US Army Corps
of Engineers
Philadelphia District

Pearce Creek Disposal Area Groundwater Investigation
Pearce Creek, MD

Phase II Report

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PEARCE CREEK DREDGED MATERIAL DISPOSAL AREA

GROUNDWATER INVESTIGATION
PHASE II REPORT

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Executive Summary

This study was conducted to address the concerns of possible groundwater impacts from the Pearce Creek dredged material disposal area in the vicinity of West View Shores, MD. The overall geology, hydrogeology and chemical makeup of the groundwater in this area has been extensively examined during this investigation. All findings indicate that the Elk River/Chesapeake Bay seems to be the predominant recharge source for the local aquifers and water quality was poor at all locations sampled. The perceived threat of future disposal site activities to the local groundwater regime relies primarily on the downward movement of water through the dredged material and into the drinking water aquifer. The findings of the subsurface investigation, pump testing and chemical analysis refute this threat. The low vertical hydraulic conductivity observed during the phase II pump test and confirmed by geotechnical analysis, suggests that the continued use of the Pearce Creek dredged material disposal area does not pose a threat to the local water supply. The poor quality of local groundwater cannot be denied, however, it is apparent that the Pearce Creek dredged material disposal site activities are not the source of the problem.

1.0 Introduction

In a study conducted by Maryland Environmental Services (MES), groundwater in some of the wells of the community of West View Shores (WVS) were found to contain elevated levels of contaminants that are potentially linked to oxidation of chemicals in sediments. The study was inconclusive in identifying the sources for the contamination because of a lack of groundwater flow information in the area.

In response to Maryland Department of the Environment (MDE) concerns of groundwater impacts from the Pearce Creek Dredged Material Disposal site (Pearce Creek), the USACE, Philadelphia District, has conducted a two-phase groundwater investigation in accordance with EC (Engineering Circular)1110-2-287, Groundwater Investigations. Concerns have been raised that surface water may be migrating downward vertically through the dredged material sediments into the drinking water aquifer thereby impacting the water quality of local residential wells.

In Phase 1 of this investigation, Black & Veatch Special Projects Corporation (B&VSPC), under a previous Delivery Order for the U. S. Army Corps of Engineers, Philadelphia District , prepared a "Final Work Plan, Investigation of Pearce Creek Disposal Area" in September, 1995 to outline a phased investigation of groundwater flow in the area. That work plan focused on the groundwater and potential contaminants in the Corps' Pearce Creek dredged material disposal area.

Upon completion of Phase 1, B&VSPC prepared a report, "Subsurface Investigations, Pearce Creek Disposal Area" which forms the basis of this report and describes the work performed in Phase I study of the work plan. Phase 1 was conducted from October 30, 1995 to March 1, 1996. The purpose of that phase of the study was to (1) establish the groundwater flow regime in the Pearce Creek Disposal site and (2) gather information on the geochemical characteristics in and below the disposal area. The study included a subsurface exploration program consisting of the installation of monitoring wells, characterization of site geology and hydrogeology, the determination of aquifer parameters, and chemical sampling of soil and groundwater.

The Philadelphia District performed Phase II of the Pearce Creek Groundwater Investigation to further our understanding of the geological and hydrogeological parameters of the site vicinity. Phase II was designed to determine the following geological and hydrogeological elements of the Pearce Creek Site: subsurface geology, groundwater flow directions, step test results, and pump test results. This phase included subsurface investigation, a pump test of existing well CSW-1, the installation of six new monitoring wells and analytical sampling of soil and groundwater.

2.0 Pearce Creek Background

2.1 Site Location

The Pearce Creek Disposal Area lies in the western part of Cecil County, Maryland just east of the Chesapeake Bay, Figure 2-1. The site is located along Elk River and Pearce Creek. Figure 2-2 shows the boundaries of the disposal area.

2.2 Site Description

This site is a one cell dredged material disposal area. There are no buildings on the site. There are some depressions within the diked area that contain water. Vegetation varies across the site with stressed vegetation on the top and sides of the dikes in some locations to thick stands of tall reeds in other locations. The last sediment disposal episode occurred in the fall of 1993.

2.3 Vicinity Characteristics

2.3.1 Surface Features/Hydraulics/Meteorology

The disposal area has one cell of approximately 300 acres. The topography within the cell is fairly level with some depressions. Topography and elevations are shown in the MES report (1995). The elevation within the cell is approximately +40 and on top of the dikes is >+50. The land area within one mile of the site has gently rolling hills, varying from less than 20 feet to 99 feet National Geodetic Vertical Datum (NGVD). Surface soils are listed in the County Soil Survey, dated 1973, as mostly Made Land, with some small areas of sandy loam.

Pearce Creek lies to the northeast of the site, and drains into the Elk River. The Elk River leads into the Chesapeake Bay. The mean tidal range at Courthouse Point (eight miles further up the Elk River) is 2.2 feet (Rogers, Golden, and Halpern, 1986).

The meteorology of the area is described in the Cecil County Soil Survey. Cecil County has a humid, continental climate with well-defined seasons. The Chesapeake Bay and its tributaries and, to a lesser degree, the Atlantic Ocean, have a modifying effect on the climate, especially in moderating extreme temperatures. Average temperatures and precipitation from 1931 to 1960 were calculated for Elkton, Maryland. The average daily temperature maximum is 65.6 degrees Fahrenheit, and the average daily minimum temperature is 43.4 degrees Fahrenheit. The average total yearly precipitation is 45.35 inches.

2.3.2 Geology/Hydrogeology

The disposal area lies within the Northern Atlantic Coastal Plain physiographic region. The Coastal Plain consists of a seaward-dipping wedge of unconsolidated sediments that are primarily clay, silt, sand, and gravel and are classified as continental, coastal, or marine-type deposits (Zapecza, 1984). Hydrologic units that are mostly sand and gravel are permeable and are considered aquifers, and those that are mostly silt or clay are relatively impermeable and are considered confining units. Multiple geologic formations may be grouped together as a single hydrogeologic unit. Coastal Plain sediments, including surficial deposits, range from Cretaceous to Recent in age. The Coastal Plain sediments strike northeast-southwest and dip to the southeast.

The general stratigraphy of the site area includes a blanket of Cenozoic sediments unconformably overlying the Cretaceous Magothy Formation, which conformably overlies the thick deposits of the Cretaceous Potomac Group. Below the Potomac Group is the crystalline basement rock surface, sloping southeastward beneath the site at an elevation of approximately -900 (Vroblesky and Fleck, 1991), and at a rate of about 100 feet per mile. (Otton, et. al., 1988).

Geologic and Hydrogeologic Units

The Coastal Plain sediments of Cecil County consist of unconsolidated stratified layers of clay, silt, sand, and gravel. Saturated sand and gravel constitute the aquifers. Interspersed in, and grading laterally into the sand, are clay and silt layers that act chiefly as confining and semiconfining layers (Otton, et. al., 1988). Table 2.1 lists the geologic units and corresponding aquifers in the Coastal Plain of Cecil County, Maryland.

In general, the surficial Columbia aquifer is less than 50 feet thick in Cecil County. The Pensauken Formation of the Columbia Aquifer occupies nearly all of the upland areas east of the Elk River in the area of the site. The Pensauken Formation consists mainly of sand, gravelly sand, boulder gravel, and loam. Quartz and Quartzite clasts predominate, but rock fragments of Piedmont formations are present. The sand fraction contains appreciable amounts of feldspar. Water levels frequently indicate perched water table conditions (Otton, et. al., 1988). The surficial deposits in Cecil County often lack enough saturated thickness to be a major aquifer except where they are underlain by a subcropping sand or where a paleochannel exists (Bachman and Wilson, 1984).

The Cretaceous Magothy Formation consists of black, dark gray, and white, fine to coarse quartzose sand and clay. Coarse materials are usually lighter colored, alternating with dark-colored clay or silty clay. Highly lignitic sand is present at some outcrops. Siderite, pyrite, and marcasite are present locally as are iron-stained and iron-cemented zones. The unit dips to the southeast at an average rate of 30 to 40 feet per mile. The Magothy Formation is exposed at Crystal Beach, just north of the site. Transmissivity values range from 290 to 3,300 ft^2/day, with the mean being 490 ft^2/day. Only two values of storativity are available, 0.0001 and 0.00006. These values have been gathered from wells screened in the Magothy Formation to the northeast, east and south of the site, where the Magothy is confined by the Matawan Confining Unit. The site area lies within the outcrop zone of the

Magothy Formation (Otton et al 1988). Thickness of the Magothy Formation in Cecil County is about 45 feet, and the Formation dips to the southeast at an average rate of 30 to 40 feet per mile. (Otton, et. al., 1988).

The Cretaceous Potomac Group is comprised of sand, gravelly sand, silt and clay, and generally consists of elongate sand bodies within a matrix of silt and clay. Sand bodies are more prevalent in the upper and lower parts of the unit while the middle part is predominantly silt and clay. Some water-bearing sand occurs within the confining unit, but finer-grained materials are predominant. The aquifers in the Potomac Group are made up of numerous sands that do not appear to be physically connected. The intervening clays impede vertical and horizontal flow of ground water between the sands (Otton and Mandle, 1984). The thick sequence of sediments comprising the Potomac Group in Cecil County is divided into three hydrogeologic units: (1) the upper Potomac aquifer, (2) the middle Potomac confining unit, and (3) the lower Potomac aquifer (Otton, et. al., 1988).

Potomac Group sediments are predominantly fine-grained and include sand, silt, and clay. Interspersed irregularly throughout the section are layers of medium to coarse sand and gravel that vary greatly in thickness and lateral extent. Sand layers are white to orange-brown, crossbedded, moderately well sorted, and mostly quartzose. Gravel is almost entirely quartz or quartzite clasts, usually less than 3 inches in diameter. Localized iron-cemented layers occur throughout the section, varying from fractions of an inch to a few feet in thickness. Clay may be silty and runny, or tough, compact, and almost dry in places. The colors of fine materials range from white and yellow to deeper shades of red, purple, and dark gray. Localized occurrences of lignite and pyrite are common (Otton, et. al., 1988).

The sediments referred to by Otton et al. (1988) and in this report as the Potomac Group were divided into three units by Overbeck and others (1958). In order of increasing depth the units are the Raritan, Patapsco, and Patuxent Formations. A more detailed description of the Upper Potomac sediments can be generated from a description of the Raritan as being lithologically and hydrologically similar to the subcropping Patapsco Formation, with less highly colored clays and a higher percentage of sand. Discussing the Patapsco, Overbeck wrote that gravel is found scattered through sandy clay at places but is rarely in continuous beds. Due to the sharp changes in the character of the material, the permeability of lenses differ greatly. Wells located near one another may have to go to different depths to find a lens sufficiently permeable to yield water. The lenses are probably hydrologically connected; although individual lenses may be thin and of limited lateral extent, taken together they form a large unit of water-bearing material. The lenticularity of the sands is indicated by the different depths at which water is found in neighboring wells.

2.3.3 Well Search

Discussions with Cecil County Planning Commission officials and review of withdrawal records indicates that the community of Crystal Beach, which lies northeast of the site, has one or more township wells which withdraw 30,000 gallons per day and numerous smaller domestic wells. The Cecil County Soil Survey showed no wells within a one mile radius of the site. A list of groundwater withdrawals in the area was obtained from the Maryland Department of Natural Resources (DNR).

The MES report lists numerous domestic wells in the West View Shores subdivision and the surrounding site. These wells are predominantly listed as being screened in the Magothy and Upper Potomac aquifers. A few of the well listings do not differentiate which aquifer they are screened in.

2.4 Site History

A review of aerial photographs from the years 1973 (Soil Survey) and 1990 show that the site was used as a dredged material disposal area before 1973. Dikes observed during the site visit were in the same location seen on the 1973 and 1990 photographs. The 1990 aerial photograph shows borrowing activity on the south side of the area.

Title information shows that the property was owned by the U. S. Government since 1937. An ownership summary to 1937 is as follows:

The U. S. Government condemned and acquired properties that comprise the disposal area in 1937. Fifteen tracts were acquired ranging in size from 232 acres to 1 acre, for a total of approximately 997 acres. As noted above, only about 300 acres are being used for dredged material disposal.

No Sanborn maps were found for this site.

2.5 Surrounding Land Use and History

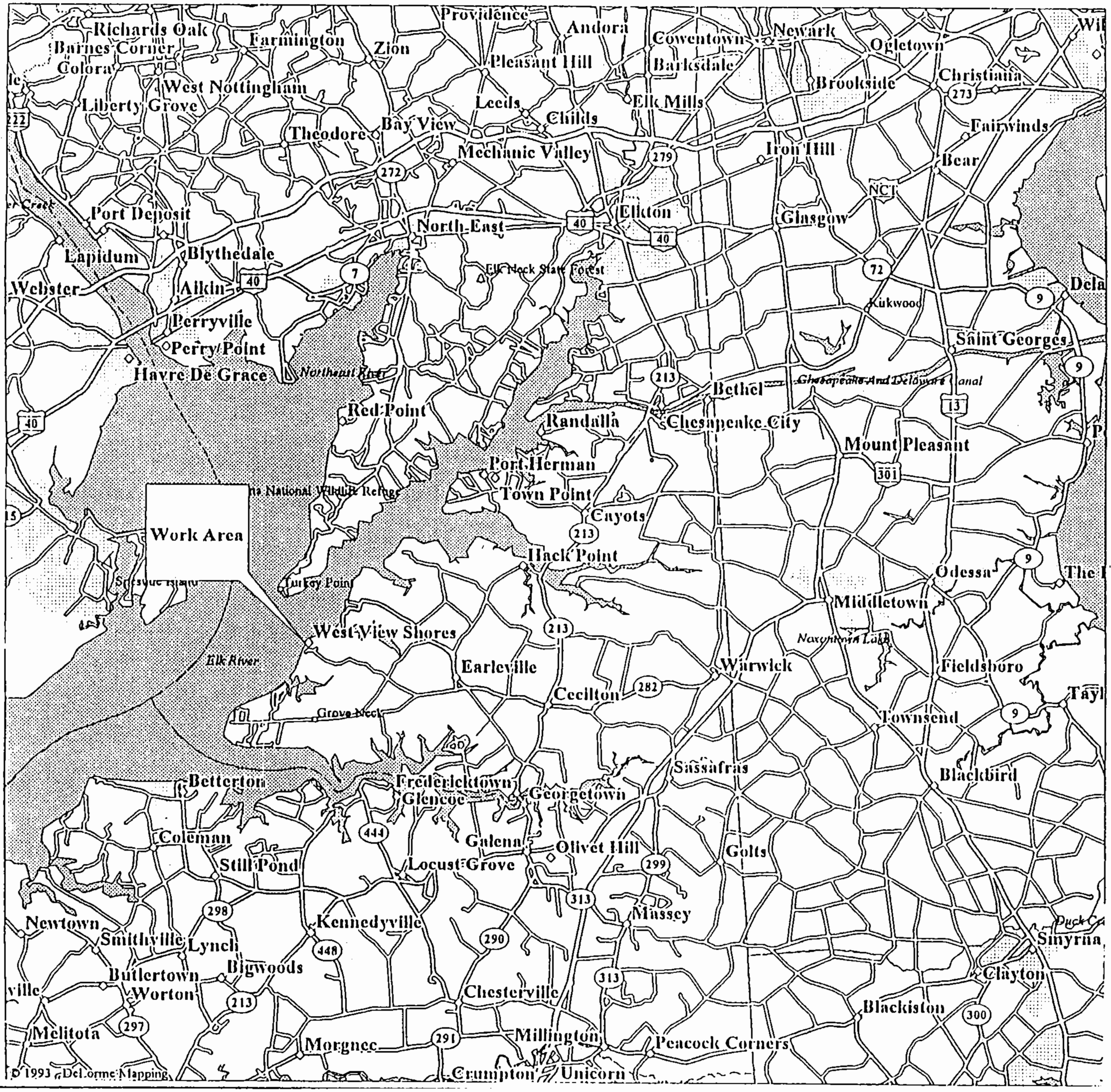
The north side of the site adjoins Elk River and Pearce Creek. The town of Crystal Beach, which has a small marina, is across Pearce Creek from the site. The area around Pearce Creek is mostly wetlands, with some hardwood forests. The east side of the site faces a forest, and the south side of the site faces Pond Neck Road and a forest. Agricultural fields are located across Pond Neck Road. The west side of the site faces a housing development named West View Shores.

Aerial photographs from 1973 and 1990 showed the same land use in the surrounding areas as observed during the site visit on October 3, 1994.

2.6 Regulatory Review

A review of regulatory documents as part of an earlier preliminary assessment (Black & Veatch, 1995) indicated the following potential sources of contamination in the local area:

Two underground storage tanks registered possibly within one mile of the site.
One solid waste landfill possibly within one mile of the site.



Scale 1:250,000 (at center)

5 Miles

5 KM

LEGEND

▒	Population Center
○	State Route
▫	Geo Feature
◇	Town, Small City
△	Park
⛉	Interstate, Turnpike
⛉	US Highway
✈	Airfield
- - - -	County Boundary
═	Major Street/Road
═	State Route
═	Interstate Highway
═	US Highway
....	River
——	Airfield
☐	Land Mass
▨	Open Water

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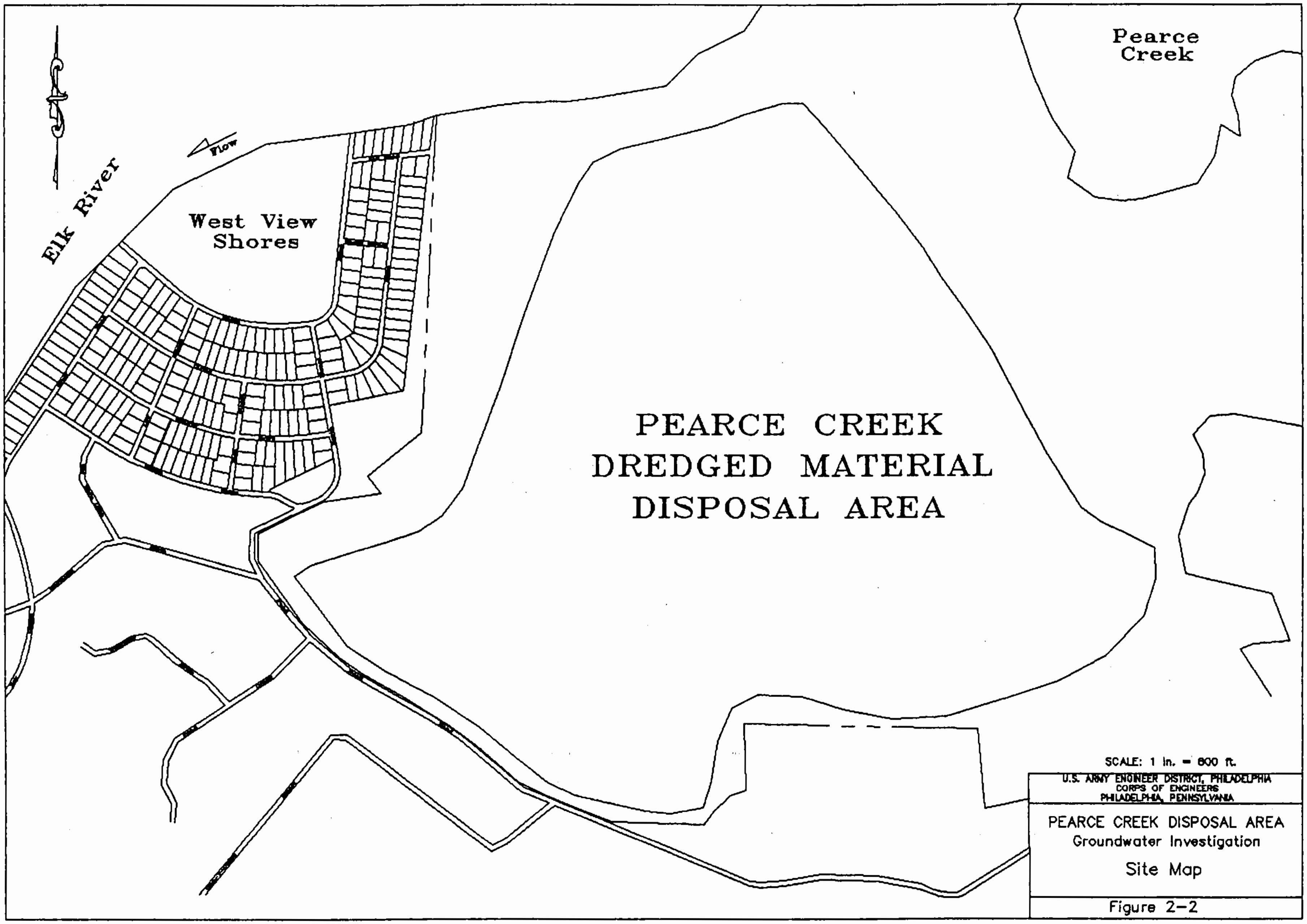
PEARCE CREEK DISPOSAL AREA

Vicinity Map

Figure 2-1



SCALE: 1 in. = 800 ft.

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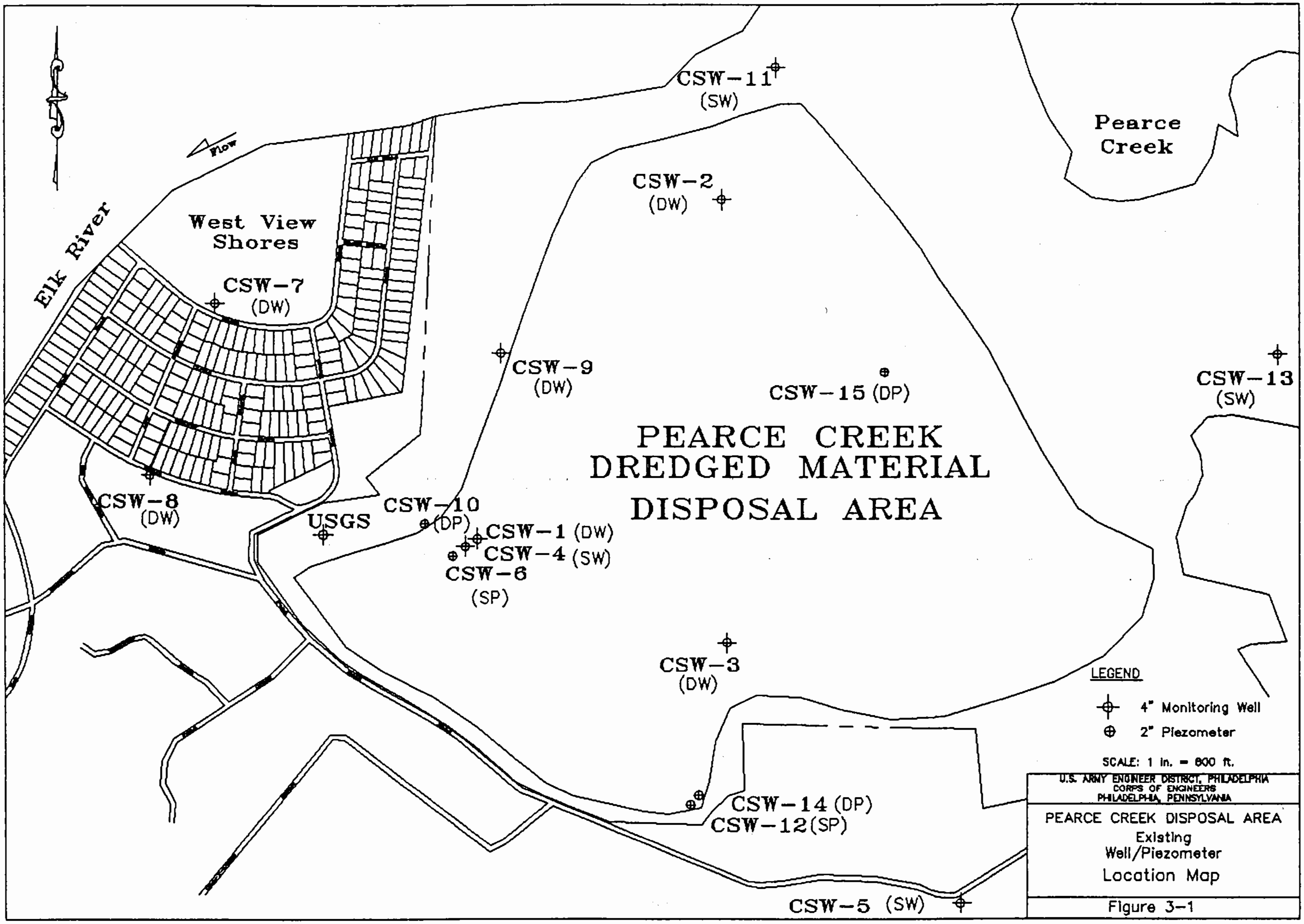
PEARCE CREEK DISPOSAL AREA
Groundwater Investigation
Site Map

Figure 2-2



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PEARCE CREEK DISPOSAL AREA
Existing
Well/Piezometer
Location Map

Figure 3-1

Erathem	System	Series	Geologic unit	Description	Hydro-geologic unit
Cenozoic	Quaternary	Holocene	Tidal-marsh deposits	Sand, silt, clay, and organic matter. Thickness generally less than 20 ft	
			Alluvium	Sand, silt, clay, and gravel with some organic material. Thickness generally less than 40 ft	
		Pleistocene	Talbot Formation	Coarse-grained facies: Coarse sand and gravel at base with some boulders. Finer sand and loam in upper part. Thickness 25 to 50 ft. Finer-grained facies: Silt and fine sand. Thickness 25 to 50 ft	Columbia aquifer
	Tertiary	Miocene	Pensauken Formation	Gravel and sand with some boulders overlain with sand and loam. Thickness generally between 15 and 90 ft	
			Upland gravel	Gravel and sand with local lenses of clay. Thickness generally less than 75 ft.	
		Paleocene	Aquia Formation	Sand, clayey, glauconitic; green and yellow. Only the lowest 70 ft present in Cecil County	Aquia-Hornerstown aquifer
			Hornerstown Formation	Sand, about 90 percent glauconite, with glauconitic interstitial clay; green. Thickness generally 20 ft	
Mesozoic	Cretaceous	Upper Cretaceous	Monmouth Group Unnamed upper unit	Sand, glauconitic, and silty sand. Thickness about 80 ft	Monmouth aquifer
			Mount Laurel Sand	Sand, glauconitic, locally contains shell fragments. Thickness about 80 ft	
			Matawan Group Marshalltown Formation	Sand, glauconitic, clayey, and silty, greenish black	Matawan confining unit
			Englishtown Formation	Sand, clayey and silty, with lignite grains; dark gray to black where unweathered. Thickness about 15 to 20 ft	
			Merchantville Formation	Sand, silty and clayey, micaceous and glauconitic, black. Thickness about 45 ft	
			Magothy Formation	Sand and clay, lignitic; black, gray, and white. Thickness about 35 ft	Magothy aquifer
			Potomac Group	Sand, gravelly sand, silt, and clay. Consists generally of elongate sand bodies within a matrix of silt and clay. Sand bodies are more prevalent in the upper and lower parts of the unit while the middle part is predominantly silt and clay.	Upper Potomac aquifer
					Middle Potomac confining unit
		Lower Cretaceous			Lower Potomac aquifer

Table 2-1 Geologic Units and Corresponding Aquifers in the Coastal Plain of Cecil County, Maryland

Pearce Creek Disposal Area

U.S. Army Corps of Engineers, Philadelphia District

3.0 Investigation Methods

3.1 Soil Borings

The soil borings and well installations were conducted by a Maryland licensed well drilling contractor under the supervision of a qualified geotechnical engineer or geologist. The wells were drilled using mud rotary methods and/or hollow stem auger. Rotary drilled boreholes were stabilized with light bentonite drilling mud as required. Wells were completed consistent with State of Maryland regulations.

Borings were established and soil samples collected using a 2 inch diameter, 2 foot long split spoon sampler according to ASTM D1586-84, Standard Penetration Test (SPT). When extreme driving resistance was encountered and sample recovery became low, the method of driving the sampler was changed to a downhole hammer, not consistent with ASTM 1586. This change is marked on the drilling logs (Appendix A) where appropriate. CSW-1,2,3,5,7,8,9,11, and 15 were continuously sampled; all other wells were either intermittently sampled or only sampled just above and within the interval to be screened. Soil classification followed standard practice. In selected locations, undisturbed tube samples were taken according to ASTM D1587-94, Thin-walled Tube Geotechnical Sampling of Soils, in the vadose zone and below the water table as directed by an experienced geologist.

Samples from the subsurface investigation were collected and forwarded to the Corps for laboratory determination of geotechnical parameters. Split-spoon samples were selected by the on-site geologist or geotechnical engineer for analysis of representative strata. The results of the geotechnical testing of these samples are summarized on Table 3-1. Complete results are included as Appendix C.

3.2 Well Installation

As per the workplan, borings were advanced to depths similar to or deeper than the wells of concern in West View Shores, which were generally screened within elevation -50 to -100. In some cases, borings were partially grouted to reseal a confining clay encountered during sampling, and so that the well could be screened in an appropriate permeable zone. The cases in which this was done are noted on the boring and well installation logs included in the Appendices A and B.

Two and four inch diameter schedule 40 PVC well casings with five to fifteen foot long machine slotted 0.010 or 0.015 inch Timco High Flow PVC well screens and Morie Co. No. 1 filter pack were installed with stainless steel centralizers on the well casings. Well installation logs for CSW-1 thru CSW-9 are presented in Appendix B. The logs for CSW-10 thru 15 are included as part of their respective boring log in Appendix A. The locations of all wells installed during this study are shown on Figure 3-1.

The wells were constructed in accordance with standard practice and ASTM D 5092-90, Design and Installation of Ground Water Monitoring Wells in Aquifers. A washed silica sand filter pack extending from the base of the boring to approximately two feet above the screen was placed in the annular space around the casing using a tremie pipe. A finer-grained secondary filter pack was placed for a length of approximately one foot above the primary filter pack to prevent intrusion of the bentonite grout into the primary filter pack. A minimum five feet thick high solids bentonite slurry was placed above the sand pack to separate the permeable zone from the uphole cement-bentonite seal. The remainder of the annulus was tremie-grouted to ground surface with a 6 to 1 (dry weight) cement-bentonite grout mixture.

Wells inside the disposal area were finished as stickup wells. To provide for later vertical extension of the wells, the top of casing was left flush-threaded. A steel protective cover was installed around the well casing to provide protection from damage. A locking well cap was installed at all locations to secure the wells. Wells CSW-5, CSW-7, and CSW-8 were finished as flushmount wells.

3.3 Well Development

After completion of monitoring well installation, the wells were developed in accordance with ASTM D5092 to remove residual drilling fluid and sediment which could clog the filter pack and/or formation. To allow the grout to harden, development occurred no earlier than 24 hours after installation of the cement-bentonite grout in the borehole. Development was accomplished by surging and pumping. Compressed air was not used for development. Water produced during development of wells on the disposal site was discharged onto the ground surface. Water produced during development of offsite wells was collected and disposed of onsite, inside the bermed area. Measurements taken during development included start and stop times, procedures, pumping rate and drawdown, in addition to the parameters of temperature, specific conductivity, pH, and salinity. The development process continued until the discharge water was reasonably clear and achieved a relatively stable pH, temperature, and specific conductivity.

3.4 Groundwater Chemical Sampling

Black and Veatch's 1995 sampling protocol was as follows: the sampling procedure for sulfate in groundwater was modified to minimize the oxidation of sulfide. This was done to prevent an increase in sulfate concentration which would not be representative of the actual groundwater conditions.

Groundwater samples were directly collected into bottles containing the preservative. The bottles were filled without air present, capped, and shaken to speed up zinc sulfide precipitation. The samples for sulfide and ferrous iron were collected unfiltered, immediately preserved, and capped to minimize aeration. The laboratory receiving the samples was notified of the presence of zinc acetate in the sample so it could identify any potential interference. All other inorganics were field filtered and preserved.

The Philadelphia District's 1996 field sampling protocol was as follows: prior to sampling with a dedicated disposable bailer, all sampling locations were purged three well volumes. Sulfide samples were preserved with zinc acetate and sodium hydroxide. Sulfide sample bottles were filled to the maximum volume to minimize aeration. Ferrous iron samples were field filtered into a hydrochloric preserved 40 mL sample bottles containing no headspace. All other inorganics were preserved with nitric acid but not field filtered. Nutrient samples were preserved in the field with sulfuric acid .

3.5 Aquifer Analysis Methodologies

3.5.1 Slug Tests

All four inch diameter wells installed during Phase 1 were slug tested according to BVSPC standard procedures and ASTM D 4044-91, Standard Test Method for Instantaneous Change in Head for Determining Hydraulic Properties of Aquifers. As per the workplan, the two inch diameter piezometer CSW-6 was not slug tested. A PVC slug was introduced into each well and measurements were taken with an automated datalogger until the water level returned to its static level. Once equilibrium was achieved, the slug was removed and measurements were taken as water levels recovered.

Slug test data were solved using the Cooper, Bredehoeft, Papadopulos 1967 type curve matching method. The computer program AQTESOLV was used to refine parameter estimates. Raw data was corrected to discount the early data points which reflect the oscillation of water levels immediately after the slug was introduced or removed. In cases where the raw data showed no change for a fraction of a second, data was also temporally corrected to start when a change began to take place. A K_r/K_z (radial to vertical permeability) ratio of 1:1 was assumed in the analysis.

3.5.2 Step Test

On 8/28/96 a step test was performed at CSW-1 to determine the proper flow rate to be used during the pump test. A four inch diameter submersible pump was set at 110 feet below the top of casing (TOC) at CSW-1 (see Figure 3-1). A manifold was configured to control the pump flow rate with a ball valve by placing the valve several feet downstream of a totalizer. The initial rate of the step test was 6 gallons per minute (gpm) which was then increased by increments of approximately 10 gpm until the final rate of 47gpm was reached. The effluent was piped approximately 100 feet to an existing ponded area. This ponded area was approximately 100 feet wide by 300 feet long by 3 feet deep and contained approximately 700,000 gallons of water. Less than 55,000 gallons were pumped from CSW-1 during the pump and step tests combined.

Digital dataloggers/transducers (Trolls) were installed at CSW-1 (deep pumping well), CSW-4 (shallow well), and CSW-6 (piezometer screened in the dredged material). The Trolls measure water level and temperature changes and store the data in their memory chips. The trolls were programmed to take water level and temperature measurements every five minutes during the step

and pump tests. Upon completion of the pump and step tests, the data from the trolls were downloaded onto a laptop computer.

3.5.3 Pump Test

The pump test began at 11:40 a.m. on September 3, 1996 for well CSW-1. The well was pumped at 47 gpm for 16 hours. This pump test was scheduled to run for 36 hours, however pump failure resulted in a shorter test. In addition to the Troll data, manual measurements were taken periodically during the pump test.

Wells CSW-10, and CSW-3 both had Trolls which malfunctioned and did not provide any water level data. A hydrograph of manual data was constructed for well CSW-10 (Figure 3-2). Well CSW-3 was located within a ponded area and was deemed unsafe for night manual readings, therefore very limited manual data is available. Well CSW-2 was located in a densely vegetated area and could not be found. Well CSW-15 was not completed prior to the pump test. The usable data from 11 of the 15 wells plus the manual data from CSW-10 provided adequate information to accomplish the Phase II tasks.

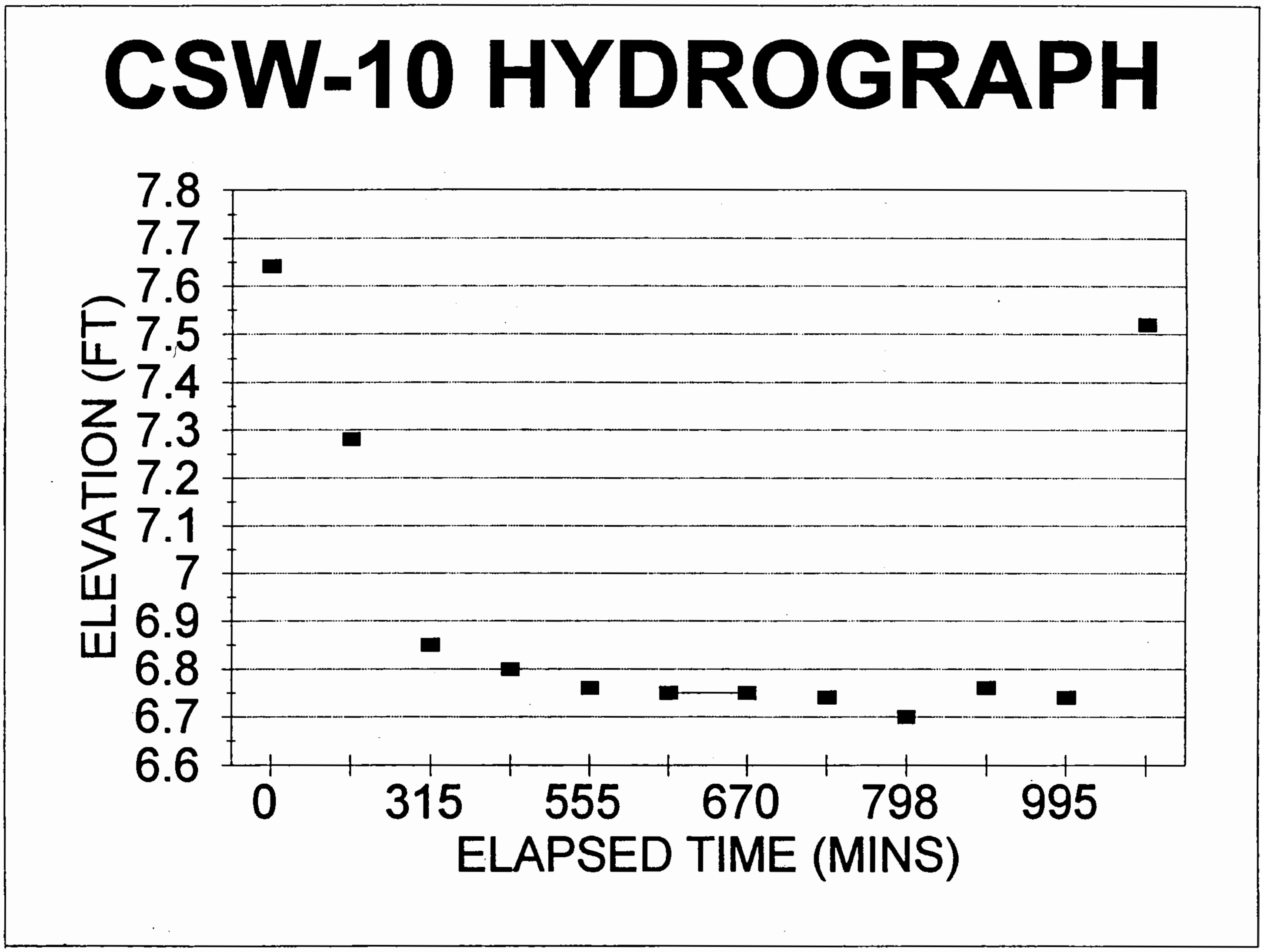

CSW-10 HYDROGRAPH
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
7
6.9
6.8
6.7
6.6
ELEVATION (FT)
0
315
555
670
798
995
ELAPSED TIME (MINS)

Figure 3-2

Table 3-1 Geotechnical Testing Results

Boring	Sample	Moisture Content (%)	Permeability (cm/s)	Atterburg Limits LL	PL	PI
CSW-1	SPT-2	54				
	SPT-3	77.0		87	40	47
	SPT-11	25				
	SPT-20	21				
CSW-2	SPT-2	43.3				
	SPT-6	53.3				
	U-1	54.7	2.25×10^{-6}	68	34	34
	SPT-11	57.7				
	SPT-37	51				
	U-2	49.7	2.8×10^{-7}	80	37	43
CSW-3	SPT-4	51.9				
	SPT-13	25.8				
	U-1	19.1	9×10^{-8}	34	20	14
	SPT-72	19.1		30	19	11
CSW-5	SPT-3	24.6				
	SPT-16	23.9		26	23	3
	SPT-52	19.1				
CSW-7	SPT-14	34.6				
	SPT-46	19.7		25	21	4
	SPT-24	40.3		54	31	23
	U-1	30.9	2.4×10^{-7}	51	27	24
	U-2	30.9	8×10^{-8}	49	28	21
CSW-8	SPT-4	12.8				
	SPT-67	18.5				

4.0 Investigation Results and Discussion

4.1 Geology/Hydrogeology

4.1.1 Geology

The borings performed encountered the following sequence of sediments, in order of increasing depth: disposal area dredged material, Holocene tidal marsh deposits, and alternating layers of deposited gravels, sands, silts and clays above the Raritin Formation. As per the original workplan developed by B&VSPC, the borings and wells were completed to a depth similar to, or deeper than, the wells of concern in West View Shores.

Tidal marsh deposits were found in a thin layer just below the disposal area, and at CSW-7 in West View Shores next to the Elk River.

The dredged material was up to 35 feet thick, and is predominately silt and clay material. At CSW-7 in West View Shores, it was also noted that the top seven feet of material was composed of dredged material and tidal marsh deposits. Clay balls resulting from dredging operations were noted in the beach erosion cuts near CSW-7, along the Elk River. Fill placement was not noted at any other locations in West View Shores, and does not seem likely based on historical maps of the area.

Two general sequences of hydrogeologic materials were observed in the borings. The first was observed at locations CSW-2 and CSW-7, and the second was seen at locations to the south and east of CSW-2 and CSW-7. The two different sequences agree with information from drillers logs for wells placed in the West View Shores community.

The first sequence exhibited a layer of dredged material on top of tidal marsh sediments, followed by an aquifer layer comprised of interbedded sand, silty sand, and gravelly sand with occasional lenses of finer-grained less permeable material. Below this shallow aquifer, an aquiclude of organic clay was found. This clay ranged in color from brown to gray, turning to a darker color after a short period of exposure to the air. This clay also contained lenses of peat and woody material. Below the clay was another aquifer layer, generally composed of white to orange sand, and silty sand, with some clay lenses. Below this, an aquiclude of tight red and gray clay was encountered.

The second sequence was similar to the first, but no intermediate layer of organic clay was encountered. Below the disposal area and tidal marsh sediments, and above the red and gray clay, one overall aquifer unit was encountered. This unit also exhibited a great deal of interlensing between sand, silty sand, gravelly sand, and clay. The clay lenses were observed to at least have an aquitard effect, based on the water level variance seen between CSW-1 (deep) and CSW-4 (intermediate) at the well cluster.

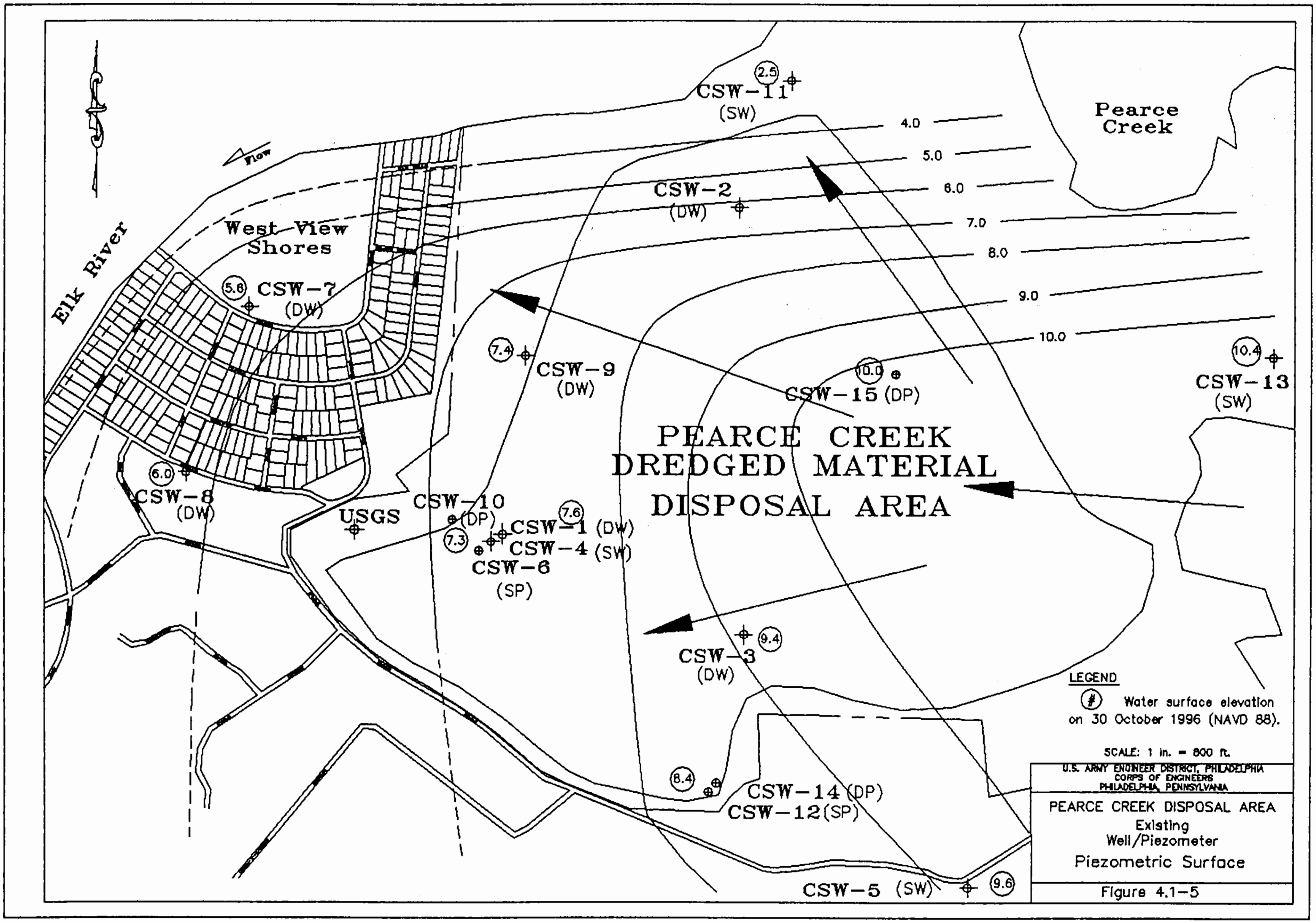
Soil samples from the investigation were collected and forwarded to the Corps for laboratory determination of geotechnical parameters. The summarized results of this testing can be found on

reason that the sand and gravel layers in the Pearce Creek area above the Raritan clay (Potomac) are not part of the Potomac aquifer, but instead local "micro-aquifers."

The groundwater flow at the site is generally westward, with a northwestern component on the West View shores side of the site. Figure 4.1-5 is the groundwater flow map constructed from water levels taken on Oct 30, 1996. The groundwater gradient across the site is approximately .001 ft/ft.

The land based recharge for the surficial aquifers appear to be an area south and southeast of the site because the site is essentially surrounded on three sides by water. The total potential recharge area is approximately 450 acres. This recharge area probably originates near the Stemmers Run Landfill and continues westward towards the site.

Within the disposal area limits there are many areas of perched water which are greater than 20 feet above the upper aquifer water table. Based on observations during the course of this investigation, it appears that this perched fresh water does not easily move into the lower aquifers. This assertion is bolstered by the extremely limited vertical hydraulic conductivity noted between CSW-1, CSW-4 & CSW-6.



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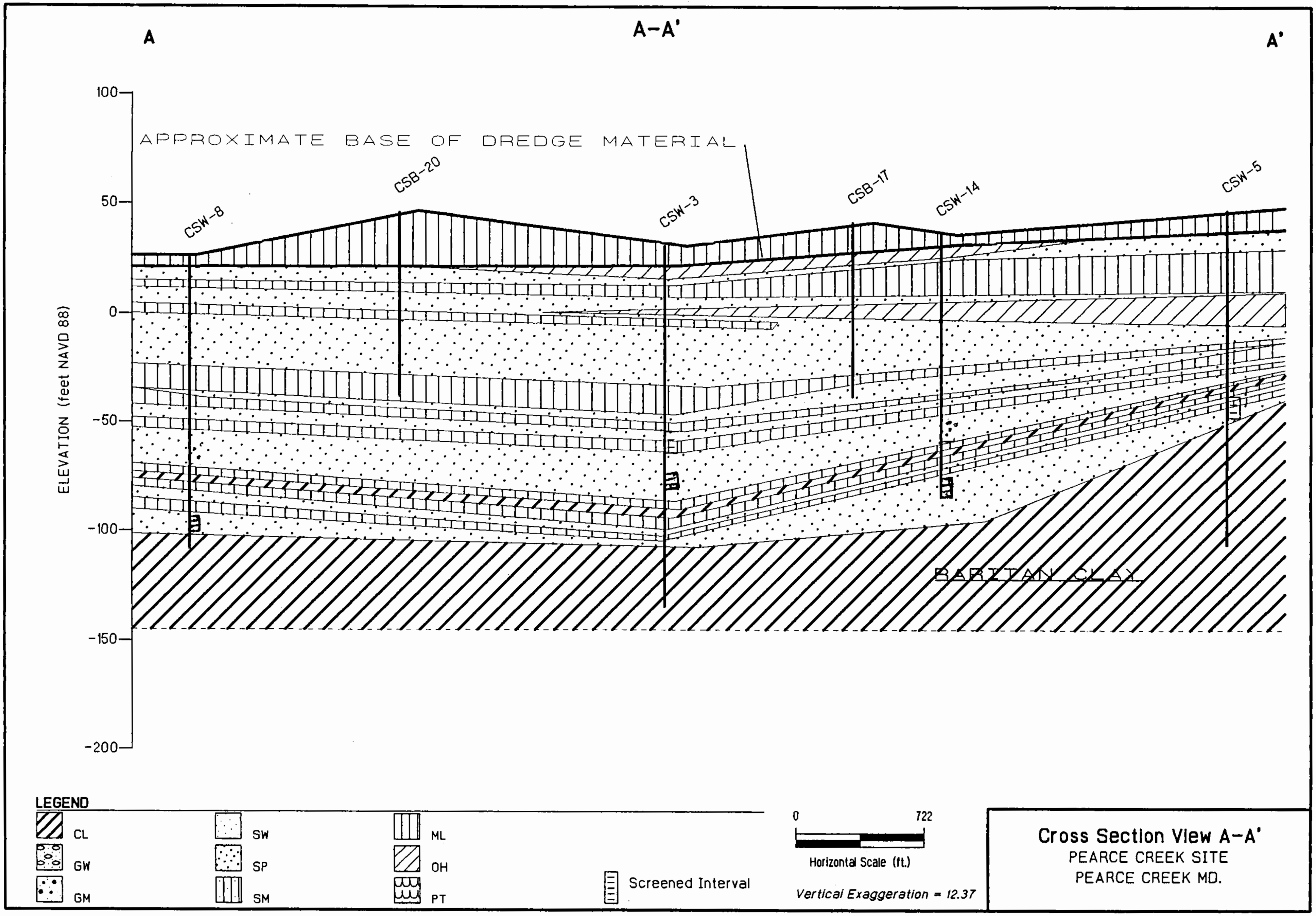
PHILADELPHIA, PENNSYLVANIA

PEARCE CREEK DISPOSAL AREA
Existing
Well/Piezometer
Piezometric Surface

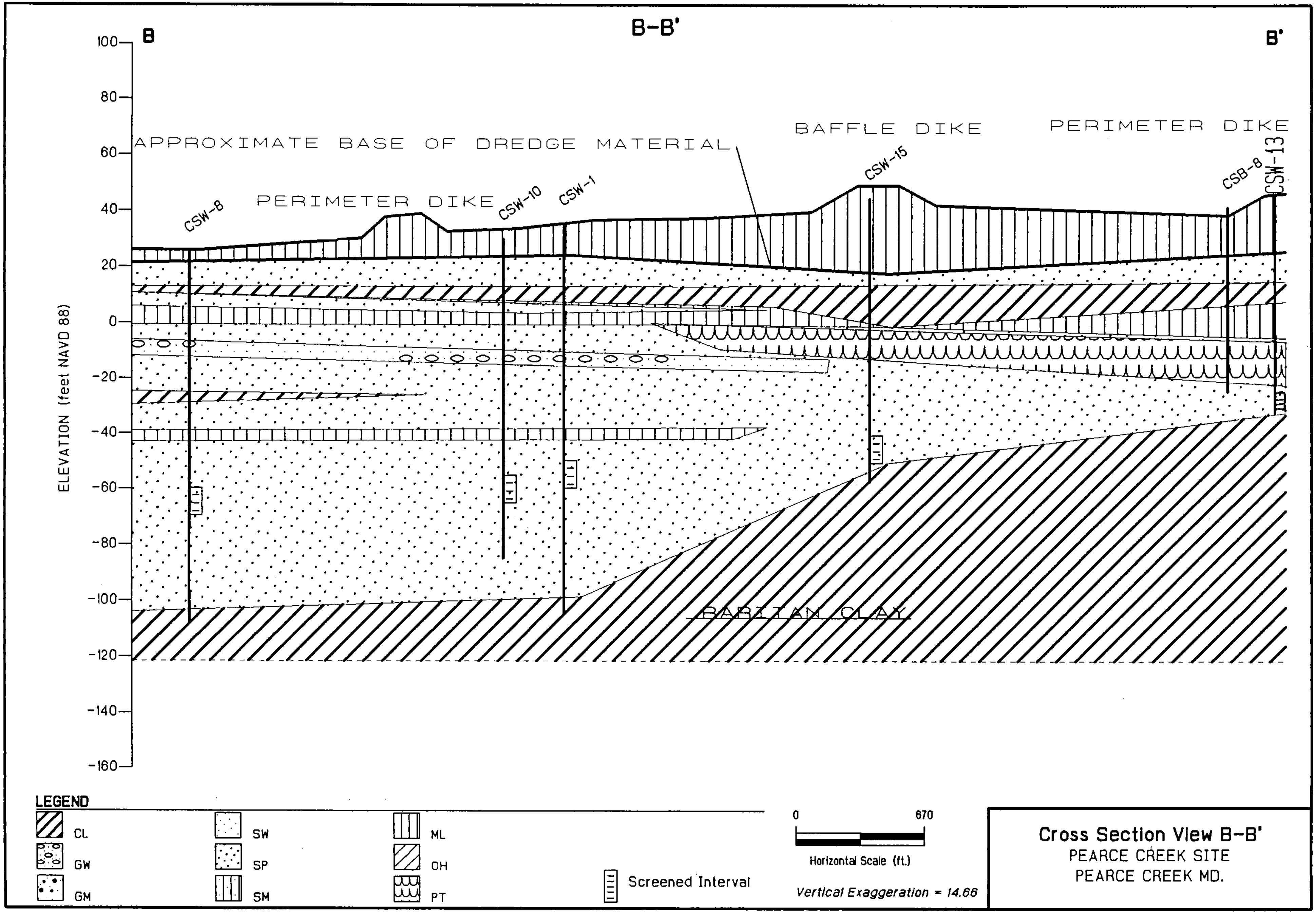
Figure 4.1-5



Cross Section View A–A'
PEARCE CREEK SITE
PEARCE CREEK MD.

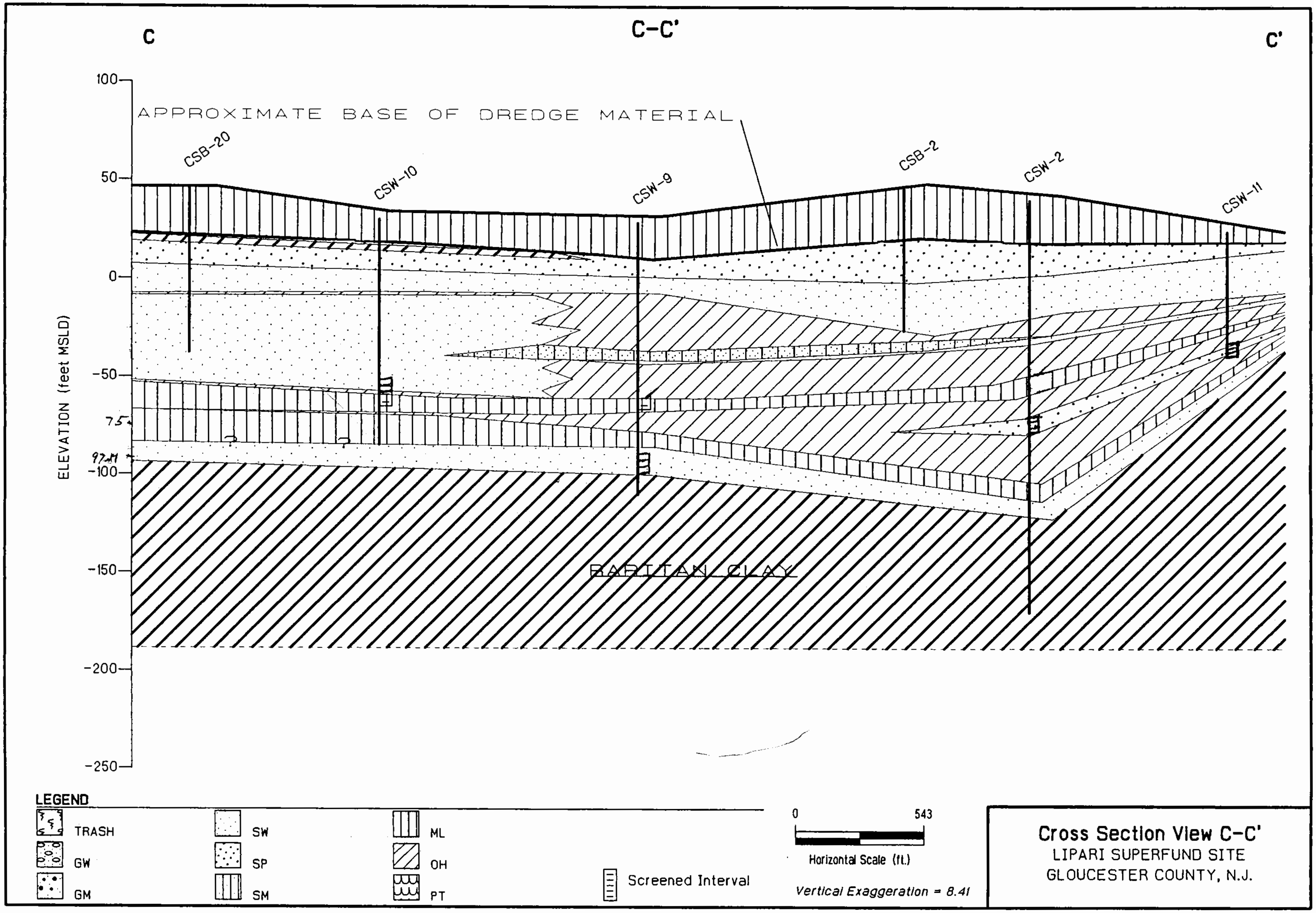
US ARMY CORPS OF ENGINEERS

Figure 4.1-1



US ARMY CORPS OF ENGINEERS

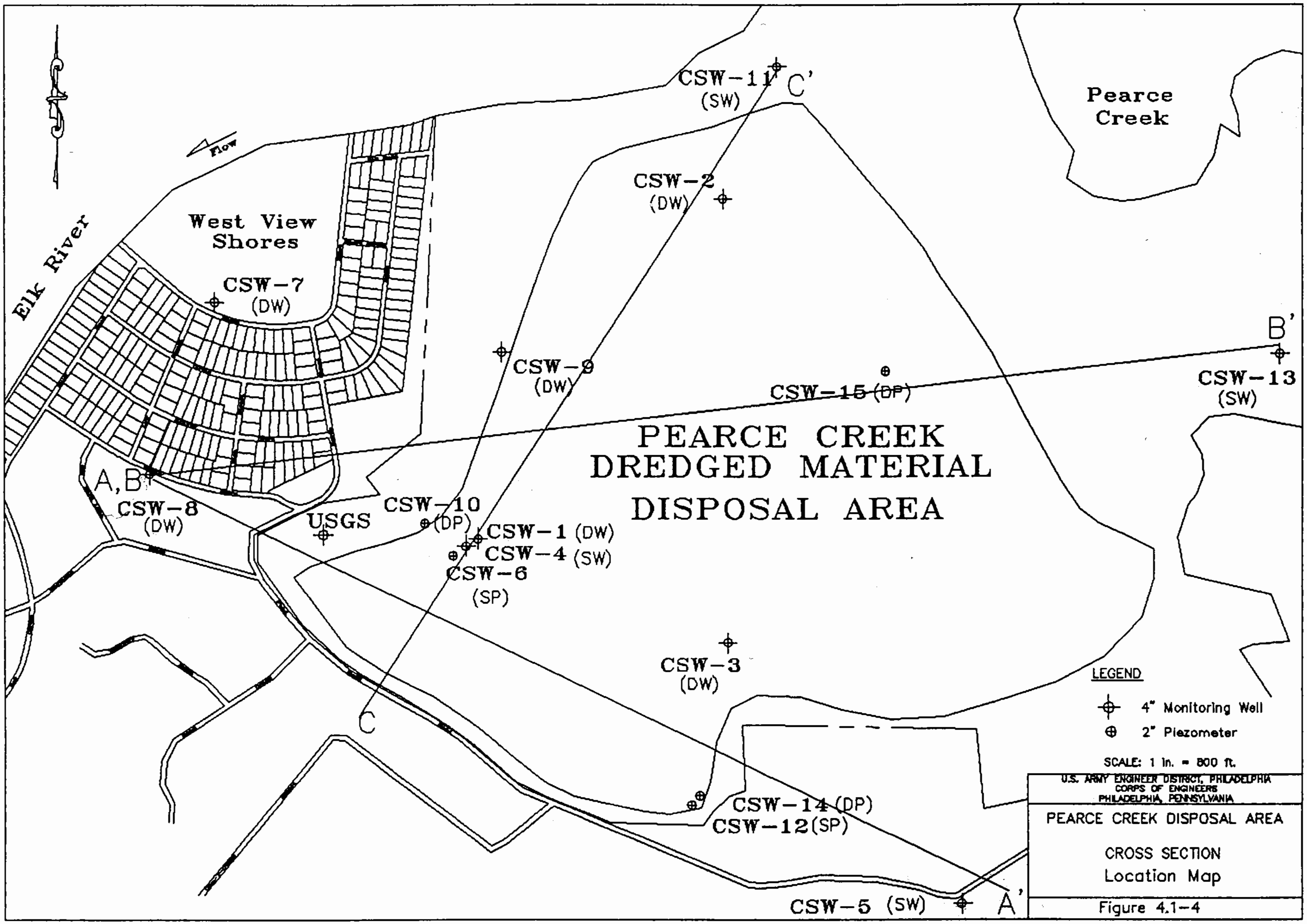
Figure 4.1-2



Cross Section View C–C'
LIPARI SUPERFUND SITE
GLOUCESTER COUNTY, N.J.

US ARMY CORPS OF ENGINEERS

Figure 4.1-3



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PHILADELPHIA, PENNSYLVANIA

PEARCE CREEK DISPOSAL AREA

CROSS SECTION
Location Map

Figure 4.1-4

4.2 Geochemical Testing

Tables 4.2-1 and 4.2-2 contain Black and Veatch's analytical results for subsurface soil and groundwater samples taken in 1995. Tables 4.2-3 and 4.2-4 contain the Philadelphia District's analytical results for subsurface soil and groundwater samples taken in 1996. Table 4.2-5 is a statistical representation of the 1996 groundwater data. These samples were collected and analyzed to compare the geochemical characteristics in soils and groundwater at a background location, in the disposal area, and in the West View Shores area. This section offers a combined evaluations of the results and implications of the findings by B&VSPC and the Philadelphia District.

4.2.1 Comparison of Soils Among Background, Disposal Area, and the West View Shores

Black and Veatch 1995 soil data results for soils at the background location (CSW-5) contain significant amounts of sulfide with concentrations generally increasing from less than 10 mg/kg near surface to over 50 mg/kg at 150 ft below surface (Table 4.2-1). This indicates that the subsurface soil and groundwater is in a fairly reduced (anaerobic) environment in which heavy metals such as lead, copper, and zinc are not very mobile. Similarly, about 2 mg/l of sulfide was found in the background well, and concentrations of copper, lead, and zinc were very low, also indicating a reducing environment. Sulfate concentrations in groundwater and soils are generally lower at CSW-5 than at other locations. The top 20 feet of soil at CSW-5 generally contain less than 100 mg/kg of sulfate. In groundwater, sulfate concentration is about 1,000 mg/l, in the low range among all locations.

The top 20 feet of soils in the disposal area (CSW-1, CSW-2, CSW-3, and CSW-15), in contrast, contain much higher concentrations of sulfate than the background location, ranging from several hundreds mg/kg to 3,500 mg/kg. Soil sulfate concentration generally decreases to about one tenth the values found in the top 20 feet. This indicates a downward migration of sulfate from the top layer that probably has been undergoing sulfide oxidation. However, the downward migration of sulfate does not appear to have much impact on the deep soil and groundwater which remain a reducing environment. This is evidenced by the sulfide found in the groundwater at CSW-1, CSW-2, CSW-3, and CSW-9.

In the West View Shores area (CSW-7 and CSW-8), the soils generally contain higher concentrations of sulfide and relatively low sulfate throughout the entire drilling length. Sulfate and sulfide concentrations in groundwater are similar to those in the background well. The redox condition at these two wells should also be anoxic, as indicated by the levels of sulfide present in the soil and groundwater.

Comparison of results at these locations indicates that the origin of the sulfate in the West View Shores area is probably local, either present in the original sedimentary environment or derived from oxidation of sulfide found in the sedimentary deposits. The deposits in the West View Shores area contain significant amounts of sulfide which is typical in the region. Oxidation of the sulfide by

infiltration may have caused the low levels of heavy metals and elevated concentrations of sulfate found in some domestic wells.

The Philadelphia District's 1996 soil samples were taken from well locations CSW-11, CSW-14, and CSW-15 (Table 4.2-3). The analytical soil data results were of similar concentrations to the Black and Veatch 1995 findings. It has been observed that all soil chemical data results vary vastly at similar elevations and different bore hole locations. An explanation for varying chemical results are believed to be influenced by the area's naturally complex geology as discussed in 4.1.1. The overall soil pH ranges from 5.97 to 3.03 for CSW-11, CSW-14, and CSW-15. CSW-14 and CSW-11 are considered to be an upgradient well with pH ranges from 5.94 to 3.86.

Sulfide was not detected in all of the 1996 soil samples. The undetected sulfide results is most likely due to the contract laboratory using a colorimetric method and not a titrimetric method. The contract laboratory reported that there were color interferences and that all soil samples had to be diluted before analyzing. This dilution was most likely responsible for the undetected sulfide concentrations.

4.2.2 Comparison of Surface Water, Shallow Groundwater, and Deep Groundwater in the Disposal Area

Black and Veatch 1995 surface water sample collected inside the disposal area has a pH of 3.72 and sulfate concentration of 1,860 mg/l, indicating oxidation of sulfide in the surficial soils. There are some metals that are mobilized by the oxidation. These metals include copper (38 ug/l), lead (15 ug/l), and zinc (4,420 ug/l). However, the presence of sulfide in the surface water (4.1 mg/l) indicates that the oxidation process takes place at fairly shallow depths. The metals mobilized from surface and near surface soil would probably be immobilized at depth. At about the same location, groundwater in a shallow well screened at about 20 ft below ground surface (CSW-6) and in an intermediate well screened at about 50 ft below ground surface (CSW-4), the concentrations of these heavy metals diminish, while the pH increase to over 5, more typical of the study area. The deep groundwater (CSW-1) appears to be from a separate aquifer that the shallow and intermediate wells (CSW-4 and CSW-6) draw from, as indicated by the much different pH and concentrations of zinc and sulfate.

1995 groundwater data results can be found in Table 4.2-2. Graphical representation of the 1996 data can be seen in Appendix D. The graphs show the groundwater concentrations for the various parameters monitored during the October, 1996 sampling event and for CSW-1 during the pump test. The data is arranged by location and depth to screen. The downgradient wells are on the left with the shallowest upper screen depth first. The middle section contains the disposal area wells, shallowest to deepest and the final section shows the upgradient wells, shallowest to deepest. By presenting the data in this way trends within and between groups is more readily apparent.

Where laboratory data was reported as a non-detect or "U", the detection limit value was used. Where applicable, the graphs (Appendix D) contain EPA Drinking Water Standard either as a heavy line (or lines) if the value can be readily discerned from the graph or contained within a box in the

graph. In order to better present the data, some parameters' Y axis concentrations are shown at less than the highest value. In these cases, the actual values are shown in small boxes on the corresponding bar.

A statistical comparison of downgradient, upgradient and with disposal area chemical data set was conducted. Monitoring wells were divided into three categories; downgradient (of the disposal area), upgradient (of the disposal area) and within the disposal area. Means and standard deviations for the parameters were calculated using the detection limit where the sample reported a "non-detect". Because environmental samples, including groundwater samples, are typically log normally distributed, the log of the parameters' values were calculated and the means and standard deviations were again calculated. These data are shown in Table 4.2-5.

The transformed (log) data was further investigated. The upgradient wells data set with the downgradient data set shows that for many parameters, the downgradient well water is of better quality (i.e., lower concentrations for chemicals and higher pH) when compared with the upgradient data set. These parameters include pH, Nitrate, Nitrite, Chloride, Phosphorus, Phosphate, Ferrous Iron, Aluminum, Arsenic, Lead, and Manganese.

Additional downgradient parameters were found to be within one standard deviation (downgradient mean minus one standard deviation) of the upgradient mean. These parameters included Alkalinity, Ammonia, Sulfate, Calcium, Copper, Iron, Magnesium, Sodium, and Zinc.

Bromide and Potassium were found to be higher in the downgradient wells as compared with the upgradient wells using both comparative methods. Currently, there is no Potassium EPA Drinking Water Standard.

With the exception of Bromide and Potassium, the available data suggest that there is no significant difference between the upgradient and downgradient parameter concentrations. This further suggests that there is no evidence of significant impact to the downgradient aquifers due to the disposal area activities.

Comparison of groundwater chemistry at different depths indicates that oxidation of sulfide at near surface and shallow depth has impacted groundwater quality at the disposal facility. This impact appears to diminish with increasing depth in the disposal area. The likelihood is therefore low for sulfide oxidation in the disposal area to significantly impact groundwater with increasing depth or distance from the site.

Groundwater data results graphed, located in Appendix D, indicate that the Confined Disposal Facility (CDF) well locations CSW-6 (elevation +15 to +14) and CSW-1 (elevation -84 to -94) contain the highest concentrations of arsenic, zinc, and aluminum. Arsenic in CSW-4 (elevation -13 to -23) was not detected and zinc was detected at a very low concentration. It would be expected to see CSW-4, CSW-6, and CSW-1 to have similar arsenic, zinc, and aluminum concentrations, if the

CDF was the source of metal ion mobility. CSW 4 is in a downgradient portion of the CDF and if there was a leaching effect CSW-4 should reflect similar concentrations.

Review of the sulfate data for 1995 and 1996 indicates that groundwater sulfate concentrations are elevated within the CDF at CSW 12, 14, 6, 4, 1, 10, and the USGS well. However this sulfate elevation was not found at CSW8 or CSW 7, implying no impact from the CDF.

The following three plots have been generated and can be seen at the end of Appendix D: Log of pH vs Sulfate Concentration, Sulfate vs Manganese, Log of Sulfate vs Log of Manganese, and, Chloride vs sulfate/Chloride Ratio.

The overall chemical review of the groundwater investigation indicates that the groundwater in the whole investigation area, upgradient, downgradient, and in the disposal area is of poor quality. The graphical interpretation of the comparison of the upgradient and downgradient wells indicate that the groundwater quality is quite similar. The sediments at Pearce Creek contain sulfide minerals in upgradient locations which support the fact that the the CDF is not the source of poor groundwater quality and that sulfide minerals are indigenous to the Pearce Creek area.

Table 4.2.1
Analytical Results for Soil Samples
Pearce Creek Disposal Area Investigation
1995

Boring	CSW-1													
Depth	0'-1'	2.5'-3'	4'-6'	6.5'-7'	13'-14'	16'-18'	24'-26'	32'-34'	78'-79.5'	128'-129.5'	128'-129.5'	128'-129.5'	138'-139.5'	160'-162'
Sample ID	1-0	1-2.5	1-4	1-6.5	1-13	1-16	1-24	1-32	1-78	1-128	1-128	1-128	1-138	1-160
Duplicate											MS	MSD		dup of 1-138
Material		Silty				Sandy		Silty	Silty					
Type	SILT	CLAY	CLAY	SAND	SAND	SILT	CLAY	SAND	SAND	SAND	SAND	SAND	CLAY	CLAY
units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
<u>Analyte</u>														
Sulfide	12.79	4.99 U	45.90	14.81	5.08 U	5.52 U	51.12	12.17	22.96	102.72	102.72	NR	116.16	126.08
Sulfate	975.70	570.54	619.67	391.80	608.64	846.90	311.72	259.12	630.10	381.35	400.24	755.61	75.76 U	74.17 U
pH	3.83	5.15	5.62	4.69	3.96	5.05	4.98	4.00	4.24	4.75	4.57	4.43	4.90	5.31
<u>Inorganics</u>														
Arsenic	9.7	4.5	8.5	6.5	2.0	8.1	5.0	0.43 B	0.36 B	8.2 N•	–	–	3.0 N•	1.6 N•
Copper	23.0	9.5	23.2	8.6	2.8	6.4	8.2	10.6	4.6	7.7 •	–	–	17.5 •	17.3 •
Iron	25500 •	12900 •	22100 •	7460 •	2960 •	9970 •	19600 •	751 •	563 •	2410 •	–	–	39600 •	29300 •
Lead	33.6	12.6	28.8	9.6	2.8	5.5	7.0	5.3	0.80	2.8 N•	–	–	5.8 N•	4.3 N•
Manganese	380	631	1310	220	37.1	474	365	55.2	82.2	43.0 N•	–	–	86.8 N•	32.7 N•
Zinc	67.5	66.3	134	137	21.3	131	26.4	2.0 B	1.3 B	6.9 •	–	–	26.2 •	12.6 •

Boring	CSW-2												
Depth	2'-3'	4'-5'	6'-7'	10'-12'	14'-16'	18'-20'	28'-30'	34'-36'	84'-86'	84'-86'	102'-104'	116'-118'	176'-177.5'
Sample ID	2-2-3	2-4-5	2-6-7	2-10	2-14	2-18	2-28	2-34	2-84	2-84	2-102	2-116	2-176
Duplicate										MSD			
Material	Silty						Clayey						
Type	SAND	SAND	SILT	SILT	SILT	SILT	SILT	SAND	PEAT	PEAT	CLAY	SAND	SILT
units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
<u>Analyte</u>													
Sulfide	16	3.2	9.5	210	13	11	15	46	150	–	37	30	38
Sulfate	1700	1200	370	1200	1000	1100	1800	1100	480	–	440	360	340
pH	4.57	6.2	5.59	4.85	5.52	5.37	5.25	4.63	5.08	–	5.52	4.98	5.23
<u>Inorganics</u>													
Arsenic	5.2 N	8.5 N	7.9 N	2.8 N	8.4 N	12.2 N	5.5 N	2.1 N	10.7 N	10.3	15.4 N	2.0 N	0.23 N
Copper	12.0 E	22.7 E	27.6 E	9.3 E	32.7 E	48.8 E	13.7 BE	2.4 E	23.8 E	21.8	17.2 E	4.8 E	10.1 E
Iron	13800	20200	21500	9020	22600	36100	21800	6840	17900	20200	18400	3590	38100
Lead	15.8 •	24.7 •	32.7 •	12.3 •	31.7 •	48.4 •	15.1 •	2.6 •	18.5 •	10.3	13.8 •	2.1 •	1.0 •
Manganese	924 E	908 E	668 E	393 E	710 E	709 E	878 E	189 E	114 E	127	145 E	8.0 E	474 E
Zinc	87.3	109	168	39.9	84.4	223	43.4	10.3	71.5	70.1	90.2	9.7	9.7

Table 4.2.1 (cont.) 1995

Boring	CSW-3							
Depth	0'-2'	2'-4'	4'-6'	10'-12'	14'-16'	18'-20'	34'-35'	85'-85.5'
Sample ID	3-0	3-2	3-4	3-10	3-14	3-18	3-34	3-85
Duplicate								
Material					Sandy	Silty		
Type	SILT	SILT	SILT	CLAY	SILT	SAND	SAND	SILT
units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte								
Sulfide	60	8.3	3.9	66	140	15	78	11.38
Sulfate	3500	3000	1600	1000	1000	420	350	441
pH	5.53	6.15	4.4	5.51	5.45	4.46	4.57	5.65
Inorganics								
Arsenic	10.7 S	10.7 S	10.0 +	7.5	8.6 s	18.4	3.1	0.30 UN*
Copper	28.3 *	27.9 *	28.8 *	22.2 *	16.1 *	7.6 *	2.5 B*	3.4
Iron	25100 *	27100 *	30300 *	33200 *	25400 *	13600 *	1420 *	187
Lead	37.4 N	39.7 N	38.4 N	24.6 N	20.5 N	7.9 N	4.3 N	3.5
Manganese	3270 *	1860 *	604 *	1000 *	1250 *	100 *	107 *	96.0 N
Zinc	252	161	88.5	61.2	97.2	7.7	1.4 B	4.4 N

Boring	CSW-5										
Depth	0'-2'	2'-4'	4'-6'	8'-10'	12'-14'	18'-20'	50'-52'	54.25'-54.5'	54'-56'	84'-85.5'	152'-153.5'
Sample ID	5-0	5-2	5-4	5-8	5-13	5-18	5-49	5-53	5-56'	5-84'	5-152'
Duplicate								(dup of 5-49)			
Material	Silty	Sandy	Sandy			Sandy	Silty	Silty			Silty
Type	SAND	SILT	SILT	SILT	SAND	SILT	CLAY	CLAY	PEAT	SAND	CLAY
units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte											
Sulfide	8.37	7.60	16.53	18.32	14.60	8.61	24.88	29.30	43.86	46.82	53.08
Sulfate	71.77 U	76.05	70.84 U	84.25 U	83.94 U	359.16	289.80	429.30	231.83	456.18	72.38 U
pH	5.68	5.63	4.62	5.59	4.60	3.74	3.41	3.95	4.36	5.01	6.26
Inorganics											
Arsenic	5.5 N*	6.3 N*	3.0 N*	23.1 N*	7.7 N*	11.8 N*	14.0 N*	69.6 N*	16.0	0.28 U	1.1
Copper	5.6	4.8	11.6	12.9	2.8	12.8	7.4	8.4	8.5	3.0	25.2
Iron	12900	17000	15800	27200	3530	5050	16600	34500	15900	1530	21400
Lead	10.8	7.2	8.9	6.1	3.8	8.6	11.0	23.0	10.3 *	0.86 *	9.9 *
Manganese	117 N	149 N	50.4 N	22.3 N	12.9 N	4.2 N	65.2 N	70.7 N	54.7 N	17.3 N	393 N
Zinc	35.0 N	24.8 N	29.6 N	20.1 N	13.5 N	10.5 N	57.6 N	57.2 N	53.5	3.2	50.6

Table 4.2.1 (cont.) 1995

Boring	CSW-7										
Depth	1'-2'	2'-3'	4'-5'	10'-11'	14'-15'	24'-26'	30'-32'	58'-60'	69.5'-70'	84'-85'	100'-101.5'
Sample ID	7-1	7-2	7-4	7-10	7-14	7-24	7-30	7-58	7-69.5	7-84	7-100
Duplicate											
Material										Silty	Silty
Type	SAND	SAND	SILT	SAND	SAND	SILT	CLAY	CLAY	PEAT	SAND	SAND
units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
<u>Analyte</u>											
Sulfide	136.72	137.00	149.76	98.04	28.20	245.88	233.38	124.25	191.94	195.57	136.92
Sulfate	67.80 U	70.26 U	72.46 U	73.53 U	70.51 U	70.59 U	75.28 U	89.82 U	2985.78	219.04	91.69
pH	5.70	5.89	6.15	5.86	5.80	5.05	5.40	6.71	5.16	4.60	4.45
<u>Inorganics</u>											
Arsenic	7.0 N*	5.1 N*	2.0 N*	3.1 N*	0.81 BN	2.0 N*	2.0 N*	2.1 N*	6.8 N*	2.2 N*	0.25 UN*
Copper	10.8 *	4.6 *	7.1 *	8.0 *	4.2 *	8.6 *	11.8 *	22.0 *	15.6 *	2.1 B*	6.4 *
Iron	7640 *	3810 *	12000 *	8190 *	2630 *	8960 *	10800 *	36100 *	40000 *	6300 *	326 *
Lead	13.1 N*	9.7 N*	8.3 N*	8.8 N*	4.5 N*	7.2 N*	12.3 N*	17.1 N*	15.5 N*	1.3 N*	5.4 N*
Manganese	17.7 N*	6.6 N*	62.2 N*	57.4 N*	61.1 N*	68.8 N*	82.3 N*	292 N*	66.2 N*	5.4 N*	2.7 N*
Zinc	15.2 *	9.1 *	22.3 *	8.4 *	3.4 *	45.0 *	51.2 *	91.8 *	69.3 *	1.1 U*	0.87 U*

Boring	CSW-8									
Depth	0'-1'	0'-1'	2'-3'	4'-5'	6'-7'	8'-10'	14'-14.5'	18'-20'	48'-50'	98'-99.5'
Sample ID	8-0'-1	8-0'-1	8-2'-3	8-4'-5	8-6'-7	8-8-10	8-14	8-18	8-48	8-98
Duplicate		MS			dup of 8-0'-1					
Material	Sandy	Sandy	Silty		Sandy					Silty
Type	SILT	SILT	SAND	SAND	SILT	SAND	SILT	SAND	SAND	SAND
units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
<u>Analyte</u>										
Sulfide	61.16	54.36	49.95	22.04	20.11	41.62	76.24	21.69	36.99	10.80
Sulfate	67.95 U	67.95 U	63.76 U	62.96 U	63.49 U	65.72 U	106.38	72.29 U	171.84 U	177.67
pH	5.46	5.29	5.11	6.20	5.05	5.13	5.27	5.12	4.63	4.52
<u>Inorganics</u>										
Arsenic	1.7	–	2.4	0.98	2.1	1.3	3.3	0.27 U	1.9	0.25 U
Copper	4.4	–	2.8	1.9 B	2.0 B	1.9 B	17.8	1.6 B	4.0	1.5 B
Iron	6730	–	4670	1840	6360	2580	2230	236	8660	2500 *
Lead	6.7 *	–	3.7 *	3.6 *	4.3 *	3.1 *	16.7 *	2.9 *	1.4 *	0.78
Manganese	186 N	–	42.3 N	20.0 N	67.8 N	23.5 N	10.2 N	1.3 BN	18.3 N	11.9
Zinc	18.5	–	6.1	3.4	10.0	3.3	40.0	2.2	6.5	2.3

RINSATE BLANKS

Sample ID	RB-1	RB-2	RB-3	RB-4
units	ug/L	ug/L	ug/L	ug/L
Analyte				
Sulfide	0.2 U	1.2	0.2	0.2 U
Sulfate	3.0 U	3.0 U	3 U	3 U
pH	5.64	5.62	5.71	7.06
Inorganics				
Arsenic	2.6 UN	5.0 U	2.6 UN*	2.6 UN*
Copper	1.7 BE	1.5 U*	1.5 U	1.5 U*
Iron	76.7 B	100 *	23.9 U	23.9 U*
Lead	2.1 U*	2.1 UN	2.1 U	2.1 UN*
Manganese	2.4 BE	1.0 U*	1.0 UN	1.0 UN*
Zinc	10.0 U	10.0 U	10.0 UN	9.0 U*

NOTES

NR - Not Required
U - Undetected
B - Reported value less than Contract Required Detection Limit (CRDL) but greater than or equal to Instrument Detection Limit (IDL).
N - Spiked sample recovery not within control limits.
E - Estimated because of presence of interference.
* - Duplicate analysis not within control limits.
-- Not Analyzed
mg/kg - milligrams per kilograms, parts per million (reported on a dry weight basis)
ug/L - micrograms per liter, parts per billion

Table 4.2.2
Analytical Results for Water Samples
Inorganics
Pearce Creek Disposal Area Investigation 1995

Well	CSW-1	CSW-2	CSW-3	CSW-4	CSW-5	CSW-6	CSW-7	CSW-8	CSW-9	CSW-10 (dup of CSW-3)	SWS-1	RB-1
Field Measurements												
Temperature (C)	14	13.5	13.5	14	14	13.5	14	13	14	NA	NA	NA
Salinity (ppt)	3	0	4	4.0	2.2	2.6	0.5	1.5	1	NA	NA	NA
Conductivity (umhos)	4400	210	5100	4700	2900	3750	1450	2000	1750	NA	NA	NA
pH, units	4.27	6.19	4.37	5.47	5.14	6.19	5.96	5.03	5.8	NA	NA	NA
Appearance, Other	clear, slight odor	clear, slight odor	clear	clear, foamy	clear	clear, slight haze	clear	clear	very hazy	NA	NA	NA
units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Analyte												
Alkalinity	8	72	20.2	92	64	74	37	21	29.8	19.8	1 U	1 U
Bromide	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.3
Chloride	631	35	1251.0	686	339	436.00	145	256	347.0	1100.0	163.0	1 U
pH, units	4.10	6.01	4.23	5.21	5.39	5.29	5.72	5.11	5.08	4.27	3.72	6.57
Sulfate	560	62	3950	2900	1040	2800	920	1600	1700	3590	1860	3 U
Sulfide	2.1	0.9	4.1	1.7	2.1	2.5	1.7	2.5	5.7	3.3	4.1	0.9
Unfiltered Metals												
Ferrous Iron	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Filtered Metals												
Aluminum	29100	46.6 U	23900	4350	46.6 U	65.4 B	49.4 B	86.4 B	50 B	23200	23700	46.6 U
Arsenic	18.9	5.1 U	17.3	5.1 U	5.1 U	31.5	5.1 U	5.1 U	5.1 U	19.0	5.7 B	5.1 U
Calcium	198000 E	12400 E	341000 E	244000 E	124000 E	300000 E	90600 E	124000 E	109000 E	327000 E	166000 E	503 UE
Copper	9.0 U	9.0 U	9.0 U	9.0 U	9.0 U	9.0 U	9.0 U	9.0 U	9.0 U	9.0 U	38.2	9.0 U
Ferric Iron	540	17.3	446	574	376	119	134	212	386	403	2.3	1 U
Lead	5.4 N	1.4 U	18.6	5.8 N	1.4 UN	23.6 N	1.4 UN	1.4 UN	1.4 UN	19.0 N	15.3 N	1.4 UN
Magnesium	206000	2280 B	276000	203000	143000	222000	81500	113000	75800	266000	124000	2180 U
Manganese	191000	214	374000	198000	56300	268000	37100	48400	24700	336000	135000	12.2 B
Sodium	336000	19100	706000	433000	165000	282000	47500	109000	72500	636000	137000	685 U
Zinc	1730 E	10.5 BE	2690 E	682 E	28.5 E	715 E	295 E	2070 E	205 E	2590 E	4420 E	6.4 UE

NOTES
NA - Not Analyzed
U - Undetected
B - Reported value less than Contract Required Detection Limit (CRDL) but greater than or equal to Instrument Detection Limit (IDL).
N - Spiked sample recovery not within control limits.
E - Estimated because of presence of interference.
mg/L - milligrams per liter, parts per million
ug/L - micrograms per liter, parts per billion

Table 4.2.3
Analytical Results for Soil Samples
Sulfide, Sulfate, pH, and Inorganics
Pearce Creek Disposal Area Investigation 1996

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Boring	**CSW-11-05**	**CSW-11-06**	**CSW-14-01**	**CSW-14-02**	**CSW-14-03**	**CSW-14-04**	**CSW-15-07**	**CSW-15-08**	**Rinsate 01**
Depth	**24-26'**	**53-58'**	**5-8'**	**35-39'**	**50-54'**	**115-119'**	**19-22'**	**90-92'**	
Sample ID	**BRD 804**	**BRD 805**	**BRD800**	**BRD801**	**BRD802**	**BRD803**	**BRD806**	**BRD807**	**BRD820**
Duplicate									
Material									
Type									
units	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/L**
Analyte									
Sulfide	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.1 U
Sulfate	11.0	9.0	130.0	26.0	13.0	23.0 U	110	4.17	5.0
pH	4.98	5.90	5.94	3.86	5.20	5.68	5.97	3.03	7.10
Inorganics									
Arsenic	0.9 U	0.9 U	12	2.4	1.1	0.97	18	2.5	0.003
Copper	0.87	5.5	35	2.6	1.9	2.4	40	1.6	0.009
Iron	840	21800	35000	1810	2140	750	34300	2090	0.25
Lead	0.97	2.3	50	5.4	2.2	1.6	59	1.1	ND
Manganese	14	24	615	66.8	34	18	1100	7	0.005
Zinc	2.8	11	130	2.1	3.4	5.9	290	12	0.016
Sample Date	8-23-96	8-23-96	8-20-96	8-20-96	8-20-96	8-21-96	8-27-96	9-4-96	8-20-96

NOTES:
U- Undetected
mg/L- Milligrams per liter
mg/Kg - milligrams per kilograms

Table 4.2.4
Analytical Results for Water Samples
Inorganics, Nutrients and Field Parameters
Pearce Creek Disposal Area Investigation
Sampling dates: October 7, 8, 9, and 16, 1996

Well Location	CSW-1	Pump-01*	CSW-2**	CSW-3	CSW-4	CSW-5	CSW-6	CSW-7	CSW-8	CSW-9
Field Measurements										
Temperature (C)	14.7	NA	13.5	16.1	14.4	14.1	14.7	15.3	15.0	14.1
Conductivity (umhos)	7770	NA	210	11510	7880	5290	3900	3020	4150	3350
pH, units	4.27	NA	6.19	4.15	5.60	5.37	5.99	5.60	5.08	5.50
Appearance, Other	slight odor		slight odor					Suspended solids		
units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Analyte										
Alkalinity	5 U	5 U	72	60	28	60	5 U	99	240	130
Nitrate	0.1 U	NA	NA	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1	0.1 U
Nitrite	0.1	NA	NA	0.1 U	0.1	0.1	0.1 U	0.1 U	0.1	0.1 U
Ammonia	12.0	NA	NA	2.0	18.0	1.3	8.0	1.6	1.1	1.6
Bromide	2.0 U	2 U	0.1 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Chloride	622	617	35	164	750	144	188	8	49	30
Phosphrous	0.07	NA	NA	0.07	0.10	0.06	1.00	0.25	0.06	0.05 U
Phosphate	0.05 U	NA	NA	0.05 U	0.05 U	0.05	1.00 U	0.25	0.05	0.05 U
Sulfate	3412	3250	62	486	3075	372	1528	27	316	247
Sulfide	1 U	1 U	0.9	1 U	1 U	0.2 U	1 U	0.1 U	0.1 U	0.1 U
units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Filtered Inorganics										
Ferrous Iron	620000	510,000 U	1000 U	10000	570000	220000	140000	1400	90	2800
units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Unfiltered Inorganics										
Aluminum	10600	31200	47 U	830	720	370	1100	180	370	160
Arsenic	16	40 U	5.1 U	8.0 U	8.0 U	8.0 U	21	8.0 U	8 U	8.0 U
Calcium	231000	214000	12400	141000	322000	116000	252000	20000	8900	23900
Copper	40	48	9 U	10 U	36	10 U	30	10 U	10 U	10 U
Ferric Iron	4000	144000	NA	900	106000	10000	24000	19600	3410	4100
Iron	624000	654000	17	10900	676000	230000	164000	21000	3500	6900
Lead	10	25 U	1 U	5 U	5 U	5 U	5 U	2 J	9	5 U
Magnesium	220000	247000 U	2280	52400	239000	71700	167000	3100	18400	10500
Manganese	180000	212000	214	46700	209000	21200	158000	480	836	2330
Potassium	17000	NA	NA	15000	33000	21000	20000	25000	149000	37000
Sodium	346000	367000	19100	172000	495000	97100	196000	15000	125000	86800
Zinc	63100	2370	11	940	340	95	2130	84	210	37

NOTES

NA - Not Analyzed

J - Estimated value

U - Undetected

mg/L - milligrams per liter, parts per million

ug/L - micrograms per liter, parts per billion

*Pump-01 - Sample location CSW-1 during pump test Sept. 3, 1996.

**CSW-2 was not located during this sampling round. Data is from the 1995 Black and Veatch sampling round.

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Table 4.2.4 (cont.)

Analytical Results for Water Samples
Inorganics, Nutrients and Field Parameters
Pearce Creek Disposal Area Investigation

Sampling dates: October 7, 8, 9, and 16, 1996

Well Location	CSW-10	CSW-11	CSW-11DUP	CSW-12	CSW-13	CSW-14	CSW-15	USGS	Rinsate 01	Rinsate 02
Field Measurements										
Temperature (C)	14.5	14.2	14.2	13.9	14.3	16.4	14.9	14.4	26.6	NA
Conductivity (umhos)	3560	3930	3930	5530	800	5340	4750	7650	50	NA
pH, units	6.01	5.61	5.61	3.08	4.43	5.38	6.25	3.67	8.0	NA
Appearance, Other		Suspended solids	Suspended solids	Poorly Installed	Suspended solids					
units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Analyte										
Alkalinity	110	47	45	220	5 U	11	75	5 U	5 U	5.00 U
Nitrate	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nitrite	0.1 U	0.1 U	0.1 U	0.1 U	0.1	0.1	1.0 U	0.1 U	0.1 U	0.1 U
Ammonia	31	2.7	3.6	18	0.86	18	3.4	15	0.79	0.2 U
Bromide	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Chloride	471	827	837	612	82	814	57	604	1 U	1 U
Phosphrous	0.05	0.18	0.20	1.10	0.14	0.16	0.72	0.07	0.05 U	0.05 U
Phosphate	0.08	0.18	0.17	0.98	0.12	0.25	0.68	0.05 U	0.05 U	0.05 U
Sulfate	1180	192	194	1507	231	2680	28	1780	5 U	5 U
Sulfide	0.5 U	0.2 U	0.2 U	0.2 U	0.2 U	54	14	1.0 U	0.1 U	0.5 U
units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Filtered Inorganics										
Ferrous Iron	19000	20000	21000	360000	48000	250000	51000	110000	30 U	30 U
units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Unfiltered Inorganics										
Aluminum	1400	1300	1200	10400	5000	9100	1700	20500	100 U	84 J
Arsenic	3.7 J	8.0 U	8.0 U	16 U	8.0 U	12 J	1.7 U	8.0 U	8 U	8.0 J
Calcium	188000	41700	42700	156000	22600	293000	21600	224000	250	360
Copper	10 J	10 U	10 U	40	10 U	21	17	380	10 U	3 J
Iron	25500	28800	29600	387000	6250	277000	63400	125000	100 U	25 J
Ferric Iron	6500	8800	8600	27000	14500	27000	12400	15000	100 U	100 U
Lead	2 J	5 U	5 U	31	5 U	14	4.9 J	40	5 U	1 J
Magnesium	65800	41100	42000	144000	16800	193000	9600	177000	100 U	40 J
Manganese	34000	2150	2190	82000	2190	199000	1150	106000	15	5 U
Potassium	96500	20000	20000	20000	8200	50300	4000	14000	500 U	110 J
Sodium	484000	444000	454000	428000	66200	533000	35000	359000	740	930
Zinc	470	67	58	190	420	1400	230	2030	20 U	17 J

NOTES

NA - Not Analyzed

J - Estimated value

U - Undetected

mg/L - milligrams per liter, parts per million

ug/L - micrograms per liter, parts per billion

*Pump-01 - Sample location CSW-1 during pump test Sept. 3, 1996.

**CSW-2 was not located during this sampling round. Data is from the 1995 Black and Veatch sampling round.

Table 4.2.6
Log Normal Data Summaries
Down Gradient, Disposal Area, and Up Gradient Wells
Pearce Creek Disposal Area Investigation
Sampling dates: October 7, 8, 9, and 16, 1996

		Field Parameters				Laboratory Parameters								
Log Normal Data Well Set	Statistic	pH units	Cond. umhos	DO %	Temp. C	Alkalinity mg/L	Nitrate mg/L	Nitrite mg/L	Ammo mg/L	Bromide mg/L	Chloride mg/L	Phosphorus mg/L	Phosphate mg/L	Sulfate mg/L
Down Gradient	MEAN	0.71	3.61	1.54	1.17	1.85	-1.00	-1.00	0.62	0.30	1.90	-1.12	-1.10	2.53
	STD. DEV.	0.08	0.14	0.24	0.01	0.59	0.00	0.00	0.59	0.00	0.72	0.26	0.26	0.64
Disposal Area	MEAN	0.73	3.60	1.28	1.17	1.29	-1.00	-1.00	0.81	0.12	2.36	-0.69	-0.81	2.92
	STD. DEV.	0.07	0.54	0.23	0.03	0.53	0.00	0.00	0.35	0.46	0.56	0.51	0.60	0.71
Up Gradient	MEAN	0.59	3.10	1.15	1.02	1.35	-0.75	-0.75	0.59	0.26	2.24	-0.50	-0.50	2.44
	STD. DEV.	0.19	0.94	0.39	0.30	0.58	0.53	0.53	0.47	0.08	0.72	0.56	0.57	0.78
Down Gradient minus 1 SD	MEAN - 1 SD	0.63	3.47	1.30	1.15	1.26	-1.00	-1.00	0.03	0.30	1.19	-1.38	-1.37	1.89
Better Quality Down vs. Up	MEAN	Down	Up		Up	Up	Down	Down	Up	Up	Down	Down	Down	Up
Better Quality Down vs. Up	MEAN - 1 SD	Down	Up		Up	Down	Down	Down	Down	Up	Down	Down	Down	Down

		Unfiltered	Filtered Metals											
Log Normal Data Well Set	Statistic	Ferrous Iron ug/L	Aluminum ug/L	Arsenic ug/L	Calcium ug/L	Copper ug/L	Iron ug/L	Ferric Iron ug/L	Lead ug/L	Magnesium ug/L	Manganese ug/L	Potassium ug/L	Sodium ug/L	Zinc ug/L
Down Gradient	MEAN	3.57	2.90	0.84	4.65	1.32	4.24	3.89	0.77	4.37	3.71	4.65	4.89	2.36
	STD. DEV.	1.05	0.78	0.13	0.56	0.63	0.53	0.30	0.48	0.61	0.92	0.38	0.46	0.60
Disposal Area	MEAN	4.87	3.27	0.82	5.01	1.19	4.65	4.20	0.79	4.84	4.44	4.25	5.23	2.94
	STD. DEV.	0.98	0.82	0.39	0.51	0.52	1.40	0.77	0.39	0.72	1.36	0.34	0.51	1.00
Up Gradient	MEAN	4.44	3.05	0.88	4.33	1.05	4.34	3.67	0.85	4.24	3.74	3.78	4.70	2.09
	STD. DEV.	1.34	0.98	0.27	1.30	0.35	1.36	1.09	0.34	1.27	1.24	1.12	1.40	0.70
Down Gradient minus 1 SD	MEAN - 1 SD	2.53	2.11	0.70	4.09	0.68	3.71	3.58	0.29	3.76	2.79	4.28	4.43	1.76
Better Quality Down vs. Up	MEAN	Down	Down	Down	Up	Up	Up	Up	Down	Up	Down	Up	Up	Up
Better Quality Down vs. Up	MEAN - 1 SD	Down	Down	Down	Down	Down	Down	Up	Down	Down	Down	Up	Down	Down

umhos - microhmos
mg/L - milligrams per liter
ug/L - micro grams per liter
ERR = No data available
STD. DEV. - standard deviation
SD - standard deviation

4.3 Aquifer Analysis

4.3.1 Slug Tests

Values of transmissivity and storativity were calculated for the slug tests using AQTESOLV software and the Cooper, Bredehoeff, Papadopulos (1967) type curve method. The results are presented in Table 4.3-1, below. The range of calculated values exhibit a high degree of variability attributed to variation in stratigraphy and aquifer thickness noted in the borings. The range of these values is similar to background values for the confined Magothy formation found in published literature, as noted in section 2.3.2. Slug testing was only conducted during Phase 1.

Table 4.3-1 Slug Test Results

Well	Test	Parameter Estimates	
		T (ft^2/d)	S
CSW1	Rising Head Falling Head	850.1 703.1	1.0E-10* 1.0E-10*
CSW2	Rising Head Falling Head	69.7 103.6	1.7E-3 1.2E-4
CSW3	Rising Head Falling Head	404.5 963.0	9.1E-6 1.1E-14
CSW4	Rising Head Falling Head	941.8 1199.7	1.2E-7 1.0E-10*
CSW7	Rising Head Falling Head	297.0 296.1	8.3E-5 4.1E-5
CSW8	Rising Head Falling Head	2528.2 2495.7	1.0E-10* 1.0E-10*
CSW9	Rising Head Falling Head	1503.0 521.2	1.0E-10* 1.0E-10*

* 1.0E-10 is the smallest S value the parameter was allowed to converge to on these analyses.

** Invalid data was collected at the tests on CSW-5 due to transducer problems.

*** As per the workplan, no slug test was performed for the 2 inch diameter CSW-6 piezometer.

4.3.2 Step Test

A step test was performed to determine the maximum withdrawal rate for the pump test. The final rate of the step test was 47 gpm for well CSW-1 which represented the maximum rate of the CSW-1 pump test. At 47 gpm, the head in well CSW-1 went down 41 feet almost immediately. The initial depth to water at CSW-1 was 30.54 feet below TOC therefore the 41 foot drawdown brought the head down to 70 feet below TOC. At the completion of the step test, the recovery of CSW-1 was almost immediate suggesting a high horizontal hydraulic conductivity and a large water source available for recharge. (see Figure 4.3-1)

4.3.2 Pump Test

Antecedent Data

Prior to the pump test 12 total Trolls were installed in wells around the site including the three installed during the step test. The trolls began taking background (antecedent) data on August 29, 1996. The antecedent measurements provided important data on tidal influence of the monitoring wells.

Tidal Influence

The hydrographs (Figures 4.3-2 and 4.3-3) from the Troll data show varying degrees of tidal influence. The tidal signals seen in the deep well hydrographs of Figure 4.3-3, appear to be nearly in phase with the nearby Betterton, Maryland tides, with the peak water levels lagging the predicted tides by 1 to 3 hours. This high tidal efficiency can be interpolated as the pressure response of loading and unloading of tidal water on the aquifer by the Elk River. The increased load on the aquifer during high tide pressurizes the aquifer and this pressure is transmitted through the aquifer. The magnitude of the tidal signal detected, decreases with distance from shoreline. Well CSW-7 had the largest deep well water level fluctuation (Table 4.3-2) and is 447 feet from the shore line. Well CSW-9 had approximately half of the tidal water level fluctuation of CSW-7 and is located 1468 feet from the shoreline. Well CSW-11 is not a deep well but it is stratigraphically located at the base of the aquifer due to the thickening of the Raritan Clay (see Figure 4.1-3). The tidal signals from this well also correlate well with the Betterton tides.

Well CSW-5 is located south of the dredged material disposal area, near several home wells. Brief visual observations of the water level signal in CSW-5 indicated a potential tidal influence. However, detailed spectral analysis of the time series data indicates the energy is spread throughout a broad range of frequencies, with no concentration of energy at the known tidal frequencies. The hydrograph from well CSW-5 (Figure 4.3-2) shows evidence of drawdown prior to the start of the pump test. This drawdown is attributed to pumping from a nearby home or agricultural well and not from pump test activities.

The hydrographs from the shallower wells CSW-4, 6, and 12 show small fluctuations such as in CSW-4 (Figure 4.3-2). The phasing of the shallower wells is on the order of <0.1 ft. per cycle. It is unclear what the cause of the phasing was, but it does not appear to be tidal based on the length of the cycles.

Test Results

The pump test resulted in a large cone-of-influence effecting well CSW-9 which was screened at a similar depth. Well CSW-9 was drawn down 0.28 feet in 4 hours (Figure 4.3-3) which is significant because it is located 1,127 feet from the pumping well. Figure 4.3-3 shows the beginning of both drawdown and recovery phases of CSW-9 matching the pumping well CSW-1. Note that the drawdown effect at well CSW-9 was an order of magnitude greater than the tidal signal. Well CSW-10 was screened at a similar level as both CSW-1 and CSW-9, and was located approximately 320 feet from the pumping well. This well experienced a 0.95 foot drop in head due to the pumping effects of CSW-1. The thin gravel layer, similar to that seen in cross section B-B' (Figure 4.1-2), may have contributed to the limited drawdown seen in CSW-9 and possibly CSW-10. Many small gravel or sand and gravel layers were noted during the recent drilling, and a continuous gravel layer(s) may extend across the entire site. When the head in the pumping well goes below the elevation of a gravel layer, the gravel layer acts as a drain for the overlying sediments within the aquifer. The net result is a lateral extension of the cone-of-influence. From the drawdowns, it is clear that the 47 gpm pumping rate over 16 hours resulted in an extensive cone-of-influence in the deep aquifer which adequately stressed the aquifer.

The effects of the pumping at CSW-1 were much less vertically apparent at the nearby wells CSW-4 and CSW-6 which were located 56 feet, and 63 feet from CSW-1, respectively. Well CSW-4 is a shallow 4 inch diameter well screened 49 to 59 feet below ground surface (bgs). Well CSW-6 is a 2 inch diameter piezometer screened 21 to 22 feet bgs. Well CSW-4 had approximately 0.1 foot of drawdown, and well CSW-6 did not appear to have been influenced by the nearby pumping well. The progressively decreasing vertical effects of the deep aquifer pumping must be the result of a confining layer or layers (confining unit). As previously mentioned confining layers encountered during drilling are in this area are represented in cross section B-B' and C-C' (Figures 4.1-2 & 4.1-3). The confining unit appears to have effectively hydraulically insulated the upper portion of the aquifer and dredged material sediments from the lower aquifer.

The pump test information was utilized to determine the transmissivity of the aquifer. The pump test transmissivity calculated for CSW-1 was 700 ft^2/day which is very similar to the 703-850 ft^2/day range calculated by Black & Veatch slug test data.

Wells such as CSW-7 and CSW-8 did not show any effects of the pumping at CSW-1. These wells (located in West View Shores) did not even show pumping effects from surrounding home wells several of which are within 300-400 feet. Although some of the residences are seasonal, it

was observed that many of the homes near CSW-7 and CSW-8 were occupied during the antecedent measurement and pump test period.

Recovery Results

The aquifer recovery was almost instantaneous in the pumping well CSW-1 during both the step test and the pump test (Figures 4.3-1 and 4.3-3). The pumping well reached 95 % recovery in 5 minutes after pumping water for 16 hours. This extremely fast recovery is probably due to the unlimited water available from the Elk River/ Chesapeake Bay source. The unlimited Elk River/ Chesapeake Bay recharge water may also explain the lack of home well pumping influence in wells (CSW-7 and CSW-8, Figure 4.3-3). The longer drawdown and recovery of monitor wells CSW-9 and CSW-10 was on the order of hours. This long recovery discounts any assertion that gravel layers are primarily responsible for transporting upgradient water into West View Shore homeowner wells.

CSW1 STEP TEST

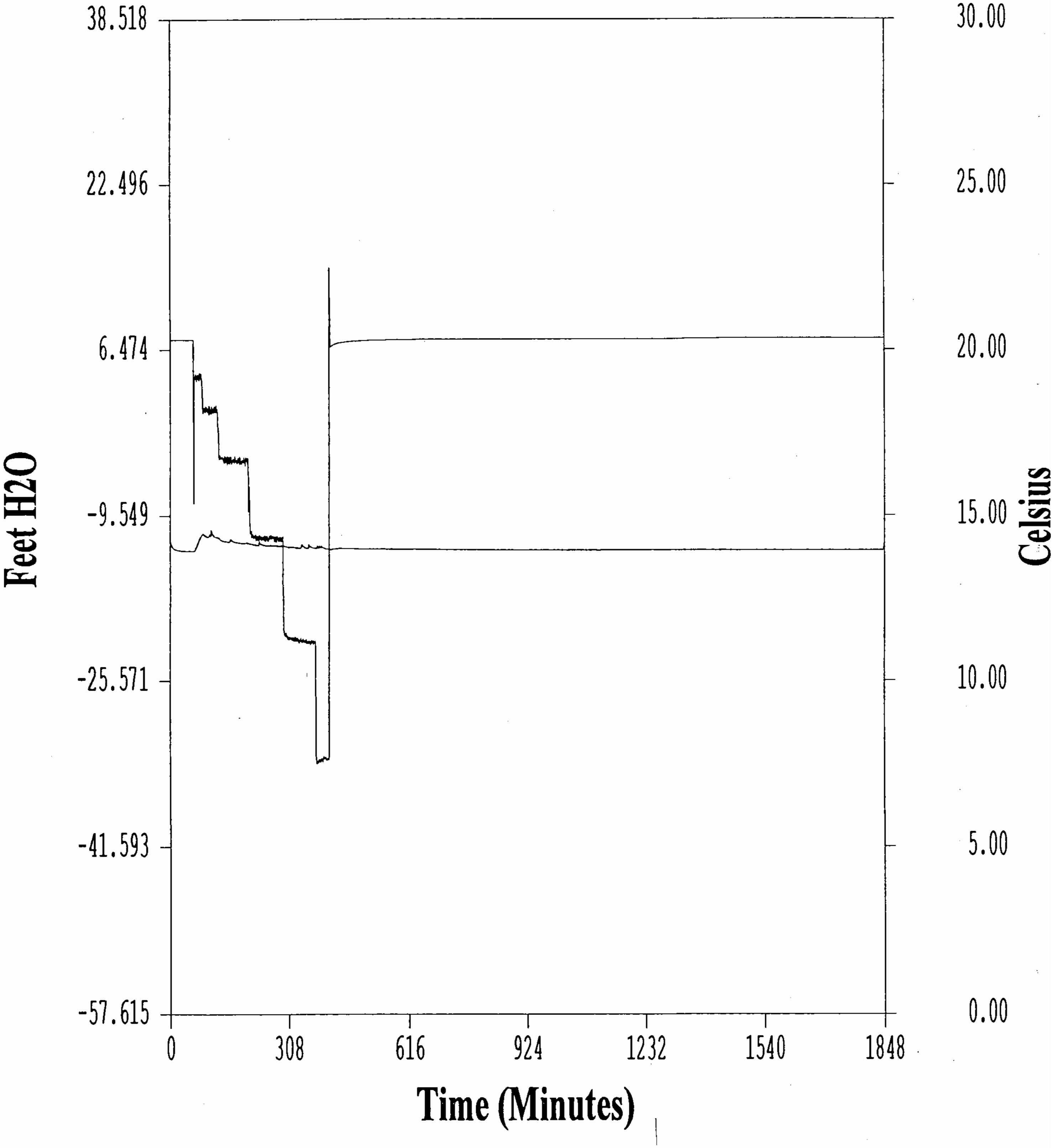

Figure 4.3-1

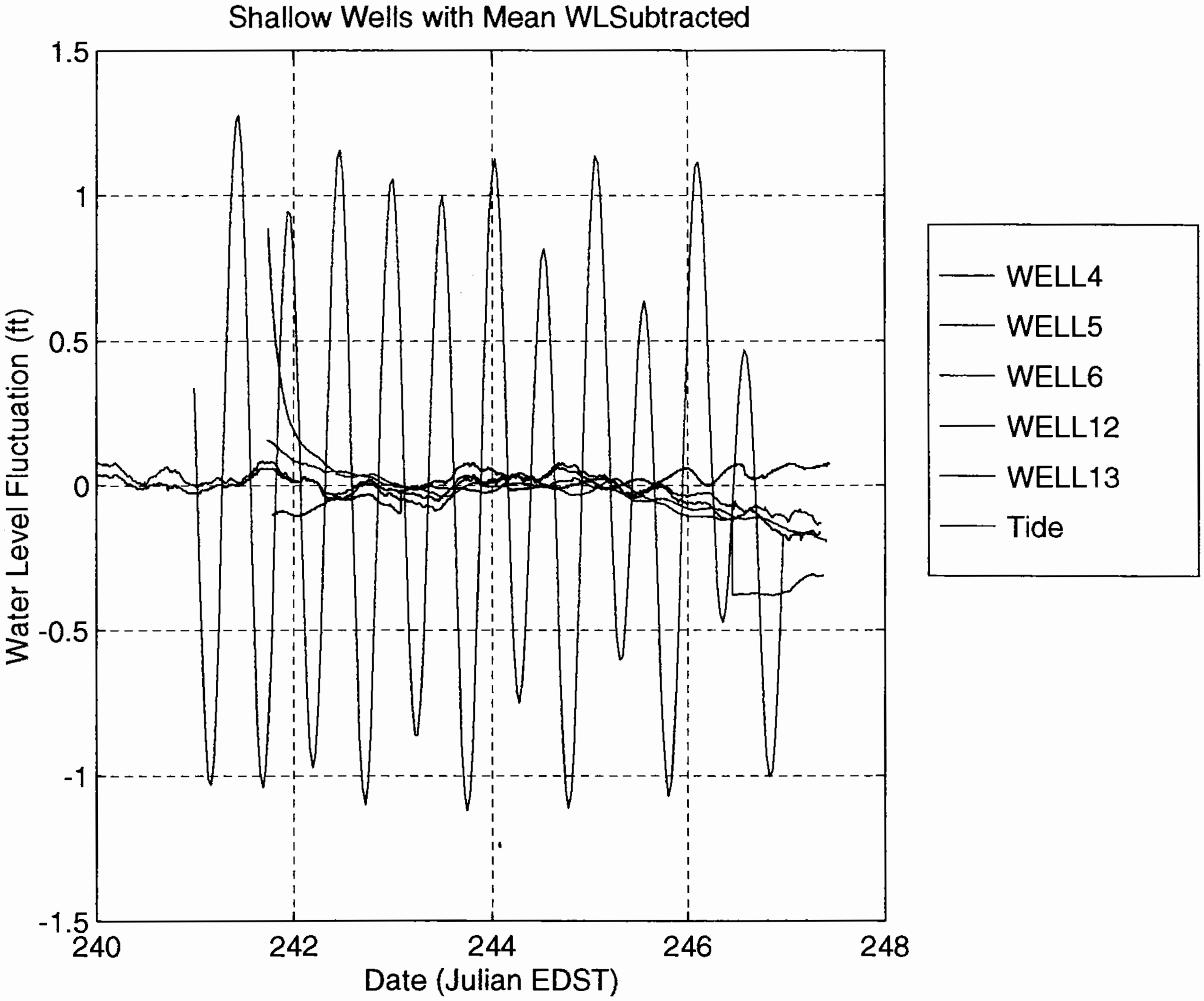
Shallow Wells with Mean WLSubtracted
1.5
1
0.5
0
-0.5
-1
-1.5
Water Level Fluctuation (ft)
240
242
244
246
248
Date (Julian EDST)
WELL4
WELL5
WELL6
WELL12
WELL13
Tide

Figure 4.3-2

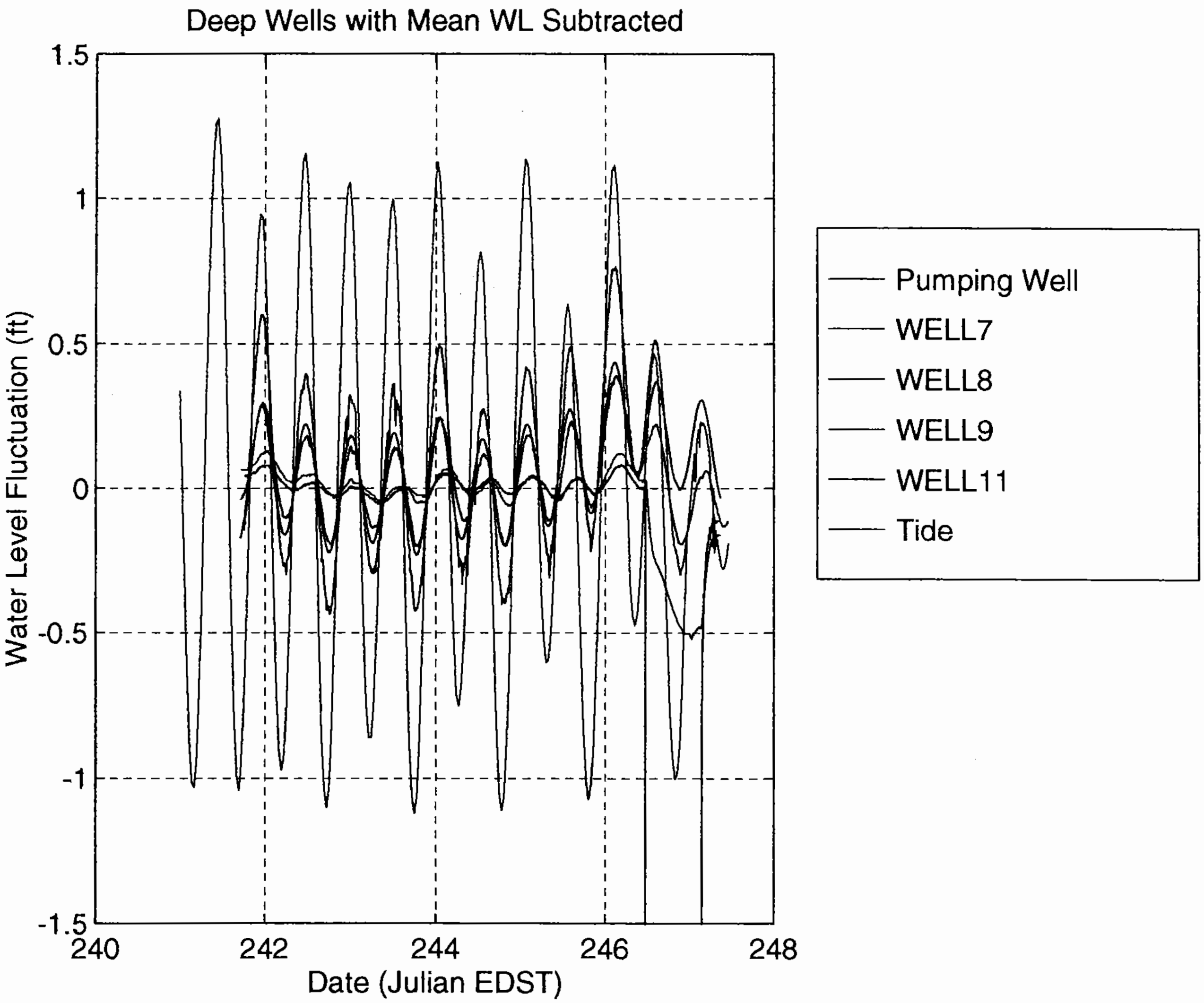
Deep Wells with Mean WL Subtracted
Water Level Fluctuation (ft)
1.5
1
0.5
0
-0.5
-1
-1.5
240
242
244
246
248
Date (Julian EDST)
Pumping Well
WELL7
WELL8
WELL9
WELL11
Tide

Figure 4.3-3

Table 4.3-2 Tidal Influence

			Duration (Julian EDST)				Water Level (ft NAVD)					Distance (ft)				Tidal Characteristics wrt Betterton		
Well #	Well Type		Begin	End	Duration		Mean	Std Dev	Min	Max		From Shore	From Pump	Azimuth (TN)		Range (ft)	Range (% Bett)	Lag (hrs)
1p	Pumping		241.77	247.34	5.58		2.75	12.67	-32.73	7.49		2351	N/A	N/A		N/A	N/A	N/A
4	Shallow		238.56	247.35	8.79		9.14	0.06	8.95	9.24		2338	82	239		N/A	N/A	N/A
5	Shallow		241.79	247.44	5.66		8.61	0.05	8.50	8.68		5494	3588	127		N/A	N/A	N/A
6	Piez		238.56	247.35	8.79		20.00	0.07	19.85	20.17		2381	165	234		N/A	N/A	N/A
7	Deep		241.71	247.47	5.76		4.96	0.28	4.45	5.65		447	2088	312		0.74	56	1.22
8	Deep		241.72	247.46	5.74		5.48	0.14	5.24	5.84		1209	1963	281		0.33	25	1.51
9	Deep		241.73	247.37	5.64		7.15	0.15	6.67	7.32		1468	1111	8		0.08	6	2.87
11	Deep		241.73	247.37	5.64		1.14	0.16	0.84	1.51		758	3232	37		0.41	31	1.15
12	Shallow		241.74	247.41	5.66		9.17	0.12	8.98	10.06		4301	2026	142		N/A	N/A	N/A

4.4 Site Survey

After installation of the wells, Corps surveyors determined northing and easting coordinates and top of casing elevations for all the wells. Horizontal control was referenced to Maryland State Plane Coordinates, North American Datum (NAD) 83. Elevations were referenced to the North American Vertical Datum of 1988. Table 4.4-1 displays the survey results. When plotting and analyzing the water level contours, the elevations and coordinates shown below were used.

Table 4.4-1
Well Coordinates and Elevations

Well	Northing	Easting	Top of casing elev.
CSW-1	642557	1598009	38.02
CSW-2	644581	1599473	42.37
CSW-3	641963	1599503	34.4
CSW-4	642540	1597955	39.13
CSW-5	640418	1600880	47.30
CSW-6	642536	1597949	39.27
CSW-7	643973	1596467	8.12
CSW-8	642953	1596085	25.28
CSW-9	643674	1598164	30.9
CSW-10	642664	1597712	32.53
CSW-11	645357	1599793	24.46
CSW-12	641002	1599284	39.02
CSW-13	643662	1602744	18.32
CSW-14	640997	1599271	38.48
CSW-15	643560	1600433	47.00

5.0 Summary and Conclusions

The overall geology and hydrogeology of this site indicate the existence of local micro-aquifers existing above the Raritan Clay. The aquifers are surrounded on the north, northwest and northeast sides by surface water. The elevation of the Raritan clay increases to the noutheast, east and southeast thereby defining a half bowl shaped basin. The general effect of this basin shape is limit the volume of land based recharge moving into the basin. The total amount of land based recharge of water passing under the site is approximately only 160 acres.

The Elk River/Chesapeake Bay recharge seems to be the predominant source when pumping occurs close to the shoreline. Wells CSW-7 and CSW-8 showed no effects from either the CSW-1 pump test or local home well pumping, due to the instant recharge from a large source of water. This large source of water was most likely the adjacent Elk River/Chesapeake Bay water and not the small upgradient land based source.

Wells such as well CSW-5 which was the furthest well from the shoreline showed obvious effects from pumping at some nearby well (unrelated to pump test activities). This well appears to have received recharge water which did not overwhelm nearby pumping effects (as opposed to CSW-7 and CSW-8). Therefore, this upgradient well was probably recharged from the smaller land based recharge system.

The pump test showed that micro-aquifers existing above the Raritan clay had low vertical hydraulic conductivity as noted by the data from wells CSW-4 and CSW-6. These wells, located very close to the pumping well (CSW-1) and screened at much higher elevations than CSW-1, showed little or no drawdown. The occurrence of several perched water ponds within the disposal area are further evidence of the low vertical hydraulic conductivity noted during the pump test.

The wells were screened at an elevation similar to the wells of concern in West View Shores, which is well below the disposal area. Values of transmissivity and storativity calculated for the slug tests exhibited a high degree of variability which is attributed to variations in stratigraphy and aquifer thickness noted in the borings.

The perceived threat of future disposal site activities to the local groundwater regime relies primarily on the downward movement of water through the dredged material and into the drinking water aquifer. The cross sections suggest that the most likely area to have groundwater degradation due to vertical groundwater migration would be the western portion of the site. Additionally, the logical location of a pump test would be upgradient of the home wells at West View Shores. This has been accomplished during this investigation and the low vertical hydraulic conductivity observed during the phase II pump test suggests that the continued use of the Pearce Creek Dredged Material Disposal Area does not pose a threat to the local water supply. The poor quality of local groundwater can't be denied, however; it is apparent that the Pearce Creek Dredged Material Disposal site activities are not the source of the problem.

6.0 References

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Appendix A

Boring Logs

Hole No.CSW-1

DRILLING LOG

DIVISION NORTH ATLANTIC DIVISION

INSTALLATION PHILADELPHIA DISTRICT

SHEET 1 OF 7

1. PROJECT Pearce Creek
2. LOCATION *(Coordinates or Station)* 1598009 E, 642557 N
3. DRILLING AGENCY UNI-TECH DRILLING CO., INC.
4. HOLE NO. *(As shown on drawing title and file number)* CSW-1
5. NAME OF DRILLER Joseph Jester
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE 139.5 Ft.
10. SIZE AND TYPE OF BIT 4-3/4" side discharge drag bit
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)* NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 68 undisturbed: 1 att. 0 accepted
14. TOTAL NUMBER OF CORE BOXES 0
15. ELEVATION GROUND WATER
16. DATE HOLE STARTED 12/07/95 COMPLETED 12/12/95
17. ELEVATION TOP OF HOLE 35.27 Ft.
18. TOTAL CORE RECOVERY FOR BORING
19. SIGNATURE OF INSPECTOR S.M. Cook

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
35.3 33.5	.0 1.8		SILT; dark brown; medium dense; with some wood; trace mica; dry; turning black; solfter and moist; with less vegetation in tip 2"	14"	SPT 1	Boring located in western part of disposal area, on flat silty area 2-4 ft. above surrounding ground. Unless otherwise noted SPT samples were taken according to ASTM 1586. Chemical sample CSW-1-1'-1' @ 14:10, from top of sample.	8 10 11 11
33.0 32.8 32.3	2.3 2.5 3.0		Silty CLAY; black; low plasticity; firm; moist; then 6" Silty SAND; dark gray; loose; fine grained; poorly graded; w/ trace mica; then 6" Silty CLAY as top	18"	SPT 2	Areas with wood are orangish. Chemical sample CSW-1-2.5'-3' taken @ 14:28 (middle 6" Silty SAND)	8 4 3 3
			CLAY; black; soft; low plasticity; organic; with trace wood; trace mica; trace sand in one <1/2" lens Top 5" as above; then	24"	SPT 3	Chemical sample CSW-1-4'-6' taken @ 14:35 (1 jar) Turned chocolate brown after exposed to air in sample jar for several days.	WOH WOH WOH 5
29.0	6.3		SAND; dark brown; dense; medium grained; poorly graded; with trace silt; trace mica	12"	SPT 4	Chemical sample CSW-1-6.5'-7' taken @ 14:45	10 14 17 17
27.0	8.3		Top 7" SAND; as base of SPT4 with coarser grains; wet Base 6" clay; black; as SPT3	13"	SPT 5	trace red and yellow and black colors in thin lenses	8 2 3 2
24.1 23.3	11.2 12.0		As base of SPT 5, grading drier with some vegetation with increasing sand; then base 7" Silty SAND; dark brown-black; loose	22"	SPT 6		2 3 3 4
22.1	13.2		Top 14" Silty CLAY; light brown with black spots; with some vegetation ; then grading through black Silty SAND to SAND; tan; medium dense, medium grained, poorly graded.	24"	SPT 7	Chemical sample CSW-1-13'-14' taken @ 15:06	5 6 6 7
19.3	16.0		SAND; as base of SPT 7; with more gray and black areas with some silt. Trace gray and red clay and wood in tip	8"	SPT 8		4 5 7 7
			Sandy SILT; dark brown; loose; fine grained sand; wet	7"	SPT 9	Chemical sample CSW-1-16'-18' taken @ 15:13	4 3 3 2
						(continued)	

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PROJECT Pearce Creek

HOLE NUMBER CSW-1

Hole No.CSW-1

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 35.27 Ft.	*SHEET 2 OF 7*
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
17.3	18.0						
16.3	19.0	▥		0"	U-1	Undisturbed tube driven @ 15:15 @ 200 psi. Recovered 0" @ 15:30. No recovery	
		░	SAND; black; medium dense; moderately well graded; medium grained; organic smell; with one large piece of wood; trace fine gravel; with some silt.	9"	SPT 10		4 7 8 8
11.3	24.0	░	SAND; as SPT 10 above with trace soft brown clay in one 2" lens.	14"	SPT 11		7 8 10 10
9.3	26.0	▨	CLAY; yellow-brown; firm; very moist-wet; plastic; with some silt; trace sand	19"	SPT 12	Chemical sample CSW-1-24'-26' taken @ 15:57	2 3 3 5
		▥	Sandy SILT; yellow-brown; medium dense; dry; with trace gravel; trace mica	10"	SPT 13	Harder and drier than SPT 12 Soil pH in water = 5.7 @10 min.	10 12 12 14
5.1	30.2	▥	As SPT 13	2"	SPT 14	Driller says gad a difficult time getting spoon down, may be trying to push a piece of gravel. End of day 12/7/95	7 11 15 18
3.3	32.0	░	Top 4" as SPT 13; then SAND; light pinkish gray with some orange areas; very dense; v. fine grained; poorly graded; wet; with some silt in lenses.	12"	SPT 15		7 21 32 37
		▥	Silty SAND; pintk and yellow; dense; fine grained; poorly graded; with trace clay.	14"	SPT 16	Chemical sample CSW-1-32'-34' taken	10 15 17 23
-.7	36.0	▥	Top 9" Silty SAND; gray-pink; dense; very fine grained; poorly graded; with trace clay; then Silty SAND; yellow and orange; very dense; moderately well graded; with trace clay in laminations	14"	SPT 17	Silty SAND has dark red-orange spots.	14 15 20 27
		░	SAND; white; very dense; medium grained; angular; quartz; clean.	9"	SPT 18		55 100/ 5"
		░	SAND; as SPT 18	3"	SPT 19	Gravel and Clay in 6" slough	100/ 3"
						(continued)	

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PROJECT	HOLE NUMBER
Pearce Creek	CSW-1

Hole No.CSW-1

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 35.27 Ft.	SHEET 3 OF 7
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-4.7	40.0						
			SAND; as SPT 18; poorly graded in lenses; with some coarse grained sand.	12"	SPT 20		55 100/ 6"
			SAND; white; very dense; coarse grained; poorly graded; clean; quartz with trace feldspar; angular.	5"	SPT 21		67 100/ 6"
			SAND; pinkish and yellow; very dense; coarse grained; well graded; angular; with some silt	9"	SPT 22	Switched to downhole hammer to improve recovery and driving distance. Hole reamed w/6" open-discharge bit. Blows listed below are not directly comparable to standard N values.	12 20 27
-10.7	46.0						
			Gravelly SAND; white; very dense; well graded; gravel is fine sized; with 4" lens of fine Silty SAND; gray and yellow.	8"	SPT 23		7 52 50/ 2"
			As SPT 23 with yellow and black silt/clay lens.	2"	SPT 24	2" gravel slough. Circulating longer and harder as ream to 50'.	100/ 4"
			As SPT 23	<1"	SPT 25	4" gravel in top slough	100/ 5"
			Gravelly SAND; white, very dense; medium grained; well graded; clean; gravel is fine sized, rounded	5"	SPT 26		100/ 5"
			As SPT 26 with 2" yellowish lens	7"	SPT 27		47 100/ 6"
-20.7	56.0						
			SAND; tan; very dense; medium grained; poorly graded.	<1"	SPT 28		100/ 4"
-22.7	58.0						
			Gravelly SAND; tan; very dense; medium grained; poorly graded.	1"	SPT 29		100/ 2"
			Gravelly SAND; pinkish; as SPT 26	1"	SPT 30		60 100/ 4"
-26.7	62.0					(continued)	

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PROJECT	HOLE NUMBER
Pearce Creek	CSW-1

Hole No.CSW-1

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 35.27 Ft.

SHEET 4 OF 7

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-26.7	62.0						
			SAND; pinkish light brown; very dense; medium grained; poorly graded; with trace silt (light brown and white)	3"	SPT 31		100/ 5"
			SAND; light brown; as SPT 31	6"	SPT 32	Soil pH in water = 6.25 @ 10 min.	100/ 6"
			SAND; light brown; very dense; medium grained; very poorly graded; clean	4"	SPT 33		57 50/ 2"
			SAND; as SPT 31	3"	SPT 34		100/ 4"
			SAND; white; very dense; medium grained; poorly graded; with some white silt.	8"	SPT 35		20 29 39
			SAND; as SPT 33; clean	4"	SPT 36		40 50/ 2"
			SAND; light brown with yellow and dark red lens near base very dense; medium grained; poorly graded; with some silt.	9"	SPT 37	Dark red-black lens is cemented, <1/2" thick	27 54 50/ 1"
-40.7	76.0						
			Sandy SILT; white with orange spots and pink, very dense; poorly graded; sand is very fine-fine; dilatant; with trace clay.	14"	SPT 38	Orange spots are harder w/larger grains.	7 12 40
-42.7	78.0						
			SAND; light brown; pink and white; very dense; very fine to fine grained; low dilatancy; with some silt; trace gray-white silty clay.	12"	SPT 39	One yellow-brown area near base. Chemical sample CSW-1-78'-79.5' taken @ 14:52	27 55 43
			No recovery	0"	SPT 40	End of day 12/8/95 Slough	38 50/ 1"
			SAND; white, very clean; very fine-fine grained; poorly graded with trace white silt.	8"	SPT 41	Magothy	27 35 53
						(continued)	

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PROJECT Pearce Creek

HOLE NUMBER CSW-1

Hole No.CSW-1

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 35.27 Ft.	SHEET 5 OF 7
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-48.7	84.0		SAND; same as SPT 41	8"	SPT 42		15 23 31
	86		No recovery	0"	SPT 43	1/2" slough	21 38 50
	88		SAND; same as SPT 41	10"	SPT 44		15 23 30
	90		SAND; same as SPT 41	1"	SPT 45	2" slough	19 28 60
	92		SAND; same as SPT 41	8"	SPT 46		21 60 50/1"
	94		SAND; same as SPT 41	9"	SPT 47		19 43 60
	96		SAND; same as SPT 41	12"	SPT 48		15 21 29
	98		SAND; same as SPT 41	7"	SPT 49		15 25 39
	100		SAND; same as SPT 41	1/2"	SPT 50		59 50/1"
	102		SAND; light gray; very dense; medium grained; poorly graded; clean	4"	SPT 51		45 50/2"
	104		SAND; same as SPT 51	2"	SPT 52		37 50/2"
	106					*(continued)*	

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PROJECT Pearce Creek

HOLE NUMBER CSW-1

Hole No.CSW-1

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 35.27 Ft.	*SHEET 6 OF 7*
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-70.7	106.0						
			SAND; light gray; very dense; medium grained; well graded; trace gravel	4"	SPT 53		45 50/ 2"
			SAND; same as SPT 51	2"	SPT 54	End of day 12/11/95	39 50/ 1"
			SAND; white; very dense; coarse grained; well graded; trace gravel; some white silt.	2"	SPT 55	2" slough	27 32 55
			SAND; pinkish white; very dense; medium grained; poorly graded; trace silt.	6"	SPT 56	Similar to SPT 41	39 50/ 1"
			SAND; same as SPT 56	5"	SPT 57		100/ 5"
			SAND; same as SPT 56	2"	SPT 58		100/ 6"
			SAND; same as SPT 56	1/2"	SPT 59	1/2" slough	100/ 4"
			No recovery	0"	SPT 60		100/ 3"
			No soil recovery, 1/2" size sand stone gravel pinkish brown.	1/2"	SPT 61		100/ 5"
			No recovery	0"	SPT 62		100/ 2"
			No recovery	0"	SPT 63		82 100/ 5"
						(continued)	

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PROJECT Pearce Creek	HOLE NUMBER CSW-1

Hole No.CSW-1

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 35.27 Ft.

SHEET 7 OF 7

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-92.7	128.0						
		░	SAND; 9" gray; 1" olive gray; very dense; coarse grained; well graded.	10"	SPT 64	Sample 13:00 No sample	27 39 50
		░	SAND; olive yellow; very dense; coarse grained; well graded.	8"	SPT 65		43 100/ 5"
		░	No sample			Hit hardpan and drilled through, no sample.	
-97.7	133.0						
		▨				— RARiTan	
	134 135	▨	CLAY; with some brown and light gray with occasional black spots; hard, moist to dry; plastic.	12"	SPT 67		24 40 62
	136 137	▨	CLAY; variegated red and gray; hard; dry; plastic.	4"	SPT 68		39 50/ 2"
	138 139	▨	CLAY; red gray mix; hard; dry; plastic;	9"	SPT 69	Chemical sample CSW-1-138'-139.5' taken @ 14:30	15 27 39
-104.2	139.5						
			Classifications listed above are based on BVWS standard classification procedures and ASTM D 2488-90 Visual Manual Classification; not on Laboratory Analyses.			End of Boring at 139.5' Placed well screen (119'-129') on 12/13/95.	

128 130 132 134 136 138 140 142 144 146 148 150

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PROJECT Pearce Creek

HOLE NUMBER CSW-1

Hole No.CSW-2

DRILLING LOG	DIVISION NORTH ATLANTIC DIVISION	INSTALLATION PHILADELPHIA DISTRICT SHEET 1 OF 10

1. PROJECT
Pearce Creek

2. LOCATION *(Coordinates or Station)*
1599473.82 E, 644581.83 N

3. DRILLING AGENCY
UNI-TECH DRILLING CO., INC.

4. HOLE NO. *(As shown on drawing title and file number)* CSW-2

5. NAME OF DRILLER
Joseph Jester

6. DIRECTION OF HOLE
☒ VERTICAL ☐ INCLINED

7. THICKNESS OF OVERBURDEN

8. DEPTH DRILLED INTO ROCK

9. TOTAL DEPTH OF HOLE 209.2 Ft.

10. SIZE AND TYPE OF BIT 4-3/4" side discharge trivane

11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*
NAVD 88

12. MANUFACTURER'S DESIGNATION OF DRILL
Failing 1500

13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN
disturbed: undisturbed: att. accepted

14. TOTAL NUMBER OF CORE BOXES 0

15. ELEVATION GROUND WATER

16. DATE HOLE STARTED COMPLETED
10/30/95 11/07/95

17. ELEVATION TOP OF HOLE 39.89 Ft.

18. TOTAL CORE RECOVERY FOR BORING

19. SIGNATURE OF INSPECTOR
S.M. Cook

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
39.9	.0						
		▥	Silty SAND; brown; loose; moist.	2"	SPT 1	Unless otherwise noted, SPT samples taken according to ASTM 1586 Using bentonite mud, "QuickGel" by Baroid. Recovery too low; no environmental sample.	2 3 2 3
		▥	Silty SAND; brown; loose; medium-grained; moist	14"	SPT 2	Chemical sample CSW-2-2'-3' taken @ 10:46	5 5 4 4
35.9	4.0						
		░	SAND; gray-black; very loose; medium-grained; moist; with some silt; some organics.	13"	SPT 3	Chemical sample CSW-2-6'-7' taken @ 10:50	1 1 2 4
34.9	5.0						
		▥	SILT; gray-black; very loose; with some fine to coarse sand; moist. SILT; brown; loose; with some sand; some wood; trace mica.	10"	SPT 4		2 3 2 3
		▥	As SPT 4, above	17"	SPT 5		2 3 2 1
		▥	As SPT 4, above	13"	SPT 6	Chemical sample CSW-2-10'-12' taken @ 10:59	2 3 2 1
		▥	As SPT 4 above, with silty sand lens; lens is black; moist; with medium sand; 3" at base.	24"	SPT 7		2 2 2 2
		▥	SILT; brown; loose; moist with some wood; trace sand; clay.	24"	SPT 8	Chemical sample CSW-2-14'-16' taken @ 11:07 ~10% fine to medium sand by settling jar volume.	2 3 3 3
		▥	As SPT 8, above.	24"	U-1	Drove Undisturbed tube @ 11:11 @ 1150 psi Retrieved tube @ 11:27	
						(continued)	

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MAR 71

PROJECT	HOLE NUMBER
Pearce Creek	CSW-2

Hole No.CSW-2

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 39.89 Ft.

SHEET 2 OF 10

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
21.9	18.0						
		▥	As SPT 8, slightly drier Base has more organic black silty clay	24"	SPT 9	Chemical sample CSW-2-18'-20' taken @ 11:39	3 3 4 4
		▥	As SPT 8 above, with middle 0.8' SILT; black and brown laminations; very loose; very moist.	24"	SPT 10		0 0 1 2
17.9	22.0						
		▨	Organic Silty CLAY; dark brown; firm; medium plasticity; trace mica	24"	SPT 11		3 4 4 5
		▨	As SPT 11, moist. Silty CLAY; gray with black mottles; drier near base; one red-brown mottle at 25.2; low plasticity.	24"	SPT 12		2 2 2 2
		▨	Clayey SILT; loose; gray and yellow-brown; with some very fine sand; with trace fine to medium sand; one 4" silty sand lens.	20"	SPT 13		2 2 2 2
		▨		16"	SPT 14	Chemical sample CSW-2-28'-30' taken @ 12:05	3 4 4 7
		▨	As SPT 14, above.	12"	SPT 15		0 0 1 2
7.9	32.0						
		░	SAND; tan; dense; poorly graded; medium grained; quartz; rounded; wet; with trace wood.	14"	SPT 16		16 12 23 14
		░	SAND; brown-tan; medium dense; poorly graded; fine grained; with some medium sand; trace silt in lenses.	9"	SPT 17	Chemical sample CSW-2-34'-36' taken @ 13:31	6 7 7 7
		░	Top 4" Sand, as above,then				
3.5	36.3						
		▥	SILT; dark brown; medium dense; with trace fine sand; trace mica	16"	SPT 18		5 7 7 4
		▥	Organic SILT; black; with some wood	24"	SPT 19	Sampled base	3 4 4 4
.7	39.2						
		▨	Base 10" clayey SILT; brown and red.				

(continued)

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT Pearce Creek

HOLE NUMBER CSW-2

Hole No.CSW-2

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 39.89 Ft.	SHEET 3 OF 10
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-.1 -1.1 -2.1	40.0 41.0 42.0	▨ ▥	Top as SPT 19 above; colored black; brown; red with yellow mottles. Base 12" Brown SILT and tan SAND lenses.	24"	SPT 20		4 6 5 5
-2.7 -3.1	42.6 43.0	▨ ▥ ░	Top 7" Silty CLAY as top of SPT 20 then 3" SAND; gray medium grained then 2" SILT; then 5" SAND; tan; fine-grained; wet; with organic black laminations.	17"	SPT 21		7 8 12 14
-5.6 -6.1	45.5 46.0	░ ▥	SAND; tan; medium dense; poorly graded; very fine grained; in laminations. Base 6" Gray-brown SILT and SAND laminations; with silt; wood and roots in bottom 2".	17"	SPT 22		9 9 11 15
		░	SAND; gray-brown; dense; well graded; fine to coarse grained; quartz; wet; with brown woody silt lenses.	18"	SPT 23		13 16 18 23
		░		1"	SPT 24	No sample - insufficient recovery 1.5" piece of shattered quartz gravel stuck in tip of spoon Lost ~10 gal. mud, mixed thicker	6 12 12 14
		░	SAND; gray-brown; medium dense; well graded; fine to coarse grained; mostly medium, with some fine gravel.	10"	SPT 25		11 11 14 16
		░	SAND; gray; medium dense; medium to coarse grained; with some fine gravel.	11"	SPT 26		7 12 14 21
		░	SAND; gray; dense; well graded; medium to coarse grained; with some fine rounded quartz gravel.	13"	SPT 27		16 22 17 18
-18.1	58.0	░	SAND; gray; medium dense; well-graded; medium to coarse grained.	12"	SPT 28		16 12 9 8
-20.1	60.0	▥	Silty SAND; dark brown; medium dense; fine grained; wet; with trace wood.	24"	SPT 29		5 7 7 12
		░	SAND; brown; medium dense; poorly graded into 2"-4" lense; fine to medium grained; with some coarse sand; with trace gravel; trace silt.	11"	SPT 30		7 9 14 20
						(continued)	

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT	HOLE NUMBER
Pearce Creek	CSW-2

Hole No.CSW-2

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 39.89 Ft.	*SHEET 4* *OF 10*
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-22.1	62.0						
			SAND; medium brown; very dense; poorly graded; fine grained; grains are quartz; med-high sphericity; with trace silt.	16"	SPT 31		25 29 42 57
-24.8	64.7		As above, yellow; grading more silty Base 10" clayey SILT; gray; medium dense; moist; with trace fine sand; grading to CLAY; medium plasticity.	17"	SPT 32		16 9 9 10
-27.0 *-27.9* *-28.1*	66.9 67.8 68.0		Top CLAY; light gray; as above, then 12" SAND; yellow-brown; very dense; with some silt; then 2" Gray CLAY in base.	21"	SPT 33		7 11 57 24
-30.1	70.0		3"-4" lenses of alternating Silty SAND; yellow-brown and gray; with some gravel; rounded; up to 1.25" and CLAY; gray; as above.	17"	SPT 34		25 33 40 44
-32.1	72.0		Silty SAND; brown and gray; very dense; sand is brownish; fine to medium grained; poorly graded; silty areas are light gray.	5"	SPT 35		100/5"
			Organic Silty CLAY; dark gray; very stiff; medium plasticity; with trace fine sand; trace mica; trace wood often in whitish spots. Top 4" has trace gravel.	24"	SPT 36		12 13 14 15
			Silty CLAY; as above; very stiff	24"	SPT 37	Slightly easier to cut w/knife than above	7 9 11 13
-38.1	78.0		Silty CLAY; as above; with trace fine to coarse sand in top 7".	24"	SPT 38		13 12 12 15
			Organic CLAY; gray; medium plasticity; trace wood.	24"	U-2	Drove Undisturbed tube @ 10:02 @ 100 psi Retrieved @ 10:19	
			Organic CLAY; gray; stiff; medium plasticity; trace wood.	24"	SPT 39		7 8 7 9
			Organic CLAY; gray; as SPT 39	24"	SPT 40		6 7 9 8
						(continued)	

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PROJECT	HOLE NUMBER
Pearce Creek	CSW-2

Hole No.CSW-2

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 39.89 Ft.	*SHEET 5 OF 10*
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.	
-44.1 *-44.3*	84.0 84.2							84
-46.2	86.1		Top 4" as above; grading brownish; then PEAT; brown changing to black; medium dense; dry	24"	SPT 41	Chemical sample CSW-2-84'-86' taken @ 11:20 Turns darker with exposure to air; Silt goes from brown to black in seconds.	9 16 13 28	86
			Top 2" PEAT; as above, then Organic Silty CLAY; gray with black spots; very stiff; medium; plasticity; mosit; with trace mica sparkles.	24"	SPT 42	Cuts easily w/knife - cream cheese texture	10 11 12 13	88
			As SPT 42 above	24"	SPT 43	Top has 1/2" nodule of geenish white rounded medium sand-sized particles.	19 20 22 30	90
			Organic Silty CLAY; gray-brown; very stiff; as above.	24"	SPT 44		11 10 15 10	92
-52.8	92.7		Organic Silty CLAY; as above; then Base 4" Silty SAND; gray; medium dense; poorly graded; medium dense; poorly graded; medium grained; wet.	24"	SPT 45	Brown changes to gray w/exposure to air. Sampled base	70 68 118 110	94
-54.8 *-55.1* *-55.3* *-56.1*	94.7 95.0 95.2 96.0		Top 8" Silty SAND; as above, then Organic Silty CLAY; gray-brown; some wood; with 2" silty SAND lens 95-95.2.	24"	SPT 46	Sampled top	12 13 18 18	96
			Organic CLAY; gray-brown; hard; dry; with some wood; trace mica sparkles (less than SPT 42).	24"	SPT 47		19 20 19 23	98
			Organic CLAY; very stiff; as above.	24"	SPT 48		11 12 14 14	100
			Organic CLAY; hard; as above.	24"	SPT 49		13 17 18 18	102
			Organic CLAY; very stiff; as above.	24"	SPT 50	Chemical sample CSW-2-102'-104' taken	7 9 9 11	104
			Organic CLAY; very stiff; as above.	24"	SPT 51		6 8 11 11	106
						(continued)		

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

Hole No.CSW-2

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 39.89 Ft.

SHEET 6 OF 10

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-66.1	106.0	▨	As above; stiff; with trace fine sand, trace gravel; with 2" Silty SAND lens Top 6" as above then grades to	24"	SPT 52		8 8 8 7
-68.6	108.5	░	Silty SAND; brown; fine; then SAND; white-light gray; very dense; poorly graded; fine to medium grained; rounded; wet; quartz.	8.5"	SPT 53		26 50/2.5"
		░	4" SAND; white; as above; with black roots; then SAND; gray-brown; very dense; some silt; fine grained; grading to SAND; gray; fine to medium; with trace silt; trace fine quartz rounded gravel.	15"	SPT 54		22 37 100/6"
		░	SAND; gray; very dense; fine grained; with trace silt; trace gray clay in 1" lens	5"	SPT 55		100/6"
		░	SAND; gray and brown; very dense; very fine to medium grained; with some silt.	4"	SPT 56	Piece of gravel in slough	90 50/2"
		░	SAND; brown and gray; very dense; poorly graded; fine to medium grained; with some silt; some gravel.	17"	SPT 57	Chemical sample CSW-2-116'-118' taken	55 36 27 21
		░	SAND; brown, black, and gray; very dense; well graded; with some silt.	3"	SPT 58		60/3"
-80.1	120.0	⁘	Gravelly SAND; gray with orange-brown areas; very dense; well graded; with trace silt.	6"	SPT 59	Rounded piece of gravel (quartz) stuck in tip of spoon	76 33 19 34
-82.1	122.0	░	SAND; light greenish brown; very dense; poorly graded; medium grained; with trace dark brown-black silty (lens); trace gravel in yellowish lens at tip.	17"	SPT 60	~5% silt by settling jar test.	80 72 54 30
-84.1	124.0	⁘	Sandy GRAVEL; gray, brown-black, and yellow; very dense; rounded; spherical; with trace black silt; sand matrix is mostly medium-grained	11"	SPT 61	Maximum particle axis is 1.25"	19 26 78 100/5"
-86.1	126.0	░	SAND; gray with orange spots; very dense; poorly graded; fine to medium grained; with some gravel; trace silt.	4"	SPT 62	Sounds like bit is on gravel as reaming to 126' Circulating strongly for ~5 min. to remove gravel	52 100/5"
						(continued)	

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PROJECT Pearce Creek

HOLE NUMBER CSW-2

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 39.89 Ft.
	SHEET 7 OF 10
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-88.1	128.0	░	SAND; pink-white; very dense; poorly graded; very fine to fine grained; with some silt.	8"	SPT 63	2" brownish pink silty sand lens	36 78 50/3"
-90.1	130.0	○	GRAVEL; very dense; matrix is pink silt and sand; some silt; trace sand.	2"	SPT 64	changed to 6" rollerbit when reaming to 132'	100/3"
		○	No recovery.	0"	SPT 65	A few pieces of rounded gravel in spoon	200/3"
-93.1	133.0	▨	Clayey SILT; white with some red; very dense; low plasticity; slightly moist; with some fine sand.	15"	SPT 66	Extra recovery from dropping spoon into base of hole; Driven when set.	58 100/6"
-96.1	136.0	▥	Interbedded SILT and SAND; white to pink; very dense; sand is very fine grained; very poorly graded; silt has some clay; dilatant; low plasticity.	14"	SPT 67	Driven when set	94 50/2"
		▥	As SPT 67 above Clayey SILT is light gray lenses are ~4" thick	12"	SPT 68	Driven when set	66 50/2"
-100.1	140.0	▨	Silty CLAY; gray; hard; medium plasticity; moist; with <2" lenses of Sandy SILT.	20"	SPT 69	Driven when set	49 56 100/6"
-102.1	142.0	░	SAND; white-gray; very dense; fine grained; poorly graded; wet; with trace silt.	4"	SPT 70	Driven when set	130/3"
-104.1	144.0	▨	Interbedded SAND; white with orange-stained spot; very dense; fine- grained; with some silt; and CLAY; gray; hard; medium plasticity.	4"	SPT 71	Driven when set	150/3"
-106.1	146.0	░	SAND; white, gray, and black; very dense; fine grained; poorly graded; wet with some silt.	4"	SPT 72	Rounded quartz gravel stuck in tip	100/5"
		░	SAND; tan; very dense; very poorly graded; medium grained; quartz; with trace silt (<5%).	3"	SPT 73		100/3"
-110.1	150.0					(continued)	

Hole No.CSW-2

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 39.89 Ft.	SHEET 8 OF 10
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-110.1	150.0						
		▨	Interbedded SAND; white; fine to medium grained; poorly graded; and Silty CLAY; light gray; medium plasticity.	6"	SPT 74	Driven when set	100/4"
-112.1	152.0						
		░	SAND; tan; very dense; very poorly graded; medium grained; clean.	3"	SPT 75		100/3"
		░	SAND; as SPT 75 above.	1"	SPT 76	Driven when set; material in top Spoon bounced but didn't move at all	50/0"
		░	SAND; tan and yellow; very dense; medium grained; with trace silt.	2"	SPT 77	Changed to downhole hammer; reamed to 156'w/open-end 6" trivane bit. Blows from SPT 77 on not valid for comparison with standard N values. Silt <5% by settling jar	20 110/6"
		░	SAND; tan-yellow; very dense; medium grained; very poorly graded; rounded.	1"	SPT 78	Lots of slough in spoon Sand in wash	25 27 85/3"
		░	SAND; tan-yellow; as above (SPT 77)	5"	SPT 79	No movement over last 40 blows	61 100/5"
		░	SAND; as above; with a tan silty spot	4"	SPT 80		140/5"
		░	SAND; as SPT 77 and 78 above	3"	SPT 81		100/5"
-126.4	166.3						
		▩	Top 2" SAND; as above then 1/2" bright red silty sand; then 12" CLAY; gray; hard; medium plasticity; dry.	14"	SPT 82	Spoon bulging open; will only drive 18" on rest Significantly below plastic limit	50 60 80 70
-128.1	168.0						
		▨	Silty CLAY; gray w/red areas; hard;low plasticity; dry; w/trace fine sand.	18"	SPT 83		39 34 41
-130.1	170.0						
		▩	CLAY; gray with some red spots; hard; medium plasticity; dry-slightly moist.	24"	SPT 84	Driven when set	26 49 32
-132.1	172.0						
						(continued)	

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PROJECT	HOLE NUMBER
Pearce Creek	CSW-2

Hole No.CSW-2

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 39.89 Ft.	*SHEET 9 OF 10*
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-132.1	172.0						
		▥	SILT; light gray; very dense; unable to roll thread; slight dilitancy; dry-slightly moist; with trace clay; some very fine sand.	24"	SPT 85	Driven when set ~15% sand in settling jar	24 43 34
		▥	SILT; light gray; very dense; not plastic; with trace sand; slightly moist.	17"	SPT 86		23 30 54
		▥	SILT; light gray; very dense; non-plastic; some very fine to coarse sand; slightly moist to dry; with trace mica.	16"	SPT 87	Chemical sample CSW-2-176'-177.5' taken @ 10:15	33 20 31
		▥	SILT; as SPT 87 above with a few brown spots.	17"	SPT 88		18 29 34
-140.1	180.0						
		▨	Silty CLAY; gray and brown laminations; hard; medium plasticity; dry; with trace mica.	15"	SPT 89		16 22 35
		▨	Silty CLAY; as SPT 89 above.	20"	SPT 90	Driven when set	17 32 31
		▨	Silty CLAY; gray with some brown and occasional black organic spots; medium plasticity; dry.	19"	SPT 91	top of sample is siltier	31 31 33
-146.1	186.0						
		▩	CLAY; dark gray to brown; hard; medium plasticity; trace wood; slightly moist-dry.	15"	SPT 92		14 25 32
		▩	CLAY; as SPT 92 above; with a light gray silty lens.	12"	SPT 93		14 20 47
		▩	CLAY; dark gray-brown; as SPT 92 above.	15"	SPT 94		12 25 26
		▩	CLAY; dark gray, as above, then CLAY; red and light gray; hard; medium plasticity; slightly moist-dry.	18"	SPT 95		12 18 22
						(continued)	

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT	HOLE NUMBER
Pearce Creek	CSW-2

Hole No.CSW-2

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE	39.89 Ft.
SHEET 10 OF 10	
PROJECT	Pearce Creek
INSTALLATION	PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-154.1	194.0						
		▨	CLAY; red, brown, and gray; hard; with coarse sand-sized nodules throughout; dry-slightly moist.	11"	SPT 96	Sand-sized material is rounded. Parts of sample are cemented together.	14 23 32
		▨	CLAY; red and gray; hard; medium plasticity; dry-slightly moist.	12"	SPT 97	No nodules as in previous sample.	13 25 30
		▨	CLAY; as SPT 97 above.	11"	SPT 98		12 24 33
		▨	CLAY; as SPT 97 above.	13"	SPT 99		14 24 30
		▨	CLAY; as SPT 97 above.	12"	SPT 100		14 25 21
		▨	CLAY; as SPT 97 above; very hard; dry; trace sand.	11"	SPT 101		17 42 50/1"
		▨	CLAY; as SPT 101 above.	12"	SPT 102		62 50/2"
		▨	CLAY; as SPT 101 above.	13"	SPT 103		54 63 50/2"
-169.3	209.2						
			Classifications listed above are based on BVWS standard classification procedures and ASTM D 2488-90 Visual Manual Classification; not on Laboratory Analyses.			Grouted up to ~130 depth w/ tremie pipe (~108 gallons) on 11/07/95. Placed well screen (~117.5'-127.5') on 11/09/95.	

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
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PROJECT Pearce Creek	HOLE NUMBER CSW-2

DRILLING LOG DIVISION NORTH ATLANTIC DIVISION

INSTALLATION PHILADELPHIA DISTRICT

SHEET 1 OF 8

1. PROJECT Pearce Creek
2. LOCATION *(Coordinates or Station)* 1598503 E, 641963 N
3. DRILLING AGENCY UNI-TECH DRILLING CO., INC.
4. HOLE NO. *(As shown on drawing title and file number)* CSW-3
5. NAME OF DRILLER Joseph Jester
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE 165.5 Ft.
10. SIZE AND TYPE OF BIT 4-3/4" side discharge trivane
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)* NVAD 88
12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 83 undisturbed: 0 attempted1
14. TOTAL NUMBER OF CORE BOXES 0
15. ELEVATION GROUND WATER
16. DATE HOLE STARTED 11/09/95 COMPLETED 11/20/95
17. ELEVATION TOP OF HOLE 31.07 Ft.
18. TOTAL CORE RECOVERY FOR BORING
19. SIGNATURE OF INSPECTOR S.M. Cook

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
31.1	.0						
		▥	SILT; brown; loose; moist; with trace sand; trace vegetation trace mica	7"	SPT 1	Unless otherwise noted, SPT samples taken according to ASTM 1586 Using bentonite mud, "QuickGel" by Baroid. Chemical sample CSW-3-0'-2' taken @ 9:40	2 2 2 4
		▥	SILT; brown; loose; moist with trace sand; trace very fine mica	15"	SPT 2	Chemical sample CSW-3-2'-4' taken @ Soil pH in water= 7.5	1 2 3 4
		▥	SILT; as SPT 2, above.	21"	SPT 3	Chemical sample CSW-3-4'-6' taken @ Soil pH in water= 6	3 4 5 6
		▥	SILT; as SPT 1, above	15"	SPT 4		2 2 3 5
21.1	10.0	▥	SILT; brown; loose moist; with some wood; trace sand; trace mica.	24"	SPT 5		2 2 2 2
19.1	12.0	▨	CLAY; black; soft; low plasticity; trace silt; trace organics	17"	SPT 6	Chemical sample CSW-3-10'-12' taken @ Soil pH in water= 6.33	2 2 2 3
17.1	14.0	▨	Silty CLAY; dark gray, brown mix; soft; some organics.	21"	SPT 7		1 1 1 1
15.1	16.0	▥	Sandy SILT; dark brown to yellow; loose; trace gravel; moist.	13"	SPT 8		2 1 3 3
13.1	18.0	░	SAND; brown; dense; poorly graded; find grained; with trace silt.	15"	SPT 9		16 18 24 32
						(continued)	

Hole No.CSW-3

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 31.07 Ft.	SHEET 6 OF 8
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-74.9	106.0						
		░	SANE; gray with white mix; very dense; medium grained; well graded; quartz; subangular; wet.	11"	SPT 54		22 57 50/2"
		░	SAND; same as SPT 54.	8"	SPT 55		45 50 50/1"
		░	SAND; same as SPT 54.	2"	SPT 56		75 50/1"
		░	SAND; light olive brown; dense; well graded; coarse grained; wet; trace gravel; trace silt.	9"	SPT 57		45 51 50/2"
-82.9	114.0						
		▥	Silty SAND; light gray; dense; poorly graded; fine grained; wet; trace gravel.	9"	SPT 58		25 34 51
-84.9	116.0						
		░	SAND; light gray; dense; poorly graded; fine grained; wet; with trace silt; Two 1-1/2 inch CLAY; gray, brown mix; plastic; moist; very stiff; between sand.	12"	SPT 59	first Clay lenses observed; red and brown	27 45 62
		░	SAND; light gray; very dense; poorly graded; fine grained; wet; with trace silt.	9"	SPT 60		35 70 54/1"
		░	SAND; light gray; bottom 2 inches bright red; dense; poorly graded; fine grained; dry to moist; with trace silt.	11"	SPT 61		19 31 45
-90.9	122.0						
		▨	5 inch CLAY; light gray and red; very stiff; plastic; moist; then 3 inch SAND at bottom; gray; dense; poorly graded; fine grained; moist.	8"	SPT 62		22 39 27
		▨	CLAY; gray, hard; low plasticity; dry; sand lens in between (1-1/2 inch) gray; dense	12"	SPT 63		12 21 25
-94.4	125.5						
		░	SAND; gray; dense; fine grained; poorly graded; moist; 2 inch clay on top; gray; hard; plastic; moist.	11"	SPT 64		11 17 22
-96.9	128.0					(continued)	

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PROJECT	HOLE NUMBER
Pearce Creek	CSW-3

Hole No.CSW-3

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 31.07 Ft.	SHEET 7 OF 8
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-96.9	128.0						
		▥	Silty SAND; light tan-gray; medium dense; fine grained; clay lenses; gray; hard; plastic; dry.	12"	SPT 65		14 19 30
-98.9	130.0						
		░	SAND; tan; medium dense; fine grained; 2 inches silt at bottome; dark gray; hard; dry.	13"	SPT 66		7 16 23
-100.3	131.4						
		░	SAND; dark gray; medium dense; fine grained; poorly graded; trace silt.	9"	SPT 67		14 20 29
		░	SAND; same as SPT 67.	11"	SPT 68		17 39 53
-104.9	136.0						
		▥	Silty SAND top 6 inches; dark gray; dense; poorly graded; fine grained; moist; silty clay bottom 7 inches; dark gray; hard; plastic; dry.	13"	SPT 69		39 50/1"
-106.9	138.0						
		░	SAND; dark gray; dense; fine grained; poorly graded;	11"	SPT 70		17 35 49
-107.7	138.7	▨	Silty CLAY; bottom 2 inches; dark gray; hard; plastic; dry.				
		▨	CLAY; dark purplish gray; dense; hard; dry.	11"	SPT 71	pH = 5.64	8 14 22
		▨	Same as SPT 71.	13"	SPT 72		10 21 29
		▨	Same CLAY; a little more brownish.	12"	SPT 73		12 21 30
		▨	Same CLAY as 140 feet to 142 feet.	15"	SPT 74		12 24 29
		▨	Same CLAY with trace white gray color.	15"	SPT 75		9 14 23
						(continued)	

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PROJECT	HOLE NUMBER
Pearce Creek	CSW-3

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 31.07 Ft.

SHEET 8 OF 8

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-118.9	150.0						
		▨	Same CLAY as SPT 71; with trace organics; (wood chips); dary gray- brown color; trace white gray silty clay.	16"	SPT 76	pH = 5.57	14 41 36
		▨	Same CLAY as SPT 71; dark gray-brown; plasticity; no dilitancy.	12"	SPT 77		14 27 32
		▨	CLAY; brown; hard; dry; with bottom 3 inches vary gray.	12"	SPT 78		17 23 35
		▨	CLAY; same as SPT 77; dark gray-brown.	11"	SPT 79		16 29 38
		▨	CLAY; dark gray-brown; hard; dry; with trace organics.	15.5"	SPT 80		12 23 36
		▨	CLAY; dark gray; hard; dry.	10"	SPT 81		14 20 29
		▨	CLAY; dark gray; dense; hard; dry.	16"	SPT 82		12 20 35
		▨	Same CLAY as SPT 82.	15"	SPT 83	No geotech jar sample	8 17 25
-134.4	165.5						
			Classifications listed above are based on BVWS standard classification procedures and ASTM D 2488-90 Visual Manual Classification; not on Laboratory Analyses.			End of Boring at 165.5' on 11/20/95. Grouted up to ~125 depth w/ tremie pipe (~45 gallons) on 11/20/95. Placed well screen (109'-119') on 11/21/95.	

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PROJECT Pearce Creek

HOLE NUMBER CSW-3

Hole No.CSW-4

DRILLING LOG	DIVISION NORTH ATLANTIC DIVISION	INSTALLATION PHILADELPHIA DISTRICT *SHEET 1 OF 3*

1. PROJECT
Pearce Creek
2. LOCATION *(Coordinates or Station)*
1597955.23 E, 642539.68 N
3. DRILLING AGENCY
UNI-TECH DRILLING CO., INC.
4. HOLE NO. *(As shown on drawing title and file number)* CSW-4
5. NAME OF DRILLER
Joseph Jester
6. DIRECTION OF HOLE
☒ VERTICAL ☐ INCLINED
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE 60 Ft.
10. SIZE AND TYPE OF BIT 4-3/4 inch side discharge drag bit
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*
NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL
Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN
disturbed: undisturbed: 1 att. 0 accepted
14. TOTAL NUMBER OF CORE BOXES 0
15. ELEVATION GROUND WATER
16. DATE HOLE STARTED 1/3/96 COMPLETED 1/4/96
17. ELEVATION TOP OF HOLE 36.25 Ft.
18. TOTAL CORE RECOVERY FOR BORING
19. SIGNATURE OF INSPECTOR
Lusheng Yan

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
36.2	.0						
			See log of CSW-1 (located ~100 feet away) for continuous samples and better defined lithology/stratigraphy.			Mud rotary drilling with Bentonite mud. SPT samples according to ASTM 1586: 2-inch spoon; SPT sampler driven w/140 lb. hammer; 30" drop.	
				0"	U-X	Tube driven; no recovery	
						(continued)	

0 2 4 6 8 10 12 14 16 18

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PROJECT	HOLE NUMBER
Pearce Creek	CSW-4

Hole No.CSW-4

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 36.25 Ft.

SHEET 2 OF 3

PROJECT: Pearce Creek

INSTALLATION: PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
18.2	18.0						
		▥	Silty SAND; dark gray; loose; wet. Lower 6" CLAY; black; organic; w/trace sand, trace gravel, trace white shells.	20"	SPT 1		10 12 12 16
16.2	20.0						
		░	SAND; dark gray; dense; medium to coarse grained; w/trace gravel	8"	SPT 2		13 16 17 20
11.2	25.0						
		▥					
-.7	37.0						
		░					
						(continued)	

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PROJECT: Pearce Creek

HOLE NUMBER: CSW-4

Hole No.CSW-4

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE
36.25 Ft.

SHEET 3
OF 3

PROJECT
Pearce Creek

INSTALLATION
PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-3.7	40.0						
		░	SAND; white; dense; medium grained	5"	SPT 3	some gravel slough on top	100/5"
		░		0"	SPT 4	No recovery for split spoon sample	100/4"
		░	SAND; white; coarse grained; w/some gravel	1"	SPT 5		100/1"
-22.1	58.4	▨	Top 5" SAND; light gray; dense; poorly graded; coarse grained; w/some gravel Lower 6" Silty CLAY; white; hard; moist	11"	SPT 6		42 31 41 50
-23.7	60.0		Classifications listed above are based on BVWS standard classification procedures and ASTM D 2488-90 Visual Manual Classification; not on Laboratory Analyses.			end of boring at 60' on 1/3/96. Placed well screen 49'-59' on 1/4/96.	

Hole No.CSW-5

DRILLING LOG

DIVISION NORTH ATLANTIC DIVISION

INSTALLATION PHILADELPHIA DISTRICT

SHEET 1 OF 8

1. PROJECT Pearce Creek
2. LOCATION (Coordinates or Station) 1600880.22 E, 640417.95 N
3. DRILLING AGENCY UNI-TECH DRILLING CO., INC.
4. HOLE NO. (As shown on drawing title and file number) CSW-5
5. NAME OF DRILLER Joseph Jester
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE 153.5 Ft.
10. SIZE AND TYPE OF BIT 4-3/4" side-discharge trivane
11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: undisturbed: att. accepted
14. TOTAL NUMBER OF CORE BOXES 0
15. ELEVATION GROUND WATER
16. DATE HOLE STARTED 11/27/95 COMPLETED 11/30/95
17. ELEVATION TOP OF HOLE 47.30 Ft.
18. TOTAL CORE RECOVERY FOR BORING
19. SIGNATURE OF INSPECTOR S.M. Cook

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
47.3	.0						
			Silty SAND; brown; loose; trace gravel; trace clay	15"	SPT 1	Unless otherwise noted, SPT samples taken according to ASTM 1586 Using bentonite mud, "QuickGel" by Baroid. Chemical sample CSW-5-0'-2' taken @ 10:04	5 6 8 8
			Sandy SILT; brown; loose; fine grained; moist; trace organics; trace gravel.	16"	SPT 2	Chemical sample CSW-5-2'-4' taken @ 10:10	3 3 5 3
			Sandy SILT; brown-gray; medium dense; sand is very fine grained; with trace organics.	20"	SPT 3	Chemical sample CSW-5-4'-6' taken @ 10:15	7 8 10 12
41.3	6.0						
			SILT; gray with yellow-orange spots; medium dense; gravel mix on top 12 inches with some sand; trace organics; trace mica.	23"	SPT 4		8 9 12 14
			SILT; gray; hard; moist; trace organics; 8 inches fine sand at bottom; gray; medium dense.	18"	SPT 5	Chemical sample CSW-5-8'-10' taken @ 10:30 pH = 7.6	8 12 12 15
37.3	10.0						
			SAND; gray and brown mix; medium dense; poorly graded; medium dense; with some silt.	15"	SPT 6		11 15 19 21
			SAND; gray; medium dense; fine grained; poorly graded; moist; with trace silt.	14"	SPT 7	Chemical sample CSW-5-12'-14' taken @ 10:45	7 11 11 14
			SAND; same as SPT 14	12"	SPT 8		11 14 19 25
			SAND; yellowish-brown; medium dense; well graded; with some silt;	15"	SPT 9		7 7 8 10
29.9	17.4		8 inch black sandy silt at bottom; trace gravel; trace mica.			(continued)	

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PROJECT Pearce Creek

HOLE NUMBER CSW-5

Hole No.CSW-5

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 47.30 Ft.	*SHEET 2 OF 8*
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
29.3	18.0	▥	Sandy SILT; dark gray to black; medium dense; moist; trace gravel.	13"	SPT 10	Chemical sample CSW-5-18'-20' taken @ 11:00 pH = 6.65 pH @ 15 min.= 6.25	7 7 9 10
		▥	Silty SAND; dark gray-black; loose; very poorly graded; very fine grained; with trace mica.	12"	SPT 11	pH = 6.3	8 8 10 10
		▥	Silty SAND; same as SPT 11.	22"	SPT 12	pH = 5.6	7 7 8 7
		▥	Sandy SILT; dark gray-balck; medium dense; soft; moist.	18"	SPT 13		8 10 10 12
		▥	Sandy SILT; same as SPT 13.	18"	SPT 14	pH = 6.0	9 9 10 10
19.3	28.0	▥	SILT; dark gray-black; medium dense; moist; trace gravel; some very fine sand.	14"	SPT 15	10 inches slough	7 7 9 7
		▥	SILT; black, gray, and brown traces; soft; moist; some very fine sand; trace clay; trace mica.	13"	SPT 16	pH = 5.8 pH @ 10 min.= 5.8	7 7 6 7
		▥	SILT; same as SPT 16.	14"	SPT 17	pH = 5.8	5 5 6 5
		▥	SILT; black; hard; moist to dry; some clay.	16"	SPT 18	pH = 6.0	6 6 6 6
11.3	36.0	▨	Silty CLAY; black; stiff; moist; non-plastic; trace mica.	24"	SPT 19		7 7 8 9
		▨	Silty CLAY; same as SPT 19.	24"	SPT 20		8 12 14 17
						(continued)	

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PROJECT Pearce Creek	HOLE NUMBER CSW-5

Hole No.CSW-5

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 47.30 Ft.	SHEET 3 OF 8
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
7.3	40.0	▨	Silty CLAY; same as SPT 19.	24"	SPT 21		7 8 12 14
5.3	42.0	▨	CLAY; black; stiff; plastic; moist.	4"	SPT 22	pH = 6.1	8 10 10 10
		▨	CLAY; black; stiff; plastic; moist; lenses of gravel; trace sand.	24"	SPT 23		7 11 11 10
1.3	46.0	▨	Silty CLAY; black; stiff; non plastic; moist.	20"	SPT 24		5 7 8 10
		▨	No recovery.	0"	SPT 25	No recovery	5 6 6 7
		▨	Silty CLAY; same as SPT 20; trace organics on top 6 inches; trace gravel.	24"	SPT 26	Chemical sample CSW-5-50'-52' taken @ 13:45	7 11 15 19
		▨	Silty CLAY; black; hard; medium plastic; moist; trace sand; trace gravel.		SPT 27	pH = 6.4	6 9 12 18
		▨	3 inches Silty CLAY at top; same as SPT 27; 2 inches organic peat; black.	5"	SPT 28	Chemical sample CSW-5-54'-56' taken @ 14:15 on 11/27/95 Sampled peat	100/5"
-8.9	56.2	░	Silty CLAY; greenish-gray, top 2 inches; SAND; gray; dense; medium grained; quartz; poorly graded; bottom 8 inches.	10"	SPT 29	greenish clay sampled	32 45 58 100/2"
-10.2	57.5	▨	Silty CLAY; black; hard; plastic; moist.	1"	SPT 30	Changed to downhole hammer; reamed to 58'w/open-end 6" trivane bit. Blows below are not valid for comparison with standard N values. Only driving sampler <1.5 feet so it doesn't get stuck	75 50/1"
-11.7	59.0	░	SAND; white; dense; fine grained; poorly graded.	3"	SPT 31		100/5"
						(continued)	

Hole No.CSW-5

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 47.30 Ft.

SHEET 4 OF 8

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-14.7	62.0						
			SAND; gray and black; dense; fine grained; poorly graded; with trace clay in lens.	10"	SPT 32	pH = 6.15	36 100/6"
			SAND; gray-white, very dense; medium grained; poorly graded.	5"	SPT 33		48 50/2"
			No recovery.	0"	SPT 34	No recovery	50/2"
			SAND; gray to dark gray; very dense; poorly graded; fine to medium grained; with trace organics; trace silt.		SPT 35		39 68 32
-22.5	69.7						
-23.4	70.7		Top 8 inches CLAY; dark gray; hard; medium plasticity; moist; with trace mica. Base 5 inches CLAY; as above; thinly bedded with SAND; gray; medium grained; with some wood; trace gravel.	13"	SPT 36		6 12 13
-24.7	72.0						
			SAND; gray; very dense; fine to medium grained; poorly graded; rounded; clean.	7"	SPT 37		61 50/2"
			SAND; light gray; very dense; fine grained; poorly graded; with trace wood; clean.	11"	SPT 38		46 53 67
-28.7	76.0						
			Clayey SAND; dark gray; very fine to fine grained; poorly graded; with some silt; trace wood; thinly bedded with laminations of CLAY; gray as SPT 36 Top.	15"	SPT 39		9 12 18
-31.0	78.2						
			Top 3 inches as above; then Silty SAND; orange-brown; medium grained; poorly graded; rounded quartz.	6.5"	SPT 40	Contact is cemented. Drilling harder as go to 80' Jarred sample of base	45 50/2"
-32.7	80.0						
			SAND; tan with orange and black areas; very dense; coarse grained; poorly graded; quartz; some feldspar; with some medium-fine sand; with trace fine gravel; trace wood; trace silt.	10"	SPT 41	pH = 6.3	33 55 69
-34.7	82.0						
			Gravelly SAND; orange-light brown; very dense; well graded; with trace silt; trace wood.	11"	SPT 42	~3/4" Silt lens in tip Bentonite drilling mud invading coarser areas of sample	37 58 72
-36.7	84.0						
						(continued)	

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PROJECT Pearce Creek

HOLE NUMBER CSW-5

Hole No.CSW-5

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 47.30 Ft.

SHEET 5 OF 8

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-36.7	84.0						
		░	SAND; tan and orange; dense; subrounded to subangular; poorly graded in lenses; fine to coarse grained; with trace silt and light brown silt lens.	9"	SPT 43	Silt lens ~1/2" thick Bentonite drilling mud invading coarser areas of sample, removed from sample. Chemical sample CSW-5-84'-85.5' taken @ 10:40 on 11/28/95.	21 25 40
-38.7	86.0						
		⁘	Gravelly SAND; light brown-orange alternating in layers; very dense; well graded; medium grained; gravel is <3/8" size; quartz; rounded.	8"	SPT 44		67 100/5"
		⁘	Gravelly SAND; as above; with some white and light gray bands; with trace pyrite in top.	11"	SPT 45	One pyrite concretion in slough. Broke it open and included in sample. Fine gravel sized.	30 68 34
-42.7	90.0						
		░	SAND; orange, gray, and white in bands; very dense; medium grained; poorly graded; with some coarse grained sand in lenses; with trace silt; trace gravel.	10"	SPT 46		9 12 24
-44.5	91.7						
		▨	CLAY; cream-colored with orange spots in top 10 inches; turning light gray without spots below; stiff; slightly moist; low plasticity.	13"	SPT 47		7 13 23
-46.5	93.7						
		▨	Silty CLAY; light gray-white; very stiff; very slightly moist; low plasticity.	15"	SPT 48		9 20 27
		▨	Clayey SILT; light gray-white; hard; very slightly moist; with some very fine sand.	15"	SPT 49		15 23 29
		▨	Silty CLAY; variegated gray with brown areas; very hard; low plasticity; very slightly moist.	12"	SPT 50	One blue-black area	11 21 32
-52.4	99.7						
		▨	CLAY; medium brown with a few red or yellow spots; hard; plastic; dry; with trace medium sand-sized particles in one blob (~1/4 inch diameter)	18"	SPT 51		9 23 30
		▨	CLAY; red and gray with some yellowish-green; hard; dry.	15"	SPT 52		17 33 42
		▨	CLAY; red, gray and pink; with some yellow spots; hard; dry.	15"	SPT 53		7 17 23
						(continued)	

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PROJECT Pearce Creek

HOLE NUMBER CSW-5

Hole No.CSW-5

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 47.30 Ft.

SHEET 6 OF 8

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.	
-58.7	106.0							10
-60.4	107.7	▩	CLAY; gray with some red areas; as above.	14"	SPT 54		12 27 30	
		▨	Silty CLAY: light gray with red, yellow and purple spots; hard; dry; with trace very fine sand in laminations.	18"	SPT 55		11 22 25	108
		▨	Silty CLAY; light gray, brown and red with some yellow areas; as SPT 55 above.	18"	SPT 56		9 16 24	110
		▨	Silty CLAY; light gray, yellow-brown, and redish; as SPT 55 above; without sand.	14"	SPT 57		12 26 34	112
		▨	Silty CLAY; light gray and brown; as above SPT 57.	15"	SPT 58		17 29 42	114
-70.4	117.7	▨	As SPT 58; with a few black spots in brown clay.	15"	SPT 59		15 35 42	116
		▩	CLAY; brown with a few gray, black and yellowish spots; hard; dry; low plasticity; with trace sparkles (mica?).	10"	SPT 60		19 26 38	118
		▩	CLAY; dark red-brownish gray with a few black organic spots; hard; dry; low plasticity; with trace sparkles (mica?).	17"	SPT 61		9 26 31	12
		▩	As SPT 61	11"	SPT 62	pH = 6.2	12 27 35	122
		▩	As SPT 61	15"	SPT 63	Brown-black spots of decompised wood also have white sand-sized hard grains. Driller said began to chatter as drilling to 126'.	10 25 40	12
-80.4	127.7	▩	As SPT 61; with trace sand to fine gravel-sized pieces of gray hardpan.	5"	SPT 64	Lots of difficulty drilling to 128', bit chattering ~ 126.3'-127.3'.	100/5"	12
						(continued)		128

Hole No.CSW-5

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 47.30 Ft.

SHEET 7 OF 8

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-80.7	128.0	▨	Silty CLAY; dark purplish brown-gray with trace whitish hardpan up to trace gravel size.	15"	SPT 65	Large piece of hardpan near top of spoon. pH = 6.1 end of day 11/28/95	15 31 39
		▨	No sample.			No sample - hardpan 129.5'-131.5'	
		▨	Silty CLAY; dark purplish gray-brown; hard; dry; with occasional hard spots of tan and more occasional spots of blue-black; with trace sparkles (mica?).	14"	SPT 66		15 23 35
		▨	As SPT 66.	8"	SPT 67		27 100/5"
		▨	Silty CLAY; dark chocolate brown with hard tan and gray spots; as SPT 66.	13"	SPT 68		19 30 43
		▨	As SPT 66 above.	17"	SPT 69		14 22 30
		▨	Silty CLAY; dark and light gray-brown laminations; hard; with trace fine sand-sized material in light gray laminations.	4"	SPT 70	More hardpan as drilling to 142'.	100/5"
		▨	As SPT 70, increasing gray laminations.	18"	SPT 71		19 23 25
		▨	As SPT 71.	17"	SPT 72		11 21 23
		▨	As SPT 71.	10"	SPT 73	More hardpan as drilling to 148'.	15 19 25
		▨				Hardpan to ~149' depth. No sample.	
						(continued)	

ENG FORM 1838 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT Pearce Creek

HOLE NUMBER CSW-5

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 47.30 Ft.

SHEET 8 OF 8

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-102.7	150.0						
		▨	As SPT 71.	18"	SPT 74		11 20 25
		▨	As SPT 70, fewer gray laminations.	14"	SPT 75	Chemical sample CSW-5-152'-153.5' taken @ 14:40	12 24 28
-106.2	153.5		Classifications listed above are based on BVWS standard classification procedures and ASTM D 2488-90 Visual Manual Classification; not on Laboratory Analyses.			end of boring @ 153.5 Grouted up to ~92 depth w/ tremie pipe (~75 gallons) on 11/29/95. Placed well screen (80.3'-90.3') on 11/30/95.	

DRILLING LOG

DIVISION NORTH ATLANTIC DIVISION

INSTALLATION PHILADELPHIA DISTRICT

SHEET 1 OF 2

1. PROJECT Pearce Creek
2. LOCATION *(Coordinates or Station)* 1597948.77 E, 642535.94 N
3. DRILLING AGENCY UNI-TECH DRILLING CO., INC.
4. HOLE NO. *(As shown on drawing title and file number)* CSW-6
5. NAME OF DRILLER Joseph Jester
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE 22 Ft.
10. SIZE AND TYPE OF BIT 6 inch side discharge drag bit
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)* NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 2 undisturbed: 0 attempted
14. TOTAL NUMBER OF CORE BOXES 0
15. ELEVATION GROUND WATER
16. DATE HOLE STARTED 01/04/96 COMPLETED 01/04/96
17. ELEVATION TOP OF HOLE 36.23 Ft.
18. TOTAL CORE RECOVERY FOR BORING
19. SIGNATURE OF INSPECTOR Lusheng Yan

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
36.2	.0						
						No sample in first 18 feet Refer to logs of CSW-1 and CSW-4 for lithology/stratigraphy.	
						Unless otherwise noted, samples taken according to ASTM 1586. Using bentonite mud "QuickGel" by Baroid to drill.	
18.2	18.0						
						(continued)	

0
2
4
6
8
10
12
14
16
18

Hole No.CSW-6

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 38.23 Ft.

SHEET 2 OF 2

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
18.2	18.0						
17.7	18.5	░	Top 6": SAND; white; wet; w/some gravel Middle 12": CLAY; black; soft; wet; w/white shells Bottom 3": SAND; black; coarse grained; w/some gravel	21"	SPT 1		4 5 12 14
16.7	19.5	▨ ░	SAND; black; loose; coarse grained; wet; w/some gravel	10"	SPT 2		7 9 15 15
14.2	22.0		Classifications listed above are based on B&V standard classification procedures and ASTM D 2488-90 Visual Manual Classification; not on Laboratory Analyses.			End of boring at 22'. Installed 2" diameter piezometer on 1/4/96. One foot screened interval placed at 21'-22' depth.	

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT Pearce Creek

HOLE NUMBER CSW-6

DRILLING LOG

DIVISION
NORTH ATLANTIC DIVISION

INSTALLATION
PHILADELPHIA DISTRICT

SHEET 1
OF 6

1. PROJECT
Pearce Creek

2. LOCATION (Coordinates or Station)
1596466.66 E, 643972.77 N

3. DRILLING AGENCY
UNI-TECH DRILLING CO., INC.

4. HOLE NO. (As shown on drawing title and file number) CSW-7

5. NAME OF DRILLER
Joseph Jester

6. DIRECTION OF HOLE
☒ VERTICAL ☐ INCLINED

7. THICKNESS OF OVERBURDEN

8. DEPTH DRILLED INTO ROCK

9. TOTAL DEPTH OF HOLE 106.6 Ft.

10. SIZE AND TYPE OF BIT 4-3/4" side-discharge trivane

11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
NAVD 88

12. MANUFACTURER'S DESIGNATION OF DRILL
Failing 1500

13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN
disturbed: 51 undisturbed: 3 att. 2 accepted

14. TOTAL NUMBER OF CORE BOXES 0

15. ELEVATION GROUND WATER

16. DATE HOLE STARTED 12/14/95 COMPLETED 12/15/95

17. ELEVATION TOP OF HOLE 8.12 Ft.

18. TOTAL CORE RECOVERY FOR BORING

19. SIGNATURE OF INSPECTOR
S.M. Cook

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/6in.
8.1	.0						
		░	SAND; brown-orange; medium grained; poorly graded; with trace roots; trace silt; trace gray clay in one ball; moist-wet; medium dense.	16"	SPT 1	Unless otherwise noted, SPT samples taken according to ASTM 1586 Using bentonite mud, "QuickGel" by Baroid. Chemical sample CSW-7-1'-2' taken @	5 8 10 10
4.1	4.0	░	SAND; brown; medium grained; poorly graded; wet; trace silt; medium dense.	9"	SPT 2	Chemical sample CSW-7-2'-3' taken @ 11:17	7 11 11 12
		▥	SILT; brown; soft; wet; with trace sand.	6"	SPT 3	Chemical sample CSW-7-4'-5' taken @ 11:21 Mud on outside of spoon is red (dredge fill clay)	3 2 2 2
1.1	7.0	▥ ░	SILT; as above; then At 7 foot grades into SAND; brown; medium dense; medium to fine grained; well graded; wet; with some rounded gravel.	22"	SPT 4		2 7 8 8
		░	No recovery.	0"	SPT 5	Not enough for chemical sample. Quartz gravel stuck in tip.	4 5 7 8
		░	SAND; as above SPT 5 base; trace mica.	12"	SPT 6	Chemical sample CSW-7-10'-11' taken @ 11:38 2 large gravel pieces in tip.	6 7 9 11
		░	SAND; brown; medium dense; medium grained; moderately well graded; subangular; with some coarse sand; trace gravel; quartz; wet.	13"	SPT 7		8 8 10 12
-7.9	16.0	░	SAND; same as SPT 7	11"	SPT 8	Chemical sample CSW-7-14'-15' taken @ 11:48	9 12 15 19
		▒	Sandy GRAVEL; brown; well graded; with trace ; trace silt.	5"	SPT 9	Larger gravel pieces in slough.	11 15 17 19
						(continued)	

Hole No.CSW-7

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE: 8.12 Ft.

SHEET 2 OF 6

PROJECT: Pearce Creek

INSTALLATION: PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-9.9	18.0						
			Gravelly SAND; brown; medium dense.	7"	SPT 10		15 15 19 20
			Piece of gravel stuck in tip.	1"	SPT 11	Recovery too low for chemical sample. Circulating hard to clean out gravel.	15 21 30 25
			Gravelly SAND; brown and gray; as SPT 10; with trace silt.	4"	SPT 12	Recovery too low for chemical sample.	12 15 23 29
-15.9 *-16.4*	24.0 24.5		Top 6 inches Silty SAND; fine grading to SILT; brown-gray; stiff; with some sand; trace mica; trace wood; trace coarse sand.	14"	U-X	Chemical sample CSW-7-24'-26' taken @ 12:20	5 6 6 7
-18.9	27.0		No recovery.	0"	SPT 13	No recovery. When drove tube, kelly picked up. Small amount of gray clay and large gravel fell out of tip.	
			Organic CLAY; brownish gray w/occ. black spots; hard; not dilatant; low plasticity; with trace sand and gravel; trace organics; moist.	22"	SPT 14		16 21 27 34
			CLAY; as SPT 14; not quite as moist.	14"	SPT 15		10 12 18 23
			CLAY; as SPT 14; with less gravel.	24"	SPT 16	Sample cut down middle by a piece of gravel driven in tip.	11 13 17 21
			CLAY; as SPT 14; with less gravel.	18"	SPT 17		10 15 21 25
			CLAY; brown-gray; very stiff; not dilatant; low to moderate plasticity; with trace sand; trace mica; trace organics.	20"	SPT 18		9 15 15 20
			CLAY; as SPT 18.	16"	SPT 19	Sample cut by gravel; looks like twisted ribbon; unable to clean all bentonite mud off.	10 19 27 25
						(continued)	

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MAR 71

PROJECT: Pearce Creek

HOLE NUMBER: CSW-7

Hole No.CSW-7

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 8.12 Ft.	SHEET 3 OF 6
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.	
-31.9	40.0							40
		▨	CLAY; as SPT 18 above.	24"	SPT 20	Piece of rounded gravel in tip.	12 19 23 21	
		▨	CLAY; as SPT 18 above.	24"	SPT 21		11 15 17 19	42
		▨	CLAY; as above; with shell decomposed in top; fine gravel-sized orange piece of cemented sand-sized grains.	24"	U-1	Drove @ 14:56 @ 100 psi. Retrieved 24" @ 15:15 Took jar sample of top 1"		44
		▨	CLAY; gray; as above; no sand.	24"	SPT 22		7 9 12 15	46
		▨	CLAY; gray; as above; no sand.	24"	SPT 23		12 12 17 19	48
		▨	CLAY; gray with occasional black spots; as SPT 18 above; trace sand-sized grains in orange spots; moist.	24"	SPT 24		12 13 13 17	50
		▨	CLAY; as SPT 24.	24"	SPT 25		7 9 9 12	52
		▨	CLAY; as SPT 24.	24"	SPT 26		8 9 11 11	54
		▨	CLAY; as SPT 24; slightly moister.	24"	SPT 27		10 13 13 15	56
		▨	CLAY; as SPT 24; moister.	24"	SPT 28	Chemical sample CSW-7-58'-60' taken @ 16:32 on 12/14/95.	9 12 21 25	58
		▨	CLAY; brown-gray with occasional black spots; firm; plastic; moist.	24"	SPT 29	Easily able to push in thumb 1"	8 10 10 13	60
						(continued)		62

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT	HOLE NUMBER
Pearce Creek	CSW-7

Hole No.CSW-7

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 8.12 Ft.	SHEET 4 OF 6
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-53.9	62.0						
			CLAY; as SPT 29 above.	20"	SPT 30		8 8 10 12
			CLAY; as SPT 29 above.	18"	SPT 31		7 7 8 9
			CLAY; as SPT 29; firm; very moist.	17"	SPT 32		9 12 14 18
-61.5 -61.9	69.6 70.0		Organic CLAY; light brown; as SPT 29; grading more woody; then; Base 4 inches peat; brown turning black with air exposure; dry.	24"	SPT 33	Chemical sample of peat, CSW-7-69.5'-70' taken @ 08:55 on 12/15/95. Peat pH in water = 8.45 after 12 minutes. @ 15 minutes = 8.01 @ 35 minutes = 7.0 @ 1 hour = 7.0	5 11 17 19
-63.5 -63.9	71.6 72.0		Sandy SILT; gray-green; medium dense; with some clay as in SPT 33; grading to 4 inches peat in tip.	24"	U-2	Parts of SPT 34 are runny in spoon.	10 13 17 20
-65.9	74.0		PEAT and tan-white SAND; medium grained.	20"	SPT 34	Drove tube @ 9:08 @ 100 psi Recovered 20" @ 9:23	
-67.9	76.0		SILT; light brown-white; medium dense; very moist; with some peat/ wood; some sand; with trace mica; some clay (gray and brown).	13"	SPT 35	Parts of sample are runny	8 9 14 20
-69.4	77.5		Silty SAND; gray; very dense; medium grained; poorly graded; some clay near top.	12"	SPT 36	Silt/Clay in <1/2" laminations	15 23 35 45
-70.2	78.3		Top 4 inches CLAY; brown and gray with some gravel; then; SAND; red, tan, gray, and yellow; very dense; medium grained; poorly graded; top 1 inch is read weakly cemented, with trace silt.	10"	SPT 37	One large rounded piece of gravel in top clay.	47 100/4"
			SAND; brown with yellowish laminations; very dense; medium grained; poorly graded.	7"	SPT 38	Changed to downhole hammer; reamed to 80'w/open-end 6" trivane bit. Blows below not valid for comparison with standard N values.	37 50/2"
			SAND	0"	SPT 39	One yellow cemented piece of sand in spoon, 3/4" size	41 100/6"
-75.9	84.0					*(continued)*	

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT	HOLE NUMBER
Pearce Creek	CSW-7

Hole No.CSW-7

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 8.12 Ft.	SHEET 5 OF 6
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-75.9	84.0						
-77.4	85.5	▥	Silty SAND; orange-yellow and brown; very dense; medium grained; poorly graded; with trace white clay in one 3/4 inch spot. silt lens.	10"	SPT 40	Chemical sample CSW-7-84'-85' taken @ 11:23	30 59 50/1"
-79.4	87.5	░	SAND; yellow, red, black, white, and gray; very dense; fine to medium grained; with some white clay; some moderately cemented black and red areas; some yellow-orange silt.	11"	SPT 41	1" gray Sand/Silt 2" yellow 1" cemented black 1" white Clay 1-2" white Sand 4" yellow w/red	27 100/5"
		▥	Silty SAND; tan, orange-yellow; very dense; medium to fine grained; poorly graded; with some white clay/silt; trace gravel.	14"	SPT 42	Interlayered 1/4"-1/2" laminations of tan clean Sand; yellow Silty Sand; white Clay; white Silty Sand. SPT 41 Soil (yellow Silty Sand) pH in water: @ 1 min.= 6.5 @ 2 min.= 6.2 @ 10 min.= 5.5	15 35 41
-83.4 -83.9	91.5 92.0	▥ ▨	Silty SAND; as above in SPT 42; with 5 inch coarse sand; then Silty SAND; orange-yellow, red, white; then CLAY; pink; hard; not dilatant; very slightly moist.	18"	SPT 43	4" yellow-orange Silty Sand 3/4" red Silty Sand 3" white Silty Sand 4" pink/white Silt/Clay	12 26 39
		▥	Sandy SILT; white; dense; sand is very fine to fine grained; with some clay; interlayered <1 inch lenses; grading to 4 inches red and white silty clay in base; variegated.	18"	SPT 44		12 22 37
		▥	Silty SAND; white; very dense; very fine-fine grained; poorly graded; with trace clay and gravel near top.	7"	SPT 45	Sandy areas are wet.	12 30 47
-89.6	97.7	▥	Sandy SILT; white with trace pink; very dense; with some clay.	18"	SPT 46	Interlayered area w/more Clay/Silt are <1" thick	15 28 35
-91.4	99.5	▨	Silty CLAY; white; hard; not dilatant; very slightly moist; plastic; with trace sand.	11"	SPT 47	2" fine-medium sand lens @ 2"-4" above base	17 33 48
-93.4	101.5	▥	Silty SAND; white; very dense; interbedded in laminations; with some clay.	12"	SPT 48	Chemical sample CSW-7-100'-101.5' taken @ 13:03 from sandier parts of sample. Clay is light gray w/trace pink and red.	15 25 27
		░	SAND; white-tan; very dense; fine to medium grained; very poorly; graded; clean; quartz; with trace silt in hairline; laminations.	10"	SPT 49		37 51 50/1"
		░	SAND; as SPT 49 above; with trace red-orange clay laminations.	6"	SPT 50		58 50/1"
						(continued)	

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT	HOLE NUMBER
Pearce Creek	CSW-7

Hole No.CSW-7

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 8.12 Ft.	*SHEET 6 OF 6*
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-97.9	106.0						
-98.9	107.0	▨	SAND; as SPT 49 above; with ~40% white clay in discrete lumps and laminations.	6"	SPT 51	Chemical sample CSW-7-106'-106.6' taken @ 13:48	33 50/1"
			Classifications listed above are based on BVWS standard classification procedures and ASTM D 2488-90 Visual Manual Classification; not on Laboratory Analyses.			Grouted up to >91' depth w/ tremie pipe (~25 gallons) on 12/15/95. Reamed and placed well screen (81'-91 ') on 12/18/95.	

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71	PROJECT Pearce Creek	HOLE NUMBER CSW-7

DRILLING LOG

DIVISION
NORTH ATLANTIC DIVISION

INSTALLATION
PHILADELPHIA DISTRICT

SHEET 1
OF 7

1. PROJECT
Pearce Creek

2. LOCATION (Coordinates or Station)
1596085.38 E, 642953.40 N

3. DRILLING AGENCY
UNI-TECH DRILLING CO., INC.

4. HOLE NO. (As shown on drawing title and file number) CSW-8

5. NAME OF DRILLER
Joseph Jester

6. DIRECTION OF HOLE
☒ VERTICAL ☐ INCLINED

7. THICKNESS OF OVERBURDEN

8. DEPTH DRILLED INTO ROCK

9. TOTAL DEPTH OF HOLE 133.5 Ft.

10. SIZE AND TYPE OF BIT 4-3/4" side-discharge trivane

11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
NAVD 88

12. MANUFACTURER'S DESIGNATION OF DRILL
Failing 1500

13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN
disturbed: 67 undisturbed: 0 attempted

14. TOTAL NUMBER OF CORE BOXES 0

15. ELEVATION GROUND WATER

16. DATE HOLE STARTED COMPLETED
12/04/95 12/07/95

17. ELEVATION TOP OF HOLE 25.38 Ft.

18. TOTAL CORE RECOVERY FOR BORING

19. SIGNATURE OF INSPECTOR
S.M. Cook

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
25.4	.0						
		▥	Sandy SILT; brown; loose; sand is fine to medium grained; slightly moist.	11"	SPT 1	Unless otherwise noted, SPT samples taken according to ASTM 1586 Using bentonite mud, "QuickGel" by Baroid. Chemical sample CSW-8-0'-1' taken @ 08:24	3 4 6 8
21.4	4.0	▥	Silty SAND; orange-brown; medium dense; medium grained; dry; quartz; subrounded; poorly graded.	7"	SPT 2	Chemical sample CSW-8-2'-3' taken @ 08:30 Extra volume for QA duplicate taken.	8 12 12 16
		░	SAND; orange-brown; dense; medium grained; poorly graded; quartz; subrounded; dry; with trace silt.	5"	SPT 3	Chemical sample CSW-8-4'-5' taken @ 08:36	17 19 24 25
		░	SAND; tan; very dense; medium grained; poorly graded; dry; with traced fine sand.	11"	SPT 4		18 24 28 -
		░	SAND; tan; medium dense; medium grained; poorly graded; slightly moist; with some fine sand; trace silt in lenses; trace black organic spots.	17"	SPT 5	Chemical sample CSW-8-8'-10' taken @ 09:02	8 8 9 10
		░	SAND; tan; mediume dense; medium to coarse grained; moderately well graded; with trace fine sand and silt in lenses; wet.	11"	SPT 6		7 8 8 8
11.4	14.0	░	SAND; orange-brown; loose; coarse grained; moderately well graded; as SPT 6.	12"	SPT 7		4 4 3 3
10.8 9.4	14.6 16.0	▥ ▨	7 inches SILT; black; loose; moist; with trace sand; then CLAY; tan; stiff; moderately plastic; wet; with trace mica.	18"	SPT 8	Chemical sample CSW-8-14'-14.5' taken @ 09:22	4 5 5 6
7.4	18.0	▧	Clayey SILT; tan; medium dense; with some fine sand; trace mica.	19"	SPT 9		3 8 10 10
						(continued)	

Hole No.CSW-8

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 25.38 Ft.	SHEET 2 OF 7
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
7.4	18.0						
			SAND; tan and yellowisk; medium dense; fine grained; with trace silt in lenses; wet.	13"	SPT 10	Chemical sample CSW-8-18'-20' taken @ 09:33	8 10 10 12
			SAND; light brown; loose; fine-medium grained; with some silt.	13"	SPT 11		3 4 4 4
3.4	22.0						
			Silty SAND; light brown; loose; fine grained; poorly graded; subrounded; quartz; wet.	20"	SPT 12		2 2 2 2
			Silty SAND; light and dark brown; loose; fine-medium grained; wet; poorly graded. Base 5 inches SILT; dark brown-black; with wood.	20"	SPT 13		3 2 2 2
-.6	26.0						
-1.4	26.8		Organic SILT; brown and black; medium dense; Top 5 inches light brown clayey; wet; then; 3 inches as Base of SPT 13; then; <1 inch SAND; white; with trace fine gravel.	9"	SPT 14		3 5 7 8
			SAND; tan and bright orange; medium dense; medium grained; poorly graded; with some orange silt in lenses.	18"	SPT 15	Soil pH in water = 7.95	18 19 5 33
			SAND; tan; dense; medium grained; moderately well graded; with some silt; trace quartz fine gravel.	16"	SPT 16		15 19 21 24
-6.6	32.0						
			Gravelly SAND; tan with orange-red silty laminations; medium grained; well graded; with trace silt.	10"	SPT 17	Silt ~ 10% by volume in settling jar. Gravel maximum axis is 1". Gravel is rounded quartz.	17 21 27 32
			Gravelly SAND; orange-yellow; dense; well graded; with some silt.	14"	SPT 18		17 18 18 21
-11.1	36.5						
			Top 6 inches as SPT 18; then; SAND; tan and orange; dense; fine grained; poorly graded; with trace silt	11"	SPT 19		12 15 18 20
			SAND; tan, light gray, and orange; dense; fine and medium grained; (finer near top); with some silt in fine grained areas.	16"	SPT 20		13 15 15 17
						(continued)	

Hole No.CSW-8

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 25.38 Ft.	SHEET 3 OF 7
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-14.6	40.0						
			SAND; tan and orange; medium dense; medium grained; poorly graded; with trace orange silt in base.	11"	SPT 21	Base 5" orange	11 12 15 25
			SAND; tan and orange; very dense; fine and medium grained; poorly graded; with trace silt.	13"	SPT 22		18 45 100/3"
			SAND; tan; very dense; medium grained; poorly graded; with trace light orange silt in laminations.	16"	SPT 23		26 34 45 60
			SAND; as SPT 23 above in top 6 inches; Base 4" grading finer sand and some orange silt.	10"	SPT 24		12 20 32 49
			SAND; orange with some tan near base; very dense; medium grained; poorly graded; with some orange silt.	20"	SPT 25	Chemical sample CSW-8-48'-50' taken @ 12:08	25 34 40 44
-24.6	50.0						
			Clayey SAND; tan, orange, and light gray; dense; fine to medium grained; poorly graded; with some silt.	22"	SPT 26	gray Clay, Clayey Sand interlayered w/orange Sand, Silty Sand.	17 19 20 24
-26.6	52.0						
-27.1	52.5		Top 6 inches Silty SAND; tan, orange and light gray; then CLAY; light gray; hard; plastic; with trace silt and sand in orange spots.	14"	SPT 27		19 25 31 40
-28.6	54.0						
			Silty SAND; gray and orange; dense; fine grained; poorly graded; with some gray clay.	17"	SPT 28	orange laminations Clay mostly in one 3" lens	25 23 19 19
			As SPT 28 above; with more gray silt and clay	13"	SPT 29		15 18 25 32
			Sandy SILT; white-light gray with orange laminations; dense; sand is very fine to fine grained; moist-wet; with trace mica; some gray clay	17"	SPT 30		15 25 25 32
			As SPT 30.	14"	SPT 31		11 17 12 35
						(continued)	

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
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PROJECT	HOLE NUMBER
Pearce Creek	CSW-8

Hole No.CSW-8

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 25.38 Ft.

SHEET 4 OF 7

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-36.6	62.0						
-37.4 *-37.8*	62.8 63.2	▥ ▨ ░	As SPT 30 above; with 6 inches gray CLAY in middle. SAND; tan; medium grained; in tip	14"	SPT 32	gray Clay has orange Silty Sand spots	11 20 100/6"
-40.2	65.6	░	SAND; tan with some light orange areas; very dense; medium grained; poorly graded; with trace gray silty spots and orange silt.	10"	SPT 33		60 100/5"
-42.6	68.0	▥	Silty SAND; tan and orange with some light gray; fine grained; poorly graded; with some gray clay in lenses.	15"	SPT 34		23 38 67 70
		░	SAND; tan with orange laminations; very dense; fine grained; poorly graded; with some silt.	13"	SPT 35		23 57 100/5"
		░	SAND; tan and light orange; very dense; fine grained; poorly graded; with some silt.	18"	SPT 36		37 57 57 58
		░	SAND; as SPT 36; with some mediume grained sand.	14"	SPT 37		38 100/3"
		░	SAND; orange with gray silty blobs; very dense; medium grained; poorly graded; with some orange silt.	6"	SPT 38		100/6"
-52.6	78.0	░	SAND; tan-orange; very dense; medium grained; poorly graded; with trace silt.	6"	SPT 39		100/6"
-53.4	78.7	▥ ░	Silty SAND; yellow-orange; very dense; fine grained; poorly graded.	13"	SPT 40	Changed to downhole hammer; reamed to 78'w/open-end 6" trivane bit and large rods. Blows below 78' not valid for comparison with standard N values. Soil pH in water: @ 1 min.= 4.8 @ 15 min.= 5.0 Settling volume @ 15 min.~50% silt	21 23 29
		░	SAND; yellow-orange with some whitish lenses; coarse graded; with trace yellow-orange silt; trace medium-fine sand; trace white clay.	10"	SPT 41		21 78 50/2"
-58.6	84.0	░	SAND; tan; very dense; fine to medium grained; poorly graded; with some white-light gray with orange spots clay; trace mica.	4"	SPT 42	*(continued)*	100/5"

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
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PROJECT Pearce Creek

HOLE NUMBER CSW-8

Hole No.CSW-8

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 25.38 Ft.

SHEET 5 OF 7

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-58.6	84.0						
-60.6	86.0		SAND; yellow; very dense; medium grained; poorly graded; with silty CLAY; white-light gray; hard.	1"	SPT 43	Low recovery SAND and CLAY separate	100/4"
			SAND; yellow-orange; very dense; medium grained; poorly graded; with some silt.	2"	SPT 44		100/5"
			SAND; as SPT 44 above; with some white silty clay in one lens.	6"	SPT 45		100/6"
			No recovery.	0"	SPT 46	No recovery	100/5"
			SAND; orange with some dark brown-black cemented spots; very dense; fine to medium grained; poorly graded; with some orange silt.	14"	SPT 47	Top is medium grained Base is fine grained	43 21 25
			SAND; orange; very dense; coarse to medium grained; moderately well graded; with some orange silt; with trace laminations of cream- colored silt; trace dark brown iron-cemented nodules (as SPT 47).	12"	SPT 48		11 21 27
-72.4	97.7		SAND; orange; very dense; medium grained; well graded; with some silt.	12"	SPT 49	cream-colored laminations of Silt	15 51 45
			Silty SAND; orange with dark brown and cream-colored lamiantions; fine to medium grained; poorly graded.	14"	SPT 50	Chemical sample CSW-8-98'-98.5' taken @ 11:50 on 12/7/95 Dark brown iron-cemented grains concentrated in laminations; cream- colored Silt in laminations.	37 47 59
-76.4	101.7		As SPT 50; more medium grained; much less dark brown laminations; lighter color (tan-orange).	9"	SPT 51	trace reddish color near tip	15 27 35
-78.4	103.7		SAND; tan and orange; very dense; mostly medium grained; with some silt; trace clay.	13"	SPT 52	some fine orange Silty Sand and gray-cream Clay laminations, mostly near base	33 34 35
-79.6	105.0		Silty SAND and CLAY; sand is light orange to dark orange-brown; clay is light gray with orange spots; sand is fine to medium; poorly graded; clay is plastic.	7"	SPT 53	Clay mainly in 3" lens	45 100/4"
						(continued)	

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PROJECT Pearce Creek

HOLE NUMBER CSW-8

Hole No.CSW-8

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 25.38 Ft.	SHEET 6 OF 7
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-80.6	106.0						
-81.6	107.0		SILT; white to light gray with some yellow-orange, brown and ice red; very dense; with some sand; sand is mostly fine-very fine grained; with trace clay.	9"	SPT 54	medium grained sand, silt, and 1/4" x 3/4" rust colored cemented Sand nodule in tip. d=110.2 ~3/4" spot of light gray Silt @ top. Darder orange-brown in the Sand just below this.	12 17 24
-83.6	109.0		Silty SAND; tan and orange; very dense; fine to medium grained; poorly graded; with lens of tan silt.	6"	SPT 55		49 50/1.5"
			SAND; tan and orange; very dense; medium grained; poorly graded; with some silt.	8"	SPT 56		33 47 50/2"
			SAND; tan; very dense; medium grained; poorly graded; quartz; subrounded; with trace beige silt in some areas of the sand.	3"	SPT 57	occasional white grains 116.2 Low recovery 118.2 Silt near top 120.2 ~5% Silt by settling volume 122.2 Soil pH in water = 6.3 @ 5 min. occasional white grains	49 50/2"
			SAND; as SPT 57 above.	5"	SPT 58		59 50/1"
-90.6 -91.6	116.0 117.0		SILT; white; with some sand mostly cemented into dark rust colored nodules.	1.5"	SPT 59		39 50/1"
			SAND; orange-tan; as SPT 57; without beige siltier areas; some white silt in one lens; with dark rust-colored sand nodules.	5"	SPT 60		30 50/2"
			SAND; orange-brown; very dense; medium to coarse grained; with trace silt.	5"	SPT 61		27 39 50/1"
			SAND; orange; as SPT 61; quartz; subangular.	9"	SPT 62		30 41 58
			SAND; greenish-yellow and tan; very dense; medium to coarse grained; poorly graded; with trace silt; some fine sand.	10"	SPT 63	One black laminationand one red Silt lamination Silt <10% by settling volume	15 25 39
			SAND; orange with trace black, white and red spots; as SPT 63.	9"	SPT 64		33 50 50/1"
						(continued)	

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PROJECT	HOLE NUMBER
Pearce Creek	CSW-8

Hole No.CSW-8

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 25.38 Ft.	SHEET 7 OF 7
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-102.6	128.0						
		░	SAND; tan; very dense; medium to coarse grained; subangular; quartz; with trace feldspar; with some fine sand; trace silt.	9"	SPT 65	One dark rust-colored nodule.	21 43 60
-104.6	130.0	▨	Silty CLAY; light gray and pinkish brown; low plasticity; moist; with trace sand.	8"	SPT 66		20 39 50/3"
		▨	Clayey SILT; variegated light gray and dark red with some pinkish brown and occasional dark blue spots; low dilatancy; some parts low plasticity; with some lenses with very fine sand.	17"	SPT 67		15 32 44
-108.1	133.5		Classifications listed above are based on BVWS standard classification procedures and ASTM D 2488-90 Visual Manual Classification; not on Laboratory Analyses.			Reamed to 132' depth Set well base @ 130'6.5" on 12/6/95.	

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PROJECT	HOLE NUMBER
Pearce Creek	CSW-8

Hole No.CSW-9

DRILLING LOG

DIVISION: NORTH ATLANTIC DIVISION

INSTALLATION: PHILADELPHIA DISTRICT

SHEET 1 OF 7

1. PROJECT: Pearce Creek
2. LOCATION *(Coordinates or Station)*: 1598164 E, 643674 N
3. DRILLING AGENCY: UNI-TECH DRILLING CO., INC.
4. HOLE NO. *(As shown on drawing title and file number)*: CSW-9
5. NAME OF DRILLER: Joseph Jester
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE: 139 Ft.
10. SIZE AND TYPE OF BIT: 4-3/4" side-discharge trivane
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: NAVD 29
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: disturbed: 69 undisturbed: 0 attempted
14. TOTAL NUMBER OF CORE BOXES: 0
15. ELEVATION GROUND WATER
16. DATE HOLE: STARTED 02/19/96 COMPLETED 02/21/96
17. ELEVATION TOP OF HOLE: 28.38 Ft.
18. TOTAL CORE RECOVERY FOR BORING
19. SIGNATURE OF INSPECTOR: S.M. Cook

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
28.4	.0						0
		▒	SAND; tan; medium dense; poorly graded; medium grained; with trace clay.	12"	SPT 1	Unless otherwise noted, SPT samples taken according to ASTM 1586 Using bentonite mud, "QuickGel" by Baroid.	7 14 10 6
26.4	2.0						2
		▨	CLAY; yellow with some gray and red; stiff; low plasticity; with some sand.	9"	SPT 2		7 7 9 12
24.1	4.3						4
		▒	Top 4" CLAY; gray-brown with some red; low plasticity; then SAND; tan; dense; medium grained; poorly graded; wet;	13"	SPT 3		8 11 14 16
							6
		▒	SAND; tan turning black at tip; as above; medium dense; silty at tip; wet.	13"	SPT 4		6 5 6 9
20.4	8.0						8
20.1	8.3	▥	Top 4" Silty SAND; black; grading to silt; black soft; wet; non-plastic; trace fine sand;	14"	SPT 5		WOH - - -
18.4	10.0						10
		▥	Alternating black organic clayey silt and fine silty sand; soft; wet; trace organic material; Base 2" is woody; drier	20"	SPT 6		1 0 1 1
							12
		▥	as SPT 6; runny in parts; gray and black spotted clay.	24"	SPT 7		WOH - - -
							14
		▥	Sandy SILT; yellow-gray; wet; runny; soft.	8"	SPT 8		1 WOH WOH WOH
							16
		▥	Silty SAND; yellow-gray; very loose; runny; wet; medium grained; poorly graded	6"	SPT 9		1 0 1 1
						(continued)	18

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PROJECT: Pearce Creek

HOLE NUMBER: CSW-9

Hole No.CSW-9

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 28.38 Ft.	SHEET 2 OF 7
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
10.4	18.0	▥	Silty SAND; As SPT 9; dark brown with yellow near tip.	9"	SPT 10		WOR - - -
8.4	20.0	░	SAND; tan; loose; medium grained; poorly graded; wet with trace silt; some multicolored clay in top 3"; trace mica.	8"	SPT 11		2 4 5 7
		░	SAND; brown with occ. orange areas; dense; medium to fine grained; poorly graded; with some silty trace mica.	15"	SPT 12		10 17 18 18
		░	SAND; orange; dense; medium grained; poorly graded; with some silt; trace mica flakes.	15"	SPT 13		18 22 27 30
		░	SAND; as SPT 13.	13"	SPT 14		18 27 32 30
		░	SAND; orange to reddish; As SPT 13.	16"	SPT 15		14 15 16 16
-2.1	30.5	▥	Top 6" as above; then Silty SAND; gray-yellow, medium dense; very fine; trace mica; trace black orange silt spots; trace gravel.	20"	SPT 16	On piece of gravel at sand/silty sand interface.	9 9 10 12
		▥	Silty SAND; gray; medium dense; very fine grained; poorly graded; with trace mica.	13"	SPT 17		10 8 8 8
-5.6	34.0	▨	Silty CLAY; gray; stiff; with some very fine sand; with trace mica; trace wood.	12"	SPT 18		9 7 6 7
		▨	As SPT 18; Silty CLAY; with some very fine sand.	19"	SPT 19		4 6 6 8
-9.6	38.0	▩	CLAY; gray; very stiff; low plasticity; trace mica; trace sand.	21"	SPT 20		10 10 12 10
						(continued)	

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT Pearce Creek	HOLE NUMBER CSW-9

Hole No.CSW-9

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 28.38 Ft.

SHEET 3 OF 7

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (If significant)	BLOWS/ 6in.
-11.6	40.0		Top 7" as SPT 21, slightly softer; grading brown; then: Clayey PEAT; brown-black; moist; grading into woody clay at base.	24"	SPT 21	Peat turns black with exposure to air.	10 8 7 8
			CLAY; gray-brown; stiff; low plasticity; with trace wood; some; trace angular sand-sized grains.	22"	SPT 22		8 8 7 8
			CLAY; brown; as SPT 22.	21"	SPT 23		6 6 6 5
			CLAY; brown; as SPT 22.	21"	SPT 24	One orange spot ~ 1/4" wide.	5 6 7 7
-19.6	48.0		Silty CLAY; brown with occ. white or gray sand blobs; as SPT 22.	19"	SPT 25	Turns darker with exposure to air.	8 6 8 8
-21.6	50.0		CLAY; brown truning to gray-black with exposure to air; hard; as SPT 22; with some black areas.	24"	SPT 26		22 25 32 35
			CLAY; as SPT 26; with more frequent white spots on inner surface of sample as broken apart; no angular grains as before.	23"	SPT 27		11 15 9 12
			CLAY; as SPT 27	20"	SPT 28		11 14 9 12
			CLAY; as SPT 27.	4"	SPT 29	Looks like most of sample pulled out tip (did not break off - trap bent backwards).	12 10 25 18
			CLAY; gray and black; as SPT 27.	21"	SPT 30		12 15 15 18
			CLAY; as SPT 30.	20"	SPT 31		10 10 9 10
						(continued)	

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MAR 71

PROJECT	HOLE NUMBER
Pearce Creek	CSW-9

Hole No.CSW-9

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE	SHEET
28.38 Ft.	*SHEET 4 OF 7*

PROJECT	INSTALLATION
Pearce Creek	PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-33.6	62.0						
			CLAY; as SPT 31.	23"	SPT 32		12 12 17 15
			CLAY; as SPT 31; with more frequent white shells (trace).	23"	SPT 33		5 9 11 12
			CLAY; as SPT 31.	24"	SPT 34		10 10 12 10
-39.6	68.0						
			Silty SAND; dark gray; very dense; fine grained; with trace mica; trace wood.	24"	SPT 35		14 17 20 20
-41.6	70.0						
			Silty CLAY; gray and black; firm; low plasticity; low to no dilatancy; with trace wood and trace mica flakes.	21"	SPT 36	End of day 02/19/96.	3 4 5 5
-43.6	72.0						
			CLAY; dark olive green with black; with trace vegetative matter; trace mica; moderate plasticity; no dilatancy; moist;	24"	SPT 37		12 10 12 15
			As SPT 37; with occ. white spots (shell remnants).	24"	SPT 38		3 1 9 9
			As SPT 38.	24"	SPT 39		3 3 4 3
			As SPT 38; slightly more frequent shell pieces; turning black with green in base 8"	24"	SPT 40		3 5 8 9
			CLAY; black; as SPT 40.	5"	SPT 41	Low recovery; appears most of sample pulled out base of spoon.	8 17 20 25
-54.6	83.0		Top 12" as SPT 41; PEAT; gray with brown and black; dry; light; some shells.	21"	SPT 42		13 12 16 18
						(continued)	

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT	HOLE NUMBER
Pearce Creek	CSW-9

Hole No.CSW-9

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 28.38 Ft. — *SHEET 5 OF 7*
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-55.6	84.0						
				21"		Drilled to 86' easily no resistance – still in peat or clay.	
-57.6 *-58.3*	86.0 86.7		Top 8" as SPT 41 (black organic clay) then Grading over 4" into SAND; gray; very dense; fine to coarse grained in poorly graded lenses; with trace silt; trace wood; trace fine gravel.	16"	SPT 43	Photo.	7 37 66 48
-59.6	88.0		Interbedded lenses of SAND; PEAT and woody CLAY. As SPT 42 and 43; and brown woody clay.	17"	SPT 44		10 25 18 15
			Slough of CLAY to fine gravel; as SPT 44.	0"	SPT 45	~ 2" slough.	51 18 35 50
-62.6	91.0		SAND; light brown to yellow-brown; very dense; coarse grained; poorly graded; with some fine gravel; some medium sand.	14"	SPT 46		57 40 30 52
			As SPT 46; SAND.	5"	SPT 47	Switched to downhole hammer @ 94'. Sampling through open and trivane 6" bit, large rods. Blow counts not comparable to above. Difficulty turning bit @ 94.7. Broken pieces of large quartz rounded gravel in wash as circulating @ 96'.	12 22 46
-67.6	96.0		Silty SAND; white; poorly graded; medium grained; soupy in parts; slightly dilatant (rubbery) when manipulated.	14"	SPT 48		
-69.6	98.0		Silty SAND and CLAY; as SPT 48; with <2" lenses of light gray clay; clay is plastic; moist.	15"	SPT 49		17 21 20
			SAND and CLAY; clay as SPT 49; sand is medium grained; poorly graded; with some silt.	15"	SPT 50		22 33 41
			As SPT 50; clay has trace gravel.	7"	SPT 51		25 39 70
			As SPT 51.	5"	SPT 52		150/6"
						(continued)	

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT	HOLE NUMBER
Pearce Creek	CSW-9

Hole No.CSW-9

DRILLING LOG (Cont. Sheet)

ELEVATION TOP OF HOLE 28.38 Ft.

SHEET 6 OF 7

PROJECT Pearce Creek

INSTALLATION PHILADELPHIA DISTRICT

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-77.6	106.0						
		▨	As SPT 51; SAND and CLAY interlensed.	5"	SPT 53	Lenses <2" thick.	54 100/4"
		▨		0"	SPT 54	No Recovery.	33 100/3"
-80.6	109.0						
		▥	Silty SAND; white; fine to medium grained; poorly graded.	2"	SPT 55	Piece of quartz slough blocking spoon; broken gravel originally > spoon diameter.	31 100/4"
		▥		<1"	SPT 56	~ 2" slough sand and clay.	100/5"
-85.6	114.0						
		░	SAND; light tan to white; dense; medium grained; very poorly graded; quartz; trace silt.	4"	SPT 57	Some drilling fluid invaded sample, scraped most off @ edges.	100/6"
		░	SAND; as SPT 57; slightly coarser (still medium grained); slightly darker.	5"	SPT 58		50 50/1"
		░	SAND; as SPT 58; brown.	5"	SPT 59		62 50/1"
		░	SAND; as SPT 58; brown to gray.	5"	SPT 60	Gray may be from drilling fluid.	100/6"
		░	SAND; white, tan, and brown; very dense; coarse grained; poorly graded; with some silt; trace fine-medium sand; trace clay in laminations.	10"	SPT 61	Slightly more feldspar grains than previously, still <5%.	31 57 50/1"
		░	SAND; reddish-brown; dense; coarse grained; moderately well graded; with some silt; some gray clay in 1/2" lenses.	6"	SPT 62	Gray and red clay in wash as drill to 126'.	39 50/1"
-97.1	125.5						
		▨	CLAY; variegated brown, red, pink, gray, and green; hard; plastic; with deep wine red or orange spots; moderately moist; with multicolored sand in base 1".	16"	SPT 63	Lot of coarse sand (slough?) on top.	16 31 38
-99.6	128.0					*(continued)*	

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT Pearce Creek

HOLE NUMBER CSW-9

Hole No.CSW-9

DRILLING LOG (Cont. Sheet)	ELEVATION TOP OF HOLE 28.38 Ft.	SHEET 7 OF 7
PROJECT Pearce Creek	INSTALLATION PHILADELPHIA DISTRICT	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS (if significant)	BLOWS/ 6in.
-99.6	128.0						
		▨	Silty SAND and CLAY; orange red and gray; sand and silt weakly to moderately cemented in laminations.	4"	SPT 64		29 41
		▨	Sandy CLAY; light gray; hard; dilatant.	9"	SPT 65		29 37 50
-103.6	132.0						
		▨	CLAY; variegated red and gray; dry; moderately plastic; with some silt; trace very fine sand.	20"	SPT 66	Driven 2" when set silt and sand more prevalent in gray areas.	12 25 32
		▨	CLAY; red and gray; as SPT 66.	20"	SPT 67	Driven when set.	50/1" 27 36
-107.6	136.0						
		▨	Sandy CLAY; light gray; dense slightly moist; fine grained; with trace medium trace coarse grained sand.	20"	SPT 68	Able to mold with finger pressure 60% silt/clay by settling volume after ~ 16 hours.	14 34 45
		▨	Sandy CLAY; as SPT 68.	11"	SPT 69		42 100/6"
-110.6	139.0						
			Classifications listed above are based on BVWS standard classification procedures and ASTM D 2488-90 Visual Manual Classification; not on Laboratory Analyses.			E.O.B. @ 139'.	

128 130 132 134 136 138 140 142 144 146 148 150

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

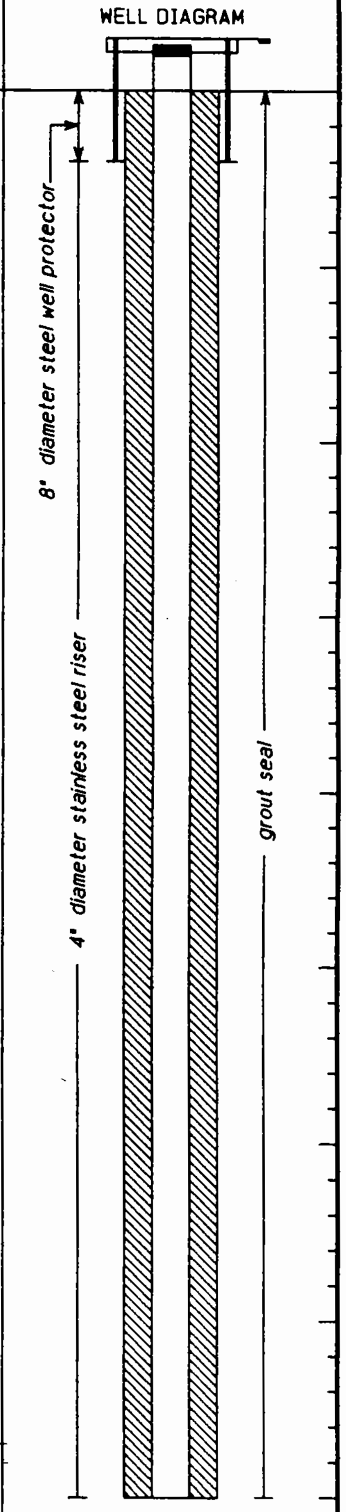
PROJECT	HOLE NUMBER
Pearce Creek	CSW-9

US ARMY CORP OF ENGINEERS

BORING NUMBER CSW-10
DATE DRILLED 8/6/96
SURFACE ELEVATION 32.53 NAVD 88
NORTHING 1597712

CLIENT USEPA
PROJECT PEARCE CREEK
GEOLOGIST D. SIRKIS
EASTING 642664

DEPTH feet	SAMPLE	RECOVERY (ft)	BLOWS/FT.	PID (ppm)	GRAPHIC LOG	SOIL CLASS	DESCRIPTION AND REMARKS
						SP	
5							
10							
15							
20		0.7	36	NA			light grey, very fine SAND, with rust brown lenses, some silt
		1.0	64	NA			light grey, very fine SAND, with rust brown lenses, some silt, with some clay
		1.3	9	NA		SW	light rust brown fine SAND
25							alternating light brown, light rust, and light grey fine to medium SAND, with clay lenses from 24'-24'2"
		1.0	18	NA			alternating light brown, light rust, and light grey fine to medium SAND
		0.8	8	NA		SP	light brown medium SAND
30		1.2	35	NA		SW	alternating layers of light brown, rust, and light grey fine to medium SAND
		1.3	16	NA			
		1.5	98	NA			alternating layers of light brown, rust, and light grey fine to medium SAND, trace clay
35							rust brown medium to coarse SAND, some clay
		1.1	25	NA			
		1.0	44	NA			alternating thin layers of light brown and light grey medium to coarse SAND, trace clay
40		1.2	73	NA			

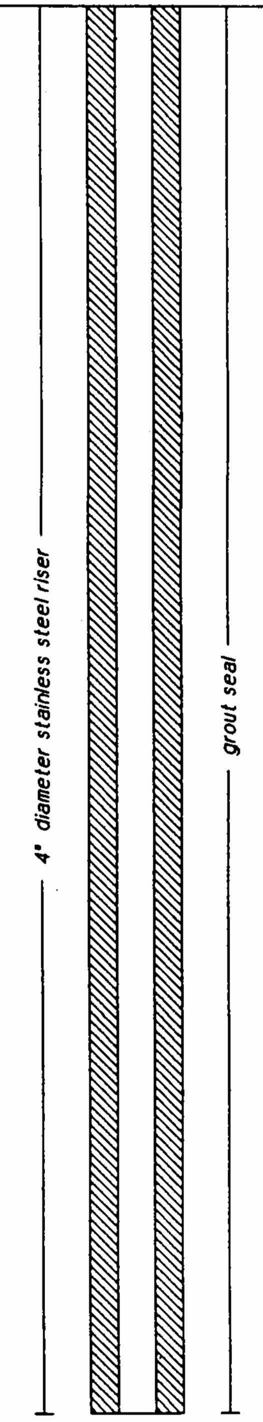


US ARMY CORP OF ENGINEERS

BORING NUMBER *CSW-10*
DATE DRILLED *8/6/96*
SURFACE ELEVATION *32.53 NAVD 88*
NORTHING *1597712*
CLIENT *USEPA*
PROJECT *PEARCE CREEK*
GEOLOGIST *D. SIRKIS*
EASTING *642664*

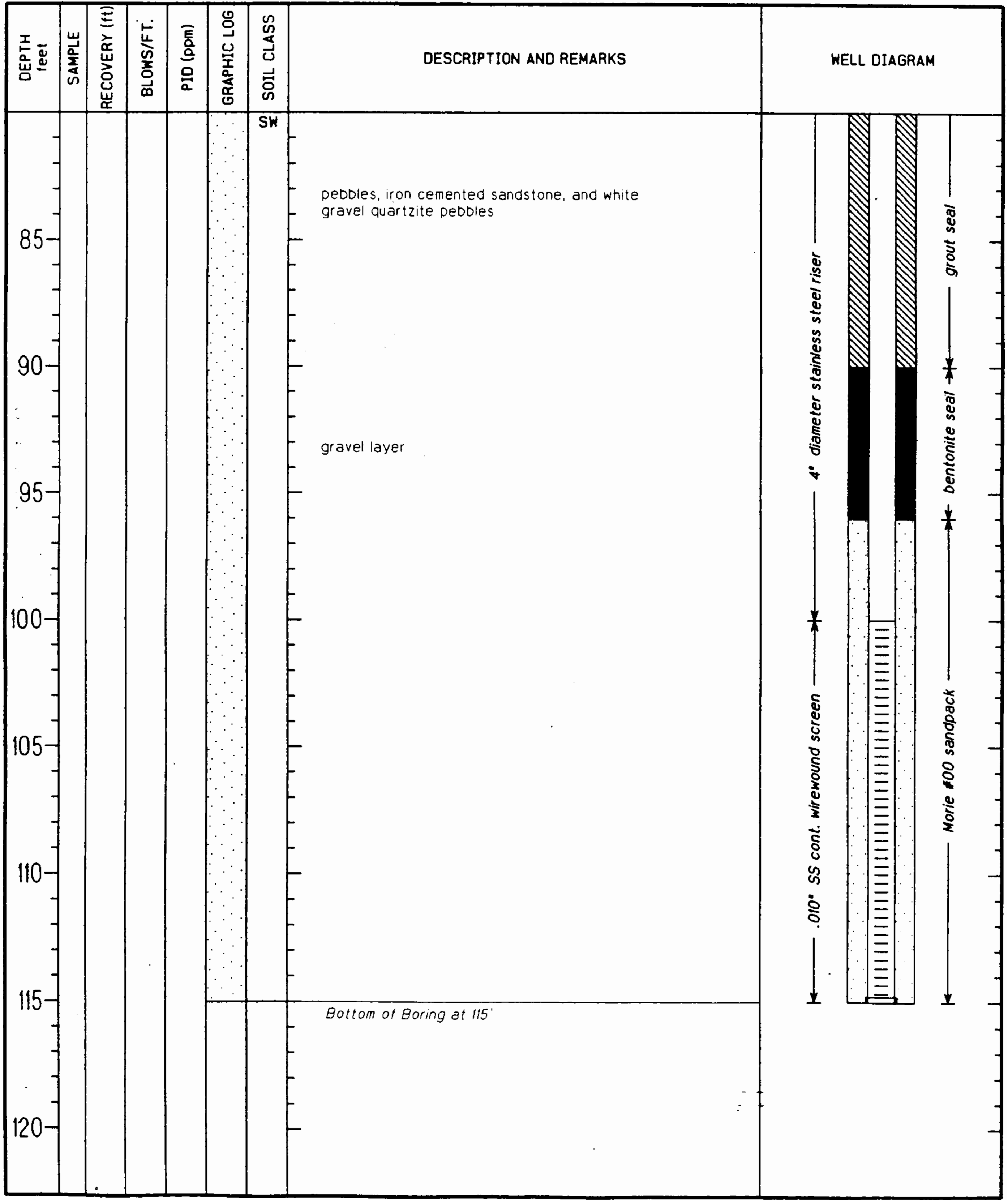
DEPTH feet	SAMPLE	RECOVERY (ft)	BLOWS/FT.	PID (ppm)	GRAPHIC LOG	SOIL CLASS	DESCRIPTION AND REMARKS
						SW	alternating thin layers of light brown and light grey medium to coarse SAND, trace gravel
		0.7	41	NA		GW	light brown sandy GRAVEL
							maximum diameter is .5"
							purplish grey silty sand on tip of spoon
		1.0	65	NA		SM	
45							purplish grey silty SAND grading into cream colored gravelly SAND at 45.1'
		1.1	55	NA			purplish grey silty SAND grading into cream colored gravelly SAND to 47.4'
						SP	white clean fine SAND and gravel
		0.75	55	NA			as above, no gravel
50						SW	white coarse well sorted SAND, trace fine black sand particles
		0.5	50	NA			white fine to medium SAND, some soft silty clay micaeous
		0.25	50	NA			1" thick gravel and sand lens, trace clay
55							micaeous white fine to medium SAND, trace clay
60							
65							gravel
70							
75							
80							

WELL DIAGRAM



US ARMY CORP OF ENGINEERS

BORING NUMBER CSW-10
DATE DRILLED 8/6/96
SURFACE ELEVATION 32.53 NAVD 88
NORTHING 1597712
CLIENT USEPA
PROJECT PEARCE CREEK
GEOLOGIST D. SIRKIS
EASTING 642664



pebbles, iron cemented sandstone, and white gravel quartzite pebbles

gravel layer

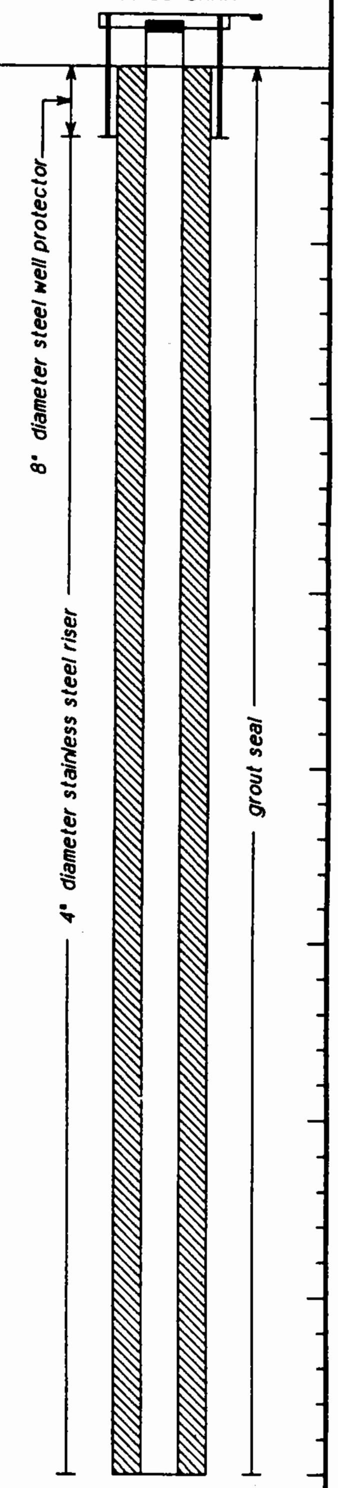
Bottom of Boring at 115'

US ARMY CORP OF ENGINEERS

BORING NUMBER CSW-11
DATE DRILLED 8/22/96
SURFACE ELEVATION 24.46 NAVD 88
NORTHING 1599284
CLIENT USEPA
PROJECT PEARCE CREEK
GEOLOGIST D. SIRKIS
EASTING 645357

DEPTH feet	SAMPLE	RECOVERY (ft)	BLOWS/FT.	PID (ppm)	GRAPHIC LOG	SOIL CLASS	DESCRIPTION AND REMARKS
						SM	brown silty SAND, trace gravel, dry
		1.0	39	NA			dark brown micaceous silty SAND
		1.0	13	NA		SW	orange fine to medium SAND, trace gravel, dry
5							
		1.0	8	NA		CL	grey soft CLAY
						SP	tan medium clean sand
		1.2	8	NA		SW	orange fine to coarse SAND, trace gravel
						GW	white SAND and GRAVEL, dry
10		1.3	15	NA			
		1.2	17	NA			
		1.1	17	NA			
15							
		1.0	22	NA			
		1.2	11	NA		SW	orange-brown fine to medium SAND, trace gravel, moist
20		1.5	8	NA			dark grey to light grey fine to coarse SAND, trace gravel
		2.0	28	NA			grey fine to coarse SAND, saturated, trace gravel to 1" maximum diameter
							brown-grey fine to coarse sand, saturated
		1.6	21	NA			more gravelly
25							
		1.7	30	NA			1" max gravel diameter
		1.7	11	NA			grey-brown fine to coarse SAND, trace gravel
30		1.6	[illegible]	NA			greenish-grey very fine to medium SAND, trace silt, saturated
							grey gravelly SAND, saturated
		2.0	37	NA			greenish-grey very fine to medium SAND, trace silt, saturated
		2.0	34	NA			as above, very fine to coarse, trace gravel
35							wood pieces, small amount of red clay, more gravel
		2.0	21	NA		CL	orange and grey CLAY with lenses of sandy clay and clayey sand
		1.2	14	NA			more orange, few lignite seams
40		1.6	27	NA			

WELL DIAGRAM

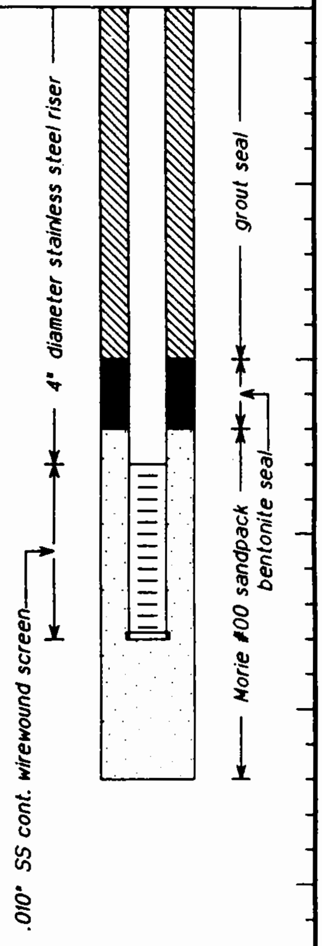


US ARMY CORP OF ENGINEERS

BORING NUMBER *CSW-11*
DATE DRILLED *8/22/96*
SURFACE ELEVATION *24.46 NAVD 88*
NORTHING *1599284*
CLIENT *USEPA*
PROJECT *PEARCE CREEK*
GEOLOGIST *D. SIRKIS*
EASTING *645357*

DEPTH feet	SAMPLE	RECOVERY (ft)	BLOWS/FT.	PID (ppm)	GRAPHIC LOG	SOIL CLASS	DESCRIPTION AND REMARKS
						CL	0.2' gravelly sand lense
		1.7	5	NA		SW	orange-brown fine to coarse SAND
							grey clay lense, gravelly sand
		0.6	9	NA		CL	orange, tan, and light grey CLAY, sandy gravel to 44.1'
45							
		1.1	27	NA			
							light grey sandy clay
		1.4	16	NA			light grey CLAY and sandy CLAY
50		1.6	17	NA			
		1.7	35	NA			
						SP	orange and tan medium SAND, saturated
		1.0	45	NA		SW	0.1' iron concretion
55							
		1.1	45	NA			
			24	NA			gravel piece
							gravel piece
60		1.0	40	NA		CL	orange-brown gravelly SAND
							red-grey stiff CLAY
-374							*Bottom of Boring at 62'*
65							
70							
75							
80							

WELL DIAGRAM

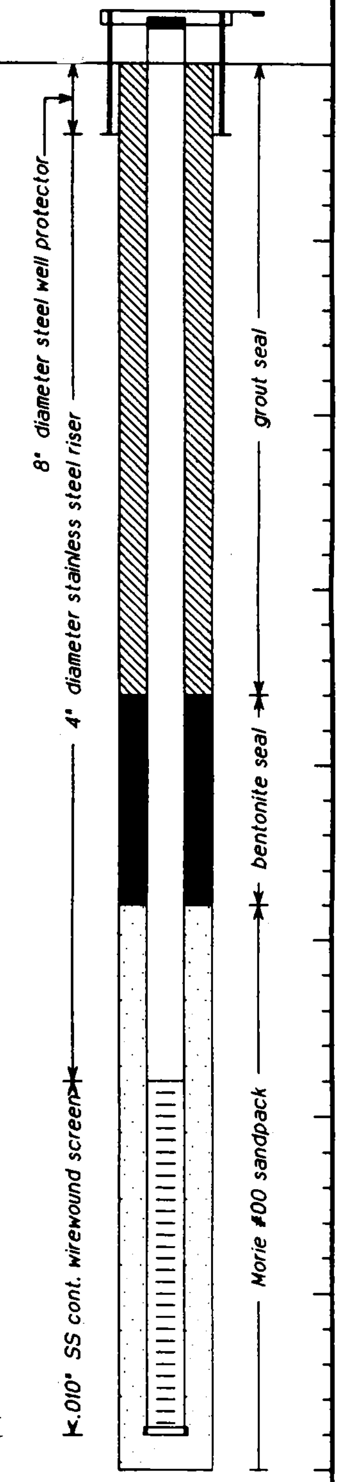


US ARMY CORP OF ENGINEERS

BORING NUMBER CSW-12
DATE DRILLED 8/14/96 - 8/22/96
SURFACE ELEVATION 39.02 NAVD 88
NORTHING 1599284
CLIENT USEPA
PROJECT PEARCE CREEK
GEOLOGIST D. SIRKIS
EASTING 641002

DEPTH feet	SAMPLE	RECOVERY (ft)	BLOWS/FT.	PID (ppm)	GRAPHIC LOG	SOIL CLASS	DESCRIPTION AND REMARKS
						OH	dark brown organic SILT, some clay
5							
							dark brown organic CLAY, some peat
		1.7	2	NA			grey silty CLAY (from cuttings), slightly micaeous, soft
10							
15							silty CLAY
20							
25							grey silty material (from cuttings)
30						SP	white and black fine grained, well sorted SAND, wet
							as above, becoming all white, trace very fine black mineral
		1.5	76	NA		SW	tan fine to medium grained silty SAND
		0.3	50	NA			
35						SP	tan medium clean SAND
							1/4" grey clay seam
		1.0	11	NA			white medium SAND with 1/4" brown clay seams
		1.0	9	NA			white fine grained SAND, trace kaolinite
40		1.3	60	NA		SW	yellow silty clay seam, trace gravel
						SP	tan fine to medium grained SAND

WELL DIAGRAM

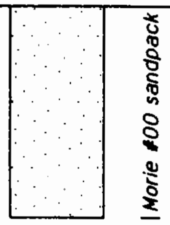


US ARMY CORP OF ENGINEERS

BORING NUMBER CSW-12
DATE DRILLED 8/14/96 - 8/22/96
SURFACE ELEVATION 39.02 NAVD 88
NORTHING 1599284
CLIENT USEPA
PROJECT PEARCE CREEK
GEOLOGIST D. SIRKIS
EASTING 641002

DEPTH feet	SAMPLE	RECOVERY (ft)	BLOWS/FT.	PID (ppm)	GRAPHIC LOG	SOIL CLASS	DESCRIPTION AND REMARKS
						SP	white fine grained SAND
		1.2	24	NA			GRAVEL (from cuttings)
						SW	grey fine to medium grained silty SAND
						OL	yellow-brown silty CLAY, some sand, trace gravel
		2.0	84	NA		SW	whitish grey fine to medium SAND, trace mica
45						SP	as above, trace silt
6.8			18	NA			light colored fine SAND (from cuttings)
							Bottom of Boring at 46'
50							
55							
60							
65							
70							
75							
80							

WELL DIAGRAM



US ARMY CORP OF ENGINEERS

BORING NUMBER *CSW-13*

DATE DRILLED *8/8/96 - 8/9/96*

SURFACE ELEVATION *18.32 NAVD 88*

NORTHING *1602744*

CLIENT *USEPA*

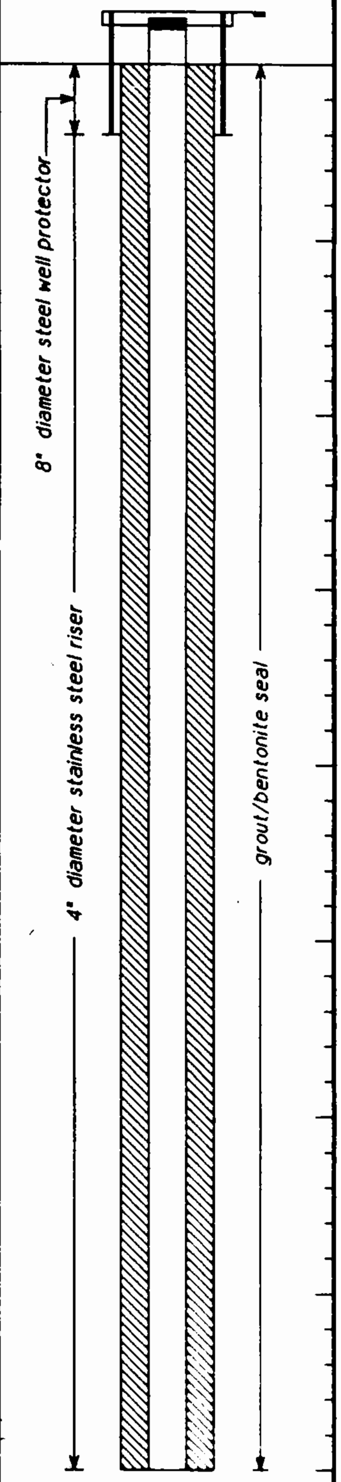
PROJECT *PEARCE CREEK*

GEOLOGIST *D. SIRKIS*

EASTING *643662*

DEPTH feet	SAMPLE	RECOVERY (ft)	BLOWS/FT.	PID (ppm)	GRAPHIC LOG	SOIL CLASS	DESCRIPTION AND REMARKS
5							
10							
15							
20							
25							
30							
35							
40							

WELL DIAGRAM

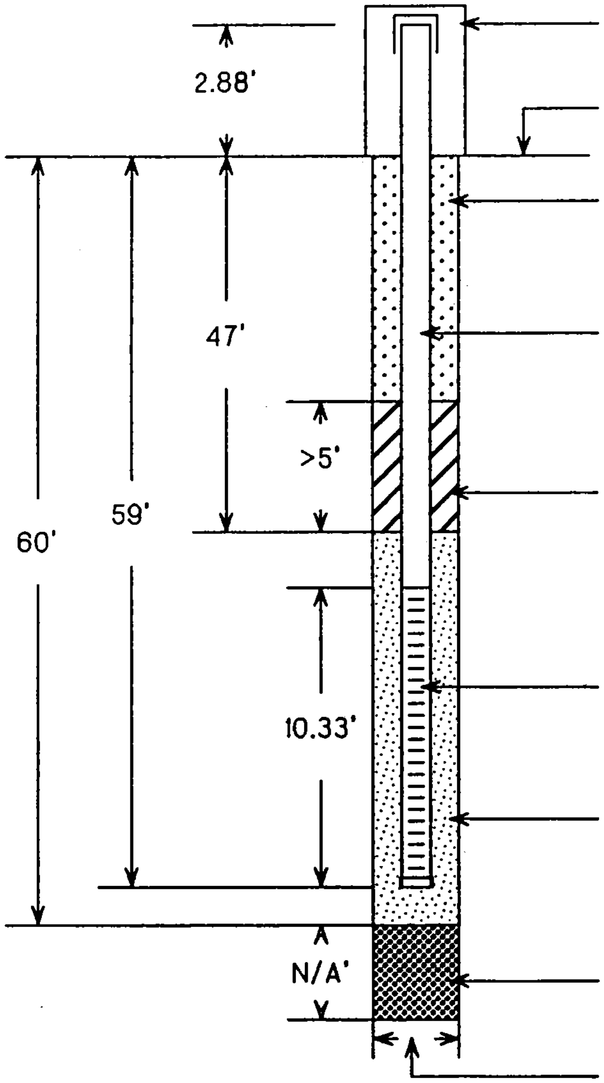


BLACK & VEATCH Special Projects Corp.

WELL INSTALLATION LOG

NO. CSW-4

CLIENT USACE - Phila. District	**PROJECT** Pearce Creek		**PROJECT NO.** 40650.001
PROJECT LOCATION West of Cecilton, MD (Cecil Co.)	**COORDINATES** N 642539.68 E 1597955.23	**TOP OF RISER ELEVATION (DATUM)** 39.13 (NAVD 88)	**DATE** 1/3/96
STRATUM MONITORED Sand		**LOGGED BY** Lusheng Yan	
CHECKED BY S.M. Cook		**APPROVED BY**	
DRILLING CONTRACTOR Uni-Tech Drilling Co.		**DRILL RIG** Failing 1500	**DRILLER** J. Jester



PROTECTIVE CASING
8 inch diameter steel locking

GROUND ELEVATION
36.25 (NAVD 88)

TYPE OF SEAL
Cement-Bentonite grout

I.D. & TYPE OF RISER PIPE
4 inch Schedule 40 PVC
Johnson/Wheelabrator

TYPE OF SEAL
Bentonite Slurry
Baroid granular bentonite

SCREEN OR OPENINGS SIZE
4 inch Sched. 40 PVC
w/0.015" slots
Timco Mfg. High-Flow 9 rows/inch

TYPE OF FILTER
Morie Co. #1
New Jersey Well Gravel (4 bags)

TYPE OF SEAL

DIAMETER
8 inches (0.67 ft.)

METHOD OF INSTALLATION:
Boring sampled at 10-12', 18-20', 20-22', 40-42', 50-52', 55-57', and 58-60'. The hole was reamed to 8". 3 centralizers were placed. Measuring point marked on top of casing.

REMARKS:
Maryland Permit #CE-94-1019. Top of casing female threaded for later extension. Well developed on 01/05/95 using a surge block and submersible pump. Final flow rate 7.5 gpm. Static water level 31.82' BTOC @ 10:58 on 03/01/96.

BLACK & VEATCH Special Projects

WELL INSTALLATION LOG

NO. CSW-5

CLIENT
USACE - Phila. District

PROJECT
Pearce Creek

PROJECT NO.
40650.001

PROJECT LOCATION
West of Cecilton, MD (Cecil Co.)

COORDINATES
N 640417.95 E 1600880.22

TOP OF RISER ELEVATION (DATUM)
47.30 (NAVD 88)

DATE
11/30/95

STRATUM MONITORED
Sand

LOGGED BY
S.M. Cook

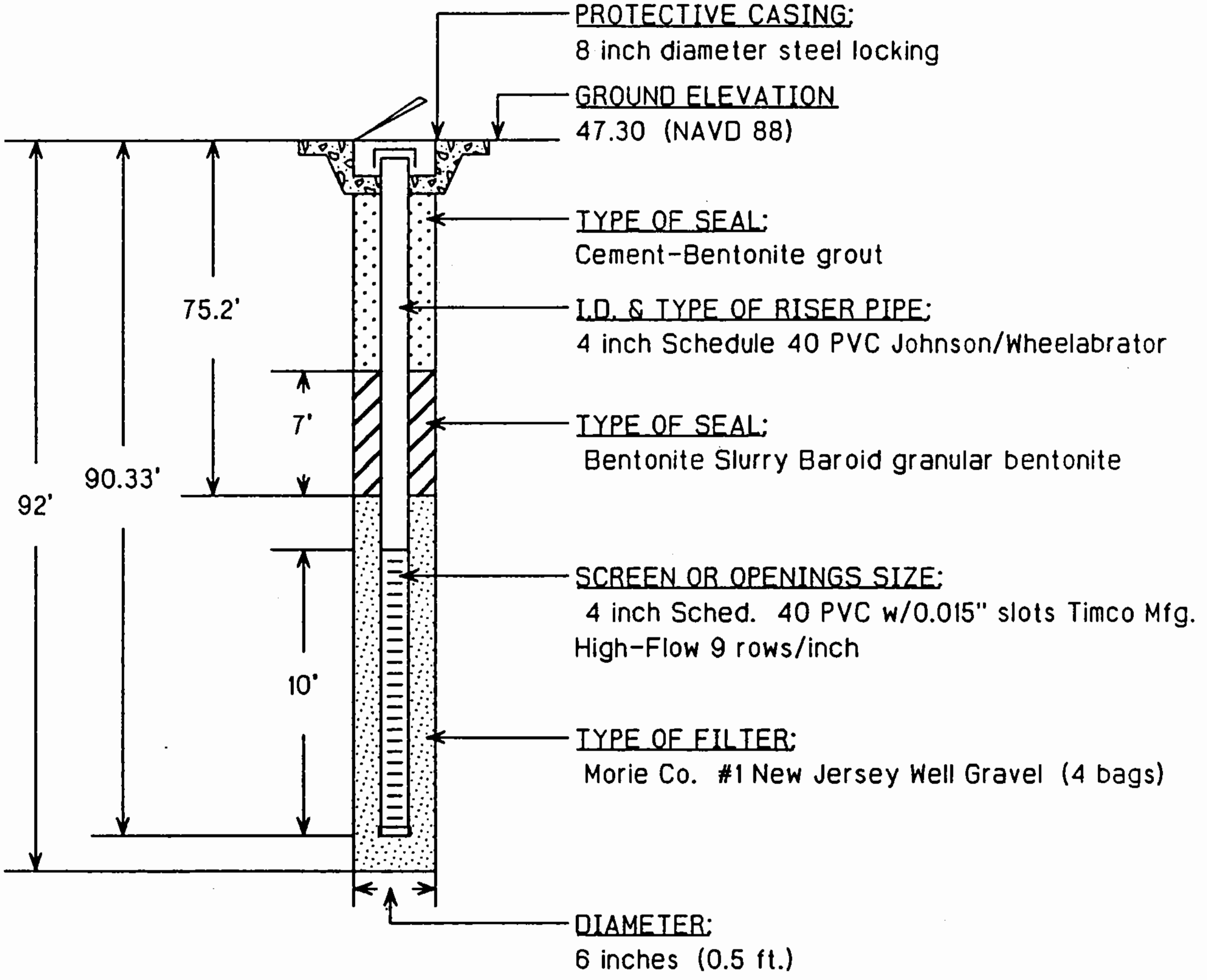
CHECKED BY
S.M. Cook

APPROVED BY

DRILLING CONTRACTOR
Uni-Tech Drilling Co.

DRILL RIG
Failing 1500

DRILLER
J. Jester



PROTECTIVE CASING:
8 inch diameter steel locking

GROUND ELEVATION
47.30 (NAVD 88)

TYPE OF SEAL:
Cement-Bentonite grout

I.D. & TYPE OF RISER PIPE:
4 inch Schedule 40 PVC Johnson/Wheelabrator

TYPE OF SEAL:
Bentonite Slurry Baroid granular bentonite

SCREEN OR OPENINGS SIZE:
4 inch Sched. 40 PVC w/0.015" slots Timco Mfg.
High-Flow 9 rows/inch

TYPE OF FILTER:
Morie Co. #1 New Jersey Well Gravel (4 bags)

DIAMETER:
6 inches (0.5 ft.)

METHOD OF INSTALLATION:
Boring sampled to 153.5 depth, grouted up to 91.5' depth on 11/29/95. On 11/30/95 reamed to 92' depth. Set screen/casing to depth, tremied filter pack to 76.5' then put 1.3' of Morie Co. #0 sand on top to form a secondary filter pack and prevent intrusion of bentonite slurry seal. Tremied slurry seal, allowed to hydrate for ~1 hour, then placed grout seal. 3 Centralizers placed. One at base, one 30' above base, one 60' above base. Flushmounted with 8 inch diameter protector, a locking cap, and 3' x 3' pad. Measuring point marked on top of casing.

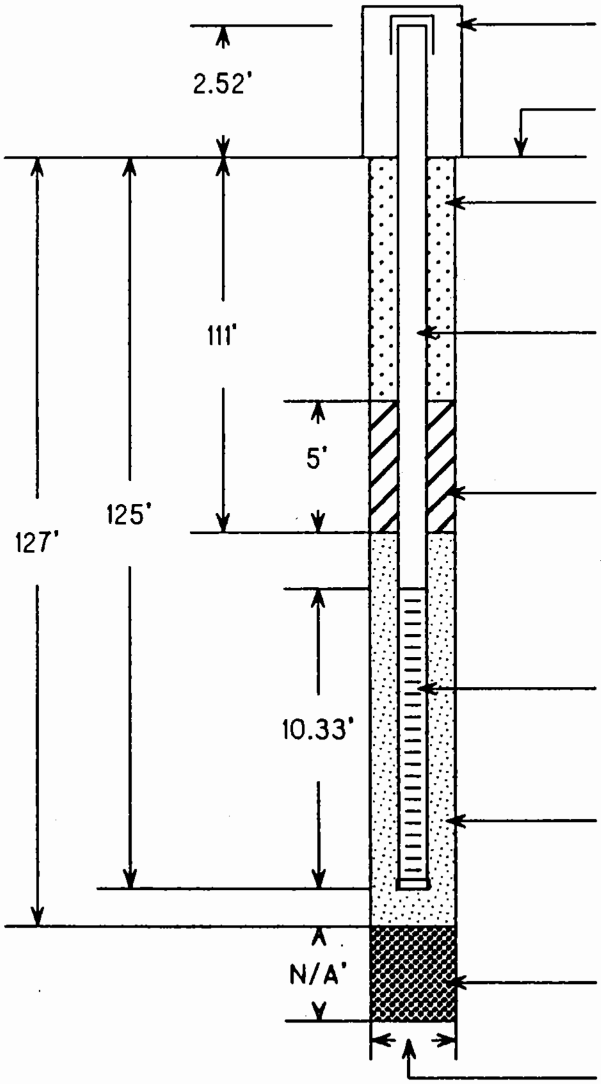
REMARKS:
Maryland Permit #CE-94-1080. Well developed on 01/24/96 using a surge block and submersible pump, Final flow rate 30+ gpm. Static water level 38.92' BTOC @ 09:07 on 03/01/96.

BLACK & VEATCH Special Projects Corp.

WELL INSTALLATION LOG

NO. CSW-9

CLIENT USACE - Phila. District	**PROJECT** Pearce Creek		**PROJECT NO.** 40650.001
PROJECT LOCATION West of Cecilton, MD (Cecil Co.)	**COORDINATES** N E	**TOP OF RISER ELEVATION (DATUM)** 30.9 (NAVD 88)	**DATE** 2/22/96
STRATUM MONITORED Sand		**LOGGED BY** S.M. Cook	
CHECKED BY S.M. Cook		**APPROVED BY**	
DRILLING CONTRACTOR Uni-Tech Drilling Co.		**DRILL RIG** Failing 1500	**DRILLER** J. Jester



PROTECTIVE CASING
8 inch diameter steel locking

GROUND ELEVATION
28.38 (NAVD 88)

TYPE OF SEAL
Cement-Bentonite grout

I.D. & TYPE OF RISER PIPE
4 inch Schedule 40 PVC
Johnson/Wheelabrator

TYPE OF SEAL
Bentonite Slurry
Baroid granular bentonite

SCREEN OR OPENINGS SIZE
4 inch Sched. 40 PVC
w/0.015" slots
Timco Mfg. High-Flow 9 rows/inch

TYPE OF FILTER
Morie Co. #1
New Jersey Well Gravel (4 bags)

TYPE OF SEAL
N/A

DIAMETER
8 inches (0.67 ft.)

METHOD OF INSTALLATION:

Boring sampled to 139' depth. Reamed to 127' depth. Held screen/casing 125' depth, tremied filter pack to 113' and placed ~2' of Morie Co. #0 sand on top to form a secondary filter pack and prevent intrusion of bentonite slurry seal. Tremied slurry seal, allowed to hydrate, then placed grout seal using tremie pipe. 4 Centralizers placed, one at 25' above base, then every thirty feet above. Placed 8 inch diameter stickup protector, a locking cap, and 3' x 3' pad. Measuring point marked on top of casing.

REMARKS:

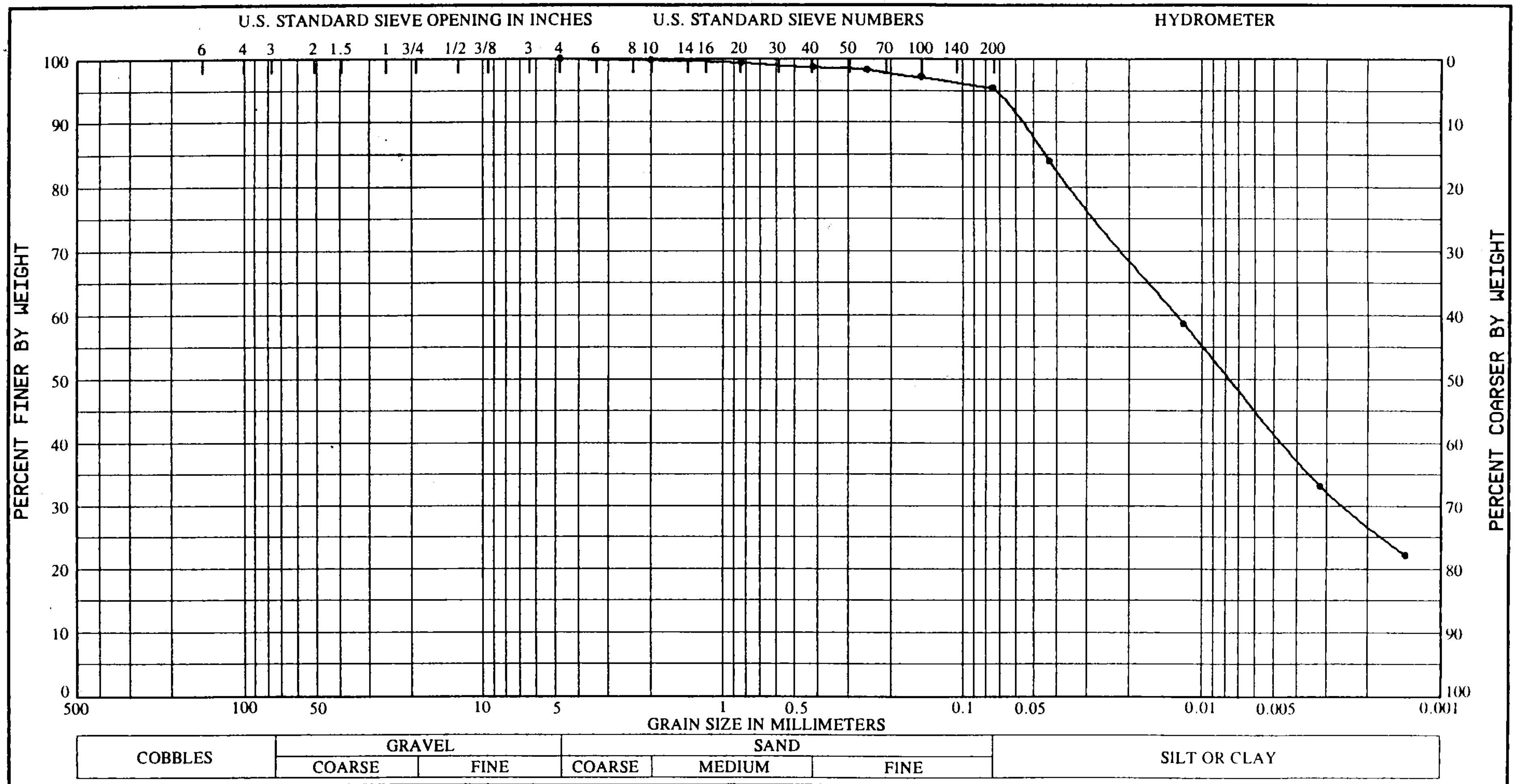
Maryland Permit #CE-94-1134 Well developed on 02/23/96 using a surge block and submersible pump. Final flow rate 10 gpm. Static water level 25.10' BTOC @ 17:06 on 03/01/96.

Appendix C

Geotechnical Testing Results

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7312
REQUISITION: CENAP-EN-94-629



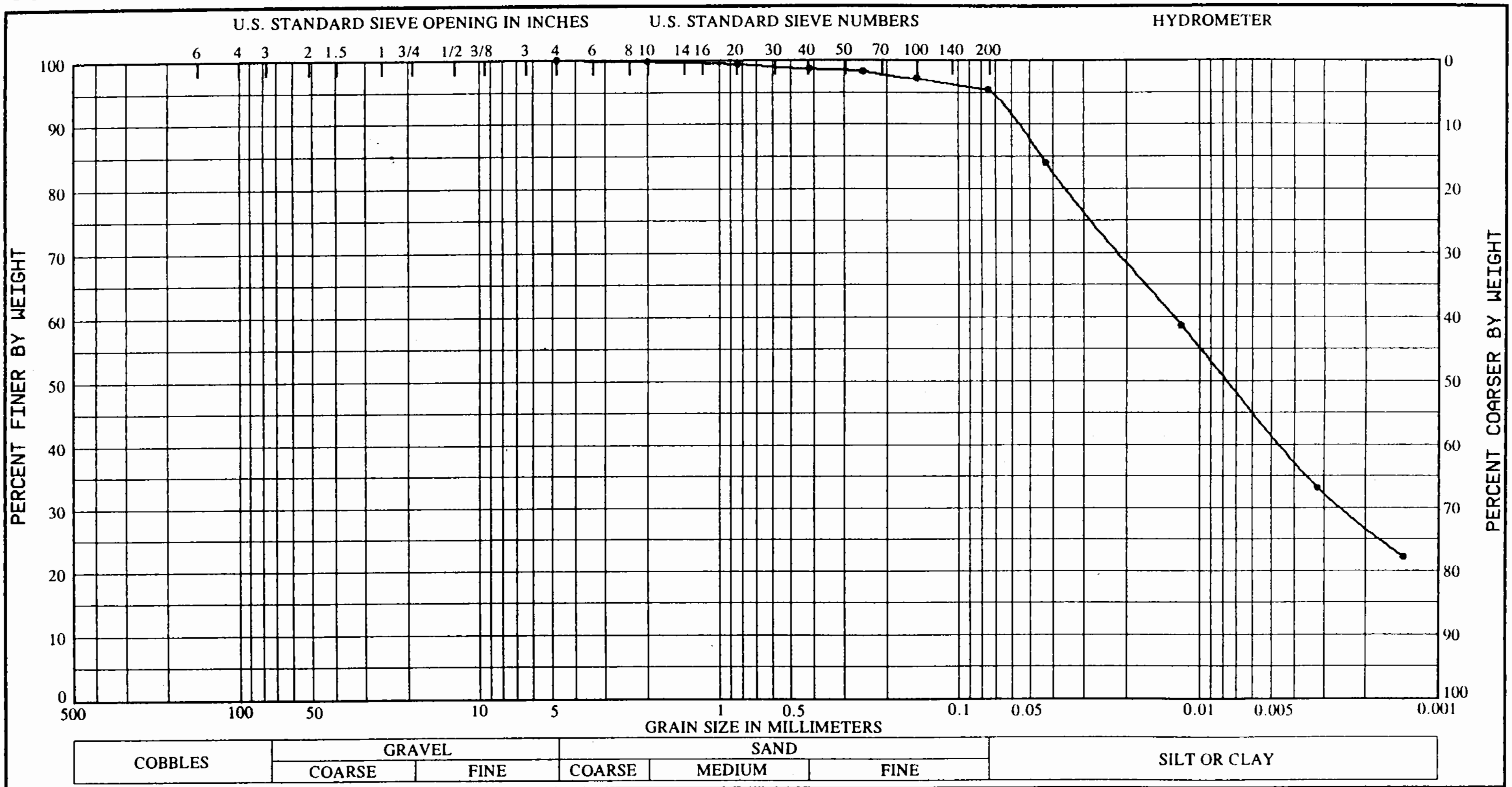
Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
U-1	16.0-18.0	GRAY, CLAYEY INORGANIC SILT HIGH LL	54.7	68	34	34
		(MH), WITH A TRACE OF SAND SIZES AND				
		MICA.				
		PI PLOTS NEAR A-LINE.				

Project PEARCE CREEK
Ground Water Investigation
Lab No. 184/1194
Boring No. CSW-2
Date 03/13/96

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7312
REQUISITION: CENAP-EN-94-629



Type of Specimen UNDISTURBED

Diam. 1.52 in. Height 2.00 in.

Class. GRAY, CLAYEY INORGANIC SILT HIGH LL (MH), WITH A TRACE OF SAND SIZES AND MICA.

LL 68 PL 34 G_s 2.55 D_{10}<0.002MM

	Before Test		After Test	
Water Content	w_o	54.7 %	w_f	58.6 %
Void Ratio	e_o	1.488	e_f	1.488
Saturation	S_o	93.8 %	S_f	100.0 %
Dry Density	γ_d	64.0 lb/ft^3	k_{20}	0.0225 $x10^{-4}cm/s$

Project PEARCE CREEK

Ground Water Investigation

Boring No. CSW-2

Sample No. U-1

Lab No. 184/1194

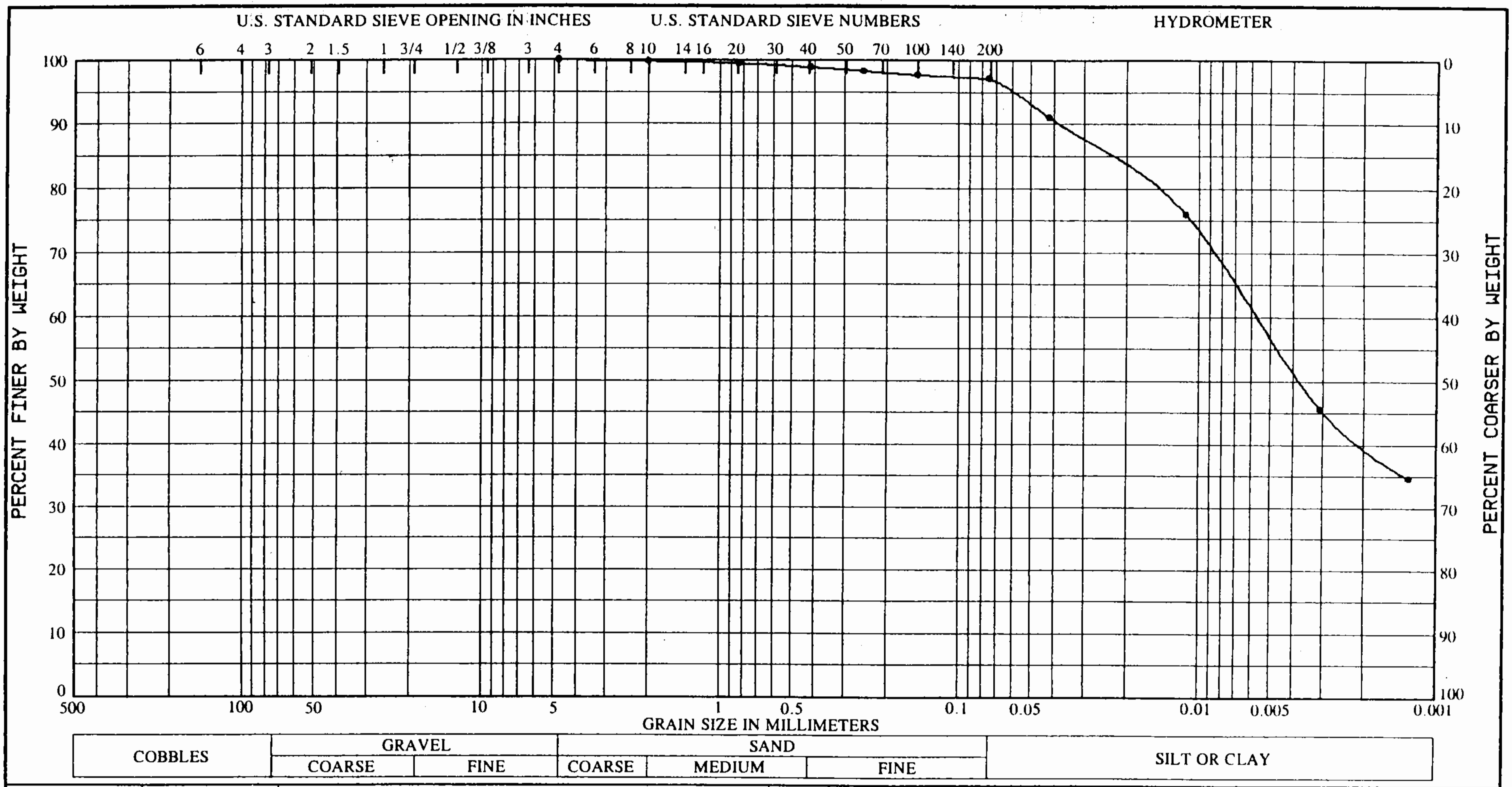
Depth (ft) 16.0-18.0

Date 03/13/96

Variable/~~Constant~~ Head PERMEABILITY TEST REPORT

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7312
REQUISITION: CENAP-EN-94-629



Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
U-2	78.0-80.0	GRAY, CLAYEY INORGANIC SILT HIGH LL	49.7	80	37	43
		(MH). WITH A TRACE OF SAND SIZES.				
		PI PLOTS NEAR A-LINE.				

Project PEARCE CREEK

Ground Water Investigation

Lab No. 184/1195

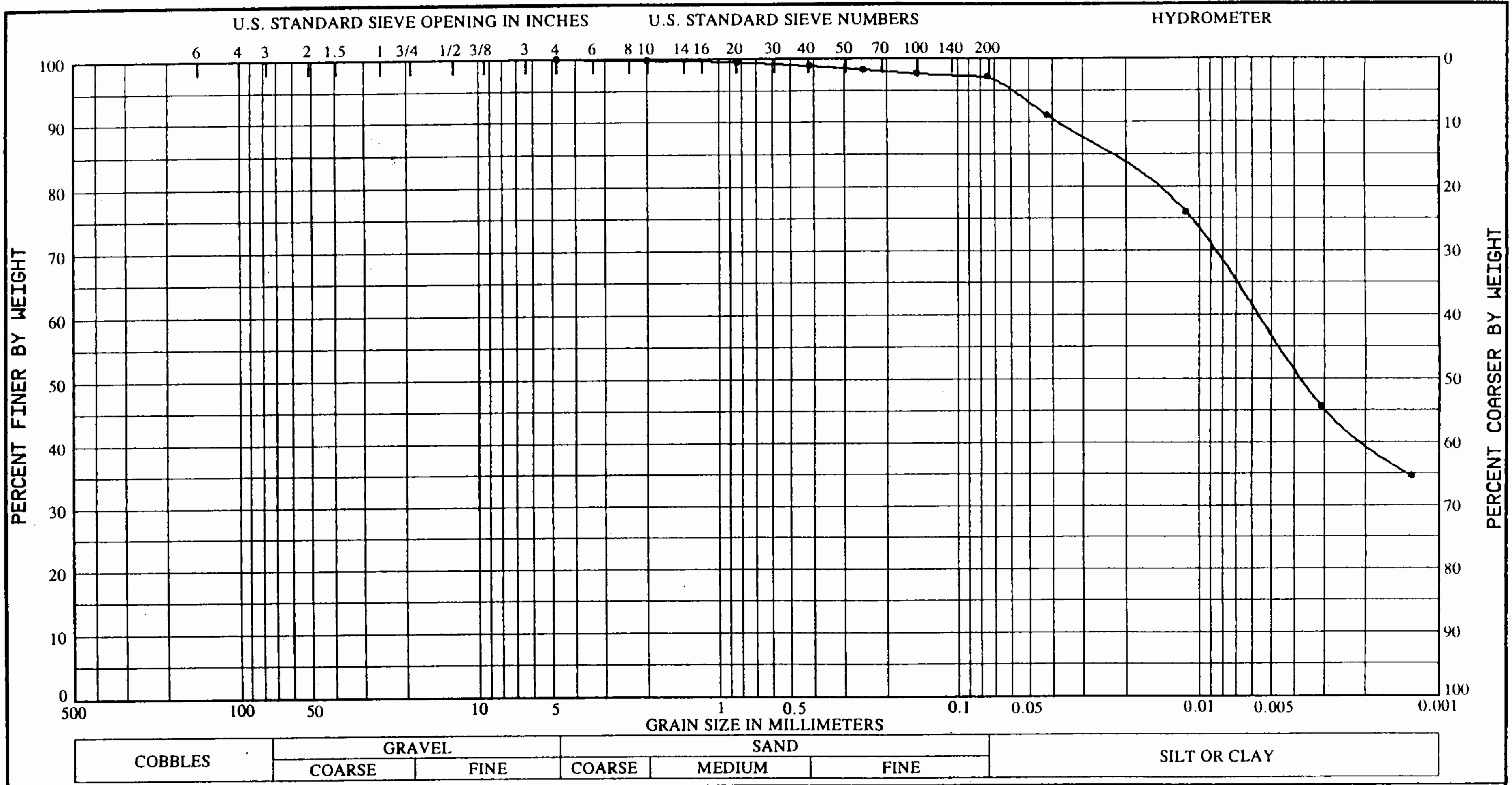
Boring No. CSW-2

Date 03/13/96

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7312
REQUISITION: CENAP-EN-94-629

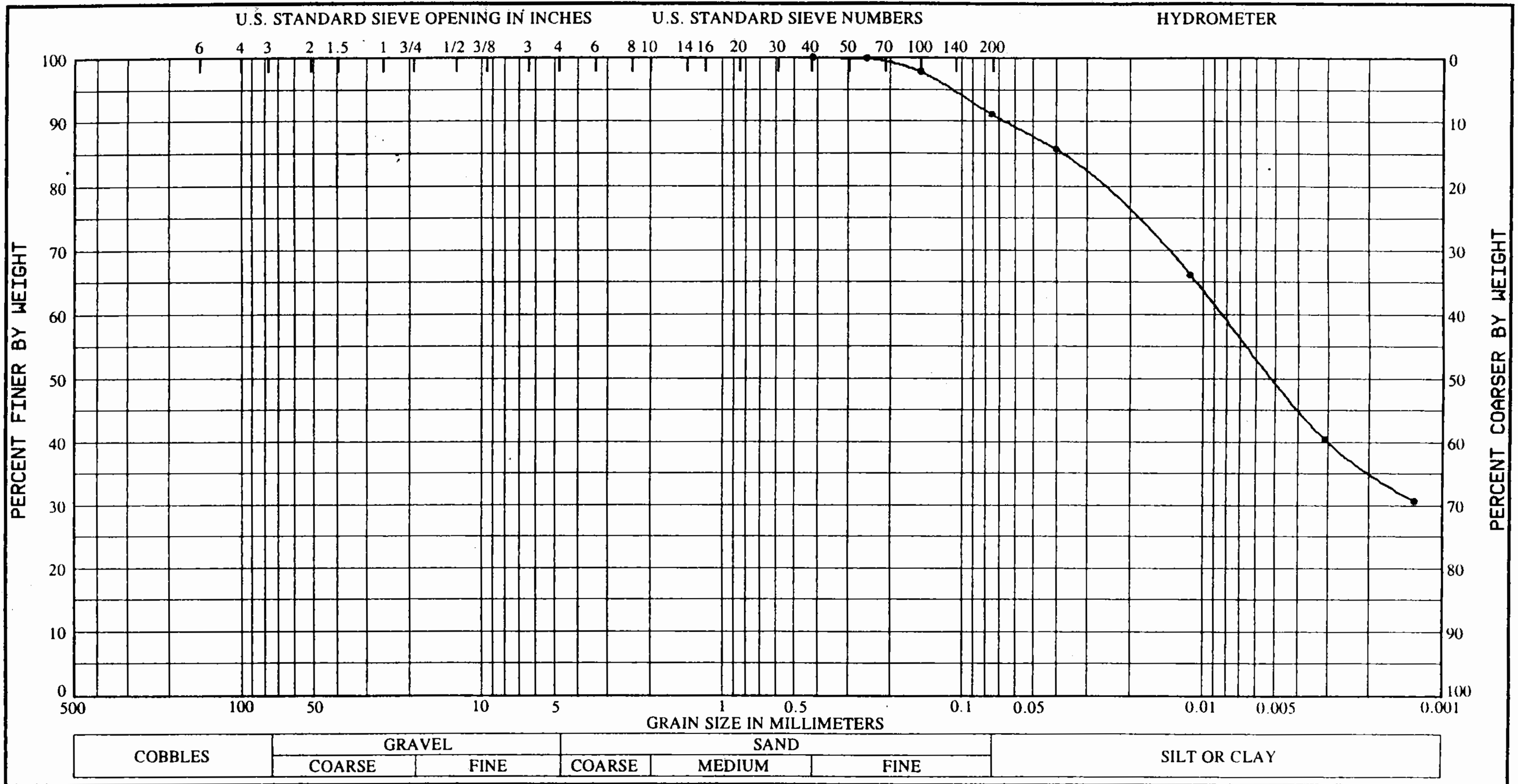


Type of Specimen UNDISTURBED				Before Test		After Test		Project PEARCE CREEK	
Diam. 1.52 in.	Height 2.00 in.		Water Content	w_0	49.7 %	w_f	51.0 %	Ground Water Investigation	
Class. GRAY, CLAYEY INORGANIC SILT HIGH LL (MH). WITH A TRACE OF SAND SIZES.			Void Ratio	e_0	1.342	e_f	1.342		
			Saturation	S_0	97.4 %	S_f	100.0 %	Boring No. CSW-2	
LL 80	PI 37	G_s 2.63	D_{10}< 0.002MM	Dry Density	γ_d	70.1 lb/ft^3	k_{20}	0.0028 x10^{-4}cm/s	Sample No. U-2	Lab No. 184/1195
								Depth (ft) 78.0-80.0	Date 03/13/96

Variable/~~Constant~~ Head PERMEABILITY TEST REPORT

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7312
REQUISITION: CENAP-EN-94-629



Sample No.	Depth (Ft)	Classification	Nat w%	LL	PL	PI
U-1	86.0-88.0	GRAY, LEAN CLAY (CL), WITH A TRACE OF SAND AND MICA.	19.1	34	20	14

Project PEARCE CREEK

Ground Water Investigation

Lab No. 184/1196

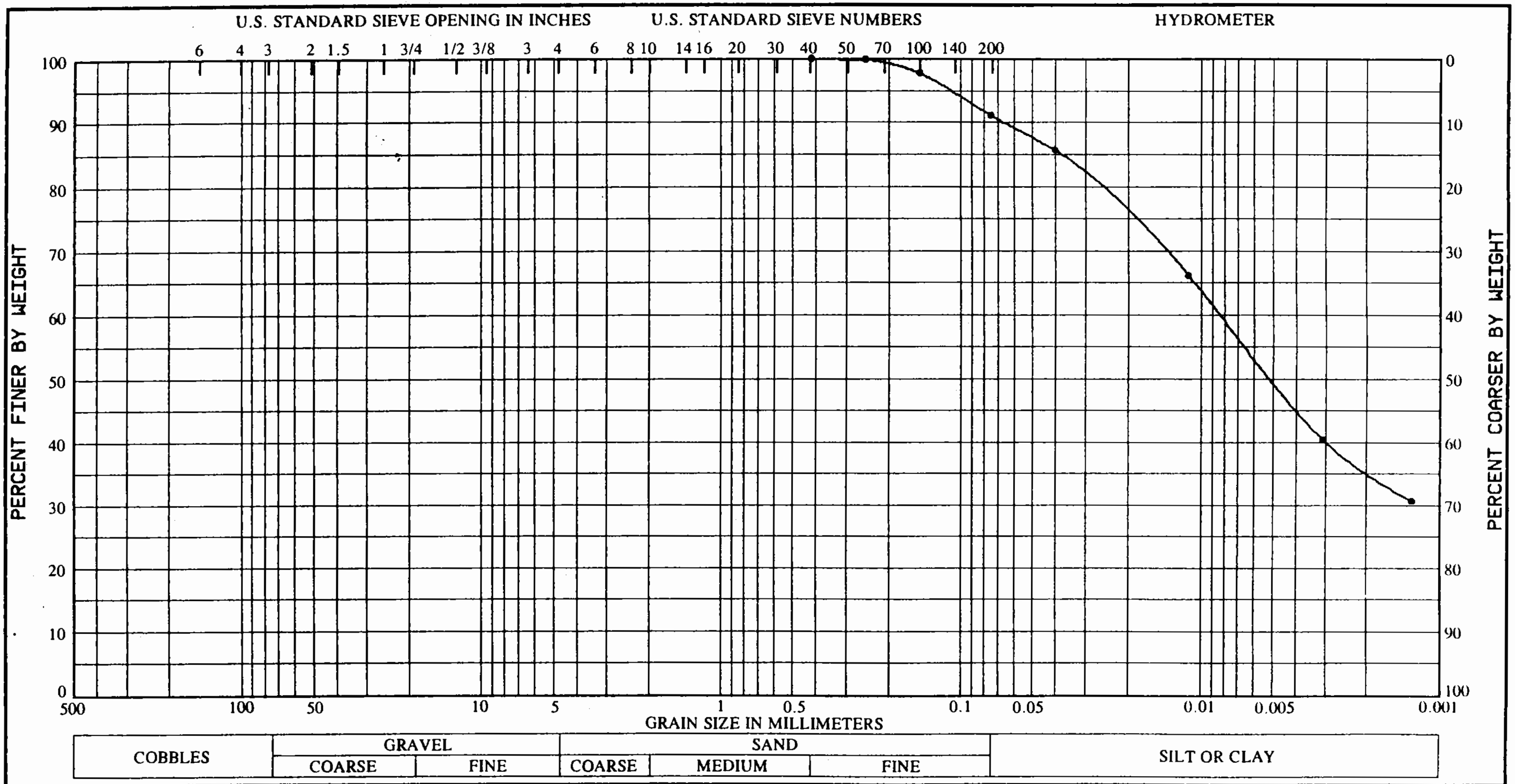
Boring No. CSW-3

Date 03/20/96

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7312
REQUISITION: CENAP-EN-94-629

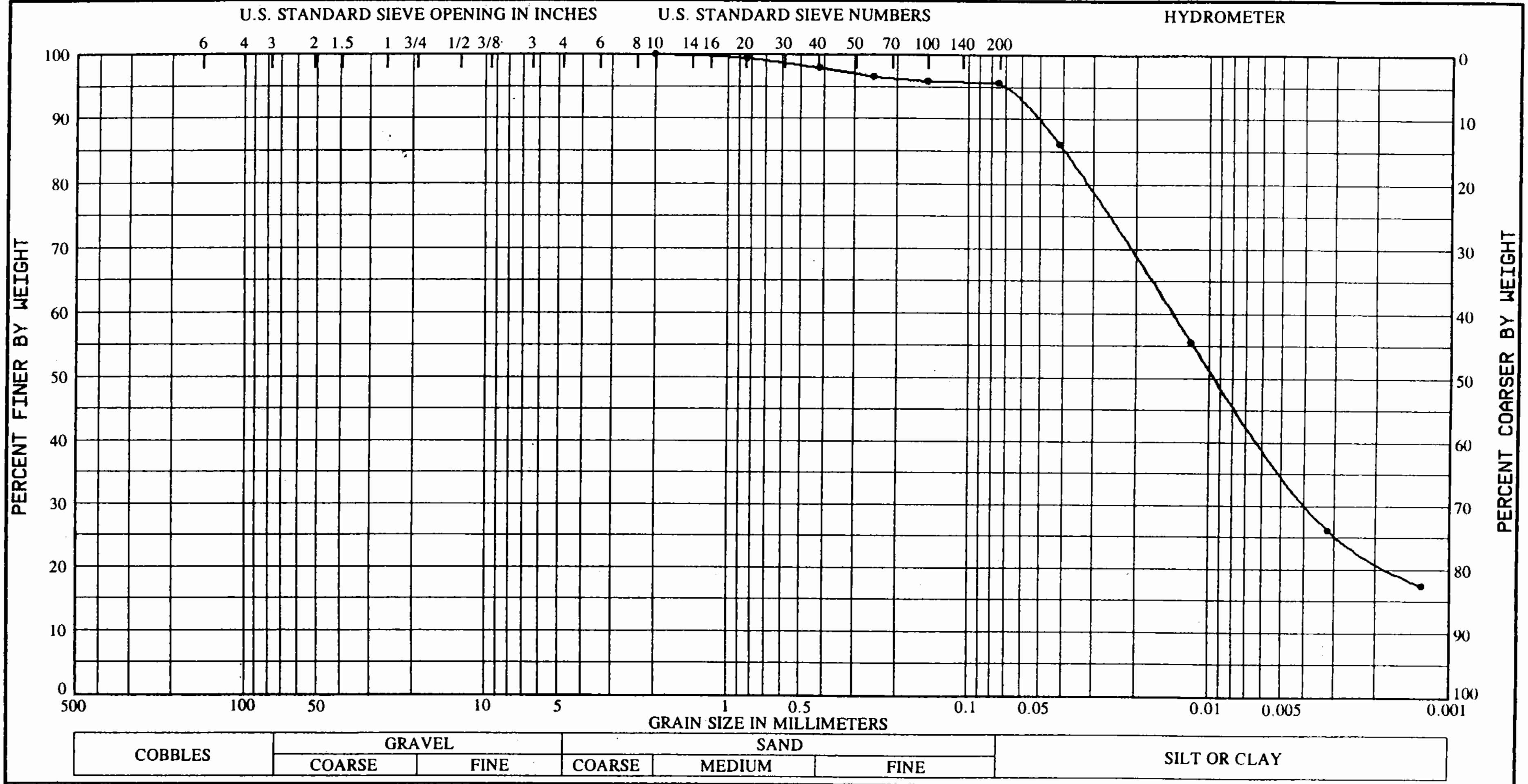


Type of Specimen UNDISTURBED					Before Test			After Test		Project PEARCE CREEK
Diam. 1.52 in.		Height 2.00 in.		Water Content	w_0	19.1 %	w_f	20.2 %		Ground Water Investigation
Class. GRAY, LEAN CLAY (CL), WITH A TRACE OF				Void Ratio	e_0	0.542	e_f	0.542		
SAND AND MICA.				Saturation	S_0	94.5 %	S_f	100.0 %		Boring No. CSW-3
LL 34	PL 20	G_s 2.69	D_{10}<0.002MM	Dry Density	γ_d	108.9 lb/ft^3	k_{20}	0.0009 x10^{-4}cm/s		Sample No. U-1 / Lab No. 184/1196
										Depth (ft) 86.0-88.0 / Date 03/21/96

Variable/~~Constant~~ Head PERMEABILITY TEST REPORT

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7312
REQUISITION: CENAP-EN-94-629



Sample No.	Depth (Ft)	Classification	Nat w%	LL	PL	PI
U-1	44.0-46.0	GRAY, SILTY FAT CLAY (CH), WITH A TRACE OF SAND AND MICA.	30.9	51	27	24

Project PEARCE CREEK

Groundwater Investigation

Lab No. 184/1197

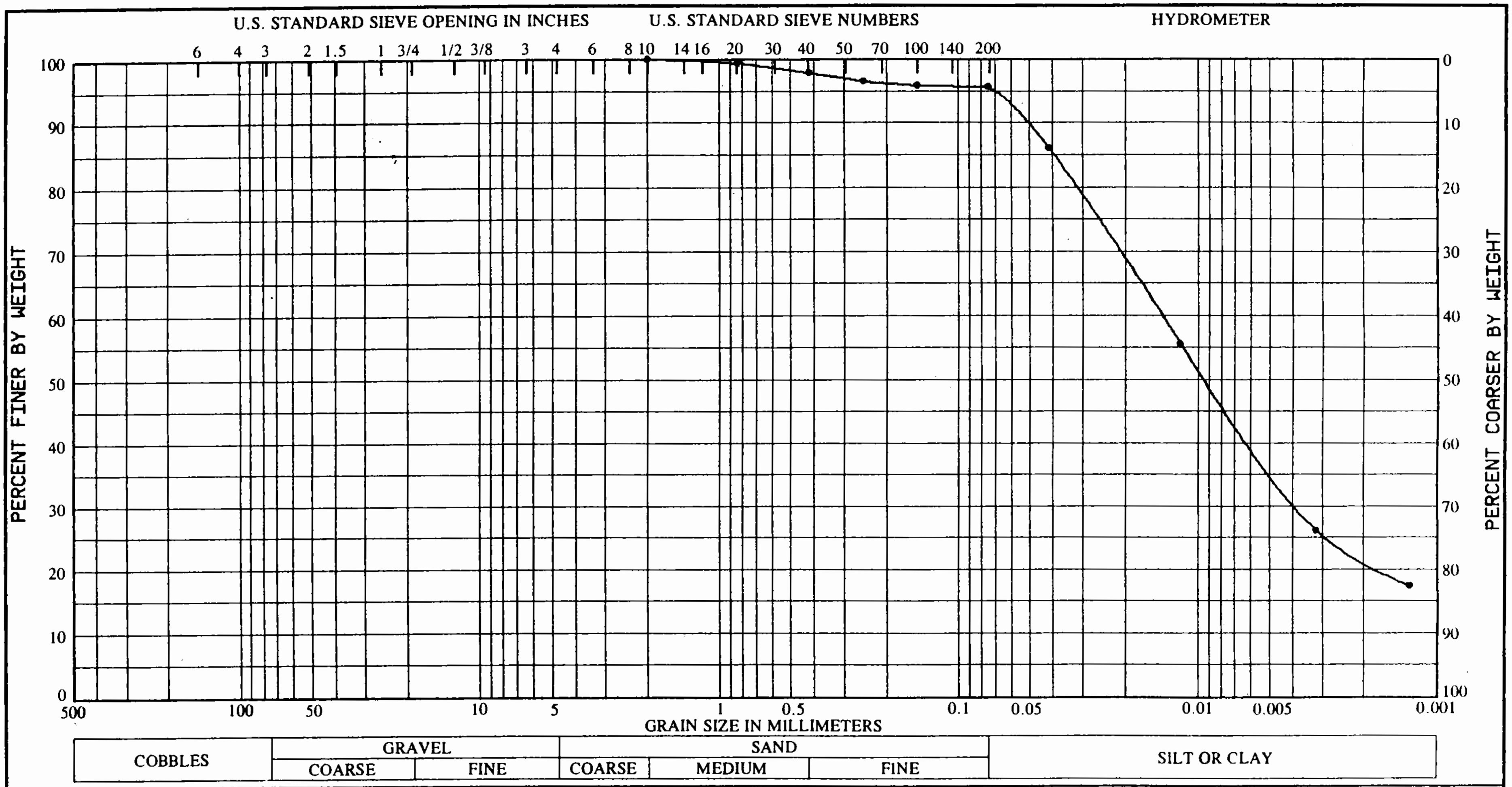
Boring No. CSW-7

Date 03/20/96

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7312
REQUISITION: CENAP-EN-94-629



Type of Specimen UNDISTURBED

Diam. 1.52 in. Height 2.00 in.

Class. GRAY, SILTY FAT CLAY (CH), WITH A TRACE OF SAND AND MICA.

LL 51 PL 27 G_s 2.67 D_{10}<0.002MM

	Before Test		After Test	
Water Content	w_0	30.9 %	w_f	33.1 %
Void Ratio	e_0	0.878	e_f	0.878
Saturation	S_0	94.0 %	S_f	100.0 %
Dry Density	γ_d	88.8 lb/ft^3	k_{20}	0.0024 x10^{-4}cm/s

Project PEARCE CREEK

Ground Water Investigation

Boring No. CSW-7

Sample No. U-1

Lab No. 184/1197

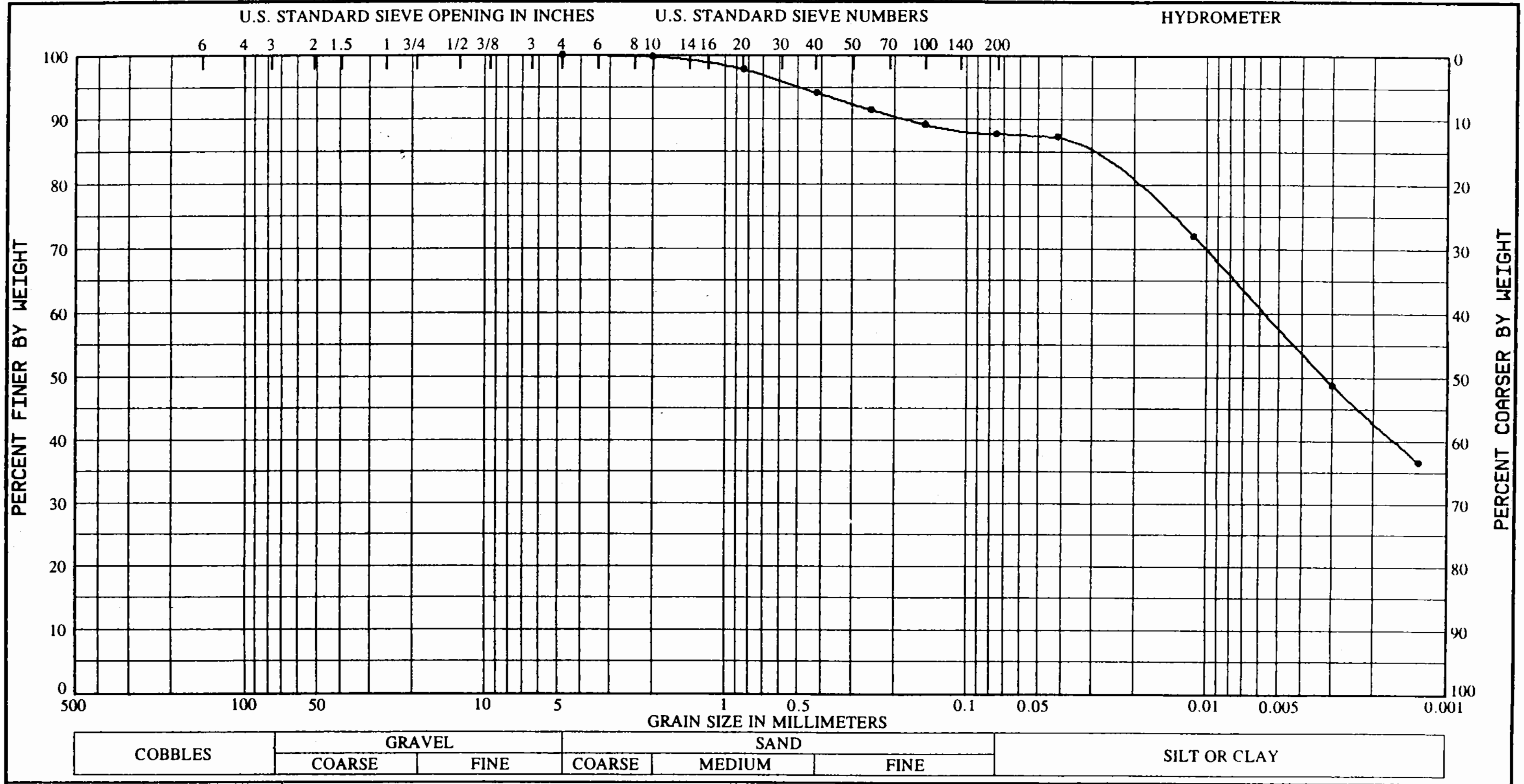
Depth (ft) 44.0-46.0

Date 03/21/96

Variable/~~Constant~~ Head PERMEABILITY TEST REPORT

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7312
REQUISITION: CENAP-EN-94-629



Sample No.	Depth (Ft)	Classification	Nat w%	LL	PL	PI
U-2	72.0-74.0	GRAY, LEAN CLAY (CL), WITH A LITTLE SAND SIZES AND A TRACE OF MICA.	**30.9**	49	28	21

Project PEARCE CREEK

Ground Water Investigation

Lab No. 184/1198

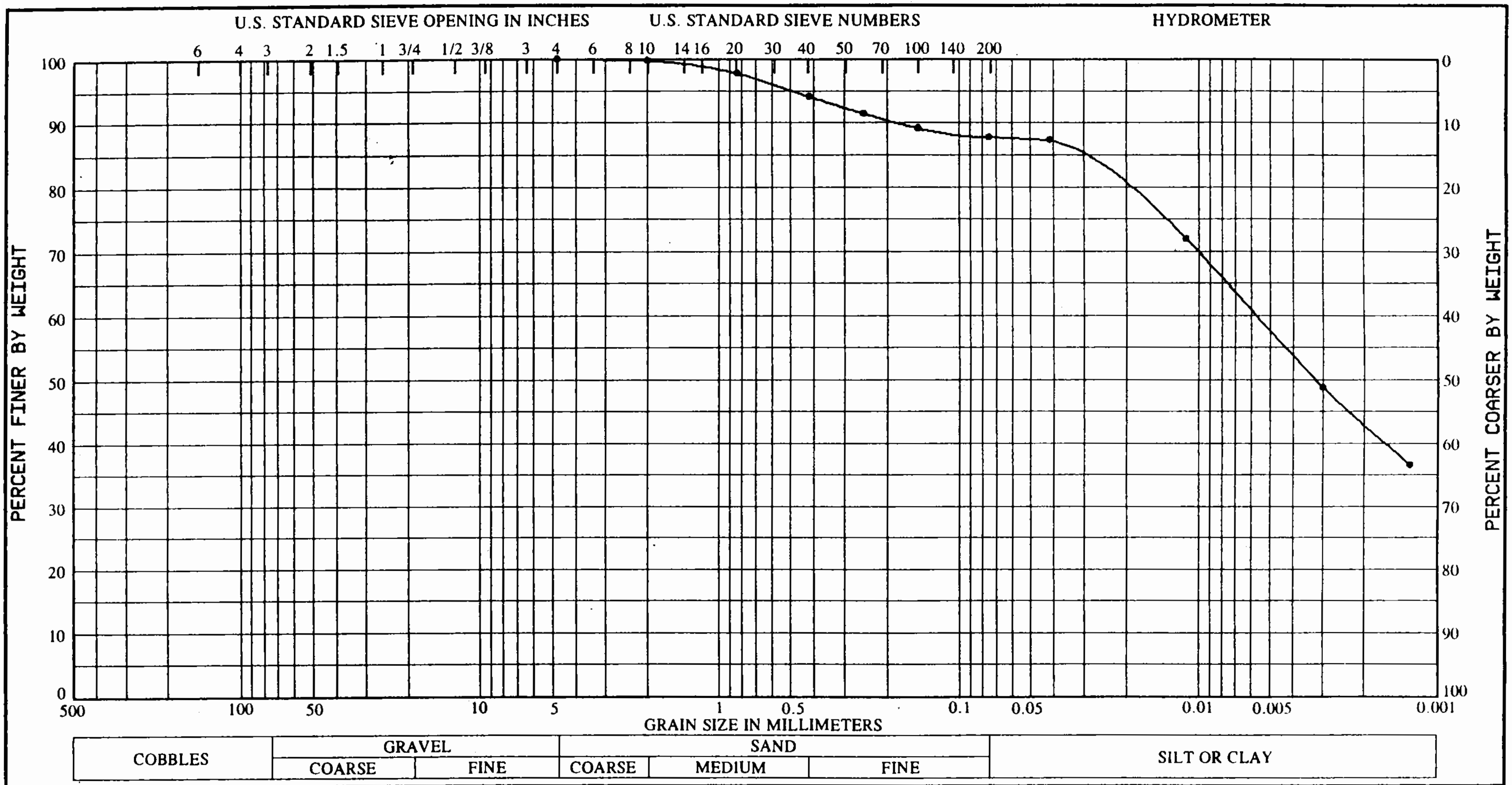
Boring No. CSW-7

Date 03/20/96

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7312
REQUISITION: CENAP-EN-94-629



Type of Specimen UNDISTURBED			Before Test			After Test		Project PEARCE CREEK
Diam. 1.52 in.	Height 2.00 in.		Water Content	w_0	30.9 %	w_f	32.2 %	Ground Water Investigation
Class. GRAY, LEAN CLAY (CL), WITH A LITTLE SAND			Void Ratio	e_0	0.870	e_f	0.870	
SIZES AND A TRACE OF MICA.			Saturation	S_0	95.9 %	S_f	100.0 %	Boring No. CSW-7
LL 49	PL 28	G_s 2.70	D_{10} < 0.002MM	Dry Density γ_d	90.1 lb/ft^3	k_{20}	0.0008 x10^{-4}cm/s	Sample No. U-2 / Lab No. 184/1198
								Depth (ft) 72.0-74.0 / Date 03/21/96

Variable/~~Constant~~ Head PERMEABILITY TEST REPORT

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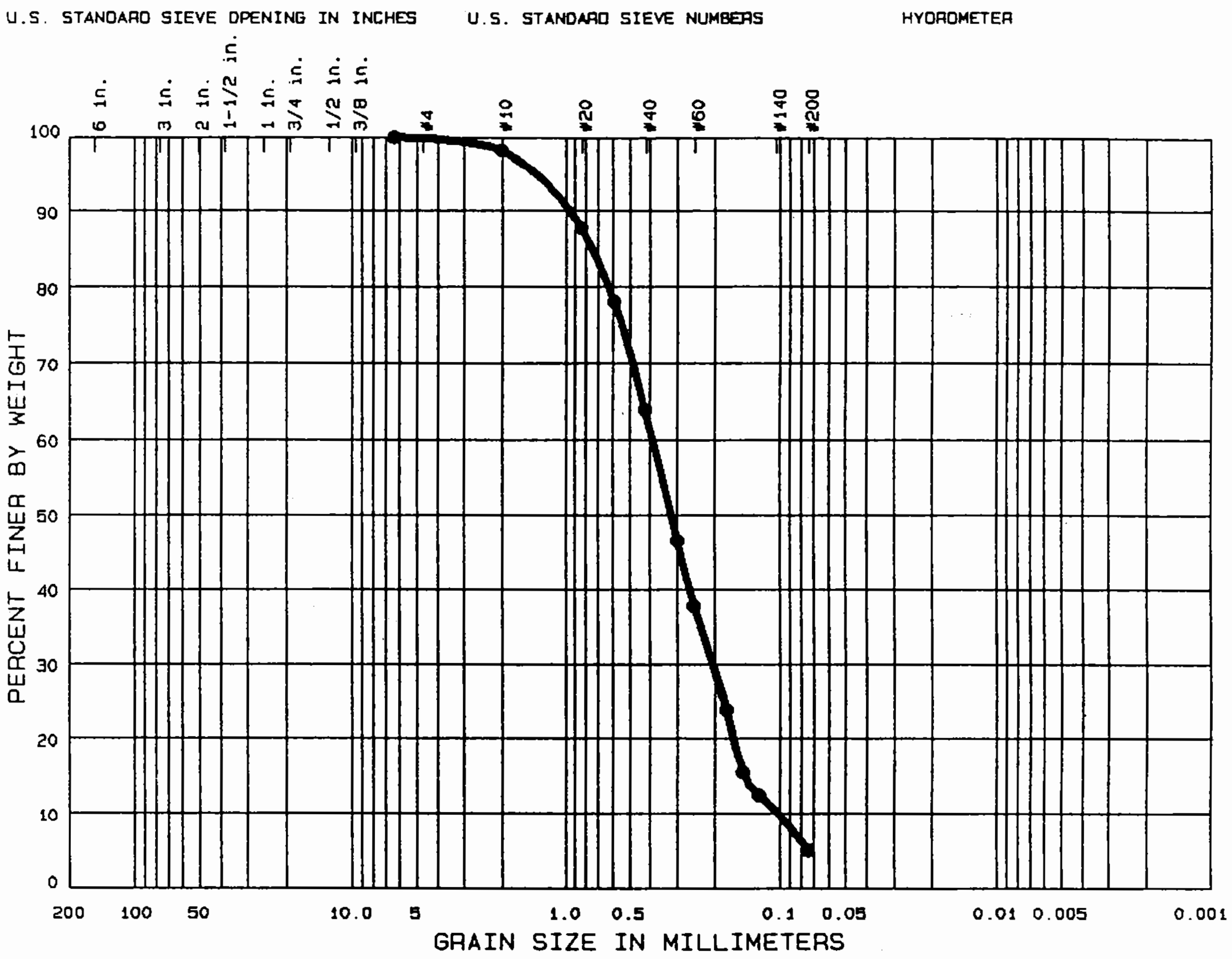
================================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA         Test No.: 2
--------------------------------------------------------------------------------
Date:           2 January 91
W.O. No.:       PEARCE CREEK, MD
Req. No.:
Contract No.:
Project line 1  PEARCE CREEK DISPOSAL AREA
Project line 2  GROUND WATER STUDY
Area line 1:
Area line 2:
Boring No.:     CSW-1

--------------------------------------------------------------------------------
                                     Sample Data
--------------------------------------------------------------------------------
Lab No.:
Sample No.:     SPT-19,20,&21
Elev or Depth:  40'-41.5'
Class 1::
Class 2::
Natural water content:                  Liquid limit:
Plastic limit:
--------------------------------------------------------------------------------
                              Mechanical Analysis Data
--------------------------------------------------------------------------------
                          Initial     After wash
Dry sample and tare=    682.40        666.60
Tare              =     295.50        295.50
Dry sample weight  =    386.90        371.10
Minus #200 from wash=    4.1 %
Sieve tare method
  Sieve              Weight       Sieve     Percent
                     retained     tare      finer
  0.25  inches         0.30        0.00      99.9
  # 10                 6.80        0.00      98.2
  # 20                40.60        0.00      87.7
  # 30                37.30        0.00      78.0
  # 40                55.00        0.00      63.8
  # 50                67.40        0.00      46.4
  # 60                33.30        0.00      37.8
  # 80                54.40        0.00      23.7
  # 100               31.90        0.00      15.5
  # 120               11.70        0.00      12.5
  # 200               28.40        0.00       5.1
--------------------------------------------------------------------------------
                               Fractional Components
--------------------------------------------------------------------------------
% + 3 in. =  0.0     % GRAVEL =  0.2    % SAND = 94.7
% FINES =  5.1

D85=   0.75  D60=   0.388  D50=    0.318
D30=   0.2049  D15=   0.14672  D10=  0.10151
Cc =   1.0666  Cu =   3.8194
```

W.O. No. PEARCE CREEK, MD
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.2	94.7	5.1

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-19, 20, &21	40'-41.5'					1.07	3.8

CLASSIFICATION

●

Remarks:

Project PEARCE CREEK DISPOSAL AREA
GROUND WATER STUDY
Lab No.
Area
Boring No. CSW-1
Date 2 January 91

GRADATION CURVES

DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET

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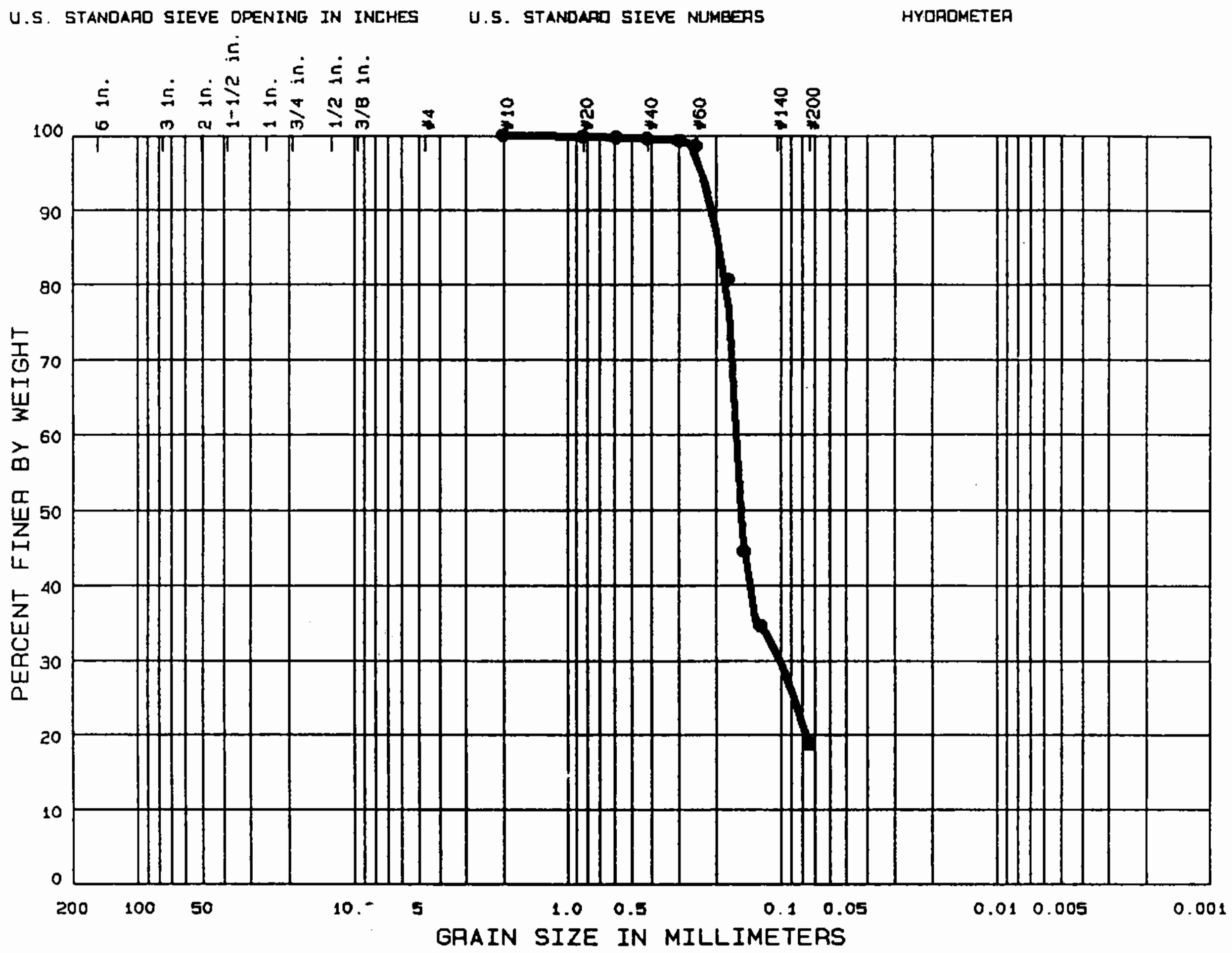
================================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA          Test No.: 2
--------------------------------------------------------------------------------
Date:           2 January 91
W.O. No.:       PEARCE CREEK, MD
Req. No.:
Contract No.:
Project line 1  PEARCE CREEK DISPOSAL AREA
Project line 2  GROUND WATER STUDY
Area line 1:
Area line 2:
Boring No.:     CSW-1

--------------------------------------------------------------------------------
                                  Sample Data
--------------------------------------------------------------------------------
Lab No.:
Sample No.:     SPT-46
Elev or Depth:  92'-93.3'
Class 1::
Class 2::
Natural water content:                  Liquid limit:
Plastic limit:
--------------------------------------------------------------------------------
                            Mechanical Analysis Data
--------------------------------------------------------------------------------
                     Initial     After wash
Dry sample and tare=   625.90       575.20
Tare               =   308.20       308.20
Dry sample weight  =   317.70       267.00
Minus #200 from wash=  16.0 %
Sieve tare method
  Sieve               Weight       Sieve    Percent
                      retained     tare     finer
  # 10                  0.10         0.00     100.0
  # 20                  0.50         0.00      99.8
  # 30                  0.40         0.00      99.7
  # 40                  0.40         0.00      99.6
  # 50                  0.90         0.00      99.3
  # 60                  2.20         0.00      98.6
  # 80                 56.80         0.00      80.7
  # 100               114.90         0.00      44.5
  # 120                31.70         0.00      34.6
  # 200                50.20         0.00      18.8
--------------------------------------------------------------------------------
                             Fractional Components
--------------------------------------------------------------------------------
% + 3 in. =   0.0     % GRAVEL =   0.0    % SAND = 81.2
% FINES = 18.8

D85=    0.19  D60=    0.163  D50=    0.155
D30=    0.1017
```

W.O. No. PEARCE CREEK, MD
Req. No.
Contract No.

DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	81.2	18.8

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-46	92'-93.3'						

CLASSIFICATION

●

Remarks:

Project PEARCE CREEK DISPOSAL AREA
GROUND WATER STUDY
Lab No.
Area

Boring No. CSW-1 Date 2 January 91

GRADATION CURVES

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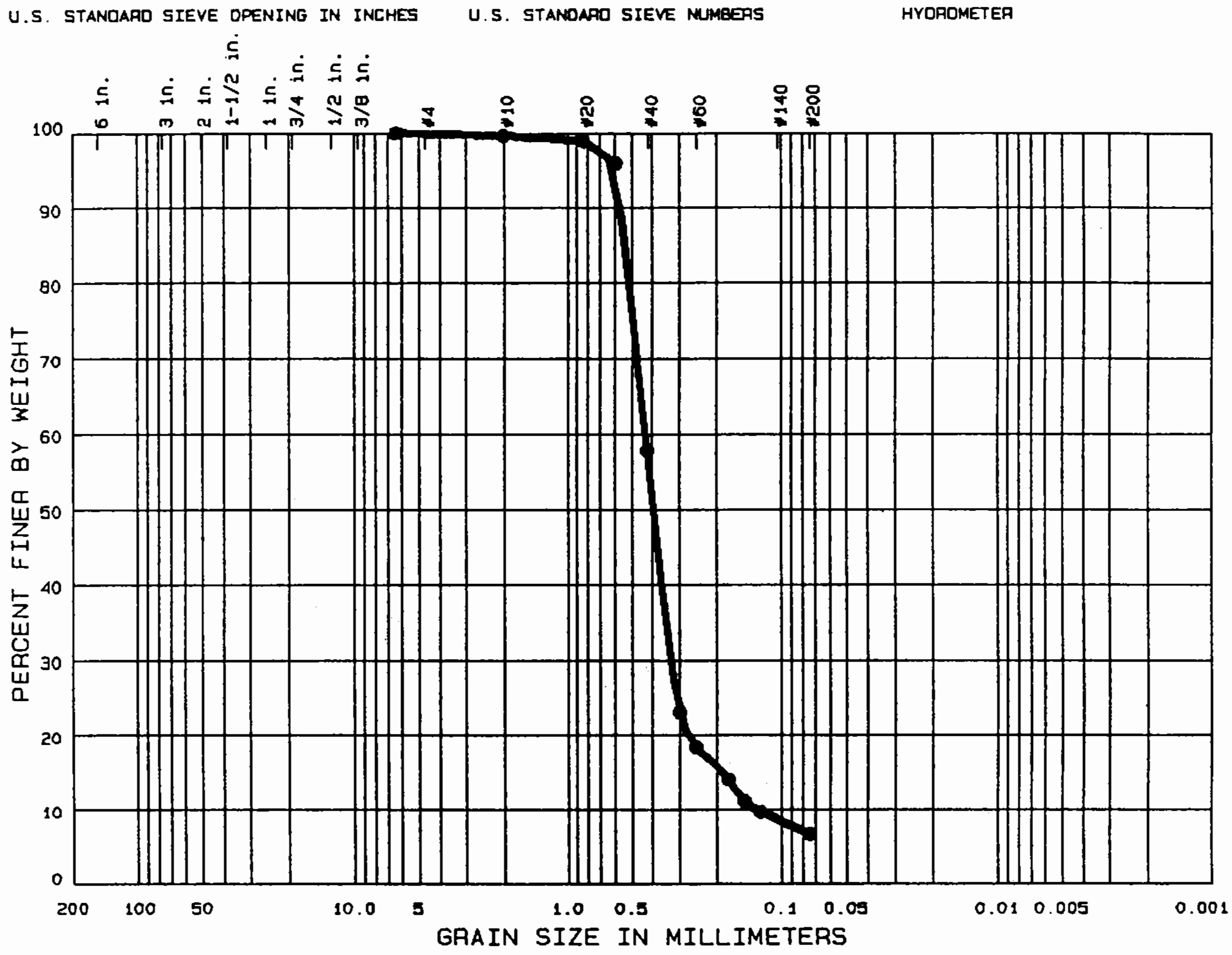
================================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA          Test No.: 2
--------------------------------------------------------------------------------
Date:            2 January 91
W.O. No.:        PEARCE CREEK, MD
Req. No.:
Contract No.:
Project line 1   PEARCE CREEK DISPOSAL AREA
Project line 2   GROUND WATER STUDY
Area line 1:
Area line 2:
Boring No.:      CSW-1

--------------------------------------------------------------------------------
                                   Sample Data
--------------------------------------------------------------------------------
Lab No.:
Sample No.:      SPT-53
Elev or Depth:   106'-107.5'
Class 1::
Class 2::
Natural water content:                    Liquid limit:
Plastic limit:
--------------------------------------------------------------------------------
                              Mechanical Analysis Data
--------------------------------------------------------------------------------
                         Initial     After wash
Dry sample and tare=    465.40        454.90
Tare               =    298.40        298.40
Dry sample weight  =    167.00        156.50
Minus #200 from wash=    6.3 %
Sieve tare method
  Sieve              Weight       Sieve    Percent
                     retained     tare     finer
  0.25  inches         0.10        0.00      99.9
  # 10                 0.60        0.00      99.6
  # 20                 1.10        0.00      98.9
  # 30                 5.00        0.00      95.9
  # 40                63.60        0.00      57.8
  # 50                58.10        0.00      23.1
  # 60                 7.80        0.00      18.4
  # 80                 7.30        0.00      14.0
  # 100                4.80        0.00      11.1
  # 120                2.40        0.00       9.7
  # 200                5.10        0.00       6.6
--------------------------------------------------------------------------------
                                Fractional Components
--------------------------------------------------------------------------------
% + 3 in. =  0.0     % GRAVEL =  0.1    % SAND = 93.2
% FINES =  6.7

D85=   0.54  D60=   0.429  D50=   0.395
D30=   0.3281  D15=   0.18880  D10=  0.13062
Cc =   1.9231  Cu =   3.2810
```

DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET

W.O. No. PEARCE CREEK, MD
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.1	93.2	6.7

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-53	106'-107.5'					1.92	3.3

CLASSIFICATION

●

Remarks:

Project PEARCE CREEK DISPOSAL AREA
GROUND WATER STUDY
Lab No.
Area
Boring No. CSW-1
Date 2 January 91

GRADATION CURVES

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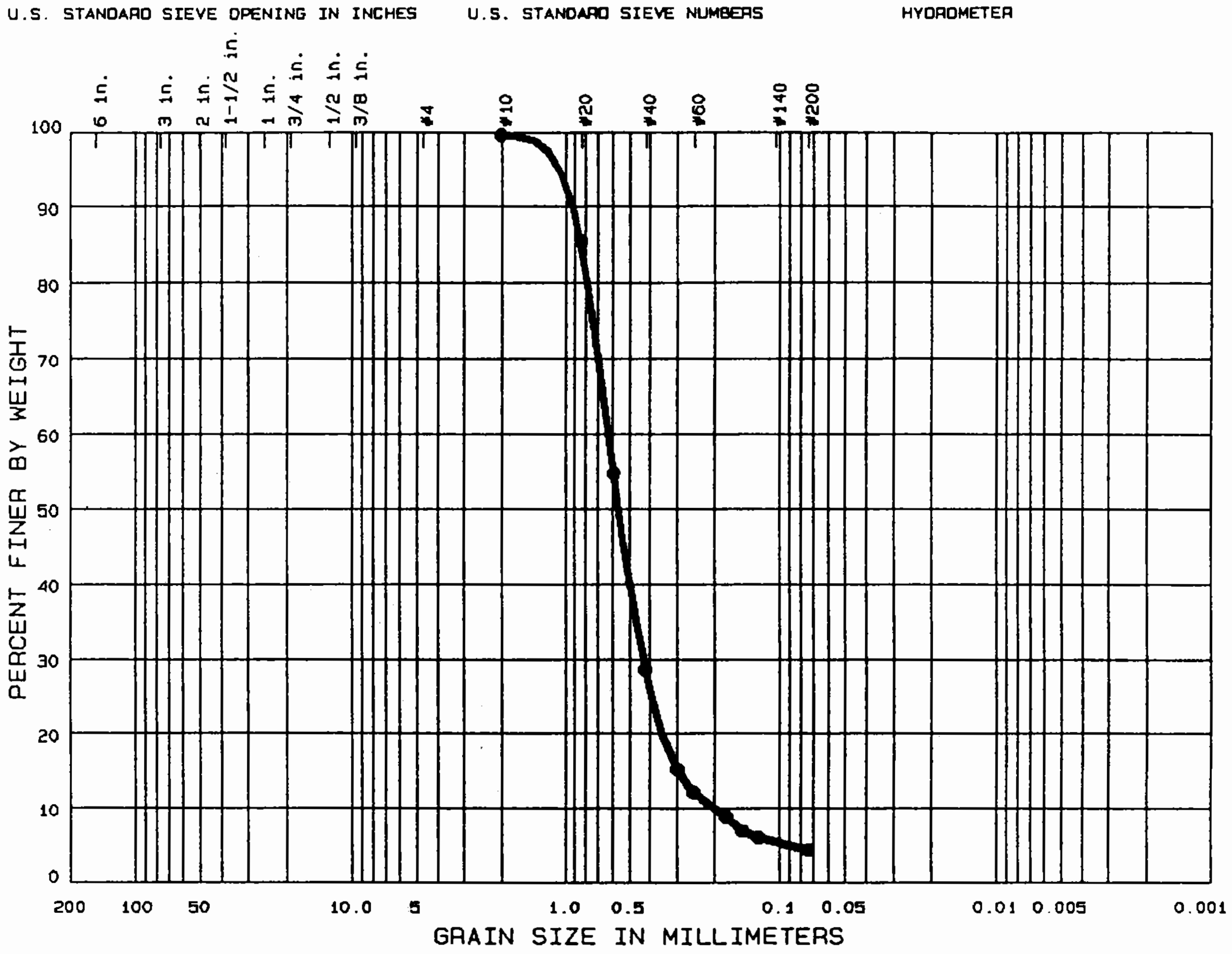
==============================================================================
                           GRAIN SIZE DISTRIBUTION TEST DATA         Test No.: 2
------------------------------------------------------------------------------
Date:           \
W.O. No.:       PEARCE CREEK, MD
Req. No.:
Contract No.:
Project line 1  PEARCE CREEK DISPOSAL AREA
Project line 2  GROUND WATER STUDY
Area line 1:
Area line 2:
Boring No.:     CSW-1

------------------------------------------------------------------------------
                                     Sample Data
------------------------------------------------------------------------------
Lab No.:
Sample No.:     SPT-65
Elev or Depth:  130'-131.5'
Class 1::
Class 2::
Natural water content:                   Liquid limit:
Plastic limit:
------------------------------------------------------------------------------
                               Mechanical Analysis Data
------------------------------------------------------------------------------
                     Initial     After wash
Dry sample and tare=   627.40        613.70
Tare               =   296.00        296.00
Dry sample weight  =   331.40        317.70
Minus #200 from wash=    4.1 %
Sieve tare method
  Sieve             Weight      Sieve     Percent
                    retained    tare      finer
  # 10                1.50      0.00       99.5
  # 20               46.80      0.00       85.4
  # 30              101.90      0.00       54.7
  # 40               86.60      0.00       28.5
  # 50               44.30      0.00       15.2
  # 60               10.00      0.00       12.2
  # 80               11.00      0.00        8.8
  # 100               6.30      0.00        6.9
  # 120               2.90      0.00        6.1
  # 200               5.80      0.00        4.3
------------------------------------------------------------------------------
                                Fractional Components
------------------------------------------------------------------------------
% + 3 in. =  0.0    % GRAVEL =  0.0   % SAND = 95.7
% FINES =  4.3

D85=    0.83  D60=    0.626  D50=    0.560
D30=    0.4295  D15=    0.29376  D10=   0.19634
Cc =    1.5014  Cu =    3.1879
```

W.O. No. PEARCE CREEK, MD
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	95.7	4.3

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-65	130'-131.5'					1.50	3.2

CLASSIFICATION

●

Remarks:

Project PEARCE CREEK DISPOSAL AREA
GROUND WATER STUDY
Lab No.
Area
Boring No. CSW-1 Date \

GRADATION CURVES

DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET

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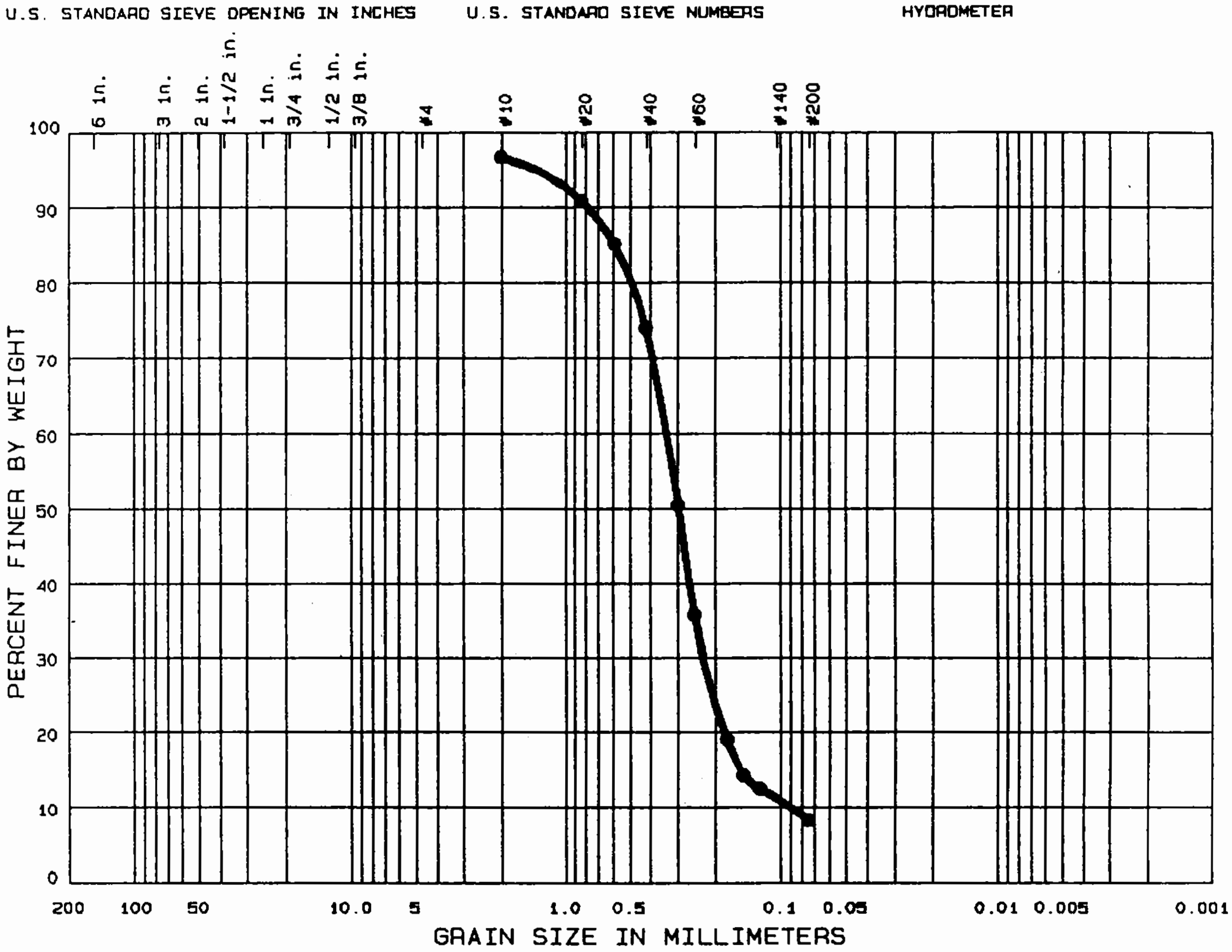
================================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA         Test No.: 1
--------------------------------------------------------------------------------
Date:           3 January 96
W.O. No.:       Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1  Pearce Creek Disposal Area
Project line 2  Ground Water Study
Area line 1:
Area line 2:
Boring No.:     CSW-2

--------------------------------------------------------------------------------
                                  Sample Data
--------------------------------------------------------------------------------
Lab No.:
Sample No.:     SPT-16
Elev or Depth:  32'-34'
Class 1::
Class 2::
Natural water content:                  Liquid limit:
Plastic limit:
--------------------------------------------------------------------------------
                            Mechanical Analysis Data
--------------------------------------------------------------------------------
                     Initial
Dry sample and tare=   246.30
Tare               =     0.00
Dry sample weight  =   246.30
Sieve tare method
  Sieve            Weight      Sieve    Percent
                   retained    tare     finer
  # 10               8.20        0.00     96.7
  # 20              14.30        0.00     90.9
  # 30              14.10        0.00     85.1
  # 40              27.70        0.00     73.9
  # 50              57.90        0.00     50.4
  # 60              36.20        0.00     35.7
  # 80              41.10        0.00     19.0
  # 100             11.80        0.00     14.2
  # 120              4.40        0.00     12.4
  # 200             10.30        0.00      8.2
--------------------------------------------------------------------------------
                             Fractional Components
--------------------------------------------------------------------------------
% + 3 in. =  0.0    % GRAVEL =  0.0   % SAND = 91.8
% FINES =  8.2

D85=   0.58  D60=   0.335  D50=   0.295
D30=   0.2294  D15=   0.15453  D10=  0.08995
Cc =   1.7478  Cu =   3.7196
```

W.O. No. Pearce Creek, MD
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	91.8	8.2

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-16	32'-34'					1.75	3.7

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-2
Date 3 January 96

GRADATION CURVES

DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET

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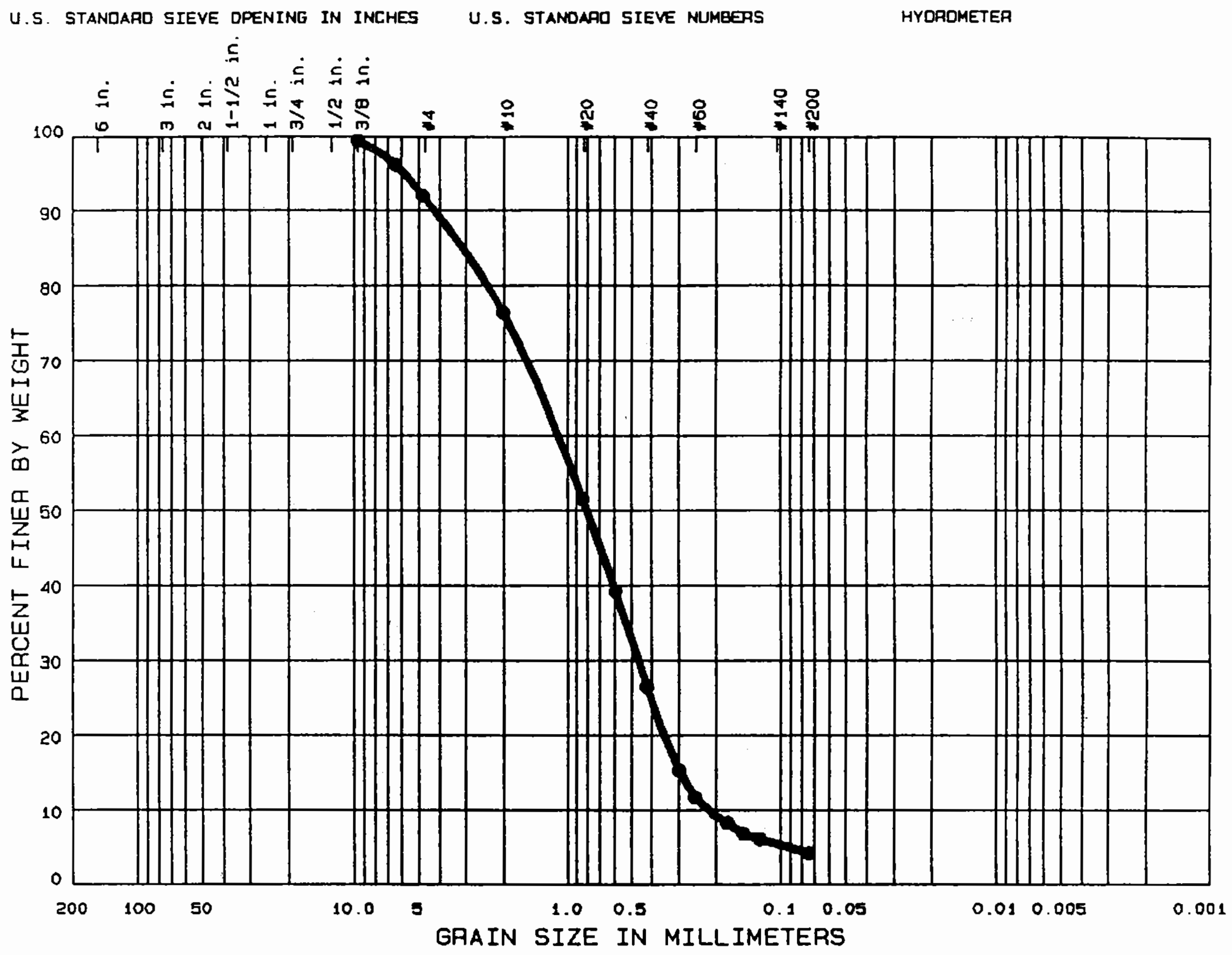
==============================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA         Test No.: 2
------------------------------------------------------------------------------
Date:               2 January 91
W.O. No.:           PEARCE CREEK, MD
Req. No.:
Contract No.:
Project line 1      PEARCE CREEK DISPOSAL AREA
Project line 2      GROUND WATER STUDY
Area line 1:
Area line 2:
Boring No.:         CSW-2

------------------------------------------------------------------------------
                                   Sample Data
------------------------------------------------------------------------------
Lab No.:
Sample No.:         SPT-25&26
Elev or Depth:      50'-54'
Class 1::
Class 2::
Natural water content:                   Liquid limit:
Plastic limit:
------------------------------------------------------------------------------
                             Mechanical Analysis Data
------------------------------------------------------------------------------
                         Initial     After wash
Dry sample and tare=   1051.90       1021.70
Tare                =   252.30        252.30
Dry sample weight   =   799.60        769.40
Minus #200 from wash=    3.8 %
Sieve tare method
  Sieve               Weight       Sieve     Percent
                      retained     tare      finer
  0.375 inches          5.80        0.00       99.3
  0.25  inches         25.60        0.00       96.1
  # 4                  32.90        0.00       92.0
  # 10                124.80        0.00       76.4
  # 20                199.60        0.00       51.4
  # 30                 98.40        0.00       39.1
  # 40                101.10        0.00       26.4
  # 50                 89.10        0.00       15.3
  # 60                 28.80        0.00       11.7
  # 80                 27.50        0.00        8.3
  # 100                11.70        0.00        6.8
  # 120                 5.50        0.00        6.1
  # 200                15.50        0.00        4.2
------------------------------------------------------------------------------
                              Fractional Components
------------------------------------------------------------------------------
% + 3 in. =  0.0     % GRAVEL =  8.0    % SAND = 87.8
% FINES =  4.2

D85=   3.09  D60=   1.096  D50=   0.804
D30=   0.4624  D15=   0.29174  D10=  0.21627
```

W.O. No. PEARCE CREEK, MD
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	8.0	87.8	4.2

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-25&26	50'-54'					0.90	5.1

CLASSIFICATION

●

Remarks:

Project PEARCE CREEK DISPOSAL AREA
GROUND WATER STUDY
Lab No.
Area
Boring No. CSW-2
Date 2 January 91

GRADATION CURVES

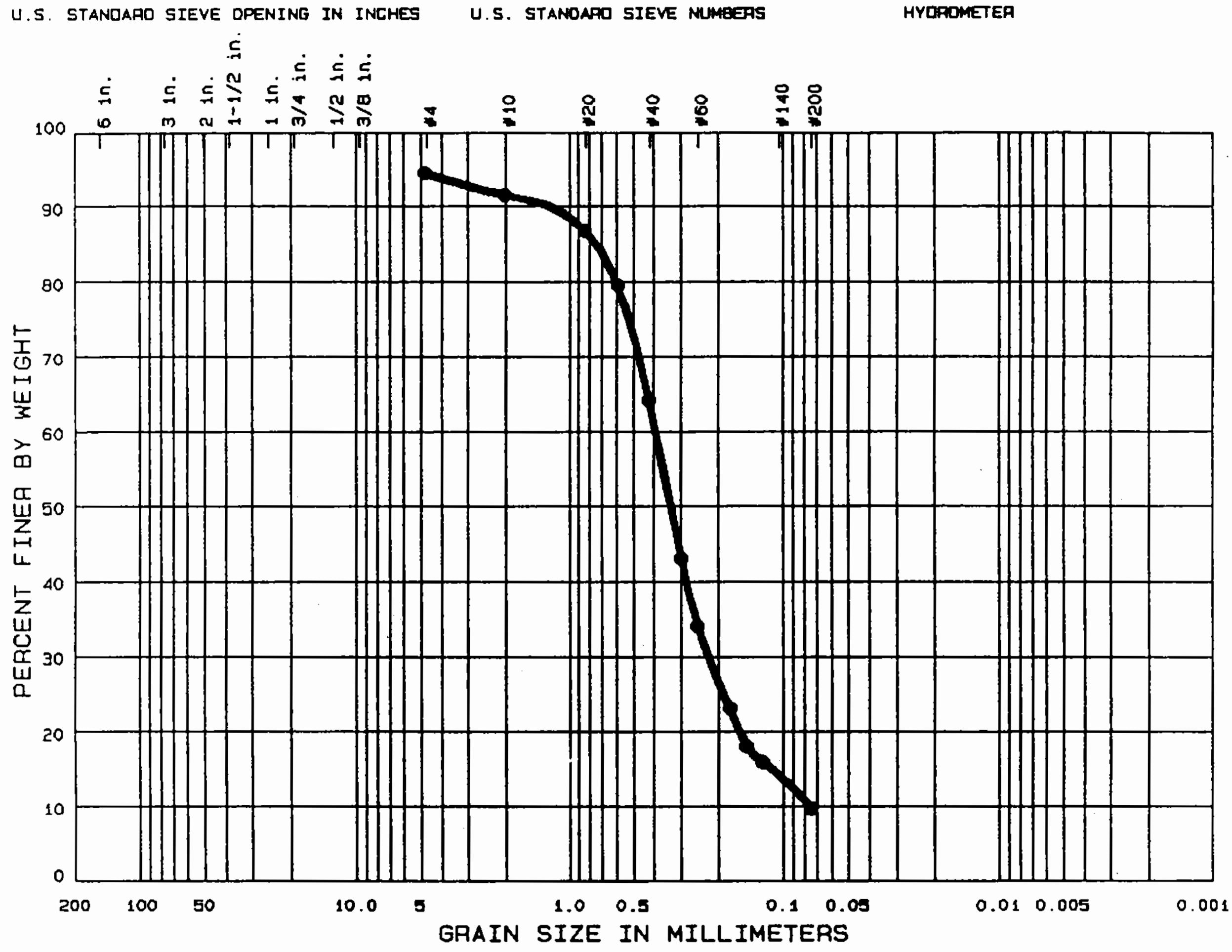
DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET

```
===============================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA         Test No.: 1
-------------------------------------------------------------------------------
Date:           January 96
W.O. No.:       Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1  Pearce Creek Disposal Area
Project line 2  Ground Water Study
Area line 1:
Area line 2:
Boring No.:     CSW-2

-------------------------------------------------------------------------------
                                  Sample Data
-------------------------------------------------------------------------------
Lab No.:
Sample No.:     SPT-31
Elev or Depth:  62'-64'
Class 1::
Class 2::
Natural water content:                  Liquid limit:
Plastic limit:
-------------------------------------------------------------------------------
                            Mechanical Analysis Data
-------------------------------------------------------------------------------
                     Initial     After wash
Dry sample and tare=   529.70       343.30
Tare               =   152.60         0.00
Dry sample weight  =   377.10       343.30
Minus #200 from wash=   9.0 %
Sieve tare method
  Sieve           Weight      Sieve    Percent
                  retained    tare     finer
  # 4               21.10       0.00     94.4
  # 10              11.10       0.00     91.5
  # 20              17.80       0.00     86.7
  # 30              27.40       0.00     79.5
  # 40              57.70       0.00     64.2
  # 50              79.80       0.00     43.0
  # 60              34.00       0.00     34.0
  # 80              41.20       0.00     23.1
  # 100             18.80       0.00     18.1
  # 120              8.10       0.00     15.9
  # 200             23.50       0.00      9.7
-------------------------------------------------------------------------------
                             Fractional Components
-------------------------------------------------------------------------------
% + 3 in. =  0.0    % GRAVEL =  5.6   % SAND = 84.7
% FINES =  9.7

D85=   0.74  D60=   0.391  D50=   0.333
D30=   0.2246  D15=   0.11130  D10=  0.07525
Cc =   1.7159  Cu =   5.1940
```

W.O. No. Pearce Creek, MD
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	5.6	84.7	9.7

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-31	62'-64'					1.72	5.2

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-2
Date January 96

GRADATION CURVES

DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET

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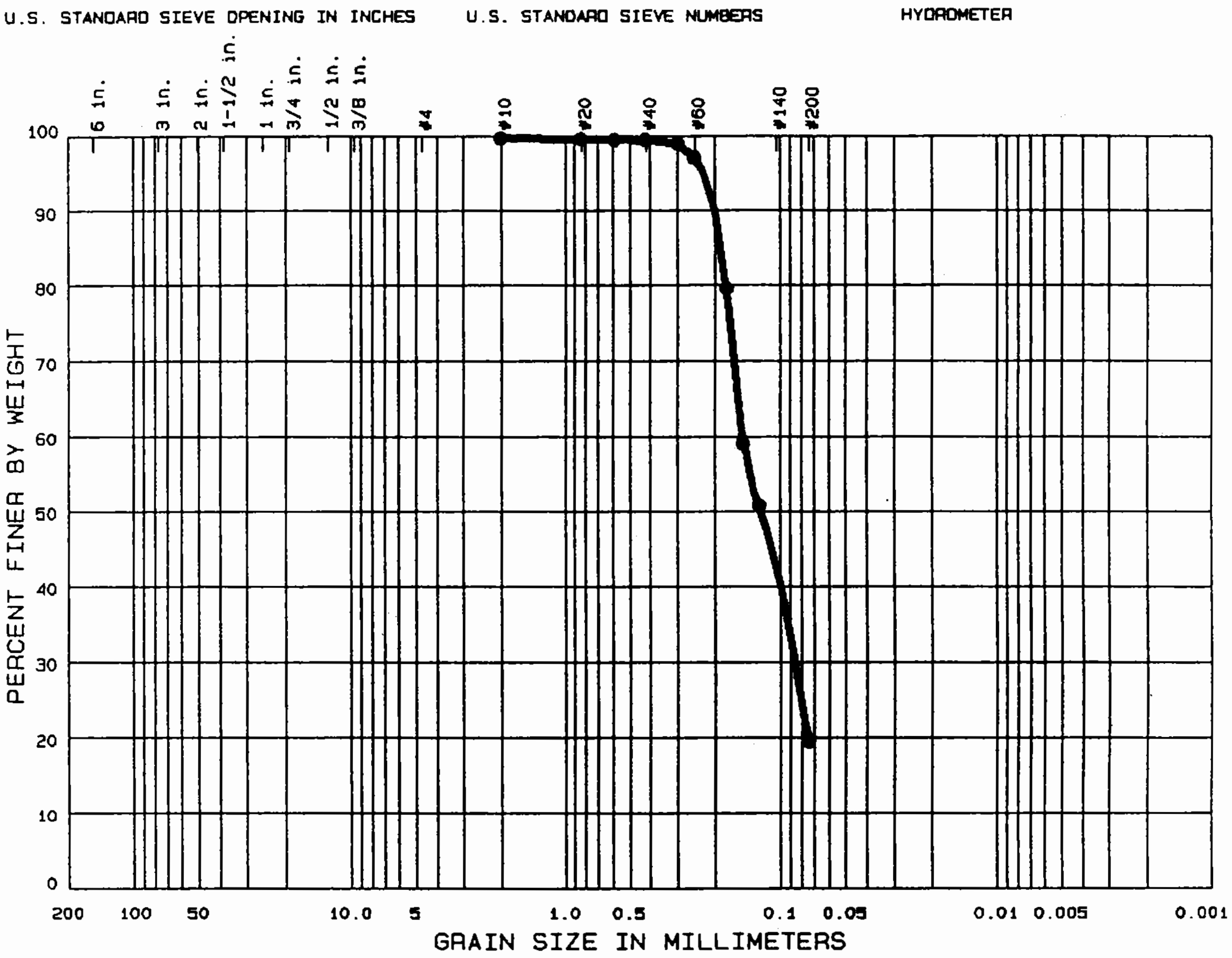
=================================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA         Test No.: 1
---------------------------------------------------------------------------------
Date:              3 January 96
W.O. No.:          Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1     Pearce Creek Disposal Area
Project line 2     Ground Water Study
Area line 1:
Area line 2:
Boring No.:        CSW-3

---------------------------------------------------------------------------------
                                    Sample Data
---------------------------------------------------------------------------------
Lab No.:
Sample No.:        SPT-13
Elev or Depth:     24'-26'
Class 1:: *
Class 2:: *
Natural water content:                     Liquid limit:
Plastic limit:
---------------------------------------------------------------------------------
                               Mechanical Analysis Data
---------------------------------------------------------------------------------
                        Initial     After wash
Dry sample and tare=     302.00       263.70
Tare               =       0.00         0.00
Dry sample weight  =     302.00       263.70
Minus #200 from wash=    12.7 %
Sieve tare method
  Sieve              Weight       Sieve     Percent
                     retained     tare      finer
  # 10                 1.20        0.00       99.6
  # 20                 0.40        0.00       99.5
  # 30                 0.20        0.00       99.4
  # 40                 0.20        0.00       99.3
  # 50                 1.50        0.00       98.8
  # 60                 5.60        0.00       97.0
  # 80                52.70        0.00       79.5
  # 100               62.00        0.00       59.0
  # 120               25.20        0.00       50.7
  # 200               94.20        0.00       19.5
---------------------------------------------------------------------------------
                                Fractional Components
---------------------------------------------------------------------------------
% + 3 in. =   0.0    % GRAVEL =   0.0    % SAND = 80.5
% FINES = 19.5

D85=    0.19  D60=    0.150  D50=    0.122
D30=    0.0856
```

W.O. No. Pearce Creek, MD
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	80.5	19.5

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-13	24'-26'						

CLASSIFICATION

● *

*

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-3
Date 3 January 96

GRADATION CURVES

DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET

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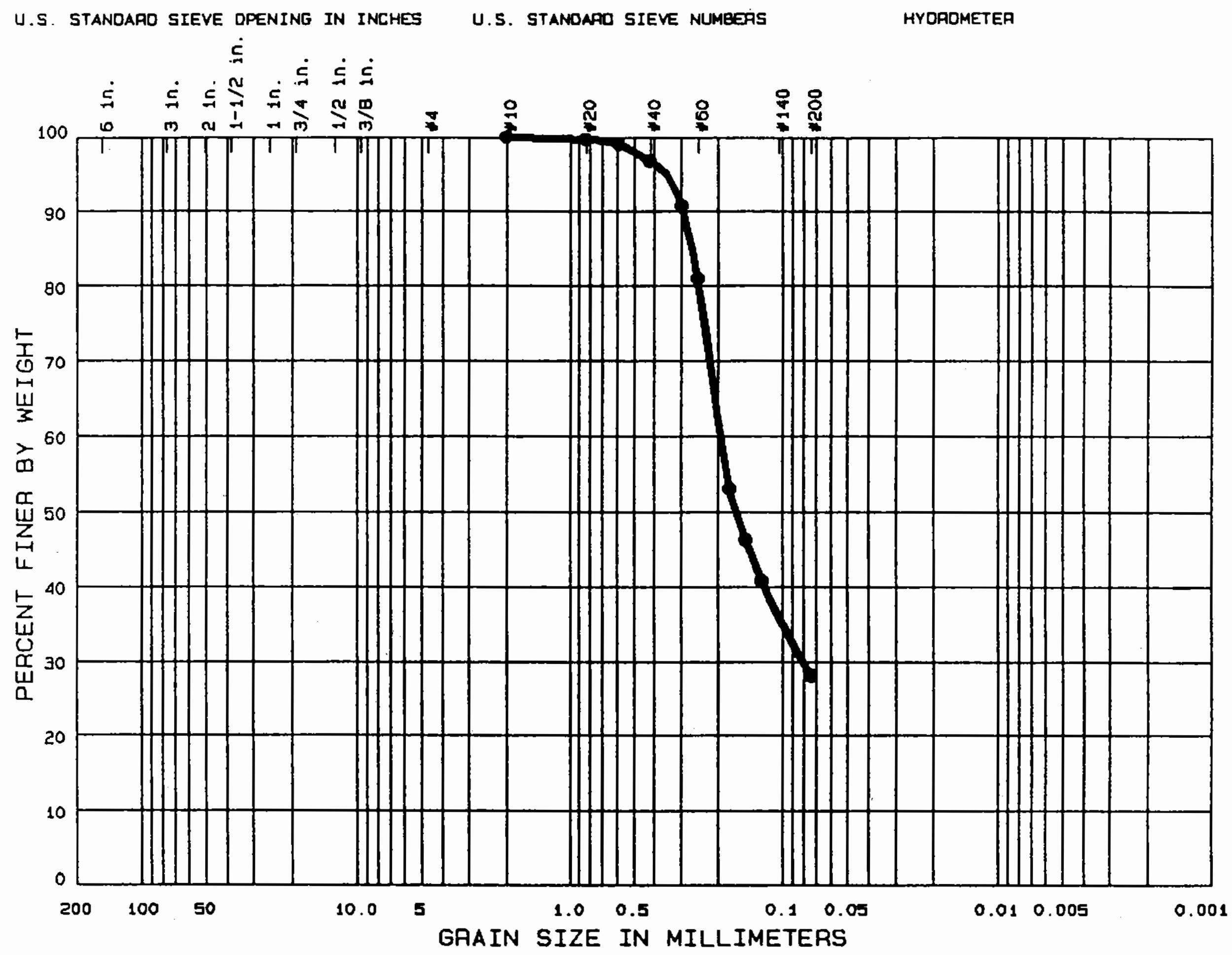
===============================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA        Test No.: 5
-------------------------------------------------------------------------------
Date:           01/2/96
W.O. No.:       Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1  Pearce Creek Disposal Area
Project line 2  Ground Water Study
Area line 1:
Area line 2:
Boring No.:     CSW-3

-------------------------------------------------------------------------------
                                  Sample Data
-------------------------------------------------------------------------------
Lab No.:
Sample No.:     SPT-17
Elev or Depth:  32-34'
Class 1::
Class 2::
Natural water content:                  Liquid limit:
Plastic limit:
-------------------------------------------------------------------------------
                             Mechanical Analysis Data
-------------------------------------------------------------------------------
                     Initial     After wash
Dry sample and tare=   651.70       566.70
Tare               =   295.40       295.40
Dry sample weight  =   356.30       271.30
Minus #200 from wash=  23.9 %
Sieve tare method
  Sieve            Weight       Sieve    Percent
                   retained     tare     finer
  # 10                0.10        0.00    100.0
  # 20                1.20        0.00     99.6
  # 30                2.30        0.00     99.0
  # 40                7.80        0.00     96.8
  # 50               21.50        0.00     90.8
  # 60               34.90        0.00     81.0
  # 80               99.40        0.00     53.1
  # 100              24.50        0.00     46.2
  # 120              19.50        0.00     40.7
  # 200              45.10        0.00     28.1
-------------------------------------------------------------------------------
                              Fractional Components
-------------------------------------------------------------------------------
% + 3 in. =  0.0    % GRAVEL =  0.0    % SAND = 71.9
% FINES = 28.1

D85=    0.27  D60=    0.195  D50=    0.166
D30=    0.0804
```

W.O. No. Pearce Creek, MD
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	71.9	28.1

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-17	32-34'						

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-3 Date 01/2/96

GRADATION CURVES

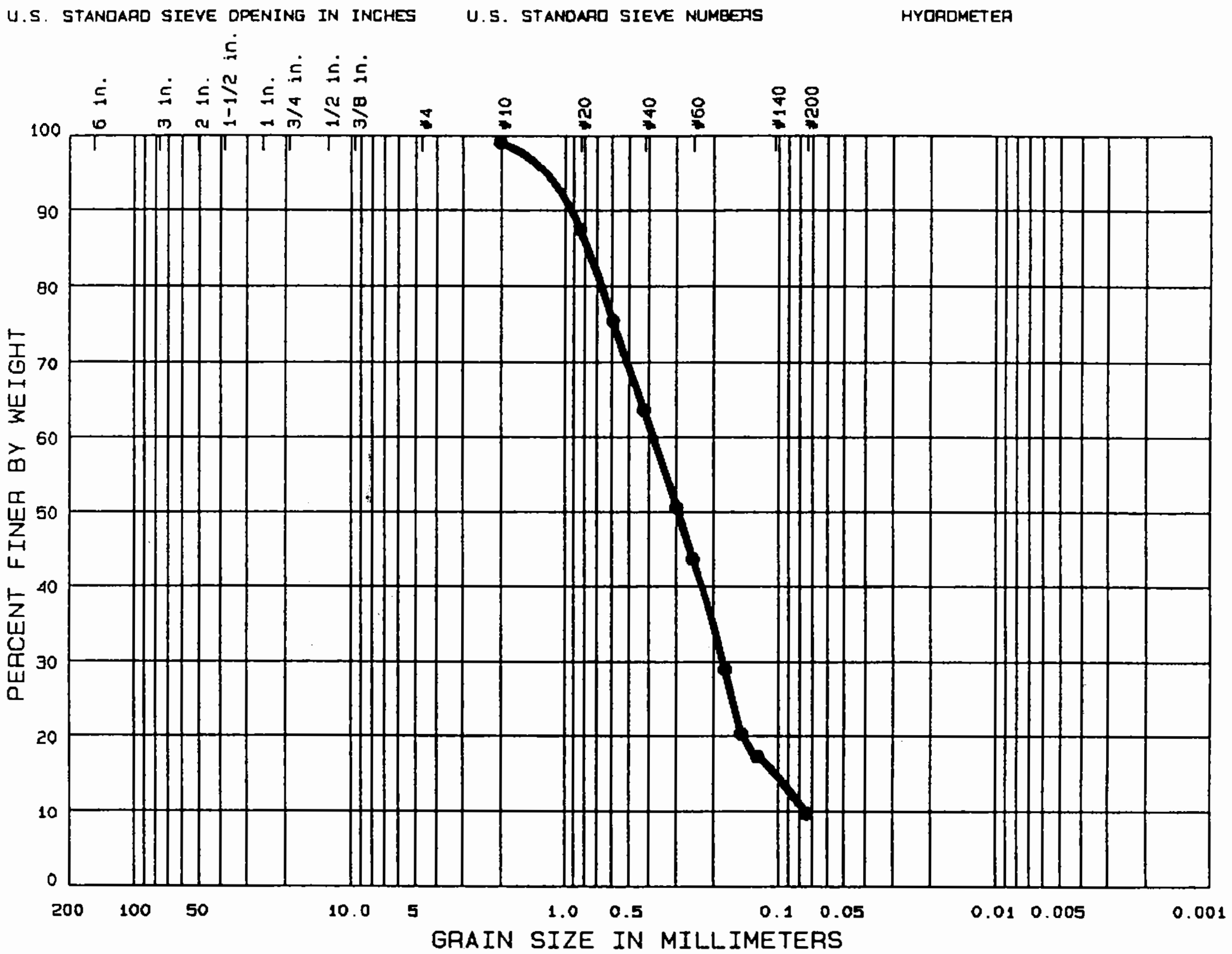
DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET

```
===============================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA         Test No.: 5
-------------------------------------------------------------------------------
Date:           01/2/96
W.O. No.:       Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1  Pearce Creek Disposal Area
Project line 2  Ground Water Study
Area line 1:
Area line 2:
Boring No.:     CSW-3

-------------------------------------------------------------------------------
                                  Sample Data
-------------------------------------------------------------------------------
Lab No.:
Sample No.:     SPT-23
Elev or Depth:  44'-46'
Class 1::
Class 2::
Natural water content:                  Liquid limit:
Plastic limit:
-------------------------------------------------------------------------------
                             Mechanical Analysis Data
-------------------------------------------------------------------------------
                     Initial     After wash
Dry sample and tare=   683.30       649.20
Tare               =   295.70       295.70
Dry sample weight  =   387.60       353.50
Minus #200 from wash=   8.8 %
Sieve tare method
  Sieve           Weight      Sieve    Percent
                  retained    tare     finer
  # 10               3.60      0.00      99.1
  # 20              45.00      0.00      87.5
  # 30              46.80      0.00      75.4
  # 40              46.10      0.00      63.5
  # 50              50.20      0.00      50.5
  # 60              27.00      0.00      43.6
  # 80              56.80      0.00      28.9
  # 100             33.50      0.00      20.3
  # 120             11.60      0.00      17.3
  # 200             29.50      0.00       9.7
-------------------------------------------------------------------------------
                             Fractional Components
-------------------------------------------------------------------------------
% + 3 in. =  0.0    % GRAVEL =  0.0    % SAND = 90.3
% FINES =  9.7

D85=   0.77  D60=   0.379  D50=   0.293
D30=   0.1805  D15=   0.10268  D10=  0.07525
Cc =   1.1416  Cu =   5.0408
```

W.O. No. Pearce Creek, MD
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	90.3	9.7

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-23	44'-46'					1.14	5.0

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-3 Date 01/2/96

GRADATION CURVES

EPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
ORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET

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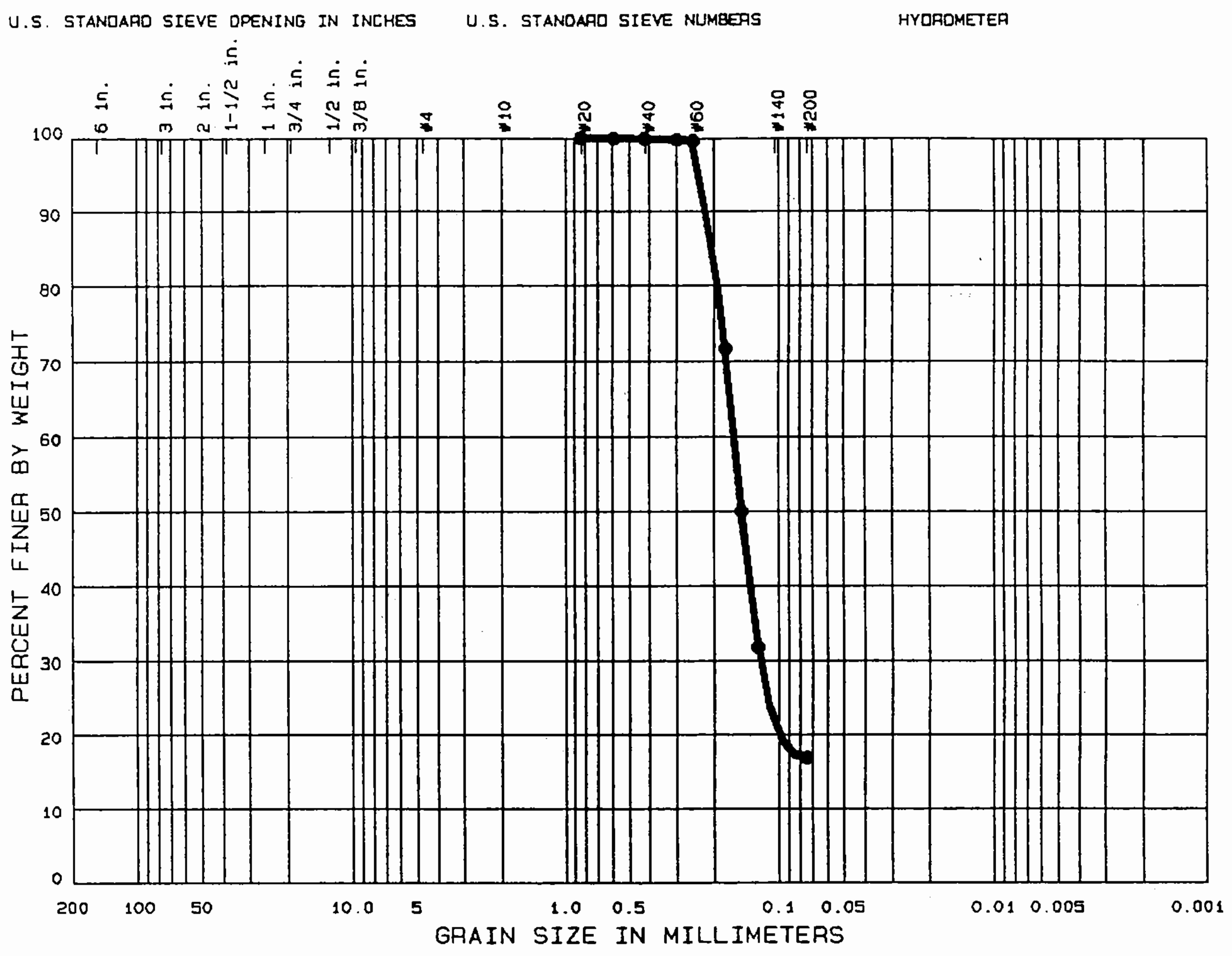
===============================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA        Test No.: 6
-------------------------------------------------------------------------------
Date:           01/2/96
W.O. No.:       Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1  Pearce Creek Disposal Area
Project line 2  Ground Water Study
Area line 1:
Area line 2:
Boring No.:     CSW-3

-------------------------------------------------------------------------------
                                  Sample Data
-------------------------------------------------------------------------------
Lab No.:
Sample No.:     SPT-33
Elev or Depth:  64'-66
Class 1::
Class 2::
Natural water content:                  Liquid limit:
Plastic limit:
-------------------------------------------------------------------------------
                            Mechanical Analysis Data
-------------------------------------------------------------------------------
                     Initial     After wash
Dry sample and tare=   509.00       475.40
Tare               =   295.60       295.60
Dry sample weight  =   213.40       179.80
Minus #200 from wash=  15.7 %
Sieve tare method
  Sieve            Weight      Sieve    Percent
                   retained    tare     finer
  # 20                0.10       0.00    100.0
  # 30                0.10       0.00     99.9
  # 40                0.10       0.00     99.9
  # 50                0.20       0.00     99.8
  # 60                0.50       0.00     99.5
  # 80               59.50       0.00     71.6
  # 100              46.40       0.00     49.9
  # 120              38.90       0.00     31.7
  # 200              31.60       0.00     16.9
-------------------------------------------------------------------------------
                             Fractional Components
-------------------------------------------------------------------------------
% + 3 in. =  0.0    % GRAVEL =  0.0    % SAND = 83.1
% FINES = 16.9

D85=   0.21  D60=   0.161  D50=   0.149
D30=   0.1223
```

W.O. No. Pearce Creek, MD
Req. No.
Contract No.

EPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
ORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	83.1	16.9

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-33	64'-66						

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-3 Date 01/2/96

GRADATION CURVES

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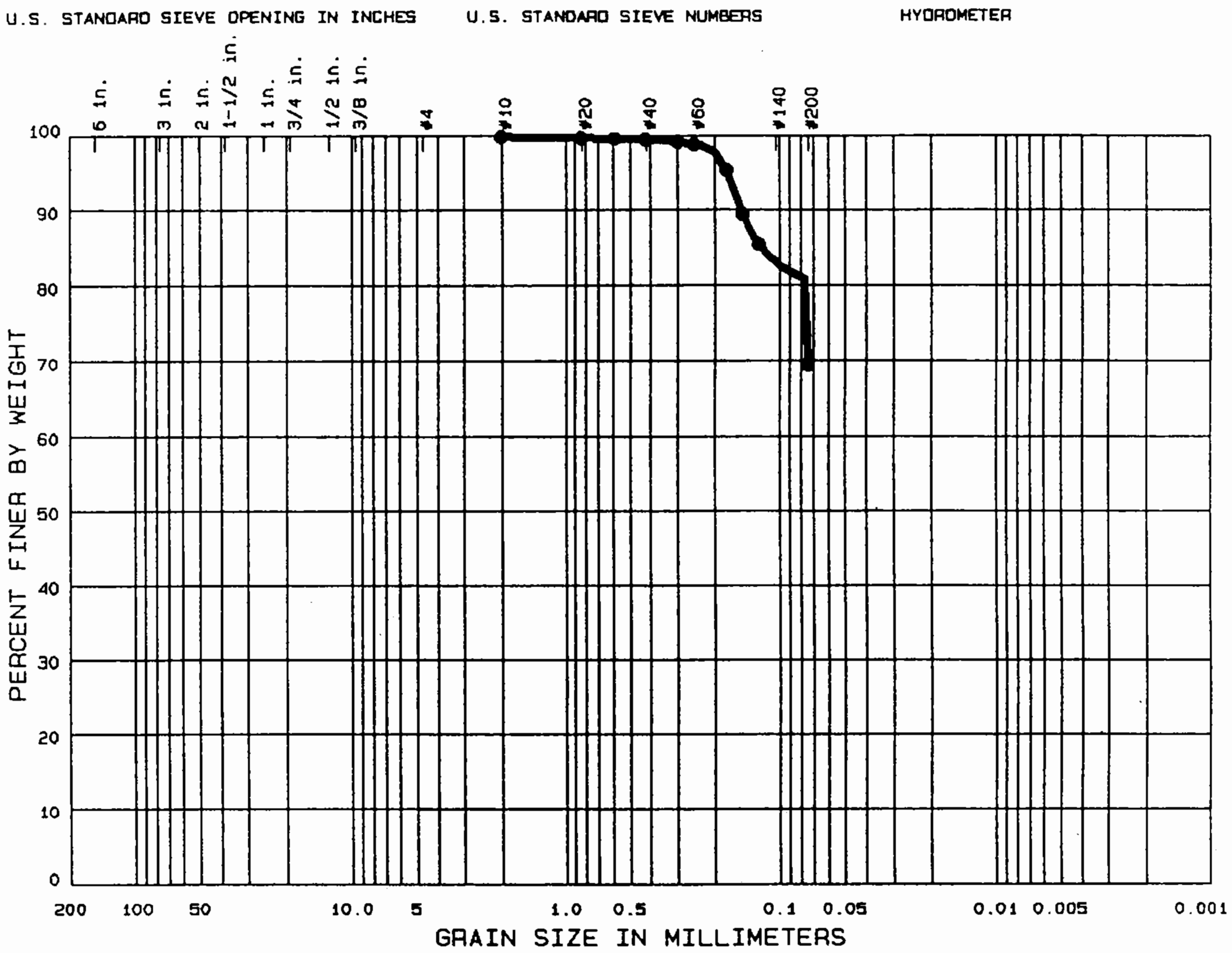
================================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA          Test No.: 6
--------------------------------------------------------------------------------
Date:               PPPP
W.O. No.:           Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1      Pearce Creek Disposal Area
Project line 2      Ground Water Study
Area line 1:
Area line 2:
Boring No.:         CSW-3

--------------------------------------------------------------------------------
                                    Sample Data
--------------------------------------------------------------------------------
Lab No.:
Sample No.:         SPT-40
Elev or Depth:      78'-80'
Class 1::
Class 2::
Natural water content:                     Liquid limit:
Plastic limit:
--------------------------------------------------------------------------------
                              Mechanical Analysis Data
--------------------------------------------------------------------------------
                         Initial      After wash
Dry sample and tare=       636.80         415.10
Tare               =       304.00         304.00
Dry sample weight  =       332.80         111.10
Minus #200 from wash=      66.6 %
Sieve tare method
  Sieve               Weight       Sieve      Percent
                      retained     tare       finer
  # 10                   0.90        0.00       99.7
  # 20                   0.60        0.00       99.5
  # 30                   0.30        0.00       99.5
  # 40                   0.30        0.00       99.4
  # 50                   0.10        0.00       99.3
  # 60                   1.20        0.00       99.0
  # 80                  11.40        0.00       95.6
  # 100                 19.80        0.00       89.6
  # 120                 13.30        0.00       85.6
  # 200                 52.90        0.00       69.7
--------------------------------------------------------------------------------
                                  Fractional Components
--------------------------------------------------------------------------------
% + 3 in. =   0.0     % GRAVEL =   0.0    % SAND = 30.3
% FINES = 69.7

D85=   0.12
```

W.O. No. Pearce Creek, MD
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	19.4	80.6

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-40	78'-80'						

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-3 Date 01/2/96

GRADATION CURVES

DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET

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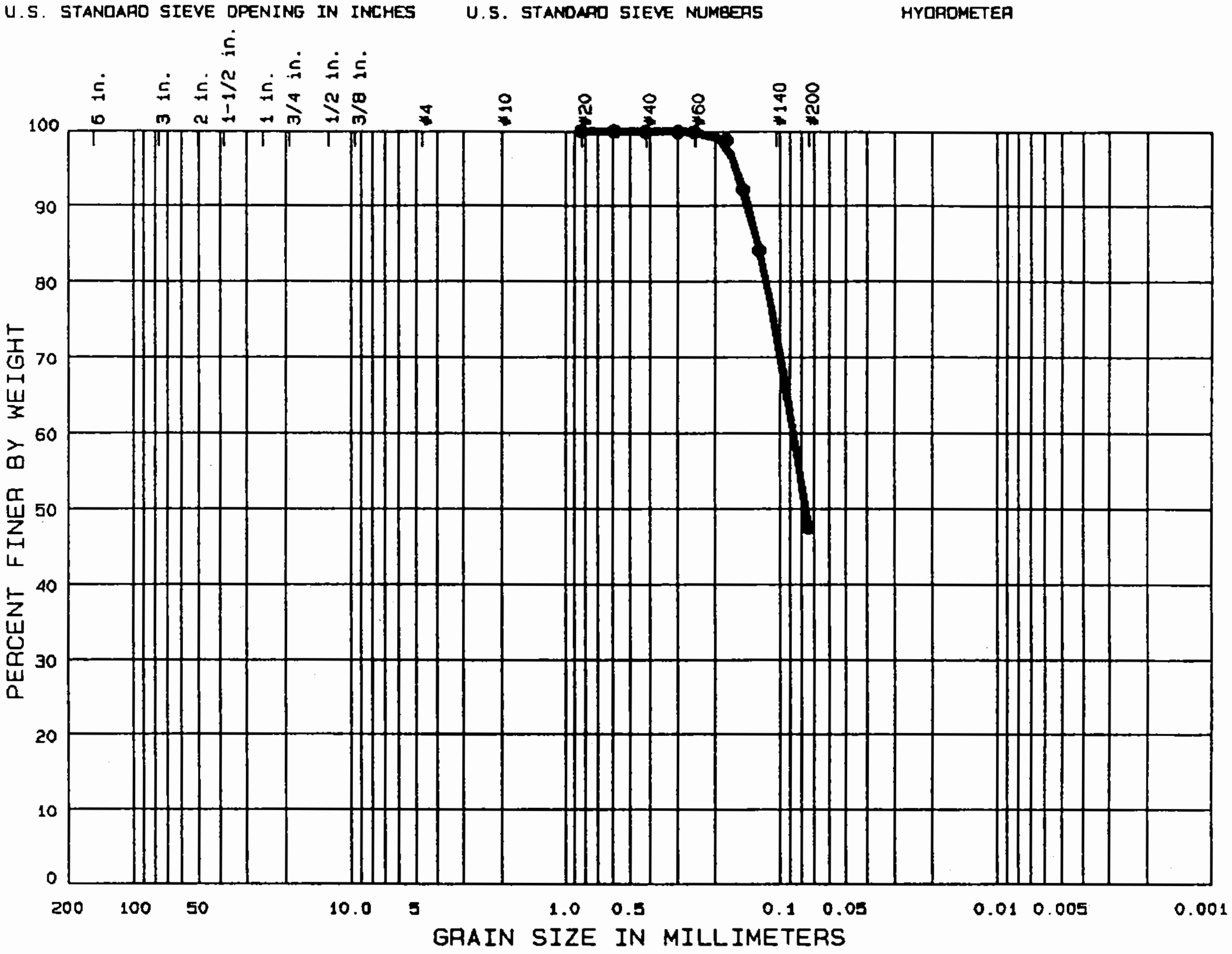
================================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA          Test No.: 6
--------------------------------------------------------------------------------
Date:            01/2/96
W.O. No.:        Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1   Pearce Creek Disposal Area
Project line 2   Ground Water Study
Area line 1:
Area line 2:
Boring No.:      CSW-3

--------------------------------------------------------------------------------
                                    Sample Data
--------------------------------------------------------------------------------
Lab No.:
Sample No.:      SPT-47
Elev or Depth:   92'-93.5'
Class 1::
Class 2::
Natural water content:                  Liquid limit:
Plastic limit:
--------------------------------------------------------------------------------
                              Mechanical Analysis Data
--------------------------------------------------------------------------------
                       Initial     After wash
Dry sample and tare=    694.10       527.00
Tare               =    289.70       289.70
Dry sample weight  =    404.40       237.30
Minus #200 from wash=   41.3 %
Sieve tare method
  Sieve              Weight       Sieve     Percent
                     retained     tare      finer
  # 20                  0.10        0.00     100.0
  # 30                  0.10        0.00     100.0
  # 40                  0.20        0.00      99.9
  # 50                  0.10        0.00      99.9
  # 60                  0.20        0.00      99.8
  # 80                  4.60        0.00      98.7
  # 100                26.60        0.00      92.1
  # 120                32.50        0.00      84.1
  # 200               148.10        0.00      47.5
--------------------------------------------------------------------------------
                                 Fractional Components
--------------------------------------------------------------------------------
% + 3 in. =  0.0    % GRAVEL =  0.0   % SAND = 52.5
% FINES = 47.5

D85=   0.13  D60=   0.087  D50=   0.076
```

W.O. No. Pearce Creek, MD
Req. No.
Contract No.

EPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
ORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	52.5	47.5

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-47	92'-93.5'						

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-3 Date 01/2/96

GRADATION CURVES

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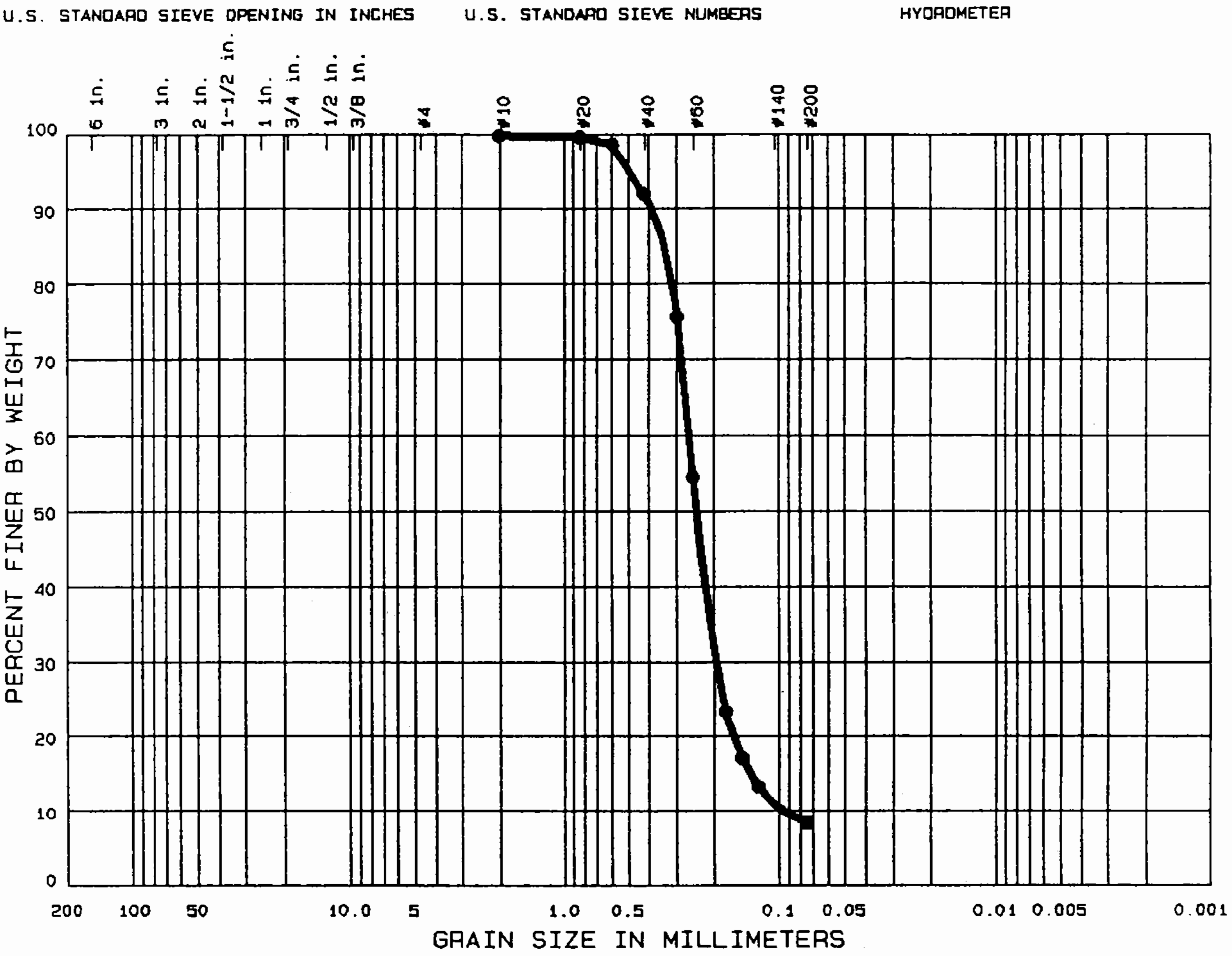
===============================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA         Test No.: 5
-------------------------------------------------------------------------------
Date:           01/2/96
W.O. No.:       Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1  Pearce Creek Disposal Area
Project line 2  Ground Water Study
Area line 1:
Area line 2:
Boring No.:     CSW-3

-------------------------------------------------------------------------------
                                  Sample Data
-------------------------------------------------------------------------------
Lab No.:
Sample No.:     SPT-54
Elev or Depth:  106'-107.5'
Class 1::
Class 2::
Natural water content:                  Liquid limit:
Plastic limit:
-------------------------------------------------------------------------------
                            Mechanical Analysis Data
-------------------------------------------------------------------------------
                     Initial     After wash
Dry sample and tare=   580.60       557.90
Tare               =   288.00       288.00
Dry sample weight  =   292.60       269.90
Minus #200 from wash=   7.8 %
Sieve tare method
  Sieve          Weight      Sieve    Percent
                 retained    tare     finer
  # 10              0.80       0.00     99.7
  # 20              0.60       0.00     99.5
  # 30              2.90       0.00     98.5
  # 40             19.30       0.00     91.9
  # 50             48.00       0.00     75.5
  # 60             61.70       0.00     54.4
  # 80             91.30       0.00     23.2
  # 100            18.10       0.00     17.1
  # 120            11.20       0.00     13.2
  # 200            14.10       0.00      8.4
-------------------------------------------------------------------------------
                             Fractional Components
-------------------------------------------------------------------------------
% + 3 in. =  0.0    % GRAVEL =  0.0   % SAND = 91.6
% FINES =  8.4

D85=   0.34  D60=   0.261  D50=   0.241
D30=   0.1966  D15=   0.13599  D10=  0.09517
Cc =   1.5560  Cu =   2.7416
```

W.O. No. Pearce Creek, MD
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	91.6	8.4

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-54	106'-107.5'					1.56	2.7

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-3
Date 01/2/96

GRADATION CURVES

DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 5

Date: 01/2/96
W.O. No.: Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1 Pearce Creek Disposal Area
Project line 2 Ground Water Study
Area line 1:
Area line 2:
Boring No.: CSW-3

Sample Data

Lab No.:
Sample No.: SPT-68
Elev or Depth: 134'-135.5'
Class 1::
Class 2::
Natural water content: Liquid limit:
Plastic limit:

Mechanical Analysis Data

	Initial	After wash
Dry sample and tare=	688.30	577.40
Tare =	295.60	295.60
Dry sample weight =	392.70	281.80
Minus #200 from wash=	28.2 %	

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 10	0.50	0.00	99.9
# 20	0.40	0.00	99.8
# 30	0.20	0.00	99.7
# 40	0.30	0.00	99.6
# 50	0.40	0.00	99.5
# 60	0.80	0.00	99.3
# 80	21.10	0.00	94.0
# 100	67.90	0.00	76.7
# 120	43.90	0.00	65.5
# 200	129.20	0.00	32.6

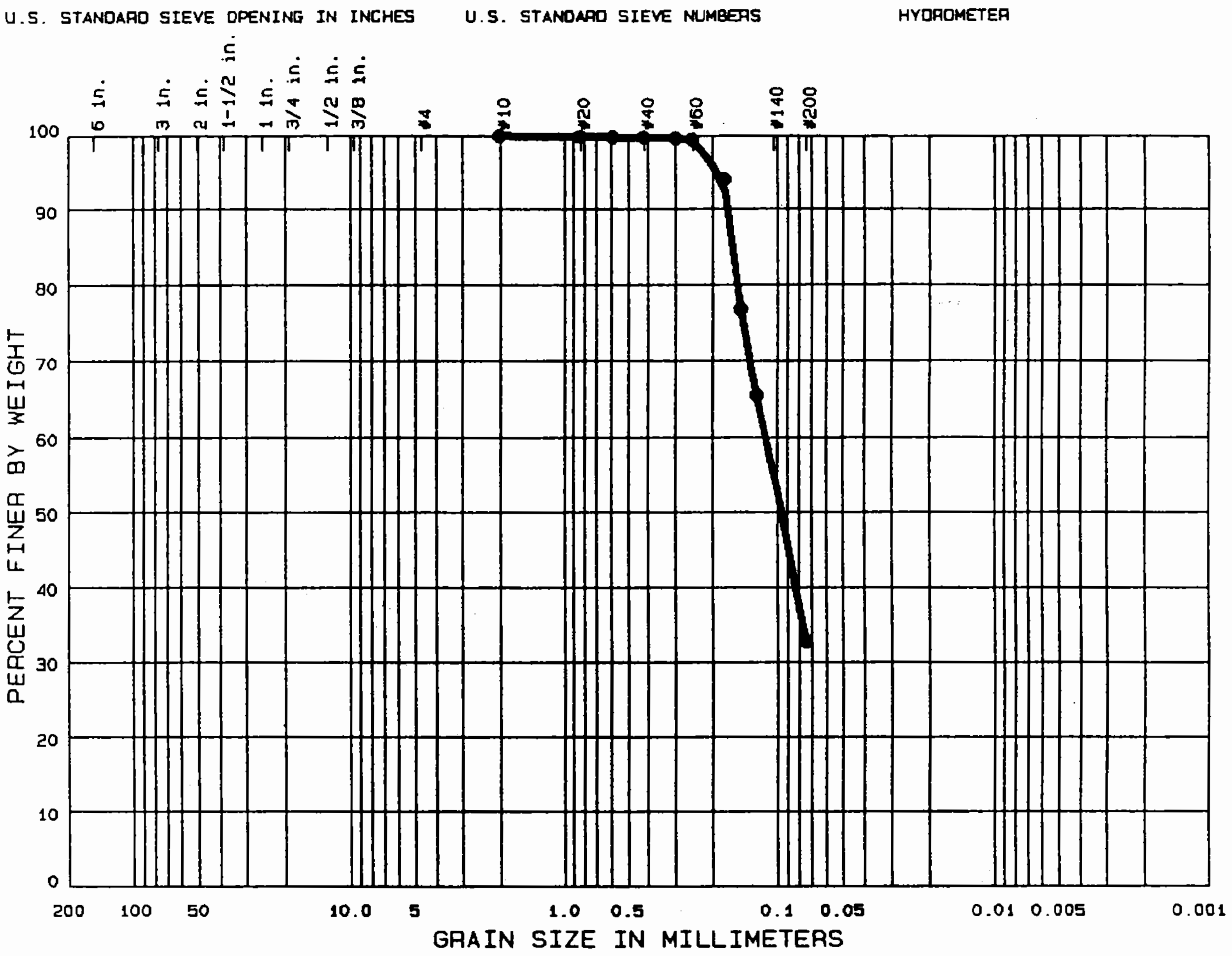
Fractional Components

% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 67.4
% FINES = 32.6

D85= 0.16 D60= 0.113 D50= 0.096

W.O. No. Pearce Creek, MD
Req. No.
Contract No.

EPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
ORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	67.4	32.6

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-68	134'-135.5'						

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-3 Date 01/2/96

GRADATION CURVES

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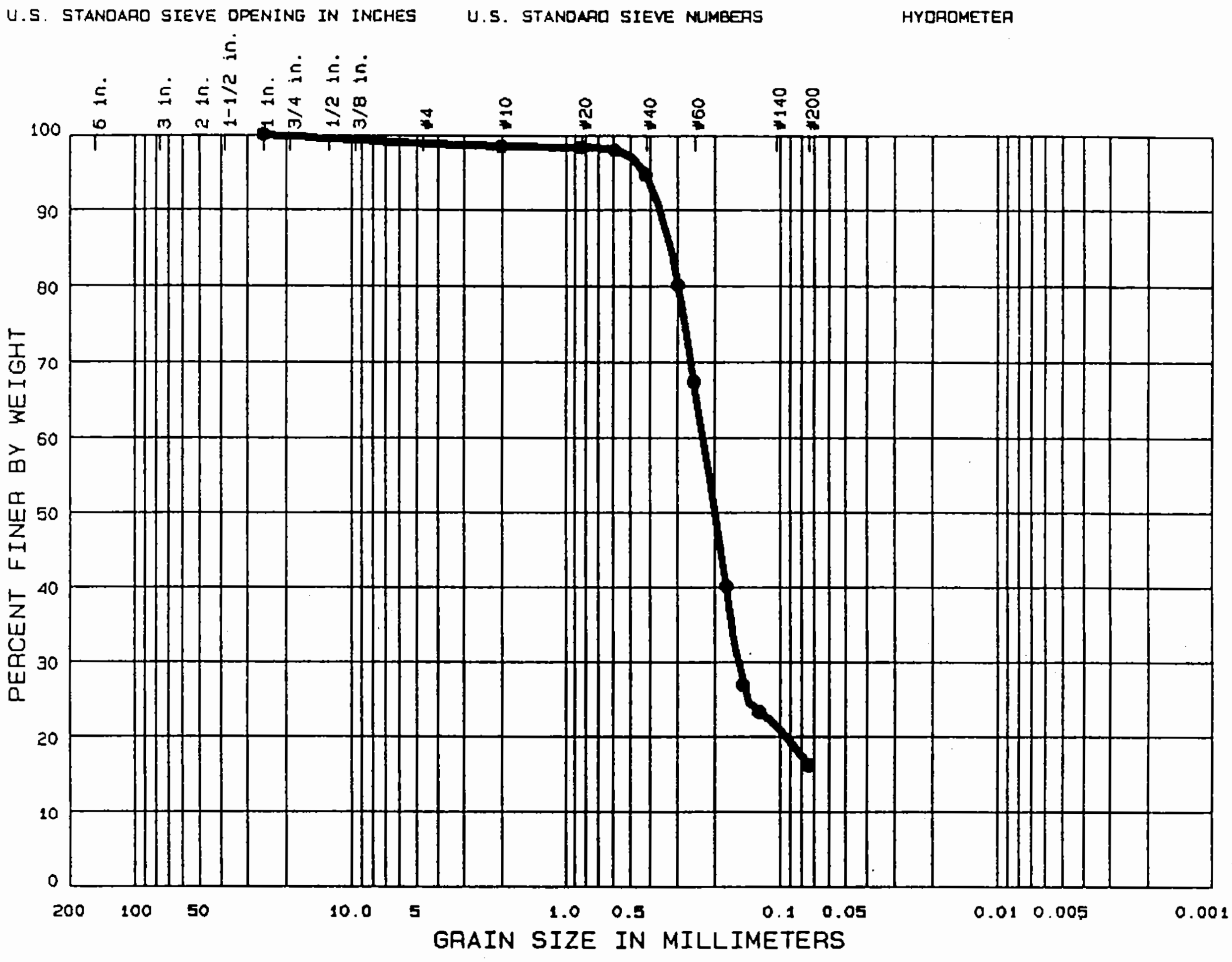
===============================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA          Test No.: 6
-------------------------------------------------------------------------------
Date:           01/2/96
W.O. No.:       Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1  Pearce Creek Disposal Area
Project line 2  Ground Water Study
Area line 1:
Area line 2:
Boring No.:     CSW-5

-------------------------------------------------------------------------------
                                  Sample Data
-------------------------------------------------------------------------------
Lab No.:
Sample No.:     SPT-35
Elev or Depth:  68'-70'
Class 1::
Class 2::
Natural water content:                  Liquid limit:
Plastic limit:
-------------------------------------------------------------------------------
                            Mechanical Analysis Data
-------------------------------------------------------------------------------
                     Initial     After wash
Dry sample and tare=   580.10       534.20
Tare               =   292.00       292.00
Dry sample weight  =   288.10       242.20
Minus #200 from wash=  15.9 %
Sieve tare method
  Sieve              Weight      Sieve    Percent
                     retained    tare     finer
  1     inches          0.00       0.00    100.0
  # 10                  4.40       0.00     98.5
  # 20                  0.50       0.00     98.3
  # 30                  1.00       0.00     98.0
  # 40                  9.40       0.00     94.7
  # 50                 42.00       0.00     80.1
  # 60                 36.60       0.00     67.4
  # 80                 78.90       0.00     40.0
  # 100                37.80       0.00     26.9
  # 120                10.30       0.00     23.3
  # 200                20.50       0.00     16.2
-------------------------------------------------------------------------------
                             Fractional Components
-------------------------------------------------------------------------------
% + 3 in. =  0.0    % GRAVEL =  1.2    % SAND = 82.6
% FINES = 16.2

D85=   0.32  D60=   0.227  D50=   0.200
D30=   0.1567
```

W.O. No. Pearce Creek, MD
Req. No.
Contract No.

DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	1.2	82.6	16.2

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-35	68'-70'						

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area

Boring No. CSW-5 Date 01/2/96

GRADATION CURVES

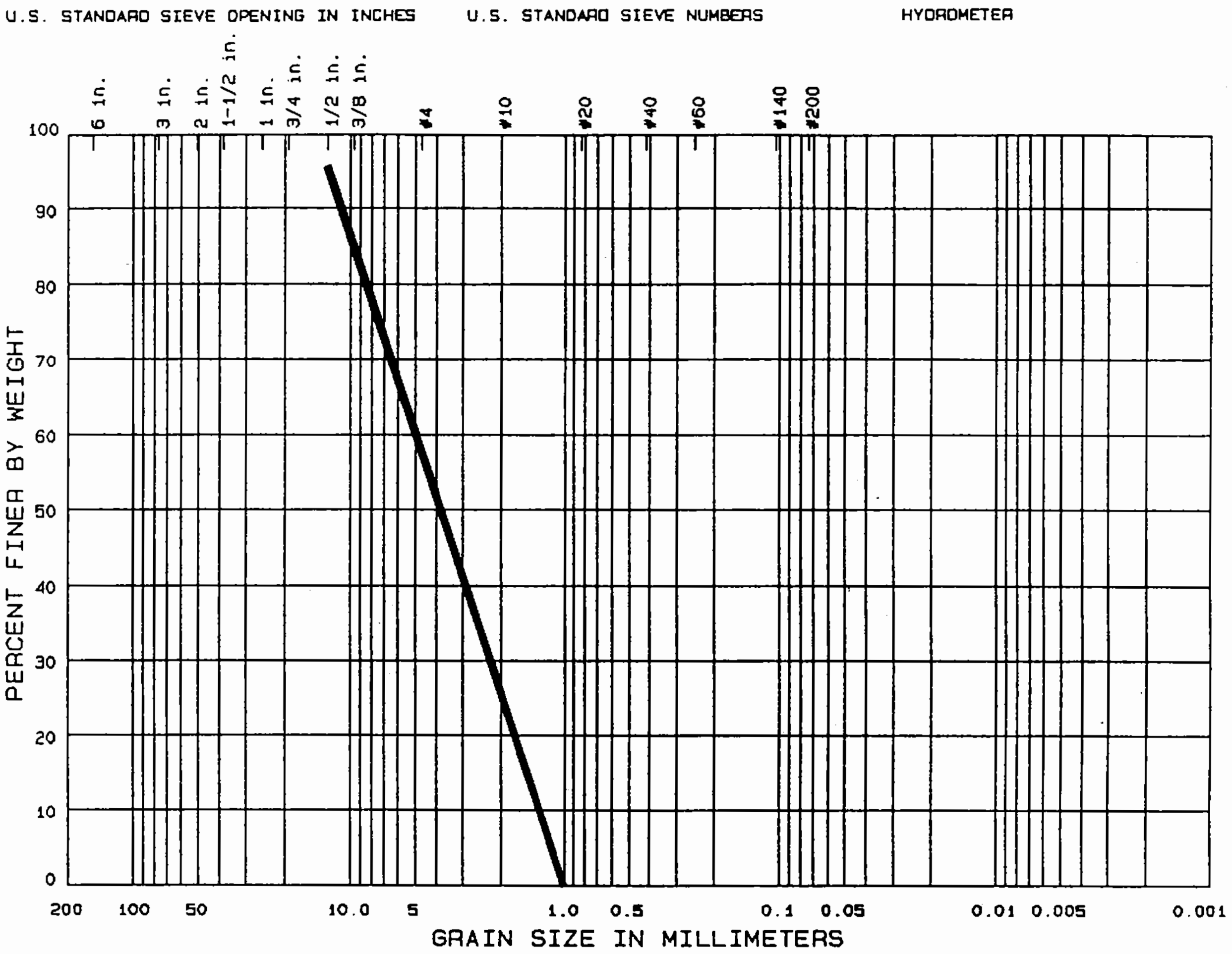
```
==============================================================================
                      GRAIN SIZE DISTRIBUTION TEST DATA        Test No.: 5
------------------------------------------------------------------------------
Date:             01/2/96
W.O. No.:         Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1    Pearce Creek Disposal Area
Project line 2    Ground Water Study
Area line 1:
Area line 2:
Boring No.:       CSW-5

------------------------------------------------------------------------------
                                    Sample Data
------------------------------------------------------------------------------
Lab No.:
Sample No.:       SPT-44
Elev or Depth:    86'-87'
Class 1::
Class 2::
Natural water content:                       Liquid limit:
Plastic limit:
------------------------------------------------------------------------------
                              Mechanical Analysis Data
------------------------------------------------------------------------------
                         Initial     After wash
Dry sample and tare=     543.40        529.50
Tare               =     296.20        296.20
Dry sample weight  =     247.20        233.30
Minus #200 from wash=     5.6 %
Sieve tare method
  Sieve               Weight       Sieve     Percent
                      retained     tare      finer
  0.5   inches         11.10        0.00      95.5
  0.375 inches         13.80        0.00      89.9
  0.25  inches         15.30        0.00      83.7
  # 4                  15.70        0.00      77.4
  # 10                 32.90        0.00      64.1
  # 20                 33.70        0.00      50.4
  # 30                 21.40        0.00      41.8
  # 40                 21.00        0.00      33.3
  # 50                 15.50        0.00      27.0
  # 60                 10.10        0.00      22.9
  # 80                 18.20        0.00      15.6
  # 100                 5.70        0.00      13.3
  # 120                 6.00        0.00      10.8
  # 200                11.10        0.00       6.4
------------------------------------------------------------------------------
                               Fractional Components
------------------------------------------------------------------------------
% + 3 in. =  0.0     % GRAVEL = 22.6    % SAND = 71.0
% FINES =  6.4

D85=   6.76  D60=   1.445  D50=   0.822
```

W.O. No. Pearce Creek, MD
Req. No.
Contract No.

DEPARTMENT OF THE ARMY. PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	0.0	

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-44	86'-87'						

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-5 Date 01/2/96

GRADATION CURVES

```
================================================================================
                      GRAIN SIZE DISTRIBUTION TEST DATA          Test No.: 4
--------------------------------------------------------------------------------
Date:              01/2/96
W.O. No.:          PEARCE CREEK, MD
Req. No.:          7-40
Contract No.:
Project line 1     Pearce Creek Disposal Area
Project line 2     Ground Water Study
Area line 1:
Area line 2:
Boring No.:        CSW-7

--------------------------------------------------------------------------------
                                   Sample Data
--------------------------------------------------------------------------------
Lab No.:
Sample No.:        SPT-40
Elev or Depth:     84'-85.1'
Class 1::
Class 2::
Natural water content:                   Liquid limit:
Plastic limit:
--------------------------------------------------------------------------------
                              Mechanical Analysis Data
--------------------------------------------------------------------------------
                         Initial     After wash
Dry sample and tare=     456.90        431.30
Tare               =     296.10        296.10
Dry sample weight  =     160.80        135.20
Minus #200 from wash=    15.9 %
Sieve tare method
  Sieve              Weight       Sieve     Percent
                     retained     tare      finer
  # 10                  0.10        0.00      99.9
  # 20                  0.30        0.00      99.8
  # 30                  2.20        0.00      98.4
  # 40                 38.10        0.00      74.7
  # 50                 63.10        0.00      35.4
  # 60                 13.60        0.00      27.0
  # 80                  9.90        0.00      20.8
  # 100                 2.70        0.00      19.2
  # 120                 1.60        0.00      18.2
  # 200                 3.10        0.00      16.2
--------------------------------------------------------------------------------
                               Fractional Components
--------------------------------------------------------------------------------
% + 3 in. =   0.0     % GRAVEL =   0.0    % SAND = 83.8
% FINES = 16.2

D85=    0.47  D60=    0.372  D50=    0.343
D30=    0.2710
```

W.O. No. PEARCE CREEK, MD
Req. No. 7-40
Contract No.

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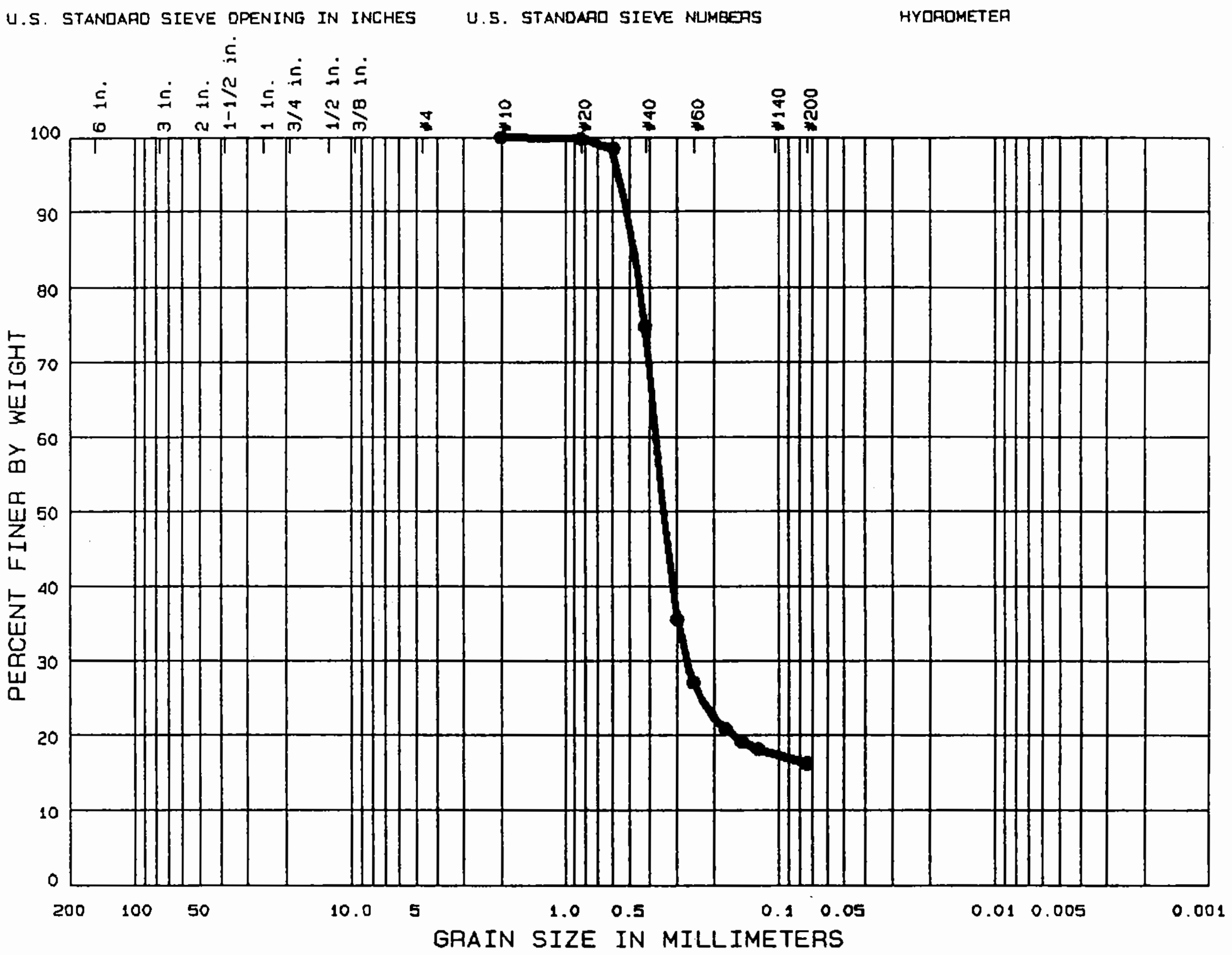


	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	83.8	16.2

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-40	84'-85.1'						

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-7 Date 01/2/96

GRADATION CURVES

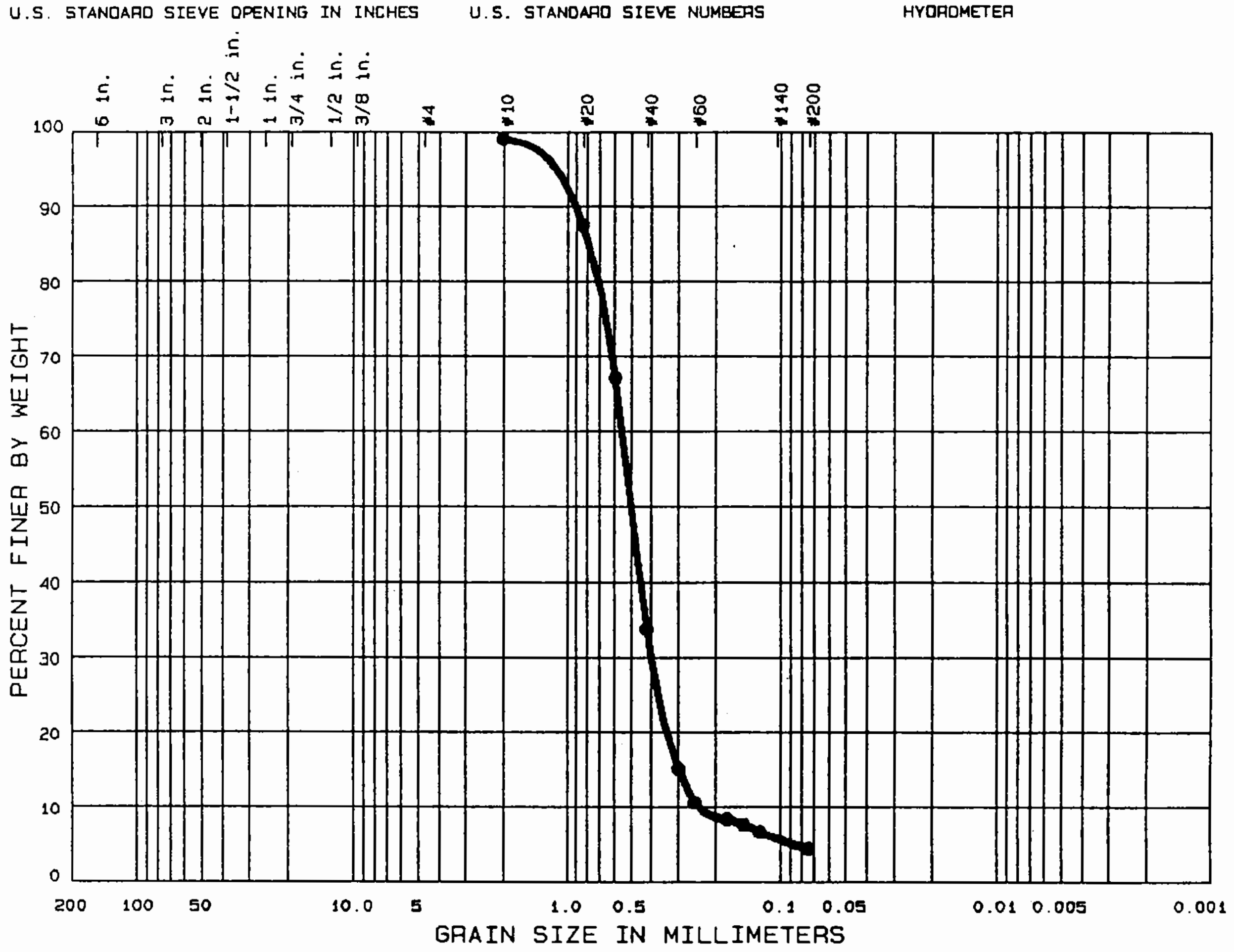
```
==============================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA         Test No.: 4
------------------------------------------------------------------------------
Date:              01/2/96
W.O. No.:          Pearce Creek, MD
Req. No.:          8-4
Contract No.:
Project line 1     Pearce Creek Disposal Area
Project line 2     Ground Water Study
Area line 1:
Area line 2:
Boring No.:        CSW-8

------------------------------------------------------------------------------
                                     Sample Data
------------------------------------------------------------------------------
Lab No.:
Sample No.:        SPT-4
Elev or Depth:     6'-7.5'
Class 1::
Class 2::
Natural water content:                       Liquid limit:
Plastic limit:
------------------------------------------------------------------------------
                              Mechanical Analysis Data
------------------------------------------------------------------------------
                     Initial     After wash
Dry sample and tare=   474.50       467.50
Tare               =   288.90       288.90
Dry sample weight  =   185.60       178.60
Minus #200 from wash=    3.8 %
Sieve tare method
  Sieve              Weight       Sieve      Percent
                     retained     tare       finer
  # 10                 1.90        0.00        99.0
  # 20                21.30        0.00        87.5
  # 30                37.90        0.00        67.1
  # 40                62.00        0.00        33.7
  # 50                34.50        0.00        15.1
  # 60                 8.40        0.00        10.6
  # 80                 4.20        0.00         8.3
  # 100                1.30        0.00         7.6
  # 120                1.80        0.00         6.6
  # 200                4.20        0.00         4.4
------------------------------------------------------------------------------
                               Fractional Components
------------------------------------------------------------------------------
% + 3 in. =  0.0    % GRAVEL =  0.0    % SAND = 95.6
% FINES =  4.4

D85=   0.79  D60=   0.547  D50=   0.497
D30=   0.4004  D15=   0.29614  D10=  0.24071
Cc =   1.2176  Cu =   2.2725
```

W.O. No. Pearce Creek, MD
Req. No. 8-4
Contract No.

EPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
ORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	95.6	4.4

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-4	6'-7.5'					1.22	2.3

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area

Boring No. CSW-8 Date 01/2/96

GRADATION CURVES

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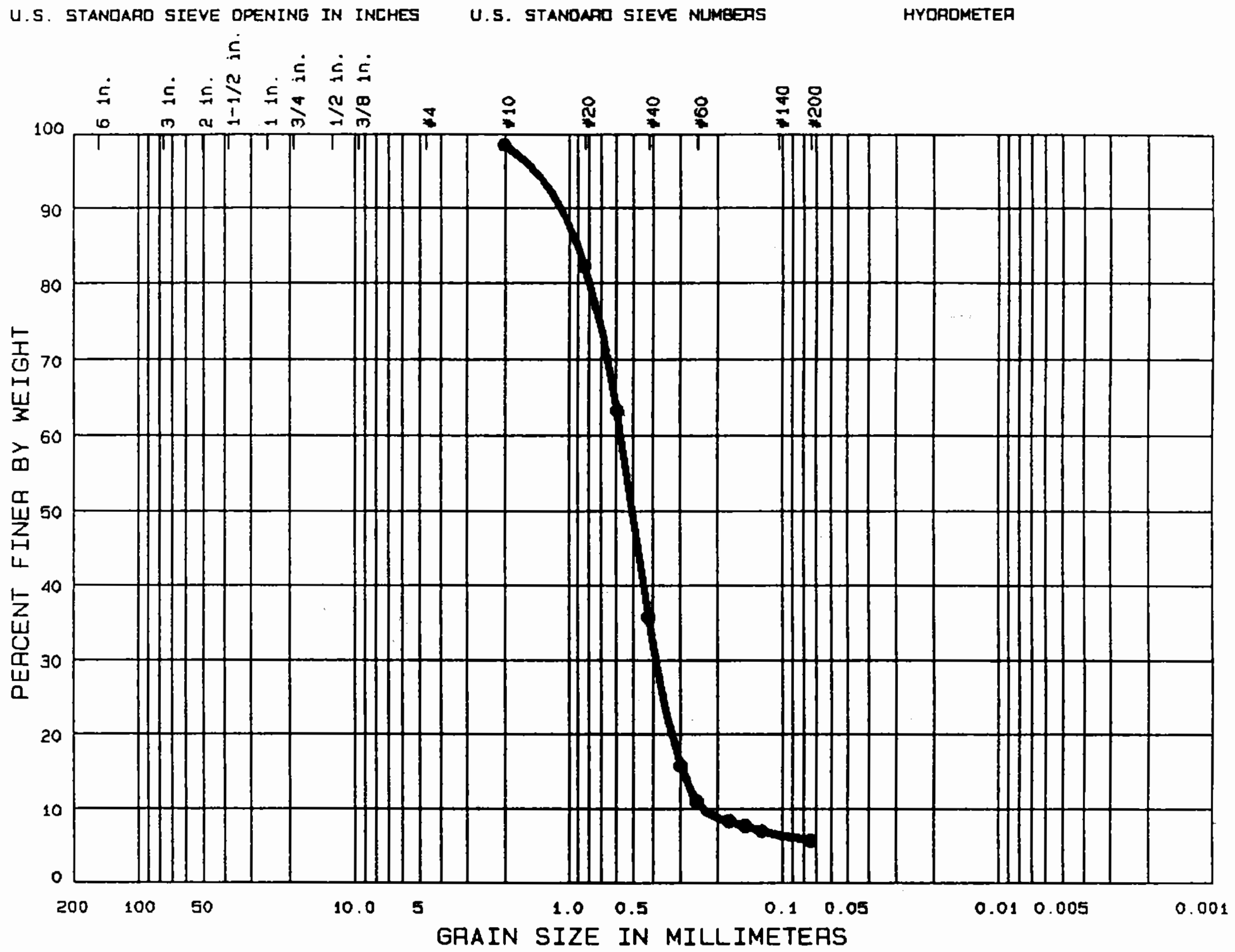
==============================================================================
                      GRAIN SIZE DISTRIBUTION TEST DATA         Test No.: 5
------------------------------------------------------------------------------
Date:               01/2/96
W.O. No.:           Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1      Pearce Creek Disposal Area
Project line 2      Ground Water Study
Area line 1:
Area line 2:
Boring No.:         CSW-8

------------------------------------------------------------------------------
                                    Sample Data
------------------------------------------------------------------------------
Lab No.:
Sample No.:         SPT-6
Elev or Depth:      10'-12'
Class 1::
Class 2::
Natural water content:                  Liquid limit:
Plastic limit:
------------------------------------------------------------------------------
                              Mechanical Analysis Data
------------------------------------------------------------------------------
                         Initial     After wash
Dry sample and tare=     536.60        523.30
Tare                =    294.50        294.50
Dry sample weight   =    242.10        228.80
Minus #200 from wash=     5.5 %
Sieve tare method
  Sieve             Weight       Sieve     Percent
                    retained     tare      finer
  # 10                3.70        0.00       98.5
  # 20               39.40        0.00       82.2
  # 30               46.00        0.00       63.2
  # 40               66.90        0.00       35.6
  # 50               47.90        0.00       15.8
  # 60               11.70        0.00       10.9
  # 80                6.40        0.00        8.3
  # 100               1.60        0.00        7.6
  # 120               1.60        0.00        7.0
  # 200               3.10        0.00        5.7
------------------------------------------------------------------------------
                               Fractional Components
------------------------------------------------------------------------------
% + 3 in. =  0.0    % GRAVEL =  0.0    % SAND = 94.3
% FINES =  5.7

D85=    0.91  D60=    0.565  D50=    0.500
D30=    0.3882  D15=    0.29040  D10=   0.23335
Cc =    1.1429  Cu =    2.4210
```

W.O. No. Pearce Creek, MD
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	94.3	5.7

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-6	10'-12'					1.14	2.4

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-8 Date 01/2/96

GRADATION CURVES

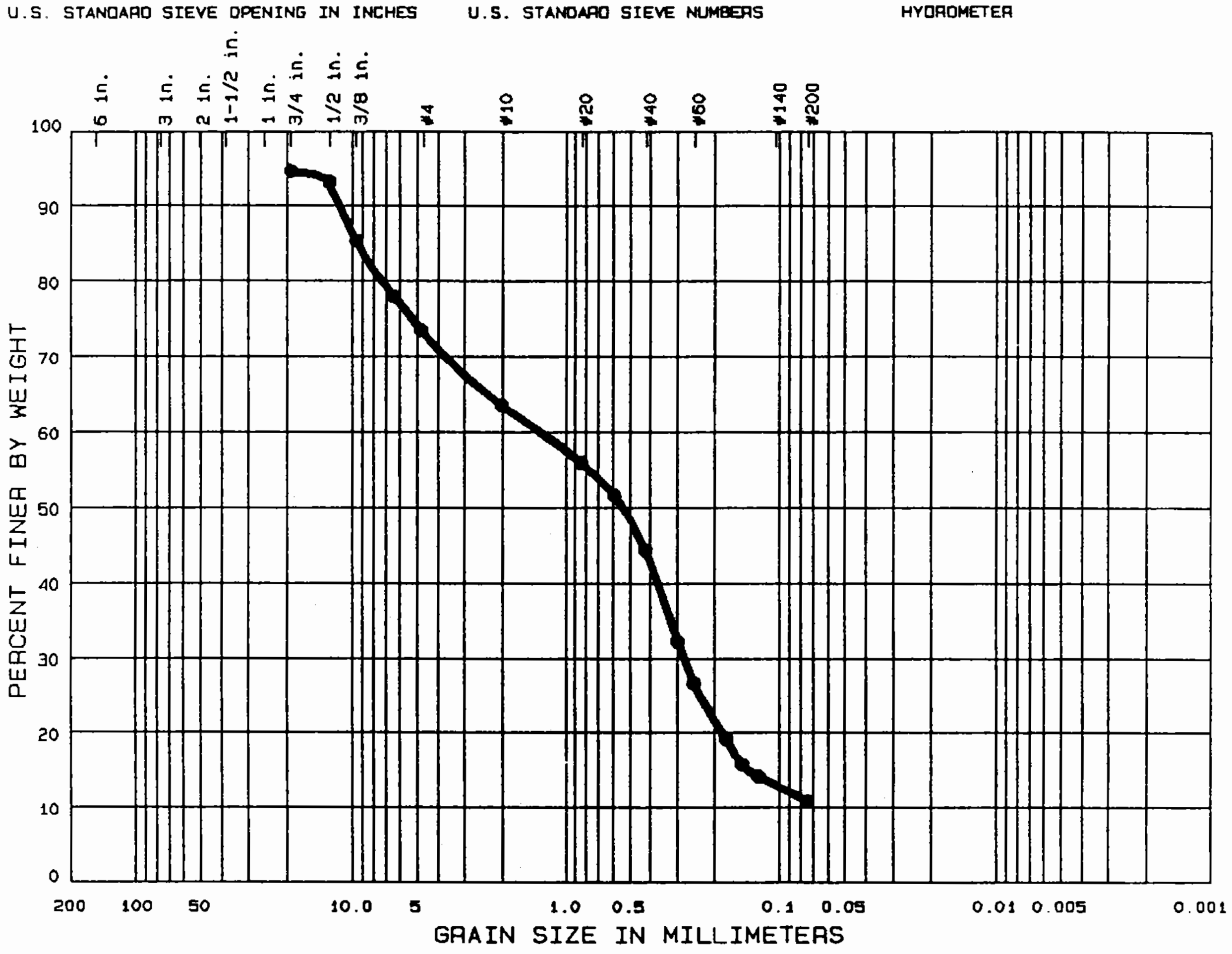
DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET

```
================================================================================
                         GRAIN SIZE DISTRIBUTION TEST DATA         Test No.: 5
--------------------------------------------------------------------------------
Date:               01/2/96
W.O. No.:           Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1      Pearce Creek Disposal Area
Project line 2      Ground Water Study
Area line 1:
Area line 2:
Boring No.:         CSW-8

--------------------------------------------------------------------------------
                                     Sample Data
--------------------------------------------------------------------------------
Lab No.:
Sample No.:         SPT-18
Elev or Depth:      34'-36'
Class 1::
Class 2::
Natural water content:                   Liquid limit:
Plastic limit:
--------------------------------------------------------------------------------
                                Mechanical Analysis Data
--------------------------------------------------------------------------------
                         Initial      After wash
Dry sample and tare=      666.30        628.50
Tare               =      299.50        299.50
Dry sample weight  =      366.80        329.00
Minus #200 from wash=     10.3 %
Sieve tare method
  Sieve              Weight       Sieve      Percent
                     retained     tare       finer
  0.75   inches        20.00        0.00       94.5
  0.5    inches         5.00        0.00       93.2
  0.375  inches        28.80        0.00       85.3
  0.25   inches        27.30        0.00       77.9
  # 4                  16.40        0.00       73.4
  # 10                 36.30        0.00       63.5
  # 20                 28.20        0.00       55.8
  # 30                 15.80        0.00       51.5
  # 40                 26.60        0.00       44.3
  # 50                 44.40        0.00       32.2
  # 60                 20.30        0.00       26.6
  # 80                 27.50        0.00       19.1
  # 100                12.70        0.00       15.7
  # 120                 5.90        0.00       14.1
  # 200                12.20        0.00       10.7
--------------------------------------------------------------------------------
                                  Fractional Components
--------------------------------------------------------------------------------
% + 3 in. =  0.0    % GRAVEL = 26.6    % SAND = 62.7
% FINES = 10.7
```

W.O. No. Pearce Creek, MD
Req. No.
Contract No.

DEPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
CORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	26.6	62.7	10.7

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-18	34'-36'						

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area

Boring No. CSW-8 Date 01/2/96

GRADATION CURVES

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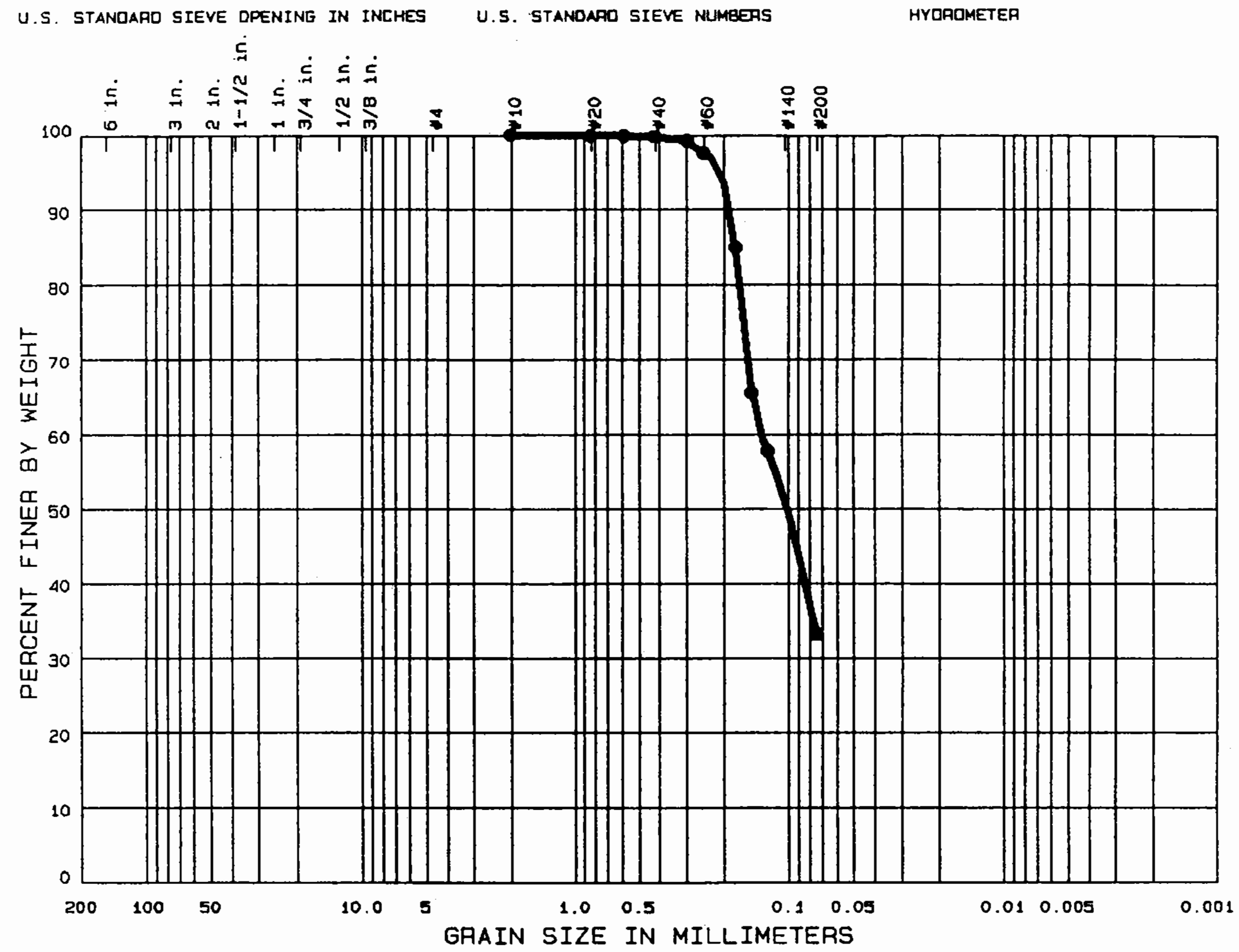
==========================================================================
                     GRAIN SIZE DISTRIBUTION TEST DATA          Test No.: 5
--------------------------------------------------------------------------
Date:               01/2/96
W.O. No.:           Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1      Pearce Creek Disposal Area
Project line 2      Ground Water Study
Area line 1:
Area line 2:
Boring No.:         CSW-8

--------------------------------------------------------------------------
                                Sample Data
--------------------------------------------------------------------------
Lab No.:
Sample No.:         SPT-25
Elev or Depth:      48'-50'
Class 1::
Class 2::
Natural water content:                  Liquid limit:
Plastic limit:
--------------------------------------------------------------------------
                          Mechanical Analysis Data
--------------------------------------------------------------------------
                         Initial      After wash
Dry sample and tare=     649.40        602.30
Tare               =     298.30        298.30
Dry sample weight  =     351.10        304.00
Minus #200 from wash=    13.4 %
Sieve tare method
  Sieve              Weight       Sieve     Percent
                     retained     tare      finer
  # 20                 1.10       0.00       99.7
  # 30                 8.50       0.00       97.3
  # 40                84.20       0.00       73.3
  # 50               142.30       0.00       32.8
  # 60                28.40       0.00       24.7
  # 80                17.90       0.00       19.6
  # 100                5.30       0.00       18.1
  # 120                5.80       0.00       16.4
  # 200                9.90       0.00       13.6
--------------------------------------------------------------------------
                           Fractional Components
--------------------------------------------------------------------------
% + 3 in. =  0.0     % GRAVEL =  0.0    % SAND = 86.4
% FINES = 13.6

D85=    0.48  D60=    0.377  D50=    0.349
D30=    0.2851 D15=    0.09886
```

W.O. No. Pearce Creek, MD
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	66.9	33.1

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-36	70'-72'						

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-8 Date 01/2/96

EPARTMENT OF THE ARMY. PHILADELPHIA DISTRICT
ORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET

GRADATION CURVES

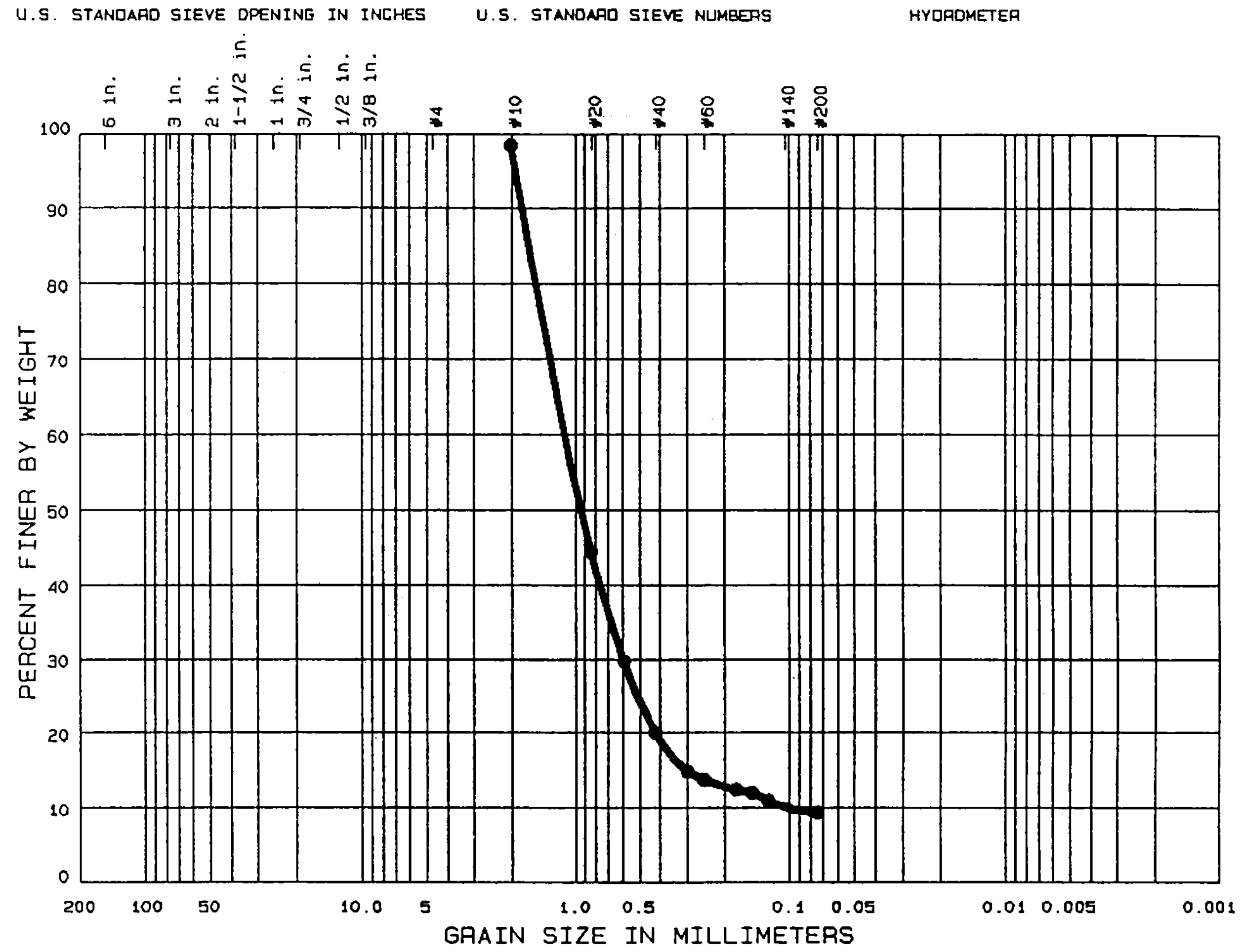
```
================================================================================
                           GRAIN SIZE DISTRIBUTION TEST DATA          Test No.: 6
--------------------------------------------------------------------------------
Date:              01/2/96
W.O. No.:          Pearce Creek, MD
Req. No.:
Contract No.:
Project line 1     Pearce Creek Disposal Area
Project line 2     Ground Water Study
Area line 1:
Area line 2:
Boring No.:        CSW-8

--------------------------------------------------------------------------------
                                       Sample Data
--------------------------------------------------------------------------------
Lab No.:
Sample No.:        SPT-64
Elev or Depth:     126-127.1
Class 1::
Class 2::
Natural water content:                        Liquid limit:
Plastic limit:
--------------------------------------------------------------------------------
                                 Mechanical Analysis Data
--------------------------------------------------------------------------------
                          Initial     After wash
Dry sample and tare=     590.80         563.80
Tare               =     296.10         296.10
Dry sample weight  =     294.70         267.70
Minus #200 from wash=     9.2 %
Sieve tare method
  Sieve              Weight        Sieve     Percent
                     retained      tare      finer
  # 10                  4.80         0.00      98.4
  # 20                159.40         0.00      44.3
  # 30                 43.20         0.00      29.6
  # 40                 28.50         0.00      20.0
  # 50                 15.10         0.00      14.8
  # 60                  3.10         0.00      13.8
  # 80                  4.10         0.00      12.4
  # 100                 1.40         0.00      11.9
  # 120                 3.00         0.00      10.9
  # 200                 4.60         0.00       9.3
--------------------------------------------------------------------------------
                                  Fractional Components
--------------------------------------------------------------------------------
% + 3 in. =   0.0     % GRAVEL =   0.0    % SAND = 90.7
% FINES =   9.3

D85=    1.65  D60=    1.118  D50=    0.939
D30=    0.5963  D15=    0.30234  D10=   0.09897
Cc =    3.2137  Cu =   11.2980
```

EPARTMENT OF THE ARMY, PHILADELPHIA DISTRICT
ORPS OF ENGINEERS, CUSTOM HOUSE, 2ND & CHESTNUT STREET

W.O. No. Pearce Creek, MD
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	90.7	9.3

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	SPT-64	126-127.1					3.21	11.3

CLASSIFICATION

●

Remarks:

Project Pearce Creek Disposal Area
Ground Water Study
Lab No.
Area
Boring No. CSW-8 Date 01/2/96

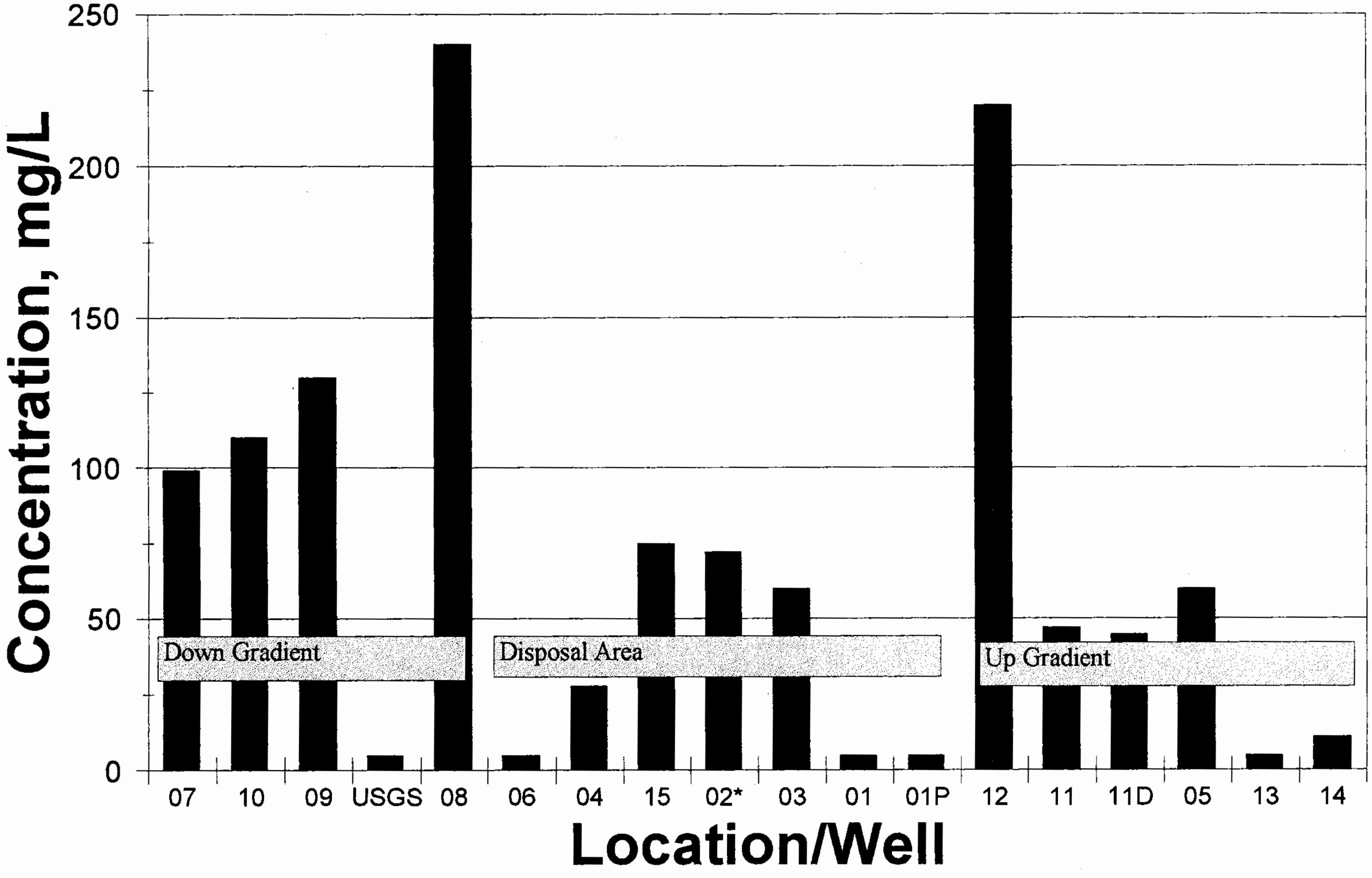
GRADATION CURVES

Appendix D

Geochemical Data Graphing

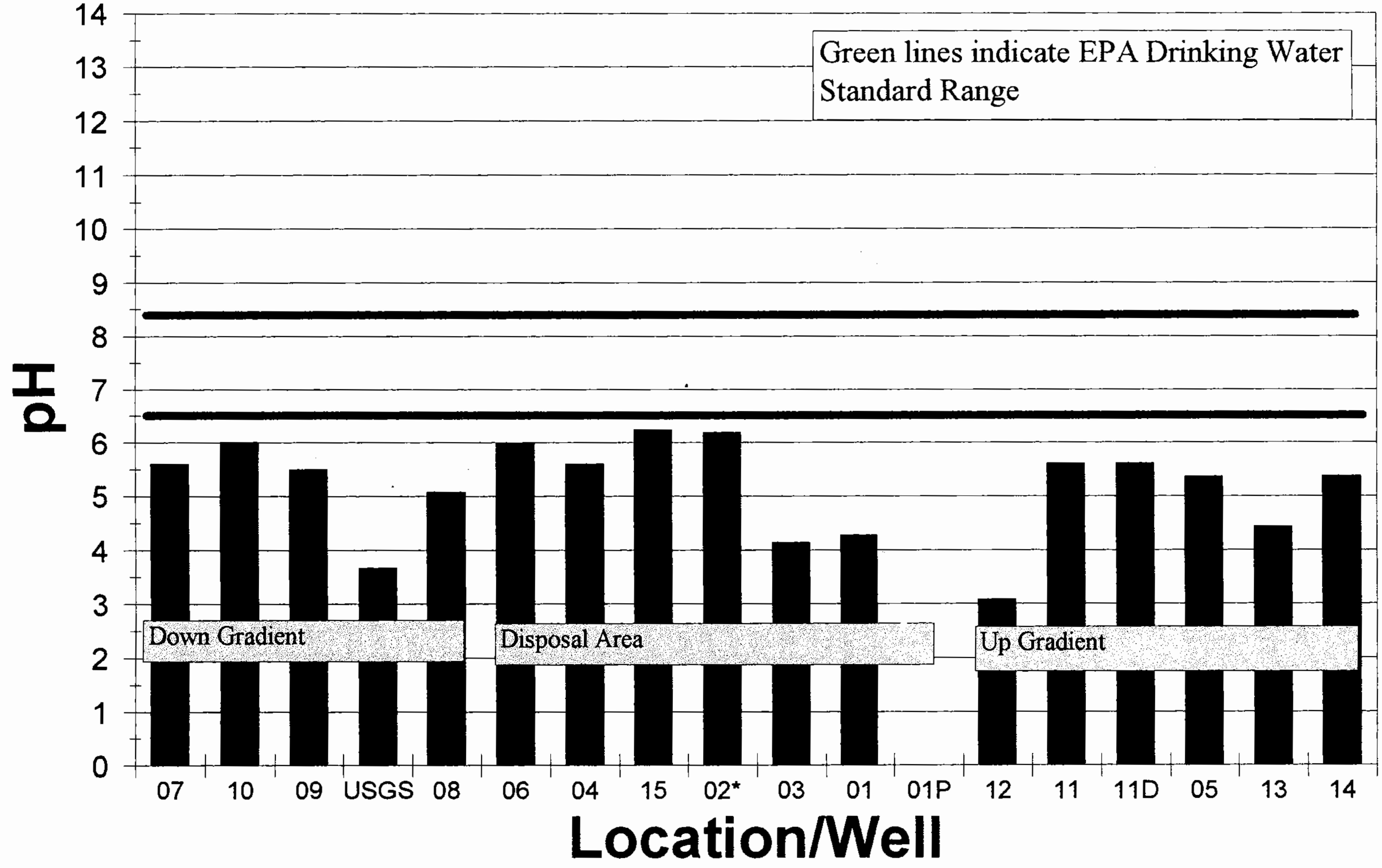
Alkalinity as CaCO3

Oct. 7, 8, 9 and 16, 1996



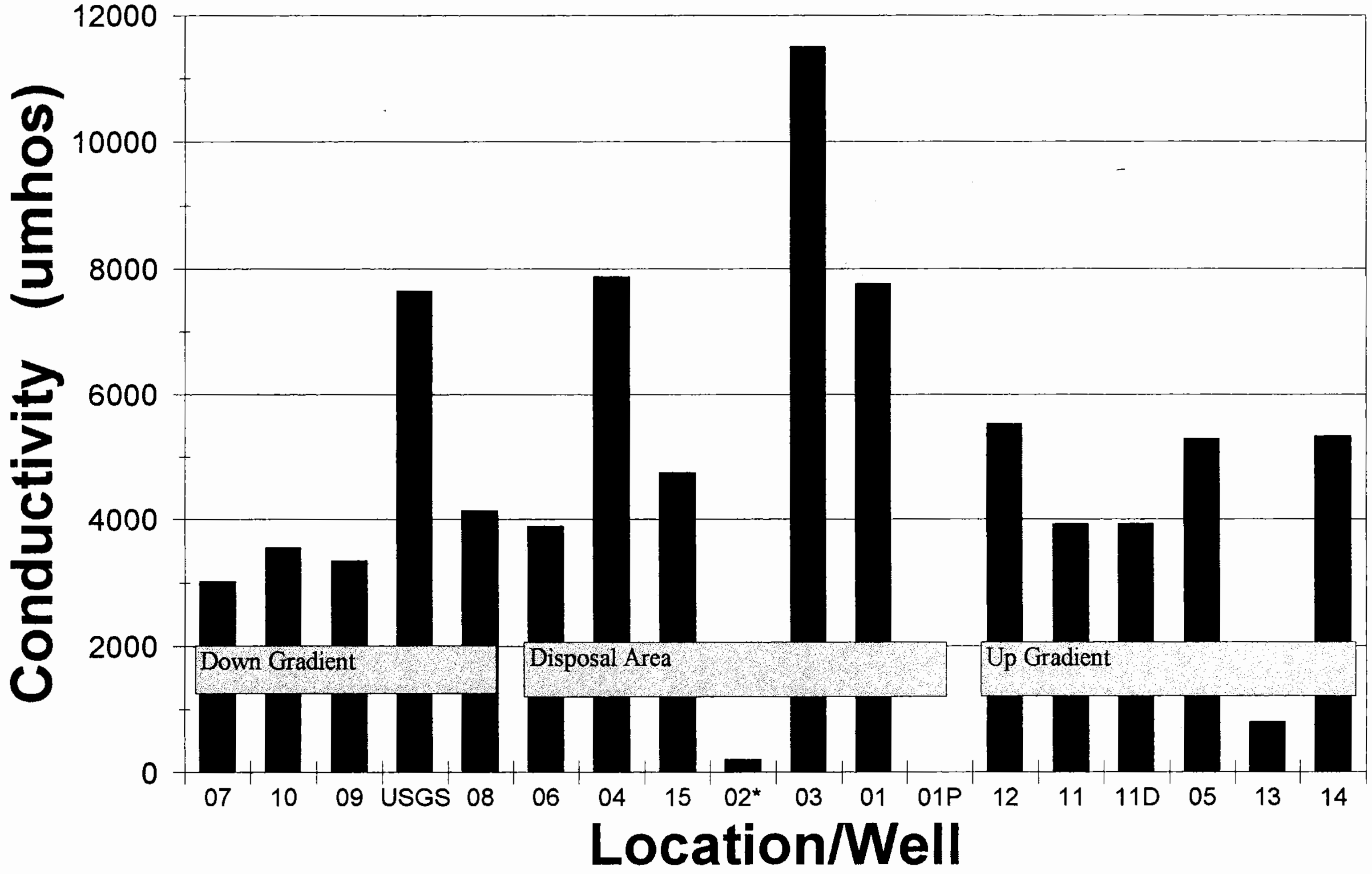
pH

Oct. 7, 8, 9 and 16, 1996



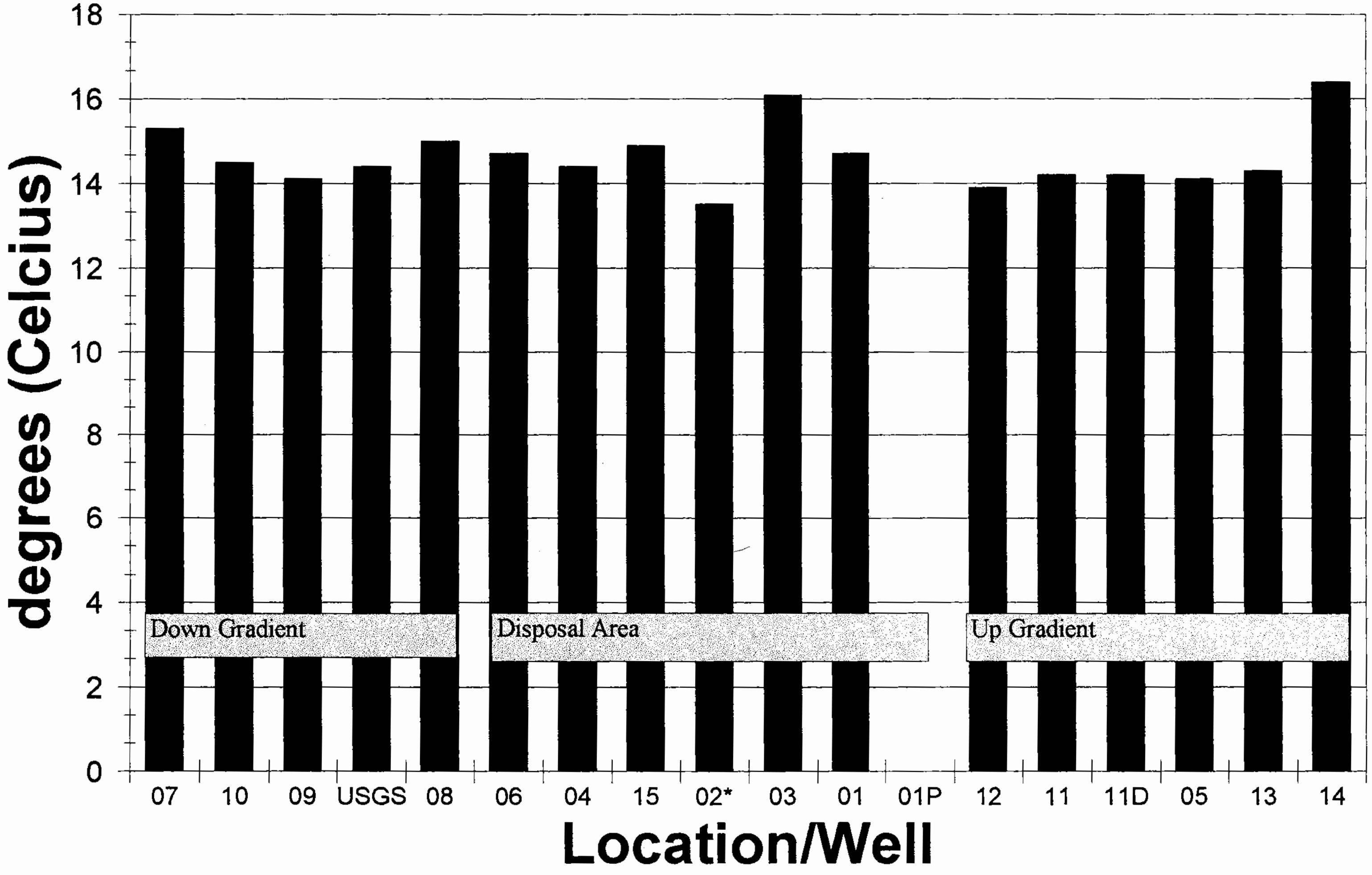
Conductivity

Oct. 7, 8, 9 and 16, 1996



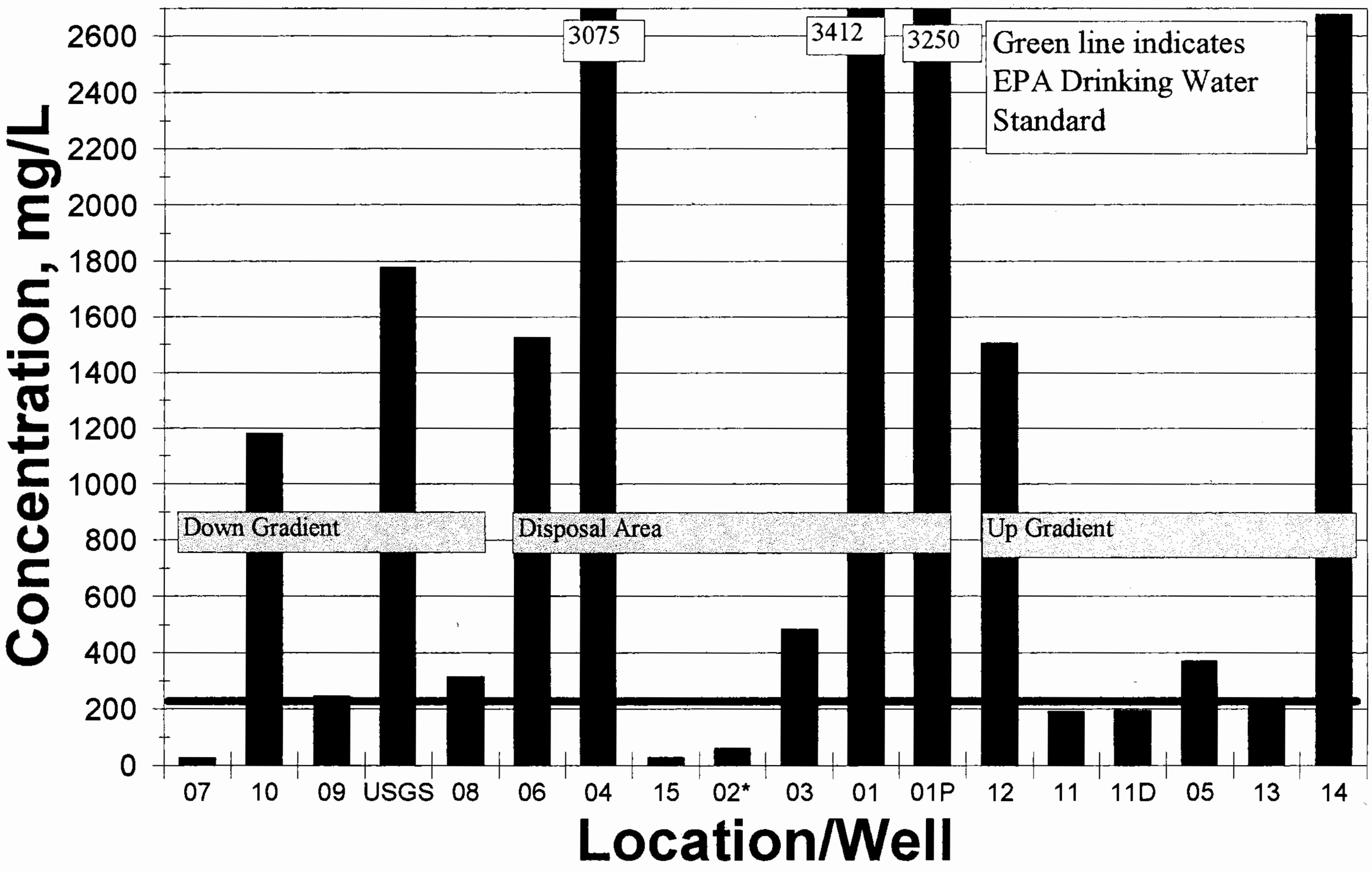
Temperature

Oct. 7, 8, 9 and 16, 1996



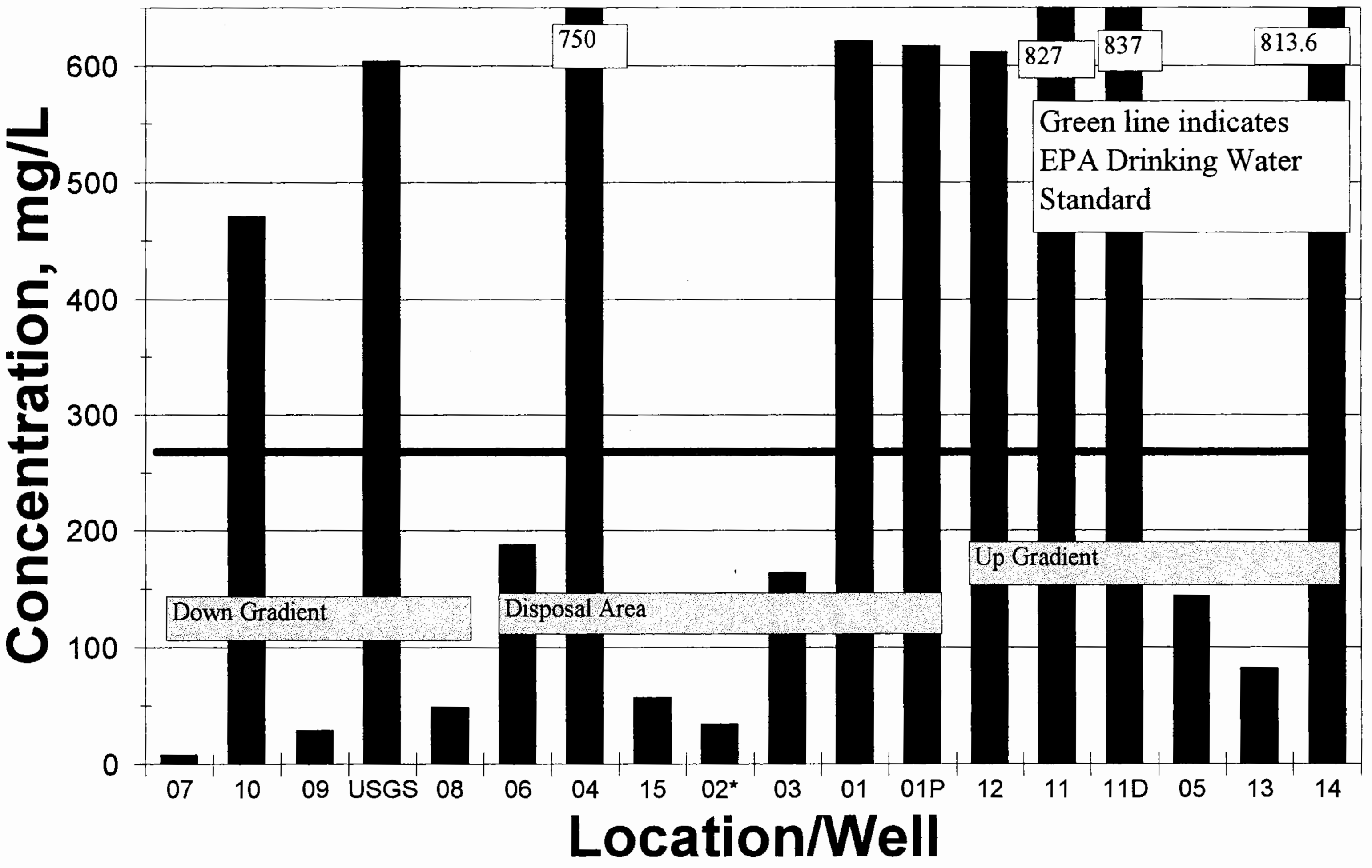
Sulfate

Oct. 7, 8, 9 and 16, 1996



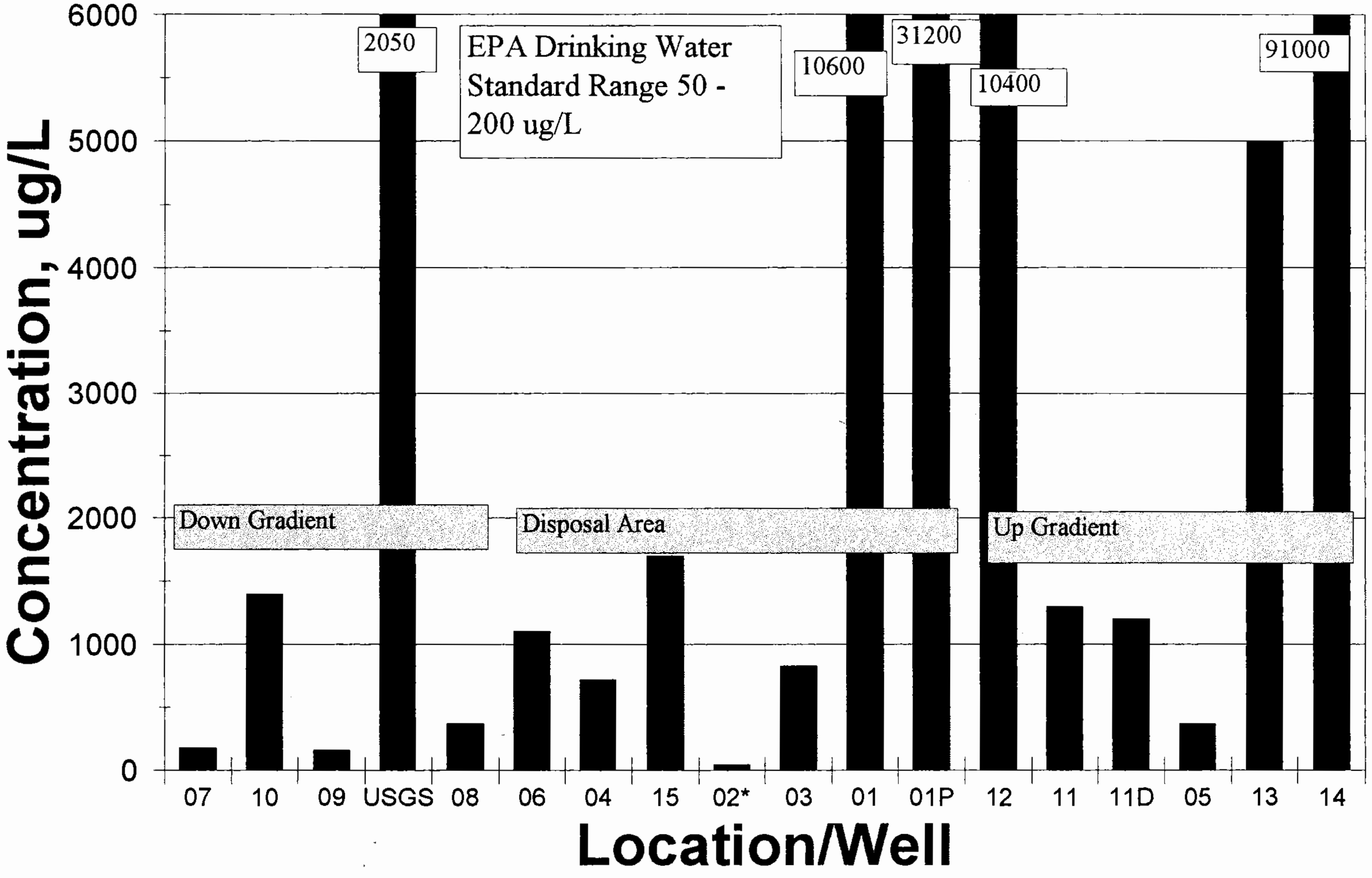
Chloride

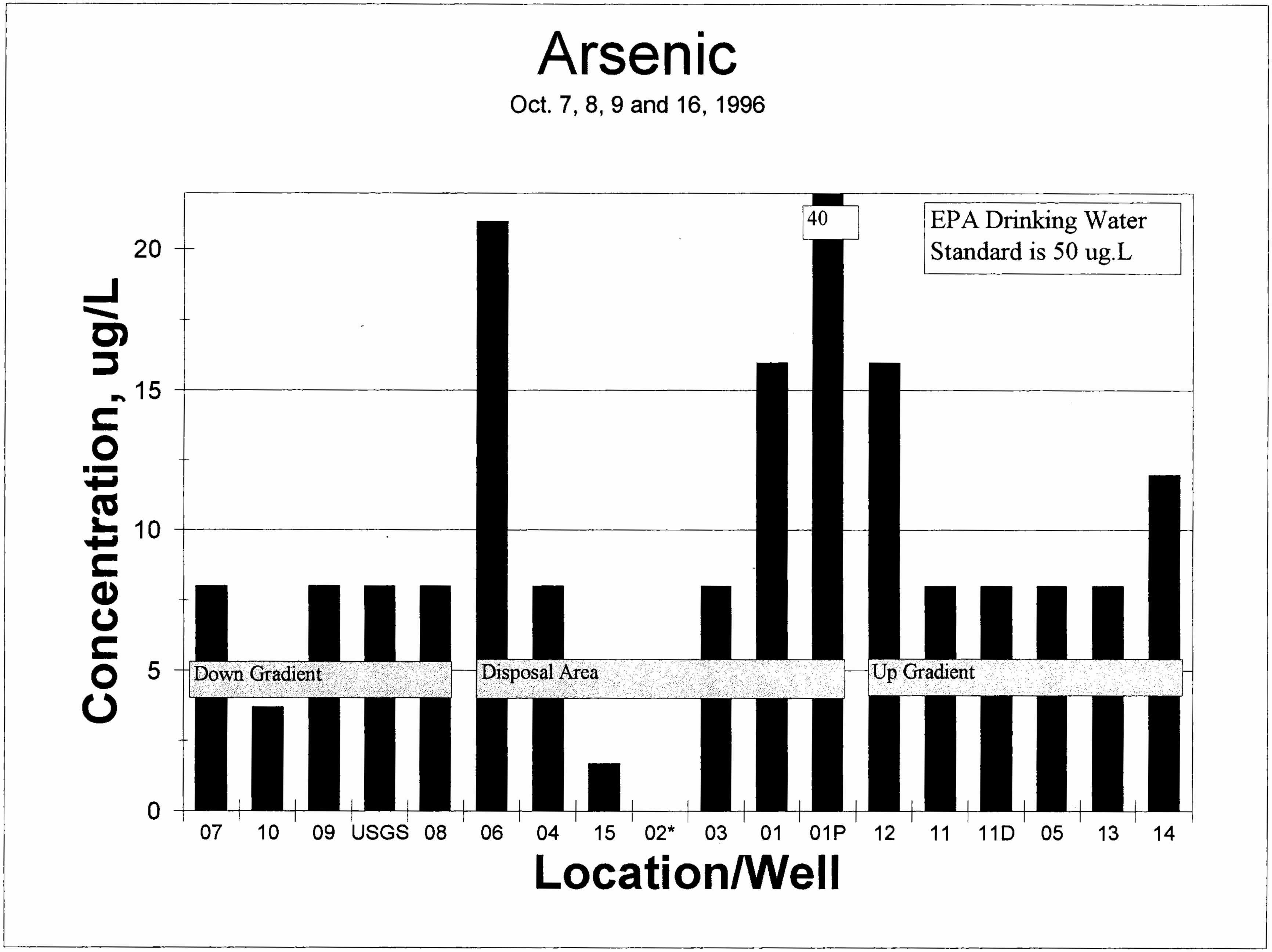
Oct. 7, 8, 9 and 16, 1996



Aluminum

Oct. 7, 8, 9 and 16, 1996



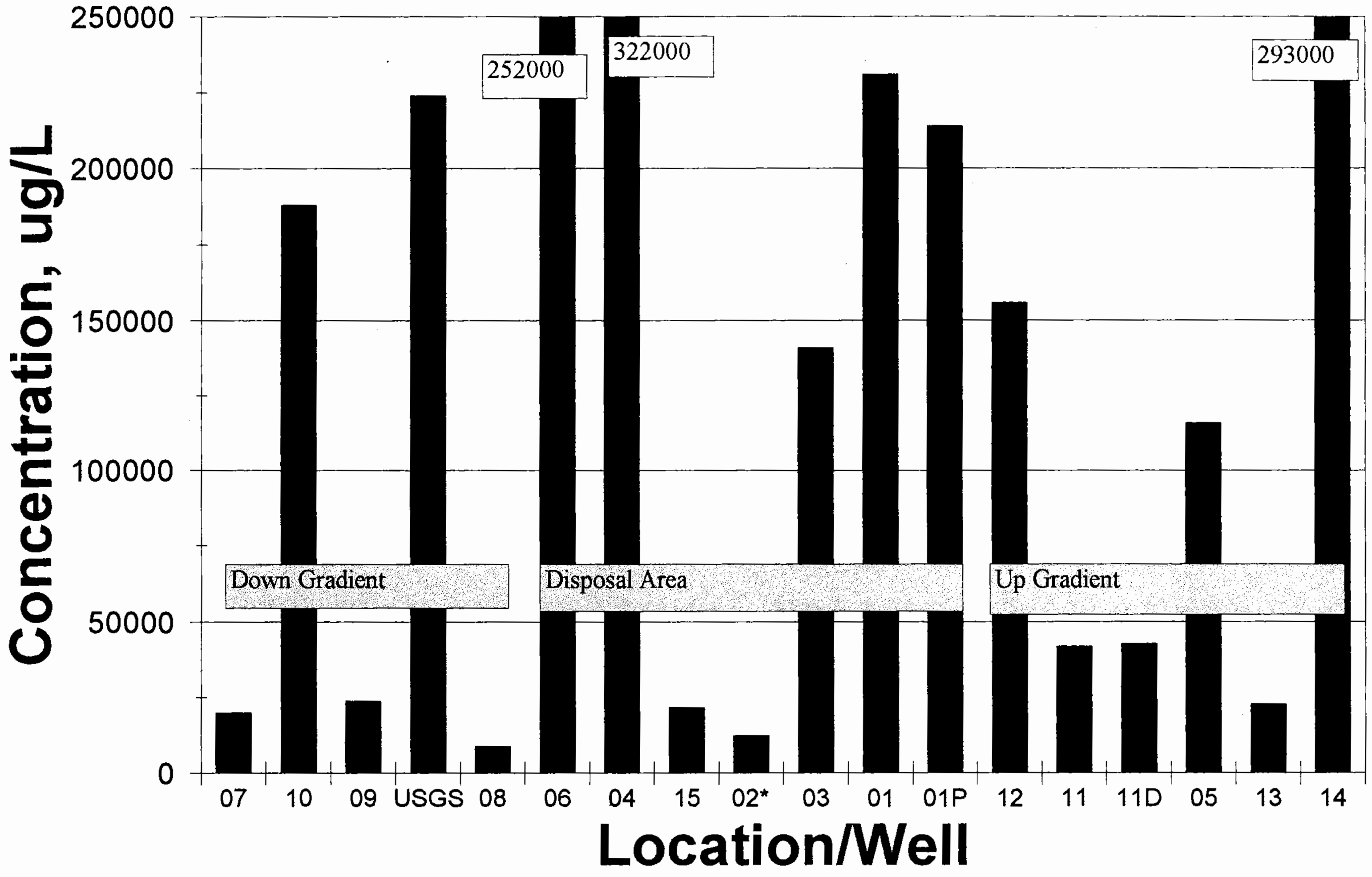


Arsenic

Oct. 7, 8, 9 and 16, 1996

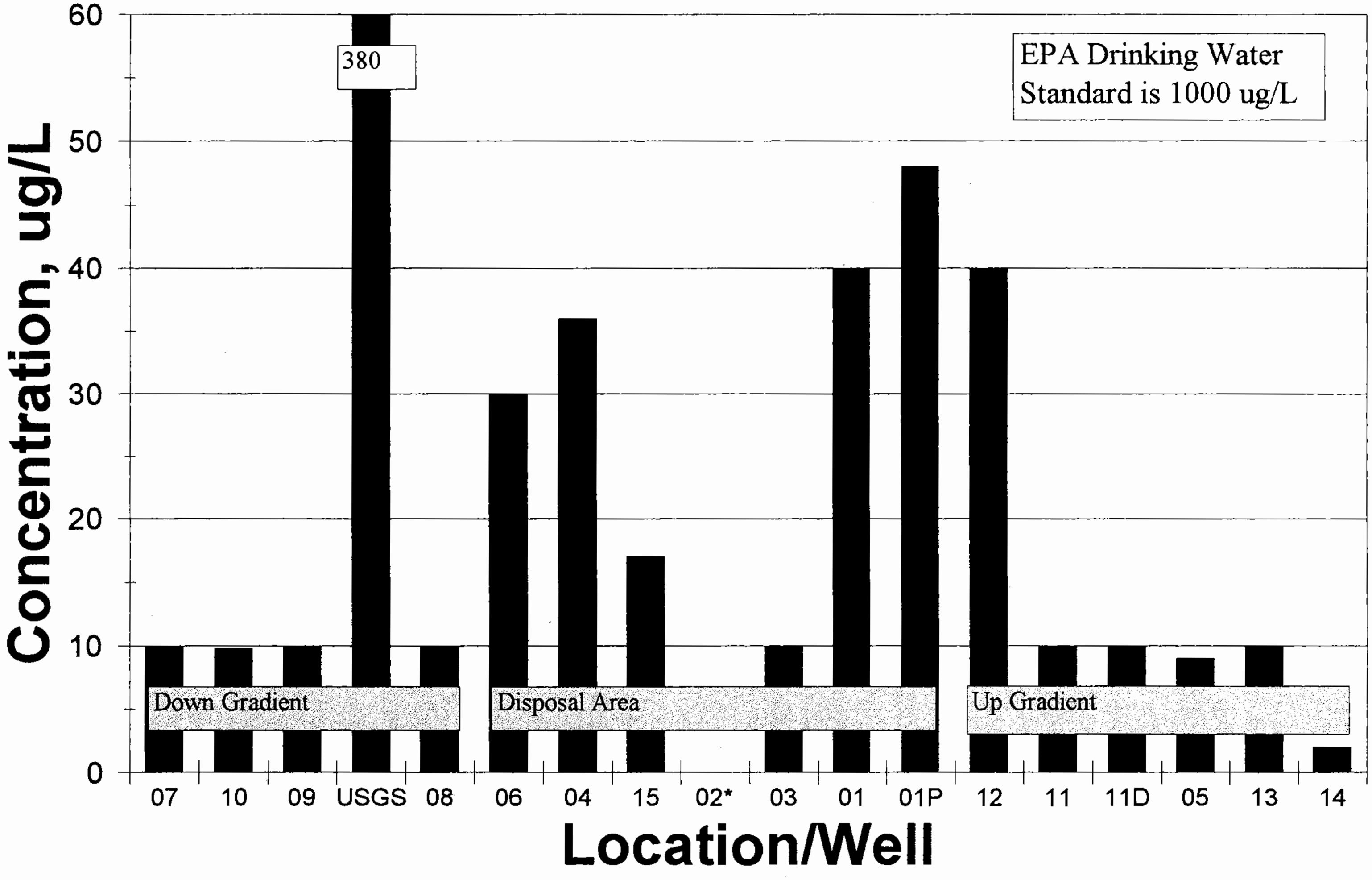
Calcium

Oct. 7, 8, 9 and 16, 1996



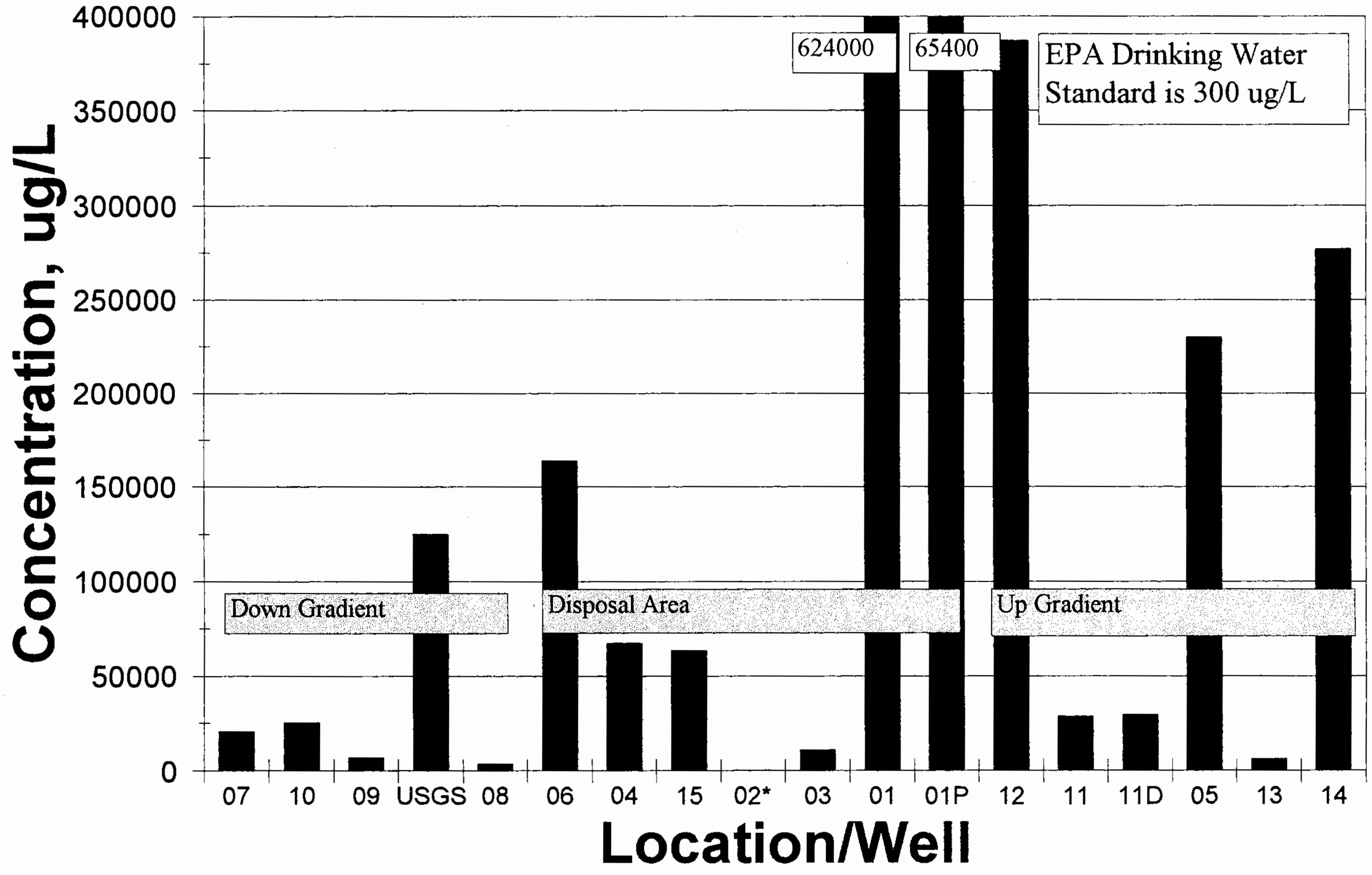
Copper

Oct. 7, 8, 9 and 16, 1996



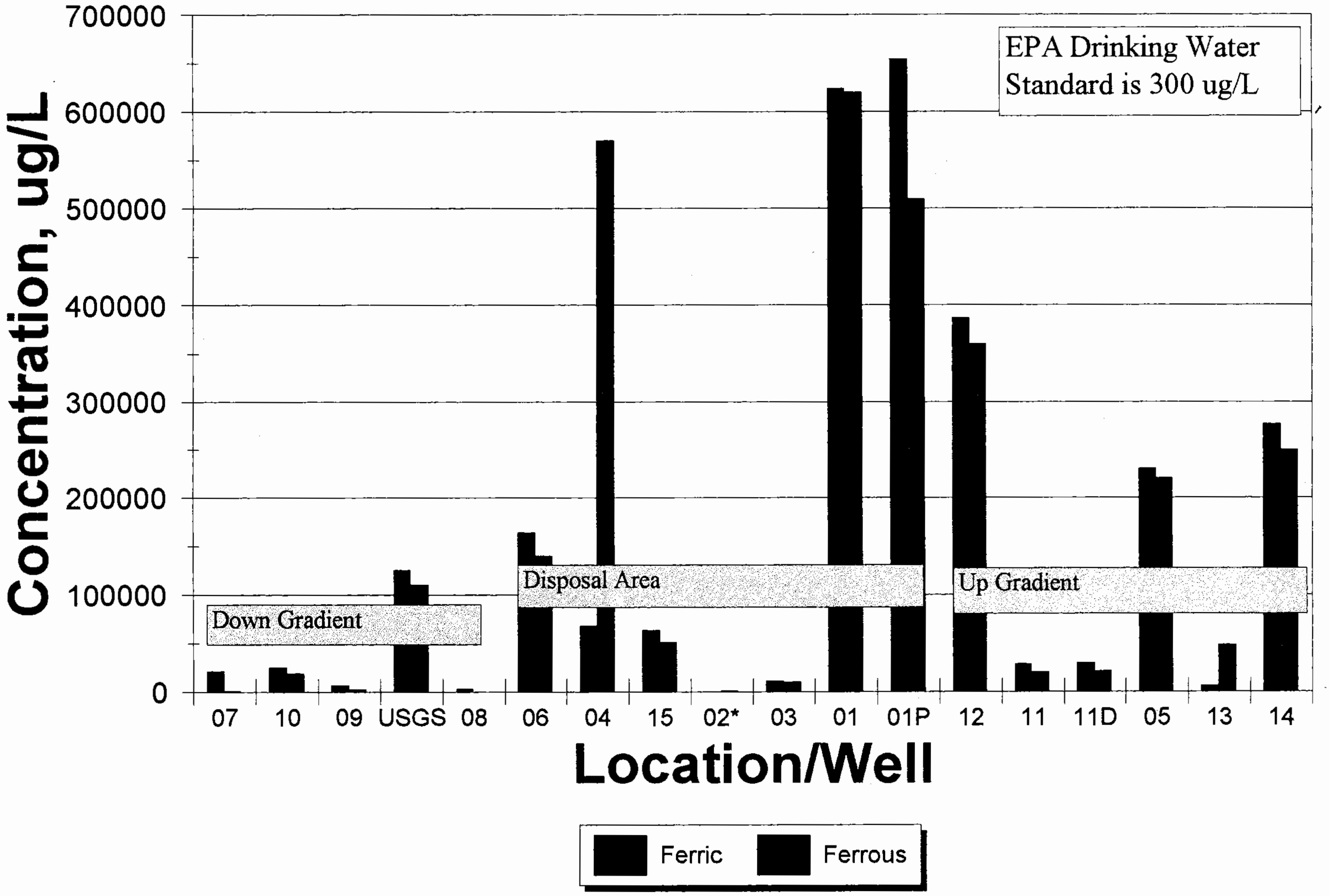
Iron

Oct. 7, 8, 9 and 16, 1996



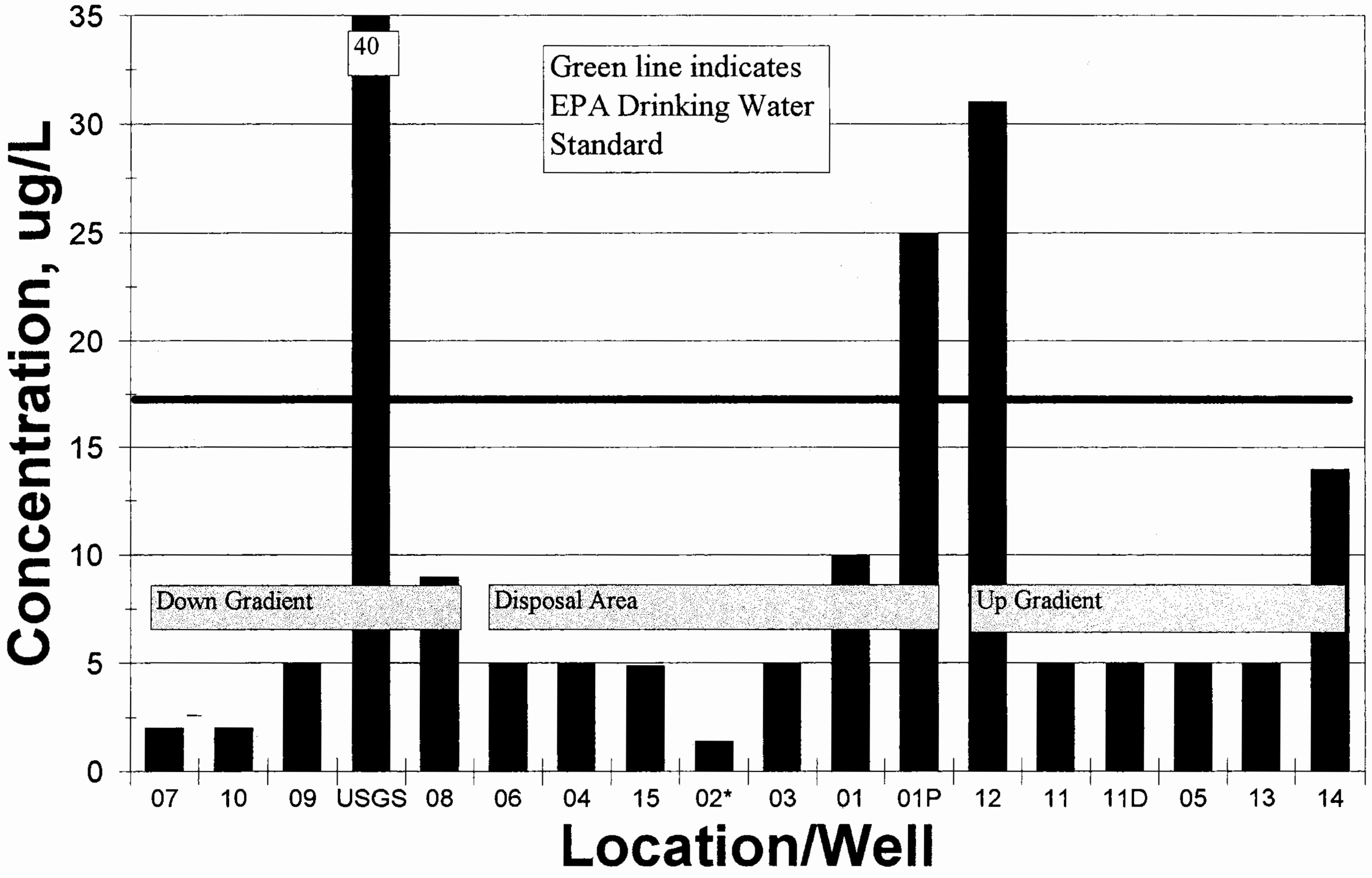
Ferric and Ferrous Iron

Oct. 7, 8, 9 and 16, 1996



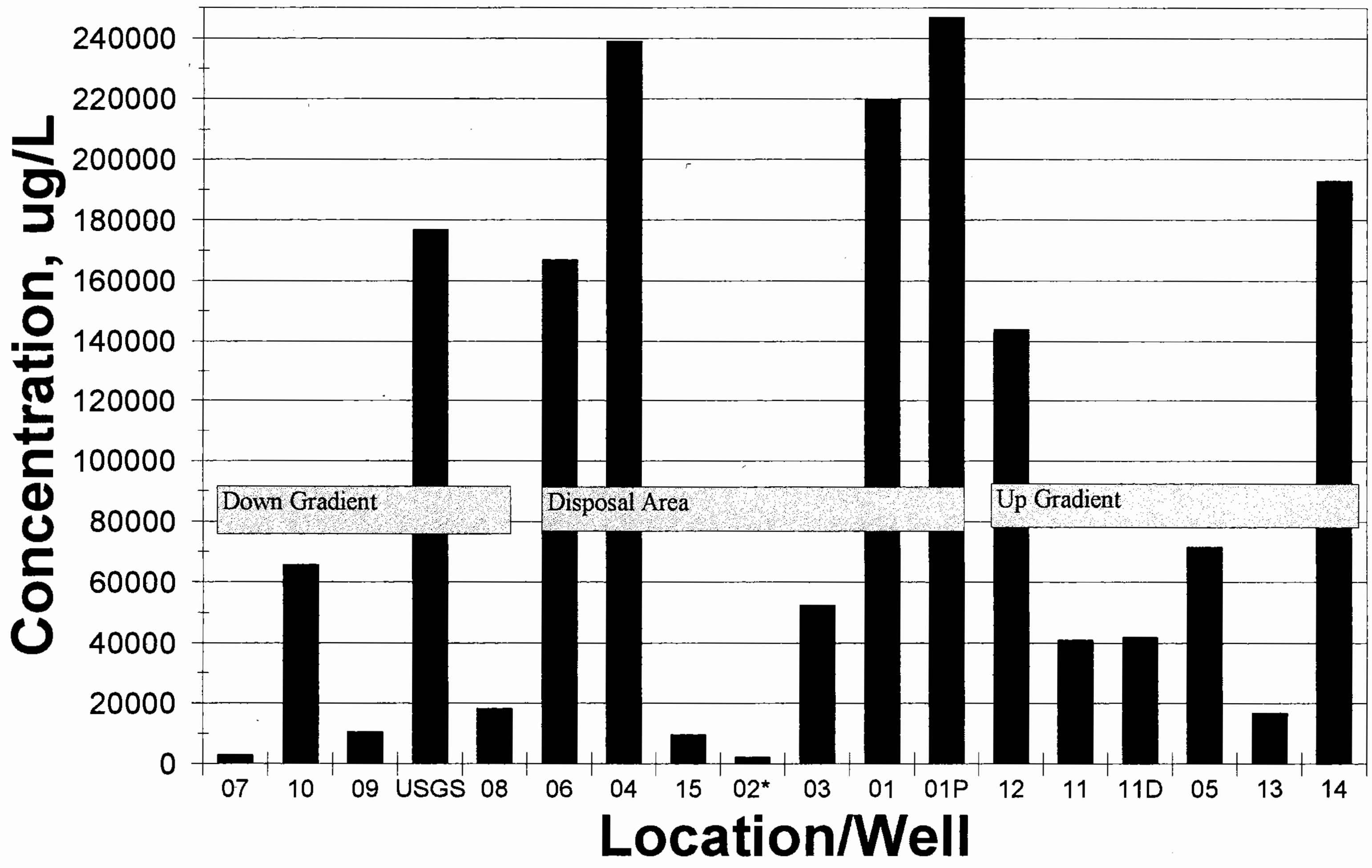
Lead

Oct. 7, 8, 9 and 16, 1996



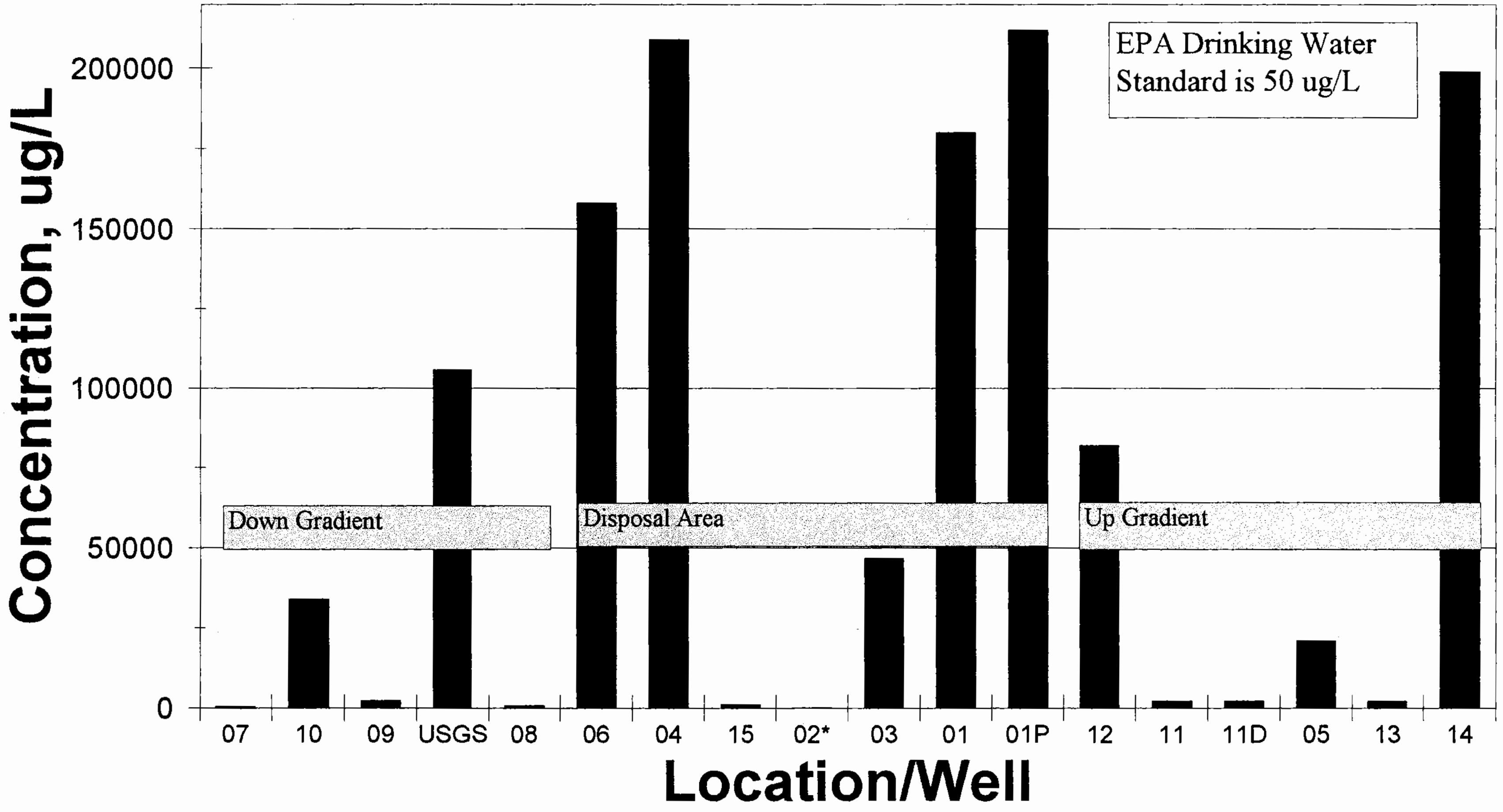
Magnesium

Oct. 7, 8, 9 and 16, 1996



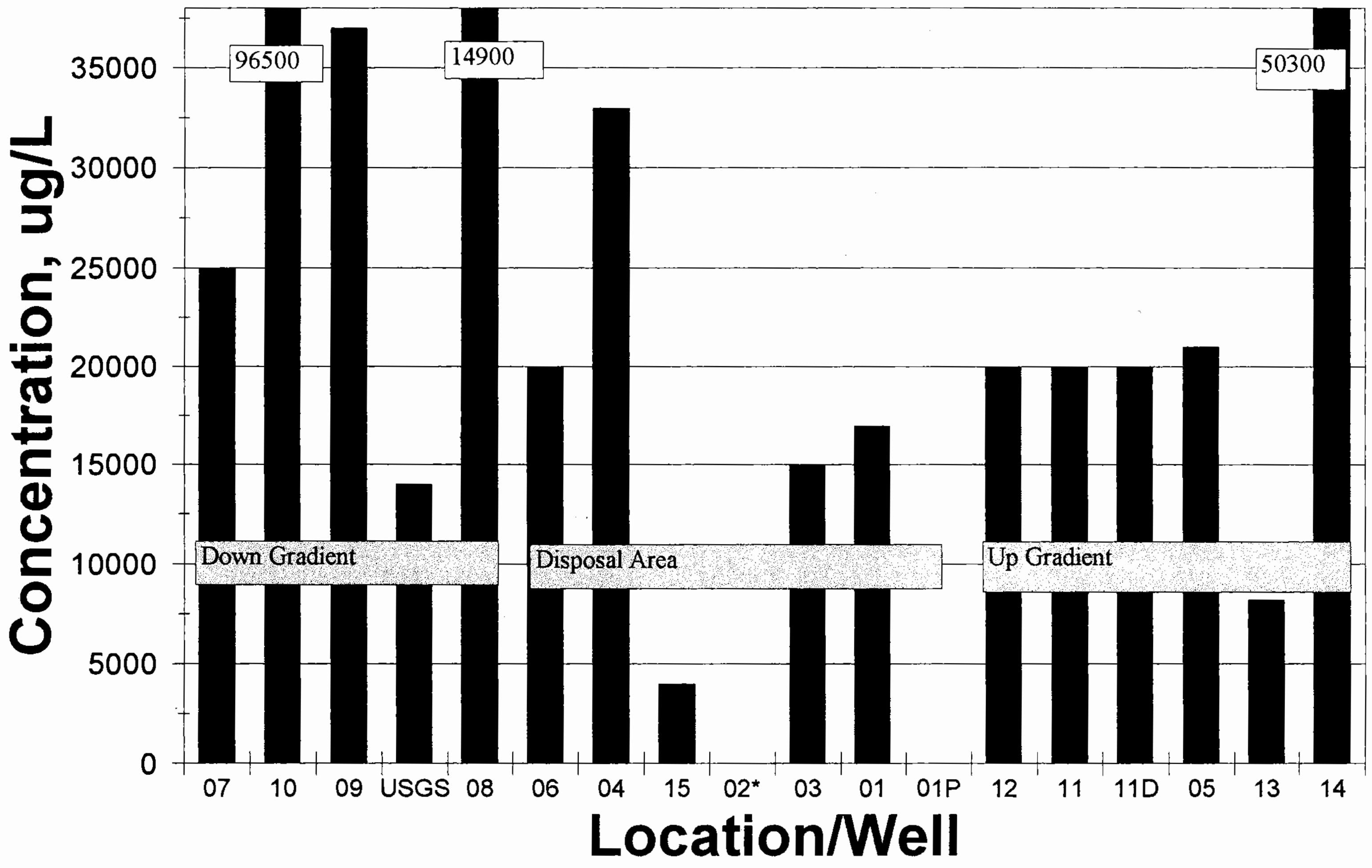
Manganese

Oct. 7, 8, 9 and 16, 1996



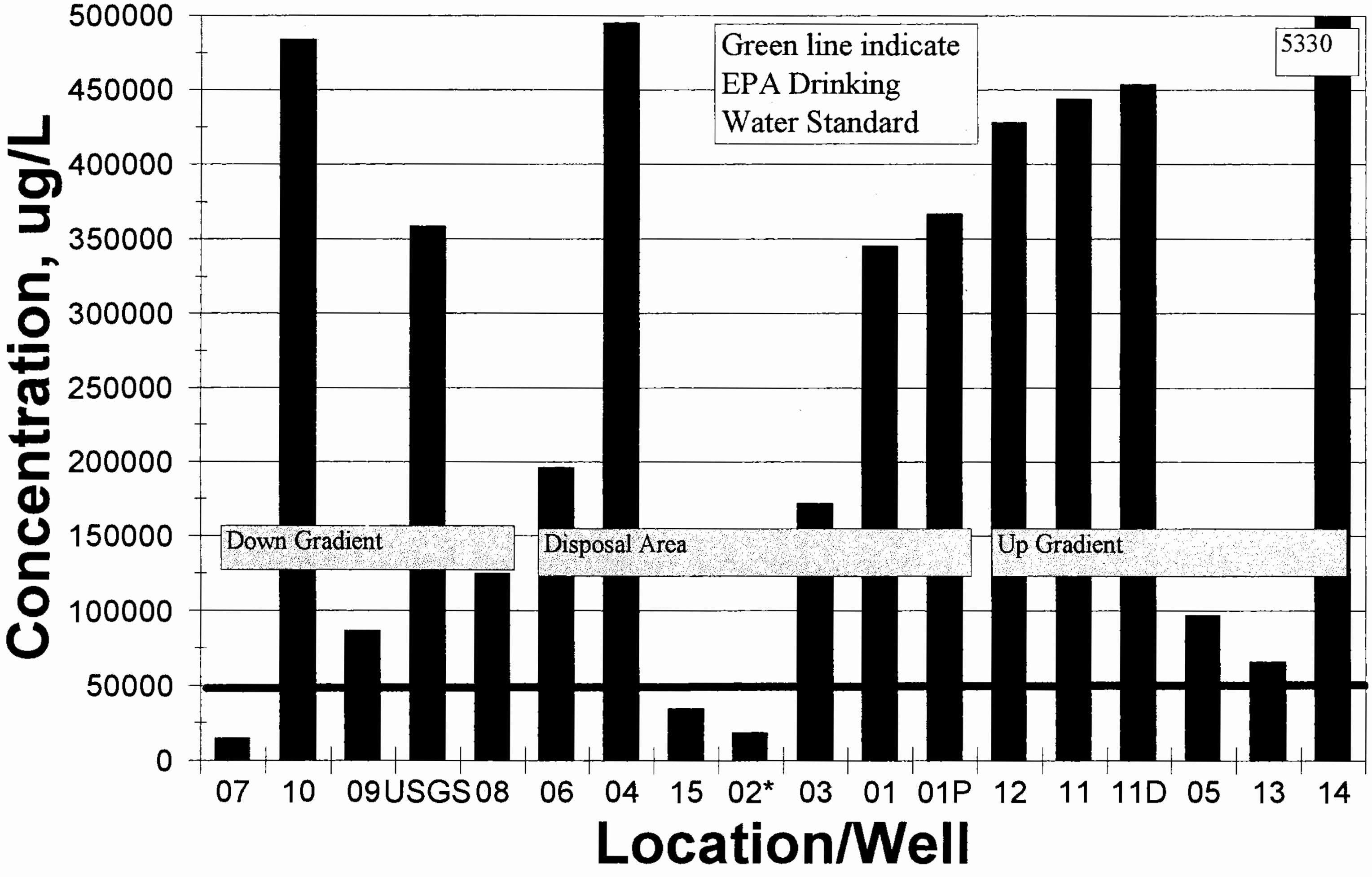
Potassium

Oct. 7, 8, 9 and 16, 1996



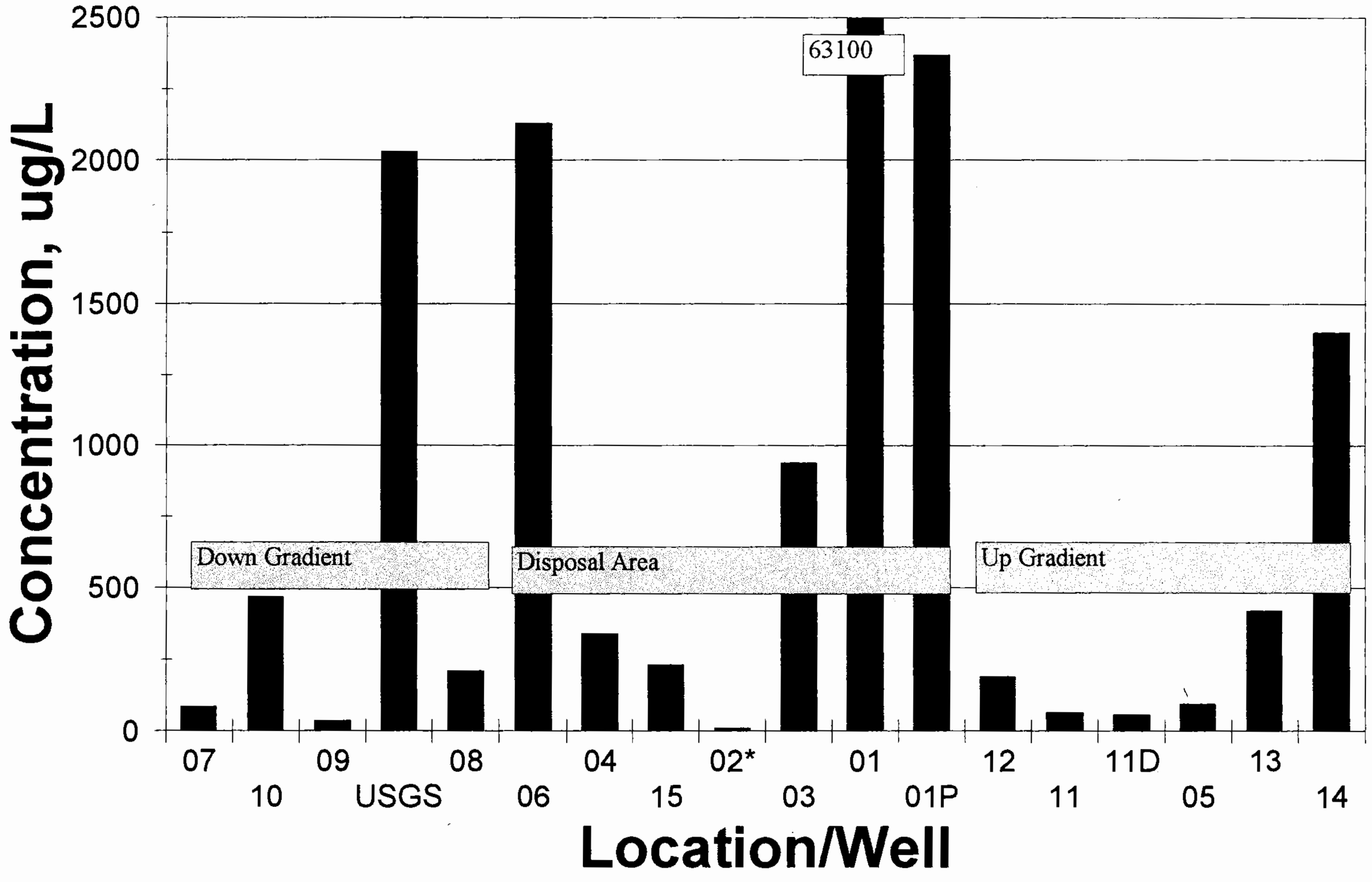
Sodium

Oct. 7, 8, 9 and 16, 1996



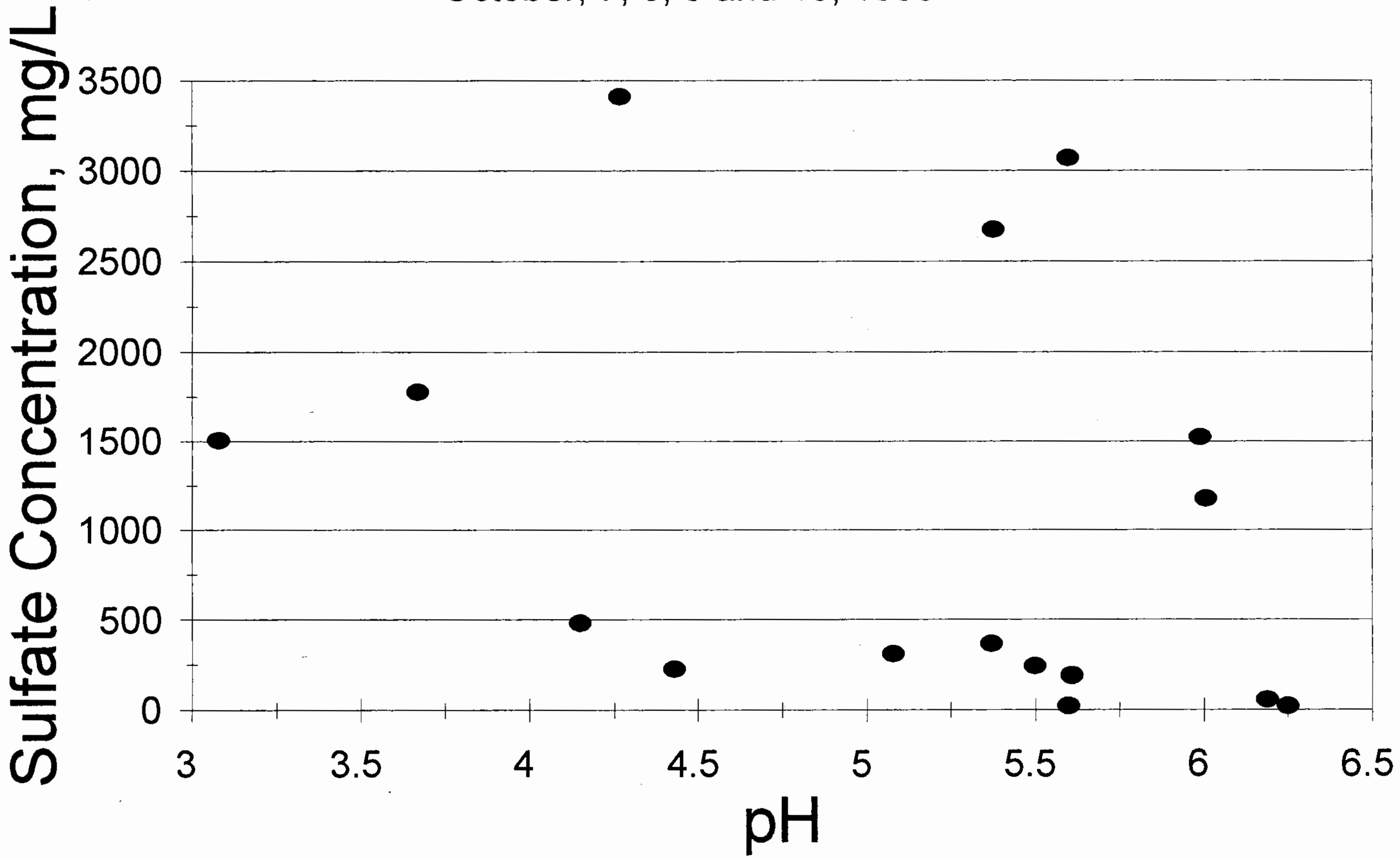
Zinc

Oct. 7, 8, 9 and 16, 1996



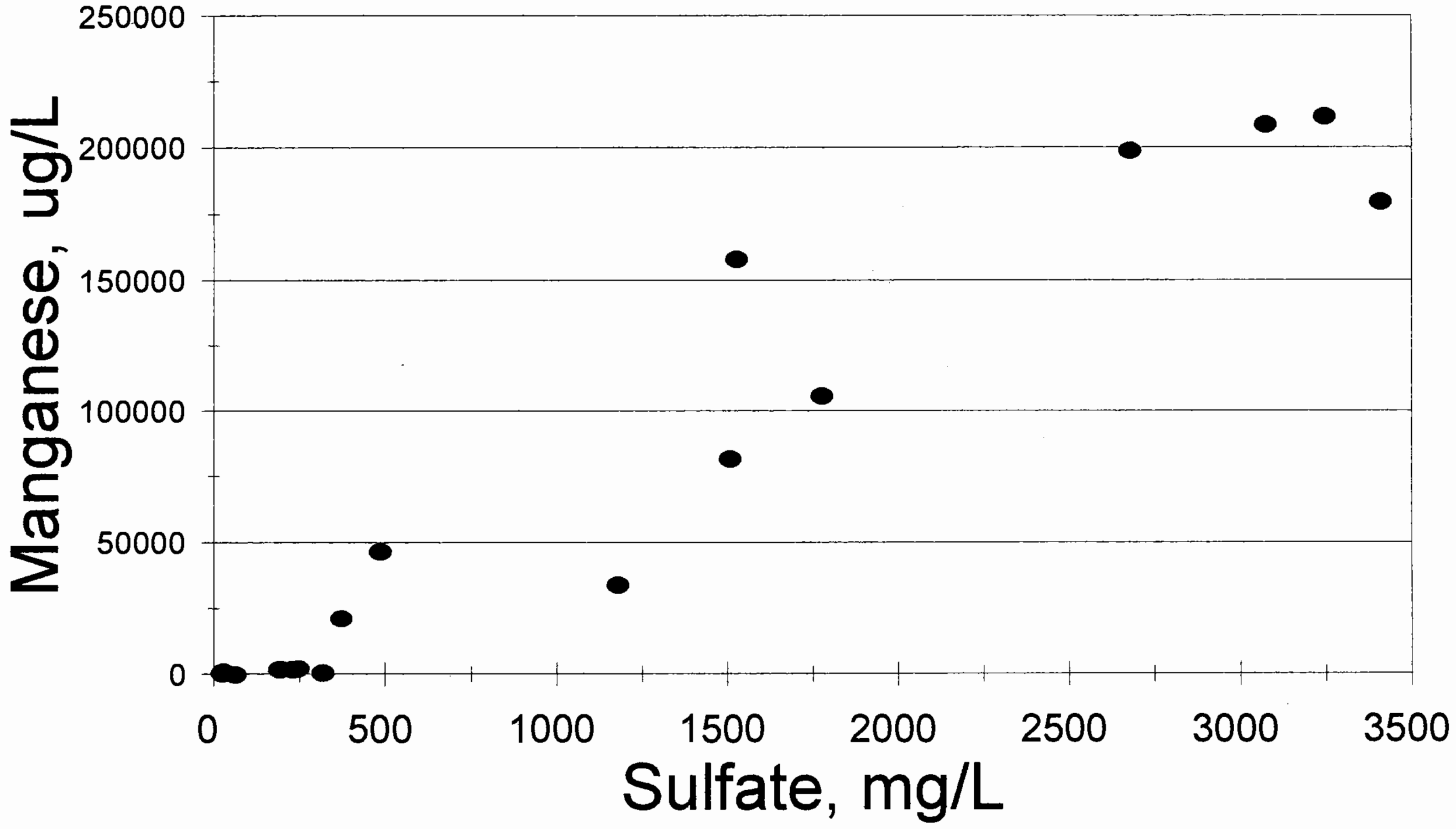
pH vs. Sulfate Concentration

October, 7, 8, 9 and 16, 1996



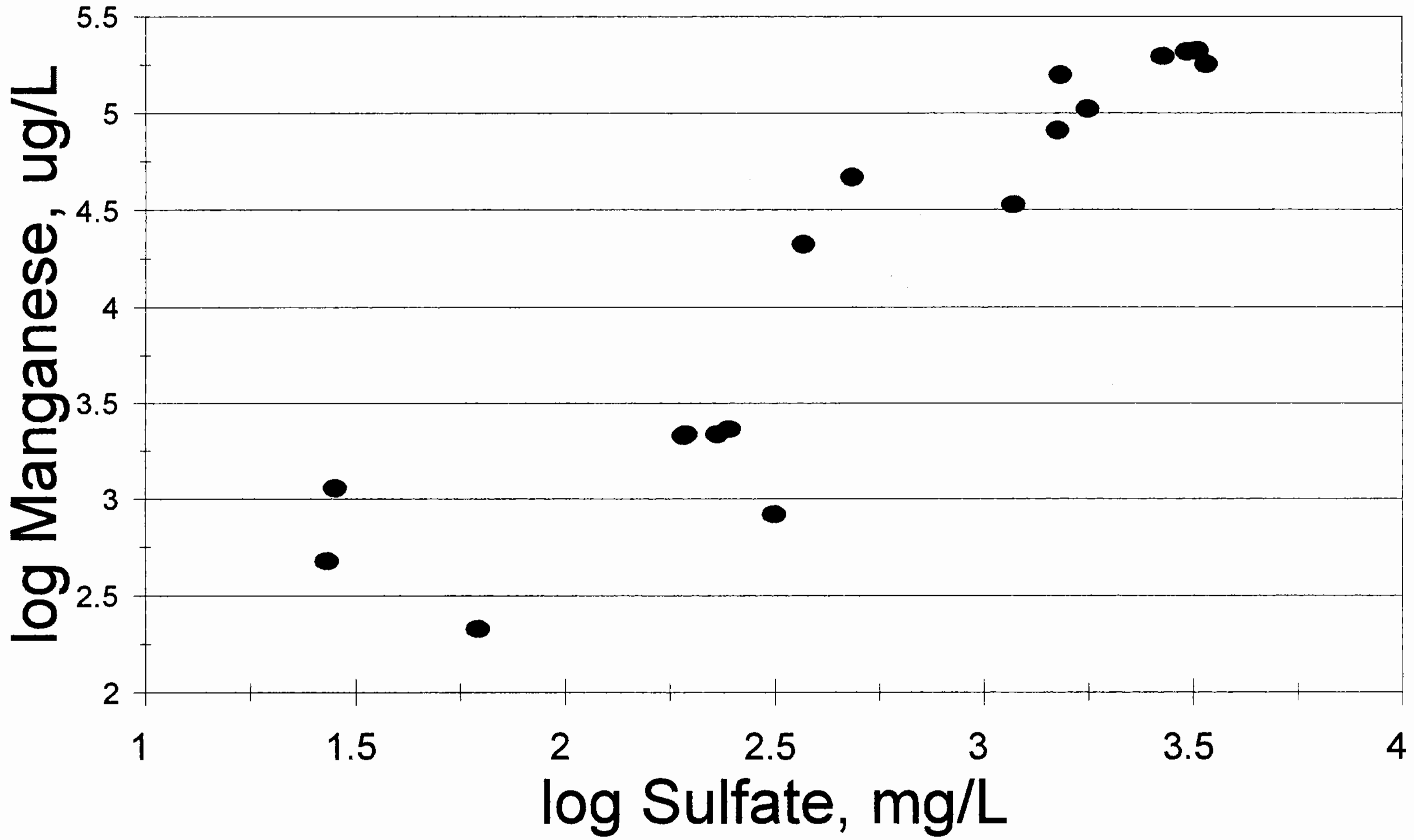
Sulfate-Manganese

October 7, 8, 9 and 16, 1996



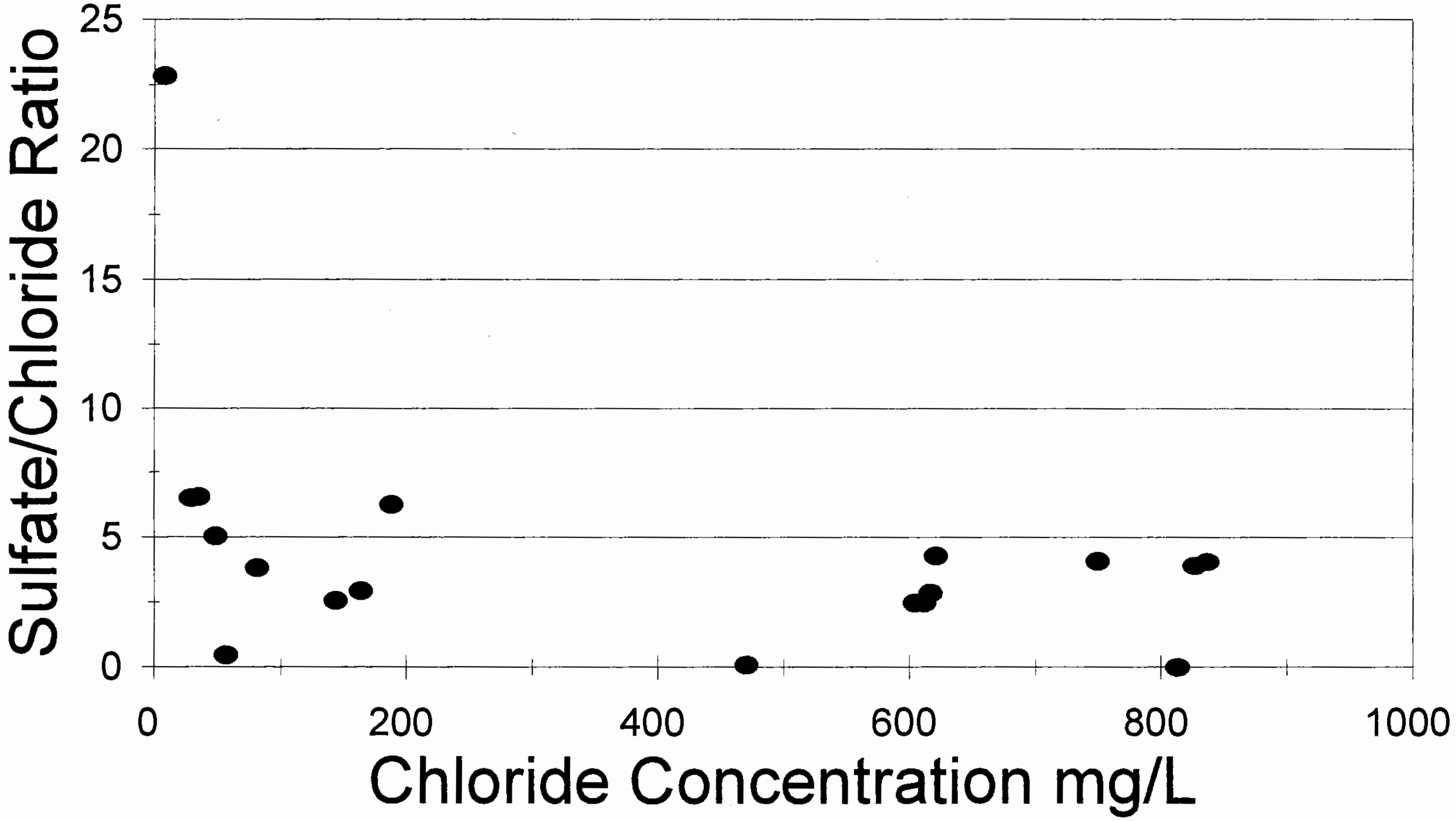
Sulfate-Manganese

October 7, 8, 9 and 16, 1996



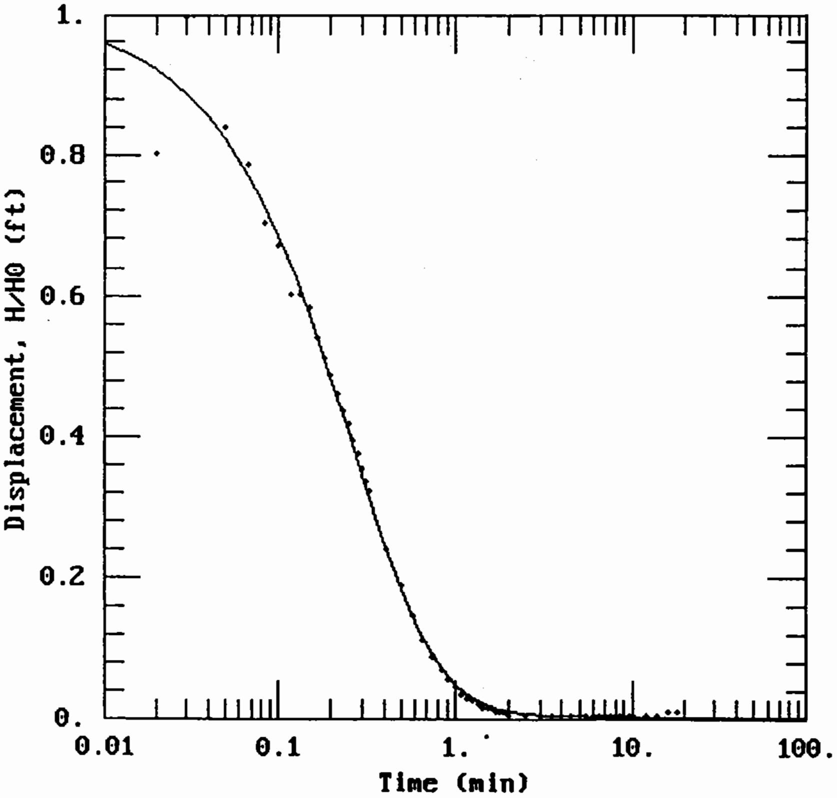
Chloride vs. Sulfate/Chloride Ratio

October 7, 8, 9 and 16, 1996



Appendix E

Slug Test Graphs/Data/Calculations



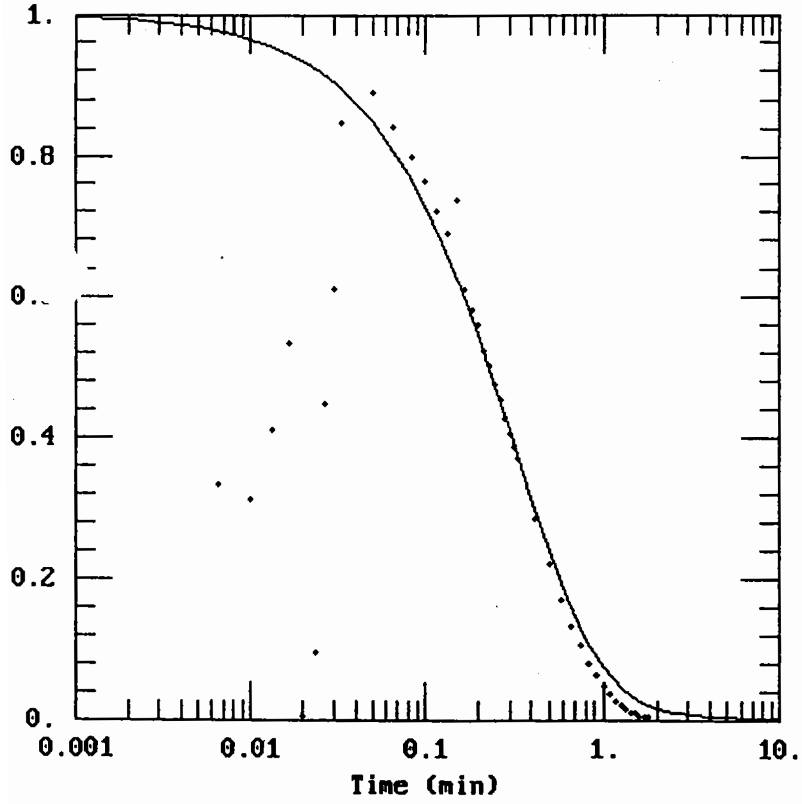
DATA SET:
CSW1RISE.DAT
04/21/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 2.06 ft
r_c= 0.1667 ft
r_w= 0.3334 ft

PARAMETER ESTIMATES:
T = 850.1 ft^2/day
S = 1.E-10



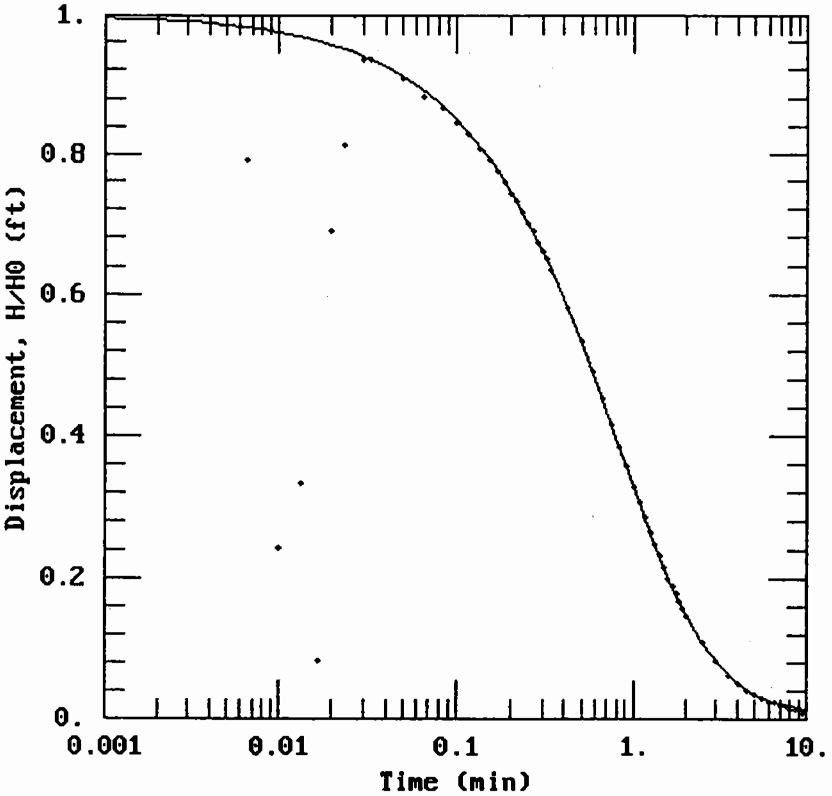
DATA SET:
CSW1FALL.DAT
04/21/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 1.9 ft
r_c= 0.1667 ft
r_w= 0.3334 ft

PARAMETER ESTIMATES:
T = 703.1 ft^2/day
S = 1.E-10



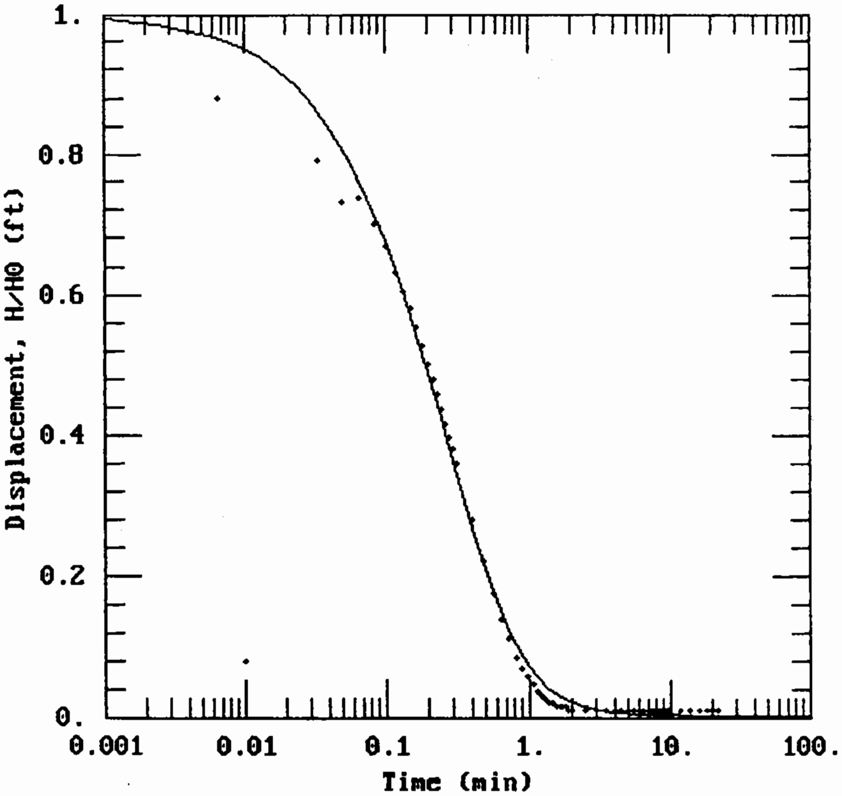
DATA SET:
CSW2FALL.DAT
04/16/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 1.86 ft
r_c= 0.1667 ft
r_w= 0.3334 ft

PARAMETER ESTIMATES:
T = 103.6 ft^2/day
S = 0.0001228



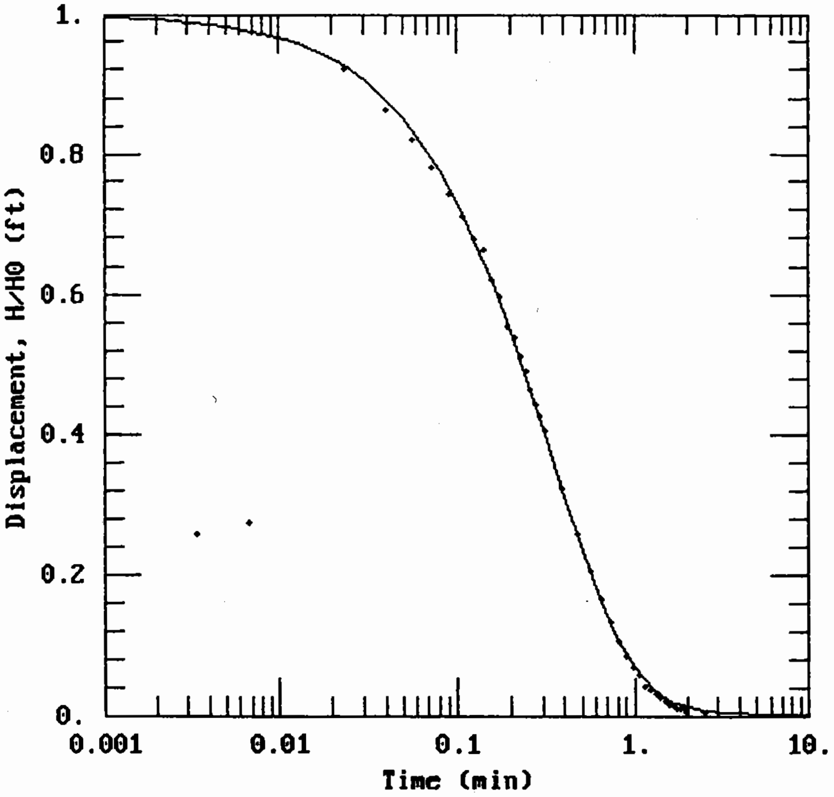
DATA SET:
CSW3RISE.DAT
04/21/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 1.9 ft
r_c= 0.1667 ft
r_w= 0.3334 ft

PARAMETER ESTIMATES:
T = 404.5 ft^2/day
S = 9.088E-06



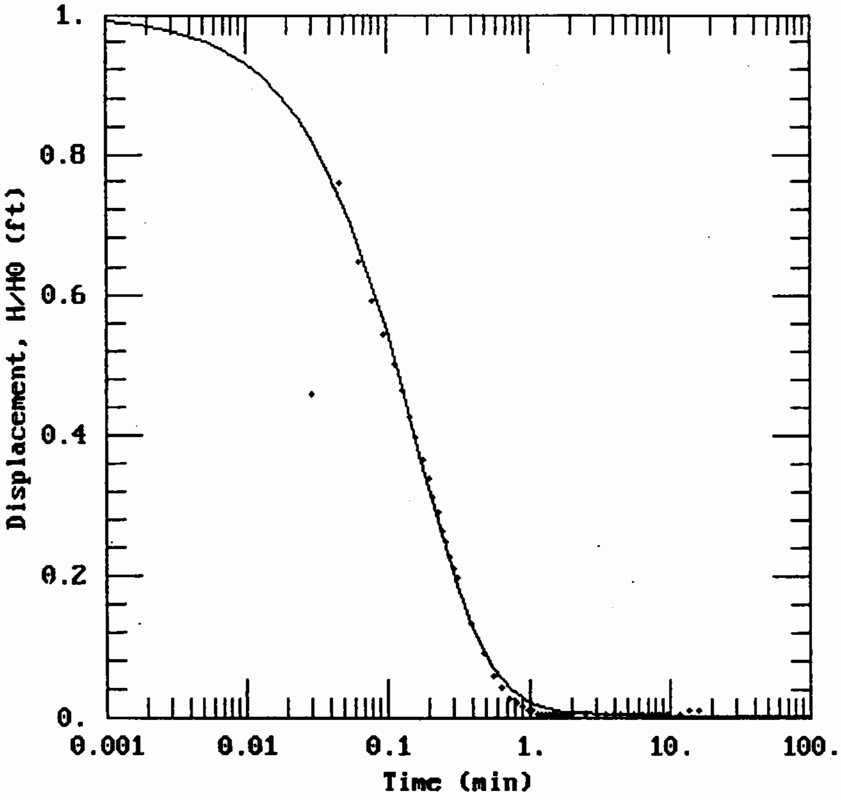
DATA SET:
CSW3FALL.DAT
04/21/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 1.9 ft
r_c= 0.1667 ft
r_w= 0.5 ft

PARAMETER ESTIMATES:
T = 963. ft^2/day
S = 1.118E-14



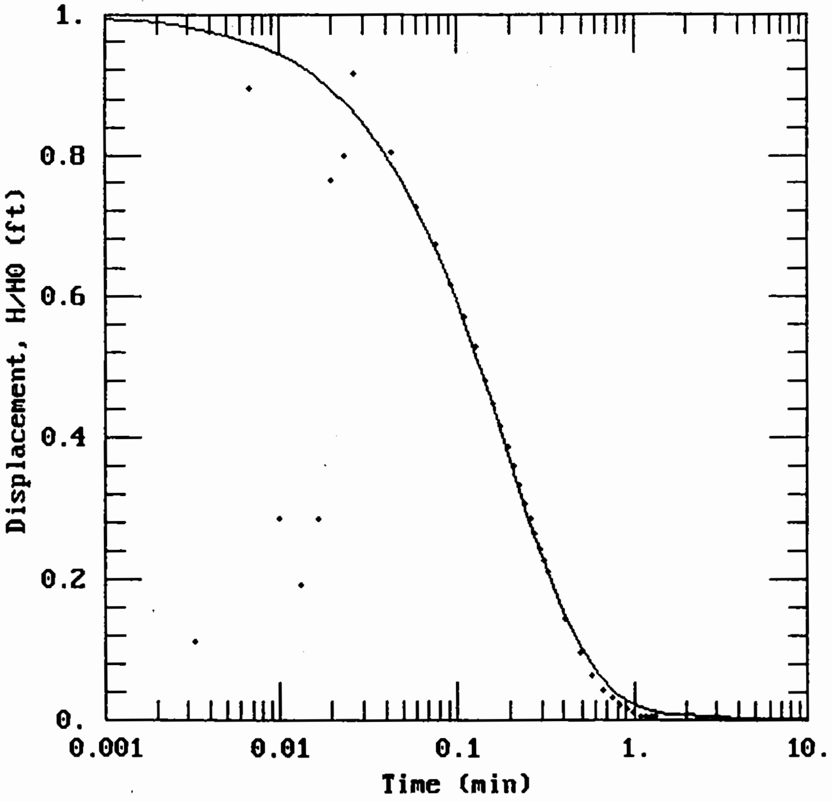
DATA SET:
CSW4RISE.DAT
04/21/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 1.9 ft
r_c= 0.1667 ft
r_w= 0.3334 ft

PARAMETER ESTIMATES:
T = 941.8 ft^2/day
S = 1.223E-07



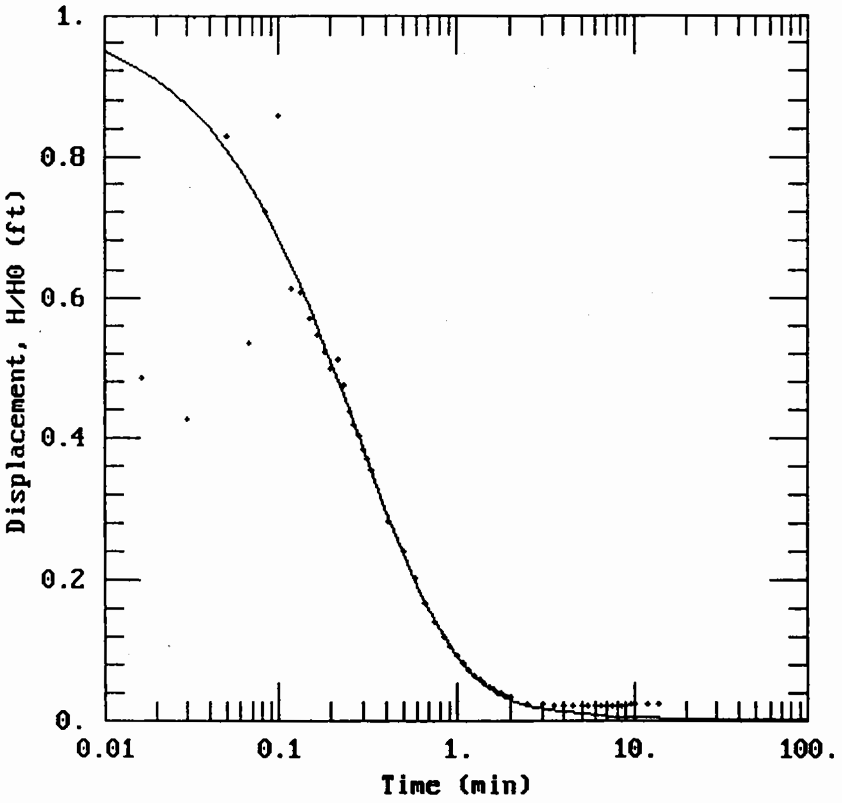
DATA SET:
CSW4FALL.DAT
04/21/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 1.9 ft
r_c= 0.1667 ft
r_w= 0.3334 ft

PARAMETER ESTIMATES:
T = 1199.7 ft^2/day
S = 1.E-10



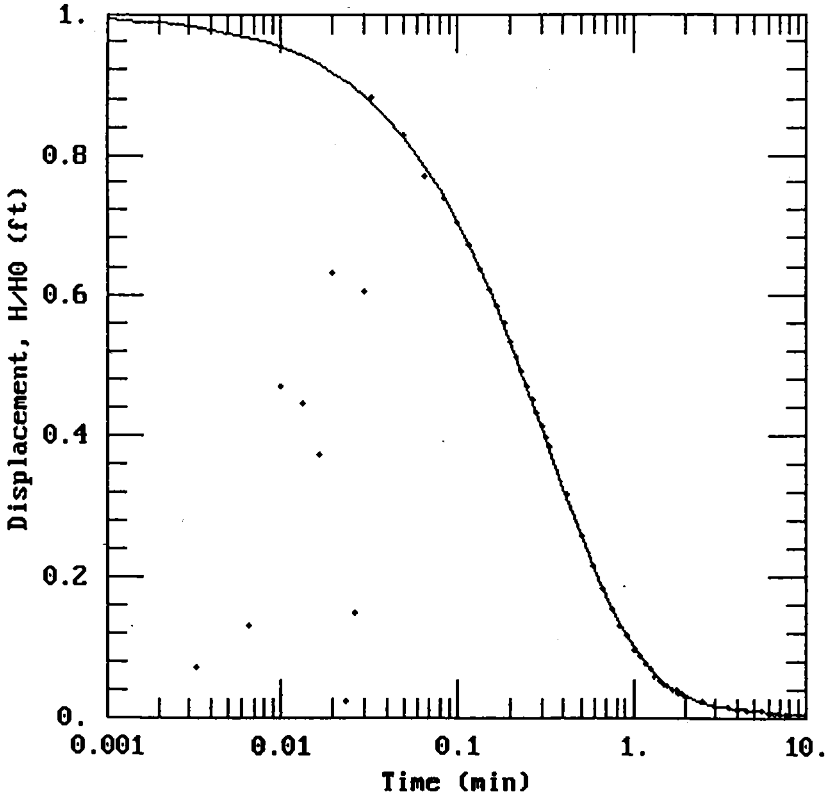
DATA SET:
CSW7RISE.DAT
04/21/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 2.09 ft
r_c= 0.1667 ft
r_w= 0.3334 ft

PARAMETER ESTIMATES:
T = 297. ft^2/day
S = 8.285E-05



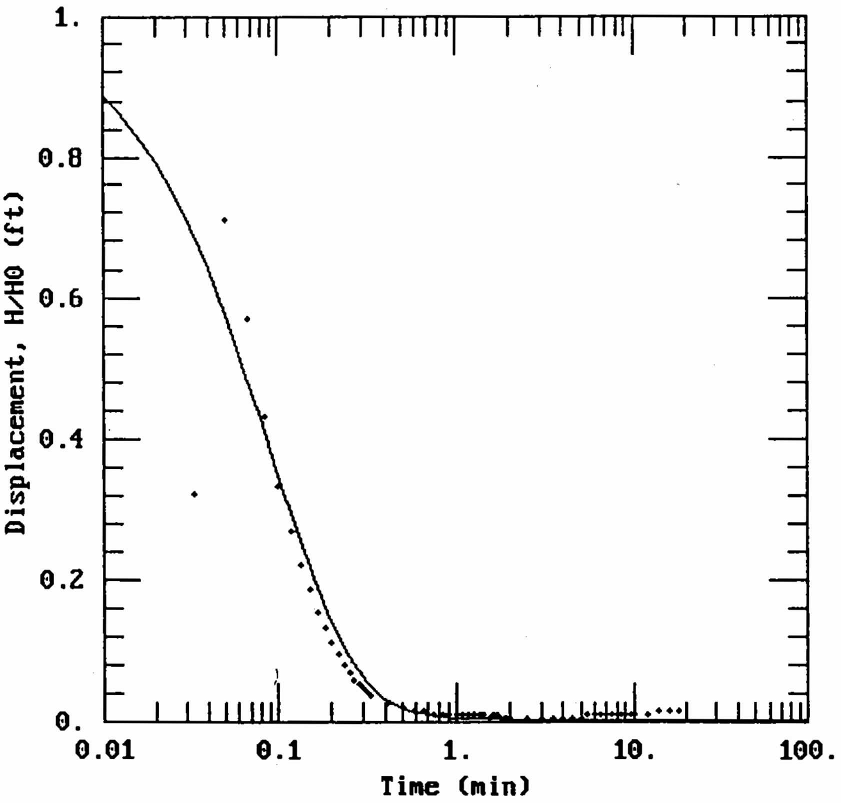
DATA SET:
CSW7FALL.DAT
04/21/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 2.09 ft
r_c= 0.1667 ft
r_w= 0.3334 ft

PARAMETER ESTIMATES:
T = 296.1 ft^2/day
S = 4.113E-05



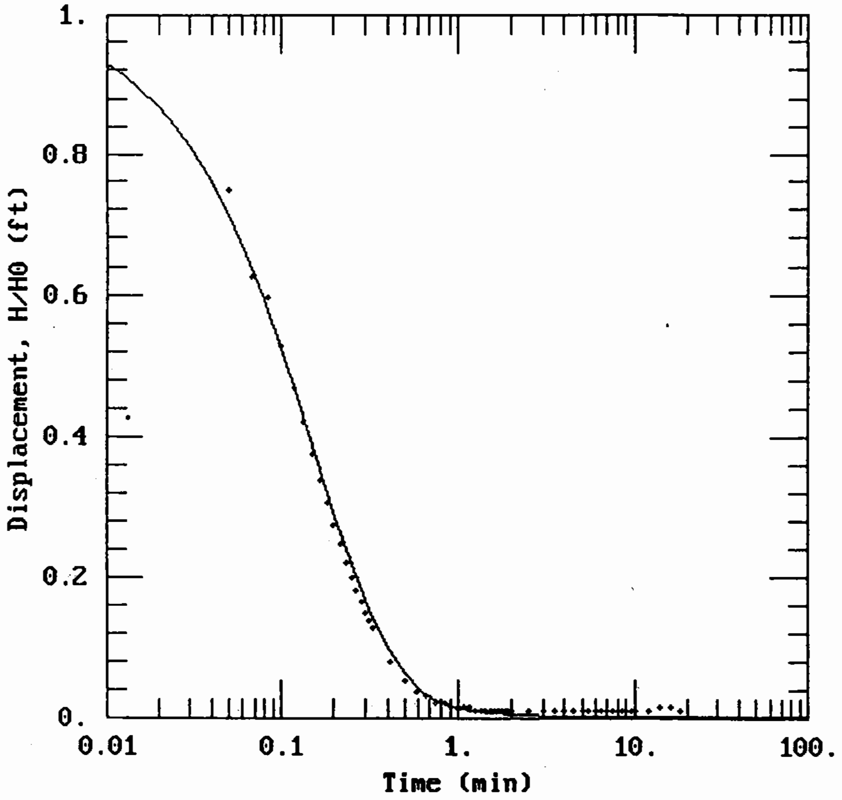
DATA SET:
CSW8RISE.DAT
04/21/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 1.9 ft
r_c= 0.1667 ft
r_w= 0.3334 ft

PARAMETER ESTIMATES:
T = 2528.2 ft^2/day
S = 1.E-10



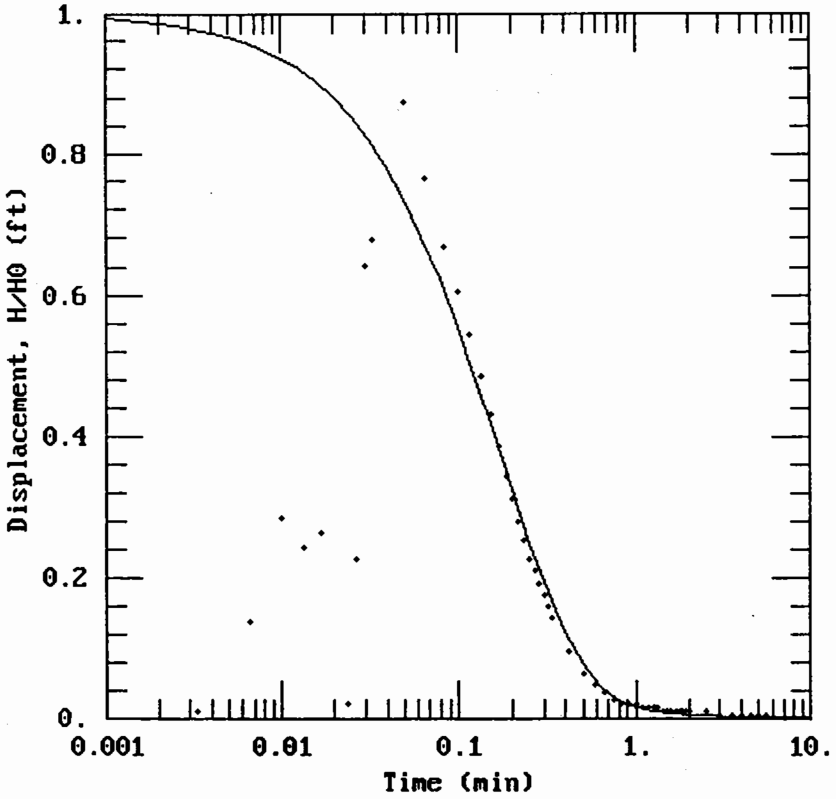
DATA SET:
CSW9RISE.DAT
04/21/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 1.9 ft
r_c= 0.1667 ft
r_w= 0.3334 ft

PARAMETER ESTIMATES:
T = 1503. ft^2/day
S = 1.E-10



DATA SET:
CSW9FALL.DAT
04/21/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 1.9 ft
r_c= 0.1 ft
r_w= 0.1 ft

PARAMETER ESTIMATES:
T = 521.2 ft^2/day
S = 1.E-10

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                        A Q T E S O L V    R E S U L T S
                                  Version 2.10

              Developed by Glenn M. Duffield, HydroSOLVE, Inc.
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04/21/96                                                                20:49:26

================================================================================
                                TEST DESCRIPTION

Data set........... CSW1RISE.DAT
Output file........ CSW1RISE.OUT
Data set title..... CSW-1 RISING HEAD
Company............ BLACK & VEATCH
Project............ 40650.001
Client............. USACE - Philadelphia District
Location........... Pearce Crek Disposal Area, MD
Test date.......... 3/1/96

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 2.06
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.3334
   Aquifer saturated thickness...... 97
   Well screen length............... 10
   Static height of water in well... 97
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.3334
   Log(Re/Rw)....................... 3.853
   Constants A, B and C............. 0.000 ,  0.000,  1.969
   No. of observations.............. 63

================================================================================
                                ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

================================================================================
                       RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate         Std. Error
   T  =   8.5010E+002 +/-   2.4302E+002 ft^2/day
   S  =   1.0000E-010 +/-   6.5332E-010


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 41
   Number of estimated parameters.... 2
   Degrees of freedom................ 39
   Residual mean..................... 0.004039
   Residual standard deviation....... 0.04629
   Residual variance................. 0.002142


Model Residuals:

     Time         Observed      Calculated      Residual        Weight
 -------------  -------------  -------------  -------------  -------------
        0.0333           2.06         1.8027        0.25734              1
          0.05           1.73         1.6929       0.037146              1
        0.0666           1.62         1.5921       0.027879              1
        0.0833           1.45         1.4981      -0.048121              1
           0.1           1.38         1.4107      -0.030681              1
        0.1166           1.24         1.3296      -0.089638              1
        0.1333           1.24         1.2535      -0.013494              1
          0.15            1.2         1.1823       0.017694              1
        0.1666           1.11         1.1161     -0.0060679              1
        0.1833           1.05         1.0536     -0.0036354              1
           0.2              1        0.99511      0.0048901              1
        0.2166           0.95        0.94053      0.0094709              1
        0.2333            0.9        0.88898       0.011018              1
          0.25           0.86        0.84057       0.019426              1
        0.2666           0.81        0.79536       0.014644              1
        0.2833           0.77        0.75259       0.017411              1
           0.3           0.73        0.71237       0.017627              1
        0.3166           0.69        0.67476        0.01524              1
        0.3333           0.66        0.63914       0.020856              1
        0.4167           0.49        0.49001   -6.6448E-006              1
           0.5           0.39        0.37898       0.011015              1
        0.5833            0.3        0.29566      0.0043448              1
        0.6667           0.23        0.23265     -0.0026463              1
          0.75           0.18        0.18482     -0.0048235              1
        0.8333           0.14        0.14825     -0.0082547              1
        0.9167           0.11        0.12009      -0.010091              1
             1           0.09       0.098318     -0.0083185              1
        1.0833           0.07       0.081358      -0.011358              1
        1.1667           0.06       0.068048     -0.0080483              1
          1.25           0.05       0.057559     -0.0075593              1
        1.3333           0.04       0.049227     -0.0092267              1
        1.4166           0.03       0.042561      -0.012561              1
           1.5           0.03       0.037185     -0.0071854              1
        1.5833           0.03       0.032828     -0.0028283              1
        1.6667           0.02       0.029262     -0.0092615              1
          1.75           0.02       0.026326      -0.006326              1
        1.8333           0.02       0.023887     -0.0038875              1
        1.9167           0.02       0.021843     -0.0018432              1
             2           0.01       0.020119      -0.010119              1
           2.5           0.01       0.013775     -0.0037746              1
             3           0.01       0.010645    -0.00064471              1

===============================================================================
                       RESULTS FROM VISUAL CURVE MATCHING
```

```
VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   T  =   8.5010E+002 ft^2/day
   S  =   1.0000E-010

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                        A Q T E S O L V   R E S U L T S
                                  Version 2.10

              Developed by Glenn M. Duffield, HydroSOLVE, Inc.
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04/21/96                                                                20:40:5

===============================================================================
                                  TEST DESCRIPTION

Data set........... CSW1FALL.DAT
Output file........ CSW1FALL.OUT
Data set title..... CSW-1 FALLING HEAD
Company............ BLACK & VEATCH
Project............ 40650.001
Client............. USACE - Philadelphia District
Location........... Pearce Creek Disposal Area, MD
Test date.......... 3/1/96

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.9
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.3334
   Aquifer saturated thickness...... 97
   Well screen length............... 10
   Static height of water in well... 1
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.3334
   Log(Re/Rw)....................... 0.8636
   Constants A, B and C............. 2.444 ,  0.397,  0.000
   No. of observations.............. 44

===============================================================================
                                  ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

===============================================================================
                       RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std.  Error
   T  =   7.0311E+002 +/-   2.5908E+002 ft^2/day
   S  =   1.0000E-010 +/-   8.3965E-010


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 36
   Number of estimated parameters.... 2
   Degrees of freedom................ 34
   Residual mean..................... -0.004723
   Residual standard deviation....... 0.05627
   Residual variance................. 0.003166


Model Residuals:

     Time         Observed       Calculated      Residual        Weight
 -------------  -------------  -------------  -------------  -------------
       0.0333           1.61         1.6997      -0.089653             1
         0.05           1.69         1.6127       0.077263             1
       0.0666            1.6         1.5321       0.067853             1
       0.0833           1.52         1.4562       0.063848             1
          0.1           1.45         1.3847       0.065279             1
       0.1166           1.37         1.3178       0.052167             1
       0.1333           1.31         1.2543       0.055654             1
         0.15            1.4         1.1944        0.20561             1
       0.1666           1.16          1.138       0.021966             1
       0.1833            1.1         1.0844       0.015611             1
          0.2           1.06         1.0336         0.0264             1
       0.2166           0.99        0.98577      0.0042327             1
       0.2333           0.95        0.94015      0.0098497             1
         0.25            0.9        0.89689      0.0031068             1
       0.2666           0.86         0.8561       0.003904             1
       0.2833           0.81        0.81714     -0.0071386             1
          0.3           0.77        0.78015      -0.010153             1
       0.3166           0.73        0.74523      -0.015234             1
       0.3333            0.7        0.71186      -0.011855             1
       0.4167           0.54        0.56828      -0.028283             1
          0.5           0.42        0.45644      -0.036441             1
       0.5833           0.32        0.36874      -0.048737             1
       0.6667           0.25        0.29956      -0.049563             1
         0.75            0.2         0.2449      -0.044895             1
       0.8333           0.15        0.20145      -0.051449             1
       0.9167           0.12        0.16674      -0.046738             1
            1           0.09        0.13896      -0.048957             1
       1.0833           0.07         0.1166      -0.046601             1
       1.1667           0.05       0.098514      -0.048514             1
         1.25           0.04       0.083854      -0.043854             1
       1.3333           0.03       0.071904      -0.041904             1
       1.4166           0.02       0.062121      -0.042121             1
          1.5           0.02       0.054067      -0.034067             1
       1.5833           0.01       0.047422      -0.037422             1
       1.6667           0.01       0.041899      -0.031899             1
         1.75           0.01         0.0373        -0.0273             1

===============================================================================
                      RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   T  =   7.0311E+002 ft^2/day
```

```
  S  =   1.0000E-010

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```

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                         A Q T E S O L V   R E S U L T S
                                  Version 2.10

                 Developed by Glenn M. Duffield, HydroSOLVE, Inc.
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04/21/96                                                                13:26:01

================================================================================
                                TEST DESCRIPTION

Data set........... CSW2RISE.DAT
Output file........ CSW2RISE.OUT
Data set title..... CSW-2 RISING HEAD
Company............ BLACK & VEATCH
Project............ 40650.001
Client............. USACE - Philadelphia District
Location........... Pearce Creek Disposal Area, MD
Test date.......... 3/1/96

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.93
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.3334
   Aquifer saturated thickness...... 25
   Well screen length............... 10
   Static height of water in well... 25
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.3334
   Log(Re/Rw)....................... 3.121
   Constants A, B and C............. 0.000 ,  0.000,  1.969
   No. of observations.............. 65

================================================================================
                                ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

================================================================================
                      RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate         Std.  Error
   T  =   6.9743E+001 +/-   5.0362E+000 ft^2/day
   S  =   1.7147E-003 +/-   6.0575E-004


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 61
   Number of estimated parameters.... 2
   Degrees of freedom................ 59
   Residual mean..................... -0.002878
   Residual standard deviation....... 0.04753
   Residual variance................. 0.002259


Model Residuals:

     Time            Observed      Calculated      Residual        Weight
 -------------  -------------  -------------  -------------  -------------
       0.0266           1.93         1.7892        0.14081              1
         0.05           1.41         1.7143       -0.30432              1
       0.0666           1.56         1.6681       -0.10807              1
       0.0833           1.59         1.6253      -0.035333              1
          0.1           1.57         1.5855       -0.01554              1
       0.1166           1.55         1.5484      0.0016312              1
       0.1333           1.52          1.513      0.0069993              1
         0.15           1.49         1.4794       0.010605              1
       0.1666           1.46         1.4475       0.012467              1
       0.1833           1.43         1.4169       0.013133              1
          0.2            1.4         1.3875       0.012539              1
       0.2166           1.38         1.3594       0.020629              1
       0.2333           1.35         1.3322       0.017833              1
         0.25           1.32         1.3059       0.014058              1
       0.2666            1.3         1.2808       0.019223              1
       0.2833           1.28         1.2563       0.023693              1
          0.3           1.25         1.2326       0.017365              1
       0.3166           1.23         1.2098       0.020152              1
       0.3333           1.21         1.1876        0.02237              1
       0.4167           1.11          1.086       0.023958              1
          0.5           1.02        0.99768       0.022318              1
       0.5833           0.94         0.9199       0.020096              1
       0.6667           0.86        0.85081      0.0091862              1
         0.75            0.8         0.7892       0.010801              1
       0.8333           0.74         0.7339      0.0061048              1
       0.9167           0.68        0.68398     -0.0039815              1
            1           0.64        0.63887      0.0011295              1
       1.0833            0.6        0.59791      0.0020871              1
       1.1667           0.55        0.56057      -0.010573              1
         1.25           0.52        0.52652     -0.0065224              1
       1.3333           0.49        0.49536     -0.0053561              1
       1.4166           0.46        0.46677     -0.0067658              1
          1.5           0.43        0.44045      -0.010454              1
       1.5833            0.4        0.41625       -0.01625              1
       1.6667           0.38        0.39389       -0.01389              1
         1.75           0.36        0.37325      -0.013249              1
       1.8333           0.34        0.35414       -0.01414              1
       1.9167           0.32         0.3364        -0.0164              1
            2           0.31        0.31995     -0.0099477              1
          2.5           0.23        0.24226       -0.01226              1
            3           0.18        0.18986     -0.0098565              1
          3.5           0.14        0.15317      -0.013171              1
            4           0.12        0.12666     -0.0066596              1
          4.5            0.1        0.10696     -0.0069624              1
            5           0.09       0.091964     -0.0019638              1
```

```
         5.5          0.08        0.08029    -0.00029023                1
          6           0.07        0.071025    -0.0010246                1
         6.5          0.06        0.06354     -0.0035398                1
          7           0.06        0.057397     0.0026027                1
         7.5          0.05        0.052284    -0.0022844                1
          8           0.05        0.047974      0.002026                1
         8.5          0.04        0.044298    -0.0042982                1
          9           0.04        0.041131    -0.0011312                1
         9.5          0.04        0.038377     0.0016229                1
         10           0.04        0.035962      0.004038                1
         12           0.03        0.028701      0.001299                1
         14           0.03        0.023859     0.0061414                1
         16           0.02        0.020403   -0.00040333                1
         18           0.02        0.017815     0.0021845                1
         20           0.02        0.015806     0.0041943                1
         22           0.02        0.014201     0.0057995                1

================================================================================
                          RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
  T  =   6.9743E+001 ft^2/day
  S  =   1.7147E-003


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                      A Q T E S O L V    R E S U L T S
                                Version 2.10

              Developed by Glenn M. Duffield, HydroSOLVE, Inc.
                   (c) 1988-1995  Geraghty & Miller, Inc.

04/16/96                                                                19:17:05

================================================================================
                                TEST DESCRIPTION

Data set...........
Output file........ CSW2FALL.OUT
Data set title..... CSW-2 FALLING HEAD
Company............ BLACK & vEATCH
Project............ 40650.001
Client............. USACE - Philadelphia District
Location........... Pearce Creek Disposal Area, MD
Test date.......... 3/1/96

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.86
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.3334
   Aquifer saturated thickness...... 25
   Well screen length............... 1
   Static height of water in well... 1
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.3334
   Log(Re/Rw)....................... 0.5218
   Constants A, B and C............. 1.655 ,  0.255,  0.000
   No. of observations.............. 63

================================================================================
                                ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

================================================================================
                      RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

          Estimate          Std.  Error
   T  =   1.0355E+002 +/-   3.1004E+000 ft^2/day
   S  =   1.2282E-004 +/-   2.8428E-005


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 57
   Number of estimated parameters.... 2
   Degrees of freedom................ 55
   Residual mean..................... -0.0009551
   Residual standard deviation....... 0.01474
   Residual variance................. 0.0002173


Model Residuals:

     Time          Observed        Calculated       Residual          Weight
 -------------  -------------  -------------  -------------  -------------
        0.0266           1.86         1.7601       0.099861              1
          0.03           1.74         1.7502      -0.010222              1
        0.0333           1.74         1.7408    -0.00081943              1
          0.05           1.69         1.6959     -0.0058915              1
        0.0666           1.64         1.6546      -0.014566              1
        0.0833           1.61         1.6155     -0.0055089              1
           0.1           1.57         1.5785     -0.0084999              1
        0.1166           1.54         1.5434     -0.0034342              1
        0.1333            1.5         1.5097     -0.0096701              1
          0.15           1.47         1.4773     -0.0072584              1
        0.1666           1.44         1.4463     -0.0062532              1
        0.1833           1.41         1.4162      -0.006177              1
           0.2           1.38         1.3871     -0.0071335              1
        0.2166           1.36         1.3592     0.00078493              1
        0.2333           1.33          1.332     -0.0020227              1
          0.25            1.3         1.3057     -0.0056725              1
        0.2666           1.28         1.2803    -0.00026693              1
        0.2833           1.25         1.2555     -0.0054571              1
           0.3           1.23         1.2314     -0.0013598              1
        0.3166           1.21         1.2081      0.0019217              1
        0.3333           1.18         1.1853     -0.0053005              1
        0.4167           1.08         1.0803    -0.00027467              1
           0.5           0.99        0.98791      0.0020863              1
        0.5833           0.91        0.90599      0.0040055              1
        0.6667           0.84        0.83285      0.0071479              1
          0.75           0.77        0.76741      0.0025854              1
        0.8333           0.71        0.70858      0.0014191              1
        0.9167           0.66        0.65546      0.0045421              1
             1           0.61        0.60748      0.0025249              1
        1.0833           0.57        0.56397      0.0060256              1
        1.1667           0.53         0.5244       0.005595              1
          1.25           0.49        0.48843      0.0015748              1
        1.3333           0.46        0.45561      0.0043927              1
        1.4166           0.43        0.42562      0.0043787              1
           1.5            0.4        0.39815      0.0018533              1
        1.5833           0.37        0.37299      -0.002994              1
        1.6667           0.35        0.34988     0.00012156              1
          1.75           0.33        0.32866      0.0013441              1
        1.8333           0.31        0.30912     0.00087934              1
        1.9167           0.29        0.29109     -0.0010946              1
             2           0.27        0.27448     -0.0044801              1
           2.5            0.2        0.19773      0.0022724              1
             3           0.15        0.14813      0.0018748              1
           3.5           0.11        0.11491     -0.0049084              1
             4           0.09       0.091934     -0.0019342              1
```

```
          4.5          0.07       0.075564     -0.0055641          1
            5          0.06       0.063574     -0.0035736          1
          5.5          0.05       0.054564     -0.0045638          1
            6          0.04       0.047632     -0.0076321          1
          6.5          0.04       0.042183     -0.0021826          1
            7          0.03       0.037813      -0.007813          1
          7.5          0.03       0.034246     -0.0042463          1
            8          0.02       0.031288      -0.011288          1
          8.5          0.02       0.028798     -0.0087979          1
            9          0.02       0.026676     -0.0066756          1
          9.5          0.01       0.024846      -0.014846          1
           10          0.01       0.023252      -0.013252          1

================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   T  =   1.0355E+002 ft^2/day
   S  =   1.2282E-004


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                       A Q T E S O L V   R E S U L T S
                                Version 2.10

                Developed by Glenn M. Duffield, HydroSOLVE, Inc.
                    (c) 1988-1995  Geraghty & Miller, Inc.

04/21/96                                                                13:37:29

================================================================================
                                TEST DESCRIPTION

Data set........... CSW3RISE.DAT
Output file........ CSW3RISE.OUT
Data set title..... CSW-3 RISING HEAD

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.9
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.3334
   Aquifer saturated thickness...... 30
   Well screen length............... 10
   Static height of water in well... 30
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.3334
   Log(Re/Rw)....................... 3.225
   Constants A, B and C............. 0.000 ,  0.000,  1.969
   No. of observations.............. 64

================================================================================
                               ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

================================================================================
                      RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std.  Error
   T  =   4.0447E+002 +/-   5.5558E+001 ft^2/day
   S  =   9.0875E-006 +/-   1.3423E-005


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
   ghted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 39
   Number of estimated parameters.... 2
```

```
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                    A Q T E S O L V    R E S U L T S
                              Version 2.10

              Developed by Glenn M. Duffield, HydroSOLVE, Inc.
                   (c) 1988-1995  Geraghty & Miller, Inc.

04/21/96                                                                13:23:4

================================================================================
                                TEST DESCRIPTION

Data set........... CSW3FALL.DAT
Output file........ CSW3FALL.OUT
Data set title..... CSW-3 FALLING HEAD
Company............ BLACK & VEATCH
Project............ 40650.001
Client............. USACE - Philadelphia District
Location........... Pearce Creek Disposal Area, MD
Test date.......... 3/1/96

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.9
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.5
   Aquifer saturated thickness...... 30
   Well screen length............... 10
   Static height of water in well... 30
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.5
   Log(Re/Rw)....................... 2.843
   Constants A, B and C............. 0.000 ,  0.000,  1.661
   No. of observations.............. 42

================================================================================
                                ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

================================================================================
                     RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate            Std. Error
   T  =   9.6303E+002 +/-   1.0061E+002 ft^2/day
   S  =   1.1184E-014 +/-   3.6665E-014


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 40
   Number of estimated parameters.... 2
   Degrees of freedom................ 38
   Residual mean..................... -0.003527
   Residual standard deviation....... 0.012
   Residual variance................. 0.0001439


Model Residuals:

     Time         Observed      Calculated     Residual        Weight
 -------------  -------------  -------------  -------------  -------------
       0.0234           1.75         1.7591     -0.0090549             1
         0.04           1.64         1.6696      -0.029611             1
       0.0567           1.56         1.5855      -0.025518             1
       0.0734           1.48         1.5065      -0.026545             1
         0.09           1.41         1.4326      -0.022605             1
       0.1067           1.35         1.3624      -0.012413             1
       0.1234           1.29         1.2961     -0.0061034             1
         0.14           1.26         1.2338       0.026235             1
       0.1567           1.18         1.1744      0.0055957             1
       0.1734           1.13         1.1182       0.011809             1
         0.19           1.05         1.0652       -0.01524             1
       0.2067           1.02         1.0147      0.0052649             1
       0.2234           0.97        0.96684      0.0031605             1
         0.24           0.93        0.92167       0.008333             1
       0.2567           0.88        0.87853      0.0014664             1
       0.2734           0.84        0.83759       0.002412             1
         0.29           0.81        0.79894       0.011064             1
       0.3067           0.77          0.762      0.0080027             1
       0.3901           0.61        0.60327      0.0067301             1
       0.4734           0.49        0.47995       0.010054             1
       0.5567           0.39         0.3836      0.0063968             1
       0.6401           0.31        0.30798      0.0020182             1
       0.7234           0.25        0.24856      0.0014365             1
       0.8067            0.2        0.20166     -0.0016557             1
       0.8901           0.16        0.16446     -0.0044607             1
       0.9734           0.13        0.13494     -0.0049387             1
       1.0567           0.11         0.1114     -0.0013952             1
       1.1401           0.08       0.092534      -0.012534             1
       1.2234           0.07       0.077406     -0.0074064             1
       1.3067           0.06       0.065213     -0.0052131             1
         1.39           0.05       0.055348     -0.0053481             1
       1.4734           0.04       0.047328     -0.0073276             1
       1.5567           0.03       0.040796      -0.010796             1
       1.6401           0.03       0.035443      -0.005443             1
       1.7234           0.02       0.031047      -0.011047             1
       1.8067           0.02       0.027416     -0.0074161             1
       1.8901           0.02         0.0244        -0.0044             1
       1.9734           0.01       0.021888      -0.011888             1
       2.4734           0.01       0.013184     -0.0031837             1
       2.9734           0.01      0.0095245     0.00047553             1

===============================================================================
                       RESULTS FROM VISUAL CURVE MATCHING
```

```
VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   T  =   9.6303E+002 ft^2/day
   S  =   1.1184E-014


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                       A Q T E S O L V   R E S U L T S
                                 Version 2.10

               Developed by Glenn M. Duffield, HydroSOLVE, Inc.
                    (c) 1988-1995  Geraghty & Miller, Inc.

04/21/96                                                                13:47:06

================================================================================
                                TEST DESCRIPTION

Data set........... CSW4RISE.DAT
Output file........ CSW4RISE.OUT
Data set title..... CSW-4 RISING HEAD

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.9
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.3334
   Aquifer saturated thickness...... 21
   Well screen length............... 10
   Static height of water in well... 21
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.3334
   Log(Re/Rw)....................... 3.02
   Constants A, B and C............. 0.000 ,  0.000,  1.969
   No. of observations.............. 60

================================================================================
                                ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

================================================================================
                    RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std.  Error
   T  =   9.4182E+002 +/-    8.1953E+001 ft^2/day
   S  =   1.2234E-007 +/-    1.6990E-007


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
   ghted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 28
   Number of estimated parameters.... 2
```

```
   Degrees of freedom............... 26
   Residual mean.................... -0.005074
   Residual standard deviation....... 0.02119
   Residual variance................ 0.000449


Model Residuals:

     Time           Observed       Calculated       Residual          Weight
 -------------   -------------  -------------  -------------   -------------
       0.0466            1.44          1.4082         0.0318               1
       0.0633            1.23          1.2774      -0.047407               1
         0.08            1.12          1.1615      -0.041466               1
       0.0966            1.03          1.0587      -0.028728               1
       0.1133            0.95         0.96606      -0.016064               1
         0.13            0.88         0.88294     -0.0029385               1
       0.1466            0.81         0.80861      0.0013888               1
       0.1633            0.75         0.74105      0.0089531               1
         0.18            0.69         0.68002       0.009977               1
       0.1966            0.64         0.62511       0.014895               1
       0.2133            0.59         0.57502       0.014983               1
         0.23            0.55         0.52956       0.020437               1
       0.2466             0.5          0.4885         0.0115               1
       0.2633            0.47         0.45091       0.019087               1
         0.28            0.43         0.41669       0.013312               1
       0.2966             0.4         0.38567        0.01433               1
       0.3133            0.37         0.35719       0.012807               1
       0.3967            0.25          0.2476      0.0023979               1
         0.48            0.17         0.17654     -0.0065391               1
       0.5633            0.11         0.12943      -0.019434               1
       0.6467            0.08        0.097552      -0.017552               1
         0.73            0.05        0.075599      -0.025599               1
       0.8133            0.04         0.06016       -0.02016               1
       0.8967            0.03        0.049075      -0.019075               1
         0.98            0.02        0.040976      -0.020976               1
       1.0633            0.02         0.03493       -0.01493               1
       1.1467            0.01        0.030322      -0.020322               1
         1.23            0.01         0.02675       -0.01675               1

===============================================================================
                     RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

          Estimate
   T  =   9.4182E+002  ft^2/day
   S  =   1.2234E-007


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                       A Q T E S O L V   R E S U L T S
                                Version 2.10

               Developed by Glenn M. Duffield, HydroSOLVE, Inc.
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04/21/96                                                                  17:21:59

==================================================================================
                                TEST DESCRIPTION

Data set........... CSW4FALL.DAT
Output file........ CSW4FALL.OUT
Data set title..... CSW-4 FALLING HEAD

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.9
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.3334
   Aquifer saturated thickness...... 21
   Well screen length............... 10
   Static height of water in well... 21
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.3334
   Log(Re/Rw)....................... 3.02
   Constants A, B and C............. 0.000 ,  0.000,  1.969
   No. of observations.............. 38

==================================================================================
                                ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

==================================================================================
                       RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

          Estimate         Std. Error
   T  =   1.1997E+003 +/-  2.5763E+002 ft^2/day
   S  =   1.0000E-010 +/-  4.9386E-010


ANALYSIS OF MODEL RESIDUALS

Residual = observed - calculated
   ghted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 27
   Number of estimated parameters.... 2
```

```
   Degrees of freedom................ 25
   Residual mean..................... 0.005194
   Residual standard deviation....... 0.02627
   Residual variance................. 0.0006899


Model Residuals:

     Time          Observed        Calculated       Residual         Weight
 -------------  -------------  -------------  -------------  -------------
       0.0267           1.74         1.6352        0.10475              1
       0.0434           1.53         1.4976       0.032359              1
         0.06           1.38         1.3749      0.0050964              1
       0.0767           1.28         1.2634       0.016645              1
       0.0934           1.17         1.1622      0.0077909              1
         0.11           1.08         1.0708      0.0092305              1
       0.1267              1        0.98693       0.013066              1
       0.1434           0.91        0.91043    -0.00042806              1
         0.16           0.85        0.84092      0.0090819              1
       0.1767           0.79        0.77693       0.013072              1
       0.1934           0.73        0.71833       0.011669              1
         0.21           0.68        0.66493       0.015068              1
       0.2267           0.63        0.61564       0.014357              1
       0.2434           0.58         0.5704      0.0096013              1
         0.26           0.54        0.52908       0.010923              1
       0.2767            0.5        0.49086       0.009142              1
       0.2934           0.46        0.45571      0.0042928              1
         0.31           0.43        0.42355      0.0064546              1
       0.3267            0.4        0.39375      0.0062539              1
       0.4101           0.27        0.27635     -0.0063513              1
       0.4934           0.18        0.19751      -0.017511              1
       0.5767           0.12        0.14383       -0.02383              1
       0.6601           0.08         0.1068      -0.026797              1
       0.7434           0.06       0.080996      -0.020996              1
       0.8267           0.04       0.062766      -0.022766              1
       0.9101           0.03       0.049705      -0.019705              1
       0.9934           0.02       0.040243      -0.020243              1

================================================================================
                      RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

          Estimate
   T  =   1.1997E+003 ft^2/day
   S  =   1.0000E-010


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                    A Q T E S O L V    R E S U L T S
                              Version 2.10

              Developed by Glenn M. Duffield, HydroSOLVE, Inc.
                  (c) 1988-1995  Geraghty & Miller, Inc.

04/21/96                                                                17:50:28

================================================================================
                              TEST DESCRIPTION

Data set........... CSW7RISE.DAT
Output file........ CSW7RISE.OUT
Data set title..... CSW-7 RISING HEAD
Company............ BLACK & VEATCH
Project............ 40650.001
Client............. USACE - Philadelphia District
Location........... Pearce Creek Disposal Area, MD
Test date.......... 3/1/96

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 2.09
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.3334
   Aquifer saturated thickness...... 13
   Well screen length............... 1
   Static height of water in well... 1
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.3334
   Log(Re/Rw)....................... 0.5384
   Constants A, B and C............. 1.655 ,  0.255,  0.000
   No. of observations.............. 62

================================================================================
                              ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

================================================================================
                    RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std. Error
   T  =   2.9697E+002 +/-   7.5848E+001 ft^2/day
   S  =   8.2850E-005 +/-   1.7649E-004


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 40
   Number of estimated parameters.... 2
   Degrees of freedom................ 38
   Residual mean..................... 0.002944
   Residual standard deviation....... 0.1097
   Residual variance................. 0.01203


Model Residuals:

     Time         Observed      Calculated      Residual        Weight
 -------------  -------------  -------------  -------------  -------------
       0.0333           2.09         1.8007         0.2893              1
         0.05           1.73          1.694       0.035981              1
       0.0666           1.12         1.5989       -0.47887              1
       0.0833           1.51         1.5117     -0.0017343              1
          0.1           1.79         1.4318        0.35825              1
       0.1166           1.28         1.3583      -0.078323              1
       0.1333           1.27         1.2898      -0.019801              1
         0.15           1.19          1.226      -0.036042              1
       0.1666           1.14         1.1669      -0.026899              1
       0.1833           1.09         1.1113       -0.02125              1
          0.2           1.04         1.0591      -0.019114              1
       0.2166           1.07         1.0105       0.059528              1
       0.2333           0.99        0.96448       0.025524              1
         0.25           0.91        0.92119      -0.011194              1
       0.2666           0.87        0.88066      -0.010657              1
       0.2833           0.84        0.84219     -0.0021914              1
          0.3            0.8        0.80588     -0.0058812              1
       0.3166           0.77        0.77177      -0.001775              1
       0.3333           0.74        0.73933     0.00067483              1
       0.4167           0.59         0.6012      -0.011201              1
          0.5            0.5         0.4948      0.0051967              1
       0.5833           0.42        0.41165       0.008352              1
       0.6667           0.35        0.34586      0.0041412              1
         0.75           0.29        0.29342     -0.0034192              1
       0.8333           0.25        0.25119     -0.0011869              1
       0.9167           0.22        0.21685      0.0031468              1
            1           0.19        0.18879      0.0012111              1
       1.0833           0.17        0.16565      0.0043529              1
       1.1667           0.15        0.14641       0.003593              1
         1.25           0.13        0.13034    -0.00033961              1
       1.3333           0.12        0.11682      0.0031848              1
       1.4166           0.11        0.10536      0.0046415              1
          1.5            0.1       0.095582      0.0044176              1
       1.5833           0.09       0.087211      0.0027895              1
       1.6667           0.08       0.079982    1.7955E-005              1
         1.75           0.08       0.073721      0.0062793              1
       1.8333           0.07       0.068261      0.0017395              1
       1.9167           0.07       0.063468      0.0065315              1
            2           0.07       0.059252       0.010748              1
          2.5           0.05       0.041983      0.0080167              1

================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING
```

```
VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   T  =   2.9697E+002 ft^2/day
   S  =   8.2850E-005


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                       A Q T E S O L V    R E S U L T S
                                 Version 2.10

              Developed by Glenn M. Duffield, HydroSOLVE, Inc.
                  (c) 1988-1995  Geraghty & Miller, Inc.

04/21/96                                                                18:00:18

================================================================================
                               TEST DESCRIPTION

Data set........... CSW7FALL.DAT
Output file........ CSW7FALL.OUT
Data set title..... CSW-7 FALLING HEAD
Company............ BLACK & vEATCH
Project............ 40650.001
Client............. USACE - Philadelphia District
Location........... Pearce Creek Disposal Area, MD
Test date.......... 3/1/96

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 2.09
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.3334
   Aquifer saturated thickness...... 13
   Well screen length............... 10
   Static height of water in well... 13
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.3334
   Log(Re/Rw)....................... 2.733
   Constants A, B and C............. 0.000 ,  0.000,  1.969
   No. of observations.............. 59

================================================================================
                               ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

================================================================================
                    RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std.  Error
   T  =   2.9608E+002 +/-   4.8481E+000 ft^2/day
   S  =   4.1129E-005 +/-   6.1128E-006


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals.............. 48
   Number of estimated parameters.... 2
   Degrees of freedom............... 46
   Residual mean.................... -0.0008463
   Residual standard deviation....... 0.006794
   Residual variance................ 4.615E-005


Model Residuals:

     Time           Observed       Calculated      Residual         Weight
 -------------  -------------  -------------  -------------  -------------
        0.0333           1.84         1.8262       0.013769              1
          0.05           1.73         1.7261      0.0038678              1
        0.0666           1.61         1.6361      -0.026077              1
        0.0833           1.54          1.553      -0.013007              1
           0.1           1.47         1.4763      -0.006259              1
        0.1166            1.4         1.4054     -0.0053846              1
        0.1333           1.33         1.3389     -0.0088847              1
          0.15           1.27         1.2767     -0.0066885              1
        0.1666           1.22         1.2187      0.0012855              1
        0.1833           1.17         1.1639      0.0060866              1
           0.2           1.11         1.1123     -0.0023441              1
        0.2166           1.07          1.064      0.0059728              1
        0.2333           1.02         1.0182      0.0018481              1
          0.25           0.98        0.97481      0.0051863              1
        0.2666           0.94        0.93407      0.0059309              1
        0.2833            0.9        0.89526      0.0047361              1
           0.3           0.86         0.8585      0.0014979              1
        0.3166           0.83        0.82385       0.006148              1
        0.3333            0.8        0.79077      0.0092264              1
        0.4167           0.66        0.64868       0.011323              1
           0.5           0.54        0.53763      0.0023674              1
        0.5833           0.45        0.44974      0.0002615              1
        0.6667           0.38        0.37942     0.00058066              1
          0.75           0.32        0.32282     -0.0028164              1
        0.8333           0.27        0.27684      -0.006839              1
        0.9167           0.24        0.23918     0.00081745              1
             1            0.2        0.20821     -0.0082061              1
        1.0833           0.18        0.18253     -0.0025261              1
        1.1667           0.16        0.16108     -0.0010814              1
          1.25           0.14        0.14311     -0.0031096              1
        1.3333           0.12        0.12794     -0.0079411              1
        1.4166           0.11        0.11507     -0.0050666              1
           1.5            0.1        0.10407     -0.0040671              1
        1.5833           0.09       0.094642      -0.004642              1
        1.6667           0.08       0.086504     -0.0065042              1
          1.75           0.08       0.079459      0.0005408              1
        1.8333           0.07       0.073322      -0.003322              1
        1.9167           0.07       0.067944      0.0020561              1
             2           0.06        0.06322       -0.00322              1
           2.5           0.05       0.044033      0.0059669              1
             3           0.03       0.033553     -0.0035529              1
           3.5           0.03       0.027098      0.0029016              1
             4           0.02       0.022745     -0.0027455              1
           4.5           0.02       0.019608     0.00039244              1
             5           0.02       0.017233      0.0027672              1
```

```
          5.5           0.02         0.01537      0.0046301              1
            6           0.01        0.013868      -0.003868              1
          6.5           0.01        0.012631     -0.0026311              1

  ==============================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   T  =   2.9608E+002 ft^2/day
   S  =   4.1129E-005


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                       A Q T E S O L V   R E S U L T S
                                 Version 2.10

                 Developed by Glenn M. Duffield, HydroSOLVE, Inc.
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04/21/96                                                                18:11:21

================================================================================
                                TEST DESCRIPTION

Data set........... CSW8RISE.DAT
Output file........ CSW8RISE.OUT
Data set title..... CSW-8 RISING HEAD
Company............ BLACK & VEATCH
Project............ 40650.001
Client............. USACE - Philadelphia District
Location........... Pearce Creek Disposal Area, MD
Test date.......... 3/1/96

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.9
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.3334
   Aquifer saturated thickness...... 13
   Well screen length............... 1
   Static height of water in well... 1
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.3334
   Log(Re/Rw)....................... 0.5384
   Constants A, B and C............. 1.655 ,  0.255,  0.000
   No. of observations.............. 63

================================================================================
                                ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

================================================================================
                       RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

          Estimate          Std. Error
   T  =   2.5282E+003 +/-   1.9138E+003 ft^2/day
   S  =   1.0000E-010 +/-   1.7763E-009


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 32
   Number of estimated parameters.... 2
   Degrees of freedom................ 30
   Residual mean..................... -0.00451
   Residual standard deviation....... 0.1261
   Residual variance................. 0.0159


Model Residuals:

     Time         Observed      Calculated      Residual       Weight
 -------------  -------------  -------------  -------------  -------------
         0.05           1.35         1.0954        0.25458              2
       0.0666           1.08        0.92388        0.15612              2
       0.0833           0.82        0.78117       0.038831              2
          0.1           0.63        0.66266      -0.032657              2
       0.1166           0.51        0.56441      -0.054405              2
       0.1333           0.42         0.4817      -0.061704              2
         0.15           0.35        0.41236      -0.062357              2
       0.1666           0.29        0.35438      -0.064381              2
       0.1833           0.25        0.30521      -0.055207              2
          0.2           0.21        0.26368      -0.053676              2
       0.2166           0.18        0.22872      -0.048716              2
       0.2333           0.15        0.19887      -0.048867              2
         0.25           0.13        0.17349      -0.043491              1
       0.2666           0.11        0.15199      -0.041991              1
       0.2833            0.1        0.13351      -0.033514              1
          0.3           0.09         0.1177      -0.027705              1
       0.3166           0.08        0.10422      -0.024223              1
       0.3333           0.07       0.092561      -0.022561              1
       0.4167           0.05        0.05421     -0.0042102              1
          0.5           0.04       0.035001      0.0049989              1
       0.5833           0.03       0.024739       0.005261              1
       0.6667           0.03       0.018864       0.011136              1
         0.75           0.02       0.015258      0.0047424              1
       0.8333           0.02       0.012875       0.007125              1
       0.9167           0.02       0.011191      0.0088095              1
            1           0.02      0.0099321       0.010068              1
       1.0833           0.02       0.008946       0.011054              1
       1.1667           0.02      0.0081446       0.011855              1
         1.25           0.02      0.0074772       0.012523              1
       1.3333           0.02      0.0069097        0.01309              1
       1.4166           0.02      0.0064199        0.01358              1
          1.5           0.01      0.0059918      0.0040082              1

================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   T  =   2.5282E+003 ft^2/day
   S  =   1.0000E-010


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                         A Q T E S O L V   R E S U L T S
                                  Version 2.10

                Developed by Glenn M. Duffield, HydroSOLVE, Inc.
                    (c) 1988-1995  Geraghty & Miller, Inc.

04/21/96                                                                18:22:03

================================================================================
                                TEST DESCRIPTION

Data set........... CSW8FALL.DAT
Output file........ CSW8FALL.OUT
Data set title..... CSW-8 FALLING HEAD
Company............ BLACK & VEATCH
Project............ 40650.001
Client............. USACE - Philadelphia District
Location........... Pearce Creek Disposal Area, MD
Test date.......... 3/1/96

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.9
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.3334
   Aquifer saturated thickness...... 13
   Well screen length............... 10
   Static height of water in well... 13
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.3334
   Log(Re/Rw)....................... 2.733
   Constants A, B and C............. 0.000 ,  0.000,  1.969
   No. of observations.............. 48

================================================================================
                                ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

================================================================================
                      RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

          Estimate          Std. Error
   T  =   2.4957E+003 +/-   2.5945E+003 ft^2/day
   S  =   1.0000E-010 +/-   2.4610E-009


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 27
   Number of estimated parameters.... 2
   Degrees of freedom................ 25
   Residual mean..................... 0.02151
   Residual standard deviation....... 0.1145
   Residual variance................. 0.01311


Model Residuals:

     Time          Observed       Calculated      Residual        Weight
 ------------- ------------- ------------- ------------- -------------
          0.05          1.51        1.1028       0.40724             1
        0.0666          1.24       0.93195       0.30805             1
        0.0833          0.98       0.78954       0.19046             1
           0.1          0.77       0.67103      0.098968             1
        0.1166          0.61       0.57258      0.037424             1
        0.1333          0.48       0.48954    -0.0095353             1
          0.15          0.39       0.41976     -0.029764             1
        0.1666          0.32       0.36132     -0.041318             1
        0.1833          0.26       0.31165     -0.051652             1
           0.2          0.22       0.26963     -0.049628             1
        0.2166          0.19       0.23419     -0.044189             1
        0.2333          0.16       0.20388     -0.043877             1
          0.25          0.13       0.17806     -0.048064             1
        0.2666          0.12       0.15616     -0.036157             1
        0.2833           0.1        0.1373     -0.037302             1
           0.3          0.09       0.12114     -0.031143             1
        0.3166          0.08       0.10734     -0.027343             1
        0.3333          0.07      0.095389     -0.025389             1
        0.4167          0.04      0.055942     -0.015942             1
           0.5          0.03      0.036082    -0.0060818             1
        0.5833          0.03      0.025438     0.0045617             1
        0.6667          0.02      0.019339    0.00066114             1
          0.75          0.02      0.015599     0.0044012             1
        0.8333          0.02      0.013134     0.0068655             1
        0.9167          0.02      0.011398     0.0086018             1
             1          0.02      0.010106     0.0098943             1
        1.0833          0.01     0.0090962    0.00090379             1

================================================================================
                        RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

          Estimate
  T  =   2.4957E+003 ft^2/day
  S  =   1.0000E-010


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                      A Q T E S O L V    R E S U L T S
                                 Version 2.10

                 Developed by Glenn M. Duffield, HydroSOLVE, Inc.
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04/21/96                                                              20:15:45

================================================================================
                                TEST DESCRIPTION

Data set........... CSW9RISE.DAT
Output file........ CSW9RISE.OUT
Data set title..... CSW-9 RISING HEAD
Company............ BLACK & VEATCH
Project............ 40650.001
Client............. USACE - Philadelphia District
Location........... Pearce Creek Disposal Area, MD
Test date.......... 3/1/96

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.9
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.3334
   Aquifer saturated thickness...... 11
   Well screen length............... 10
   Static height of water in well... 11
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.3334
   Log(Re/Rw)....................... 2.63
   Constants A, B and C............. 0.000 ,  0.000,  1.969
   No. of observations.............. 63

================================================================================
                                ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

================================================================================
                      RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

          Estimate          Std.  Error
   T  =   1.5030E+003 +/-   1.3964E+003 ft^2/day
   S  =   1.0000E-010 +/-   2.1521E-009


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 34
   Number of estimated parameters.... 2
   Degrees of freedom................ 32
   Residual mean..................... 0.01676
   Residual standard deviation....... 0.1207
   Residual variance................. 0.01457


Model Residuals:

     Time          Observed       Calculated       Residual         Weight
 -------------  -------------  -------------  -------------  -------------
        0.0233           2.14         1.6137         0.5263              1
        0.0333           1.92         1.5108         0.4092              1
          0.05           1.42         1.3565        0.06349              1
        0.0666           1.19         1.2214      -0.031367              1
        0.0833           1.13         1.1009       0.029118              1
           0.1              1        0.99375      0.0062463              1
        0.1166           0.89        0.89878     -0.0087846              1
        0.1333            0.8         0.8134      -0.013398              1
          0.15           0.71        0.73698      -0.026984              1
        0.1666           0.64        0.66889      -0.028886              1
        0.1833           0.58        0.60739      -0.027387              1
           0.2           0.52        0.55214      -0.032136              1
        0.2166           0.47        0.50273      -0.032727              1
        0.2333           0.42        0.45797      -0.037965              1
          0.25           0.38        0.41763      -0.037632              1
        0.2666           0.34        0.38146      -0.041464              1
        0.2833           0.31        0.34861       -0.03861              1
           0.3           0.28        0.31893      -0.038931              1
        0.3166           0.26        0.29225      -0.032251              1
        0.3333           0.24        0.26796      -0.027958              1
        0.4167           0.15        0.17671      -0.026714              1
           0.5            0.1        0.12015      -0.020148              1
        0.5833           0.07       0.084347      -0.014347              1
        0.6667           0.06       0.061219     -0.0012189              1
          0.75           0.04       0.046007     -0.0060068              1
        0.8333           0.04       0.035771       0.004229              1
        0.9167           0.03        0.02872        0.00128              1
             1           0.03       0.023759      0.0062413              1
        1.0833           0.03       0.020175      0.0098248              1
        1.1667           0.03       0.017517       0.012483              1
          1.25           0.02         0.0155      0.0045004              1
        1.3333           0.02       0.013926      0.0060737              1
        1.4166           0.02       0.012669      0.0073307              1
           1.5           0.02       0.011641      0.0083592              1

===============================================================================
                        RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

          Estimate
   T  =   1.5030E+003 ft^2/day
   S  =   1.0000E-010
```

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                       A Q T E S O L V   R E S U L T S
                                 Version 2.10

                 Developed by Glenn M. Duffield, HydroSOLVE, Inc.
                      (c) 1988-1995  Geraghty & Miller, Inc.

04/21/96                                                                       20:26:59

========================================================================================
                                 TEST DESCRIPTION

Data set............ CSW9FALL.DAT
Output file......... CSW9FALL.OUT
Data set title...... CSW-9 FALLING HEAD
Company............. BLACK & VEATCH
Project............. 40650.001
Client.............. USACE - Philadelphia District
Location............ Pearce Creek Disposal Area, MD
Test date........... 3/1/96

Units of Measurement
   Length........... ft
   Time............. min

Test Well Data
   Initial displacement in well..... 1.9
   Radius of well casing............ 0.1
   Radius of wellbore............... 0.1
   Aquifer saturated thickness...... 11
   Well screen length............... 10
   Static height of water in well... 11
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1
   Effective wellbore radius........ 0.1
   Log(Re/Rw)....................... 3.606
   Constants A, B and C............. 0.000, 0.000, 4.329
   No. of observations.............. 54

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                                 ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

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                      RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate            Std. Error
   T  =   5.2119E+002  +/-  3.7313E+002 ft^2/day
   S  =   1.0000E-010  +/-  1.7564E-009

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 43
   Number of estimated parameters.... 2
   Degrees of freedom................ 41
   Residual mean..................... -0.002031
   Residual standard deviation....... 0.09047
   Residual variance................. 0.008185


Model Residuals:

     Time          Observed       Calculated       Residual         Weight
 -------------  -------------  -------------  -------------  -------------
         0.03          1.22          1.5737        -0.35366           1
       0.0333          1.29           1.543        -0.25298           1
         0.05          1.66          1.3986         0.26144           1
       0.0666          1.45          1.2707         0.17932           1
       0.0833          1.27          1.1555         0.11452           1
          0.1          1.15           1.052        0.097987           1
       0.1166          1.03         0.95939        0.070609           1
       0.1333          0.92         0.87532        0.044683           1
         0.15          0.82         0.79937        0.020632           1
       0.1666          0.73         0.73106      -0.0010623           1
       0.1833          0.65         0.66882       -0.018819           1
          0.2          0.59          0.6124       -0.022401           1
       0.2166          0.53         0.56151       -0.031509           1
       0.2333          0.48         0.51501       -0.035008           1
         0.25          0.43         0.47275       -0.042754           1
       0.2666           0.4         0.43455       -0.034551           1
       0.2833          0.36         0.39957       -0.039566           1
          0.3          0.33         0.36771        -0.03771           1
       0.3166           0.3         0.33885       -0.038849           1
       0.3333          0.27         0.31237       -0.042368           1
       0.4167          0.18         0.21084       -0.030843           1
          0.5          0.12         0.14574       -0.025739           1
       0.5833          0.09         0.10329       -0.013293           1
       0.6667          0.07        0.075163      -0.0051626           1
         0.75          0.05        0.056269      -0.0062687           1
       0.8333          0.04        0.043349      -0.0033488           1
       0.9167          0.04        0.034351       0.0056493           1
            1          0.04        0.027984        0.012016           1
       1.0833          0.03        0.023384       0.0066157           1
       1.1667          0.03         0.01999         0.01001           1
         1.25          0.03        0.017439        0.012561           1
       1.3333          0.03        0.015476        0.014524           1
       1.4166          0.02        0.013933        0.006067           1
          1.5          0.02        0.012693       0.0073069           1
       1.5833          0.02        0.011679       0.0083212           1
       1.6667          0.02        0.010831        0.009169           1
         1.75          0.02        0.010112        0.009888           1
       1.8333          0.02       0.0094918        0.010508           1
       1.9167          0.02        0.008949        0.011051           1
            2          0.02       0.0084695        0.011531           1
          2.5          0.02         0.00642         0.01358           1
            3          0.01       0.0051523       0.0048477           1
          3.5          0.01       0.0042879       0.0057121           1

===============================================================================
```

```
                          RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

                Estimate
   T   =     5.2119E+002 ft^2/day
   S   =     1.0000E-010

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