Characterization and Bioremediation Viability of Polycyclic Aromatic Hydrocarbon Contamination in the Banks of the Mahoning River

by

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Abstract:

Discharge of wastes into the lower Mahoning River in Northeastern Ohio since the 19^{th} century has resulted in the accumulation of toxic hydrocarbons, including PAHs, in the river channel and river bank sediments. This study characterizes the polluted bank sediments and evaluates the feasibility of cleanup using in situ bioremediation. Characterization was undertaken in order to study the feasibility of in situ bioremediation. This was accomplished through the collection of 208 samples from 37 soil borings from both banks at five locations along the river. Samples were then analyzed by grain-size analysis and hydraulic conductivities were estimated using the Hazen method. Soil borings also revealed the following: depth to groundwater, depth to bedrock, the upper and lower limits of hydrocarbon contamination, and the thickness of the hydrocarbon contamination in the river banks. Slug tests were performed at four locations to evaluate hydraulic conductivity in very fine-grained sediments, which could not properly be evaluated by the Hazen method. Flow between the groundwater in the bank and the river channel was monitored at four locations for a period of up to one year. Monitoring confirmed the active exchange of flow between the river channel and the banks. This exchange is capable of recontaminating the river's channel by transporting the dissolved contaminants from the bank, via groundwater if the banks are not remediated. PAHs were analyzed in soil samples taken from five locations which verified PAH impact at all four locations. Based on groundwater flow directions, sediment makeup, hydraulic conductivity distribution, thickness of contamination, and PAH availability, this study suggests first, the probability of leaching from impacted bank sediment to groundwater and second, based on the values of hydraulic conductivity that in situ bioremediation is feasible.

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1. Introduction

1.1. Overview

The Mahoning River is situated in Northeastern Ohio and Western Pennsylvania and once served as a center of industry for the surrounding communities (Figure 1). The Mahoning River is approximately 108 miles long, rising in Columbiana County, Ohio and flowing northward to Warren, Ohio and then southeasterly to New Castle, Pennsylvania, where it joins the Shenango River to form the Beaver River. The drainage area of the Mahoning River is approximately 1,130 square miles (USACE 2001).

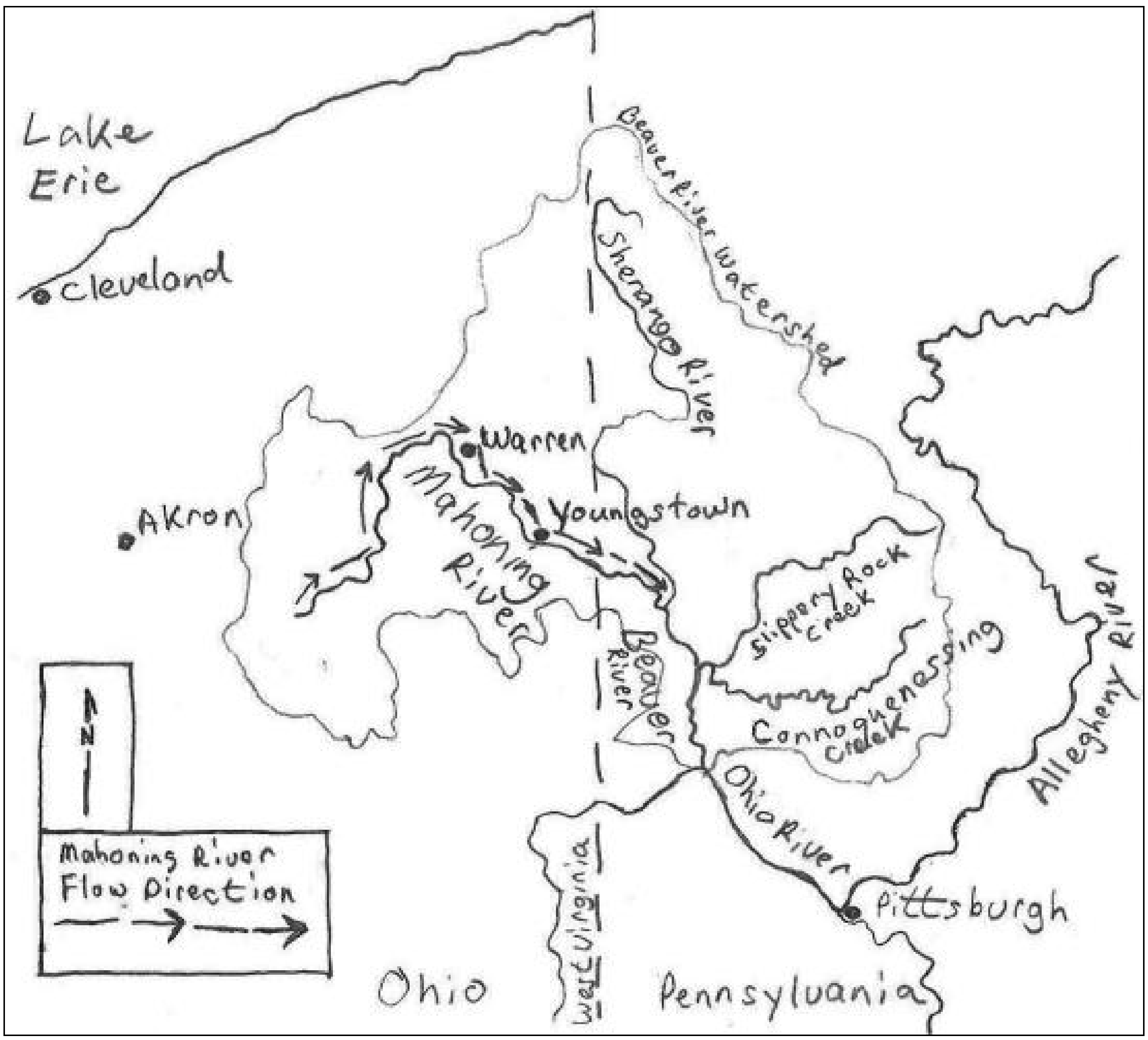

Figure 1: Beaver River Drainage Basin and Mahoning River (drawn using USGS base maps)

The Lower Mahoning River was once heavily industrialized, especially with steel mills, and has left a legacy of pollution including hydrocarbon and heavy metal contamination (OEPA 1996). The United States Environmental Protection Agency (USEPA) estimates that during the 1970's levels of hydrocarbon discharge reached as much as 70,000 pounds per day (lbs/day), which is equivalent to 200 barrels per day (USACE 1999). This study focuses on a segment of the Lower Mahoning River, stretching from the city of Warren through Girard in Trumbull County; then flowing through Youngstown, Struthers, and Lowellville in Mahoning County. Figure 2 on the following page details the Lower Mahoning River, the low-head dam locations, study site locations, and right and left bank designations. Past industry has significantly impacted the flow of the river with the construction of 12 low-head dams (Figure 2). Three of the original twelve dams were removed due to structural and flooding concerns. The 9 existing dams have created a series of pools, between flowing segments of the river, above the low-head dams that have acted to retain sediment contamination (OEPA 1996).

The banks of the Mahoning River contain polycyclic aromatic hydrocarbon (PAH) contamination as a legacy of the area's industrialized past. It has been reported that the majority of PAHs entering aquatic environments remains close to sites of deposition, suggesting that lakes, rivers, estuaries, and coastal environments near centers of human population are the primary repositories for aquatic PAHs (Eisler 2000). Exposure to PAHs is a concern because of the possible acute and chronic effects to humans and soil biota, due to the persistence of PAHs in the environment. PAHs have the potential to cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure in both humans and animals (ATSDR 1995).

Disturbance of sediment along the Lower Mahoning River banks has been shown to negatively affect the riparian habitat by releasing PAH containing oil to the river water and exposing it to the sediment surface (OEPA 2010). Flooding events pose the most potential for eroding the river banks and releasing contamination. Other potential sources for river bank erosion include; dam degradation or failure, natural migration of the river channel, uprooted trees during high wind events, and degradation of other man-made structures such as roads, buildings and railway trusses.

The United States Army Corps of Engineers (USACE) has assessed the Mahoning River and recommended the course to take for remedial action. The original goal of the USEPA and USACE study was to "Remediate the Mahoning River within the study area to restore the aquatic ecosystem to the biotic integrity existing on a model reach of the Mahoning River just upstream of the study area and to eliminate the Ohio Department of Health Human Health Advisory" (USACE 1999). The "model reach" of the Mahoning River had been designated a warm water habitat (WWH) by the OEPA. In a February 2012 phone interview, John Kwolek of the OEPA indicated that the objectives of the USACE and USEPA have not changed. The preferred remedial alternative recommended by the USACE was as follows. The USACE plans to use a combination of vacuum dredging and mechanical dredging techniques on the river channel sediment and then landfill the sediment after dewatering. The USACE also recommends the removal of several of the low-head dams as part of the remedial action. The USACE recommends removal of the river banks with varying degrees of bank restoration including the use of geosynthetic liners, rip rap, bank replacement, and bioremediation (USACE 1999). While effective, removal of river bank sediment will have a social, economic, and environmental impact. John Kwolek also indicated that due to regulatory and economic complications, plans to remediate the river channel have stalled and there are no immediate plans to remediate the banks of the river.

One of the objectives of this thesis was to investigate the potential for migration of dissolved hydrocarbons in groundwater stored in the banks to the river water and recontamination of river water and channel sediment. River sediments, in general, are sinks for pollutants in aquatic systems (Machado et al. 2012). This study also investigates in situ bioremediation as a viable way to remediate the banks of the Mahoning River without their complete removal. If the potential for recontamination was proven, remediation of the channel sediments would be expensive and have inherent impacts associated with bank removal. In situ bioremediation of the river banks has the potential to be much more cost effective and have less social and environmental impact to the existing riparian zone along the river. Therefore, the hydrologic connection between groundwater in the banks and river channel water must be characterized to assess the recontamination potential. If the potential for recontamination of the river channel (from dissolved contaminants contained within the groundwater in the banks) exists, then in situ bioremediation of PAHs in the banks of the Mahoning River may be looked at as a viable option to address this.

In this thesis site characterization of selected sites along the Lower Mahoning River banks was undertaken. Site selection was based upon historical information available regarding impacts documented during previous studies, public land designation, and the accessibility of river bank sediment for sampling. Each study area was named by looking downriver (highest gradient to lowest gradient) and assigning left bank and right bank designations along with the name of the closest city (Water Bioassessment Website 2012). Right and left banks study locations were chosen at Warren, Girard, Youngstown, Struthers, and Lowellville. Figure 2 depicts the Lower Reach of the Mahoning River, Right and Left bank designations, and the study locations near the major cities within the study area.

Site characterization of the river banks was accomplished through the collection of 208 sediment samples from 37 soil borings obtained from both banks of the river at five locations; Warren, Girard, Youngstown, Struthers, and Lowellville. The depth to groundwater, depth to bedrock, depth to hydrocarbon contamination, and thickness of hydrocarbon contamination were determined for all borings. The soil borings were then analyzed or soil type by grain-size analysis. Hydraulic conductivities were then estimated for each collected sample based upon the Hazen method. Soil borings were converted to monitoring wells in seven banks of the five study locations in order to monitor groundwater levels and perform slug testing.

Slug tests were performed in six banks to evaluate hydraulic conductivity of fine grained sediment that could not properly be determined by the Hazen method. The slug tests were interpreted using the Bouwer and Rice method. Values of the hydraulic conductivity were calculated for the two banks at each site to determine whether bioremediation was feasible. From a hydraulic point of view, bioremediation will be successful only if the hydraulic conductivity value of the river bank sediment is greater than 0.3 feet/day or 10^{-4} cm/sec. to allow for the transport of the electron acceptor and nutrients through the aquifer. (Bedient 1999).

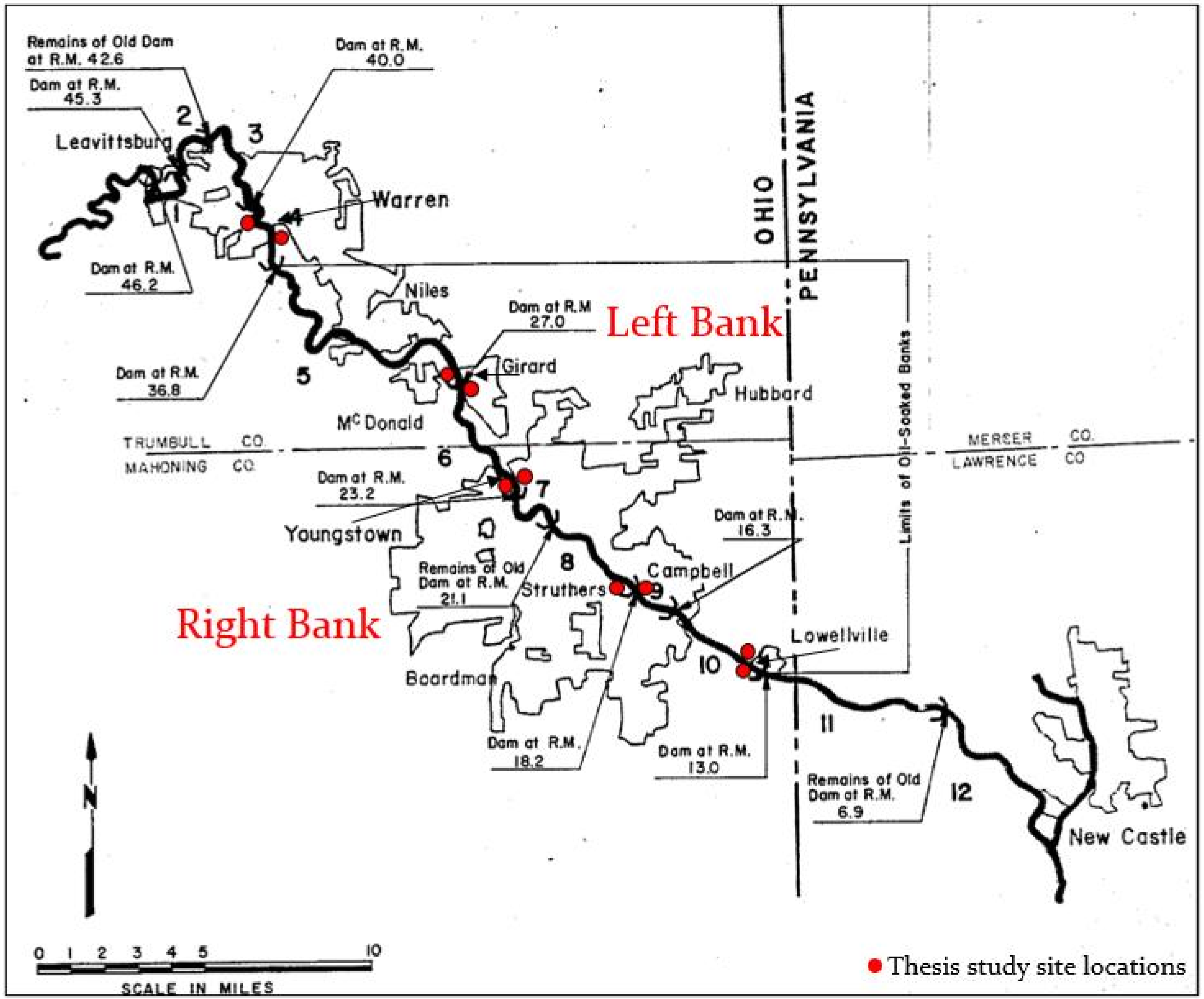

Figure 2: Map Depicting the Lower Mahoning River (base map from USACE 1999)

Groundwater flow between the river bank aquifer and the river channel was monitored at seven banks of four site locations for a period of up to 1 year. The depth to groundwater in monitoring wells was measured relative to the depth to water in the river channel using a laser transit. This was accomplished by gauging the depth to water in monitoring wells and the depth to water in the river channel from the level plane of the laser transit and comparing one to the other. This was done to study movement of groundwater and see if the Mahoning River was both a gaining and a losing stream at different times due to seasonal fluctuations in rainfall. Study locations included Warren, Girard, Youngstown, and Lowellville. Results were then compared to concurrent historical rainfall data, river discharge data, and historical flood stage levels.

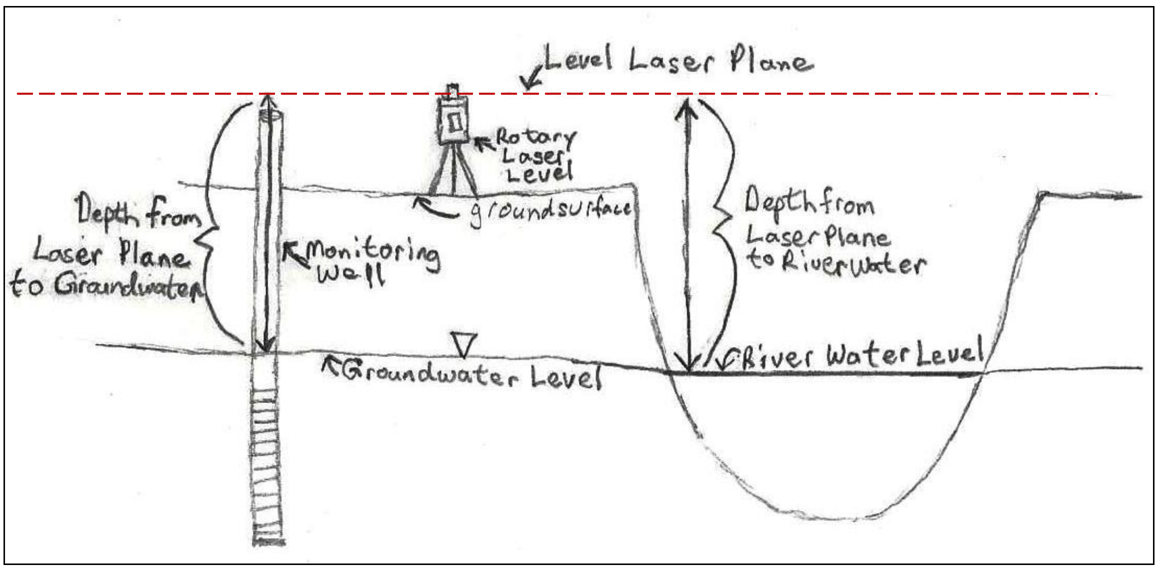

Figure 3: Depiction of gauging depths to groundwater and river water.

PAHs were analyzed in sediment samples taken from three depths from six banks at four study site locations (Warren Right Bank, Girard Right Bank, Struthers Left Bank, Lowellville Left Bank, and Lowellville Right Bank), as depicted in Figures 1 and 2. This was done to verify the presence of PAHs in the bank aquifer being studied and compare the PAH impacts between the studied banks and at differing depths.

1.2. Objectives

The objective of this study was to characterize the aquifer along the banks of the Mahoning River, the PAH contamination therein, and to evaluate the potential for in situ bioremediation based upon the characterization results. The USEPA states that characterization of a hazardous waste site involves gathering and analyzing data to describe the processes controlling the transport of wastes from the site. Characterization provides the understanding to predict future groundwater flow parameters based on groundwater flow parameters. It can encompass the characterization of the contamination itself as well as that of the various transport pathways such as air, surface water, biota, and groundwater that can transport it. Groundwater is often the most significant and least apparent transport pathway (USEPA 1991). All thesis field data collection and sample collection was performed between May 2006 and November 2008. Data analysis and interpretation and inclusion of rainfall data occurred in June 2012 with the addition of discharge data in August 2015. The main body of the thesis was begun in June 2007 with major edits in 2012 and 2014. The thesis was completed in August 2015.

The study area of this research included the right and left banks of the five site locations (Warren, Girard, Youngstown, Struthers, and Lowellville) along a 31 mile stretch of the Lower Mahoning River between the cities of Warren and Lowellville. The scope of this project included advancing bore holes and collecting soil composition data based on field observations, soil grain-size analysis, evaluation of hydraulic conductivity within the river banks, monitoring the elevation of the river water in relation to that of the groundwater in the aquifer banks, and PAH analysis utilizing gas chromatography-mass spectrometry (GC-MS).

The elevations of the river water and groundwater in the banks were measured in order to determine whether groundwater flows from the banks into the river channel. This flow has the potential to recontaminate the river channel by transport of dissolved contaminants if the banks are not remediated. The only possible way to avoid this scenario is to remediate both the banks and the river channel, not only the river channel as currently proposed by the USACE.

Soil bore holes were advanced with a hand auger noting the depth to groundwater, depth to hydrocarbon contamination, thickness of hydrocarbon contamination, depth to bedrock, and observed features such as the presence of metal oxides. Metal oxide contamination could indicate former industry upriver and has the potential to affect the in situ microbiological community in the river banks.

Values for hydraulic conductivity were calculated for the banks to determine whether bioremediation is feasible from a hydraulic point of view. Bioremediation will be successful only if the hydraulic conductivity value is greater than 0.30 feet/day (ft./day) or 10^{-4} centimeters/second (cm/sec.) (Bedient 1999).

1.3. Comparative Studies

Findlay et al. 1996 published a study on the Little Scioto River in Marion, Ohio that used a method for PAH analysis upon which the method used in this thesis was based. In this study the extraction was performed on in-river sediment. Therefore, results of Findley et al. 1996 study could potentially differ from the results thesis results, due to the thesis samples having been collected from the river bank sediment.

In a thesis, Mosher (2002) published a study of the Mahoning River in which quantification PAHs in-river sediment was undertaken. Mosher (2002) also studied sites at Youngstown, Girard, and Lowellville. However, the Mosher (2002) theses studied sediment from the bottom of the Mahoning River Channel and utilized USEPA method 3350.

In a another thesis, Lee (2005) performed a study on the Mahoning River in which PAHs were extracted and quantified for a river bank in Lowellville, OH. The Lee (2005) study used a method for extraction and analysis of PAHs based on the Fang and Findley method used in the published Findley et al. (1996) study.

Amin and Jacobs (2012) published a paper in which the Mahoning River bank sediments were studied. The study included information regarding soil characteristics and hydraulic conductivity of the banks, distribution of contamination in the banks, and the interchange of water between the bank aquifer and the river channel similar to this thesis.

2. Site Investigation

The purpose of this site investigation was to characterize the following.

1) The geologic composition of the river bank aquifer.
2) The distribution of hydraulic conductivity of the bank aquifer.
3) The possibility of interflow between the bank aquifer and the river channel (flow from the aquifer to the river channel and vice versa).

2.1 Geologic Composition of the River Bank Aquifer

The mineralogy and size distribution of the sediment determines the magnitude of the permeability (capacity of the sediment or rock to allow water to flow through it), which controls the rate of the movement of groundwater and dissolved contaminants between the banks and the river. Permeability also determines the rate of nutrient delivery in bioremediation (Bendient 1999).

2.1.1 Methodology - Geologic Composition of the River Bank Aquifer

Bore holes were advanced utilizing an AMS manual auger in the right and left banks of five different locations along the Lower Mahoning River (Warren, Girard, Youngstown, Struthers, and Lowellville). All soil boring locations were within 10 feet (ft.) of the edge of the river water and within a 25 ft. radius of one another at each study site. Soil samples were collected from hand auger cuttings at 1 ft. intervals from each soil boring. Site characterization of the bank aquifer was accomplished by recording sediment type, depth to hydrocarbon contamination, presence of iron oxide discoloration, thickness of hydrocarbon contamination, moisture content, depth to groundwater, and the depth to bedrock. All samples were removed from the hand auger with the aid of a steel spade and/or steel putty knife. All equipment was rinsed with water between collection of each sample and with detergent and water between all bore holes. Nitrile plastic gloves were worn when handling samples and properly decontaminated or replaced between each sample and all bore holes. Each individual sample was placed into a sealable plastic storage bag upon collection and labeled with the sample location, date of collection, sample identification, and the collection depth below surface grade (bsg). Bagged samples were then brought back to the laboratory and segregated for PAH extraction and/or grain-size analysis.

Figure 4: Hand Auger Collection of Sediment Samples

The average values of depth to groundwater, depth to bedrock, depth to hydrocarbon contamination, and thickness of the hydrocarbon contamination were calculated for each site based on the total number of boreholes per site.

2.1.2 Results - Geologic Composition of the River Bank Aquifer

Between June 2006 and August 2007, a total 37 soil borings were advanced in both left and right banks at the five locations along the river. Four soil borings were advanced in the left bank of Warren, five in the right bank of Warren, four in the left bank of Girard, two in the right bank of Girard, two in the left bank of Youngstown, three in the right bank of Youngstown, four in the left bank of Struthers, four in the right bank of Struthers, six in the left bank of Lowellville, and three in the right bank of Lowellville.

A summary of the observed characteristics is presented in Table 1 with a more detailed description presented in Appendix A along with a summary of soil boring lithological descriptions from the hand auger locations field notes.

Table 1: Characterization Summary of Mahoning River Banks Averaged by Site				
Site Location (Bank)	**Depth to Groundwater**	**Depth to Bedrock**	**Depth to Hydrocarbons**	**Thickness of Hydrocarbons**
Warren Left	3 ft.	5 ft.	2.5 ft.	2.5 ft.
Warren Right	3.3 ft.	6.7 ft.	2 ft.	4.7 ft.
Girard Left	3 ft.	6.25 ft.	1.5 ft.	4.75 ft.
Girard Right	3 ft.	9.25 ft.	0.5 ft.	9.25 ft.
Struthers Left	3.9 ft.	7.3 ft.	1.7 ft.	5.6 ft.
Struthers Right	3.3 ft.	7 ft.	1.9 ft.	7 ft.
Youngstown Left	3 ft.	10 ft.	2 ft.	8 ft.
Youngstown Right	3 ft.	> 13.5 ft.	2.3 ft.	> 10 ft.
Lowellville Left	3 ft.	8 ft.	2.4 ft.	5.5 ft.
Lowellville Right	3.1 ft.	6.3 ft.	2 ft.	4.3 ft.

Subsurface sediment makeup observed in the left bank of Warren were composed of sandy clay with traces of silt to a depth of approximately 3 ft. bsg, over a layer of clay with traces of sand to a depth of approximately 4 ft. bsg, over a layer of brown clay with traces of sand to a depth of approximately 5 ft. bsg, over sandstone bedrock which was encountered at a depth of approximately 5 ft. bsg. Groundwater saturation was observed at a depth of approximately 3 ft. bsg. The heaviest observed hydrocarbon impact was noted from approximately 3 ft. to 4 ft. bsg with a thickness of 1 ft. Impact in this area appeared to be less than in the other study areas.

Subsurface sediment makeup observed in the right bank of Warren were composed of sand and silt to a depth of approximately 2 ft. bsg, over a layer of silty sand with some clay to a depth of approximately 3 ft. bsg, over a layer of silty clay with sand to a depth of approximately 5 ft. bsg, over a layer of silty sand with traces of gravel to a depth of approximately 7 ft. bsg, over sandstone bedrock which was encountered at a depth of approximately 7 ft. bsg Groundwater saturation was observed at a depth of approximately 3 ft. bsg The heaviest observed hydrocarbon impact was noted from approximately 4 ft. to 6 ft. bsg with a thickness of 2 ft. Additionally, metal oxide was observed between 3 ft. to 5 ft. bsg

Subsurface sediment makeup observed in the left bank of Girard were composed of silty sand with traces of clay to a depth of approximately 2 ft. bsg, over a layer of brown clay and sand to a depth of approximately 4 ft. bsg, over a layer of sandy clay with traces of silt to a depth of approximately 7 ft. bsg, over unknown bedrock which was encountered at a depth of approximately 7 ft. bsg Groundwater saturation was observed at a depth of approximately 3 ft. bsg The heaviest observed hydrocarbon impact was noted from approximately 3 ft. to 5 ft. bsg with a thickness of 2 ft. Additionally, red oxidation was observed between 2 ft. to 6 ft. bsg

Subsurface sediment makeup observed in the right bank of Girard were composed of brown silty clay with traces of silt to a depth of approximately 3 ft. bsg, over a layer of blue clay with traces of silt to a depth of approximately 4 ft. bsg, over a layer of blue and brown mottled clay to a depth of approximately 7 ft. bsg, over a layer of blue and brown mottled hardpan clay to a depth of approximately 9 ft. bsg over an unknown bedrock which was encountered at a depth of approximately 9 ft. bsg Groundwater saturation was observed at a depth of approximately 3 ft. bsg The heaviest observed hydrocarbon impact was noted from approximately 3 ft. to 5 ft. bsg with a thickness of 2 ft.

Subsurface sediment makeup observed in the left bank of Youngstown were composed of brown silty sand to a depth of approximately 7 ft. bsg, over a layer of coarse grained sand with traces of silt to a depth of approximately 9 ft. bsg, over a layer of coarse grained sand with gravel to a depth of approximately 10 ft. bsg, over sandstone bedrock which was encountered at a depth of approximately 10 ft. bsg Groundwater saturation was observed at a depth of an approximately 3 ft. bsg The heaviest observed hydrocarbon impact was noted from approximately 5 ft. to 9 ft. bsg with a thickness of 4 ft. Additionally, red oxidation was observed between 2 ft. to 9 ft. bsg

Subsurface sediment makeup observed in the right bank of Youngstown were composed of sand and clay with traces of silt to a depth of approximately 4 ft. bsg, over a layer of silty sand with gravel to a depth of approximately 6 ft. bsg, over a layer of silty sand to a depth of approximately 9 ft. bsg, over a layer of silty clay with sand to a depth of approximately twelve ft. bsg, over a layer of coarse grained sand with clay to a depth of approximately 11 ft. bsg, over a layer of clayey sand to a depth of approximately 13 ft. bsg, over an unknown bedrock which was encountered at a depth of approximately 13 ft. bsg. Groundwater saturation was observed at a depth of approximately 3 ft. bsg. The heaviest observed hydrocarbon impact was noted from approximately 6 ft. to 12e ft. bsg with a thickness of 6 ft. Additionally, red oxidation was observed between 3 ft. to 7 ft. bsg.

Subsurface sediment makeup observed in the left bank of Struthers were composed of silt and sand to a depth of approximately 4 ft. bsg, over a layer of silty sand with gravel to a depth of approximately 11 ft. bsg, over an unknown bedrock which was encountered at a depth of between approximately 5 ft. and 13 ft. bsg Groundwater saturation was observed at a depth of approximately 4 ft. bsg The heaviest observed hydrocarbon impact was noted from approximately 4 ft. to 9 ft. bsg with a thickness of 5 ft. Additionally, red oxidation was observed between 2 ft. to 4 ft. bsg.

Subsurface sediment makeup observed in the right bank of Struthers were composed of silty sand with traces of clay to a depth of approximately 5 ft. bsg, over a layer of silty sand with gravel to a depth of approximately 9 ft. bsg, over a sandstone bedrock which was encountered at a depth of approximately 7 ft. to 9 ft. bsg. Groundwater saturation was observed at a depth of approximately 3 ft. bsg. The heaviest observed hydrocarbon impact was noted from approximately 5 ft. to 9 ft. bsg with a thickness of 4 ft. Additionally, red oxidation was observed between 3 ft. to 5 ft. bsg.

Subsurface sediment makeup observed in the left bank of Lowellville were composed of silty sand to a depth of approximately 4 ft. bsg, over a layer of silty clay to a depth of approximately 9 ft. bsg, over a sandstone bedrock layer which was encountered at a depth of approximately 8 ft. to 9 ft. bsg. Groundwater saturation was observed at a depth of approximately 3 ft. bsg. The heaviest observed hydrocarbon impact was noted from approximately 4 ft. to 6 ft. bsg with a thickness of 2 ft. Red oxidation was observed between 2 ft. to 4 ft. bsg.

Subsurface sediment makeup observed in the right bank of Lowellville were composed of sandy clay to a depth of approximately 4 ft. bsg, over a layer of clay with sand to a depth of approximately 5 ft. bsg, over a layer of clay with traces of sand and gravel to a depth of approximately 7 ft. bsg, over a sandstone bedrock which was encountered at a depth of approximately 6 ft. to 7 ft. bsg Groundwater saturation was observed at a depth of approximately 3 ft. bsg The heaviest observed hydrocarbon impact was noted from approximately 3 ft. to 6 ft. bsg with a thickness of 3 ft. Additionally, red oxidation was observed between 3 ft. to 4 ft. bsg

2.1.3 Discussion of Results - Geologic Composition of the River Bank Aquifer

According to Ohio Department of Natural Resources (ODNR), USGS, and USACE published maps and geologic data, the Mahoning River lies within the Allegheny Plateau Physiographic Region within the Lower Mississippian Age Shales and sandstones of the Cuyahoga, Berea, and Bedford Formations (USACE 2003).

This is overlaid by Pennsylvania Age rock of the Pottsville and Allegheny Groups. Of these, the Cuyahoga formation underlies the majority of the Lower Mahoning River study area. The Cuyahoga formation is comprised of Orangeville Shale Member, Sharpsville Sandstone Member and partially by the Meadville Shale member. The contact between the Cuyahoga and the underlying Berea Sandstone and Bedford Shale Formations is mapped nearly coincident with the Mahoning River from Perkins Park in Warren to a point nearly 4 miles downstream, approximately 1.5 miles west of Niles (USACE 2003).

Beginning to the north of Girard, the Pennsylvanian Age rock of the Allegheny and Pottsville Groups overlies the Cuyahoga Formation along the walls of the Mahoning River Valley. Below Girard, the aerial extent of the Cuyahoga Formation necks down to a progressively narrow strip that barely extends beyond the banks of the river (USACE 2003).

The thesis study area of the Mahoning River is part of a valley filled with glacial-derived sediment that is comprised primarily of outwash gravels south of Warren. Well logs indicate that up to 70 ft. of clay and other surficial materials lie above the bedrock of the river valley, although in some areas, the bedrock intrudes directly into the river channel (USACE 2003).

Soils along the Mahoning River are predominantly of the Conotton-Chili-Holly association. These deep soils were formed in glacial outwash and alluvium; they inherited many of their physical and chemical characteristics from properties of the glacial material. Conotton and Chili soils are found on outwash plains, kames, eskers, and terraces. Conotton soils are sandy and gravelly and are droughty during dry periods; they are predominantly gently sloping to very steep. Chili soils are deep and well drained and underlain by sand and gravel. Holly soils are found on flood plains. They are poorly drained and frequently flooded, and have a high water table (USACE 2001).

Other soils found along the Mahoning River Valley include Ravenna-Canfield-Frenchtown, Canfield-Ravenna, Canfield-Loudonville, Udothents-Canfield-Ravenna associations which are poorly to well drained and formed in glacial fill; Braceville, Chagrin, Lobdell, Ravenna, Holly, and Sloan series, which are silty loams and occur primarily in outwash plains, terraces, floodplains, and moraines (USACE 2003).

Subsurface sediment characteristics among the five study site locations at left and right banks varied, consisting of fine to coarse grained sand and brown/gray clay layers with differing amounts of silt and gravel to a depth of approximately 5 ft. to a depth of greater than 13 ft. bsg. Notably, blue clay was only encountered at the Girard Right bank at a depth of approximately 3 ft. bsg to 9 ft. bsg, with varying amounts of sand and mottled gray clay. A detailed description is presented in Appendix A as well as a summary of soil boring lithological descriptions from the hand auger locations. Monitoring well construction logs are presented in Appendix B.

Of the five study sites (right and left banks), all soil borings encountered what was presumed to be bedrock between approximately 5 ft. bsg and 10 ft. bsg, with the exception of the Youngstown Right Bank study sit, where bedrock was not encountered at a depth greater than 13 ft. bsg. Gravel encountered above the bedrock layer or pieces of recovered bedrock, at the Warren (left and right banks), Youngstown (left bank), Struthers (right and left banks), and Lowellville (right and left banks) appeared to be comprised of sandstone. At the Girard Right Bank the bedrock type was not characterized for either bank because rock chips were not recovered. The presence of a blue clay layer over hardpan clay in the Girard Right Bank borings may suggest a shale or siltstone bedrock composition.

The average depth to groundwater varied only slightly between the five studied site locations ranging from a depth of approximately 3 ft. bsg to 5 ft. bsg. Since the study site locations were chosen based on accessibility for sampling and all sample locations were located within 10 ft. of the river channel, this suggests some degree of heterogeneity within the studied area of the river in regards to groundwater elevations. If the steeper sections of the river banks had been studied this may not have been the case.

The depth to first observed hydrocarbon impact ranged from 0.5 ft. bsg at the Girard Right Bank and greater than 2.5 ft. at the Warren Left Bank. The thickness of observed hydrocarbons contamination varied from approximately 3 ft. bsg at the Warren Left Bank to greater than 10 ft. bsg at the Youngstown Right Bank. The least amount of hydrocarbon contamination observed was noted at the Warren Left Bank and the greatest amount of hydrocarbon contamination appeared to be in Youngstown (right and left banks). Based on observed visual and olfactory characterization of hydrocarbon impacts appeared to be more severe in the right banks of all study areas with the exception of Lowellville and Struthers. Hydrocarbon impacts to the left and right banks at the two locations appeared to display heterogeneity.

2.2 Hydraulic Conductivity Distribution in the River Bank Aquifer

Hydraulic conductivity controls groundwater movement, which is often the most significant transport pathway for contaminants such as PAHs. The hydraulic conductivity of an aquifer has a direct relation to the potential movement of contamination from the banks of the Mahoning River via groundwater to the river channel water and sediment. Hydraulic conductivity of the study area was determined using grain size analysis and slug testing methods as discussed in the following sections.

2.2.1 Methodology - Hydraulic Conductivity Determination

Grain Size Analysis and the Hazen Method

A total of 208 river bank sediment samples were collected from 37 boreholes from five site locations (Warren Left Bank, Warren Right Bank, Girard Left Bank, Girard Right Bank, Youngstown Left Bank, Youngstown Right Bank, Struthers Left Bank, Struthers Right Bank, Lowellville Left, and Lowellville Right), as described in **Section 2.1.1**. The samples were taken to the laboratory for sediment size analysis and evaluation using the Hazen Formula. Analysis was done utilizing a mechanical-shaker, set of sieves, and an electronic scale. Sieve sizes of 0.044 mm. 0.063 mm, 0.125 mm, 0.25 mm, 0.5 mm, and 1.0 mm were selected for determination of grain-size distribution. The Hazen Formula was used to estimate the hydraulic conductivity from the samples. The 0.044 mm sieve was damaged and replaced with a comparable sieve size of 0.037 mm. This did not have an apparent effect on the overall data set. Each sample was quartered and then oven dried at 100°C overnight.

Figure 5: Grain Size Distribution in Sieves after Shaking

A mechanical shaker and the predetermined sieves sizes were used to obtain grain-size distribution. Samples were run on the mechanical shaker for 5 minutes. Samples retained by the sieves and pan were then weighed on a Intell-Lab™ PD-3000 Top Loading Balance. Grain size distribution results for each sample were plotted on a distribution chart with cumulative percentage on the y-axis and sediment size on the x-axis. Details for grain-size distribution chart data are presented in Appendix C.

Analysis was done using the Hazen Formula for average hydraulic conductivity. The Hazen Formula is $K= Ad^2_{90,}$ where: K is the value of hydraulic conductivity and d_{90}

represents the effective grain-size or the point on the plotted curve at which 90% of the grains are retained or 10 % are passing (finer). The variable A = 1.0 if K has units of cm/sec. The Hazen approximation of K is applicable when the d_{90} retained (d_{10} passing) effective particle size is between 0.1 and 3.0 mm. The value of K was then estimated by the Hazen Formula for each sample. The samples were collected at 1 ft. intervals. An average K value was calculated from these approximations using the geometric mean based on all samples for each bank of the five study sites.

<u>Groundwater Monitoring Well Installation, Development, and Slug Testing</u>

Groundwater monitoring wells were installed selected bore holes as described in Section 2.1.1. These were based upon sediment makeup data collected from historical soil borings and grain-size analysis data. Monitoring well construction consisted of varying lengths of 3 inch (in.) diameter, schedule 40 Polyvinyl Chloride (PVC), with an approximate 0.010 in. louvered slot screen, which was constructed manually in the field and capped on the bottom. The specific length of screen and riser varied depending on site-specific factors, such as water table fluctuations and the depth to bedrock. All monitoring wells were fully penetrating and screened within the groundwater aquifer. The annular borehole space consisted of the collapsed formation. Each well was completed above grade with 1 ft. to 3 ft. of riser and a cap, with the exception of monitoring well MW-1 at Girard Left Bank which was installed without a riser. Groundwater monitoring well construction details are recorded and diagramed on monitoring well logs which are presented in Appendix B.

Monitoring well development consisted of purging each monitoring well until the discharge cleared or until the monitoring well bailed dry twice. This was done a period of between 3 hours (Girard Left and Right Bank) to 24 hours (all other Banks) before slug testing took place. On the day of slug testing the well caps were removed and the groundwater level was allowed to come to equilibrium. The groundwater level was gauged using a water level meter from the top of the well casing and recorded. After measuring the depth to water, the thickness of the water column was determined. Monitoring well locations are depicted in Figure 6.

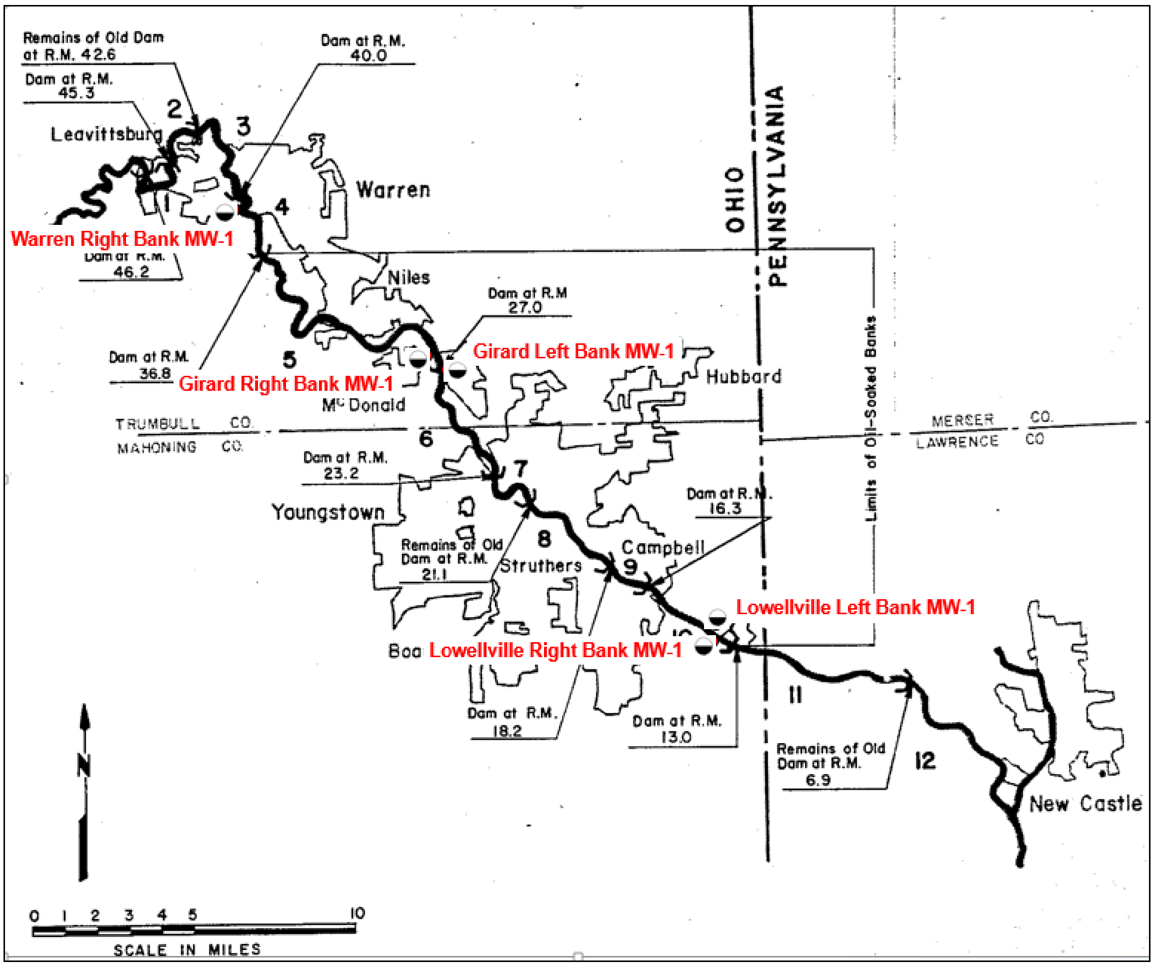

Figure 6: Monitoring well locations.

Slug tests were performed in one monitoring well at five separate banks locations utilizing a slug bar and a water-level meter. The slug bars were constructed of varying lengths of PVC based on the aquifer saturated thickness, filled with sand for weight, capped on both ends, and tied to a rope on one end for easy insertion into and removal from the monitoring well. The slug tests involved the immediate insertion (slug in) and removal (slug out) of a slug bar into and from the water column within the monitoring well and recording the water level changes over time as the head in the system returns to equilibrium. This is done in a small diameter monitoring well to determine the hydraulic conductivity of the aquifer in the immediate vicinity of the well (AQTESOLV 2015).

There are two types of slug tests: the falling-head test and the rising head test. The falling head or "Slug-in" test involves monitoring the change in the head with time (H_t) as it falls back to equilibrium after being artificially raised from its initial level (H_o) by adding a slug to the well (AQTESOLV 2015). Likewise, the rising head or "Slug-out" test involves monitoring the head with time as it rises back to equilibrium after the head has been artificially lowered from its initial level by removing a slug from the well. For each timed interval, the change in head from the initial head (absolute value of H_0-H_t) is calculated. This change in head is called the drawdown (ΔH). The formula can be expressed as $K = F (H_0-H_t) / t$; where K = horizontal saturated hydraulic conductivity, H_0 = initial head in the well at time zero (static water level), H_t = the head in the well at a given time (t) after the initial displacement, and F = factors specific to the geometry of the well. The rate of change of drawdown is a function of the hydraulic conductivity (Fetter 2001).

Displacement was achieved by adding or removing a slug bar (2 in. PVC cylinder) into the water column within the monitoring well which caused a change in the water head. The designed length of the slug was dependent upon the height of the water column. Water level changes in the monitoring well were monitored and recorded using the water-level meter.

Figure 7: Slug Test

Data collected during slug testing were then input into spreadsheets and analyzed by the Bower and Rice 1976 method for unconfined aquifers at steady flow state using AQTESOLV, a program designed to calculate hydraulic conductivity and other aquifer properties (AQTESOLV 2015).

2.2.2 Results –Hydraulic Conductivity Determination

<u>Grain Size Distribution and Hazen Method</u>

The geometric mean for results of the Hazen method was calculated for the left and right banks at each site location. Average hydraulic conductivity results based on the Hazen method ranged from 8.50E-04 cm/sec. at Struthers Right Bank to 1.05E-03 cm/sec. at Warren Right Bank. Detailed results of the particle size analysis and Hazen method for the individual samples are presented in Appendix C. Table 2 shows the average hydraulic conductivity for all ten sample locations.

Table 2: Average Hydraulic Conductivity by Site (Hazen Method)

Site Location	K Geometric Mean (cm/s)
Warren Left Bank	4.84E-04
Warren Right Bank	1.05E-03
Girard Left Bank	4.89E-04
Girard Right Bank	1.62E-04
Youngstown Left Bank	2.73E-04
Youngstown Right Bank	7.06E-04
Struthers Left Bank	2.88E-04
Struthers Right Bank	8.50E-04
Lowellville Left Bank	1.93E-03
Lowellville Right Bank	1.67E-03

Slug Test Analysis

Data collected during slug testing were then input into spreadsheets and analyzed using Bower and Rice 1976 method for unconfined aquifers at steady flow state. This was done using AQTESOLV, a program which can calculate hydraulic conductivity utilizing the Bouwer and Rice method. The Bouwer and Rice method is a mathematical equation for calculating the hydraulic conductivity of an aquifer by matching a straight-line solution to the water displacement during a slug test (AQTESOLV 2015). Detailed summaries of the results of the slug test at individual monitoring wells are presented in Appendix D and Table 3 summarizes the average for all tests at each well site.

The geometric means of results for slug-in and slug-out tests were was calculated for each study location. Average hydraulic conductivity values calculated from slug test analysis ranged from 1.72E-05 cm/s in Lowellville Left Bank (MW-1) to 1.09E-03 cm/s in Girard Left Bank (MW-1).

Table 3: Average Hydraulic Conductivity by Site (AQTESOLV)				
Site Location and Monitoring Well	K Value	K Value	K Value	K Geometric Mean (cm/s)
	Slug In (1st)	Slug Out	Slug In (2nd)	Average
Warren Right Bank(MW-1)	6.16E-04	4.28E-04	6.81E-04	5.64E-04
Girard Left Bank (MW-1)	1.65E-03	7.24E-04	-	1.09E-03
Girard Right Bank (MW-1)	8.02E-04	6.55E-04	-	7.25E-04
Lowellville Left Bank (MW-1)	2.99E-05	6.76E-06	2.50E-05	1.72E-05
Lowellville Right Bank (MW-1)	4.40E-04	6.20E-04	1.48E-03	7.39E-04

2.2.3 Discussion of Results – Hydraulic Conductivity Determination

Generally the hydraulic conductivities seen were indicative of semi-pervious, unconsolidated soil types with moderate sorting. This was supported by the bore hole logging observations made during soil boring and sediment sampling field activities. Bioremediation will be successful only if the hydraulic conductivity value of the bank sediment is greater than 0.3 ft./day or 10^{-4} cm/sec to allow for the transport of the electron acceptor and nutrients through the aquifer (Bedient 1999).

The results obtained based on the Hazen method estimation indicate that hydraulic conductivities calculated for each of the ten locations meet these criteria and suggest that bioremediation should be feasible. All sites where slug testing was performed, with the exception of Lowellville Left Bank, also meet these criteria and suggest that bioremediation should be feasible based on the results of the Bouwer and Rice method calculation of hydraulic conductivity. The differences in the estimation of hydraulic conductivity between the Hazen method and the slug test data analyzed via the Bouwer and Rice method can be explained by the heterogeneity of the soil and the nature of the methods. Sieve size analysis by the Hazen method estimates a relatively small portion of the aquifer based on the grain size distributions of the collected samples, while the slug test analysis by the Bouwer and Rice method calculates hydraulic conductivity based on a larger portion of the aquifer where the sediment makeup of the test area remains relatively undisturbed (Bouwer and Rice 1976).

2.3 Potential River Bank Aquifer and the River Channel Interflow

2.3.1 Methodology - Potential Bank Aquifer and Channel Interflow

Monitoring of the levels of groundwater in the river banks and water within the river channel was completed to evaluate interconnectivity and the potential for recontamination of the Mahoning River via movement of contaminants via groundwater flow. This involved the collection of groundwater elevation data and river channel water elevation data relative to one another (on the same date at all monitoring well locations when possible). Measurements were made and recorded between February 9, 2008 and November 12, 2008. An additional measurement collected on October 4, 2007, prior to collection of the main portion of the data set, at Lowellville Left Bank was also included in the evaluation. Additionally, the flood event observed on February 9, 2008 at all study locations was included in the evaluation. It was determined that these were important and helped determine the interconnectivity of the interflow exchange of river band and river channel water. Therefore, there are gaps in the associated data sets (Appendix E and Figures 9 through 16) where neither rainfall data nor gauging data are presented because they were not relevant to the study.

Groundwater and river elevation measurements were taken utilizing a rotary laser level transit and gauging the depth to water in monitoring wells and the depth to water in the river channel from the level plane of the laser level transit and comparing one to the other (Figures 3 and 8). This was performed in triplicate and averaged to ensure readings were being taken accurately. The intent was to show that the Mahoning River was both a gaining and a losing stream at different times and locations due to rainfall and snow melt associated with seasonal changes.

Figure 8: Gauging of River and Monitoring Well Water Elevations

River and bank gauging measurements were evaluated against rainfall data obtained from the National Oceanic and Atmospheric Administration (NOAA) for the appropriate date range at the six sites. The four NOAA rainfall gauging locations that were evaluated and their approximate distance to the closest study location were Warren 3 S (2.8 miles S-SE of Warren Left Bank), Youngstown Regional Airport (7.05 miles N of Girard Right Bank), Mosquito Creek Lake (4.85 miles NE of Warren Right Bank), and New Castle 1 N (9.27 miles E-NE of Lowellville Right Bank). A 7 day period prior to the gauging event was chosen to compensate for differing rates of surface water runoff, infiltration, discharge, and hydraulic conductivity. The 7 day was intended to account for these criteria and to help normalize the data for comparison. Figure 7 shows a comparison of rainfall data at all four NOAA rainfall gauging stations. Of the four NOAA rainfall gauging stations, Warren 3 S was chosen for comparison to river and groundwater gauging due to its drainage gradient's proximity to the river and relative location upriver to the bank study gauging locations.

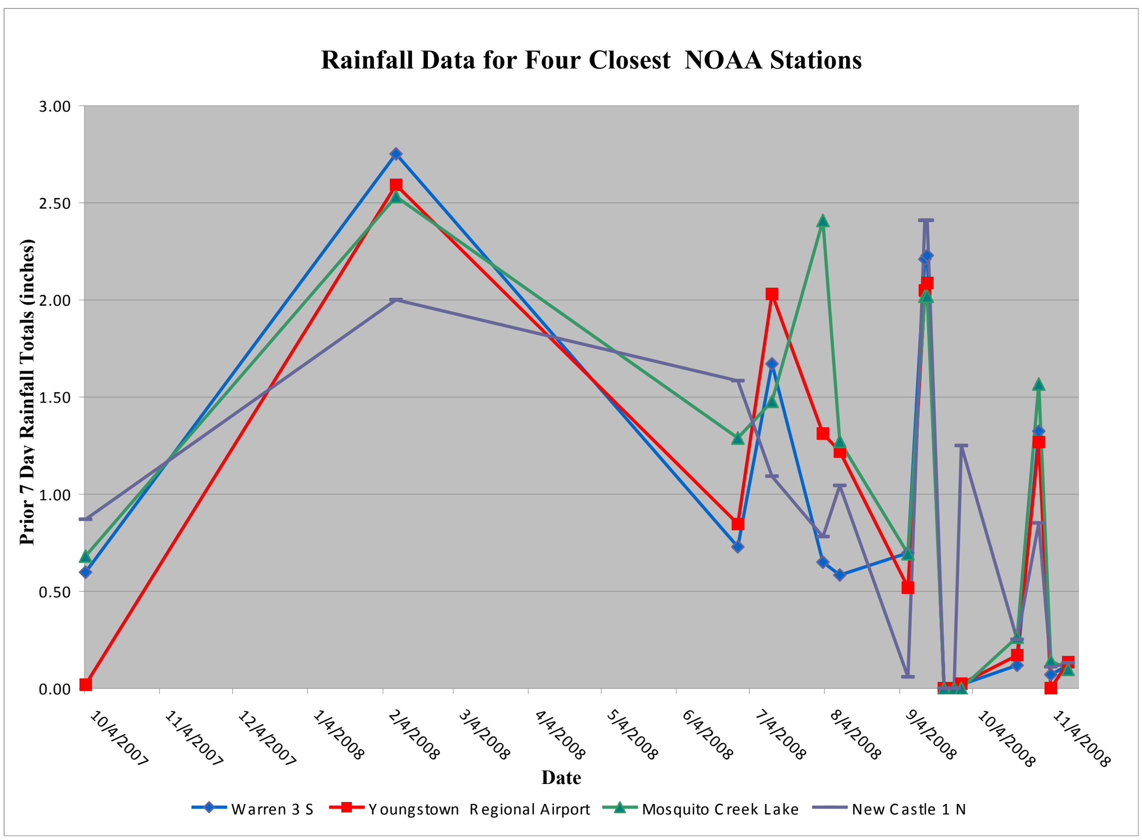

Figure 9: Comparison of the Four Closest NOAA Rainfall Gauging Station Relative to Sites

2.3.2 Results - Potential Bank Aquifer and Channel Interflow

Results of groundwater and river channel water elevation monitoring varied by location. The river flood stage that was reached on February 9, 2008 is represented on the following gauging and rainfall graphs (Figure 7 through Figure 13) below as -1.0 ft. All wells and all well locations were completely inundated by river flood water and banks were at full saturation on this date. Therefore, this date was chosen as a reference point to correlate rainfall data to the associated gauging data. Detailed summaries of field data collection for individual monitoring wells are presented in Appendix E.

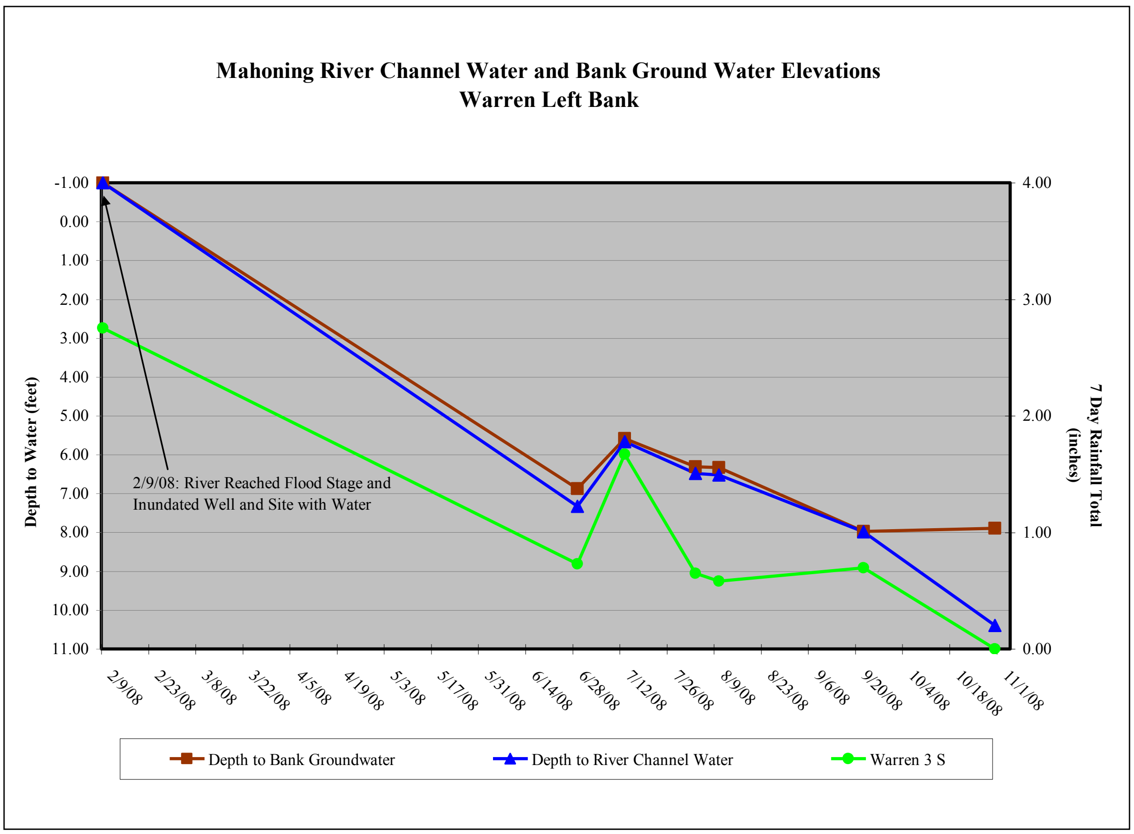

Figure 10: Rainfall Compared to Channel & River Water Elevations (Warren Left Bank)

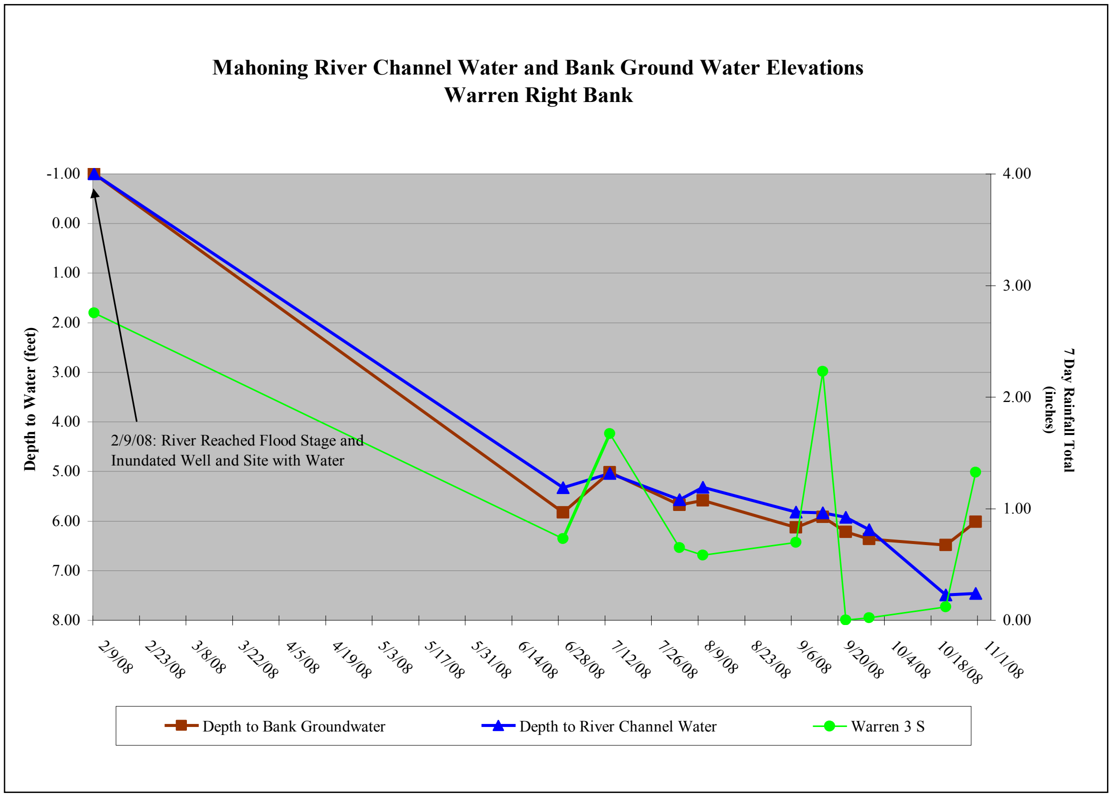

Figure 11: Rainfall Compared to Channel & River Water Elevations (Warren Right Bank)

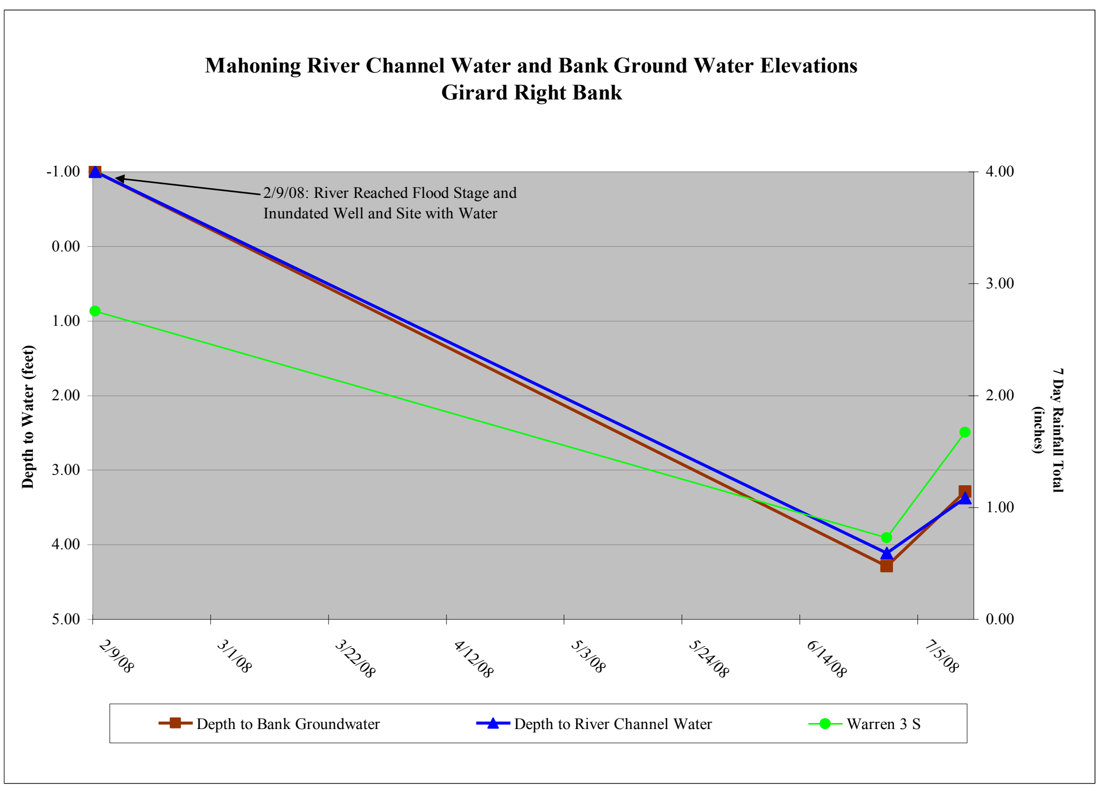

Figure 12: Rainfall Compared to Channel & River Water Elevations (Girard Right Bank)

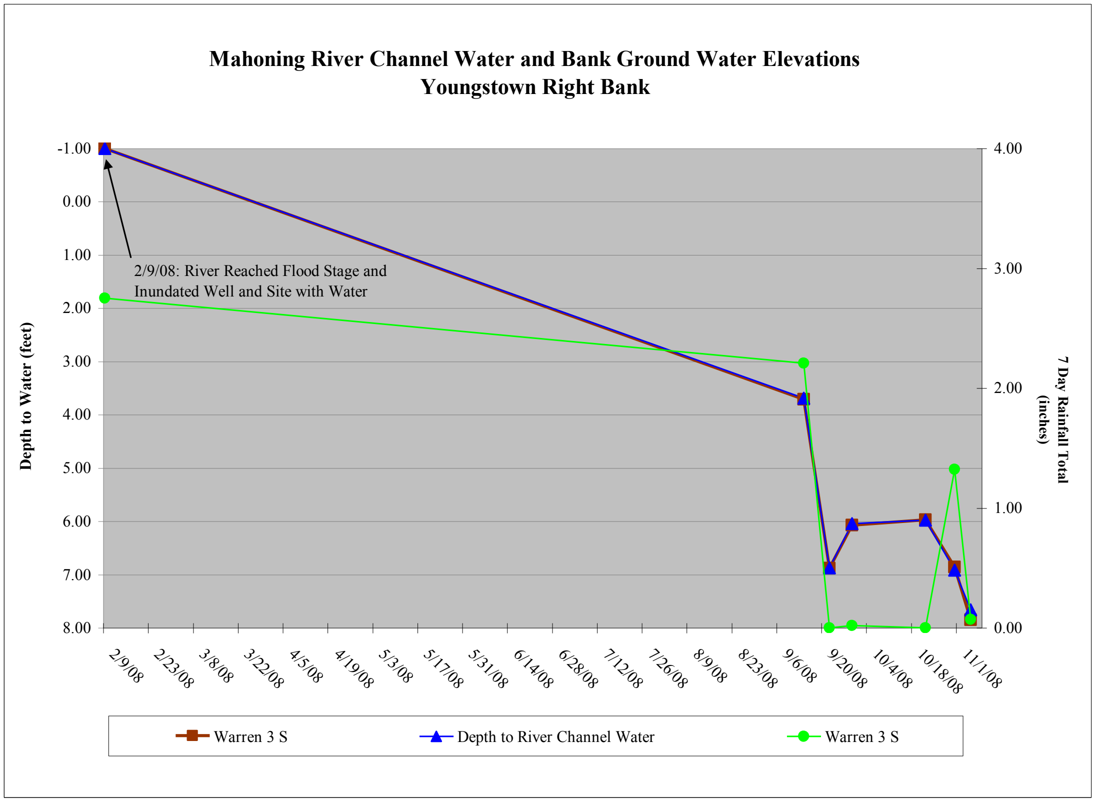

Figure 13: Rainfall Compared to Channel & River Water Elevations (Yo. Right Bank)

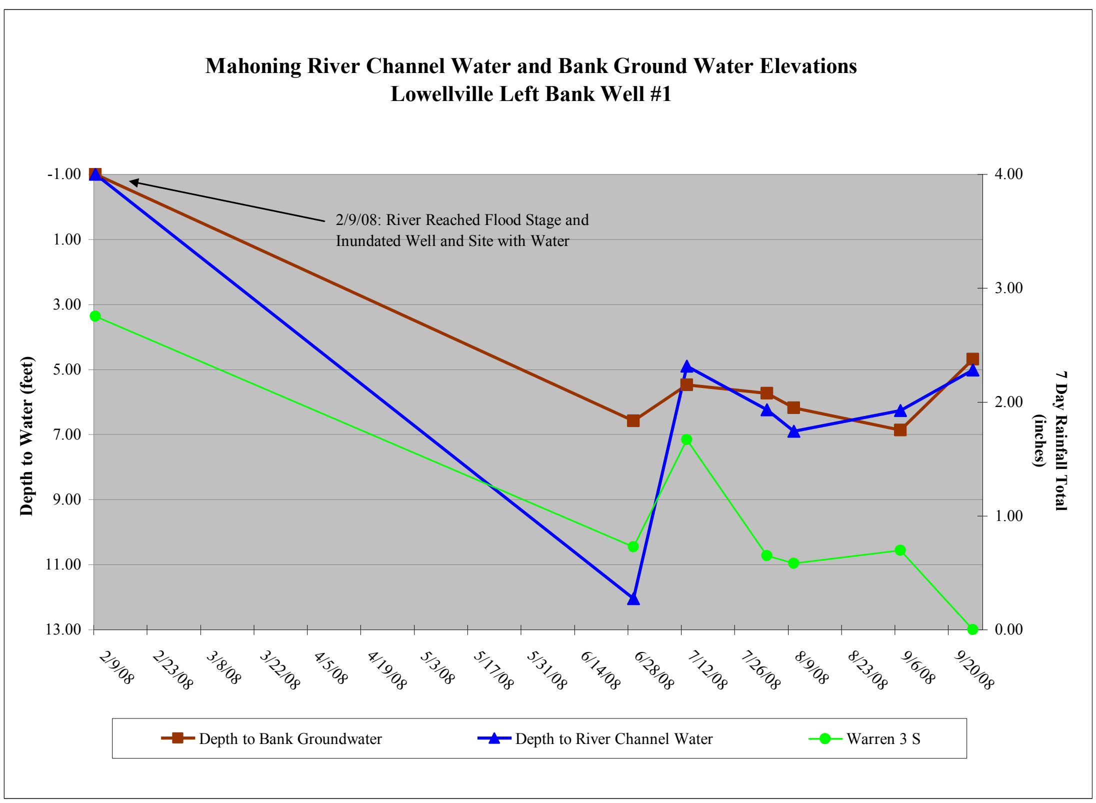

Figure 14: Rainfall Compared to Channel & River Water Elevations (Lowell. Left Bank)

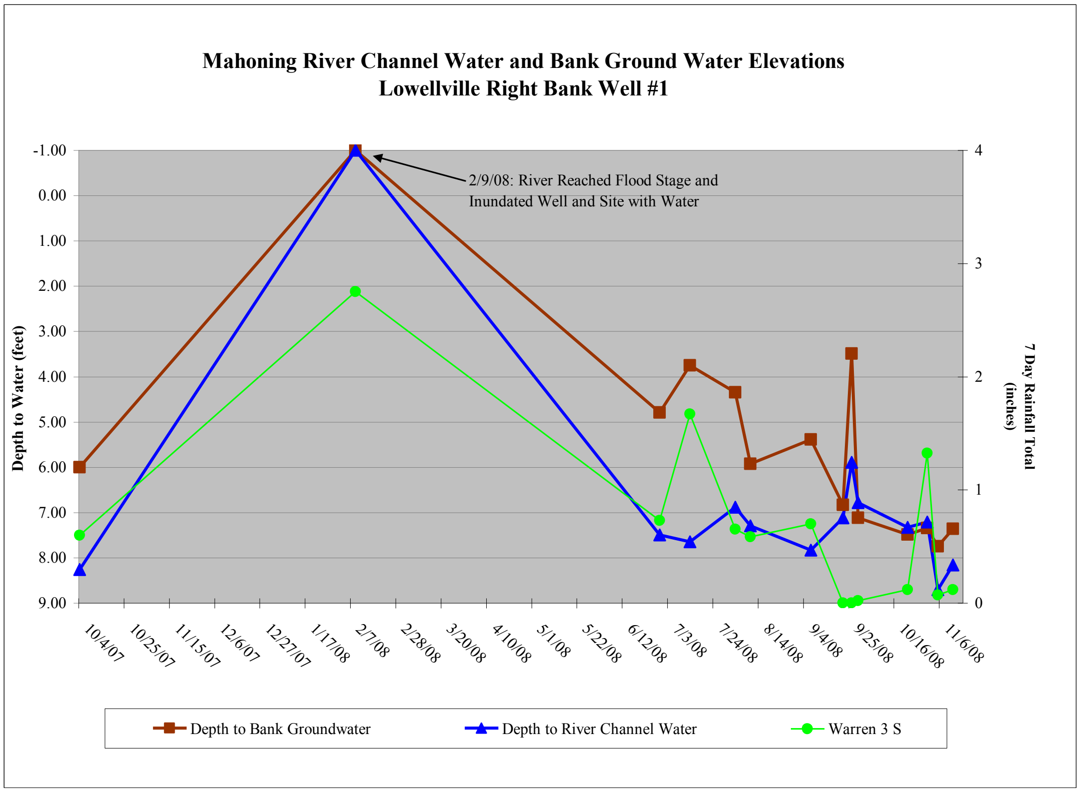

Figure 15: Rainfall Compared to Channel & River Water Elevations (Lowell. Right Bank)

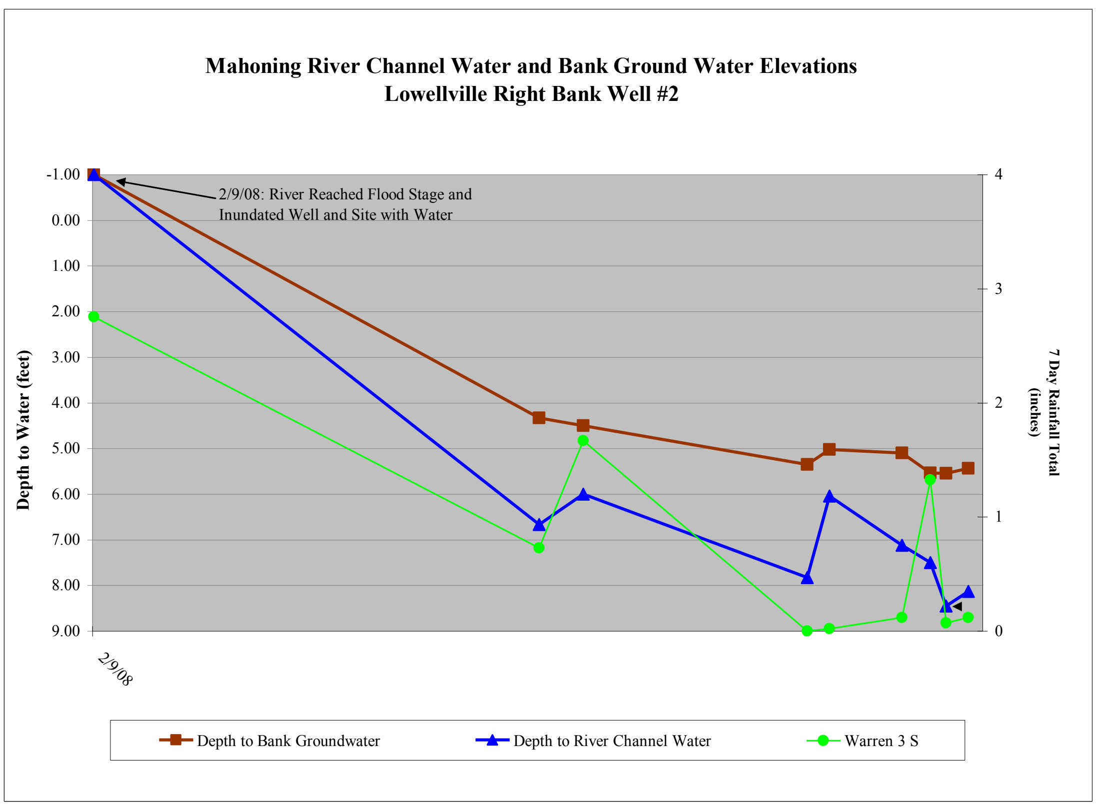

Figure 16: Rainfall Compared to Channel & River Water Elevations (Lowell. Right Bank)

2.3.3 Discussion of Results - Potential Bank Aquifer and Channel Interflow

Lowellville Left Bank, Warren Left Bank, Warren Right Bank, and Youngstown Right bank showed a change from a gaining stream to a losing stream during the monitoring period. This would be associated with groundwater flow from the bank to the river and from the river to the bank. The results for Girard Right Bank were inconclusive, as access to the monitoring well location was lost and only two gauging events took place during the monitoring period. Lowellville Right Bank appeared to be a gaining stream during the monitoring period for all but one gauging event, when the elevations reached approximate equilibrium.

Figure 17: Lowellville Left Bank Well Site Inundated by River Flooding

There was no obvious correlation between rainfall events and the interchange of water between the banks and river channel. This may be partially due to the urbanization of the area surrounding the Mahoning River including the use of the river water upstream for municipal water supply for private industry and the differing surface water runoff and infiltration rates caused by paved surfaces. This could also partially be due to flood controls placed on the river and its tributaries beginning in the early part of the twentieth century. The USGS StreamStats website also notes that flow of the river is regulated by Berlin Lake reservoir, Milton Reservoir, Michael J. Kirwan Reservoir on West Branch, Mosquito Creek Lake reservoir, Meander Creek Reservoir, Squaw Creek reservoir, and 2 small reservoirs on Mill Creek (USGS 2015).

River flow data were obtained from the USGS website and plotted against the NOAA rainfall data to look for patterns typical of an urbanized riverine system. Two river discharge gauging stations (Leavittsburg and Youngstown) were selected based upon availability of data and spacing along the studied reach of the river. One rainfall gauging station (Warren 3 S) was selected due to its proximity to the river. This data plot is graphically presented in Figure 15 and Figure 16.

The data indicate that discharge increased with distance down river and shows a relatively short lag time between peak rainfall events and the increase in discharge overall (less than 7 days). The sharp peaks seen in Figures 14 and 15 for the discharge response to rainfall events are expected in urbanized areas where water runs quickly across the paved ground surface to the river. This is also punctuated by less water infiltration into the ground. It would be expected that at the times the river may go from gaining to losing until equilibrium is once again reached.

The flood event that was observed on February 9, 2008, as indicated in Figure 15, was accompanied by increased rainfall and an increase in the discharge of the river.

Since other rainfall events of similar magnitude to the 2008 flood events were also observed, it is reasonable to assume that snowmelt and/or flood control measures also may have played a part in the differing effects of the rainfall events on the river.

During the flood stage of the river that was observed, it can be assumed that the interchange of water was fully from the channel to the bank for all study locations until the river crested and reached some equilibrium point. The bank aquifer would have been completely saturated causing the elevation of the groundwater level to exceed that of the river water. As a result, flow is reversed, i.e. groundwater from the banks flows into the river channel.

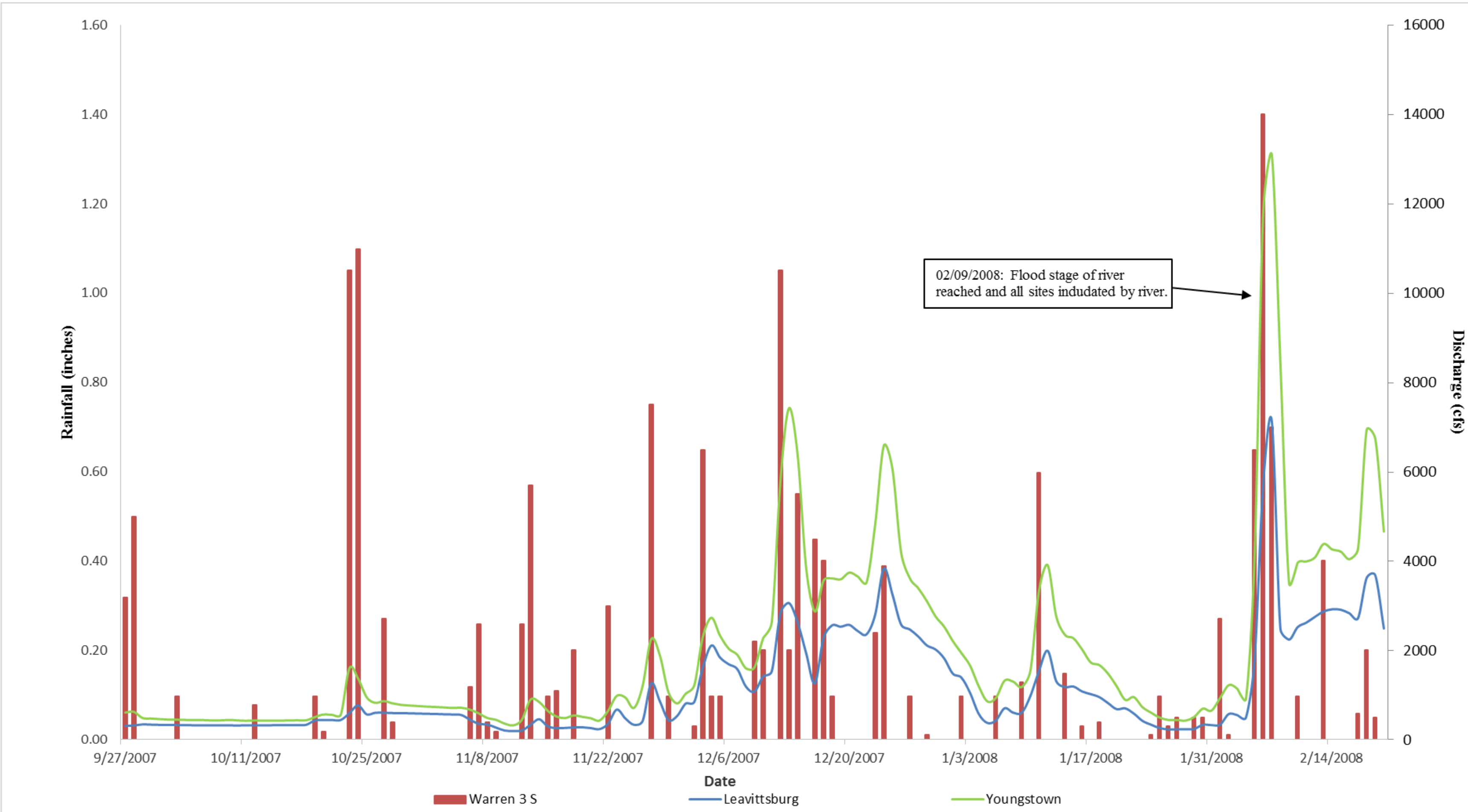

Figure 18: Mahoning River Rainfall Verses Discharge (early data)

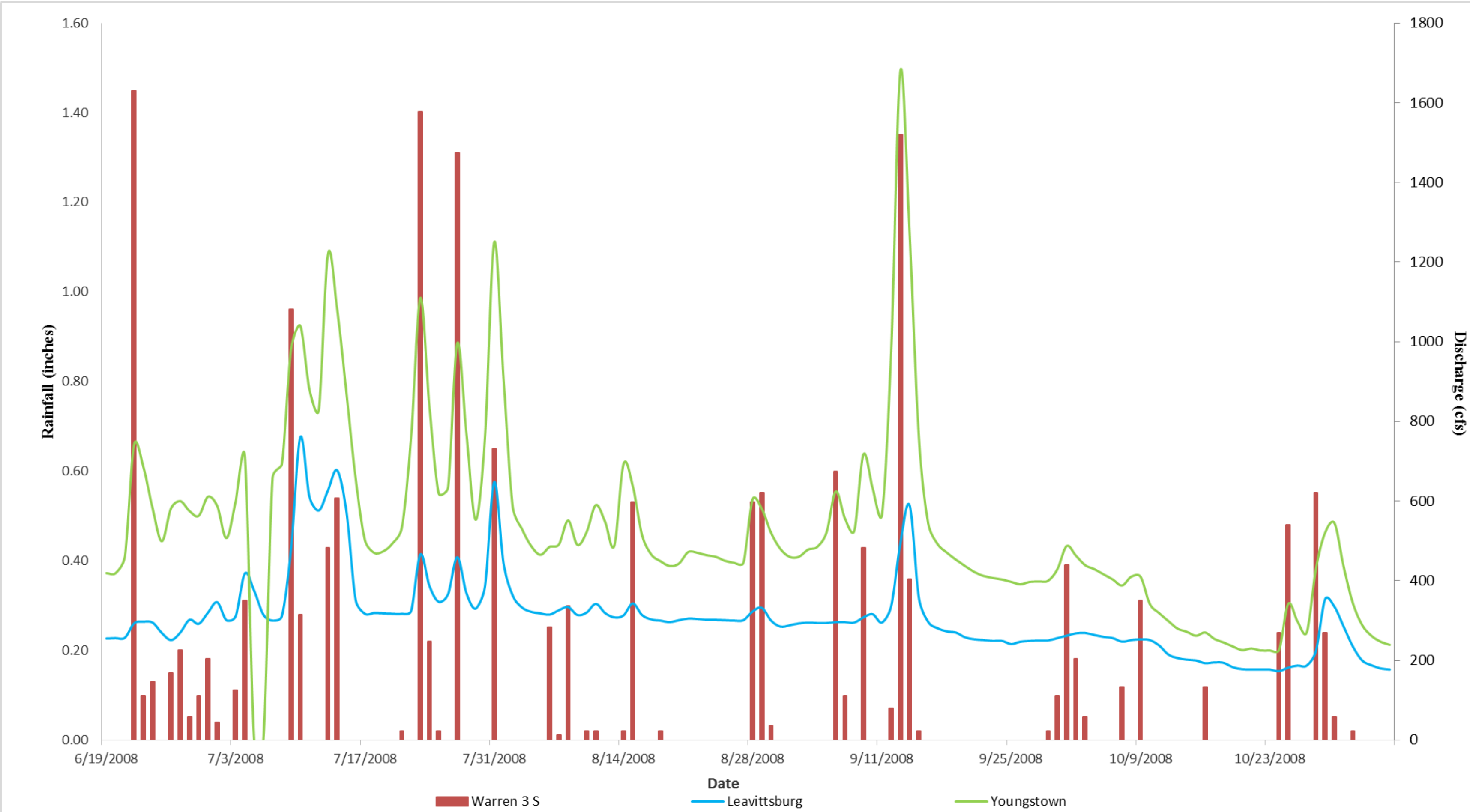

Figure 19: Mahoning River Rainfall Verses Discharge (late data)

The observed data show that there was a continuous exchange of water between the banks and the river channel. This interconnectivity points towards the potential for an exchange of PAH contamination that may be present in the river banks. Also noted were uprooted trees and erosion of the river banks related to rainfall and flooding of the river. This could potentially expose contaminated bank sediment directly to surface water runoff or increase infiltration and groundwater flow. These are also potential pathways for contamination contained in the bank aquifer to be introduced to the river channel.

3. Polycyclic Aromatic Hydrocarbon Analysis

PAHs are hydrocarbons composed of two or more fused benzene rings, which can be arranged in linear, angular, or cluster forms and may or may not have substituted groups attached to one or more of the benzene rings. The usual structure of a benzene ring consists of six carbon atoms with alternating double bonds. PAHs are generally divided into two groups based on their physical, chemical, and biological characteristics. The lower molecular weight PAHs (e.g., 2 to 3 ring group of PAHs such as naphthalenes, fluorenes, phenanthrenes, and anthracenes) have significant acute toxicity to aquatic organisms, whereas the higher molecular weight PAHs, 4 to 7 ring (from chrysenes to coronenes) do not. However, several members of the higher molecular weight PAHs have been known to be carcinogenic (Eisler 2000). According to the USACE (2006) Benzo(a)anthracene, Chrysene, Benzo(b&k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene, Indeno(1,2,3-c,d)pyrene, and Benzo(g,h,i)perylene are prevalent in the sediment of the Mahoning River.

Of major environmental concern are mobile PAHs that vary in molecular weight from 128.16 (naphthalene, $C_{10}H_8$) to 300.36 (coronae, $C_{24}H_{12}$). Higher molecular-weight

PAHs are relatively immobile because of their large molecular volumes and their extremely low volatility and solubility (Eisler 2000). For this study PAHs (Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b&k)fluoranthene, Benzo(a) pyrene) were chosen due their relatively lower molecular weight which increases their potential to mobilize in groundwater and contaminate the Mahoning River waters.

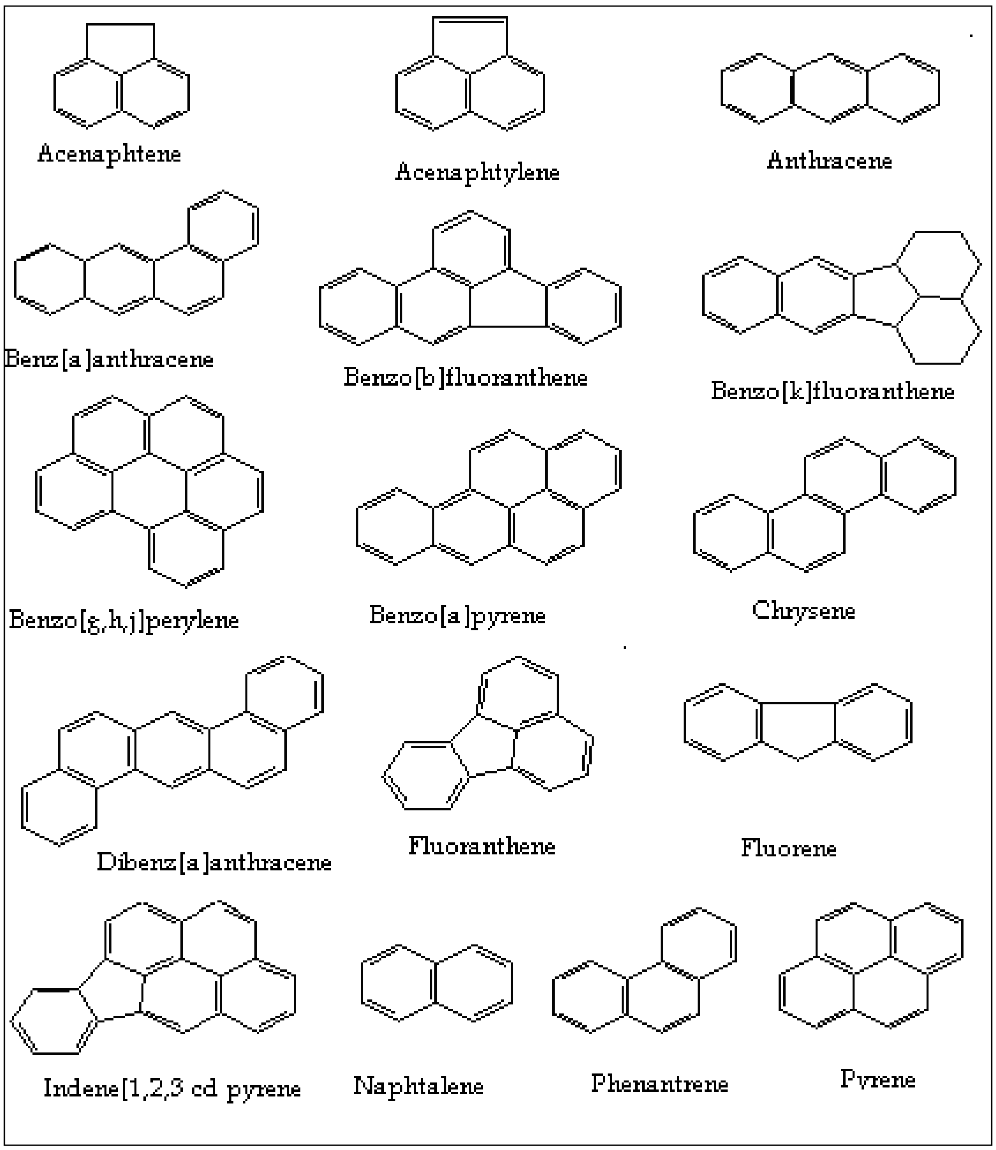

Figure 20: Priority PAHs according to USEPA

3.1 Methodology - Polycyclic Aromatic Hydrocarbon Analysis

All sediment sampling, PAH extraction, and GC/MS analysis was performed by the author of this thesis. Sediment samples were collected from five locations along the Mahoning River banks for the analysis of PAHs. These locations were the Warren Right Bank, Girard Right Bank, Struthers Left Bank, Lowellville Left Bank, and Lowellville Right Bank (Figures 1 and 2). In all, 41 individual PAH analyses of samples were performed on 15 sample intervals collected at 5 bank locations as summarized in Table 4.

Table 4: Sediment Sample Depths and Number for PAH Analysis

Site Location	Sample Depth (bsg.) and Number (*n*)			Total Number of Samples Anaylzed per Bank
Warren Right Bank	4 ft. (n=3)	6 ft. (n=3)	9 ft. (n=3)	$n = 9$
Girard Right Bank	4 ft. (n=3)	7 ft. (n=2)	10 ft. (n=2)	$n = 7$
Struthers Left Bank	6 ft. (n=3)	8 ft. (n=3)	10 ft. (n=3)	$n = 9$
Lowellville Left Bank	9 ft. (n=3)	10 ft. (n=3)	12 ft. (n=3)	$n = 9$
Lowellville Right Bank	5 ft. (n=2)	6 ft. (n=3)	7 ft. (n=2)	$n = 7$

Sampling locations for PAH analysis were based on bank characterization observations performed as part of this study. All samples were collected from below the water table and are representative of the saturated zone of the aquifer. A top, middle, and bottom sample was chosen from recovered sample depths at each bank to be representative of the thickness of the aquifer. Where samples recovered at multiple depths that could be representative of these intervals (top, middle, bottom), samples were biased towards the depths that displayed the greatest visual and olfactory characteristics typically expected to be associated with high PAH contamination. These characteristics have been observed to include the appearance of heavy, black, highly viscous sediment having a strong petroleum odor (Lee 2005). Sediment samples were collected using an

AMS manual auger as described in the preceding Section 2.1. Upon returning to the lab, bagged samples that were selected to be analyzed for PAHs were immediately refrigerated at a temperature of 4°C until the extraction had begun. Sediment taken for extraction from the bagged sample was collected from the center of the sample volume in order to minimize the effect of volatilization. Sample extraction was begun within 24 hours of collection times. The remainder of these samples was then analyzed by grain-size analysis to approximate hydraulic conductivity.

PAH extraction and cleanup was done using a variation of the Fang and Findlay extraction method (Findlay 2003). Approximately 0.65 grams of sediment sample was measured out, placed into a 50 milliliters glass test tube, and mixed with 0.5 ml of milli-Q water by gently hand shaking. A mixture of 7.5 ml of Optima grade dichloromethane (DCM), 15 ml of Optima grade methanol, and approximately 4.5 ml of 50 mM phosphate buffer (enough to bring the total volume to 6 ml total) was added to a 50 ml glass tube with Teflon cap along with 50 μl of a surrogate solution. The sample was then capped, shaken again by hand, and vented by unscrewing the caps slightly to release built up vapor pressure. The samples were then placed on a platform shaker (covered with foil to prevent light penetration) and shaken at 320 repetitions per minute (RPM) for 2 hours.

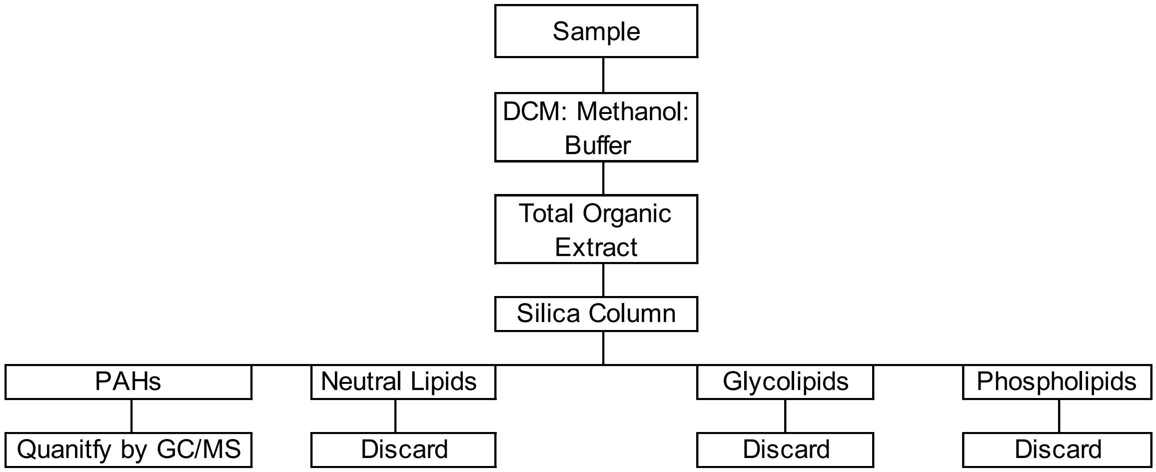

Figure 21: PAH Extraction Matrix

After completion of machine shaking samples were removed and another 7.5 ml of DCM and 7.5 ml of phosphate buffer were added. The samples were then hand shaken and vented. A pinch of sodium chloride was added and the samples were again hand shaken and vented. The test tubes containing the samples were then placed in a centrifuge for 20 minutes at between 1,000 and 1,500 rpm to separate the PAHs from the sediment and the upper water/methanol phase. The upper water/methanol phase was removed with a Pasteur pipette connected to an aspirator and the bottom portion was discarded. A 5 ml pipette was used to transfer the organic phase to sodium sulfate columns into 15 ml conical tubes. To recover more of the sample, 1 ml of DCM was added to the 15ml conical test tube and the sample was then vortexed for 5 minutes and added to the column. Rinsing with 1 ml DCM was repeated two more times without vortexing and added to the columns.

Sodium sulfate columns were prepared using 6 ml glass columns with Teflon frits containing 1 gram of dry sodium sulfate and packed with 2 ml of DCM such that the sodium sulfate was always covered with DCM. One ml of DCM was then added to the original 15 ml tube, vortexed and the organic phase transferred onto the sodium sulfate column. This step was repeated two more times without vortexing. Samples were collected in 15 ml round bottom evaporating flasks under the Supelco Visiprep and columns. Samples were then pulled through the sodium sulfate columns. The columns were rinsed with two 1 ml aliquots of DCM and pulled to dryness.

The evaporating flasks were concentrated to around 1 drop on a Rotovap but not allowed to be taken to dryness. The remaining sample was then transferred to a 15 ml conical test tube using a clean pipette. The evaporating flask was rinsed with two 1 ml aliquots of DCM and added to the conical test tube. The sample was then dried in the conical test tube under nitrogen at 35 – 40 °C and capped. Samples were brought up to between 1 ml and 1.5 ml using chloroform. At this point the samples were preserved in chloroform and the extraction process was postponed and continued at a later time.

The samples were then dried again to approximately 1 drop under nitrogen at 35 – 40 °C to 1 ml. The remaining sample volume was brought up to 200 µl using hexane in a conical test tube. Methanol was added until the sample cleared to remove any remaining water. The top PAH fraction was transferred off using a pipette and the bottom MeOH fraction was discarded. The PAH fraction was doped with 1 drop of chloroform, vortexed, and added to the aminopropyl column. Prior to their use, the aminopropyl columns were cleaned with 3 ml of Optima grade chloroform and 2 ml of hexane, pulled through at 1 drop/sec. without letting the column run dry. The columns were then rinsed using 5 ml hexane in 3 aliquots: 1 ml, 2 ml, 3 ml and let go to dryness. Finally, the sample was concentrated to 0.5 ml, transferred to an autosampler vial, and 20 µl of internal standard was added before being placed on the GC/MS for analysis.

The PAHs were analyzed on a Hewlett Packard 5890 Gas Chromatograph/5970B Mass Spectrometer. The GC was fitted with a DA-5 column 30 M, 0.32 mm ID, and .25 µm film thickness. The samples (1.0 µl) were injected splitless using a Finnigan-Mert A 2005 autosampler.

The injection temperature was set at 250°C. For PAHs, the oven temperature was held at 45°C for 2 minutes then ramped at 20°C per minute to 310°C. The final temperature was held for 5.5 minutes. The total running time was 20.75 minutes. Responses were taken from the GC/MS software and used to determine final concentrations of PAHs.

3.2 Results - Polycyclic Aromatic Hydrocarbon Analysis

PAHs concentration were not quantified in the analyzed sediment samples, but were instead reported qualitatively using relative concentrations. Since the same sample collection, extraction, and analysis methodology was used for all sediment samples (n=42) it was reasonable to compare data sets of PAH analyses at each river bank relative to one another. PAH analytical results were based on the wet weights of the samples. Samples with negative analytical results were considered invalid data and excluded from the data sets and non-detect results were treated as zero relative concentration (USEPA 2011). Analytical results were based on a minimum analysis of 7 samples per bank (Table 4).

The highest reported average concentration for sample depths (Lowellville Left Bank – 12 ft. bsg) was set to 100 and all other values were divided by this initial highest result (46) and multiplied by 100 to calculate relative concentrations. Results were rounded to the nearest whole number or to one decimal place if the value was less than one. Total average relative concentrations per bank were then calculated and compared with one another. This gave an indication of the presence of PAH contamination in the bank locations and the degree of impact in each bank relative to one another within the study area. A qualitative ranking was then assigned to each bank.

PAHs were detected in individual samples at all five bank sample locations. A total of eleven individual PAH analytes were detected in the banks of the study area; naphthalene, acenaphthylene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b&k)fluoranthene, and benzo(a)pyrene (Tables 5 through 9). From highest to lowest relative concentrations the bank study locations were ranked as follows; Struthers Right Bank (86), Lowellville Left Bank (84), Lowellville Right Bank (32), Girard right Bank (10), and then Warren Right Bank (3).

Table 5: Warren Right Bank Relative PAH Concentrations by Depth						
PAH Name	**4 ft. bsg.**	**6 ft. bsg.**	**9 ft. bsg.**	**Site Average[1]**	**Standard Dev**	**Relative StDev**
4) Naphthalene	ND[2]	ND	ND	-	-	-
7) Acenaphthylene	ND	ND	ND	-	-	-
8) Acenaphthene	ND	ND	ND	-	-	-
9) Fluorene	ND	ND	ND	-	-	-
11) Phenanthrene	ND	ND	ND	-	-	-
12) Anthracene	ND	ND	ND	-	-	-
13) Fluoranthene	ND	ND	ND	-	-	-
14) Pyrene	ND	ND	ND	-	-	-
17) Benzo(a)anthracene	N.A.[3]	N.A.	N.A.	-	-	-
18) Chrysene	N.A.	N.A.	N.A.	-	-	-
19) Benzo(b&k)fluoranthene	0.6	2	2	2	0.7	49
20) Benzo(a)pyrene	0.4	1	1	1	0.5	49
Total Average Relative PAHs by Sample Depth	1	3	3	**Total Average Relative PAH Concentration by Bank**		3

1) Average concentrations per depth based on triplicate analysis: 3 from 4-ft. bsg, 3 from 6-ft. bsg., and 3 from 9-ft. bsg.

2) ND = Non-Detect (non-detect results were treated as zero relative concentration).

3) N.A. = Not Applicable (negative data was considered invalid and excluded from data set).

Table 6: Girard Right Bank Relative PAH Concentrations by Depth						
PAH Name	**4 ft. bsg.**	**7 ft. bsg.**	**10 ft. bsg.**	**Site AVG[1]**	**StDev**	**RelStDev**
4) Naphthalene	ND[2]	ND	ND	-	-	-
7) Acenaphthylene	ND	ND	ND	-	-	-
8) Acenaphthene	ND	ND	ND	-	-	-
9) Fluorene	ND	ND	ND	-	-	-
11) Phenanthrene	ND	ND	3	1	2	173
12) Anthracene	N.A.[3]	N.A.	N.A.	-	-	-
13) Fluoranthene	2	8	2	4	3	91
14) Pyrene	ND	7	2	4	4	86
17) Benzo(a)anthracene	N.A.	N.A.	N.A.	-	-	-
18) Chrysene	N.A.	N.A.	N.A.	-	-	-
19) Benzo(b&k)fluoranthene	1	1	2	1	0.5	35
20) Benzo(a)pyrene	0.9	0.7	ND	0.5	0.5	89
Total Average Relative PAHs by Sample Depth	4	16	9	**Total Average Relative PAH Concentration by Bank**		10

1) Average concentrations per depth based on duplicate or triplicate analysis: 3 from 4-ft. bsg, 2 from 7-ft. bsg., and 2 from 10-ft. bsg.
2) ND = Non-Detect (non-detect results were treated as zero relative concentration).
3) N.A. = Not Applicable (negative data was considered invalid and excluded from data set).

Table 7: Struthers Left Bank Relative PAH Concentrations by Depth						
PAH Name	**6 ft. bsg.**	**8 ft. bsg.**	**10 ft. bsg.**	**Site AVG[1]**	**StDev**	**RelStDev**
4) Naphthalene	0.3	ND[2]	ND	0.1	0.2	153
7) Acenaphthylene	ND	0.6	ND	0.2	0.3	173
8) Acenaphthene	ND	ND	ND	-	-	-
9) Fluorene	ND	ND	ND	-	-	-
11) Phenanthrene	12	15	15	14	2	11
12) Anthracene	0.9	2	2	2	0.9	46
13) Fluoranthene	25	15	16	19	6	29
14) Pyrene	32	15	18	22	9	42
17) Benzo(a)anthracene	N.A.[3]	N.A.	N.A.	-	-	-
18) Chrysene	N.A.	N.A.	N.A.	-	-	-
19) Benzo(b&k)fluoranthene	6	13	12	11	4	36
20) Benzo(a)pyrene	11	23	22	18	6	35
Total Average Relative PAHs by Sample Depth	88	84	86	**Total Average Relative PAH Concentration by Bank**		86

1) Average concentrations per depth based on triplicate analysis: 3 from 6-ft. bsg, 3 from 8-ft. bsg., and 3 from 10-feet bsg.

2) ND = Non-Detect (non-detect results were treated as zero relative concentration).

3) N.A. = Not Applicable (negative data was considered invalid and excluded from data set).

Table 8: Lowellville Left Bank Relative PAH Concentrations by Depth						
PAH Name	**9 ft. bsg.**	**10 ft. bsg.**	**12 ft. bsg.**	**Site AVG[1]**	**StDev**	**RelStDev**
4) Naphthalene	0.3	ND[2]	0.2	0.2	0.2	85
8) Acenaphthene	ND	ND	ND	-	-	-
7) Acenaphthylene	ND	ND	ND	-	-	-
9) Fluorene	2	2	3	2	0.6	25
11) Phenanthrene	22	15	18	18	3	18
12) Anthracene	2	0.8	2	1	0.5	37
13) Fluoranthene	23	20	27	23	4	16
14) Pyrene	20	17	24	20	4	18
17) Benzo(a)anthracene	N.A.[3]	N.A.	N.A.	-	-	-
18) Chrysene	N.A.	N.A.	N.A.	-	-	-
19) Benzo(b&k)fluoranthene	6	6	9	7	2	25
20) Benzo(a)pyrene	9	9	16	11	4	36
Total Average Relative PAHs by Sample Depth	83	70	100	**Total Average Relative PAH Concentration by Bank**		84

1) Average relative concentrations per depth based on triplicate analysis: 3 from 9-ft. bsg, 3 from 10-ft. bsg., and 3 from 12-ft. bsg.

2) ND = Non-Detect (non-detect results were treated as zero relative concentration).

3) N.A. = Not Applicable (negative data was considered invalid and excluded from data set).

Table 9: Lowellville Right Bank Relative PAH Concentrations by Depth						
PAH Name	**5 ft. bsg.**	**6 ft. bsg.**	**7 ft. bsg.**	**Site AVG[1]**	**StDev**	**RelStDev**
4) Naphthalene	ND[2]	ND	ND	-	-	-
7) Acenaphthylene	ND	ND	ND	-	-	-
8) Acenaphthene	ND	ND	ND	-	-	-
9) Fluorene	0.4	0.8	0.4	0.5	0.2	40
11) Phenanthrene	ND	ND	ND	-	-	-
12) Anthracene	N.A.[3]	N.A.	0.0	-	-	-
13) Fluoranthene	13	10	6	10	4	40
14) Pyrene	12	11	6	10	3	30
17) Benzo(a)anthracene	ND	ND	ND	-	-	-
18) Chrysene	ND	ND	ND	-	-	-
19) Benzo(b&k)fluoranthene	10	6	3	6	4	67
20) Benzo(a)pyrene	10	5	3	6	4	67
Total Average Relative PAHs by Sample Depth	46	32	18	**Total Average Relative PAH Concentration by Bank**		32

1) Average concentrations per depth based on duplicate or triplicate analysis: 2 from 5-ft. bsg, 3 from 6-ft. bsg., and 2 from 7-ft. bsg.
2) ND = Non-Detect (non-detect results were treated as zero relative concentration).
3) N.A. = Not Applicable (negative data was considered invalid and excluded from data set).

3.2 Discussion of Results - Polycyclic Aromatic Hydrocarbon Analysis

All samples analyzed for PAHs were collected from within the saturated zone of the aquifer (Table 1). The presence of PAH contamination was observed within samples analyzed from all five banks (Tables 4 through 8). This shows that both the contaminant and potential pathway for movement of the contaminant via groundwater from the river bank to the river channel are present.

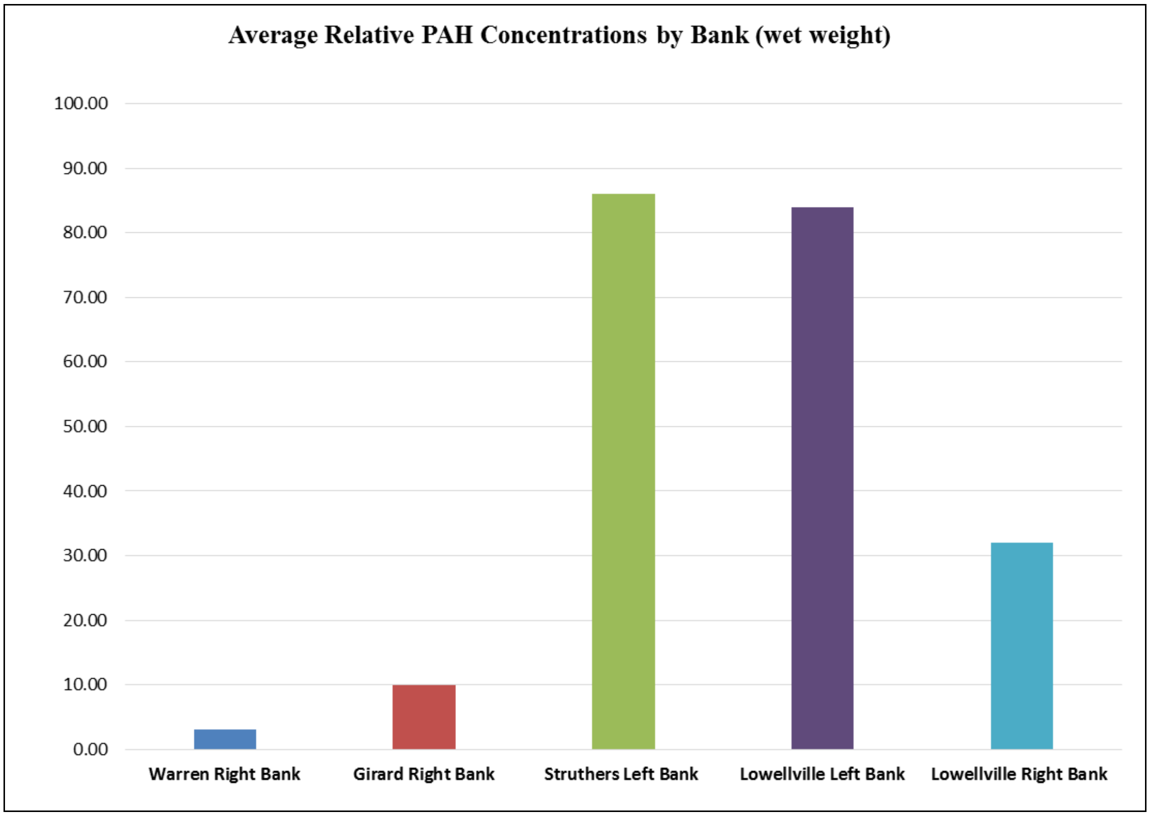

Figure 22: Total Average Relative PAH Concentrations by Bank

Based on a comparison between the study sites, the total average relative concentration of PAH contaminant varied from bank to bank as depicted in Figure 22. The highest relative concentration of PAH contamination by bank was observed at Struthers Left Bank and the lowest relative concentration of PAH contamination was observed at Warren Right Bank. The data indicates a possible correlation between the relative PAH concentration and the distance downriver within the study area. This is useful information for planning future characterization and studies.

According to Lee (2005) a total of 11 individual PAH analytes were detected and quantified in Lowellville bottom samples; naphthalene, acenaphthylene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b&k)fluoranthene, and acenaphthylene. In Lee (2005), an overall concentration of 249.9 µg/g PAHs was detected in the Lowellville bottom sediments at approximately 16.4 ft. bsg. This was done using the same Fang and Findley PAH extraction method as was done in this thesis.

According to Johnston and Leff (2014) a total of 14 individual PAH analytes were detected and quantified from a location on the Mahoning River in Girard, OH. This location was relatively close to the thesis Girard Right site that was analyzed for PAHs. The 14 individual PAHs were naphthalene, acenaphthylene, acenaphthene, fluorene; phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[b,k]fluoranthene; benzo[a]pyrene and dibenzo[a,h]anthracene, and benzo[ghi]perylene. Total PAH concentration ranged from 19,700 to 102,000 µg/kg dry weight. PAHs were extracted by Soxhlet extraction following USEPA Method 3540C (Johnston and Leff 2014). This method is an industry standard extraction technique in the environmental field, is relatively simple and inexpensive, and involves fewer steps than the Fang and Findley method for extraction. Therefore, there are fewer steps involved for PAHs to volatilize which may, in part, explain the large discrepancy in concentrations when compared to the Lee (2005) results, which were more similar to the results of this thesis.

4. Conclusions and Recommendation

4.1 Conclusions

Contaminated sediment of the Mahoning River banks consisted primarily of varying amounts of sand, silt, and clay with small amounts of gravel. Sediment borings revealed hydrocarbon contaminant thicknesses ranging from 2.5 ft. to greater than 10 ft. beginning at depths as shallow as 0.5 ft. bsg. The average depth to groundwater for all sites was 3.16 ft. bsg, but complete inundation during flood stage and likely complete saturation of the entire depth of the bank was observed at all sites.

PAH contamination was confirmed at five locations where sediment samples were analyzed and qualitatively compared relative to one another. A correlation between the total averages of PAH contamination and the distance downriver within the study area was proven and the left bank total average concentrations were also noted as being greater than those of the right banks. A comparison of total average PAH concentrations by depth at all banks studied proved an overall increase of PAH contamination with the depth of collected samples between 4 ft. bsg and 12 ft. bsg (Table 4).

Hydraulic conductivities estimated by the Hazen approximation ranged from 8.50 E-04 at Struthers Right Bank to 1.05 E-03 at Warren Right Bank. Hydraulic conductivities calculated from slug data analyzed by AQTESOLV, utilizing the Bouwer and Rice method ranged from 1.72 E-05 at Lowellville Left Bank to 1.09 E-03 at Girard Left Bank. With the exception of Lowellville Left Bank (based on slug test analysis), all mean hydraulic conductivity values for the studied sites meet the required hydraulic conductivity ($>10^{-4}$ cm/sec.) needed to allow transport of electron acceptors and nutrients through the aquifer (Bedient 1999).

The interconnectivity and potential for recontamination of the Mahoning River via movement of PAH contamination by groundwater flow was evaluated through the collection of groundwater elevation data and river water elevation data relative to one another. River discharge data and rainfall data were also analyzed and correlated to bank ground water and river water gauging level. These data indicate an influence of groundwater and river water flow by rainfall and snow melt. Depending on the amount of rainfall, river discharge, and the height of the river water, there are times when the river is gaining or losing water in different sections of the river. This interchange of water makes the possibility of PAH migration from the bank to the river channel possible.

Results of the bank characterization indicate that PAH contamination has the possibility of moving via groundwater transport from the banks to the river channel. This also indicates that in situ bioremediation is a viable and less invasive alternative to removing the contaminated sediment for treatment or disposal.

The USACE suggested that there were three possible options for remediation of the Mahoning River which included steps for continued mitigation (USACE 2003). A generalized summary of these options are as follows:

1) No remedial action is necessary due to no contamination being present. This would result from the lack of hydrocarbon contamination in the Mahoning River banks.
2) Remedial action is necessary and bioremediation is not possible. This option involves the presence of hydrocarbon contamination, but rules out potential for leaching of PAHs into the groundwater as dissolved phase contamination. Further study would be needed to determine if remediation is necessary. This outcome

involves the determination that there is no considerable groundwater movement between the banks and the river channel. This option could involve major impact to the river and surrounding communities if removal of the banks is necessary.

3) Remedial action is necessary and bioremediation is possible. This option involves the potential for leaching of PAHs into the groundwater as dissolved phase contamination and further study is needed along with possible remediation. All criteria for bioremediation have been met. Determination of the feasibility of bioremediation would then have to be studied further. This outcome involves the determination that groundwater moves continuously between the banks and the river.

Based on the results of the characterization conducted in this study, the following conclusions were made:

1) PAH concentrations were shown to be present at every study location. Therefore, option 1 is invalidated and remediation is necessary.
2) In situ bioremediation is hydraulically possible based on the calculated hydraulic conductivity values. Therefore, option number 2 is invalidated.
3) Option 3 was validated, since PAH concentrations were shown to be present at every study location. Bioremediation was also shown to be possible based on hydraulic conductivity values and the potential for mobilization of PAHs from the aquifer to the river channel via groundwater exists. Additionally, an interchange of groundwater between the river channel and the bank aquifer was proven.

4.2 Recommendations

Continued study of the contaminated segment of the Mahoning River is recommended and could be expanded to include an area near the City of Niles if an accessible study location can be found. Methods utilized in this characterization were adequate and conclusive. However, the following recommendations could be used:

1) Composite samples from 2 ft. or greater intervals could be analyzed for hydraulic conductivity using the grain size analysis and the Hazen method to determine if values of the hydraulic conductivity change with scale (larger samples).
2) PAH analysis using the Fang and Findlay method was effective and allowed a ready comparison with the works of Mosher (2002) and Lee (2009). However, the additional steps involved in this method for lipid extraction likely led to at least partial volatilization of PAHs and a lowering of the final results. A method where PAHs are more directly extracted and analyzed would be more ideal for characterization and could possibly give a more accurate representation of in situ PAH contaminant concentrations. Additionally, sediment samples could be collected with an alternative method (such as a direct-push soil sampler) to minimize disturbance and potential volatilization of PAHs which could lessen their concentration results.
3) Additional groundwater characterization and analysis for PAHs is also recommended. Groundwater sample locations could be determined based on historical PAH concentrations in sediment samples including this thesis. Analysis of groundwater would prove if the PAHs contained in the river banks were mobile and readily available for transport by groundwater hydraulic conductivity.

4) Computer aided contaminant transport modeling of the river channel, bank aquifer, and the interchange of groundwater could yield a greater understanding of the potential for recontamination. This could also be correlated with river discharge and regional rainfall data. This would involve a comparison of partitioning coefficients, geotechnical data, and groundwater chemical characteristics and field parameters.

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6. Appendices:

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Appendix A: Sediment Data and Field Observation Summaries

Sediment Data Summary: Mahoning River Bank Observations Averaged by Boring

Mahoning River Bank Observations Averaged by Bore Hole				
Lowellville Left	**Depth to Groundwater**	**Depth to Bedrock (bsg)**	**Depth to Hydrocarbons**	**Thickness of Hydrocarbons**
BH-1	-	-	3 ft.	-
BH-2	-	-	-	-
BH-3	2 ft.	7 ft.	2 ft.	5 ft.
BH-4	4 ft.	9 ft.	2 ft.	7 ft.
BH-5	-	-	3 ft.	-
BH-6	3 ft.	8 ft.	2 ft.	6 ft.
Site Mean	3 ft.	8 ft.	2.4 ft.	5.5 ft.
Lowellville Right	**Depth to Groundwater**	**Depth to Bedrock**	**Depth to Hydrocarbons**	**Thickness of Hydrocarbons**
BH-1	4 ft.	6 ft.	3	3 ft.
BH-2	3 ft.	6 ft.	1	5 ft.
BH-3	2.5 ft.	7 ft.	2	5 ft.
Site Mean	3.1 ft.	6.3 ft.	2 ft.	4.3 ft.

Mahoning River Bank Observations Averaged by Bore Hole (continued)				
Warren Left	**Depth to Groundwater**	**Depth to Bedrock**	**Depth to Hydrocarbons**	**Thickness of Hydrocarbons**
BH-1	3 ft.	5 ft.	2.5 ft.	2.5 ft.
BH-2	-	-	-	-
BH-3	3 ft.	-	2.5 ft.	-
BH-4	3 ft.	5 ft.	2.5 ft.	2.5 ft.
Site Mean	3 ft.	5 ft.	2.5 ft.	2.5 ft.
Warren Right	**Depth to Groundwater**	**Depth to Bedrock**	**Depth to Hydrocarbons**	**Thickness of Hydrocarbons**
BH-1	-		-	
BH-2	-		-	
BH-3	3 ft.	6 ft.	2.5 ft.	3.5 ft.
BH-4	3 ft.	7 ft.	2 ft.	5 ft.
BH-5	4 ft.	7 ft.	1.5 ft.	5.5 ft.
Site Mean	3.3 ft.	6.7 ft.	2 ft.	4.7 ft.

Mahoning River Bank Observations Averaged by Bore Hole (continued)				
Girard Left	**Depth to Groundwater**	**Depth to Bedrock**	**Depth to Hydrocarbons**	**Thickness of Hydrocarbons**
BH-1	3 ft.	7.5 ft.	1.5 ft.	6 ft.
BH-2	3 ft.	6.5 ft.	1.5 ft.	5 ft.
BH-3	3 ft.	5 ft.	1.5 ft.	3.5 ft.
BH-4	-		1.5 ft.	
Site Mean	3 ft.	6.25 ft.	1.5 ft.	4.75 ft.
Girard Right	**Depth to Groundwater**	**Depth to Bedrock**	**Depth to Hydrocarbons**	**Thickness of Hydrocarbons**
BH-1	3 ft.	9 ft.	0.5 ft.	9 ft.
BH-2	3 ft.	9.5 ft.	0.5 ft.	9.5 ft.
Site Mean	3 ft.	9.25 ft.	0.5 ft.	9.25 ft.

Mahoning River Bank Observations Averaged by Bore Hole (continued)				
Struthers Left	**Depth to Groundwater**	**Depth to Bedrock**	**Depth to Hydrocarbons**	**Thickness of Hydrocarbons**
BH-1	3 ft.	-	1.5 ft.	-
BH-2	4 ft.	7 ft.	1.5 ft.	5.5 ft.
BH-3	4 ft.	5 ft.	1.5 ft.	3.5 ft.
BH-4	5 ft.	11 ft.	2.5 ft.	8.5 ft.
Site Mean	3.9 ft.	7.3 ft.	1.7 ft.	5.6 ft.
Struthers Right	**Depth to Groundwater**	**Depth to Bedrock**	**Depth to Hydrocarbons**	**Thickness of Hydrocarbons**
BH-1	1.5 ft.		1.5 ft.	
BH-2	4 ft.	9 ft.	2 ft.	9 ft.
BH-3	5 ft.	8 ft.	2 ft.	8 ft.
BH-4	4 ft.	7 ft.	2 ft.	7 ft.
Site Mean	3.3 ft.	7 ft.	1.9 ft.	7 ft.

Mahoning River Bank Observations Averaged by Bore Hole (continued)				
Youngstown Left	**Depth to Groundwater**	**Depth to Bedrock**	**Depth to Hydrocarbons**	**Thickness of Hydrocarbons**
BH-1	3 ft.	10.5 ft.	2 ft.	8.5 ft.
BH-2	3 ft.	9.5 ft.	2 ft.	7.5 ft.
Site Mean	3 ft.	10 ft.	2 ft.	8 ft.
Youngstown Right	**Depth to Groundwater**	**Depth to Bedrock**	**Depth to Hydrocarbons**	**Thickness of Hydrocarbons**
BH-1	3 ft.	> 13.5 ft.	2 ft.	> 7 ft.
BH-2	3 ft.	> 13.5 ft.	4 ft.	> 9 ft.
BH-3	3 ft.	> 13.5 ft.	1.5 ft.	> 11 ft.
Site Mean	3 ft.	> 13.5 ft.	2.3 ft.	> 10 ft.

Bore Hole and Field Observation Summary

Field Characterization of Mahoning River Banks					
Warren Left BH-1	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sandy Clay	Dry	None visible	Plant roots present
S2	1-2	Sandy Clay	Moist	None visible	Brown clay
S3	2-3	Sandy Clay	Wet	Traces of black hydrocarbons	Strong petroleum smell
S4	3-4	Clay with traces of sand	Saturated	Medium amount of hydrocarbons	End of bore hole at 5 ft. due to bedrock - no recovery (4-5 ft.)
Warren Left BH-2	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sandy Clay	Dry	None visible	Plant roots / brown clay
S2	1-2	Sand and Clay	Dry	None visible	End of bore hole due to tree root
Warren Left BH-3	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sandy Clay	Dry	None visible	Plant roots present
S2	1-2	Sandy Clay with silt	Moist	None visible	Brown Clay
S3	2-3	Sandy Clay	Wet	Traces of black hydrocarbons	End of bore hole at 4 ft. – no recovery due to tree root (saturation at 3 ft.)

Field Characterization of Mahoning River Banks					
Warren Left BH-4	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sand and Clay	Dry	None visible	Plant roots present
S2	1-2	Sandy Clay with silt	Moist	None visible	Brown clay and clear glass in sample
S3	2-3	Clay with traces of sand	Wet	Traces of black hydrocarbons	Tree roots present
S4	3-4	Clay with traces of sand	Saturated	Medium amount of hydrocarbons	Petroleum smell
S5	4-5	Brown Clay	Saturated	Traces of black hydrocarbons	End of borehole due to bedrock
Warren Right BH-1	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sandy Silt	Dry	None visible	Plant roots present
S2	1-2	Sandy Silt	Moist	None visible	End of bore hole due to tree root

Field Characterization of Mahoning River Banks					
Warren Right BH-2	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sandy Silt	Dry	None visible	End of bore hole due to tree root
Warren Right BH-3	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sandy Silt	Dry	None visible	Plant roots present
S2	1-2	Silty Sand	Moist	None visible	Tree roots
S3	2-3	Silty Clay	Wet	Traces of black hydrocarbons	Tree roots
S4	3-4	Hard Clay with Silt	Saturated	Heavy amount of hydrocarbons	Red oxidation and visible metallics
S5	5-6	Sandy clay with traces of gravel	Saturated	Heavy amount of hydrocarbons	End of bore hole due to rock

Field Characterization of Mahoning River Banks					
Warren Right BH-4	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sandy Silt	Dry	None visible	Plant roots present
S2	1-2	Silty Sand	Moist	None visible	Pottery in sample
S3	2-3	Silty Sand	Wet	Medium amount of hydrocarbons	Tree roots
S4	3-4	Silty Sand with clay	Saturated	Heavy amount of hydrocarbons	Red oxidation
S5	4-5	Hard Clay with Silt	Saturated	Heavy amount of hydrocarbons	Red oxidation
S6	5-6	-	Saturated	Heavy amount of hydrocarbons	Hydrocarbons make of lithologic classification impossible
S7	6-7	Sand with traces of gravel	Saturated	Medium amount of hydrocarbons	End of borehole due to bedrock

Field Characterization of Mahoning River Banks					
Warren Right BH-5	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sandy Silt	Dry	None visible	Plant roots present
S2	1-2	Silt and Sand	Moist	Traces of black hydrocarbons	Slight petroleum smell and red oxidation
S3	2-3	Silty Clay	Wet	Traces of black hydrocarbons	Tree roots
S4	3-4	Hard Clay with Silt	Wet	Medium amount of hydrocarbons	Red oxidation and visible metallics / brown clay
S5	4-5	No Recovery	Saturated	Heavy amount of hydrocarbons	Hydrocarbons make of lithologic classification impossible
S6	5-6	Silty Sand	Saturated	Medium amount of hydrocarbons	Strong petroleum smell
S7	6-7	Silty Sand	Saturated	Traces of black hydrocarbons	End of borehole due to bedrock

Field Characterization of Mahoning River Banks					
Girard Left BH-1	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silty Sand	Dry	None visible	Plant roots present
S2	1-2	Sandy Clay	Moist	Lighter amount of hydrocarbons	Trace red oxidation and green glass - tree roots
S3	2-3	Sandy Silt	Wet	Medium amount of hydrocarbons	Abundant red oxidation
S4	3-4	Sandy Clay with Silt	Saturated	Heavy amount of hydrocarbons	Abundant red oxidation - visible metallics in sample
S5	4-5	Sandy Clay with Silt	Saturated	Heavy amount of hydrocarbons	Abundant red oxidation - visible metallics in sample
S6	5-6	Sandy Clay	Saturated	Heavy amount of hydrocarbons	Some red oxidation - strong petroleum smell
S7	6-7	Sandy Clay	Saturated	Medium amount of hydrocarbons	End boring 7.5 ft. at bedrock

Field Characterization of Mahoning River Banks					
Girard Left BH-2	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sand and Clay	Moist	None visible	Plant roots present
S2	1-2	Silty Sand with Clay	Wet	Lighter amount of hydrocarbons	Abundant red oxidation
S3	2-3	Clayey Sand	Saturated	Medium amount of hydrocarbons	Abundant red oxidation
S4	3-4	Clayey Sand	Saturated	Heavy amount of hydrocarbons	Abundant red oxidation
S5	4-5	Clay with trace sand	Saturated	Heavy amount of hydrocarbons	Some red oxidation - strong petroleum smell
S6	5-6	Clayey Sand	Saturated	Medium amount of hydrocarbons	End boring 6.5 ft. at bedrock
Girard Left BH-3	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sandy Clay	Dry	Plant roots	Plant roots present
S2	1-2	Clayey Sand	Moist	Lighter amount of hydrocarbons	Abundant red oxidation
S3	2-3	Sandy Clay	Wet	Medium amount of hydrocarbons	Abundant red oxidation - Tree roots
S4	3-4	Clayey Sand	Saturated	Heavy amount of hydrocarbons	Abundant red oxidation
S5	4-5	Sandy	Saturated	Heavy amount of hydrocarbons	End boring at possible bedrock

Field Characterization of Mahoning River Banks					
Girard Left BH-4	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silty Sand	Dry	None visible	Beach like material - brown sand
S2	1-2	Sandy Silt	Moist	Lighter amount of hydrocarbons	End boring on tree root
Girard Right BH-1	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silty Clay	Moist	Light traces of hydrocarbons	Trace of hydrocarbons at bottom of boring
S2	1-2	Silty Clay	Wet	Medium amount of hydrocarbons	Heavier hydrocarbons - lighter brown clay
S3	2-3	Silty Clay	Wet	Heavy amount of hydrocarbons	Clay changes from brown to blue - strong petroleum smell
S4	3-4	Blue Clay with trace silt	Saturated	Heavy amount of hydrocarbons	Mostly blue clay - strong petroleum smell
S5	4-5	Blue / Brown Mottled Clay	Saturated	Heavy amount of hydrocarbons	Turning to solid blue clay at bottom of bore hole - strong petroleum smell
S6	8-9	Hardpan Clay	Saturated	Little to no traces of hydrocarbons	End on hard blue-gray hard pan clay and bedrock

Field Characterization of Mahoning River Banks					
Girard Right BH-2	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silty Clay	Dry	Light traces of hydrocarbons	Brown clay with plant roots
S2	1-2	Silty Clay	Wet	Medium amount of hydrocarbons	Light brown clay with streaks of blue
S3	2-3	Silty Clay	Wet	Medium amount of hydrocarbons	Strong Petroleum Smell
S4	3-4	Blue Clay	Saturated	Heavy amount of hydrocarbons	Strong Petroleum Smell
S5	5-6	Blue / Brown Mottled Clay	Saturated	Medium amount of hydrocarbons	Less Petroleum Smell
S6	8-9	Hardpan Clay	Saturated	Little to no traces of hydrocarbons	End bore hole at 9.5 ft. on hard blue-gray hard pan clay and bedrock

Field Characterization of Mahoning River Banks					
Youngstown Left BH-1	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silty Sand	Dry	None visible	-
S2	1-2	Silty Sand	Moist	None visible	Red oxidation present
S3	2-3	Silty Sand	Wet	Lighter amount of hydrocarbons	Red oxidation present
S4	3-4	Silty Sand	Saturated	Medium amount of hydrocarbons	Red oxidation present - petroleum smell
S5	4-5	Silty Sand	Saturated	Heavy amount of hydrocarbons	Red oxidation present - Strong petroleum smell
S6	5-6	Silty Sand	Saturated	Heavy amount of hydrocarbons	Red oxidation present - Strong petroleum smell
S7	6-7	Silty Sand	Saturated	Heavy amount of hydrocarbons	Red oxidation present - Strong petroleum smell
S8	7-8	Coarse Sand with Silt	Saturated	Heavy amount of hydrocarbons	Red oxidation present - Strong petroleum smell
S9	8-9	Coarse Sand with Silt	Saturated	Heavy amount of hydrocarbons	Red oxidation present - Strong petroleum smell
S10	9-10	Coarse Sand with Silt and Gravel	Saturated	Medium amount of hydrocarbons	End bore hole on bedrock at 10.5 ft. - petroleum smell

Field Characterization of Mahoning River Banks					
Youngstown Left BH-2	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silty Sand	Dry	None visible	-
S2	1-2	Silty Sand	Moist	Lighter amount of hydrocarbons	Red oxidation present
S3	3-4	Silty Sand	Wet	Medium amount of hydrocarbons	Red oxidation present - petroleum smell
S4	4-5	Coarse Sand with Silt	Saturated	Heavy amount of hydrocarbons	Red oxidation present - Strong petroleum smell
S5	5-6	Silty Sand	Saturated	Heavy amount of hydrocarbons	Red oxidation present - Strong petroleum smell
S6	6-7	Silty Sand	Saturated	Heavy amount of hydrocarbons	Red oxidation present - Strong petroleum smell
S7	7-8	Coarse Sand with Silt	Saturated	Heavy amount of hydrocarbons	Red oxidation present - Strong petroleum smell
S8	8-9	Silty Sand	Saturated	Heavy amount of hydrocarbons	End bore hole on bedrock at 9.5 ft. - petroleum smell

Field Characterization of Mahoning River Banks					
Youngstown Right BH-1	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silty Sand with clay	Dry	None visible	Plant roots - boring taken from bank near B&O Station
S2	1-2	Silty Sand with clay	Moist	None visible	-
S3	2-3	Silty Sand with clay	Wet	Light traces of hydrocarbons	Red oxidation present
S4	3-4	Silty Sand with clay	Saturated	Light traces of hydrocarbons	Red oxidation present
S5	5-6	Silty Sand with Gravel	Saturated	Medium amount of hydrocarbons	Red oxidation present - petroleum smell
S6	6-7	Hydrocarbons make of lithologic classification impossible	Saturated	Heavy amount of hydrocarbons	Red oxidation present - Strong petroleum smell
S7	7-8	Silty Sand	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell - Coarse grained black sand present
S8	8-9	Silty Sand	Saturated	Heavy amount of hydrocarbons	Did not encounter bedrock - ran out of pole extensions at 13.5 ft. No recovery (10-13 ft.)

Field Characterization of Mahoning River Banks					
Youngstown Right BH-2	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silty Clay	Dry	None visible	Plant roots - boring taken from bank near river access road near water public works
S2	1-2	Silty Clay	Moist	None visible	-
S3	2-3	Silty Clay	Wet	None visible	Red oxidation present
S4	3-4	Silty Clay	Saturated	None visible	Red oxidation present
S5	4-5	Silty Clay	Saturated	Light traces of hydrocarbons	Red oxidation present - visible metallics in sample
S6	5-6	Silty Clay	Saturated	Medium traces of hydrocarbons	Red oxidation present
S7	6-7	Sandy Clay	Saturated	Heavy amount of hydrocarbons	Less red oxides visible - more hydrocarbons with increased smell
S8	8-9	Hydrocarbons make of lithologic classification impossible	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S9	10-11	Silty Clay with Sand	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S10	11-12	Coarse grained sand	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S11	12-13	Clay with Sand	Saturated	Medium amount of hydrocarbons	Did not encounter bedrock - ran out of pole extensions at 13.5 ft.

Field Characterization of Mahoning River Banks					
Youngstown Right BH-3	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silty Clay	Dry	None visible	Plant roots - Red oxidation present
S2	1-2	Silty Clay	Moist	Light traces of hydrocarbons	Red oxidation present
S3	2-3	Silty Clay	Wet	Medium traces of hydrocarbons	Red oxidation present
S4	3-4	Silty Clay	Saturated	Heavy amount of hydrocarbons	Red oxidation present
S5	4-5	Silty Clay	Saturated	Heavy amount of hydrocarbons	Red oxidation present
S6	5-6	Silty Clay	Saturated	Heavy amount of hydrocarbons	Red oxidation present
S7	8-9	Silty Clay	Saturated	Heavy amount of hydrocarbons	Brown Clay
S8	9-10	Silty Clay with Sand	Saturated	Heavy amount of hydrocarbons	-
S9	10-11	Silty Clay	Saturated	Heavy amount of hydrocarbons	-
S10	11-12	Silty Clay with Sand	Saturated	Heavy amount of hydrocarbons	-
S11	12-13	Clay with Sand	Saturated	Medium amount of hydrocarbons	Did not encounter bedrock - ran out of pole extensions at 13.5 ft.

Field Characterization of Mahoning River Banks					
Struthers Left BH-1	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silt and Sand	Dry	None visible	Plant roots present
S2	1-2	Silty Sand	Moist	Light traces of hydrocarbons	Bore hole was about 4 ft. from river edge
S3	2-3	Silt and Sand	Wet	Medium amount of hydrocarbons	Large amounts of black sand and strong petroleum smell
S4	3-4	Silt and Sand	Saturated	Heavy amount of hydrocarbons	End of borehole due to rock

Field Characterization of Mahoning River Banks					
Struthers Left BH-2	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silt and Sand	Dry	None visible	Plant roots present
S2	1-2	Silty Sand	Dry	Traces of hydrocarbon steaks	Brown sand with large amounts of black sand
S3	2-3	Silt and Sand	Moist	Medium amount of hydrocarbons	Tree roots present
S4	3-4	Silty Sand	Wet	Heavy amount of hydrocarbons	Strong petroleum smell
S5	4-5	Silty Sand	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S6	5-6	Silty Sand	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S7	6-7	Silty Sand	Saturated	Lighter amount of hydrocarbons	End of borehole due to bedrock
Struthers Left BH-3	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silt and Sand	Dry	None visible	Plant roots present
S2	1-2	Silty Sand	Moist	Light amount of hydrocarbons	
S3	2-3	Silty Sand	Moist	Medium amount of hydrocarbons	Tree roots present
S4	3-4	Silty Sand	Wet	Heavy amount of hydrocarbons	Strong petroleum smell
S5	4-5	Silty Sand	Saturated	Heavy amount of hydrocarbons	End of borehole due to bedrock

Field Characterization of Mahoning River Banks					
Struthers Left BH-4	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silt and Sand	Dry	None visible	Plant roots present
S2	1-2	Silty Sand	Dry	None visible	Large amounts of black sand
S3	2-3	Silt and Sand	Moist	Light traces of hydrocarbons	Large amounts of black sand and red oxidation
S4	3-4	Silt and Sand	Moist	Medium amount of hydrocarbons	Tree roots present and red oxidation
S5	4-5	Silt and Sand	Wet	Heavy amount of hydrocarbons	Strong petroleum smell
S6	5-6	Silty Sand	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S7	6-7	Silty Sand	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S8	7-8	Silty Sand	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S9	8-9	Silty Sand	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S10	10-11	Silty Sand	Saturated	Medium amount of hydrocarbons	End of borehole due to bedrock

Field Characterization of Mahoning River Banks					
Struthers Right BH-1	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silty Sand	Wet	None visible	Right bank collected 50 ft. from rail road bridge
S2	1-2	Silty Sand	Saturated	Light traces of hydrocarbons	Bore hole was 3 ft. from river edge
S3	2-3	Silty Sand	Saturated	Medium amount of hydrocarbons	End of borehole due to rock
Struthers Right BH-2	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silty Sand	Dry	None visible	Mostly black sand with some brown
S2	1-2	Silty Sand	Dry	None visible	-
S3	2-3	Silty Sand	Moist	Light traces of hydrocarbons	-
S4	3-4	Silty Sand	Wet	Light traces of hydrocarbons	Red oxidation
S5	4-5	Silty Sand	Saturated	Medium amount of hydrocarbons	Strong petroleum smell - red oxidation
S6	5-6	Silty Sand	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S7	6-7	Silty Sand	Saturated	Light traces of hydrocarbons	-
S8	7-8	Silty Sand	Saturated	Medium amount of hydrocarbons	-
S9	8-9	Silty Sand	Saturated	Heavy amount of hydrocarbons	End of borehole due to bed rock

Field Characterization of Mahoning River Banks					
Struthers Right BH-3	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sand and Silt	Dry	None visible	Primarily black sand
S2	1-2	Sand with Silt and traces of Clay	Dry	None visible	Looks like slag
S3	2-3	Sand with Silt and traces of Clay	Moist	Light traces of hydrocarbons	-
S4	3-4	Silty Sand	Wet	Light traces of hydrocarbons	-
S5	4-5	Silty Sand	Wet	Medium amount of hydrocarbons	Strong petroleum smell
S6	5-6	Silty Sand with Gravel	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S7	6-7	Silty Sand with Gravel	Saturated	Heavy amount of hydrocarbons	-
S8	7-8	Silty Sand	Saturated	Heavy amount of hydrocarbons	End of borehole due to bedrock

Field Characterization of Mahoning River Banks					
Struthers Right BH-4	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sand and Silt	Dry	None visible	Large amount of black sand
S2	1-2	Silty Sand	Moist	None visible	Looks like slag
S3	2-3	Silty Sand	Moist	Light traces of hydrocarbons	-
S4	3-4	Silty Sand	Wet	Light traces of hydrocarbons	-
S5	4-5	Silty Sand	Saturated	Light traces of hydrocarbons	-
S6	5-6	Silty Sand	Saturated	Medium amount of hydrocarbons	Strong petroleum smell
S7	6-7	Sand with Silt and traces of Clay	Saturated	Heavy amount of hydrocarbons	End of borehole due to bedrock

Field Characterization of Mahoning River Banks					
Lowellville Left BH-1	**Depth (bsg) (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silty Sand	Dry	None visible	Plant roots present
S2	1-2	Sandy Clay	Moist	None visible	-
S3	2-3	Silty Sand	Wet	Light amount of hydrocarbons	End of bore hole due to tree root
Lowellville Left BH-2	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	4-5	Sand with Gravel	Dry	None visible	End of bore hole due to tree root
Lowellville Left BH-3	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sand with Silt	Dry	None visible	Mostly sand
S2	1-2	Clayey Sand	Wet	Light amount of hydrocarbons	Some brown and black sand - light brown clay
S3	2-3	Sandy Clay	Saturated	Medium amount of hydrocarbons	Strong petroleum smell
S4	4-5	Hydrocarbons make lithologic classification impossible	Saturated	Heavy amount of hydrocarbons	End of borehole due to bedrock at 7 ft. - No recovery (5-7 ft.)

Field Characterization of Mahoning River Banks					
Lowellville Left BH-4	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sand with some Silt	Dry	None visible	Medium Brown Sand
S2	2-3	Clayey Sand	Moist	Light amount of hydrocarbons	Brown Clay
S3	3-4	Hydrocarbons make lithologic classification impossible	Wet	Heavy amount of hydrocarbons	Strong petroleum smell
S4	5-6	Sandy Clay	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S5	7-8	Sandy Clay	Saturated	Medium amount of hydrocarbons	End of borehole due to bedrock at 9 ft. - No recovery (8-9 ft.)
Lowellville Left BH-5	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silty Sand	Dry	None visible	Plant roots present
S2	1-2	Clayey Sand	Moist	Medium amount of hydrocarbons	Light brown clay - brown and black sand
S3	2-3	Sandy Clay	Wet	Heavy amount of hydrocarbons	Increased amount of clay - end boring on rock
Lowellville Left BH-6	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Silty Sand	Dry	None visible	Plant roots present
S2	1-2	Sand with clay and silt	Moist	None visible	More clay than other bore holes
S3	2-3	Clayey Sand	Wet	Medium amount of hydrocarbons	Heavy red oxidation and petroleum smell
S4	3-4	Sandy Clay	Saturated	Heavy amount of hydrocarbons	Red oxidation and strong petroleum smell
S5	6-7	Sandy Clay	Saturated	Heavy amount of hydrocarbons	End of borehole at 8' due to bedrock - no recovery (7-8) or (8-9)

Field Characterization of Mahoning River Banks					
Lowellville Right BH-1	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sand with Clay	Dry	None visible	-
S2	1-2	Clay with trace of Sand	Dry	None visible	-
S3	2-3	Sandy Clay	Moist	None visible	-
S4	3-4	Sandy Clay	Wet	Heavy amount of hydrocarbons	Red oxidation and strong petroleum smell
S5	4-5	Clay with trace of Sand	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S6	5-6	Clay with trace of Sand and gravel	Saturated	Heavy amount of hydrocarbons	End of borehole due to bedrock
Lowellville Right BH-2	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Clayey Sand	Dry	Trace amount of hydrocarbons towards bottom	Plant roots present
S2	1-2	Sandy Clay	Moist	Heavy amount of hydrocarbons	Strong petroleum smell
S3	2-3	Sandy Clay	Wet	Heavy amount of hydrocarbons	Strong petroleum smell
S4	3-4	Hydrocarbons make of lithologic classification impossible	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S5	4-5	Hydrocarbons make of lithologic classification impossible	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S6	5-6	Clay with trace of Sand and gravel	Saturated	Medium amount of hydrocarbons	End of borehole due to bedrock

Field Characterization of Mahoning River Banks					
Lowellville Right BH-3	**Depth (ft)**	**Lithology**	**Moisture Content**	**Contaminant Notes**	**Field Observation Notes**
S1	0-1	Sand with Clay	Dry	None visible	Plant roots present
S2	1-2	Sand with Clay	Moist	Medium amount of hydrocarbons	Some brown and black sand - light brown clay
S3	2-3	Sandy Clay	Wet/Saturated	Heavy amount of hydrocarbons	Saturated at 2.5 ft.
S4	3-4	Sandy Clay	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S5	4-5	Sandy Clay	Saturated	Heavy amount of hydrocarbons	Strong petroleum smell
S6	5-6	Sandy Clay	Saturated	Heavy amount of hydrocarbons	End of borehole at 7' due to bedrock - no recovery (6-7)

Appendix B – Monitoring Well Construction Diagrams and Field Logs

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BANK DESIGNATION **Warren Right Bank (Packard Park)**
PROJECT NAME: **Mahoning River Investigation**
LOCATION: **Warren, Ohio**
DRILLING CO: **Youngstown State University**
DRILLING METHOD: **Hand Auger**
FIELD PARTY: **Buffone / Amin**
GEOLOGIST: **Amin / Buffone**
DATE BEGUN: **6/16/2007** DATE COMPLETED: **6/16/2007**

BOREHOLE / WELL LOG: MW-1

TOTAL DEPTH: **9.0'**
BOREHOLE DIA. (O.D./I.D.): **4"**
PACK (INTERVAL): **Collapsed Formation**
CASING: **3" SCHEDULE 40 PVC**
SCREEN: **3" 0.01" SLOTTED SCHEDULE 40 PVC**
RELATIVE GROUND SURFACE ELEVATION: **858' AMSL**
COORDINATES: **N41° 15' 5.77" W80° 50' 0.39"**

WATER LEVEL	DURING	AFTER DRILLING
Depth (ft)	5.25'	3.38'
Date	6/17/2007	6/23/2007

DEPTH	DRILLING METHOD	WATER LEVEL	DESCRIPTION / REMARKS SOIL TYPE, COLOR, MOISTURE	LITHOLOGY	WELL INSTALLATION
1.0			RISER: with well cap.		
0.0			TOPSOIL: topsoil surface consisting of sandy silt and organics..		
-1.0	HAND AUGER		Sandy Silt: with some clay, some organic material, very red to rust colored tint.		
-2.0	HAND AUGER		Clay and Silt: with black petroleum impact, moist.		
-3.0	HAND AUGER		Clay: with less silt, heavier black petroleum impact, wet.		
-4.0	HAND AUGER	▼	Sandy Silt: with some clay, heavy black petroleum impact, saturated.		
-5.0	HAND AUGER	▽	Sand and Silt: with clay, heavy black petroleum impact, saturated.		
-6.0	HAND AUGER		Sand and Silt: with trace of clay, heavy black petroleum impact, saturated.		
-7.0	HAND AUGER		Sand and Silt: heavy petroleum impact, saturated.		
-8.0	HAND AUGER		Sand and Silt: with some grave, black petroleum impact, saturated.		
-9.0			Sandstone: bedrock.		

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BOREHOLE / WELL LOG: MW-1

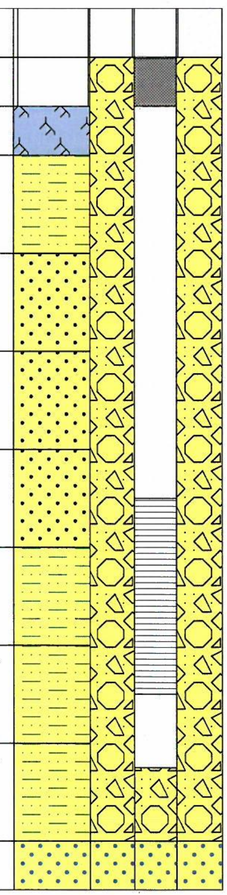
BANK DESIGNATION **Girard Left Bank**
PROJECT NAME: **Mahoning River Investigation**
LOCATION: **Girard, Ohio**
DRILLING CO: **Youngstown State University**
DRILLING METHOD: **Hand Auger**
FIELD PARTY: **Buffone / Amin**
GEOLOGIST: **Amin / Buffone**
DATE BEGUN: **6/24/2007** DATE COMPLETED: **6/24/2007**

TOTAL DEPTH: **8.0'**
BOREHOLE DIA. (O.D./I.D.): **4"**
PACK (INTERVAL): **Collapsed Formation**
CASING: **3" SCHEDULE 40 PVC**
SCREEN: **3" 0.01" SLOTTED SCHEDULE 40 PVC**
RELATIVE GROUND SURFACE ELEVATION: **835' AMSL**
COORDINATES: **N41° 9' 17.11" W80° 42' 23.44"**

WATER LEVEL	▽ DURING	▼ AFTER DRILLING
Depth (ft)	3.74'	3.34'
Date	6/24/2007	6/30/2007

DEPTH	DRILLING METHOD	WATER LEVEL	DESCRIPTION / REMARKS SOIL TYPE, COLOR, MOISTURE
0.0			RISER: with well cap.
			TOPSOIL: topsoil surface consisting of sand, little clay, and organics..
-1.0	HAND AUGER		Clayey Sand: with some silt, redish color to soil, little black petroleum impact.
-2.0	HAND AUGER		Sand: with clay, redish color to soil, increasing black petroleum impact, moist.
-3.0	HAND AUGER	▼ ▽	Sand: with little clay, heavy black petroleum impact, wet.
-4.0	HAND AUGER		Sand: with clay, redish color to soil, heavy black petroleum impact, saturated.
-5.0	HAND AUGER		Clayey Sand: redish color to soil, heavy black petroleum impact, saturated.
-6.0	HAND AUGER		Clayey Sand: blue clay with silt, heavy black petroleum impact, saturated.
-7.0	HAND AUGER		Clayey Sand: clay blue in color, heavy black petroleum impact, saturated.
-8.0	HAND AUGER		Sandstone: bedrock.

LITHOLOGY / WELL INSTALLATION



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BOREHOLE / WELL LOG: MW-1

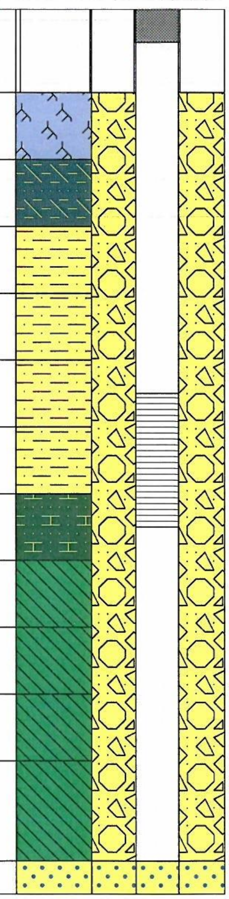
BANK DESIGNATION **Girard Right Bank**
PROJECT NAME: **Mahoning River Investigation**
LOCATION: **Girard, Ohio**
DRILLING CO: **Youngstown State University**
DRILLING METHOD: **Hand Auger**
FIELD PARTY: **Buffone / Amin**
GEOLOGIST: **Amin / Buffone**
DATE BEGUN: **6/24/2007** DATE COMPLETED: **6/24/2007**

TOTAL DEPTH: **11.5'**
BOREHOLE DIA. (O.D./I.D.): **4"**
PACK (INTERVAL): **Collapsed Formation**
CASING: **3" SCHEDULE 40 PVC**
SCREEN: **3" 0.01" SLOTTED SCHEDULE 40 PVC**
RELATIVE GROUND SURFACE ELEVATION: **845' AMSL**
COORDINATES: **N41° 9' 17.11" W80° 42' 23.44"**

WATER LEVEL	▽ DURING	▼ AFTER DRILLING
Depth (ft)	3.28'	2.61'
Date	6/24/2007	6/30/2007

DEPTH	DRILLING METHOD	WATER LEVEL	DESCRIPTION / REMARKS SOIL TYPE, COLOR, MOISTURE
1.0			RISER: with well cap.
0.0			TOPSOIL: topsoil surface consisting of silt, clay, and organics..
-1.0	HAND AUGER		Clay and Sand: with some silt, some organic material, black petroleum impact.
-2.0	HAND AUGER		Silt: with black petroleum impact, moist.
-3.0	HAND AUGER	▽ ▼	Silt: with less silt, heavier black petroleum impact, wet.
-4.0	HAND AUGER		Silt: with some clay, heavy black petroleum impact, saturated.
-5.0	HAND AUGER		Silt: with clay, heavy black petroleum impact, saturated.
-6.0	HAND AUGER		Clay and Silt: blue clay with silt, less black petroleum impact, saturated.
-7.0	HAND AUGER		Clay: clay blue in color, little petroleum impact.
-8.0	HAND AUGER		Clay: clay blue in color, little or no noticable petroleum impact.
-9.0	HAND AUGER		Clay: light brown and less blue, little or no noticable petroleum impact.
-10.0	HAND AUGER		Clay: light brown, no noticable petroleum impact, drilling stopped at 11'.
-11.0			Bedrock

LITHOLOGY / WELL INSTALLATION



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BANK DESIGNATION **Lowellville Left Bank**
PROJECT NAME: **Mahoning River Investigation**
LOCATION: **Lowellville, Ohio**
DRILLING CO: **Youngstown State University**
DRILLING METHOD: **Hand Auger**
FIELD PARTY: **Buffone / Amin**
GEOLOGIST: **Amin / Buffone**
DATE BEGUN: **6/2/2007** DATE COMPLETED: **6/2/2007**

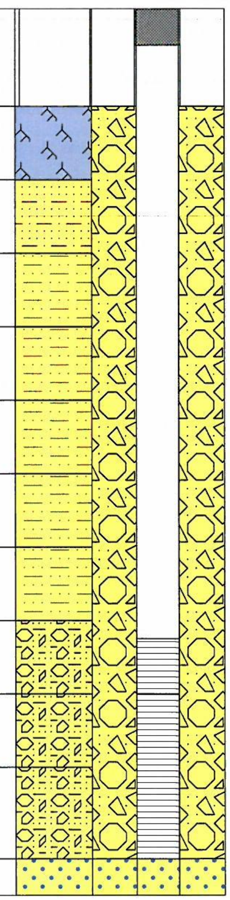
BOREHOLE / WELL LOG: MW-1

TOTAL DEPTH: **10.25**
BOREHOLE DIA. (O.D./I.D.): **4"**
PACK (INTERVAL): **Collapsed Formation**
CASING: **3" SCHEDULE 40 PVC**
SCREEN: **3" 0.01" SLOTTED SCHEDULE 40 PVC**
RELATIVE GROUND SURFACE ELEVATION: **824' AMSL**
COORDINATES: **N41° 02' 16.5" W80° 32' 20.94"**

WATER LEVEL	▽ DURING	▼ AFTER DRILLING
Depth (ft)	5.42'	3.63'
Date	6/2/2007	6/2/2007

DEPTH	DRILLING METHOD	WATER LEVEL	DESCRIPTION / REMARKS SOIL TYPE, COLOR, MOISTURE
1.0			RISER: with well cap.
0.0			TOPSOIL: topsoil surface consisting of sandy silt and organics..
-1.0	HAND AUGER		Sand and Silt: with a little gravel, and a trace of organics, brown, very loose.
-2.0	HAND AUGER		Clayey Sand: with some gravel, tint of red and black color, moist.
-3.0	HAND AUGER		Clayey Sand: with a little silt, and a trace of black petroleum impact, redish tint, wet.
-4.0	HAND AUGER		Clayey Sand: with a little silt, heavy black petroleum impact, redish tint, wet.
-5.0	HAND AUGER	▼ ▽	Clayey Sand: with a little silt, heavy black petroleum impact, saturated.
-6.0	HAND AUGER		Clayey Sand: with a little gavel, heavy petroleum impact, saturated.
-7.0	HAND AUGER		Gravel and Sand: heavy petroleum impact, saturated.
-8.0	HAND AUGER		Gravel and Sand: heavy black petroleum impact, soft, saturated.
-9.0	HAND AUGER		Gravel and Sand: heavy black petroleum impact, saturated.
-10.0	HAND AUGER		Sandstone: bedrock.

LITHOLOGY / WELL INSTALLATION



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BANK DESIGNATION **Lowellville Right Bank**
PROJECT NAME: **Mahoning River Investigation**
LOCATION: **Lowellville, Ohio**
DRILLING CO: **Youngstown State University**
DRILLING METHOD: **Hand Auger**
FIELD PARTY: **Buffone / Amin**
GEOLOGIST: **Amin / Buffone**
DATE BEGUN: **6/9/2007** DATE COMPLETED: **6/9/2007**

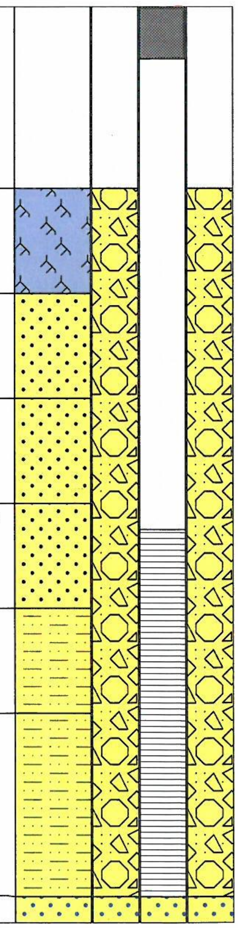
BOREHOLE / WELL LOG: MW-1

TOTAL DEPTH: **6.75**
BOREHOLE DIA. (O.D./I.D.): **4"**
PACK (INTERVAL): **Collapsed Formation**
CASING: **3" SCHEDULE 40 PVC**
SCREEN: **3" 0.01" SLOTTED SCHEDULE 40 PVC**
RELATIVE GROUND SURFACE ELEVATION: **805' AMSL**
COORDINATES: **N41° 02' 8.5" W80° 32' 11.26"**

WATER LEVEL	▽ DURING	▼ AFTER DRILLING
Depth (ft)	1.89	2.36
Date	6/9/2007	6/10/2007

DEPTH	DRILLING METHOD	WATER LEVEL	DESCRIPTION / REMARKS SOIL TYPE, COLOR, MOISTURE
1.0			RISER: with well cap.
0.0			TOPSOIL: topsoil surface consisting of sandy silt and organics..
-1.0	HAND AUGER		Sand: with some clay, some organic material.
-2.0	HAND AUGER	▽ ▼	Sand: with some clayand silt, trace of organic material, moist.
-3.0	HAND AUGER		Sand: with some clay, and a trace of black petroleum impact, redish tint to soil, wet.
-4.0	HAND AUGER		Clayey Sand: with some clay, heavy black petroleum impact, saturated.
-5.0	HAND AUGER		Clayey Sand: heavy black petroleum impact, saturated.
-6.0	HAND AUGER		
			Sandstone: bedrock.
-7.0			

LITHOLOGY | WELL INSTALLATION



Appendix C: Hydraulic Conductivity by Depth (Hazen Method) and Soil Grain-size Distribution Documentation

Hydraulic Conductivity by Depth (Hazen Method)

Table A-3: Average Hydraulic Conductivity by Depth (Hazen Method)				
Warren Left BH-1	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.015	0.000225	4.85E-04
S2	2.0	0.031	0.000961	
S3	3.0	0.023	0.000529	
S4	4.0	0.022	0.000484	
Warren Left BH-2	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.051	0.002601	1.12E-03
S2	2.0	0.022	0.000484	
Warren Left BH-3	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.022	0.000484	4.12E-04
S2	2.0	0.019	0.000361	
S3	3.0	0.02	0.0004	
Warren Left BH-4	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.013	0.000169	3.81E-04
S2	2.0	0.02	0.0004	
S3	3.0	0.02	0.0004	
S4	4.0	0.021	0.000441	
S5	5.0	0.026	0.000676	

a. Calculation of hydraulic conductivity (K) by Hazen method based on formula $K = d^2_{90.}$

Table A-3: Average Hydraulic Conductivity by Depth (Hazen Method)				
Warren Right BH-1	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.03	0.0009	8.70E-04
S2	2.0	0.029	0.000841	
Warren Right BH-2	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.036	0.001296	1.30E-03
Warren Right BH-3	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.012	0.000144	3.80E-04
S2	2.0	0.014	0.000196	
S3	3.0	0.019	0.000361	
S4	4.0	0.022	0.000484	
S5	6.0	0.04	0.0016	
Warren Right BH-4	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.038	0.001444	1.27E-03
S2	2.0	0.041	0.001681	
S3	3.0	0.041	0.001681	
S4	4.0	0.042	0.001764	
S5	5.0	0.032	0.001024	
S6	6.0	0.029	0.000841	
S7	7.0	0.029	0.000841	
Warren Right BH-5	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.038	0.001444	1.84E-03
S2	2.0	0.04	0.0016	
S3	3.0	0.041	0.001681	
S4	4.0	0.046	0.002116	
S5	5.0	0.046	0.002116	
S6	6.0	0.044	0.001936	
S7	7.0	0.046	0.002116	

a. Calculation of hydraulic conductivity (K) by Hazen method based on formula $K = d^2_{90}$.

Table A-3: Average Hydraulic Conductivity by Depth (Hazen Method)				
Girard Left BH-1	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.03	0.0009	4.02E-04
S2	2.0	0.018	0.000324	
S3	3.0	0.025	0.000625	
S4	4.0	0.012	0.000144	
S5	5.0	0.013	0.000169	
S6	6.0	0.02	0.0004	
S7	7.0	0.018	0.000324	
Girard Left BH-2	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.013	0.000169	3.86E-04
S2	2.0	0.031	0.000961	
S3	3.0	0.022	0.000484	
S4	4.0	0.02	0.0004	
S5	5.0	0.027	0.000729	
S6	6.0	0.012	0.000144	
Girard Left BH-3	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.023	0.000529	8.07E-04
S2	2.0	0.037	0.001369	
S3	3.0	0.022	0.000484	
S4	4.0	0.026	0.000676	
S5	5.0	0.038	0.001444	
Girard Left BH-4	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.039	0.001521	9.75E-04
S2	2.0	0.025	0.000625	

a. Calculation of hydraulic conductivity (K) by Hazen method based on formula $K = d^2_{90}$.

Table A-3: Average Hydraulic Conductivity by Depth (Hazen Method)				
Girard Right BH-1	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.016	0.000256	1.65E-04
S2	2.0	0.011	0.000121	
S3	3.0	0.012	0.000144	
S4	4.0	0.012	0.000144	
S5	5.0	0.018	0.000324	
S6	9.0	0.011	0.000121	
Girard Right BH-2	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.014	0.000196	1.53E-04
S2	2.0	0.011	0.000121	
S3	3.0	0.011	0.000121	
S4	4.0	0.011	0.000121	
S5	6.0	0.012	0.000144	
S6	9.0	0.016	0.000256	

a. Calculation of hydraulic conductivity (K) by Hazen method based on formula $K = d^2_{90}$.

Table A-3: Average Hydraulic Conductivity by Depth (Hazen Method)				
Youngstown Left BH-1	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.013	0.000169	2.84E-04
S2	2.0	0.015	0.000225	
S3	3.0	0.013	0.000169	
S4	4.0	0.014	0.000196	
S5	5.0	0.014	0.000196	
S6	6.0	0.015	0.000225	
S7	7.0	0.016	0.000256	
S8	8.0	0.021	0.000441	
S9	9.0	0.021	0.000441	
S10	10.0	0.035	0.001225	
Youngstown Left BH-2	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.021	0.000441	2.60E-04
S2	2.0	0.015	0.000225	
S3	4.0	0.012	0.000144	
S4	5.0	0.02	0.0004	
S5	6.0	0.018	0.000324	
S6	7.0	0.016	0.000256	
S7	8.0	0.015	0.000225	
S8	9.0	0.014	0.000196	

a. Calculation of hydraulic conductivity (K) by Hazen method based on formula $K = d^2_{90}$.

Table A-3: Average Hydraulic Conductivity by Depth (Hazen Method)				
Youngstown Right BH-1	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.026	0.000676	1.70E-03
S2	2.0	0.02	0.0004	
S3	3.0	0.02	0.0004	
S4	4.0	0.019	0.000361	
S5	6.0	0.116	0.013456	
S6	7.0	0.075	0.005625	
S7	8.0	0.051	0.002601	
S8	9.0	0.095	0.009025	
Youngstown Right BH-2	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.02	0.0004	3.34E-04
S2	2.0	0.017	0.000289	
S3	3.0	0.012	0.000144	
S4	4.0	0.013	0.000169	
S5	5.0	0.014	0.000196	
S6	6.0	0.014	0.000196	
S7	7.0	0.028	0.000784	
S8	9.0	0.011	0.000121	
S9	11.0	0.022	0.000484	
S10	12.0	0.051	0.002601	
S11	13.0	0.021	0.000441	
Youngstown Right BH-3	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.016	0.000256	7.90E-04
S2	2.0	0.017	0.000289	
S3	3.0	0.011	0.000121	
S4	4.0	0.015	0.000225	
S5	5.0	0.011	0.000121	
S6	6.0	0.013	0.000169	
S7	9.0	0.022	0.000484	
S8	10.0	0.022	0.000484	
S9	11.0	0.126	0.015876	
S10	12.0	0.223	0.049729	
S11	13.0	0.099	0.009801	

a. Calculation of hydraulic conductivity (K) by Hazen method based on formula $K = d^2_{90}$.

Table A-3: Average Hydraulic Conductivity by Depth (Hazen Method)				
Struthers Left BH-1	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.016	0.000256	2.50E-04
S2	2.0	0.025	0.000625	
S3	3.0	0.012	0.000144	
S4	4.0	0.013	0.000169	
Struthers Left BH-2	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.034	0.001156	3.31E-04
S2	2.0	0.021	0.000441	
S3	3.0	0.018	0.000324	
S4	4.0	0.016	0.000256	
S5	5.0	0.014	0.000196	
S6	6.0	0.012	0.000144	
S7	7.0	0.019	0.000361	
Struthers Left BH-3	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.028	0.000784	4.44E-04
S2	2.0	0.023	0.000529	
S3	3.0	0.019	0.000361	
S4	4.0	0.017	0.000289	
S5	5.0	0.02	0.0004	
Struthers Left BH-4	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.028	0.000784	2.23E-04
S2	2.0	0.02	0.0004	
S3	3.0	0.02	0.0004	
S4	4.0	0.013	0.000169	
S5	5.0	0.013	0.000169	
S6	6.0	0.011	0.000121	
S7	7.0	0.013	0.000169	
S8	8.0	0.014	0.000196	
S9	9.0	0.012	0.000144	
S10	11.0	0.012	0.000144	

a. Calculation of hydraulic conductivity (K) by Hazen method based on formula $K = d^2_{90}$.

Table A-3: Average Hydraulic Conductivity by Depth (Hazen Method)				
Struthers Right BH-1	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.016	0.000256	3.79E-04
S2	2.0	0.022	0.000484	
S3	3.0	0.021	0.000441	
Struthers Right BH-2	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.023	0.000529	9.79E-04
S2	2.0	0.018	0.000324	
S3	3.0	0.019	0.000361	
S4	4.0	0.024	0.000576	
S5	5.0	0.027	0.000729	
S6	6.0	0.068	0.004624	
S7	7.0	0.054	0.002916	
S8	8.0	0.029	0.000841	
S9	9.0	0.053	0.002809	
Struthers Right BH-3	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.022	0.000484	6.70E-04
S2	2.0	0.018	0.000324	
S3	3.0	0.019	0.000361	
S4	4.0	0.028	0.000784	
S5	5.0	0.024	0.000576	
S6	6.0	0.053	0.002809	
S7	7.0	0.029	0.000841	
S8	8.0	0.026	0.000676	
Struthers Right BH-4	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.026	0.000676	1.31E-03
S2	2.0	0.034	0.001156	
S3	3.0	0.033	0.001089	
S4	4.0	0.068	0.004624	
S5	5.0	0.062	0.003844	
S6	6.0	0.037	0.001369	
S7	7.0	0.018	0.000324	

a. Calculation of hydraulic conductivity (K) by Hazen method based on formula $K = d^2_{90}$.

Table A-3: Average Hydraulic Conductivity by Depth (Hazen Method)				
Lowellville Left BH-1	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.042	0.001764	1.74E-03
S2	2.0	0.041	0.001681	
S3	3.0	0.042	0.001764	
Lowellville Left BH-2	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	5.0	0.041	0.001681	1.68E-03
Lowellville Left BH-3	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.046	0.002116	1.71E-03
S2	2.0	0.040	0.0016	
S3	3.0	0.038	0.001444	
S4	5.0	0.042	0.001764	
Lowellville Left BH-4	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.039	0.001521	1.92E-03
S2	3.0	0.038	0.001444	
S3	4.0	0.043	0.001849	
S4	6.0	0.046	0.002116	
S5	8.0	0.055	0.003025	
Lowellville Left BH-5	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.047	0.002209	1.78E-03
S2	2.0	0.040	0.0016	
S3	3.0	0.040	0.0016	
Lowellville Left BH-6	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.089	0.007921	2.47E-03
S2	2.0	0.042	0.001764	
S3	3.0	0.046	0.002116	
S4	4.0	0.042	0.001764	
S5	7.0	0.042	0.001764	

a. Calculation of hydraulic conductivity (K) by Hazen method based on formula $K = d^2_{90}$.

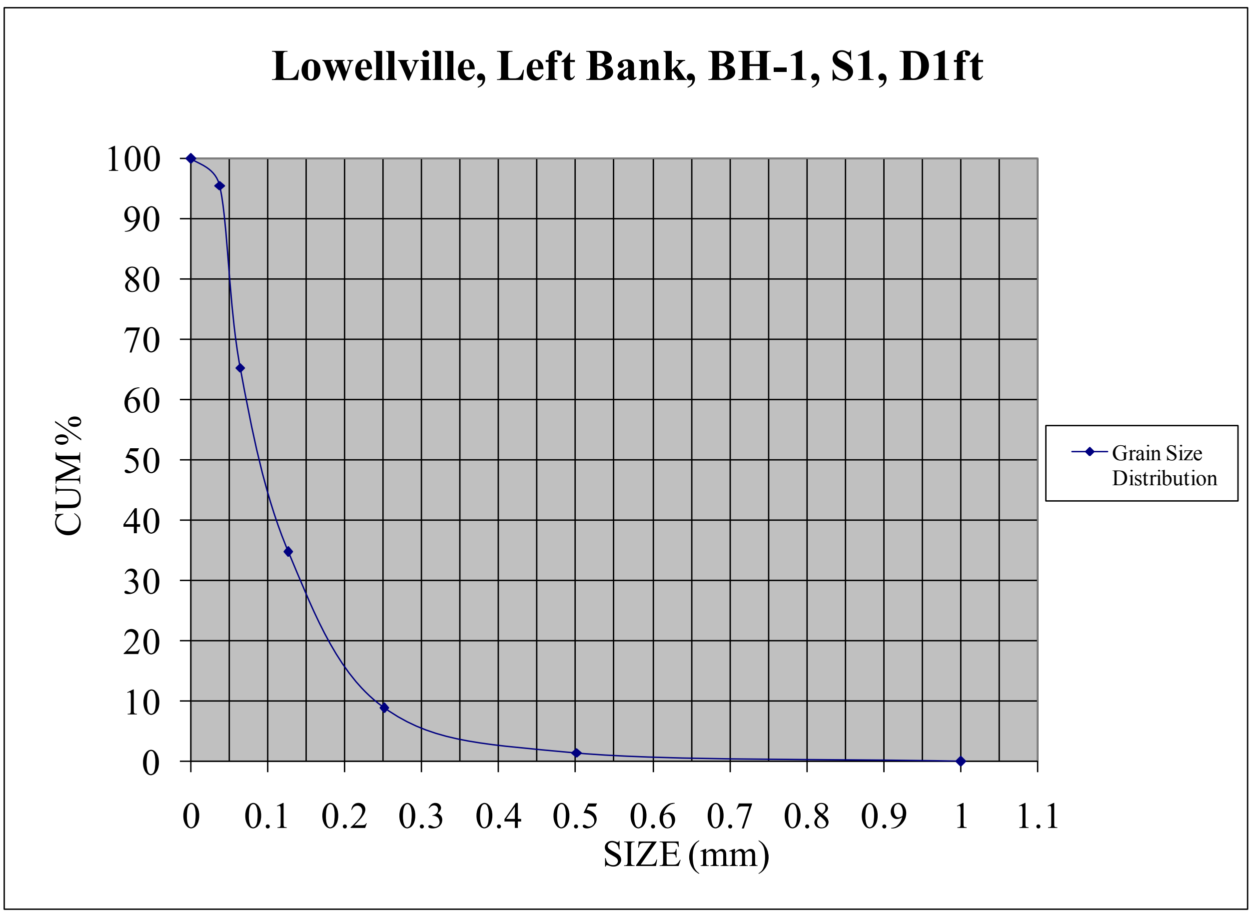
Table A-3: Average Hydraulic Conductivity by Depth (Hazen Method)				
Lowellville Right BH-1	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.051	0.002601	1.60E-03
S2	2.0	0.039	0.001521	
S3	3.0	0.036	0.001296	
S4	4.0	0.031	0.000961	
S5	5.0	0.036	0.001296	
S6	6.0	0.051	0.002601	
Lowellville Right BH-2	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.044	0.001936	2.08E-03
S2	2.0	0.042	0.001764	
S3	3.0	0.041	0.001681	
S4	4.0	0.063	0.003969	
S5	5.0	0.043	0.001849	
S6	6.0	0.044	0.001936	
Lowellville Right BH-3	**Depth (ft)**	**d_{90}**	**K (cm/s)**	**K Mean (cm/s)**
S1	1.0	0.028	0.000784	1.40E-03
S2	2.0	0.043	0.001849	
S3	3.0	0.042	0.001764	
S4	4.0	0.033	0.001089	
S5	5.0	0.042	0.001764	
S6	6.0	0.039	0.001521	

a. Calculation of hydraulic conductivity (K) by Hazen method based on formula $K = d^2_{90}$.

Soil Grain-size Distribution Documentation Data

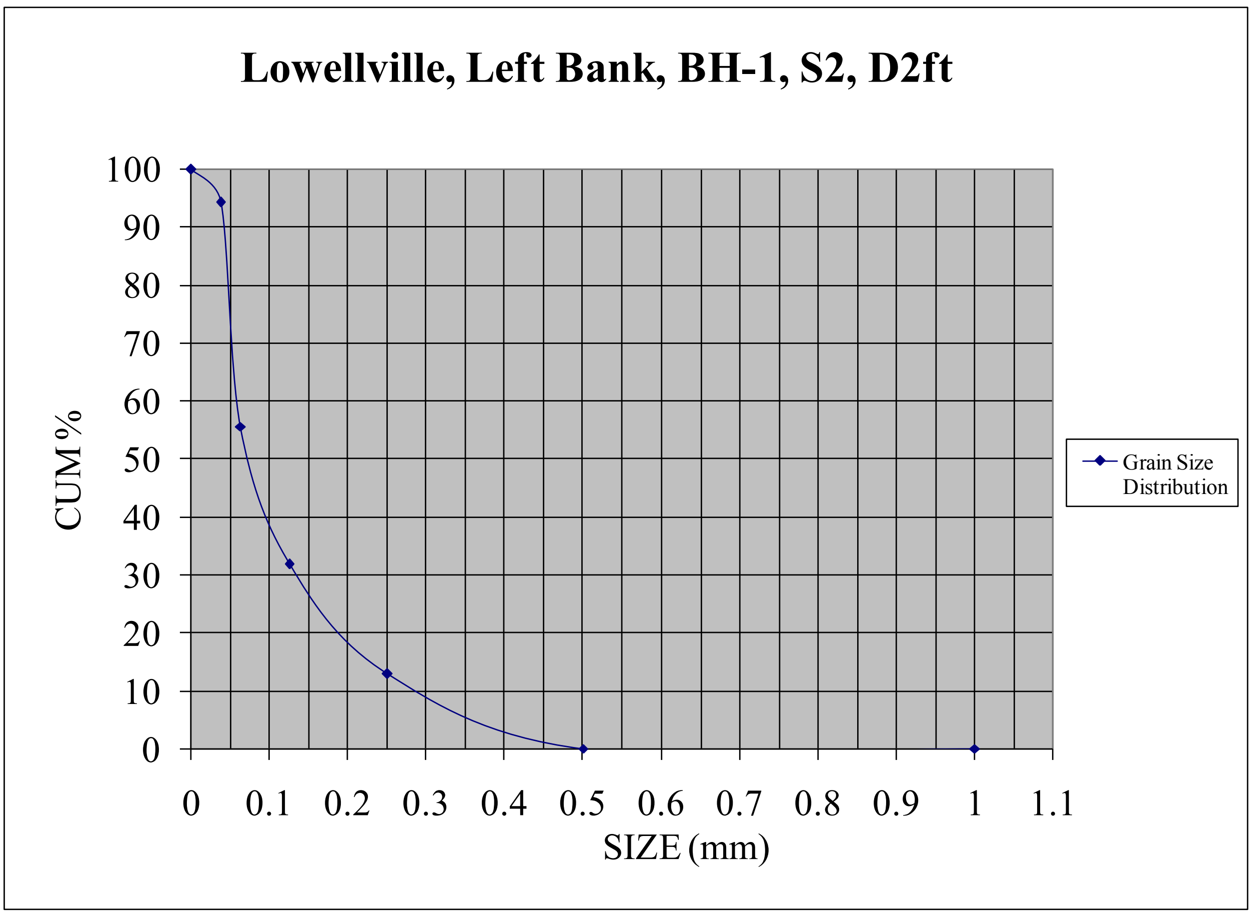
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/14/06	
BH-1, S1, 1 ft. bsg[a]		Original Sample Weight: 109.1g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	1.6	1.6	1
0.25	8.0	9.6	9
0.125	28.4	38.0	35
0.063	33.4	71.4	65
0.037	33.0	104.4	96
pan	4.9	109.3	100

a. Below surface grade.



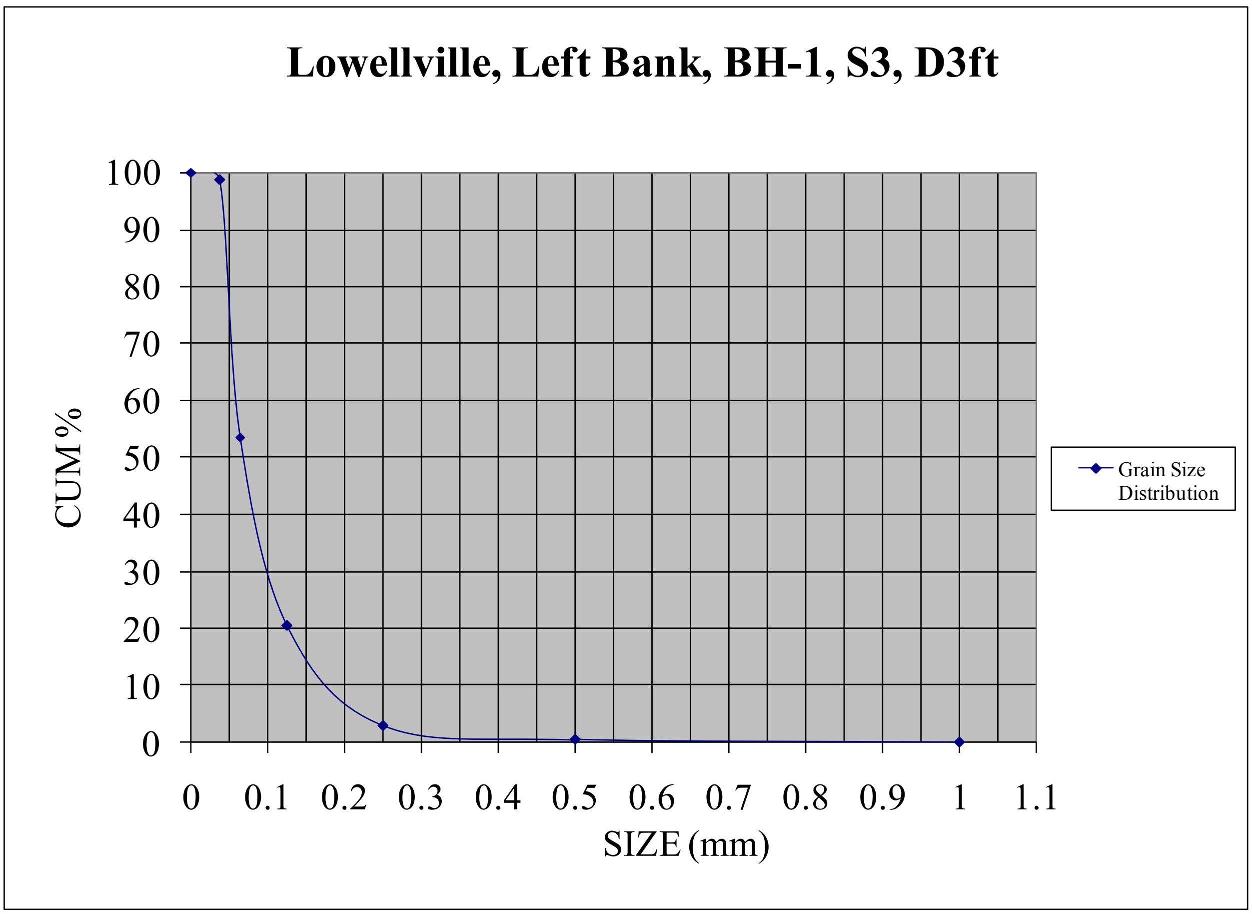
Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/14/06	
BH-1, S2, 2 ft. bsg[a]		Original Sample Weight: 105.1g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	0.4	0.4	0
0.25	13.0	13.4	13
0.125	19.7	33.1	32
0.063	24.6	57.7	56
0.037	40.1	97.8	94
pan	6.0	103.8	100

a. Below surface grade.



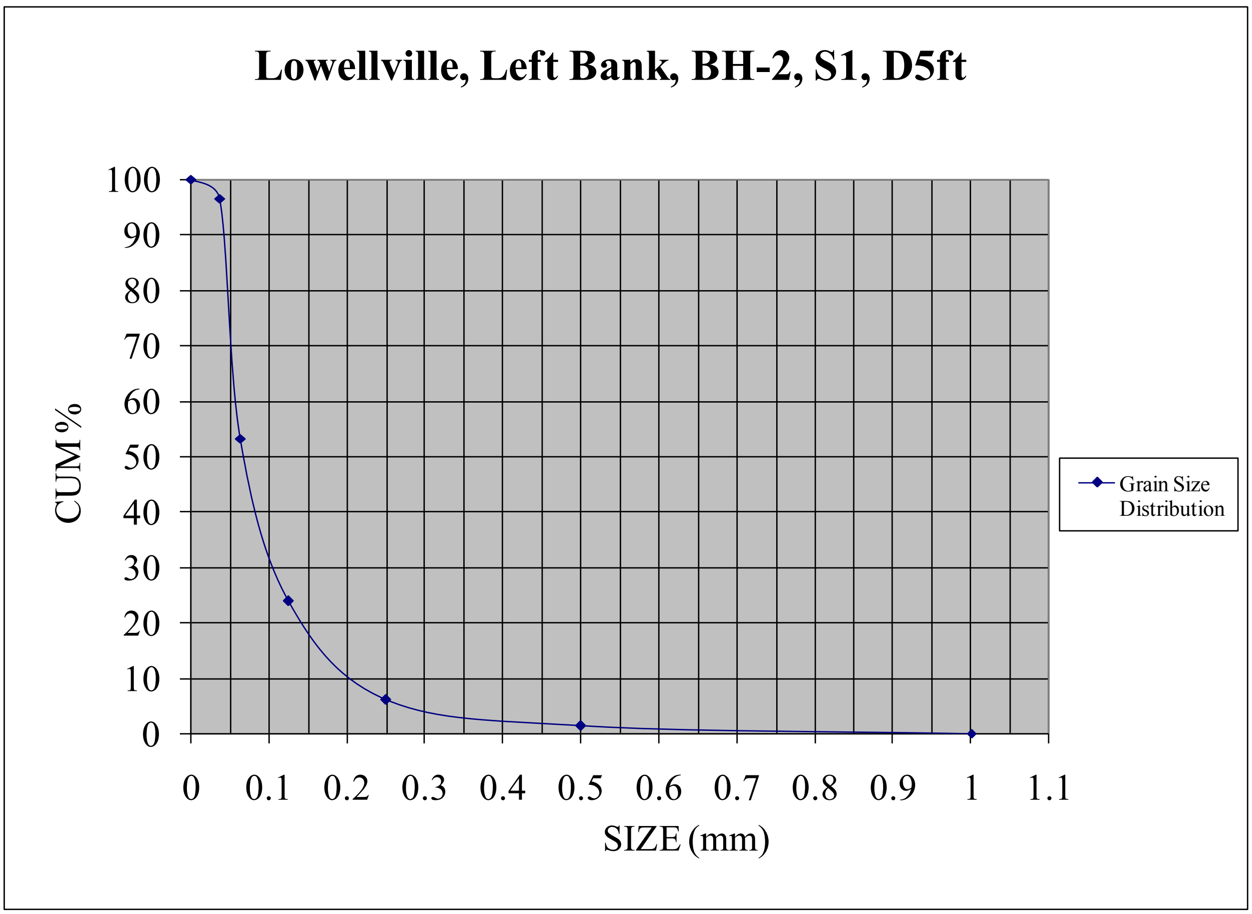
Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/14/06	
BH-1, S3, 3 ft. bsg[a]		Original Sample Weight: 109.6g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	0.5	0.5	1
0.25	2.7	3.2	3
0.125	18.0	21.2	20
0.063	34.3	55.5	54
0.044	46.5	102.0	99
pan	1.5	103.5	100

a. Below surface grade.



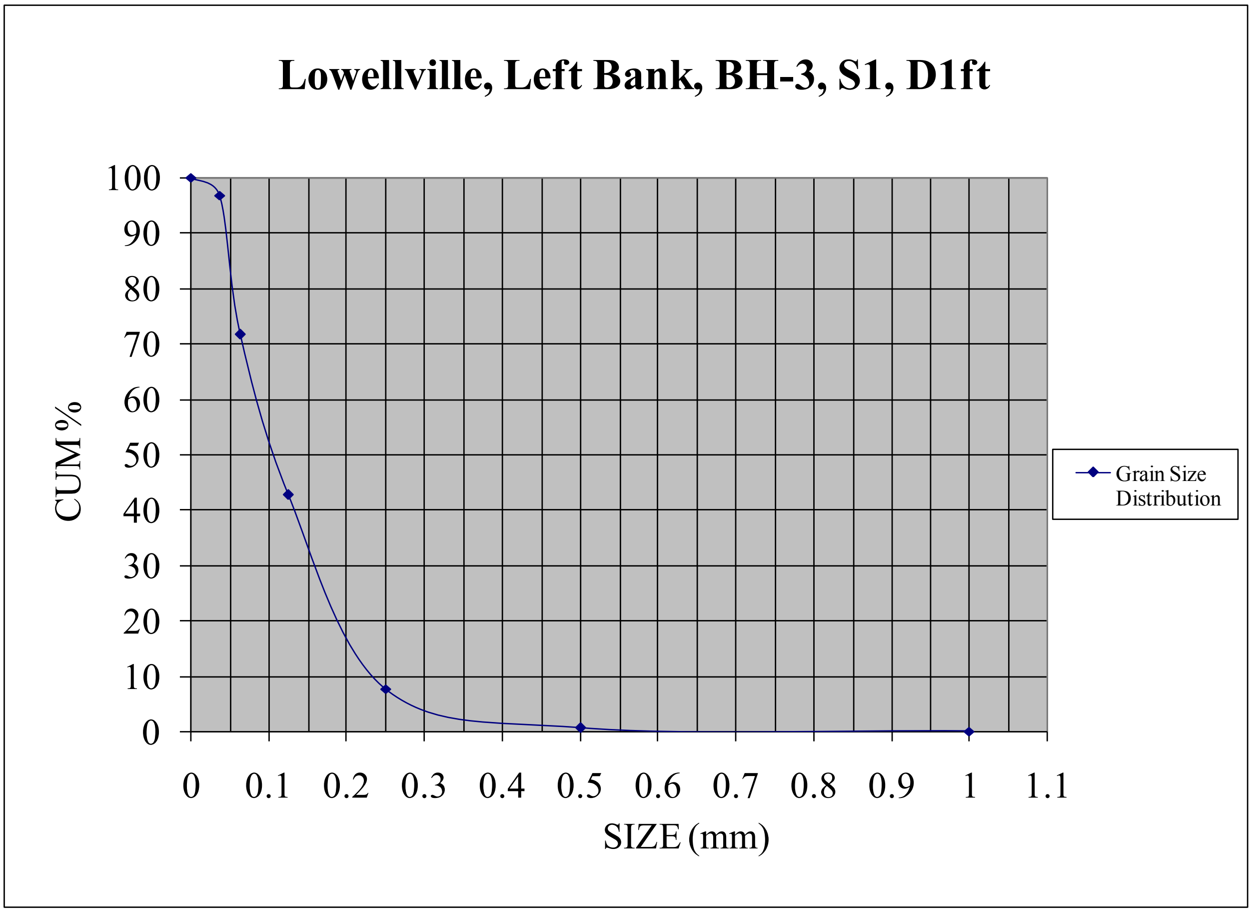
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/14/06	
BH-2, S1, 5 ft. bsg[a]		Original Sample Weight: 108.0g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	1.4	1.4	1
0.25	5.1	6.5	6
0.125	18.9	25.4	24
0.063	31.2	56.6	53
0.044	46.0	102.6	97
pan	3.7	106.3	100

a. Below surface grade.



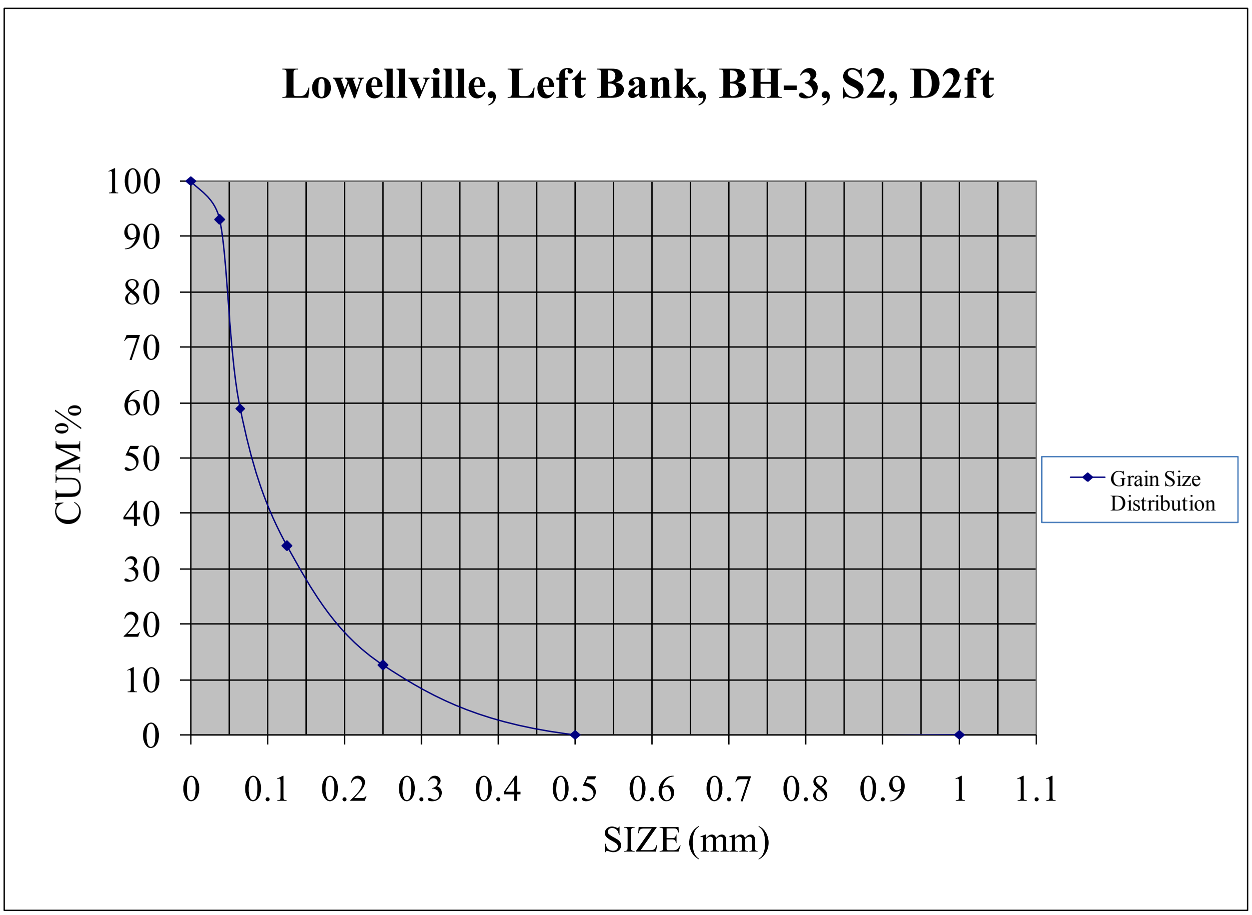
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/14/06	
BH-3, S1, 1 ft. bsg[a]		Original Sample Weight: 102.8g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	0.5	0.5	1
0.25	7.2	7.7	8
0.125	35.6	43.3	43
0.063	29.4	72.7	72
0.044	25.6	98.3	97
pan	3.3	101.6	100

a. Below surface grade.



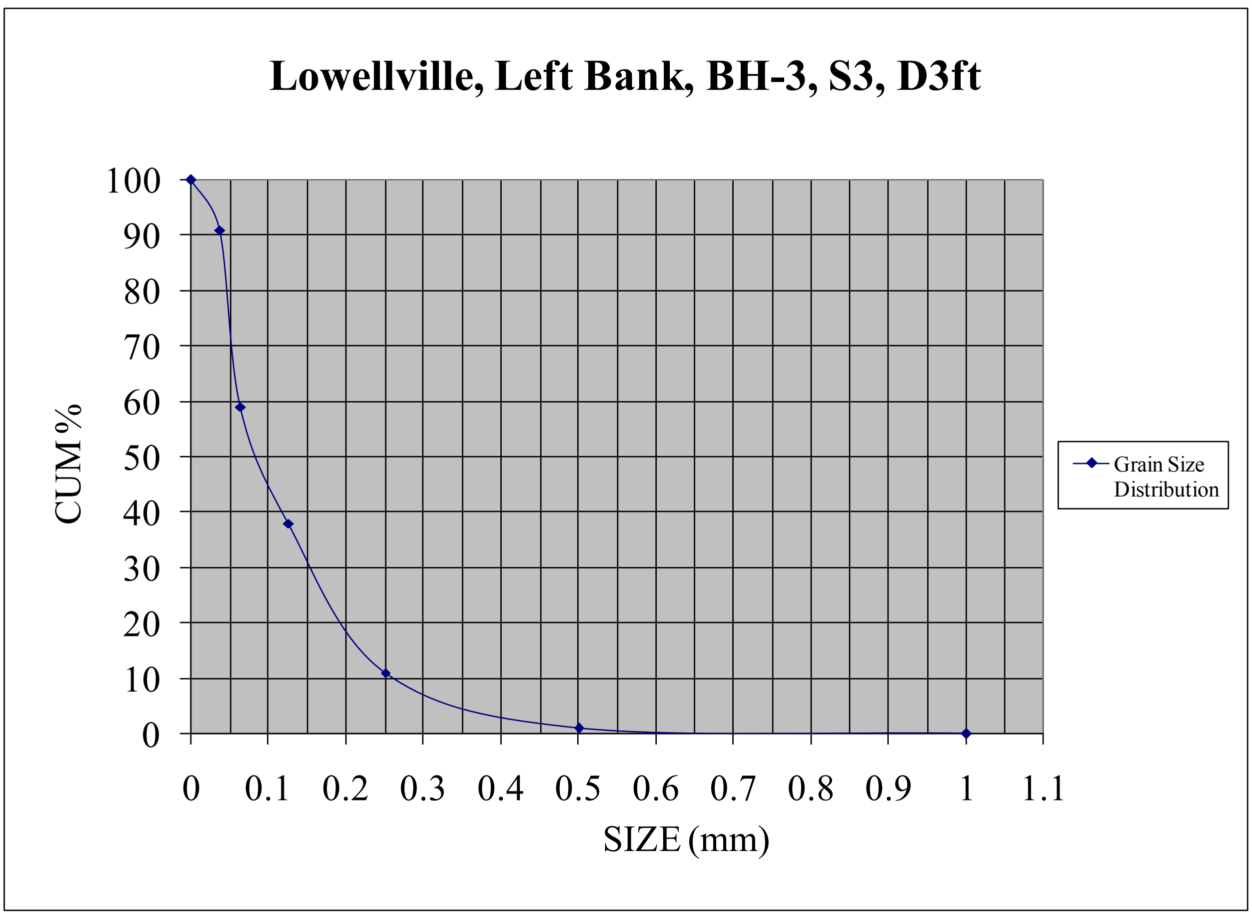
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/14/06	
BH-3, S2, 2 ft. bsg[a]		Original Sample Weight: 109.3g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	0.0	0.0	0
0.25	13.1	13.1	13
0.125	22.7	35.8	34
0.063	26.2	62.0	59
0.044	35.7	97.7	93
pan	7.5	105.2	100

a. Below surface grade.



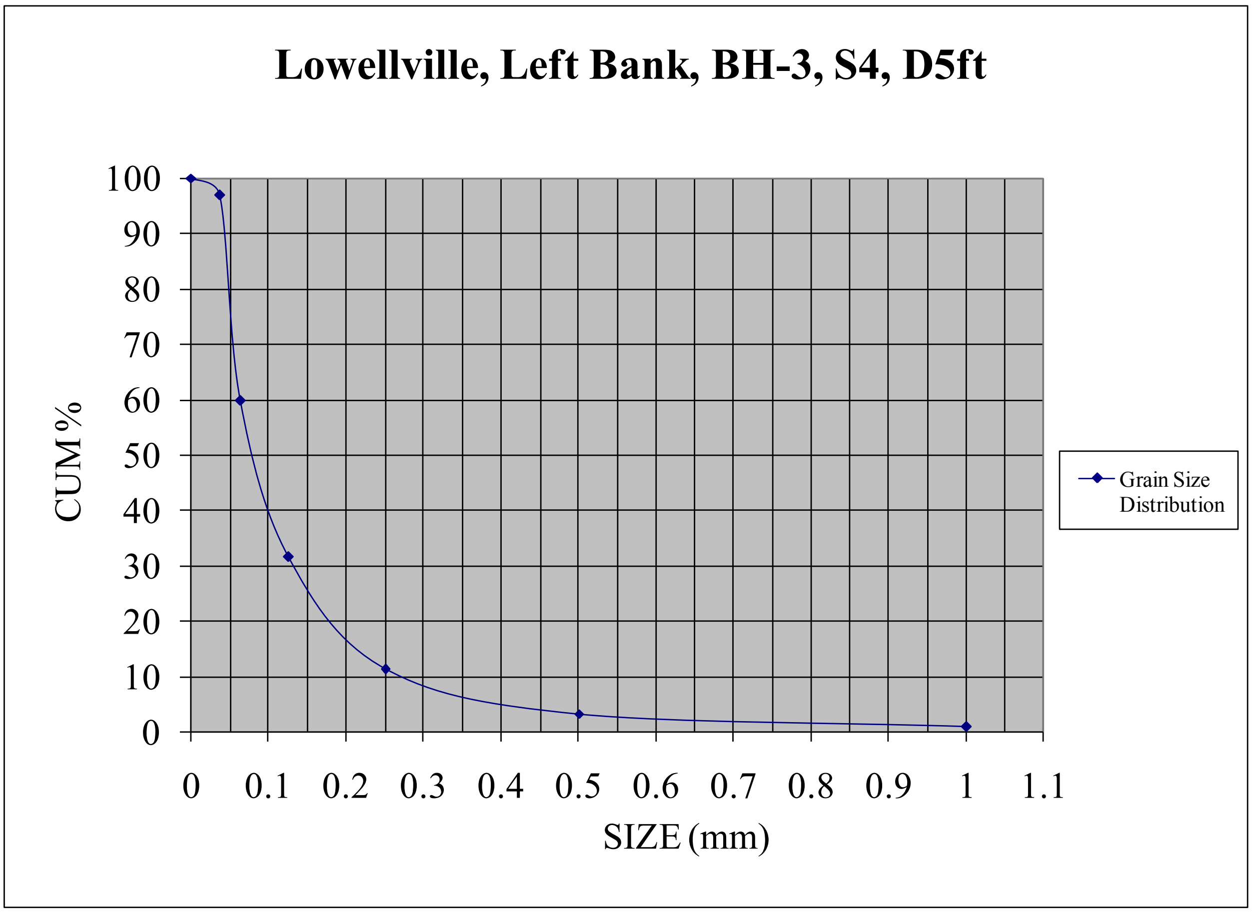
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/14/06	
BH-3, S3, 3 ft. bsg[a]		Original Sample Weight: 109.3g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	0.9	0.9	1
0.25	11.2	12.1	11
0.125	28.8	40.9	38
0.063	22.3	63.2	59
0.044	34.5	97.7	91
pan	9.4	107.1	100

a. Below surface grade.



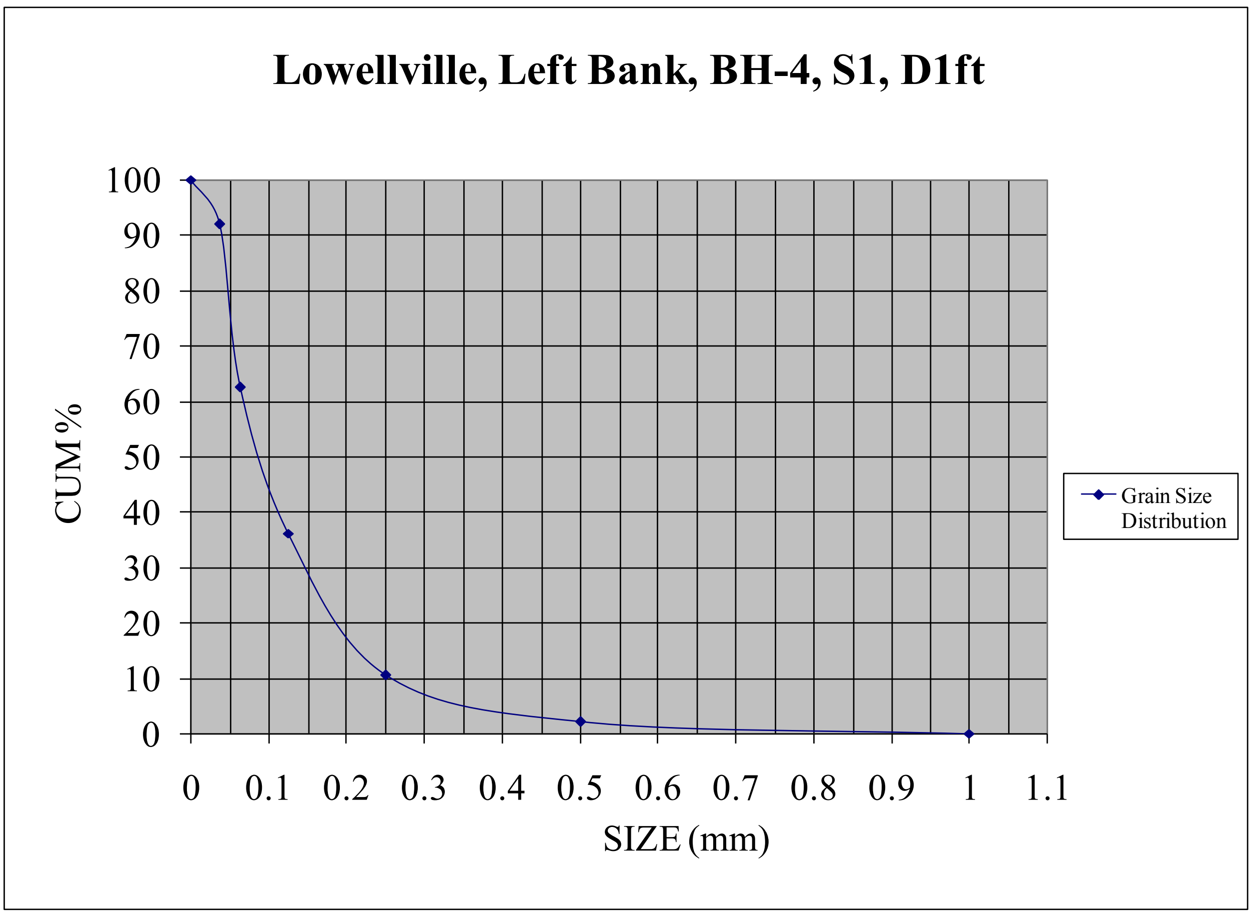
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/14/06	
BH-3, S4, 5 ft. bsg[a]		Original Sample Weight: 102.5g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.8	0.8	1
0.5	2.5	3.3	3
0.25	8.5	11.8	11
0.125	21.2	33.0	32
0.063	29.6	62.6	60
0.044	39.1	101.7	97
pan	3.2	104.9	100

a. Below surface grade.



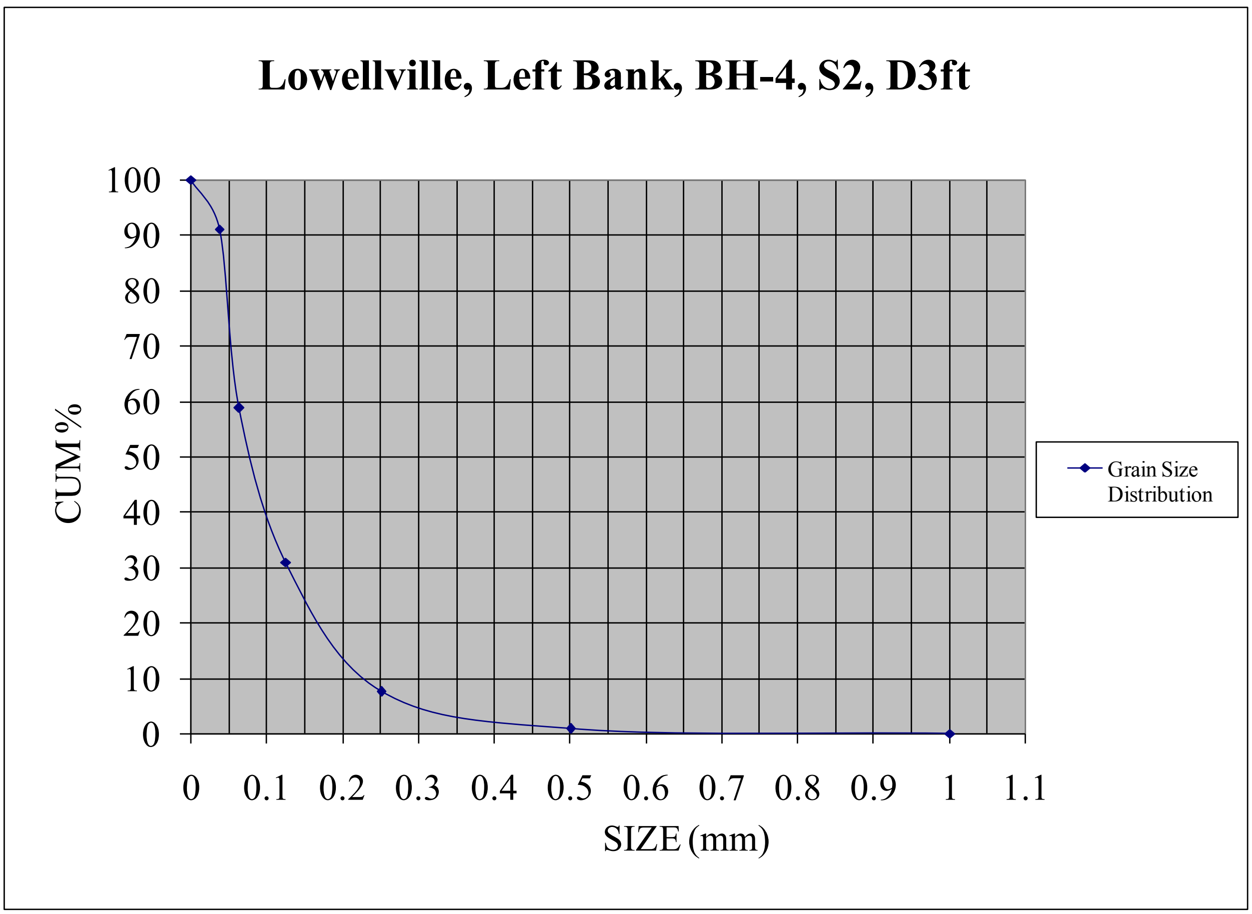
Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/27/06	
BH-4, S1, 1 ft. bsg[a]		Original Sample Weight: 106.4g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	2.3	2.3	2
0.25	8.8	11.1	11
0.125	27.0	38.1	36
0.063	27.8	65.9	62
0.044	31.1	97.0	92
pan	8.5	105.5	100

a. Below surface grade.



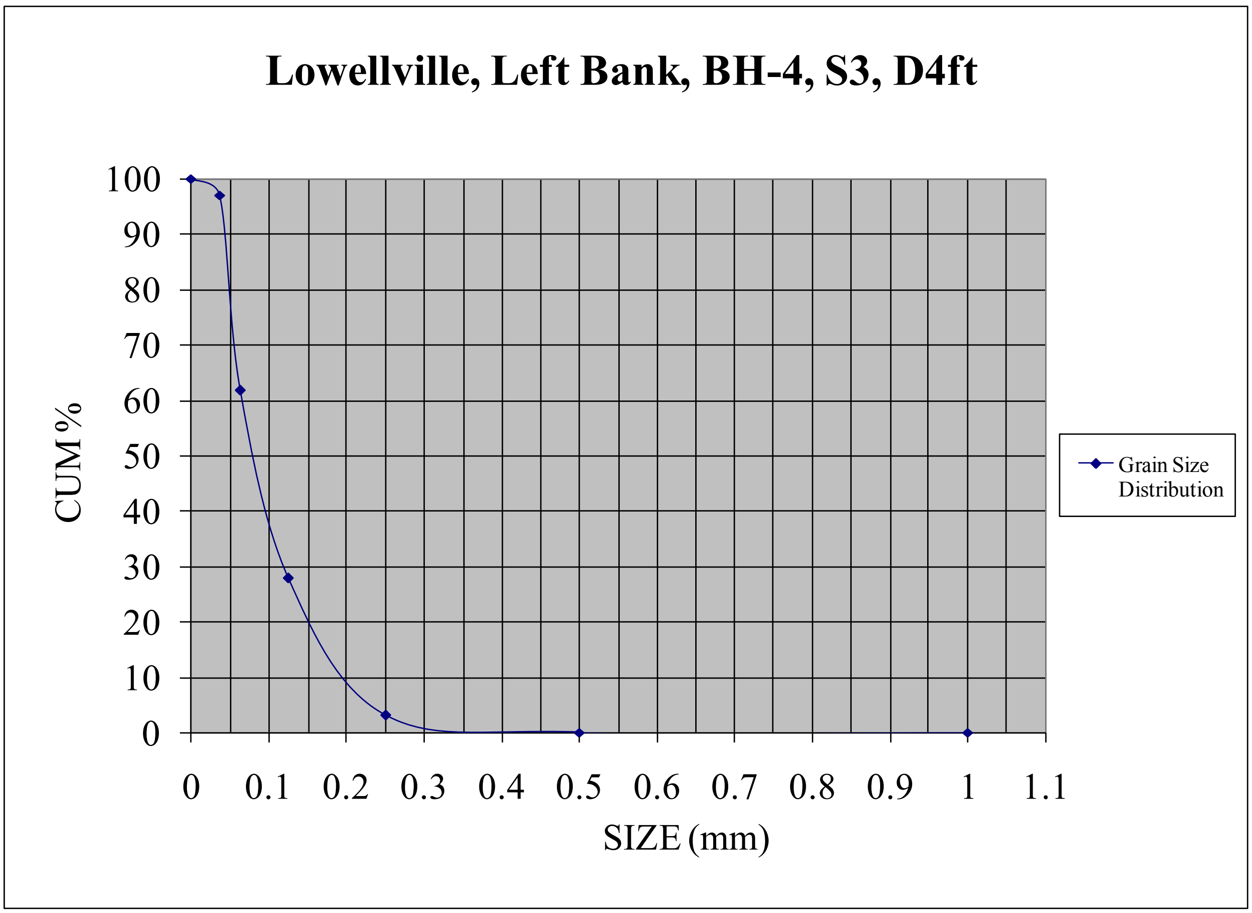
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/14/06	
BH-4, S2, 3 ft. bsg[a]		Original Sample Weight: 93.1g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	0.7	0.7	1
0.25	6.3	7.0	8
0.125	21.7	28.7	31
0.063	25.8	54.5	59
0.044	30.0	84.5	91
pan	8.3	92.8	100

a. Below surface grade.



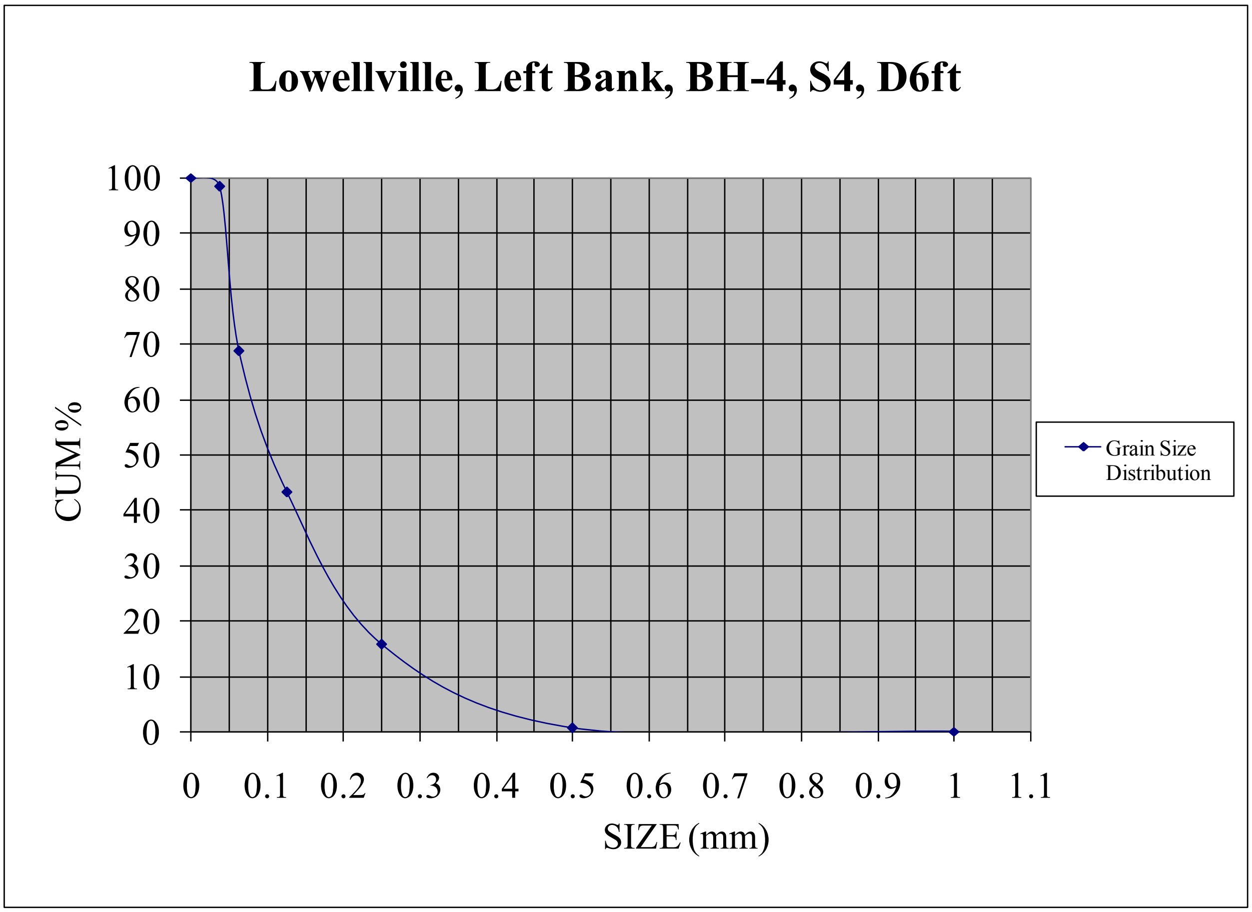
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/14/06	
BH-4, S3, 4 ft. bsg[a]		Original Sample Weight: 105.7g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	0.0	0.0	0
0.25	3.6	3.6	3
0.125	25.2	28.8	28
0.063	35.3	64.1	62
0.044	36.6	100.7	97
pan	3.1	103.8	100

a. Below surface grade.



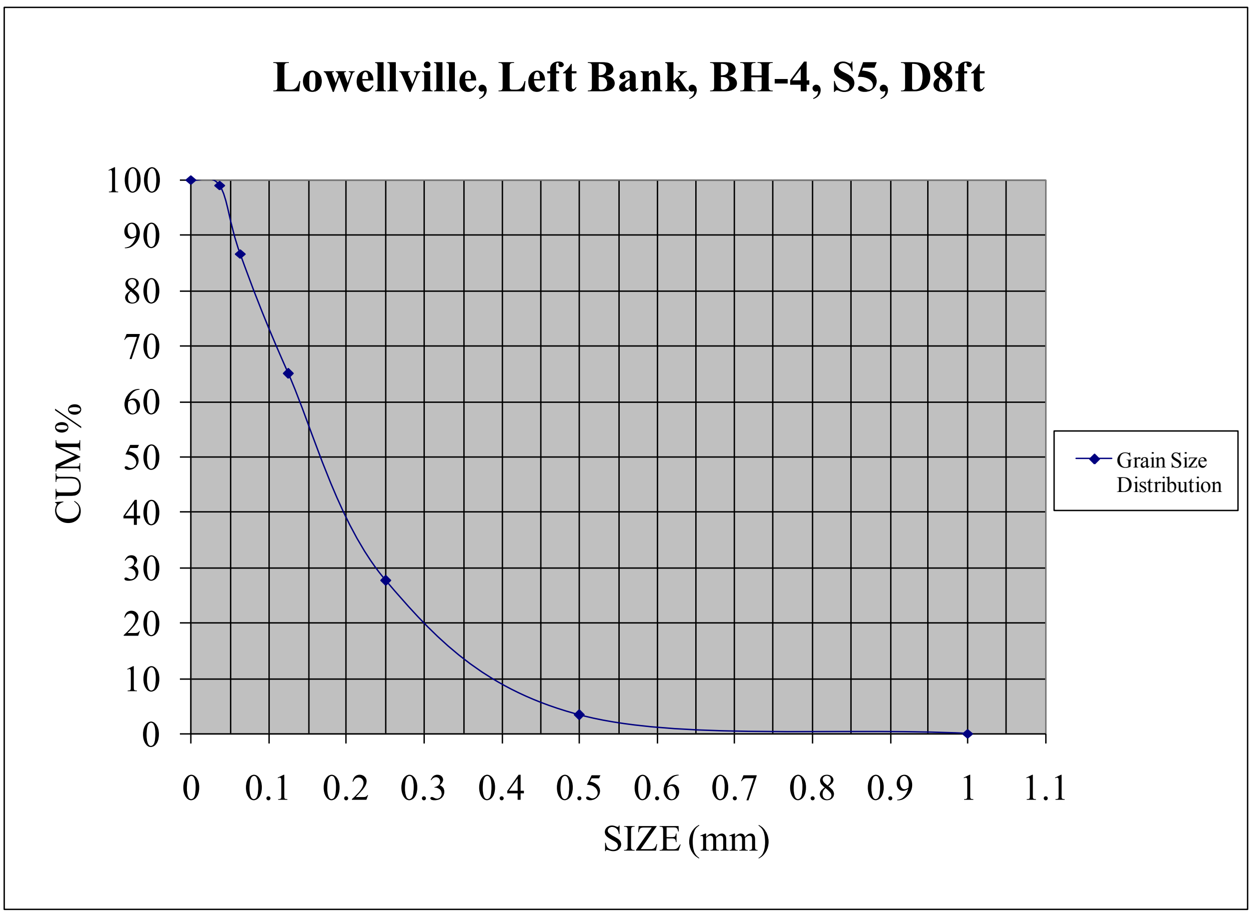
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/14/06	
BH-4, S4, 6 ft. bsg[a]		Original Sample Weight: 106.9g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	0.7	0.7	1
0.25	16.0	16.7	16
0.125	29.1	45.8	43
0.063	27.1	72.9	69
0.044	31.5	104.4	98
pan	1.7	106.1	100

a. Below surface grade.



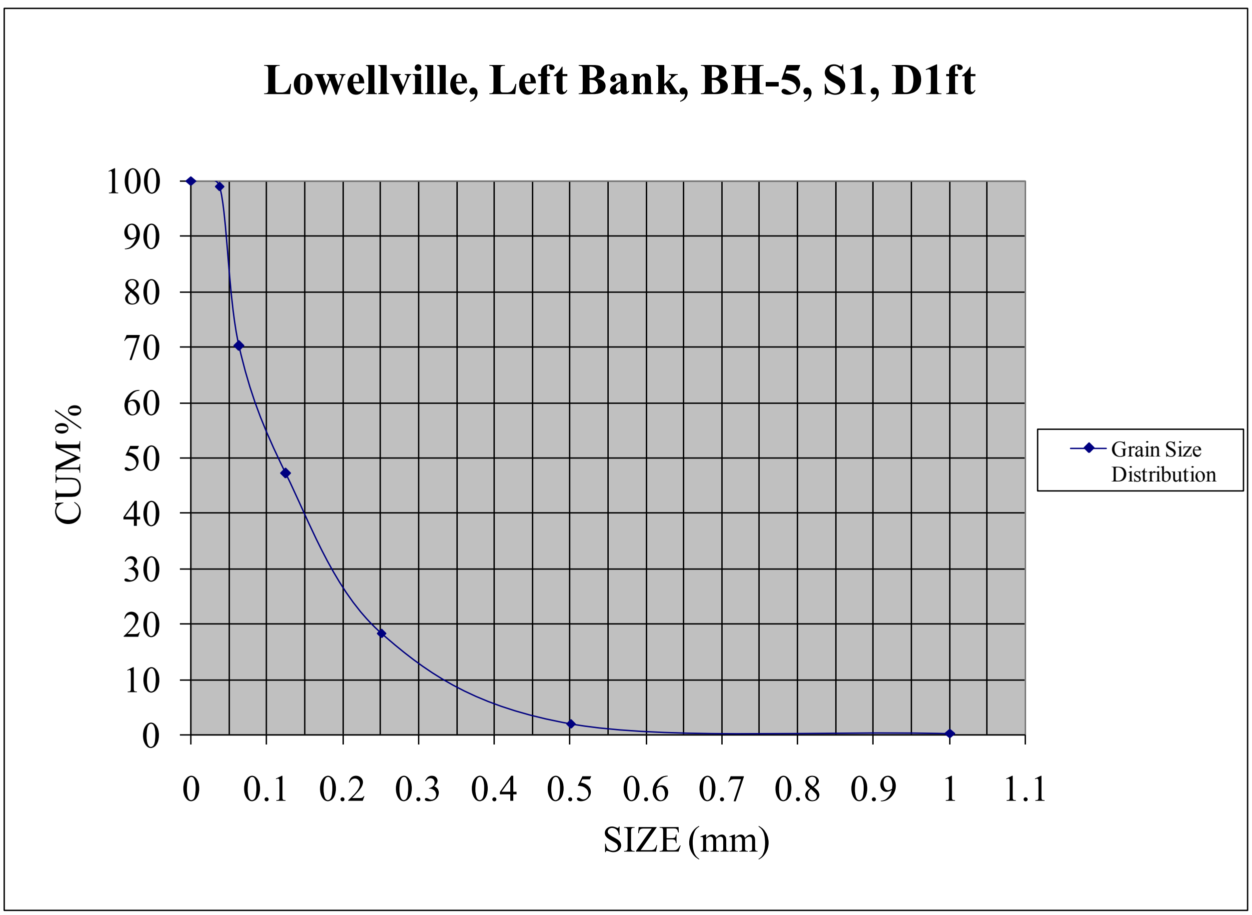
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/14/06	
BH-4, S5, 8 ft. bsg[a]		Original Sample Weight: 110.4g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	3.6	3.6	3
0.25	26.5	30.1	28
0.125	40.7	70.8	65
0.063	23.7	94.5	87
0.044	13.5	108.0	99
pan	1.1	109.1	100

a. Below surface grade.



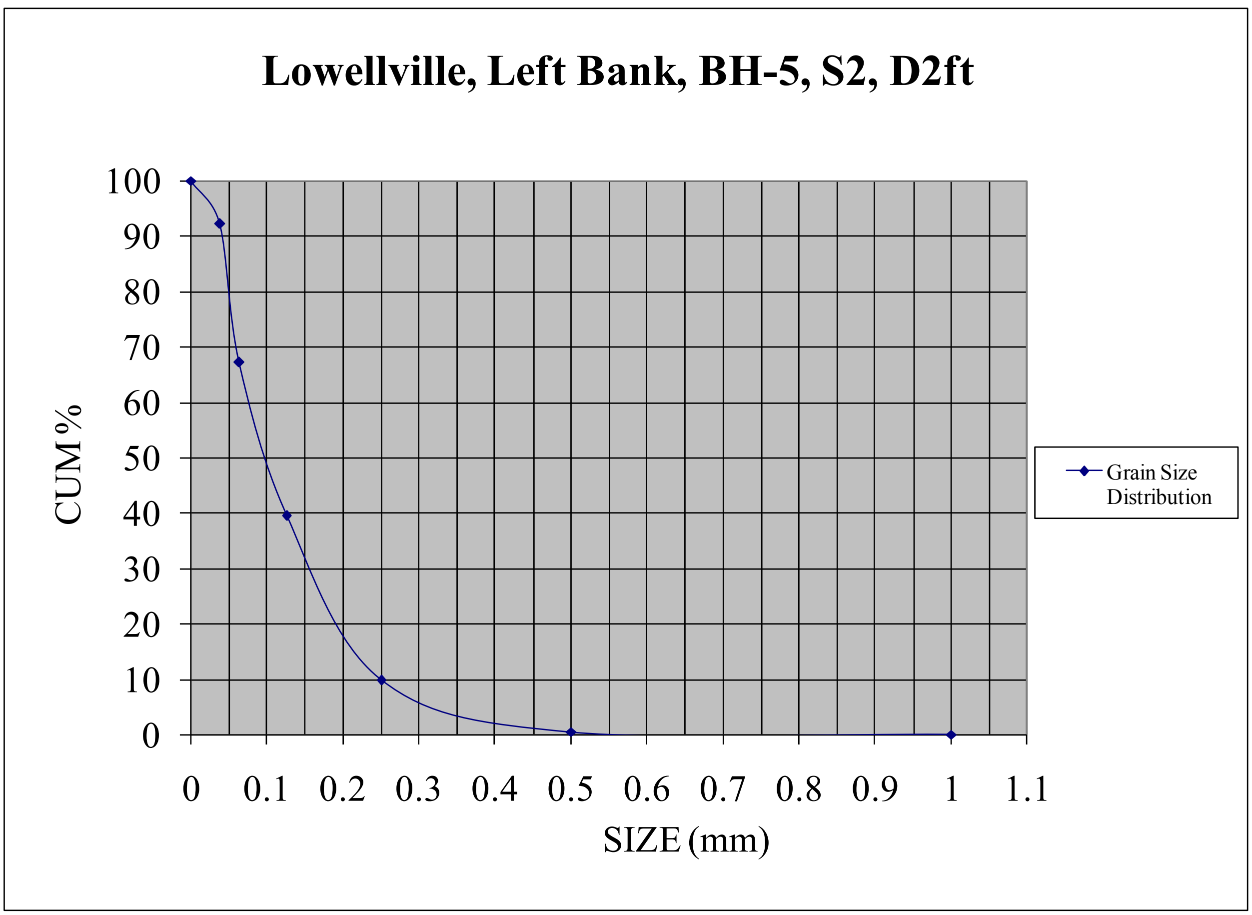
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/27/06	
BH-5, S1, 1 ft. bsg[a]		Original Sample Weight: 117.7g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.2	0.2	0
0.5	2.1	2.3	2
0.25	19.2	21.5	18
0.125	33.7	55.2	47
0.063	27.0	82.2	70
0.044	33.8	116.0	99
pan	1.2	117.2	100

a. Below surface grade.



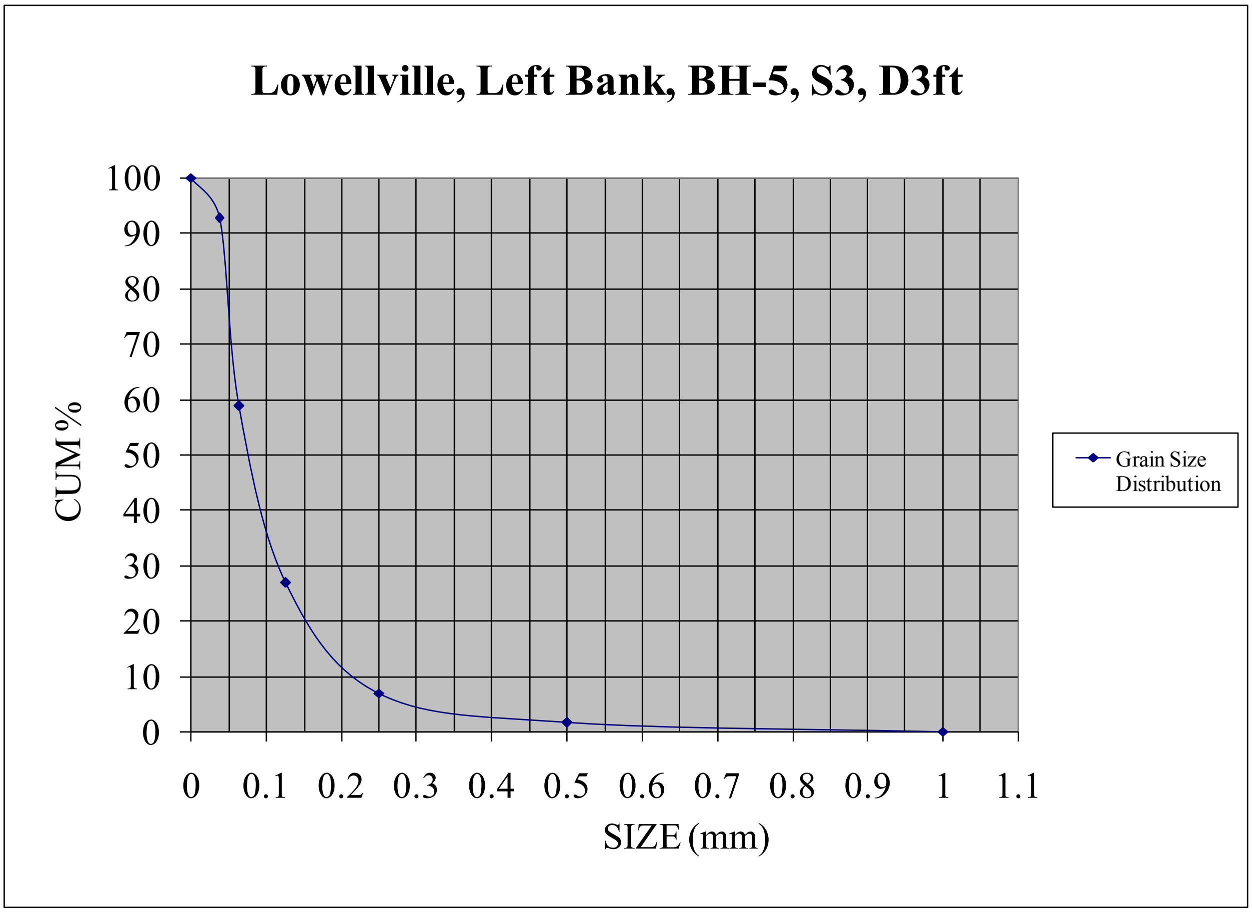
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/27/06	
BH-5, S2, 2ft. bsg[a]		Original Sample Weight: 92.1g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	0.4	0.4	0
0.25	8.4	8.8	10
0.125	27.1	35.9	39
0.063	25.3	61.2	67
0.044	22.7	83.9	92
pan	7.1	91.0	100

a. Below surface grade.



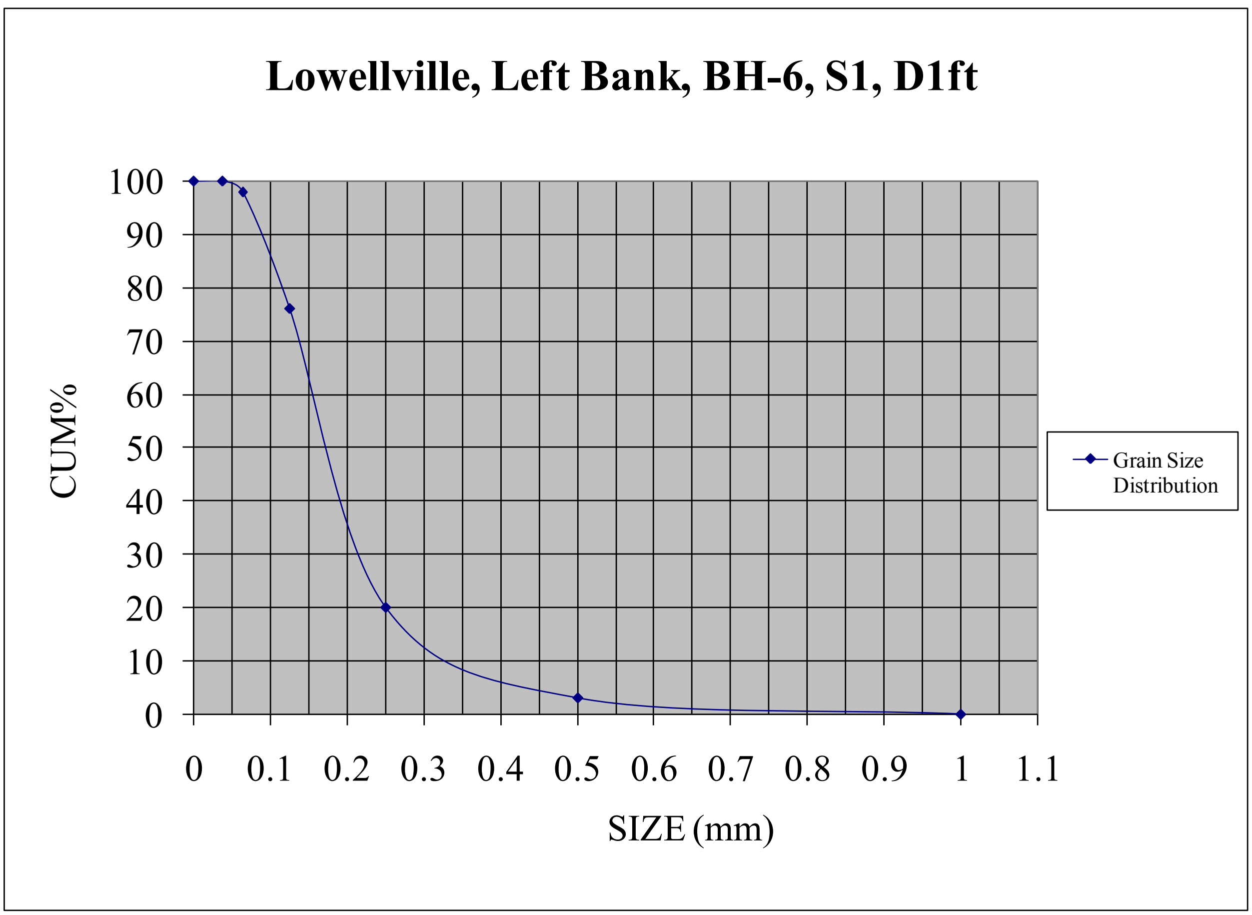
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/27/06	
BH-5, S3, 3ft. bsg[a]		Original Sample Weight: 113.0g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	1.8	1.8	2
0.25	5.9	7.7	7
0.125	22.3	30.0	27
0.063	35.5	65.5	59
0.044	38.0	103.5	93
pan	8.1	111.6	100

a. Below surface grade.



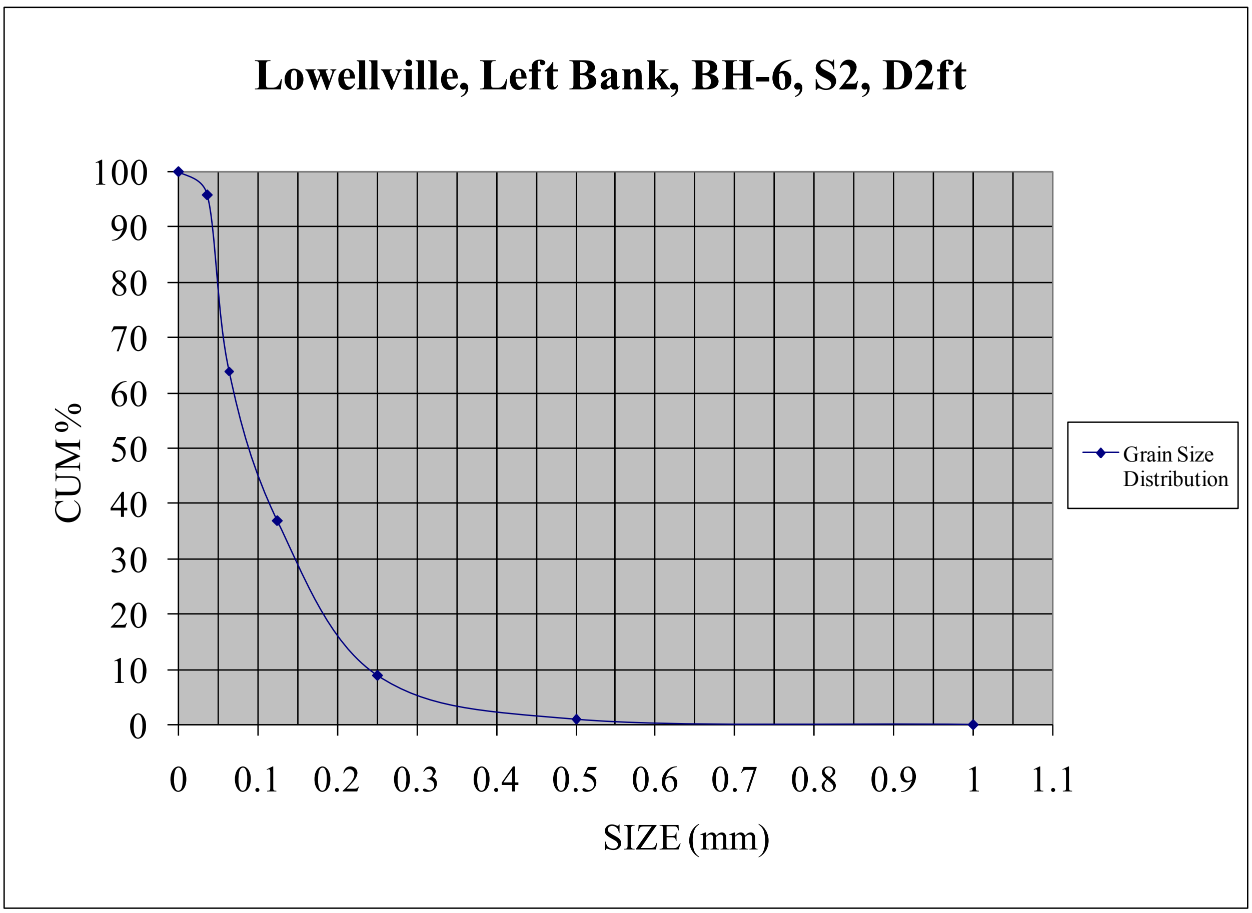
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/27/06	
BH-6, S1, 1ft. bsg[a]		Original Sample Weight: 101.4g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	3.2	3.2	3
0.25	16.7	19.9	20
0.125	55.0	74.9	76
0.063	21.7	96.6	98
0.044	1.8	98.4	100
pan	0.3	98.7	100

a. Below surface grade.



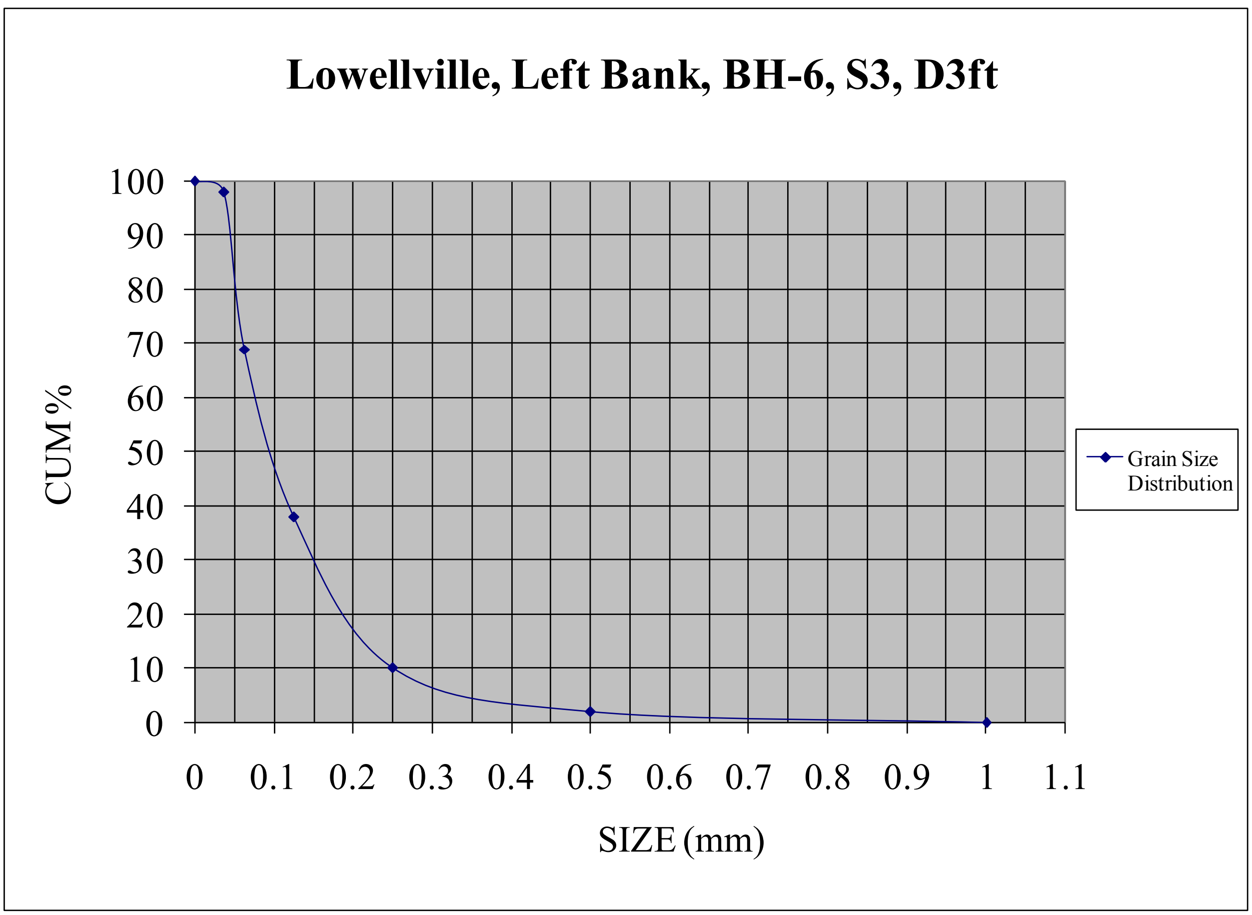
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/27/06	
BH-6, S2, 2 ft. bsg[a]		Original Sample Weight: 106.9g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	1.0	1.0	1
0.25	8.1	9.1	9
0.125	29.5	38.6	37
0.063	28.4	67.0	64
0.044	33.3	100.3	96
pan	4.3	104.6	100

a. Below surface grade.



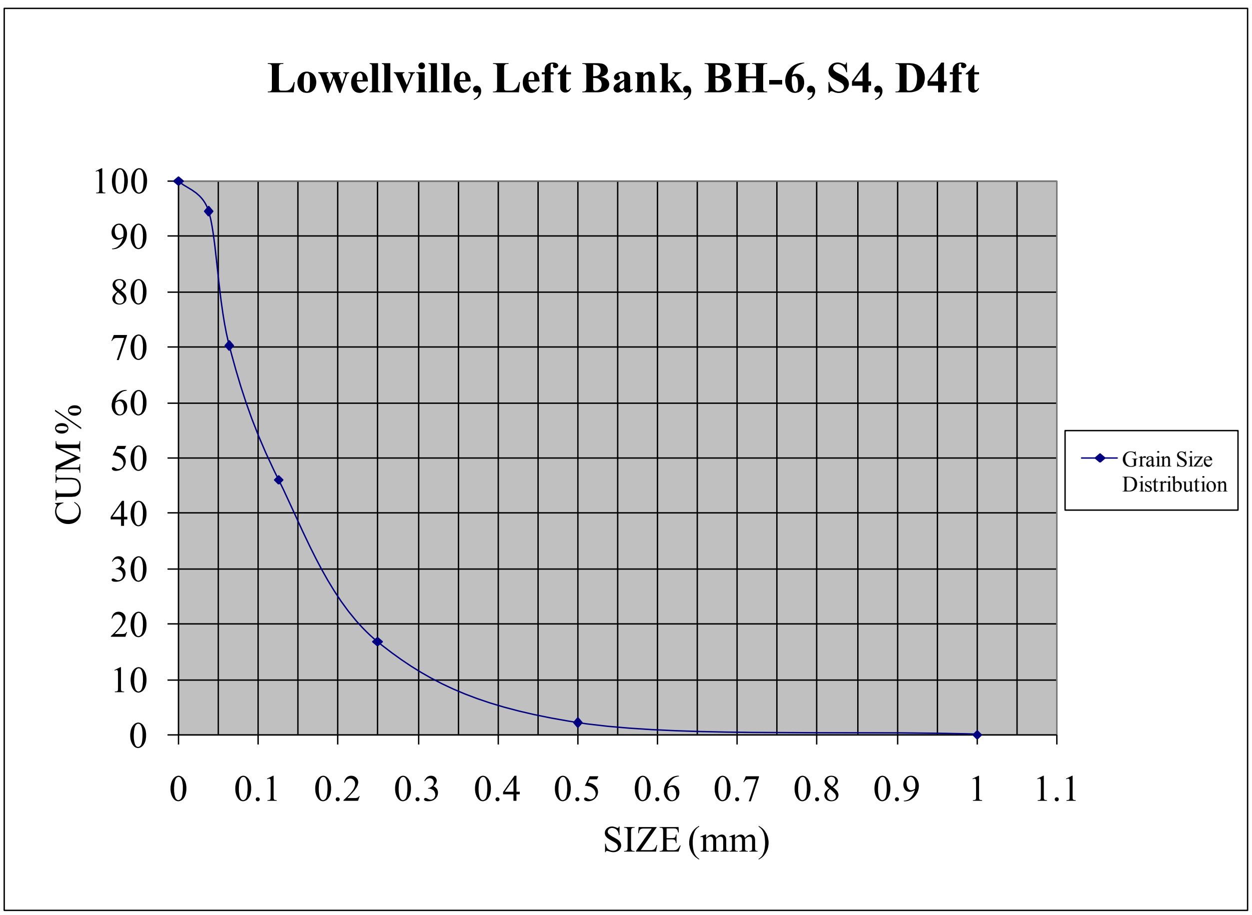
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/27/06	
BH-6, S3, 3ft. bsg[a]		Original Sample Weight: 106.3g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	2.1	2.1	2
0.25	8.5	10.6	10
0.125	29.6	40.2	38
0.063	32.8	73.0	69
0.044	30.7	103.7	98
pan	2.1	105.8	100

a. Below surface grade.



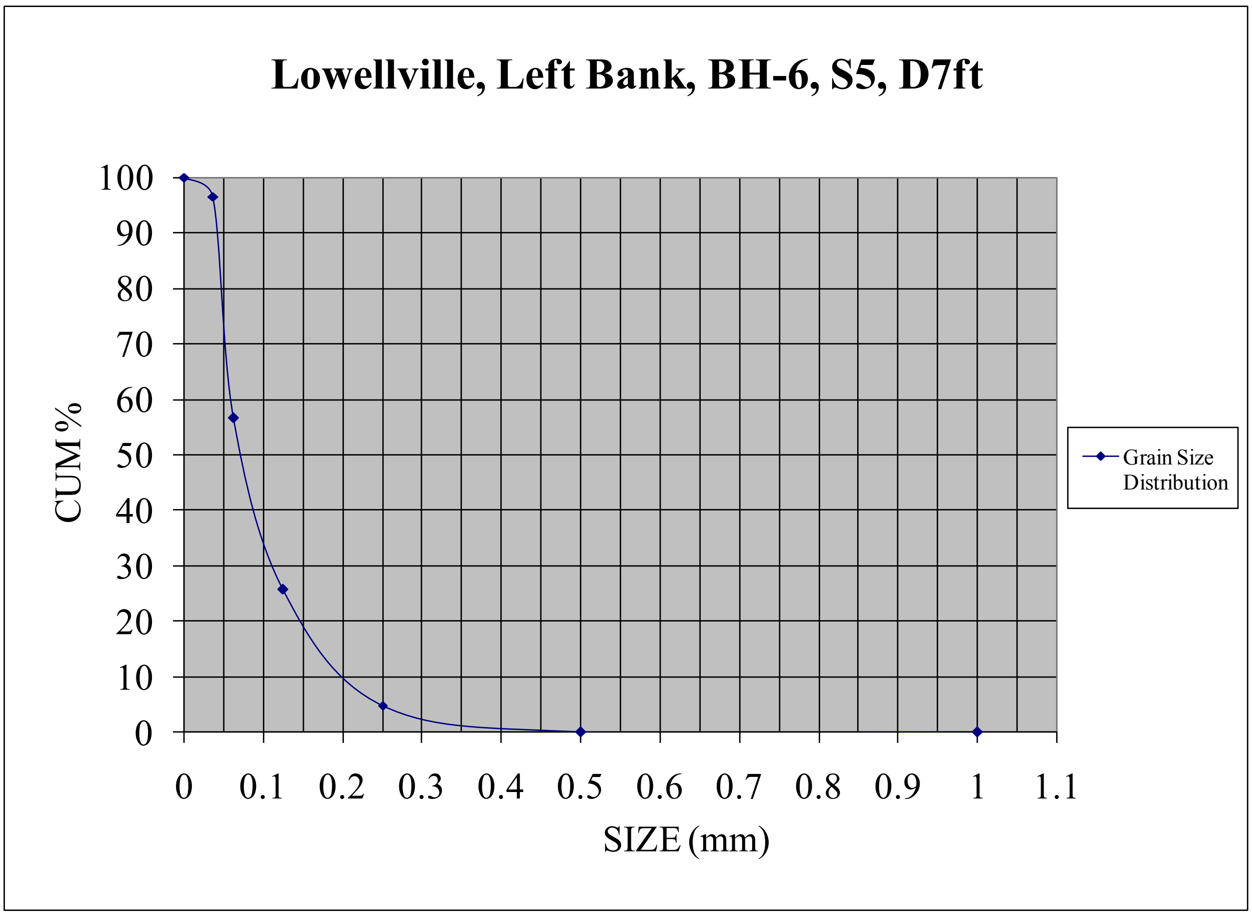
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		**Sample Date: 5/27/06**	
BH-6, S4, 4ft. bsg[a]		**Original Sample Weight: 104.8g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	2.2	2.2	2
0.25	15.0	17.2	17
0.125	30.6	47.8	46
0.063	24.7	72.5	70
0.044	25.1	97.6	95
pan	5.6	103.2	100

a. Below surface grade.



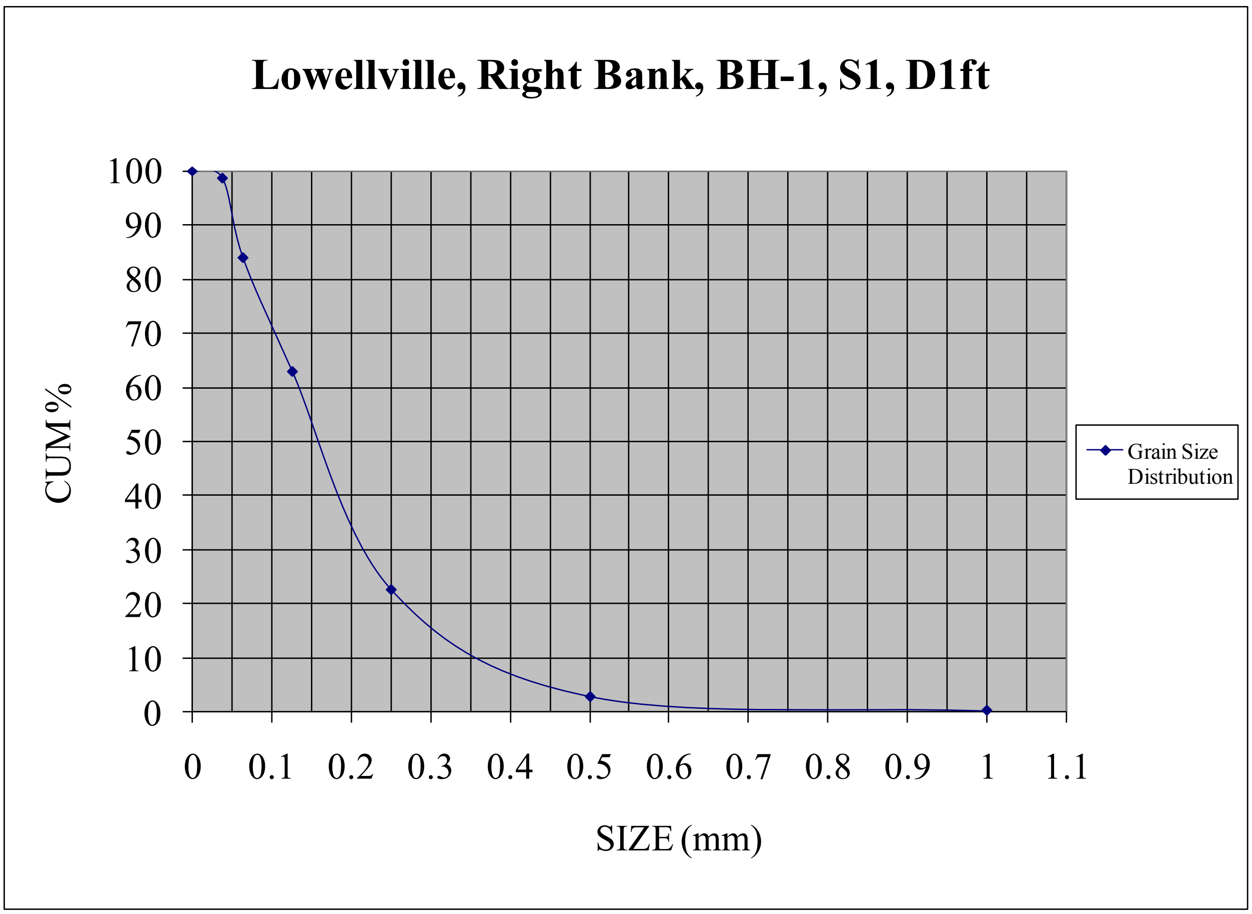
Soil Grain-size Analysis Laboratory Results			
Lowellville Left Bank		Sample Date: 5/27/06	
BH-6, S5, 7ft. bsg[a]		Original Sample Weight: 103.9g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	0.3	0.3	0
0.25	4.6	4.9	5
0.125	21.4	26.3	26
0.063	31.6	57.9	57
0.044	40.8	98.7	96
pan	3.6	102.3	100

a. Below surface grade.



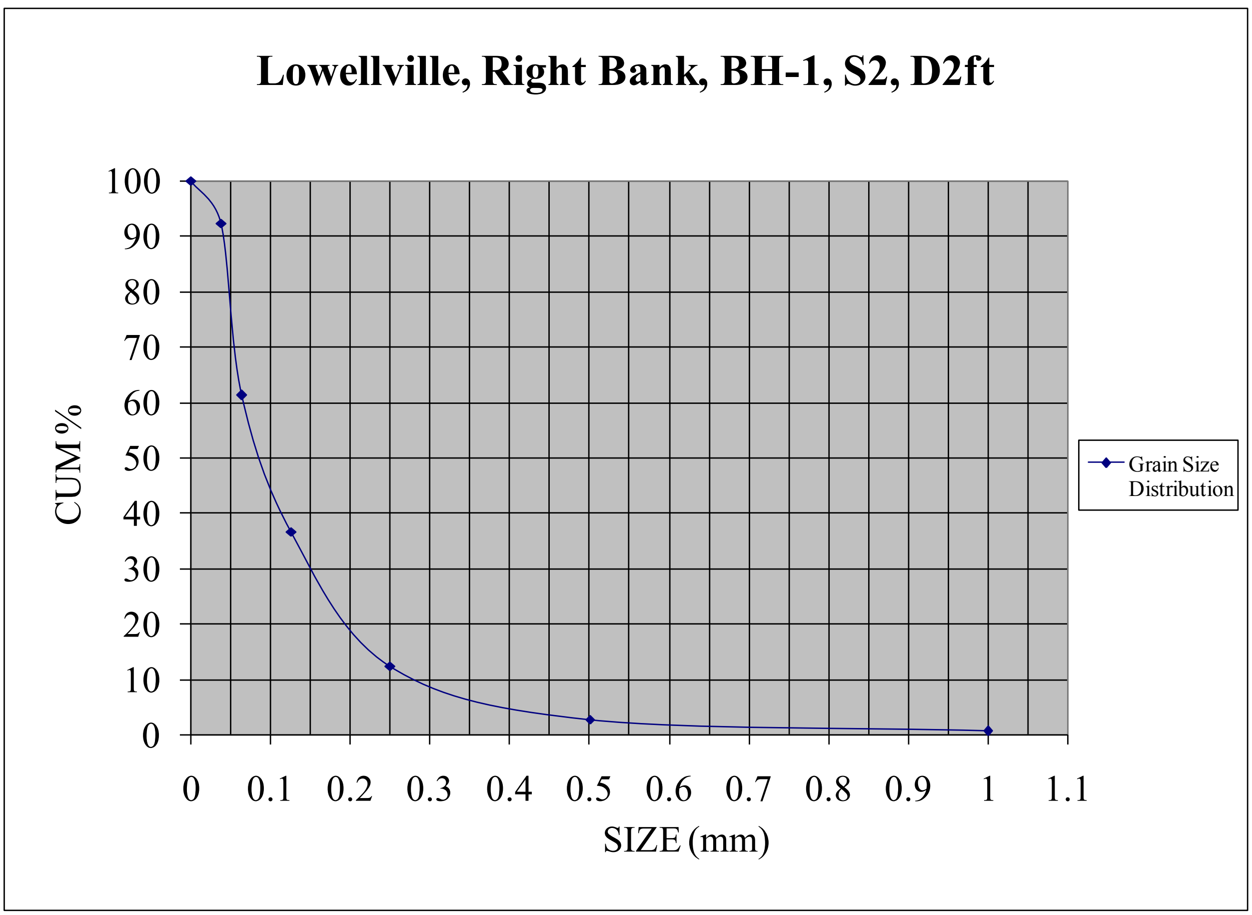
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		Sample Date: 6/24/06	
BH-1, S1, 1 ft. bsg[a]		Original Sample Weight: 115.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.3	0.3	0
0.5	3.0	3.3	3
0.25	22.4	25.7	23
0.125	46.2	71.9	63
0.063	23.9	95.8	84
0.037	16.9	112.7	99
pan	1.6	114.3	100

a. Below surface grade.



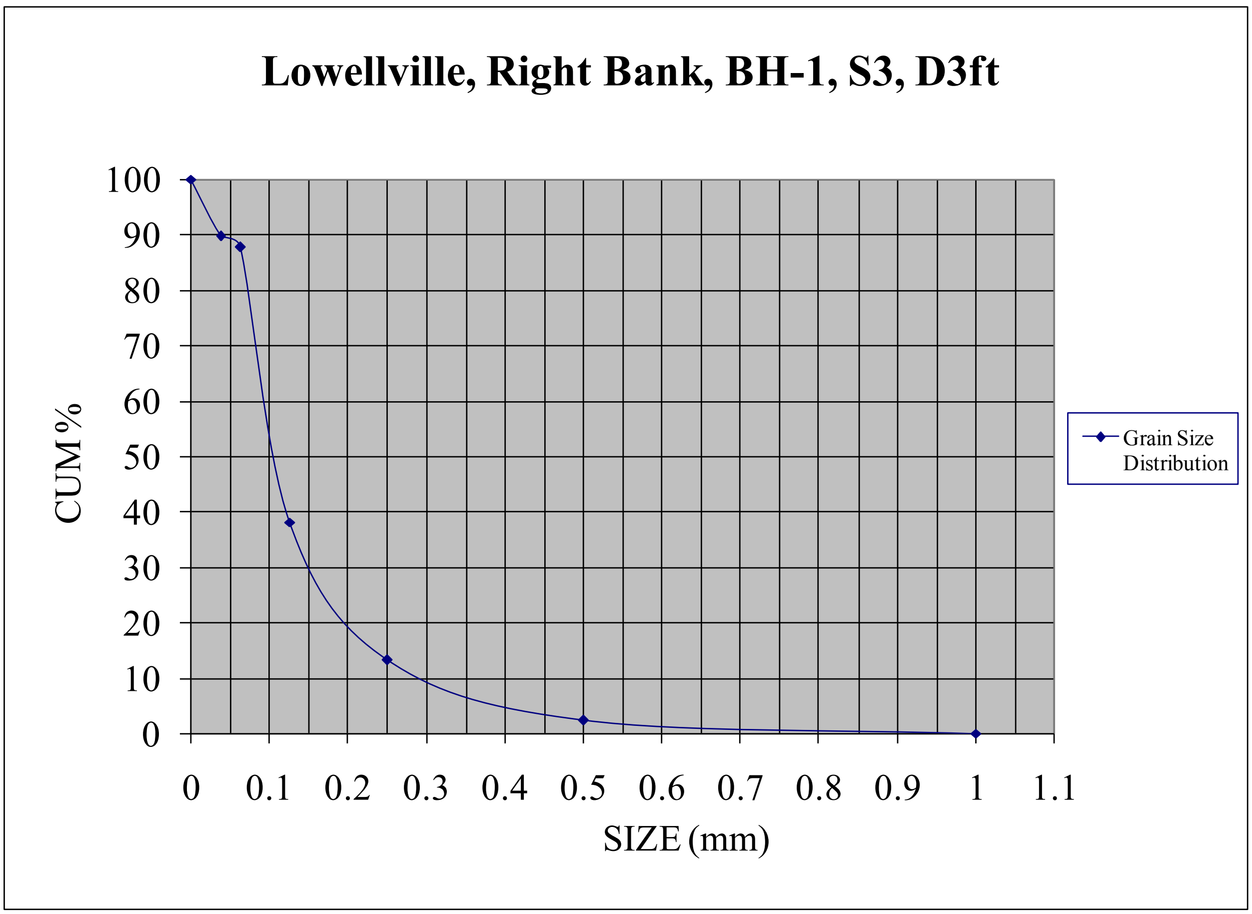
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		**Sample Date: 6/24/06**	
BH-1, S2, 2ft. bsg[a]		**Original Sample Weight: 110.0g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.6	0.6	1
0.5	2.3	2.9	3
0.25	10.6	13.5	12
0.125	26.8	40.3	37
0.063	26.7	67.0	61
0.037	33.9	100.9	92
pan	8.4	109.3	100

a. Below surface grade.



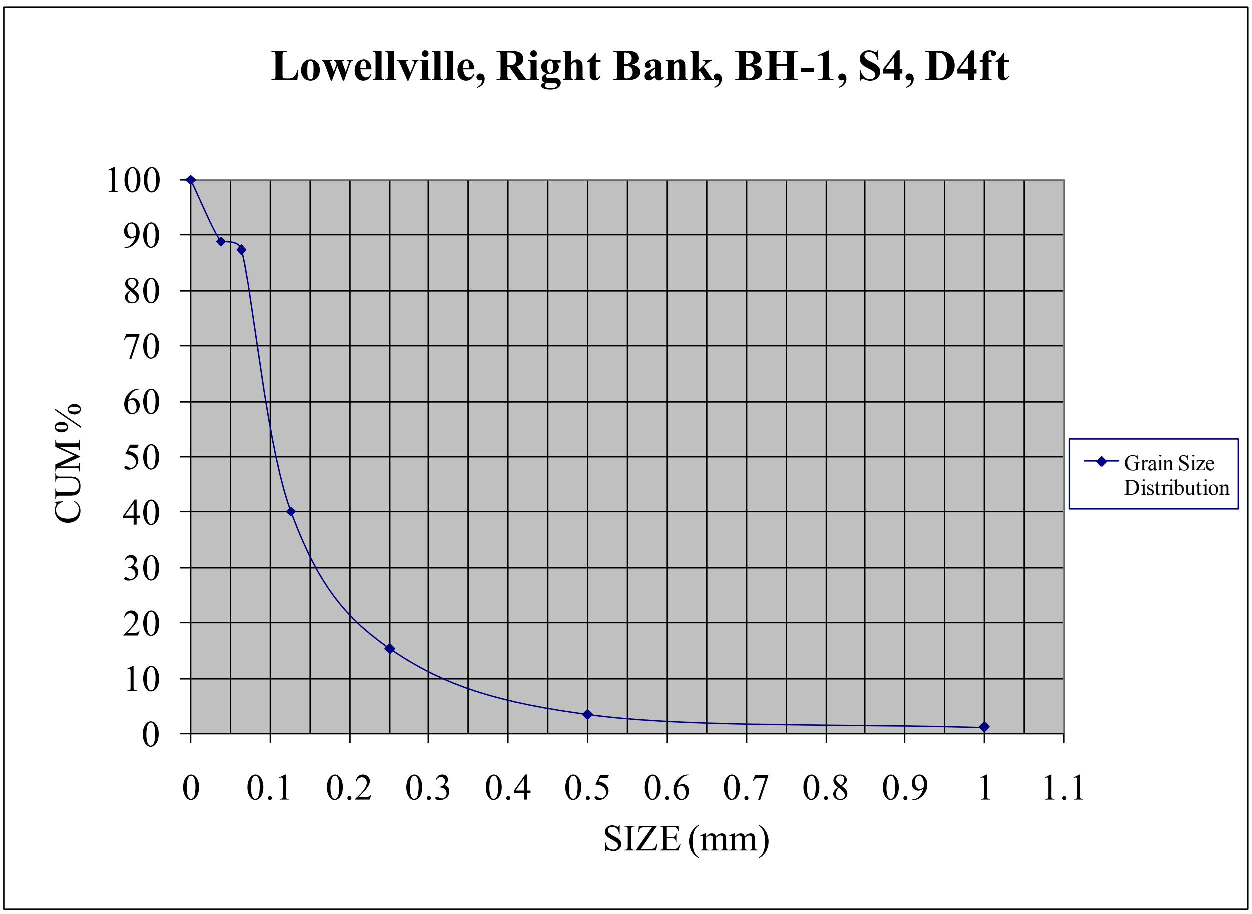
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		Sample Date: 6/24/06	
BH-1, S3, 3ft. bsg[a]		Original Sample Weight: 111.2g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	2.6	0.0	2
0.25	12.0	14.6	13
0.125	27.5	42.1	38
0.063	54.8	96.9	88
0.037	2.3	99.2	90
pan	11.3	110.5	100

a. Below surface grade.



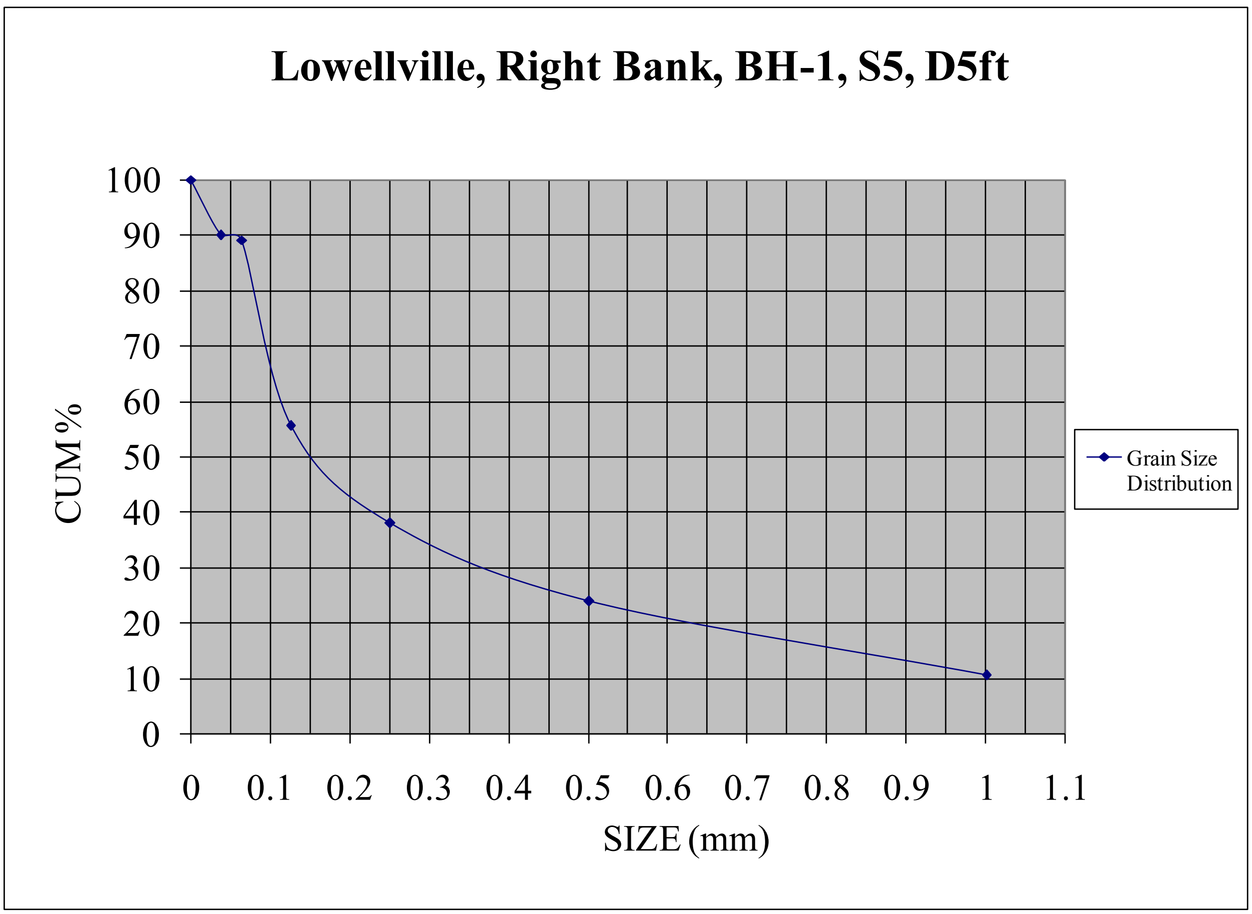
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		Sample Date: 6/24/06	
BH-1, S4, 4ft. bsg[a]		Original Sample Weight: 107.4g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.5	0.5	1
0.5	3.0	3.5	3
0.25	12.7	16.2	15
0.125	26.4	42.6	40
0.063	50.1	92.7	87
0.037	1.9	94.6	89
pan	11.7	106.3	100

a. Below surface grade.



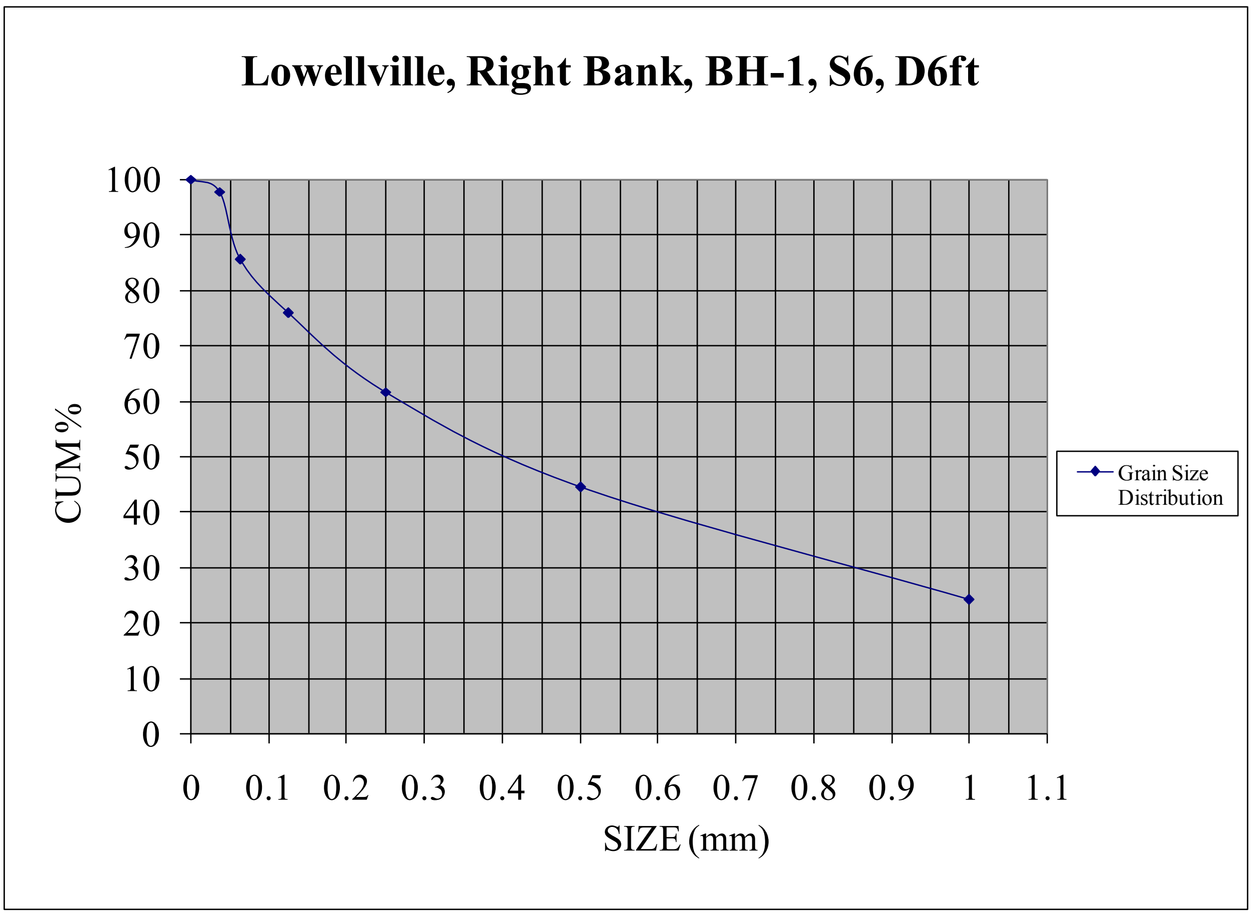
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		Sample Date: 6/24/06	
BH-1, S5, 5ft. bsg[a]		Original Sample Weight: 107.5g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	11.2	11.2	11
0.5	14.3	25.5	24
0.25	15.0	40.5	38
0.125	18.7	59.2	56
0.063	35.7	94.9	89
0.037	1.4	96.3	90
pan	10.2	106.5	100

a. Below surface grade.



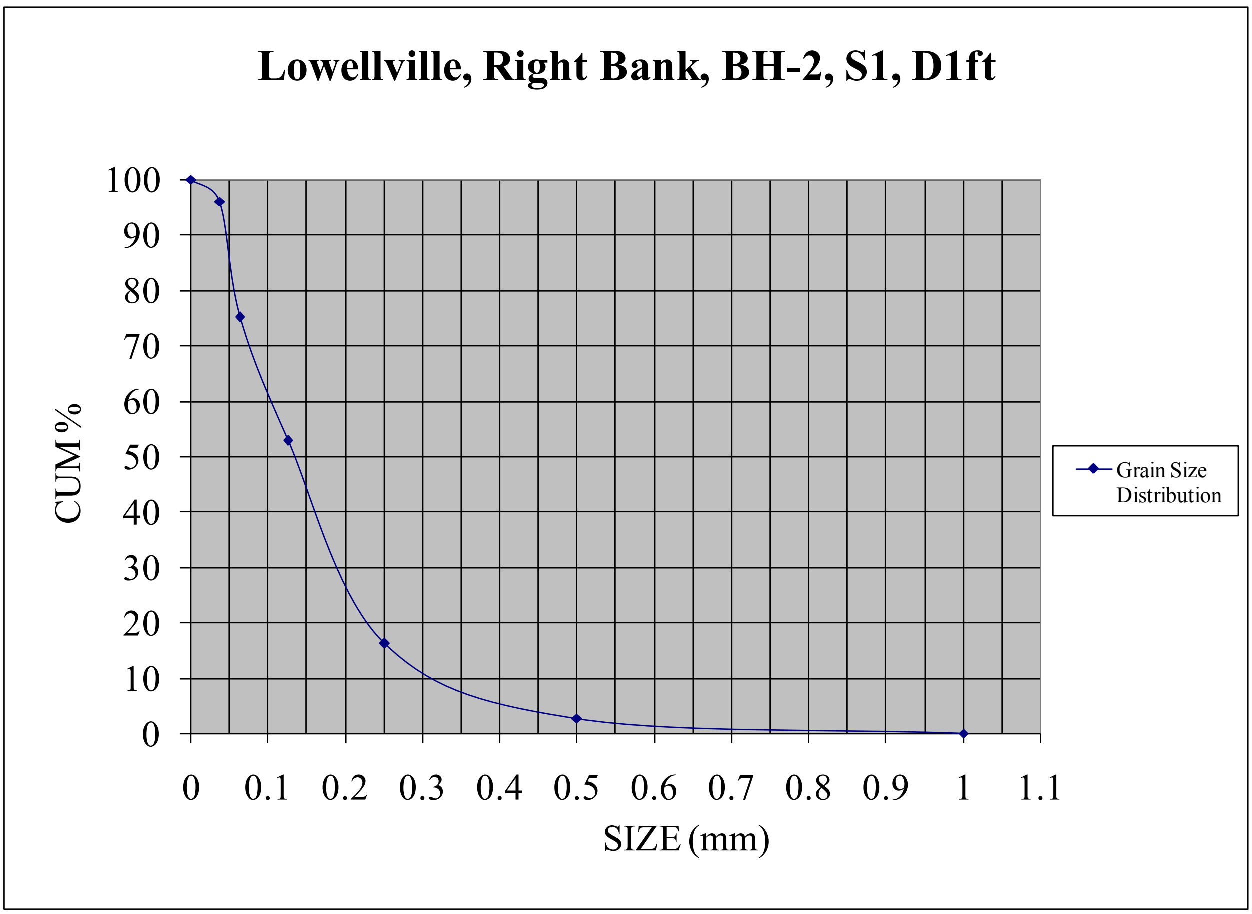
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		Sample Date: 6/24/06	
BH-1, S6, 6ft. bsg[a]		Original Sample Weight: 124.0g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	29.8	29.8	24
0.5	24.9	54.7	44
0.25	21.3	76.0	62
0.125	17.4	93.4	76
0.063	12.2	105.6	86
0.037	15.0	120.6	98
pan	2.7	123.3	100

a. Below surface grade.



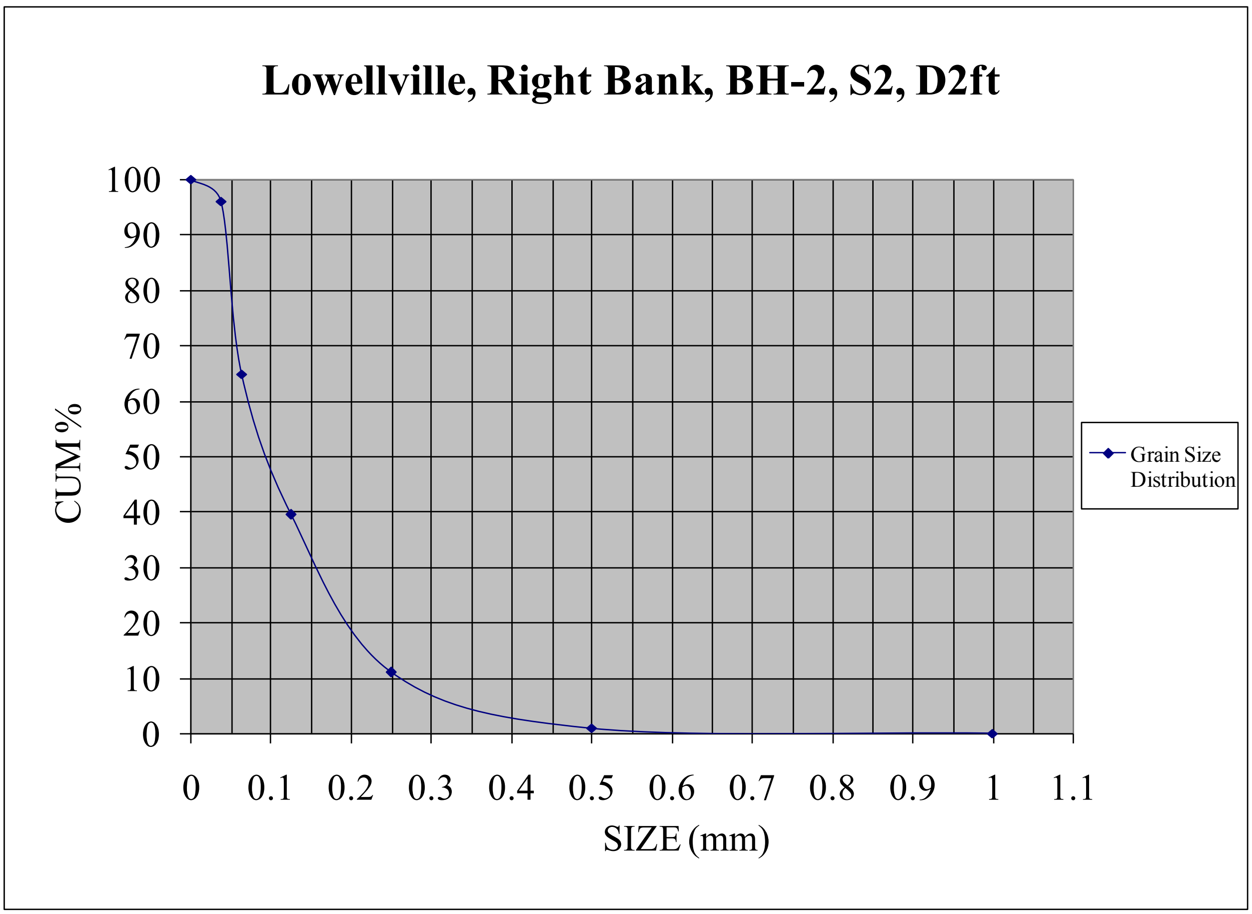
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		Sample Date: 6/24/06	
BH-2, S1, 1 ft. bsg[a]		Original Sample Weight: 109.0g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	2.9	2.9	3
0.25	14.6	17.4	16
0.125	39.3	56.8	53
0.063	23.9	80.7	75
0.037	22.4	103.1	96
pan	4.2	107.3	100

a. Below surface grade.



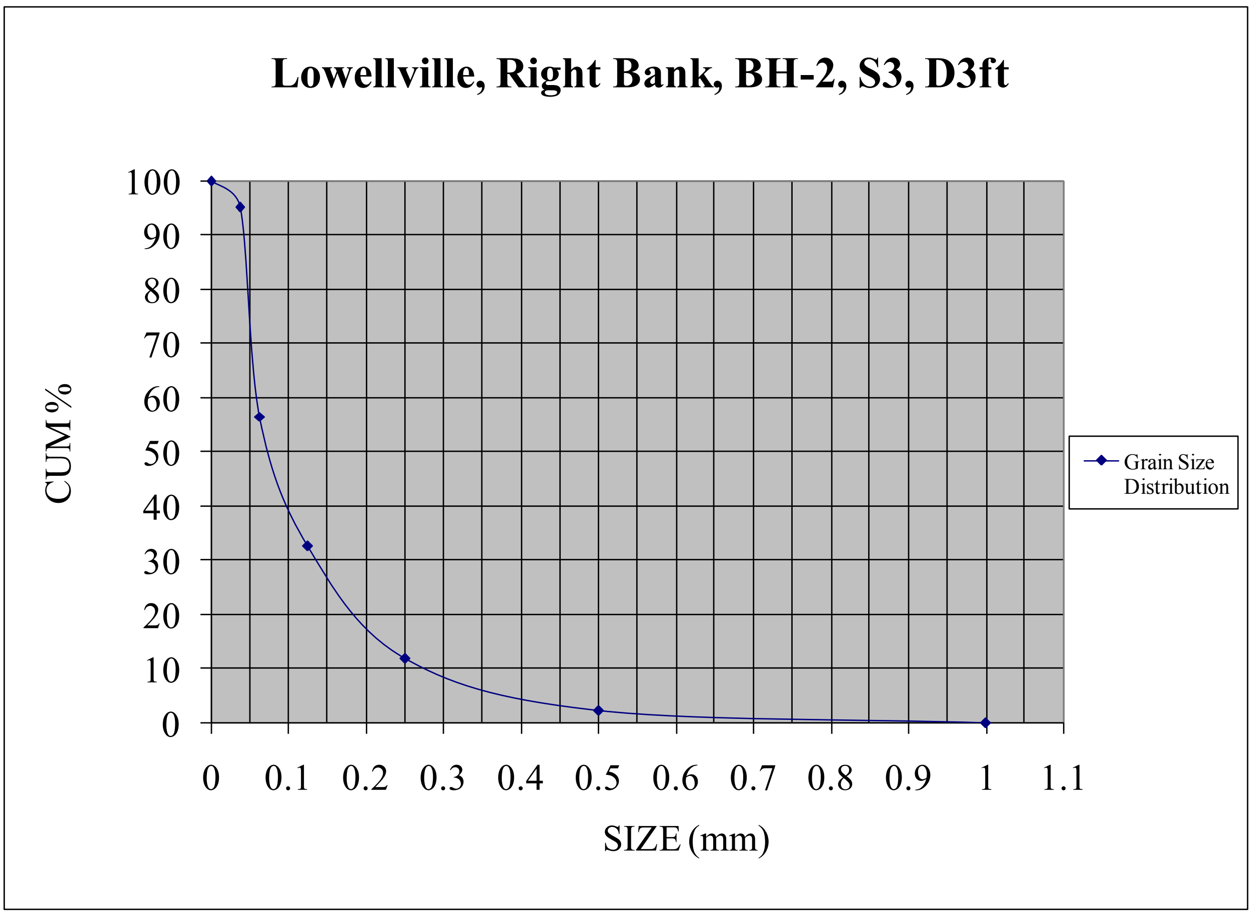
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		**Sample Date: 6/24/06**	
BH-2, S2, 2 ft. bsg[a]		**Original Sample Weight: 113.4g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	1.1	1.1	1
0.25	11.4	12.5	11
0.125	32.1	44.6	39
0.063	28.8	73.4	65
0.037	35.3	108.7	96
pan	4.4	113.1	100

a. Below surface grade.



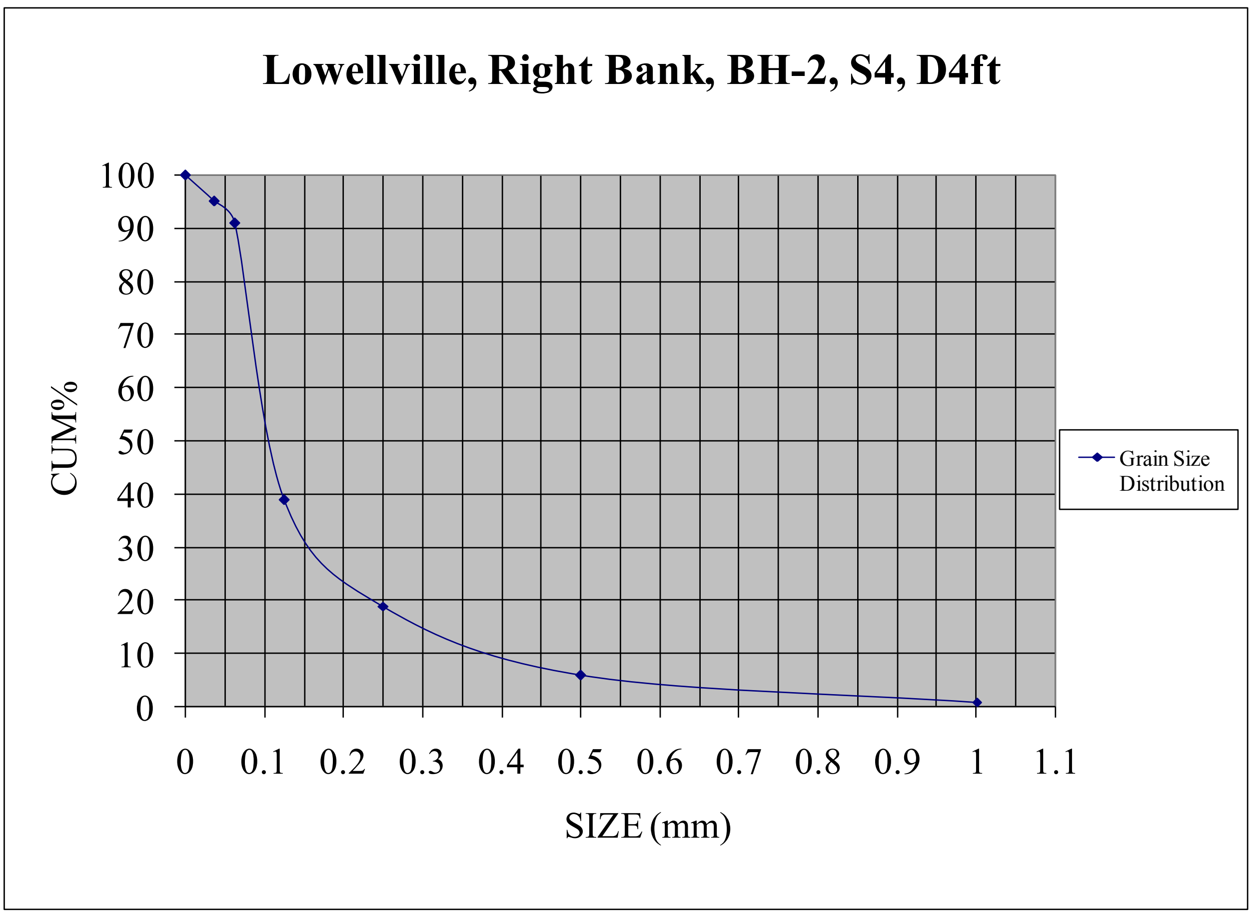
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		Sample Date: 6/24/06	
BH-2, S3, 3 ft. bsg[a]		Original Sample Weight: 110.6g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	2.5	2.5	2
0.25	10.5	13.0	12
0.125	22.8	35.8	33
0.063	26.2	62.0	57
0.037	42.2	104.3	95
pan	5.2	109.5	100

a. Below surface grade.



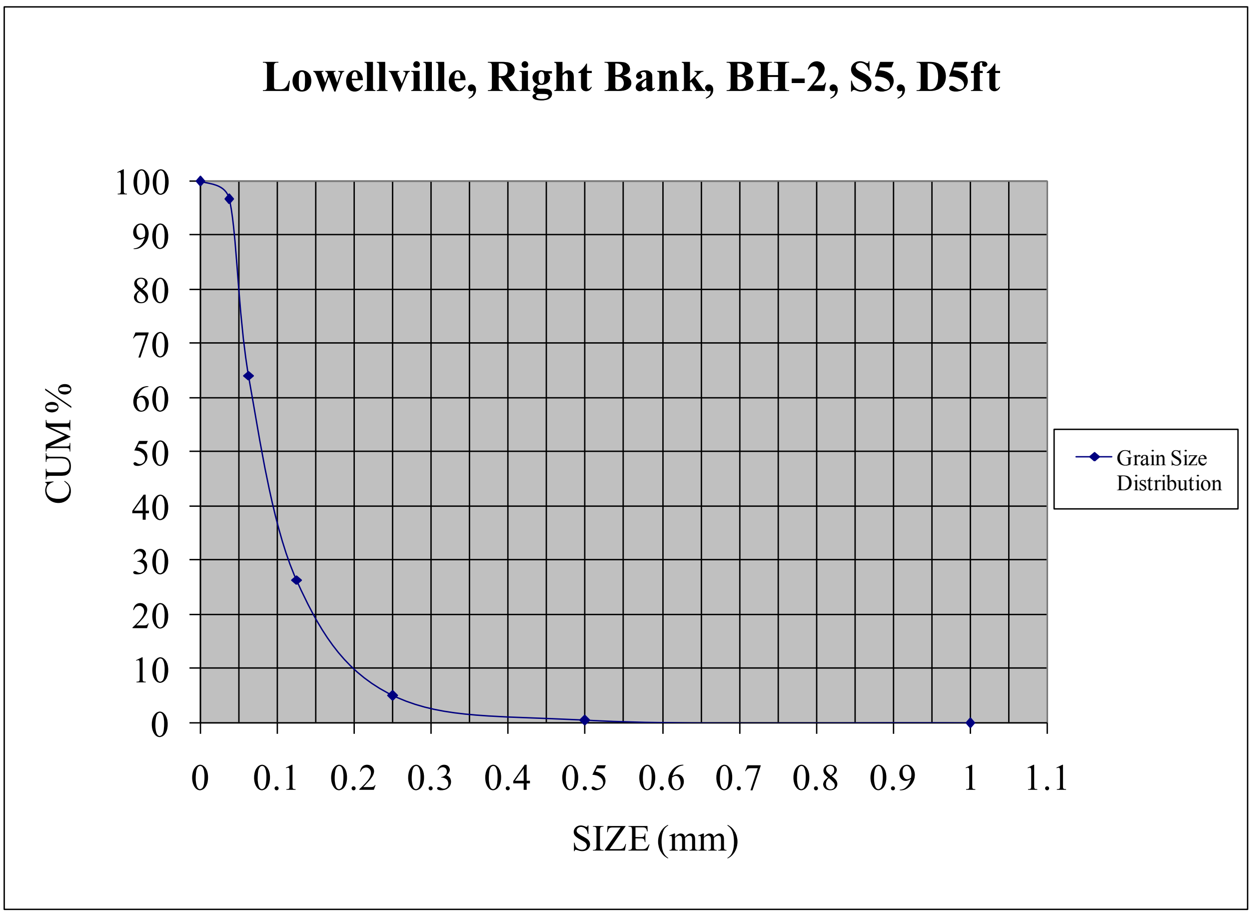
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		Sample Date: 6/24/06	
BH-2, S4, 4 ft. bsg[a]		Original Sample Weight: 101.6g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.1	1.1	1
0.5	5.1	6.2	6
0.25	13.4	19.6	19
0.125	19.7	39.3	39
0.063	52.2	91.5	91
0.037	4.3	95.8	95
pan	5.2	101.0	100

a. Below surface grade.



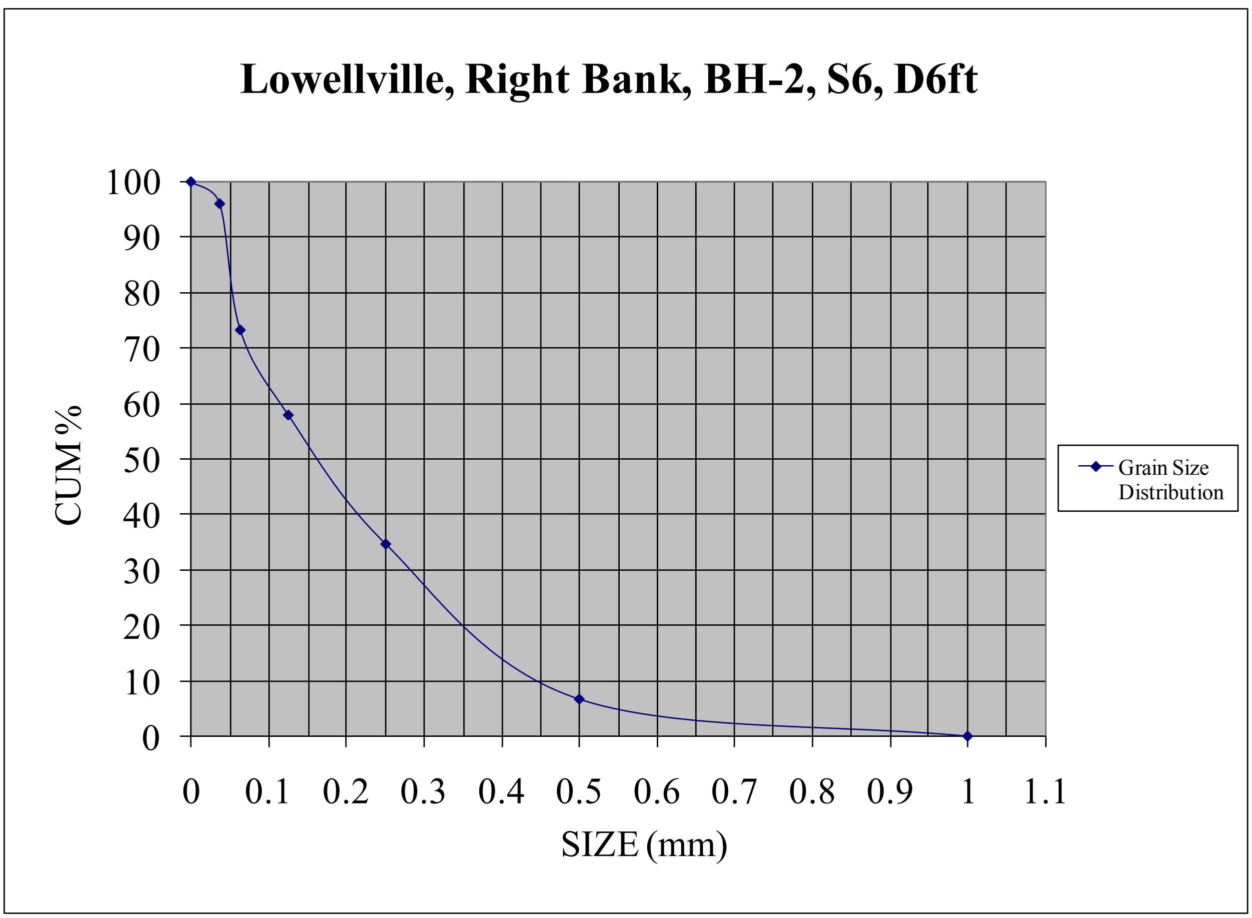
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		Sample Date: 6/24/06	
BH-2, S5, 5 ft. bsg[a]		Original Sample Weight: 116.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	0.5	0.5	0
0.25	5.4	6.0	5
0.125	24.7	30.7	27
0.063	43.6	74.3	64
0.037	37.7	112.0	97
pan	3.7	115.7	100

a. Below surface grade.



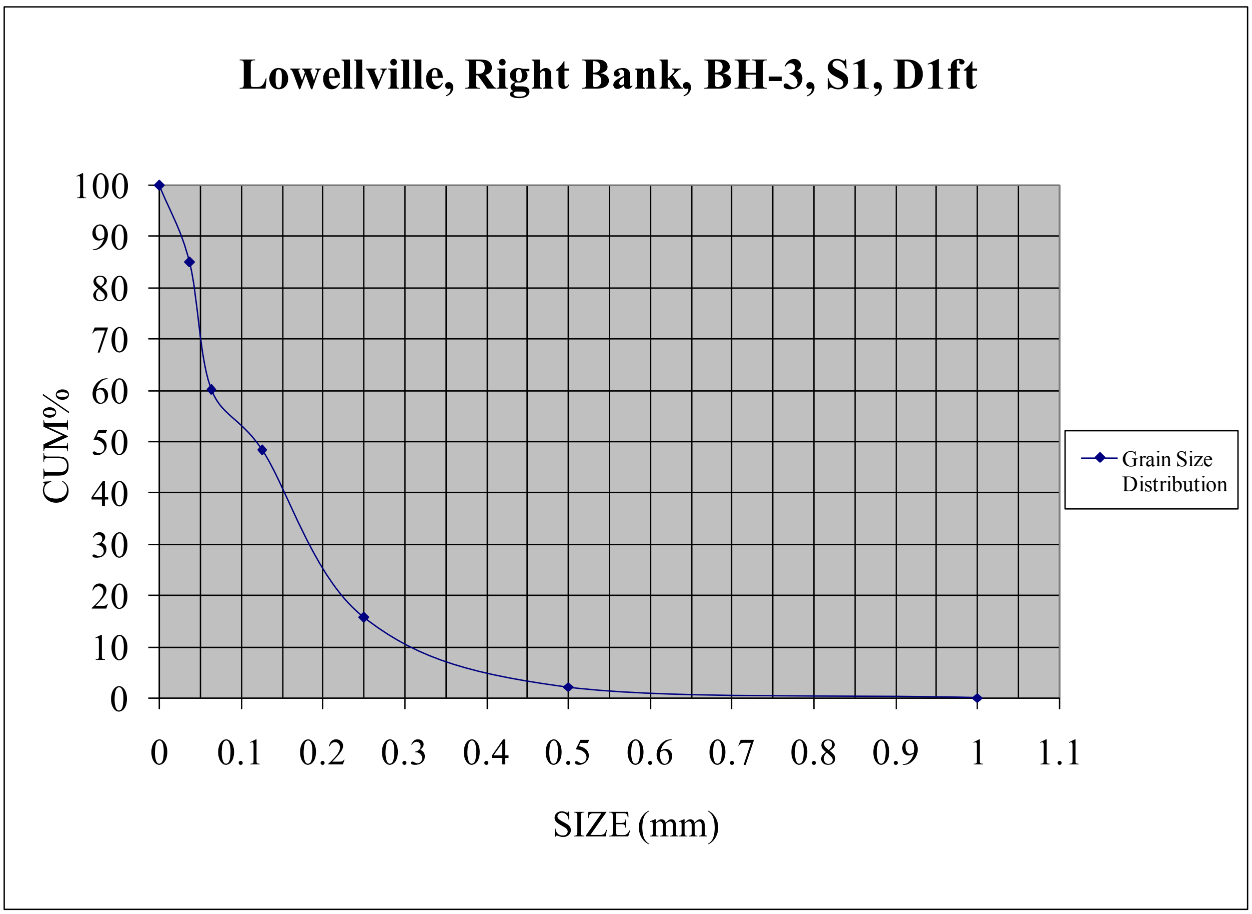
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		Sample Date: 6/24/06	
BH-2, S6, 6 ft. bsg[a]		Original Sample Weight: 114.3g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	7.6	7.6	7
0.25	31.8	39.3	35
0.125	26.2	65.5	58
0.063	17.3	82.8	73
0.037	25.9	108.7	96
pan	4.5	113.2	100

a. Below surface grade.



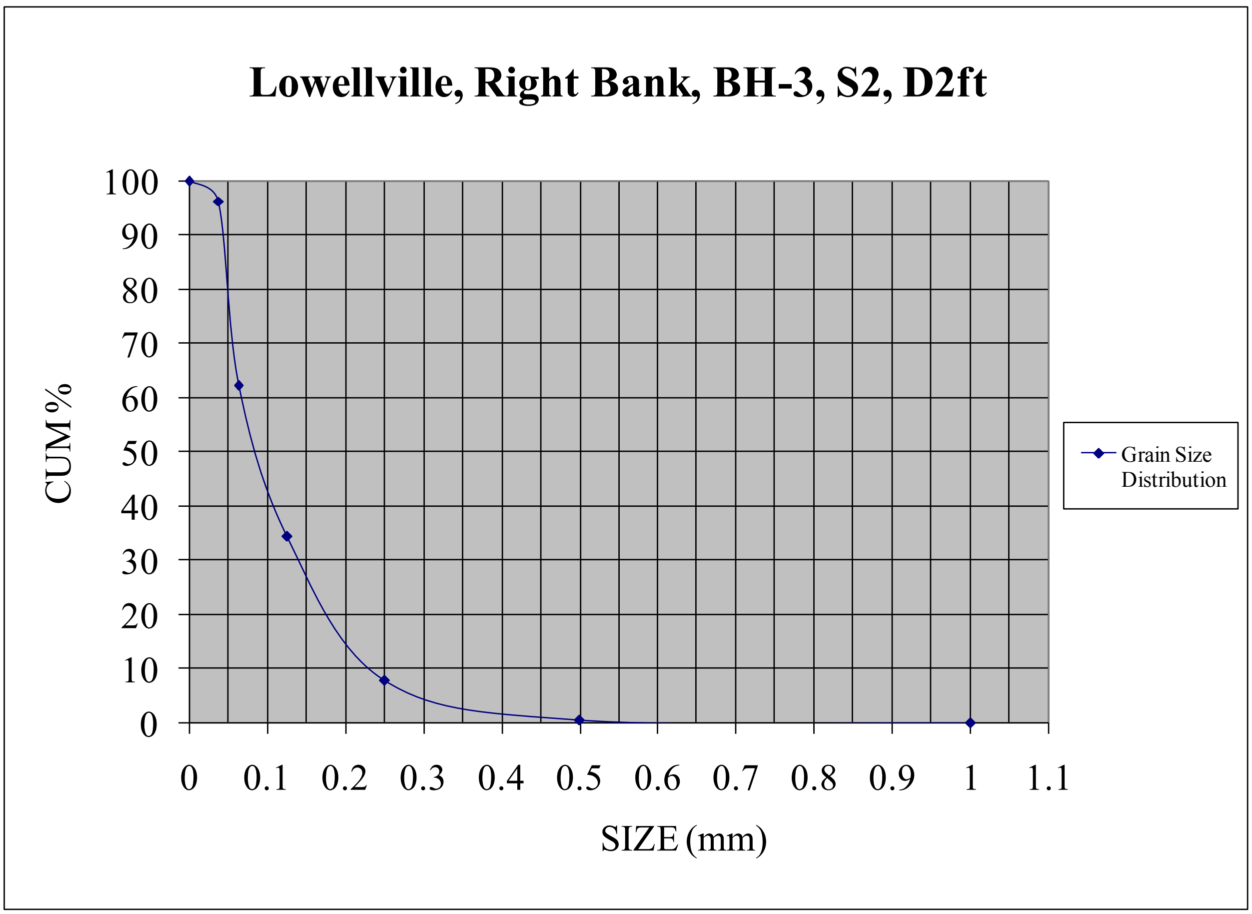
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		Sample Date: 6/24/06	
BH-3, S1, 1 ft. bsg[a]		Original Sample Weight: 111.5g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.5	0.5	0
0.5	1.9	2.4	2
0.25	14.4	16.8	15
0.125	36.3	53.1	48
0.063	12.8	65.9	60
0.037	27.3	93.2	85
pan	16.5	109.7	100

a. Below surface grade.



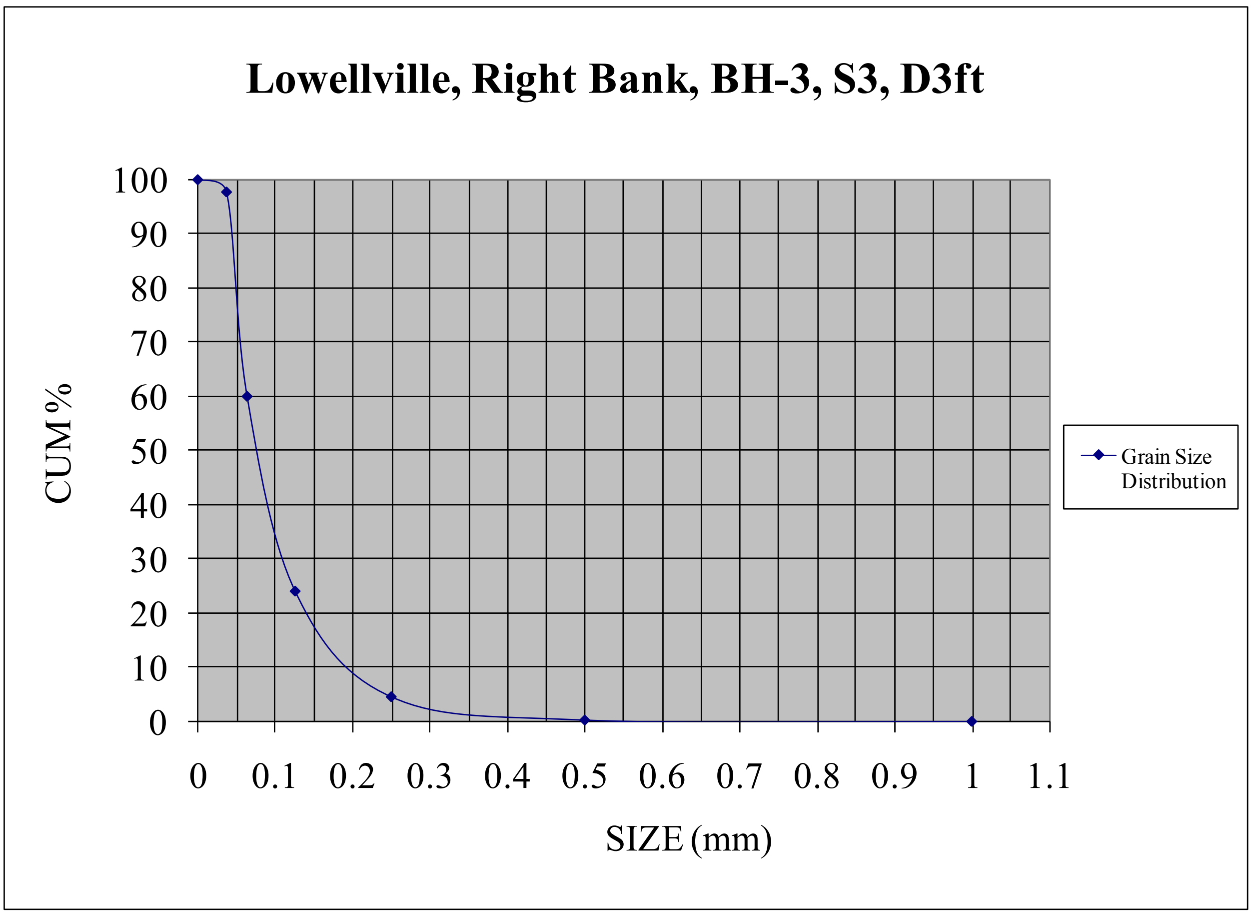
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		**Sample Date: 6/24/06**	
BH-3, S2, 2 ft. bsg[a]		**Original Sample Weight: 112.7g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	0.6	0.6	1
0.25	8.1	8.7	8
0.125	29.7	38.4	34
0.063	31.0	69.4	62
0.037	37.9	107.4	96
pan	4.0	111.4	100

a. Below surface grade.



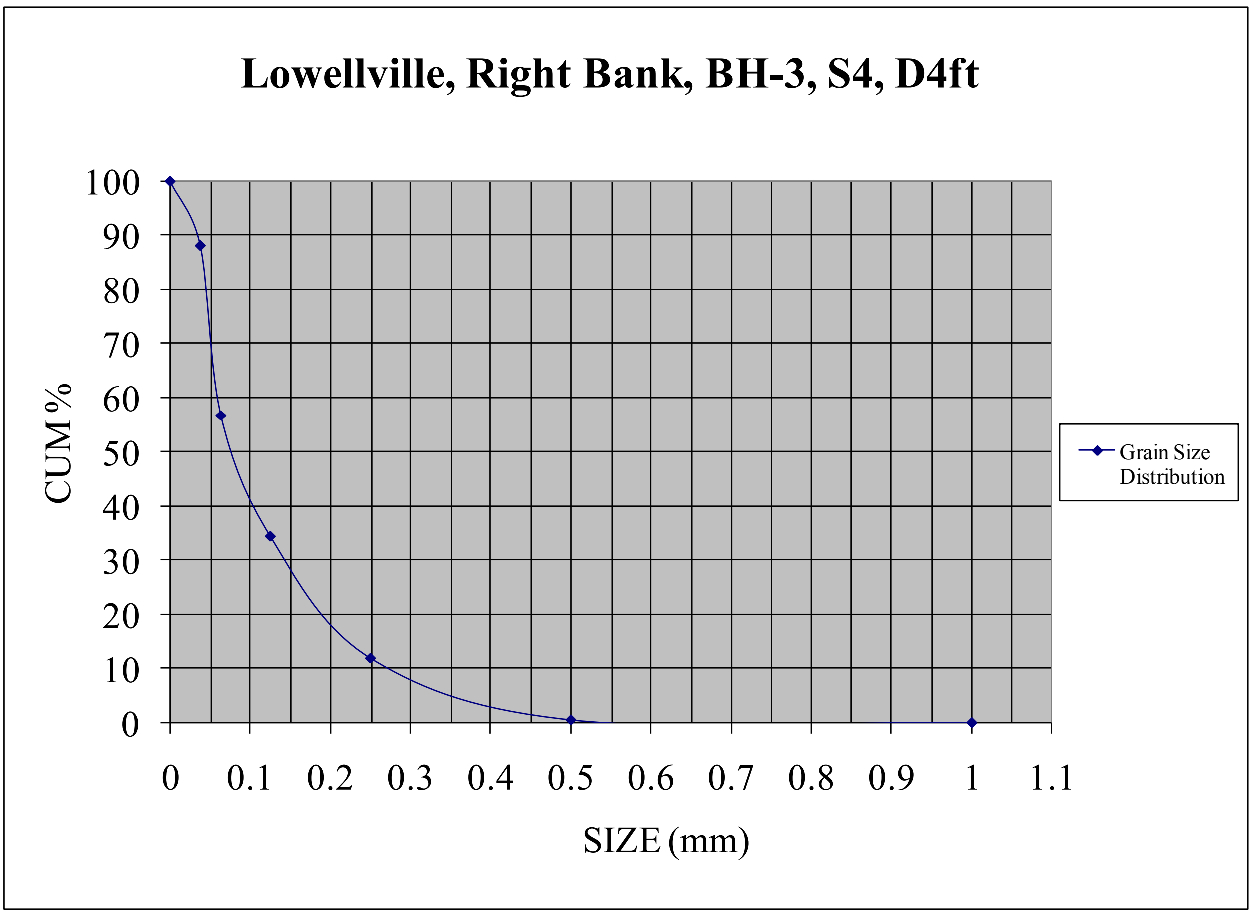
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		Sample Date: 6/24/06	
BH-3, S3, 3 ft. bsg[a]		Original Sample Weight: 114.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	0.3	0.3	0
0.25	4.8	5.1	5
0.125	22.2	27.3	24
0.063	41.0	68.3	60
0.037	42.9	111.2	98
pan	2.6	113.8	100

a. Below surface grade.



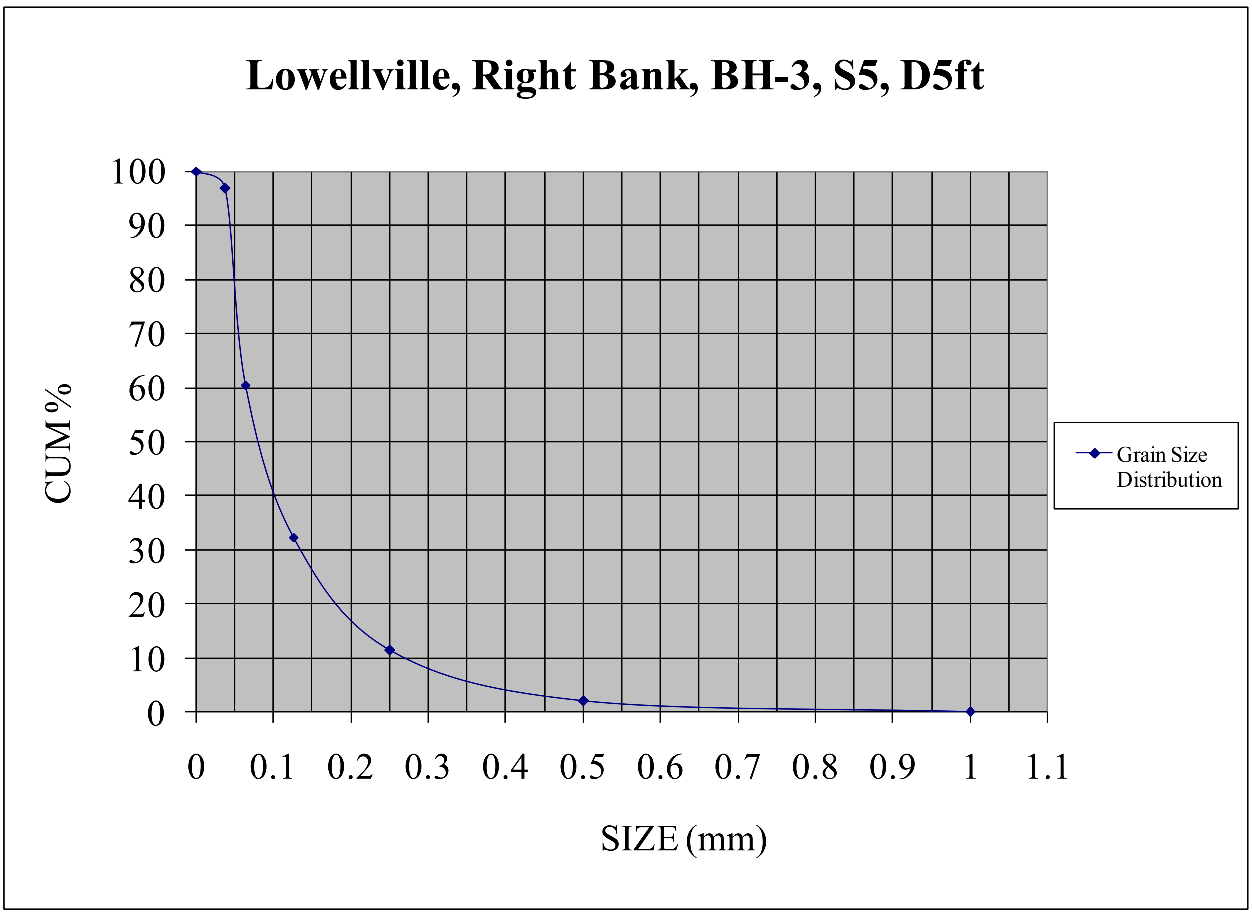
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		**Sample Date: 6/24/06**	
BH-3, S4, 4 ft. bsg[a]		**Original Sample Weight: 109.6g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	0.5	0.5	0
0.25	12.4	12.9	12
0.125	24.2	37.1	34
0.063	24.3	61.4	57
0.037	33.8	95.2	88
pan	12.7	107.9	100

a. Below surface grade.



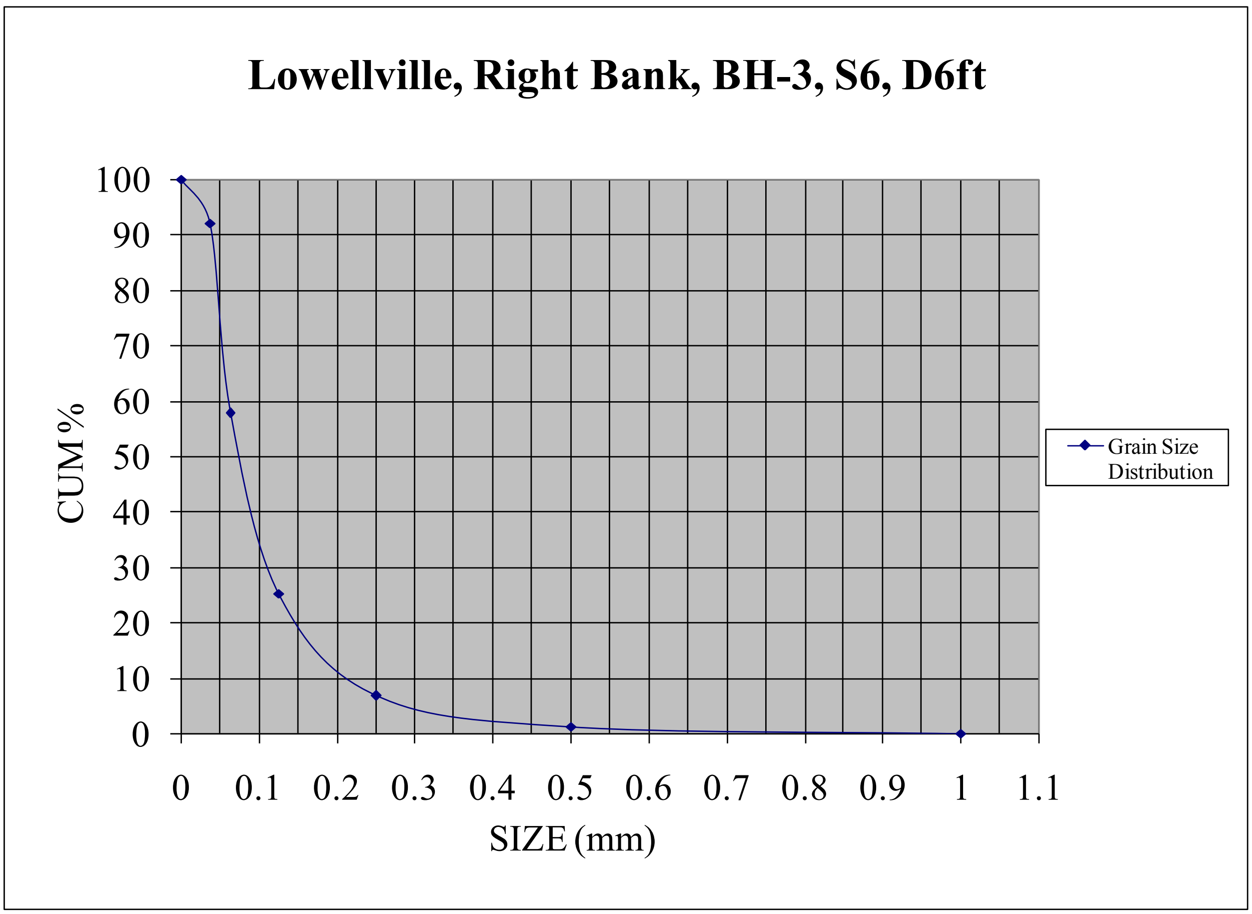
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		Sample Date: 6/24/06	
BH-3, S5, 5 ft. bsg[a]		Original Sample Weight: 110.2g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	2.2	2.2	2
0.25	10.2	12.5	11
0.125	22.8	35.3	32
0.063	30.7	66.0	60
0.037	39.7	105.7	97
pan	3.4	109.1	100

a. Below surface grade.



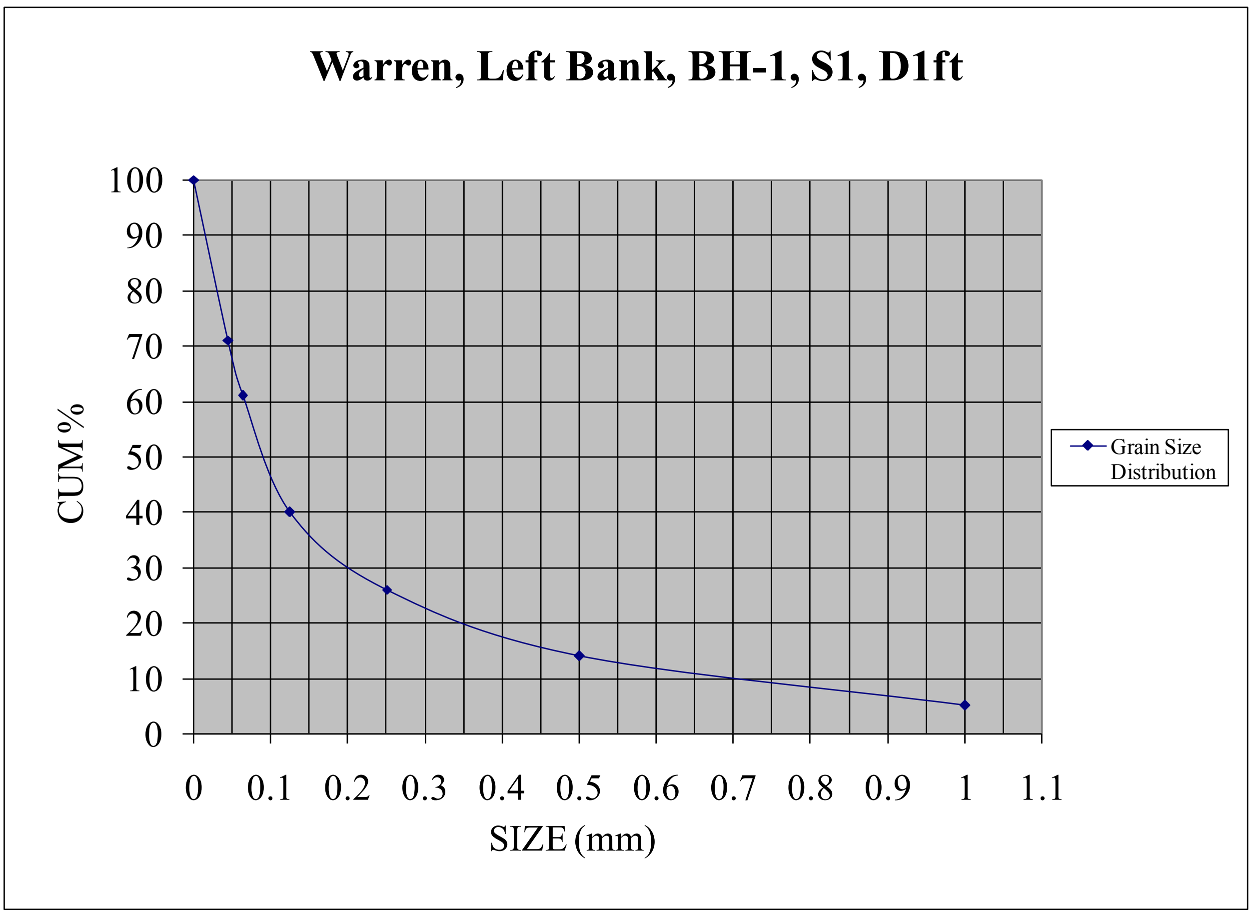
Soil Grain-size Analysis Laboratory Results			
Lowellville Right Bank		Sample Date: 6/24/06	
BH-3, S6, 6 ft. bsg[a]		Original Sample Weight: 114.0g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	1.4	1.4	1
0.25	6.3	7.7	7
0.125	21.0	28.6	25
0.063	37.0	65.6	58
0.037	39.0	104.6	92
pan	8.9	113.5	100

a. Below surface grade.



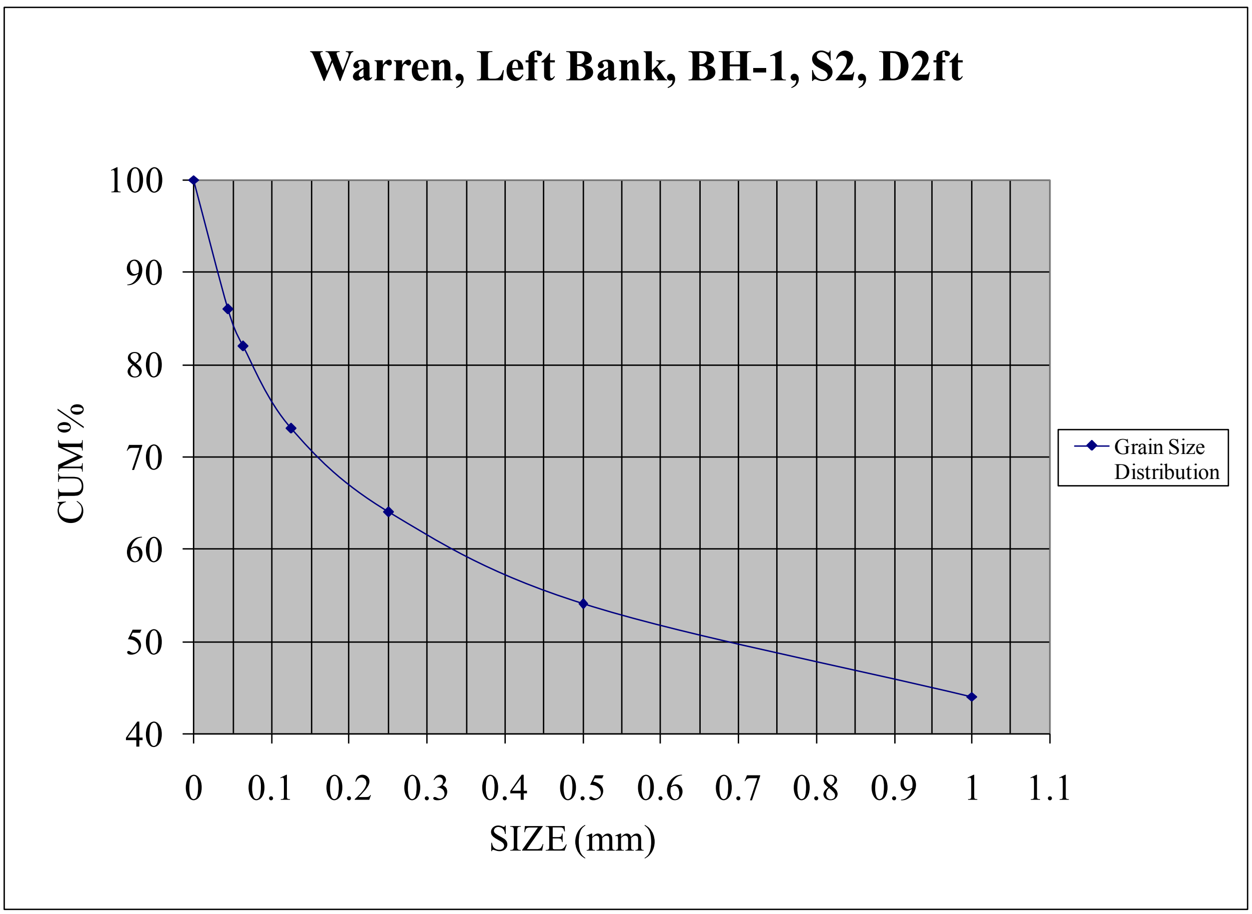
Soil Grain-size Analysis Laboratory Results			
Warren Left Bank		Sample Date: 9/9/06	
BH-1, S1, 1ft. bsg[a]		Original Sample Weight: 107.1g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	5.7	5.7	5
0.5	9.5	15.2	14
0.25	12.6	27.8	26
0.125	15.3	43.1	40
0.063	21.4	64.5	61
0.044	11.3	75.8	71
pan	30.7	106.5	100

a. Below surface grade.



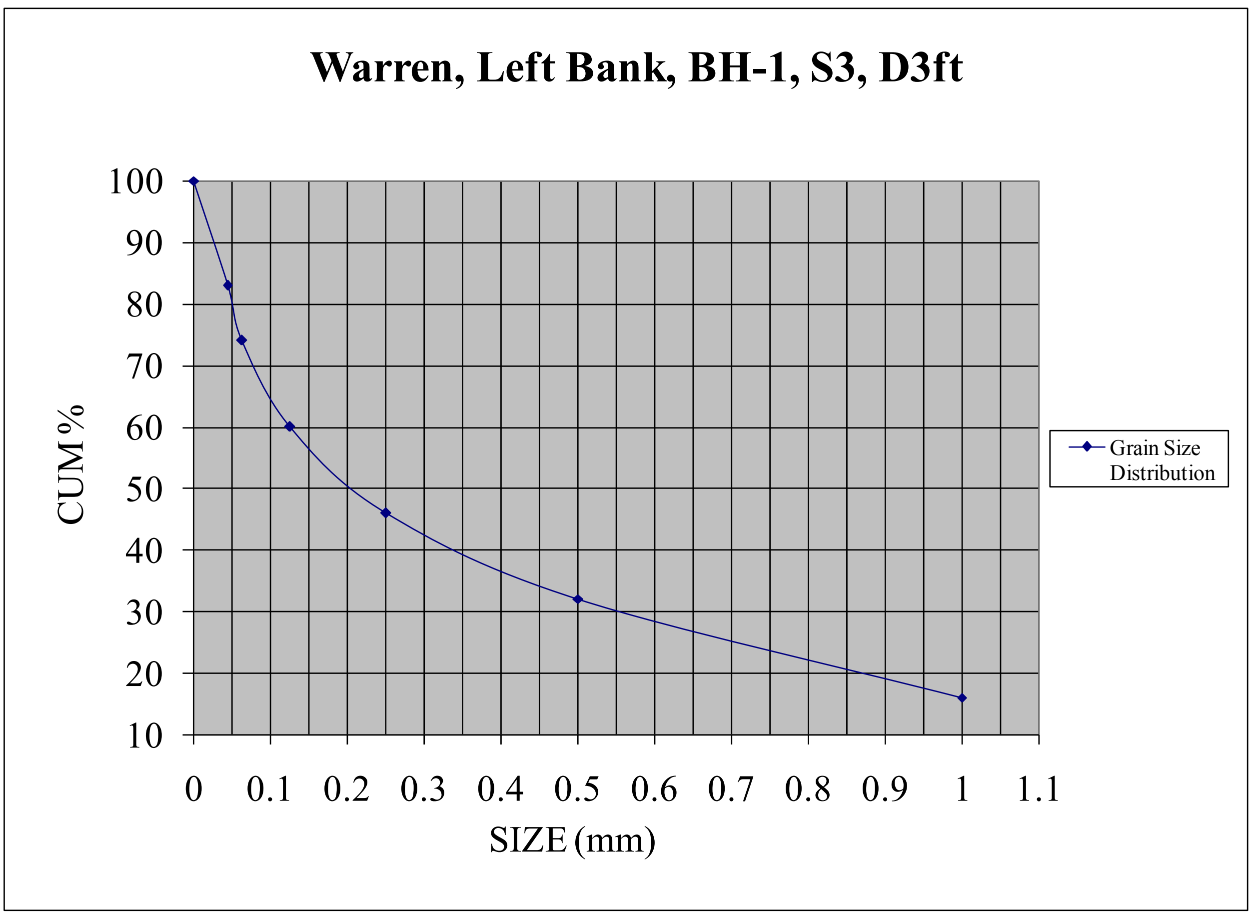
Soil Grain-size Analysis Laboratory Results			
Warren Left Bank		Sample Date: 9/9/06	
BH-1, S2, 2ft. bsg[a]		Original Sample Weight: 130.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	58.3	58.3	44
0.5	14	72.3	54
0.25	12.9	85.2	64
0.125	11.8	97	73
0.063	12	109	82
0.044	6.4	115.4	86
pan	18.1	133.5	100

a. Below surface grade.



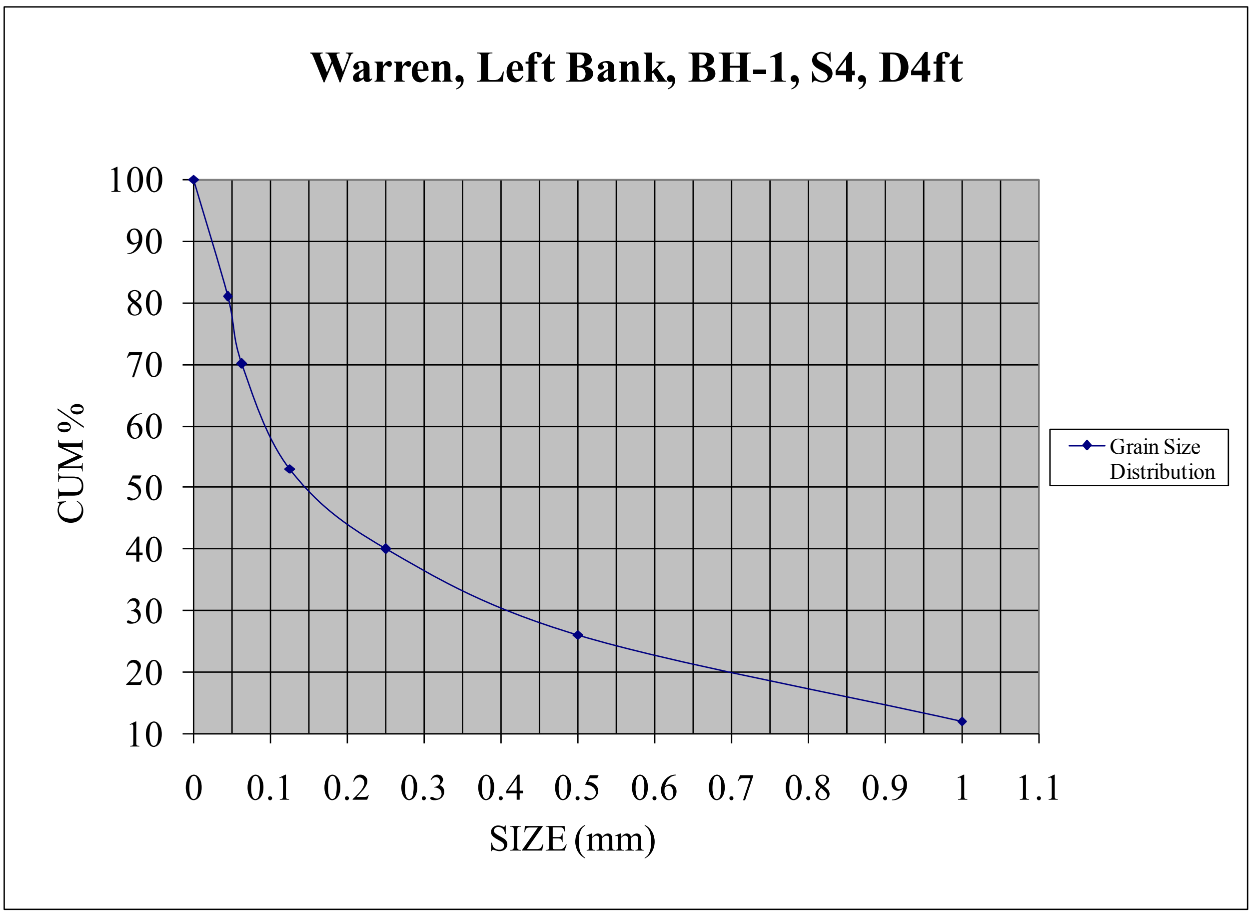
Soil Grain-size Analysis Laboratory Results			
Warren Left Bank		Sample Date: 9/9/06	
BH-1, S3, 3ft. bsg[a]		Original Sample Weight: 132.1g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	20.5	20.5	16
0.5	21.5	42	32
0.25	18.3	60.3	46
0.125	17.8	78.1	60
0.063	18.8	96.9	74
0.044	12	108.9	83
pan	22.2	131.1	100

a. Below surface grade.



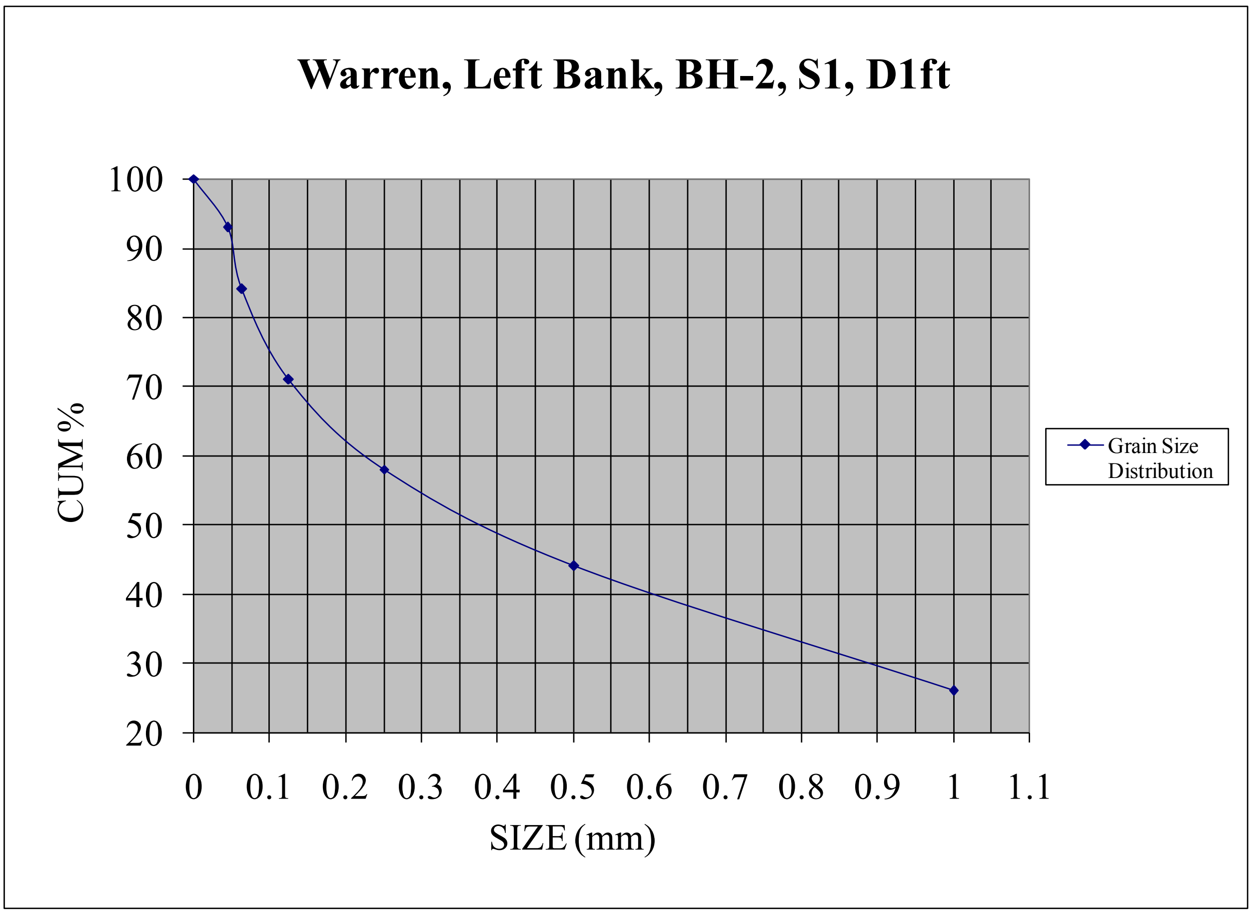
Soil Grain-size Analysis Laboratory Results			
Warren Left Bank		Sample Date: 9/9/06	
BH-1, S4, 4ft. bsg[a]		Original Sample Weight: 137.1g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	16.1	16.1	12
0.5	18.7	34.8	26
0.25	19.8	54.6	40
0.125	17.5	72.1	53
0.063	22.4	94.5	70
0.044	15	109.5	81
pan	26.2	135.7	100

a. Below surface grade.



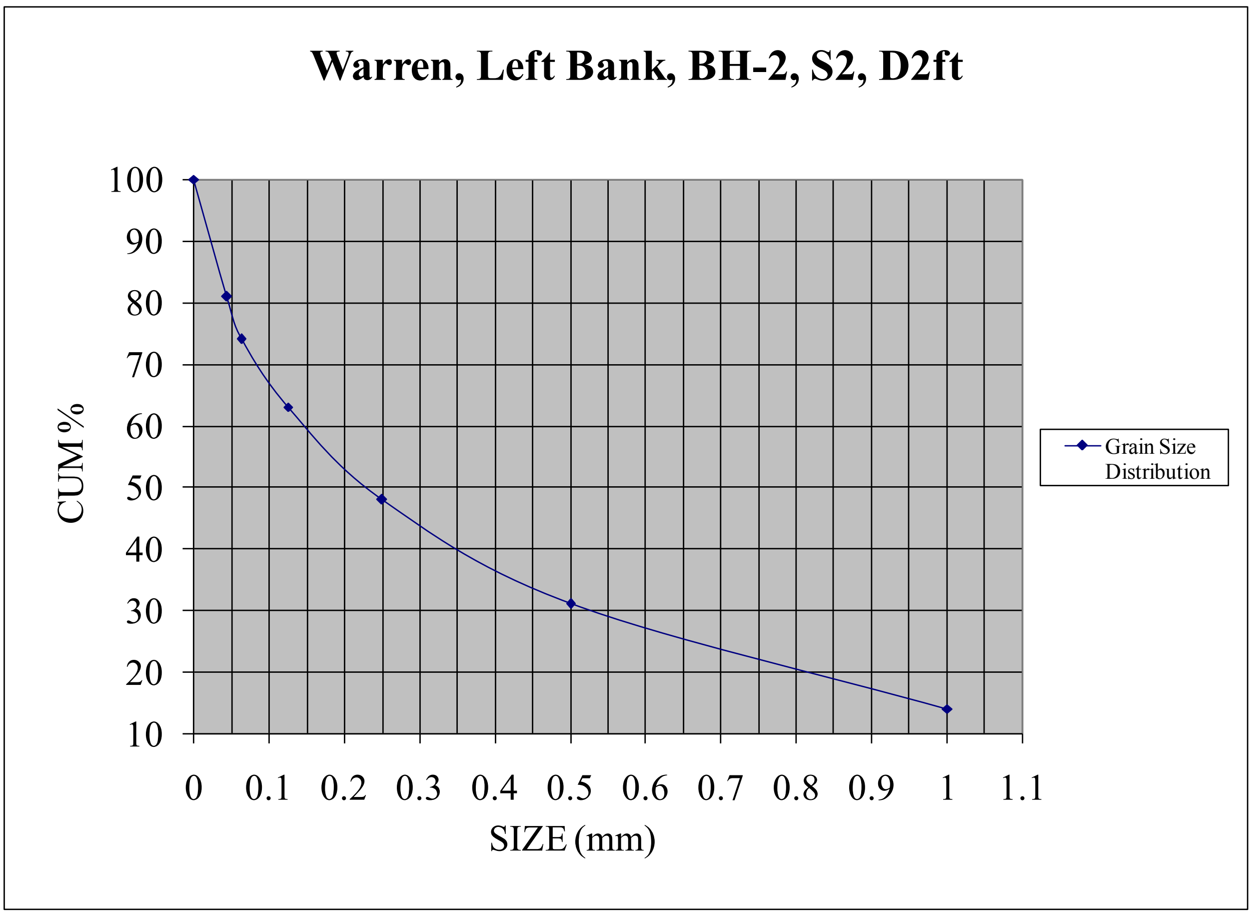
Soil Grain-size Analysis Laboratory Results			
Warren Left Bank		Sample Date: 9/9/06	
BH-2, S1, 1ft. bsg[a]		Original Sample Weight: 133.6g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	35	35	26
0.5	23.4	58.4	44
0.25	19.3	77.7	58
0.125	17.3	95	71
0.063	16.8	111.8	84
0.044	11.7	123.5	93
pan	9.4	132.9	100

a. Below surface grade.



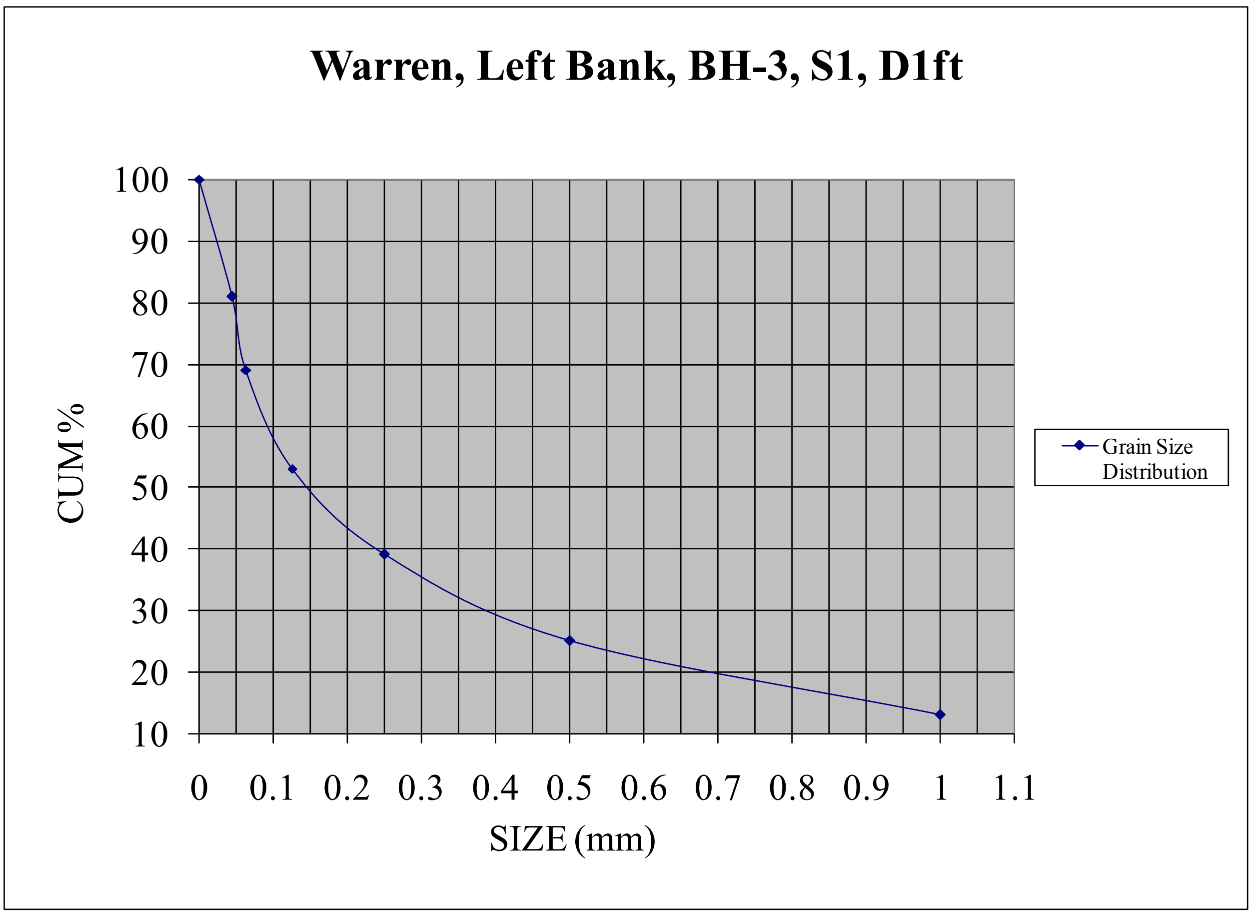
Soil Grain-size Analysis Laboratory Results			
Warren Left Bank		Sample Date: 9/9/06	
BH-2, S2, 2ft. bsg[a]		Original Sample Weight: 108.3g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	15	15	14
0.5	17.7	32.7	31
0.25	18.2	50.9	48
0.125	16.3	67.2	63
0.063	11.8	79	74
0.044	8	87	81
pan	19.8	106.8	100

a. Below surface grade.



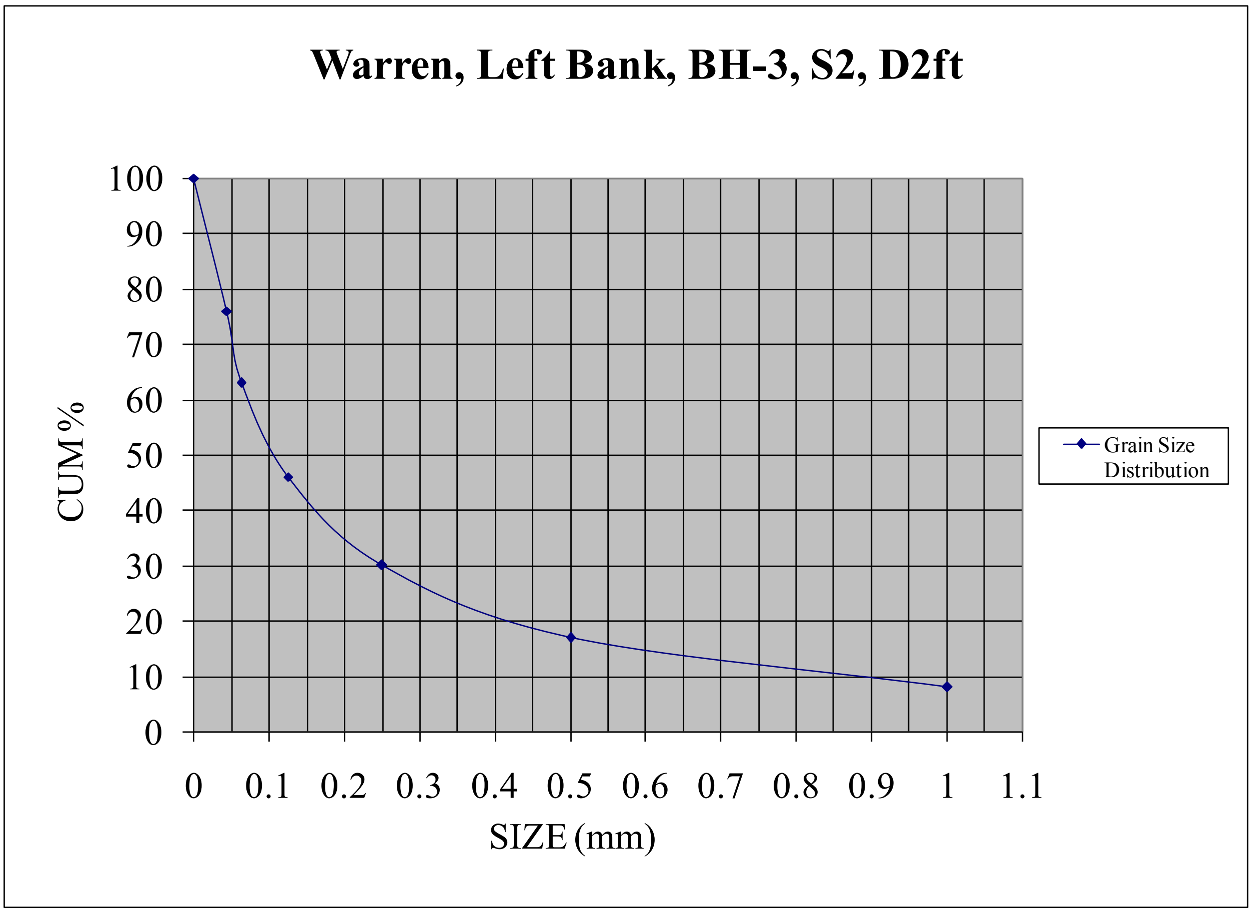
Soil Grain-size Analysis Laboratory Results			
Warren Left Bank		Sample Date: 9/9/06	
BH-3, S1, 1ft. bsg[a]		Original Sample Weight: 124.6g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	16.2	16.2	13
0.5	14.8	31	25
0.25	17.2	48.2	39
0.125	16.9	65.1	53
0.063	20	85.1	69
0.044	14.8	99.9	81
pan	23.2	123.1	100

a. Below surface grade.



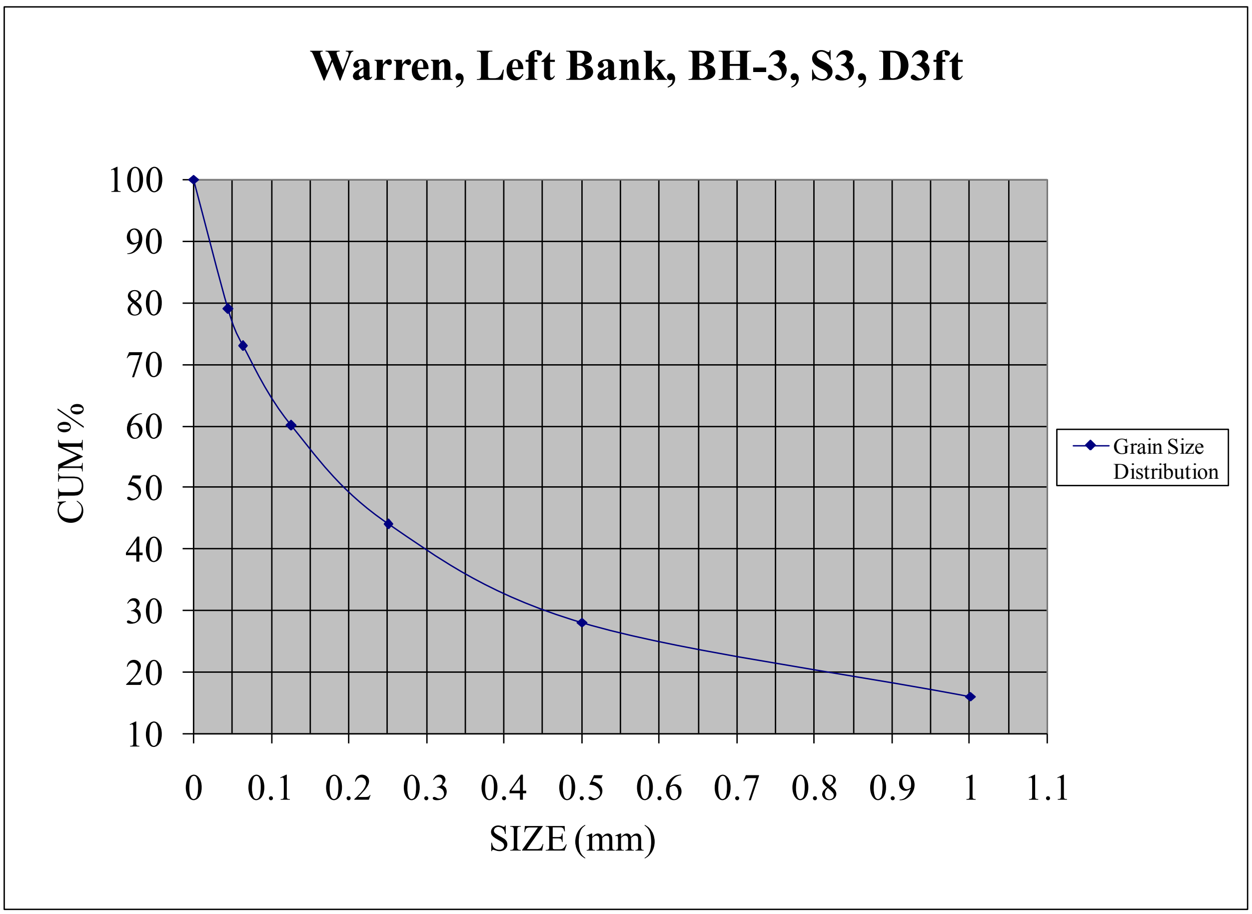
Soil Grain-size Analysis Laboratory Results			
Warren Left Bank		Sample Date: 9/9/06	
BH-3, S2, 2ft. bsg[a]		Original Sample Weight: 117.0g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	8.9	8.9	8
0.5	11.1	20	17
0.25	15.5	35.5	30
0.125	18	53.5	46
0.063	20.1	73.6	63
0.044	15	88.6	76
pan	28.1	116.7	100

a. Below surface grade.



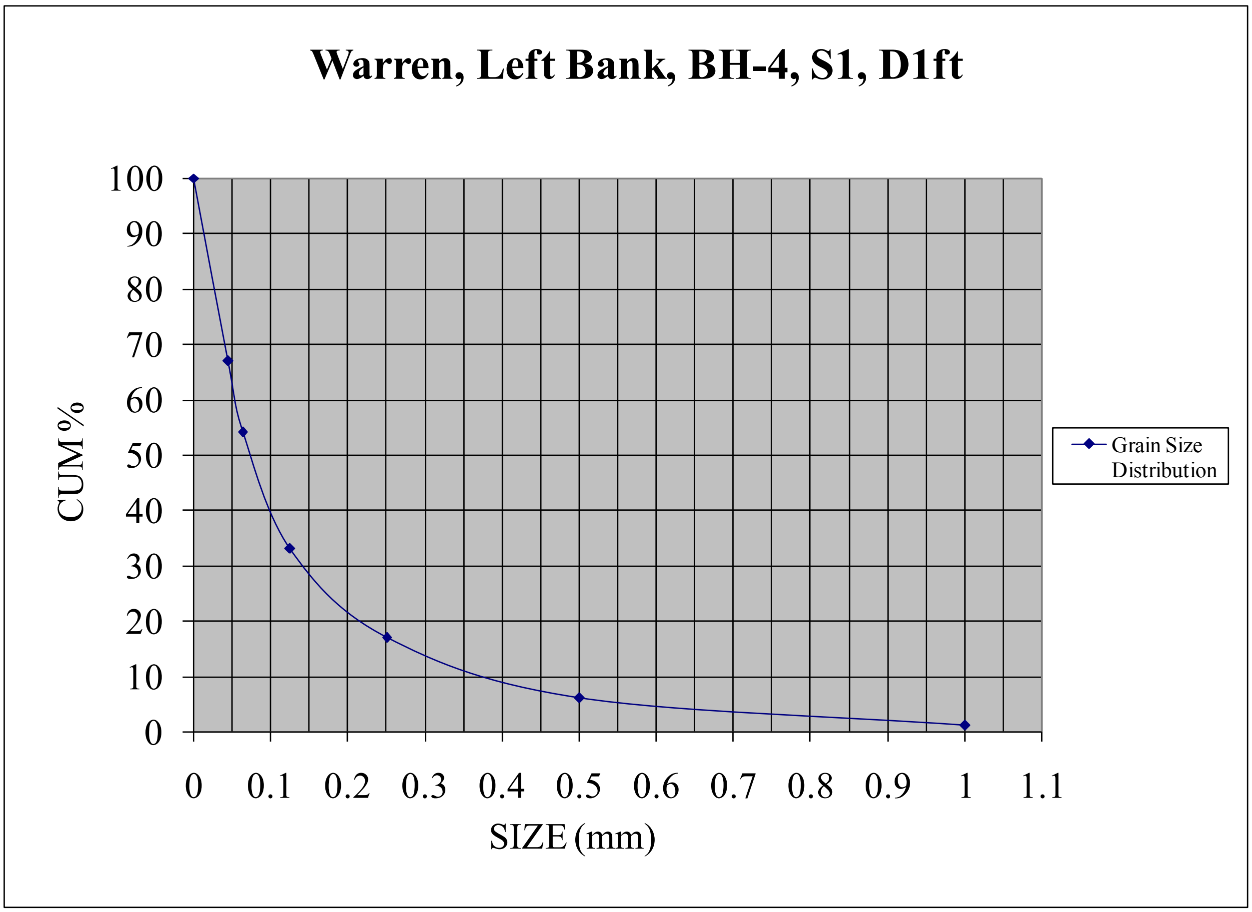
Soil Grain-size Analysis Laboratory Results			
Warren Left Bank		Sample Date: 9/9/06	
BH-3, S3, 3ft. bsg[a]		Original Sample Weight: 127.0g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	20	20	16
0.5	15.2	35.2	28
0.25	19.1	54.3	44
0.125	20.6	74.9	60
0.063	15.7	90.6	73
0.044	7.9	98.5	79
pan	25.9	124.4	100

a. Below surface grade.



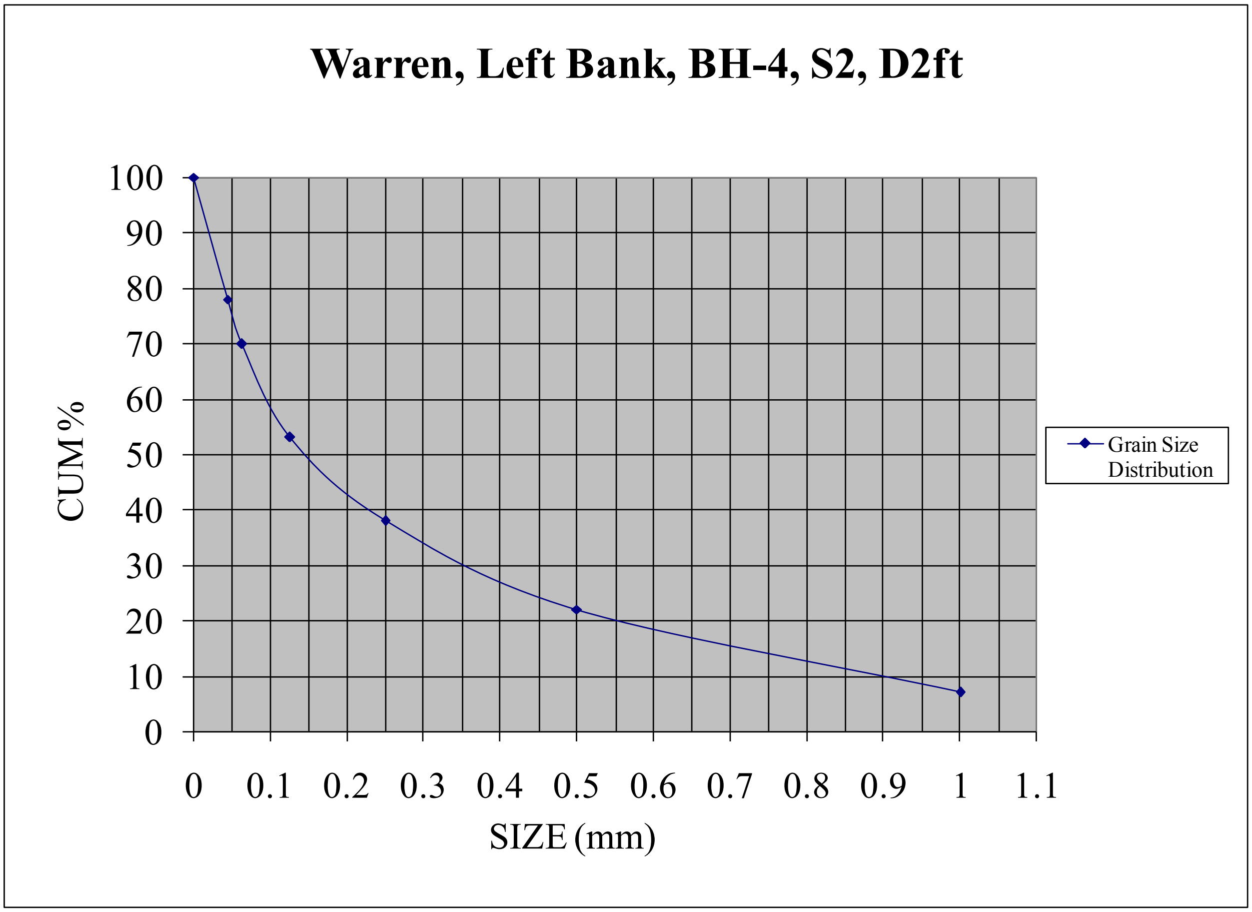
Soil Grain-size Analysis Laboratory Results			
Warren Left Bank		Sample Date: 9/9/06	
BH-4, S1, 1ft. bsg[a]		Original Sample Weight: 122.4g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.4	1.4	1
0.5	5.5	6.9	6
0.25	14	20.9	17
0.125	19.4	40.3	33
0.063	24.5	64.8	54
0.044	16.8	81.6	67
pan	39.4	121	100

a. Below surface grade.



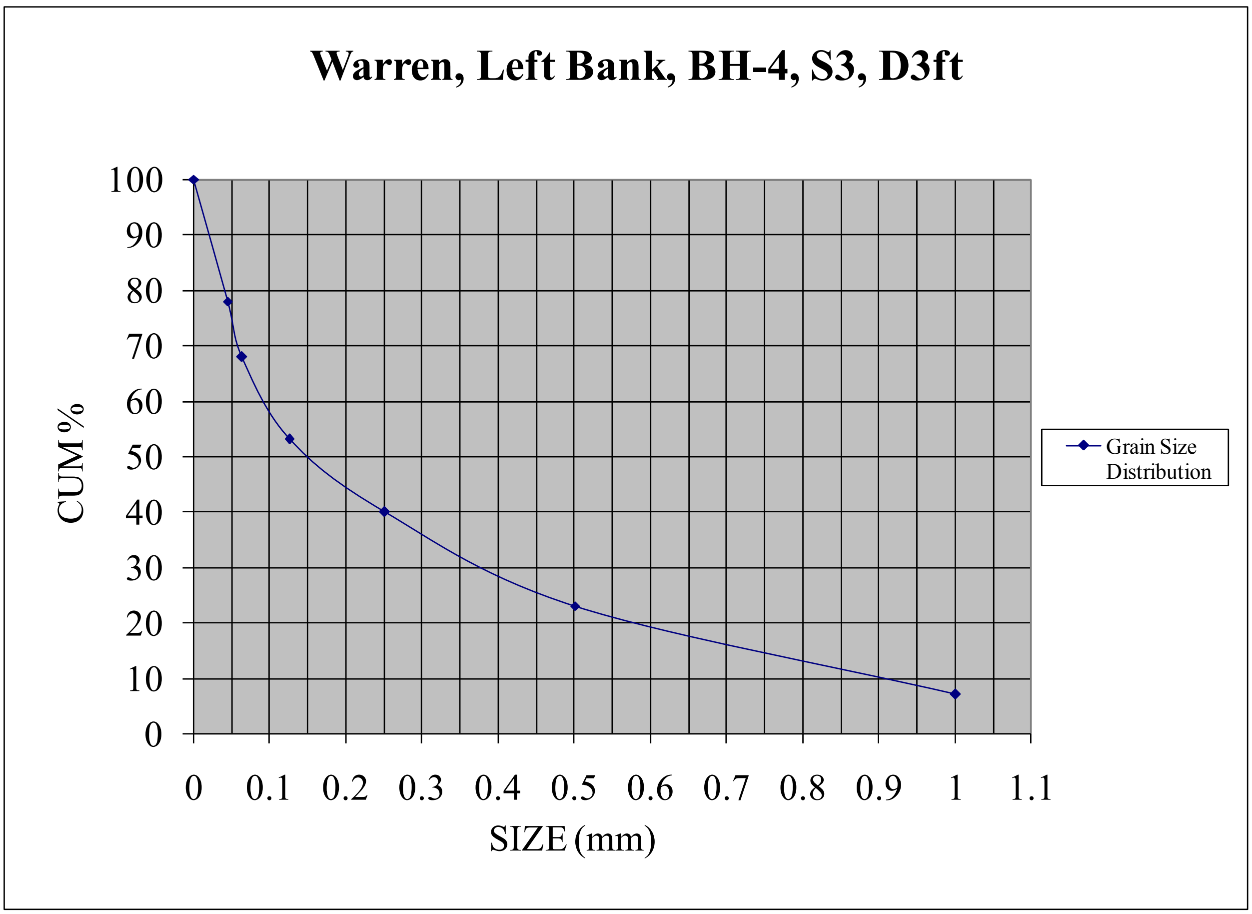
Soil Grain-size Analysis Laboratory Results			
Warren Left Bank		Sample Date: 9/9/06	
BH-4, S2, 2ft. bsg[a]		Original Sample Weight: 111.7g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	7.9	7.9	7
0.5	16.2	24.1	22
0.25	18.3	42.4	38
0.125	16.3	58.7	53
0.063	18.6	77.3	70
0.044	9.2	86.5	78
pan	23.8	110.3	100

a. Below surface grade.



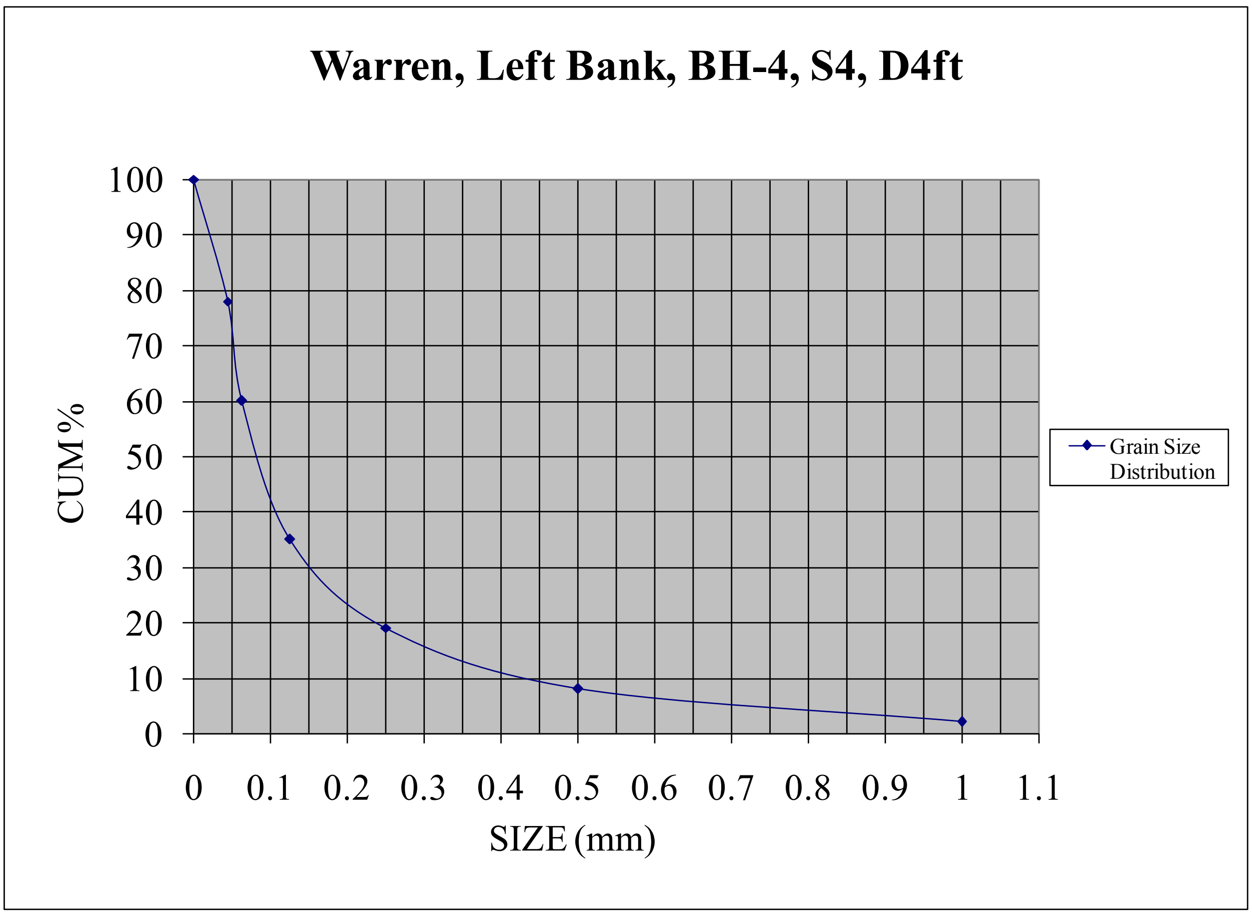
Soil Grain-size Analysis Laboratory Results			
Warren Left Bank		Sample Date: 9/9/06	
BH-4, S3, 3ft. bsg[a]		Original Sample Weight: 100.7g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	7.4	7.4	7
0.5	15.6	23	23
0.25	16.4	39.4	40
0.125	13.5	52.9	53
0.063	14.9	67.8	68
0.044	9.3	77.1	78
pan	22.1	99.2	100

a. Below surface grade.



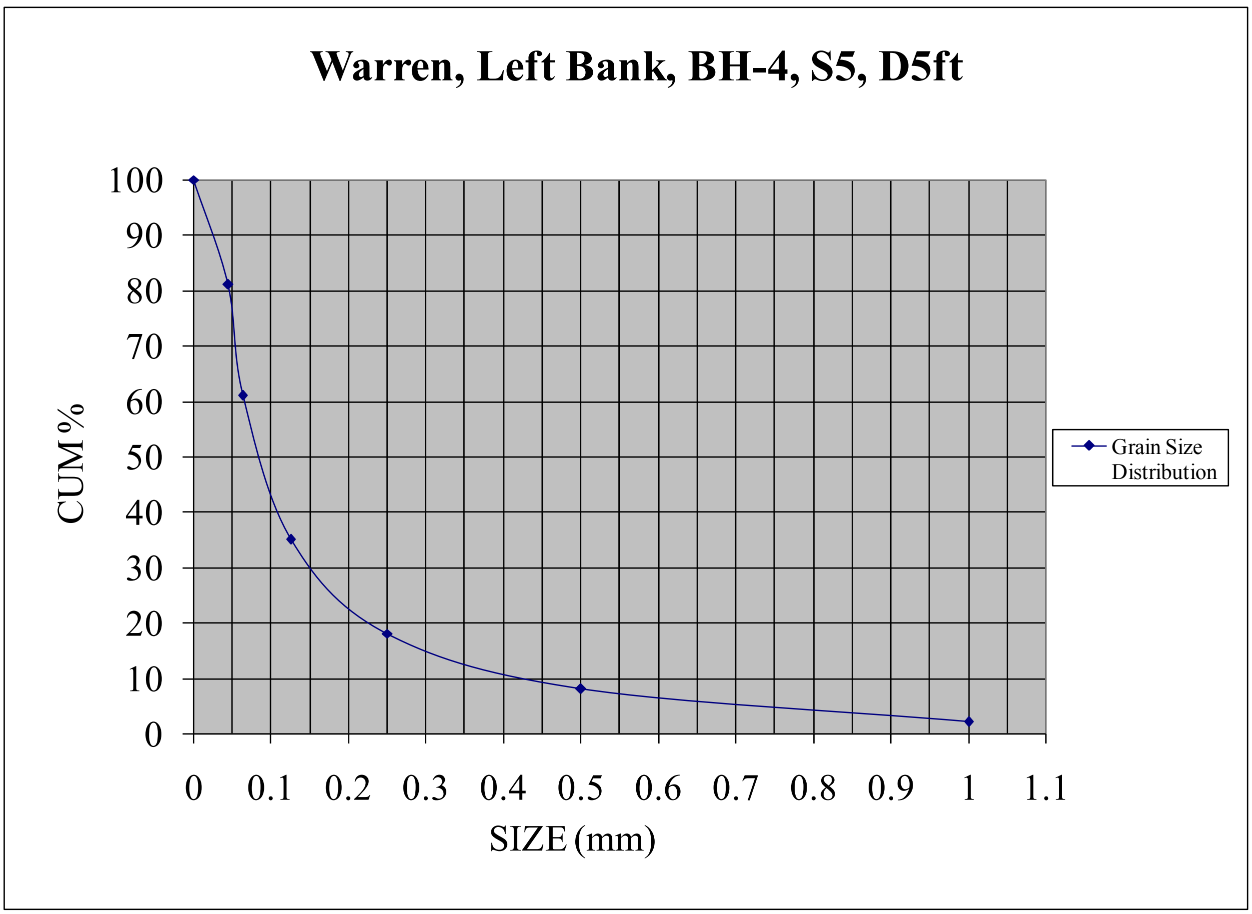
Soil Grain-size Analysis Laboratory Results			
Warren Left Bank		Sample Date: 9/9/06	
BH-4, S4, 4ft. bsg[a]		Original Sample Weight: 104.1g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	1.7	1.7	2
0.5	6.1	7.8	8
0.25	11.1	18.9	19
0.125	16.6	35.5	35
0.063	26	61.5	60
0.044	18.6	80.1	78
pan	22	102.1	100

a. Below surface grade.



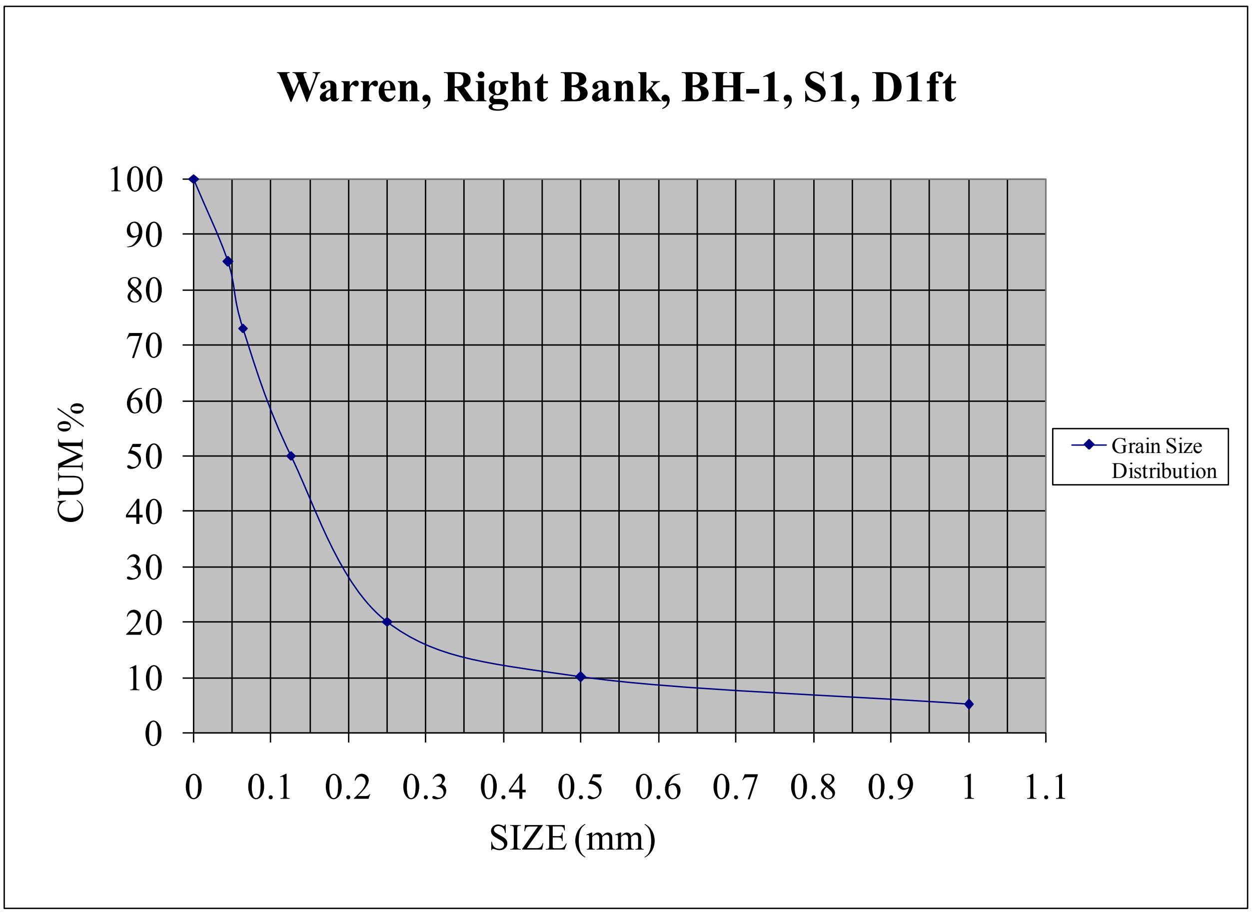
Soil Grain-size Analysis Laboratory Results			
Warren Left Bank		Sample Date: 9/9/06	
BH-4, S5, 5ft. bsg[a]		Original Sample Weight: 125.1g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.9	2.9	2
0.5	7.1	10	8
0.25	12.2	22.2	18
0.125	20.8	43	35
0.063	31.6	74.6	61
0.044	24.6	99.2	81
pan	24	123.2	100

a. Below surface grade.



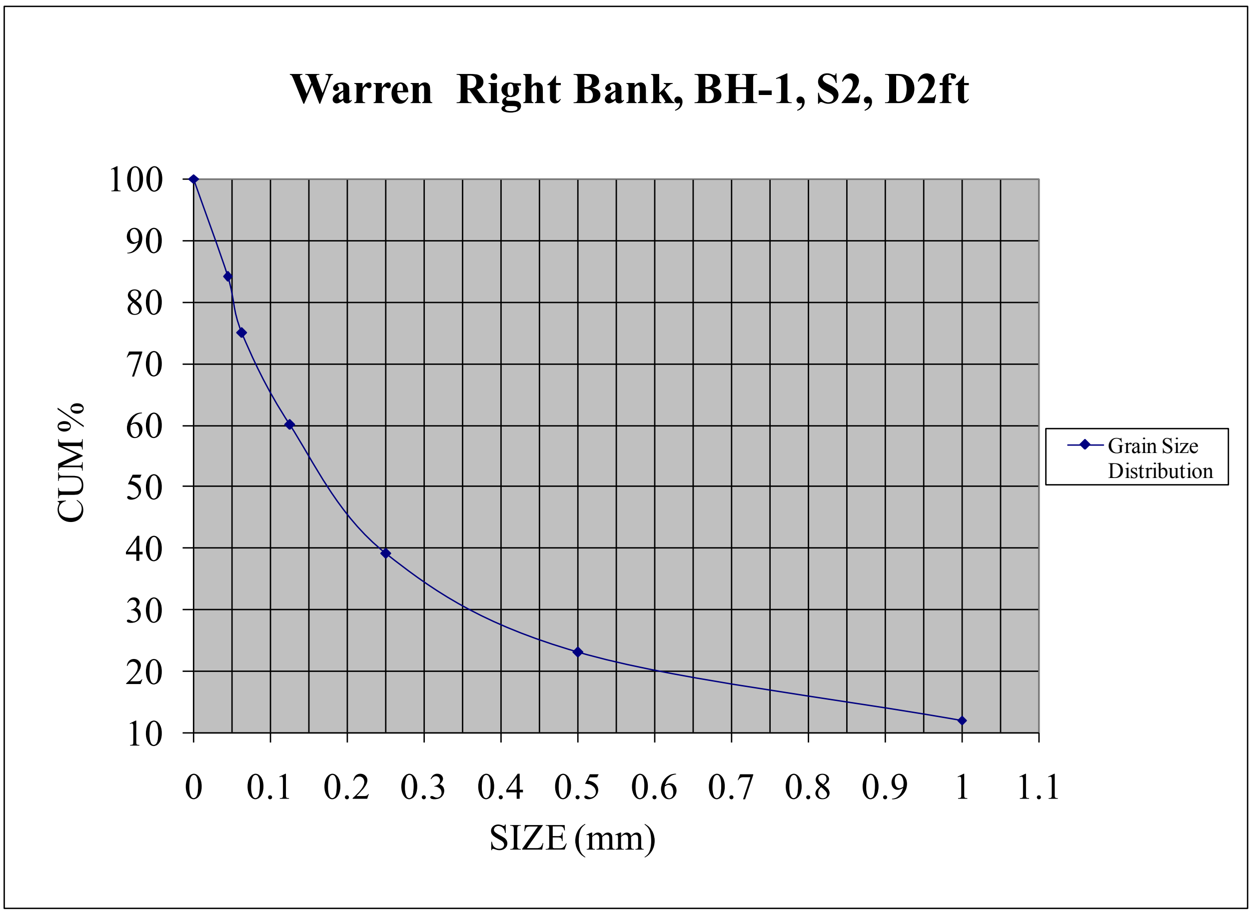
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-1, S1, 1ft. bsg[a]		Original Sample Weight: 115.6g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	5.7	5.7	5
0.5	5.7	11.4	10
0.25	11.4	22.8	20
0.125	34.3	57.1	50
0.063	26.3	83.4	73
0.044	13.7	97.1	85
pan	17.1	114.2	100

a. Below surface grade.



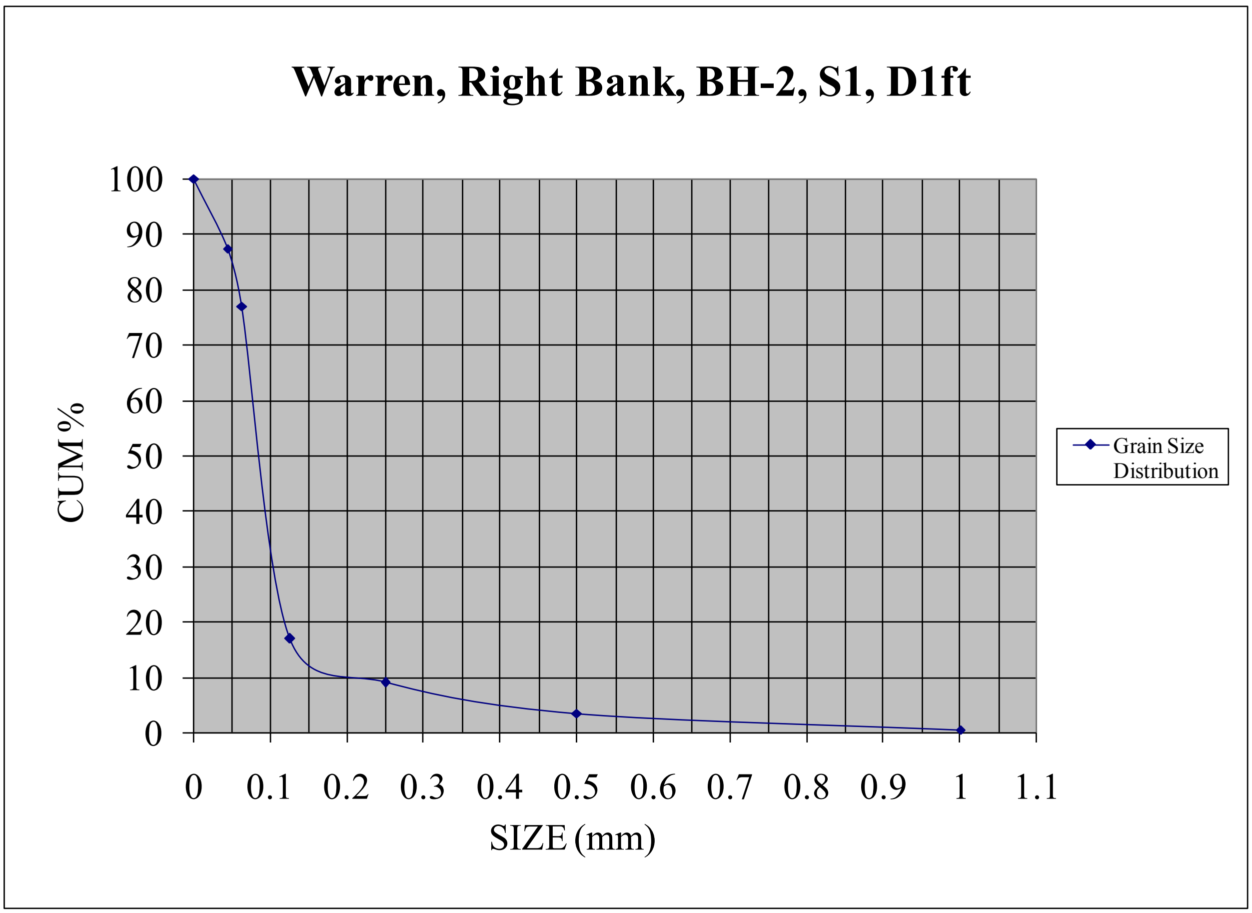
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-1, S2, 2ft. bsg[a]		Original Sample Weight: 124.8g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	14.7	14.7	12
0.5	13.5	28.2	23
0.25	19.6	47.9	39
0.125	25.8	73.6	60
0.063	18.4	92.0	75
0.044	11.0	103.1	84
pan	19.6	122.7	100

a. Below surface grade.



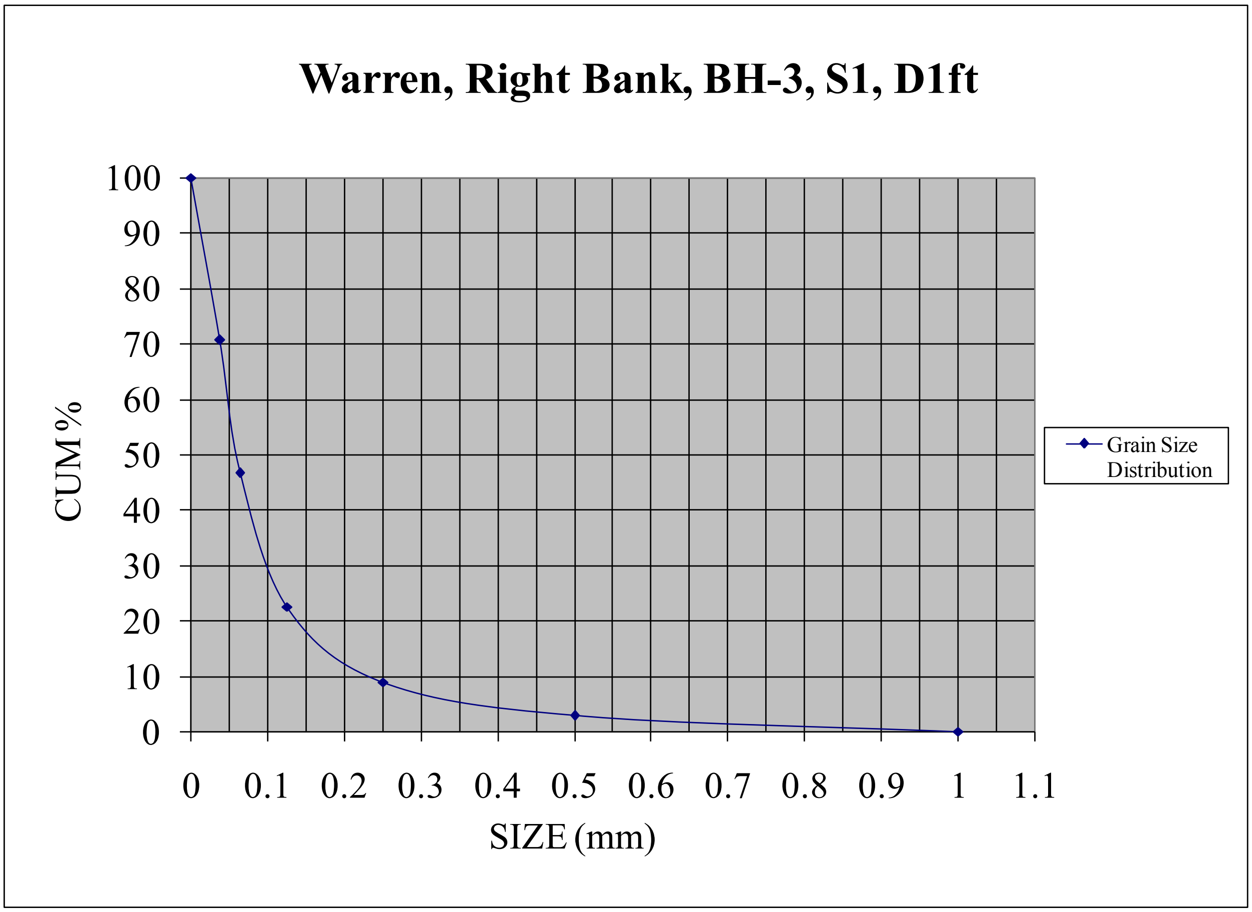
Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-2, S1, 1ft. bsg[a]		Original Sample Weight: 114.8g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.5	0.5	0
0.5	3.4	3.9	3
0.25	6.3	10.2	9
0.125	8.9	19.1	17
0.063	68.2	87.3	77
0.044	11.8	99.1	87
pan	14.3	113.4	100

a. Below surface grade.



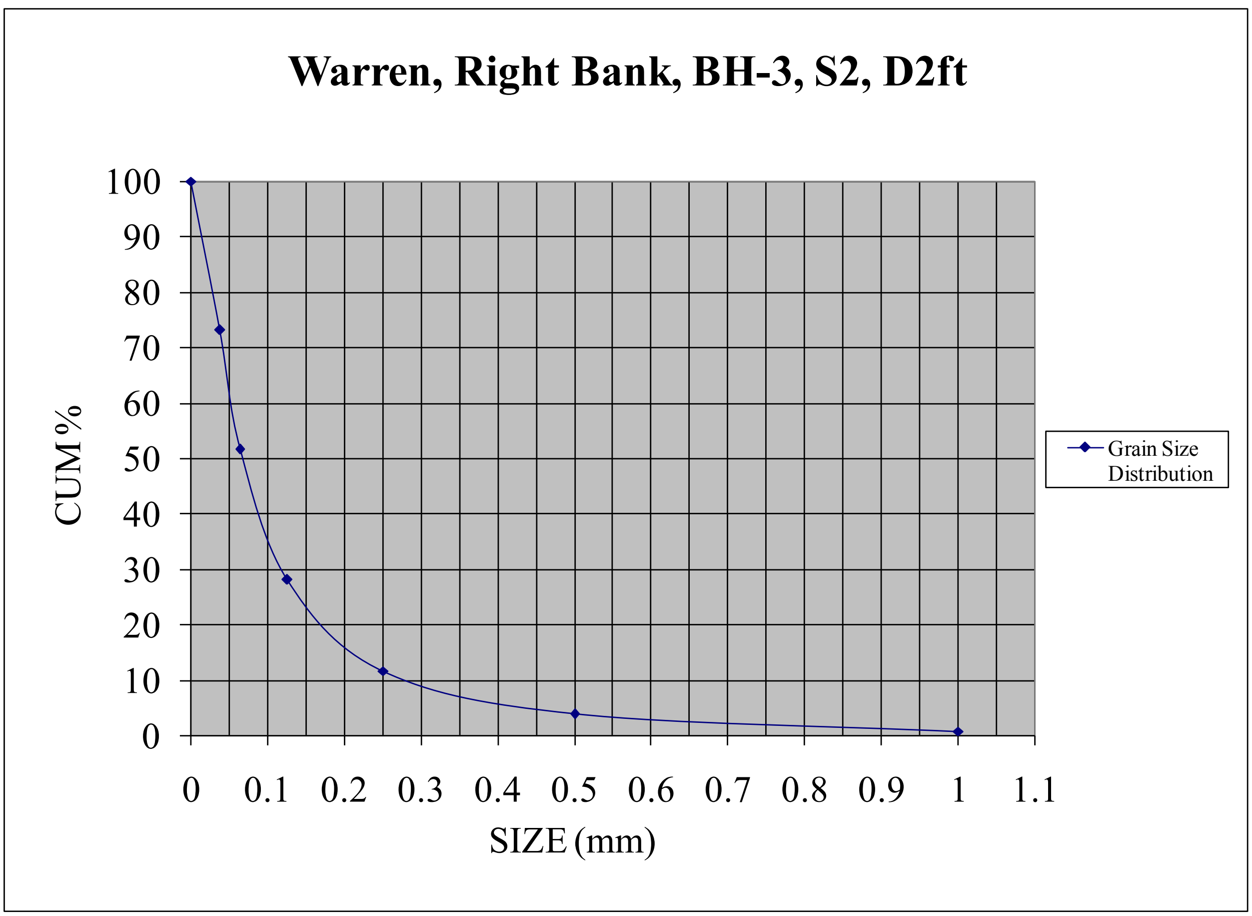
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		**Sample Date: 7/2/06**	
BH-3, S1, 1ft. bsg[a]		**Original Sample Weight: 123.0g**	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.6	0.6	0
0.5	2.7	3.3	3
0.25	7.4	10.7	9
0.125	16.4	27.1	23
0.063	29.1	56.2	47
0.044	28.7	84.9	71
pan	35.3	120.2	100

a. Below surface grade.



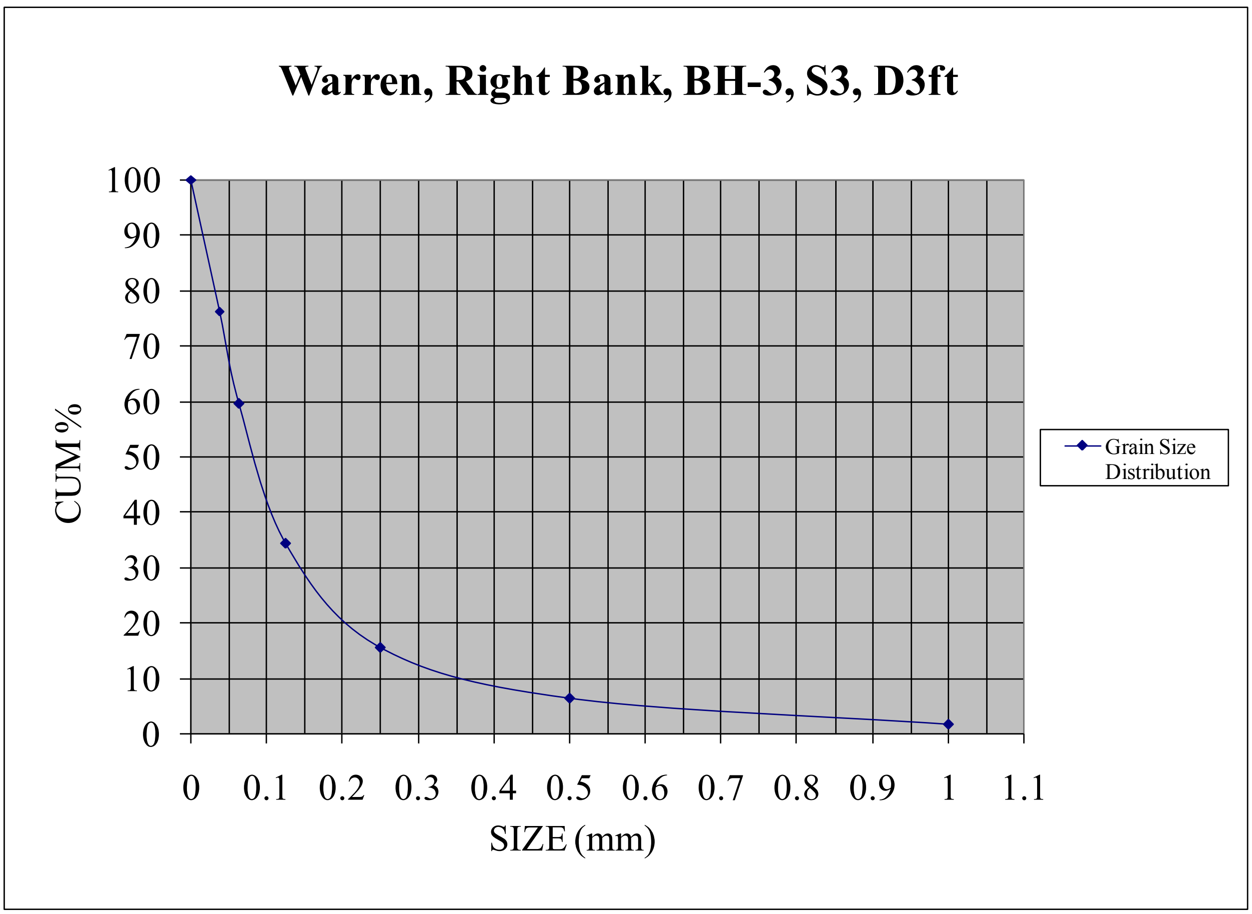
Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-3, S2, 2ft. bsg[a]		Original Sample Weight: 124.8g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.8	0.8	1
0.5	3.8	4.6	4
0.25	9.6	14.2	12
0.125	20.1	34.3	28
0.063	28.6	62.9	52
0.044	26.4	89.3	73
pan	32.6	121.9	100

a. Below surface grade.



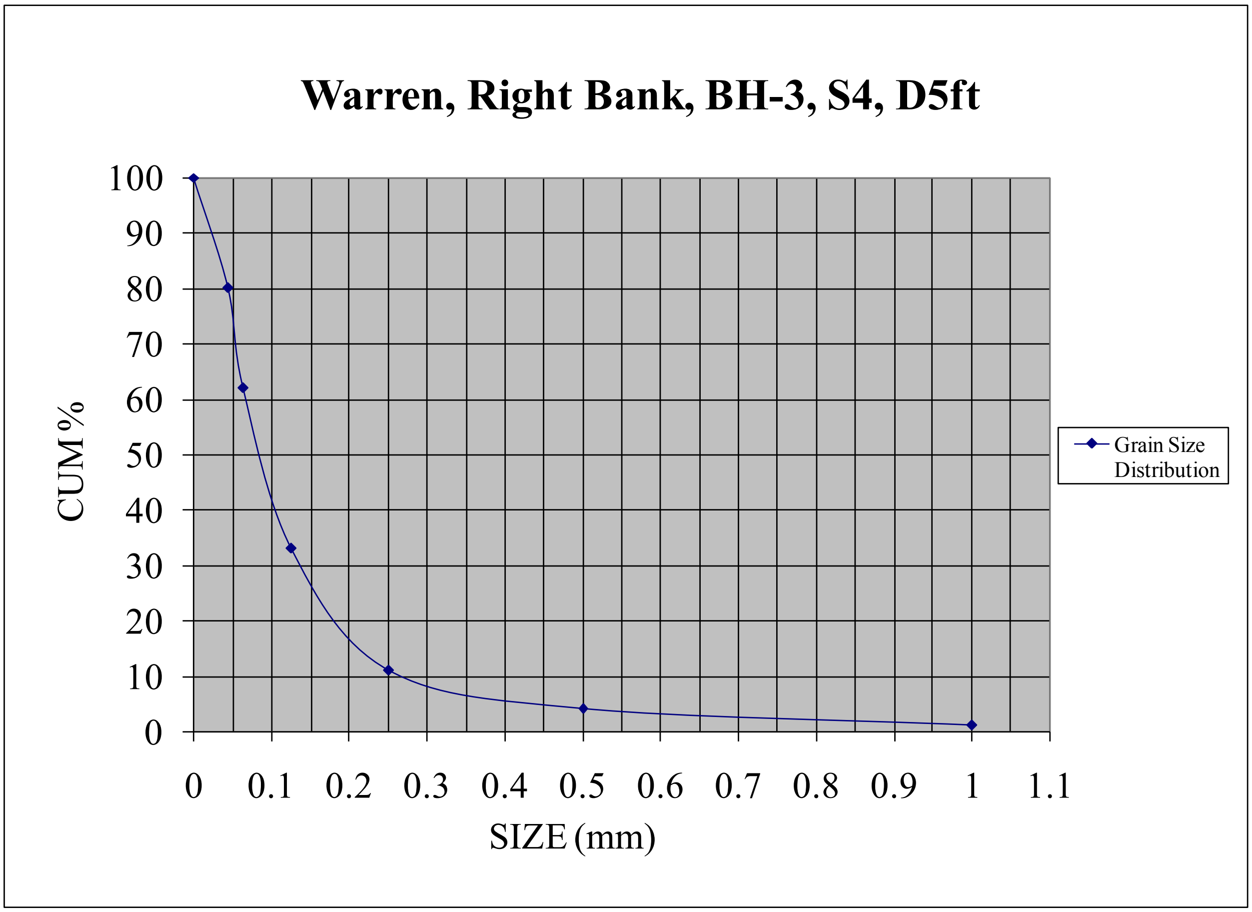
Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-3, S3, 3ft. bsg[a]		Original Sample Weight: 129.4g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.0	2.0	2
0.5	5.8	7.8	6
0.25	11.7	19.5	15
0.125	23.7	43.2	34
0.063	32.0	75.2	60
0.044	21.0	96.2	76
pan	30.1	126.3	100

a. Below surface grade.



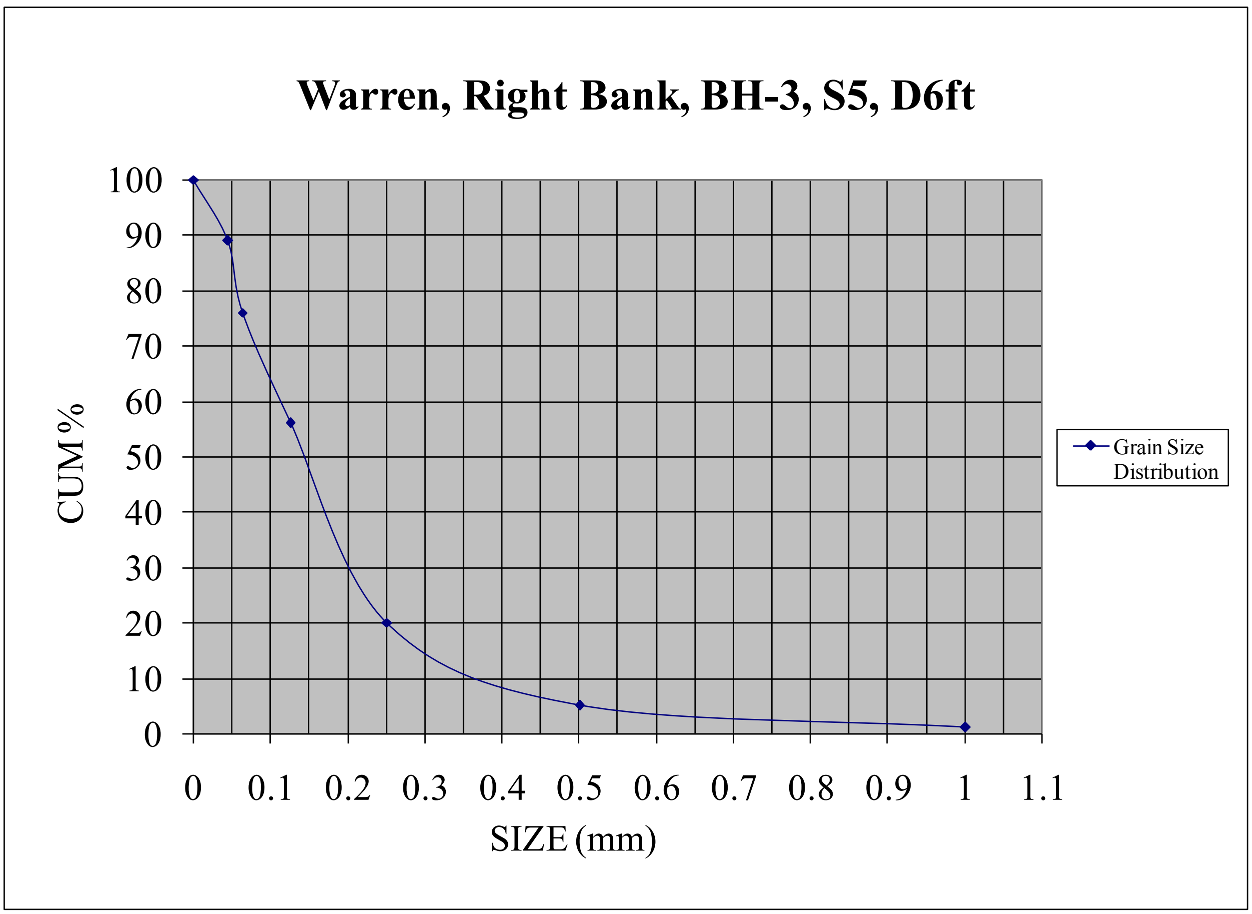
Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-3, S4, 5ft. bsg[a]		Original Sample Weight: 117.5g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.2	1.2	1
0.5	3.5	4.7	4
0.25	8.2	12.8	11
0.125	25.7	38.5	33
0.063	33.8	72.4	62
0.044	21.0	93.4	80
pan	23.3	116.7	100

a. Below surface grade.



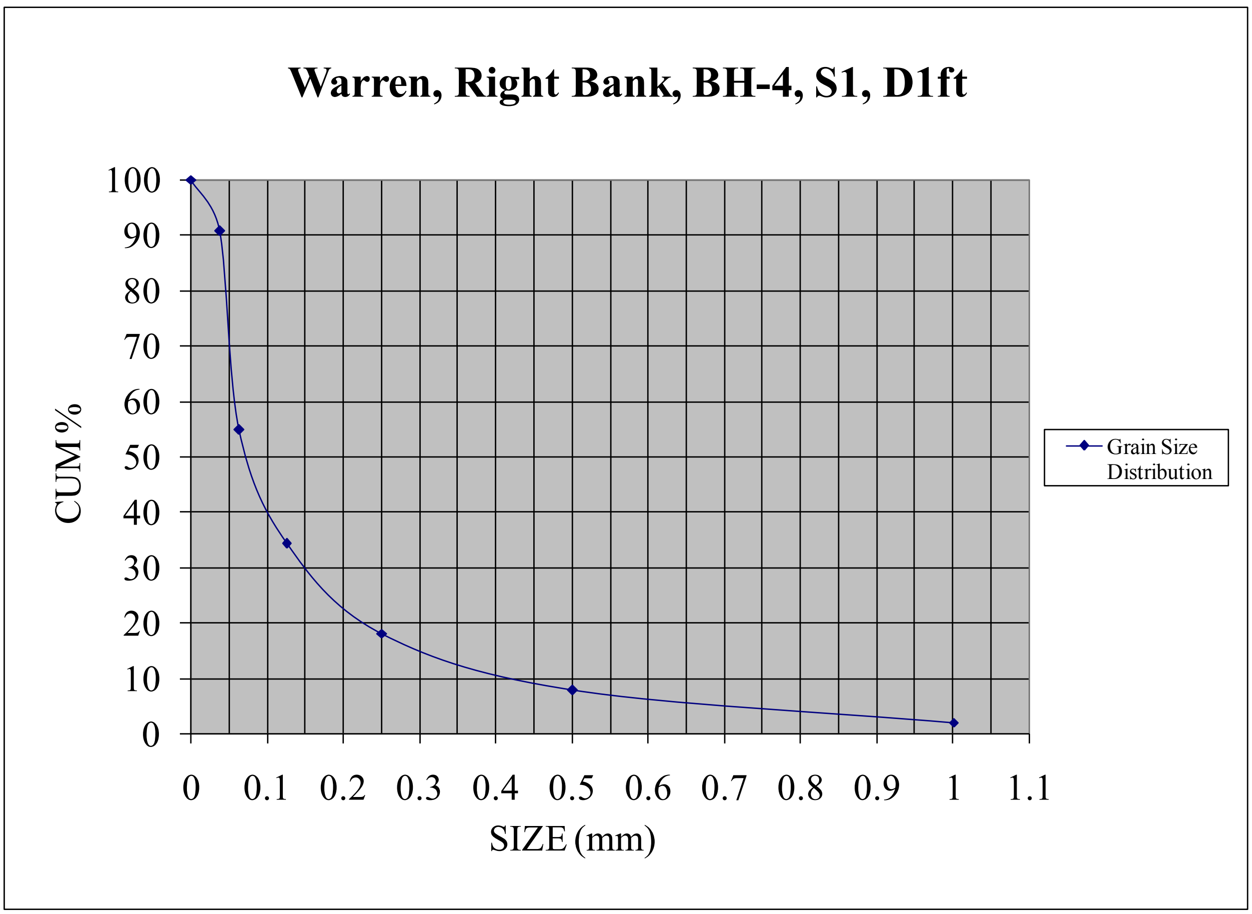
Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-3, S5, 6ft. bsg[a]		Original Sample Weight: 115.4g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	1.1	1.1	1
0.5	4.6	5.7	5
0.25	17.2	22.9	20
0.125	41.3	64.2	56
0.063	22.9	87.1	76
0.044	14.9	102.0	89
pan	12.6	114.6	100

a. Below surface grade.



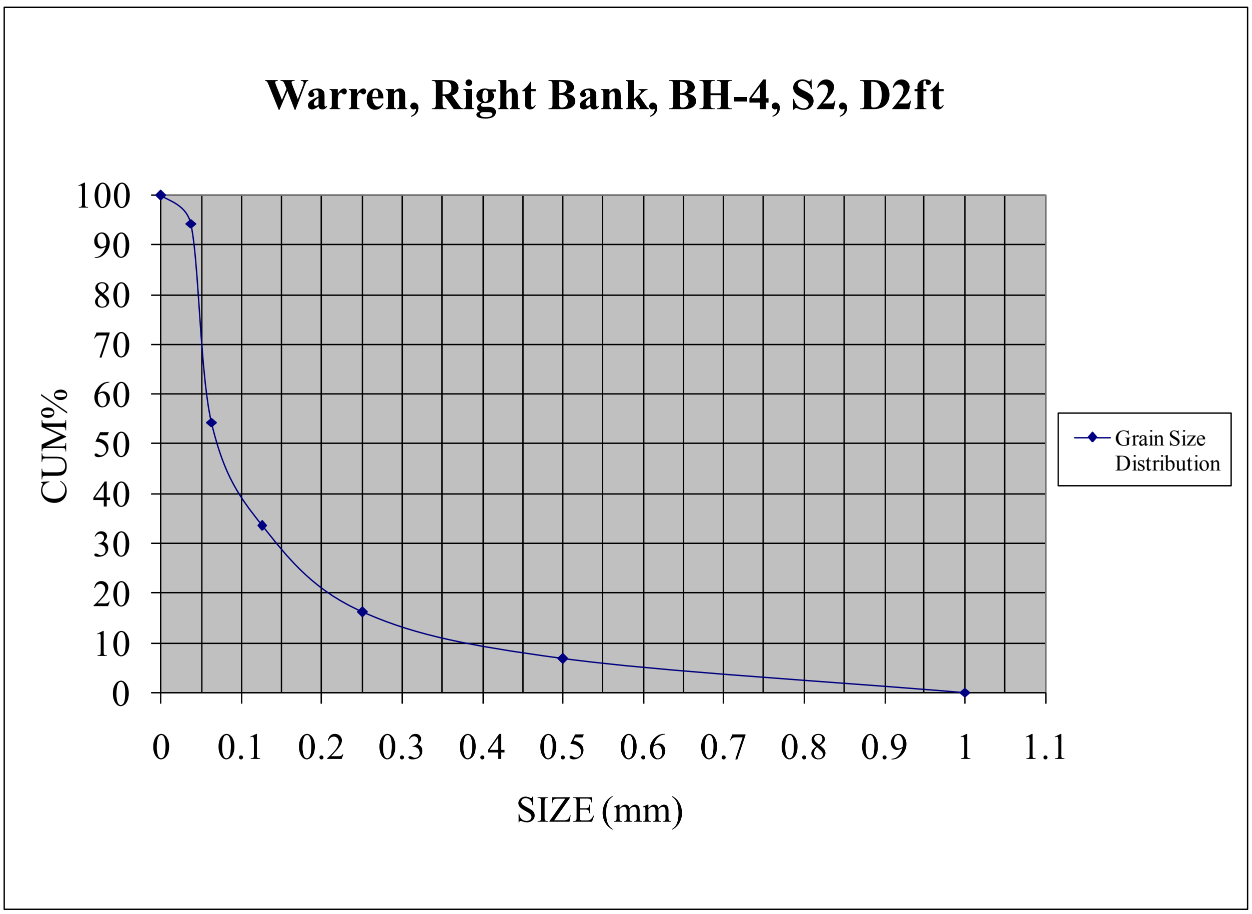
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		**Sample Date: 7/2/06**	
BH-4, S1, 1ft. bsg[a]		**Original Sample Weight: 123.0g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	2.4	2.4	2
0.5	7.1	9.5	8
0.25	12.5	22.0	18
0.125	19.6	41.6	34
0.063	25.2	66.8	55
0.037	43.9	110.7	91
pan	11.1	121.8	100

a. Below surface grade.



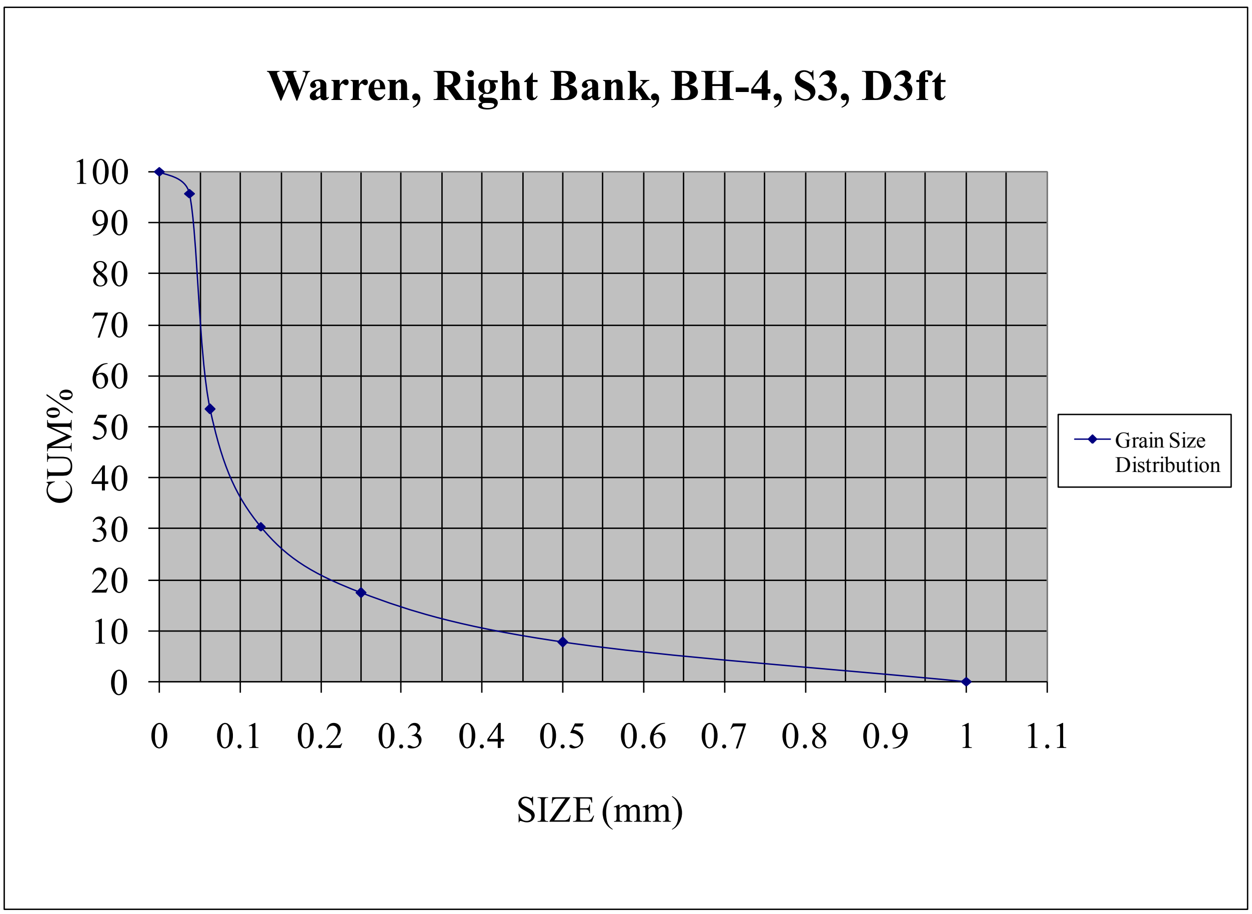
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		**Sample Date: 7/2/06**	
BH-4, S2, 2ft. bsg[a]		**Original Sample Weight: 119.0g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	2.3	2.3	2
0.5	5.7	8.0	7
0.25	11.6	19.6	17
0.125	20.1	39.7	34
0.063	24.6	64.3	54
0.037	47.4	111.7	94
pan	6.7	118.4	100

a. Below surface grade.



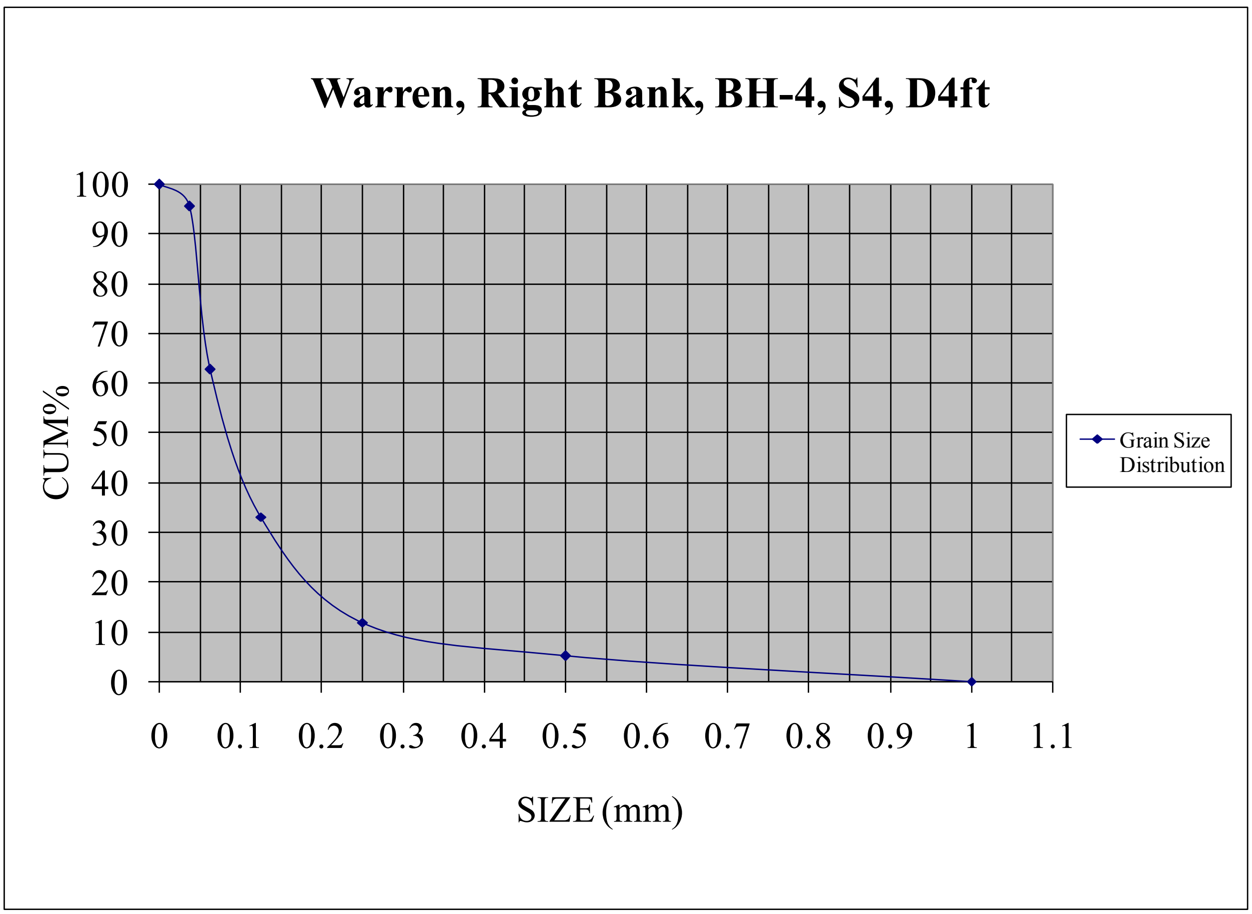
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-4, S3, 3ft. bsg[a]		Original Sample Weight: 130.4g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	2.8	2.8	2
0.5	7.1	9.9	8
0.25	12.6	22.5	17
0.125	16.8	39.3	30
0.063	29.5	68.8	53
0.037	54.8	123.6	96
pan	5.5	129.1	100

a. Below surface grade.



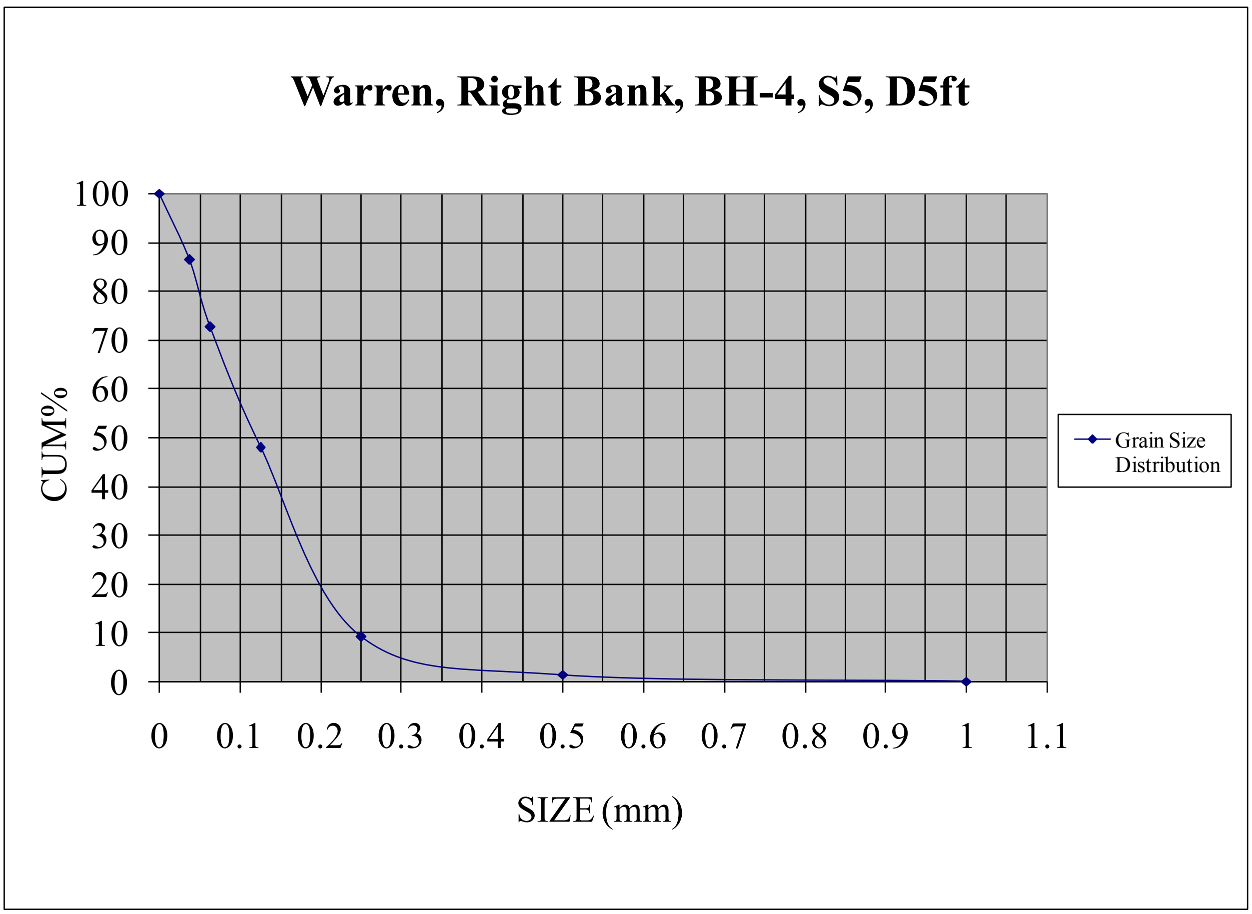
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-4, S4, 4ft. bsg[a]		Original Sample Weight: 140.1g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	2.6	2.6	2
0.5	4.6	7.2	5
0.25	9.2	16.4	12
0.125	29.1	45.5	33
0.063	40.9	86.4	63
0.037	45.1	131.5	96
pan	6.1	137.6	100

a. Below surface grade.



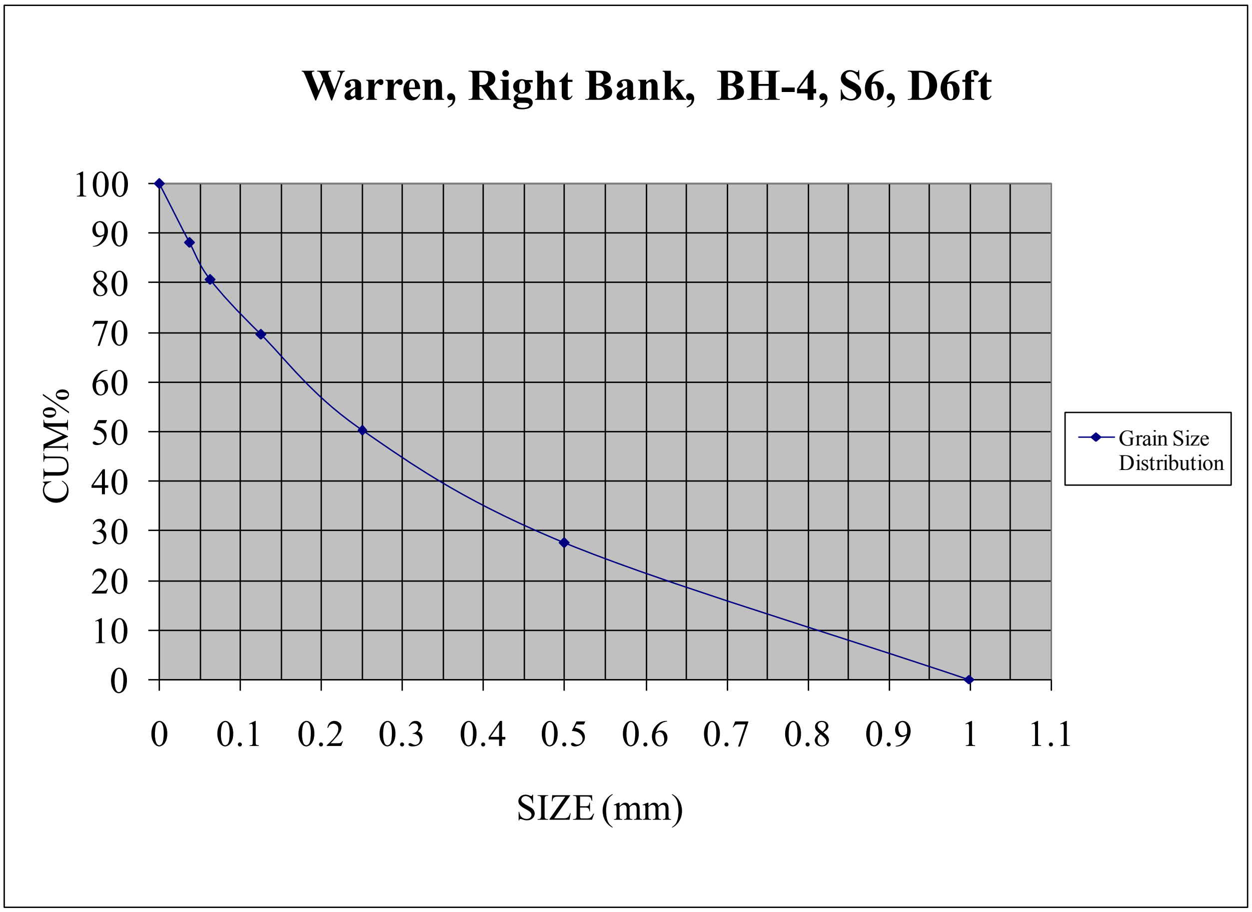
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-4, S5, 5ft. bsg[a]		Original Sample Weight: 109.4g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.1	0.1	0
0.5	1.4	1.5	1
0.25	8.4	9.9	9
0.125	41.5	51.4	48
0.063	26.3	77.7	73
0.044	14.7	92.4	86
pan	14.6	107.0	100

a. Below surface grade.



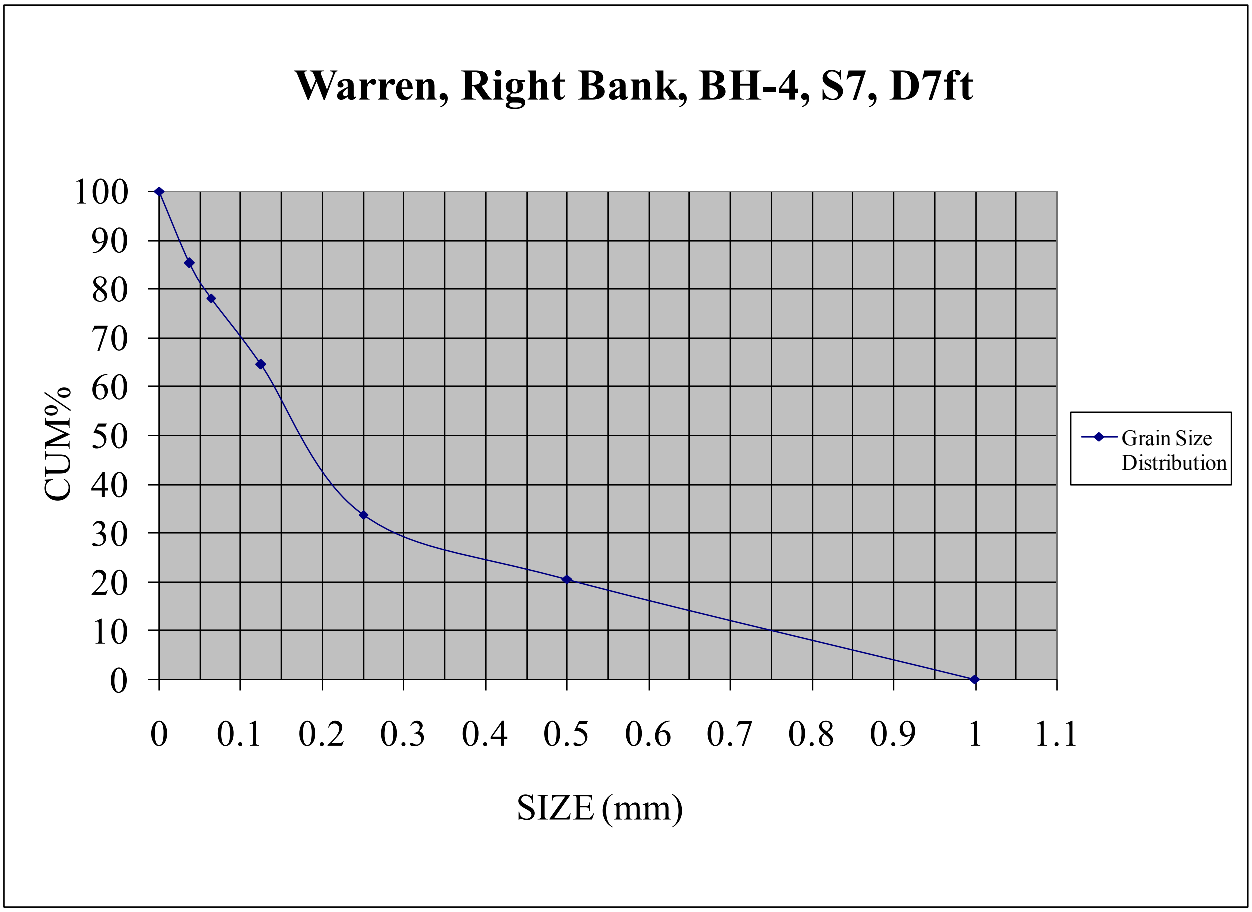
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-4, S6, 6ft. bsg[a]		Original Sample Weight: 127.0g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	25.5	25.5	20
0.5	9.0	34.5	28
0.25	28.6	63.1	50
0.125	24.1	87.2	70
0.063	13.8	101.0	81
0.044	9.3	110.3	88
pan	14.9	125.2	100

a. Below surface grade.



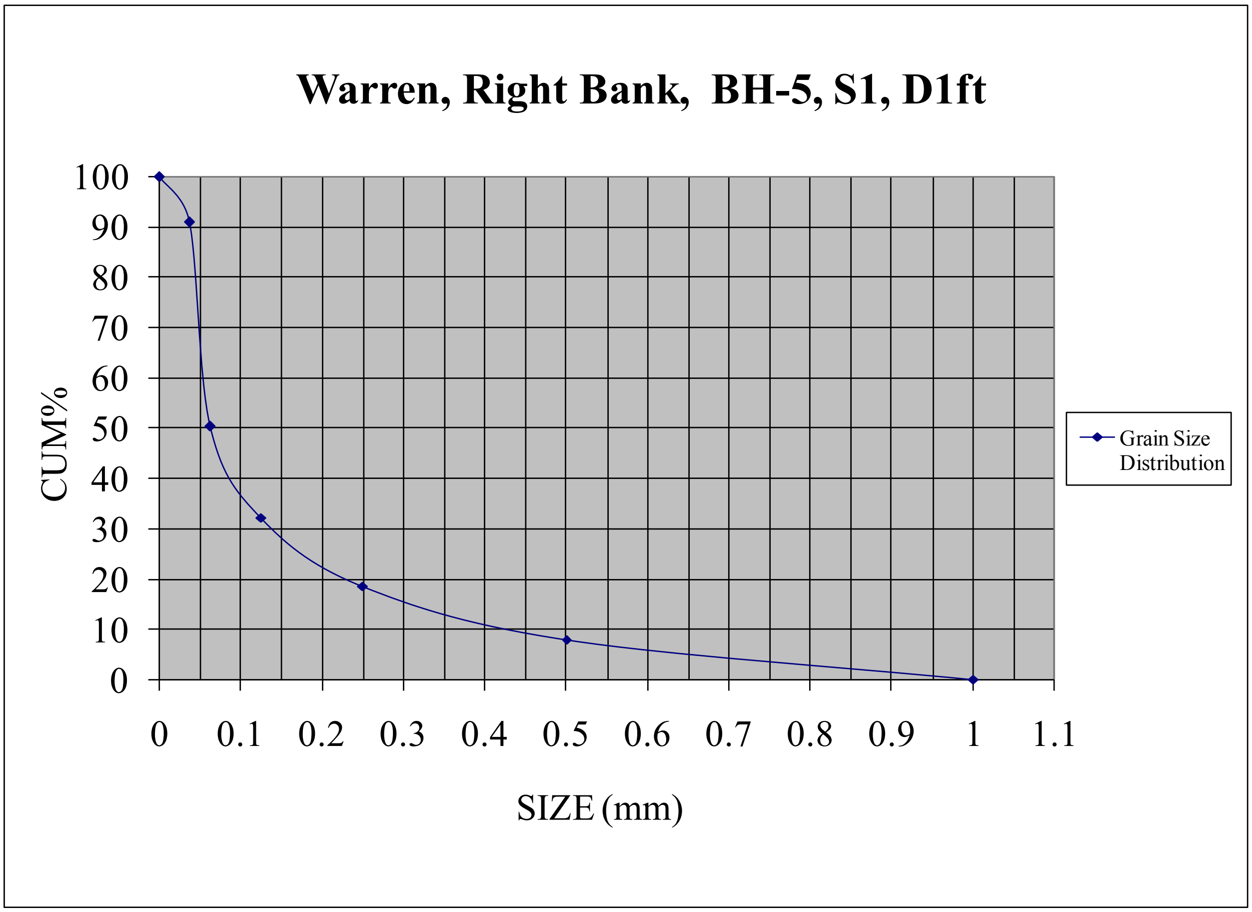
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-4, S7, 7ft. bsg[a]		Original Sample Weight: 119.9g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	19.6	19.6	16
0.5	4.8	24.4	20
0.25	15.8	40.2	34
0.125	36.7	76.9	65
0.063	16.2	93.1	78
0.044	8.5	101.6	85
pan	17.6	119.2	100

a. Below surface grade.



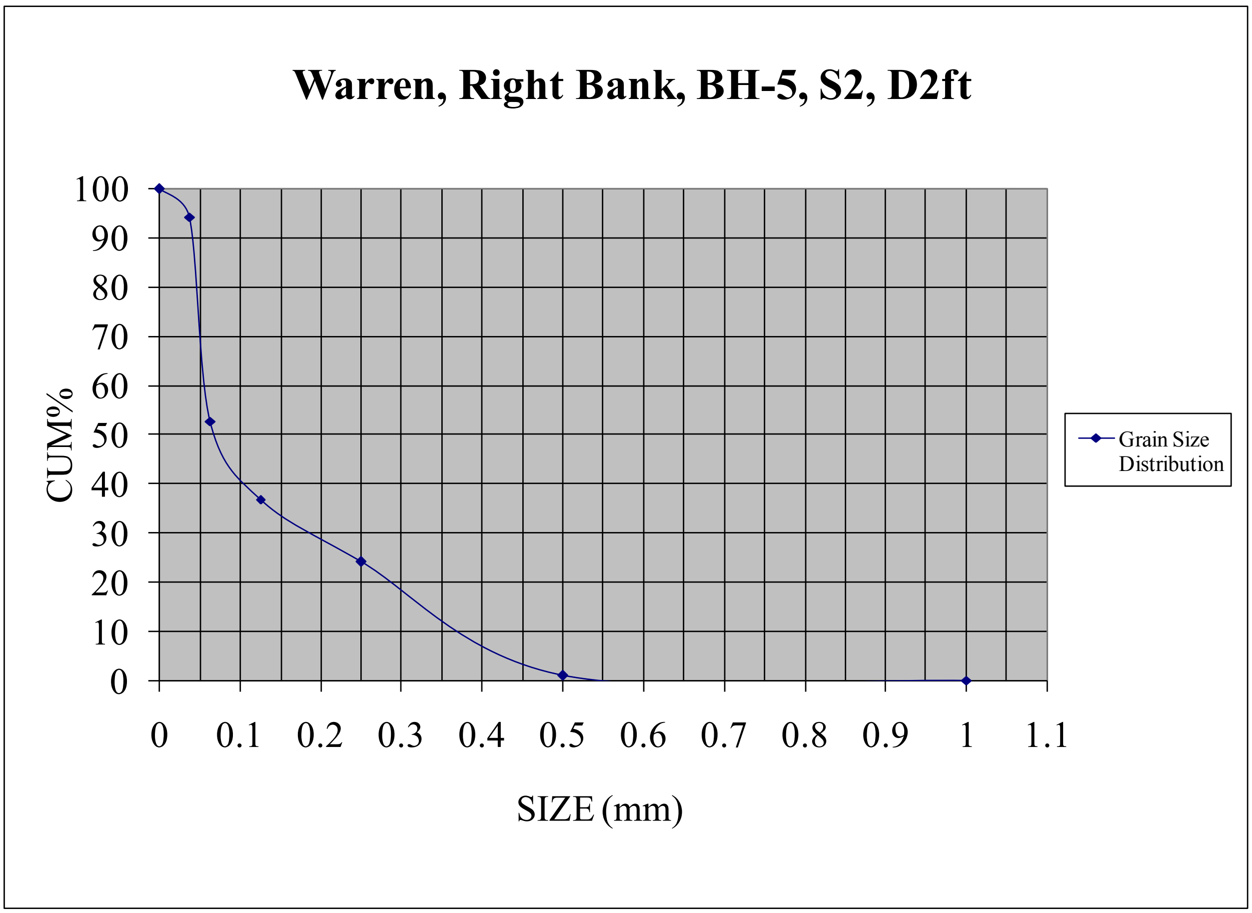
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-5, S1, 1ft. bsg[a]		Original Sample Weight: 113.69g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	2.2	2.2	2
0.5	6.6	8.8	8
0.25	12.0	20.8	19
0.125	15.3	36.1	32
0.063	20.3	56.4	50
0.037	45.6	102.0	91
pan	10.1	112.1	100

a. Below surface grade.



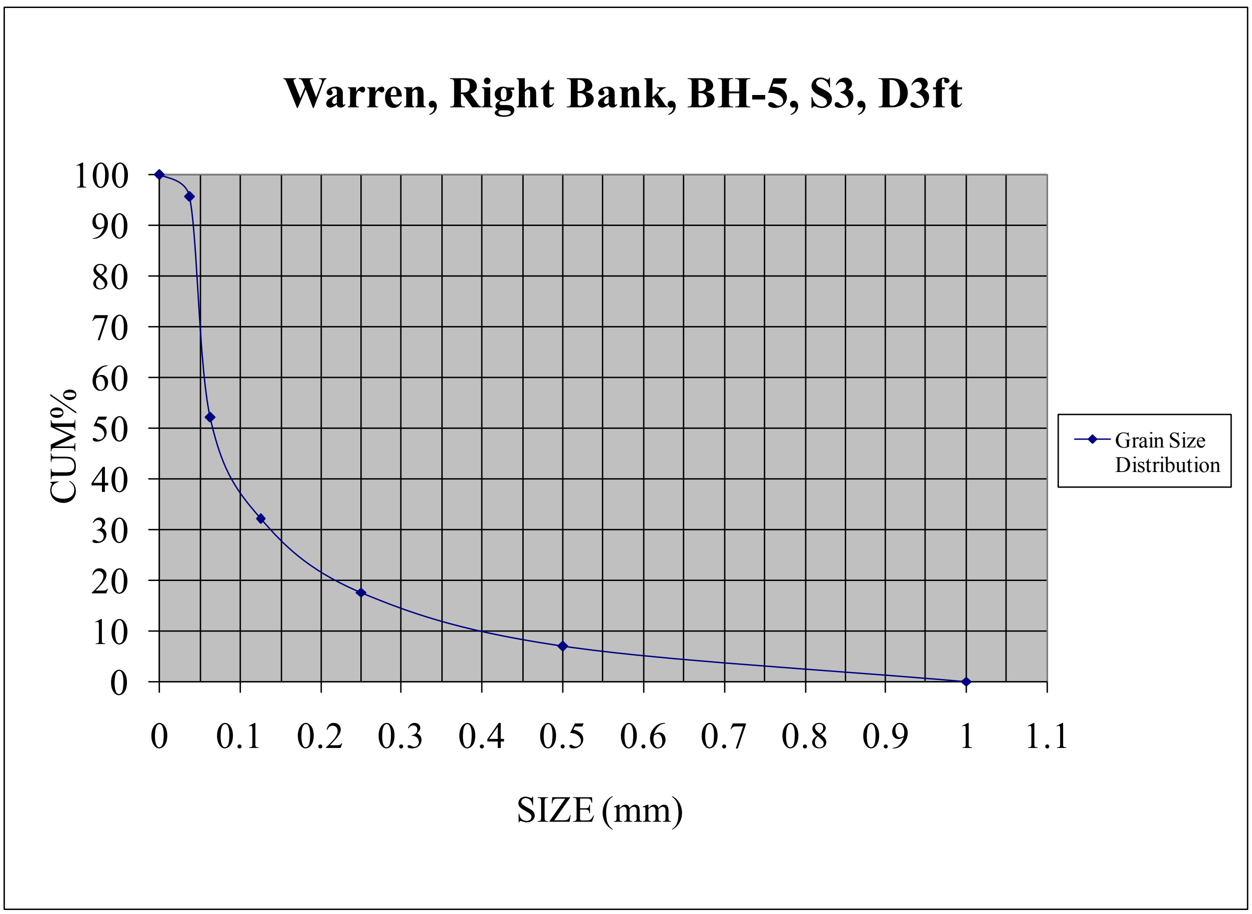
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-5, S2, 2ft. bsg[a]		Original Sample Weight: 120.0g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	3.1	3.1	3
0.5	9.8	12.9	11
0.25	16.0	28.9	24
0.125	15.2	44.1	37
0.063	19.0	63.1	53
0.037	49.6	112.7	94
pan	7.0	119.7	100

a. Below surface grade.



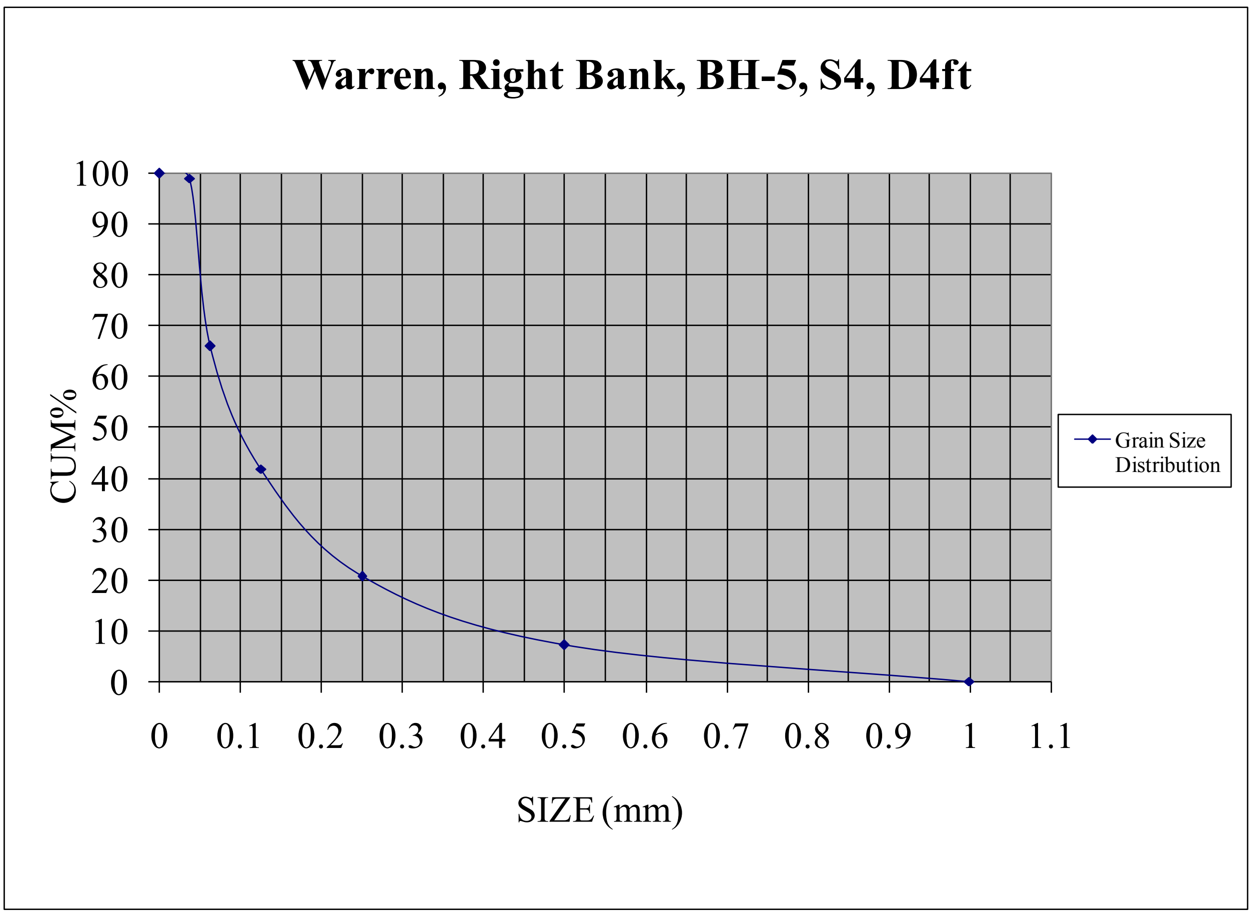
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		**Sample Date: 7/2/06**	
BH-5, S3, 3ft. bsg[a]		**Original Sample Weight: 111.4g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	1.6	1.6	1
0.5	6.0	7.6	7
0.25	11.6	19.2	18
0.125	15.8	35.0	32
0.063	22.0	57.0	52
0.037	47.4	104.4	96
pan	4.7	109.1	100

a. Below surface grade.



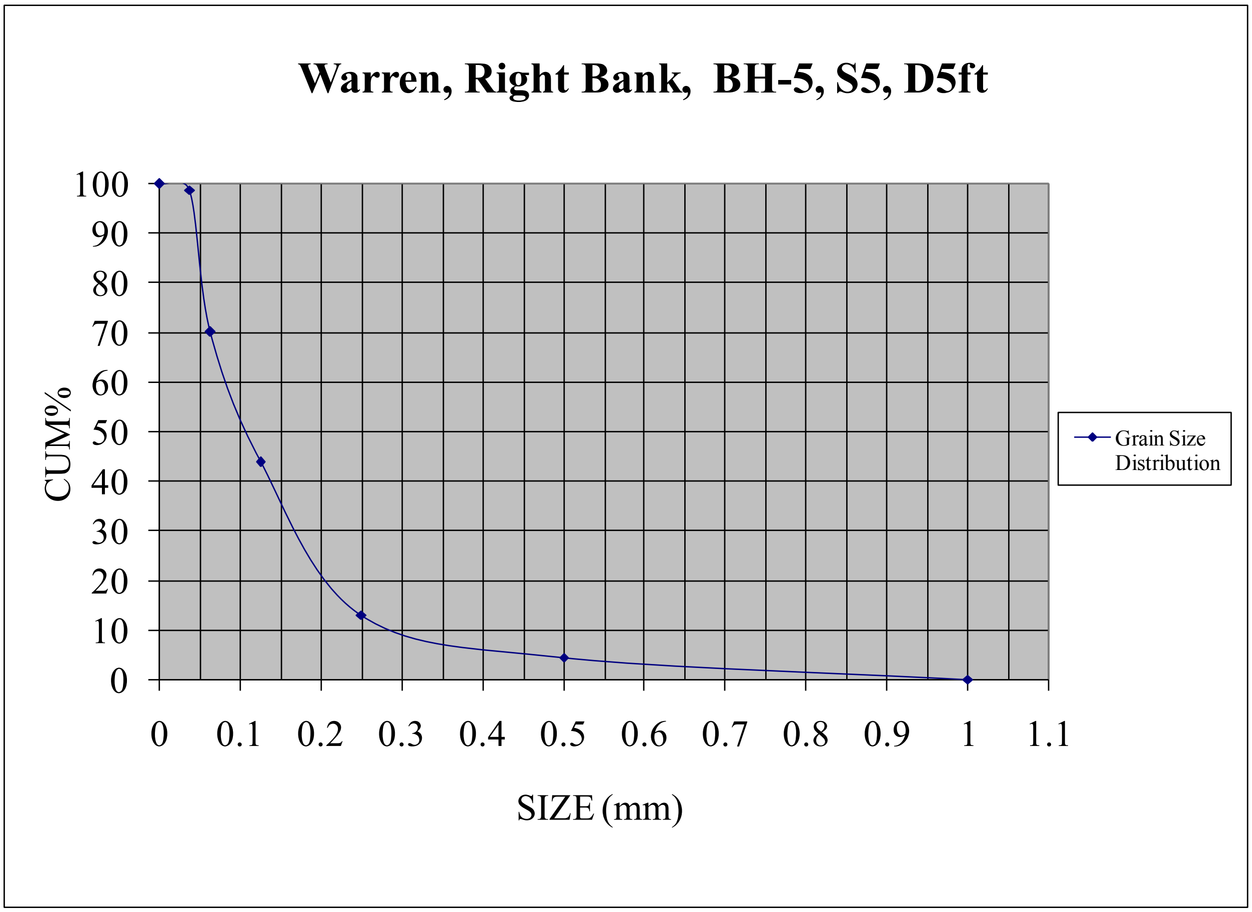
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-5, S4, 4ft. bsg[a]		Original Sample Weight: 119.4g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.2	2.2	2
0.5	6.1	8.3	7
0.25	15.8	24.1	21
0.125	24.9	49.0	42
0.063	28.2	77.2	66
0.037	38.7	115.9	99
pan	1.2	117.1	100

a. Below surface grade.



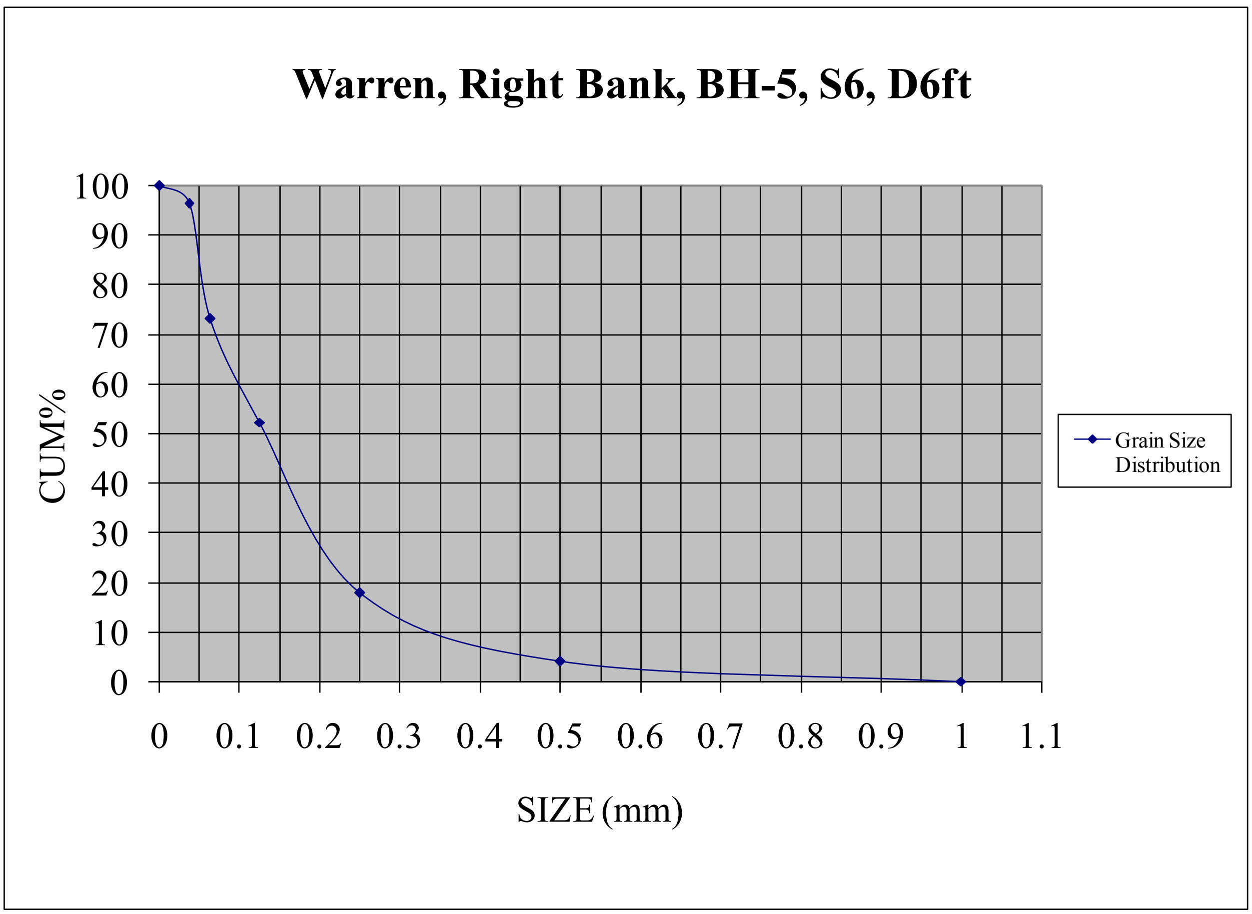
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-5, S5, 5ft. bsg[a]		Original Sample Weight: 114.8g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	1.6	1.6	1
0.5	3.5	5.1	4
0.25	9.6	14.7	13
0.125	35.0	49.7	44
0.063	29.9	79.6	70
0.037	32.4	112.0	99
pan	1.4	113.4	100

a. Below surface grade.



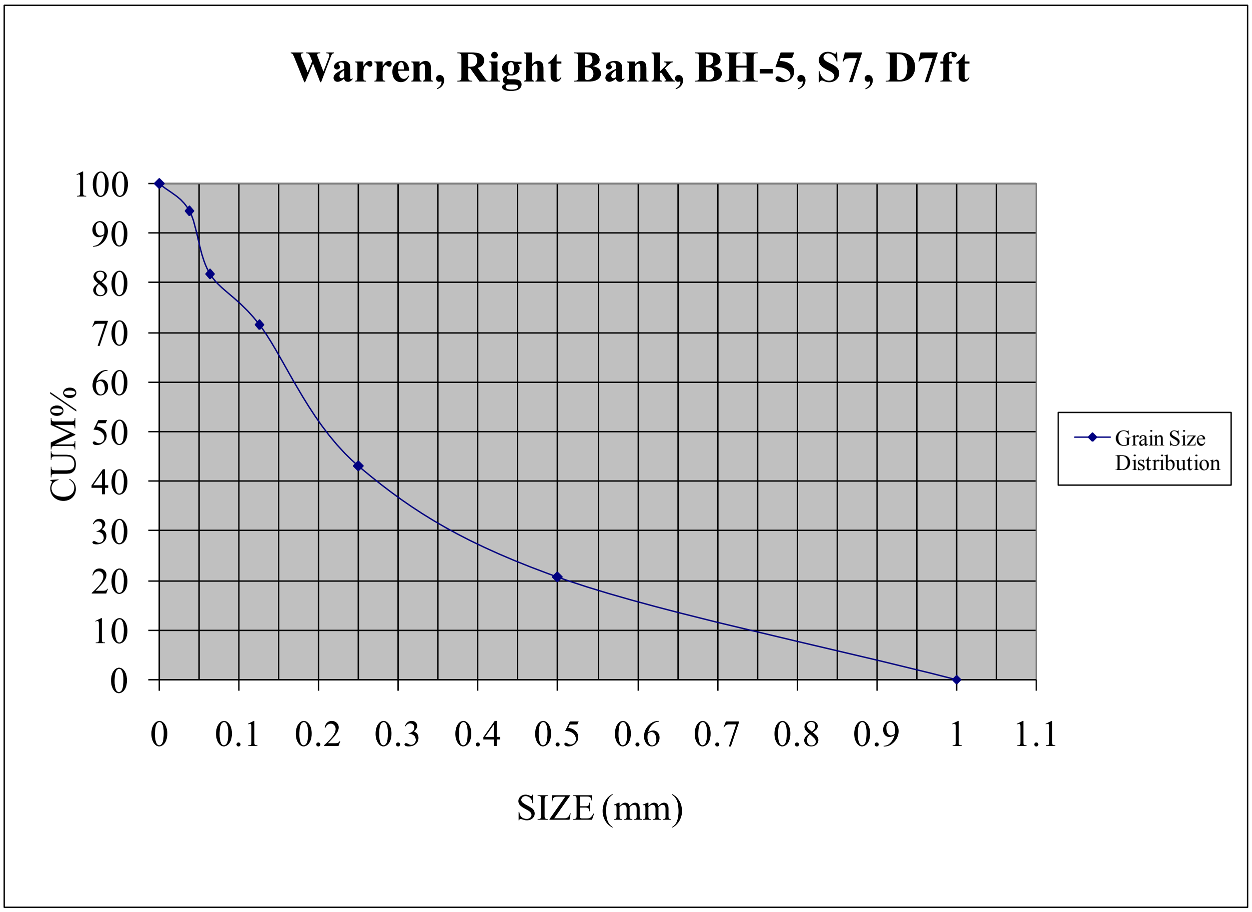
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-5, S6, 6ft. bsg[a]		Original Sample Weight: 129.9g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	1.7	1.7	1
0.5	3.5	5.2	4
0.25	17.8	23.0	18
0.125	44.4	67.4	52
0.063	27.0	94.4	73
0.037	29.8	124.2	96
pan	4.7	128.9	100

a. Below surface grade.



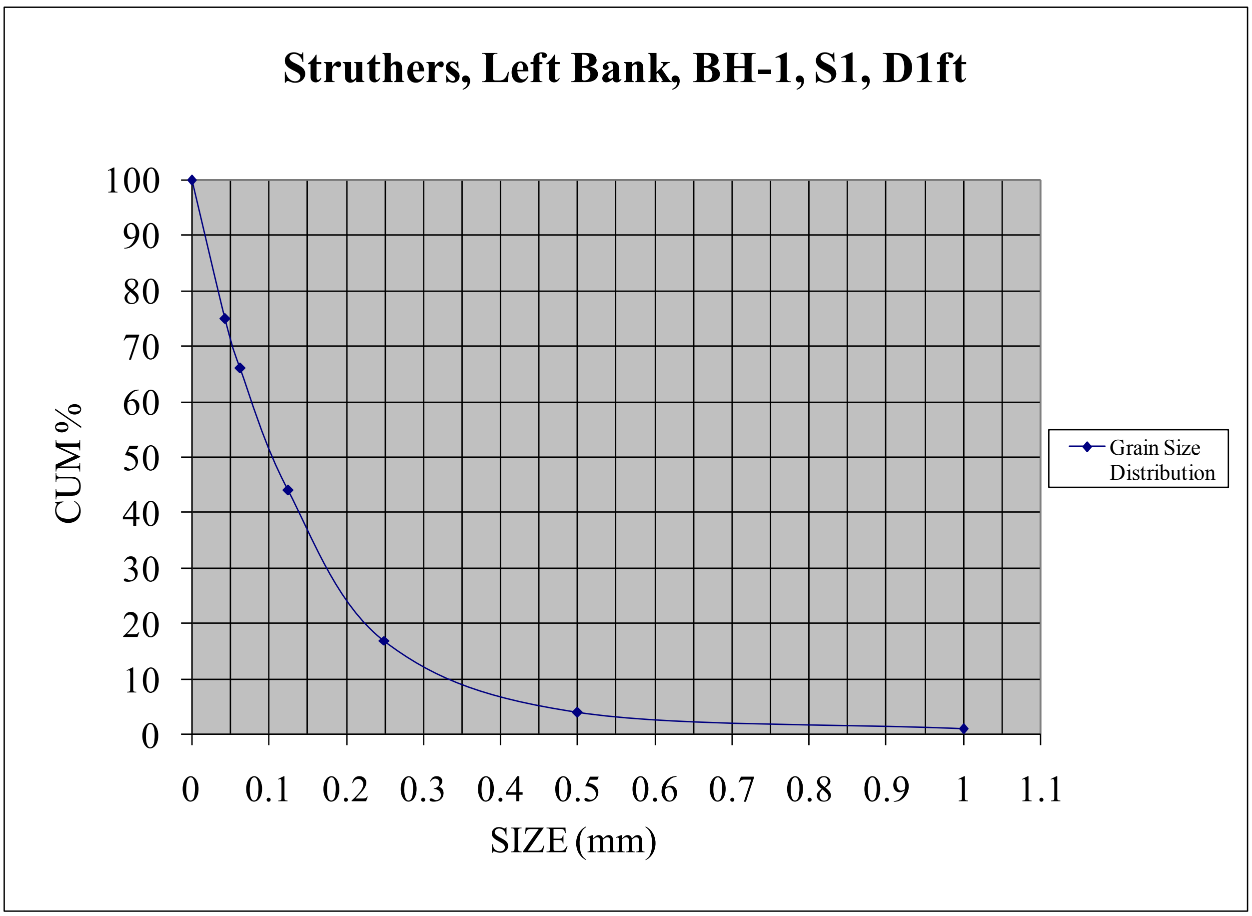
Soil Grain-size Analysis Laboratory Results			
Warren Right Bank		Sample Date: 7/2/06	
BH-5, S7, 7ft. bsg[a]		Original Sample Weight: 131.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	13.7	13.7	11
0.5	13.2	26.9	21
0.25	29.1	56.0	43
0.125	36.9	92.9	72
0.063	13.2	106.1	82
0.037	16.5	122.6	94
pan	7.2	129.8	100

a. Below surface grade.



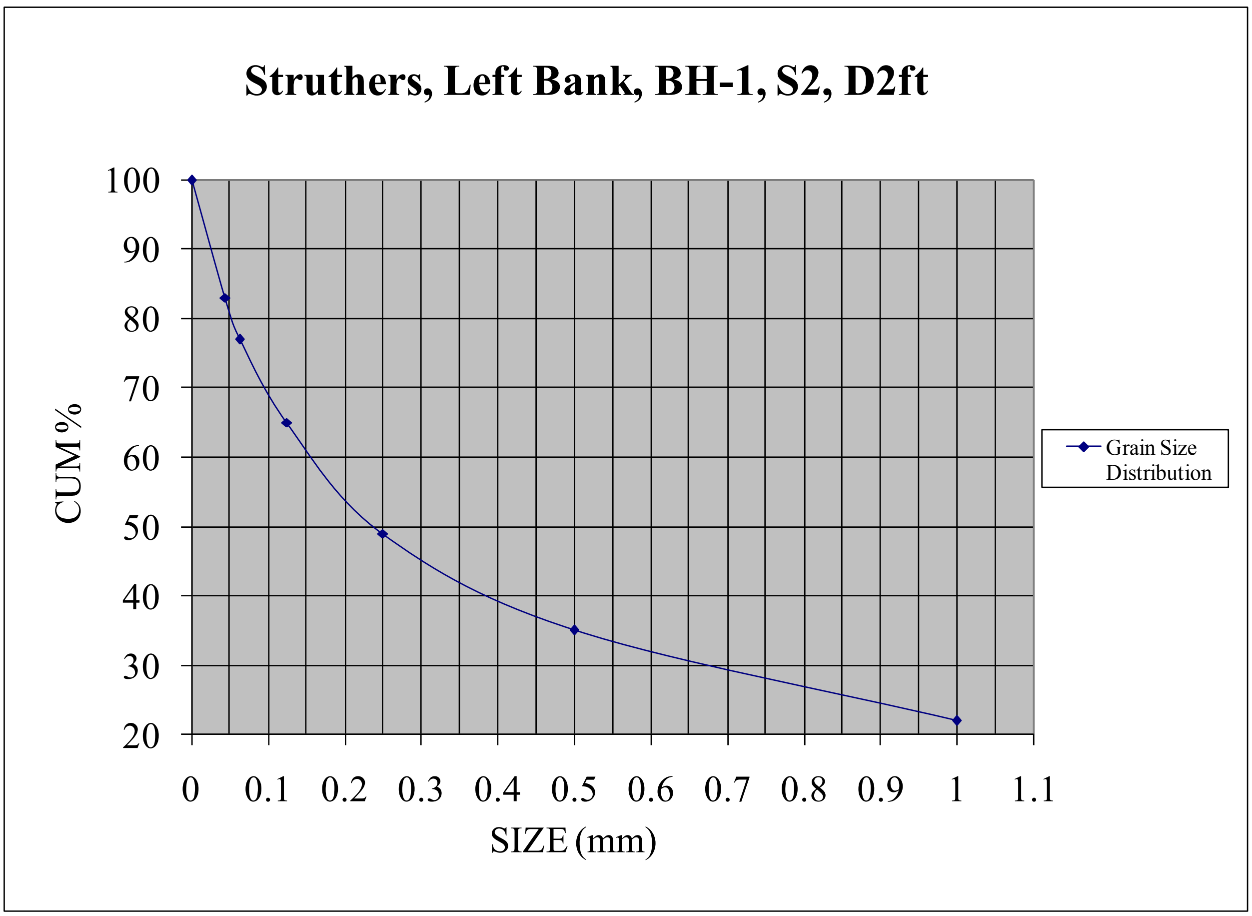
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 9/26/06	
BH-1, S1, 1ft. bsg[a]		Original Sample Weight: 105.3g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.7	0.7	1
0.5	3.6	4.3	4
0.25	13.2	17.5	17
0.125	28.6	46.1	44
0.063	23.0	69.1	66
0.044	9.4	78.5	75
pan	25.9	104.4	100

a. Below surface grade.



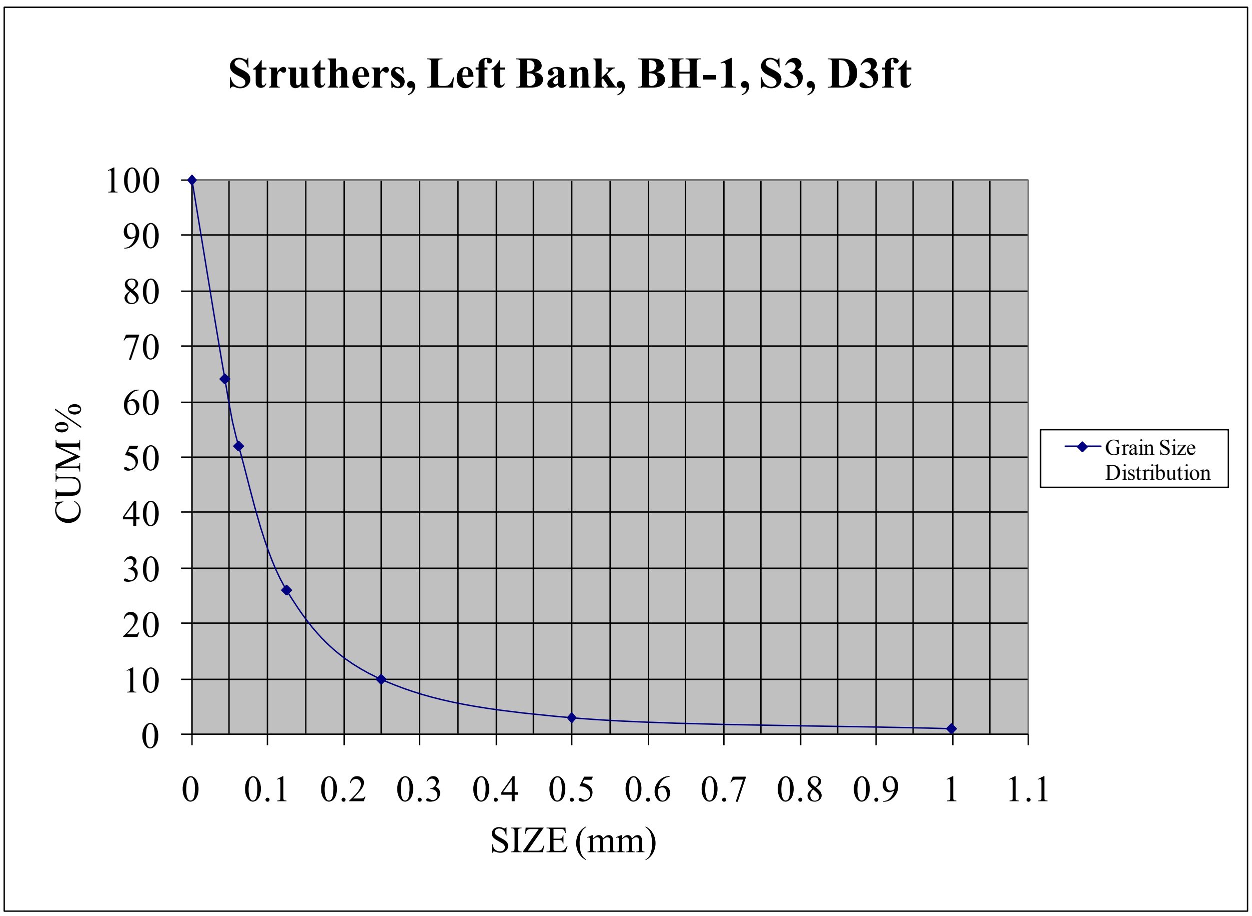
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 9/26/06	
BH-1, S2, 2ft. bsg[a]		Original Sample Weight: 109.3g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	23.8	23.8	22
0.5	13.6	37.4	35
0.25	15.6	53.0	49
0.125	17.7	70.7	65
0.063	13.1	83.8	77
0.044	6.1	89.9	83
pan	18.3	108.2	100

a. Below surface grade.



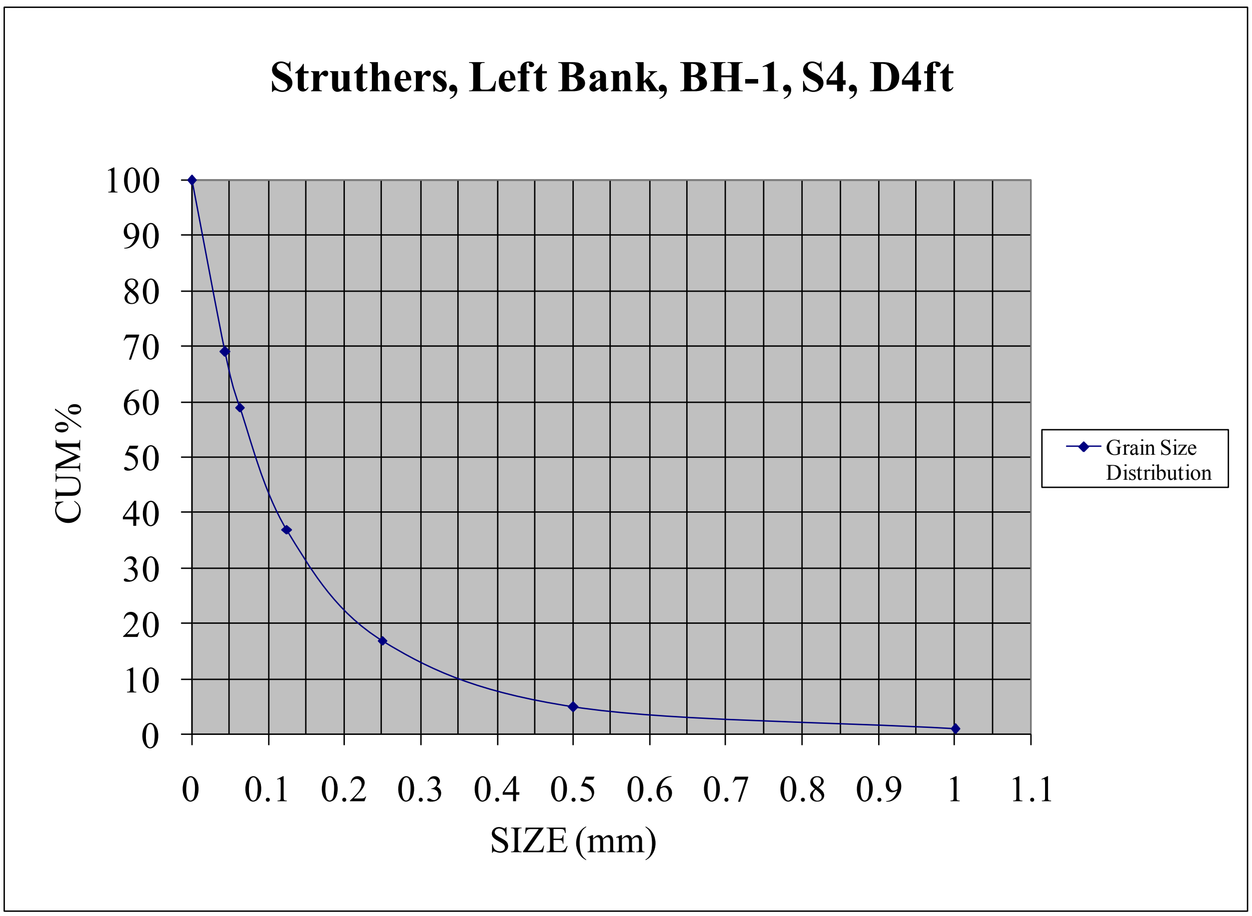
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 9/26/06	
BH-1, S3, 3ft. bsg[a]		Original Sample Weight: 129.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.0	1.0	1
0.5	2.6	3.6	3
0.25	8.6	12.2	10
0.125	21.6	33.8	26
0.063	32.4	66.2	52
0.044	16.1	82.3	64
pan	45.6	127.9	100

a. Below surface grade.



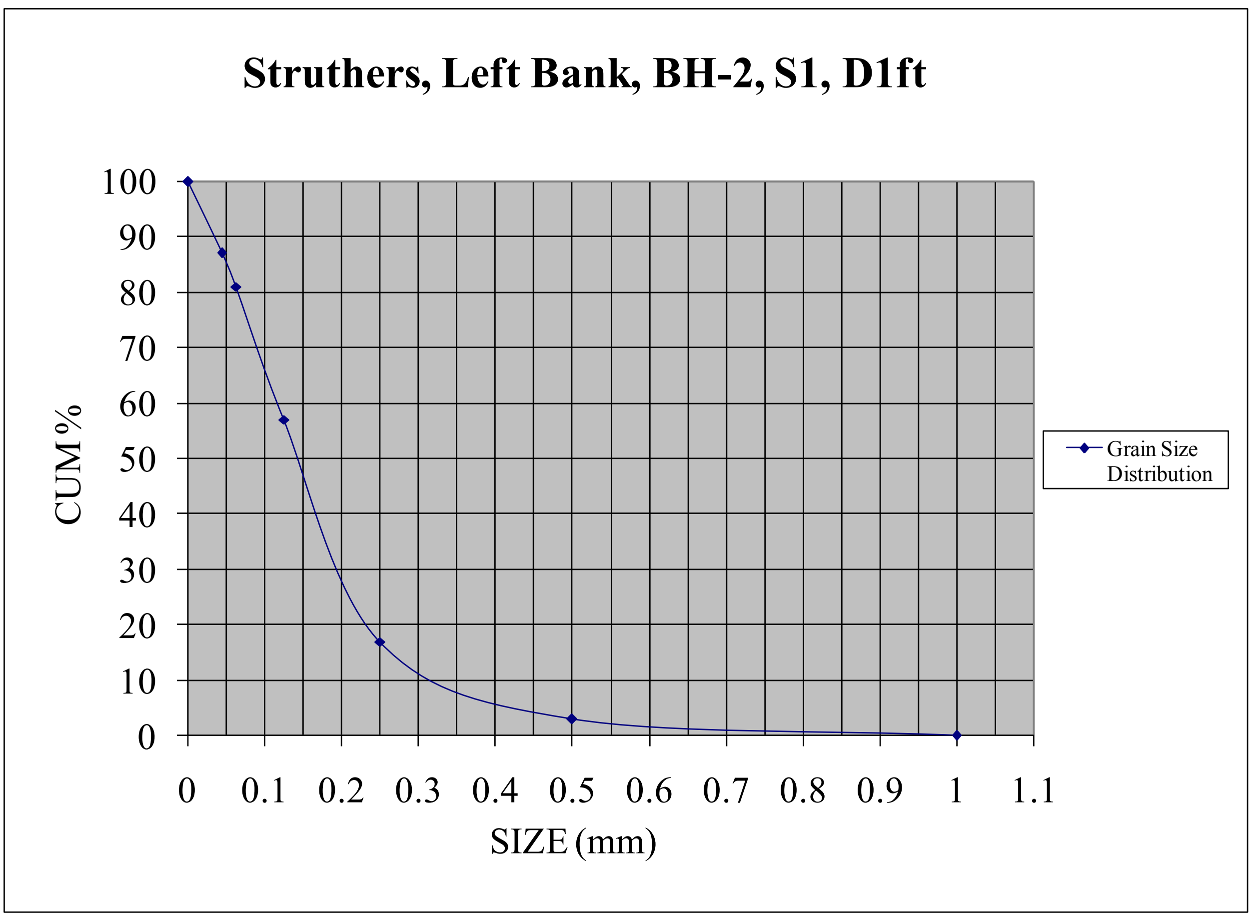
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 9/26/06	
BH-1, S4, 4ft. bsg[a]		Original Sample Weight: 94.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.0	1.0	1
0.5	3.3	4.3	5
0.25	11.6	15.9	17
0.125	19.0	34.9	37
0.063	20.5	55.4	59
0.044	8.7	64.1	69
pan	29.3	93.4	100

a. Below surface grade.



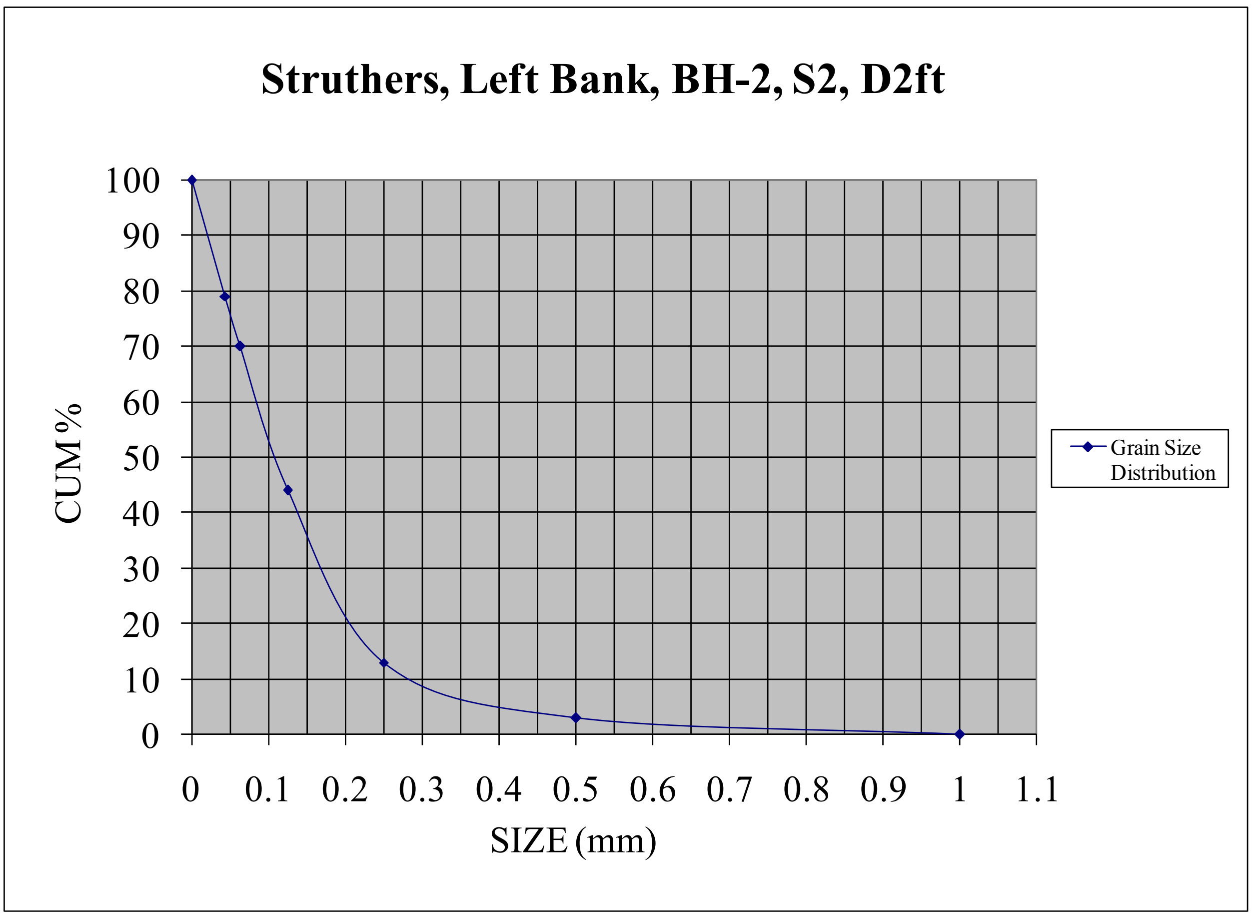
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		**Sample Date: 9/26/06**	
BH-2, S1, 1ft. bsg[a]		**Original Sample Weight: 125.9g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.4	0.4	0
0.5	2.7	3.1	3
0.25	18.1	21.2	17
0.125	49.3	70.5	57
0.063	30.0	100.5	81
0.044	8.2	108.7	87
pan	16.0	124.7	100

a. Below surface grade.



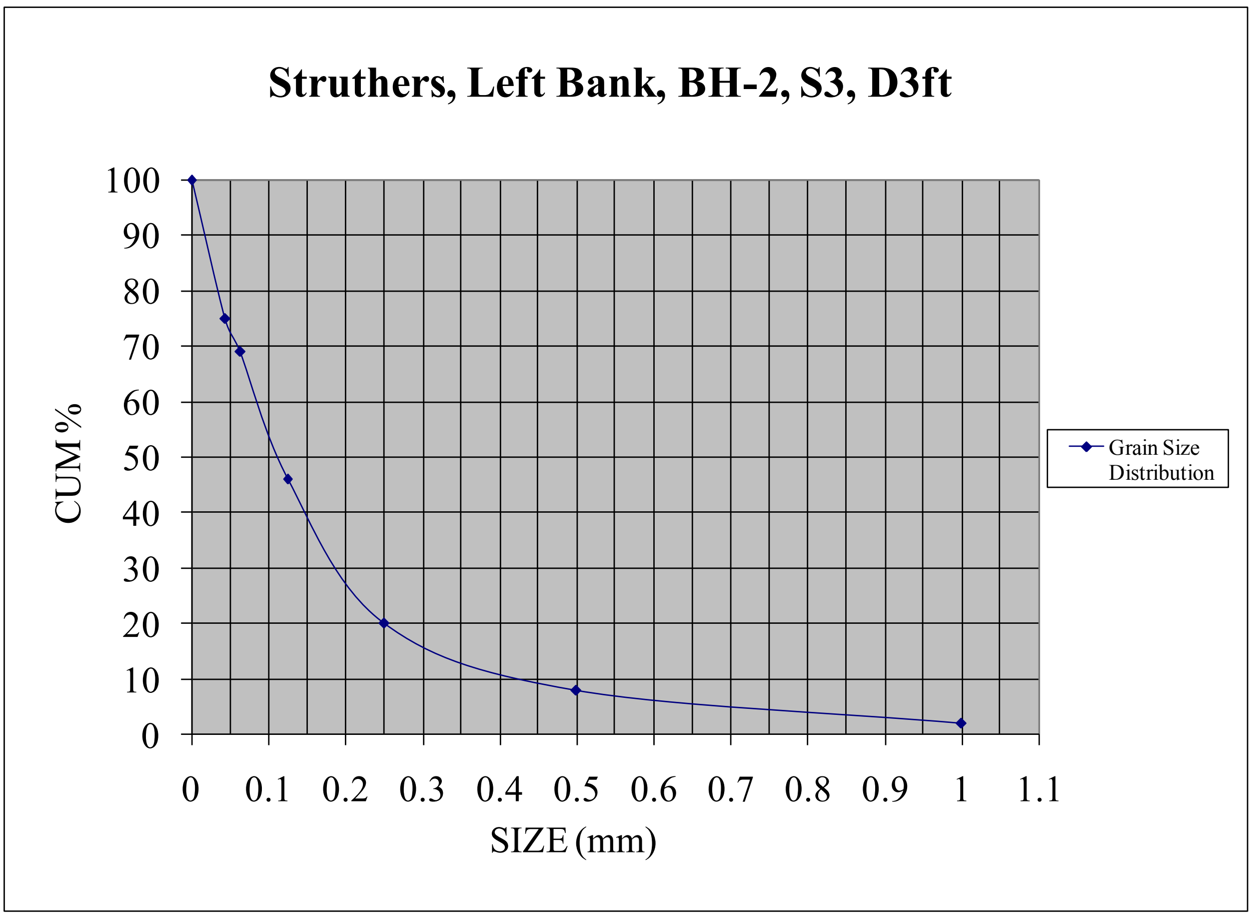
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 9/26/06	
BH-2, S2, 2ft. bsg[a]		Original Sample Weight: 105.9g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.2	0.2	0
0.5	3.1	3.3	3
0.25	10.5	13.8	13
0.125	32.6	46.4	44
0.063	27.4	73.8	70
0.044	8.8	82.6	79
pan	22.4	105.0	100

a. Below surface grade.



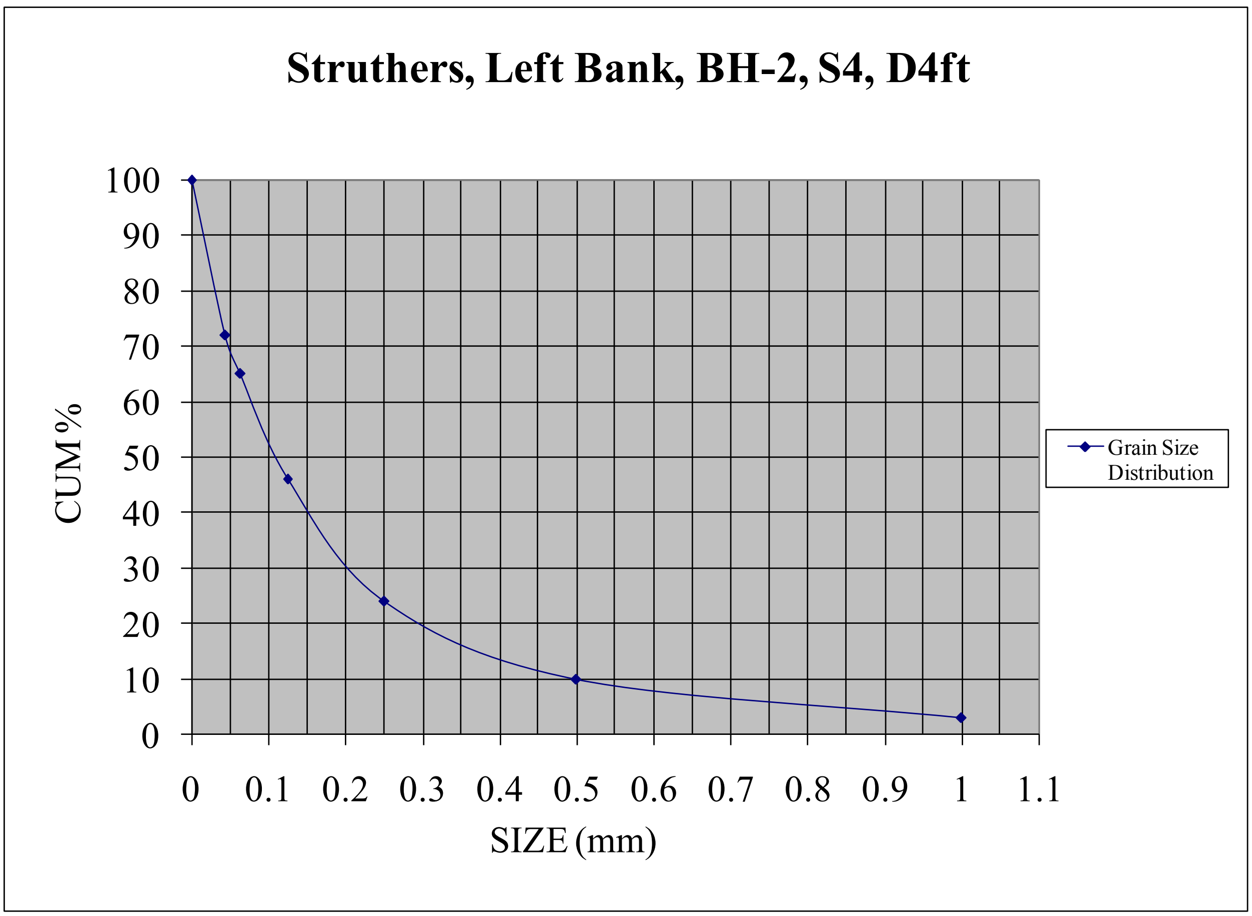
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		**Sample Date: 9/26/06**	
BH-2, S3, 3ft. bsg[a]		**Original Sample Weight: 105.4g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	2.1	2.1	2
0.5	6.5	8.6	8
0.25	12.3	20.9	20
0.125	27.2	48.1	46
0.063	23.2	71.3	69
0.044	6.7	78.0	75
pan	25.8	103.8	100

a. Below surface grade.



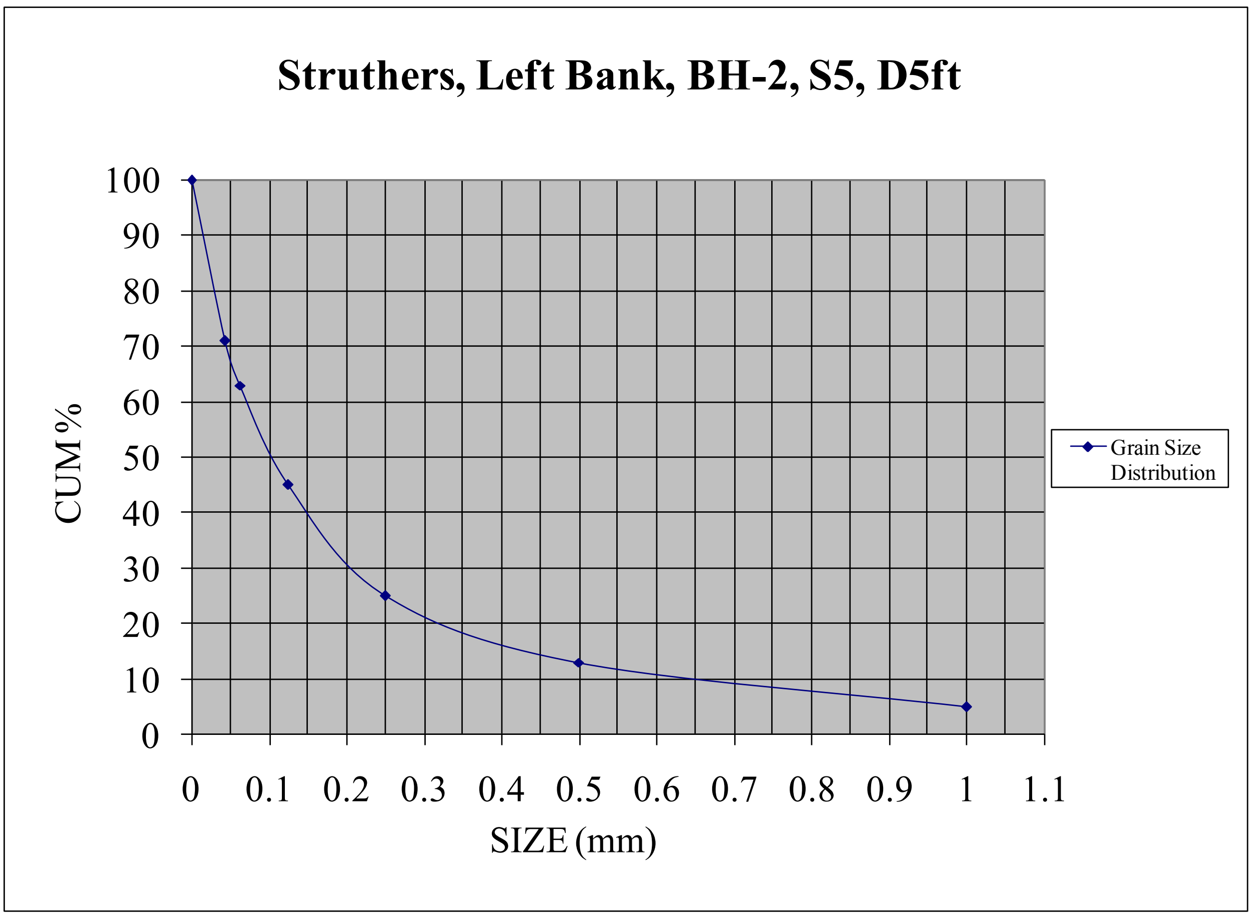
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 9/26/06	
BH-2, S4, 4ft. bsg[a]		Original Sample Weight: 102.4g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.8	2.8	3
0.5	7.1	9.9	10
0.25	13.6	23.5	24
0.125	21.1	44.6	46
0.063	18.8	63.4	65
0.044	6.9	70.3	72
pan	27.7	98.0	100

a. Below surface grade.



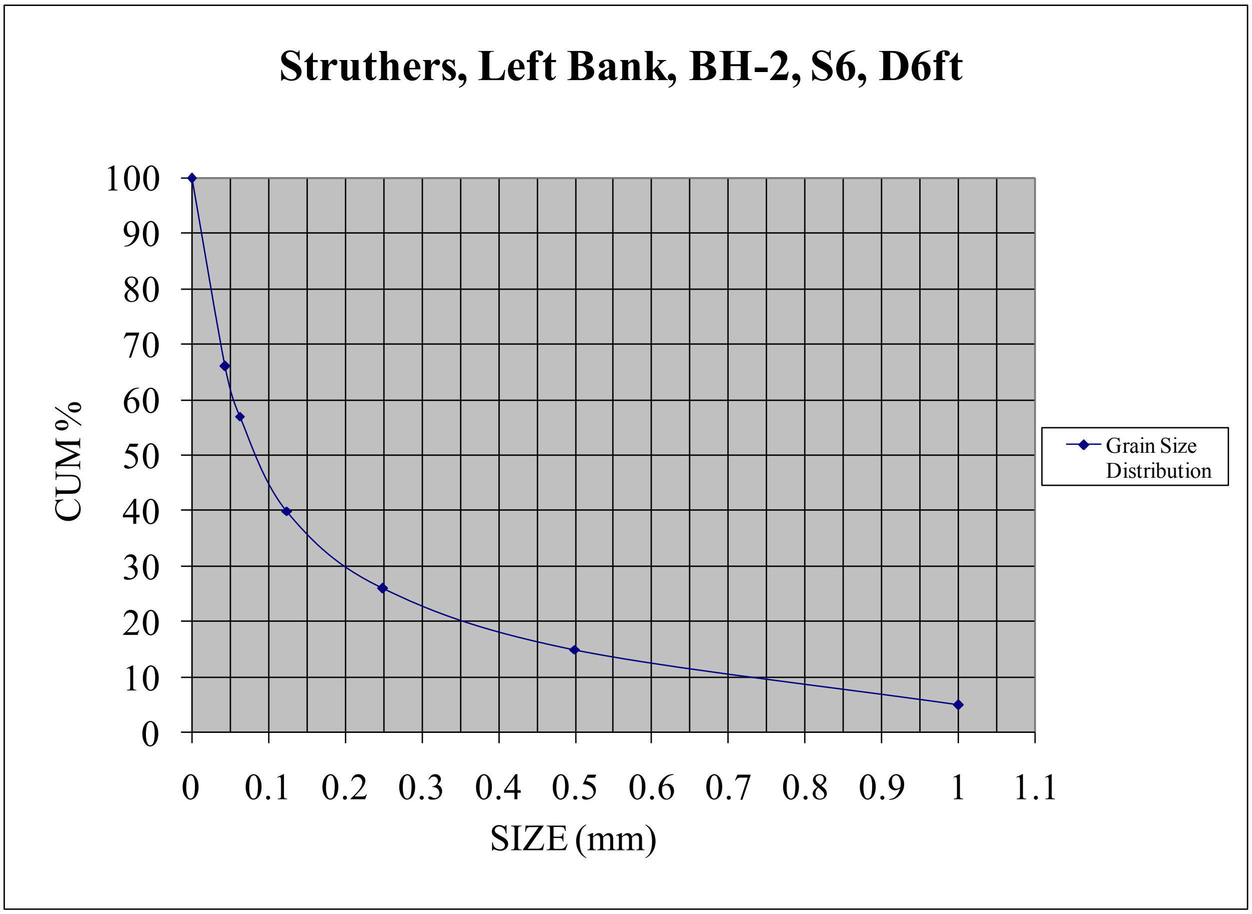
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 9/26/06	
BH-2, S5, 5ft. bsg[a]		Original Sample Weight: 106.8g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	5.0	5.0	5
0.5	8.6	13.6	13
0.25	13.1	26.7	25
0.125	20.1	46.8	45
0.063	19.9	66.7	63
0.044	7.9	74.6	71
pan	30.5	105.1	100

a. Below surface grade.



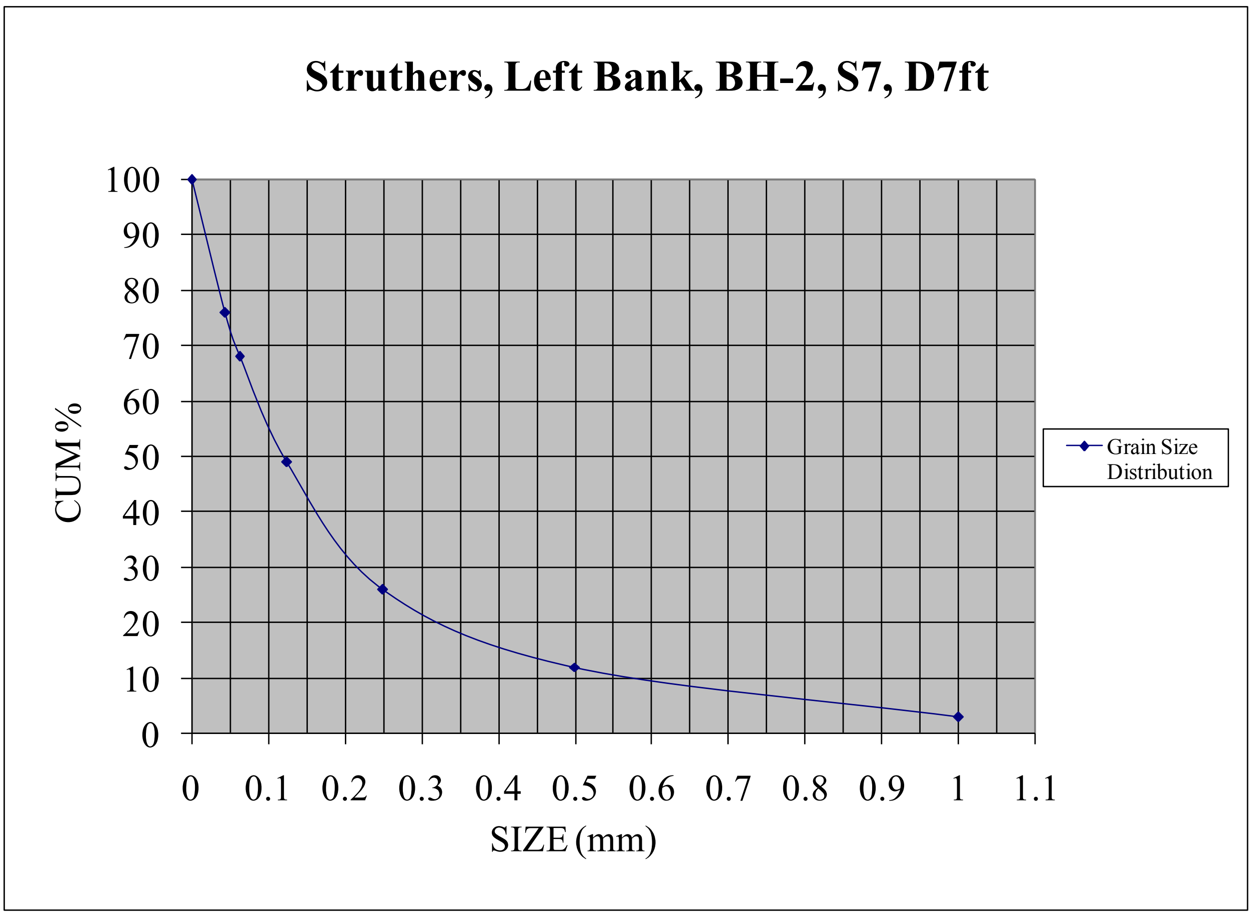
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 9/26/06	
BH-2, S6, 6ft. bsg[a]		Original Sample Weight: 105.5g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	5.4	5.4	5
0.5	9.8	15.2	15
0.25	12.0	27.2	26
0.125	14.6	41.8	40
0.063	17.8	59.6	57
0.044	9.0	68.6	66
pan	35.1	103.7	100

a. Below surface grade.



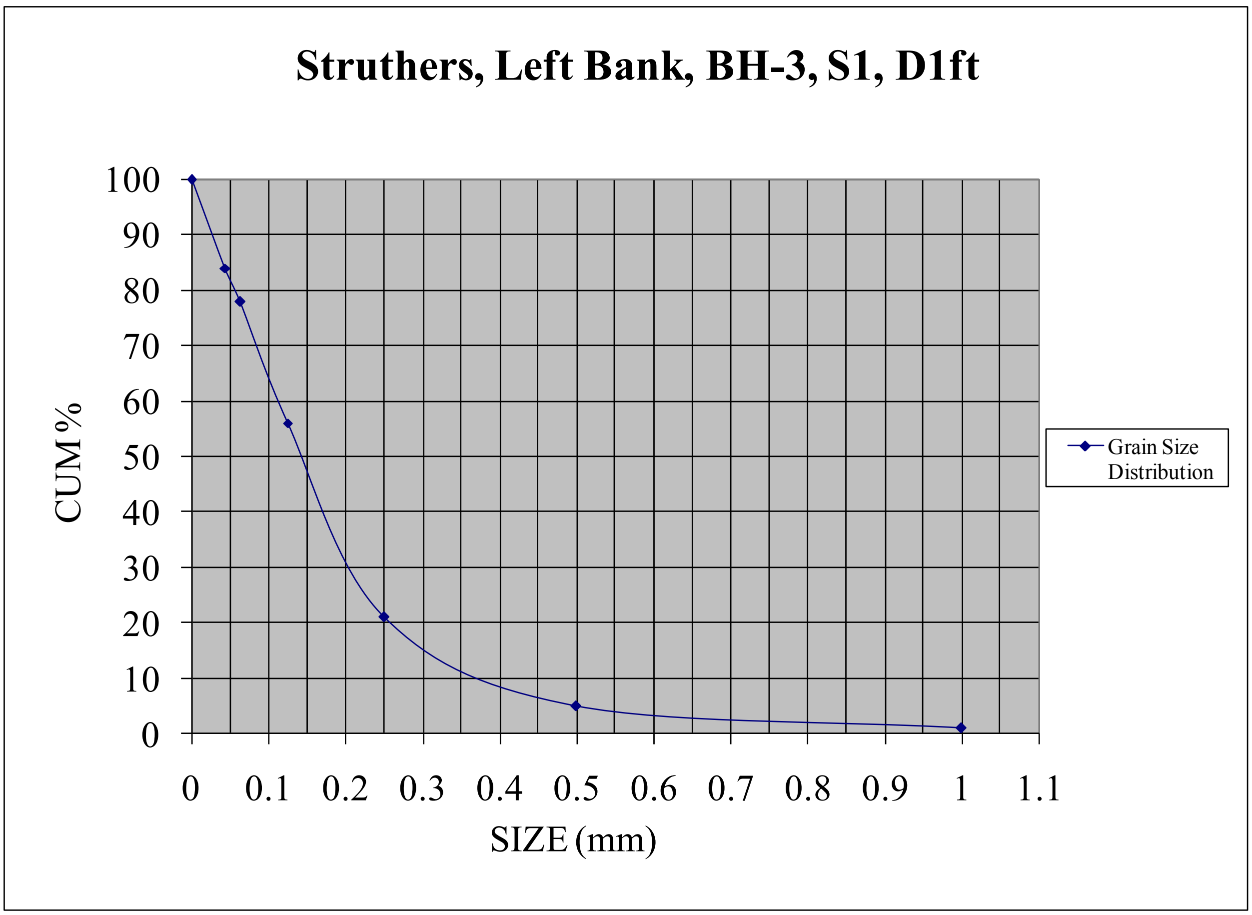
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 9/26/06	
BH-2, S7, 7ft. bsg[a]		Original Sample Weight: 125.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	3.8	3.8	3
0.5	11.1	14.9	12
0.25	18.1	33.0	26
0.125	28.1	61.1	49
0.063	23.1	84.2	68
0.044	9.9	94.1	76
pan	30.5	124.6	100

a. Below surface grade.



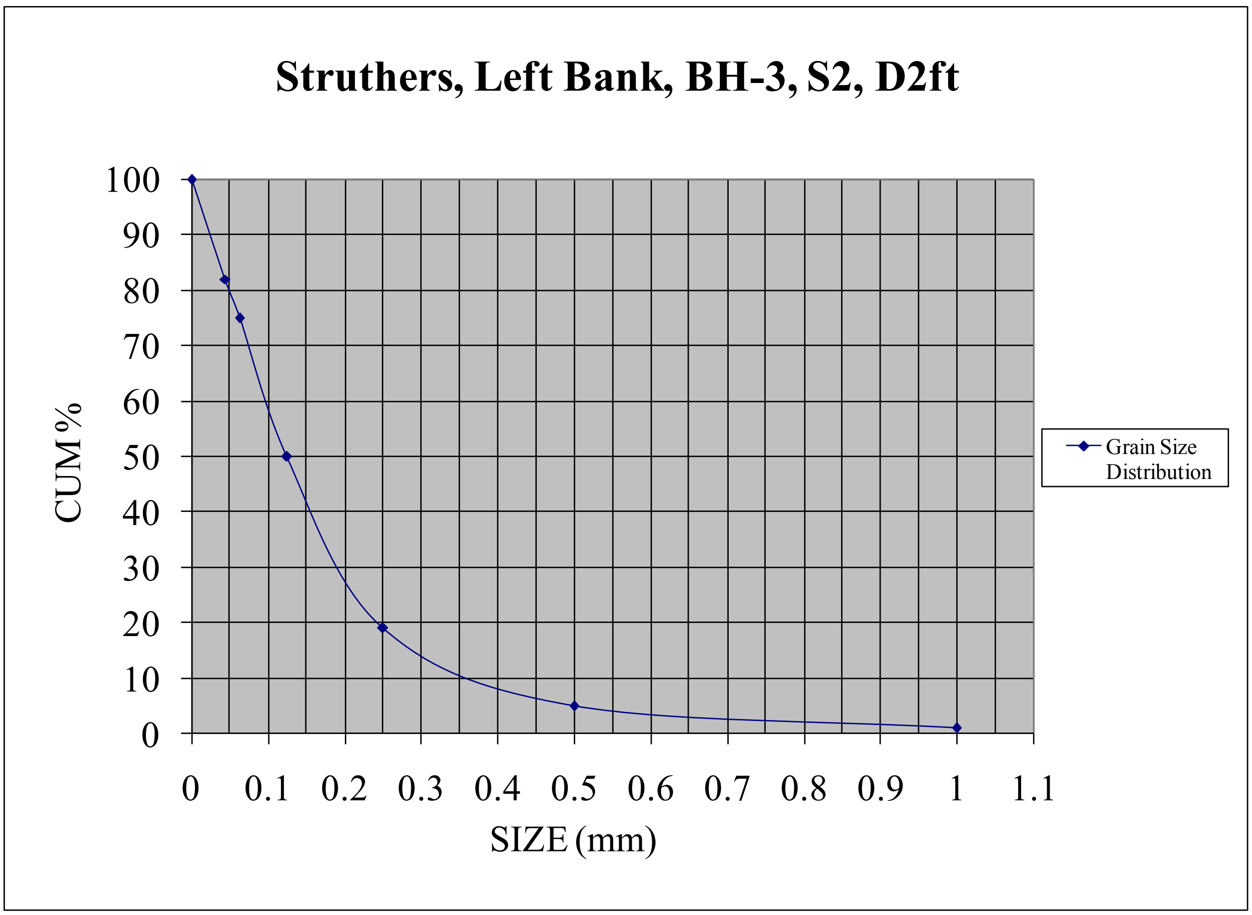
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		**Sample Date: 9/26/06**	
BH-3, S1, 1ft. bsg[a]		**Original Sample Weight: 118.5g**	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.9	0.9	1
0.5	5.2	6.1	5
0.25	18.0	24.1	21
0.125	41.3	65.4	56
0.063	25.6	91.0	78
0.044	7.6	98.6	84
pan	18.6	117.2	100

a. Below surface grade.



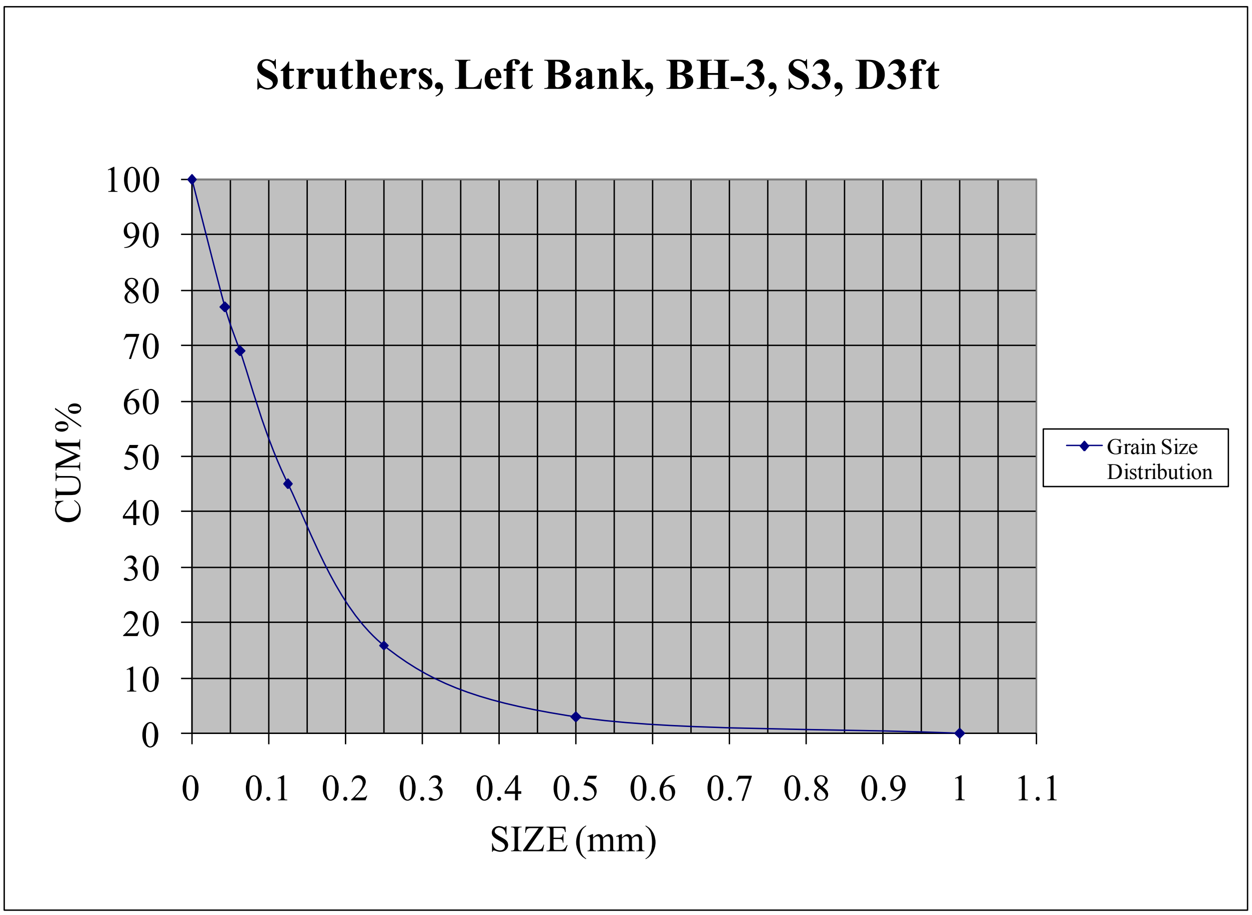
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 9/26/06	
BH-3, S2, 2ft. bsg[a]		Original Sample Weight: 122.1g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.1	1.1	1
0.5	5.3	6.4	5
0.25	17.2	23.6	19
0.125	37.5	61.1	50
0.063	30.1	91.2	75
0.044	8.7	99.9	82
pan	21.7	121.6	100

a. Below surface grade.



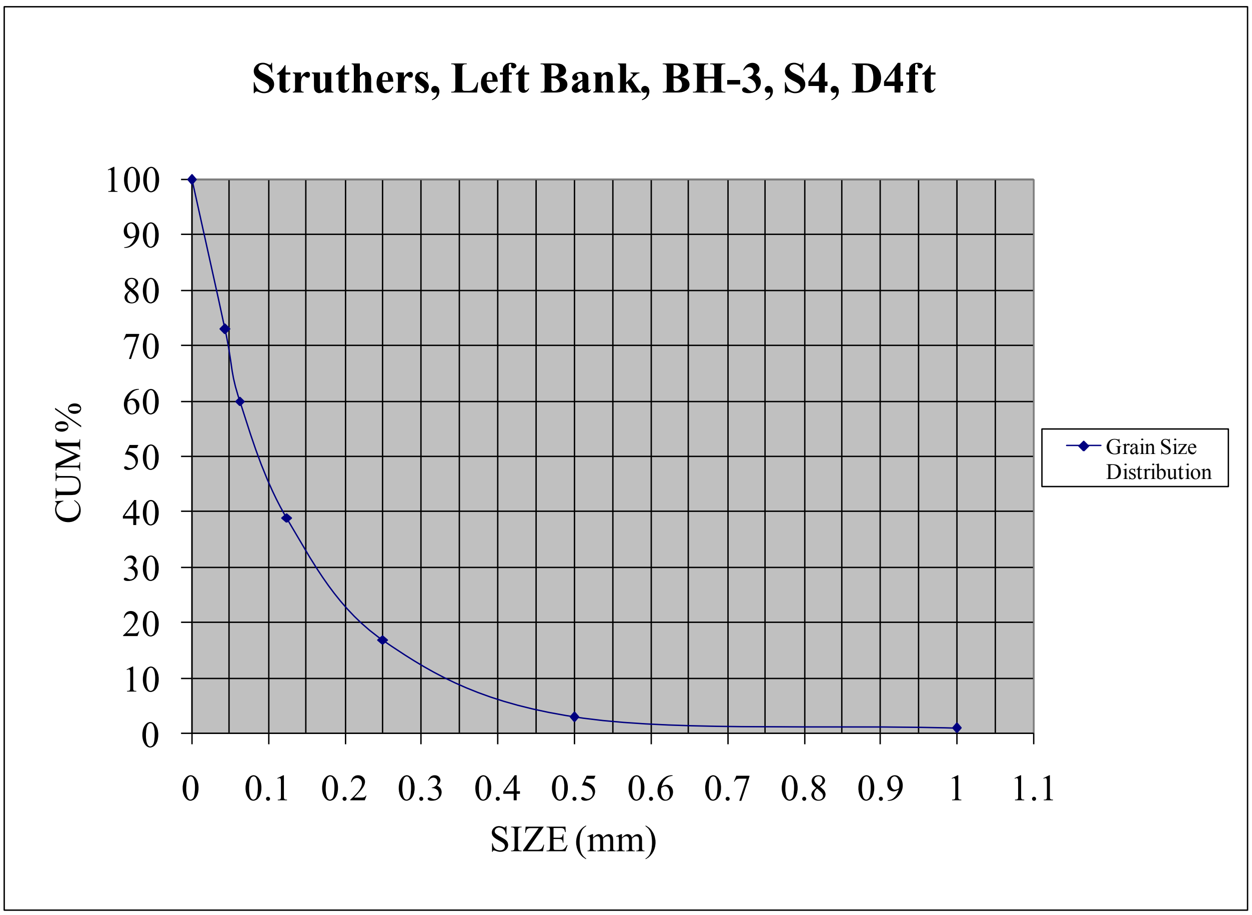
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		**Sample Date: 9/26/06**	
BH-3, S3, 3ft. bsg[a]		**Original Sample Weight: 121.1g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.2	0.2	0
0.5	3.3	3.5	3
0.25	15.9	19.4	16
0.125	35.8	55.2	45
0.063	28.3	83.5	69
0.044	9.6	93.1	77
pan	28.4	121.5	100

a. Below surface grade.



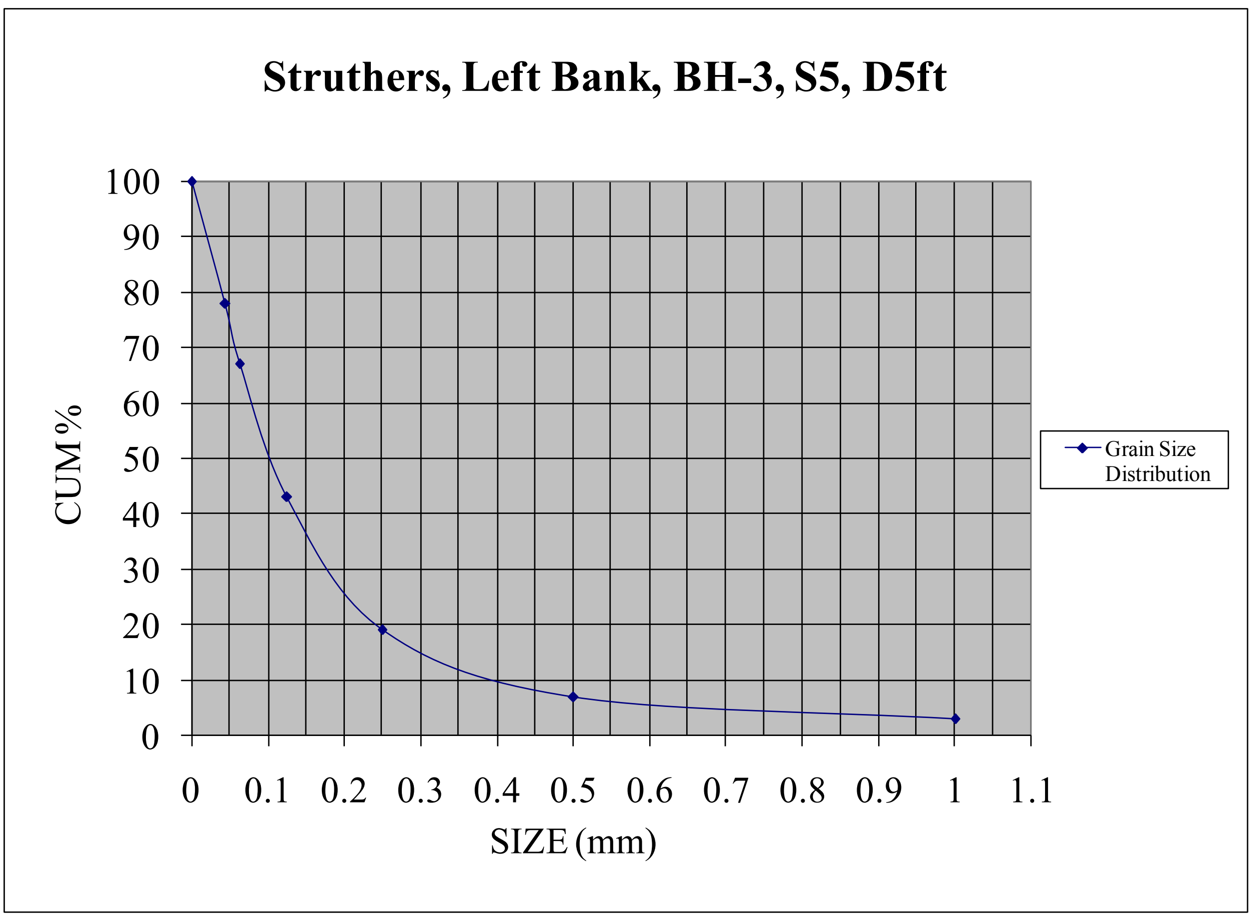
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		**Sample Date: 9/26/06**	
BH-3, S4, 4ft. bsg[a]		**Original Sample Weight: 125.8g**	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.7	0.7	1
0.5	3.6	4.3	3
0.25	16.7	21.0	17
0.125	28.3	49.3	39
0.063	26.2	75.5	60
0.044	16.0	91.5	73
pan	34.0	125.5	100

a. Below surface grade.



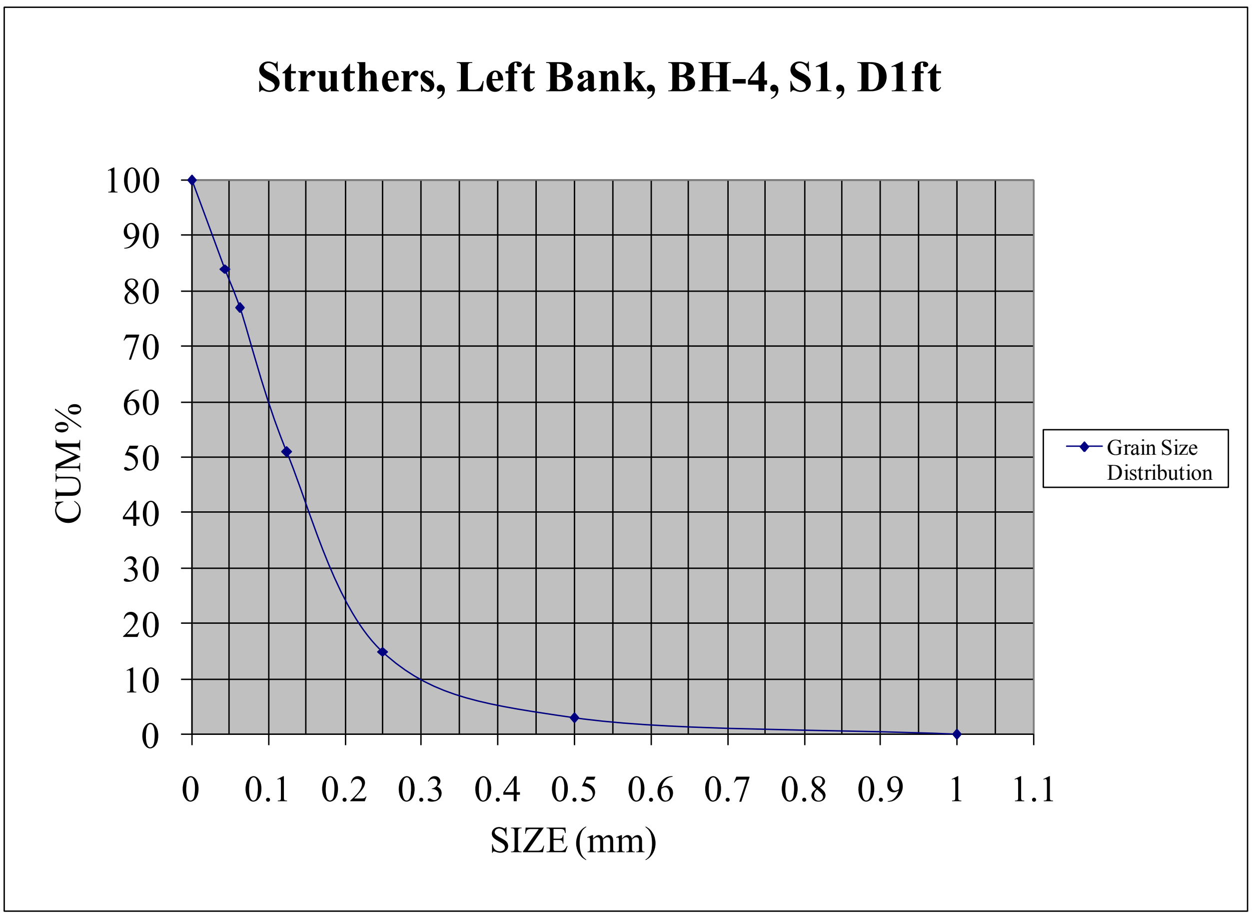
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 9/26/06	
BH-3, S5, 5ft. bsg[a]		Original Sample Weight: 131.7g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	3.3	3.3	3
0.5	6.5	9.8	7
0.25	15.4	25.2	19
0.125	31.9	57.1	43
0.063	31.3	88.4	67
0.044	14.2	102.6	78
pan	28.8	131.4	100

a. Below surface grade.



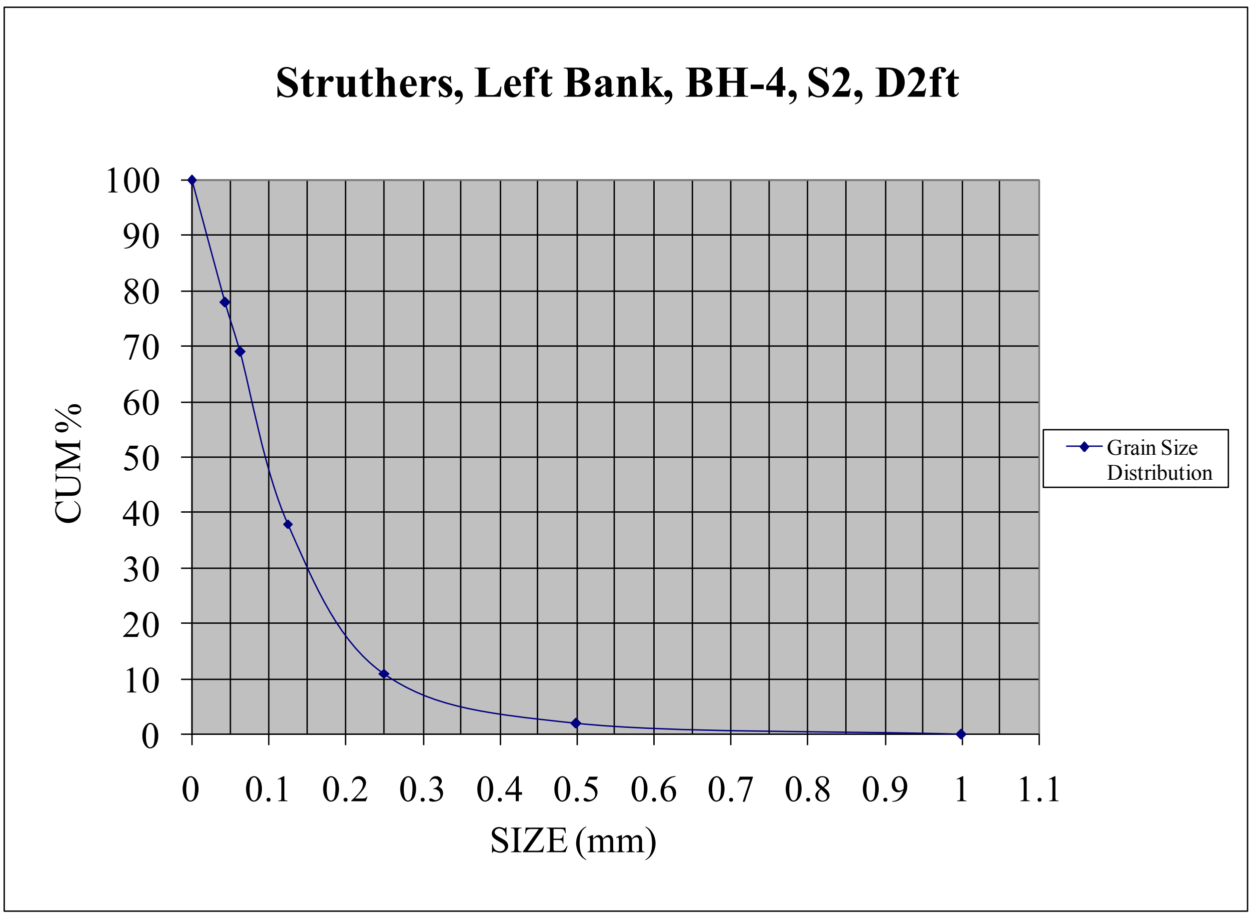
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 10/3/06	
BH-4, S1, 1ft. bsg[a]		Original Sample Weight: 115.5g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.3	0.3	0
0.5	3.4	3.7	3
0.25	13.5	17.2	15
0.125	40.9	58.1	51
0.063	30.4	88.5	77
0.044	7.7	96.2	84
pan	18.3	114.5	100

a. Below surface grade.



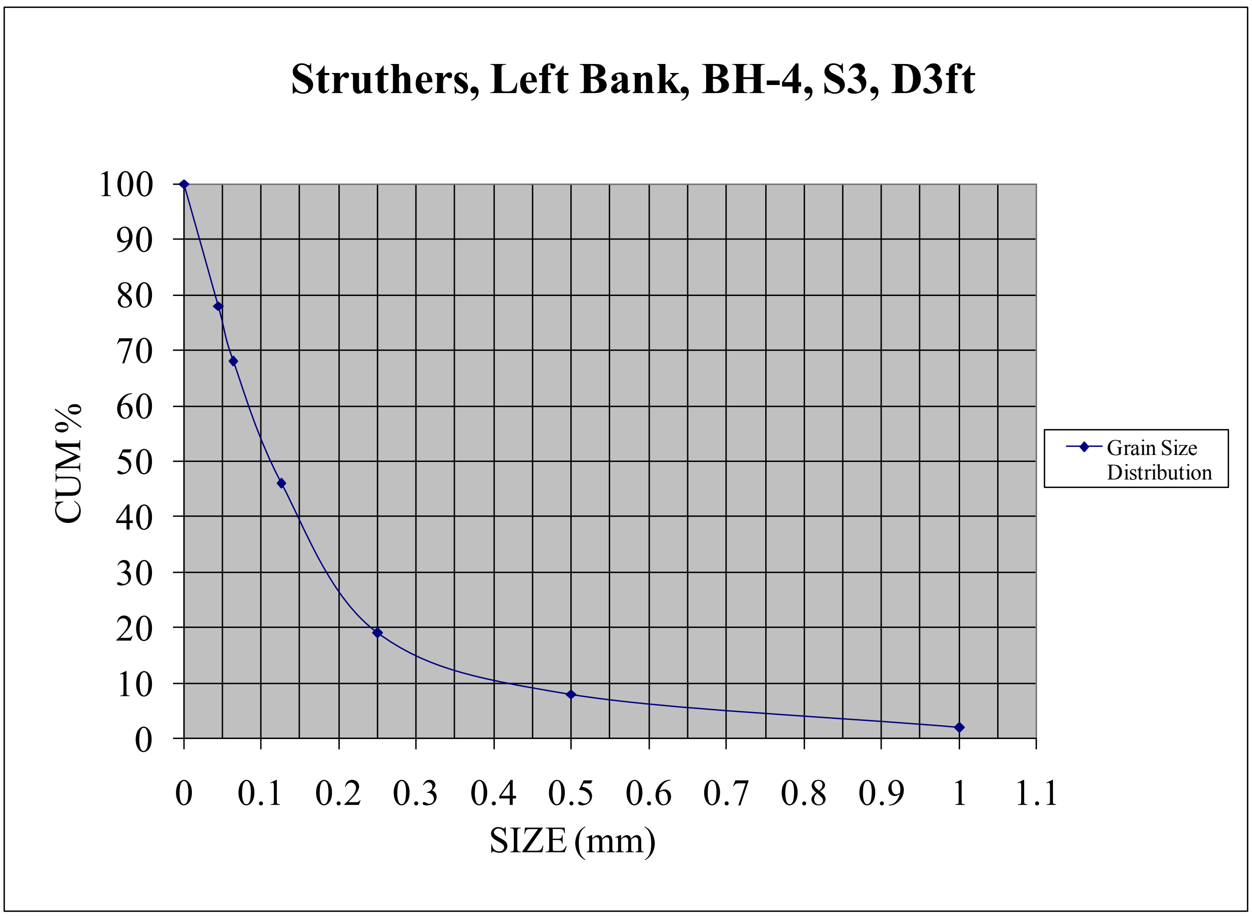
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 10/3/06	
BH-4, S2, 2ft. bsg[a]		Original Sample Weight: 110.9g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.1	0.1	0
0.5	2.2	2.3	2
0.25	9.3	11.6	11
0.125	30.0	41.6	38
0.063	33.7	75.3	69
0.044	10.5	85.8	78
pan	23.8	109.6	100

a. Below surface grade.



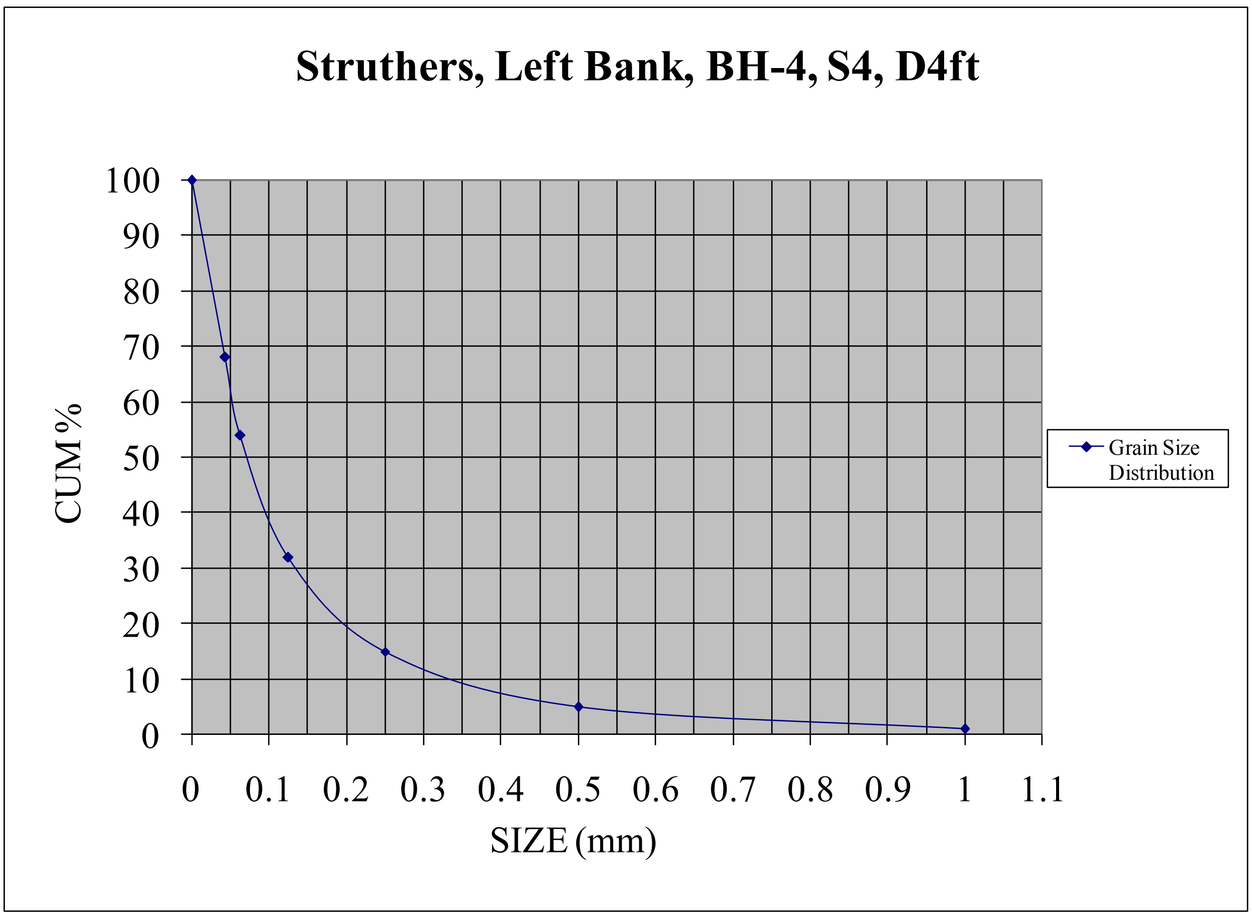
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 10/3/06	
BH-4, S3, 3ft. bsg[a]		Original Sample Weight: 129.9g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.6	2.6	2
0.5	7.7	10.3	8
0.25	14.4	24.7	19
0.125	35.1	59.8	46
0.063	28.8	88.6	68
0.044	12.4	101.0	78
pan	28.5	129.5	100

a. Below surface grade.



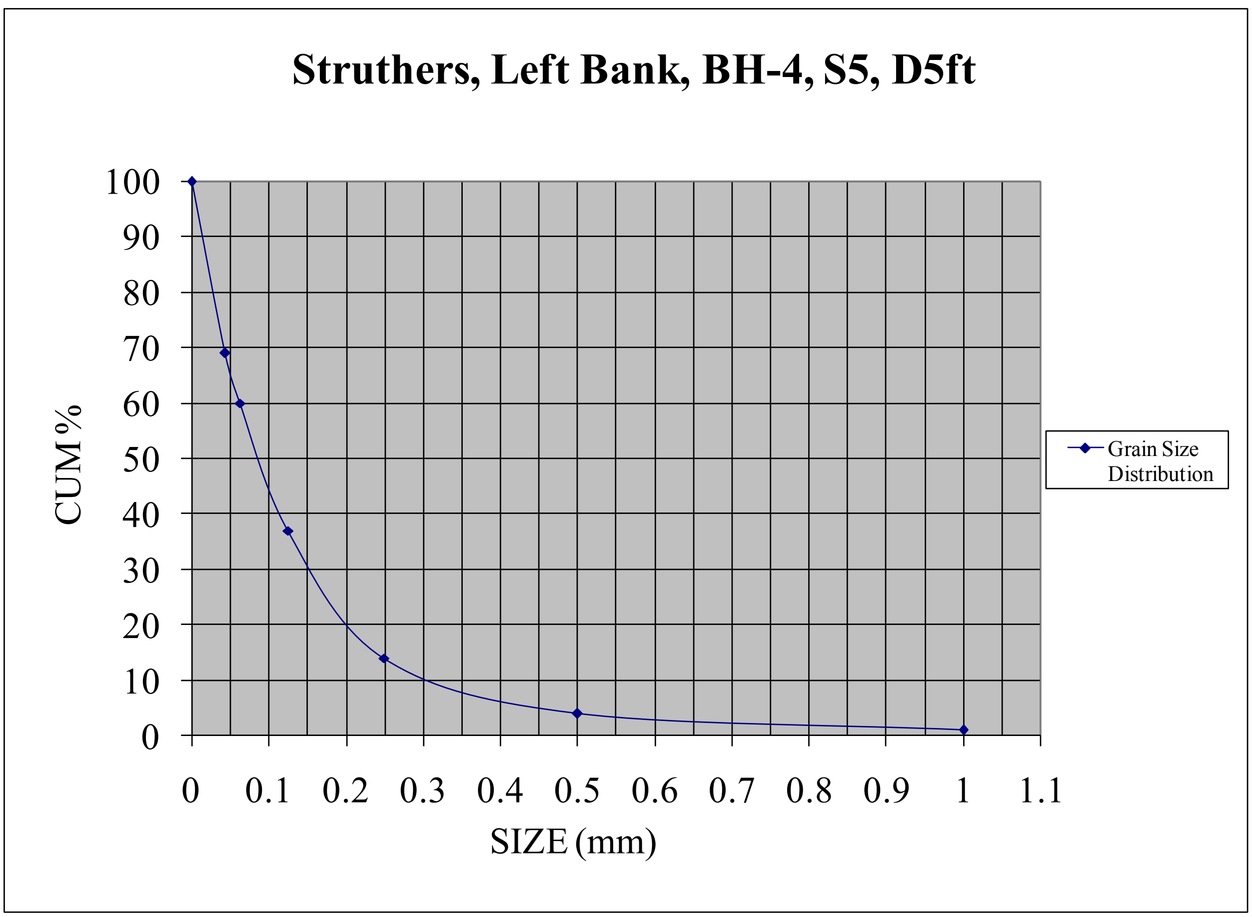
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 10/3/06	
BH-4, S4, 4ft. bsg[a]		Original Sample Weight: 127.1g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.1	1.1	1
0.5	5.2	6.3	5
0.25	12.3	18.6	15
0.125	21.9	40.5	32
0.063	27.7	68.2	54
0.044	18.1	86.3	68
pan	39.8	126.1	100

a. Below surface grade.



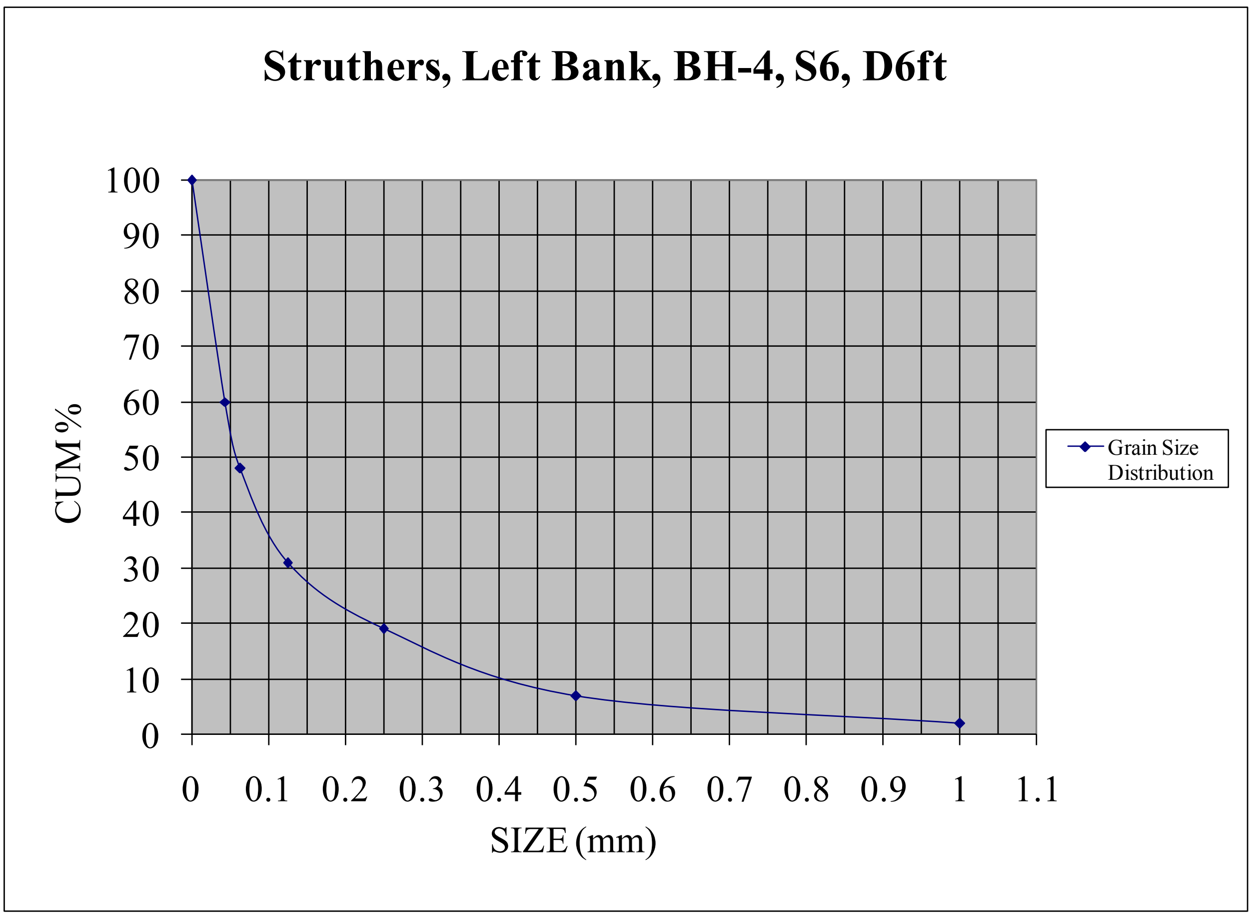
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 10/3/06	
BH-4, S5, 5ft. bsg[a]		Original Sample Weight: 110.9g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.8	0.8	1
0.5	3.1	3.9	4
0.25	11.5	15.4	14
0.125	25.3	40.7	37
0.063	25.5	66.2	60
0.044	9.3	75.5	69
pan	34.7	110.2	100

a. Below surface grade.



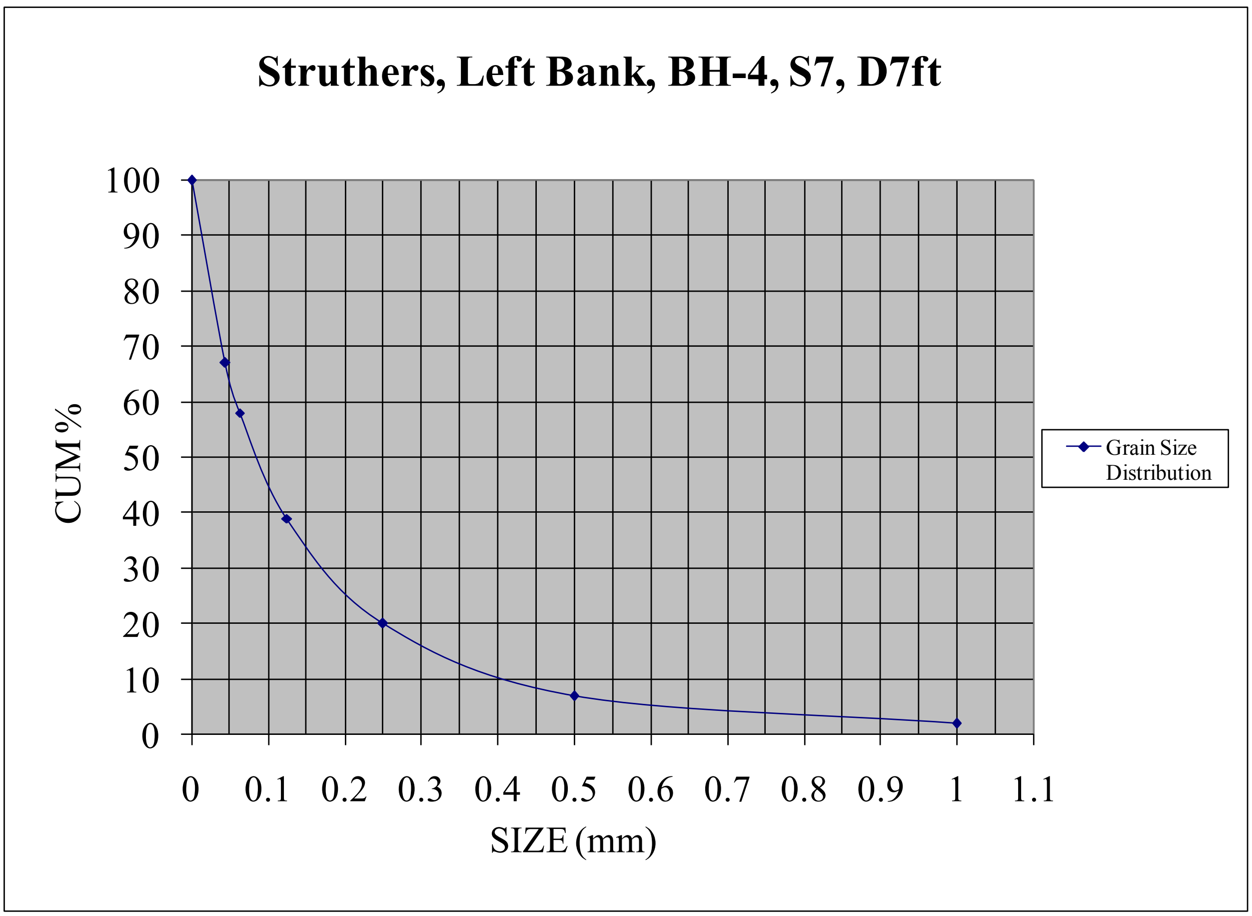
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 10/3/06	
BH-4, S6, 6ft. bsg[a]		Original Sample Weight: 119.8	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	1.8	1.8	2
0.5	6.9	8.7	7
0.25	13.1	21.8	19
0.125	14.7	36.5	31
0.063	19.7	56.2	48
0.044	14.0	70.2	60
pan	47.5	117.7	100

a. Below surface grade.



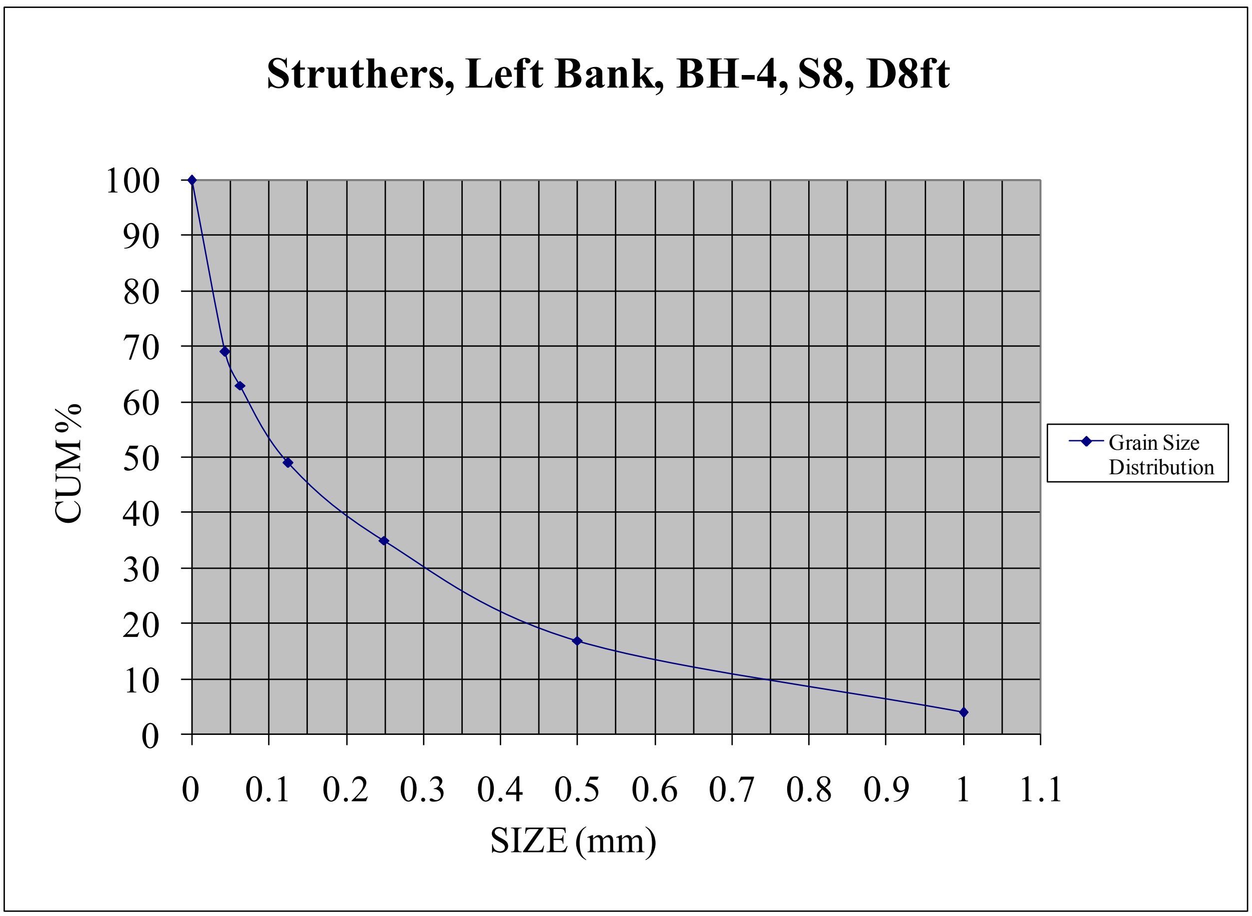
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 10/3/06	
BH-4, S7, 7ft. bsg[a]		Original Sample Weight: 107.9g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.6	1.6	2
0.5	5.5	7.1	7
0.25	14.2	21.3	20
0.125	20.4	41.7	39
0.063	19.9	61.6	58
0.044	9.3	70.9	67
pan	34.9	105.8	100

a. Below surface grade.



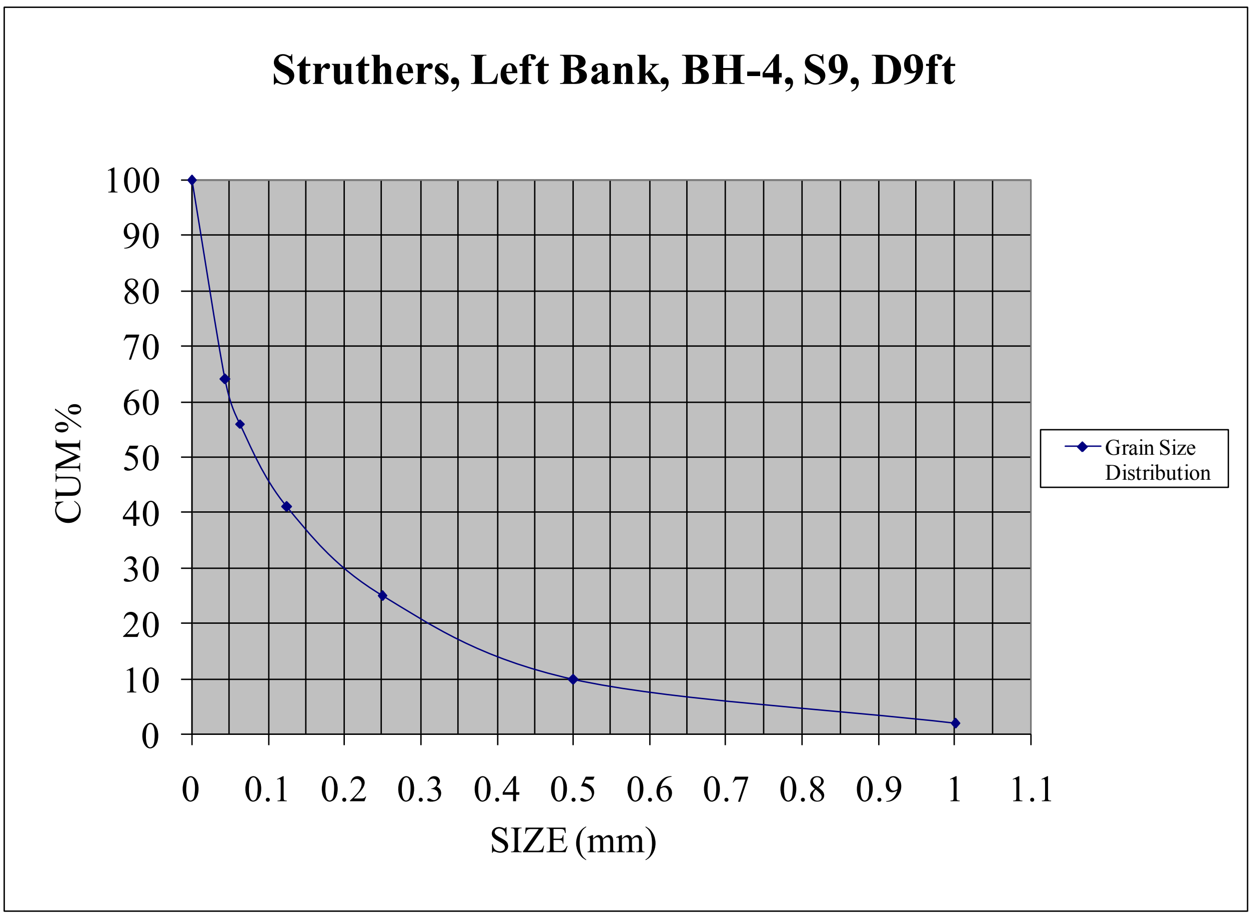
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 10/3/06	
BH-4, S8, 8ft. bsg[a]		Original Sample Weight: 123.7g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	4.3	4.3	4
0.5	16.5	20.8	17
0.25	21.5	42.3	35
0.125	17.6	59.9	49
0.063	16.7	76.6	63
0.044	7.5	84.1	69
pan	38.2	122.3	100

a. Below surface grade.



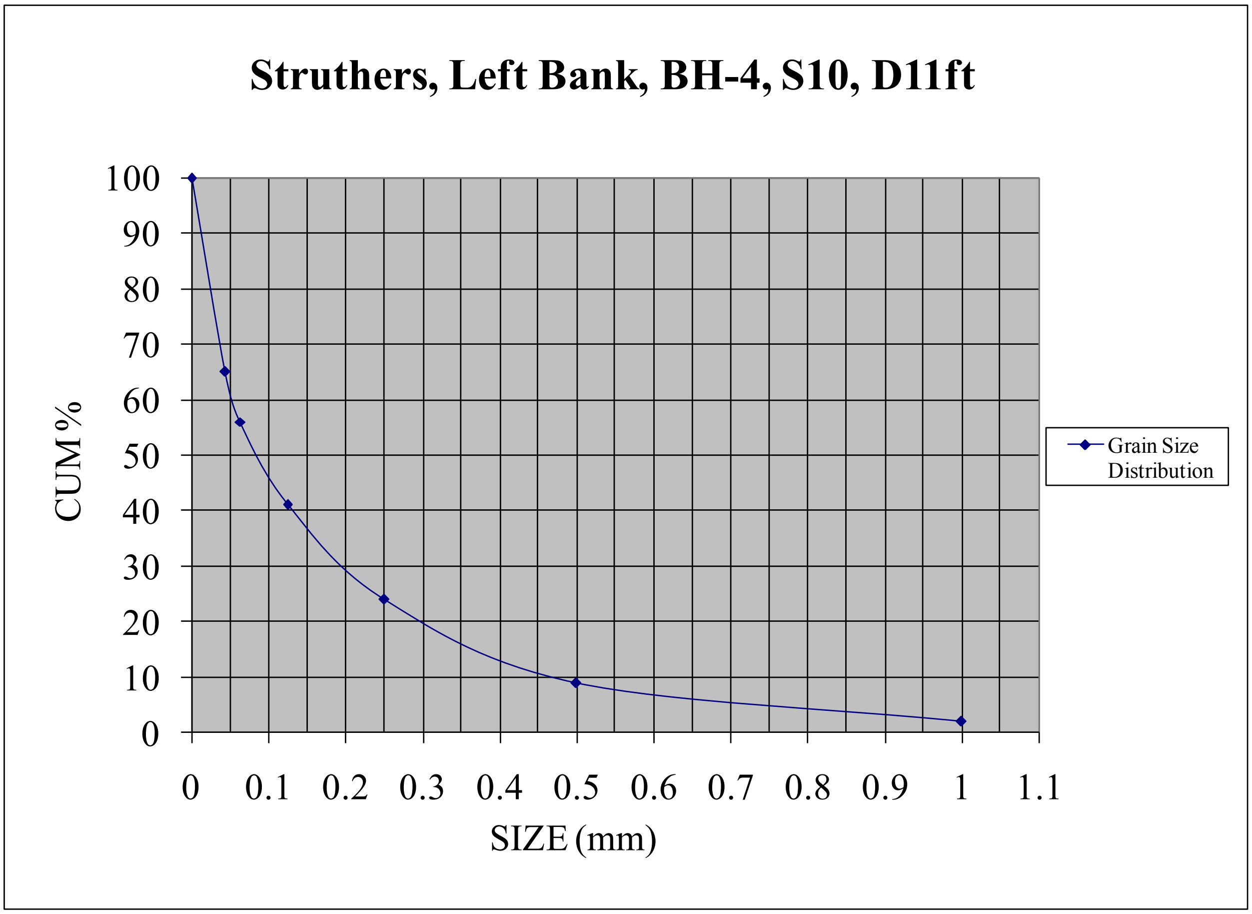
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		Sample Date: 10/3/06	
BH-4, S9, 9ft. bsg[a]		Original Sample Weight: 111.5g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.3	2.3	2
0.5	8.8	11.1	10
0.25	16.1	27.2	25
0.125	17.2	44.4	41
0.063	16.4	60.8	56
0.044	8.6	69.4	64
pan	39.1	108.5	100

a. Below surface grade.



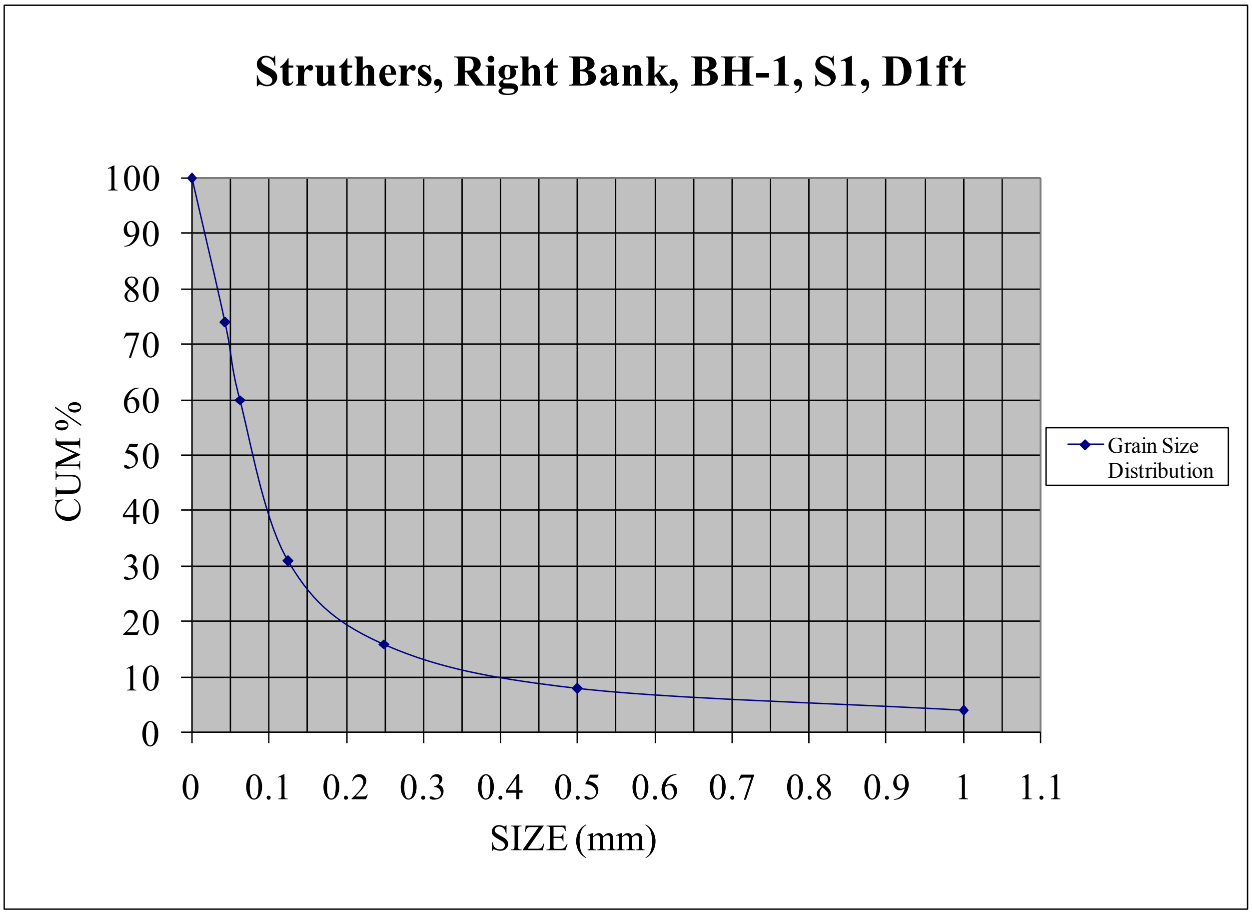
Soil Grain-size Analysis Laboratory Results			
Struthers Left Bank		**Sample Date: 10/3/06**	
BH-4, S10, 11ft. bsg[a]		**Original Sample Weight: 118.0g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	1.9	1.9	2
0.5	8.2	10.1	9
0.25	17.2	27.3	24
0.125	19.9	47.2	41
0.063	17.8	65.0	56
0.044	9.5	74.5	65
pan	40.7	115.2	100

a. Below surface grade.



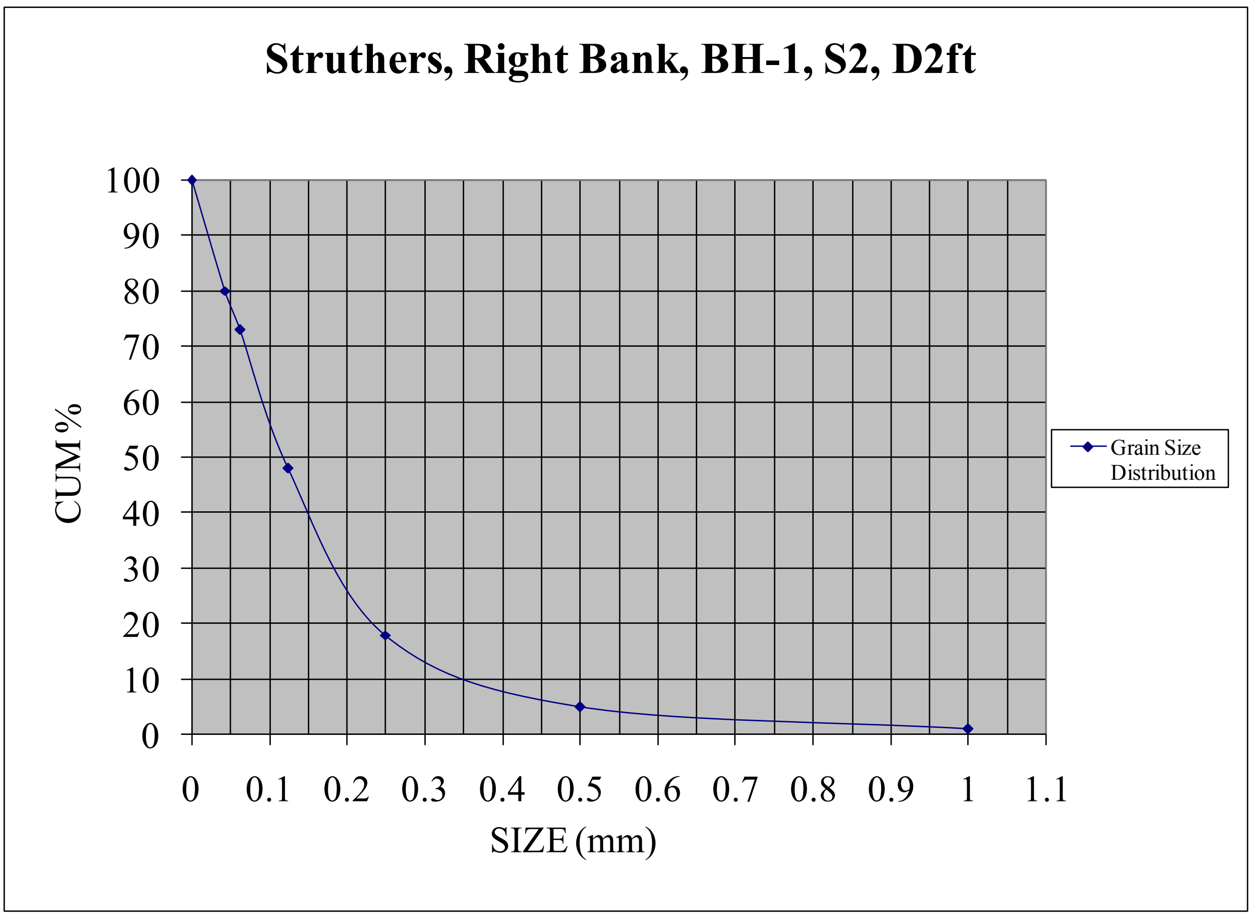
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-1, S1, 1ft. bsg[a]		Original Sample Weight: 105.9g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	4.1	4.1	4
0.5	4.6	8.7	8
0.25	7.9	16.6	16
0.125	16.2	32.8	31
0.063	30.3	63.1	60
0.044	14.0	77.1	74
pan	27.4	104.5	100

a. Below surface grade.



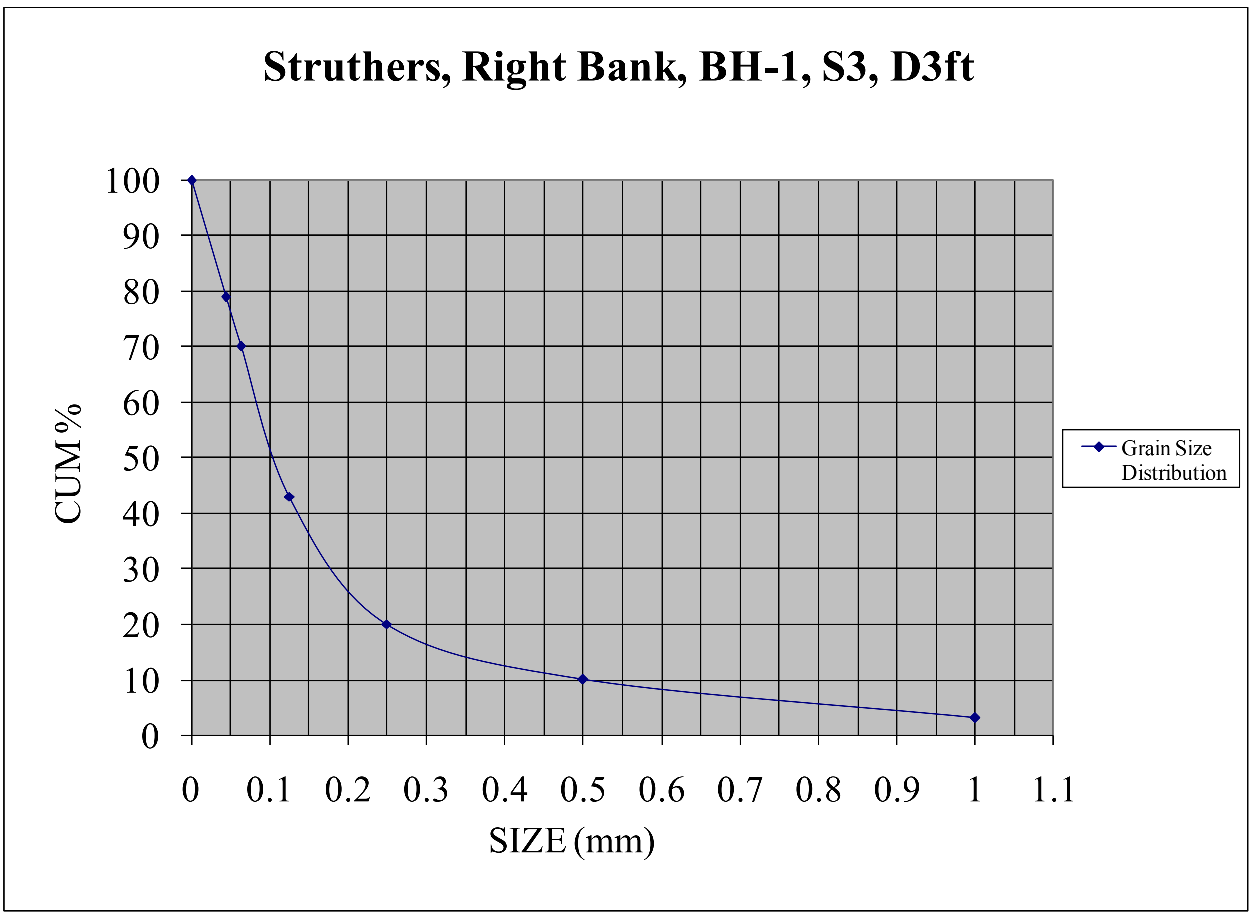
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		**Sample Date: 10/7/06**	
BH-1, S2, 2ft. bsg[a]		**Original Sample Weight: 103.7g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	1.2	1.2	1
0.5	4.1	5.3	5
0.25	13.6	18.9	18
0.125	30.6	49.5	48
0.063	25.8	75.3	73
0.044	6.9	82.2	80
pan	20.7	102.9	100

a. Below surface grade.



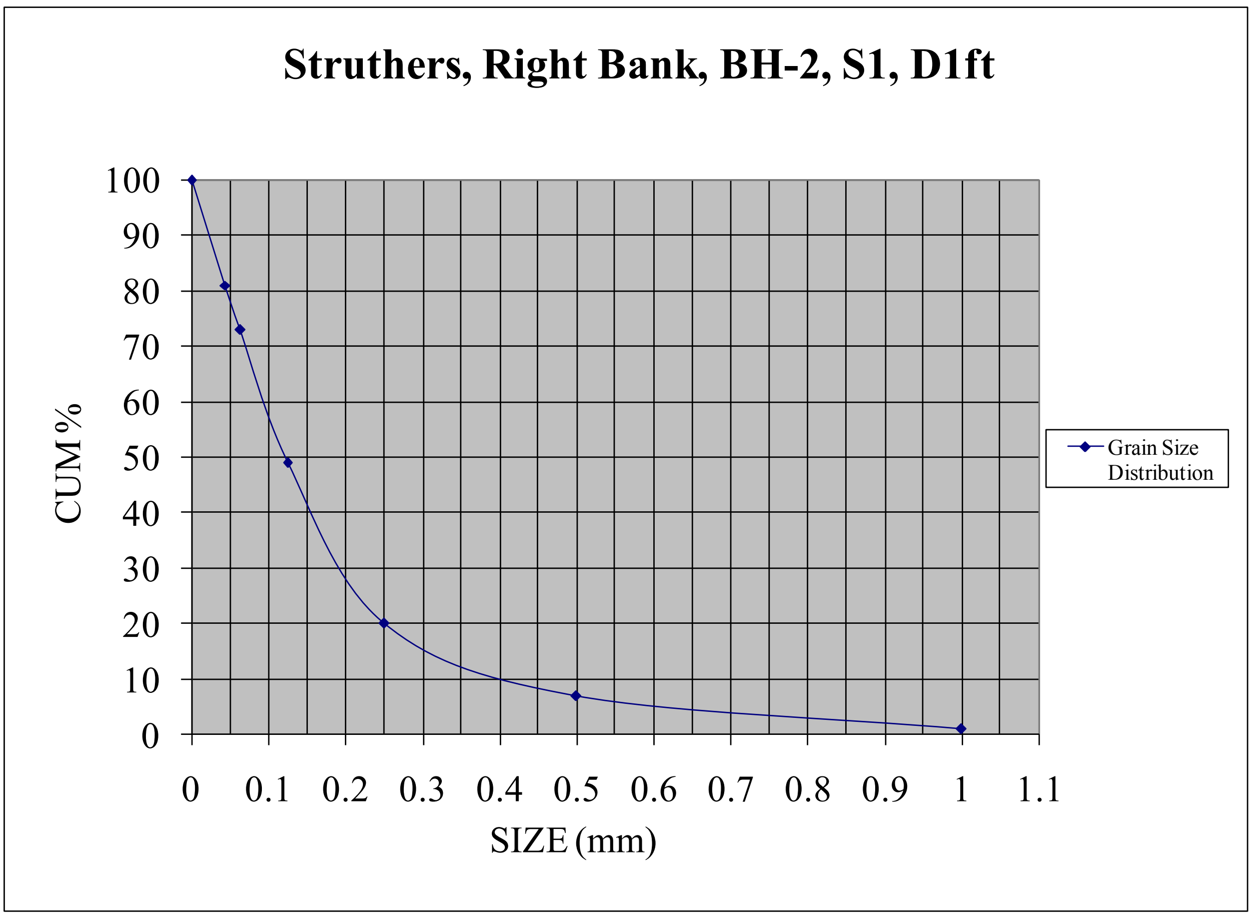
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-1, S3, 3ft. bsg[a]		Original Sample Weight: 105.6g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.7	2.7	3
0.5	7.4	10.1	10
0.25	10.5	20.6	20
0.125	25.0	45.6	43
0.063	28.1	73.7	70
0.044	9.8	83.5	79
pan	21.8	105.3	100

a. Below surface grade.



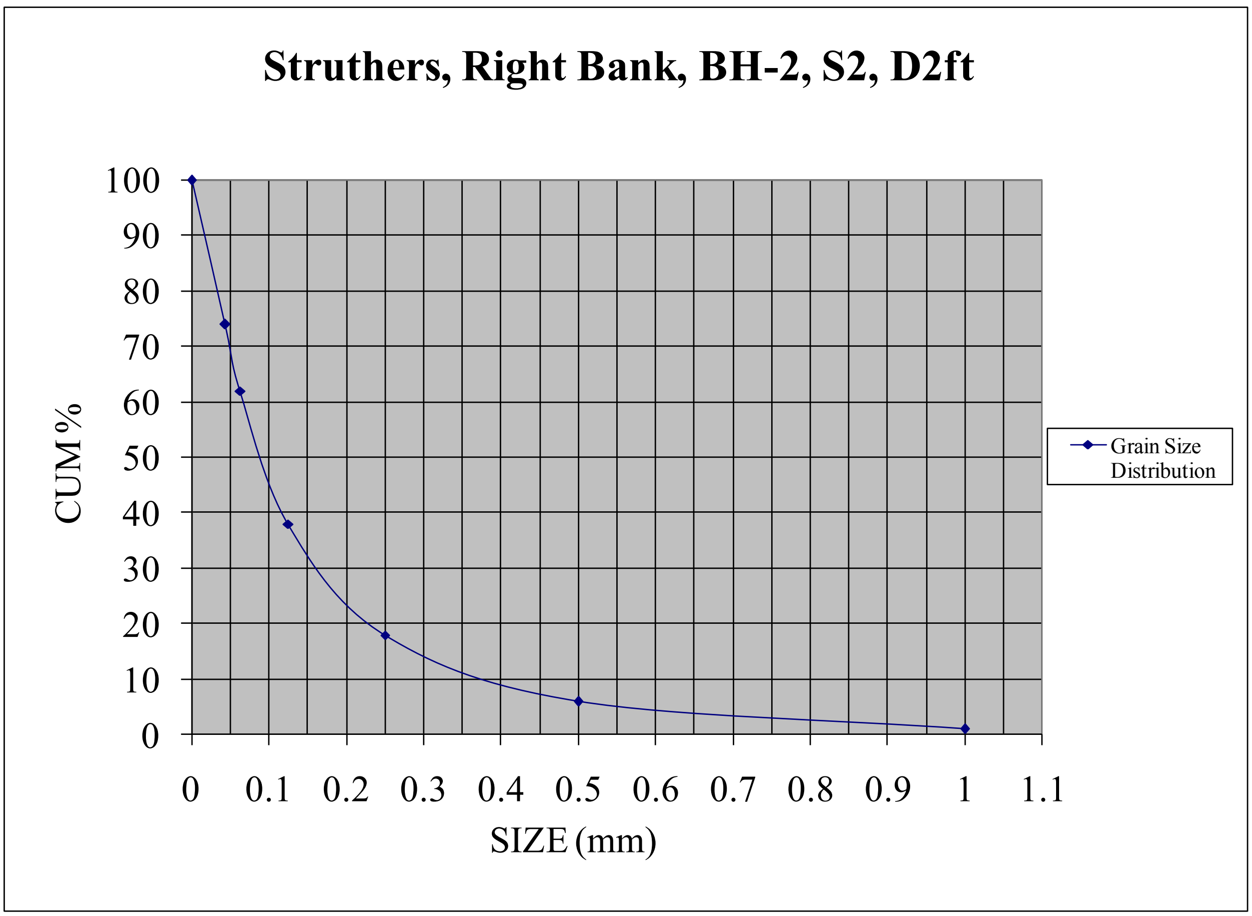
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-2, S1, 1ft. bsg[a]		Original Sample Weight: 120.4g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.5	1.5	1
0.5	7.4	8.9	7
0.25	15.1	24.0	20
0.125	34.3	58.3	49
0.063	29.7	88.0	73
0.044	9.3	97.3	81
pan	22.5	119.8	100

a. Below surface grade.



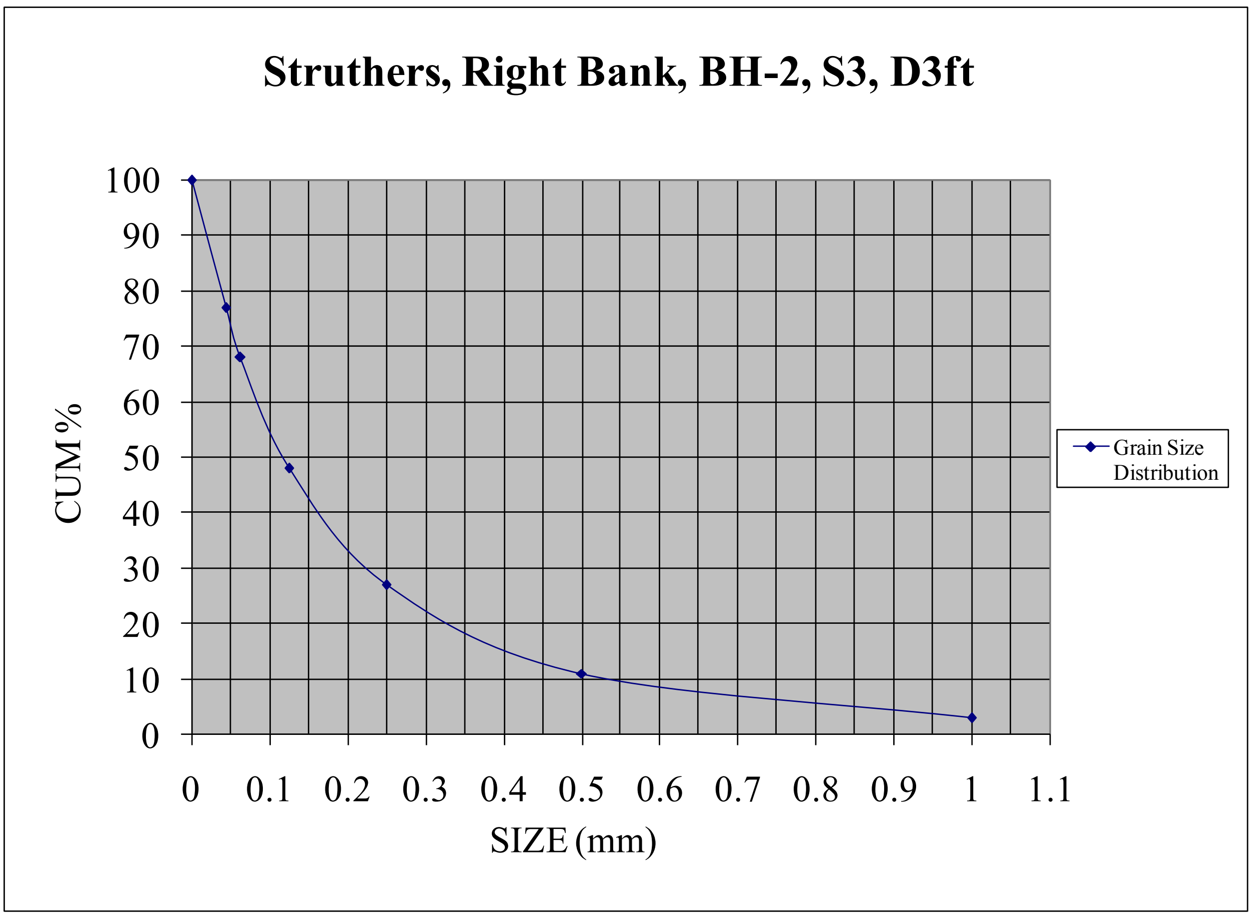
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-2, S2, 2ft. bsg[a]		Original Sample Weight: 129.0g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.4	1.4	1
0.5	6.7	8.1	6
0.25	15.5	23.6	18
0.125	25.7	49.3	38
0.063	31.3	80.6	62
0.044	14.9	95.5	74
pan	33.6	129.1	100

a. Below surface grade.



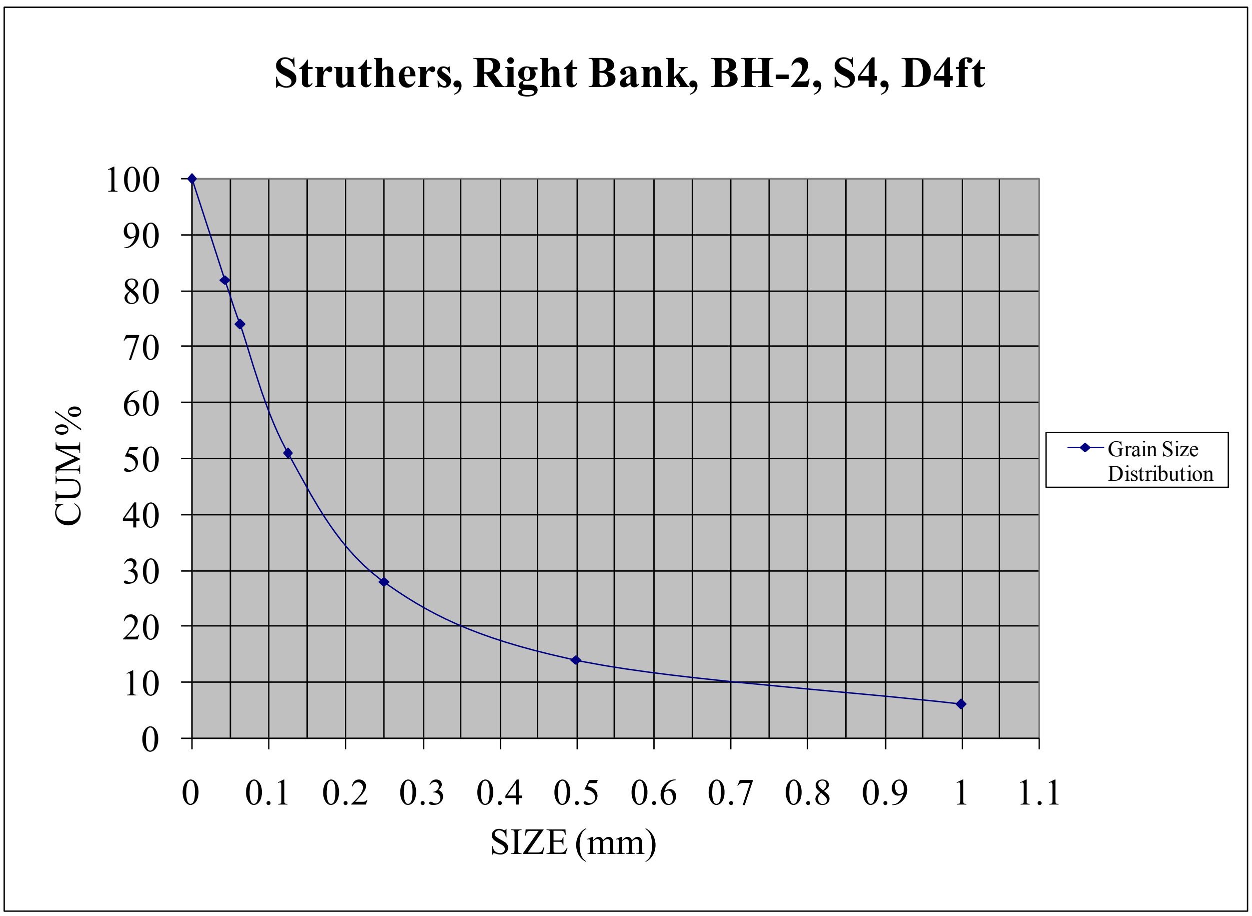
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-2, S3, 3ft. bsg[a]		Original Sample Weight: 122.6g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	3.2	3.2	3
0.5	10.3	13.5	11
0.25	19.4	32.9	27
0.125	25.3	58.2	48
0.063	25.5	83.7	68
0.044	10.2	93.9	77
pan	28.4	122.3	100

a. Below surface grade.



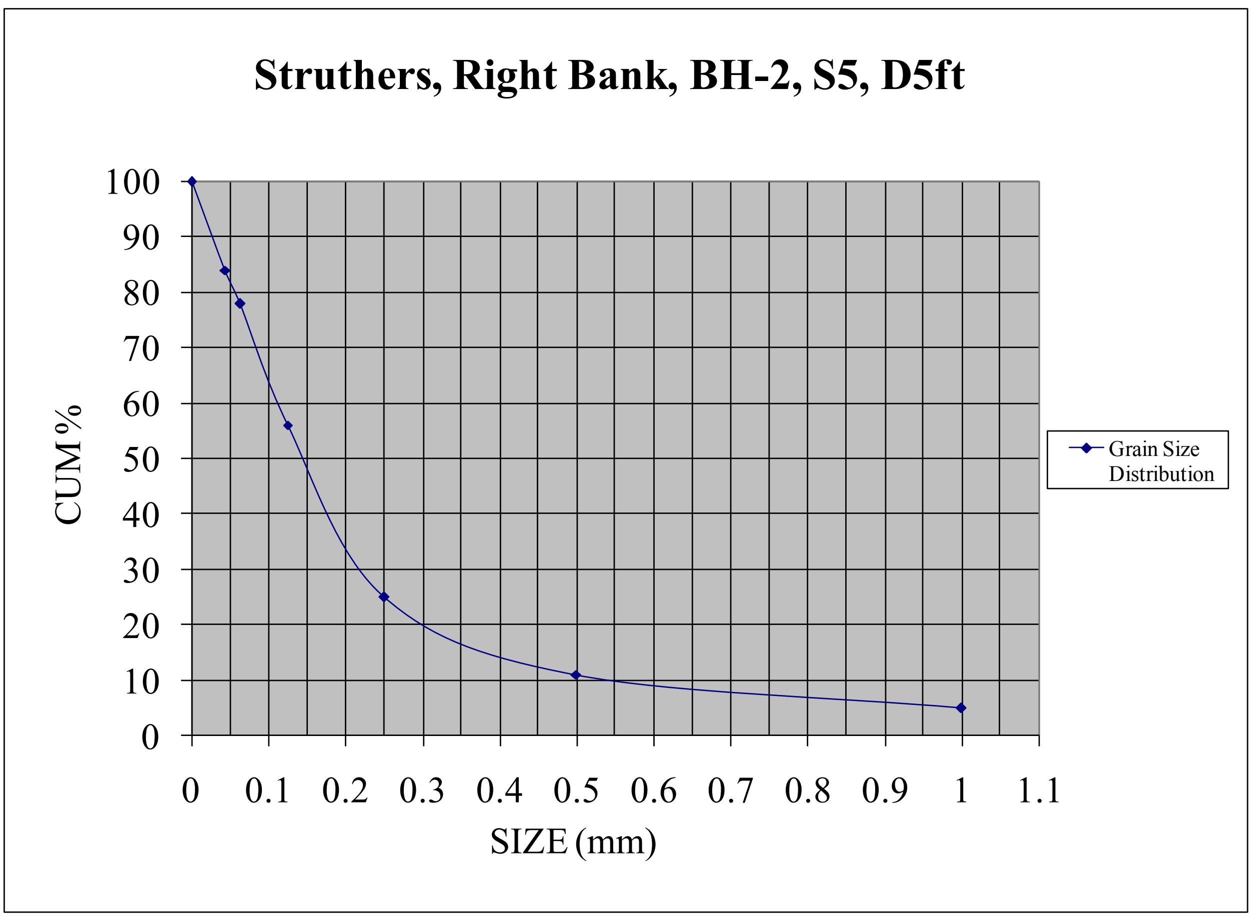
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		**Sample Date: 10/7/06**	
BH-2, S4, 4ft. bsg[a]		**Original Sample Weight: 129.3g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	7.6	7.6	6
0.5	9.9	17.5	14
0.25	18.2	35.7	28
0.125	30.2	65.9	51
0.063	29.2	95.1	74
0.044	10.0	105.1	82
pan	23.0	128.1	100

a. Below surface grade.



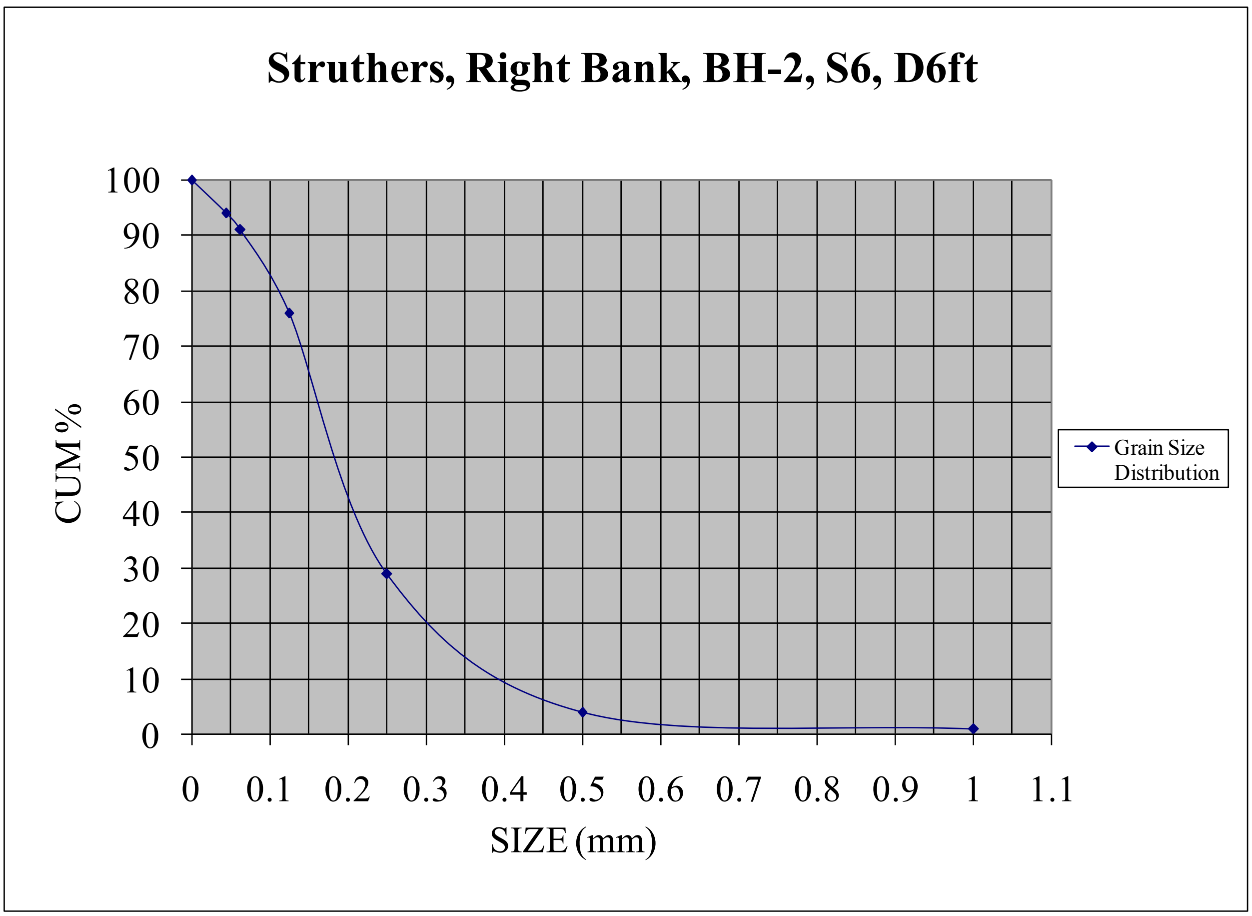
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		**Sample Date: 10/7/06**	
BH-2, S5, 5ft. bsg[a]		**Original Sample Weight: 104.1g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	4.9	4.9	5
0.5	6.1	11.0	11
0.25	15.2	26.2	25
0.125	31.1	57.3	56
0.063	22.9	80.2	78
0.044	6.5	86.7	84
pan	16.5	103.2	100

a. Below surface grade.



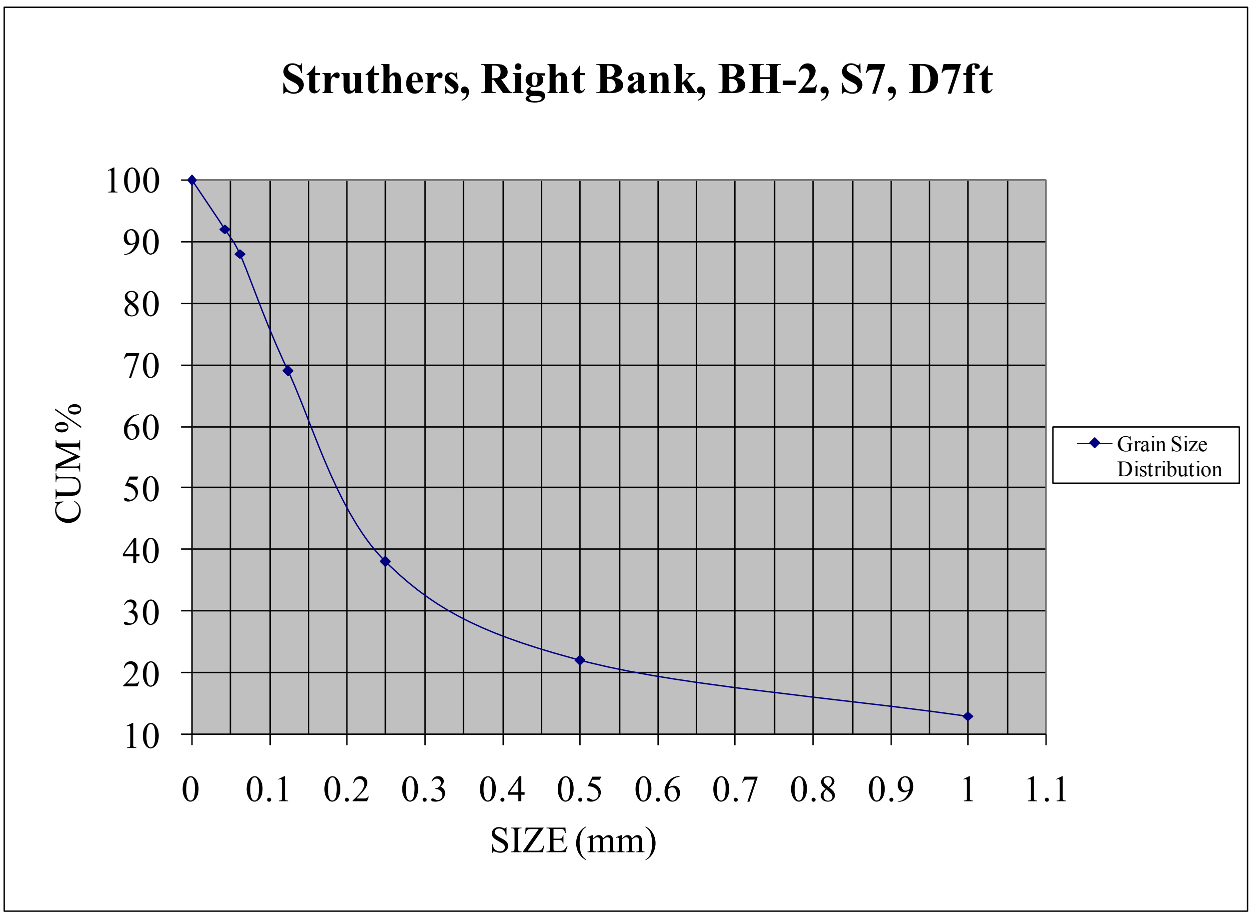
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-2, S6, 6ft. bsg[a]		Original Sample Weight: 106.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.1	1.1	1
0.5	3.5	4.6	4
0.25	26.0	30.6	29
0.125	48.9	79.5	75
0.063	15.9	95.4	91
0.044	3.1	98.5	94
pan	6.8	105.3	100

a. Below surface grade.



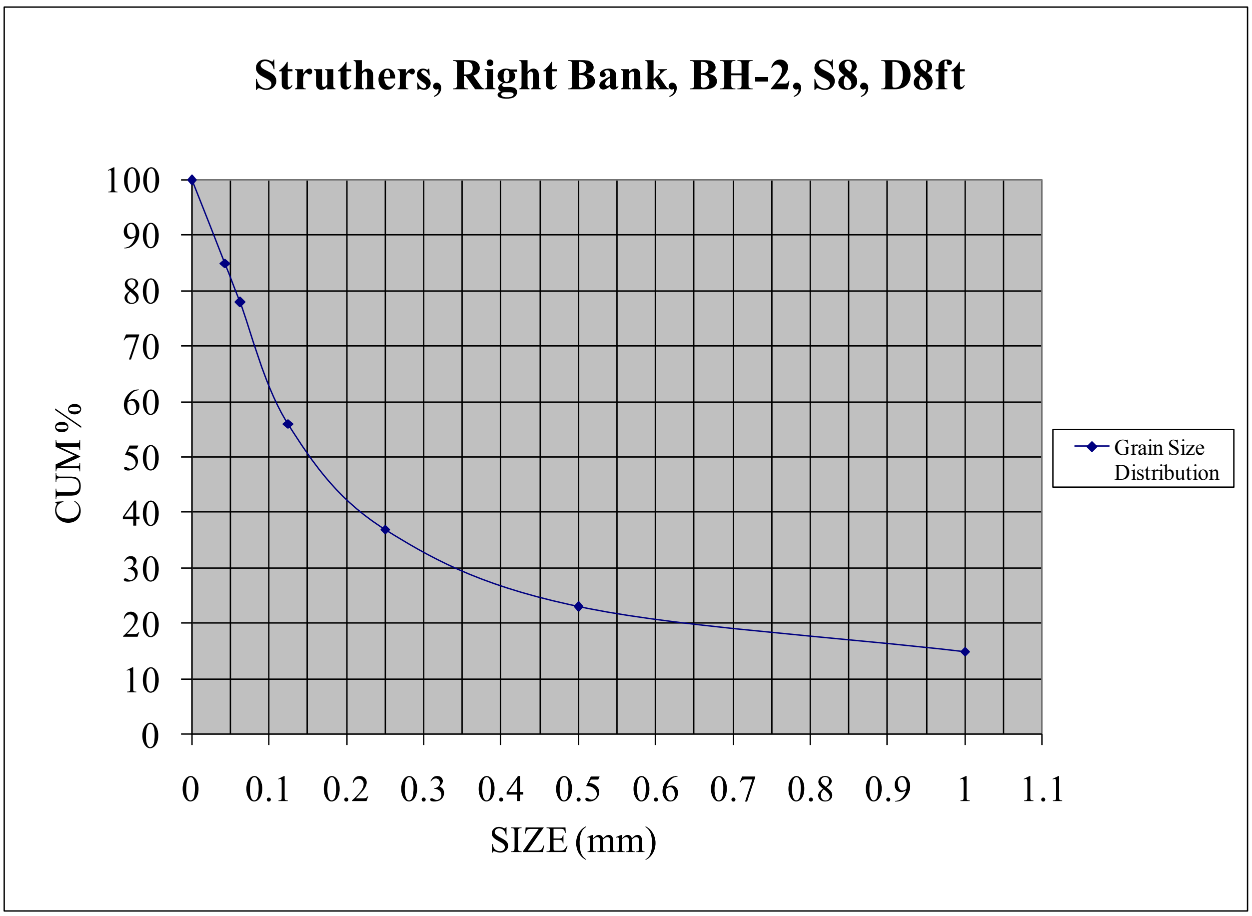
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-2, S7, 7ft. bsg[a]		Original Sample Weight: 109.3g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	13.6	13.6	13
0.5	9.9	23.5	22
0.25	17.7	41.2	38
0.125	33.9	75.1	69
0.063	20.0	95.1	88
0.044	4.3	99.4	92
pan	8.8	108.2	100

a. Below surface grade.



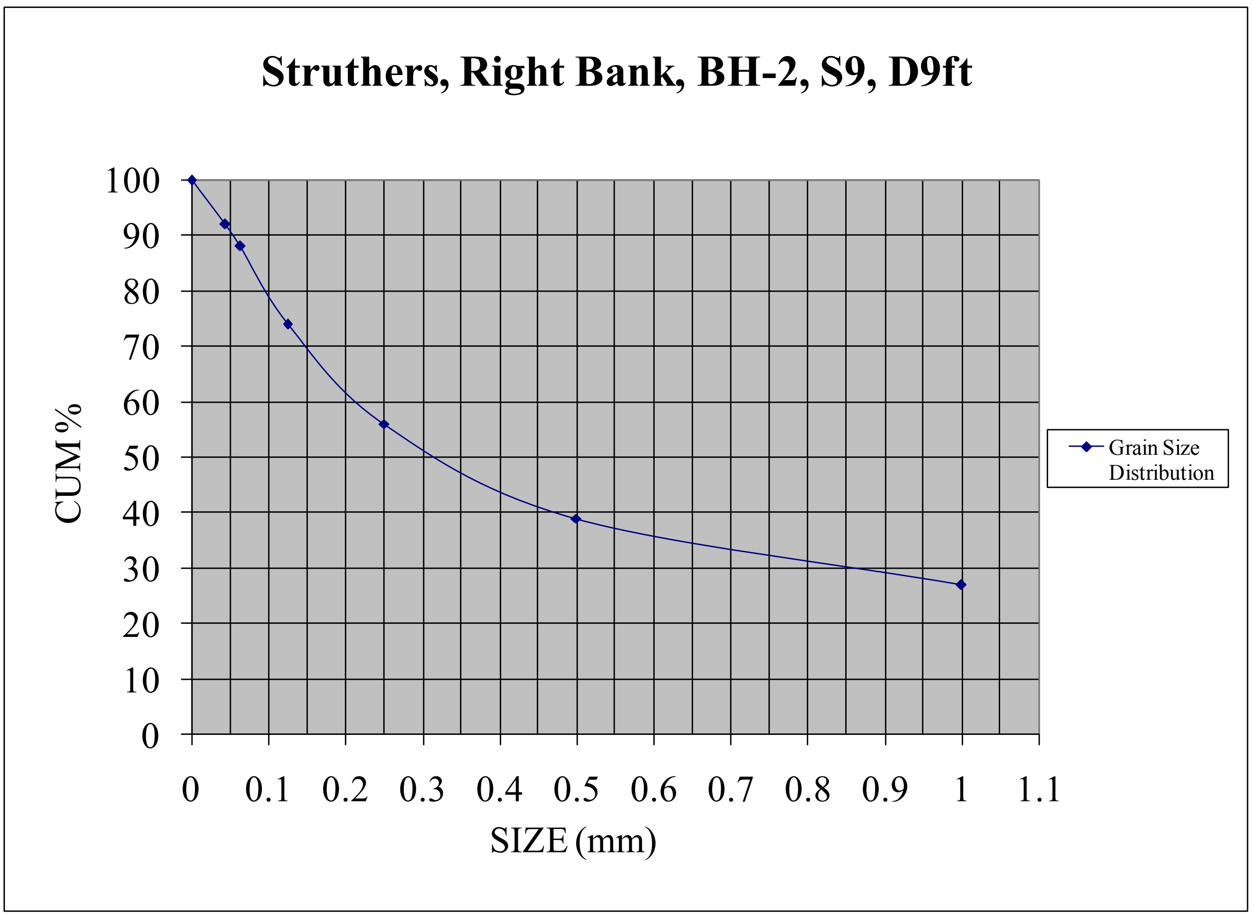
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-2, S8, 8ft. bsg[a]		Original Sample Weight: 108.4g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	16.0	16.0	15
0.5	8.7	24.7	23
0.25	15.4	40.1	37
0.125	20.1	60.2	56
0.063	23.5	83.7	78
0.044	7.3	91.0	85
pan	16.2	107.2	100

a. Below surface grade.



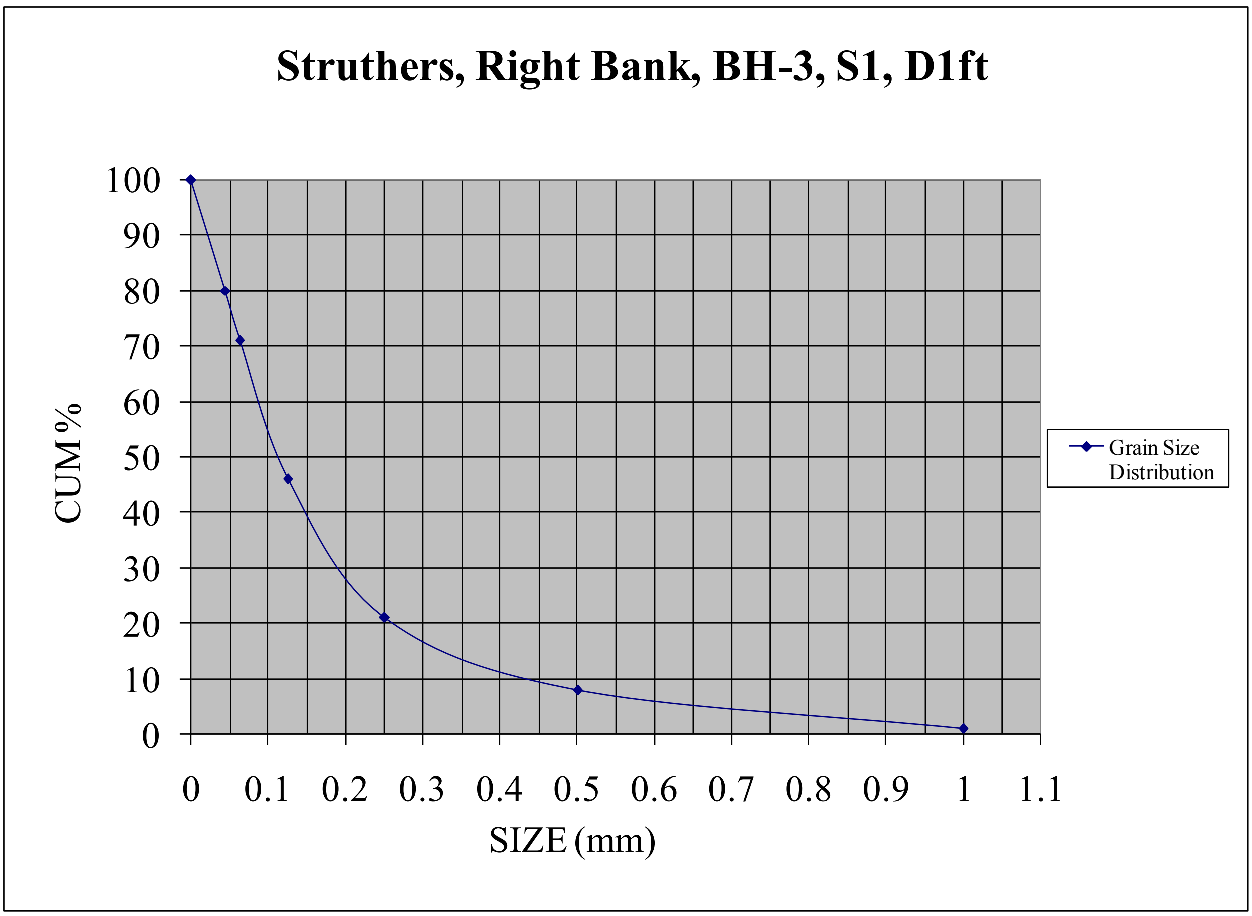
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		**Sample Date: 10/7/06**	
BH-2, S9, 9ft. bsg[a]		**Original Sample Weight: 105.6g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	27.9	27.9	27
0.5	12.6	40.5	39
0.25	18.0	58.5	56
0.125	19.5	78.0	74
0.063	14.1	92.1	88
0.044	4.3	96.4	92
pan	8.6	105.0	100

a. Below surface grade.



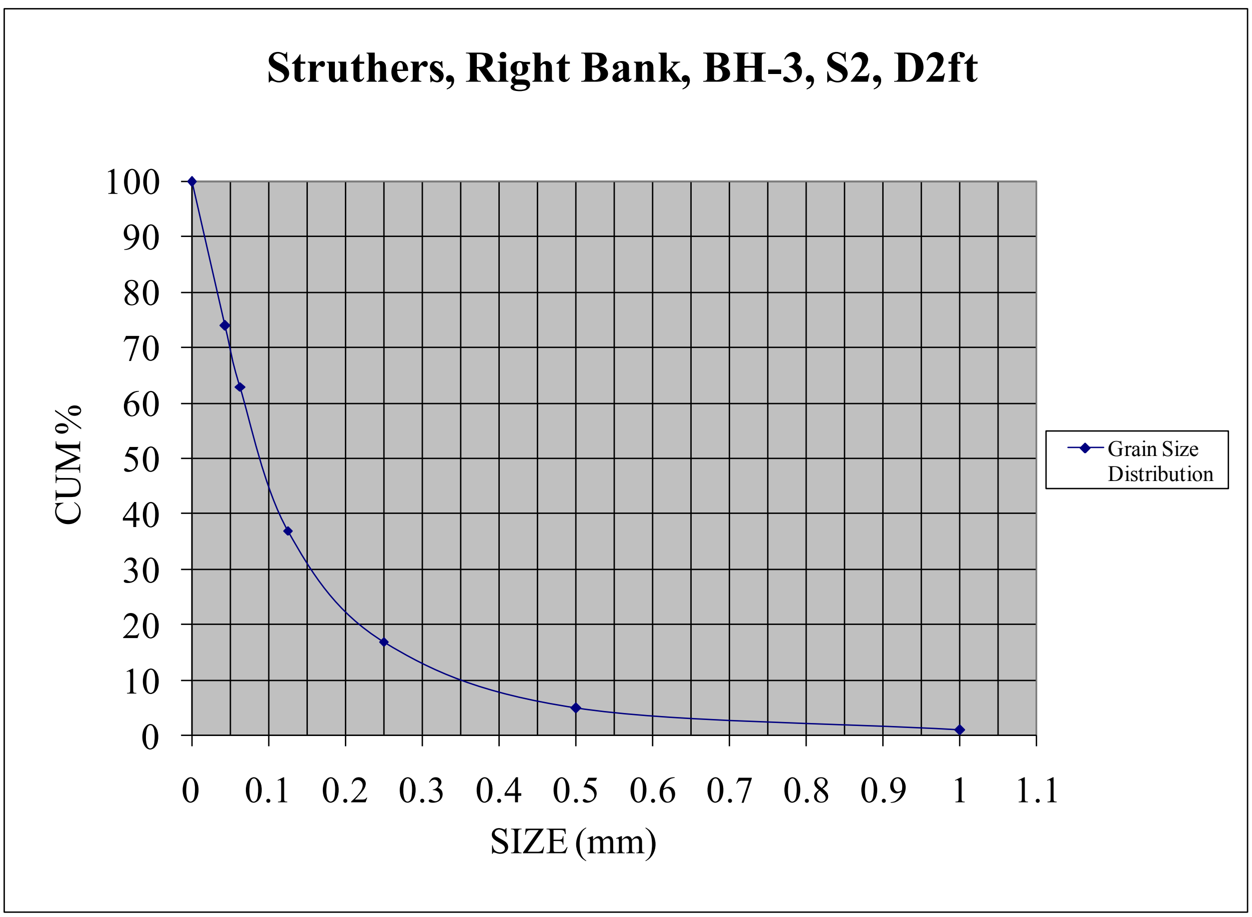
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		**Sample Date: 10/7/06**	
BH-3, S1, 1ft. bsg[a]		**Original Sample Weight: 124.4g**	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.0	1.0	1
0.5	8.8	9.8	8
0.25	16.2	26.0	21
0.125	30.4	56.4	46
0.063	31.0	87.4	71
0.044	10.7	98.1	80
pan	25.1	123.2	100

a. Below surface grade.



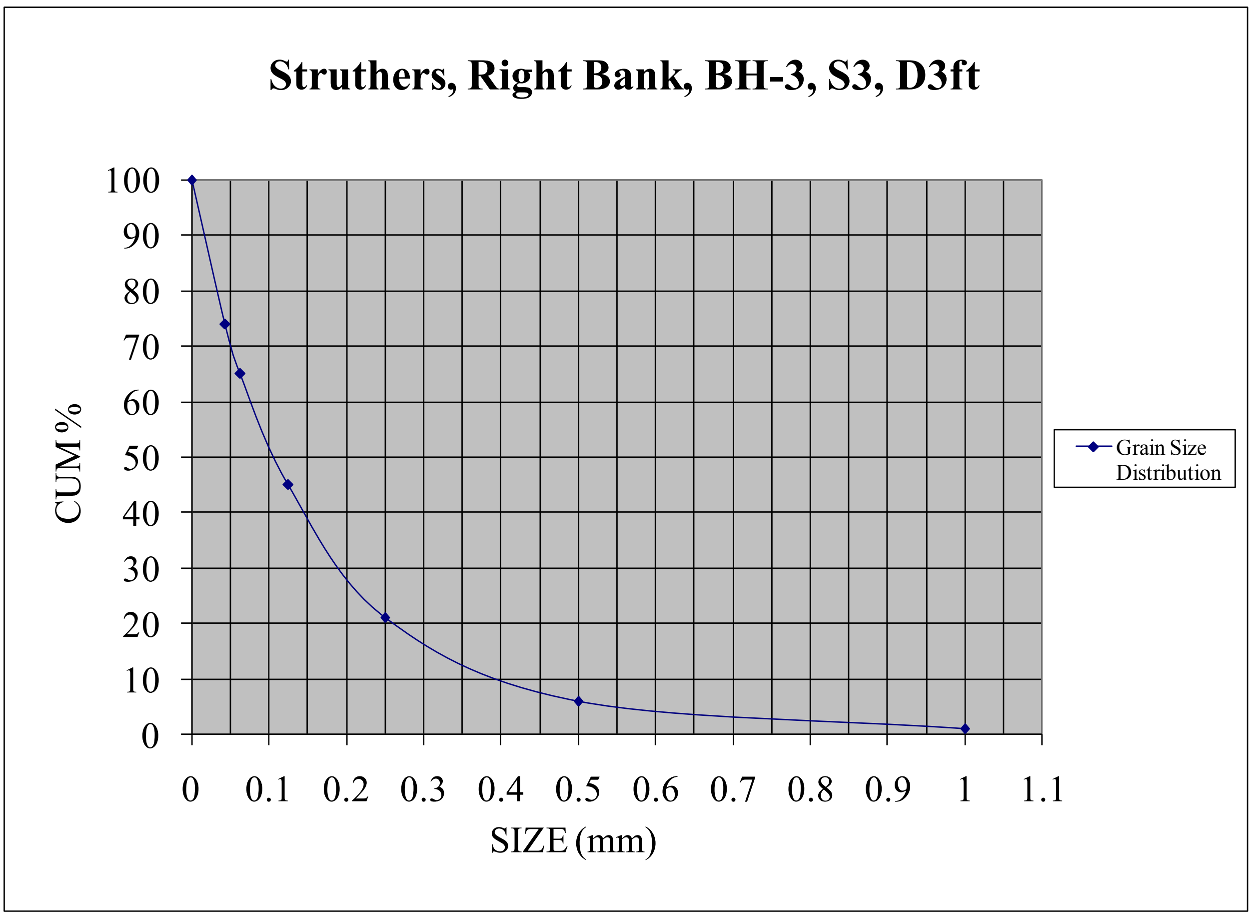
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-3, S2, 2ft. bsg[a]		Original Sample Weight: 124.0g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.7	0.7	1
0.5	5.6	6.3	5
0.25	14.7	21.0	17
0.125	25.3	46.3	37
0.063	31.5	77.8	63
0.044	13.0	90.8	73
pan	32.8	123.6	100

a. Below surface grade.



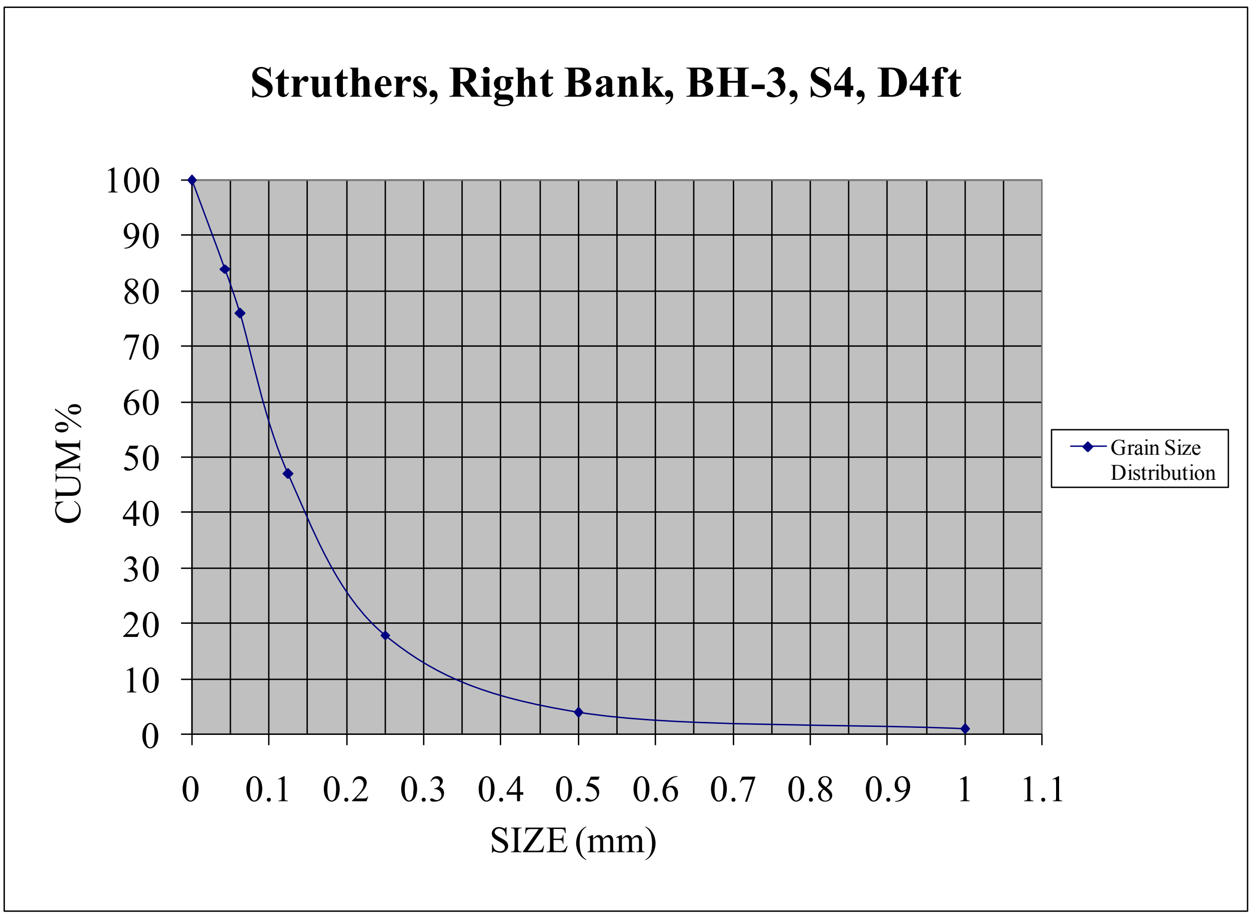
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-3, S3, 3ft. bsg[a]		Original Sample Weight: 129.4g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.8	0.8	1
0.5	6.4	7.2	6
0.25	19.5	26.7	21
0.125	30.8	57.5	45
0.063	26.5	84.0	65
0.044	11.0	95.0	74
pan	33.4	128.4	100

a. Below surface grade.



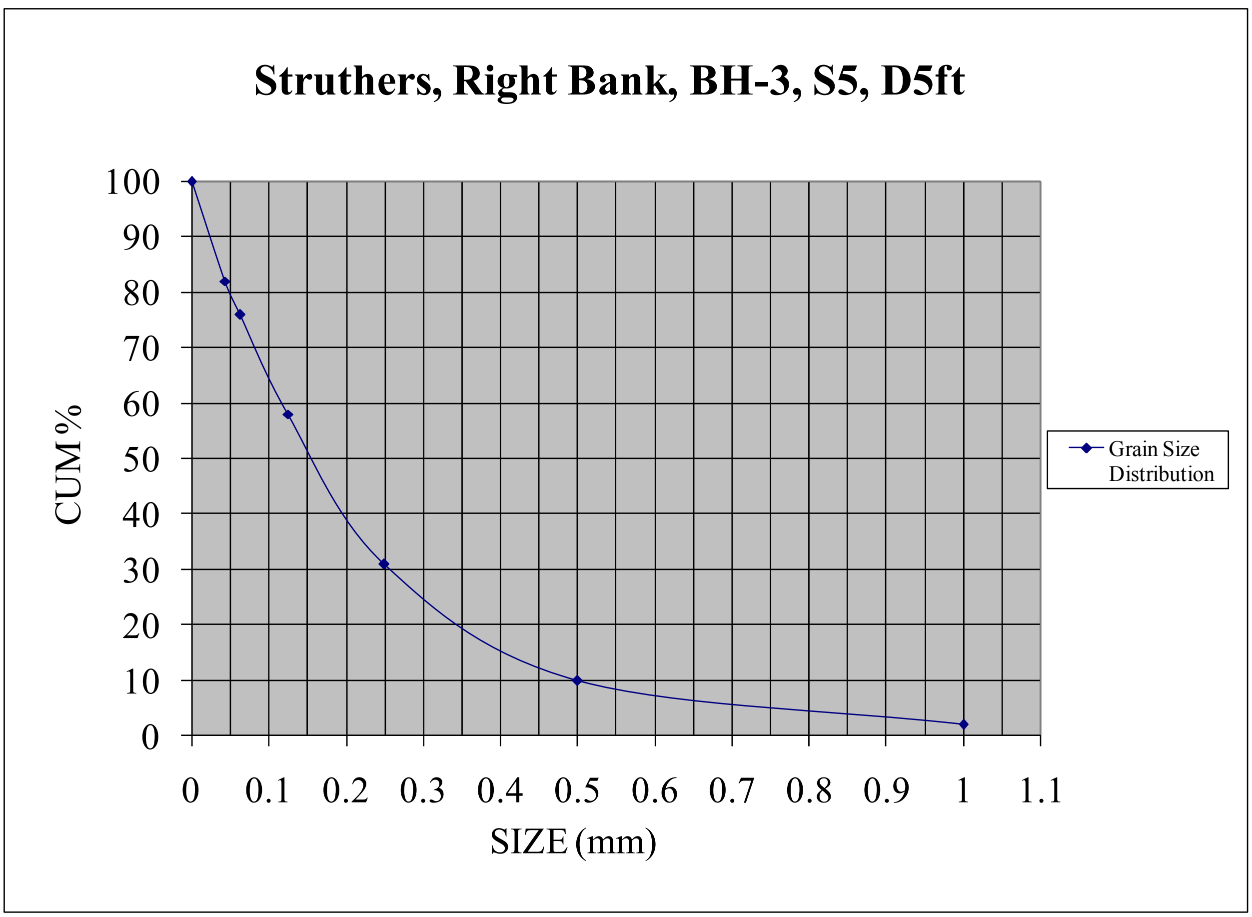
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		**Sample Date: 10/7/06**	
BH-3, S4, 4ft. bsg[a]		**Original Sample Weight: 110.5g**	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.9	0.9	1
0.5	3.8	4.7	4
0.25	15.4	20.1	18
0.125	31.2	51.3	47
0.063	32.2	83.5	76
0.044	8.8	92.3	84
pan	18.1	110.4	100

a. Below surface grade.



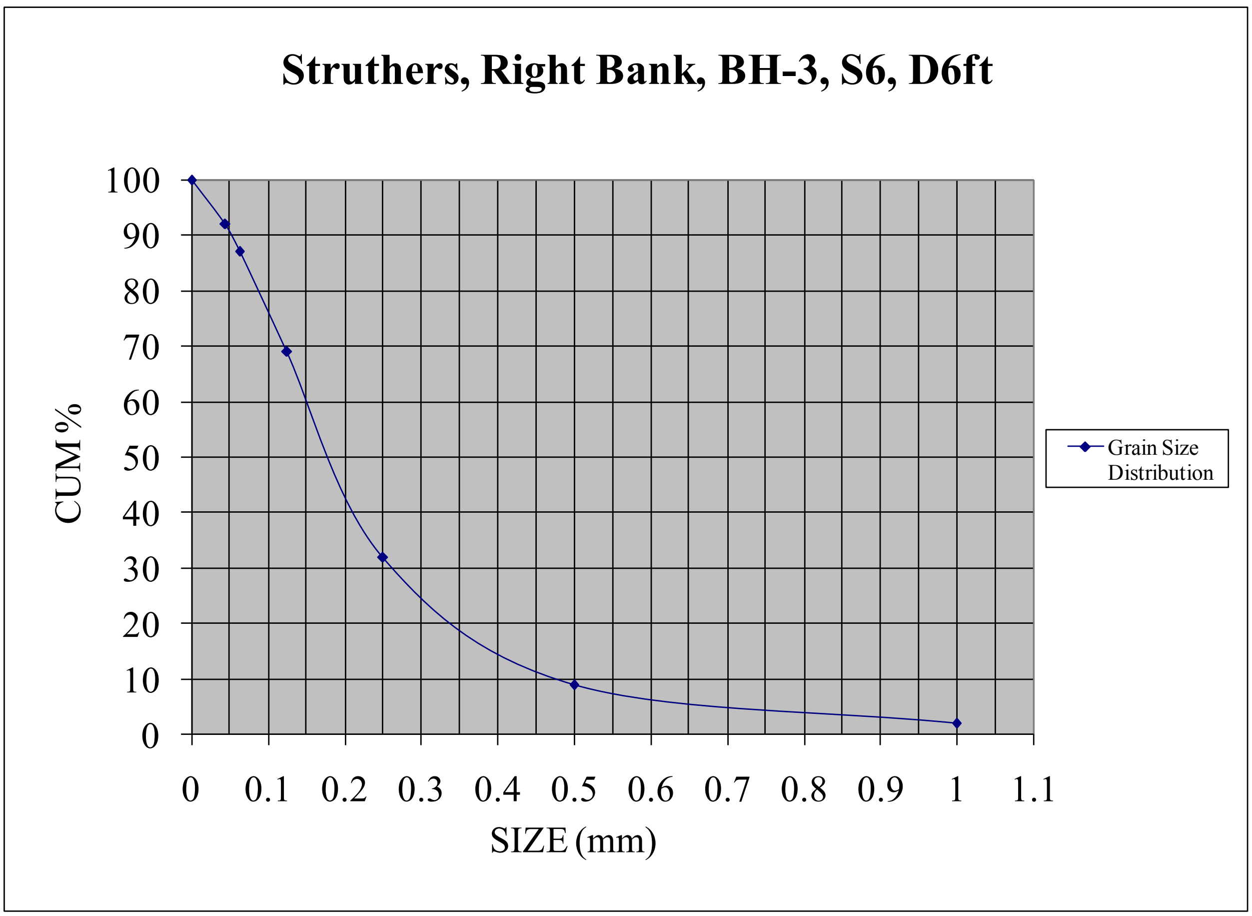
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-3, S5, 5ft. bsg[a]		Original Sample Weight: 102.7g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.8	1.8	2
0.5	7.9	9.7	10
0.25	21.1	30.8	31
0.125	27.8	58.6	58
0.063	17.8	76.4	76
0.044	6.4	82.8	82
pan	17.9	100.7	100

a. Below surface grade.



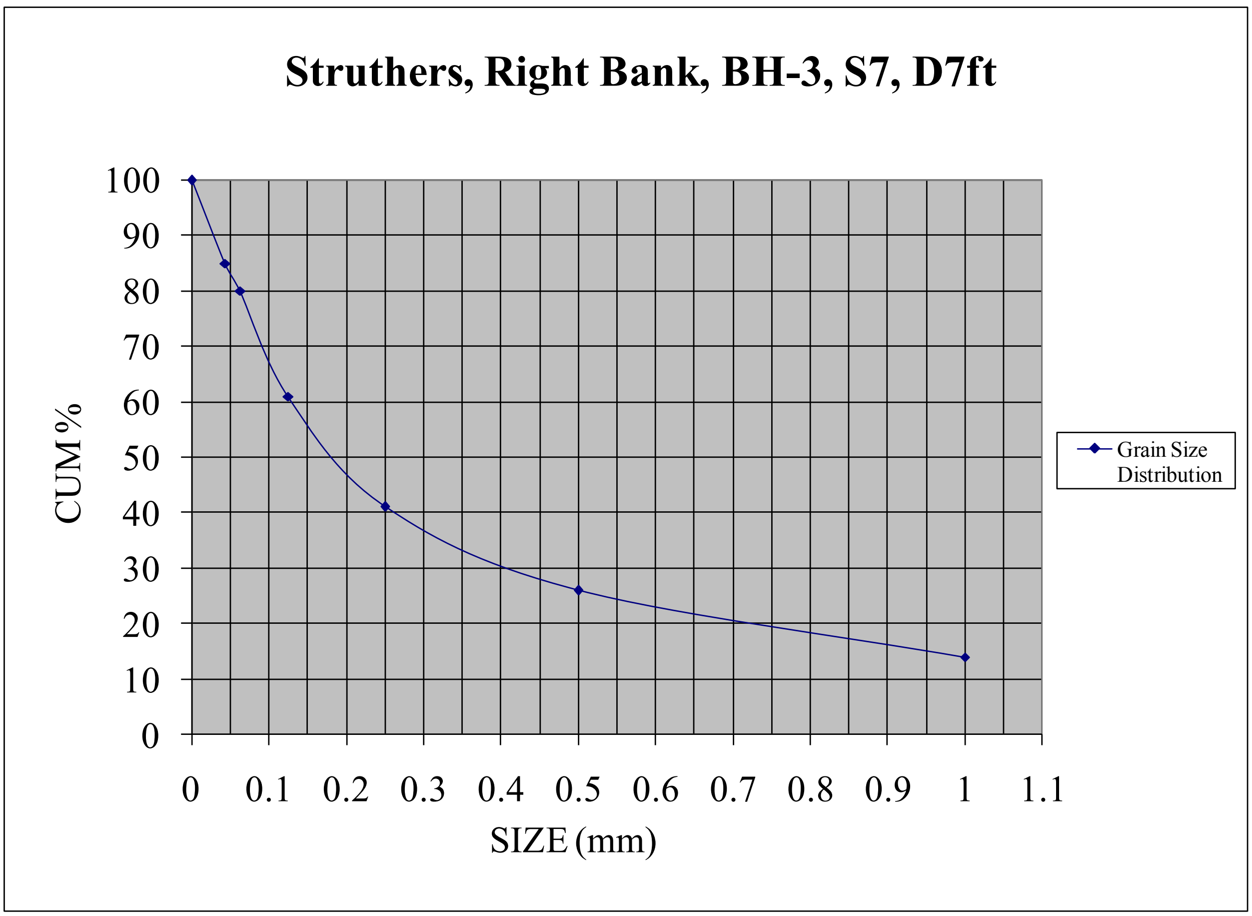
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		**Sample Date: 10/7/06**	
BH-3, S6, 6ft. bsg[a]		**Original Sample Weight: 116.1g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	2.3	2.3	2
0.5	7.9	10.2	9
0.25	25.7	35.9	31
0.125	42.3	78.2	69
0.063	20.5	98.7	87
0.044	6.4	105.1	92
pan	8.9	114.0	100

a. Below surface grade.



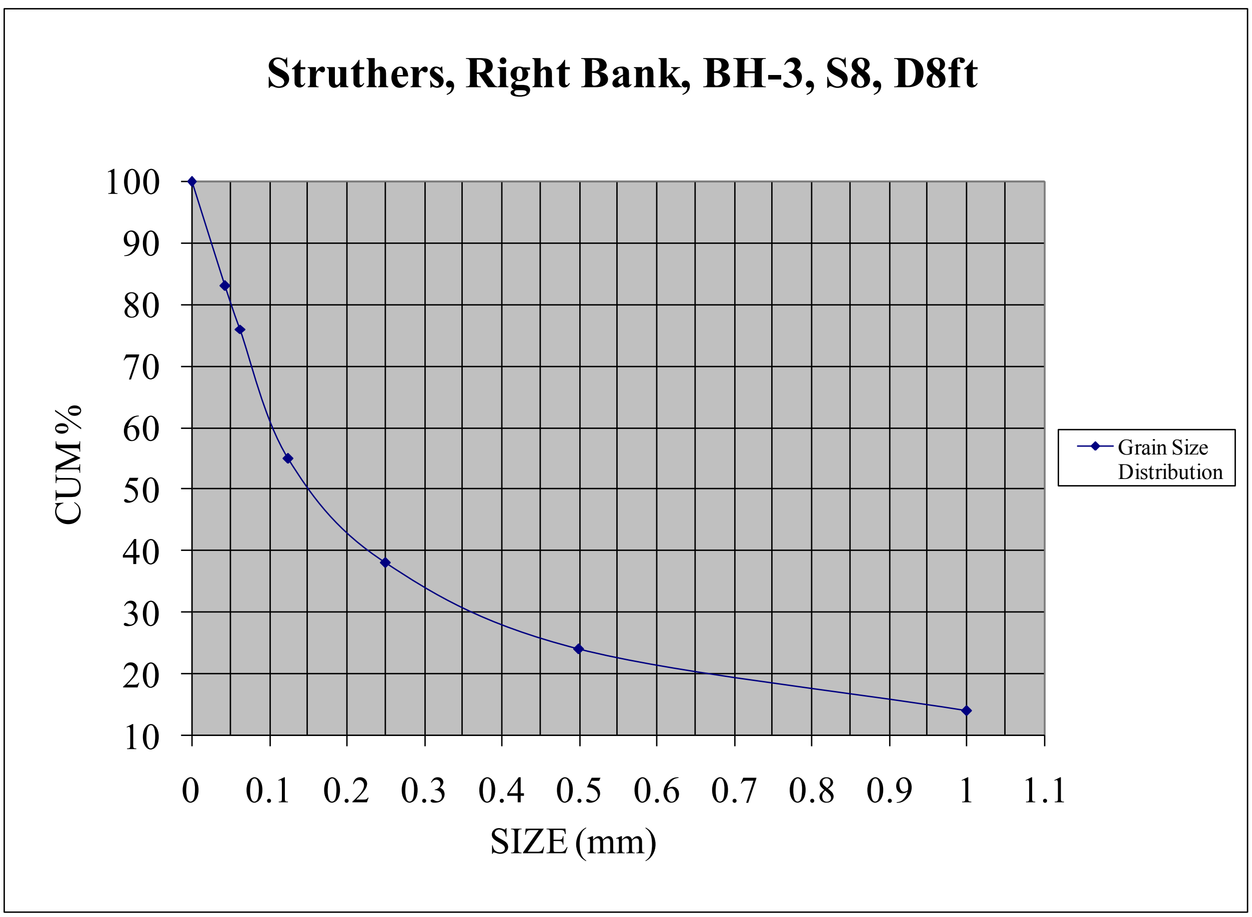
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		**Sample Date: 10/7/06**	
BH-3, S7, 7ft. bsg[a]		**Original Sample Weight: 104.7g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	14.5	14.5	14
0.5	12.4	26.9	26
0.25	16.2	43.1	41
0.125	20.4	63.5	61
0.063	19.4	82.9	80
0.044	6.0	88.9	85
pan	15.2	104.1	100

a. Below surface grade.



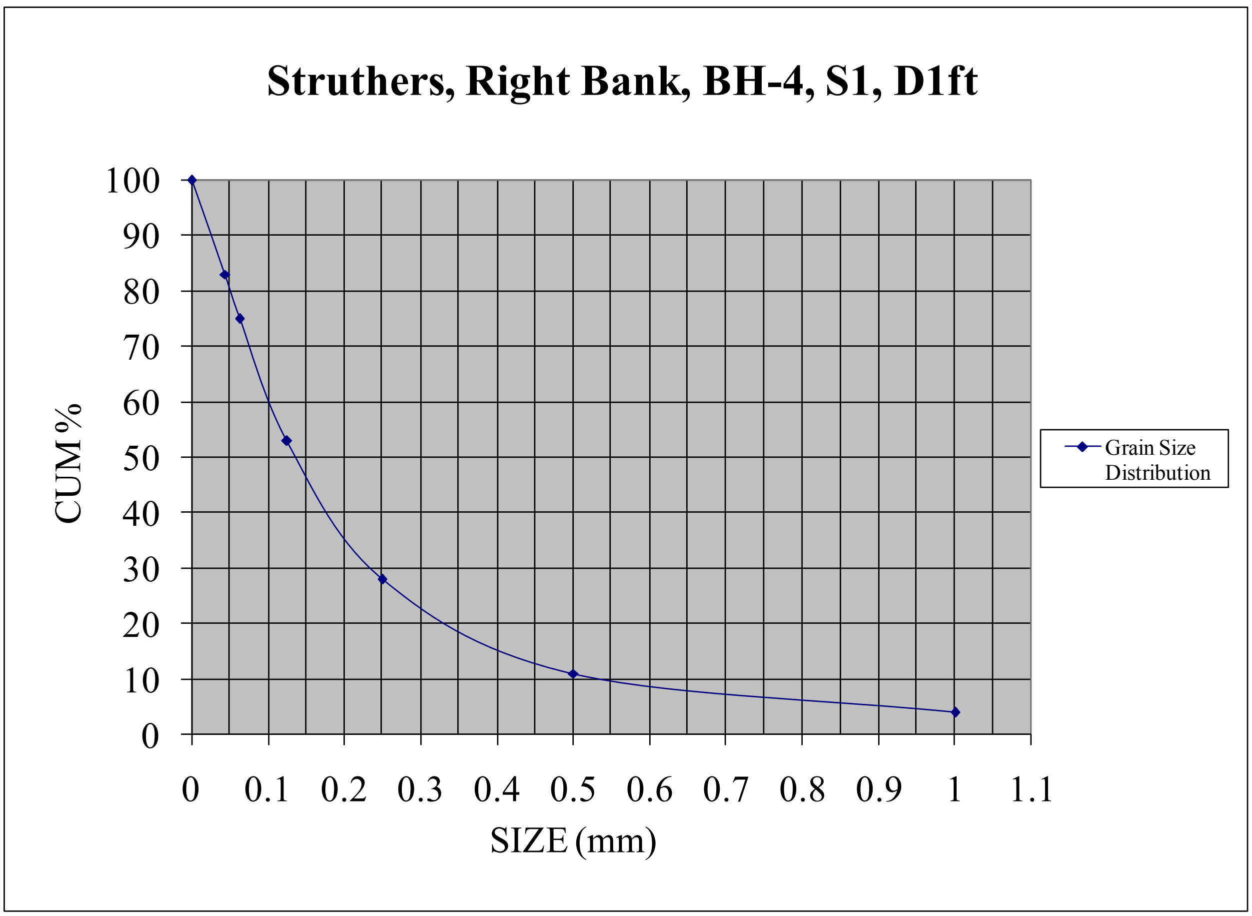
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		**Sample Date: 10/7/06**	
BH-3, S8, 8ft. bsg[a]		**Original Sample Weight: 113.2g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	16.0	16.0	14
0.5	10.2	26.2	24
0.25	15.9	42.1	38
0.125	19.2	61.3	55
0.063	22.9	84.2	76
0.044	8.1	92.3	83
pan	18.8	111.1	100

a. Below surface grade.



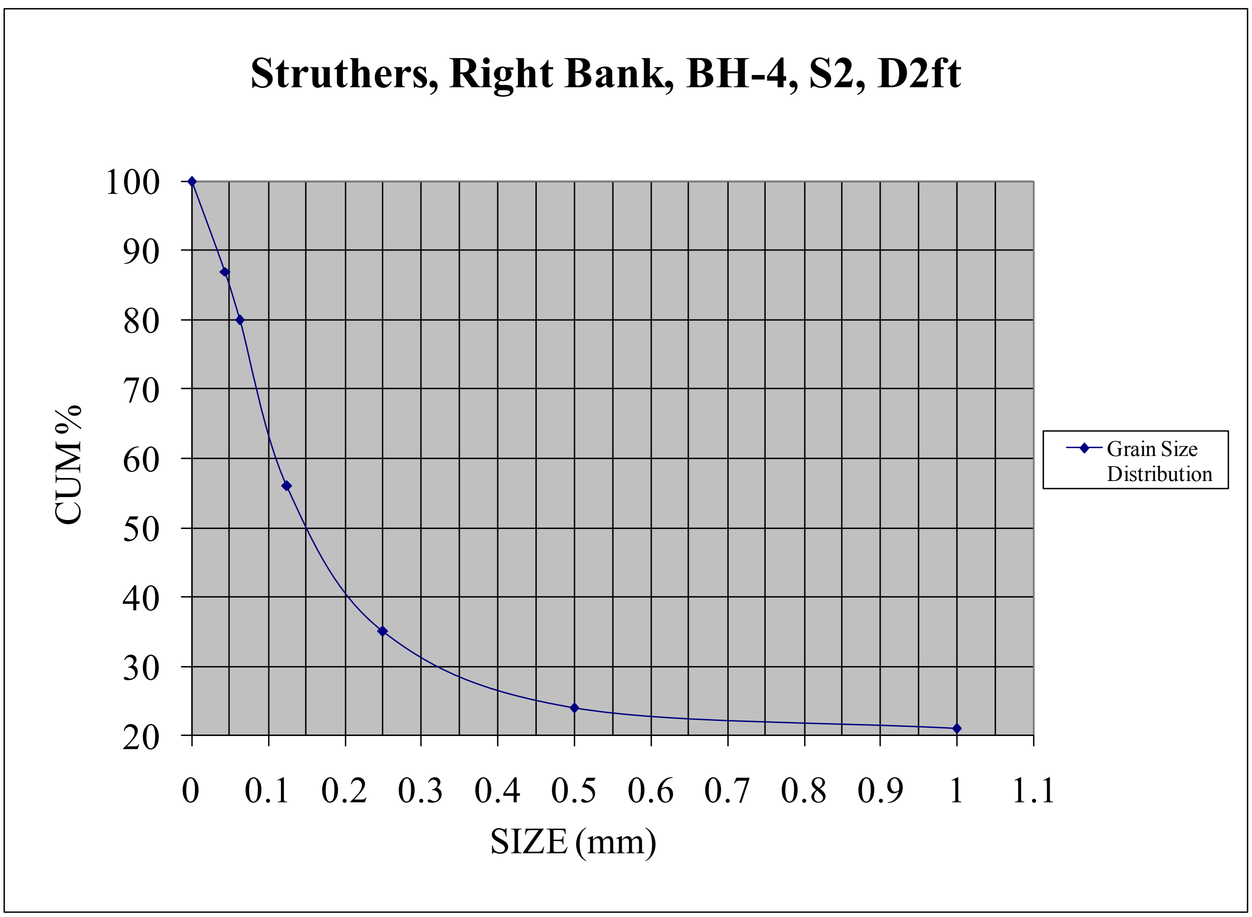
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		**Sample Date: 10/7/06**	
BH-4, S1, 1ft. bsg[a]		**Original Sample Weight: 124.8g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	4.6	4.6	4
0.5	9.3	13.9	11
0.25	21.6	35.5	28
0.125	30.5	66.0	53
0.063	27.1	93.1	75
0.044	9.9	103.0	83
pan	21.9	124.9	100

a. Below surface grade.



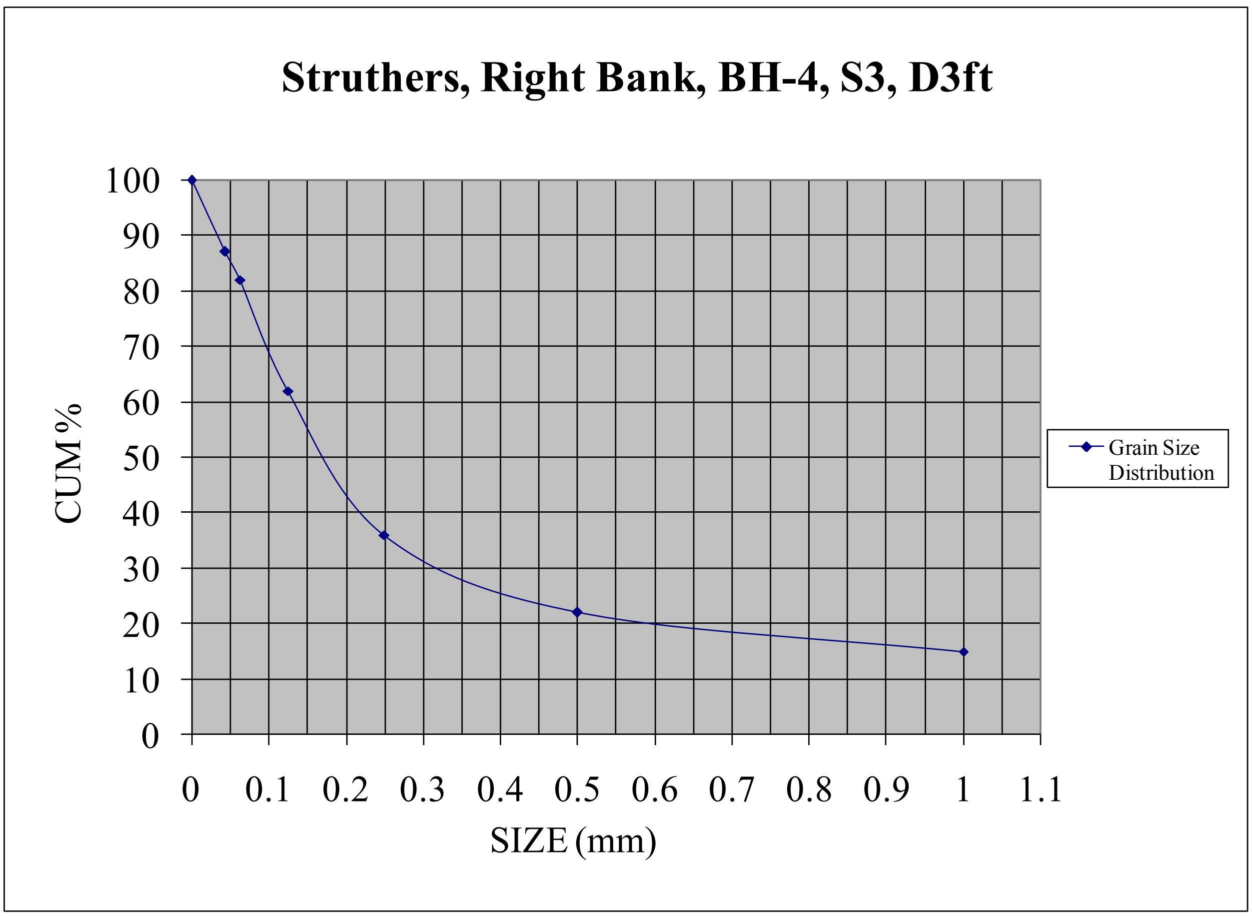
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-4, S2, 2ft. bsg[a]		Original Sample Weight: 122.0g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	25.8	25.8	21
0.5	3.8	29.6	24
0.25	12.7	42.3	35
0.125	26.2	68.5	56
0.063	28.7	97.2	80
0.044	8.6	105.8	87
pan	15.9	121.7	100

a. Below surface grade.



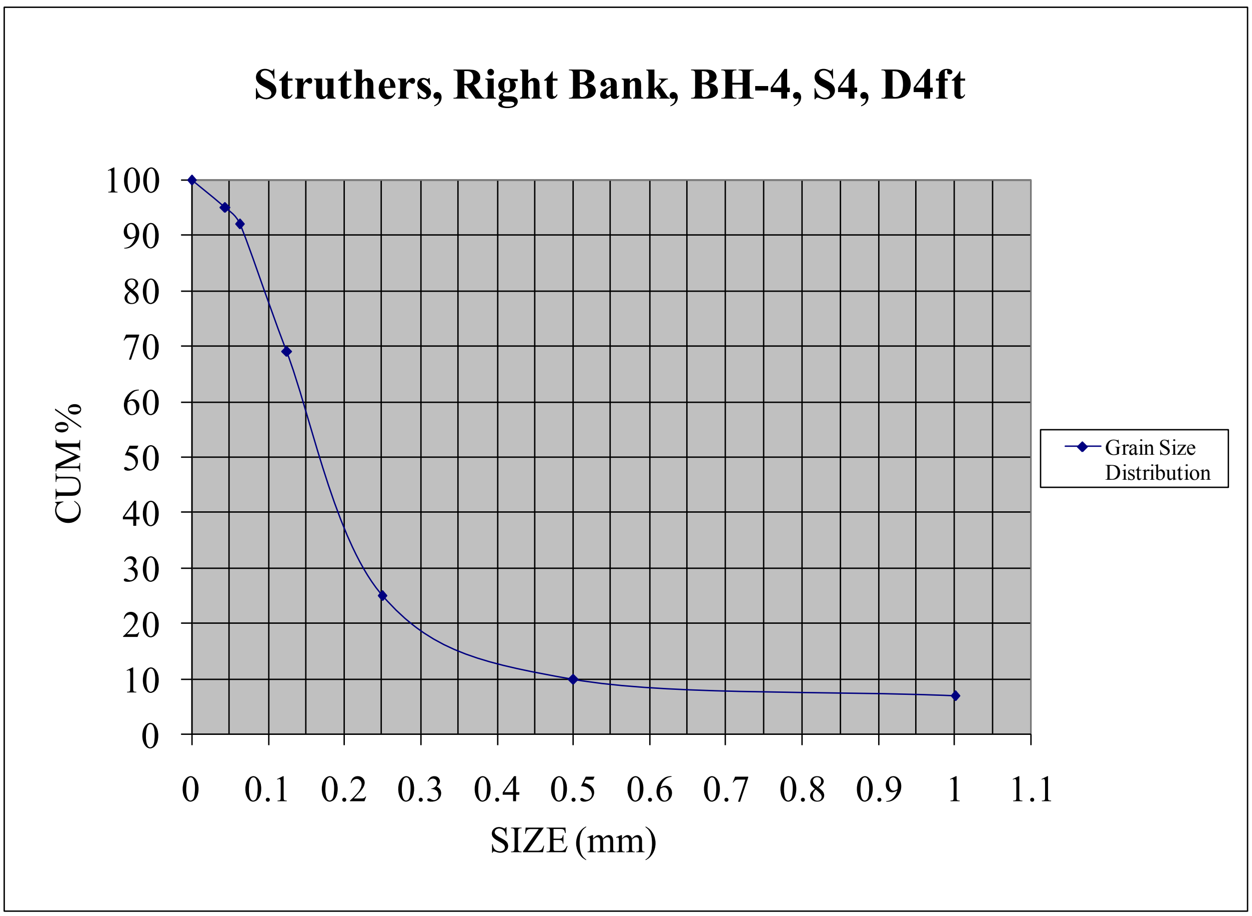
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-4, S3, 3ft. bsg[a]		Original Sample Weight: 120.3g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	17.7	17.7	15
0.5	7.6	25.3	22
0.25	16.6	41.9	36
0.125	31.3	73.2	62
0.063	23.4	96.6	82
0.044	6.4	103.0	87
pan	14.8	117.8	100

a. Below surface grade.



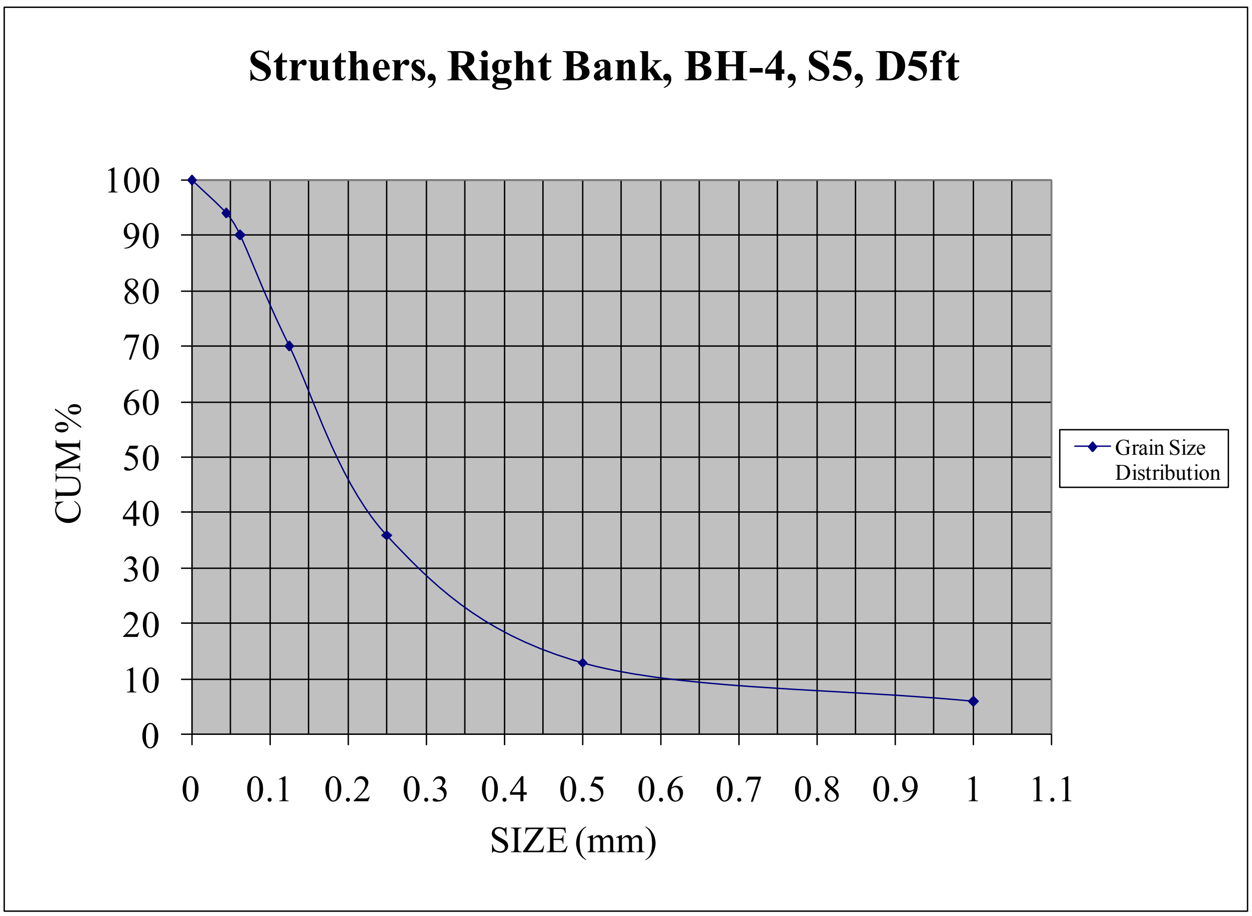
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-4, S4, 4ft. bsg[a]		Original Sample Weight: 117.1g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	7.8	7.8	7
0.5	4.0	11.8	10
0.25	17.7	29.5	25
0.125	50.9	80.4	69
0.063	26.7	107.1	92
0.044	3.6	110.7	95
pan	6.3	117.0	100

a. Below surface grade.



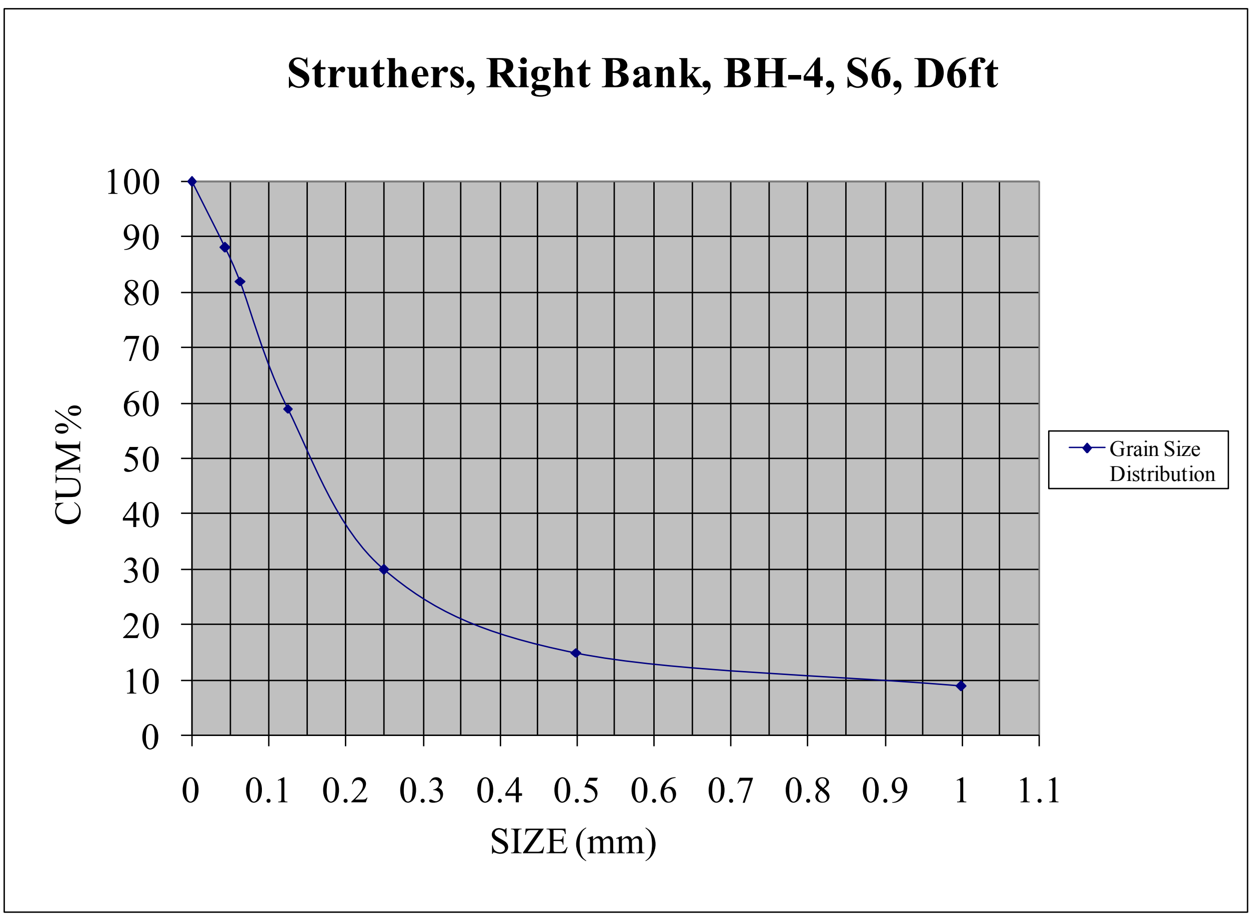
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		**Sample Date: 10/7/06**	
BH-4, S5, 5ft. bsg[a]		**Original Sample Weight: 126.1g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	7.3	7.3	6
0.5	9.2	16.5	13
0.25	28.6	45.1	36
0.125	42.5	87.6	70
0.063	25.2	112.8	90
0.044	5.8	118.6	94
pan	7.4	126.0	100

a. Below surface grade.



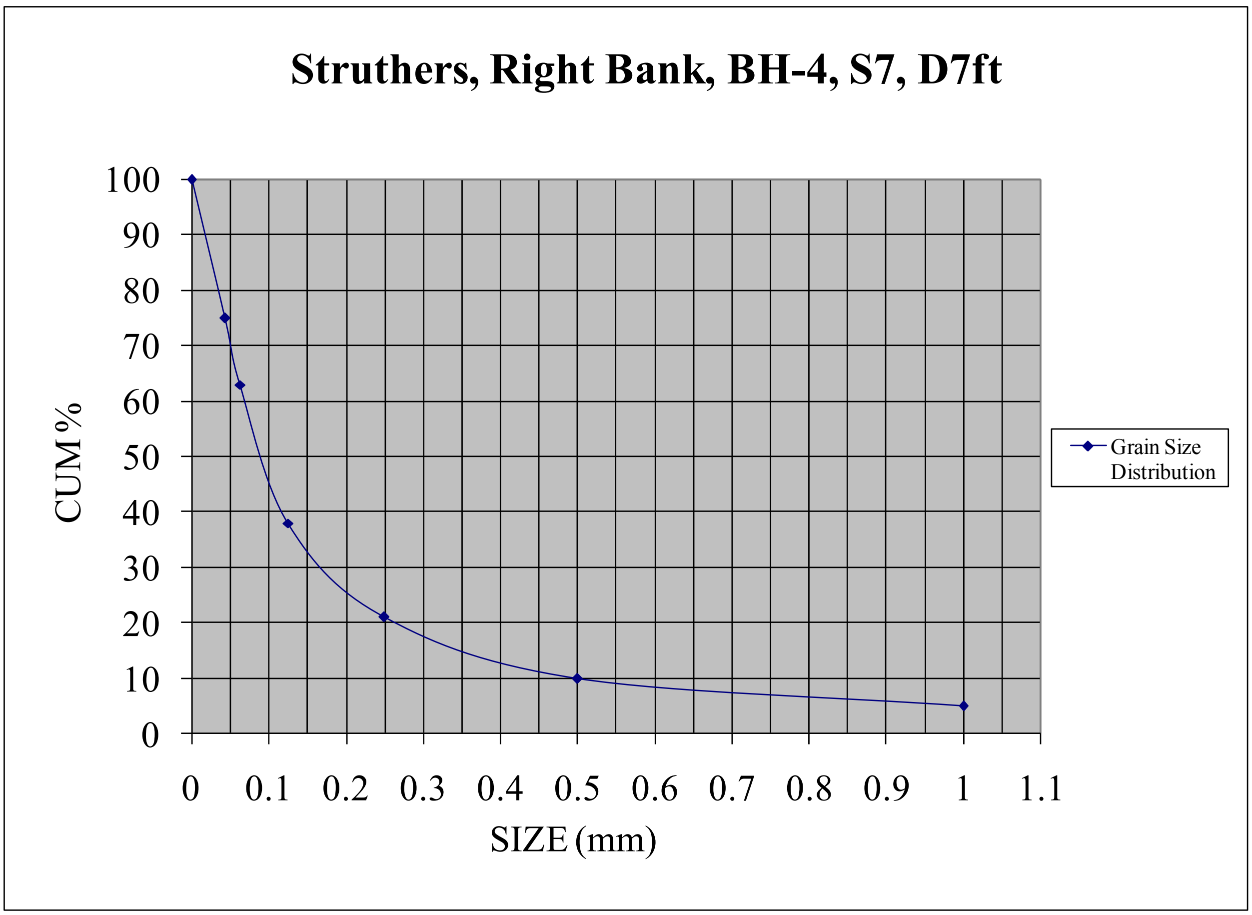
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		Sample Date: 10/7/06	
BH-4, S6, 6ft. bsg[a]		Original Sample Weight: 130.0g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	11.3	11.3	9
0.5	8.3	19.6	15
0.25	20.1	39.7	30
0.125	38.1	77.8	59
0.063	29.1	106.9	82
0.044	7.8	114.7	88
pan	16.2	130.9	100

a. Below surface grade.



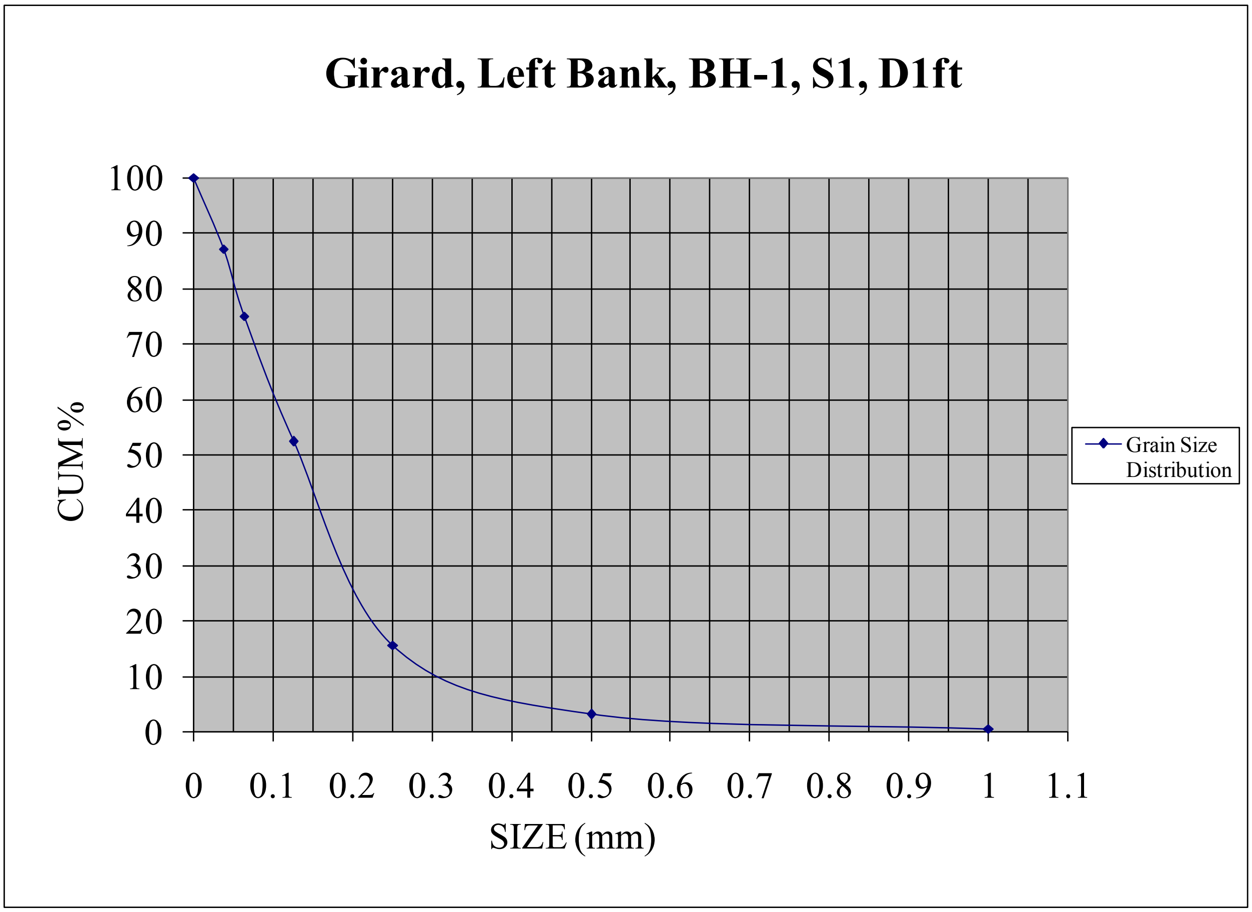
Soil Grain-size Analysis Laboratory Results			
Struthers Right Bank		**Sample Date: 10/7/06**	
BH-4, S7, 7ft. bsg[a]		**Original Sample Weight: 126.4g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	6.9	6.9	5
0.5	6.0	12.9	10
0.25	13.4	26.3	21
0.125	22.6	48.9	38
0.063	31.2	80.1	63
0.044	15.9	96.0	75
pan	31.4	127.4	100

a. Below surface grade.



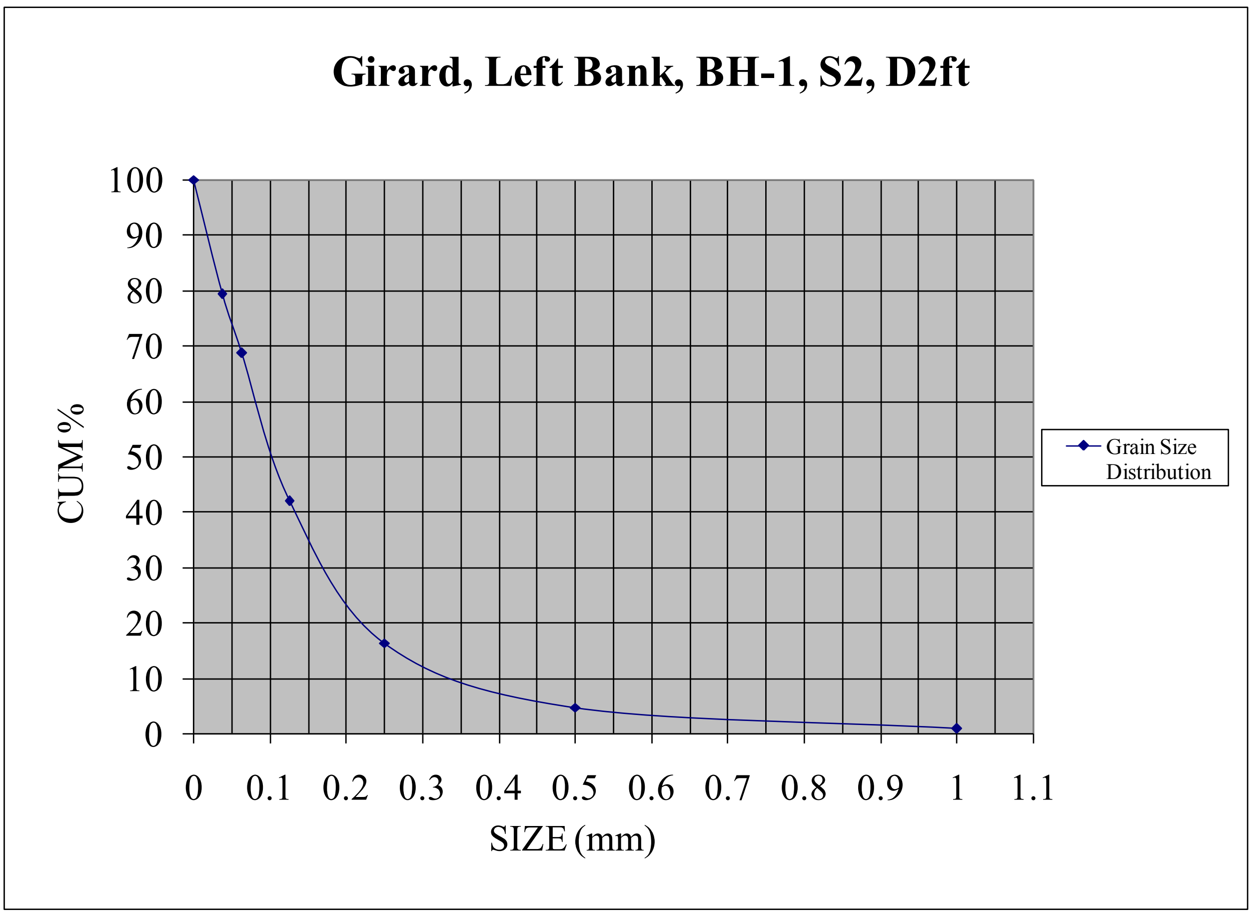
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-1, S1, 1ft. bsg[a]		Original Sample Weight: 114.6g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.5	0.5	0
0.5	3.0	3.5	3
0.25	14.2	17.7	16
0.125	41.8	59.5	52
0.063	25.8	85.2	75
0.044	13.8	99.1	87
pan	14.6	113.7	100

a. Below surface grade.



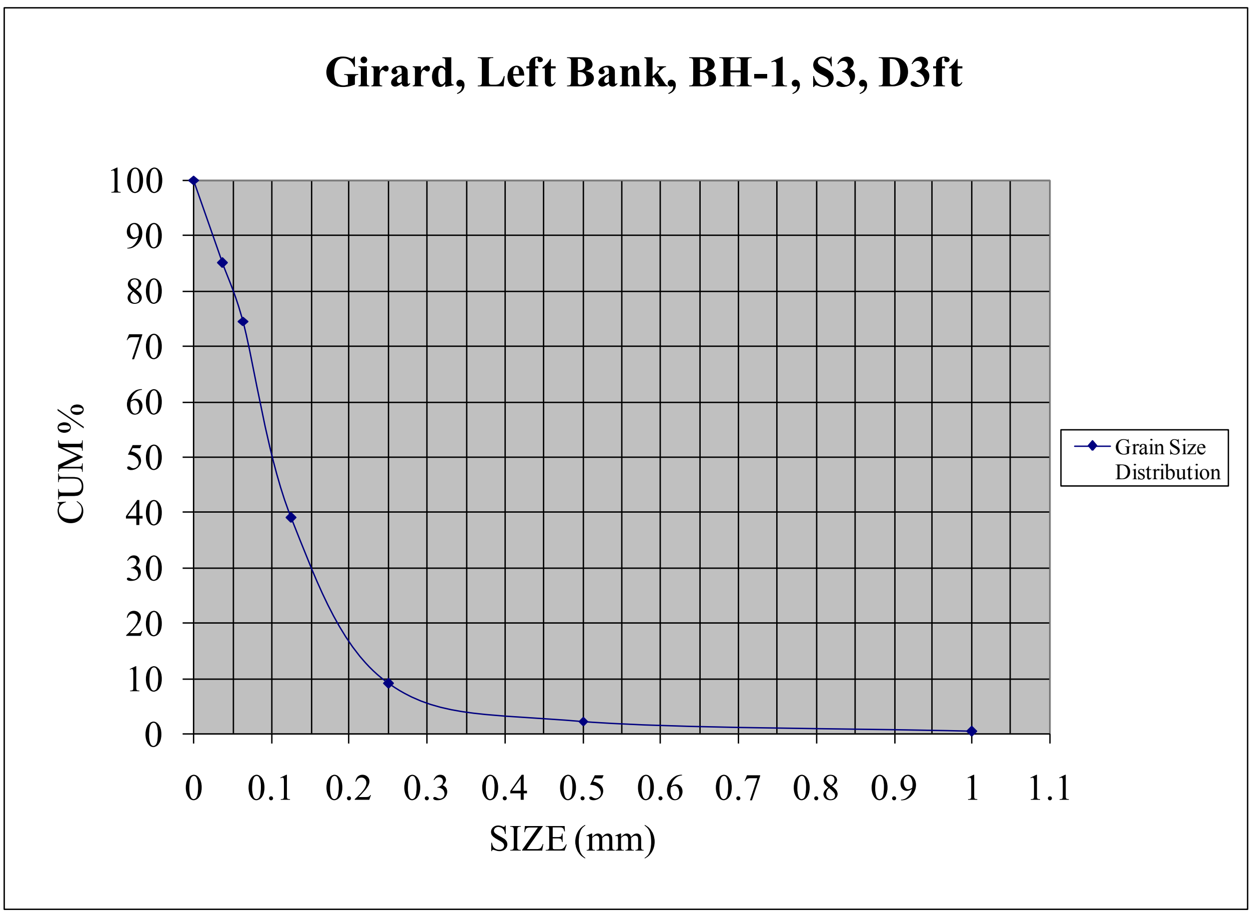
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-1, S2, 2ft. bsg[a]		Original Sample Weight: 112.3g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.8	0.8	1
0.5	4.3	5.2	5
0.25	13.0	18.1	16
0.125	28.6	46.7	42
0.063	29.7	76.4	69
0.044	11.8	88.2	79
pan	23.0	111.2	100

a. Below surface grade.



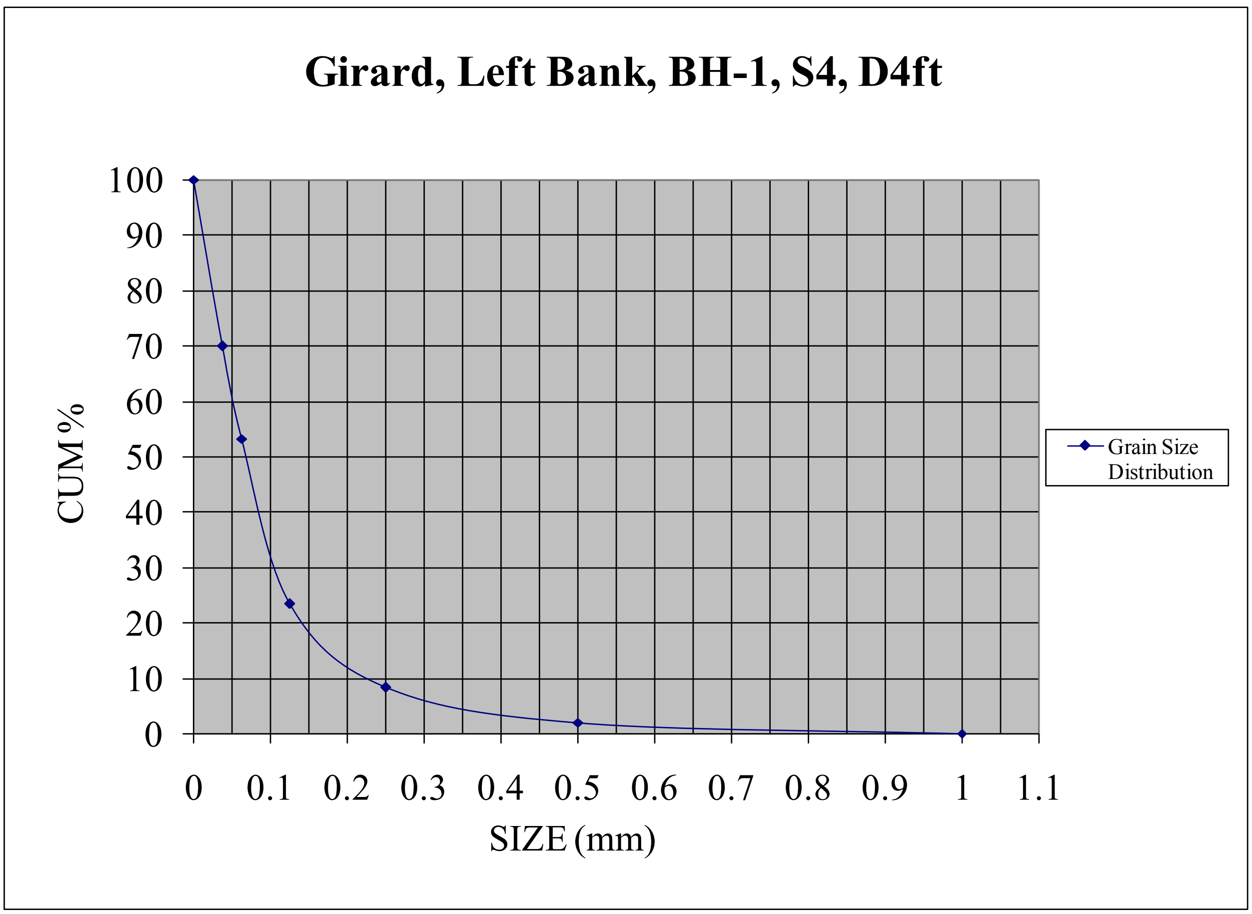
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-1, S3, 3ft. bsg[a]		Original Sample Weight: 103.5g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.3	0.3	0
0.5	2.0	2.3	2
0.25	6.9	9.2	9
0.125	30.7	39.9	39
0.063	36.4	76.3	74
0.044	10.7	87.0	85
pan	15.4	102.4	100

a. Below surface grade.



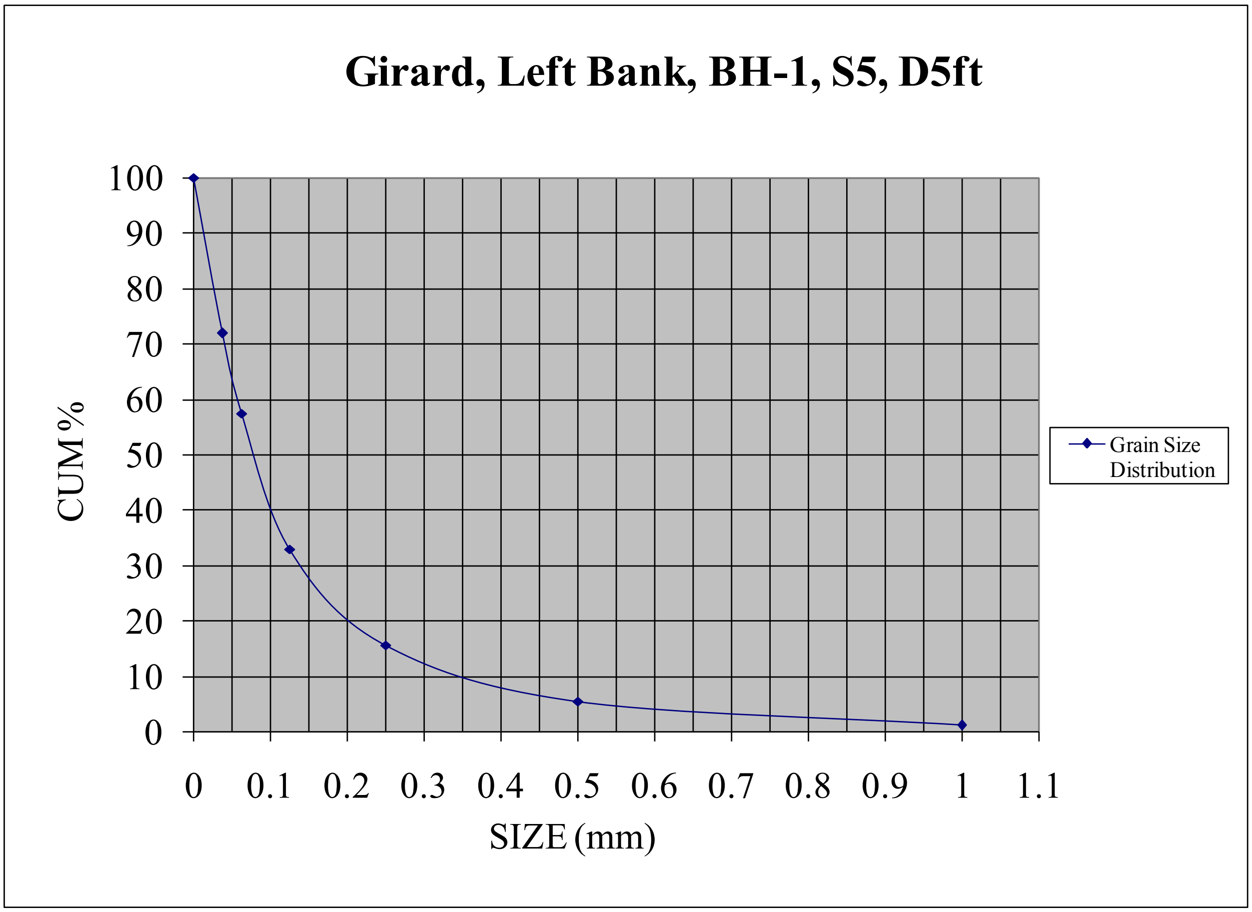
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		**Sample Date: 6/17/06**	
BH-1, S4, 4ft. bsg[a]		**Original Sample Weight: 112.7g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	2.1	2.1	2
0.25	7.1	9.3	8
0.125	16.9	26.1	23
0.063	33.3	59.4	53
0.044	18.7	78.1	70
pan	33.5	111.6	100

a. Below surface grade.



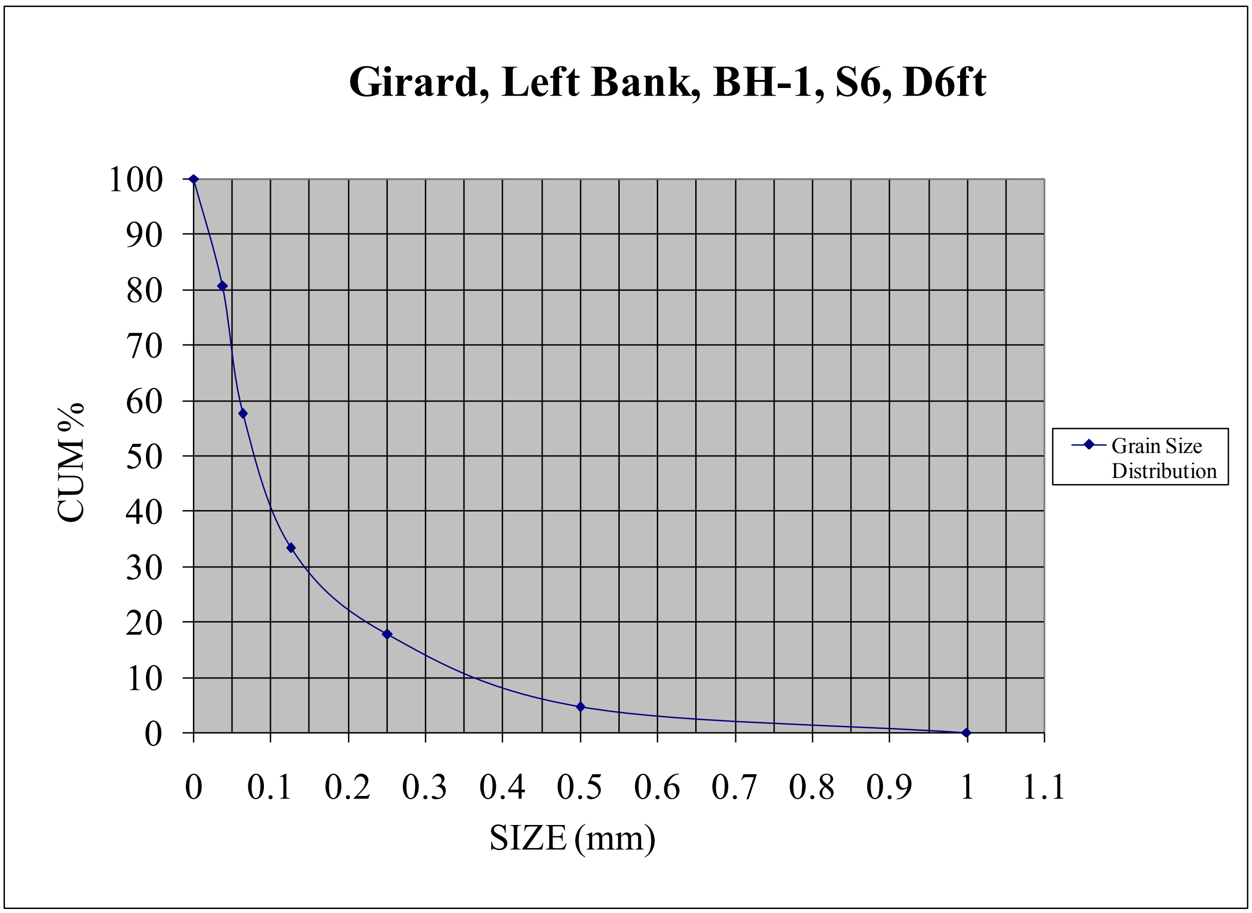
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		**Sample Date: 6/17/06**	
BH-1, S5, 5ft. bsg[a]		**Original Sample Weight: 113.4g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	1.1	1.1	1
0.5	5.0	6.1	5
0.25	11.5	17.6	16
0.125	19.5	37.2	33
0.063	27.7	64.9	57
0.044	16.4	81.2	72
pan	31.8	113.0	100

a. Below surface grade.



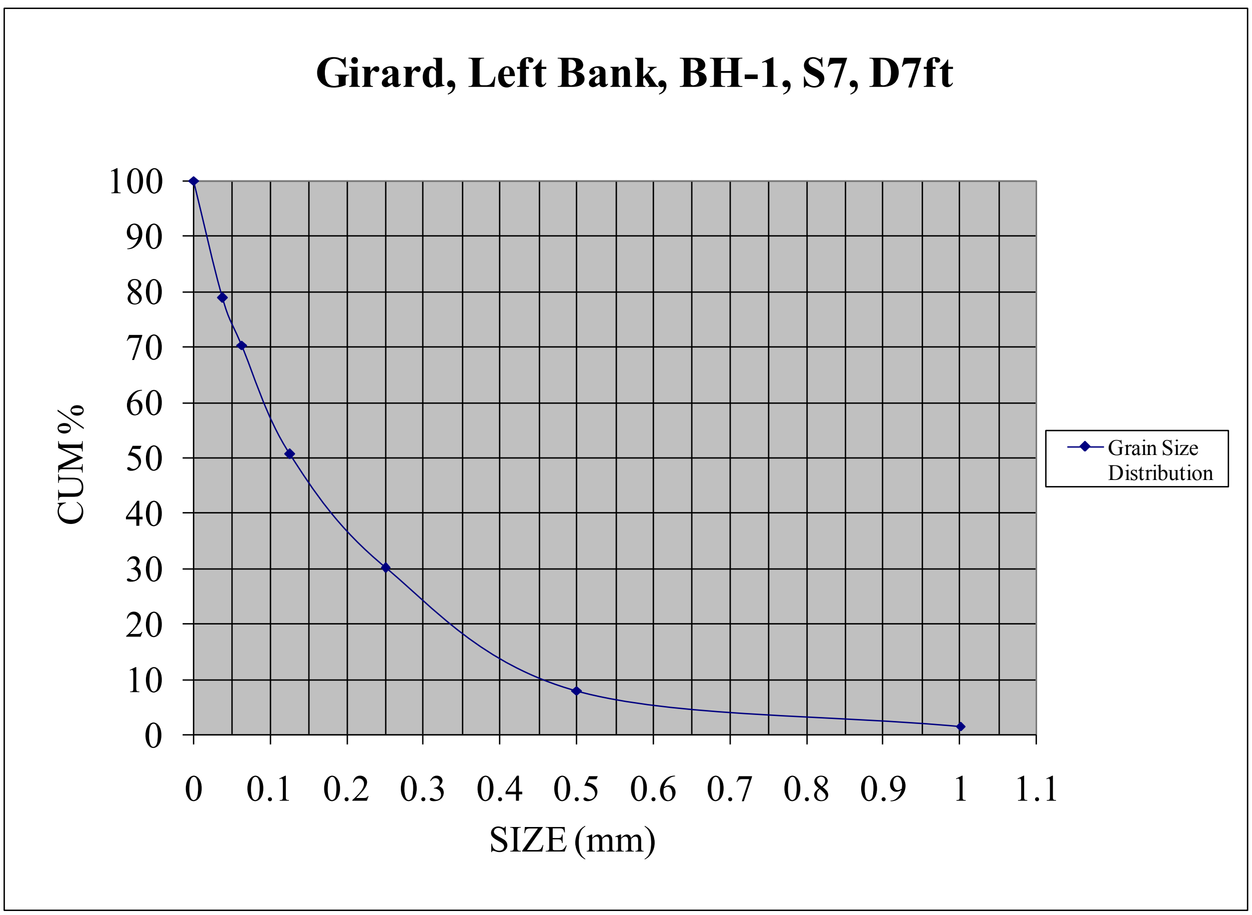
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		**Sample Date: 6/17/06**	
BH-1, S6, 6ft. bsg[a]		**Original Sample Weight: 120.3g**	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.0	0.0	0
0.5	5.5	5.5	5
0.25	15.5	21.0	18
0.125	18.6	39.6	33
0.063	29.1	68.7	58
0.044	27.3	96.0	81
pan	23.2	119.2	100

a. Below surface grade.



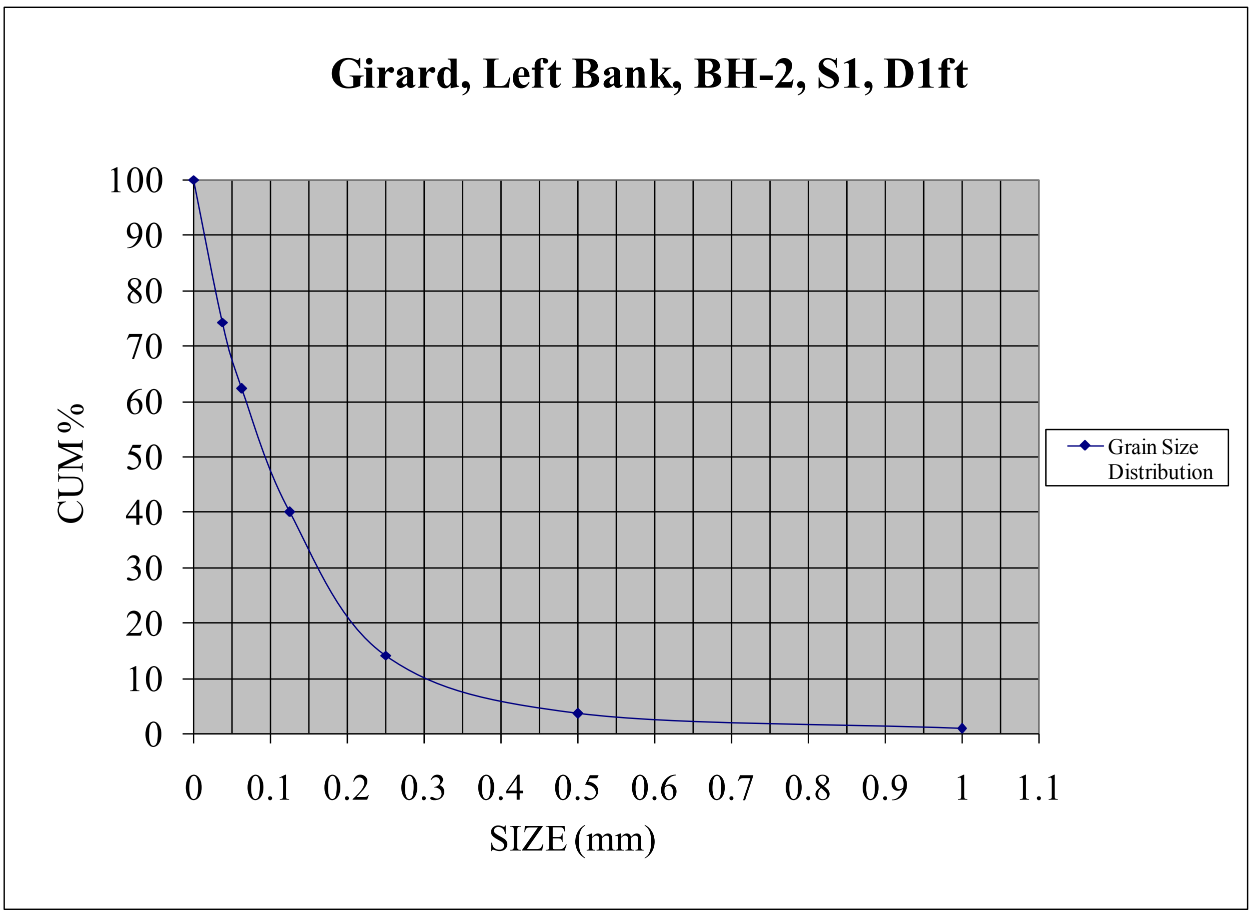
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-1, S7, 7ft. bsg[a]		Original Sample Weight: 118.5g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.7	1.7	1
0.5	7.5	9.2	8
0.25	25.9	35.1	30
0.125	24.1	59.2	51
0.063	23.1	82.3	70
0.044	10.0	92.4	79
pan	24.7	117.1	100

a. Below surface grade.



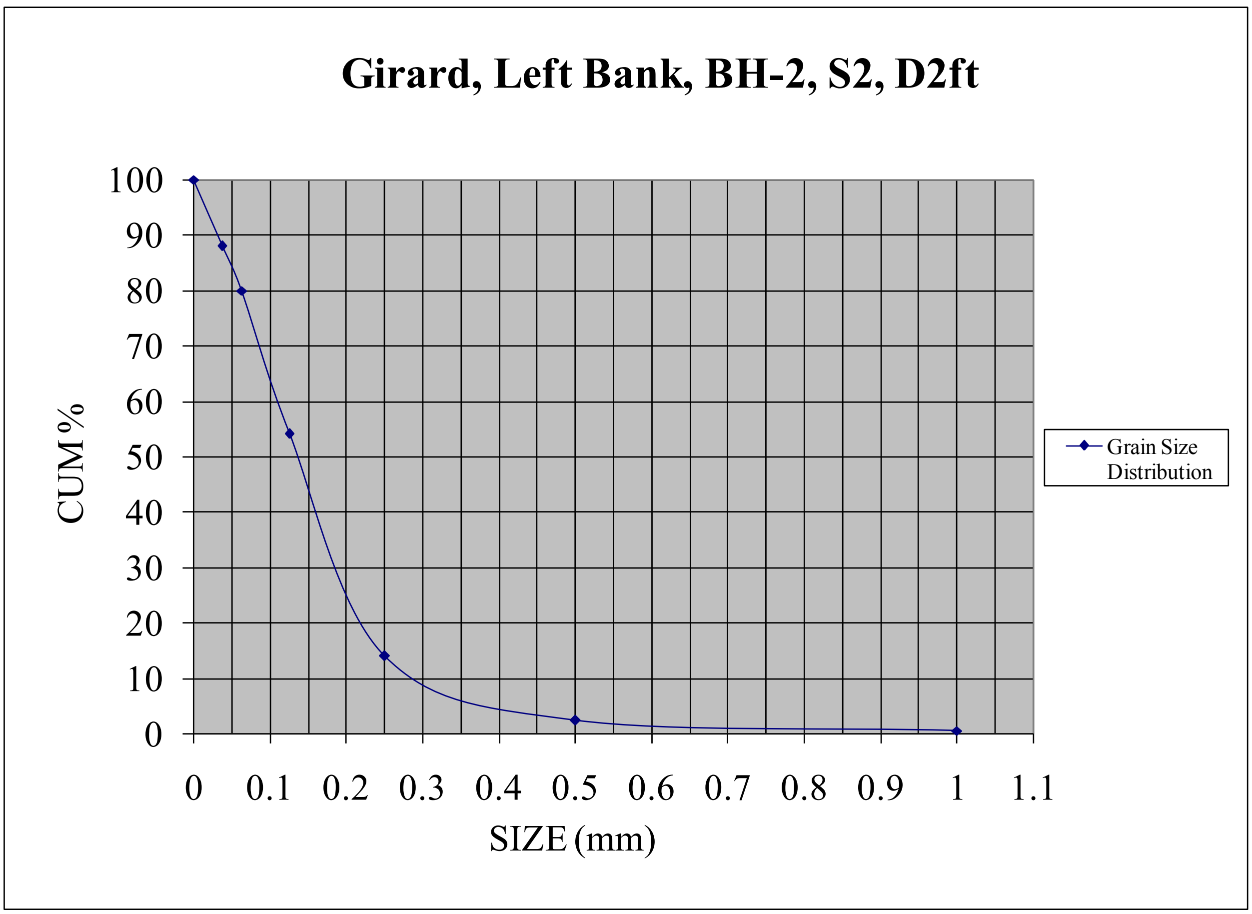
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-2, S1, 1ft. bsg[a]		Original Sample Weight: 117.5g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.0	1.0	1
0.5	3.2	4.2	4
0.25	12.1	16.3	14
0.125	30.0	46.3	40
0.063	25.9	72.2	62
0.044	13.8	86.0	74
pan	29.9	115.9	100

a. Below surface grade.



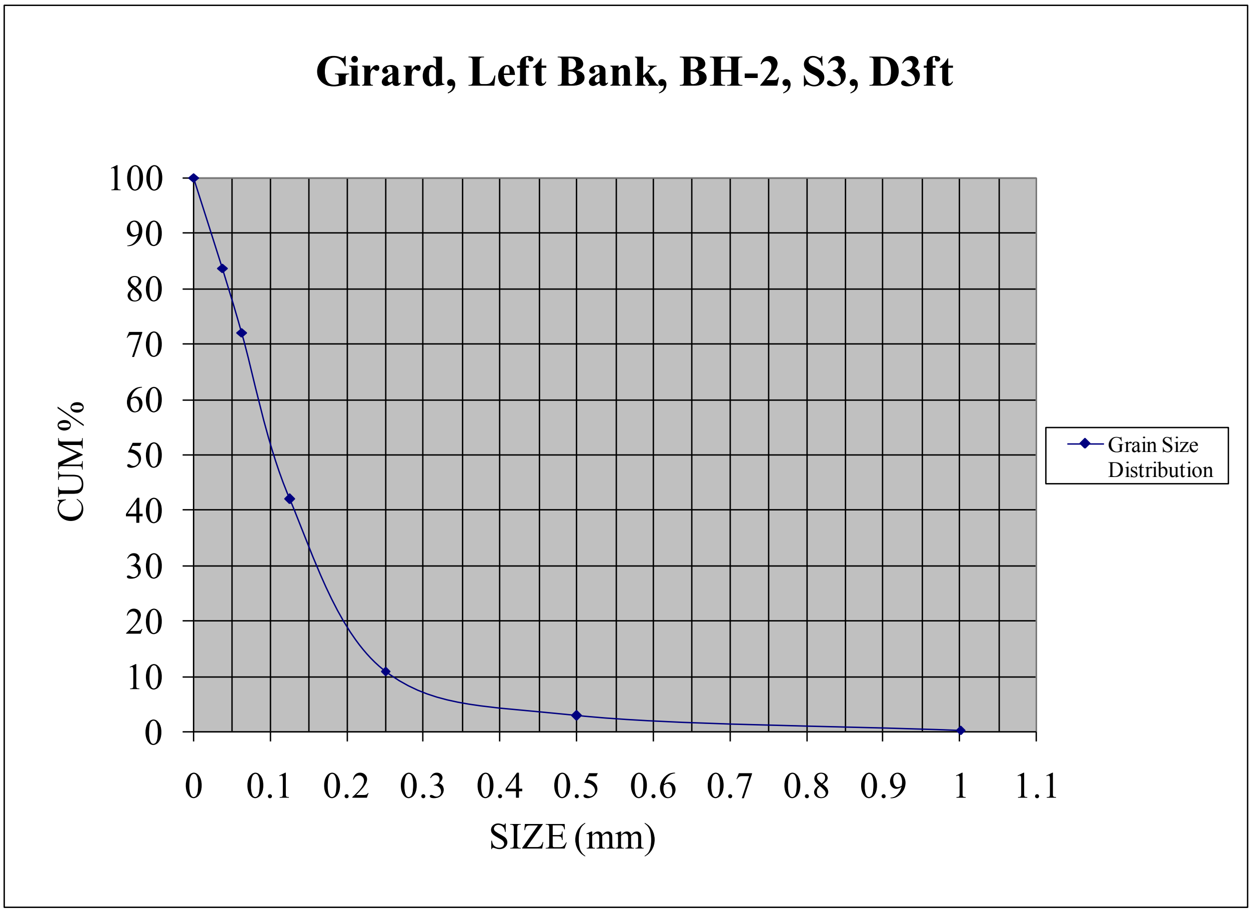
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-2, S2, 2ft. bsg[a]		Original Sample Weight: 118.9g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.5	0.5	0
0.5	2.2	2.7	2
0.25	13.6	16.4	14
0.125	46.9	63.3	54
0.063	30.4	93.7	80
0.044	9.5	103.1	88
pan	14.1	117.2	100

a. Below surface grade.



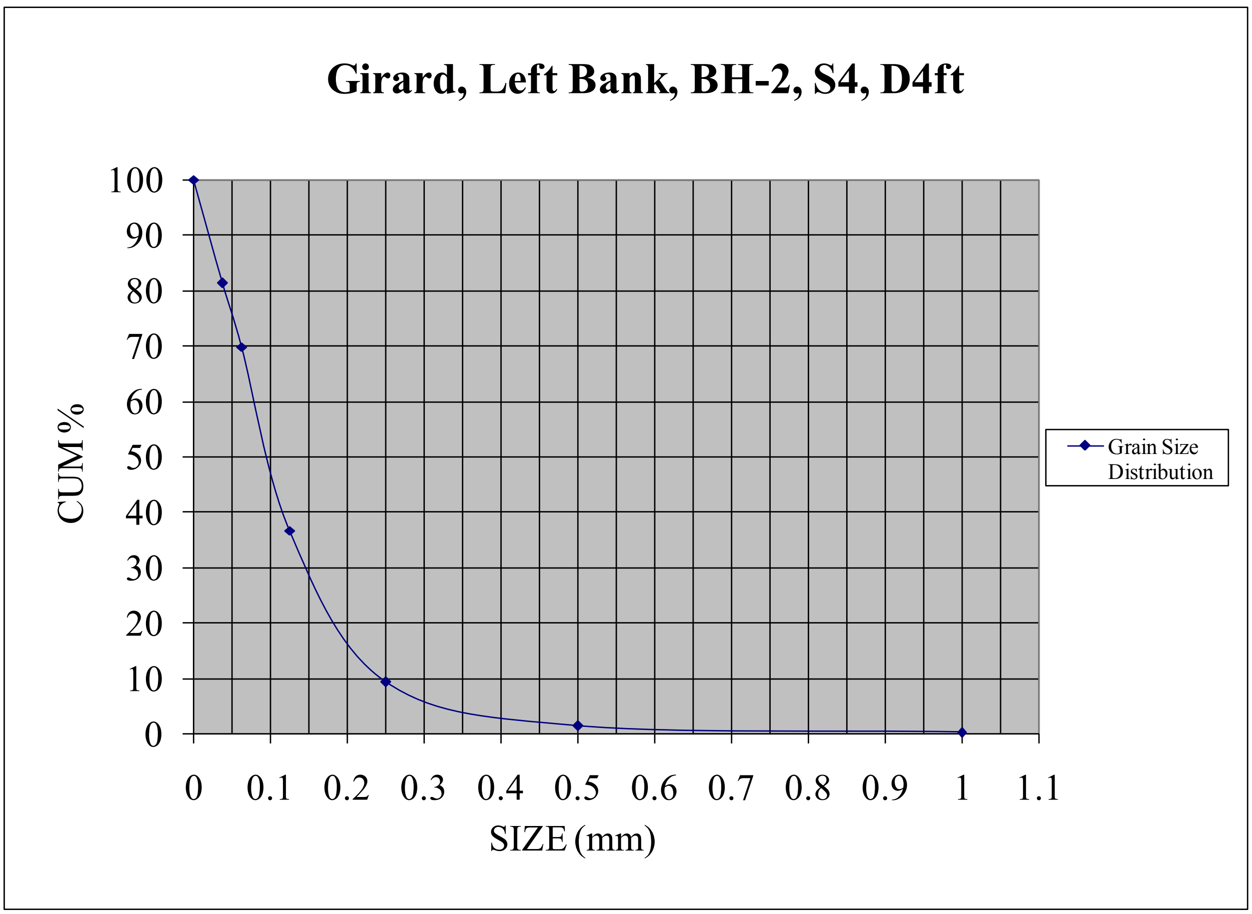
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-2, S3, 3ft. bsg[a]		Original Sample Weight: 117.5g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.2	0.2	0
0.5	3.1	3.3	3
0.25	9.4	12.7	11
0.125	36.3	48.9	42
0.063	35.3	84.2	72
0.044	13.6	97.8	84
pan	19.1	116.9	100

a. Below surface grade.



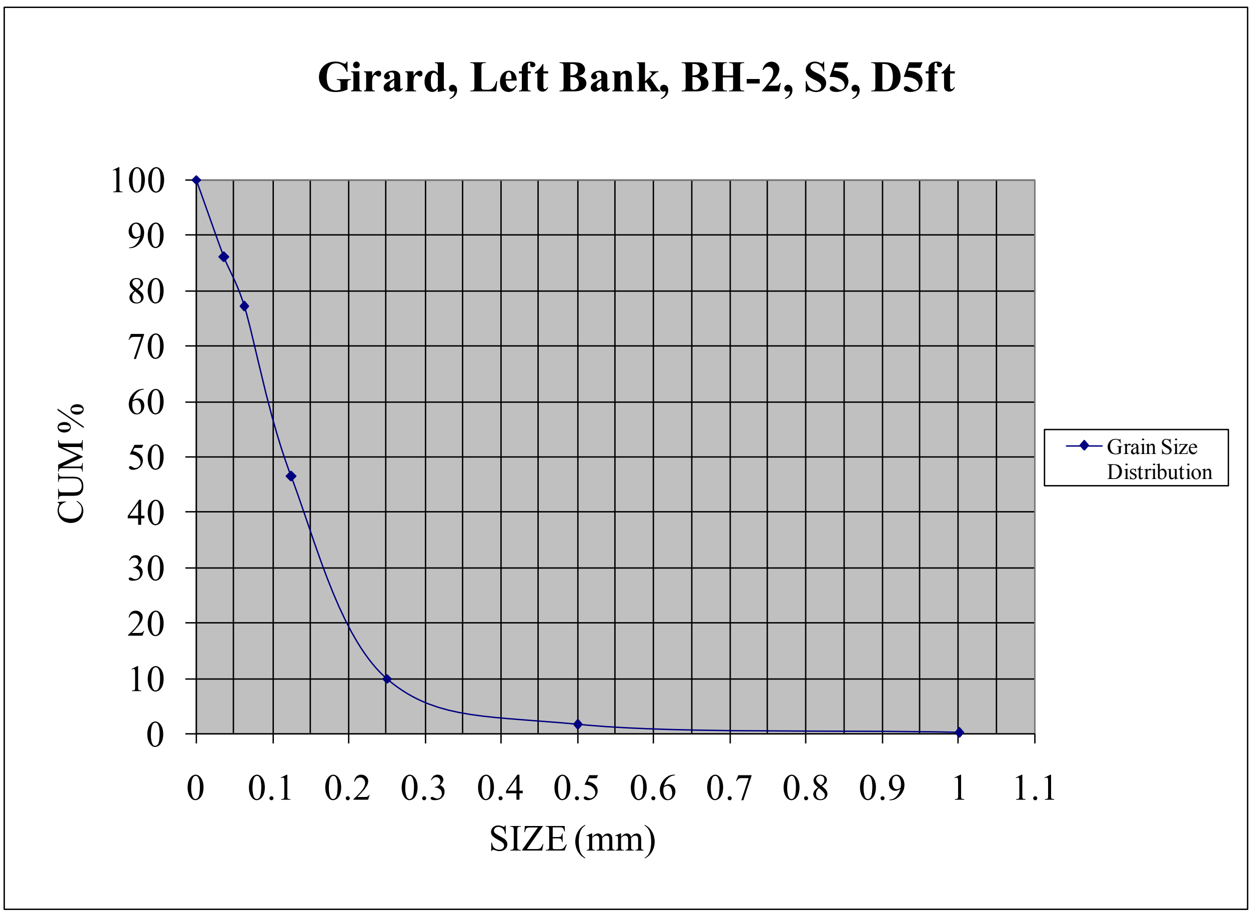
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-2, S4, 4ft. bsg[a]		Original Sample Weight: 109.7g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.2	0.2	0
0.5	1.2	1.4	1
0.25	8.5	9.9	9
0.125	29.6	39.5	37
0.063	35.7	75.2	70
0.044	12.5	87.7	81
pan	20.1	107.8	100

a. Below surface grade.



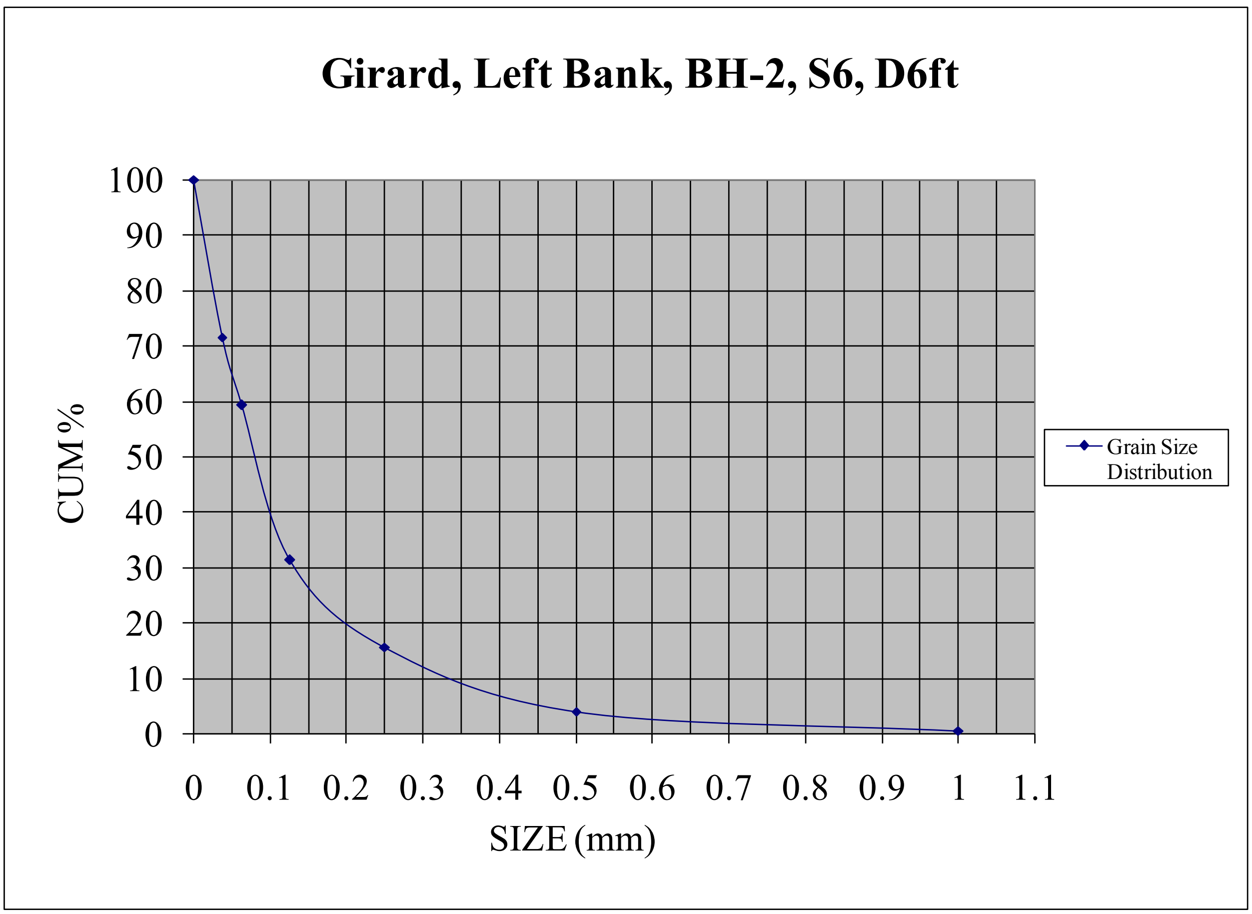
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-2, S5, 5ft. bsg[a]		Original Sample Weight: 110.4g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.2	0.2	0
0.5	1.5	1.7	2
0.25	9.1	10.8	10
0.125	39.8	50.6	46
0.063	33.6	84.2	77
0.044	9.7	93.9	86
pan	15.2	109.1	100

a. Below surface grade.



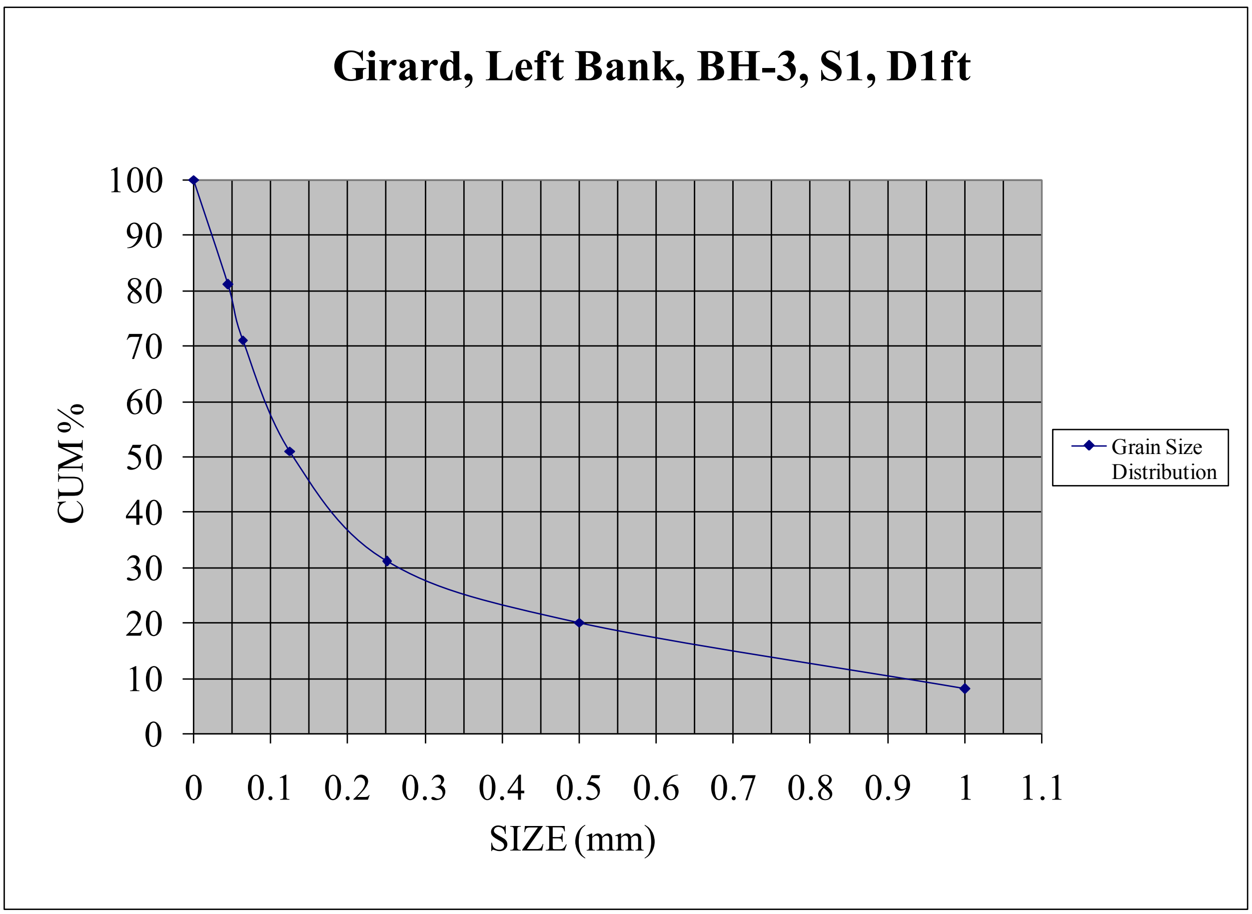
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-2, S6, 6ft. bsg[a]		Original Sample Weight: 112.6g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.9	2.9	0
0.5	10.0	12.9	4
0.25	16.2	29.1	16
0.125	16.8	45.9	31
0.063	18.4	64.3	59
0.044	13.6	77.9	72
pan	30.6	108.5	100

a. Below surface grade.



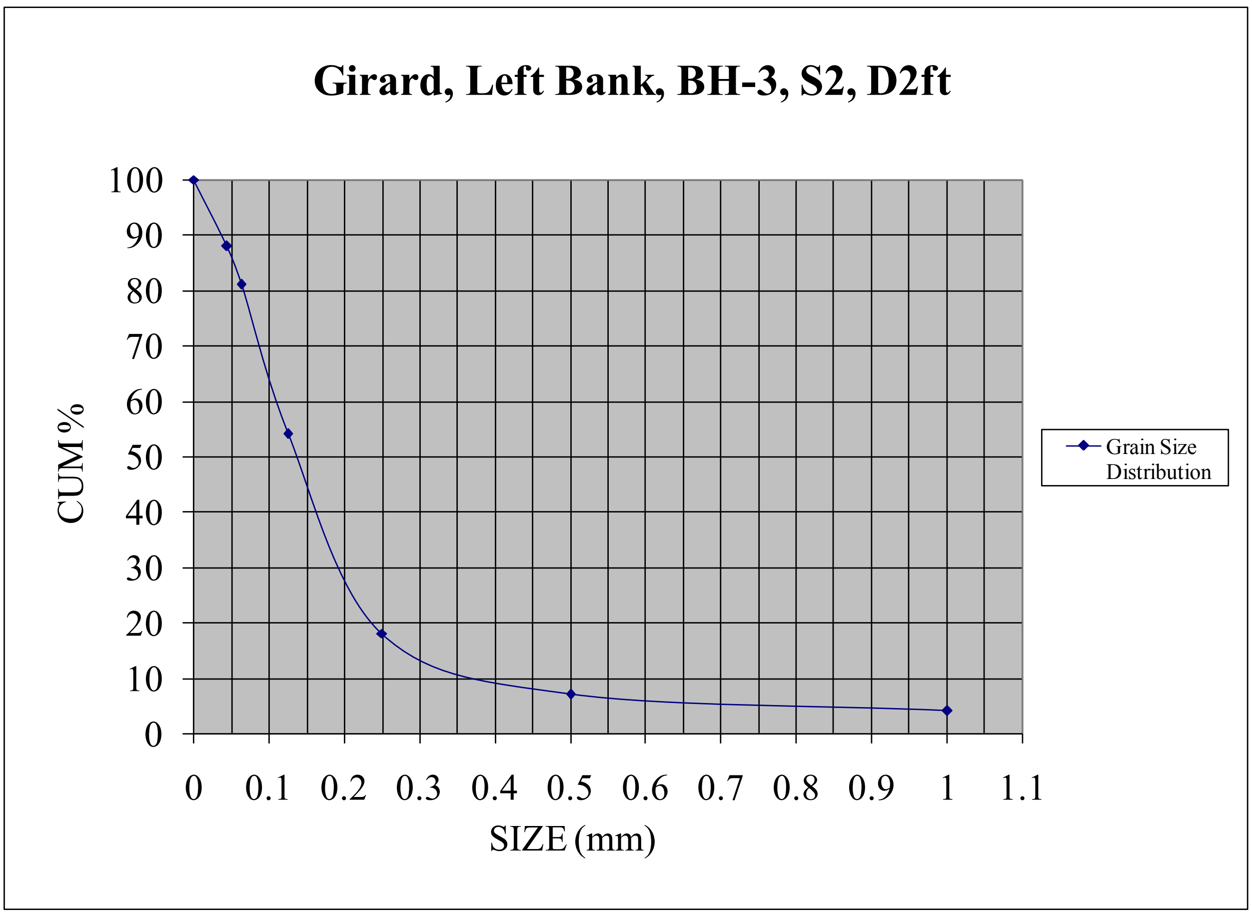
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		**Sample Date: 6/17/06**	
BH-3, S1, 1ft. bsg[a]		**Original Sample Weight: 109.3g**	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	8.6	8.6	8
0.5	12.9	21.5	20
0.25	11.8	33.4	31
0.125	21.5	54.9	51
0.063	21.5	76.5	71
0.044	10.8	87.2	81
pan	20.5	107.7	100

a. Below surface grade.



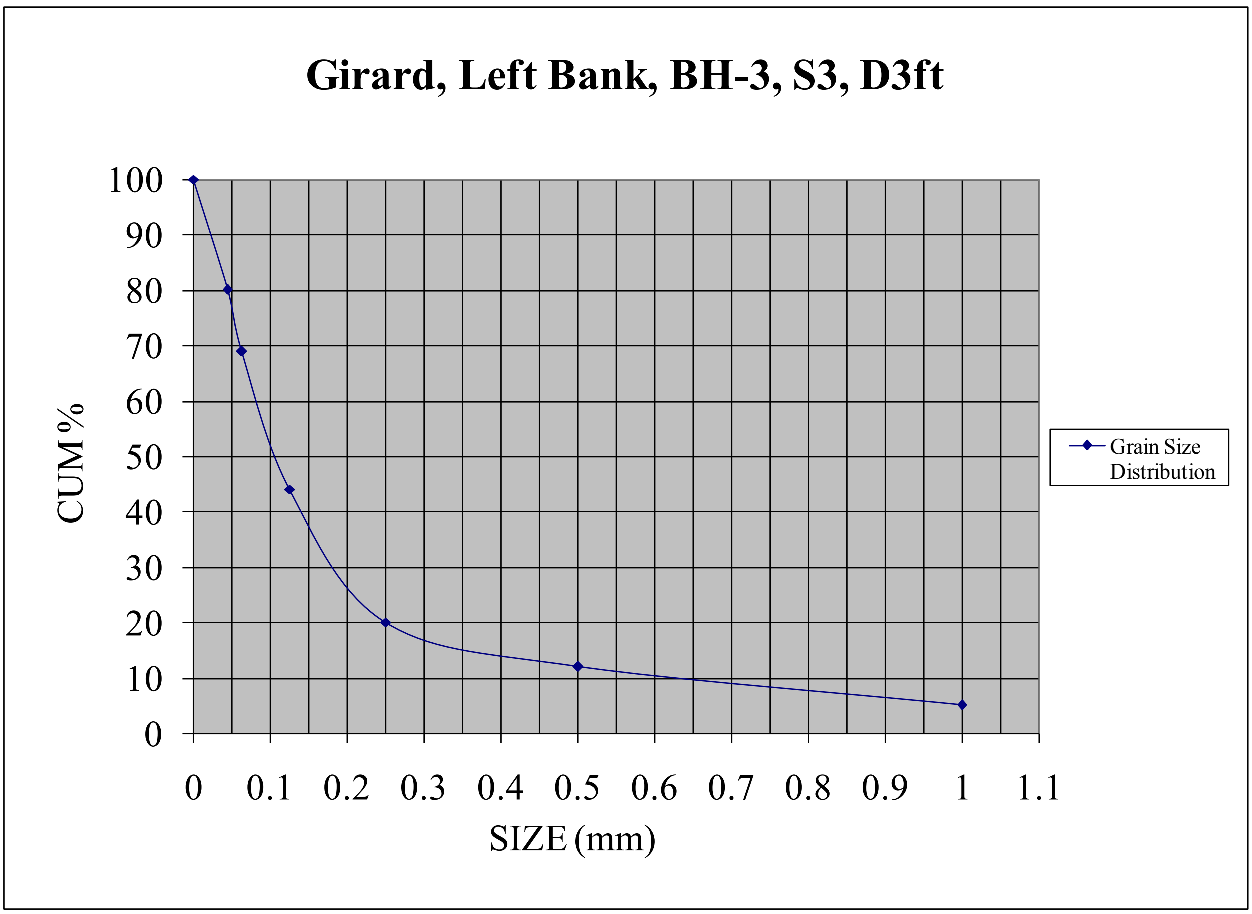
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-3, S2, 2ft. bsg[a]		Original Sample Weight: 108.1g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	4.3	4.3	4
0.5	3.2	7.5	7
0.25	11.8	19.3	18
0.125	38.6	57.9	54
0.063	28.9	86.8	81
0.044	7.5	94.3	88
pan	12.9	107.2	100

a. Below surface grade.



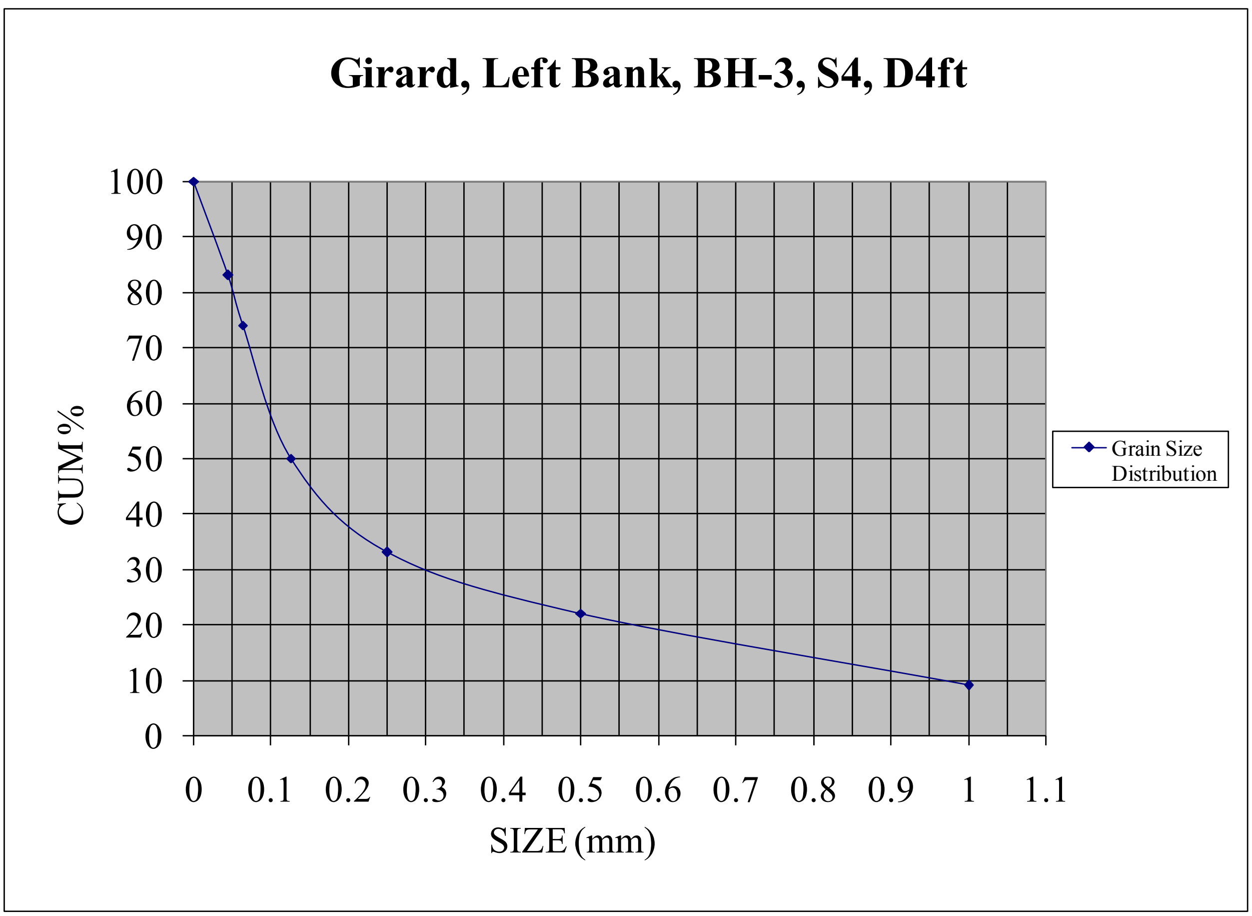
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-3, S3, 3ft. bsg[a]		Original Sample Weight: 112.5g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	5.5	5.5	5
0.5	7.7	13.3	12
0.25	8.8	22.1	20
0.125	26.5	48.7	44
0.063	27.7	76.3	69
0.044	12.2	88.5	80
pan	22.1	110.6	100

a. Below surface grade.



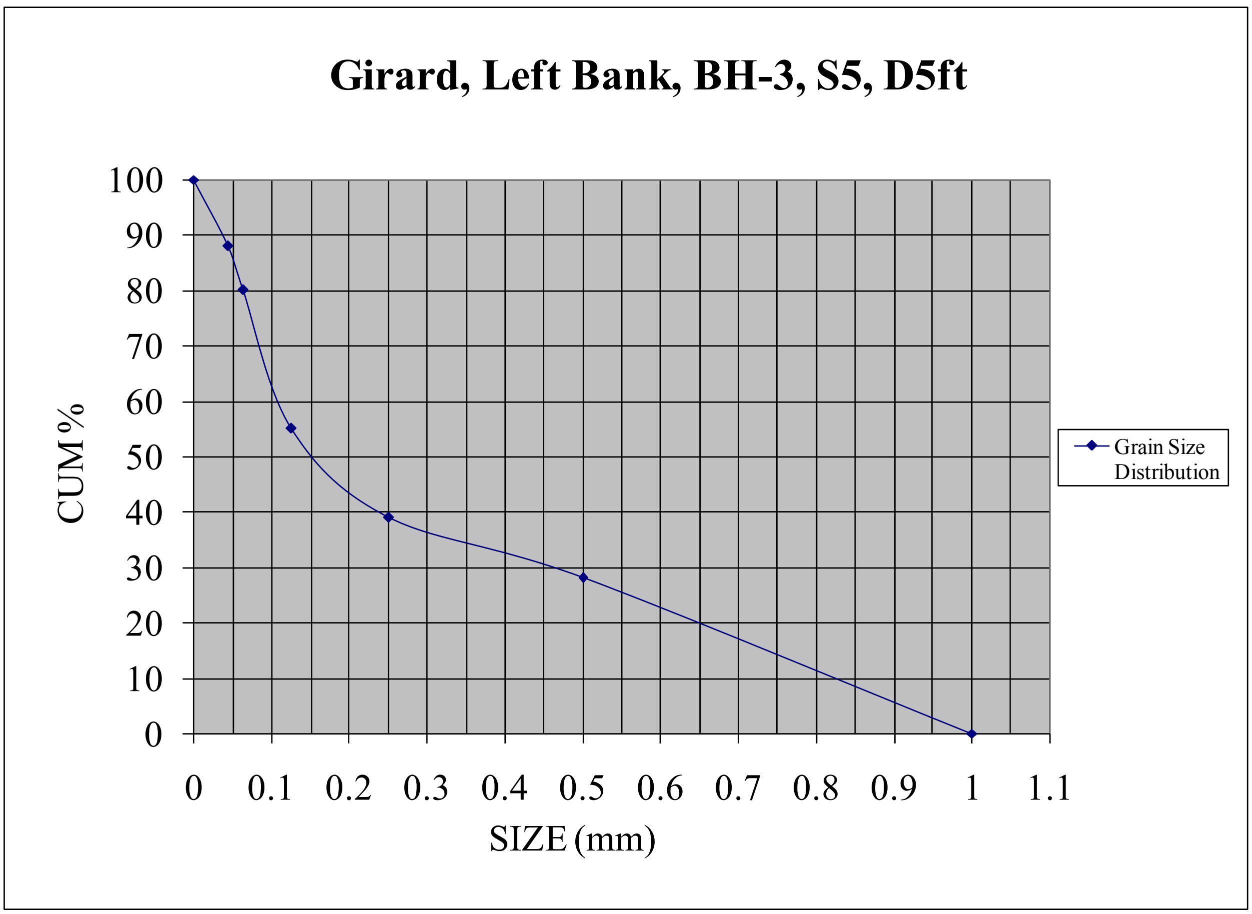
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		**Sample Date: 6/17/06**	
BH-3, S4, 4ft. bsg[a]		**Original Sample Weight: 113.4g**	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	5.6	5.6	9
0.5	7.8	13.4	22
0.25	8.9	22.3	33
0.125	26.8	49.1	50
0.063	27.9	77.1	74
0.044	12.3	89.4	83
pan	22.3	111.7	100

a. Below surface grade.



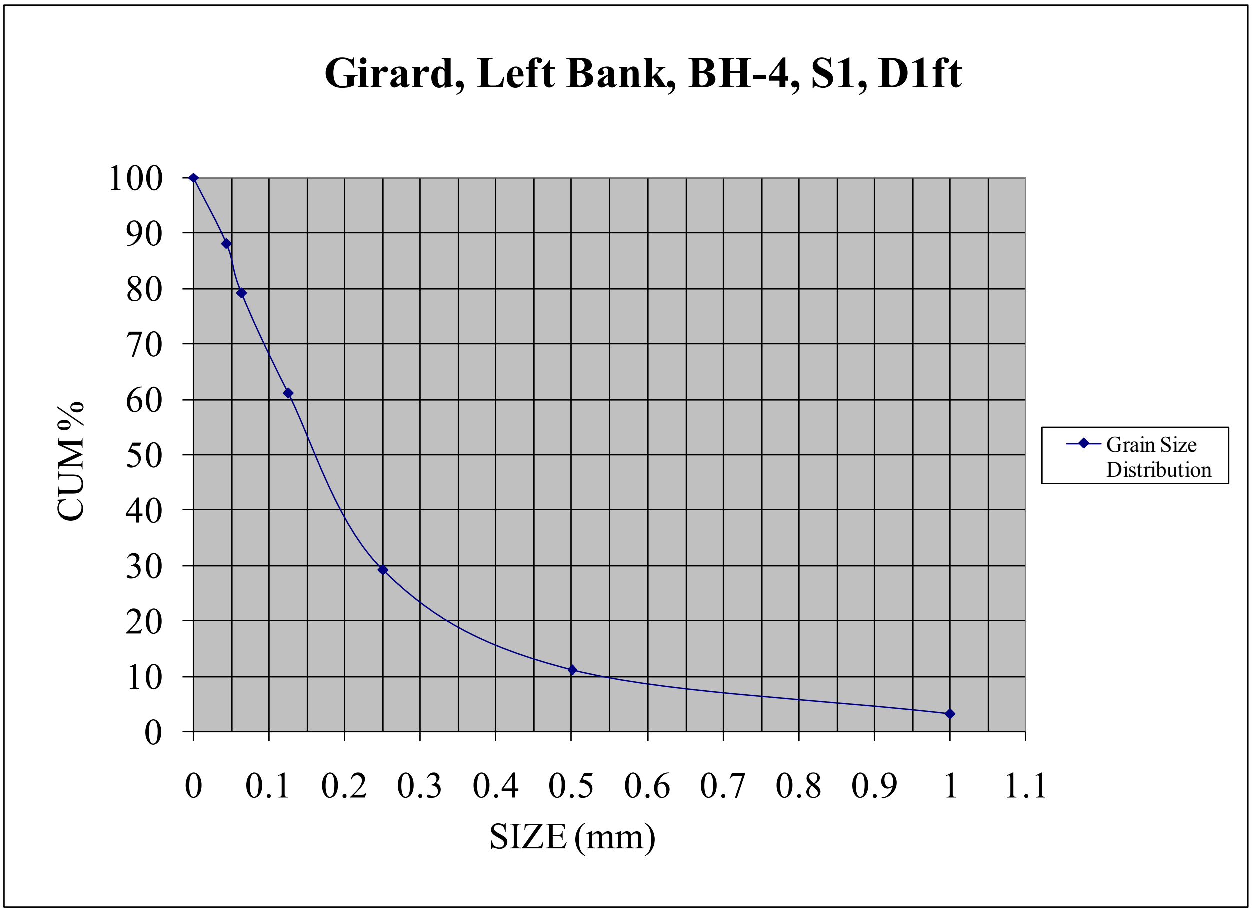
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-3, S5, 5ft. bsg[a]		Original Sample Weight: 109.9g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.0	0.0	0
0.5	30.4	30.4	28
0.25	11.9	42.3	39
0.125	17.4	59.7	55
0.063	27.1	86.8	80
0.044	8.7	95.5	88
pan	13.0	108.5	100

a. Below surface grade.



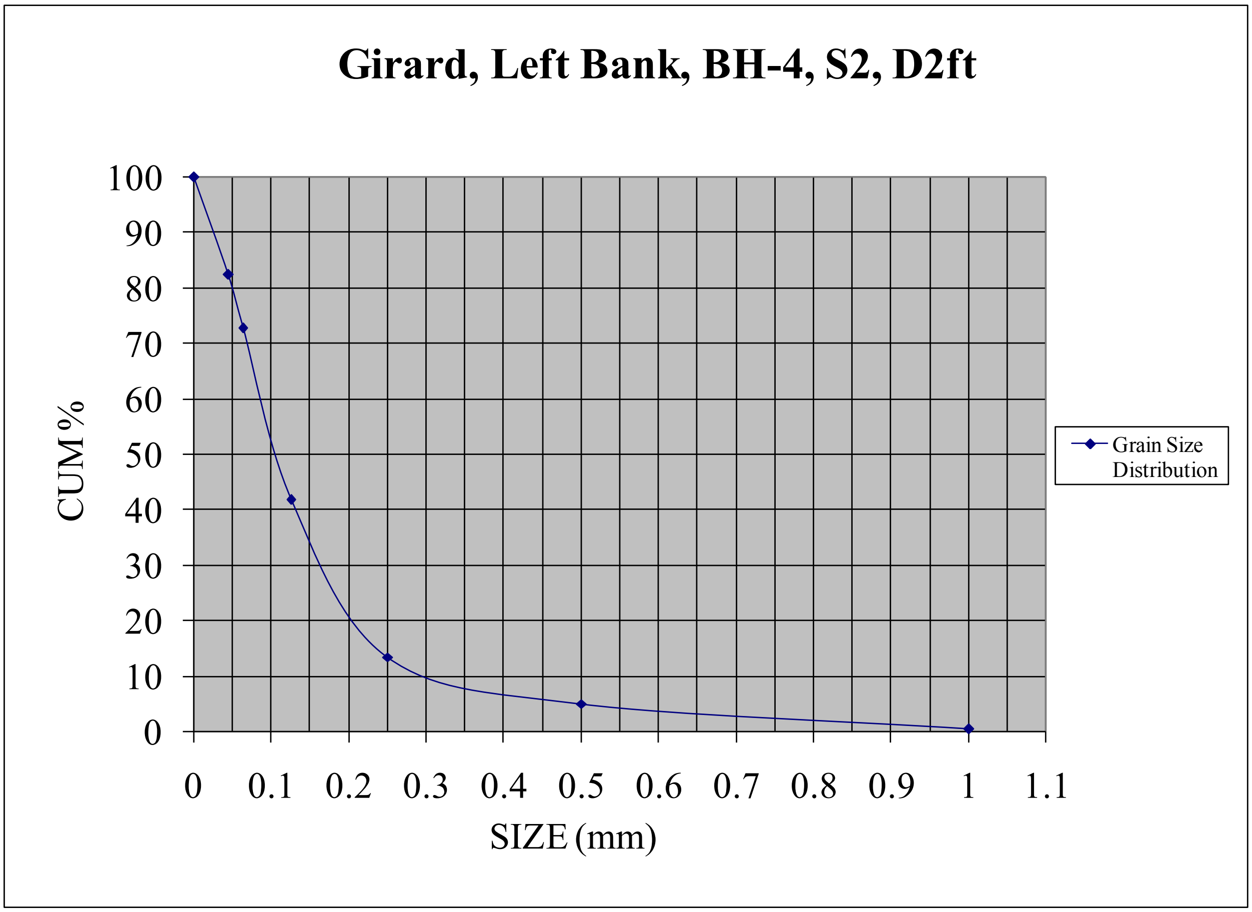
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-4, S1, 1ft. bsg[a]		Original Sample Weight: 116.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	3.5	3.5	3
0.5	9.2	12.7	11
0.25	20.7	33.4	29
0.125	36.8	70.2	61
0.063	20.7	90.9	79
0.044	10.4	101.3	88
pan	13.8	115.1	100

a. Below surface grade.



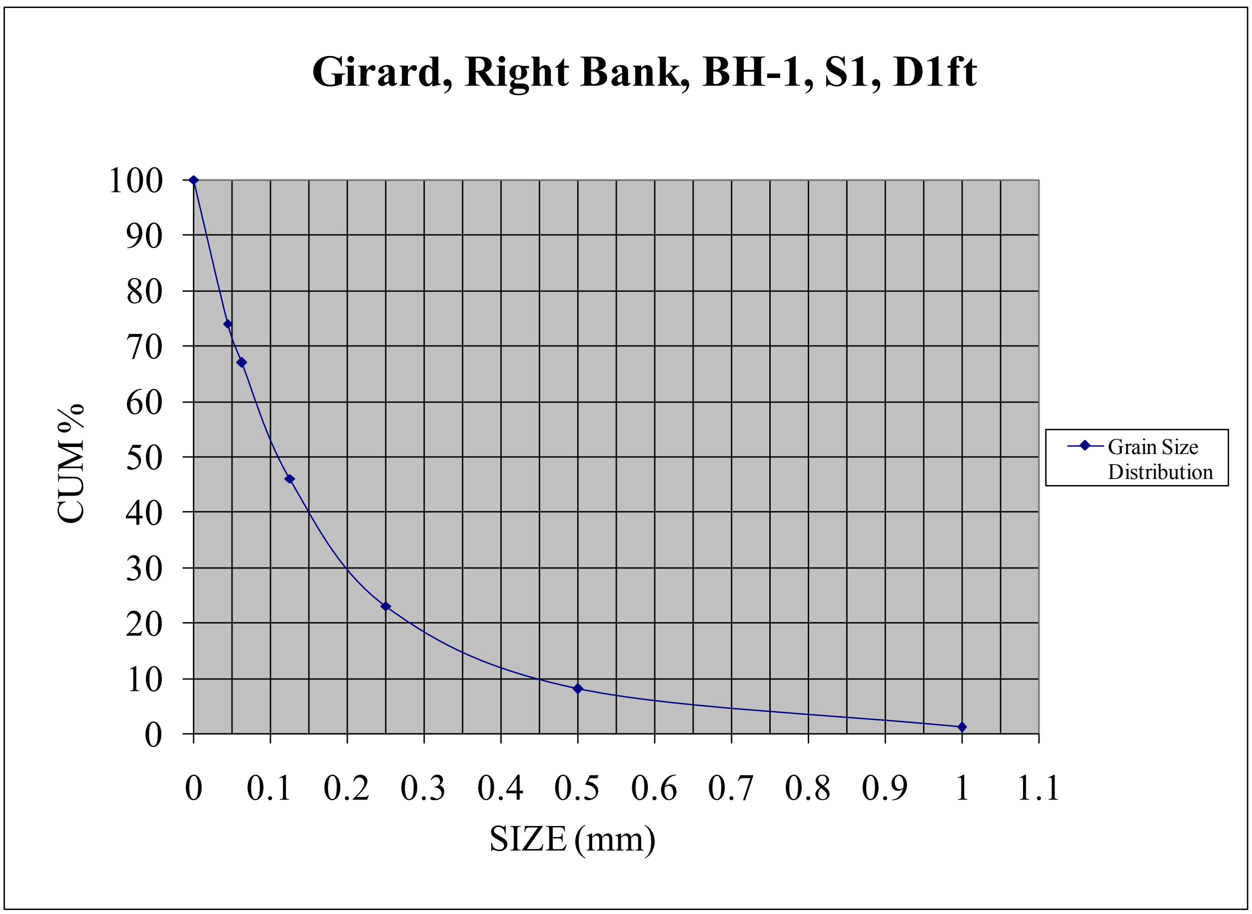
Soil Grain-size Analysis Laboratory Results			
Girard Left Bank		Sample Date: 6/17/06	
BH-4, S2, 2ft. bsg[a]		Original Sample Weight: 116.8g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.5	0.5	0
0.5	5.3	5.8	5
0.25	9.7	15.5	13
0.125	32.7	48.2	42
0.063	35.7	83.9	73
0.044	11.2	95.1	83
pan	20.2	115.3	100

a. Below surface grade.



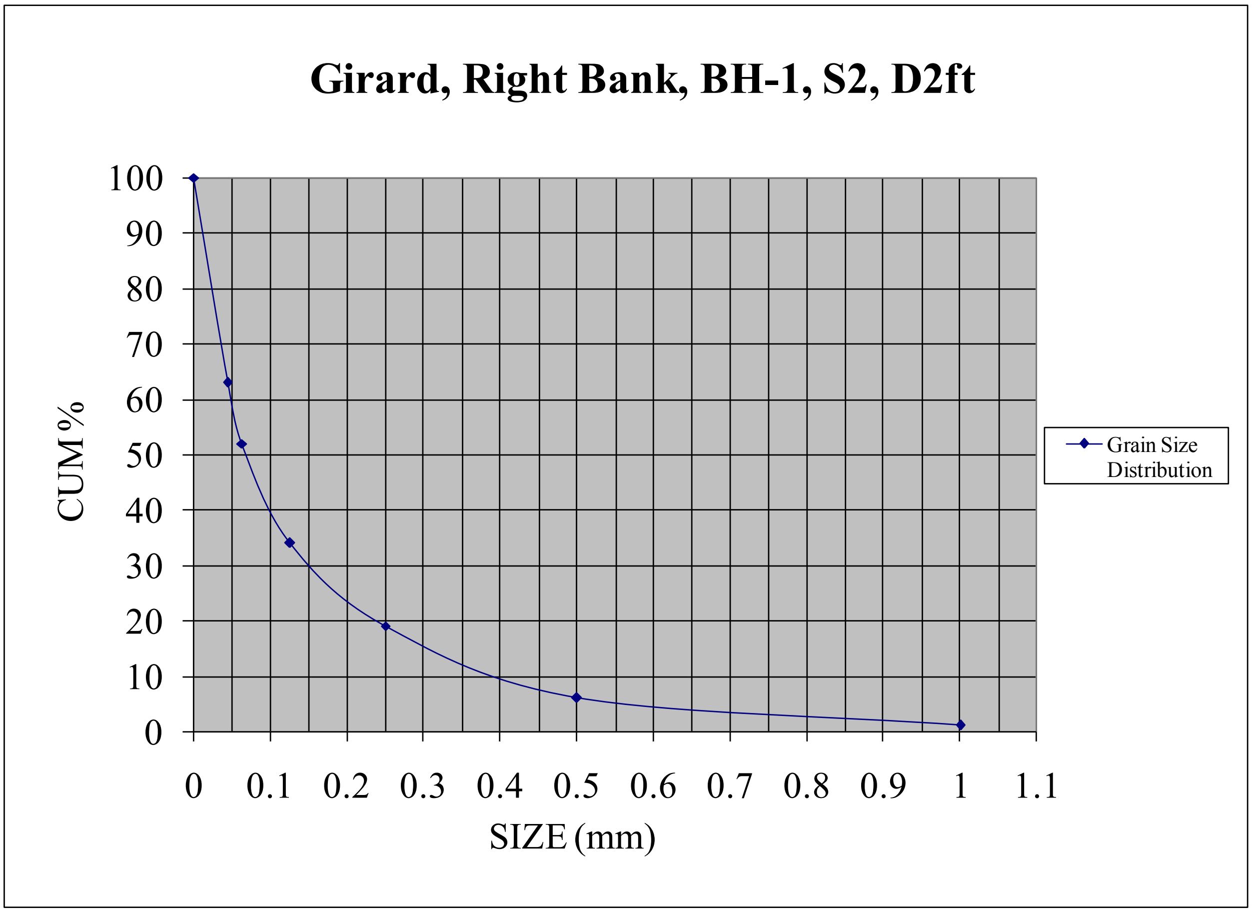
Soil Grain-size Analysis Laboratory Results			
Girard Right Bank		Sample Date: 9/23/06	
BH-1, S1, 1ft. bsg[a]		Original Sample Weight: 110.1g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.1	1.1	1
0.5	7.5	8.6	8
0.25	16.9	25.5	23
0.125	24.4	49.9	46
0.063	22.5	72.4	67
0.044	7.9	80.3	74
pan	28.3	108.6	100

a. Below surface grade.



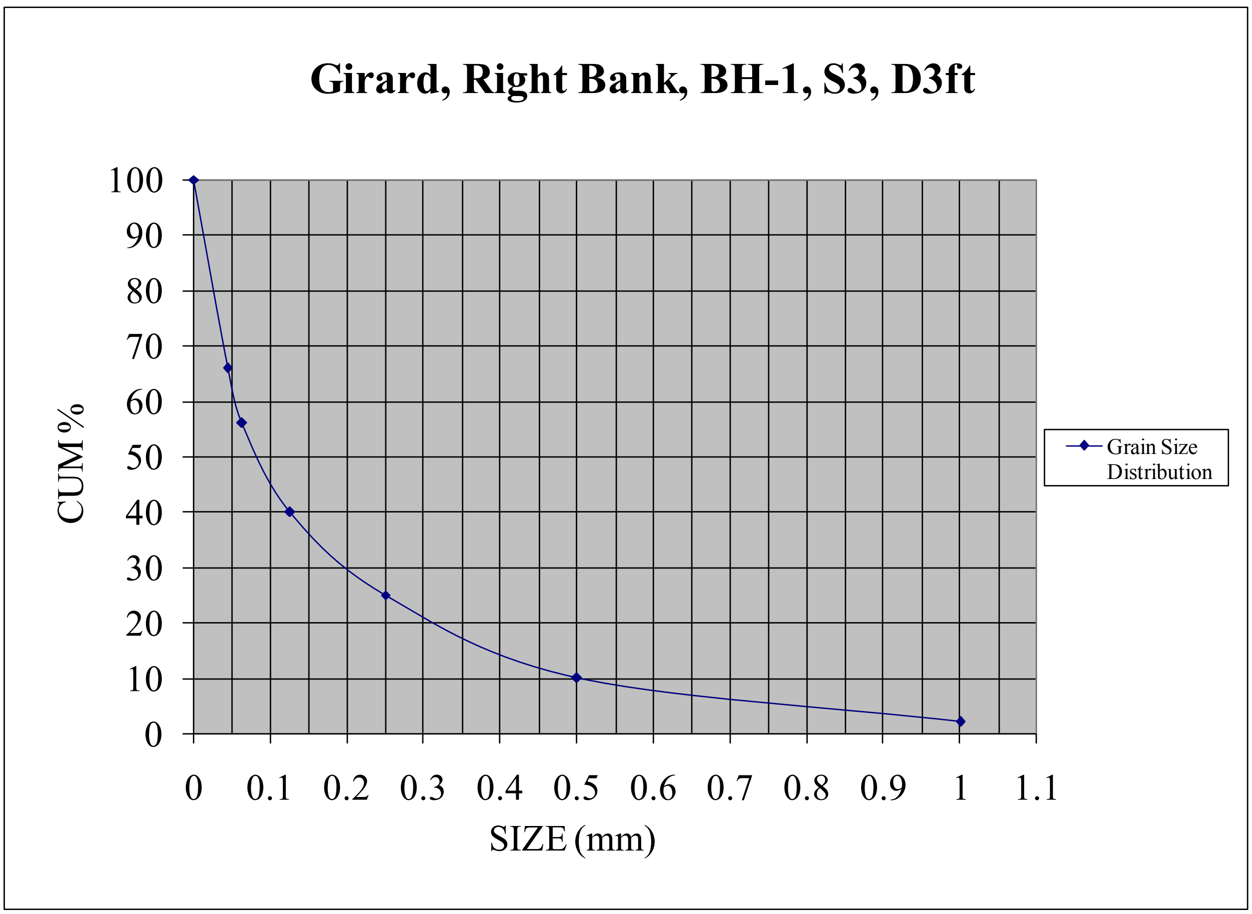
Soil Grain-size Analysis Laboratory Results			
Girard Right Bank		Sample Date: 9/23/06	
BH-1, S2, 2ft. bsg[a]		Original Sample Weight: 110.3g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.8	0.8	1
0.5	5.6	6.4	6
0.25	13.6	20	19
0.125	16.5	36.5	34
0.063	19.1	55.6	52
0.044	12.3	67.9	63
pan	39.5	107.4	100

a. Below surface grade.



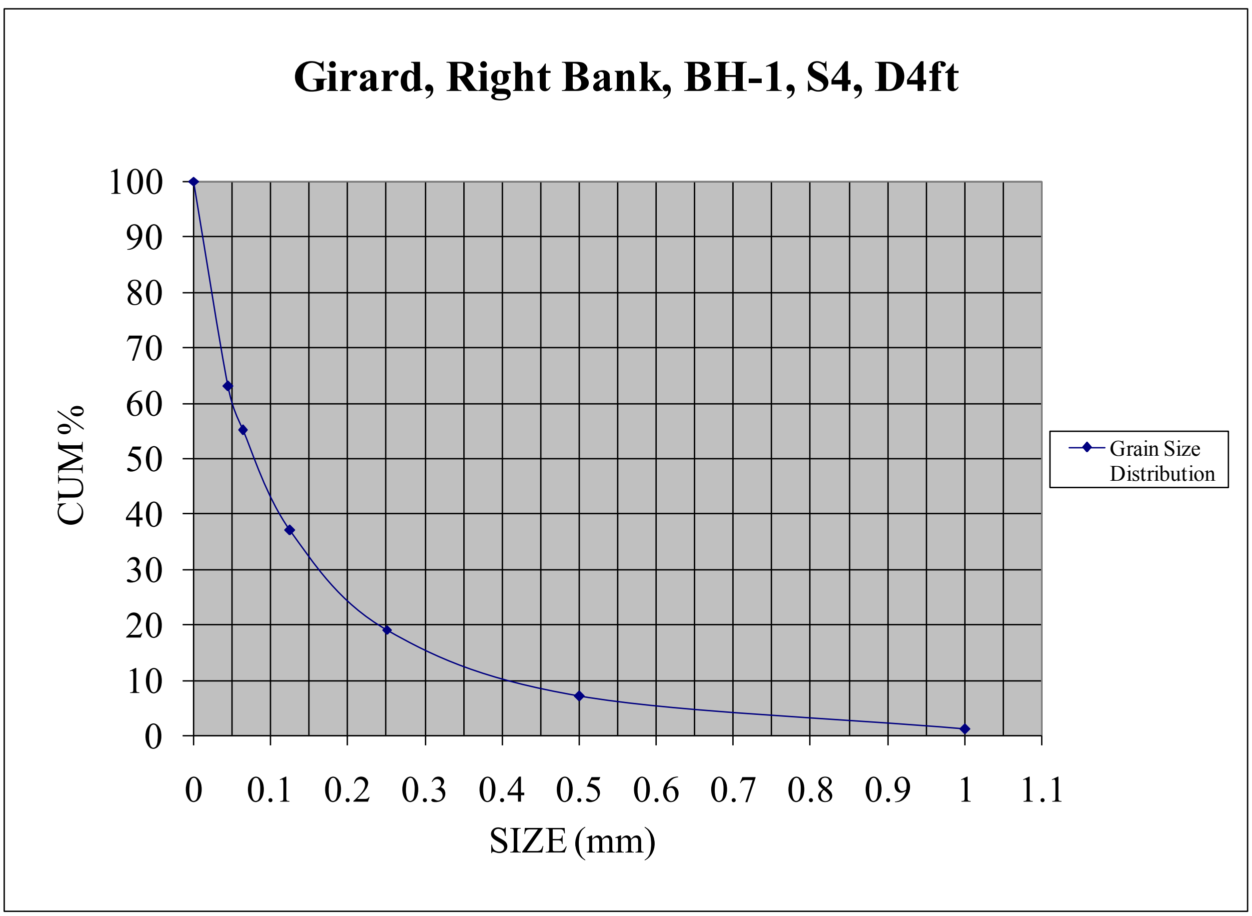
Soil Grain-size Analysis Laboratory Results			
Girard Right Bank		Sample Date: 9/23/06	
BH-1, S3, 3ft. bsg[a]		Original Sample Weight: 106.0g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2	2	2
0.5	8.7	10.7	10
0.25	15.6	26.3	25
0.125	15.3	41.6	40
0.063	16.5	58.1	56
0.044	10.3	68.4	66
pan	35.6	104	100

a. Below surface grade.



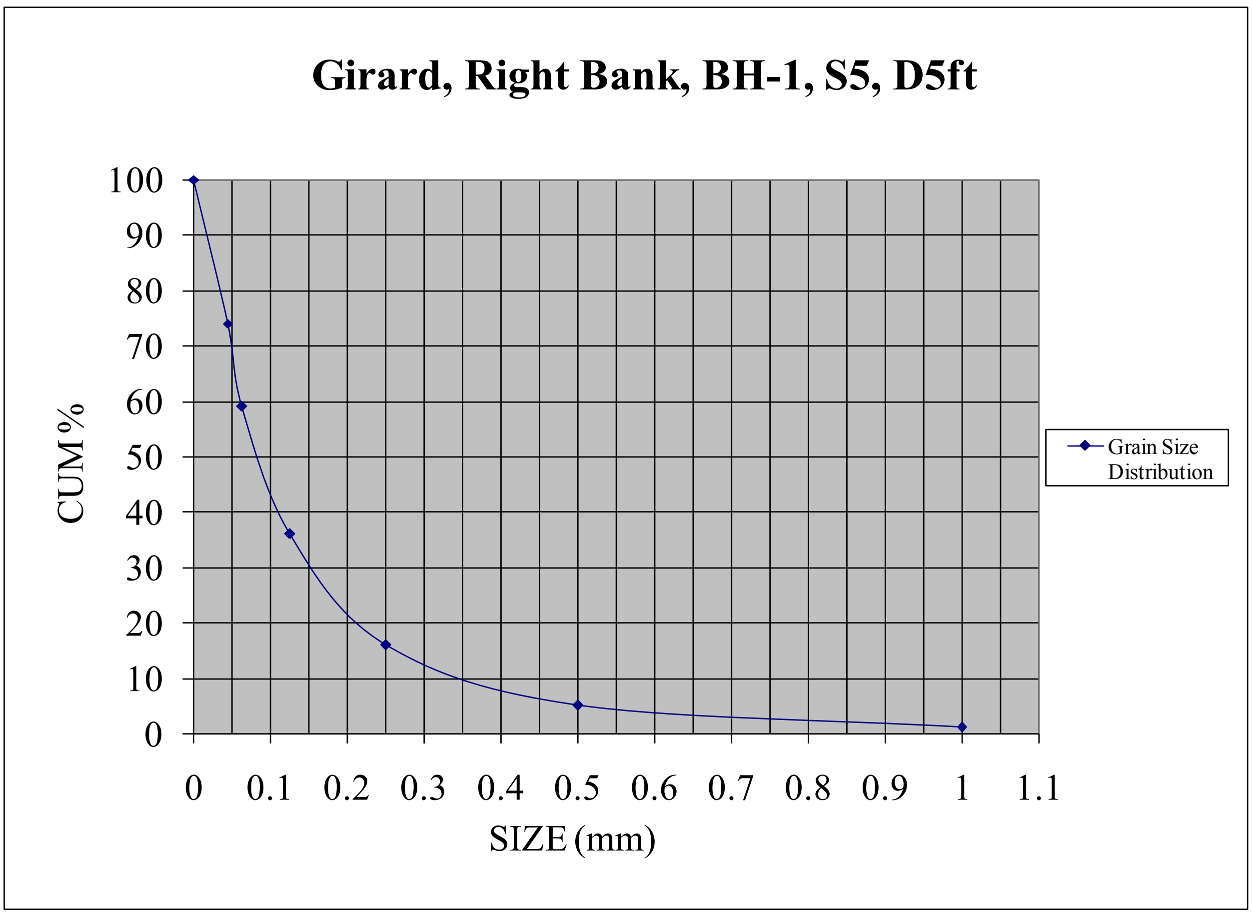
Soil Grain-size Analysis Laboratory Results			
Girard Right Bank		Sample Date: 9/23/06	
BH-1, S4, 4ft. bsg[a]		Original Sample Weight: 127.2g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	1.3	1.3	1
0.5	7.1	8.4	7
0.25	15.4	23.8	19
0.125	21.6	45.4	37
0.063	23	68.4	55
0.044	10.2	78.6	63
pan	45.6	124.2	100

a. Below surface grade.



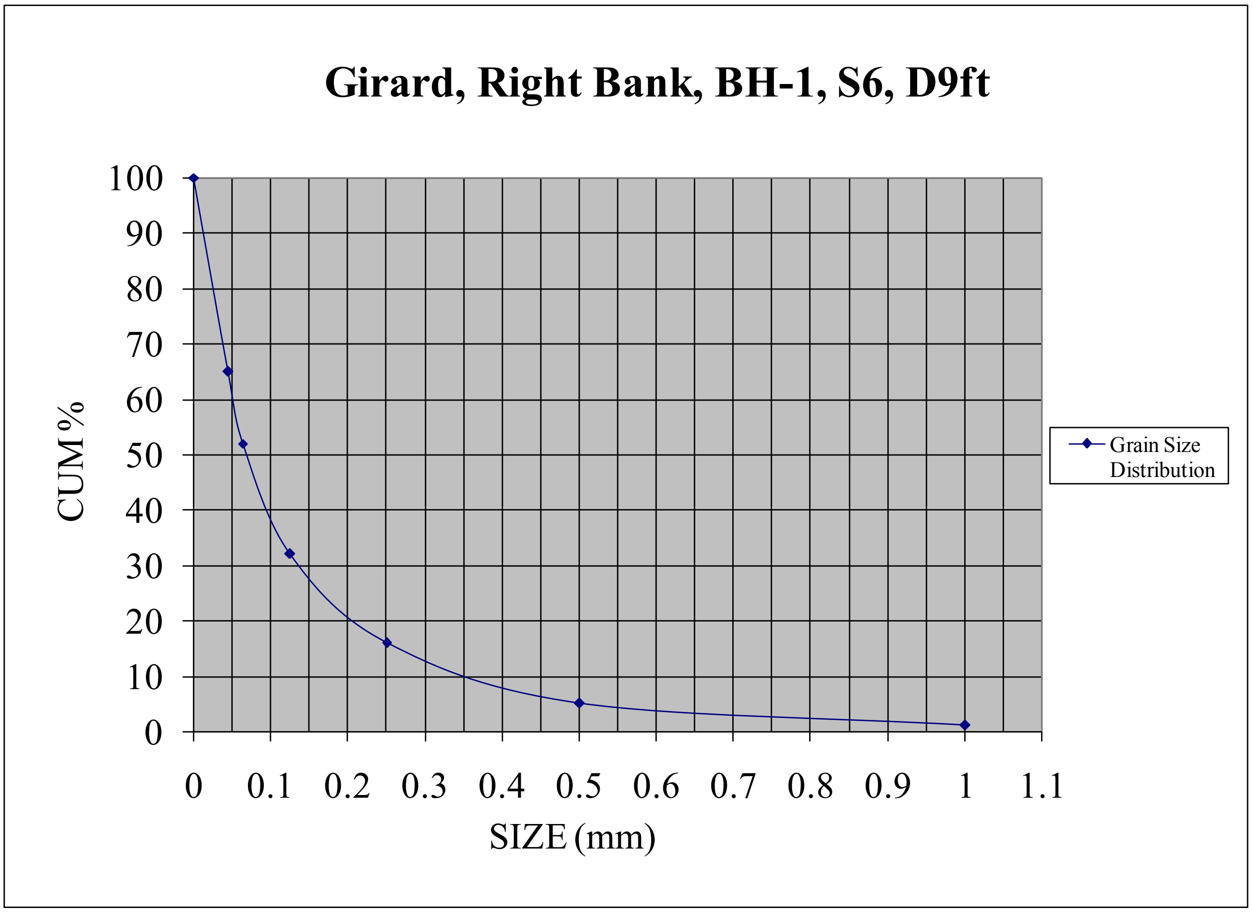
Soil Grain-size Analysis Laboratory Results			
Girard Right Bank		Sample Date: 9/23/06	
BH-1, S5, 5ft. bsg[a]		Original Sample Weight: 119.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.9	0.9	1
0.5	5.2	6.1	5
0.25	12.7	18.8	16
0.125	22.8	41.6	36
0.063	26.3	67.9	59
0.044	17.9	85.8	74
pan	29.9	115.7	100

a. Below surface grade.



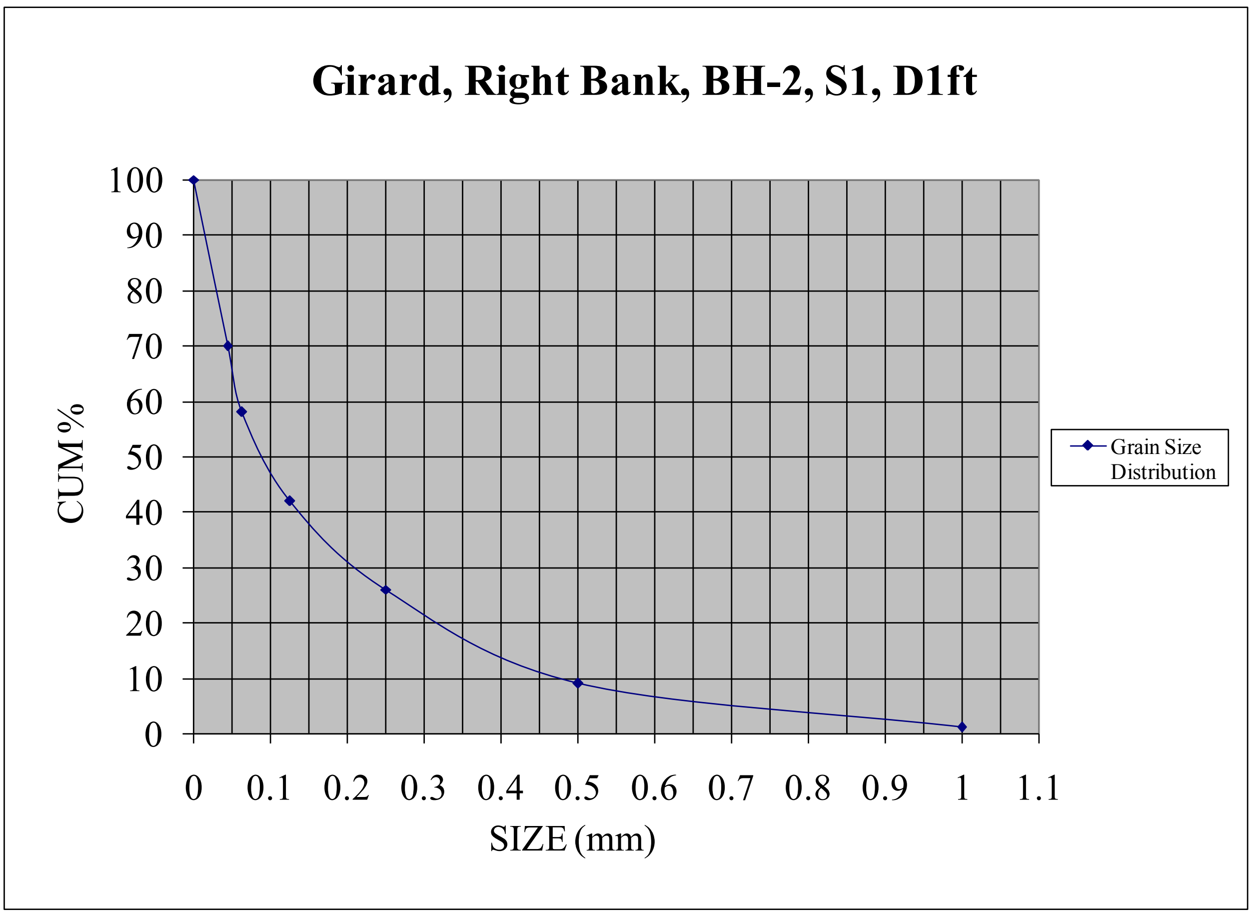
Soil Grain-size Analysis Laboratory Results			
Girard Right Bank		Sample Date: 9/23/06	
BH-1, S6, 9ft. bsg[a]		Original Sample Weight: 122.4g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1	1	1
0.5	5.5	6.5	5
0.25	13.1	19.6	16
0.125	18.7	38.3	32
0.063	24	62.3	52
0.044	15	77.3	65
pan	41.6	118.9	100

a. Below surface grade.



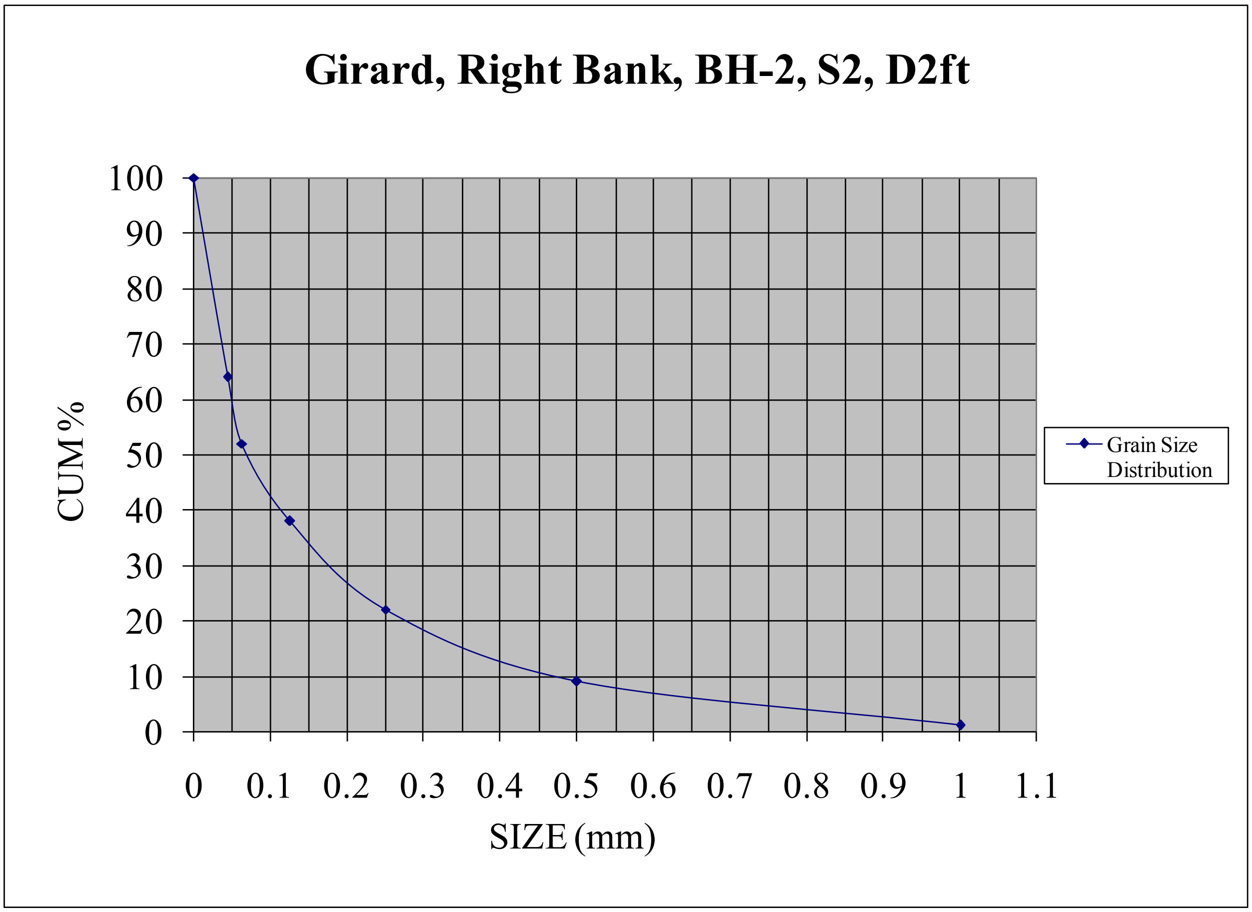
Soil Grain-size Analysis Laboratory Results			
Girard Right Bank		Sample Date: 9/23/06	
BH-2, S1, 1ft. bsg[a]		Original Sample Weight: 127.7g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.9	0.9	1
0.5	10.7	11.6	9
0.25	20.9	32.5	26
0.125	20.7	53.2	42
0.063	19.8	73	58
0.044	15	88	70
pan	38.3	126.3	100

a. Below surface grade.



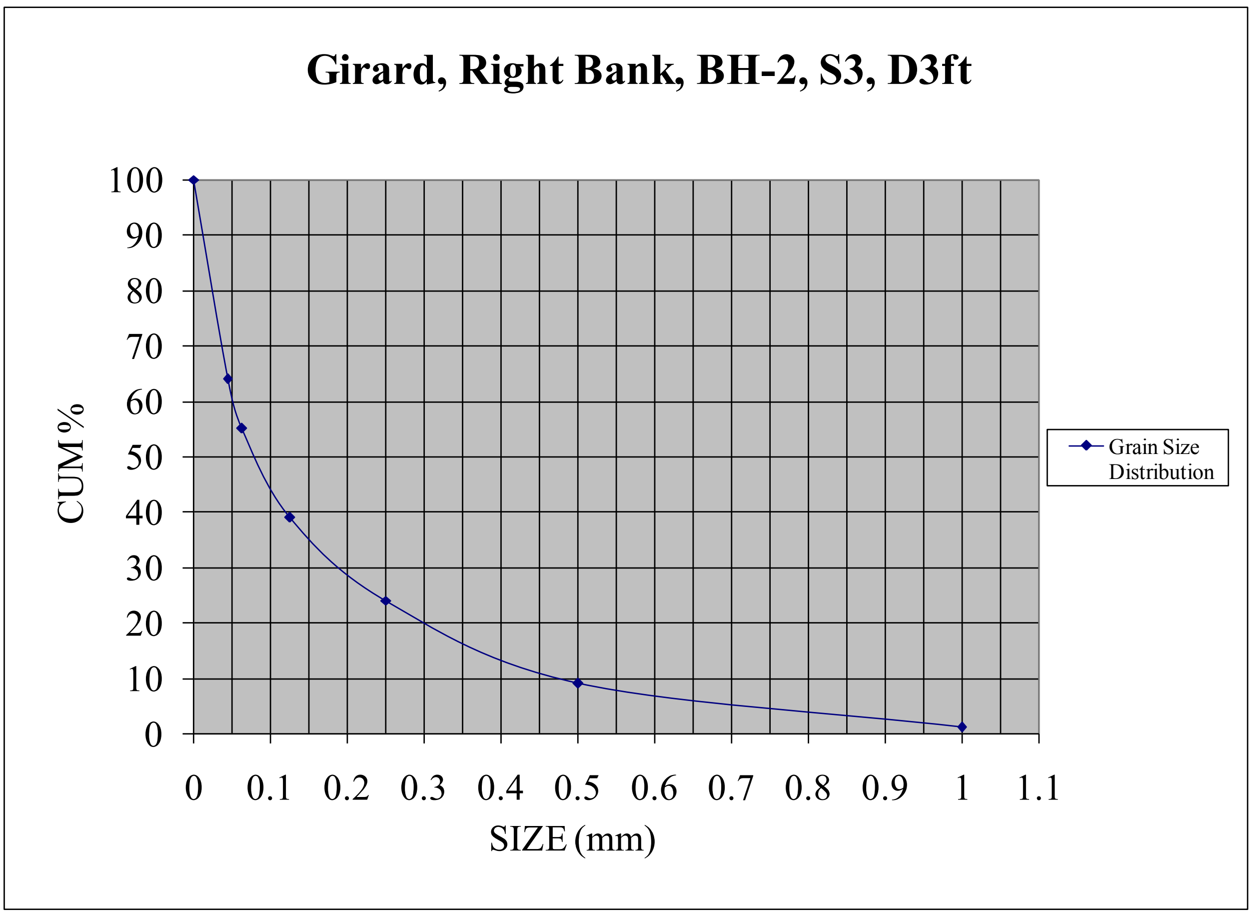
Soil Grain-size Analysis Laboratory Results			
Girard Right Bank		Sample Date: 9/23/06	
BH-2, S2, 2ft. bsg[a]		Original Sample Weight: 108.3g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.5	1.5	1
0.5	7.5	9	9
0.25	14.4	23.4	22
0.125	16.2	39.6	38
0.063	15.4	55	52
0.044	11.9	66.9	64
pan	38.4	105.3	100

a. Below surface grade.



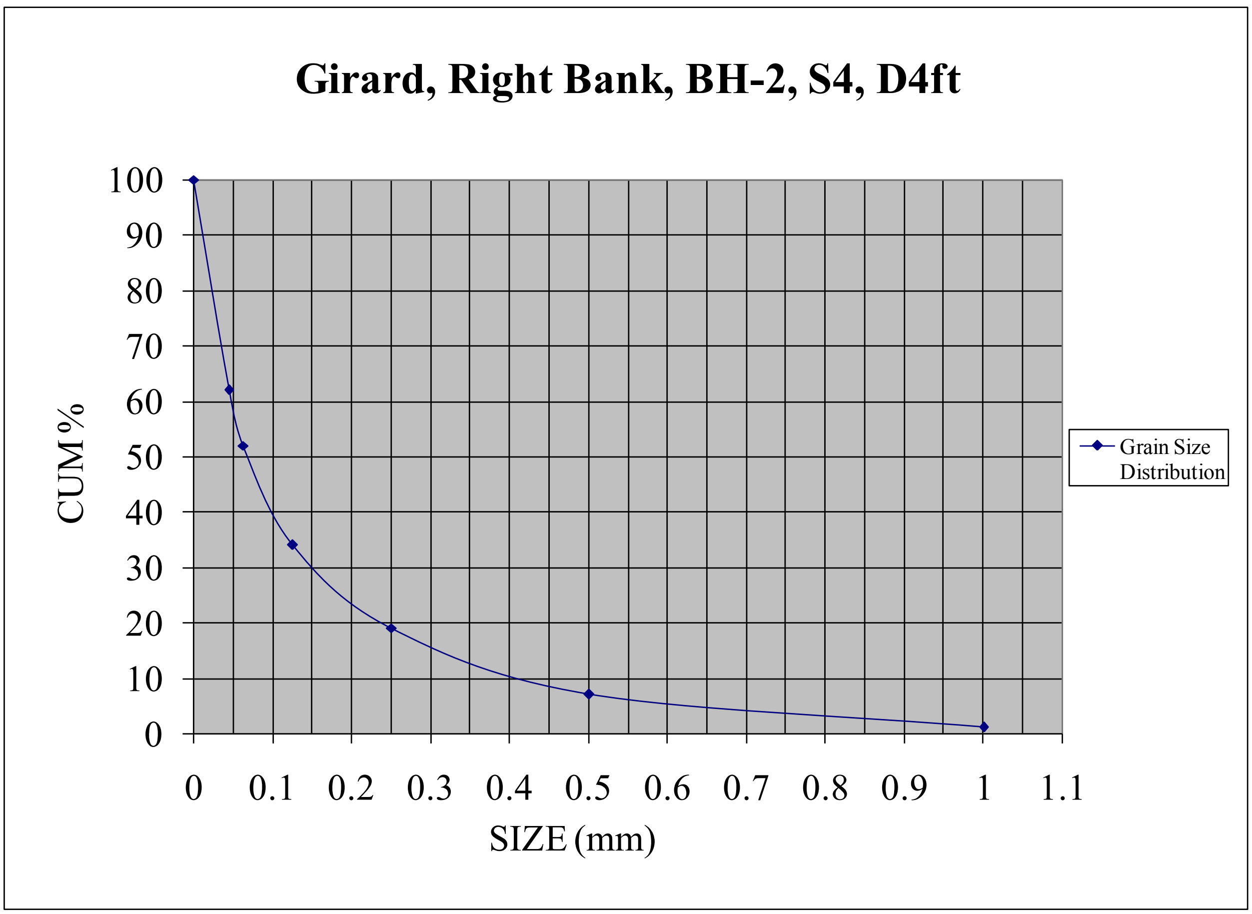
Soil Grain-size Analysis Laboratory Results			
Girard Right Bank		Sample Date: 9/23/06	
BH-2, S3, 3ft. bsg[a]		Original Sample Weight: 113.8g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.4	1.4	1
0.5	8.4	9.8	9
0.25	16.4	26.2	24
0.125	16.6	42.8	39
0.063	18	60.8	55
0.044	10.1	70.9	64
pan	40.1	111	100

a. Below surface grade.



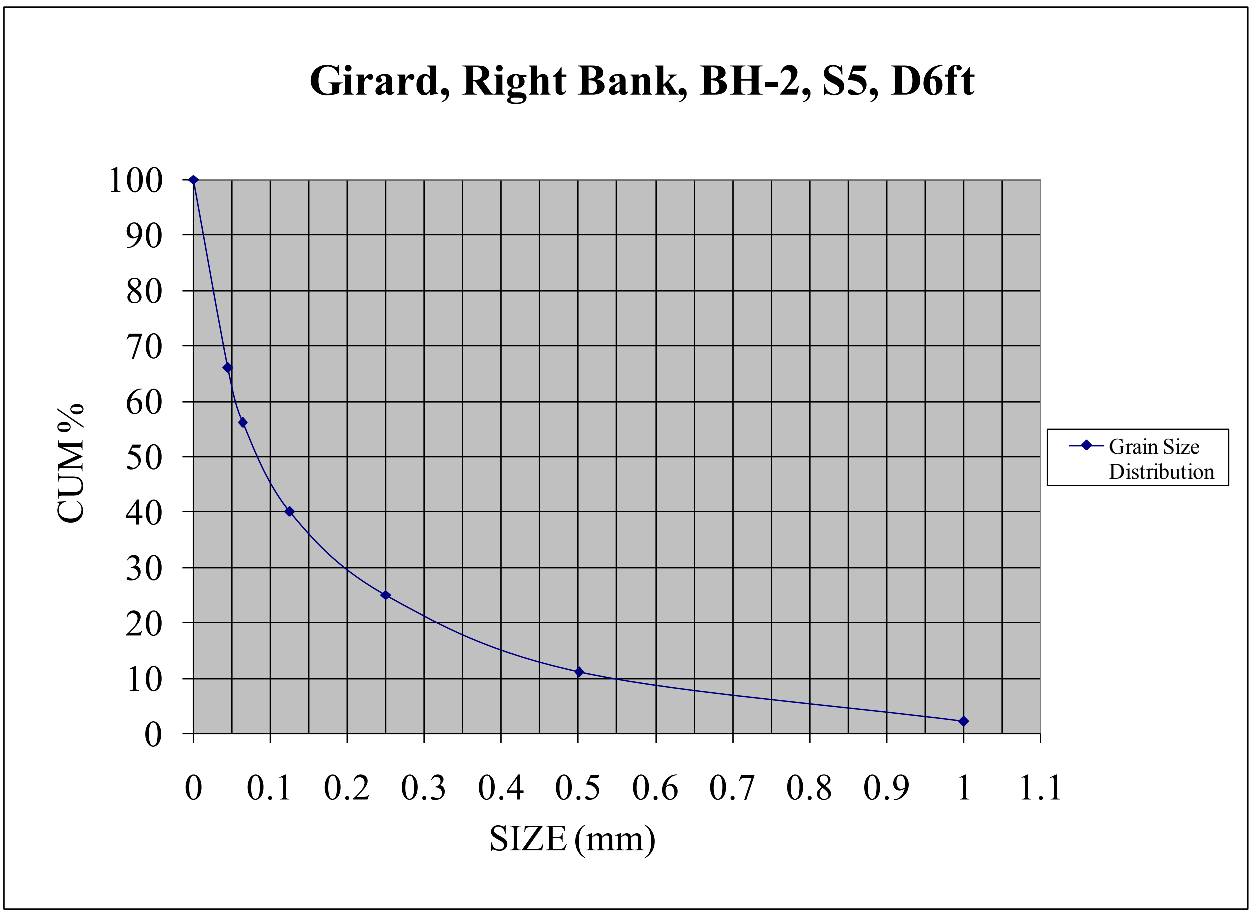
Soil Grain-size Analysis Laboratory Results			
Girard Right Bank		Sample Date: 9/23/06	
BH-2, S4, 4ft. bsg[a]		Original Sample Weight: 89.0g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.1	1.1	1
0.5	4.9	6	7
0.25	9.9	15.9	19
0.125	12.7	28.6	34
0.063	15.6	44.2	52
0.044	8.4	52.6	62
pan	32	84.6	100

a. Below surface grade.



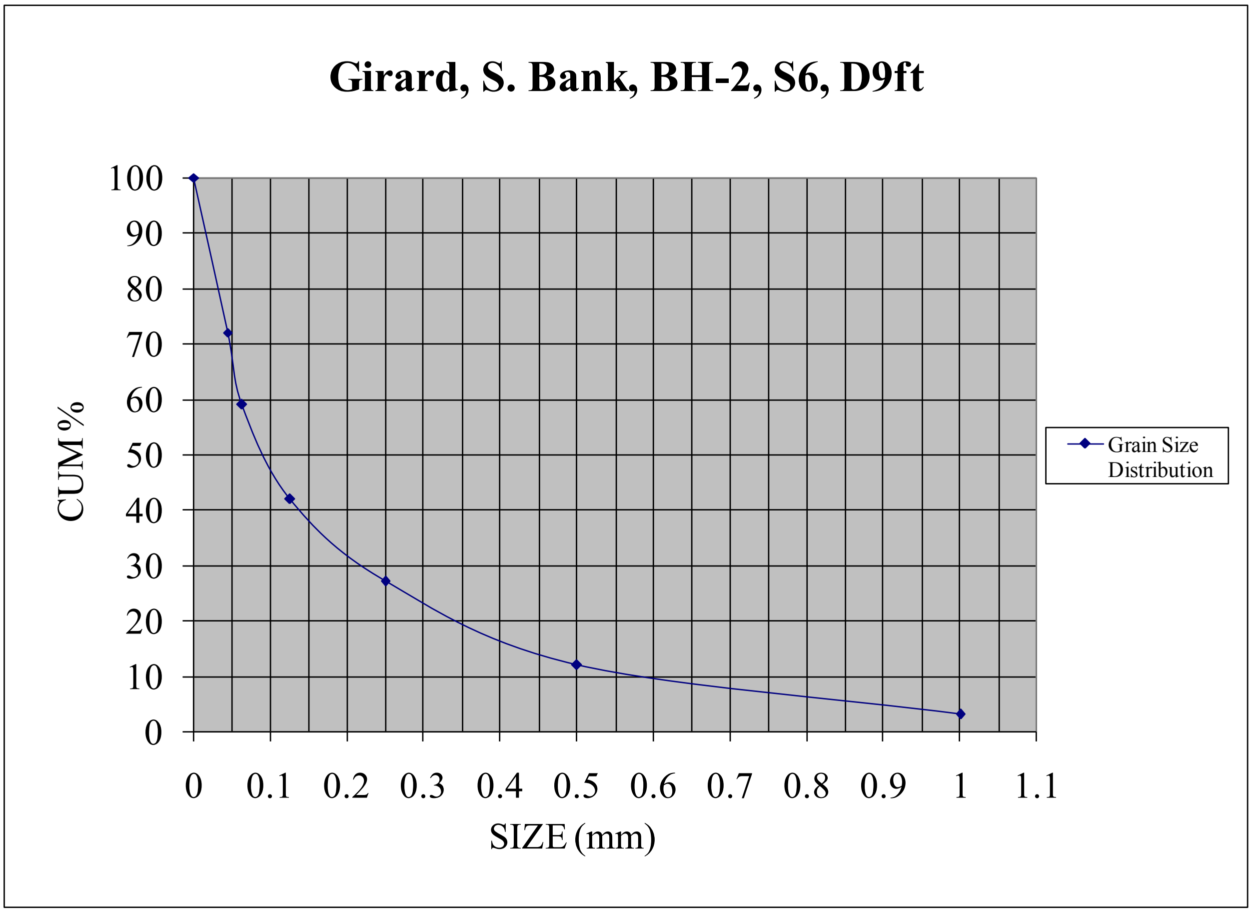
Soil Grain-size Analysis Laboratory Results			
Girard Right Bank		Sample Date: 9/23/06	
BH-2, S5, 6ft. bsg[a]		Original Sample Weight: 126.0g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.9	2.9	2
0.5	10.1	13	11
0.25	17.6	30.6	25
0.125	18.4	49	40
0.063	19.9	68.9	56
0.044	12.5	81.4	66
pan	42	123.4	100

a. Below surface grade.



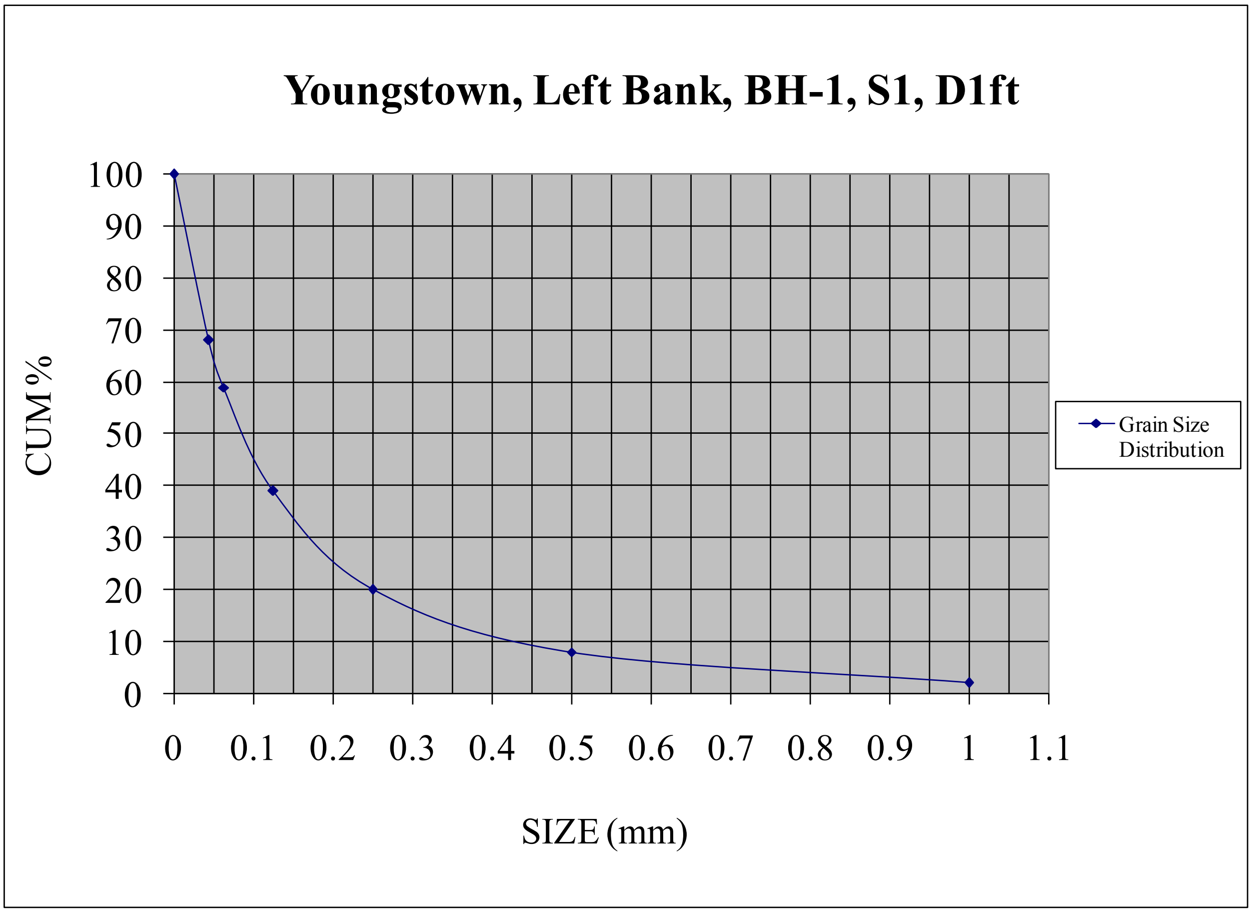
Soil Grain-size Analysis Laboratory Results			
Girard Right Bank		Sample Date: 9/23/06	
BH-2, S6, 9ft. bsg[a]		Original Sample Weight: 112.6g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.9	2.9	3
0.5	10	12.9	12
0.25	16.2	29.1	27
0.125	16.8	45.9	42
0.063	18.4	64.3	59
0.044	13.6	77.9	72
pan	30.6	108.5	100

a. Below surface grade.



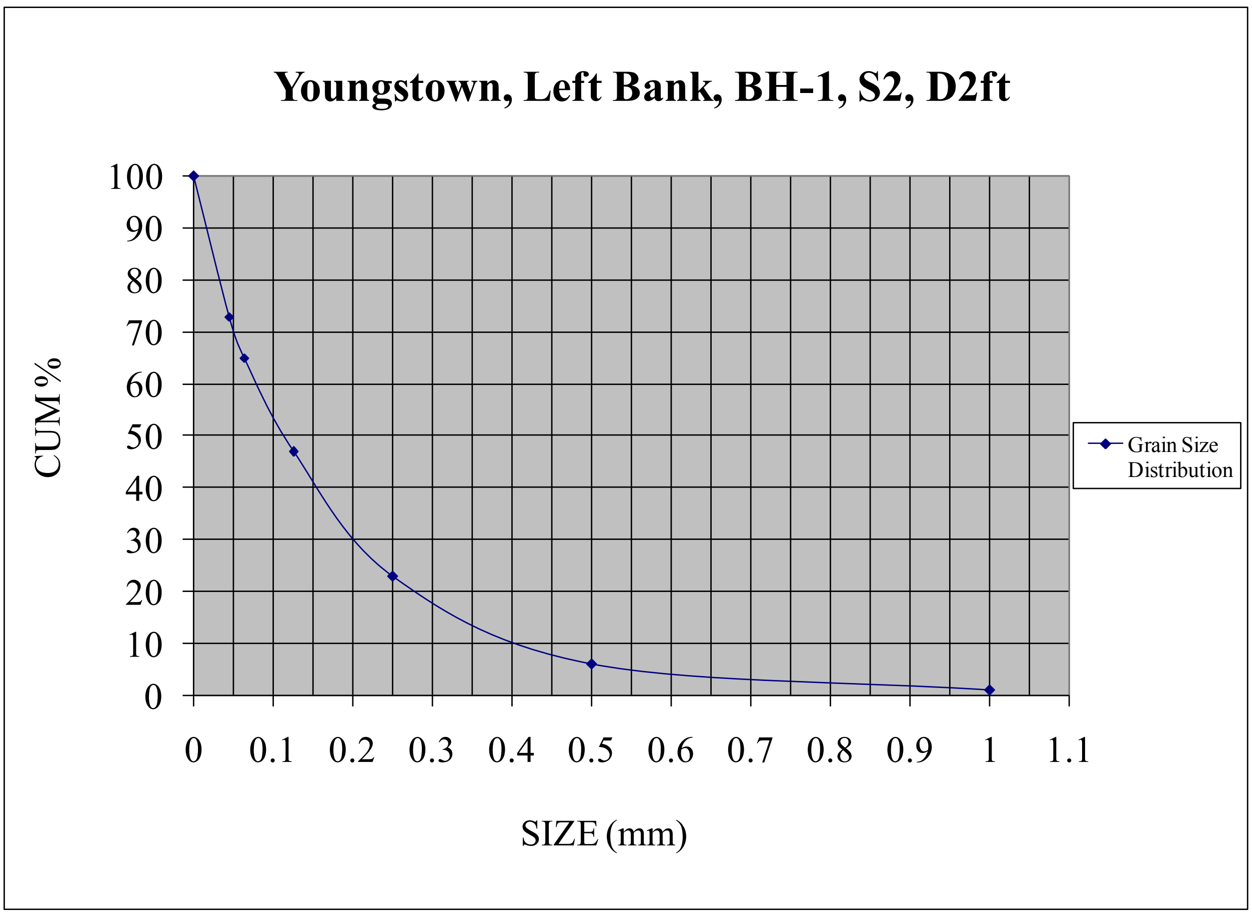
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-1, S1, 1 ft. bsg[a]		Original Sample Weight: 108g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.9	1.9	2
0.5	6.3	8.2	8
0.25	13.6	21.8	20
0.125	20.1	41.9	39
0.063	21.8	63.7	59
0.044	9.7	73.4	68
pan	33.8	107.2	100

a. Below surface grade.



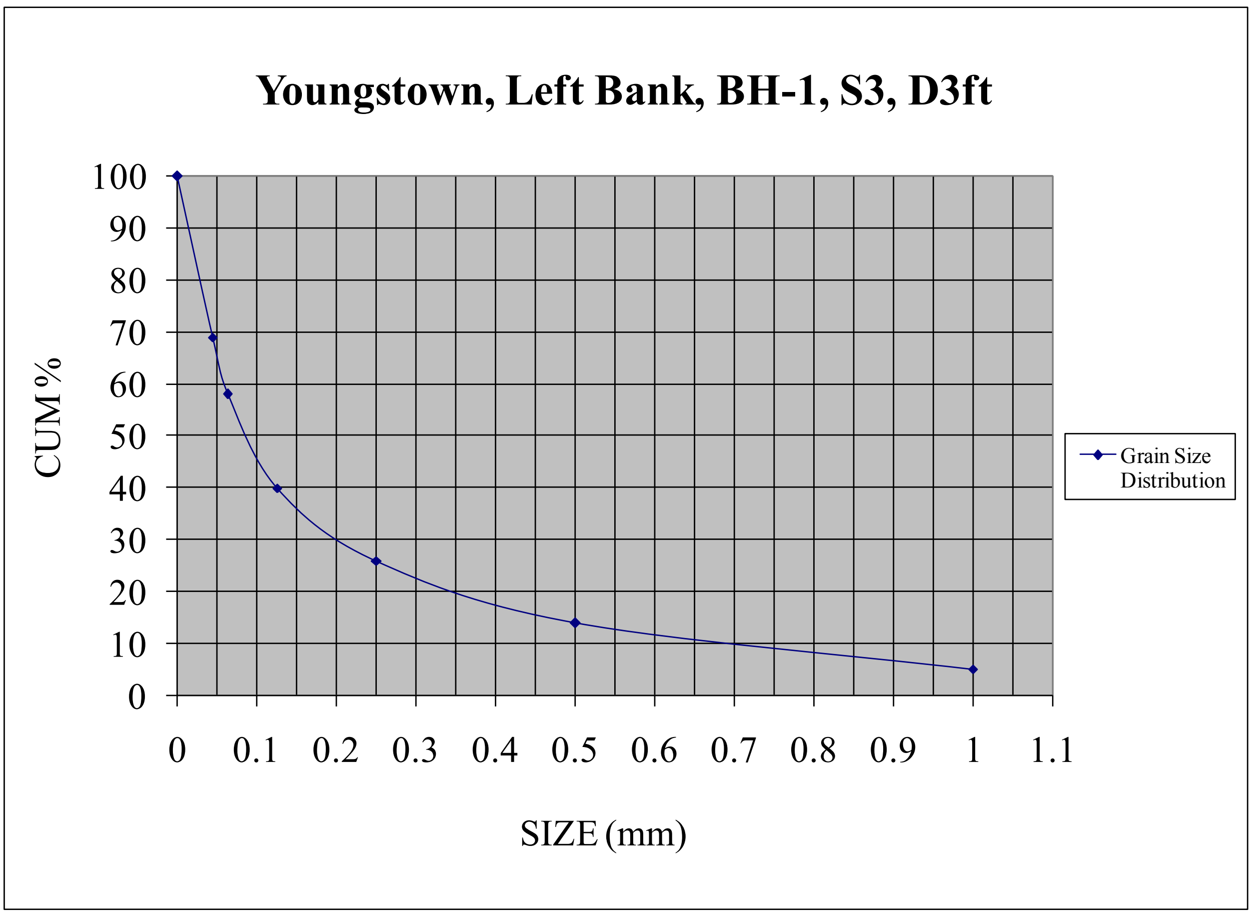
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-1, S2, 2 ft. bsg[a]		Original Sample Weight: 107.7g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	1.2	1.2	1
0.5	5.0	6.2	6
0.25	18.2	24.4	23
0.125	24.9	49.3	47
0.063	19.0	68.3	65
0.044	8.5	76.8	73
pan	28.8	105.6	100

a. Below surface grade.



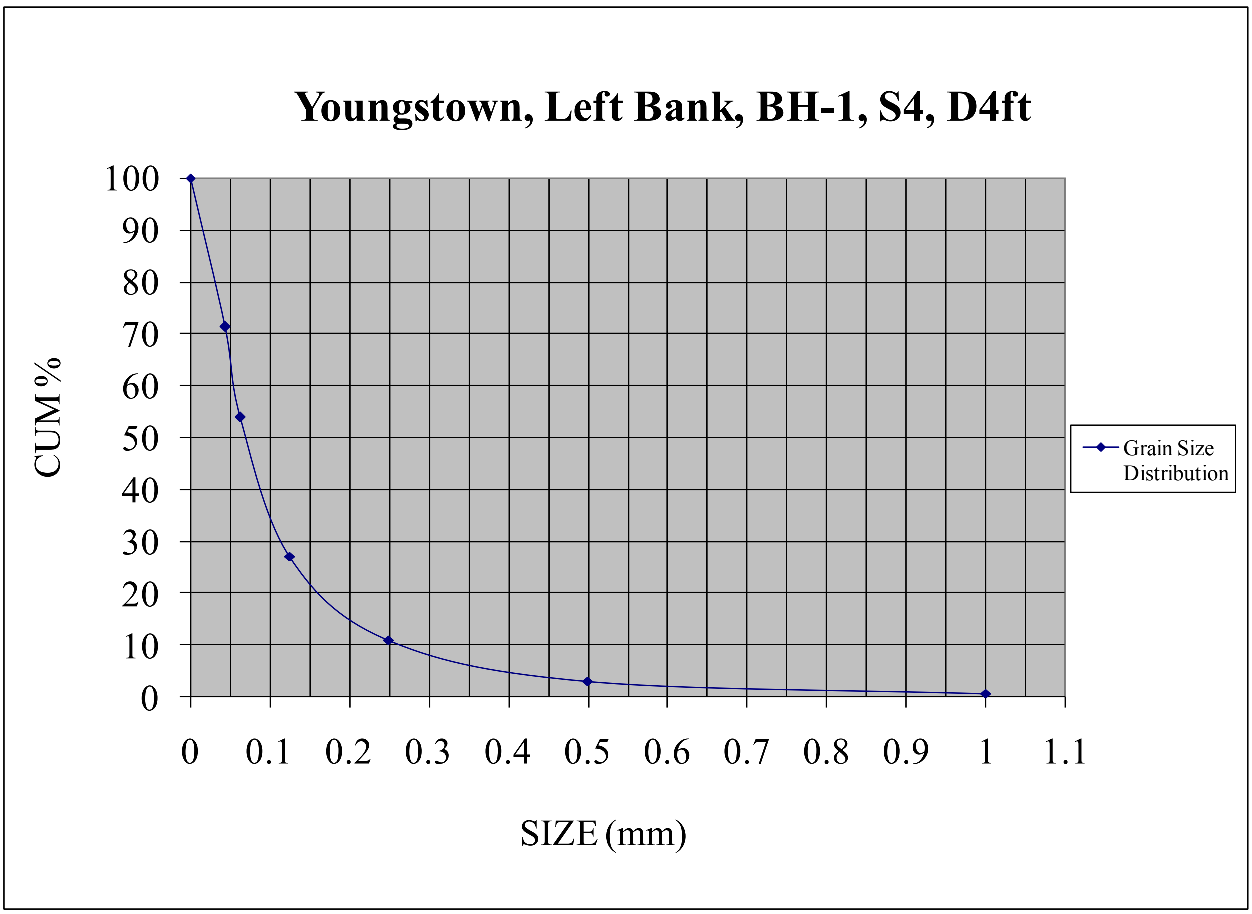
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-1, S3, 3ft. bsg[a]		Original Sample Weight: 110.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	5.5	5.5	5
0.5	9.5	15.0	14
0.25	13.3	28.3	26
0.125	15.2	43.5	40
0.063	19.8	63.3	58
0.044	10.9	74.2	69
pan	34.1	108.3	100

a. Below surface grade.



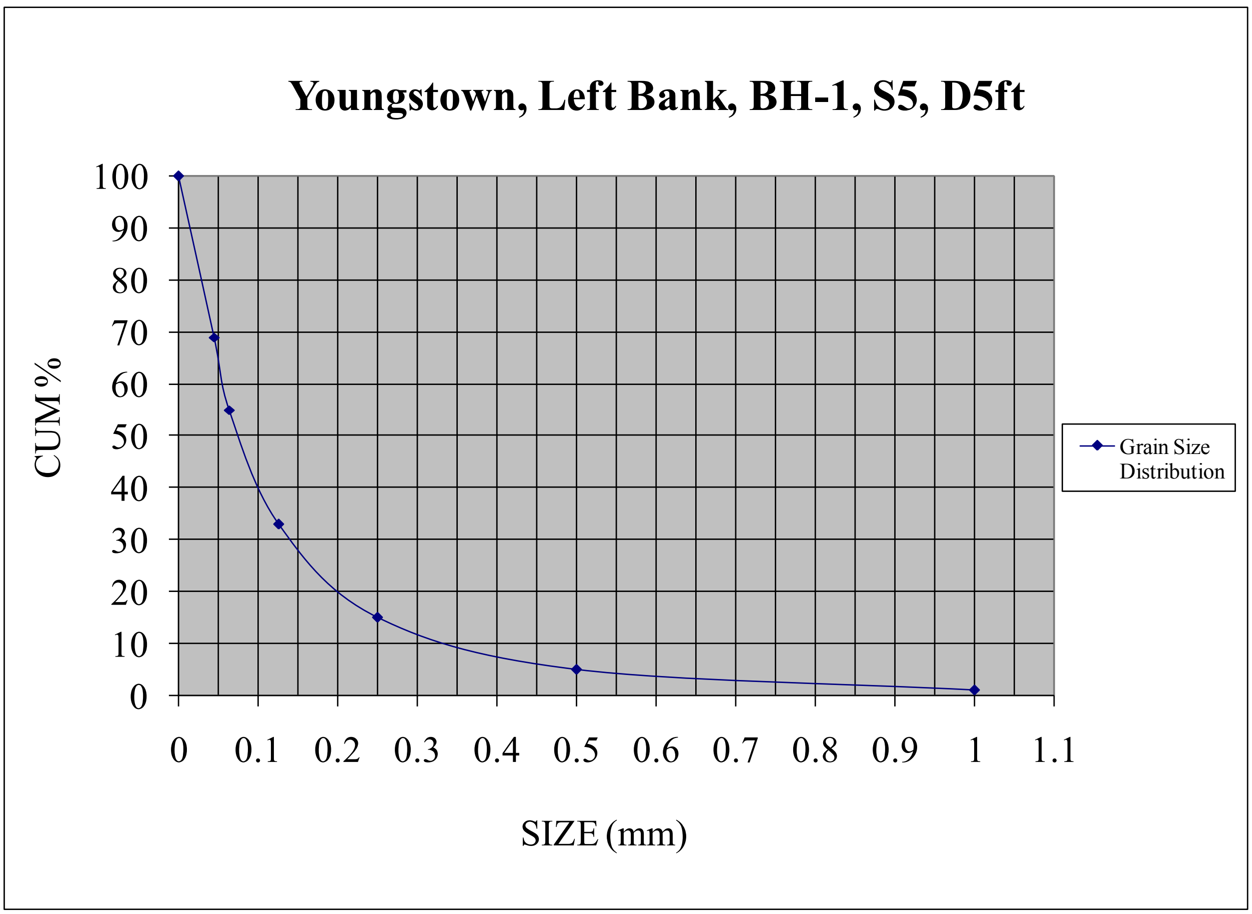
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-1, S4, 4ft. bsg[a]		Original Sample Weight: 110.9g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.8	0.8	1
0.5	2.6	3.4	3
0.25	8.6	12.0	11
0.125	17.6	29.6	27
0.063	29.3	58.9	54
0.044	19.0	77.9	71
pan	31.2	109.1	100

a. Below surface grade.



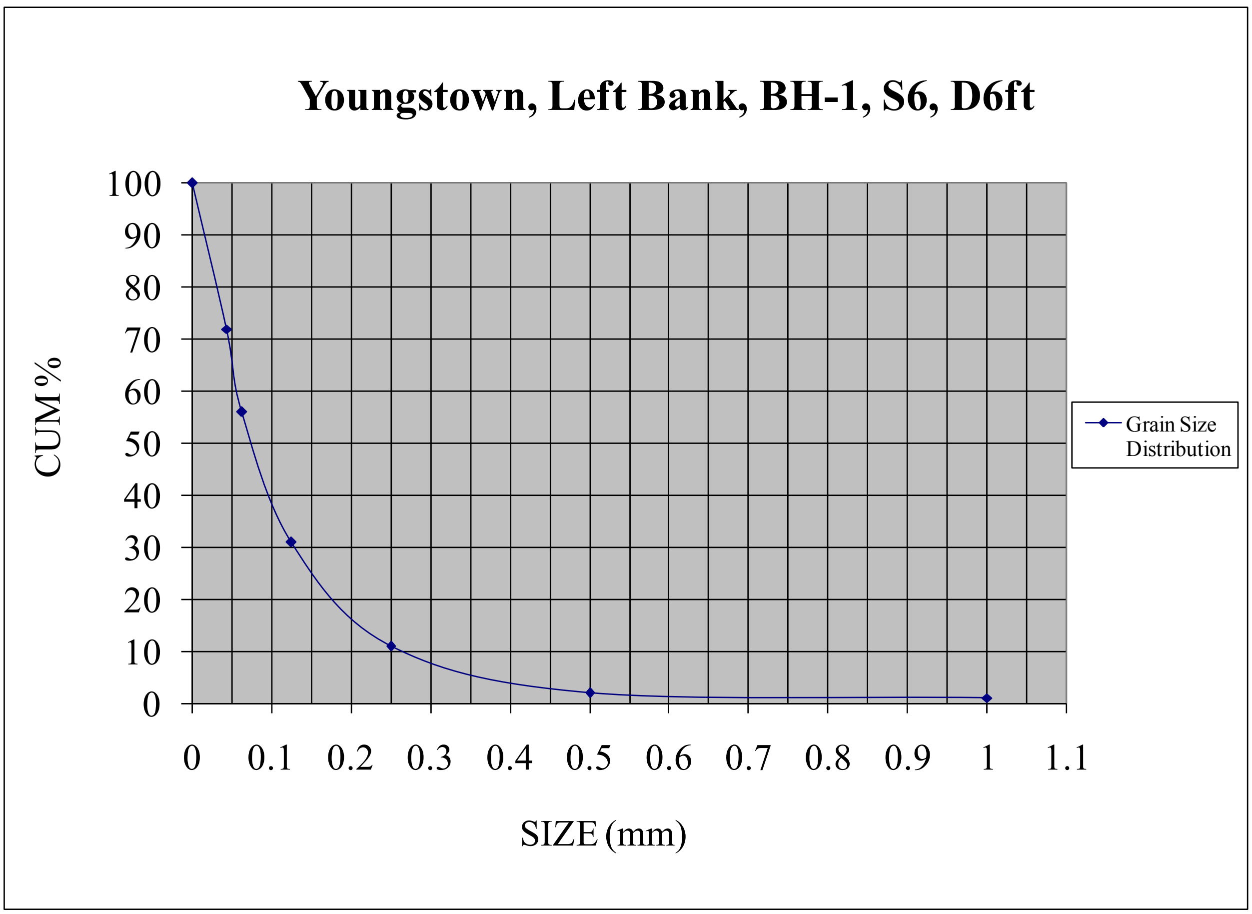
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-1, S5, 5ft. bsg[a]		Original Sample Weight: 105.3g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.1	1.1	1
0.5	4.0	5.1	5
0.25	10.5	15.6	15
0.125	18.4	34.0	33
0.063	22.2	56.2	55
0.044	14.6	70.8	69
pan	32.0	102.8	100

a. Below surface grade.



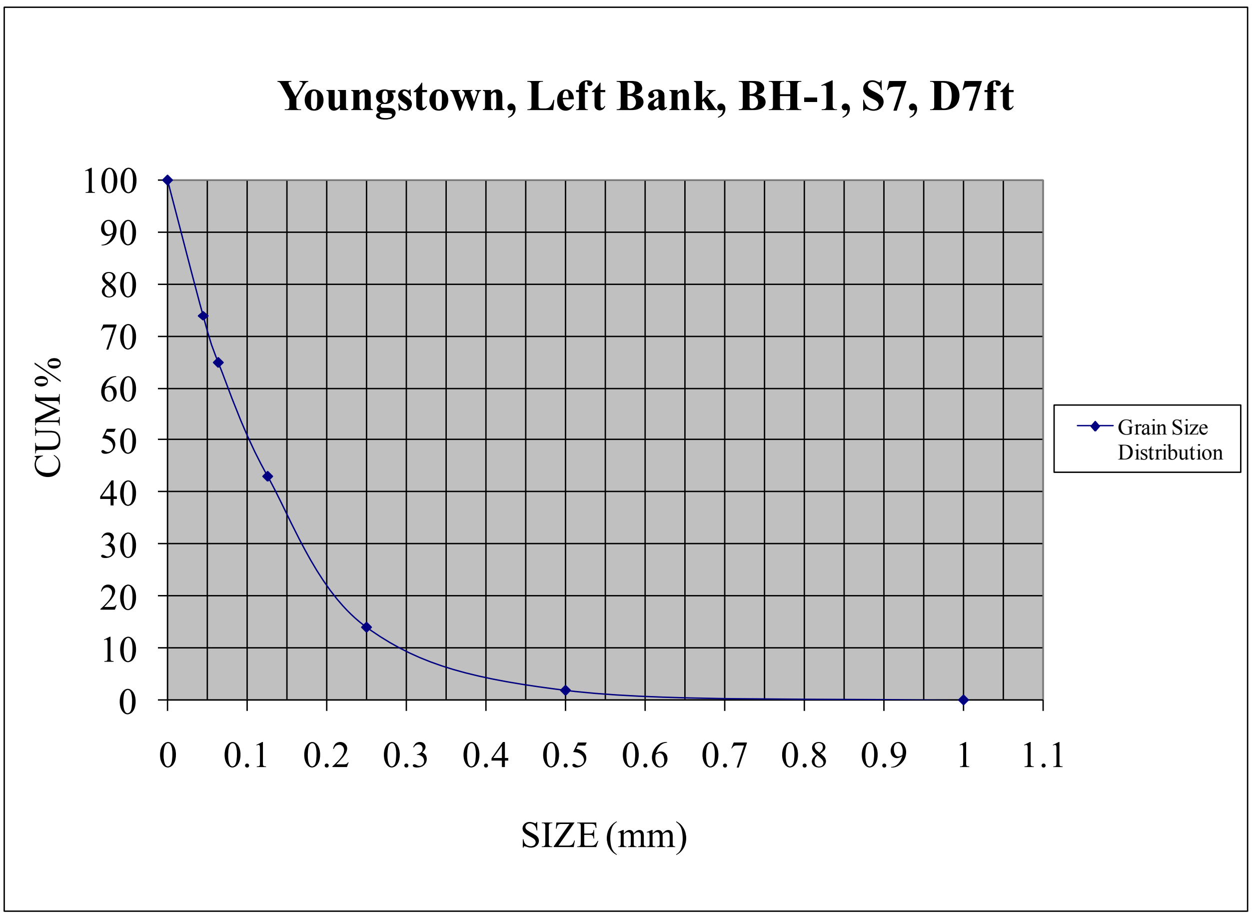
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-1, S6, 6ft. bsg[a]		Original Sample Weight: 106g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.6	0.6	1
0.5	1.9	2.5	2
0.25	8.8	11.3	11
0.125	21.3	32.6	31
0.063	25.3	57.9	56
0.044	17.1	75.0	72
pan	29.1	104.1	100

a. Below surface grade.



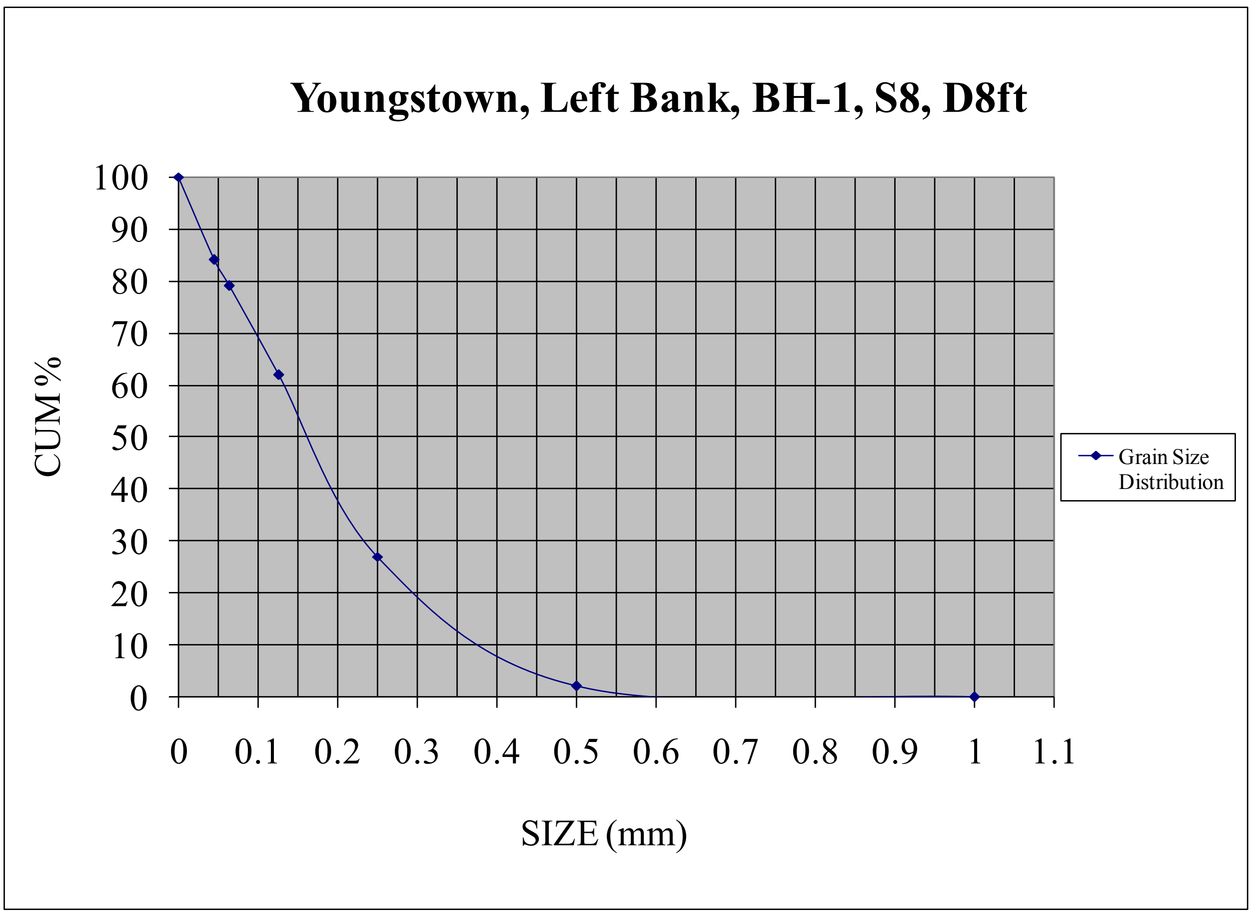
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-1, S7, 7ft. bsg[a]		Original Sample Weight: 106.7g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.3	0.3	0
0.5	2.1	2.4	2
0.25	12.5	14.9	14
0.125	30.2	45.1	43
0.063	23.0	68.1	65
0.044	9.0	77.1	74
pan	27.5	104.6	100

a. Below surface grade.



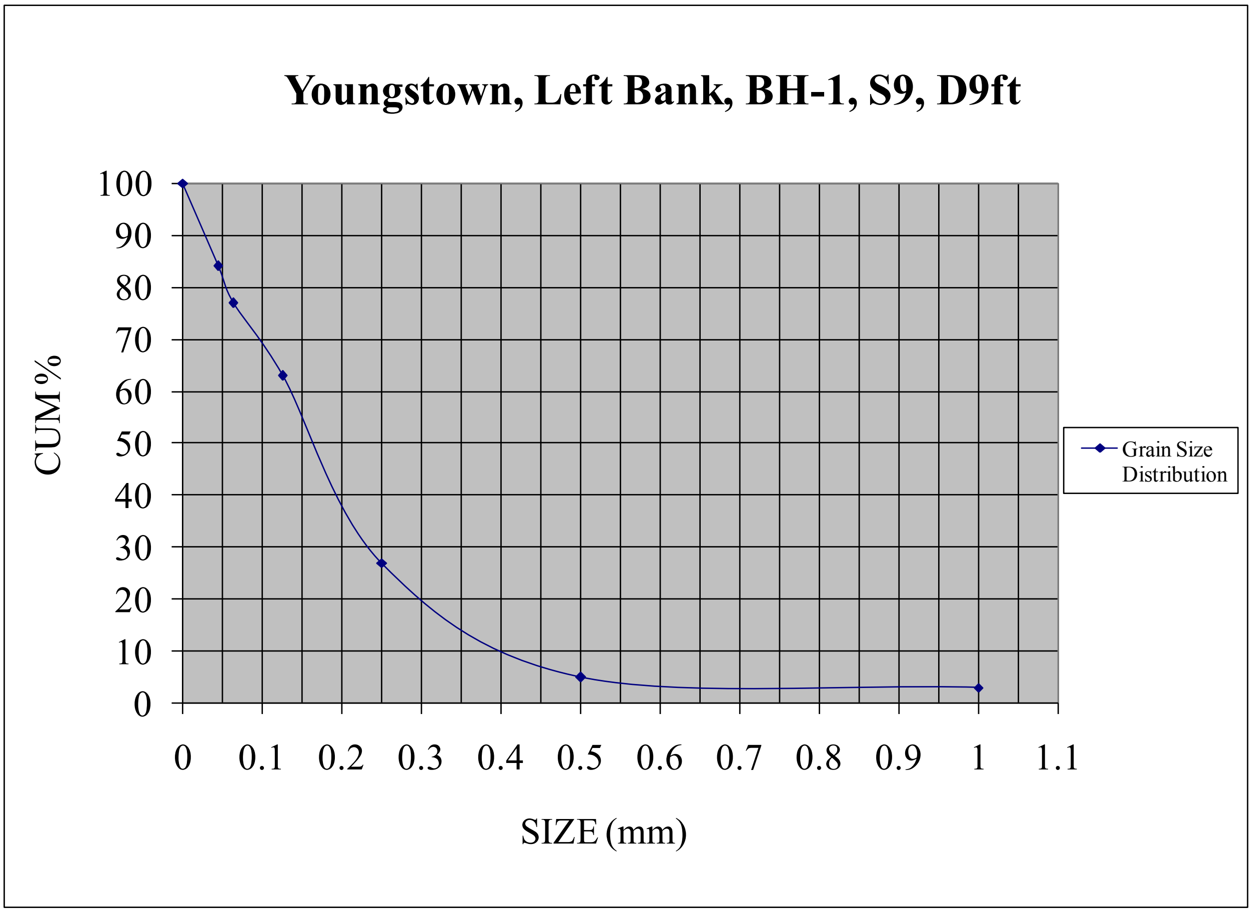
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-1, S8, 8ft. bsg[a]		Original Sample Weight: 115.3g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.2	0.2	0
0.5	2.6	2.8	2
0.25	27.5	30.3	27
0.125	39.8	70.1	62
0.063	19.4	89.5	79
0.044	6.5	96.0	84
pan	17.7	113.7	100

a. Below surface grade.



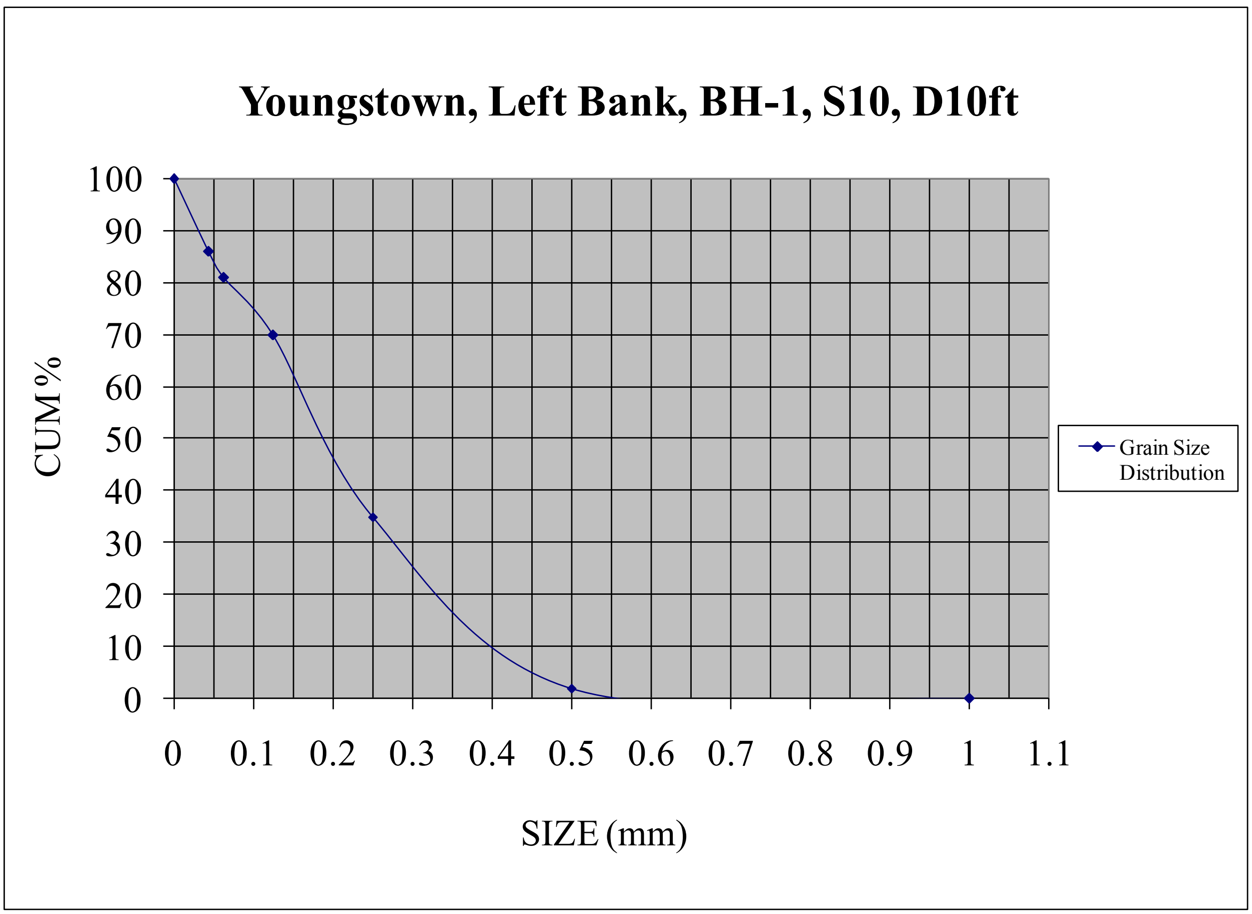
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-1, S9, 9ft. bsg[a]		Original Sample Weight: 104.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	3.1	3.1	3
0.5	1.8	4.9	5
0.25	23.0	27.9	27
0.125	36.8	64.7	63
0.063	14.8	79.5	77
0.044	6.5	86.0	84
pan	16.9	102.9	100

a. Below surface grade.



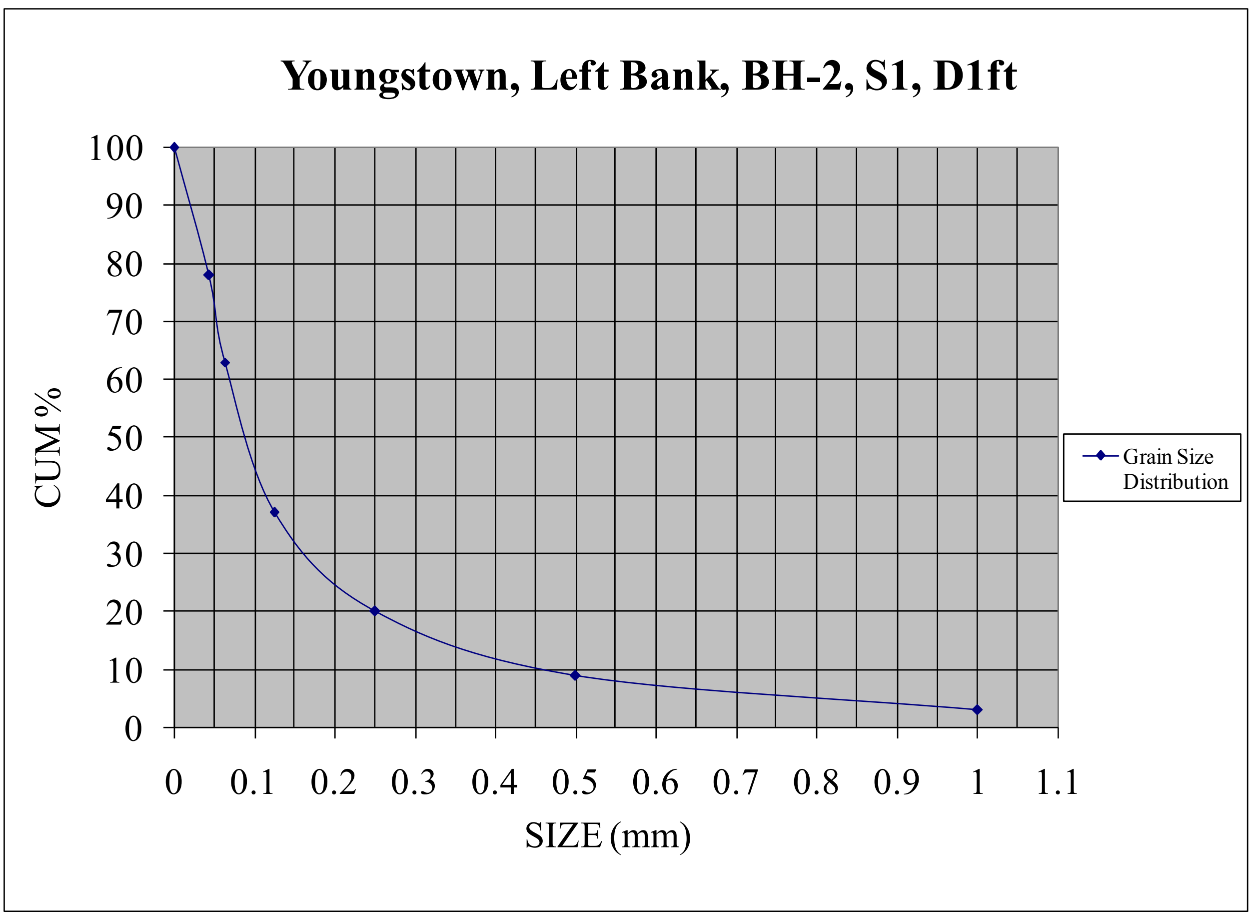
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-1, S10, 10ft. bsg[a]		Original Sample Weight: 111.1g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.3	0.3	0
0.5	1.9	2.2	2
0.25	36.4	38.6	35
0.125	37.6	76.2	70
0.063	12.3	88.5	81
0.044	5.7	94.2	86
pan	15.2	109.4	100

a. Below surface grade.



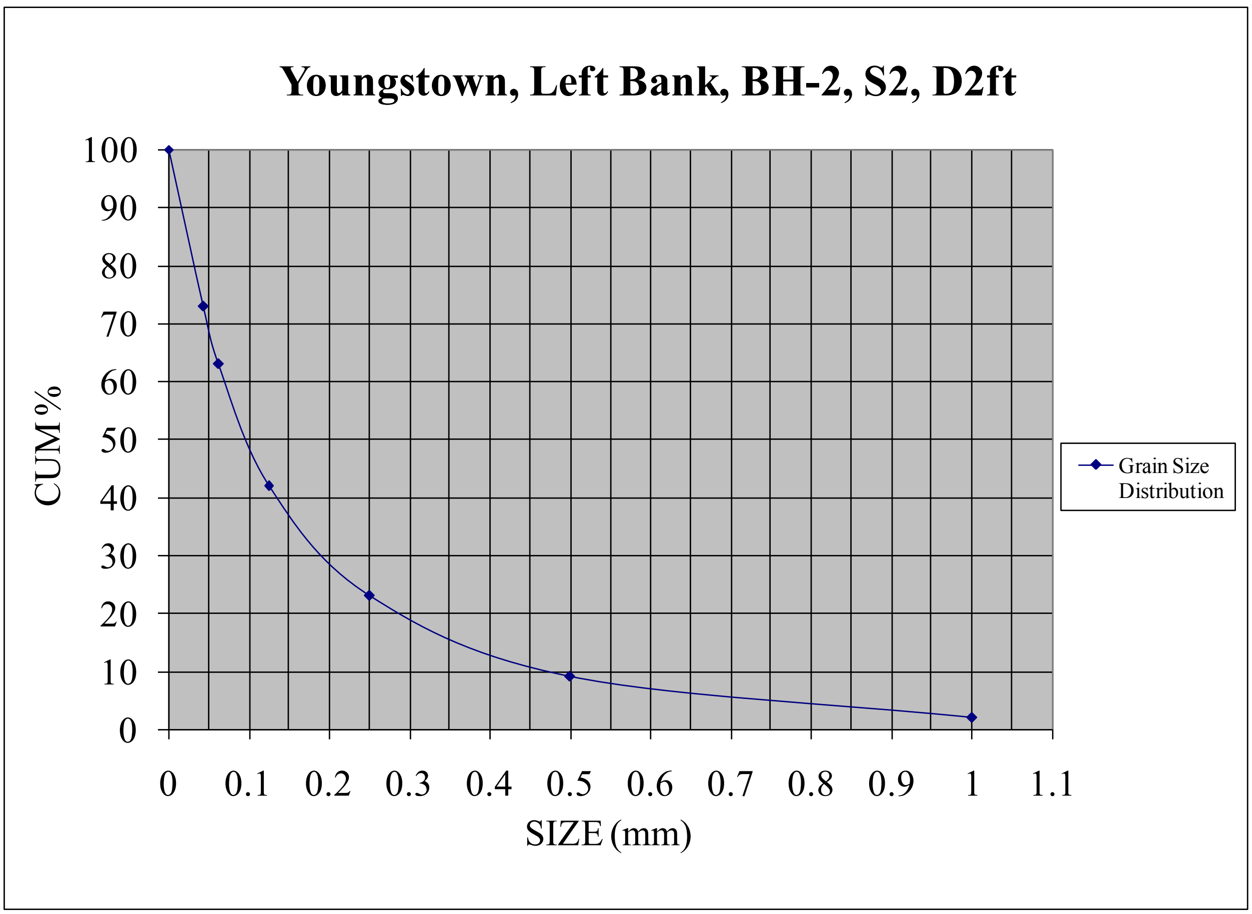
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-2, S1, 1ft. bsg[a]		Original Sample Weight: 104.1g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.7	2.7	3
0.5	6.3	9.0	9
0.25	10.9	19.9	20
0.125	18.0	37.9	37
0.063	26.1	64.0	63
0.044	15.8	79.8	78
pan	22.0	101.8	100

a. Below surface grade.



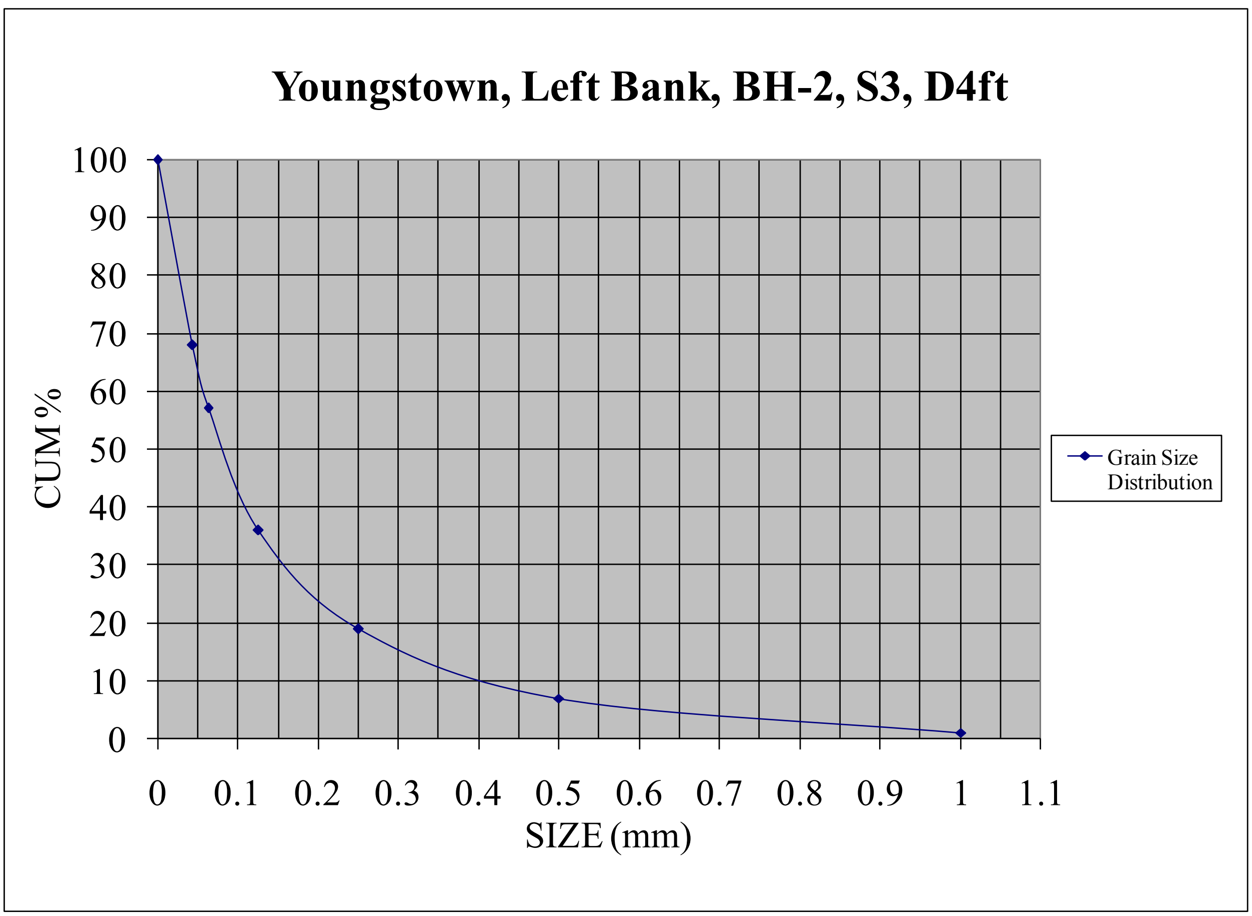
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-2, S2, 2ft. bsg[a]		Original Sample Weight: 105.8g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.8	1.8	2
0.5	7.8	9.6	9
0.25	14.2	23.8	23
0.125	19.2	43.0	42
0.063	21.9	64.9	63
0.044	10.9	75.8	73
pan	27.6	103.4	100

a. Below surface grade.



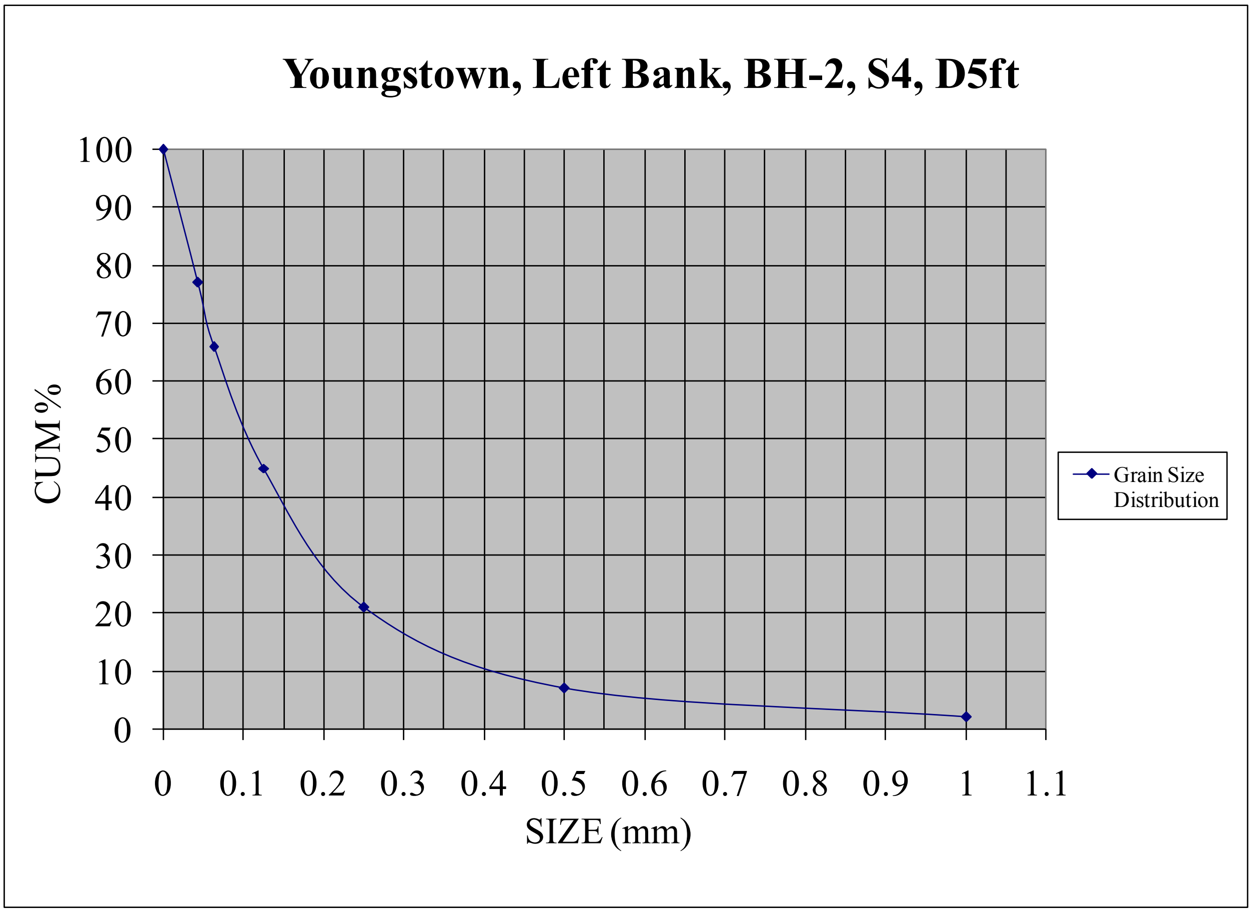
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-2, S3, 4ft. bsg[a]		Original Sample Weight: 108.2g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	1.6	1.6	1
0.5	6.4	8.0	7
0.25	12.0	20.0	19
0.125	18.6	38.6	36
0.063	22.3	60.9	57
0.044	11.8	72.7	68
pan	34.4	107.1	100

a. Below surface grade.



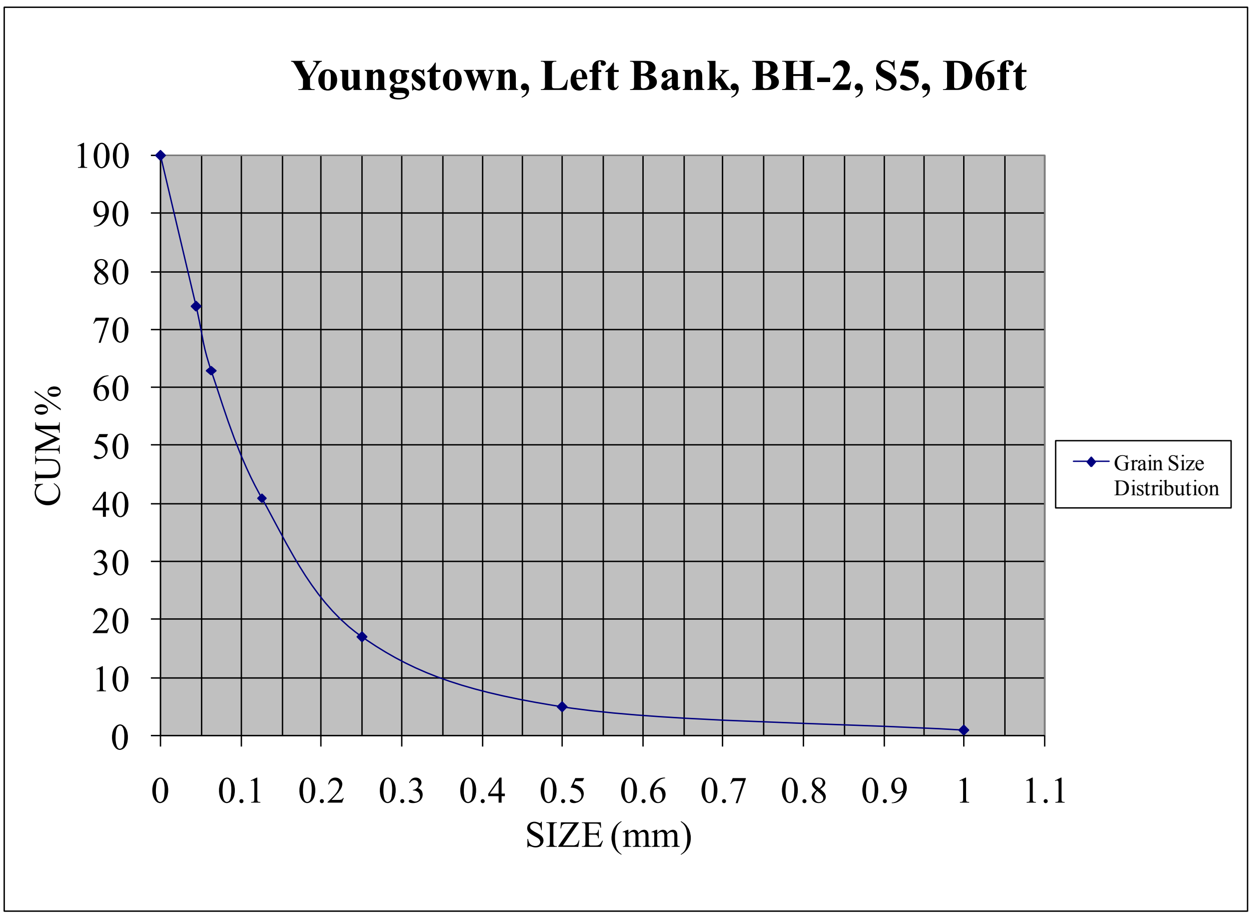
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-2, S4, 5ft. bsg[a]		Original Sample Weight: 106.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.6	1.6	2
0.5	5.6	7.2	7
0.25	14.6	21.8	21
0.125	25.2	47.0	45
0.063	22.1	69.1	66
0.044	11.3	80.4	77
pan	23.6	104.0	100

a. Below surface grade.



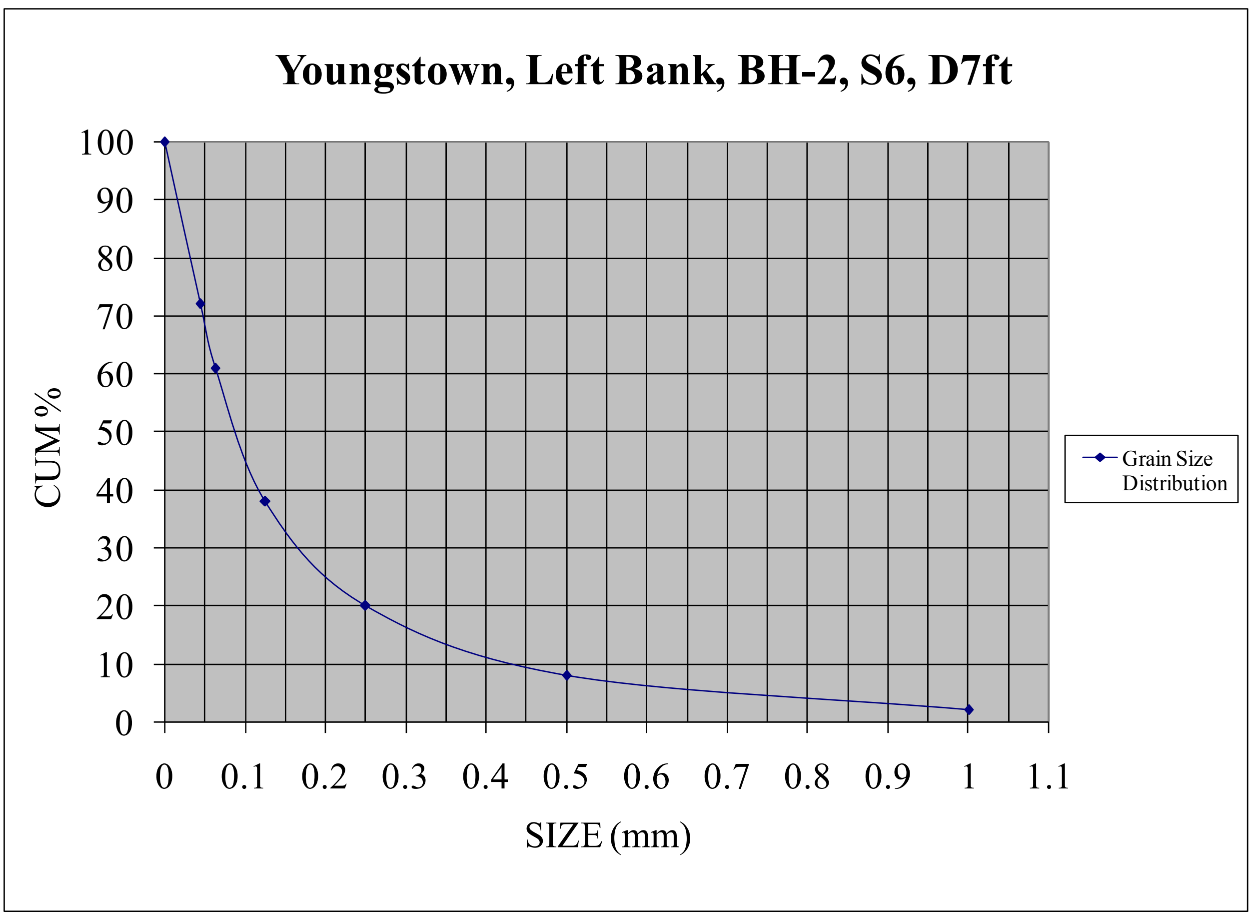
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-2, S5, 6ft. bsg[a]		Original Sample Weight: 108.6g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.0	1.0	1
0.5	4.8	5.8	5
0.25	12.6	18.4	17
0.125	25.8	44.2	41
0.063	23.8	68.0	63
0.044	11.4	79.4	74
pan	28.0	107.4	100

a. Below surface grade.



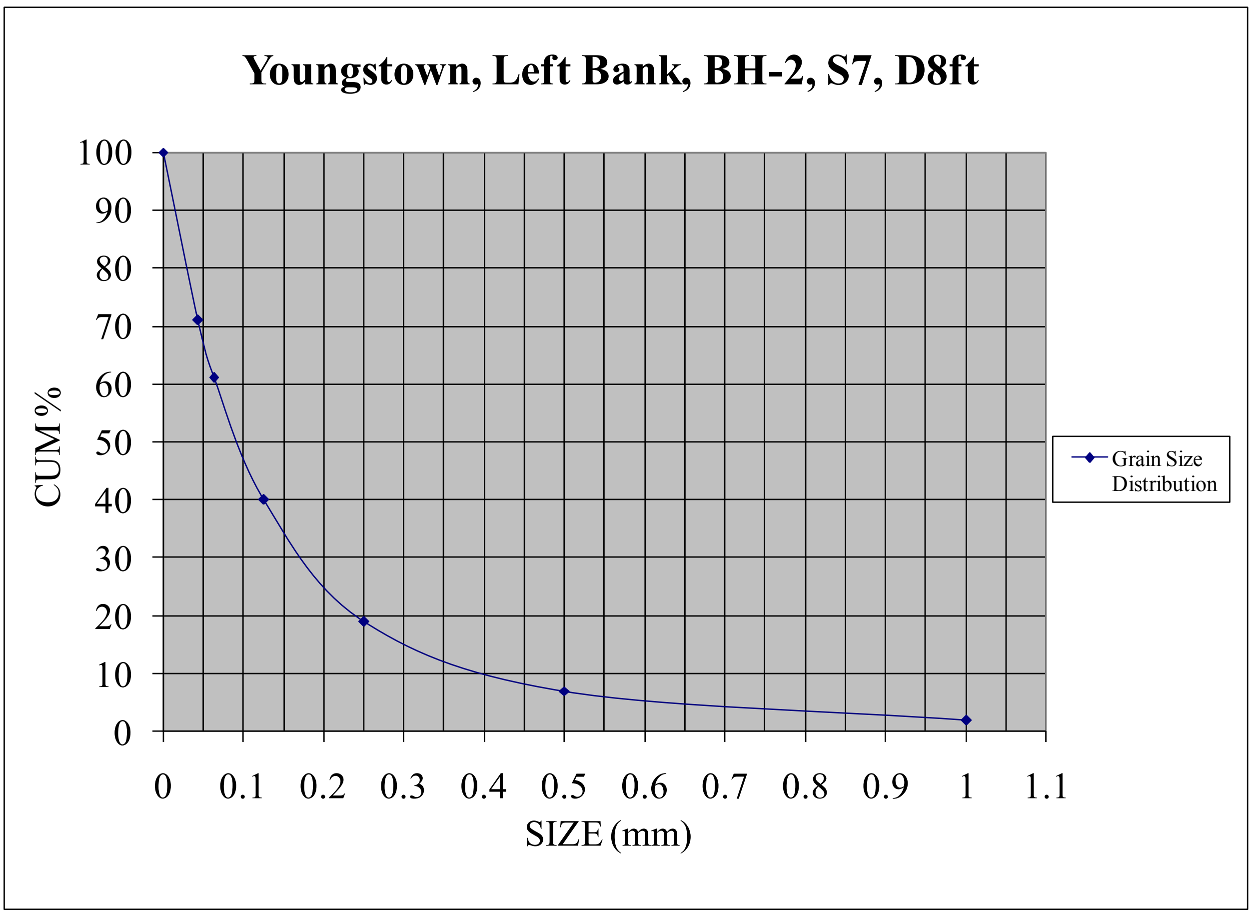
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-2, S6, 7ft. bsg[a]		Original Sample Weight: 103.3g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.6	1.6	2
0.5	6.1	7.7	8
0.25	12.5	20.2	20
0.125	18.8	39.0	38
0.063	22.7	61.7	61
0.044	11.5	73.2	72
pan	28.5	101.7	100

a. Below surface grade.



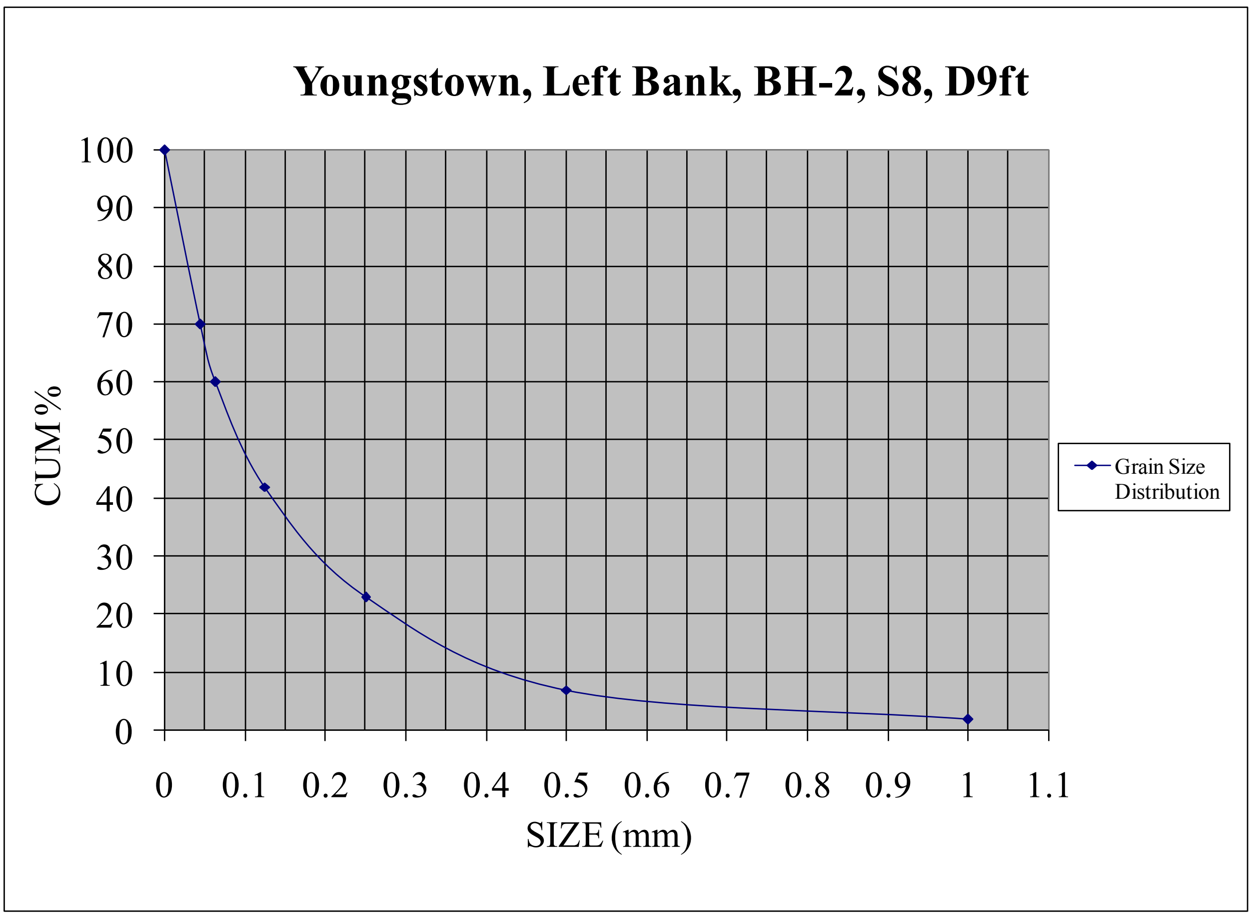
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-2, S7, 8ft. bsg[a]		Original Sample Weight: 104.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.7	1.7	2
0.5	5.1	6.8	7
0.25	12.4	19.2	19
0.125	22.2	41.4	40
0.063	22.0	63.4	61
0.044	10.2	73.6	71
pan	29.5	103.1	100

a. Below surface grade.



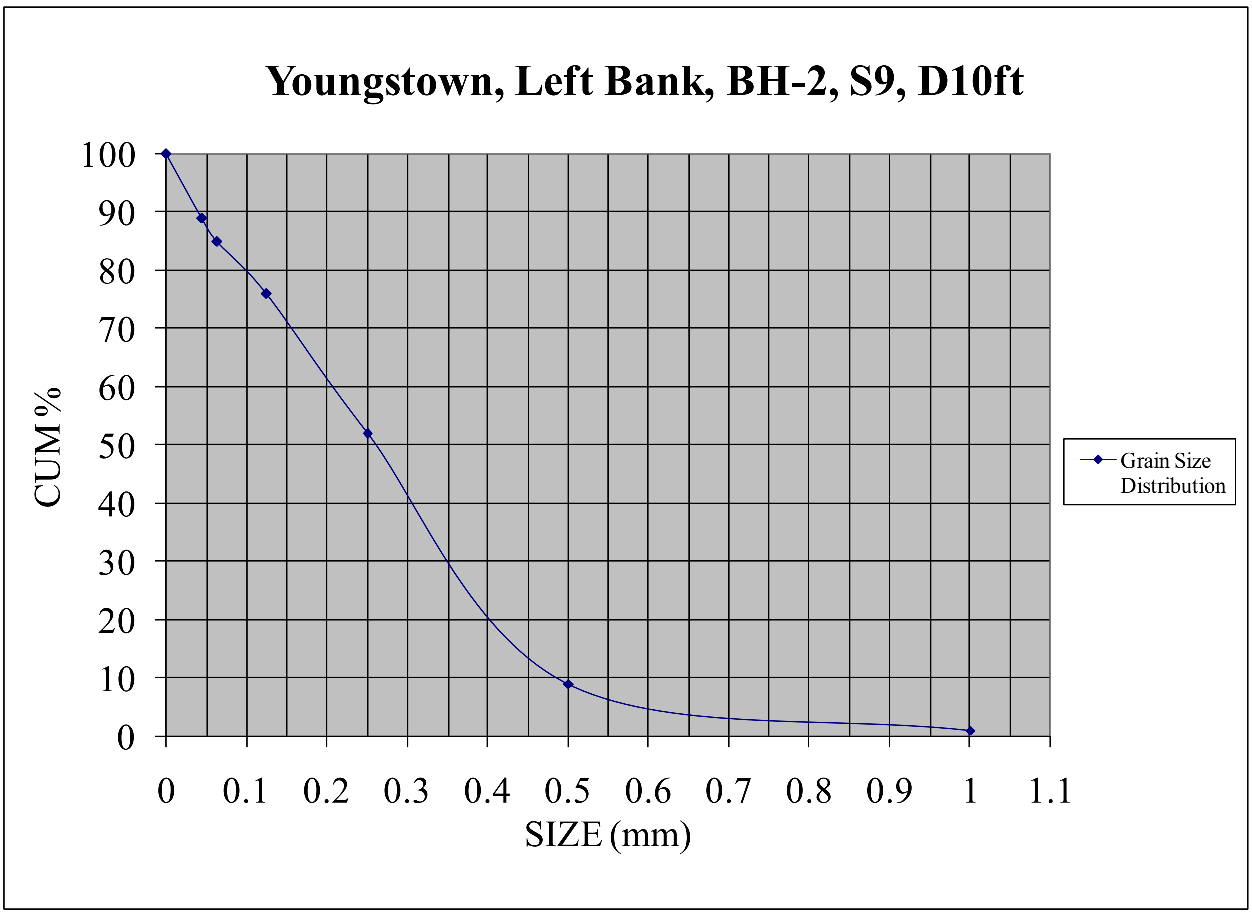
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-2, S8, 9ft. bsg[a]		Original Sample Weight: 108.6g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.1	2.1	2
0.5	5.6	7.7	7
0.25	16.8	24.5	23
0.125	20.6	45.1	42
0.063	19.5	64.6	60
0.044	10.6	75.2	70
pan	32.3	107.5	100

a. Below surface grade.



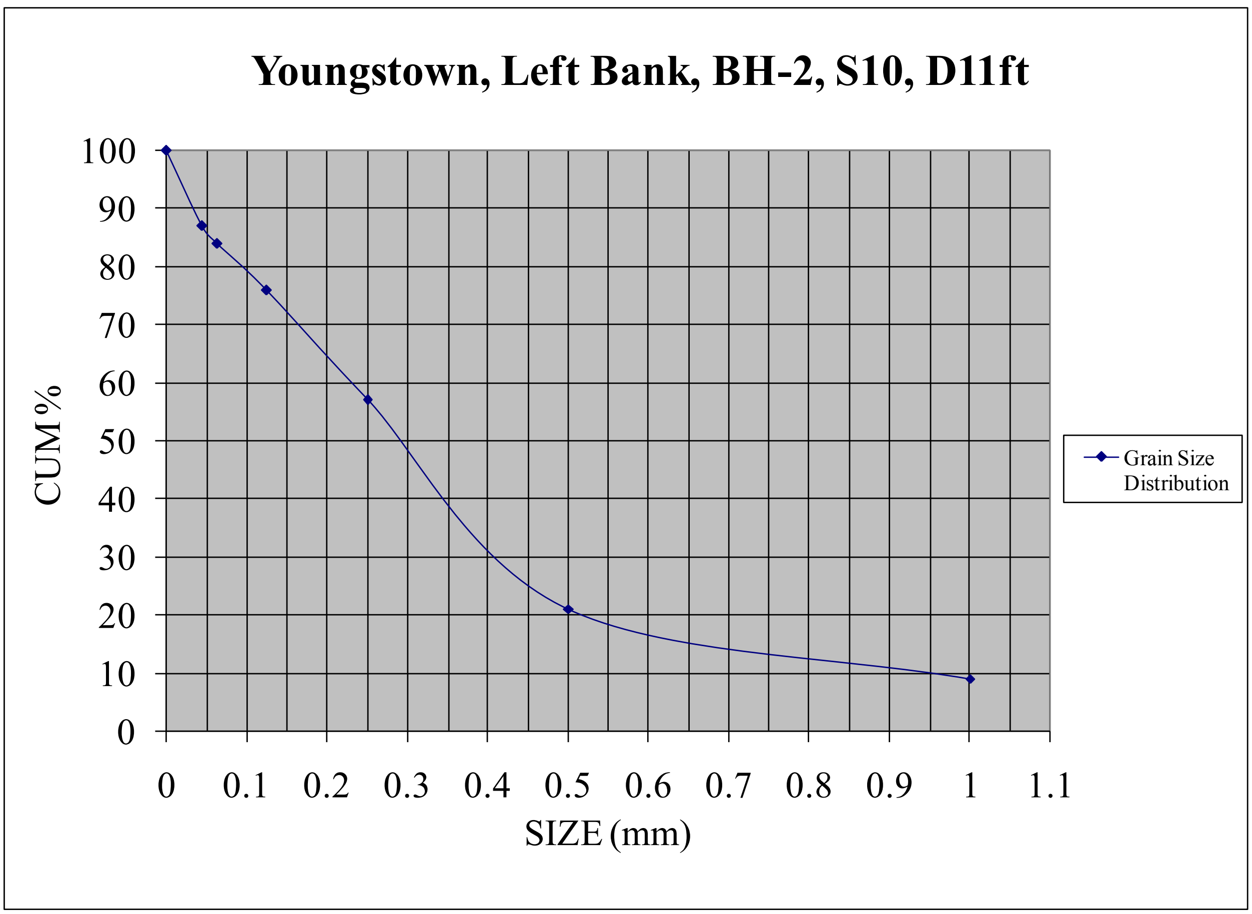
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-2, S9, 10ft. bsg[a]		Original Sample Weight: 109.4g	
Sieve Opening(mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	1.5	1.5	1
0.5	8.6	10.1	9
0.25	45.7	55.8	52
0.125	26.9	82.7	76
0.063	9.8	92.5	85
0.044	4.2	96.7	89
pan	11.5	108.2	100

a. Below surface grade.



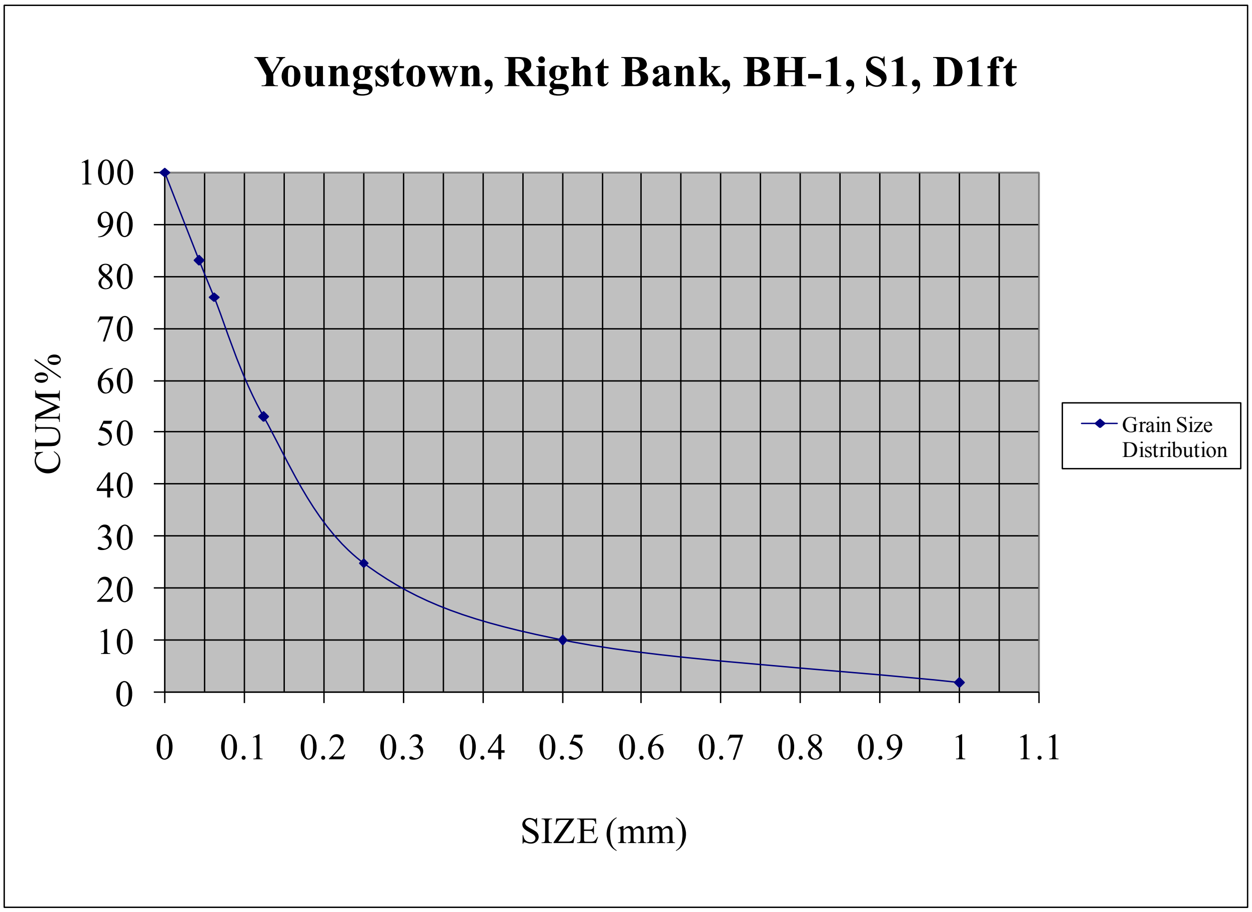
Soil Grain-size Analysis Laboratory Results			
Youngstown Left Bank		Sample Date: 11/2/06	
BH-2, S10, 11ft. bsg[a]		Original Sample Weight: 117.4g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	9.9	9.9	9
0.5	14.1	24.0	21
0.25	42.3	66.3	57
0.125	21.7	88.0	76
0.063	9.4	97.4	84
0.044	3.7	101.1	87
pan	15.1	116.2	100

a. Below surface grade.



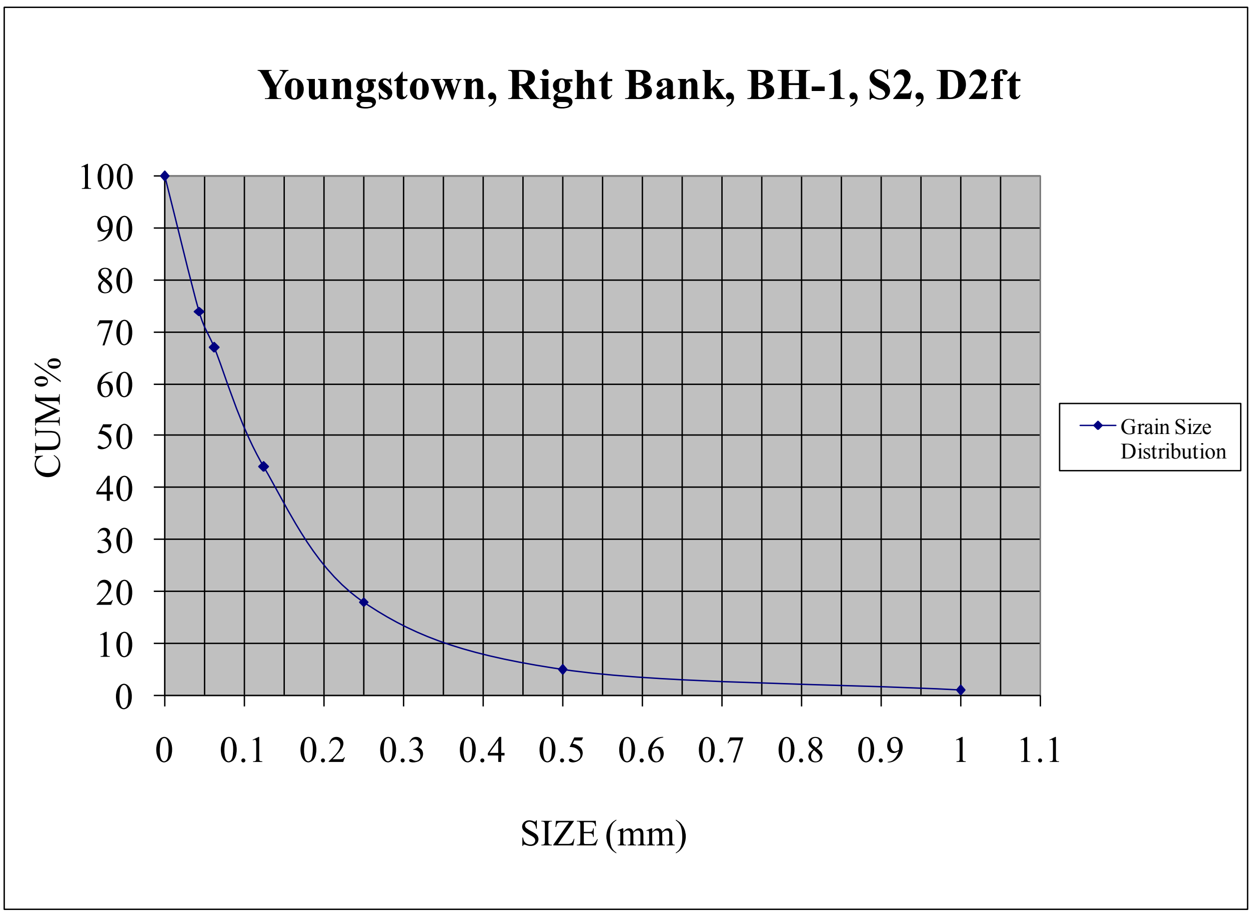
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 10/22/06	
BH-1, S1, 1ft. bsg[a]		Original Sample Weight: 101.9g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.9	1.9	2
0.5	8.2	10.1	10
0.25	15.5	25.6	25
0.125	27.9	53.5	53
0.063	22.6	76.1	76
0.044	7.2	83.3	83
pan	17.2	100.5	100

a. Below surface grade.



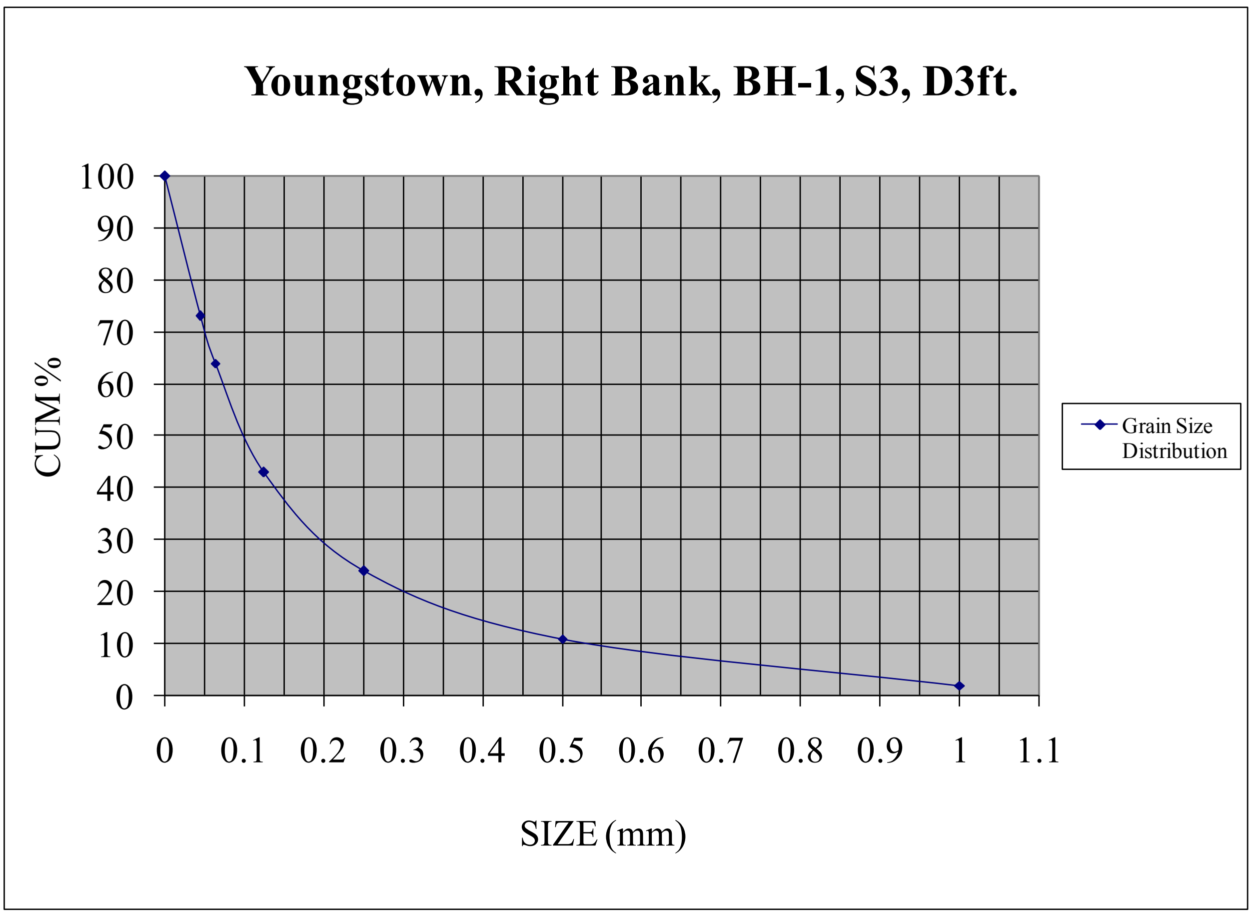
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 10/22/06	
BH-1, S2, 2ft. bsg[a]		Original Sample Weight: 98.2g	
Sieve Opening (mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.5	0.5	1
0.5	4.1	4.6	5
0.25	12.4	17.0	18
0.125	25.4	42.4	44
0.063	22.0	64.4	67
0.044	7.4	71.8	74
pan	24.8	96.6	100

a. Below surface grade.



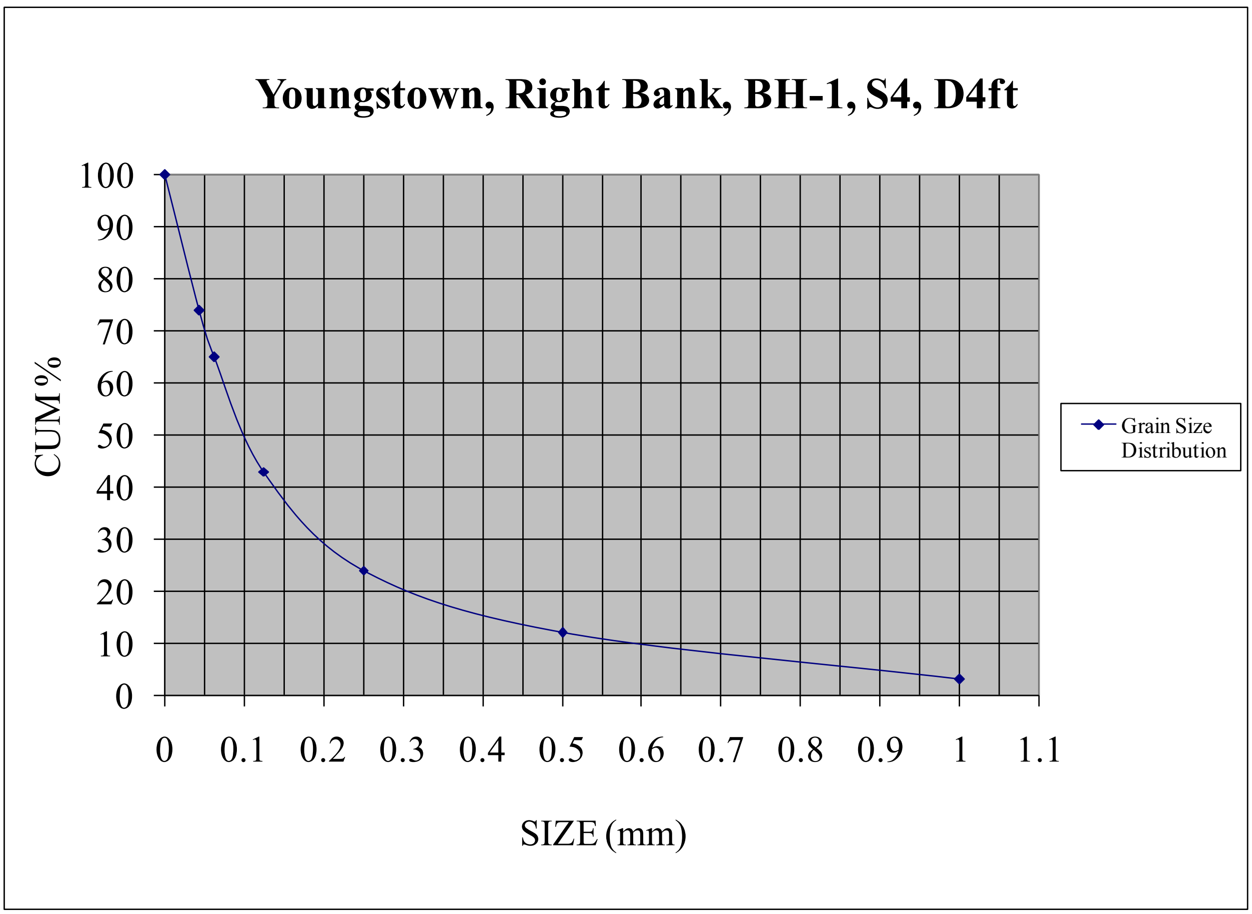
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 10/22/06	
BH-1, S3, 3ft. bsg[a]		Original Sample Weight: 113.3g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.4	2.4	2
0.5	9.5	11.9	11
0.25	14.8	26.7	24
0.125	21.1	47.8	43
0.063	23.9	71.7	64
0.044	9.5	81.2	73
pan	30.3	111.5	100

a. Below surface grade.



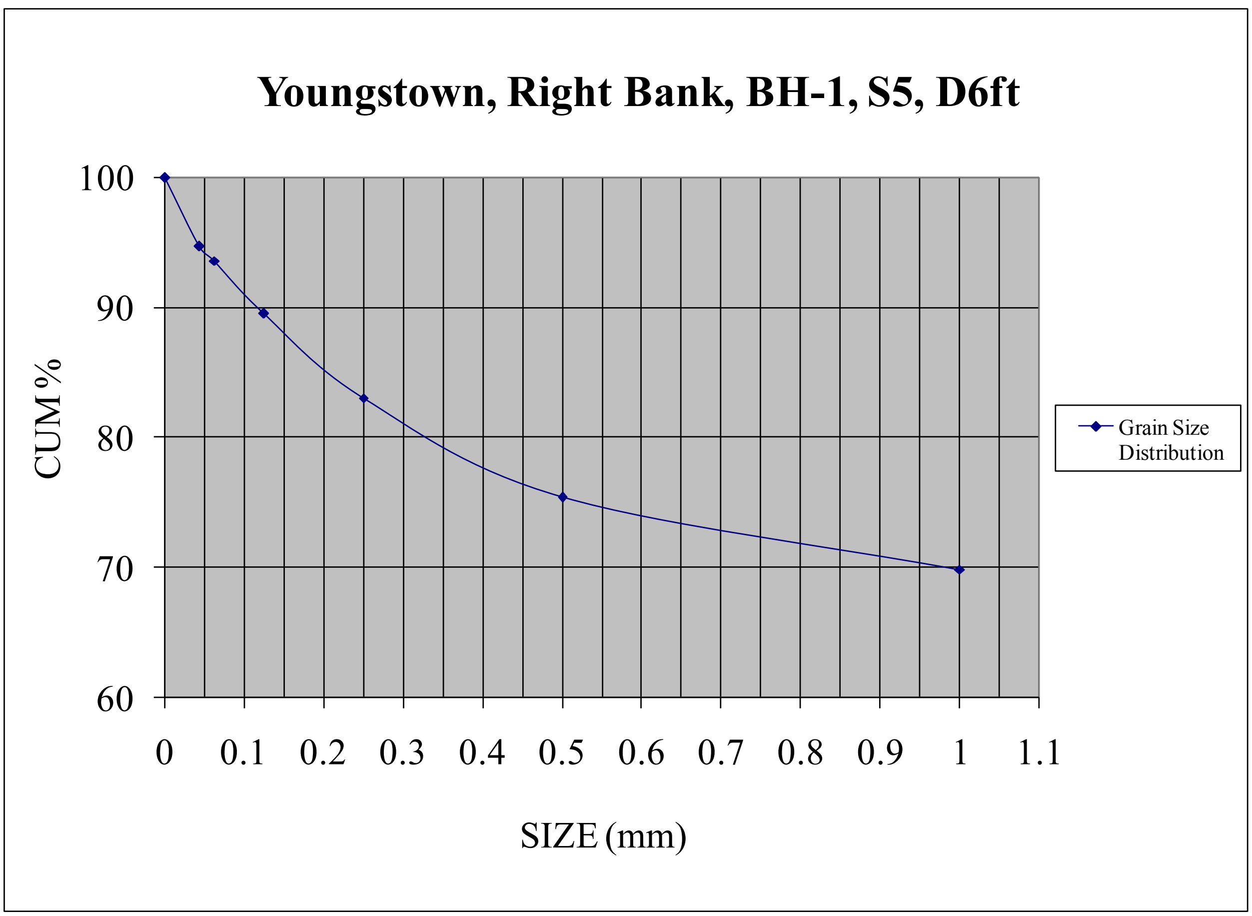
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 10/22/06	
BH-1, S4, 4ft. bsg[a]		Original Sample Weight: 109.1g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	3.4	3.4	3
0.5	9.5	12.9	12
0.25	13.0	25.9	24
0.125	20.1	46.0	43
0.063	24.4	70.4	65
0.044	9.5	79.9	74
pan	27.9	107.8	100

a. Below surface grade.



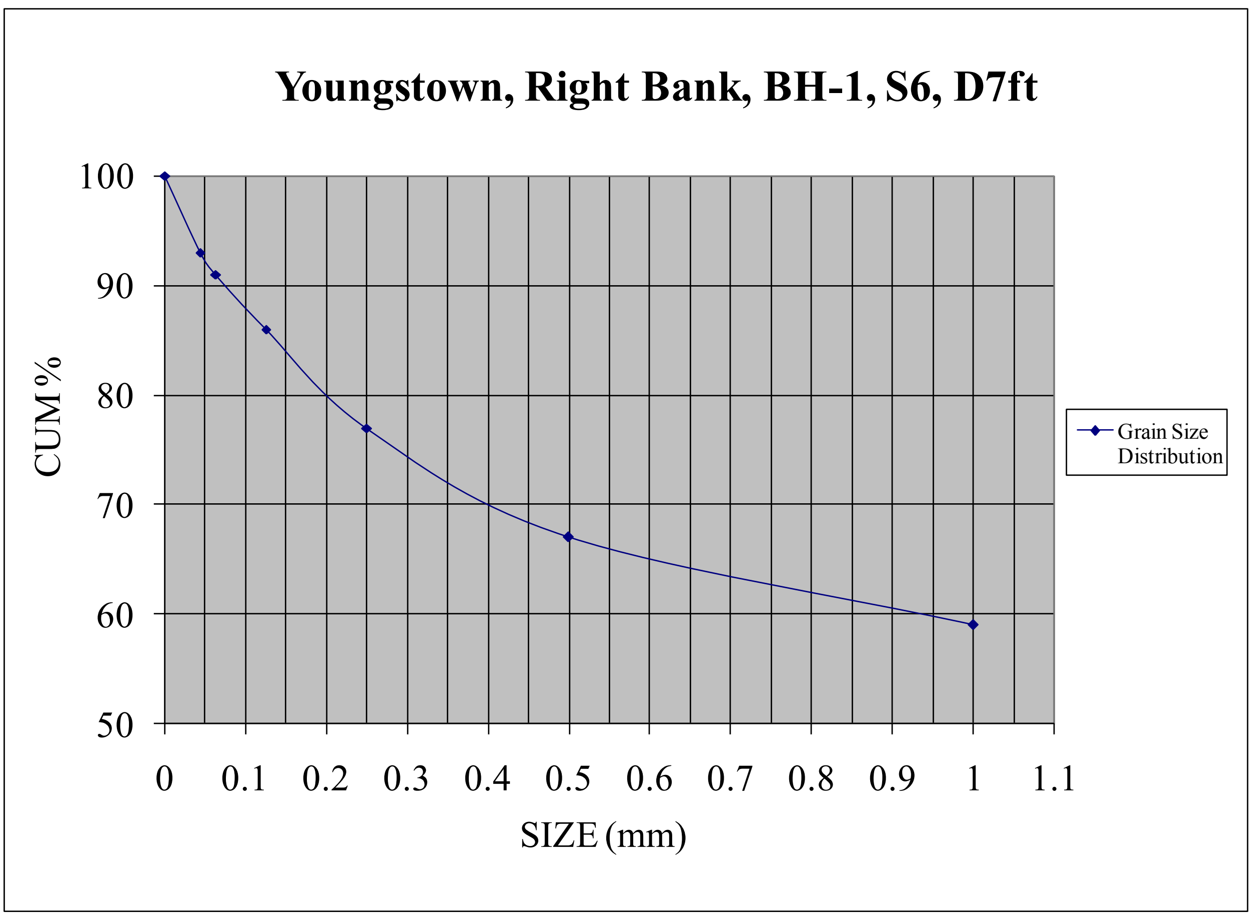
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 10/22/06	
BH-1, S5, 6ft. bsg[a]		Original Sample Weight: 110.8 g	
Sieve Opening (mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	76.7	76.7	70
0.5	6.1	82.8	75
0.25	8.4	91.2	83
0.125	7.1	98.3	90
0.063	4.5	102.8	94
0.044	1.2	104.0	95
pan	5.8	109.8	100

a. Below surface grade.



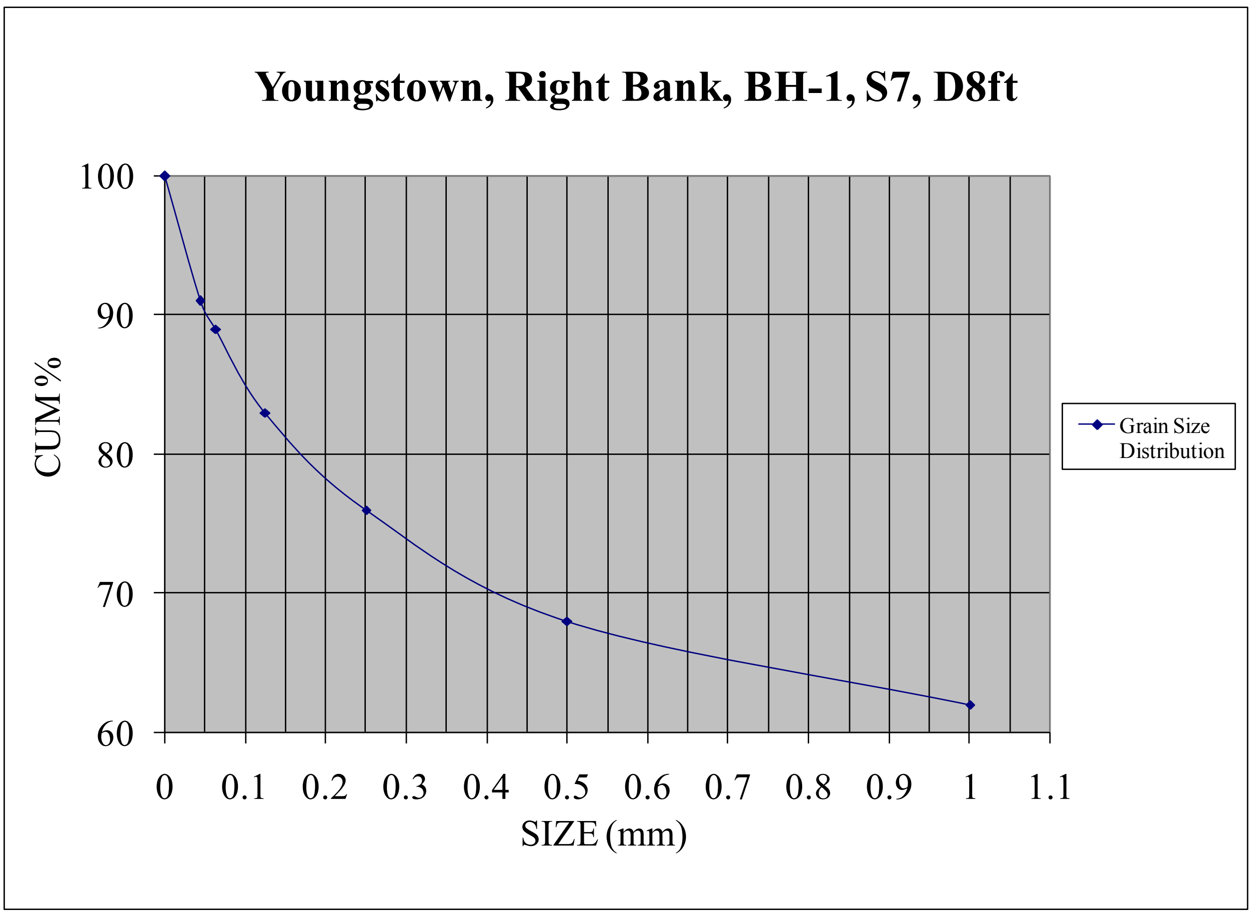
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 10/22/06	
BH-1, S6, 7ft. bsg[a]		Original Sample Weight: 123.7g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	72.6	72.6	59
0.5	8.9	81.5	67
0.25	12.7	94.2	77
0.125	10.4	104.6	86
0.063	6.9	111.5	91
0.044	2.1	113.6	93
pan	8.6	122.2	100

a. Below surface grade.



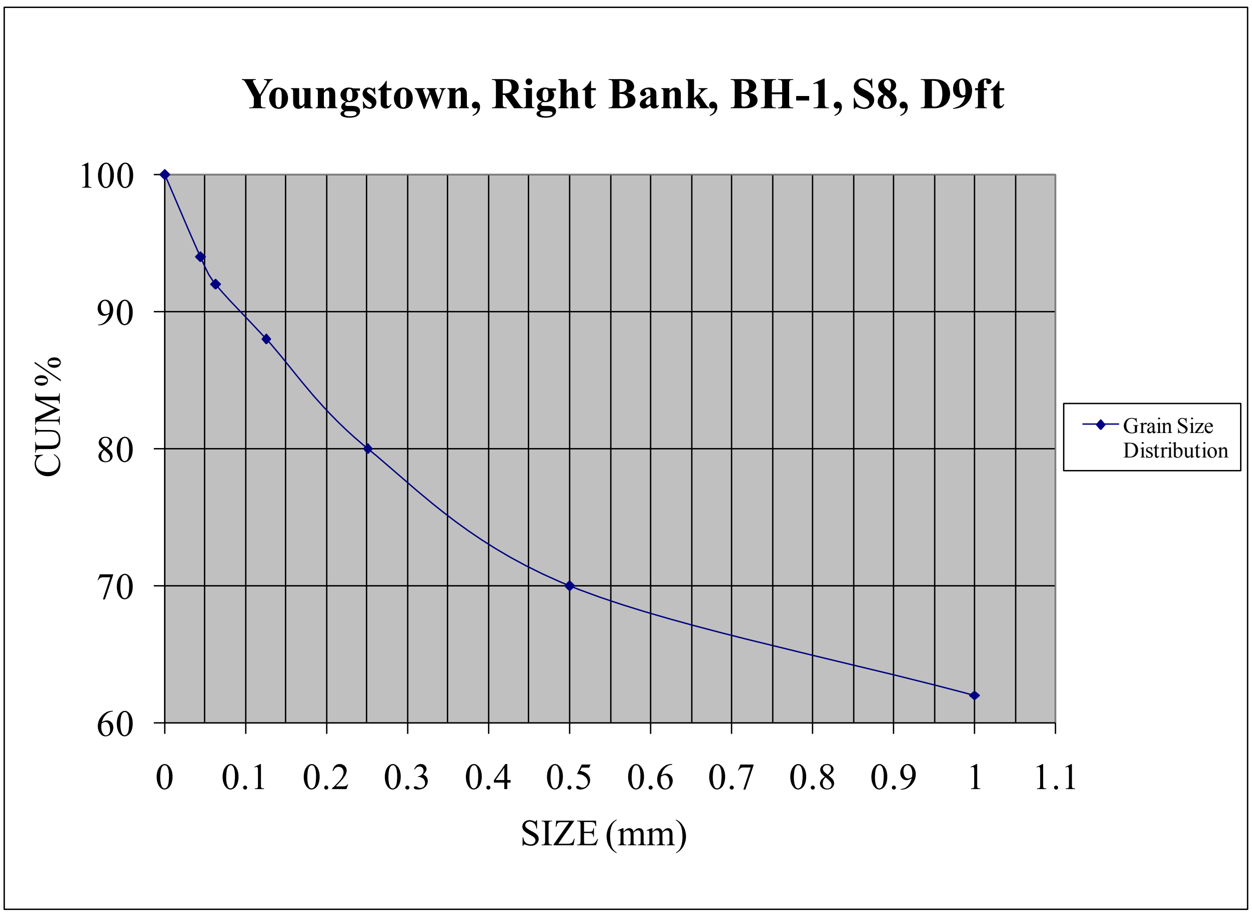
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 10/22/06	
BH-1, S7, 8ft. bsg[a]		Original Sample Weight: 105.5g	
Sieve Opening (mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	64.6	64.6	62
0.5	6.2	70.8	68
0.25	8.0	78.8	76
0.125	8.0	86.8	83
0.063	6.4	93.2	89
0.044	2.0	95.2	91
pan	9.1	104.3	100

a. Below surface grade.



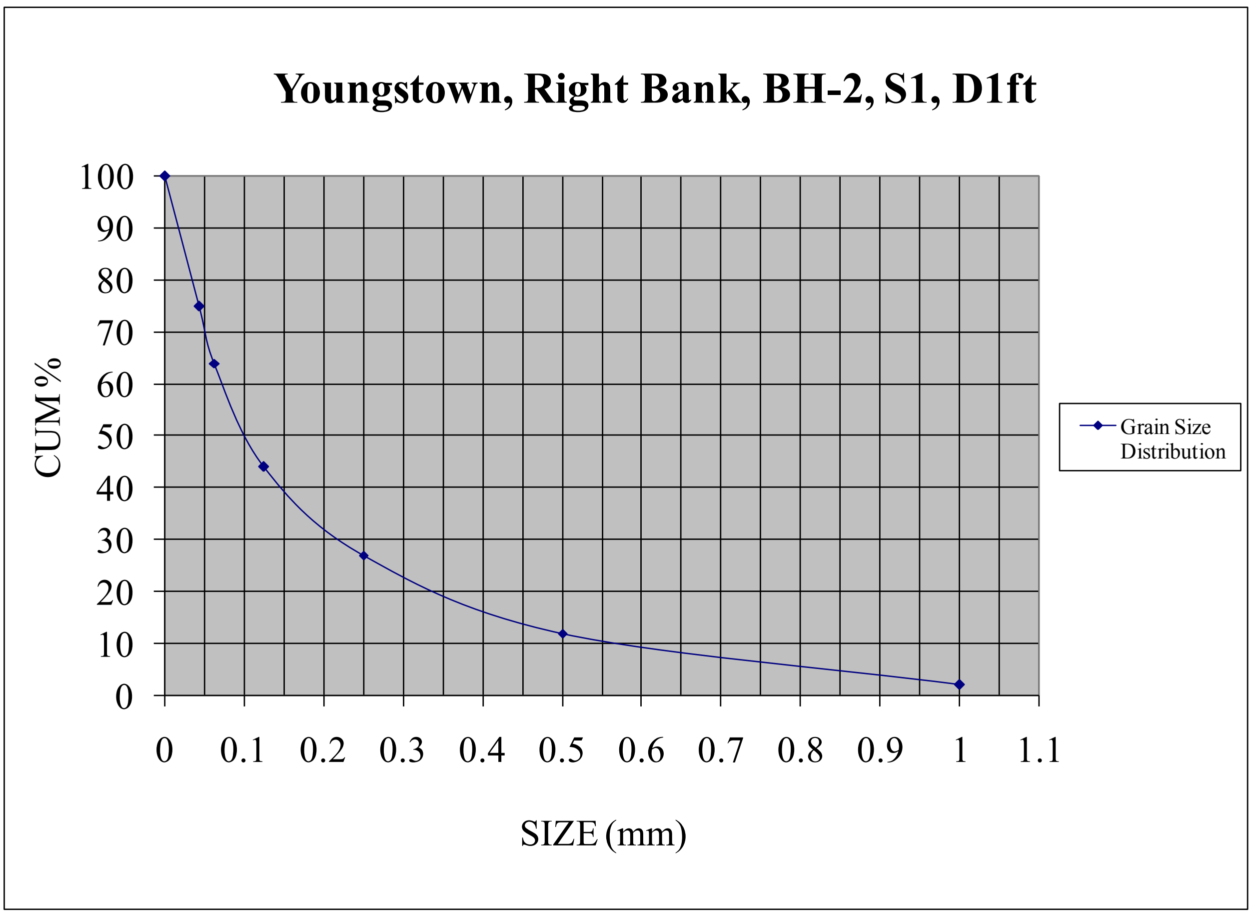
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 10/22/06	
BH-1, S8, 9ft. bsg[a]		Original Sample Weight: 110.3g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	67.9	67.9	62
0.5	8.9	76.8	70
0.25	10.8	87.6	80
0.125	8.6	96.2	88
0.063	5.1	101.3	92
0.044	1.5	102.8	94
pan	6.8	109.6	100

a. Below surface grade.



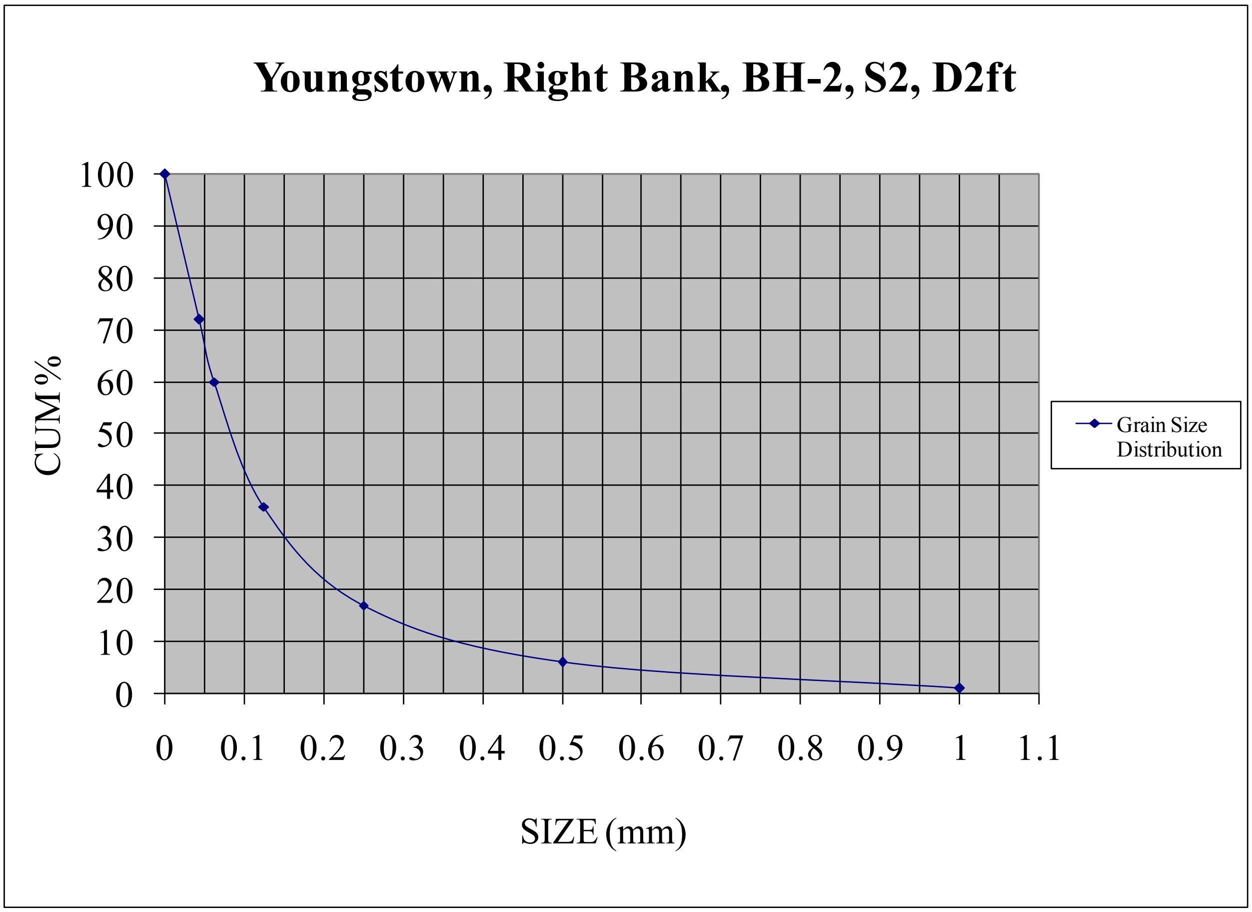
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-2, S1, 1ft. bsg[a]		Original Sample Weight: 116.6g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.7	2.7	2
0.5	11.2	13.9	12
0.25	17.2	31.1	27
0.125	19.5	50.6	44
0.063	23.4	74.0	64
0.044	12.8	86.8	75
pan	28.8	115.6	100

a. Below surface grade.



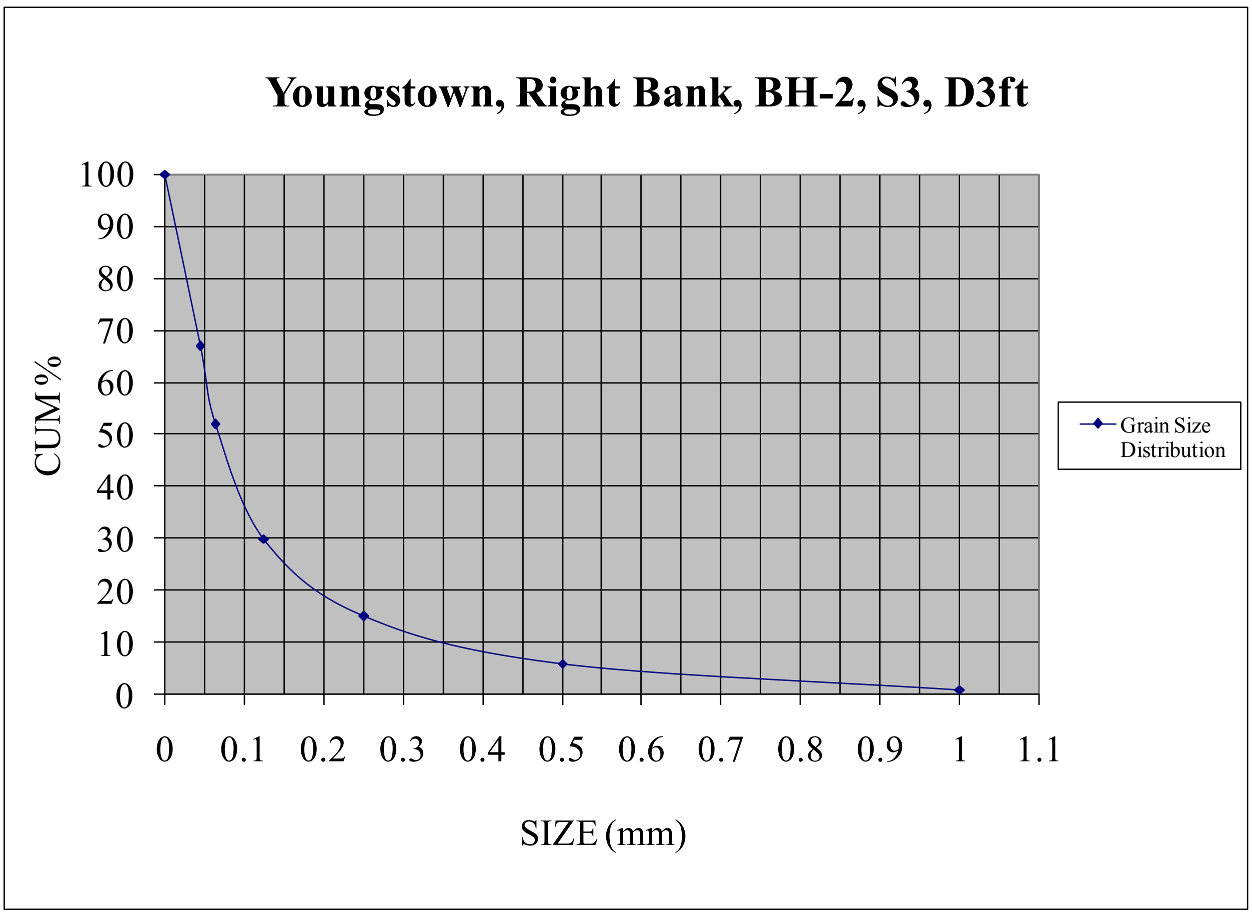
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-2, S2, 2ft. bsg[a]		Original Sample Weight: 103.6g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.2	1.2	1
0.5	4.8	6.0	6
0.25	11.0	17.0	17
0.125	19.9	36.9	36
0.063	23.5	60.4	60
0.044	13.0	73.4	72
pan	28.1	101.5	100

a. Below surface grade.



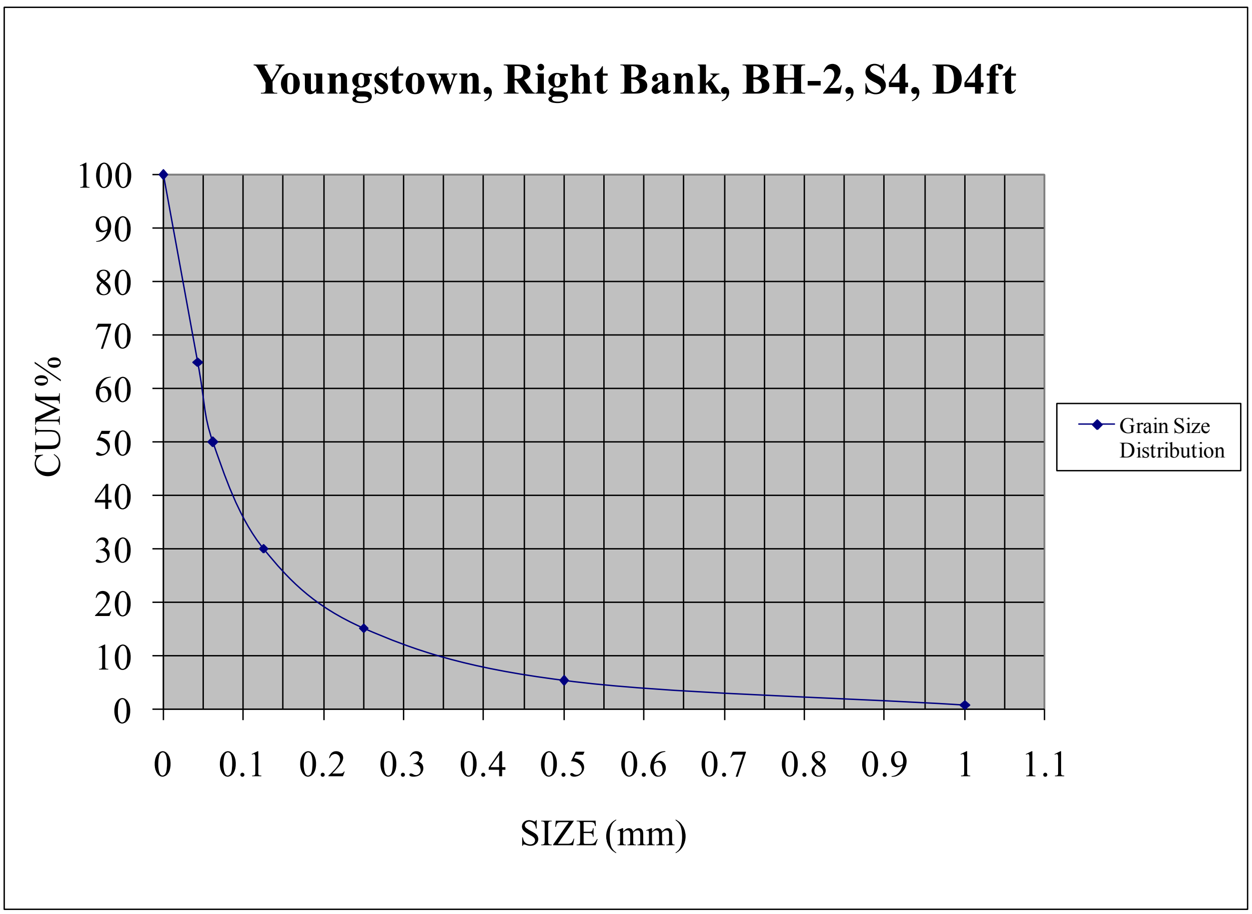
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-2, S3, 3ft. bsg[a]		Original Sample Weight: 118.1g	
Sieve Opening (mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	1.5	1.5	1
0.5	5.3	6.8	6
0.25	11.1	17.9	15
0.125	16.5	34.4	30
0.063	25.6	60.0	52
0.044	18.1	78.1	67
pan	38.0	116.1	100

a. Below surface grade.



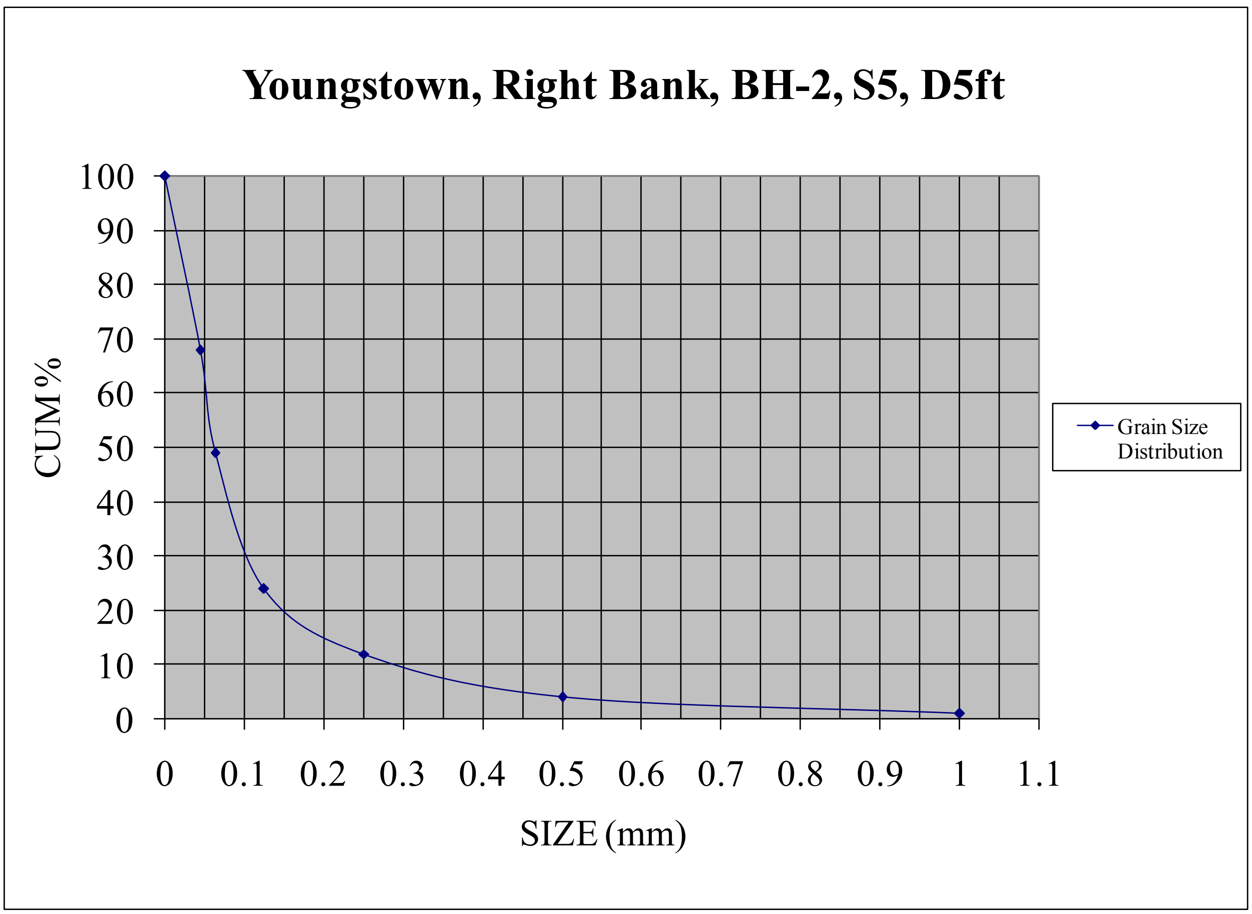
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		**Sample Date: 11/4/06**	
BH-2, S4, 4ft. bsg[a]		**Original Sample Weight: 103.2g**	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.0	1.0	1
0.5	4.5	5.5	5
0.25	10.0	15.5	15
0.125	15.1	30.6	30
0.063	20.1	50.7	50
0.044	15.3	66.0	65
pan	35.4	101.4	100

a. Below surface grade.



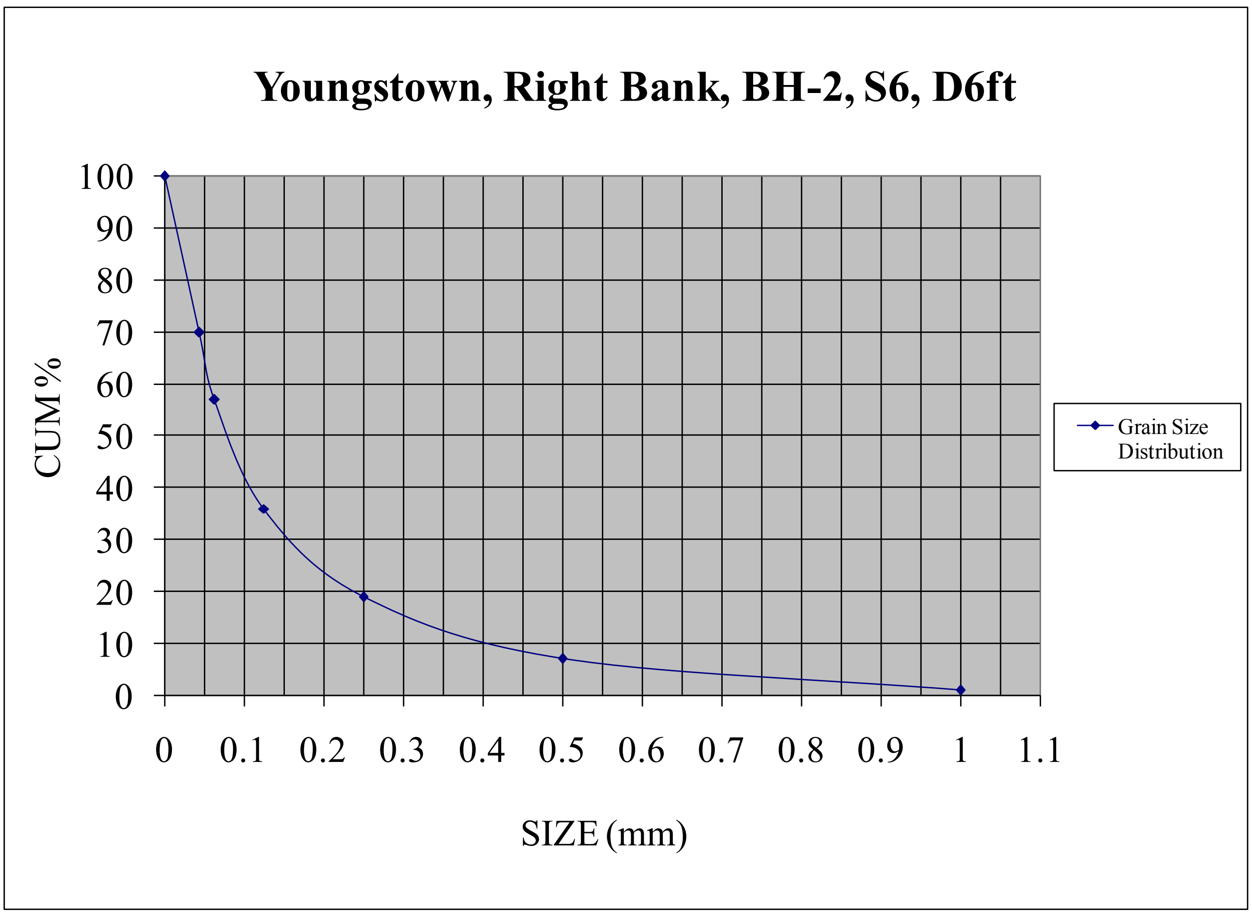
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-2, S5, 5ft. bsg[a]		Original Sample Weight: 113.9g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.9	0.9	1
0.5	3.8	4.7	4
0.25	9.1	13.8	12
0.125	13.3	27.1	24
0.063	28.0	55.1	49
0.044	20.4	75.5	68
pan	36.3	111.8	100

a. Below surface grade.



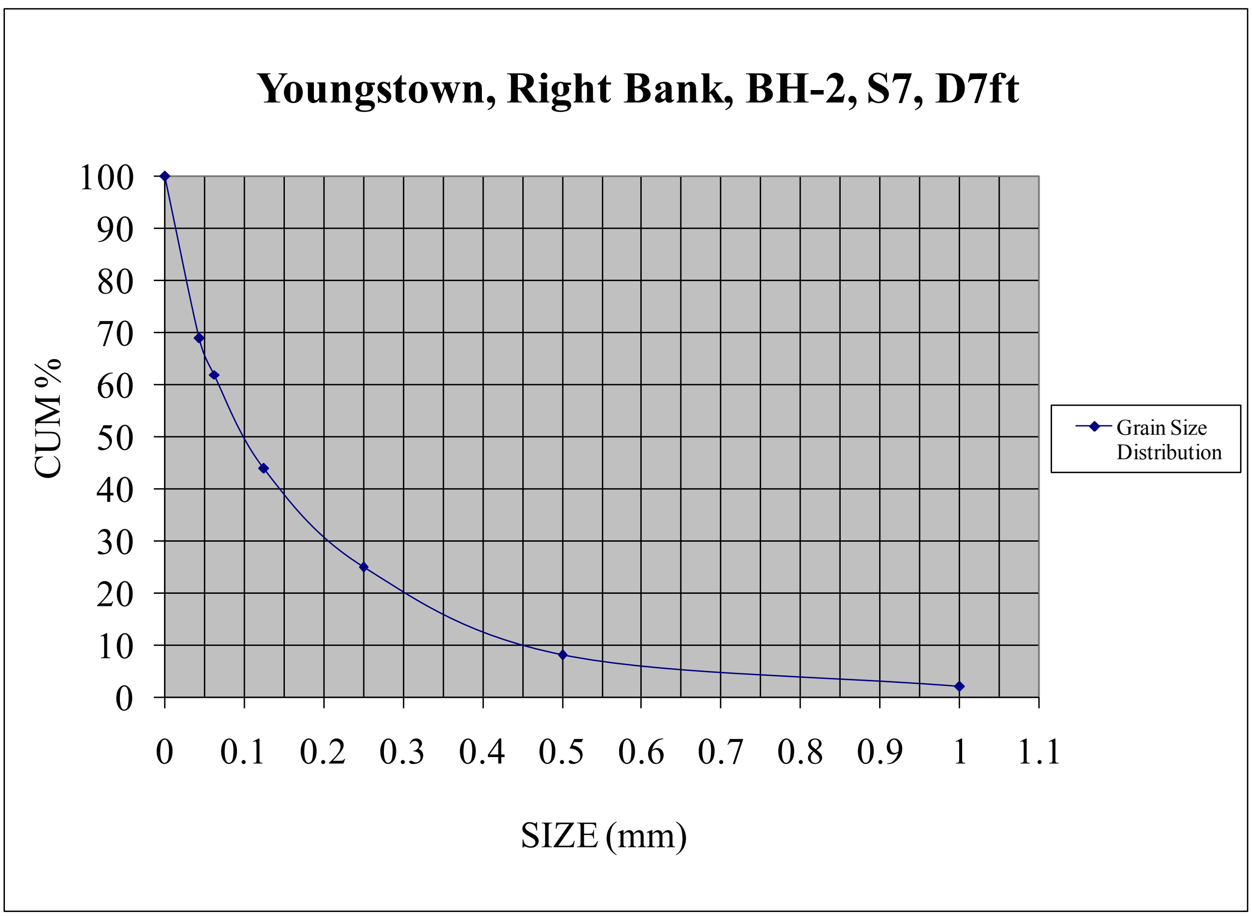
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-2, S6, 6ft. bsg[a]		Original Sample Weight: 106.5g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.2	1.2	1
0.5	5.7	6.9	7
0.25	12.7	19.6	19
0.125	17.9	37.5	36
0.063	21.9	59.4	57
0.044	14.3	73.7	70
pan	31.1	104.8	100

a. Below surface grade.



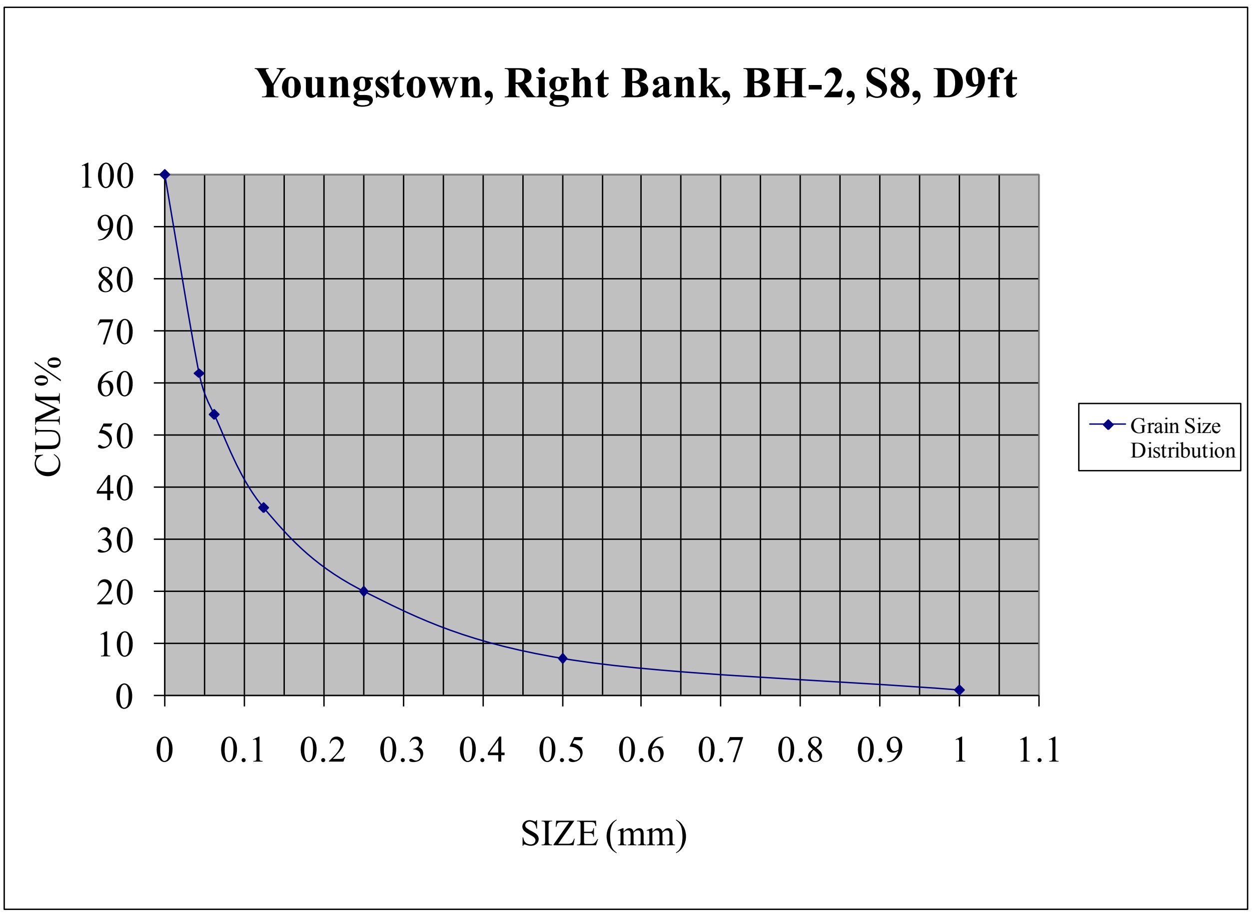
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-2, S7, 7ft. bsg[a]		Original Sample Weight: 111.8g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	2.4	2.4	2
0.5	6.3	8.7	8
0.25	18.6	27.3	25
0.125	21.2	48.5	44
0.063	19.8	68.3	62
0.044	8.1	76.4	69
pan	33.8	110.2	100

a. Below surface grade.



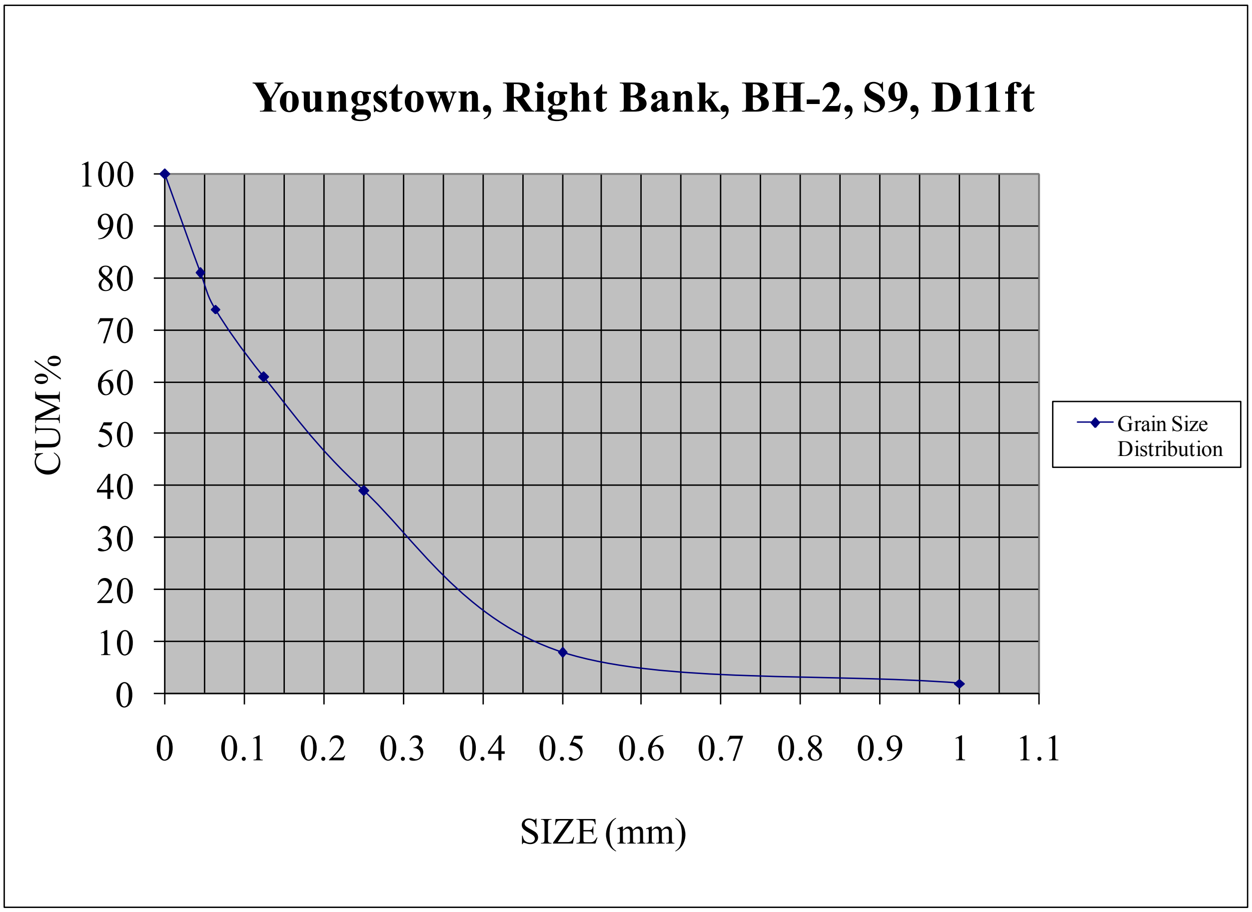
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-2, S8, 9ft. bsg[a]		Original Sample Weight: 110.4g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.5	1.5	1
0.5	5.8	7.3	7
0.25	13.8	21.1	20
0.125	17.6	38.7	36
0.063	19.2	57.9	54
0.044	8.7	66.6	62
pan	41.3	107.9	100

a. Below surface grade.



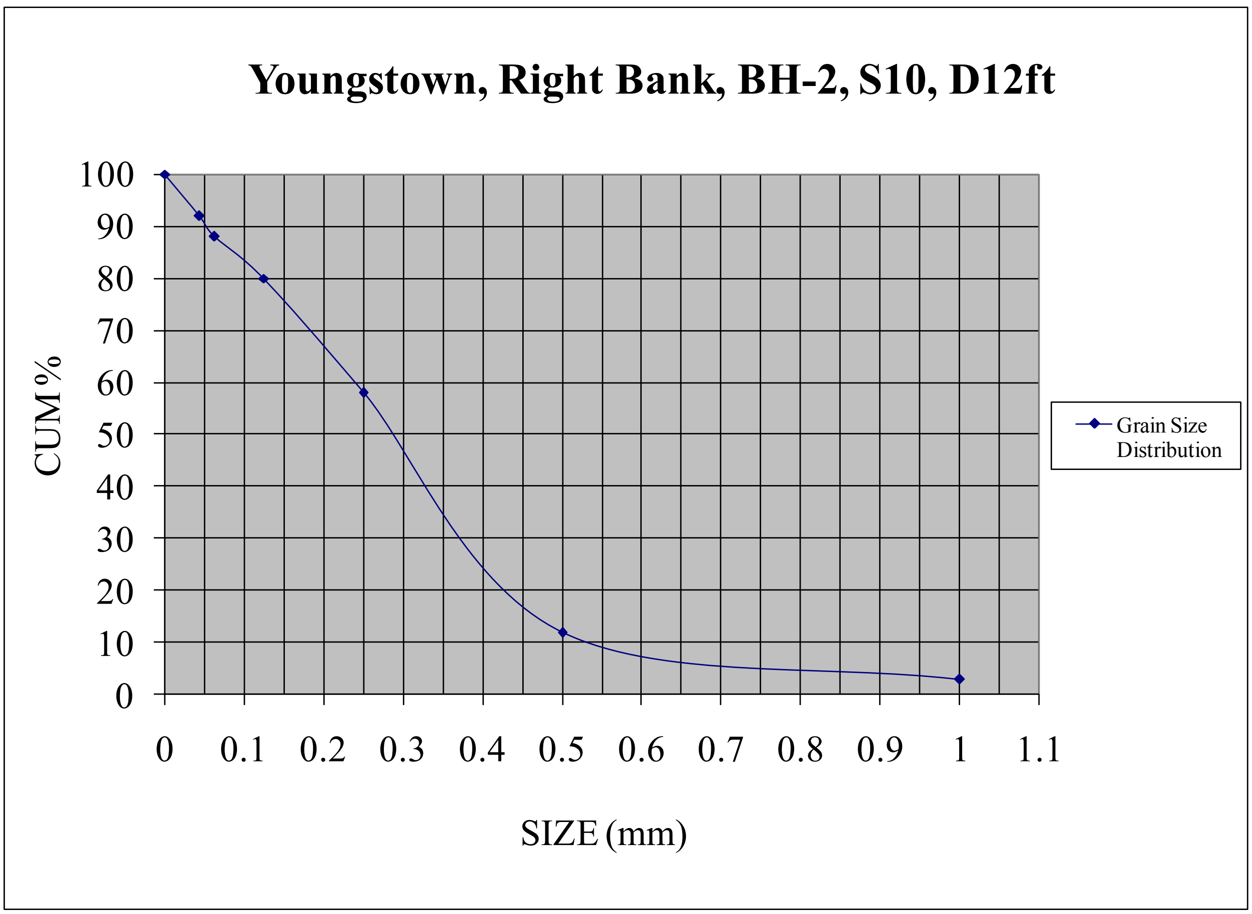
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-2, S9, 11ft. bsg[a]		Original Sample Weight: 116.6g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	1.9	1.9	2
0.5	6.9	8.8	8
0.25	36.7	45.5	39
0.125	25.0	70.5	61
0.063	15.2	85.7	74
0.044	7.7	93.4	81
pan	22.5	115.9	100

a. Below surface grade.



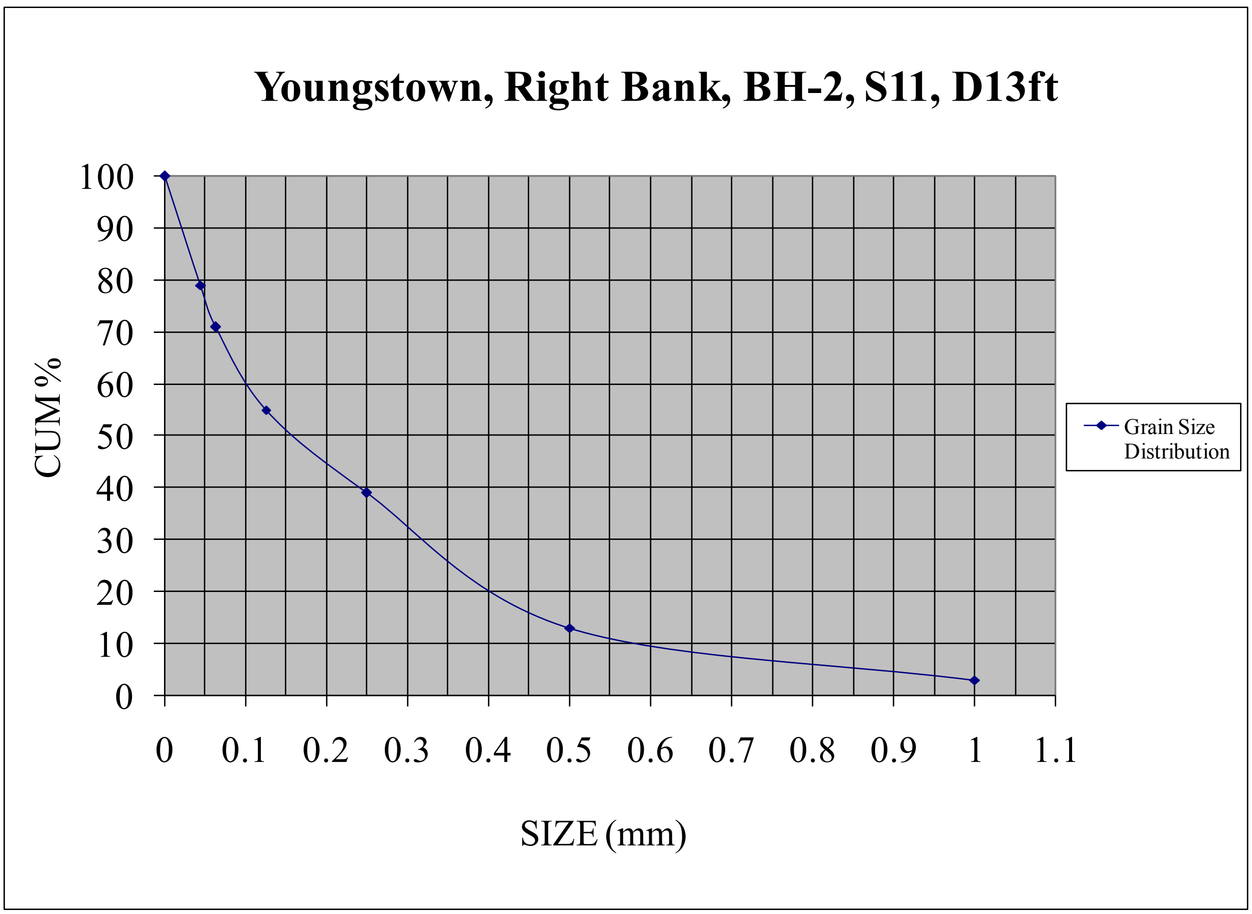
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-2, S10, 12ft. bsg[a]		Original Sample Weight: 111.2g	
Sieve Opening (mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	3.1	3.1	3
0.5	9.9	13.0	12
0.25	49.7	62.7	58
0.125	25.0	87.7	80
0.063	8.6	96.3	88
0.044	3.7	100.0	92
pan	9.0	109.0	100

a. Below surface grade.



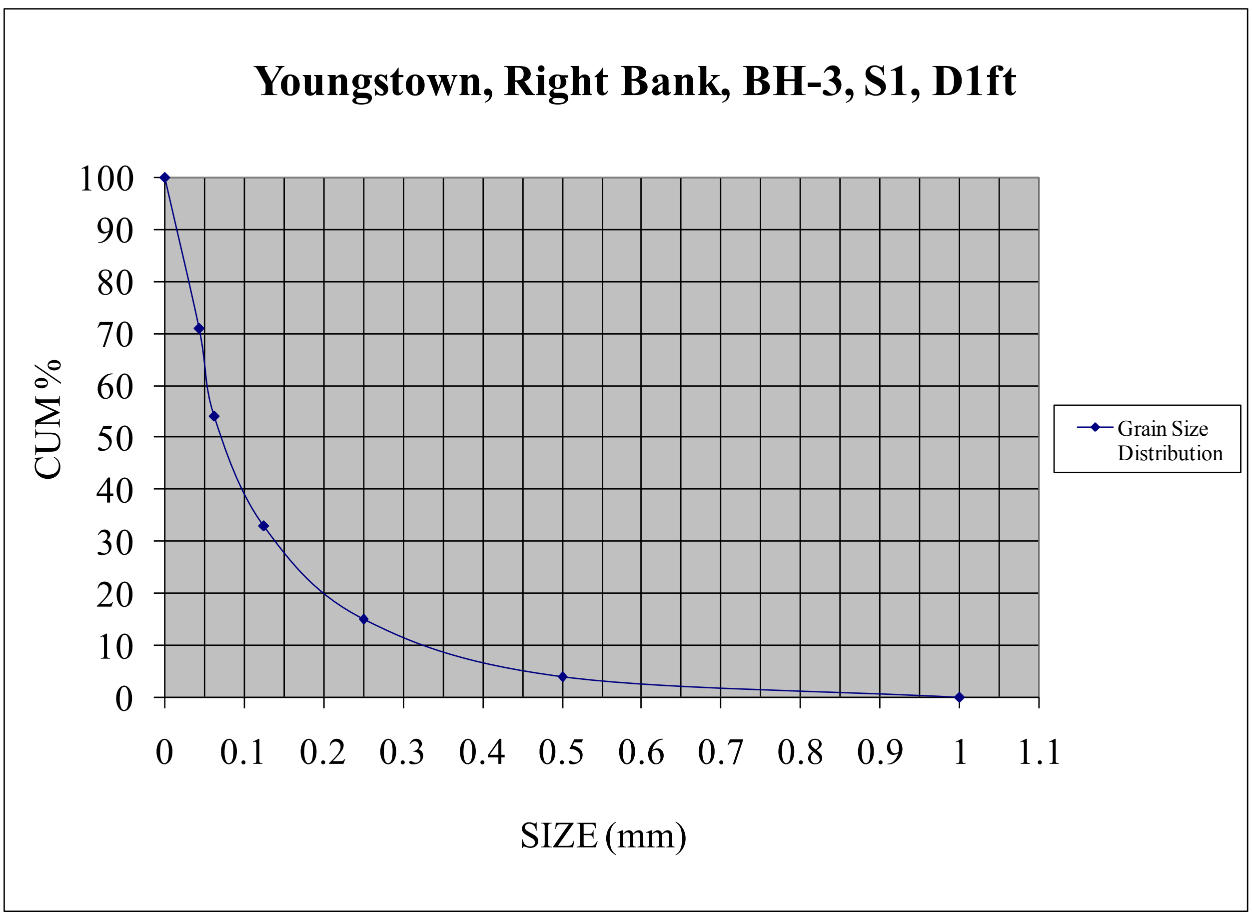
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-2, S11, 13ft. bsg[a]		Original Sample Weight: 106g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	3.3	3.3	3
0.5	10.0	13.3	13
0.25	27.5	40.8	39
0.125	16.8	57.6	55
0.063	16.5	74.1	71
0.044	7.9	82.0	79
pan	22.4	104.4	100

a. Below surface grade.



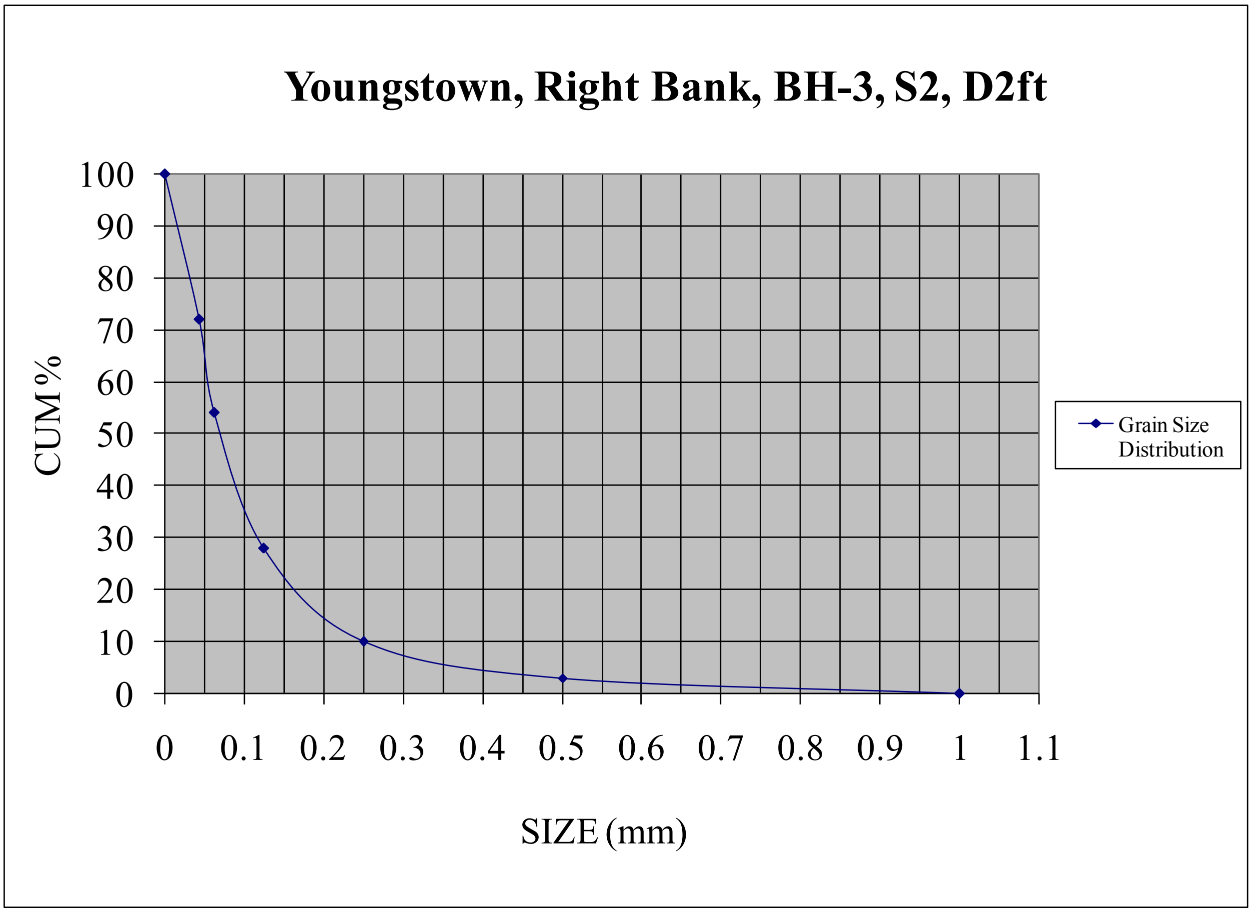
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-3, S1, 1ft. bsg[a]		Original Sample Weight: 110.8g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.5	0.5	0
0.5	3.4	3.9	4
0.25	12.9	16.8	15
0.125	18.9	35.7	33
0.063	23.7	59.4	54
0.044	18.6	78.0	71
pan	31.5	109.5	100

a. Below surface grade.



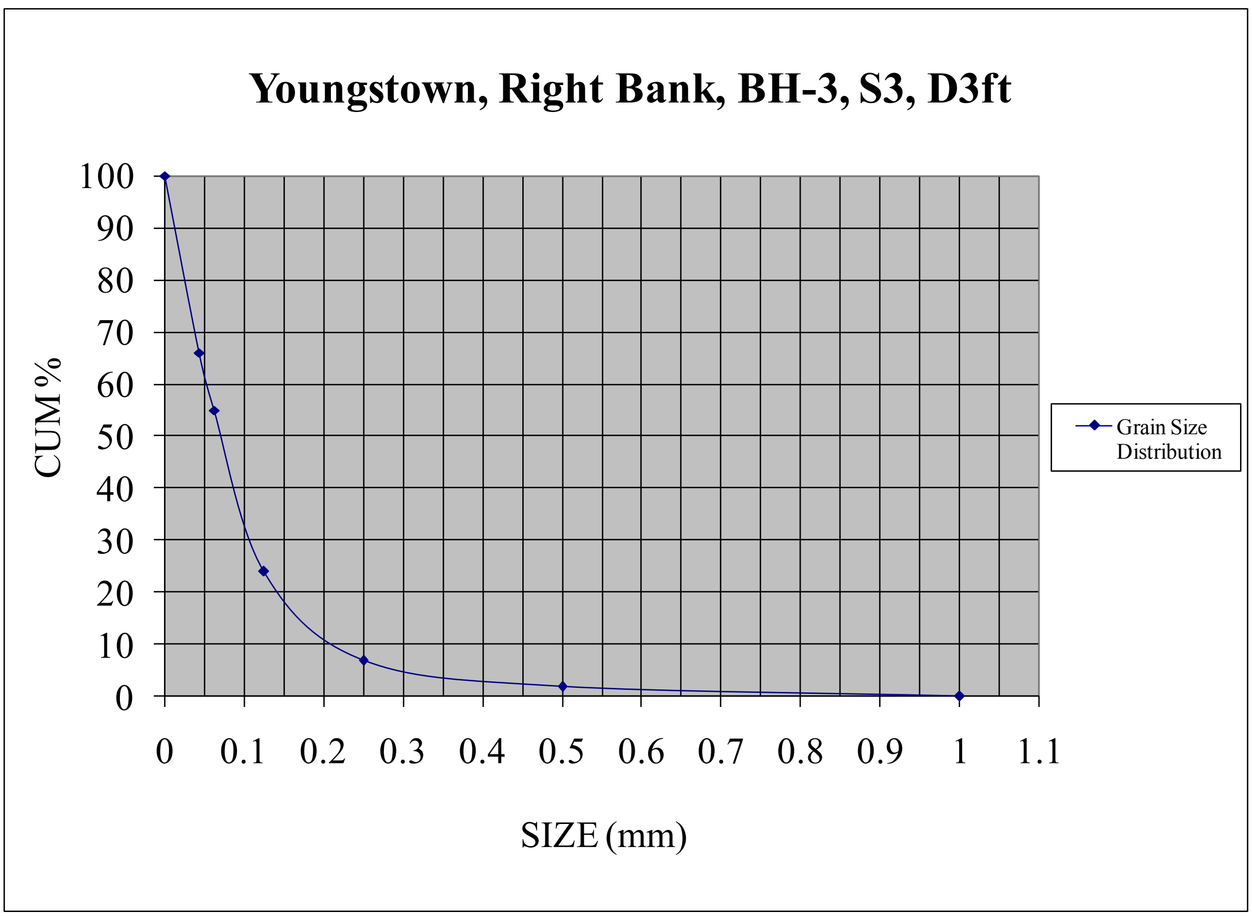
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-3, S2, 2ft. bsg[a]		Original Sample Weight: 106.6g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.5	0.5	0
0.5	2.4	2.9	3
0.25	7.7	10.6	10
0.125	19.4	30.0	28
0.063	27.1	57.1	54
0.044	19.1	76.2	72
pan	29.2	105.4	100

a. Below surface grade.



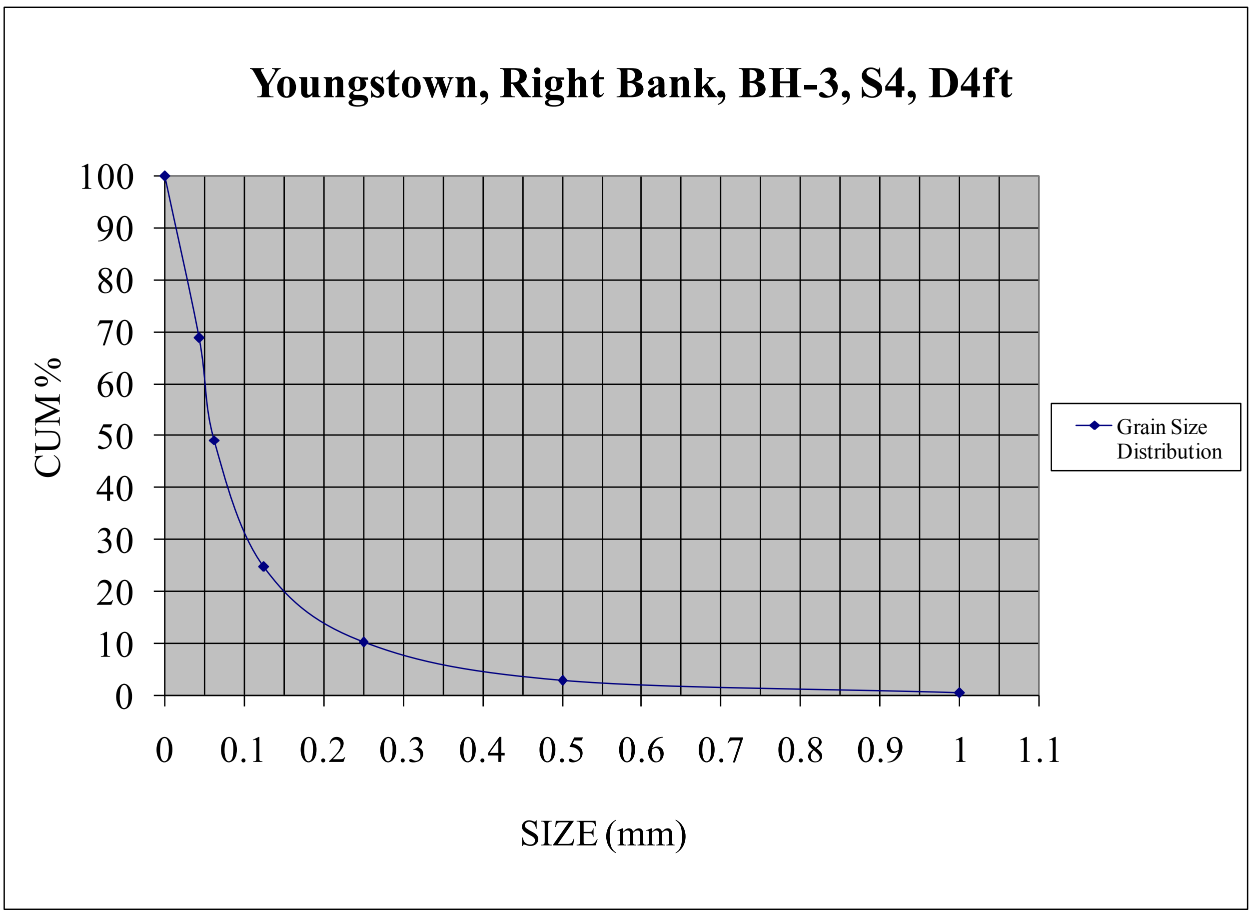
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-3, S3, 3ft. bsg[a]		Original Sample Weight: 102.4g	
Sieve Opening (mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.2	0.2	0
0.5	1.4	1.6	2
0.25	5.3	6.9	7
0.125	17.4	24.3	24
0.063	30.5	54.8	55
0.044	11.9	66.7	66
pan	33.8	100.5	100

a. Below surface grade.



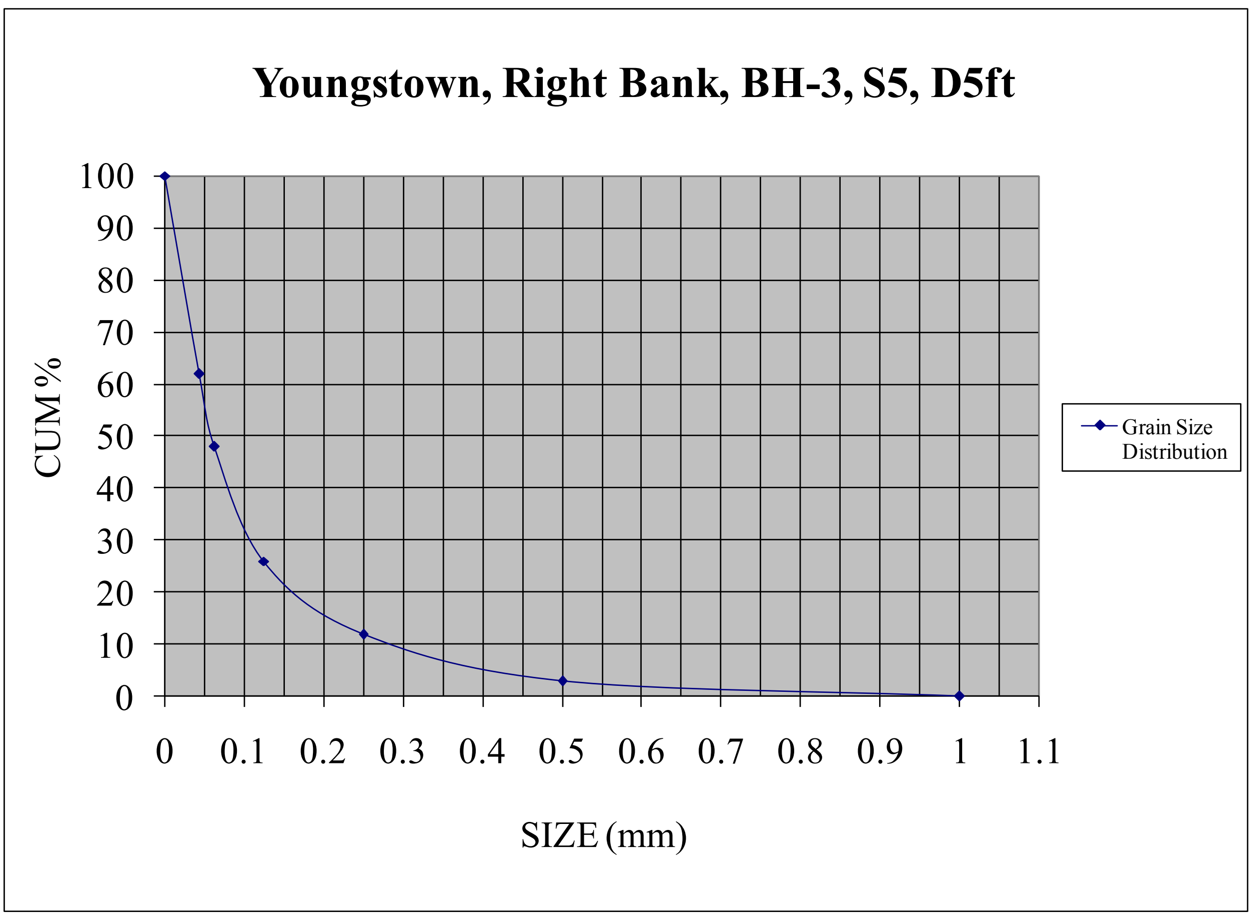
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-3, S4, 4ft. bsg[a]		Original Sample Weight: 102.4g	
Sieve Opening (mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	0.5	0.5	1
0.5	2.4	2.9	3
0.25	7.3	10.2	10
0.125	14.4	24.6	25
0.063	24.4	49.0	49
0.044	19.6	68.6	69
pan	31.0	99.6	100

a. Below surface grade.



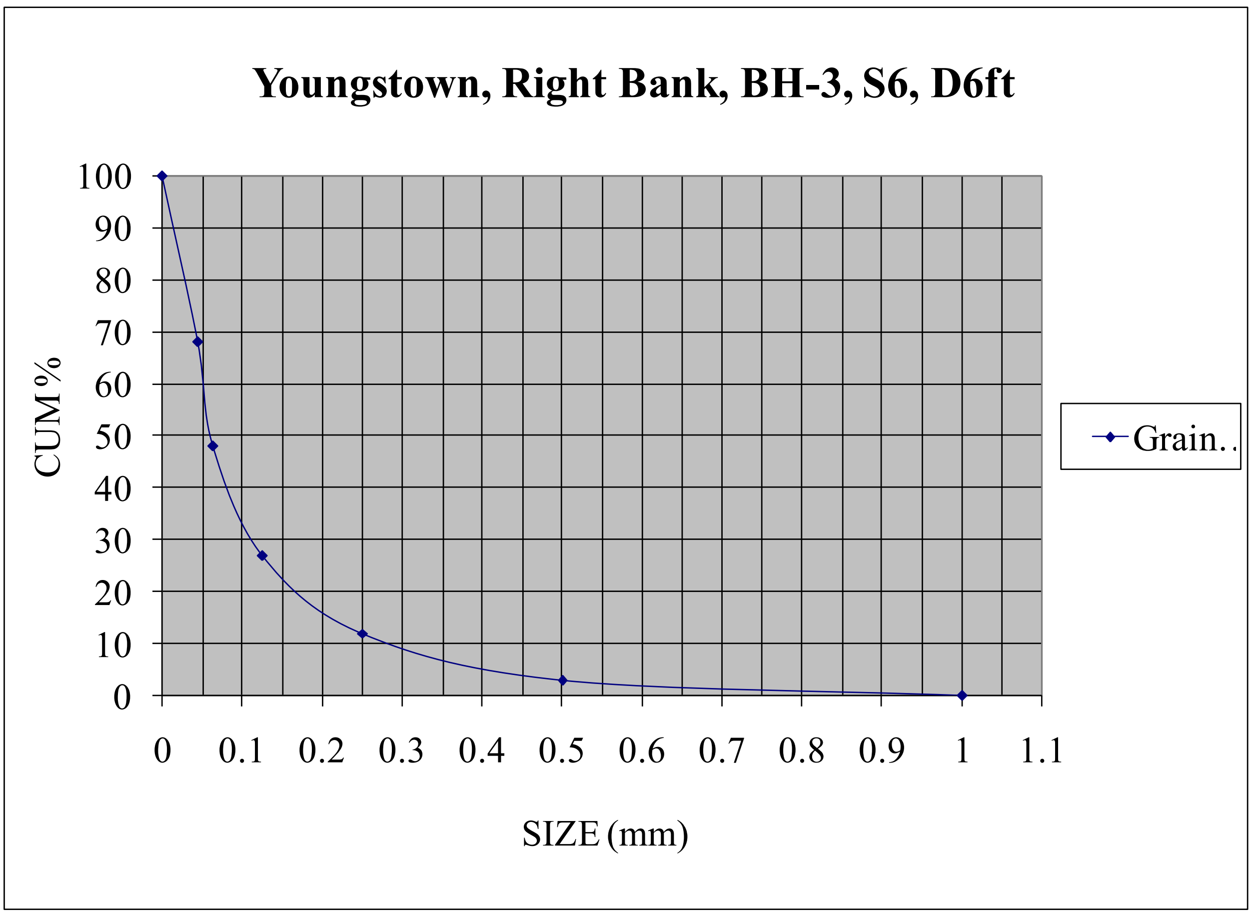
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-3, S5, 5ft. bsg[a]		Original Sample Weight: 104.1g	
Sieve Opening (mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.4	0.4	0
0.5	2.5	2.9	3
0.25	9.4	12.3	12
0.125	14.4	26.7	26
0.063	22.7	49.4	48
0.044	13.8	63.2	62
pan	39.3	102.5	100

a. Below surface grade.



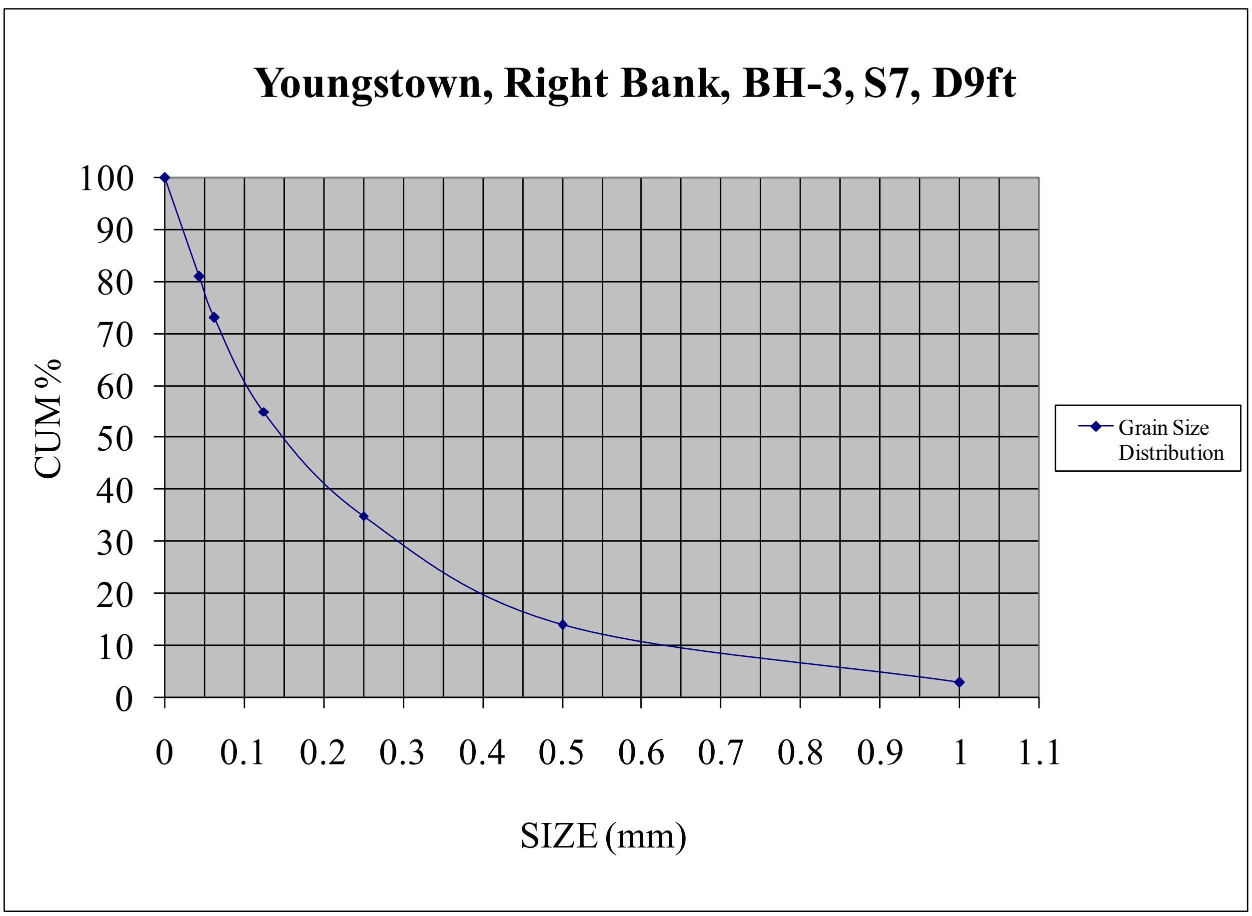
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-3, S6, 6ft. bsg[a]		Original Sample Weight: 105.8g	
Sieve Opening (mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.4	0.4	0
0.5	2.6	3.0	3
0.25	9.2	12.2	12
0.125	15.6	27.8	27
0.063	22.0	49.8	48
0.044	20.7	70.5	68
pan	32.7	103.2	100

a. Below surface grade.



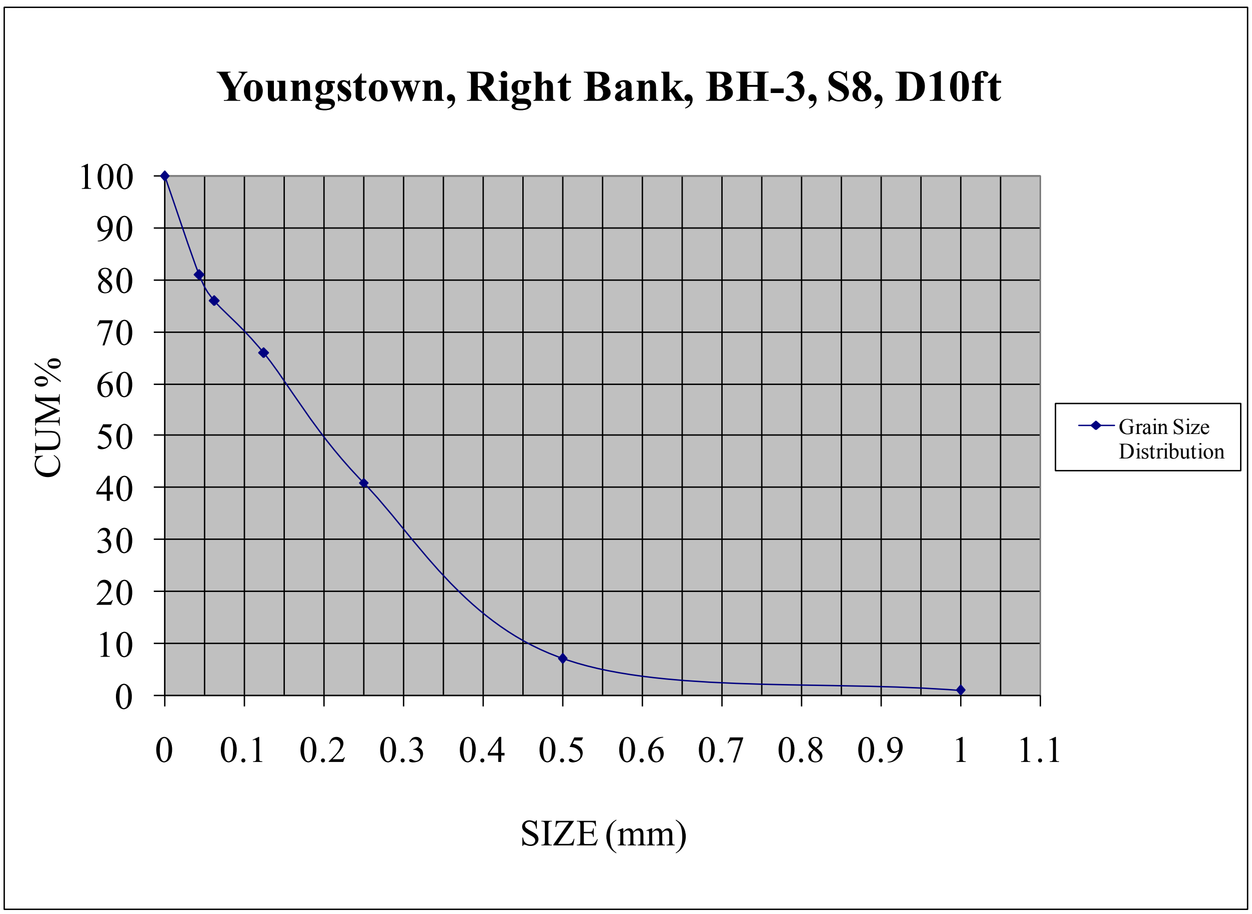
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-3, S7, 9 ft. bsg[a]		Original Sample Weight: 106.1g	
Sieve Opening (mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	3.1	3.1	3
0.5	11.1	14.2	14
0.25	22.8	37.0	35
0.125	20.4	57.4	55
0.063	19.0	76.4	73
0.044	8.4	84.8	81
pan	19.7	104.5	100

a. Below surface grade.



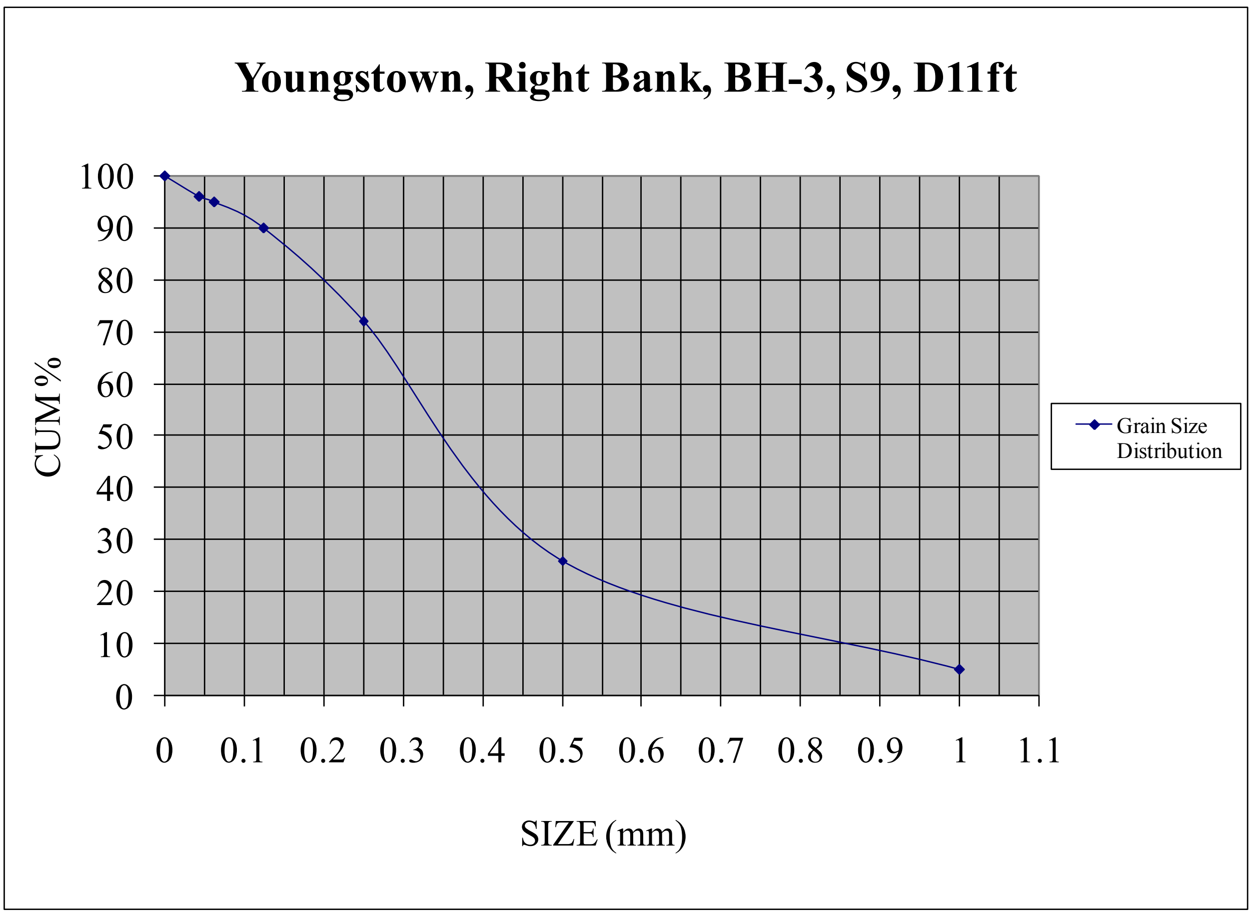
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		**Sample Date: 11/4/06**	
BH-3, S8, 10 ft. bsg[a]		**Original Sample Weight: 104.1g**	
Sieve Opening (mm)	**Weight(g)**	**Cumulative Weight(g)**	**Cumulative %**
1	0.6	0.6	1
0.5	6.8	7.4	7
0.25	34.8	42.2	41
0.125	26.6	68.8	66
0.063	9.7	78.5	76
0.044	5.3	83.8	81
pan	20.0	103.8	100

a. Below surface grade.



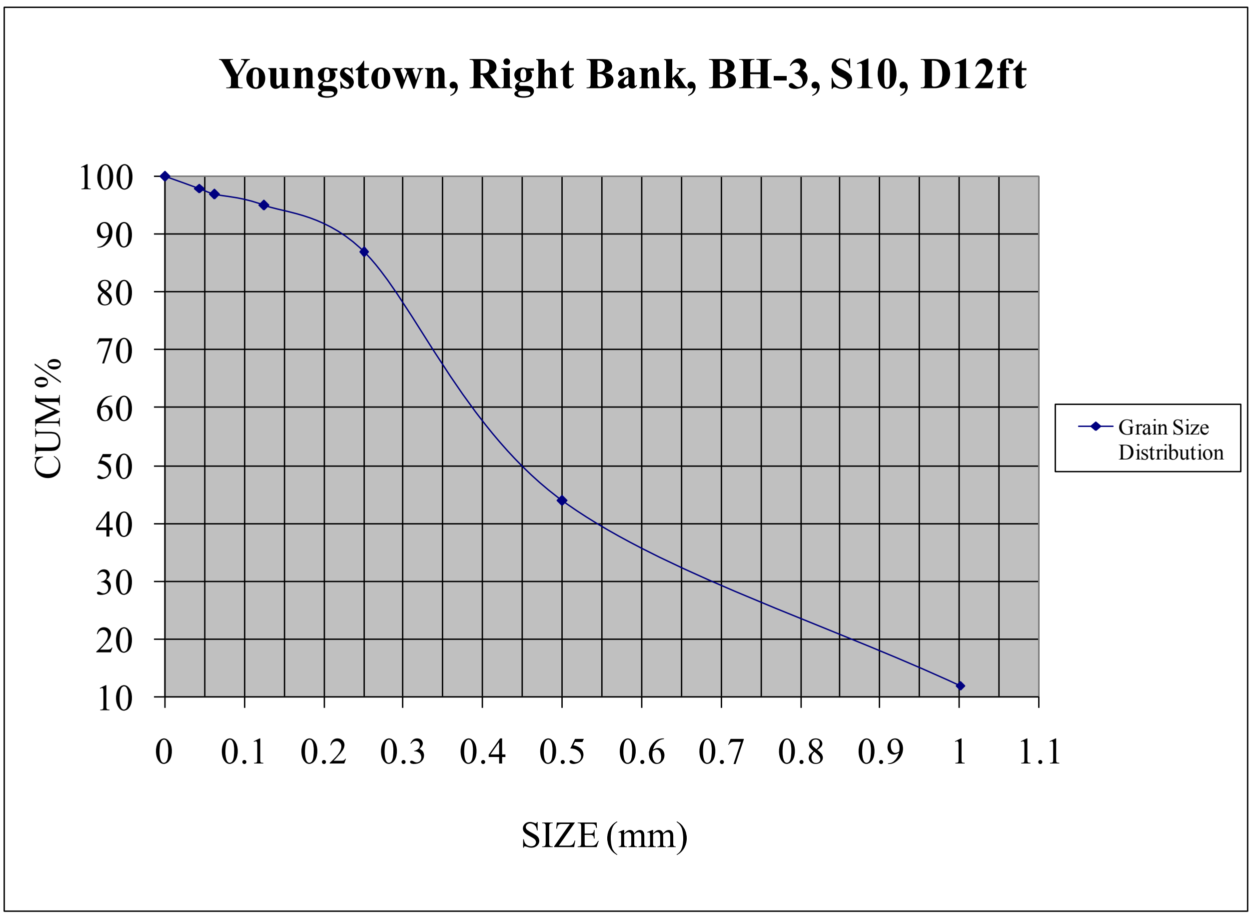
Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-3, S9, 11 ft. bsg[a]		Original Sample Weight: 118.9g	
Sieve Opening (mm)	**Weight (g)**	**Cumulative Weight (g)**	**Cumulative %**
1	6.3	6.3	5
0.5	24.6	30.9	26
0.25	54.7	85.6	72
0.125	20.6	106.2	90
0.063	5.7	111.9	95
0.044	1.4	113.3	96
pan	4.8	118.1	100

a. Below surface grade.

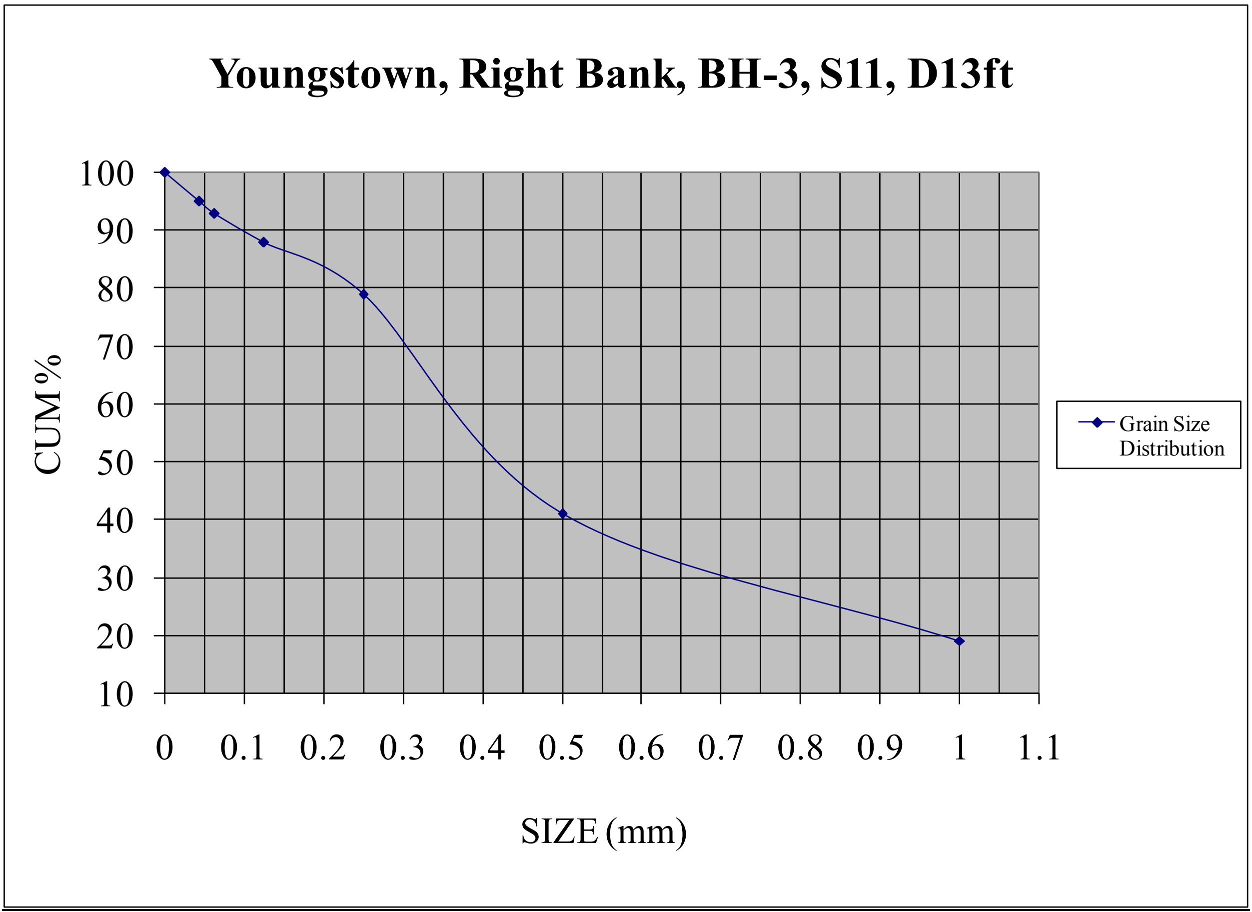


Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-3, S10, 12ft. bsg[a]		Original Sample Weight:111.1g	
Sieve Opening (mm)	Weight (g)	Cumulative Weight (g)	Cumulative %
1	13.1	13.1	12
0.5	35.6	48.7	44
0.25	46.8	95.5	87
0.125	9.2	104.7	95
0.063	1.9	106.6	97
0.044	1.1	107.7	98
pan	2.2	109.9	100

a. Below surface grade.



Soil Grain-size Analysis Laboratory Results			
Youngstown Right Bank		Sample Date: 11/4/06	
BH-3, S11, 13ft. bsg[a]		Original Sample Weight: 108.2g	
Sieve Opening(mm)	Weight(g)	Cumulative Weight(g)	Cumulative %
1	20.1	20.1	19
0.5	24.2	44.3	41
0.25	40.3	84.6	79
0.125	9.9	94.5	88
0.063	5.3	99.8	93
0.044	2.2	102.0	95
pan	4.9	106.9	100

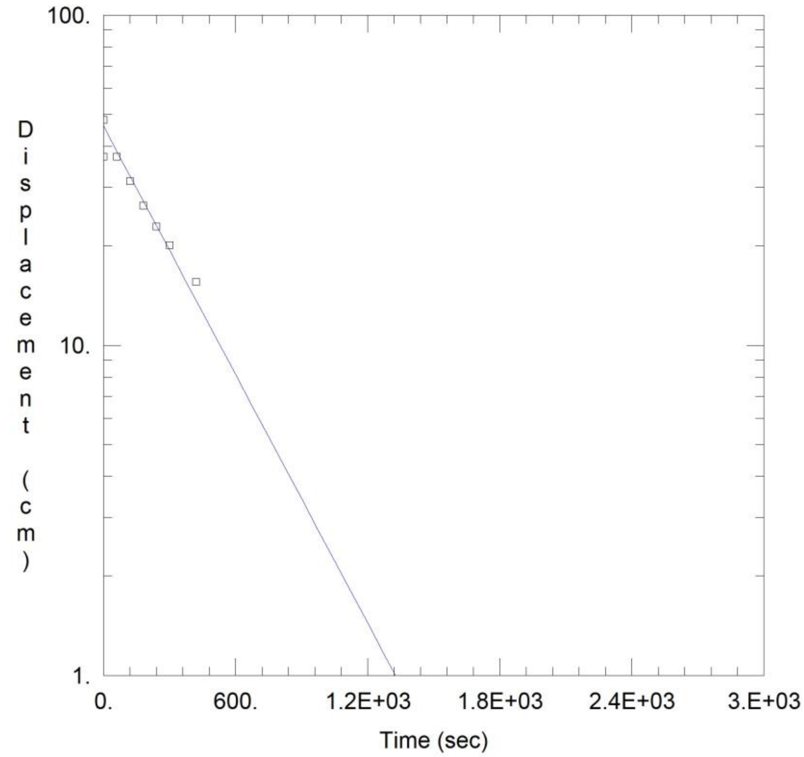


a. Below surface grade.

Appendix D – Slug Test Data and Summary

Slug Test Gauging (In #1): 6/16/07		
Weather: Clear Sky / Sunny		
Measured from:	Top of Casing (ft.)	Ground Level (ft.)
H_o (ft.):	4.380	3.380
Time (min)	Depth Water	Depth Water
1	3.16	2.160
2	3.350	2.350
3	3.510	2.510
4	3.630	2.630
5	3.720	2.720
7	3.870	2.870
10	bar in way	bar in way

Warren Right Bank - Well 1					
Slug Test Gauging (Out): 6/16/07			**Slug Test Gauging (In #2): 6/16/07**		
Weather: Clear Sky / Sunny			Weather: Clear Sky / Sunny		
Measured from:	Top of Casing (ft.)	Ground Level (ft.)	Measured from:	Top of Casing (ft.)	Ground Level (ft.)
H_o (ft.):	4.182	3.182	H_o (ft.):	4.440	3.440
Time (min)	Depth Water	Depth Water	Time (min)	Depth Water	Depth Water
0.5	5.66	4.660	0.5	3.35	2.350
1	5.580	4.580	1	3.490	2.490
1.5	5.490	4.490	1.5	3.600	2.600
2	5.420	4.420	2	3.700	2.700
2.5	5.350	4.350	2.5	3.760	2.760
3	5.300	4.300	3	3.810	2.810
3.5	5.240	4.240	3.5	3.870	2.870
4	5.200	4.200	4	3.910	2.910
5	5.110	4.110	4.5	3.960	2.960
6	5.020	4.020	5	3.990	2.990
7	4.960	3.960	5.5	4.030	3.030
8	4.900	3.900	6	4.060	3.060
9	4.850	3.850	6.5	4.090	3.090
10	4.810	3.810	7	4.110	3.110
11	4.770	3.770	7.5	4.130	3.130
12	4.740	3.740	8	4.155	3.155
13	4.705	3.705	9.5	4.170	3.170
14	4.680	3.680	10.5	4.190	3.190
15	4.650	3.650	11.5	4.210	3.210
16	4.630	3.630	12.5	4.230	3.230
17	4.610	3.610	17.5	4.290	3.290
18	4.590	3.590	22.5	4.320	3.320
19	4.570	3.570	32.5	4.340	3.340
22	4.540	3.540	42.5	4.360	3.360
25	4.510	3.510	52.5	4.370	3.370
30	4.480	3.480	End Test		
35	4.450	3.450			
40	4.440	3.440			



WARREN, RIGHT BANK, MW-1, SLUG IN

Data Set: G:\AQTESOLV Slug Tests 7-01-2015\Warren-Right-In-MW-1.aqt
Date: 07/01/15 Time: 22:03:46

PROJECT INFORMATION

Company: Youngstown State University
Client: Steven Buffone
Project: Thesis
Test Location: Lowellville, Ohio
Test Well: MW-1

AQUIFER DATA

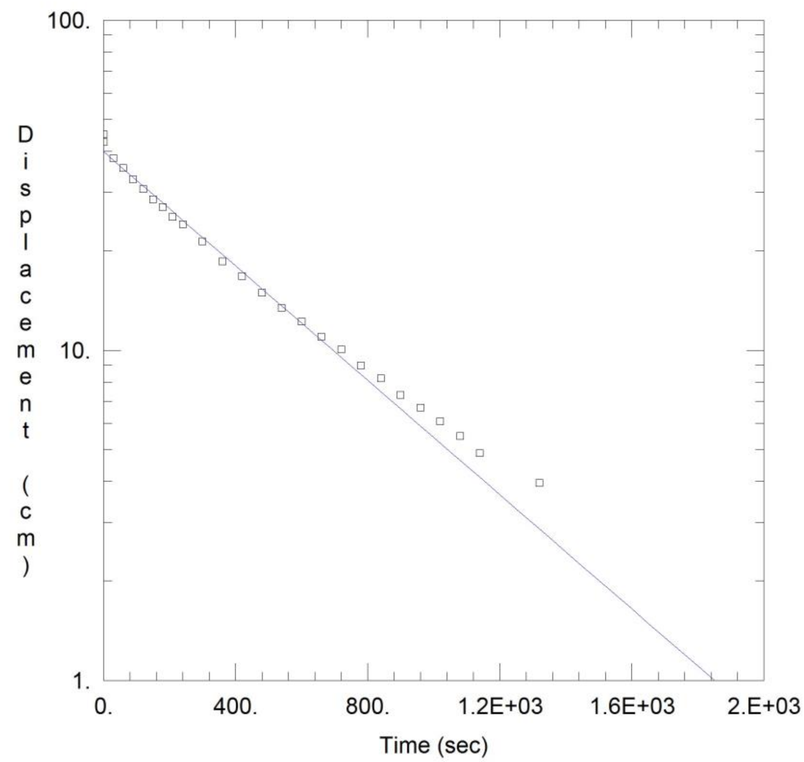
Saturated Thickness: 171.3 cm
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1)

Initial Displacement: 37.19 cm
Casing Radius: 3.863 cm
Wellbore Radius: 4.445 cm
Well Skin Radius: 4.445 cm
Screen Length: 91.44 cm
Total Well Penetration Depth: 171.3 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0006159 cm/sec
y0 = 46.18 cm



WARREN, RIGHT BANK, MW-1, SLUG OUT

Data Set: C:\Documents and Settings\Owner\Desktop\AQTESOLV Slug Tests 6-28-2015\Warren-Right-Out-MW-1.aqt
Date: 06/29/15 Time: 01:31:08

PROJECT INFORMATION

Company: Youngstown State University
Client: Steven Buffone
Project: Thesis
Test Location: Lowellville, Ohio
Test Well: MW-1

AQUIFER DATA

Saturated Thickness: 177.3 cm Anisotropy Ratio (Kz/Kr): 1.

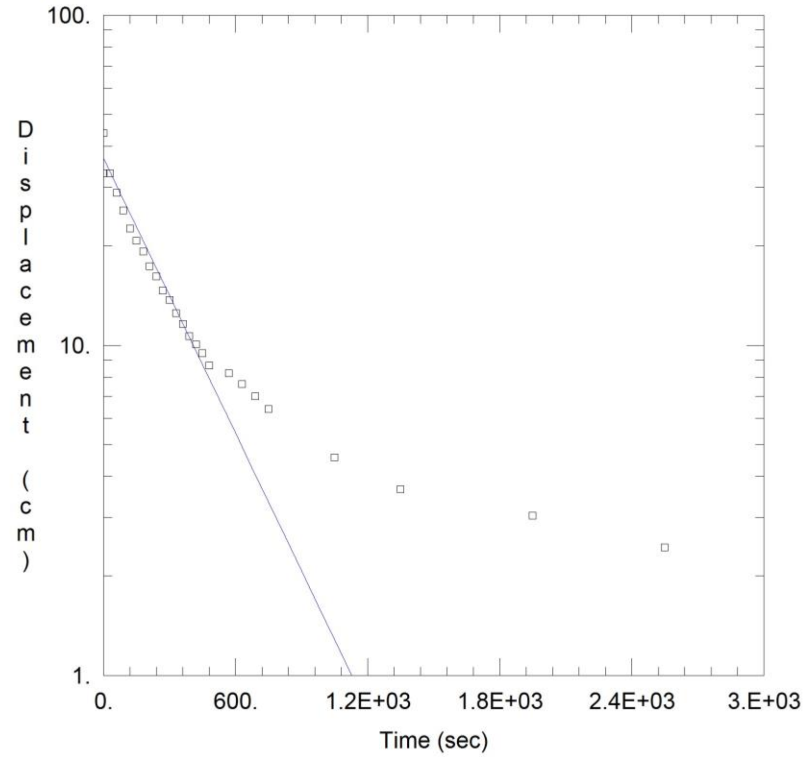
WELL DATA (MW-1)

Initial Displacement: 45.05 cm
Wellbore Radius: 4.445 cm
Screen Length: 91.44 cm
Casing Radius: 3.863 cm
Well Skin Radius: 4.445 cm
Total Well Penetration Depth: 177.3 cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0004281 cm/sec y0 = 39.95 cm



WARREN, RIGHT BANK, MW-1, SLUG IN2

Data Set: C:\Documents and Settings\Owner\Desktop\AQTESOLV Slug Tests 6-28-2015\Warren-Right-In2-MW-1.aqt
Date: 06/29/15 Time: 01:30:44

PROJECT INFORMATION

Company: Youngstown State University
Client: Steven Buffone
Project: Thesis
Test Location: Lowellville, Ohio
Test Well: MW-1

AQUIFER DATA

Saturated Thickness: 169.5 cm Anisotropy Ratio (Kz/Kr): 1.

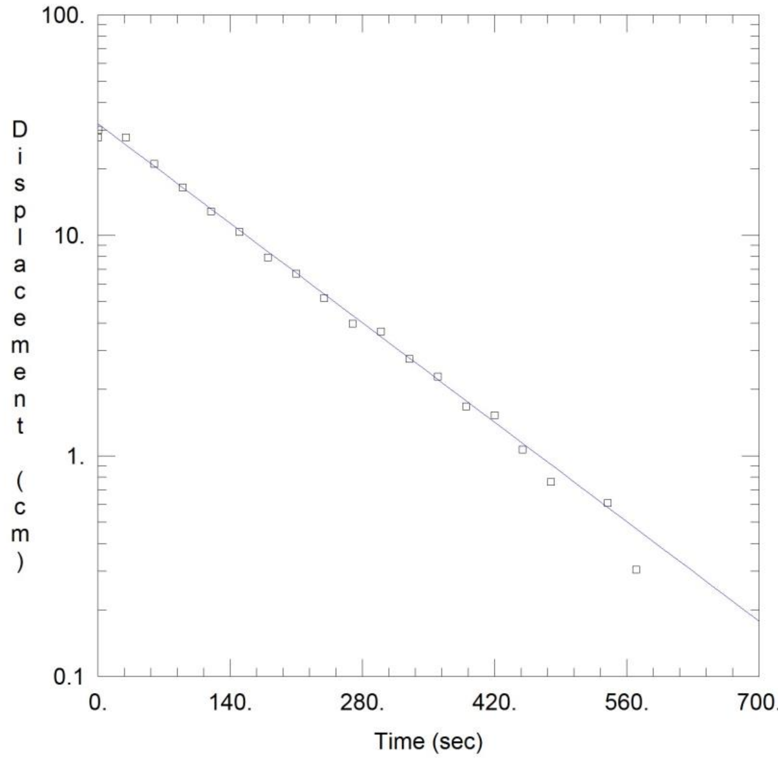
WELL DATA (MW-1)

Initial Displacement: 33.22 cm Casing Radius: 3.863 cm
Wellbore Radius: 4.445 cm Well Skin Radius: 4.445 cm
Screen Length: 91.44 cm Total Well Penetration Depth: 169.5 cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 0.0006805 cm/sec y0 = 36.93 cm

Girard Left Bank - Well 1					
Slug Test Gauging (In): 6/30/07			Slug Test (Out): 6/30/07		
Weather: Clear Sky / Sunny			Weather: Clear Sky / Sunny		
Measured from:	Top of Casing (ft.)	Ground Level (ft.)	Measured from:	Top of Casing (ft.)	Ground Level (ft.)
H_o (ft.):	3.340	3.340	H_o (ft.):	3.345	3.345
Time (min)	Depth Water	Depth Water	Time (min)	Depth Water	Depth Water
0.5	2.43	2.430	0.5	5.05	5.050
1	2.650	2.650	1	4.890	4.890
1.5	2.800	2.800	1.5	4.730	4.730
2	2.920	2.920	2	4.600	4.600
2.5	3.000	3.000	2.5	4.490	4.490
3	3.080	3.080	3	4.380	4.380
3.5	3.120	3.120	3.5	4.280	4.280
4	3.170	3.170	4	4.200	4.200
4.5	3.210	3.210	4.5	4.110	4.110
5	3.220	3.220	5	4.050	4.050
5.5	3.250	3.250	5.5	3.980	3.980
6	3.265	3.265	6	3.910	3.910
6.5	3.285	3.285	6.5	3.870	3.870
7	3.290	3.290	7	3.820	3.820
7.5	3.305	3.305	7.5	3.780	3.780
8	3.315	3.315	8	3.740	3.740
9	3.320	3.320	8.5	3.705	3.705
9.5	3.330	3.330	9	3.670	3.670
10	3.340	3.340	9.5	3.640	3.640
11	3.345	3.345	10	3.610	3.610
12	3.345	3.345	10.5	3.590	3.590
13	3.345	3.345	11	3.570	3.570
15	3.345	3.345	11.5	3.550	3.550
End test			12	3.530	3.530
			12.5	3.505	3.505
			13	3.490	3.490
			14	3.470	3.470
			15	3.450	3.450
			16	3.430	3.430
			17	3.420	3.420
			18	3.410	3.410
			19	3.395	3.395
			20	3.390	3.390
			22	3.380	3.380
			24	3.380	3.380
			26	3.370	3.370
			28	3.370	3.370
			30	3.370	3.370
			35	3.370	3.370
			45	3.370	3.370



GIRARD, LEFT BANK, MW-1, SLUG IN

Data Set: C:\Documents and Settings\Owner\Desktop\AQTESOLV Slug Tests 6-28-2015\Girard-Left-Out-MW-1.aqt
Date: 06/29/15 Time: 01:28:23

PROJECT INFORMATION

Company: Youngstown State University
Client: Steven Buffone
Project: Thesis
Test Location: Lowellville, Ohio
Test Well: MW-1

AQUIFER DATA

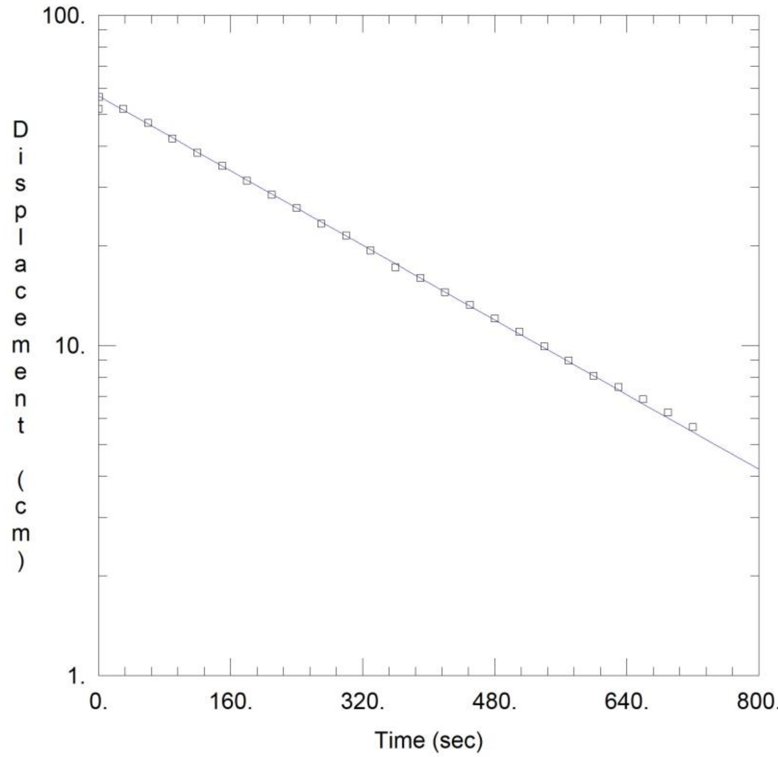
Saturated Thickness: 142.1 cm Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1)

Initial Displacement: 27.74 cm Casing Radius: 3.863 cm
Wellbore Radius: 4.445 cm Well Skin Radius: 4.445 cm
Screen Length: 60.69 cm Total Well Penetration Depth: 96.32 cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 0.00165 cm/sec y0 = 32.03 cm



GIRARD, LEFT BANK, MW-1, SLUG OUT

Data Set: G:\AQTESOLV Slug Tests 7-01-2015\Girard-Left-Out-MW-1.aqt
Date: 07/01/15 Time: 21:59:03

PROJECT INFORMATION

Company: Youngstown State University
Client: Steven Buffone
Project: Thesis
Test Location: Lowellville, Ohio
Test Well: MW-1

AQUIFER DATA

Saturated Thickness: 141.9 cm Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1)

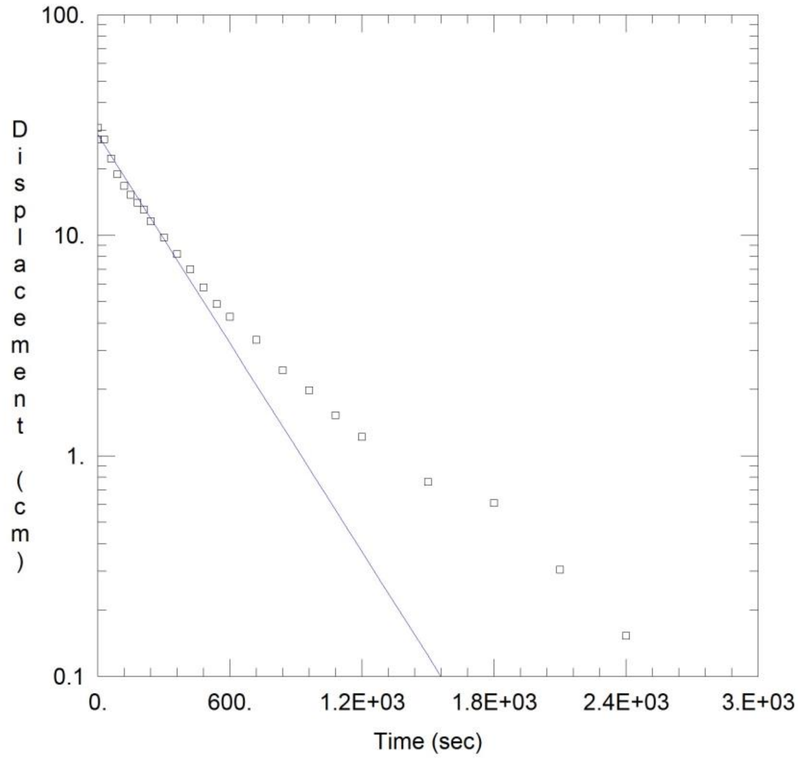
Initial Displacement: 51.97 cm Casing Radius: 3.863 cm
Wellbore Radius: 4.445 cm Well Skin Radius: 4.445 cm
Screen Length: 60.69 cm Total Well Penetration Depth: 96.16 cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0007235 cm/sec y0 = 56.85 cm

Girard Right Bank - Well 1					
Slug Test (In): 6/30/07			**Slug Test (Out): 6/30/07**		
Weather: Clear Sky / Sunny			Weather: Clear Sky / Sunny		
Measured from:	Top of Casing (ft.)	Ground Level (ft.)	Measured from:	Top of Casing (ft.)	Ground Level (ft.)
H_o (ft.):	3.860	2.610	H_o (ft.):	3.860	2.610
Time (min)	Depth Water	Depth Water	Time (min)	Depth Water	Depth Water
0.5	2.97	1.720	0.5	4.71	3.460
1	3.130	1.880	1	4.640	3.390
1.5	3.240	1.990	1.5	4.580	3.330
2	3.310	2.060	2	4.530	3.280
2.5	3.360	2.110	2.5	4.480	3.230
3	3.400	2.150	3	4.420	3.170
3.5	3.430	2.180	3.5	-	-
4	3.480	2.230	4	4.330	3.080
5	3.540	2.290	4.5	-	-
6	3.590	2.340	5	4.245	2.995
7	3.630	2.380	5.5	4.210	2.960
8	3.670	2.420	6	4.180	2.930
9	3.700	2.450	6.5	4.150	2.900
10	3.720	2.470	7	4.120	2.870
12	3.750	2.500	7.5	4.100	2.850
14	3.780	2.530	8	4.075	2.825
16	3.795	2.545	9	4.030	2.780
18	3.810	2.560	10	4.010	2.760
20	3.820	2.570	11	3.985	2.735
25	3.835	2.585	12	3.970	2.720
30	3.840	2.590	14	3.940	2.690
35	3.850	2.600	16	3.930	2.680
40	3.855	2.605	18	3.910	2.660
45	3.860	2.610	20	3.905	2.655
End Test			23	3.895	2.645
			26	3.890	2.640
			29	3.880	2.630
			32	3.880	2.630
			35	3.880	2.630
			40	3.880	2.630
			50	3.880	2.630



GIRARD, RIGHT BANK, MW-1, SLUG IN

Data Set: C:\Documents and Settings\Owner\Desktop\AQTESOLV Slug Tests 6-28-2015\Girard-Right-In-MW-1.aqt
Date: 06/29/15 Time: 01:28:47

PROJECT INFORMATION

Company: Youngstown State University
Client: Steven Buffone
Project: Thesis
Test Location: Lowellville, Ohio
Test Well: MW-1

AQUIFER DATA

Saturated Thickness: 271. cm Anisotropy Ratio (Kz/Kr): 1.

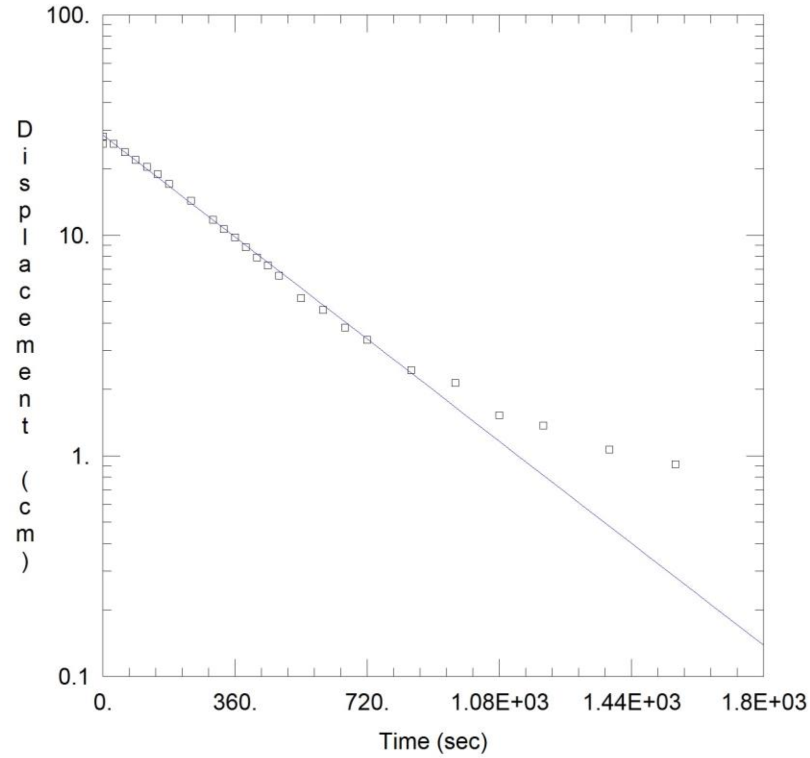
WELL DATA (MW-1)

Initial Displacement: 27.13 cm Casing Radius: 3.863 cm
Wellbore Radius: 4.445 cm Well Skin Radius: 4.445 cm
Screen Length: 60.69 cm Total Well Penetration Depth: 118.6 cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0008023 cm/sec y0 = 28.6 cm



GIRARD, RIGHT BANK, MW-1, SLUG OUT

Data Set: C:\Documents and Settings\Owner\Desktop\AQTESOLV Slug Tests 6-28-2015\Girard-Right-Out-MW-1.aqt
Date: 06/29/15 Time: 01:29:07

PROJECT INFORMATION

Company: Youngstown State University
Client: Steven Buffone
Project: Thesis
Test Location: Lowellville, Ohio
Test Well: MW-1

AQUIFER DATA

Saturated Thickness: 271. cm
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1)

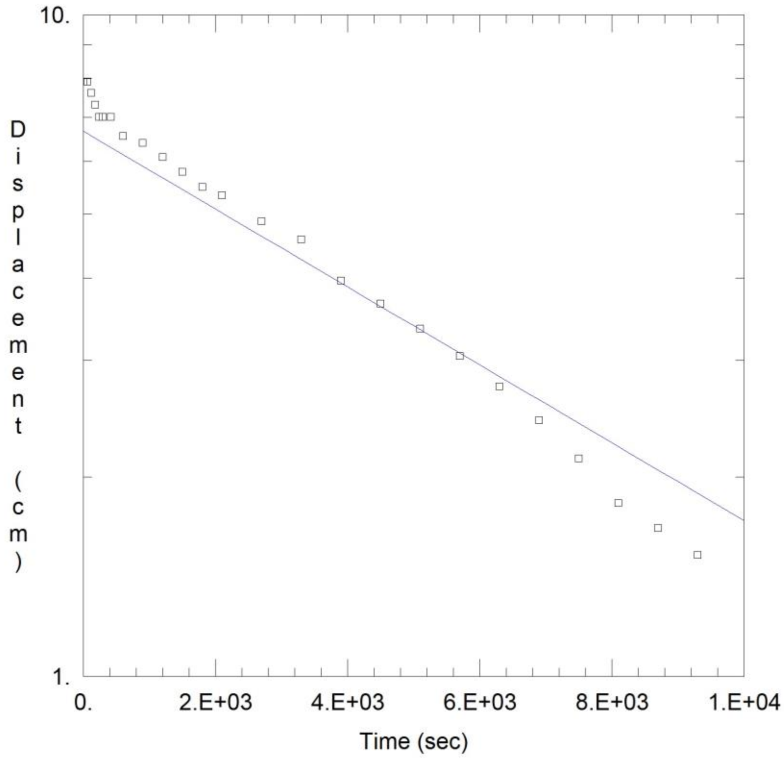
Initial Displacement: 25.91 cm
Casing Radius: 3.863 cm
Wellbore Radius: 4.445 cm
Well Skin Radius: 4.445 cm
Screen Length: 60.69 cm
Total Well Penetration Depth: 118.6 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.000655 cm/sec
y0 = 28.52 cm

Lowellville Left Bank Well 1		
Slug Test Gauging (In #1): 6/3/07		
Weather: Cloudy / Partly Rainy		
Measured from:	Top of Casing (ft.)	Ground Level (ft.)
H_o (ft.):	4.960	3.630
Time (min)	Depth Water	Depth Water
1	4.700	3.370
2	4.710	3.380
3	4.720	3.390
4	4.730	3.400
5	4.730	3.400
7	4.730	3.400
10	4.745	3.415
15	4.750	3.420
20	4.760	3.430
25	4.770	3.440
30	4.780	3.450
35	4.785	3.455
45	4.800	3.470
55	4.810	3.480
65	4.830	3.500
75	4.840	3.510
85	4.850	3.520
95	4.860	3.530
105	4.870	3.540
115	4.880	3.550
125	4.890	3.560
135	4.900	3.570
145	4.905	3.575
155	4.910	3.580

Lowellville Left Bank Well 1					
Slug Test Gauging (Out): 6/3/07			**Slug Test Gauging (In #2): 6/3/07**		
Weather: Cloudy / Partly Rainy			Weather: Cloudy / Partly Rainy		
Measured from:	Top of Casing (ft.)	Ground Level (ft.)	Measured from:	Top of Casing (ft.)	Ground Level (ft.)
H_o (ft.):	4.910	3.580	H_o (ft.):	5.490	4.160
Time (min)	Depth Water	Depth Water	Time (min)	Depth Water	Depth Water
1	5.120	3.790	1	5.250	3.920
2	5.110	3.780	2	5.250	3.920
3	5.110	3.780	3	5.255	3.925
4	5.110	3.780	4	5.255	3.925
5	5.110	3.780	5	5.260	3.930
7	5.105	3.775	7	5.260	3.930
10	5.105	3.775	10	5.265	3.935
15	5.105	3.775	15	5.270	3.940
20	5.100	3.770	20	5.270	3.940
25	5.100	3.770	25	5.270	3.940
30	5.100	3.770	30	5.275	3.945
35	5.100	3.770	35	5.275	3.945
45	5.100	3.770	45	5.280	3.950
55	5.100	3.770	55	5.280	3.950
End Test			65	5.280	3.950
			75	5.285	3.955
			94	5.290	3.960
			205	5.305	3.975
			215	5.305	3.975
			225	5.305	3.975
			End Test		



LOWELLVILLE, LEFT BANK, MW-1, SLUG IN

Data Set: C:\Documents and Settings\Owner\Desktop\AQTESOLV Slug Tests 6-28-2015\Lowell-Left-In-MW-1.AQT
Date: 06/29/15 Time: 01:29:35

PROJECT INFORMATION

Company: Youngstown State University
Client: Steven Buffone
Project: Thesis
Test Location: Lowellville, Ohio
Test Well: MW-1

AQUIFER DATA

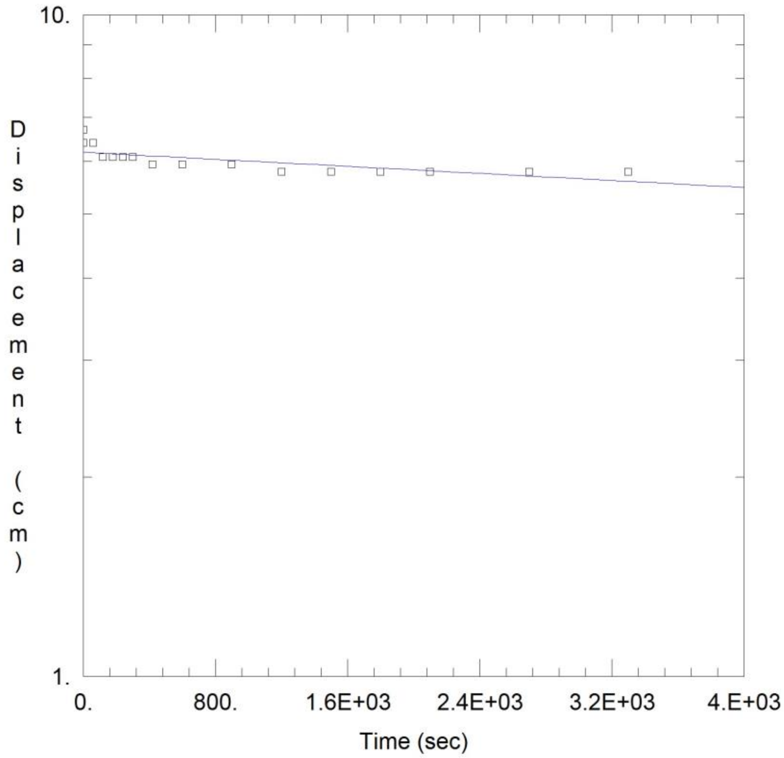
Saturated Thickness: 201.8 cm
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1)

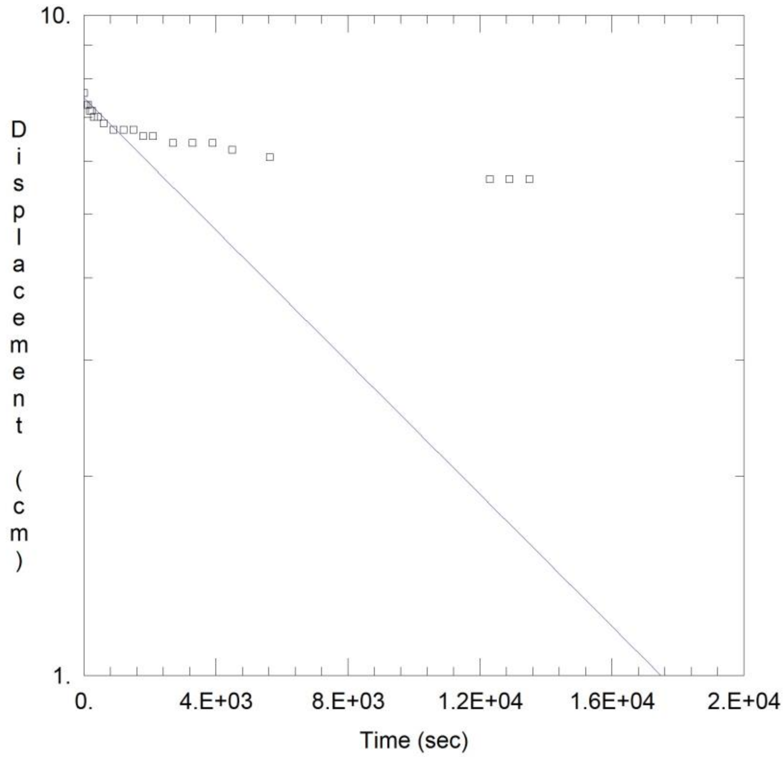
Initial Displacement: 7.925 cm
Casing Radius: 3.863 cm
Wellbore Radius: 4.445 cm
Well Skin Radius: 4.445 cm
Screen Length: 91.44 cm
Total Well Penetration Depth: 201.8 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.991E-05 cm/sec
y0 = 6.669 cm



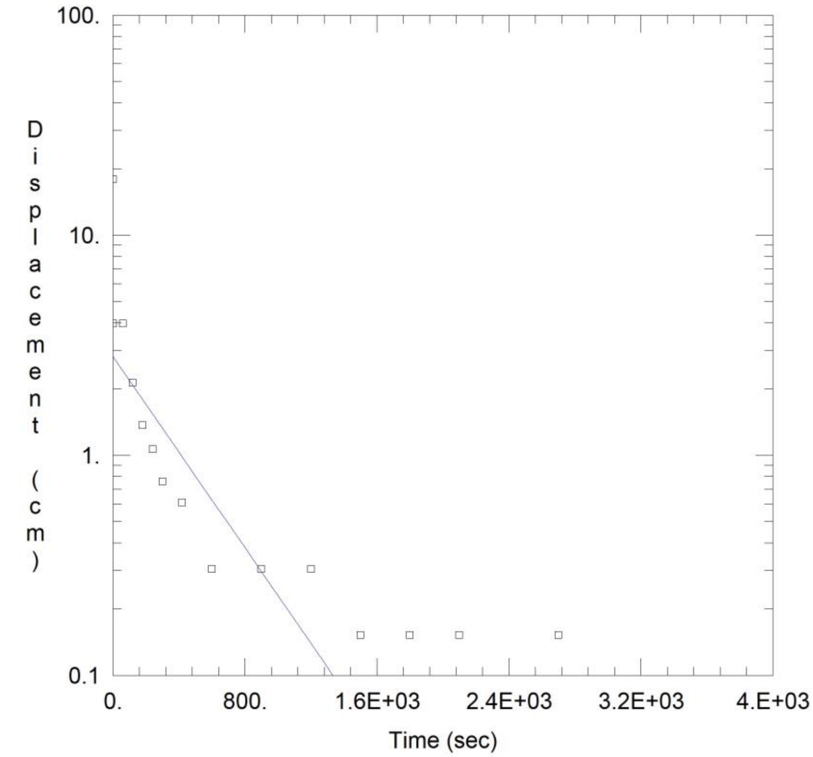
LOWELLVILLE, LEFT BANK, MW-1, SLUG OUT	
Data Set: C:\Documents and Settings\Owner\Desktop\AQTESOLV Slug Tests 6-28-2015\Lowell-Left-Out-MW-1.aqt	
Date: 06/29/15	Time: 01:29:52
PROJECT INFORMATION	
Company: Youngstown State University	
Client: Steven Buffone	
Project: Thesis	
Test Location: Lowellville, Ohio	
Test Well: MW-1	
AQUIFER DATA	
Saturated Thickness: 203.3 cm	Anisotropy Ratio (Kz/Kr): 1.
WELL DATA (MW-1)	
Initial Displacement: 6.401 cm	Casing Radius: 3.863 cm
Wellbore Radius: 4.445 cm	Well Skin Radius: 4.445 cm
Screen Length: 91.44 cm	Total Well Penetration Depth: 203.3 cm
SOLUTION	
Aquifer Model: Unconfined	Solution Method: Bouwer-Rice
K = 6.755E-06 cm/sec	y0 = 6.193 cm



LOWELLVILLE, LEFT BANK, MW-1, SLUG IN2	
Data Set: C:\Documents and Settings\Owner\Desktop\AQTESOLV Slug Tests 6-28-2015\Lowell-Left-In2-MW-1.aqt	
Date: 06/29/15	Time: 01:29:23
PROJECT INFORMATION	
Company: Youngstown State University	
Client: Steven Buffone	
Project: Thesis	
Test Location: Lowellville, Ohio	
Test Well: MW-1	
AQUIFER DATA	
Saturated Thickness: 185.6 cm	Anisotropy Ratio (Kz/Kr): 1.
WELL DATA (MW-1)	
Initial Displacement: 7.315 cm	Casing Radius: 3.863 cm
Wellbore Radius: 4.445 cm	Well Skin Radius: 4.445 cm
Screen Length: 91.44 cm	Total Well Penetration Depth: 185.6 cm
SOLUTION	
Aquifer Model: Unconfined	Solution Method: Bouwer-Rice
K = 2.497E-05 cm/sec	y0 = 7.493 cm

Lowellville Right Bank - Well 1		
Slug Test Gauging 1 (In #1): 6/10/07		
Weather: Clear Sky / Sunny		
Measured from:	Top of Casing (ft.)	Ground Level (ft.)
H_o (ft.):	4.090	2.360
Time (min)	Depth Water	Depth Water
1	3.96	2.230
2	4.020	2.290
3	4.045	2.315
4	4.055	2.325
5	4.065	2.335
7	4.070	2.340
10	4.080	2.350
15	4.080	2.350
20	4.080	2.350
25	4.085	2.355
30	4.085	2.355
35	4.085	2.355
45	4.085	2.355

Lowellville Right Bank - Well 1					
Slug Test 2 (Out): 6/10/07			**Slug Test 3 (In #2): 6/10/07**		
Weather: Clear Sky / Sunny			Weather: Clear Sky / Sunny		
Measured from:	Top of Casing (ft.)	Ground Level (ft.)	Measured from:	Top of Casing (ft.)	Ground Level (ft.)
H_o (ft.):	4.085	2.355	H_o (ft.):	4.095	2.365
Time (min)	Depth Water	Depth Water	Time (min)	Depth Water	Depth Water
1	4.2	2.470	1	3.97	2.240
2	4.130	2.400	2	4.030	2.300
3	4.110	2.380	3	4.050	2.320
4	4.110	2.380	4	4.070	2.340
5	4.090	2.360	5	4.080	2.350
7	4.095	2.365	7	4.080	2.350
10	4.095	2.365	10	4.080	2.350
15	4.095	2.365	15	4.080	2.350
20	4.095	2.365	20	4.090	2.360
25	4.095	2.365	25	4.090	2.360
30	4.095	2.365	30	4.090	2.360
35	4.095	2.365	35	4.095	2.365
45	4.095	2.365	End Test		



LOWELLVILLE, RIGHT BANK, MW-1, SLUG IN

Data Set: C:\Documents and Settings\Owner\Desktop\AQTESOLV Slug Tests 6-28-2015\Lowell-Right-In-MW-1.aqt
Date: 06/29/15 Time: 01:30:18

PROJECT INFORMATION

Company: Youngstown State University
Client: Steven Buffone
Project: Thesis
Test Location: Lowellville, Ohio
Test Well: MW-1

AQUIFER DATA

Saturated Thickness: 133.8 cm Anisotropy Ratio (Kz/Kr): 1.

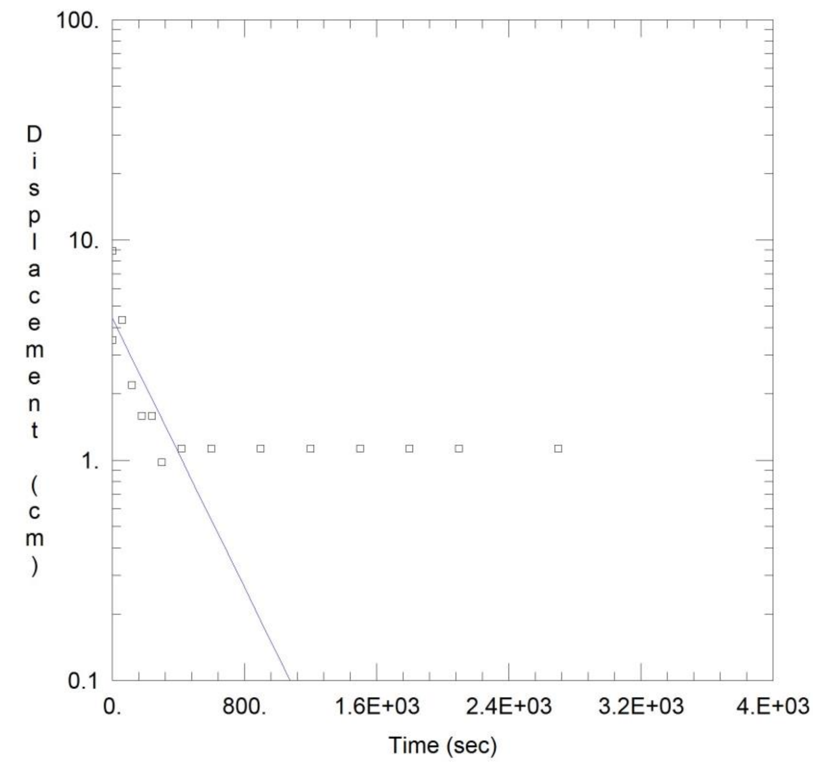
WELL DATA (MW-1)

Initial Displacement: 3.962 cm
Wellbore Radius: 4.445 cm
Screen Length: 106.7 cm
Casing Radius: 3.863 cm
Well Skin Radius: 4.445 cm
Total Well Penetration Depth: 133.8 cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0004399 cm/sec y0 = 2.81 cm



LOWELLVILLE, RIGHT BANK, MW-1, SLUG OUT

Data Set: C:\Documents and Settings\Owner\Desktop\AQTESOLV Slug Tests 6-28-2015\Lowell-Right-Out-MW-1.aqt
Date: 06/29/15 Time: 01:30:30

PROJECT INFORMATION

Company: Youngstown State University
Client: Steven Buffone
Project: MRLB-1
Test Location: Lowellville, Ohio
Test Well: MW-1

AQUIFER DATA

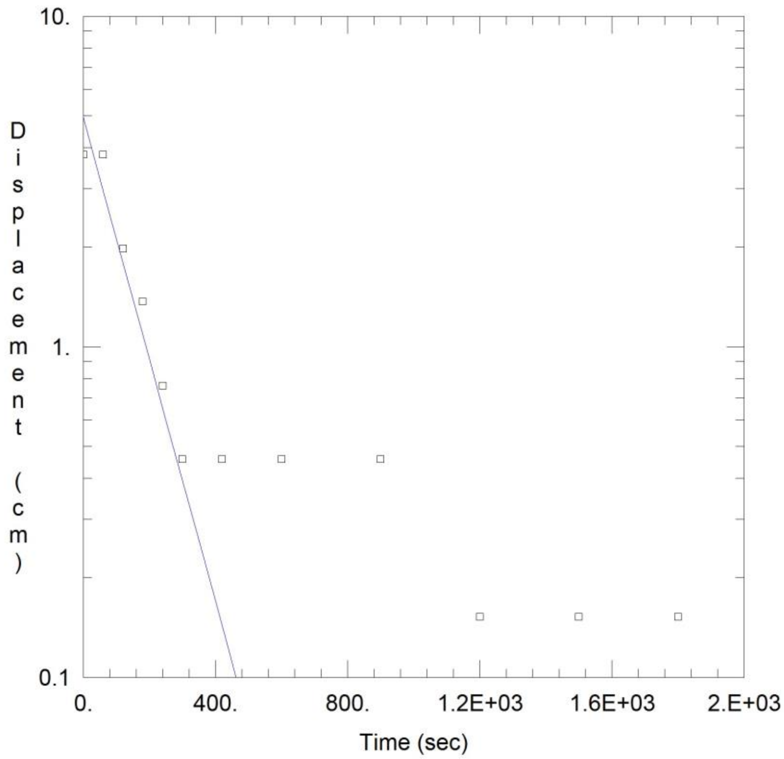
Saturated Thickness: 134. cm Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1)

Initial Displacement: 3.505 cm Casing Radius: 3.863 cm
Wellbore Radius: 4.445 cm Well Skin Radius: 4.445 cm
Screen Length: 106.7 cm Total Well Penetration Depth: 134. cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 0.0006196 cm/sec y0 = 4.427 cm



LOWELLVILLE, RIGHT BANK, MW-1, SLUG IN2

Data Set: C:\Documents and Settings\Owner\Desktop\AQTESOLV Slug Tests 6-28-2015\Lowell-Right-In2-MW-1.aqt
Date: 06/29/15 Time: 01:30:06

PROJECT INFORMATION

Company: Youngstown State University
Client: Steven Buffone
Project: Thesis
Test Location: Lowellville, Ohio
Test Well: MW-1

AQUIFER DATA

Saturated Thickness: 133.7 cm Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-1)

Initial Displacement: 3.81 cm Casing Radius: 3.863 cm
Wellbore Radius: 4.445 cm Well Skin Radius: 4.445 cm
Screen Length: 106.7 cm Total Well Penetration Depth: 133.7 cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.001481 cm/sec y0 = 4.944 cm

Appendix E: Rainfall, River Gauging, and Groundwater Gauging Summary

Mahoning River Bank Ground Water Compared to River Channel (continued)							
Location	**Well ID**	**Date**	**DTW - Channel (ft.)**	**DTW - Bank (ft.)**	**Difference (ft.)**	**Rainfall (inches)**	**Notes**
Warren Perkins Park (Left Bank)	Well #1	2/9/2008	Wells submersed and site completely inundated by flood waters.			2.75	Site flooded
	Well #1	6/29/2008	7.33	6.88	0.46	0.73	Partly sunny
	Well #1	7/13/2008	5.67	5.58	0.08	1.67	Mixture of sun and showers
	Well #1	8/3/2008	6.49	6.31	0.17	0.65	Sunny
	Well #1	8/10/2008	6.52	6.33	0.19	0.58	Partly sunny
	Well #1	9/7/2008	7.41	dry	NA	0.70	Partly sunny
	Well #1	9/15/2008	Covered by fallen tree.				
	Well #1	9/22/2008	7.98	7.97	0.01	0.00	Sunny and dry
	Well #1	9/29/2008	7.63	dry	N A	0.02	Partly sunny
	Well #1	10/22/2008	Reinstalled monitoring well #1 due to casing damage.				
	Well #1	10/31/2008	10.39	7.89	2.50	0.00	Clear and sunny

Note: Negative numbers indicate instances where water table elevation in the river bank was higher than the elevation of the river within the channel.

Note: River at flood stage represented on associated graphs as value = -1.

Note: Rainfall volumes taken from NOAA station at Warren 3 S.

NA = Not Applicable

Mahoning River Bank Ground Water Compared to River Channel (continued)							
Location	**Well ID**	**Date**	**DTW - Channel (ft.)**	**DTW - Bank (ft.)**	**Difference (ft.)**	**Rainfall (inches)**	**Notes**
Warren Packard Park (Right Bank)	Well #1	2/9/2008	Wells submersed and site completely inundated by flood waters.			2.75	Site flooded
	Well #1	6/29/2008	5.33	5.83	-0.50	0.73	Partly sunny
	Well #1	7/13/2008	5.05	5.02	0.03	1.67	Mixture of sun and showers
	Well #1	8/3/2008	5.58	5.68	-0.10	0.65	Sunny
	Well #1	8/10/2008	5.33	5.59	-0.26	0.58	Sunny
	Well #1	9/7/2008	5.82	6.13	-0.31	0.70	Partly sunny
	Well #1	9/15/2008	5.84	5.92	-0.08	2.23	Partly sunny
	Well #1	9/22/2008	5.93	6.22	-0.29	0.00	Sunny and dry
	Well #1	9/29/2008	6.18	6.37	-0.19	0.02	Partly sunny
	Well #1	10/22/2008	7.49	6.49	1.00	0.12	Dry and sunny
	Well #1	10/31/2008	7.46	6.02	1.44	1.32	Clear and sunny

Note: Negative numbers indicate instances where water table elevation in the river bank was higher than the elevation of the river within the channel.

Note: River at flood stage represented on associated graphs as value = -1.

Note: Rainfall volumes taken from NOAA station at Warren 3 S.

Mahoning River Bank Ground Water Compared to River Channel (continued)							
Location	**Well ID**	**Date**	**DTW - Channel (ft.)**	**DTW - Bank (ft.)**	**Difference (ft.)**	**Rainfall (inches)**	**Notes**
Girard (Right Bank)	Well #1	2/9/2008	Wells submersed and site completely inundated by flood waters.			27.52	Site flooded
	Well #1	6/29/2008	4.12	4.29	-0.18	7.28	Cloudy with showers
	Well #1	7/13/2008	3.38	3.29	0.08	16.69	Cloudy
	Well #1	8/3/2008	Could not access well due to chain across access road.				

Note: All negative numbers indicate instances where water table elevation in the river bank was higher than the elevation of the river within the channel.

Note: River at flood stage represented on associated graphs as value = -1.

Note: Rainfall volumes taken from NOAA station at Warren 3 S.

Mahoning River Bank Ground Water Compared to River Channel (continued)							
Location	**Well ID**	**Date**	**DTW - Channel (ft.)**	**DTW - Bank (ft.)**	**Difference (ft.)**	**Rainfall (inches)**	**Notes**
Youngstown (Right Bank)	Well #1	2/9/2008	Wells submersed and site completely inundated by flood waters.			2.75	Site flooded
	Well #1	9/14/2008	3.69	3.71	-0.02	2.21	Cloudy
	Well #1	9/22/2008	6.87	6.88	-0.01	0.00	Cloudy
	Well #1	9/29/2008	6.04	6.07	-0.03	0.02	Partly sunny
	Well #1	10/22/2008	5.98	5.97	0.01	0.00	Dry and sunny
	Well #1	10/31/2008	6.92	6.86	0.06	1.32	Clear and sunny
	Well #1	11/5/2008	7.66	7.85	-0.19	0.07	A few clouds

Note: Negative numbers indicate instances where water table elevation in the river bank was higher than the elevation of the river within the channel.

Note: River at flood stage represented on associated graphs as value = -1.

Note: Rainfall volumes taken from NOAA station at Warren 3 S.

Mahoning River Bank Ground Water Compared to River Channel (continued)							
Location	**Well ID**	**Date**	**DTW - Channel (ft.)**	**DTW - Bank (ft.)**	**Difference (ft.)**	**Rainfall (inches)**	**Notes**
Lowellville (Left Bank)	Well #1	10/4/2007	dry	NR	NA	0.60	Cloudy
	Well #1	2/9/2008	Wells submersed and site completely inundated by flood waters.			2.75	Site flooded
	Well #2						
	Well #1	6/29/2008	12.04	6.58	5.46	0.73	Cloudy with drizzle
	Well #2	6/29/2008	7.58	dry	NA		
	Well #1	7/13/2008	4.90	5.48	-0.58	1.67	Cloudy with steady rain
	Well #2	7/13/2008	dry	NR	NA		
	Well #1	8/3/2008	6.24	5.74	0.51	0.65	Sunny
	Well #2	8/3/2008	Discontinued gauging well due to persistently being dry.				
	Well #1	8/10/2008	6.90	6.19	0.71	0.58	Sunny
	Well #1	9/7/2008	6.26	6.86	-0.60	0.70	Partly sunny
	Well #1	9/26/2008	5.02	4.69	0.33	0.00	Cloudy
	Well #1	9/29/2008	Well destroyed by flooding and downed tree.				

Note: Negative numbers indicate instances where water table elevation in the river bank was higher than the elevation of the river within the channel.

Note: River at flood stage represented on associated graphs as value = -1.

Note: Rainfall volumes taken from NOAA station at Warren 3 S.

NR = Not Recorded

NA = Not Applicable

<table>
<tr><th colspan="8">Mahoning River Bank Ground Water Compared to River Channel</th></tr>
<tr><th>Location</th><th>Well ID</th><th>Date</th><th>DTW - Channel (ft.)</th><th>DTW - Bank (ft.)</th><th>Difference (ft.)</th><th>Rainfall (inches)</th><th>Notes</th></tr>
<tr><td rowspan="13">Lowellville (Right Bank)</td><td>Well #1</td><td>10/4/2007</td><td>8.26</td><td>6.00</td><td>2.26</td><td>0.60</td><td>Cloudy</td></tr>
<tr><td>Well #1</td><td rowspan="2">2/9/2008</td><td rowspan="2" colspan="3">Wells submersed and site completely inundated by flood waters.</td><td rowspan="2">2.75</td><td rowspan="2">Cloudy with rain/snow</td></tr>
<tr><td>Well #2</td></tr>
<tr><td>Well #1</td><td>6/29/2008</td><td>7.50</td><td>4.79</td><td>2.71</td><td rowspan="2">0.73</td><td rowspan="2">Cloudy with drizzle</td></tr>
<tr><td>Well #2</td><td>6/29/2008</td><td>6.67</td><td>4.33</td><td>2.33</td></tr>
<tr><td>Well #1</td><td>7/13/2008</td><td>7.65</td><td>3.75</td><td>3.90</td><td rowspan="2">1.67</td><td rowspan="2">Cloudy with steady rain</td></tr>
<tr><td>Well #2</td><td>7/13/2008</td><td>6.00</td><td>4.50</td><td>1.50</td></tr>
<tr><td>Well #1</td><td>8/3/2008</td><td>6.89</td><td>4.35</td><td>2.54</td><td>0.65</td><td>Sunny</td></tr>
<tr><td>Well #1</td><td>8/10/2008</td><td>7.30</td><td>5.93</td><td>1.37</td><td>0.58</td><td>Sunny</td></tr>
<tr><td>Well #1</td><td>9/7/2008</td><td>7.83</td><td>5.39</td><td>2.44</td><td>0.70</td><td>Partly sunny</td></tr>
<tr><td>Well #1</td><td>9/22/2008</td><td>7.12</td><td>6.83</td><td>0.29</td><td rowspan="2">0.00</td><td>Sunny and dry</td></tr>
<tr><td>Well #2</td><td>9/22/2008</td><td>7.83</td><td>5.35</td><td>2.48</td><td>Sunny and dry</td></tr>
</table>

Note: Negative numbers indicate instances where water table elevation in the river bank was higher than the elevation of the river within the channel.

Note: River at flood stage represented on associated graphs as value = -1.

Note: Rainfall volumes taken from NOAA station at Warren 3 S.

Mahoning River Bank Ground Water Compared to River Channel (continued)							
Location	**Well ID**	**Date**	**DTW - Channel (ft.)**	**DTW - Bank (ft.)**	**Difference (ft.)**	**Rainfall (inches)**	**Notes**
Lowellville (Right Bank)	Well #1	9/26/2008	5.89	3.49	2.40	0.00	Cloudy
	Well #1	9/29/2008	6.78	7.12	-0.34	0.02	Partly sunny
	Well #2	9/29/2008	6.04	5.02	1.02		
	Well #1	10/22/2008	7.33	7.49	-0.16	0.12	Sunny and dry
	Well #2	10/22/2008	7.12	5.10	2.02		
	Well #1	10/31/2008	7.21	7.35	-0.14	1.32	Sunny and dry
	Well #2	10/31/2008	7.50	5.54	1.96		
	Well #1	11/5/2008	8.71	7.75	0.96	0.07	Sunny and dry
	Well #2	11/5/2008	8.45	5.55	2.90		
	Well #1	11/12/2008	8.16	7.36	0.80	0.12	Sunny and dry
	Well #2	11/12/2008	8.13	5.44	2.69		

Note: Negative numbers indicate instances where water table elevation in the river bank was higher than the elevation of the river within the channel.

Note: River at flood stage represented on associated graphs as value = -1.

Note: Rainfall volumes taken from NOAA station at Warren 3 S.

Appendix F – PAH Extraction Laboratory Analytical Reports

Quantitation Report   (Not Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0420071.D                   Vial: 1
Acq On    : 20 Apr 2007  18:27                       Operator: rr
Sample    : hex                                      Inst     : GC/MS Ins
Misc      :                                          Multiplr: 1.00
                                                Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Apr 23  9:56 19107              Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	0.00	152	0	0.00 ug/ml	-5.84
3) Naphthalene-d8	0.00	136	0	0.00	-7.52
6) Acenaphthene-d10	0.00	164	0	0.00 ug/ml	-9.86
10) Phenanthrene-d10	0.00	188	0	0.00 ug/ml	-11.80
16) Chrysene-d12	0.00	240	0	0.00 ug/ml	-15.32
21) Perylene-d12	0.00	264	0	0.00 ug/ml	-17.40

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	0.00	172	0	N.D.	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	0.00	244	0	N.D.	
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0420071.D SBUFF.M   Fri Jun 29 22:55:37 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0420072.D                    Vial: 2
Acq On    : 20 Apr 2007  18:57                        Operator: rr
Sample    : intl                                      Inst    : GC/MS Ins
Misc      :                                           Multiplr: 1.00
                                                 Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Apr 23  9:59 19107             Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.72	152	9759520	40.00 ug/ml	-0.12
3) Naphthalene-d8	7.39	136	33530451	40.00	-0.13
6) Acenaphthene-d10	9.73	164	22269436	40.00 ug/ml	-0.13
10) Phenanthrene-d10	11.69	188	44632212	40.00 ug/ml	-0.11
16) Chrysene-d12	15.26	240	29317934	40.00 ug/ml	-0.06
21) Perylene-d12	17.38	264	16292691m	40.00 ug/ml	-0.02

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.47	82	8309525	100.17 ug/ml	100
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.86	172	21391804	98.06 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.85	244	30502138	114.59 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0420072.D SBUFF.M Fri Jun 29 22:55:55 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0420073.D                    Vial: 3
Acq On    : 20 Apr 2007  19:27                        Operator: rr
Sample    : int2                                      Inst     : GC/MS Ins
Misc      :                                           Multiplr: 1.00
                                                 Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Apr 23 10:02 19107              Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.73	152	9975118	40.00 ug/ml	-0.11
3) Naphthalene-d8	7.40	136	33857253	40.00	-0.12
6) Acenaphthene-d10	9.74	164	22650306	40.00 ug/ml	-0.12
10) Phenanthrene-d10	11.70	188	44442261	40.00 ug/ml	-0.10
16) Chrysene-d12	15.28	240	32311985	40.00 ug/ml	-0.04
21) Perylene-d12	17.39	264	19183313m	40.00 ug/ml	0.00

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.49	82	8507911	100.33 ug/ml	100
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	21210326	96.26 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.87	244	33408648	125.55 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0420073.D SBUFF.M   Fri Jun 29 22:56:10 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0420074.D                Vial: 4
Acq On    : 20 Apr 2007  19:57                    Operator: rr
Sample    : int3                                  Inst    : GC/MS Ins
Misc      :                                       Multiplr: 1.00
                                            Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Apr 23 10:04 19107            Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.72	152	9929553	40.00 ug/ml	-0.12
3) Naphthalene-d8	7.39	136	34079100	40.00	-0.13
6) Acenaphthene-d10	9.73	164	22733904	40.00 ug/ml	-0.13
10) Phenanthrene-d10	11.69	188	45500042	40.00 ug/ml	-0.11
16) Chrysene-d12	15.26	240	33628736	40.00 ug/ml	-0.06
21) Perylene-d12	17.39	264	19744651m	40.00 ug/ml	-0.01

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.48	82	8658402	102.41 ug/ml	100
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.86	172	21965168	99.09 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.85	244	34446233	126.41 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0420074.D SBUFF.M Fri Jun 29 22:56:25 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0420075.D                    Vial: 5
Acq On    : 20 Apr 2007  20:27                        Operator: rr
Sample    : int4                                      Inst    : GC/MS Ins
Misc      :                                           Multiplr: 1.00
                                               Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Apr 23 10:05 19107              Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.72	152	10216671	40.00 ug/ml	-0.12
3) Naphthalene-d8	7.39	136	35710371	40.00	-0.13
6) Acenaphthene-d10	9.73	164	23525513	40.00 ug/ml	-0.13
10) Phenanthrene-d10	11.69	188	46718334	40.00 ug/ml	-0.11
16) Chrysene-d12	15.26	240	33051269	40.00 ug/ml	-0.06
21) Perylene-d12	17.39	264	19549523m	40.00 ug/ml	-0.01

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	6.47	82	9325717	106.87 ug/ml	100
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.86	172	22923858	98.68 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.85	244	34834050	124.57 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0420075.D SBUFF.M   Fri Jun 29 22:56:43 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0420076.D                Vial: 6
Acq On    : 20 Apr 2007  20:57                     Operator: rr
Sample    : int5                                   Inst    : GC/MS Ins
Misc      :                                        Multiplr: 1.00
                                              Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Apr 23 10:06 19107           Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.72	152	10512593	40.00 ug/ml	-0.12
3) Naphthalene-d8	7.39	136	36230509	40.00	-0.13
6) Acenaphthene-d10	9.72	164	23889622	40.00 ug/ml	-0.14
10) Phenanthrene-d10	11.69	188	47218903	40.00 ug/ml	-0.11
16) Chrysene-d12	15.26	240	32954222	40.00 ug/ml	-0.06
21) Perylene-d12	17.38	264	19322709m	40.00 ug/ml	-0.02

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.47	82	10697356	118.31 ug/ml	100
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.85	172	24810965	105.40 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.85	244	36737247	129.77 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0420076.D SBUFF.M   Fri Jun 29 22:57:13 2007

Quantitation Report (Not Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0412071.D                    Vial: 1
Acq On    : 12 Apr 2007  15:43                        Operator: sb
Sample    : LvlMethanol                               Inst     : GC/MS Ins
Misc      :                                           Multiplr: 1.00
                                                  Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Apr 13 11:01 19107              Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	0.00	152	0	0.00 ug/ml	-5.84
3) Naphthalene-d8	0.00	136	0	0.00	-7.52
6) Acenaphthene-d10	0.00	164	0	0.00 ug/ml	-9.86
10) Phenanthrene-d10	0.00	188	0	0.00 ug/ml	-11.80
16) Chrysene-d12	0.00	240	0	0.00 ug/ml	-15.32
21) Perylene-d12	0.00	264	0	0.00 ug/ml	-17.40

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	0.00	172	0	N.D.	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	0.00	244	0	N.D.	
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0412071.D SBUFF.M   Fri Jun 29 23:11:21 2007

Quantitation Report (Not Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0412072.D                  Vial: 2
Acq On    : 12 Apr 2007  16:13                      Operator: sb
Sample    : blank                                   Inst    : GC/MS Ins
Misc      :                                         Multiplr: 1.00
                                              Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Apr 13 11:03 19107            Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	0.00	152	0	0.00 ug/ml	-5.84
3) Naphthalene-d8	0.00	136	0	0.00	-7.52
6) Acenaphthene-d10	0.00	164	0	0.00 ug/ml	-9.86
10) Phenanthrene-d10	0.00	188	0	0.00 ug/ml	-11.80
16) Chrysene-d12	0.00	240	0	0.00 ug/ml	-15.32
21) Perylene-d12	0.00	264	0	0.00 ug/ml	-17.40

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	0.00	172	0	N.D.	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	0.00	244	0	N.D.	
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0412072.D SBUFF.M Fri Jun 29 23:11:36 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0412073.D Vial: 3
Acq On : 12 Apr 2007 16:42 Operator: sb
Sample : 9a Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Apr 13 11:14 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.76	152	28709321	40.00 ug/ml	-0.08
3) Naphthalene-d8	7.43	136	105906788	40.00	-0.09
6) Acenaphthene-d10	9.77	164	63745812	40.00 ug/ml	-0.09
10) Phenanthrene-d10	11.72	188	110520842	40.00 ug/ml	-0.08
16) Chrysene-d12	15.28	240	65451095	40.00 ug/ml	-0.04
21) Perylene-d12	17.43	264	28102376	40.00 ug/ml	0.03

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.89	172	21974918	30.63 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	11.75	178	10404784	11.97	100
12) Anthracene	11.81	178	5060081	1.45 ug/ml	100
13) Fluoranthene	13.35	202	19501780	13.22 ug/ml	100
14) Pyrene	13.64	202	17702425	11.49 ug/ml	100
15) Terephenyl-d14	13.88	244	24093169	39.93 ug/ml	100
17) Benzo(a)anthracene	15.30	228	2306845m	-60.03 ug/ml	
18) Chrysene	15.31	228	3912617m	-15.19 ug/ml	
19) Benzo(b&k)fluoranthene	16.86	252	2171143m	2.34 ug/ml	
20) Benzo(a)pyrene	17.37	252	1782824m	3.62 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0412073.D SBUFF.M Fri Jun 29 23:11:52 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0412074.D Vial: 4
Acq On : 12 Apr 2007 17:12 Operator: sb
Sample : 9b Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Apr 13 11:25 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.76	152	28023345	40.00 ug/ml	-0.08
3) Naphthalene-d8	7.43	136	102124016	40.00	-0.09
6) Acenaphthene-d10	9.77	164	61276449	40.00 ug/ml	-0.09
10) Phenanthrene-d10	11.72	188	99435700	40.00 ug/ml	-0.08
16) Chrysene-d12	15.28	240	62385127	40.00 ug/ml	-0.04
21) Perylene-d12	17.41	264	29525019	40.00 ug/ml	0.01

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.90	172	17156679	24.45 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	10.49	166	1643959m	1.39 ug/ml	
11) Phenanthrene	11.75	178	5314387m	8.16	
12) Anthracene	11.81	178	2791526m	0.40 ug/ml	
13) Fluoranthene	13.35	202	9287663	7.67 ug/ml	100
14) Pyrene	13.65	202	8432020	6.80 ug/ml	100
15) Terephenyl-d14	13.88	244	46652176	80.22 ug/ml	100
17) Benzo(a)anthracene	15.29	228	1810738m	-61.64 ug/ml	
18) Chrysene	15.31	228	2406643m	-17.08 ug/ml	
19) Benzo(b&k)fluoranthene	16.85	252	2617682m	2.72 ug/ml	
20) Benzo(a)pyrene	17.35	252	1821970m	3.84 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0412074.D SBUFF.M Fri Jun 29 23:12:07 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0412075.D Vial: 5
Acq On : 12 Apr 2007 17:41 Operator: sb
Sample : 9d Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Apr 13 11:32 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.75	152	32106067	40.00 ug/ml	-0.09
3) Naphthalene-d8	7.43	136	116360396	40.00	-0.09
6) Acenaphthene-d10	9.77	164	67567361	40.00 ug/ml	-0.09
10) Phenanthrene-d10	11.72	188	117534166	40.00 ug/ml	-0.08
16) Chrysene-d12	15.28	240	70946822	40.00 ug/ml	-0.04
21) Perylene-d12	17.43	264	29197367	40.00 ug/ml	0.03

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.57	82	422348m	8.65 ug/ml	
4) Naphthalene	7.45	128	3498736	0.47	100
5) 2-Fluorobiphenyl	8.89	172	37830391	49.06 ug/ml	100
7) Acenaphthylene	9.56	152	225959m	0.32 ug/ml	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	10.49	166	1571907m	1.21 ug/ml	
11) Phenanthrene	11.75	178	8539697	9.96	100
12) Anthracene	11.81	178	3374892	0.43 ug/ml	100
13) Fluoranthene	13.35	202	16450630	10.78 ug/ml	100
14) Pyrene	13.64	202	13695888	8.78 ug/ml	100
15) Terephenyl-d14	13.87	244	56118171	81.55 ug/ml	100
17) Benzo(a)anthracene	15.29	228	2813591m	-58.89 ug/ml	
18) Chrysene	15.30	228	3881693m	-15.64 ug/ml	
19) Benzo(b&k)fluoranthene	16.86	252	3978387m	3.34 ug/ml	
20) Benzo(a)pyrene	17.35	252	2408796m	4.36 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0412075.D SBUFF.M Fri Jun 29 23:12:24 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0412076.D                  Vial: 6
Acq On    : 12 Apr 2007  18:11                      Operator: sb
Sample    : 10a                                     Inst     : GC/MS Ins
Misc      :                                         Multiplr: 1.00
                                               Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Apr 13 11:37 19107              Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.75	152	28618803	40.00 ug/ml	-0.09
3) Naphthalene-d8	7.42	136	107468444	40.00	-0.10
6) Acenaphthene-d10	9.77	164	63164868	40.00 ug/ml	-0.09
10) Phenanthrene-d10	11.72	188	107455965	40.00 ug/ml	-0.08
16) Chrysene-d12	15.28	240	64077829	40.00 ug/ml	-0.04
21) Perylene-d12	17.42	264	28313726	40.00 ug/ml	0.02

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.54	82	701469m	9.89 ug/ml	
4) Naphthalene	7.45	128	2634946	0.01	100
5) 2-Fluorobiphenyl	8.89	172	30632073	42.78 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	10.48	166	1913310m	1.57 ug/ml	
11) Phenanthrene	11.75	178	6272131	8.62	100
12) Anthracene	11.81	178	3617043	0.73 ug/ml	100
13) Fluoranthene	13.35	202	16258308	11.54 ug/ml	100
14) Pyrene	13.64	202	14072523	9.67 ug/ml	100
15) Terephenyl-d14	13.87	244	51568801	81.95 ug/ml	100
17) Benzo(a)anthracene	15.30	228	3332654m	-55.68 ug/ml	
18) Chrysene	15.31	228	3240869m	-16.01 ug/ml	
19) Benzo(b&k)fluoranthene	16.85	252	4378575m	3.88 ug/ml	
20) Benzo(a)pyrene	17.35	252	2888848m	5.59 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0412076.D SBUFF.M Fri Jun 29 23:12:39 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0412077.D                  Vial: 7
Acq On    : 12 Apr 2007  18:41                       Operator: sb
Sample    : 10b                                      Inst    : GC/MS Ins
Misc      :                                          Multiplr: 1.00
                                                Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Apr 13 11:43 19107              Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.75	152	26530559	40.00 ug/ml	-0.09
3) Naphthalene-d8	7.42	136	96494712	40.00	-0.10
6) Acenaphthene-d10	9.76	164	60491041	40.00 ug/ml	-0.10
10) Phenanthrene-d10	11.72	188	103632201	40.00 ug/ml	-0.08
16) Chrysene-d12	15.28	240	58672606	40.00 ug/ml	-0.04
21) Perylene-d12	17.45	264	23530659	40.00 ug/ml	0.05

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	7.44	128	680321m	-1.46	
5) 2-Fluorobiphenyl	8.89	172	11227333	16.36 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	10.48	166	661972m	0.57 ug/ml	
11) Phenanthrene	11.75	178	2747243m	5.64	
12) Anthracene	11.76	178	2388751m	0.10 ug/ml	
13) Fluoranthene	13.35	202	8402586	6.85 ug/ml	100
14) Pyrene	13.64	202	7955310	6.30 ug/ml	100
15) Terephenyl-d14	13.87	244	19611226	35.32 ug/ml	100
17) Benzo(a)anthracene	15.30	228	1412062m	-62.93 ug/ml	
18) Chrysene	15.31	228	1812221m	-17.76 ug/ml	
19) Benzo(b&k)fluoranthene	16.89	252	1408534m	1.94 ug/ml	
20) Benzo(a)pyrene	17.36	252	994689m	2.49 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0412077.D SBUFF.M Fri Jun 29 23:13:54 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0412078.D                    Vial: 8
Acq On    : 12 Apr 2007  19:10                        Operator: sb
Sample    : 10c                                       Inst    : GC/MS Ins
Misc      :                                           Multiplr: 1.00
                                                 Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Apr 13 11:46 19107              Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.76	152	29651820	40.00	ug/ml	-0.08
3) Naphthalene-d8	7.44	136	108106044	40.00		-0.08
6) Acenaphthene-d10	9.78	164	65244890	40.00	ug/ml	-0.08
10) Phenanthrene-d10	11.73	188	111137534	40.00	ug/ml	-0.07
16) Chrysene-d12	15.29	240	63439503	40.00	ug/ml	-0.03
21) Perylene-d12	17.45	264	25181463	40.00	ug/ml	0.05

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc	Units	Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.		
4) Naphthalene	7.46	128	452082m	-1.70		
5) 2-Fluorobiphenyl	8.91	172	4927256	5.27	ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.		
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	10.50	166	735097m	0.59	ug/ml	
11) Phenanthrene	11.76	178	4361183m	6.83		
12) Anthracene	11.82	178	2803879m	0.23	ug/ml	
13) Fluoranthene	13.36	202	12057053	8.68	ug/ml	100
14) Pyrene	13.66	202	10938452	7.65	ug/ml	100
15) Terephenyl-d14	13.89	244	33785995	53.73	ug/ml	100
17) Benzo(a)anthracene	15.31	228	2266614m	-59.90	ug/ml	
18) Chrysene	15.33	228	2375743m	-17.18	ug/ml	
19) Benzo(b&k)fluoranthene	16.88	252	2161882m	2.38	ug/ml	
20) Benzo(a)pyrene	17.36	252	1967216m	4.04	ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.		
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
0412078.D SBUFF.M   Fri Jun 29 23:14:08 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0412079.D                    Vial: 9
Acq On    : 12 Apr 2007  19:40                        Operator: sb
Sample    : 12a                                       Inst     : GC/MS Ins
Misc      :                                           Multiplr: 1.00
                                                 Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Apr 13 11:50 19107              Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.75	152	34250943	40.00 ug/ml	-0.09
3) Naphthalene-d8	7.42	136	121414553	40.00	-0.10
6) Acenaphthene-d10	9.77	164	71442683	40.00 ug/ml	-0.09
10) Phenanthrene-d10	11.72	188	128071718	40.00 ug/ml	-0.08
16) Chrysene-d12	15.27	240	78268693	40.00 ug/ml	-0.05
21) Perylene-d12	17.41	264	32854105	40.00 ug/ml	0.00

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.55	82	568593m	9.03 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.89	172	21383511	25.72 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	10.48	166	1373693m	1.00 ug/ml	
11) Phenanthrene	11.74	178	4964127	6.79	100
12) Anthracene	11.80	178	3946609	0.56 ug/ml	100
13) Fluoranthene	13.34	202	20592664	12.18 ug/ml	100
14) Pyrene	13.63	202	18489465	10.51 ug/ml	100
15) Terephenyl-d14	13.87	244	46339316	63.00 ug/ml	100
17) Benzo(a)anthracene	15.24	228	3662471m	-57.04 ug/ml	
18) Chrysene	15.30	228	6135230m	-13.53 ug/ml	
19) Benzo(b&k)fluoranthene	16.83	252	6985912m	4.79 ug/ml	
20) Benzo(a)pyrene	17.33	252	5860570m	8.88 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0412079.D SBUFF.M   Fri Jun 29 23:14:23 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0412080.D                  Vial: 10
Acq On    : 12 Apr 2007  20:10                      Operator: sb
Sample    : 12b                                     Inst    : GC/MS Ins
Misc      :                                         Multiplr: 1.00
                                               Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Apr 13 11:54 19107           Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.75	152	33371480	40.00 ug/ml	-0.09
3) Naphthalene-d8	7.42	136	120459417	40.00	-0.10
6) Acenaphthene-d10	9.76	164	68734345	40.00 ug/ml	-0.10
10) Phenanthrene-d10	11.72	188	112907904	40.00 ug/ml	-0.08
16) Chrysene-d12	15.27	240	79757009	40.00 ug/ml	-0.05
21) Perylene-d12	17.40	264	42333200	40.00 ug/ml	0.00

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	7.45	128	3339757	0.27	100
5) 2-Fluorobiphenyl	8.89	172	16756298	19.92 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	10.48	166	2171641m	1.64 ug/ml	
11) Phenanthrene	11.75	178	6989397	8.95	100
12) Anthracene	11.81	178	4477693	1.09 ug/ml	100
13) Fluoranthene	13.34	202	20067039	13.31 ug/ml	100
14) Pyrene	13.64	202	19819689	12.44 ug/ml	100
15) Terephenyl-d14	13.87	244	20706229	34.38 ug/ml	100
17) Benzo(a)anthracene	15.24	228	2658074	-60.53 ug/ml	100
18) Chrysene	15.30	228	4908467m	-15.03 ug/ml	
19) Benzo(b&k)fluoranthene	16.82	252	6371076m	4.38 ug/ml	
20) Benzo(a)pyrene	17.31	252	4689214m	7.11 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0412080.D SBUFF.M Fri Jun 29 23:14:40 2007

Quantitation Report (Not Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0228071.D                    Vial: 1
Acq On    : 28 Feb 2007  15:41                        Operator: rr
Sample    : blank                                     Inst    : GC/MS Ins
Misc      :                                           Multiplr: 1.00
                                                Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Apr 19 12:10 19107             Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	0.00	152	0	0.00 ug/ml	-5.84
3) Naphthalene-d8	0.00	136	0	0.00	-7.52
6) Acenaphthene-d10	0.00	164	0	0.00 ug/ml	-9.86
10) Phenanthrene-d10	0.00	188	0	0.00 ug/ml	-11.80
16) Chrysene-d12	0.00	240	0	0.00 ug/ml	-15.32
21) Perylene-d12	0.00	264	0	0.00 ug/ml	-17.40

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	0.00	172	0	N.D.	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	0.00	244	0	N.D.	
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0228071.D SBUFF.M Fri Jun 29 22:59:34 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0228072.D                  Vial: 2
Acq On    : 28 Feb 2007  16:10                      Operator: rr
Sample    : 5a                                      Inst     : GC/MS Ins
Misc      :                                         Multiplr: 1.00
                                               Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Mar 30 11:04 19107              Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	0.00	152	0	0.00	ug/ml	-5.84
3) Naphthalene-d8	0.00	136	0	0.00		-7.52
6) Acenaphthene-d10	0.00	164	0	0.00	ug/ml	-9.86
10) Phenanthrene-d10	0.00	188	0	0.00	ug/ml	-11.80
16) Chrysene-d12	0.00	240	0	0.00	ug/ml	-15.32
21) Perylene-d12	0.00	264	0	0.00	ug/ml	-17.40

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	0.00	172	0	N.D.	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	0.00	244	0	N.D.	
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0228072.D SBUFF.M Fri Jun 29 22:59:57 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0228073.D Vial: 3
Acq On : 28 Feb 2007 16:40 Operator: rr
Sample : 5b Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Apr 19 12:14 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Thu Apr 19 12:05:50 2007
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.72	152	21168510	40.00	ug/ml	-0.12
3) Naphthalene-d8	7.39	136	75601827	40.00		-0.13
6) Acenaphthene-d10	9.73	164	44594420	40.00	ug/ml	-0.13
10) Phenanthrene-d10	11.68	188	65400101	40.00	ug/ml	-0.12
16) Chrysene-d12	15.25	240	25907366	40.00	ug/ml	-0.07
21) Perylene-d12	17.38	264	22704845	40.00	ug/ml	-0.02

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc	Units	Qvalue
2) Nitrobenzene-d5	6.52	82	963937m	12.19	ug/ml	
4) Naphthalene	0.00	128	0	N.D.		
5) 2-Fluorobiphenyl	8.86	172	52248159	106.38	ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.		
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	10.45	166	449759m	-2.25	ug/ml	
11) Phenanthrene	0.00	178	0	N.D.		
12) Anthracene	0.00	178	0	N.D.		
13) Fluoranthene	13.32	202	4487075	6.01	ug/ml	100
14) Pyrene	13.61	202	4083224	5.41	ug/ml	100
15) Terephenyl-d14	13.84	244	69224038	174.76	ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.		
18) Chrysene	0.00	228	0	N.D.		
19) Benzo(b&k)fluoranthene	16.82	252	2475698m	5.06	ug/ml	
20) Benzo(a)pyrene	17.30	252	938144m	4.61	ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.		
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
0228073.D SBUFF.M Fri Jun 29 23:00:15 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0228074.D                 Vial: 4
Acq On    : 28 Feb 2007  17:10                     Operator: rr
Sample    : 5c                                     Inst    : GC/MS Ins
Misc      :                                        Multiplr: 1.00
                                              Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Mar 30 11:42 19107           Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.72	152	24970524	40.00 ug/ml	-0.12
3) Naphthalene-d8	7.39	136	85335609	40.00	-0.13
6) Acenaphthene-d10	9.73	164	49496164	40.00 ug/ml	-0.13
10) Phenanthrene-d10	11.68	188	74812132	40.00 ug/ml	-0.12
16) Chrysene-d12	15.25	240	34827844	40.00 ug/ml	-0.07
21) Perylene-d12	17.37	264	30524542	40.00 ug/ml	-0.03

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.49	82	4714094m	27.83 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.86	172	64214410	116.00 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	10.45	166	390101m	0.41 ug/ml	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	13.31	202	5462862m	6.31 ug/ml	
14) Pyrene	13.61	202	5007413	5.69 ug/ml	100
15) Terephenyl-d14	13.83	244	78896591	174.14 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	16.82	252	2591968m	4.14 ug/ml	
20) Benzo(a)pyrene	17.28	252	1154823m	4.28 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0228074.D SBUFF.M Fri Jun 29 23:00:31 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0228076.D                 Vial: 6
Acq On    : 28 Feb 2007  18:09                      Operator: rr
Sample    : 6b                                      Inst     : GC/MS Ins
Misc      :                                         Multiplr: 1.00
                                               Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Mar 30 12:00 19107            Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.72	152	19435449	40.00	ug/ml	-0.12
3) Naphthalene-d8	7.39	136	70708550	40.00		-0.13
6) Acenaphthene-d10	9.73	164	44627737	40.00	ug/ml	-0.13
10) Phenanthrene-d10	11.68	188	70027269	40.00	ug/ml	-0.12
16) Chrysene-d12	15.26	240	34498071	40.00	ug/ml	-0.06
21) Perylene-d12	17.39	264	27412786	40.00	ug/ml	0.00

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc	Units	Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.		
4) Naphthalene	0.00	128	0	N.D.		
5) 2-Fluorobiphenyl	8.87	172	14840165	31.01	ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.		
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	10.47	166	228989m	0.27	ug/ml	
11) Phenanthrene	0.00	178	0	N.D.		
12) Anthracene	0.00	178	0	N.D.		
13) Fluoranthene	13.32	202	2465172m	3.78	ug/ml	
14) Pyrene	13.62	202	3124046m	4.31	ug/ml	
15) Terephenyl-d14	13.84	244	32022216	78.32	ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.		
18) Chrysene	0.00	228	0	N.D.		
19) Benzo(b&k)fluoranthene	16.84	252	903127m	2.04	ug/ml	
20) Benzo(a)pyrene	17.30	252	297849m	1.57	ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.		
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
0228076.D SBUFF.M Fri Jun 29 23:01:09 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0228076.D                  Vial: 6
Acq On    : 28 Feb 2007  18:09                      Operator: rr
Sample    : 6b                                      Inst    : GC/MS Ins
Misc      :                                         Multiplr: 1.00
                                              Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Mar 30 12:00 19107            Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.72	152	19435449	40.00 ug/ml	-0.12
3) Naphthalene-d8	7.39	136	70708550	40.00	-0.13
6) Acenaphthene-d10	9.73	164	44627737	40.00 ug/ml	-0.13
10) Phenanthrene-d10	11.68	188	70027269	40.00 ug/ml	-0.12
16) Chrysene-d12	15.26	240	34498071	40.00 ug/ml	-0.06
21) Perylene-d12	17.39	264	27412786	40.00 ug/ml	0.00

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	14840165	31.01 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	10.47	166	228989m	0.27 ug/ml	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	13.32	202	2465172m	3.78 ug/ml	
14) Pyrene	13.62	202	3124046m	4.31 ug/ml	
15) Terephenyl-d14	13.84	244	32022216	78.32 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	16.84	252	903127m	2.04 ug/ml	
20) Benzo(a)pyrene	17.30	252	297849m	1.57 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0228076.D SBUFF.M Fri Jun 29 23:01:09 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0228077.D Vial: 7
Acq On : 28 Feb 2007 18:39 Operator: rr
Sample : 6c Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Mar 30 12:05 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.72	152	22167219	40.00 ug/ml	-0.12
3) Naphthalene-d8	7.40	136	78906230	40.00	-0.12
6) Acenaphthene-d10	9.73	164	48019626	40.00 ug/ml	-0.13
10) Phenanthrene-d10	11.68	188	75697248	40.00 ug/ml	-0.12
16) Chrysene-d12	15.25	240	39997402	40.00 ug/ml	-0.07
21) Perylene-d12	17.37	264	32834298	40.00 ug/ml	-0.03

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.53	82	556121m	9.96 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.86	172	18622483	35.10 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	10.45	166	336063m	0.36 ug/ml	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	13.61	202	4083533	5.03 ug/ml	100
14) Pyrene	13.61	202	4106964	4.91 ug/ml	100
15) Terephenyl-d14	13.84	244	41485837	92.88 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	16.81	252	1663312m	2.71 ug/ml	
20) Benzo(a)pyrene	17.28	252	800053m	2.82 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0228077.D SBUFF.M Fri Jun 29 23:03:35 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0228078.D Vial: 8
Acq On : 28 Feb 2007 19:09 Operator: rr
Sample : 7a Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Mar 30 12:12 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.73	152	25876039	40.00 ug/ml	-0.11
3) Naphthalene-d8	7.40	136	90585528	40.00	-0.12
6) Acenaphthene-d10	9.74	164	53695013	40.00 ug/ml	-0.12
10) Phenanthrene-d10	11.68	188	94612006	40.00 ug/ml	-0.12
16) Chrysene-d12	15.25	240	55485339	40.00 ug/ml	-0.07
21) Perylene-d12	17.36	264	46591442	40.00 ug/ml	-0.04

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	6.51	82	1529960m	13.67 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.86	172	27635621	45.92 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	10.46	166	238808m	0.23 ug/ml	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	13.32	202	1957382m	2.81 ug/ml	
14) Pyrene	13.61	202	1802974m	2.72 ug/ml	
15) Terephenyl-d14	13.84	244	68632005	121.33 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	16.80	252	1017437m	1.69 ug/ml	
20) Benzo(a)pyrene	17.18	252	469385m	1.55 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0228078.D SBUFF.M Fri Jun 29 23:03:52 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0228079.D                 Vial: 9
Acq On    : 28 Feb 2007  19:38                     Operator: rr
Sample    : 7b                                     Inst     : GC/MS Ins
Misc      :                                        Multiplr: 1.00
                                              Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Mar 30 12:18 19107             Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.73	152	20031255	40.00 ug/ml	-0.11
3) Naphthalene-d8	7.40	136	71591280	40.00	-0.12
6) Acenaphthene-d10	9.73	164	45799609	40.00 ug/ml	-0.13
10) Phenanthrene-d10	11.69	188	81110848	40.00 ug/ml	-0.11
16) Chrysene-d12	15.26	240	48152573	40.00 ug/ml	-0.06
21) Perylene-d12	17.39	264	37118423	40.00 ug/ml	0.00

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	6.49	82	6127166	40.61 ug/ml	100
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.86	172	51544501	110.91 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	10.46	166	101478m	0.12 ug/ml	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	13.33	202	1123688m	2.35 ug/ml	
14) Pyrene	13.62	202	1210828m	2.46 ug/ml	
15) Terephenyl-d14	13.84	244	125952691	254.07 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	16.83	252	583708m	1.42 ug/ml	
20) Benzo(a)pyrene	17.21	252	245664m	1.18 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0228079.D SBUFF.M Fri Jun 29 23:04:07 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0228080.D                Vial: 10
Acq On    : 28 Feb 2007  20:08                     Operator: rr
Sample    : 7c                                     Inst    : GC/MS Ins
Misc      :                                        Multiplr: 1.00
                                              Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Mar 30 12:30 19107          Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	0.00	152	0	0.00	ug/ml	-5.84
3) Naphthalene-d8	0.00	136	0	0.00		-7.52
6) Acenaphthene-d10	0.00	164	0	0.00	ug/ml	-9.86
10) Phenanthrene-d10	11.69	188	643802m	40.00	ug/ml	-0.11
16) Chrysene-d12	15.30	240	1715484m	40.00	ug/ml	-0.02
21) Perylene-d12	17.46	264	1240768m	40.00	ug/ml	0.06

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc	Units	Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.		
4) Naphthalene	0.00	128	0	N.D.		
5) 2-Fluorobiphenyl	8.87	172	28993642	N.D.		
7) Acenaphthylene	0.00	152	0	N.D.		
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	10.48	166	196624	N.D.		
11) Phenanthrene	11.72	178	1931569m	283.72		
12) Anthracene	0.00	178	0	-1.27	ug/ml	
13) Fluoranthene	13.32	202	2063287m	215.76	ug/ml	
14) Pyrene	13.61	202	1943126m	189.09	ug/ml	
15) Terephenyl-d14	13.84	244	74451625	18557.08	ug/ml	
17) Benzo(a)anthracene	15.30	228	1335145m	132.65	ug/ml	
18) Chrysene	15.33	228	839387m	23.05	ug/ml	
19) Benzo(b&k)fluoranthene	16.86	252	1157395m	30.32	ug/ml	
20) Benzo(a)pyrene	17.34	252	540912m	35.44	ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	20.19	ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
0228080.D SBUFF.M   Fri Jun 29 23:04:22 2007

Quantitation Report (Not Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0628071.D                     Vial: 1
Acq On    : 28 Jun 2007  23:49                          Operator: rr
Sample    : hex                                         Inst    : GC/MS Ins
Misc      :                                             Multiplr: 1.00
                                                    Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Jun 29 22:17 19107              Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	0.00	152	0	0.00 ug/ml	-5.84
3) Naphthalene-d8	0.00	136	0	0.00	-7.52
6) Acenaphthene-d10	0.00	164	0	0.00 ug/ml	-9.86
10) Phenanthrene-d10	0.00	188	0	0.00 ug/ml	-11.80
16) Chrysene-d12	0.00	240	0	0.00 ug/ml	-15.32
21) Perylene-d12	0.00	264	0	0.00 ug/ml	-17.40

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	0.00	172	0	N.D.	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	0.00	244	0	N.D.	
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0628071.D SBUFF.M Fri Jun 29 22:27:55 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0628072.D                 Vial: 2
Acq On    : 29 Jun 2007  00:18                      Operator: rr
Sample    : control                                 Inst    : GC/MS Ins
Misc      :                                         Multiplr: 1.00
                                               Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Jun 29 22:29 19107             Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.73	152	13203234	40.00 ug/ml	-0.11
3) Naphthalene-d8	7.41	136	40478906	40.00	-0.11
6) Acenaphthene-d10	9.74	164	25207536	40.00 ug/ml	-0.12
10) Phenanthrene-d10	11.69	188	41109602	40.00 ug/ml	-0.11
16) Chrysene-d12	15.30	240	19304156	40.00 ug/ml	-0.02
21) Perylene-d12	17.48	264	7191179m	40.00 ug/ml	0.08

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	3057837m	9.97 ug/ml	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	13.35	202	702236m	2.57 ug/ml	
14) Pyrene	13.35	202	727404m	2.63 ug/ml	
15) Terephenyl-d14	13.88	244	13095561	56.06 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0628072.D SBUFF.M Fri Jun 29 22:30:09 2007

O WaR Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0628073.D                    Vial: 3
Acq On    : 29 Jun 2007  00:48                        Operator: rr
Sample    : 4a                                        Inst    : GC/MS Ins
Misc      :                                           Multiplr: 1.00
                                                 Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Jun 29 22:26 19107          Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.74	152	13733571	40.00 ug/ml	-0.10
3) Naphthalene-d8	7.41	136	44748216	40.00	-0.11
6) Acenaphthene-d10	9.74	164	26031072	40.00 ug/ml	-0.12
10) Phenanthrene-d10	11.69	188	42835447	40.00 ug/ml	-0.11
16) Chrysene-d12	15.25	240	25950377	40.00 ug/ml	-0.07
21) Perylene-d12	17.36	264	13125846m	40.00 ug/ml	-0.04

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	12080575	40.42 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.85	244	18508666	74.27 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0628073.D SBUFF.M Fri Jun 29 22:27:20 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0628074.D                  Vial: 4
Acq On    : 29 Jun 2007   1:18                      Operator: rr
Sample    : 4b                                      Inst     : GC/MS Ins
Misc      :                                         Multiplr: 1.00
                                               Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Jun 29 22:32 19107              Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.74	152	12169282	40.00 ug/ml	-0.10
3) Naphthalene-d8	7.41	136	39395697	40.00	-0.11
6) Acenaphthene-d10	9.74	164	23367797	40.00 ug/ml	-0.12
10) Phenanthrene-d10	11.69	188	42085645	40.00 ug/ml	-0.11
16) Chrysene-d12	15.28	240	15011600m	40.00 ug/ml	-0.04
21) Perylene-d12	17.47	264	5369279m	40.00 ug/ml	0.07

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	4702323m	16.83 ug/ml	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.86	244	4835911m	23.39 ug/ml	
17) Benzo(a)anthracene	0.00	228	0	-69.17 ug/ml	
18) Chrysene	0.00	228	0	-20.51 ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89 ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0628074.D SBUFF.M   Fri Jun 29 22:32:38 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0628075.D Vial: 5
Acq On : 29 Jun 2007 1:47 Operator: rr
Sample : 4c Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Jun 29 22:34 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.74	152	12806401	40.00 ug/ml	-0.10
3) Naphthalene-d8	7.41	136	42946828	40.00	-0.11
6) Acenaphthene-d10	9.74	164	24959365	40.00 ug/ml	-0.12
10) Phenanthrene-d10	11.69	188	41966947	40.00 ug/ml	-0.11
16) Chrysene-d12	15.25	240	23281544	40.00 ug/ml	-0.07
21) Perylene-d12	17.36	264	10640171m	40.00 ug/ml	-0.04

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	10503055	36.44 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.84	244	24472968	98.51 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0628075.D SBUFF.M Fri Jun 29 22:34:47 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0628076.D Vial: 6
Acq On : 29 Jun 2007 2:17 Operator: rr
Sample : 6a Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Jun 29 22:36 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.74	152	12010797	40.00	ug/ml	-0.10
3) Naphthalene-d8	7.41	136	37449397	40.00		-0.11
6) Acenaphthene-d10	9.74	164	24086510	40.00	ug/ml	-0.12
10) Phenanthrene-d10	11.70	188	44016976	40.00	ug/ml	-0.10
16) Chrysene-d12	15.30	240	19111910m	40.00	ug/ml	-0.02
21) Perylene-d12	17.49	264	6943273m	40.00	ug/ml	0.09

System Monitoring Compounds

Target Compounds						Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.		
4) Naphthalene	0.00	128	0	N.D.		
5) 2-Fluorobiphenyl	8.87	172	10717927m	42.96	ug/ml	
7) Acenaphthylene	0.00	152	0	N.D.		
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	0.00	166	0	N.D.		
11) Phenanthrene	0.00	178	0	N.D.		
12) Anthracene	0.00	178	0	N.D.		
13) Fluoranthene	0.00	202	0	N.D.		
14) Pyrene	0.00	202	0	N.D.		
15) Terephenyl-d14	13.87	244	20240579	78.73	ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	-69.17	ug/ml	
18) Chrysene	0.00	228	0	-20.51	ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89	ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61	ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	20.19	ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
0628076.D SBUFF.M Fri Jun 29 22:36:44 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0628077.D                    Vial: 7
Acq On    : 29 Jun 2007   2:46                        Operator: rr
Sample    : 6b                                        Inst     : GC/MS Ins
Misc      :                                           Multiplr: 1.00
                                                 Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Jun 29 22:38 19107             Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.74	152	15780819	40.00	ug/ml	-0.10
3) Naphthalene-d8	7.41	136	49419487	40.00		-0.11
6) Acenaphthene-d10	9.74	164	30969804	40.00	ug/ml	-0.12
10) Phenanthrene-d10	11.69	188	59708008	40.00	ug/ml	-0.11
16) Chrysene-d12	15.29	240	28147003m	40.00	ug/ml	-0.03
21) Perylene-d12	17.51	264	10471020m	40.00	ug/ml	0.11

System Monitoring Compounds

Target Compounds						Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.		
4) Naphthalene	0.00	128	0	N.D.		
5) 2-Fluorobiphenyl	8.87	172	12500949	37.76	ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.		
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	0.00	166	0	N.D.		
11) Phenanthrene	0.00	178	0	N.D.		
12) Anthracene	0.00	178	0	N.D.		
13) Fluoranthene	0.00	202	0	N.D.		
14) Pyrene	0.00	202	0	N.D.		
15) Terephenyl-d14	13.86	244	32859127	93.24	ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	-69.17	ug/ml	
18) Chrysene	0.00	228	0	-20.51	ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89	ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61	ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	20.19	ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
0628077.D SBUFF.M   Fri Jun 29 22:38:56 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0628078.D                    Vial: 8
Acq On    : 29 Jun 2007   3:16                        Operator: rr
Sample    : 6c                                        Inst    : GC/MS Ins
Misc      :                                           Multiplr: 1.00
                                                 Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Jun 29 22:40 19107            Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.74	152	17576625	40.00 ug/ml	-0.10
3) Naphthalene-d8	7.40	136	45856688	40.00	-0.12
6) Acenaphthene-d10	9.74	164	32020029	40.00 ug/ml	-0.12
10) Phenanthrene-d10	11.69	188	52559780	40.00 ug/ml	-0.11
16) Chrysene-d12	15.30	240	20500954m	40.00 ug/ml	-0.02
21) Perylene-d12	17.51	264	7362479m	40.00 ug/ml	0.11

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	6.57	82	916116m	12.91 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	14548130	47.83 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.87	244	22868801	74.76 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	-69.17 ug/ml	
18) Chrysene	0.00	228	0	-20.51 ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89 ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0628078.D SBUFF.M Fri Jun 29 22:41:17 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0628079.D Vial: 9
Acq On : 29 Jun 2007 3:45 Operator: rr
Sample : 9a Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Jun 29 22:43 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.74	152	18010351	40.00 ug/ml	-0.10
3) Naphthalene-d8	7.41	136	57147905	40.00	-0.11
6) Acenaphthene-d10	9.74	164	35695161	40.00 ug/ml	-0.12
10) Phenanthrene-d10	11.70	188	53442637	40.00 ug/ml	-0.10
16) Chrysene-d12	15.30	240	21049862m	40.00 ug/ml	-0.02
21) Perylene-d12	17.51	264	7698093m	40.00 ug/ml	0.11

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	6.59	82	458525m	10.00 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	11109864m	28.58 ug/ml	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.87	244	22510294m	72.53 ug/ml	
17) Benzo(a)anthracene	0.00	228	0	-69.17 ug/ml	
18) Chrysene	0.00	228	0	-20.51 ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89 ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0628079.D SBUFF.M Fri Jun 29 22:43:41 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0628081.D                     Vial: 11
Acq On    : 29 Jun 2007   4:44                         Operator: rr
Sample    : 9c                                         Inst    : GC/MS Ins
Misc      :                                            Multiplr: 1.00
                                                  Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Jun 29 22:48 19107           Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.74	152	17330440	40.00 ug/ml	-0.10
3) Naphthalene-d8	7.41	136	55558984	40.00	-0.11
6) Acenaphthene-d10	9.74	164	33047892	40.00 ug/ml	-0.12
10) Phenanthrene-d10	11.69	188	62474408	40.00 ug/ml	-0.11
16) Chrysene-d12	15.30	240	24877981m	40.00 ug/ml	-0.02
21) Perylene-d12	17.49	264	9021972m	40.00 ug/ml	0.09

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	9660023m	25.37 ug/ml	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.87	244	27562010	75.73 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	-69.17 ug/ml	
18) Chrysene	0.00	228	0	-20.51 ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89 ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0628081.D SBUFF.M Fri Jun 29 22:48:29 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\070407CT.D Vial: 2
Acq On : 4 Oct 2007 23:20 Operator: sb
Sample : control Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Oct 5 20:35 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.67	152	34055220	40.00	ug/ml	-0.17
3) Naphthalene-d8	7.32	136	93562548	40.00		-0.20
6) Acenaphthene-d10	9.64	164	49528811	40.00	ug/ml	-0.22
10) Phenanthrene-d10	11.57	188	90105056m	40.00	ug/ml	-0.23
16) Chrysene-d12	15.10	240	10178868m	40.00	ug/ml	-0.22
21) Perylene-d12	0.00	264	0	0.00	ug/ml	-17.40

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc	Units	Qvalue
2) Nitrobenzene-d5	6.42	82	7891612m	32.52	ug/ml	
4) Naphthalene	0.00	128	0	N.D.		
5) 2-Fluorobiphenyl	8.77	172	42419541	69.15	ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.		
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	0.00	166	0	N.D.		
11) Phenanthrene	0.00	178	0	3.16		
12) Anthracene	0.00	178	0	-1.27	ug/ml	
13) Fluoranthene	0.00	202	0	1.42	ug/ml	
14) Pyrene	0.00	202	0	1.53	ug/ml	
15) Terephenyl-d14	13.70	244	72266945	133.62	ug/ml	
17) Benzo(a)anthracene	0.00	228	0	-69.17	ug/ml	
18) Chrysene	0.00	228	0	-20.51	ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89	ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61	ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.		
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
070407CT.D SBUFF.M Fri Oct 05 21:09:57 2007

Quantitation Report (Not Reviewed)

```
Data File : C:\HPCHEM\1\DATA\070407HX.D                 Vial: 1
Acq On    :  4 Oct 2007  22:51                      Operator: sb
Sample    : blank-hexane                            Inst     : GC/MS Ins
Misc      :                                         Multiplr: 1.00
                                               Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Oct  5 21:10 19107             Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	0.00	152	0	0.00 ug/ml	-5.84
3) Naphthalene-d8	0.00	136	0	0.00	-7.52
6) Acenaphthene-d10	0.00	164	0	0.00 ug/ml	-9.86
10) Phenanthrene-d10	0.00	188	0	0.00 ug/ml	-11.80
16) Chrysene-d12	0.00	240	0	0.00 ug/ml	-15.32
21) Perylene-d12	0.00	264	0	0.00 ug/ml	-17.40

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	0.00	172	0	N.D.	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	0.00	244	0	N.D.	
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
070407HX.D SBUFF.M Fri Oct 05 21:11:11 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\070407T1.D                    Vial: 3
Acq On    :  4 Oct 2007  23:49                         Operator: sb
Sample    : Ta                                         Inst    : GC/MS Ins
Misc      :                                            Multiplr: 1.00
                                                  Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Oct  5 20:43 19107             Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.67	152	35651516	40.00 ug/ml	-0.17
3) Naphthalene-d8	7.32	136	124204267	40.00	-0.20
6) Acenaphthene-d10	9.64	164	64403152	40.00 ug/ml	-0.22
10) Phenanthrene-d10	11.57	188	91325937	40.00 ug/ml	-0.23
16) Chrysene-d12	15.11	240	9376318m	40.00 ug/ml	-0.21
21) Perylene-d12	0.00	264	0	0.00 ug/ml	-17.40

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.77	172	32769394	39.46 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.70	244	53891859	99.62 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	-69.17 ug/ml	
18) Chrysene	0.00	228	0	-20.51 ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89 ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
070407T1.D SBUFF.M   Fri Oct 05 21:11:33 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\070407T2.D                Vial: 4
Acq On    :  5 Oct 2007  00:19                     Operator: sb
Sample    : Tb                                     Inst    : GC/MS Ins
Misc      :                                        Multiplr: 1.00
                                              Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Oct  5 10:39 19107         Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	0.00	152	0	0.00 ug/ml	-5.84
3) Naphthalene-d8	7.32	136	10817928	40.00	-0.20
6) Acenaphthene-d10	9.63	164	5841473	40.00 ug/ml	-0.23
10) Phenanthrene-d10	11.56	188	9116421	40.00 ug/ml	-0.24
16) Chrysene-d12	0.00	240	0	0.00 ug/ml	-15.32
21) Perylene-d12	0.00	264	0	0.00 ug/ml	-17.40

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.77	172	16077166	230.91 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.70	244	39995184	708.77 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
070407T2.D SBUFF.M Fri Oct 05 21:12:05 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\070407T3.D Vial: 5
Acq On : 5 Oct 2007 00:49 Operator: sb
Sample : Tc Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Oct 5 20:48 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.67	152	26006830	40.00	ug/ml	-0.17
3) Naphthalene-d8	7.32	136	92689410	40.00		-0.20
6) Acenaphthene-d10	9.64	164	45400380	40.00	ug/ml	-0.22
10) Phenanthrene-d10	11.56	188	71112188	40.00	ug/ml	-0.24
16) Chrysene-d12	15.09	240	10866276m	40.00	ug/ml	-0.23
21) Perylene-d12	0.00	264	0	0.00	ug/ml	-17.40

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc	Units	Qvalue
2) Nitrobenzene-d5	6.46	82	1036468m	11.57	ug/ml	
4) Naphthalene	0.00	128	0	N.D.		
5) 2-Fluorobiphenyl	8.77	172	26336739	42.64	ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.		
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	0.00	166	0	N.D.		
11) Phenanthrene	0.00	178	0	N.D.		
12) Anthracene	0.00	178	0	N.D.		
13) Fluoranthene	13.47	202	1378592m	2.72	ug/ml	
14) Pyrene	0.00	202	0	N.D.		
15) Terephenyl-d14	13.70	244	41709420	99.05	ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	-69.17	ug/ml	
18) Chrysene	0.00	228	0	-20.51	ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89	ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61	ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.		
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
070407T3.D SBUFF.M Fri Oct 05 21:12:25 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\070407T4.D                Vial: 6
Acq On    :  5 Oct 2007   1:18                     Operator: sb
Sample    : Ma                                     Inst    : GC/MS Ins
Misc      :                                        Multiplr: 1.00
                                              Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Oct  5 20:51 19107          Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.68	152	25267776	40.00	ug/ml	-0.16
3) Naphthalene-d8	7.33	136	88881543	40.00		-0.19
6) Acenaphthene-d10	9.65	164	41248110	40.00	ug/ml	-0.21
10) Phenanthrene-d10	11.58	188	58289148	40.00	ug/ml	-0.22
16) Chrysene-d12	15.13	240	17874592m	40.00	ug/ml	-0.19
21) Perylene-d12	0.00	264	0	0.00	ug/ml	-17.40

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc	Units	Qvalue
2) Nitrobenzene-d5	6.45	82	1965332m	15.71	ug/ml	
4) Naphthalene	0.00	128	0	N.D.		
5) 2-Fluorobiphenyl	8.79	172	28832261	48.94	ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.		
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	0.00	166	0	N.D.		
11) Phenanthrene	0.00	178	0	N.D.		
12) Anthracene	0.00	178	0	N.D.		
13) Fluoranthene	13.20	202	4786213m	6.91	ug/ml	
14) Pyrene	13.50	202	4491061m	6.32	ug/ml	
15) Terephenyl-d14	13.73	244	41014017	117.84	ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	-69.17	ug/ml	
18) Chrysene	0.00	228	0	-20.51	ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89	ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61	ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.		
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
070407T4.D SBUFF.M Fri Oct 05 21:12:41 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\070407T5.D Vial: 7
Acq On : 5 Oct 2007 1:48 Operator: sb
Sample : Mb Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Oct 5 20:52 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.67	152	5376136m	40.00 ug/ml	-0.17
3) Naphthalene-d8	7.32	136	16509204	40.00	-0.20
6) Acenaphthene-d10	9.63	164	8098105	40.00 ug/ml	-0.23
10) Phenanthrene-d10	11.56	188	10464276	40.00 ug/ml	-0.24
16) Chrysene-d12	0.00	240	0	0.00 ug/ml	-15.32
21) Perylene-d12	0.00	264	0	0.00 ug/ml	-17.40

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	6.43	82	2716386m	62.38 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.77	172	31637746	298.30 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.71	244	42162993	651.35 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
070407T5.D SBUFF.M Fri Oct 05 21:13:09 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\070407T6.D                    Vial: 8
Acq On    :  5 Oct 2007   2:17                         Operator: sb
Sample    : Mc                                         Inst     : GC/MS Ins
Misc      :                                            Multiplr: 1.00
                                                  Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Oct  5 20:56 19107             Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	0.00	152	0	0.00	ug/ml	-5.84
3) Naphthalene-d8	0.00	136	0	0.00		-7.52
6) Acenaphthene-d10	0.00	164	0	0.00	ug/ml	-9.86
10) Phenanthrene-d10	0.00	188	0	0.00	ug/ml	-11.80
16) Chrysene-d12	0.00	240	0	0.00	ug/ml	-15.32
21) Perylene-d12	0.00	264	0	0.00	ug/ml	-17.40

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc	Qvalue
2) Nitrobenzene-d5	6.44	82	2046902	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.77	172	30926207	N.D.	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	13.48	202	5345792	N.D.	
14) Pyrene	13.48	202	5360699	N.D.	
15) Terephenyl-d14	13.72	244	39488649	N.D.	
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
070407T6.D SBUFF.M Fri Oct 05 21:13:27 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\070407T7.D Vial: 9
Acq On : 5 Oct 2007 2:47 Operator: sb
Sample : Ba Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Oct 5 20:57 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	0.00	152	0	0.00	ug/ml	-5.84
3) Naphthalene-d8	0.00	136	0	0.00		-7.52
6) Acenaphthene-d10	0.00	164	0	0.00	ug/ml	-9.86
10) Phenanthrene-d10	0.00	188	0	0.00	ug/ml	-11.80
16) Chrysene-d12	0.00	240	0	0.00	ug/ml	-15.32
21) Perylene-d12	0.00	264	0	0.00	ug/ml	-17.40

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc	Qvalue
2) Nitrobenzene-d5	6.42	82	6270722	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.77	172	37676756	N.D.	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.70	244	40302769	N.D.	
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
070407T7.D SBUFF.M Fri Oct 05 21:13:44 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\070407T8.D                    Vial: 10
Acq On    :  5 Oct 2007   3:16                          Operator: sb
Sample    : Bb                                          Inst     : GC/MS Ins
Misc      :                                             Multiplr: 1.00
                                                   Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Oct  5 20:59 19107          Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.67	152	29234576	40.00 ug/ml	-0.17
3) Naphthalene-d8	7.32	136	103686785	40.00	-0.20
6) Acenaphthene-d10	9.64	164	53142453	40.00 ug/ml	-0.22
10) Phenanthrene-d10	11.57	188	78733300	40.00 ug/ml	-0.23
16) Chrysene-d12	15.09	240	10657502m	40.00 ug/ml	-0.23
21) Perylene-d12	0.00	264	0	0.00 ug/ml	-17.40

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.42	82	6031948m	29.74 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.77	172	34281137	49.92 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.70	244	36291225	78.90 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	-69.17 ug/ml	
18) Chrysene	0.00	228	0	-20.51 ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89 ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
070407T8.D SBUFF.M   Fri Oct 05 21:14:04 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\070407T9.D                    Vial: 11
Acq On    :  5 Oct 2007   3:46                         Operator: sb
Sample    : Bc                                          Inst     : GC/MS Ins
Misc      :                                            Multiplr: 1.00
                                                  Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Oct  5 21:01 19107           Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.67	152	24885223	40.00	ug/ml	-0.17
3) Naphthalene-d8	7.32	136	87492983	40.00		-0.20
6) Acenaphthene-d10	9.63	164	44361721	40.00	ug/ml	-0.23
10) Phenanthrene-d10	11.56	188	67304820m	40.00	ug/ml	-0.24
16) Chrysene-d12	15.08	240	14887100m	40.00	ug/ml	-0.24
21) Perylene-d12	0.00	264	0	0.00	ug/ml	-17.40

System Monitoring Compounds

Target Compounds						Qvalue
2) Nitrobenzene-d5	6.44	82	1995009m	15.97	ug/ml	
4) Naphthalene	0.00	128	0	N.D.		
5) 2-Fluorobiphenyl	8.77	172	21921535	37.38	ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.		
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	0.00	166	0	N.D.		
11) Phenanthrene	0.00	178	0	3.16		
12) Anthracene	0.00	178	0	-1.27	ug/ml	
13) Fluoranthene	0.00	202	0	1.42	ug/ml	
14) Pyrene	0.00	202	0	1.53	ug/ml	
15) Terephenyl-d14	13.70	244	54544218	134.97	ug/ml	
17) Benzo(a)anthracene	0.00	228	0	-69.17	ug/ml	
18) Chrysene	0.00	228	0	-20.51	ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89	ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61	ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.		
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
070407T9.D SBUFF.M Fri Oct 05 21:14:20 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\070607S6.D                    Vial: 7
Acq On    :  7 Jul 2007   1:49                         Operator: sb
Sample    : Mb                                         Inst    : GC/MS Ins
Misc      :                                            Multiplr: 1.00
                                                  Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Jul 12 19:07 19107              Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.74	152	16961813	40.00 ug/ml	-0.10
3) Naphthalene-d8	7.41	136	54829529	40.00	-0.11
6) Acenaphthene-d10	9.74	164	25620344	40.00 ug/ml	-0.12
10) Phenanthrene-d10	11.69	188	36837526	40.00 ug/ml	-0.11
16) Chrysene-d12	15.26	240	21377345	40.00 ug/ml	-0.06
21) Perylene-d12	17.34	264	16685583m	40.00 ug/ml	-0.06

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.50	82	5109840m	40.11 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	18763045	51.74 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	13.33	202	7498099m	15.04 ug/ml	
14) Pyrene	13.62	202	5909132	11.50 ug/ml	100
15) Terephenyl-d14	13.86	244	35778301	160.77 ug/ml	100
17) Benzo(a)anthracene	15.28	228	4542033m	-14.07 ug/ml	
18) Chrysene	15.28	228	4751912m	-0.72 ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
070607S6.D SBUFF.M Fri Oct 05 21:21:25 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\070607S7.D
Acq On : 7 Jul 2007 2:19
Sample : Mc
Misc :

Vial: 8
Operator: sb
Inst : GC/MS Ins
Multiplr: 1.00
Sample Amount: 0.00

Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Jul 12 19:05 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.73	152	15503812	40.00	ug/ml	-0.11
3) Naphthalene-d8	7.40	136	51417855	40.00		-0.12
6) Acenaphthene-d10	9.74	164	24736362	40.00	ug/ml	-0.12
10) Phenanthrene-d10	11.69	188	32981910	40.00	ug/ml	-0.11
16) Chrysene-d12	15.28	240	17490462	40.00	ug/ml	-0.04
21) Perylene-d12	17.35	264	15346937	40.00	ug/ml	-0.05

System Monitoring Compounds

Target Compounds						Qvalue
2) Nitrobenzene-d5	6.51	82	2496941m	24.80	ug/ml	
4) Naphthalene	0.00	128	0	N.D.		
5) 2-Fluorobiphenyl	8.87	172	18145148	53.41	ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.		
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	0.00	166	0	N.D.		
11) Phenanthrene	0.00	178	0	N.D.		
12) Anthracene	0.00	178	0	N.D.		
13) Fluoranthene	13.34	202	5664792m	12.91	ug/ml	
14) Pyrene	13.63	202	5034768m	11.02	ug/ml	
15) Terephenyl-d14	13.87	244	28043042	141.36	ug/ml	100
17) Benzo(a)anthracene	15.30	228	3251754m	-20.96	ug/ml	
18) Chrysene	15.30	228	3548878m	-2.44	ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.		
20) Benzo(a)pyrene	0.00	252	0	N.D.		
22) Dibenz(ah)anthracene	0.00	276	0	N.D.		
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
070607S7.D SBUFF.M Fri Oct 05 21:21:44 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\070607S8.D Vial: 9
Acq On : 7 Jul 2007 2:48 Operator: sb
Sample : Ba Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Jul 12 19:09 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.74	152	12970140	40.00 ug/ml	-0.10
3) Naphthalene-d8	7.41	136	46149202	40.00	-0.11
6) Acenaphthene-d10	9.74	164	25845776	40.00 ug/ml	-0.12
10) Phenanthrene-d10	11.69	188	43974388	40.00 ug/ml	-0.11
16) Chrysene-d12	15.29	240	19175193m	40.00 ug/ml	-0.03
21) Perylene-d12	17.48	264	9006460m	40.00 ug/ml	0.08

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.51	82	3237095m	34.47 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	12311284	39.92 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.85	244	41243982	155.42 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	-69.17 ug/ml	
18) Chrysene	0.00	228	0	-20.51 ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89 ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
070607S8.D SBUFF.M Fri Oct 05 21:22:10 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\070607S9.D                 Vial: 10
Acq On    :  7 Jul 2007   3:18                      Operator: sb
Sample    : Bb                                      Inst     : GC/MS Ins
Misc      :                                         Multiplr: 1.00
                                               Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: Jul 12 19:11 19107            Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.74	152	15698317	40.00 ug/ml	-0.10
3) Naphthalene-d8	7.41	136	53015430	40.00	-0.11
6) Acenaphthene-d10	9.74	164	29046152	40.00 ug/ml	-0.12
10) Phenanthrene-d10	11.69	188	47671759	40.00 ug/ml	-0.11
16) Chrysene-d12	15.28	240	18386479m	40.00 ug/ml	-0.04
21) Perylene-d12	17.46	264	8410709m	40.00 ug/ml	0.06

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.52	82	1974175m	20.95 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	10436313m	28.97 ug/ml	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.85	244	42183094	146.91 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	-69.17 ug/ml	
18) Chrysene	0.00	228	0	-20.51 ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89 ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
070607S9.D SBUFF.M Fri Oct 05 21:23:01 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\070607SB.D Vial: 11
Acq On : 7 Jul 2007 3:47 Operator: sb
Sample : Bc Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: Jul 12 19:13 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.74	152	15112026	40.00	ug/ml	-0.10
3) Naphthalene-d8	7.41	136	46838511	40.00		-0.11
6) Acenaphthene-d10	9.74	164	25586747	40.00	ug/ml	-0.12
10) Phenanthrene-d10	11.69	188	42509654	40.00	ug/ml	-0.11
16) Chrysene-d12	15.30	240	16922427m	40.00	ug/ml	-0.02
21) Perylene-d12	17.50	264	7246671m	40.00	ug/ml	0.10

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc	Units	Qvalue
2) Nitrobenzene-d5	6.53	82	1969978m	21.45	ug/ml	
4) Naphthalene	0.00	128	0	N.D.		
5) 2-Fluorobiphenyl	8.87	172	11459979	36.46	ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.		
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	0.00	166	0	N.D.		
11) Phenanthrene	0.00	178	0	N.D.		
12) Anthracene	0.00	178	0	N.D.		
13) Fluoranthene	0.00	202	0	N.D.		
14) Pyrene	0.00	202	0	N.D.		
15) Terephenyl-d14	13.85	244	36756239	143.67	ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	-69.17	ug/ml	
18) Chrysene	0.00	228	0	-20.51	ug/ml	
19) Benzo(b&k)fluoranthene	0.00	252	0	0.89	ug/ml	
20) Benzo(a)pyrene	0.00	252	0	0.61	ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	20.19	ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
070607SB.D SBUFF.M Fri Oct 05 21:23:22 2007

Quantitation Report (Not Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0504071.D                Vial: 1
Acq On    :  4 May 2007  15:10                    Operator: rr
Sample    : hex                                   Inst    : GC/MS Ins
Misc      :                                       Multiplr: 1.00
                                             Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: May  8 14:49 19107            Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	0.00	152	0	0.00	ug/ml	-5.84
3) Naphthalene-d8	0.00	136	0	0.00		-7.52
6) Acenaphthene-d10	0.00	164	0	0.00	ug/ml	-9.86
10) Phenanthrene-d10	0.00	188	0	0.00	ug/ml	-11.80
16) Chrysene-d12	0.00	240	0	0.00	ug/ml	-15.32
21) Perylene-d12	0.00	264	0	0.00	ug/ml	-17.40

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc	Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	0.00	172	0	N.D.	
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	0.00	244	0	N.D.	
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0504071.D SBUFF.M Fri Jun 29 22:49:44 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0504072.D Vial: 2
Acq On : 4 May 2007 15:40 Operator: rr
Sample : cntrl Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: May 8 14:50 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.72	152	26918693	40.00 ug/ml	-0.12
3) Naphthalene-d8	7.39	136	99265000	40.00	-0.13
6) Acenaphthene-d10	9.73	164	66681071	40.00 ug/ml	-0.13
10) Phenanthrene-d10	11.69	188	135358825	40.00 ug/ml	-0.11
16) Chrysene-d12	15.27	240	99645259	40.00 ug/ml	-0.05
21) Perylene-d12	17.40	264	57392536	40.00 ug/ml	0.00

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	0.00	82	0	N.D.	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	11679289	16.56 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	0.00	178	0	N.D.	
12) Anthracene	0.00	178	0	N.D.	
13) Fluoranthene	0.00	202	0	N.D.	
14) Pyrene	0.00	202	0	N.D.	
15) Terephenyl-d14	13.85	244	128754126	157.55 ug/ml	100
17) Benzo(a)anthracene	0.00	228	0	N.D.	
18) Chrysene	0.00	228	0	N.D.	
19) Benzo(b&k)fluoranthene	0.00	252	0	N.D.	
20) Benzo(a)pyrene	0.00	252	0	N.D.	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0504072.D SBUFF.M Fri Jun 29 22:50:34 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0504073.D Vial: 3
Acq On : 4 May 2007 16:09 Operator: rr
Sample : 6a Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: May 8 15:00 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.72	152	27650187	40.00 ug/ml	-0.12
3) Naphthalene-d8	7.39	136	101803892	40.00	-0.13
6) Acenaphthene-d10	9.73	164	65214649	40.00 ug/ml	-0.13
10) Phenanthrene-d10	11.68	188	106360014	40.00 ug/ml	-0.12
16) Chrysene-d12	15.24	240	70808454	40.00 ug/ml	-0.08
21) Perylene-d12	17.34	264	57724859	40.00 ug/ml	-0.06

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.50	82	2344513m	16.48 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.86	172	42590832	63.66 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	11.71	178	4178508m	6.84	
12) Anthracene	11.71	178	4024941m	0.98 ug/ml	
13) Fluoranthene	13.32	202	8015153	6.46 ug/ml	100
14) Pyrene	13.61	202	7808267	6.10 ug/ml	100
15) Terephenyl-d14	13.84	244	78455108	123.29 ug/ml	100
17) Benzo(a)anthracene	15.26	228	5464501m	-49.16 ug/ml	
18) Chrysene	15.26	228	5268244m	-13.89 ug/ml	
19) Benzo(b&k)fluoranthene	16.76	252	4489186m	3.66 ug/ml	
20) Benzo(a)pyrene	17.27	252	3912313m	6.72 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0504073.D SBUFF.M Fri Jun 29 22:50:52 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0504074.D                 Vial: 4
Acq On    :  4 May 2007  16:39                     Operator: rr
Sample    : 6b                                     Inst     : GC/MS Ins
Misc      :                                        Multiplr: 1.00
                                              Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: May  8 15:05 19107          Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.73	152	29275357	40.00 ug/ml	-0.11
3) Naphthalene-d8	7.40	136	105621311	40.00	-0.12
6) Acenaphthene-d10	9.74	164	63297343	40.00 ug/ml	-0.12
10) Phenanthrene-d10	11.69	188	89904217	40.00 ug/ml	-0.11
16) Chrysene-d12	15.25	240	59818829	40.00 ug/ml	-0.07
21) Perylene-d12	17.33	264	48137359	40.00 ug/ml	-0.07

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.50	82	4188298m	22.84 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	53894821	78.06 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	11.72	178	2315523m	5.57	
12) Anthracene	11.72	178	2315890m	0.26 ug/ml	
13) Fluoranthene	13.33	202	31918217	25.17 ug/ml	100
14) Pyrene	13.62	202	47161147	34.13 ug/ml	100
15) Terephenyl-d14	13.85	244	58499612	109.34 ug/ml	100
17) Benzo(a)anthracene	15.28	228	3093049m	-55.76 ug/ml	
18) Chrysene	15.28	228	3006931m	-16.03 ug/ml	
19) Benzo(b&k)fluoranthene	16.77	252	2520914m	2.73 ug/ml	
20) Benzo(a)pyrene	17.16	252	2294506m	4.85 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0504074.D SBUFF.M Fri Jun 29 22:51:10 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0504075.D                Vial: 5
Acq On    :  4 May 2007  17:10                    Operator: rr
Sample    : 6c                                    Inst    : GC/MS Ins
Misc      :                                      Multiplr: 1.00
                                            Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: May  8 15:10 19107          Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.72	152	25070782	40.00	ug/ml	-0.12
3) Naphthalene-d8	7.39	136	89438709	40.00		-0.13
6) Acenaphthene-d10	9.73	164	53713232	40.00	ug/ml	-0.13
10) Phenanthrene-d10	11.68	188	85731590	40.00	ug/ml	-0.12
16) Chrysene-d12	15.24	240	44804899	40.00	ug/ml	-0.08
21) Perylene-d12	17.34	264	35023571	40.00	ug/ml	-0.06

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc	Units	Qvalue
2) Nitrobenzene-d5	6.53	82	1234085m	12.59	ug/ml	
4) Naphthalene	0.00	128	0	N.D.		
5) 2-Fluorobiphenyl	8.86	172	23611120	39.48	ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.		
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	0.00	166	0	N.D.		
11) Phenanthrene	11.71	178	1221549m	4.49		
12) Anthracene	11.71	178	1178631m	-0.46	ug/ml	
13) Fluoranthene	13.31	202	2614009m	3.46	ug/ml	
14) Pyrene	13.61	202	3163732	3.83	ug/ml	100
15) Terephenyl-d14	13.84	244	39836202	79.50	ug/ml	100
17) Benzo(a)anthracene	15.27	228	1760021m	-58.98	ug/ml	
18) Chrysene	15.27	228	1793144m	-16.95	ug/ml	
19) Benzo(b&k)fluoranthene	16.79	252	1236378m	2.10	ug/ml	
20) Benzo(a)pyrene	17.27	252	1214995m	3.61	ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.		
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
0504075.D SBUFF.M Fri Jun 29 22:51:28 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0504076.D                    Vial: 6
Acq On    :  4 May 2007  17:40                        Operator: rr
Sample    : 8a                                        Inst     : GC/MS Ins
Misc      :                                           Multiplr: 1.00
                                                  Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: May  8 15:14 19107            Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.73	152	24699448	40.00 ug/ml	-0.11
3) Naphthalene-d8	7.40	136	89174000	40.00	-0.12
6) Acenaphthene-d10	9.73	164	53780071	40.00 ug/ml	-0.13
10) Phenanthrene-d10	11.68	188	95352638	40.00 ug/ml	-0.12
16) Chrysene-d12	15.25	240	66093435	40.00 ug/ml	-0.07
21) Perylene-d12	17.37	264	39266801	40.00 ug/ml	-0.03

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.50	82	2721875m	19.25 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.87	172	23957400	40.22 ug/ml	100
7) Acenaphthylene	9.53	152	477190m	0.86 ug/ml	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	11.72	178	2402995m	5.52	
12) Anthracene	11.72	178	2488727m	0.28 ug/ml	
13) Fluoranthene	13.32	202	4685770	4.71 ug/ml	100
14) Pyrene	13.61	202	4974653	4.78 ug/ml	100
15) Terephenyl-d14	13.84	244	83772776	145.90 ug/ml	100
17) Benzo(a)anthracene	15.28	228	6365336m	-44.20 ug/ml	
18) Chrysene	15.28	228	6437331m	-11.84 ug/ml	
19) Benzo(b&k)fluoranthene	16.81	252	6569921m	5.23 ug/ml	
20) Benzo(a)pyrene	17.29	252	4553083m	8.22 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0504076.D SBUFF.M   Fri Jun 29 22:51:45 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0504077.D Vial: 7
Acq On : 4 May 2007 18:10 Operator: rr
Sample : 8b Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: May 8 15:18 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.72	152	25148318	40.00	ug/ml	-0.12
3) Naphthalene-d8	7.39	136	91999339	40.00		-0.13
6) Acenaphthene-d10	9.73	164	55835118m	40.00	ug/ml	-0.13
10) Phenanthrene-d10	11.69	188	107935546	40.00	ug/ml	-0.11
16) Chrysene-d12	15.25	240	79034926	40.00	ug/ml	-0.07
21) Perylene-d12	17.37	264	44720027	40.00	ug/ml	-0.03

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc	Units	Qvalue
2) Nitrobenzene-d5	6.50	82	3475655m	22.31	ug/ml	
4) Naphthalene	0.00	128	0	N.D.		
5) 2-Fluorobiphenyl	8.86	172	32809896	53.99	ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	d	
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	0.00	166	0	N.D.		
11) Phenanthrene	11.71	178	5030414m	7.52		
12) Anthracene	11.71	178	4864527m	1.41	ug/ml	
13) Fluoranthene	13.31	202	10266844	7.78	ug/ml	100
14) Pyrene	13.61	202	10580498	7.63	ug/ml	100
15) Terephenyl-d14	13.84	244	111269210	170.34	ug/ml	100
17) Benzo(a)anthracene	15.27	228	10392312m	-35.07	ug/ml	
18) Chrysene	15.27	228	10995110m	-8.12	ug/ml	
19) Benzo(b&k)fluoranthene	16.80	252	8733479m	5.71	ug/ml	
20) Benzo(a)pyrene	17.30	252	6537728m	9.75	ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.		
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
0504077.D SBUFF.M Fri Jun 29 22:52:00 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0504078.D Vial: 8
Acq On : 4 May 2007 18:40 Operator: rr
Sample : 8c Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: May 8 15:22 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.73	152	24660118	40.00 ug/ml	-0.11
3) Naphthalene-d8	7.40	136	92917709	40.00	-0.12
6) Acenaphthene-d10	9.73	164	59395490	40.00 ug/ml	-0.13
10) Phenanthrene-d10	11.69	188	108966815	40.00 ug/ml	-0.11
16) Chrysene-d12	15.24	240	80435119	40.00 ug/ml	-0.08
21) Perylene-d12	17.35	264	48457054	40.00 ug/ml	-0.05

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	6.49	82	6364951m	35.40 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.86	172	37465901	61.29 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	11.71	178	5141379m	7.57	
12) Anthracene	11.71	178	5368843m	1.66 ug/ml	
13) Fluoranthene	13.31	202	11644114	8.57 ug/ml	100
14) Pyrene	13.61	202	11376443	8.02 ug/ml	100
15) Terephenyl-d14	13.84	244	109998328	166.90 ug/ml	100
17) Benzo(a)anthracene	15.22	228	3278458	-58.60 ug/ml	100
18) Chrysene	15.27	228	9720036	-9.75 ug/ml	100
19) Benzo(b&k)fluoranthene	16.78	252	11440781m	7.10 ug/ml	
20) Benzo(a)pyrene	17.28	252	9191213m	13.24 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0504078.D SBUFF.M Fri Jun 29 22:52:18 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0504079.D Vial: 9
Acq On : 4 May 2007 19:11 Operator: rr
Sample : 10a Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: May 8 15:25 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc	Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.72	152	25190508	40.00	ug/ml	-0.12
3) Naphthalene-d8	7.40	136	94632406	40.00		-0.12
6) Acenaphthene-d10	9.73	164	60741536	40.00	ug/ml	-0.13
10) Phenanthrene-d10	11.69	188	98444471	40.00	ug/ml	-0.11
16) Chrysene-d12	15.24	240	54207297	40.00	ug/ml	-0.08
21) Perylene-d12	17.36	264	38798905	40.00	ug/ml	-0.04

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc	Units	Qvalue
2) Nitrobenzene-d5	6.50	82	4973071m	28.77	ug/ml	
4) Naphthalene	0.00	128	0	N.D.		
5) 2-Fluorobiphenyl	8.87	172	38361632	61.63	ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.		
8) Acenaphthene	0.00	153	0	N.D.		
9) Fluorene	0.00	166	0	N.D.		
11) Phenanthrene	11.71	178	4925836m	7.84		
12) Anthracene	11.71	178	5007497m	1.75	ug/ml	
13) Fluoranthene	13.32	202	6521385	5.85	ug/ml	100
14) Pyrene	13.61	202	7055972	5.99	ug/ml	100
15) Terephenyl-d14	13.84	244	77634008	131.47	ug/ml	100
17) Benzo(a)anthracene	15.27	228	6406927m	-38.52	ug/ml	
18) Chrysene	15.27	228	6383638m	-10.03	ug/ml	
19) Benzo(b&k)fluoranthene	16.78	252	5794343m	5.56	ug/ml	
20) Benzo(a)pyrene	17.27	252	4624143m	10.04	ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.		
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.		
24) Benzo(ghi)perylene	0.00	276	0	N.D.		

(#) = qualifier out of range (m) = manual integration
0504079.D SBUFF.M Fri Jun 29 22:52:39 2007

Quantitation Report (QT Reviewed)

Data File : C:\HPCHEM\1\DATA\0504080.D Vial: 10
Acq On : 4 May 2007 19:41 Operator: rr
Sample : 10b Inst : GC/MS Ins
Misc : Multiplr: 1.00
Sample Amount: 0.00
Integration Parameters - MS: EVENTS.E GC1: EVENTS2.E GC2: events3.e
Quant Time: May 8 15:27 19107 Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title :
Last Update : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.73	152	28530491	40.00 ug/ml	-0.11
3) Naphthalene-d8	7.40	136	105235154	40.00	-0.12
6) Acenaphthene-d10	9.73	164	68674713	40.00 ug/ml	-0.13
10) Phenanthrene-d10	11.69	188	121984812	40.00 ug/ml	-0.11
16) Chrysene-d12	15.25	240	87750833	40.00 ug/ml	-0.07
21) Perylene-d12	17.37	264	52170874	40.00 ug/ml	-0.03

System Monitoring Compounds

Target Compounds					Qvalue
2) Nitrobenzene-d5	6.50	82	3498912m	20.61 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.86	172	37650981	54.17 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	11.72	178	4158551m	6.35	
12) Anthracene	11.72	178	4163933m	0.76 ug/ml	
13) Fluoranthene	13.31	202	10917925m	7.41 ug/ml	
14) Pyrene	13.61	202	10816682	7.04 ug/ml	100
15) Terephenyl-d14	13.84	244	121720334	165.03 ug/ml	100
17) Benzo(a)anthracene	15.23	228	2717539	-61.14 ug/ml	100
18) Chrysene	15.27	228	9003129	-11.38 ug/ml	100
19) Benzo(b&k)fluoranthene	16.79	252	11730901m	6.73 ug/ml	
20) Benzo(a)pyrene	17.27	252	8262457m	11.01 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	N.D.	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0504080.D SBUFF.M Fri Jun 29 22:52:55 2007

Quantitation Report (QT Reviewed)

```
Data File : C:\HPCHEM\1\DATA\0504081.D                  Vial: 11
Acq On    :  4 May 2007  20:11                      Operator: rr
Sample    : 10c                                     Inst     : GC/MS Ins
Misc      :                                         Multiplr: 1.00
                                              Sample Amount: 0.00
Integration Parameters -  MS: EVENTS.E   GC1: EVENTS2.E   GC2: events3.e
Quant Time: May  8 15:30 19107           Quant Results File: SBUFF.RES

Quant Method : C:\HPCHEM\1\METHODS\SBUFF.M (Chemstation Integrator)
Title        :
Last Update  : Tue Dec 05 13:02:11 2006
Response via : Initial Calibration
DataAcq Meth : SBUFF
```

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) 1,4-Dichlorobenzene-d4	5.73	152	26741758	40.00 ug/ml	-0.11
3) Naphthalene-d8	7.40	136	96417492	40.00	-0.12
6) Acenaphthene-d10	9.73	164	65283595	40.00 ug/ml	-0.13
10) Phenanthrene-d10	11.69	188	107317807	40.00 ug/ml	-0.11
16) Chrysene-d12	15.24	240	66030575	40.00 ug/ml	-0.08
21) Perylene-d12	17.36	264	41175213m	40.00 ug/ml	-0.04

System Monitoring Compounds

Target Compounds	R.T.	QIon	Response	Conc Units	Qvalue
2) Nitrobenzene-d5	6.56	82	809816m	10.52 ug/ml	
4) Naphthalene	0.00	128	0	N.D.	
5) 2-Fluorobiphenyl	8.86	172	23891493	36.95 ug/ml	100
7) Acenaphthylene	0.00	152	0	N.D.	
8) Acenaphthene	0.00	153	0	N.D.	
9) Fluorene	0.00	166	0	N.D.	
11) Phenanthrene	11.71	178	3489531m	6.20	
12) Anthracene	11.71	178	3706398m	0.78 ug/ml	
13) Fluoranthene	13.31	202	12801947	9.40 ug/ml	100
14) Pyrene	13.61	202	18484814	12.24 ug/ml	100
15) Terephenyl-d14	13.84	244	62980492	99.10 ug/ml	100
17) Benzo(a)anthracene	15.27	228	6578137m	-43.34 ug/ml	
18) Chrysene	15.27	228	6584413m	-11.63 ug/ml	
19) Benzo(b&k)fluoranthene	16.80	252	5829029m	4.74 ug/ml	
20) Benzo(a)pyrene	17.29	252	4958413m	8.91 ug/ml	
22) Dibenz(ah)anthracene	0.00	276	0	20.19 ug/ml	
23) Indeno(1,2,3-cd)pyrene	0.00	278	0	N.D.	
24) Benzo(ghi)perylene	0.00	276	0	N.D.	

(#) = qualifier out of range (m) = manual integration
0504081.D SBUFF.M Fri Jun 29 22:53:12 2007

Appendix G: Chemicals and Solutions for PAH Extraction

Optima Grade Chloroform (Fisher): $CHCl_3$, stabilized with ca. 0.75% ethanol.

Optima Grade Dichloromethane (Fisher): CH_2Cl_2, Assay - 99.9% minimum by GC.

Optima Grade Methanol (Fisher): CH_4O, Assay - 99.9% minimum by GC.

Optima Grade Hexanes (Fisher): C_6H_{14}, Assay - 99.9% min by GC.

Sodium Chloride (Fisher): NaCl, ≥ 99.0 %.

Milli-Q water: Water deionized and filtered using a Millipore Corporation *Milli-Q*

system.

50 mM Phosphate buffer: add 8.7 g of K_2HPO_4 (Sigma) to approximately 950 ml of Millipore water. Adjust pH to 7.4 with 1N hydrochloric acid. Adjust to 1000 ml final volume in 1L volumetric flask with Millipore water.

Sodium sulfate (Na_2SO_4) columns: Use clean 6ml glass column with Teflon frit in the bottom. Prepare the columns just before the samples are to be run so the DCM does not dry out. Rinse columns with DCM and then load columns with frits. Add 1 g of dry Na_2SO_4 to column. Clean round bottom evaporating flasks (collection flasks) with DCM and then add 2 ml of DCM to column. Rinse the $NaSO_4$ by allowing DCM to drip through, stopping when the meniscus is just above the $NaSO_4$ into a rinse collection tube. Replace collection tube with the round bottom flask and Na_2SO_4 column is ready.

Solvent exchange (DCM to Hexane): Transfer total lipid fraction in chloroform to 200µl hexane using solvent exchange. (Do not dry completely as this reduces PAH recovery.) Dry sample in DCM to 100µl then add 1ml Optima hexane. Dry sample to 100µl again. Dope sample with 1 drop chloroform, vortex and transfer to silica column. Draw sample through but do not let column dry. Repeat step 4.3.1 two more times using two aliquots 100µl hexane.

Unisil activated silicic columns (Clarkson Chromatography): Weigh 0.5 g of Unisil (100 – 200 mesh) and place into 10 ml tubes. Heat tubes at 100 °C for 2 hours to activate Unisil. Place glass columns in VisiPrep apparatus and close valves. Add 2ml chloroform to tubes and transfer to glass column (repeat four times). Open valves and let chloroform drip through at 1 drop/sec., but do not let column dry out. Rinse the glass column with 2ml of chloroform. Add copper filings (20 – 30) per column.

Aminopropyl (NH_2) column (VWR): Use 3ml aminopropyl column. Rinse column with 1 ml of optima grade chloroform, then another 2 ml and let drip through. Rinse column with 2ml hexane and pull through with vacuum 1 drop/sec., but do not let the column dry.

Appendix H: Internal Standards correlation to PAHs and Surrogates

Surrogate Solution: Restek B/N surrogate mix (1,000 µg / ml each in methylene chloride, 1 ml / ampul):

- 2-fluorobiphenyl
- nitrobenzene-d5
- *p*-terphenyl-d14

Calibration Mix: Restek SV Calibration Mix #5 / 610 PAH Mix (2,000 µg / ml each in methylene chloride, 1ml / ampul):

acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(ghi)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorine, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene

Internal Standards: Restek SV Internal Standard Mixes (2,000 µg / ml each in methylene chloride, 1 ml / ampul):

acenaphthene-d10, chrysene-d12, 1,4-dichlorobenzene-d4, naphthalene-d8, perylene-d12, phenanthrene-d10

Internal Standards correlation to PAHs and Surrogates

Internal Standards	Surrogates	PAHs
Napthalene-d8	Nitrobenzene-d5	Napthalene
Acenaphthene-d10	2-fluorobiphenyl	Acenaphthylene
		Acenaphthene
		Fluorene
Phenanthrene-d10	-	Phenanthrene-d10
		Anthracene
		Fluoranthene
		Pyrene
Chrysene-d12	Terephenyl-d14	Benzo(a)anthracene
		Chrysene
		Benzo(b,k)fluoranthene
		Benzo(a)pyrene
Perylene-d12	-	Dibenz(ah)anthracene
		Ideno(1,2,3-cd)pyrene
		Benzo(ghi)perylene

Appendix I: Standard Curve Concentrations for PAHs

The concentrations used to generate standard curves for GC/MS calibration were 5, 10, 20, 40, 60, 80, 100 µg/ml (ppm). A summary of the calibration mix is presented in the table below. All volumes of sample were adjusted to 1.0 ml with hexane in the 2 ml autosampler vials that were used.

Standard Curve Concentrations for GC/MS Analysis of PAHs							
Concentration (ppm)	5	10	20	40	60	80	100
Surrogate (µl)	2.5	5	10	20	30	40	50
Internal Standards (µl)	40	40	40	40	40	40	40
PAHs (µl)	10	20	40	80	120	160	200
Total (µl)	1000	1000	1000	1000	1000	1000	1000
Hexane (µl)	947.5	935	910	860	810	760	710