

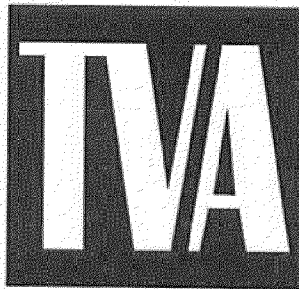
**TENNESSEE VALLEY AUTHORITY
KINGSTON FOSSIL PLANT**

**OPERATIONS MANUAL
DREDGE CELL LATERAL EXPANSION**

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**Tennessee Valley Authority
Fossil Engineering Services**

APPENDIX E

Hydrogeologic Evaluation of Ash Pond Area

TENNESSEE VALLEY AUTHORITY
River System Operations & Environment
Research & Technology Applications
Environmental Engineering Services - East

KINGSTON FOSSIL PLANT

**HYDROGEOLOGIC EVALUATION OF
COAL-COMBUSTION BYPRODUCT DISPOSAL FACILITY EXPANSION**

WR2004-2-36-130

Prepared by

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November 2004



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SUMMARY

The expansion of Class II coal-combustion byproduct (CCB) disposal facilities proposed within the existing Ash Disposal Area of Kingston Fossil Plant (KIF) was evaluated for two possible disposal options. The first (Option A) would involve future codisposal of coal ash and gypsum derived from flue-gas desulfurization. Under Option B the facility would receive only coal ash. Hydrogeological evaluations of the proposed facilities associated with both options were performed to examine their suitability relative to the appropriate standards of the Tennessee Department of Environment and Conservation (TDEC) Rule 1200-1-7. Evaluations addressed effects of proposed disposal facilities on local groundwater and surface water resources during both the operational and post-closure periods. Comparisons of water quality impacts for facility designs with and without a constructed three-foot geologic buffer were also provided as the basis for an alternative to an artificial geologic buffer.

Recent site investigations supporting these evaluations included 12 soil borings, installation and monitoring of three piezometers, and field hydraulic conductivity (K) testing at two sites and laboratory K testing of two ash samples. A survey of private water wells and public water supplies within two miles of the site was also conducted to determine current water use. Additional hydrogeologic data was obtained from previous studies in the existing Ash Disposal Area, and included 25 soil borings, water level data for 16 monitoring wells, 7 field aquifer tests in soil and bedrock wells, and lab K measurements for 10 soil and ash samples.

The Lower Conasauga Group and the Rome formation comprise bedrock beneath the proposed disposal area, and consist primarily of shale with thin, interbedded limestone, siltstone, and conglomerate. Drilling within the Conasauga and Rome in and around the disposal site revealed no evidence of karstification. A mantle of predominantly alluvial soils consisting of clay, silt, and sand with occasional gravel lies above bedrock. Thickness of the alluvium is highly variable, ranging from about 5 to 65 ft. Ash and ash-soil fill materials ranging up to 83 ft in thickness are present above the alluvium. Ash deposits are composed almost entirely of fly ash, with bottom ash comprising less than 10% of the ash fill. The first occurrence of groundwater below the area is generally within the existing ash fill. Groundwater movement at the site generally follows topography with groundwater flowing eastward from Pine Ridge toward Swan Pond Creek embayment, the Emory River, and the plant intake channel. An exception occurs in the Ash Dredge Cell area where mounding of the water table produces localized groundwater movement toward an on-site drainage feature that flows northeastward along the base of Pine Ridge. All groundwater originating on, or flowing beneath, the proposed disposal site ultimately discharges to the reservoir without traversing private property.

The proposed CCB disposal facilities would be developed entirely on existing ash deposits. Laboratory testing indicates the ash would not meet the hydraulic conductivity requirements of TDEC Rule 1200-1-7-.04 or Policy Memorandum SW-93. The environmental benefit of constructing an artificial 3-ft clay buffer at the base of the Phase 2 and 3 disposal areas was examined by numerically simulating leachate seepage from these disposal facilities with and without a clay buffer. The evaluation focused on the effects of ash and gypsum leachate on stream water quality, since leachate from proposed disposal facilities would ultimately discharge to the Emory River. Estimates of maximum in-stream concentrations were performed for selected CCB-related constituents under low stream flow conditions.

Hydrogeologic conditions at the proposed disposal site appear to satisfy geologic and hydrologic standards for Class II disposal facilities. Key findings and recommendations are summarized as follows:

- A survey of water use in May 2004 identified 13 residential wells and one public water supply spring located within approximately one mile of the proposed disposal facility boundary. Neither the public spring nor any of the residential wells is located downgradient of the proposed facility. Furthermore, there is no potential for future development of groundwater supplies downgradient of the facility since all property between the disposal site and surface water boundaries lies within the plant reservation.
- Modeling results indicate that construction of an artificial 3-ft clay buffer, having a hydraulic conductivity of 10^{-6} cm/s or less, beneath the Phase 2 and 3 disposal areas would not provide a substantial environmental benefit. During the operational phase, predicted leachate seepage rates for the no-buffer and buffer designs for Option A differed by 38% or less. Similar comparisons for Option B showed differences of 28% or less. Following facility closure, differences in seepage rates would be less than 1% due to the infiltration-limiting effect of the 10^{-6} cm/s clay cap. On this basis, construction of an artificial clay buffer is not recommended.
- Evaluation of CCB leachate seepage effects on local stream water quality further supports the suitability of the site for the proposed disposal options without an artificial geologic buffer. Under Option A, maximum cumulative COC stream loadings predicted for the Emory River during low flow conditions would not produce in-stream concentrations exceeding the drinking water standards maximum contaminant limit (MCL) or aquatic life criteria for either the buffer or no-buffer cases. Predicted COC concentrations for the Emory River under disposal Option B were below drinking water and aquatic life standards for all COC except ammonia. Worst-case $\text{NH}_3\text{-N}$ concentrations of 0.58 and 0.47 mg/L estimated for the no-buffer and buffer designs pose no threat to human health, but could exceed the criteria continuous concentration (CCC) under

coincident conditions of extreme pH, temperature, and low flow in the Emory River. Historical data suggest the joint probability of such an occurrence would be less than 0.3%. The potential risk associated with ammonia under Option B can be addressed by future monitoring. Periodic sampling of ash ammonia content and groundwater downgradient of the facility would be performed to assure ammonia levels remain within the limits assumed in this evaluation.

- There is no evidence of Holocene-age faulting within the required 200-ft facility exclusion zone. In addition, there are no indications of karstification or other geologic features which might adversely affect facility containment.
- No streams, springs or lakes are located within 200 ft of the site, and facility would lie entirely above the projected 100-year flood stage of the Emory and Clinch Rivers.

1. INTRODUCTION

1.1 Background

The proposed coal-combustion byproduct (CCB) facility at TVA's Kingston Fossil Plant (KIF) is located on the west bank of the Emory River (mile 2 to 2.5) in Roane County, Tennessee (Figure 1-1). The disposal site encompasses approximately 244 acres and is located within the existing Ash Disposal Area. Land surface across the disposal site ranges from elevation 760 to 805 ft (above mean seal level), and is entirely above the 100-year flood stage of elevation 748 ft.

The facility Part II Permit Application, submitted to TDEC on June 10, 2004, considers two options for future CCB disposal at KIF. The first option (referred to in this report as Option A) proposes codisposal of coal ash and flue gas desulfurization (FGD) derived gypsum. If approved, a total of 12.4 million cubic yards (CY) of fly ash and bottom ash and 7.20 million CY of gypsum would be deposited in the area between 2004 and 2029. Under Option B the facility would receive only coal ash. A total of 21.4 million CY of fly ash and bottom ash would be deposited in the facility between 2004 and 2048.

1.2 Purpose and Scope

The objective of this report is to evaluate the suitability of the proposed CCB disposal facility in terms of the hydrogeologic features of the site and compliance with the design standards of TDEC Rule 1200-1-7. The potential effects of the facility on local groundwater and surface water resources are addressed for both the operational and post-closure periods. The focus is on stream water quality effects since shallow groundwater originating on, or flowing beneath, the site ultimately discharges to streams without traversing off-site property. Numerical models were used to estimate leachate generation rates from each disposal area. Leachate seepage estimates were used along with CCB leachate chemical compositions in predicting worst-case in-stream concentrations of selected constituents under low stream flow conditions. Separate evaluations were performed for Options A and B. Additionally, comparisons of water quality impacts for facility designs with and without a constructed 3-ft geologic buffer are provided for each disposal option. Hydrogeologic data used to support the analysis were derived from recent geotechnical investigations at the site conducted by MACTEC Engineering and Consulting, Inc. (2004) and from several previous site investigations (described in Section 1.3). A survey of private water wells and public water supplies within two miles of the site was conducted to establish local water use.

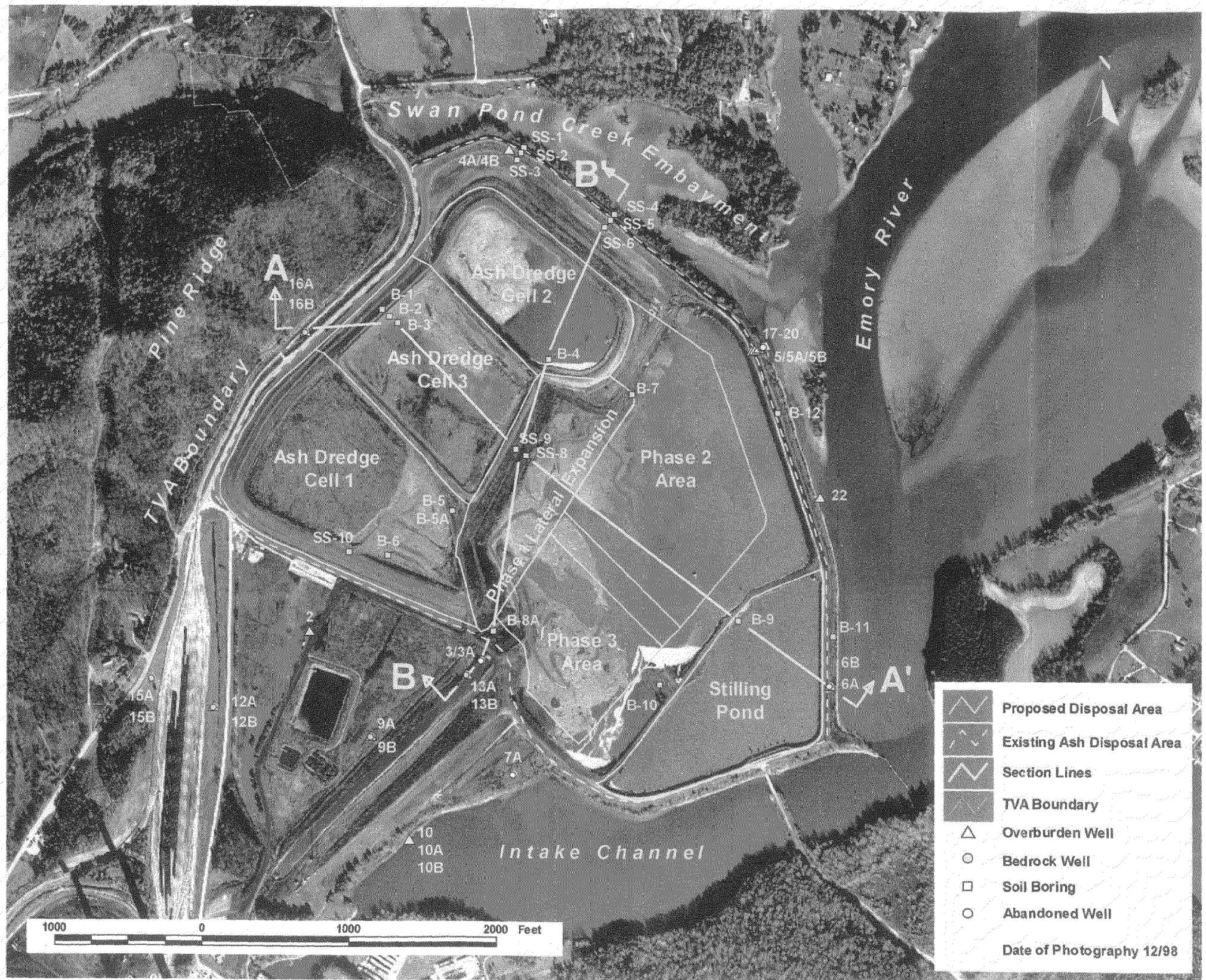


Figure 1-1. Site Location Map Showing Soil Borings and Monitoring Wells

Results of recent geotechnical investigations supporting disposal facility design and the hydrogeological evaluation are reported in MACTEC Engineering and Consulting, Inc. (2004). Investigations included 12 geotechnical borings (B-1 through B-12) drilled to refusal at locations in and around the proposed site to characterize overburden stratigraphy and to acquire samples for laboratory testing (Figure 1-1). Sample collection and standard penetration resistance testing were performed at 5-ft intervals. Appendix A contains lithologic logs for these borings and a description of soil sampling methods. Laboratory hydraulic conductivity tests were performed on two remolded ash samples collected from the existing Ash Dredge Cell Area. Three additional auger borings were completed at existing ash deposits for in-situ hydraulic conductivity testing (designated B-1A, B-1B, and B-2A). Three piezometers were installed adjacent to borings B-1 through B-3 for periodic water level monitoring. These piezometers are located on the northwest-facing slope of Ash Dredge Cell 3. Cone penetrometer soundings were performed at 11 locations within the proposed disposal site to supplement boring data. Complete descriptions of sampling and testing procedures used in these investigations are presented in MACTEC (2004).

1.3 Previous Investigations

The hydrogeologic data used in the present evaluation are partially based on three previous investigations at the KIF site. The first was an EPA-sponsored study by Milligan and Ruane (1980) to examine the effects of coal ash leachate on groundwater quality. This study was initiated in 1976 with core sampling and monitoring well construction at eight sites, J1 through J8 (Figure 1-1). (Note that the "J" well prefix was dropped in later investigations and does not appear on figure well labels in the present report.) Soil samples were collected using a 2-inch diameter split-spoon sampler through a 12-inch outer diameter hollow-stem auger. Fourteen, four-inch diameter PVC wells, screened over the lower 1.5 ft, were installed through the auger following core sampling. Wells were installed either singly or in staged multiple-well clusters. Lithologic logs for these wells are presented in Appendix A. In addition, laboratory permeameter measurements of the horizontal and vertical components of hydraulic conductivity were performed on selected core samples. Soil column studies were also performed to examine the potential for geochemical attenuation of ash-related contaminants, particularly trace metals.

Velasco and Bohac (1991) performed a site-wide assessment of groundwater conditions at the KIF reservation. Single-well or multiple-well clusters were installed at eight additional sites (sites 9 through 16) in 1988 as part of the investigation. Wells were constructed with 2-inch PVC casing and were screened over the lower 10 ft. Lithologic logs for these wells are included in Appendix A along with a description of sampling methods. Well construction diagrams are presented in Appendix B. These wells, and those installed in 1976, were sampled six times between 1988 and

1990 to examine spatial and temporal trends in groundwater quality at the plant site. Constant-rate injection tests were performed at eight wells to determine bulk hydraulic conductivities of the overburden and shallow bedrock materials. These data were used in development of a groundwater flow model of the site. In addition, their investigations included an evaluation of the potential of geochemical attenuation of ash-related contaminants. Mineralogical analyses were conducted on 20 soil samples collected adjacent to monitoring wells 1 through 6 (Figure 1-1). X-ray diffraction analysis indicated clay minerals predominantly consisted of kaolinite and illite with trace amounts of other minerals, all of which tend to adsorb cations present in groundwater. Iron oxides were detected at contents of 0.33 to 0.60%, and are also known to adsorb several metals, e.g. arsenic, chromium, and zinc. Soil cation exchange capacities ranging from 6.6 to 34 meq/100 g were reported. Application of the MINTEQ geochemical speciation model using site soils data and representative chemical data for ash leachate indicated significant adsorption of arsenic, lead, and zinc. Attenuation of barium, chromium, and iron were predicted to occur by precipitation reactions (Velasco and Bohac, 1991).

Singleton Laboratories (1994) performed drilling and sampling investigations in the Ash Dredge Cell area at 10 locations (SS-1 through SS-10). Two-inch split-spoon and three-inch Shelby tube samples were collected for laboratory geotechnical testing. Top-of-rock and groundwater level elevations were established at each site. Boring logs are included in Appendix A.

A hydrogeologic evaluation was prepared by Boggs et al. (1995) for closure of the existing Ash Disposal Area on which the proposed CCB facility would be developed. The evaluation focused on the long-term impacts of the Ash Disposal Area on local groundwater and surface water resources following facility closure. The study was initiated with an examination of local hydrogeologic conditions, groundwater quality, and groundwater use in the site vicinity. Hydrogeologic and water quality data were derived from previous groundwater investigations at the plant site. Local groundwater use was established by a survey of residents within a two-mile radius of the disposal site. A water budget simulation of the closed facility was performed to quantify ash leachate production rates during a 30-year post-closure period. The ultimate impact of the closed facility was evaluated using the predicted leachate discharge in conjunction with leachate chemical characteristics and groundwater flow patterns in the site vicinity.

2. HYDROGEOLOGIC CONDITIONS

2.1 Geology and Soils

Kingston Fossil Plant resides within the Valley and Ridge physiographic province, a region characterized by narrow, subparallel ridges and valleys trending northeast-southwest. The controlling structural feature of the region is a series of northeast-striking thrust faults which have forced older rocks from the southeast over younger units. Bedrock units of the Rome Formation (lower Cambrian age), the Conasauga Group (middle to upper Cambrian), and the Knox Group (upper Cambrian to Ordovician) subcrop beneath the site in northeast-trending bands (Figure 2-1). These units generally dip to the southeast at angles averaging 45 to 50 degrees (Benziger and Kellberg, 1951). The band of Rome on the northwest side of the site, along with the overlying Conasauga and Knox formations, represent a thrust fault block which has been forced over the Knox outcrop to the northwest. The two major faults associated with this thrust block, shown on Figure 2-1, constitute the two closest faults to the proposed disposal site. Both faults are located in excess of 1000 ft from the proposed disposal area, placing them outside of the 200-ft exclusion zone required by Rule 1200-1-7-.04(1)(u). Foundation exploration in the plant powerhouse area indicated bedrock jointing but no evidence of faulting (Benziger and Kellberg, 1951). Drilling of the overlying Quaternary age alluvium there and elsewhere on the reservation has showed no evidence of faulting in these sediments.

The site lies within the Eastern Tennessee seismic zone (ETSZ), a 300-km long, northeast-trending seismic feature running through the lower mid-Atlantic and southeastern United States (Powell et al., 1994). With the exception of the New Madrid seismic zone, the rate of earthquake activity in the ETSZ has been the highest of any area east of the Rocky Mountains. However, the mean focal depth of recorded earthquakes within the ETSZ is 15 km, placing earthquakes in crystalline basement rocks and not in the overlying sedimentary rocks. Thrust faulting in the region was associated with the Appalachian Orogeny which ended in late Permian time, i.e., at least 250 million years ago. Further movement along these faults is improbable. The areas specifically proposed for future CCB disposal are underlain by the Lower Conasauga Group, with the exception of a narrow band along the northwestern side of the proposed site which is underlain by the Rome formation (Figure 2-1). The Nolichucky, Maryville, Rogersville, Rutledge, and Pumpkin Valley formations make up the Lower Conasauga Group, whereas the Maynardville formation is associated with the Upper Conasauga. Total aggregate thickness of these units is unknown but estimated to be approximately 1500 ft (Harris and Foxx, 1982). These units

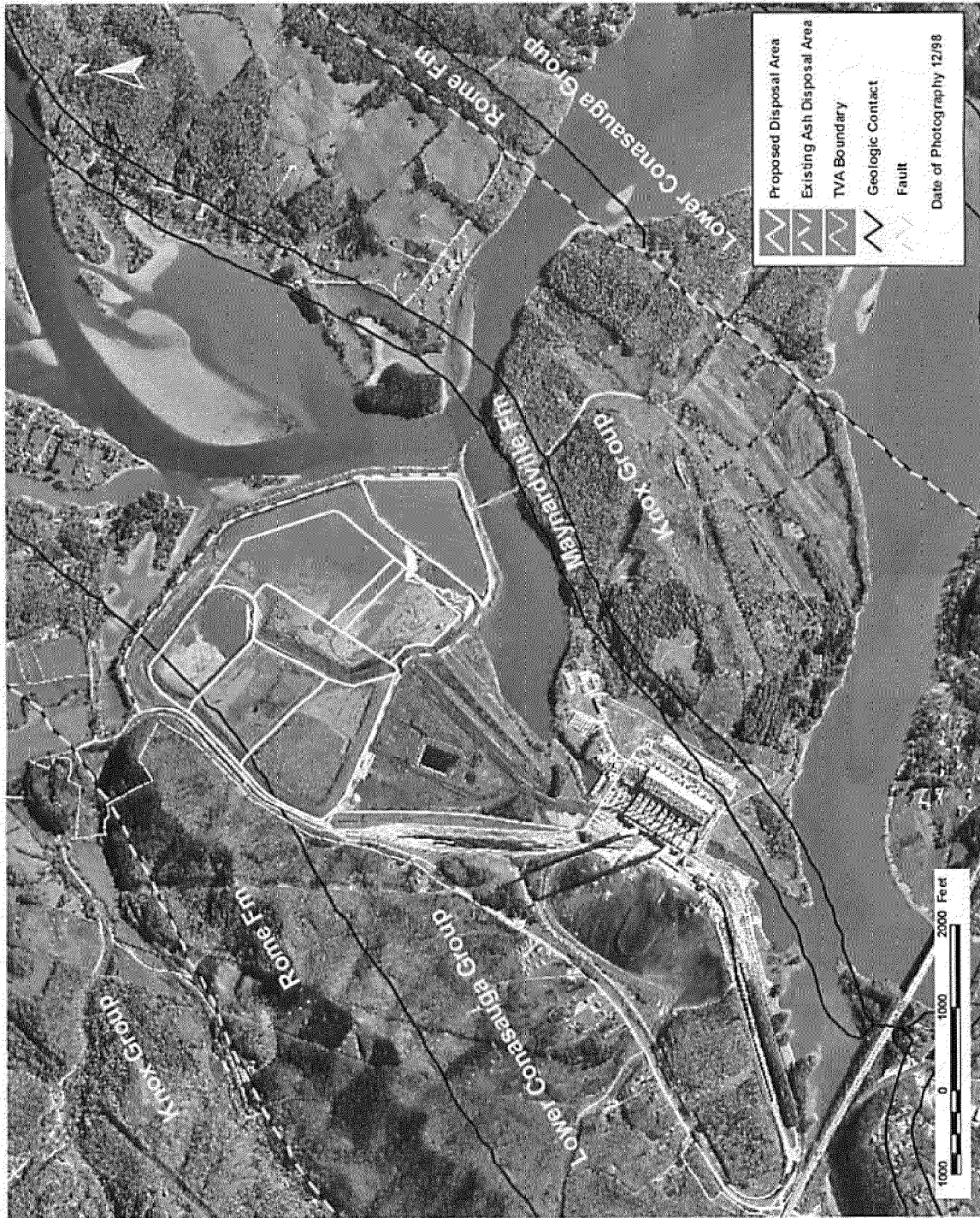


Figure 2-1. Site Geologic Map

predominantly consist of shale with interbedded siltstone, limestone, and conglomerate, and are locally of low water-producing capacity. Extensive rock coring of the Conasauga in the plant powerhouse area indicates that limestone accounts for only about 20% of the total cored material, and is present in relatively thin beds ranging from an inch to several feet in thickness (Benziger and Kellberg, 1951). This accounts for the absence of local evidence of karstification in areas underlain of the Lower Conasauga. The Rome formation which lies beneath the northwestern edge of the proposed disposal area consists of interbedded shale, sandstone, and siltstone.

The elevation of the top of rock directly beneath the proposed disposal area is relatively uniform, ranging from approximately 700 to 715 ft and averaging about 705 ft (Figure 2-2). Outside this area the bedrock surface rises steeply to the west and southwest. The lower bedrock terrace corresponding to the disposal area apparently represents an erosion surface associated with the ancestral Emory River. The upper few feet of bedrock generally consists of weathered fissile shale with occasional limestone fragments.

A mantle of predominantly alluvial soils (Quaternary age) generally lies above bedrock in the ash pond area as indicated in the hydrogeologic profiles presented on Figures 2-3 and 2-4 and the soil isopachous map of Figure 2-5. Soil thickness is highly variable, ranging from about 5 ft along a portion of the northern perimeter of the site to a maximum of 65 ft on the western boundary. The alluvial deposits are unconsolidated and heterogeneous mixtures of clay, silt, sand, and gravel that typically grade coarser with depth. Laboratory testing of recently collected alluvial soil samples from the site typically fall into the CL and SM classifications (MACTEC, 2004). A thin, discontinuous layer of residuum, composed of clay and silt with weathered shale fragments, is present directly above bedrock.

The ash and ash-soil fill present above the alluvial/residual soils range up to 83 ft in thickness. Ash deposits consist almost entirely of fly ash, with bottom ash comprising less than 10% of the ash fill. Particle size analysis indicates the existing ash is generally composed of silt and sand size particles with lesser amounts of clay and gravel size material (MACTEC, 2004). Ash pond dikes are constructed of mixtures of fly ash, bottom ash, and silty clay soil. The phreatic surface generally lies within the ash deposits.

Appendix C provides a compilation of grain-size data for unconsolidated soil and ash samples associated with several previous investigations. Atterberg limits and natural moisture content data are included where available along with a description of laboratory testing procedures.

While the number and density of soil borings and rock coreholes in some areas may be below the minimum requirements of the Division of Solid Waste Management's (DSWM's) Hydrogeologic Guidance Document, we believe the available data are sufficient to characterize subsurface conditions at the proposed CCB disposal site. A total of 30 soil borings have been completed within and immediately around the footprint of the proposed site in the unconsolidated ash and underlying alluvial deposits. Drilling has been limited by necessity to locations along perimeter dikes bounding the existing ash pond, stilling pond, and dredge cells. Characterization of the unconsolidated overburden should be adequate because coal ash, which comprises the upper 20 to 80 ft of overburden and represents the "natural" geologic buffer, exhibits a high-degree of homogeneity requiring fewer borings/samples for adequate characterization. In addition, available information indicates the thickness of the underlying alluvium and top-of-rock surface elevation to be relatively uniform, reducing the need for further exploratory drilling. Only two coreholes (i.e., 13B and 16B) have penetrated the underlying bedrock to depths ranging from 7 to 17 ft. However, three additional coring sites (9B, 12B, and 15B) are located within about a 1000 ft of the proposed disposal site, and extensive coring data are available from foundation studies in the plant powerhouse situated approximately 0.5 mile to the southwest.

2.2 Groundwater Occurrence

The first occurrence of groundwater below the proposed CCB disposal areas is generally within the existing ash fill. Under present conditions, groundwater is derived from infiltration of precipitation, seepage from various ash-related impoundments, and from lateral inflow along the western boundary of the reservation. Groundwater movement, as inferred from potentiometric maps developed from water-level measurements in shallow monitoring wells primarily located outside of existing ash disposal areas, is generally eastward from Pine Ridge toward Swan Pond Creek embayment, the Emory River and the plant intake channel (Figure 2-6). However, continuous recharge by ash sluice water in the active ash pond and dredge cells produces local mounding of the water table that is largely undetected by peripheral monitoring wells. Accounting for the measured water surface levels in Ash Dredge Cell 2, the ash pond, and stilling pond results in the alternative potentiometric surface shown on Figure 2-7. This figure indicates radial movement of groundwater away from the surface impoundments, including movement from Cell 2 toward Pine Ridge. Groundwater movement from the dredge cells toward Pine Ridge converges with groundwater flowing down slope. Groundwater entering the region of convergence either discharges into the ephemeral drainage feature paralleling Swan Pond Road on the northwest side,

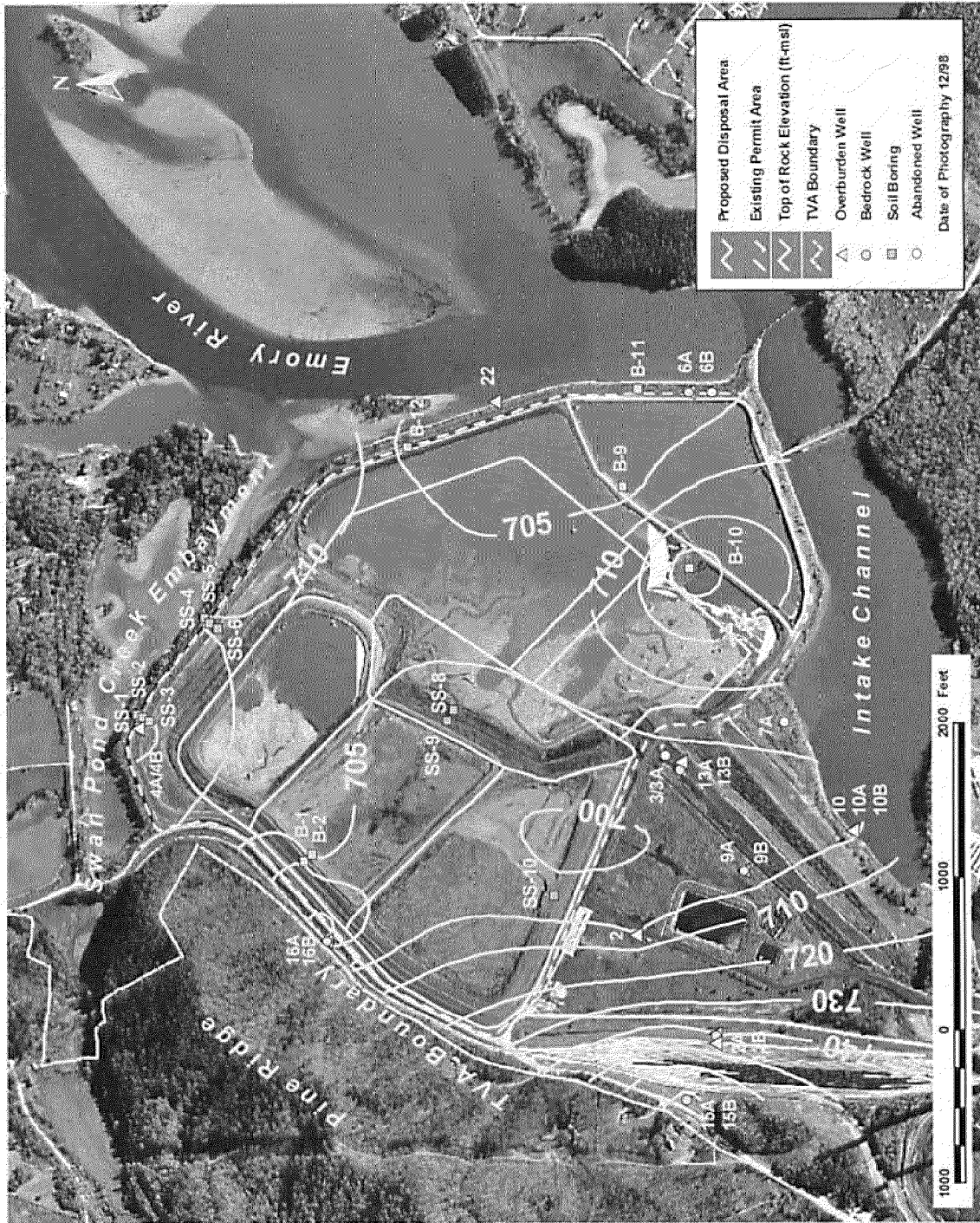


Figure 2-2. Top-of-Rock Elevation Map

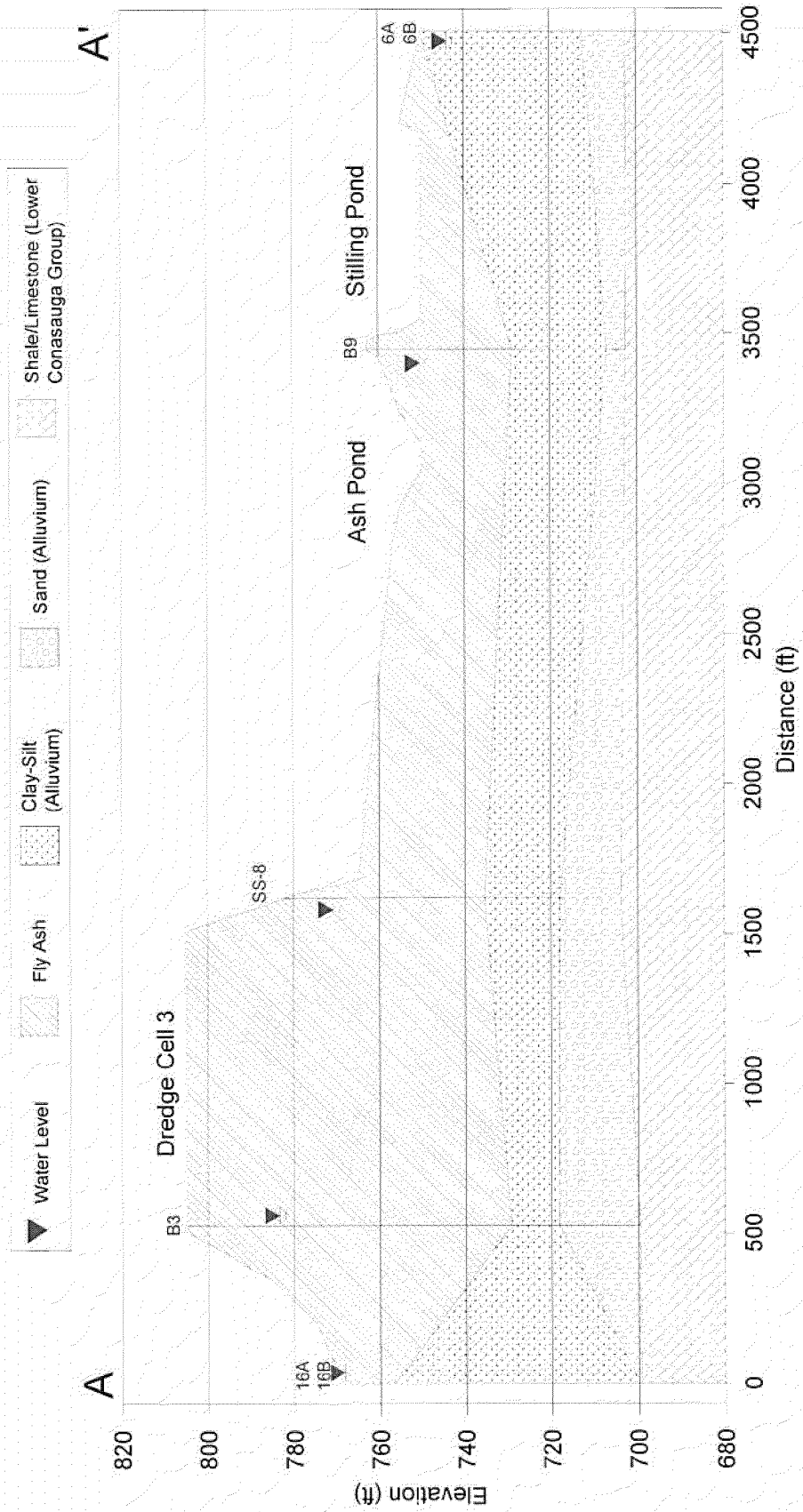


Figure 2-3. Hydrogeologic Section A-A'

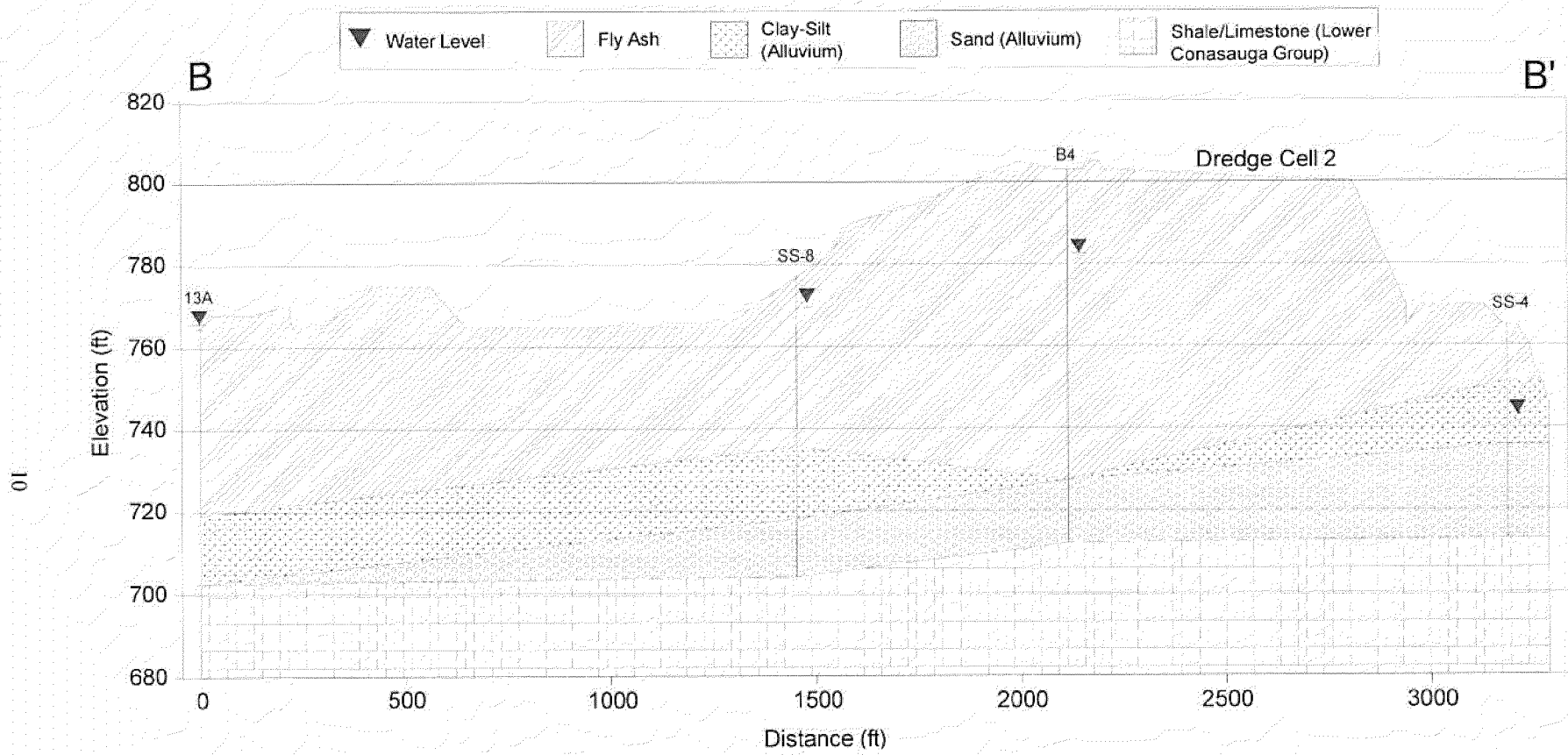


Figure 2-4. Hydrogeologic Section B-B'

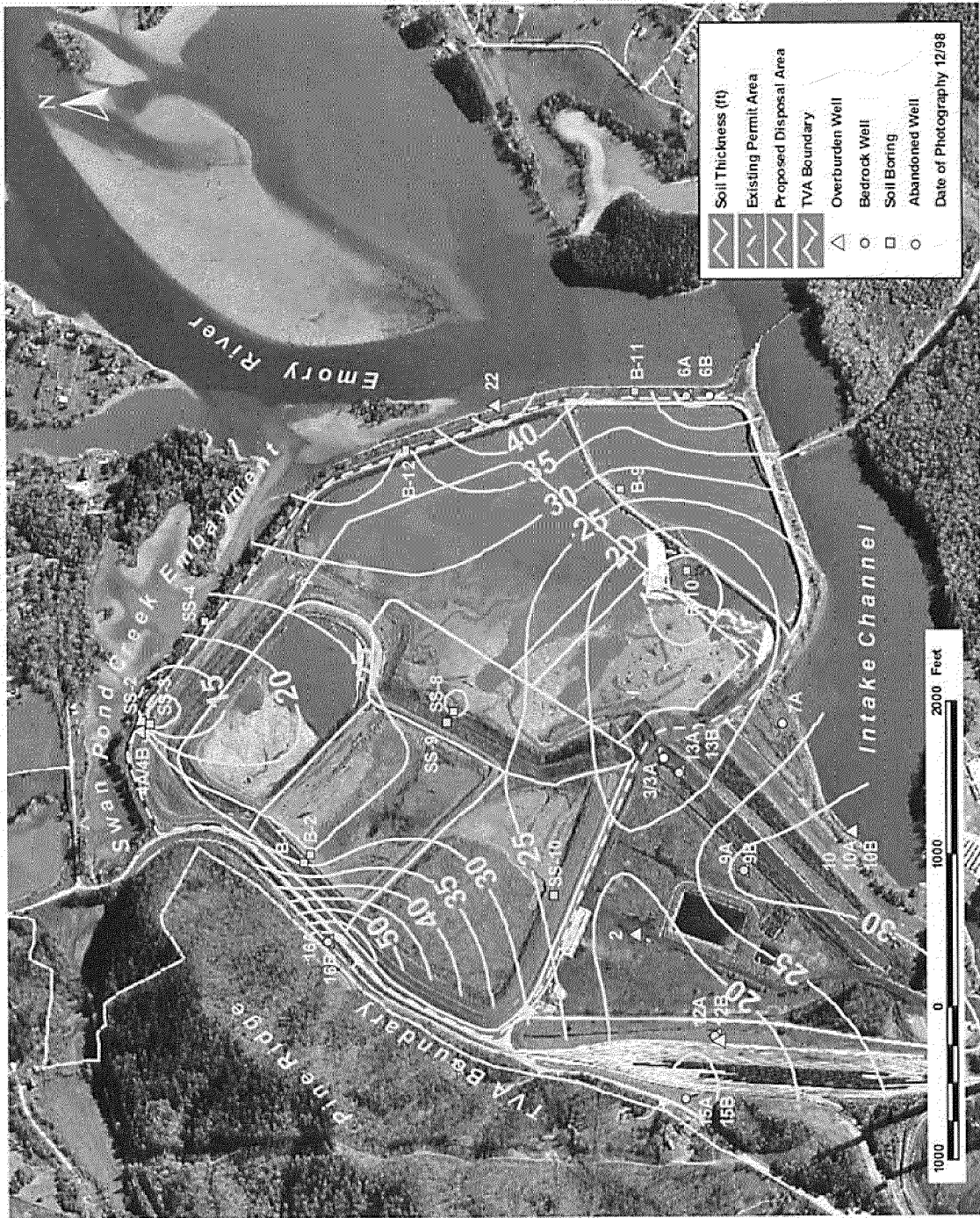


Figure 2-5. Alluvium-Residuum Thickness Map

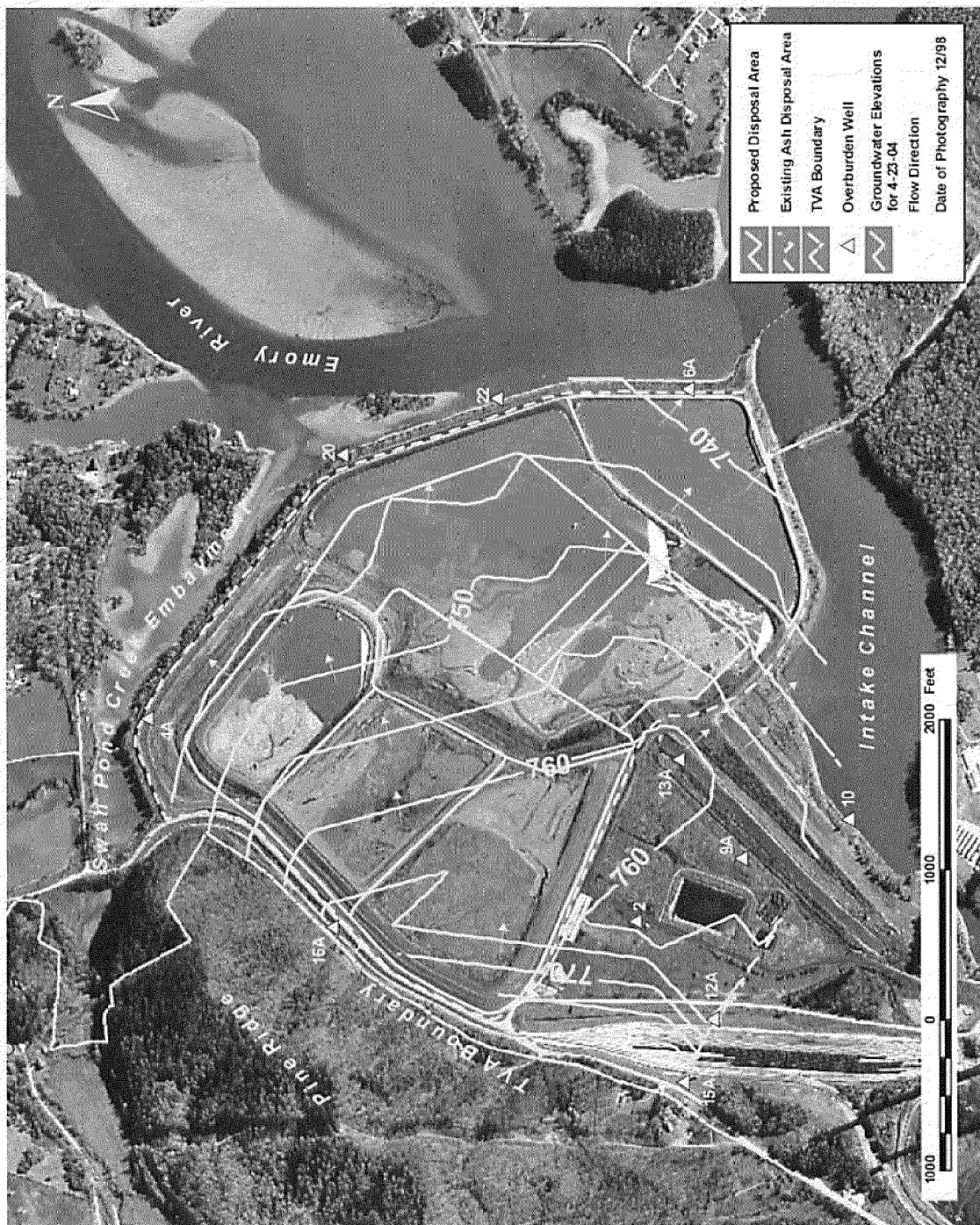


Figure 2-6. Groundwater Potentiometric Surface on April 23, 2004

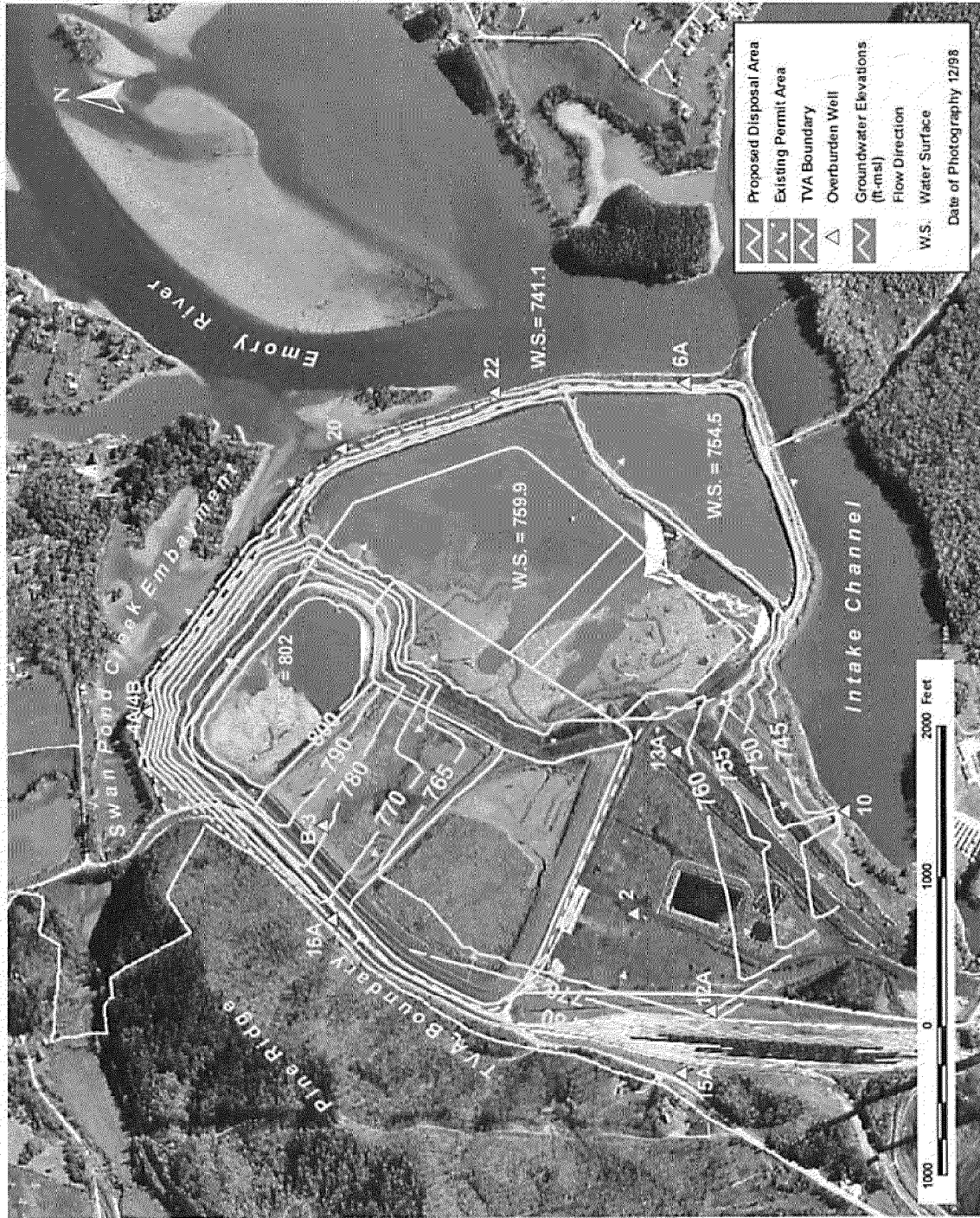


Figure 2-7. Groundwater Potentiometric Surface for April 23, 2004 Accounting for Surface Impoundments

or flows around the dredge cells to the northeast or southwest. Since the drainage paralleling Swan Pond Road lies on the KIF reservation, off-site movement of groundwater appears unlikely. In general, all groundwater originating on, or flowing beneath, the proposed disposal site ultimately discharges to the reservoir without traversing private property.

Long-term hydrographs for 10 monitoring wells surrounding the disposal site are presented on Figures 2-8(a) and 2-8(b). Groundwater level data used in these figures are tabulated in Appendix D. Natural seasonality in groundwater level trends is not discernable, due in part to the infrequency of the measurements, i.e., only four or fewer observations were made per year. However, the close proximity of most monitoring wells to the active ash pond, dredge cells, and/or the reservoir, suggests that these surface water features may largely control local groundwater levels. For example, the upward water level trends observed over the past 5 to 6 years in wells 16A and 13B, both of which are situated near ash disposal areas but away from the stabilizing influence of the reservoir, can be attributed to increasing impoundment heads in the existing Ash Pond and Ash Dredge Cells 1-3.

Short-term hydrographs for piezometers B-1 through B-3 are given on Figure 2-9 with data tabulated in Appendix D. These piezometers were installed along the northwestern slope of Ash Dredge Cell 2 in April 2004, and were monitored frequently over a three-month period. The relatively high potentiometric heads observed at these wells compared to neighboring wells (e.g., 4A, 16A) reflect mounding of the water table in the Ash Dredge Cell area created by sluice water recharge. Overall differences in the potentiometric head elevations in the three wells (i.e., highest at B-3 and lowest at B-1) can be attributed to differences in topographic position of piezometers on the dredge cell slope. Decreasing water levels were observed for all piezometers over the period, probably due to pumping from a recently installed toe drain on the northwest side of Cell 3 and perhaps to limited rainfall during the period (Appendix D).

Determination of the seasonal high water table for the proposed disposal site is problematic due to the artificial influence of multiple surface water impoundments on local groundwater levels. As noted earlier, shallow groundwater levels observed in local monitoring wells are largely controlled by reservoir stage and by recharge from adjacent impoundments. Consequently, natural variability of groundwater levels produced by seasonal differences in precipitation and evaporation is generally not discernable in temporal groundwater level records. Nevertheless, Figure 2-10 provides an estimate of the seasonal high water table based on the maximum water level observed in each monitoring well during the period of record (see Appendix D). There is little noticeable difference between overall groundwater levels and gradients indicated for the seasonal high water table configuration compared to that shown for the recent water table snapshot presented on Figure 2-7.

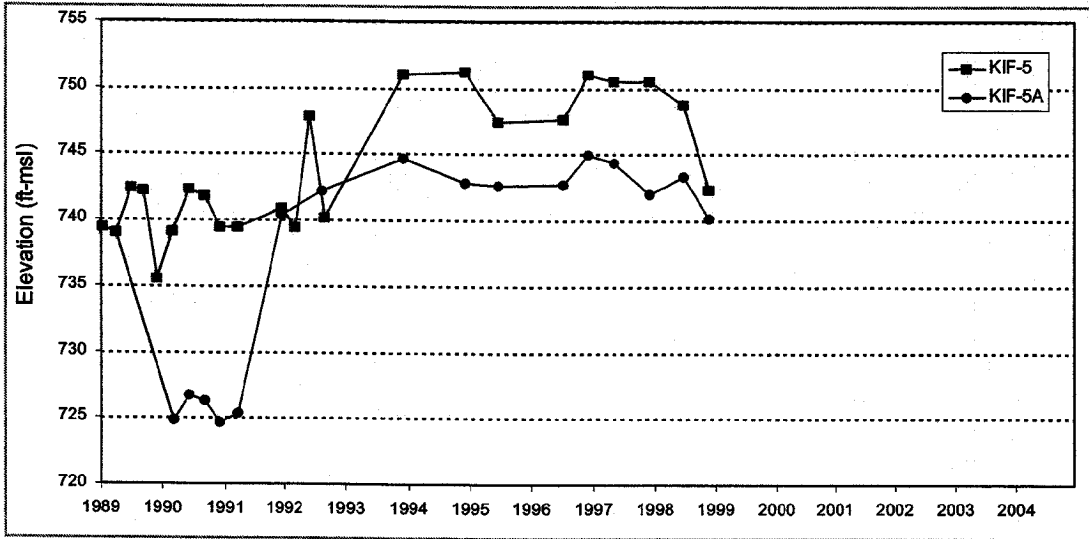
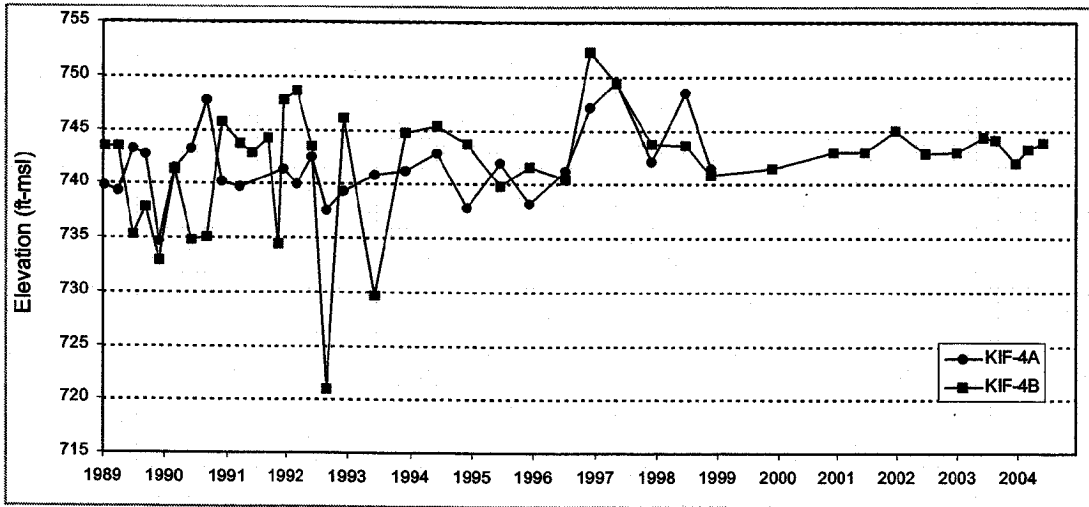
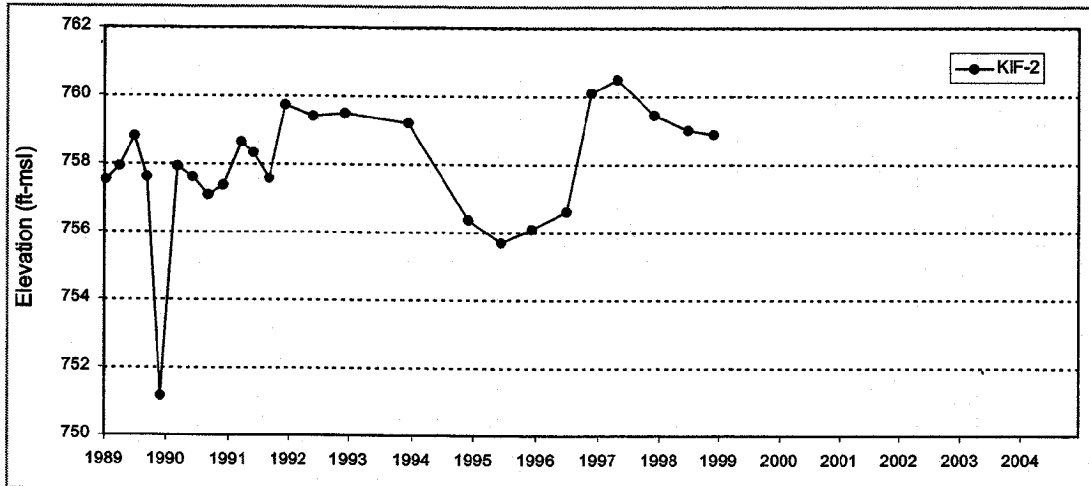


Figure 2-8(a). Long-Term Groundwater Hydrographs for Selected Monitoring Wells

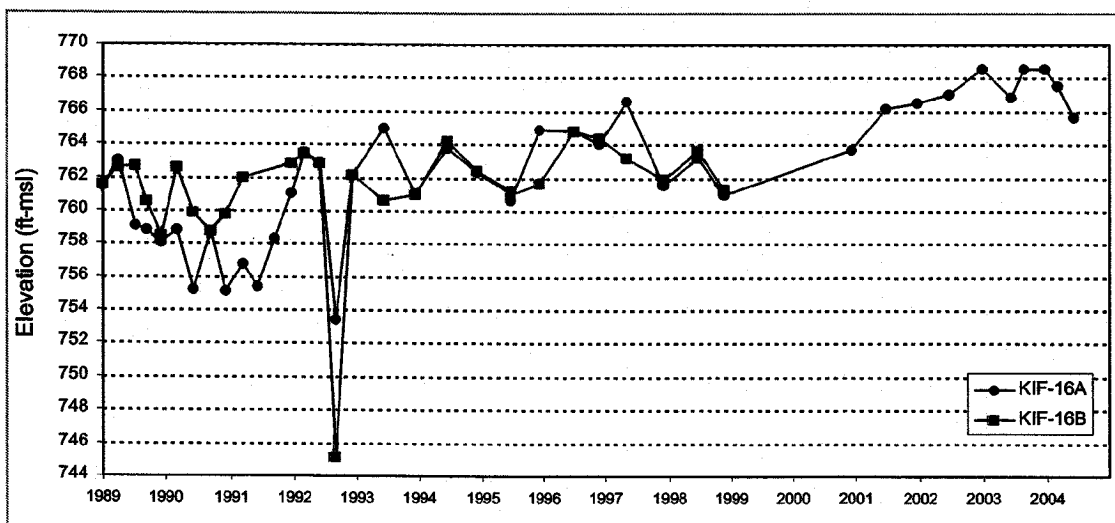
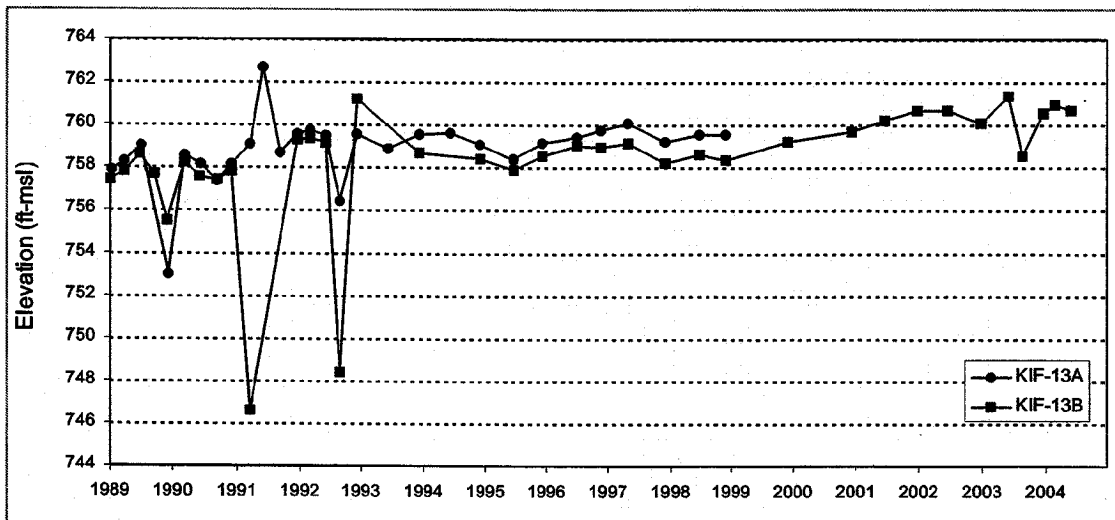
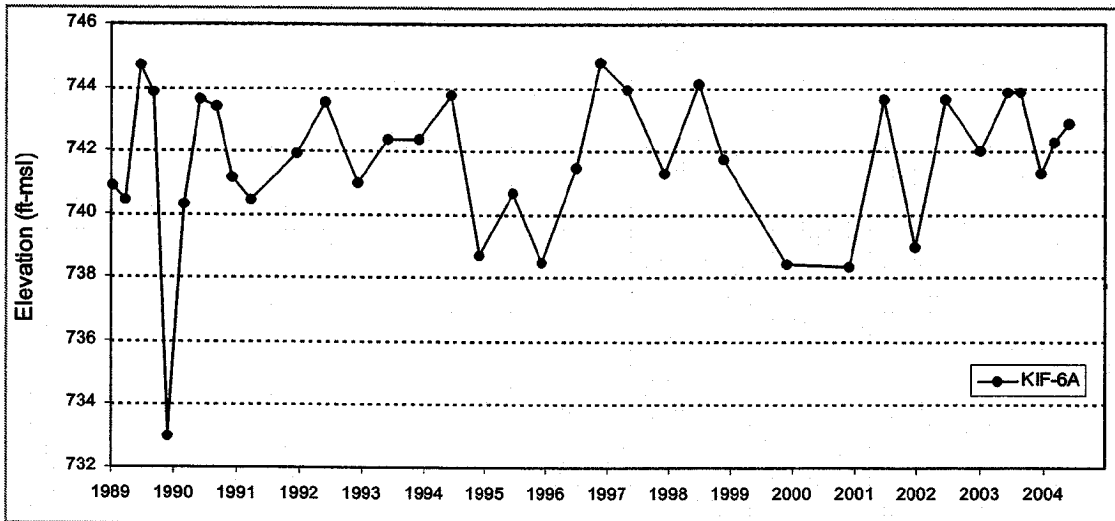


Figure 2-8(b). Long-Term Groundwater Hydrographs for Selected Monitoring Wells

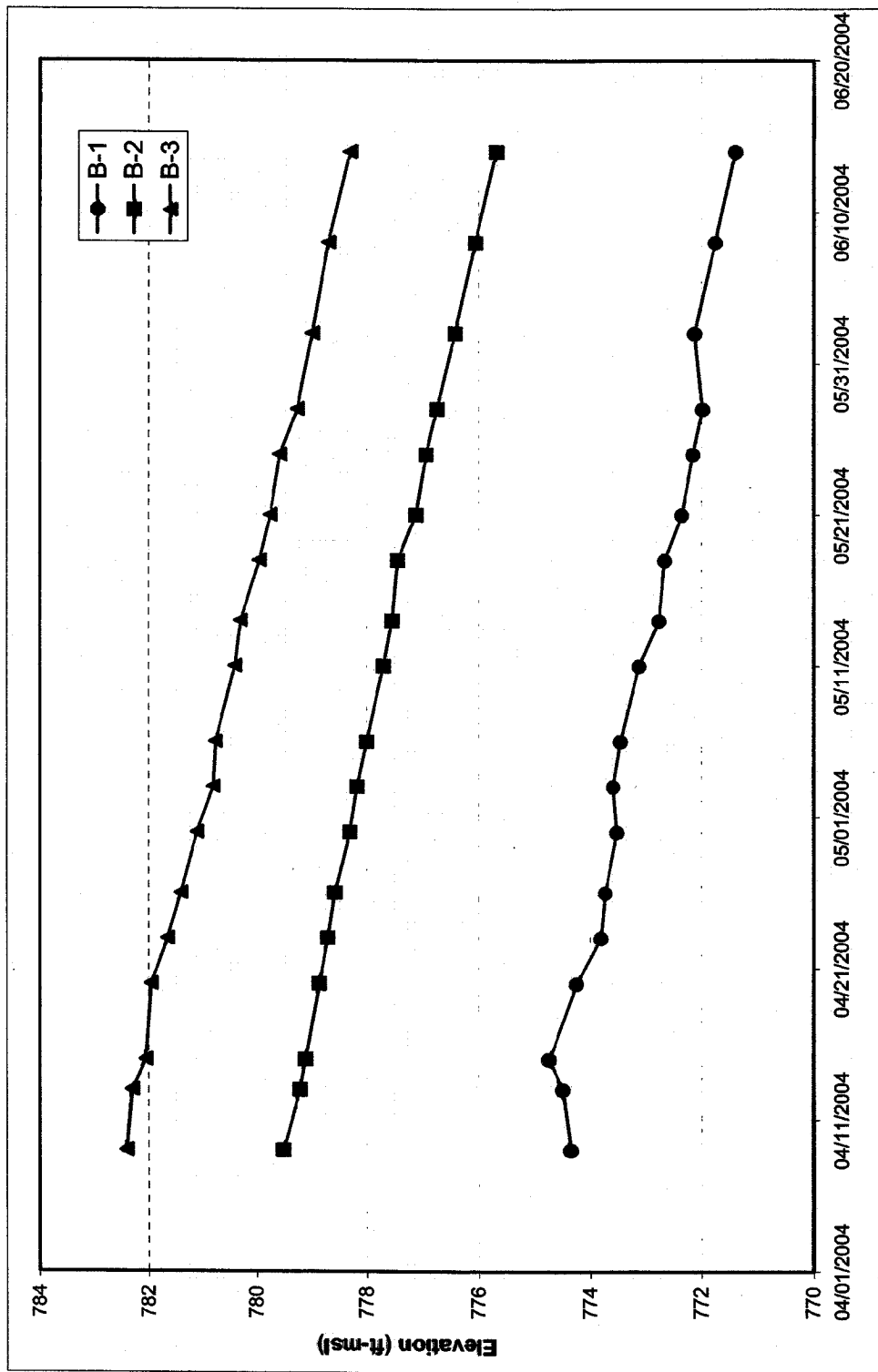


Figure 2-9. Short-Term Groundwater Hydrographs for Piezometers B1 – B3

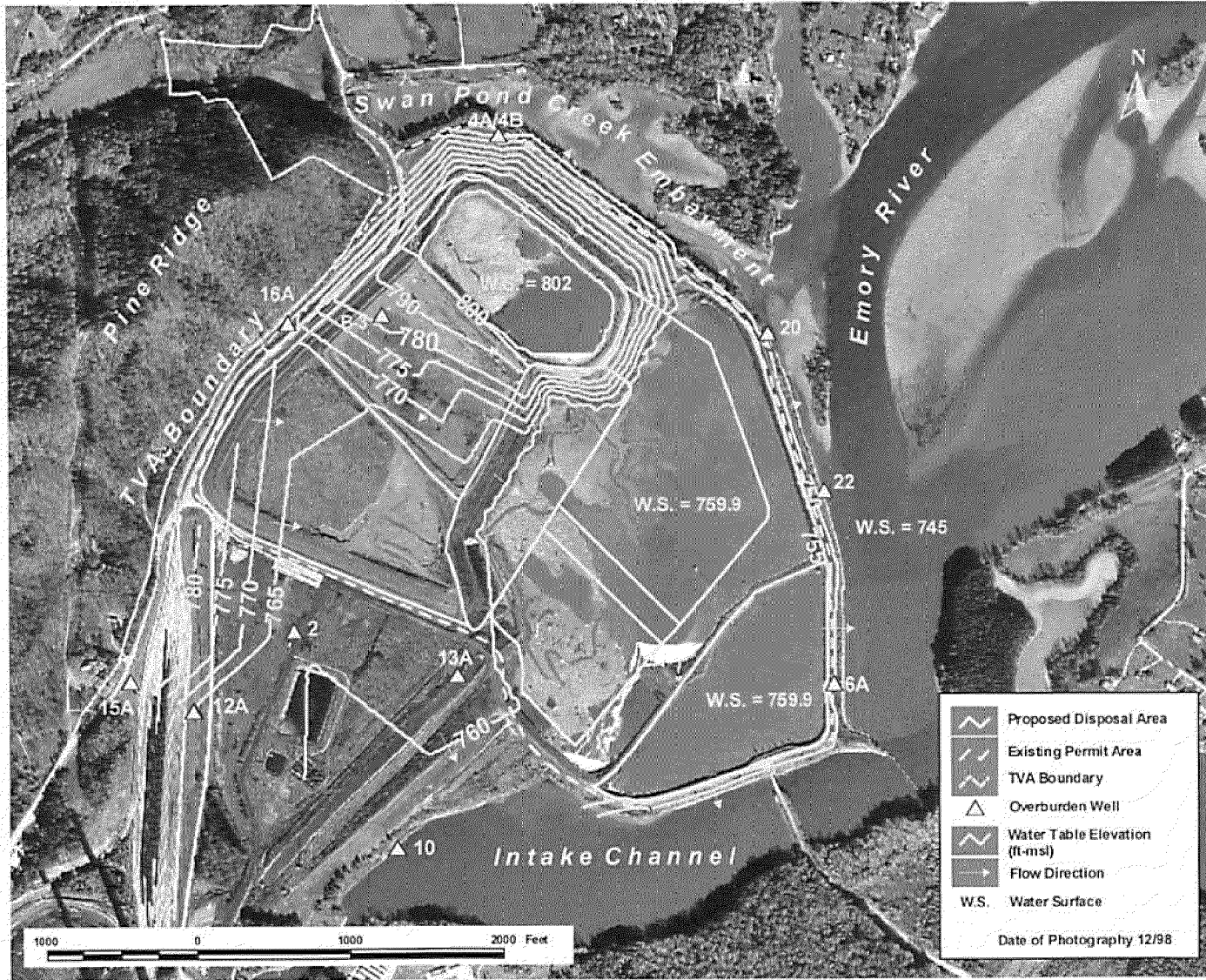


Figure 2-10. Estimated Seasonal High Water Table Map

2.3 Hydraulic Properties

A summary of field and laboratory measurements of hydraulic conductivity for ash, alluvial soils, and shallow bedrock derived from previous site investigations is presented in Table 2-1. References for the laboratory or field methods are also given in the table. Vertical hydraulic conductivities (K_v) for nine fly ash samples range from 3.6×10^{-6} to 8.3×10^{-5} cm/s and exhibit a median value of 2.0×10^{-5} cm/s. The two field measurements of fly ash horizontal conductivity (K_h) generally fall within the range of data reported for K_v . Laboratory-derived K_h and K_v data for alluvial clay-silt samples show little difference and average about 5×10^{-7} cm/s. Field measures of K_h for this unit are about an order of magnitude higher, averaging approximately 7×10^{-6} cm/s. The difference reflects the larger measurement scale associated with field tests as well as the tendency for higher K values in the horizontal direction. Field testing performed in three wells completed in the upper Conasauga shale yielded K_h values averaging 2×10^{-5} cm/s.

The "natural" geologic buffer material below the proposed CCB disposal area would largely consist of fly ash (see hydrogeologic sections on Figures 2-3 and 2-4). As indicated in Table 2-1, hydraulic conductivity measurements of fly ash are limited to laboratory analysis of seven samples and two Boutwell field tests. Although the number of hydraulic conductivity measurements is below the recommended requirements of the DSWM Hydrogeologic Guidance Document, these data are considered sufficient in view of the high-degree of homogeneity of fly ash.

The hydraulic conductivity data presented in Table 2-1 do not include data for remolded samples of landfill cap and geologic buffer materials. The source of the cap and buffer materials has not been identified. Prior to construction of either the cap or buffer, TVA will solicit bids for cap/buffer materials having specified geotechnical properties. These specifications will include a requirement that the cap/buffer materials are compacted in accordance with ASTM D-698 or D-1557, and that hydraulic conductivity be measured according to ASTM D-5084. Hydraulic conductivities equal to or less than 10^{-6} cm/s (at design compaction) will be required of buffer materials.

Clay cap material will require hydraulic conductivities equal to or less than 10^{-7} cm/s. Test results will be presented to the State for approval prior to construction of the cap or buffer.

Table 2-1. Summary of Site Hydraulic Conductivity Data

Media	Location	K _h (cm/s)	K _v (cm/s)	Test Method	Reference
Fly Ash	Ash Dredge Cell 1	--	8.3E-05	ASTM D-5084	Law, 1995
Fly Ash	Ash Dredge Cell 3	--	3.4E-05	ASTM D-5084	Law, 1995
Fly Ash	B-1	1.4E-05	5.1E-06	ASTM D-6391	Mactec, 2004
Fly Ash	B-2	3.7E-06	3.6E-06	ASTM D-6391	Mactec, 2004
Fly Ash	B-2A	--	1.67E-05	ASTM D-5084	Mactec, 2004
Fly Ash	B-1A, 1B	--	1.87E-05	ASTM D-5084	Mactec, 2004
Fly Ash	--	--	2.0E-05	ASTM D-2434-68	EPRI, 1993
Fly Ash	--	--	2.1E-05	ASTM D-2434-68	EPRI, 1993
Fly Ash	--	--	2.2E-05	ASTM D-2434-68	EPRI, 1993
Bottom Ash	(?)	--	9.3E-03	ASTM D-5084	Law, 1995
Alluvial Clay-Silt	Well 2	7.4E-08	6.3E-08	(note 1)	Milligan & Ruane, 1980
Alluvial Clay-Silt	Well 4	6.6E-08	2.8E-07	(note 1)	Milligan & Ruane, 1980
Alluvial Clay-Silt	Well 5	2.8E-07	4.0E-07	(note 1)	Milligan & Ruane, 1980
Alluvial Clay-Silt	Well 6	2.5E-06	4.4E-07	(note 2)	Milligan & Ruane, 1980
Alluvial Clay-Silt	Well 2	9.1E-06	--	(note 2)	Velasco&Bohac, 1991
Alluvial Clay-Silt	Well 4B	6.1E-06	--	(note 2)	Velasco&Bohac, 1991
Alluvial Clay-Silt	Well 5	9.1E-06	--	(note 2)	Velasco&Bohac, 1991
Alluvial Clay-Silt	Well 13A	3.0E-06	--	(note 2)	Velasco&Bohac, 1991
Conasauga Shale	Well 9B	6.1E-06	--	(note 2)	Velasco&Bohac, 1991
Conasauga Shale	Well 13B	2.1E-05	--	(note 2)	Velasco&Bohac, 1991
Conasauga Shale	Well 15A	3.0E-05	--	(note 2)	Velasco&Bohac, 1991

Notes:

1. Laboratory constant-head test of undisturbed sample in triaxial cell; exact method unknown.
2. Field constant-rate pumping test in single well.

2.4 Precipitation

In the absence of long-term precipitation records for the KIF site, precipitation data were obtained for the National Oceanic and Atmospheric Administration (NOAA) station in Oak Ridge, Tennessee, located some 20 miles northwest of the site. A continuous 20-year period (1968-87) of daily precipitation data was selected. Annual precipitation for the period ranged from 38.8 to 76.3 inches and averaged approximately 52.9 inches.

3. LOCAL GROUNDWATER USE

A survey of local groundwater use within an approximate two-mile radius of the center of the ash pond area was conducted in March 1995 (Boggs et al., 1995). The survey included interviews with local residents and utility district managers. Water well records maintained by the State of Tennessee were also examined for wells within the survey region. This survey identified a total of 22 residential wells. A listing of these wells and their coordinate locations is given in Table 3-1. Note that wells were numbered 1 through 23 with no well 15. One spring (Spring 1) was identified which provides untreated water for 10 to 12 residences along Swan Pond Road and for several residents of the Kingston Heights subdivision. The spring emanates from aquifers of the Knox Group. This spring appeared to be the only spring in the survey region used for water supply. Other residents within the survey region were served by one of the four local water utilities listed in Table 3-1. These utilities provide treated water from intakes on Watts Bar Lake or the Emory River.

This area was re-surveyed in May 2004 to determine whether changes in local water use had occurred. The survey relied on interviews with local utility district managers, a drive-by inspection to identify new residences, and examination of current State well records. Six new residential wells identified, i.e., wells 24 through 29 (Figure 3-1) located east of the proposed disposal area on the opposite side of the Emory River. There was no change in public water supplies in the site vicinity.

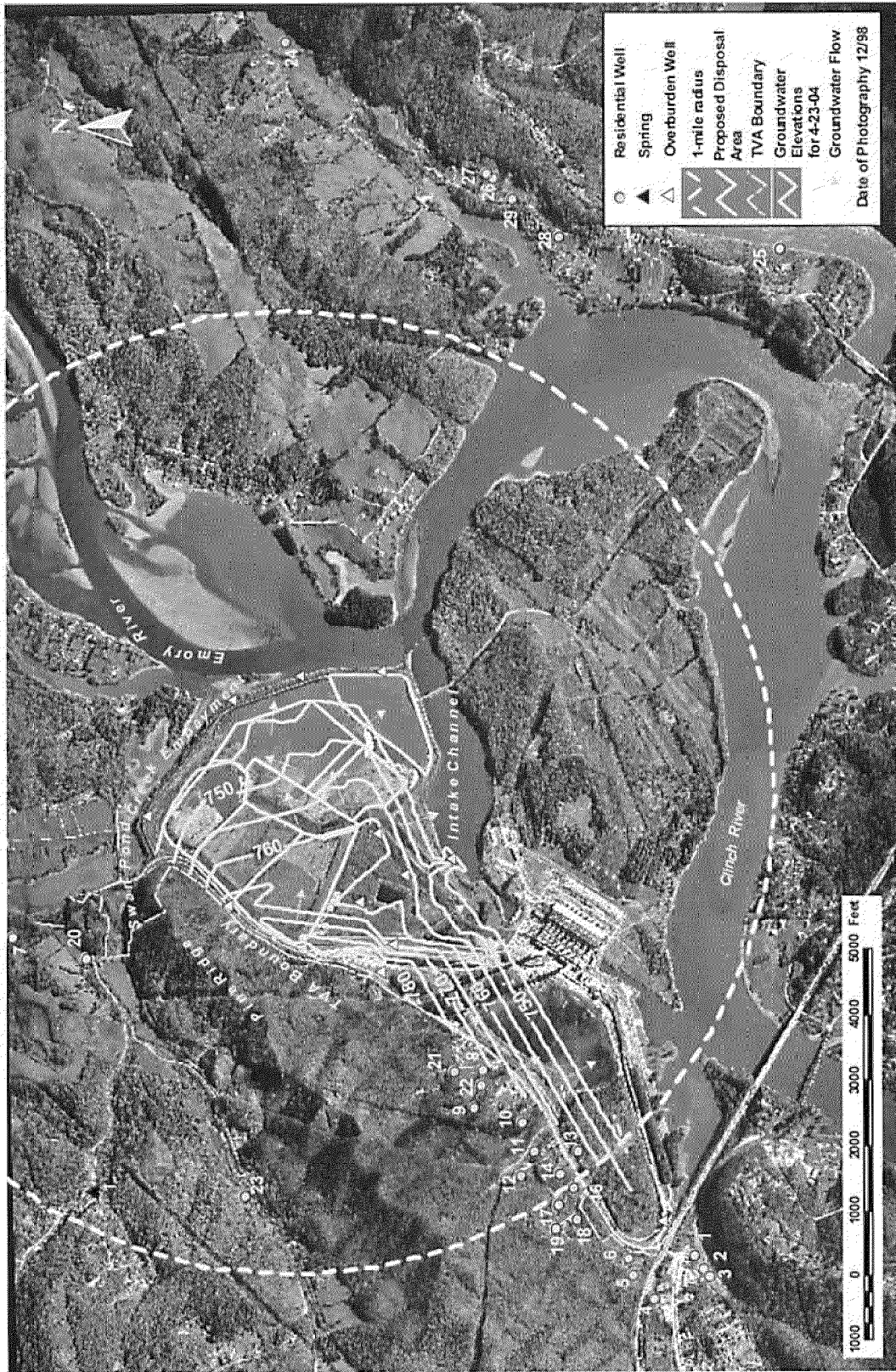


Figure 3-1. Private Water Wells and Springs in Site Vicinity

Table 3-1. Off-Site Wells, Springs, and Public Water Supplies

Location Identifier	Location Description	Longitude (dg-mn-sc) est	Latitude (dg-mn-sc) est	Inside 1 mile radius	Outside 1 mile radius	Comment
Well 1	Swan Pond Rd south of Hwy 70	35-53-35 N	84-32-05.5 W		X	
Well 2	Swan Pond Rd south of Hwy 70	35-53-34 N	84-32-09 W		X	
Well 3	Swan Pond Rd south of Hwy 70	35-53-33 N	84-32-10.5 W		X	
Well 4	North of Hwy 70, South of I-40	35-53-41.5 N	84-32-14 W		X	
Well 5	Swan Pond Rd north of Hwy 70	35-53-44.5 N	84-32-09.5 W		X	
Well 6	Swan Pond Rd north of Hwy 70	35-53-45 N	84-32-06 W		X	
Well 7	Swan Pond Circle north of Swan Pond Rd	35-55-18 N	84-31-04.5 W	X		
Well 8	Swan Pond Rd north of Hwy 70	35-54-06 N	84-31-31 W	X		
Well 9	Swan Pond Rd north of Hwy 70	35-54-07 N	84-31-37 W	X		
Well 10	Swan Pond Rd north of Hwy 70	35-54-00.5 N	84-31-41 W	X		
Well 11	Swan Pond Rd north of Hwy 70	35-53-58.5 N	84-31-46 W	X		
Well 12	Swan Pond Rd north of Hwy 70	35-54-00.5 N	84-31-50.5 W	X		
Well 13	Swan Pond Rd north of Hwy 70	35-53-52 N	84-31-47 W	X		
Well 14	Swan Pond Rd north of Hwy 70	35-53-55 N	84-31-50 W	X		
Well 16	Swan Pond Rd north of Hwy 70	35-53-53 N	84-31-53 W		X	
Well 17	Swan Pond Rd north of Hwy 70	35-53-55 N	84-31-56 W		X	
Well 18	Swan Pond Rd north of Hwy 70	35-53-52 N	84-31-58.5 W		X	
Well 19	Swan Pond Rd north of Hwy 70	35-53-56 N	84-32-00 W		X	
Well 20	Swan Pond Rd west of Swan Pond circle	35-55-06.5 N	84-31-09 W	X		
Well 21	Swan Pond Rd north of Hwy 70	35-54-11 N	84-31-31.5 W	X		
Well 22	Swan Pond Rd north of Hwy 70	35-54-05 N	84-31-05 W	X		
Well 23	Hassler Mill Rd west of Swan Pond Rd	35-54-43 N	84-31-54 W	X		
Well 24	Sugar Grove Valley Road	35-54-34N	84-28-19W		X	
Well 25	Sugar Grove Valley Road	35-54-20N	84-28-59W		X	
Well 26	Sugar Grove Valley Road	35-54-03N	84-28-45W		X	
Well 27	Sugar Grove Valley Road	35-54-04N	84-28-44W		X	
Well 28	Sugar Grove Valley Road	35-54-53N	84-28-56W		X	
Well 29	Sugar Grove Valley Road	35-54-00N	84-28-49W		X	
Spring 1	Near intersection of Swan Pond Rd and Frost Hollow Rd (used for portion of municipal supply by City of Kingston)	35-55-07 N	84-31-54 W	X		
City of Kingston	Intake off Hwy 58 south of Kingston on Watts Bar Lake	n/a	n/a			Outside 2-mile radius
Swan Pond U. D.	Purchase water from City of Harriman	n/a	n/a			Outside 2-mile radius
Midtown Utilities	Purchase water from City of Rockwood	n/a	n/a			Outside 2-mile radius
Town of Harriman	Intake on Emory River Near Mile 13	n/a	n/a			Outside 2-mile radius
City of Rockwood	Intake on Watts Bar Lake near Post Oak Creek	n/a	n/a			Outside 2-mile radius

4. EVALUATION OF POTENTIAL WATER QUALITY IMPACTS

The potential impacts of proposed future coal-combustion byproduct (CCB) disposal on local groundwater and surface water resources are examined in this section. The focus of the evaluation is on the potential effect of disposal activities on stream water quality since all shallow groundwater originating on, or flowing beneath, the site ultimately discharges to streams without traversing private property. Separate evaluations are performed for future codisposal of ash and gypsum (Option A) and disposal of ash only (Option B). Comparisons of water quality impacts for facility designs with and without a constructed 3-ft geologic buffer are provided for each disposal option.

4.1 Contaminants of Concern

Representative chemical data for fly ash and flue-gas desulfurization (FGD)-derived gypsum leachate are presented in Table 4-1. The gypsum data represent average constituent concentrations for five leachate samples collected from the gypsum pond and slurry tank at Cumberland Fossil Plant (CUF) (Appendix E). Fly ash data were obtained from a single leachate sample collected from WP21 located in the KIF active ash pond on June 7, 2004.

Eight contaminants of concern (COC) were selected for evaluation including ammonia, arsenic, cadmium, copper, mercury, nickel, selenium, and zinc. These constituents exhibit mean concentrations that are significantly above primary drinking water MCL (e.g., As, Cd, Hg, Ni, and Se) or have potential aquatic toxicity (e.g., Cd, Cu, Ni, and Zn). Ash produced after May 2004 may contain a maximum of 226 mg/kg ammonia as a result of the recently installed NO_x reduction system. Ammonia forms a residue on ash particle surfaces which is expected to be highly soluble. Residual ammonia dissolved by either sluice water or infiltrating precipitation would likely be in the form of the ammonium ion (NH₄⁺). Interstitial water remaining in sluiced ash after mixing of ammoniated-ash with sluice water is estimated to contain 2.64 mg/L NH₃-N (TVA, 2002). The same ammonia content is conservatively assumed to apply to dry "dipped" ash (i.e., ash dredged from the ash pond and hauled by truck to the disposal site). Incident precipitation infiltrating through dry stacked fly ash would form leachate-containing ammonia as well as other ash-related constituents. The NH₃-N concentration of the dry ash leachate is estimated to be approximately 733 mg/L assuming complete leaching of ammonia from a unit volume of ash by one pore volume of infiltrating water. On entering the groundwater system beneath the disposal area, ammonia may be transformed by biological nitrification to nitrate and/or nitrite.

Table 4-1. Fly Ash and Gypsum Leachate Data

	Units	MCL	CCC	KIF Ash Leachate ¹	CUF Gypsum Leachate ²
Aluminum	µg/L	200	150	<50	280.0
Antimony	µg/L	6		<3	9.3
Arsenic	µg/L	50		750	1.0
Barium	µg/L	2000		40	77.5
Beryllium	µg/L	4		<1	1.0
Boron	µg/L			730	42,500.0
Cadmium	µg/L	5	0.25	2	11.9
Chloride	mg/L	250		7.9	1,300.0
Chromium	µg/L	100	100	<1	2.3
Cobalt	µg/L			<1	9.5
Copper	µg/L	1300	9	<10	5.5
Fluoride	mg/L	4		0.57	13.1
Iron	µg/L	300		16000	205.0
Lead	µg/L	15	2.5	<1	1.0
Magnesium	µg/L			11	535.0
Manganese	µg/L	50		580	1,490.0
Mercury	µg/L	2	0.77	0.1	3.4
Nickel	µg/L	100	52	3	106.5
Selenium	µg/L	50	5	<1	137.0
Silver	µg/L	100	3.2	<10	5.2
Sodium	mg/L			5.7	19.5
TDS (180 deg)	mg/L	500		400	6,800.0
Strontium	µg/L			460	4,500.0
Sulfate	µg/L	250		130	3,020.0
Thallium	µg/L	2		<2	<2
Vanadium	µg/L			<10	<10
Zinc	µg/L	5000	120	<10	715.0

¹Data for filtered water sample from wellpoint WP-21 completed in Ash Pond.

²Average concentrations for 4 gypsum leachate samples given in Appendix E.

4.2 Methods

4.2.1 Leachate Seepage Estimation

The potential impacts associated with each of the proposed CCB disposal areas during the period of active disposal operations were assessed individually since these facilities generally involve different wastes, spatially distinct areas, and will operate over different timeframes. The HELP landfill hydrologic water budget model (Schroeder et al., 1989 and 1994) was used to estimate CCB leachate seepage rates from landfill-type facilities not involving waste impoundments (e.g., dry ash stacks, inactive ash dredge cells, and inactive gypsum rim-ditch disposal operations). Typically, individual landfills were divided for purposes of HELP simulations into subregions based on waste thickness, surface cover, and surface slope. For example, Figure 4-1 shows the subregion and stratigraphic profile associated with the proposed Phase 1 addition of sluiced ash to existing Ash Dredge Cells 1-3. Subsequent stages of Phase 1 development of Cells 1-3 (e.g., capping with dipped ash and final closure) involved additional modeling steps. Subregion and profile diagrams for these models are given on Figures F-2 and F-3 of Appendix F.

Seepage estimates for CCB impoundment facilities (e.g., active ash dredge cells and gypsum sedimentation ponds) were performed by modeling a typical section through the disposal area using the USGS MODFLOW-2000 groundwater flow model (Harbaugh et al., 2000) in conjunction with the Visual MODFLOW modeling interface (Waterloo Hydrogeologic, Inc., 2004). The average steady-state seepage rate from the base of the facility along the section was then integrated over the full area of the facility to estimate total leachate seepage.

The various CCB disposal areas associated with Option A involved modeling of 25 separate landfill and impoundment subregions. Diagrams similar to Figure 4-1 describing the individual facility models for Option A are provided in Appendix F. Likewise, Appendix G contains diagrams of facility subregions associated with Option B. Note that proposed Phase 1 disposal facilities are the same for both Options A and B.

HELP Simulations – Hydraulic properties used in the HELP simulations are presented in Table 4-2. Fly ash data represent average characteristics derived from laboratory testing of three Kingston fly ash samples (Young et al., 1993). The bottom ash hydraulic conductivity given in Table 4-2 is based on test results for a KIF bottom ash sample reported by MACTEC (2004). All other bottom ash parameters are based on lab testing of a sample of CUF bottom ash (D.B. Stephens, 1991). Since no gypsum has yet been produced at KIF, average properties for two gypsum samples from Shawnee Fossil Plant (SHF) were used (D.B. Stephens, 1991). The values for top soil were those presented by Schroeder et al. [1989] for a soil loam. The field capacity, wilting point, and porosity for the clay cap and clay buffer were those given by Schroeder et al. [1989] for a soil liner.

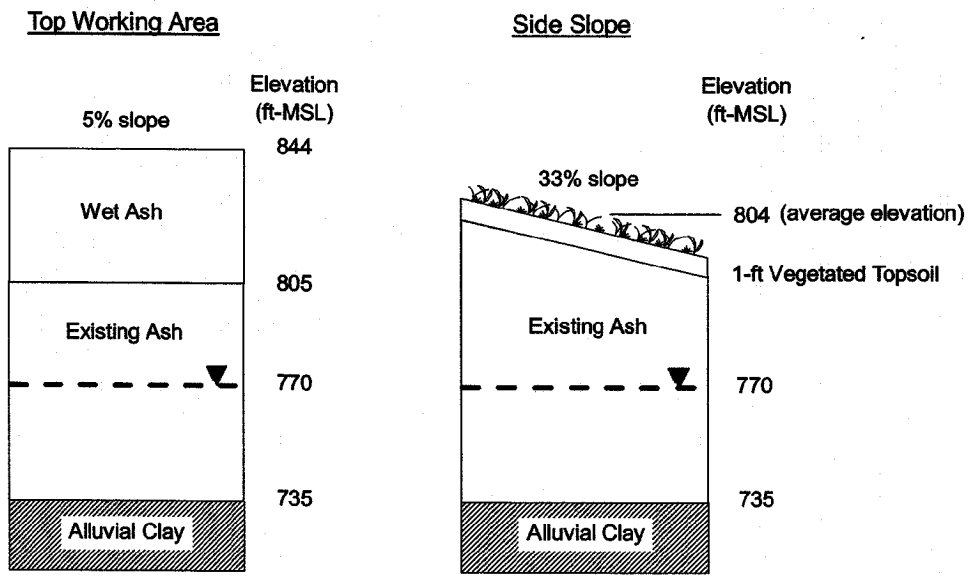
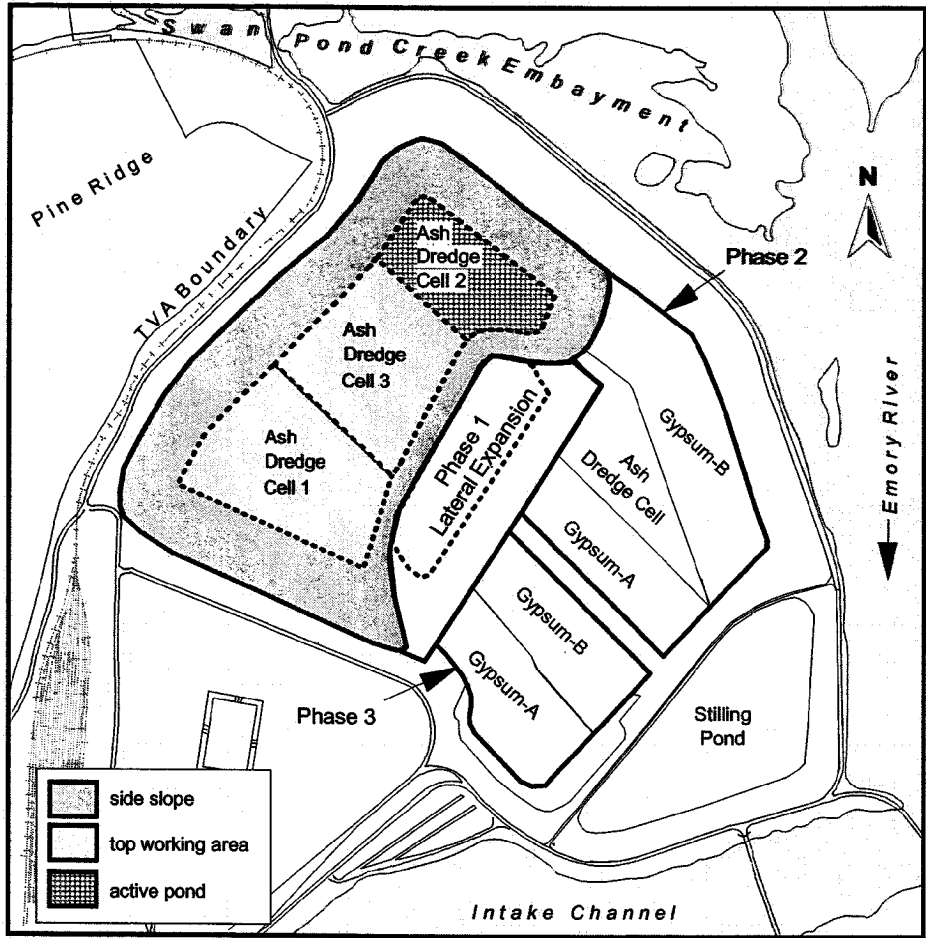


Figure 4-1. Conceptual Model of Ash Dredge Cells 1-3

Table 4-2. Hydraulic Properties Applied in HELP Simulations

Media Type	Total Porosity	Field Capacity¹	Wilting Point²	Initial Volumetric Moisture Content (%)	Hydraulic Conductivity (cm/s)
Top Soil	0.46	0.23	0.12	0.23	3.7×10^{-4}
Clay Cap	0.43	0.37	0.28	0.37	1.0×10^{-7}
Fly Ash	0.47	0.40	0.12	0.22 - 0.32	2.0×10^{-5}
Gypsum	0.68	0.54	0.28	0.50	5.1×10^{-5}
Bottom Ash	0.53	0.15	0.06	0.10	9.3×10^{-3}
Geologic Buffer	0.43	0.37	0.28	0.37	1.0×10^{-6}

¹Moisture content at pressure head of -0.33 bar.

²Moisture content at pressure head of -15 bars.

The design maximum hydraulic conductivity of the clay cap is 10^{-7} cm/s while that of the clay buffer is 10^{-6} cm/s. Initial volumetric moisture contents for the top soil, clay buffer, and clay cap were arbitrarily set at field capacity for all simulations involving these materials. The design moisture content of dry-stacked fly ash at the time of emplacement will be 0.22, whereas an initial moisture content of 0.26 was applied to existing fly ash. Initial moisture contents for gypsum and bottom ash were estimated from in situ data measured at SHF and CUF.

Soil Conservation Service curve numbers (CN), used by HELP to estimate surface runoff, were determined on the basis of vegetative cover and soil texture relationships provided by Schroeder et al. (1994, Figure 7, p. 39). CN values of 90 were used for bare fly ash and gypsum surfaces. Temporary cover consisting of top soil and a fair grass cover was assigned a CN of 80 and a leaf area index (LAI) of 2.2. Final cover applied at facility closure and consisting of top soil with a good grass cover was assigned a CN of 80 and an LAI of 3.3.

Evaporation parameters required by HELP include the evaporation coefficient and the evaporation depth. Foust and Young (1993) demonstrated by laboratory experiments and numerical simulations using fly ash from TVA's Kingston and Colbert Plants that the evaporation depth can approach several feet. For HELP simulations involving bare fly ash surfaces, a conservative evaporation depth of 30 inches was used. The measured evaporation coefficient of $14.6 \text{ mm/day}^{0.5}$ for KIF fly ash reported by Foust and Young (1993) was used for bare fly ash surfaces. For bare gypsum surfaces, an evaporation depth of 18 inches was assumed in conjunction with an evaporation coefficient of $8 \text{ mm/day}^{0.5}$ derived from a 15-month field lysimeter study involving SHF gypsum (Boggs et al., 1990). All cases involving top soil cover assumed 12-inch evaporation depths and an evaporation coefficient of $5.1 \text{ mm/day}^{0.5}$ in accordance with guidance provided by Schroeder et al. (1994).

Meteorological data was compiled from a NOAA station located in Oak Ridge, Tennessee. This station was selected because of its close proximity to KIF and because high quality data was available for a continuous 20-year period. The data include daily rainfalls and mean daily temperatures from 1968 to 1987. In order to provide 30 years of rainfall/temperature data for the water budget simulation, data for years 1968-77 were added to the end of the 1968-87 record. Daily solar radiation values were generated using a HELP subroutine that incorporates several factors including latitude and daily rainfall.

MODFLOW Simulations-- Steady-state leachate seepage from the gypsum and ash ponds were obtained from two-dimensional profile models oriented normal to the river as shown in the example on Figure 4-2. The figure depicts the finite difference model grid, subsurface hydrogeologic units, and constructed waste layers associated with the initial Phase 2 gypsum/ash impoundments. The upper model shown in Figure 4-2 represents an impoundment design without a geologic (clay) buffer, while the lower model represents an impoundment which incorporates a geologic buffer. In this example, constant-head boundary conditions of 765 ft and 740 ft are applied at the left and right model boundaries, respectively, to represent the approximate pre-impoundment ambient hydraulic gradient toward the river. The lower boundary represents approximate top of bedrock elevation and is assigned zero flux. Constant heads of 784 ft are assigned to model cells representing the upper surface of the impoundment to represent an assumed 4-ft water depth. Perimeter drains indicated in the bottom ash drainage layers were assigned fixed heads equal to the average elevation of the layer. Stratigraphic units, including the existing fly ash, alluvial clay, and alluvial sand, were assigned uniform average thicknesses based on available boring data. Table 4-3 provides the media hydraulic properties assigned to the models. In order to estimate the total steady rate of seepage through the base of the entire impoundment, the computed average flux rate across the lower side of the lowest drainage blanket for the 2D model was multiplied by the total surface area of the impoundment.

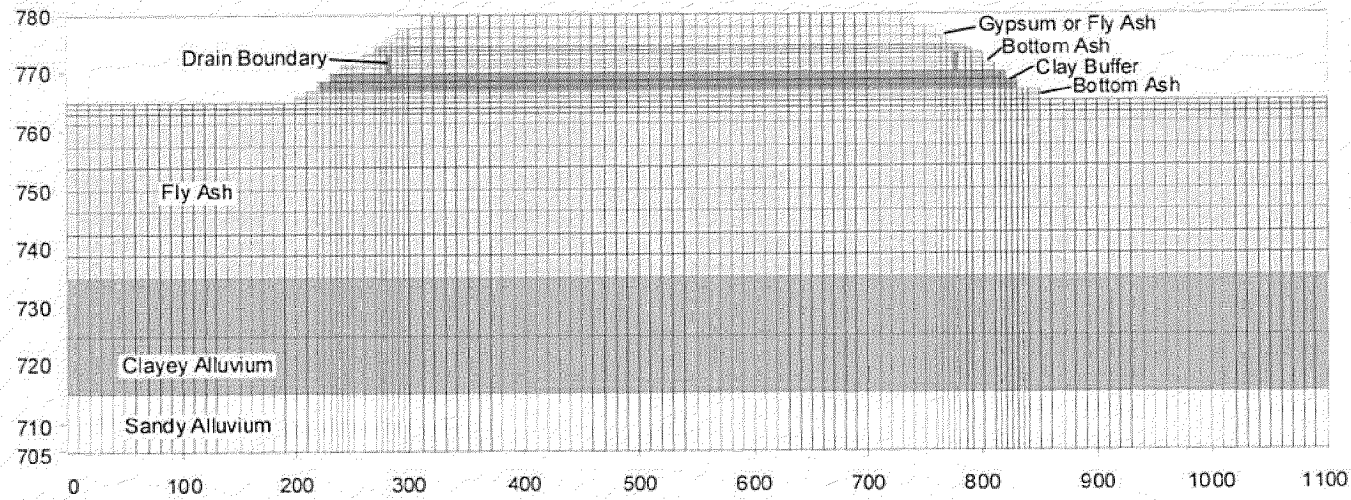
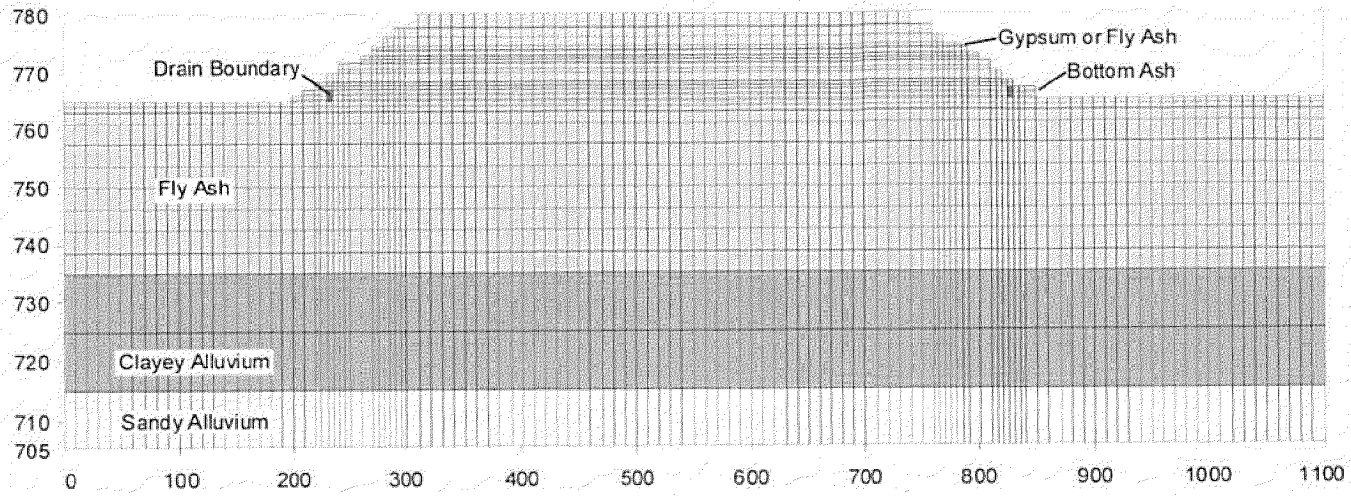


Figure 4-2. Profile View of MODFLOW Models Used for Pond Seepage Estimation

Table 4-3. Hydraulic Properties Applied in MODFLOW Simulations

Media Type	Thickness (ft)	Vertical Hydraulic Conductivity (cm/s)	Horizontal Hydraulic Conductivity (cm/s)
New Fly Ash	(varies)	2.0×10^{-5}	1.0×10^{-4}
New Gypsum	(varies)	5.1×10^{-5}	5.1×10^{-4}
Bottom Ash	2.0 ^a , 3.0 ^b	9.3×10^{-3}	1.0×10^{-2}
Geologic (Clay) Buffer	3.0	1.0×10^{-6}	1.0×10^{-5}
Existing Fly Ash	30.0	2.0×10^{-5}	1.0×10^{-4}
Alluvial Clay	20.0	4.0×10^{-7}	9.0×10^{-6}
Alluvial Sand	10.0	1.0×10^{-4}	1.0×10^{-3}

^aThickness of bottom ash drainage layer above fly ash base

^bThickness of bottom ash drainage layer above geologic (clay) buffer

4.2.2 Stream Loading Estimation

Depending on their location and mode of disposal (i.e., either landfill or impoundment), leachate seepage from the CCB disposal areas will be transported by shallow groundwater to SPC embayment, Emory River, or the plant intake channel. Groundwater flow patterns based on water levels measured in shallow monitoring wells shown on Figure 2-6 indicate that, in the absence of sluicing to Ash Dredge Cells 1-3, leachate emerging from the base of Cells 2, 3, and most of Cell 1 would be transported by ambient groundwater flow to SPC. Leachate seepage from Phase 1 Lateral Expansion Area and from the Phase 2 and 3 Areas would ultimately discharge in the Emory River or the intake channel. The presence of impoundment disposal facilities during different phases of disposal operations would to some extent alter groundwater flow patterns and ultimate leachate discharge points. For example, incorporating the potentiometric heads associated with active Cell 2, ash pond, and stilling pond (Figure 2-7) indicates leachate seepage to SPC would be limited to Cell 2, while leachate from the remaining cells would discharge to the river and intake channel. For conservatism, all leachate seepage produced from Ash Dredge Cells 1-3 is assumed to ultimately discharge to SPC, whereas leachate from all other areas discharges to the Emory River.

In estimating worst-case in-stream COC concentrations, no credit was taken for mixing and dilution of leachate by ambient groundwater during transport or for geochemical attenuation. The mean leachate seepage rate estimated using HELP or MODFLOW for each facility during the active disposal period, along with the initial COC concentrations given in Table 4-1, were used to compute the mass loading (in kg/day) to the stream for each COC. To estimate COC concentrations in the stream, complete mixing of predicted mass loadings with the appropriate low stream flow was assumed. The 7Q10 stream flow was applied to in-stream concentration estimates for ammonia,

whereas the 1Q10 was used for other COC constituents in accordance with TDEC guidance. Note that estimates of the maximum COC in-stream concentrations for the Emory River account for the cumulative contributions of COC mass loadings from multiple CCB disposal areas and from tributary SPC. On the other hand, the existing Ash Dredge Cells 1-3 represent the only area contributing COC mass to SPC. In this case the maximum concentrations for SPC were estimated using the highest stream load predicted for any future operational phase at Cells 1-3, including the post-closure phase.

Because no historical stream flow data are available for SPC, 1Q10 and 7Q10 low flows were estimated on the basis of continuous flow data (1935-70) for Whites Creek near Sharps Chapel, Tennessee. Whites Creek watershed (above the gauging station) is approximately 2.7 mi² and is closest in size of any of the gauged streams in the region to the 4.1 mi² watershed area of SPC. The 1Q10 and 7Q10 for Whites Creek are reported to be 0.216 and 0.240 cfsm (cubic feet per second per square mile). Applying the Whites Creek unit flows to the SPC watershed yields 1Q10 and 7Q10 estimates of 0.89 and 0.96 cfs.

Emory River 1Q10 and 7Q10 flows of 0.40 and 0.68 cfs are reported for the USGS gauging station at Oakdale located approximately 16 miles upstream of KIF (Flohr et al., 1993). However, flow of the Emory River in the immediate vicinity of KIF is controlled by upstream releases from Melton Hill Dam and plant intake withdrawals which average approximately 2200 cfs. Numerical flow-temperature simulations indicate that under worst-case low flow conditions (i.e., low natural inflow from the Emory River upstream and no releases from Melton Hill Dam) the flow toward the plant intake from the upstream reach of the Emory adjacent to the ash pond is approximately 84 cfs (personal communication, 5/6/02, Ming Shiao of the TVA Hydrothermal Team). The plant-controlled low flow of 84 cfs was used in stream loading analyses instead of the traditional 1Q10 and 7Q10 flows.

4.3 Option A - Future Codisposal of Coal Ash and FGD-Derived Gypsum

4.3.1 Facility Description

Figure 4-3 provides the schedule of CCB disposal operations proposed under Option A. Phase 1 operations will involve sluiced fly ash disposal in the existing Ash Dredge Cells 1-3 and in the Phase 1 Dredge Cell Lateral Expansion Area between 2004 and 2015. Approximately 4.034 million CY will be deposited in these areas bringing the grade elevation to approximately 844 ft in Cells 1-3 and to elevation 810 ft in the Lateral Expansion Area. Between 2015 and 2017 approximately 951,200 CY of dipped ash will be placed atop Cells 1-3 raising the final grade to a maximum elevation of 858 ft.

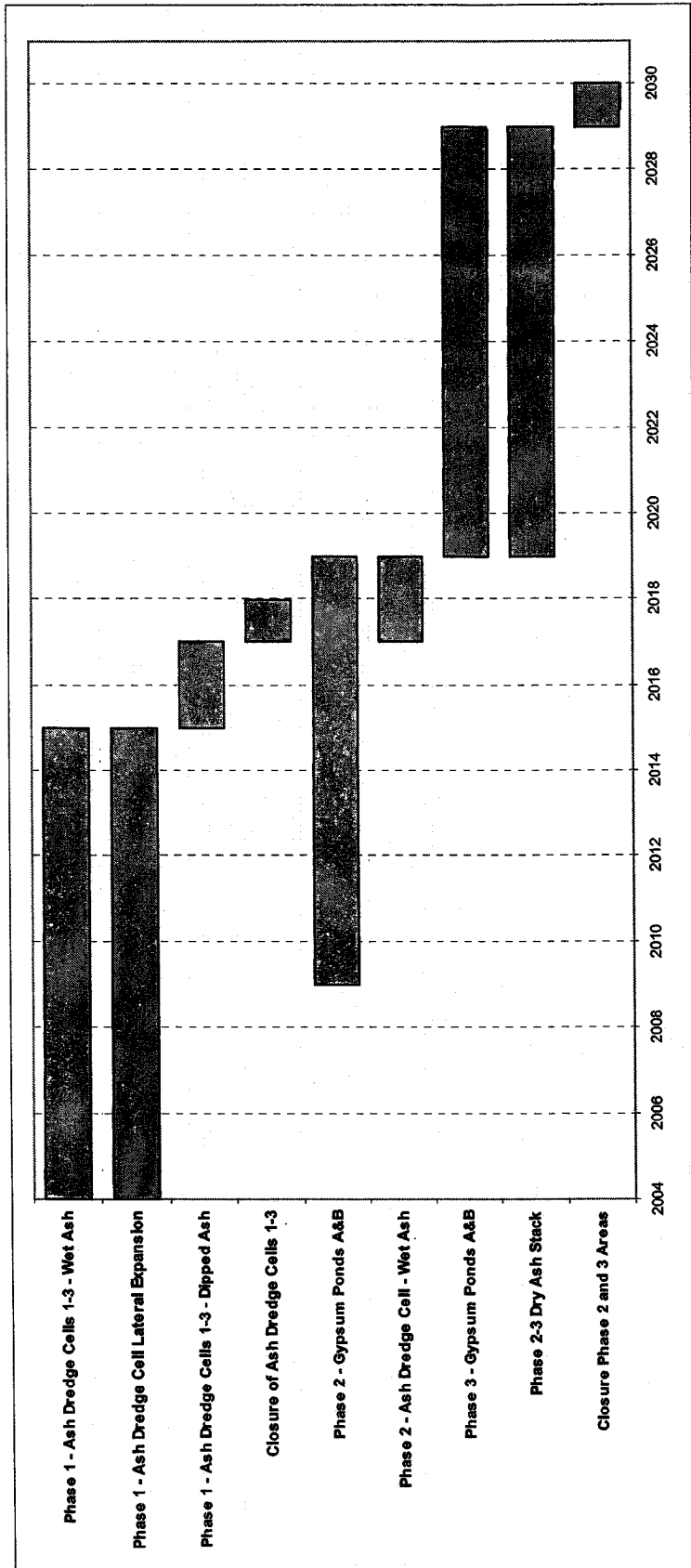


Figure 4-3. Option A – Schedule of Facility Operations

Dredge Cells 1-3 will be partially closed in 2017 by construction of a 1-ft thick clay cap having maximum hydraulic conductivity of 10^{-6} cm/s followed by 1 ft of vegetated top soil. The cap will extend over the entire Cells 1-3 area with the exception of the southeast-facing side slopes which will be left uncovered to allow for subsequent contiguous Phase 2 and 3 disposal operations. Maximum surface elevation of the closed facility will be approximately 860 ft.

Gypsum byproduct disposal in the Phase 2 area is expected to begin in 2009 when flue-gas scrubbers are scheduled for operation. Wet gypsum will be alternately sluiced to rim-ditch systems in Ponds A and B until 2019 when the stack reaches elevation 870 ft. At that point, gypsum byproduct will be directed to rim-ditch systems in the Phase 3 area. Stacking of dry fly ash in the region between the Phase 2 and 3 areas will also begin in 2019. Gypsum disposal in the Phase 3 area is expected to continue until 2029 when the stack reaches elevation 870 ft. Total volumes of gypsum deposited in the Phase 2 and 3 areas are estimated at approximately 3.27 million CY and 3.60 million CY, respectively.

Dry fly ash stacking will continue above the gypsum stacks until approximately 2029. The total volume of dry ash deposited in the Phase 2 and 3 areas will be approximately 5.7 million CY. Closure of the Phase 2 and 3 areas will involve placement of a clay cap and vegetated top soil over the entire area. Design of the cap and cover will be the same as that applied to the Phase 1 area.

4.3.2 Leachate Seepage Results

Average leachate seepage estimates for each of the proposed disposal facilities considered under Option A are presented in Table 4-4. Detailed seepage data for all disposal facility subregions are given in Appendix H, along with information regarding estimation methods.

The mean leachate seepage rate during the period (2004-14) of wet sluicing of ash to Dredge Cells 1-3 is estimated at approximately 425,000 liters per day (Lpd) (Table 4-5). This estimate conservatively assumes active ash sluicing to Cell 2 (closest to SPC embayment) and exposure of working surfaces of inactive Cells 1 and 3 to incident precipitation. Approximately 37% of the total seepage is derived from seepage below the assumed impoundment in Cell 2 as estimated with MODFLOW (Appendix H). Seepage from the remaining area was estimated using the HELP model. The average seepage rate outside of Cell 2 represents approximately 22% of average precipitation, and reflects the relatively high infiltration rates associated with exposed ash surfaces and the interim topsoil on side slope areas. Capping and closure of Dredge Cells 1-3 in 2018 is predicted to reduce the average seepage rate by 32 % to approximately 287,400 Lpd.

Table 4-4. Option A – Facility Leachate Seepage Estimates

Facility	Start Date	End Date	Waste	Mean Leachate Seepage (Lpd)	Seepage Difference Buffer vs. No Buffer
Phase 1 - Ash Dredge Cells 1-3	2004	2014	wet ash	425,135	NA
Phase 1 - Ash Dredge Cells 1-3	2015	2016	dipped ash	243,499	NA
Closure of Ash Dredge Cells 1-3	2017	2046	mixed ash	287,409	NA
Phase 1 - Dredge Cell Lateral Expansion Area	2004	2014	wet ash	56,936	NA
Phase 2 - Gypsum Ponds A&B - NO BUFFER	2009	2018	gypsum	62,287	33%
Phase 2 - Gypsum Ponds A&B - BUFFER	2009	2018	gypsum	41,506	
Phase 2 - Ash Dredge Cell - NO BUFFER	2009	2018	wet ash	21,844	20%
Phase 2 - Ash Dredge Cell - BUFFER	2009	2018	wet ash	17,370	
Phase 3 - Gypsum Ponds A&B - NO BUFFER	2019	2028	gypsum	60,733	38%
Phase 3 - Gypsum Ponds A&B - BUFFER	2019	2028	gypsum	37,798	
Phase 2&3 Dry Ash Stack - NO BUFFER	2019	2028	dry ash	10,268	20%
Phase 2&3 Dry Ash Stack - BUFFER	2019	2028	dry ash	8,243	
Closure of Phase 2&3 Areas - NO BUFFER	2029	2058	ash/gypsum	179,456	1%
Closure of Phase 2&3 Areas - BUFFER	2029	2058	ash/gypsum	177,878	

Table 4-5. Option A - Predicted Worst-Case Stream Loadings and In-Stream Concentrations

Constituent	MCL	CCC	Swan Pond Creek Embayment		Emory River - No Buffer Case		Emory River - Buffer Case	
			Maximum Loading (kg/day)	Maximum Concentration (mg/L)	Maximum Loading (kg/day)	Maximum Concentration (mg/L)	Maximum Loading (kg/day)	Maximum Concentration (mg/L)
Ammonia-N	10/1	(**)	4.24E-01	0.15221	5.14E+01	0.25018	5.10E+01	0.24800
Arsenic	0.05	0.15	1.57E-03	0.00061	6.38E-02	0.00031	6.32E-02	0.00031
Cadmium	0.005	0.00021	4.25E-04	0.00016	1.88E-03	0.00001	1.59E-03	0.00001
Copper	1.3	0.0072	1.08E-02	0.00414	9.55E-03	0.00005	9.28E-03	0.00005
Mercury	0.002	0.00077	2.55E-04	0.00010	6.28E-04	0.00000	5.04E-04	0.00000
Nickel	0.1	0.0422	1.98E-02	0.00763	2.92E-02	0.00014	2.46E-02	0.00012
Selenium	0.05	0.005	4.25E-04	0.00016	1.72E-02	0.00008	1.33E-02	0.00006
Zinc	5	0.0957	8.89E-02	0.03424	1.60E-01	0.00078	1.29E-01	0.00063

**See Table 4-6

Leachate seepage rates from the Phase 2 and 3 Gypsum and Ash Disposal Areas were conservatively estimated for the maximum sedimentation pond surface areas which occur during the early stage of disposal operations. A working surface elevation of 780 ft was assumed for the gypsum and ash disposal areas. Net seepage from Phase 2 Gypsum Ponds A and B is estimated to be approximately 62,300 Lpd for the no-buffer case and 41,500 Lpd for the buffer design, indicating a 33% overall reduction in seepage provided by the clay buffer. The Phase 3 Gypsum Disposal Area showed similar results with the buffer providing a 38% reduction in seepage generation. Incorporating artificial clay buffers below the Phase 2 Ash Dredge Cell and the dry ash stack situated between the Phase 2 and 3 areas decreased seepage by approximately 20% in both cases.

Average leachate seepage rates predicted during 30-year post-closure simulations of the combined Phase 2 and 3 areas were approximately 179,500 Lpd for the no-buffer design and 177,900 Lpd with a clay buffer (Table 4-4). The 1-ft, 10^{-6} cm/s clay cap constructed over the disposal area at closure would largely control net infiltration through the CCB materials. Since the hydraulic conductivity of the clay cap and buffer would be the same, the buffer would provide essentially no (i.e., less than 1%) additional containment of leachate seepage. Overall, results indicate that while modest seepage reductions of 20 to 38% could be expected by the addition of a clay buffer during active disposal operations, the long-term benefit of a buffer would be negligible.

4.3.3 Predicted COC Concentrations in Swan Pond Creek Embayment

The only disposal area that would contribute COC-containing leachate to SPC would be Ash Dredge Cells 1-3, as discussed in Section 4.2.2. Except for ammonia, future ash leachate generated from this area is expected to be chemically similar to current leachate. Therefore, future loadings of COC other than ammonia would not be expected to differ significantly from current loadings to SPC.

Estimates of the mass loading of each COC produced by leachate seepage from future disposal operations are presented in Table H2 (Appendix H). These estimates are subsequently used in estimating the cumulative COC loadings to SPC and the Emory River shown on Figures 4-4 and 4-5, and worst-case in-stream COC concentrations presented in Table 4-5. To illustrate the method of computing the facility mass loadings, consider the following example calculation for ammonia. From Table 4-4 the mean leachate seepage rate during the period (2004-14) of wet sluicing to Ash Dredge Cells 1-3 is 425,135 Lpd. The volume-weighted average $\text{NH}_3\text{-N}$ concentration of 1.00 mg/L for leachate generated from Cells 1-3 shown in Table H2 is based on 4.034 million CY of new sluiced ash (above elevation 805 ft) having a pore water $\text{NH}_3\text{-N}$ concentration of 2.64 mg/L and 6.652 million CY of existing ash (between elevations 760 and 805 ft) having a zero $\text{NH}_3\text{-N}$ concentration. Applying the weighted-average pore water $\text{NH}_3\text{-N}$

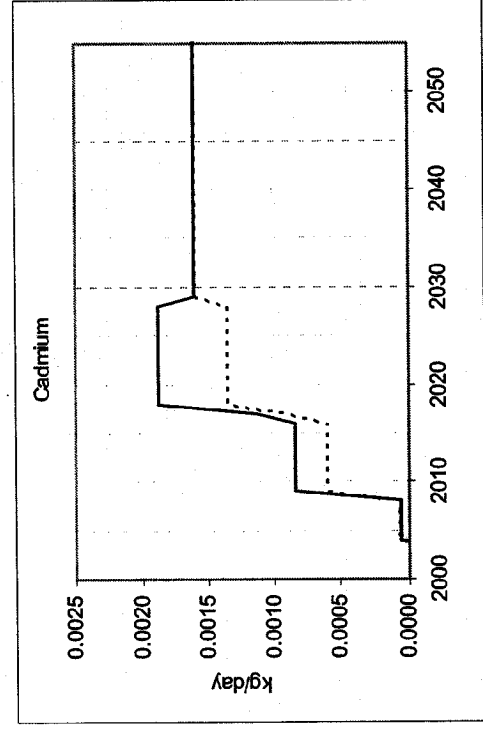
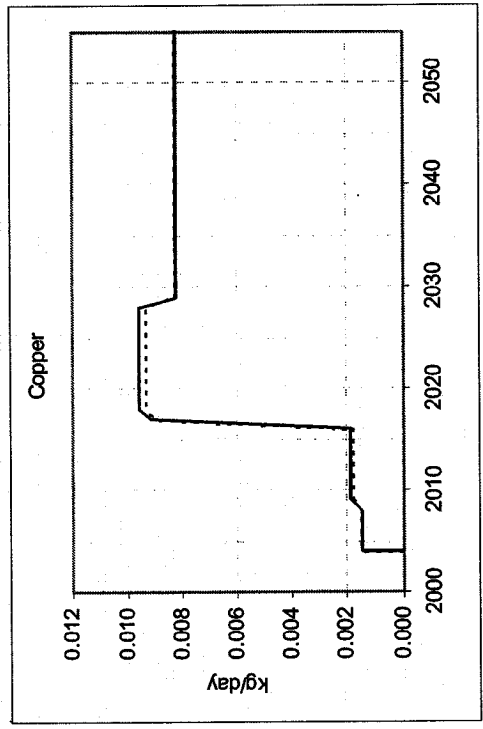
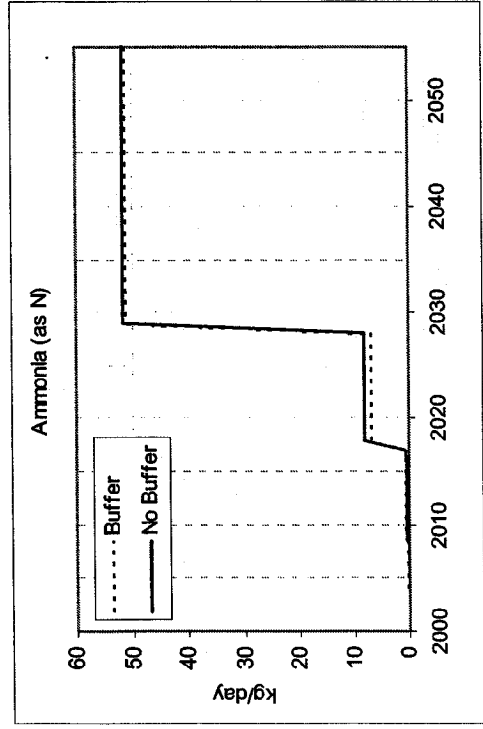
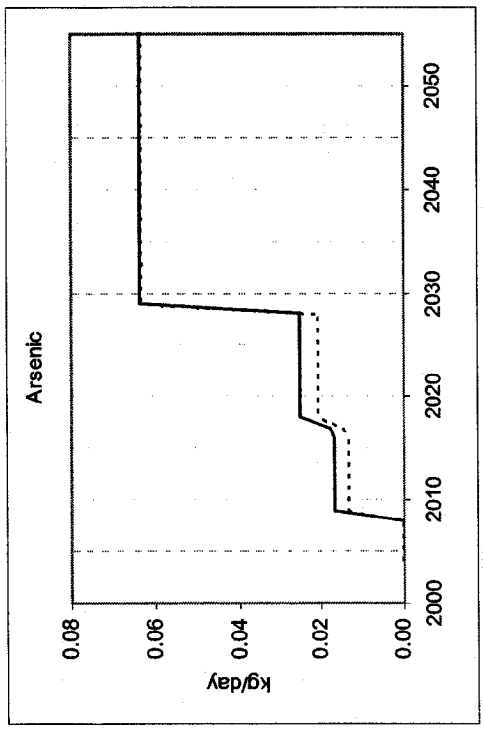


Figure 4-4. Option A – Cumulative COC Mass Loading for Emory River (Ammonia, Arsenic, Cadmium, and Copper)

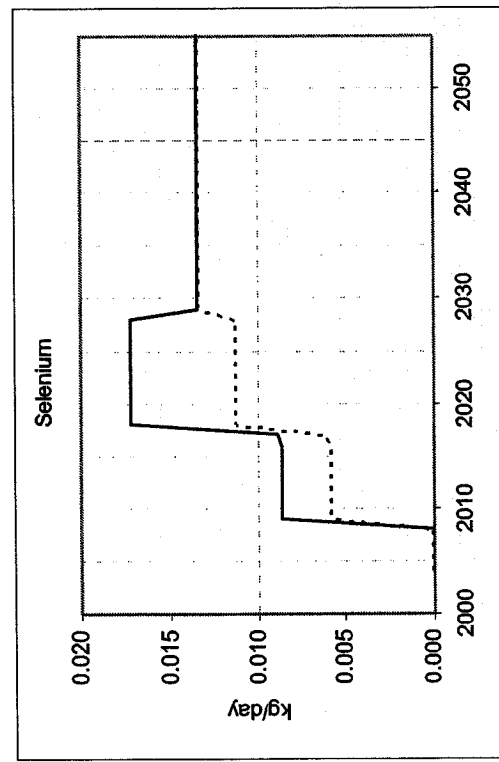
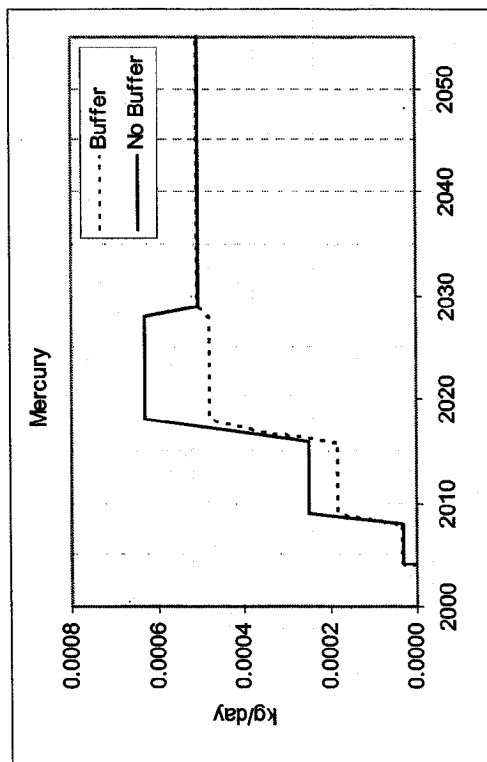
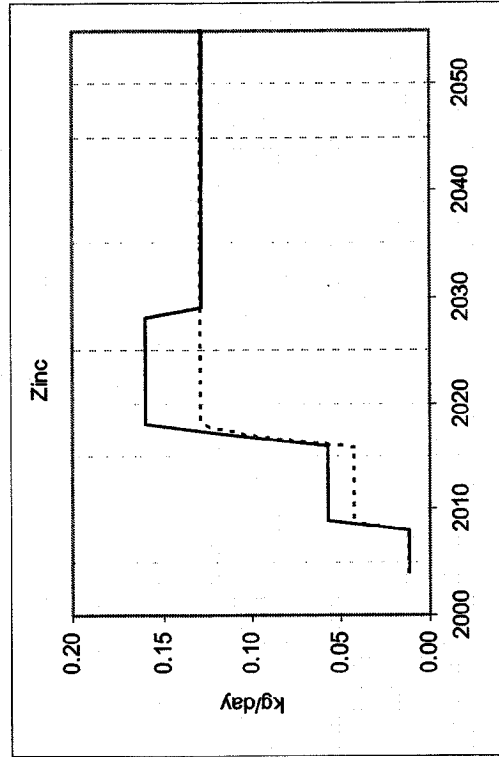
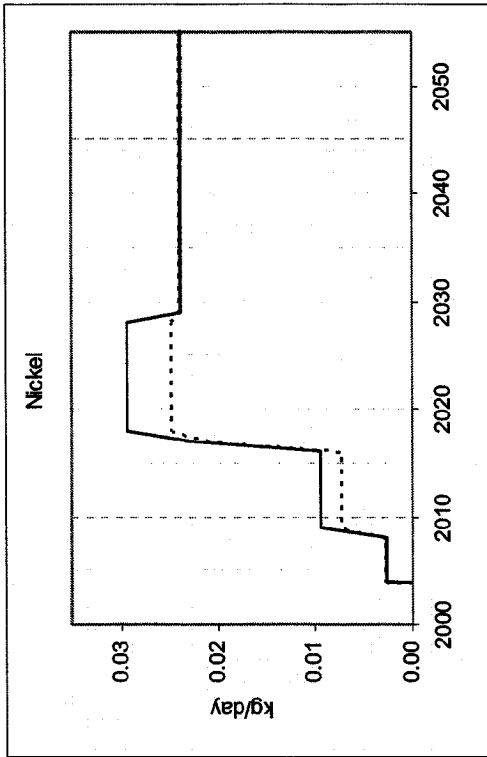


Figure 4-5. Option A – Cumulative COC Mass Loading for Emory River (Mercury, Nickel, Selenium, and Zinc)

concentration to the predicted seepage rate yields a mass loading of 0.424 kg/day. Since SPC discharges into the Emory River a short distance downstream, the NH₃-N loading to the Emory River is also 0.424 kg/day. Loadings of other ash-related COC to SPC were computed using historical mean groundwater quality data for monitoring wells 4A, 4B, 5, 5A, and 5B (Appendix I). As shown on Figure 2-6, these wells are situated downgradient of existing ash disposal areas, and provide representative COC concentrations of ash leachate currently entering SPC.

The period of wet sluicing of ash to Ash Dredge Cells 1-3 produces the largest ammonia loading to SPC of any of the future disposal activities in this area. Consequently, the worst-case NH₃-N concentration in SPC after full mixing of the predicted maximum loading (0.424 kg/day) with the 7Q10 low flow would be approximately 0.15 mg/L (Table 4-5). While there is no drinking water MCL for ammonia, conversion of ammonia to nitrate or nitrite is possible during groundwater transport, and these constituents have MCLs of 10 mg/L and 1 mg/L, respectively. Resulting NO₃-N or NO₂-N concentrations in SPC would be <0.15 mg/L for either constituent and would be below MCLs. Maximum allowable levels of ammonia for protection of aquatic life presented in Table 4-6 are dependent on stream pH and temperature. Although no historical pH data are available for SPC embayment, three measurements performed on July 21, 2004, indicated pH of approximately 8.0 to 8.1. The estimated NH₃-N level is below the aquatic life CCC for the expected range of stream pH and temperature conditions. Further examination of Table 4-5 indicates that the predicted maximum stream loadings for the remaining COC produce in-stream concentrations meeting applicable MCL and CCC standards.

Table 4-6. Maximum Allowable Ammonia Concentrations to Protect Aquatic Life^a

Temp ^c (°C)	CMC (mg N/L) ^b				CCC (mg N/L)			
	pH=7.0	pH=7.5	pH=8.0	pH=8.5	pH=7.0	pH=7.5	pH=8.0	pH=8.5
15					5.73	4.23	2.36	1.06
20					4.15	3.07	1.71	0.77
25	36.09	19.89	8.41	3.20	3.01	2.22	1.24	0.55
30					2.18	1.61	0.90	0.40

^aAssumes Salmonids absent and fish early life stages present.

^bCMC is not temperature dependent.

^cChronic values do not change with temperature below 14.6°C.

4.3.4 Predicted COC Concentrations in Emory River

The summary of maximum COC stream loadings and concentrations for the Emory River presented in Table 4-5 account for the cumulative contributions of COC mass loadings from multiple CCB disposal areas and from SPC. The graphs shown on Figures 4-4 and 4-5 provide cumulative mass loading time-series for each COC based on the facility operational schedules and loading data derived from Table H2. These graphs provide a general indication of the temporal variation of stream loadings in response to proposed disposal activities.

Figure 4-4 shows that the cumulative ammonia loading to the Emory River is low for both the buffer and no-buffer cases until 2019, when disposal of dry ash, with its relatively high ammonia content, begins in the region between the Phase 2 and 3 areas. The cumulative loads peak at closure (2029) after the maximum quantity of dry ash has been placed between and over the Phase 2 and 3 gypsum stacks. The worst-case NH₃-N loading estimated for the no-buffer design is 51.4 kg/day, resulting in an in-stream concentration of approximately 0.250 mg/L under low-flow conditions (Table 4-5). The clay buffer design slightly reduces the predicted in-stream concentration to 0.248 mg/L. These results suggest a negligible environmental advantage to the clay buffer, particularly since the in-stream NH₃-N concentration in both cases is below MCL and CCC.

Predicted worst-case in-stream concentrations for the remaining COC are also well below human health and aquatic life criteria in all cases. Differences between the estimated COC concentrations for the no-buffer and buffer design cases are directly related to predicted seepage differences and are generally 22% or less. As expected, constituents strongly associated with gypsum (e.g., cadmium, mercury, nickel, selenium and zinc) show substantial increases in cumulative load during the Phase 2 and 3 gypsum disposal periods from 2009 to 2029 (Figures 4-4 and 4-5). Loadings decrease substantially in 2029 after closure of the Phase 2 and 3 areas in response to decreased surface infiltration provided by the low-permeability clay cap.

4.4 Option B - Future Disposal of Coal Ash Only

4.4.1 Facility Description

Figure 4-6 provides the schedule of CCB disposal operations proposed for the ash-only disposal option. Phase 1 ash disposal operations would be the same as those described in Section 4.3.1 including closure of Ash Dredge Cells 1-3 in 2018. Sluiced ash disposal in the Phase 2 area is expected to begin in 2017. Ash would be alternately sluiced to two or three dredge cells until 2029 when the stack reaches elevation 870 ft. At that point, dry ash disposal operations would begin in the Phase 3 area.

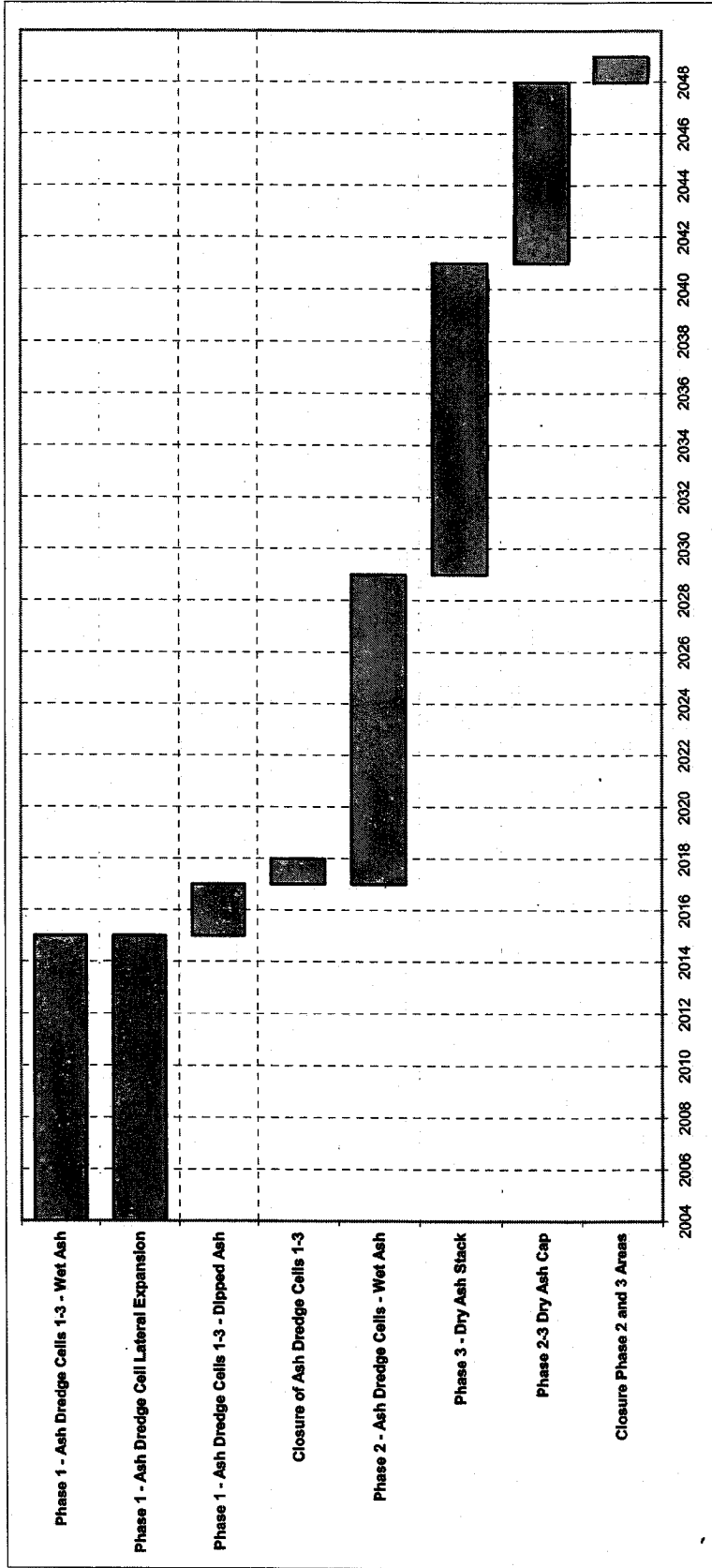


Figure 4-6. Option B – Schedule of Facility Operations

Dry ash stacking is expected to continue in the Phase 2 and 3 areas until 2048 when the stack attains a maximum elevation of 930 ft. Closure of the Phase 2 and 3 areas and the Phase 1 Lateral Expansion Area would occur in 2048 in the same manner described in Section 4.3.1 for Option A.

4.4.2 Leachate Seepage Results

Average leachate seepage estimates for each of the proposed disposal facilities considered under Option B are presented in Table 4-7. Detailed seepage data for all disposal facility subregions are given in Table J1 (Appendix J) along with information regarding estimation methods.

Leachate seepage estimates for Ash Dredge Cells 1-3 and the Lateral Expansion Area given in Table 4-7 are identical to those presented in Table 4-4 for Option A, since proposed disposal operations in these areas would be the same under both options. Results indicate that construction of an artificial clay buffer beneath the Phase 2 and 3 areas would reduce seepage during the active disposal period by 22 to 28%. As with Option A, 30-year post-closure simulations of the combined Phase 2 and 3 areas indicate essentially no difference between leachate production rates with or without a clay buffer.

4.4.3 Predicted COC Concentrations in Swan Pond Creek Embayment

Maximum COC stream loadings and concentrations for SPC embayment for Option B presented in Table J2 are identical to those presented for Option A (Table H2), since future disposal operations affecting SPC are the same for both disposal options. Refer to Section 4.2.3 for discussion of potential water quality impacts to SPC.

4.4.4 Predicted COC Concentrations in Emory River

Except for ammonia, future ash leachate generated from existing ash disposal areas is expected to be chemically similar to current ash leachate. Therefore, future loadings of COC other than ammonia would not be expected to differ significantly from current loadings to the Emory River. Nevertheless, worst-case in-stream concentrations for the remaining COC are included in the analysis for consistency.

Table 4-7. Option B – Facility Leachate Seepage Estimates

Facility	Start Date	End Date	Waste	Mean Leachate Seepage (Lpd)	Seepage Difference Buffer vs. No Buffer
Phase 1 - Ash Dredge Cells 1-3	2004	2014	wet ash	425,135	NA
Phase 1 - Ash Dredge Cells 1-3	2015	2016	dipped ash	243,499	NA
Closure of Ash Dredge Cells 1-3	2017	2046	mixed ash	287,409	NA
Phase 1 - Dredge Cell Lateral Expansion Area	2004	2014	wet ash	56,936	NA
Phase 2 - Ash Dredge Cells - NO BUFFER	2017	2028	wet ash	125,956	27%
Phase 2 - Ash Dredge Cells - BUFFER	2017	2028	wet ash	92,002	
Phase 3 - Dry Ash Stack - NO BUFFER	2029	2040	dry ash	111,158	28%
Phase 3 - Dry Ash Stack - BUFFER	2029	2040	dry ash	80,042	
Phase 2&3 - Dry Ash Cap - NO BUFFER	2041	2047	dry ash	88,160	22%
Phase 2&3 - Dry Ash Cap - BUFFER	2041	2047	dry ash	68,837	
Closure of Phase 2&3 Areas - NO BUFFER	2048	2077	ash	230,944	1%
Closure of Phase 2&3 Areas - BUFFER	2048	2077	ash	229,223	

Facility COC mass loadings for Option B are provided in Table J2, while Figures 4-7 and 4-8 show predicted cumulative COC mass loading time series for the Emory River. The ammonia loading to the Emory River is low for both buffer and no-buffer cases until 2029, when dry ash disposal, with its relatively high ammonia content, begins in the Phase 3 Area. The ammonia load decreases following facility closure (2048) in response to reduced infiltration through the clay cap. Table 4-8 indicates the worst-case cumulative NH₃-N loading estimated for the no-buffer design is approximately 119 kg/day, resulting in an in-stream concentration of approximately 0.58 mg/L for the Emory River low-flow condition (Section 4.2.2). The clay buffer reduces the predicted in-stream concentration by 19% to approximately 0.47 mg/L. For both buffer and no-buffer cases, potential ammonia-derived nitrate or nitrite byproduct concentrations would be well below drinking water limits during low flow conditions. Predicted ammonia levels would also be below the CCC under typical pH conditions for the Emory River (Figure 4-9). Potential adverse aquatic impacts could occur under coincident conditions of extreme pH, temperature, and low flow in the Emory River (i.e., pH > 8.0 and temperature ≥ 30°C). Historical data for Oakdale (RM 18.3) show that river pH exceeds 8.0 less than 8% of the time, whereas temperatures of 30°C or more occur less than 3% of the time. Disregarding the probability of the Emory River low flow condition at the plant for which data are unavailable, the joint probability of the extreme pH and temperature conditions would be less than 0.3%.

Worst-case in-stream concentrations for the remaining COC are also well below human health and aquatic life criteria in all cases. Differences between the estimated COC concentrations for the no-buffer and buffer design cases are directly related to predicted seepage differences and are generally less than 13%.

4.5 Potential Impacts to Groundwater Users

There are currently 13 residential wells and one public water supply spring located within approximately one mile of the proposed disposal area (Figure 3-1). Wells 7 and 20 lie north of Swan Creek embayment and are hydrologically isolated from the disposal site. Similarly, the public water supply spring (Spring 1) and well 23 are hydrologically isolated from the site by Pine Ridge. The ten remaining wells, located to the southwest along Swan Pond Road, are situated indirectly upgradient of the site. There is no indication of groundwater movement from the proposed disposal site toward any off-site wells or springs. No adverse off-site groundwater impacts associated with the proposed CCB disposal facilities are anticipated under present or future conditions.

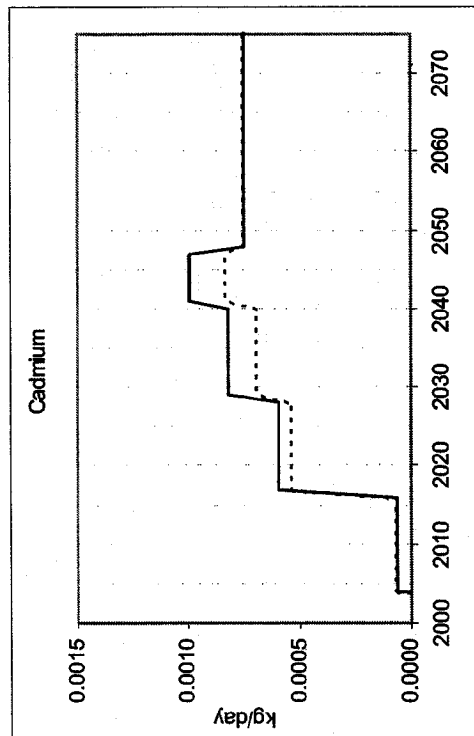
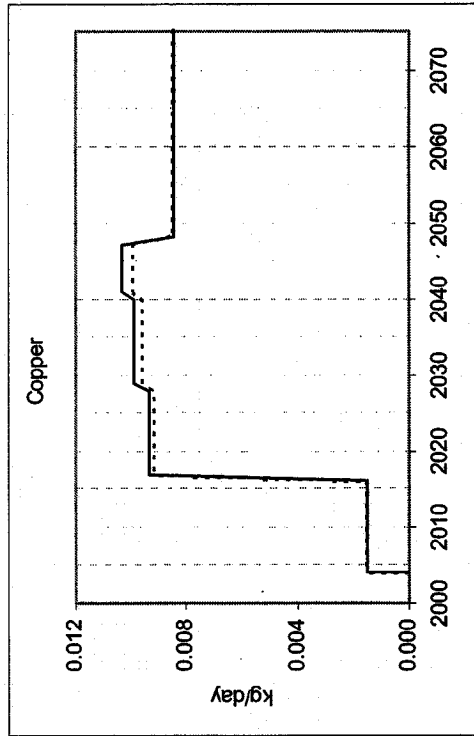
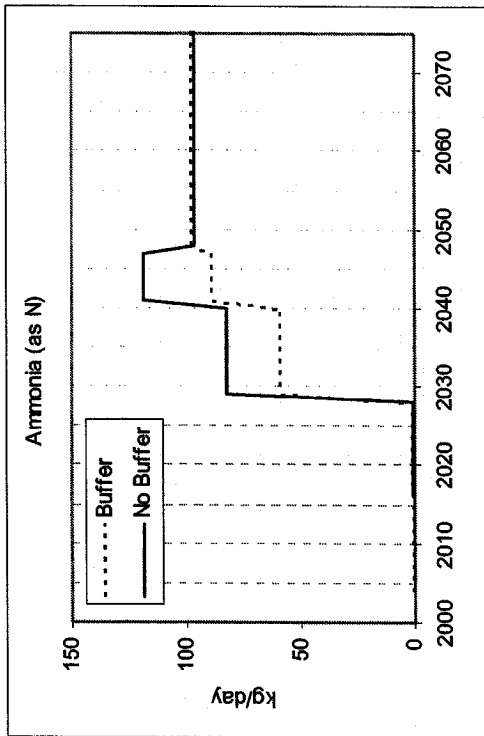
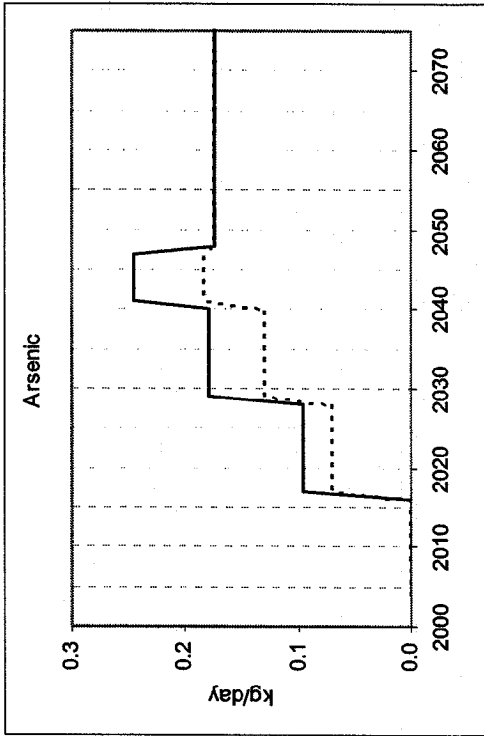


Figure 4-7. Option B – Cumulative COC Mass Loading for Emory River (Ammonia, Arsenic, Cadmium, and Copper)

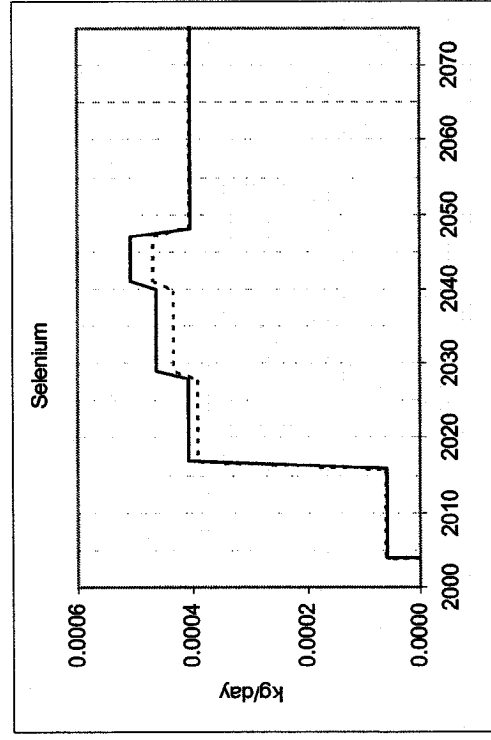
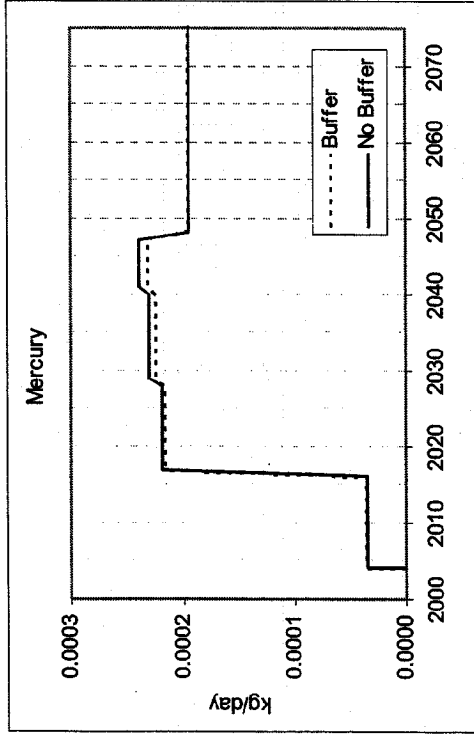
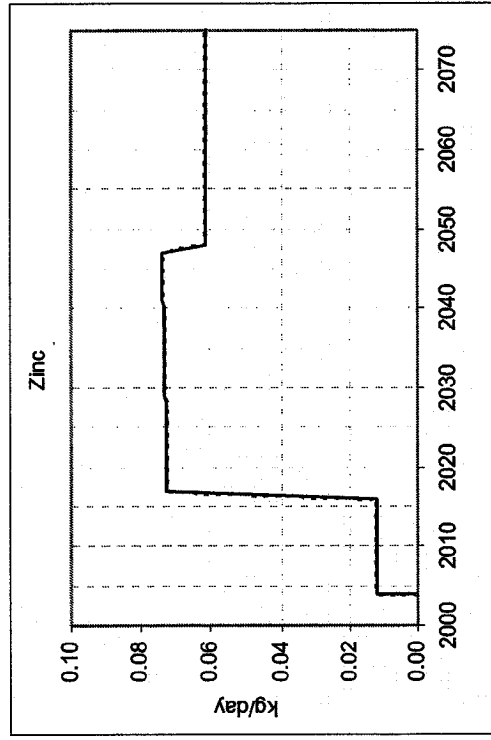
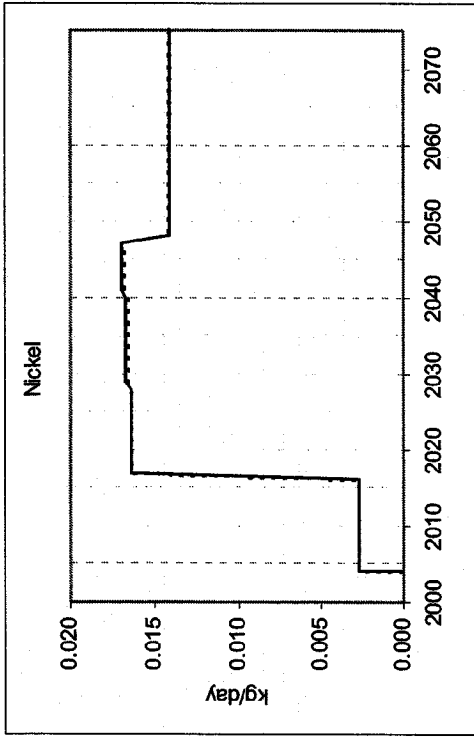


Figure 4-8. Option B – Cumulative COC Mass Loading for Emory River (Mercury, Nickel, Selenium, and Zinc)

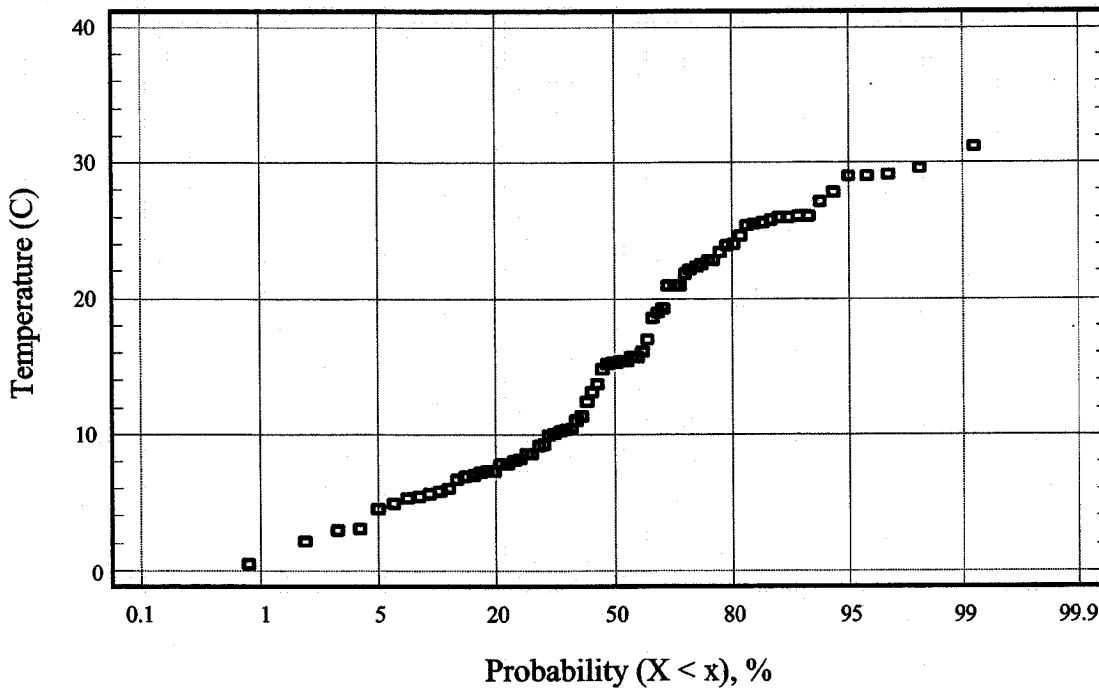
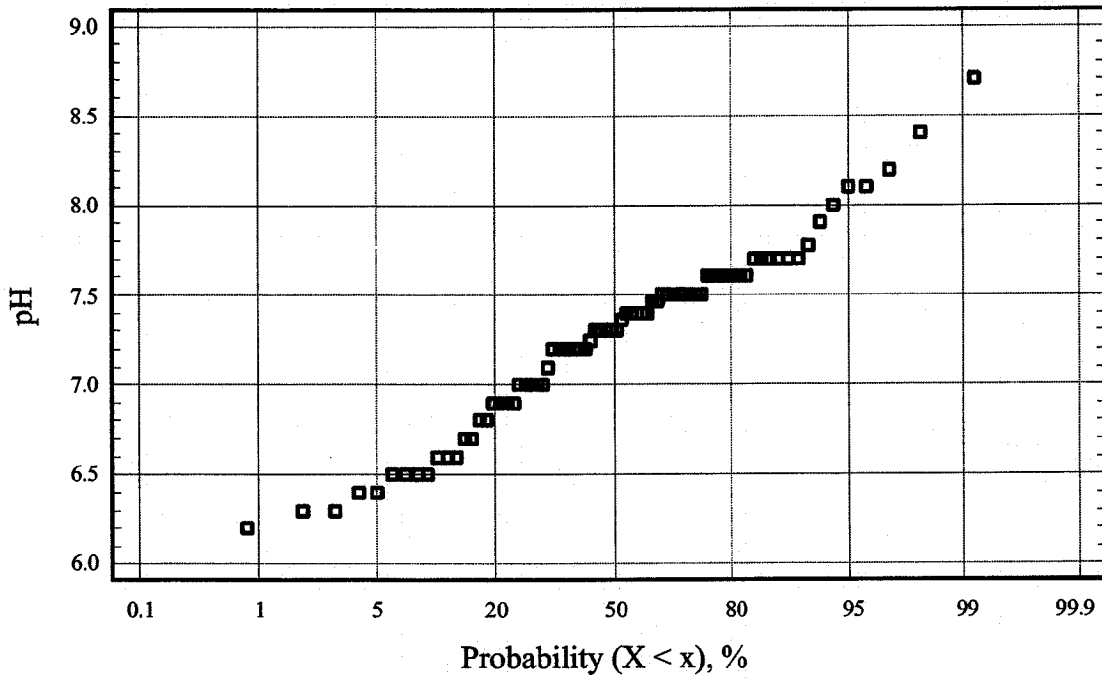


Figure 4-9. Emory River (RM 18.3) pH and Temperature Duration Data (1986-2001)

Table 4-8. Option B - Predicted Maximum Stream Loadings and In-Stream Concentrations

Constituent	MCL	CCC	Swan Pond Creek Embayment		Emory River - No Buffer Case		Emory River - Buffer Case	
			Maximum Loading (kg/day)	Maximum Concentration (mg/L)	Maximum Loading (kg/day)	Maximum Concentration (mg/L)	Maximum Loading (kg/day)	Maximum Concentration (mg/L)
Ammonia-N	10/1	(**)	4.24E-01	0.15221	1.19E+02	0.57939	9.67E+01	0.47043
Arsenic	0.05	0.15000	1.57E-03	0.00061	2.45E-01	0.00119	1.82E-01	0.00089
Cadmium	0.005	0.00021	4.25E-04	0.00016	9.95E-04	0.00000	8.26E-04	0.00000
Copper	1.3	0.00720	1.08E-02	0.00414	1.03E-02	0.00005	9.92E-03	0.00005
Mercury	0.002	0.00077	2.55E-04	0.00010	2.39E-04	0.00000	2.31E-04	0.00000
Nickel	0.1	0.04220	1.98E-02	0.00763	1.70E-02	0.00008	1.68E-02	0.00008
Selenium	0.05	0.00500	4.25E-04	0.00016	5.07E-04	0.00000	4.65E-04	0.00000
Zinc	5	0.09570	8.89E-02	0.03424	7.36E-02	0.00036	7.32E-02	0.00036

** See Table 4-6

4.6 Discussion and Conclusions

Modeling of leachate seepage from proposed CCB disposal facilities indicates that construction of an artificial 3-ft clay buffer having a hydraulic conductivity of 10^{-6} cm/s or less beneath the Phase 2 and 3 disposal areas would not provide a significant environmental benefit. During the operational phase, predicted leachate seepage rates for the no-buffer and buffer designs for Option A differed by 38% or less. Similar comparisons for Option B showed differences of 28% or less. In general, differences in seepage rates with and without the buffer are relatively small because hydraulic conductivity of the clay buffer is only an order of magnitude lower than that of CCB materials. Following facility closure, differences in seepage rates were 1% or less for both disposal options indicating essentially no long-term environmental benefit of an artificial clay buffer.

A conservative evaluation of leachate seepage effects on local stream water quality further supports the suitability of the site for the proposed disposal options without an artificial geologic buffer. Under Option A, maximum cumulative COC stream loadings predicted for the Emory River during low flow conditions would not produce in-stream concentrations exceeding the drinking water MCL or aquatic life criteria for either the buffer or no-buffer cases. Predicted COC concentrations for the Emory River low-flow condition under disposal Option B were below drinking water and aquatic life standards for all COC except ammonia. Worst-case $\text{NH}_3\text{-N}$ concentrations of 0.58 and 0.47 mg/L estimated for the no-buffer and buffer designs pose no threat to human health, but could exceed the CCC under coincident conditions of extreme pH, temperature, and low flow in the Emory River. Historical data suggest the joint probability of such an occurrence would be less than 0.3%. The potential risk associated with ammonia under Option B can be addressed by future monitoring. Periodic sampling of ash ammonia content and groundwater downgradient of the facility could be performed to assure ammonia levels remain within the limits assumed in this evaluation.

The facility poses no risk to existing or future groundwater users. There are no existing groundwater wells downgradient of the proposed facility, and there is no potential for future development of such wells. All downgradient property between the disposal site and surface water boundaries lies within plant reservation boundaries.

5. REFERENCES

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APPENDIX A

SOIL BORING LOGS

**This information taken from "Report of Geotechnical Exploration – Ash Disposal Area –
Kingston Fossil Plant, Kingston, Tennessee," MACTEC Engineering and Consulting, Inc.,
May 4, 2004.**

FIELD EXPLORATORY PROCEDURES

Soil Test Boring (Hollow Stem)

All boring and sampling operations were conducted in general accordance with ASTM D 1586. The borings were advanced by mechanically turning continuous steel hollow-stem auger flights into the ground. At regular intervals, soil samples were obtained with a standard 1.4-inch I.D., 2-inch O.D., split-tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot of penetration was recorded and is designated the "standard penetration test (SPT) resistance." Proper evaluation of the penetration resistance provides an index to the soil's strength, density, and ability to support foundations.

Representative portions of the soil samples obtained from the split-tube sampler were sealed in glass jars and transported to our laboratory for testing and further examination. Test Boring Records are attached, graphically showing the soil descriptions and penetration resistances.

Plugging and Abandonment of Boreholes

Upon completion of drilling and sampling, the geotechnical boreholes were plugged with a Type I Portland cement-bentonite grout mixture using a tremie pipe method. The borings were plugged in general accordance with the requirements specified by TVA. The borings were plugged immediately after drilling and sampling of the boreholes.

Bulk Samples

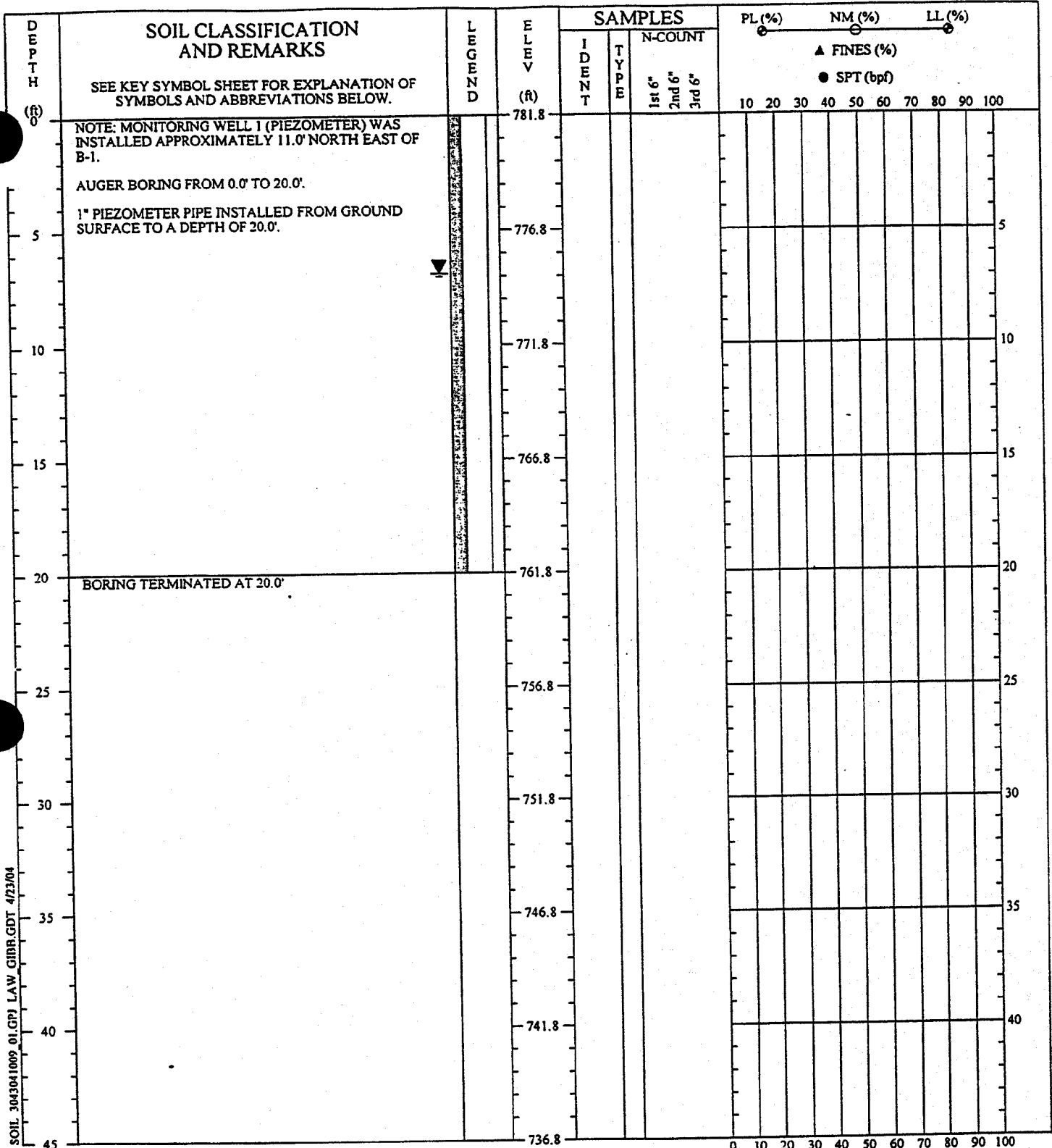
Bulk samples of several ash types obtained at various elevations were collected for testing.

Undisturbed Sampling

The relatively undisturbed soil samples were obtained by pushing a section of 3-inch O.D., 16-gauge steel tubing into the soil at the desired sampling level. The sampling procedure is described by ASTM D-1587. The tube, together with the encased soils, was carefully removed from the ground, made airtight, and transported to our laboratory.

May 4, 2004

To obtain relatively undisturbed samples of ash a 3-1/2-inch OD, 3-inch ID split spoon with liner was used. The spoon was pushed into the bottoms of the boreholes at the desired sampling depths. The ash samples, enclosed in the liners, were then sealed with a wax / motor oil mixture at both ends and then capped to minimize changes in the structure and moisture content of the samples.




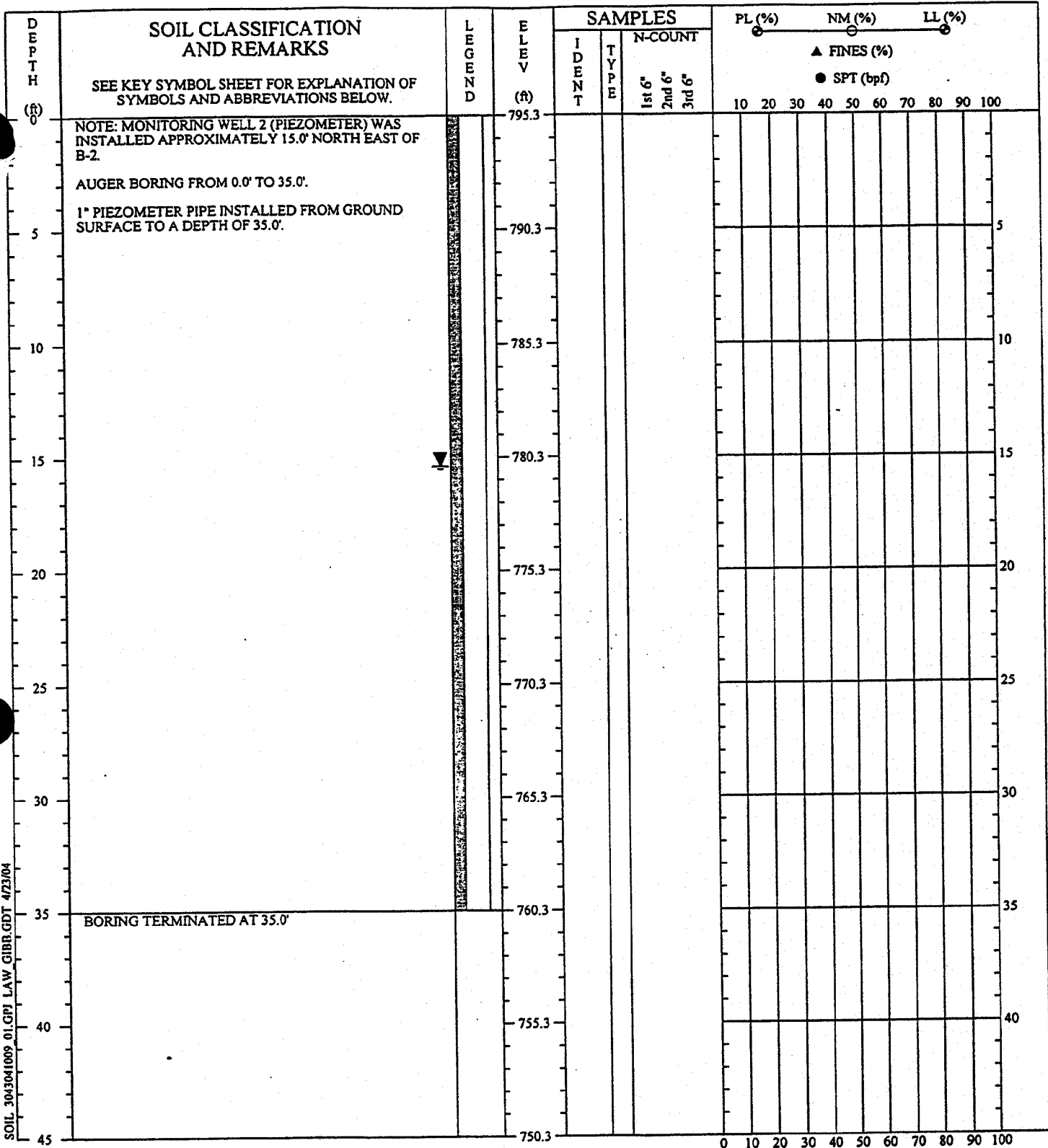
SOIL 3043041009 01.GPJ LAW CHDR.GDT 4/23/04

REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller: Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD	
PROJECT: Kingston Fossil Plant - Ash Diposal Area	
DRILLED: March 25, 2004	BORING NO.: MW-1
PROJ. NO.: 3043041009/0001	PAGE 1 OF 1
 MACTEC	




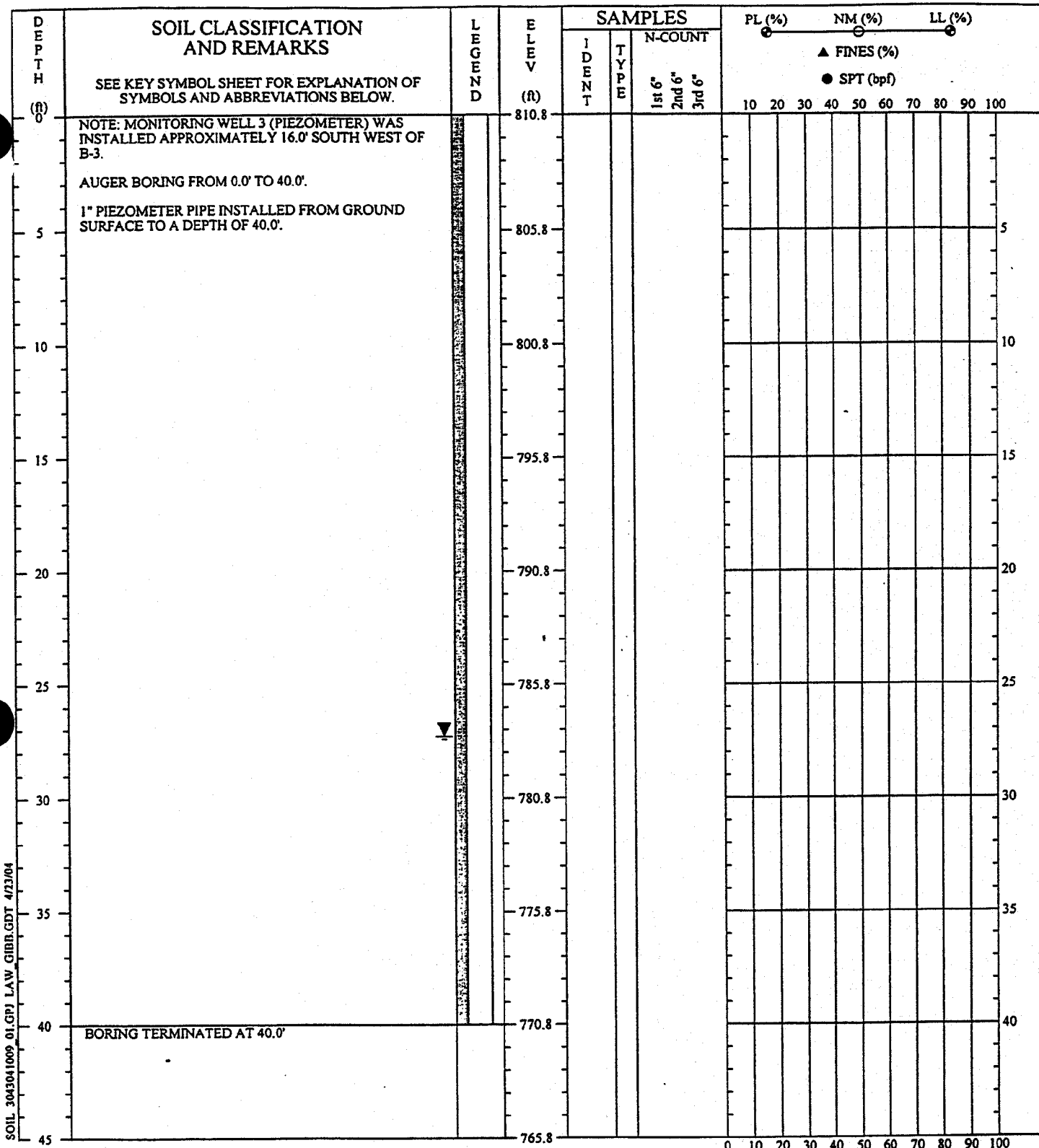
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TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD	
PROJECT: Kingston Fossil Plant - Ash Diposal Area	
DRILLED: March 25, 2004	BORING NO.: MW-2
PROJ. NO.: 3043041009/0001	PAGE 1 OF 1
 MACTEC	




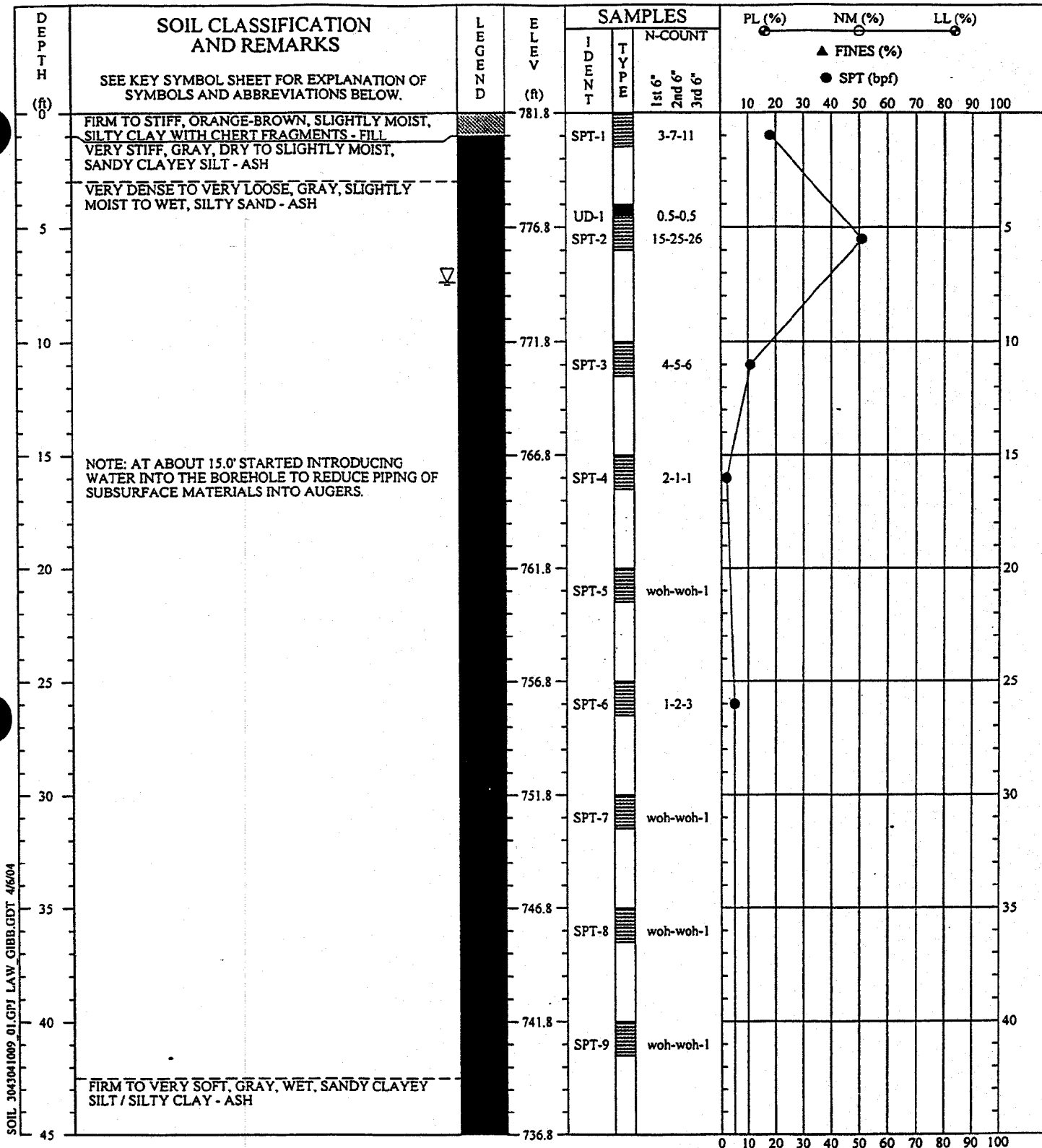
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TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD	
PROJECT: Kingston Fossil Plant - Ash Diposal Area	
DRILLED: March 25, 2004	BORING NO.: MW-3
PROJ. NO.: 3043041009/0001	PAGE 1 OF 1
 MACTEC	



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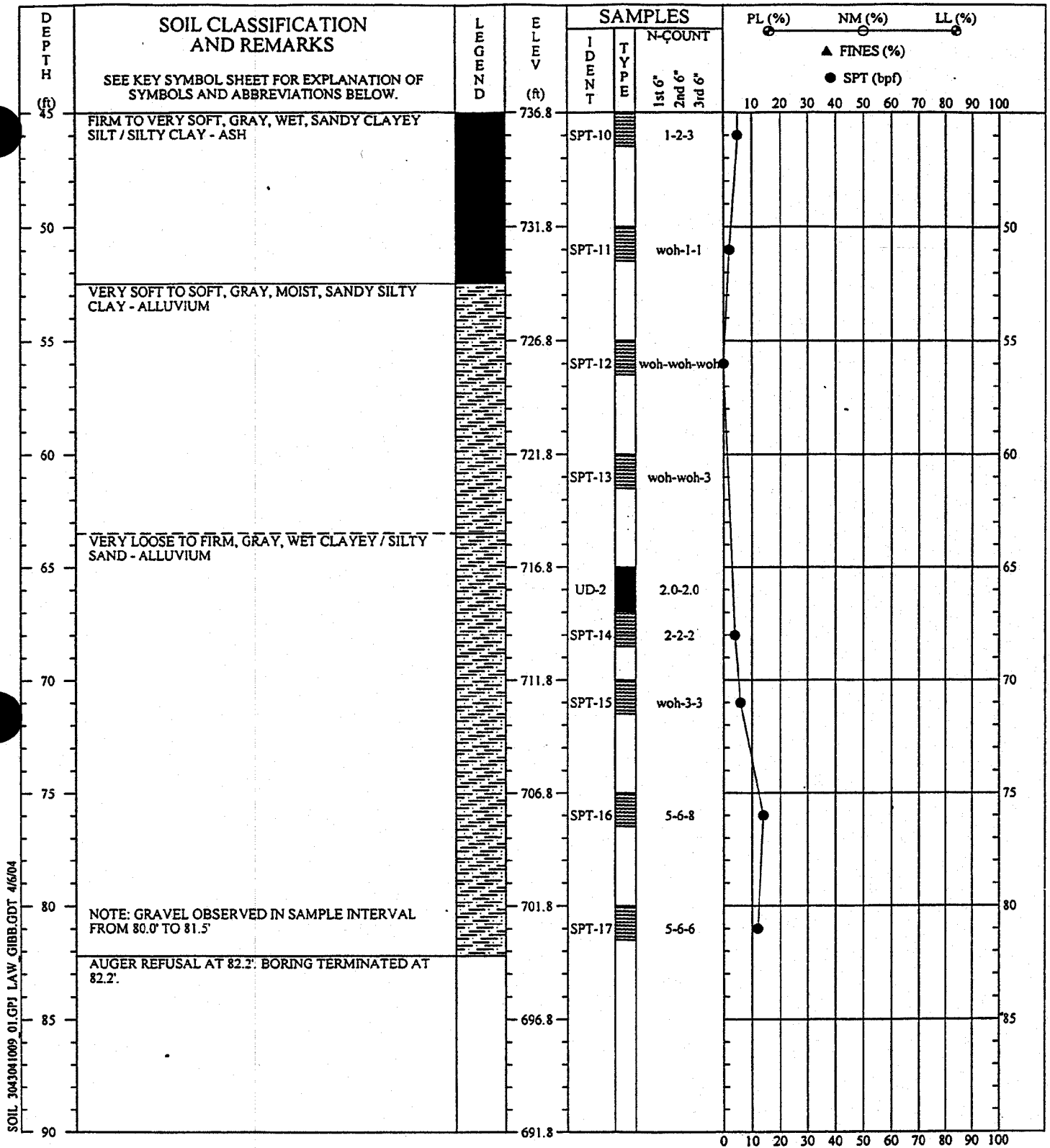
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Driller: Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD

PROJECT: TVA Kingston Ash
DRILLED: March 8, 2004
BORING NO.: B-1
PROJ. NO.: 3043041009/0001
PAGE 1 OF 2





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Driller : Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD

PROJECT: TVA Kingston Ash

DRILLED: March 8, 2004

BORING NO.: B-1

PROJ. NO.: 3043041009/0001

PAGE 2 OF 2




DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES			PL (%)	NM (%)	LL (%)								
				IDENT	TYPE	N-COUNT			▲ FINES (%)								
						1st 6"	2nd 6"	3rd 6"	● SPT (bpf)								
							10	20	30	40	50	60	70	80	90	100	
0	SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW. NOTE: B-1A WAS OFFSET APPROXIMATELY 22.0' SOUTH WEST OF B-1. AUGER BORING FROM 0.0' TO 5.0' USED FOR IN-SITU HYDRAULIC CONDUCTIVITY TESTING.		781.8														
5	BORING TERMINATED AT 5.0'		776.8														
10			771.8														
15			766.8														
20			761.8														
25			756.8														
30			751.8														
35			746.8														
40			741.8														
45			736.8														

SOIL 3043041009 01.CPJ LAW_GIBB.GDT 4/7/04

REMARKS:

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Driller : Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD	
PROJECT: TVA Kingston Ash	BORING NO.: B-1A
DRILLED: March 15, 2004	
PROJ. NO.: 3043041009/0001	PAGE 1 OF 1
 MACTEC	


DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES			PL (%)	NM (%)	LL (%)										
			IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"	● FINES (%)												
						● SPT (bpf)												
0	NOTE: B-1B WAS OFFSET APPROXIMATELY 47.0' SOUTH WEST OF B-1. AUGER BORING FROM 0.0' TO 5.0' USED FOR IN-SITU HYDRAULIC CONDUCTIVITY TESTING.	781.8																
5	BORING TERMINATED AT 5.0'	776.8																
10		771.8																
15		766.8																
20		761.8																
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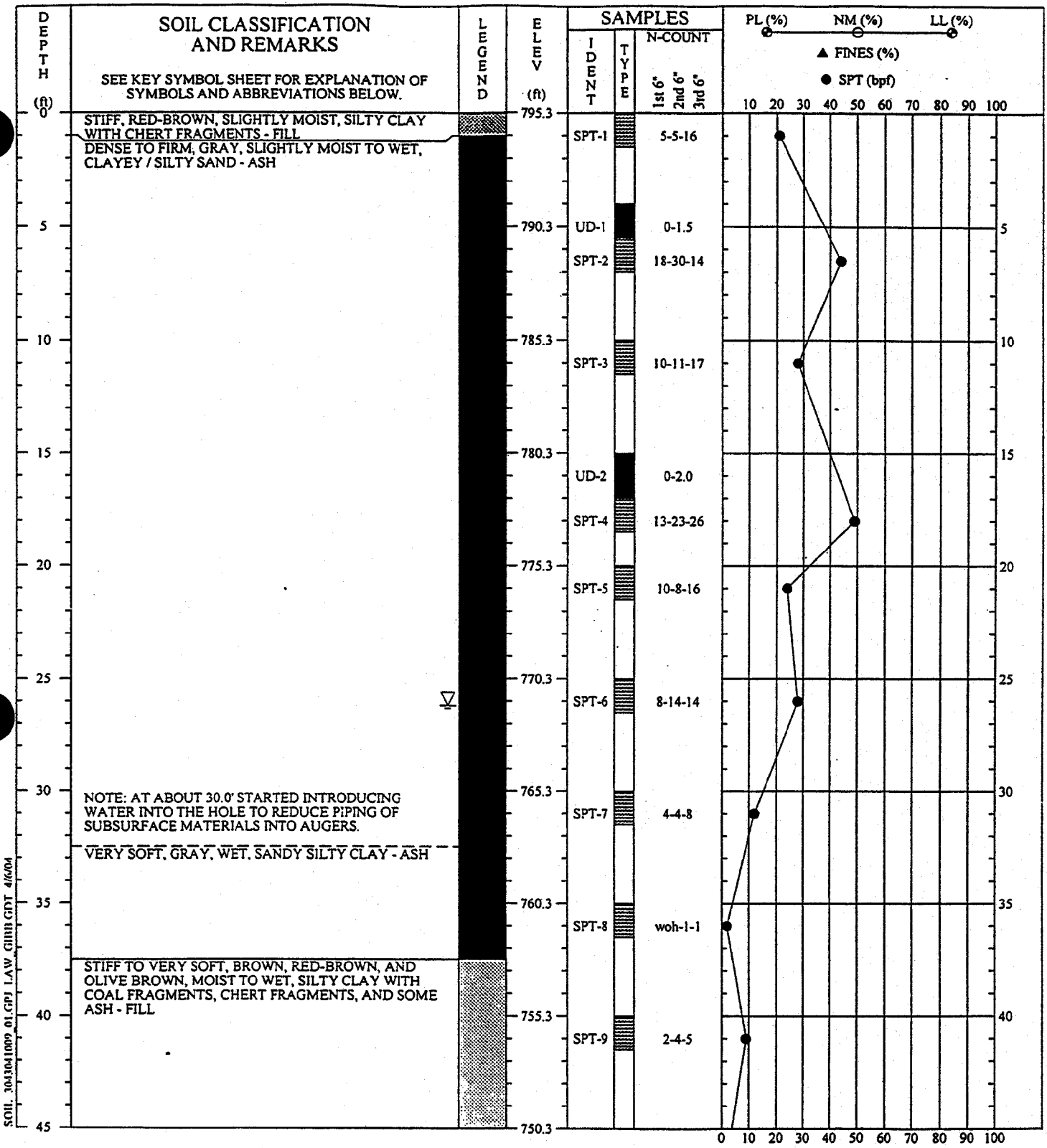
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LOCATION. SUBSURFACE CONDITIONS AT OTHER
LOCATIONS AND AT OTHER TIMES MAY DIFFER.
INTERFACES BETWEEN STRATA ARE APPROXIMATE.
TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD	
PROJECT: TVA Kingston Ash	BORING NO.: B-1B
DRILLED: March 15, 2004	PROJ. NO.: 3043041009/0001
PAGE 1 OF 1	
	




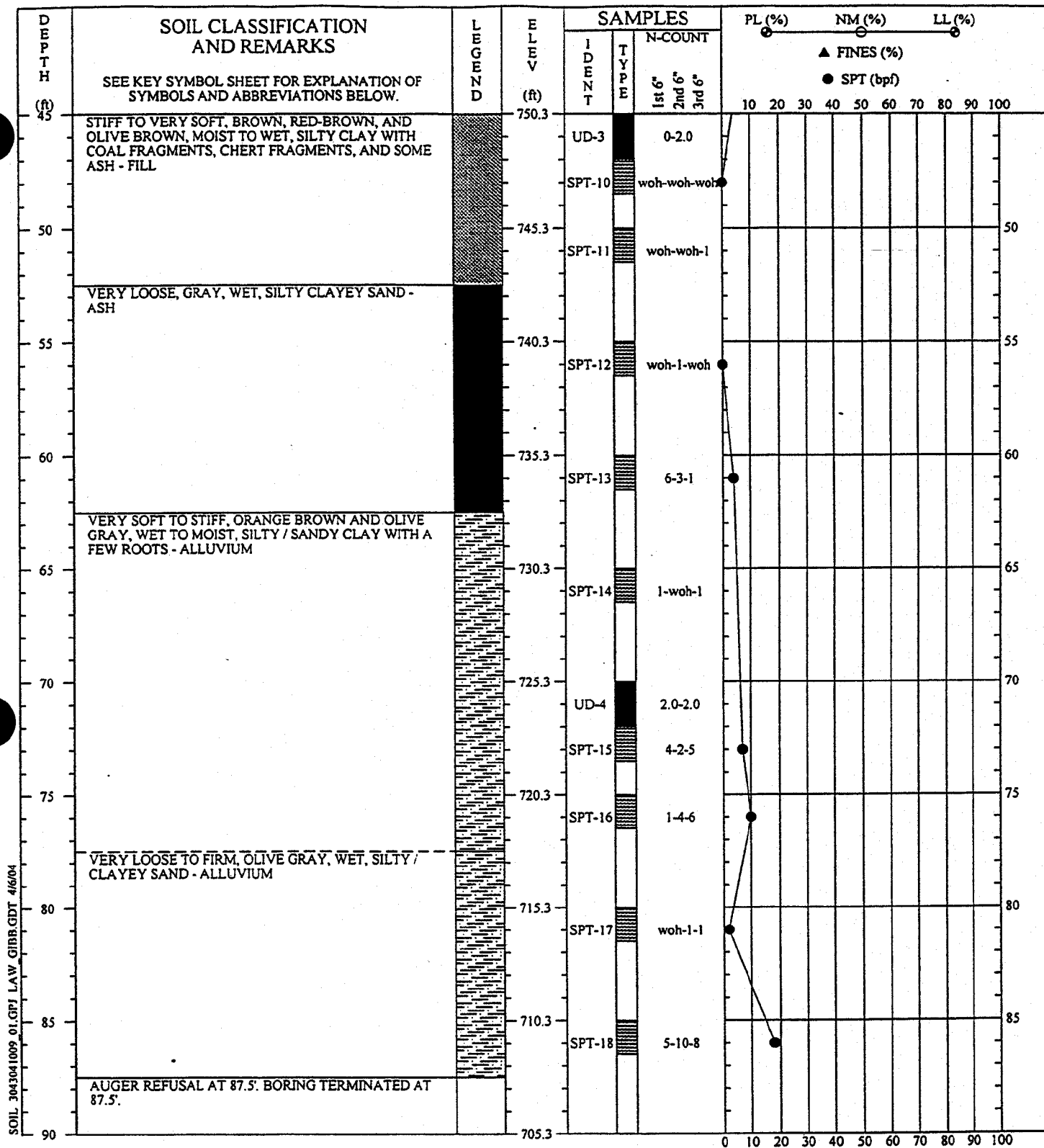
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REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

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Driller : Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD	
PROJECT: TVA Kingston Ash	BORING NO.: B-2
DRILLED: March 4, 2004	PAGE 1 OF 2
PROJ. NO.: 3043041009/0001	
	



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Driller : Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD

PROJECT: TVA Kingston Ash
DRILLED: March 4, 2004
BORING NO.: B-2
PROJ. NO.: 3043041009/0001
PAGE 2 OF 2



DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	DEPTH IN FEET	ELEV (ft)	SAMPLES			PL (%)	NM (%)	LL (%)
				IDENT	TYPE	N-COUNT	FINES (%)		
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10			785.3						
15			780.3						
20			775.3						
25			770.3						
30			765.3						
35			760.3						
40			755.3						
45			750.3						

SOIL 3043041009 01.GPJ LAW_GIBB.GDT 4/7/04

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LOCATIONS AND AT OTHER TIMES MAY DIFFER.
INTERFACES BETWEEN STRATA ARE APPROXIMATE.
TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller: Akins
Prepared By: Justice
Checked By:

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PROJECT: TVA Kingston Ash

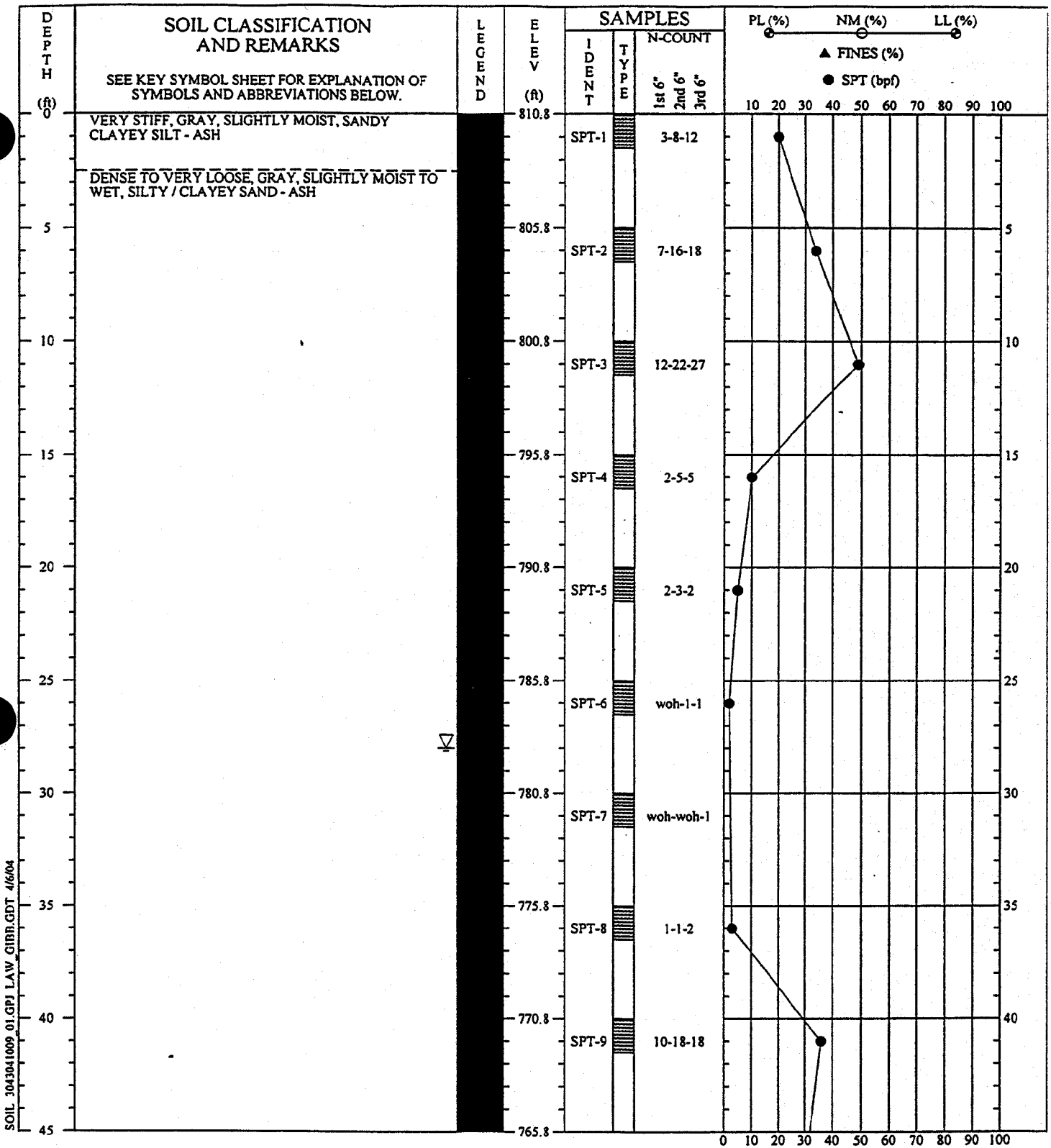
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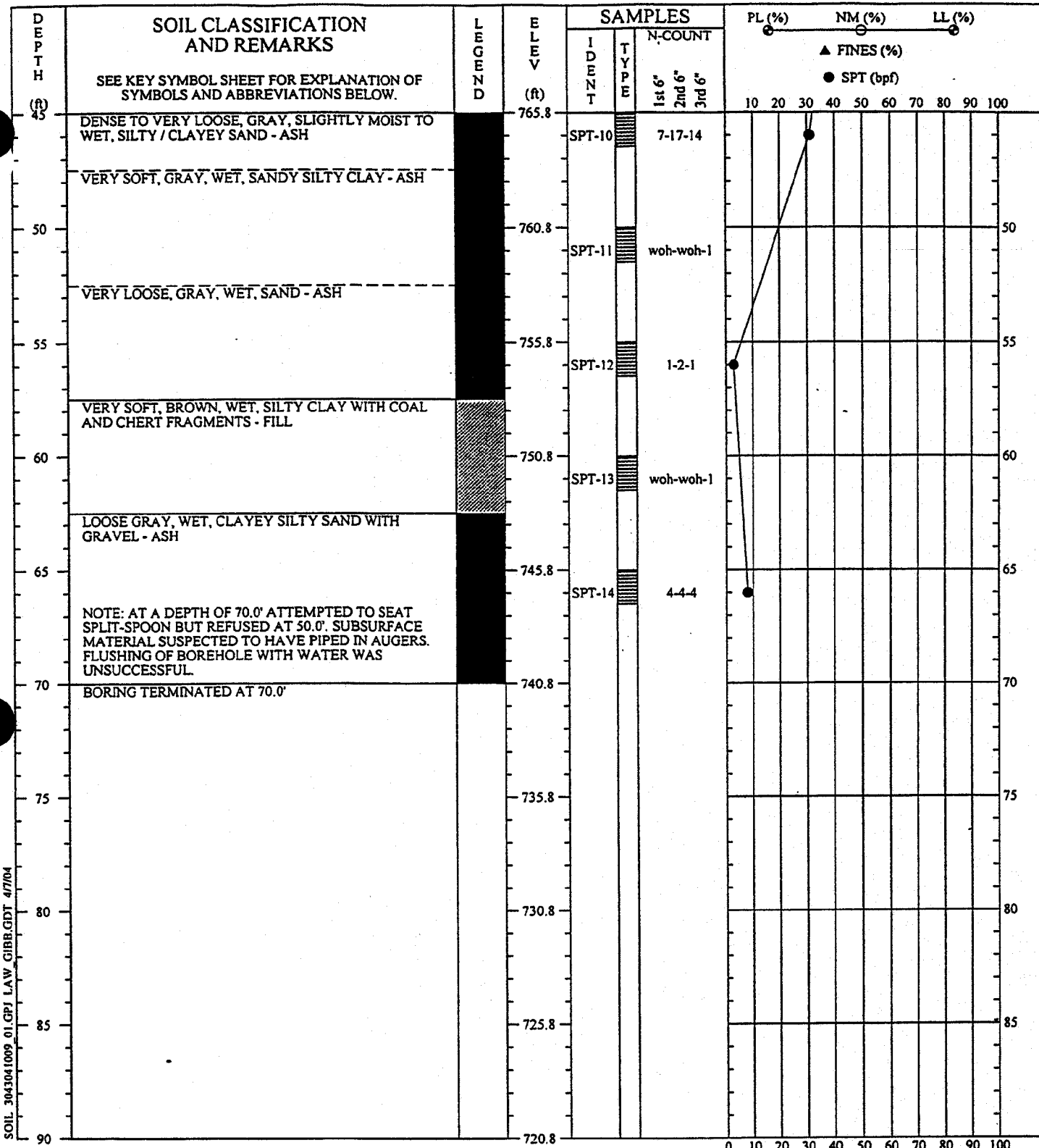
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Driller: Akins
 Prepared By: Justice
 Checked By:





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REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

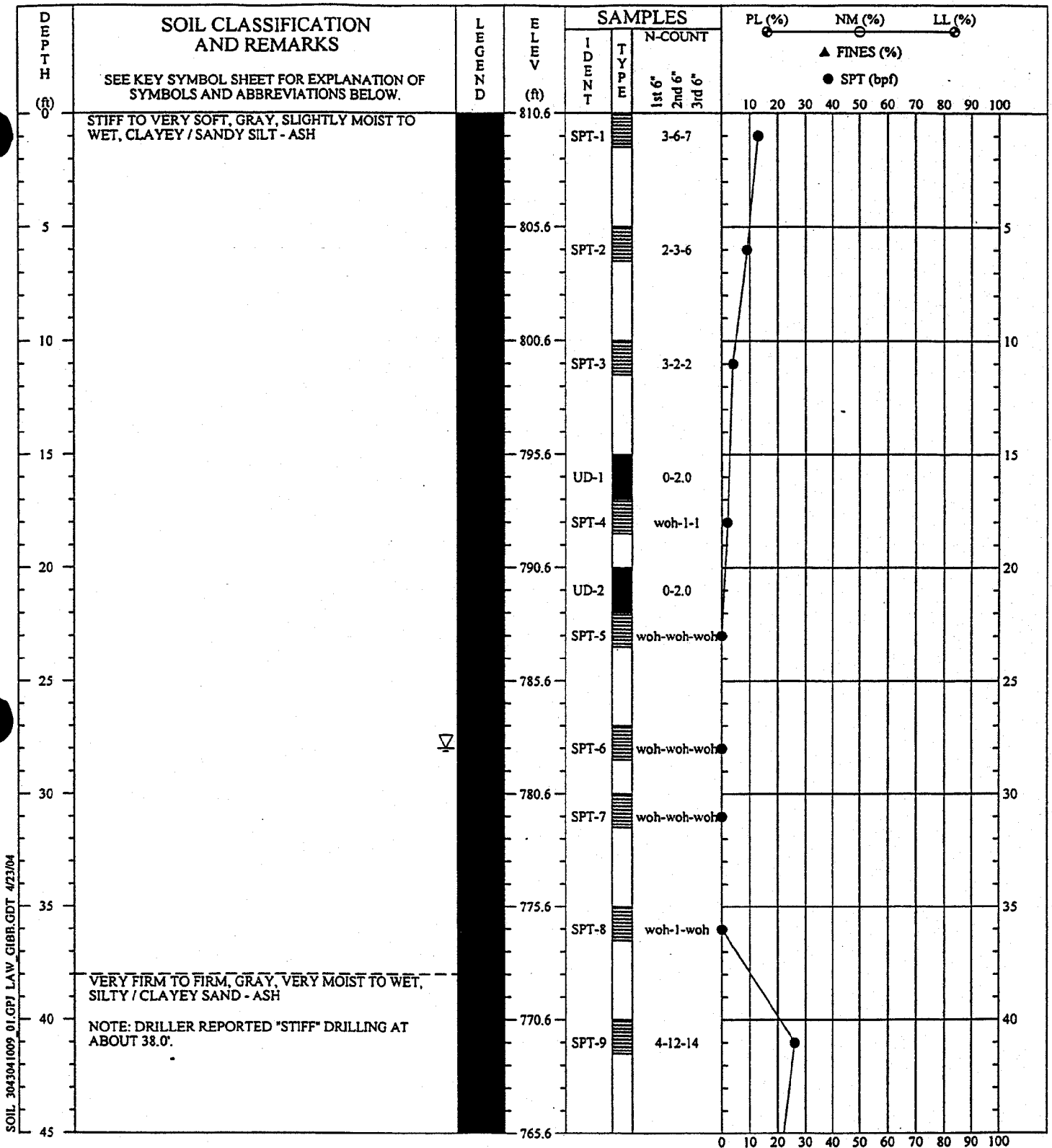
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Driller : Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD

PROJECT: TVA Kingston Ash
DRILLED: March 3, 2004 BORING NO.: B-3
PROJ. NO.: 3043041009/0001 PAGE 2 OF 2





REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

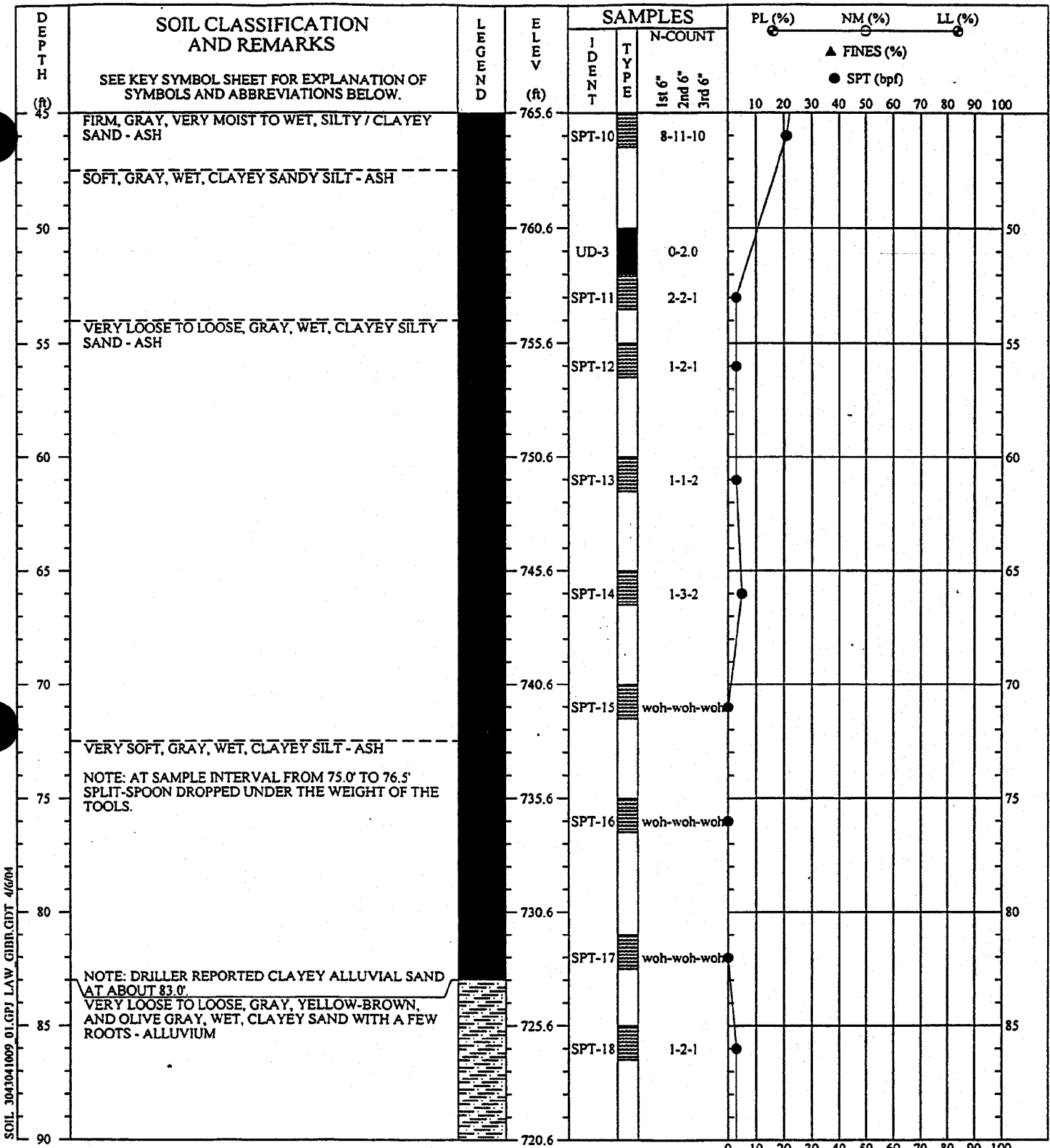
SOIL TEST BORING RECORD

PROJECT: Kingston Fossil Plant - Ash Diposal Area
 DRILLED: March 23, 2004 BORING NO.: B-4
 PROJ. NO.: 3043041009/0001 PAGE 1 OF 3

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
 Prepared By: Justice
 Checked By:





SOIL 3043041009 01.GPJ LAW GIBB.GDT 4/6/04

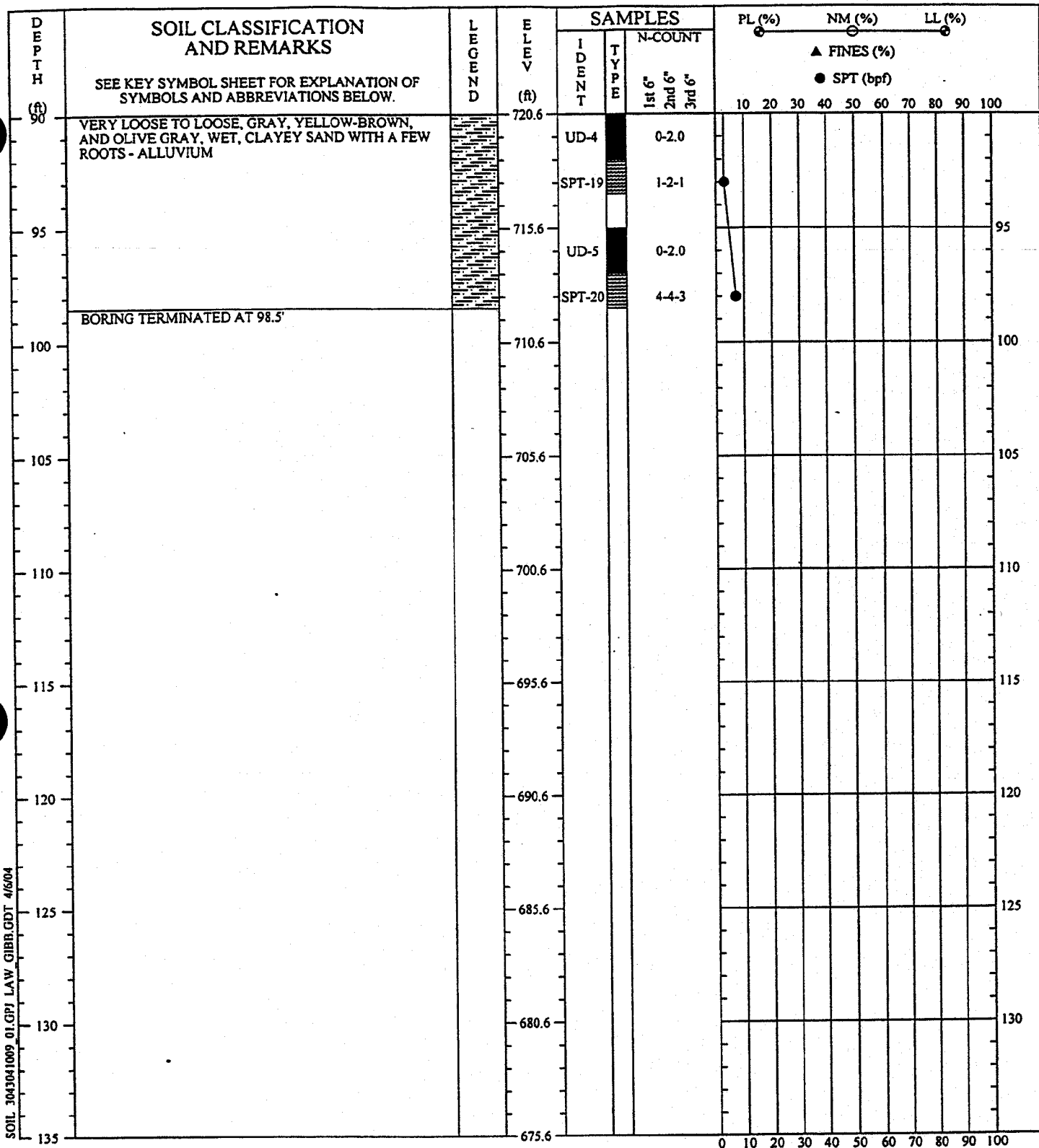
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PROJECT: TVA Kingston Ash	BORING NO.: B-4
DRILLED: March 23, 2004	
PROJ. NO.: 3043041009/0001	PAGE 2 OF 3

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By:





SOIL 3043041009 01.GPJ LAW QIBR.GDT 4/6/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

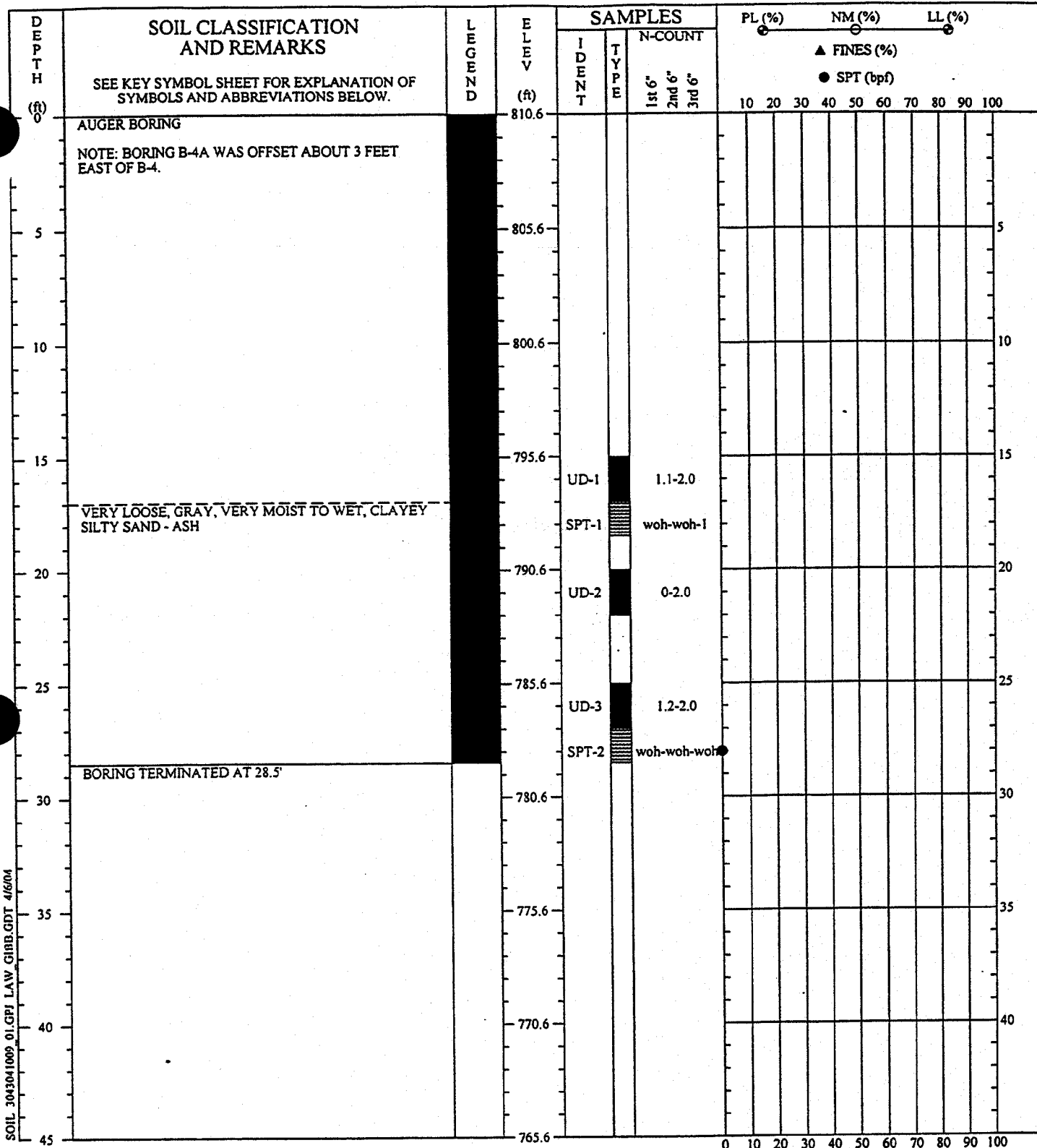
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Driller : Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD

PROJECT: TVA Kingston Ash
 DRILLED: March 23, 2004
 BORING NO.: B-4
 PROJ. NO.: 3043041009/0001
 PAGE 3 OF 3






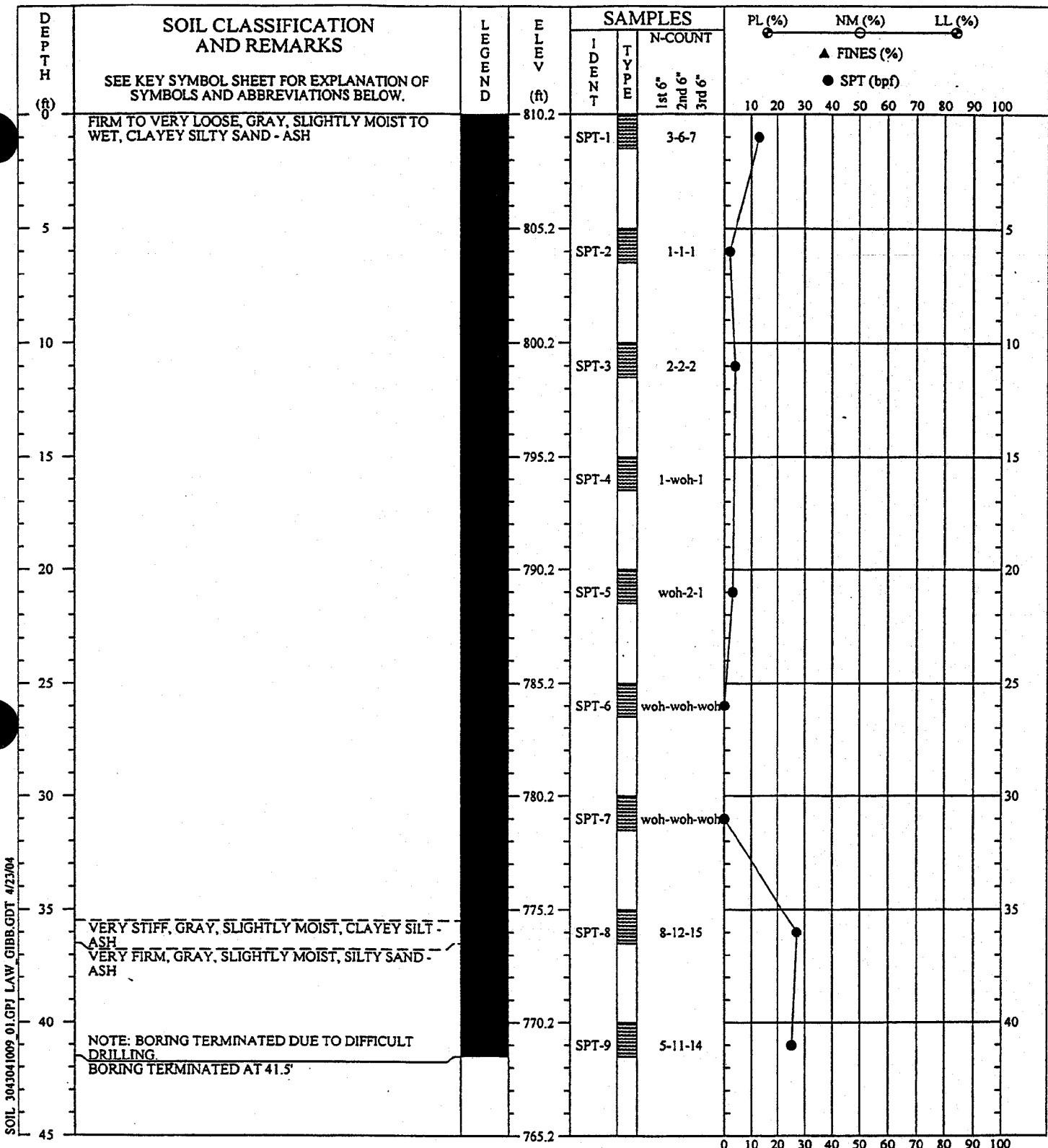
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REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.


Driller : Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD	
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DRILLED: March 24, 2004	
PROJ. NO.: 3043041009/0001	PAGE 1 OF 1
 MACTEC	



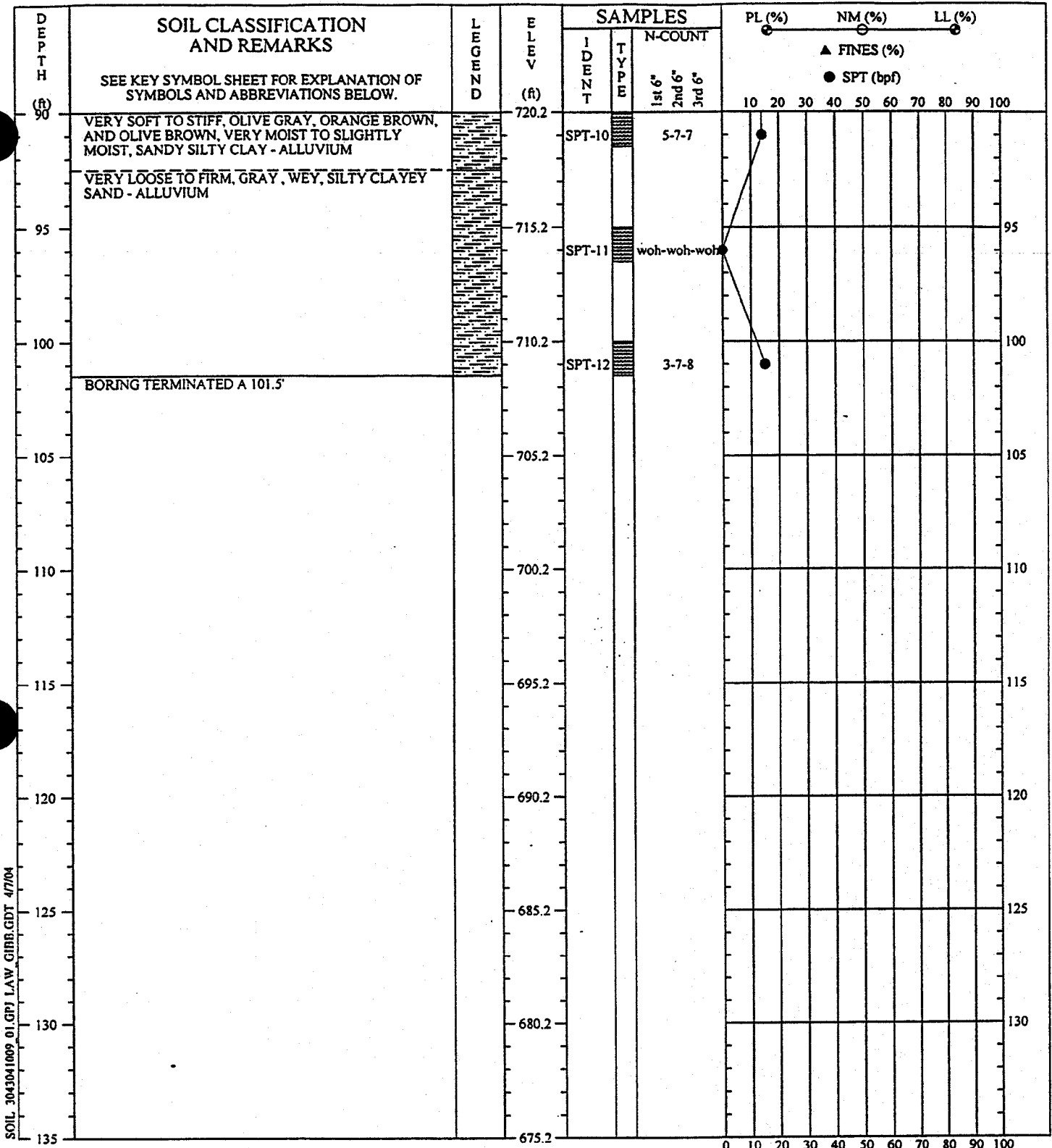
SOIL 3043041009 01.GPJ LAW.GIBB.GDT 4/23/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION.

SOIL TEST BORING RECORD	
PROJECT: Kingston Fossil Plant - Ash Diposal Area	
DRILLED: March 1, 2004	BORING NO.: B-5
PROJ. NO.: 3043041009/0001	PAGE 1 OF 1
	

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By:



SOIL. 3043041009.01.GPJ L.A.W. GIBB.GDT 4/7/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

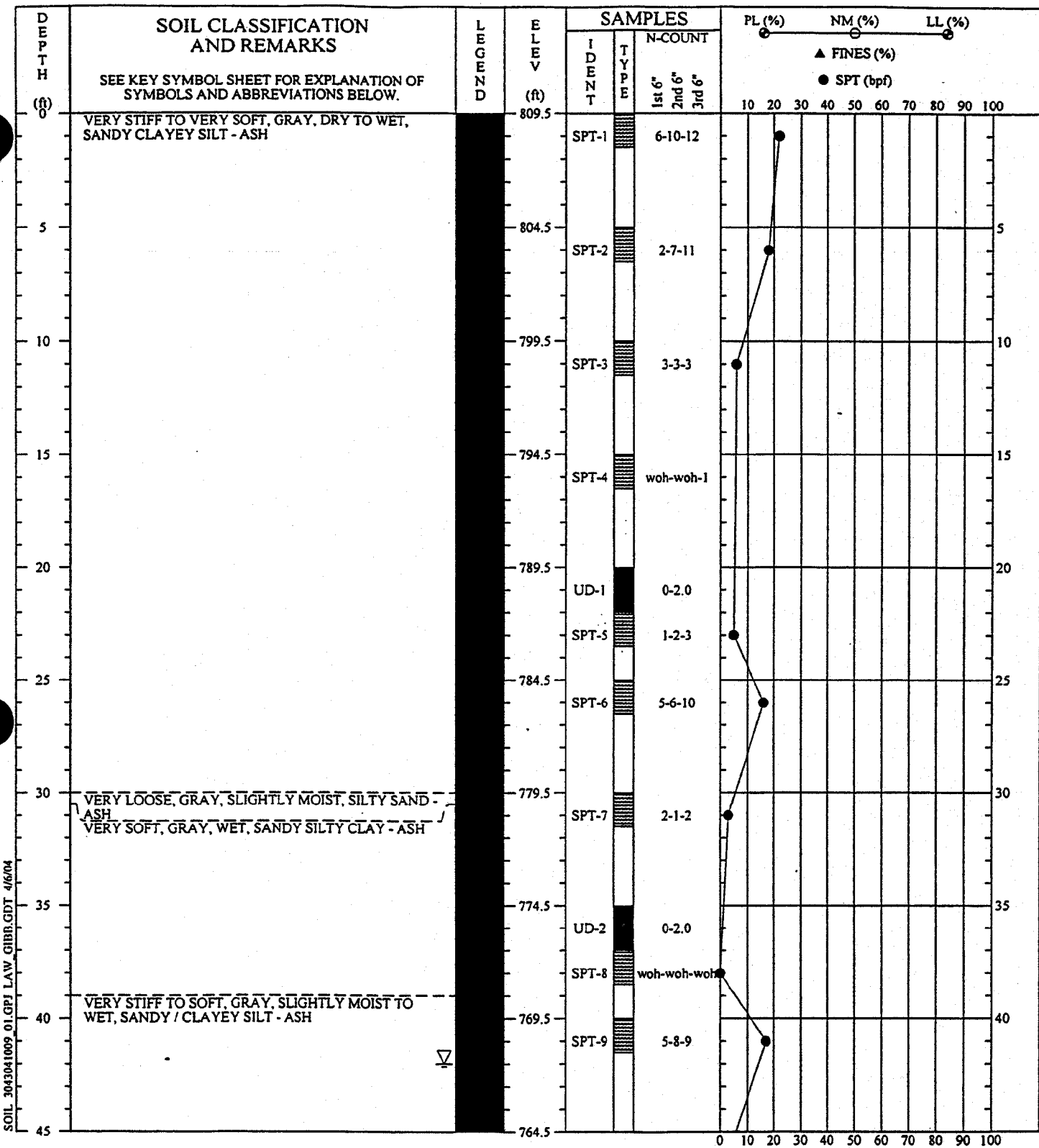
SOIL TEST BORING RECORD

PROJECT: TVA Kingston Ash
 DRILLED: March 2, 2004 BORING NO.: B-5A
 PROJ. NO.: 3043041009/0001 PAGE 3 OF 3

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
 Prepared By: Justice
 Checked By:





SOIL 3043041009_01.GPJ LAW_GIBB.GDT 4/6/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

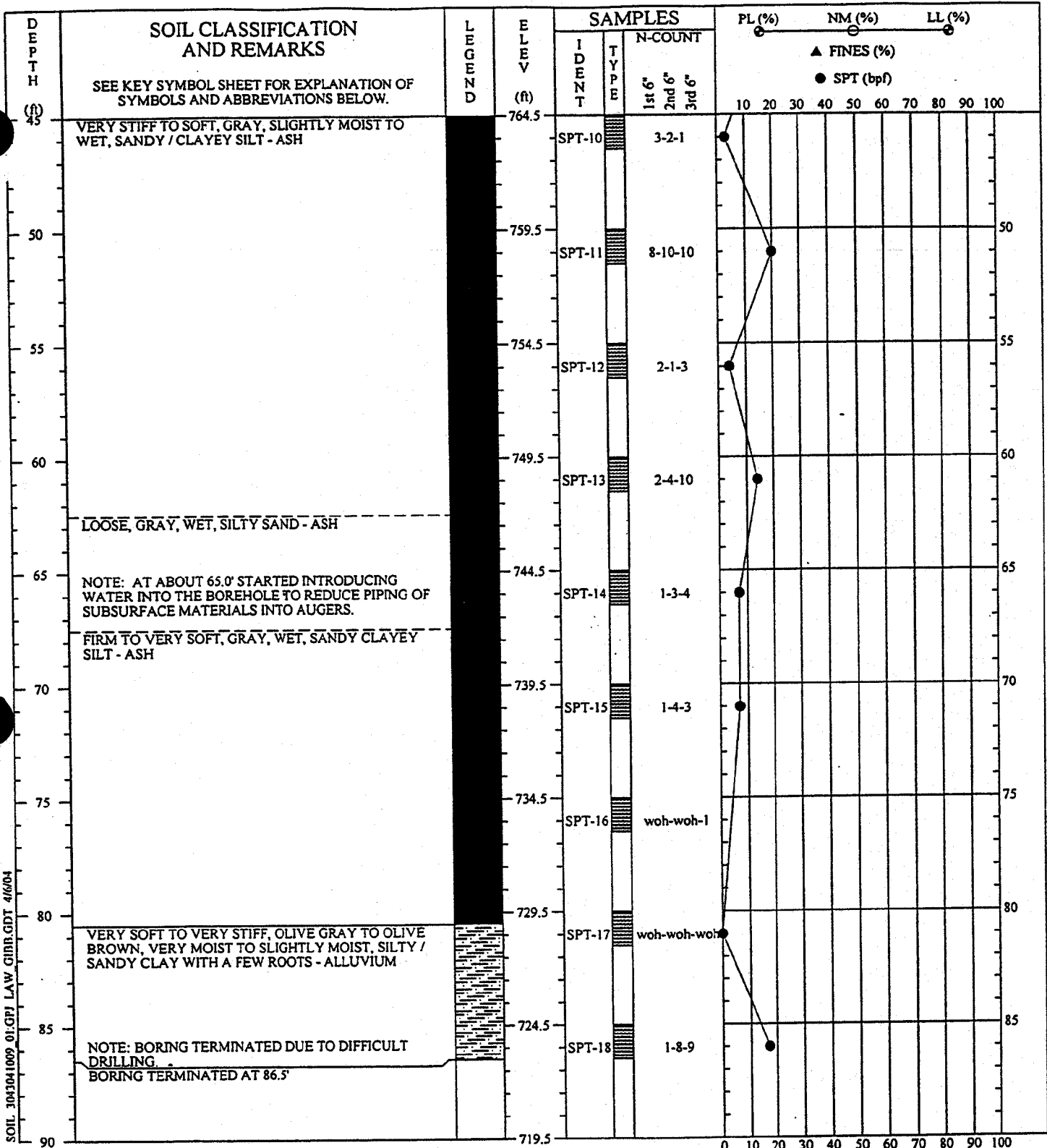
SOIL TEST BORING RECORD

PROJECT: TVA Kingston Ash
 DRILLED: March 10, 2004 BORING NO.: B-6
 PROJ. NO.: 3043041009/0001 PAGE 1 OF 2

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
 Prepared By: Justice
 Checked By:





SOIL 3043041009 01.GPJ LAW GIBB.GDT 4/6/04

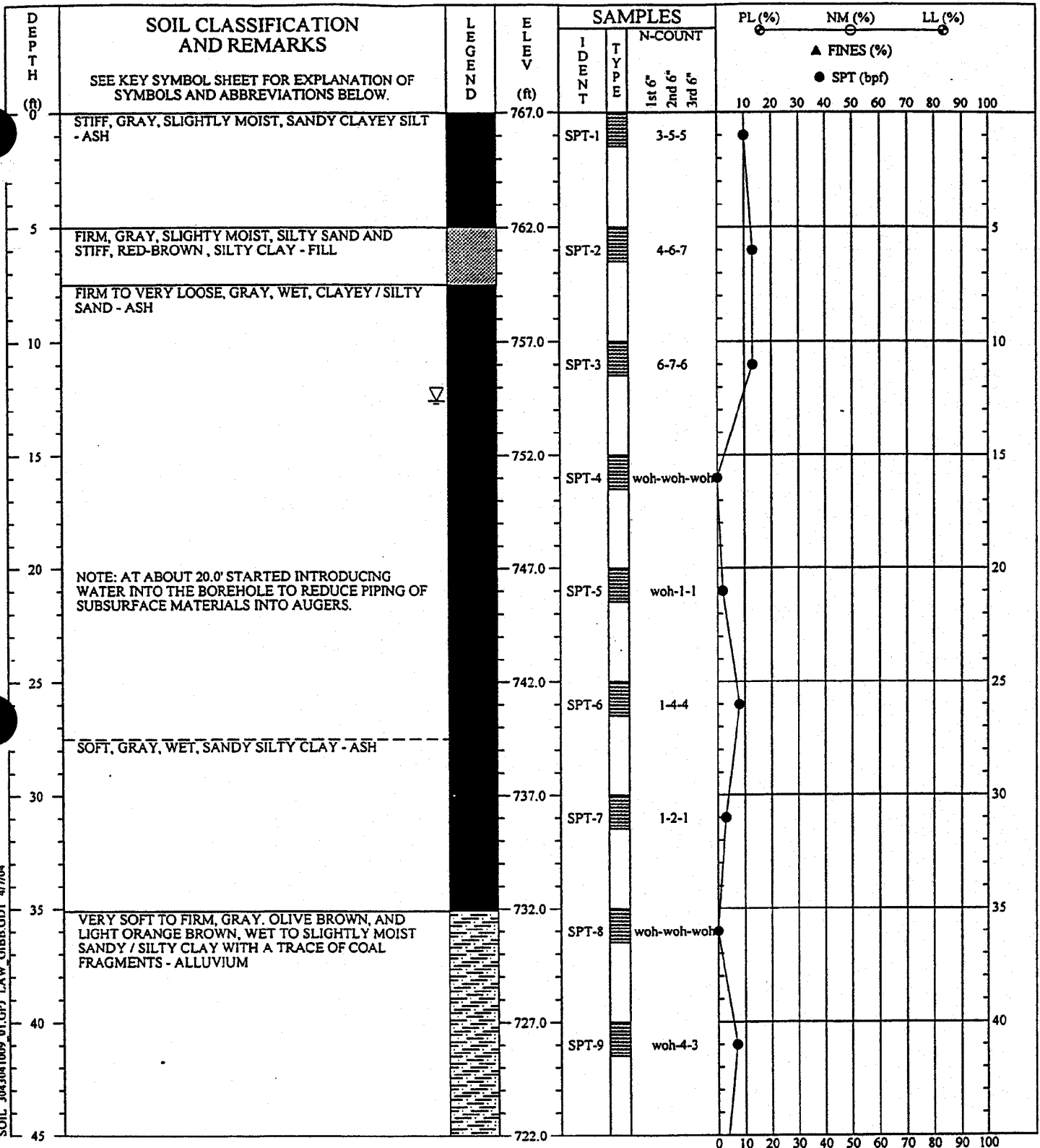
REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

SOIL TEST BORING RECORD	
PROJECT: TVA Kingston Ash	BORING NO.: B-6
DRILLED: March 10, 2004	
PROJ. NO.: 3043041009/0001	PAGE 2 OF 2

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By:





SOIL 3043041009 01.GPJ LAW GIBB.GDT 4/7/04

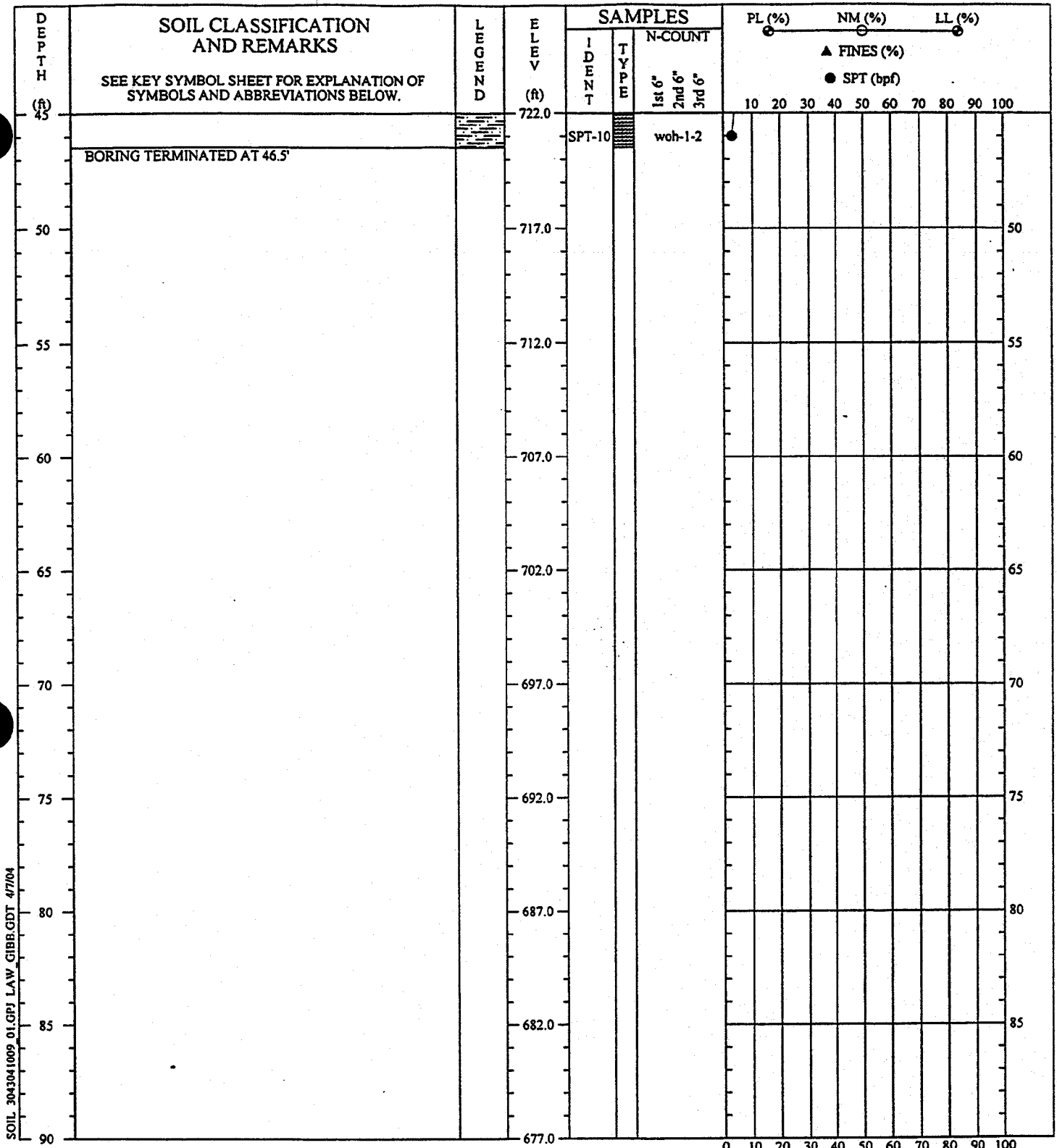
REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD	
PROJECT: TVA Kingston Ash	BORING NO.: B-7
DRILLED: March 11, 2004	
PROJ. NO.: 3043041009/0001	PAGE 1 OF 2





SOIL 3043041009_01.GPJ LAW GIBB.GDT 4/7/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

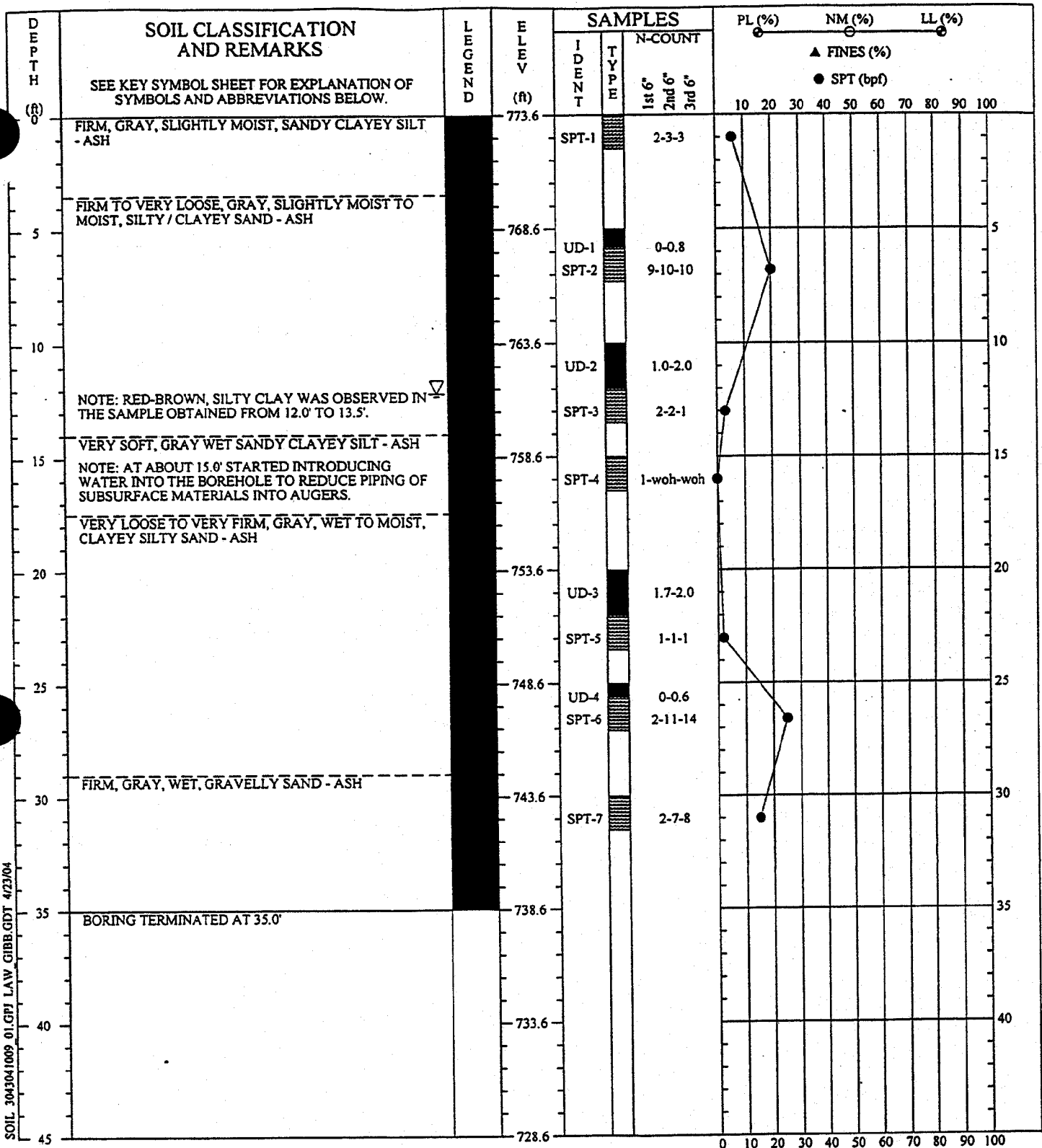
SOIL TEST BORING RECORD

PROJECT: TVA Kingston Ash
 DRILLED: March 11, 2004 BORING NO.: B-7
 PROJ. NO.: 3043041009/0001 PAGE 2 OF 2

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
 Prepared By: Justice
 Checked By:





SOIL 3043041009 01.GPJ LAW_GIBB.GDT 4/23/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

SOIL TEST BORING RECORD

PROJECT: Kingston Fossil Plant - Ash Diposal Area

DRILLED: March 19, 2004

BORING NO.: B-8

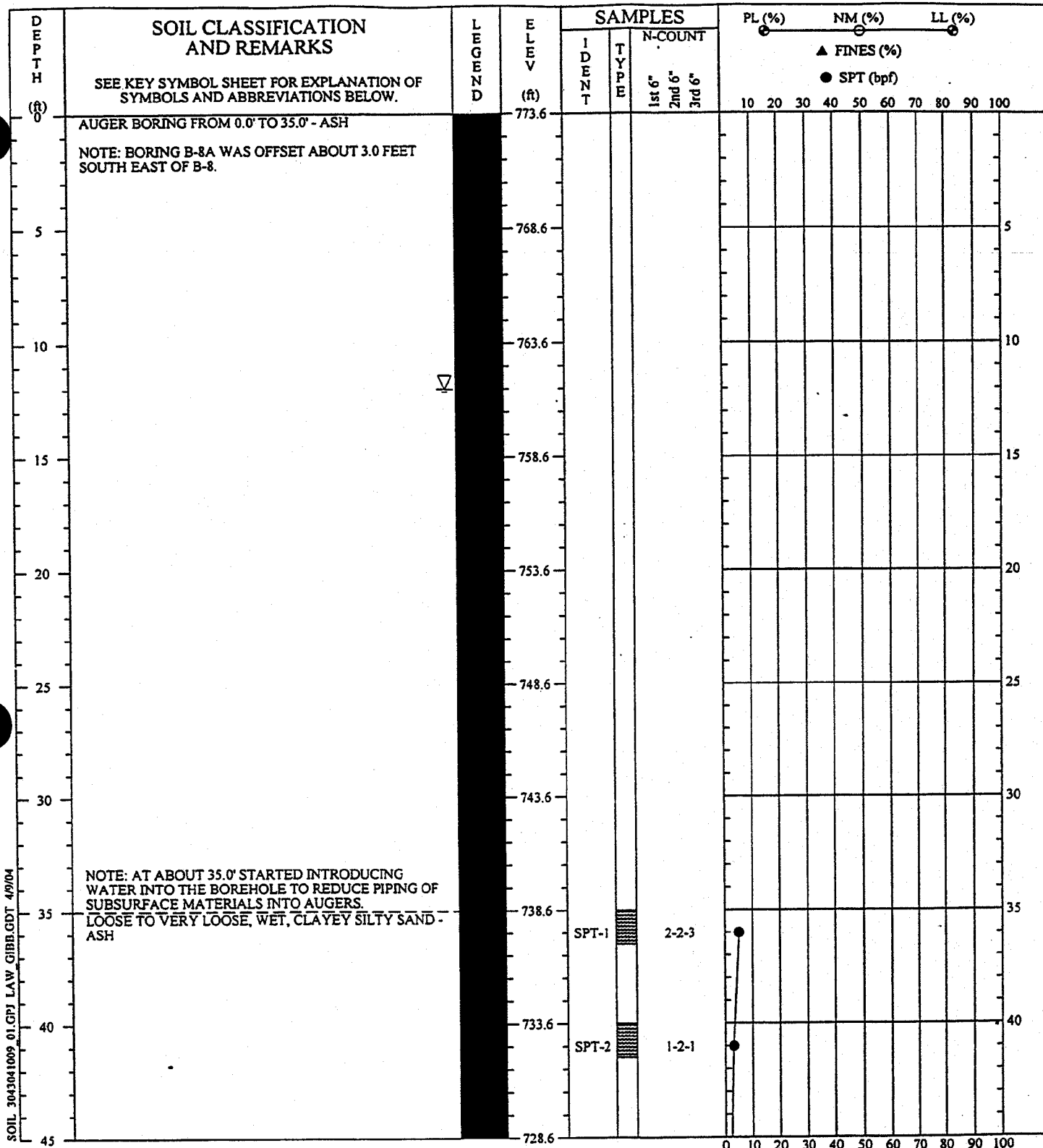
PROJ. NO.: 3043041009/0001

PAGE 1 OF 1

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By:






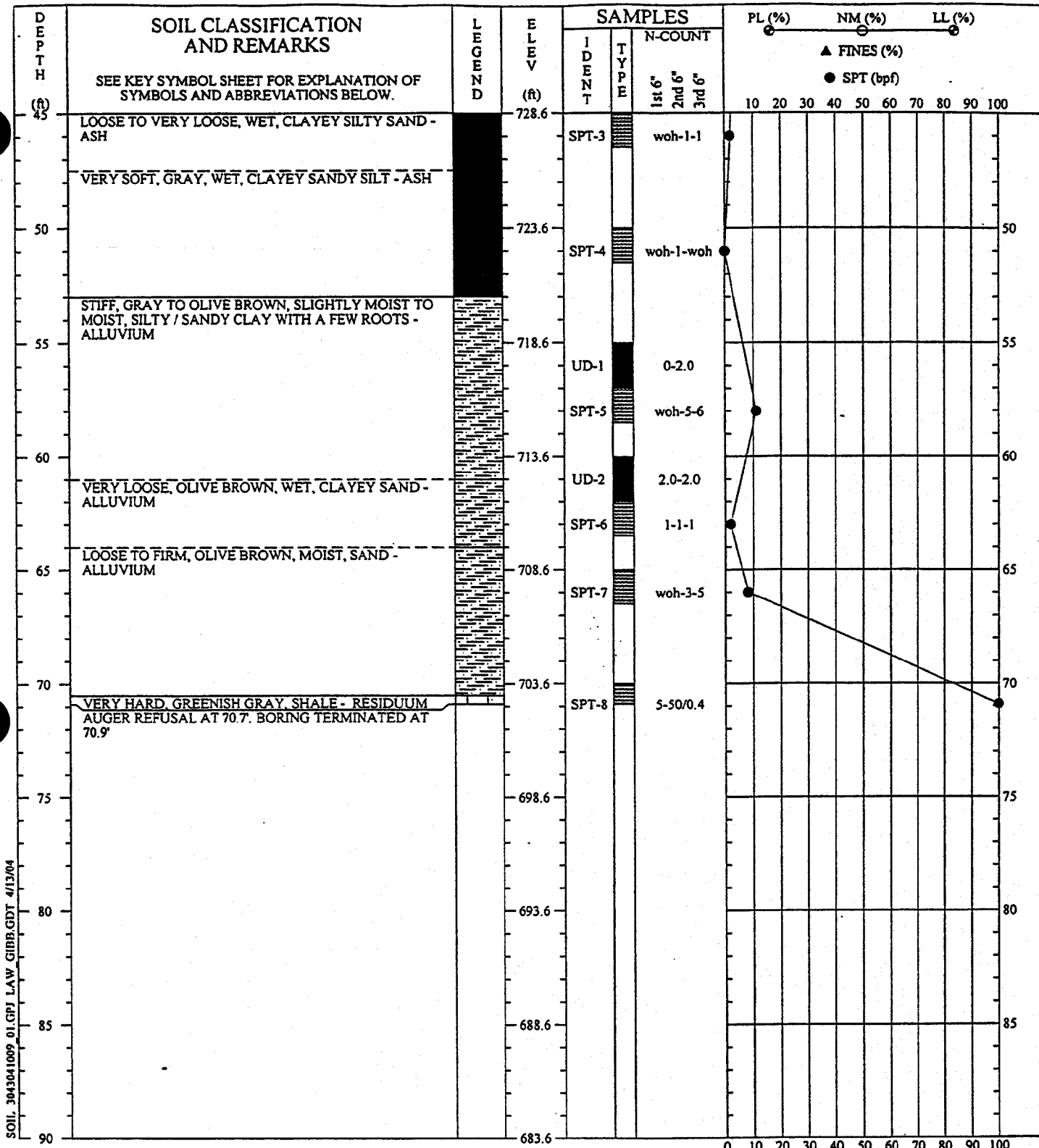
SOIL 3043041009 01.CPJ LAW GIBB.GDT 4/9/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

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Driller: Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD	
PROJECT: TVA Kingston Ash	BORING NO.: B-8A
DRILLED: March 22, 2004	PAGE 1 OF 2
PROJ. NO.: 3043041009/0001	
	



SOIL 3043041009 01.GPJ LAW GIBB.GDT 4/13/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

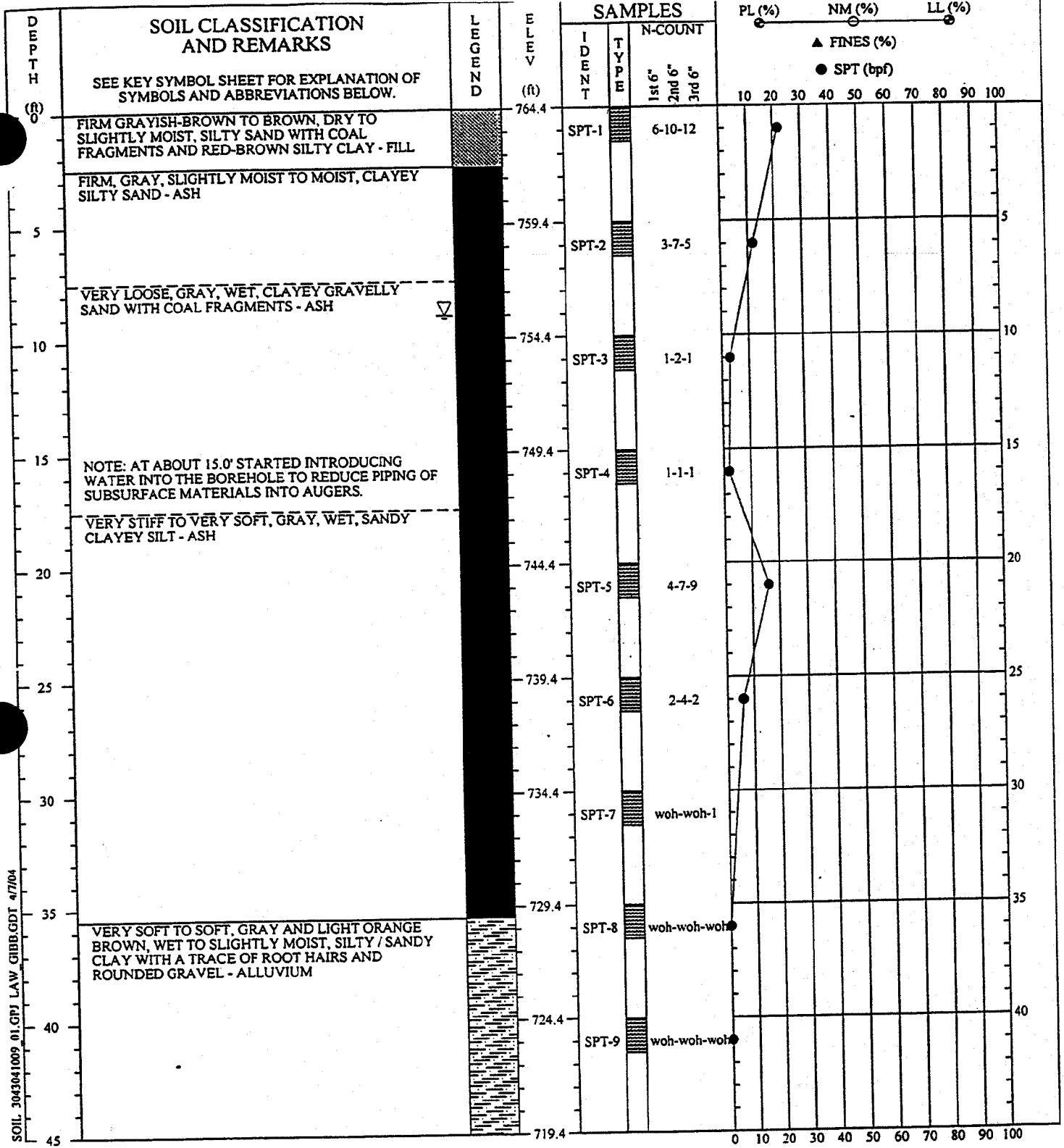
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD

PROJECT: TVA Kingston Ash
DRILLED: March 22, 2004 BORING NO.: B-8A
PROJ. NO.: 3043041009/0001 PAGE 2 OF 2





SOIL 3043041009 01.CPJ LAW GBB.GDT 4/7/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

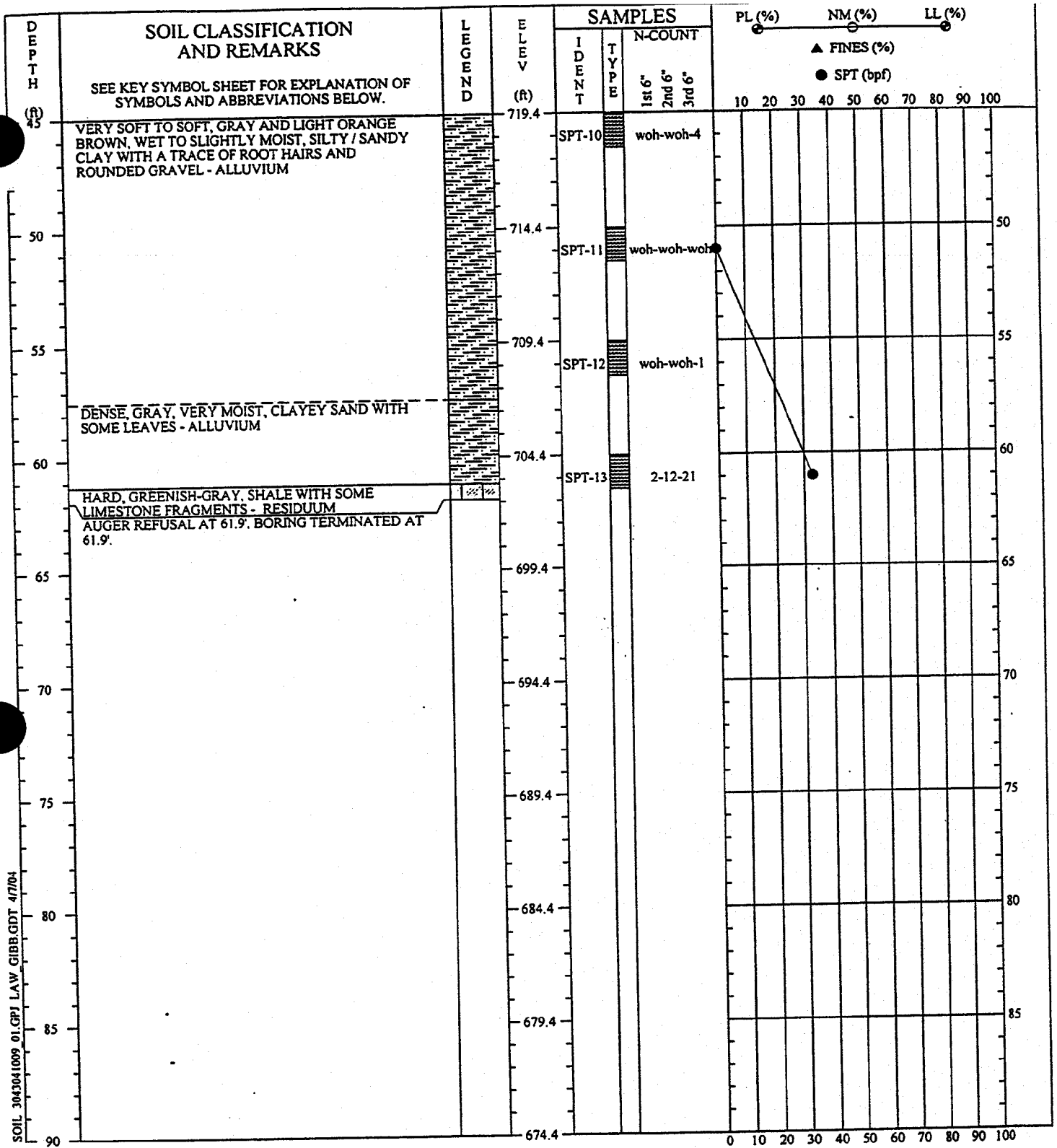
SOIL TEST BORING RECORD

PROJECT: TVA Kingston Ash
 DRILLED: March 12, 2004
 BORING NO.: B-9
 PROJ. NO.: 3043041009/0001
 PAGE 1 OF 2

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
 Prepared By: Justice
 Checked By:





SOIL 3043041009 01.GPJ LAW GIBB.CDDT 4/7/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

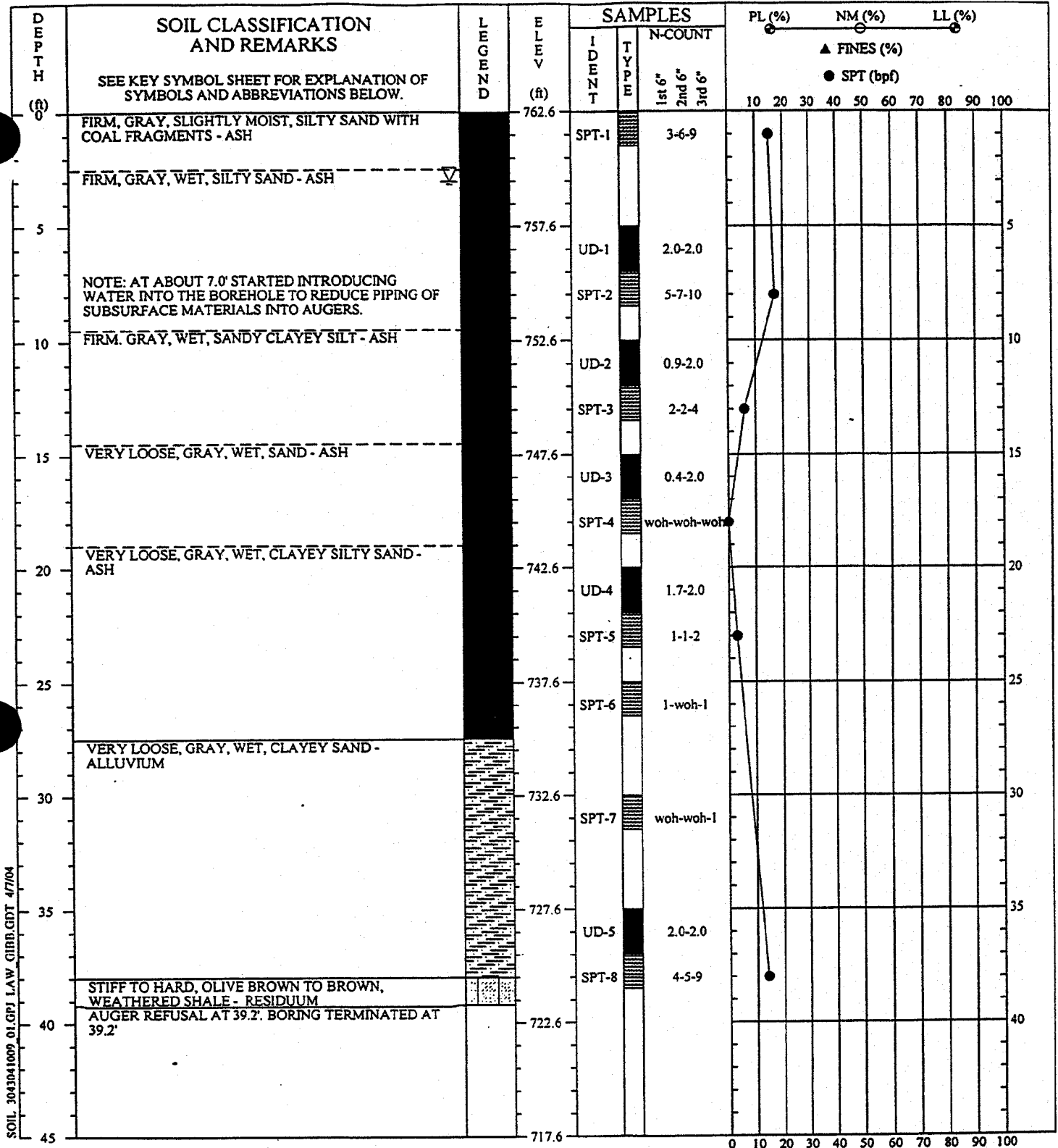
SOIL TEST BORING RECORD

PROJECT: TVA Kingston Ash
DRILLED: March 12, 2004
PROJ. NO.: 3043041009/0001
BORING NO.: B-9
PAGE 2 OF 2

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.


Driller : Akins
 Prepared By: Justice
 Checked By:





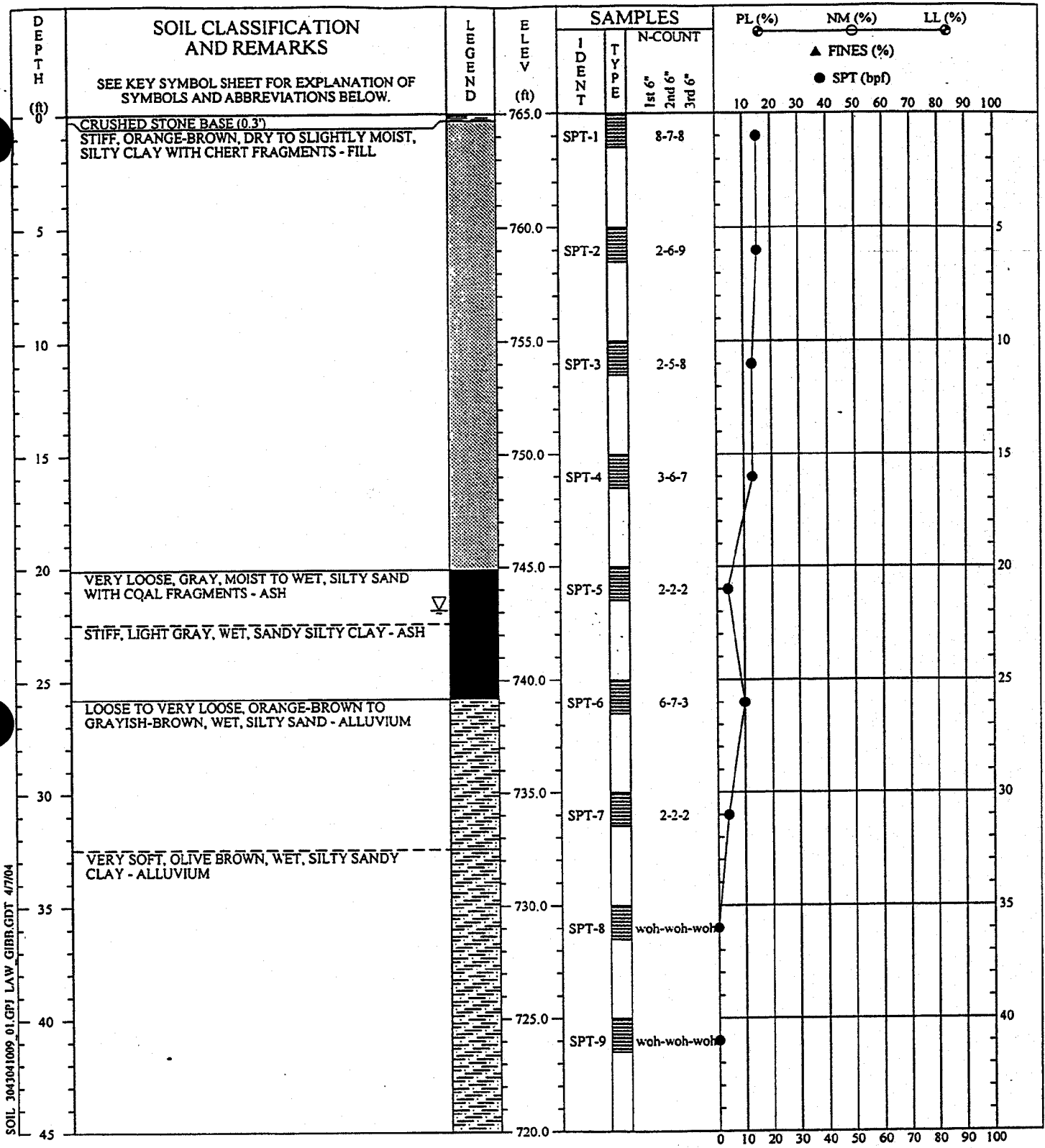
SOIL 3043041009_01.GPJ LAW GIBB.GDT 4/7/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

SOIL TEST BORING RECORD	
PROJECT: TVA Kingston Ash	BORING NO.: B-10
DRILLED: March 18, 2004	
PROJ. NO.: 3043041009/0001	PAGE 1 OF 1
	

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By:



SOIL 3043041009 01.GPJ LAW GIBB.GDT 4/7/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

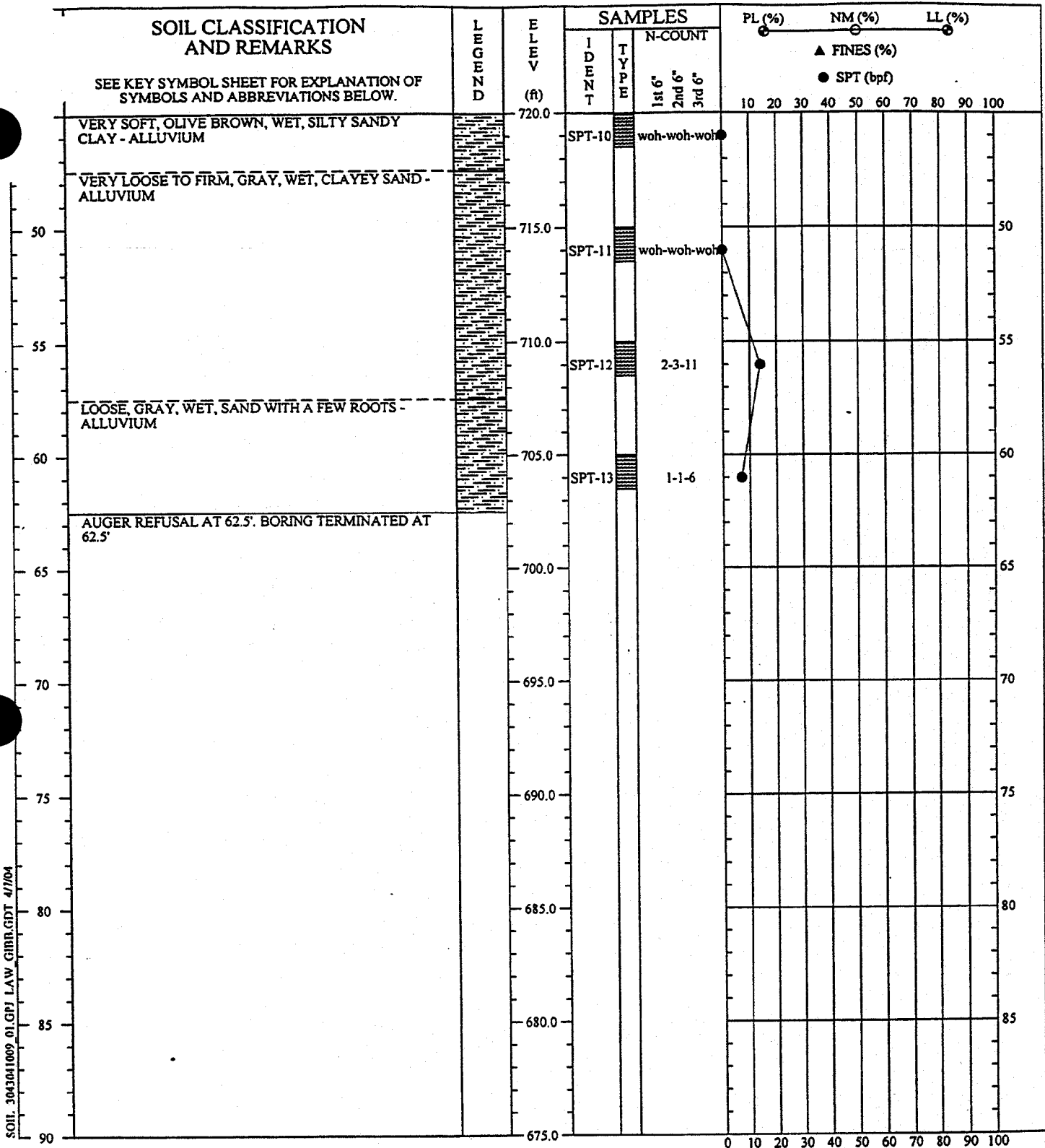
SOIL TEST BORING RECORD

PROJECT: TVA Kingston Ash
 DRILLED: March 15, 2004 BORING NO.: B-11
 PROJ. NO.: 3043041009/0001 PAGE 1 OF 2

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
 Prepared By: Justice
 Checked By:





REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller: Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD

PROJECT: TVA Kingston Ash

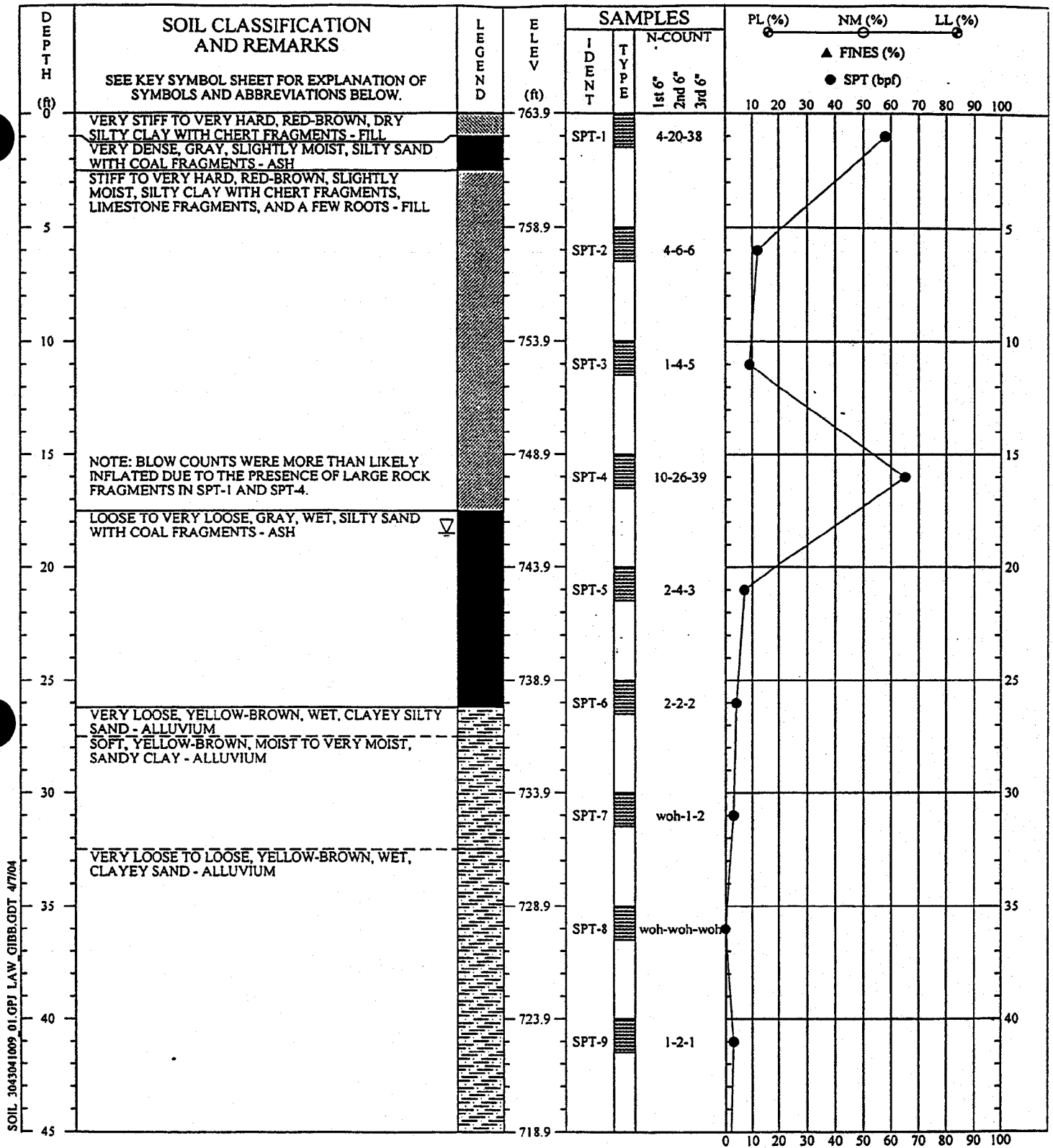
DRILLED: March 15, 2004

BORING NO.: B-11

PROJ. NO.: 3043041009/0001

PAGE 2 OF 2





SOIL 3043041009_01.GPJ LAW GIBB.GDT 4/7/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

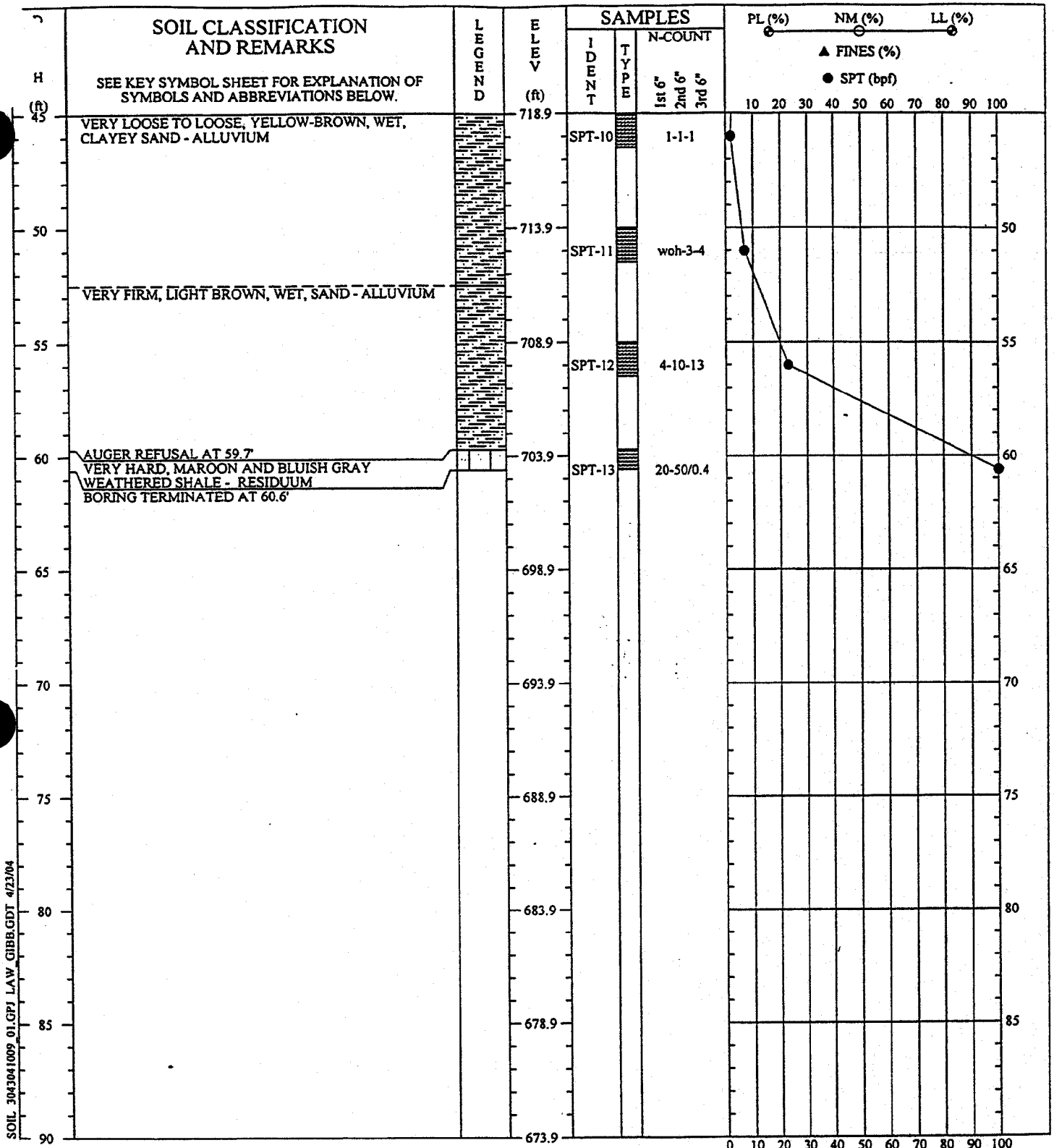
SOIL TEST BORING RECORD

PROJECT: TVA Kingston Ash
 DRILLED: March 16, 2004 BORING NO.: B-12
 PROJ. NO.: 3043041009/0001 PAGE 1 OF 2

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller: Akins
 Prepared By: Justice
 Checked By:





SOIL 3043041009 01.GPJ LAW GIBB.GDT 4/23/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By:

SOIL TEST BORING RECORD	
PROJECT: Kingston Fossil Plant - Ash Diposal Area	
DRILLED: March 16, 2004	BORING NO.: B-12
PROJ. NO.: 3043041009/0001	PAGE 2 OF 2

This information taken from "Kingston Fossil Plant – Dredge Cells/Closure Soil Investigation," Singleton Laboratories Report 015-672-142A, September 29, 1994.

SINGLETON LABORATORIES

SOIL PROFILE LEGEND AND SYMBOLS

Depth 1"=5'	El	SPT (N)	Log*	W	LL	PI	Gr	Description or Test Results
Boring Depth and Scale	Elevation	Blows Per Foot (SS Boring)	Lab Soil Type	Moisture Content	Liquid Limit	Plasticity Index	Soil Group Number	

Legend

Cl, etc	Soil Type (Unified Classification)
Mat'l	Notation of Soil Not Sampled (SS, PAH, HAH Logs)
(Core) Type	Bedrock (Note core if cored)
▽	Initial Water Table Reading
▾	24 h Water Table Reading
	Explanation of US Sampling Limits if Applicable

Boring Symbols

- SS - 2-in. od Split Spoon Boring
- SPT - Standard Penetration Test
Blows Per Foot With 2-in.
Split Spoon
- CPT - Cone Penetration Test
- US - Undisturbed Sample Boring
- PAH - Power Auger Hole
- HAH - Hand Auger Hole
- TP - Test Pit or Trench
- V - Vane Shear
- P - Piezometer

Under Description or Test Results		
Test	Engineering Test Results	
Q, R, R, S	Friction Angle (degrees)	Cohesion (tsf)
UC	Unconfined Compressive Strength (tsf)	Sensitivity Ratio
C	Compression Index	Preconsolidation Pressure (tsf)
k	Coefficient of Permeability (cm/sec)	

Example:

Q 12.0 0.62 R 19.6 0.21 S 34.0 0
UC 4.0 2.6 C 0.72 2.0 k 5.6

Soil Test Symbols

- Q - Unconsolidated-Undrained Triaxial
Compression
- R - Consolidated-Undrained Triaxial
Compression (Saturated)
- R̄ - Effective Consolidated-Undrained
Triaxial Compression
- R nat - Consolidated-Undrained Triaxial
Compression (Natural Moisture)
- S - Consolidated-Drained Direct Shear
- UC - Unconfined Compression
- C - Consolidation
- k - Permeability

SINGLETON LABORATORIES

FIELD LOG ABBREVIATIONS

<u>Typical Name</u>	<u>Abbreviation</u>	<u>Lithology and Mineralogy</u>	<u>Abbreviation</u>
Sandy gravel	sd gv	Bedrock	br
Silty gravel	si gv	Chert	cht
Clayey gravel	cl gv	Dolomite	dol
Sand	sd	Limestone	ls
Silty sand	si sd	Manganese	mn
Clayey sand	cl sd	Micaceous	mic
Sandy silt	sd si	Pyrite	py
Clayey silt	cl si	Quartz	qtz
Fat silt	ft si	Sandstone	ss
Sandy clay	sd cl	Shale	sh
Silty clay	si cl	Bentonite	bent
Medium clay	md cl	Hematite	hem
Fat clay	ft cl		
Cobble	cob		
Blouder	bldr	<u>Color</u>	
Riprap	rr	Black	blk
Topsoil	ts	Blue	blu
		Brown	brn
<u>Name Modifiers</u>		Cream	crm
Clean	cln	Dark	dk
Coarse	crs	Gray	gy
Dirty	dtv	Green	grn
Fine	fn	Light	lt
Organic	org	Maroon	mrn
Poorly graded	pgd	Mottled	mott
Well graded	wgd	Olive	olv
Degraded	degd	Pink	pk
		Purple	pur
<u>Gravel Shape</u>		Red	r
Angular	ang	Rust	rst
Platy	plty	Tan	tn
Round/Rounded	rd	White	wht
Subangular	sb ang	Yellow	yel
Subrounded	sb rd		

<u>Structure</u>	<u>Abbreviation</u>	<u>Consistency</u>	<u>Abbreviation</u>
Blocky	blky	Dense	dns
Fissured	fis	Firm	f
Homogeneous	homo	Hard	hd
Laminated	lam	Loose	lse
Saprolitic	sapr	Soft	s
Shaly	shly	Stiff	stf
Slickensided	slsid	Very Stiff	v stf
Stratified	strat		

Origin

Alluvial	all
Colluvial	coll
Loess	lss
Residual	resd

Moisture

Dry	d
Moist	mst
V Moist	v mst
Wet	w

General Modifiers

Alternate/Alternating	alt	Layers	lyrs
Angle	ˆ	Low	l
Augering	augg	Material	mtl
Bottom Ash	ba	Medium	md
Coal	col	Mud	mud
Contaminated	cont	Original	orig
Dip	dp	Partings	prtgs
Disturbed	dstrb	Plastic	plste
Debris	dbr	River	rvr
Discontinued	disc	Roots	rts
Drive	dr	Rough	rou
Dust	dst	Slow	sl
Elevation	el	Small	sm
Feet	ft	Spoil	sp
Fill	fl	Terraced	ter
Fiber	fbr	Thick	thk
Fly Ash	fa	Thin	thn
High/highly	h	Trace	tr
Horizontal	hor	Variable	var
Hydraulic	hyd	Vegetation	veg
Inch	in	Vertical	vert
Inclusion	inc	Weathered	wth
Incomplete Recovery	IR	With	w/
Interface	infa	Wood	wd

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 1 OF 2

PROJECT: KINGSTON FP
 BORING: SS-1 STATION:
 DATE DRILLED: 7/28/94

FEATURE: DREDGE CELLS
 RANGE:
 PREPARED BY: mhd

SURFACE EL: 752.0
 CHECKED BY: TA

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	750							
5			CL	12.4	31	12	5	TN & GY SI CL, D
	745							
10			CL	19.2	26	8	9	LT BRN SI CL w/TR GY TS, MST
	740							
15			CL	17.0	26	8	6	BRN SI CL, D
	735							
20			CL	27.1	26	8	9	BRN & GY SI CL, V MST
	730							
25			CL	24.1	26	8	9	BRN & GY SI CL, V MST
	725							
30			SM	19.5	NP	NP	10	GY SI SC TR GY, MST (FA)
	720							
35								

1'-5'

* LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 2 OF 2

PROJECT: KINGSTON FP

FEATURE: DREDGE CELLS

BORING: SS-1 STATION:

RANGE:

SURFACE EL: 752.0

DATE DRILLED: 7/28/94

PREPARED BY: mhd

CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	N	LL	PI	GR	FIELD DESCRIPTION
			SM	27.6	NP	NP	10	GY SI SD, V MST (FA)
40	715							REFUSAL
								GROUND WATER LEVEL = 8'9"
45	710							
50	705							
55	700							
60	695							
65	690							
70	685							
1'-5'								* LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 1 OF 2

PROJECT: KINGSTON FP

FEATURE: DREDGE CELLS

BORING: SS-2 STATION:

RANGE:

SURFACE EL: 764.0

DATE DRILLED: 7/27/94

PREPARED BY: mhd

CHECKED BY: *TAL*

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
5	760	14	MH- CH	21.9	59	28	2	BRN SI CL w/GV, TR TS, D
10	755	10	MH- CH	22.8	59	28	2	R-BRN SI CL, TR GV, D
15	750	8	MH- CH	28.0	59	28	2	R-BRN SI CL, TR GV, MST
20	745	13	SM	25.6	NP	NP	10	GY SI SD w/TR GV (FA), V MST
25	740	-	SM	19.0	NP	NP	10	GY SI SD w/GV (FA), W
30	735	-	SM	28.1	NP	NP	3	BRN SD WI CL (FA), W
35	730							

1" = 5'

*
LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 2 OF 2

PROJECT: KINGSTON FP
BORING: SS-2 STATION:
DATE DRILLED: 7/27/94

FEATURE: DREDGE CELLS
RANGE:
PREPARED BY: mhd

SURFACE EL: 764.0
CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	N	LL	PI	GR	FIELD DESCRIPTION
		-	CL	33.6	26	8	9	BRN SI CL w/GY SI (FA), V MST
40	725	3	CL	20.1	26	8	9	DRNG & GY SI CL, V MST
45	720	28	ML	14.0	NP	NP	8	GY SD mix w/PKTS GY CL, MST
50	715	50+	ML	15.8	NP	NP	8	GY SD mix w/PKTS GY CL, MST
55	710							REFUSAL GROUND WATER LEVEL = 5'8"
60	705							
65	700							
70	695							

* LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 1 OF 2

PROJECT: KINGSTON FP

FEATURE: DREDGE CELLS

BORING: SS-3 STATION:

RANGE:

SURFACE EL: 773.0

DATE DRILLED: 7/28/94

PREPARED BY: mhd

CHECKED BY: TAC

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	770							
5		25	ML	23.3	NP	NP	12	GY CL SI (FA), MST
	765							
10		5	SM	23.0	NP	NP	10	GY SD CL, TR GV (FA), V MST
	760							
15		4	SM	28.6	NP	NP	10	GY SD CL, TR GV (FA), V MST
	755							
20		1	SM	28.6	NP	NP	10	GY SD SI CL, TR GV (FA), W
	750							
25		2	SM	27.1	NP	NP	10	GY SD SI CL, TR GV (FA), W
	745							
30		1	SM	27.0	NP	NP	10	GY SD SI CL, TR GV (FA), W
	740							
35								

1'-5'

*
LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 2 OF 2

PROJECT: KINGSTON FP

FEATURE: DREDGE CELLS

BORING: SS-3 STATION:

RANGE:

SURFACE EL: 773.0

DATE DRILLED: 7/28/94

PREPARED BY: mhd

CHECKED BY: JAC

DEPTH ft.	EL	SPT (N)	* LOG	N	LL	PI	GR	FIELD DESCRIPTION
		2	ML	28.8	NP	NP	12	GY SD SI CL, TR GV (FA), N
	735							
40		2	SM	22.0	NP	NP	10	GY SD SI CL, TR GV (FA), N
	730							
45		-	ML	33.9	NP	NP	12	GY CL SI, TR GV (FA), N
	725							
50		-	ML	15.7	NP	NP	8	GY CL SI W/GV (FA), V MST
	720							
55		50+	ML	5.8	NP	NP	12	GY CL SI, TR GV
	715							
60								REFUSAL GROUND WATER LEVEL = 9'8"
	710							
65								
	705							
70								
1' = 5'			* LAB CLASSIF.					

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 1 OF 2

PROJECT: KINGSTON FP

FEATURE: DREDGE CELLS

BORING: SS-4 STATION:

RANGE:

SURFACE EL: 752.0

DATE DRILLED: 7/26/94

PREPARED BY: mhd

CHECKED BY: TA

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	750							
5		10	CL	14.2	26	8	6	LT BRN SI CL w/TS, D
	745							
10		3	CL- ML	23.8	26	4	1	BRN & GY SI CL w/TS, MST
	740							
15		8	CL	22.3	31	12	5	TN & GY SI CL (FA), V MST
	735							
20		4	SM	20.9	NP	NP	3	TN SI SD, MST
	730							
25		-	SM	34.8	NP	NP	3	TN SI SD, MST
	725							
30		7	SM	21.4	NP	NP	3	TN SI SD, MST
	720							
35								

1" = 5'

*
LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 2 OF

PROJECT: KINGSTON FP
 BORING: SS-4 STATION:
 DATE DRILLED: 7/26/94

FEATURE: DREDGE CELLS
 RANGE:
 PREPARED BY: mhd

SURFACE EL: 752.0
 CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	N	LL	PI	GR	FIELD DESCRIPTION
	715	36	SM	20.4	NP	NP	3	TN SI SD, MST
40								REFUSAL GROUND WATER LEVEL - 9'0"
	710							
45								
	705							
50								
	700							
55								
	695							
60								
	690							
65								
	685							
70								
1''=5'		* LAB CLASSIF.						

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 1 OF 2

PROJECT: KINGSTON FP

FEATURE: DREDGE CELLS

BORING: SS-5 STATION:

RANGE:

SURFACE EL: 764.0

DATE DRILLED: 7/27/94

PREPARED BY: mhd

CHECKED BY: 7A^L

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
5	760	18	MH- CH	19.6	59	28	2	R-BRN SI CL w/TR CTH, D
10	755	14	MH- CH	24.2	59	28	2	BRN SI CL w/GV, D
15	750	54	CL- ML	23.5	26	4	1	BRN SI CL w/PKTS GY CL SI, TR CHT, MST
20	745	20	SM	24.3	NP	NP	10	GY SI SD, TR GV (FA), MST
25	740	3	CL	20.9	26	8	6	LT BRN SD SI CL, TR GV, V MST
30	735	14	CL	23.6	31	12	5	TN & GY SI CL, V MST
35	730							

1''-5'

*
LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 2 OF 2

PROJECT: KINGSTON FP
 BORING: SS-5 STATION:
 DATE DRILLED: 7/27/94

FEATURE: DREDGE CELLS
 RANGE:
 PREPARED BY: mhd

SURFACE EL: 764.0
 CHECKED BY: JAL

DEPTH ft.	EL	SPT (N)	* LOG	N	LL	PI	GR	FIELD DESCRIPTION
		16	ML	21.5	NP	NP	7	BRN SI CL w/GY FA, V MST
40	725							
		2	SM	24.2	NP	NP	3	ORNG CL SD, V MST
45	720							
		2	CL	21.9	26	8	9	TN CL SI w/PKTS GY FA, V MST
50	715							
		30	SC/ SM	10.8	NP	NP	4	LT BRN SI SD w/GY, V MST
55	710							
		50+	ML	13.9	NP	NP	12	BRN & GY CL SI, FA, MST
								REFUSAL
								GROUND WATER LEVEL = 20'
60	705							
65	700							
70	695							

1" = 5'

*
LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 1 OF 2

PROJECT: KINGSTON FP
 BORING: SS-6 STATION:
 DATE DRILLED: 8/1/94

FEATURE: DREDGE CELLS
 RANGE:
 PREPARED BY: mhd

SURFACE EL: 773.0
 CHECKED BY: TAC

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	770							
5		24	ML	25.2	NP	NP	12	GY SI (FA), MST
	765							
10		5	SM	19.7	NP	NP	10	GY SI (FA), MST
	760							
15		2	SM	28.8	NP	NP	11	GY SI SD (FA), MST
	755							
20		-	ML	25.8	NP	NP	12	GY SI (FA), MST
	750							
25		3	ML	23.3	NP	NP	8	BRN SI CL w/GY FA, TR GV, V MST
	745							
30		1	ML	32.7	NP	NP	12	GY SI (FA), W
	740							
35								

1' -5'

* LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 2 OF 2

PROJECT: KINGSTON FP
 BORING: SS-6 STATION:
 DATE DRILLED: 8/1/94

FEATURE: DREDGE CELLS
 RANGE:
 PREPARED BY: mhd

SURFACE EL: 773.0
 CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
		9	CL	19.6	26	8	9	BRN CL SI mix w/FA
	735							
40		12	SM	19.4	NP	NP	3	BRN SI SD, V MST
	730							
45		1	SM	29.3	NP	NP	3	BRN SI SD, V MST
	725							
50		3	SM	21.8	NP	NP	3	BRN SD CL, V MST
	720							
55		6	ML	22.3	NP	NP	8	GY SI SD w/FA, MST
	715							
60		50+	ML	9.9	NP	NP	12	GY SI, FA, MST
	710							
								REFUSAL
								GROUND WATER LEVEL = 16' 7"
	705							
	70							
1'-5'								

* LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 1 OF 3

PROJECT: KINGSTON FP

FEATURE: DREDGE CELLS

BORING: SS-8 STATION:

RANGE:

SURFACE EL: 782.0

DATE DRILLED: 8/2/94

PREPARED BY: mhd

CHECKED BY: *TH*

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	780							
5		50+	SM	17.6	NP	NP	10	GY SI (FA), TR GY, D
	775							
10		50+	SM	18.4	NP	NP	10	GY SI (FA), TR GY, D
	770							
15		50+	SM	21.9	NP	NP	10	GY SI (FA), TR GY, D
	765							
20		8	SM	43.9	NP	NP	11	GY SI SD (FA), MST
	760							
25		15	SM	17.9	NP	NP	10	GY SI SD w/GY (FA), MST
	755							
30		-	ML	31.7	NP	NP	12	GY SI (FA), W
	750							
35								

1''=5'

* LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 2 OF 3

PROJECT: KINGSTON FP
 BORING: SS-8 STATION:
 DATE DRILLED: 8/2/94

FEATURE: DREDGE CELLS
 RANGE:
 PREPARED BY: mhd

SURFACE EL: 782.0
 CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	N	LL	PI	GR	FIELD DESCRIPTION
			ML	24.4	NP	NP	12	GY SI (FA), MST
40	745							
		3	ML	23.8	NP	NP	12	GY SI (FA), MST
45	740							
		9	ML	31.2	NP	NP	12	GY SI (FA), MST
50	735							
		4	ML	22.3	NP	NP	8	GY CL SI w/LUMPS TN SI CL, MST
55	730							
		13	ML	18.2	NP	NP	7	MOTT BRN/TN/GY SI CL, MST
60	725							
		13	ML	18.6	NP	NP	7	MOTT BRN/TN/GY SI CL, MST
65	720							
		4	SC/ SM	27.7	NP	NP	4	TN SI SD, W
70	715							
1'-5'								

* LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 3 OF 3

PROJECT: KINGSTON FP
 BORING: SS-8 STATION:
 DATE DRILLED: 8/2/94

FEATURE: DREDGE CELLS
 RANGE:
 PREPARED BY: mhd

SURFACE EL: 782.0
 CHECKED BY: 7AL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	710	5	SM	24.9	NP	NP	10	GY SD SI (FA), W
75								
	705	7	SC/ SM	22.7	NP	NP	4	TN SI SD, V MST
80								REFUSAL
	700							GROUND WATER LEVEL = 11' 3"
85								
	695							
90								
	690							
95								
	685							
100								
	680							
105								
1'-5'								

*
LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 1 OF 3

PROJECT: KINGSTON FP
 BORING: SS-9 STATION:
 DATE DRILLED: 8/2/94

FEATURE: DREDGE CELLS
 RANGE:
 PREPARED BY: mhd

SURFACE EL: 795.0
 CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	795							
5	790	20	ML	17.8	NP	NP	12	GY SI (FA), MST
10	785	50+	ML	19.5	NP	NP	12	GY SI (FA), MST
15	780	44	ML	20.1	NP	NP	12	GY SI (FA), MST
20	775	46	ML	18.3	NP	NP	12	GY SI (FA), MST
25	770	6	ML	30.2	NP	NP	12	GY SI (FA), MST
30	765	5	ML	35.2	NP	NP	12	GY SI (FA), N
35	760							

1'-5'

*
LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 2 OF 3

PROJECT: KINGSTON FP

FEATURE: DREDGE CELLS

BORING: SS-9 STATION:

RANGE:

SURFACE EL: 795.0

DATE DRILLED: 8/2/94

PREPARED BY: mhd

CHECKED BY: TAC

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	760	2	ML	17.3	NP	NP	12	GY SI (FA), W
40	755	1	ML	31.0	NP	NP	12	GY SI (FA), W
45	750	-	ML	23.0	NP	NP	12	GY SI (FA), D
50	745	-	ML	31.7	NP	NP	12	GY SI (FA), TR GV, W
55	740	5	ML	30.0	NP	NP	12	GY SI (FA), TR GV, W
60	735	6	ML	32.6	NP	NP	12	GY SI (FA), TR GV, W
65	730	-	ML	26.9	NP	NP	8	BRN SI CL w/GY SI (FA), MST
70	725							

1''-5'

*
LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 3 OF 3

PROJECT: KINGSTON FP

FEATURE: DREDGE CELLS

BORING: SS-9 STATION:

RANGE:

SURFACE EL: 795.0

DATE DRILLED: 8/2/94

PREPARED BY: mhd

CHECKED BY: JAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	725	13	CL	19.2	26	8	9	BRN, TN & GY SI CL, TR CL, MST
75	720	19	CL	19.5	26	8	6	DRNG-BRN SI CL, MST
80	715	4	SM	20.5	NP	NP	10	GY SD SI, W
85	710	19	SC/ SM	23.1	NP	NP	4	TN SI SD
90	705	8	SC/ SM	23.1	NP	NP	4	GY SI SD
95	700							REFUSAL GROUND WATER LEVEL = 29'
100	695							
105	690							
1'-5'								

*
LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 1 OF 3

PROJECT: KINGSTON FP

FEATURE: DREDGE CELLS

BORING: SS-10 STATION:

RANGE:

SURFACE EL: 797.5

DATE DRILLED: 8/8/94

PREPARED BY: mhd

CHECKED BY: *TAL*

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	795							
5		50+	ML	17.3	NP	NP	12	GY SI (FA), MST
	790							
10		26	ML	24.7	NP	NP	12	GY SI (FA), MST
	785							
15		25	ML	15.0	NP	NP	12	GY SD SI, TR GY, MST
	780							
20		5	ML	22.1	NP	NP	12	GY SI (FA), MST
	775							
25		4	ML	27.4	NP	NP	12	GY SI (FA), MST
	770							
30		14	ML	29.1	NP	NP	12	GY SI (FA), MST
	765							
35								
1'-5'			* LAB CLASSIF.					

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 2 OF 3

PROJECT: KINGSTON FP
BORING: SS-10 STATION:
DATE DRILLED: 8/8/94

FEATURE: DREDGE CELLS
RANGE:
PREPARED BY: mhd

SURFACE EL: 797.5
CHECKED BY: TAC

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
		18	SM	31.2	NP	NP	11	GY SD SI (FA) w/GV, W
40	760							
		9	ML	31.4	NP	NP	12	GY SI (FA), V MST
45	755							
		-	ML	27.0	NP	NP	12	GY SD SI w/GV (FA), V MST
50	750							
		-	ML	27.2	NP	NP	12	GY SD SI w/GV (FA), V MST
55	745							
		6	SM	30.7	NP	NP	11	GY PGD SI SD (FA), V MST
60	740							
		9	SM	16.4	NP	NP	11	GY PGD SI SD (FA), V MST
65	735							
		25	SM	19.4	NP	NP	11	CRS PGD SI SD w/GV (FA)
70	730							

1'-5'

*
LAB CLASSIF.

SINGLETON LABORATORIES

SOIL PROFILE: SPLIT-SPOON

SHEET 3 OF 3

PROJECT: KINGSTON FP
 BORING: SS-10 STATION:
 DATE DRILLED: 8/8/94

FEATURE: DREDGE CELLS
 RANGE:
 PREPARED BY: mhd

SURFACE EL: 797.5
 CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
		39	ML	19.0	NP	NP	8	BRN SI CL w/PKTS GY SI (FA), V MST
	725							
75		17	CL	19.2	26	8	9	BRN & GY SI CL, V MST
	720							
80		18	CL	16.9	26	8	6	ORNG-BRN SD SI CL, MST
	715							
85		16	ML	18.9	NP	NP	8	GY SI SD, MST
	710							
90		50+	ML	3.7	NP	NP	8	GY SI SD w/GV
	705							
95								
	700							REFUSAL GROUND WATER LEVEL -
100								
	695							
105								
1'-5'			* LAB CLASSIF.					

**This information taken from "Report of Soil Borings, Monitoring Well Installation and Soil Laboratory Testing -- Tennessee Valley Authority -- Watts Bar and Kingston Facilities,"
Law Engineering, November 30, 1988.**



FIELD EXPLORATORY PROCEDURES

SOIL TEST BORING (HOLLOW STEM)

All boring and sampling operations were conducted in general accordance with ASTM Designation D 1586-67. The borings were advanced by mechanically twisting continuous steel hollow-stem auger flights into the ground. At regular intervals, soil samples were obtained with a standard 1.4-inch I.D., 2-inch O.D., split-tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot of penetration was recorded and is designated the "standard penetration resistance". The penetration resistance, when properly evaluated, is an index to the soil strength, density and ability to support foundations.

Representative portions of the soil samples, obtained from the split-tube sampler, were sealed in glass jars and transported to our laboratory. In the laboratory, the samples were examined by our engineer to verify the driller's field classifications. Test Boring Records are attached, graphically showing the soil descriptions and penetration resistances.



Law Engineering

Boring Record

BORING NUMBER J-9A
 DATE DRILLED 10-3-88
 JOB NUMBER K-88195
 PAGE 1 OF 2

DEPTH (FT.)	DESCRIPTION	ELEV. *	PENETRATION-BLOWS PER FOOT																	
			5	10	20	30	40	50	60	80	100 "N"									
0.0	GRAY FLY ASH WHICH CONTAINS COAL FRAGMENTS AND CINDERS. MOISTURE CONTENT INCREASED IN SAMPLES TO A DEPTH OF 13 FEET AT WHICH TIME THE SAMPLES BECAME SATURATED.																			
40.0																				

REMARKS: * ELEVATION TO BE PROVIDED BY TVA



Law Engineering

Boring Record

BORING NUMBER J - 9A
 DATE DRILLED 10-3-88
 JOB NUMBER K-88195
 PAGE 2 OF 2

DEPTH (FT.)	DESCRIPTION	ELEV. *	PENETRATION-BLOWS PER FOOT																		
			5	10	20	30	40	50	60	80	100	"N"									
40.0	GRAY FLY ASH WHICH CONTAINS COAL FRAGMENTS AND CINDERS. MOISTURE CONTENT INCREASED IN SAMPLES TO A DEPTH OF 13 FEET AT WHICH TIME THE SAMPLES BECAME SATURATED.																				
67.7	REFUSAL																				

REMARKS: * ELEVATION TO BE PROVIDED BY TVA



Law Engineering

Boring Record

BORING NUMBER J-9B
 DATE DRILLED 10-3-88
 JOB NUMBER K-88195
 PAGE 1 OF 3

DEPTH (FT.)	DESCRIPTION	ELEV. *	PENETRATION-BLOWS PER FOOT																		
			5	10	20	30	40	50	60	80	100	"N"									
0.0	DRY GRAY ASH																				
35.0	ALLUVIAL CLAY, SAND AND GRAVEL WITH WEATHERED SHALE FRAGMENTS																				
40.0																					

REMARKS: BORING DRILLED USING AIR ROTARY EQUIPMENT
 * ELEVATION TO BE PROVIDED BY TVA



Law Engineering

Boring Record

BORING NUMBER J-9B
 DATE DRILLED 10-3-88
 JOB NUMBER K-88195
 PAGE 2 OF 3

DEPTH (FT.)	DESCRIPTION	ELEV.	PENETRATION-BLOWS PER FOOT																			
			5	10	20	30	40	50	60	80	100	"N"										
40.0	ALLUVIAL CLAY, SAND AND GRAVEL WITH WEATHERED SHALE FRAGMENTS																					
67.5	BLUE GRAY SHALE WITH CALCITE JOINTS																					
80.0																						

REMARKS:



Law Engineering

Boring Record

BORING NUMBER J-9B
 DATE DRILLED 10-3-88
 JOB NUMBER K-88195
 PAGE 3 OF 3

DEPTH (FT.)	DESCRIPTION	ELEV.	PENETRATION-BLOWS PER FOOT																		
			5	10	20	30	40	50	60	80	100	"N"									
80.0																					
82.4	BLUE GRAY SHALE WITH CALCITE JOINTS																				
	BORING TERMINATED																				

REMARKS:



Law Engineering

Boring Record

BORING NUMBER J-10
 DATE DRILLED 9-27-88
 JOB NUMBER K-88195
 PAGE 1 OF 1

DEPTH (FT.)	DESCRIPTION	ELEV. *	PENETRATION-BLOWS PER FOOT																	
			5	10	20	30	40	50	60	80	100	"N"								
0.0	WASH BORING TO A PREDETERMINED DEPTH																			
12.0																				
15.0	BORING TERMINATED																			

REMARKS: * ELEVATION TO BE PROVIDED BY TVA



Law Engineering

Boring Record

BORING NUMBER J-10A
 DATE DRILLED 9-27-88
 JOB NUMBER K-88195
 PAGE 1 OF 1

DEPTH (FT.)	DESCRIPTION	ELEV.	PENETRATION-BLOWS PER FOOT																		
			*	5	10	20	30	40	50	60	80	100	"N"								
0.0	WASH BORING TO A PREDETERMINED DEPTH																				
29.9	BORING TERMINATED																				

REMARKS: * ELEVATION TO BE PROVIDED BY TVA



Law Engineering

Boring Record

BORING NUMBER J-11B
 DATE DRILLED 9-19-88
 JOB NUMBER K-88195
 PAGE 1 OF 1

DEPTH (FT.)	DESCRIPTION	ELEV.	PENETRATION-BLOWS PER FOOT																	
			5	10	20	30	40	50	60	80	100	"N"								
0.0	RED SILTY CLAY-POSSIBLE FILL																			
1.0	TANNISH-BROWN SHALEY SILTY CLAY - RESIDUUM																			
5.0	DARK BROWN AND GRAYISH GREEN SHALE																			
31.5	BORING TERMINATED																			

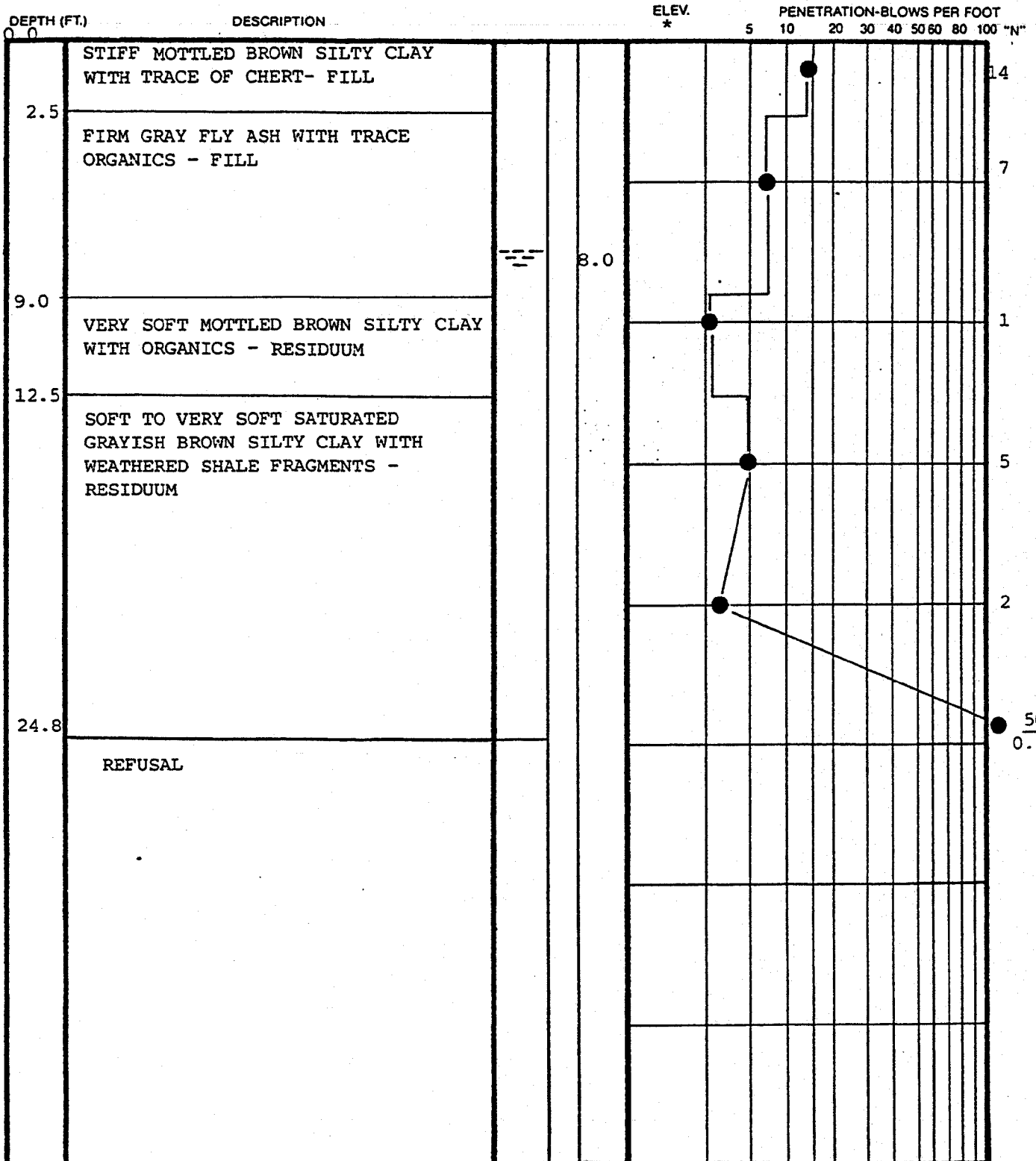
REMARKS: BORING ADVANCED USING AIR ROTARY EQUIPMENT



Law Engineering

Soil Test Boring Record

BORING NUMBER J-12A
 DATE DRILLED 9-22-88
 JOB NUMBER K-88195
 PAGE 1 OF 1



REMARKS: * ELEVATION TO BE PROVIDED BY TVA



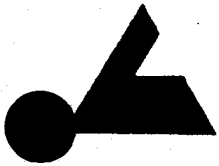
Law Engineering

Boring Record

BORING NUMBER J-12B
 DATE DRILLED 9-26-88
 JOB NUMBER K-88195
 PAGE 1 OF 2

DEPTH (FT.)	DESCRIPTION	ELEV. *	PENETRATION-BLOWS PER FOOT																	
			5	10	20	30	40	50	60	80	100	"N"								
3.0	RED-BROWN SILTY CLAY WITH CHERT FRAGMENTS																			
	DARK GRAY ASH AND ASH AND ASH CLAY MIXTURE																			
20.0	GREENISH GRAY SHALE SLURRY WITH LIMESTONE FRAGMENTS																			
28.0	DUE TO A CAVE-IN AT 28.0 FEET THE BORING WAS OFFSET AND RE-DRILLED																			
	GRAY SHALE																			
40.0																				

REMARKS: BORING ADVANCED USING AIR ROTARY EQUIPMENT
 * ELEVATION TO BE PROVIDED BY TVA



Law Engineering

Boring Record

BORING NUMBER J-12B
 DATE DRILLED 9-26-88
 JOB NUMBER K-88195
 PAGE 2 OF 2

DEPTH (FT.)	DESCRIPTION	ELEV.	PENETRATION-BLOWS PER FOOT																		
			5	10	20	30	40	50	60	80	100	"N"									
40.0	GRAY SHALE																				
54.2		BORING TERMINATED																			

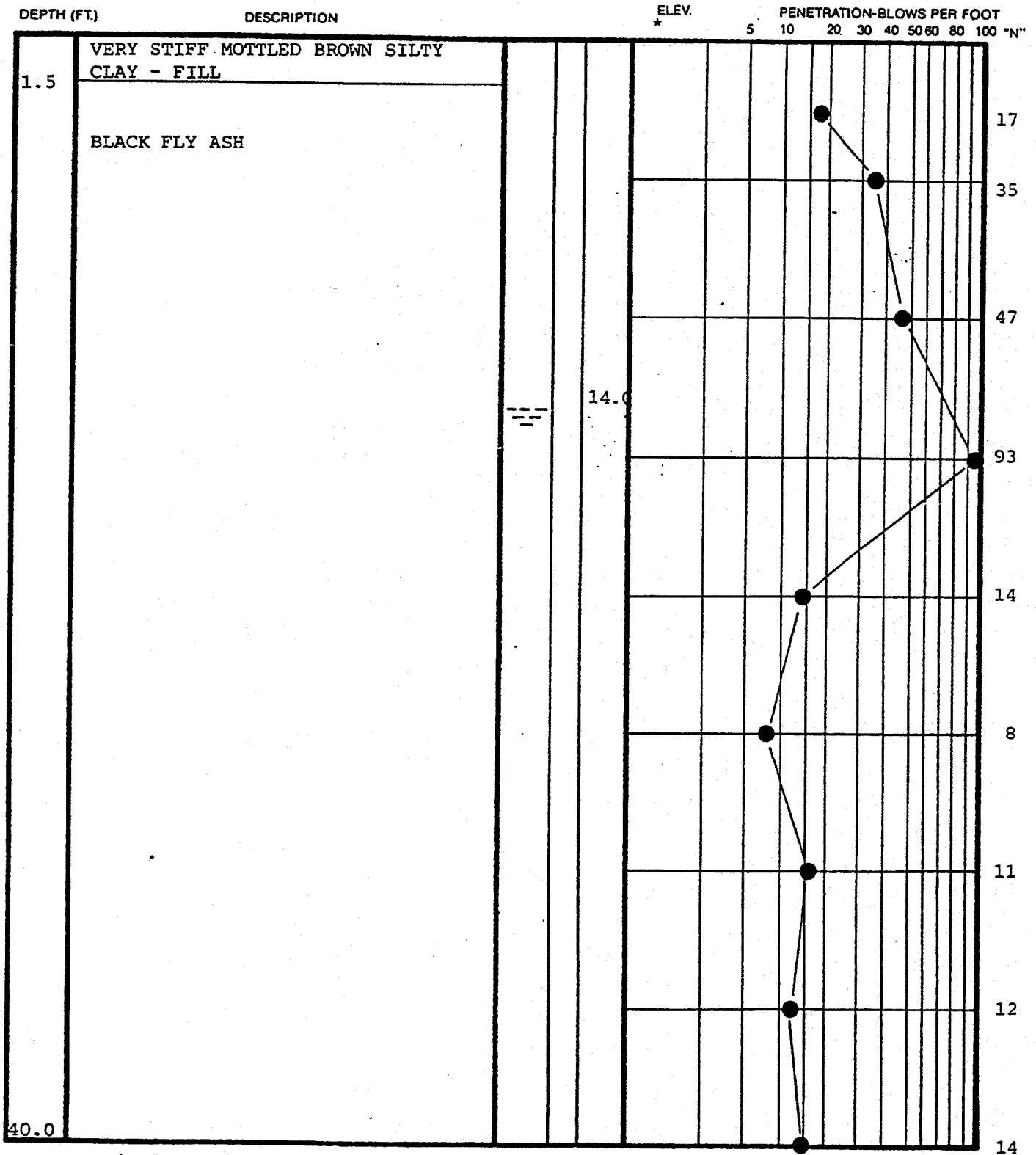
REMARKS:



Law Engineering

Soil Test Boring Record

BORING NUMBER J-13A
 DATE DRILLED 9-28-88
 JOB NUMBER K-88195
 PAGE 1 OF 2



REMARKS: * ELEVATION TO BE PROVIDED BY TVA



Law Engineering

Boring Record

BORING NUMBER J-13B
 DATE DRILLED 9/29 - 30/88
 JOB NUMBER K-88195
 PAGE 1 OF 3

DEPTH (FT.)	DESCRIPTION	ELEV.	PENETRATION-BLOWS PER FOOT																	
			*	5	10	20	30	40	50	60	80	100 "N"								
0.0																				
0.5	TOPSOIL																			
	BROWN SILTY CLAY AND WEATHERED SHALE																			
4.0	GRAY ASH																			
40.0																				

REMARKS: BORING ADVANCED USING AIR ROTARY EQUIPMENT
 * ELEVATION TO BE PROVIDED BY TVA



Law Engineering

Boring Record

BORING NUMBER J-13B
 DATE DRILLED 9/29-30/88
 JOB NUMBER K-88195
 PAGE 2 OF 3

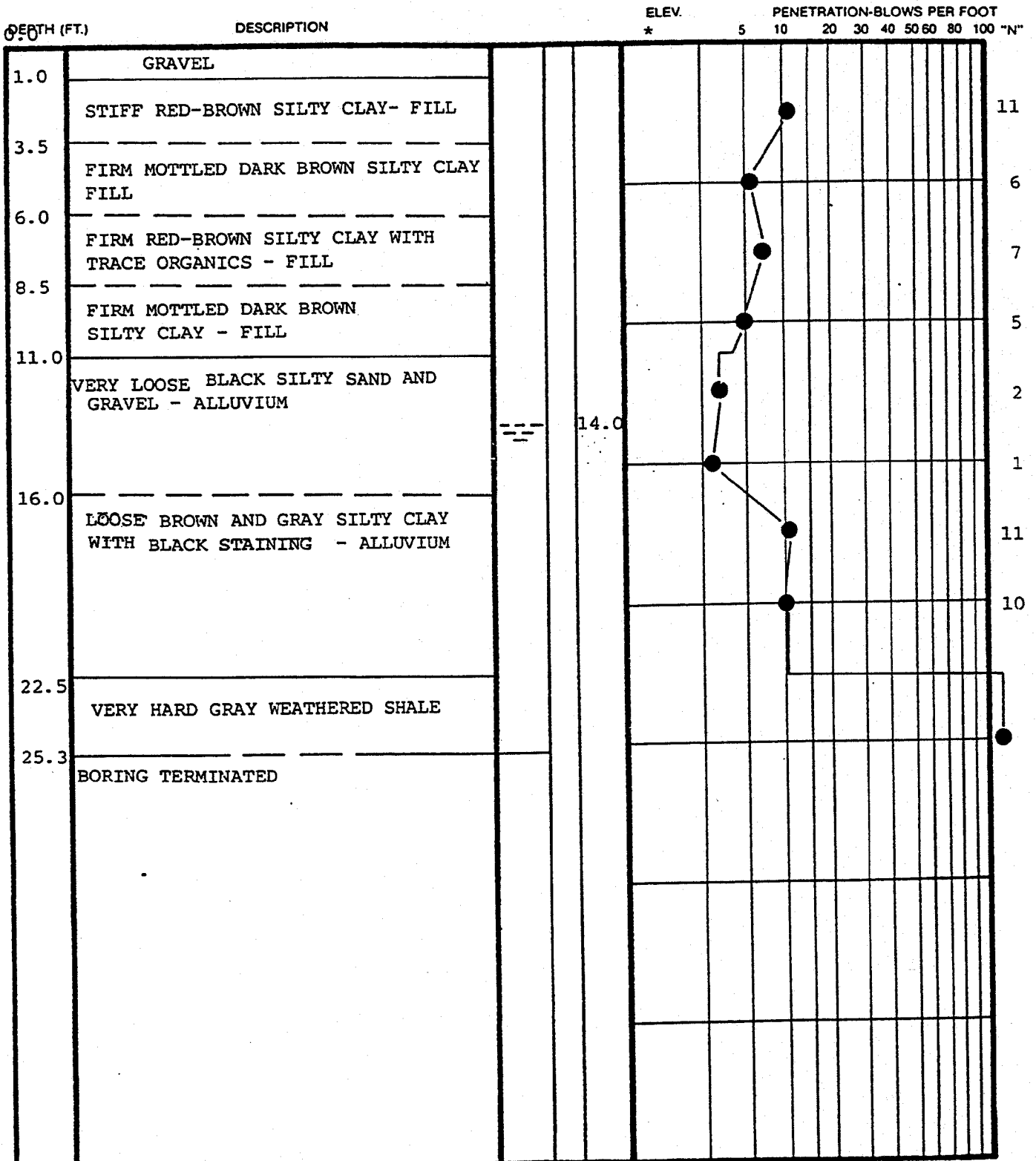
DEPTH (FT.)	DESCRIPTION	ELEV.	PENETRATION-BLOWS PER FOOT																		
			5	10	20	30	40	50	60	80	100	"N"									
40.0	GRAY ASH																				
45.0	ASH AND SAND (VERY WET)																				
65.0	GRAY SHALE WITH ZONES OF LIMESTONE AND SANDSTONE																				
80.0																					

REMARKS:

Law Engineering

Soil Test Boring Record

BORING NUMBER J-14
 DATE DRILLED 9-23-88
 JOB NUMBER K-88195
 PAGE 1 OF 1



REMARKS: *ELEVATION TO BE PROVIDED BY TVA



Law Engineering

Boring Record

BORING NUMBER J-14A
 DATE DRILLED 9-22-88
 JOB NUMBER K-88195
 PAGE 1 OF 1

DEPTH (FT.)	DESCRIPTION	ELEV. *	PENETRATION-BLOWS PER FOOT																		
			5	10	20	30	40	50	60	80	100	"N"									
	RED-BROWN AND DARK BROWN SILTY CLAY WITH ROCK FRAGMENTS-FILL (FILL USED FOR CONSTRUCTING THE RAILROAD)																				
17.0	TANISH GRAY SILT WITH TRACE OF ASH - FILL																				
19.0	WEATHERED BROWN AND TAN SHALE																				
25.0	BORING TERMINATED																				

REMARKS: BORING ADVANCED USING AIR ROTARY EQUIPMENT
 * ELEVATION TO BE PROVIDED BY TVA



Law Engineering

Boring Record

BORING NUMBER J-14B
 DATE DRILLED 9-22-88
 JOB NUMBER K-88195
 PAGE 1 OF 1

DEPTH (FT.)	DESCRIPTION	ELEV. *	PENETRATION-BLOWS PER FOOT																	
			5	10	20	30	40	50	60	80	100	"N"								
0.0	RED BROWN SILTY CLAY -FILL (FILL USED FOR CONSTRUCTING THE RAILROAD)																			
18.0	GRAY BROWN SILTY CLAY WITH A TRACE OF ASH																			
24.5	REFUSAL																			
40.0	BROWN AND GRAY TO GRAY SHALE WITH CALCITE SEAMS																			

BORING TERMINATED
 REMARKS: BORING ADVANCED USING AIR ROTARY EQUIPMENT
 * ELEVATION TO BE PROVIDED BY TVA

Law Engineering

Soil Test Boring Record

BORING NUMBER J-15
 DATE DRILLED 9-23-88
 JOB NUMBER K-88195
 PAGE 1 OF 1

DEPTH (FT.)	DESCRIPTION	ELEV. *	PENETRATION-BLOWS PER FOOT																			
			5	10	20	30	40	50	60	80	100	"N"										
0.0																						
2.0	STIFF MOTTLED REDDISH-BROWN SILTY CLAY - FILL																					
4.0	STIFF MOTTLED BROWN SILTY CLAY WITH ROCK FRAGMENT - FILL																					
	SOFT TO FIRM REDDISH BROWN SILTY CLAY - RESIDUUM																					
10.5	LIGHT BROWN VERY WEATHERED SHALE-RESIDUUM																					
12.0	REFUSAL																					

REMARKS: * ELEVATION TO BE PROVIDED BY TVA



Law Engineering

Boring Record

BORING NUMBER J-15A
 DATE DRILLED 9-21-88
 JOB NUMBER K-88195
 PAGE 1 OF 1

DEPTH (FT.)	DESCRIPTION	ELEV. *	PENETRATION-BLOWS PER FOOT																	
			5	10	20	30	40	50	60	80	100	"N"								
8.0	TANISH-BROWN TO BROWN SILTY CLAY																			
13.5	GRAY-BROWN SILT WITH SHALE FRAGMENTS																			
	REFUSAL																			
25.2	GRAY SHALE																			
40.0	BORING TERMINATED																			

REMARKS: BORING ADVANCED USING AIR ROTARY EQUIPMENT
 * ELEVATION TO BE PROVIDED BY TVA



Law Engineering

Boring Record

BORING NUMBER J-15B
 DATE DRILLED 9-21-88
 JOB NUMBER K-88195
 PAGE 1 OF 2

DEPTH (FT.)	DESCRIPTION	ELEV. *	PENETRATION-BLOWS PER FOOT																		
			5	10	20	30	40	50	60	80	100	"N"									
0.0	WEATHERED SHALE																				
3.0	BROWN AND GRAY-BROWN SILTY CLAY WITH TRACE SHALE FRAGMENTS																				
14.0	GRAY SHALE																				
40.0																					

REMARKS: BORING ADVANCED USING AIR ROTARY EQUIPMENT
 * ELEVATION TO BE PROVIDED BY TVA



Law Engineering

Boring Record

BORING NUMBER J-15B
 DATE DRILLED 9-21-88
 JOB NUMBER K-88195
 PAGE 2 OF 2

DEPTH (FT.)	DESCRIPTION	ELEV.	PENETRATION-BLOWS PER FOOT																	
			5	10	20	30	40	50	60	80	100	"N"								
40.0																				
	GRAY SHALE																			
44.2	BORING TERMINATED																			

REMARKS:

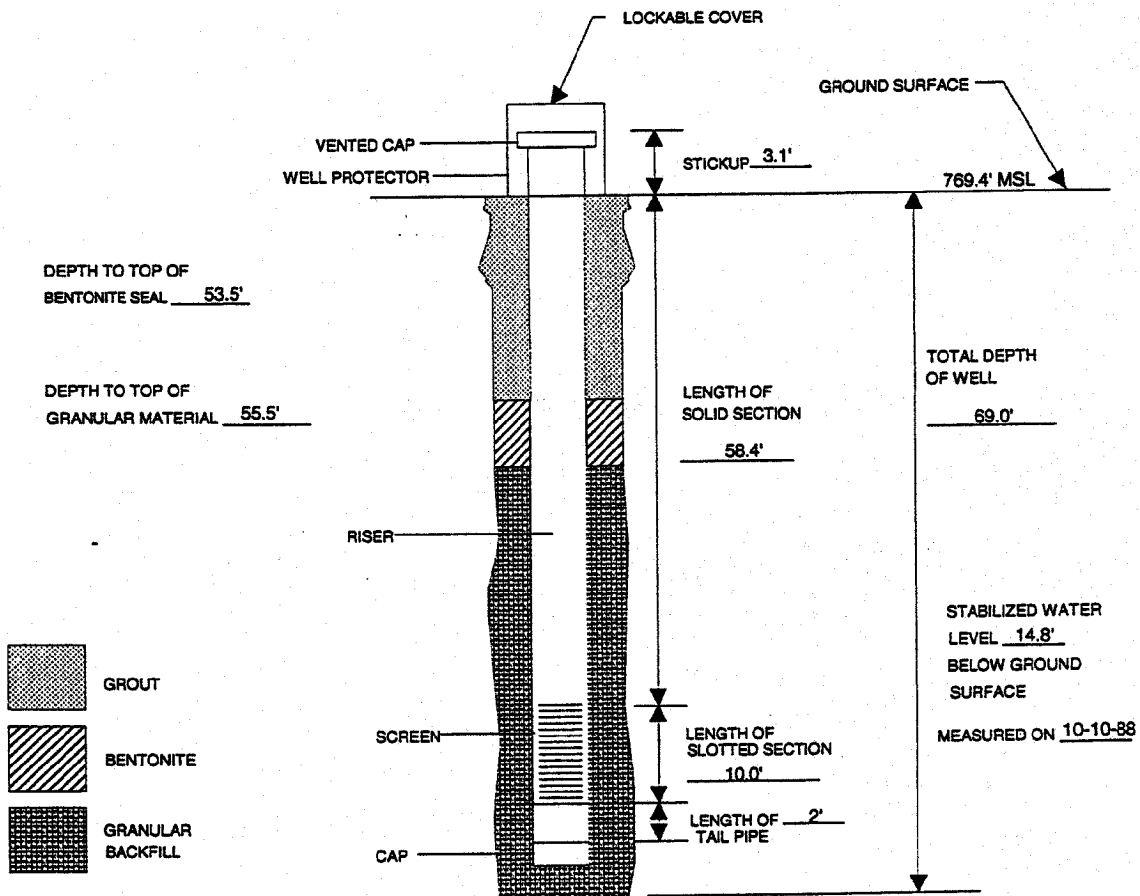
APPENDIX B

MONITORING WELL DIAGRAMS

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT <u>KINGSTON STEAM PLANT</u>	JOB NUMBER <u>K-88195</u>
WELL NUMBER <u>J-9 A</u>	INSTALLATION DATE <u>10-3 TO 10-4-88</u>
LOCATION <u>PLANT COORDINATES W 9+44 N 19+07</u>	<u>Tennessee Lambert NAD83 Easting 2408204.75 Northing 575458</u>
GROUND SURFACE ELEVATION <u>769.4' MSL</u>	TOP OF INNER CASING <u>772.5' MSL</u>
GRANULAR BACKFILL MATERIAL <u>QUARTZ SAND, COARSE</u>	SLOT SIZE <u>.010 INCHES</u>
CASING MATERIAL <u>PVC</u>	CASING DIAMETER <u>2 INCHES</u>
DRILLING TECHNIQUE <u>POWER AUGER</u>	DRILLING CONTRACTOR <u>LAW ENGINEERING</u>
BOREHOLE DIAMETER <u>11 INCHES</u>	FIELD REPRESENTATIVE <u>H. W. ROBINSON</u>
LOCKABLE COVER ? <u>YES</u>	KEY CODE/COMBINATION <u>2043</u>
RISER MATERIAL <u>PVC</u>	SCREEN MATERIAL <u>PVC</u>
COMMENTS _____	

(NOT TO SCALE)

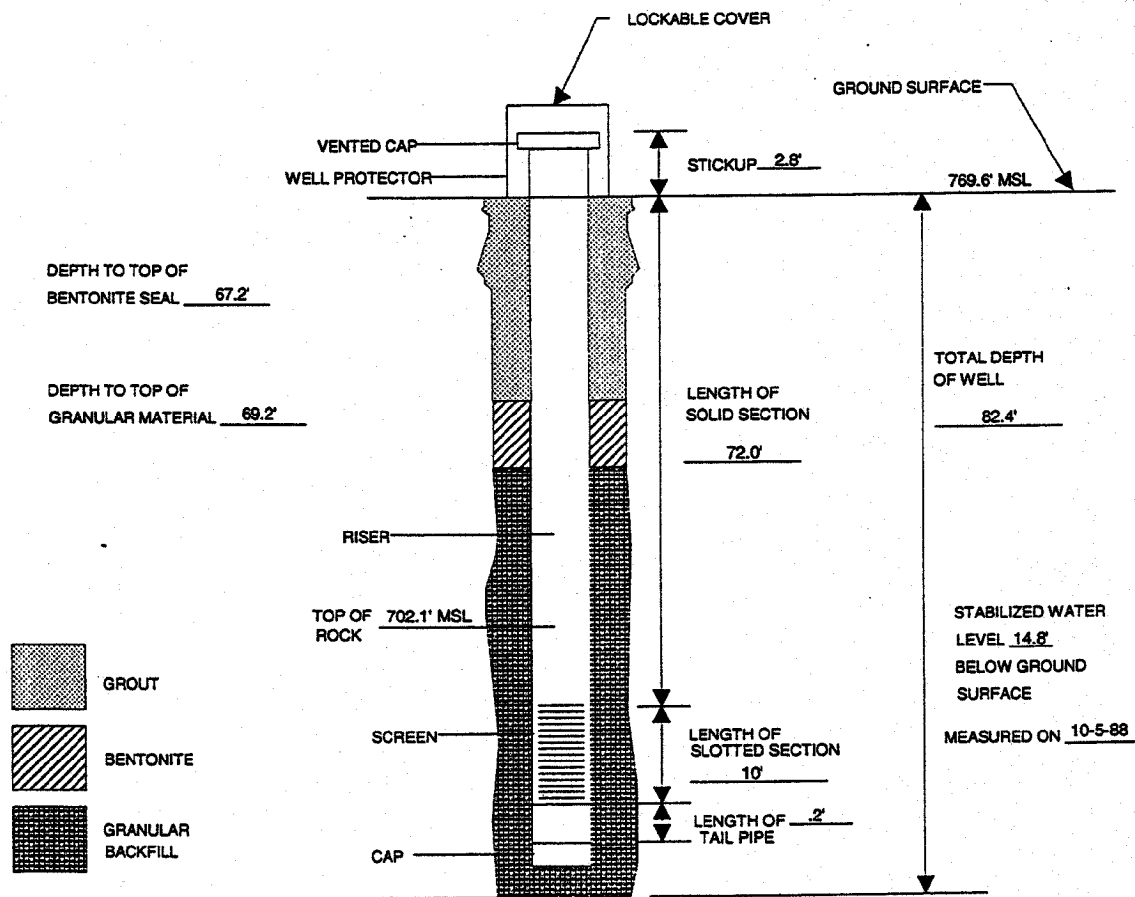


DWG LAB 10/2/88

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT <u>KINGSTON STEAM PLANT</u>	JOB NUMBER <u>K-88195</u>
WELL NUMBER <u>J-9B</u>	INSTALLATION DATE <u>9-28 TO 9-29-88</u>
LOCATION <u>PLANT COORDINATES W 9+42 , N 19+22</u>	<u>Tennessee Lambert NAD83 Easting 2408204.25 Northing 575457.5</u>
GROUND SURFACE ELEVATION <u>769.6' MSL</u>	TOP OF INNER CASING <u>772.4' MSL</u>
GRANULAR BACKFILL MATERIAL <u>QUARTZ SAND COURSE</u>	SLOT SIZE <u>.010 INCHES</u>
CASING MATERIAL <u>PVC</u>	CASING DIAMETER <u>2 INCHES</u>
DRILLING TECHNIQUE <u>AIR ROTARY</u>	DRILLING CONTRACTOR <u>HIGHLAND DRILLING</u>
BOREHOLE DIAMETER <u>5 7/8 (ROLLER CONE)</u>	FIELD REPRESENTATIVE <u>H. W. ROBINSON</u>
LOCKABLE COVER ? <u>YES</u>	KEY CODE/COMBINATION <u>2043</u>
RISER MATERIAL <u>PVC</u>	SCREEN MATERIAL <u>PVC</u>
COMMENTS _____	

(NOT TO SCALE)

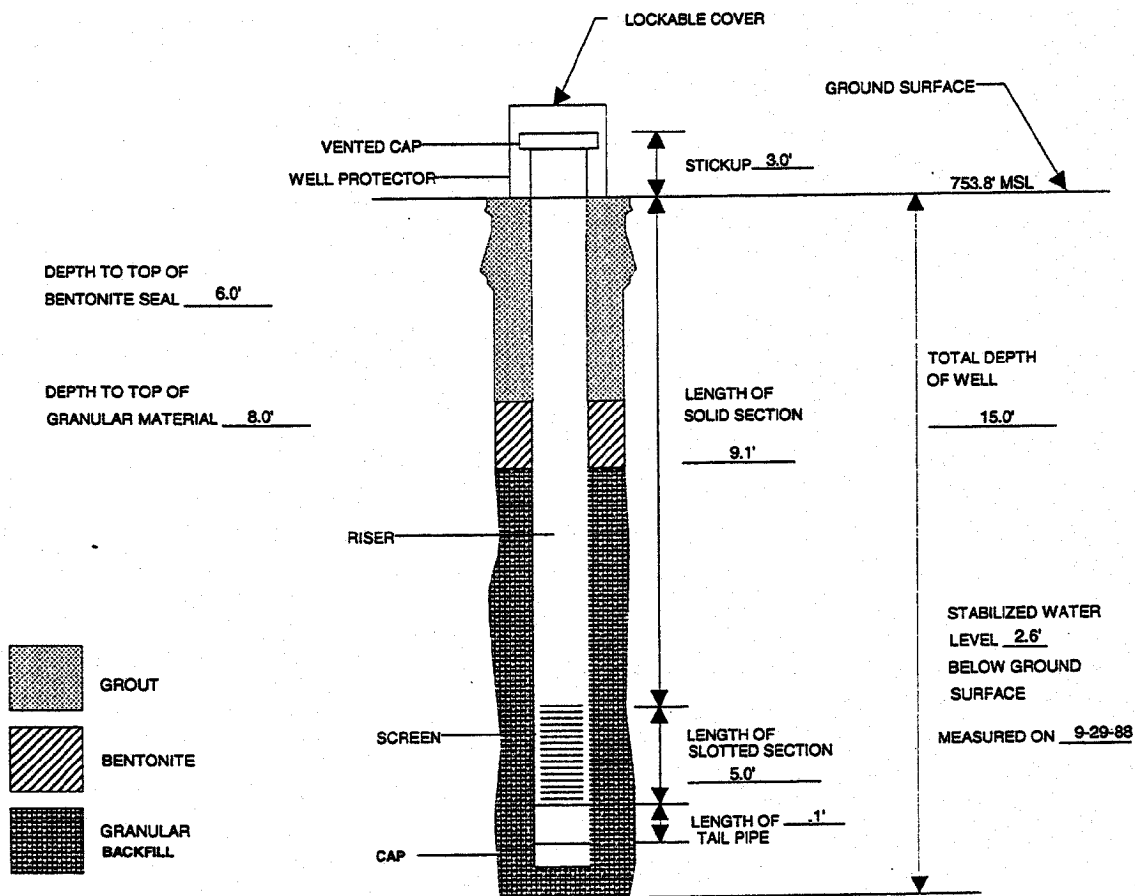


ENG LAB 102000

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT <u>KINGSTON STEAM PLANT</u>	JOB NUMBER <u>K-88195</u>
WELL NUMBER <u>J-10</u>	INSTALLATION DATE <u>9-27-88</u>
LOCATION <u>PLANT COORDINATES W 4+79, N 16+36 Tennessee Lambert NAD83 Easting 2408462.25 Northing 574754.063</u>	
GROUND SURFACE ELEVATION <u>753.8' MSL</u>	TOP OF INNER CASING <u>756.8' MSL</u>
GRANULAR BACKFILL MATERIAL <u>QUARTZ SAND, COURSE</u>	SLOT SIZE <u>.010 INCHES</u>
CASING MATERIAL <u>PVC</u>	CASING DIAMETER <u>2 INCHES</u>
DRILLING TECHNIQUE <u>POWER AUGER</u>	DRILLING CONTRACTOR <u>LAW ENGINEERING</u>
BOREHOLE DIAMETER <u>11 INCHES</u>	FIELD REPRESENTATIVE <u>H. W. ROBINSON</u>
LOCKABLE COVER ? <u>YES</u>	KEY CODE/COMBINATION <u>2043</u>
RISER MATERIAL <u>PVC</u>	SCREEN MATERIAL <u>PVC</u>
COMMENTS _____	

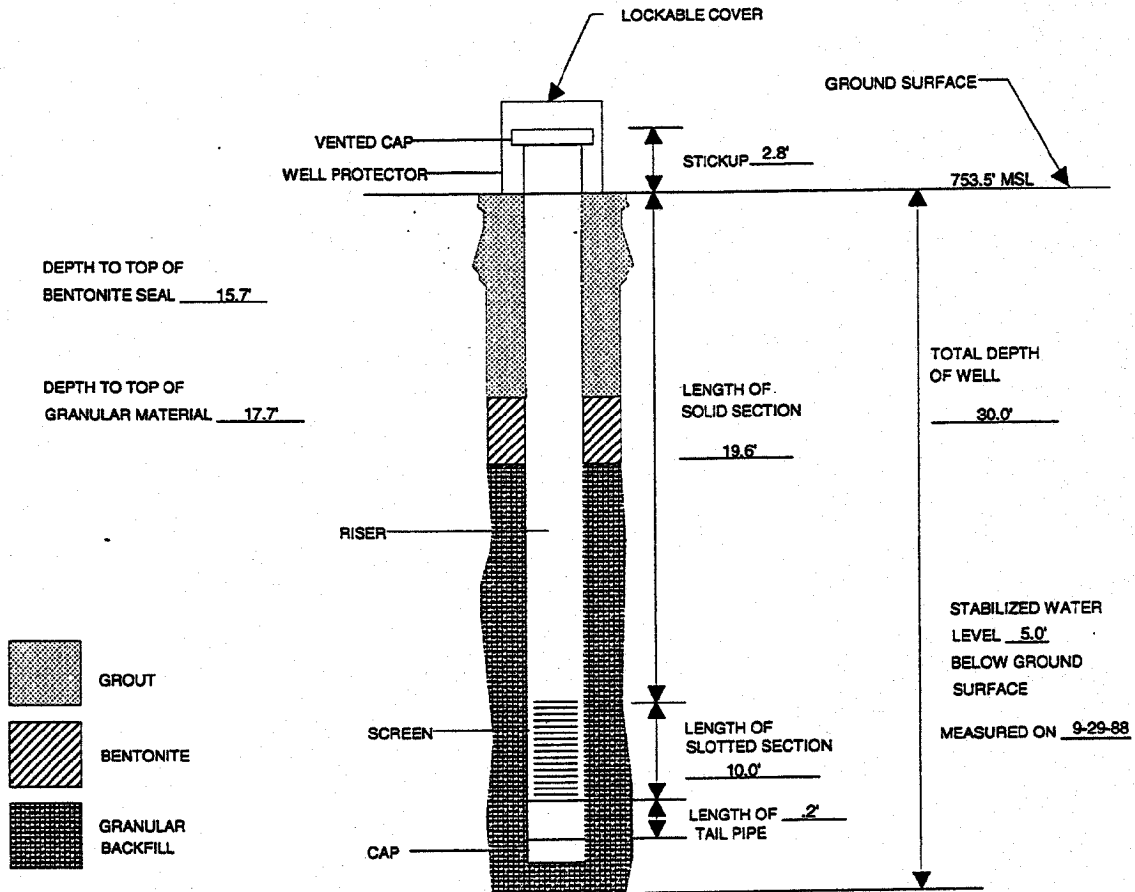
(NOT TO SCALE)



TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT <u>KINGSTON STEAM PLANT</u>	JOB NUMBER <u>K-88195</u>
WELL NUMBER <u>J-10A</u>	INSTALLATION DATE <u>9-19 TO 9-27-88</u>
LOCATION <u>PLANT COORDINATES W 4+68, N 16+51</u>	<u>Tennessee Lambert NAD83 Easting 2408462.25 Northing 574754.063</u>
GROUND SURFACE ELEVATION <u>753.5' MSL</u>	TOP OF INNER CASING <u>756.3' MSL</u>
GRANULAR BACKFILL MATERIAL <u>QUARTZ SAND, COURSE</u>	SLOT SIZE <u>.010 INCHES</u>
CASING MATERIAL <u>PVC</u>	CASING DIAMETER <u>2 INCHES</u>
DRILLING TECHNIQUE <u>AIR ROTARY & POWER AUGER</u>	DRILLING CONTRACTOR <u>HIGHLAND DRILLING & LAW ENGINEERING</u>
BOREHOLE DIAMETER <u>11 INCHES</u>	FIELD REPRESENTATIVE <u>H. W. ROBINSON</u>
LOCKABLE COVER ? <u>YES</u>	KEY CODE/COMBINATION <u>2043</u>
RISER MATERIAL <u>PVC</u>	SCREEN MATERIAL <u>PVC</u>
COMMENTS _____	

(NOT TO SCALE)

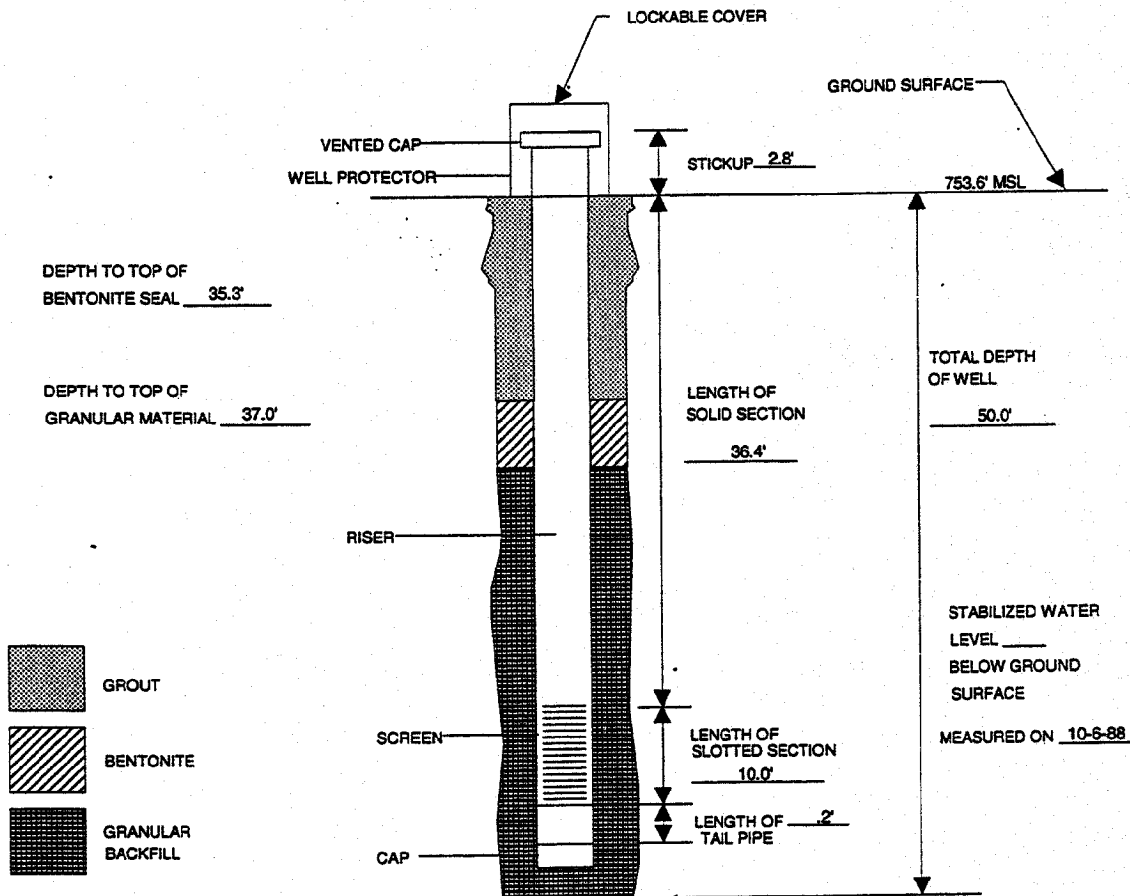


ENG LAB 10290

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT <u>KINGSTON STEAM PLANT</u>	JOB NUMBER <u>K-88195</u>
WELL NUMBER <u>J-10 B</u>	INSTALLATION DATE <u>9-23-88</u>
LOCATION <u>PLANT COORDINATES W 4+73, N 16+51</u>	Tennessee Lambert NAD83 Easting <u>2408462.25</u> Northing <u>574754.063</u>
GROUND SURFACE ELEVATION <u>753.6' MSL</u>	TOP OF INNER CASING <u>756.4' MSL</u>
GRANULAR BACKFILL MATERIAL <u>QUARTZ SAND, COURSE</u>	SLOT SIZE <u>.010 INCHES</u>
CASING MATERIAL <u>PVC</u>	CASING DIAMETER <u>2 INCHES</u>
DRILLING TECHNIQUE <u>POWER AUGER</u>	DRILLING CONTRACTOR <u>LAW ENGINEERING</u>
BOREHOLE DIAMETER <u>11 INCHES</u>	FIELD REPRESENTATIVE <u>H. W. ROBINSON</u>
LOCKABLE COVER ? <u>YES</u>	KEY CODE/COMBINATION <u>2043</u>
RISER MATERIAL <u>PVC</u>	SCREEN MATERIAL <u>PVC</u>
COMMENTS _____	

(NOT TO SCALE)

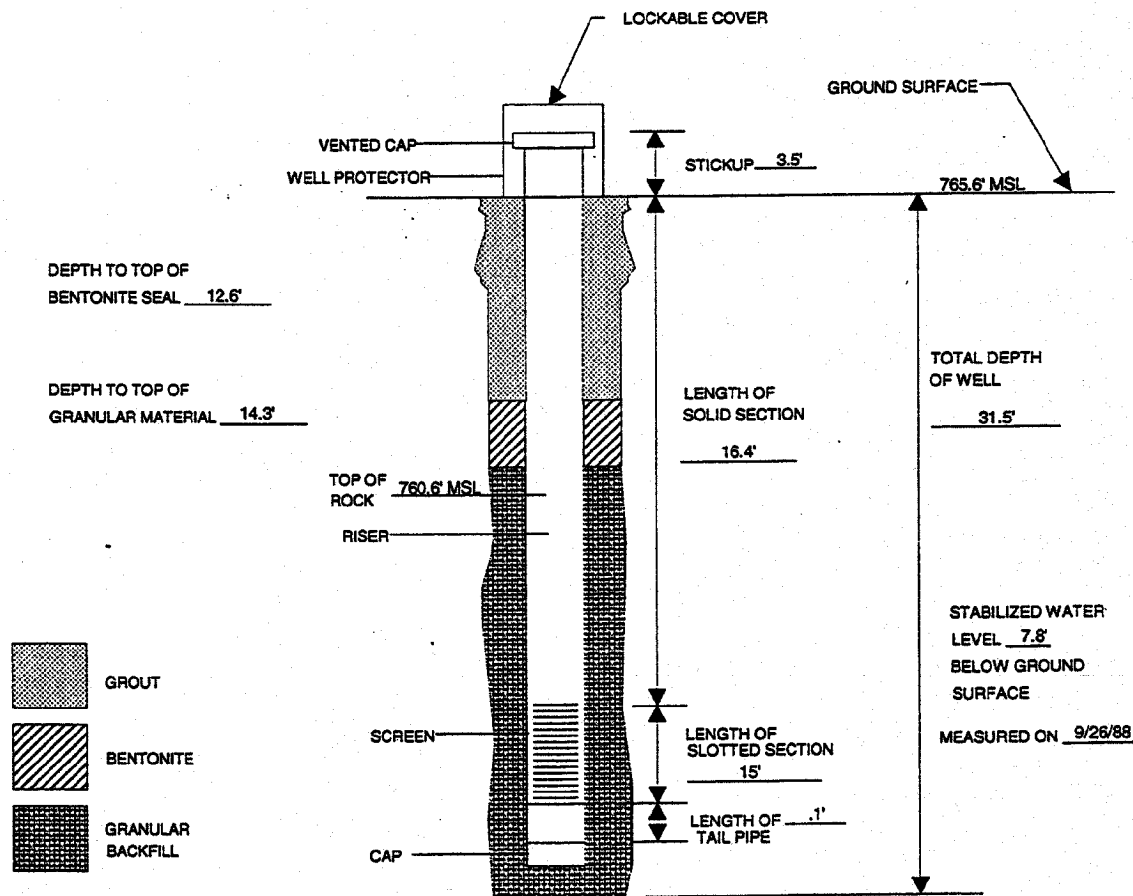


ENG LAB 10290

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT <u>KINGSTON STEAM PLANT</u>	JOB NUMBER <u>K-88195</u>
WELL NUMBER <u>J-11 B</u>	INSTALLATION DATE <u>9-19-88</u>
LOCATION <u>PLANT COORDINATES W 7+84, N 7+97</u>	
GROUND SURFACE ELEVATION <u>765.6' MSL</u>	TOP OF INNER CASING <u>769.1' MSL</u>
GRANULAR BACKFILL MATERIAL <u>QUARTZ SAND, COURSE</u>	SLOT SIZE <u>0.10 INCHES</u>
CASING MATERIAL <u>PVC</u>	CASING DIAMETER <u>2 INCHES</u>
DRILLING TECHNIQUE <u>AIRWATER ROTARY</u>	DRILLING CONTRACTOR <u>HIGHLAND DRILLING</u>
BOREHOLE DIAMETER <u>8 INCHES</u>	FIELD REPRESENTATIVE <u>H. W. ROBINSON</u>
LOCKABLE COVER ? <u>YES</u>	KEY CODE/COMBINATION <u>2043</u>
RISER MATERIAL <u>PVC</u>	SCREEN MATERIAL <u>PVC</u>
COMMENTS _____	

(NOT TO SCALE)

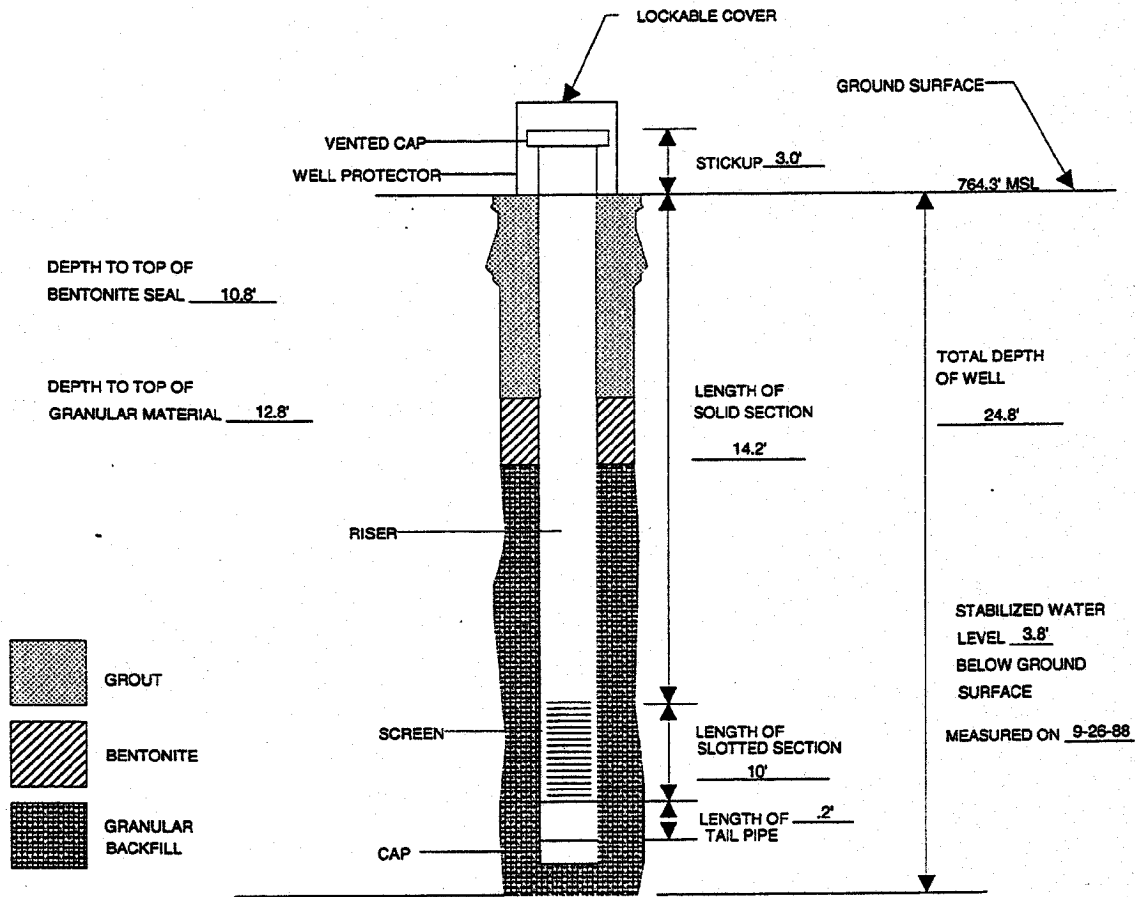


ENG LAB 10290

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT <u>KINGSTON STEAM PLANT</u>	JOB NUMBER <u>K-88195</u>
WELL NUMBER <u>J-12 A</u>	INSTALLATION DATE <u>9-22-88</u>
LOCATION <u>PLANT COORDINATES W 17+40, N 15+57</u>	<u>Tennessee Lambert NAD83 Easting 2407132.25 Northing 575644</u>
GROUND SURFACE ELEVATION <u>784.3' MLS</u>	TOP OF INNER CASING <u>767.3' MLS</u>
GRANULAR BACKFILL MATERIAL <u>QUARTZ SAND COURSE</u>	SLOT SIZE <u>.010 INCHES</u>
CASING MATERIAL <u>PVC</u>	CASING DIAMETER <u>2 INCHES</u>
DRILLING TECHNIQUE <u>POWER AUGER</u>	DRILLING CONTRACTOR <u>LAW ENGINEERING</u>
BOREHOLE DIAMETER <u>10 1/4 INCHES</u>	FIELD REPRESENTATIVE <u>H. W. ROBINSON</u>
LOCKABLE COVER ? <u>YES</u>	KEY CODE/COMBINATION <u>2043</u>
RISER MATERIAL <u>PVC</u>	SCREEN MATERIAL <u>PVC</u>
COMMENTS _____	

(NOT TO SCALE)

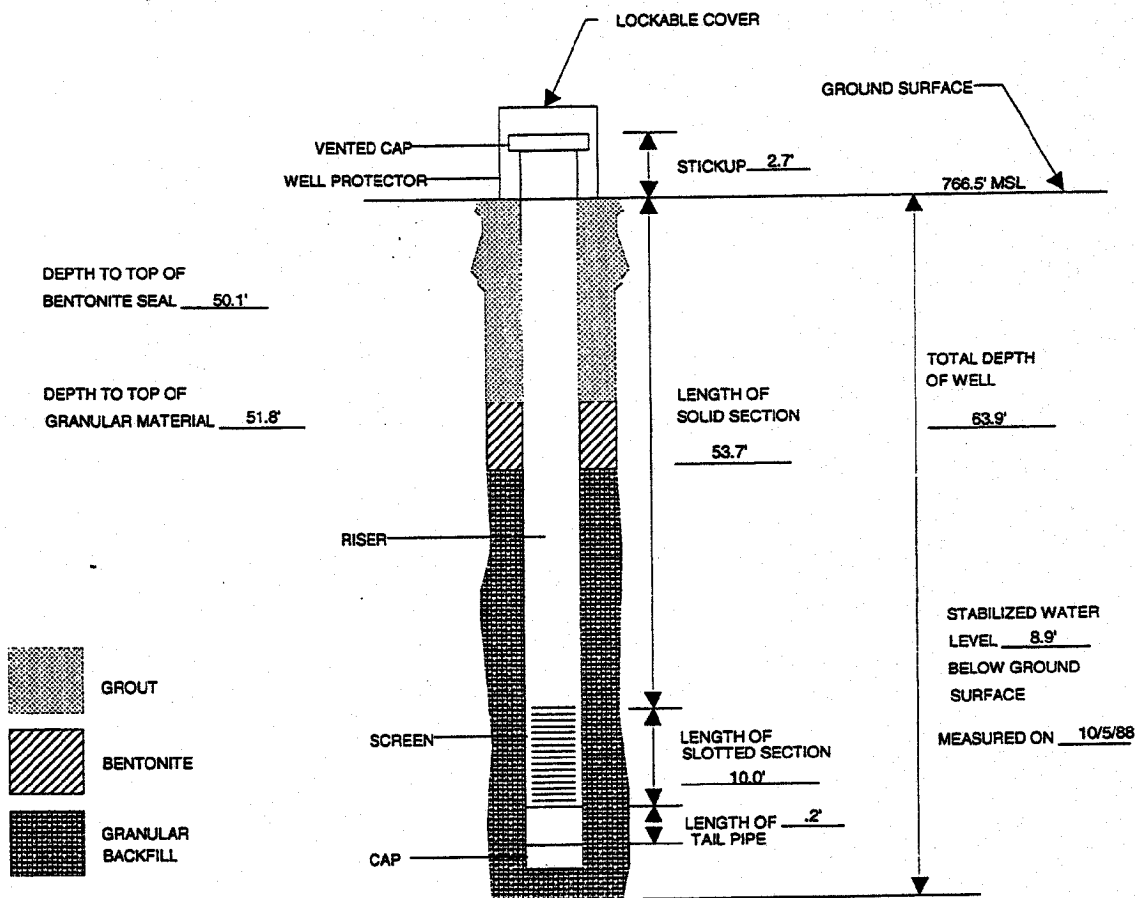


ENG LAB 102/80

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT KINGSTON STEAM PLANT JOB NUMBER K-88195
 WELL NUMBER J-13 A INSTALLATION DATE 9-28 TO 9-30-88
 LOCATION PLANT COORDINATES W 7+13, N 31+23 Tennessee Lambert NAD83 Easting 2408856.75 Northing 575872.44
 GROUND SURFACE ELEVATION 766.5' MSL TOP OF INNER CASING 769.2' MSL
 GRANULAR BACKFILL MATERIAL QUARTZ SAND, COARSE SLOT SIZE .010 INCH
 CASING MATERIAL PVC CASING DIAMETER 2 INCHES
 DRILLING TECHNIQUE POWER AUGER DRILLING CONTRACTOR LAW ENGINEERING
 BOREHOLE DIAMETER APPROXIMATELY 11 INCHES FIELD REPRESENTATIVE H. W. ROBINSON
 LOCKABLE COVER ? YES KEY CODE/COMBINATION 2043
 RISER MATERIAL PVC SCREEN MATERIAL PVC
 COMMENTS _____

(NOT TO SCALE)

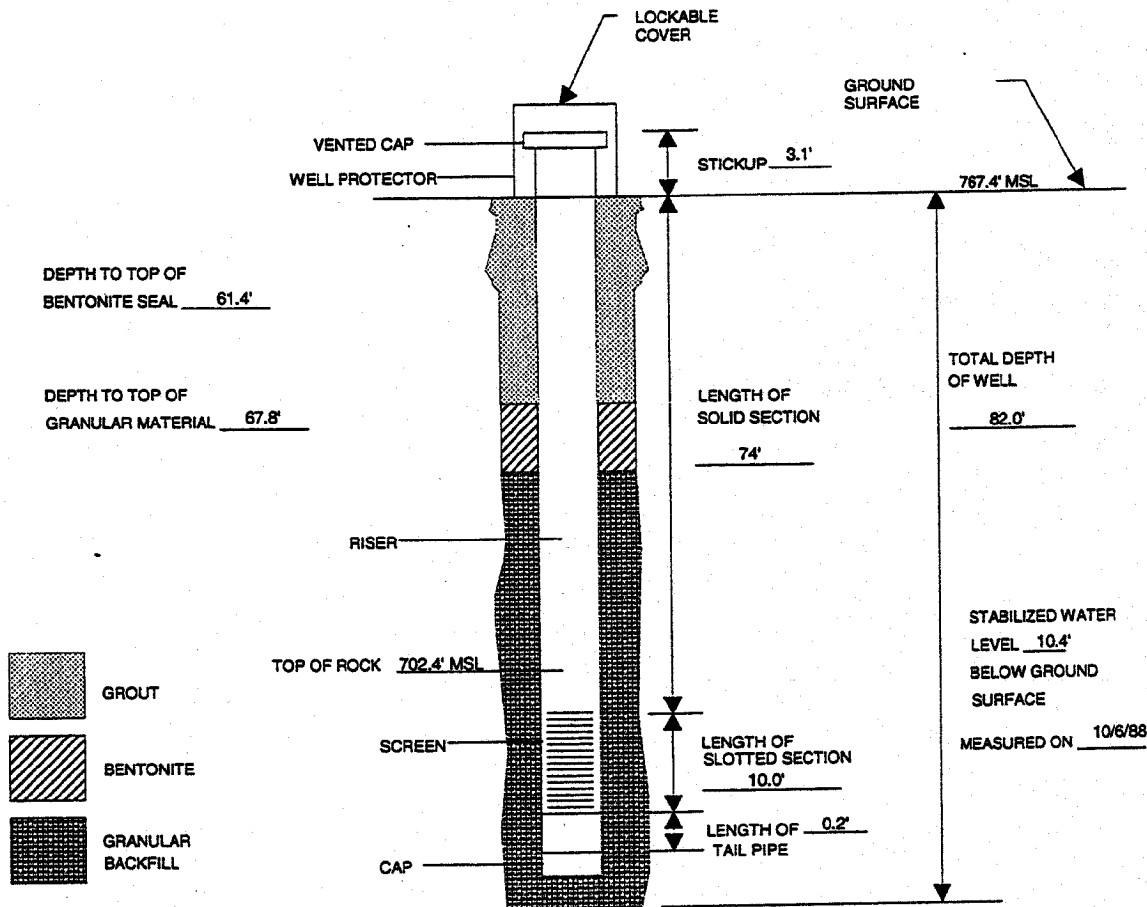


ENG LAB 10000

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT KINGSTON STEAM PLANT JOB NUMBER K-88195
 WELL NUMBER J-13 B INSTALLATION DATE 9-29 TO 9-30-88
 LOCATION PLANT COORDINATES W 7+34, N 31+04 Tennessee Lambert NAD83 Easting 2408856.25 Northing 575872.43
 GROUND SURFACE ELEVATION 767.4' MSL TOP OF INNER CASING 770.5' MSL
 GRANULAR BACKFILL MATERIAL QUARTZ SAND SLOT SIZE .010 INCH
 CASING MATERIAL PVC CASING DIAMETER 2 INCHES
 DRILLING TECHNIQUE AUGER AND AIR ROTARY DRILLING CONTRACTOR HIGHLAND DRILLING
 BOREHOLE DIAMETER 8" AUGER, 5 7/8" (ROLLER CONE) FIELD REPRESENTATIVE H.W. ROBINSON
 LOCKABLE COVER ? YES KEY CODE/COMBINATION 2043
 RISER MATERIAL PVC SCREEN MATERIAL PVC
 COMMENTS _____

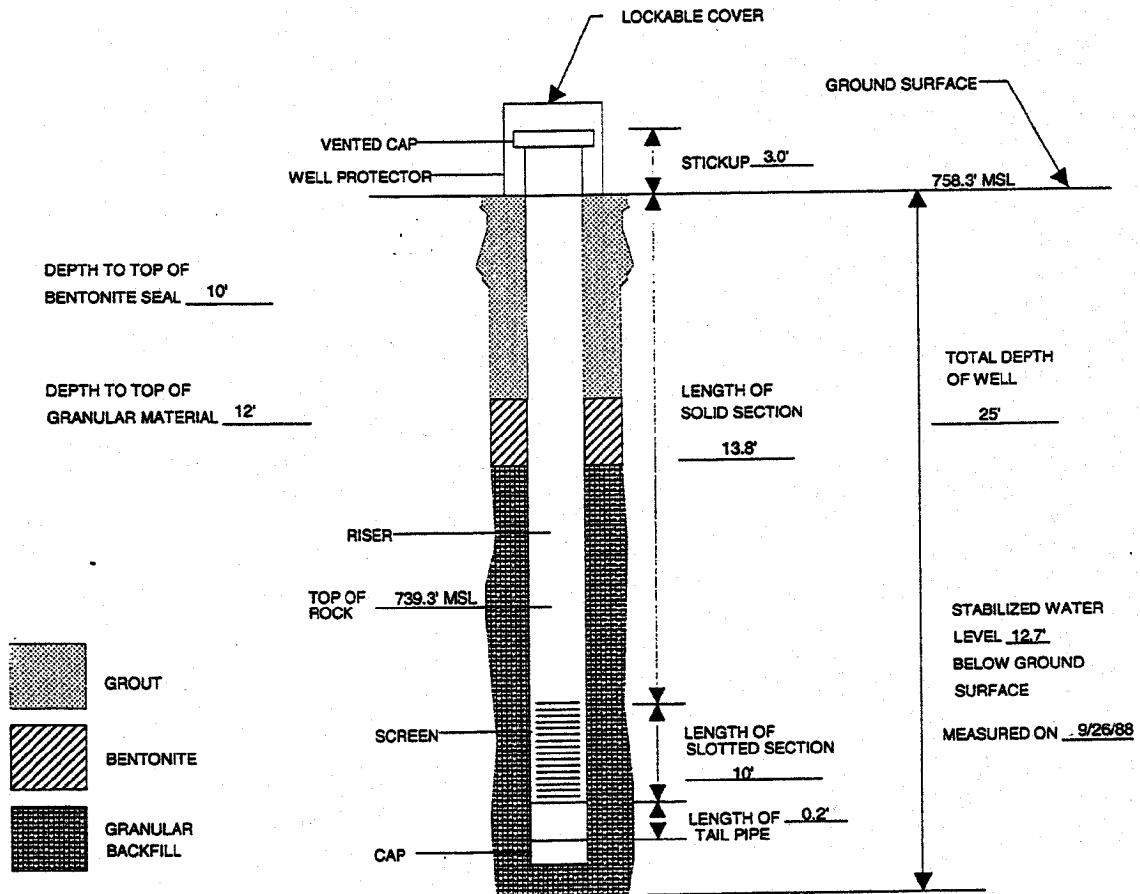
(NOT TO SCALE)



TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT <u>KINGSTON STEAM PLANT</u>	JOB NUMBER <u>K-88195</u>
WELL NUMBER <u>J-14 A</u>	INSTALLATION DATE <u>9-22-88</u>
LOCATION <u>PLANT COORDINATES W 30+46, N 37+49</u>	<u>Tennessee Lambert NAD83 Easting 2402915.5 Northing 571535.31</u>
GROUND SURFACE ELEVATION <u>758.3' MSL</u>	TOP OF INNER CASING <u>761.3' MSL</u>
GRANULAR BACKFILL MATERIAL <u>QUARTZ SAND, COARSE</u>	SLOT SIZE <u>.010 INCH</u>
CASING MATERIAL <u>PVC</u>	CASING DIAMETER <u>2 INCHES</u>
DRILLING TECHNIQUE <u>AIRWATER ROTARY</u>	DRILLING CONTRACTOR <u>HIGHLAND DRILLING</u>
BOREHOLE DIAMETER <u>8 INCHES</u>	FIELD REPRESENTATIVE <u>H.W. ROBINSON</u>
LOCKABLE COVER ? <u>YES</u>	KEY CODE/COMBINATION <u>2043</u>
RISER MATERIAL <u>PVC</u>	SCREEN MATERIAL <u>PVC</u>
COMMENTS _____	

(NOT TO SCALE)

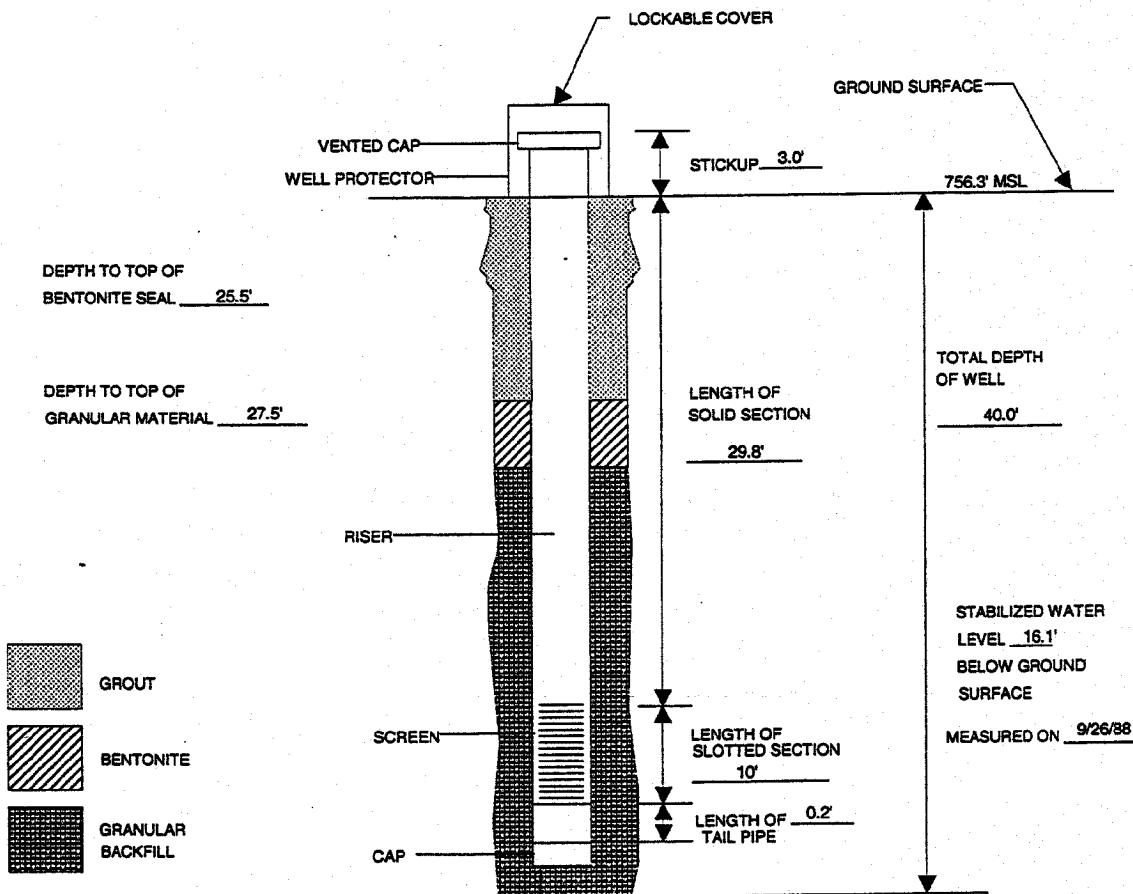


ENG LAB 102/88

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT <u>KINGSTON STEAM PLANT</u>	JOB NUMBER <u>K-88195</u>
WELL NUMBER <u>J-14 B</u>	INSTALLATION DATE <u>9-22-88</u>
LOCATION <u>PLANT COORDINATES W 30+56, S 37+80</u>	<u>Tennessee Lambert NAD83 Easting 2402915.5 Northing 571535.31</u>
GROUND SURFACE ELEVATION <u>758.3' MSL</u>	TOP OF INNER CASING <u>761.3' MSL</u>
GRANULAR BACKFILL MATERIAL <u>QUARTZ,SAND,COARSE</u>	SLOT SIZE <u>.010 INCH</u>
CASING MATERIAL <u>PVC</u>	CASING DIAMETER <u>2 INCHES</u>
DRILLING TECHNIQUE <u>AIR/WATER ROTARY</u>	DRILLING CONTRACTOR <u>HIGHLAND DRILLING</u>
BOREHOLE DIAMETER <u>8 INCHES</u>	FIELD REPRESENTATIVE <u>H.W. ROBINSON</u>
LOCKABLE COVER ? <u>YES</u>	KEY CODE/COMBINATION <u>2043</u>
RISER MATERIAL <u>PVC</u>	SCREEN MATERIAL <u>PVC</u>
COMMENTS _____	

(NOT TO SCALE)



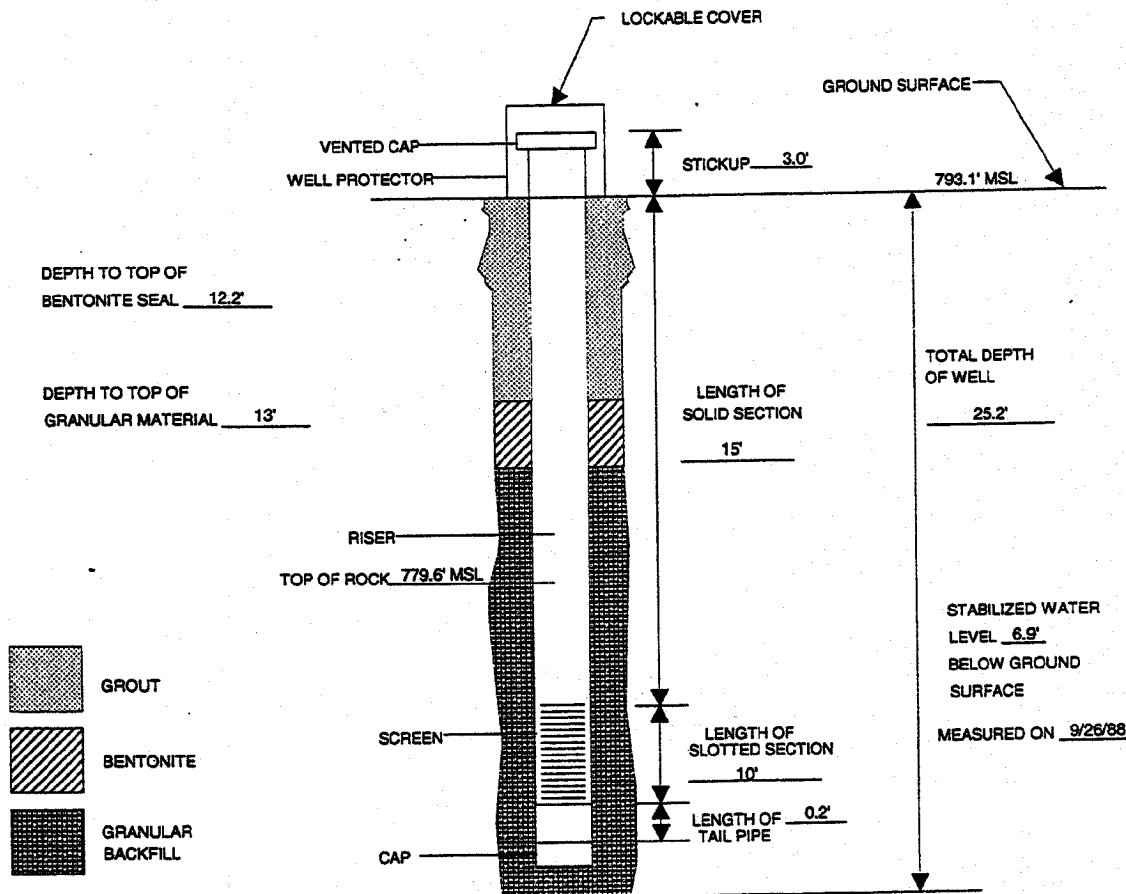
ENG LAB 102/80

TVA-00016867

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT <u>KINGSTON STEAM PLANT</u>	JOB NUMBER <u>K-88195</u>
WELL NUMBER <u>J-15 A</u>	INSTALLATION DATE <u>9-21-88</u>
LOCATION <u>PLANT COORDINATES W 24+39, N 6+35</u>	Tennessee Lambert NAD83 Easting <u>2406718</u> Northing <u>575840</u>
GROUND SURFACE ELEVATION <u>793.1' MSL</u>	TOP OF INNER CASING <u>796.1' MSL</u>
GRANULAR BACKFILL MATERIAL <u>QUARTZ SAND, COURSE</u>	SLOT SIZE <u>.010 INCH</u>
CASING MATERIAL <u>PVC</u>	CASING DIAMETER <u>2 INCHES</u>
DRILLING TECHNIQUE <u>AIR/WATER ROTARY</u>	DRILLING CONTRACTOR <u>HIGHLAND DRILLING</u>
BOREHOLE DIAMETER <u>8 INCHES</u>	FIELD REPRESENTATIVE <u>H.W. ROBINSON</u>
LOCKABLE COVER ? <u>YES</u>	KEY CODE/COMBINATION <u>2043</u>
RISER MATERIAL <u>PVC</u>	SCREEN MATERIAL <u>PVC</u>
COMMENTS _____	

(NOT TO SCALE)

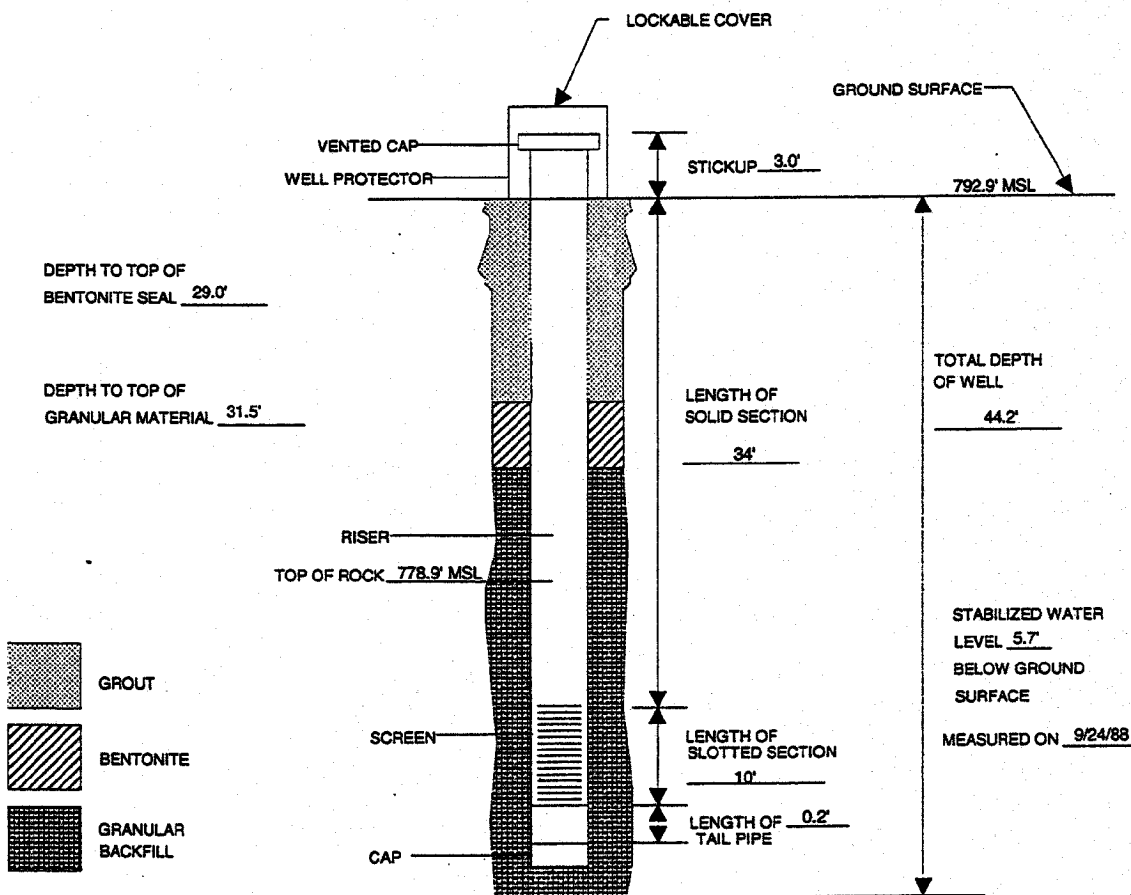


ENG LAB 10290

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT <u>KINGSTON STEAM PLANT</u>	JOB NUMBER <u>K-88195</u>
WELL NUMBER <u>J-15 B</u>	INSTALLATION DATE <u>9-21-88</u>
LOCATION <u>PLANT COORDINATES W 24+38, N 6+50</u>	<u>Tennessee Lambert NAD83 Easting 2406718 Northing 575840</u>
GROUND SURFACE ELEVATION <u>792.9' MSL</u>	TOP OF INNER CASING <u>795.9' MSL</u>
GRANULAR BACKFILL MATERIAL <u>QUARTZ SAND, COARSE</u>	SLOT SIZE <u>.010 INCH</u>
CASING MATERIAL <u>PVC</u>	CASING DIAMETER <u>2 INCHES</u>
DRILLING TECHNIQUE <u>AIR/WATER ROTARY</u>	DRILLING CONTRACTOR <u>HIGHLAND DRILLING</u>
BOREHOLE DIAMETER <u>8 INCHES</u>	FIELD REPRESENTATIVE <u>H.W. ROBINSON</u>
LOCKABLE COVER ? <u>YES</u>	KEY CODE/COMBINATION <u>2043</u>
RISER MATERIAL <u>PVC</u>	SCREEN MATERIAL <u>PVC</u>
COMMENTS _____	

(NOT TO SCALE)



ENG LAB 102/90

Law Engineering

Boring Record

BORING NUMBER J-16A
 DATE DRILLED 10-5-88
 JOB NUMBER K-88195
 PAGE 1 OF 2

DEPTH (FT.)	DESCRIPTION	ELEV. *	PENETRATION-BLOWS PER FOOT																	
			5	10	20	30	40	50	60	80	100	"N"								
0.2	TOPSOIL																			
	RED-BROWN AND BROWN SILTY CLAY - FILL																			
13.0	GRAY BROWN SILTY CLAY - FILL (SOME OF THE SOILS APPEAR TO BE ASSOCIATED WITH AN OLD ROAD SURFACE)	14.0																		
18.0	RED BROWN SANDY CLAY (SLURRY) - POSSIBLE RESIDUUM																			
40.0																				

REMARKS: * ELEVATION TO BE PROVIDED BY TVA

Law Engineering

Boring Record

BORING NUMBER J-16B
 DATE DRILLED 9-23-88
 JOB NUMBER K-RR195
 PAGE 1 OF 2

DEPTH (FT.)	DESCRIPTION	ELEV. *	PENETRATION-BLOWS PER FOOT																	
			5	10	20	30	40	50	60	80	100	"N"								
0.0	RED-BROWN SILTY CLAY WITH SMALL ROCK FRAGMENTS - FILL																			
10.0	RED TO RED-BROWN TO BROWN SILTY CLAY - FILL																			
20.5	BROWN SILTY CLAY - POSSIBLE TOPSOIL																			
22.0	GRAY AND BROWN SLURRY WITH ROCK FRAGMENTS																			
40.0																				

REMARKS: BORING ADVANCED USING AIR ROTARY EQUIPMENT
 * ELEVATION TO BE PROVIDED BY TVA

Law Engineering

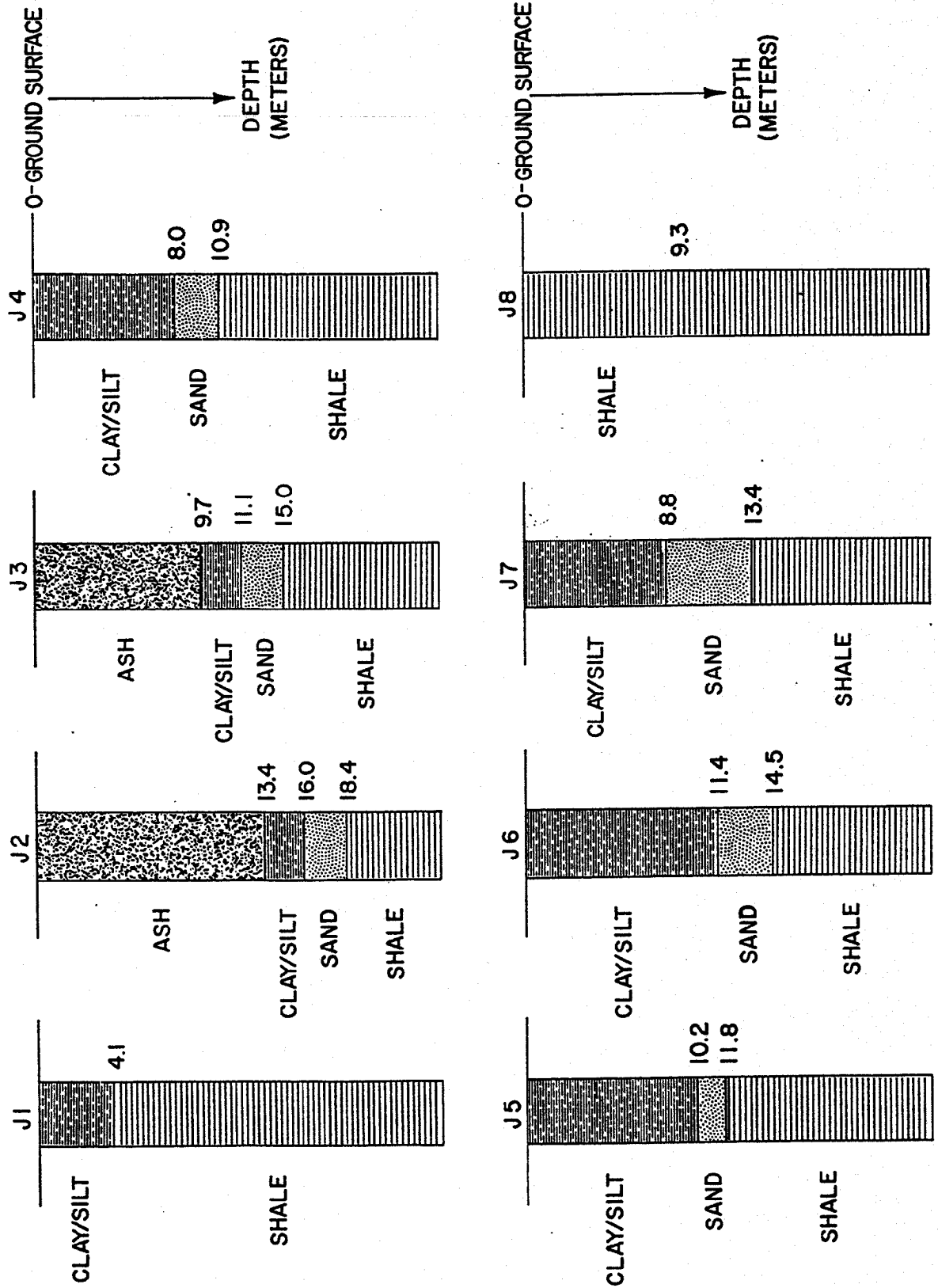
BORING NUMBER J-16B
 DATE DRILLED 9-23-88
 JOB NUMBER K-88195
 PAGE 2 OF 2

Boring Record

DEPTH (FT.)	DESCRIPTION	ELEV.	PENETRATION-BLOWS PER FOOT																				
			5	10	20	30	40	50	60	80	100	"N"											
41.0	CASING "BLEW-OUT" AROUND 41 FEET. THE BORING WAS OFFSET AND REDRILLED RED-BROWN, BROWN AND GRAY SILTY CLAY WITH SHALE FRAGMENTS																						
56.0	BROWN AND GRAY SHALE																						
73.0	BORING TERMINATED																						

REMARKS:

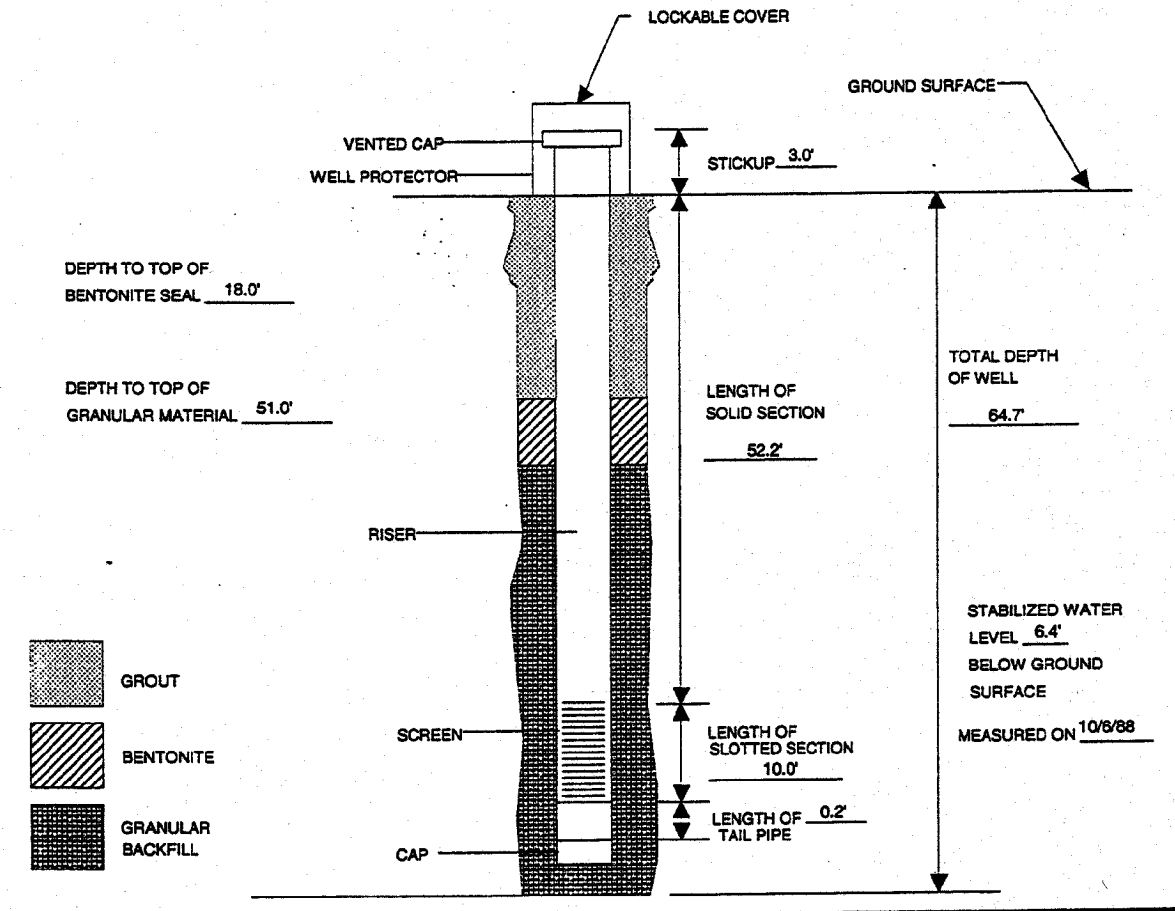
VERTICAL PROFILE OF THE SUBSTRATUM AT PLANT J's MONITORING WELL LOCATIONS



TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT <u>KINGSTON STEAM PLANT</u>	JOB NUMBER <u>K-88195</u>
WELL NUMBER <u>J-16 A</u>	INSTALLATION DATE <u>10-5-88</u>
LOCATION <u>PLANT COORDINATES W 27+87,N 40+08</u>	Tennessee Lambert NAD83 Easting <u>2407752</u> Northing <u>578181.56</u>
GROUND SURFACE ELEVATION <u>756.6' MSL</u>	TOP OF INNER CASING <u>768.6' MSL</u>
GRANULAR BACKFILL MATERIAL <u>QUARTZ SAND, COARSE</u>	SLOT SIZE <u>.010 INCH</u>
CASING MATERIAL <u>PVC</u>	CASING DIAMETER <u>2 INCHES</u>
DRILLING TECHNIQUE <u>POWER AUGER</u>	DRILLING CONTRACTOR <u>HIGHLAND DRILLING</u>
BOREHOLE DIAMETER <u>11 INCHES</u>	FIELD REPRESENTATIVE <u>H.W. ROBINSON</u>
LOCKABLE COVER ? <u>YES</u>	KEY CODE/COMBINATION <u>2043</u>
RISER MATERIAL <u>PVC</u>	SCREEN MATERIAL <u>PVC</u>
COMMENTS _____	

(NOT TO SCALE)

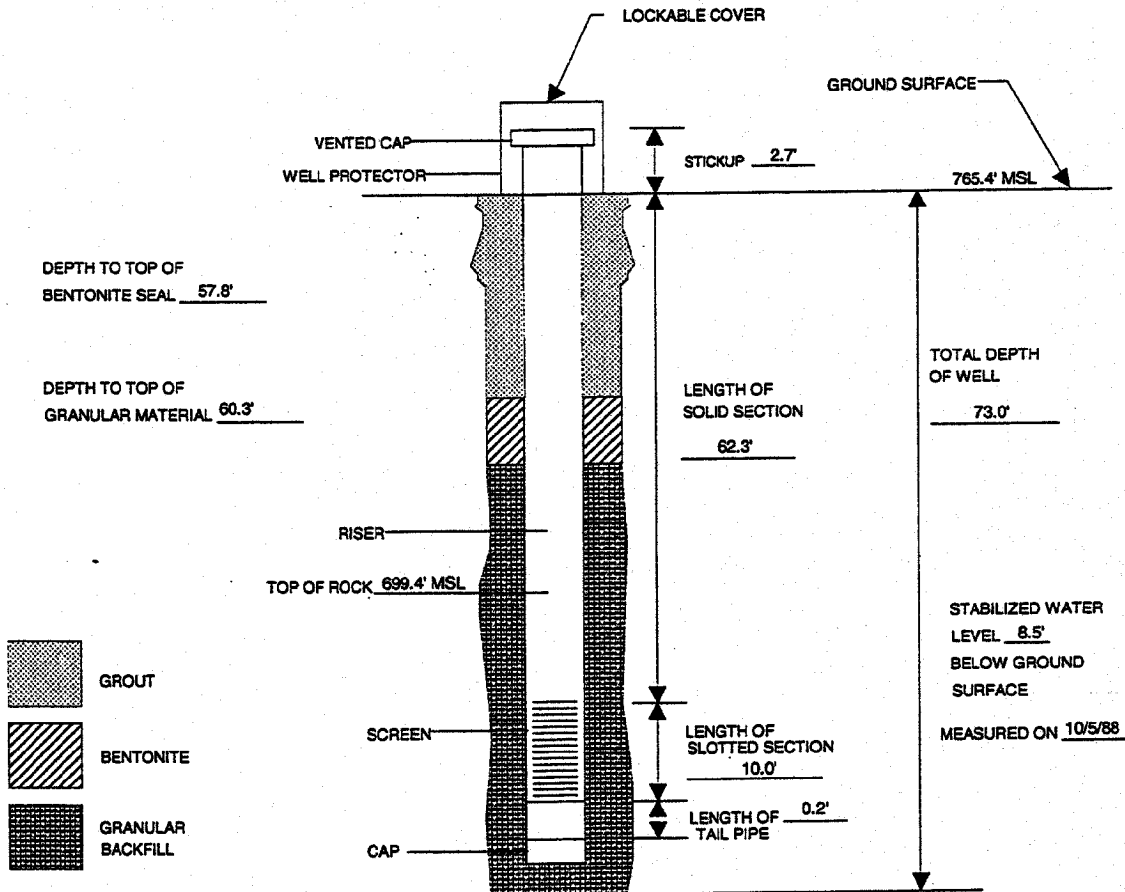


ENR LAB 102/86

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT <u>KINGSTON STEAM PLANT</u>	JOB NUMBER <u>K-88195</u>
WELL NUMBER <u>J-16 B</u>	INSTALLATION DATE <u>9-23-88</u>
LOCATION <u>PLANT COORDINATES W 27+80,N 40+34</u>	Tennessee Lambert NAD83 Easting <u>2407751</u> Northing <u>578181.05</u>
GROUND SURFACE ELEVATION <u>765.4' MSL</u>	TOP OF INNER CASING <u>768.1' MSL</u>
GRANULAR BACKFILL MATERIAL <u>QUARTZ SAND, COARSE</u>	SLOT SIZE <u>.010 INCHES</u>
CASING MATERIAL <u>PVC</u>	CASING DIAMETER <u>2 INCHES</u>
DRILLING TECHNIQUE <u>AUGER AND AIR ROTARY</u>	DRILLING CONTRACTOR <u>HIGHLAND DRILLING</u>
BOREHOLE DIAMETER <u>8" AUGER, 5 7/8" AIR ROTARY</u>	FIELD REPRESENTATIVE <u>H.W. ROBINSON</u>
LOCKABLE COVER ? <u>YES</u>	KEY CODE/COMBINATION <u>2043</u>
RISER MATERIAL <u>PVC</u>	SCREEN MATERIAL <u>PVC</u>
COMMENTS _____	

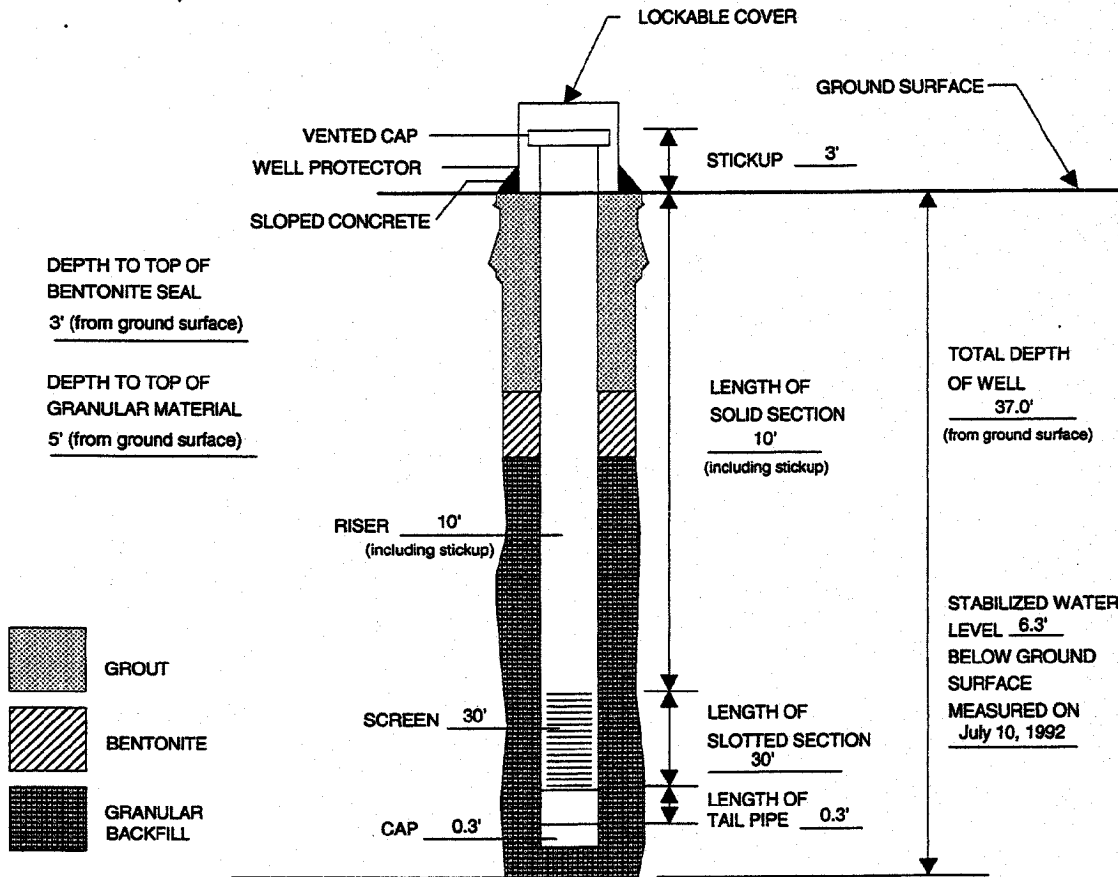
(NOT TO SCALE)



TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT	Kingston Fossil Plant		
WELL NUMBER	17	INSTALLATION DATE	July 8, 1992
LOCATION	Tennessee Lambert NAD83	Easting	2410795.25
		Northing	578066.65
GROUND SURFACE ELEVATION	762.42' MSL	TOP OF INNER CASING	765.42' MSL
GRANULAR BACKFILL MATERIAL	Sand	SLOT SIZE	0.010 "
CASING MATERIAL	4" SCH 40 PVC	CASING DIAMETER	4" SCH 40 PVC
DRILLING TECHNIQUE	HSA	DRILLING CONTRACTOR	John Voekel, Law Engr.
BOREHOLE DIAMETER	4.25" HSA (ID)	FIELD REPRESENTATIVE	Mel Wagner
LOCKABLE COVER ?	Yes	FILTER CLOTH AROUND SCREEN?	No
COMMENTS	The 4.25" HSA was used first with the continuous sampling barrel.		
	Next, the 6.25" (ID) auger was used to provide room for the sand pack around the screen.		

(NOT TO SCALE)

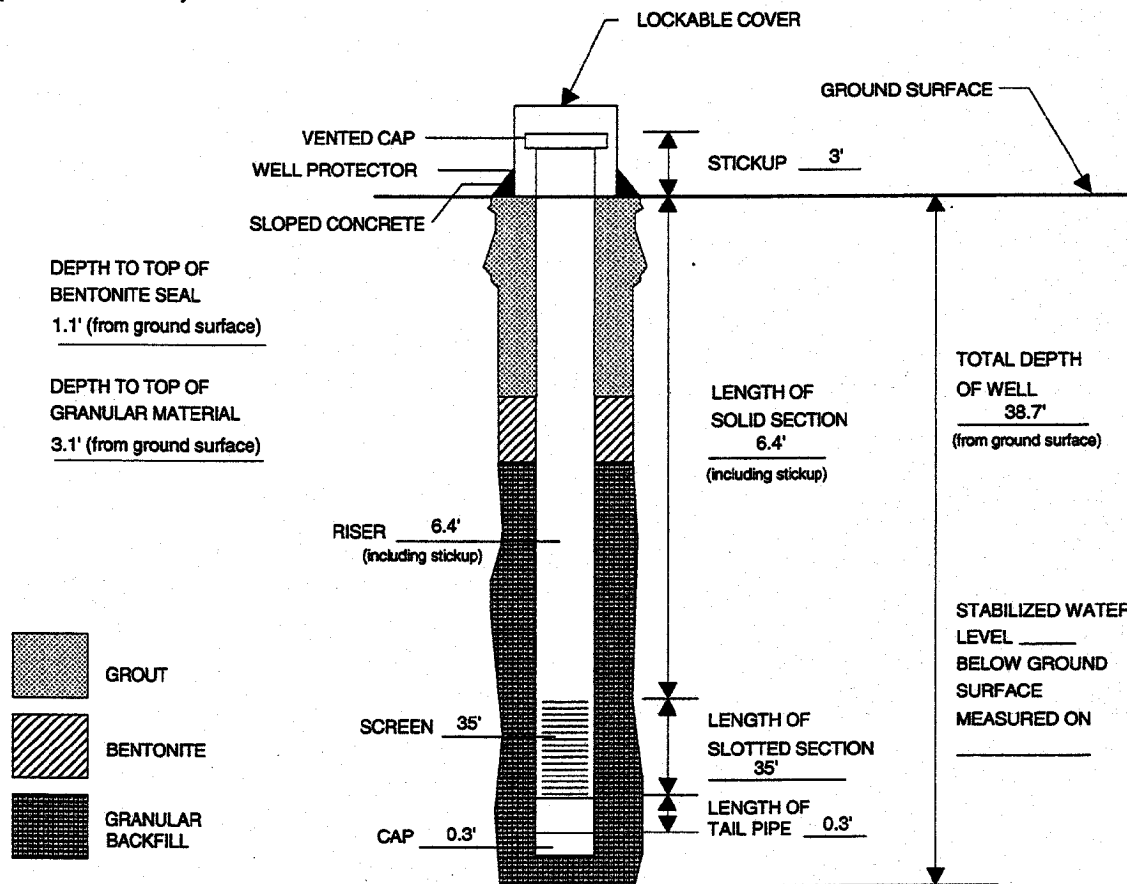


ENG LAB 6/10/92

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT	Kingston Fossil Plant		
WELL NUMBER	18	INSTALLATION DATE	July 10, 1992
LOCATION	Tennessee Lambert NAD83	Easting	2410814.93
		Northing	578075.63
GROUND SURFACE ELEVATION	764.32' MSL	TOP OF INNER CASING	767.32' MSL
GRANULAR BACKFILL MATERIAL	Sand	SLOT SIZE	0.010 "
CASING MATERIAL	4" SCH 40 PVC	CASING DIAMETER	4" SCH 40 PVC
DRILLING TECHNIQUE	HSA	DRILLING CONTRACTOR	John Voekel, Law Engr.
BOREHOLE DIAMETER	4.25" HSA (ID)	FIELD REPRESENTATIVE	Mel Wagner
LOCKABLE COVER ?	Yes	FILTER CLOTH AROUND SCREEN?	No
COMMENTS	The 4.25" HSA was used first with the continuous sampling barrel.		
	Next, the 6.25" (ID) auger was used to provide room for the sand pack around the screen.		

(NOT TO SCALE)

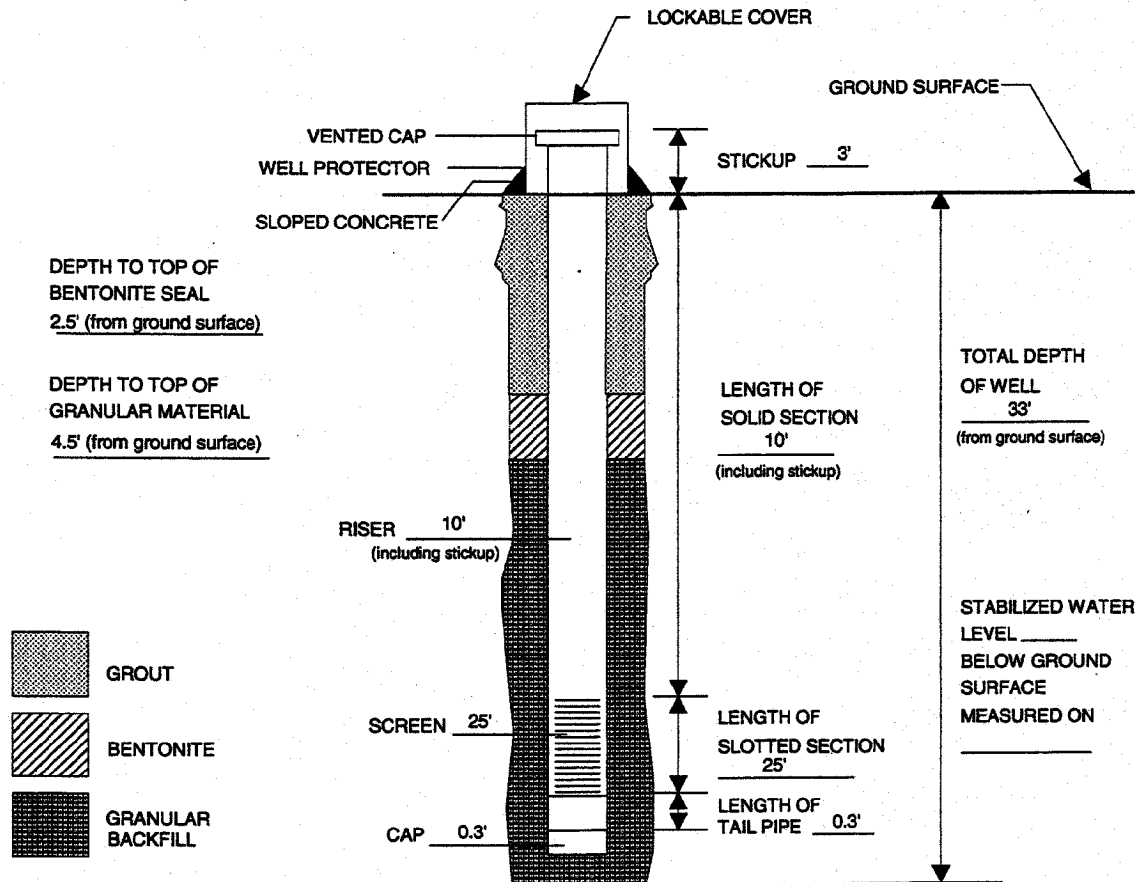


ENG LAB 6719/95

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT	Kingston Fossil Plant		
WELL NUMBER	19	INSTALLATION DATE	July 13, 1992
LOCATION	Tennessee Lambert NAD83	Easting	2410840.11 Northing 578086.78
GROUND SURFACE ELEVATION	763.90' MSL	TOP OF INNER CASING	766.90' MSL
GRANULAR BACKFILL MATERIAL	Sand	SLOT SIZE	0.010 "
CASING MATERIAL	4" SCH 40 PVC	CASING DIAMETER	4" SCH 40 PVC
DRILLING TECHNIQUE	HSA	DRILLING CONTRACTOR	John Voekel, Law Engr.
BOREHOLE DIAMETER	4.25" HSA (ID)	FIELD REPRESENTATIVE	Mel Wagner
LOCKABLE COVER ?	Yes	FILTER CLOTH AROUND SCREEN?	No
COMMENTS	The 4.25" HSA was used first with the continuous sampling barrel. Next, the 6.25" (ID) auger was used to provide room for the sand pack around the screen.		

(NOT TO SCALE)

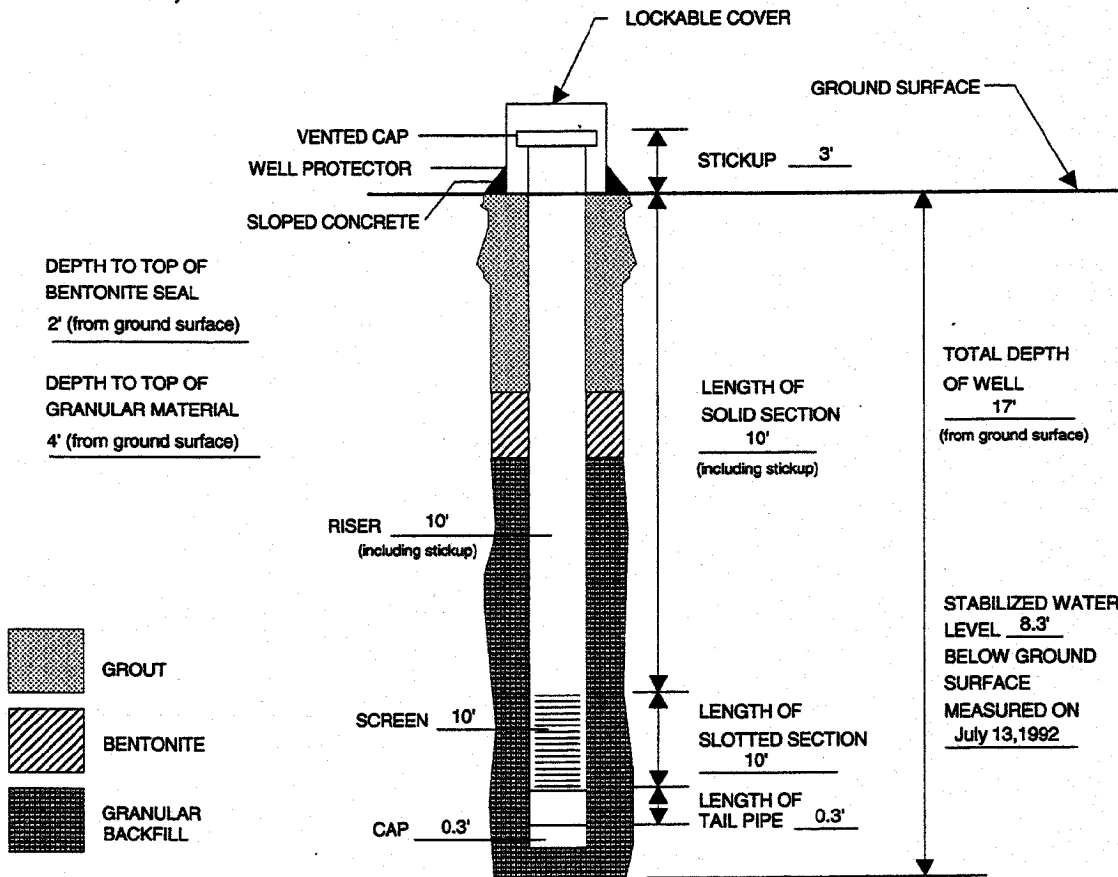


ENG LAB 8/19/95

TYPE II MONITORING WELL INSTALLATION RECORD

PROJECT	Kingston Fossil Plant		
WELL NUMBER	20	INSTALLATION DATE	July 10, 1992
LOCATION	Tennessee Lambert NAD 83	Easting	2410890.94
		Northing	578108.22
GROUND SURFACE ELEVATION	750.06' MSL	TOP OF INNER CASING	753.06' MSL
GRANULAR BACKFILL MATERIAL	Sand	SLOT SIZE	0.010"
CASING MATERIAL	4" SCH 40 PVC	CASING DIAMETER	4" SCH 40 PVC
DRILLING TECHNIQUE	HSA	DRILLING CONTRACTOR	John Voekel, Law Engr.
BOREHOLE DIAMETER	4.25" HSA (ID)	FIELD REPRESENTATIVE	Mel Wagner
LOCKABLE COVER ?	Yes	FILTER CLOTH AROUND SCREEN?	No
COMMENTS	The 4.25" HSA was used first with the continuous sampling barrel.		
	The 6.25" HSA was not used because the well was drilled in a clay-filled berm.		

(NOT TO SCALE)



ENG LAB 6/19/95

MONITORING WELL INSTALLATION RECORD

PROJECT Kingston Fossil Plant

WELL NUMBER KIF-22 INSTALLATION DATE July 10, 2002

TOP OF INNER CASING 756.2 ft-msl CASING MATERIAL PVC Sch 80

DRILLING TECHNIQUE Hollow-Stem Auger BOREHOLE DIAMETER 8 1/4 in.

DRILLED BY Lynn England LOGGED BY Jim Overton

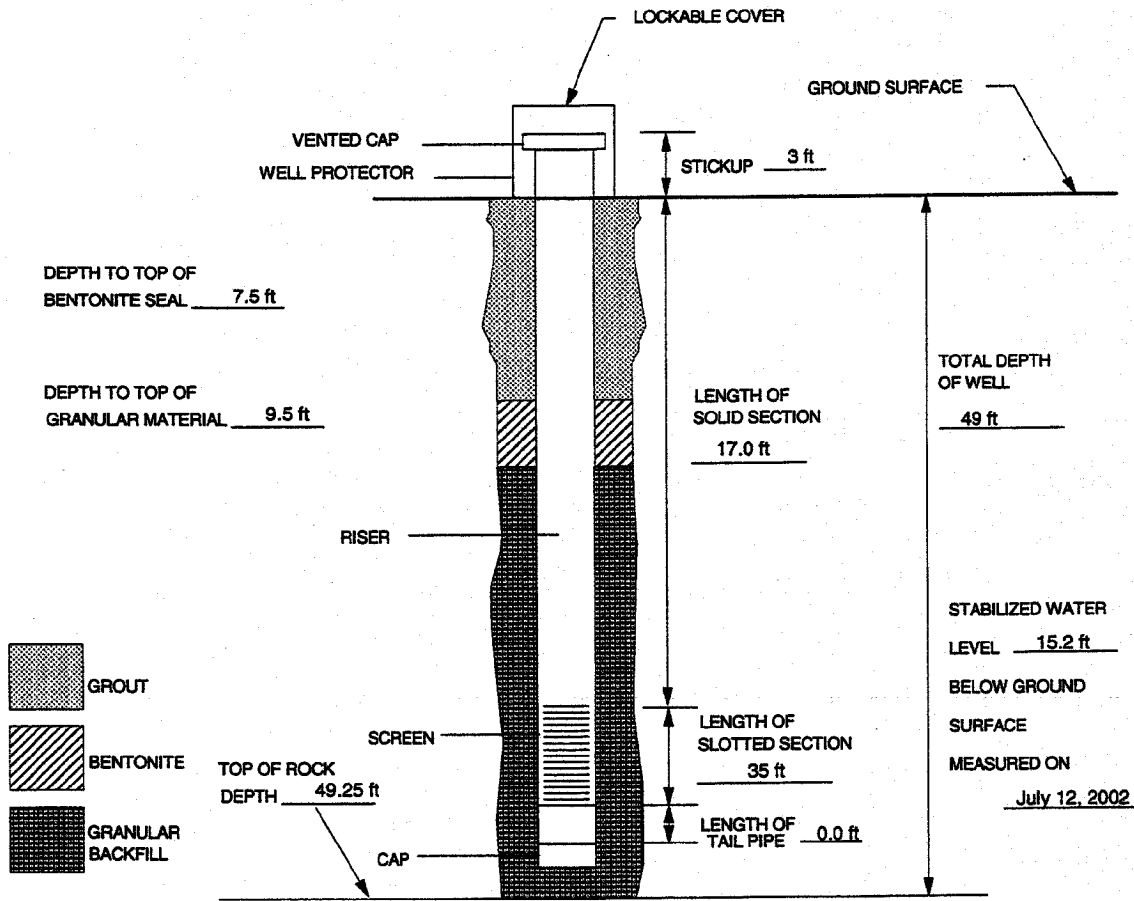
COMMENTS Filter sand was placed into the annulus from the bottom up with a sand injector.

Soil descriptions were taken from split spoon sampler.

Well completed with 4 inch by 4 inch by 5 foot lockable steel well protector and a 4 foot diameter concrete pad.

Four steel bollards were placed around the concrete pad.

(NOT TO SCALE)



APPENDIX C

SOIL GRAIN SIZE, MOISTURE CONTENT, AND ATTERBERG LIMITS DATA

**This information taken from "Report of Geotechnical Exploration – Ash Disposal Area –
Kingston Fossil Plant, Kingston, Tennessee," MACTEC Engineering and Consulting, Inc.,
May 4, 2004.**

LABORATORY TEST PROCEDURES

Moisture Content

The moisture content in a given mass of soil is the ratio, expressed as a percentage, of the weight of the water to the weight of the solid particles. This test was conducted in accordance with ASTM D 2216.

Unit Weights

The moist or dry unit weight of a given soil mass is obtained by dividing the weight of the soil mass by the volume. Selected portions of the 3-inch split spoon and Shelby tube samples obtained during the exploration were measured and weighed in our laboratory to determine sample unit weights.

Specific Gravity of Soil Solids

The specific gravity of soil solids is the ratio of the mass of a unit volume of a soil solid to the mass of the same volume of gas-free distilled water at 20C. The test method for determining the specific gravity of soil solids that passes the 4.75-mm (No. 4) sieve using a water pycnometer is described in ASTM D 854, Method B, and "Test Methods for Specific Gravity of Soil Solids by Water Pycnometer".

Atterberg Limits

Originally, the Atterberg Limits consisted of seven "limits of consistency" of fine-grained soils. In current engineering usage, the term usually refers only to the liquid limit (LL) and plastic limit (PL). The LL (between the liquid and plastic states) is the water content at which a trapezoidal groove of specified shape, cut in moist soil held in a special cup, is closed after 25 taps on a hard rubber plate. The PL (between plastic and semi-solid states) is the water content at which the soil crumbles when rolled into threads of 1/8 inch in diameter.

The LL has been found to be proportional to the compressibility of the normally consolidated soil. The PI is the calculated difference in water contents between the LL and the PL. Together the LL and PI are used to classify silts and clays according to the Unified Soil Classification System

(ASTM D 2487). The PI is used to predict the potential for volume changes in confined soils beneath foundations or grade slabs. The LL, PL, and PI are determined in accordance with ASTM D 4318.

Grain Size Distribution

Grain Size Tests are performed to aid in determining the soil classification and the grain size distribution. The soil samples are prepared for testing according to ASTM D 421 (dry preparation) or ASTM D 2217 (wet preparation). If only the grain size distribution of soils coarser than a number 200 sieve (0.074-mm opening) is desired, the grain size distribution is determined by washing the sample over a number 200 sieve and, after drying, passing the samples through a standard set of nested sieves. If the grain size distribution of the soils finer than the number 200 sieve is also desired, the grain size distribution of the soils coarser than the number 10 sieve is determined by passing the sample through a set of nested sieves. Materials passing the number 10 sieve are dispersed with a dispersing agent and suspended in water, and the grain size distribution calculated from the measured settlement rate of the particles. These tests are conducted in accordance with ASTM D 422.

Triaxial Shear Tests

Triaxial shear tests are used to determine the strength characteristics and friction angle of a given soil sample. Triaxial tests are also used to determine the elastic properties of the soil specimen.

Triaxial shear tests are performed on several sections of a relatively undisturbed sample extruded from the sampling tube. The samples are trimmed into cylinders 1.4 to 2.8 inches in diameter and encased in rubber membranes. Each is then placed in a compression chamber and confined by all-around air pressure. The test results are presented in the form of stress-strain curves and Mohr envelopes, or p-q plots on the accompanying Triaxial Shear Test Sheets.

One of three types of triaxial tests is normally performed, the most suitable type being determined by the loading conditions imposed on the soil in the field and the soil characteristics.

1. Consolidated-Undrained (Designated as a CU or R Test)
2. Consolidated-Drained (designated as a CD or S Test)
3. Unconsolidated-Undrained (designated as a UU or Q Test)

Consolidation Test

Consolidation tests are conducted on representative soil samples to determine the change in height of the sample with increasing load. The results of these tests are used to estimate the amount and rate of settlement of structures constructed on similar soils.

A consolidation test is conducted according to ASTM D-2435 on a single section of an undisturbed sample extruded from a sample tube. The sample is trimmed into a disc 2.0 or 2.5 inches in diameter and 1 inch thick. The disc is confined in a steel ring and sandwiched between porous plates. Depending on the conditions in the field, the test may be conducted with a sample either at its natural moisture content or saturated. It is then subjected to incrementally increasing vertical loads, and the resulting deformations are measured with a micrometer dial gauge. Void ratios are then calculated from these deformation readings. The test results are presented in the form of pressure-versus-void-ratio curves on the accompanying Consolidation Test Sheet.

Falling Head Permeability Test

The test sample was taken from the bottom of the undisturbed sample. The physical dimensions and weight were obtained and the sample was encased in a rubber membrane and placed in a triaxial chamber. The sample was then back-pressure saturated until a B value of 0.95 or greater was reached. After saturation was obtained, the sample was consolidated under 10-psi confining stress. Upon completion of consolidation, a falling head permeability test was performed. The test was conducted in accordance with ASTM D 5084.

**TABLE 3
 NATURAL MOISTURE CONTENT AND
 ATTERBERG LIMITS LABORATORY TEST RESULTS**

Boring Number	Sample Number	Sample Type	Sample Description/ Origin	Sample Depth (Feet)	Moisture Content (%)	Atterberg Limits		
						Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)
B-1	UD-1	UD	ASH	4-4.5	19	NT	NT	NT
B-1	UD-2	UD	Alluvium	65-67	20	NV	NP	NP
B-2	UD-4	UD	Alluvium	70-72	17	NV	NP	NP
B-3	1	SPT	ASH	0-1.5	24	NT	NT	NT
B-3	2	SPT	ASH	5-6.5	20	NT	NT	NT
B-3	3	SPT	ASH	10-11.5	16	NT	NT	NT
B-3	4	SPT	ASH	15-16.5	17	NT	NT	NT
B-3	5	SPT	ASH	20-21.5	39	NT	NT	NT
B-3	6	SPT	ASH	25-26.5	40	NT	NT	NT
B-3	7	SPT	ASH	30-31.5	34	NT	NT	NT
B-3	8	SPT	ASH	35-36.5	22	NT	NT	NT
B-3	9	SPT	ASH	40-41.5	22	NT	NT	NT
B-3	10	SPT	ASH	45-46.5	31	NT	NT	NT
B-3	11	SPT	ASH	50-51.5	39	NT	NT	NT
B-3	12	SPT	ASH	55-56.5	43	NT	NT	NT
B-3	13	SPT	FILL/ASH	60-61.5	30	NT	NT	NT
B-3	14	SPT	ASH	65-66.5	16	NT	NT	NT
B-4A	UD-1	UD	ASH	15-17	37	NT	NT	NT
B-4A	UD-3	UD	ASH	25-27	38	NT	NT	NT
B-5	1	SPT	ASH	0-1.5	22	NT	NT	NT
B-5	2	SPT	ASH	5-6.5	39	NT	NT	NT
B-5	3	SPT	ASH	10-11.5	25	NT	NT	NT
B-5	4	SPT	ASH	15-16.5	32	NT	NT	NT
B-5	5	SPT	ASH	20-21.5	30	NT	NT	NT
B-5	6	SPT	ASH	25-26.5	39	NT	NT	NT
B-5	7	SPT	ASH	30-31.5	41	NT	NT	NT
B-5	8	SPT	ASH	35-36.5	29	NT	NT	NT
B-5	9	SPT	ASH	40-41.5	34	NT	NT	NT
B-8	1	SPT	ASH	0-1.5	25	NT	NT	NT
B-8	2	SPT	ASH	5.8-7.3	20	NT	NT	NT
B-8	UD-2	UD	ASH	10-12	19	NT	NT	NT
B-8	3	SPT	ASH	12-13.5	22	NT	NT	NT
B-8	4	SPT	ASH	15-16.5	45	NT	NT	NT
B-8	UD-3	UD	ASH	20-22	32	NT	NT	NT

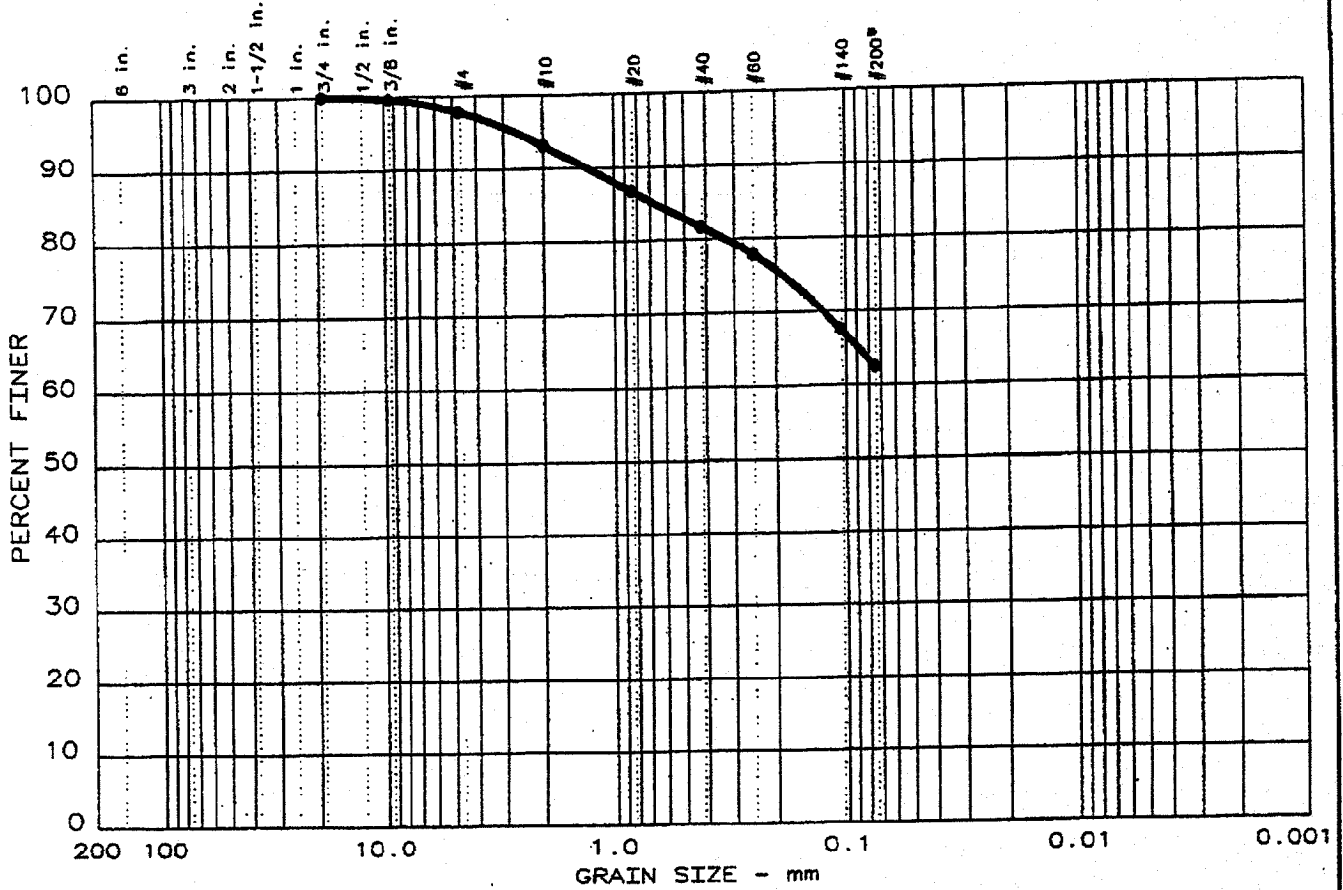
**TABLE 3
 NATURAL MOISTURE CONTENT AND
 ATTERBERG LIMITS LABORATORY TEST RESULTS**

Boring Number	Sample Number	Sample Type	Sample Description/ Origin	Sample Depth (Feet)	Moisture Content (%)	Atterberg Limits		
						Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)
B-8	5	SPT	ASH	22-23.5	43	NT	NT	NT
B-8	6	SPT	ASH	25.6-27.1	27	NT	NT	NT
B-8	7	SPT	ASH	30-31.5	25	NT	NT	NT
B-8A	1	SPT	ASH	35-36.5	37	NT	NT	NT
B-8A	2	SPT	ASH	40-41.5	47	NT	NT	NT
B-8A	3	SPT	ASH	45-46.5	37	NT	NT	NT
B-8A	4	SPT	ASH	50-51.5	36	NT	NT	NT
B-8A	5	SPT	Alluvium	57-58.5	24	26	15	11
B-8A	6	SPT	Alluvium	62-63.5	24			
B-8A	UD-2	UD	Alluvium	60-62	22	26	16	10
B-8A	7	SPT	Alluvium	65-66.5	27	NV	NP	NP
B-8A	8	SPT	Alluvium	70-70.9	17			
B-10	1	SPT	ASH	0-1.5	18	NT	NT	NT
B-10	UD-1	UD	ASH	5-7	25	NT	NT	NT
B-10	2	SPT	ASH	7-8.5	28	NT	NT	NT
B-10	UD-2	UD	ASH	10-12	25	NT	NT	NT
B-10	3	SPT	ASH	12-13.5	30	NT	NT	NT
B-10	UD-3	UD	ASH	15-17	38	NT	NT	NT
B-10	4	SPT	ASH	17-18.5	45	NT	NT	NT
B-10	UD-4	UD	ASH	20-22	37	NT	NT	NT
B-10	5	SPT	ASH	22-23.5	32	NT	NT	NT
B-10	6	SPT	ASH	25-26.5	48	NT	NT	NT
B-10	7	SPT	Alluvium	30-31.5	25	NT	NT	NT
B-10	UD-5	UD	Alluvium	35-37	22	NV	NP	NP
B-10	8	SPT	Alluvium	37-38.5	20	NT	NT	NT

NT - Not Tested
 NV - Non-Viscous
 NP - Non-Plastic
 SPT - Standard Penetration Test

Prepared By CTJ Date 5/4/04 Checked By mbh Date 5/4/04

PARTICLE SIZE ANALYSIS REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 15	0.0	2.2	35.3	62.5	

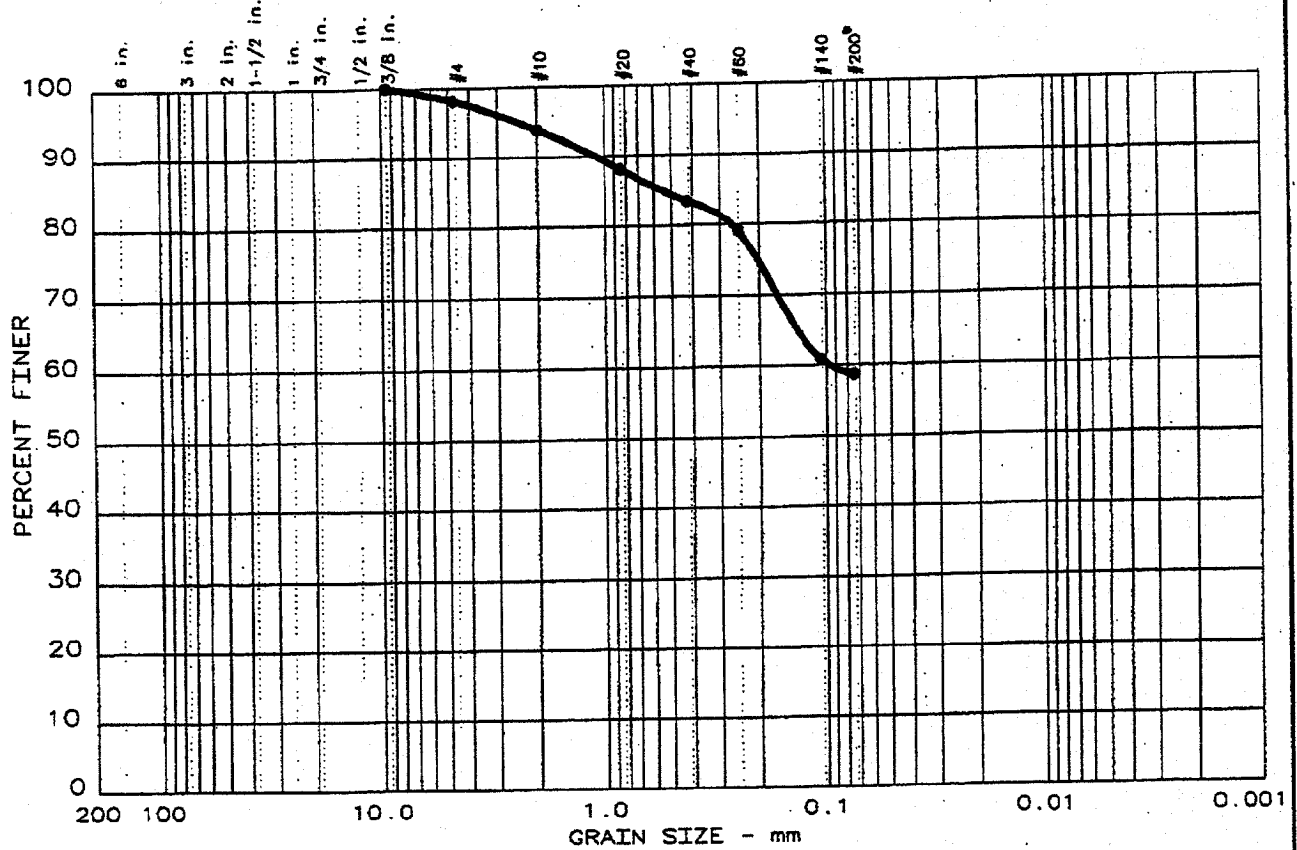
LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
● NV	NP	0.668							

MATERIAL DESCRIPTION	USCS	AASHTO
● Grey Bottom Ash with Fly Ash		

Project No.: 3043-04-1009.0001
 Project: TVA Kingston Ash Disposal Area
 ● Location: B-1A & B Bulk @ 0'-5'
 Date: 04-19-04

Remarks:
 Specific Gravity: 2.35

PARTICLE SIZE ANALYSIS REPORT



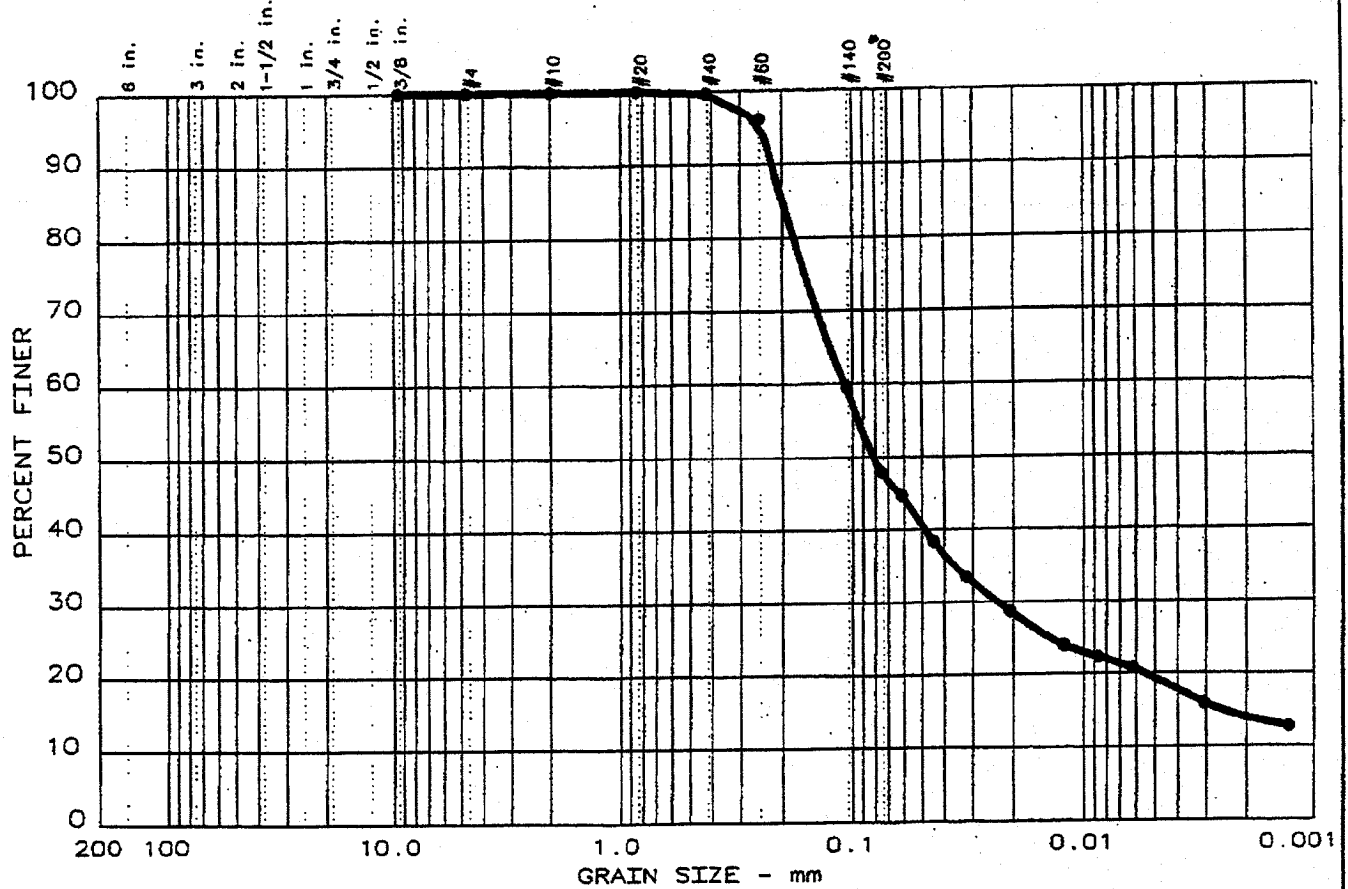
Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 6	0.0	1.8	39.4	58.8	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
● NV	NP	0.550	0.0966						

MATERIAL DESCRIPTION	USCS	AASHTO
● Grey Fly Ash with Bottom Ash		

<p>Project No.: 3043-04-1009.0001 Project: TVA Kingston Ash Disposal Area ● Location: B-1 UD @ 4'-4.5'</p> <p>Date: 04-19-04</p> <p style="text-align: center;">PARTICLE SIZE ANALYSIS REPORT LAW ENGINEERING AND ENVIRONMENTAL SERVICES</p>	<p>Remarks: Moisture Content: 19.0%</p> <p>Fig. No.: _____</p>
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PARTICLE SIZE ANALYSIS REPORT



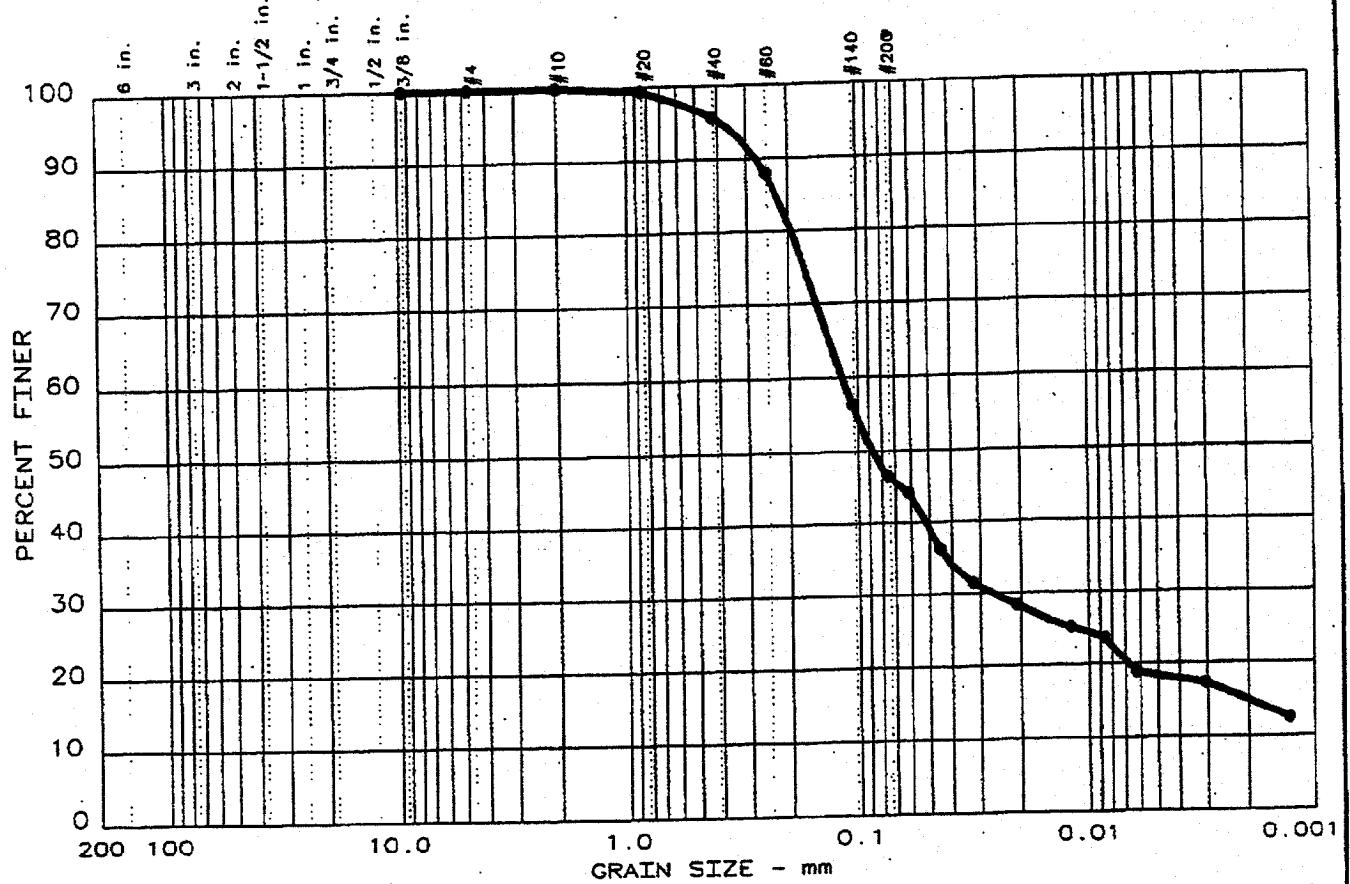
Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 5	0.0	0.0	52.1	28.6	19.3

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
● NV	NP	0.198	0.107	0.0814	0.0235	0.0026			

MATERIAL DESCRIPTION	USCS	AASHTO
● Orange-Grey Silty Fine Sand	SM	

<p>Project No.: 3043-04-1009.0001 Project: TVA Kingston Ash Disposal Area ● Location: B-1 UD @ 65'-67'</p> <p>Date: 04-19-04</p>	<p>Remarks: Moisture Content: 20.0%</p>
<p>PARTICLE SIZE ANALYSIS REPORT</p> <p>LAW ENGINEERING AND ENVIRONMENTAL SERVICES</p>	
<p>Fig. No.: _____</p>	

PARTICLE SIZE ANALYSIS REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 2	0.0	0.0	53.5	28.1	18.4

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
● NV	NP	0.224	0.116	0.0878	0.0265	0.0020			

MATERIAL DESCRIPTION	USCS	AASHTO
● Orange-Brown Silty Fine Sand	SM	

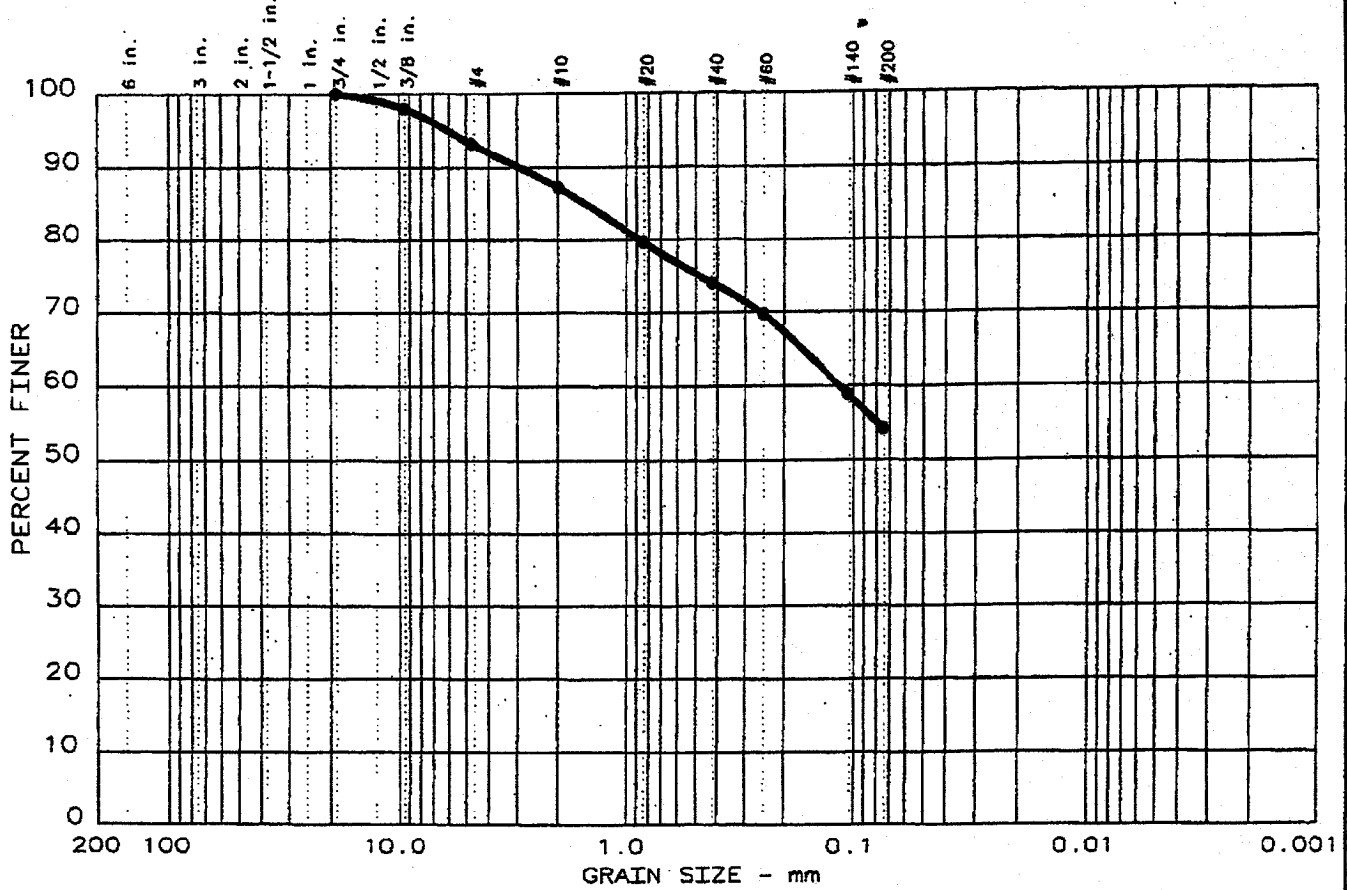
Project No.: 3043-04-1009.0001
 Project: TVA Kingston Ash Disposal Area
 ● Location: B-2 UD @ 70'-72'
 Date: 04-19-04

Remarks:
 Moisture Content: 16.8%

PARTICLE SIZE ANALYSIS REPORT
LAW ENGINEERING AND ENVIRONMENTAL SERVICES

Fig. No.: _____

PARTICLE SIZE ANALYSIS REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 16	0.0	6.8	38.9	54.3	

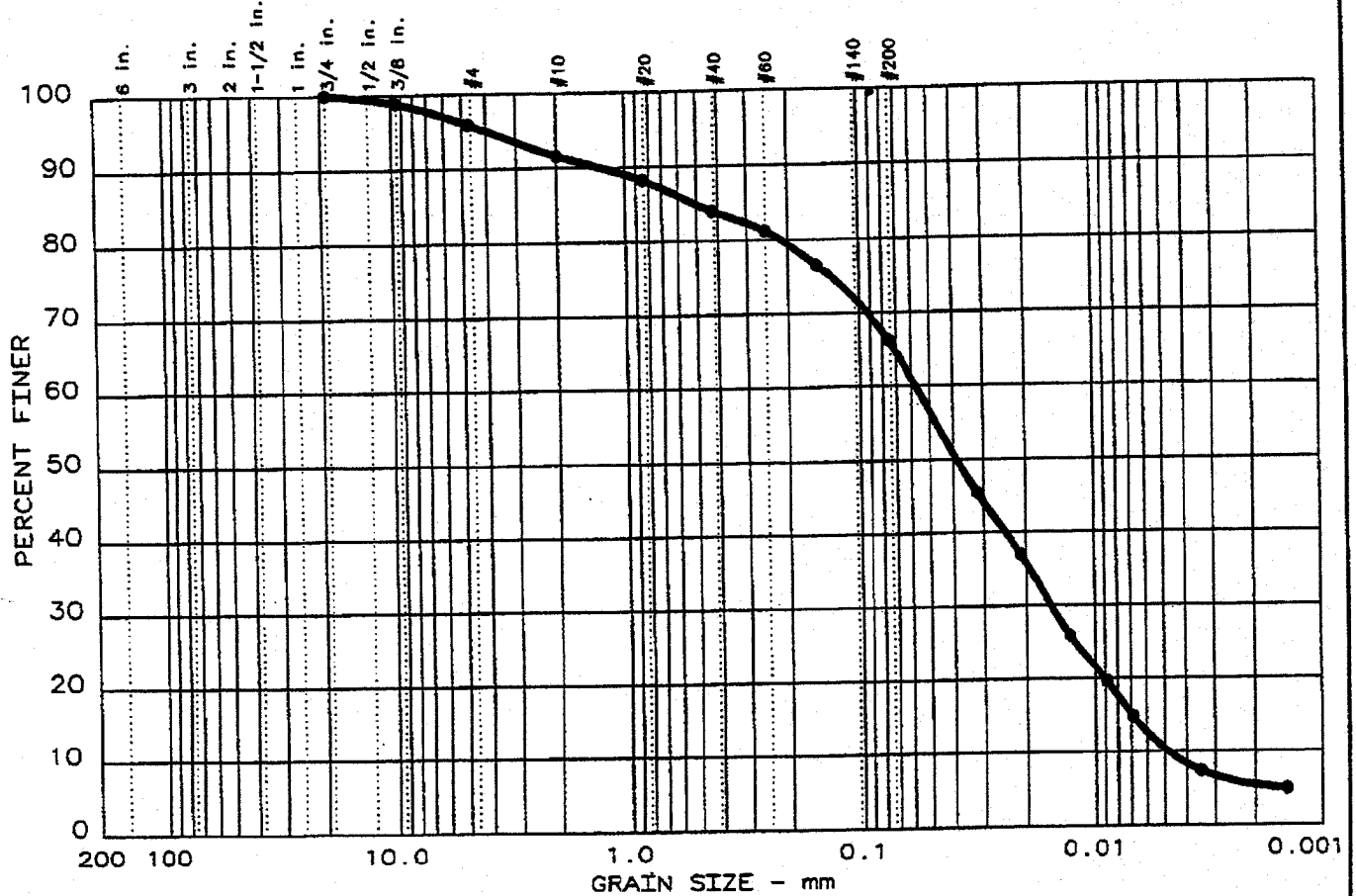
LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
● NV	NP	1.51	0.114						

MATERIAL DESCRIPTION	USCS	AASHTO
● Grey Bottom Ash with Fly Ash		

Project No.: 3043-04-1009.0001 Project: TVA Kingston Ash Disposal Area ● Location: B-2A Bulk @ 0'-5' Date: 04-19-04	Remarks: Specific Gravity: 2.40
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PARTICLE SIZE ANALYSIS REPORT LAW ENGINEERING AND ENVIRONMENTAL SERVICES	Fig. No.: _____
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PARTICLE SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
4	0.0	4.0	29.7	56.0	10.3	NT	NT	NT

SIEVE inches size	PERCENT FINER	
	●	
0.75	100.0	
0.375	98.8	
 GRAIN SIZE 		
D ₆₀	0.0569	
D ₃₀		
D ₁₀	0.0048	
 COEFFICIENTS 		
C _c	0.89	
C _u	11.8	

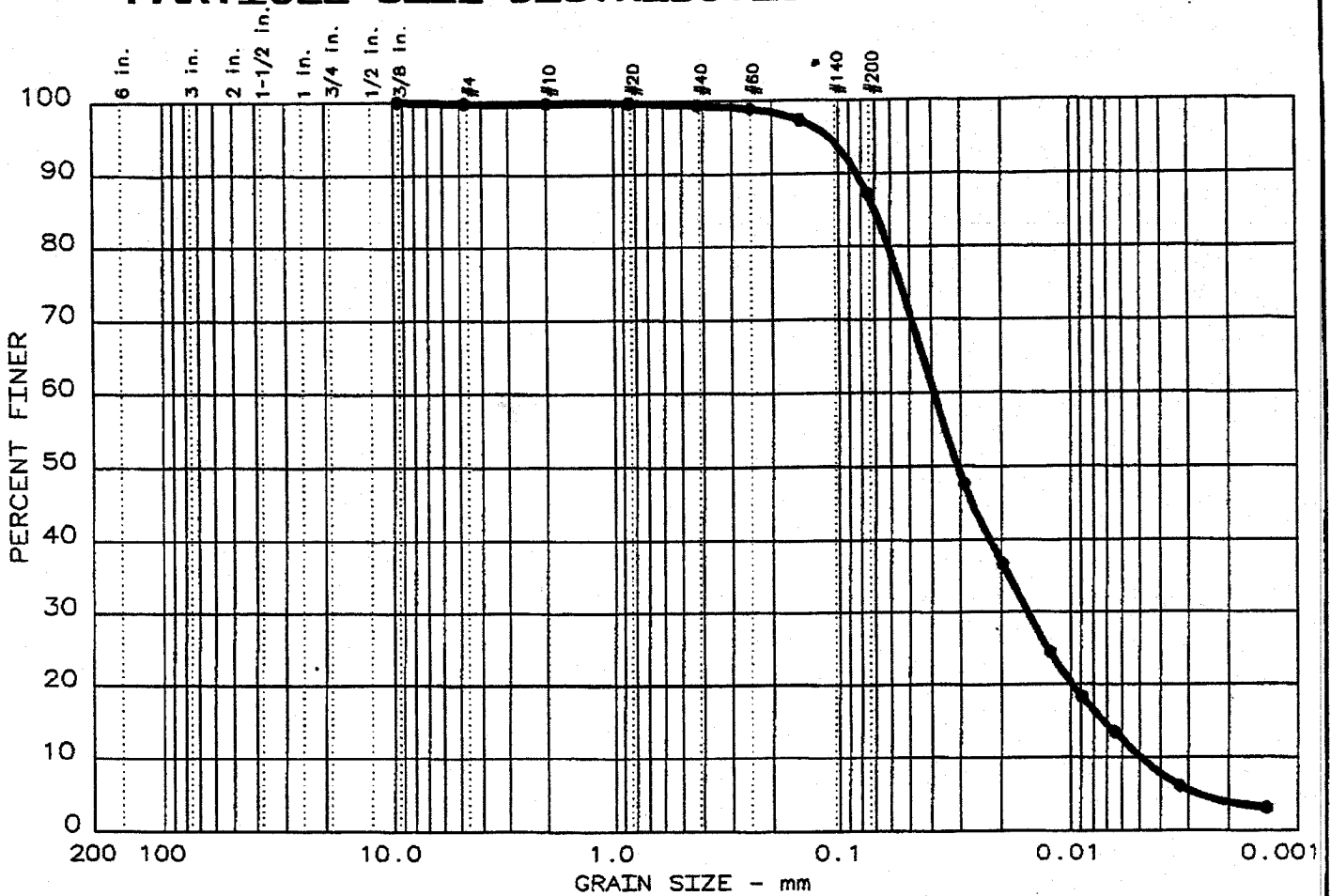
SIEVE number size	PERCENT FINER	
	●	
4	96.0	
10	91.6	
20	88.3	
40	84.0	
60	81.3	
100	76.5	
200	66.3	

Sample information:
 ● B-3, 5-6.5' & 10-11.5'
 Gray ash
 SPT Samples

Remarks:
 Methods: Particle Size:
 ASTM D 422-63(2002);
 Specific Gravity of
 Portion < No. 10: 2.40

LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.	Project No.: 3043041009.0001 Project: TVA Kingston Ash Date: April 21, 2004
Fig. No.: B3	

PARTICLE SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
5	0.0	0.2	12.6	77.1	10.1	NT	NT	NT

SIEVE inches size	PERCENT FINER	
	●	
0.375	100.0	
× GRAIN SIZE		
D ₆₀	0.0391	
D ₃₀		
D ₁₀	0.0049	
× COEFFICIENTS		
C _c	1.23	
C _u	8.0	

SIEVE number size	PERCENT FINER	
	●	
4	99.8	
10	99.7	
20	99.7	
40	99.4	
60	98.9	
100	97.3	
200	87.2	

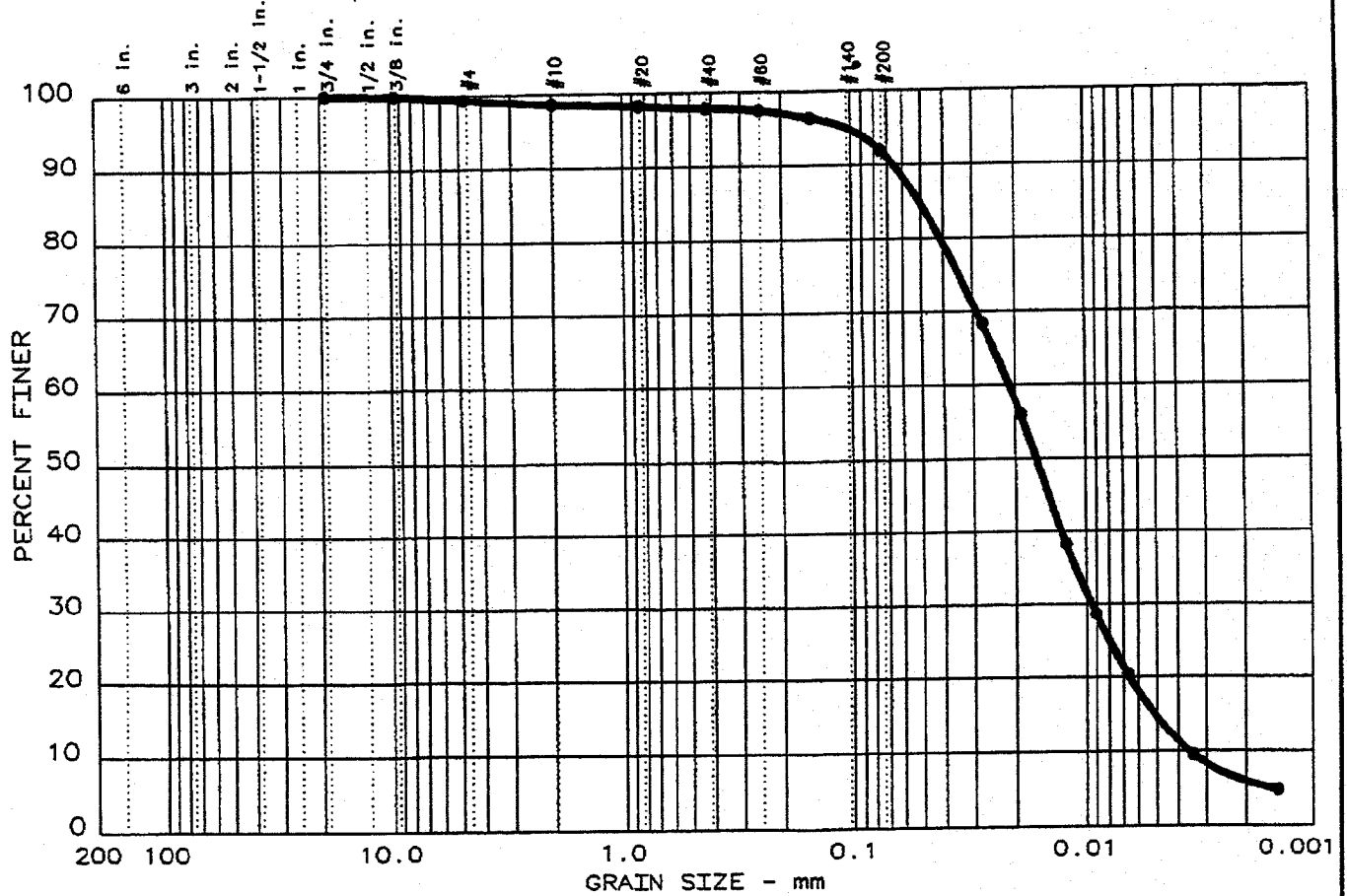
Sample information:
 ● B-3, 15-16.5' & 20-21.5'
 Gray ash
 SPT Samples

Remarks:
 Methods: Particle Size:
 ASTM D 422-63(2002);
 Specific Gravity of
 Portion < No. 10: 2.58

**LAW ENGINEERING
 AND ENVIRONMENTAL
 SERVICES, INC.**

Project No.: 3043041009.0001
 Project: TVA Kingston Ash
 Date: April 21, 2004
 Fig. No.: 83

PARTICLE SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
6	0.0	0.7	7.3	77.4	14.6	NT	NT	NT

SIEVE inches size	PERCENT FINER	
	●	
0.75	100.0	
0.375	99.9	
GRAIN SIZE		
D ₆₀	0.0211	
D ₃₀		
D ₁₀	0.0036	
COEFFICIENTS		
C _c	1.20	
C _u	5.9	

SIEVE number size	PERCENT FINER	
	●	
4	99.3	
10	98.6	
20	98.3	
40	97.9	
60	97.5	
100	96.4	
200	92.0	

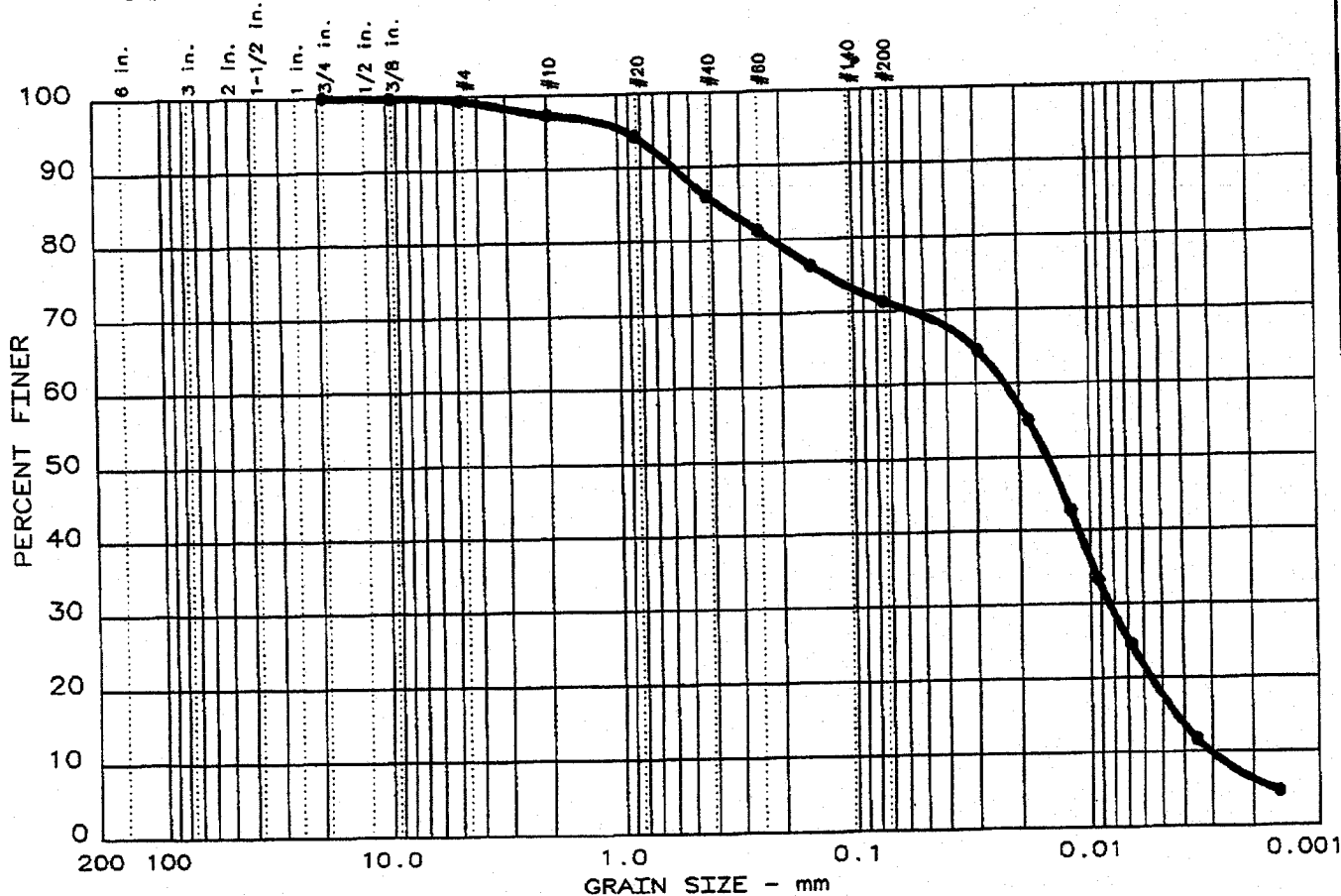
Sample information:
 ● B-3, 25-26.5' & 30-31.5'
 Gray ash
 SPT Samples

Remarks:
 Methods: Particle Size:
 ASTM D 422-63(2002);
 Specific Gravity of
 Portion < No. 10: 2.42

**LAW ENGINEERING
 AND ENVIRONMENTAL
 SERVICES, INC.**

Project No.: 3043041009.0001
 Project: TVA Kingston Ash
 Date: April 21, 2004
 Fig. No.: B3

PARTICLE SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
● 11	0.0	0.7	27.9	53.6	17.8	NT	NT	NT

SIEVE inches size	PERCENT FINER	
	●	
0.75	100.0	
0.375	99.8	
X GRAIN SIZE		
D ₆₀	0.0226	
D ₃₀		
D ₁₀	0.0031	
X COEFFICIENTS		
C _c	1.01	
C _u	7.4	

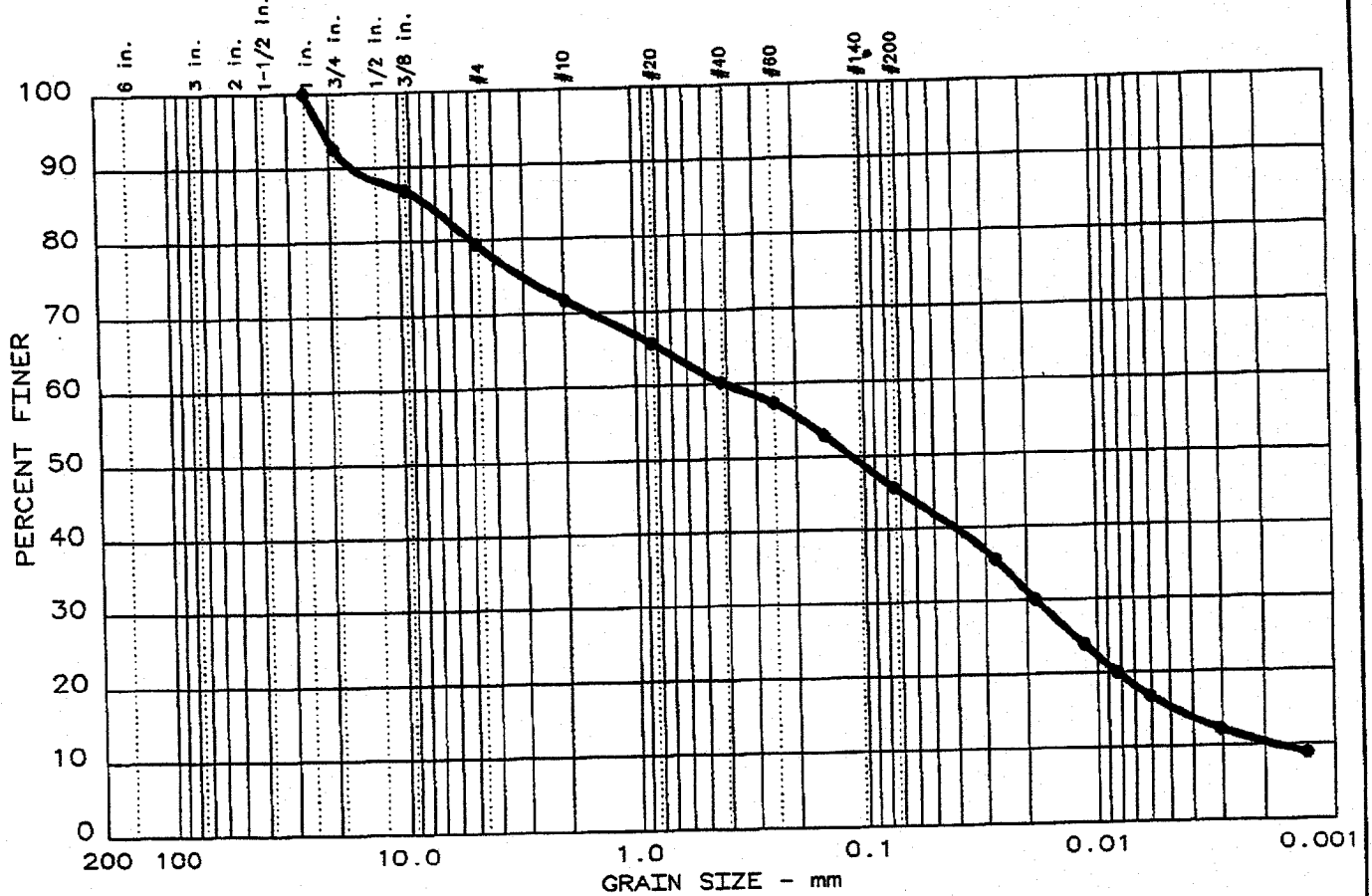
SIEVE number size	PERCENT FINER	
	●	
4	99.3	
10	97.3	
20	94.3	
40	86.0	
60	81.3	
100	76.4	
200	71.4	

Sample information:
 ● B-3, 50-51.5. & 55-56.5'
 Gray ash
 SPT Samples

Remarks:
 Methods: Particle Size:
 ASTM D 422-63(2002);
 Specific Gravity of
 Portion < No. 10: 2.27

LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.	Project No.: 3043041009.0001 Project: TVA Kingston Ash Date: April 15, 2004
	Fig. No.: B3

PARTICLE SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
8	0.0	20.6	33.8	30.3	15.3	NT	NT	NT

SIEVE inches size	PERCENT FINER	
	●	
1	100.0	
0.75	92.5	
0.375	86.8	
GRAIN SIZE		
D ₆₀	0.403	
D ₃₀		
D ₁₀	0.0017	
COEFFICIENTS		
C _c	0.48	
C _u	234.4	

SIEVE number size	PERCENT FINER	
	●	
4	79.4	
10	71.8	
20	65.7	
40	60.3	
60	57.4	
100	52.8	
200	45.6	

Sample information:
 ● B-3, 60-61.5' & 65-66.5'
 Gray and brown ash
 SPT Samples

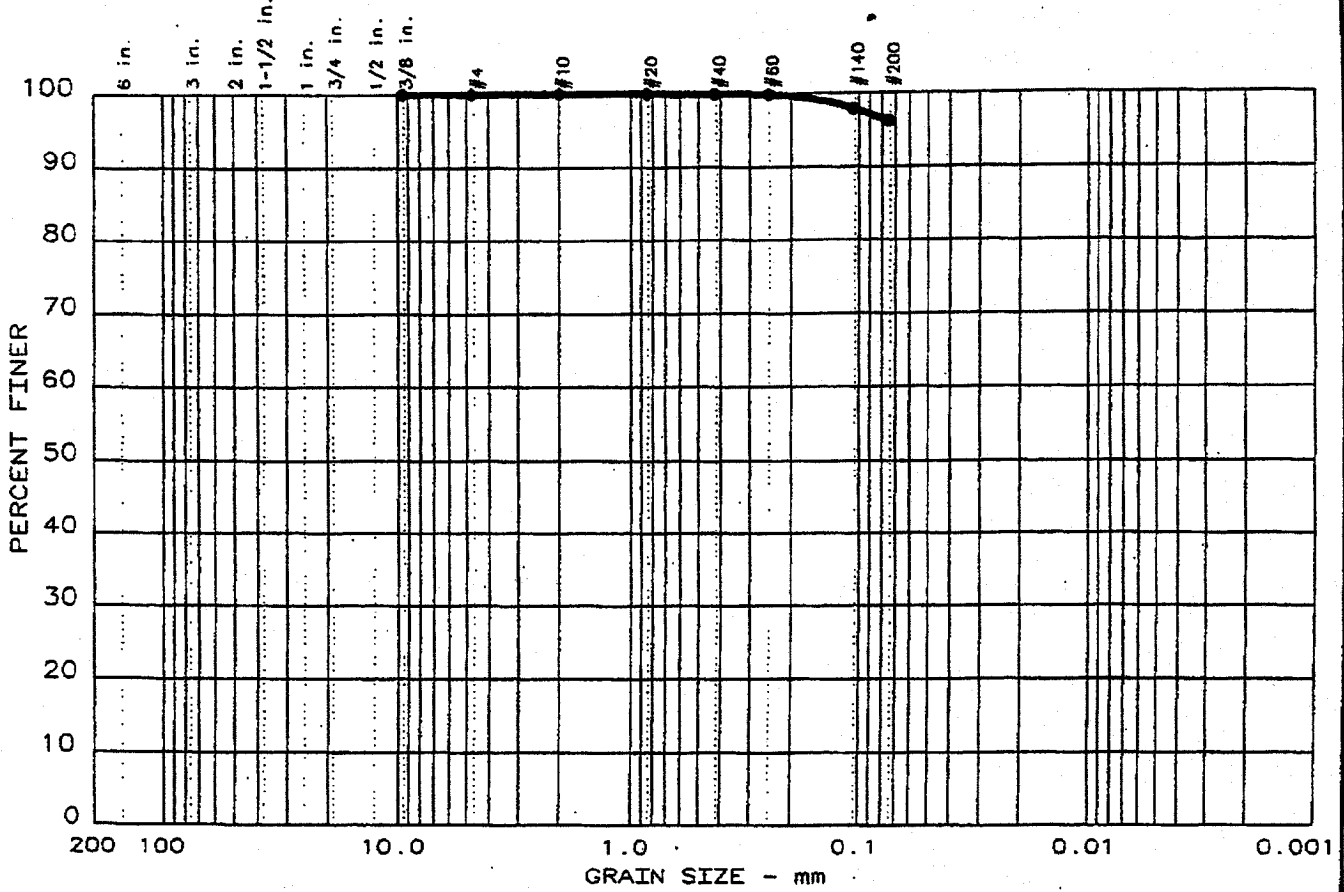
Remarks:
 Methods: Particle Size:
 ASTM D 422-63(2002);
 Specific Gravity of
 Portion < No. 10: 2.54

**LAW ENGINEERING
 AND ENVIRONMENTAL
 SERVICES, INC.**

Project No.: 3043041009.0001
 Project: TVA Kingston Ash
 Date: April 21, 2004

Fig. No.: B3

PARTICLE SIZE ANALYSIS REPORT



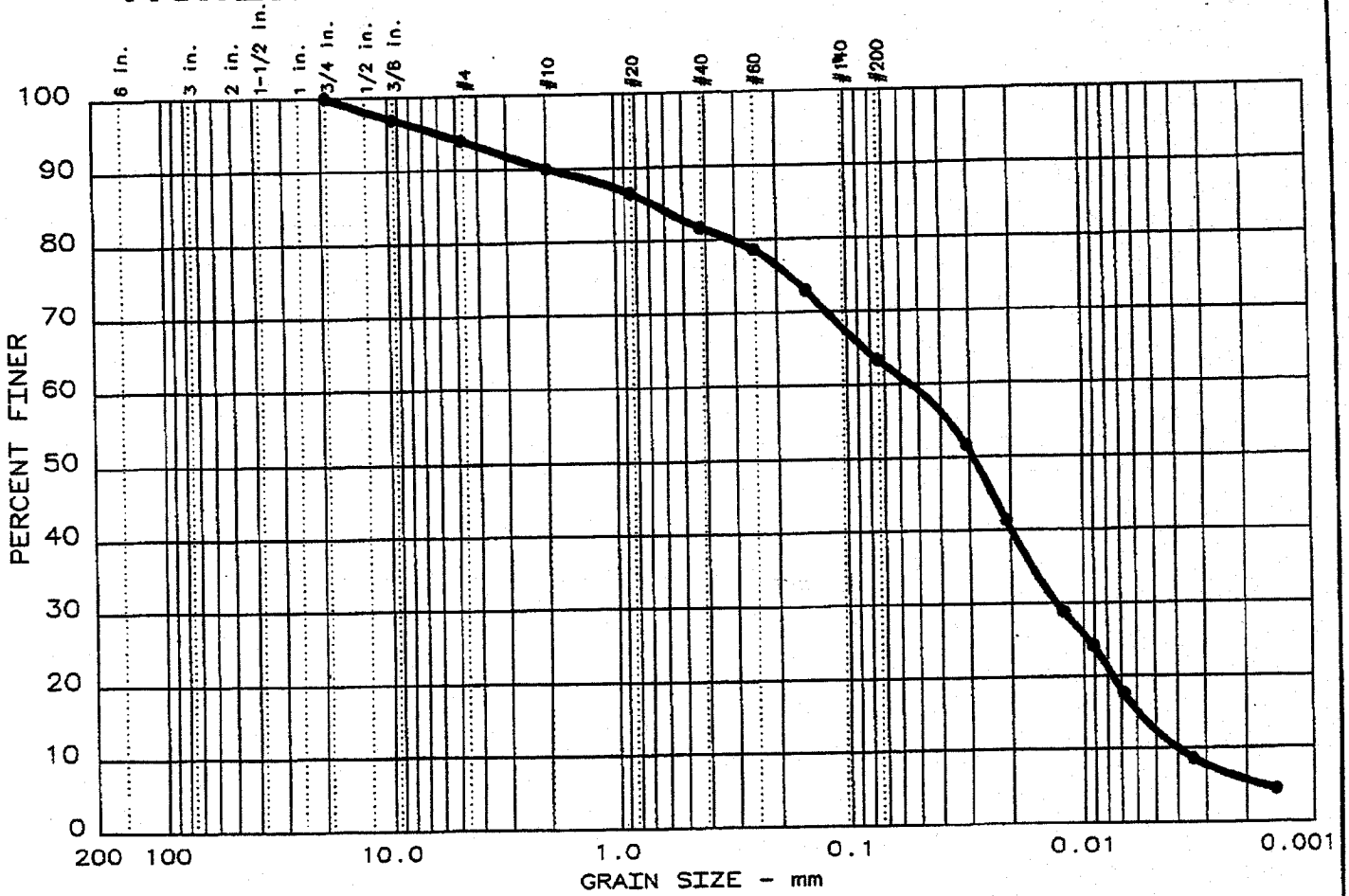
Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 8	0.0	0.0	3.8	96.2	

LL	PI	D85	D60	D50	D30	D15	D10	Cc	Cu
● NV	NP								

MATERIAL DESCRIPTION	USCS	AASHTO
● Grey Fly Ash		

Project No.: 3043-04-1009.0001 Project: TVA Kingston Ash Disposal Area ● Location: B-4A UD @ 25'-27' Date: 04-19-04	Remarks: Moisture Content: 32.0% Specific Gravity: 2.32
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PARTICLE SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
9	0.0	6.0	30.6	51.0	12.4	NT	NT	NT

SIEVE inches size	PERCENT FINER	
	●	
0.75	100.0	
0.375	97.0	
× GRAIN SIZE		
D ₆₀	0.0543	
D ₃₀		
D ₁₀	0.0040	
× COEFFICIENTS		
C _c	0.77	
C _u	13.6	

SIEVE number size	PERCENT FINER	
	●	
4	94.0	
10	90.0	
20	86.5	
40	81.7	
60	78.6	
100	73.0	
200	63.4	

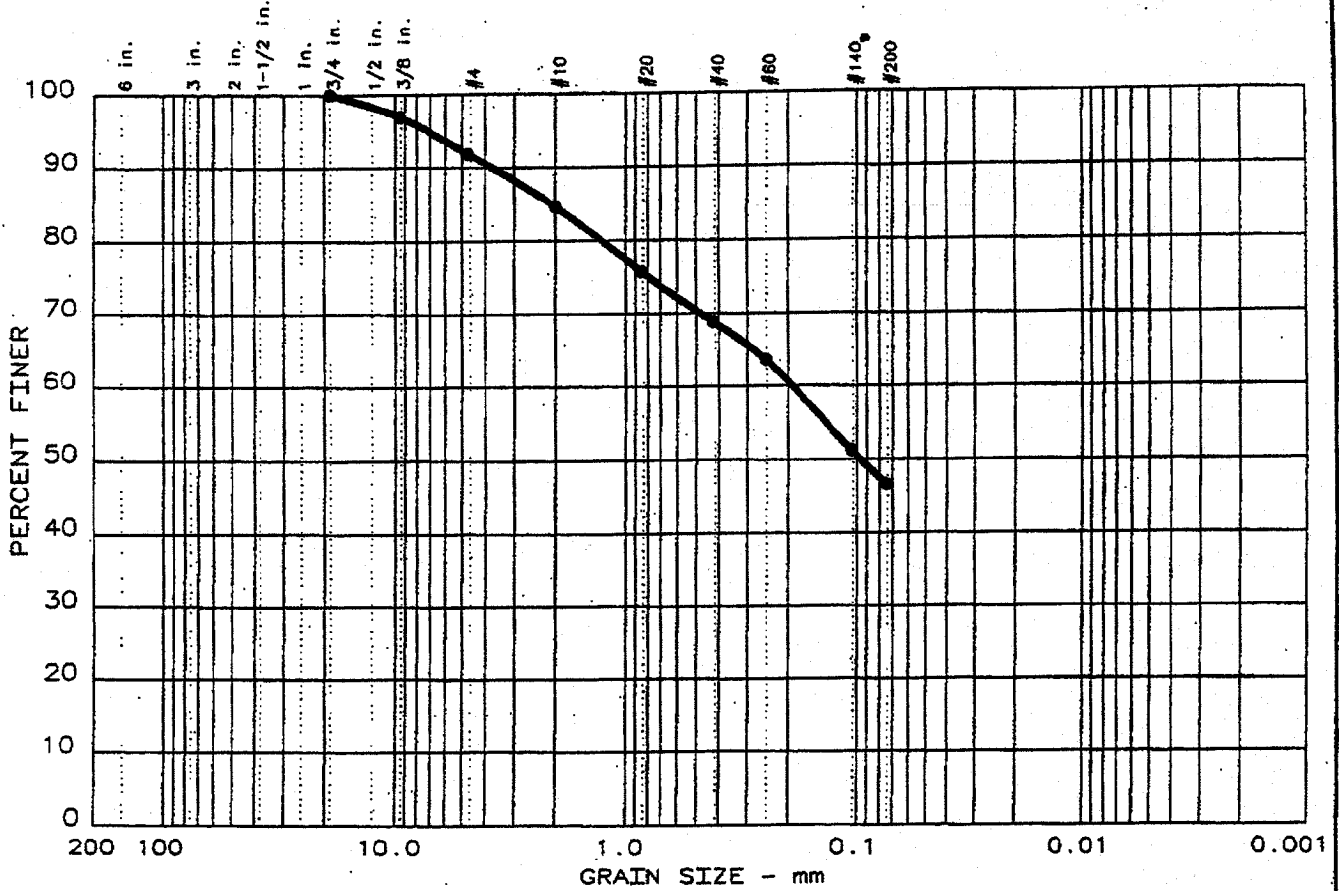
Sample information:
 ● B-8, 0-1.5' & 5.8-7.3'
 Gray ash
 SPT Samples

Remarks:
 Methods: Particle Size:
 ASTM D 422-63(2002);
 Specific Gravity of
 Portion < No. 10: 2.35

**LAW ENGINEERING
 AND ENVIRONMENTAL
 SERVICES, INC.**

Project No.: 3043041009.0001
 Project: TVA Kingston Ash
 Date: April 21, 2004
 Fig. No.: B8

PARTICLE SIZE ANALYSIS REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 9	0.0	8.1	45.3	46.6	

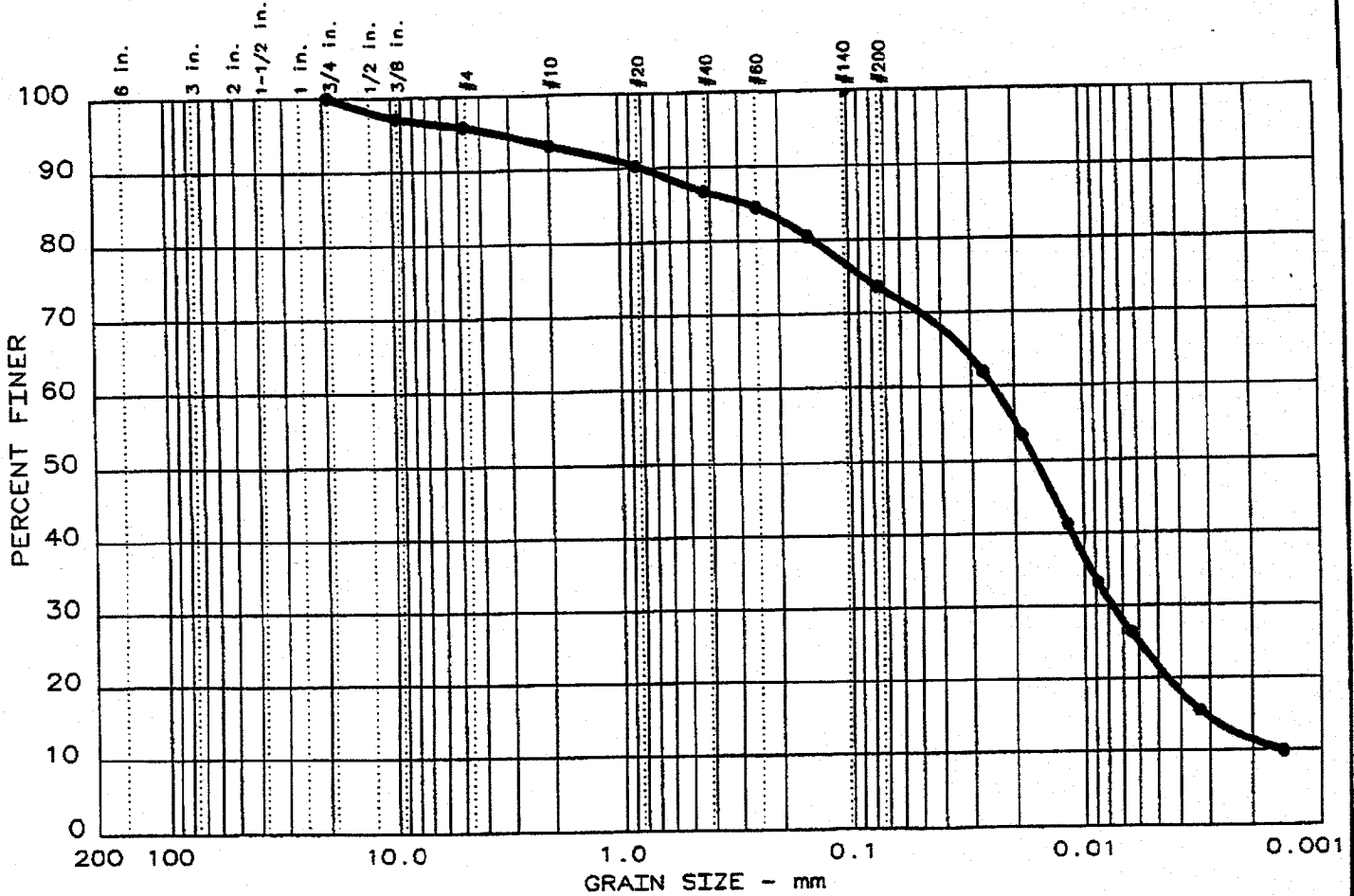
LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
● NV	NP	2.07	0.188	0.0966					

MATERIAL DESCRIPTION	USCS	AASHTO
● Grey Bottom Ash with Fly Ash		

Project No.: 3043-04-1009.0001 Project: TVA Kingston Ash Disposal Area ● Location: B-8 UD @ 10'-12' Date: 04-19-04	Remarks: Moisture Content: 19.4%
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PARTICLE SIZE ANALYSIS REPORT LAW ENGINEERING AND ENVIRONMENTAL SERVICES	Fig. No.: _____
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PARTICLE SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
● 12	0.0	4.1	22.3	52.0	21.6	NT	NT	NT

SIEVE inches size	PERCENT FINER	
●		
0.75	100.0	
0.375	97.2	
 GRAIN SIZE 		
D ₆₀	0.0243	
D ₃₀		
D ₁₀	0.0015	
 COEFFICIENTS 		
C _c	1.62	
C _u	16.2	

SIEVE number size	PERCENT FINER	
●		
4	95.9	
10	93.2	
20	90.3	
40	86.7	
60	84.5	
100	80.5	
200	73.6	

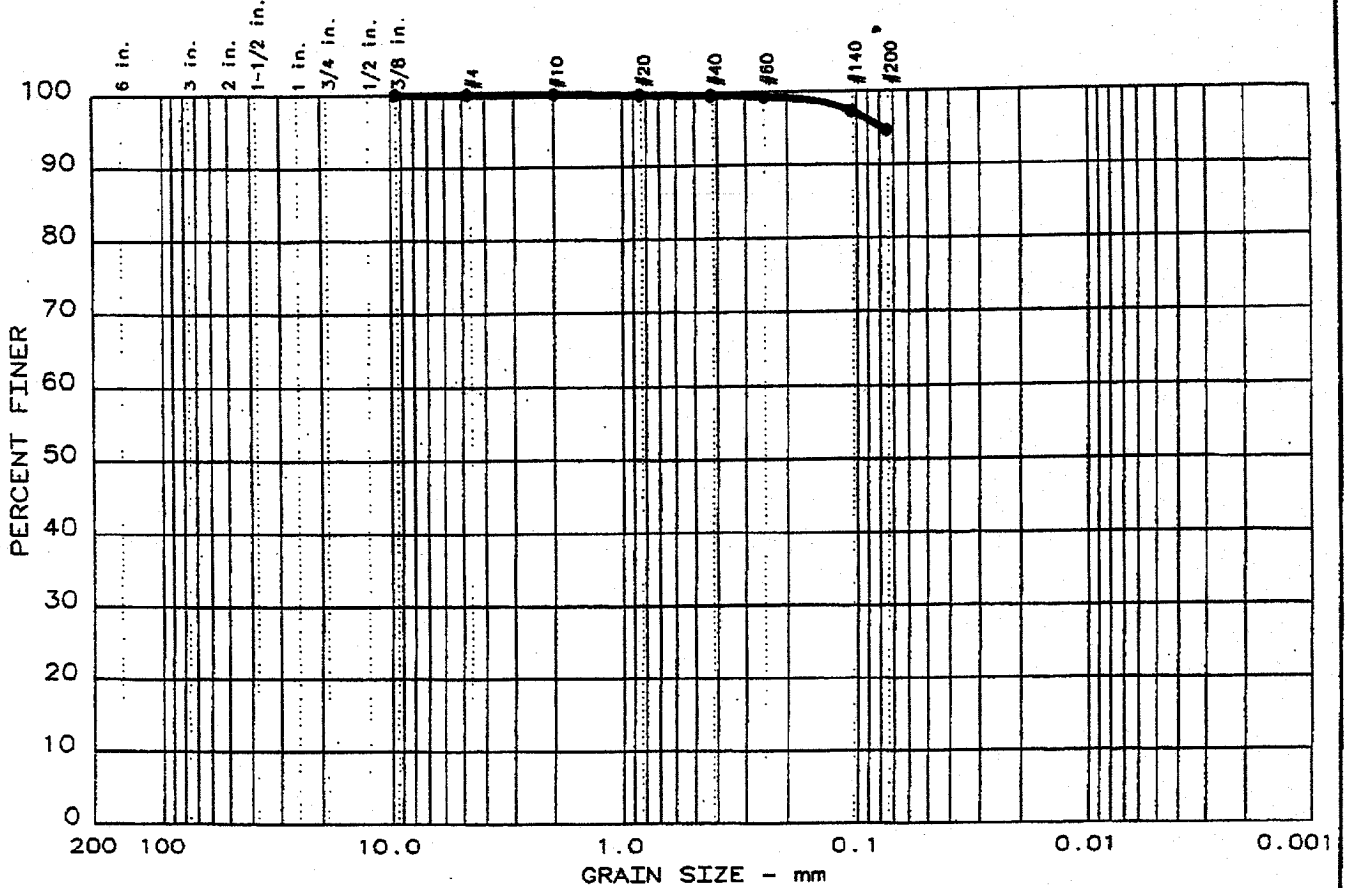
Sample information:
 ● B-8, 12-13.5' & 15-16.5'
 Gray brown ash
 SPT Samples

Remarks:
 Methods: Particle Size:
 ASTM D 422-63(2002);
 Specific Gravity of
 Portion < No. 10: 2.38.

**LAW ENGINEERING
 AND ENVIRONMENTAL
 SERVICES, INC.**

Project No.: 3043041009.0001
 Project: TVA Kingston Ash
 Date: April 21, 2004
 Fig. No.: B8

PARTICLE SIZE ANALYSIS REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 10	0.0	0.0	5.3	94.7	

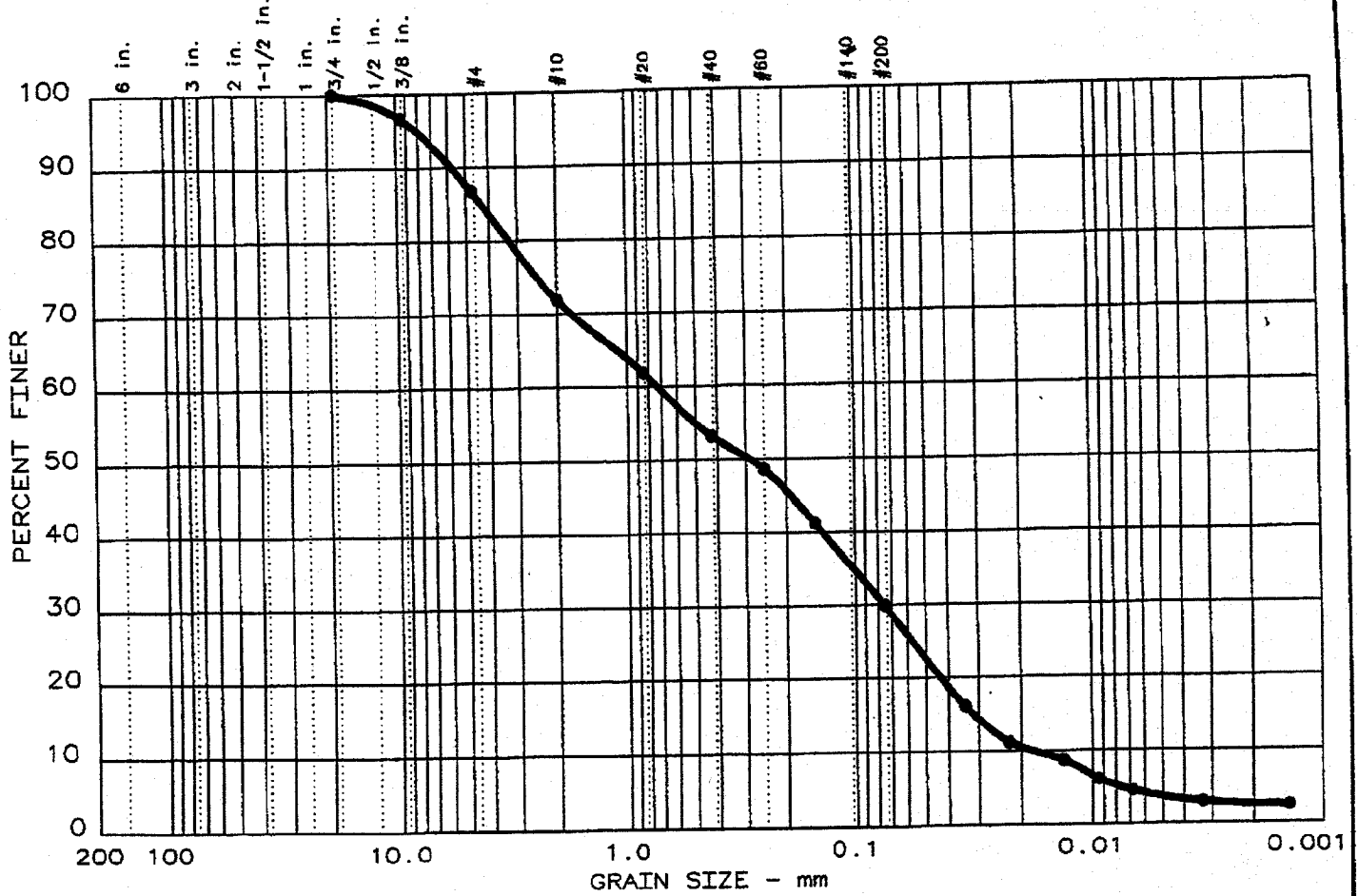
LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
● NV	NP								

MATERIAL DESCRIPTION	USCS	AASHTO
● Grey Fly Ash		

Project No.: 3043-04-1009.0001
 Project: TVA Kingston Ash Disposal Area
 ● Location: B-8 UD @ 20'-22'
 Date: 04-19-04

Remarks:
 Moisture Content: 32.2%

PARTICLE SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
● 10	0.0	13.2	56.9	26.2	3.7	NT	NT	NT

SIEVE inches size	PERCENT FINER	
	●	
0.75	100.0	
0.375	96.7	
 GRAIN SIZE 		
D ₆₀	0.733	
D ₃₀		
D ₁₀	0.0178	
 COEFFICIENTS 		
C _c	0.43	
C _u	41.2	

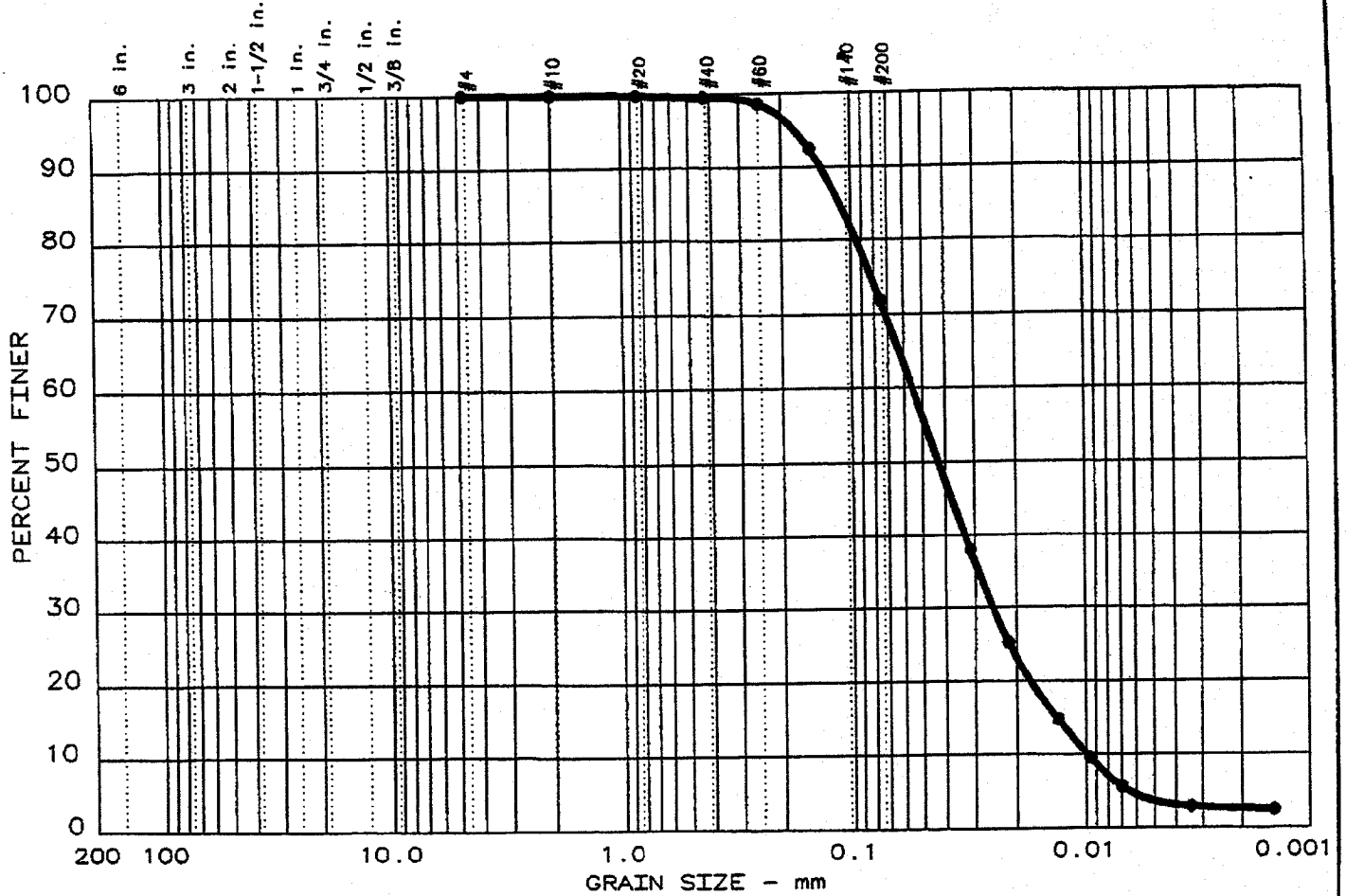
SIEVE number size	PERCENT FINER	
	●	
4	86.8	
10	71.9	
20	61.9	
40	53.2	
60	48.7	
100	41.2	
200	29.9	

Sample information:
 ● B-8, 25.6-27.1' & 30-31.5'
 Gray ash
 SPT Samples

Remarks:
 Methods: Particle Size:
 ASTM D 422-63(2002);
 Specific Gravity of
 Portion < No. 10: 2.49

LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.	Project No.: 3043041009.0001 Project: TVA Kingston Ash Date: April 21, 2004
	Fig. No.: B8

PARTICLE SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
● 13	0.0	0.0	28.2	68.2	3.6	NT	NT	NT

SIEVE inches size	PERCENT FINER	
	●	
X	GRAIN SIZE	
D ₆₀	0.0550	
D ₃₀		
D ₁₀	0.0098	
X	COEFFICIENTS	
C _c	1.18	
C _u	5.6	

SIEVE number size	PERCENT FINER	
	●	
4	100.0	
10	99.9	
20	99.8	
40	99.5	
60	98.6	
100	92.4	
200	71.8	

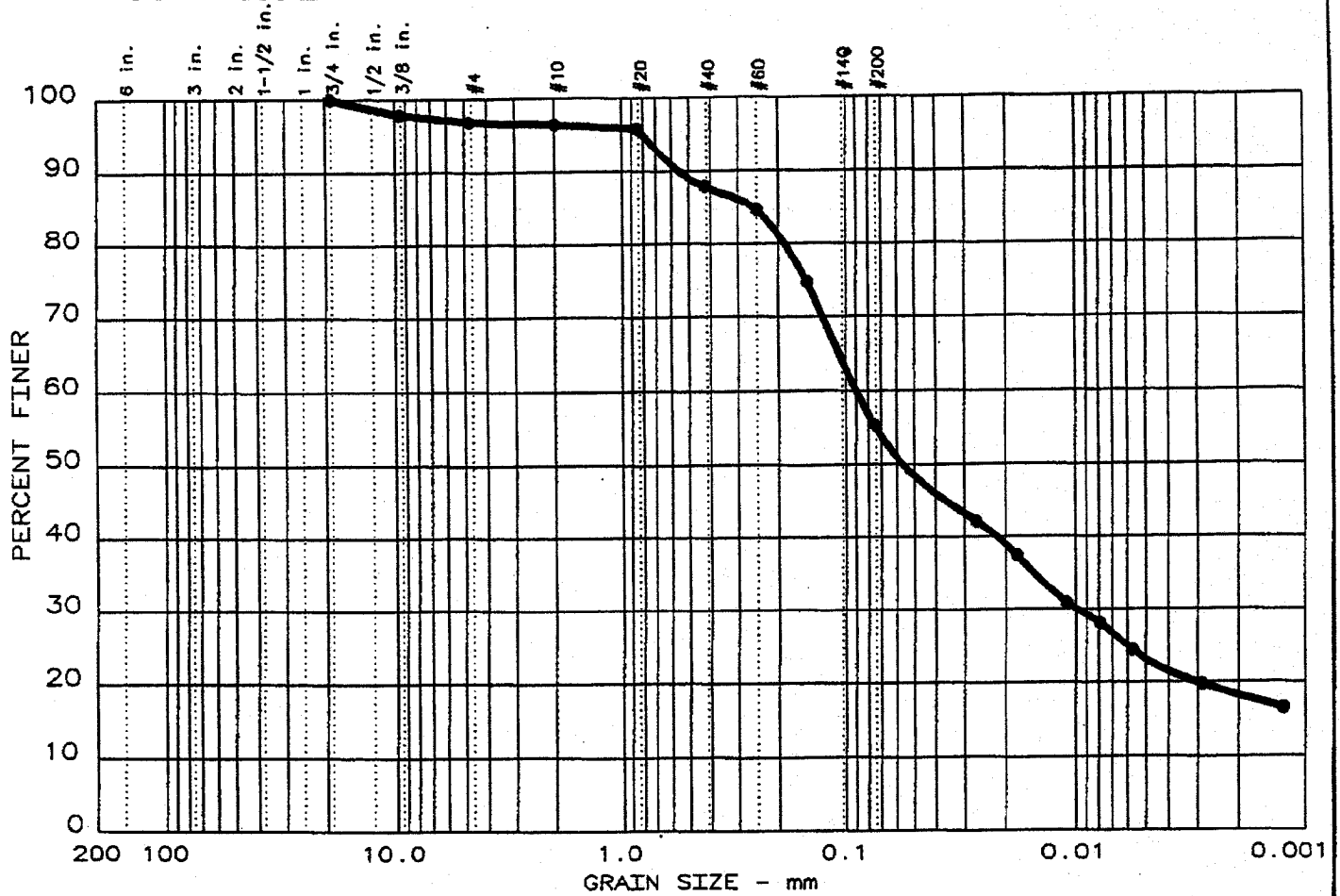
Sample information:
 ● B-8A, 40-41.5' & 45-46.5'
 Dark gray ash
 SPT Samples

Remarks:
 Methods: Particle Size:
 ASTM D 422-63(2002);
 Specific Gravity of
 Portion < No. 10: 2.52

**LAW ENGINEERING
 AND ENVIRONMENTAL
 SERVICES, INC.**

Project No.: 3043041009.0001
 Project: TVA Kingston Ash
 Date: April 21, 2004
 Fig. No.: B8A

PARTICLE SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
● 15	0.0	3.2	41.4	32.4	23.0	CL	25	11

SIEVE inches size	PERCENT FINER		
	●		
0.75	100.0		
0.375	97.9		
 GRAIN SIZE 			
D ₆₀	0.0901		
D ₃₀			
D ₁₀			
 COEFFICIENTS 			
C _c			
C _u			

SIEVE number size	PERCENT FINER		
	●		
4	96.8		
10	96.4		
20	95.8		
40	87.9		
60	84.7		
100	74.7		
200	55.4		

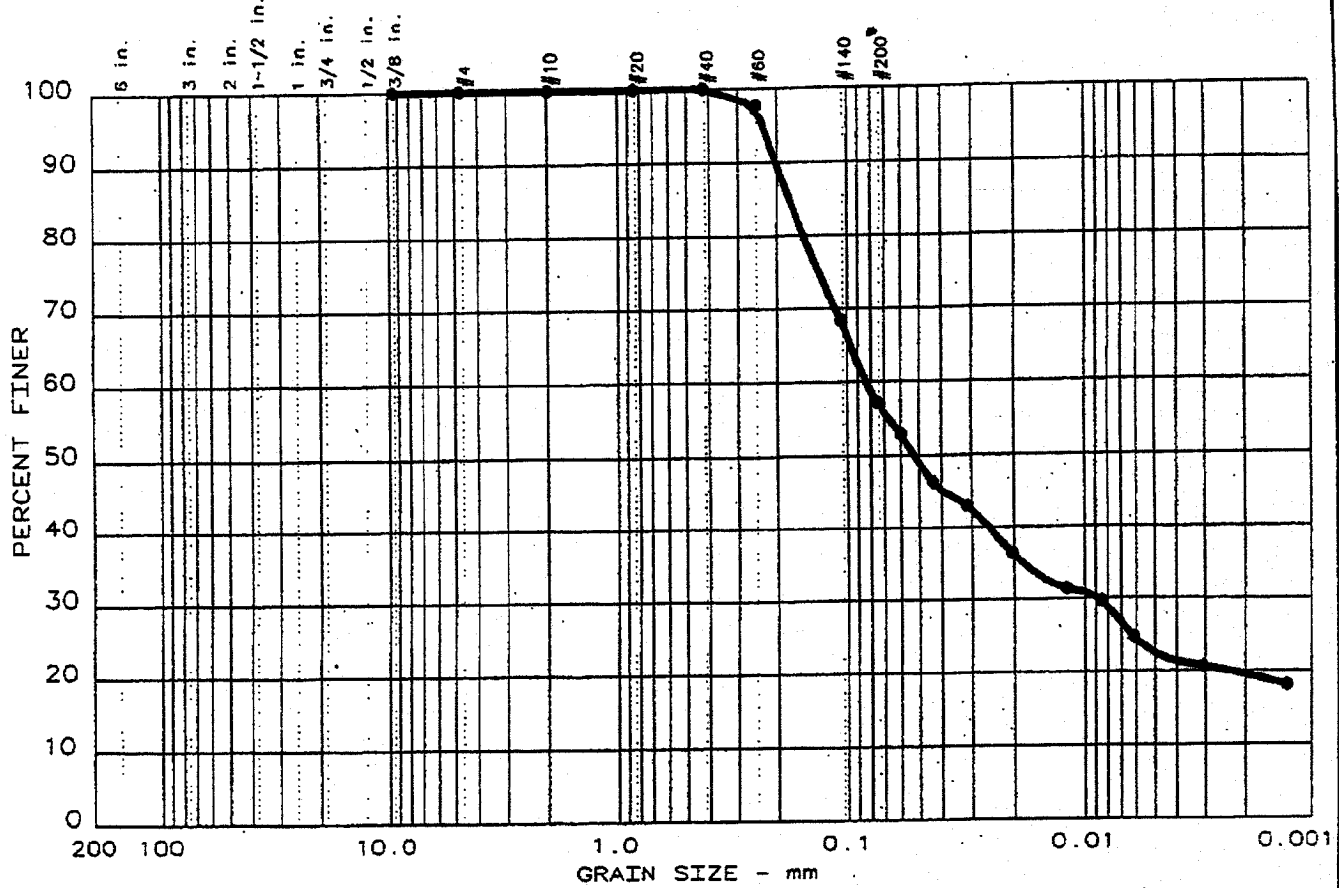
Sample information:
 ● B-8A, 57-58.5' & 62-63.5'
 Tan sandy lean clay
 SPT Samples

Remarks:
 Methods: Particle Size:
 ASTM D 422-63(2002);
 Specific Gravity of
 Portion < No. 40: 2.68

**LAW ENGINEERING
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 SERVICES, INC.**

Project No.: 3043041009.0001
 Project: TVA Kingston Ash
 Date: April 21, 2004
 Fig. No.: B8A

PARTICLE SIZE ANALYSIS REPORT



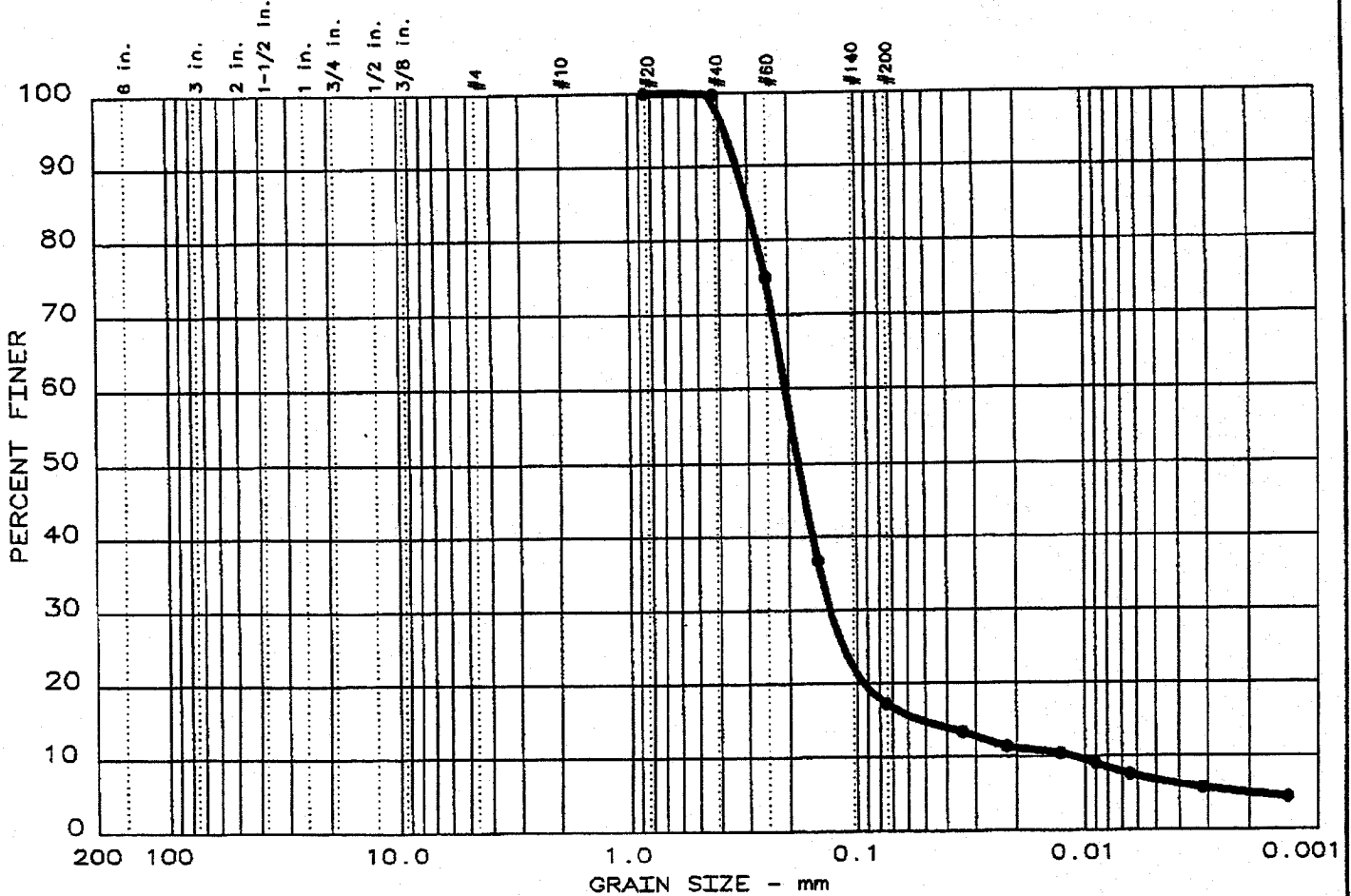
Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● .4	0.0	0.0	42.8	34.7	22.5

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	c _c	c _u
● 26	10	0.176	0.0832	0.0524	0.0088				

MATERIAL DESCRIPTION	USCS	AASHTO
● Grey-Brown Sandy Lean Clay	CL	

<p>Project No.: 3043-04-1009.0001 Project: TVA Kingston Ash Disposal Area ● Location: B-8A UD @ 60'-62'</p> <p>Date: 04-19-04</p> <p style="text-align: center;">PARTICLE SIZE ANALYSIS REPORT LAW ENGINEERING AND ENVIRONMENTAL SERVICES</p>	<p>Remarks:</p> <p>Moisture Content: 21.9%</p> <p>Specific Gravity: 2.67</p> <p>Fig. No.: _____</p>
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PARTICLE SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
● 14	0.0	0.0	82.7	10.5	6.8	SM	NP	NP

SIEVE inches size	PERCENT FINER	
	●	
X	GRAIN SIZE	
D ₆₀	0.206	
D ₃₀		
D ₁₀	0.0111	
X	COEFFICIENTS	
C _c	7.62	
C _u	18.5	

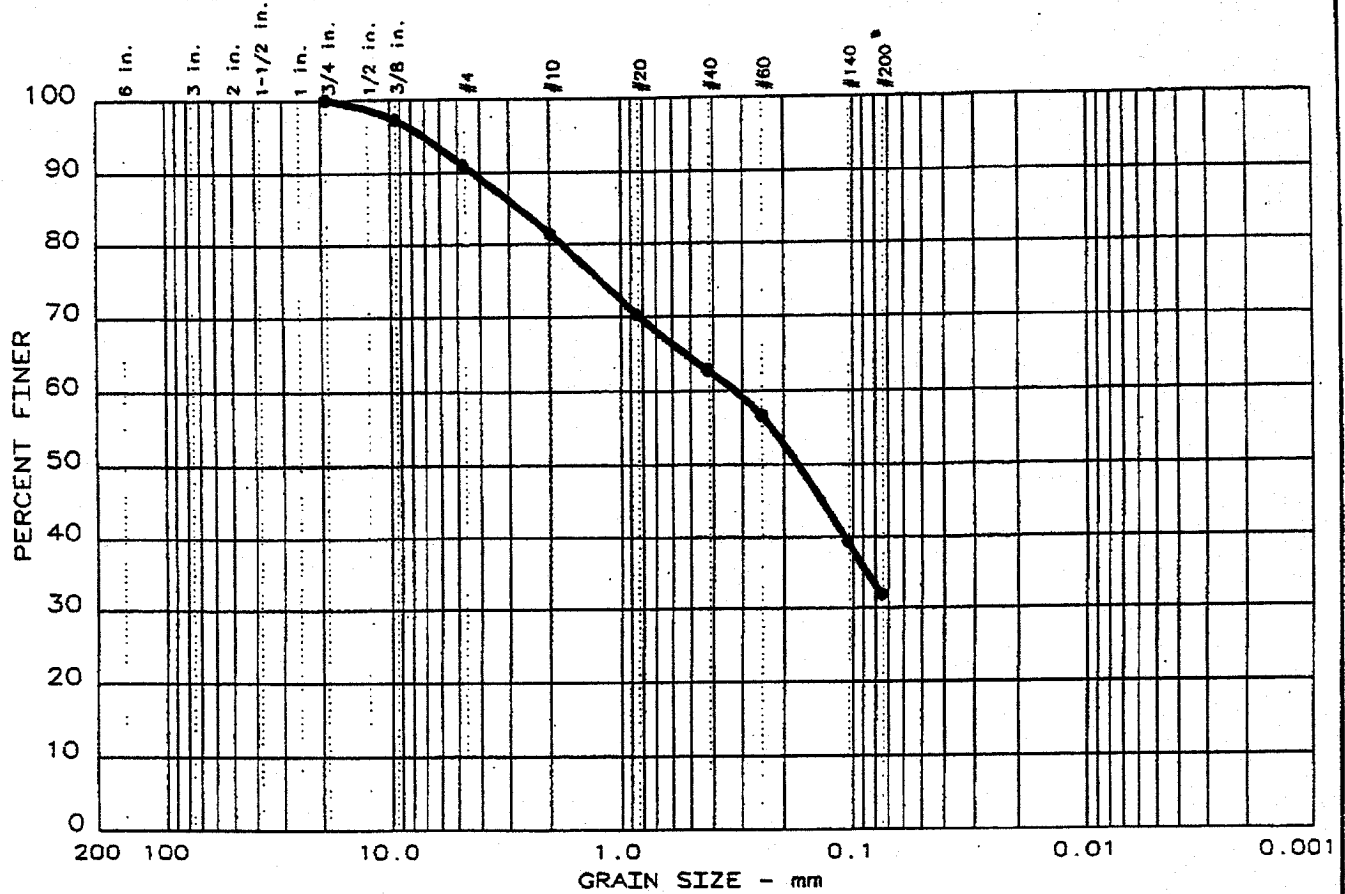
SIEVE number size	PERCENT FINER	
	●	
20	100.0	
40	99.7	
60	75.0	
100	36.7	
200	17.3	

Sample information:
 ● B-8A, 65-66.5' & 70-70.9'
 Gray brown silty sand
 SPT Samples

Remarks:
 Methods: Particle Size:
 ASTM D 422-63(2002);
 Specific Gravity of
 Portion < No. 40: 2.67

LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.	Project No.: 3043041009.0001 Project: TVA Kingston Ash Date: April 21, 2004
	Fig. No.: B8A

PARTICLE SIZE ANALYSIS REPORT



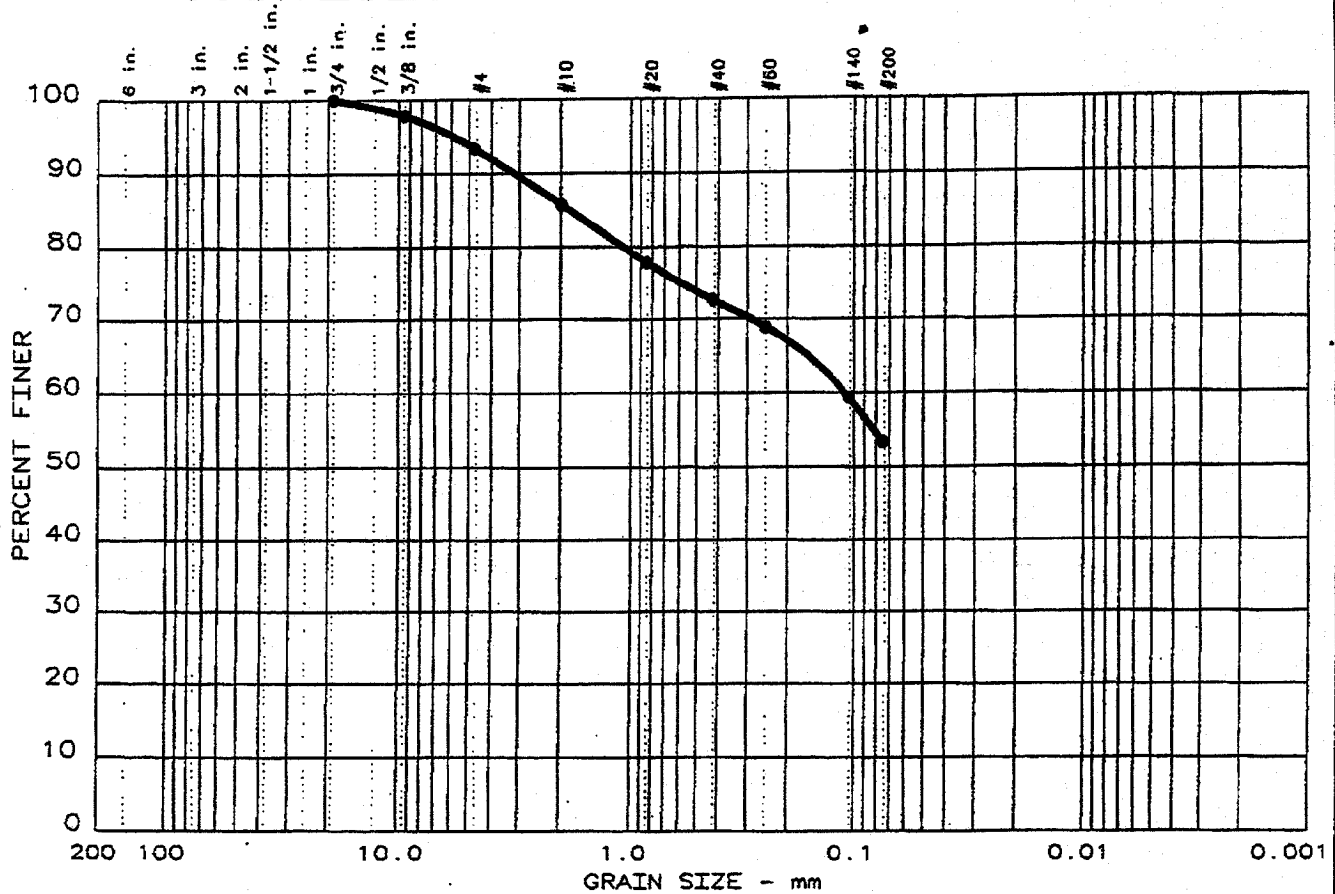
Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 11	0.0	9.0	59.1	31.9	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
• NV	NP	2.66	0.320	0.172					

MATERIAL DESCRIPTION	USCS	AASHTO
• Grey Fly Ash with Bottom Ash		

Project No.: 3043-04-1009.0001 Project: TVA Kingston Ash Disposal Area • Location: B-10 UD @ 5'-7' Date: 04-19-04	Remarks: Moisture Content: 24.7% Specific Gravity: 2.29
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PARTICLE SIZE ANALYSIS REPORT



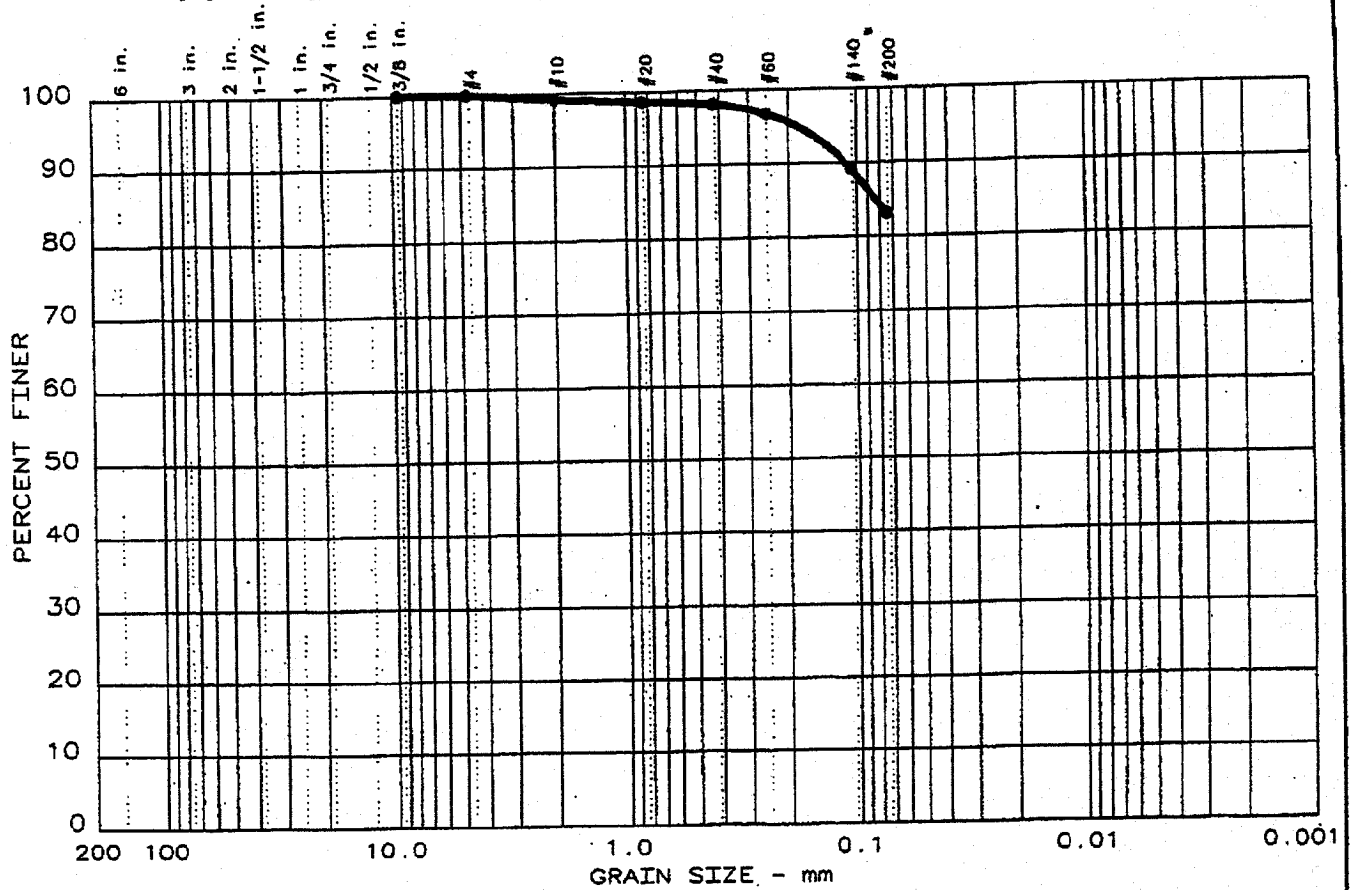
Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 12	0.0	6.6	40.0	53.4	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
● NV	NP	1.82	0.110						

MATERIAL DESCRIPTION	USCS	AASHTO
● Grey Fly Ash with Bottom Ash		

Project No.: 3043-04-1009.0001 Project: TVA Kingston Ash Disposal Area ● Location: B-10 UD @ 10'-12' Date: 04-19-04	Remarks: Moisture Content: 24.5%
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PARTICLE SIZE ANALYSIS REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 14	0.0	0.0	16.9	83.1	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
● NV	NP	0.0832							

MATERIAL DESCRIPTION	USCS	AASHTO
● Grey Fly Ash		

Project No.: 3043-04-1009.0001 Project: TVA Kingston Ash Disposal Area ● Location: B-10 UD @ 20'-22' Date: 04-19-04	Remarks: Moisture Content: 36.5% Specific Gravity: 2.28
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This information taken from "Kingston Fossil Plant - Dredge Cells/Closure Soil Investigation," Singleton Laboratories Report 015-672-142A, September 29, 1994.

LABORATORY TESTING

All split-spoon samples obtained were visually classified and tested for moisture content in accordance with ASTM D 2216, while Atterberg limits, grain-size analysis, and specific gravity tests were performed on representative SPT soil samples in accordance with ASTM D 4318, and D 422, and D 854, respectively. Test results are shown in the field logs. Individual test data sheets are enclosed in Appendix C.

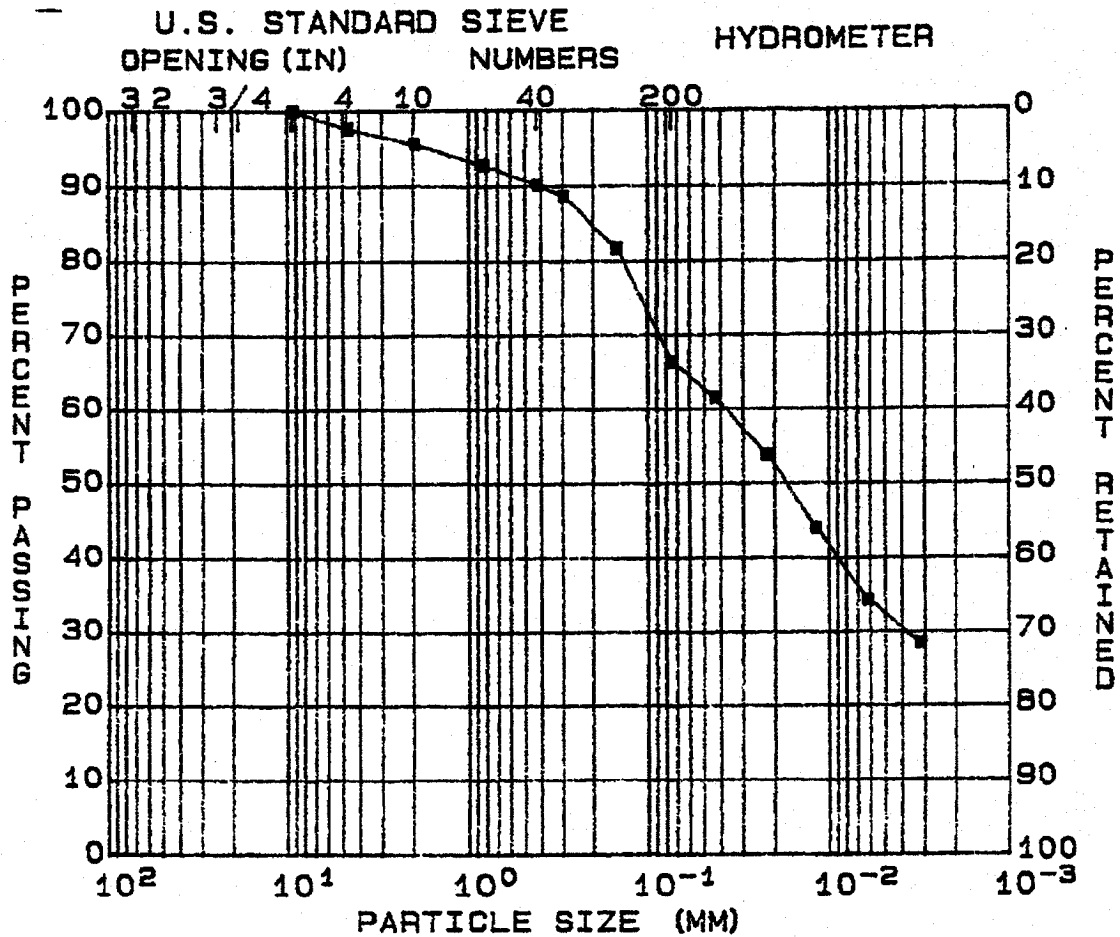
All twenty-five (25) undisturbed soil samples obtained from the dike areas were tested for moisture content, classification, grain-size, Atterberg limits, specific gravity, and unit weight in accordance with ASTM D 2216, D 2488, D 422, D 4318, D 854, and SLP-2, respectively. Unconsolidated-undrained triaxial (Q) and consolidated-undrained triaxial (R) with pore water pressure measurements were performed on five (5) selected undisturbed soil samples in accordance with ASTM D 4767 and D 5084, respectively. Test results are also summarized in Table 1. Individual test data sheets are enclosed in Appendix D. Under Q test conditions, angles of internal friction ranged from zero (with 1.85 tsf cohesion) to 37.4 degrees, and cohesions varied from zero to 1.85 tsf. Under R test conditions, apparent angles of internal friction and cohesions ranged from 4.4 to 35.8 degrees and from 0.32 to 3.65 tsf, respectively, and effective angles of internal friction and cohesions varied from 9.2 to 37.5 degrees and from zero to 2.91 tsf, respectively.

All bulk soil samples obtained from the Dredge Cell 2 were visually classified as a gray silty sand (fly ash) and tested for moisture content on representative samples. Natural moisture contents ranged from 34.5 to 39.9 percent with an average of 37.6 percent. Two (2) soil classes were identified from all the bulk samples. Compaction tests were performed in accordance with ASTM D 698 Method A. Optimum moisture contents and maximum dry densities were determined to be 25.4 percent and 79.8 pcf, respectively for soil Class I, and 24.5 percent and 79.9 pcf, respectively for soil Class II. As indicated from the test results, Soil Classes I and II are very similar. A family of compaction curves was established for each soil class and the compaction curves are enclosed. For each soil class, classification tests including grain-size analysis, specific gravity, and Atterberg Limits were performed. Test results are summarized in Table 2 and also shown in the attached compaction curves. Individual test data sheets and compaction curves are enclosed in Appendix E.

Unconsolidated-undrained triaxial (Q) and consolidated-undrained triaxial (R) with pore water pressure measurements tests were performed on the soil samples remolded to the optimum moisture content with 95 and 100 percent maximum dry density. Test results are also summarized in Table 2. Individual test data sheets are also enclosed in Appendix E. Under Q test conditions, angles of internal friction ranged from 23.7 to 24.0 degrees and cohesions varied from 1.04 to 1.10 tsf. Under R test conditions, apparent angles of internal friction and cohesions ranged from 17.9 to 17.9 degrees and from 0.19 to 0.21 tsf, respectively, and effective angles of internal friction and cohesions varied from 28.3 to 38.3 degrees and from 0.06 to 0.27 tsf, respectively.

**SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS**

PROJECT: TVA/KINGSTON FP	BORING: SS-1 thru SS-10
FEATURE: DREDGE CELLS/CLOSURE	EL. :
STATION:	SAMPLE: Gr 1
RANGE :	DATE : 09-29-94
PART :	



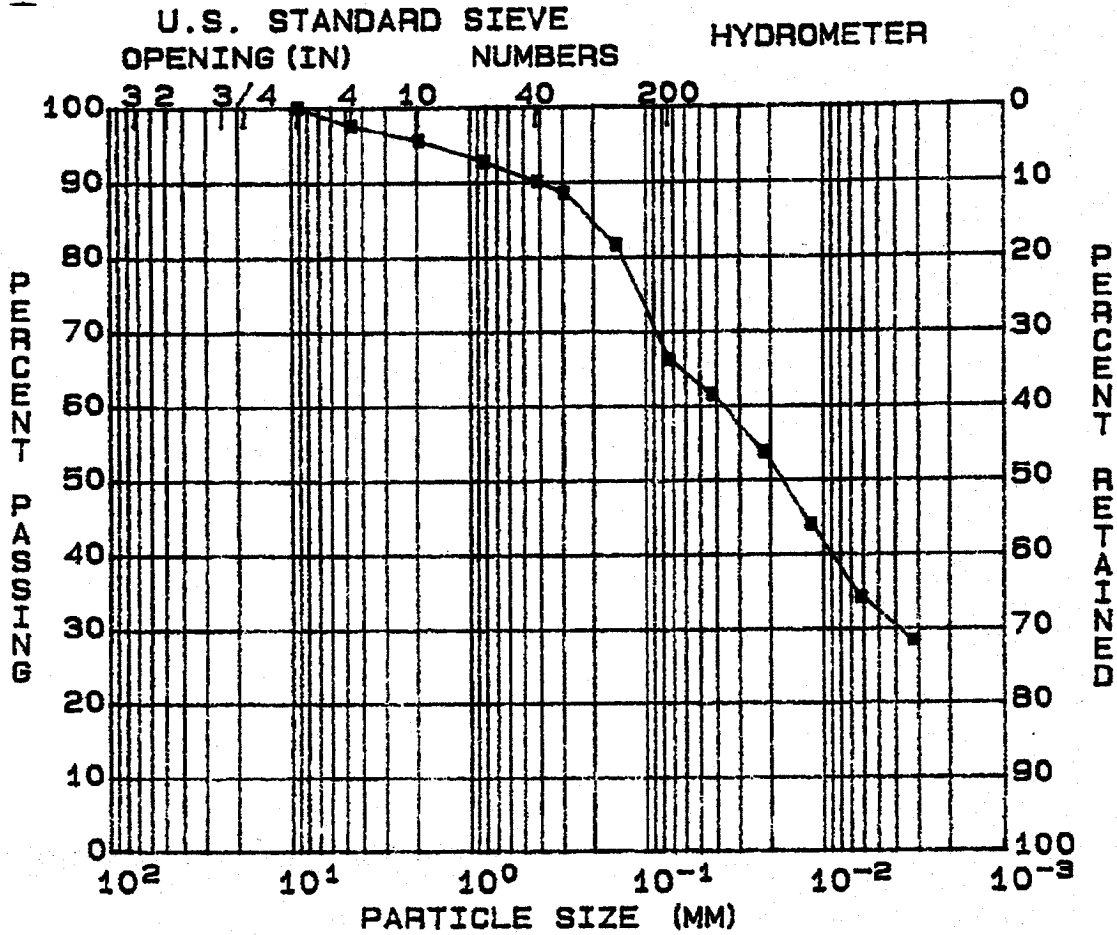
GRAVEL (%) = 2	D10 (MM) = --
SAND (%) = 32	D30 (MM) = --
SILT (%) = 34	D60 (MM) = --
CLAY (%) = 32	COEF UNIF = --

SOIL SYMBOL = CL-ML	L.L. (%) = 26	DENSITY (pcf) = --
MOISTURE (%) =	P.I. (%) = 4	SATURATION (%) = --
SP. GR. = 2.65		VOID RATIO = --

REMARKS:

SINGLETON LABORATORIES PARTICLE SIZE ANALYSIS

PROJECT: TVA/KINGSTON FP BORING: SS-1 thru SS-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: Gr 1
 RANGE : DATE : 09-29-94
 PART :



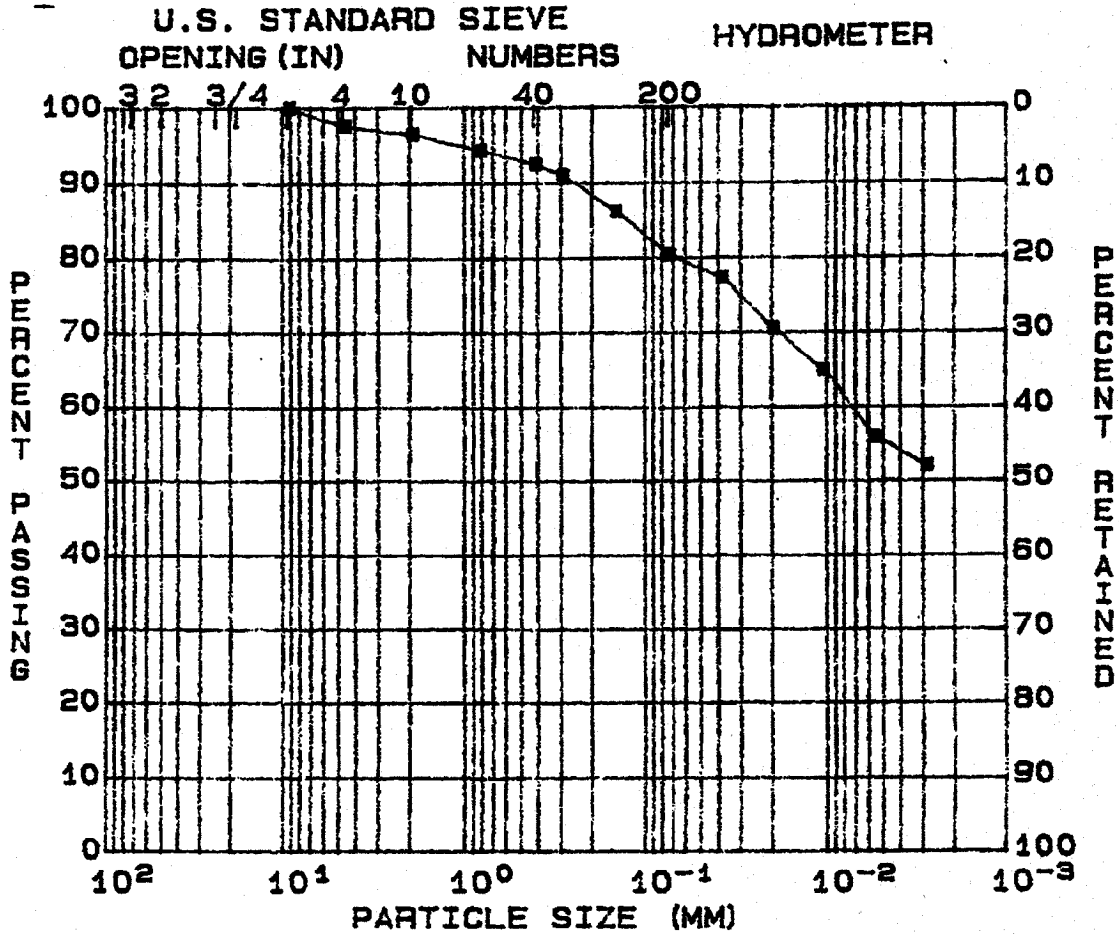
GRAVEL (%) = 2	D10 (MM) = ---
SAND (%) = 32	D30 (MM) = --
SILT (%) = 34	D60 (MM) = --
CLAY (%) = 32	COEF UNIF = --

SOIL SYMBOL = CL-ML	L.L. (%) = 25	DENSITY (pcf) = --
MOISTURE (%) =	P.I. (%) = 4	SATURATION (%) = --
SP. GR. = 2.65		VOID RATIO = --

REMARKS:

SINGLETON LABORATORIES PARTICLE SIZE ANALYSIS

PROJECT: TVA/KINGSTON FP BORING: 99-1 thru 99-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: Gr 2
 RANGE : DATE : 09-29-94
 PART :



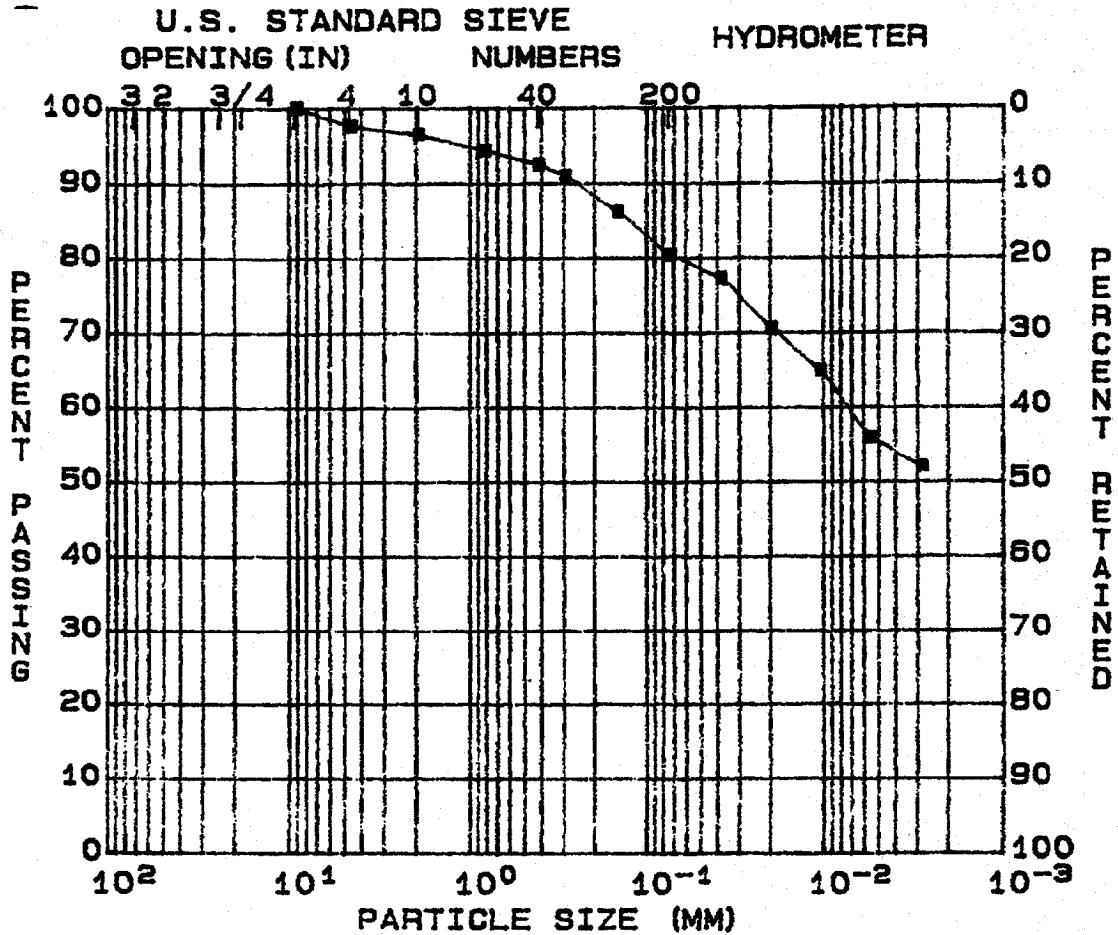
GRAVEL (%) = 1	D10 (MM) = --
SAND (%) = 18	D30 (MM) = --
SILT (%) = 25	D60 (MM) = --
CLAY (%) = 56	COEF UNIF = --

SOIL SYMBOL = MH/CH	L.L. (%) = 59	DENSITY (pcf) = --
MOISTURE (%) =	P.I. (%) = 28	SATURATION (%) = --
SP. GR. = 2.73		VOID RATIO = --

REMARKS:

SINGLETON LABORATORIES PARTICLE SIZE ANALYSIS

PROJECT: TVA/KINGSTON FP BORING: SS-1 thru SS-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: 6r 2
 RANGE : DATE : 09-29-84
 PART :



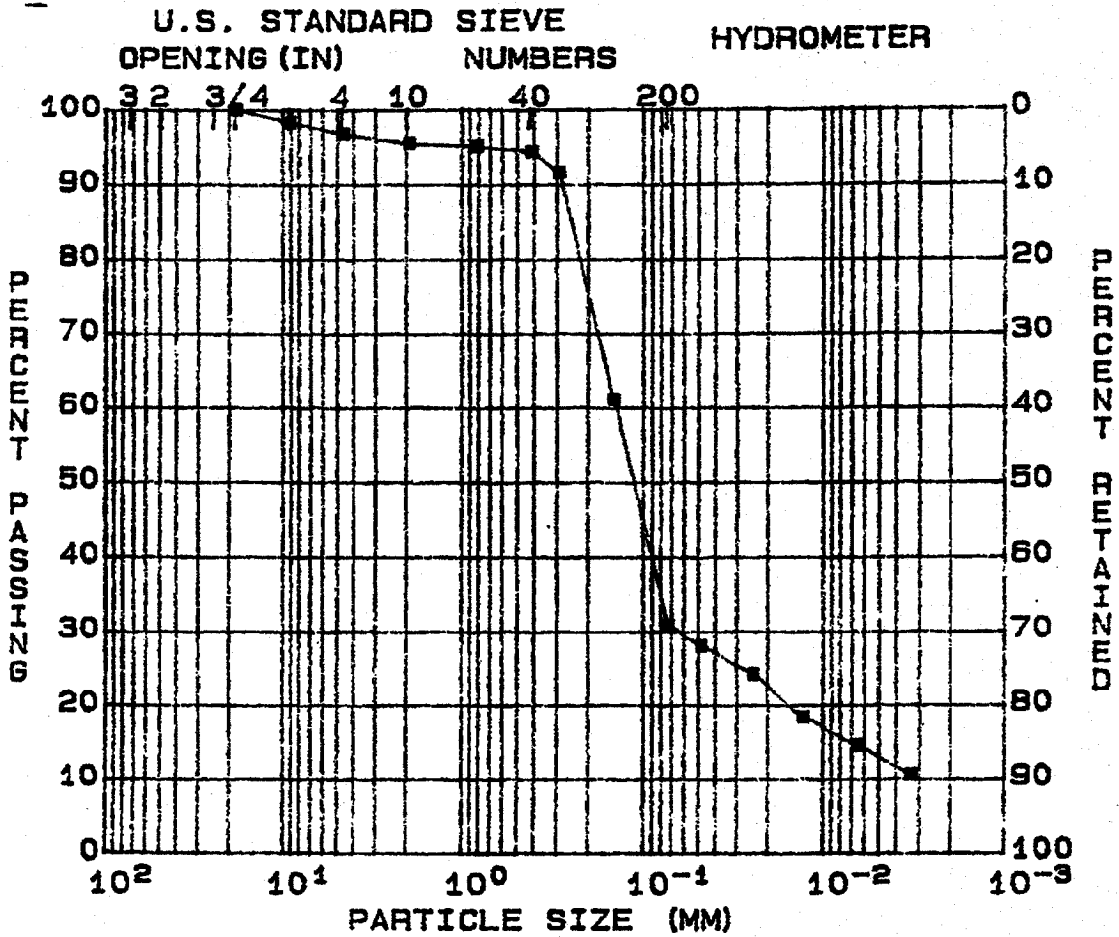
GRAVEL (%) = 1	D10 (MM) = ---
SAND (%) = 18	D30 (MM) = ---
SILT (%) = 25	D60 (MM) = ---
CLAY (%) = 56	COEF UNIF = ---

SOIL SYMBOL = MH/CH	L.L. (%) = 59	DENSITY (pcf) = ---
MOISTURE (%) =	P.I. (%) = 27	SATURATION (%) = ---
SP. GR. = 2.73		VOID RATIO = ---

REMARKS:

**SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS**

PROJECT: TVA/KINGSTON FP BORING: SS-1 thru SS-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: Gr 3
 RANGE : DATE : 09-29-94
 PART :



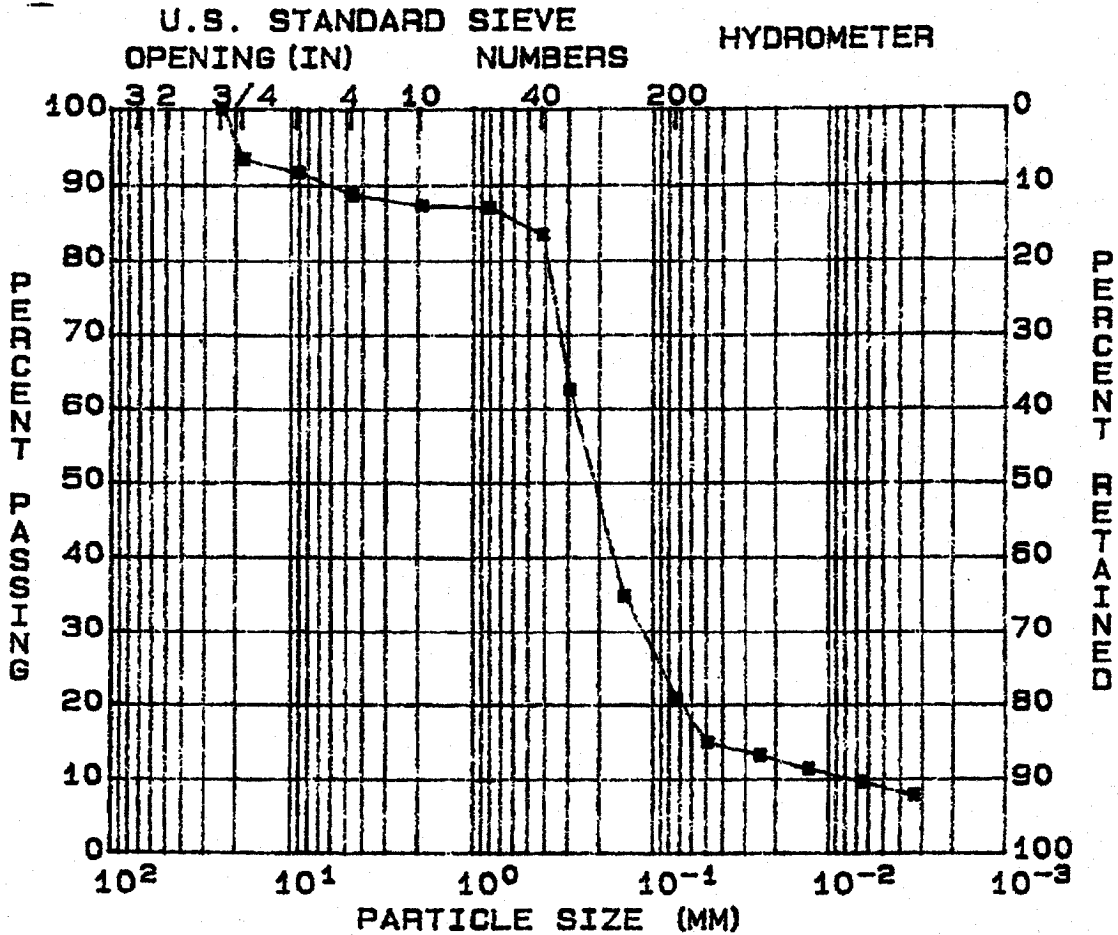
GRAVEL (%) = 3	D10 (MM) = 0.0029
SAND (%) = 66	D30 (MM) = 0.0648
SILT (%) = 18	D60 (MM) = 0.1456
CLAY (%) = 13	COEF UNIF = 49.4

SOIL SYMBOL = SM	L.L. (%) = NP	DENSITY (pcf) = --
MOISTURE (%) =	P.I. (%) = NP	SATURATION (%) = --
SP. GR. = 2.64		VOID RATIO = --

REMARKS:

**SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS**

PROJECT: TVA/KINGSTON FP BORING: SS-1 thru SS-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: Gr 4
 RANGE : DATE : 09-29-84
 PART :



GRAVEL (%) = 11
 SAND (%) = 68
 SILT (%) = 12
 CLAY (%) = 9

D10 (MM) = 0.0076
 D30 (MM) = 0.1176
 D60 (MM) = 0.2804
 COEF UNIF = 37.1

SOIL SYMBOL = SC/SM
 MOISTURE (%) =
 SP. GR. = 2.66

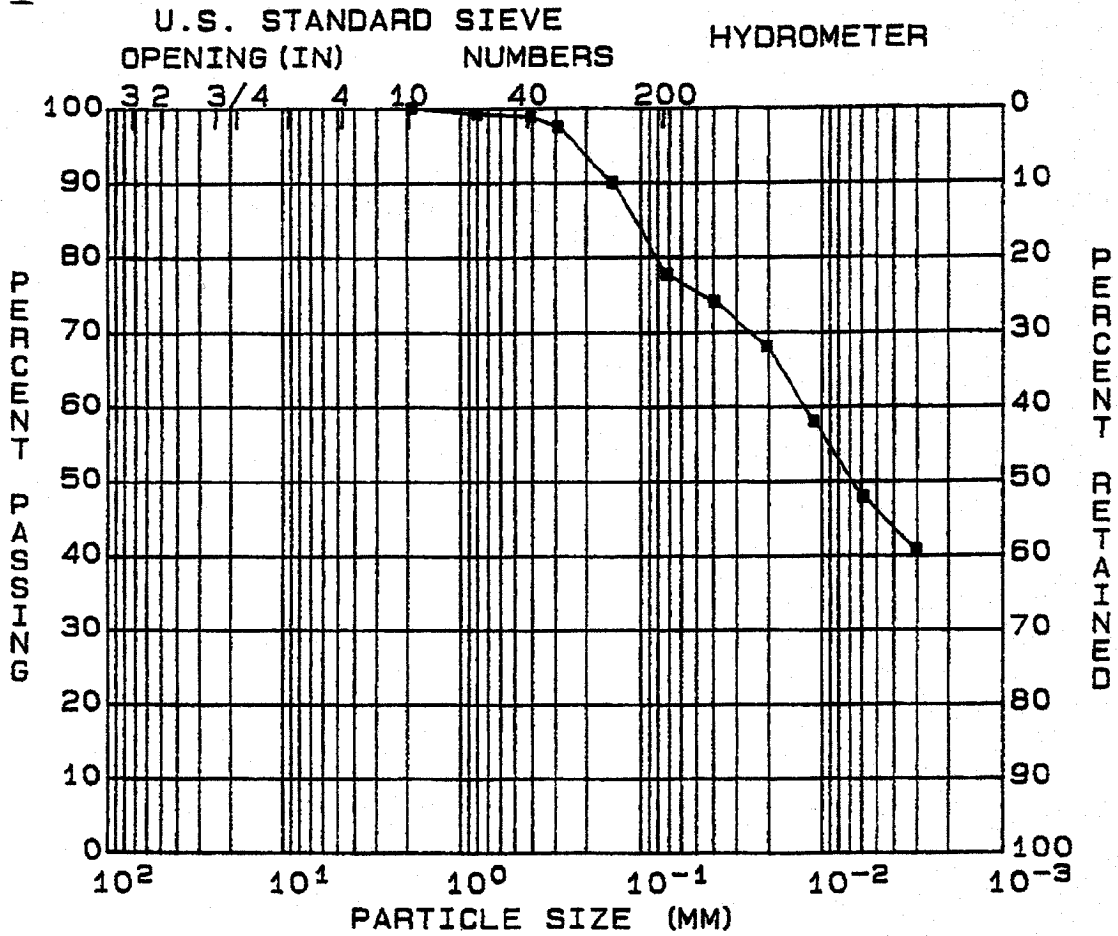
L.L. (%) = NP
 P.I. (%) = NP

DENSITY (pcf) = --
 SATURATION (%) = --
 VOID RATIO = --

REMARKS:

**SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS**

PROJECT: TVA/KINGSTON FP BORING: SS-1 thru SS-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: Gr 5
 RANGE : DATE : 09-29-94
 PART :



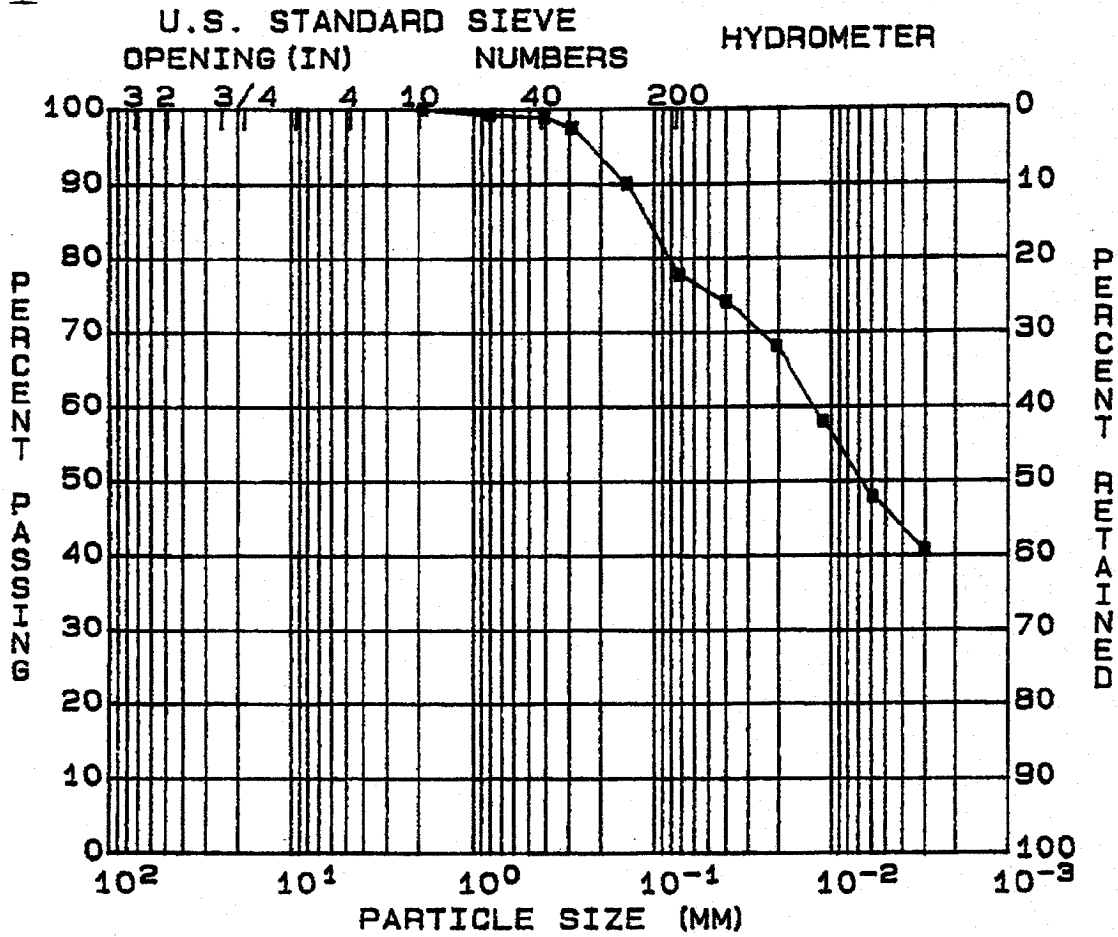
GRAVEL (%) = 0	D10 (MM) = --
SAND (%) = 22	D30 (MM) = --
SILT (%) = 32	D60 (MM) = --
CLAY (%) = 46	COEF UNIF = --

SOIL SYMBOL = CL	L.L. (%) = 31	DENSITY (pcf) = --
MOISTURE (%) =	P.I. (%) = 12	SATURATION (%) = --
SP. GR. = 2.66		VOID RATIO = --

REMARKS:

SINGLETON LABORATORIES PARTICLE SIZE ANALYSIS

PROJECT: TVA/KINGSTON FP BORING: SS-1 thru SS-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: Gr 5
 RANGE : DATE : 09-29-94
 PART :



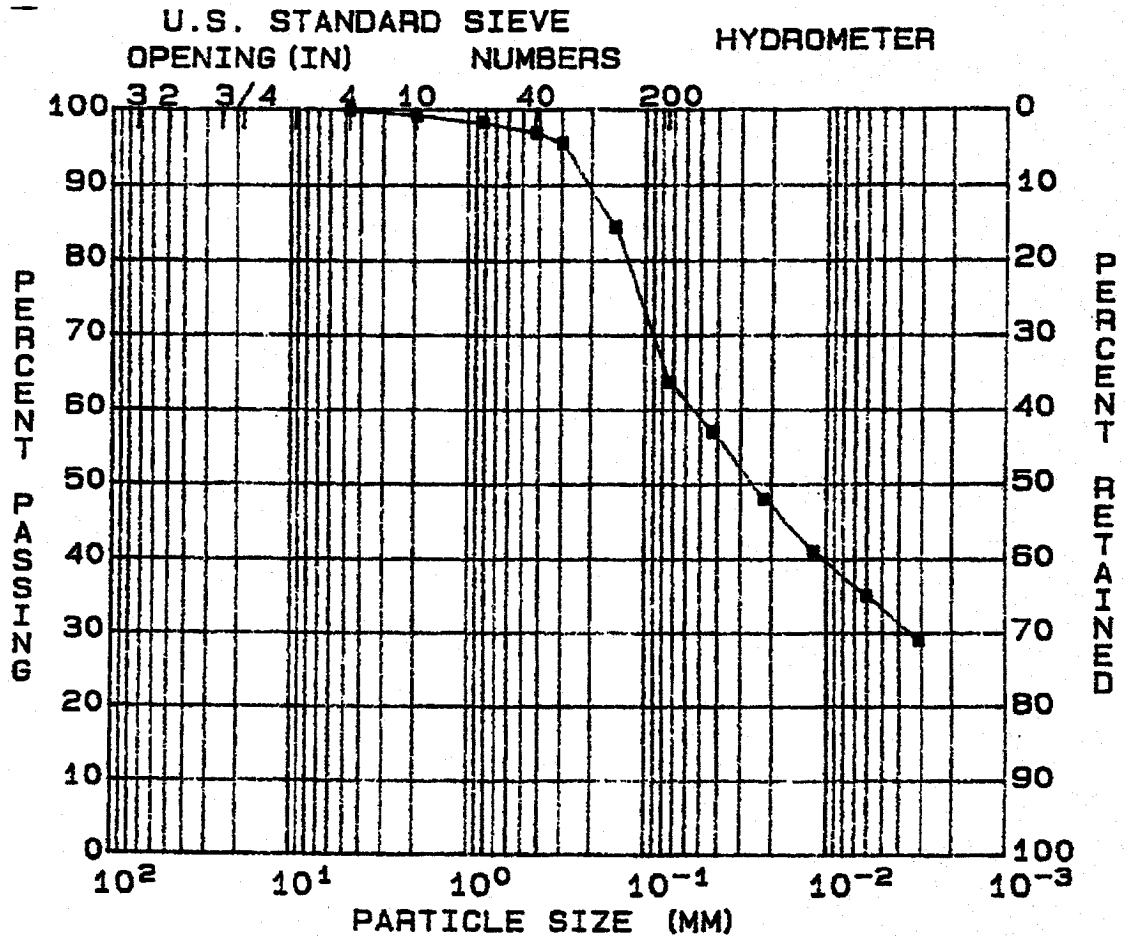
GRAVEL (%) = 0	D10 (MM) = --
SAND (%) = 22	D30 (MM) = --
SILT (%) = 32	D60 (MM) = --
CLAY (%) = 46	COEF UNIF = --

SOIL SYMBOL = CL	L.L. (%) = 30	DENSITY (pcf) = --
MOISTURE (%) =	P.I. (%) = 11	SATURATION (%) = --
SP. GR. = 2.66		VOID RATIO = --

REMARKS:

SINGLETON LABORATORIES PARTICLE SIZE ANALYSIS

PROJECT: TVA/KINGSTON FP BORING: SS-1 thru SS-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: Gr 6
 RANGE : DATE : 09-29-94
 PART :



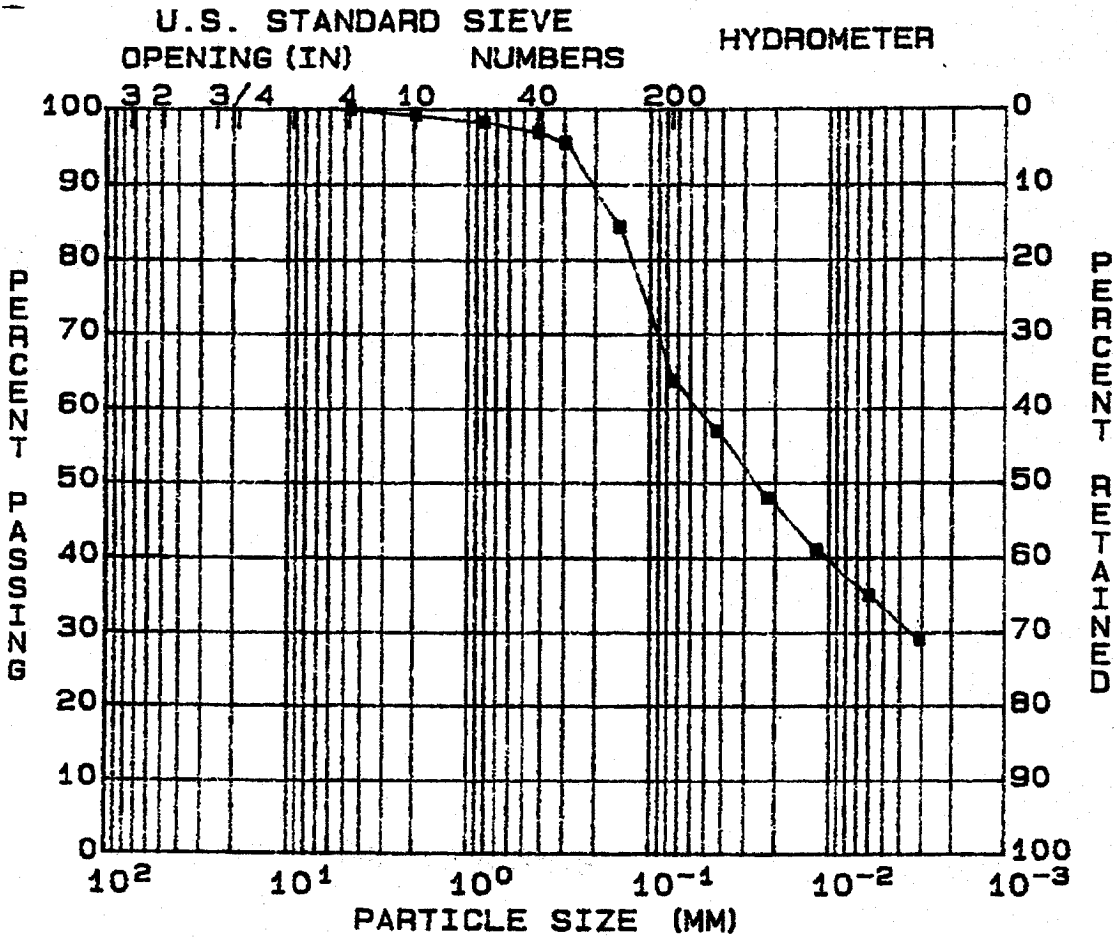
GRAVEL (%) = 0	D10 (MM) = --
SAND (%) = 36	D30 (MM) = --
SILT (%) = 30	D60 (MM) = --
CLAY (%) = 34	COEF UNIF = --

SOIL SYMBOL = CL	L.L. (%) = 26	DENSITY (pcf) = --
MOISTURE (%) =	P.I. (%) = 8	SATURATION (%) = --
SP. GR. = 2.71		VOID RATIO = --

REMARKS:

SINGLETON LABORATORIES PARTICLE SIZE ANALYSIS

PROJECT: TVA/KINGSTON FP BORING: SS-1 thru SS-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: Gr 6
 RANGE : DATE : 09-29-94
 PART :



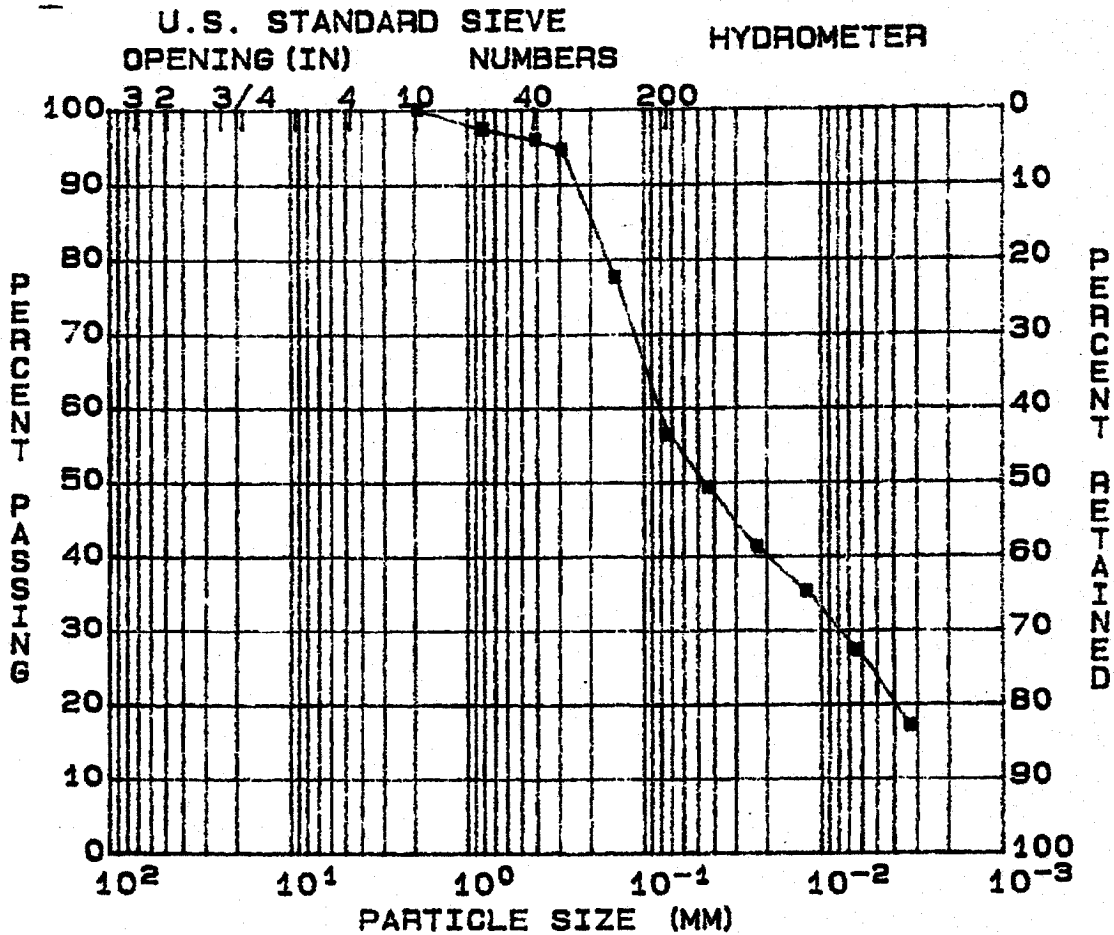
GRAVEL (%) = 0	D10 (MM) = --
SAND (%) = 36	D30 (MM) = --
SILT (%) = 30	D60 (MM) = --
CLAY (%) = 34	COEF UNIF = --

SOIL SYMBOL = CL	L.L. (%) = 26	DENSITY (pcf) = --
MOISTURE (%) =	P.I. (%) = 8	SATURATION (%) = --
SP. GR. = 2.71		VOID RATIO = --

REMARKS:

**SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS**

PROJECT: TVA/KINGSTON FP BORING: SS-1 thru SS-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: Gr 7
 RANGE : DATE : 09-29-94
 PART :



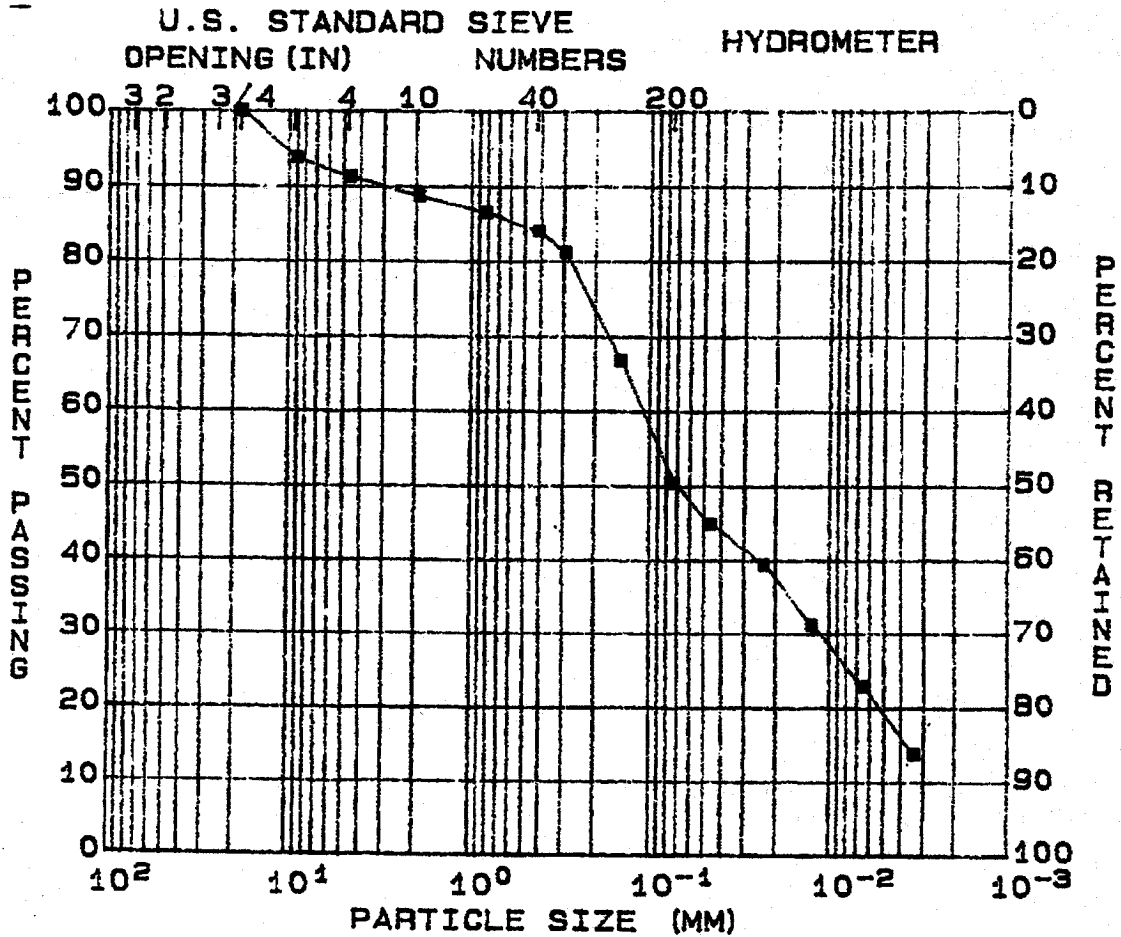
GRAVEL (%) = 0	D10 (MM) = --
SAND (%) = 43	D30 (MM) = --
SILT (%) = 33	D60 (MM) = --
CLAY (%) = 24	COEF UNIF = --

SOIL SYMBOL = ML	L.L. (%) = NP	DENSITY (pcf) = --
MOISTURE (%) =	P.I. (%) = NP	SATURATION (%) = --
SP. GR. = 2.65		VOID RATIO = --

REMARKS:

SINGLETON LABORATORIES PARTICLE SIZE ANALYSIS

PROJECT: TVA/KINGSTON FP BORING: SS-1 thru SS-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: Gr 8
 RANGE : DATE : 09-29-94
 PART :



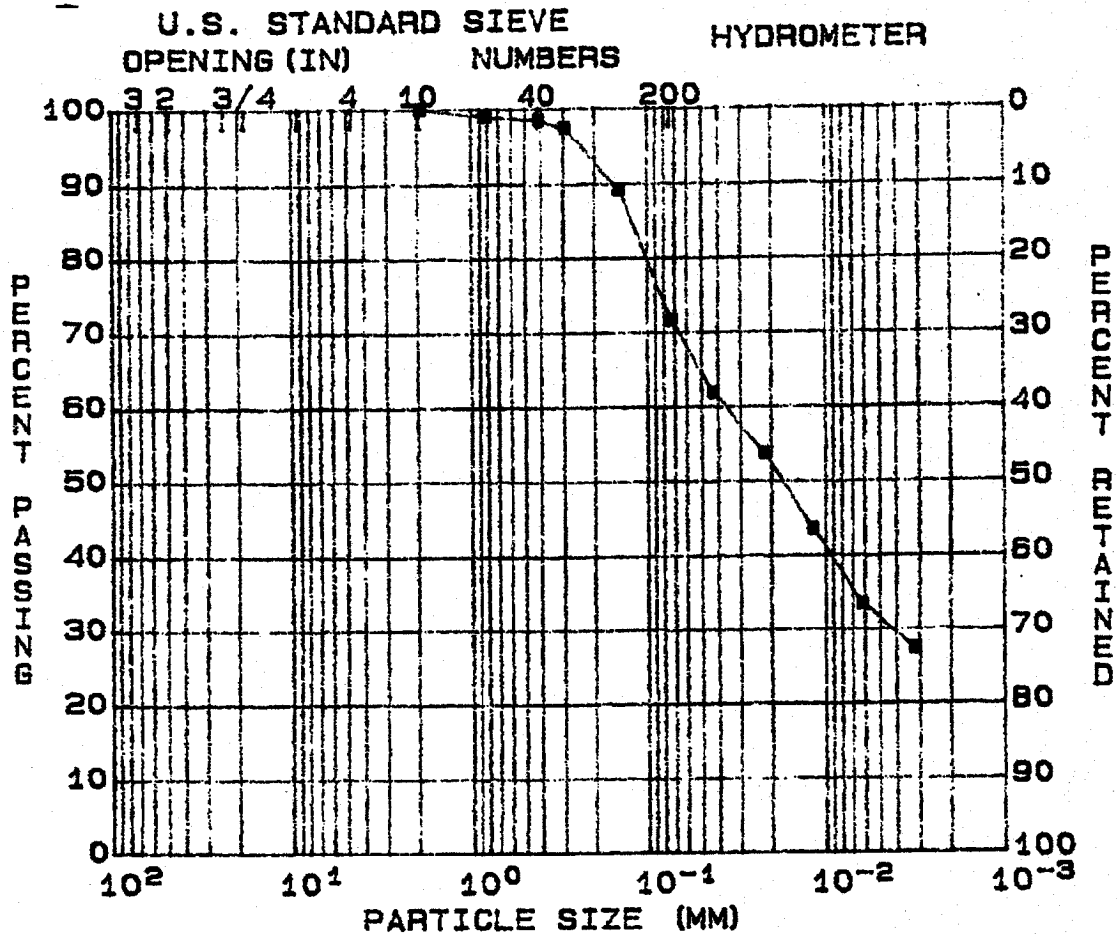
GRAVEL (%) = 8	D10 (MM) = --
SAND (%) = 41	D30 (MM) = --
SILT (%) = 31	D60 (MM) = --
CLAY (%) = 20	COEF UNIF = --

SOIL SYMBOL = ML	L.L. (%) = NP	DENSITY (pcf) = --
MOISTURE (%) =	P.I. (%) = NP	SATURATION (%) = --
SP. GR. = 2.56		VOID RATIO = --

REMARKS:

SINGLETON LABORATORIES PARTICLE SIZE ANALYSIS

PROJECT: TVA/KINGSTON FP BORING: SS-1 thru SS-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: gr 9
 RANGE : DATE : 09-29-94
 PART :



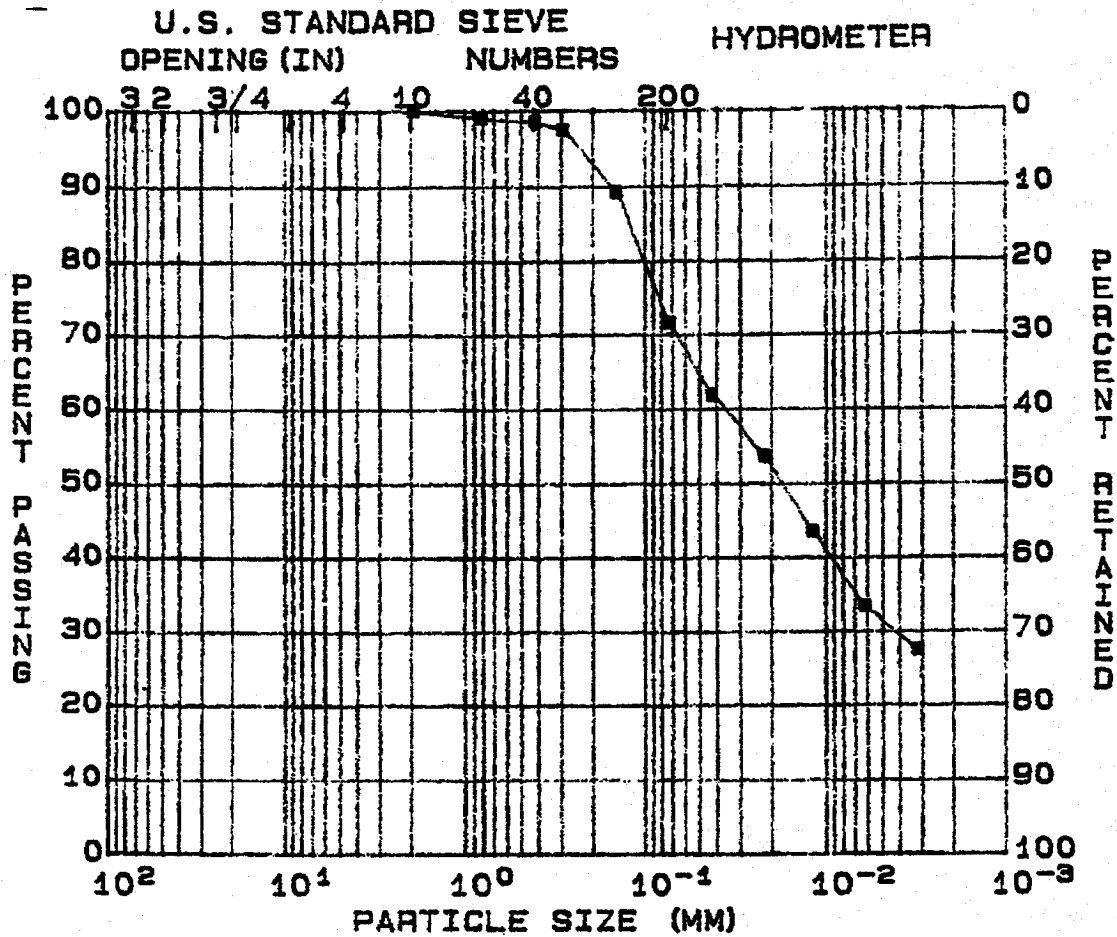
GRAVEL (%) = 0	D10 (MM) = --
SAND (%) = 28	D30 (MM) = --
SILT (%) = 40	D60 (MM) = --
CLAY (%) = 32	COEF UNIF = --

SOIL SYMBOL = CL	L.L. (%) = 26	DENSITY (pcf) = --
MOISTURE (%) =	P.I. (%) = 8	SATURATION (%) = --
SP. GR. = 2.64		VOID RATIO = --

REMARKS:

SINGLETON LABORATORIES PARTICLE SIZE ANALYSIS

PROJECT: TVA/KINGSTON FP BORING: ss-1 thru ss-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: Gr 9
 RANGE : DATE : 09-29-94
 PART :



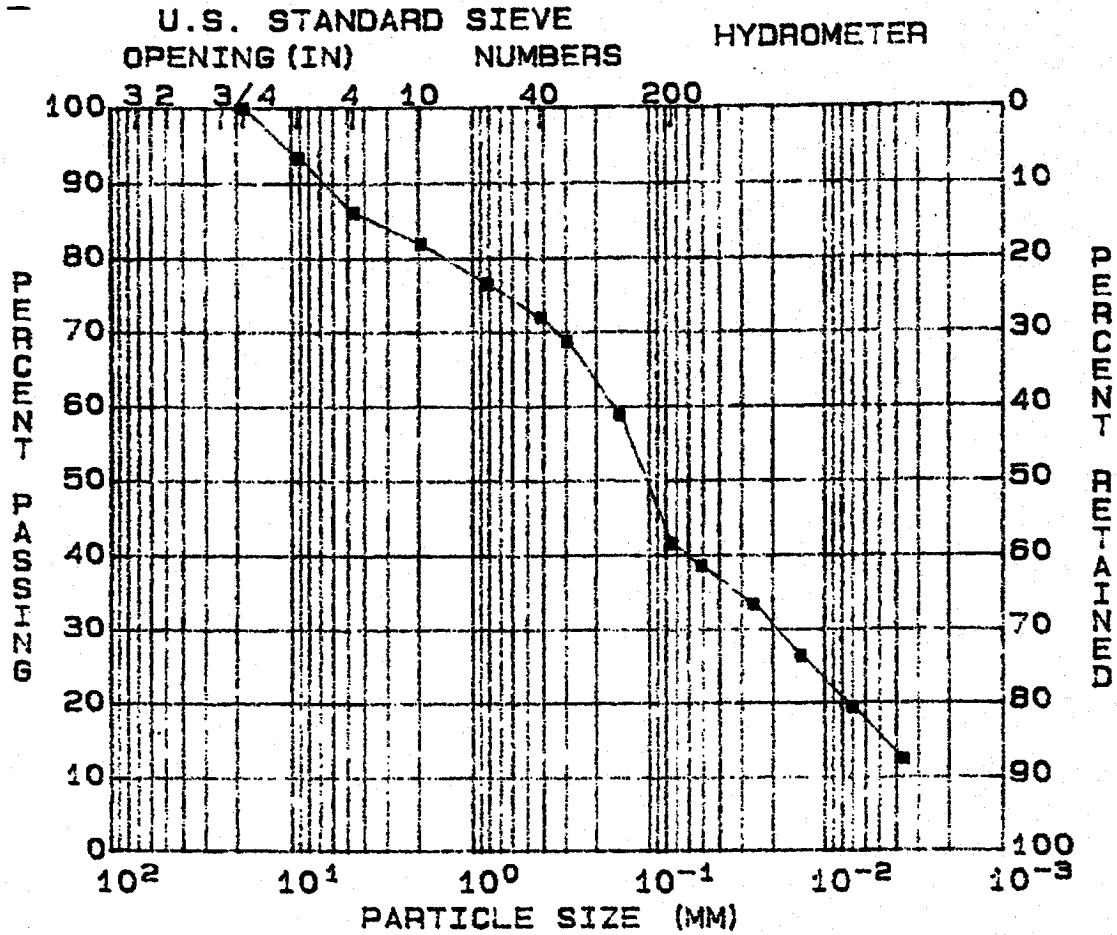
GRAVEL (%) = 0	D10 (MM) = --
SAND (%) = 28	D30 (MM) = --
SILT (%) = 40	D60 (MM) = --
CLAY (%) = 32	COEF UNIF = --

SOIL SYMBOL = CL	L.L. (%) = 26	DENSITY (pcf) = --
MOISTURE (%) =	P.I. (%) = 8	SATURATION (%) = --
SP. GR. = 2.64		VOID RATIO = --

REMARKS:

SINGLETON LABORATORIES PARTICLE SIZE ANALYSIS

PROJECT: TVA/KINGSTON FP BORING: SS-1 thru SS-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: Gr 10
 RANGE : DATE : 09-29-94
 PART :



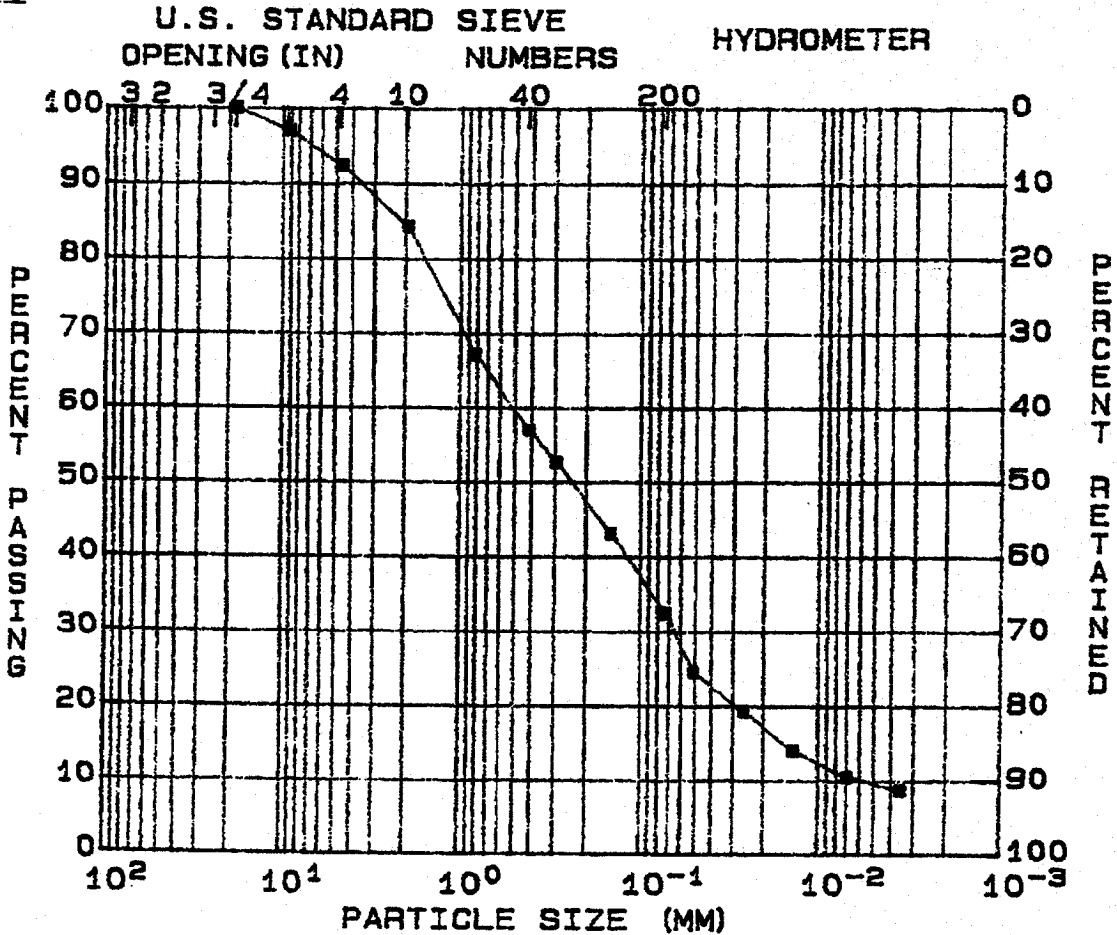
GRAVEL (%) = 13	D10 (MM) = 0.0029
SAND (%) = 45	D30 (MM) = 0.0185
SILT (%) = 26	D60 (MM) = 0.1552
CLAY (%) = 16	COEF UNIF=54.2

SOIL SYMBOL = SM	L.L. (%) = NP	DENSITY (pcf) = ---
MOISTURE (%) =	P.I. (%) = NP	SATURATION (%) = ---
SP. GR. = 2.40		VOID RATIO = ---

REMARKS:

**SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS**

PROJECT: TVA/KINGSTON FP BORING: SS-1 thru SS-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: Gr 11
 RANGE : DATE : 09-29-94
 PART :



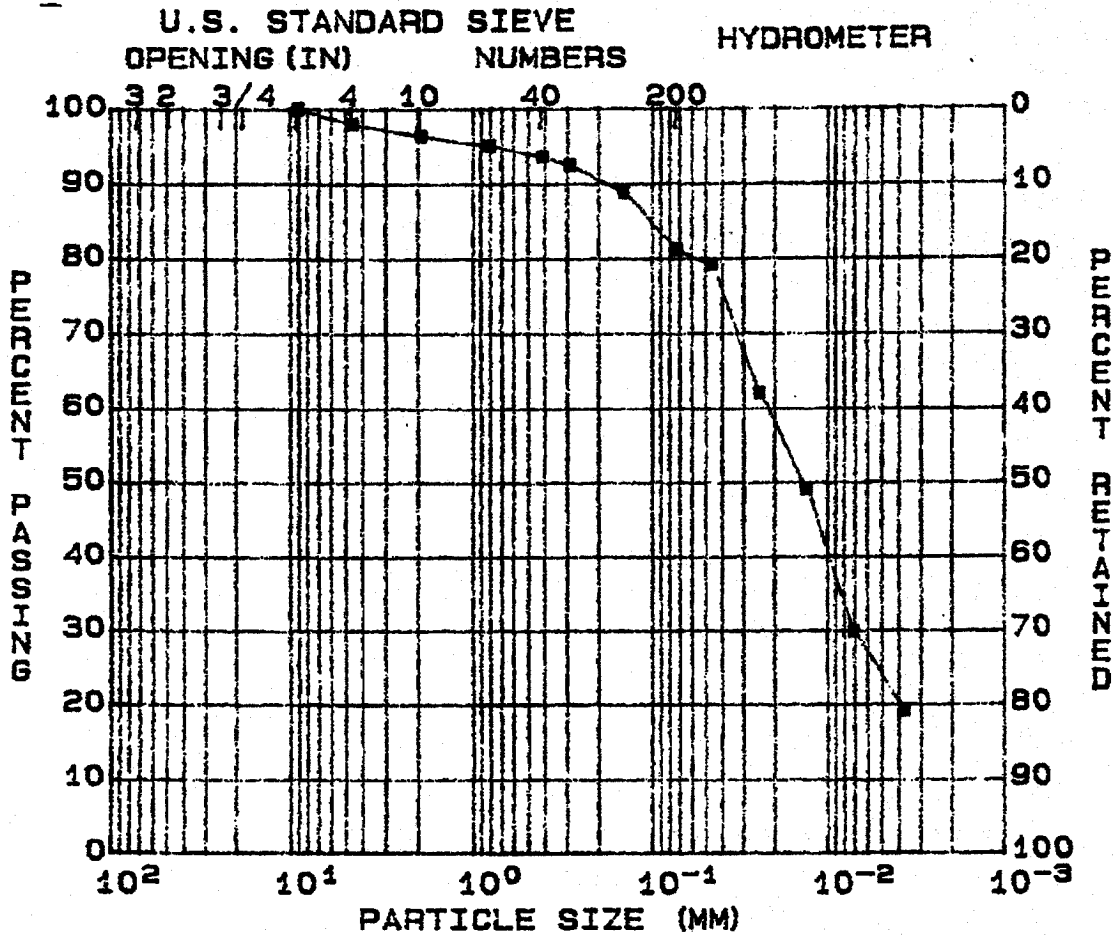
GRAVEL (%) = 7	D10 (MM) = 0.0056
SAND (%) = 61	D30 (MM) = 0.0662
SILT (%) = 23	D60 (MM) = 0.5022
CLAY (%) = 9	COEF UNIF=90.5

SOIL SYMBOL = SM	L.L. (%) = NP	DENSITY (pcf) = --
MOISTURE (%) =	P.I. (%) = NP	SATURATION (%) = --
SP. GR. = 2.51		VOID RATIO = --

REMARKS:

SINGLETON LABORATORIES PARTICLE SIZE ANALYSIS

PROJECT: TVA/KINGSTON FP BORING: SS-1 thru SS-10
 FEATURE: DREDGE CELLS/CLOSURE EL. :
 STATION: SAMPLE: 6r 12
 RANGE : DATE : 09-29-94
 PART :



GRAVEL (%) = 1	D10 (MM) = --
SAND (%) = 17	D30 (MM) = --
SILT (%) = 57	D60 (MM) = --
CLAY (%) = 25	COEF UNIF = --

SOIL SYMBOL = ML	L.L. (%) = NP	DENSITY (pcf) = --
MOISTURE (%) =	P.I. (%) = NP	SATURATION (%) = --
SP. GR. = 2.31		VOID RATIO = --

REMARKS:

**This information taken from "Report of Soil Borings, Monitoring Well Installation and Soil Laboratory Testing - Tennessee Valley Authority - Watts Bar and Kingston Facilities,"
Law Engineering, November 30, 1988.**

LABORATORY TESTING PROCEDURES

ATTERBERG LIMITS


The Atterberg Limits consist of moisture contents of soils which produce specified consistencies. The Atterberg Limits consist of the Liquid Limit (LL), Plastic Limit (PL) and Shrinkage Limit (SL). The LL (between the liquid and plastic states) is the water content at which a trapezoidal groove of specified shape, cut in moist soil held in a special cup, is closed after 25 taps on a hard rubber plate. The PL (between the semi-solid and solid states) is the maximum water content at which a reduction in water content will not cause a decrease in the volume of the soil mass.

The LL has been found to be proportional to the compressibility of the normally consolidated soil. The Plasticity Index (PI) is the calculated difference in water contents between the LL and PL. Together the LL and PI are used to classify silts and clays according to the Unified System Classification of Soils (ASTM D-2487). The PI is used to predict the potential for volume changes in confined soils beneath foundations or grade slabs. Should the PI indicate the potential for soil volume change, Shrinkage Limit (SL) testing can be performed to estimate the amount of volume changes in confined soils beneath foundations or grade slabs.

The LL, (PL and PI) and SL are determined in accordance with ASTM's D-423, D-424 and D-427, respectively.

GRAIN SIZE DISTRIBUTION

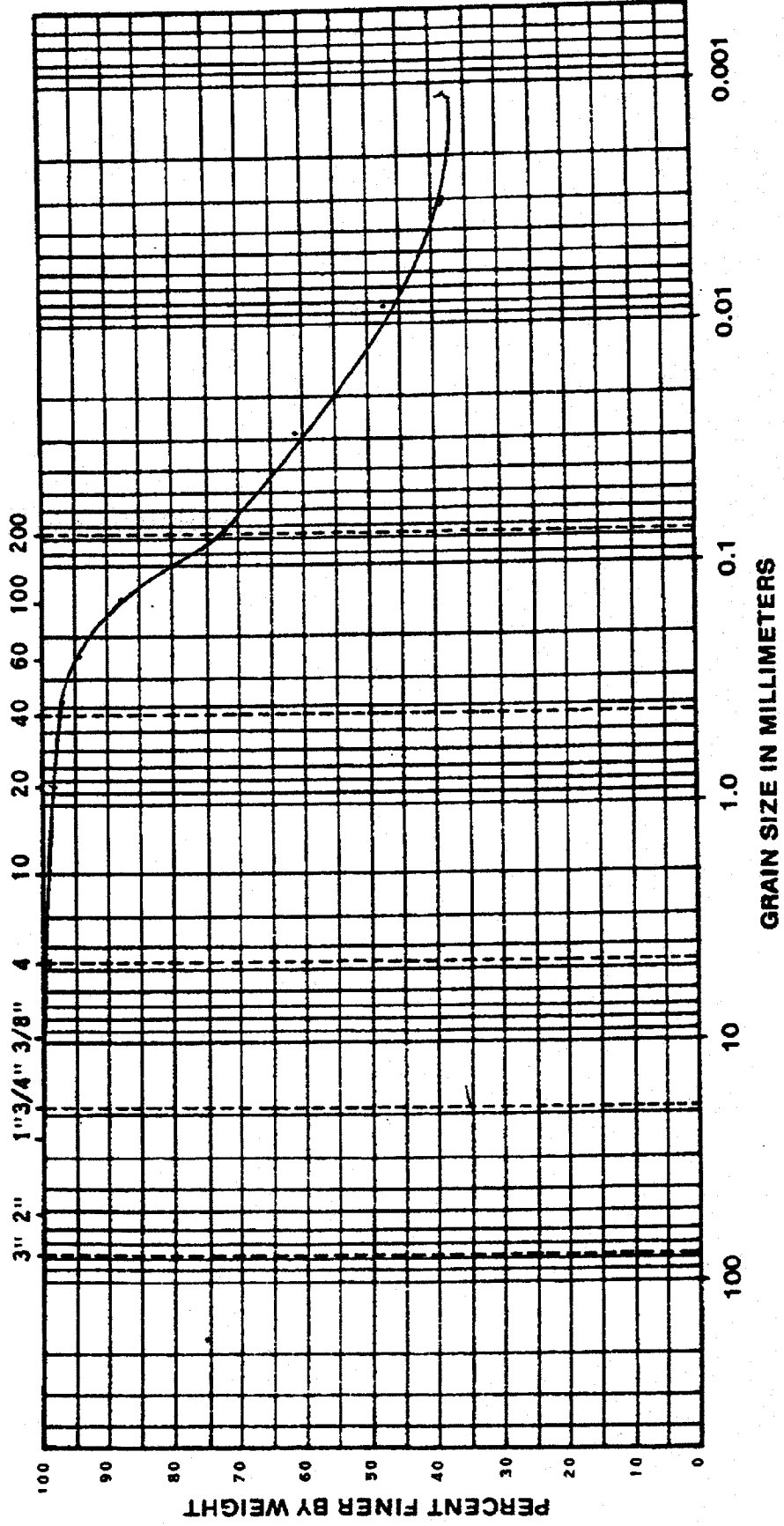
Grain Size Tests are performed to aid in determining the soil classification and the grain size distribution. The soil samples are prepared for testing according to ASTM D-421 (dry preparation) or ASTM D-2217 (wet preparation). If only the grain size distribution of soils coarser than a number 200 sieve (0.074 mm opening) is desired, the grain size distribution is determined by washing the sample over a #200 sieve and after drying passing the samples through a standard set of nested sieves. If the



grain size distribution of the soils finer than the #200 sieve is also desired, the grain size distribution of the soils coarser than the #10 sieve is determined by passing the sample through a set of nested sieves. Materials passing the number 10 sieve are dispersed with a dispersing agent and suspended in water and the grain size distribution calculated from the measured settlement rate of the particles. These tests are conducted in accordance with ASTM D-422.

SOIL	GRAVEL		SAND			SILT SIZES		FINES
	COARSE	FINE	COARSE	MEDIUM	FINE	CLAY SIZES		

U. S. STANDARD SIEVE SIZES

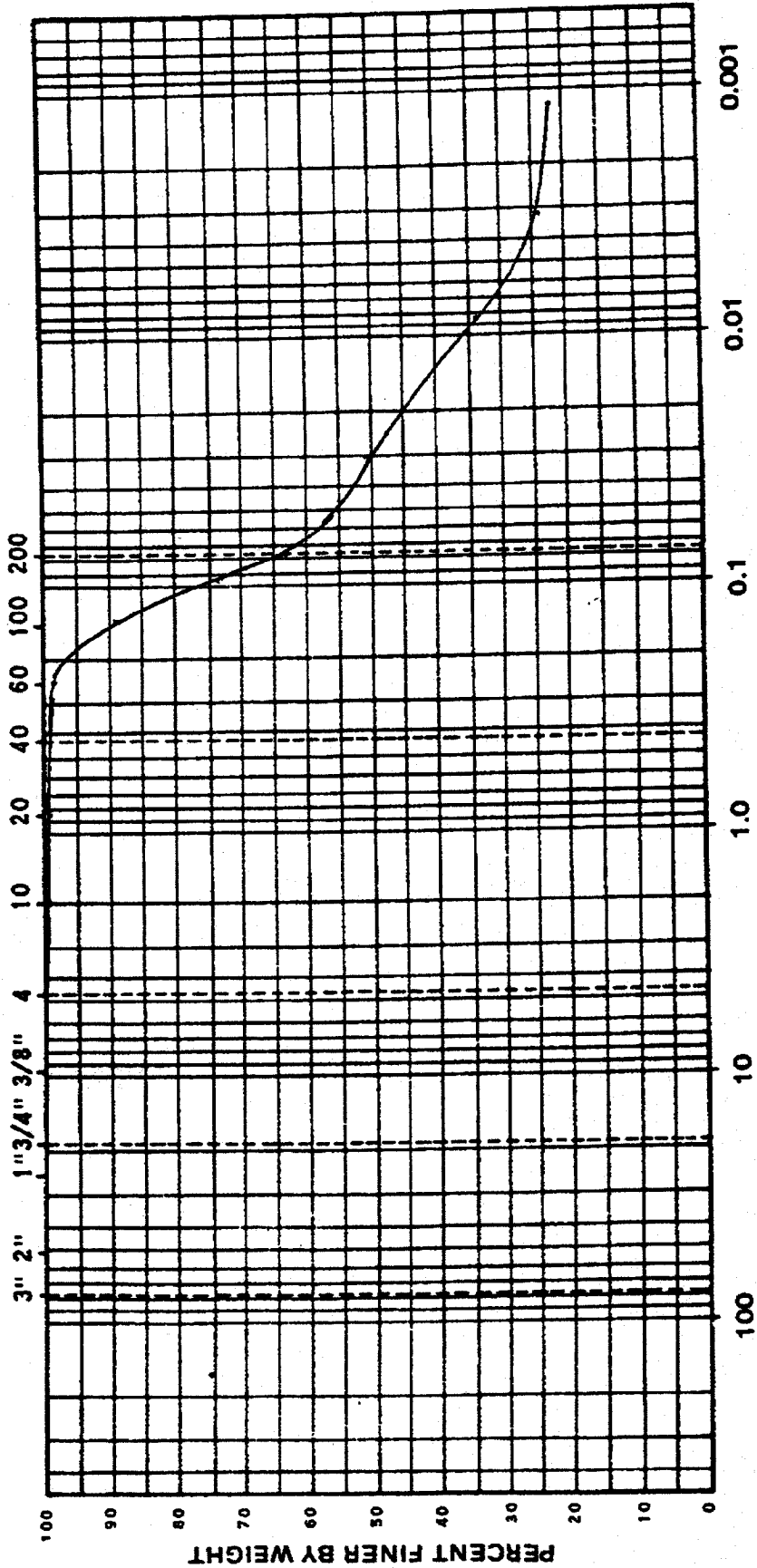


**Law Engineering
Testing Company**
Grain Size Distribution


BORING NO. WB-1	DEPTH 4 TO 5.5 FEET	NAT WC 16.6%	LL 41	PL 20	PI 21	DESCRIPTION OR CLASSIFICATION CL - INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY

COBBLES	GRAVEL		SAND			SILT SIZES		FINES
	COARSE	FINE	COARSE	MEDIUM	FINE			CLAY SIZES

U. S. STANDARD SIEVE SIZES

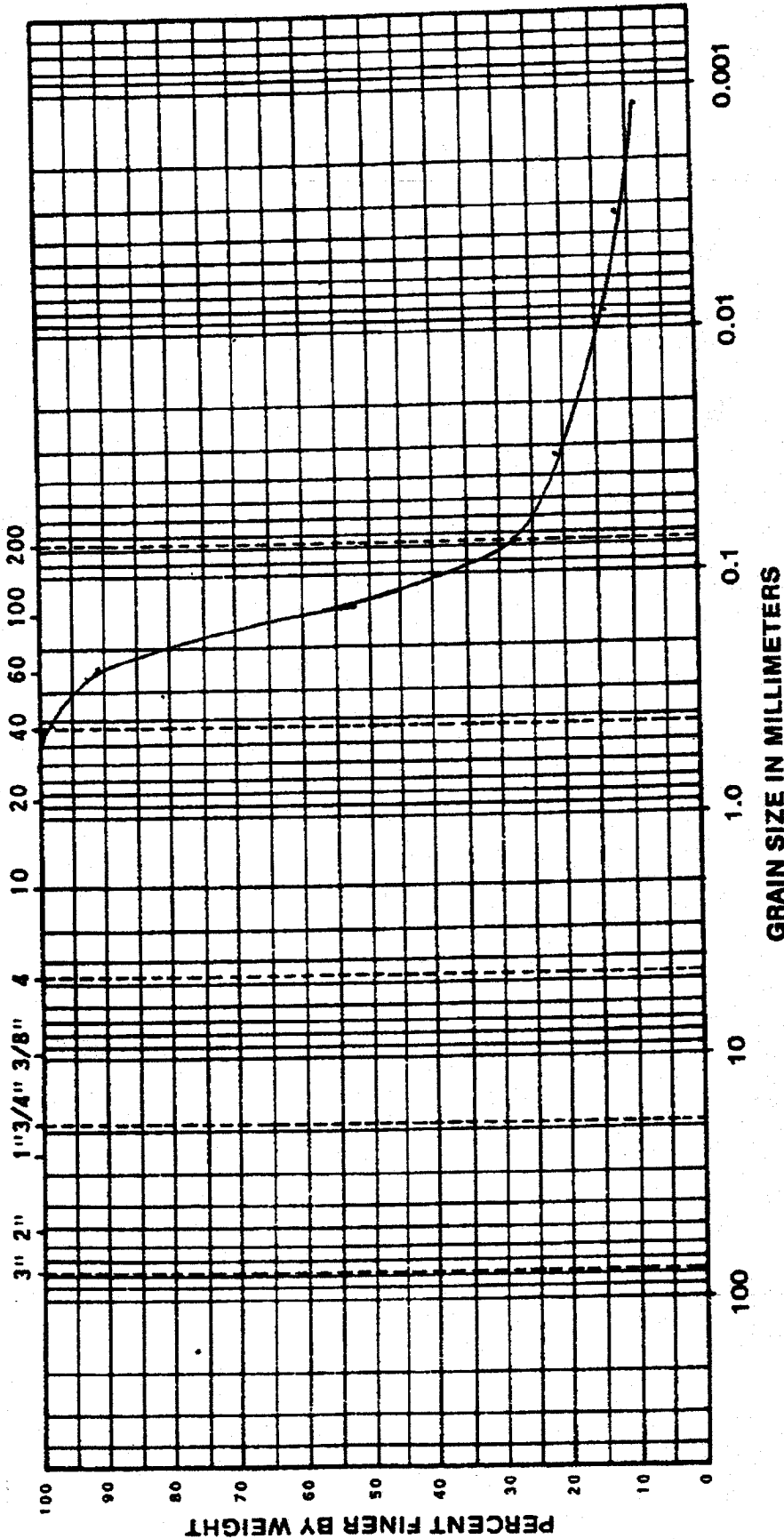


GRAIN SIZE IN MILLIMETERS

 Law Engineering Testing Company Grain Size Distribution	BORING NO.	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
	WB-1	19 TO 20.5 FEET	19.1%	27	17	10	CL - INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY
	JOB NO. K-88195						

ROCK FRAGMENTS	COBBLES		GRAVEL		SAND			SILT SIZES		CLAY SIZES	
	COARSE	FINE	COARSE	FINE	COARSE	MEDIUM	FINE				

U. S. STANDARD SIEVE SIZES

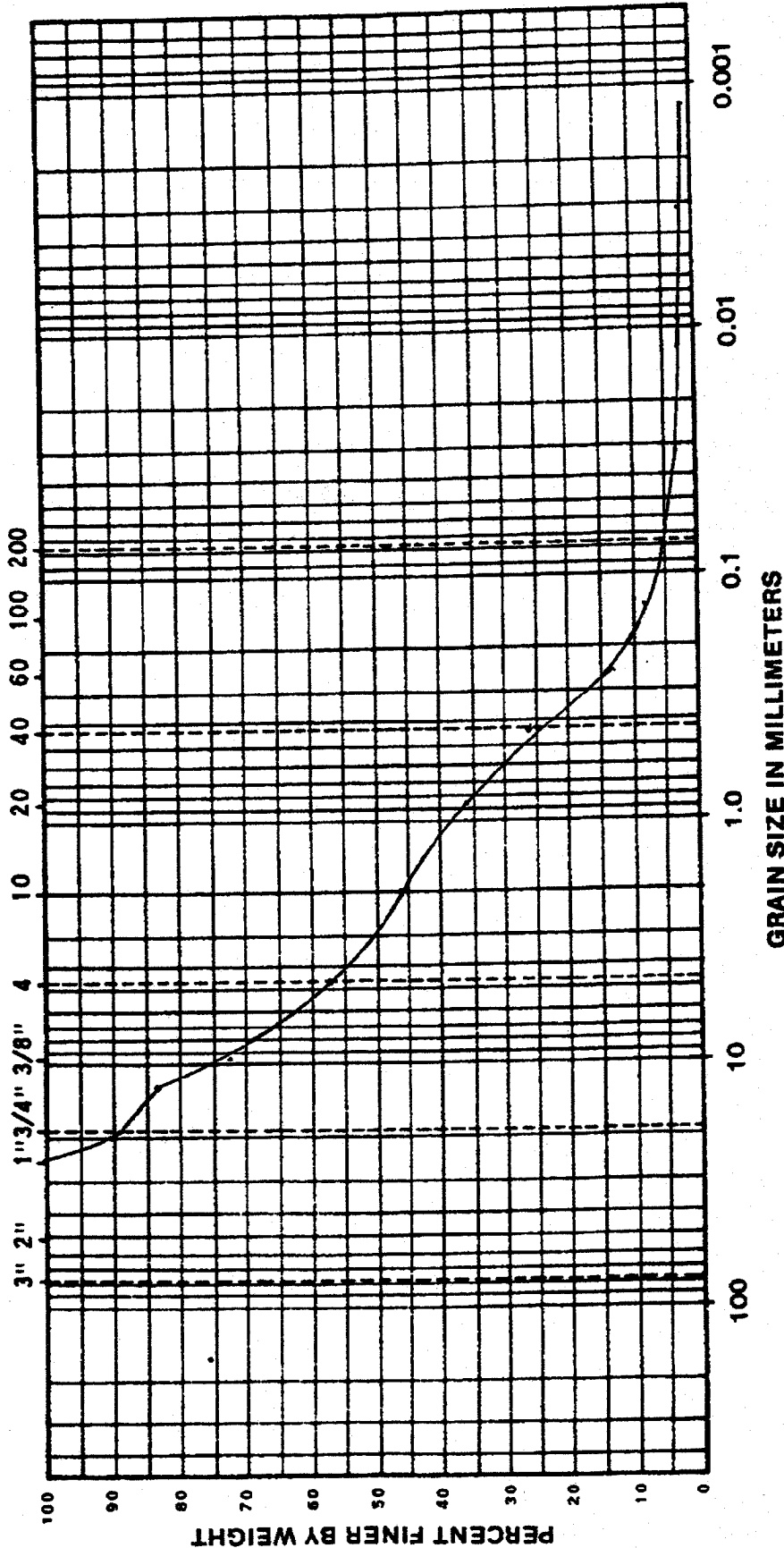


GRAIN SIZE IN MILLIMETERS


Law Engineering Testing Company Grain Size Distribution		BORING NO.	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
		WB-1	34 TO 35.5 FEET	26.3%	23	20	3	
		JOB NO.						
		K-88195						

BOULDER		GRAVEL		SAND			FINES		
COARSE		FINE		COARSE		MEDIUM		FINE	
								CLAY SIZES	

U. S. STANDARD SIEVE SIZES

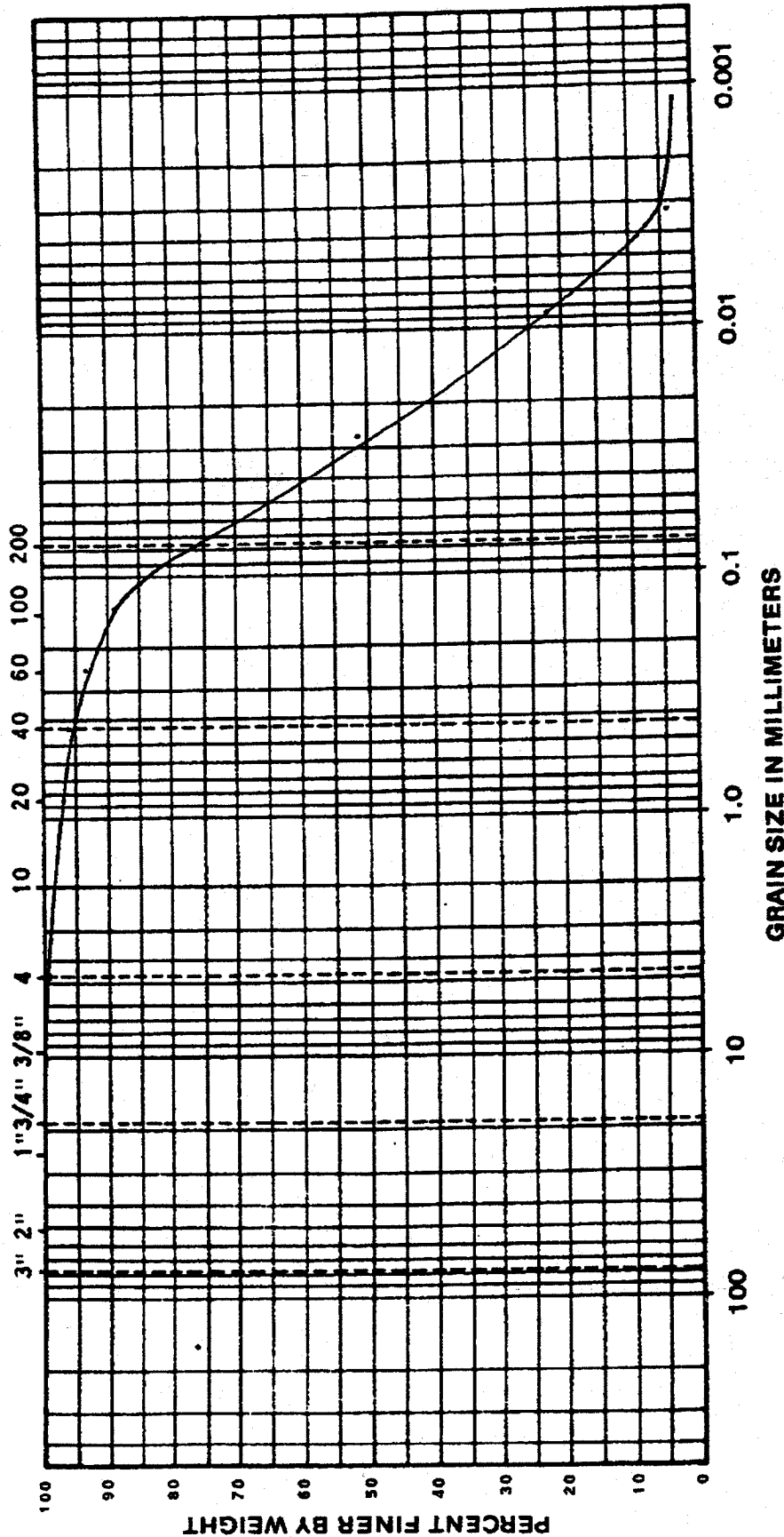


GRAIN SIZE IN MILLIMETERS

 Law Engineering Testing Company Grain Size Distribution		BORING NO.	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
		WB-1	44 TO 45.5 FEET	10.3	NON-PLASTIC			SP-SM - POORLY GRADED SANDS TO SILTY SANDS
		JOB NO.						
		K-88195						

BOULDERS		GRAVEL		SAND			SILT SIZES		FINES		CLAY SIZES	
		COARSE	FINE	COARSE	MEDIUM	FINE						

U. S. STANDARD SIEVE SIZES

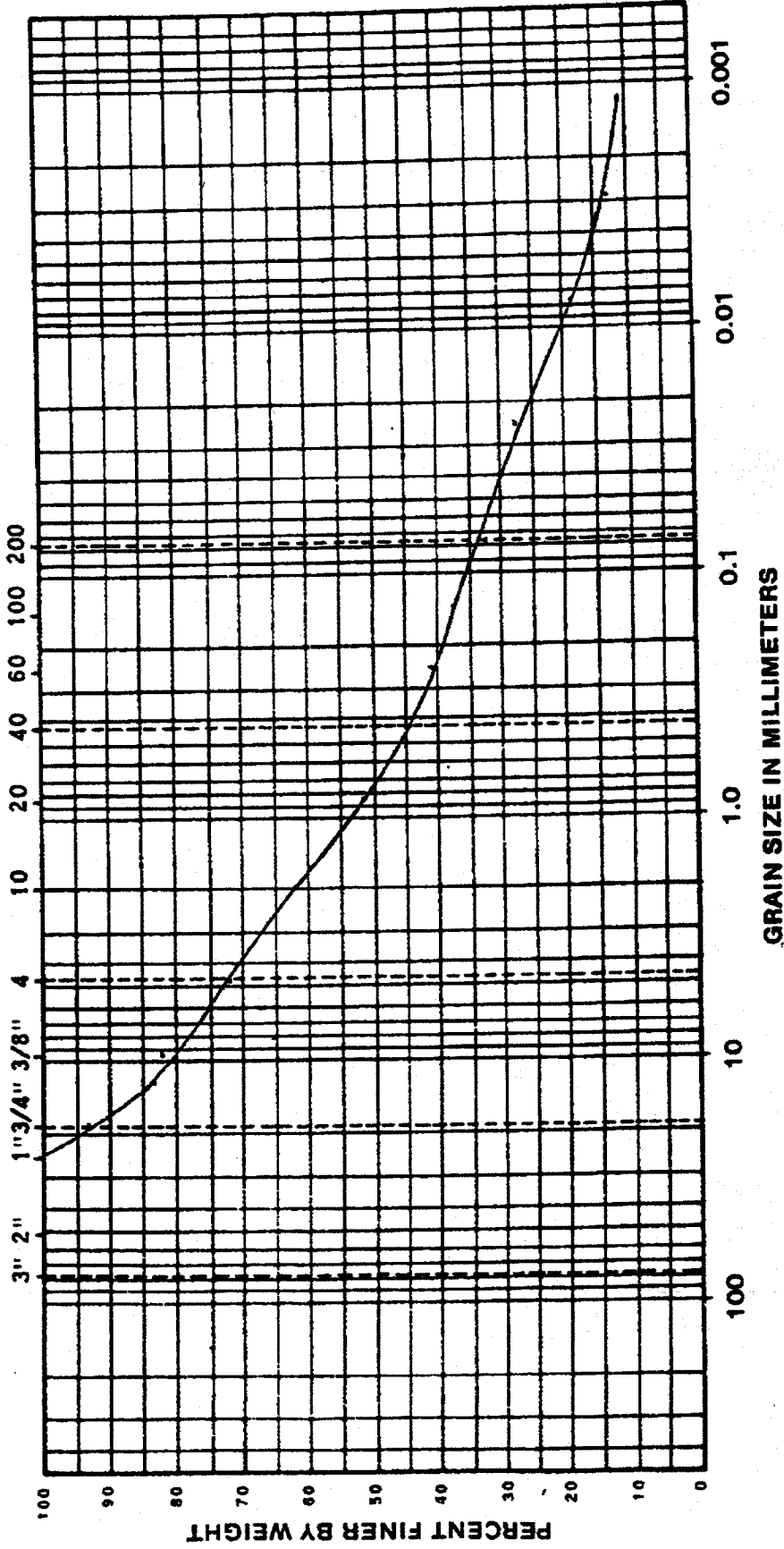


GRAIN SIZE IN MILLIMETERS

Law Engineering Testing Company Grain Size Distribution		BORING NO.	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
		J-9A	9 TO 10.5 FEET	23.5%	NON-PLASTIC SOIL			
		JOB NO.						
		K-88195						

BOULDER		GRAVEL		SAND			SILT SIZES		CLAY SIZES	
COARSE		FINE		COARSE	MEDIUM	FINE				

U. S. STANDARD SIEVE SIZES



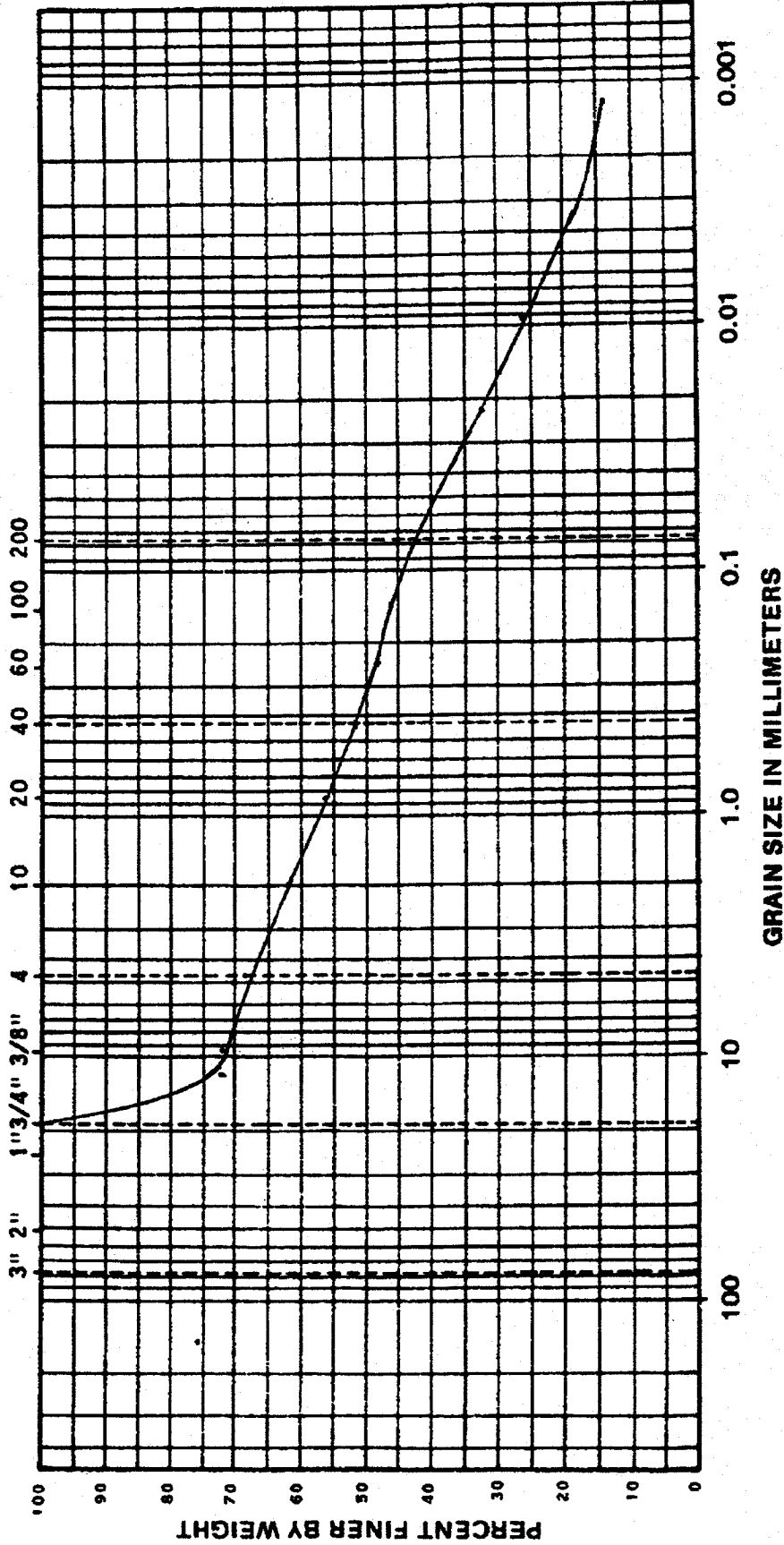
GRAIN SIZE IN MILLIMETERS

BORING NO.		DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
J-10B		4.0 TO 5.5					SAMPLE NOT LARGE ENOUGH TO PERFORM PLASTICITY TESTS
JOB NO.		FEET	11.4%				
K-88195							


**Law Engineering
Testing Company**
Grain Size Distribution

BOULDER		GRAVEL		SAND			FINES	
COARSE		FINE		MEDIUM		FINE		CLAY SIZES

U. S. STANDARD SIEVE SIZES

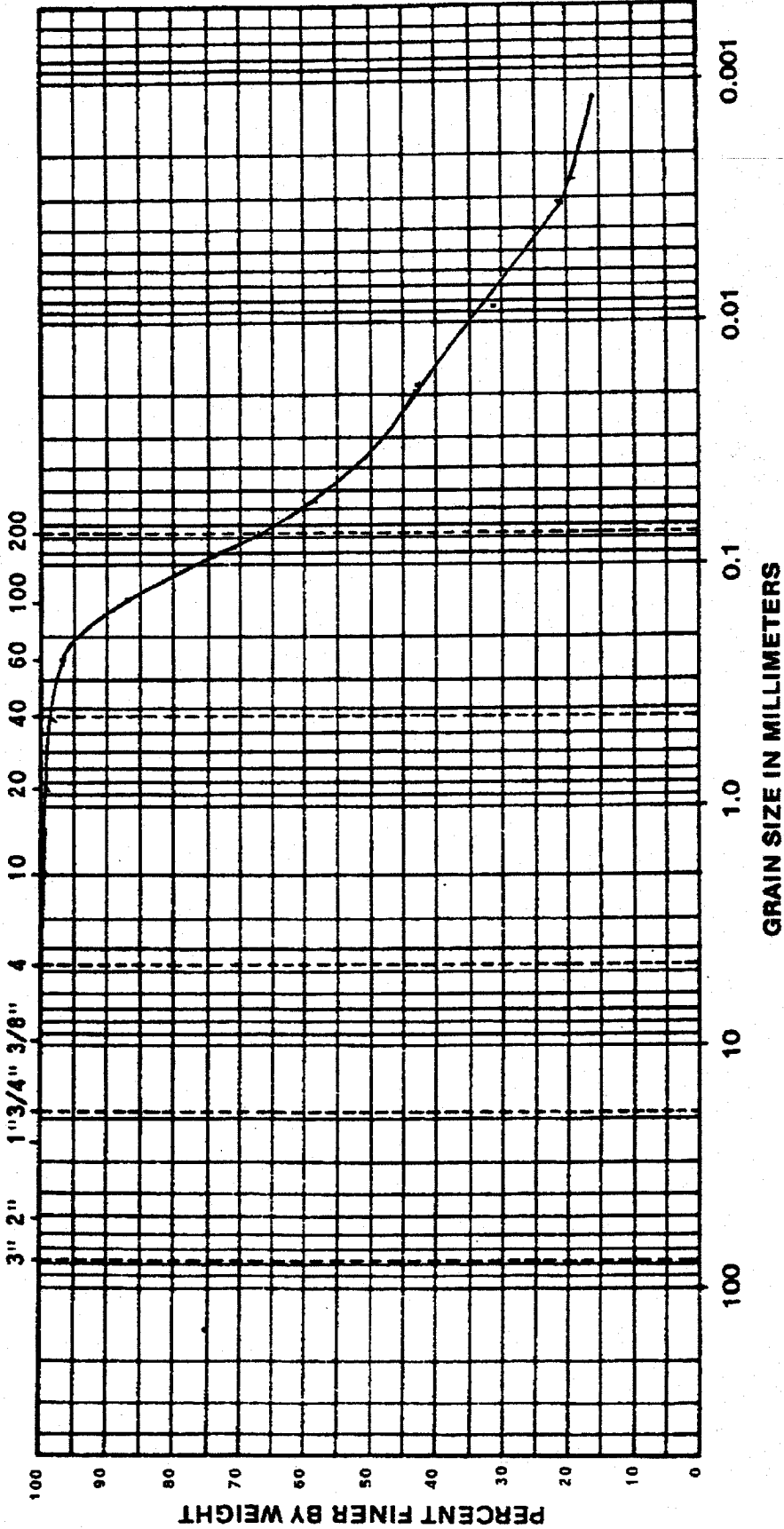


GRAIN SIZE IN MILLIMETERS

 Law Engineering Testing Company Grain Size Distribution	BORING NO. J-12A	DEPTH 14 TO 15.5 FEET	NAT WC 21.3%	L.L. 36	P.L. 21	P.I. 15	DESCRIPTION OR CLASSIFICATION GC - CLAYEY GRAVELS, GRAVEL - SAND-CLAY MIXTURE
	JOB NO. K-88195						

BOULDERS	GRAVEL		SAND		SILT SIZES		FINES	CLAY SIZES
	COARSE	FINE	COARSE	MEDIUM	FINE			

U. S. STANDARD SIEVE SIZES

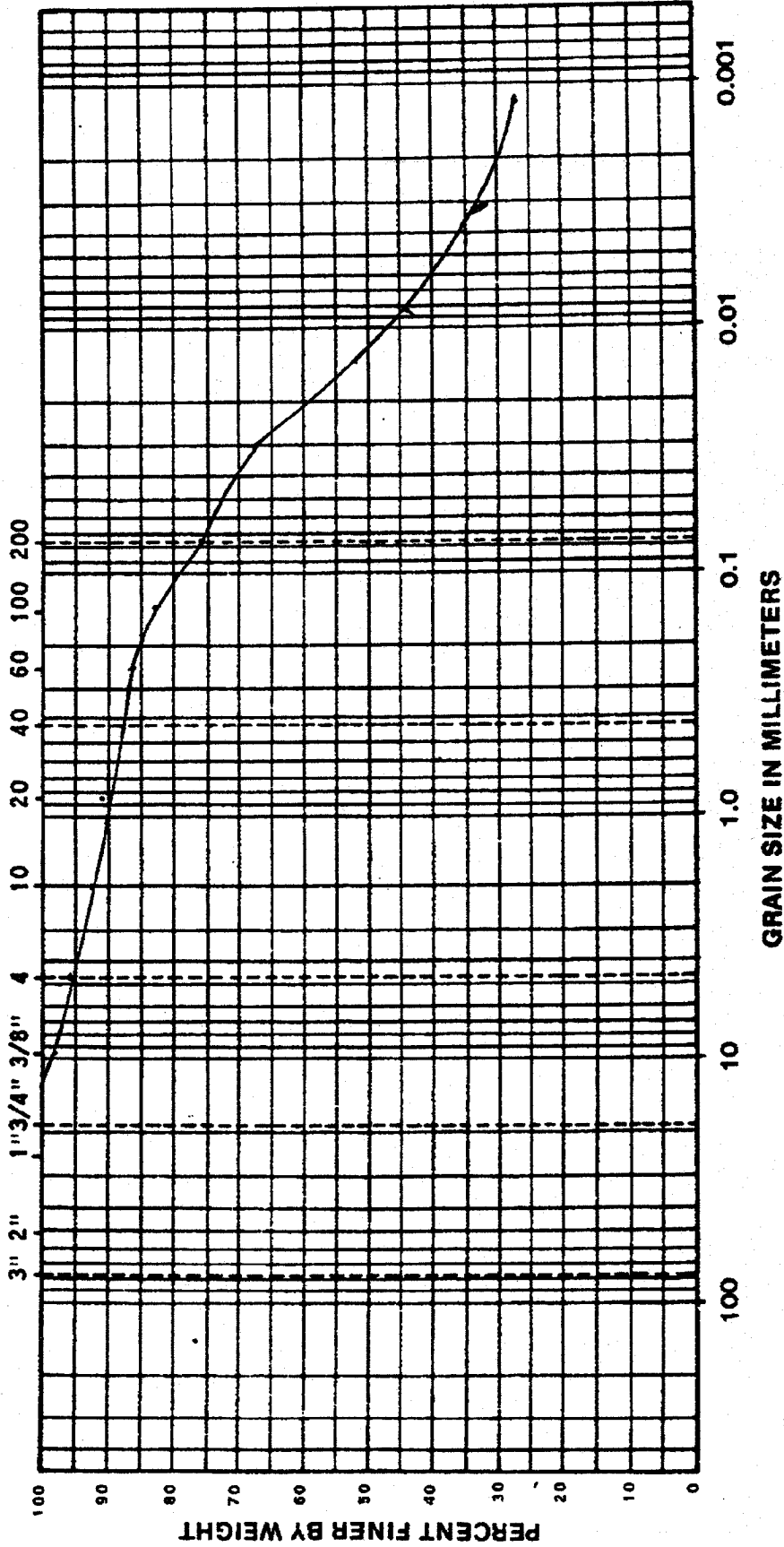



**Law Engineering
Testing Company**
Grain Size Distribution

BORING NO.	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
J-13 A	54 TO 55.5 FEET	29.3%	27	17	10	CL - INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY
JOB NO.	K-88195					

BOULDER		GRAVEL		SAND			FINES	
COARSE		FINE	COARSE	MEDIUM	FINE	SILT SIZES		CLAY SIZES

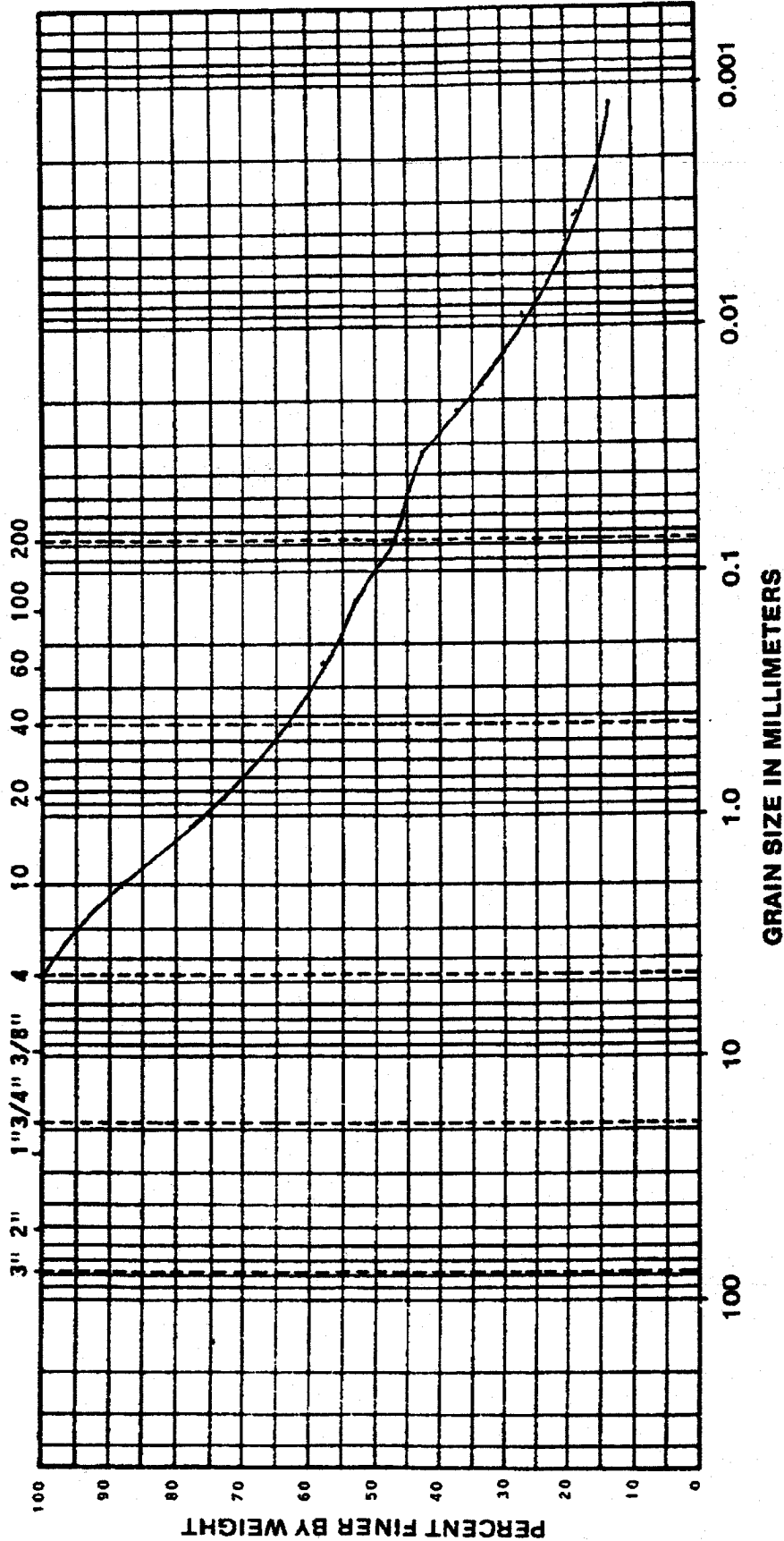
U. S. STANDARD SIEVE SIZES



 <p>Law Engineering Testing Company Grain Size Distribution</p>		BORING NO.	DEPTH	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
		J-14	9 TO 10.5 FEET	17.8%	28	14	14	CL - INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY
		JOB NO. K-88195						

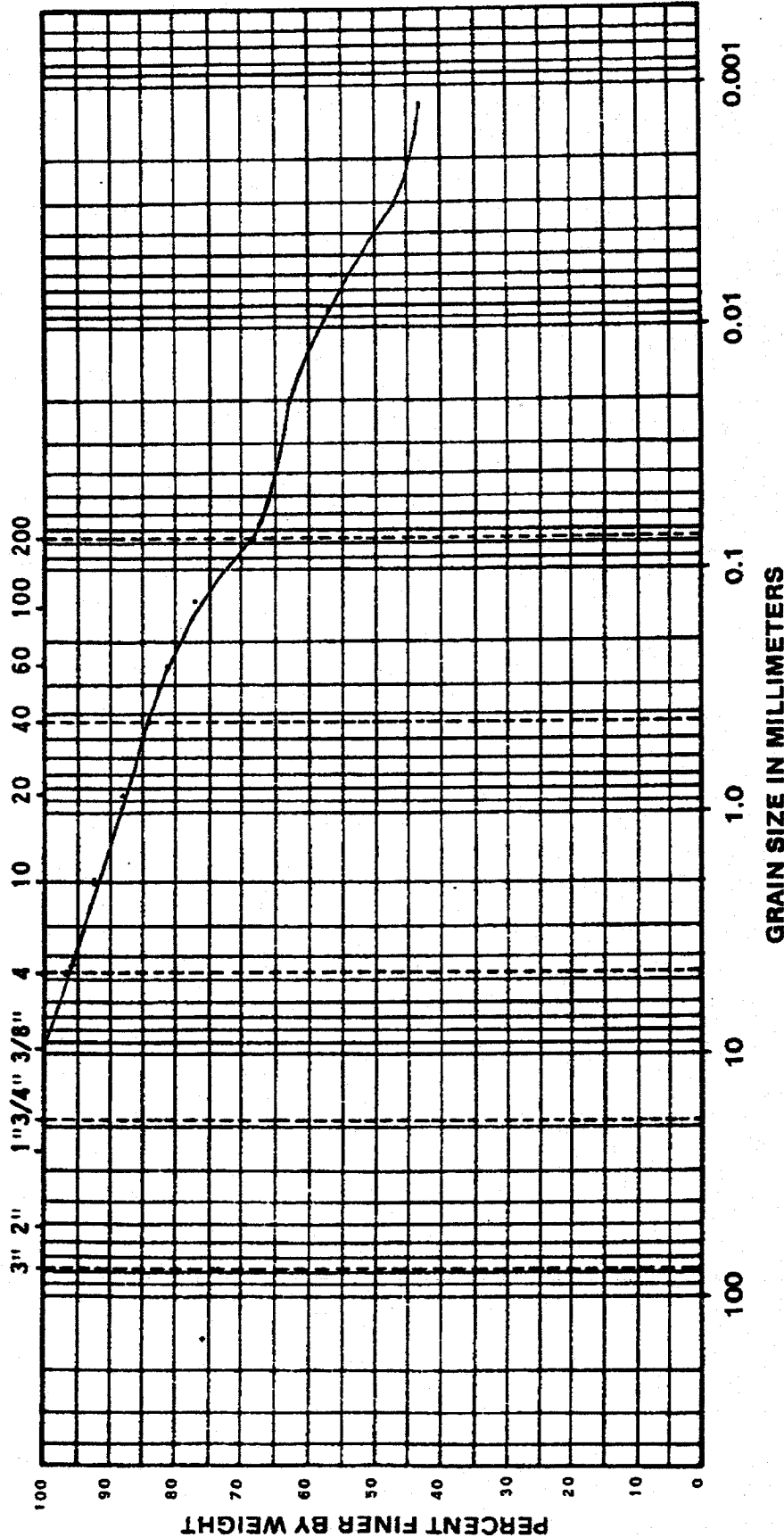
BOULDER		GRAVEL		SAND			SILT SIZES		FINES		CLAY SIZES	
		COARSE	FINE	COARSE	MEDIUM	FINE						

U. S. STANDARD SIEVE SIZES



BOULDER		GRAVEL		SAND			SILT SIZES		FINES		CLAY SIZES	
COARSE		FINE		COARSE	MEDIUM		FINE					

U. S. STANDARD SIEVE SIZES



Law Engineering Testing Company
Grain Size Distribution

BORING NO.	DEPTH	NAT WC	LL	FL	PI	DESCRIPTION OR CLASSIFICATION
J-16A	9 TO 10.5 FEET	21.8%	45	20	25	CL - INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY
JOB NO.	K-88195					

APPENDIX D

**TABULATED GROUNDWATER LEVEL DATA FOR
SELECTED MONITORING WELLS**

Kingston Fossil Plant - Groundwater Level Data for Selected Monitoring Wells

Date	KIF-10 (ft-msl)	KIF-10A (ft-msl)	KIF-10B (ft-msl)	KIF-11B (ft-msl)	KIF-12A (ft-msl)	KIF-12B (ft-msl)	KIF-13A (ft-msl)	KIF-13B (ft-msl)	KIF-16A (ft-msl)	KIF-16B (ft-msl)	KIF-2 (ft-msl)	KIF-4A (ft-msl)	KIF-4B (ft-msl)	KIF-5 (ft-msl)	KIF-5A (ft-msl)	KIF-5B (ft-msl)	KIF-6A (ft-msl)
01/04/1989	750.72	747.01	749.70	761.32	761.45	760.76		757.45	761.42	761.55							
01/05/1989							757.91				757.51	739.83	743.37	739.40		741.01	740.88
01/11/1989															739.01		
03/28/1989	750.98	747.15	749.31	761.84								739.30	743.41	738.98		740.62	740.45
03/29/1989					762.11	760.79	758.27	757.84	762.99	762.53	757.94						
03/30/1989												743.21	735.20	742.36		744.26	744.72
06/28/1989				762.50	761.06	761.45					758.79						
06/29/1989								758.80									
07/05/1989	751.21	748.92	751.90				759.02										
07/06/1989									759.06	762.63							
09/13/1989												742.68	737.80	742.19		743.70	743.86
09/14/1989	751.18	749.18	751.90	757.38				757.88	758.76	760.53	757.61						
11/29/1989											751.15	734.68	732.87	735.50		733.83	733.01
11/30/1989	751.15	744.00	748.62	755.18													
12/04/1989									758.01	758.43							
12/05/1989					755.12		752.99										
12/06/1989																	
03/06/1990																740.72	
03/07/1990				761.88							757.94	741.44	741.27	739.14	724.84		740.32
03/08/1990									758.76	762.57							
03/12/1990					761.09			758.20									
03/13/1990	751.21	747.38	749.93														
03/14/1990					761.88		758.53										
06/05/1990											757.61	743.21	734.78	742.22		744.72	743.64
06/06/1990	751.35	748.56	751.12	757.64		760.17		757.55									
06/07/1990									755.22	759.84					726.64		
06/11/1990																	
06/14/1990					760.93		758.17										
09/05/1990											757.09	747.74	735.01	741.77		743.31	743.41
09/06/1990															726.25		
09/10/1990					760.11	759.71	757.35	757.45									
09/11/1990	751.48	749.70	750.89	757.09					758.73	758.73							
12/04/1990											757.35	740.16	745.70	739.44		741.08	741.17
12/05/1990									755.12	759.74					724.61		

Kingston Fossil Plant - Groundwater Level Data for Selected Monitoring Wells

Date	KIF-10 (ft-msl)	KIF-10A (ft-msl)	KIF-10B (ft-msl)	KIF-11B (ft-msl)	KIF-12A (ft-msl)	KIF-12B (ft-msl)	KIF-13A (ft-msl)	KIF-13B (ft-msl)	KIF-16A (ft-msl)	KIF-16B (ft-msl)	KIF-2 (ft-msl)	KIF-4A (ft-msl)	KIF-4B (ft-msl)	KIF-5 (ft-msl)	KIF-5A (ft-msl)	KIF-5B (ft-msl)	KIF-6A (ft-msl)
12/06/1990					761.68	760.99	758.14	757.81									
12/10/1990	752.26	747.57	750.10	759.78					756.73	761.98							
03/15/1991																	
03/20/1991	752.33	748.23	750.49	762.43							758.63	739.67	743.67	739.37		740.98	740.45
03/21/1991					762.01	761.29	759.09	746.59							725.36		
06/03/1991									755.41								
06/04/1991	752.49	749.34					762.70				758.33		742.75				
06/06/1991													744.13				
09/08/1991																	
09/10/1991	755.91	752.00									757.56						
09/11/1991							758.66		758.30								
11/12/1991													734.42				
12/17/1991													747.67	740.85	740.32	742.59	741.93
12/18/1991	756.59	751.80															
12/19/1991					762.11	761.35	759.55	759.25	761.06	762.80							
12/23/1991			751.28	760.99													
03/03/1992	756.33	750.98															
03/04/1992							759.74	759.35	763.48	763.39		739.90	748.56	739.37		741.27	
06/02/1992																	
06/03/1992	756.43	752.30			761.15	760.43	759.51	759.12									
06/04/1992									762.86	762.83							
08/20/1992															742.13		
09/01/1992	755.91	742.29					756.43	748.39				737.47	720.90	740.09		740.16	
09/02/1992									753.38	745.11							
12/07/1992																	
12/08/1992	756.46	750.46	751.41	759.55			759.55	761.19			759.48	739.24	746.03				740.98
12/10/1992									762.11	762.11							
06/07/1993					761.78	760.86											
06/08/1993	755.81	752.03					756.89					740.75	729.63				742.36
06/09/1993									764.99	760.56							
12/06/1993	756.79	752.23	752.85	761.78	762.96	761.98	759.55	758.66	761.02	760.93	759.22	741.21	744.65	750.95	744.62	747.61	742.36
05/20/1994																	
06/13/1994	756.43	752.30										742.78	745.37				743.77
06/14/1994							759.65		763.75	764.17							

Kingston Fossil Plant - Groundwater Level Data for Selected Monitoring Wells

Date	KIF-10 (ft-msl)	KIF-10A (ft-msl)	KIF-10B (ft-msl)	KIF-11B (ft-msl)	KIF-12A (ft-msl)	KIF-12B (ft-msl)	KIF-13A (ft-msl)	KIF-13B (ft-msl)	KIF-16A (ft-msl)	KIF-16B (ft-msl)	KIF-2 (ft-msl)	KIF-4A (ft-msl)	KIF-4B (ft-msl)	KIF-5 (ft-msl)	KIF-5A (ft-msl)	KIF-5B (ft-msl)	KIF-6A (ft-msl)
11/29/1994																	
12/06/1994	756.77	760.43	754.40	758.99	762.50	761.35	759.06	758.43	762.34	762.40	756.36	737.76	743.64	751.25	742.75	741.50	738.68
06/19/1995	755.64	751.38		759.48	761.48	760.47	758.37	757.91	761.02	761.15	755.68	741.86	739.76	747.44	742.62	741.96	740.65
06/21/1995	755.71	751.64					758.43					741.86	739.80				740.65
06/22/1995			752.17						760.60	760.96							
12/11/1995				761.02							758.07	738.19	741.57				738.45
12/12/1995	755.97	749.65	751.08					758.53									
12/13/1995					762.53	761.19	759.12										
12/14/1995									764.83	761.65							
07/08/1996	756.00	751.87	752.72	760.73	761.61	760.56	759.38	758.99	764.80	764.76	756.59	741.21	740.39	747.57	742.72	743.08	741.47
12/02/1996	756.96	753.08	753.54	764.60	763.68	762.24	759.74	758.92	764.04	764.37	760.07	747.11	752.20	750.98	744.98	745.18	744.78
05/06/1997	756.86	752.69	753.28	762.76	763.45	761.94	760.07	759.15	766.57	763.16	760.47	749.44	749.31	750.49	744.32	743.80	743.93
12/08/1997	756.86	754.69	754.92	761.88	763.22	761.05	759.19	758.23	761.52	761.84	759.45	742.06	743.67	750.52	741.93	740.55	741.27
06/29/1998	756.10	752.23	752.85	759.97	762.60	761.12	759.55	758.60	763.19	763.55	758.99	748.46	743.57	748.75	743.31	743.14	744.09
12/01/1998	756.33	751.28	751.67	758.27	761.32	760.37	759.55	758.37	760.93	761.32	758.89	741.40	740.78	742.22	740.09	740.03	741.73
12/06/1999								759.22					741.37				738.42
12/14/2000								759.68	763.68				742.91				738.32
06/27/2001								760.24	766.17				742.98				738.60
12/31/2001								760.66	766.50				744.98				738.94
06/28/2002								760.70	766.99				742.81				743.64
01/09/2003								760.11	768.57				742.88				741.99
06/16/2003								761.32	766.83				744.36				743.86
09/02/2003								758.53	768.57				744.06				743.83
12/29/2003								760.56	768.57				741.86				741.27
03/10/2004								760.96	767.49				743.21				742.29
06/07/2004								760.70	765.63				743.76				742.87
Maximum =	756.86	754.69	754.92	764.60	763.68	762.24	762.70	761.32	768.57	764.76	760.47	749.44	752.20	751.25	744.98	747.61	744.78

**Kingston Fossil Plant - Groundwater Level Data for Selected Monitoring Wells
(Continued)**

Well Elevations	B-1		B-2		B-3		RAINFALL (IN.)
	782.1		795.3		811.4		24:00 - 24:00
	Depth	Elevation	Depth	Elevation	Depth	Elevation	
04/09/2004	7.75	774.35	15.80	779.50	29.00	782.40	0.00
04/10/2004		782.10		795.30		811.40	0.00
04/11/2004		782.10		795.30		811.40	0.70
04/12/2004		782.10		795.30		811.40	0.80
04/13/2004	7.60	774.50	16.10	779.20	29.10	782.30	1.00
04/14/2004		782.10		795.30		811.40	0.10
04/15/2004	7.35	774.75	16.20	779.10	29.35	782.05	0.00
04/16/2004		782.10		795.30		811.40	0.00
04/17/2004		782.10		795.30		811.40	0.00
04/18/2004		782.10		795.30		811.40	0.00
04/19/2004		782.10		795.30		811.40	0.00
04/20/2004	7.85	774.25	16.45	778.85	29.45	781.95	0.00
04/21/2004		782.10		795.30		811.40	0.10
04/22/2004		782.10		795.30		811.40	0.18
04/23/2004	8.30	773.80	16.60	778.70	29.75	781.65	0.18
04/24/2004		782.10		795.30		811.40	0.00
04/25/2004		782.10		795.30		811.40	0.01
04/26/2004	8.38	773.72	16.73	778.57	30.00	781.40	0.03
04/27/2004		782.10		795.30		811.40	0.00
04/28/2004		782.10		795.30		811.40	0.00
04/29/2004		782.10		795.30		811.40	0.00
04/30/2004	8.60	773.50	17.00	778.30	30.30	781.10	0.00
05/01/2004		782.10		795.30		811.40	0.00
05/02/2004		782.10		795.30		811.40	0.00
05/03/2004	8.53	773.57	17.13	778.17	30.60	780.80	0.00
05/04/2004		782.10		795.30		811.40	0.00
05/05/2004		782.10		795.30		811.40	0.00
05/06/2004	8.66	773.44	17.30	778.00	30.64	780.76	0.00
05/07/2004		782.10		795.30		811.40	0.00
05/08/2004		782.10		795.30		811.40	0.00
05/09/2004		782.10		795.30		811.40	0.00
05/10/2004		782.10		795.30		811.40	0.10
05/11/2004	9.00	773.10	17.60	777.70	31.00	780.40	0.30
05/12/2004		782.10		795.30		811.40	0.00
05/13/2004		782.10		795.30		811.40	0.25
05/14/2004	9.35	772.75	17.75	777.55	31.10	780.30	0.00
05/15/2004		782.10		795.30		811.40	0.00
05/16/2004		782.10		795.30		811.40	0.00
05/17/2004		782.10		795.30		811.40	0.00
05/18/2004	9.45	772.65	17.85	777.45	31.45	779.95	0.00
05/19/2004		782.10		795.30		811.40	0.00
05/20/2004		782.10		795.30		811.40	0.00
05/21/2004	9.75	772.35	18.17	777.13	31.65	779.75	0.00
05/22/2004		782.10		795.30		811.40	0.00

Well Elevations	B-1		B-2		B-3		RAINFALL (IN.)
	782.1		795.3		811.4		24:00 - 24:00
	Depth	Elevation	Depth	Elevation	Depth	Elevation	
05/23/2004		782.10		795.30		811.40	0.00
05/24/2004		782.10		795.30		811.40	0.00
05/25/2004	9.95	772.15	18.35	776.95	31.83	779.57	0.00
05/26/2004		782.10		795.30		811.40	0.90
05/27/2004		782.10		795.30		811.40	0.00
05/28/2004	10.12	771.98	18.55	776.75	32.15	779.25	0.30
05/29/2004		782.10		795.30		811.40	0.00
05/30/2004		782.10		795.30		811.40	0.10
05/31/2004		782.10		795.30		811.40	0.80
06/01/2004		782.10		795.30		811.40	0.00
06/02/2004	9.98	772.12	18.87	776.43	32.42	778.98	0.2
06/03/2004		782.10		795.30		811.40	0
06/04/2004		782.10		795.30		811.40	0.35
06/05/2004		782.10		795.30		811.40	0
06/06/2004		782.10		795.30		811.40	0
06/07/2004		782.10		795.30		811.40	0
06/08/2004	10.34	771.76	19.24	776.06	32.71	778.69	0
06/09/2004		782.10		795.30		811.40	0
06/10/2004		782.10		795.30		811.40	0
06/11/2004		782.10		795.30		811.40	0
06/12/2004		782.10		795.30		811.40	0.5
06/13/2004		782.10		795.30		811.40	0
06/14/2004	10.7	771.40	19.61	775.69	33.1	778.30	0



APPENDIX E

**CHEMICAL ANALYSIS OF GYPSUM LEACHATE SAMPLES FROM
CUMBERLAND FOSSIL PLANT**

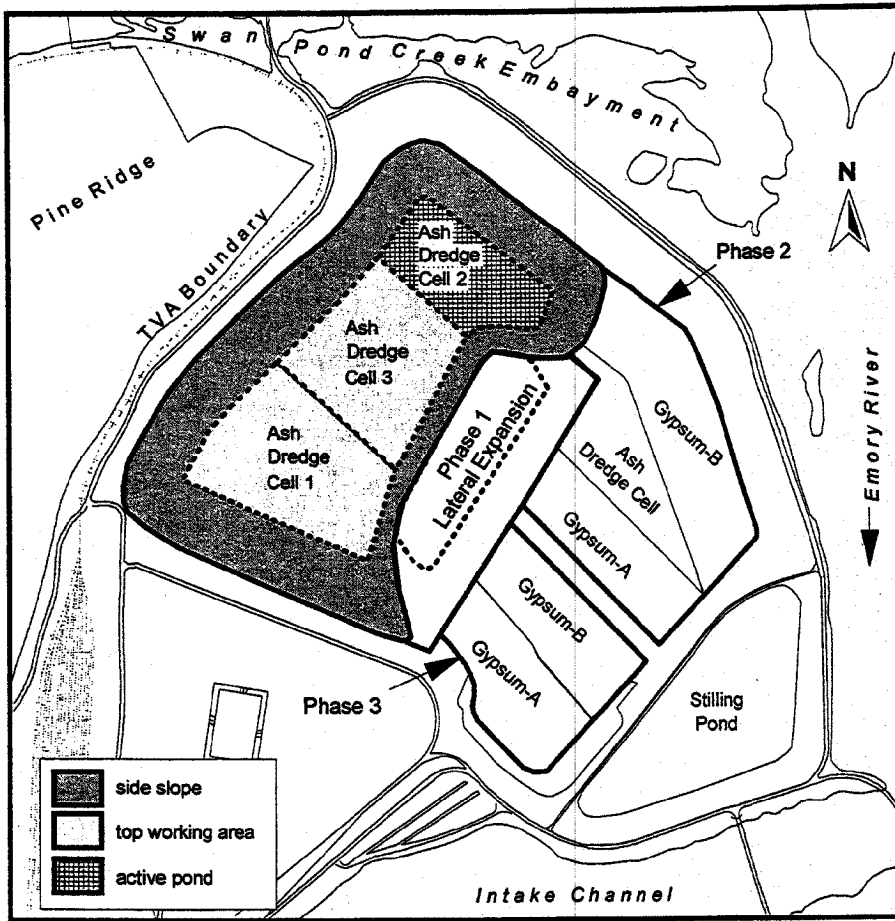
Chemical Analysis of Gypsum Leachate Samples from Cumberland Fossil Plant

Constituent	Units	MCL	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Aluminum, total	ug/L	200	580		140	350	<
Antimony, total	ug/L	6	12		13	6	<
Arsenic, total	ug/L	50	<		1	1	<
Barium, total	ug/L	2000	130		120	30	30
Beryllium, total	ug/L	4	<		1		
Boron, total	ug/L	--	54000		54000	25000	37000
Cadmium, total	ug/L	5	9.2		3.5	22	13
Calcium, total	mg/L	--	870		880	760	790
Chloride, total	mg/L	250	1000	1200	1000	1400	1900
Chromium, total	ug/L	100	5		1	<	1
Cobalt, total	ug/L	--	10		9		
Copper, total	ug/L	1300	<		10	1	<
Fluoride, total	mg/L	4	18	1.2	20		
Iron, total	ug/L	300	790		10	10	<
Lead, total	ug/L	15	<		1	1	<
Magnesium, total	mg/L	--	350		350	650	790
Manganese, total	ug/L	50	2600		2500	110	750
Mercury, total	ug/L	2	<		0.2	13	0.2
Nickel, total	ug/L	100	97		85	167	77
pH (field)	pH	6.5-8.5	6.99	7.19	7.48		
Selenium, total	ug/L	50	25		28	396	99
Silver, total	ug/L	100	<		10	0.4	0.3
Sodium, total	mg/L	--	18		21		
TDS (180)	mg/L	500	6300	8100	6000		
Strontium, total	ug/L	--	4500		4500		
Sulfate, total	mg/L	250	3700	2100	3800	2700	2800
Thallium, total	ug/L	2	<		2		
Vanadium, total	ug/L	--	<		10		
Zinc, total	ug/L	5000	880		1000	840	140

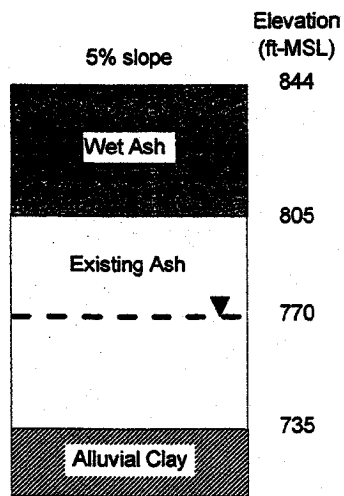
1. Sample collected on 2/25/99 before effluent entered gypsum pond overflow weir.
2. Sample collected on 7/21/99 before effluent entered gypsum pond overflow weir.
3. Sample collected on 2/25/99 at RP-3.
4. Filtered sample collected on 9/23/03 at RP-4.
5. Filtered sample collected on 9/23/03 from end of gypsum effluent pipe.

APPENDIX F

**OPTION A – FACILITY SUBREGIONS AND PROFILES FOR
SEEPAGE MODEL SIMULATIONS**



Top Working Area



Side Slope

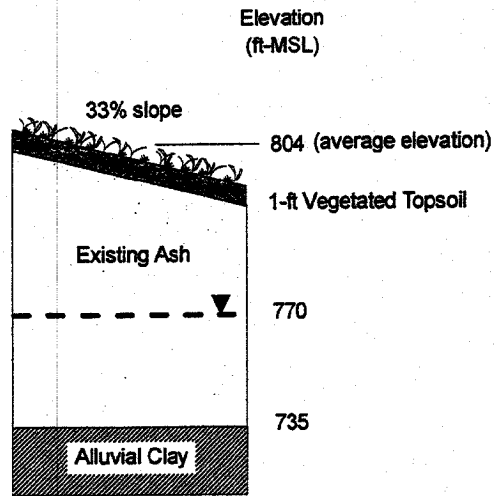
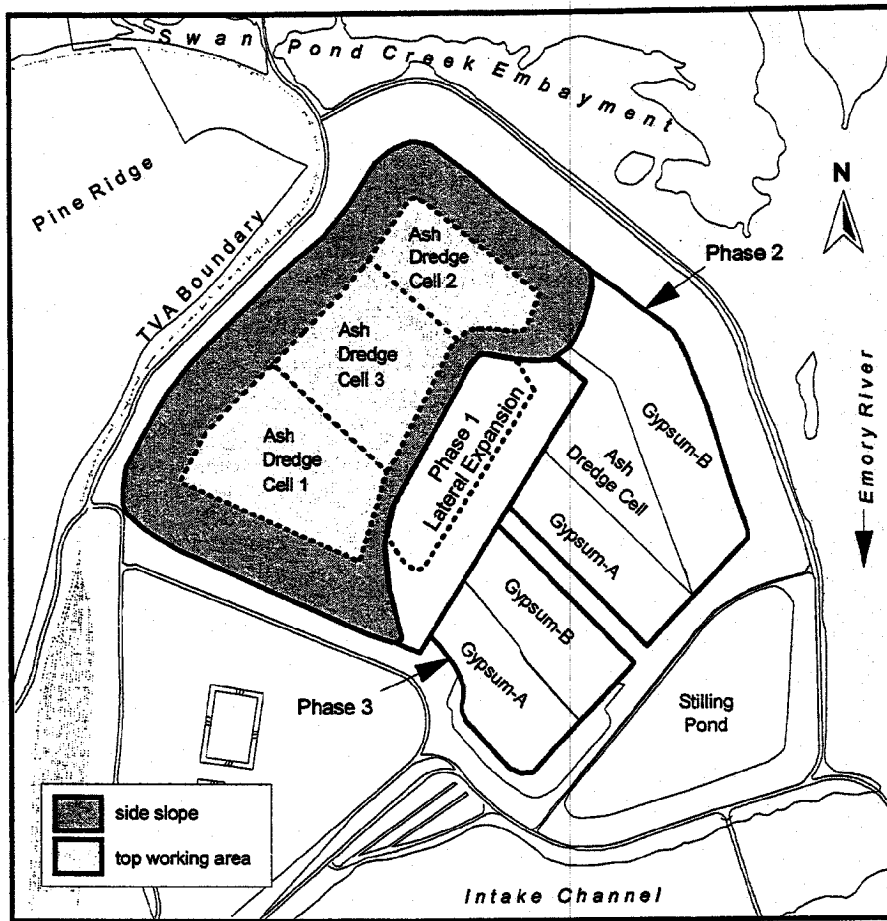
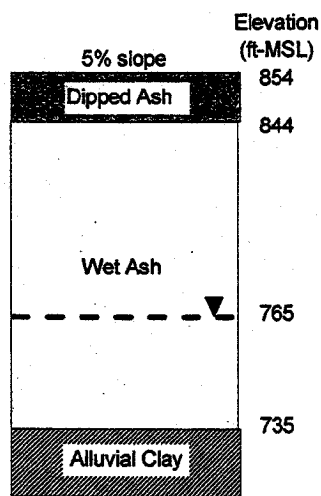


Figure F-1



Top Working Area



Side Slope

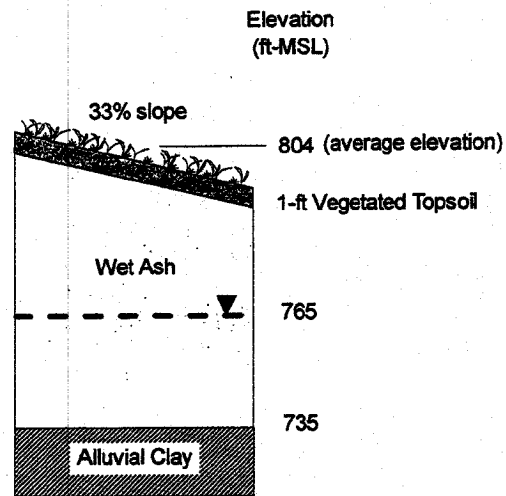
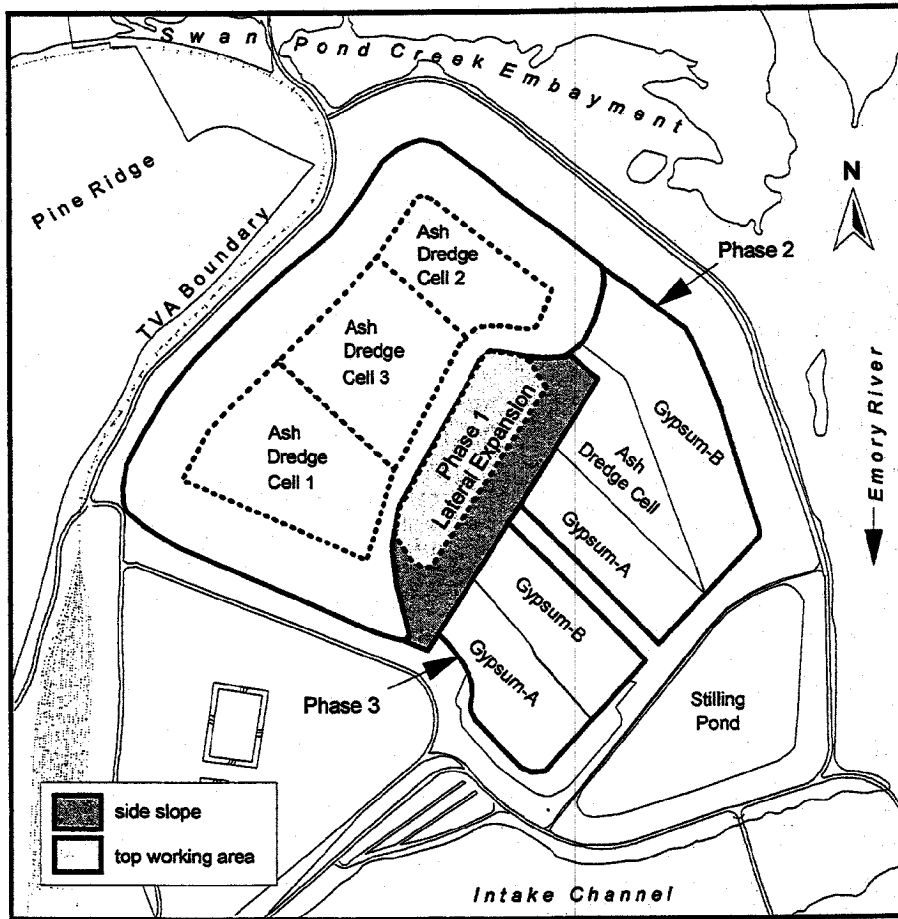
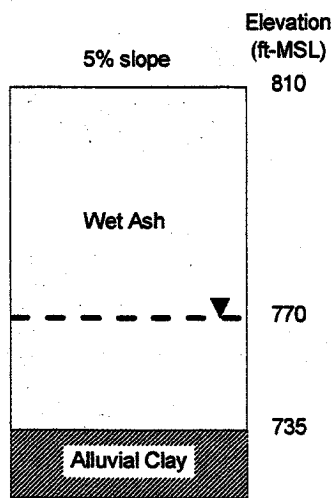


Figure F-2



Top Working Area



Side Slope

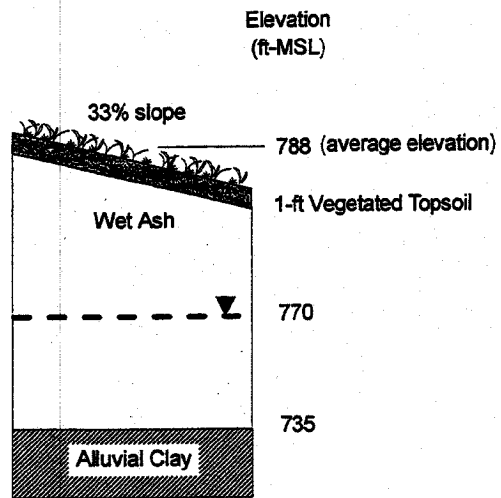
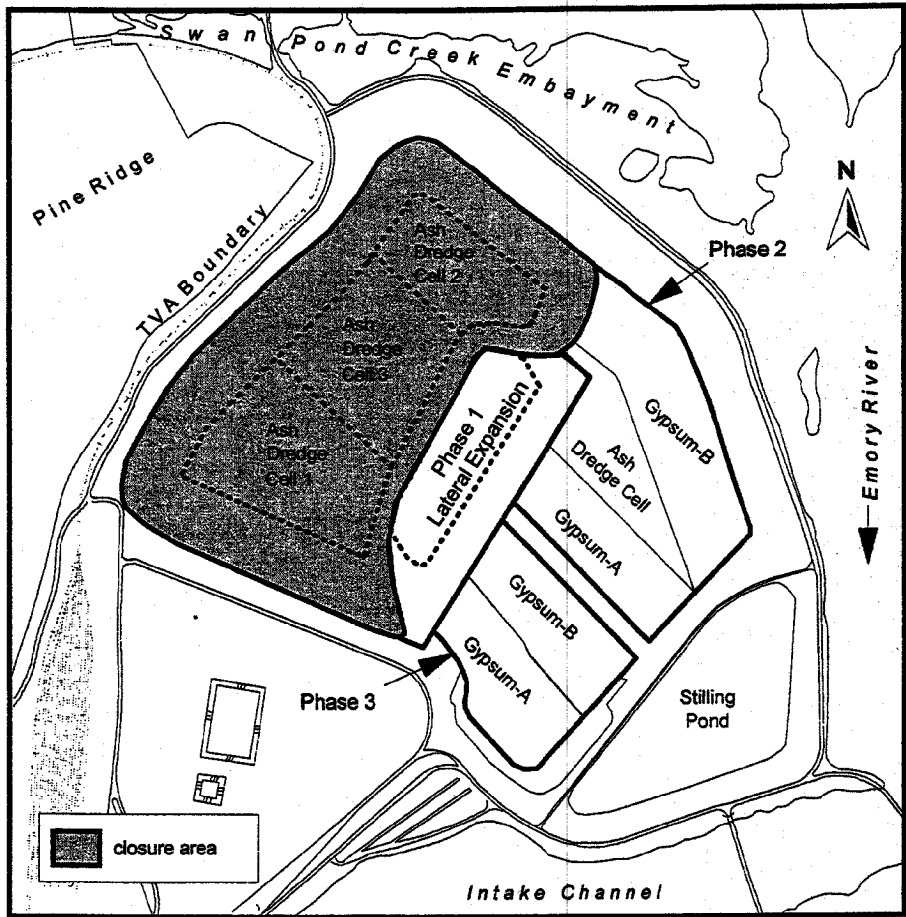
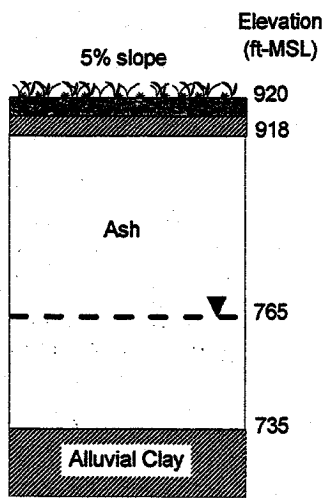


Figure F-3



Top Working Area



Capped Side Slope

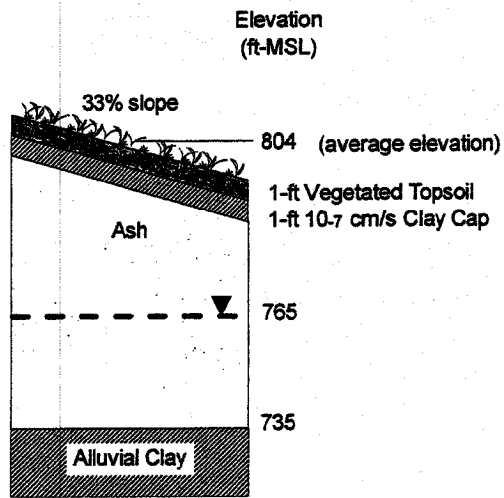
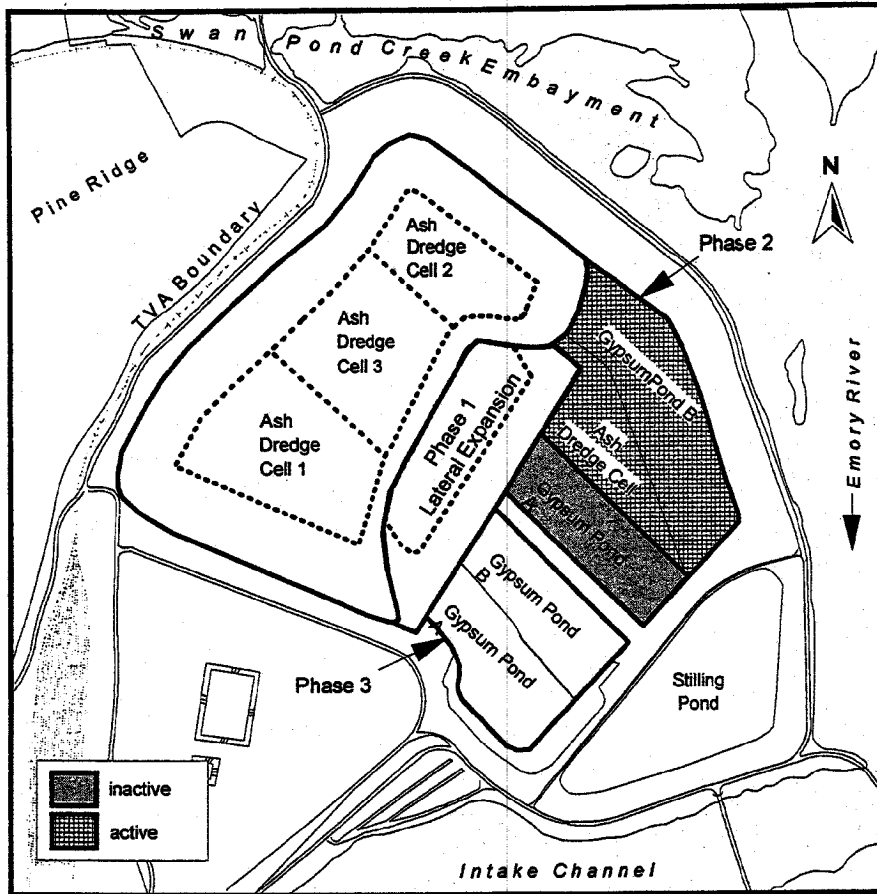
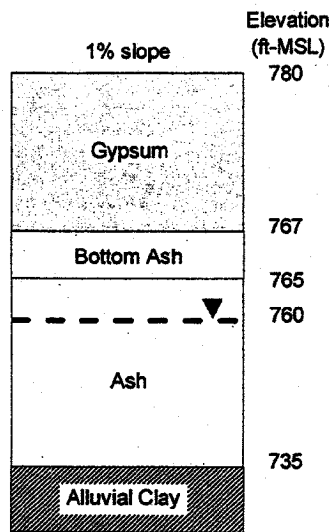


Figure F-4



Pond A Profile without Buffer



Pond A Profile with Buffer

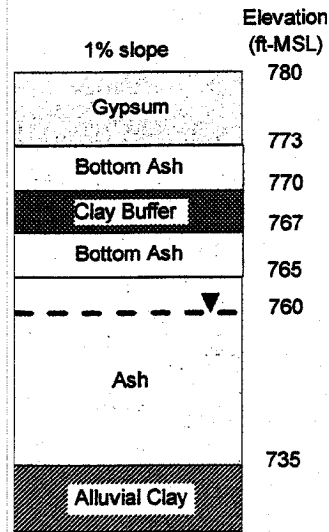
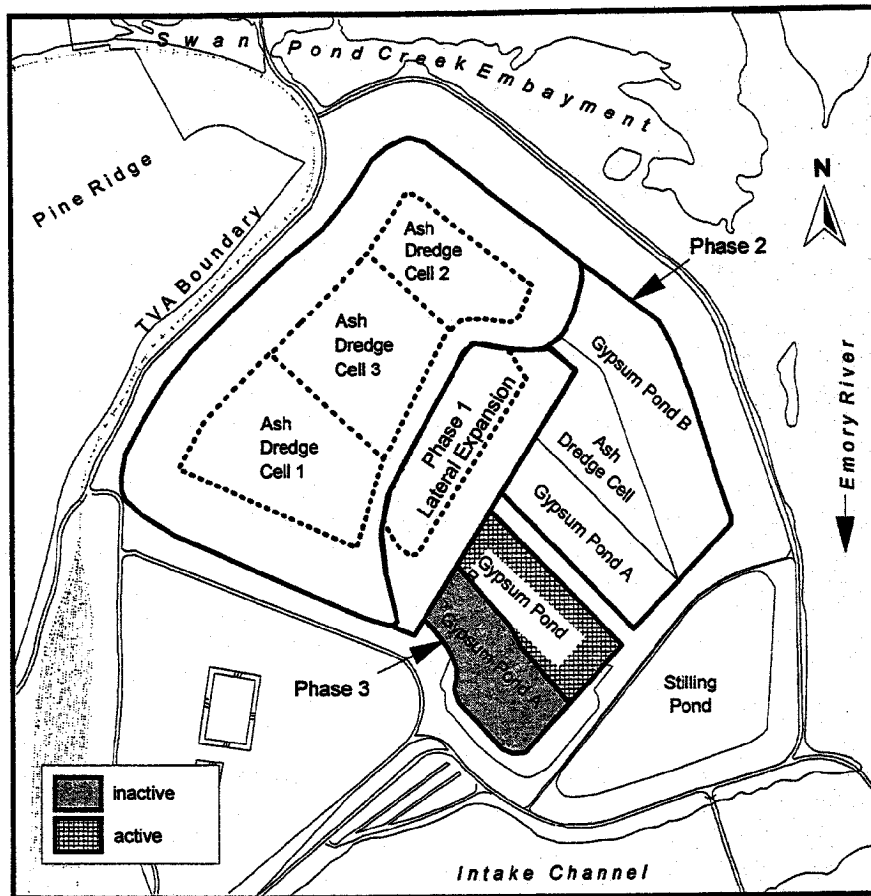
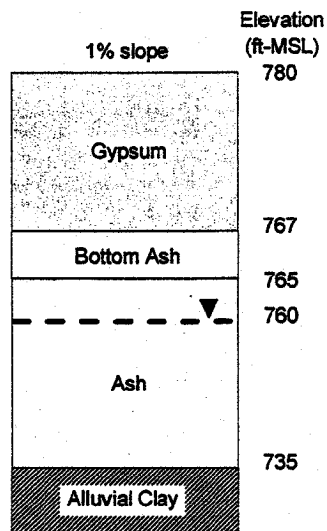


Figure F-5



Pond A Profile without Buffer



Pond A Profile with Buffer

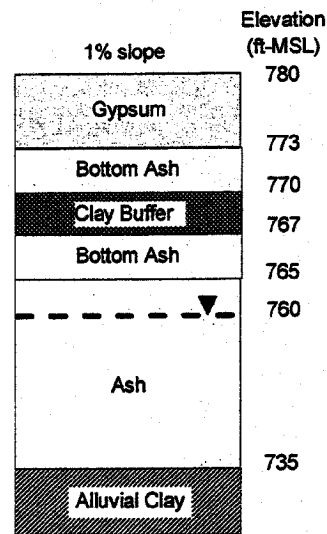
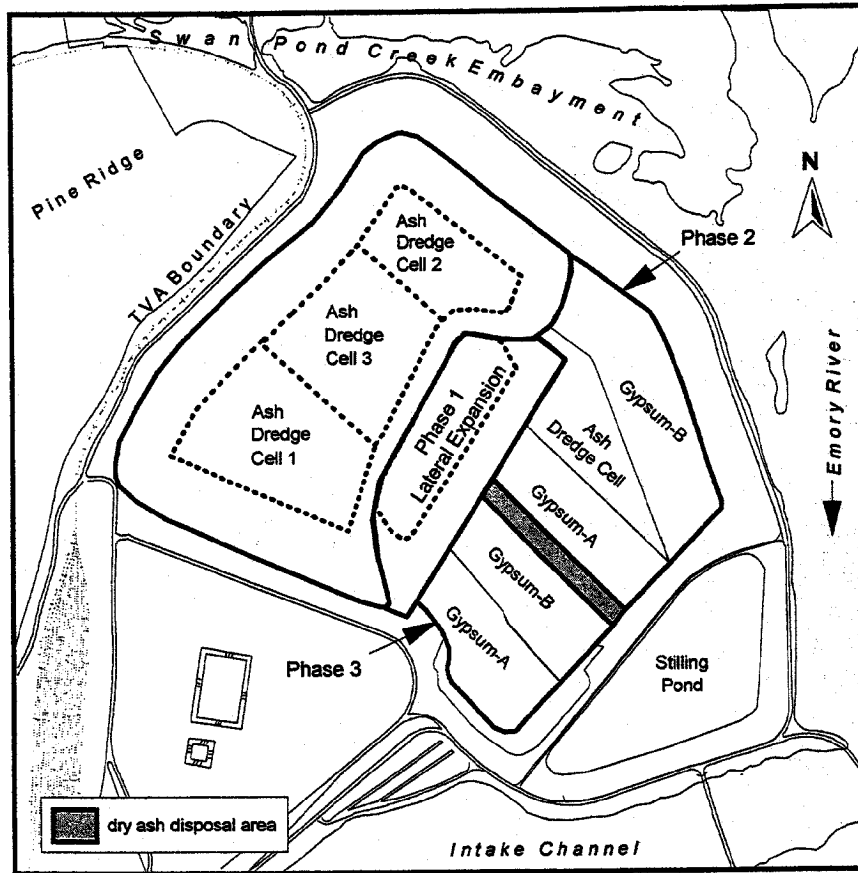
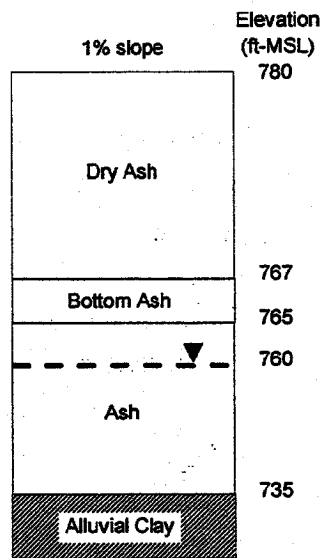


Figure F-6



Profile without Buffer



Profile with Buffer

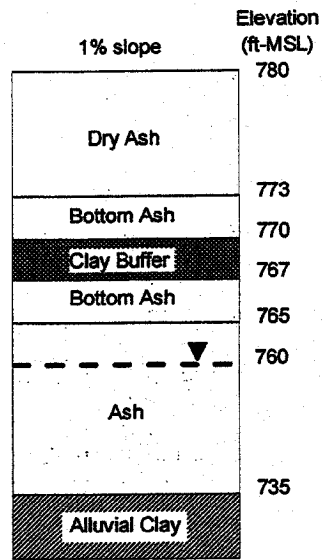


Figure F-7

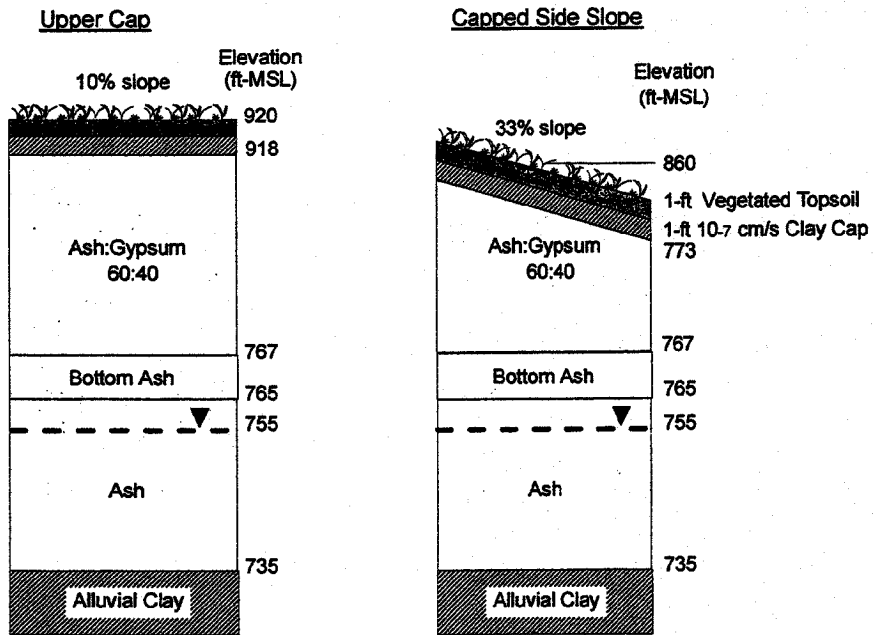
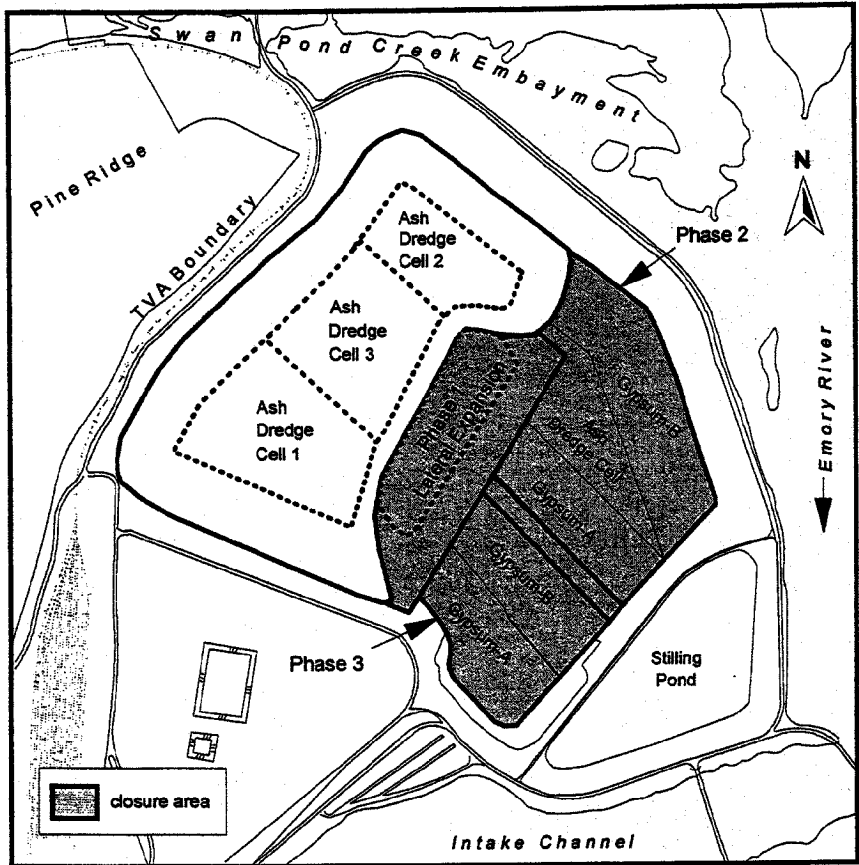


Figure F-8

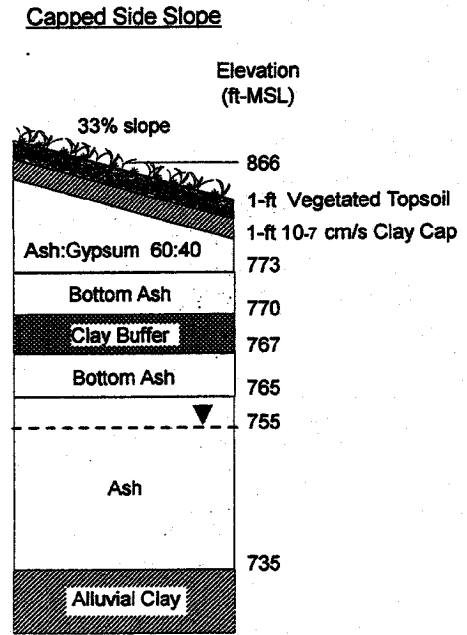
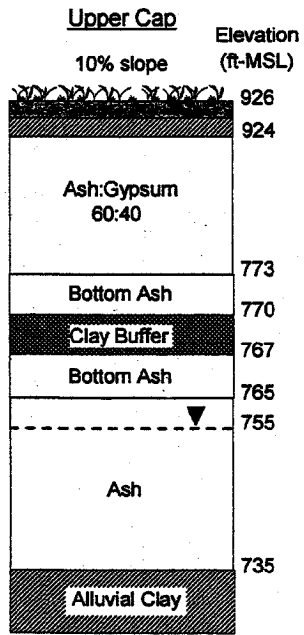
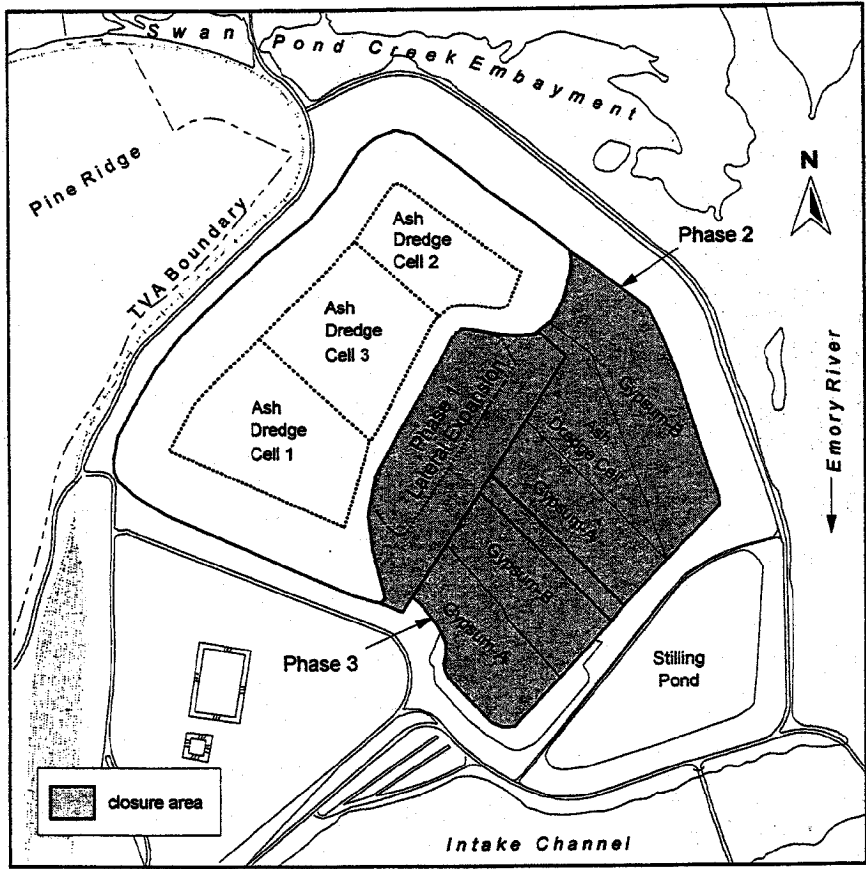
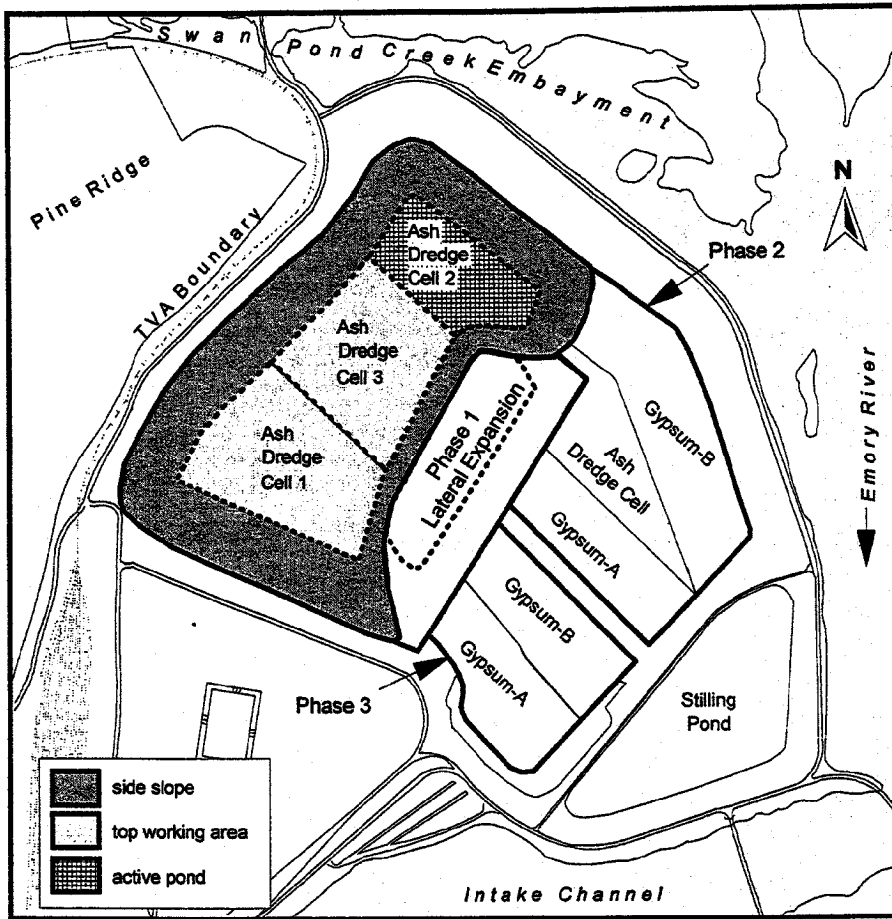


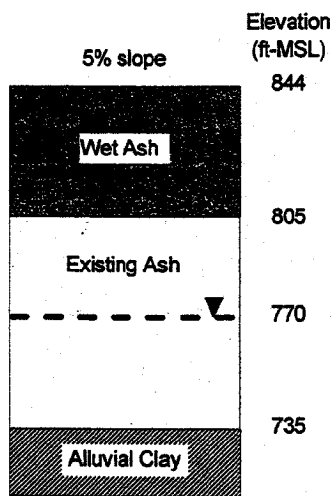
Figure F-9

APPENDIX G

**OPTION B – FACILITY SUBREGIONS AND PROFILES FOR
SEEPAGE MODEL SIMULATIONS**



Top Working Area



Side Slope

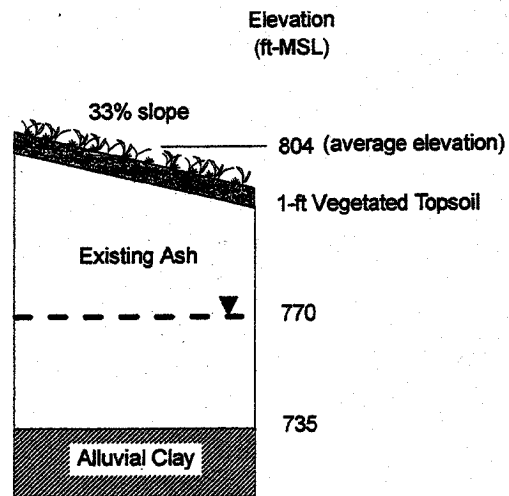


Figure G-1

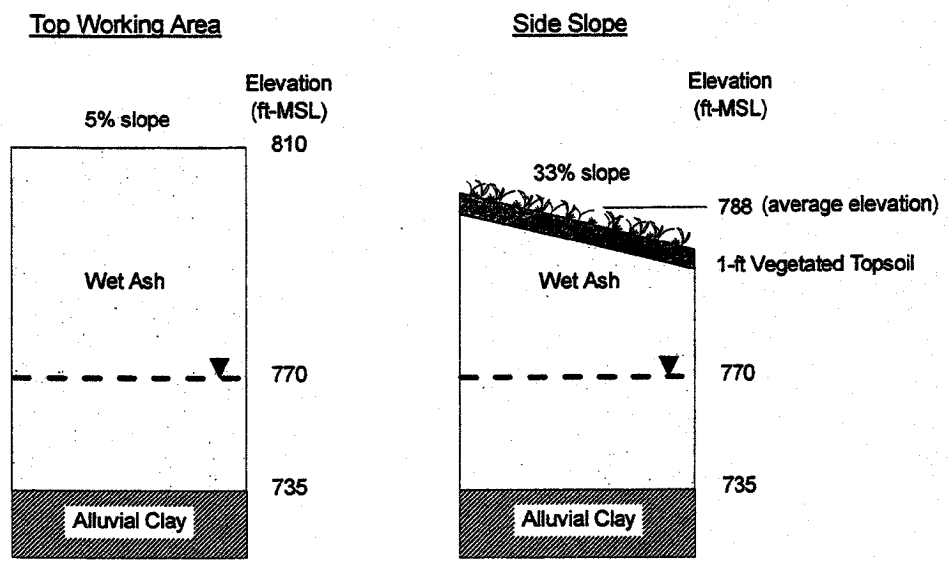
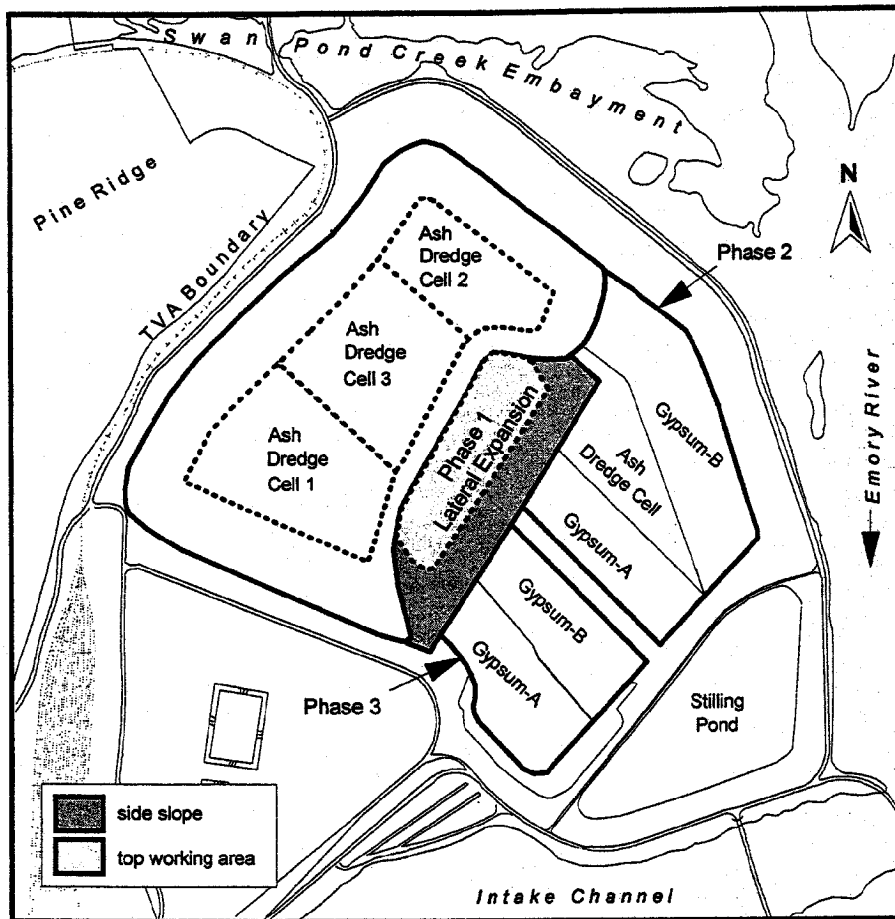


Figure G-2

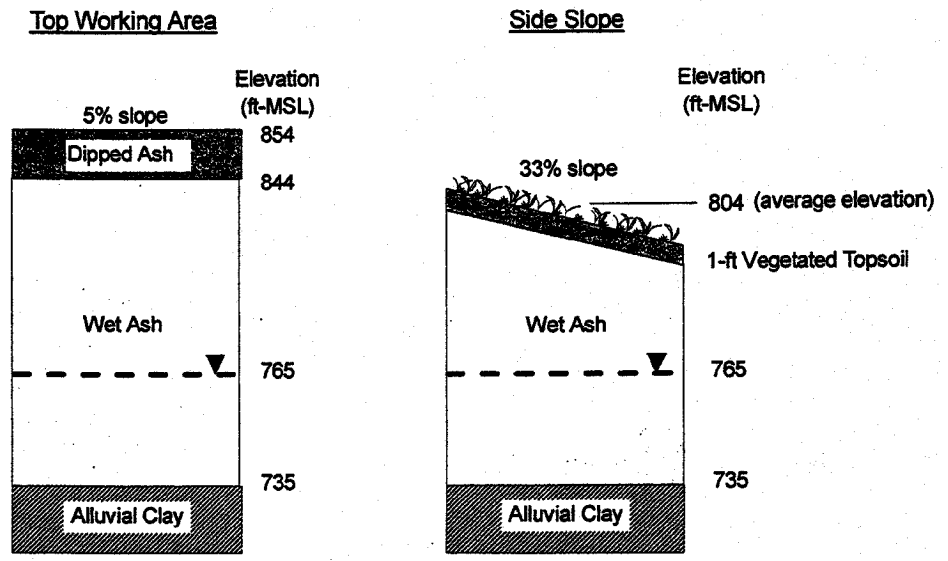
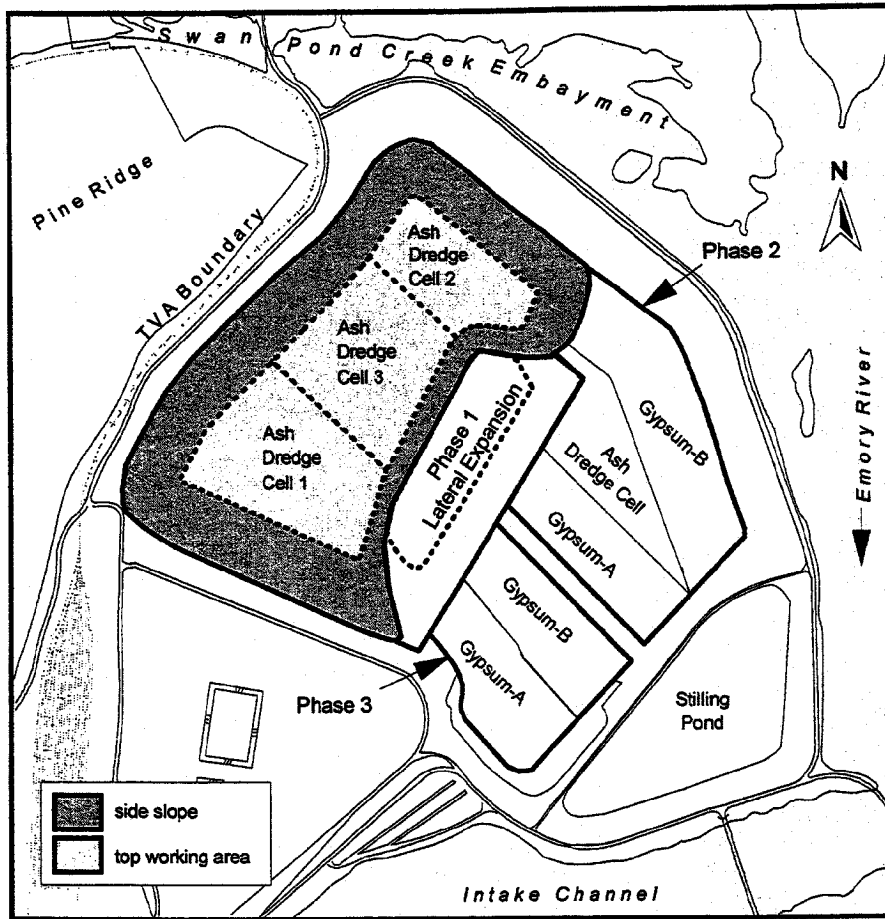
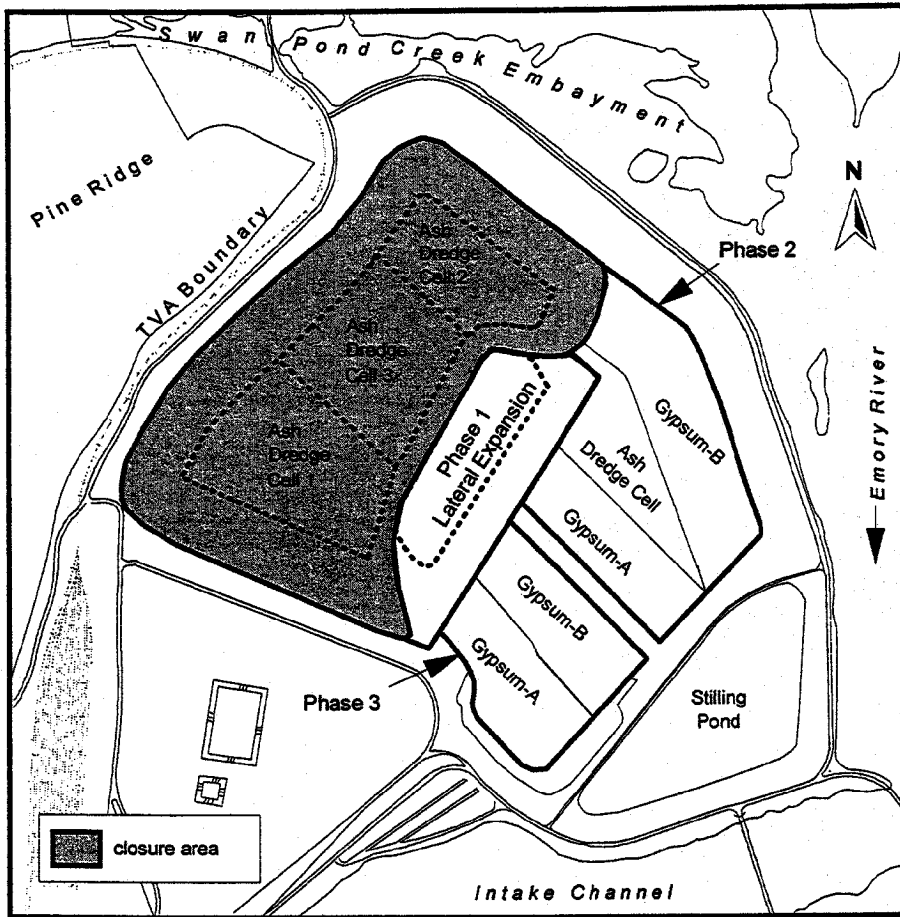
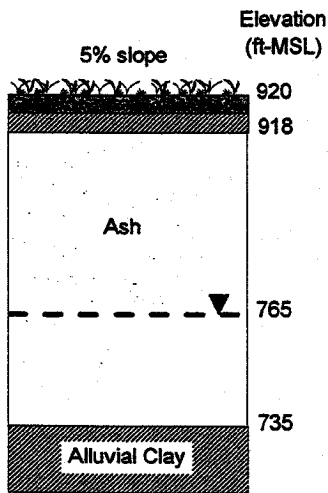


Figure G-3



Top Working Area



Capped Side Slope

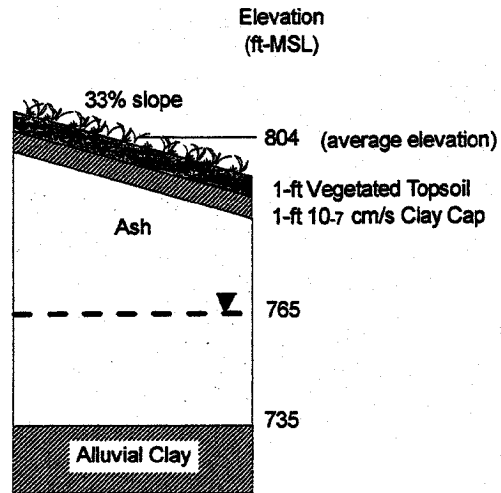
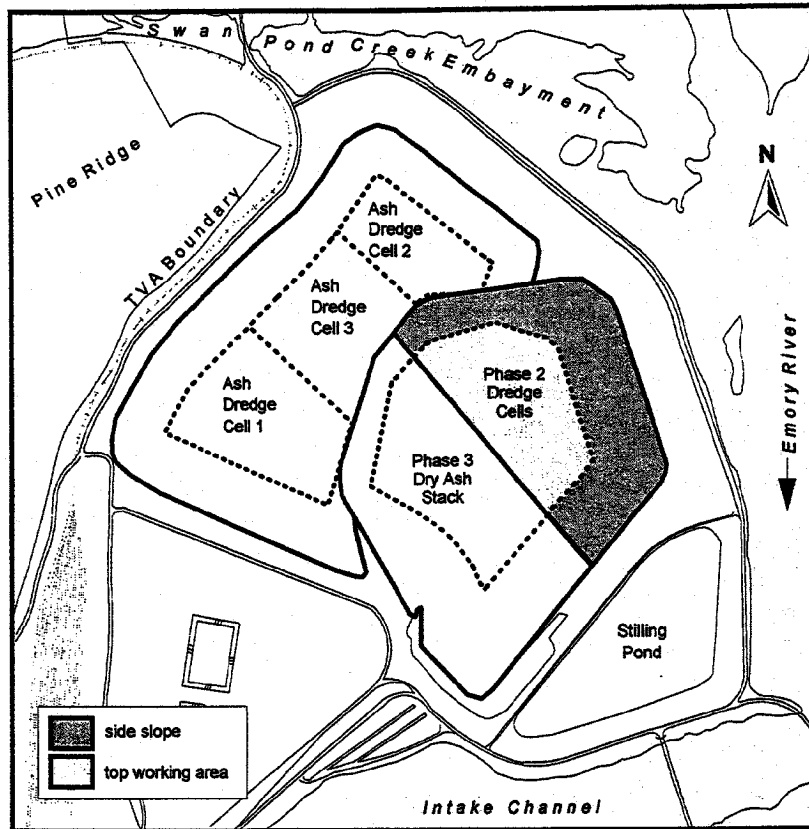
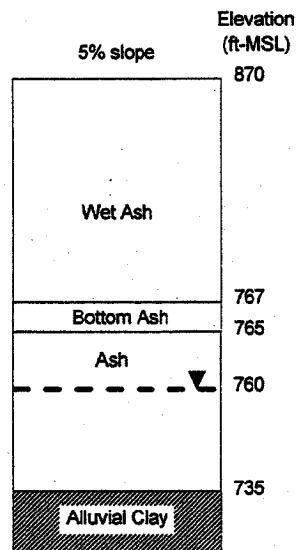


Figure G-4



Profile without Buffer



Profile without Buffer

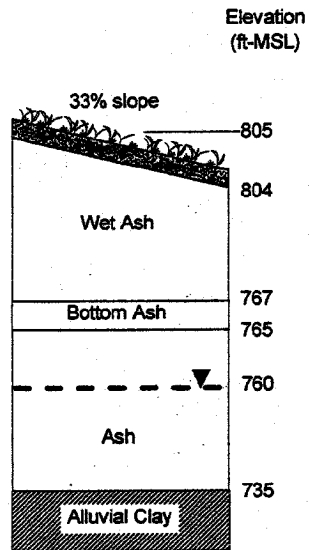
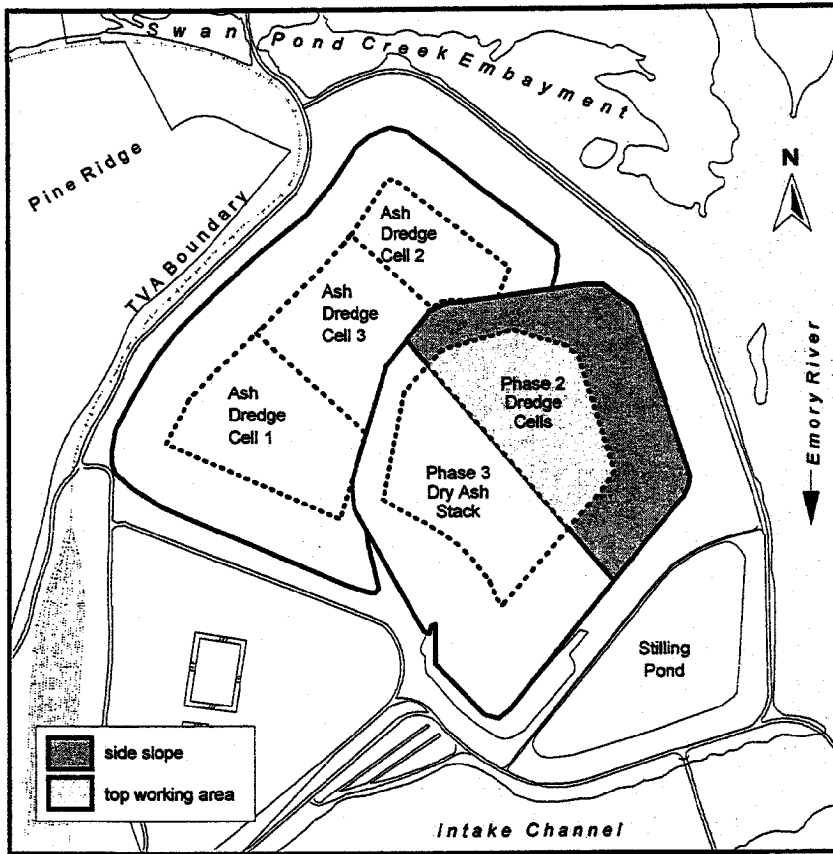
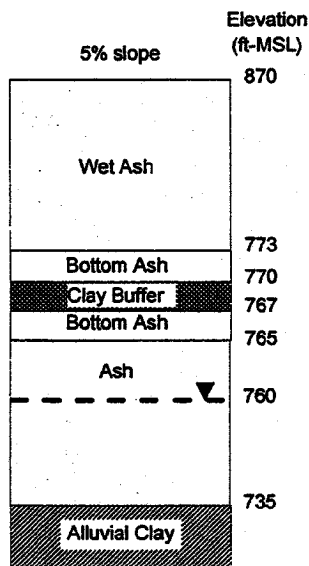


Figure G-5



Profile with Buffer



Profile with Buffer

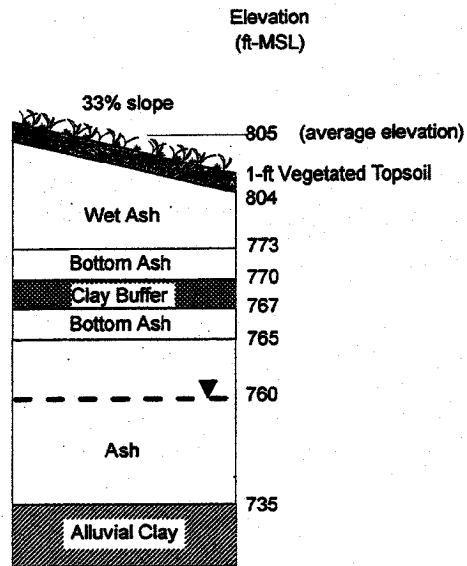
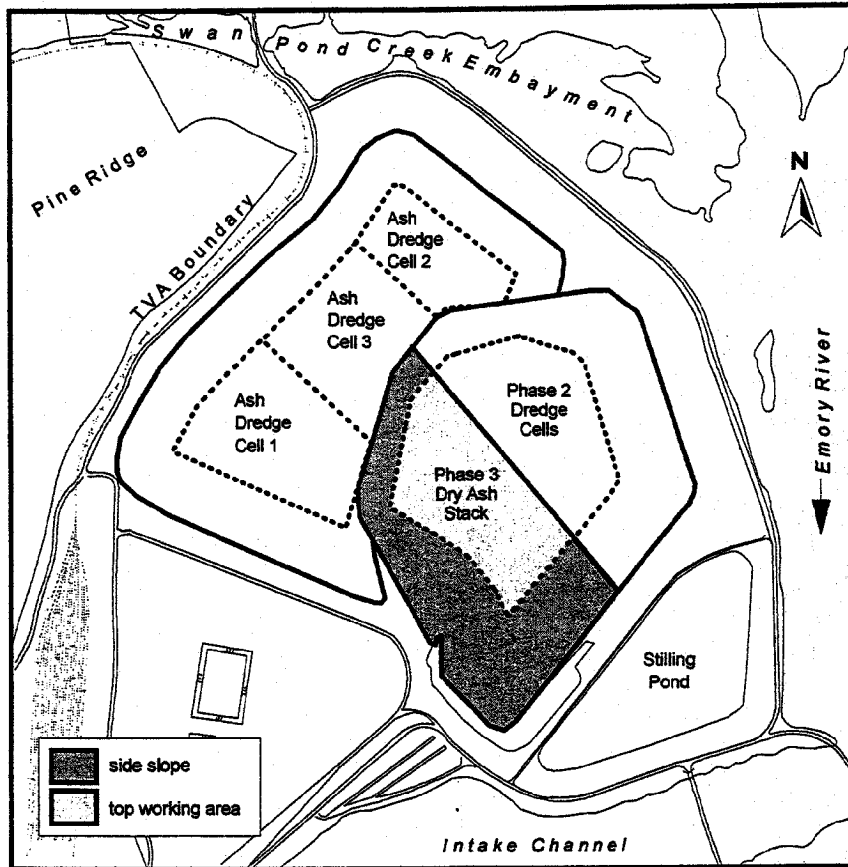
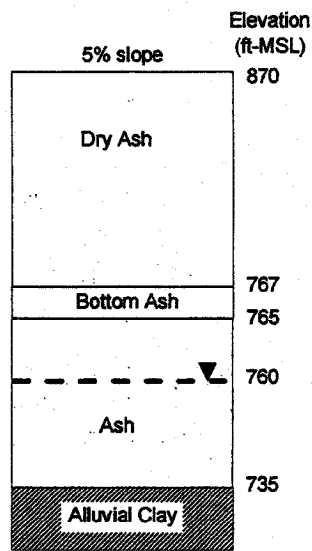


Figure G-6



Profile without Buffer



Profile without Buffer

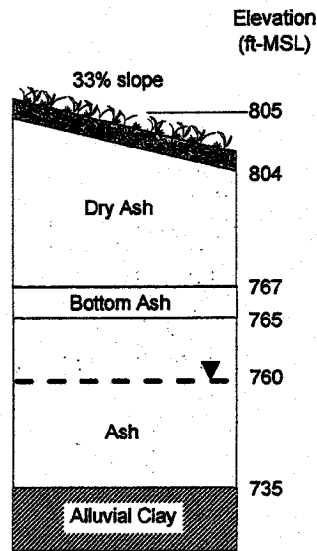
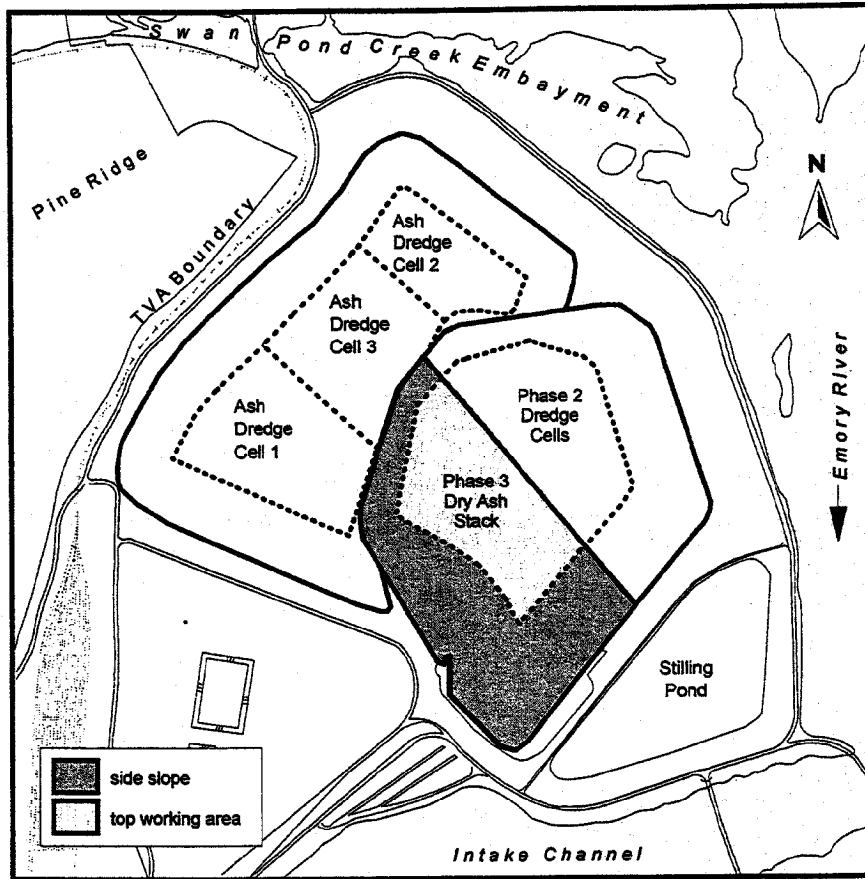
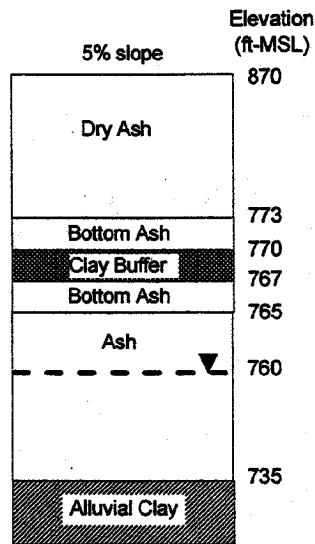


Figure G-7



Profile with Buffer



Profile with Buffer

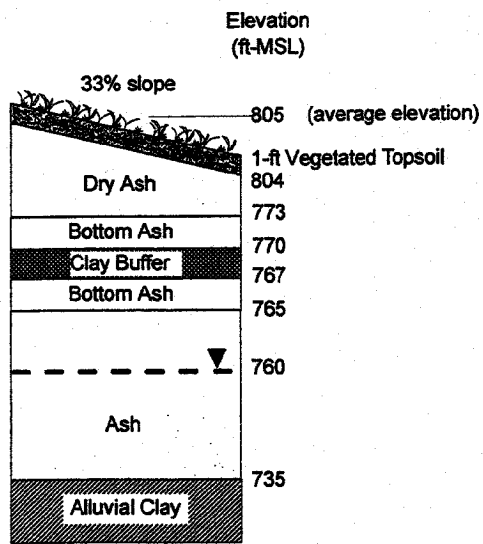
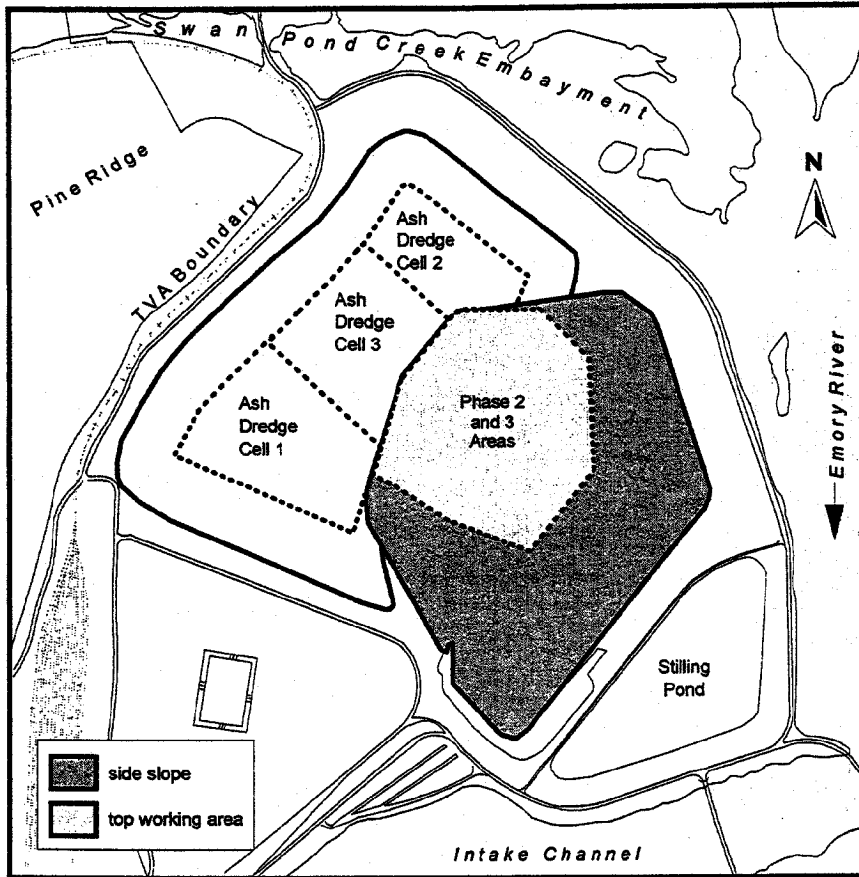


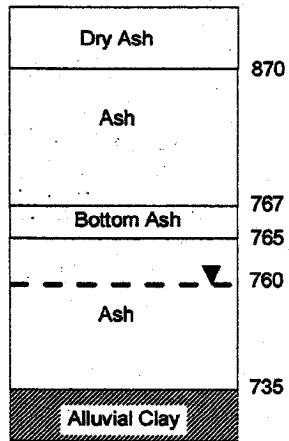
Figure G-8



Top Working Area

10% slope

Elevation
(ft-MSL)



Side Slope

Elevation
(ft-MSL)

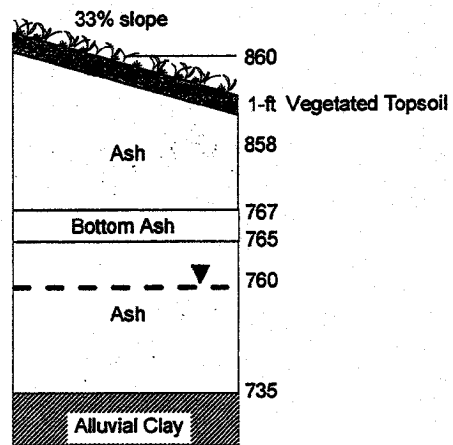


Figure G-9

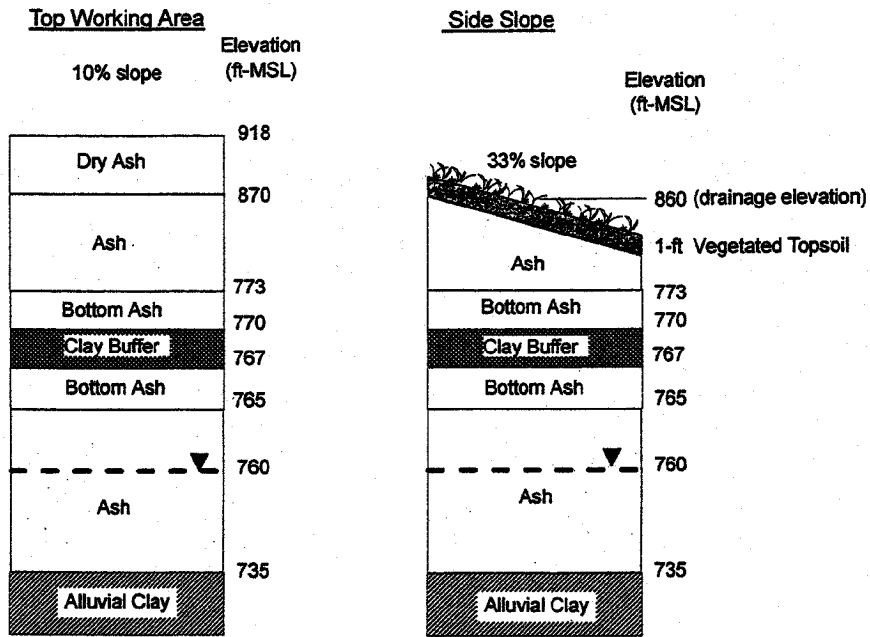
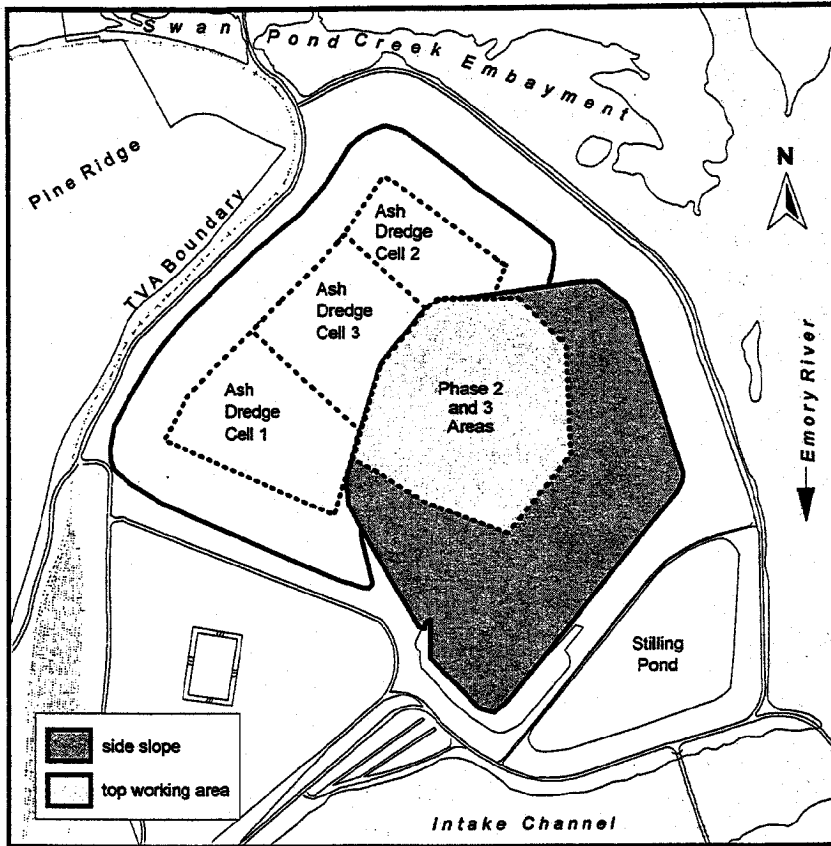


Figure G-10

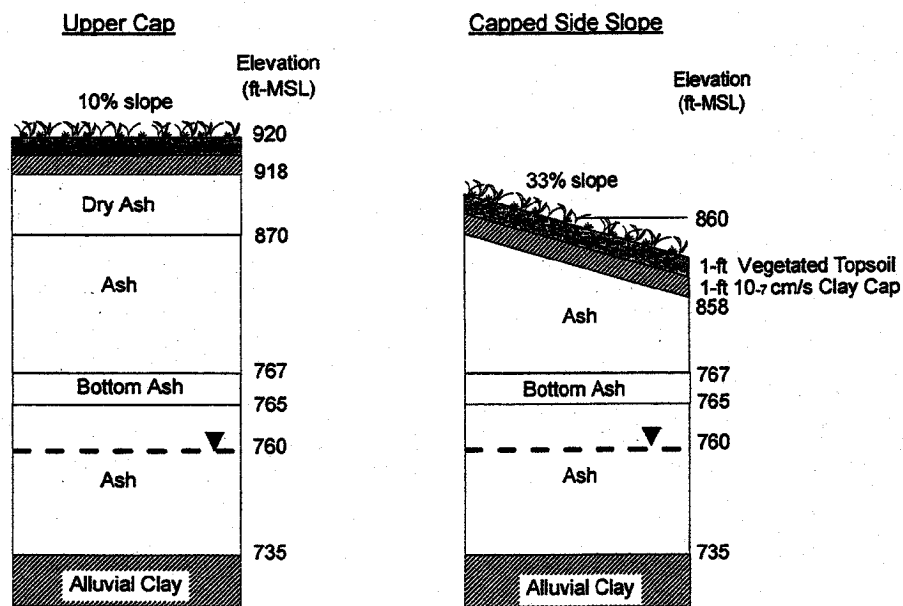
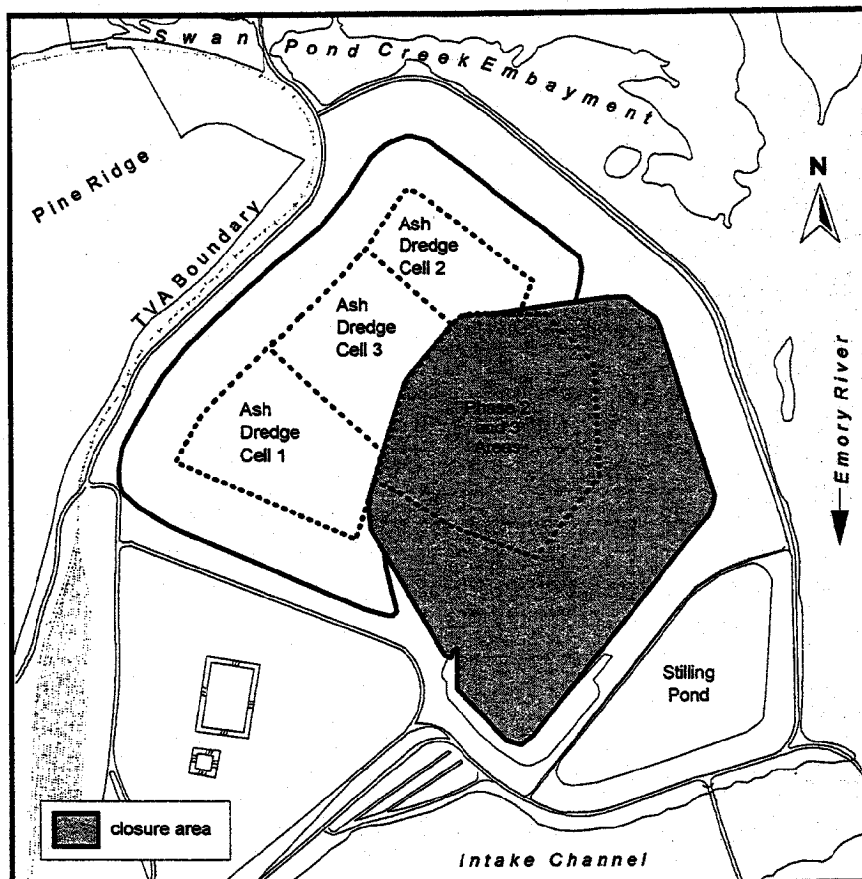


Figure G-11

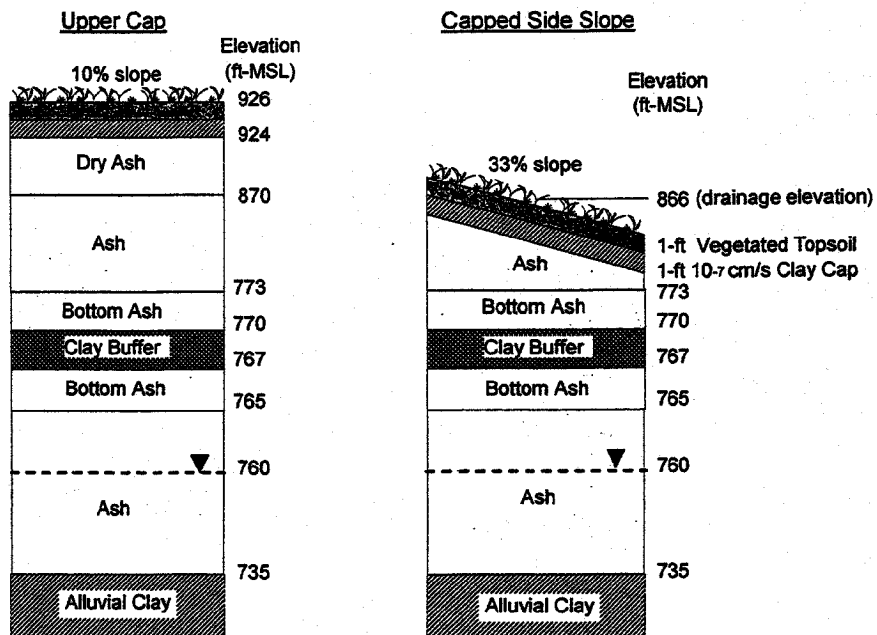
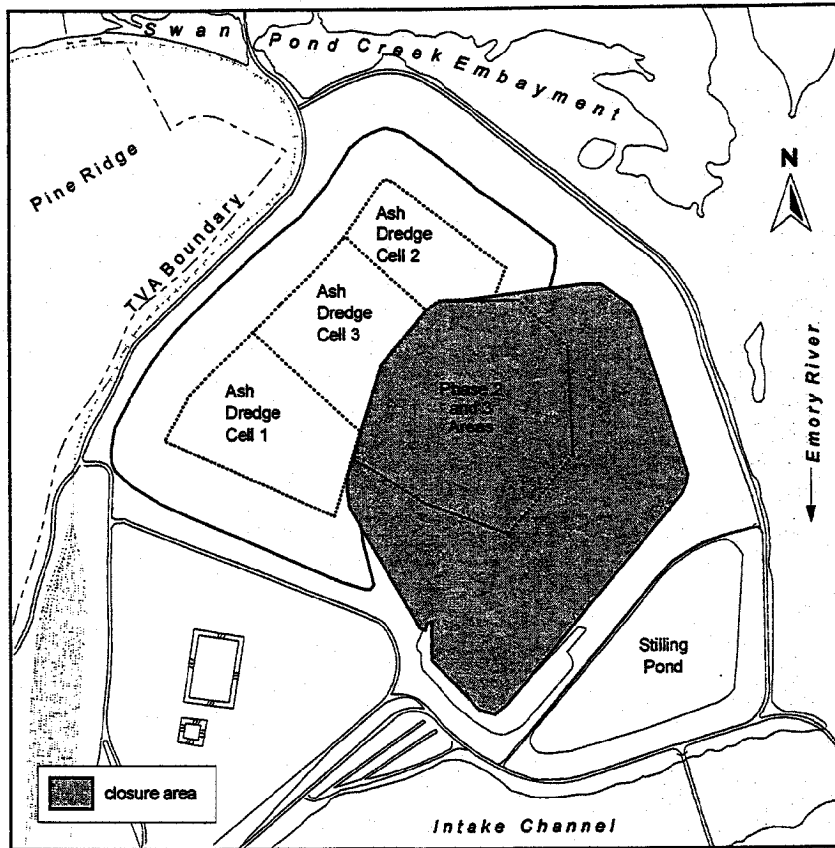


Figure G-12

APPENDIX H

OPTION A – LEACHATE SEEPAGE AND COC MASS LOADING ESTIMATES

Table H1. Option A – Leachate Seepage Estimates for Disposal Facility Subregions

Facility Subregion	Start Date	End Date	Waste	Surface Area (sq ft)	Mean Seepage (%P) ¹	Mean Seepage (Lpd)	Model Applied for Seepage Estimate	Subregion Figure No. (Appendix F)
Phase 1 - Ash Dredge Cells 1& 3 - Top Working Area	2004	2014	wet ash	1,596,662	11.6	67,618	HELP	F-1
Phase 1 - Ash Dredge Cells 1& 3 - Side Slopes	2004	2014	wet ash	1,799,163	30.7	200,760	HELP	F-1
Phase 1 - Ash Dredge Cell 2 (active pond)	2004	2014	wet ash	798,350	--	156,757	MODFLOW	F-1
Phase 1 - Ash Dredge Cells 1-3 - Top Working Area	2015	2016	dipped ash	1,965,662	13.5	90,215	HELP	F-2
Phase 1 - Ash Dredge Cells 1-3 - Side Slopes	2015	2016	dipped ash	2,581,418	17.4	153,283	HELP	F-2
Closure of Ash Dredge Cells 1-3 - Upper Cap	2017	2046	mixed ash	1,965,662	19.2	132,247	HELP	F-3
Closure of Ash Dredge Cells 1-3 - Side Slopes	2017	2046	mixed ash	2,581,418	17.2	155,163	HELP	F-3
Phase 1 - Dredge Cell Lateral Expansion Area - Top	2004	2014	wet ash	496,898	16.9	12,454	HELP	F-4
Phase 1 - Dredge Cell Lateral Expansion Area - Slope	2004	2014	wet ash	502,432	24.4	44,483	HELP	F-4
Phase 2 - Gypsum Pond A (inactive) - NO BUFFER	2009	2018	gypsum	417,835	24.6	37,940	HELP	F-5
Phase 2 - Gypsum Pond A (inactive) - BUFFER	2009	2018	gypsum	417,835	16.2	24,962	HELP	F-5
Phase 2 - Gypsum Pond B (active) - NO BUFFER	2009	2018	wet gypsum	405,015	--	24,347	MODFLOW	F-5
Phase 2 - Gypsum Pond B (active) - BUFFER	2009	2018	wet gypsum	405,015	--	16,545	MODFLOW	F-5
Phase 2 - Ash Pond (active) - NO BUFFER	2009	2018	wet ash	449,658	--	21,844	MODFLOW	F-5
Phase 2 - Ash Pond (active) - BUFFER	2009	2018	wet ash	449,658	--	17,370	MODFLOW	F-5
Phase 3 - Gypsum Pond A (inactive) - NO BUFFER	2019	2028	gypsum	384,240	27.5	38,890	HELP	F-6
Phase 3 - Gypsum Pond A (inactive) - BUFFER	2019	2028	gypsum	384,240	16.2	22,955	HELP	F-6
Phase 3 - Gypsum Pond B (active) - NO BUFFER	2019	2028	wet gypsum	363,363	--	21,844	MODFLOW	F-6
Phase 3 - Gypsum Pond B (active) - BUFFER	2019	2028	wet gypsum	363,363	--	14,843	MODFLOW	F-6
Dry Ash Stack between Phase 2&3 - NO BUFFER	2019	2028	dry ash	249,655	11.2	10,266	HELP	F-7
Dry Ash Stack between Phase 2&3 - BUFFER	2019	2028	dry ash	249,655	9.0	8,243	HELP	F-7
Closure of Phase 2&3 Areas - Upper Cap - NO BUFFER	2029	2058	60:40 ash/gypsum	1,538,324	12.0	65,409	HELP	F-8
Closure of Phase 2&3 Areas - Upper Cap - BUFFER	2029	2058	60:40 ash/gypsum	1,538,324	12.2	66,629	HELP	F-8
Closure of Phase 2&3 Areas - Side Slopes - NO BUFFER	2029	2058	60:40 ash/gypsum	2,709,399	11.9	114,047	HELP	F-8
Closure of Phase 2&3 Areas - Side Slopes - BUFFER	2029	2058	60:40 ash / gypsum	2,709,399	12.1	115,311	HELP	F-8

¹Percent of mean annual precipitation

Table H2. Option A – COC Mass Loading Estimates

Facility	Start Date	End Date	Waste	Ammonia			Arsenic			Cadmium			
				Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)	Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)	Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)	
Phase 1 - Ash Dredge Cells 1-3	2004	2014	wet ash	1.00	0.4237	0.4237	0.004	0.0016	0.0016	0.3189	0.001	0.0004	0.0004
Phase 1 - Ash Dredge Cells 1-3	2015	2016	dipped ash	1.13	0.2754	0.2754	0.004	0.0009	0.1826	0.001	0.0002	0.0002	0.0002
Closure of Ash Dredge Cells 1-3	2017	2046	mixed ash	1.13	0.3250	0.3250	0.004	0.0011	0.0503	0.001	0.0003	0.0003	0.0003
Phase 1 - Dredge Cell Lateral Expansion Area	2004	2014	wet ash	2.64	--	0.1503	0.0037	0.0002	0.0427	0.001	--	0.0001	0.0001
Phase 2 - Gypsum Ponds A&B - NO BUFFER	2009	2018	gypsum	0.000	--	0.000	0.001	0.000	0.000	0.012	--	0.0007	0.0007
Phase 2 - Gypsum Ponds A&B - BUFFER	2009	2018	gypsum	0.000	--	0.000	0.001	0.000	0.000	0.012	--	0.0005	0.0005
Phase 2 - Ash Dredge Cell - NO BUFFER	2009	2018	wet ash	2.64	--	0.0577	0.7500	0.0164	0.0164	0.002	--	4.37E-05	4.37E-05
Phase 2 - Ash Dredge Cell - BUFFER	2009	2018	wet ash	2.64	--	0.0459	0.7500	0.0130	0.0130	0.002	--	3.47E-05	3.47E-05
Phase 3 - Gypsum Ponds A&B - NO BUFFER	2019	2028	gypsum	0.00	--	0.0000	0.0005	0.0000	0.0000	0.012	--	0.0007	0.0007
Phase 3 - Gypsum Ponds A&B - BUFFER	2019	2028	gypsum	0.00	--	0.0000	0.0005	0.0000	0.0000	0.012	--	0.0005	0.0005
Phase 2&3 Dry Ash Stack - NO BUFFER	2019	2028	dry ash	733.00	--	7.5263	0.7500	0.0077	0.0077	0.002	--	2.05E-05	2.05E-05
Phase 2&3 Dry Ash Stack - BUFFER	2019	2028	dry ash	733.00	--	6.0425	0.7500	0.0062	0.0062	0.002	--	1.65E-05	1.65E-05
Closure of Phase 2&3 Areas - NO BUFFER	2029	2058	60:40 ash/gyp	284.69	--	50.6395	0.3496	0.0627	0.0113	0.007	--	0.0013	0.0013
Closure of Phase 2&3 Areas - BUFFER	2029	2058	60:40 ash/gyp	284.69	--	51.0986	0.3496	0.0622	0.0105	0.007	--	0.0013	0.0013

Table H2. Option A – COC Mass Loading Estimates (cont.)

Facility	Start Date	End Date	Waste	Copper			Mercury			Nickel		
				Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)	Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)	Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)
Phase 1 - Ash Dredge Cells 1-3	2004	2014	wet ash	0.025	0.0108	0.0108	0.0006	2.55E-04	2.55E-04	0.0466	1.98E-02	1.98E-02
Phase 1 - Ash Dredge Cells 1-3	2015	2016	dipped ash	0.025	0.0062	0.0062	0.0006	1.46E-04	1.46E-04	0.0466	1.13E-02	1.13E-02
Closure of Ash Dredge Cells 1-3	2017	2046	mixed ash	0.025	0.0073	0.0073	0.0006	1.72E-04	1.72E-04	0.0466	1.34E-02	1.34E-02
Phase 1 - Dredge Cell Lateral Expansion Area	2004	2014	wet ash	0.025	--	0.0014	0.0006	--	3.42E-05	0.0466	--	0.0027
Phase 2 - Gypsum Ponds A&B - NO BUFFER	2009	2018	gypsum	0.006	--	0.0003	0.0034	--	2.12E-04	0.107	--	0.0066
Phase 2 - Gypsum Ponds A&B - BUFFER	2009	2018	gypsum	0.006	--	0.0002	0.0034	--	1.41E-04	0.107	--	0.0044
Phase 2 - Ash Dredge Cell - NO BUFFER	2009	2018	wet ash	0.005	--	1.09E-04	0.0001	--	2.18E-06	0.003	--	6.55E-05
Phase 2 - Ash Dredge Cell - BUFFER	2009	2018	wet ash	0.005	--	8.69E-05	0.0001	--	1.74E-06	0.003	--	5.21E-05
Phase 3 - Gypsum Ponds A&B - NO BUFFER	2019	2028	gypsum	0.006	--	0.0003	0.0034	--	2.06E-04	0.107	--	0.0065
Phase 3 - Gypsum Ponds A&B - BUFFER	2019	2028	gypsum	0.006	--	0.0002	0.0034	--	1.29E-04	0.107	--	0.0040
Phase 2&3 Dry Ash Stack - NO BUFFER	2019	2028	dry ash	0.005	--	0.0001	0.0001	--	1.03E-06	0.003	--	3.08E-05
Phase 2&3 Dry Ash Stack - BUFFER	2019	2028	dry ash	0.005	--	0.0000	0.0001	--	8.24E-07	0.003	--	2.47E-05
Closure of Phase 2&3 Areas - NO BUFFER	2029	2058	60:40 ash/gyp	0.005	--	0.0009	0.0019	--	3.34E-04	0.058	--	0.0105
Closure of Phase 2&3 Areas - BUFFER	2029	2058	60:40 ash/gyp	0.005	--	0.0009	0.0019	--	3.31E-04	0.058	--	0.0104

Table H2. Option A – COC Mass Loading Estimates (cont.)

Facility	Start Date	End Date	Waste	Selenium			Zinc		
				Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)	Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)
Phase 1 - Ash Dredge Cells 1-3	2004	2014	wet ash	0.001	0.0004	4.25E-04	0.209	0.0889	0.0889
Phase 1 - Ash Dredge Cells 1-3	2015	2016	dipped ash	0.001	0.0002	2.43E-04	0.209	0.0509	0.0509
Closure of Ash Dredge Cells 1-3	2017	2046	mixed ash	0.001	0.0003	2.87E-04	0.209	0.0601	0.0601
Phase 1 - Dredge Cell Lateral Expansion Area	2004	2014	wet ash	0.001	--	5.69E-05	0.209	--	0.0119
Phase 2 - Gypsum Ponds A&B - NO BUFFER	2009	2018	gypsum	0.137	--	8.53E-03	0.715	--	0.0445
Phase 2 - Gypsum Ponds A&B - BUFFER	2009	2018	gypsum	0.137	--	5.69E-03	0.715	--	0.0297
Phase 2 - Ash Dredge Cell - NO BUFFER	2009	2018	wet ash	0.001	--	1.09E-05	0.005	--	1.09E-04
Phase 2 - Ash Dredge Cell - BUFFER	2009	2018	wet ash	0.001	--	8.69E-06	0.005	--	8.69E-05
Phase 3 - Gypsum Ponds A&B - NO BUFFER	2019	2028	gypsum	0.137	--	8.32E-03	0.715	--	0.0434
Phase 3 - Gypsum Ponds A&B - BUFFER	2019	2028	gypsum	0.137	--	5.18E-03	0.715	--	0.0270
Phase 2&3 Dry Ash Stack - NO BUFFER	2019	2028	dry ash	0.001	--	5.13E-06	0.005	--	0.0001
Phase 2&3 Dry Ash Stack - BUFFER	2019	2028	dry ash	0.001	--	4.12E-06	0.005	--	0.0000
Closure of Phase 2&3 Areas - NO BUFFER	2029	2058	60:40 ash/gyp	0.073	--	1.32E-02	0.3843	--	0.0690
Closure of Phase 2&3 Areas - BUFFER	2029	2058	60:40 ash/gyp	0.073	--	1.31E-02	0.3843	--	0.0684

APPENDIX I

OPTION B – LEACHATE SEEPAGE AND COC MASS LOADING ESTIMATES

Table I1. Option B – Leachate Seepage Estimates for Disposal Facility Subregions

Facility Subregion	Start Date	End Date	Waste	Surface Area (sq ft)	Mean Seepage (%P) ¹	Mean Seepage (Lpd)	Model Applied for Seepage Estimate	Appendix VII Subregion Figure No.
Phase 1 - Ash Dredge Cells 1& 3 - Top Working Area	2004	2014	wet ash	1,596,662	11.6	67,618	HELP	1
Phase 1 - Ash Dredge Cells 1& 3 - Side Slope	2004	2014	wet ash	1,799,163	30.7	200,760	HELP	1
Phase 1 - Ash Dredge Cell 2 (active pond)	2004	2014	wet ash	798,350	--	156,757	MODFLOW	1
Phase 1 - Ash Dredge Cells 1-3 - Top Working Area	2015	2016	dipped ash	1,965,662	13.5	90,215	HELP	2
Phase 1 - Ash Dredge Cells 1-3 - Side Slope	2015	2016	dipped ash	2,581,418	17.4	153,283	HELP	2
Closure of Ash Dredge Cells 1-3 - Upper Cap	2017	2046	mixed ash	1,965,662	19.2	132,247	HELP	3
Closure of Ash Dredge Cells 1-3 - Side Slope	2017	2046	mixed ash	2,581,418	17.2	155,163	HELP	3
Phase 1 - Dredge Cell Lateral Expansion Area - Top	2004	2014	wet ash	496,898	16.9	12,454	HELP	4
Phase 1 - Dredge Cell Lateral Expansion Area - Slope	2004	2014	wet ash	502,432	24.4	44,483	HELP	4
Phase 2 - Ash Dredge Cell - Top - NO BUFFER	2009	2009	wet ash	900,003	7.1	23,559	HELP	5
Phase 2 - Ash Dredge Cell - Top - BUFFER	2017	2017	wet ash	900,003	5.4	17,950	HELP	6
Phase 2 - Ash Dredge Cell - Slope - NO BUFFER	2009	2009	wet ash	1,175,800	23.6	102,398	HELP	5
Phase 2 - Ash Dredge Cell - Slope - BUFFER	2009	2009	wet ash	1,175,800	17.1	74,052	HELP	6
Phase 3 - Dry Ash Stack - Top - NO BUFFER	2019	2019	dry ash	897,897	2.9	9,747	HELP	6
Phase 3 - Dry Ash Stack - Top - BUFFER	2019	2019	dry ash	897,897	1.8	6,013	HELP	7
Phase 3 - Dry Ash Stack - Slope - NO BUFFER	2019	2019	dry ash	1,307,901	21.0	101,410	HELP	6
Phase 3 - Dry Ash Stack - Slope - BUFFER	2019	2019	dry ash	1,307,901	15.3	74,029	HELP	7
Phase2-3 - Dry Ash Cap - Top - NO BUFFER	2029	2029	mixed ash	2,709,399	2.0	10,880	HELP	8
Phase2-3 - Dry Ash Cap - Top - BUFFER	2029	2029	mixed ash	1,538,324	1.9	10,583	HELP	9
Phase2-3 - Dry Ash Cap - Slope - NO BUFFER	2029	2029	mixed ash	2,709,399	7.8	77,280	HELP	8
Phase2-3 - Dry Ash Cap - Slope - BUFFER	2029	2029	mixed ash	1,538,324	5.9	58,254	HELP	9
Closure of Phase 2&3 Areas - Upper Cap - NO BUFFER	2029	2058	60:40 ash/gypsum	1,538,324	14.5	78,822	HELP	10
Closure of Phase 2&3 Areas - Upper Cap - BUFFER	2029	2058	60:40 ash/gypsum	1,538,324	14.2	77,024	HELP	11
Closure of Phase 2&3 Areas - Side Slope - NO BUFFER	2029	2058	60:40 ash/gypsum	2,709,399	16.0	152,122	HELP	10
Closure of Phase 2&3 Areas - Side Slope - BUFFER	2029	2058	60:40 ash/gypsum	2,709,399	16.0	152,199	HELP	11

¹Percent of mean annual precipitation

Table I2. Options B – COC Mass Loading Estimates

Facility	Start Date	End Date	Waste	Ammonia			Arsenic			Cadmium			
				Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)	Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)	Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)	
Phase 1 - Ash Dredge Cells 1-3	2004	2014	wet ash	1.00	0.4237	0.4237	0.0037	0.0016	0.0016	0.0016	0.0004	0.0004	0.0004
Phase 1 - Ash Dredge Cells 1-3	2015	2016	dipped ash	1.13	0.2754	0.2754	0.0037	0.0009	0.0009	0.0009	0.0002	0.0002	0.0002
Closure of Ash Dredge Cells 1-3	2017	2046	mixed ash	1.13	0.3250	0.3250	0.0037	0.0011	0.0011	0.0011	0.0003	0.0003	0.0003
Phase 1 - Dredge Cell Lateral Expansion Area	2004	2014	wet ash	2.64	--	0.1503	0.0037	--	--	0.0002	--	--	0.0001
Phase 2 - Ash Dredge Cells - NO BUFFER	2017	2028	wet ash	2.64	--	0.2429	0.75	--	--	0.0690	--	--	0.0002
Phase 2 - Ash Dredge Cells - BUFFER	2017	2028	wet ash	2.64	--	0.3325	0.75	--	--	0.0945	--	--	0.0003
Phase 3 - Dry Ash Stack - NO BUFFER	2029	2040	dry ash	733.00	--	58.6711	0.75	--	--	0.0600	--	--	0.0002
Phase 3 - Dry Ash Stack - BUFFER	2029	2040	dry ash	733.00	--	81.4785	0.75	--	--	0.0834	--	--	0.0002
Phase 2&3 - Dry Ash Cap - NO BUFFER	2041	2047	dry ash	417.21	--	28.7193	0.75	--	--	0.0516	--	--	0.0001
Phase 2&3 - Dry Ash Cap - BUFFER	2041	2047	dry ash	417.21	--	36.7811	0.75	--	--	0.0661	--	--	0.0002
Closure of Phase 2&3 Areas - NO BUFFER	2048	2077	ash	417.21	--	96.3518	0.75	--	--	0.1732	--	--	0.0005
Closure of Phase 2&3 Areas - BUFFER	2048	2077	ash	417.21	--	95.6339	0.75	--	--	0.1719	--	--	0.0005

Table I2. Options B – COC Mass Loading Estimates (cont.)

Facility	Start Date	End Date	Waste	Copper			Mercury			Nickel		
				Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)	Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)	Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)
Phase 1 - Ash Dredge Cells 1-3	2004	2014	wet ash	0.0253	0.0108	0.0108	0.0006	0.00026	0.00026	0.0466	0.0198	0.0198
Phase 1 - Ash Dredge Cells 1-3	2015	2016	dipped ash	0.0253	0.0062	0.0062	0.0006	0.00015	0.00015	0.0466	0.0113	0.0113
Closure of Ash Dredge Cells 1-3	2017	2046	mixed ash	0.0253	0.0073	0.0073	0.0006	0.00017	0.00017	0.0466	0.0134	0.0134
Phase 1 - Dredge Cell Lateral Expansion Area	2004	2014	wet ash	0.0253	--	0.0014	0.0006	--	0.00003	0.0466	--	0.0027
Phase 2 - Ash Dredge Cells - NO BUFFER	2017	2028	wet ash	0.005	--	0.0005	0.0001	--	0.00001	0.003	--	0.0003
Phase 2 - Ash Dredge Cells - BUFFER	2017	2028	wet ash	0.005	--	0.0006	0.0001	--	0.00001	0.003	--	0.0004
Phase 3 - Dry Ash Stack - NO BUFFER	2029	2040	dry ash	0.005	--	0.0004	0.0001	--	0.00001	0.003	--	0.0002
Phase 3 - Dry Ash Stack - BUFFER	2029	2040	dry ash	0.005	--	0.0006	0.0001	--	0.00001	0.003	--	0.0003
Phase 2&3 - Dry Ash Cap - NO BUFFER	2041	2047	dry ash	0.005	--	0.0003	0.0001	--	0.00001	0.003	--	0.0002
Phase 2&3 - Dry Ash Cap - BUFFER	2041	2047	dry ash	0.005	--	0.0004	0.0001	--	0.00001	0.003	--	0.0003
Closure of Phase 2&3 Areas - NO BUFFER	2048	2077	ash	0.005	--	0.0012	0.0001	--	0.00002	0.003	--	0.0007
Closure of Phase 2&3 Areas - BUFFER	2048	2077	ash	0.005	--	0.0011	0.0001	--	0.00002	0.003	--	0.0007

Table I2. Options B – COC Mass Loading Estimates (cont.)

Facility	Start Date	End Date	Waste	Selenium			Zinc		
				Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)	Weighted Average Leachate Conc. (mg/L)	Mass Loading SPC (kg/day)	Mass Loading Emory River (kg/day)
Phase 1 - Ash Dredge Cells 1-3	2004	2014	wet ash	0.001	0.0004	0.0004	0.209	0.0889	0.0889
Phase 1 - Ash Dredge Cells 1-3	2015	2016	dipped ash	0.001	0.0002	0.0002	0.209	0.0509	0.0509
Closure of Ash Dredge Cells 1-3	2017	2046	mixed ash	0.001	0.0003	0.0003	0.209	0.0601	0.0601
Phase 1 - Dredge Cell Lateral Expansion Area	2004	2014	wet ash	0.001	--	0.0001	0.209	--	0.0119
Phase 2 - Ash Dredge Cells - NO BUFFER	2017	2028	wet ash	0.001	--	0.0000	0.005	--	0.0005
Phase 2 - Ash Dredge Cells - BUFFER	2017	2028	wet ash	0.001	--	0.0001	0.005	--	0.0006
Phase 3 - Dry Ash Stack - NO BUFFER	2029	2040	dry ash	0.001	--	0.0000	0.005	--	0.0004
Phase 3 - Dry Ash Stack - BUFFER	2029	2040	dry ash	0.001	--	0.0001	0.005	--	0.0006
Phase 2&3 - Dry Ash Cap - NO BUFFER	2041	2047	dry ash	0.001	--	0.0000	0.005	--	0.0003
Phase 2&3 - Dry Ash Cap - BUFFER	2041	2047	dry ash	0.001	--	0.0000	0.005	--	0.0004
Closure of Phase 2&3 Areas - NO BUFFER	2048	2077	ash	0.001	--	0.0001	0.005	--	0.0012
Closure of Phase 2&3 Areas - BUFFER	2048	2077	ash	0.001	--	0.0001	0.005	--	0.0011

APPENDIX J

**SELECTED GROUNDWATER QUALITY DATA FOR MONITORING
WELLS 4A, 4B, 5, 5A, AND 5B**

Groundwater Quality Data for Selected Wells

Well	Sample Date	Arsenic	Cadmium	Copper	Mercury	Nickel	Selenium	Zinc
KIF-4A	07/02/76		1	60	0.2	50	1	200
KIF-4A	03/09/77	4	1	10	2	50	1	10
KIF-4A	01/11/89	1	3	20			1	620
KIF-4A	03/29/89	1	2	10			1	440
KIF-4A	06/28/89	2	2	20			1	480
KIF-4A	09/13/89	2	5	10		140	1	690
KIF-4A	11/29/89	1	4	40			1	1200
KIF-4A	03/06/90	3	5	90			1	820
KIF-4A	06/05/90	6	4	10			1	870
KIF-4A	09/05/90	4	5	40			1	830
KIF-4A	12/04/90	1	3	30			1	790
KIF-4A	03/20/91	3	4	10			1	860
KIF-4A	12/17/91	13	3	50				670
KIF-4A	03/03/92	1	5	160				830
KIF-4A	06/02/92	2	3	170				810
KIF-4A	09/01/92	3	4	10				790
KIF-4A	12/07/92	2	3	10		120		670
KIF-4A	06/08/93	1	2	10		100		660
KIF-4A	12/09/93	9	2	10		180		650
KIF-4A	06/13/94	1	3	10		98		580
KIF-4A	12/06/94	3	5	10		110		560
KIF-4A	06/21/95	2		10		92		450
KIF-4A	12/11/95	1		10		99		400

KIF-4B	07/02/76		1	180	0.6	310	1	2
KIF-4B	03/09/77	4	1	10	2	80	1	10
KIF-4B	01/11/89	2	0.1	10			1	10
KIF-4B	03/29/89	2	0.1	10			1	40
KIF-4B	06/28/89	6	0.4	30			1	70
KIF-4B	09/13/89	4	0.5	20		20	1	80
KIF-4B	11/29/89	6	0.4	20			1	110
KIF-4B	03/06/90	2	0.6	10			1	100
KIF-4B	06/05/90	2	0.3	10			1	60
KIF-4B	09/05/90	3	0.8	40			1	30
KIF-4B	12/04/90	6	0.3	10			1	70
KIF-4B	03/20/91	2	0.3	10			1	10
KIF-4B	06/04/91	10	0.4	10			1	30
KIF-4B	09/10/91	11	0.5	10			1	40
KIF-4B	12/17/91	7	0.3	30				20
KIF-4B	03/03/92	1	0.1	10				10
KIF-4B	06/02/92	1	0.5	60				100
KIF-4B	09/01/92	1	0.3	10				40
KIF-4B	12/07/92	5	0.4	10		9		60
KIF-4B	06/08/93	1	0.1	10		3		40
KIF-4B	12/09/93	1	0.1	10		16		10
KIF-4B	06/13/94	1	0.5	10		23		40
KIF-4B	12/06/94	1		10		15		10
KIF-4B	06/21/95	1		10		13		10
KIF-4B	12/11/95	6		10		84		90
KIF-4B	12/03/96	2	0.1	10		5		10
KIF-4B	12/04/96	1	0.2	10		7		100
KIF-4B	05/07/97	1	0.3	10		19		10
KIF-4B	05/08/97	1	0.2	10		1		10

Groundwater Quality Data for Selected Wells (continued)

Well	Sample Date	Arsenic	Cadmium	Copper	Mercury	Nickel	Selenium	Zinc
KIF-4B	12/09/97	3	0.3	10		16		50
KIF-4B	12/10/97	3	0.9	10		2		10
KIF-4B	06/30/98	1	0.5	10		32		40
KIF-4B	12/02/98	1	0.3	10		14		20
KIF-4B	12/03/98	3	2	10		39		50
KIF-4B	12/06/99	1	0.1	10		6		10
KIF-4B	12/07/99	1	0.4	10		11		13
KIF-4B	12/14/00	2	0.1	10	0.2	27	1	28
KIF-4B	06/28/01	1	0.18	12	0.2	2	1	11
KIF-4B	12/31/01	4.2	1	10	0.1	3.3	1	17
KIF-4B	06/28/02	1	0.1	10	0.1	7	1	10
KIF-4B	01/08/03	4	0.1	10	0.1	7.9	2.2	10
KIF-4B	06/16/03	1	0.5	10	0.1	16	1	40
KIF-4B	09/02/03	1.2	0.32	10	0.1	8.4	0.9	20
KIF-4B	12/29/03	0.4	0.29	10	0.1	7.9	0.3	10
KIF-4B	03/10/04	2	0.33	10	0.1	1.1	0.5	10
KIF-4B	06/07/04	4	0.4	10	0.1	4	1	30
KIF-4B	09/14/04	1	0.1	10	0.1	1	1	10

KIF-5	07/02/76		1	40	0.2	50	1	80
KIF-5	03/09/77	4	1	10	2	50	1	10
KIF-5	01/11/89	2	0.1	20			1	130
KIF-5	03/29/89	2	0.3	80			1	150
KIF-5	06/28/89	2	1	60			1	100
KIF-5	09/13/89	3	0.5	30		33	1	230
KIF-5	11/29/89	3	0.1	30			1	310
KIF-5	03/06/90	5	1	70			1	210
KIF-5	06/05/90	3	0.3	30			1	190
KIF-5	09/05/90	7	0.5	30			1	170
KIF-5	12/04/90	16	0.1	50			1	140
KIF-5	03/20/91	4	0.2	10			1	120
KIF-5	12/17/91	12	0.5	50				220
KIF-5	03/03/92	4	0.2	40				140
KIF-5	06/03/92	17	1	20				60
KIF-5	06/30/92			10				40
KIF-5	09/01/92	17	0.1	10				30

KIF-5A	07/02/76		1	90	0.2	180	1	410
KIF-5A	03/09/77	6	1	10	2	60	1	50
KIF-5A	03/28/89	1	0.3	10			1	10
KIF-5A	09/13/89	3	0.5	30		33	1	230
KIF-5A	11/29/89	3	0.1	30			1	310
KIF-5A	03/06/90	5	1	70			1	210
KIF-5A	03/07/90	2	1	100			1	80
KIF-5A	06/07/90	8	0.6	10			1	40
KIF-5A	09/06/90	2	0.9	10			1	10
KIF-5A	12/05/90	1	0.3	10			1	1300
KIF-5A	03/21/91	1	0.5	20			1	220
KIF-5A	12/17/91	5	0.5	10				90
KIF-5A	12/17/91	12	0.5	50				220
KIF-5A	06/30/92			10				250
KIF-5A	08/20/92			190				1200

Groundwater Quality Data for Selected Wells (continued)

Well	Sample Date	Arsenic	Cadmium	Copper	Mercury	Nickel	Selenium	Zinc
KIF-5B	03/09/77	4	1	20	2	50	1	200
KIF-5B	01/11/89	1	0.1	10			1	10
KIF-5B	03/29/89	1	1	10			1	10
KIF-5B	06/28/89	2	0.1	10			1	20
KIF-5B	09/13/89	1	0.1	10		12	1	60
KIF-5B	11/29/89	1	0.2	10			1	190
KIF-5B	03/06/90	1	0.4	20			1	50
KIF-5B	06/05/90	1	0.1	10			1	40
KIF-5B	09/05/90	1	0.5	30			1	20
KIF-5B	12/04/90	4	0.3	10			1	10
KIF-5B	03/20/91	1	0.1	20			1	110
KIF-5B	12/17/91	7	0.2	20				20
KIF-5B	03/03/92	1	0.2	10				250
KIF-5B	06/03/92	47	1	(1000)*				260
KIF-5B	06/30/92			10				110
KIF-5B	09/01/92	3	0.2	10				
Average Concentration =		3.8	1.0	26	0.6	46	1.0	210

* outlier

