!	9	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
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0	#DIV/0!	0	0	0	#DIV/0!	17	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	18	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	19	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	20	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!	0	0	0	#DIV/0!	21	0	#DIV/0!	0.0000	#DIV/0!	0	0	0	100	0	1	
0	#DIV/0!																
0	#DIV/0!																
0	#DIV/0!		total hole depth		45.08	ft bgs											
0	#DIV/0!		hole diameter		0	in.											
0	#DIV/0!		casing depth		0	ft bgs	**integral of hole flow**										
0	#DIV/0!		casing diam.		0	in.	is 0??	**#DIV/0!**									
0	#DIV/0!																

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APPENDIX E

GEOTECHNICAL LABORATORY REPORTS

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Appendix E – Laboratory Test Results

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Appendix E.1 – Soil Index Testing

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28001 Cabot Drive, Suite 250
Novi, MI 48377
Phone: (248) 486-5100
Fax: (248) 486-5050

Material Test Report

Project No.: 1188070011-05B
ReportNo: ASM:FH18-W00338

Client: Strata-G, LLC
CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

This report shall not be reproduced (in part or whole) without the written constent of:

Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	USCS	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00338-S01	FH18-W00338-S02	FH18-W00338-S03	FH18-W00338-S04	FH18-W00338-S05	FH18-W00338-S06
Field Sample ID	GW978-SS1	GW978-SS3	GW978-SS4	GW978-SS5	GW978-SS8	GW978-SS9
Date Sampled	2/10/2018	2/10/2018	2/10/2018	2/10/2018	2/10/2018	2/10/2018

Other Test Results

Description	Method	Results						Limits
Water Content (%)	ASTM D 2216	21.8	19.3	24.0	21.0	11.5	11.7	
Method		B	B	B	B	B	B	
Group Symbol	ASTM D 2487			CL				
Group Name				Sandy lean clay				
Approximate maximum grain size	ASTM D 4318							
Material retained on 425µm (No. 40) (%)				12.1				
Method of Removal								
Grooving Tool Type				Metal				
Specimen preparation method				Wet				
Drying Method				Air				
Special selection process				Quartered				
Rolling Method for PL				Hand				
As Received Water Content (%)				24.0				
Liquid Limit Device Type				Manual				
Liquid Limit				45				
Plastic Limit				21				
Plasticity Index				24				
Liquid Limit Procedure				Multipoint (A)				
Method	ASTM D 6913			Method B				
Sample Obtained While				Air-Dried				
Group Name				Sandy lean clay				
Group Symbol				CL				
Composite Sieving Used				No				
Dispersion Method				Dispersant by hand				
Prior Testing				Atterberg limits				

Comments

N/A

28001 Cabot Drive, Suite 250
Novi, MI 48377
Phone: (248) 486-5100
Fax: (248) 486-5050

Material Test Report

Project No.: 1188070011-05B
ReportNo: ASM:FH18-W00338

Client: Strata-G, LLC

CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

This report shall not be reproduced (in part or whole) without the written constent of:

Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	USCS	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00338-S07
Field Sample ID	GW978-SS10
Date Sampled	2/10/2018

Other Test Results

Description	Method	Results	Limits
Water Content (%)	ASTM D 2216	11.1	
Method		B	

Comments

N/A

28001 Cabot Drive, Suite 250
Novi, MI 48377
Phone: (248) 486-5100
Fax: (248) 486-5050

Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00338-S03

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

This report shall not be reproduced (in part or whole) without the written constent of:

Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00338-S03
Field Sample ID	GW978-SS4
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/10/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A

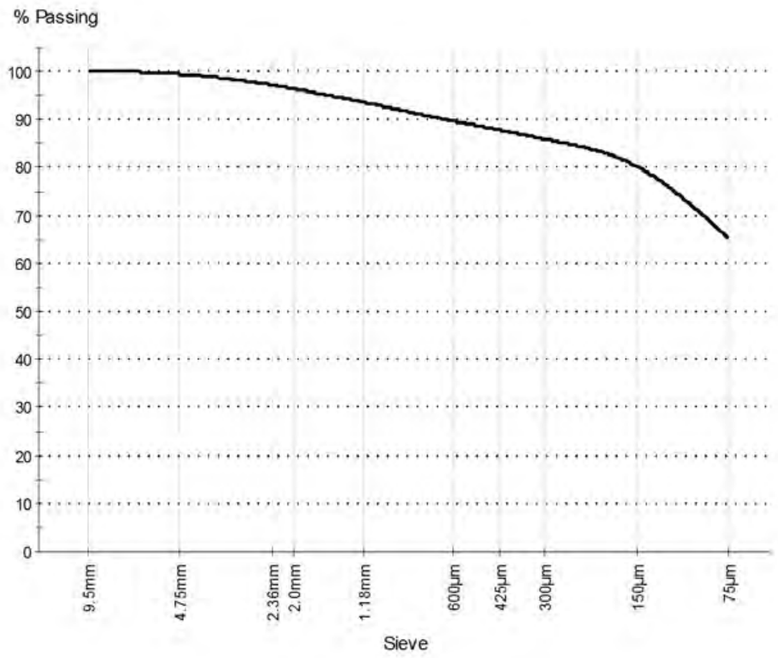
Atterberg Limit:

Liquid Limit: 45
Plastic Limit: 21
Plasticity Index: 24

Sample Description:

Brown mottled sandy lean clay (CL)

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES (65.3%)	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(0.5%)	(3.1%)	(8.5%)	(22.6%)		

Grading: ASTM D 6913

Drying by: Oven
Date Tested: 2/15/2018
Tested By: David Cook

Sieve Size	% Passing	Limits
3/8in	100.0	
No.4	99.5	
No.8	97.2	
No.10	96.4	
No.16	93.6	
No.30	89.7	
No.40	87.9	
No.50	85.9	
No.100	80.3	
No.200	65.3	

D85: 0.2684 **D60:** N/A **D50:** N/A
D30: N/A **D15:** N/A **D10:** N/A

Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00338-S03

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00338-S03
Field Sample ID	GW978-SS4
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/10/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	**Method**	**Result**	**Limits**
Water Content (%)	ASTM D 2216	24.0	
Method		B	
Date Tested		2/15/2018	
Group Symbol	ASTM D 2487	CL	
Group Name		Sandy lean clay	
Date Tested		2/20/2018	
Approximate maximum grain size	ASTM D 4318		
Material retained on 425µm (No. 40) (%)		12.1	
Method of Removal			
Grooving Tool Type		Metal	
Specimen preparation method		Wet	
Drying Method		Air	
Special selection process		Quartered	
Rolling Method for PL		Hand	
As Received Water Content (%)		24.0	
Liquid Limit Device Type		Manual	
Liquid Limit		45	
Plastic Limit		21	
Plasticity Index		24	
Liquid Limit Procedure		Multipoint (A)	
Date Tested		2/15/2018	
Method	ASTM D 6913	Method B	
Sample Obtained While		Air-Dried	
Group Name		Sandy lean clay	
Group Symbol		CL	
Composite Sieving Used		No	

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00338-S03

Client: Strata-G, LLC

CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00338-S03
Field Sample ID	GW978-SS4
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/10/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Dispersion Method		Dispersant by hand	
Prior Testing		Atterberg limits	

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: ASM:FH18-W00381

Client: Strata-G, LLC

CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	Unified Soil Classification System	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00381-S01	FH18-W00381-S02	FH18-W00381-S03	FH18-W00381-S04	FH18-W00381-S05	FH18-W00381-S06
Field Sample ID	GW980-SS2	GW980-SS3	GW980-SS4	GW980-SS6	GW980-SS8	GW980-SS9
Date Sampled	2/13/2018	2/13/2018	2/13/2018	2/13/2018	2/13/2018	2/13/2018

Particle Size Distribution

Method:
ASTM D 422
Description:
Analysis of Particle Size Distribution in Soils. Sieving for Particles >75µm, Hydrometer
Drying by:
Oven
Washed:
Sample Washed

Sieve Size	% Passing						Limits
1½in (37.5mm)	100						
1in (25.0mm)	91						
½in (12.5mm)	83						
3/8in (9.5mm)	74						
No.4 (4.75mm)	55						
No.10 (2.0mm)	40						
No.40 (425µm)	31						
No.100	27						
No.200 (75µm)	23						

Other Test Results

Description	Method	Results						Limits
Water Content (%)	ASTM D 2216	13.8	15.1	15.0	12.6	14.5	10.2	
Method		B	B	B	B	B	B	
Dispersion device	ASTM D 422	Dispersion Cup and Mixer						
Dispersion time (min)		1						
Shape								
Hardness								
Approximate maximum grain size	ASTM D 4318							
Material retained on 425µm (No. 40) (%)								
Method of Removal								
Grooving Tool Type			Plastic					
Specimen preparation method			Wet					
Drying Method			Air					
Special selection process			Quartering					
Rolling Method for PL			Hand					
As Received Water Content (%)			15.1					
Liquid Limit Device Type			Manual					
Liquid Limit			N/A					
Plastic Limit			NP					
Plasticity Index			NP					
Liquid Limit Procedure			Multipoint (A)					

Comments

NP = Non Plastic

Material Test Report

Project No.: 1188070011-05B
ReportNo: ASM:FH18-W00381

Client: Strata-G, LLC
CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	USCS	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00381-S07	FH18-W00381-S08	FH18-W00381-S09
Field Sample ID	GW980-SS10	GW980-SS12	GW980-SS13
Date Sampled	2/13/2018	2/13/2018	2/13/2018

Other Test Results

Description	**Method**	**Results**			**Limits**
Water Content (%)	ASTM D 2216	4.3	11.7	12.3	
Method		B	B	B	

Comments

NP = Non Plastic

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00381-S01

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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AASHTO ACCREDITATION PROGRAM

Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

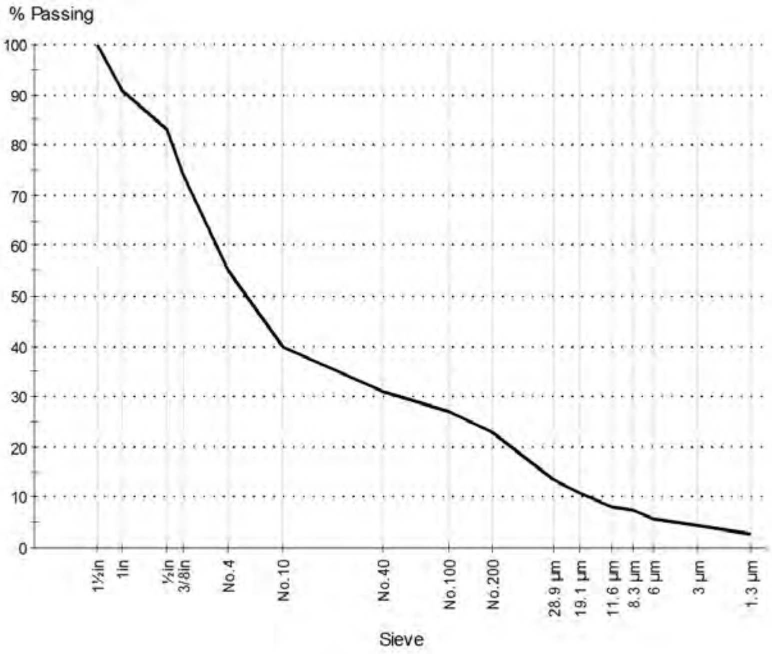
Sample Details

Sample ID	FH18-W00381-S01
Field Sample ID	GW980-SS2
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/13/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	Unified Soil Classification System
Sampling Method	Split Spoon
Contractor	N/A

Sample Description:

Brown silty sand with gravel (SM)

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(12.8%)	(32.2%)	(15.0%)	(9.0%)	(8.0%)	(17.6%)	(5.4%)

Grading: ASTM D 422

Drying by: Oven
Date Tested: 2/28/2018
Tested By: Sheila Bowers

Sieve Size	% Passing	Limits
1½in	100	
1in	91	
½in	83	
3/8in	74	
No.4	55	
No.10	40	
No.40	31	
No.100	27	
No.200	23	
28.9 µm	13.4	
19.1 µm	10.7	
11.6 µm	8.1	
8.3 µm	7.3	
6.0 µm	5.9	
3.0 µm	4.5	
1.3 µm	2.7	

D85: 14.8651 **D60:** 5.7005 **D50:** 3.5602
D30: 0.3276 **D15:** 0.0339 **D10:** 0.0167
Cu: 341.34 **Cc:** 1.13

E-14

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00381-S01

Client: Strata-G, LLC
CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00381-S01
Field Sample ID	GW980-SS2
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/13/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	Unified Soil Classification System
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	13.8	
Method		B	
Date Tested		2/26/2018	
Dispersion device	ASTM D 422	Dispersion Cup and Mixer	
Dispersion time (min)		1	
Shape			
Hardness			

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: ASM:FH18-W00342

Client: Strata-G, LLC

CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	USCS	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00342-S01	FH18-W00342-S02	FH18-W00342-S03	FH18-W00342-S04	FH18-W00342-S05	FH18-W00342-S06
Field Sample ID	GW982-SS2	GW982-SS3	GW982-SS4	GW982-SS5	GW982-SS8	GW982-SS10
Date Sampled	2/7/2018	2/7/2018	2/7/2018	2/7/2018	2/7/2018	2/7/2018

Other Test Results

Description	Method	Results						Limits
Water Content (%)	ASTM D 2216	11.0	13.1	12.5	12.3	13.9	10.8	
Method		B	B	B	B	B	B	
Group Symbol	ASTM D 2487				CL			
Group Name					Sandy lean clay			
Approximate maximum grain size	ASTM D 4318							
Material retained on 425µm (No. 40) (%)					28.3			
Method of Removal								
Grooving Tool Type					Metal			
Specimen preparation method					Wet			
Drying Method					Air			
Special selection process					Quartered			
Rolling Method for PL					Hand			
As Received Water Content (%)					12.3			
Liquid Limit Device Type					Manual			
Liquid Limit					33			
Plastic Limit					23			
Plasticity Index					10			
Liquid Limit Procedure					Multipoint (A)			
Method	ASTM D 6913				Method B	Method B		
Sample Obtained While					Air-Dried	Air-Dried		
Group Name					Sandy lean clay	N/A		
Group Symbol					CL	N/A		
Composite Sieving Used					No	No		
Dispersion Method					Dispersant by hand	Dispersant by hand		
Prior Testing					Atterberg limits	Atterberg limits		

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: ASM:FH18-W00342

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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AASHTO ACCREDITATION PROGRAM

Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	USCS	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00342-S07	FH18-W00342-S08	FH18-W00342-S09	FH18-W00342-S10	FH18-W00342-S11
Field Sample ID	GW982-SS13	GW982-SS16	GW982-SS18	GW982-SS21	GW982-SS23
Date Sampled	2/7/2018	2/8/2018	2/8/2018	2/8/2018	2/8/2018

Other Test Results

Description	Method	Results					Limits
Water Content (%)	ASTM D 2216	11.9	4.7	8.9	7.0	5.5	
Method		B	B	B	B	B	
Group Symbol	ASTM D 2487				SC		
Group Name					Clayey sand		
Approximate maximum grain size	ASTM D 4318						
Material retained on 425µm (No. 40) (%)					54.5		
Method of Removal							
Grooving Tool Type					Metal		
Specimen preparation method					Wet		
Drying Method					Air		
Special selection process					Quartered		
Rolling Method for PL					Hand		
As Received Water Content (%)					7.0		
Liquid Limit Device Type					Manual		
Liquid Limit					28		
Plastic Limit					19		
Plasticity Index					9		
Liquid Limit Procedure					Multipoint (A)		
Method	ASTM D 6913				Method B		
Sample Obtained While					Air-Dried		
Group Name					Clayey sand		
Group Symbol					SC		
Composite Sieving Used					No		
Dispersion Method					Dispersant by hand		
Prior Testing					Atterberg limits		

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00342-S04

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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AASHTO ACCREDITATION PROGRAM

Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00342-S04
Field Sample ID	GW982-SS5
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/7/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A

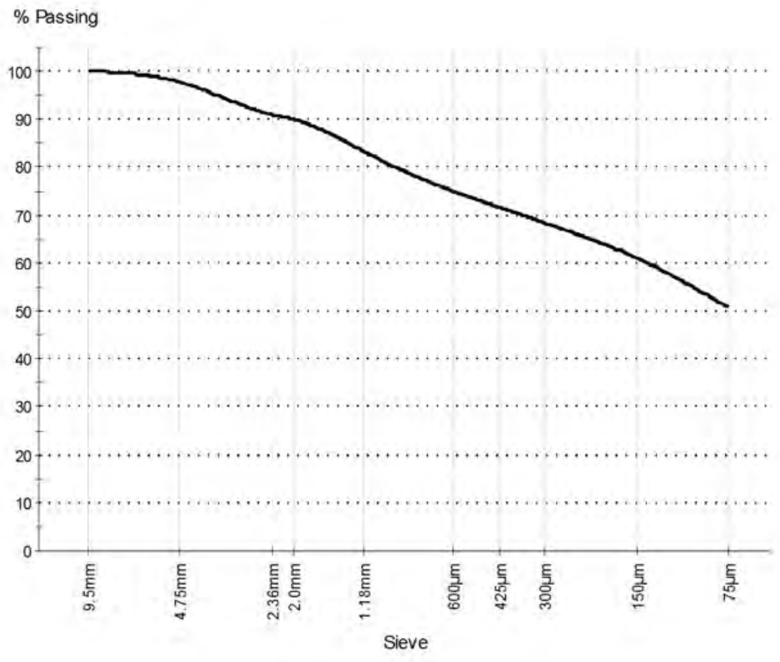
Atterberg Limit:

Liquid Limit: 33
Plastic Limit: 23
Plasticity Index: 10

Sample Description:

Brown sandy lean clay (CL)

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES (50.8%)	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(2.2%)	(7.8%)	(18.3%)	(20.9%)		

Grading: ASTM D 6913

Drying by: Oven
Date Tested: 2/15/2018
Tested By: David Cook

Sieve Size	% Passing	Limits
3/8in	100.0	
No.4	97.8	
No.8	91.0	
No.10	90.0	
No.16	83.3	
No.30	75.0	
No.40	71.7	
No.50	68.4	
No.100	61.1	
No.200	50.8	

D85: 1.3490 **D60:** 0.1393 **D50:** N/A
D30: N/A **D15:** N/A **D10:** N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00342-S04

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00342-S04
Field Sample ID	GW982-SS5
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/7/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	12.3	
Method		B	
Date Tested		2/15/2018	
Group Symbol	ASTM D 2487	CL	
Group Name		Sandy lean clay	
Date Tested		2/20/2018	
Approximate maximum grain size	ASTM D 4318		
Material retained on 425µm (No. 40) (%)		28.3	
Method of Removal			
Grooving Tool Type		Metal	
Specimen preparation method		Wet	
Drying Method		Air	
Special selection process		Quartered	
Rolling Method for PL		Hand	
As Received Water Content (%)		12.3	
Liquid Limit Device Type		Manual	
Liquid Limit		33	
Plastic Limit		23	
Plasticity Index		10	
Liquid Limit Procedure		Multipoint (A)	
Date Tested		2/15/2018	
Method	ASTM D 6913	Method B	
Sample Obtained While		Air-Dried	
Group Name		Sandy lean clay	
Group Symbol		CL	
Composite Sieving Used		No	

Comments

N/A

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Material Test Report

Project No.:	1188070011-05B
ReportNo:	MAT:FH18-W00342-S04

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

AASHTO ACCREDITATION PROGRAM

Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00342-S04
Field Sample ID	GW982-SS5
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/7/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Dispersion Method		Dispersant by hand	
Prior Testing		Atterberg limits	

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00342-S05

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

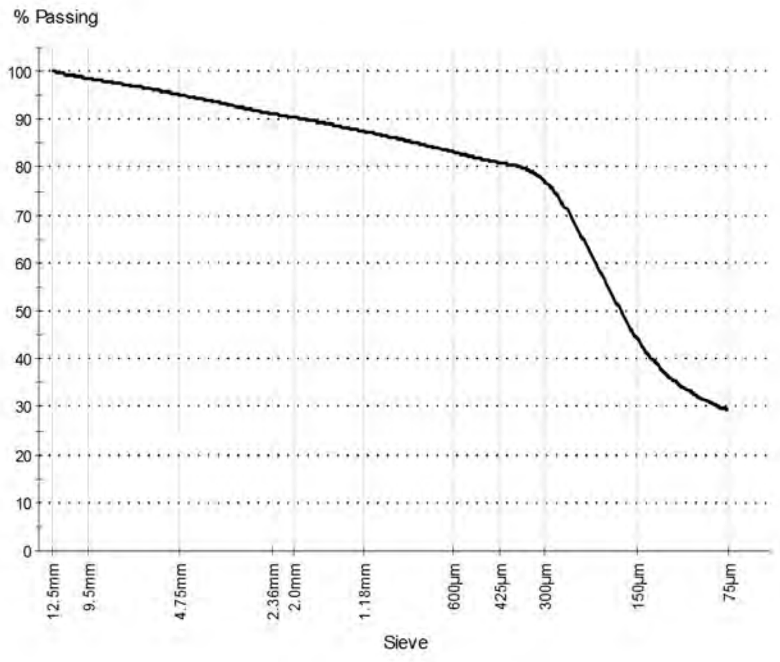
Sample Details

Sample ID	FH18-W00342-S05
Field Sample ID	GW982-SS8
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/7/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A

Sample Description:

Dark brown clayey sand with unweathered shale

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES (29.3%)	
(0.0%)	Coarse (0.0%)	Fine (4.8%)	Coarse (4.8%)	Medium (9.4%)	Fine (51.7%)	Silt	Clay

Grading: ASTM D 6913

Drying by: Oven
Date Tested: 2/15/2018
Tested By: David Cook

Sieve Size	% Passing	Limits
½in	100.0	
3/8in	98.6	
No.4	95.2	
No.8	91.2	
No.10	90.4	
No.16	87.5	
No.30	83.2	
No.40	81.0	
No.50	77.1	
No.100	44.4	
No.200	29.3	

D85: 0.7964	**D60:** 0.2088	**D50:** 0.1689
D30: 0.0774	**D15:** N/A	**D10:** N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00342-S05

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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AASHTO ACCREDITATION PROGRAM

Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00342-S05
Field Sample ID	GW982-SS8
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/7/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	13.9	
Method		B	
Date Tested		2/15/2018	
Method	ASTM D 6913	Method B	
Sample Obtained While		Air-Dried	
Group Name		N/A	
Group Symbol		N/A	
Composite Sieving Used		No	
Dispersion Method		Dispersant by hand	
Prior Testing		Atterberg limits	

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00342-S10

Client: Strata-G, LLC
CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00342-S10
Field Sample ID	GW982-SS21
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/8/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A

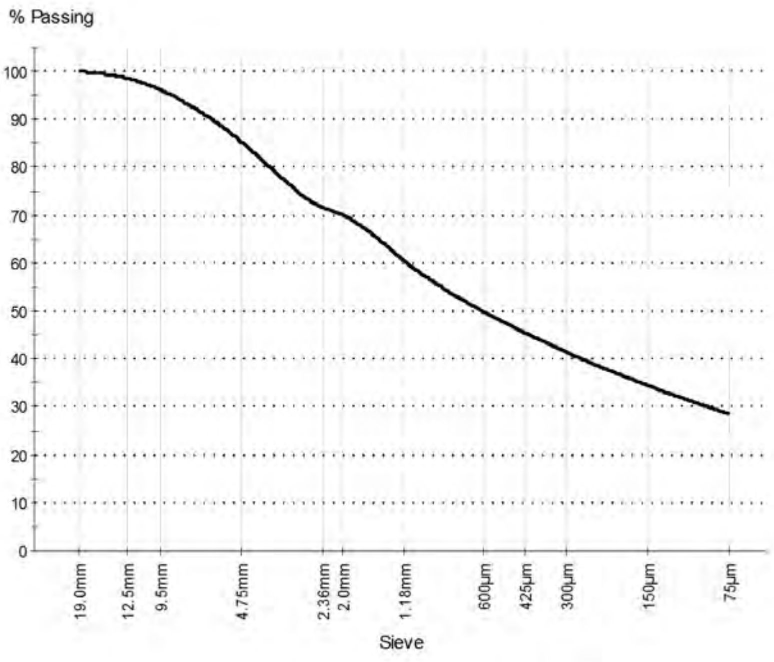
Atterberg Limit:

Liquid Limit: 28
Plastic Limit: 19
Plasticity Index: 9

Sample Description:

Brown clayey sand (SC)

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES (28.5%)	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(14.7%)	(15.3%)	(24.5%)	(17.0%)		

Grading: ASTM D 6913

Drying by: Oven
Date Tested: 2/15/2018
Tested By: David Cook

Sieve Size	% Passing	Limits
¾in	100.0	
½in	98.6	
3/8in	96.2	
No.4	85.3	
No.8	71.6	
No.10	70.0	
No.16	60.4	
No.30	49.8	
No.40	45.5	
No.50	41.5	
No.100	34.5	
No.200	28.5	

D85: 4.6778 **D60:** 1.1503 **D50:** 0.6077
D30: 0.0892 **D15:** N/A **D10:** N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00342-S10

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00342-S10
Field Sample ID	GW982-SS21
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/8/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	7.0	
Method		B	
Date Tested		2/15/2018	
Group Symbol	ASTM D 2487	SC	
Group Name		Clayey sand	
Date Tested		2/20/2018	
Approximate maximum grain size	ASTM D 4318		
Material retained on 425µm (No. 40) (%)		54.5	
Method of Removal			
Grooving Tool Type		Metal	
Specimen preparation method		Wet	
Drying Method		Air	
Special selection process		Quartered	
Rolling Method for PL		Hand	
As Received Water Content (%)		7.0	
Liquid Limit Device Type		Manual	
Liquid Limit		28	
Plastic Limit		19	
Plasticity Index		9	
Liquid Limit Procedure		Multipoint (A)	
Date Tested		2/15/2018	
Method	ASTM D 6913	Method B	
Sample Obtained While		Air-Dried	
Group Name		Clayey sand	
Group Symbol		SC	
Composite Sieving Used		No	

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00342-S10

Client: Strata-G, LLC

CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00342-S10
Field Sample ID	GW982-SS21
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/8/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Dispersion Method		Dispersant by hand	
Prior Testing		Atterberg limits	

Comments

N/A

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Material Test Report

Project No.:	1188070011-05B
ReportNo:	ASM:FH18-W00388

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Reviewed By: Timothy A. Moore, Jr.

Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	USCS	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00388-S01	FH18-W00388-S02	FH18-W00388-S03	FH18-W00388-S04	FH18-W00388-S05	FH18-W00388-S06
Field Sample ID	GW986-SS2	GW986-SS3	GW986-SS4	GW986-SS6	GW986-SS7	GW986-SS9
Date Sampled	2/15/2018	2/15/2018	2/15/2018	2/15/2018	2/15/2018	2/15/2018

Other Test Results

Description	**Method**	**Results**						**Limits**
Water Content (%)	ASTM D 2216	20.4	21.1	14.6	8.4	8.7	4.3	
Method		B	B	B	B	B	B	
Approximate maximum grain size	ASTM D 4318							
Material retained on 425µm (No. 40) (%)								
Method of Removal								
Grooving Tool Type		Metal						
Specimen preparation method		Wet						
Drying Method		Air						
Special selection process		Quartering						
Rolling Method for PL		Hand						
As Received Water Content (%)		20.4						
Liquid Limit Device Type		Manual						
Liquid Limit		37						
Plastic Limit		18						
Plasticity Index		19						
Liquid Limit Procedure		Multipoint (A)						
Method	ASTM D 6913			Method B				
Sample Obtained While				Air-Dried				
Group Name				Clayey sand				
Group Symbol				SC				
Composite Sieving Used				No				
Dispersion Method				Dispersant by hand				
Prior Testing				Moisture				

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00388-S03

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Reviewed By: Timothy A. Moore, Jr.

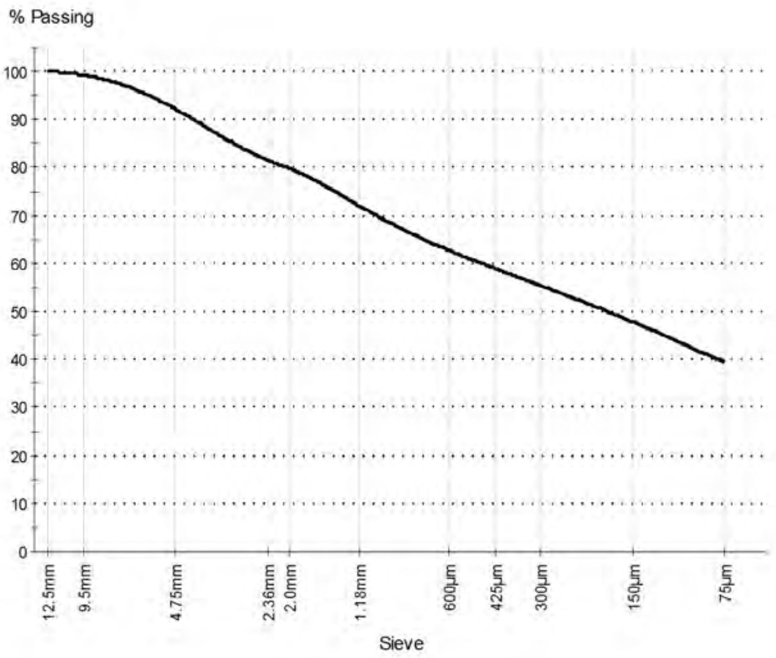
Sample Details

Sample ID	FH18-W00388-S03
Field Sample ID	GW986-SS4
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/15/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A

Sample Description:

Brown clayey sand (SC)

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES (39.4%)	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(7.8%)	(12.4%)	(20.8%)	(19.6%)		

Grading: ASTM D 6913

Drying by:	Oven
Date Tested:	3/2/2018
Tested By:	David Cook

Sieve Size	% Passing	Limits
½in	100.0	
3/8in	99.3	
No.4	92.2	
No.8	81.5	
No.10	79.8	
No.16	72.0	
No.30	62.7	
No.40	59.0	
No.50	55.4	
No.100	47.9	
No.200	39.4	

D85: 2.9667 **D60:** 0.4665 **D50:** 0.1821
D30: N/A **D15:** N/A **D10:** N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00388-S03

Client: Strata-G, LLC **CC:**

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Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00388-S03
Field Sample ID	GW986-SS4
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/15/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	14.6	
Method		B	
Date Tested		2/26/2018	
Method	ASTM D 6913	Method B	
Sample Obtained While		Air-Dried	
Group Name		Clayey sand	
Group Symbol		SC	
Composite Sieving Used		No	
Dispersion Method		Dispersant by hand	
Prior Testing		Moisture	

Comments

N/A

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Material Test Report

Project No.:	**1188070011-05B**
ReportNo:	**ASM:FH18-W00343**

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

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Timothy a Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	USCS	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00343-S01	FH18-W00343-S02	FH18-W00343-S03	FH18-W00343-S04	FH18-W00343-S05	FH18-W00343-S06
Field Sample ID	GW988-SS2	GW988-SS3	GW988-SS4	GW988-SS6	GW988-SS8	GW988-SS11
Date Sampled	2/7/2018	2/7/2018	2/7/2018	2/7/2018	2/7/2018	2/7/2018

Other Test Results

Description	**Method**	**Results**						**Limits**
Water Content (%)	ASTM D 2216	34.6	25.1	33.6	29.8	26.2	21.5	
Method		B	B	B	B	B	B	
Group Symbol	ASTM D 2487			ML				
Group Name				Sandy silt				
Approximate maximum grain size	ASTM D 4318							
Material retained on 425µm (No. 40) (%)				24.3				
Method of Removal								
Grooving Tool Type				Metal				
Specimen preparation method				Wet				
Drying Method				Air				
Special selection process				Quartered				
Rolling Method for PL				Hand				
As Received Water Content (%)				33.6				
Liquid Limit Device Type				Manual				
Liquid Limit				41				
Plastic Limit				27				
Plasticity Index				14				
Liquid Limit Procedure				Multipoint (A)				
Method	ASTM D 6913			Method B				
Sample Obtained While				Air-Dried				
Group Name				Sandy silt				
Group Symbol				ML				
Composite Sieving Used				No				
Dispersion Method				Dispersant by hand				
Prior Testing				Atterberg limits				

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: ASM:FH18-W00343

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Oak Ridge, Tennessee

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Reviewed By: Timothy A. Moore, Jr.

Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	USCS	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00343-S07	FH18-W00343-S08	FH18-W00343-S09
Field Sample ID	GW988-SS13	GW988-SS16	GW988-SS18
Date Sampled	2/7/2018	2/7/2018	2/7/2018

Other Test Results

Description	Method	Results			Limits
Water Content (%)	ASTM D 2216	16.0	9.9	9.9	
Method		B	B	B	
Group Symbol	ASTM D 2487		SC		
Group Name			Clayey sand		
Approximate maximum grain size	ASTM D 4318				
Material retained on 425μm (No. 40) (%)			48.6		
Method of Removal					
Grooving Tool Type			Metal		
Specimen preparation method			Wet		
Drying Method			Air		
Special selection process			Quartered		
Rolling Method for PL			Hand		
As Received Water Content (%)			9.9		
Liquid Limit Device Type			Manual		
Liquid Limit			32		
Plastic Limit			19		
Plasticity Index			13		
Liquid Limit Procedure			Multipoint (A)		
Method	ASTM D 6913		Method B		
Sample Obtained While			Air-Dried		
Group Name			Clayey sand		
Group Symbol			SC		
Composite Sieving Used			No		
Dispersion Method			Dispersant by hand		
Prior Testing			Atterberg limits		

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00343-S03

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00343-S03
Field Sample ID	GW988-SS4
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/7/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A

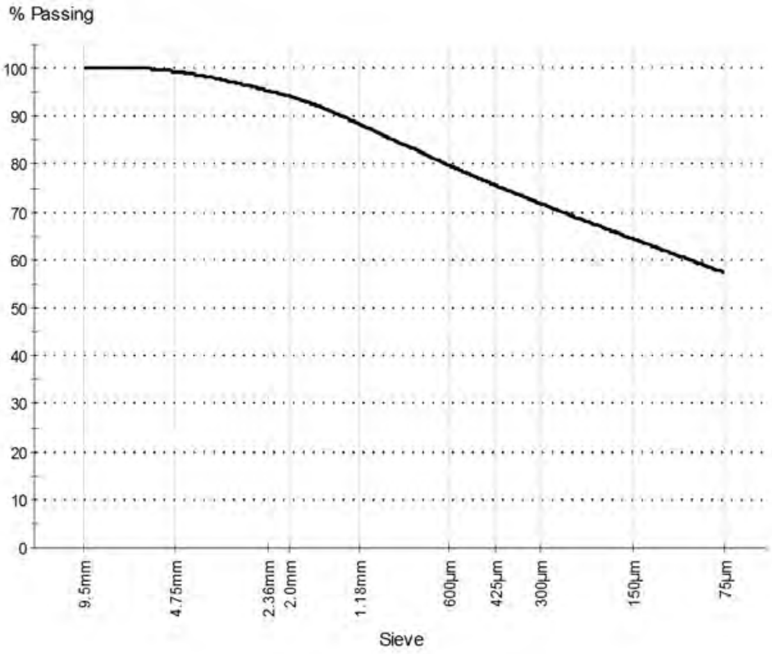
Atterberg Limit:

Liquid Limit: 41
Plastic Limit: 27
Plasticity Index: 14

Sample Description:

Brown mottled sandy silt (ML)

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES (57.4%)	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(0.6%)	(5.2%)	(18.5%)	(18.3%)		

Grading: ASTM D 6913

Drying by: Oven
Date Tested: 2/16/2018
Tested By: David Cook

Sieve Size	% Passing	Limits
3/8in	100.0	
No.4	99.4	
No.8	95.4	
No.10	94.2	
No.16	88.4	
No.30	79.8	
No.40	75.7	
No.50	71.8	
No.100	64.5	
No.200	57.4	

D85: 0.9031 **D60:** 0.0967 **D50:** N/A
D30: N/A **D15:** N/A **D10:** N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00343-S03

Client: Strata-G, LLC
CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00343-S03
Field Sample ID	GW988-SS4
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/7/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	33.6	
Method		B	
Date Tested		2/16/2018	
Group Symbol	ASTM D 2487	ML	
Group Name		Sandy silt	
Date Tested		2/20/2018	
Approximate maximum grain size	ASTM D 4318		
Material retained on 425µm (No. 40) (%)		24.3	
Method of Removal			
Grooving Tool Type		Metal	
Specimen preparation method		Wet	
Drying Method		Air	
Special selection process		Quartered	
Rolling Method for PL		Hand	
As Received Water Content (%)		33.6	
Liquid Limit Device Type		Manual	
Liquid Limit		41	
Plastic Limit		27	
Plasticity Index		14	
Liquid Limit Procedure		Multipoint (A)	
Date Tested		2/16/2018	
Method	ASTM D 6913	Method B	
Sample Obtained While		Air-Dried	
Group Name		Sandy silt	
Group Symbol		ML	
Composite Sieving Used		No	

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00343-S03

Client: Strata-G, LLC

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Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Sample Details

Sample ID	FH18-W00343-S03
Field Sample ID	GW988-SS4
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/7/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Dispersion Method		Dispersant by hand	
Prior Testing		Atterberg limits	

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00343-S08

Client: Strata-G, LLC
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Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00343-S08
Field Sample ID	GW988-SS16
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/7/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A

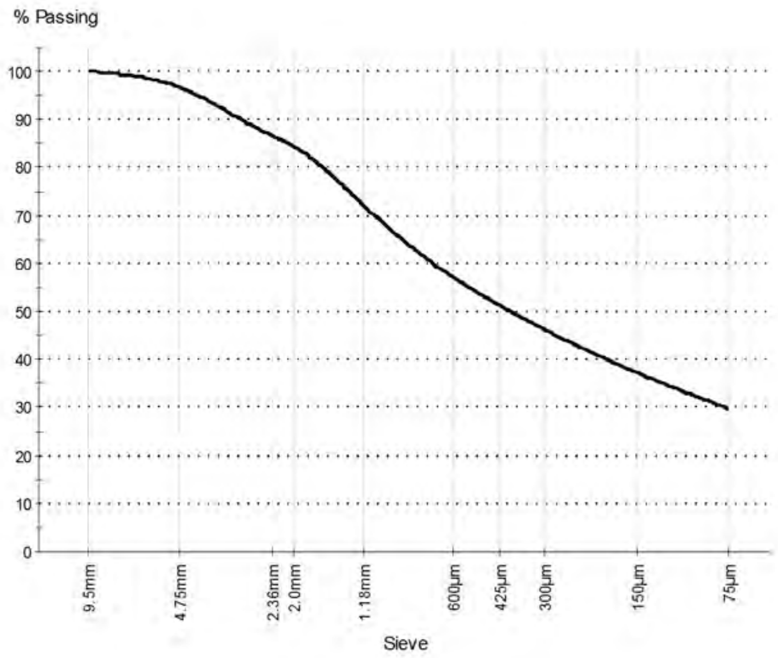
Atterberg Limit:

Liquid Limit: 32
Plastic Limit: 19
Plasticity Index: 13

Sample Description:

Gray clayey sand (SC)

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES (29.8%)	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(3.3%)	(12.3%)	(33.0%)	(21.6%)		

Grading: ASTM D 6913

Drying by: Oven
Date Tested: 2/16/2018
Tested By: David Cook

Sieve Size	**% Passing**	**Limits**
3/8in	100.0	
No.4	96.7	
No.8	86.6	
No.10	84.4	
No.16	72.1	
No.30	57.1	
No.40	51.4	
No.50	46.2	
No.100	37.3	
No.200	29.8	

D85: 2.0923 **D60:** 0.6838 **D50:** 0.3870
D30: 0.0764 **D15:** N/A **D10:** N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00343-S08

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00343-S08
Field Sample ID	GW988-SS16
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/7/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	9.9	
Method		B	
Date Tested		2/16/2018	
Group Symbol	ASTM D 2487	SC	
Group Name		Clayey sand	
Date Tested		2/20/2018	
Approximate maximum grain size	ASTM D 4318		
Material retained on 425µm (No. 40) (%)		48.6	
Method of Removal			
Grooving Tool Type		Metal	
Specimen preparation method		Wet	
Drying Method		Air	
Special selection process		Quartered	
Rolling Method for PL		Hand	
As Received Water Content (%)		9.9	
Liquid Limit Device Type		Manual	
Liquid Limit		32	
Plastic Limit		19	
Plasticity Index		13	
Liquid Limit Procedure		Multipoint (A)	
Date Tested		2/16/2018	
Method	ASTM D 6913	Method B	
Sample Obtained While		Air-Dried	
Group Name		Clayey sand	
Group Symbol		SC	
Composite Sieving Used		No	

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00343-S08

Client: Strata-G, LLC
CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00343-S08
Field Sample ID	GW988-SS16
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/7/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Dispersion Method		Dispersant by hand	
Prior Testing		Atterberg limits	

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: ASM:FH18-W00402

Client: Strata-G, LLC
CC:

Project: EMDF Site 7c Characterization
Oak Ridge, Tennessee

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Timothy a Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	USCS	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00402-S01	FH18-W00402-S02	FH18-W00402-S03	FH18-W00402-S04	FH18-W00402-S05	FH18-W00402-S06
Field Sample ID	GW992-SS1	GW992-SS2	GW992-SS4	GW992-SS5	GW992-SS7	GW992-SS8
Date Sampled	2/16/2018	2/16/2018	2/16/2018	2/16/2018	2/16/2018	2/16/2018

Other Test Results

Description	Method	Results						Limits
Water Content (%)	ASTM D 2216	29.3	23.9	37.1	13.4	21.3	16.2	
Method		B	B	B	B	B	B	
Approximate maximum grain size	ASTM D 4318							
Material retained on 425µm (No. 40) (%)								
Method of Removal								
Grooving Tool Type		Metal						
Specimen preparation method		Wet						
Drying Method		Air						
Special selection process		Quartering						
Rolling Method for PL		Hand						
As Received Water Content (%)		29.3						
Liquid Limit Device Type		Manual						
Liquid Limit		38						
Plastic Limit		20						
Plasticity Index		18						
Liquid Limit Procedure		Multipoint (A)						
Dispersion device	ASTM D 422		Dispersion Cup and Mixer					
Dispersion time (min)			1					
Shape								
Hardness								

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: ASM:FH18-W00402

Client: Strata-G, LLC

CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	Unified Soil Classification System	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00402-S07	FH18-W00402-S08	FH18-W00402-S09
Field Sample ID	GW992-SS10	GW992-SS12	GW992-SS13
Date Sampled	2/16/2018	2/16/2018	2/16/2018

Particle Size Distribution

Method:
ASTM D 422
Description:
Analysis of Particle Size Distribution in Soils. Sieving for Particles >75µm, Hydrometer
Drying by:
Oven
Washed:
Sample Washed

Sieve Size	% Passing			Limits
1½in (37.5mm)				
1in (25.0mm)				
½in (12.5mm)				
3/8in (9.5mm)	100			
No.4 (4.75mm)	99			
No.10 (2.0mm)	86			
No.40 (425µm)	54			
No.100	41			
No.200 (75µm)	37			

Other Test Results

Description	Method	Results			Limits
Water Content (%)	ASTM D 2216	15.5	17.6	10.8	
Method		B	B	B	
Dispersion device	ASTM D 422	Dispersion Cup and Mixer			
Dispersion time (min)		1			
Shape					
Hardness					

Comments

N/A

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Material Test Report

Project No.:	1188070011-05B
ReportNo:	MAT:FH18-W00402-S02

Client:	Strata-G, LLC	**CC:**
Project:	EMDF Site 7c Characterization Oak Ridge, Tennessee	

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

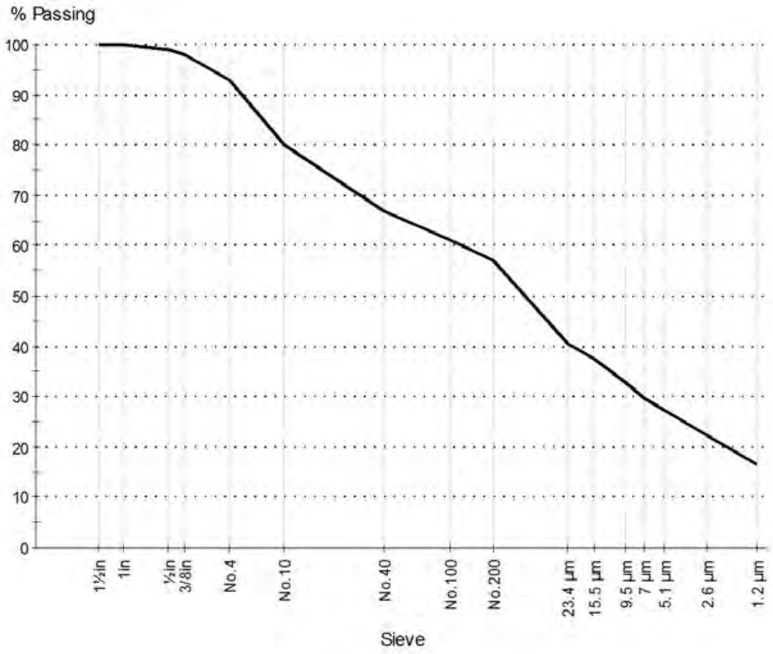
Sample Details

Sample ID	FH18-W00402-S02
Field Sample ID	GW992-SS2
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/16/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	Unified Soil Classification System
Sampling Method	Split Spoon
Contractor	N/A

Sample Description:

Brown / orange sandy lean clay (CL)

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.5%)	(6.5%)	(13.0%)	(13.0%)	(10.0%)	(30.0%)	(27.0%)

Grading: ASTM D 422

Drying by:	Oven
Date Tested:	2/28/2018
Tested By:	Sheila Bowers

Sieve Size	% Passing	Limits
1½in	100	
1in	100	
½in	99	
3/8in	98	
No.4	93	
No.10	80	
No.40	67	
No.100	61	
No.200	57	
23.4 µm	40.6	
15.5 µm	37.5	
9.5 µm	32.7	
7.0 µm	29.6	
5.1 µm	27.2	
2.6 µm	22.2	
1.2 µm	16.7	

D85: 2.7894 **D60:** 0.1261 **D50:** 0.0456
D30: 0.0073 **D15:** N/A **D10:** N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00402-S02

Client: Strata-G, LLC

CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00402-S02
Field Sample ID	GW992-SS2
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/16/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	Unified Soil Classification System
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	23.9	
Method		B	
Date Tested		3/1/2018	
Dispersion device	ASTM D 422	Dispersion Cup and Mixer	
Dispersion time (min)		1	
Shape			
Hardness			

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00402-S07

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Reviewed By: Timothy A. Moore, Jr.

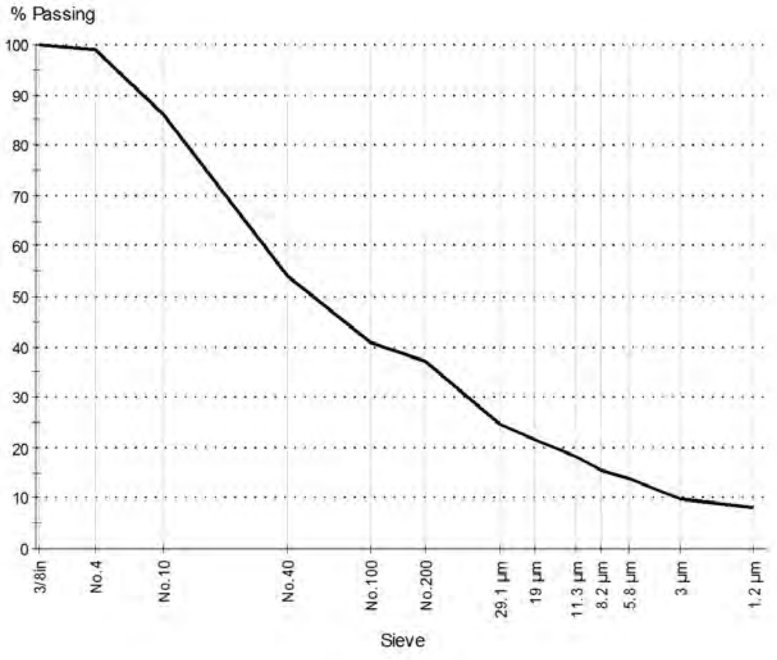
Sample Details

Sample ID	FH18-W00402-S07
Field Sample ID	GW992-SS10
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/16/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	Unified Soil Classification System
Sampling Method	Split Spoon
Contractor	N/A

Sample Description:

Brown clayey sand

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(1.0%)	(13.0%)	(32.0%)	(17.0%)	(24.3%)	(12.7%)

Grading: ASTM D 422

Drying by: Oven
Date Tested: 2/28/2018
Tested By: Sheila Bowers

Sieve Size	% Passing	Limits
3/8in	100	
No.4	99	
No.10	86	
No.40	54	
No.100	41	
No.200	37	
29.1 µm	24.8	
19.0 µm	21.5	
11.3 µm	18.1	
8.2 µm	15.6	
5.8 µm	13.9	
3.0 µm	9.8	
1.2 µm	8.1	

D85: 1.9055 **D60:** 0.5682 **D50:** 0.3085
D30: 0.0436 **D15:** 0.0073 **D10:** 0.0031
Cu: 183.41 **Cc:** 1.08

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00402-S07

Client: Strata-G, LLC
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Project: EMDF Site 7c Characterization

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Sample Details

Sample ID	FH18-W00402-S07
Field Sample ID	GW992-SS10
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/16/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	Unified Soil Classification System
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	15.5	
Method		B	
Date Tested		3/1/2018	
Dispersion device	ASTM D 422	Dispersion Cup and Mixer	
Dispersion time (min)		1	
Shape			
Hardness			

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: ASM:FH18-W00403

Client: Strata-G, LLC

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Project: EMDF Site 7c Characterization

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Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	USCS	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00403-S01	FH18-W00403-S02	FH18-W00403-S03	FH18-W00403-S04	FH18-W00403-S05	FH18-W00403-S06
Field Sample ID	GW994-SS2	GW994-SS3	GW994-SS4	GW994-SS6	GW994-SS8	GW994-SS10
Date Sampled	2/16/2018	2/16/2018	2/16/2018	2/16/2018	2/16/2018	2/16/2018

Other Test Results

Description	Method	Results						Limits
Water Content (%)	ASTM D 2216	22.8	23.6	21.7	39.2	24.4	16.6	
Method		B	B	B	B	B	B	
Approximate maximum grain size	ASTM D 4318							
Material retained on 425µm (No. 40) (%)								
Method of Removal								
Grooving Tool Type		Metal						
Specimen preparation method		Wet						
Drying Method		Air						
Special selection process		Quartering						
Rolling Method for PL		Hand						
As Received Water Content (%)		22.8						
Liquid Limit Device Type		Manual						
Liquid Limit		47						
Plastic Limit		18						
Plasticity Index		29						
Liquid Limit Procedure		Multipoint (A)						
Method	ASTM D 6913			Method B				
Sample Obtained While				Air-Dried				
Group Name				Lean clay				
Group Symbol				CL				
Composite Sieving Used				No				
Dispersion Method				Dispersant by hand				
Prior Testing				Moisture				

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: ASM:FH18-W00403

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Reviewed By: Timothy A. Moore, Jr.

Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	USCS	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00403-S07	FH18-W00403-S08	FH18-W00403-S09	FH18-W00403-S10	FH18-W00403-S11
Field Sample ID	GW994-SS12	GW994-SS14	GW994-SS15	GW994-SS17	GW994-SS18
Date Sampled	2/16/2018	2/16/2018	2/16/2018	2/16/2018	2/16/2018

Other Test Results

Description	Method	Results					Limits
Water Content (%)	ASTM D 2216	18.7	13.6	13.3	15.9	14.6	
Method		B	B	B	B	B	
Method	ASTM D 6913		Method B				
Sample Obtained While			Air-Dried				
Group Name							
Group Symbol							
Composite Sieving Used			No				
Dispersion Method			Dispersant by hand				
Prior Testing			Moisture				

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00403-S03

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Reviewed By: Timothy A. Moore, Jr.

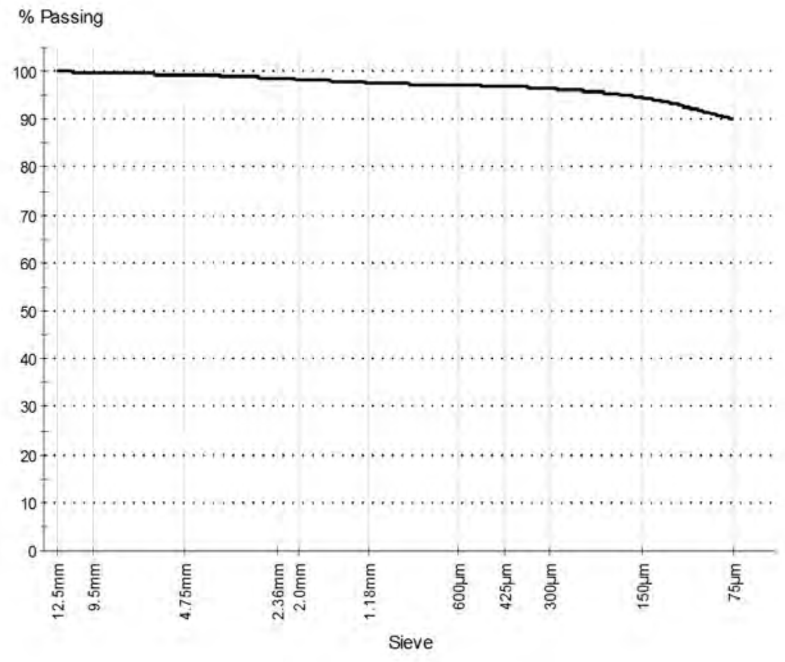
Sample Details

Sample ID	FH18-W00403-S03
Field Sample ID	GW994-SS4
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/16/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A

Sample Description:

Brown mottled lean clay (CL)

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES (90.0%)	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(0.6%)	(1.0%)	(1.5%)	(6.9%)		

Grading: ASTM D 6913

Drying by: Oven
Date Tested: 3/2/2018
Tested By: David Cook

Sieve Size	% Passing	Limits
½in	100.0	
3/8in	99.7	
No.4	99.4	
No.8	98.6	
No.10	98.4	
No.16	97.7	
No.30	97.1	
No.40	96.9	
No.50	96.4	
No.100	94.6	
No.200	90.0	

D85: N/A **D60:** N/A **D50:** N/A
D30: N/A **D15:** N/A **D10:** N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00403-S03

Client: Strata-G, LLC
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Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00403-S03
Field Sample ID	GW994-SS4
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/16/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	21.7	
Method		B	
Date Tested		3/1/2018	
Method	ASTM D 6913	Method B	
Sample Obtained While		Air-Dried	
Group Name		Lean clay	
Group Symbol		CL	
Composite Sieving Used		No	
Dispersion Method		Dispersant by hand	
Prior Testing		Moisture	

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00403-S08

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

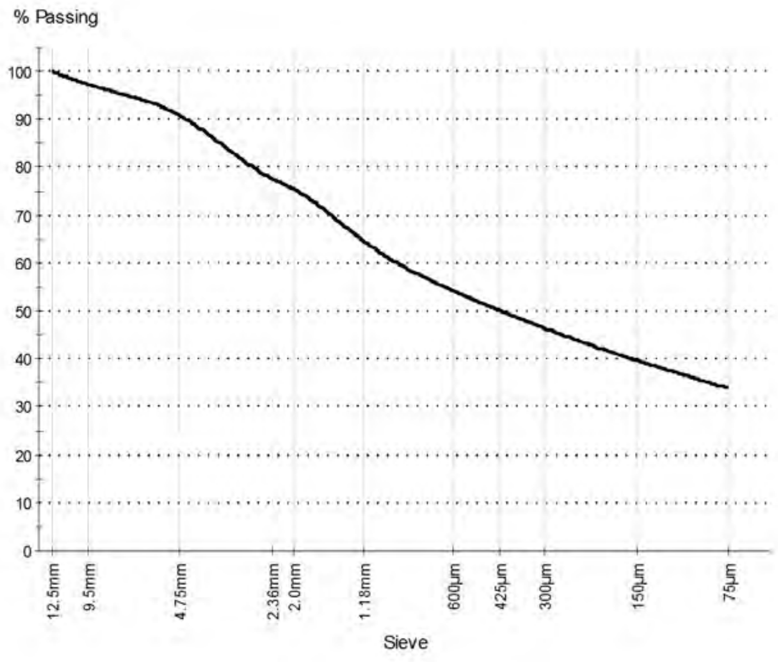
Sample Details

Sample ID	FH18-W00403-S08
Field Sample ID	GW994-SS14
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/16/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A

Sample Description:

Brown clayey sand

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES (33.9%)	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(9.2%)	(15.4%)	(25.2%)	(16.3%)		

Grading: ASTM D 6913

Drying by: Oven
Date Tested: 3/2/2018
Tested By: David Cook

Sieve Size	% Passing	Limits
½in	100.0	
3/8in	97.3	
No.4	90.8	
No.8	77.6	
No.10	75.4	
No.16	64.6	
No.30	54.2	
No.40	50.2	
No.50	46.4	
No.100	39.7	
No.200	33.9	

D85: 3.4931 **D60:** 0.8749 **D50:** 0.4173
D30: N/A **D15:** N/A **D10:** N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00403-S08

Client: Strata-G, LLC
CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00403-S08
Field Sample ID	GW994-SS14
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/16/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	13.6	
Method		B	
Date Tested		3/1/2018	
Method	ASTM D 6913	Method B	
Sample Obtained While		Air-Dried	
Group Name			
Group Symbol			
Composite Sieving Used		No	
Dispersion Method		Dispersant by hand	
Prior Testing		Moisture	

Comments

N/A

E-48

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Material Test Report

Project No.: 1188070011-05B
ReportNo: ASM:FH18-W00404

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	USCS	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00404-S01	FH18-W00404-S02	FH18-W00404-S03	FH18-W00404-S04	FH18-W00404-S05	FH18-W00404-S06
Field Sample ID	GW998-SS1	GW998-SS2	GW998-SS3	GW998-SS4	GW998-SS5	GW998-SS7
Date Sampled	2/14/2018	2/14/2018	2/14/2018	2/14/2018	2/14/2018	2/14/2018

Other Test Results

Description	Method	Results						Limits
Water Content (%)	ASTM D 2216	18.9	22.0	27.4	18.6	26.0	23.8	
Method		B	B	B	B	B	B	
Approximate maximum grain size	ASTM D 4318							
Material retained on 425µm (No. 40) (%)								
Method of Removal								
Grooving Tool Type		Metal						
Specimen preparation method		Wet						
Drying Method		Air						
Special selection process		Quartering						
Rolling Method for PL		Hand						
As Received Water Content (%)		27.4						
Liquid Limit Device Type		Manual						
Liquid Limit		38						
Plastic Limit		22						
Plasticity Index		16						
Liquid Limit Procedure		Multipoint (A)						
Method	ASTM D 6913				Method B			
Sample Obtained While					Air-Dried			
Group Name								
Group Symbol								
Composite Sieving Used					No			
Dispersion Method					Dispersant by hand			
Prior Testing					Moisture			

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: ASM:FH18-W00404

Client: Strata-G, LLC
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Project: EMDF Site 7c Characterization

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Reviewed By: Timothy A. Moore, Jr.

Material Details

Source	Geotechnical Drilling Samples	**Sampled From**	Split Spoon
Description	Native Existing Material	**Location**	Oak Ridge, Tennessee
Specification	USCS	**Sampling Method**	Split Spoon

Sample Details

Sample ID	FH18-W00404-S07
Field Sample ID	GW998-SS9
Date Sampled	2/14/2018

Other Test Results

Description	Method	Results	Limits
Water Content (%)	ASTM D 2216	15.4	
Method		B	

Comments

N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00404-S04

Client: Strata-G, LLC

CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

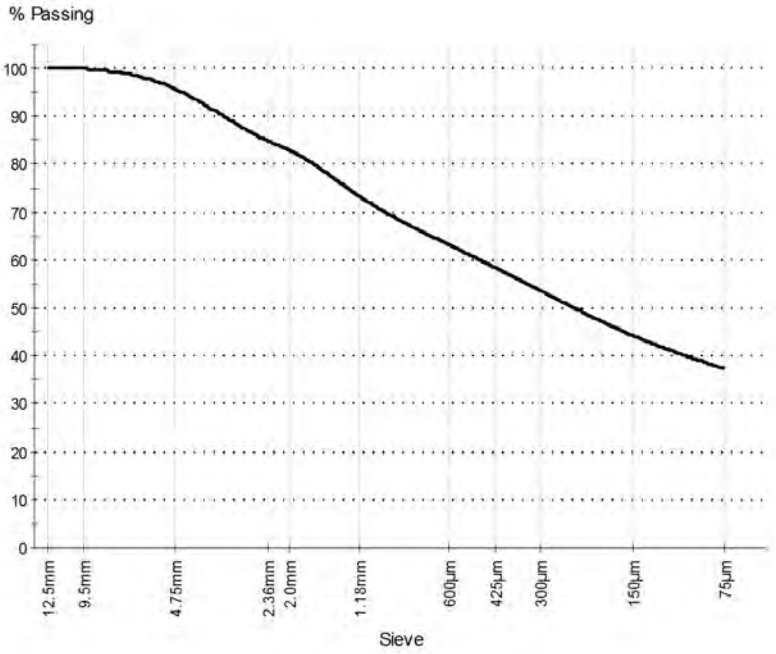
Sample Details

Sample ID	FH18-W00404-S04
Field Sample ID	GW998-SS4
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/14/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A

Sample Description:

Brown clayey sand

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES (37.3%)	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(4.3%)	(12.8%)	(24.4%)	(21.2%)		

Grading: ASTM D 6913

Drying by: Oven
Date Tested: 3/2/2018
Tested By: David Cook

Sieve Size	% Passing	Limits
½in	100.0	
3/8in	99.9	
No.4	95.7	
No.8	84.9	
No.10	82.9	
No.16	73.3	
No.30	63.2	
No.40	58.5	
No.50	53.6	
No.100	44.3	
No.200	37.3	

D85: 2.3753 **D60:** 0.4744 **D50:** 0.2294
D30: N/A **D15:** N/A **D10:** N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00404-S04

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

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Timothy A Moore Jr

Reviewed By: Timothy A. Moore, Jr.

Sample Details

Sample ID	FH18-W00404-S04
Field Sample ID	GW998-SS4
Location	Oak Ridge, Tennessee
Sampled By	Mike Partenio
Date Sampled	2/14/2018
Date Completed	
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	USCS
Sampling Method	Split Spoon
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	18.6	
Method		B	
Date Tested		3/13/2018	
Method	ASTM D 6913	Method B	
Sample Obtained While		Air-Dried	
Group Name			
Group Symbol			
Composite Sieving Used		No	
Dispersion Method		Dispersant by hand	
Prior Testing		Moisture	

Comments

N/A

Appendix E.2 – Bulk Soil Sample Testing

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Novi, MI 48377
Phone: (248) 486-5100
Fax: (248) 486-5050

Proctor Report

Project No.: 1188070011-05B
ReportNo: PTR:FH18-W00468-S01

Client: Strata-G, LLC
CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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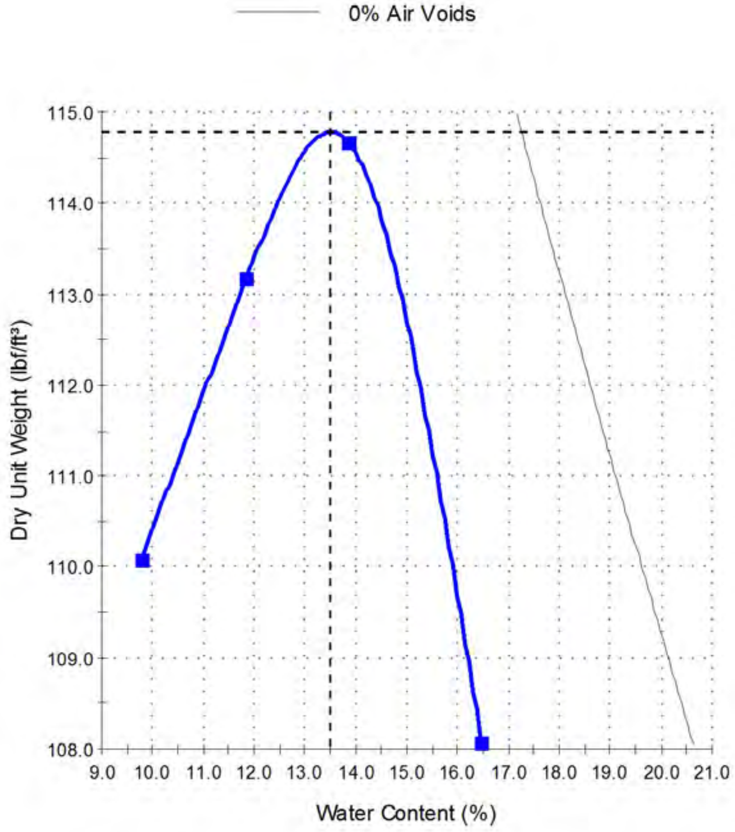
Reviewed By: Peng Lor

Sample Details

Sample ID:	FH18-W00468-S01	**Field Sample ID:**	GW979
Date Sampled:	2/21/2018	**Sampled By:**	Mike Partenio
Sampling Method:	In-Place		
Contractor:	N/A		
Source:	Geotechnical Drilling Samples		
Material:	Native Existing Material		
Specification:	N/A		
Location:	Boring Spoils		
Tested By:	Sheila Bowers	**Date Tested:**	3/16/2018

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D 1557

Maximum Dry Unit Weight (lbf/ft³):	**114.8**
Optimum Water Content (%):	**13.5**
Method:	B
Preparation Method:	Moist
Specific Gravity (Fines):	2.70
Visual Description:	Redish/Brown Clay

Comments

E-55

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Novi, MI 48377
Phone: (248) 486-5100
Fax: (248) 486-5050

Proctor Report

Project No.: 1188070011-05B
ReportNo: PTR:FH18-W00468-S02

Client: Strata-G, LLC
CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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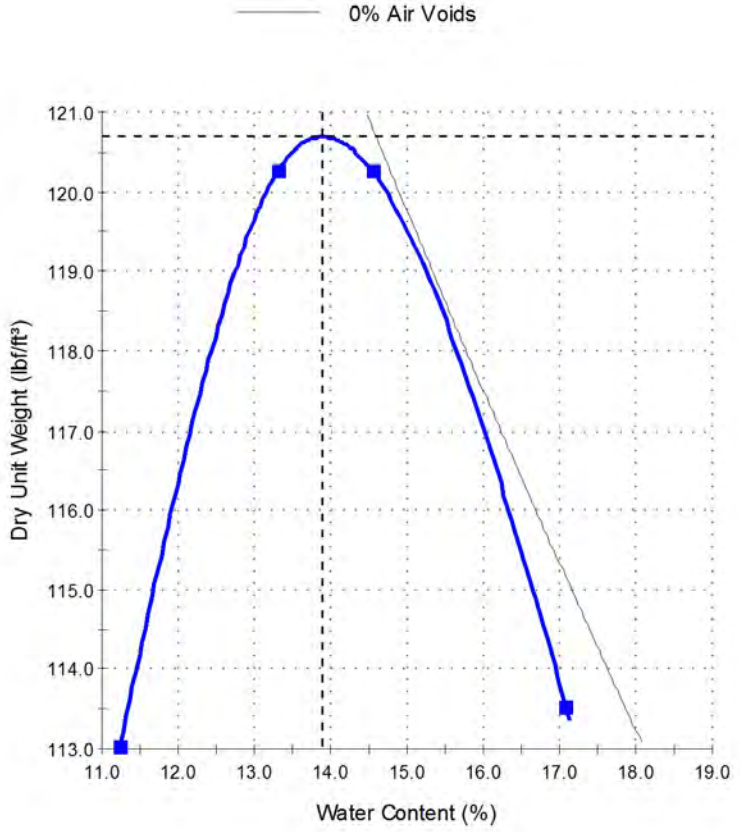
Reviewed By: Peng Lor

Sample Details

Sample ID:	FH18-W00468-S02	**Field Sample ID:**	GW981
Date Sampled:	2/23/2018	**Sampled By:**	Mike Partenio
Sampling Method:	In-Place		
Contractor:	N/A		
Source:	Geotechnical Drilling Samples		
Material:	Native Existing Material		
Specification:	N/A		
Location:	Boring Spoils		
Tested By:	Sheila Bowers	**Date Tested:**	3/16/2018

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D 1557

Maximum Dry Unit Weight (lbf/ft³):	**120.7**
Optimum Water Content (%):	**13.9**
Method:	B
Preparation Method:	Moist
Specific Gravity (Fines):	2.70
Visual Description:	Brown Clay

Comments

E-56

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Novi, MI 48377
Phone: (248) 486-5100
Fax: (248) 486-5050

Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00468-S03

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Reviewed By: Peng Lor

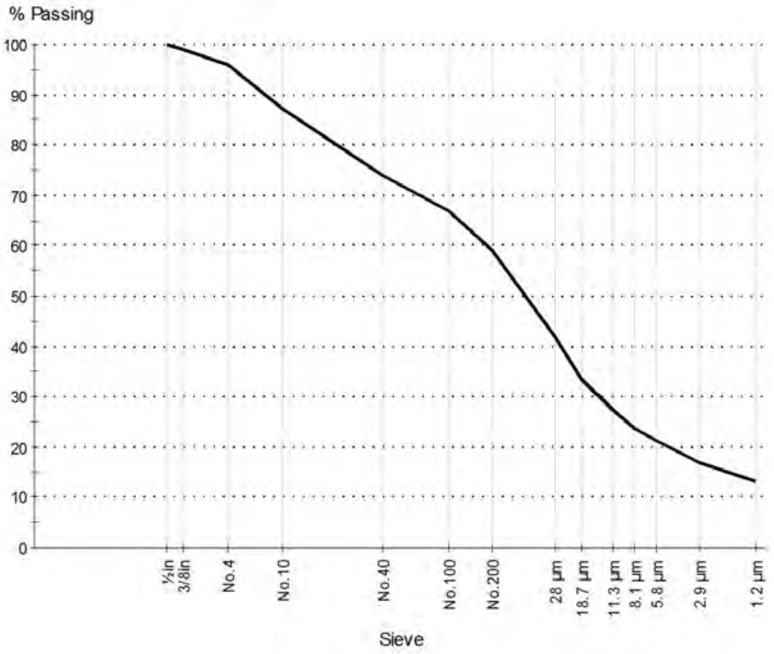
Sample Details

Sample ID	FH18-W00468-S03
Field Sample ID	GW983
Location	Boring Spoils
Sampled By	Mike Partenio
Date Sampled	2/21/2018
Date Completed	3/13/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	N/A
Sampling Method	In-Place
Contractor	N/A

Sample Description:

Brown Sandy Clay

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(4.0%)	(9.0%)	(13.0%)	(15.0%)	(38.9%)	(20.1%)

Grading: ASTM D 422

Drying by: Oven
Date Tested: 3/22/2018
Tested By: David Cook

Sieve Size	% Passing	Limits
½in	100	
3/8in	99	
No.4	96	
No.10	87	
No.40	74	
No.100	67	
No.200	59	
28.0 µm	41.8	
18.7 µm	33.4	
11.3 µm	27.4	
8.1 µm	23.8	
5.8 µm	21.4	
2.9 µm	16.8	
1.2 µm	13.2	

D85: 1.5760 **D60:** 0.0818 **D50:** 0.0448
D30: 0.0141 **D15:** 0.0019 **D10:** N/A

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Novi, MI 48377
Phone: (248) 486-5100
Fax: (248) 486-5050

Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00468-S03

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Reviewed By: Peng Lor

Sample Details

Sample ID	FH18-W00468-S03
Field Sample ID	GW983
Location	Boring Spoils
Sampled By	Mike Partenio
Date Sampled	2/21/2018
Date Completed	3/13/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	N/A
Sampling Method	In-Place
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Maximum Dry Unit Weight (lbf/ft³)	ASTM D 1557	120.2	
Corrected Maximum Dry Unit Weight (lbf/ft³)		120.2	
Optimum Water Content (%)		11.3	
Corrected Optimum Water Content (%)		11.3	
Method		B	
Preparation Method		Moist	
Visual Description		Brown Sandy Clay	
Specific Gravity (Fines)		2.70	
Date Tested		3/20/2018	
Dispersion device	ASTM D 422	Soil Dispersion Cup and Mixer	
Dispersion time (min)		1	
Shape			
Hardness			
Maximum Dry Unit Weight (lbf/ft³)	ASTM D 698	112.2	
Corrected Maximum Dry Unit Weight (lbf/ft³)		112.2	
Optimum Water Content (%)		11.7	
Corrected Optimum Water Content (%)		11.7	
Method		B	
Preparation Method		Moist	
Visual Description		Brown Sandy Clay	
Retained Sieve 3/8" (9.5mm) (%)		0	
Specific Gravity (Fines)		2.70	
Date Tested		3/20/2018	

Comments

N/A

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Phone: (248) 486-5100
Fax: (248) 486-5050

Proctor Report

Project No.: 1188070011-05B
ReportNo: PTR:FH18-W00468-S03

Client: Strata-G, LLC

CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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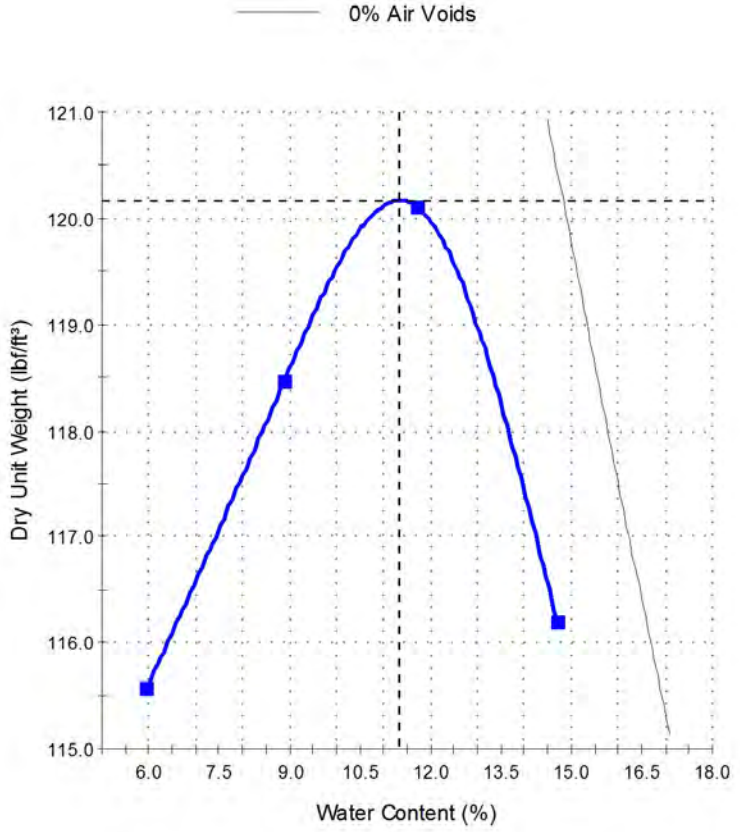
Reviewed By: Peng Lor

Sample Details

Sample ID:	FH18-W00468-S03	**Field Sample ID:**	GW983
Date Sampled:	2/21/2018	**Sampled By:**	Mike Partenio
Sampling Method:	In-Place		
Contractor:	N/A		
Source:	Geotechnical Drilling Samples		
Material:	Native Existing Material		
Specification:	N/A		
Location:	Boring Spoils		
Tested By:	Sheila Bowers	**Date Tested:**	3/20/2018

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D 1557

Maximum Dry Unit Weight (lbf/ft³):	**120.2**
Optimum Water Content (%):	**11.3**
Method:	B
Preparation Method:	Moist
Specific Gravity (Fines):	2.70
Visual Description:	Brown Sandy Clay

Comments

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Proctor Report

Project No.: 1188070011-05B
ReportNo: PTR:FH18-W00468-S03

Client: Strata-G, LLC
CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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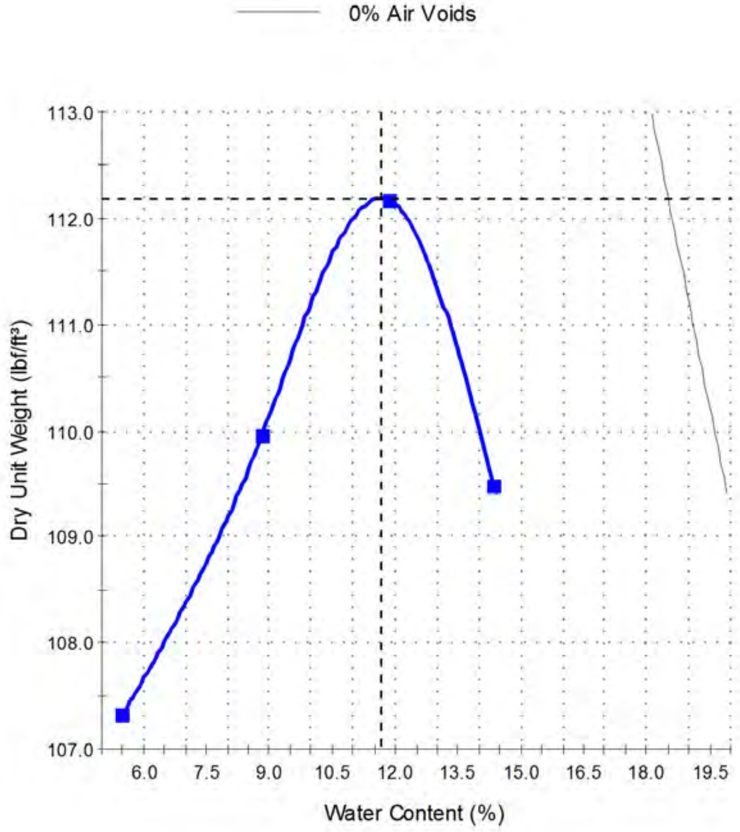
Reviewed By: Peng Lor

Sample Details

Sample ID: FH18-W00468-S03
Field Sample ID: GW983
Date Sampled: 2/21/2018
Sampled By: Mike Partenio
Sampling Method: In-Place
Contractor: N/A
Source: Geotechnical Drilling Samples
Material: Native Existing Material
Specification: N/A
Location: Boring Spoils
Tested By: Sheila Bowers
Date Tested: 3/20/2018

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D 698

Maximum Dry Unit Weight (lbf/ft³):	**112.2**
Optimum Water Content (%):	**11.7**
Method:	B
Preparation Method:	Moist
Specific Gravity (Fines):	2.70
Retained Sieve 3/8" (9.5mm) (%):	0
Passing Sieve 3/8" (9.5mm) (%):	100
Visual Description:	Brown Sandy Clay

Comments

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Novi, MI 48377
Phone: (248) 486-5100
Fax: (248) 486-5050

Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00468-S04

Client: Strata-G, LLC

CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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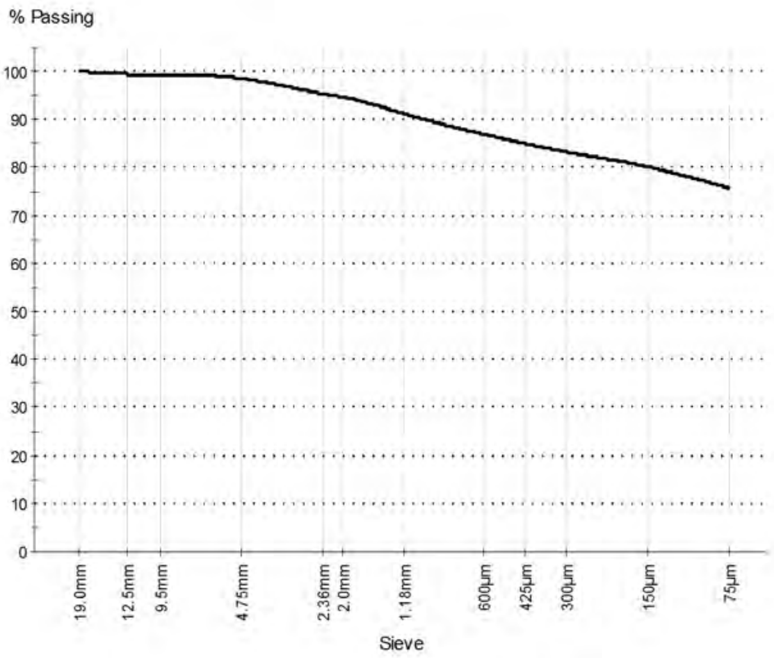
Sample Details

Sample ID	FH18-W00468-S04
Field Sample ID	GW989
Location	Boring Spoils
Sampled By	Mike Partenio
Date Sampled	2/27/2018
Date Completed	3/13/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	N/A
Sampling Method	In-Place
Contractor	N/A

Sample Description:

Brown Clay with Sand

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES (75.7%)	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(1.4%)	(3.9%)	(9.7%)	(9.3%)		

Grading: ASTM D 6913

Drying by: Oven
Date Tested: 3/15/2018
Tested By: Sheila Bowers

Sieve Size	% Passing	Limits
¾in	100.0	
½in	99.5	
3/8in	99.5	
No.4	98.6	
No.8	95.4	
No.10	94.7	
No.16	91.2	
No.30	86.9	
No.40	85.0	
No.50	83.3	
No.100	80.2	
No.200	75.7	

D85: 0.4250 **D60:** N/A **D50:** N/A
D30: N/A **D15:** N/A **D10:** N/A

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Novi, MI 48377
Phone: (248) 486-5100
Fax: (248) 486-5050

Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00468-S04

Client: Strata-G, LLC
CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Reviewed By: Peng Lor

Sample Details

Sample ID	FH18-W00468-S04
Field Sample ID	GW989
Location	Boring Spoils
Sampled By	Mike Partenio
Date Sampled	2/27/2018
Date Completed	3/13/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	N/A
Sampling Method	In-Place
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Maximum Dry Unit Weight (lbf/ft³)	ASTM D 1557	107.8	
Corrected Maximum Dry Unit Weight (lbf/ft³)		107.8	
Optimum Water Content (%)		12.5	
Corrected Optimum Water Content (%)		12.5	
Method		B	
Preparation Method		Moist	
Visual Description		Brown Clay with Sand	
Specific Gravity (Fines)		2.70	
Method	ASTM D 6913	Method B	
Sample Obtained While		Oven-Dried	
Group Name			
Group Symbol			
Composite Sieving Used		No	
Dispersion Method		Dispersant by hand	
Prior Testing		Moisture	

Comments

N/A

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Novi, MI 48377
Phone: (248) 486-5100
Fax: (248) 486-5050

Proctor Report

Project No.: 1188070011-05B
ReportNo: PTR:FH18-W00468-S04

Client: Strata-G, LLC
CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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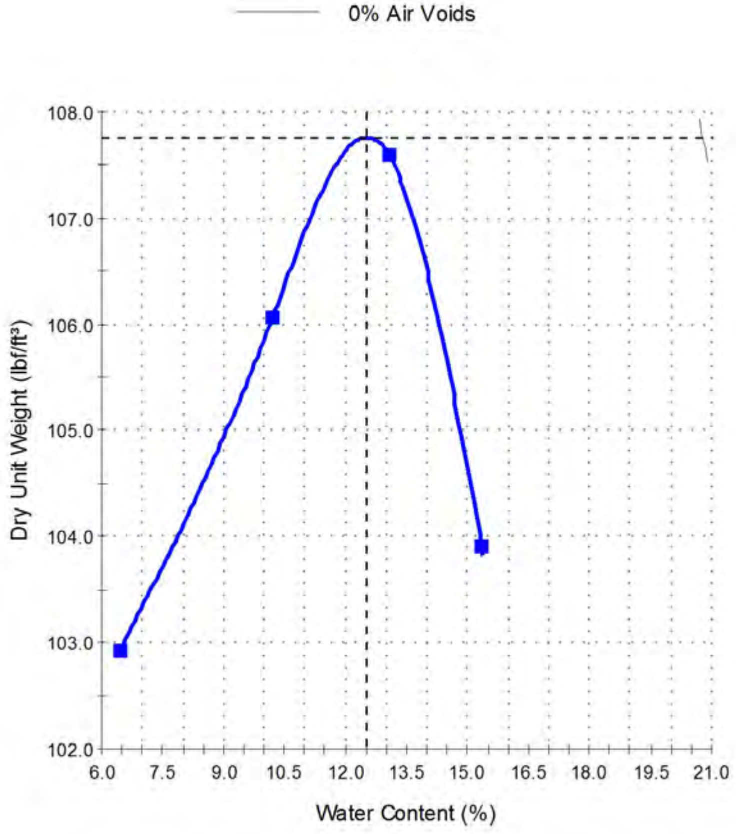
Reviewed By: Peng Lor

Sample Details

Sample ID:	FH18-W00468-S04	**Field Sample ID:**	GW989
Date Sampled:	2/27/2018	**Sampled By:**	Mike Partenio
Sampling Method:	In-Place		
Contractor:	N/A		
Source:	Geotechnical Drilling Samples		
Material:	Native Existing Material		
Specification:	N/A		
Location:	Boring Spoils		
Tested By:	Sheila Bowers	**Date Tested:**	

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D 1557

Maximum Dry Unit Weight (lbf/ft³):	**107.8**
Optimum Water Content (%):	**12.5**
Method:	B
Preparation Method:	Moist
Specific Gravity (Fines):	2.70
Visual Description:	Brown Clay with Sand

Comments

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Novi, MI 48377
Phone: (248) 486-5100
Fax: (248) 486-5050

Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00468-S06

Client: Strata-G, LLC

CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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AASHTO

Reviewed By: Peng Lor

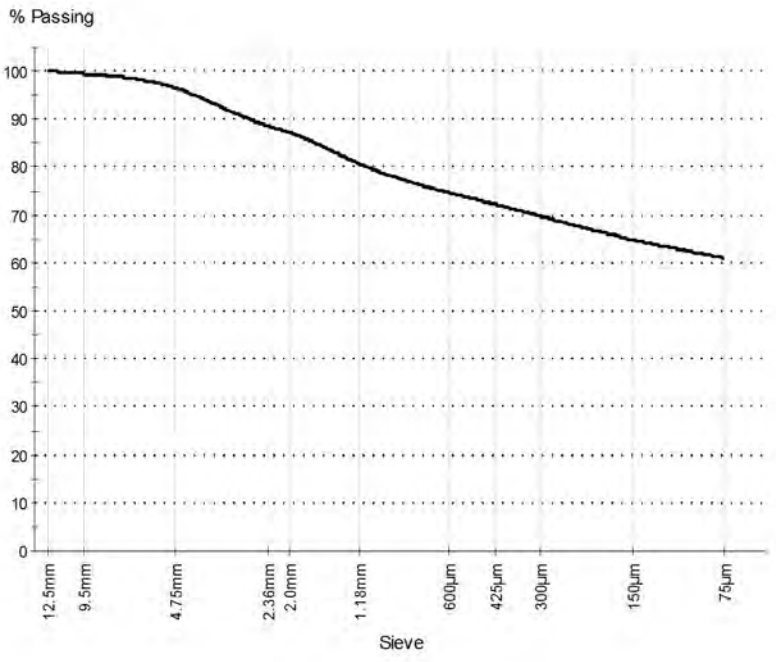
Sample Details

Sample ID	FH18-W00468-S06
Field Sample ID	GW999
Location	Boring Spoils
Sampled By	Mike Partenio
Date Sampled	2/20/2018
Date Completed	3/13/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	N/A
Sampling Method	In-Place
Contractor	N/A

Sample Description:

Brown Sandy Clay

Particle Size Distribution



<table>
<tr><th>COBBLES</th><th colspan="2">GRAVEL</th><th colspan="3">SAND</th><th colspan="2">FINES (61.1%)</th></tr>
<tr><td>(0.0%)</td><td>Coarse
(0.0%)</td><td>Fine
(3.5%)</td><td>Coarse
(9.3%)</td><td>Medium
(14.9%)</td><td>Fine
(11.2%)</td><td>Silt</td><td>Clay</td></tr>
</table>

Grading: ASTM D 6913

Drying by: Oven
Date Tested: 3/15/2018
Tested By: Sheila Bowers

Sieve Size	% Passing	Limits
½in	100.0	
3/8in	99.5	
No.4	96.5	
No.8	88.6	
No.10	87.2	
No.16	80.7	
No.30	74.7	
No.40	72.3	
No.50	69.8	
No.100	64.9	
No.200	61.1	

D85: 1.6729 **D60:** N/A **D50:** N/A
D30: N/A **D15:** N/A **D10:** N/A

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Material Test Report

Project No.: 1188070011-05B
ReportNo: MAT:FH18-W00468-S06

Client: Strata-G, LLC
CC:

Project: EMDF Site 7c Characterization

Oak Ridge, Tennessee

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Reviewed By: Peng Lor

Sample Details

Sample ID	FH18-W00468-S06
Field Sample ID	GW999
Location	Boring Spoils
Sampled By	Mike Partenio
Date Sampled	2/20/2018
Date Completed	3/13/2018
Source	Geotechnical Drilling Samples
Material	Native Existing Material
Specification	N/A
Sampling Method	In-Place
Contractor	N/A
Dispersion Method	

Other Test Results

Description	Method	Result	Limits
Maximum Dry Unit Weight (lbf/ft³)	ASTM D 1557	110.6	
Corrected Maximum Dry Unit Weight (lbf/ft³)		110.6	
Optimum Water Content (%)		12.1	
Corrected Optimum Water Content (%)		12.1	
Method		B	
Preparation Method		Moist	
Visual Description		Brown Sandy Clay	
Specific Gravity (Fines)		2.70	
Method	ASTM D 6913	Method B	
Sample Obtained While		Oven-Dried	
Group Name			
Group Symbol			
Composite Sieving Used		No	
Dispersion Method		Dispersant by hand	
Prior Testing		Moisture	

Comments

N/A

28001 Cabot Drive, Suite 250
Novi, MI 48377
Phone: (248) 486-5100
Fax: (248) 486-5050

Proctor Report

Project No.: 1188070011-05B
ReportNo: PTR:FH18-W00468-S06

Client: Strata-G, LLC **CC:**

Project: EMDF Site 7c Characterization

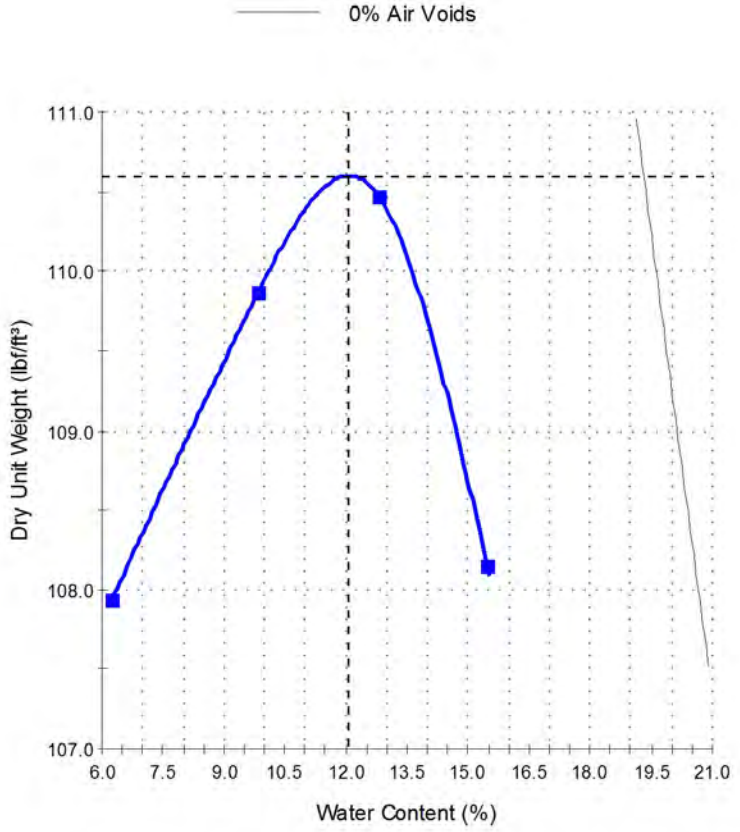
Oak Ridge, Tennessee

Reviewed By: Peng Lor

Sample Details

Sample ID:	FH18-W00468-S06	**Field Sample ID:**	GW999
Date Sampled:	2/20/2018	**Sampled By:**	Mike Partenio
Sampling Method:	In-Place		
Contractor:	N/A		
Source:	Geotechnical Drilling Samples		
Material:	Native Existing Material		
Specification:	N/A		
Location:	Boring Spoils		
Tested By:	Sheila Bowers	**Date Tested:**	

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D 1557

Maximum Dry Unit Weight (lbf/ft³):	**110.6**
Optimum Water Content (%):	**12.1**
Method:	B
Preparation Method:	Moist
Specific Gravity (Fines):	2.70
Visual Description:	Brown Sandy Clay

Comments

Appendix E.3 – Shelby Tube Sample Testing

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BOWSER-MORNER, INC.
Delivery Address: 4518 Taylorsville Road • Dayton, Ohio 45424 **Mailing Address**: P. O. Box 51 • Dayton, Ohio 45401
AASHTO/ISO 17025 Accredited • USACE Validated ACIL INDEPENDENCE

LABORATORY REPORT

Report To:
CTI & Associates, Inc.
Attn: Michael Partenio
28001 Cabot Drive, Ste. 250
Novi, MI 48377

Report Date: April 17, 2018
Job No.: 183923
Report No.: 430211
No. of Pages: 2

Report On:
Laboratory Analysis of One Shelby Tube Sample
Project: EMDF Characterization – Project No. 1188070011
Sample ID: GW993 – ST-1, 3.0'-5.0' – Sample Date: 2/22/18
Depth of Test Specimen: 3.5' - 3.8'

On March 5, 2018, one Shelby tube sample was submitted for laboratory determination of permeability. Testing was performed as specified by the client and in accordance with ASTM D 5084, "Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter".

Results are presented in the following table.

Test Parameter	Results
Average Permeability, cm/sec:	**5.5×10^{-7}**

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805, extension 322.

Respectfully submitted,
BOWSER-MORNER, INC.

Karl A. Fletcher, Manager
Construction Materials and
Geotechnical Laboratories

KAF/blc
430211
1-File
1-mpartenio@cticompanies.com
1-kfoye@cticompanies.com

FALLING HEAD PERMEABILITY TEST
ASTM D 5084, Measurement of Hydraulic Conductivity

UNDISTURBED

Client:	**CTI and Associates, Inc.**
Project:	**EMDF Characterization - Project No. 1188070011**
BMI Work Order Number:	183923
Sample Identification:	GW993 - ST-1, 3.0'-5.0'
Depth, ft:	3.5'-3.8'
Visual Description:	brown clay and silt, little gravel

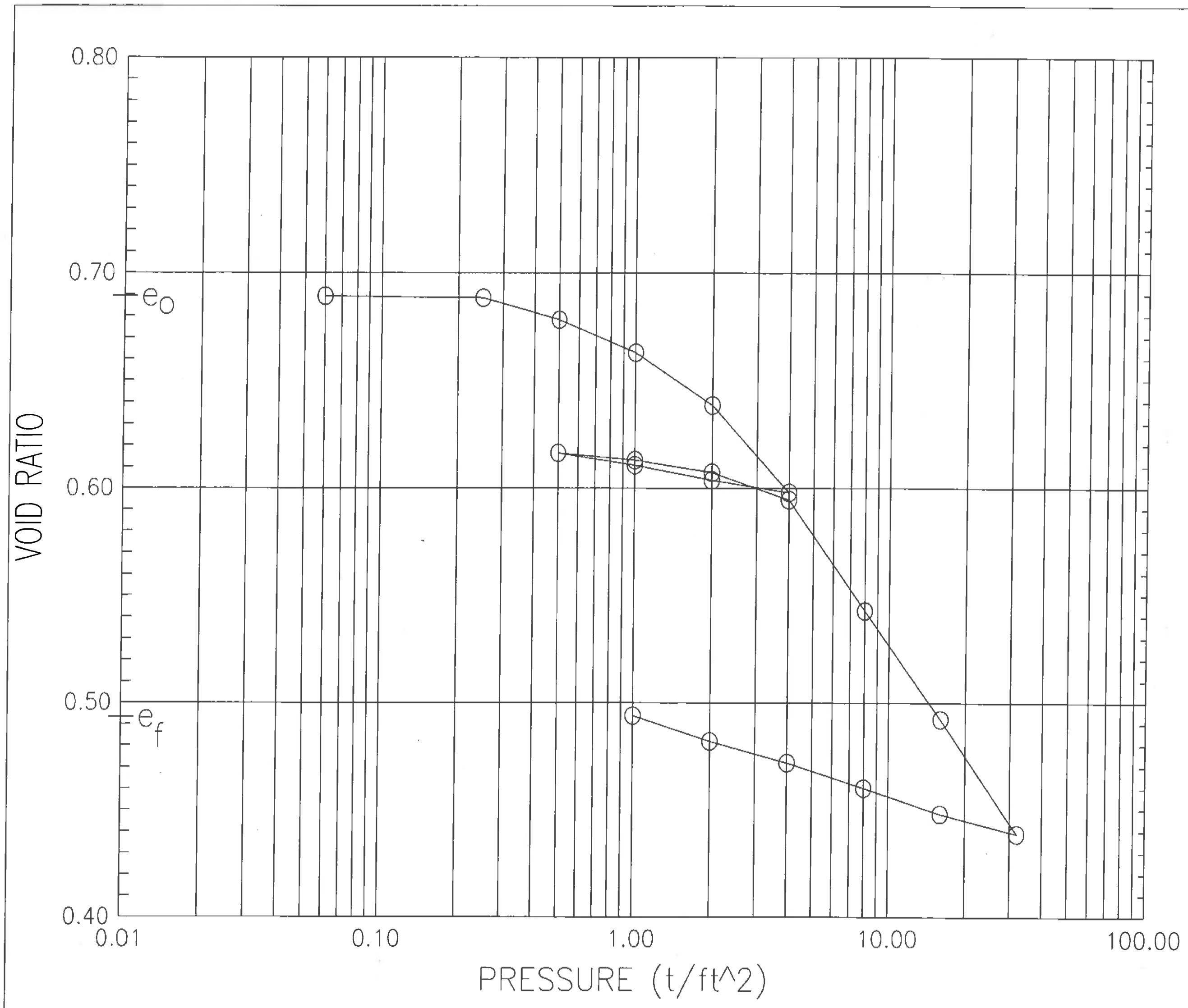
SPECIMEN DATA:

Dimension, inches	
Height:	2.559
Diameter:	2.82
Mass, lbs:	1.149
Moisture Content,%	
Initial:	26.5
Final:	26.2
Wet Unit Weight, pcf	
Initial:	124.2
Final:	123.9
Initial Dry Unit Weight, pcf:	98.2
Back Pressure Saturation, psi	
Back Pressure, Exit:	60
Back Pressure, Enter:	63
Lateral Pressure:	67

Permeability (k), cm/sec: **5.5×10^{-7}**

April 17, 2018

BOWSER MORNER



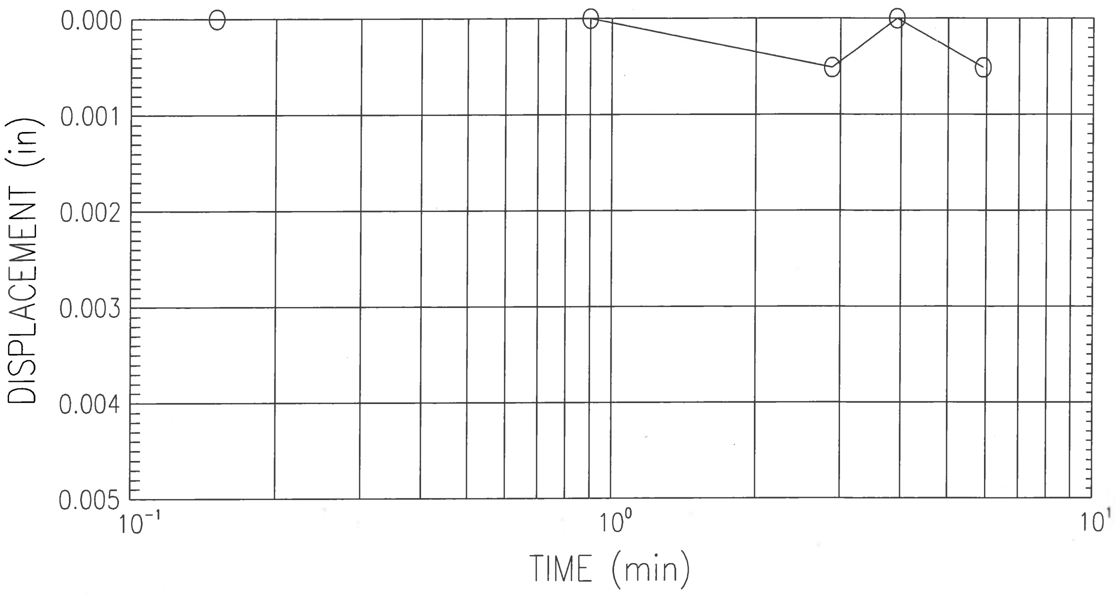
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE (t/ft^2)		WATER CONTENT (%)	21.2	18.2
PRECONSOL. PRESSURE (t/ft^2)		DRY DENSITY (lb/ft^3)	99.33	112.37
COMPRESSION INDEX		SATURATION (%)	82.63	98.95
TYPE SPECIMEN	Undisturb	VOID RATIO	0.69	0.49
DIA. (in) 2.500	HT. (in) 1.020	BACK PRESSURE (t/ft^2)	---	---

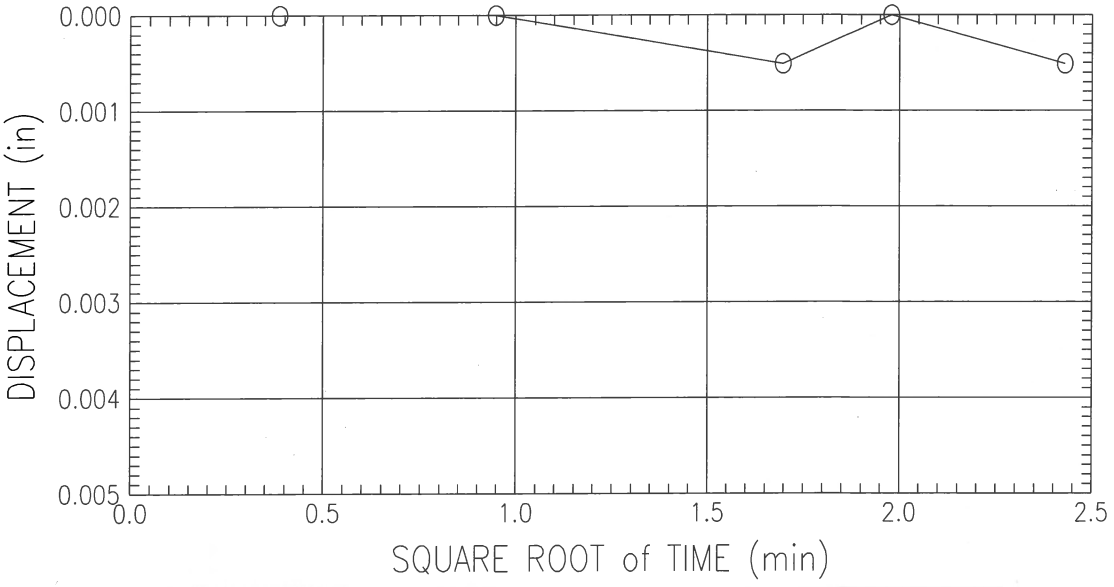
CLASSIFICATION red/brown silty clay and sand (visual description)

LL ---	PL ---	PI ---	PROJECT EMDF Characterization
GS 2.689	D_{10}		987ST3
REMARKS		BORING NO. GW987-ST-3	SAMPLE NO. GW987-ST-3
Use: Foundation berm/fill		DEPTH 2.8'-3.0'	DATE 3-15-18

Bowser Morner
CONSOLIDATION TEST REPORT

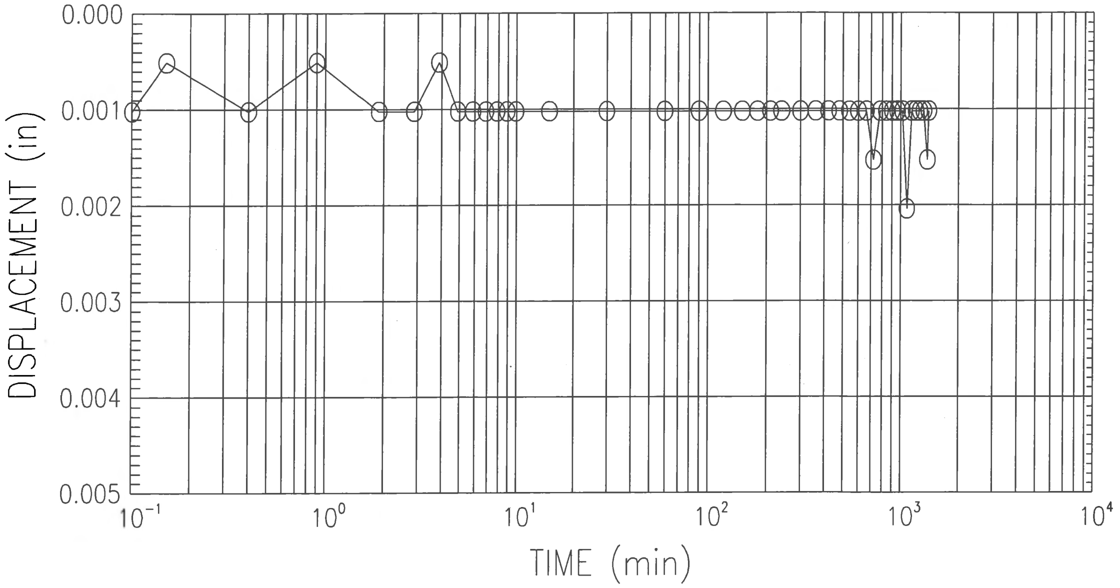
CONSOLIDATION TEST
TIME CURVES (STEP 1 OF 20)
STRESS : 0.06 (t/ft^2)

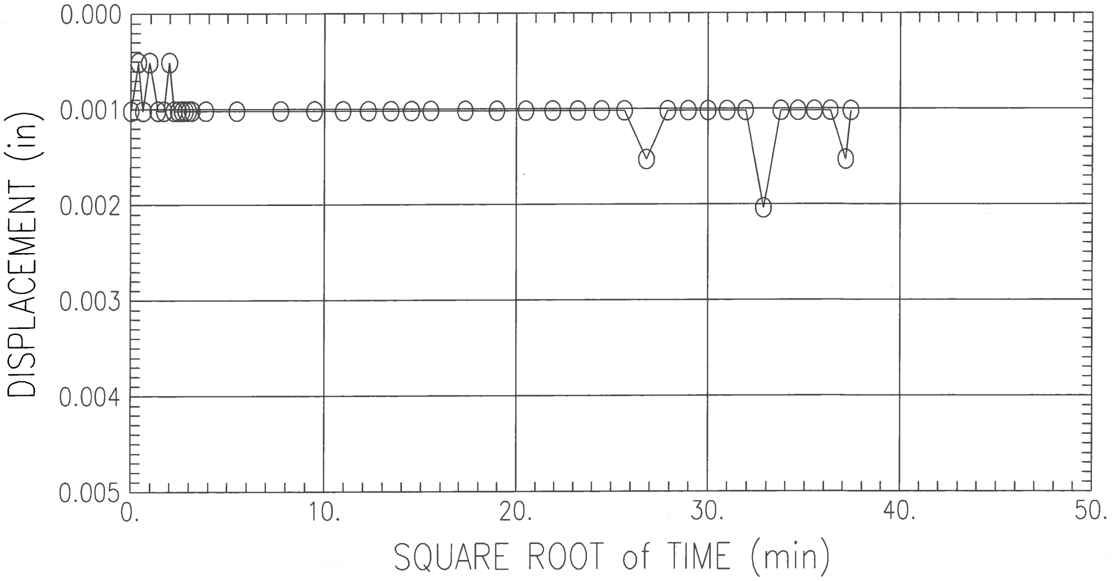




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3
Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'
Description : red/brown silty clay and sand (visual description)

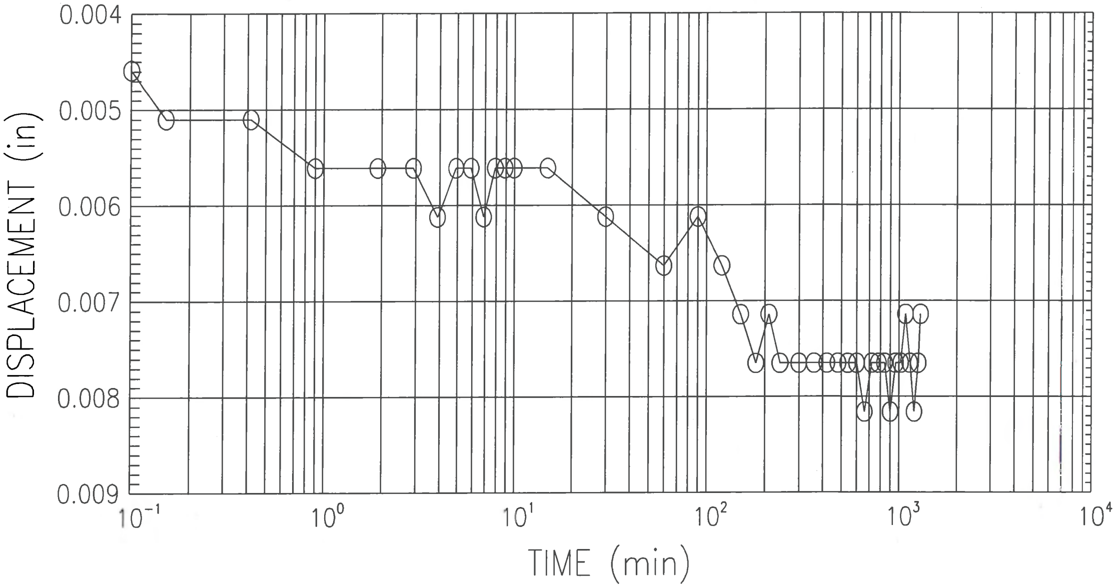
CONSOLIDATION TEST
TIME CURVES (STEP 2 OF 20)
STRESS : 0.25 (t/ft^2)

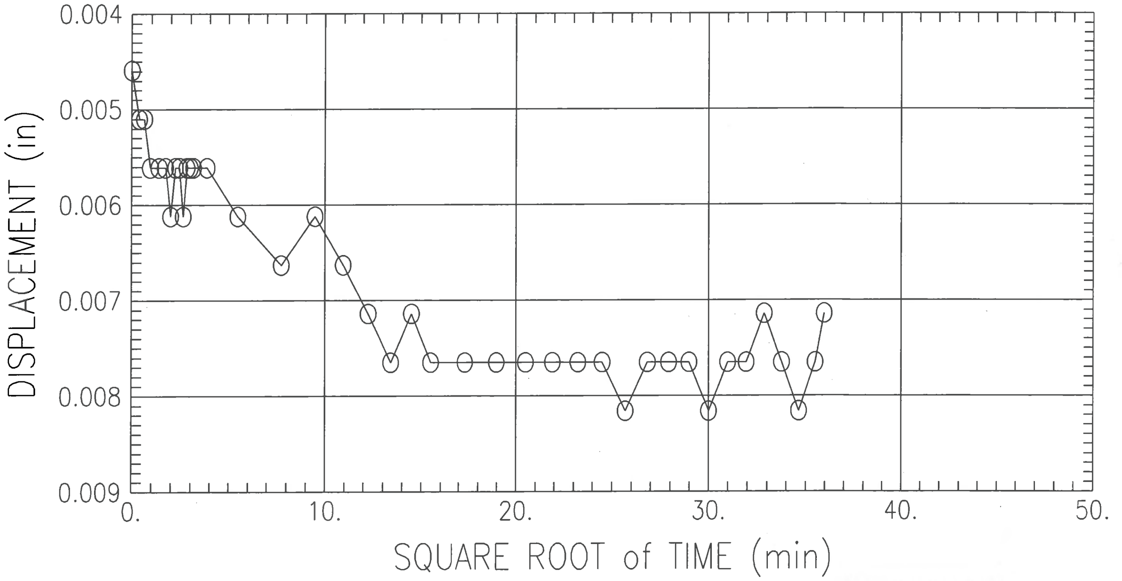




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3
Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'
Description : red/brown silty clay and sand (visual description)

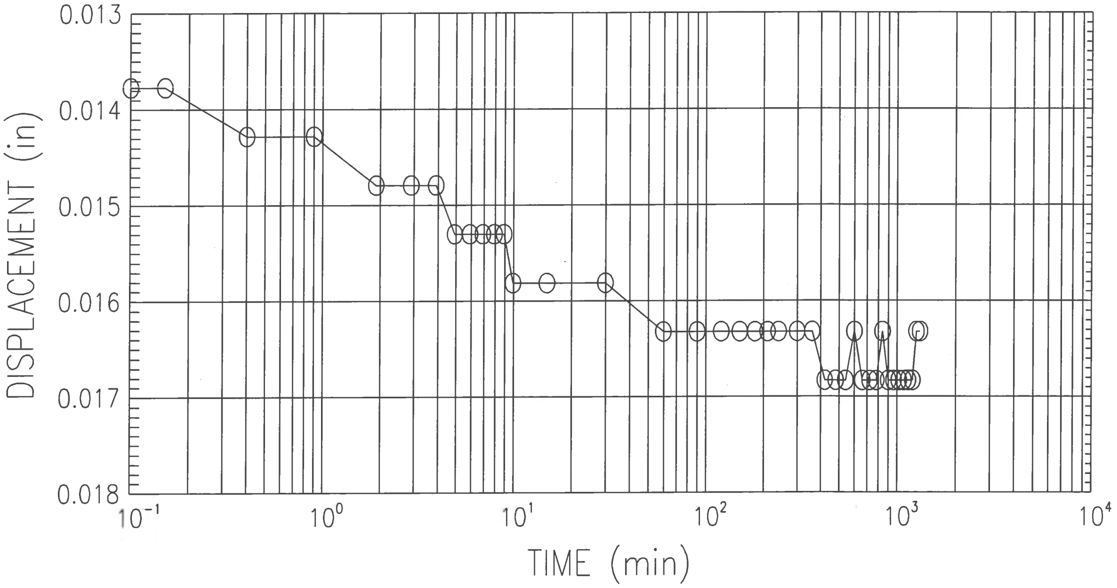
CONSOLIDATION TEST
TIME CURVES (STEP 3 OF 20)
STRESS : 0.5 (t/ft^2)

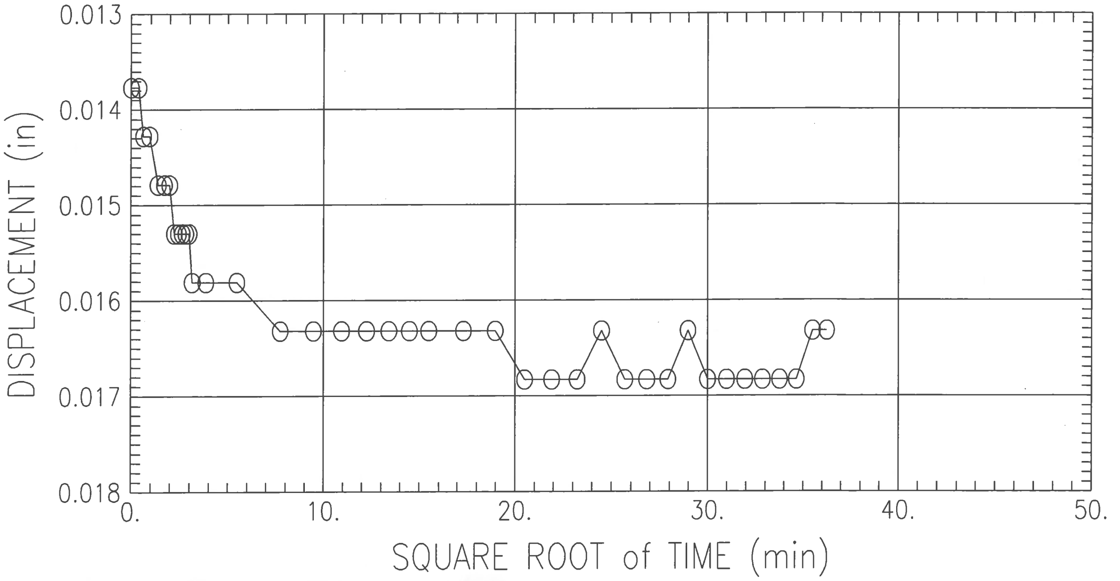




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3
Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'
Description : red/brown silty clay and sand (visual description)

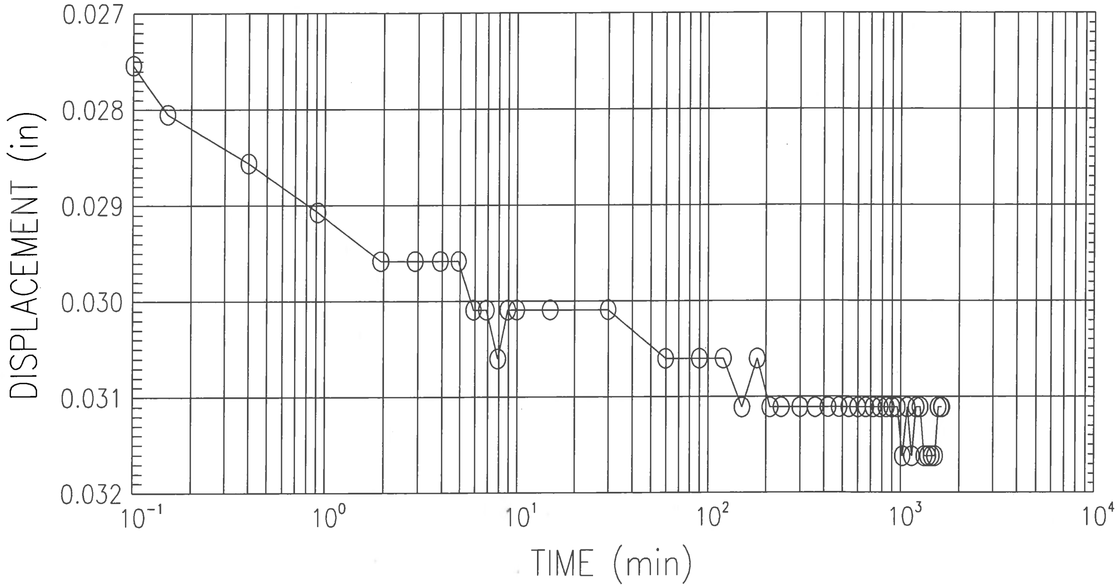
CONSOLIDATION TEST
TIME CURVES (STEP 4 OF 20)
STRESS : 1 (t/ft^2)

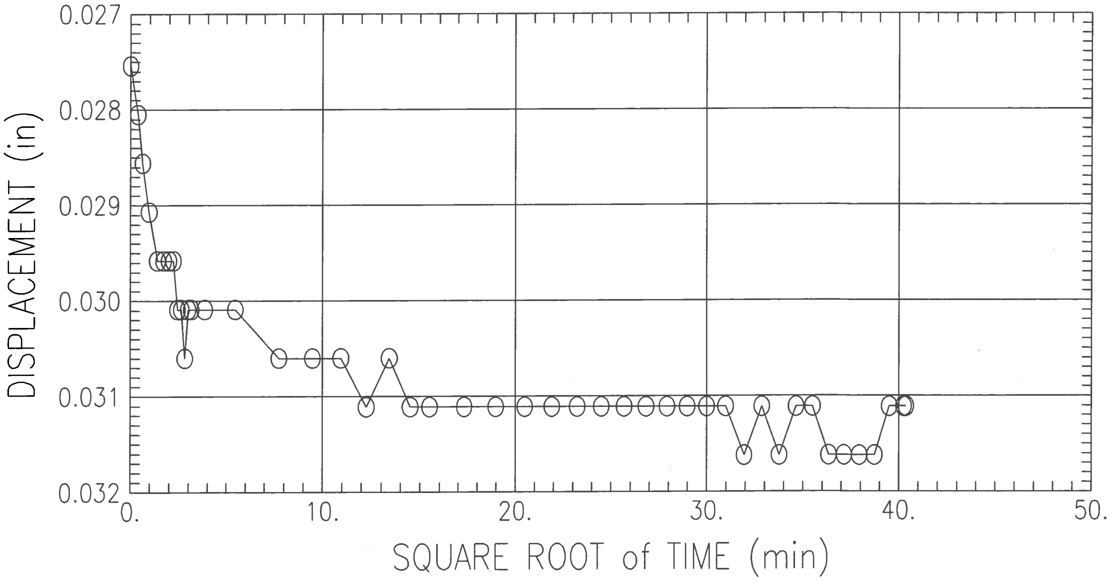




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3
Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'
Description : red/brown silty clay and sand (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 5 OF 20)
STRESS : 2 (t/ft^2)





Bowser Morner

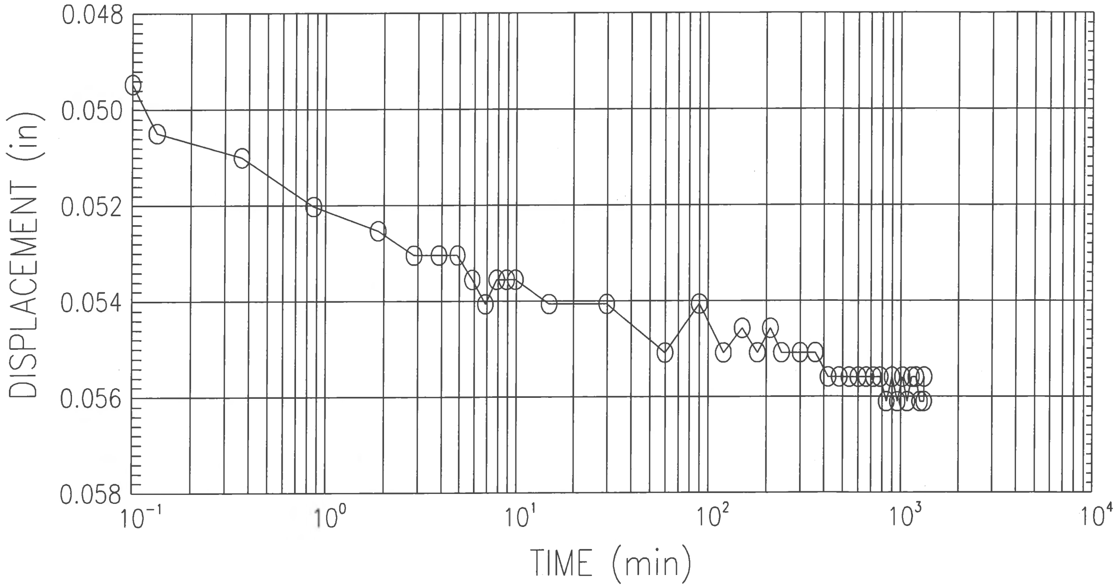
Project Name : EMDF Characterization

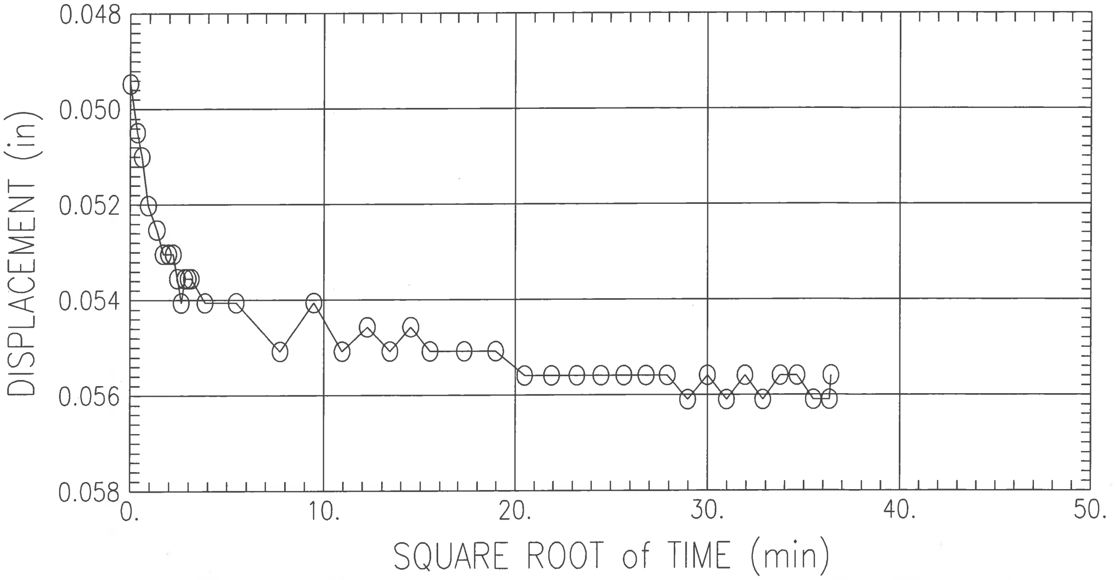
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3

Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'

Description : red/brown silty clay and sand (visual description)

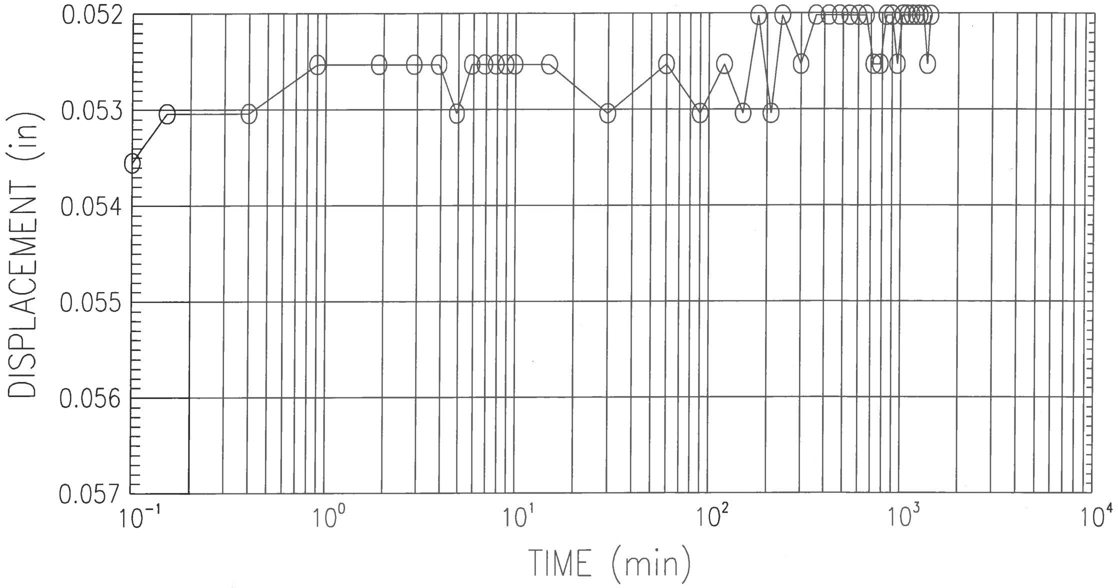
CONSOLIDATION TEST
TIME CURVES (STEP 6 OF 20)
STRESS : 4 (t/ft^2)

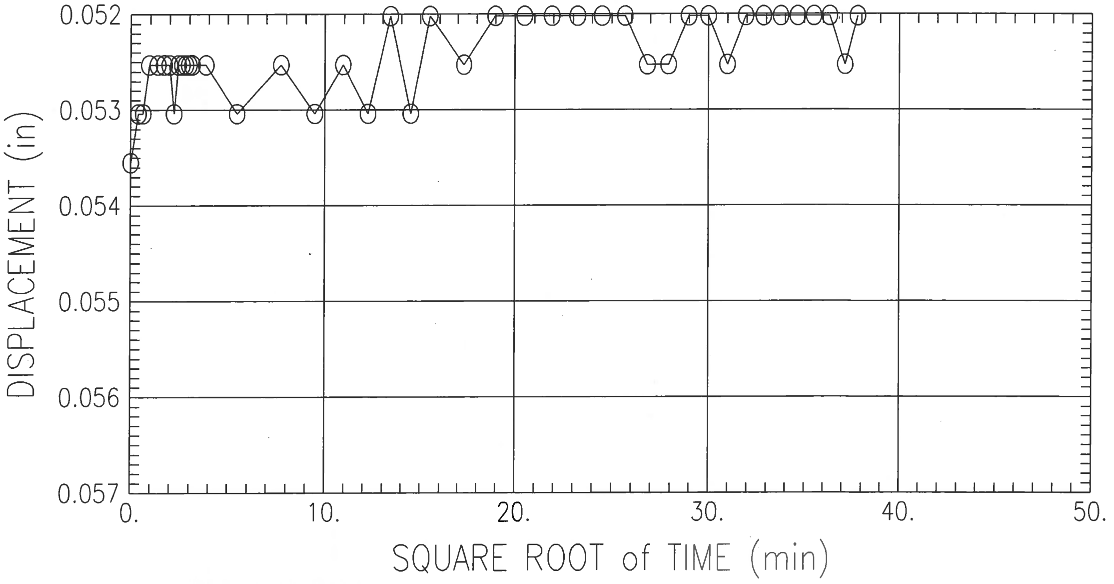




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3
Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'
Description : red/brown silty clay and sand (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 7 OF 20)
STRESS : 2 (t/ft^2)





Bowser Morner

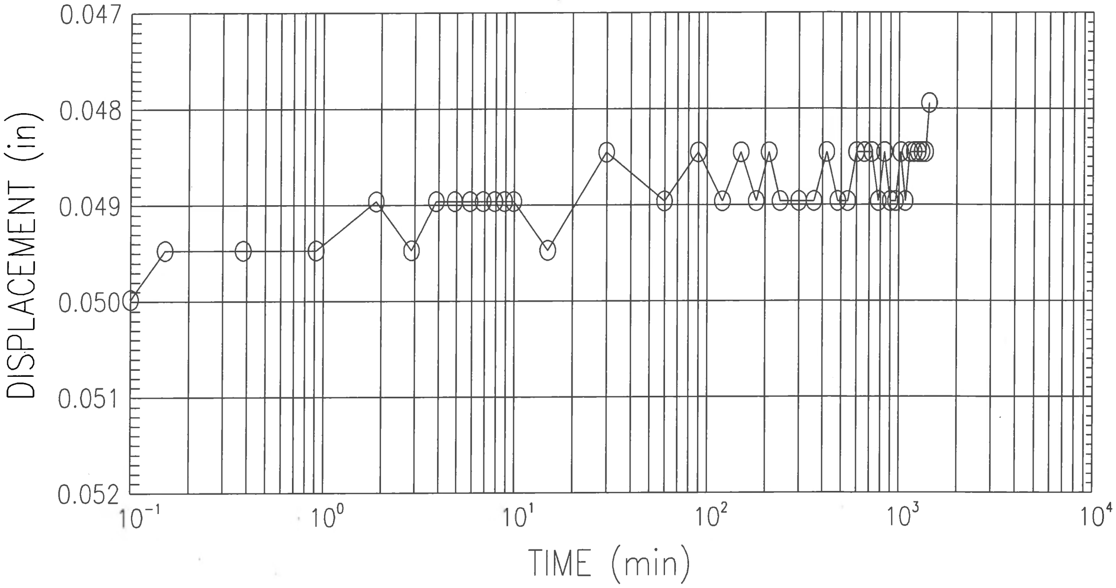
Project Name : EMDF Characterization

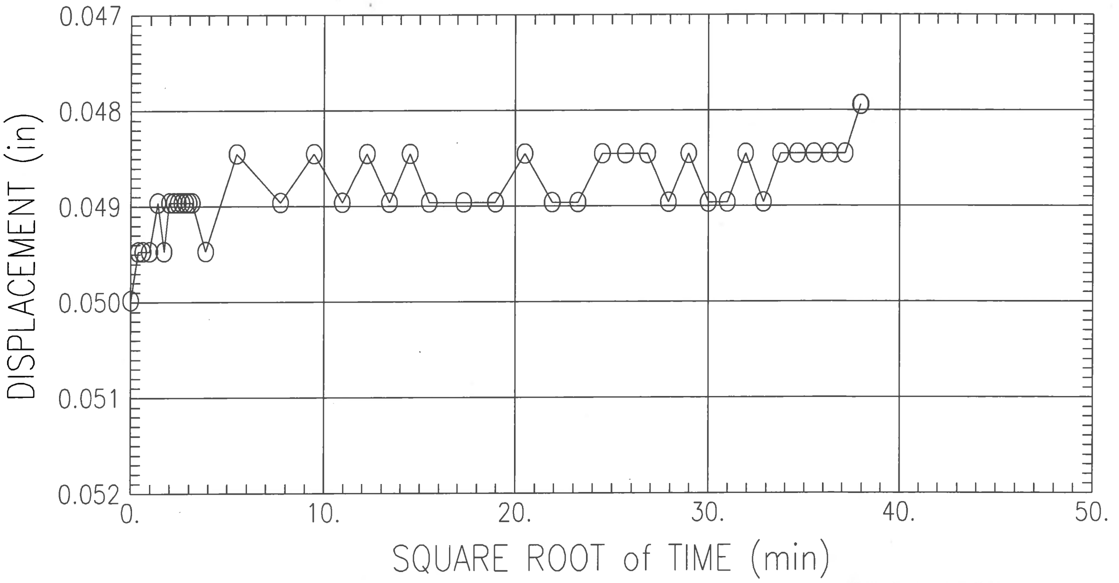
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3

Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'

Description : red/brown silty clay and sand (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 8 OF 20)
STRESS : 1 (t/ft^2)





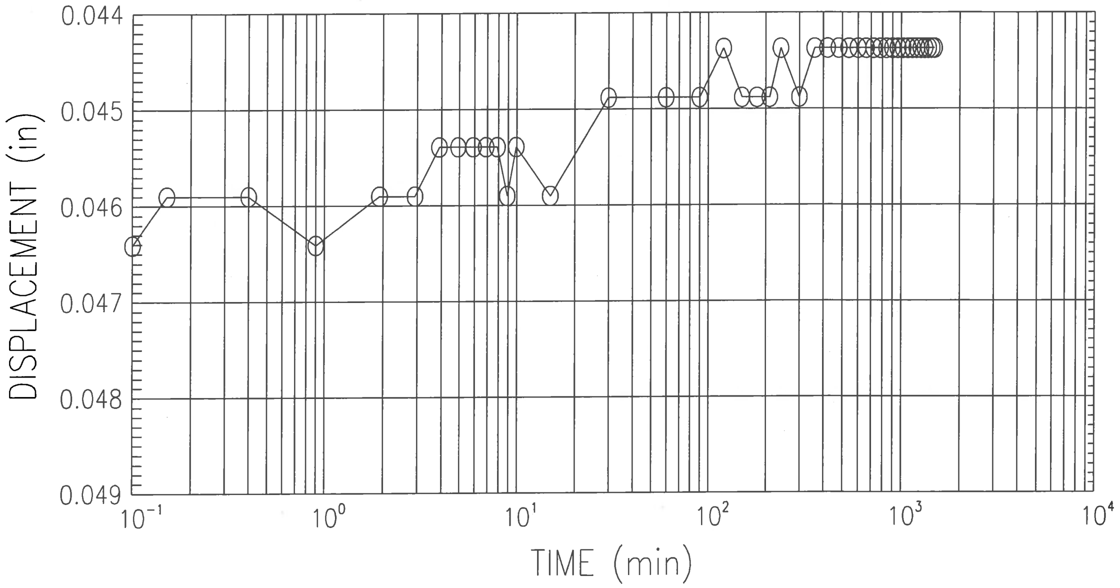
Bowser Morner

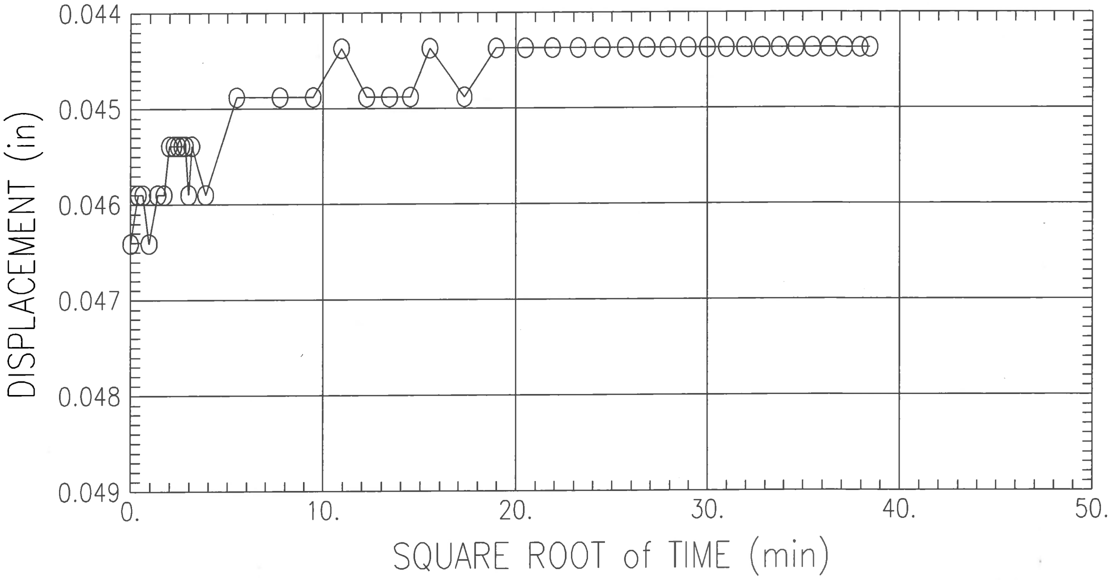
Project Name : EMDF Characterization

Project No : 183923	Boring No : GW987-ST-3 Sample No : GW987-ST-3
Test Date : 3-15-18	Test No : GW987-ST-3 Depth : 2.8'-3.0'

Description : red/brown silty clay and sand (visual description)

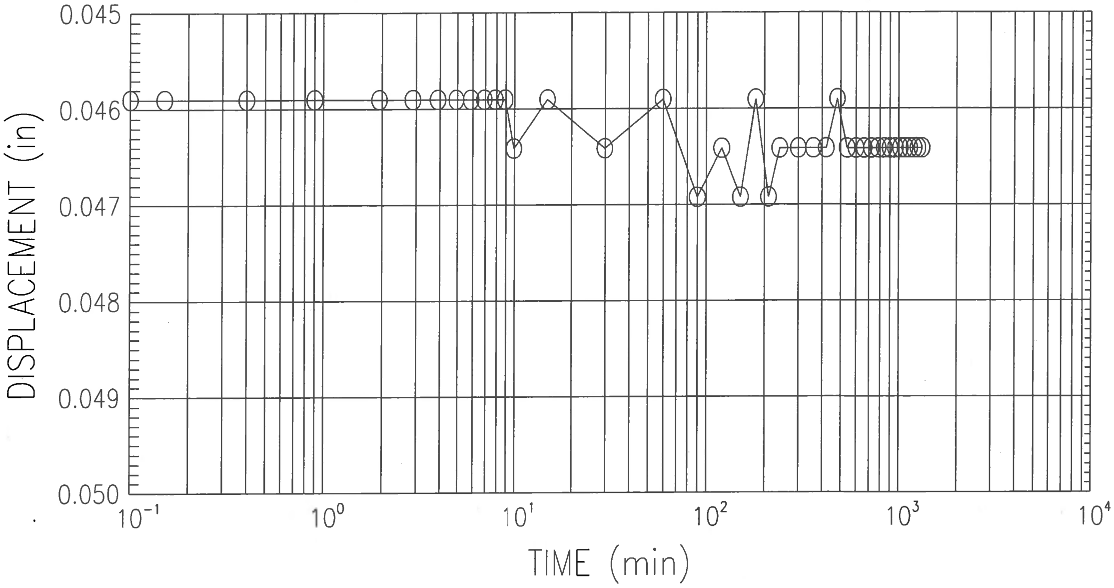
CONSOLIDATION TEST
TIME CURVES (STEP 9 OF 20)
STRESS : 0.5 (t/ft^2)

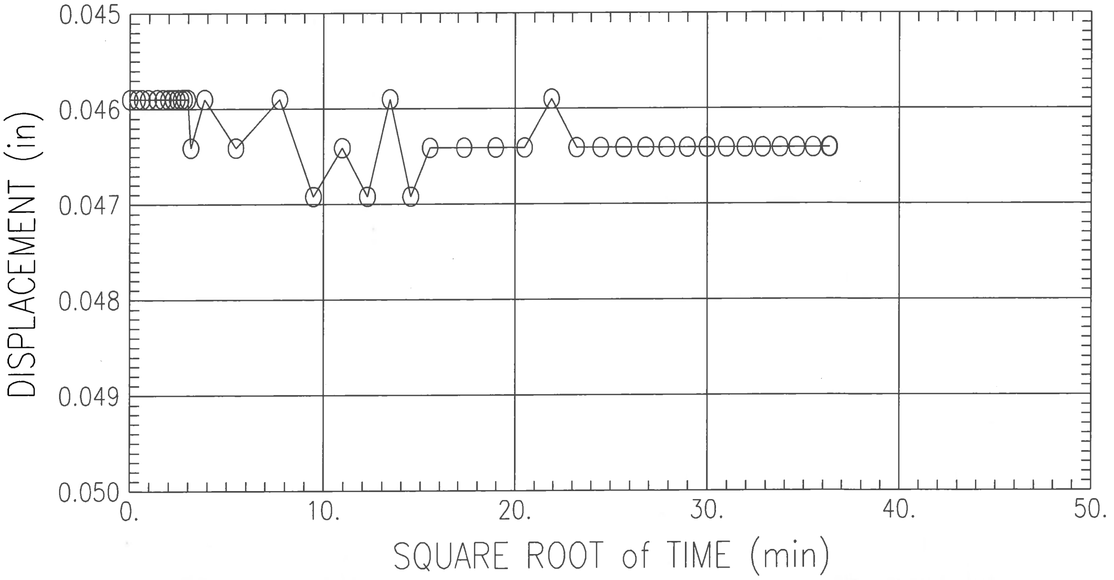




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3
Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'
Description : red/brown silty clay and sand (visual description)

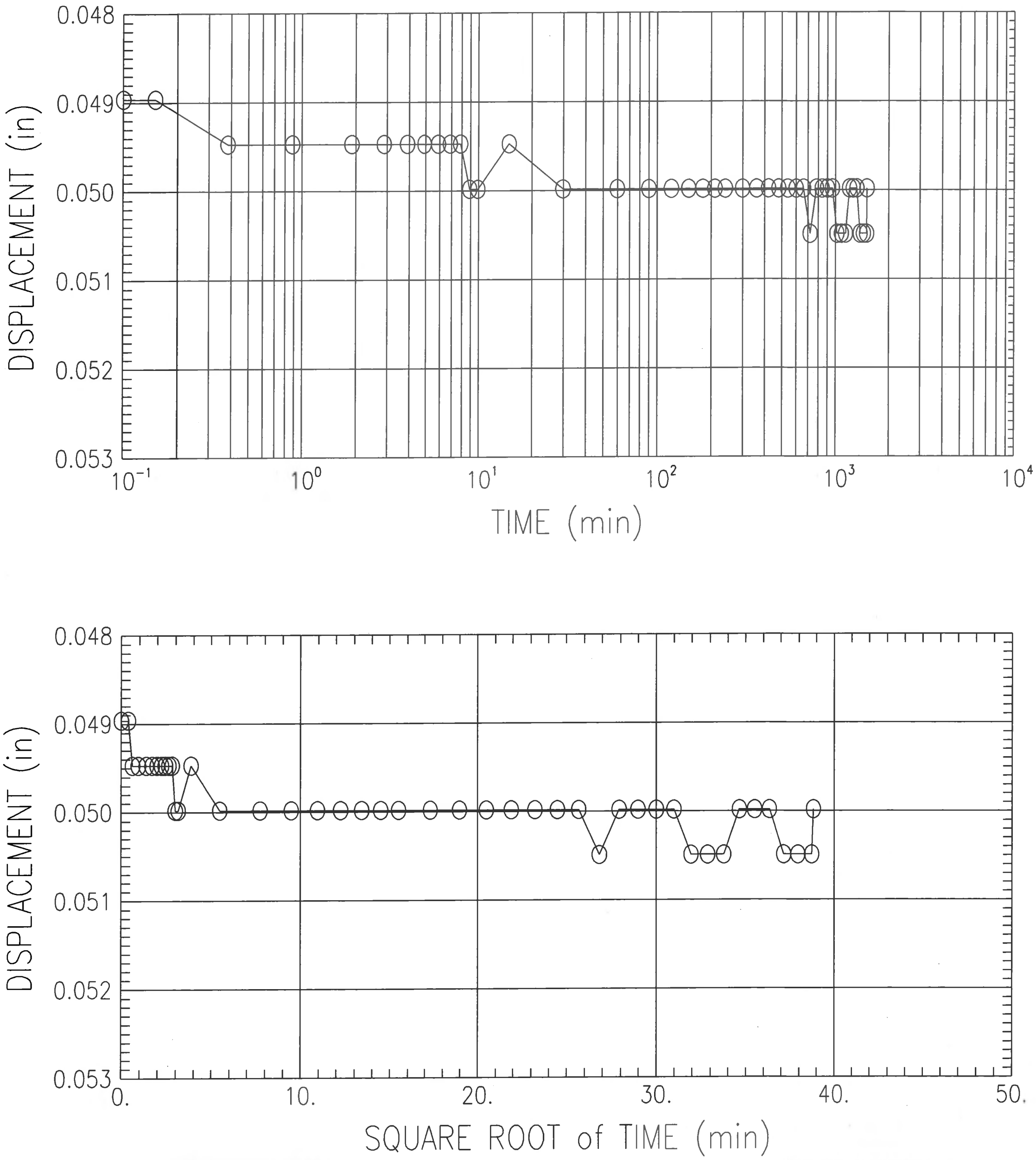
CONSOLIDATION TEST
TIME CURVES (STEP 10 OF 20)
STRESS : 1 (t/ft^2)





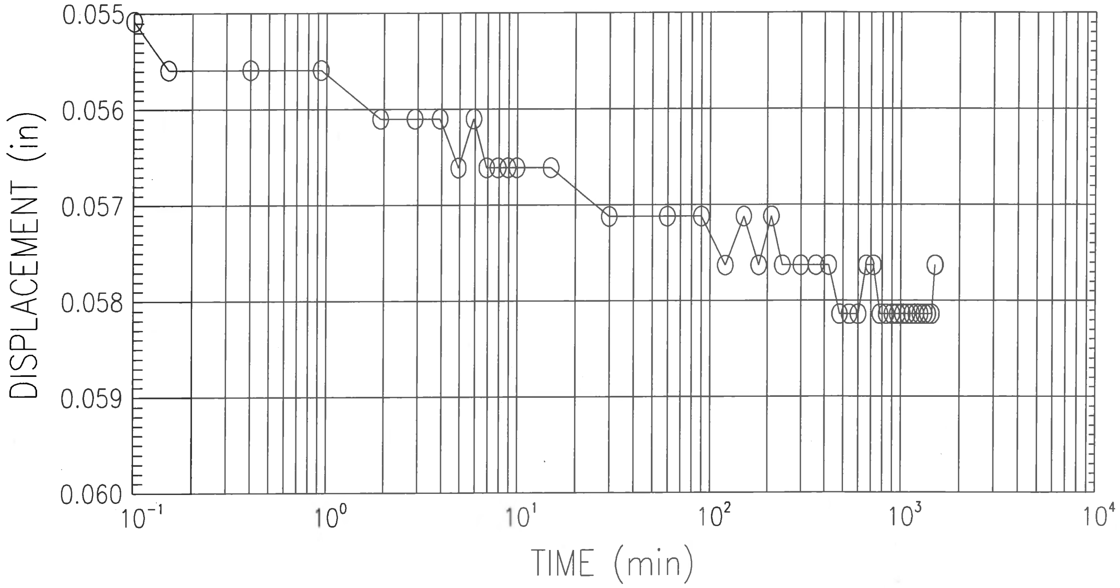
Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3
Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'
Description : red/brown silty clay and sand (visual description)

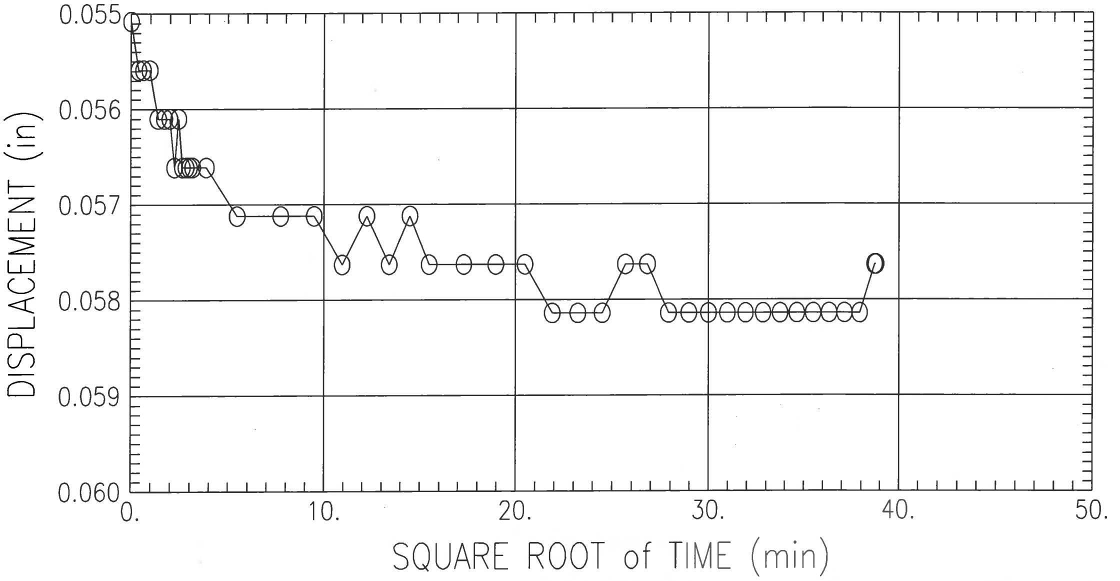
CONSOLIDATION TEST
TIME CURVES (STEP 11 OF 20)
STRESS : 2 (t/ft^2)



Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3
Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'
Description : red/brown silty clay and sand (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 12 OF 20)
STRESS : 4 (t/ft^2)





Bowser Morner

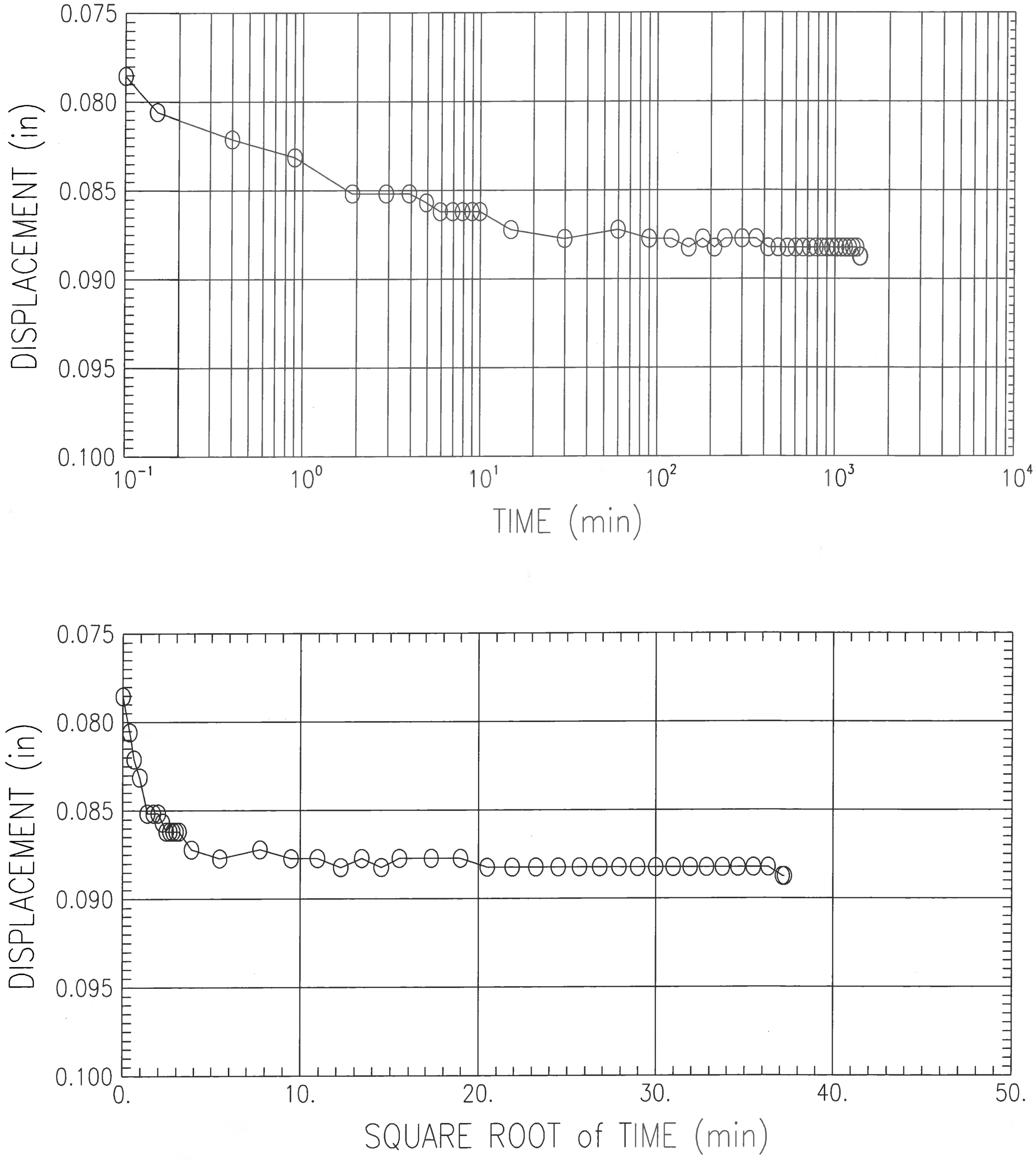
Project Name : EMDF Characterization

Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3

Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'

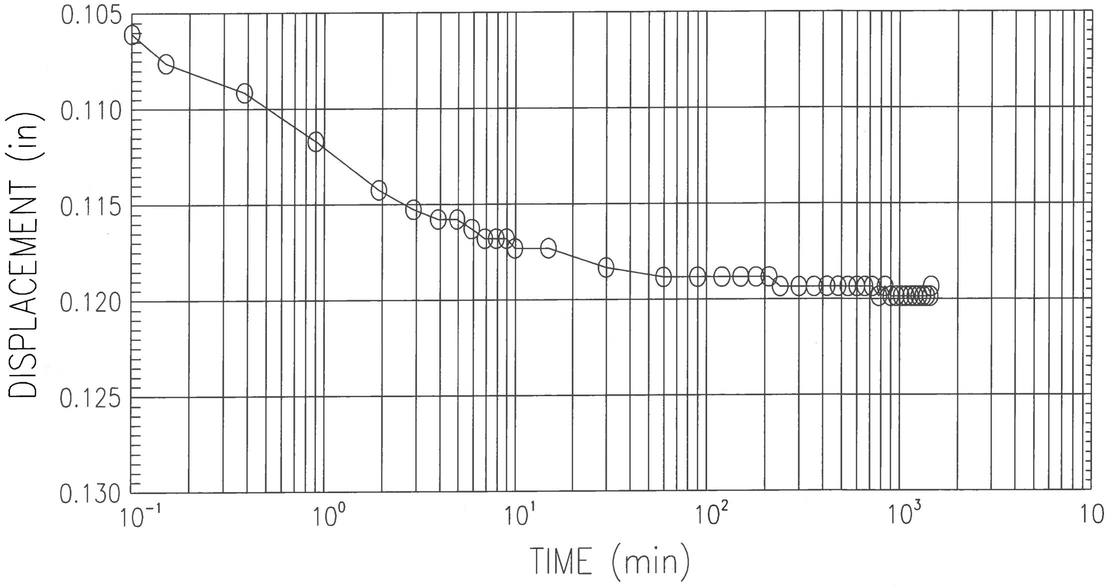
Description : red/brown silty clay and sand (visual description)

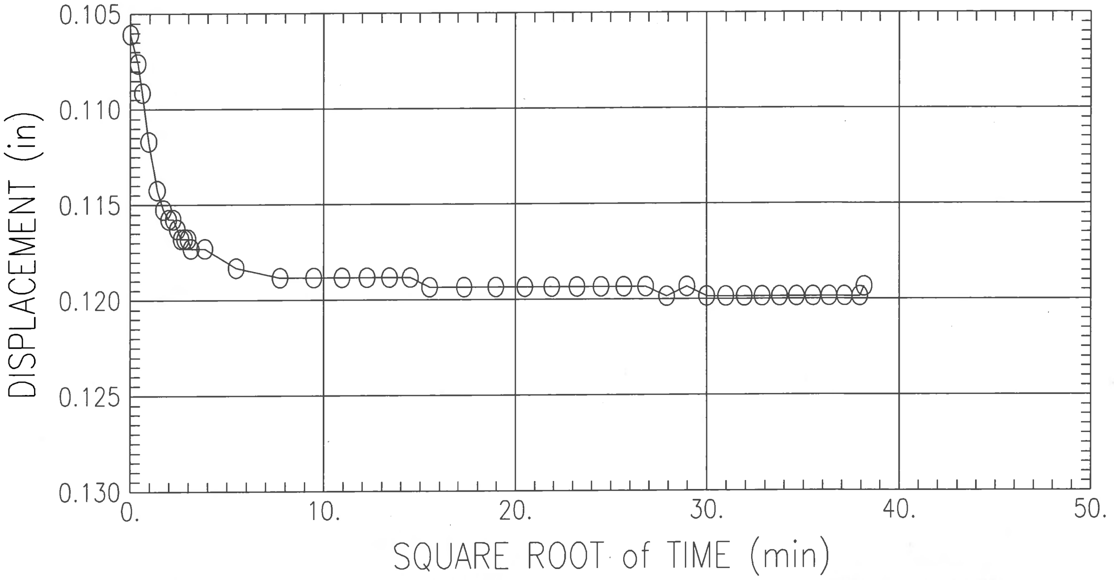
CONSOLIDATION TEST
TIME CURVES (STEP 13 OF 20)
STRESS : 8 (t/ft^2)



Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3
Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'
Description : red/brown silty clay and sand (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 14 OF 20)
STRESS : 16 (t/ft^2)





Bowser Morner

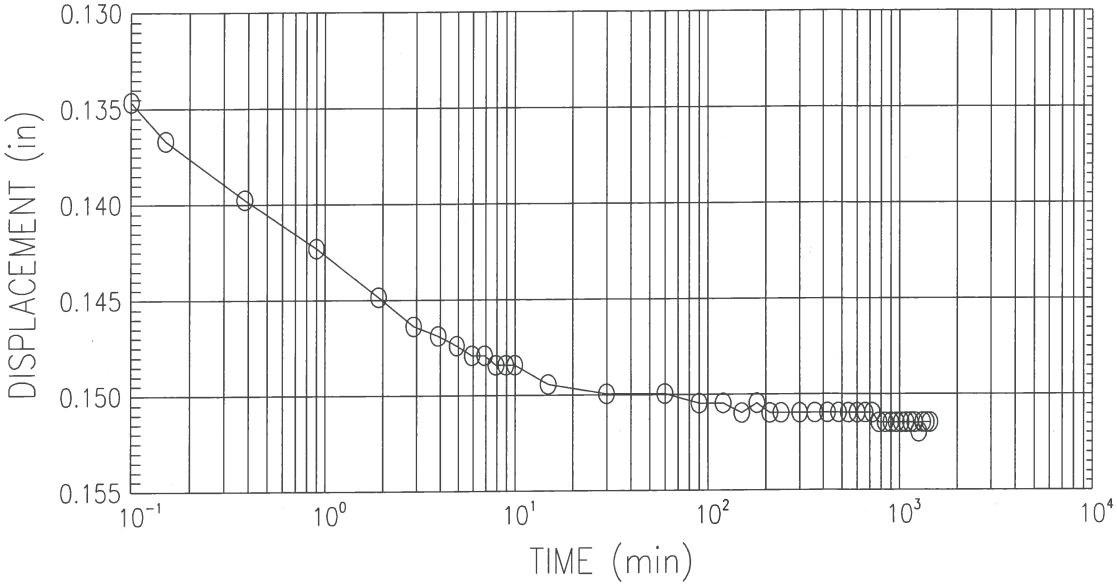
Project Name : EMDF Characterization

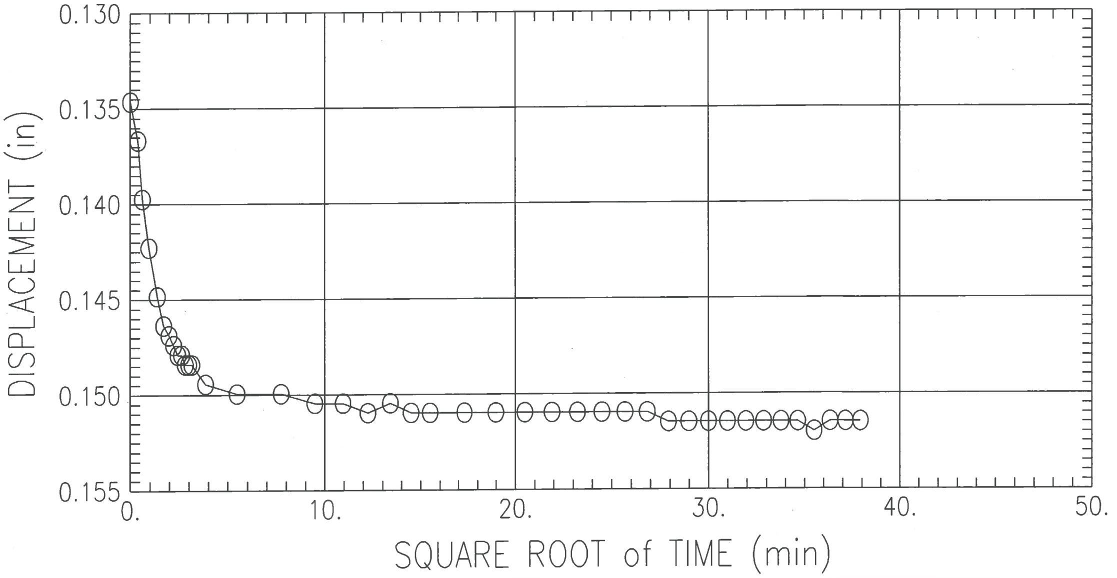
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3

Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'

Description : red/brown silty clay and sand (visual description)

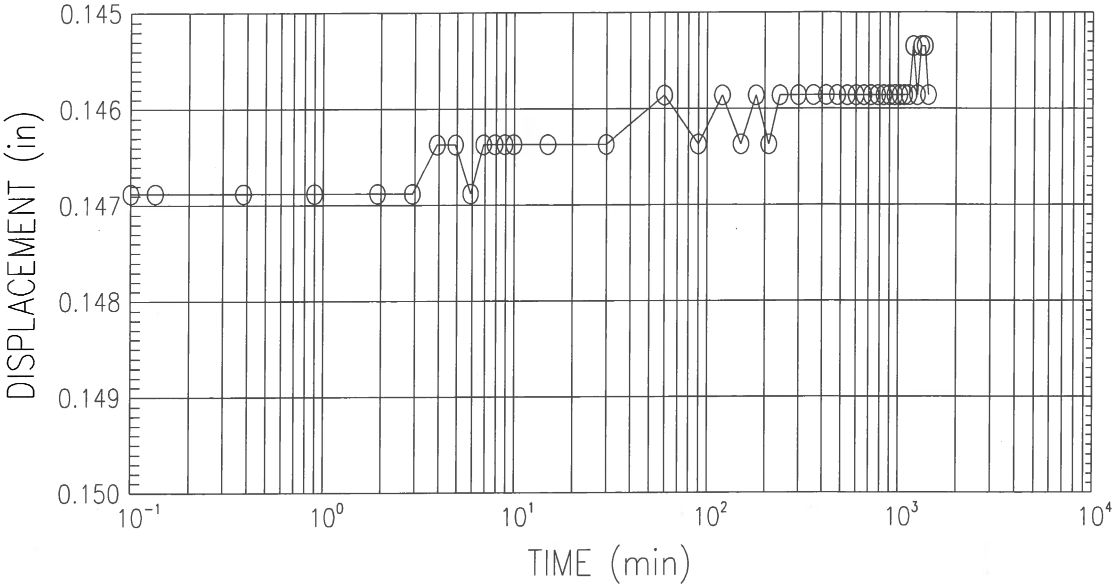
CONSOLIDATION TEST
TIME CURVES (STEP 15 OF 20)
STRESS : 32 (t/ft^2)

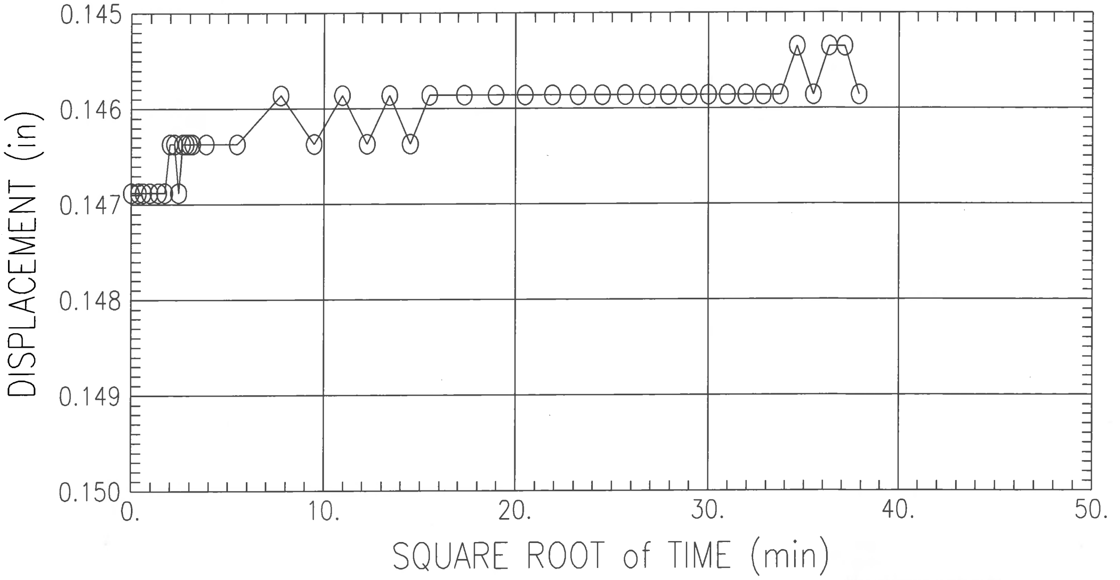




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3
Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'
Description : red/brown silty clay and sand (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 16 OF 20)
STRESS : 16 (t/ft^2)





Bowser Morner

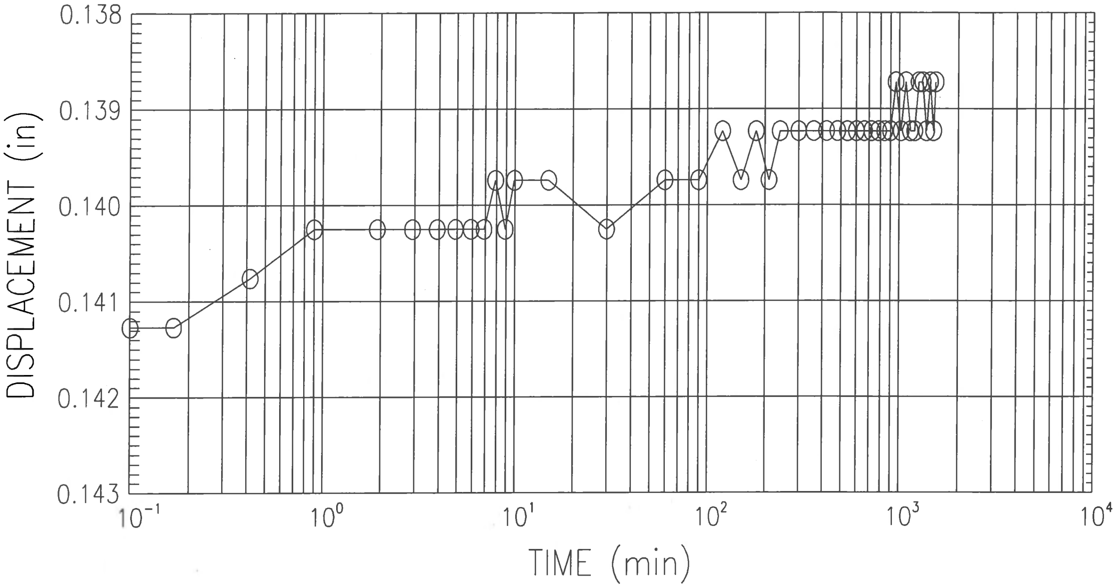
Project Name : EMDF Characterization

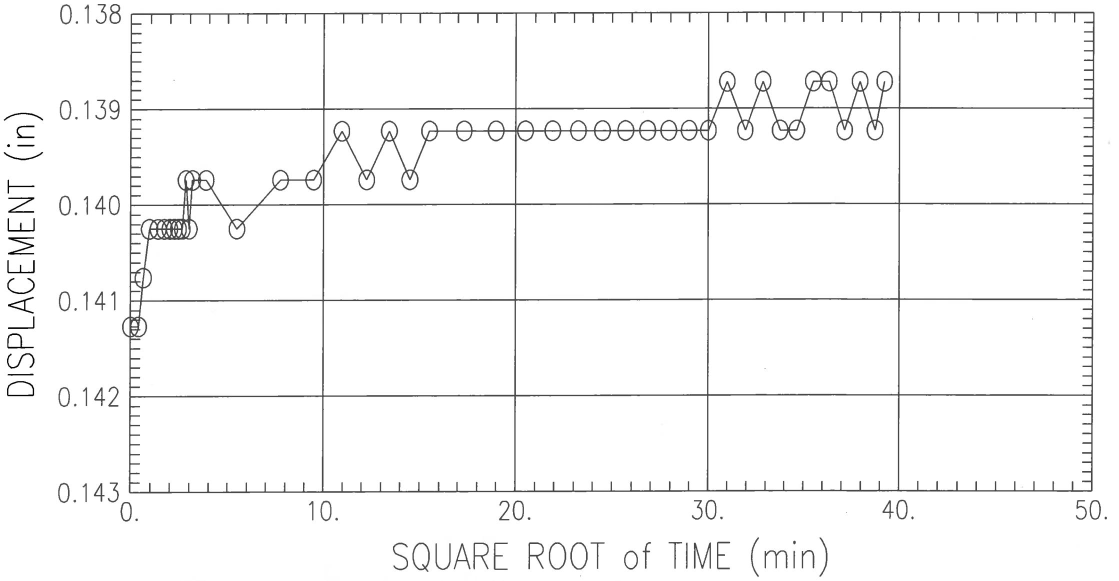
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3

Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'

Description : red/brown silty clay and sand (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 17 OF 20)
STRESS : 8 (t/ft^2)





Bowser Morner

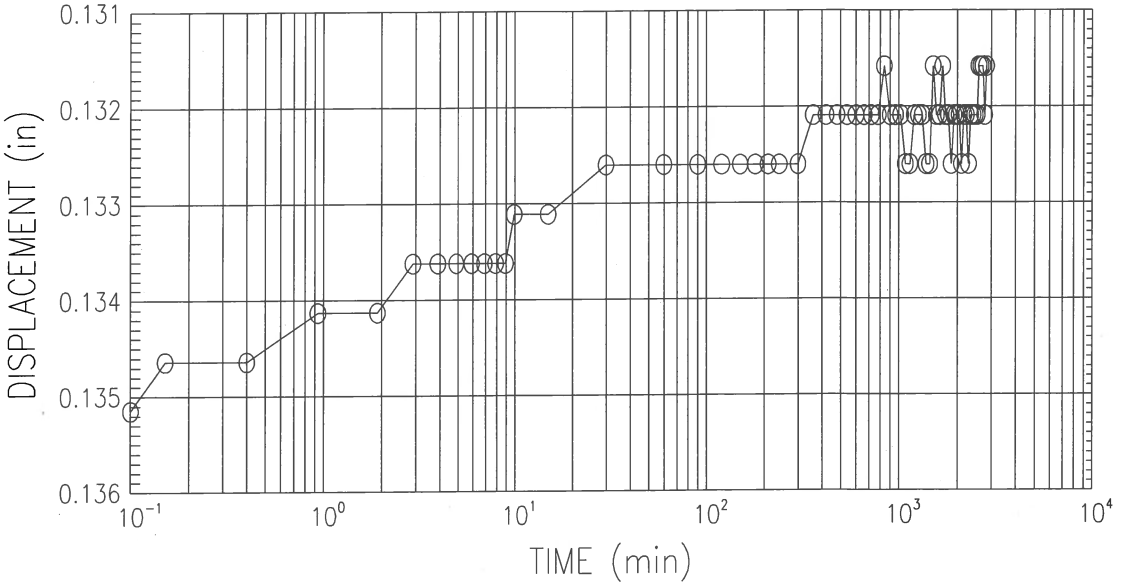
Project Name : EMDF Characterization

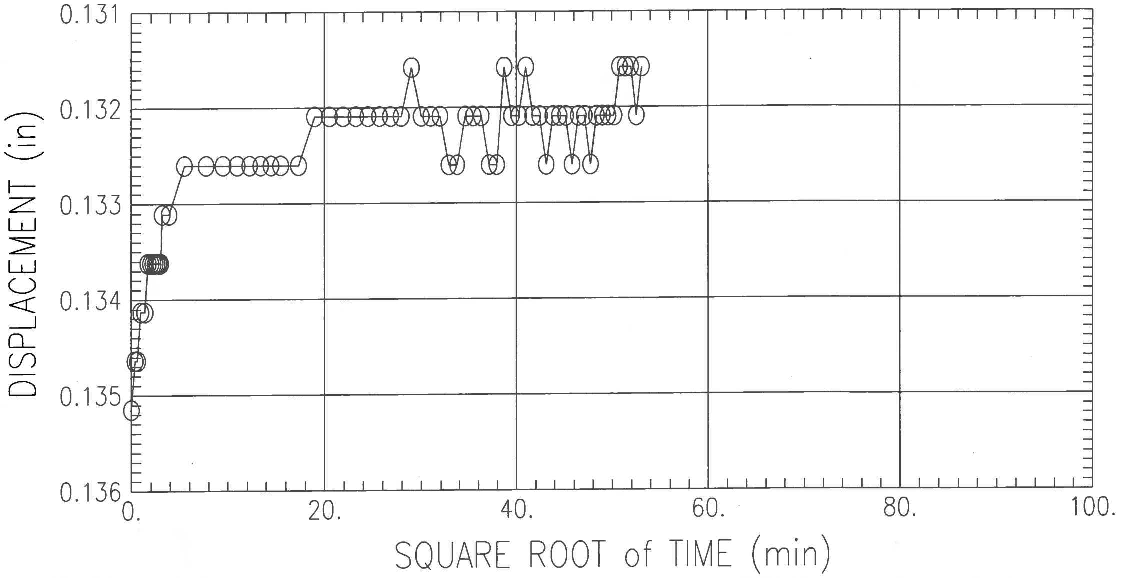
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3

Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'

Description : red/brown silty clay and sand (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 18 OF 20)
STRESS : 4 (t/ft^2)





Bowser Morner

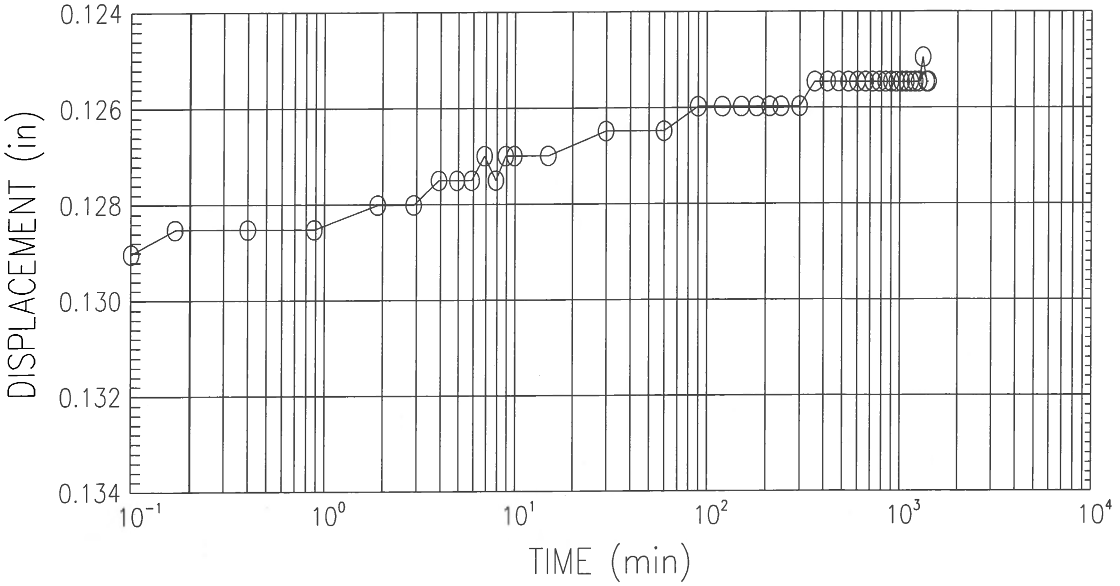
Project Name : EMDF Characterization

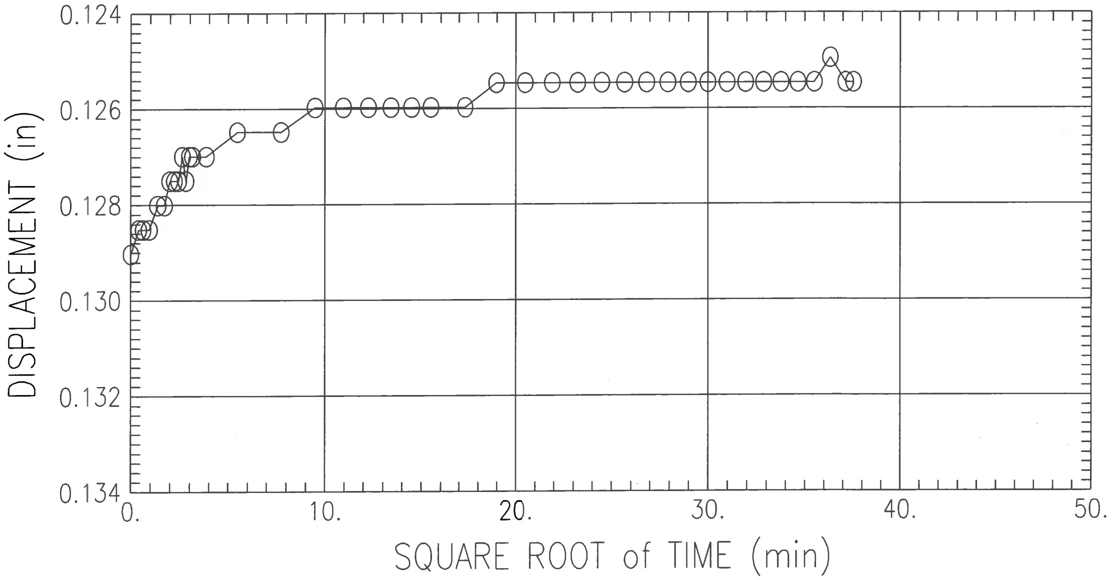
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3

Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'

Description : red/brown silty clay and sand (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 19 OF 20)
STRESS : 2 (t/ft^2)





Bowser Morner

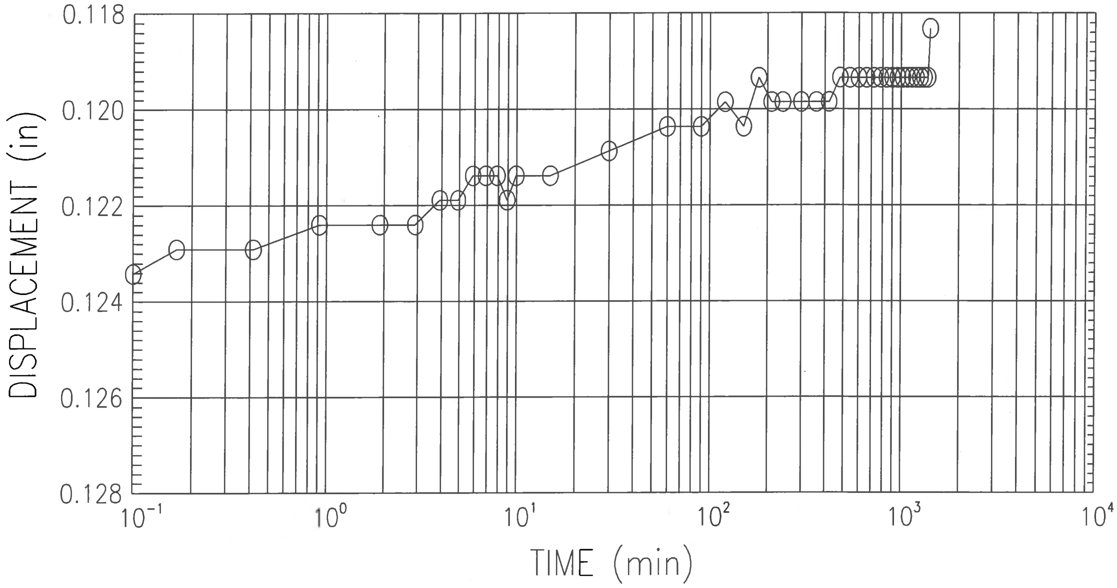
Project Name : EMDF Characterization

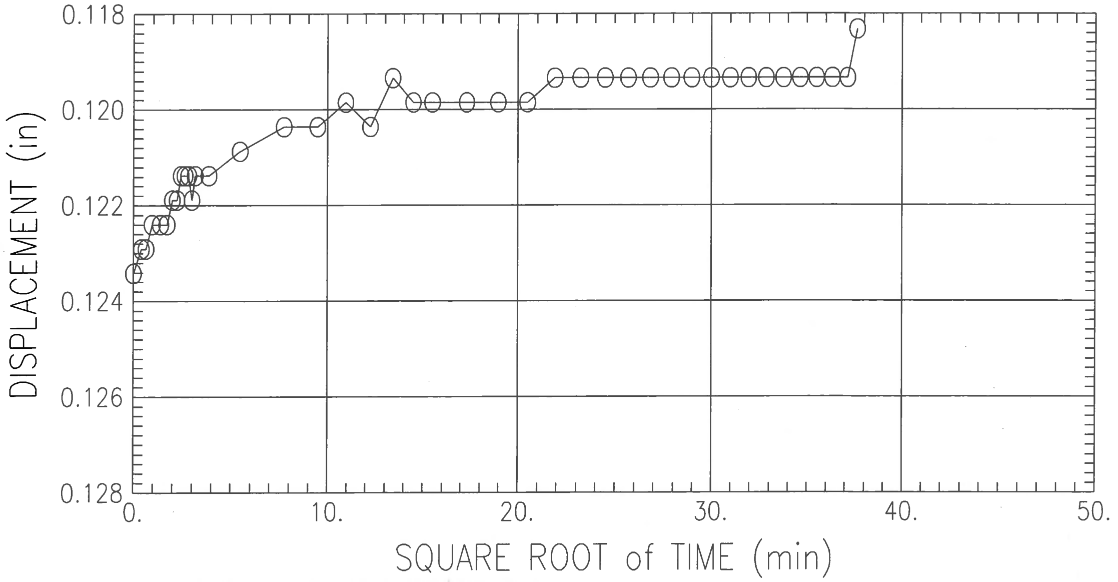
Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3

Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'

Description : red/brown silty clay and sand (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 20 OF 20)
STRESS : 1 (t/ft^2)





Bowser Morner

Project Name : EMDF Characterization

Project No : 183923 Boring No : GW987-ST-3 Sample No : GW987-ST-3

Test Date : 3-15-18 Test No : GW987-ST-3 Depth : 2.8'-3.0'

Description : red/brown silty clay and sand (visual description)

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

	APPLIED PRESSURE (t/ft^2)	FINAL DISPLACEMENT (in)	VOID RATIO	STRAIN AT END (%)	FITTING T50 TIME (min) SQ.RT.	LOG	COEFFICIENT OF CONSOLIDATION (in^2/s) SQ.RT.	LOG	AVE
1)	0.06	0.001	0.689	0.05	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
2)	0.25	0.001	0.688	0.10	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
3)	0.50	0.007	0.678	0.70	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
4)	1.00	0.016	0.663	1.60	4.1	0.0	2.05E-004	0.00E+000	2.05E-004
5)	2.00	0.031	0.638	3.05	1.0	0.0	7.94E-004	0.00E+000	7.94E-004
6)	4.00	0.056	0.598	5.45	0.9	0.0	8.76E-004	0.00E+000	8.76E-004
7)	2.00	0.052	0.604	5.11	0.0	0.6	0.00E+000	1.35E-003	1.35E-003
8)	1.00	0.048	0.611	4.70	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
9)	0.50	0.044	0.616	4.36	23.5	0.0	3.31E-005	0.00E+000	3.31E-005
10)	1.00	0.047	0.613	4.56	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
11)	2.00	0.050	0.607	4.90	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
12)	4.00	0.058	0.595	5.65	4.6	0.0	1.67E-004	0.00E+000	1.67E-004
13)	8.00	0.089	0.543	8.71	0.8	0.0	9.37E-004	0.00E+000	9.37E-004
14)	16.00	0.119	0.492	11.70	0.9	0.0	7.96E-004	0.00E+000	7.96E-004
15)	32.00	0.152	0.439	14.86	0.8	0.0	8.06E-004	0.00E+000	8.06E-004
16)	16.00	0.146	0.448	14.31	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
17)	8.00	0.139	0.460	13.60	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
18)	4.00	0.132	0.472	12.90	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
19)	2.00	0.126	0.482	12.31	21.4	0.0	3.05E-005	0.00E+000	3.05E-005
20)	1.00	0.118	0.494	11.60	39.4	0.0	1.68E-005	0.00E+000	1.68E-005

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Specific Gravity : 2.69
Initial Void Ratio : 0.69
Final Void Ratio : 0.49

Liquid Limit : 0
Plastic Limit : 0
Plasticity Index : 0

Initial Height : 1.02 (in)
Sample Diameter : 2.50 (in)

	BEFORE CONSOLIDATION		AFTER CONSOLIDATION	
	TRIMMINGS	SPECIMEN + RING	SPECIMEN + RING	TRIMMINGS
CONTAINER NO.		RING	RING	
WT CONTAINER + WET SOIL (gm)	158.23	158.23	154.28	154.28
WT CONTAINER + DRY SOIL (gm)	130.55	130.55	130.55	130.55
WT CONTAINER (gm)	0.00	0.00	0.00	0.00
WT DRY SOIL (gm)	130.55	130.55	130.55	130.55
WATER CONTENT (%)	21.20	21.20	18.18	18.18
VOID RATIO	------	0.69	0.49	------
DEGREE OF SATURATION (%)	------	82.63	98.95	------
DRY DENSITY (lb/ft^3)	------	99.33	112.37	------

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefor values may not represent actual values for the specimen.

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW987-ST-3, 2.0'-4.0'
Project No.: 183923
Boring No.: GW987-ST-3
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW987-ST-3
Test Date : 3-15-18
Depth : 2.8'-3.0'
Test No. : GW987-ST-3
Sample Type: Undisturb

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 1 of 20
Stress increment from 0.00 (t/ft^2) to 0.06 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.15	0.39	0.0000	0.690	0.00
2)	0.90	0.95	0.0000	0.690	0.00
3)	2.88	1.70	0.0005	0.689	0.05
4)	3.92	1.98	0.0000	0.690	0.00
5)	5.90	2.43	0.0005	0.689	0.05

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 2 of 20
Stress increment from 0.06 (t/ft^2) to 0.25 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0010	0.688	0.10
2)	0.15	0.39	0.0005	0.689	0.05
3)	0.40	0.63	0.0010	0.688	0.10
4)	0.90	0.95	0.0005	0.689	0.05
5)	1.88	1.37	0.0010	0.688	0.10
6)	2.88	1.70	0.0010	0.688	0.10
7)	3.88	1.97	0.0005	0.689	0.05
8)	4.88	2.21	0.0010	0.688	0.10
9)	5.88	2.43	0.0010	0.688	0.10
10)	6.88	2.62	0.0010	0.688	0.10
11)	7.88	2.81	0.0010	0.688	0.10
12)	8.90	2.98	0.0010	0.688	0.10
13)	9.90	3.15	0.0010	0.688	0.10
14)	14.88	3.86	0.0010	0.688	0.10
15)	29.90	5.47	0.0010	0.688	0.10
16)	59.90	7.74	0.0010	0.688	0.10
17)	89.88	9.48	0.0010	0.688	0.10
18)	119.88	10.95	0.0010	0.688	0.10
19)	149.90	12.24	0.0010	0.688	0.10
20)	179.88	13.41	0.0010	0.688	0.10
21)	209.88	14.49	0.0010	0.688	0.10
22)	239.90	15.49	0.0010	0.688	0.10
23)	299.88	17.32	0.0010	0.688	0.10
24)	359.90	18.97	0.0010	0.688	0.10
25)	419.88	20.49	0.0010	0.688	0.10
26)	479.88	21.91	0.0010	0.688	0.10
27)	539.90	23.24	0.0010	0.688	0.10
28)	599.88	24.49	0.0010	0.688	0.10
29)	659.90	25.69	0.0010	0.688	0.10
30)	719.88	26.83	0.0015	0.687	0.15
31)	779.88	27.93	0.0010	0.688	0.10
32)	839.88	28.98	0.0010	0.688	0.10
33)	899.88	30.00	0.0010	0.688	0.10
34)	959.88	30.98	0.0010	0.688	0.10
35)	1019.88	31.94	0.0010	0.688	0.10

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW987-ST-3, 2.0'-4.0'
Project No.: 183923
Boring No.: GW987-ST-3
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW987-ST-3
Test Date : 3-15-18
Depth : 2.8'-3.0'
Test No. : GW987-ST-3
Sample Type: Undisturb

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 2 of 20
Stress increment from 0.06 (t/ft^2) to 0.25 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.0020	0.687	0.20
37)	1139.88	33.76	0.0010	0.688	0.10
38)	1199.90	34.64	0.0010	0.688	0.10
39)	1259.90	35.50	0.0010	0.688	0.10
40)	1319.88	36.33	0.0010	0.688	0.10
41)	1379.88	37.15	0.0015	0.687	0.15
42)	1400.37	37.42	0.0010	0.688	0.10

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW987-ST-3, 2.0'-4.0'
Project No.: 183923
Boring No.: GW987-ST-3
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW987-ST-3
Test Date : 3-15-18
Depth : 2.8'-3.0'
Test No. : GW987-ST-3
Sample Type: Undisturb

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 3 of 20
Stress increment from 0.25 (t/ft^2) to 0.50 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0046	0.682	0.45
2)	0.15	0.39	0.0051	0.682	0.50
3)	0.42	0.65	0.0051	0.682	0.50
4)	0.90	0.95	0.0056	0.681	0.55
5)	1.90	1.38	0.0056	0.681	0.55
6)	2.92	1.71	0.0056	0.681	0.55
7)	3.90	1.97	0.0061	0.680	0.60
8)	4.92	2.22	0.0056	0.681	0.55
9)	5.92	2.43	0.0056	0.681	0.55
10)	6.90	2.63	0.0061	0.680	0.60
11)	7.92	2.81	0.0056	0.681	0.55
12)	8.90	2.98	0.0056	0.681	0.55
13)	9.92	3.15	0.0056	0.681	0.55
14)	14.92	3.86	0.0056	0.681	0.55
15)	29.93	5.47	0.0061	0.680	0.60
16)	59.95	7.74	0.0066	0.679	0.65
17)	89.90	9.48	0.0061	0.680	0.60
18)	119.90	10.95	0.0066	0.679	0.65
19)	149.92	12.24	0.0071	0.678	0.70
20)	179.90	13.41	0.0077	0.677	0.75
21)	209.90	14.49	0.0071	0.678	0.70
22)	239.90	15.49	0.0077	0.677	0.75
23)	299.92	17.32	0.0077	0.677	0.75
24)	359.90	18.97	0.0077	0.677	0.75
25)	419.92	20.49	0.0077	0.677	0.75
26)	479.92	21.91	0.0077	0.677	0.75
27)	539.90	23.24	0.0077	0.677	0.75
28)	599.92	24.49	0.0077	0.677	0.75
29)	659.92	25.69	0.0082	0.676	0.80
30)	719.90	26.83	0.0077	0.677	0.75
31)	779.92	27.93	0.0077	0.677	0.75
32)	839.90	28.98	0.0077	0.677	0.75
33)	899.95	30.00	0.0082	0.676	0.80
34)	959.90	30.98	0.0077	0.677	0.75
35)	1019.90	31.94	0.0077	0.677	0.75

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                          CONSOLIDATION TEST DATA

Project    : EMDF Characterization     Location    : GW987-ST-3, 2.0'-4.0'     Project No.: 183923
Boring No.: GW987-ST-3                 Tested by   : BMI: blc                  Checked by : KAF
Sample No.: GW987-ST-3                 Test Date   : 3-15-18                   Depth      : 2.8'-3.0'
Test No.   : GW987-ST-3                Sample Type: Undisturb

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 3 of 20
Stress increment from 0.25 (t/ft^2)  to 0.50 (t/ft^2)
Start Date :              Start Time :

               ELAPSED TIME      SQRT. OF       CHANGE IN       VOID       STRAIN
                   (min)         TIME (min)     HEIGHT (in)     RATIO        (%)

         36)     1079.90          32.86          0.0071         0.678        0.70
         37)     1139.92          33.76          0.0077         0.677        0.75
         38)     1199.90          34.64          0.0082         0.676        0.80
         39)     1259.92          35.50          0.0077         0.677        0.75
         40)     1293.48          35.96          0.0071         0.678        0.70
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CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 4 of 20
Stress increment from 0.50 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0138	0.667	1.35
2)	0.15	0.39	0.0138	0.667	1.35
3)	0.40	0.63	0.0143	0.666	1.40
4)	0.90	0.95	0.0143	0.666	1.40
5)	1.90	1.38	0.0148	0.665	1.45
6)	2.90	1.70	0.0148	0.665	1.45
7)	3.90	1.97	0.0148	0.665	1.45
8)	4.92	2.22	0.0153	0.665	1.50
9)	5.92	2.43	0.0153	0.665	1.50
10)	6.92	2.63	0.0153	0.665	1.50
11)	7.93	2.82	0.0153	0.665	1.50
12)	8.90	2.98	0.0153	0.665	1.50
13)	9.90	3.15	0.0158	0.664	1.55
14)	14.90	3.86	0.0158	0.664	1.55
15)	29.90	5.47	0.0158	0.664	1.55
16)	59.90	7.74	0.0163	0.663	1.60
17)	89.92	9.48	0.0163	0.663	1.60
18)	119.92	10.95	0.0163	0.663	1.60
19)	149.92	12.24	0.0163	0.663	1.60
20)	179.92	13.41	0.0163	0.663	1.60
21)	209.90	14.49	0.0163	0.663	1.60
22)	239.92	15.49	0.0163	0.663	1.60
23)	299.90	17.32	0.0163	0.663	1.60
24)	359.92	18.97	0.0163	0.663	1.60
25)	419.90	20.49	0.0168	0.662	1.65
26)	479.90	21.91	0.0168	0.662	1.65
27)	539.90	23.24	0.0168	0.662	1.65
28)	599.90	24.49	0.0163	0.663	1.60
29)	659.92	25.69	0.0168	0.662	1.65
30)	719.90	26.83	0.0168	0.662	1.65
31)	779.93	27.93	0.0168	0.662	1.65
32)	839.92	28.98	0.0163	0.663	1.60
33)	899.93	30.00	0.0168	0.662	1.65
34)	959.88	30.98	0.0168	0.662	1.65
35)	1019.90	31.94	0.0168	0.662	1.65

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW987-ST-3, 2.0'-4.0'
Project No.: 183923
Boring No.: GW987-ST-3
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW987-ST-3
Test Date : 3-15-18
Depth : 2.8'-3.0'
Test No. : GW987-ST-3
Sample Type: Undisturb

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 4 of 20
Stress increment from 0.50 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.0168	0.662	1.65
37)	1139.90	33.76	0.0168	0.662	1.65
38)	1199.90	34.64	0.0168	0.662	1.65
39)	1259.90	35.50	0.0163	0.663	1.60
40)	1313.87	36.25	0.0163	0.663	1.60

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW987-ST-3, 2.0'-4.0'
Project No.: 183923
Boring No.: GW987-ST-3
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW987-ST-3
Test Date : 3-15-18
Depth : 2.8'-3.0'
Test No. : GW987-ST-3
Sample Type: Undisturb

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 5 of 20
Stress increment from 1.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0275	0.644	2.70
2)	0.15	0.39	0.0281	0.644	2.75
3)	0.40	0.63	0.0286	0.643	2.80
4)	0.92	0.96	0.0291	0.642	2.85
5)	1.93	1.39	0.0296	0.641	2.90
6)	2.90	1.70	0.0296	0.641	2.90
7)	3.92	1.98	0.0296	0.641	2.90
8)	4.90	2.21	0.0296	0.641	2.90
9)	5.90	2.43	0.0301	0.640	2.95
10)	6.90	2.63	0.0301	0.640	2.95
11)	7.92	2.81	0.0306	0.639	3.00
12)	8.92	2.99	0.0301	0.640	2.95
13)	9.93	3.15	0.0301	0.640	2.95
14)	14.90	3.86	0.0301	0.640	2.95
15)	29.92	5.47	0.0301	0.640	2.95
16)	59.92	7.74	0.0306	0.639	3.00
17)	89.90	9.48	0.0306	0.639	3.00
18)	119.92	10.95	0.0306	0.639	3.00
19)	149.90	12.24	0.0311	0.638	3.05
20)	179.92	13.41	0.0306	0.639	3.00
21)	209.90	14.49	0.0311	0.638	3.05
22)	239.90	15.49	0.0311	0.638	3.05
23)	299.90	17.32	0.0311	0.638	3.05
24)	359.92	18.97	0.0311	0.638	3.05
25)	419.90	20.49	0.0311	0.638	3.05
26)	479.90	21.91	0.0311	0.638	3.05
27)	539.92	23.24	0.0311	0.638	3.05
28)	599.90	24.49	0.0311	0.638	3.05
29)	659.88	25.69	0.0311	0.638	3.05
30)	719.90	26.83	0.0311	0.638	3.05
31)	779.90	27.93	0.0311	0.638	3.05
32)	839.90	28.98	0.0311	0.638	3.05
33)	899.90	30.00	0.0311	0.638	3.05
34)	959.92	30.98	0.0311	0.638	3.05
35)	1019.90	31.94	0.0316	0.638	3.10

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 5 of 20
Stress increment from 1.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.0311	0.638	3.05
37)	1139.90	33.76	0.0316	0.638	3.10
38)	1199.90	34.64	0.0311	0.638	3.05
39)	1259.90	35.50	0.0311	0.638	3.05
40)	1319.92	36.33	0.0316	0.638	3.10
41)	1379.90	37.15	0.0316	0.638	3.10
42)	1439.90	37.95	0.0316	0.638	3.10
43)	1499.88	38.73	0.0316	0.638	3.10
44)	1559.88	39.50	0.0311	0.638	3.05
45)	1619.90	40.25	0.0311	0.638	3.05
46)	1628.88	40.36	0.0311	0.638	3.05

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 6 of 20
Stress increment from 2.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0495	0.608	4.85
2)	0.13	0.37	0.0505	0.606	4.95
3)	0.37	0.61	0.0510	0.605	5.00
4)	0.87	0.93	0.0520	0.604	5.10
5)	1.87	1.37	0.0525	0.603	5.15
6)	2.87	1.69	0.0530	0.602	5.20
7)	3.87	1.97	0.0530	0.602	5.20
8)	4.87	2.21	0.0530	0.602	5.20
9)	5.87	2.42	0.0536	0.601	5.25
10)	6.88	2.62	0.0541	0.600	5.30
11)	7.88	2.81	0.0536	0.601	5.25
12)	8.88	2.98	0.0536	0.601	5.25
13)	9.87	3.14	0.0536	0.601	5.25
14)	14.87	3.86	0.0541	0.600	5.30
15)	29.87	5.47	0.0541	0.600	5.30
16)	59.90	7.74	0.0551	0.599	5.40
17)	89.88	9.48	0.0541	0.600	5.30
18)	119.87	10.95	0.0551	0.599	5.40
19)	149.87	12.24	0.0546	0.600	5.35
20)	179.87	13.41	0.0551	0.599	5.40
21)	209.92	14.49	0.0546	0.600	5.35
22)	239.87	15.49	0.0551	0.599	5.40
23)	299.88	17.32	0.0551	0.599	5.40
24)	359.87	18.97	0.0551	0.599	5.40
25)	419.87	20.49	0.0556	0.598	5.45
26)	479.87	21.91	0.0556	0.598	5.45
27)	539.87	23.24	0.0556	0.598	5.45
28)	599.87	24.49	0.0556	0.598	5.45
29)	659.87	25.69	0.0556	0.598	5.45
30)	719.88	26.83	0.0556	0.598	5.45
31)	779.87	27.93	0.0556	0.598	5.45
32)	839.87	28.98	0.0561	0.597	5.50
33)	899.87	30.00	0.0556	0.598	5.45
34)	959.87	30.98	0.0561	0.597	5.50
35)	1019.88	31.94	0.0556	0.598	5.45

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW987-ST-3, 2.0′-4.0′
Project No.: 183923
Boring No.: GW987-ST-3
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW987-ST-3
Test Date : 3-15-18
Depth : 2.8′-3.0′
Test No. : GW987-ST-3
Sample Type: Undisturb

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 6 of 20
Stress increment from 2.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date :
Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.85	32.86	0.0561	0.597	5.50
37)	1139.88	33.76	0.0556	0.598	5.45
38)	1199.87	34.64	0.0556	0.598	5.45
39)	1259.85	35.49	0.0561	0.597	5.50
40)	1319.85	36.33	0.0561	0.597	5.50
41)	1325.73	36.41	0.0556	0.598	5.45

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW987-ST-3, 2.0'-4.0'
Project No.: 183923
Boring No.: GW987-ST-3
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW987-ST-3
Test Date : 3-15-18
Depth : 2.8'-3.0'
Test No. : GW987-ST-3
Sample Type: Undisturb

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 7 of 20
Stress increment from 4.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0536	0.601	5.25
2)	0.15	0.39	0.0530	0.602	5.20
3)	0.40	0.63	0.0530	0.602	5.20
4)	0.90	0.95	0.0525	0.603	5.15
5)	1.88	1.37	0.0525	0.603	5.15
6)	2.88	1.70	0.0525	0.603	5.15
7)	3.90	1.97	0.0525	0.603	5.15
8)	4.88	2.21	0.0530	0.602	5.20
9)	5.88	2.43	0.0525	0.603	5.15
10)	6.88	2.62	0.0525	0.603	5.15
11)	7.88	2.81	0.0525	0.603	5.15
12)	8.88	2.98	0.0525	0.603	5.15
13)	9.88	3.14	0.0525	0.603	5.15
14)	14.90	3.86	0.0525	0.603	5.15
15)	29.88	5.47	0.0530	0.602	5.20
16)	59.90	7.74	0.0525	0.603	5.15
17)	89.90	9.48	0.0530	0.602	5.20
18)	119.88	10.95	0.0525	0.603	5.15
19)	149.92	12.24	0.0530	0.602	5.20
20)	179.90	13.41	0.0520	0.604	5.10
21)	209.88	14.49	0.0530	0.602	5.20
22)	239.88	15.49	0.0520	0.604	5.10
23)	299.88	17.32	0.0525	0.603	5.15
24)	359.88	18.97	0.0520	0.604	5.10
25)	419.88	20.49	0.0520	0.604	5.10
26)	479.93	21.91	0.0520	0.604	5.10
27)	539.88	23.24	0.0520	0.604	5.10
28)	599.88	24.49	0.0520	0.604	5.10
29)	659.88	25.69	0.0520	0.604	5.10
30)	719.90	26.83	0.0525	0.603	5.15
31)	779.93	27.93	0.0525	0.603	5.15
32)	839.87	28.98	0.0520	0.604	5.10
33)	899.88	30.00	0.0520	0.604	5.10
34)	959.88	30.98	0.0525	0.603	5.15
35)	1019.88	31.94	0.0520	0.604	5.10

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 7 of 20
Stress increment from 4.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.0520	0.604	5.10
37)	1139.88	33.76	0.0520	0.604	5.10
38)	1199.87	34.64	0.0520	0.604	5.10
39)	1259.90	35.50	0.0520	0.604	5.10
40)	1319.90	36.33	0.0520	0.604	5.10
41)	1379.88	37.15	0.0525	0.603	5.15
42)	1429.40	37.81	0.0520	0.604	5.10

CONSOLIDATION TEST DATA

Project : EMDF Characterization Location : GW987-ST-3, 2.0'-4.0' Project No.: 183923
Boring No.: GW987-ST-3 Tested by : BMI: blc Checked by : KAF
Sample No.: GW987-ST-3 Test Date : 3-15-18 Depth : 2.8'-3.0'
Test No. : GW987-ST-3 Sample Type: Undisturb

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 8 of 20
Stress increment from 2.00 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0500	0.607	4.90
2)	0.15	0.39	0.0495	0.608	4.85
3)	0.38	0.62	0.0495	0.608	4.85
4)	0.92	0.96	0.0495	0.608	4.85
5)	1.88	1.37	0.0490	0.609	4.80
6)	2.88	1.70	0.0495	0.608	4.85
7)	3.88	1.97	0.0490	0.609	4.80
8)	4.88	2.21	0.0490	0.609	4.80
9)	5.88	2.43	0.0490	0.609	4.80
10)	6.88	2.62	0.0490	0.609	4.80
11)	7.90	2.81	0.0490	0.609	4.80
12)	8.88	2.98	0.0490	0.609	4.80
13)	9.90	3.15	0.0490	0.609	4.80
14)	14.88	3.86	0.0495	0.608	4.85
15)	29.92	5.47	0.0485	0.610	4.75
16)	59.90	7.74	0.0490	0.609	4.80
17)	89.90	9.48	0.0485	0.610	4.75
18)	119.90	10.95	0.0490	0.609	4.80
19)	149.90	12.24	0.0485	0.610	4.75
20)	179.90	13.41	0.0490	0.609	4.80
21)	209.88	14.49	0.0485	0.610	4.75
22)	239.90	15.49	0.0490	0.609	4.80
23)	299.88	17.32	0.0490	0.609	4.80
24)	359.88	18.97	0.0490	0.609	4.80
25)	419.88	20.49	0.0485	0.610	4.75
26)	479.90	21.91	0.0490	0.609	4.80
27)	539.88	23.24	0.0490	0.609	4.80
28)	599.90	24.49	0.0485	0.610	4.75
29)	659.90	25.69	0.0485	0.610	4.75
30)	719.90	26.83	0.0485	0.610	4.75
31)	779.90	27.93	0.0490	0.609	4.80
32)	839.90	28.98	0.0485	0.610	4.75
33)	899.88	30.00	0.0490	0.609	4.80
34)	959.88	30.98	0.0490	0.609	4.80
35)	1019.88	31.94	0.0485	0.610	4.75

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW987-ST-3, 2.0'-4.0'
Project No.: 183923
Boring No.: GW987-ST-3
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW987-ST-3
Test Date : 3-15-18
Depth : 2.8'-3.0'
Test No. : GW987-ST-3
Sample Type: Undisturb

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 8 of 20
Stress increment from 2.00 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.0490	0.609	4.80
37)	1139.90	33.76	0.0485	0.610	4.75
38)	1199.88	34.64	0.0485	0.610	4.75
39)	1259.88	35.49	0.0485	0.610	4.75
40)	1319.88	36.33	0.0485	0.610	4.75
41)	1379.88	37.15	0.0485	0.610	4.75
42)	1439.88	37.95	0.0479	0.611	4.70
43)	1441.43	37.97	0.0479	0.611	4.70

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0′-4.0′
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8′-3.0′

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 9 of 20
Stress increment from 1.00 (t/ft^2) to 0.50 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0464	0.613	4.55
2)	0.15	0.39	0.0459	0.614	4.50
3)	0.40	0.63	0.0459	0.614	4.50
4)	0.90	0.95	0.0464	0.613	4.55
5)	1.92	1.38	0.0459	0.614	4.50
6)	2.92	1.71	0.0459	0.614	4.50
7)	3.90	1.97	0.0454	0.615	4.45
8)	4.92	2.22	0.0454	0.615	4.45
9)	5.92	2.43	0.0454	0.615	4.45
10)	6.90	2.63	0.0454	0.615	4.45
11)	7.90	2.81	0.0454	0.615	4.45
12)	8.90	2.98	0.0459	0.614	4.50
13)	9.90	3.15	0.0454	0.615	4.45
14)	14.93	3.86	0.0459	0.614	4.50
15)	29.92	5.47	0.0449	0.616	4.40
16)	59.90	7.74	0.0449	0.616	4.40
17)	89.90	9.48	0.0449	0.616	4.40
18)	119.92	10.95	0.0444	0.616	4.35
19)	149.92	12.24	0.0449	0.616	4.40
20)	179.88	13.41	0.0449	0.616	4.40
21)	209.90	14.49	0.0449	0.616	4.40
22)	239.90	15.49	0.0444	0.616	4.35
23)	299.90	17.32	0.0449	0.616	4.40
24)	359.90	18.97	0.0444	0.616	4.35
25)	419.88	20.49	0.0444	0.616	4.35
26)	479.88	21.91	0.0444	0.616	4.35
27)	539.92	23.24	0.0444	0.616	4.35
28)	599.90	24.49	0.0444	0.616	4.35
29)	659.90	25.69	0.0444	0.616	4.35
30)	719.90	26.83	0.0444	0.616	4.35
31)	779.93	27.93	0.0444	0.616	4.35
32)	839.92	28.98	0.0444	0.616	4.35
33)	899.92	30.00	0.0444	0.616	4.35
34)	959.90	30.98	0.0444	0.616	4.35
35)	1019.88	31.94	0.0444	0.616	4.35

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 9 of 20
Stress increment from 1.00 (t/ft^2) to 0.50 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.0444	0.616	4.35
37)	1139.90	33.76	0.0444	0.616	4.35
38)	1199.90	34.64	0.0444	0.616	4.35
39)	1259.92	35.50	0.0444	0.616	4.35
40)	1319.90	36.33	0.0444	0.616	4.35
41)	1379.92	37.15	0.0444	0.616	4.35
42)	1439.90	37.95	0.0444	0.616	4.35
43)	1479.32	38.46	0.0444	0.616	4.35

CONSOLIDATION TEST DATA

Project : EMDF Characterization	Location : GW987-ST-3, 2.0'-4.0'	Project No.: 183923
Boring No.: GW987-ST-3	Tested by : BMI: blc	Checked by : KAF
Sample No.: GW987-ST-3	Test Date : 3-15-18	Depth : 2.8'-3.0'
Test No. : GW987-ST-3	Sample Type: Undisturb	

Soil Description : red/brown silty clay and sand (visual description)

Remarks : Use: Foundation berm/fill

Load Increment : 10 of 20

Stress increment from 0.50 (t/ft^2) to 1.00 (t/ft^2)

Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0459	0.614	4.50
2)	0.15	0.39	0.0459	0.614	4.50
3)	0.40	0.63	0.0459	0.614	4.50
4)	0.90	0.95	0.0459	0.614	4.50
5)	1.93	1.39	0.0459	0.614	4.50
6)	2.88	1.70	0.0459	0.614	4.50
7)	3.90	1.97	0.0459	0.614	4.50
8)	4.90	2.21	0.0459	0.614	4.50
9)	5.88	2.43	0.0459	0.614	4.50
10)	6.92	2.63	0.0459	0.614	4.50
11)	7.90	2.81	0.0459	0.614	4.50
12)	8.90	2.98	0.0459	0.614	4.50
13)	9.90	3.15	0.0464	0.613	4.55
14)	14.88	3.86	0.0459	0.614	4.50
15)	29.88	5.47	0.0464	0.613	4.55
16)	59.90	7.74	0.0459	0.614	4.50
17)	89.90	9.48	0.0469	0.612	4.60
18)	119.90	10.95	0.0464	0.613	4.55
19)	149.88	12.24	0.0469	0.612	4.60
20)	179.88	13.41	0.0459	0.614	4.50
21)	209.90	14.49	0.0469	0.612	4.60
22)	239.90	15.49	0.0464	0.613	4.55
23)	299.90	17.32	0.0464	0.613	4.55
24)	359.93	18.97	0.0464	0.613	4.55
25)	419.90	20.49	0.0464	0.613	4.55
26)	479.88	21.91	0.0459	0.614	4.50
27)	539.90	23.24	0.0464	0.613	4.55
28)	599.90	24.49	0.0464	0.613	4.55
29)	659.90	25.69	0.0464	0.613	4.55
30)	719.88	26.83	0.0464	0.613	4.55
31)	779.90	27.93	0.0464	0.613	4.55
32)	839.90	28.98	0.0464	0.613	4.55
33)	899.88	30.00	0.0464	0.613	4.55
34)	959.90	30.98	0.0464	0.613	4.55
35)	1019.90	31.94	0.0464	0.613	4.55

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 10 of 20
Stress increment from 0.50 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.0464	0.613	4.55
37)	1139.88	33.76	0.0464	0.613	4.55
38)	1199.88	34.64	0.0464	0.613	4.55
39)	1259.90	35.50	0.0464	0.613	4.55
40)	1319.88	36.33	0.0464	0.613	4.55
41)	1322.27	36.36	0.0464	0.613	4.55

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                                CONSOLIDATION TEST DATA

Project    : EMDF Characterization      Location    : GW987-ST-3, 2.0'-4.0'      Project No.: 183923
Boring No.: GW987-ST-3                  Tested by   : BMI: blc                   Checked by : KAF
Sample No.: GW987-ST-3                  Test Date   : 3-15-18                    Depth      : 2.8'-3.0'
Test No.   : GW987-ST-3                 Sample Type: Undisturb

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 11 of 20
Stress increment from 1.00 (t/ft^2)  to 2.00 (t/ft^2)
Start Date :              Start Time :

                ELAPSED TIME      SQRT. OF      CHANGE IN      VOID      STRAIN
                   (min)         TIME (min)     HEIGHT (in)    RATIO       (%)

        1)         0.00             0.00          0.0490       0.609      4.80
        2)         0.15             0.39          0.0490       0.609      4.80
        3)         0.38             0.62          0.0495       0.608      4.85
        4)         0.88             0.94          0.0495       0.608      4.85
        5)         1.90             1.38          0.0495       0.608      4.85
        6)         2.88             1.70          0.0495       0.608      4.85
        7)         3.90             1.97          0.0495       0.608      4.85
        8)         4.90             2.21          0.0495       0.608      4.85
        9)         5.90             2.43          0.0495       0.608      4.85
       10)         6.88             2.62          0.0495       0.608      4.85
       11)         7.88             2.81          0.0495       0.608      4.85
       12)         8.88             2.98          0.0500       0.607      4.90
       13)         9.88             3.14          0.0500       0.607      4.90
       14)        14.88             3.86          0.0495       0.608      4.85
       15)        29.88             5.47          0.0500       0.607      4.90
       16)        59.90             7.74          0.0500       0.607      4.90
       17)        89.90             9.48          0.0500       0.607      4.90
       18)       119.88            10.95          0.0500       0.607      4.90
       19)       149.88            12.24          0.0500       0.607      4.90
       20)       179.90            13.41          0.0500       0.607      4.90
       21)       209.88            14.49          0.0500       0.607      4.90
       22)       239.88            15.49          0.0500       0.607      4.90
       23)       299.88            17.32          0.0500       0.607      4.90
       24)       359.90            18.97          0.0500       0.607      4.90
       25)       419.88            20.49          0.0500       0.607      4.90
       26)       479.90            21.91          0.0500       0.607      4.90
       27)       539.88            23.24          0.0500       0.607      4.90
       28)       599.88            24.49          0.0500       0.607      4.90
       29)       659.88            25.69          0.0500       0.607      4.90
       30)       719.88            26.83          0.0505       0.606      4.95
       31)       779.90            27.93          0.0500       0.607      4.90
       32)       839.88            28.98          0.0500       0.607      4.90
       33)       899.88            30.00          0.0500       0.607      4.90
       34)       959.90            30.98          0.0500       0.607      4.90
       35)      1019.88            31.94          0.0505       0.606      4.95
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CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 11 of 20
Stress increment from 1.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.0505	0.606	4.95
37)	1139.88	33.76	0.0505	0.606	4.95
38)	1199.88	34.64	0.0500	0.607	4.90
39)	1259.88	35.49	0.0500	0.607	4.90
40)	1319.88	36.33	0.0500	0.607	4.90
41)	1379.88	37.15	0.0505	0.606	4.95
42)	1439.88	37.95	0.0505	0.606	4.95
43)	1499.88	38.73	0.0505	0.606	4.95
44)	1507.35	38.82	0.0500	0.607	4.90

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 12 of 20
Stress increment from 2.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0551	0.599	5.40
2)	0.15	0.39	0.0556	0.598	5.45
3)	0.40	0.63	0.0556	0.598	5.45
4)	0.93	0.97	0.0556	0.598	5.45
5)	1.92	1.38	0.0561	0.597	5.50
6)	2.90	1.70	0.0561	0.597	5.50
7)	3.92	1.98	0.0561	0.597	5.50
8)	4.92	2.22	0.0566	0.596	5.55
9)	5.92	2.43	0.0561	0.597	5.50
10)	6.92	2.63	0.0566	0.596	5.55
11)	7.92	2.81	0.0566	0.596	5.55
12)	8.92	2.99	0.0566	0.596	5.55
13)	9.92	3.15	0.0566	0.596	5.55
14)	14.92	3.86	0.0566	0.596	5.55
15)	29.92	5.47	0.0571	0.595	5.60
16)	59.92	7.74	0.0571	0.595	5.60
17)	89.93	9.48	0.0571	0.595	5.60
18)	119.92	10.95	0.0576	0.595	5.65
19)	149.92	12.24	0.0571	0.595	5.60
20)	179.93	13.41	0.0576	0.595	5.65
21)	209.93	14.49	0.0571	0.595	5.60
22)	239.95	15.49	0.0576	0.595	5.65
23)	299.92	17.32	0.0576	0.595	5.65
24)	359.92	18.97	0.0576	0.595	5.65
25)	419.92	20.49	0.0576	0.595	5.65
26)	479.92	21.91	0.0581	0.594	5.70
27)	539.92	23.24	0.0581	0.594	5.70
28)	599.90	24.49	0.0581	0.594	5.70
29)	659.93	25.69	0.0576	0.595	5.65
30)	719.92	26.83	0.0576	0.595	5.65
31)	779.93	27.93	0.0581	0.594	5.70
32)	839.92	28.98	0.0581	0.594	5.70
33)	899.92	30.00	0.0581	0.594	5.70
34)	959.92	30.98	0.0581	0.594	5.70
35)	1019.93	31.94	0.0581	0.594	5.70

CONSOLIDATION TEST DATA

Project : EMDF Characterization	Location : GW987-ST-3, 2.0'-4.0'	Project No.: 183923
Boring No.: GW987-ST-3	Tested by : BMI: blc	Checked by : KAF
Sample No.: GW987-ST-3	Test Date : 3-15-18	Depth : 2.8'-3.0'
Test No. : GW987-ST-3	Sample Type: Undisturb	

Soil Description : red/brown silty clay and sand (visual description)

Remarks : Use: Foundation berm/fill

Load Increment : 12 of 20

Stress increment from 2.00 (t/ft^2) to 4.00 (t/ft^2)

Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.93	32.86	0.0581	0.594	5.70
37)	1139.90	33.76	0.0581	0.594	5.70
38)	1199.90	34.64	0.0581	0.594	5.70
39)	1259.93	35.50	0.0581	0.594	5.70
40)	1319.90	36.33	0.0581	0.594	5.70
41)	1379.93	37.15	0.0581	0.594	5.70
42)	1439.90	37.95	0.0581	0.594	5.70
43)	1499.92	38.73	0.0576	0.595	5.65
44)	1504.80	38.79	0.0576	0.595	5.65

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 13 of 20
Stress increment from 4.00 (t/ft^2) to 8.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0785	0.560	7.70
2)	0.15	0.39	0.0806	0.556	7.90
3)	0.40	0.63	0.0821	0.554	8.05
4)	0.90	0.95	0.0831	0.552	8.15
5)	1.88	1.37	0.0852	0.549	8.35
6)	2.90	1.70	0.0852	0.549	8.35
7)	3.90	1.97	0.0852	0.549	8.35
8)	4.90	2.21	0.0857	0.548	8.40
9)	5.90	2.43	0.0862	0.547	8.45
10)	6.93	2.63	0.0862	0.547	8.45
11)	7.88	2.81	0.0862	0.547	8.45
12)	8.93	2.99	0.0862	0.547	8.45
13)	9.92	3.15	0.0862	0.547	8.45
14)	14.88	3.86	0.0872	0.546	8.55
15)	29.88	5.47	0.0877	0.545	8.60
16)	59.93	7.74	0.0872	0.546	8.55
17)	89.90	9.48	0.0877	0.545	8.60
18)	119.88	10.95	0.0877	0.545	8.60
19)	149.90	12.24	0.0882	0.544	8.65
20)	179.90	13.41	0.0877	0.545	8.60
21)	209.90	14.49	0.0882	0.544	8.65
22)	239.90	15.49	0.0877	0.545	8.60
23)	299.92	17.32	0.0877	0.545	8.60
24)	359.88	18.97	0.0877	0.545	8.60
25)	419.90	20.49	0.0882	0.544	8.65
26)	479.88	21.91	0.0882	0.544	8.65
27)	539.88	23.24	0.0882	0.544	8.65
28)	599.95	24.49	0.0882	0.544	8.65
29)	659.90	25.69	0.0882	0.544	8.65
30)	719.88	26.83	0.0882	0.544	8.65
31)	779.90	27.93	0.0882	0.544	8.65
32)	839.90	28.98	0.0882	0.544	8.65
33)	899.90	30.00	0.0882	0.544	8.65
34)	959.88	30.98	0.0882	0.544	8.65
35)	1019.92	31.94	0.0882	0.544	8.65

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 13 of 20
Stress increment from 4.00 (t/ft^2) to 8.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.0882	0.544	8.65
37)	1139.90	33.76	0.0882	0.544	8.65
38)	1199.88	34.64	0.0882	0.544	8.65
39)	1259.88	35.49	0.0882	0.544	8.65
40)	1319.90	36.33	0.0882	0.544	8.65
41)	1379.90	37.15	0.0887	0.543	8.70
42)	1387.95	37.26	0.0887	0.543	8.70

CONSOLIDATION TEST DATA

Project : EMDF Characterization	Location : GW987-ST-3, 2.0'-4.0'	Project No.: 183923
Boring No.: GW987-ST-3	Tested by : BMI: blc	Checked by : KAF
Sample No.: GW987-ST-3	Test Date : 3-15-18	Depth : 2.8'-3.0'
Test No. : GW987-ST-3	Sample Type: Undisturb	

Soil Description : red/brown silty clay and sand (visual description)

Remarks : Use: Foundation berm/fill

Load Increment : 14 of 20

Stress increment from 8.00 (t/ft^2) to 16.00 (t/ft^2)

Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1061	0.514	10.40
2)	0.15	0.39	0.1076	0.512	10.55
3)	0.38	0.62	0.1091	0.509	10.70
4)	0.90	0.95	0.1117	0.505	10.95
5)	1.92	1.38	0.1142	0.501	11.20
6)	2.90	1.70	0.1153	0.499	11.30
7)	3.90	1.97	0.1158	0.498	11.35
8)	4.92	2.22	0.1158	0.498	11.35
9)	5.88	2.43	0.1163	0.497	11.40
10)	6.88	2.62	0.1168	0.496	11.45
11)	7.90	2.81	0.1168	0.496	11.45
12)	8.93	2.99	0.1168	0.496	11.45
13)	9.90	3.15	0.1173	0.496	11.50
14)	14.88	3.86	0.1173	0.496	11.50
15)	29.90	5.47	0.1183	0.494	11.60
16)	59.90	7.74	0.1188	0.493	11.65
17)	89.88	9.48	0.1188	0.493	11.65
18)	119.88	10.95	0.1188	0.493	11.65
19)	149.88	12.24	0.1188	0.493	11.65
20)	179.88	13.41	0.1188	0.493	11.65
21)	209.90	14.49	0.1188	0.493	11.65
22)	239.90	15.49	0.1193	0.492	11.70
23)	299.90	17.32	0.1193	0.492	11.70
24)	359.88	18.97	0.1193	0.492	11.70
25)	419.90	20.49	0.1193	0.492	11.70
26)	479.88	21.91	0.1193	0.492	11.70
27)	539.88	23.24	0.1193	0.492	11.70
28)	599.90	24.49	0.1193	0.492	11.70
29)	659.90	25.69	0.1193	0.492	11.70
30)	719.90	26.83	0.1193	0.492	11.70
31)	779.90	27.93	0.1199	0.491	11.75
32)	839.88	28.98	0.1193	0.492	11.70
33)	899.88	30.00	0.1199	0.491	11.75
34)	959.90	30.98	0.1199	0.491	11.75
35)	1019.90	31.94	0.1199	0.491	11.75

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 14 of 20
Stress increment from 8.00 (t/ft^2) to 16.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.1199	0.491	11.75
37)	1139.90	33.76	0.1199	0.491	11.75
38)	1199.90	34.64	0.1199	0.491	11.75
39)	1259.88	35.49	0.1199	0.491	11.75
40)	1319.90	36.33	0.1199	0.491	11.75
41)	1379.88	37.15	0.1199	0.491	11.75
42)	1439.90	37.95	0.1199	0.491	11.75
43)	1456.88	38.17	0.1193	0.492	11.70

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 15 of 20
Stress increment from 16.00 (t/ft^2) to 32.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1346	0.467	13.20
2)	0.15	0.39	0.1367	0.464	13.40
3)	0.38	0.62	0.1397	0.458	13.70
4)	0.90	0.95	0.1423	0.454	13.95
5)	1.90	1.38	0.1448	0.450	14.20
6)	2.90	1.70	0.1464	0.447	14.35
7)	3.90	1.97	0.1469	0.447	14.40
8)	4.90	2.21	0.1474	0.446	14.45
9)	5.92	2.43	0.1479	0.445	14.50
10)	6.90	2.63	0.1479	0.445	14.50
11)	7.92	2.81	0.1484	0.444	14.55
12)	8.92	2.99	0.1484	0.444	14.55
13)	9.93	3.15	0.1484	0.444	14.55
14)	14.90	3.86	0.1494	0.442	14.65
15)	29.90	5.47	0.1499	0.442	14.70
16)	59.92	7.74	0.1499	0.442	14.70
17)	89.92	9.48	0.1505	0.441	14.75
18)	119.92	10.95	0.1505	0.441	14.75
19)	149.90	12.24	0.1510	0.440	14.80
20)	179.90	13.41	0.1505	0.441	14.75
21)	209.90	14.49	0.1510	0.440	14.80
22)	239.90	15.49	0.1510	0.440	14.80
23)	299.92	17.32	0.1510	0.440	14.80
24)	359.92	18.97	0.1510	0.440	14.80
25)	419.90	20.49	0.1510	0.440	14.80
26)	479.90	21.91	0.1510	0.440	14.80
27)	539.88	23.24	0.1510	0.440	14.80
28)	599.88	24.49	0.1510	0.440	14.80
29)	659.90	25.69	0.1510	0.440	14.80
30)	719.92	26.83	0.1510	0.440	14.80
31)	779.90	27.93	0.1515	0.439	14.85
32)	839.88	28.98	0.1515	0.439	14.85
33)	899.90	30.00	0.1515	0.439	14.85
34)	959.90	30.98	0.1515	0.439	14.85
35)	1019.88	31.94	0.1515	0.439	14.85

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 15 of 20
Stress increment from 16.00 (t/ft^2) to 32.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.1515	0.439	14.85
37)	1139.90	33.76	0.1515	0.439	14.85
38)	1199.90	34.64	0.1515	0.439	14.85
39)	1259.90	35.50	0.1520	0.438	14.90
40)	1319.90	36.33	0.1515	0.439	14.85
41)	1379.90	37.15	0.1515	0.439	14.85
42)	1438.68	37.93	0.1515	0.439	14.85

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 16 of 20
Stress increment from 32.00 (t/ft^2) to 16.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1469	0.447	14.40
2)	0.13	0.37	0.1469	0.447	14.40
3)	0.38	0.62	0.1469	0.447	14.40
4)	0.90	0.95	0.1469	0.447	14.40
5)	1.92	1.38	0.1469	0.447	14.40
6)	2.92	1.71	0.1469	0.447	14.40
7)	3.92	1.98	0.1464	0.447	14.35
8)	4.90	2.21	0.1464	0.447	14.35
9)	5.90	2.43	0.1469	0.447	14.40
10)	6.90	2.63	0.1464	0.447	14.35
11)	7.90	2.81	0.1464	0.447	14.35
12)	8.90	2.98	0.1464	0.447	14.35
13)	9.90	3.15	0.1464	0.447	14.35
14)	14.90	3.86	0.1464	0.447	14.35
15)	29.92	5.47	0.1464	0.447	14.35
16)	59.93	7.74	0.1459	0.448	14.30
17)	89.90	9.48	0.1464	0.447	14.35
18)	119.88	10.95	0.1459	0.448	14.30
19)	149.90	12.24	0.1464	0.447	14.35
20)	179.90	13.41	0.1459	0.448	14.30
21)	209.90	14.49	0.1464	0.447	14.35
22)	239.92	15.49	0.1459	0.448	14.30
23)	299.88	17.32	0.1459	0.448	14.30
24)	359.90	18.97	0.1459	0.448	14.30
25)	419.90	20.49	0.1459	0.448	14.30
26)	479.88	21.91	0.1459	0.448	14.30
27)	539.90	23.24	0.1459	0.448	14.30
28)	599.92	24.49	0.1459	0.448	14.30
29)	659.90	25.69	0.1459	0.448	14.30
30)	719.88	26.83	0.1459	0.448	14.30
31)	779.88	27.93	0.1459	0.448	14.30
32)	839.90	28.98	0.1459	0.448	14.30
33)	899.95	30.00	0.1459	0.448	14.30
34)	959.88	30.98	0.1459	0.448	14.30
35)	1019.90	31.94	0.1459	0.448	14.30

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW987-ST-3, 2.0'-4.0'
Project No.: 183923
Boring No.: GW987-ST-3
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW987-ST-3
Test Date : 3-15-18
Depth : 2.8'-3.0'
Test No. : GW987-ST-3
Sample Type: Undisturb

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 16 of 20
Stress increment from 32.00 (t/ft^2) to 16.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.1459	0.448	14.30
37)	1139.88	33.76	0.1459	0.448	14.30
38)	1199.90	34.64	0.1454	0.449	14.25
39)	1259.88	35.49	0.1459	0.448	14.30
40)	1319.90	36.33	0.1454	0.449	14.25
41)	1379.88	37.15	0.1454	0.449	14.25
42)	1436.52	37.90	0.1459	0.448	14.30

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 17 of 20
Stress increment from 16.00 (t/ft^2) to 8.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1413	0.456	13.85
2)	0.17	0.41	0.1413	0.456	13.85
3)	0.42	0.65	0.1408	0.457	13.80
4)	0.90	0.95	0.1403	0.458	13.75
5)	1.92	1.38	0.1403	0.458	13.75
6)	2.92	1.71	0.1403	0.458	13.75
7)	3.92	1.98	0.1403	0.458	13.75
8)	4.90	2.21	0.1403	0.458	13.75
9)	5.92	2.43	0.1403	0.458	13.75
10)	6.92	2.63	0.1403	0.458	13.75
11)	7.92	2.81	0.1397	0.458	13.70
12)	8.90	2.98	0.1403	0.458	13.75
13)	9.92	3.15	0.1397	0.458	13.70
14)	14.93	3.86	0.1397	0.458	13.70
15)	29.92	5.47	0.1403	0.458	13.75
16)	59.92	7.74	0.1397	0.458	13.70
17)	89.90	9.48	0.1397	0.458	13.70
18)	119.92	10.95	0.1392	0.459	13.65
19)	149.93	12.24	0.1397	0.458	13.70
20)	179.92	13.41	0.1392	0.459	13.65
21)	209.90	14.49	0.1397	0.458	13.70
22)	239.92	15.49	0.1392	0.459	13.65
23)	299.92	17.32	0.1392	0.459	13.65
24)	359.92	18.97	0.1392	0.459	13.65
25)	419.92	20.49	0.1392	0.459	13.65
26)	479.92	21.91	0.1392	0.459	13.65
27)	539.93	23.24	0.1392	0.459	13.65
28)	599.90	24.49	0.1392	0.459	13.65
29)	659.90	25.69	0.1392	0.459	13.65
30)	719.92	26.83	0.1392	0.459	13.65
31)	779.90	27.93	0.1392	0.459	13.65
32)	839.92	28.98	0.1392	0.459	13.65
33)	899.92	30.00	0.1392	0.459	13.65
34)	959.90	30.98	0.1387	0.460	13.60
35)	1019.90	31.94	0.1392	0.459	13.65

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 17 of 20
Stress increment from 16.00 (t/ft^2) to 8.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.1387	0.460	13.60
37)	1139.90	33.76	0.1392	0.459	13.65
38)	1199.92	34.64	0.1392	0.459	13.65
39)	1259.90	35.50	0.1387	0.460	13.60
40)	1319.90	36.33	0.1387	0.460	13.60
41)	1379.90	37.15	0.1392	0.459	13.65
42)	1439.92	37.95	0.1387	0.460	13.60
43)	1499.90	38.73	0.1392	0.459	13.65
44)	1538.13	39.22	0.1387	0.460	13.60

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 18 of 20
Stress increment from 8.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1352	0.466	13.25
2)	0.15	0.39	0.1346	0.467	13.20
3)	0.40	0.63	0.1346	0.467	13.20
4)	0.93	0.97	0.1341	0.468	13.15
5)	1.90	1.38	0.1341	0.468	13.15
6)	2.90	1.70	0.1336	0.469	13.10
7)	3.90	1.97	0.1336	0.469	13.10
8)	4.90	2.21	0.1336	0.469	13.10
9)	5.92	2.43	0.1336	0.469	13.10
10)	6.92	2.63	0.1336	0.469	13.10
11)	7.92	2.81	0.1336	0.469	13.10
12)	8.92	2.99	0.1336	0.469	13.10
13)	9.90	3.15	0.1331	0.469	13.05
14)	14.92	3.86	0.1331	0.469	13.05
15)	29.92	5.47	0.1326	0.470	13.00
16)	59.90	7.74	0.1326	0.470	13.00
17)	89.92	9.48	0.1326	0.470	13.00
18)	119.92	10.95	0.1326	0.470	13.00
19)	149.90	12.24	0.1326	0.470	13.00
20)	179.90	13.41	0.1326	0.470	13.00
21)	209.92	14.49	0.1326	0.470	13.00
22)	239.90	15.49	0.1326	0.470	13.00
23)	299.92	17.32	0.1326	0.470	13.00
24)	359.90	18.97	0.1321	0.471	12.95
25)	419.92	20.49	0.1321	0.471	12.95
26)	479.90	21.91	0.1321	0.471	12.95
27)	539.90	23.24	0.1321	0.471	12.95
28)	599.92	24.49	0.1321	0.471	12.95
29)	659.90	25.69	0.1321	0.471	12.95
30)	719.92	26.83	0.1321	0.471	12.95
31)	779.90	27.93	0.1321	0.471	12.95
32)	839.90	28.98	0.1316	0.472	12.90
33)	899.90	30.00	0.1321	0.471	12.95
34)	959.90	30.98	0.1321	0.471	12.95
35)	1019.92	31.94	0.1321	0.471	12.95

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 18 of 20
Stress increment from 8.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.1326	0.470	13.00
37)	1139.90	33.76	0.1326	0.470	13.00
38)	1199.90	34.64	0.1321	0.471	12.95
39)	1259.90	35.50	0.1321	0.471	12.95
40)	1319.92	36.33	0.1321	0.471	12.95
41)	1379.90	37.15	0.1326	0.470	13.00
42)	1439.90	37.95	0.1326	0.470	13.00
43)	1499.90	38.73	0.1316	0.472	12.90
44)	1559.90	39.50	0.1321	0.471	12.95
45)	1619.92	40.25	0.1321	0.471	12.95
46)	1679.90	40.99	0.1316	0.472	12.90
47)	1739.90	41.71	0.1321	0.471	12.95
48)	1799.90	42.43	0.1321	0.471	12.95
49)	1859.90	43.13	0.1326	0.470	13.00
50)	1919.90	43.82	0.1321	0.471	12.95
51)	1979.90	44.50	0.1321	0.471	12.95
52)	2039.90	45.17	0.1321	0.471	12.95
53)	2099.90	45.82	0.1326	0.470	13.00
54)	2159.90	46.47	0.1321	0.471	12.95
55)	2219.90	47.12	0.1321	0.471	12.95
56)	2279.90	47.75	0.1326	0.470	13.00
57)	2339.90	48.37	0.1321	0.471	12.95
58)	2399.90	48.99	0.1321	0.471	12.95
59)	2459.90	49.60	0.1321	0.471	12.95
60)	2519.88	50.20	0.1321	0.471	12.95
61)	2579.90	50.79	0.1316	0.472	12.90
62)	2639.88	51.38	0.1316	0.472	12.90
63)	2699.90	51.96	0.1316	0.472	12.90
64)	2759.90	52.53	0.1321	0.471	12.95
65)	2818.38	53.09	0.1316	0.472	12.90

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 19 of 20
Stress increment from 4.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1290	0.476	12.65
2)	0.17	0.41	0.1285	0.477	12.60
3)	0.40	0.63	0.1285	0.477	12.60
4)	0.88	0.94	0.1285	0.477	12.60
5)	1.88	1.37	0.1280	0.478	12.55
6)	2.90	1.70	0.1280	0.478	12.55
7)	3.92	1.98	0.1275	0.479	12.50
8)	4.90	2.21	0.1275	0.479	12.50
9)	5.88	2.43	0.1275	0.479	12.50
10)	6.88	2.62	0.1270	0.480	12.45
11)	7.90	2.81	0.1275	0.479	12.50
12)	8.90	2.98	0.1270	0.480	12.45
13)	9.90	3.15	0.1270	0.480	12.45
14)	14.90	3.86	0.1270	0.480	12.45
15)	29.88	5.47	0.1265	0.480	12.40
16)	59.90	7.74	0.1265	0.480	12.40
17)	89.90	9.48	0.1260	0.481	12.35
18)	119.90	10.95	0.1260	0.481	12.35
19)	149.93	12.24	0.1260	0.481	12.35
20)	179.88	13.41	0.1260	0.481	12.35
21)	209.90	14.49	0.1260	0.481	12.35
22)	239.92	15.49	0.1260	0.481	12.35
23)	299.90	17.32	0.1260	0.481	12.35
24)	359.88	18.97	0.1255	0.482	12.30
25)	419.90	20.49	0.1255	0.482	12.30
26)	479.88	21.91	0.1255	0.482	12.30
27)	539.95	23.24	0.1255	0.482	12.30
28)	599.88	24.49	0.1255	0.482	12.30
29)	659.90	25.69	0.1255	0.482	12.30
30)	719.88	26.83	0.1255	0.482	12.30
31)	779.90	27.93	0.1255	0.482	12.30
32)	839.88	28.98	0.1255	0.482	12.30
33)	899.90	30.00	0.1255	0.482	12.30
34)	959.88	30.98	0.1255	0.482	12.30
35)	1019.90	31.94	0.1255	0.482	12.30

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 19 of 20
Stress increment from 4.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.1255	0.482	12.30
37)	1139.92	33.76	0.1255	0.482	12.30
38)	1199.88	34.64	0.1255	0.482	12.30
39)	1259.90	35.50	0.1255	0.482	12.30
40)	1319.88	36.33	0.1250	0.483	12.25
41)	1379.90	37.15	0.1255	0.482	12.30
42)	1410.45	37.56	0.1255	0.482	12.30

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW987-ST-3, 2.0'-4.0'
Project No.: 183923
Boring No.: GW987-ST-3
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW987-ST-3
Test Date : 3-15-18
Depth : 2.8'-3.0'
Test No. : GW987-ST-3
Sample Type: Undisturb

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 20 of 20
Stress increment from 2.00 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1234	0.486	12.10
2)	0.17	0.41	0.1229	0.486	12.05
3)	0.42	0.65	0.1229	0.486	12.05
4)	0.92	0.96	0.1224	0.487	12.00
5)	1.90	1.38	0.1224	0.487	12.00
6)	2.92	1.71	0.1224	0.487	12.00
7)	3.92	1.98	0.1219	0.488	11.95
8)	4.92	2.22	0.1219	0.488	11.95
9)	5.90	2.43	0.1214	0.489	11.90
10)	6.90	2.63	0.1214	0.489	11.90
11)	7.92	2.81	0.1214	0.489	11.90
12)	8.92	2.99	0.1219	0.488	11.95
13)	9.92	3.15	0.1214	0.489	11.90
14)	14.92	3.86	0.1214	0.489	11.90
15)	29.92	5.47	0.1209	0.490	11.85
16)	59.92	7.74	0.1204	0.491	11.80
17)	89.93	9.48	0.1204	0.491	11.80
18)	119.90	10.95	0.1199	0.491	11.75
19)	149.90	12.24	0.1204	0.491	11.80
20)	179.90	13.41	0.1193	0.492	11.70
21)	209.93	14.49	0.1199	0.491	11.75
22)	239.95	15.49	0.1199	0.491	11.75
23)	299.93	17.32	0.1199	0.491	11.75
24)	359.92	18.97	0.1199	0.491	11.75
25)	419.92	20.49	0.1199	0.491	11.75
26)	479.92	21.91	0.1193	0.492	11.70
27)	539.92	23.24	0.1193	0.492	11.70
28)	599.92	24.49	0.1193	0.492	11.70
29)	659.92	25.69	0.1193	0.492	11.70
30)	719.90	26.83	0.1193	0.492	11.70
31)	779.95	27.93	0.1193	0.492	11.70
32)	839.90	28.98	0.1193	0.492	11.70
33)	899.92	30.00	0.1193	0.492	11.70
34)	959.90	30.98	0.1193	0.492	11.70
35)	1019.93	31.94	0.1193	0.492	11.70

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW987-ST-3 .
Sample No.: GW987-ST-3
Test No. : GW987-ST-3

Location : GW987-ST-3, 2.0'-4.0'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 2.8'-3.0'

Soil Description : red/brown silty clay and sand (visual description)
Remarks : Use: Foundation berm/fill

Load Increment : 20 of 20
Stress increment from 2.00 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.92	32.86	0.1193	0.492	11.70
37)	1139.92	33.76	0.1193	0.492	11.70
38)	1199.92	34.64	0.1193	0.492	11.70
39)	1259.92	35.50	0.1193	0.492	11.70
40)	1319.90	36.33	0.1193	0.492	11.70
41)	1379.93	37.15	0.1193	0.492	11.70
42)	1417.50	37.65	0.1183	0.494	11.60

BOWSER-MORNER, INC.
Delivery Address: 4518 Taylorsville Road • Dayton, Ohio 45424 **Mailing Address**: P. O. Box 51 • Dayton, Ohio 45401
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LABORATORY REPORT

Report To: CTI & Associates, Inc.
Attn: Michael Partenio
28001 Cabot Drive, Ste. 250
Novi, MI 48377

Report Date: April 17, 2018
Job No.: 183923
Report No.: 430213
No. of Pages: 2

Report On: Laboratory Analysis of One Shelby Tube Sample
Project: EMDF Characterization – Project No. 1188070011
Sample ID: GW979 – ST-1, 3.0'-5.0' – Sample Date: 2/21/18

On March 5, 2018, one Shelby tube sample was submitted for determination of atterberg limits from the above referenced project. Testing was performed as specified by the client and in accordance with the following procedures:

ASTM D 1140, "Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing".

ASTM D 4318, "Liquid Limit, Plastic Limit, and Plasticity Index of Soils".

Results are presented in the following table and detailed on the attached data sheet.

Test Parameter	Results
Liquid Limit:	**48**
Plastic Limit:	**29**
Plasticity Index:	**19**
Percent Finer than No. 200 Sieve:	**73.3**

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805, extension 322.

Respectfully submitted,
BOWSER-MORNER, INC.

Karl A. Fletcher, Manager
Construction Materials and
Geotechnical Laboratories

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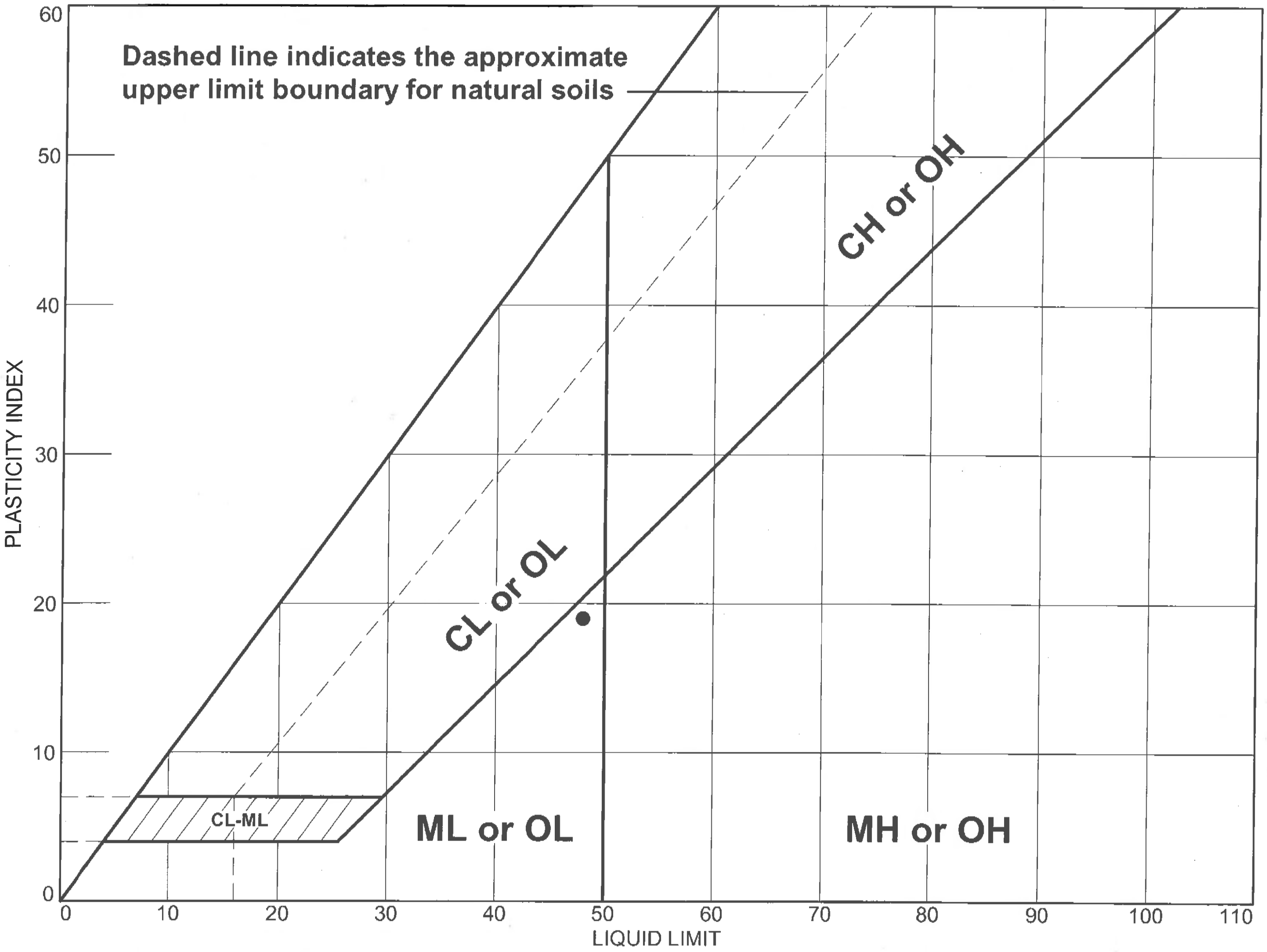
LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	GW979-ST-1	48	29	19			

Project No. 183923 **Client:** CTI and Associates, Inc.

Project: EMDF Characterization

● **Source of Sample:** GW-979 **Depth:** 3.0' - 5.0' **Sample Number:** ST-1

Remarks:

BOWSER-MORNER, INC.

Dayton, Ohio

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LABORATORY REPORT

Report To:
CTI & Associates, Inc.
Attn: Michael Partenio
28001 Cabot Drive, Ste. 250
Novi, MI 48377

Report Date: May 3, 2018
Job No.: 183923
Report No.: 430246
No. of Pages: 2

Report On:
Laboratory Analysis of One Shelby Tube Sample
Project: EMDF Characterization – Project No. 1188070011
Sample ID: GW993 – ST-1, 3.0'-5.0' – Sample Date: 2/22/18

On March 5, 2018, one Shelby tube sample was submitted for selected laboratory analysis from the above referenced project. Testing was performed as specified by the client and in accordance with the ASTM D 4318, "Liquid Limit, Plastic Limit, and Plasticity Index of Soils".

Results are presented in the following table and detailed on the attached data sheet.

Test Parameter	Results
Liquid Limit:	**35**
Plastic Limit:	**23**
Plasticity Index:	**12**

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805, extension 322.

Respectfully submitted,

BOWSER-MORNER, INC.

Karl A. Fletcher, Manager
Construction Materials and
Geotechnical Laboratories

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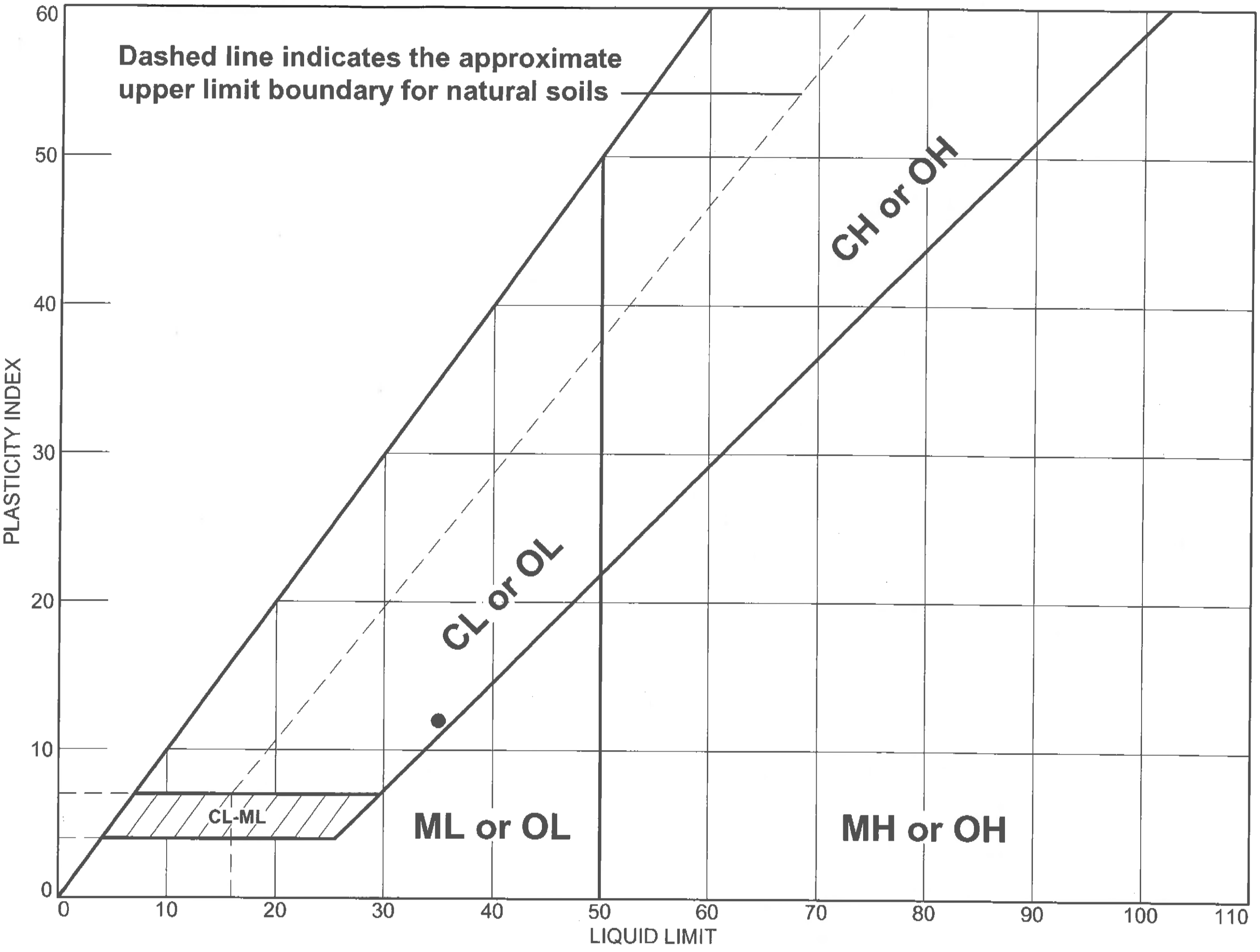
LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	brown clay, little gravel (visual description)	35	23	12			

Project No. 183923 **Client:** CTI and Associates, Inc.

Project: EMDF Characterization

● **Source of Sample:** GW-993 **Depth:** 3.0' - 5.0' **Sample Number:** ST-1

Remarks:

● As Received
Moisture Content: 25.4%

BOWSER-MORNER, INC.

Dayton, Ohio E-136

BOWSER-MORNER, INC.

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LABORATORY REPORT

Report To: CTI & Associates, Inc.
Attn: Michael Partenio
28001 Cabot Drive, Ste. 250
Novi, MI 48377

Report Date: May 22, 2018
Job No.: 183923
Report No.: 430273
No. of Pages: 2

Report On: Laboratory Analysis of One Shelby Tube Sample
Project: EMDF Characterization – Project No. 1188070011
Sample ID: GW979 – ST-2, 7.5'-8.75' – Sample Date: 2/21/18
Depth of Test Specimen: 8.2'-8.5'

On March 5, 2018, one Shelby tube sample was submitted for laboratory determination of permeability. Testing was performed as specified by the client and in accordance with ASTM D 5084, "Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter".

Results are presented in the following table.

Test Parameter	Results
Average Permeability, cm/sec:	**1.7×10^{-7}**

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805, extension 322.

Respectfully submitted,
BOWSER-MORNER, INC.

Karl A. Fletcher, Manager
Construction Materials and
Geotechnical Laboratories

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FALLING HEAD PERMEABILITY TEST

ASTM D 5084, Measurement of Hydraulic Conductivity

UNDISTURBED

Client:	**CTI and Associates, Inc.**
Project:	**EMDF Characterization**
BMI Work Order Number:	183923
Sample Identification:	GW979 ST-2, 7.5' - 8.75'
Depth, ft:	8.2' - 8.5'
Visual Description:	brown silty clay

SPECIMEN DATA:

Dimension, inches	
Height:	2.99
Diameter:	2.883
Mass, lbs:	1.428
Moisture Content,%	
Initial:	21.8
Final:	24.4
Wet Unit Weight, pcf	
Initial:	126.4
Final:	129.1
Initial Dry Unit Weight, pcf:	103.8
Back Pressure Saturation, psi	
Back Pressure, Exit:	60
Back Pressure, Enter:	63
Lateral Pressure:	67

Permeability (k), cm/sec: **1.7×10^{-7}**

May 22, 2018

BOWSER-MORNER, INC.

Delivery Address: 4518 Taylorsville Road • Dayton, Ohio 45424 **Mailing Address**: P. O. Box 51 • Dayton, Ohio 45401

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LABORATORY REPORT

Report To:	CTI & Associates, Inc. Attn: Michael Partenio 28001 Cabot Drive, Ste. 250 Novi, MI 48377	**Report Date:** **Job No.:** **Report No.:** **No. of Pages:**	May 7, 2018 183923 430253 4

Report On: Laboratory Analysis of One Shelby Tube Sample
Project: EMDF Characterization – Project No. 1188070011
Sample ID: GW989-ST-4, 14.5'-16.5' – Sample Date: 2/27/18

On March 5, 2018, one Shelby tube sample was submitted for selected laboratory analysis from the above referenced project. Testing was performed as specified by the client and in accordance with the following procedures:

ASTM D 2216, "Laboratory Determination of Water (Moisture) Content of Soil and Rock".

ASTM D 6913, "Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis".

Results are summarized in Table I and detailed on the attached data sheets.

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805, extension 322.

Respectfully submitted,

BOWSER-MORNER, INC.

Karl A. Fletcher, Manager
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Report To: CTI & Associates, Inc.
Project: EMDF Characterization
Sample No.: GW989-ST-4, 14.5'-16.6'

BMI Job No.: 183923
BMI Report No.: 430253
Date Sampled: 02/27/18

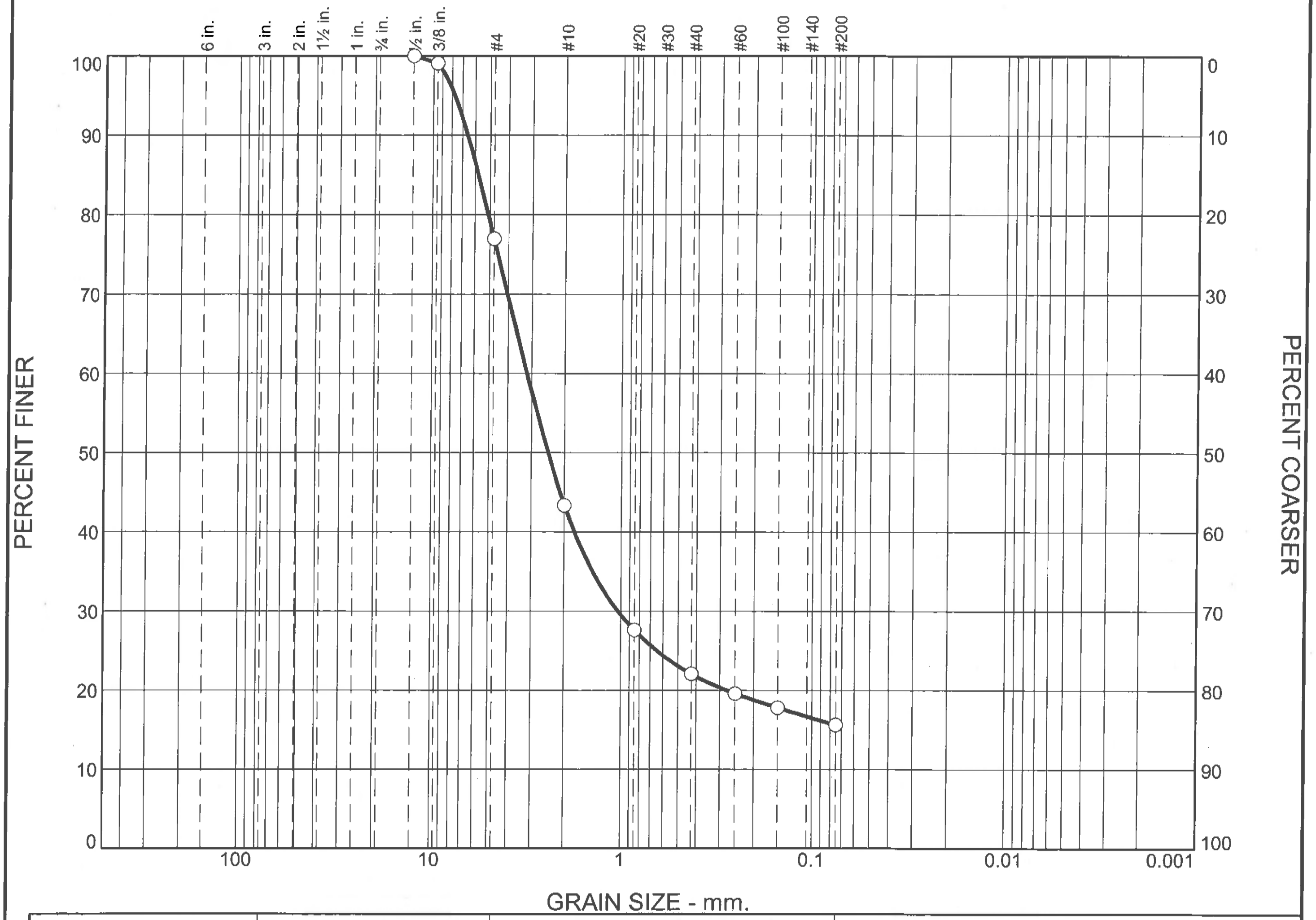
Sample ID: **GW989-ST-4, 14.5'-16.6'**

Description: **Saprolite**

TABLE I
Summary of Results

Sieve Size	Percent Passing
1/2"	**100.0**
3/8"	**99.1**
No. 4	**77.0**
No. 10	**43.4**
No. 20	**27.6**
No. 40	**22.1**
No. 60	**19.6**
No. 100	**17.8**
No. 200	**15.6**
Gravel, %:	**23.0**
Sand, %:	**61.4**
Fines, %:	**15.6**
As Received Moisture Content, %:	**14.9**

GRAIN SIZE DISTRIBUTION REPORT



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	23.0	33.6	21.3	6.5	15.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			5.7655	3.1778	2.4480	1.0368				

Material Description	USCS	AASHTO
○ Saprolite		

Project No. 183923 **Client:** CTI and Associates, Inc.
Project: EMDF Characterization

○ **Source:** GW-989 **Depth:** 14.5' - 16.5' **Sample No.:** ST-4

Remarks:
○ As Received
Moisture Content: 14.9%

BOWSER-MORNER, INC.

Dayton, Ohio

GRAIN SIZE DISTRIBUTION TEST DATA

5/7/2018

Client: CTI and Associates, Inc.
Project: EMDF Characterization
Project Number: 183923
Location: GW-989
Depth: 14.5' - 16.5'
Sample Number: ST-4
Material Description: Saprolite
Testing Remarks: As Received
Moisture Content: 14.9%

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
932.90	228.22	0.00	0.50	0.00	100.0	0.0
			0.375	6.60	99.1	0.9
			#4	162.34	77.0	23.0
			#10	398.89	43.4	56.6
			#20	510.01	27.6	72.4
			#40	549.08	22.1	77.9
			#60	566.57	19.6	80.4
			#100	579.07	17.8	82.2
			#200	594.40	15.6	84.4

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	23.0	23.0	33.6	21.3	6.5	61.4			15.6

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.2765	1.0368	1.7678	2.4480	3.1778	5.1031	5.7655	6.5876	7.7351

Fineness Modulus
3.81

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LABORATORY REPORT

Report To: CTI & Associates, Inc.
Attn: Michael Partenio
28001 Cabot Drive, Ste. 250
Novi, MI 48377

Report Date: April 11, 2018
Job No.: 183923
Report No.: 430201
No. of Pages: 1

Report On: Laboratory Analysis of One Shelby Tube Sample
Project: EMDF Characterization – Project No. 1188070011
Sample ID: GW987 – ST-3, 2.0'-4.0' – Sample Date: 2/21/18

On March 5, 2018, one Shelby tube sample was submitted for selected laboratory analysis from the above referenced project. Testing was performed as specified by the client and in accordance with the following procedures:

ASTM D 854, "Specific Gravity of Soils Solids by Water Pycnometer".
ASTM D 2216, "Laboratory Determination of Water (Moisture) Content of Soil and Rock".
ASTM D 7263, "Laboratory Determination of Density (Unit Weight) of Soil Specimens – Method B".

Results are summarized in the following table.

Test Parameter	Results
Depth of Test Specimen:	**2.0'-2.5'**
As Received Moisture Content, %:	**20.7**
Apparent Specific Gravity:	**2.69**
Wet Unit Weight, pcf:	**128.5**
Dry Unit Weight, pcf:	**106.4**
Void Ratio:	**0.5764**
Porosity, %:	**36.6**
Degree of Saturation, %:	**96.5**
Volume of Water, %:	**35.3**
Volume of Solids, %:	**63.4**
Air Filled Voids, %:	**3.5**
Water Filled Voids, %:	**96.5**

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805, extension 322.

Respectfully submitted,
BOWSER-MORNER, INC.

Karl A. Fletcher, Manager
Construction Materials and
Geotechnical Laboratories

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LABORATORY REPORT

Report To:	CTI & Associates, Inc. Attn: Michael Partenio 28001 Cabot Drive, Ste. 250 Novi, MI 48377	**Report Date:** **Job No.:** **Report No.:** **No. of Pages:**	May 22, 2018 183923 430274 2

Report On: Laboratory Analysis of One Shelby Tube Sample
Project: EMDF Characterization – Project No. 1188070011
Sample ID: GW989 – ST-2, 6.5'-8.5' – Sample Date: 2/27/18
Depth of Test Specimen: 7.3'-7.6'

On March 5, 2018, one Shelby tube sample was submitted for laboratory determination of permeability. Testing was performed as specified by the client and in accordance with ASTM D 5084, "Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter".

Results are presented in the following table.

Test Parameter	Results
Average Permeability, cm/sec:	**6.6×10^{-8}**

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805, extension 322.

Respectfully submitted,
BOWSER-MORNER, INC.

Karl A. Fletcher, Manager
Construction Materials and
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FALLING HEAD PERMEABILITY TEST

ASTM D 5084, Measurement of Hydraulic Conductivity

UNDISTURBED

Client: **CTI and Associates, Inc.**

Project: **EMDF Characterization**

BMI Work Order Number: 183923

Sample Identification: GW989 ST-2, 6.5' - 8.5'

Depth, ft: 7.3' - 7.6'

Visual Description: brown silty clay

SPECIMEN DATA:

Dimension, inches
  Height: 3.008
  Diameter: 2.86

Mass, lbs: 1.355

Moisture Content,%
  Initial: 28.0
  Final: 30.0

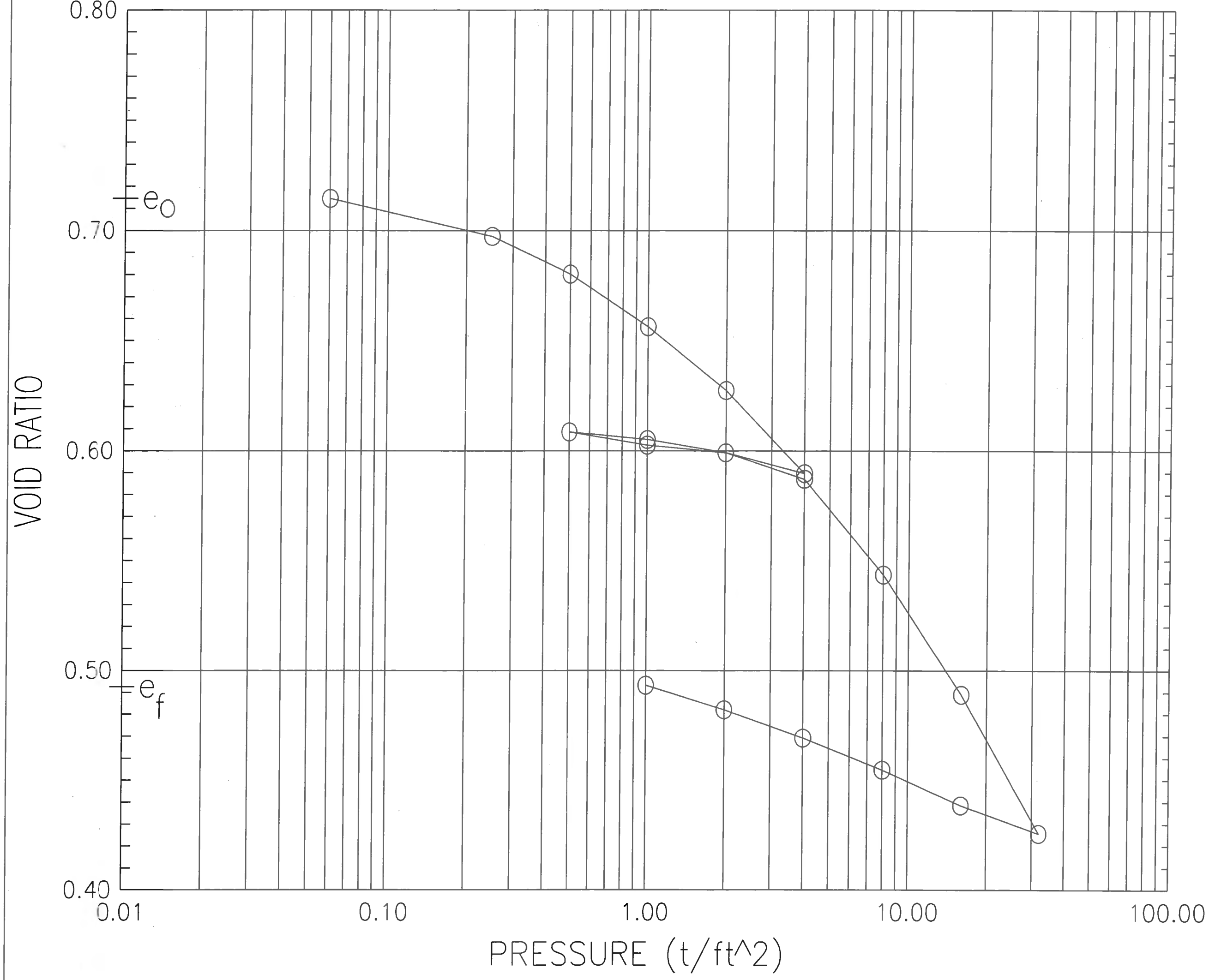
Wet Unit Weight, pcf
  Initial: 121.2
  Final: 123.1

Initial Dry Unit Weight, pcf: 94.7

Back Pressure Saturation, psi
  Back Pressure, Exit: 60
  Back Pressure, Enter: 63
  Lateral Pressure: 67

Permeability (k), cm/sec: **6.6×10^{-8}**

May 22, 2018



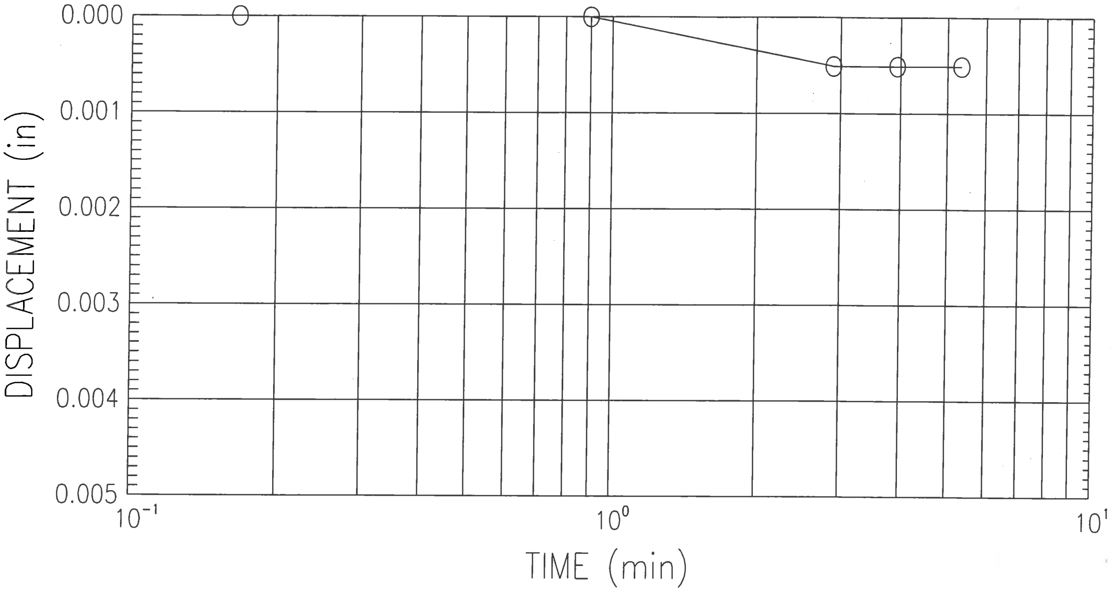
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE (t/ft^2)		WATER CONTENT (%)	26.2	18.0
PRECONSOL. PRESSURE (t/ft^2)		DRY DENSITY (lb/ft^3)	99.50	114.30
COMPRESSION INDEX		SATURATION (%)	100.24	99.61
TYPE SPECIMEN	Undisturb	VOID RATIO	0.72	0.49
DIA. (in) 2.500	HT. (in) 1.020	BACK PRESSURE (t/ft^2)	---	---

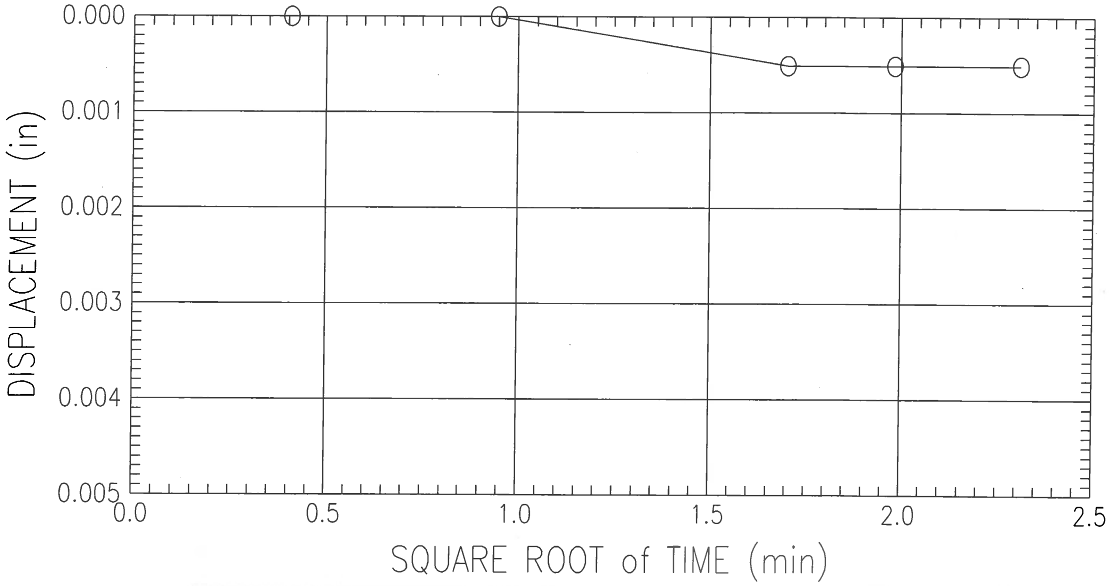
CLASSIFICATION brown clayey silt (visual description)

LL ---	PL ---	PI ---	PROJECT EMDF Characterization	
GS 2.734	D_{10}		993ST1	
REMARKS			BORING NO. GW993-ST-1	SAMPLE NO. GW993-ST-1
Use: Fill, Near foundation/geobuffer layer			DEPTH 3.6'-3.8'	DATE 3-16-18

Bowser Morner
CONSOLIDATION TEST REPORT

CONSOLIDATION TEST
TIME CURVES (STEP 1 OF 20)
STRESS : 0.06 (t/ft^2)





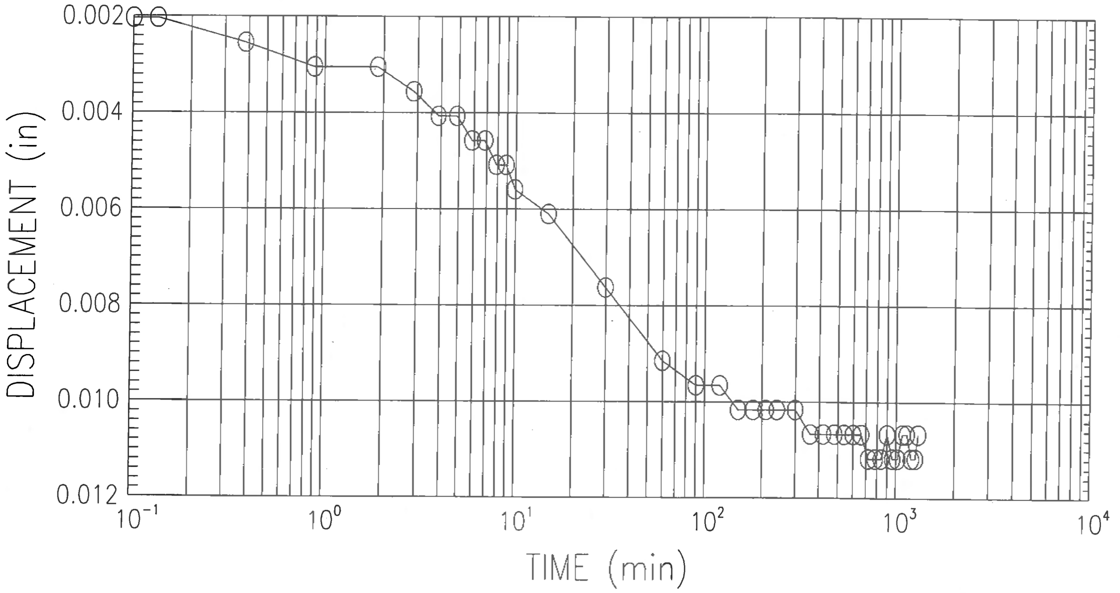
Bowser Morner

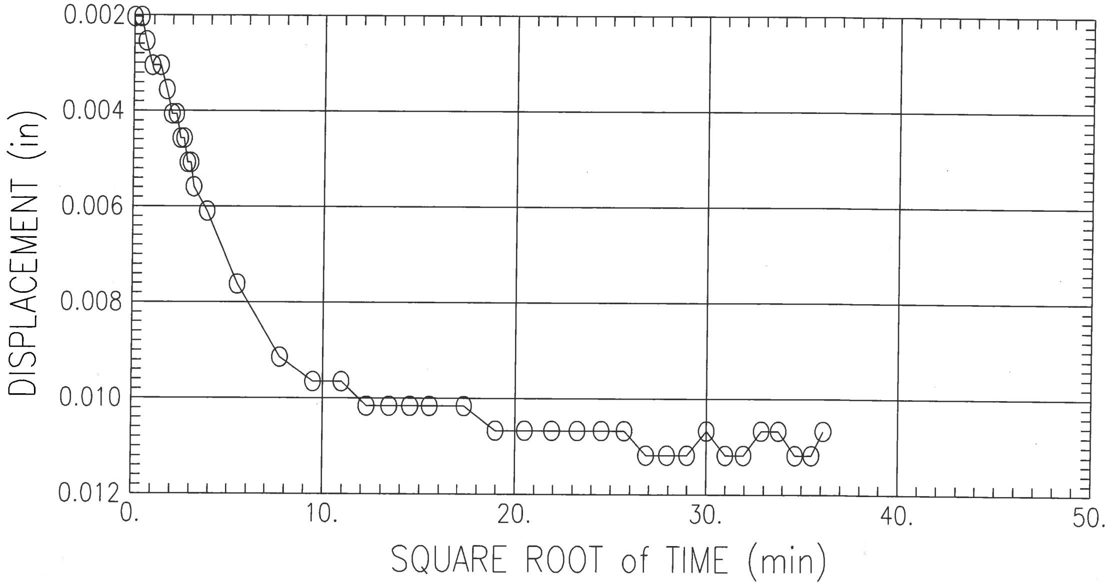
Project Name : EMDF Characterization

Project No : 183923	Boring No : GW993-ST-1	Sample No : GW993-ST-1
Test Date : 3-16-18	Test No : GW993-ST-1	Depth : 3.6'-3.8'

Description : brown clayey silt (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 2 OF 20)
STRESS : 0.25 (t/ft^2)





Bowser Morner

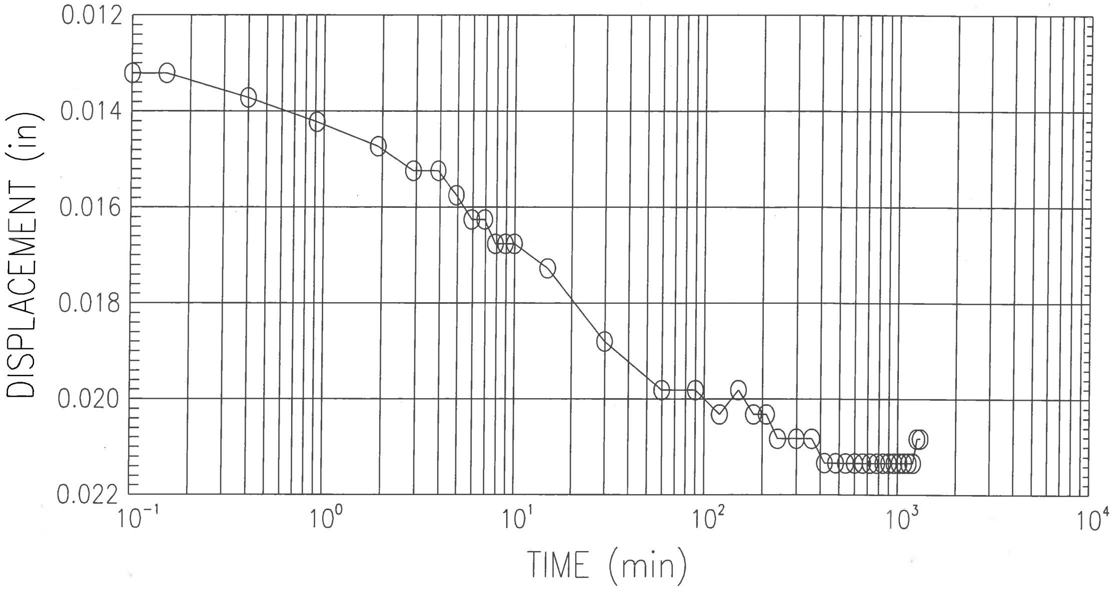
Project Name : EMDF Characterization

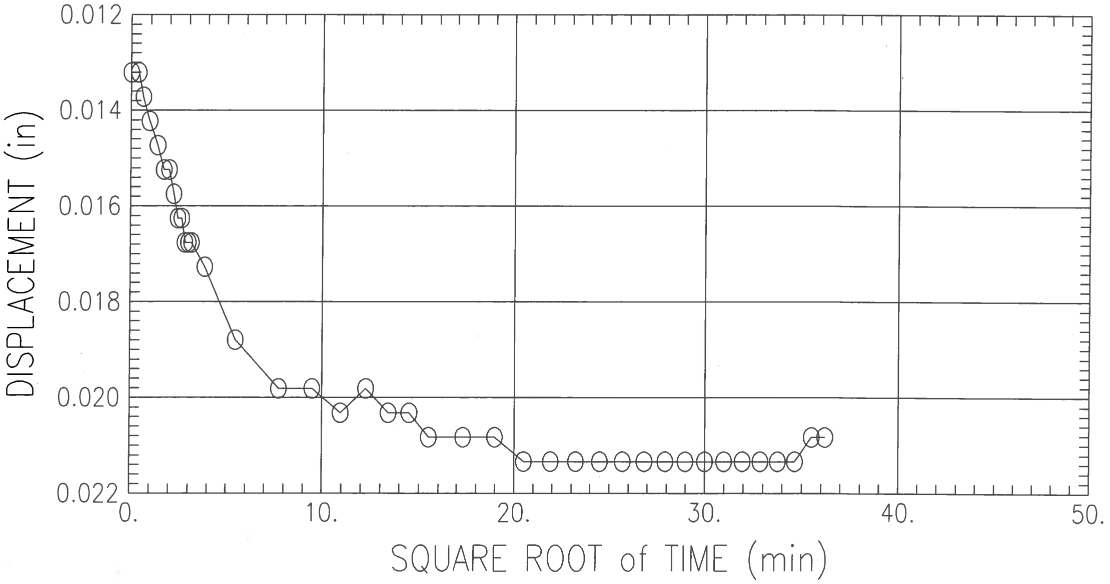
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1

Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'

Description : brown clayey silt (visual description)

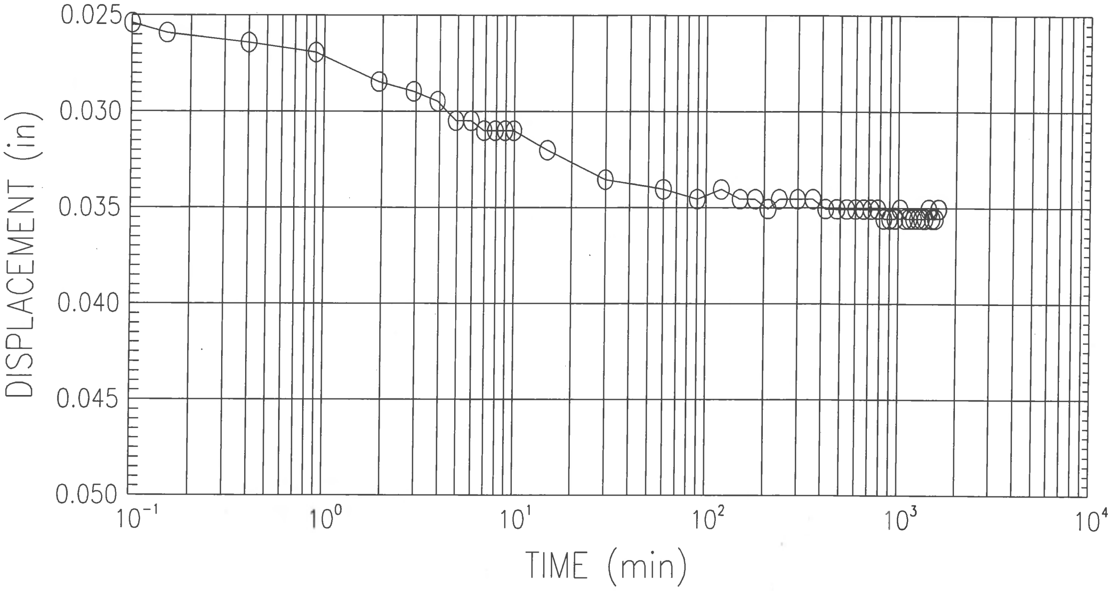
CONSOLIDATION TEST
TIME CURVES (STEP 3 OF 20)
STRESS : 0.5 (t/ft^2)

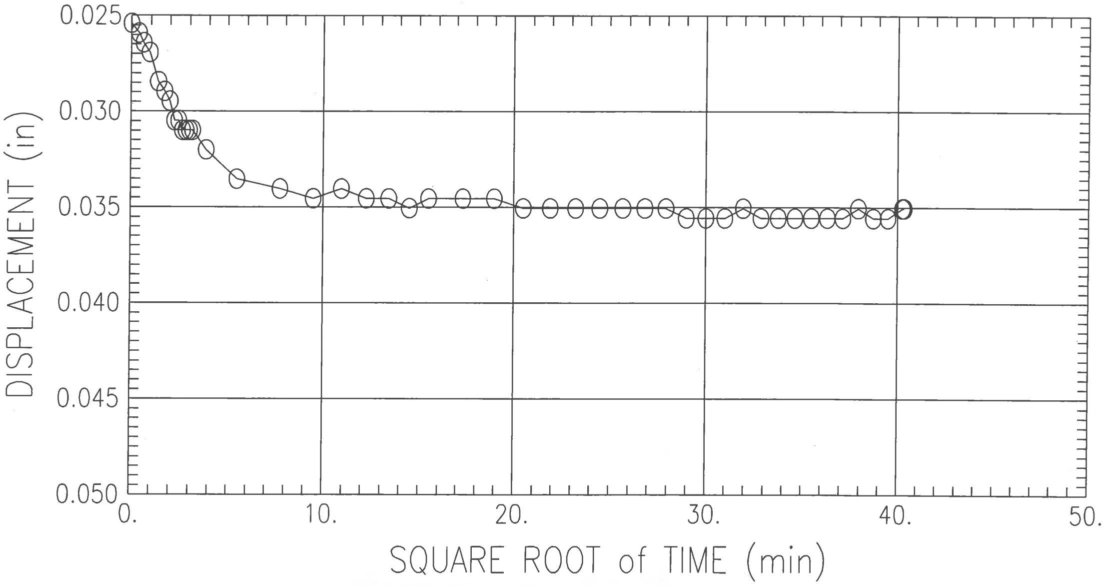




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1
Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'
Description : brown clayey silt (visual description)

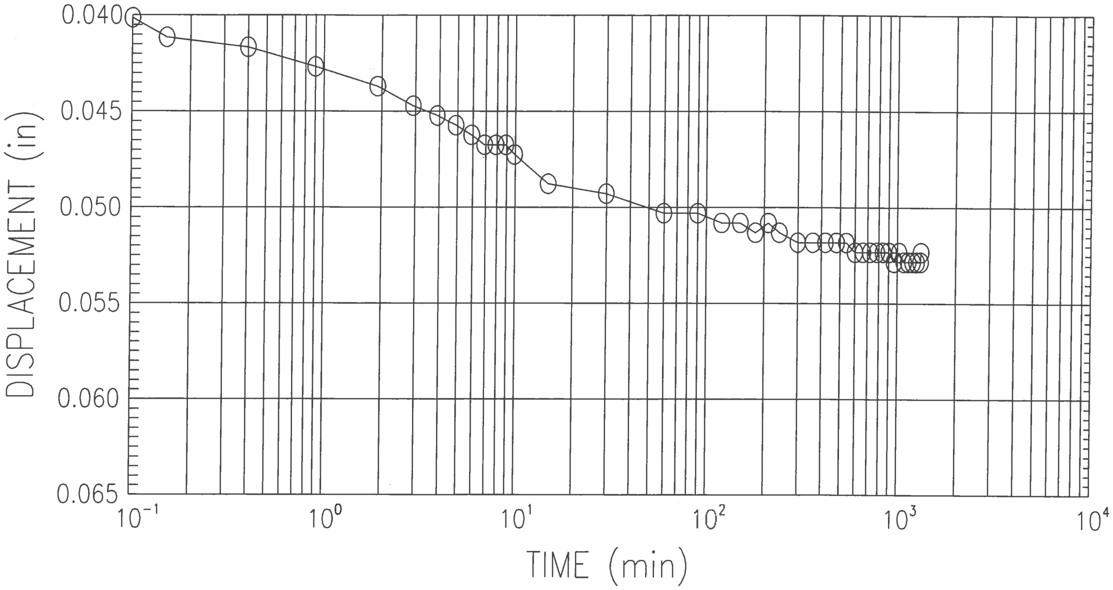
CONSOLIDATION TEST
TIME CURVES (STEP 4 OF 20)
STRESS : 1 (t/ft^2)

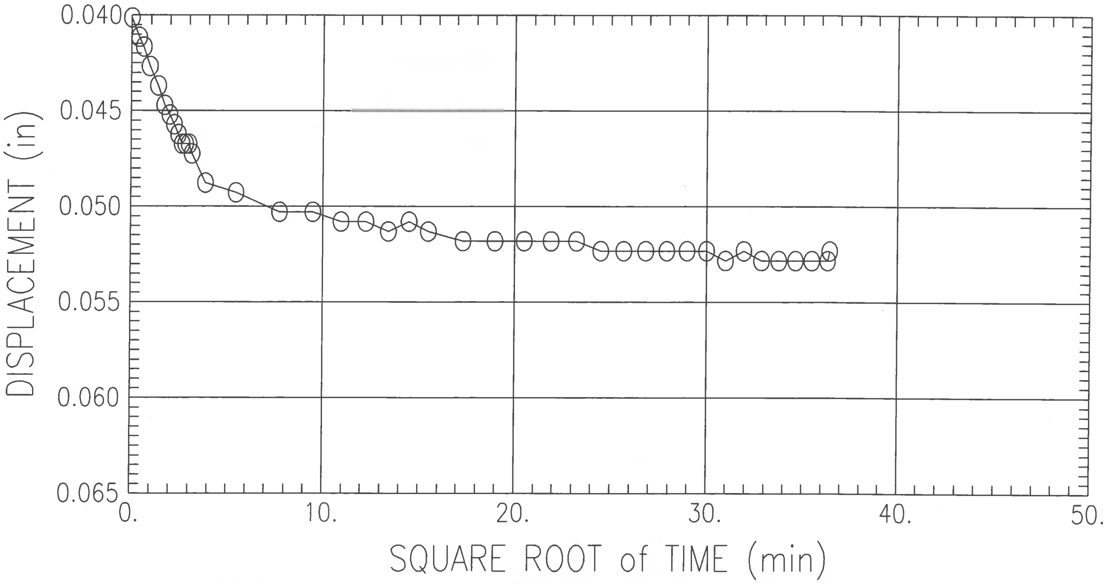




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1
Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'
Description : brown clayey silt (visual description)

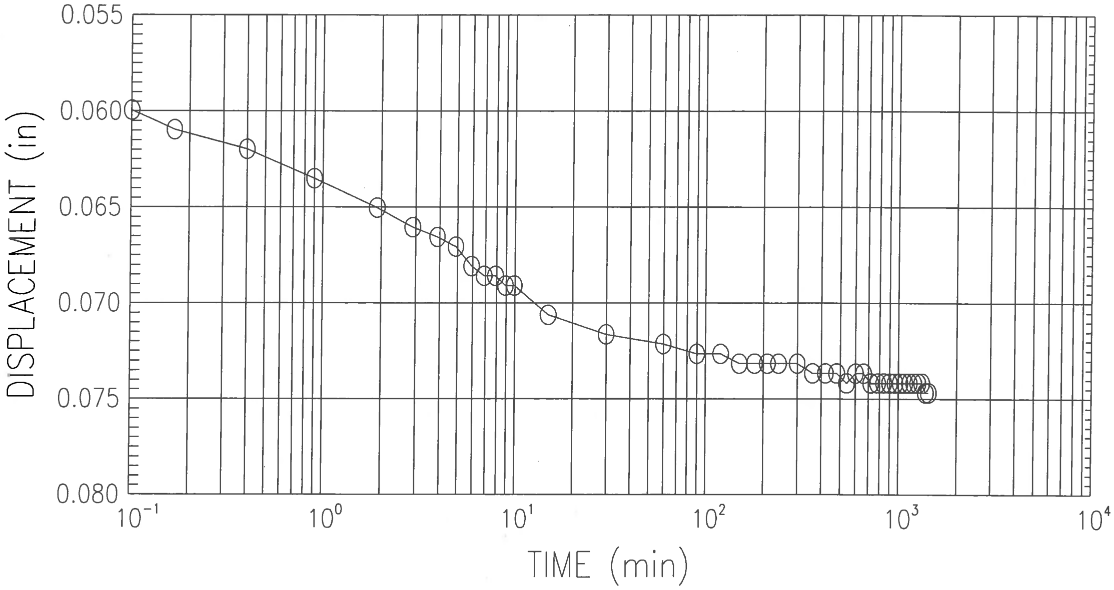
CONSOLIDATION TEST
TIME CURVES (STEP 5 OF 20)
STRESS : 2 (t/ft^2)

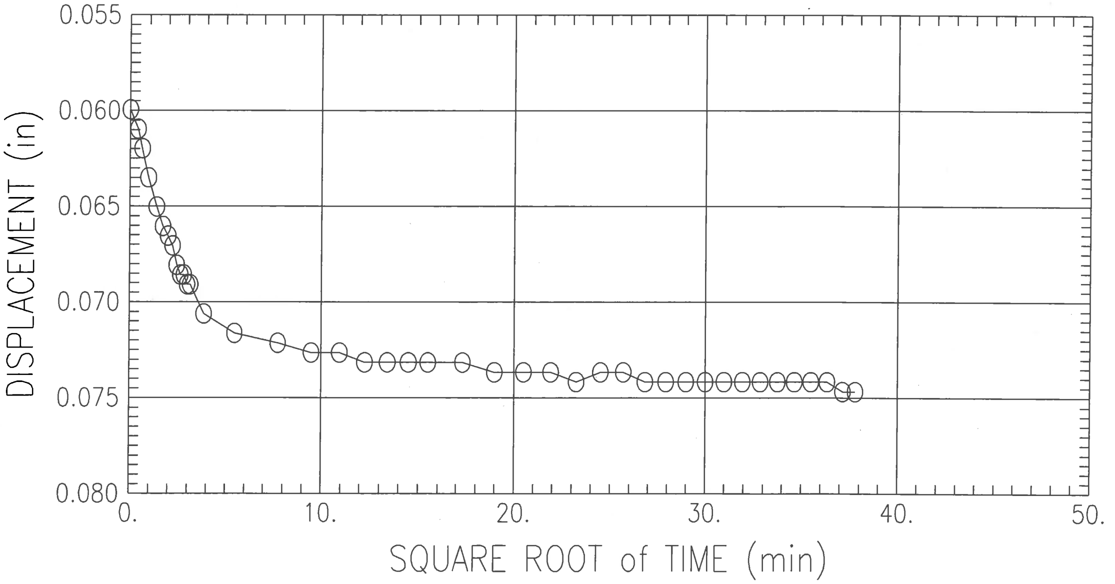




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1
Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'
Description : brown clayey silt (visual description)

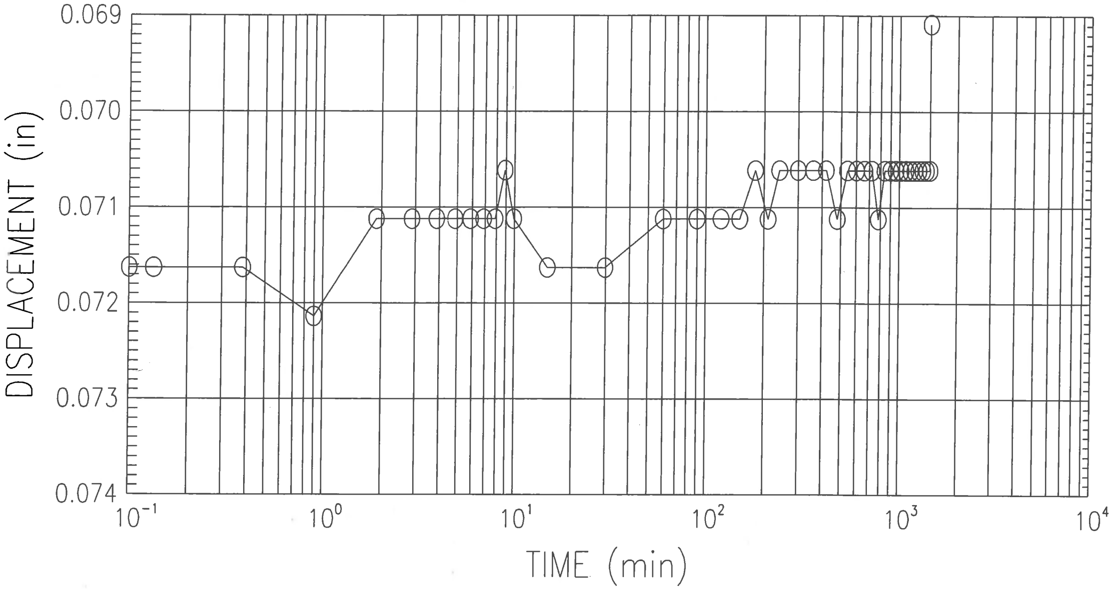
CONSOLIDATION TEST
TIME CURVES (STEP 6 OF 20)
STRESS : 4 (t/ft^2)

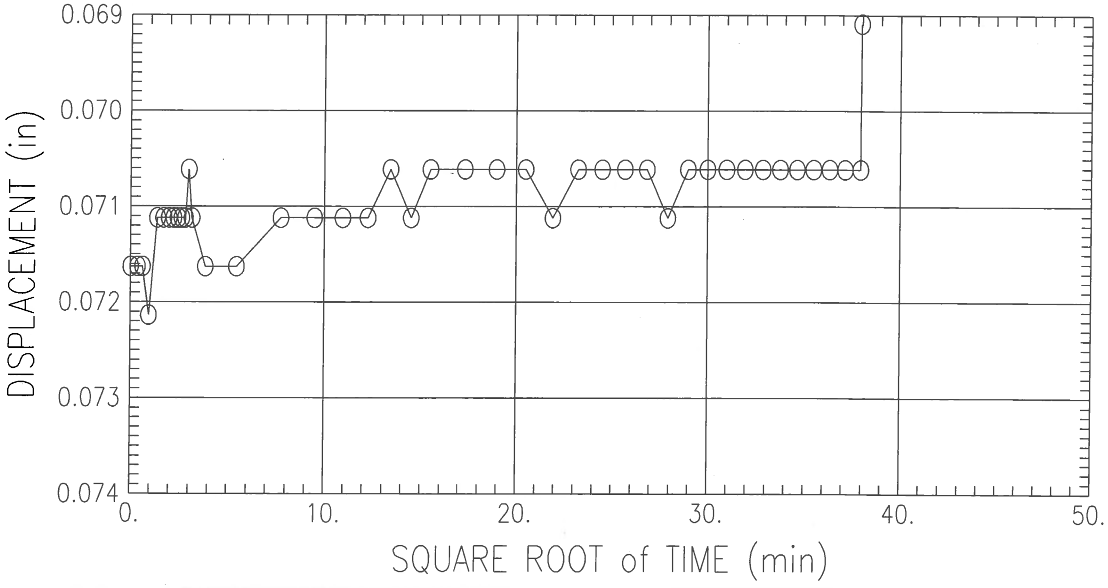




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1
Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'
Description : brown clayey silt (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 7 OF 20)
STRESS : 2 (t/ft^2)





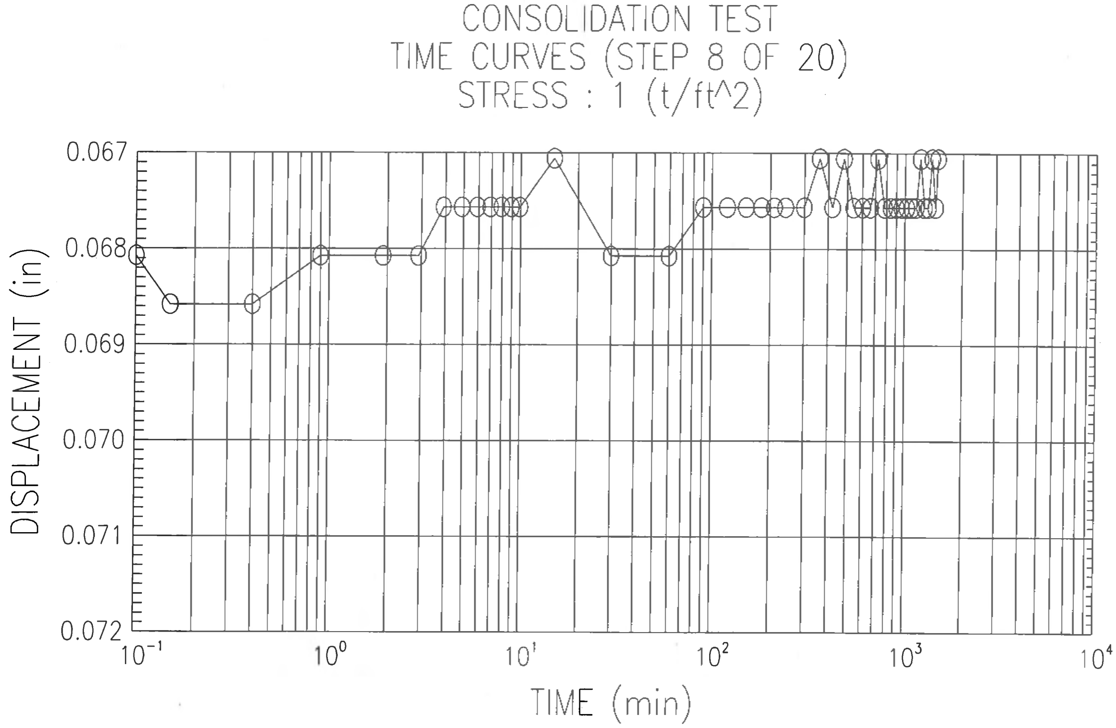
Bowser Morner

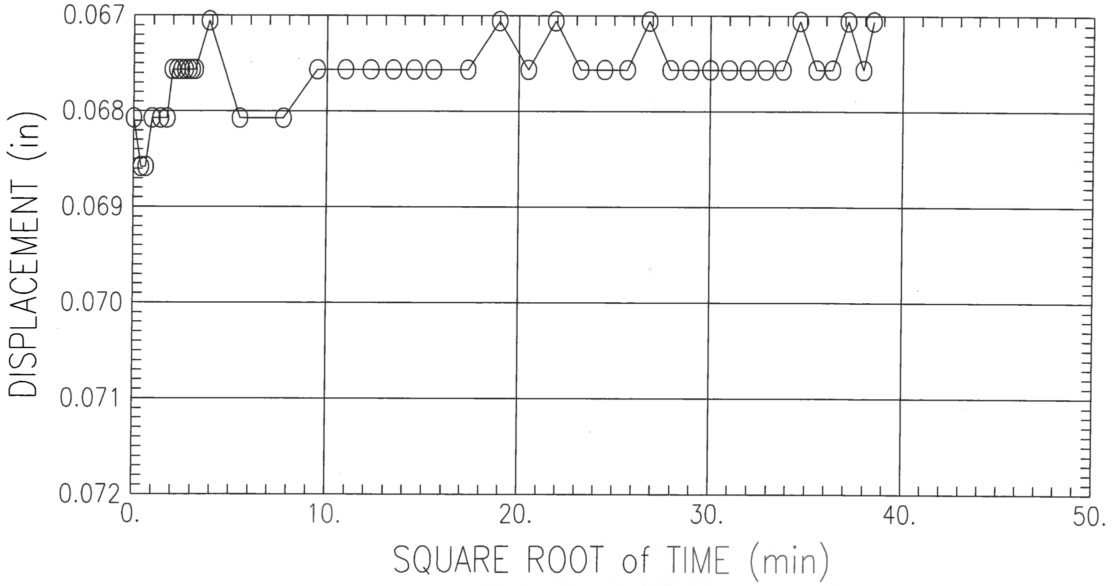
Project Name : EMDF Characterization

Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1

Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'

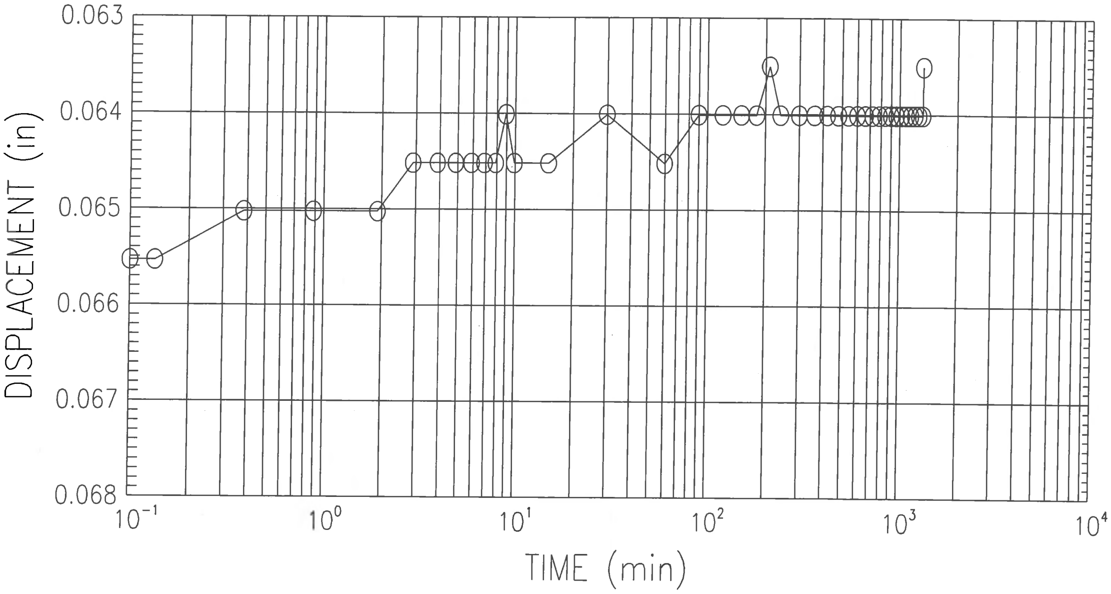
Description : brown clayey silt (visual description)

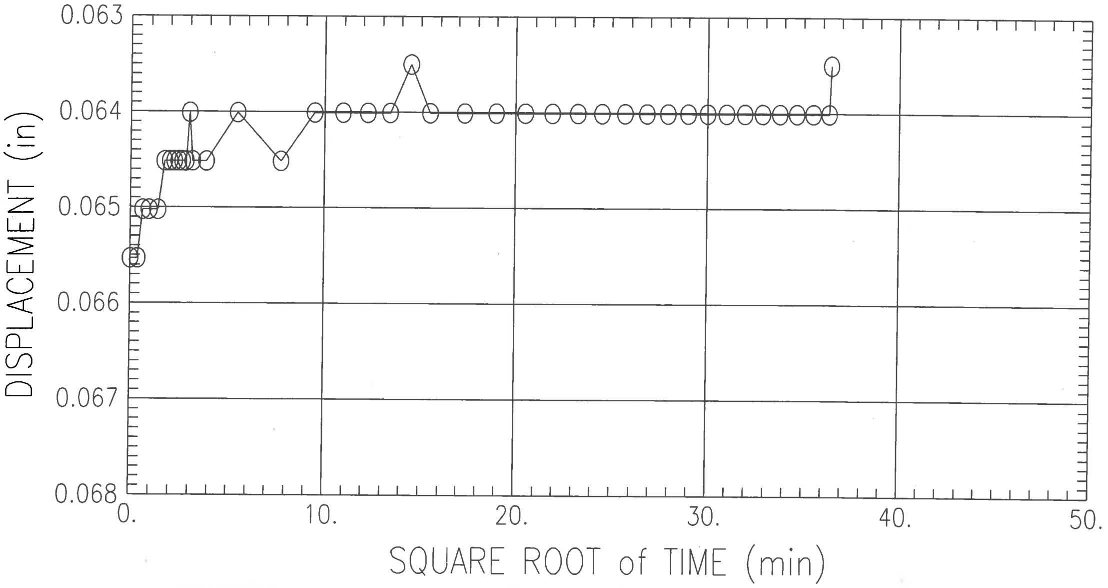




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1
Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'
Description : brown clayey silt (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 9 OF 20)
STRESS : 0.5 (t/ft^2)





Bowser Morner

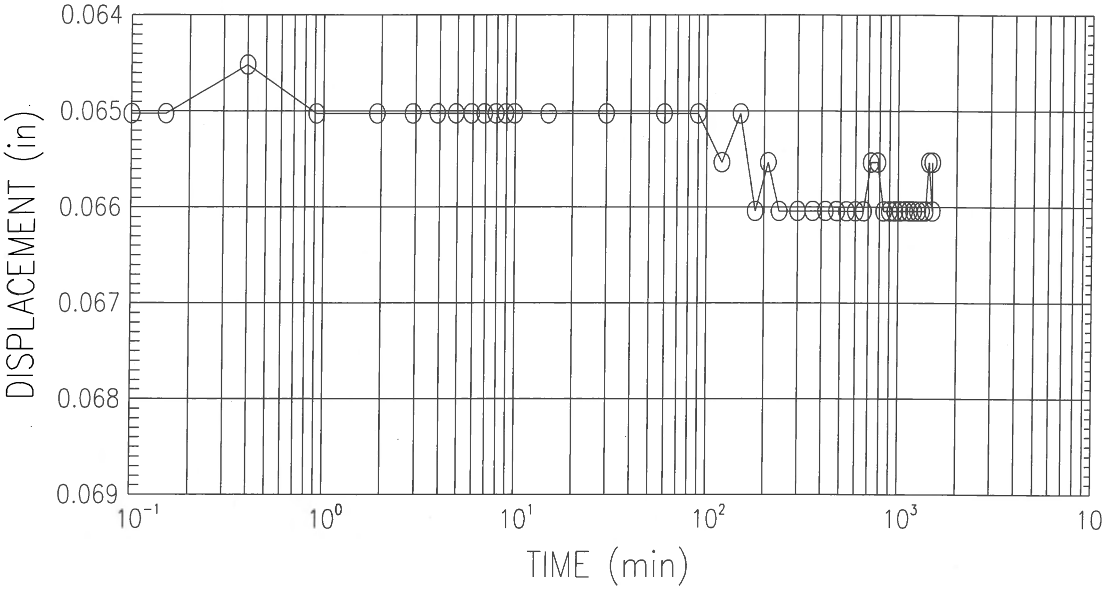
Project Name : EMDF Characterization

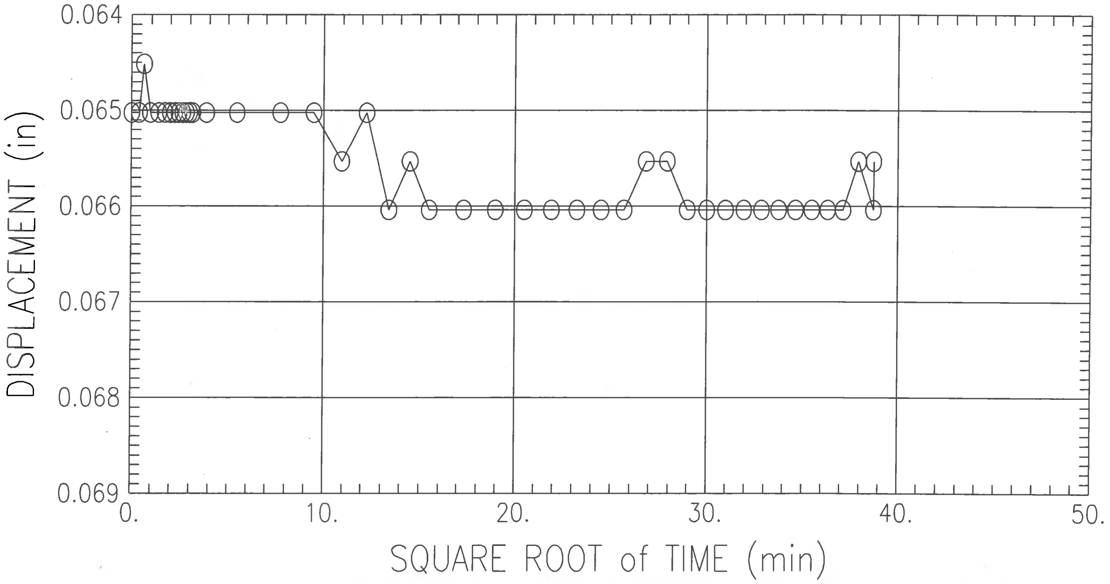
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1

Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'

Description : brown clayey silt (visual description)

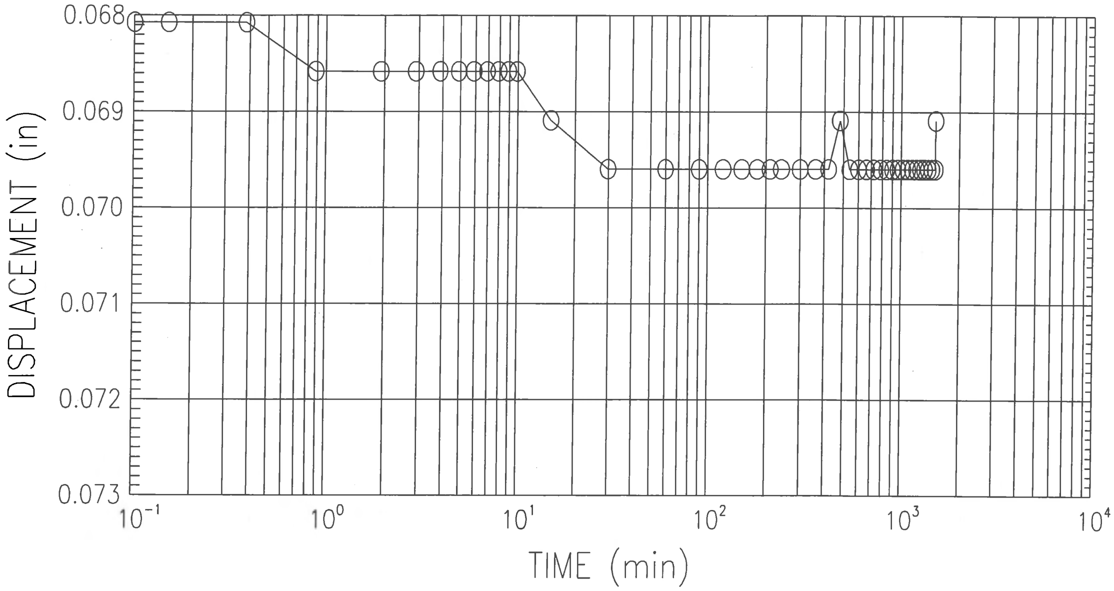
CONSOLIDATION TEST
TIME CURVES (STEP 10 OF 20)
STRESS : 1 (t/ft^2)

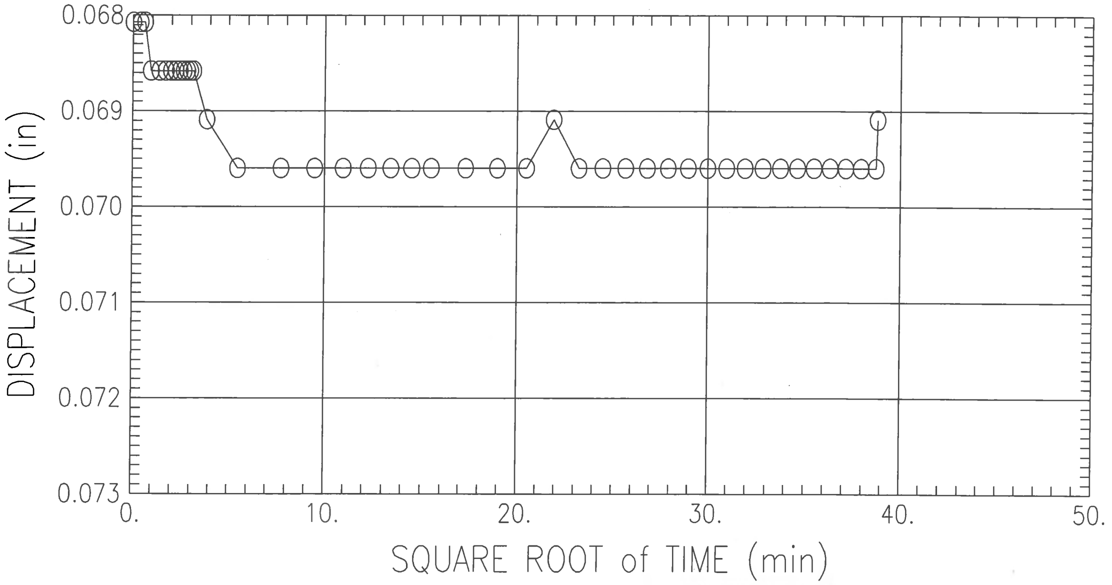




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1
Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'
Description : brown clayey silt (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 11 OF 20)
STRESS : 2 (t/ft^2)





Bowser Morner

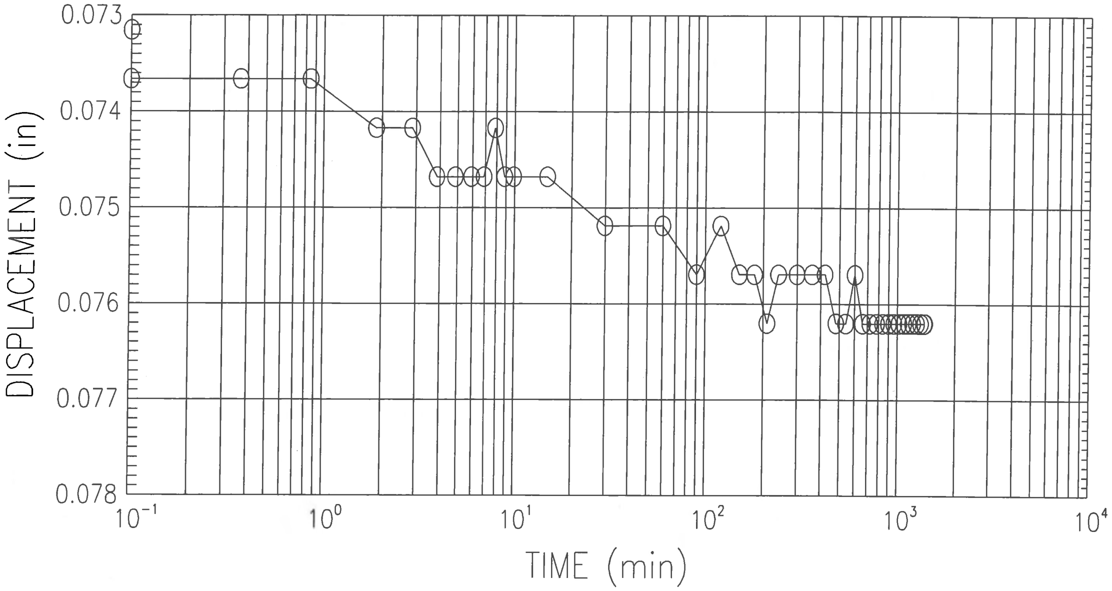
Project Name : EMDF Characterization

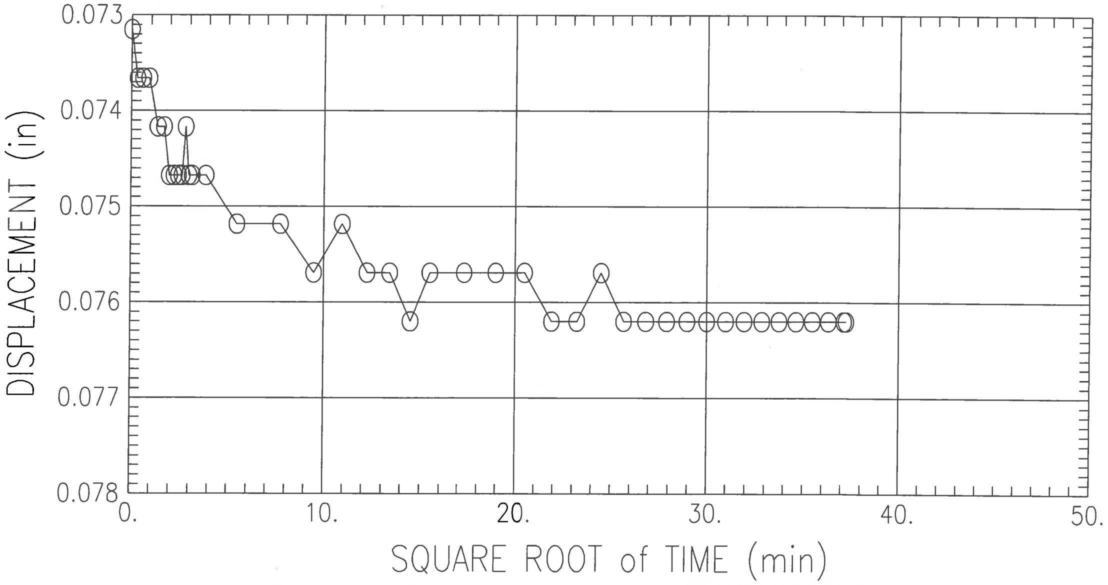
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1

Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'

Description : brown clayey silt (visual description)

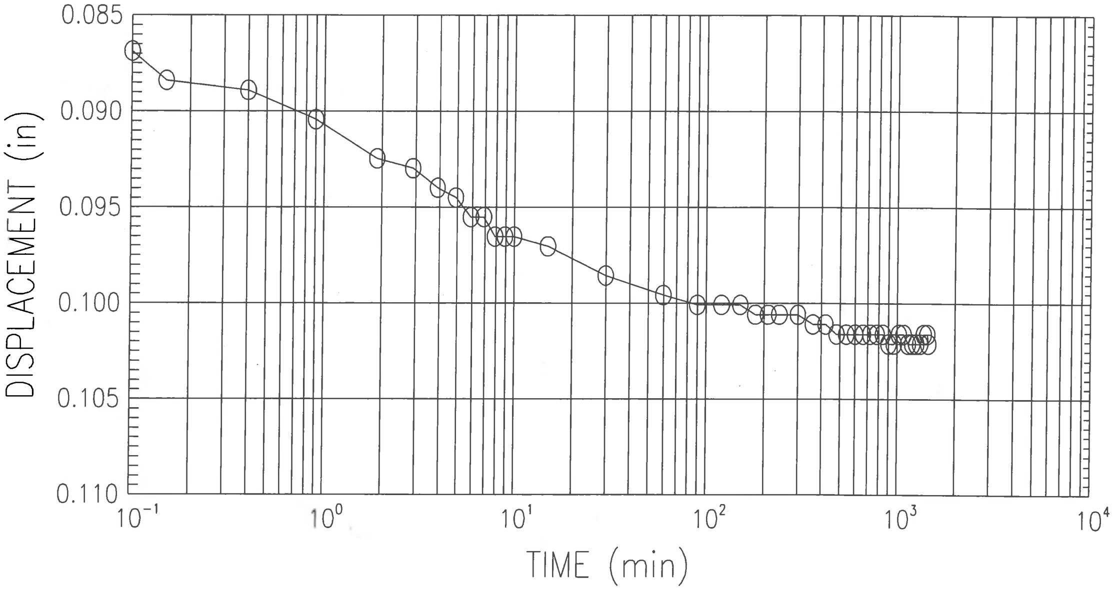
CONSOLIDATION TEST
TIME CURVES (STEP 12 OF 20)
STRESS : 4 (t/ft^2)

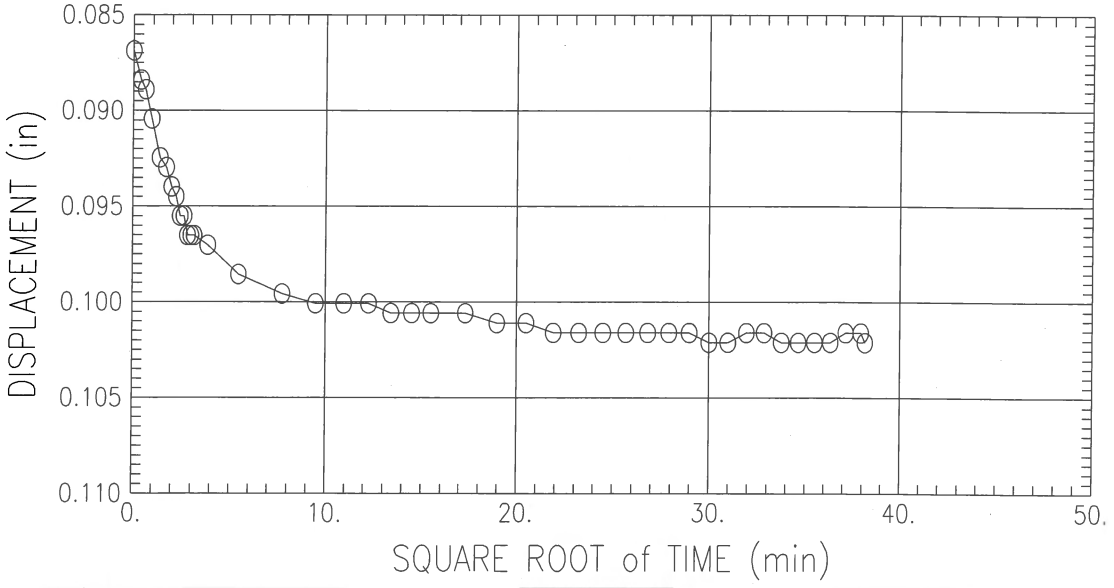




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1
Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'
Description : brown clayey silt (visual description)

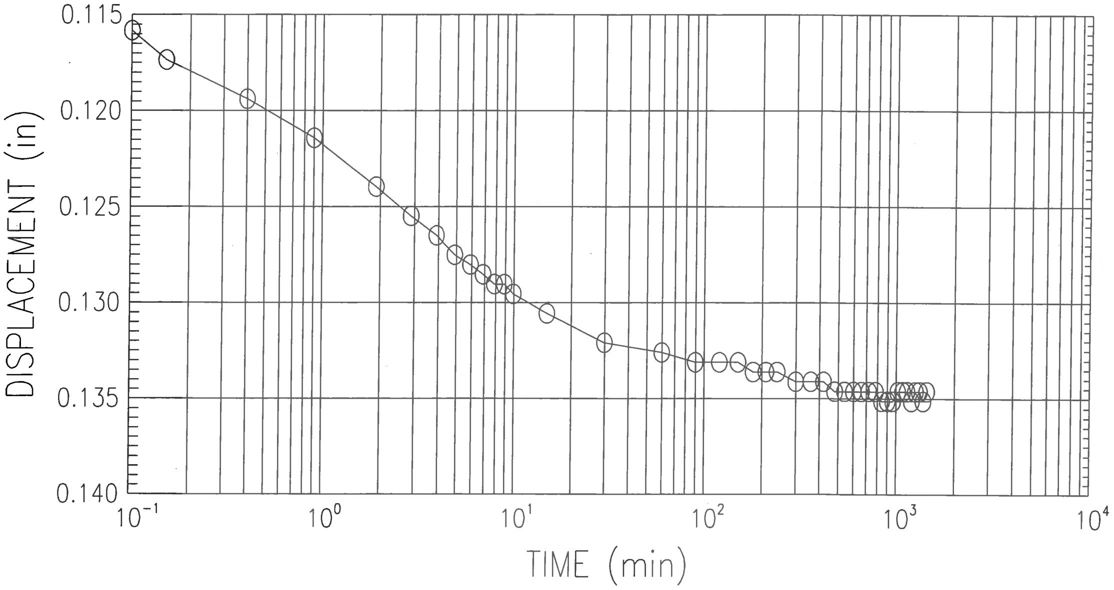
CONSOLIDATION TEST
TIME CURVES (STEP 13 OF 20)
STRESS : 8 (t/ft^2)

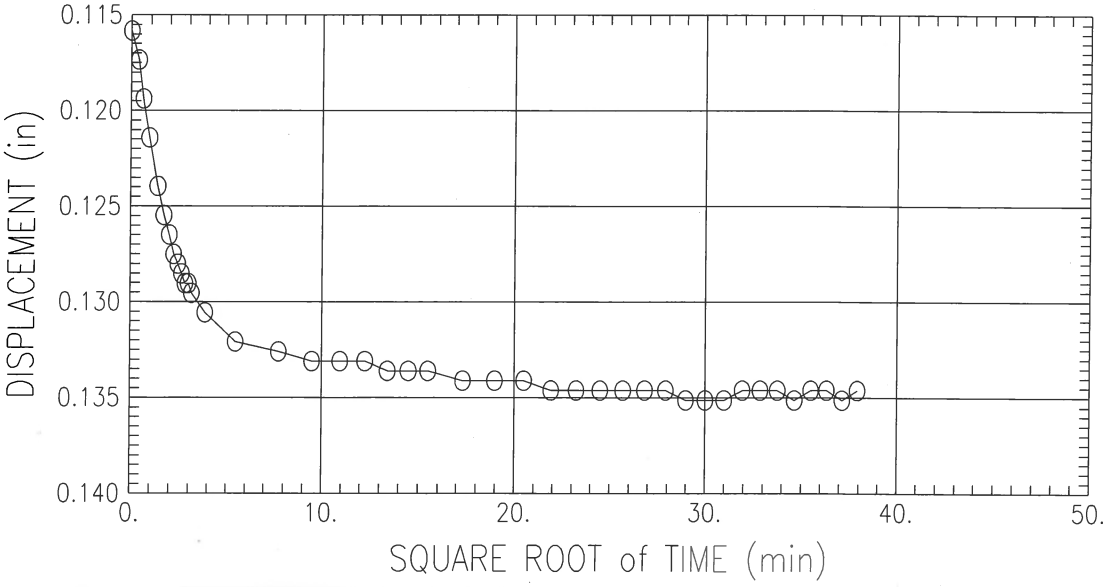




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1
Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'
Description : brown clayey silt (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 14 OF 20)
STRESS : 16 (t/ft^2)





Bowser Morner

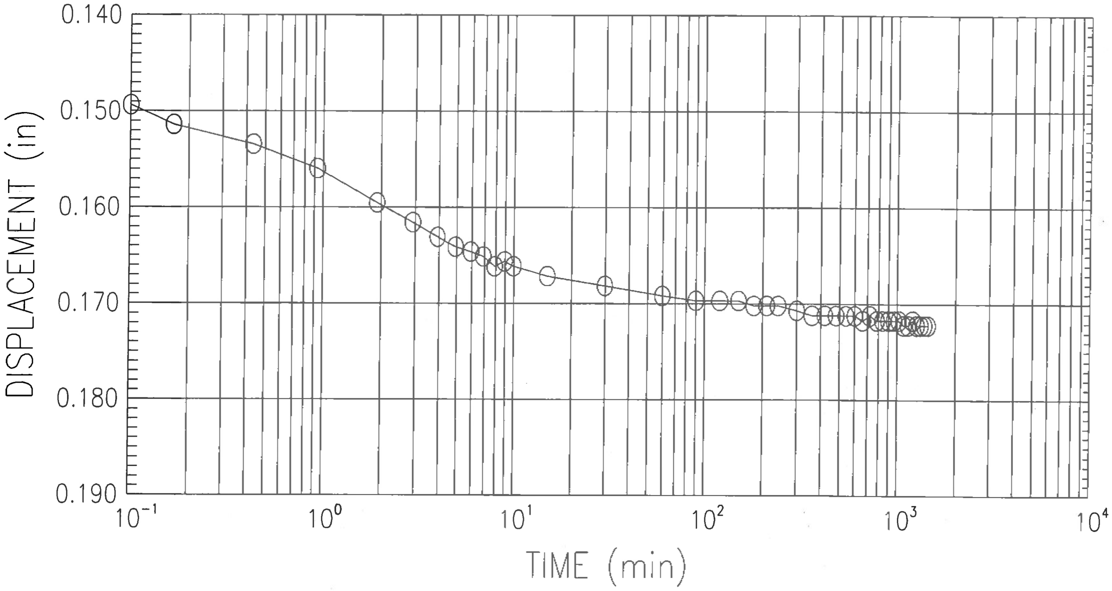
Project Name : EMDF Characterization

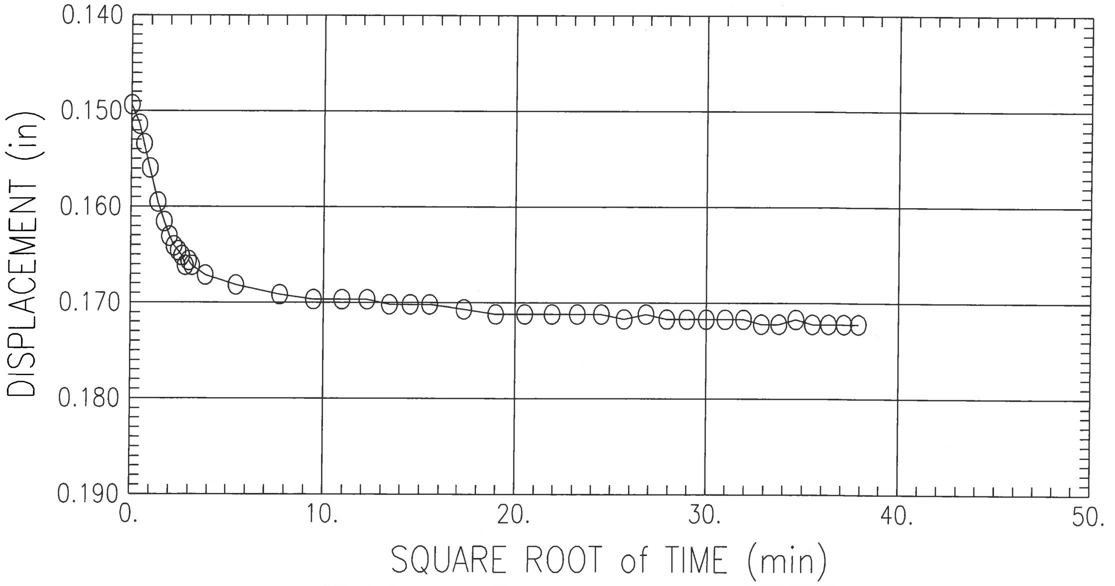
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1

Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'

Description : brown clayey silt (visual description)

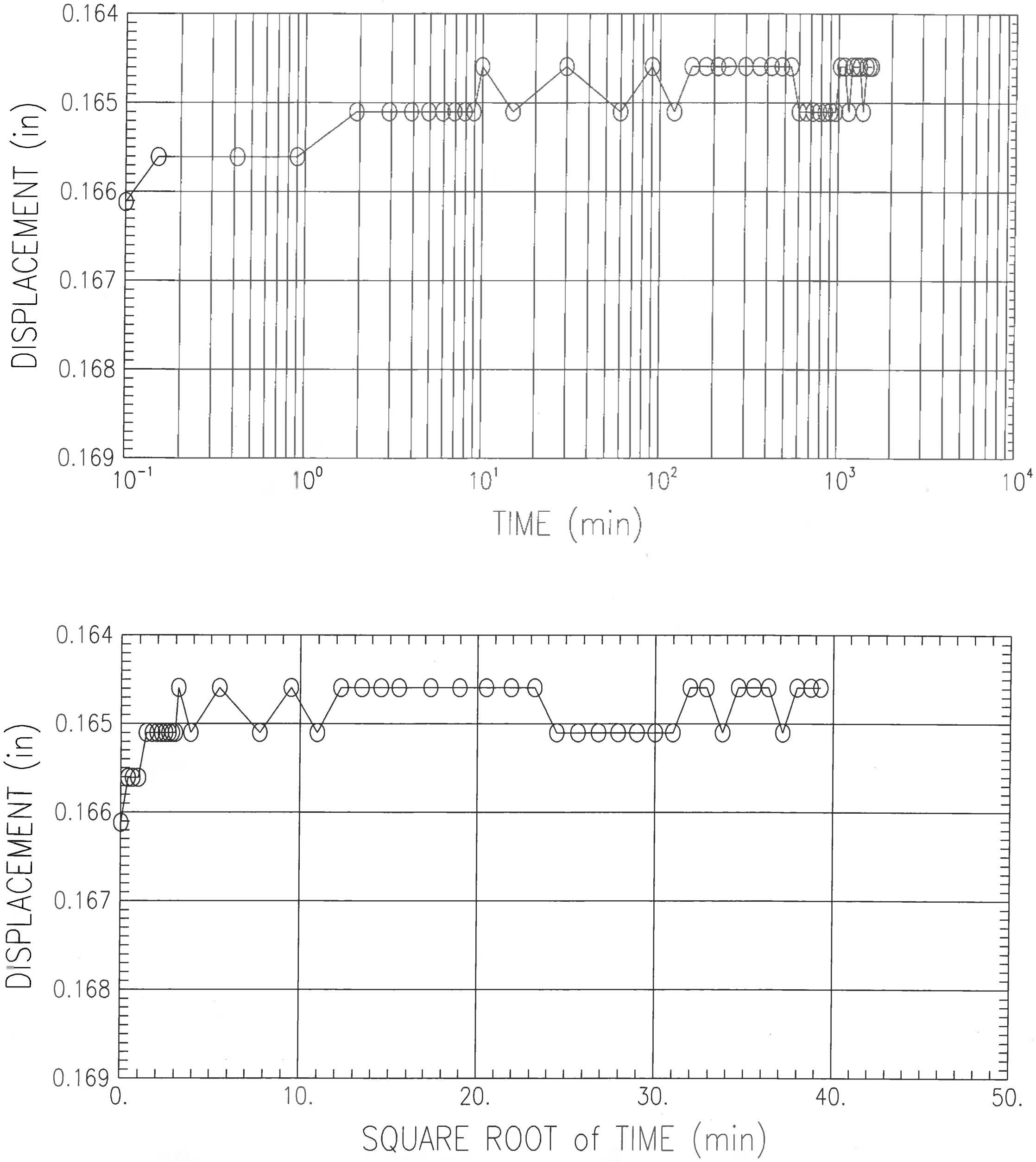
CONSOLIDATION TEST
TIME CURVES (STEP 15 OF 20)
STRESS : 32 (t/ft^2)





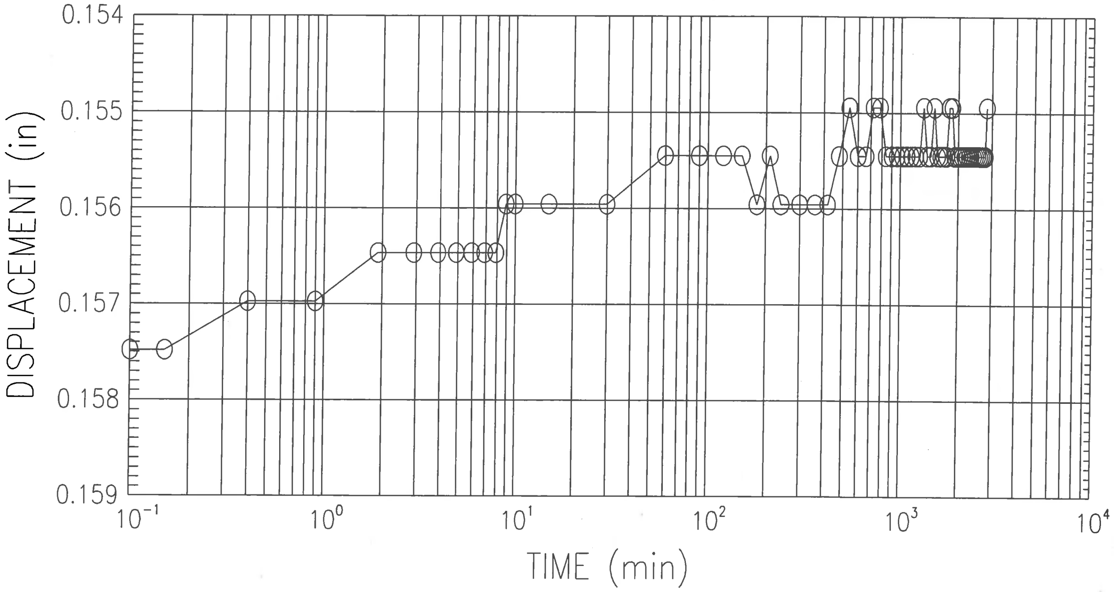
Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1
Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'
Description : brown clayey silt (visual description)

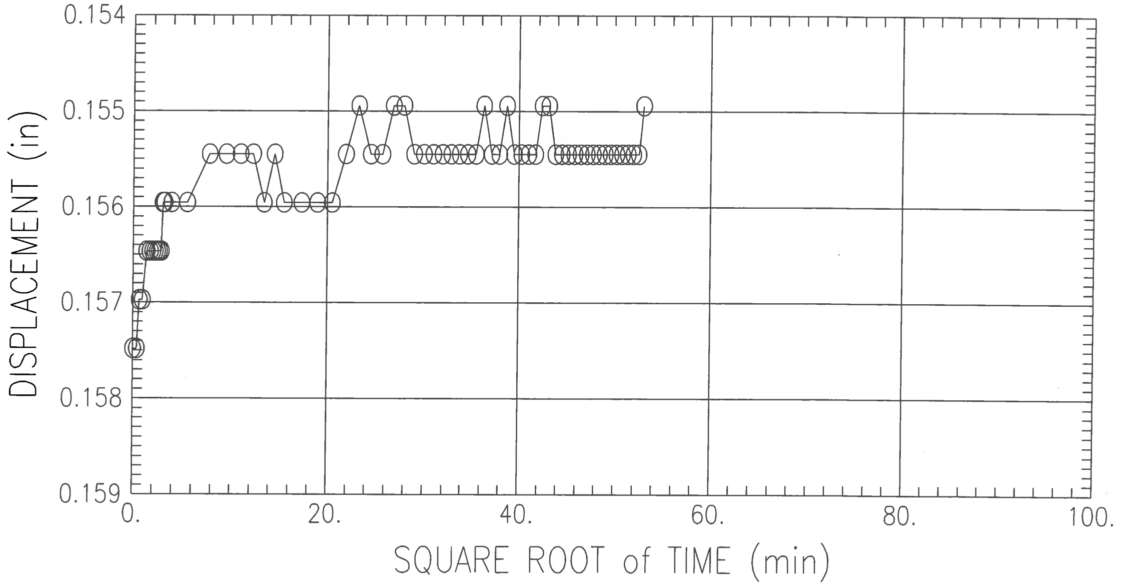
CONSOLIDATION TEST
TIME CURVES (STEP 16 OF 20)
STRESS : 16 (t/ft^2)



Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1
Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'
Description : brown clayey silt (visual description)

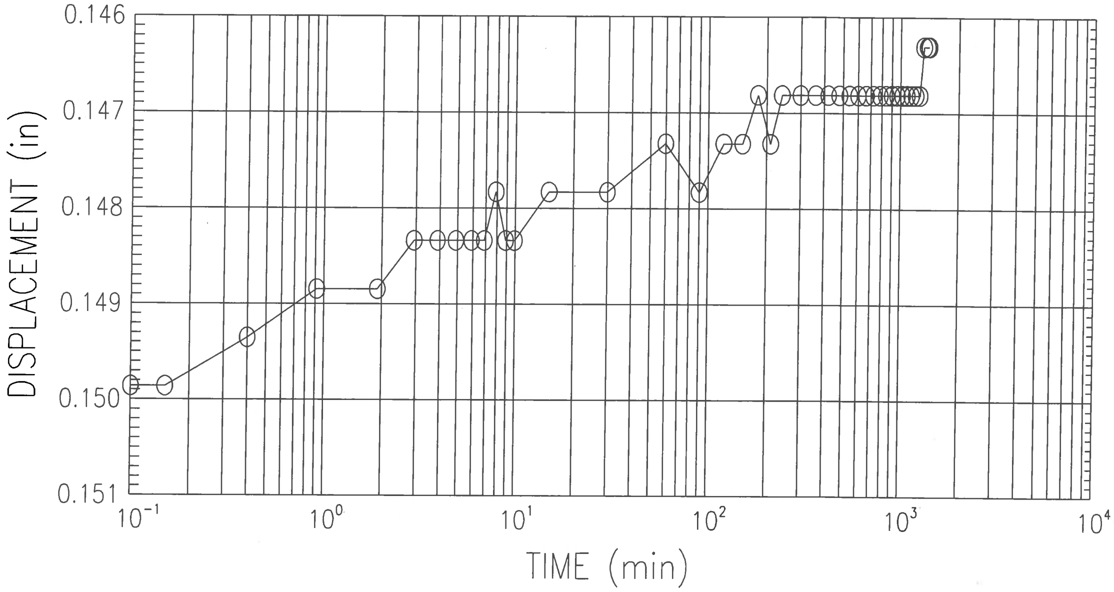
CONSOLIDATION TEST
TIME CURVES (STEP 17 OF 20)
STRESS : 8 (t/ft^2)

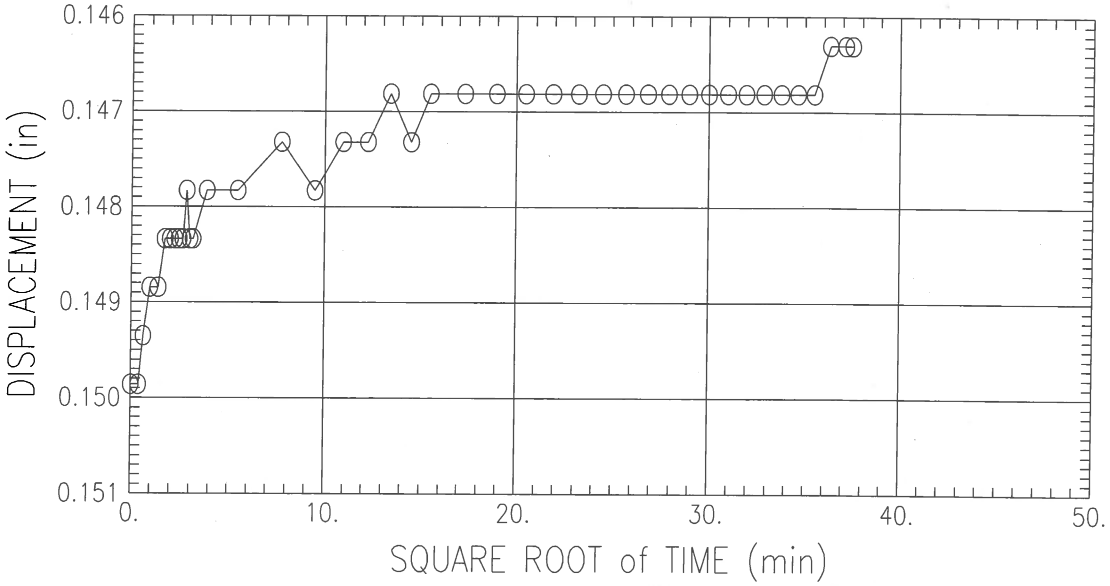




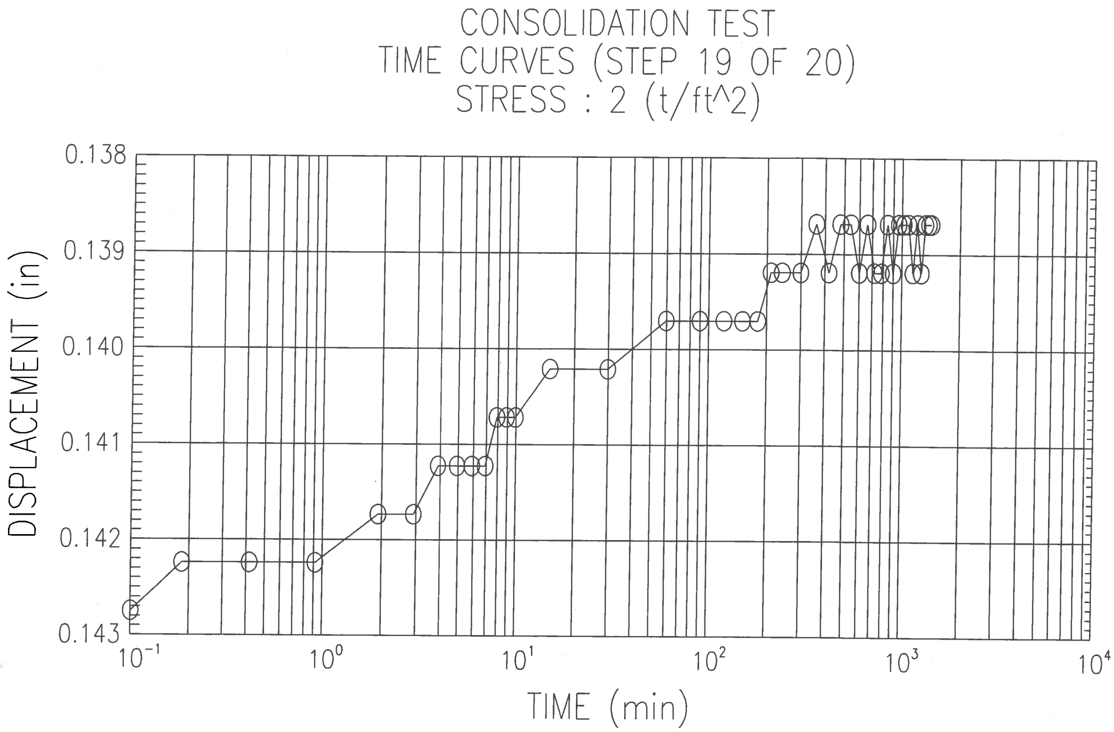
Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1
Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'
Description : brown clayey silt (visual description)

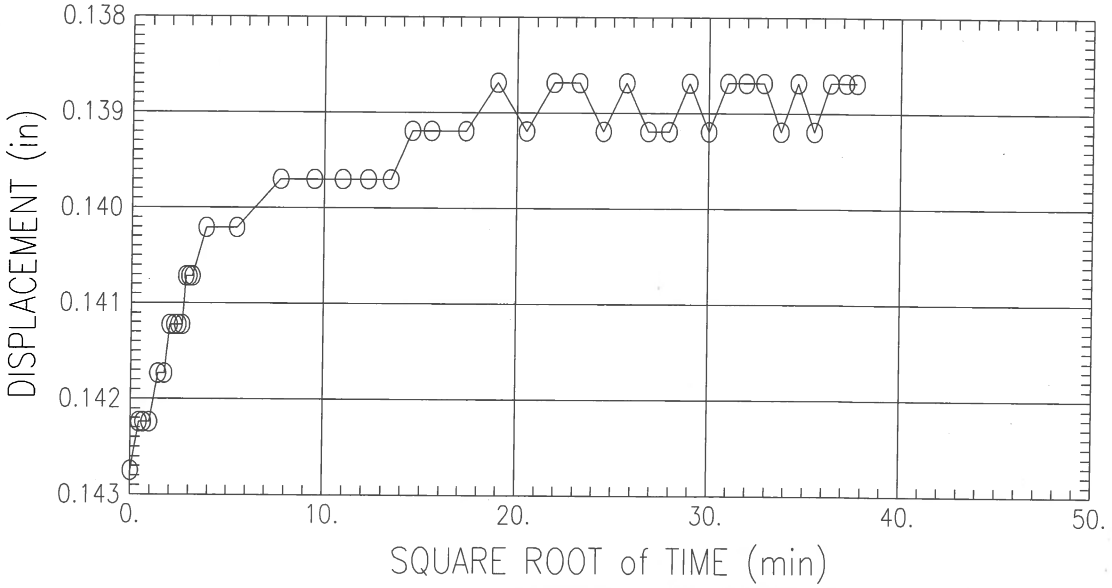
CONSOLIDATION TEST
TIME CURVES (STEP 18 OF 20)
STRESS : 4 (t/ft^2)





Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1
Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'
Description : brown clayey silt (visual description)





Bowser Morner

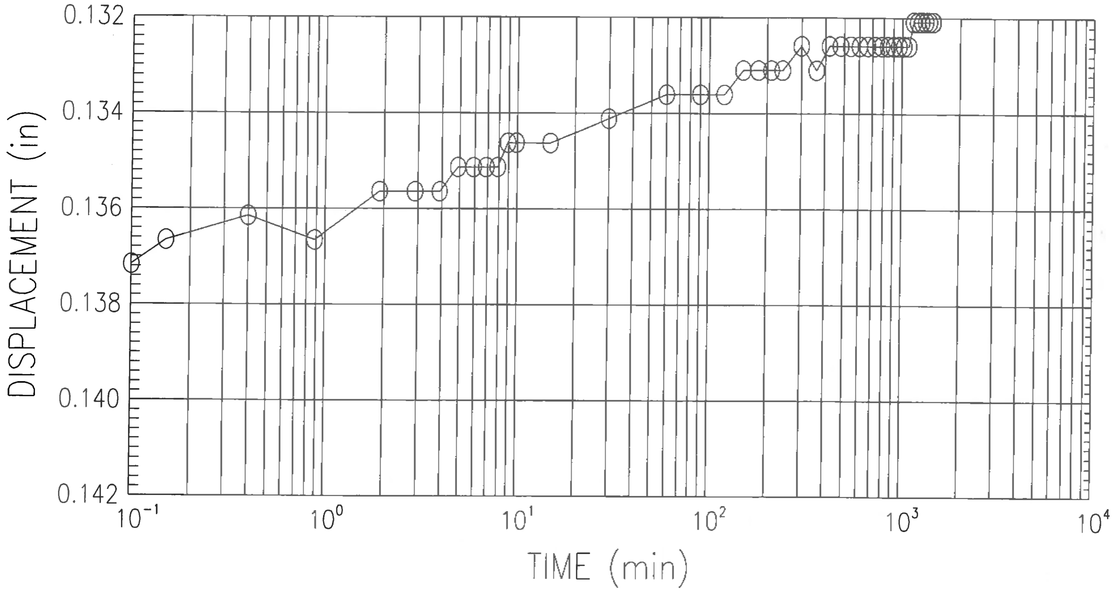
Project Name : EMDF Characterization

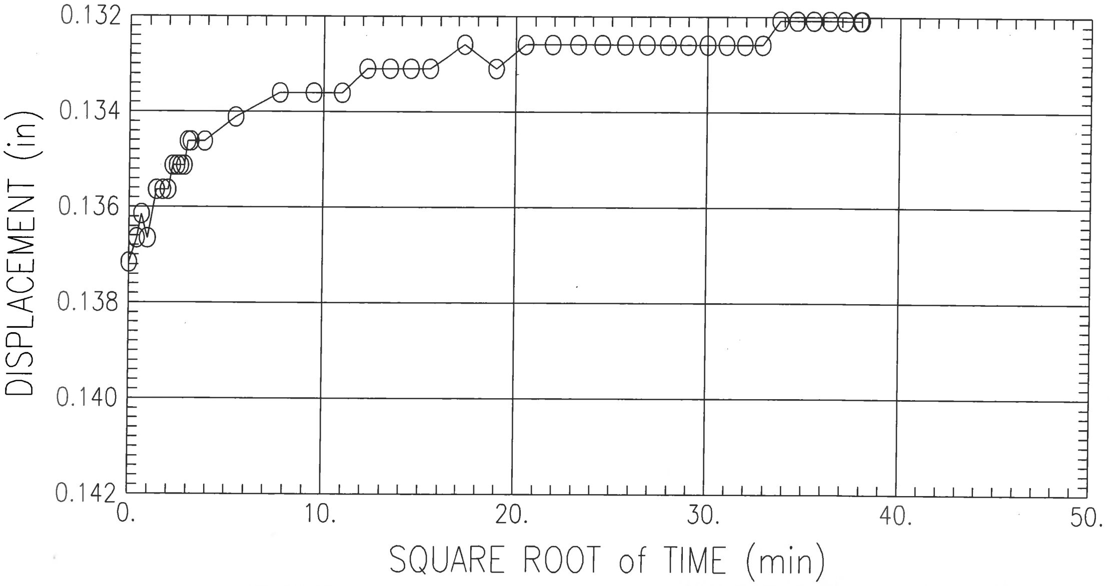
Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1

Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'

Description : brown clayey silt (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 20 OF 20)
STRESS : 1 (t/ft^2)





Bowser Morner

Project Name : EMDF Characterization

Project No : 183923 Boring No : GW993-ST-1 Sample No : GW993-ST-1

Test Date : 3-16-18 Test No : GW993-ST-1 Depth : 3.6'-3.8'

Description : brown clayey silt (visual description)

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

	APPLIED PRESSURE (t/ft^2)	FINAL DISPLACEMENT (in)	VOID RATIO	STRAIN AT END (%)	FITTING T50 TIME (min)		COEFFICIENT OF CONSOLIDATION (in^2/s)		
					SQ.RT.	LOG	SQ.RT.	LOG	AVE
1)	0.06	0.001	0.715	0.05	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
2)	0.25	0.011	0.697	1.05	12.3	0.0	6.87E-005	0.00E+000	6.87E-005
3)	0.50	0.021	0.680	2.05	14.5	0.0	5.71E-005	0.00E+000	5.71E-005
4)	1.00	0.035	0.656	3.44	6.3	0.0	1.29E-004	0.00E+000	1.29E-004
5)	2.00	0.052	0.627	5.13	3.3	3.2	2.38E-004	2.47E-004	2.43E-004
6)	4.00	0.075	0.590	7.33	3.3	0.0	2.26E-004	0.00E+000	2.26E-004
7)	2.00	0.069	0.599	6.78	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
8)	1.00	0.067	0.603	6.58	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
9)	0.50	0.064	0.609	6.23	8.4	0.0	8.87E-005	0.00E+000	8.87E-005
10)	1.00	0.066	0.605	6.43	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
11)	2.00	0.069	0.599	6.78	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
12)	4.00	0.076	0.587	7.48	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
13)	8.00	0.102	0.544	10.02	7.1	3.0	9.99E-005	2.40E-004	1.70E-004
14)	16.00	0.135	0.489	13.20	1.8	0.0	3.71E-004	0.00E+000	3.71E-004
15)	32.00	0.172	0.426	16.89	1.9	2.1	3.24E-004	3.00E-004	3.12E-004
16)	16.00	0.165	0.439	16.14	9.2	0.0	6.47E-005	0.00E+000	6.47E-005
17)	8.00	0.155	0.455	15.20	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
18)	4.00	0.146	0.469	14.35	7.6	0.0	8.18E-005	0.00E+000	8.18E-005
19)	2.00	0.139	0.482	13.60	10.7	0.0	5.89E-005	0.00E+000	5.89E-005
20)	1.00	0.132	0.493	12.95	39.7	0.0	1.62E-005	0.00E+000	1.62E-005

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Specific Gravity : 2.73
Initial Void Ratio : 0.72
Final Void Ratio : 0.49

Liquid Limit : 0
Plastic Limit : 0
Plasticity Index : 0

Initial Height : 1.02 (in)
Sample Diameter : 2.50 (in)

	BEFORE CONSOLIDATION		AFTER CONSOLIDATION	
	TRIMMINGS	SPECIMEN + RING	SPECIMEN + RING	TRIMMINGS
CONTAINER NO.		RING	RING	
WT CONTAINER + WET SOIL (gm)	165.07	165.07	154.27	154.27
WT CONTAINER + DRY SOIL (gm)	130.77	130.77	130.77	130.77
WT CONTAINER (gm)	0.00	0.00	0.00	0.00
WT DRY SOIL (gm)	130.77	130.77	130.77	130.77
WATER CONTENT (%)	26.23	26.23	17.97	17.97
VOID RATIO	------	0.72	0.49	------
DEGREE OF SATURATION (%)	------	100.24	99.61	------
DRY DENSITY (lb/ft^3)	------	99.50	114.30	------

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefor values may not represent actual values for the specimen.

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 1 of 20
Stress increment from 0.00 (t/ft^2) to 0.06 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.17	0.41	0.0000	0.715	0.00
2)	0.90	0.95	0.0000	0.715	0.00
3)	2.90	1.70	0.0005	0.715	0.05
4)	3.93	1.98	0.0005	0.715	0.05
5)	5.33	2.31	0.0005	0.715	0.05

CONSOLIDATION TEST DATA

Project	: EMDF Characterization	Location	: GW993-ST-1, 3.0'-5.0'	Project No.	: 183923
Boring No.	: GW993-ST-1	Tested by	: BMI: blc	Checked by	: KAF
Sample No.	: GW993-ST-1	Test Date	: 3-16-18	Depth	: 3.6'-3.8'
Test No.	: GW993-ST-1	Sample Type	: Undisturb		

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 2 of 20
Stress increment from 0.06 (t/ft^2) to 0.25 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0020	0.712	0.20
2)	0.13	0.37	0.0020	0.712	0.20
3)	0.38	0.62	0.0025	0.711	0.25
4)	0.88	0.94	0.0030	0.710	0.30
5)	1.87	1.37	0.0030	0.710	0.30
6)	2.87	1.69	0.0036	0.709	0.35
7)	3.87	1.97	0.0041	0.709	0.40
8)	4.88	2.21	0.0041	0.709	0.40
9)	5.88	2.43	0.0046	0.708	0.45
10)	6.87	2.62	0.0046	0.708	0.45
11)	7.90	2.81	0.0051	0.707	0.50
12)	8.88	2.98	0.0051	0.707	0.50
13)	9.90	3.15	0.0056	0.706	0.55
14)	14.88	3.86	0.0061	0.705	0.60
15)	29.88	5.47	0.0076	0.703	0.75
16)	59.88	7.74	0.0091	0.700	0.90
17)	89.92	9.48	0.0097	0.699	0.95
18)	119.88	10.95	0.0097	0.699	0.95
19)	149.90	12.24	0.0102	0.698	1.00
20)	179.88	13.41	0.0102	0.698	1.00
21)	209.87	14.49	0.0102	0.698	1.00
22)	239.87	15.49	0.0102	0.698	1.00
23)	299.88	17.32	0.0102	0.698	1.00
24)	359.88	18.97	0.0107	0.697	1.05
25)	419.88	20.49	0.0107	0.697	1.05
26)	479.87	21.91	0.0107	0.697	1.05
27)	539.87	23.24	0.0107	0.697	1.05
28)	599.88	24.49	0.0107	0.697	1.05
29)	659.90	25.69	0.0107	0.697	1.05
30)	719.88	26.83	0.0112	0.697	1.10
31)	779.87	27.93	0.0112	0.697	1.10
32)	839.88	28.98	0.0112	0.697	1.10
33)	899.87	30.00	0.0107	0.697	1.05
34)	959.88	30.98	0.0112	0.697	1.10
35)	1019.88	31.94	0.0112	0.697	1.10

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 2 of 20
Stress increment from 0.06 (t/ft^2) to 0.25 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.0107	0.697	1.05
37)	1139.88	33.76	0.0107	0.697	1.05
38)	1199.90	34.64	0.0112	0.697	1.10
39)	1259.88	35.49	0.0112	0.697	1.10
40)	1303.47	36.10	0.0107	0.697	1.05

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 3 of 20
Stress increment from 0.25 (t/ft^2) to 0.50 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0132	0.693	1.29
2)	0.15	0.39	0.0132	0.693	1.29
3)	0.40	0.63	0.0137	0.692	1.34
4)	0.92	0.96	0.0142	0.691	1.39
5)	1.90	1.38	0.0147	0.691	1.44
6)	2.90	1.70	0.0152	0.690	1.49
7)	3.92	1.98	0.0152	0.690	1.49
8)	4.92	2.22	0.0157	0.689	1.54
9)	5.93	2.44	0.0163	0.688	1.59
10)	6.93	2.63	0.0163	0.688	1.59
11)	7.90	2.81	0.0168	0.687	1.64
12)	8.92	2.99	0.0168	0.687	1.64
13)	9.93	3.15	0.0168	0.687	1.64
14)	14.90	3.86	0.0173	0.686	1.69
15)	29.90	5.47	0.0188	0.684	1.84
16)	59.92	7.74	0.0198	0.682	1.94
17)	89.92	9.48	0.0198	0.682	1.94
18)	119.93	10.95	0.0203	0.681	1.99
19)	149.93	12.24	0.0198	0.682	1.94
20)	179.92	13.41	0.0203	0.681	1.99
21)	209.92	14.49	0.0203	0.681	1.99
22)	239.92	15.49	0.0208	0.680	2.04
23)	299.92	17.32	0.0208	0.680	2.04
24)	359.90	18.97	0.0208	0.680	2.04
25)	419.92	20.49	0.0213	0.680	2.09
26)	479.90	21.91	0.0213	0.680	2.09
27)	539.90	23.24	0.0213	0.680	2.09
28)	599.92	24.49	0.0213	0.680	2.09
29)	659.92	25.69	0.0213	0.680	2.09
30)	719.92	26.83	0.0213	0.680	2.09
31)	779.92	27.93	0.0213	0.680	2.09
32)	839.90	28.98	0.0213	0.680	2.09
33)	899.92	30.00	0.0213	0.680	2.09
34)	959.92	30.98	0.0213	0.680	2.09
35)	1019.95	31.94	0.0213	0.680	2.09

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 3 of 20
Stress increment from 0.25 (t/ft^2) to 0.50 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.92	32.86	0.0213	0.680	2.09
37)	1139.90	33.76	0.0213	0.680	2.09
38)	1199.90	34.64	0.0213	0.680	2.09
39)	1259.92	35.50	0.0208	0.680	2.04
40)	1309.85	36.19	0.0208	0.680	2.04

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 4 of 20
Stress increment from 0.50 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0254	0.673	2.49
2)	0.15	0.39	0.0259	0.672	2.54
3)	0.40	0.63	0.0264	0.671	2.59
4)	0.90	0.95	0.0269	0.670	2.64
5)	1.92	1.38	0.0284	0.668	2.79
6)	2.92	1.71	0.0290	0.667	2.84
7)	3.90	1.97	0.0295	0.666	2.89
8)	4.92	2.22	0.0305	0.664	2.99
9)	5.92	2.43	0.0305	0.664	2.99
10)	6.92	2.63	0.0310	0.663	3.04
11)	7.92	2.81	0.0310	0.663	3.04
12)	8.92	2.99	0.0310	0.663	3.04
13)	9.92	3.15	0.0310	0.663	3.04
14)	14.90	3.86	0.0320	0.662	3.14
15)	29.92	5.47	0.0335	0.659	3.29
16)	59.93	7.74	0.0340	0.658	3.34
17)	89.92	9.48	0.0345	0.657	3.39
18)	119.90	10.95	0.0340	0.658	3.34
19)	149.92	12.24	0.0345	0.657	3.39
20)	179.92	13.41	0.0345	0.657	3.39
21)	209.92	14.49	0.0351	0.656	3.44
22)	239.92	15.49	0.0345	0.657	3.39
23)	299.92	17.32	0.0345	0.657	3.39
24)	359.93	18.97	0.0345	0.657	3.39
25)	419.90	20.49	0.0351	0.656	3.44
26)	479.92	21.91	0.0351	0.656	3.44
27)	539.90	23.24	0.0351	0.656	3.44
28)	599.92	24.49	0.0351	0.656	3.44
29)	659.92	25.69	0.0351	0.656	3.44
30)	719.92	26.83	0.0351	0.656	3.44
31)	779.95	27.93	0.0351	0.656	3.44
32)	839.92	28.98	0.0356	0.656	3.49
33)	899.92	30.00	0.0356	0.656	3.49
34)	959.93	30.98	0.0356	0.656	3.49
35)	1019.92	31.94	0.0351	0.656	3.44

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW993-ST-1, 3.0'-5.0'
Project No.: 183923
Boring No.: GW993-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW993-ST-1
Test Date : 3-16-18
Depth : 3.6'-3.8'
Test No. : GW993-ST-1
Sample Type: Undisturb

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 4 of 20
Stress increment from 0.50 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.0356	0.656	3.49
37)	1139.92	33.76	0.0356	0.656	3.49
38)	1199.92	34.64	0.0356	0.656	3.49
39)	1259.92	35.50	0.0356	0.656	3.49
40)	1319.90	36.33	0.0356	0.656	3.49
41)	1379.90	37.15	0.0356	0.656	3.49
42)	1439.92	37.95	0.0351	0.656	3.44
43)	1499.90	38.73	0.0356	0.656	3.49
44)	1559.90	39.50	0.0356	0.656	3.49
45)	1619.90	40.25	0.0351	0.656	3.44
46)	1626.50	40.33	0.0351	0.656	3.44

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 5 of 20
Stress increment from 1.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0401	0.648	3.93
2)	0.15	0.39	0.0411	0.646	4.03
3)	0.40	0.63	0.0417	0.645	4.08
4)	0.90	0.95	0.0427	0.644	4.18
5)	1.90	1.38	0.0437	0.642	4.28
6)	2.92	1.71	0.0447	0.640	4.38
7)	3.90	1.97	0.0452	0.639	4.43
8)	4.90	2.21	0.0457	0.638	4.48
9)	5.92	2.43	0.0462	0.638	4.53
10)	6.90	2.63	0.0467	0.637	4.58
11)	7.90	2.81	0.0467	0.637	4.58
12)	8.90	2.98	0.0467	0.637	4.58
13)	9.90	3.15	0.0472	0.636	4.63
14)	14.90	3.86	0.0488	0.633	4.78
15)	29.90	5.47	0.0493	0.633	4.83
16)	59.90	7.74	0.0503	0.631	4.93
17)	89.92	9.48	0.0503	0.631	4.93
18)	119.90	10.95	0.0508	0.630	4.98
19)	149.90	12.24	0.0508	0.630	4.98
20)	179.93	13.41	0.0513	0.629	5.03
21)	209.90	14.49	0.0508	0.630	4.98
22)	239.90	15.49	0.0513	0.629	5.03
23)	299.90	17.32	0.0518	0.628	5.08
24)	359.90	18.97	0.0518	0.628	5.08
25)	419.93	20.49	0.0518	0.628	5.08
26)	479.93	21.91	0.0518	0.628	5.08
27)	539.90	23.24	0.0518	0.628	5.08
28)	599.90	24.49	0.0523	0.627	5.13
29)	659.90	25.69	0.0523	0.627	5.13
30)	719.92	26.83	0.0523	0.627	5.13
31)	779.90	27.93	0.0523	0.627	5.13
32)	839.88	28.98	0.0523	0.627	5.13
33)	899.90	30.00	0.0523	0.627	5.13
34)	959.90	30.98	0.0528	0.627	5.18
35)	1019.90	31.94	0.0523	0.627	5.13

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW993-ST-1, 3.0'-5.0'
Project No.: 183923
Boring No.: GW993-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW993-ST-1
Test Date : 3-16-18
Depth : 3.6'-3.8'
Test No. : GW993-ST-1
Sample Type: Undisturb

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 5 of 20
Stress increment from 1.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.0528	0.627	5.18
37)	1139.90	33.76	0.0528	0.627	5.18
38)	1199.90	34.64	0.0528	0.627	5.18
39)	1259.88	35.49	0.0528	0.627	5.18
40)	1319.92	36.33	0.0528	0.627	5.18
41)	1327.82	36.44	0.0523	0.627	5.13

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 6 of 20
Stress increment from 2.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0599	0.615	5.88
2)	0.17	0.41	0.0610	0.613	5.98
3)	0.40	0.63	0.0620	0.611	6.08
4)	0.90	0.95	0.0635	0.609	6.23
5)	1.90	1.38	0.0650	0.606	6.37
6)	2.90	1.70	0.0660	0.604	6.47
7)	3.90	1.97	0.0665	0.603	6.52
8)	4.90	2.21	0.0671	0.603	6.57
9)	5.93	2.44	0.0681	0.601	6.67
10)	6.90	2.63	0.0686	0.600	6.72
11)	7.90	2.81	0.0686	0.600	6.72
12)	8.90	2.98	0.0691	0.599	6.77
13)	9.90	3.15	0.0691	0.599	6.77
14)	14.90	3.86	0.0706	0.597	6.92
15)	29.90	5.47	0.0716	0.595	7.02
16)	59.90	7.74	0.0721	0.594	7.07
17)	89.92	9.48	0.0726	0.593	7.12
18)	119.90	10.95	0.0726	0.593	7.12
19)	149.92	12.24	0.0732	0.592	7.17
20)	179.93	13.41	0.0732	0.592	7.17
21)	209.90	14.49	0.0732	0.592	7.17
22)	239.90	15.49	0.0732	0.592	7.17
23)	299.92	17.32	0.0732	0.592	7.17
24)	359.90	18.97	0.0737	0.592	7.22
25)	419.92	20.49	0.0737	0.592	7.22
26)	479.93	21.91	0.0737	0.592	7.22
27)	539.90	23.24	0.0742	0.591	7.27
28)	599.90	24.49	0.0737	0.592	7.22
29)	659.90	25.69	0.0737	0.592	7.22
30)	719.92	26.83	0.0742	0.591	7.27
31)	779.90	27.93	0.0742	0.591	7.27
32)	839.92	28.98	0.0742	0.591	7.27
33)	899.90	30.00	0.0742	0.591	7.27
34)	959.90	30.98	0.0742	0.591	7.27
35)	1019.90	31.94	0.0742	0.591	7.27

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 6 of 20
Stress increment from 2.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.0742	0.591	7.27
37)	1139.90	33.76	0.0742	0.591	7.27
38)	1199.90	34.64	0.0742	0.591	7.27
39)	1259.88	35.49	0.0742	0.591	7.27
40)	1319.92	36.33	0.0742	0.591	7.27
41)	1379.90	37.15	0.0747	0.590	7.32
42)	1428.78	37.80	0.0747	0.590	7.32

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 7 of 20
Stress increment from 4.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0716	0.595	7.02
2)	0.13	0.37	0.0716	0.595	7.02
3)	0.38	0.62	0.0716	0.595	7.02
4)	0.90	0.95	0.0721	0.594	7.07
5)	1.88	1.37	0.0711	0.596	6.97
6)	2.88	1.70	0.0711	0.596	6.97
7)	3.88	1.97	0.0711	0.596	6.97
8)	4.88	2.21	0.0711	0.596	6.97
9)	5.88	2.43	0.0711	0.596	6.97
10)	6.88	2.62	0.0711	0.596	6.97
11)	7.90	2.81	0.0711	0.596	6.97
12)	8.88	2.98	0.0706	0.597	6.92
13)	9.90	3.15	0.0711	0.596	6.97
14)	14.90	3.86	0.0716	0.595	7.02
15)	29.90	5.47	0.0716	0.595	7.02
16)	59.88	7.74	0.0711	0.596	6.97
17)	89.90	9.48	0.0711	0.596	6.97
18)	119.90	10.95	0.0711	0.596	6.97
19)	149.88	12.24	0.0711	0.596	6.97
20)	179.88	13.41	0.0706	0.597	6.92
21)	209.88	14.49	0.0711	0.596	6.97
22)	239.88	15.49	0.0706	0.597	6.92
23)	299.88	17.32	0.0706	0.597	6.92
24)	359.87	18.97	0.0706	0.597	6.92
25)	419.88	20.49	0.0706	0.597	6.92
26)	479.90	21.91	0.0711	0.596	6.97
27)	539.90	23.24	0.0706	0.597	6.92
28)	599.88	24.49	0.0706	0.597	6.92
29)	659.87	25.69	0.0706	0.597	6.92
30)	719.90	26.83	0.0706	0.597	6.92
31)	779.88	27.93	0.0711	0.596	6.97
32)	839.88	28.98	0.0706	0.597	6.92
33)	899.88	30.00	0.0706	0.597	6.92
34)	959.90	30.98	0.0706	0.597	6.92
35)	1019.88	31.94	0.0706	0.597	6.92

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 7 of 20
Stress increment from 4.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.0706	0.597	6.92
37)	1139.88	33.76	0.0706	0.597	6.92
38)	1199.88	34.64	0.0706	0.597	6.92
39)	1259.90	35.50	0.0706	0.597	6.92
40)	1319.88	36.33	0.0706	0.597	6.92
41)	1379.87	37.15	0.0706	0.597	6.92
42)	1439.88	37.95	0.0706	0.597	6.92
43)	1441.68	37.97	0.0691	0.599	6.77

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 8 of 20
Stress increment from 2.00 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0681	0.601	6.67
2)	0.15	0.39	0.0686	0.600	6.72
3)	0.40	0.63	0.0686	0.600	6.72
4)	0.90	0.95	0.0681	0.601	6.67
5)	1.90	1.38	0.0681	0.601	6.67
6)	2.90	1.70	0.0681	0.601	6.67
7)	3.90	1.97	0.0676	0.602	6.62
8)	4.90	2.21	0.0676	0.602	6.62
9)	5.90	2.43	0.0676	0.602	6.62
10)	6.92	2.63	0.0676	0.602	6.62
11)	7.92	2.81	0.0676	0.602	6.62
12)	8.92	2.99	0.0676	0.602	6.62
13)	9.88	3.14	0.0676	0.602	6.62
14)	14.92	3.86	0.0671	0.603	6.57
15)	29.90	5.47	0.0681	0.601	6.67
16)	59.90	7.74	0.0681	0.601	6.67
17)	89.90	9.48	0.0676	0.602	6.62
18)	119.92	10.95	0.0676	0.602	6.62
19)	149.90	12.24	0.0676	0.602	6.62
20)	179.92	13.41	0.0676	0.602	6.62
21)	209.92	14.49	0.0676	0.602	6.62
22)	239.93	15.49	0.0676	0.602	6.62
23)	299.92	17.32	0.0676	0.602	6.62
24)	359.92	18.97	0.0671	0.603	6.57
25)	419.88	20.49	0.0676	0.602	6.62
26)	479.90	21.91	0.0671	0.603	6.57
27)	539.92	23.24	0.0676	0.602	6.62
28)	599.90	24.49	0.0676	0.602	6.62
29)	659.92	25.69	0.0676	0.602	6.62
30)	719.90	26.83	0.0671	0.603	6.57
31)	779.92	27.93	0.0676	0.602	6.62
32)	839.90	28.98	0.0676	0.602	6.62
33)	899.90	30.00	0.0676	0.602	6.62
34)	959.88	30.98	0.0676	0.602	6.62
35)	1019.88	31.94	0.0676	0.602	6.62

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW993-ST-1, 3.0'-5.0'
Project No.: 183923
Boring No.: GW993-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW993-ST-1
Test Date : 3-16-18
Depth : 3.6'-3.8'
Test No. : GW993-ST-1
Sample Type: Undisturb

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 8 of 20
Stress increment from 2.00 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.0676	0.602	6.62
37)	1139.92	33.76	0.0676	0.602	6.62
38)	1199.92	34.64	0.0671	0.603	6.57
39)	1259.88	35.49	0.0676	0.602	6.62
40)	1319.90	36.33	0.0676	0.602	6.62
41)	1379.88	37.15	0.0671	0.603	6.57
42)	1439.88	37.95	0.0676	0.602	6.62
43)	1479.53	38.46	0.0671	0.603	6.57

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 9 of 20
Stress increment from 1.00 (t/ft^2) to 0.50 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0655	0.605	6.42
2)	0.13	0.37	0.0655	0.605	6.42
3)	0.38	0.62	0.0650	0.606	6.37
4)	0.88	0.94	0.0650	0.606	6.37
5)	1.90	1.38	0.0650	0.606	6.37
6)	2.90	1.70	0.0645	0.607	6.33
7)	3.90	1.97	0.0645	0.607	6.33
8)	4.88	2.21	0.0645	0.607	6.33
9)	5.90	2.43	0.0645	0.607	6.33
10)	6.90	2.63	0.0645	0.607	6.33
11)	7.90	2.81	0.0645	0.607	6.33
12)	8.92	2.99	0.0640	0.608	6.28
13)	9.88	3.14	0.0645	0.607	6.33
14)	14.90	3.86	0.0645	0.607	6.33
15)	29.88	5.47	0.0640	0.608	6.28
16)	59.90	7.74	0.0645	0.607	6.33
17)	89.88	9.48	0.0640	0.608	6.28
18)	119.90	10.95	0.0640	0.608	6.28
19)	149.93	12.24	0.0640	0.608	6.28
20)	179.88	13.41	0.0640	0.608	6.28
21)	209.88	14.49	0.0635	0.609	6.23
22)	239.88	15.49	0.0640	0.608	6.28
23)	299.90	17.32	0.0640	0.608	6.28
24)	359.90	18.97	0.0640	0.608	6.28
25)	419.92	20.49	0.0640	0.608	6.28
26)	479.88	21.91	0.0640	0.608	6.28
27)	539.88	23.24	0.0640	0.608	6.28
28)	599.92	24.49	0.0640	0.608	6.28
29)	659.90	25.69	0.0640	0.608	6.28
30)	719.90	26.83	0.0640	0.608	6.28
31)	779.92	27.93	0.0640	0.608	6.28
32)	839.88	28.98	0.0640	0.608	6.28
33)	899.88	30.00	0.0640	0.608	6.28
34)	959.90	30.98	0.0640	0.608	6.28
35)	1019.92	31.94	0.0640	0.608	6.28

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 9 of 20
Stress increment from 1.00 (t/ft^2) to 0.50 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.0640	0.608	6.28
37)	1139.88	33.76	0.0640	0.608	6.28
38)	1199.93	34.64	0.0640	0.608	6.28
39)	1259.88	35.49	0.0640	0.608	6.28
40)	1319.88	36.33	0.0640	0.608	6.28
41)	1327.25	36.43	0.0635	0.609	6.23

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW993-ST-1, 3.0'-5.0'
Project No.: 183923
Boring No.: GW993-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW993-ST-1
Test Date : 3-16-18
Depth : 3.6'-3.8'
Test No. : GW993-ST-1
Sample Type: Undisturb

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 10 of 20
Stress increment from 0.50 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0650	0.606	6.37
2)	0.15	0.39	0.0650	0.606	6.37
3)	0.40	0.63	0.0645	0.607	6.33
4)	0.92	0.96	0.0650	0.606	6.37
5)	1.90	1.38	0.0650	0.606	6.37
6)	2.90	1.70	0.0650	0.606	6.37
7)	3.90	1.97	0.0650	0.606	6.37
8)	4.90	2.21	0.0650	0.606	6.37
9)	5.90	2.43	0.0650	0.606	6.37
10)	6.90	2.63	0.0650	0.606	6.37
11)	7.92	2.81	0.0650	0.606	6.37
12)	8.90	2.98	0.0650	0.606	6.37
13)	9.90	3.15	0.0650	0.606	6.37
14)	14.92	3.86	0.0650	0.606	6.37
15)	29.90	5.47	0.0650	0.606	6.37
16)	59.90	7.74	0.0650	0.606	6.37
17)	89.90	9.48	0.0650	0.606	6.37
18)	119.92	10.95	0.0655	0.605	6.42
19)	149.90	12.24	0.0650	0.606	6.37
20)	179.90	13.41	0.0660	0.604	6.47
21)	209.90	14.49	0.0655	0.605	6.42
22)	239.90	15.49	0.0660	0.604	6.47
23)	299.90	17.32	0.0660	0.604	6.47
24)	359.90	18.97	0.0660	0.604	6.47
25)	419.92	20.49	0.0660	0.604	6.47
26)	479.90	21.91	0.0660	0.604	6.47
27)	539.90	23.24	0.0660	0.604	6.47
28)	599.90	24.49	0.0660	0.604	6.47
29)	659.90	25.69	0.0660	0.604	6.47
30)	719.90	26.83	0.0655	0.605	6.42
31)	779.90	27.93	0.0655	0.605	6.42
32)	839.90	28.98	0.0660	0.604	6.47
33)	899.88	30.00	0.0660	0.604	6.47
34)	959.90	30.98	0.0660	0.604	6.47
35)	1019.90	31.94	0.0660	0.604	6.47

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 10 of 20
Stress increment from 0.50 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.0660	0.604	6.47
37)	1139.90	33.76	0.0660	0.604	6.47
38)	1199.90	34.64	0.0660	0.604	6.47
39)	1259.90	35.50	0.0660	0.604	6.47
40)	1319.90	36.33	0.0660	0.604	6.47
41)	1379.90	37.15	0.0660	0.604	6.47
42)	1439.90	37.95	0.0655	0.605	6.42
43)	1499.88	38.73	0.0660	0.604	6.47
44)	1500.63	38.74	0.0655	0.605	6.42

CONSOLIDATION TEST DATA

Project	: EMDF Characterization	Location	: GW993-ST-1, 3.0'-5.0'	Project No.	: 183923
Boring No.	: GW993-ST-1	Tested by	: BMI: blc	Checked by	: KAF
Sample No.	: GW993-ST-1	Test Date	: 3-16-18	Depth	: 3.6'-3.8'
Test No.	: GW993-ST-1	Sample Type	: Undisturb		

Soil Description : brown clayey silt (visual description)

Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 11 of 20

Stress increment from 1.00 (t/ft^2) to 2.00 (t/ft^2)

Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0681	0.601	6.67
2)	0.15	0.39	0.0681	0.601	6.67
3)	0.38	0.62	0.0681	0.601	6.67
4)	0.88	0.94	0.0686	0.600	6.72
5)	1.92	1.38	0.0686	0.600	6.72
6)	2.90	1.70	0.0686	0.600	6.72
7)	3.88	1.97	0.0686	0.600	6.72
8)	4.90	2.21	0.0686	0.600	6.72
9)	5.88	2.43	0.0686	0.600	6.72
10)	6.92	2.63	0.0686	0.600	6.72
11)	7.92	2.81	0.0686	0.600	6.72
12)	8.90	2.98	0.0686	0.600	6.72
13)	9.88	3.14	0.0686	0.600	6.72
14)	14.88	3.86	0.0691	0.599	6.77
15)	29.88	5.47	0.0696	0.598	6.82
16)	59.90	7.74	0.0696	0.598	6.82
17)	89.90	9.48	0.0696	0.598	6.82
18)	119.90	10.95	0.0696	0.598	6.82
19)	149.88	12.24	0.0696	0.598	6.82
20)	179.92	13.41	0.0696	0.598	6.82
21)	209.92	14.49	0.0696	0.598	6.82
22)	239.93	15.49	0.0696	0.598	6.82
23)	299.90	17.32	0.0696	0.598	6.82
24)	359.90	18.97	0.0696	0.598	6.82
25)	419.90	20.49	0.0696	0.598	6.82
26)	479.88	21.91	0.0691	0.599	6.77
27)	539.92	23.24	0.0696	0.598	6.82
28)	599.90	24.49	0.0696	0.598	6.82
29)	659.90	25.69	0.0696	0.598	6.82
30)	719.88	26.83	0.0696	0.598	6.82
31)	779.88	27.93	0.0696	0.598	6.82
32)	839.90	28.98	0.0696	0.598	6.82
33)	899.88	30.00	0.0696	0.598	6.82
34)	959.90	30.98	0.0696	0.598	6.82
35)	1019.88	31.94	0.0696	0.598	6.82

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                                   CONSOLIDATION TEST DATA

Project    : EMDF Characterization      Location    : GW993-ST-1, 3.0'-5.0'    Project No.: 183923
Boring No.: GW993-ST-1                  Tested by   : BMI: blc                 Checked by : KAF
Sample No.: GW993-ST-1                  Test Date   : 3-16-18                  Depth      : 3.6'-3.8'
Test No.   : GW993-ST-1                 Sample Type: Undisturb

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 11 of 20
Stress increment from 1.00 (t/ft^2)  to 2.00 (t/ft^2)
Start Date :             Start Time :

               ELAPSED TIME     SQRT. OF      CHANGE IN      VOID       STRAIN
                   (min)        TIME (min)    HEIGHT (in)    RATIO        (%)

        36)      1079.88         32.86          0.0696       0.598       6.82
        37)      1139.90         33.76          0.0696       0.598       6.82
        38)      1199.88         34.64          0.0696       0.598       6.82
        39)      1259.88         35.49          0.0696       0.598       6.82
        40)      1319.88         36.33          0.0696       0.598       6.82
        41)      1379.88         37.15          0.0696       0.598       6.82
        42)      1439.90         37.95          0.0696       0.598       6.82
        43)      1499.88         38.73          0.0696       0.598       6.82
        44)      1505.98         38.81          0.0691       0.599       6.77
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CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW993-ST-1, 3.0'-5.0'
Project No.: 183923
Boring No.: GW993-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW993-ST-1
Test Date : 3-16-18
Depth : 3.6'-3.8'
Test No. : GW993-ST-1
Sample Type: Undisturb

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 12 of 20
Stress increment from 2.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0732	0.592	7.17
2)	0.10	0.32	0.0737	0.592	7.22
3)	0.37	0.61	0.0737	0.592	7.22
4)	0.85	0.92	0.0737	0.592	7.22
5)	1.87	1.37	0.0742	0.591	7.27
6)	2.87	1.69	0.0742	0.591	7.27
7)	3.87	1.97	0.0747	0.590	7.32
8)	4.87	2.21	0.0747	0.590	7.32
9)	5.92	2.43	0.0747	0.590	7.32
10)	6.88	2.62	0.0747	0.590	7.32
11)	7.87	2.80	0.0742	0.591	7.27
12)	8.85	2.97	0.0747	0.590	7.32
13)	9.87	3.14	0.0747	0.590	7.32
14)	14.87	3.86	0.0747	0.590	7.32
15)	29.87	5.47	0.0752	0.589	7.37
16)	59.87	7.74	0.0752	0.589	7.37
17)	89.85	9.48	0.0757	0.588	7.42
18)	119.87	10.95	0.0752	0.589	7.37
19)	149.85	12.24	0.0757	0.588	7.42
20)	179.88	13.41	0.0757	0.588	7.42
21)	209.87	14.49	0.0762	0.587	7.47
22)	239.87	15.49	0.0757	0.588	7.42
23)	299.90	17.32	0.0757	0.588	7.42
24)	359.87	18.97	0.0757	0.588	7.42
25)	419.87	20.49	0.0757	0.588	7.42
26)	479.85	21.91	0.0762	0.587	7.47
27)	539.88	23.24	0.0762	0.587	7.47
28)	599.87	24.49	0.0757	0.588	7.42
29)	659.87	25.69	0.0762	0.587	7.47
30)	719.90	26.83	0.0762	0.587	7.47
31)	779.87	27.93	0.0762	0.587	7.47
32)	839.90	28.98	0.0762	0.587	7.47
33)	899.85	30.00	0.0762	0.587	7.47
34)	959.88	30.98	0.0762	0.587	7.47
35)	1019.85	31.94	0.0762	0.587	7.47

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW993-ST-1, 3.0'-5.0'
Project No.: 183923
Boring No.: GW993-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW993-ST-1
Test Date : 3-16-18
Depth : 3.6'-3.8'
Test No. : GW993-ST-1
Sample Type: Undisturb

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 13 of 20
Stress increment from 4.00 (t/ft^2) to 8.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0869	0.569	8.52
2)	0.15	0.39	0.0884	0.567	8.67
3)	0.40	0.63	0.0889	0.566	8.72
4)	0.90	0.95	0.0904	0.563	8.87
5)	1.88	1.37	0.0925	0.560	9.06
6)	2.90	1.70	0.0930	0.559	9.11
7)	3.92	1.98	0.0940	0.557	9.21
8)	4.92	2.22	0.0945	0.556	9.26
9)	5.90	2.43	0.0955	0.555	9.36
10)	6.90	2.63	0.0955	0.555	9.36
11)	7.90	2.81	0.0965	0.553	9.46
12)	8.90	2.98	0.0965	0.553	9.46
13)	9.92	3.15	0.0965	0.553	9.46
14)	14.92	3.86	0.0970	0.552	9.51
15)	29.90	5.47	0.0986	0.550	9.66
16)	59.92	7.74	0.0996	0.548	9.76
17)	89.92	9.48	0.1001	0.547	9.81
18)	119.88	10.95	0.1001	0.547	9.81
19)	149.90	12.24	0.1001	0.547	9.81
20)	179.92	13.41	0.1006	0.546	9.86
21)	209.90	14.49	0.1006	0.546	9.86
22)	239.90	15.49	0.1006	0.546	9.86
23)	299.90	17.32	0.1006	0.546	9.86
24)	359.92	18.97	0.1011	0.545	9.91
25)	419.90	20.49	0.1011	0.545	9.91
26)	479.88	21.91	0.1016	0.545	9.96
27)	539.88	23.24	0.1016	0.545	9.96
28)	599.90	24.49	0.1016	0.545	9.96
29)	659.90	25.69	0.1016	0.545	9.96
30)	719.90	26.83	0.1016	0.545	9.96
31)	779.88	27.93	0.1016	0.545	9.96
32)	839.90	28.98	0.1016	0.545	9.96
33)	899.88	30.00	0.1021	0.544	10.01
34)	959.92	30.98	0.1021	0.544	10.01
35)	1019.95	31.94	0.1016	0.545	9.96

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 13 of 20
Stress increment from 4.00 (t/ft^2) to 8.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.92	32.86	0.1016	0.545	9.96
37)	1139.88	33.76	0.1021	0.544	10.01
38)	1199.90	34.64	0.1021	0.544	10.01
39)	1259.90	35.50	0.1021	0.544	10.01
40)	1319.93	36.33	0.1021	0.544	10.01
41)	1379.90	37.15	0.1016	0.545	9.96
42)	1439.88	37.95	0.1016	0.545	9.96
43)	1456.38	38.16	0.1021	0.544	10.01

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 14 of 20
Stress increment from 8.00 (t/ft^2) to 16.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1158	0.521	11.36
2)	0.15	0.39	0.1173	0.518	11.50
3)	0.40	0.63	0.1194	0.515	11.70
4)	0.90	0.95	0.1214	0.511	11.90
5)	1.90	1.38	0.1240	0.507	12.15
6)	2.88	1.70	0.1255	0.504	12.30
7)	3.92	1.98	0.1265	0.503	12.40
8)	4.90	2.21	0.1275	0.501	12.50
9)	5.92	2.43	0.1280	0.500	12.55
10)	6.88	2.62	0.1285	0.499	12.60
11)	7.88	2.81	0.1290	0.498	12.65
12)	8.88	2.98	0.1290	0.498	12.65
13)	9.90	3.15	0.1295	0.498	12.70
14)	14.88	3.86	0.1306	0.496	12.80
15)	29.92	5.47	0.1321	0.493	12.95
16)	59.88	7.74	0.1326	0.492	13.00
17)	89.88	9.48	0.1331	0.492	13.05
18)	119.90	10.95	0.1331	0.492	13.05
19)	149.88	12.24	0.1331	0.492	13.05
20)	179.90	13.41	0.1336	0.491	13.10
21)	209.88	14.49	0.1336	0.491	13.10
22)	239.92	15.49	0.1336	0.491	13.10
23)	299.88	17.32	0.1341	0.490	13.15
24)	359.90	18.97	0.1341	0.490	13.15
25)	419.88	20.49	0.1341	0.490	13.15
26)	479.88	21.91	0.1346	0.489	13.20
27)	539.90	23.24	0.1346	0.489	13.20
28)	599.90	24.49	0.1346	0.489	13.20
29)	659.90	25.69	0.1346	0.489	13.20
30)	719.90	26.83	0.1346	0.489	13.20
31)	779.90	27.93	0.1346	0.489	13.20
32)	839.90	28.98	0.1351	0.488	13.25
33)	899.88	30.00	0.1351	0.488	13.25
34)	959.90	30.98	0.1351	0.488	13.25
35)	1019.88	31.94	0.1346	0.489	13.20

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 14 of 20
Stress increment from 8.00 (t/ft^2) to 16.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.1346	0.489	13.20
37)	1139.90	33.76	0.1346	0.489	13.20
38)	1199.88	34.64	0.1351	0.488	13.25
39)	1259.88	35.49	0.1346	0.489	13.20
40)	1319.90	36.33	0.1346	0.489	13.20
41)	1379.88	37.15	0.1351	0.488	13.25
42)	1439.70	37.94	0.1346	0.489	13.20

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 12 of 20
Stress increment from 2.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.0762	0.587	7.47
37)	1139.87	33.76	0.0762	0.587	7.47
38)	1199.87	34.64	0.0762	0.587	7.47
39)	1259.85	35.49	0.0762	0.587	7.47
40)	1319.85	36.33	0.0762	0.587	7.47
41)	1379.87	37.15	0.0762	0.587	7.47
42)	1387.98	37.26	0.0762	0.587	7.47

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW993-ST-1, 3.0'-5.0'
Project No.: 183923
Boring No.: GW993-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW993-ST-1
Test Date : 3-16-18
Depth : 3.6'-3.8'
Test No. : GW993-ST-1
Sample Type: Undisturb

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 15 of 20
Stress increment from 16.00 (t/ft^2) to 32.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1494	0.464	14.64
2)	0.17	0.41	0.1514	0.461	14.84
3)	0.43	0.66	0.1534	0.457	15.04
4)	0.93	0.97	0.1560	0.453	15.29
5)	1.90	1.38	0.1595	0.447	15.64
6)	2.92	1.71	0.1615	0.444	15.84
7)	3.93	1.98	0.1631	0.441	15.99
8)	4.93	2.22	0.1641	0.439	16.09
9)	5.93	2.44	0.1646	0.439	16.14
10)	6.90	2.63	0.1651	0.438	16.19
11)	7.92	2.81	0.1661	0.436	16.29
12)	8.92	2.99	0.1656	0.437	16.24
13)	9.92	3.15	0.1661	0.436	16.29
14)	14.92	3.86	0.1671	0.434	16.39
15)	29.92	5.47	0.1681	0.433	16.49
16)	59.90	7.74	0.1692	0.431	16.58
17)	89.92	9.48	0.1697	0.430	16.63
18)	119.90	10.95	0.1697	0.430	16.63
19)	149.92	12.24	0.1697	0.430	16.63
20)	179.92	13.41	0.1702	0.429	16.68
21)	209.93	14.49	0.1702	0.429	16.68
22)	239.90	15.49	0.1702	0.429	16.68
23)	299.92	17.32	0.1707	0.428	16.73
24)	359.90	18.97	0.1712	0.427	16.78
25)	419.90	20.49	0.1712	0.427	16.78
26)	479.92	21.91	0.1712	0.427	16.78
27)	539.92	23.24	0.1712	0.427	16.78
28)	599.90	24.49	0.1712	0.427	16.78
29)	659.90	25.69	0.1717	0.427	16.83
30)	719.92	26.83	0.1712	0.427	16.78
31)	779.92	27.93	0.1717	0.427	16.83
32)	839.90	28.98	0.1717	0.427	16.83
33)	899.93	30.00	0.1717	0.427	16.83
34)	959.93	30.98	0.1717	0.427	16.83
35)	1019.92	31.94	0.1717	0.427	16.83

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 15 of 20
Stress increment from 16.00 (t/ft^2) to 32.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.1722	0.426	16.88
37)	1139.93	33.76	0.1722	0.426	16.88
38)	1199.90	34.64	0.1717	0.427	16.83
39)	1259.90	35.50	0.1722	0.426	16.88
40)	1319.90	36.33	0.1722	0.426	16.88
41)	1379.90	37.15	0.1722	0.426	16.88
42)	1436.83	37.91	0.1722	0.426	16.88

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 16 of 20
Stress increment from 32.00 (t/ft^2) to 16.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1661	0.436	16.29
2)	0.15	0.39	0.1656	0.437	16.24
3)	0.42	0.65	0.1656	0.437	16.24
4)	0.90	0.95	0.1656	0.437	16.24
5)	1.92	1.38	0.1651	0.438	16.19
6)	2.92	1.71	0.1651	0.438	16.19
7)	3.90	1.97	0.1651	0.438	16.19
8)	4.92	2.22	0.1651	0.438	16.19
9)	5.92	2.43	0.1651	0.438	16.19
10)	6.92	2.63	0.1651	0.438	16.19
11)	7.92	2.81	0.1651	0.438	16.19
12)	8.92	2.99	0.1651	0.438	16.19
13)	9.95	3.15	0.1646	0.439	16.14
14)	14.90	3.86	0.1651	0.438	16.19
15)	29.93	5.47	0.1646	0.439	16.14
16)	59.92	7.74	0.1651	0.438	16.19
17)	89.92	9.48	0.1646	0.439	16.14
18)	119.93	10.95	0.1651	0.438	16.19
19)	149.90	12.24	0.1646	0.439	16.14
20)	179.90	13.41	0.1646	0.439	16.14
21)	209.90	14.49	0.1646	0.439	16.14
22)	239.90	15.49	0.1646	0.439	16.14
23)	299.92	17.32	0.1646	0.439	16.14
24)	359.90	18.97	0.1646	0.439	16.14
25)	419.93	20.49	0.1646	0.439	16.14
26)	479.92	21.91	0.1646	0.439	16.14
27)	539.92	23.24	0.1646	0.439	16.14
28)	599.90	24.49	0.1651	0.438	16.19
29)	659.93	25.69	0.1651	0.438	16.19
30)	719.92	26.83	0.1651	0.438	16.19
31)	779.90	27.93	0.1651	0.438	16.19
32)	839.90	28.98	0.1651	0.438	16.19
33)	899.88	30.00	0.1651	0.438	16.19
34)	959.92	30.98	0.1651	0.438	16.19
35)	1019.90	31.94	0.1646	0.439	16.14

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 16 of 20
Stress increment from 32.00 (t/ft^2) to 16.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.1646	0.439	16.14
37)	1139.90	33.76	0.1651	0.438	16.19
38)	1199.95	34.64	0.1646	0.439	16.14
39)	1259.93	35.50	0.1646	0.439	16.14
40)	1319.93	36.33	0.1646	0.439	16.14
41)	1379.90	37.15	0.1651	0.438	16.19
42)	1439.90	37.95	0.1646	0.439	16.14
43)	1499.95	38.73	0.1646	0.439	16.14
44)	1542.83	39.28	0.1646	0.439	16.14

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 17 of 20
Stress increment from 16.00 (t/ft^2) to 8.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1575	0.451	15.44
2)	0.15	0.39	0.1575	0.451	15.44
3)	0.40	0.63	0.1570	0.451	15.39
4)	0.90	0.95	0.1570	0.451	15.39
5)	1.90	1.38	0.1565	0.452	15.34
6)	2.92	1.71	0.1565	0.452	15.34
7)	3.92	1.98	0.1565	0.452	15.34
8)	4.90	2.21	0.1565	0.452	15.34
9)	5.90	2.43	0.1565	0.452	15.34
10)	6.90	2.63	0.1565	0.452	15.34
11)	7.90	2.81	0.1565	0.452	15.34
12)	8.90	2.98	0.1560	0.453	15.29
13)	9.92	3.15	0.1560	0.453	15.29
14)	14.90	3.86	0.1560	0.453	15.29
15)	29.90	5.47	0.1560	0.453	15.29
16)	59.92	7.74	0.1554	0.454	15.24
17)	89.90	9.48	0.1554	0.454	15.24
18)	119.90	10.95	0.1554	0.454	15.24
19)	149.92	12.24	0.1554	0.454	15.24
20)	179.90	13.41	0.1560	0.453	15.29
21)	209.90	14.49	0.1554	0.454	15.24
22)	239.92	15.49	0.1560	0.453	15.29
23)	299.90	17.32	0.1560	0.453	15.29
24)	359.92	18.97	0.1560	0.453	15.29
25)	419.90	20.49	0.1560	0.453	15.29
26)	479.90	21.91	0.1554	0.454	15.24
27)	539.90	23.24	0.1549	0.455	15.19
28)	599.90	24.49	0.1554	0.454	15.24
29)	659.92	25.69	0.1554	0.454	15.24
30)	719.90	26.83	0.1549	0.455	15.19
31)	779.90	27.93	0.1549	0.455	15.19
32)	839.90	28.98	0.1554	0.454	15.24
33)	899.90	30.00	0.1554	0.454	15.24
34)	959.92	30.98	0.1554	0.454	15.24
35)	1019.90	31.94	0.1554	0.454	15.24

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                                CONSOLIDATION TEST DATA

Project    : EMDF Characterization     Location    : GW993-ST-1, 3.0'-5.0'    Project No.: 183923
Boring No.: GW993-ST-1                 Tested by   : BMI: blc                 Checked by : KAF
Sample No.: GW993-ST-1                 Test Date   : 3-16-18                  Depth      : 3.6'-3.8'
Test No.   : GW993-ST-1                Sample Type: Undisturb

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 17 of 20
Stress increment from 16.00 (t/ft^2)  to 8.00 (t/ft^2)
Start Date :              Start Time :

              ELAPSED TIME      SQRT. OF      CHANGE IN       VOID       STRAIN
                 (min)         TIME (min)    HEIGHT (in)      RATIO       (%)

      36)      1079.90           32.86         0.1554         0.454       15.24
      37)      1139.90           33.76         0.1554         0.454       15.24
      38)      1199.90           34.64         0.1554         0.454       15.24
      39)      1259.90           35.50         0.1554         0.454       15.24
      40)      1319.90           36.33         0.1549         0.455       15.19
      41)      1379.90           37.15         0.1554         0.454       15.24
      42)      1439.90           37.95         0.1554         0.454       15.24
      43)      1499.90           38.73         0.1549         0.455       15.19
      44)      1559.88           39.50         0.1554         0.454       15.24
      45)      1619.90           40.25         0.1554         0.454       15.24
      46)      1679.90           40.99         0.1554         0.454       15.24
      47)      1739.90           41.71         0.1554         0.454       15.24
      48)      1799.90           42.43         0.1549         0.455       15.19
      49)      1859.88           43.13         0.1549         0.455       15.19
      50)      1919.90           43.82         0.1554         0.454       15.24
      51)      1979.90           44.50         0.1554         0.454       15.24
      52)      2039.90           45.17         0.1554         0.454       15.24
      53)      2099.90           45.82         0.1554         0.454       15.24
      54)      2159.88           46.47         0.1554         0.454       15.24
      55)      2219.90           47.12         0.1554         0.454       15.24
      56)      2279.88           47.75         0.1554         0.454       15.24
      57)      2339.90           48.37         0.1554         0.454       15.24
      58)      2399.90           48.99         0.1554         0.454       15.24
      59)      2459.88           49.60         0.1554         0.454       15.24
      60)      2519.90           50.20         0.1554         0.454       15.24
      61)      2579.88           50.79         0.1554         0.454       15.24
      62)      2639.90           51.38         0.1554         0.454       15.24
      63)      2699.90           51.96         0.1554         0.454       15.24
      64)      2759.88           52.53         0.1554         0.454       15.24
      65)      2813.40           53.04         0.1549         0.455       15.19
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CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 18 of 20
Stress increment from 8.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1499	0.463	14.69
2)	0.15	0.39	0.1499	0.463	14.69
3)	0.40	0.63	0.1494	0.464	14.64
4)	0.92	0.96	0.1488	0.465	14.59
5)	1.90	1.38	0.1488	0.465	14.59
6)	2.93	1.71	0.1483	0.466	14.54
7)	3.90	1.97	0.1483	0.466	14.54
8)	4.90	2.21	0.1483	0.466	14.54
9)	5.92	2.43	0.1483	0.466	14.54
10)	6.90	2.63	0.1483	0.466	14.54
11)	7.90	2.81	0.1478	0.467	14.49
12)	8.90	2.98	0.1483	0.466	14.54
13)	9.90	3.15	0.1483	0.466	14.54
14)	14.90	3.86	0.1478	0.467	14.49
15)	29.92	5.47	0.1478	0.467	14.49
16)	59.92	7.74	0.1473	0.468	14.44
17)	89.92	9.48	0.1478	0.467	14.49
18)	119.90	10.95	0.1473	0.468	14.44
19)	149.92	12.24	0.1473	0.468	14.44
20)	179.90	13.41	0.1468	0.468	14.39
21)	209.90	14.49	0.1473	0.468	14.44
22)	239.90	15.49	0.1468	0.468	14.39
23)	299.93	17.32	0.1468	0.468	14.39
24)	359.93	18.97	0.1468	0.468	14.39
25)	419.90	20.49	0.1468	0.468	14.39
26)	479.92	21.91	0.1468	0.468	14.39
27)	539.90	23.24	0.1468	0.468	14.39
28)	599.95	24.49	0.1468	0.468	14.39
29)	659.90	25.69	0.1468	0.468	14.39
30)	719.92	26.83	0.1468	0.468	14.39
31)	779.90	27.93	0.1468	0.468	14.39
32)	839.90	28.98	0.1468	0.468	14.39
33)	899.90	30.00	0.1468	0.468	14.39
34)	959.90	30.98	0.1468	0.468	14.39
35)	1019.88	31.94	0.1468	0.468	14.39

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 18 of 20
Stress increment from 8.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.1468	0.468	14.39
37)	1139.90	33.76	0.1468	0.468	14.39
38)	1199.90	34.64	0.1468	0.468	14.39
39)	1259.90	35.50	0.1468	0.468	14.39
40)	1319.90	36.33	0.1463	0.469	14.34
41)	1379.88	37.15	0.1463	0.469	14.34
42)	1407.02	37.51	0.1463	0.469	14.34

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 19 of 20
Stress increment from 4.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1427	0.475	13.99
2)	0.18	0.43	0.1422	0.476	13.95
3)	0.42	0.65	0.1422	0.476	13.95
4)	0.92	0.96	0.1422	0.476	13.95
5)	1.92	1.38	0.1417	0.477	13.90
6)	2.92	1.71	0.1417	0.477	13.90
7)	3.90	1.97	0.1412	0.478	13.85
8)	4.93	2.22	0.1412	0.478	13.85
9)	5.90	2.43	0.1412	0.478	13.85
10)	6.93	2.63	0.1412	0.478	13.85
11)	7.93	2.82	0.1407	0.479	13.80
12)	8.90	2.98	0.1407	0.479	13.80
13)	9.92	3.15	0.1407	0.479	13.80
14)	14.92	3.86	0.1402	0.480	13.75
15)	29.90	5.47	0.1402	0.480	13.75
16)	59.90	7.74	0.1397	0.480	13.70
17)	89.92	9.48	0.1397	0.480	13.70
18)	119.92	10.95	0.1397	0.480	13.70
19)	149.90	12.24	0.1397	0.480	13.70
20)	179.90	13.41	0.1397	0.480	13.70
21)	209.93	14.49	0.1392	0.481	13.65
22)	239.92	15.49	0.1392	0.481	13.65
23)	299.90	17.32	0.1392	0.481	13.65
24)	359.90	18.97	0.1387	0.482	13.60
25)	419.90	20.49	0.1392	0.481	13.65
26)	479.92	21.91	0.1387	0.482	13.60
27)	539.92	23.24	0.1387	0.482	13.60
28)	599.93	24.49	0.1392	0.481	13.65
29)	659.95	25.69	0.1387	0.482	13.60
30)	719.92	26.83	0.1392	0.481	13.65
31)	779.92	27.93	0.1392	0.481	13.65
32)	839.92	28.98	0.1387	0.482	13.60
33)	899.92	30.00	0.1392	0.481	13.65
34)	959.90	30.98	0.1387	0.482	13.60
35)	1019.90	31.94	0.1387	0.482	13.60

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 19 of 20
Stress increment from 4.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.92	32.86	0.1387	0.482	13.60
37)	1139.93	33.76	0.1392	0.481	13.65
38)	1199.93	34.64	0.1387	0.482	13.60
39)	1259.90	35.50	0.1392	0.481	13.65
40)	1319.90	36.33	0.1387	0.482	13.60
41)	1379.90	37.15	0.1387	0.482	13.60
42)	1421.33	37.70	0.1387	0.482	13.60

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0′-5.0′
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6′-3.8′

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 20 of 20
Stress increment from 2.00 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1372	0.485	13.45
2)	0.15	0.39	0.1367	0.486	13.40
3)	0.40	0.63	0.1361	0.486	13.35
4)	0.88	0.94	0.1367	0.486	13.40
5)	1.90	1.38	0.1356	0.487	13.30
6)	2.90	1.70	0.1356	0.487	13.30
7)	3.90	1.97	0.1356	0.487	13.30
8)	4.90	2.21	0.1351	0.488	13.25
9)	5.92	2.43	0.1351	0.488	13.25
10)	6.88	2.62	0.1351	0.488	13.25
11)	7.90	2.81	0.1351	0.488	13.25
12)	8.92	2.99	0.1346	0.489	13.20
13)	9.88	3.14	0.1346	0.489	13.20
14)	14.88	3.86	0.1346	0.489	13.20
15)	29.92	5.47	0.1341	0.490	13.15
16)	59.90	7.74	0.1336	0.491	13.10
17)	89.88	9.48	0.1336	0.491	13.10
18)	119.88	10.95	0.1336	0.491	13.10
19)	149.92	12.24	0.1331	0.492	13.05
20)	179.88	13.41	0.1331	0.492	13.05
21)	209.90	14.49	0.1331	0.492	13.05
22)	239.90	15.49	0.1331	0.492	13.05
23)	299.90	17.32	0.1326	0.492	13.00
24)	359.93	18.97	0.1331	0.492	13.05
25)	419.88	20.49	0.1326	0.492	13.00
26)	479.90	21.91	0.1326	0.492	13.00
27)	539.88	23.24	0.1326	0.492	13.00
28)	599.88	24.49	0.1326	0.492	13.00
29)	659.92	25.69	0.1326	0.492	13.00
30)	719.88	26.83	0.1326	0.492	13.00
31)	779.88	27.93	0.1326	0.492	13.00
32)	839.92	28.98	0.1326	0.492	13.00
33)	899.88	30.00	0.1326	0.492	13.00
34)	959.88	30.98	0.1326	0.492	13.00
35)	1019.88	31.94	0.1326	0.492	13.00

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW993-ST-1
Sample No.: GW993-ST-1
Test No. : GW993-ST-1

Location : GW993-ST-1, 3.0'-5.0'
Tested by : BMI: blc
Test Date : 3-16-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.6'-3.8'

Soil Description : brown clayey silt (visual description)
Remarks : Use: Fill, Near foundation/geobuffer layer

Load Increment : 20 of 20
Stress increment from 2.00 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.1326	0.492	13.00
37)	1139.92	33.76	0.1321	0.493	12.95
38)	1199.90	34.64	0.1321	0.493	12.95
39)	1259.88	35.49	0.1321	0.493	12.95
40)	1319.88	36.33	0.1321	0.493	12.95
41)	1379.88	37.15	0.1321	0.493	12.95
42)	1439.88	37.95	0.1321	0.493	12.95
43)	1444.40	38.01	0.1321	0.493	12.95

BOWSER-MORNER, INC.

Delivery Address: 4518 Taylorsville Road • Dayton, Ohio 45424 **Mailing Address**: P. O. Box 51 • Dayton, Ohio 45401

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LABORATORY REPORT

Report To: CTI & Associates, Inc.
Attn: Michael Partenio
28001 Cabot Drive, Ste. 250
Novi, MI 48377

Report Date: May 3, 2018
Job No.: 183923
Report No.: 430248
No. of Pages: 3

Report On: Laboratory Analysis of One Shelby Tube Sample
Project: EMDF Characterization – Project No. 1188070011
Sample ID: GW993 – ST-1, 3.0'-5.0' – Sample Date: 2/22/18

On March 5, 2018, one Shelby tube sample was submitted for selected laboratory analysis from the above referenced project. Testing was performed as specified by the client and in accordance with ASTM D 4767, "Consolidated-Undrained Triaxial Compression Test on Cohesive Soils".

Results are summarized below and detailed on the attached data sheets.

Test Parameter	Test No.1	Test No. 2	Test No. 3
Dry Density, pcf:	**102.14**	**100.35**	**100.05**
Moisture Content, %:	**22.47**	**25.41**	**25.51**
Minor Principle Stress, psi:	**5.69**	**12.39**	**32.39**
Maximum Deviator Stress, psi:	**21.30**	**24.07**	**22.39**
Cohesion (c'), psi:	**0.0**		
phi Angle (Ø'):	**30.0**		
Apparent Specific Gravity:	**2.73**		

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805 extension 322.

Respectfully submitted,

BOWSER-MORNER, INC.

Karl A. Fletcher, Manager
Construction Materials and
Geotechnical Laboratories

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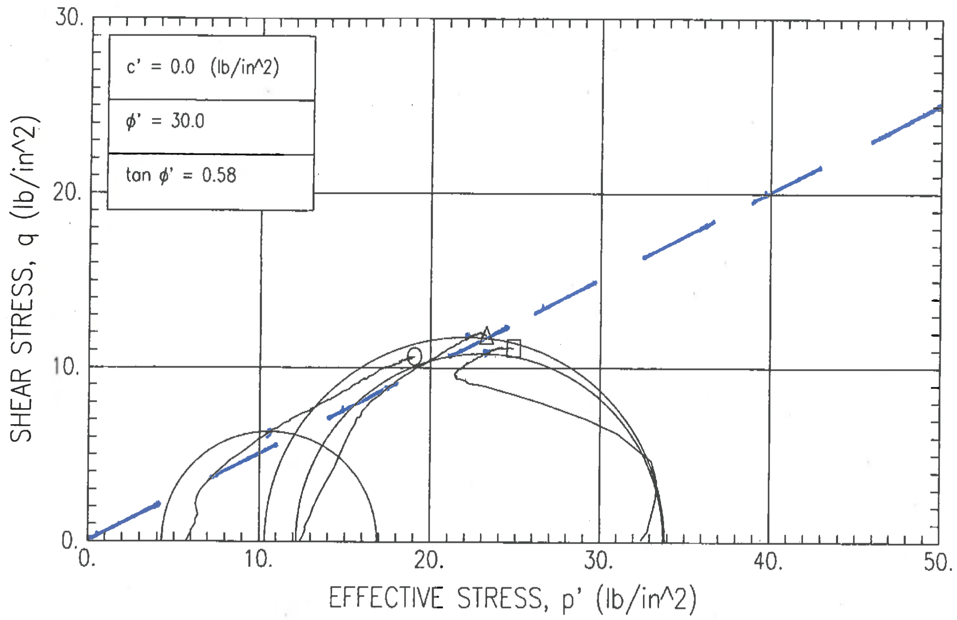
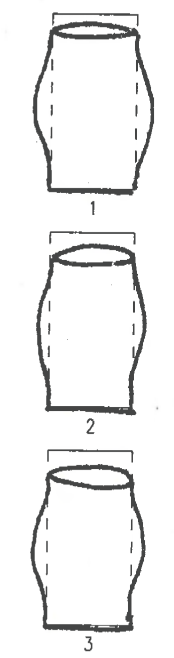
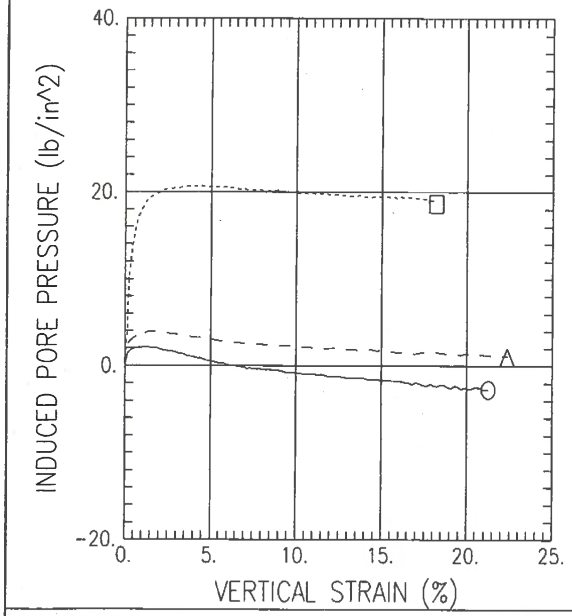
1-kfoye@cticompanies.com

$\text{Ø}' = \sin^{-1} 0.5 = 30.0°$



FAILURE SKETCHES





	SYMBOL	○	△	□
	TEST NO.	1	2	3
INITIAL	WATER CONTENT (%)	22.47	25.41	25.51
	DRY DENSITY (lb/ft^3)	102.14	100.35	100.05
	SATURATION (%)	91.66	99.23	98.93
	VOID RATIO	0.670	0.700	0.705
BEFORE SHEAR	WATER CONTENT (%)	24.01	24.44	22.88
	DRY DENSITY (lb/ft^3)	102.08	102.03	104.37
	SATURATION (%)	97.81	99.44	98.58
	VOID RATIO	0.671	0.672	0.635
	BACK PRESS. (lb/in^2)	49.31	52.61	47.61
	MINOR PRIN. STRESS (lb/in^2)	5.69	12.39	32.39
	MAX. DEV. STRESS (lb/in^2)	21.30	24.07	22.39
	TIME TO FAILURE (min)	1249	939	891
	RATE OF STRAIN INCR (%/min)	0.02	0.02	0.02
	INITIAL DIAMETER (in)	2.84	2.82	2.84
	INITIAL HEIGHT (in)	5.79	5.78	5.93

CONTROLLED STRAIN TEST

DESCRIPTION OF SPECIMENS: 1) brown clay, little gravel (visual description) 2) brown clay, little gravel (visual description) 3) brown clay, little gravel (visual description)

LL	PL	PI	GS 2.73	TYPE OF SPECIMEN 1	TYPE OF TEST CU (R)

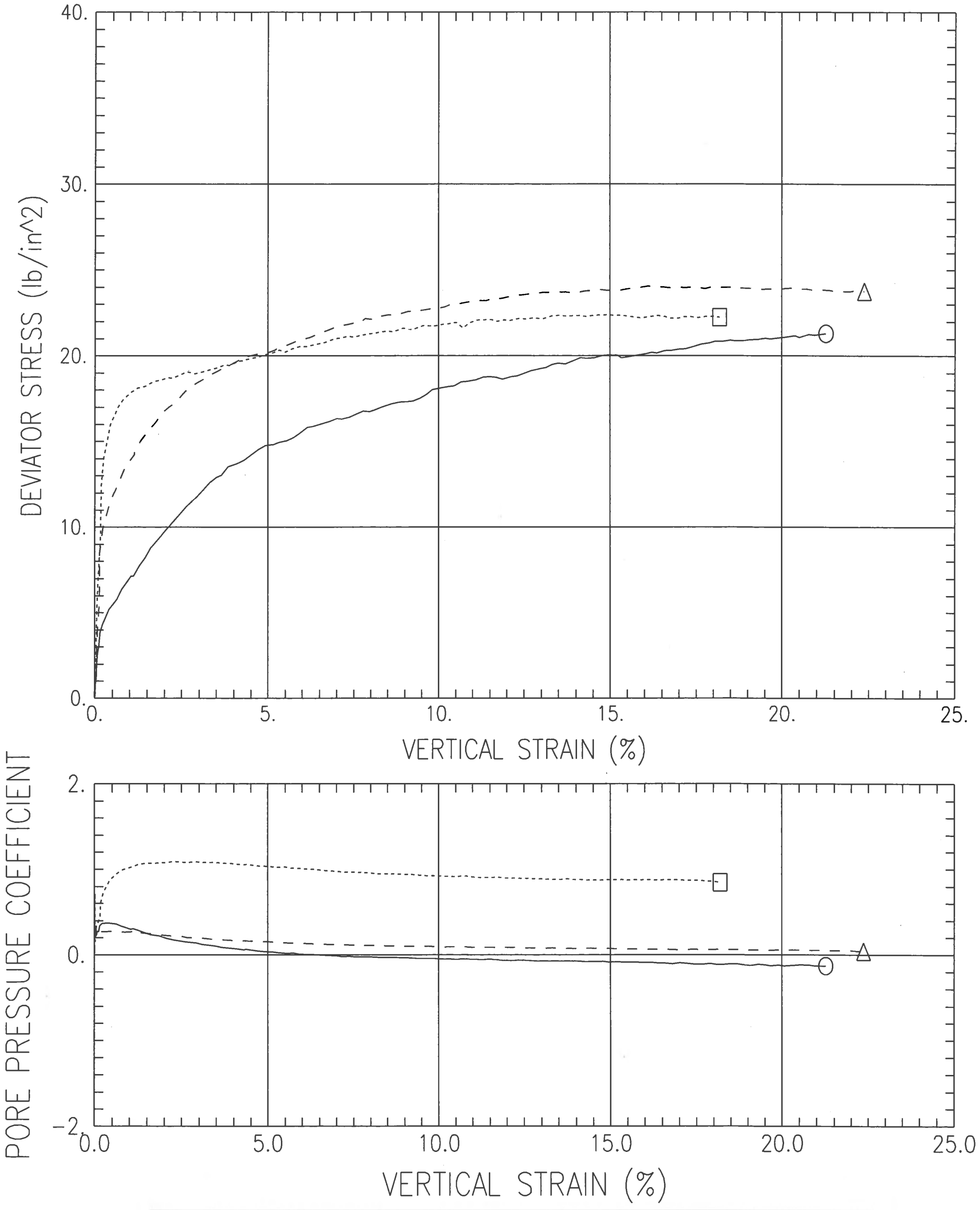
REMARKS:
1) Client: CTI & Associates, Inc.
2) Use: Fill, Near foundation/ geobuffer layer
3) Sample Date: 2-22-18

PROJECT EMDF Characterization
PROJECT NO.183923

BORING NO. GW993-ST-1	SAMPLE NO.	1	2	3
TECH. BMI: blc	DEPTH/ELEV	3.0-3.5'	3.9-5.1'	6.5-7.0'
LABORATORY	DATE	4-20-18	4-23-18	4-24-18

TRIAXIAL COMPRESSION TEST REPORT

CONSOLIDATED UNDRAINED TRIAXIAL TEST



Project Name : EMDF Characterization

Boring No: Sample No	Depth	Test No	Filename	Symbol
GW993-ST-11	3.0-3.5'	1	c:\geocomp\392311	○
GW993-ST-12	3.9-5.1'	2	c:\geocomp\392312	△
GW993-ST-23	6.5-7.0'	3	c:\geocomp\392313	□

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LABORATORY REPORT

Report To:
CTI & Associates, Inc.
Attn: Michael Partenio
28001 Cabot Drive, Ste. 250
Novi, MI 48377

Report Date: May 3, 2018
Job No.: 183923
Report No.: 430245
No. of Pages: 1

Report On:
Laboratory Analysis of One Shelby Tube Sample
Project: EMDF Characterization – Project No. 1188070011
Sample ID: GW993 – ST-1, 3.0'-5.0' – Sample Date: 2/22/18

On March 5, 2018, one Shelby tube sample was submitted for selected laboratory analysis from the above referenced project. Testing was performed as specified by the client and in accordance with the following procedures:

ASTM D 854, "Specific Gravity of Soils Solids by Water Pycnometer".
ASTM D 2216, "Laboratory Determination of Water (Moisture) Content of Soil and Rock".
ASTM D 7263, "Laboratory Determination of Density (Unit Weight) of Soil Specimens – Method B".

Results are summarized in the following table.

Test Parameter	Results
Depth of Test Specimen:	**3.9'-5.1'**
As Received Moisture Content, %:	**25.4**
Apparent Specific Gravity:	**2.73**
Wet Unit Weight, pcf:	**125.9**
Dry Unit Weight, pcf:	**100.4**
Void Ratio:	**0.6978**
Porosity, %:	**41.1**
Degree of Saturation, %:	**99.4**
Volume of Water, %:	**40.9**
Volume of Solids, %:	**58.9**
Air Filled Voids, %:	**0.6**
Water Filled Voids, %:	**99.4**

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805, extension 322.

Respectfully submitted,
BOWSER-MORNER, INC.

Karl A. Fletcher, Manager
Construction Materials and
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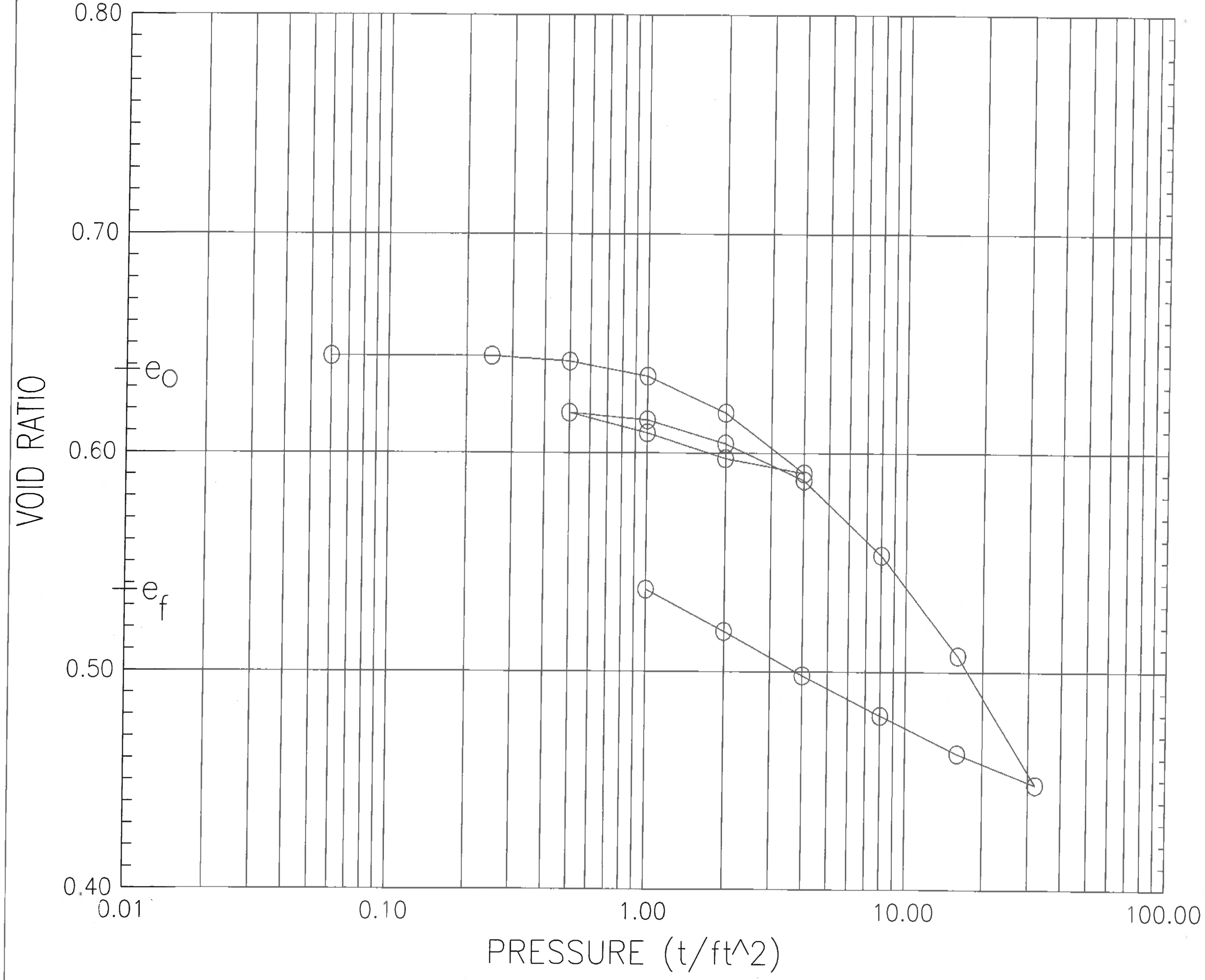


			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE (t/ft^2)		WATER CONTENT (%)	22.2	19.3
PRECONSOL. PRESSURE (t/ft^2)		DRY DENSITY (lb/ft^3)	103.68	110.48
COMPRESSION INDEX		SATURATION (%)	94.56	97.73
TYPE SPECIMEN	Undisturb	VOID RATIO	0.64	0.54
DIA. (in) 2.500	HT. (in) 1.000	BACK PRESSURE (t/ft^2)	---	---

CLASSIFICATION red/brown clayey silt (visual description)

LL --- PL --- PI ---

PROJECT EMDF Characterization

GS 2.721 D_{10}

995ST1

REMARKS

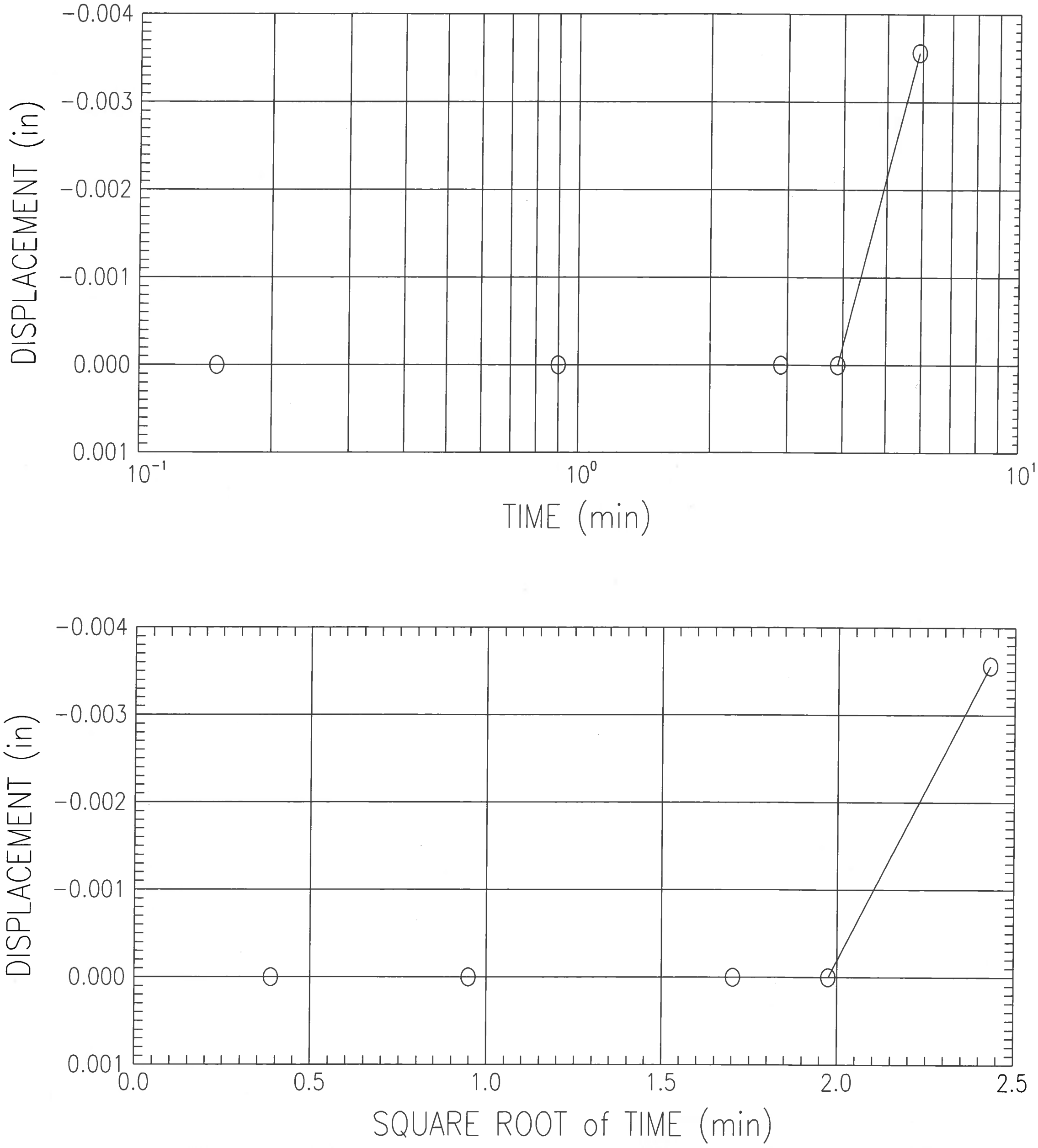
BORING NO. GW995-ST-1 SAMPLE NO. GW995-ST-1

Use: Near foundation/geobuffer layer

DEPTH 3.8'-4.0' DATE 3-15-18

Bowser Morner
CONSOLIDATION TEST REPORT

CONSOLIDATION TEST
TIME CURVES (STEP 1 OF 20)
STRESS : 0.06 (t/ft^2)



Bowser Morner

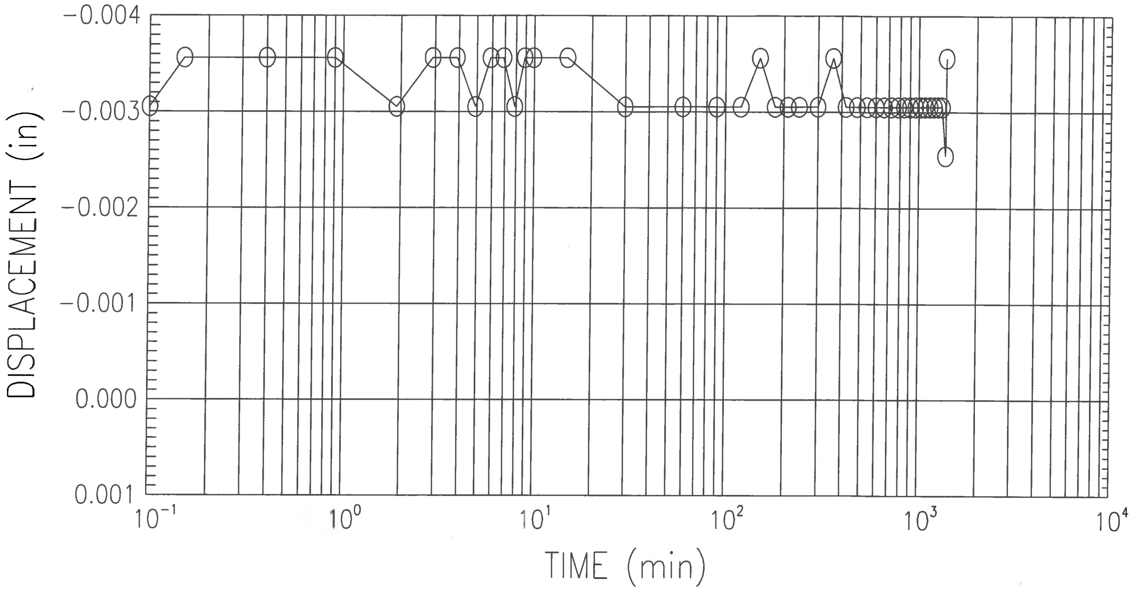
Project Name : EMDF Characterization

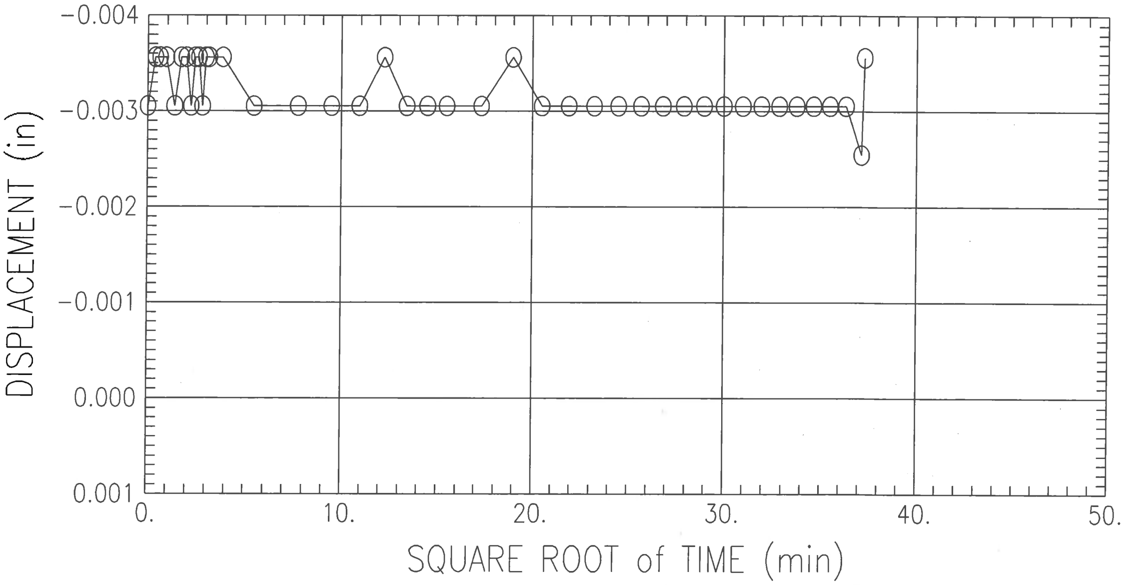
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1

Test Date : 3-15-18 Test No : GW995-ST-1 Depth :

Description : red/brown clayey silt (visual description)

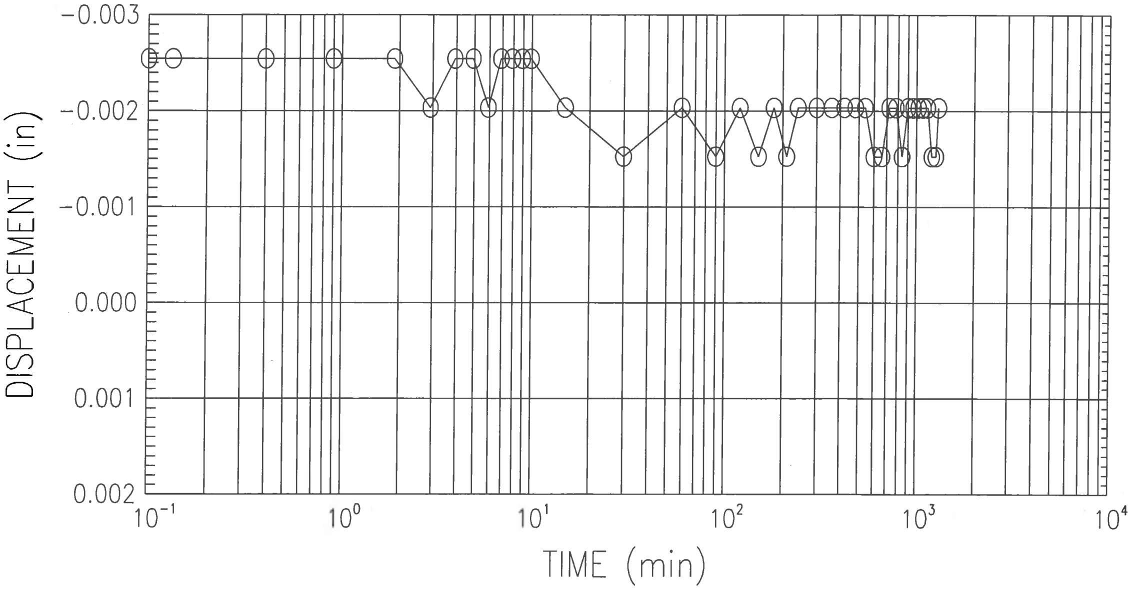
CONSOLIDATION TEST
TIME CURVES (STEP 2 OF 20)
STRESS : 0.25 (t/ft^2)

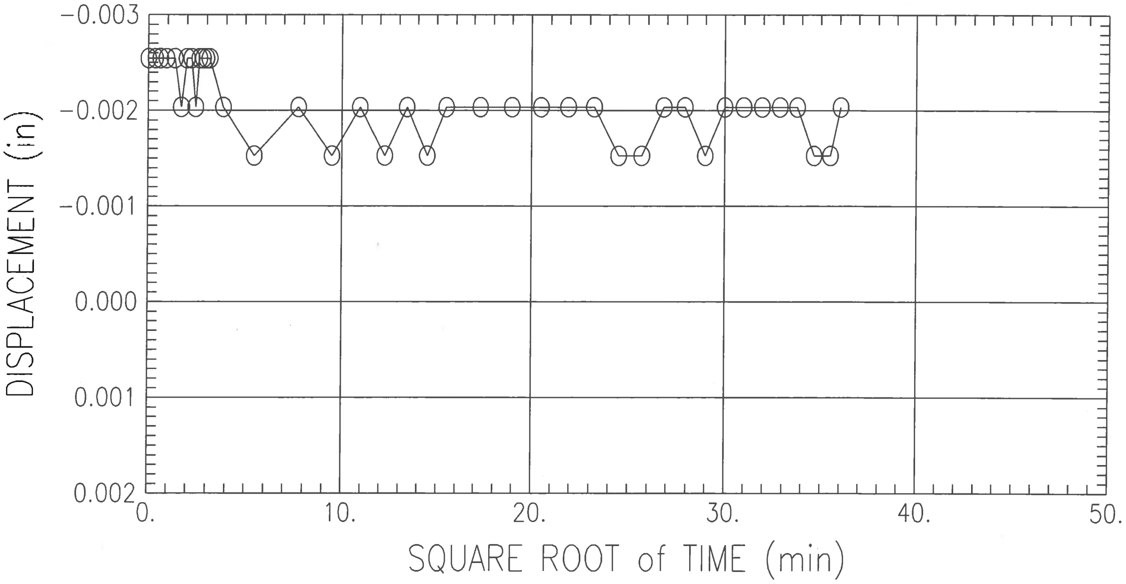




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1
Test Date : 3-15-18 Test No : GW995-ST-1 Depth :
Description : red/brown clayey silt (visual description)

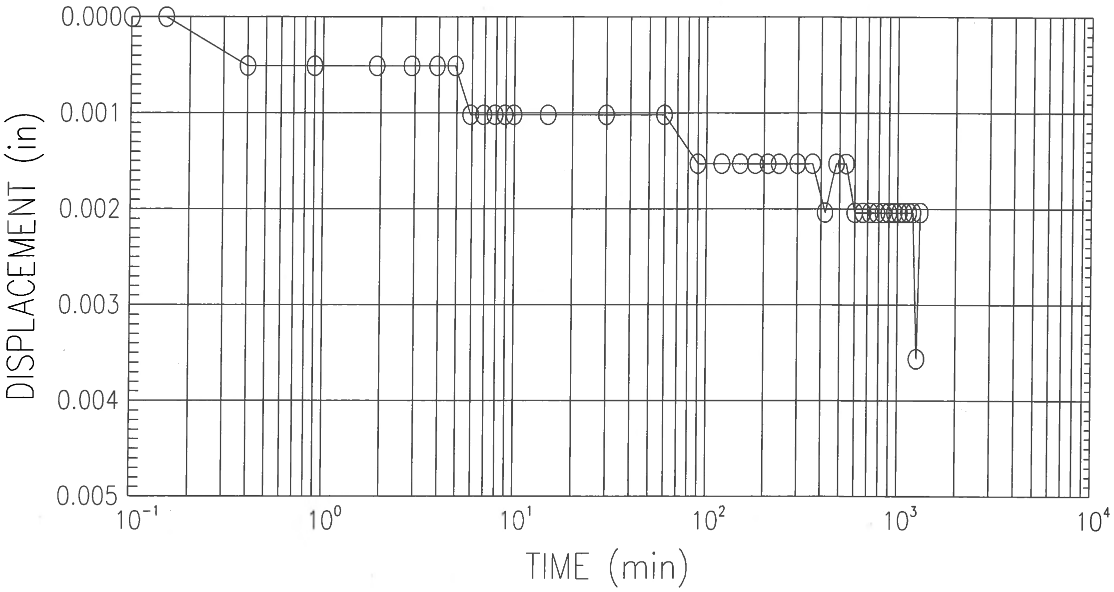
CONSOLIDATION TEST
TIME CURVES (STEP 3 OF 20)
STRESS : 0.5 (t/ft^2)

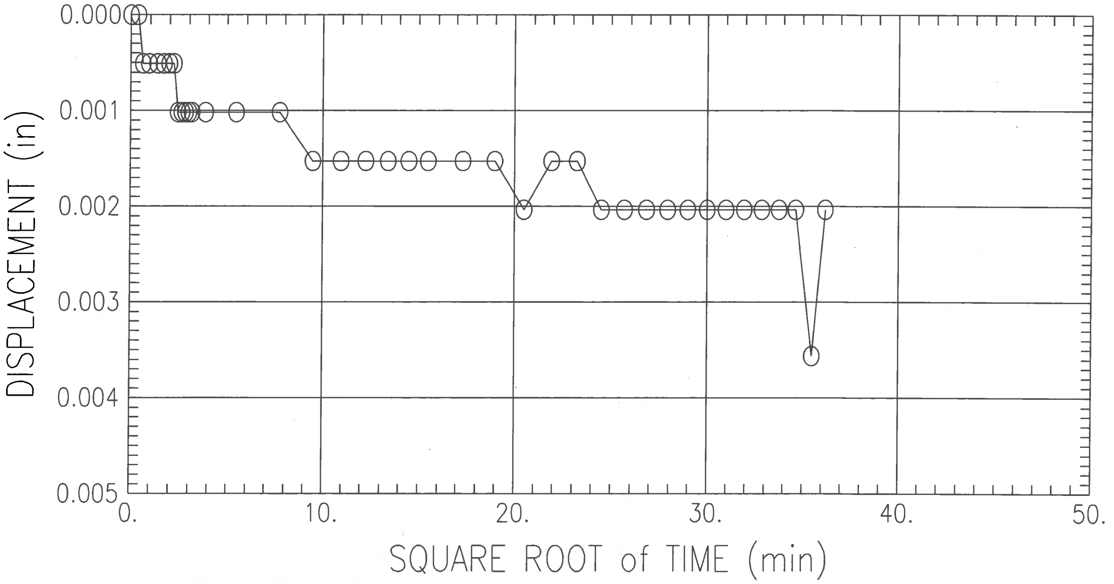




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1
Test Date : 3-15-18 Test No : GW995-ST-1 Depth :
Description : red/brown clayey silt (visual description)

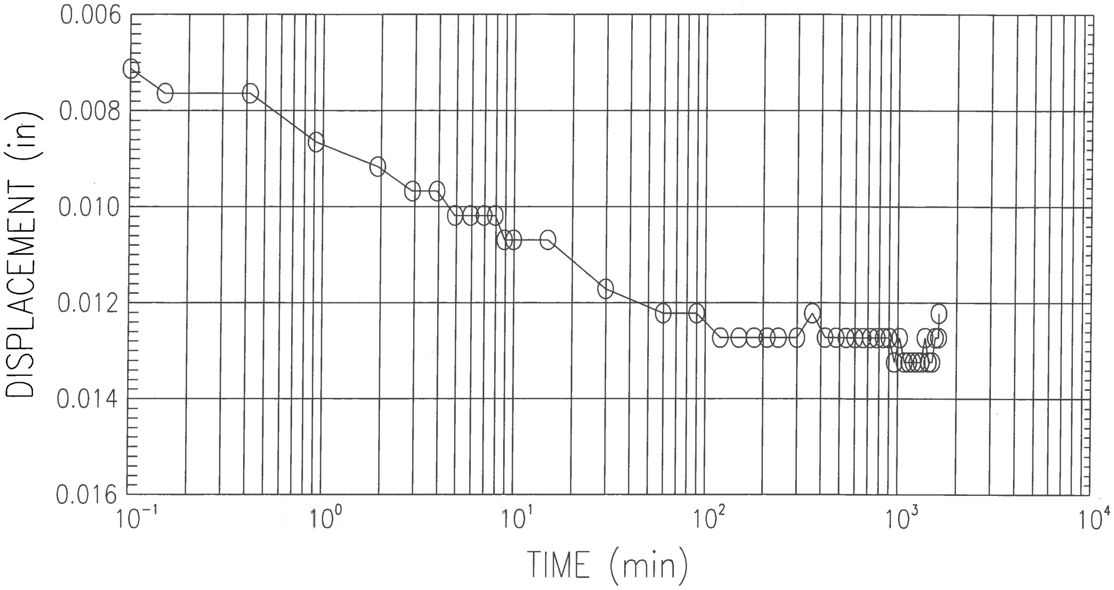
CONSOLIDATION TEST
TIME CURVES (STEP 4 OF 20)
STRESS : 1 (t/ft^2)

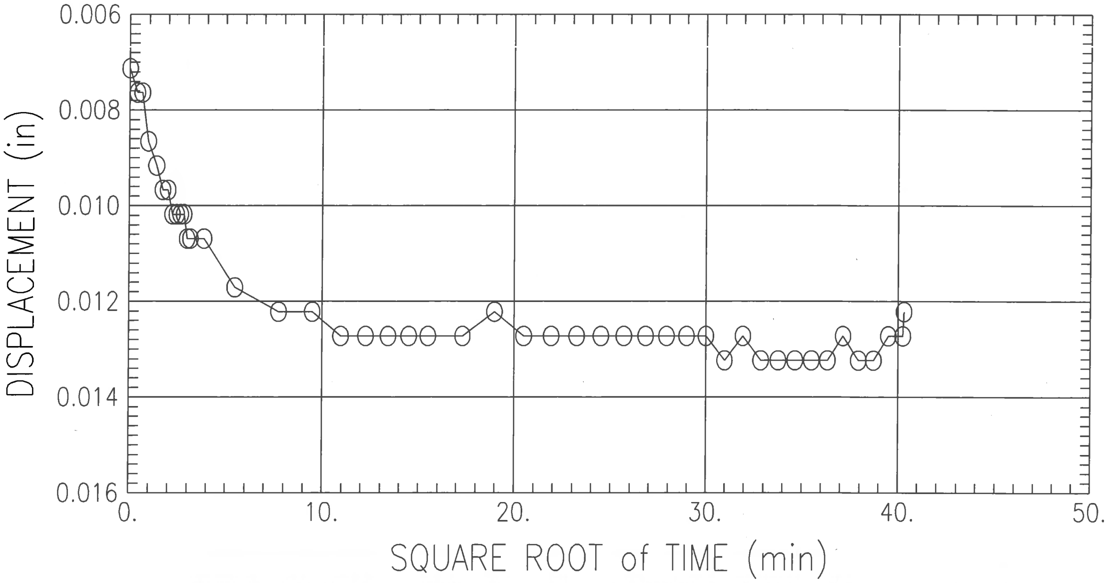




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1
Test Date : 3-15-18 Test No : GW995-ST-1 Depth :
Description : red/brown clayey silt (visual description)

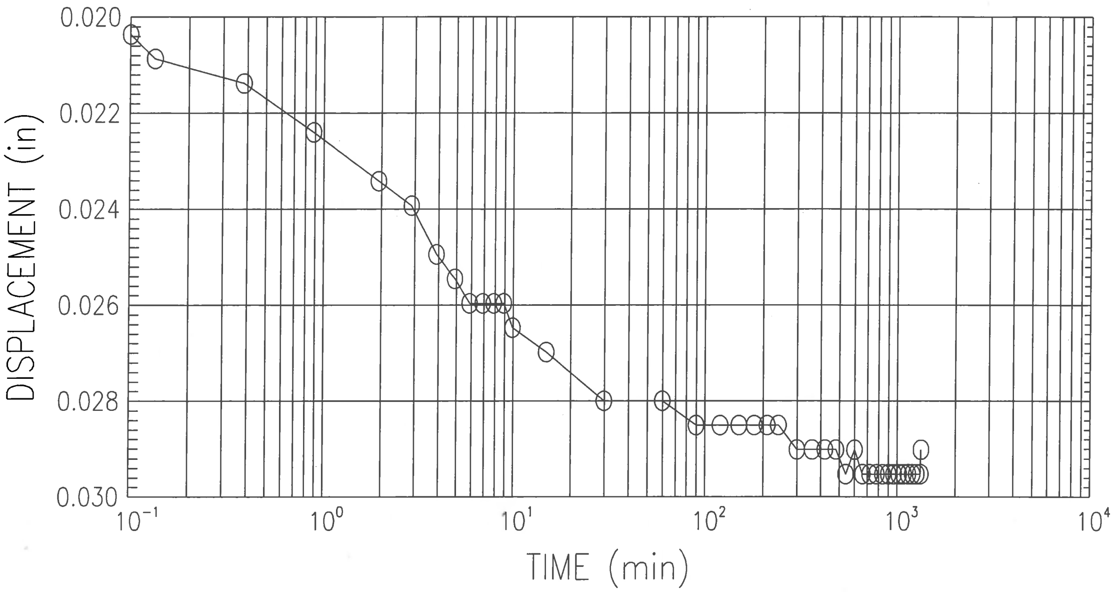
CONSOLIDATION TEST
TIME CURVES (STEP 5 OF 20)
STRESS : 2 (t/ft^2)

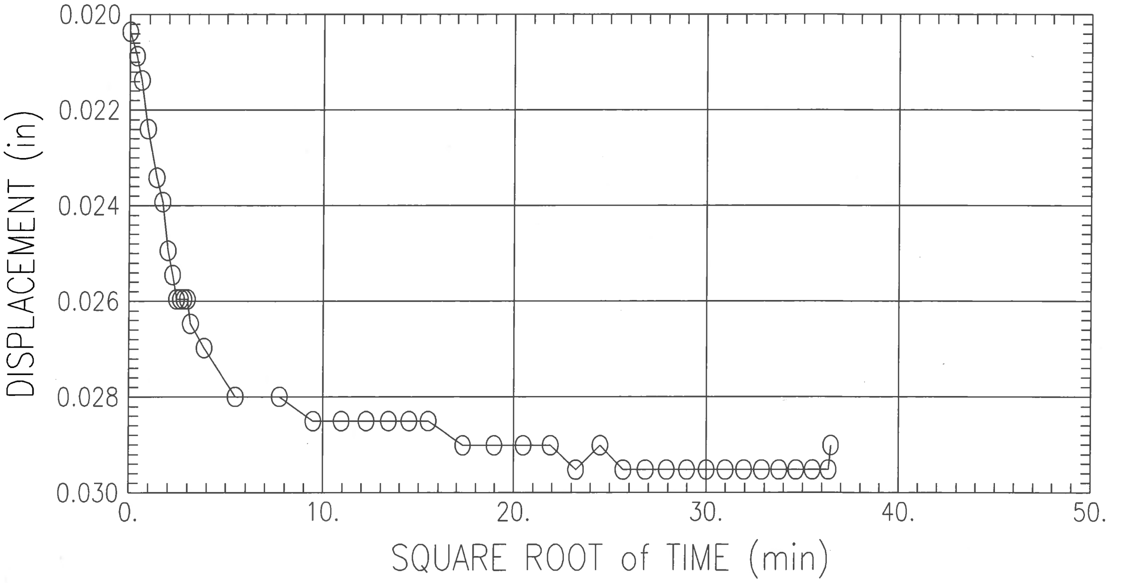




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1
Test Date : 3-15-18 Test No : GW995-ST-1 Depth :
Description : red/brown clayey silt (visual description)

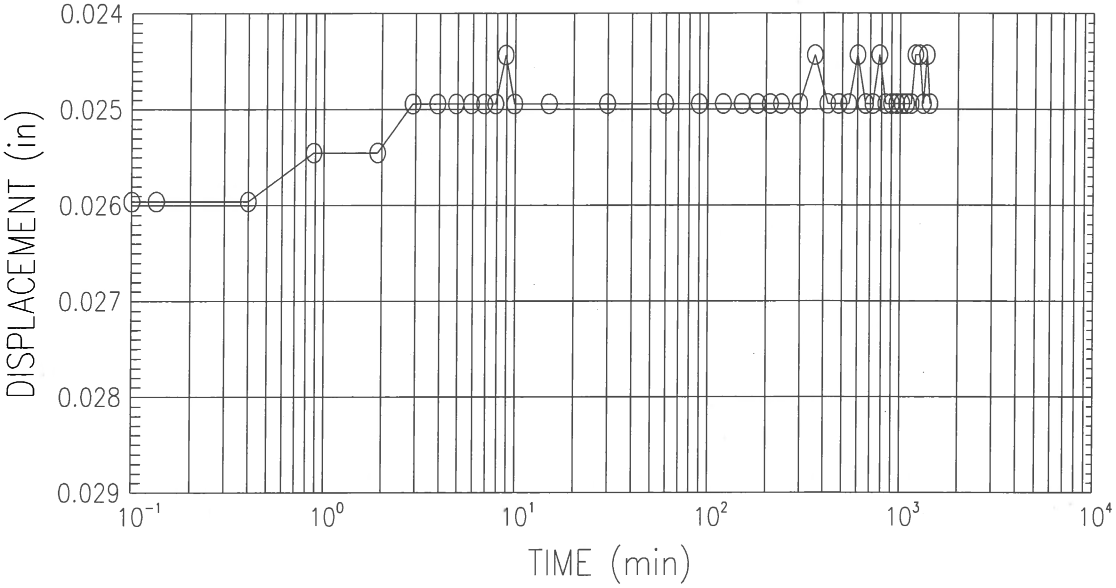
CONSOLIDATION TEST
TIME CURVES (STEP 6 OF 20)
STRESS : 4 (t/ft^2)

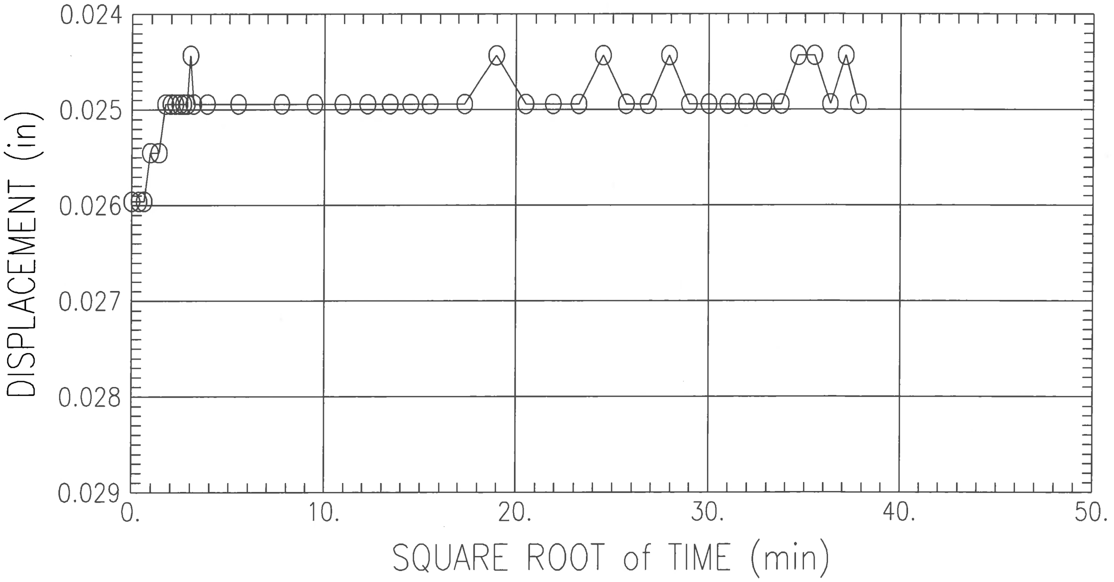




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1
Test Date : 3-15-18 Test No : GW995-ST-1 Depth :
Description : red/brown clayey silt (visual description)

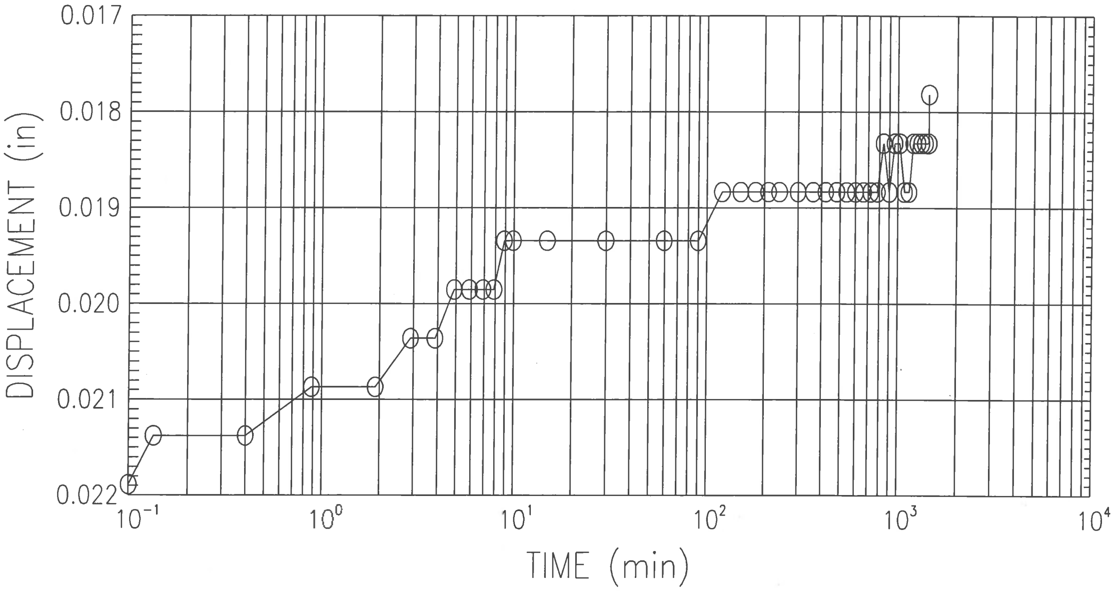
CONSOLIDATION TEST
TIME CURVES (STEP 7 OF 20)
STRESS : 2 (t/ft^2)

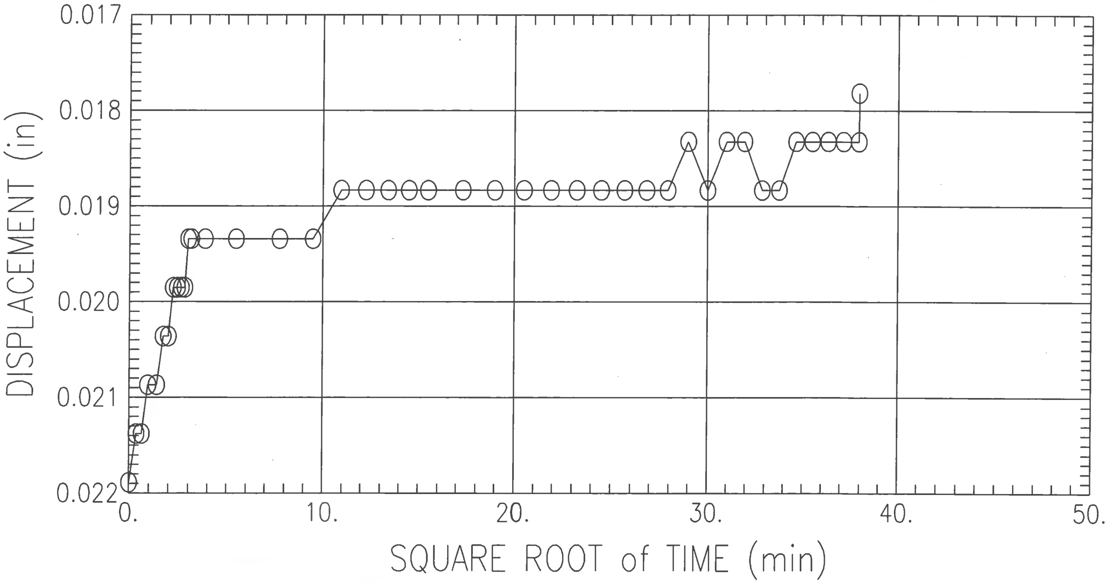




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1
Test Date : 3-15-18 Test No : GW995-ST-1 Depth :
Description : red/brown clayey silt (visual description)

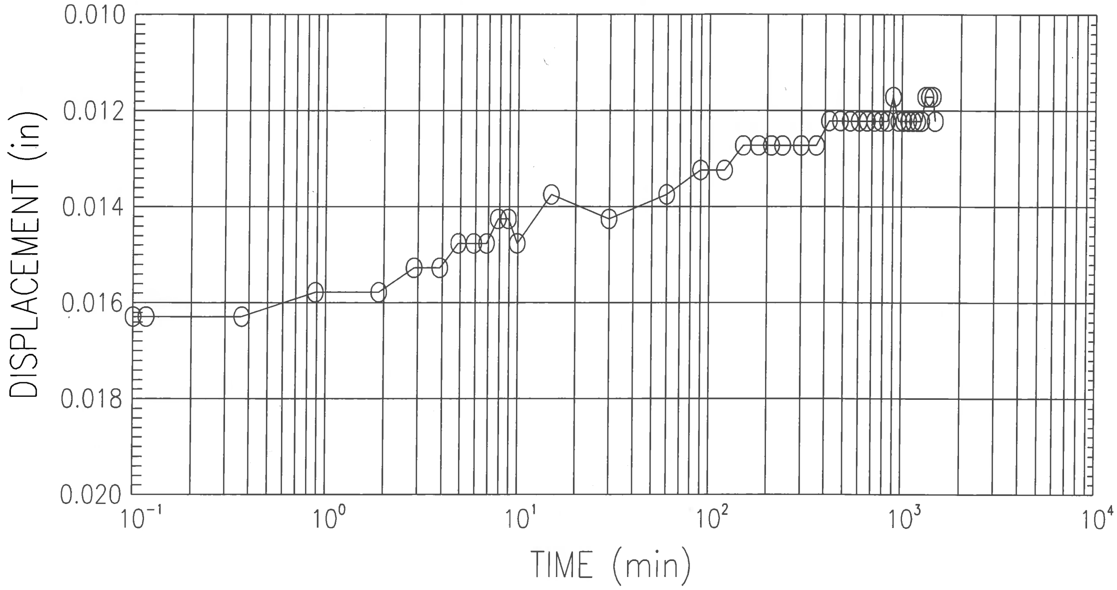
CONSOLIDATION TEST
TIME CURVES (STEP 8 OF 20)
STRESS : 1 (t/ft^2)

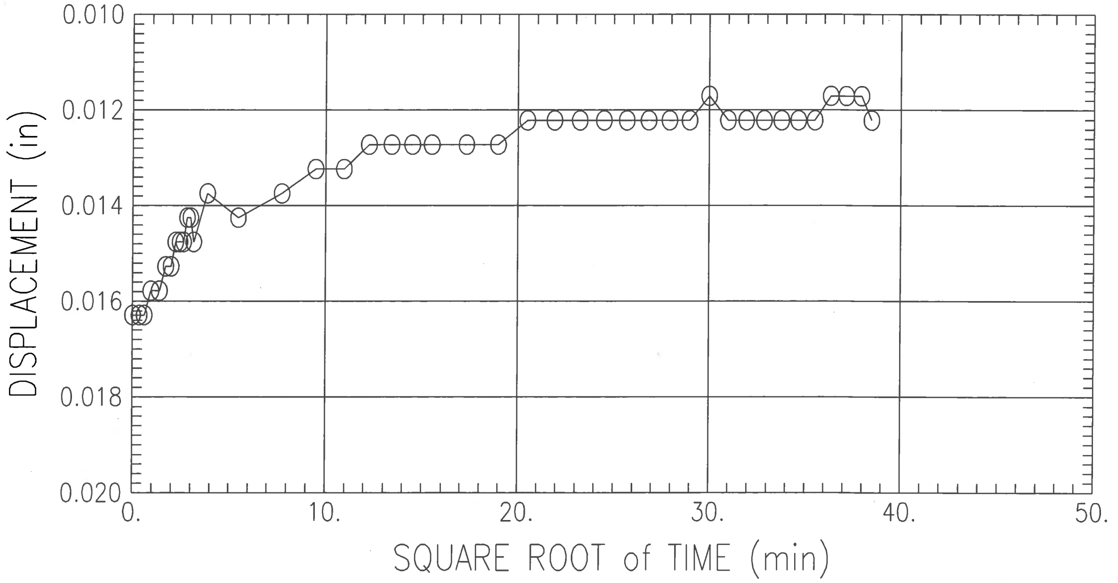




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1
Test Date : 3-15-18 Test No : GW995-ST-1 Depth :
Description : red/brown clayey silt (visual description)

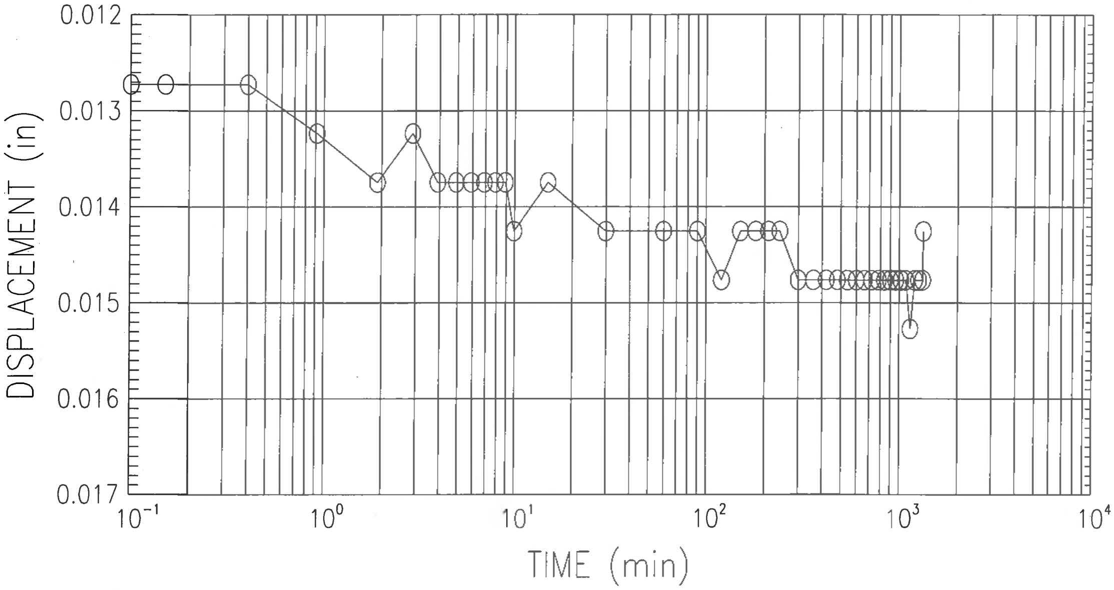
CONSOLIDATION TEST
TIME CURVES (STEP 9 OF 20)
STRESS : 0.5 (t/ft^2)

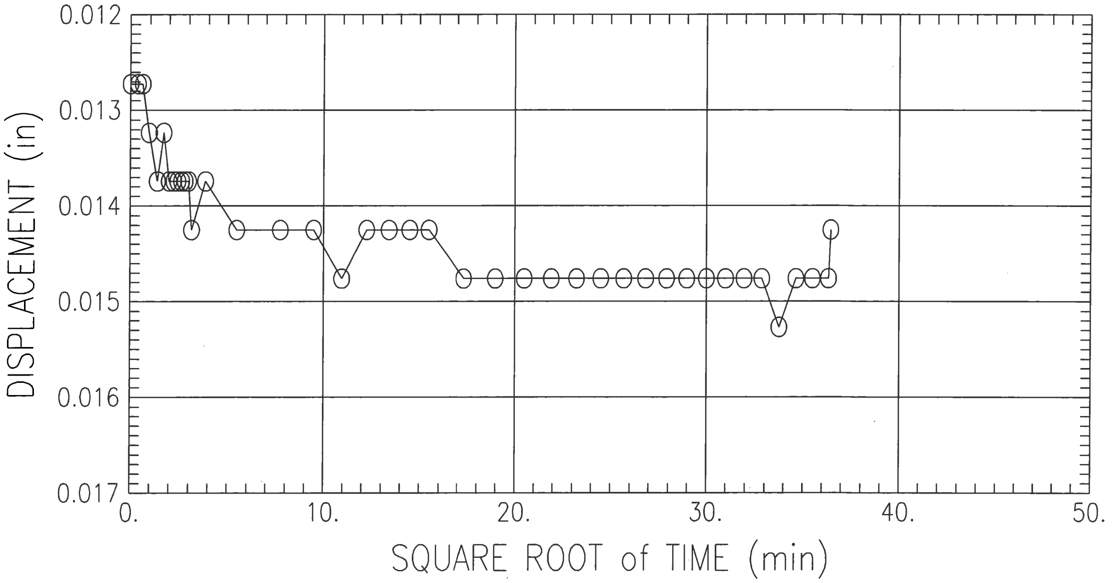




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1
Test Date : 3-15-18 Test No : GW995-ST-1 Depth :
Description : red/brown clayey silt (visual description)

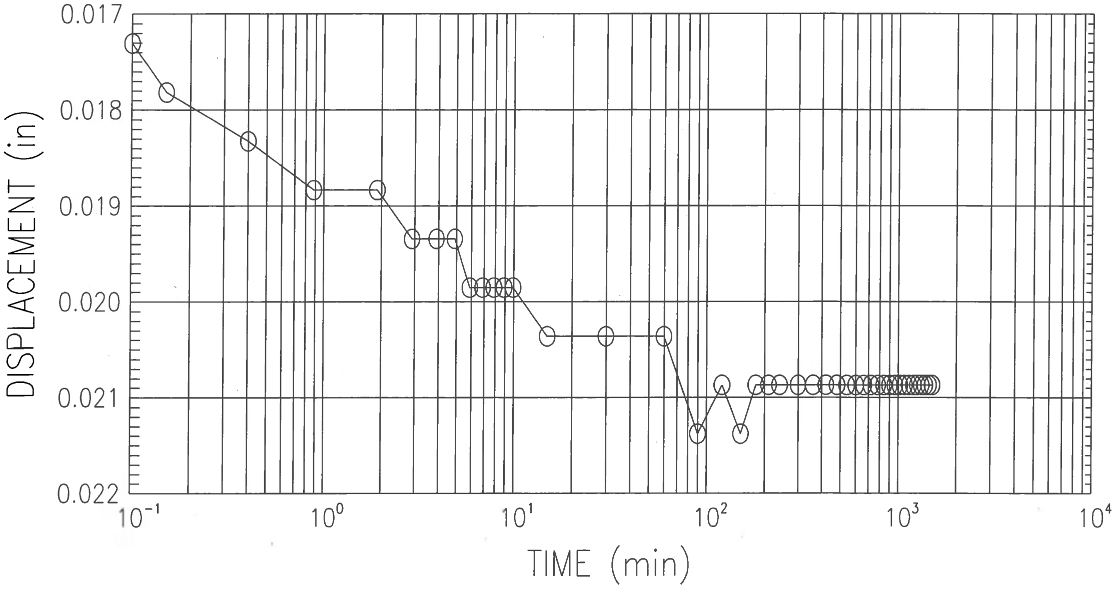
CONSOLIDATION TEST
TIME CURVES (STEP 10 OF 20)
STRESS : 1 (t/ft^2)

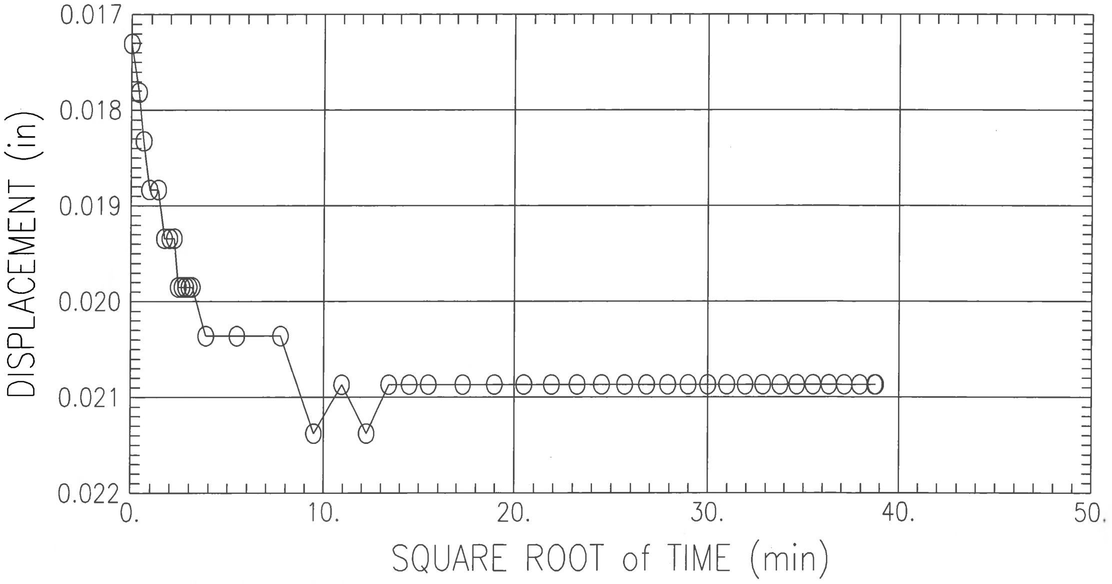




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1
Test Date : 3-15-18 Test No : GW995-ST-1 Depth :
Description : red/brown clayey silt (visual description)

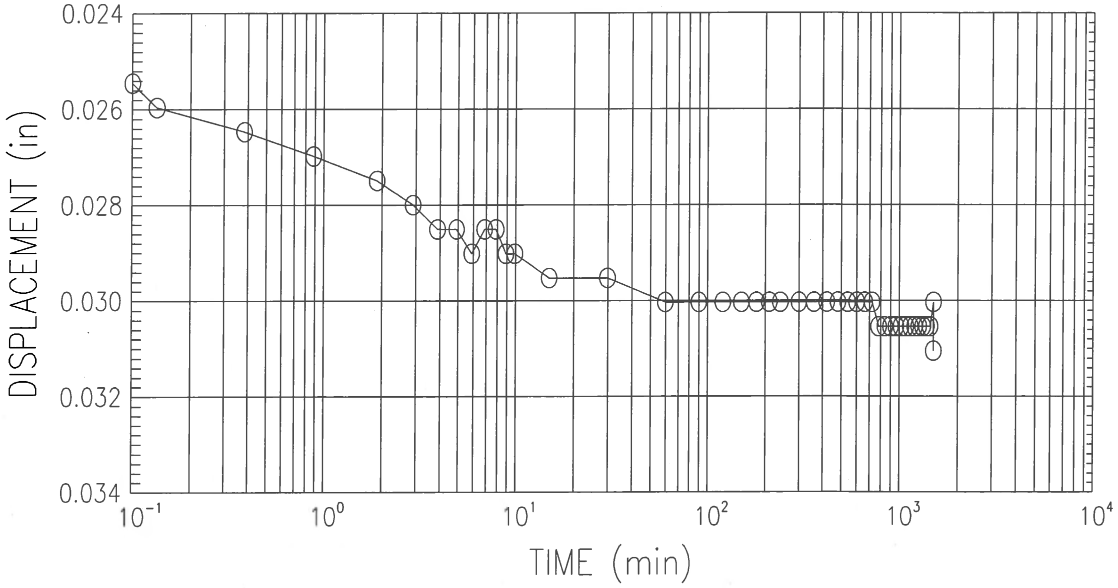
CONSOLIDATION TEST
TIME CURVES (STEP 11 OF 20)
STRESS : 2 (t/ft^2)

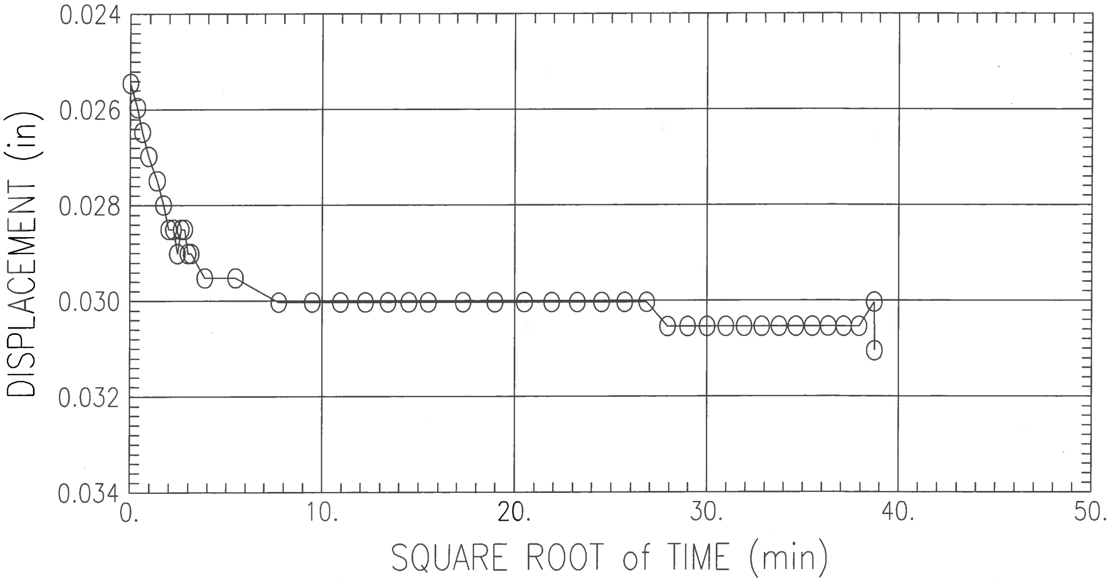




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1
Test Date : 3-15-18 Test No : GW995-ST-1 Depth :
Description : red/brown clayey silt (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 12 OF 20)
STRESS : 4 (t/ft^2)





Bowser Morner

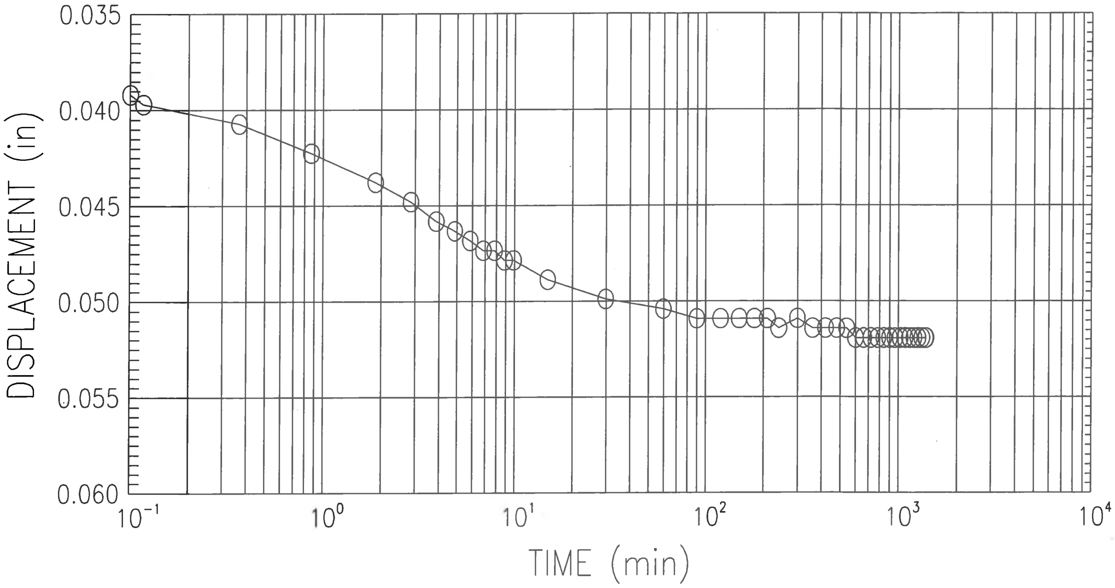
Project Name : EMDF Characterization

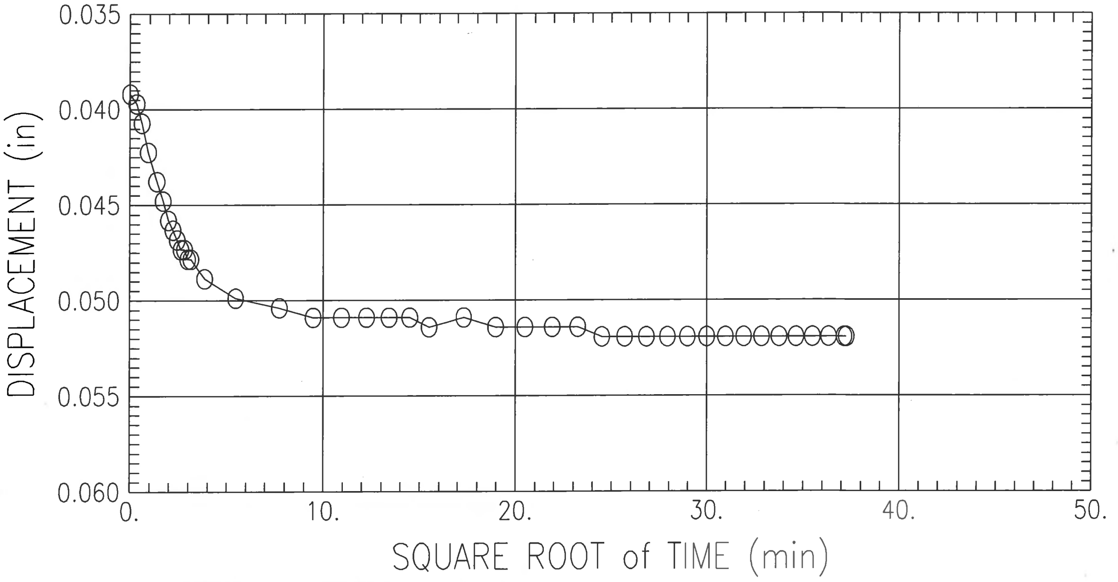
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1

Test Date : 3-15-18 Test No : GW995-ST-1 Depth :

Description : red/brown clayey silt (visual description)

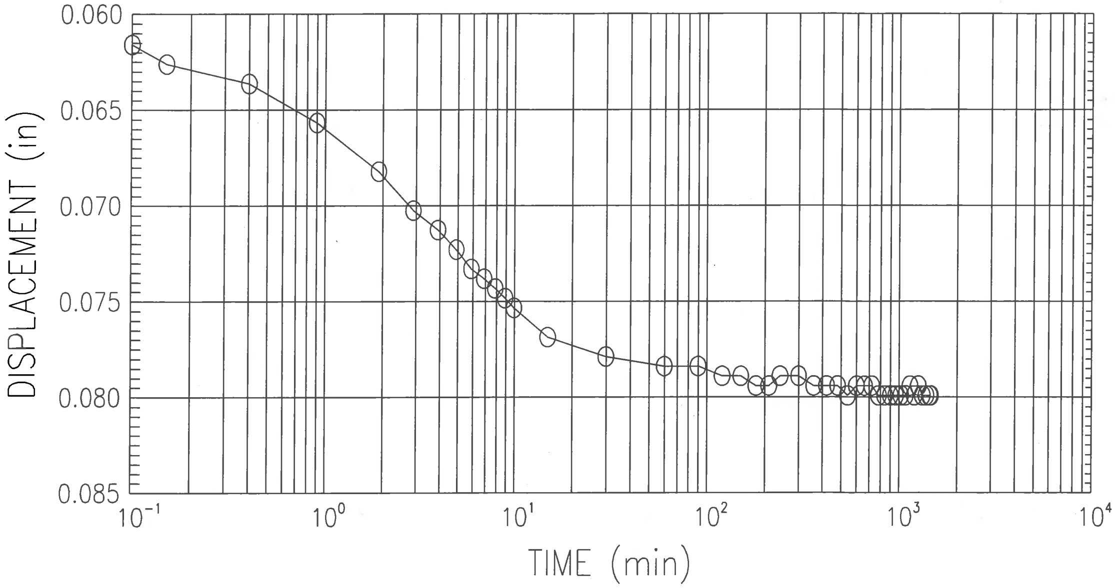
CONSOLIDATION TEST
TIME CURVES (STEP 13 OF 20)
STRESS : 8 (t/ft^2)

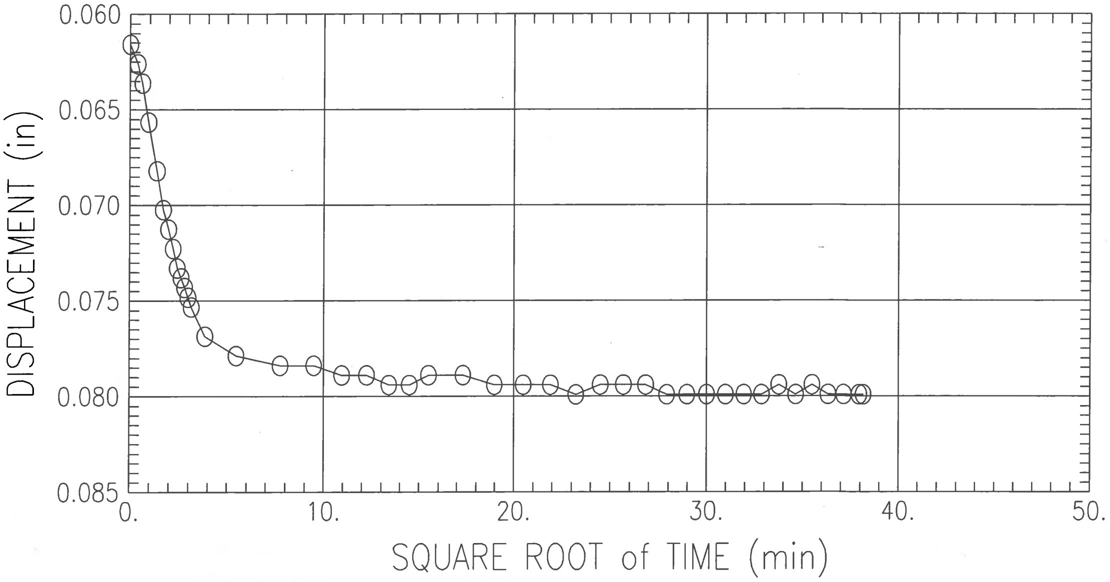




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1
Test Date : 3-15-18 Test No : GW995-ST-1 Depth :
Description : red/brown clayey silt (visual description)

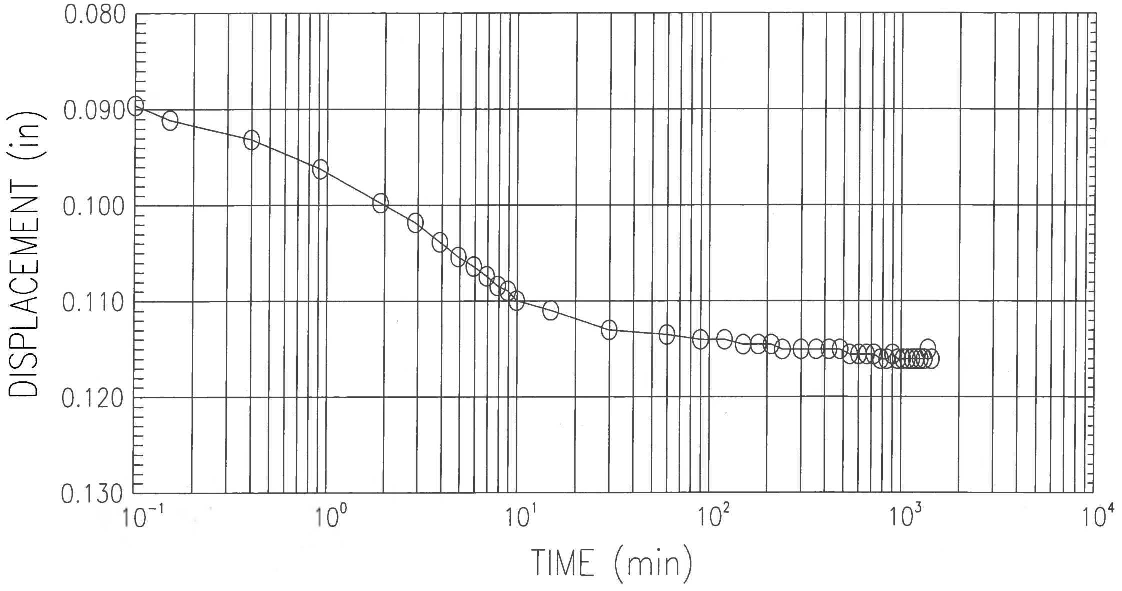
CONSOLIDATION TEST
TIME CURVES (STEP 14 OF 20)
STRESS : 16 (t/ft^2)

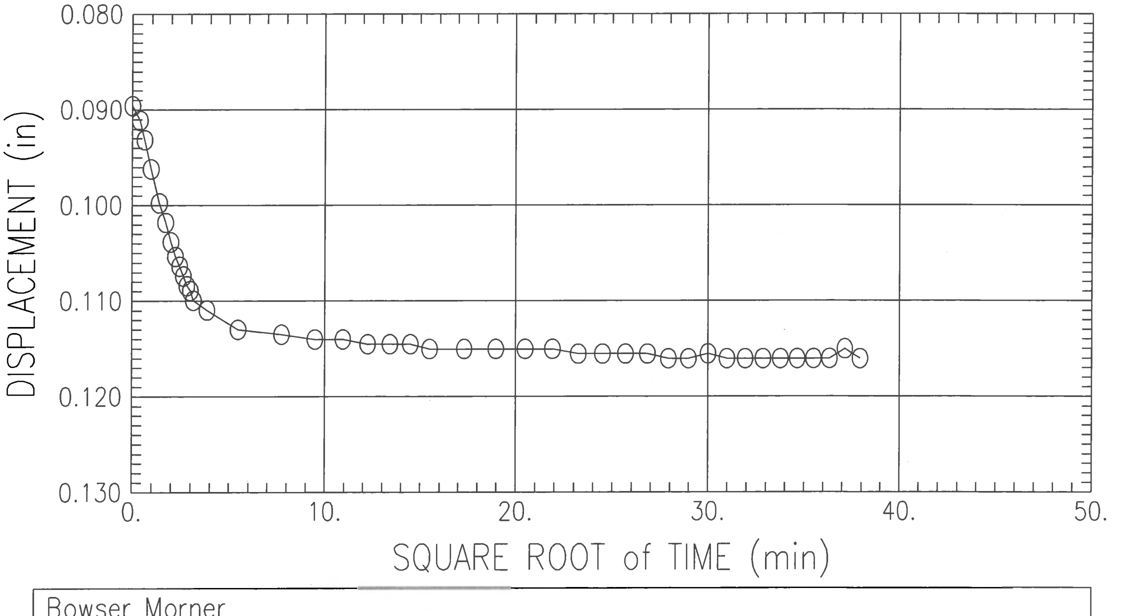




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1
Test Date : 3-15-18 Test No : GW995-ST-1 Depth :
Description : red/brown clayey silt (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 15 OF 20)
STRESS : 32 (t/ft^2)





Bowser Morner

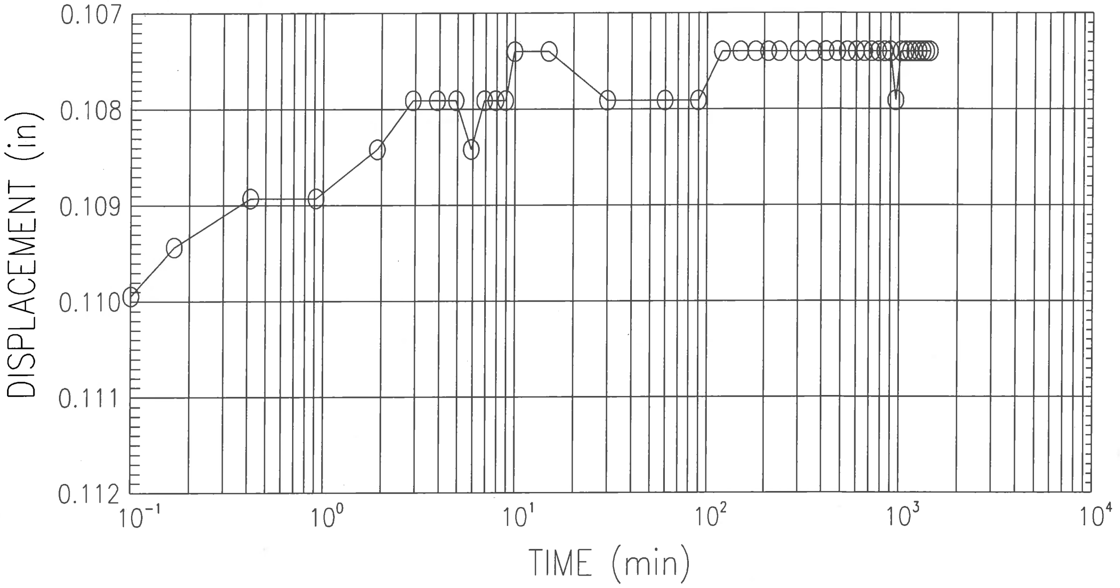
Project Name : EMDF Characterization

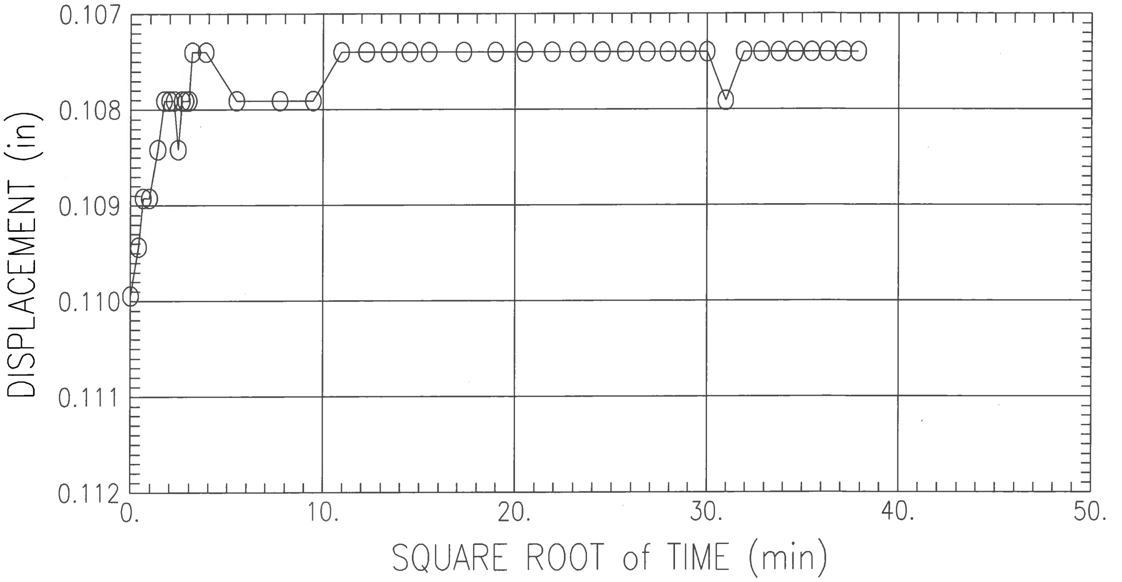
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1

Test Date : 3-15-18 Test No : GW995-ST-1 Depth :

Description : red/brown clayey silt (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 16 OF 20)
STRESS : 16 (t/ft^2)





Bowser Morner

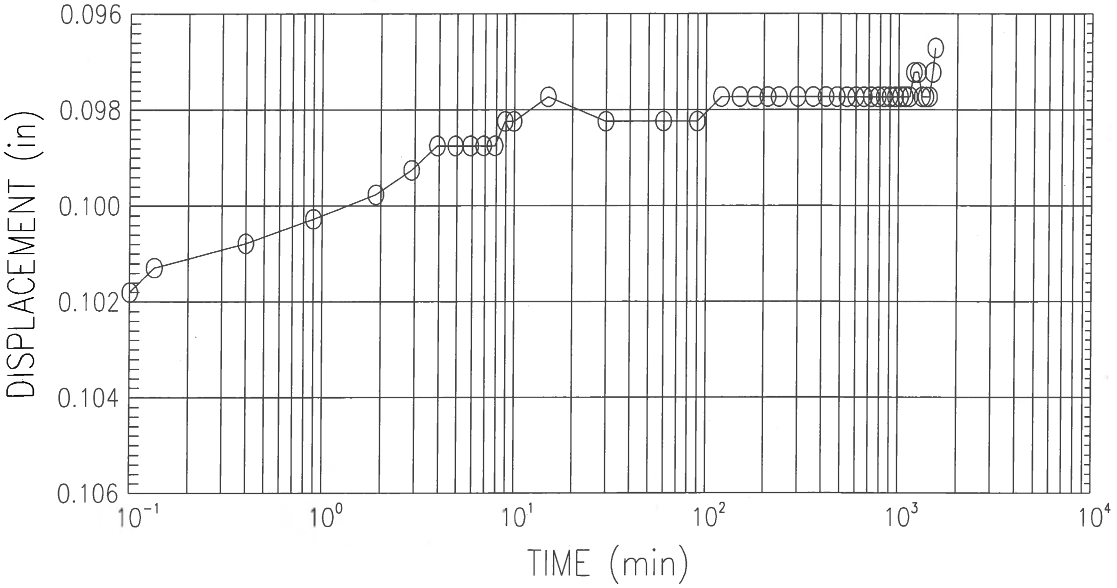
Project Name : EMDF Characterization

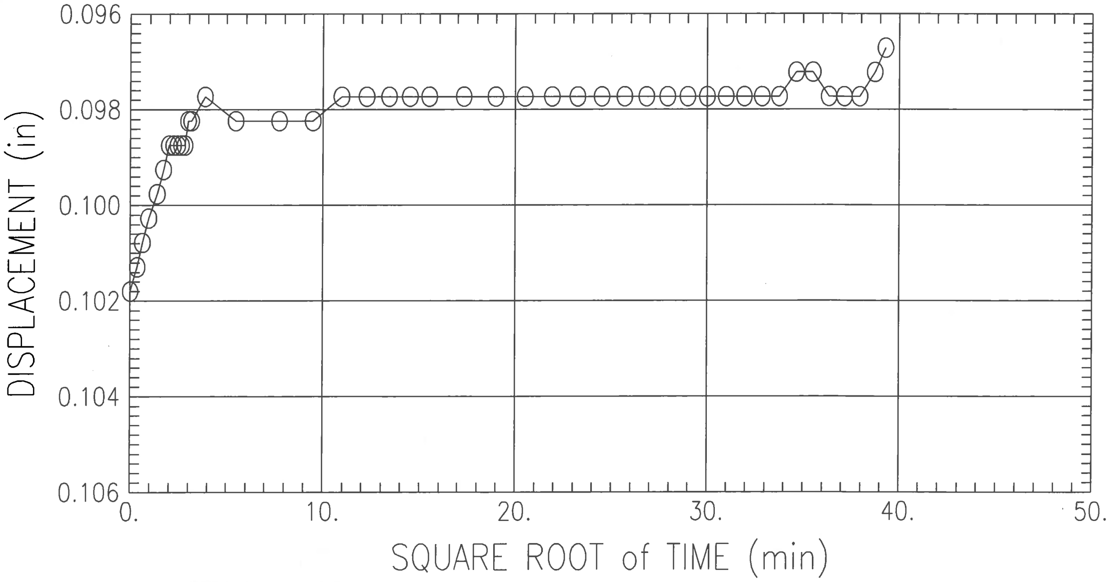
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1

Test Date : 3-15-18 Test No : GW995-ST-1 Depth :

Description : red/brown clayey silt (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 17 OF 20)
STRESS : 8 (t/ft^2)





Bowser Morner

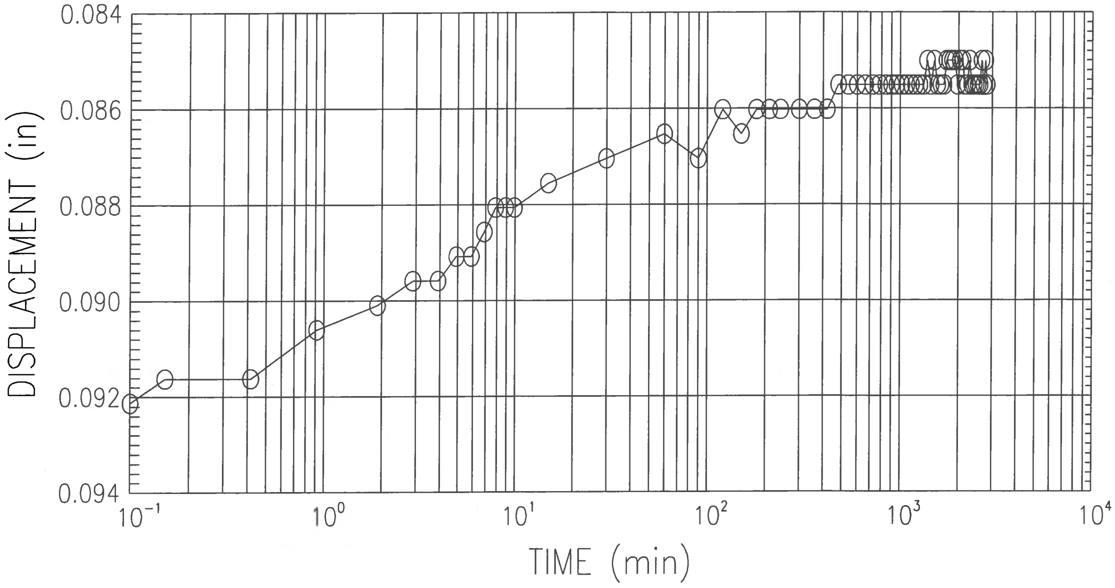
Project Name : EMDF Characterization

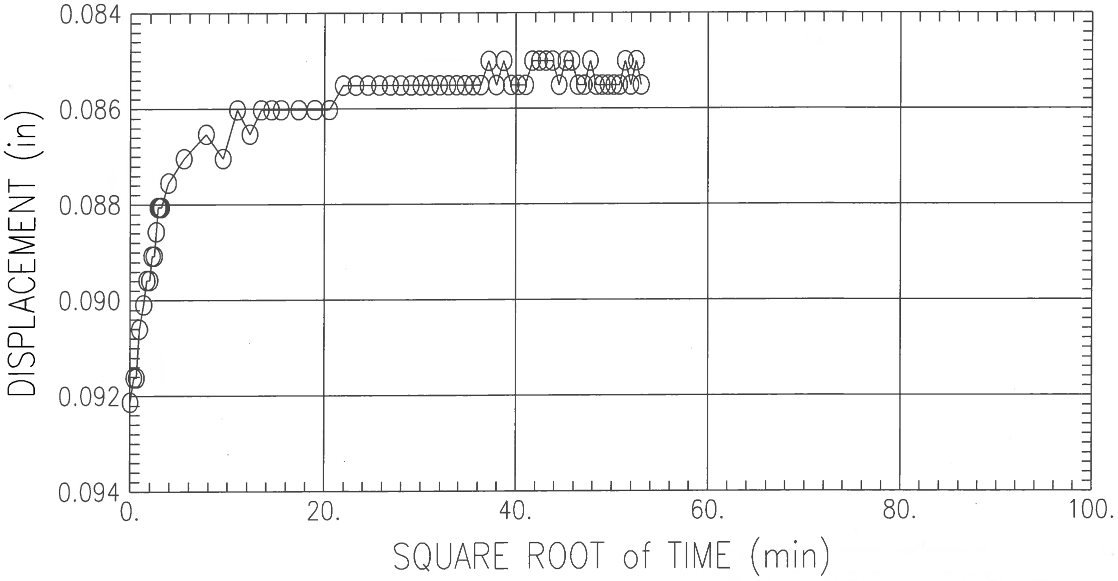
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1

Test Date : 3-15-18 Test No : GW995-ST-1 Depth :

Description : red/brown clayey silt (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 18 OF 20)
STRESS : 4 (t/ft^2)





Bowser Morner

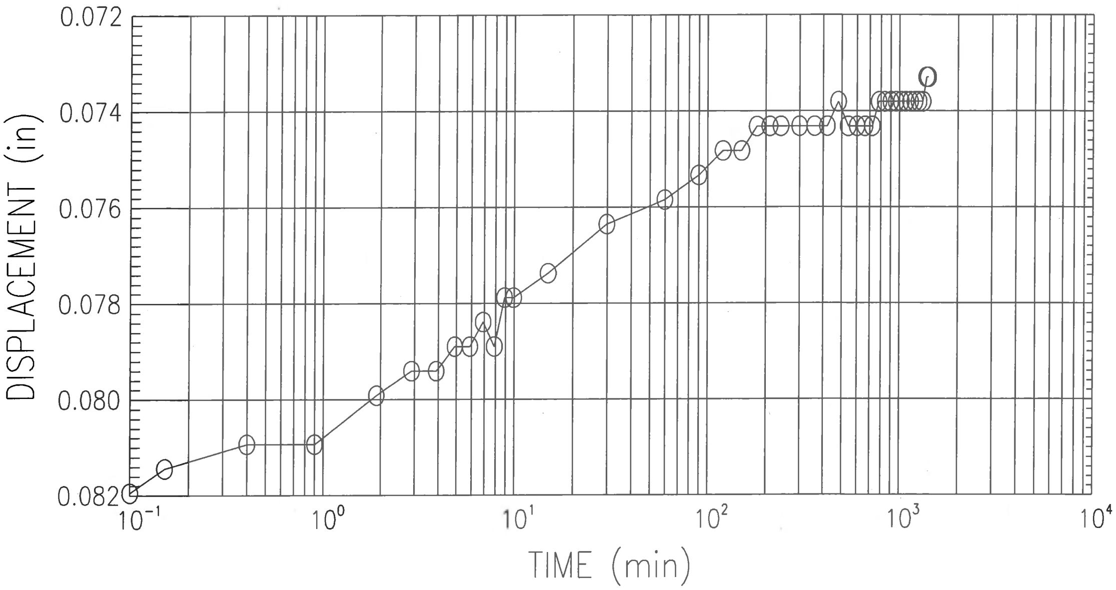
Project Name : EMDF Characterization

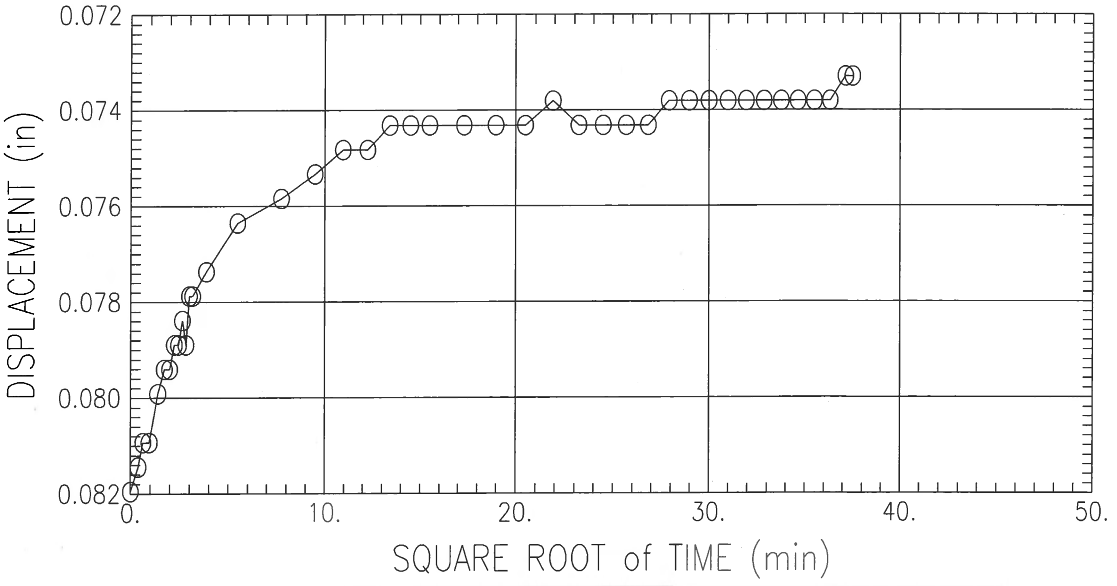
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1

Test Date : 3-15-18 Test No : GW995-ST-1 Depth :

Description : red/brown clayey silt (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 19 OF 20)
STRESS : 2 (t/ft^2)





Bowser Morner

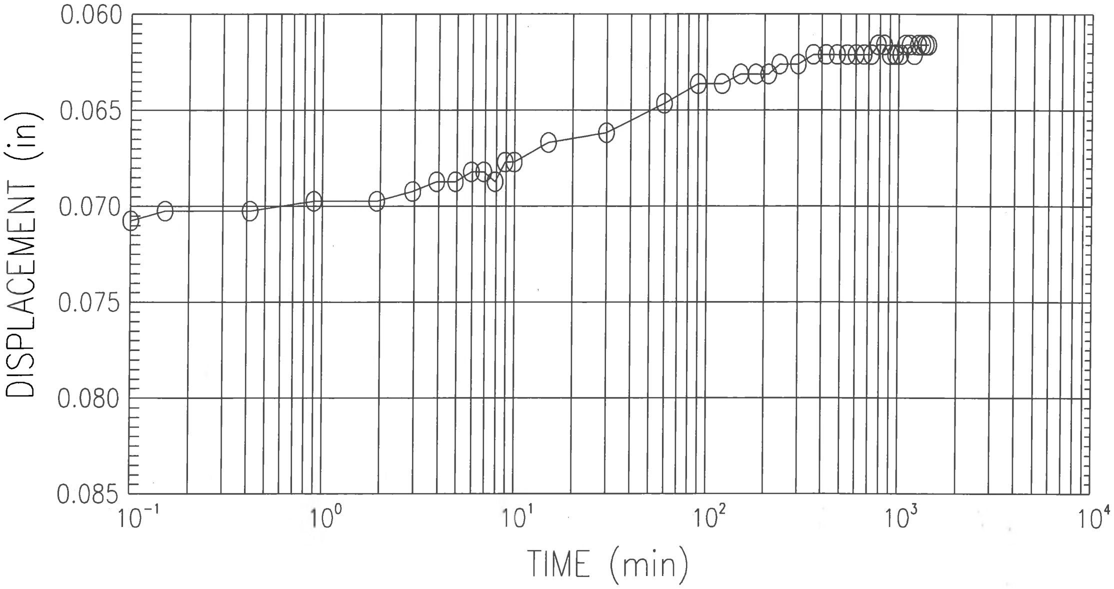
Project Name : EMDF Characterization

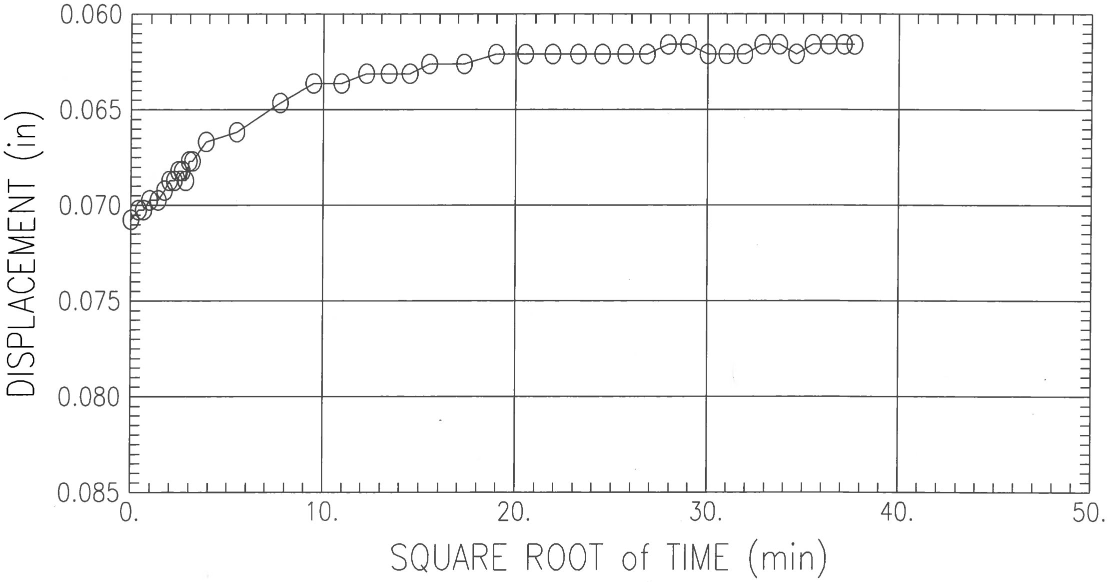
Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1

Test Date : 3-15-18 Test No : GW995-ST-1 Depth :

Description : red/brown clayey silt (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 20 OF 20)
STRESS : 1 (t/ft^2)





Bowser Morner

Project Name : EMDF Characterization

Project No : 183923 Boring No : GW995-ST-1 Sample No : GW995-ST-1

Test Date : 3-15-18 Test No : GW995-ST-1 Depth :

Description : red/brown clayey silt (visual description)

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

	APPLIED PRESSURE (t/ft^2)	FINAL DISPLACEMENT (in)	VOID RATIO	STRAIN AT END (%)	FITTING T50 TIME (min)		COEFFICIENT OF CONSOLIDATION (in^2/s)		
					SQ.RT.	LOG	SQ.RT.	LOG	AVE
1)	0.06	-0.004	0.644	-0.35	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
2)	0.25	-0.004	0.644	-0.35	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
3)	0.50	-0.002	0.642	-0.20	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
4)	1.00	0.002	0.635	0.21	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
5)	2.00	0.012	0.618	1.23	8.1	0.0	1.00E-004	0.00E+000	1.00E-004
6)	4.00	0.029	0.591	2.91	3.6	3.3	2.18E-004	2.40E-004	2.29E-004
7)	2.00	0.025	0.597	2.50	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
8)	1.00	0.018	0.609	1.79	8.8	0.0	8.91E-005	0.00E+000	8.91E-005
9)	0.50	0.012	0.618	1.23	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
10)	1.00	0.014	0.615	1.43	0.0	0.0	0.00E+000	0.00E+000	0.00E+000
11)	2.00	0.021	0.604	2.09	0.9	0.0	9.01E-004	0.00E+000	9.01E-004
12)	4.00	0.031	0.587	3.11	3.0	0.0	2.59E-004	0.00E+000	2.59E-004
13)	8.00	0.052	0.553	5.20	3.5	0.0	2.14E-004	0.00E+000	2.14E-004
14)	16.00	0.080	0.507	8.00	2.2	0.0	3.25E-004	0.00E+000	3.25E-004
15)	32.00	0.116	0.448	11.61	2.2	0.0	3.02E-004	0.00E+000	3.02E-004
16)	16.00	0.107	0.462	10.74	1.2	0.0	5.39E-004	0.00E+000	5.39E-004
17)	8.00	0.097	0.480	9.68	2.9	0.0	2.29E-004	0.00E+000	2.29E-004
18)	4.00	0.086	0.498	8.56	13.4	0.0	5.04E-005	0.00E+000	5.04E-005
19)	2.00	0.073	0.518	7.33	19.8	0.0	3.52E-005	0.00E+000	3.52E-005
20)	1.00	0.062	0.537	6.16	16.0	0.0	4.47E-005	0.00E+000	4.47E-005

CONSOLIDATION TEST DATA

Project : EMDF Characterization	Location : GW995-ST-1, 2.5'-4.5'	Project No.: 183923
Boring No.: GW995-ST-1	Tested by : BMI: blc	Checked by : KAF
Sample No.: GW995-ST-1	Test Date : 3-15-18	Depth : 3.8'-4.0'
Test No. : GW995-ST-1	Sample Type: Undisturb	

Soil Description : red/brown clayey silt (visual description)

Remarks : Use: Near foundation/geobuffer layer

Specific Gravity : 2.72	Liquid Limit : 0	Initial Height : 1.00 (in)
Initial Void Ratio : 0.64	Plastic Limit : 0	Sample Diameter : 2.50 (in)
Final Void Ratio : 0.54	Plasticity Index : 0	

	BEFORE CONSOLIDATION		AFTER CONSOLIDATION	
	TRIMMINGS	SPECIMEN + RING	SPECIMEN + RING	TRIMMINGS
CONTAINER NO.		RING	RING	
WT CONTAINER + WET SOIL (gm)	163.23	163.23	159.38	159.38
WT CONTAINER + DRY SOIL (gm)	133.59	133.59	133.59	133.59
WT CONTAINER (gm)	0.00	0.00	0.00	0.00
WT DRY SOIL (gm)	133.59	133.59	133.59	133.59
WATER CONTENT (%)	22.19	22.19	19.31	19.31
VOID RATIO	------	0.64	0.54	------
DEGREE OF SATURATION (%)	------	94.56	97.73	------
DRY DENSITY (lb/ft^3)	------	103.68	110.48	------

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefor values may not represent actual values for the specimen.

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                                  CONSOLIDATION TEST DATA

Project   : EMDF Characterization     Location    : GW995-ST-1, 2.5'-4.5'     Project No.: 183923
Boring No.: GW995-ST-1                Tested by   : BMI: blc                  Checked by : KAF
Sample No.: GW995-ST-1                Test Date   : 3-15-18                   Depth      : 3.8'-4.0'
Test No.  : GW995-ST-1                Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 1 of 20
Stress increment from 0.00 (t/ft^2)  to 0.06 (t/ft^2)
Start Date :              Start Time :

                ELAPSED TIME      SQRT. OF       CHANGE IN        VOID       STRAIN
                    (min)        TIME (min)     HEIGHT (in)       RATIO        (%)

          1)        0.15           0.39          0.0000          0.638        0.00
          2)        0.90           0.95          0.0000          0.638        0.00
          3)        2.90           1.70          0.0000          0.638        0.00
          4)        3.90           1.97          0.0000          0.638        0.00
          5)        5.90           2.43         -0.0036          0.644       -0.36
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CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 2 of 20
Stress increment from 0.06 (t/ft^2) to 0.25 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	-0.0031	0.643	-0.31
2)	0.15	0.39	-0.0036	0.644	-0.36
3)	0.40	0.63	-0.0036	0.644	-0.36
4)	0.90	0.95	-0.0036	0.644	-0.36
5)	1.90	1.38	-0.0031	0.643	-0.31
6)	2.92	1.71	-0.0036	0.644	-0.36
7)	3.92	1.98	-0.0036	0.644	-0.36
8)	4.92	2.22	-0.0031	0.643	-0.31
9)	5.90	2.43	-0.0036	0.644	-0.36
10)	6.90	2.63	-0.0036	0.644	-0.36
11)	7.90	2.81	-0.0031	0.643	-0.31
12)	8.90	2.98	-0.0036	0.644	-0.36
13)	9.90	3.15	-0.0036	0.644	-0.36
14)	14.90	3.86	-0.0036	0.644	-0.36
15)	29.90	5.47	-0.0031	0.643	-0.31
16)	59.92	7.74	-0.0031	0.643	-0.31
17)	89.90	9.48	-0.0031	0.643	-0.31
18)	119.90	10.95	-0.0031	0.643	-0.31
19)	149.92	12.24	-0.0036	0.644	-0.36
20)	179.92	13.41	-0.0031	0.643	-0.31
21)	209.90	14.49	-0.0031	0.643	-0.31
22)	239.90	15.49	-0.0031	0.643	-0.31
23)	299.90	17.32	-0.0031	0.643	-0.31
24)	359.92	18.97	-0.0036	0.644	-0.36
25)	419.90	20.49	-0.0031	0.643	-0.31
26)	479.92	21.91	-0.0031	0.643	-0.31
27)	539.90	23.24	-0.0031	0.643	-0.31
28)	599.90	24.49	-0.0031	0.643	-0.31
29)	659.90	25.69	-0.0031	0.643	-0.31
30)	719.90	26.83	-0.0031	0.643	-0.31
31)	779.92	27.93	-0.0031	0.643	-0.31
32)	839.90	28.98	-0.0031	0.643	-0.31
33)	899.90	30.00	-0.0031	0.643	-0.31
34)	959.90	30.98	-0.0031	0.643	-0.31
35)	1019.90	31.94	-0.0031	0.643	-0.31

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW995-ST-1, 2.5'-4.5'
Project No.: 183923
Boring No.: GW995-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW995-ST-1
Test Date : 3-15-18
Depth : 3.8'-4.0'
Test No. : GW995-ST-1
Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 2 of 20
Stress increment from 0.06 (t/ft^2) to 0.25 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	-0.0031	0.643	-0.31
37)	1139.90	33.76	-0.0031	0.643	-0.31
38)	1199.92	34.64	-0.0031	0.643	-0.31
39)	1259.90	35.50	-0.0031	0.643	-0.31
40)	1319.90	36.33	-0.0031	0.643	-0.31
41)	1379.90	37.15	-0.0025	0.643	-0.25
42)	1391.47	37.30	-0.0036	0.644	-0.36

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5′-4.5′
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8′-4.0′

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 3 of 20
Stress increment from 0.25 (t/ft^2) to 0.50 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	-0.0025	0.643	-0.25
2)	0.13	0.37	-0.0025	0.643	-0.25
3)	0.40	0.63	-0.0025	0.643	-0.25
4)	0.90	0.95	-0.0025	0.643	-0.25
5)	1.88	1.37	-0.0025	0.643	-0.25
6)	2.92	1.71	-0.0020	0.642	-0.20
7)	3.93	1.98	-0.0025	0.643	-0.25
8)	4.93	2.22	-0.0025	0.643	-0.25
9)	5.93	2.44	-0.0020	0.642	-0.20
10)	6.90	2.63	-0.0025	0.643	-0.25
11)	7.90	2.81	-0.0025	0.643	-0.25
12)	8.90	2.98	-0.0025	0.643	-0.25
13)	9.90	3.15	-0.0025	0.643	-0.25
14)	14.90	3.86	-0.0020	0.642	-0.20
15)	29.88	5.47	-0.0015	0.641	-0.15
16)	59.90	7.74	-0.0020	0.642	-0.20
17)	89.90	9.48	-0.0015	0.641	-0.15
18)	119.90	10.95	-0.0020	0.642	-0.20
19)	149.90	12.24	-0.0015	0.641	-0.15
20)	179.90	13.41	-0.0020	0.642	-0.20
21)	209.92	14.49	-0.0015	0.641	-0.15
22)	239.90	15.49	-0.0020	0.642	-0.20
23)	299.90	17.32	-0.0020	0.642	-0.20
24)	359.88	18.97	-0.0020	0.642	-0.20
25)	419.90	20.49	-0.0020	0.642	-0.20
26)	479.92	21.91	-0.0020	0.642	-0.20
27)	539.88	23.24	-0.0020	0.642	-0.20
28)	599.90	24.49	-0.0015	0.641	-0.15
29)	659.90	25.69	-0.0015	0.641	-0.15
30)	719.88	26.83	-0.0020	0.642	-0.20
31)	779.90	27.93	-0.0020	0.642	-0.20
32)	839.88	28.98	-0.0015	0.641	-0.15
33)	899.90	30.00	-0.0020	0.642	-0.20
34)	959.88	30.98	-0.0020	0.642	-0.20
35)	1019.92	31.94	-0.0020	0.642	-0.20

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW995-ST-1, 2.5'-4.5'
Project No.: 183923
Boring No.: GW995-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW995-ST-1
Test Date : 3-15-18
Depth : 3.8'-4.0'
Test No. : GW995-ST-1
Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 3 of 20
Stress increment from 0.25 (t/ft^2) to 0.50 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	-0.0020	0.642	-0.20
37)	1139.88	33.76	-0.0020	0.642	-0.20
38)	1199.88	34.64	-0.0015	0.641	-0.15
39)	1259.90	35.50	-0.0015	0.641	-0.15
40)	1298.28	36.03	-0.0020	0.642	-0.20

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 4 of 20
Stress increment from 0.50 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0000	0.638	0.00
2)	0.15	0.39	0.0000	0.638	0.00
3)	0.40	0.63	0.0005	0.638	0.05
4)	0.90	0.95	0.0005	0.638	0.05
5)	1.90	1.38	0.0005	0.638	0.05
6)	2.88	1.70	0.0005	0.638	0.05
7)	3.92	1.98	0.0005	0.638	0.05
8)	4.90	2.21	0.0005	0.638	0.05
9)	5.90	2.43	0.0010	0.637	0.10
10)	6.90	2.63	0.0010	0.637	0.10
11)	7.90	2.81	0.0010	0.637	0.10
12)	8.92	2.99	0.0010	0.637	0.10
13)	9.92	3.15	0.0010	0.637	0.10
14)	14.92	3.86	0.0010	0.637	0.10
15)	29.90	5.47	0.0010	0.637	0.10
16)	59.90	7.74	0.0010	0.637	0.10
17)	89.88	9.48	0.0015	0.636	0.15
18)	119.92	10.95	0.0015	0.636	0.15
19)	149.92	12.24	0.0015	0.636	0.15
20)	179.90	13.41	0.0015	0.636	0.15
21)	209.88	14.49	0.0015	0.636	0.15
22)	239.90	15.49	0.0015	0.636	0.15
23)	299.92	17.32	0.0015	0.636	0.15
24)	359.92	18.97	0.0015	0.636	0.15
25)	419.88	20.49	0.0020	0.635	0.20
26)	479.92	21.91	0.0015	0.636	0.15
27)	539.90	23.24	0.0015	0.636	0.15
28)	599.90	24.49	0.0020	0.635	0.20
29)	659.90	25.69	0.0020	0.635	0.20
30)	719.92	26.83	0.0020	0.635	0.20
31)	779.90	27.93	0.0020	0.635	0.20
32)	839.88	28.98	0.0020	0.635	0.20
33)	899.90	30.00	0.0020	0.635	0.20
34)	959.90	30.98	0.0020	0.635	0.20
35)	1019.88	31.94	0.0020	0.635	0.20

```
                              CONSOLIDATION TEST DATA

Project    : EMDF Characterization     Location    : GW995-ST-1, 2.5'-4.5'    Project No.: 183923
Boring No.: GW995-ST-1                 Tested by   : BMI: blc                 Checked by : KAF
Sample No.: GW995-ST-1                 Test Date   : 3-15-18                  Depth       : 3.8'-4.0'
Test No.   : GW995-ST-1                Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 4 of 20
Stress increment from 0.50 (t/ft^2)  to 1.00 (t/ft^2)
Start Date :              Start Time :

               ELAPSED TIME      SQRT. OF      CHANGE IN      VOID       STRAIN
                   (min)         TIME (min)    HEIGHT (in)    RATIO        (%)

        36)     1079.90          32.86          0.0020        0.635       0.20
        37)     1139.90          33.76          0.0020        0.635       0.20
        38)     1199.90          34.64          0.0020        0.635       0.20
        39)     1259.88          35.49          0.0036        0.633       0.36
        40)     1309.58          36.19          0.0020        0.635       0.20
```

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 5 of 20
Stress increment from 1.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0071	0.627	0.71
2)	0.15	0.39	0.0076	0.626	0.76
3)	0.42	0.65	0.0076	0.626	0.76
4)	0.92	0.96	0.0087	0.624	0.87
5)	1.92	1.38	0.0092	0.623	0.92
6)	2.92	1.71	0.0097	0.623	0.97
7)	3.92	1.98	0.0097	0.623	0.97
8)	4.90	2.21	0.0102	0.622	1.02
9)	5.92	2.43	0.0102	0.622	1.02
10)	6.95	2.64	0.0102	0.622	1.02
11)	7.95	2.82	0.0102	0.622	1.02
12)	8.90	2.98	0.0107	0.621	1.07
13)	9.92	3.15	0.0107	0.621	1.07
14)	14.92	3.86	0.0107	0.621	1.07
15)	29.92	5.47	0.0117	0.619	1.17
16)	59.92	7.74	0.0122	0.618	1.22
17)	89.90	9.48	0.0122	0.618	1.22
18)	119.90	10.95	0.0127	0.618	1.27
19)	149.93	12.24	0.0127	0.618	1.27
20)	179.90	13.41	0.0127	0.618	1.27
21)	209.92	14.49	0.0127	0.618	1.27
22)	239.92	15.49	0.0127	0.618	1.27
23)	299.93	17.32	0.0127	0.618	1.27
24)	359.93	18.97	0.0122	0.618	1.22
25)	419.90	20.49	0.0127	0.618	1.27
26)	479.92	21.91	0.0127	0.618	1.27
27)	539.90	23.24	0.0127	0.618	1.27
28)	599.93	24.49	0.0127	0.618	1.27
29)	659.90	25.69	0.0127	0.618	1.27
30)	719.92	26.83	0.0127	0.618	1.27
31)	779.92	27.93	0.0127	0.618	1.27
32)	839.92	28.98	0.0127	0.618	1.27
33)	899.90	30.00	0.0127	0.618	1.27
34)	959.90	30.98	0.0132	0.617	1.32
35)	1019.93	31.94	0.0127	0.618	1.27

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW995-ST-1, 2.5'-4.5'
Project No.: 183923
Boring No.: GW995-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW995-ST-1
Test Date : 3-15-18
Depth : 3.8'-4.0'
Test No. : GW995-ST-1
Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 5 of 20
Stress increment from 1.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.92	32.86	0.0132	0.617	1.32
37)	1139.90	33.76	0.0132	0.617	1.32
38)	1199.95	34.64	0.0132	0.617	1.32
39)	1259.92	35.50	0.0132	0.617	1.32
40)	1319.90	36.33	0.0132	0.617	1.32
41)	1379.90	37.15	0.0127	0.618	1.27
42)	1439.92	37.95	0.0132	0.617	1.32
43)	1499.92	38.73	0.0132	0.617	1.32
44)	1559.90	39.50	0.0127	0.618	1.27
45)	1619.90	40.25	0.0127	0.618	1.27
46)	1624.45	40.30	0.0122	0.618	1.22

CONSOLIDATION TEST DATA

Project : EMDF Characterization Location : GW995-ST-1, 2.5'-4.5' Project No.: 183923
Boring No.: GW995-ST-1 Tested by : BMI: blc Checked by : KAF
Sample No.: GW995-ST-1 Test Date : 3-15-18 Depth : 3.8'-4.0'
Test No. : GW995-ST-1 Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 6 of 20
Stress increment from 2.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0204	0.605	2.04
2)	0.13	0.37	0.0209	0.604	2.09
3)	0.38	0.62	0.0214	0.603	2.14
4)	0.88	0.94	0.0224	0.602	2.24
5)	1.93	1.39	0.0234	0.600	2.34
6)	2.88	1.70	0.0239	0.599	2.39
7)	3.90	1.97	0.0249	0.598	2.49
8)	4.92	2.22	0.0255	0.597	2.55
9)	5.88	2.43	0.0260	0.596	2.60
10)	6.90	2.63	0.0260	0.596	2.60
11)	7.88	2.81	0.0260	0.596	2.60
12)	8.90	2.98	0.0260	0.596	2.60
13)	9.90	3.15	0.0265	0.595	2.65
14)	14.88	3.86	0.0270	0.594	2.70
15)	29.88	5.47	0.0280	0.593	2.80
16)	59.88	7.74	0.0280	0.593	2.80
17)	89.88	9.48	0.0285	0.592	2.85
18)	119.90	10.95	0.0285	0.592	2.85
19)	149.90	12.24	0.0285	0.592	2.85
20)	179.90	13.41	0.0285	0.592	2.85
21)	209.90	14.49	0.0285	0.592	2.85
22)	239.90	15.49	0.0285	0.592	2.85
23)	299.92	17.32	0.0290	0.591	2.90
24)	359.88	18.97	0.0290	0.591	2.90
25)	419.90	20.49	0.0290	0.591	2.90
26)	479.92	21.91	0.0290	0.591	2.90
27)	539.90	23.24	0.0295	0.590	2.95
28)	599.88	24.49	0.0290	0.591	2.90
29)	659.88	25.69	0.0295	0.590	2.95
30)	719.90	26.83	0.0295	0.590	2.95
31)	779.90	27.93	0.0295	0.590	2.95
32)	839.88	28.98	0.0295	0.590	2.95
33)	899.90	30.00	0.0295	0.590	2.95
34)	959.90	30.98	0.0295	0.590	2.95
35)	1019.88	31.94	0.0295	0.590	2.95

CONSOLIDATION TEST DATA

Project : EMDF Characterization	Location : GW995-ST-1, 2.5'-4.5'	Project No.: 183923
Boring No.: GW995-ST-1	Tested by : BMI: blc	Checked by : KAF
Sample No.: GW995-ST-1	Test Date : 3-15-18	Depth : 3.8'-4.0'
Test No. : GW995-ST-1	Sample Type: Undisturb	

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 6 of 20
Stress increment from 2.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.0295	0.590	2.95
37)	1139.92	33.76	0.0295	0.590	2.95
38)	1199.88	34.64	0.0295	0.590	2.95
39)	1259.90	35.50	0.0295	0.590	2.95
40)	1319.90	36.33	0.0295	0.590	2.95
41)	1329.13	36.46	0.0290	0.591	2.90

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 7 of 20
Stress increment from 4.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0260	0.596	2.60
2)	0.13	0.37	0.0260	0.596	2.60
3)	0.40	0.63	0.0260	0.596	2.60
4)	0.88	0.94	0.0255	0.597	2.55
5)	1.90	1.38	0.0255	0.597	2.55
6)	2.90	1.70	0.0249	0.598	2.49
7)	3.90	1.97	0.0249	0.598	2.49
8)	4.90	2.21	0.0249	0.598	2.49
9)	5.90	2.43	0.0249	0.598	2.49
10)	6.90	2.63	0.0249	0.598	2.49
11)	7.88	2.81	0.0249	0.598	2.49
12)	8.90	2.98	0.0244	0.598	2.44
13)	9.88	3.14	0.0249	0.598	2.49
14)	14.90	3.86	0.0249	0.598	2.49
15)	29.88	5.47	0.0249	0.598	2.49
16)	59.88	7.74	0.0249	0.598	2.49
17)	89.88	9.48	0.0249	0.598	2.49
18)	119.88	10.95	0.0249	0.598	2.49
19)	149.90	12.24	0.0249	0.598	2.49
20)	179.88	13.41	0.0249	0.598	2.49
21)	209.88	14.49	0.0249	0.598	2.49
22)	239.90	15.49	0.0249	0.598	2.49
23)	299.88	17.32	0.0249	0.598	2.49
24)	359.88	18.97	0.0244	0.598	2.44
25)	419.88	20.49	0.0249	0.598	2.49
26)	479.90	21.91	0.0249	0.598	2.49
27)	539.88	23.24	0.0249	0.598	2.49
28)	599.90	24.49	0.0244	0.598	2.44
29)	659.90	25.69	0.0249	0.598	2.49
30)	719.90	26.83	0.0249	0.598	2.49
31)	779.92	27.93	0.0244	0.598	2.44
32)	839.88	28.98	0.0249	0.598	2.49
33)	899.88	30.00	0.0249	0.598	2.49
34)	959.90	30.98	0.0249	0.598	2.49
35)	1019.88	31.94	0.0249	0.598	2.49

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW995-ST-1, 2.5'-4.5'
Project No.: 183923
Boring No.: GW995-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW995-ST-1
Test Date : 3-15-18
Depth : 3.8'-4.0'
Test No. : GW995-ST-1
Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 7 of 20
Stress increment from 4.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.0249	0.598	2.49
37)	1139.88	33.76	0.0249	0.598	2.49
38)	1199.88	34.64	0.0244	0.598	2.44
39)	1259.88	35.49	0.0244	0.598	2.44
40)	1319.88	36.33	0.0249	0.598	2.49
41)	1379.88	37.15	0.0244	0.598	2.44
42)	1428.52	37.80	0.0249	0.598	2.49

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 8 of 20
Stress increment from 2.00 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0219	0.603	2.19
2)	0.13	0.37	0.0214	0.603	2.14
3)	0.40	0.63	0.0214	0.603	2.14
4)	0.88	0.94	0.0209	0.604	2.09
5)	1.90	1.38	0.0209	0.604	2.09
6)	2.90	1.70	0.0204	0.605	2.04
7)	3.88	1.97	0.0204	0.605	2.04
8)	4.90	2.21	0.0199	0.606	1.99
9)	5.88	2.43	0.0199	0.606	1.99
10)	6.92	2.63	0.0199	0.606	1.99
11)	7.88	2.81	0.0199	0.606	1.99
12)	8.90	2.98	0.0193	0.607	1.93
13)	9.90	3.15	0.0193	0.607	1.93
14)	14.90	3.86	0.0193	0.607	1.93
15)	29.88	5.47	0.0193	0.607	1.93
16)	59.90	7.74	0.0193	0.607	1.93
17)	89.90	9.48	0.0193	0.607	1.93
18)	119.90	10.95	0.0188	0.608	1.88
19)	149.88	12.24	0.0188	0.608	1.88
20)	179.90	13.41	0.0188	0.608	1.88
21)	209.92	14.49	0.0188	0.608	1.88
22)	239.90	15.49	0.0188	0.608	1.88
23)	299.88	17.32	0.0188	0.608	1.88
24)	359.90	18.97	0.0188	0.608	1.88
25)	419.88	20.49	0.0188	0.608	1.88
26)	479.88	21.91	0.0188	0.608	1.88
27)	539.88	23.24	0.0188	0.608	1.88
28)	599.90	24.49	0.0188	0.608	1.88
29)	659.88	25.69	0.0188	0.608	1.88
30)	719.88	26.83	0.0188	0.608	1.88
31)	779.88	27.93	0.0188	0.608	1.88
32)	839.90	28.98	0.0183	0.608	1.83
33)	899.90	30.00	0.0188	0.608	1.88
34)	959.88	30.98	0.0183	0.608	1.83
35)	1019.88	31.94	0.0183	0.608	1.83

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW995-ST-1, 2.5'-4.5'
Project No.: 183923
Boring No.: GW995-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW995-ST-1
Test Date : 3-15-18
Depth : 3.8'-4.0'
Test No. : GW995-ST-1
Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 8 of 20
Stress increment from 2.00 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.0188	0.608	1.88
37)	1139.88	33.76	0.0188	0.608	1.88
38)	1199.88	34.64	0.0183	0.608	1.83
39)	1259.88	35.49	0.0183	0.608	1.83
40)	1319.90	36.33	0.0183	0.608	1.83
41)	1379.88	37.15	0.0183	0.608	1.83
42)	1439.90	37.95	0.0183	0.608	1.83
43)	1441.12	37.96	0.0178	0.609	1.78

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 9 of 20
Stress increment from 1.00 (t/ft^2) to 0.50 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0163	0.612	1.63
2)	0.12	0.34	0.0163	0.612	1.63
3)	0.37	0.61	0.0163	0.612	1.63
4)	0.88	0.94	0.0158	0.613	1.58
5)	1.88	1.37	0.0158	0.613	1.58
6)	2.87	1.69	0.0153	0.613	1.53
7)	3.88	1.97	0.0153	0.613	1.53
8)	4.87	2.21	0.0148	0.614	1.48
9)	5.88	2.43	0.0148	0.614	1.48
10)	6.87	2.62	0.0148	0.614	1.48
11)	7.88	2.81	0.0143	0.615	1.43
12)	8.90	2.98	0.0143	0.615	1.43
13)	9.90	3.15	0.0148	0.614	1.48
14)	14.90	3.86	0.0137	0.616	1.37
15)	29.90	5.47	0.0143	0.615	1.43
16)	59.88	7.74	0.0137	0.616	1.37
17)	89.92	9.48	0.0132	0.617	1.32
18)	119.90	10.95	0.0132	0.617	1.32
19)	149.87	12.24	0.0127	0.618	1.27
20)	179.90	13.41	0.0127	0.618	1.27
21)	209.87	14.49	0.0127	0.618	1.27
22)	239.88	15.49	0.0127	0.618	1.27
23)	299.87	17.32	0.0127	0.618	1.27
24)	359.88	18.97	0.0127	0.618	1.27
25)	419.90	20.49	0.0122	0.618	1.22
26)	479.88	21.91	0.0122	0.618	1.22
27)	539.88	23.24	0.0122	0.618	1.22
28)	599.90	24.49	0.0122	0.618	1.22
29)	659.88	25.69	0.0122	0.618	1.22
30)	719.88	26.83	0.0122	0.618	1.22
31)	779.90	27.93	0.0122	0.618	1.22
32)	839.88	28.98	0.0122	0.618	1.22
33)	899.88	30.00	0.0117	0.619	1.17
34)	959.87	30.98	0.0122	0.618	1.22
35)	1019.88	31.94	0.0122	0.618	1.22

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 9 of 20
Stress increment from 1.00 (t/ft^2) to 0.50 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.87	32.86	0.0122	0.618	1.22
37)	1139.87	33.76	0.0122	0.618	1.22
38)	1199.88	34.64	0.0122	0.618	1.22
39)	1259.92	35.50	0.0122	0.618	1.22
40)	1319.87	36.33	0.0117	0.619	1.17
41)	1379.87	37.15	0.0117	0.619	1.17
42)	1439.88	37.95	0.0117	0.619	1.17
43)	1479.92	38.47	0.0122	0.618	1.22

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 10 of 20
Stress increment from 0.50 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0127	0.618	1.27
2)	0.15	0.39	0.0127	0.618	1.27
3)	0.40	0.63	0.0127	0.618	1.27
4)	0.92	0.96	0.0132	0.617	1.32
5)	1.90	1.38	0.0137	0.616	1.37
6)	2.90	1.70	0.0132	0.617	1.32
7)	3.92	1.98	0.0137	0.616	1.37
8)	4.92	2.22	0.0137	0.616	1.37
9)	5.90	2.43	0.0137	0.616	1.37
10)	6.92	2.63	0.0137	0.616	1.37
11)	7.90	2.81	0.0137	0.616	1.37
12)	8.90	2.98	0.0137	0.616	1.37
13)	9.90	3.15	0.0143	0.615	1.43
14)	14.90	3.86	0.0137	0.616	1.37
15)	29.95	5.47	0.0143	0.615	1.43
16)	59.92	7.74	0.0143	0.615	1.43
17)	89.90	9.48	0.0143	0.615	1.43
18)	119.92	10.95	0.0148	0.614	1.48
19)	149.92	12.24	0.0143	0.615	1.43
20)	179.92	13.41	0.0143	0.615	1.43
21)	209.92	14.49	0.0143	0.615	1.43
22)	239.92	15.49	0.0143	0.615	1.43
23)	299.90	17.32	0.0148	0.614	1.48
24)	359.92	18.97	0.0148	0.614	1.48
25)	419.92	20.49	0.0148	0.614	1.48
26)	479.90	21.91	0.0148	0.614	1.48
27)	539.92	23.24	0.0148	0.614	1.48
28)	599.93	24.49	0.0148	0.614	1.48
29)	659.90	25.69	0.0148	0.614	1.48
30)	719.90	26.83	0.0148	0.614	1.48
31)	779.90	27.93	0.0148	0.614	1.48
32)	839.92	28.98	0.0148	0.614	1.48
33)	899.90	30.00	0.0148	0.614	1.48
34)	959.90	30.98	0.0148	0.614	1.48
35)	1019.90	31.94	0.0148	0.614	1.48

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 10 of 20
Stress increment from 0.50 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.0148	0.614	1.48
37)	1139.92	33.76	0.0153	0.613	1.53
38)	1199.92	34.64	0.0148	0.614	1.48
39)	1259.90	35.50	0.0148	0.614	1.48
40)	1319.90	36.33	0.0148	0.614	1.48
41)	1328.40	36.45	0.0143	0.615	1.43

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW995-ST-1, 2.5'-4.5'
Project No.: 183923
Boring No.: GW995-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW995-ST-1
Test Date : 3-15-18
Depth : 3.8'-4.0'
Test No. : GW995-ST-1
Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 11 of 20
Stress increment from 1.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0173	0.610	1.73
2)	0.15	0.39	0.0178	0.609	1.78
3)	0.40	0.63	0.0183	0.608	1.83
4)	0.88	0.94	0.0188	0.608	1.88
5)	1.90	1.38	0.0188	0.608	1.88
6)	2.90	1.70	0.0193	0.607	1.93
7)	3.90	1.97	0.0193	0.607	1.93
8)	4.90	2.21	0.0193	0.607	1.93
9)	5.90	2.43	0.0199	0.606	1.99
10)	6.88	2.62	0.0199	0.606	1.99
11)	7.88	2.81	0.0199	0.606	1.99
12)	8.90	2.98	0.0199	0.606	1.99
13)	9.90	3.15	0.0199	0.606	1.99
14)	14.88	3.86	0.0204	0.605	2.04
15)	29.90	5.47	0.0204	0.605	2.04
16)	59.90	7.74	0.0204	0.605	2.04
17)	89.90	9.48	0.0214	0.603	2.14
18)	119.88	10.95	0.0209	0.604	2.09
19)	149.90	12.24	0.0214	0.603	2.14
20)	179.90	13.41	0.0209	0.604	2.09
21)	209.88	14.49	0.0209	0.604	2.09
22)	239.90	15.49	0.0209	0.604	2.09
23)	299.88	17.32	0.0209	0.604	2.09
24)	359.90	18.97	0.0209	0.604	2.09
25)	419.88	20.49	0.0209	0.604	2.09
26)	479.90	21.91	0.0209	0.604	2.09
27)	539.90	23.24	0.0209	0.604	2.09
28)	599.88	24.49	0.0209	0.604	2.09
29)	659.90	25.69	0.0209	0.604	2.09
30)	719.88	26.83	0.0209	0.604	2.09
31)	779.90	27.93	0.0209	0.604	2.09
32)	839.90	28.98	0.0209	0.604	2.09
33)	899.88	30.00	0.0209	0.604	2.09
34)	959.90	30.98	0.0209	0.604	2.09
35)	1019.90	31.94	0.0209	0.604	2.09

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 11 of 20
Stress increment from 1.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.0209	0.604	2.09
37)	1139.88	33.76	0.0209	0.604	2.09
38)	1199.90	34.64	0.0209	0.604	2.09
39)	1259.88	35.49	0.0209	0.604	2.09
40)	1319.88	36.33	0.0209	0.604	2.09
41)	1379.90	37.15	0.0209	0.604	2.09
42)	1439.88	37.95	0.0209	0.604	2.09
43)	1499.88	38.73	0.0209	0.604	2.09
44)	1503.95	38.78	0.0209	0.604	2.09

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 12 of 20
Stress increment from 2.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0255	0.597	2.55
2)	0.13	0.37	0.0260	0.596	2.60
3)	0.38	0.62	0.0265	0.595	2.65
4)	0.88	0.94	0.0270	0.594	2.70
5)	1.88	1.37	0.0275	0.593	2.75
6)	2.90	1.70	0.0280	0.593	2.80
7)	3.88	1.97	0.0285	0.592	2.85
8)	4.90	2.21	0.0285	0.592	2.85
9)	5.90	2.43	0.0290	0.591	2.90
10)	6.88	2.62	0.0285	0.592	2.85
11)	7.88	2.81	0.0285	0.592	2.85
12)	8.88	2.98	0.0290	0.591	2.90
13)	9.88	3.14	0.0290	0.591	2.90
14)	14.88	3.86	0.0295	0.590	2.95
15)	29.88	5.47	0.0295	0.590	2.95
16)	59.90	7.74	0.0300	0.589	3.00
17)	89.88	9.48	0.0300	0.589	3.00
18)	119.88	10.95	0.0300	0.589	3.00
19)	149.88	12.24	0.0300	0.589	3.00
20)	179.88	13.41	0.0300	0.589	3.00
21)	209.90	14.49	0.0300	0.589	3.00
22)	239.88	15.49	0.0300	0.589	3.00
23)	299.90	17.32	0.0300	0.589	3.00
24)	359.88	18.97	0.0300	0.589	3.00
25)	419.88	20.49	0.0300	0.589	3.00
26)	479.88	21.91	0.0300	0.589	3.00
27)	539.88	23.24	0.0300	0.589	3.00
28)	599.90	24.49	0.0300	0.589	3.00
29)	659.87	25.69	0.0300	0.589	3.00
30)	719.88	26.83	0.0300	0.589	3.00
31)	779.88	27.93	0.0305	0.588	3.05
32)	839.88	28.98	0.0305	0.588	3.05
33)	899.92	30.00	0.0305	0.588	3.05
34)	959.88	30.98	0.0305	0.588	3.05
35)	1019.88	31.94	0.0305	0.588	3.05

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 12 of 20
Stress increment from 2.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.0305	0.588	3.05
37)	1139.88	33.76	0.0305	0.588	3.05
38)	1199.88	34.64	0.0305	0.588	3.05
39)	1259.90	35.50	0.0305	0.588	3.05
40)	1319.88	36.33	0.0305	0.588	3.05
41)	1379.88	37.15	0.0305	0.588	3.05
42)	1439.87	37.95	0.0305	0.588	3.05
43)	1499.93	38.73	0.0300	0.589	3.00
44)	1501.02	38.74	0.0310	0.588	3.10

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 13 of 20
Stress increment from 4.00 (t/ft^2) to 8.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0392	0.574	3.92
2)	0.12	0.34	0.0397	0.573	3.97
3)	0.37	0.61	0.0407	0.572	4.07
4)	0.87	0.93	0.0422	0.569	4.22
5)	1.87	1.37	0.0438	0.567	4.38
6)	2.85	1.69	0.0448	0.565	4.48
7)	3.87	1.97	0.0458	0.563	4.58
8)	4.85	2.20	0.0463	0.563	4.63
9)	5.87	2.42	0.0468	0.562	4.68
10)	6.87	2.62	0.0473	0.561	4.73
11)	7.85	2.80	0.0473	0.561	4.73
12)	8.85	2.97	0.0478	0.560	4.78
13)	9.87	3.14	0.0478	0.560	4.78
14)	14.85	3.85	0.0489	0.558	4.89
15)	29.87	5.47	0.0499	0.557	4.99
16)	59.85	7.74	0.0504	0.556	5.04
17)	89.87	9.48	0.0509	0.555	5.09
18)	119.85	10.95	0.0509	0.555	5.09
19)	149.87	12.24	0.0509	0.555	5.09
20)	179.87	13.41	0.0509	0.555	5.09
21)	209.87	14.49	0.0509	0.555	5.09
22)	239.88	15.49	0.0514	0.554	5.14
23)	299.90	17.32	0.0509	0.555	5.09
24)	359.87	18.97	0.0514	0.554	5.14
25)	419.87	20.49	0.0514	0.554	5.14
26)	479.85	21.91	0.0514	0.554	5.14
27)	539.85	23.23	0.0514	0.554	5.14
28)	599.85	24.49	0.0519	0.553	5.19
29)	659.87	25.69	0.0519	0.553	5.19
30)	719.87	26.83	0.0519	0.553	5.19
31)	779.87	27.93	0.0519	0.553	5.19
32)	839.85	28.98	0.0519	0.553	5.19
33)	899.85	30.00	0.0519	0.553	5.19
34)	959.85	30.98	0.0519	0.553	5.19
35)	1019.85	31.94	0.0519	0.553	5.19

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5′-4.5′
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8′-4.0′

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 13 of 20
Stress increment from 4.00 (t/ft^2) to 8.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.87	32.86	0.0519	0.553	5.19
37)	1139.87	33.76	0.0519	0.553	5.19
38)	1199.87	34.64	0.0519	0.553	5.19
39)	1259.87	35.49	0.0519	0.553	5.19
40)	1319.87	36.33	0.0519	0.553	5.19
41)	1379.87	37.15	0.0519	0.553	5.19
42)	1388.23	37.26	0.0519	0.553	5.19

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW995-ST-1, 2.5'-4.5'
Project No.: 183923
Boring No.: GW995-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW995-ST-1
Test Date : 3-15-18
Depth : 3.8'-4.0'
Test No. : GW995-ST-1
Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 14 of 20
Stress increment from 8.00 (t/ft^2) to 16.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0616	0.538	6.16
2)	0.15	0.39	0.0626	0.536	6.26
3)	0.40	0.63	0.0636	0.534	6.36
4)	0.90	0.95	0.0657	0.531	6.57
5)	1.90	1.38	0.0682	0.527	6.82
6)	2.90	1.70	0.0702	0.523	7.02
7)	3.90	1.97	0.0713	0.522	7.13
8)	4.90	2.21	0.0723	0.520	7.23
9)	5.90	2.43	0.0733	0.518	7.33
10)	6.90	2.63	0.0738	0.517	7.38
11)	7.90	2.81	0.0743	0.517	7.43
12)	8.90	2.98	0.0748	0.516	7.48
13)	9.92	3.15	0.0753	0.515	7.53
14)	14.90	3.86	0.0769	0.512	7.69
15)	29.90	5.47	0.0779	0.511	7.79
16)	59.93	7.74	0.0784	0.510	7.84
17)	89.92	9.48	0.0784	0.510	7.84
18)	119.92	10.95	0.0789	0.509	7.89
19)	149.90	12.24	0.0789	0.509	7.89
20)	179.90	13.41	0.0794	0.508	7.94
21)	209.90	14.49	0.0794	0.508	7.94
22)	239.92	15.49	0.0789	0.509	7.89
23)	299.90	17.32	0.0789	0.509	7.89
24)	359.90	18.97	0.0794	0.508	7.94
25)	419.90	20.49	0.0794	0.508	7.94
26)	479.90	21.91	0.0794	0.508	7.94
27)	539.92	23.24	0.0799	0.507	7.99
28)	599.93	24.49	0.0794	0.508	7.94
29)	659.90	25.69	0.0794	0.508	7.94
30)	719.92	26.83	0.0794	0.508	7.94
31)	779.90	27.93	0.0799	0.507	7.99
32)	839.90	28.98	0.0799	0.507	7.99
33)	899.90	30.00	0.0799	0.507	7.99
34)	959.88	30.98	0.0799	0.507	7.99
35)	1019.90	31.94	0.0799	0.507	7.99

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 14 of 20
Stress increment from 8.00 (t/ft^2) to 16.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.88	32.86	0.0799	0.507	7.99
37)	1139.92	33.76	0.0794	0.508	7.94
38)	1199.88	34.64	0.0799	0.507	7.99
39)	1259.90	35.50	0.0794	0.508	7.94
40)	1319.90	36.33	0.0799	0.507	7.99
41)	1379.92	37.15	0.0799	0.507	7.99
42)	1439.90	37.95	0.0799	0.507	7.99
43)	1456.82	38.17	0.0799	0.507	7.99

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW995-ST-1, 2.5'-4.5'
Project No.: 183923
Boring No.: GW995-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW995-ST-1
Test Date : 3-15-18
Depth : 3.8'-4.0'
Test No. : GW995-ST-1
Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 15 of 20
Stress increment from 16.00 (t/ft^2) to 32.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0896	0.492	8.96
2)	0.15	0.39	0.0911	0.489	9.11
3)	0.40	0.63	0.0931	0.486	9.31
4)	0.92	0.96	0.0962	0.481	9.62
5)	1.90	1.38	0.0998	0.475	9.98
6)	2.90	1.70	0.1018	0.472	10.18
7)	3.90	1.97	0.1038	0.468	10.38
8)	4.90	2.21	0.1054	0.466	10.54
9)	5.92	2.43	0.1064	0.464	10.64
10)	6.92	2.63	0.1074	0.462	10.74
11)	7.90	2.81	0.1084	0.461	10.84
12)	8.92	2.99	0.1089	0.460	10.89
13)	9.90	3.15	0.1099	0.458	10.99
14)	14.90	3.86	0.1110	0.457	11.10
15)	29.92	5.47	0.1130	0.453	11.30
16)	59.90	7.74	0.1135	0.452	11.35
17)	89.90	9.48	0.1140	0.452	11.40
18)	119.92	10.95	0.1140	0.452	11.40
19)	149.92	12.24	0.1145	0.451	11.45
20)	179.90	13.41	0.1145	0.451	11.45
21)	209.88	14.49	0.1145	0.451	11.45
22)	239.90	15.49	0.1150	0.450	11.50
23)	299.90	17.32	0.1150	0.450	11.50
24)	359.93	18.97	0.1150	0.450	11.50
25)	419.90	20.49	0.1150	0.450	11.50
26)	479.90	21.91	0.1150	0.450	11.50
27)	539.90	23.24	0.1155	0.449	11.55
28)	599.90	24.49	0.1155	0.449	11.55
29)	659.90	25.69	0.1155	0.449	11.55
30)	719.93	26.83	0.1155	0.449	11.55
31)	779.92	27.93	0.1161	0.448	11.61
32)	839.88	28.98	0.1161	0.448	11.61
33)	899.90	30.00	0.1155	0.449	11.55
34)	959.93	30.98	0.1161	0.448	11.61
35)	1019.90	31.94	0.1161	0.448	11.61

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW995-ST-1, 2.5'-4.5'
Project No.: 183923
Boring No.: GW995-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW995-ST-1
Test Date : 3-15-18
Depth : 3.8'-4.0'
Test No. : GW995-ST-1
Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 15 of 20
Stress increment from 16.00 (t/ft^2) to 32.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.1161	0.448	11.61
37)	1139.90	33.76	0.1161	0.448	11.61
38)	1199.90	34.64	0.1161	0.448	11.61
39)	1259.88	35.49	0.1161	0.448	11.61
40)	1319.90	36.33	0.1161	0.448	11.61
41)	1379.90	37.15	0.1150	0.450	11.50
42)	1439.48	37.94	0.1161	0.448	11.61

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW995-ST-1, 2.5’-4.5’
Project No.: 183923
Boring No.: GW995-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW995-ST-1
Test Date : 3-15-18
Depth : 3.8’-4.0’
Test No. : GW995-ST-1
Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 16 of 20
Stress increment from 32.00 (t/ft^2) to 16.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1099	0.458	10.99
2)	0.17	0.41	0.1094	0.459	10.94
3)	0.42	0.65	0.1089	0.460	10.89
4)	0.92	0.96	0.1089	0.460	10.89
5)	1.90	1.38	0.1084	0.461	10.84
6)	2.92	1.71	0.1079	0.462	10.79
7)	3.90	1.97	0.1079	0.462	10.79
8)	4.90	2.21	0.1079	0.462	10.79
9)	5.90	2.43	0.1084	0.461	10.84
10)	6.92	2.63	0.1079	0.462	10.79
11)	7.92	2.81	0.1079	0.462	10.79
12)	8.90	2.98	0.1079	0.462	10.79
13)	9.92	3.15	0.1074	0.462	10.74
14)	14.90	3.86	0.1074	0.462	10.74
15)	29.93	5.47	0.1079	0.462	10.79
16)	59.92	7.74	0.1079	0.462	10.79
17)	89.90	9.48	0.1079	0.462	10.79
18)	119.92	10.95	0.1074	0.462	10.74
19)	149.90	12.24	0.1074	0.462	10.74
20)	179.90	13.41	0.1074	0.462	10.74
21)	209.90	14.49	0.1074	0.462	10.74
22)	239.90	15.49	0.1074	0.462	10.74
23)	299.90	17.32	0.1074	0.462	10.74
24)	359.93	18.97	0.1074	0.462	10.74
25)	419.90	20.49	0.1074	0.462	10.74
26)	479.90	21.91	0.1074	0.462	10.74
27)	539.90	23.24	0.1074	0.462	10.74
28)	599.90	24.49	0.1074	0.462	10.74
29)	659.92	25.69	0.1074	0.462	10.74
30)	719.88	26.83	0.1074	0.462	10.74
31)	779.92	27.93	0.1074	0.462	10.74
32)	839.90	28.98	0.1074	0.462	10.74
33)	899.88	30.00	0.1074	0.462	10.74
34)	959.92	30.98	0.1079	0.462	10.79
35)	1019.90	31.94	0.1074	0.462	10.74

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 16 of 20
Stress increment from 32.00 (t/ft^2) to 16.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.92	32.86	0.1074	0.462	10.74
37)	1139.90	33.76	0.1074	0.462	10.74
38)	1199.90	34.64	0.1074	0.462	10.74
39)	1259.90	35.50	0.1074	0.462	10.74
40)	1319.90	36.33	0.1074	0.462	10.74
41)	1379.90	37.15	0.1074	0.462	10.74
42)	1437.65	37.92	0.1074	0.462	10.74

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW995-ST-1, 2.5′-4.5′
Project No.: 183923
Boring No.: GW995-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW995-ST-1
Test Date : 3-15-18
Depth : 3.8′-4.0′
Test No. : GW995-ST-1
Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 17 of 20
Stress increment from 16.00 (t/ft^2) to 8.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.1018	0.472	10.18
2)	0.13	0.37	0.1013	0.472	10.13
3)	0.40	0.63	0.1008	0.473	10.08
4)	0.90	0.95	0.1003	0.474	10.03
5)	1.88	1.37	0.0998	0.475	9.98
6)	2.88	1.70	0.0993	0.476	9.93
7)	3.92	1.98	0.0987	0.477	9.87
8)	4.90	2.21	0.0987	0.477	9.87
9)	5.88	2.43	0.0987	0.477	9.87
10)	6.88	2.62	0.0987	0.477	9.87
11)	7.88	2.81	0.0987	0.477	9.87
12)	8.90	2.98	0.0982	0.477	9.82
13)	9.90	3.15	0.0982	0.477	9.82
14)	14.92	3.86	0.0977	0.478	9.77
15)	29.88	5.47	0.0982	0.477	9.82
16)	59.90	7.74	0.0982	0.477	9.82
17)	89.88	9.48	0.0982	0.477	9.82
18)	119.90	10.95	0.0977	0.478	9.77
19)	149.88	12.24	0.0977	0.478	9.77
20)	179.88	13.41	0.0977	0.478	9.77
21)	209.88	14.49	0.0977	0.478	9.77
22)	239.92	15.49	0.0977	0.478	9.77
23)	299.88	17.32	0.0977	0.478	9.77
24)	359.88	18.97	0.0977	0.478	9.77
25)	419.88	20.49	0.0977	0.478	9.77
26)	479.90	21.91	0.0977	0.478	9.77
27)	539.90	23.24	0.0977	0.478	9.77
28)	599.88	24.49	0.0977	0.478	9.77
29)	659.88	25.69	0.0977	0.478	9.77
30)	719.88	26.83	0.0977	0.478	9.77
31)	779.90	27.93	0.0977	0.478	9.77
32)	839.88	28.98	0.0977	0.478	9.77
33)	899.88	30.00	0.0977	0.478	9.77
34)	959.90	30.98	0.0977	0.478	9.77
35)	1019.88	31.94	0.0977	0.478	9.77

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Location : GW995-ST-1, 2.5'-4.5'
Project No.: 183923
Boring No.: GW995-ST-1
Tested by : BMI: blc
Checked by : KAF
Sample No.: GW995-ST-1
Test Date : 3-15-18
Depth : 3.8'-4.0'
Test No. : GW995-ST-1
Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 17 of 20
Stress increment from 16.00 (t/ft^2) to 8.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.92	32.86	0.0977	0.478	9.77
37)	1139.90	33.76	0.0977	0.478	9.77
38)	1199.88	34.64	0.0972	0.479	9.72
39)	1259.88	35.49	0.0972	0.479	9.72
40)	1319.88	36.33	0.0977	0.478	9.77
41)	1379.90	37.15	0.0977	0.478	9.77
42)	1439.88	37.95	0.0977	0.478	9.77
43)	1499.88	38.73	0.0972	0.479	9.72
44)	1543.13	39.28	0.0967	0.480	9.67

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 18 of 20
Stress increment from 8.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0921	0.487	9.21
2)	0.15	0.39	0.0916	0.488	9.16
3)	0.42	0.65	0.0916	0.488	9.16
4)	0.92	0.96	0.0906	0.490	9.06
5)	1.90	1.38	0.0901	0.491	9.01
6)	2.90	1.70	0.0896	0.492	8.96
7)	3.92	1.98	0.0896	0.492	8.96
8)	4.92	2.22	0.0891	0.492	8.91
9)	5.92	2.43	0.0891	0.492	8.91
10)	6.90	2.63	0.0886	0.493	8.86
11)	7.90	2.81	0.0881	0.494	8.81
12)	8.90	2.98	0.0881	0.494	8.81
13)	9.90	3.15	0.0881	0.494	8.81
14)	14.90	3.86	0.0875	0.495	8.75
15)	29.90	5.47	0.0870	0.496	8.70
16)	59.92	7.74	0.0865	0.497	8.65
17)	89.92	9.48	0.0870	0.496	8.70
18)	119.90	10.95	0.0860	0.497	8.60
19)	149.90	12.24	0.0865	0.497	8.65
20)	179.92	13.41	0.0860	0.497	8.60
21)	209.90	14.49	0.0860	0.497	8.60
22)	239.90	15.49	0.0860	0.497	8.60
23)	299.90	17.32	0.0860	0.497	8.60
24)	359.90	18.97	0.0860	0.497	8.60
25)	419.90	20.49	0.0860	0.497	8.60
26)	479.92	21.91	0.0855	0.498	8.55
27)	539.90	23.24	0.0855	0.498	8.55
28)	599.90	24.49	0.0855	0.498	8.55
29)	659.90	25.69	0.0855	0.498	8.55
30)	719.90	26.83	0.0855	0.498	8.55
31)	779.92	27.93	0.0855	0.498	8.55
32)	839.90	28.98	0.0855	0.498	8.55
33)	899.90	30.00	0.0855	0.498	8.55
34)	959.90	30.98	0.0855	0.498	8.55
35)	1019.90	31.94	0.0855	0.498	8.55

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 18 of 20
Stress increment from 8.00 (t/ft^2) to 4.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.92	32.86	0.0855	0.498	8.55
37)	1139.90	33.76	0.0855	0.498	8.55
38)	1199.90	34.64	0.0855	0.498	8.55
39)	1259.90	35.50	0.0855	0.498	8.55
40)	1319.90	36.33	0.0855	0.498	8.55
41)	1379.90	37.15	0.0850	0.499	8.50
42)	1439.90	37.95	0.0855	0.498	8.55
43)	1499.90	38.73	0.0850	0.499	8.50
44)	1559.90	39.50	0.0855	0.498	8.55
45)	1619.90	40.25	0.0855	0.498	8.55
46)	1679.90	40.99	0.0855	0.498	8.55
47)	1739.90	41.71	0.0850	0.499	8.50
48)	1799.90	42.43	0.0850	0.499	8.50
49)	1859.90	43.13	0.0850	0.499	8.50
50)	1919.90	43.82	0.0850	0.499	8.50
51)	1979.90	44.50	0.0855	0.498	8.55
52)	2039.90	45.17	0.0850	0.499	8.50
53)	2099.88	45.82	0.0850	0.499	8.50
54)	2159.90	46.47	0.0855	0.498	8.55
55)	2219.90	47.12	0.0855	0.498	8.55
56)	2279.88	47.75	0.0850	0.499	8.50
57)	2339.90	48.37	0.0855	0.498	8.55
58)	2399.88	48.99	0.0855	0.498	8.55
59)	2459.90	49.60	0.0855	0.498	8.55
60)	2519.90	50.20	0.0855	0.498	8.55
61)	2579.88	50.79	0.0855	0.498	8.55
62)	2639.90	51.38	0.0850	0.499	8.50
63)	2699.88	51.96	0.0855	0.498	8.55
64)	2759.90	52.53	0.0850	0.499	8.50
65)	2812.53	53.03	0.0855	0.498	8.55

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 19 of 20
Stress increment from 4.00 (t/ft^2) to 2.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0819	0.504	8.19
2)	0.15	0.39	0.0814	0.505	8.14
3)	0.40	0.63	0.0809	0.506	8.09
4)	0.90	0.95	0.0809	0.506	8.09
5)	1.90	1.38	0.0799	0.507	7.99
6)	2.90	1.70	0.0794	0.508	7.94
7)	3.90	1.97	0.0794	0.508	7.94
8)	4.90	2.21	0.0789	0.509	7.89
9)	5.90	2.43	0.0789	0.509	7.89
10)	6.92	2.63	0.0784	0.510	7.84
11)	7.90	2.81	0.0789	0.509	7.89
12)	8.90	2.98	0.0779	0.511	7.79
13)	9.90	3.15	0.0779	0.511	7.79
14)	14.90	3.86	0.0774	0.512	7.74
15)	29.90	5.47	0.0764	0.513	7.64
16)	59.90	7.74	0.0758	0.514	7.58
17)	89.92	9.48	0.0753	0.515	7.53
18)	119.90	10.95	0.0748	0.516	7.48
19)	149.90	12.24	0.0748	0.516	7.48
20)	179.90	13.41	0.0743	0.517	7.43
21)	209.93	14.49	0.0743	0.517	7.43
22)	239.90	15.49	0.0743	0.517	7.43
23)	299.92	17.32	0.0743	0.517	7.43
24)	359.90	18.97	0.0743	0.517	7.43
25)	419.90	20.49	0.0743	0.517	7.43
26)	479.90	21.91	0.0738	0.517	7.38
27)	539.88	23.24	0.0743	0.517	7.43
28)	599.90	24.49	0.0743	0.517	7.43
29)	659.90	25.69	0.0743	0.517	7.43
30)	719.90	26.83	0.0743	0.517	7.43
31)	779.88	27.93	0.0738	0.517	7.38
32)	839.90	28.98	0.0738	0.517	7.38
33)	899.88	30.00	0.0738	0.517	7.38
34)	959.90	30.98	0.0738	0.517	7.38
35)	1019.88	31.94	0.0738	0.517	7.38

```
                              CONSOLIDATION TEST DATA

Project   : EMDF Characterization      Location    : GW995-ST-1, 2.5'-4.5'    Project No.: 183923
Boring No.: GW995-ST-1                 Tested by   : BMI: blc                 Checked by : KAF
Sample No.: GW995-ST-1                 Test Date   : 3-15-18                  Depth      : 3.8'-4.0'
Test No.  : GW995-ST-1                 Sample Type: Undisturb

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 19 of 20
Stress increment from 4.00 (t/ft^2)  to 2.00 (t/ft^2)
Start Date :              Start Time :

            ELAPSED TIME     SQRT. OF      CHANGE IN      VOID      STRAIN
               (min)        TIME (min)    HEIGHT (in)    RATIO       (%)

    36)     1079.90          32.86          0.0738       0.517      7.38
    37)     1139.88          33.76          0.0738       0.517      7.38
    38)     1199.90          34.64          0.0738       0.517      7.38
    39)     1259.90          35.50          0.0738       0.517      7.38
    40)     1319.90          36.33          0.0738       0.517      7.38
    41)     1379.90          37.15          0.0733       0.518      7.33
    42)     1407.72          37.52          0.0733       0.518      7.33
```

CONSOLIDATION TEST DATA

Project : EMDF Characterization
Boring No.: GW995-ST-1
Sample No.: GW995-ST-1
Test No. : GW995-ST-1

Location : GW995-ST-1, 2.5'-4.5'
Tested by : BMI: blc
Test Date : 3-15-18
Sample Type: Undisturb

Project No.: 183923
Checked by : KAF
Depth : 3.8'-4.0'

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 20 of 20
Stress increment from 2.00 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
1)	0.00	0.00	0.0708	0.523	7.08
2)	0.15	0.39	0.0702	0.523	7.02
3)	0.42	0.65	0.0702	0.523	7.02
4)	0.90	0.95	0.0697	0.524	6.97
5)	1.92	1.38	0.0697	0.524	6.97
6)	2.93	1.71	0.0692	0.525	6.92
7)	3.90	1.97	0.0687	0.526	6.87
8)	4.92	2.22	0.0687	0.526	6.87
9)	5.95	2.44	0.0682	0.527	6.82
10)	6.90	2.63	0.0682	0.527	6.82
11)	7.90	2.81	0.0687	0.526	6.87
12)	8.90	2.98	0.0677	0.528	6.77
13)	9.92	3.15	0.0677	0.528	6.77
14)	14.92	3.86	0.0667	0.529	6.67
15)	29.90	5.47	0.0662	0.530	6.62
16)	59.92	7.74	0.0646	0.533	6.46
17)	89.92	9.48	0.0636	0.534	6.36
18)	119.90	10.95	0.0636	0.534	6.36
19)	149.92	12.24	0.0631	0.535	6.31
20)	179.90	13.41	0.0631	0.535	6.31
21)	209.92	14.49	0.0631	0.535	6.31
22)	239.92	15.49	0.0626	0.536	6.26
23)	299.92	17.32	0.0626	0.536	6.26
24)	359.90	18.97	0.0621	0.537	6.21
25)	419.92	20.49	0.0621	0.537	6.21
26)	479.92	21.91	0.0621	0.537	6.21
27)	539.90	23.24	0.0621	0.537	6.21
28)	599.92	24.49	0.0621	0.537	6.21
29)	659.90	25.69	0.0621	0.537	6.21
30)	719.92	26.83	0.0621	0.537	6.21
31)	779.90	27.93	0.0616	0.538	6.16
32)	839.92	28.98	0.0616	0.538	6.16
33)	899.90	30.00	0.0621	0.537	6.21
34)	959.90	30.98	0.0621	0.537	6.21
35)	1019.92	31.94	0.0621	0.537	6.21

CONSOLIDATION TEST DATA

Project : EMDF Characterization	Location : GW995-ST-1, 2.5'-4.5'	Project No.: 183923
Boring No.: GW995-ST-1	Tested by : BMI: blc	Checked by : KAF
Sample No.: GW995-ST-1	Test Date : 3-15-18	Depth : 3.8'-4.0'
Test No. : GW995-ST-1	Sample Type: Undisturb	

Soil Description : red/brown clayey silt (visual description)
Remarks : Use: Near foundation/geobuffer layer

Load Increment : 20 of 20
Stress increment from 2.00 (t/ft^2) to 1.00 (t/ft^2)
Start Date : Start Time :

	ELAPSED TIME (min)	SQRT. OF TIME (min)	CHANGE IN HEIGHT (in)	VOID RATIO	STRAIN (%)
36)	1079.90	32.86	0.0616	0.538	6.16
37)	1139.93	33.76	0.0616	0.538	6.16
38)	1199.92	34.64	0.0621	0.537	6.21
39)	1259.92	35.50	0.0616	0.538	6.16
40)	1319.92	36.33	0.0616	0.538	6.16
41)	1379.90	37.15	0.0616	0.538	6.16
42)	1420.95	37.70	0.0616	0.538	6.16

BOWSER-MORNER, INC.

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LABORATORY REPORT

Report To: CTI & Associates, Inc.
Attn: Michael Partenio
28001 Cabot Drive, Ste. 250
Novi, MI 48377

Report Date: May 24, 2018
Job No.: 183923
Report No.: 430281
No. of Pages: 1 + Appendix

Report On: Laboratory Analysis of One Shelby Tube Sample
Project: EMDF Characterization – Project No. 1188070011
Sample ID: GW995 - ST-2, 6.0'-8.0' – Sample Date: 2/20/18
Depth of Test Specimen: 6.3'-6.5'

On March 5, 2018, one shelby tube sample was submitted for selected laboratory analysis from the above referenced project. Testing was performed as specified by the client and in accordance with ASTM D 2435, "One-Dimensional Consolidation Properties of Soils Using Incremental Loading".

Results are summarized in the following table. Consolidation data is detailed in Appendix I.

Test Parameter	Before Test	After Test
Moisture Content, %:	**13.5**	**17.8**
Dry Density, pcf:	**109.66**	**112.65**
Saturation, %:	**68.66**	**98.23**
Void Ratio:	**0.53**	**0.49**
Apparent Specific Gravity:	**2.680**	

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805, extension 322.

Respectfully submitted,

BOWSER-MORNER, INC.

Karl A. Fletcher, Manager
Construction Materials and
Geotechnical Laboratories

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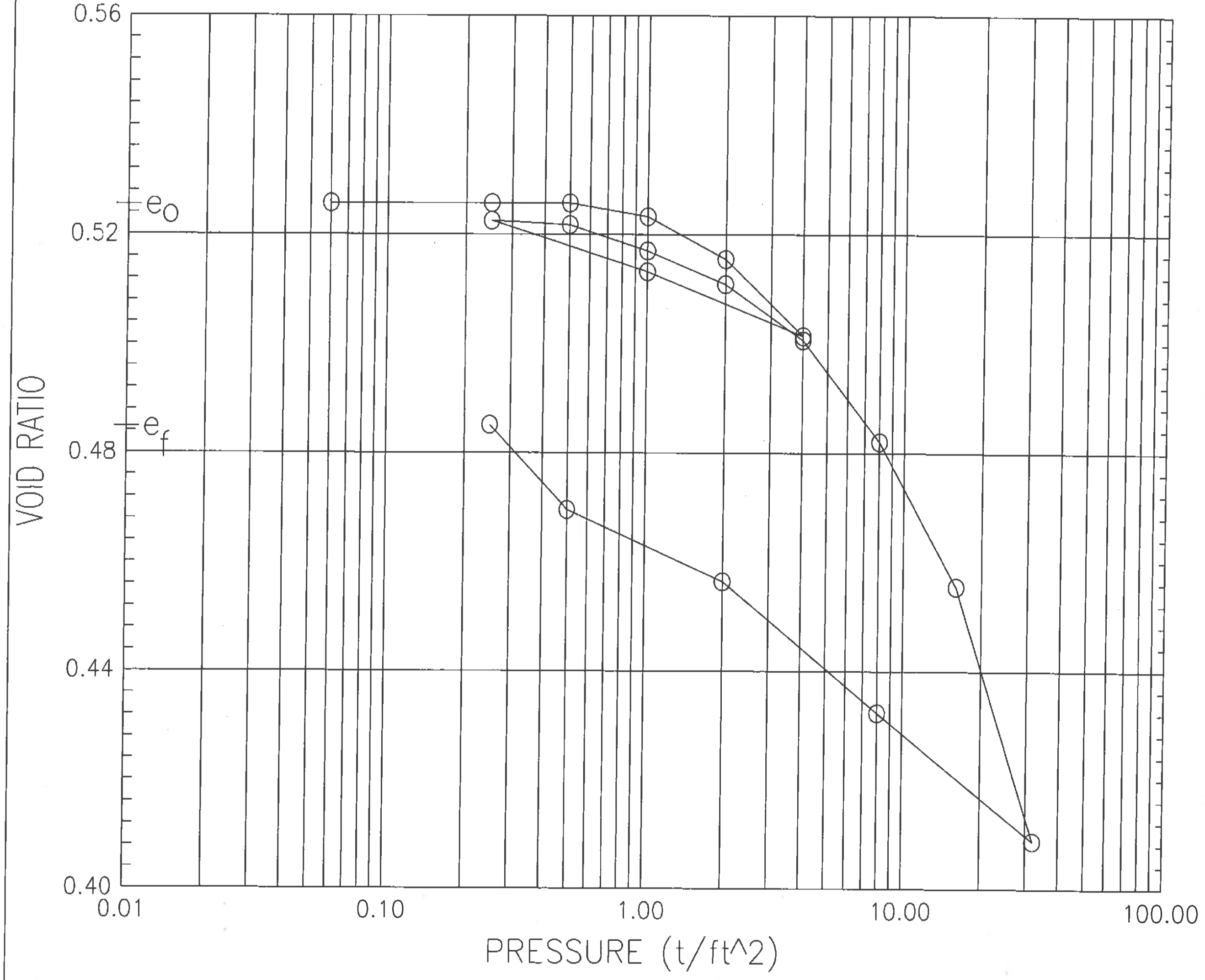
Report To: CTI and Associates
Project: EMDF Characterization

Sample ID: GW995-ST-2, 6.0'-8.0'

BMI Job No.: 183923
BMI Report No.: 430281

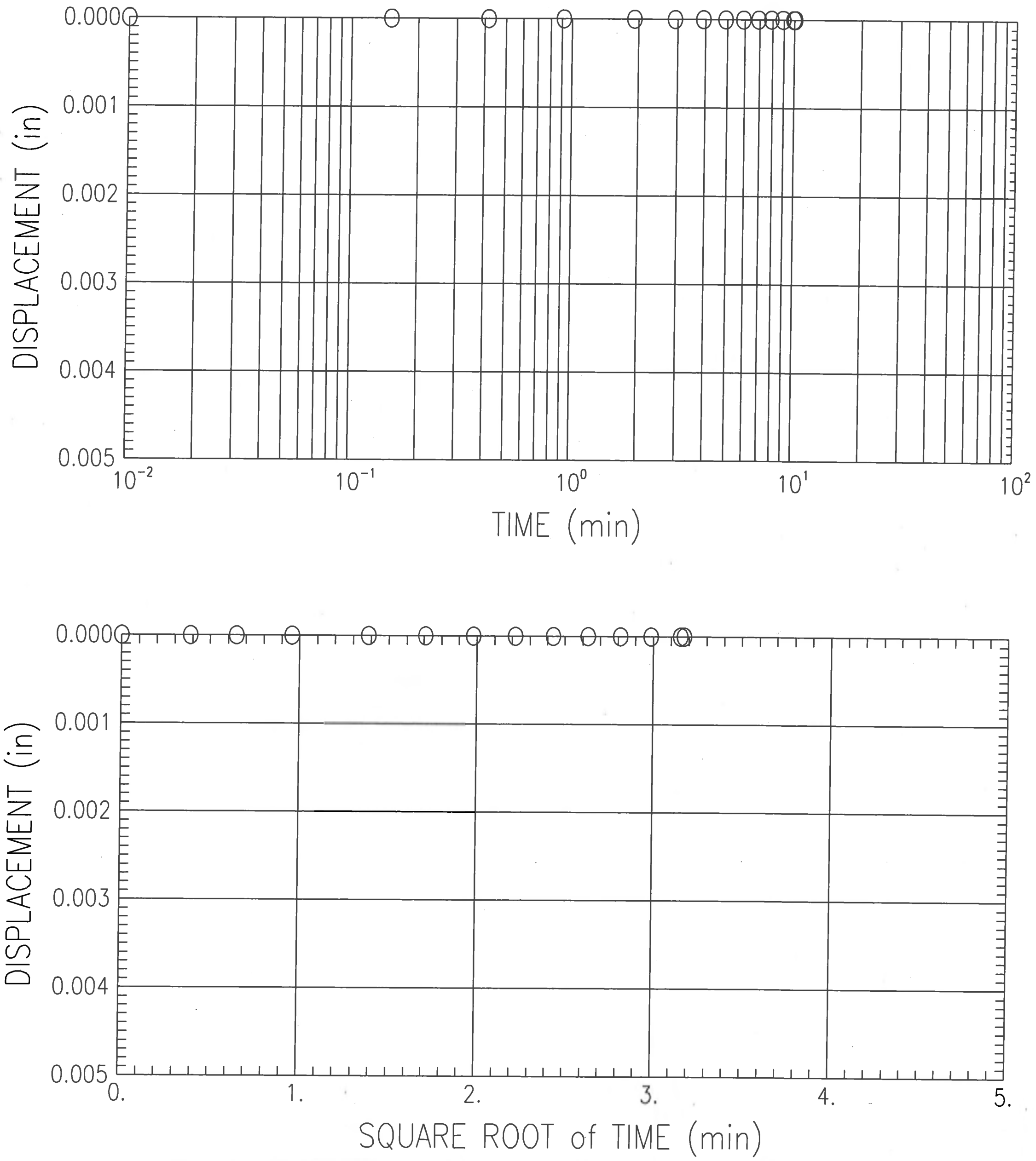
Appendix I



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE (t/ft^2)		WATER CONTENT (%)	13.5	17.8
PRECONSOL. PRESSURE (t/ft^2)		DRY DENSITY (lb/ft^3)	109.66	112.65
COMPRESSION INDEX		SATURATION (%)	68.66	98.23
TYPE SPECIMEN	Undisturb	VOID RATIO	0.53	0.49
DIA. (in) 2.500	HT. (in) 1.000	BACK PRESSURE (t/ft^2)	---	---
CLASSIFICATION brown silty clay (visual description)				
LL --- PL ---	PI ---	PROJECT EMDF Characterization		
GS 2.680	D_{10}	995ST2		
REMARKS		BORING NO. GW995-ST-2		SAMPLE NO. GW995-ST-2
Use: Near foundation/ geobuffer layer		DEPTH 6.3'-6.5'		DATE 05/09/18

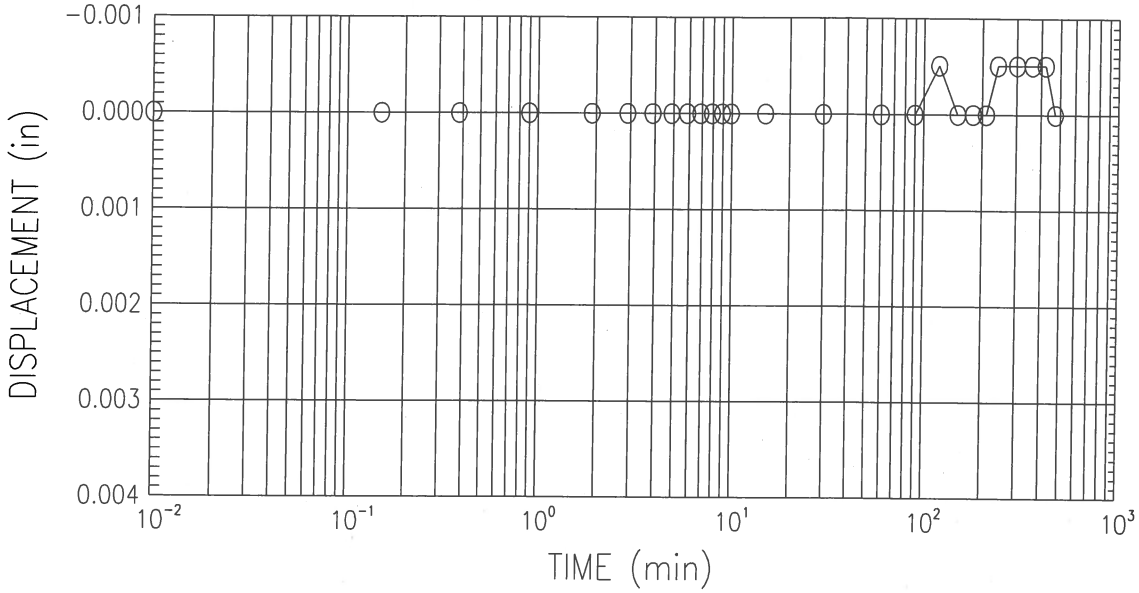
Bowser Morner
CONSOLIDATION TEST REPORT

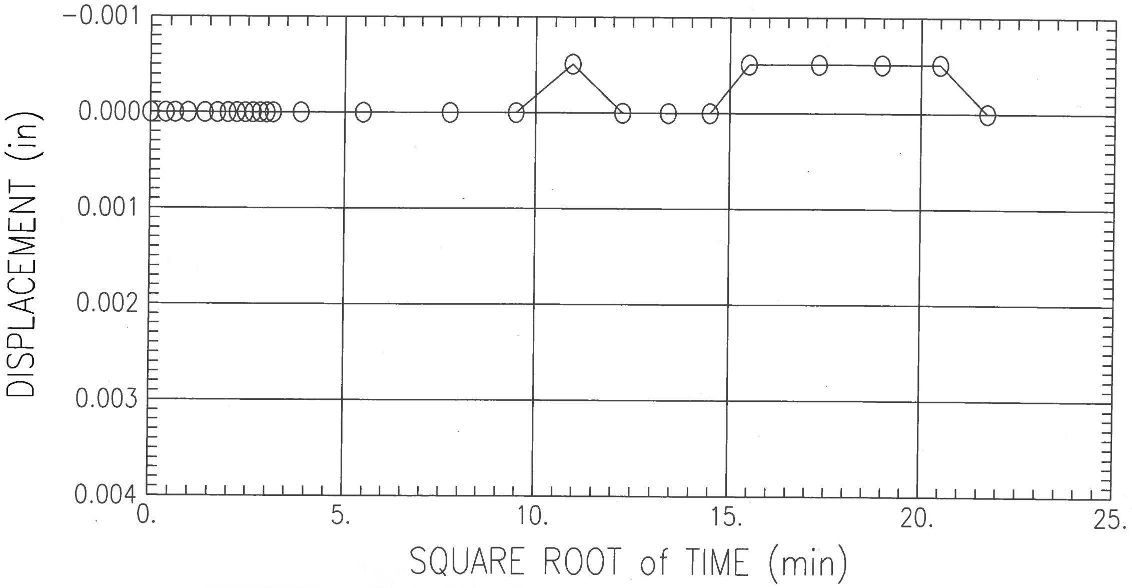
CONSOLIDATION TEST
TIME CURVES (STEP 1 OF 19)
STRESS : 0.06 (t/ft^2)



Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2
Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'
Description : brown silty clay (visual description)

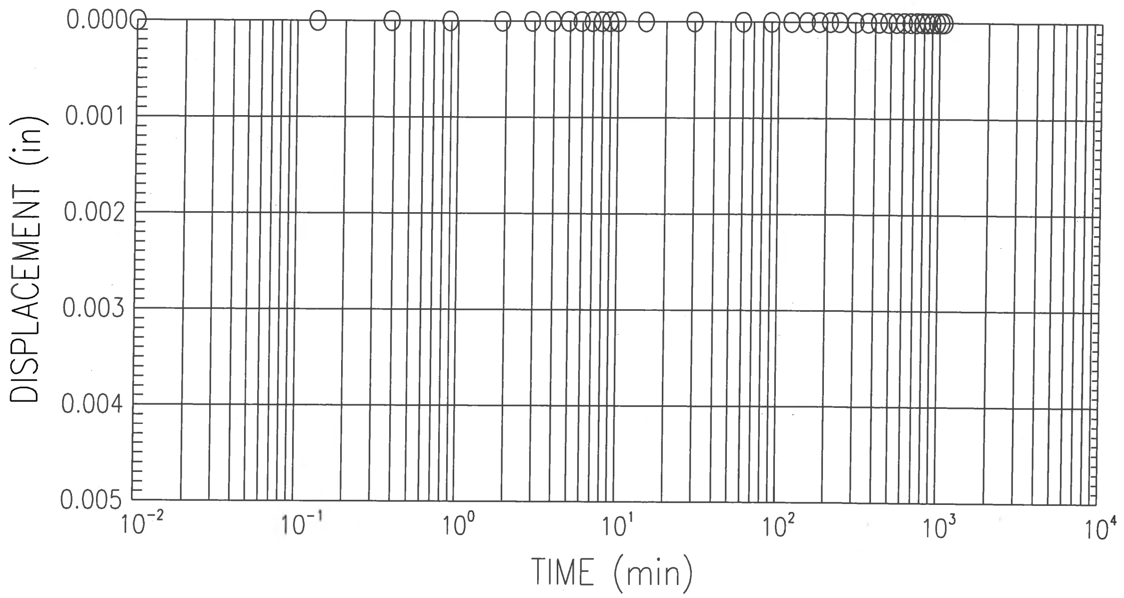
CONSOLIDATION TEST
TIME CURVES (STEP 2 OF 19)
STRESS : 0.25 (t/ft^2)

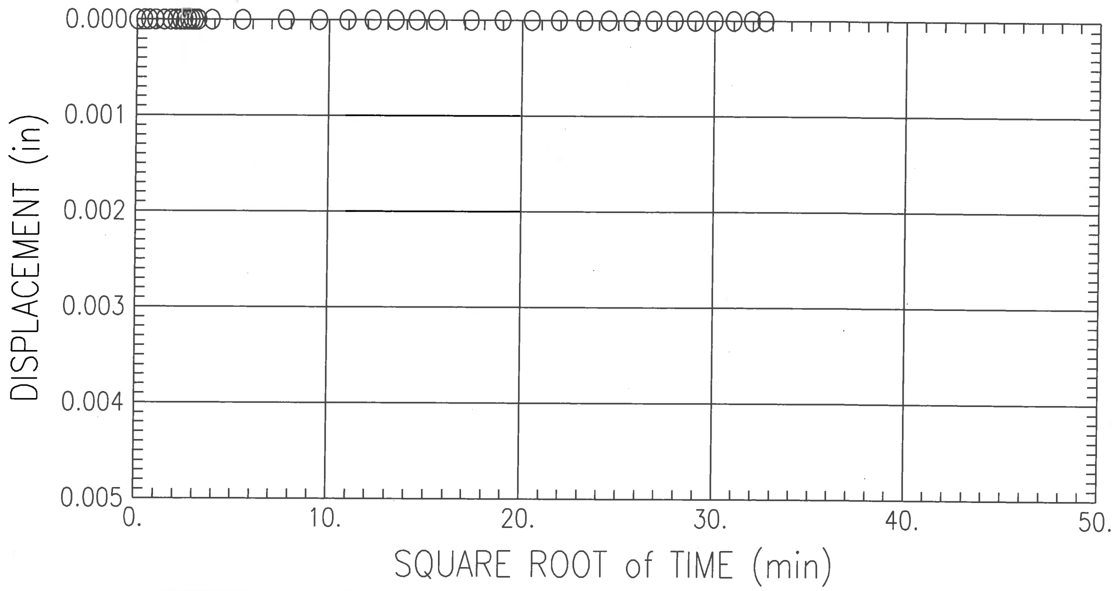




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2
Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'
Description : brown silty clay (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 3 OF 19)
STRESS : 0.5 (t/ft^2)





Bowser Morner

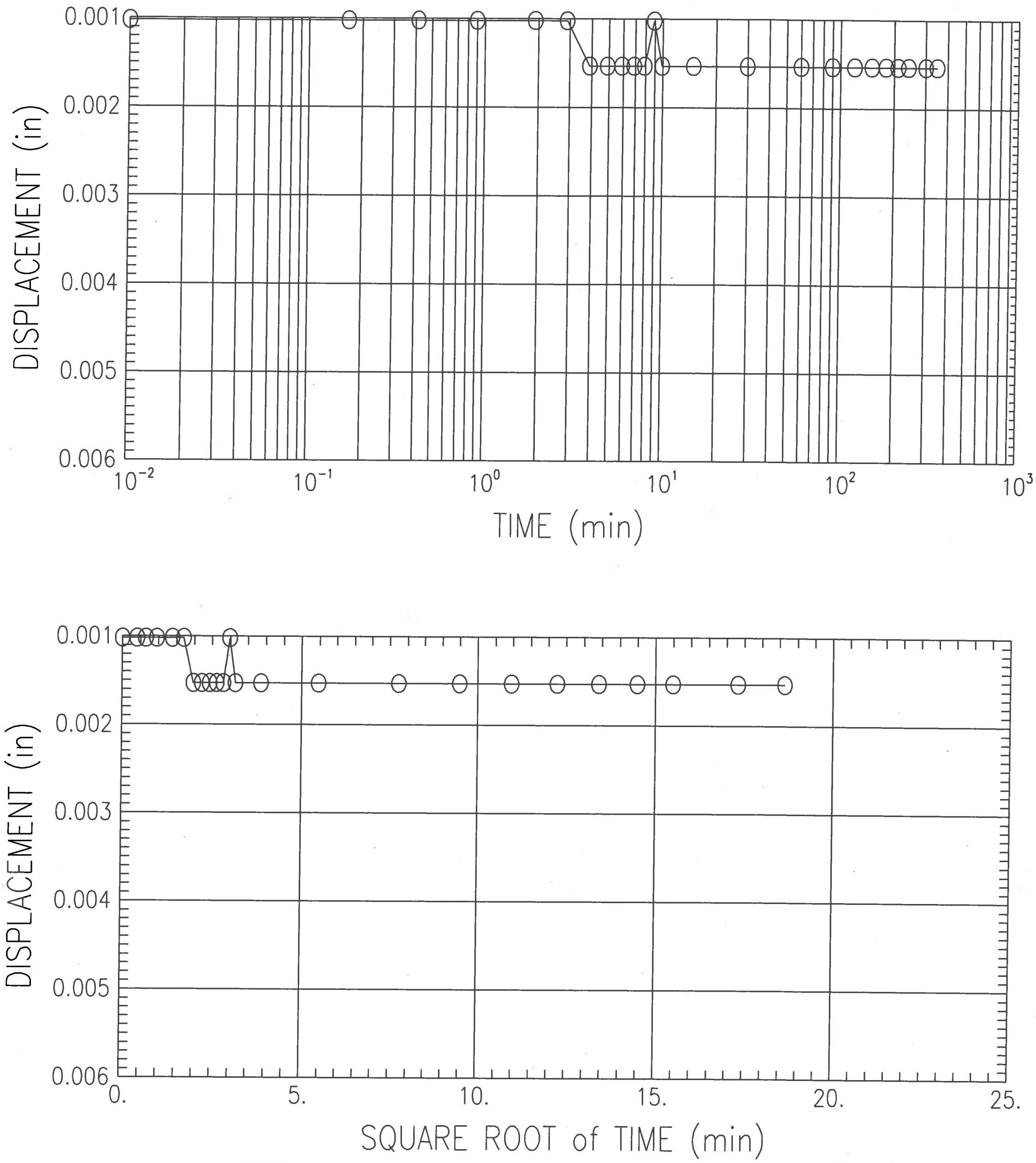
Project Name : EMDF Characterization

Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2

Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'

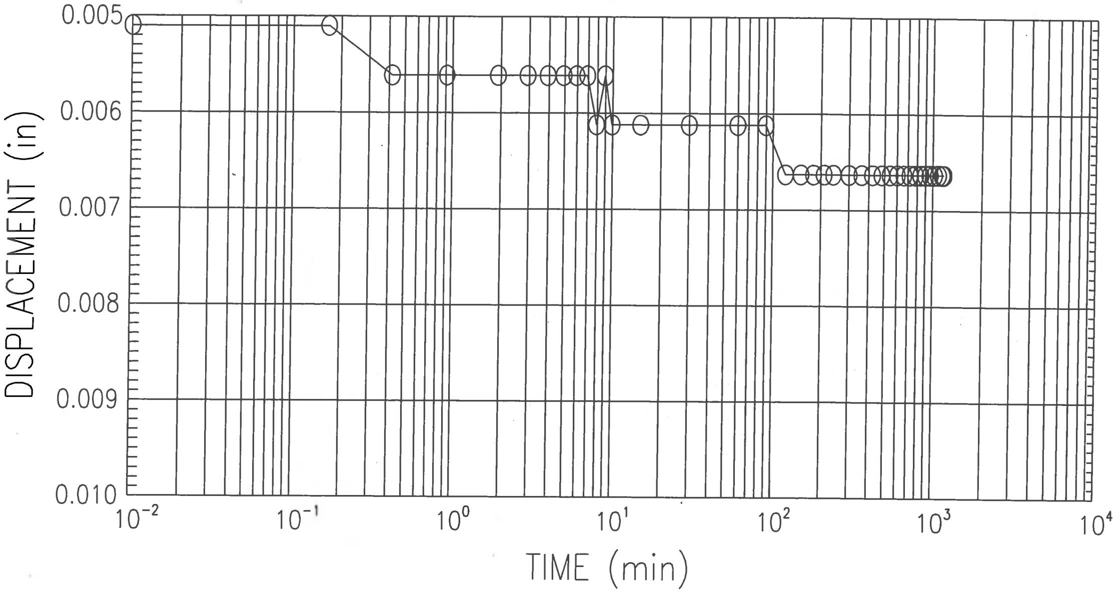
Description : brown silty clay (visual description)

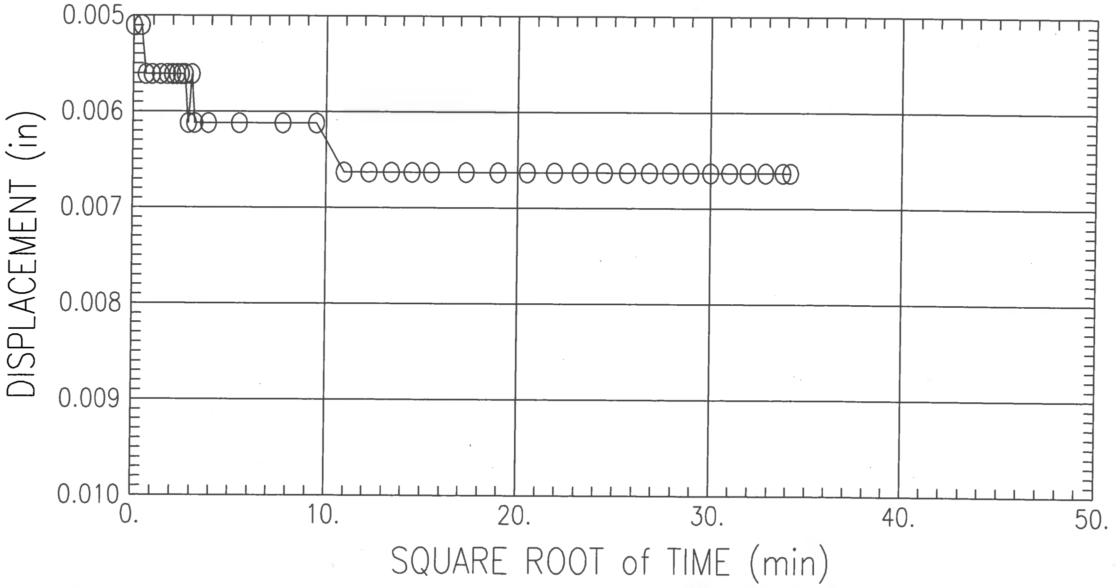
CONSOLIDATION TEST
TIME CURVES (STEP 4 OF 19)
STRESS : 1 (t/ft^2)



Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2
Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'
Description : brown silty clay (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 5 OF 19)
STRESS : 2 (t/ft^2)





Bowser Morner

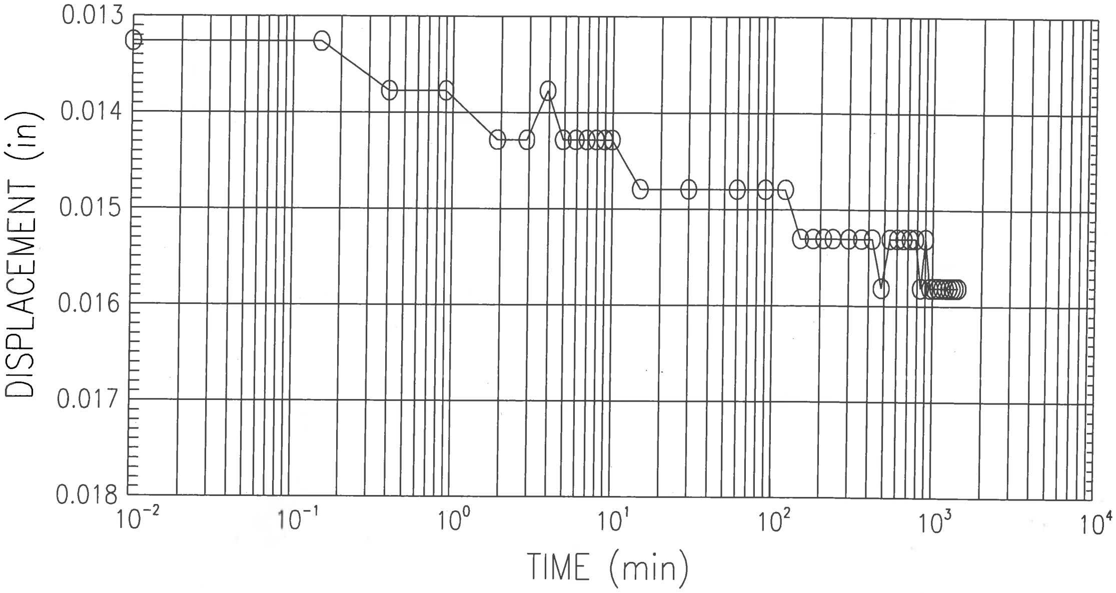
Project Name : EMDF Characterization

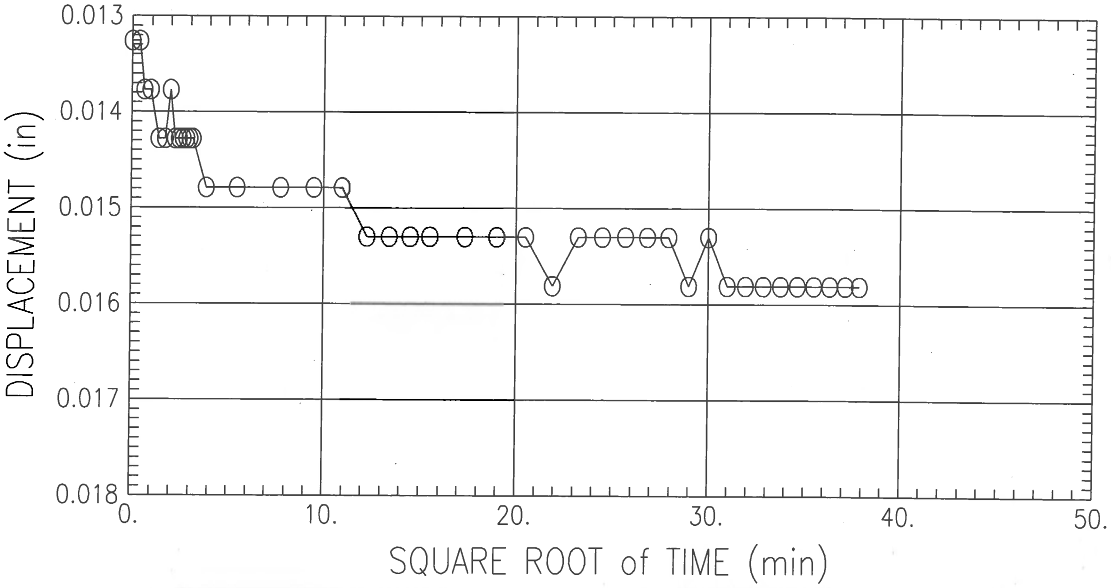
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2

Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'

Description : brown silty clay (visual description)

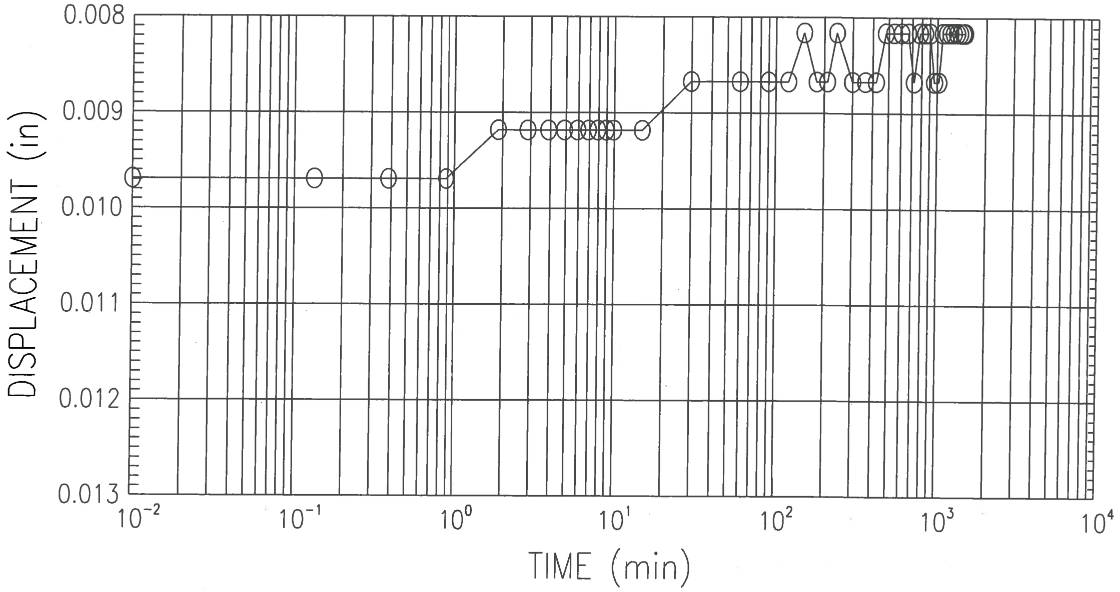
CONSOLIDATION TEST
TIME CURVES (STEP 6 OF 19)
STRESS : 4 (t/ft^2)

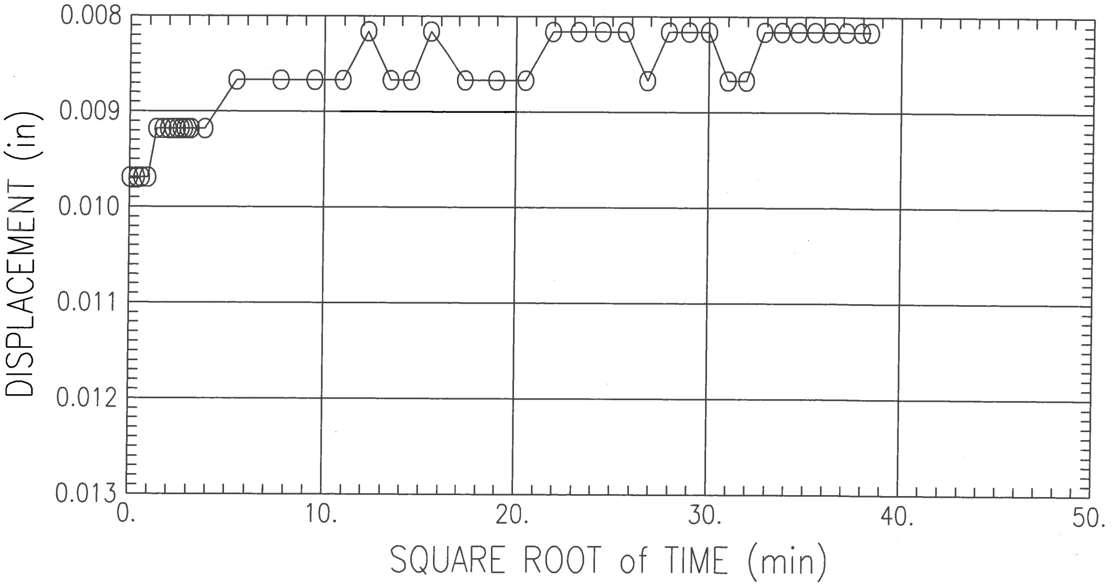




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2
Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'
Description : brown silty clay (visual description)

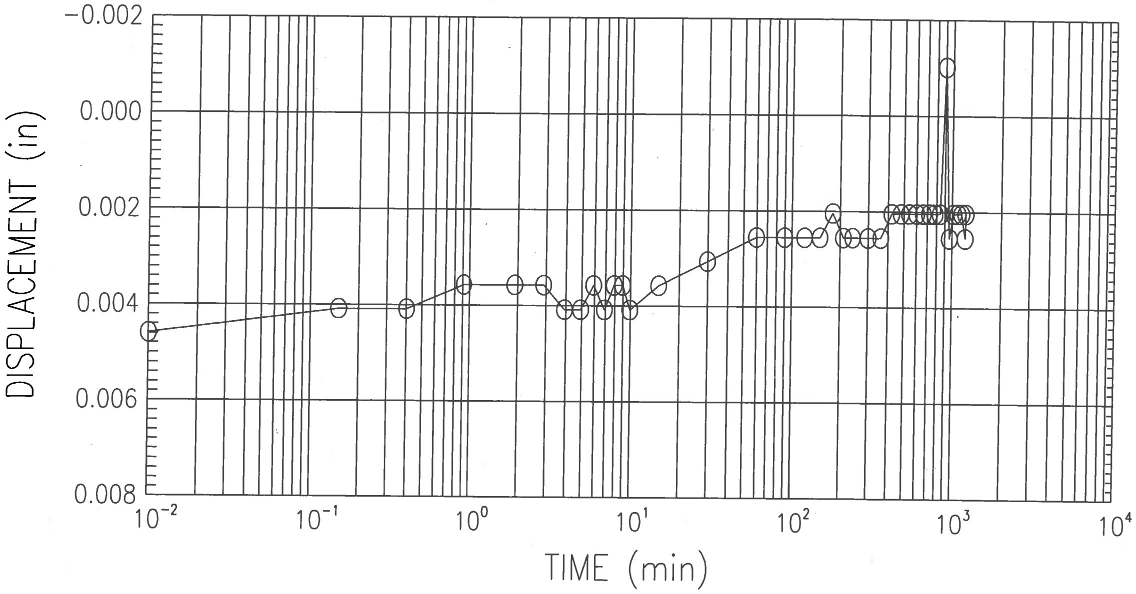
CONSOLIDATION TEST
TIME CURVES (STEP 7 OF 19)
STRESS : 1 (t/ft^2)

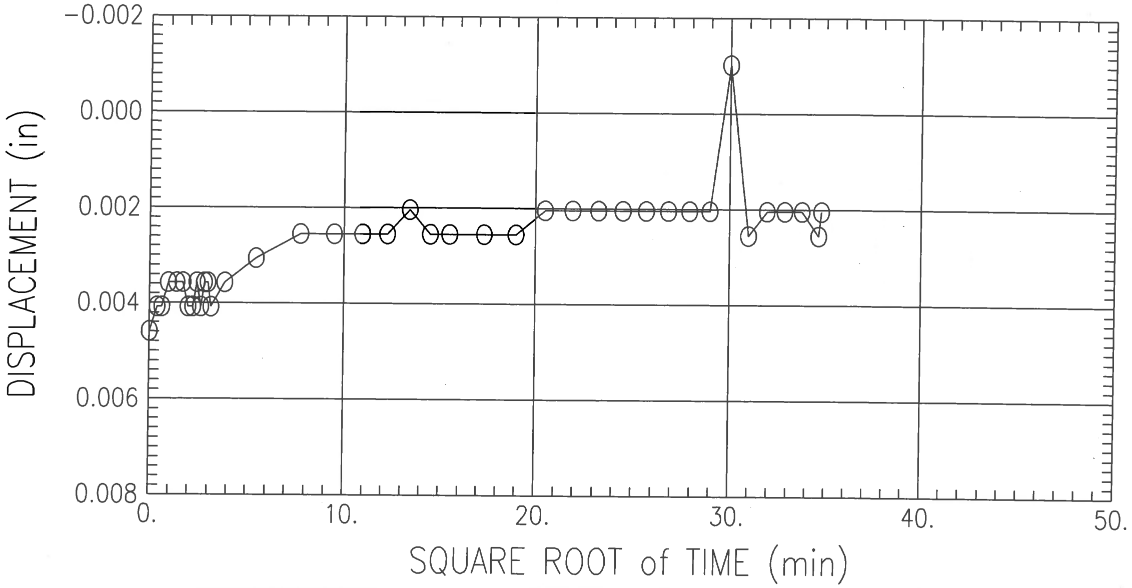




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2
Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'
Description : brown silty clay (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 8 OF 19)
STRESS : 0.25 (t/ft^2)





Bowser Morner

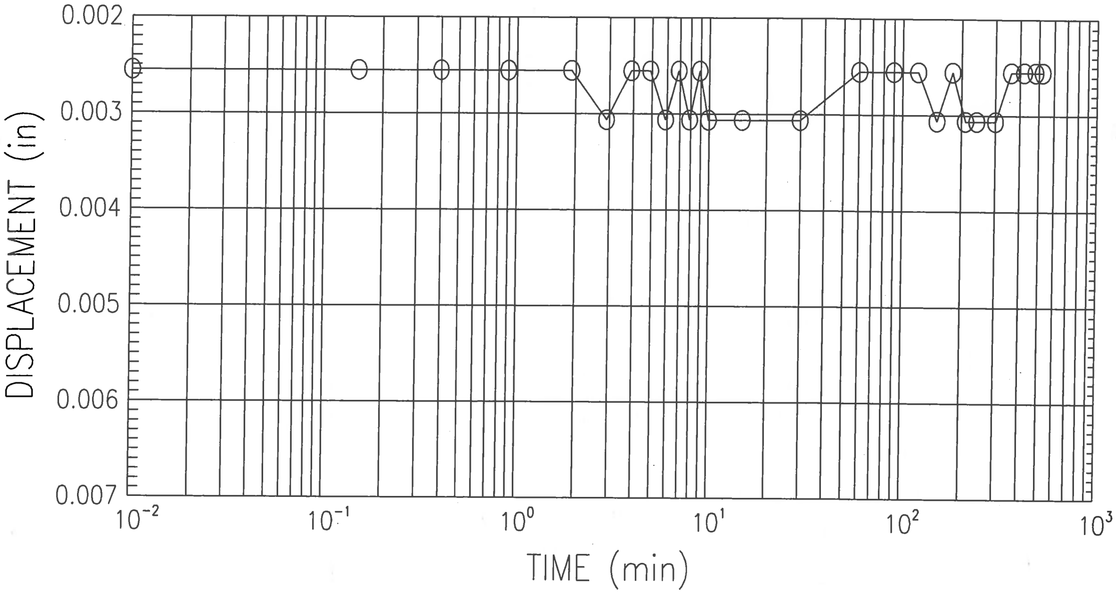
Project Name : EMDF Characterization

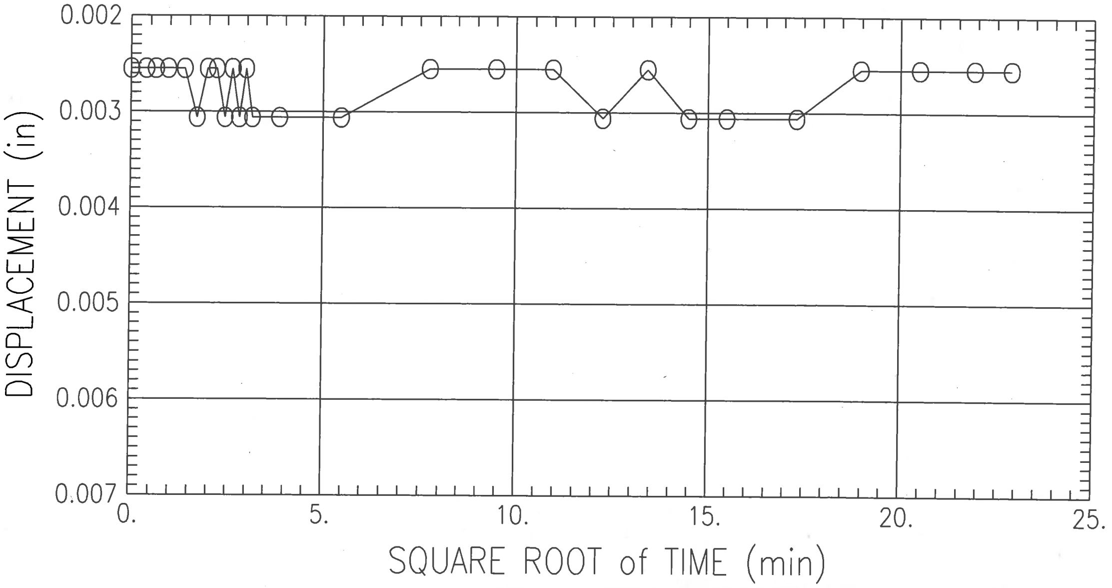
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2

Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'

Description : brown silty clay (visual description)

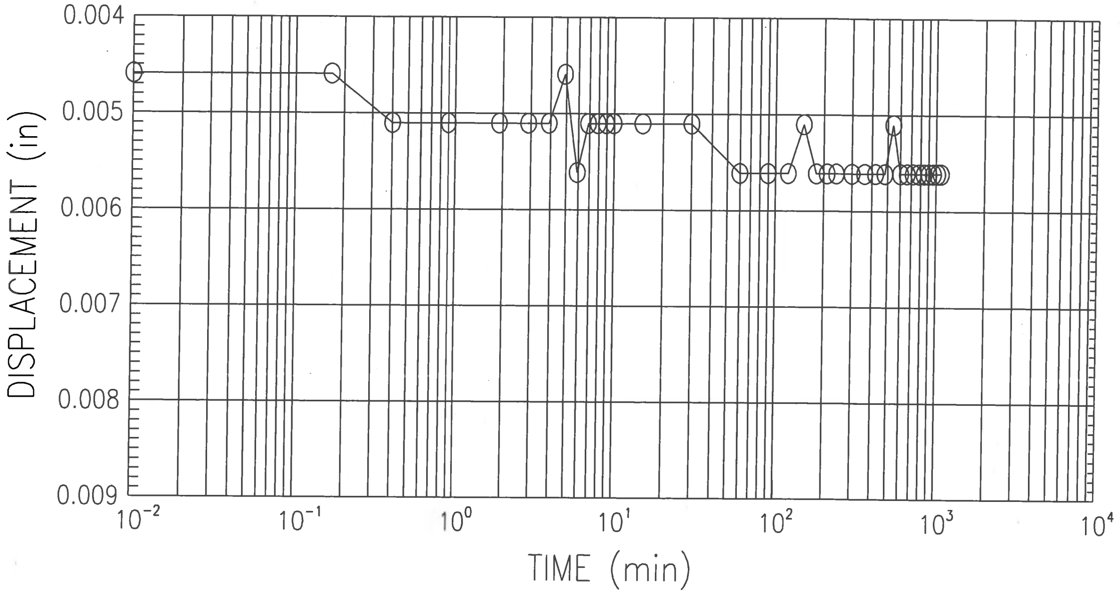
CONSOLIDATION TEST
TIME CURVES (STEP 9 OF 19)
STRESS : 0.5 (t/ft^2)

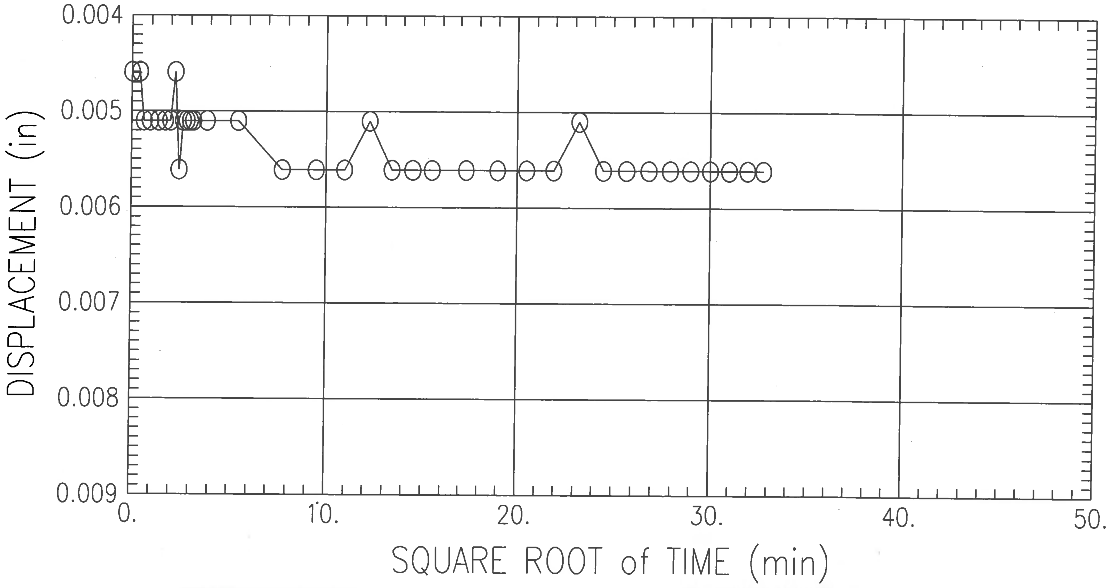




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2
Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'
Description : brown silty clay (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 10 OF 19)
STRESS : 1 (t/ft^2)





Bowser Morner

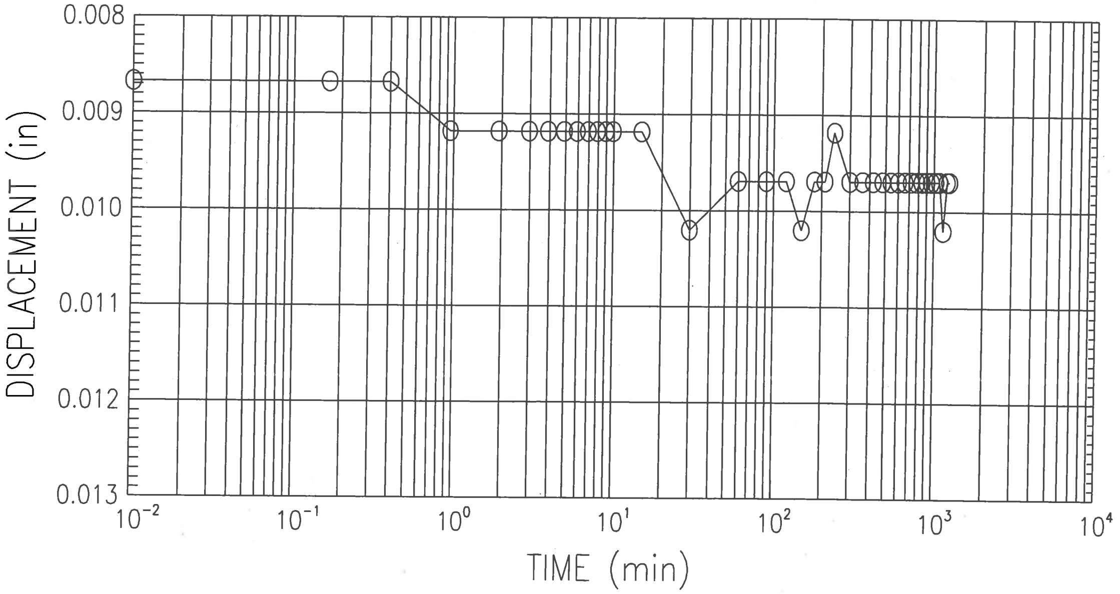
Project Name : EMDF Characterization

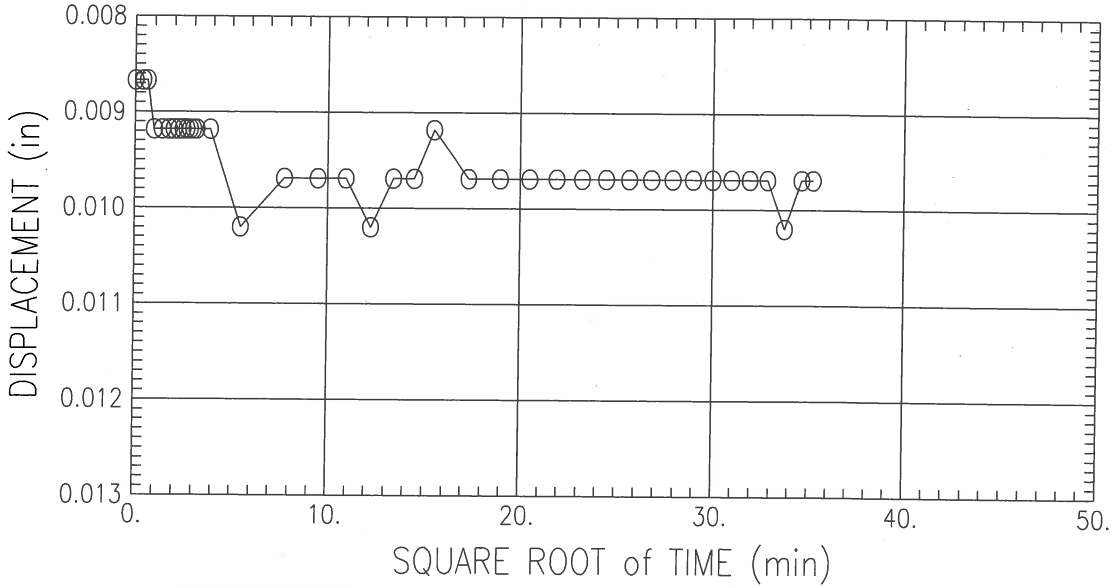
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2

Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'

Description : brown silty clay (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 11 OF 19)
STRESS : 2 (t/ft^2)





Bowser Morner

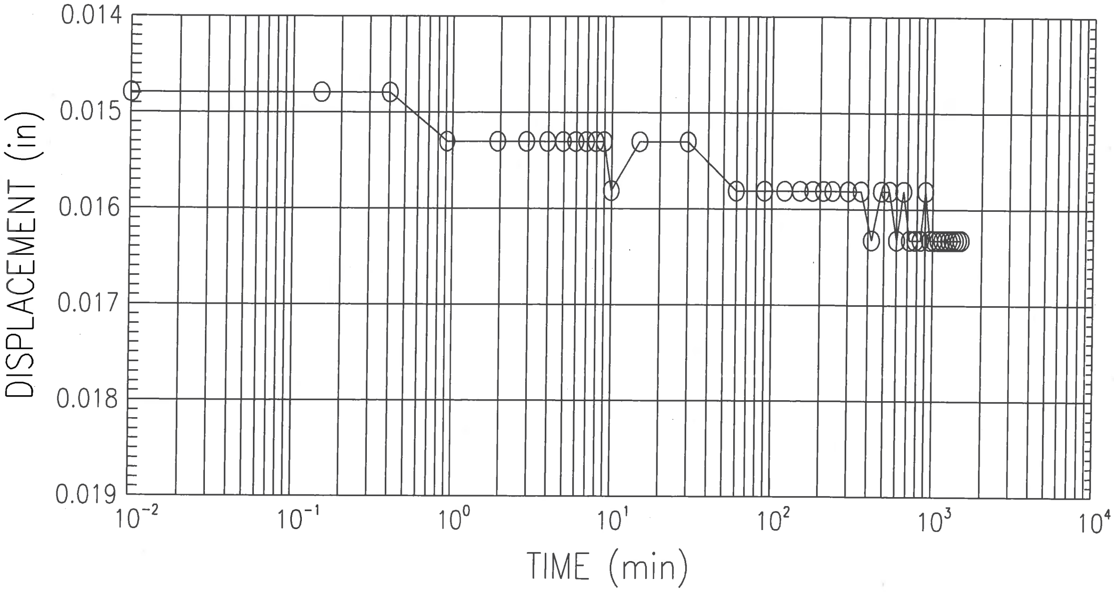
Project Name : EMDF Characterization

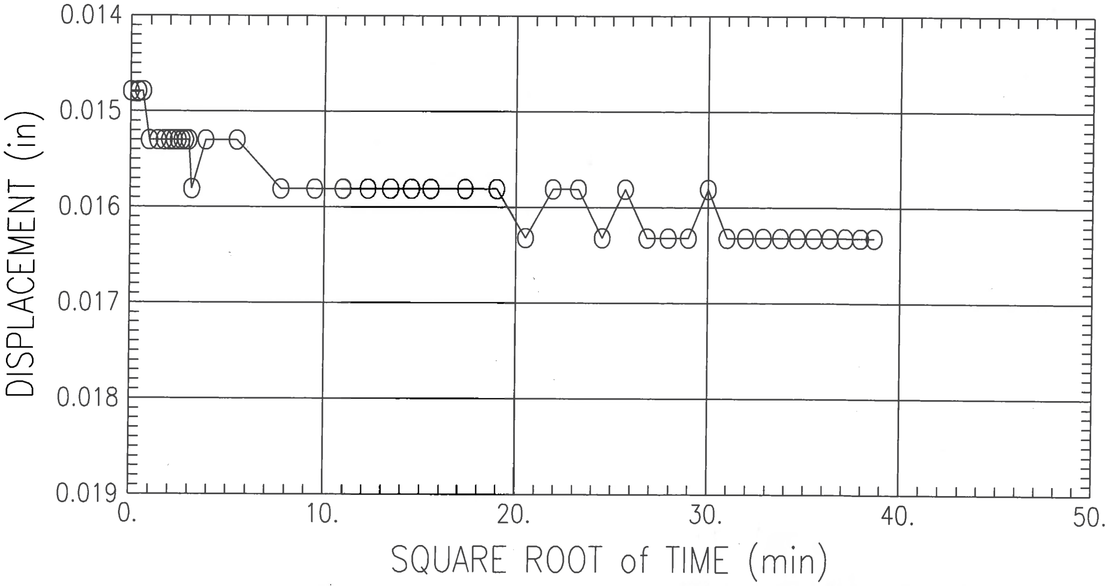
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2

Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'

Description : brown silty clay (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 12 OF 19)
STRESS : 4 (t/ft^2)





Bowser Morner

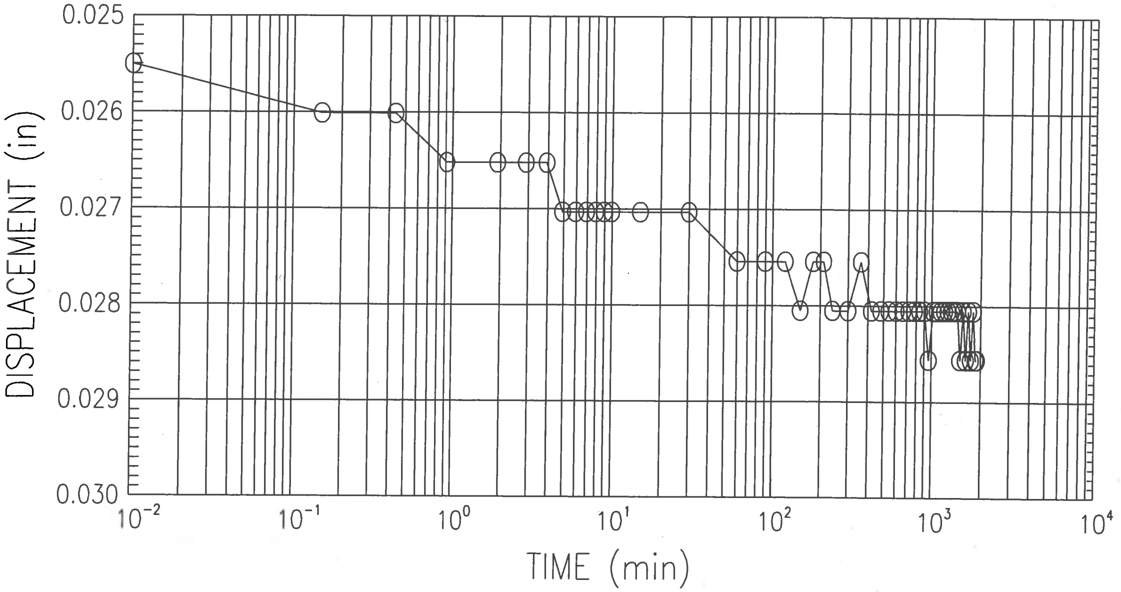
Project Name : EMDF Characterization

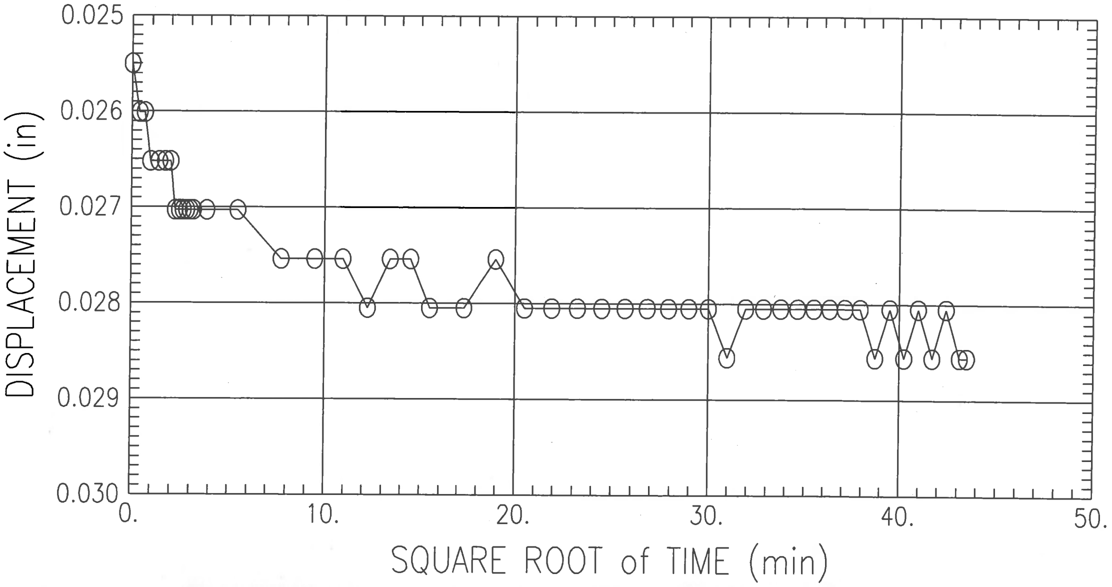
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2

Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'

Description : brown silty clay (visual description)

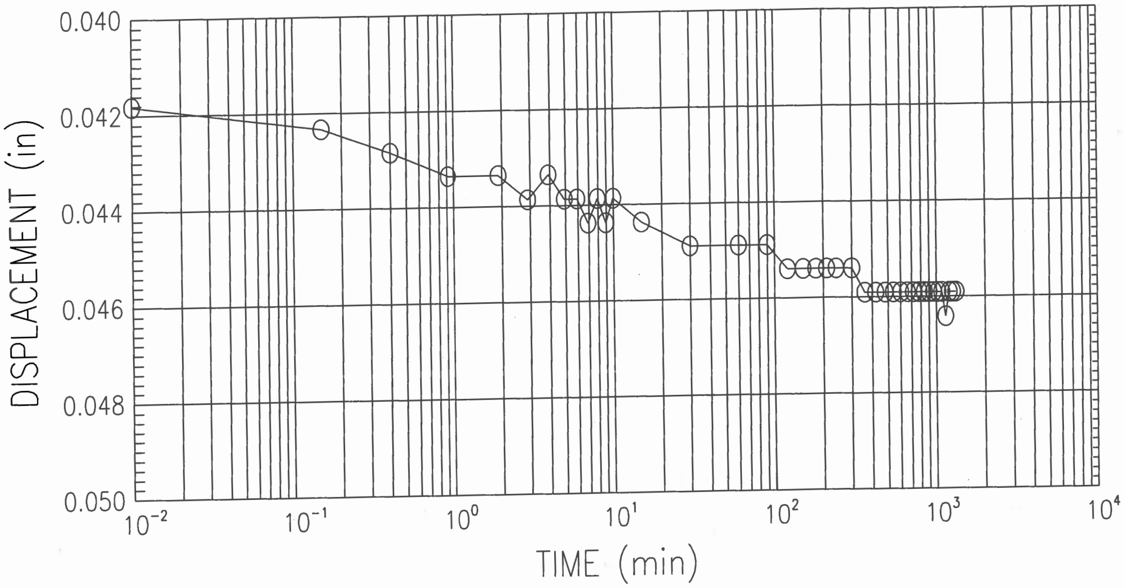
CONSOLIDATION TEST
TIME CURVES (STEP 13 OF 19)
STRESS : 8 (t/ft^2)

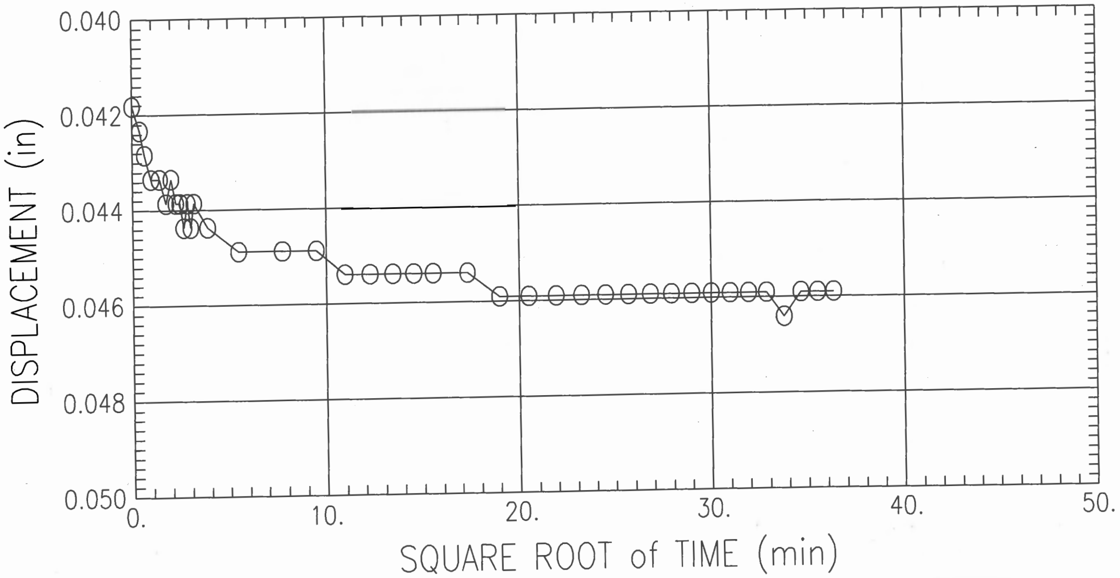




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2
Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'
Description : brown silty clay (visual description)

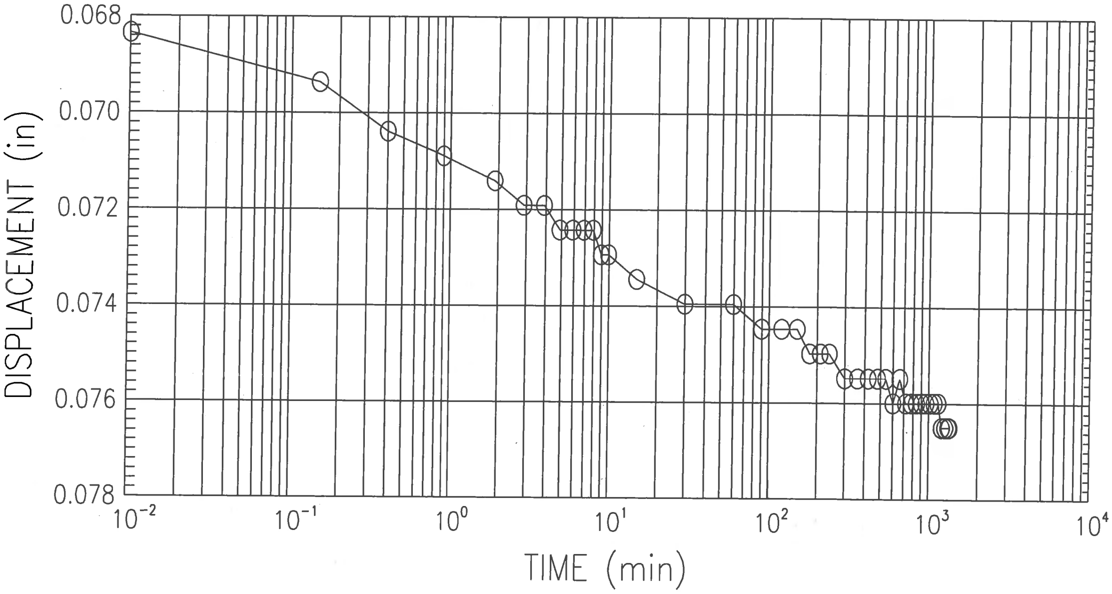
CONSOLIDATION TEST
TIME CURVES (STEP 14 OF 19)
STRESS : 16 (t/ft^2)

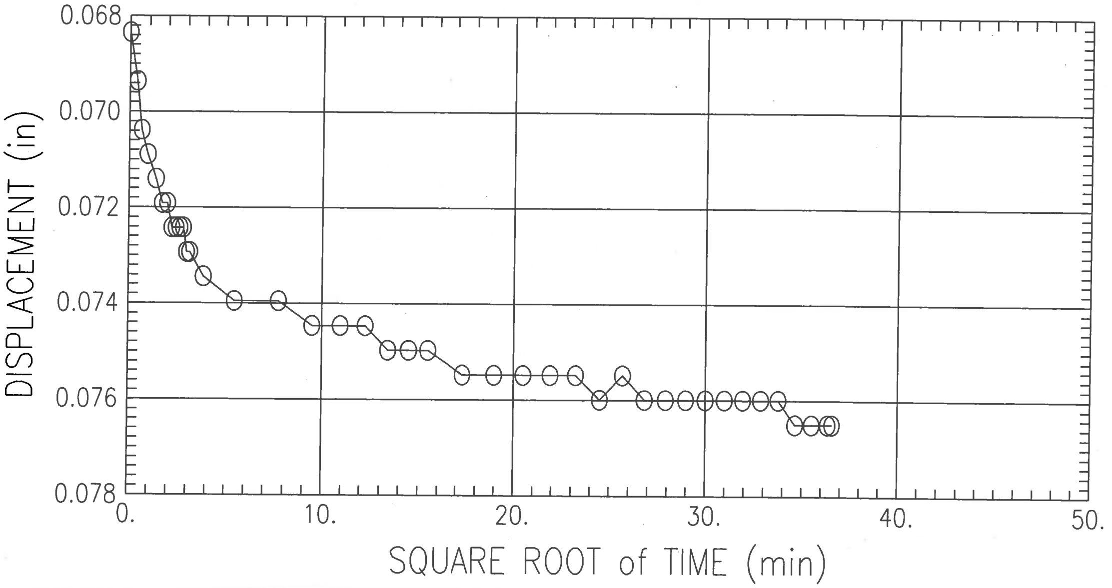




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2
Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'
Description : brown silty clay (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 15 OF 19)
STRESS : 32 (t/ft^2)





Bowser Morner

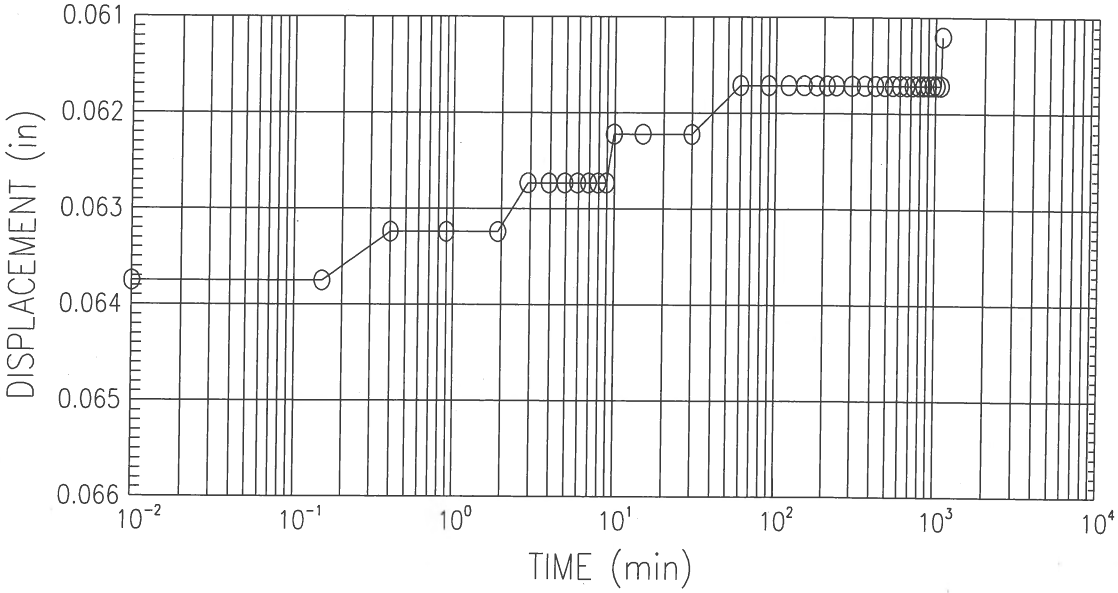
Project Name : EMDF Characterization

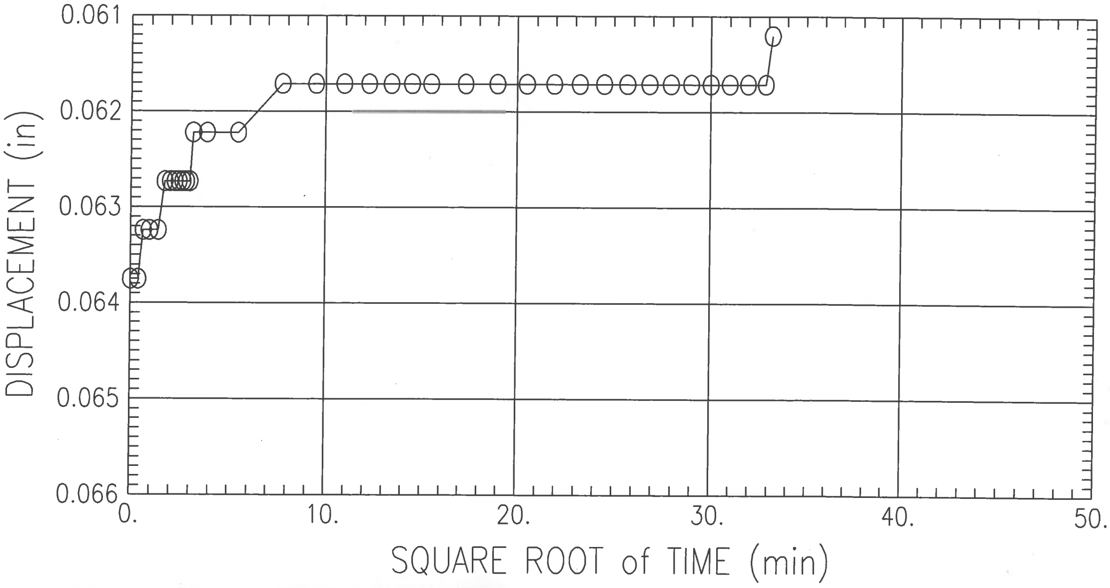
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2

Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'

Description : brown silty clay (visual description)

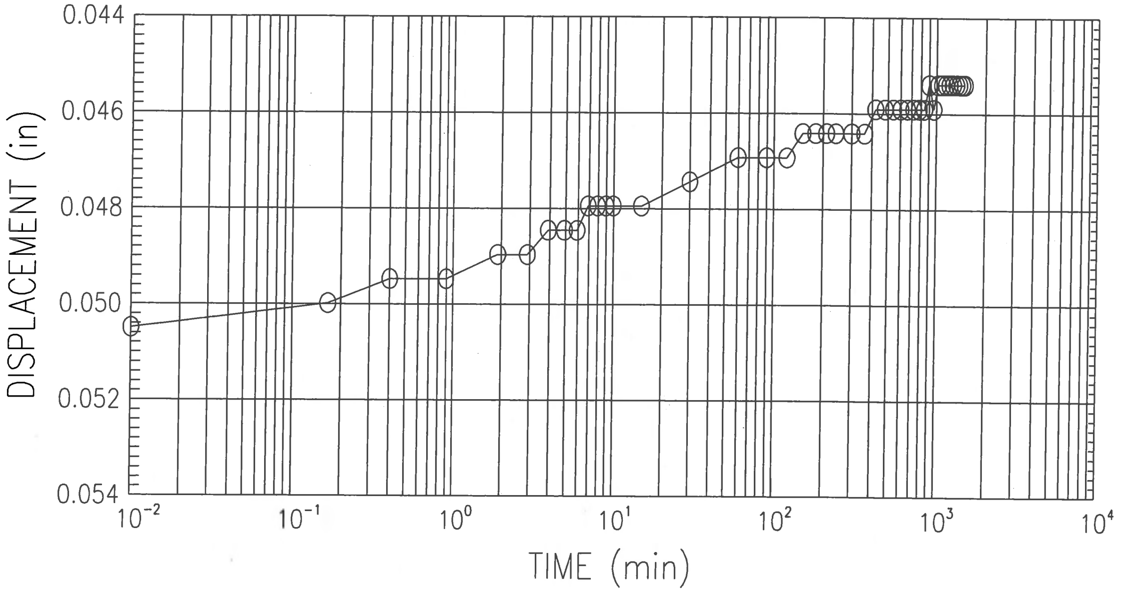
CONSOLIDATION TEST
TIME CURVES (STEP 16 OF 19)
STRESS : 8 (t/ft^2)

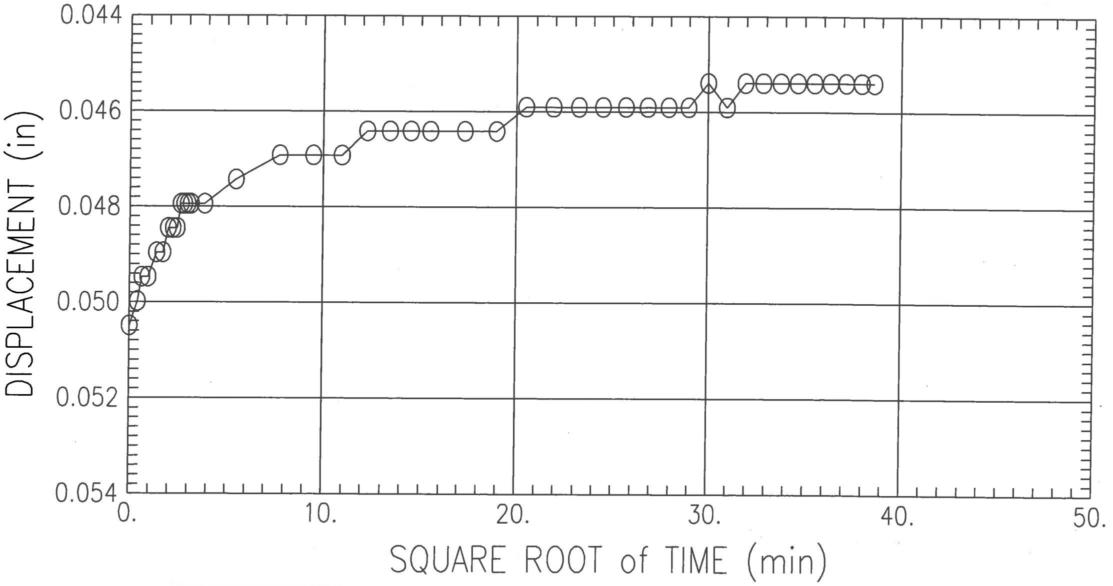




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2
Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'
Description : brown silty clay (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 17 OF 19)
STRESS : 2 (t/ft^2)





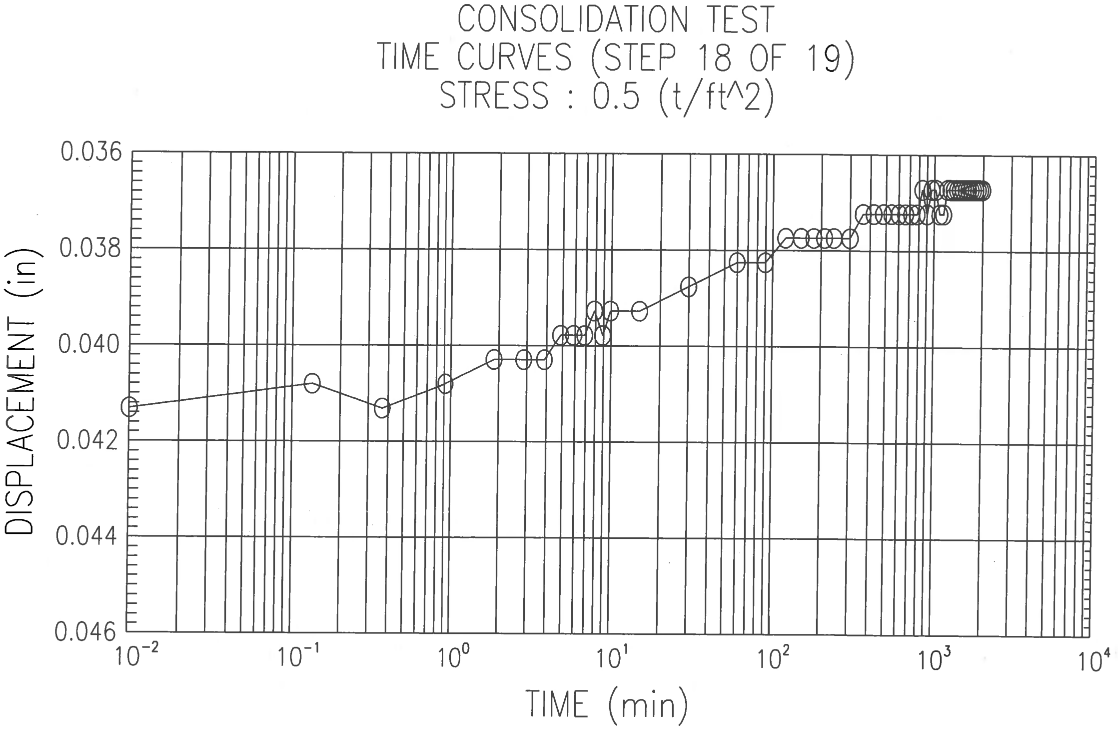
Bowser Morner

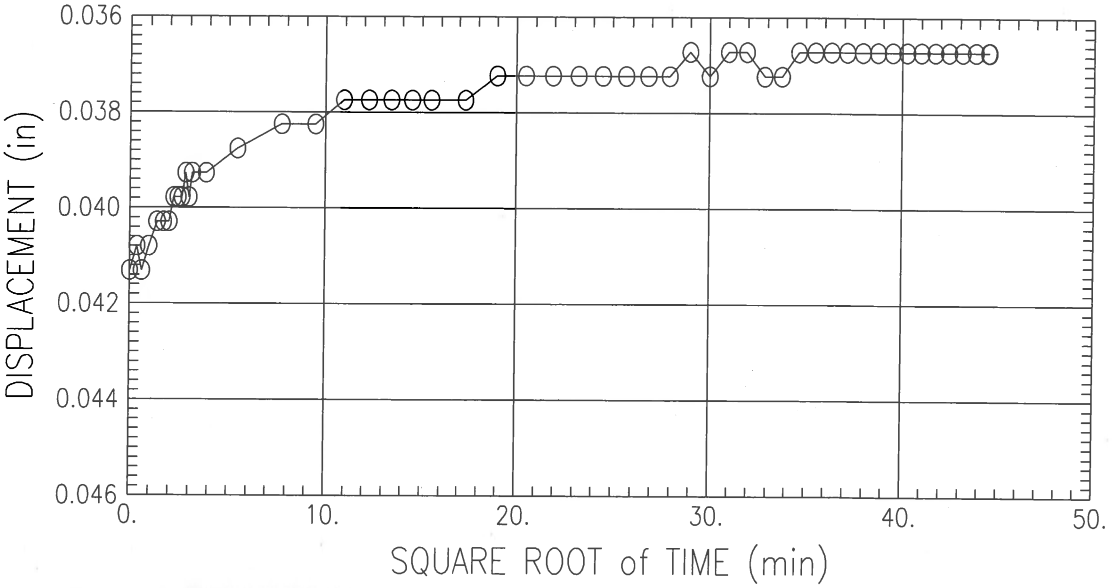
Project Name : EMDF Characterization

Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2

Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'

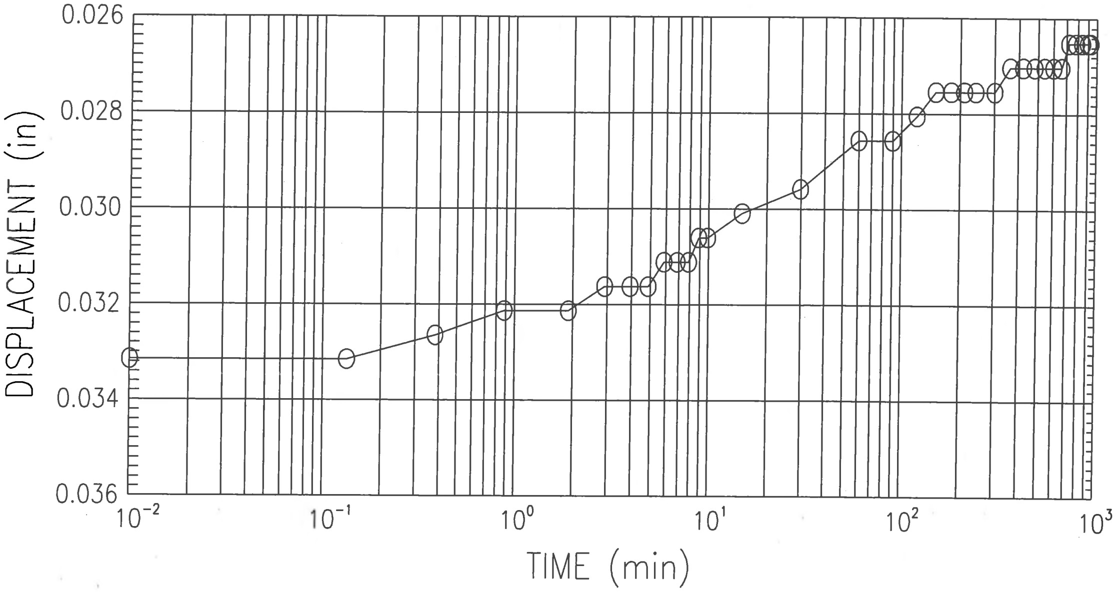
Description : brown silty clay (visual description)

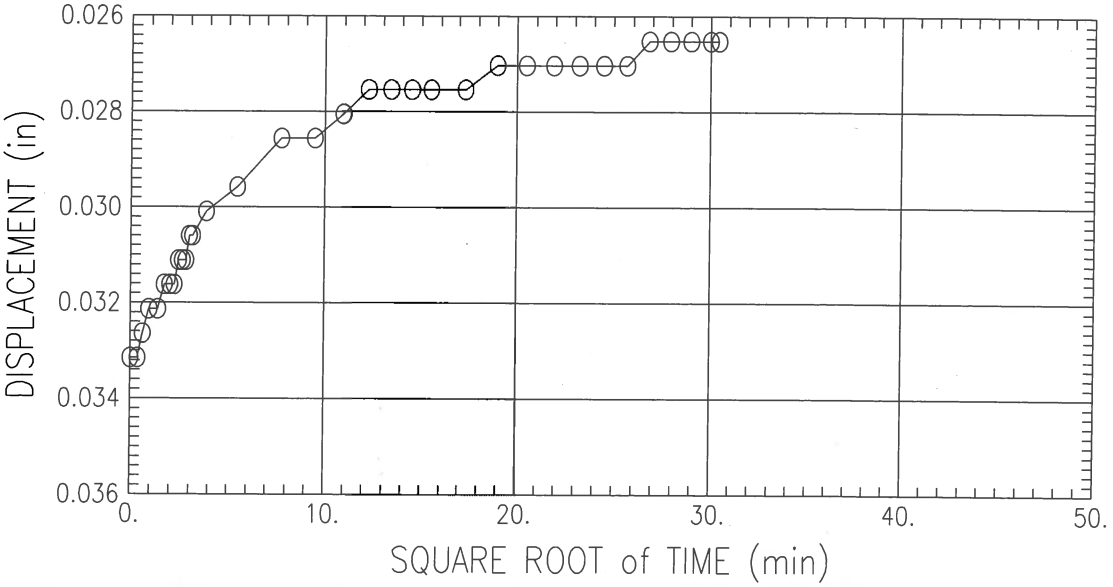




Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2
Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'
Description : brown silty clay (visual description)

CONSOLIDATION TEST
TIME CURVES (STEP 19 OF 19)
STRESS : 0.25 (t/ft^2)





Bowser Morner
Project Name : EMDF Characterization
Project No : 183923 Boring No : GW995-ST-2 Sample No : GW995-ST-2
Test Date : 05/09/18 Test No : GW995-ST-2 Depth : 6.3'-6.5'
Description : brown silty clay (visual description)

BOWSER-MORNER, INC.

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LABORATORY REPORT

Report To: CTI & Associates, Inc.
Attn: Michael Partenio
28001 Cabot Drive, Ste. 250
Novi, MI 48377

Report Date: May 17, 2018
Job No.: 183923
Report No.: 430272
No. of Pages: 3

Report On: Laboratory Analysis of One Shelby Tube Sample
Project: EMDF Characterization – Project No. 1188070011
Sample ID: GW995 – ST-2, 6.0'-8.0' – Sample Date: 2/22/18

On March 5, 2018, one Shelby tube sample was submitted for selected laboratory analysis from the above referenced project. Testing was performed as specified by the client and in accordance with ASTM D 4767, "Consolidated-Undrained Triaxial Compression Test on Cohesive Soils".

Results are summarized below and detailed on the attached data sheets.

Test Parameter	Test No.1	Test No. 2	Test No. 3
Dry Density, pcf:	**107.9**	**106.05**	**No Test**
Moisture Content, %:	**15.55**	**17.12**	**No Test**
Minor Principle Stress, psi:	**15.46**	**23.65**	**No Test**
Maximum Deviator Stress, psi:	**52.84**	**69.43**	**No Test**
Cohesion (c'), psi:		**0.0**	
phi Angle (Ø'):		**36.9**	
Apparent Specific Gravity:		**2.68**	

Note: Two triaxial points were tested instead of three due to insufficient amount of sample.

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805 extension 322.

Respectfully submitted,

BOWSER-MORNER, INC.

Karl A. Fletcher, Manager
Construction Materials and
Geotechnical Laboratories

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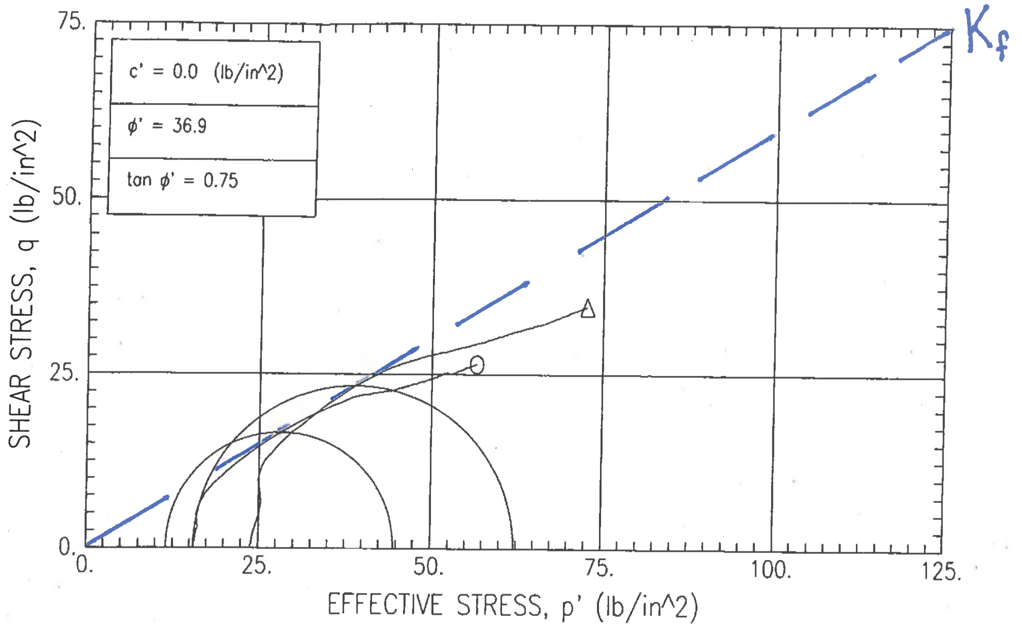
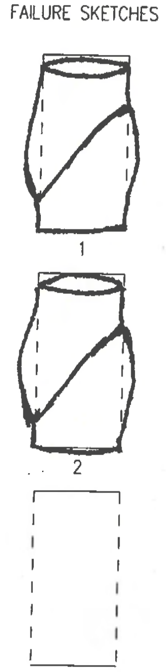
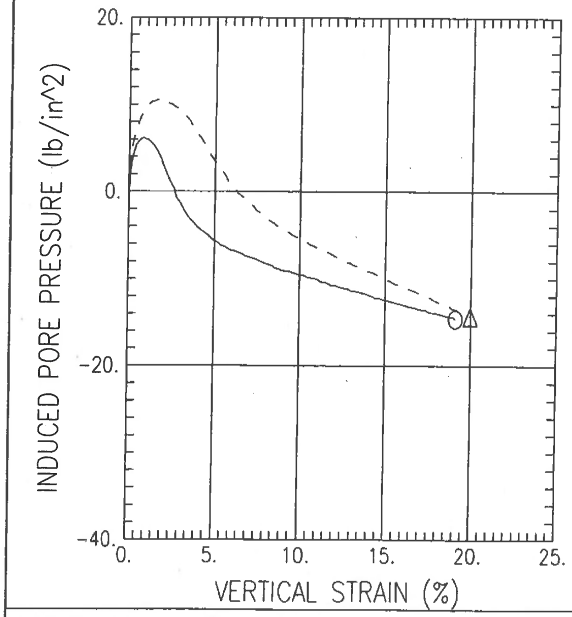
1-kfoye@cticompanies.com

$\varnothing' = \sin^{-1} 0.60 = 36.9^\circ$







SYMBOL		O	Δ		
TEST NO.		1	2		
INITIAL	WATER CONTENT (%)	15.55	17.12		
	DRY DENSITY (lb/ft^3)	107.49	106.05		
	SATURATION (%)	74.98	79.54		
	VOID RATIO	0.556	0.577		
BEFORE SHEAR	WATER CONTENT (%)	19.84	19.62		
	DRY DENSITY (lb/ft^3)	108.62	108.63		
	SATURATION (%)	98.52	97.49		
	VOID RATIO	0.540	0.539		
	BACK PRESS. (lb/in^2)	59.54	66.35		
MINOR PRIN. STRESS (lb/in^2)		15.46	23.65		
MAX. DEV. STRESS (lb/in^2)		52.84	69.43		
TIME TO FAILURE (min)		1143	1155		
RATE OF STRAIN INCR (%/min)		0.02	0.02		
INITIAL DIAMETER (in)		2.86	2.87		
INITIAL HEIGHT (in)		5.87	5.85		

CONTROLLED STRAIN TEST

DESCRIPTION OF SPECIMENS: 1) brown silty clay (visual description) 2) brown silty clay (visual description)

LL	PL	PI	GS 2.68	TYPE OF SPECIMEN Undisturbed	TYPE OF TEST CU (R)

REMARKS:

1) Client: CTI & Associates, Inc.

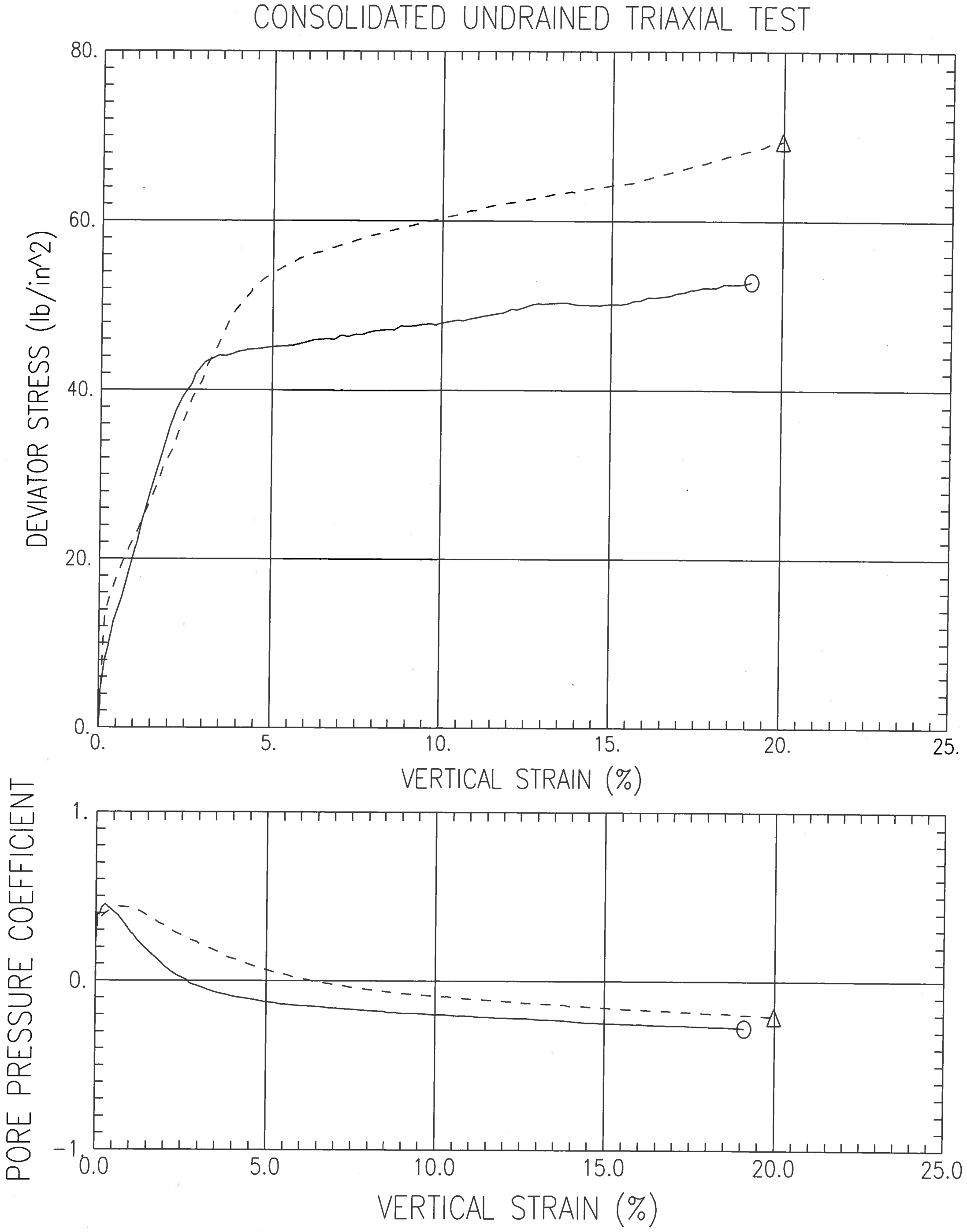
2) Use: Near foundation / geobuffer layer

PROJECT EMDF Characterization

PROJECT NO. 183923

BORING NO. GW995-ST-2	SAMPLE NO.	1	2	
TECH. BMI: blc	DEPTH/ELEV	6.5'-7.0'	7.5'-8.0'	
LABORATORY	DATE	05-13-18	05-14-18	

TRIAXIAL COMPRESSION TEST REPORT



CONSOLIDATED UNDRAINED TRIAXIAL TEST

Project Name : EMDF Characterization

Boring No:	Sample No	Depth	Test No	Filename	Symbol
GW995-ST-2	1	6.5'-7.0'	1	c:\geocomp\392344	○
GW995-ST-2	2	7.5'-8.0'	2	c:\geocomp\392355	△

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LABORATORY REPORT

Report To: CTI & Associates, Inc.
Attn: Michael Partenio
28001 Cabot Drive, Ste. 250
Novi, MI 48377

Report Date: May 4, 2018
Job No.: 183923
Report No.: 430252
No. of Pages: 2

Report On: Laboratory Analysis of One Shelby Tube Sample
Project: EMDF Characterization – Project No. 1188070011
Sample ID: GW999 – ST-1, 2.5'-4.5' – Sample Date: 2/20/18

On March 5, 2018, one Shelby tube sample was submitted for selected laboratory analysis from the above referenced project. Testing was performed as specified by the client and in accordance with the ASTM D 4318, "Liquid Limit, Plastic Limit, and Plasticity Index of Soils".

Results are presented in the following table and detailed on the attached data sheet.

Test Parameter	Results
Liquid Limit:	**46**
Plastic Limit:	**31**
Plasticity Index:	**15**

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805, extension 322.

Respectfully submitted,

BOWSER-MORNER, INC.

Karl A. Fletcher, Manager
Construction Materials and
Geotechnical Laboratories

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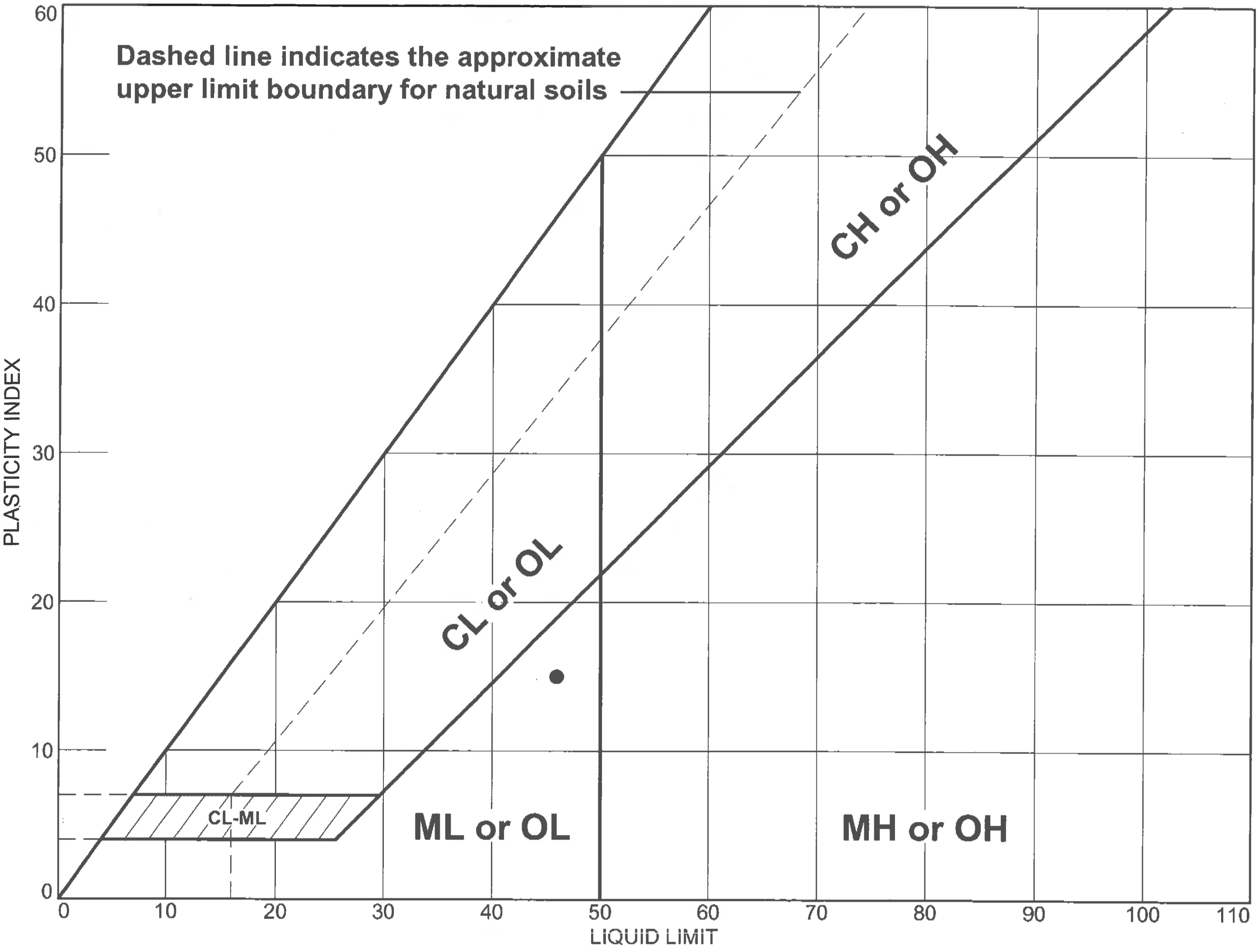
1-kfoye@cticompanies.com

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	GW999-ST-1 (Visual Description: brown clayey silt)	46	31	15			

Project No. 183923 **Client:** CTI and Associates, Inc.

Project: EMDF Characterization

● **Source of Sample:** GW-999 **Depth:** 2.5' - 4.5' **Sample Number:** ST-1

Remarks:

BOWSER-MORNER, INC.

Dayton, Ohio E-300

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LABORATORY REPORT

Report To:
CTI & Associates, Inc.
Attn: Michael Partenio
28001 Cabot Drive, Ste. 250
Novi, MI 48377

Report Date: May 3, 2018
Job No.: 183923
Report No.: 430247
No. of Pages: 2

Report On:
Laboratory Analysis of One Shelby Tube Sample
Project: EMDF Characterization – Project No. 1188070011
Sample ID: GW999 – ST-2, 5.0'-5.85' – Sample Date: 2/20/18
Depth of Test Specimen: 5.0'-5.3'

On March 5, 2018, one Shelby tube sample was submitted for laboratory determination of permeability. Testing was performed as specified by the client and in accordance with ASTM D 5084, "Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter".

Results are presented in the following table.

Test Parameter	Results
Average Permeability, cm/sec:	**3.9×10^{-8}**

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805, extension 322.

Respectfully submitted,
BOWSER-MORNER, INC.

Karl A. Fletcher, Manager
Construction Materials and
Geotechnical Laboratories

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FALLING HEAD PERMEABILITY TEST

ASTM D 5084, Measurement of Hydraulic Conductivity

UNDISTURBED

Client:	**CTI & Associates, Inc.**
Project:	**EMDF Characterization**
BMI Work Order Number:	183923
Sample Identification:	GW999-ST-2, 5.0'-5.85'
Depth, ft:	5.0'-5.3'
Visual Description:	Saprolite

SPECIMEN DATA:

Dimension, inches	
Height:	3.08
Diameter:	2.863
Mass, lbs:	1.458
Moisture Content,%	
Initial:	21.4
Final:	25.0
Wet Unit Weight, pcf	
Initial:	127.1
Final:	130.9
Initial Dry Unit Weight, pcf:	104.7
Back Pressure Saturation, psi	
Back Pressure, Exit:	60
Back Pressure, Enter:	63
Lateral Pressure:	67

Permeability (k), cm/sec: **3.9×10^{-8}**

May 3, 2018

Appendix E.4 – Rock Core Specimen Testing

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BOWSER-MORNER, INC.

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LABORATORY REPORT

Report To: CTI and Associates
Attn: Kevin Foye
28001 Cabot Drive, Suite 250
Novi, MI 48477

Report Date: 04/18/18
Job No.: 183740
Report No.: 301273
No. of Pages: 8

Source: EMDF Characterization

Date Submitted: 03/01/18

Project No.: 1188070011

Procedure: Compressive Strength of Intact Rock Core Specimens (ASTM D 7012 Method C & D)

Sample Identification:	GW 978-RC-9	GW 988-RC-10	GW 982-RC-10	GW 982-RC-13	GW 978-RC-6	GW 992-RC-4
Length As Cut, Inches:	3.97	2.85	4.33	4.69	4.65	3.38
Diameter, Inches:	2.38	2.38	2.37	2.39	2.35	2.38
Mass, grams:	757.6	599.4	802.9	940.1	868.6	607.6
Maximum Load, lbs:	6,720	32,462	190	107,074	3,241	2,755
Area, Square Inches:	4.45	4.45	4.41	4.49	4.34	4.45
Volume, cubic ft:	0.0102	0.0073	0.0111	0.0122	0.0117	0.0087
L/D Ratio:	1.67	1.20	1.83	1.96	1.98	1.42
Compressive Strength, psi:	**1,510**	**7,290**	**40**	**23,850**	**750**	**620**
Density, pcf:	**163.4**	**180.0**	**160.2**	**170.1**	**164.0**	**153.9**
Young's Modulus (E_{av})	**8.0×10^4**	**2.4×10^5**	**cannot determine**	**4.5×10^5**	**4.4×10^4**	**5.0×10^4**

Note: specimens GW 982-RC-10, GW 982-RC-13, and GW 992-RC-4 all failed along natural planes of weakness contained in the rock core. See attached photos for mode of failure criteria.

Should you have any questions, or if we may be of further service, please contact me at (937) 236-8805, ext. 322.

Respectfully submitted,
BOWSER-MORNER, INC.

Karl A. Fletcher

Karl A. Fletcher, Manager
Construction Materials and
Geotechnical Laboratories

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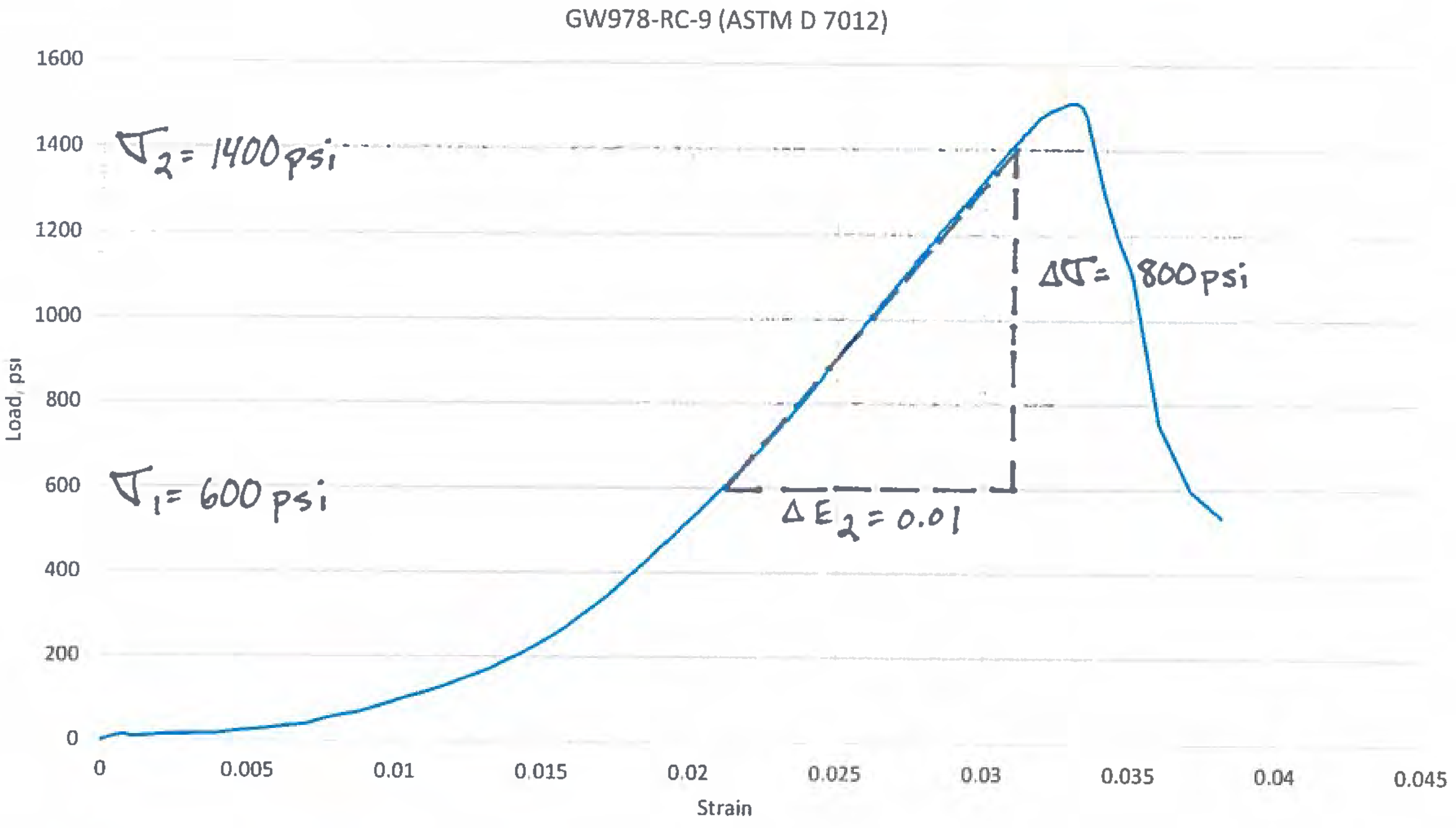
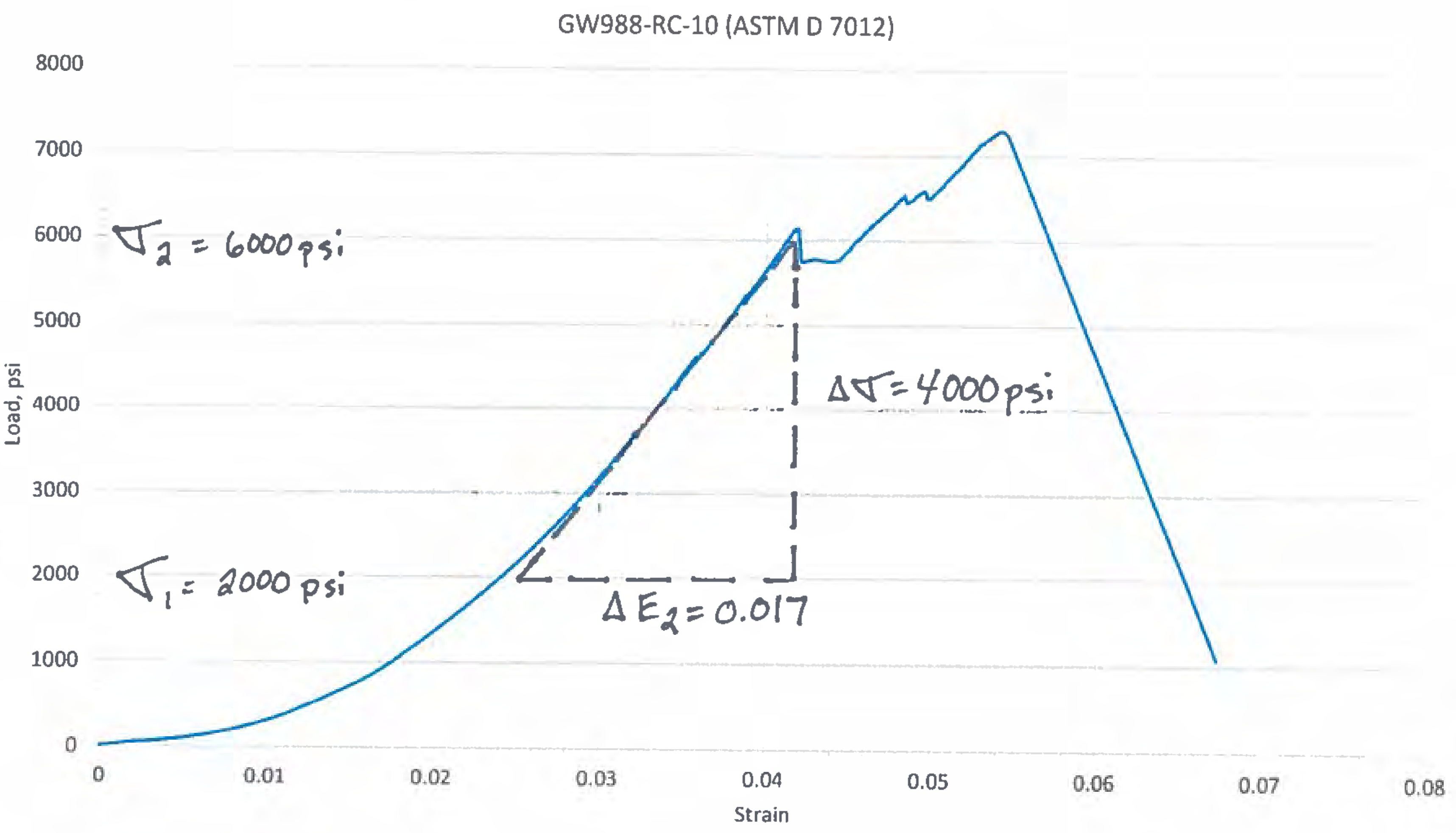
301273
1-File
1-kfoye@cticompanies.com

Client: CTI and Associates
EMDF Characterization
Project No. 1188070011

Job No. 183740
Report No. 301273



$$E_{av} = \frac{\Delta \sigma}{\Delta E_2} = \frac{800\,psi}{0.01} = 8.0 \times 10^4\,psi$$



$\sigma_2 = 6000$ psi

$\Delta\sigma = 4000$ psi

$\sigma_1 = 2000$ psi

$\Delta E_2 = 0.017$

$$E_{av} = \frac{\Delta\sigma}{\Delta E_2} = \frac{4000 \text{ psi}}{0.017} = 2.4 \times 10^5 \text{ psi}$$

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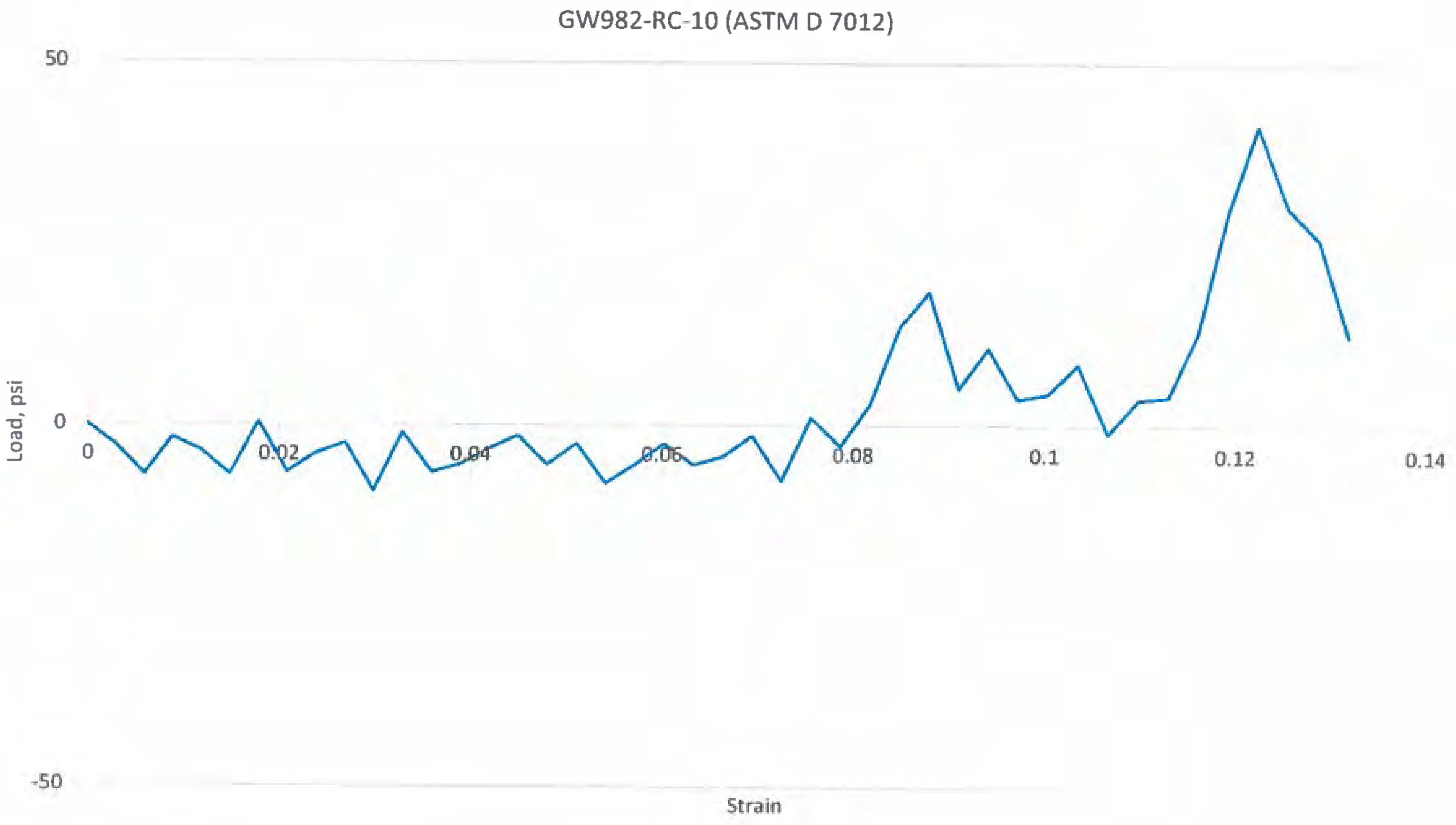
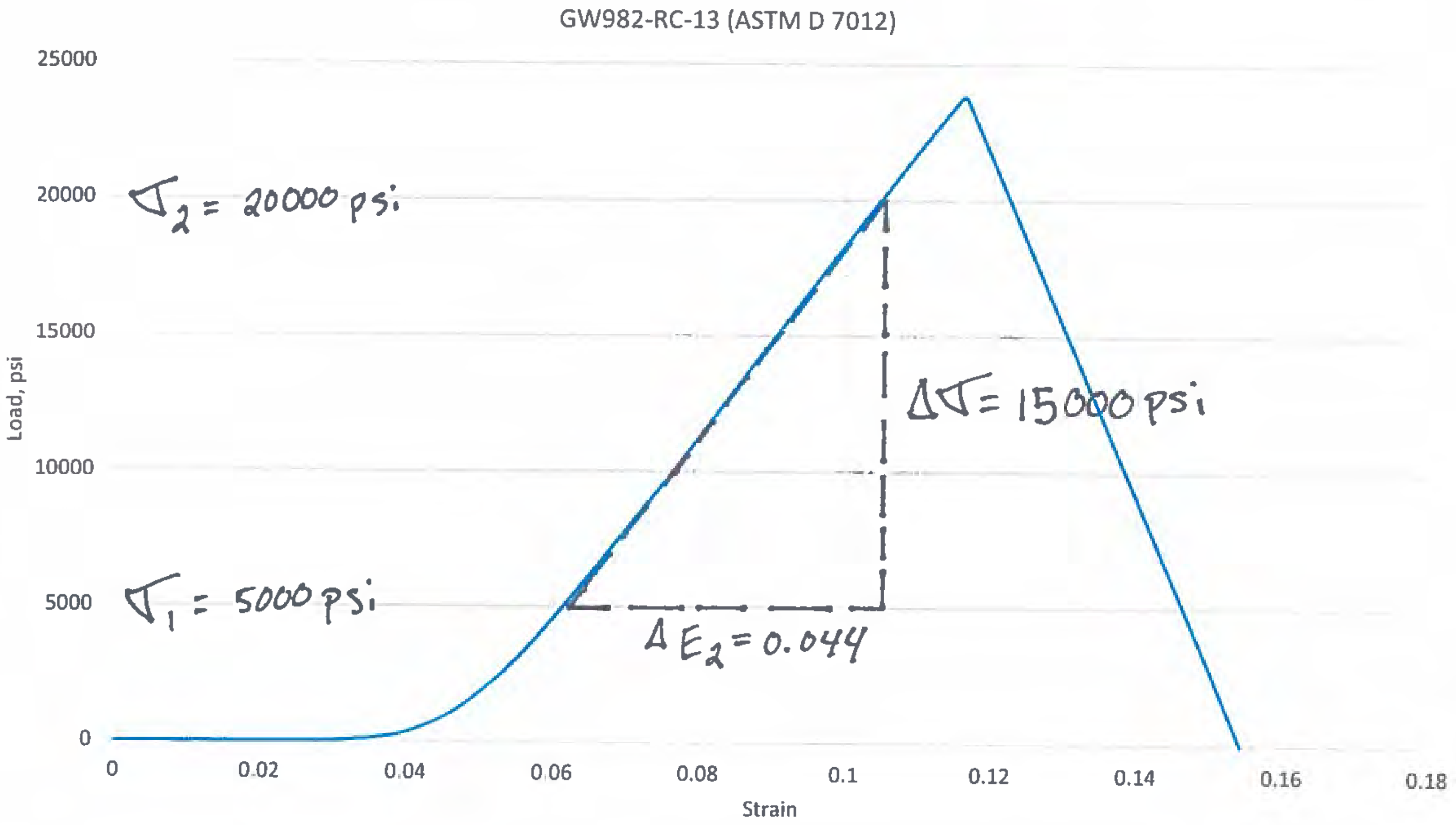
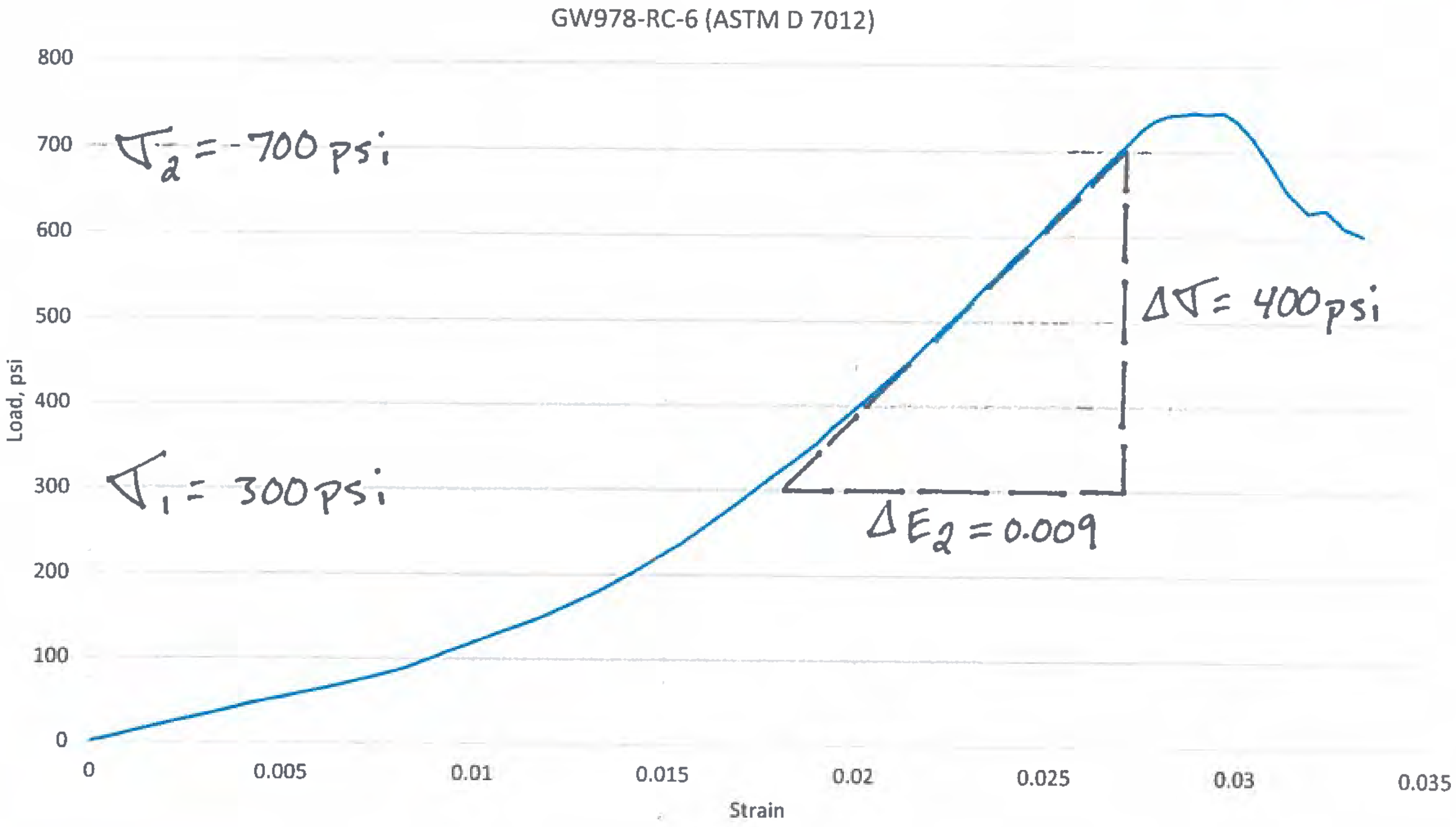


BOWSER MORNER

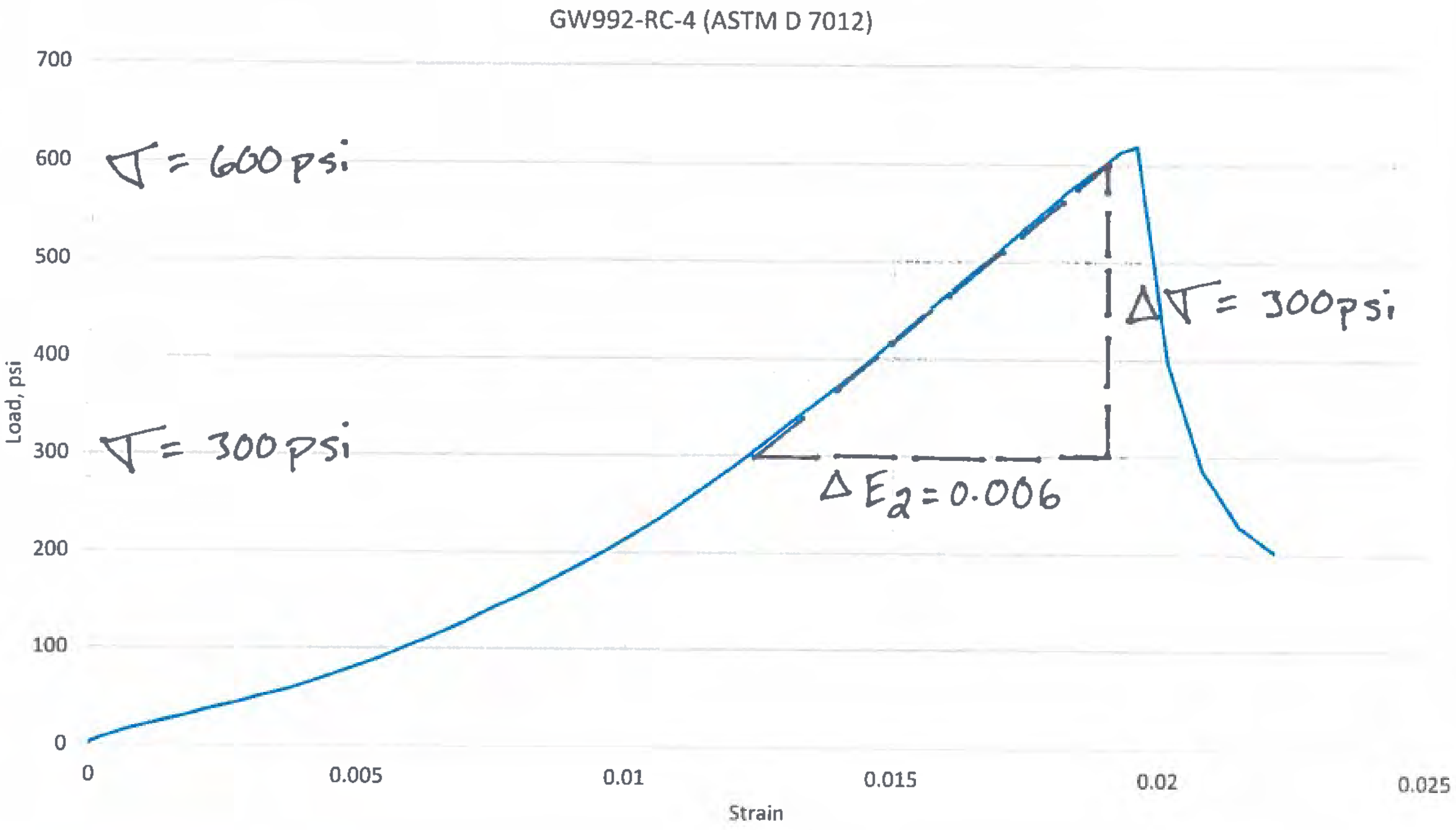


$$E_{av} = \frac{\Delta\sigma}{\Delta E_2} = \frac{20000\text{psi}}{0.044} = 4.5 \times 10^5 \text{ psi}$$

BOWSER MORNER.



$$E_{av} = \frac{\Delta\sigma}{\Delta E_2} = \frac{400\,psi}{0.009} = 4.4 \times 10^4$$



$\sigma = 600 psi$

$\Delta\sigma = 300 psi$

$\sigma = 300 psi$

$\Delta E_2 = 0.006$

$$E_{av} = \frac{\Delta\sigma}{\Delta E_2} = \frac{300 psi}{0.006} = 5.0\times10^4$$

Compressive Strength of Intact Rock Core Specimens (ASTM D 7012 Method C & D)

Before

After

DOE/OR/01-2819&D1

RECORD COPY DISTRIBUTION

File—DMC—RC

Hanson, Nancy J (3NH)

From: Linton, Jennifer L (JL9)
Sent: Thursday, May 30, 2019 2:51 PM
To: ETTP DMC
Subject: Document Submittal - Technical Memorandum #2, EMDF Phase 1 Monitoring DOE/OR/01-2819&D1
Attachments: UCOR-19-0464 S Dahlgren to B Henry Tech Memo 2 EMDF Phase 1 Monitoring DOE OR 01-2819D1 signed.pdf

Please accept the attached transmittal letter for the subject document for the UCOR DMC. Due to file size, the document is not attached. A hard copy and a CD with electronic files (pdf and word) will follow in campus mail.

Thanks!

Jen Linton
865-241-8284 (office)
513-520-4325 (cell)

From: Linton, Jennifer L (JL9)
Sent: Thursday, May 30, 2019 9:34 AM
To: Brian Henry (Brian.Henry@orem.doe.gov)
Cc: Dahlgren, Steve T (ZSR) ; David Green Adler (David.Adler@orem.doe.gov) ; Heather Cloar (Heather.Cloar@orem.doe.gov) ; Patricia J Halsey (Pat.Halsey@orem.doe.gov) ; Hernandez, Katherine (OREM) ; John Michael Japp (John.Japp@orem.doe.gov) ; John Arthur Mullis (Jay.Mullis@orem.doe.gov) ; Samantha R Pack (SP2) (Samantha.Pack@ettp.doe.gov) ; Phillips, S Todd (SAK) ; Kenneth J Rueter (KR1) (Kenneth.Rueter@ettp.doe.gov) ; Karen Stanford Shears (Karen.Shears@orem.doe.gov) ; Speed, Jessica ; Starkey, Robert S (ZTM) ; Alan G Stokes (Alan.Stokes@orem.doe.gov) ; Wilkerson, Laura Ortiz ; Annette Marie Bartlett (Annie.Bartlett@orem.doe.gov) ; Sager, Joy Lynn ; DePaoli, Susan Marie (CONTR) (Susan.DePaoli@orem.doe.gov) ; Pfeffer, Julie (JP2) ; ORO Mailroom (OROEMMailroom@science.doe.gov) ; ETTP DMC (ETTPDMC@ettp.doe.gov)
Subject: Transmittal of Technical Memorandum #2, EMDF Phase 1 Monitoring DOE/OR/01-2819&D1

Mr. Henry,

Please find attached the transmittal letter for the *Technical Memorandum #3, Environmental Management Disposal Facility Phase 1 Monitoring, Oak Ridge, Tennessee* (DOE/OR/01-2819&D1).

The letter and enclosure(s) will be delivered to the OREM Mailroom today.

Please let me know if you have any questions or concerns.

Jen Linton
UCOR OSWDF Project
865-241-8284 (office)
513-520-4325 (cell)