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REPORT OF HYDROGEOLOGIC AND ENGINEERING EVALUATION (REVISED) PROPOSED DRY FLY ASH DISPOSAL FACILITY SITE

JOHN SEVIER FOSSIL PLANT
ROGERSVILLE, TENNESSEE

Prepared for:

TENNESSEE VALLEY AUTHORITY

OCTOBER 1994

LAW ENGINEERING PROJECT 57401440.01

LAW
ENGINEERING AND ENVIRONMENTAL SERVICES

September 30, 1994

Mr. Jerry Glover
LP2G
1101 Market Street
Chattanooga, Tennessee 37402-2801

Subject: **Report of Hydrogeologic and Engineering Evaluation (Revised)**
Proposed Dry Fly Ash Disposal Facility Site
John Sevier Fossil Plant
Rogersville, Tennessee
Law Engineering Project 57401440.01

Dear Mr. Glover:

Law Engineering, Inc. is pleased to submit this Revised Report of Hydrogeologic and Engineering Evaluation for the proposed Dry Fly Ash Disposal Facility at the John Sevier Fossil Plant. The evaluation was performed in general accordance with the applicable requirements of the Tennessee Department of Environment and Conservation, Rule Chapter 1200-1-7, Solid Waste Processing and Disposal. Our services were provided as set forth in Task Order No. 395305 under the terms of Contract Number 91PS-89294B, and TVA Personal Services Contract No. TV-92663V.

We have appreciated the opportunity to conduct this study for you. If you have any questions regarding this report or if we can be of further assistance, please fell free to contact us at your convenience.

Sincerely,

LAW ENGINEERING, INC.

James W. Niehoff, P.E.
Principal Engineer
Registered, Tennessee - 22,132

David A. Miller, P.E.
Principal Engineer
Registered, Tennessee - 15,485

Attachments

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ONE OF THE LAW COMPANIES

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1.0 INTRODUCTION

The John Sevier Fossil Plant (JSF) is a coal burning power plant operated by the Tennessee Valley Authority on the south bank of the Holston River south of Rogersville, Tennessee (see Figure 1). One of the by-products of coal combustion is fly ash, a fine grained solid material trapped in electrostatic precipitators. In the past, the fly ash generated at this plant was sluiced to one of several ponds located within the TVA reservation. The ponds were permitted under NPDES regulations. Within the past few years, however, the plant has converted to a dry fly ash system to enhance the marketability of the fly ash as a construction material. At the present time, up to 1/2 of all of the ash generated is sold and transported off-site. The remaining material must be disposed of on-site utilizing a stacking procedure.

The purpose of the current work is to characterize the hydrogeologic conditions in the area of the fly ash disposal site. The proposed site is located immediately to the west of the generating facility, above and within an existing ash disposal pond (see Figure 2). This site was selected for a number of reasons:

- The site is close to the plant and will not require significant haul distance.
- The site has been used for ash disposal in the past. Thus, new land will not have to be disturbed.
- The development of the disposal facility can be coordinated with the closure of the existing ash pond.

This current study was intended to meet the requirements of the Tennessee Department of Environment and Conservation for permitting waste disposal facilities of this type. It should be noted that we have relied upon several sources of published data for assistance in developing our understanding of the local geology and hydrogeology. These sources, while not specifically referenced at the point of use in the text, are listed and acknowledged in the References Section of this report.

2.0 SCOPE OF THE EVALUATION

The scope of this evaluation included a review of existing data relating to the geology and soil conditions in the plant area, the performance of field and laboratory tests and an evaluation of the existing data and test results relative to the proposed waste disposal facility.

2.1 GENERAL

The purpose of this evaluation was to describe and define the hydrogeologic characteristics of the subject site in accordance with the requirements of Rule Chapter 1200-1-7, Solid Waste Processing and Disposal, as adopted by the Tennessee Department of Environment and Conservation, effective March 18, 1990. Rule 1200-1-7-.04(9)(a) lists the specific characteristics to be assessed by the hydrogeologic investigation. Specifically, the scope of the evaluation has included the following activities:

2.1.1. Map and Literature Research

Geologic and topographic maps of the area were examined for evidence of fracture zones, sinkholes, other karst features and areal drainage patterns. Available literature concerning the area, including State reports, soil surveys, groundwater level data, etc., was also collected and reviewed.

2.1.2 Site Reconnaissance

The site was visited by a LAW geotechnical engineer and geologist for the purpose of visual inspection of surface conditions. The field inspection included a search for obvious sinks, springs, rock outcrops, and other characteristics of geologic or hydrogeologic significance.

2.1.3 Geotechnical Exploration

A number of studies have been conducted in the proposed disposal site area by representatives of the Tennessee Valley Authority over the past few years. These studies have included the drilling of soil test borings, the installation of piezometers and wells, and the performance of field and laboratory tests for the characterization of subsurface soil and rock strata. To supplement this data, and to satisfy State of Tennessee requests and comments, four additional soil test borings were drilled as part of this study to better define the condition of overburden materials and to obtain samples for laboratory strength and moisture content tests.

3.0 GENERAL SITE INFORMATION

The following sections of this report describe the location of the site, as well as its topographic setting and current development.

3.1 SITE LOCATION

The John Sevier Fossil Plant is located on the southern (left) bank of the Holston River in Hawkins County, Tennessee, approximately three miles to the southeast of Rogersville. Access to the plant is by state Highway 70 and by a paved TVA roadway system.

The proposed site consists of an approximately 90-acre parcel located immediately west of the generating facility. When developed, the disposal facility will consist of a disposal area, access roads and surface drainage facilities.

3.2 GENERAL SITE DESCRIPTION

The TVA reservation is located within a broad, relatively flat plain located on the southern bank of the Holston River. To the south of the plant is a wide, southwest to northeast trending ridgeline which rises up to 180 feet above the plain. The ridgeline is dissected by north-west trending swales which direct overland runoff to Polly Branch and Dodson Creek. Dodson Creek empties directly into the Holston River. Polly Branch is currently impounded within the TVA reservation. No obvious sinkholes or solution features were noted on the south bank of the Holston River. To the north of the Holston River is a broad undulating flood plain with numerous apparent solution features.

The proposed disposal site is occupied by a filled ash pond. The ash pond was constructed by building dikes 30 to 40 feet above the flood plain of the Holston River. After reaching capacity a few years ago, the eastern portion of the pond was dredged to provide a disposal area (known as the "bathtub") for sluiced bottom ash. Recently, this sluicing operation was stopped and the materials directed to a pond located near the southern boundary of the TVA reservation. Since conversion to dry fly ash handling, as part of the Operating Plan, the plant has disposed of ash in a stacking procedure over the western portion of the pond surface. Consequently, the western portion of the site has risen to approximately 20 feet above the level of the impoundment dikes. Surface water within the ash pond area is controlled by a series of ditches which direct runoff to a pond at the western extreme of the disposal area. The discharge from this pond is permitted under NPDES regulations.

4.0 GEOLOGY

The John Sevier Fossil Plant is located in the eastern portion of the State of Tennessee which is underlain by ancient sedimentary rocks folded and fractured as a result of tectonic events several million years ago. A detailed description of the geologic setting of the plant site and its environs is presented in the following sections of this report.

4.1 GEOLOGIC STRUCTURE

The John Sevier Fossil Plant is located on the northwest limb of a broad syncline that is associated with the Bays Mountain Synclinorium. Rock units in the area have been subjected to several orogenic events. These events have caused folding and fracturing of the bedrock which has in turn produced extensive jointing and fracturing, particularly in the more competent limestone strata. Measurements taken on massive limestone outcrops along the north side of the Holston River directly across from the site and on massive shale outcrops located in a quarry southeast of the site indicate that the folded Sevier strata beneath the site dips at an angle between 45 and 80 degrees to the southeast (See Figure 3A). Joints were observed in both of these outcroppings running subparallel to the strike of the formations and dipping near vertical. The Sevier Shale in the Bay Mountain Synclinorium is at least 2500 feet thick and may be as thick as 5000 feet.

Based upon our review of geologic reports and our observation of topographic features, it is likely that the Holston River lies at or near a facies contact of the Sevier Shale Formation and the Newala Formation of the Knox Dolomite Group (see Figure 3 & 3A). The Newala Formation of the Knox Dolomite Group is exposed along the northern side of the river and is evidenced by the significant level of solution activity noted in this area. An ancient, inactive fault is located just north of the river and trends to the northeast near the contact of the Sevier Shale and the Knox Dolomite Group (see Figure 3A).

4.2 STRATIGRAPHY

As noted previously, the proposed disposal site had previously been developed as an ash pond. Consequently, the near surface materials include perimeter dikes composed of compacted silty clay and sandy silt fill materials surrounding settled fly and bottom ash materials. These materials are underlain in some areas by recent alluvial deposits and older terrace alluvial deposits associated with the Holston River. Beneath these water-deposited soils near the river, and beneath fill in other areas, are residual soils derived from the decomposition of the underlying bedrock. The bedrock consists of the Sevier Shale Formation of Ordovician age. This formation was explored extensively during the initial development of the site by TVA. The 60+ borings extending into the bedrock within the plant site encountered a dark gray to black, slightly calcareous shale, with thin (0.1 to 3 inch) seams of limestone. In general, the shale was found to incorporate a weathered zone of only 1 to 2 feet in thickness. Below this level, the shale was found to be relatively massive and intact. Faults and shears were present in the rock, but are apparently ancient and have recemented with calcite.

4.3 SOILS

The alluvial deposits within the plant area are typically composed of yellow-brown and red-brown silty clays and sands. Discontinuous layers of alluvial gravels can be found just above the harder residual soils and bedrock in the unconsolidated zone. Weathered residual soils derived from the Sevier Shale Formation are characteristically yellowish-brown silty clay soil with a remnant shale texture. Soil overburden at the site, which includes fill, alluvial soils and residuum, ranges from between 20 to 60 feet with an average thickness of 40 feet. The soil-bedrock interface ranges in elevation from about 1120 feet in the southern portion of the TVA reservation to less than 1060 feet along the south bank of the Holston River.

4.3.1 Soil Classification

The soil within this site is classified as part of the Holston-Urban land complex. It is composed of large areas which have been modified by cutting and filling. The SCS has classified the natural, undisturbed soils as Holston. The Holston consists of deep, loamy, well-drained soils formed by mixed sedimentary deposits in thick layers over shale bedrock. Permeability of Holston soils is moderate and available water capacity is high. The soils tend to be strongly to very strongly acidic.

4.3.2 Soil Sampling and Testing

Our interpretation of subsurface conditions in the proposed disposal area is based upon a total of eleven soil test borings drilled in 1986 around the periphery of the site (SS-1 through SS-11), ten borings/piezometers drilled in 1986 (PZ-1A/1B through PZ-5A/5B), two borings/piezometers drilled in 1991 (Wells 15 and 21), and four soil test borings/piezometers drilled in August of 1994 specifically for this study (94-1 through 94-4). Additional monitoring wells located throughout the plant site were also used in the interpretation of groundwater flow directions. The locations of the borings used in this study are shown on Figure 4 in Appendix A. Test Boring Records illustrating the classification of materials sampled and details of well construction are presented in Appendix B of this report along with a table of boring locations and elevations.

Wells 1, 2 and 3 from early TVA studies (1986) were subsequently renamed Wells 3, 4 and 5, respectively, in later TVA studies. We have utilized the most recent monitoring well designations in this report. We note that boring logs for these wells were not available, although groundwater data was provided.

Following completion of drilling, a number of the boreholes were fitted with slotted or screened PVC pipe to permit long-term measurement of water-table elevations. Water-table elevations made during the period of March through June of 1991 are presented on Table 1 in Appendix B. More recent groundwater measurements obtained from the new soil test borings are indicated on individual boring logs, but are not presented on Table 1 as they represent water levels from a significantly later time period.

Slug and pumping tests were conducted by TVA personnel in 14 borings in the site area to gauge the hydraulic conductivity of the various subsurface strata. The results of these tests indicated conductivities ranging from 5×10^{-2} to 5×10^{-4} cm/sec in the various subsurface strata. No consistent trend was noted relative to hydraulic conductivity and material type. That is, wide variations were noted in fill, alluvium and residuum. We believe this is indicative of the non-homogeneous nature of the subsurface strata. A summary of field hydraulic conductivity test results is presented on Table 2 in Appendix A.

Soil strength tests were conducted on samples of ash and alluvial soils retrieved during the more recent soil test boring program. Methods of strength determination included both triaxial shear and direct shear tests. Additionally, moisture contents were determined for samples obtained in the borings to provide a subsurface profile of the degree of saturation of the materials. Laboratory test data is presented in Appendix C. Strength and moisture content values were used to evaluate the stability of the proposed disposal area (see Section 6).

5.0 HYDROGEOLOGY

The term hydrogeology, as used in this report, refers to the recharge, discharge, and flow characteristics of subsurface water within this site.

5.1 REGIONAL SETTING

Groundwater in the site vicinity generally exists in an unconfined condition, although confined conditions may exist locally. The groundwater is stored and flows through the interstices of soil and in open partings (fractures, joints, bedding planes, etc.) in bedrock before discharging to wells, springs, and seeps of other water bodies. Most groundwater in this area originates directly from precipitation, which infiltrates soil and fractured bedrock, percolating downward until it reaches the zone of saturation (i.e., the water table). Some groundwater recharge may result from seepage through stream beds. The depth of the water table surface varies according to the relationship between local topography, base-level flow and seasonal precipitation.

Groundwater is not used to a great extent in the plant area. Most residents in the general area obtain potable water from the Persia Utility District. However, during a previous study, 50 domestic wells were identified within one-mile south of the proposed disposal site, primarily in or surrounding the McCloud Community. An additional 9 wells were identified within one mile of the site on the north side of the

Holston River during a site reconnaissance in 1994. A map indicating the locations of all of these wells is presented on Figure 5 in Appendix A. We understand that these wells generally extend only a short distance into the bedrock. All wells located on the south side of the site are considered to be upgradient of the disposal area. Although water levels were not obtained from the wells on the north side of the river, they extend into a different geologic formation and are separated from the proposed disposal site by the river, which is considered to form a hydrogeologic divide. Consequently, we consider it to be unlikely that groundwater from the site would flow toward or reach any of these wells.

The surface hydrology of the site is controlled by regional topography and by man-made drainage structures located within the plant area. Surface runoff originates as "sheet flow" which is directed to Polly Branch at the eastern side of the site, Dodson Creek at the western end of the site, and toward ditches in the central portion of the site. All surface flows ultimately discharge to the Holston River.

5.2 SITE HYDROGEOLOGY

The aquifer beneath the site area includes the soil overburden and the upper weathered portion of the Sevier Shale bedrock. Water flows through voids in the soil overburden and through fractures in the upper portion of the underlying shale. Due to the intact nature of the lower, relatively unweathered portion of the bedrock zone, it is not thought that significant flow occurs through this portion of the subsurface profile. The near-surface aquifer exists under unconfined conditions within the plant area. No confined systems are known to exist in the site vicinity, although confined conditions may exist locally.

5.2.1 Groundwater Recharge

Groundwater is recharged over the entire site mainly by the infiltration and percolation of precipitation and surface waters throughout the soil mantle. The former presence of a bottom ash pond at the eastern end of the disposal site and the stilling basin at the western end of the site, has facilitated recharge, and mounding of the groundwater table has resulted. However, most of the groundwater flowing beneath the proposed disposal site area originates from recharge areas located on the northern flank of the ridgeline located to the south of the site.

5.2.2 Groundwater Discharge

Discharge of groundwater occurs along the extreme northern border of the proposed disposal site, where the ground surface drops abruptly to form the southern bank of the Holston River. For the most part, discharge occurs at or slightly above the water elevation in the Holston River and is not generally visible. However, in a few locations (reportedly four), drainage pipes (of unknown origin or design) beneath the dike system appear to concentrate seepage and measurable flows can reportedly be observed when the river level is down. These pipes were not visible during the course of this study and therefore, their exact location could not be determined. However, the flow and chemical characteristics of the discharge from these pipes were studied in detail by the TVA and the results presented in their report entitled *Seepage Flux from John Sevier Fossil Plant Ash Disposal Area into Holston River*, dated May, 1987. It was the conclusion of this report that the majority of the flow from these pipes resulted from the sluicing of bottom ash into the "bathtub" area of the site. Since the pipes were below river level during the course of this study, it was not possible to quantify the likely reduction in flow rates resulting from the transfer of sluicing to another pond. We understand that the future use of these pipes will be controlled by NPDES regulations. The locations of these pipes will be accurately determined during the next low-water period.

When Holston River flow decreases and exposes the discharge pipes, the pipe locations will be determined by survey. The pipes will subsequently be capped and the pipe outlet plugged with non-shrink grout.

5.2.3 Groundwater Flow

The groundwater surface is relatively shallow, typically ranging from about 6 to 20 feet below the ground surface in most lower areas of the proposed disposal site. Groundwater lies at greater depth (up to 40 feet) beneath the higher (western) portions of the disposal areas. Figure 6 is a water table map of the site showing apparent contours of the water table at 10 foot intervals. Although water level readings have been recorded over extended periods of time in all locations, the map is based upon readings taken June 13, 1991 to establish a uniform datum. More recent data obtained from the soil test borings conducted in August of 1994 indicated that the mounding had been lowered as much as ten feet since sluicing operations to the "bathtub" had ceased. Further, moisture content distributions through the overlying fill did not suggest the presence of any perched zones of water above the general phreatic surface.

The groundwater surface within the plant site is generally a subdued replica of the ground surface topography. That is, groundwater generally flows from higher elevations along the southern boundary of the plant toward the lower elevations adjacent to the Holston River. Impounded water bodies present in ponds create mounds in the "normal" phreatic surface.

6.0 HYDROGEOLOGIC ASSESSMENT AND RECOMMENDATIONS

This evaluation has examined the geology and hydrogeology of the proposed Ash Disposal Facility at the John Sevier Fossil Plant with regard to applicable standards of Rule 1200-1-7-.04, Specific Requirements for Class 1, II, III, and IV Disposal Facilities. The general site characteristics and their applicability to the Rule are summarized in the following sections.

6.1 GENERAL

The proposed disposal facility is located atop an abandoned dry ash pond, which is scheduled to be closed within the next few months. At the present time, the entire site is underlain by a thick zone of fly ash and bottom ash, which is in turn underlain by alluvial and residual soils. Until recently, the ash disposal site has operated under NPDES regulations. Under current regulations, the ponds would require a closure plan under solid waste rules. The objectives of such a closure plan include: 1) a reduction of leachate generation through proper grading and construction of a low permeability cap, and 2) long term monitoring of groundwater quality through the use of a monitoring well network. It is believed that the construction of a new dry fly ash disposal facility atop the existing ash pond will enhance the objectives of a closure plan and will allow for several years of additional ash storage. The basis for this belief rests upon the following factors:

1. Construction of a stack atop the relatively flat surface of the ash pond will enhance surface runoff and reduce infiltration of precipitation.

2. Dry ash has a significant capacity both to store and evaporate water due to its porosity and high capillarity. Recent studies by the TVA at its Bull Run Fossil Plant suggest that dry fly ash stacks may not produce leachate for a period of up to 7 years or more as a result of this characteristic. After reaching a steady state condition of moisture, leachate production has still been demonstrated to be minimal at other TVA facilities.

6.2 GEOLOGIC BUFFER

Waste disposal facilities involving combustion by-products are currently required to incorporate a geologic buffer having a thickness of at least 3 feet and a permeability of 1 x 10 -6 cm/sec. With regard to this site, we believe that this should require the construction of a buffer atop the existing ash pond surface, and beneath the new dry fly ash stack. Our understanding of the hydrologic characteristics of dry fly ash suggest that such a buffer should not serve to significantly reduce the quantity of the leachate which would be generated by this facility. With this in mind, the Norris Laboratory at TVA conducted a computer modeling study of the John Sevier Fossil Plant in an effort to predict generation rates of leachate assuming: 1) installation of a 3-foot geologic buffer, 2) construction of the ash stack without the benefit of a geologic buffer, and 3) simple closure of the pond with a clay cap. The results of these studies were presented in a report entitled *Evaluation of Water Resource Impacts from Proposed Fly Ash Dry Stack at John Sevier Fossil Plant* dated April, 1992. This study indicated little or no environmental benefit relating to the installation of the buffer.

As a result of this study and similar studies at TVA's Cumberland Fossil Plant in Cumberland City Tennessee, consideration has been given to waiving the requirement for a geologic buffer, provided that an interim cover is provided during construction of the stack, and that a relatively impervious final cover is constructed upon completion.

6.3 GENERAL CONSTRUCTION SEQUENCE

The low "bathtub" area has been drained of standing water. We recommend the following sequence of construction relating to this facility:

1. Dry fly ash should be placed and compacted in the "bathtub" area to bring the entire site to level grade.
2. After leveling the low area of the site ("bathtub" area), ash should be placed and compacted in lifts employing maximum 3:1 (horizontal to vertical) side slopes. Slopes should be covered with an interim cover consisting of 12 inches of compacted soil, then vegetated with an approved grass to promote runoff and to minimize erosion.
3. Upon reaching final grade, it should be completely covered with an FML or GCL liner, an appropriate drainage medium, and 12 inches of soil suitable to support vegetation to inhibit further infiltration of rainwater into the disposal cell.

6.4 STABILITY ANALYSIS

To evaluate the stability of the proposed stack configuration, the disposal stack and underlying foundation were evaluated utilizing the PCSTABL5M computer program developed at Purdue University. Descriptions of the cases studied and the results obtained are presented in the following sub-sections of this report.

6.4.1 Slope Configuration and Materials Properties

Slope stability analyses were performed on two idealized cross-sections of the disposal site assuming completion of the stack as designed. The data used to generate the cross-sections was obtained from the available subsurface boring information and sheets 2 and 4 of the design plans for the John Sevier Fossil Plant Dry Fly Ash Stack, dated 9-15-94. The two selected sections represented typical "worst case" profiles within the eastern and western sides of the disposal area. Both were aligned approximately perpendicular to the river and the perimeter dike.

The various types of material present in the design cross-sections included: 1) ash, 2) compacted fill, 3) alluvial soils, 4) residual soils, and 5) bedrock. Strength parameters for these materials were obtained from laboratory tests conducted on undisturbed and remolded samples obtained in the field and by correlations between standard penetration resistances and strengths of similar materials at other geologically similar sites.

6.4.2 Analyses

Two cases were analyzed for the stability of each embankment configuration including the following:

1. A steady-state case analyzed with a circular failure surface using drained soil strength parameters
2. A steady-state case analyzed with a circular failure surface under pseudo-static (earthquake) loadings with a horizontal and vertical acceleration equal to 0.1g in accordance with seismic maps of the area.

In addition to the above, the stability of the final cover was evaluated using a hand-calculated block sliding method of analysis for both the static and dynamic loading conditions.

The calculated factors of safety for each case were as follows:

SECTION/LOADING	STATIC	PSEUDO-STATIC
Western Section	2.58	1.35
Eastern Section	2.36	1.24
Final Cap	1.8	1.3

Printouts of each stability calculation as well as a pictorial representation of the slope cross-section, soil parameters, and critical failure plane are presented in Appendix C.

6.4.3 Evaluation/Conclusion

Accepted minimum safety factors for static and pseudo-static (earthquake) stability of slopes are 1.5 and 1.1, respectively. Consequently, the minimum calculated stability safety factors for the design slope configuration specified for the various cases analyzed above are considered to be adequate for the facility.

6.5 BORROW SOURCES

It is our understanding that adequate borrow material for the cap is probably not available within the TVA reservation. Assuming that off-site sources of borrow soil are to be used for the interim cover and as part of the final cap, proper testing and inspection should be conducted on a regular basis to confirm that materials being used are adequate for their intended use.

6.6 GROUNDWATER MONITORING

Groundwater beneath the site does not flow toward any known well or springs. Wells in the site area are hydraulically upgradient of the facility. All flows are expected to enter the Holston River. To assess groundwater quality on a long-term basis, a series of at least three downgradient monitoring wells should be constructed along the northern side of the disposal area. As other TVA ponds and facilities are located immediately up-gradient of the site, we recommend that well W-3 (previously designated W-1), located at the southern extreme of the TVA reservation, be used for background water quality evaluation.

6.7 CONCLUSION

In conclusion, it is our opinion that the selected site should be suitable for the disposal of dry fly ash materials. The construction of the facility in this location maximizes the use of previously developed land, and will enhance the closure objectives of the existing ash pond.

7.0 REFERENCES

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Young, Steve, "Leachate Generation from Dry Stacked Fly Ash at the Bull Run Plant," Tennessee Valley Authority Engineering Laboratory Publication, 1989.

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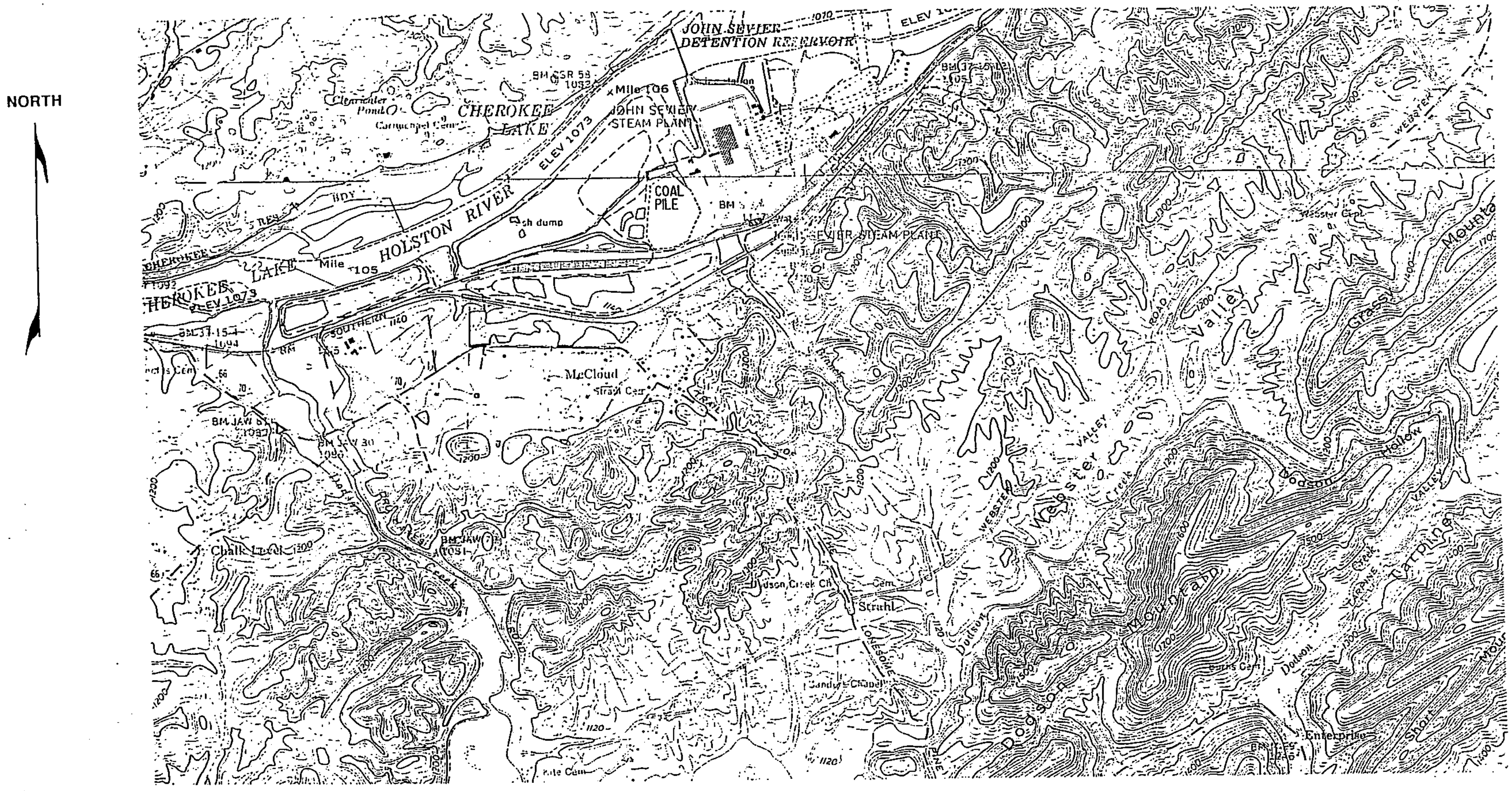
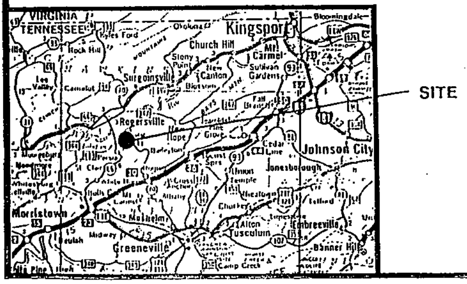
APPENDIX A





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Atlanta, Georgia
Geotechnical, Materials & Environmental Consultants

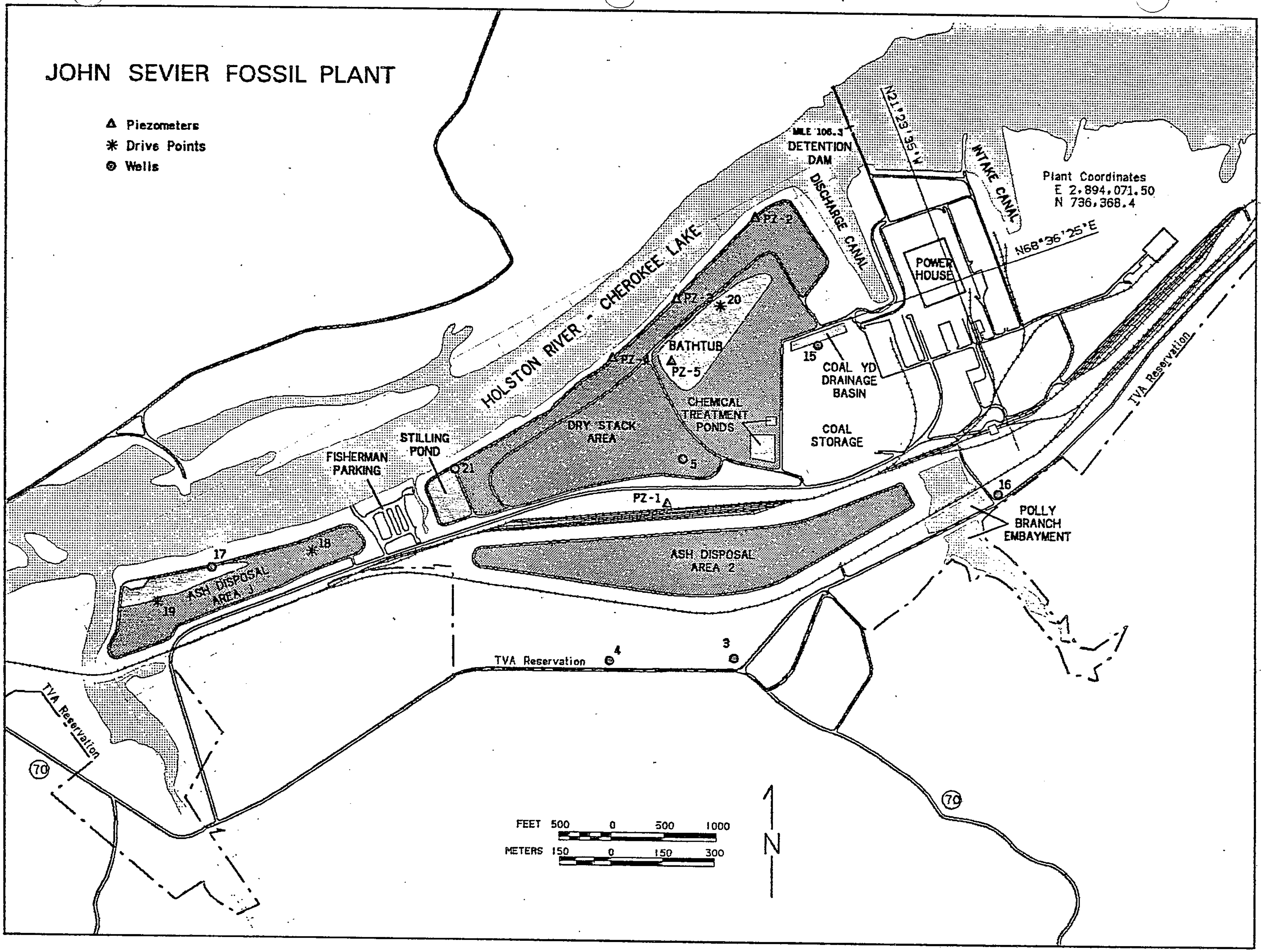
TVA JOHN SEVIER FOSSIL PLANT
ASH DISPOSAL FACILITY

SCALE	PROJECT NO.	DATE
	57401440.01	

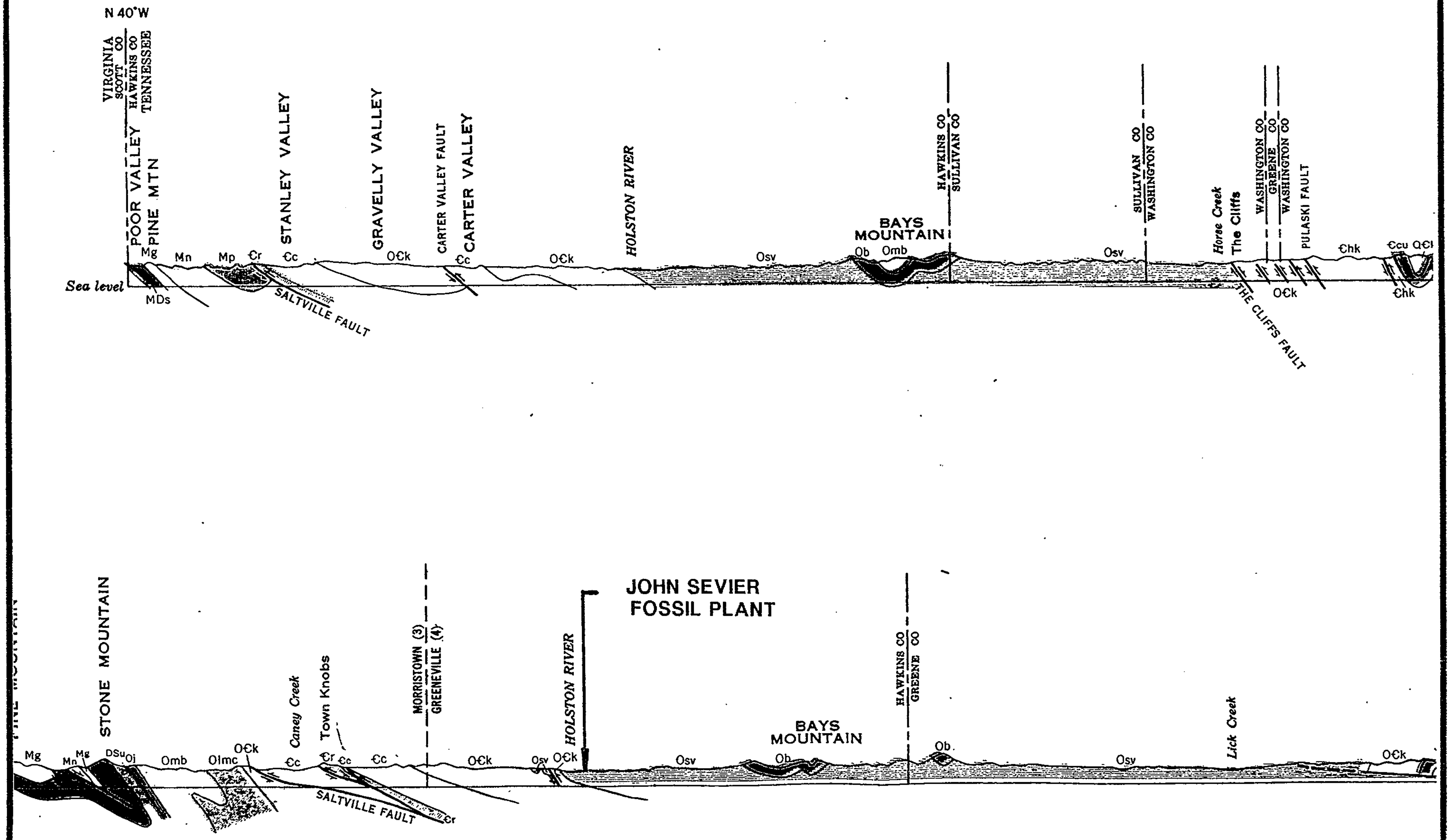
FIGURE 1

SITE LOCATION/
TOPOGRAPHIC MAP

JOHN SEVIER FOSSIL PLANT



PREPARED IN COOPERATION WITH
UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY



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Atlanta, Georgia
Geotechnical, Materials & Environmental Consultants

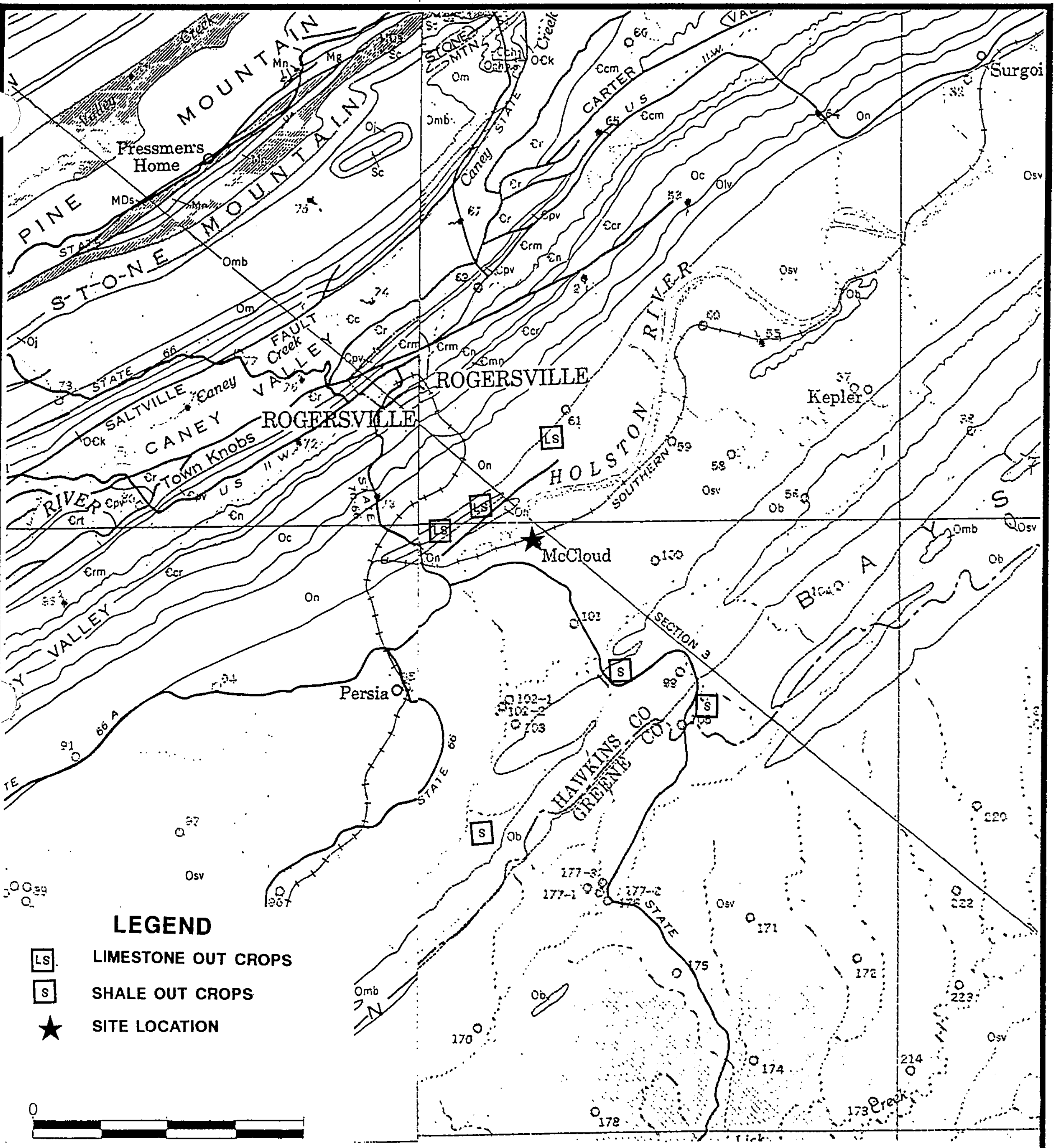
TVA JOHN SEVIER FOSSIL PLANT
ASH DISPOSAL FACILITY

Project No.	Scale	Date
57401440.01	N.T.S.	

FIGURE 3

GEOLOGIC CROSS SECTION

572864



LEGEND

LS	LIMESTONE OUT CROPS
S	SHALE OUT CROPS
★	SITE LOCATION

0

SCALE IN FEET

SOURCE: STATE OF TENNESSEE DEPARTMENT OF CONSERVATION DIVISION OF GEOLOGY

Law Engineering
Atlanta, Georgia

Geotechnical, Materials & Environmental Consultants

FIGURE 3A
GEOLOGIC FEATURES

TVA JOHN SEVIER FOSSIL PLANT
ASH DISPOSAL FACILITY

Project No.	Scale	Date
574-01440.01	AS SHOWN	SEPT. 1994

Note: Boring log for well 5 not available.

LAW ENGINEERING INC.
ATLANTA, GEORGIA

FIGURE 4 - BORING LOCATION PLAN

SCALE: 1"=200'	**APPROVED BY:** J. NIEHOFF	**DRAWN BY:** R.A.B.	
DATE: 3-24-92		**REVISED**	

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ASH DISPOSAL FACILITY

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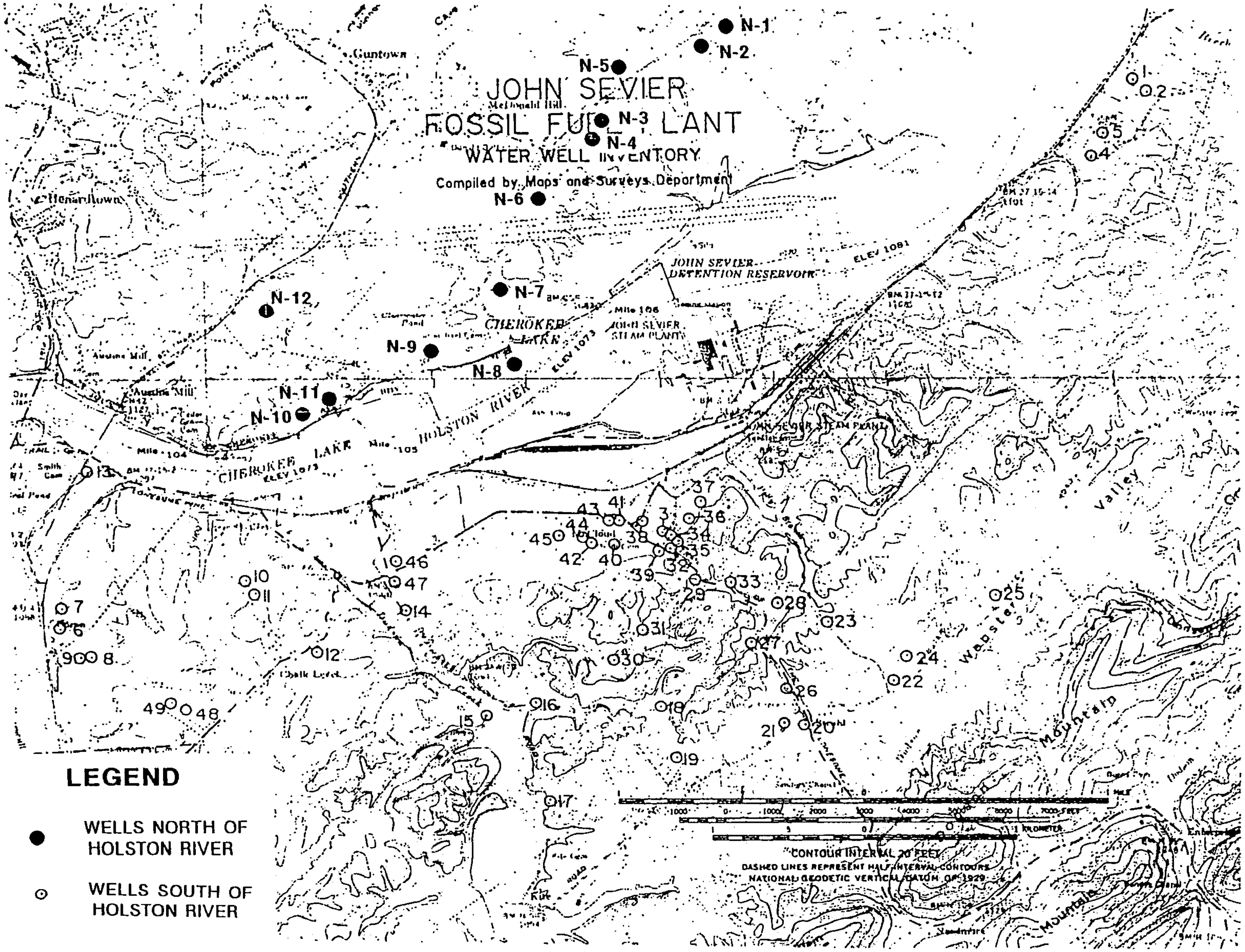


Law Engineering
Atlanta, Georgia
Geotechnical, Materials & Environmental Consultants

TVA JOHN SEVIER FOSSIL PLANT
ASH DISPOSAL FACILITY

Project No.	Scale	Date
57401440.01	AS SHOWN	SEPT. 1994

FIGURE 5
WATER WELL LOCATIONS
REVISED TO SHOW WELLS
NORTH OF HOLSTON RIVER
SEPTEMBER 1994

LAW ENGINEERING INC.
ATLANTA, GEORGIA

FIGURE 6 - PHREATIC SURFACE CONTOURS

SCALE: 1"=100'	APPROVED BY: J. NIEHOFF	DRAWN BY:- R.A.B.
DATE: 3-24-92		REVISED

JOHN SEVIER FOSSIL PLANT
ASH DISPOSAL FACILITY

PROJECT NO.

APPENDIX B

SUMMARY OF BORING LOCATIONS AND ELEVATIONS

Boring No.	Ground Surface Elevation
SS-1	1112.5
SS-2	1113.1
SS-3	1114.3
SS-4	1113.1
SS-5	1110.6
SS-6	1110.4
SS-7	1101.0
SS-8	1099.3
SS-9	1135.0
SS-10	1130.3
SS-11	1117.6
PZ-1	1121.7
PZ-1B	1121.7
PZ-2A	1113.8
PZ-2B	1114.3
PZ-3A	1112.1
PZ-3B	1112.4
PZ-4A	1110.4
PZ-4B	1111.1
PZ-5A	1098.3
PZ-5B	1099.0
15	1102.8
21	1099.4
94-1	*
94-2	*
94-3	*
94-4	*

* Boring locations were not surveyed by September 30, 1994

TABLE 1. 1991 GROUNDWATER ELEVATIONS AT JOHN SEVIER FOSSIL PLANT

WELL No.	GROUNDWATER ELEV. (ft-msl) 3/26/91	GROUNDWATER ELEV. (ft-msl) 4/29/91	GROUNDWATER ELEV. (ft-msl) 5/23-24/91	GROUNDWATER ELEV. (ft-msl) 6/13/91	GROUNDWATER ELEV. (ft-msl) 6/26/91
3	1133	1133.03	1132.45	1132.37	1132.10
4	1127.62	1126.36	1125.12	1125.76	1125.20
5	1103.58	1102.87	1102.97	1102.80	1102.57
PZ1	1110.50	ND	1109.38	1109.95	1109.28
PZ2A	1086.62	ND	1086.70	1087.22	1087.32
PZ2B	1096.49	ND	1096.08	1096.19	1096.47
PZ3A	1100.00	ND	1099.97	1100.19	1100.27
PZ3B	1100.46	ND	1100.35	1100.34	1100.45
PZ4A	1087.20	ND	1087.20	1087.54	1087.43
PZ4B	1087.65	ND	1087.43	1087.56	1087.43
PZ5A	UNDERWATER	UNDERWATER	UNDERWATER	UNDERWATER	UNDERWATER
PZ5B	UNDERWATER	UNDERWATER	UNDERWATER	UNDERWATER	UNDERWATER
15	1092.50	1092.74	1092.66	1092.58	1092.80
16	1116.63	1116.06	1115.43	1115.06	1114.60
17	1068.96	ND	ND	1070.36	1070.26
18	1096.52	1093.40	1093.22	1094.19	1093.37
19	1097.63	1098.69	1097.93	1097.43	1097.49
20	1118.97	1118.79	1118.97	1118.66	1119.25
21	ND	ND	ND	1077.95	1077.73
22	ND	ND	1077.60	1077.60	1078.30
23	ND	ND	1120.30	1120.60	1119.65
RP#1	ND	ND	1094.14	1093.30	1093.85
RP#2	ND	ND	1111.77	1111.53	1111.09
RP#3	ND	ND	1068.62	1071.30	1071.34

RP#1 - COAL YARD DRAINAGE BASIN
RP#2 - POLLY BRANCH
RP#3 - DODSON CREEK

WELL 5 IS IN THE DRY STACK AREA SO GROUND ELEVATION VARIES WITH TIME.

ND - NO DATA

TABLE 2

FIELD TEST RESULTS AT JOHN SEVIER FOSSIL PLANT

WELL No.	TEST TYPE	No. OF REPLICATE TESTS	K CM/SEC	SATURATED THICKNESS FT.	T FT^2/DAY	MATERIAL TYPE
PZ1	SLUG TEST	2	$5x10^{-3}$	8.0	10	RESIDUUM
PZ2A	SLUG TEST	2	$1x10^{-2}$	29.0	87	ALLUVIUM
PZ2B	SLUG TEST	1	$1x10^{-2}$	29.0	90	ASH AND FILL
PZ2B	PUMPTEST	1	$2x10^{-3}$	29.0	15	
PZ3A	SLUG TEST	4	$1x10^{-2}$	42.0	126	ALLUVIUM
PZ3B	SLUG TEST	2	$2x10^{-2}$	42.0	210	ASH AND FILL
PZ3B	PUMPTEST	1	$3x10^{-3}$	42.0	29	
PZ4A	SLUG TEST	4	$2x10^{-3}$	26.5	12	ALLUVIUM
W3	SLUG TEST	1	$2x10^{-2}$	19.5	117	RESIDUUM
W3	PUMPTEST	1	$4x10^{-3}$	19.5	20	
W4	SLUG TEST	3	$2x10^{-2}$	19.5	86	RESIDUUM
W4	PUMPTEST	2	$3x10^{-3}$	19.5	15	
W15	SLUG TEST	2	$5x10^{-4}$	16.0	2	RESIDUUM
W15	PUMPTEST	1	$8x10^{-4}$	16.0	3	
W16	SLUG TEST	2	$1x10^{-3}$	13.5	4	RESIDUUM
W17	SLUG TEST	1	$5x10^{-2}$	6.0	73	RESIDUUM
W18	SLUG TEST	2	$5x10^{-3}$	29.0	38	ASH
W20	PUMPTEST	1	$9x10^{-3}$	49.0	121	ASH
W21	SLUG TEST	2	$1x10^{-2}$	8.0	21	RESIDUUM

TEST BORING LEGEND
KEY TO CLASSIFICATIONS AND SYMBOLS

CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	NO. OF BLOWS, N	RELATIVE DENSITY
SANDS	0 - 4	Very Loose
	4 - 10	Loose
	10 - 30	Firm
	30 - 50	Dense
	Over 50	Very Dense
		CONSISTENCY
SILTS AND CLAYS	0 - 2	Very Soft
	2 - 4	Soft
	4 - 8	Firm
	8 - 15	Stiff
	15 - 30	Very Stiff
	30 - 50	Hard
	Over 50	Very Hard

SYMBOLS

■ - Undisturbed sample (UD) recovered

◫ - Undisturbed sample (UD) not recovered

100/2" - Number of blows (100) to drive the spoon a number of inches (2)

NQ, HQ - Core barrel sizes which obtain cores 1-7/8 and 2-1/2 inches in diameter respectively

65% - Percentage (65) of rock core recovered

RQD - Rock quality designation - % of core segments 4 or more inches long

▼ - Water table at least 24 hours after drilling

▽ - Water table one hour or less after drilling

◀ - Loss of drilling water

A - Atterberg limits test performed

C - Consolidation test performed

GS - Grain size test performed

T - Triaxial shear test performed

P - Proctor compaction test performed

V - Field vane shear test performed

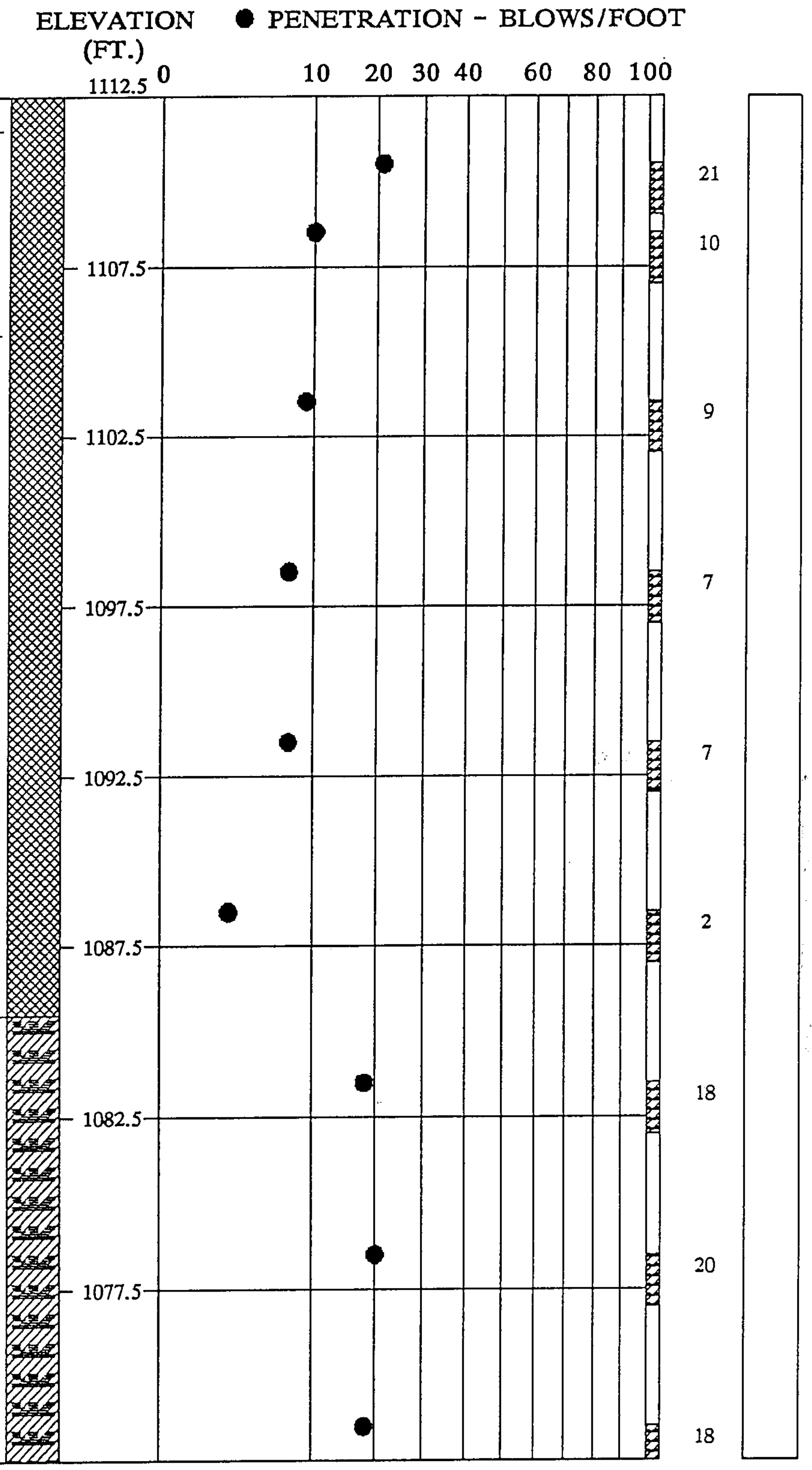
18 - Percent of natural moisture content (18)

—●— - Borehole caved

DRILLING PROCEDURES

Soil sampling and penetration testing performed in accordance with ASTM D 1586-67. The standard penetration resistance is the number of blows of a 140 pound hammer falling 30 inches to drive a 2 inch O.D., 1.4 inch I.D. split spoon sampler one foot. Core drilling in accordance with ASTM designation D 2113-62T. The undisturbed sampling procedure is described by ASTM specification D 1587-67.

DEPTH (FT.)	DESCRIPTION
0.0	FILL - LIMESTONE GRAVEL, ROAD METAL
1.0	FILL - MEDIUM DENSE TO LOOSE LIGHT BROWN TO LIGHT GRAY LAMINATED SILTY CLAY WITH TRACE LOOSE GRAVEL
7.0	FLY ASH FILL - LOOSE TO VERY LOOSE LIGHT BROWN TO DARK GRAY CLAYEY SILTY MEDIUM TO FINE SAND
27.0	ALLUVIUM - VERY STIFF DARK BROWN TO GRAY MOTTLED FINE SANDY SILTY CLAY



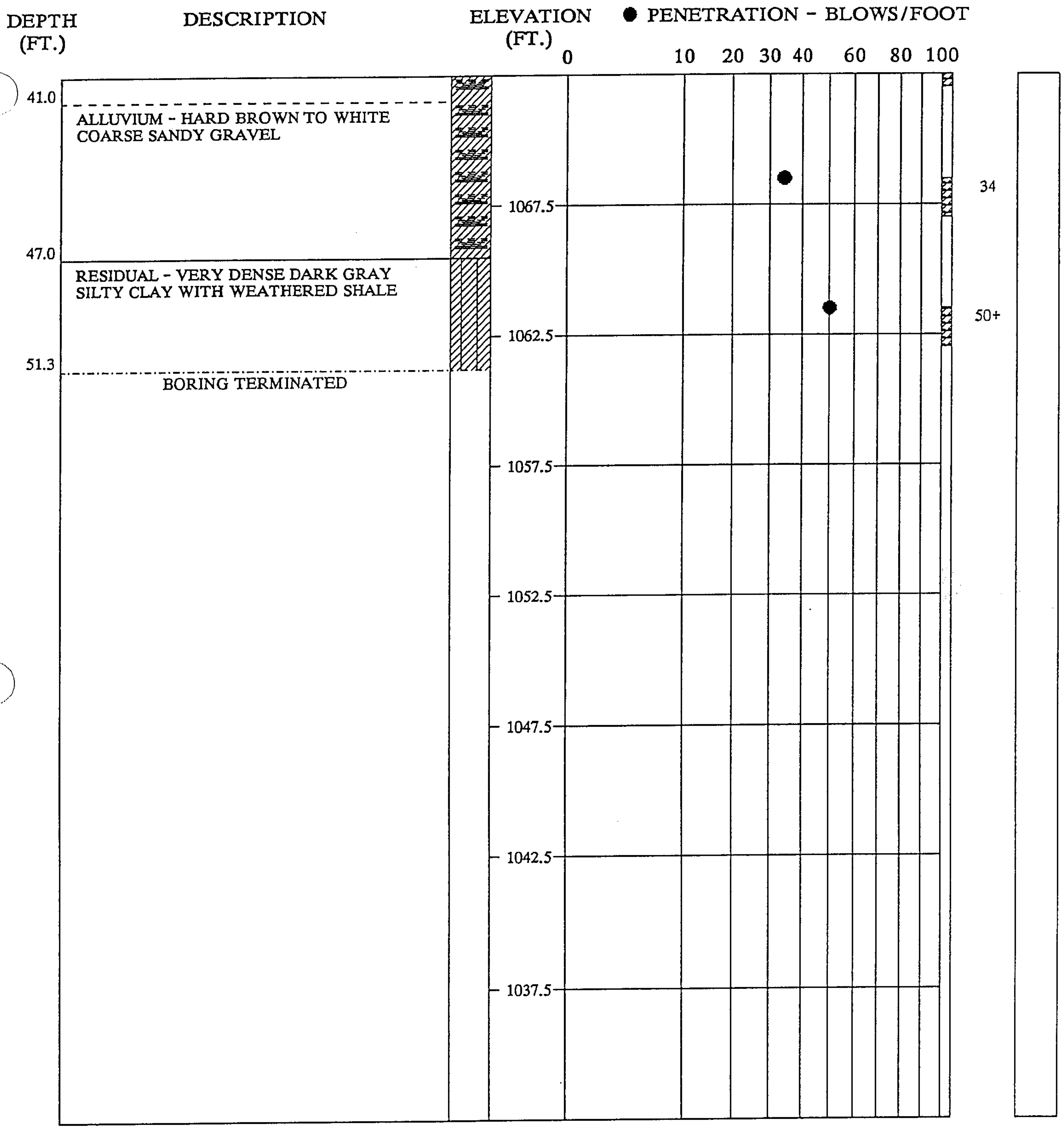
REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER SS-1
DATE DRILLED July 1, 1986
PROJECT NUMBER 57401440.04
PROJECT TVA - JOHN SEVIER S.P.
PAGE 1 OF 2

LAW ENGINEERING



ALLUVIUM - HARD BROWN TO WHITE COARSE SANDY GRAVEL

RESIDUAL - VERY DENSE DARK GRAY SILTY CLAY WITH WEATHERED SHALE

BORING TERMINATED

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

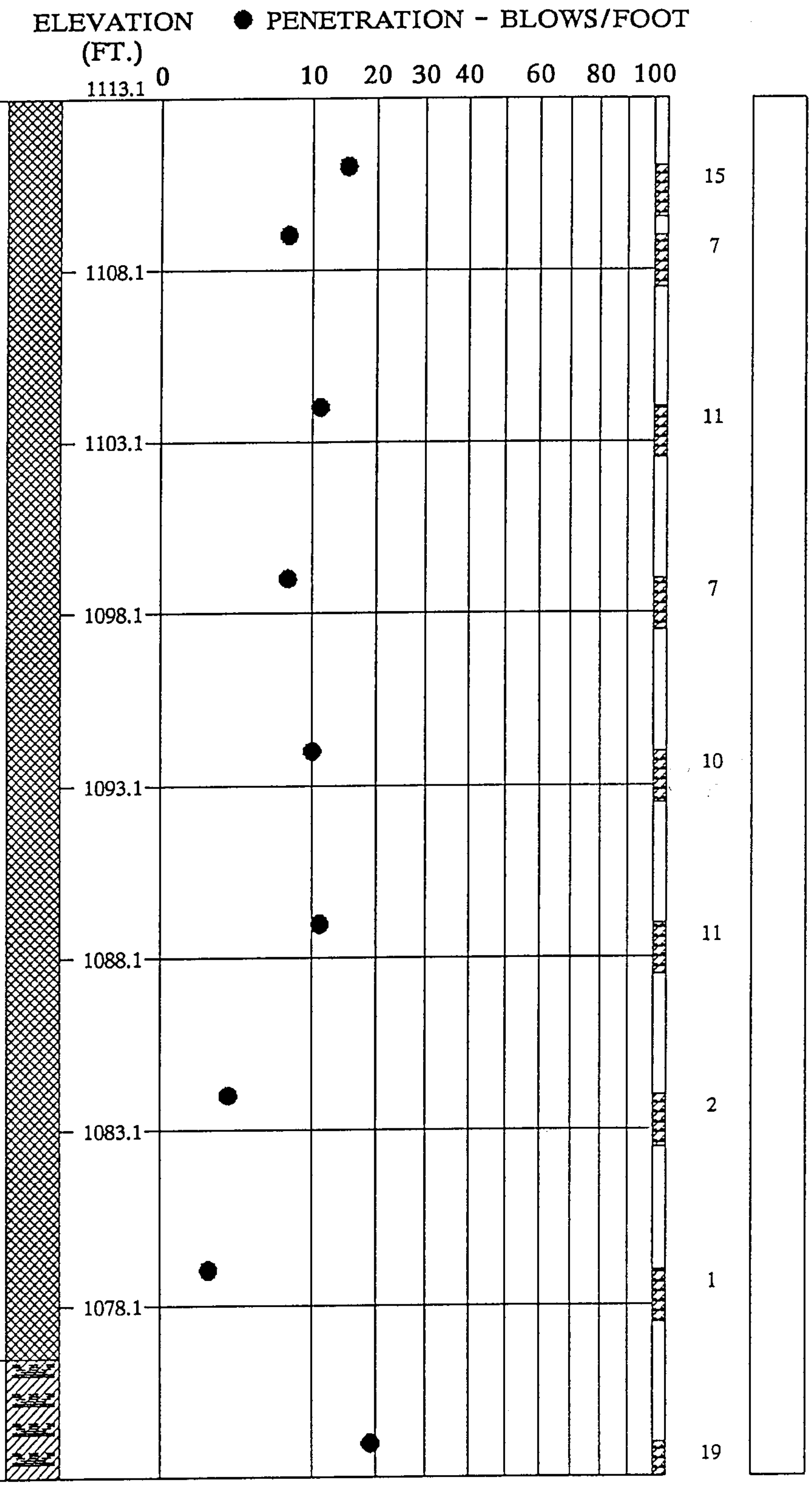
TEST BORING RECORD

BORING NUMBER	SS-1
DATE DRILLED	July 1, 1986
PROJECT NUMBER	57401440.04
PROJECT	TVA - JOHN SEVIER S.P.

PAGE 2 OF 2

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION
0.0	FILL - FIRM TO STIFF LIGHT BROWN TO LIGHT GRAY LAMINATED SILTY CLAY WITH TRACE COAL
11.5	FLY ASH FILL - LOOSE TO MEDIUM DENSE LIGHT GRAY TO DARK GRAY SILTY FINE SAND WITH TRACE LAMINATED CLAY
26.5	FLY ASH FILL - VERY SOFT BLACK TO GRAY FINE SANDY SILT
36.5	ALLUVIUM - FIRM TO VERY STIFF LIGHT BROWN TO DARK BROWN FINE SANDY SILTY CLAY



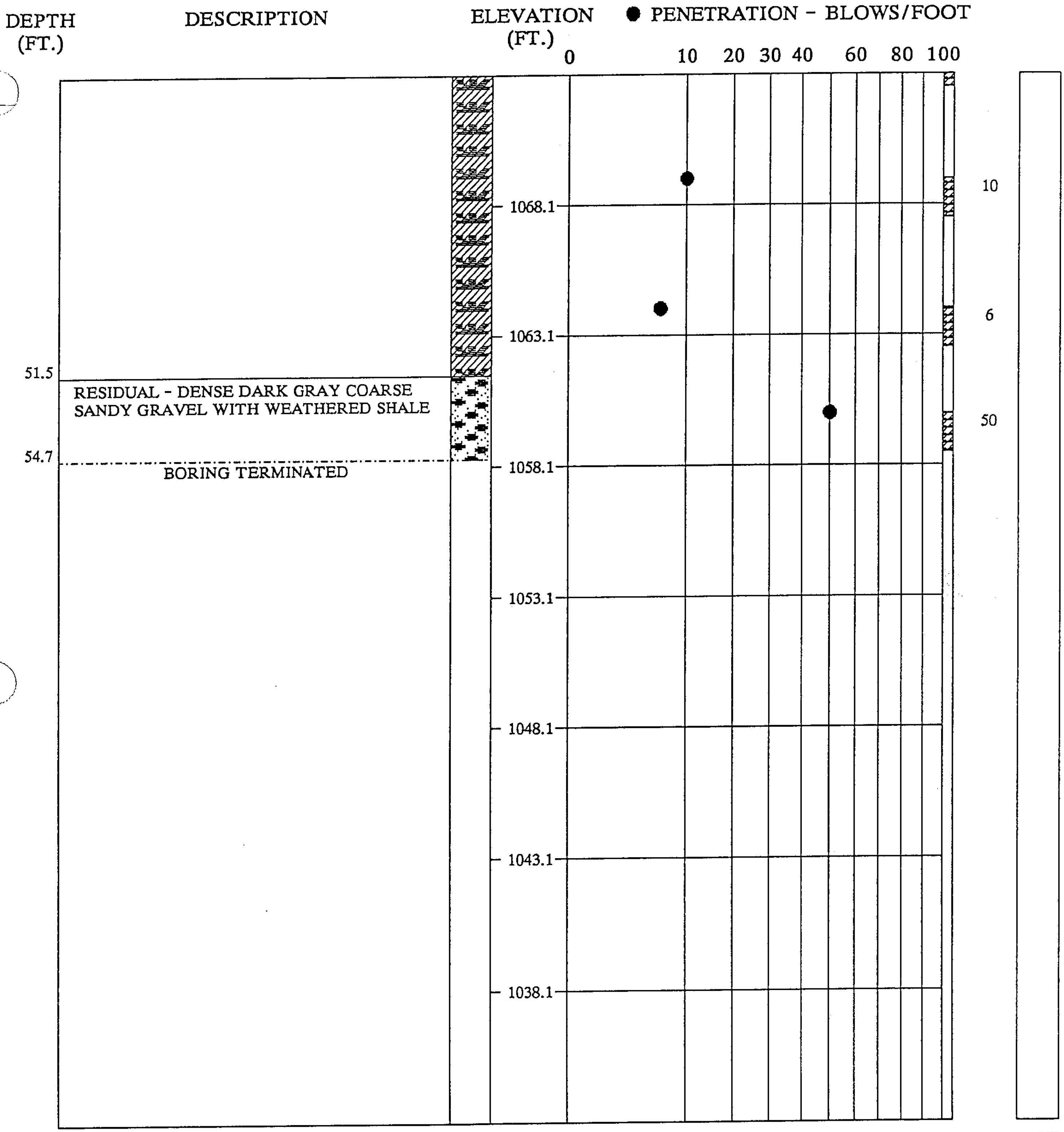
REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER SS-2
DATE DRILLED July 2, 1986
PROJECT NUMBER 57401440.04
PROJECT TVA - JOHN SEVIER S.P.
PAGE 1 OF 2

LAW ENGINEERING



RESIDUAL - DENSE DARK GRAY COARSE SANDY GRAVEL WITH WEATHERED SHALE

BORING TERMINATED

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	SS-2
DATE DRILLED	July 2, 1986
PROJECT NUMBER	57401440.04
PROJECT	TVA - JOHN SEVIER S.P.

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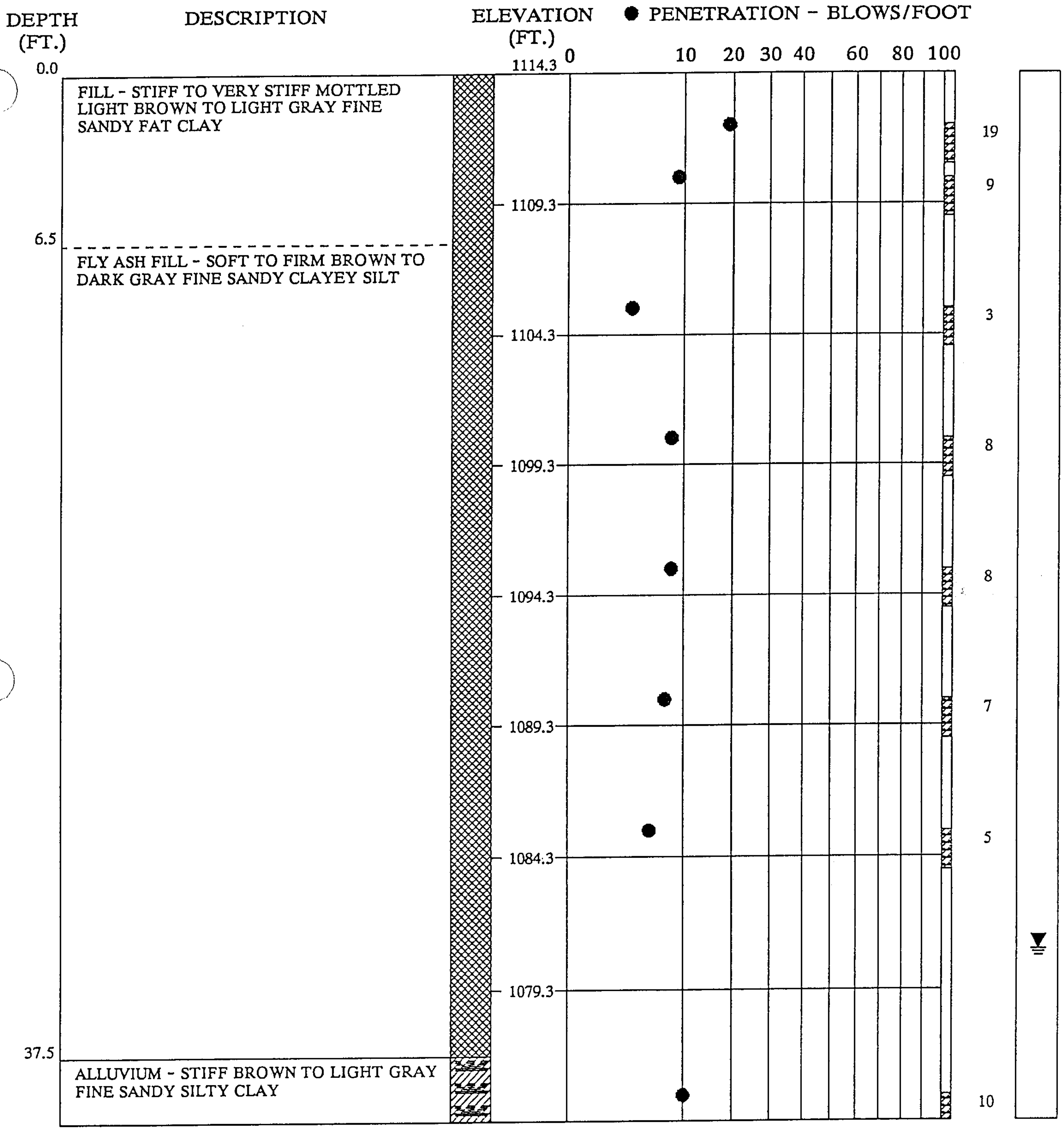
LAW ENGINEERING



FILL - STIFF TO VERY STIFF MOTTLED LIGHT BROWN TO LIGHT GRAY FINE SANDY FAT CLAY

FLY ASH FILL - SOFT TO FIRM BROWN TO DARK GRAY FINE SANDY CLAYEY SILT

ALLUVIUM - STIFF BROWN TO LIGHT GRAY FINE SANDY SILTY CLAY

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	SS-3
DATE DRILLED	July 3, 1986
PROJECT NUMBER	57401440.04
PROJECT	TVA - JOHN SEVIER S.P.

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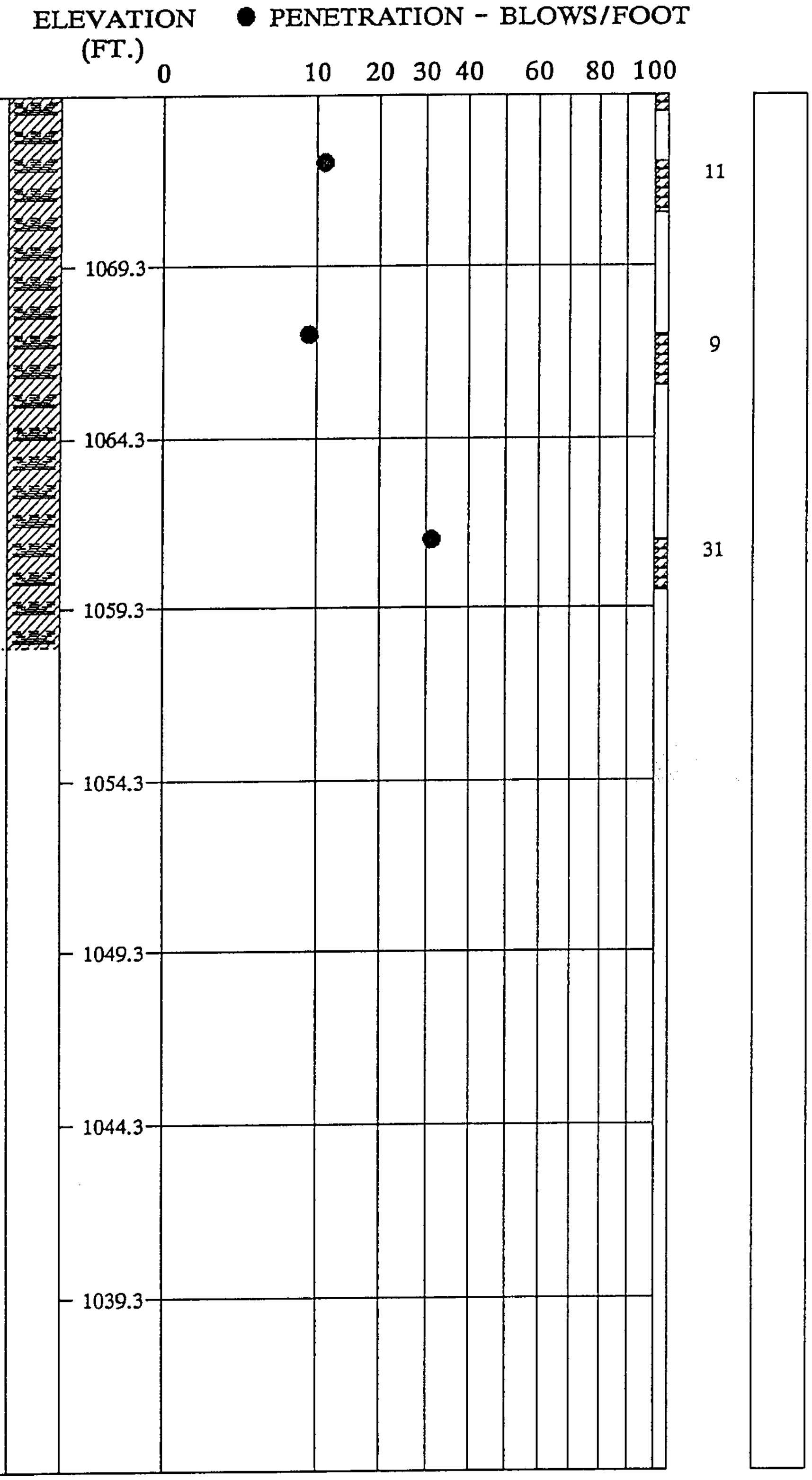
LAW ENGINEERING

DEPTH (FT.)

DESCRIPTION

49.5 ALLUVIUM - DENSE BROWN MEDIUM SANDY GRAVEL, SUBANGULAR QUARTZ AND CHERT

56.1 BORING TERMINATED ON BEDROCK



REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER SS-3
DATE DRILLED July 3, 1986
PROJECT NUMBER 57401440.04
PROJECT TVA - JOHN SEVIER S.P.
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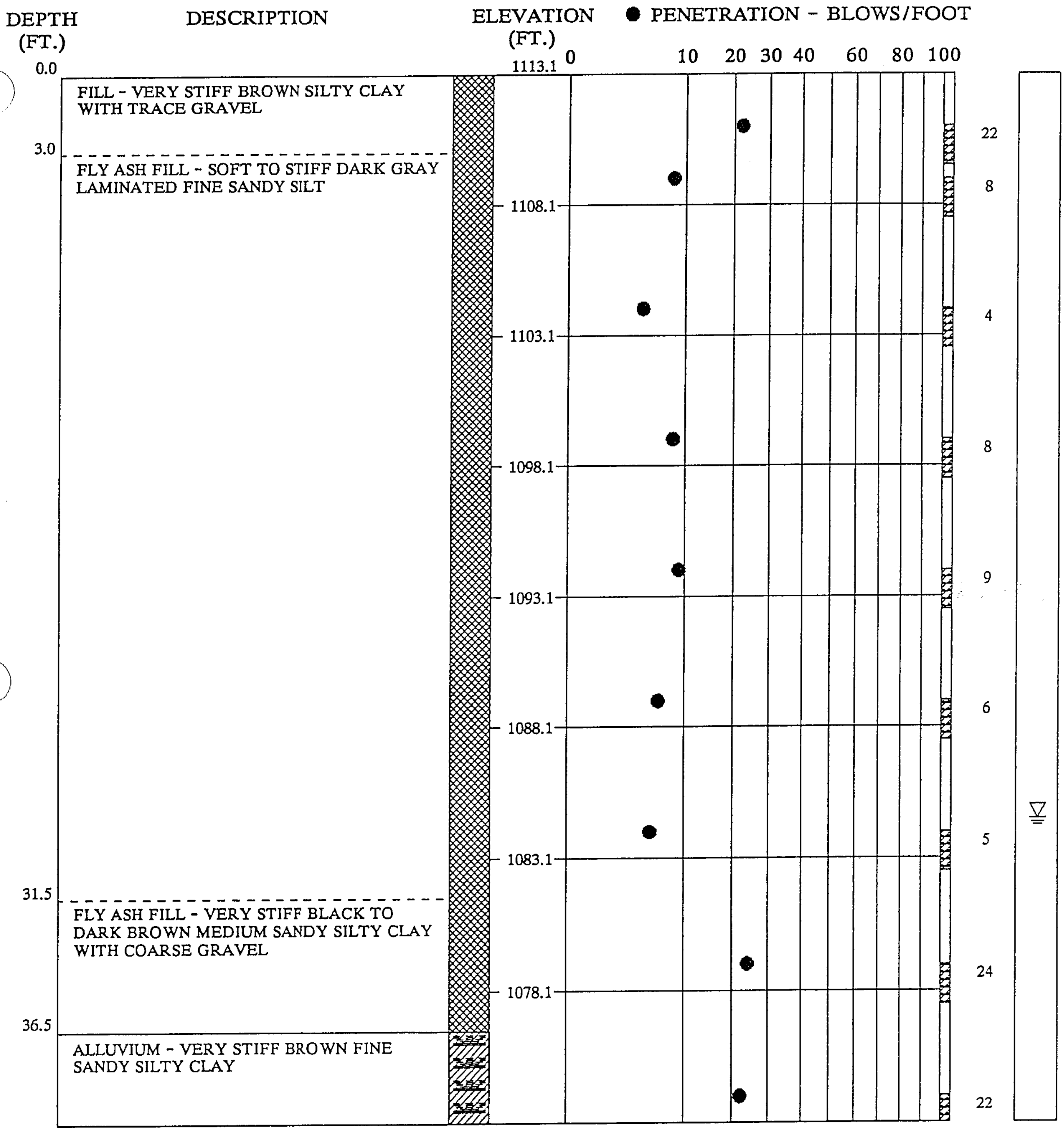
LAW ENGINEERING



0.0 FILL - VERY STIFF BROWN SILTY CLAY WITH TRACE GRAVEL

3.0 FLY ASH FILL - SOFT TO STIFF DARK GRAY LAMINATED FINE SANDY SILT

31.5 FLY ASH FILL - VERY STIFF BLACK TO DARK BROWN MEDIUM SANDY SILTY CLAY WITH COARSE GRAVEL

36.5 ALLUVIUM - VERY STIFF BROWN FINE SANDY SILTY CLAY

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	SS-4
DATE DRILLED	July 3, 1986
PROJECT NUMBER	57401440.04
PROJECT	TVA - JOHN SEVIER S.P.

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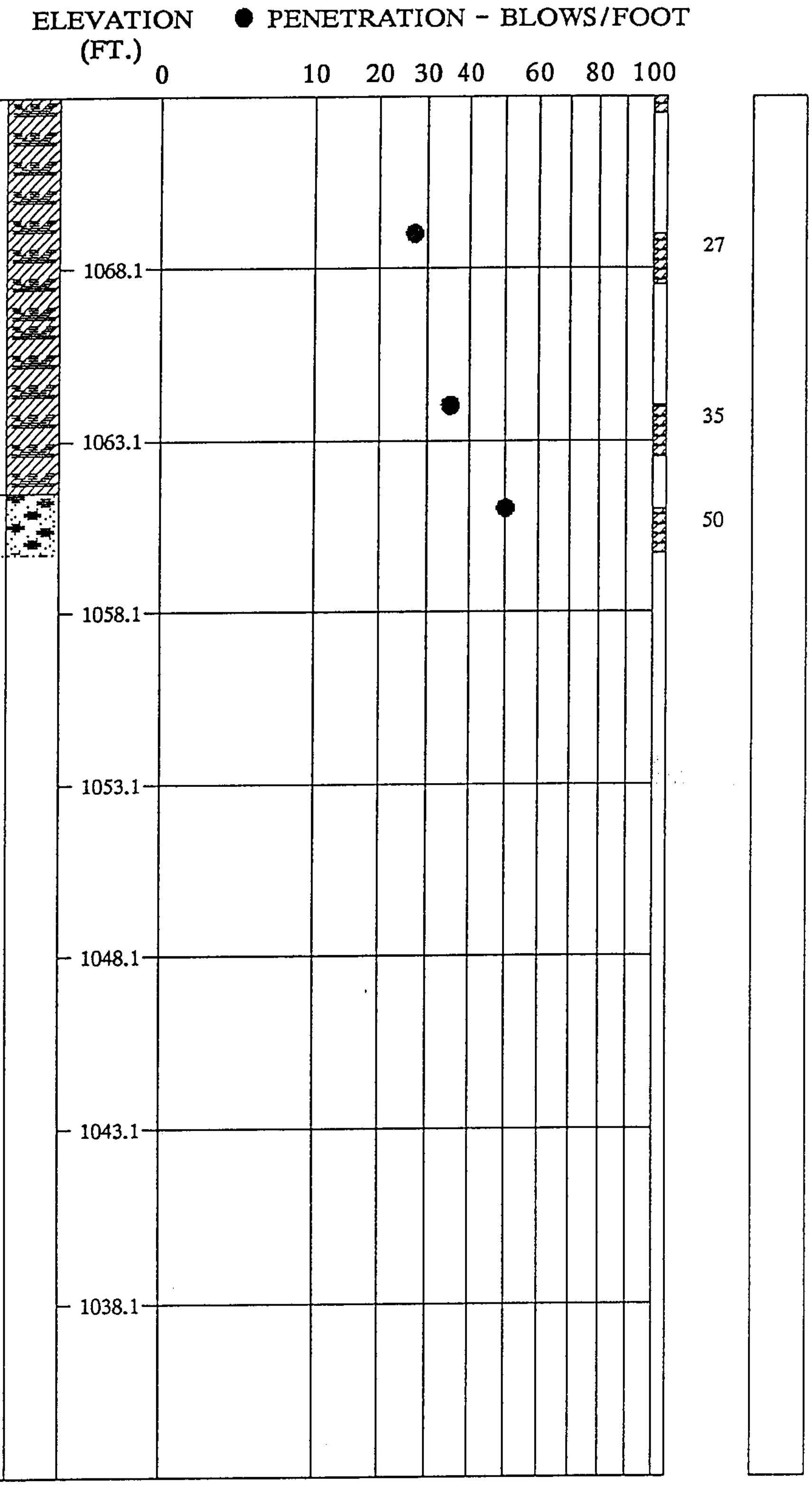
LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION
46.5	ALLUVIUM - DENSE BROWN FINE SAND WITH GRAVEL
51.5	RESIDUAL - DENSE GRAY COARSE SAND WITH GRAVEL
53.3	BORING TERMINATED



REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	SS-4
DATE DRILLED	July 3, 1986
PROJECT NUMBER	57401440.04
PROJECT	TVA - JOHN SEVIER S.P.
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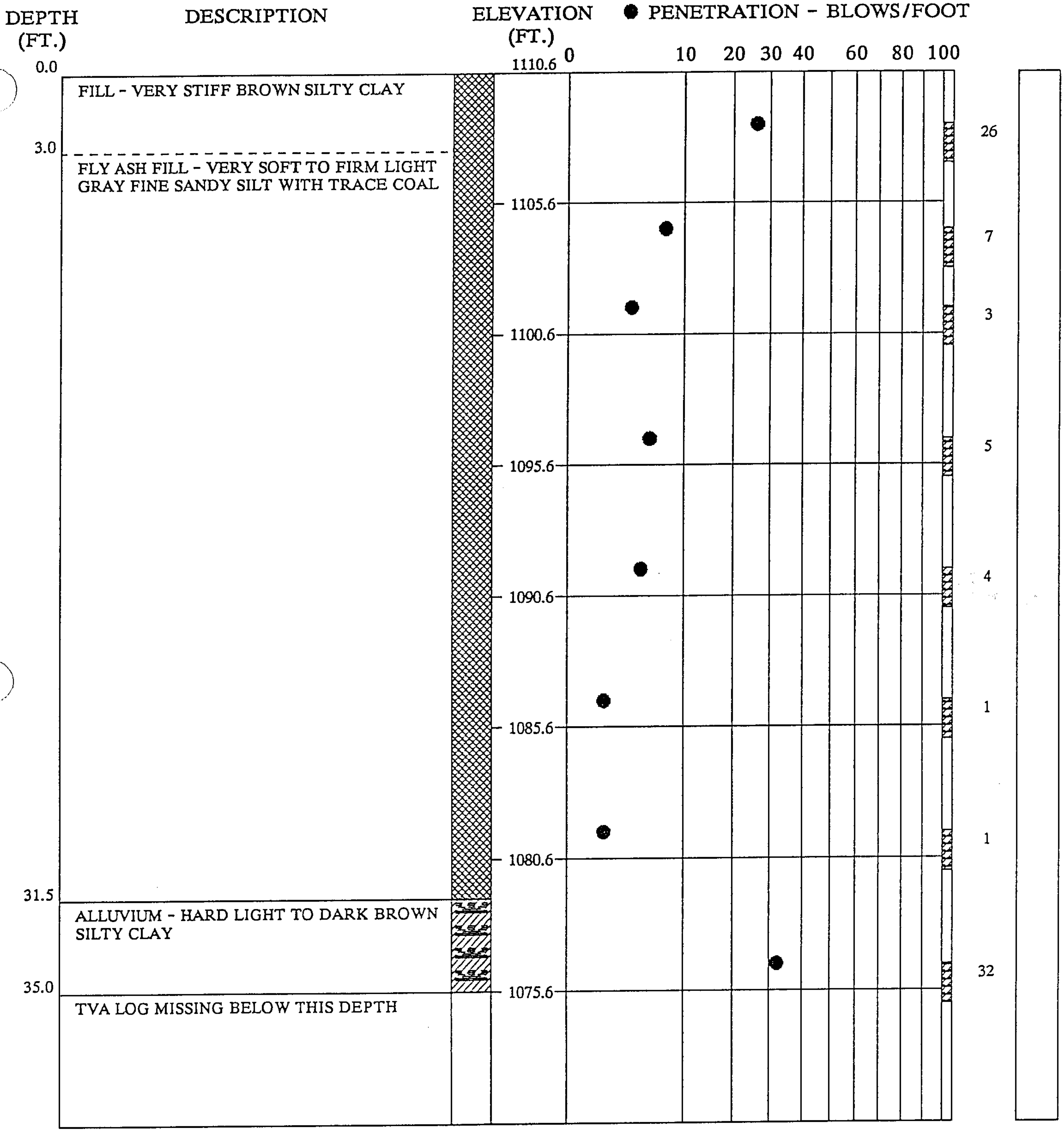
LAW ENGINEERING



0.0

FILL - VERY STIFF BROWN SILTY CLAY

3.0

FLY ASH FILL - VERY SOFT TO FIRM LIGHT GRAY FINE SANDY SILT WITH TRACE COAL

31.5

ALLUVIUM - HARD LIGHT TO DARK BROWN SILTY CLAY

35.0

TVA LOG MISSING BELOW THIS DEPTH

REMARKS:

SECOND PAGE MISSING FROM TVA LOG

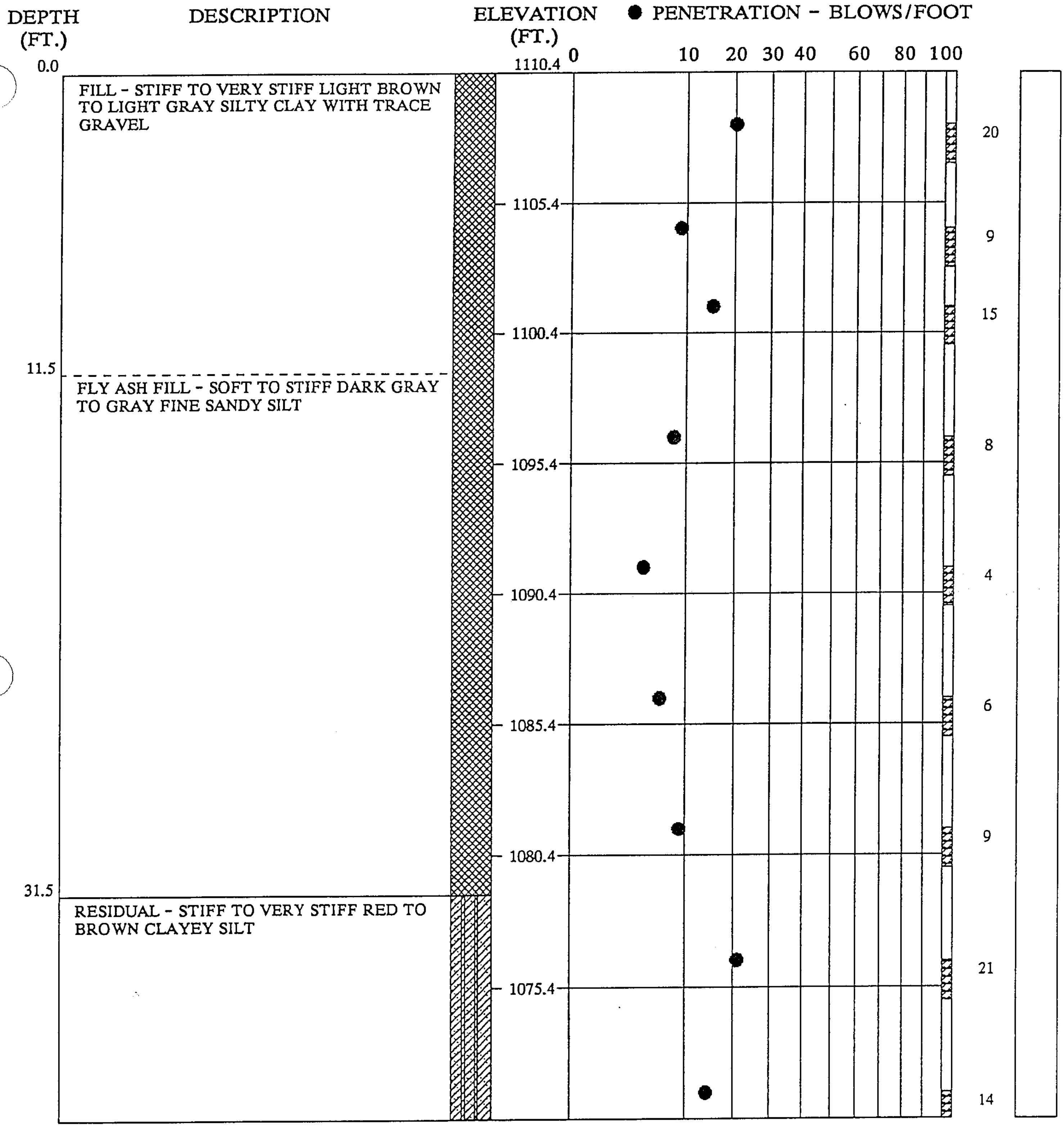
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	SS-5
DATE DRILLED	July 7, 1986
PROJECT NUMBER	57401440.04
PROJECT	TVA - JOHN SEVIER S.P.

PAGE 1 OF 1

LAW ENGINEERING



FILL - STIFF TO VERY STIFF LIGHT BROWN TO LIGHT GRAY SILTY CLAY WITH TRACE GRAVEL

FLY ASH FILL - SOFT TO STIFF DARK GRAY TO GRAY FINE SANDY SILT

RESIDUAL - STIFF TO VERY STIFF RED TO BROWN CLAYEY SILT

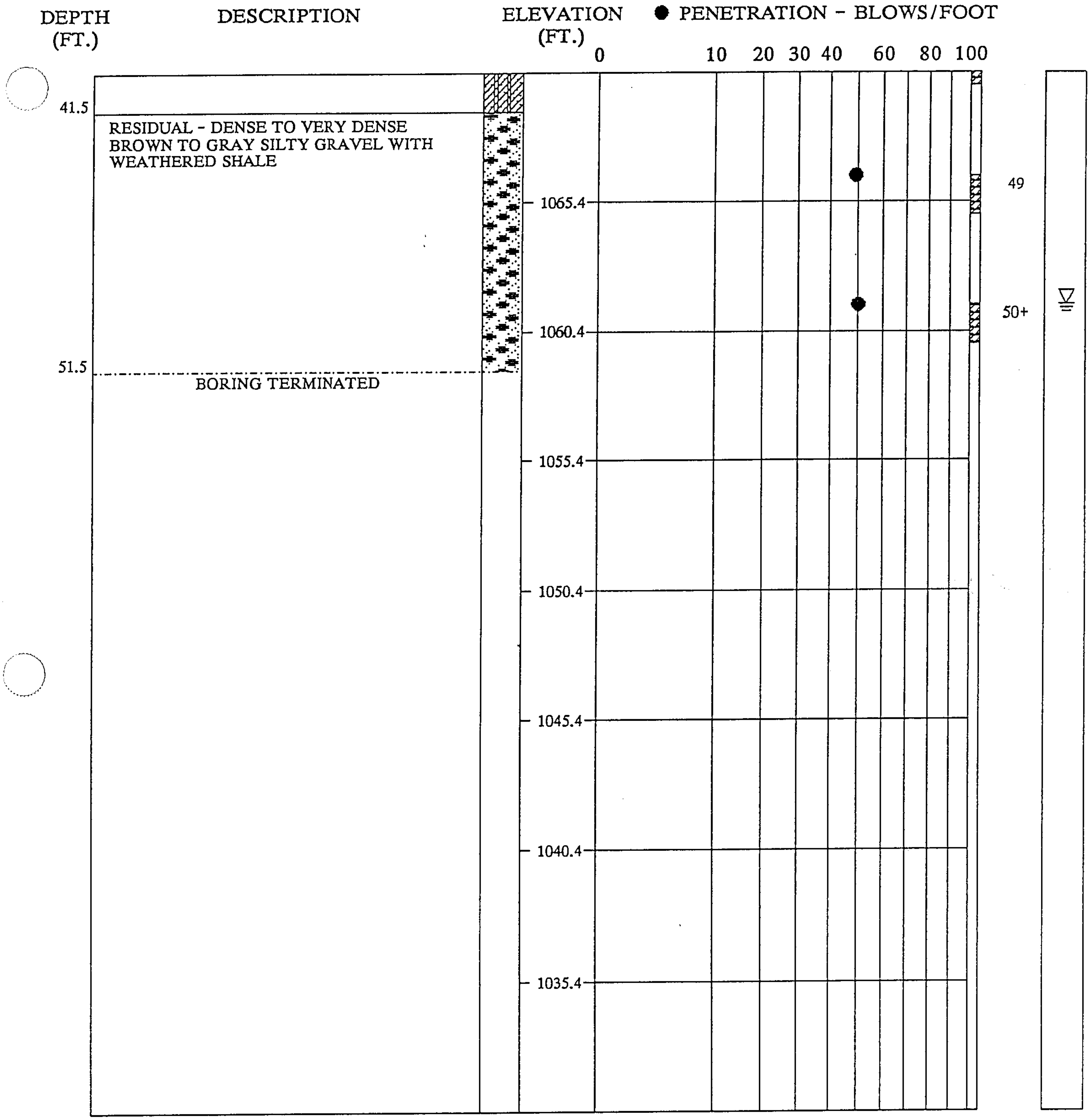
REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER SS-6
DATE DRILLED July 7, 1986
PROJECT NUMBER 57401440.04
PROJECT TVA - JOHN SEVIER S.P.
PAGE 1 OF 2

LAW ENGINEERING



RESIDUAL - DENSE TO VERY DENSE BROWN TO GRAY SILTY GRAVEL WITH WEATHERED SHALE

BORING TERMINATED

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER SS-6
DATE DRILLED July 7, 1986
PROJECT NUMBER 57401440.04
PROJECT TVA - JOHN SEVIER S.P.
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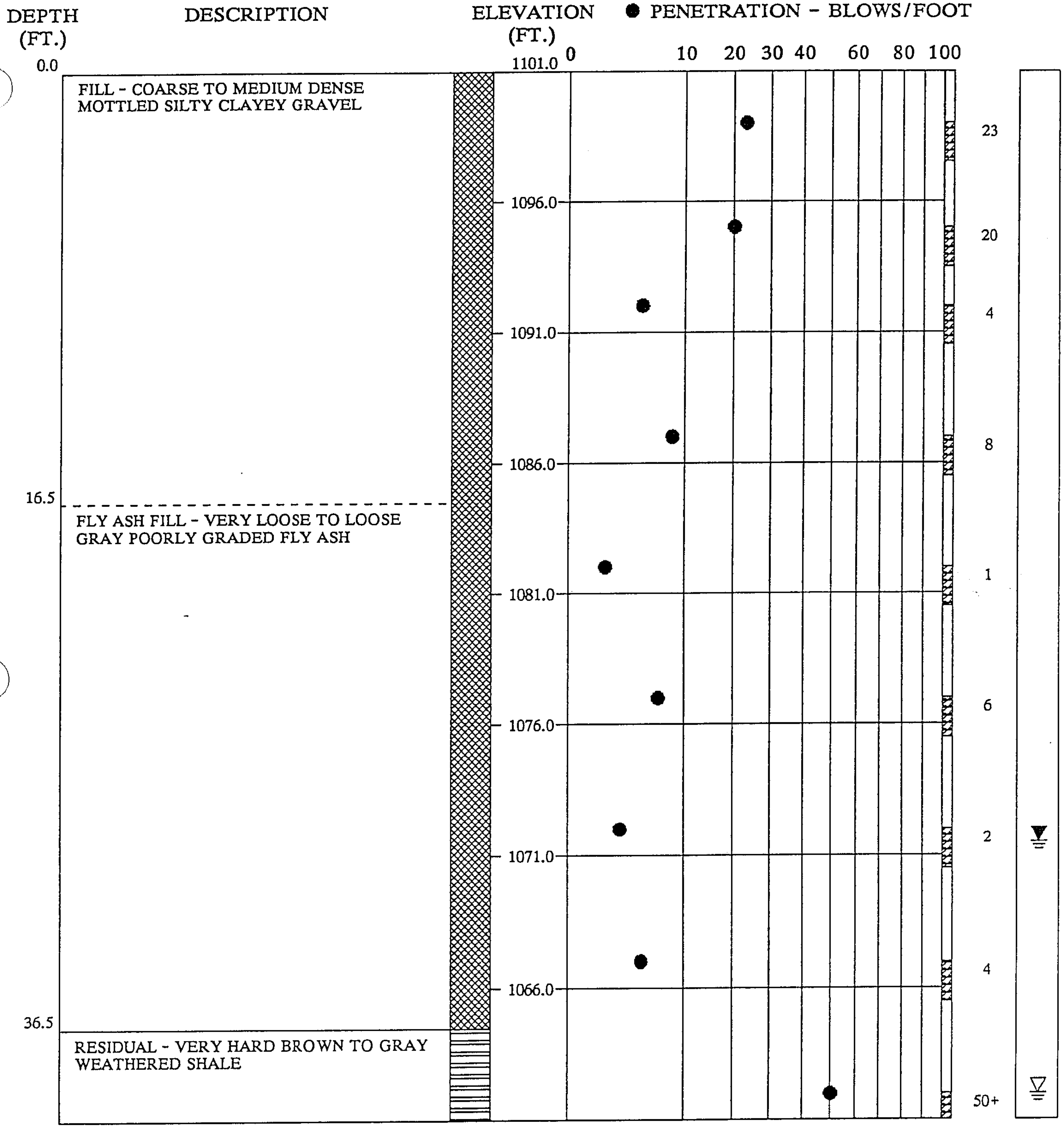
LAW ENGINEERING



REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

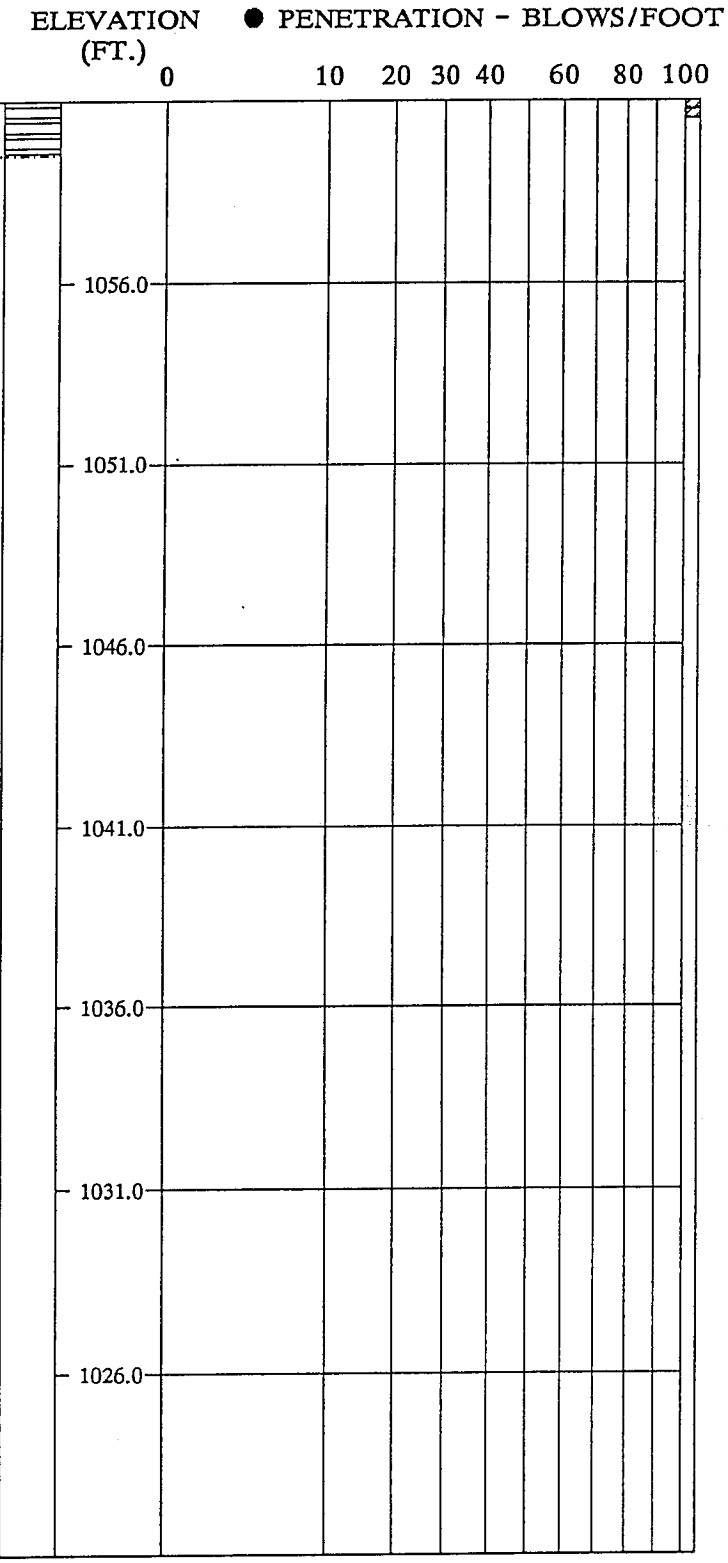
TEST BORING RECORD

BORING NUMBER	SS-7
DATE DRILLED	July 8, 1986
PROJECT NUMBER	57401440.04
PROJECT	TVA - JOHN SEVIER S.P.
PAGE 1 OF 2	

LAW ENGINEERING

DEPTH (FT.) | DESCRIPTION

41.5 BORING TERMINATED



REMARKS:

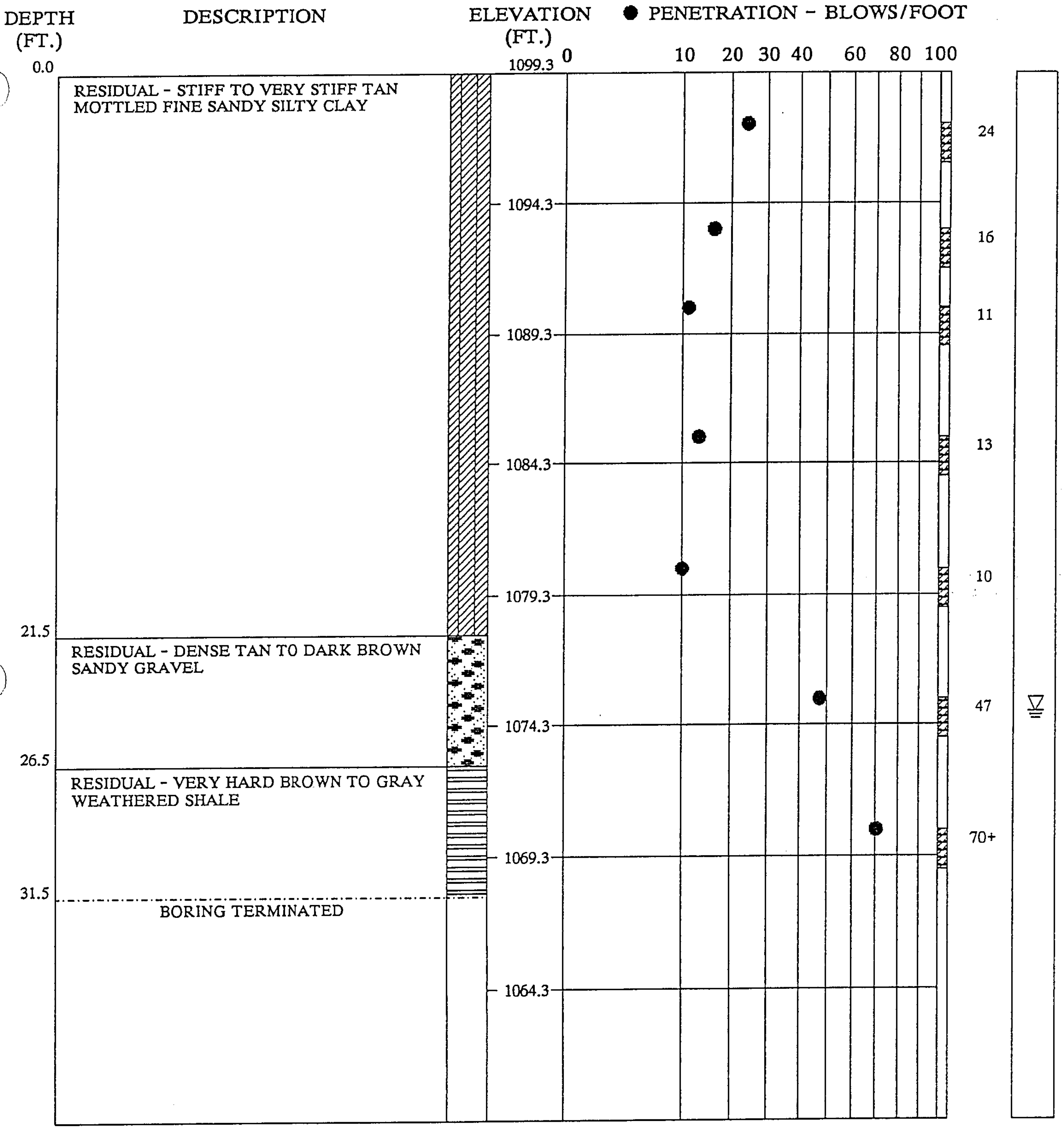
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	SS-7
DATE DRILLED	July 8, 1986
PROJECT NUMBER	57401440.04
PROJECT	TVA - JOHN SEVIER S.P.

PAGE 2 OF 2

LAW ENGINEERING



REMARKS:

SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	SS-8
DATE DRILLED	July 9, 1986
PROJECT NUMBER	57401440.04
PROJECT	TVA - JOHN SEVIER S.P.

PAGE 1 OF 1

LAW ENGINEERING

DEPTH (FT.)

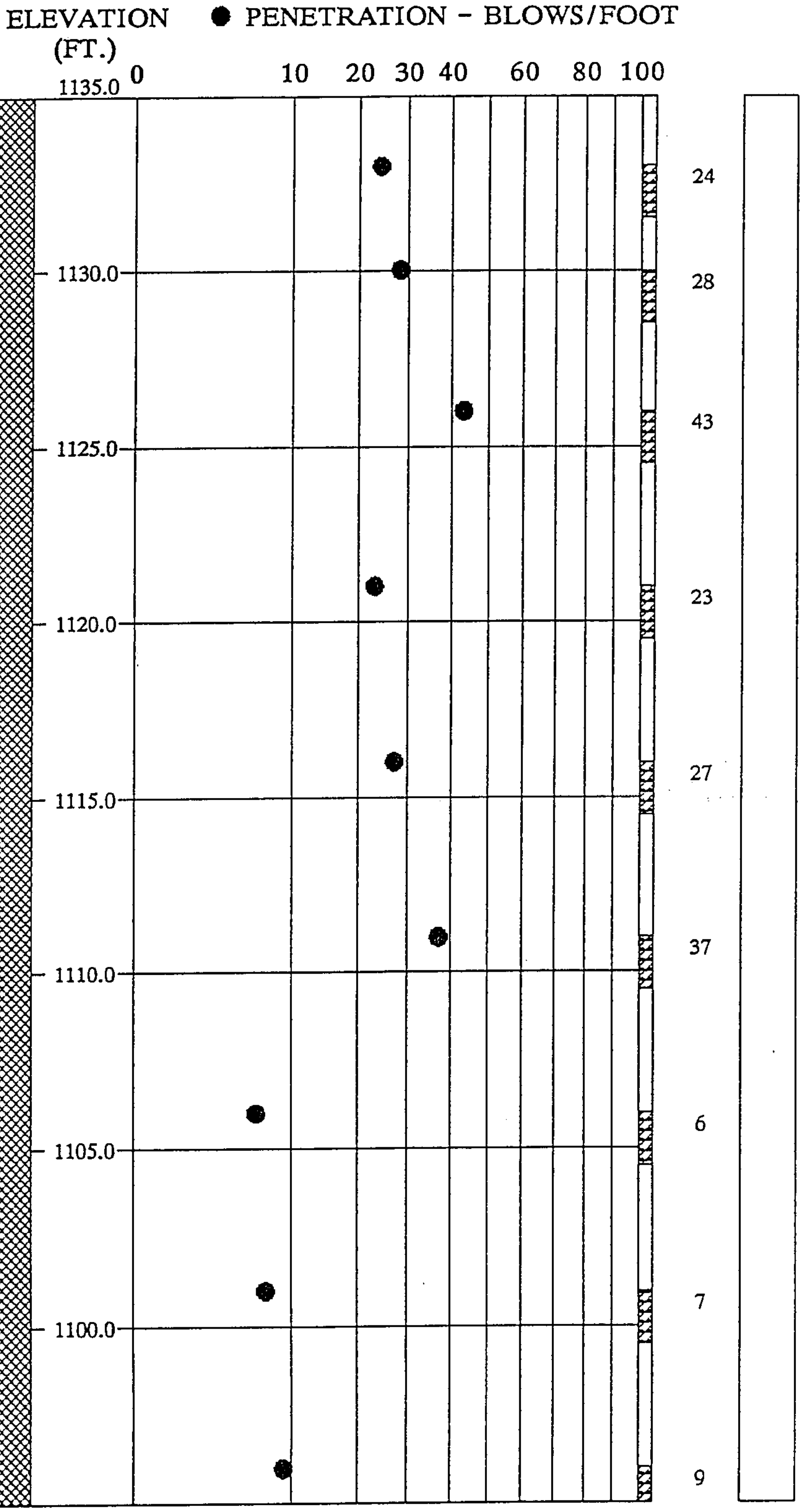
DESCRIPTION

0.0

FLY ASH FILL - MEDIUM DENSE TO DENSE GRAY FLY ASH

26.5

FLY ASH & BOTTOM ASH FILL - LOOSE TO VERY LOOSE GRAY FLY ASH & BOTTOM ASH



REMARKS:

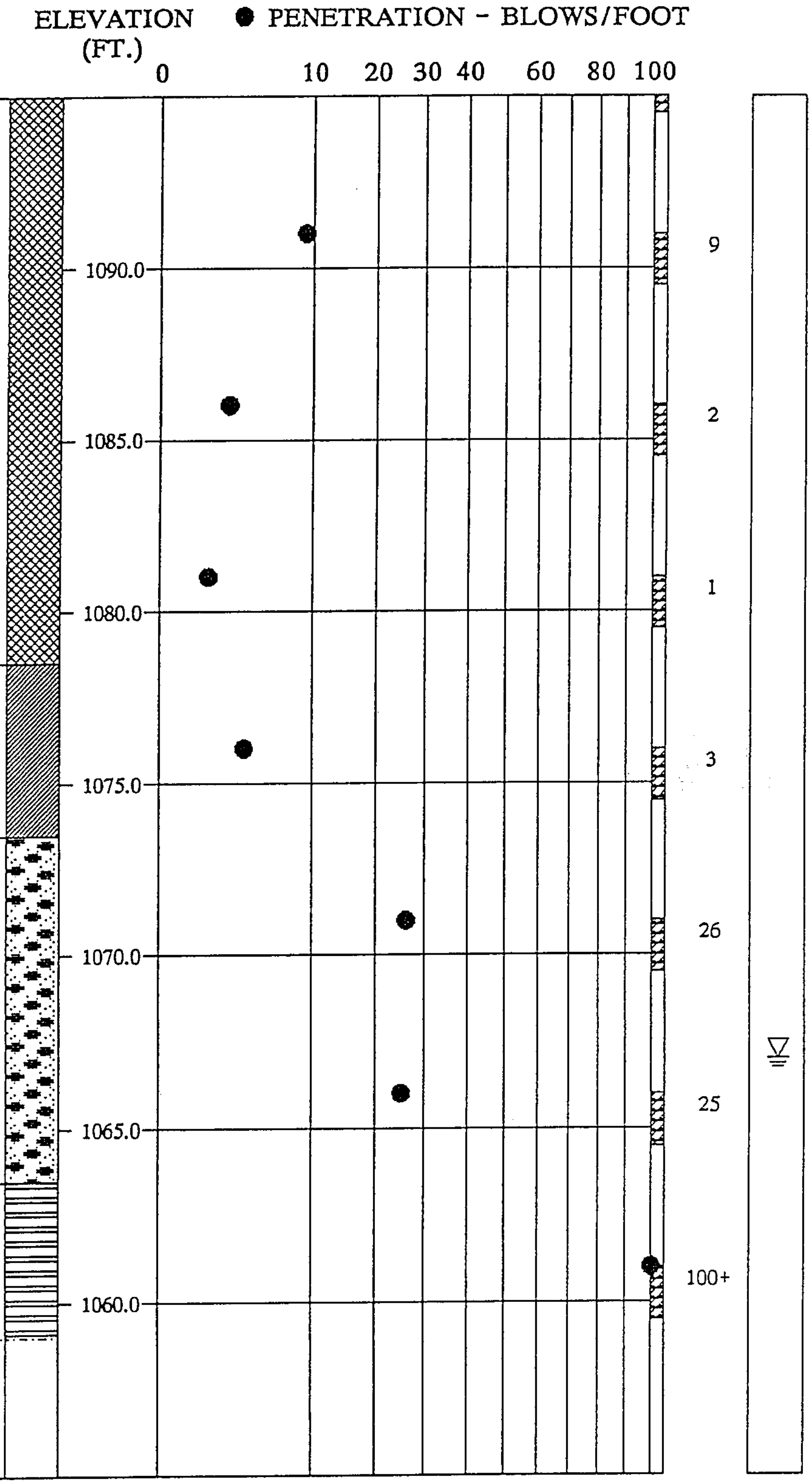
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER SS-9
DATE DRILLED July 9, 1986
PROJECT NUMBER 57401440.04
PROJECT TVA - JOHN SEVIER S.P.
PAGE 1 OF 2

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION
56.5	RESIDUAL - SOFT TAN SANDY CLAY
61.5	RESIDUAL - MEDIUM DENSE BROWN SANDY GRAVEL
71.5	RESIDUAL - VERY HARD DARK BROWN WEATHERED SHALE
76.0	BORING TERMINATED



REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER SS-9
DATE DRILLED July 9, 1986
PROJECT NUMBER 57401440.04
PROJECT TVA - JOHN SEVIER S.P.
PAGE 2 OF 2

LAW ENGINEERING

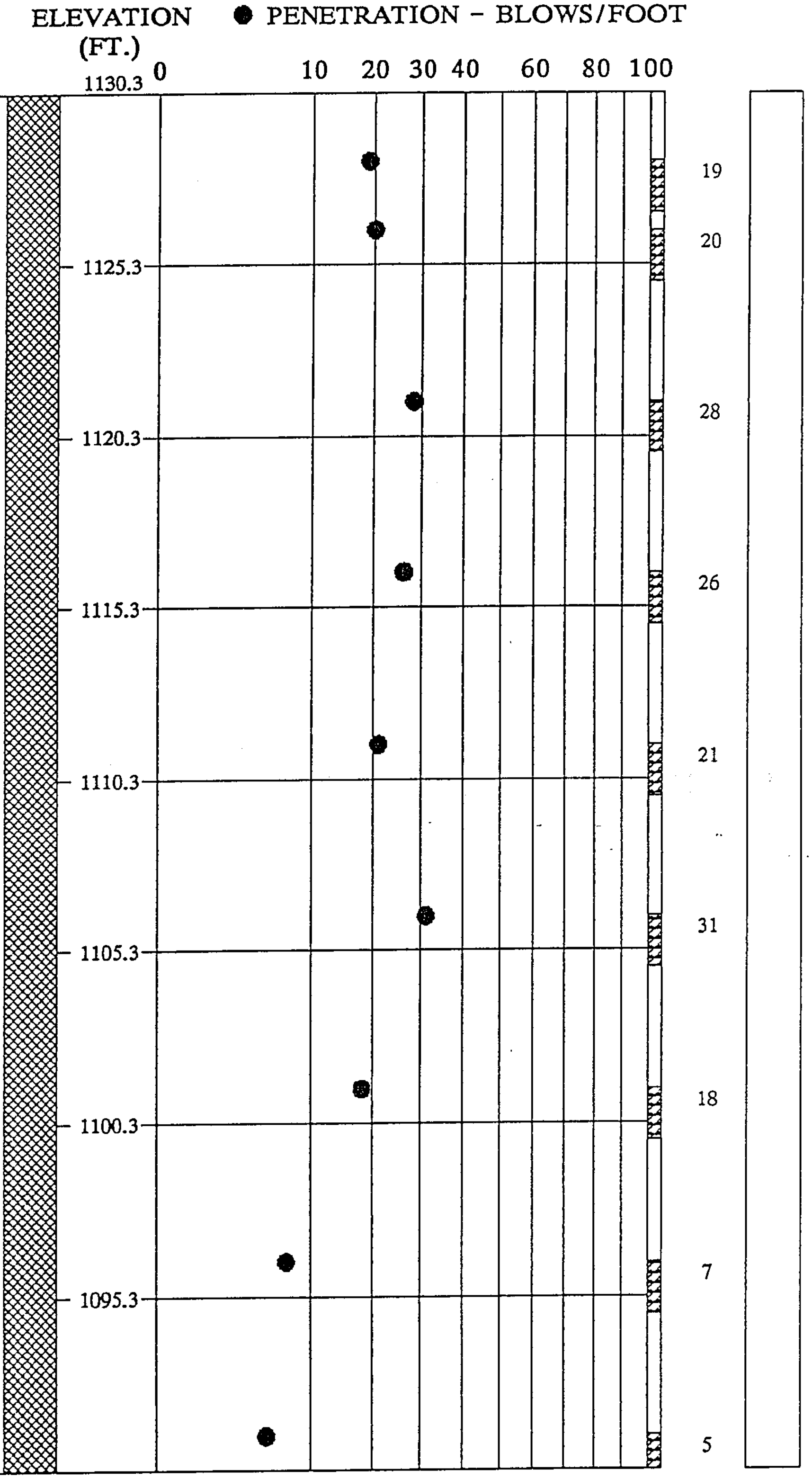
DEPTH (FT.) | DESCRIPTION

0.0

FLY ASH FILL - MEDIUM DENSE TO DENSE GRAY FINE FLY ASH

31.5

FLY ASH FILL - LOOSE TO VERY LOOSE GRAY FINE FLY ASH



REMARKS:

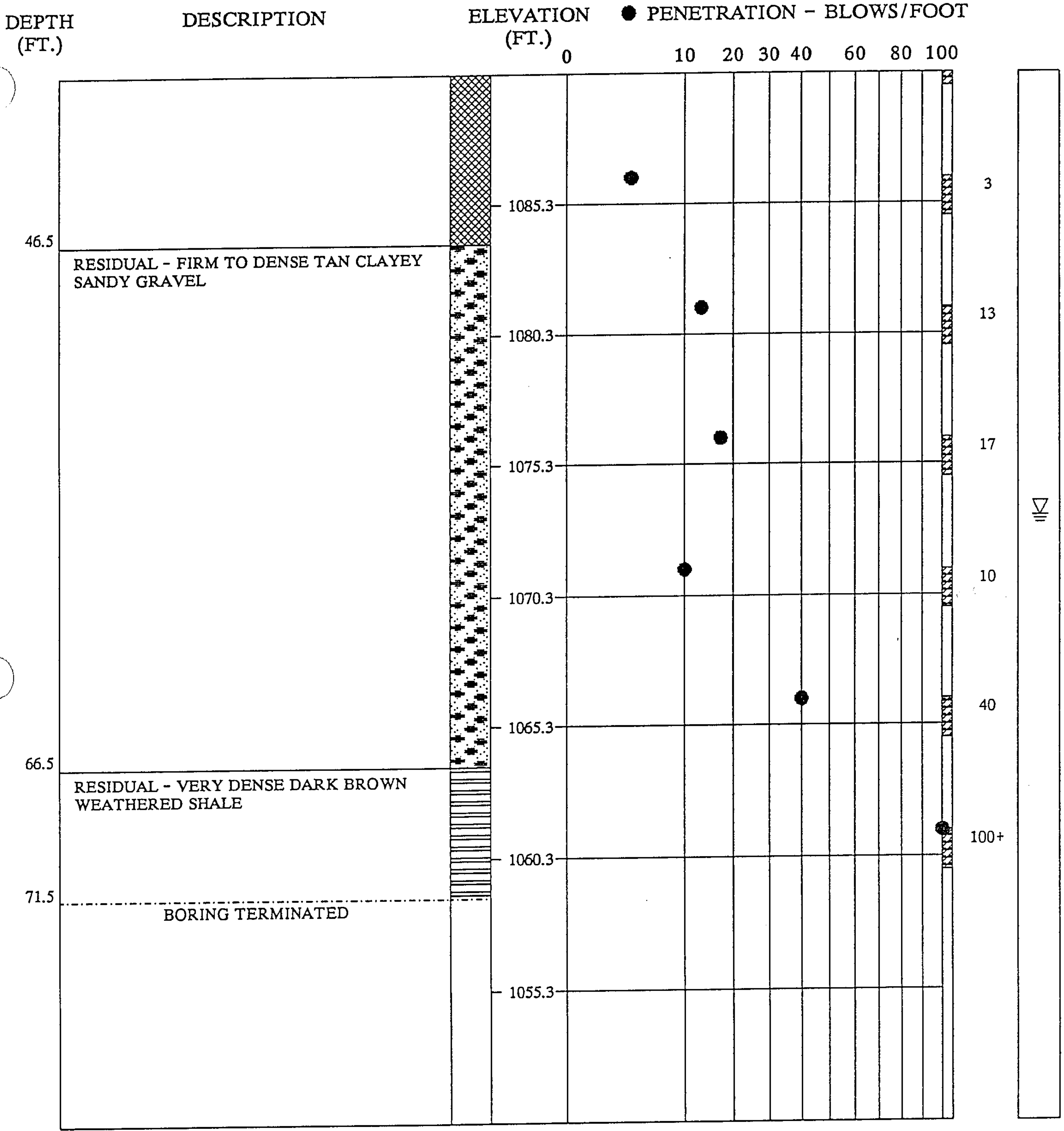
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	SS-10
DATE DRILLED	July 10, 1986
PROJECT NUMBER	57401440.04
PROJECT	TVA - JOHN SEVIER S.P.

PAGE 1 OF 2

LAW ENGINEERING



46.5 RESIDUAL - FIRM TO DENSE TAN CLAYEY SANDY GRAVEL

66.5 RESIDUAL - VERY DENSE DARK BROWN WEATHERED SHALE

71.5 BORING TERMINATED

REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER SS-10
DATE DRILLED July 10, 1986
PROJECT NUMBER 57401440.04
PROJECT TVA - JOHN SEVIER S.P.
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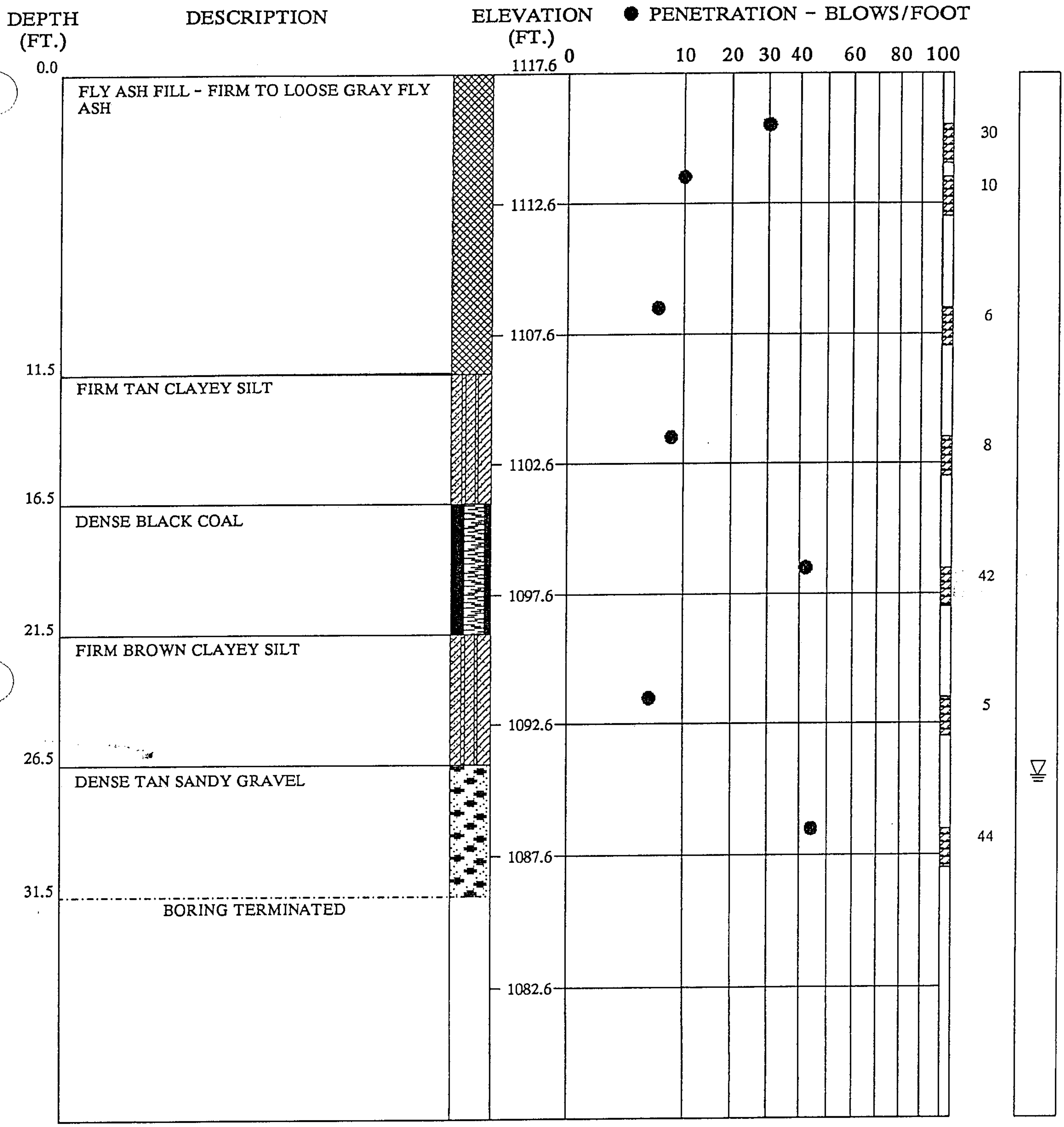
LAW ENGINEERING



REMARKS:

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

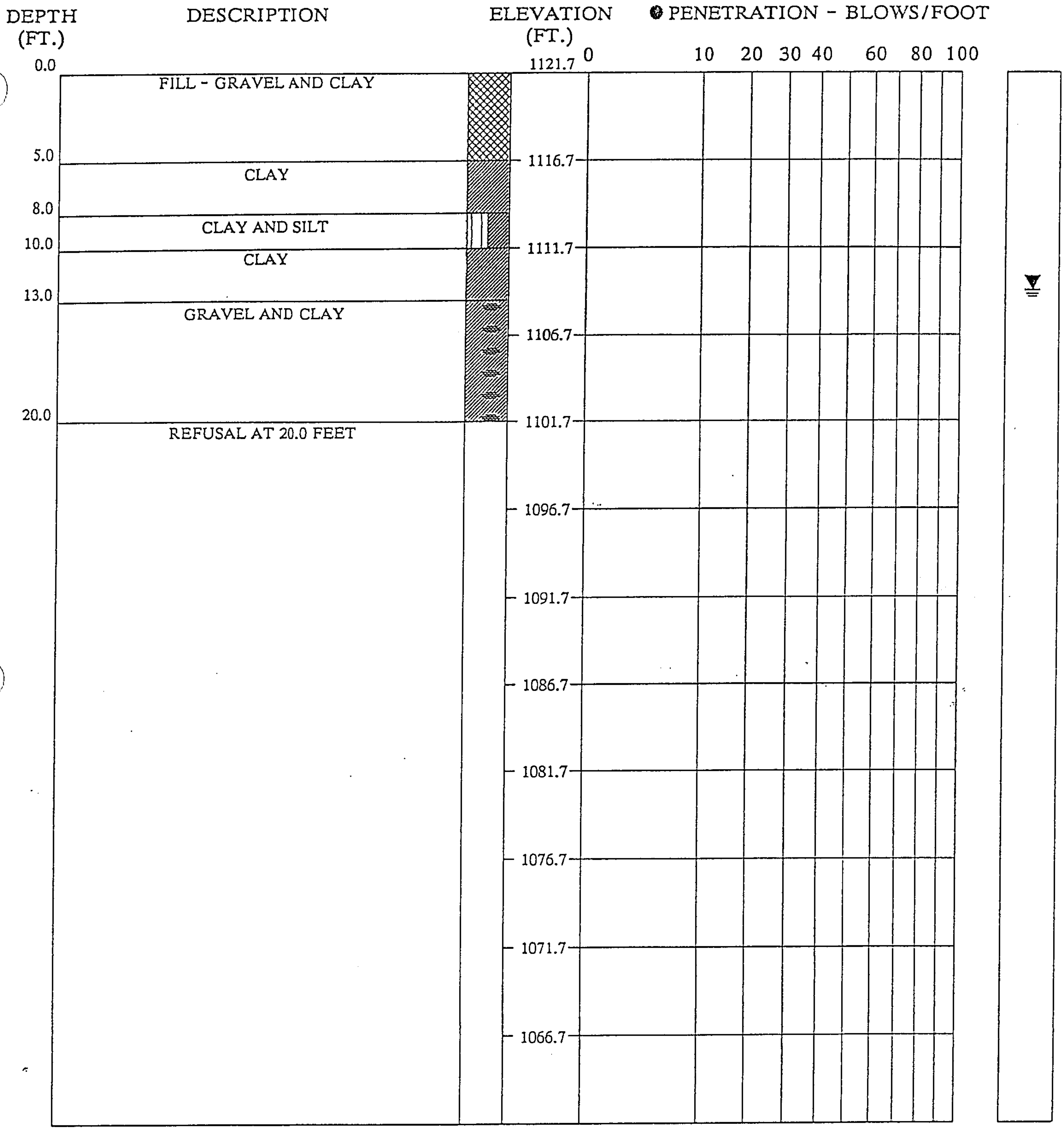
TEST BORING RECORD

BORING NUMBER	SS-11
DATE DRILLED	July 11, 1986
PROJECT NUMBER	57401440.04
PROJECT	TVA - JOHN SEVIER S.P.
PAGE 1 OF 1	

LAW ENGINEERING

BORING LOGS PZ-1 THROUGH PZ-5

Drilled in October/November 1986



REMARKS:
GROUNDWATER MEASURED ON 6-13-91.

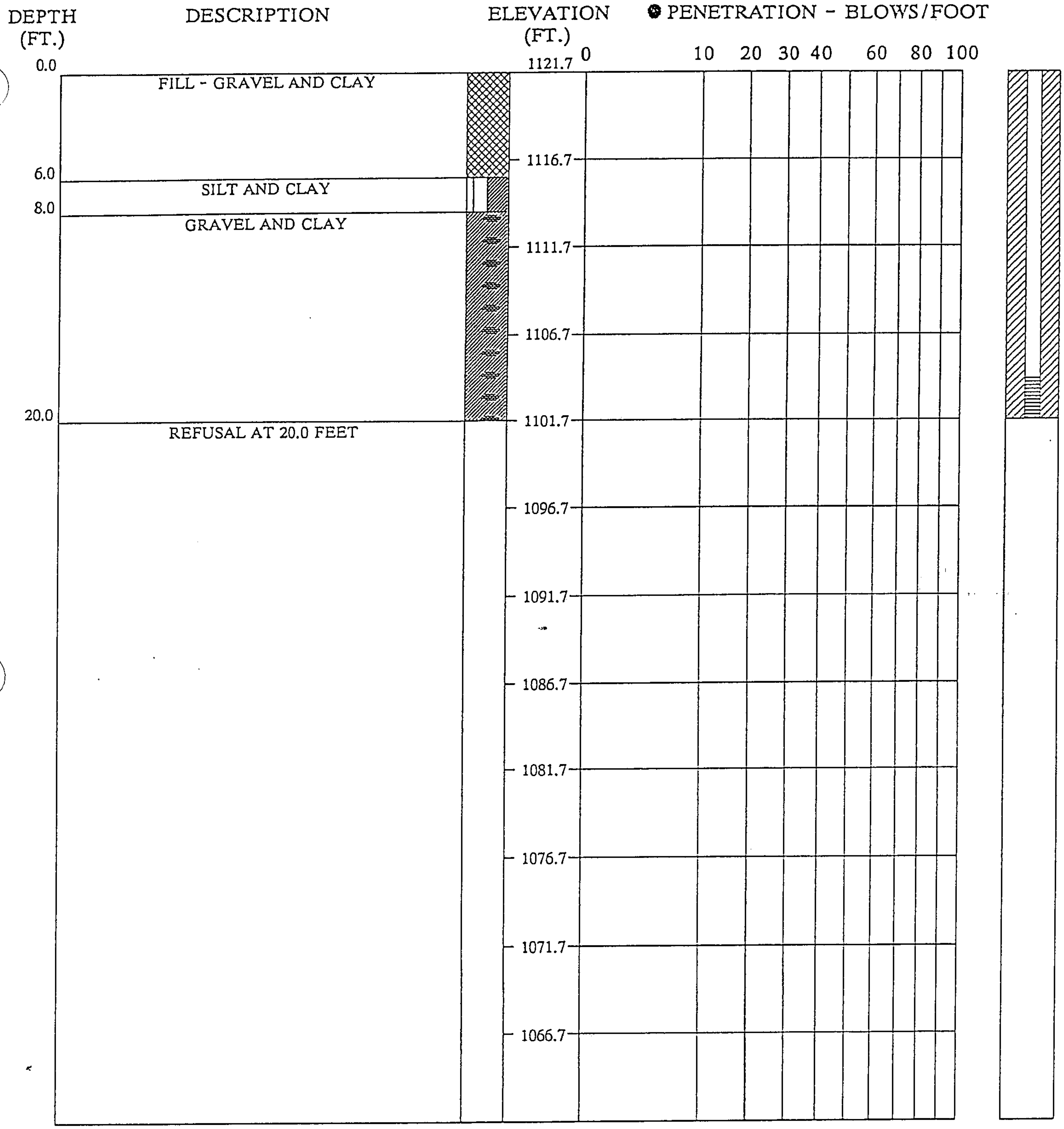
SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVATIONS USED ABOVE

AUGER BORING RECORD

BORING NUMBER	PZ-1
DATE DRILLED	November 5, 1986
PROJECT NUMBER	57401440.01
PROJECT	JOHN SEVIER FOSSIL PLANT

PAGE 1 OF 1

LAW ENGINEERING



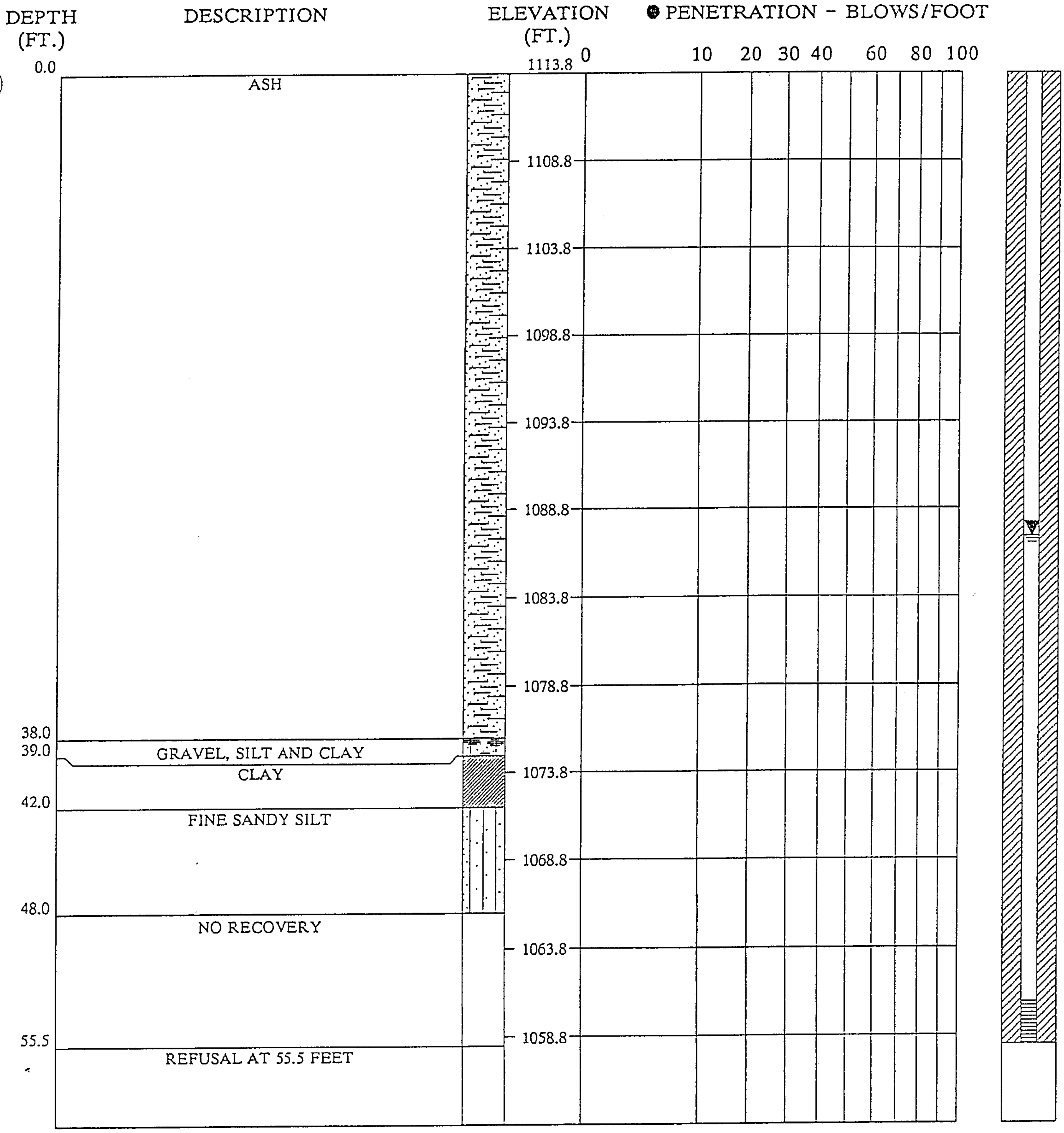
REMARKS:

SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVATIONS USED ABOVE

AUGER BORING RECORD

BORING NUMBER	PZ-1B
DATE DRILLED	November 5, 1986
PROJECT NUMBER	57401440.01
PROJECT	JOHN SEVIER FOSSIL PLANT
PAGE 1 OF 1	

LAW ENGINEERING



REMARKS:
GROUNDWATER MEASURED ON 6-13-91.

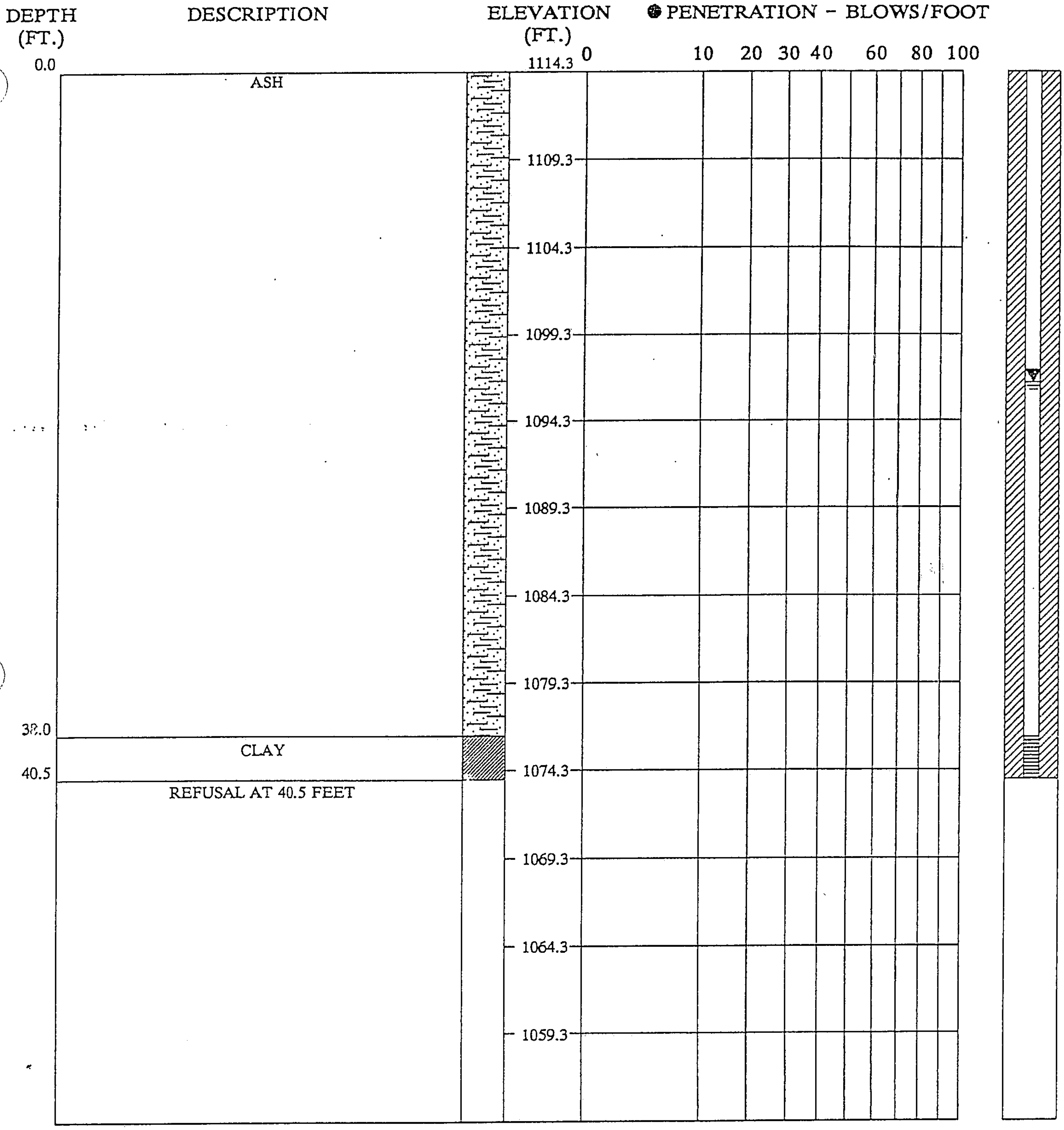
SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVATIONS USED ABOVE

AUGER BORING RECORD

BORING NUMBER	PZ-2A
DATE DRILLED	November 3, 1986
PROJECT NUMBER	57401440.01
PROJECT	JOHN SEVIER FOSSIL PLANT

PAGE 1 OF 1

LAW ENGINEERING



REMARKS:

GROUNDWATER MEASURED ON 6-13-91.

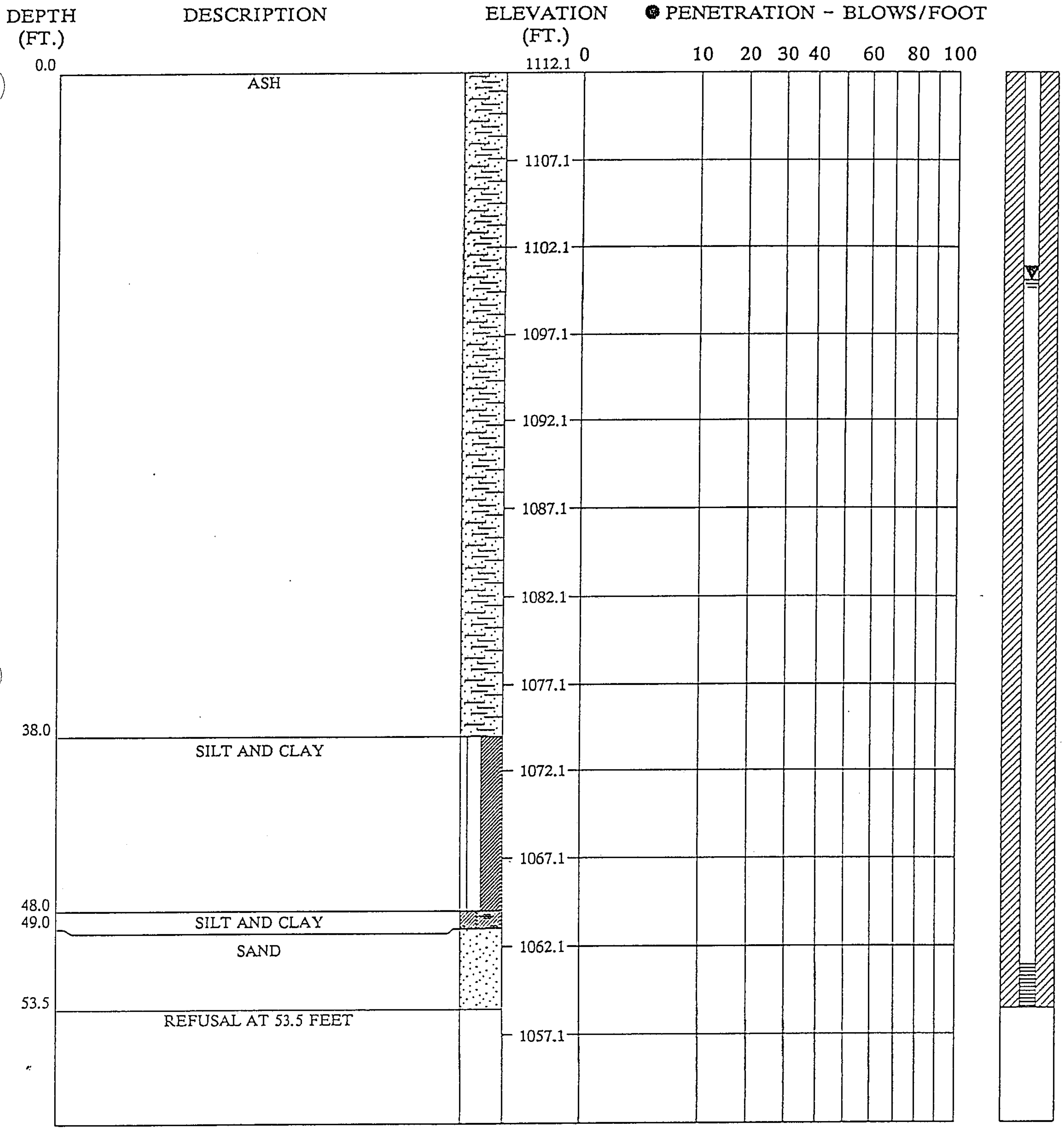
SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVATIONS USED ABOVE

AUGER BORING RECORD

BORING NUMBER	PZ-2B
DATE DRILLED	November 3, 1986
PROJECT NUMBER	57401440.01
PROJECT	JOHN SEVIER FOSSIL PLANT

PAGE 1 OF 1

LAW ENGINEERING



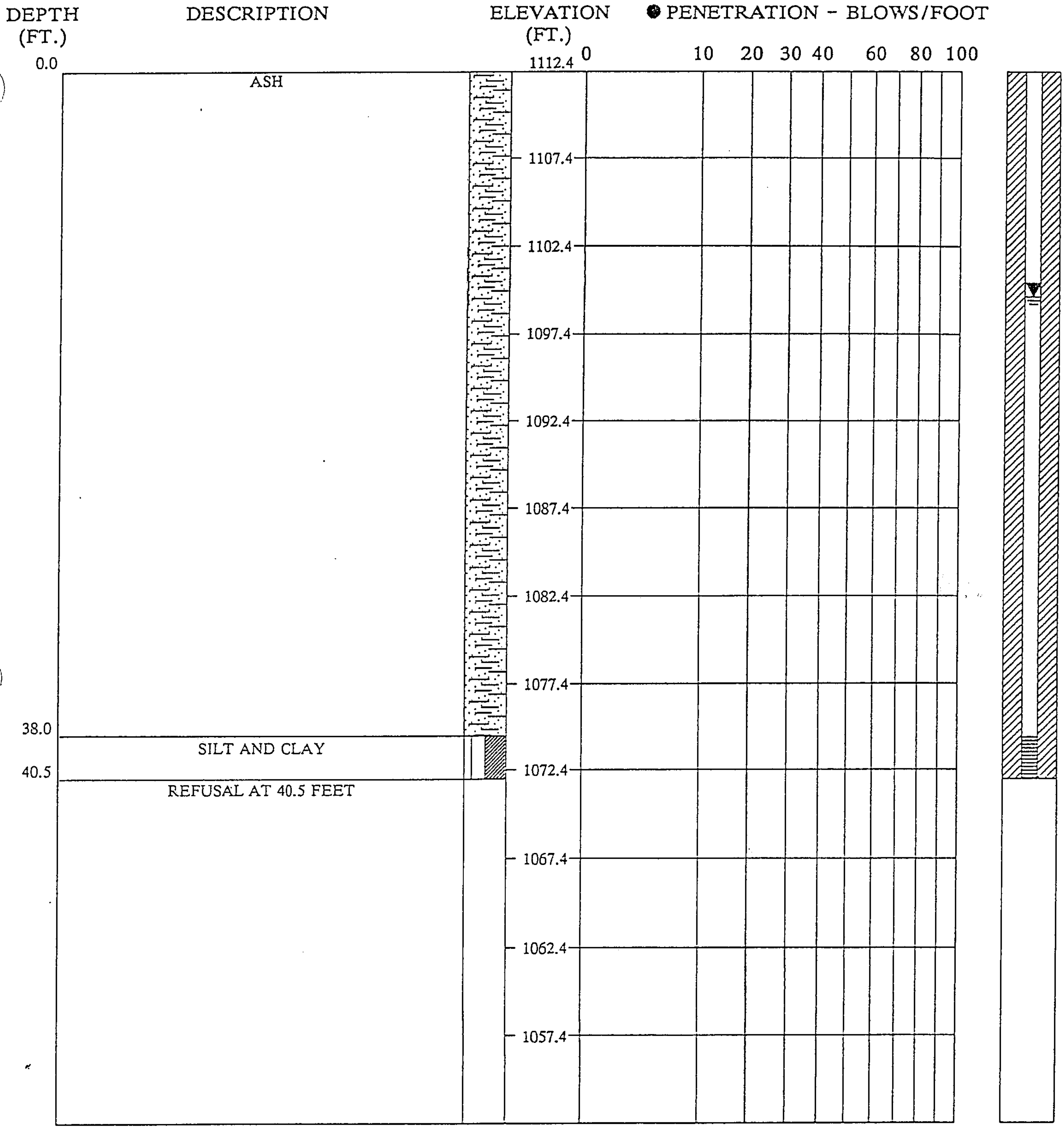
REMARKS:
GROUNDWATER MEASURED ON 6-13-91.

AUGER BORING RECORD

BORING NUMBER	PZ-3A
DATE DRILLED	October 31, 1986
PROJECT NUMBER	57401440.01
PROJECT	JOHN SEVIER FOSSIL PLANT
PAGE 1 OF 1	

SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVATIONS USED ABOVE

LAW ENGINEERING



REMARKS:
GROUNDWATER MEASURED ON 6-13-91.

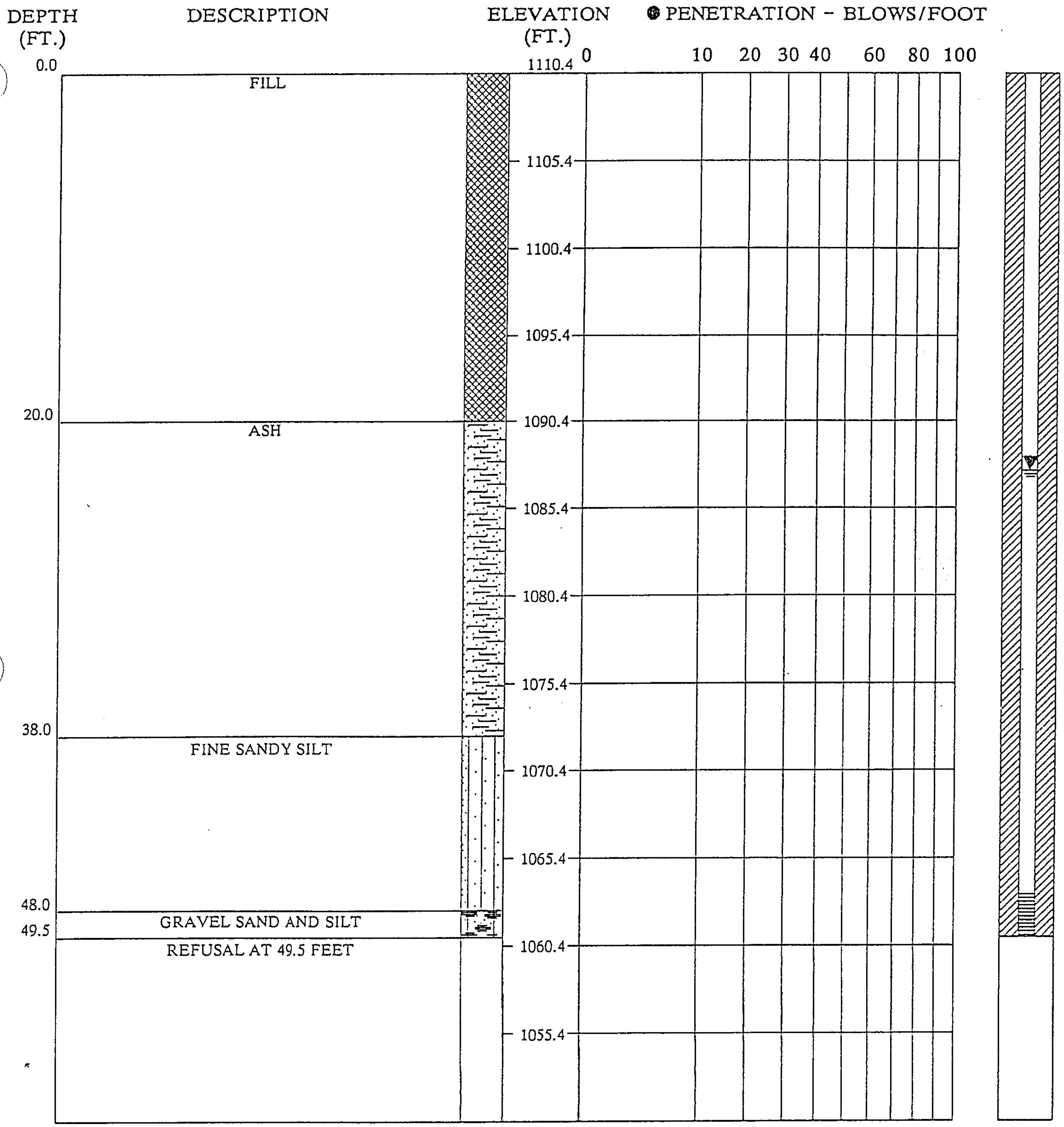
SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVATIONS USED ABOVE

AUGER BORING RECORD

BORING NUMBER	PZ-3B
DATE DRILLED	October 31, 1986
PROJECT NUMBER	57401440.01
PROJECT	JOHN SEVIER FOSSIL PLANT

PAGE 1 OF 1

LAW ENGINEERING



REMARKS:
GROUNDWATER MEASURED ON 6-13-91.

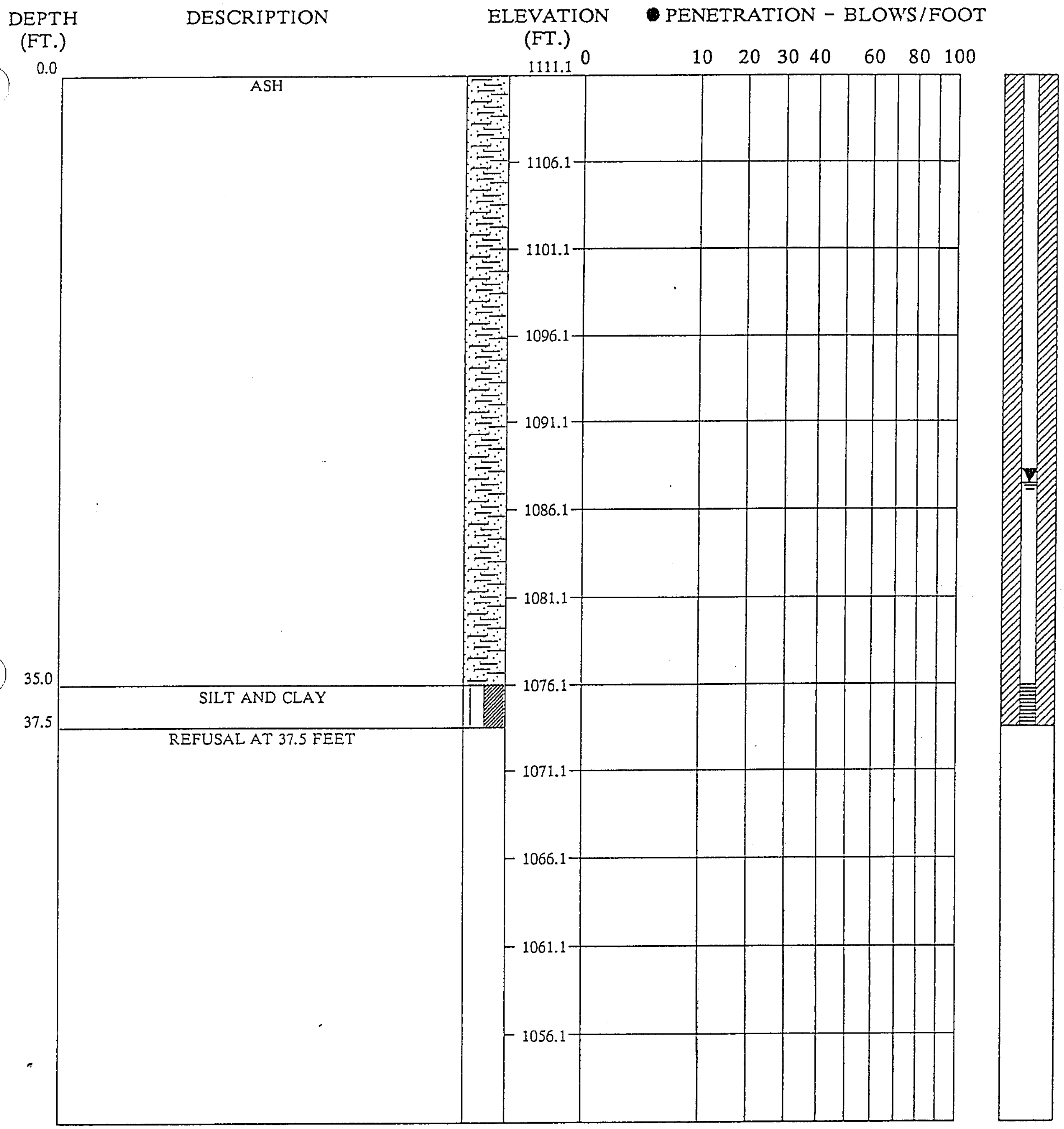
SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVATIONS USED ABOVE

AUGER BORING RECORD

BORING NUMBER	PZ-4A
DATE DRILLED	November 3, 1986
PROJECT NUMBER	57401440.01
PROJECT	JOHN SEVIER FOSSIL PLANT

PAGE 1 OF 1

LAW ENGINEERING



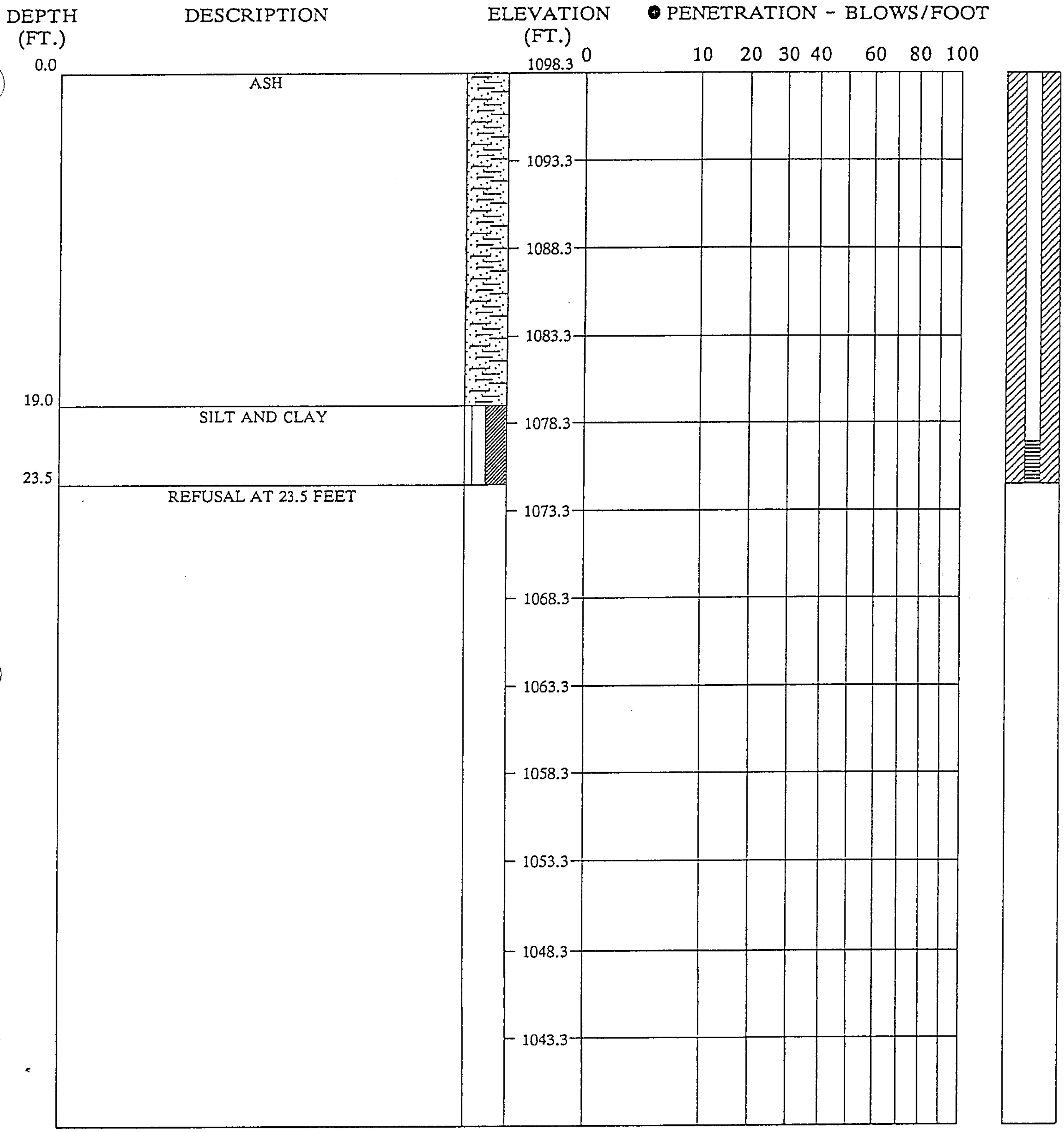
REMARKS:
GROUNDWATER MEASURED ON 6-13-91.

SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVATIONS USED ABOVE

AUGER BORING RECORD

BORING NUMBER	PZ-4B
DATE DRILLED	November 5, 1986
PROJECT NUMBER	57401440.01
PROJECT	JOHN SEVIER FOSSIL PLANT
PAGE 1 OF 1	

LAW ENGINEERING



REMARKS:
UNDERWATER

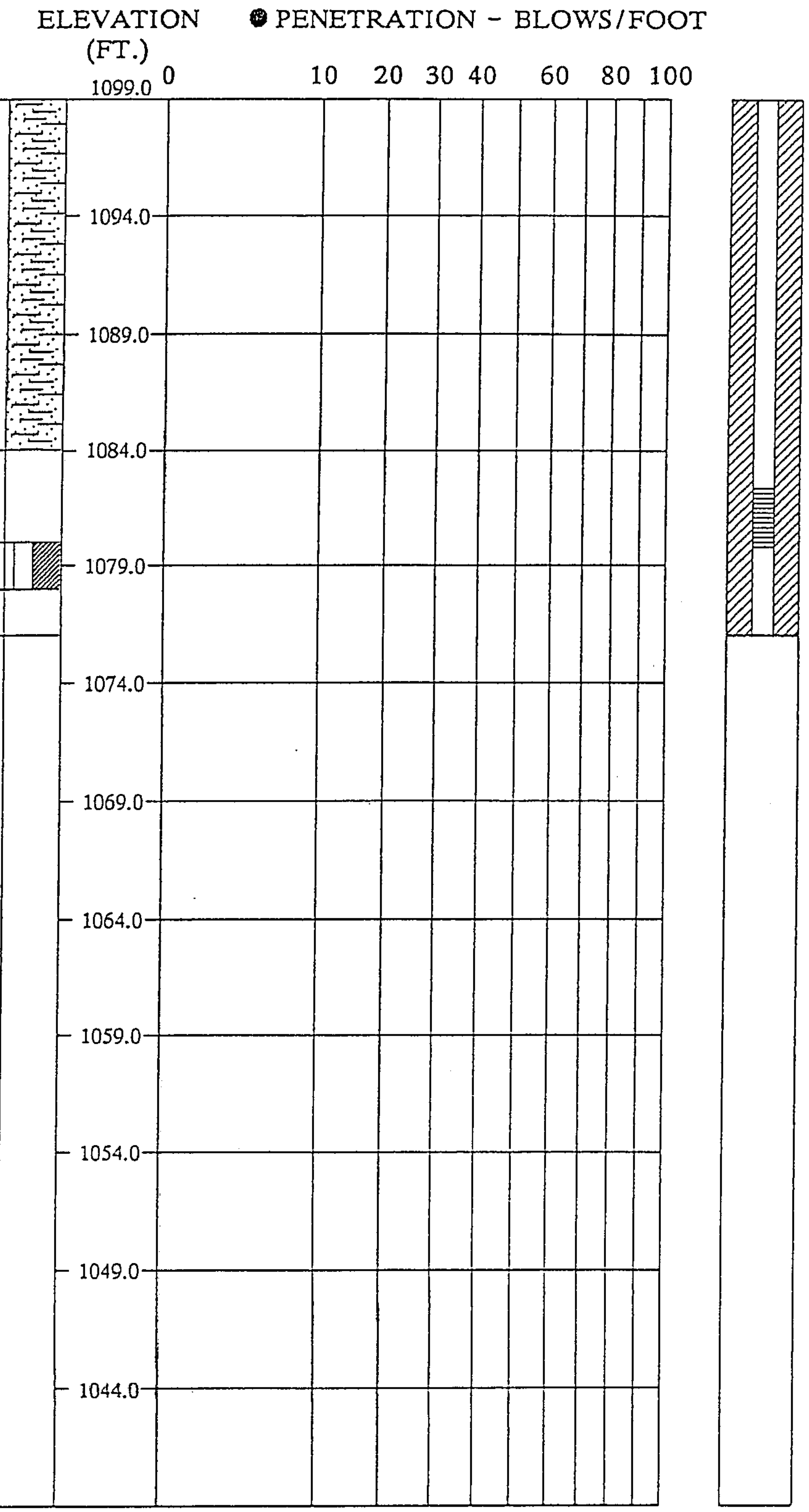
SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVATIONS USED ABOVE

AUGER BORING RECORD

BORING NUMBER	PZ-5A
DATE DRILLED	October 28, 1986
PROJECT NUMBER	57401440.01
PROJECT	JOHN SEVIER FOSSIL PLANT
PAGE 1 OF 1	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION
0.0	ASH
15.0	NO RECOVERY
19.0	SILT AND CLAY
21.0	NO RECOVERY
23.0	BORING TERMINATED AT 23.0 FEET



REMARKS:
UNDERWATER

SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVATIONS USED ABOVE

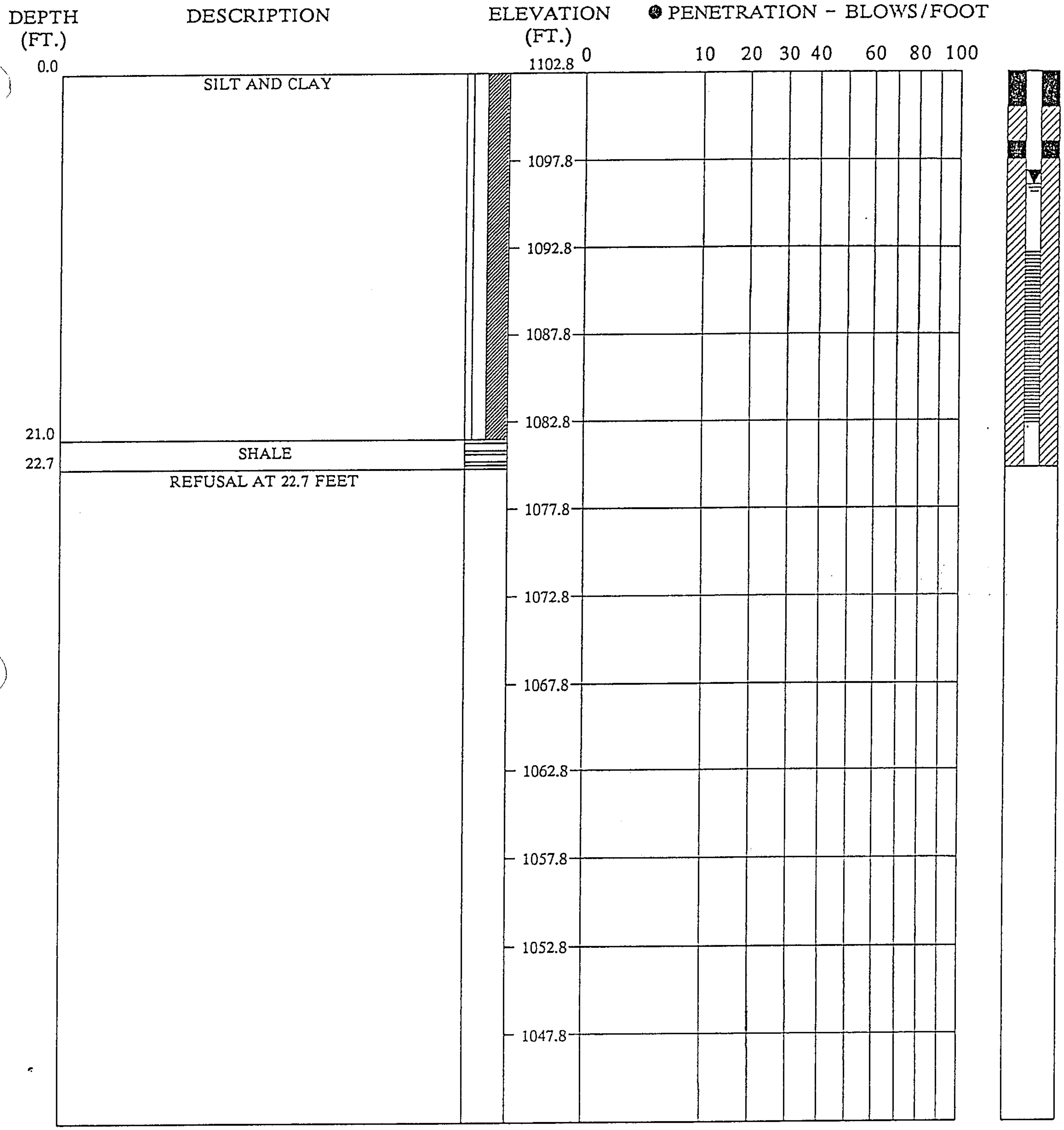
AUGER BORING RECORD

BORING NUMBER PZ-5B
DATE DRILLED October 28, 1986
PROJECT NUMBER 57401440.01
PROJECT JOHN SEVIER FOSSIL PLANT
PAGE 1 OF 1

LAW ENGINEERING

BORING LOGS 15 AND 21

Drilled By Law Engineering - December 1991



REMARKS:
GROUNDWATER MEASURED ON 6-13-91.

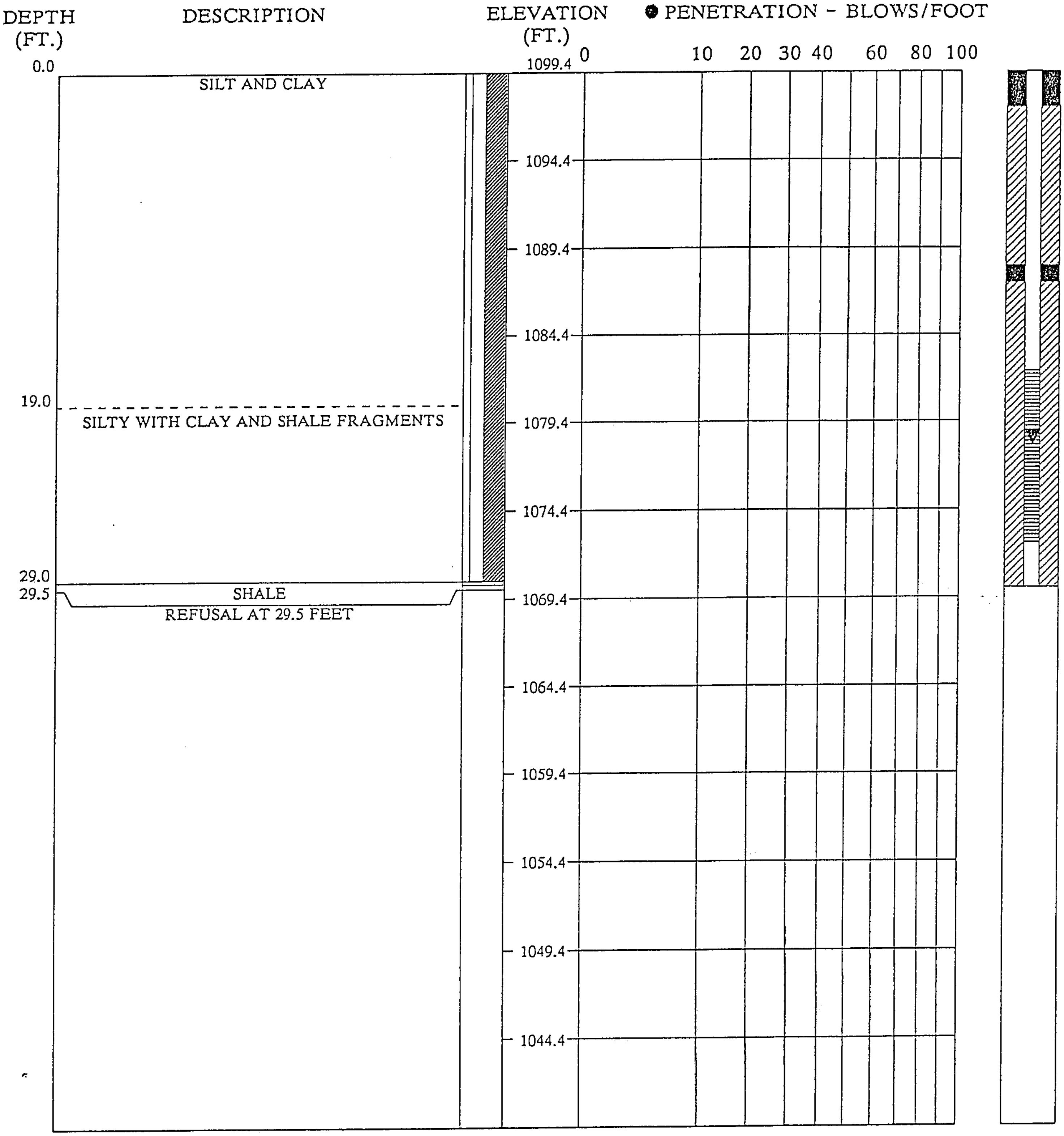
SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVATIONS USED ABOVE

AUGER BORING RECORD

BORING NUMBER	15
DATE DRILLED	December 14, 1991
PROJECT NUMBER	57401440.01
PROJECT	JOHN SEVIER FOSSIL PLANT

PAGE 1 OF 1

LAW ENGINEERING



REMARKS:

GROUNDWATER MEASURED ON 6-13-91.

AUGER BORING RECORD

BORING NUMBER	21
DATE DRILLED	December 15, 1991
PROJECT NUMBER	57401440.01
PROJECT	JOHN SEVIER FOSSIL PLANT

PAGE 1 OF 1

LAW ENGINEERING

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVATIONS USED ABOVE

BORING LOGS 94-1 THROUGH 94-4

Drilled By Law Engineering - August 1994

DEPTH (FT.) | **DESCRIPTION**

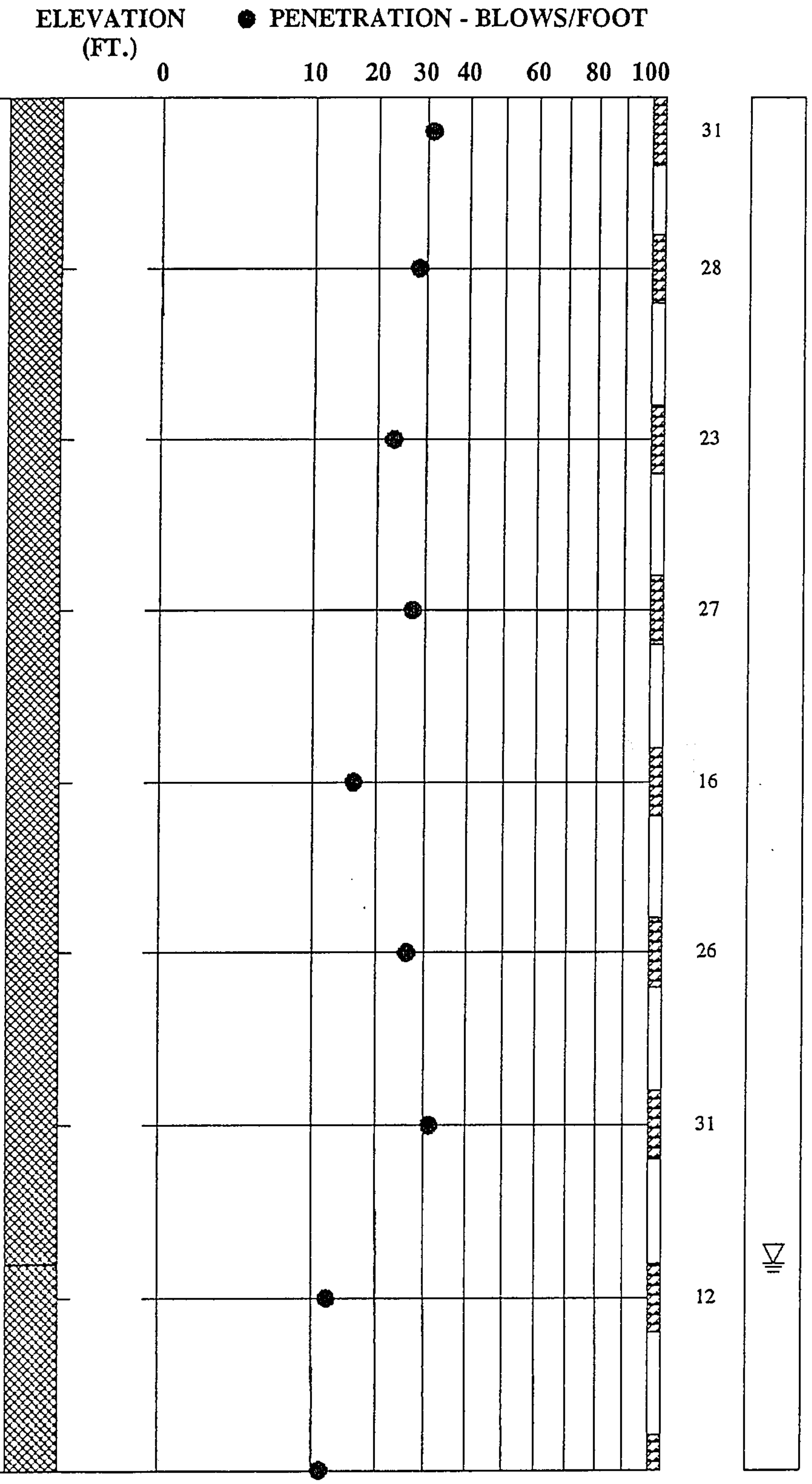
0.0

DARK GRAY ASH; SANDY SILTY TEXTURE - FILL

34.0

DARK GRAY ASH; SANDY SILTY TEXTURE; WET - FILL

40.0



REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

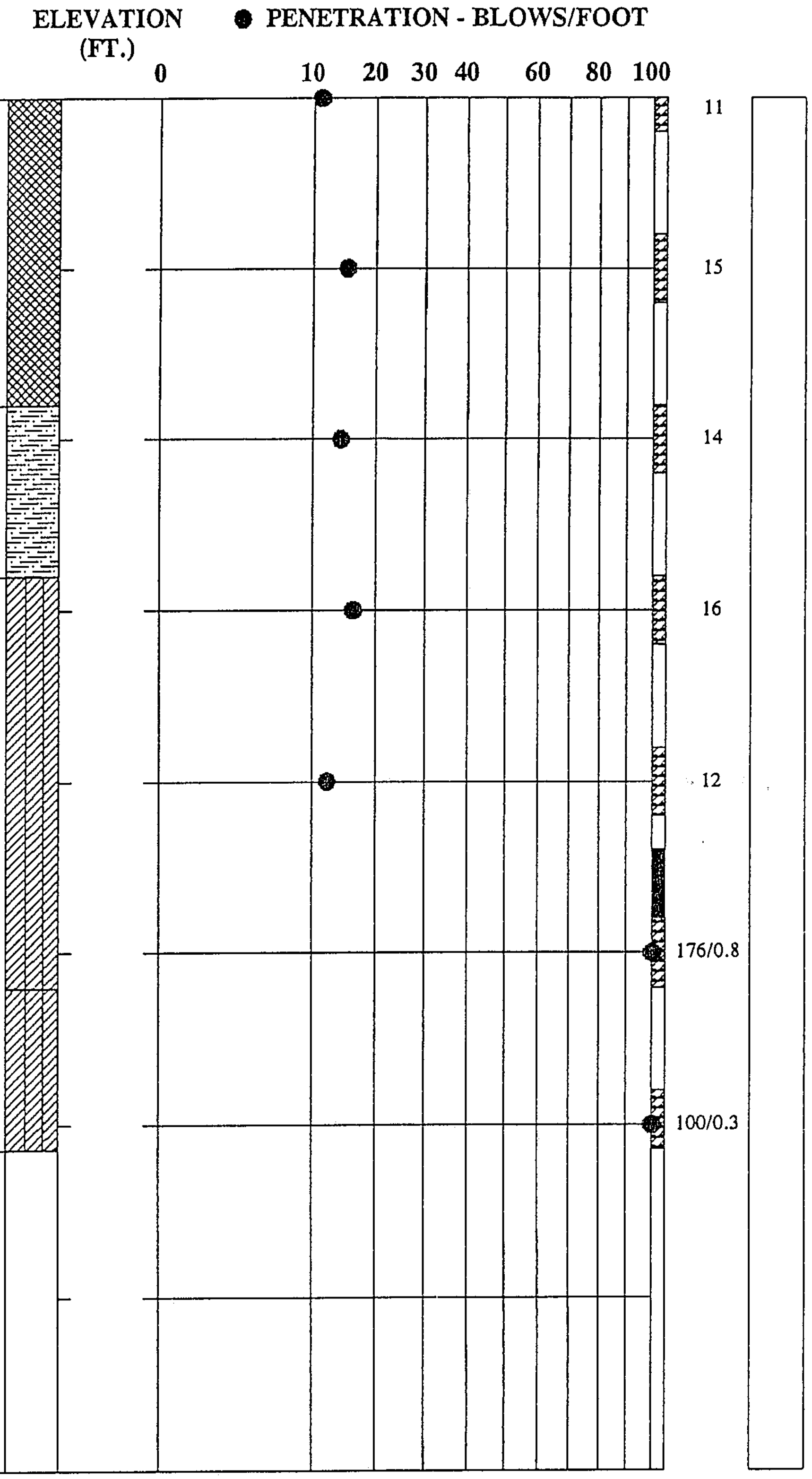
TEST BORING RECORD

BORING NUMBER	94-1
DATE DRILLED	August 22, 1994
PROJECT NUMBER	385 94467 01
PROJECT	John Sevier Fossil Fuel Ash Pile

PAGE 1 OF 2

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION
	DARK GRAY ASH; SANDY SILT TEXTURE; WET - FILL
49.0	BROWN AND GRAY SILTY CLAY - ALLUVIUM
54.0	VERY STIFF TO VERY HARD BROWN AND TAN SILTY CLAY; VERY MOIST - RESIDUUM
66.0	VERY HARD BROWN AND GRAY WEATHERED SHALE - RESIDUUM (The sample possessed the relict structure of the underlying parent bedrock.)
70.7	AUGER REFUSAL



REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

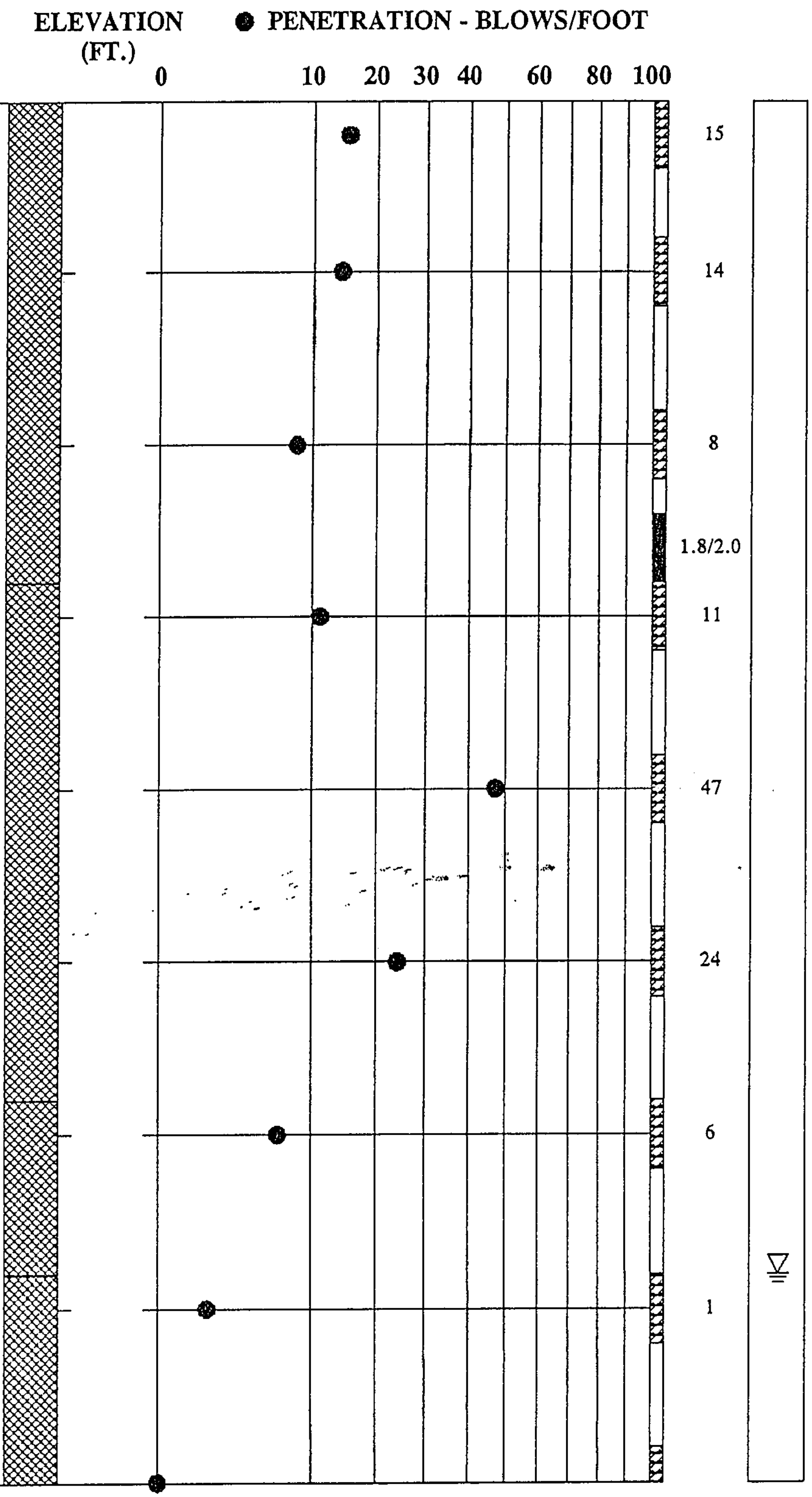
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94-1
DATE DRILLED	August 22, 1994
PROJECT NUMBER	385 94467 01
PROJECT	John Sevier Fossil Fuel Ash Pile
PAGE 2 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION
0.0	DARK GRAY ASH; SANDY SILT TEXTURE - FILL
14.0	LIGHT GRAY ASH; SILT SIZE - FILL
29.0	DARK GRAY ASH; SANDY SILT TEXTURE - FILL
34.0	GRAY ASH: SANDY SILT; VERY WET - FILL
40.0	



REMARKS:

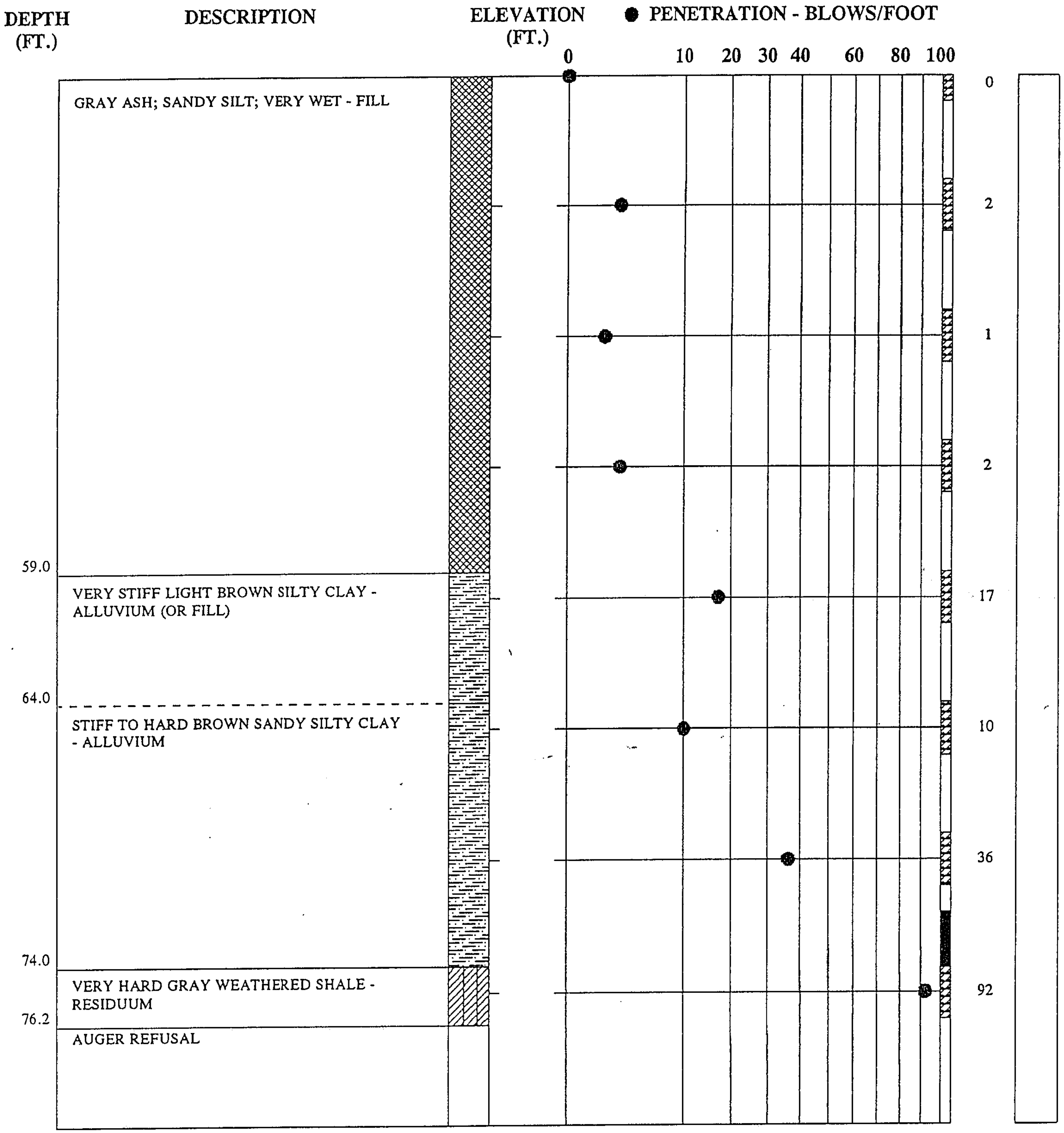
TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94-2
DATE DRILLED	August 23, 1994
PROJECT NUMBER	385 94467 01
PROJECT	John Sevier Fossil Fuel Ash Pile
PAGE 1 OF 2	

LAW ENGINEERING



DEPTH (FT.)	DESCRIPTION
	GRAY ASH; SANDY SILT; VERY WET - FILL
59.0	VERY STIFF LIGHT BROWN SILTY CLAY - ALLUVIUM (OR FILL)
64.0	STIFF TO HARD BROWN SANDY SILTY CLAY - ALLUVIUM
74.0	VERY HARD GRAY WEATHERED SHALE - RESIDUUM
76.2	AUGER REFUSAL

REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

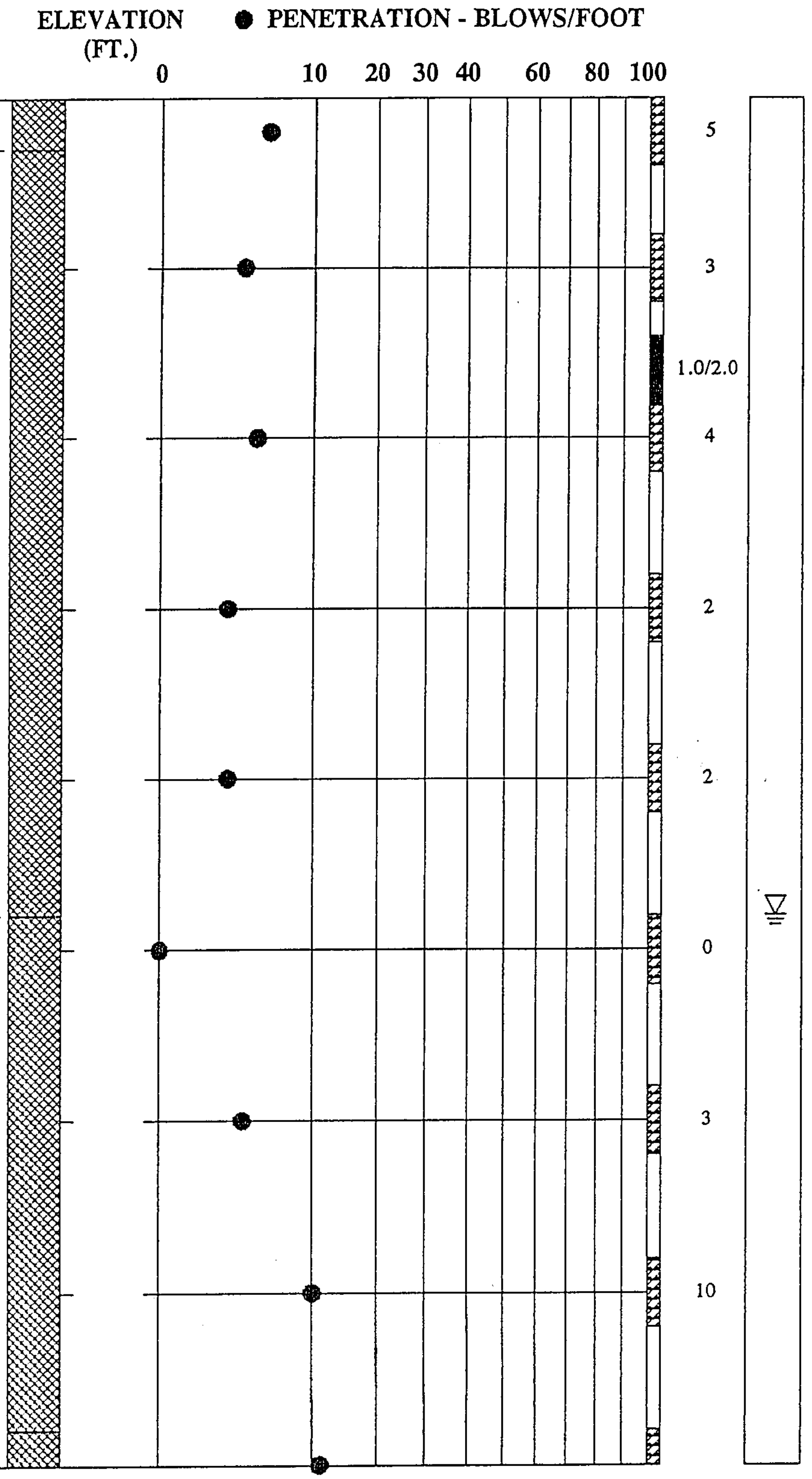
TEST BORING RECORD

BORING NUMBER	94-2
DATE DRILLED	August 23, 1994
PROJECT NUMBER	385 94467 01
PROJECT	John Sevier Fossil Fuel Ash Pile

PAGE 2 OF 2

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION
0.0	DARK BROWN SANDY SILTY CLAY - FILL
1.5	DARK GRAY ASH; SANDY SILT TEXTURE - FILL
24.0	GRAY ASH; SANDY SILT TEXTURE; VERY WET - FILL
39.0	



REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

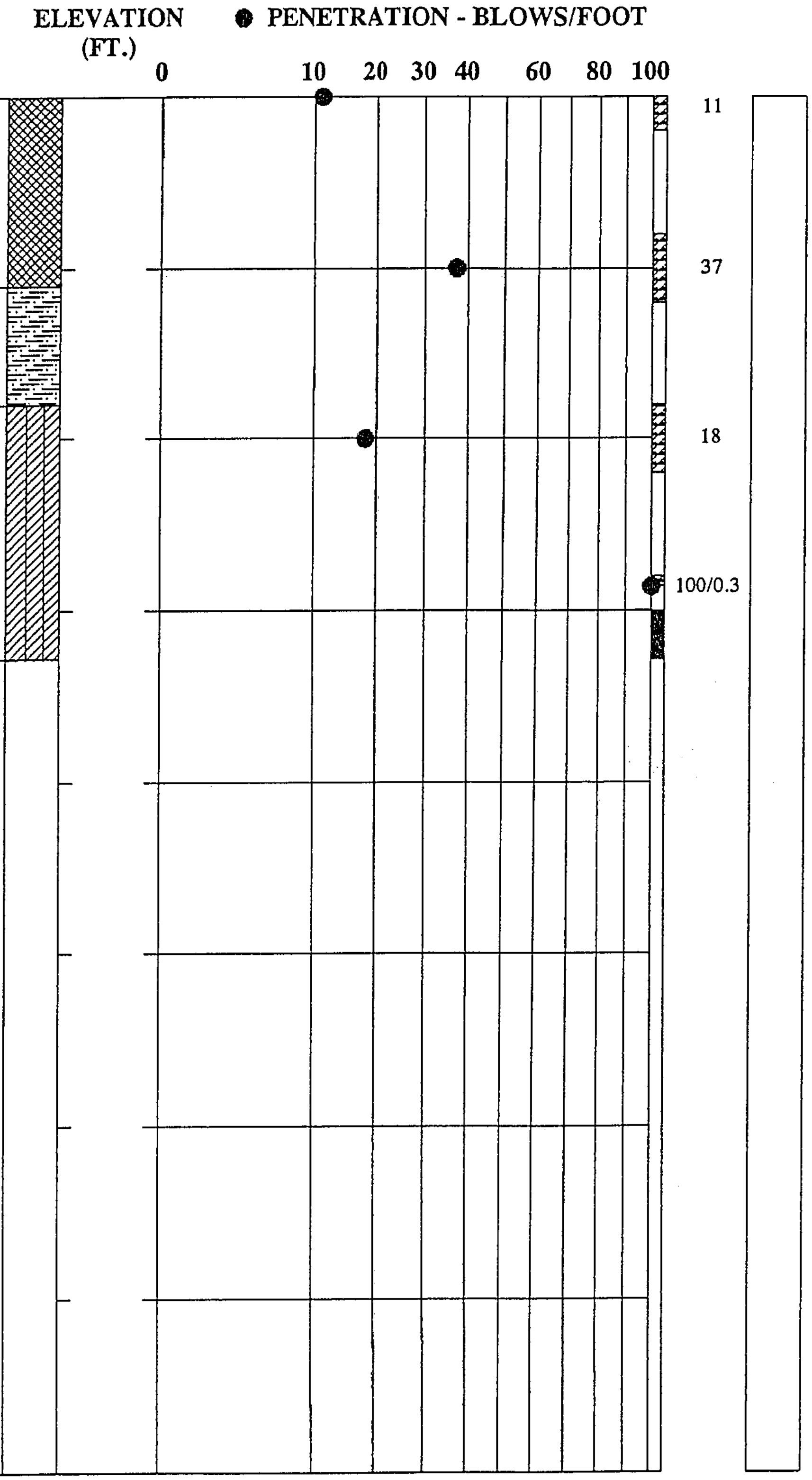
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94-3
DATE DRILLED	August 18, 1994
PROJECT NUMBER	385 94467 01
PROJECT	John Sevier Fossil Fuel Ash Pile
PAGE 1 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION
	BROWN AND GRAY SANDY SILTY CLAY - FILL (OR ALLUVIUM)
45.5	BROWN AND GRAY SILTY CLAYEY SAND - ALLUVIUM
49.0	GRAY AND BROWN WEATHERED SHALE - RESIDUUM
56.4	AUGER REFUSAL



REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

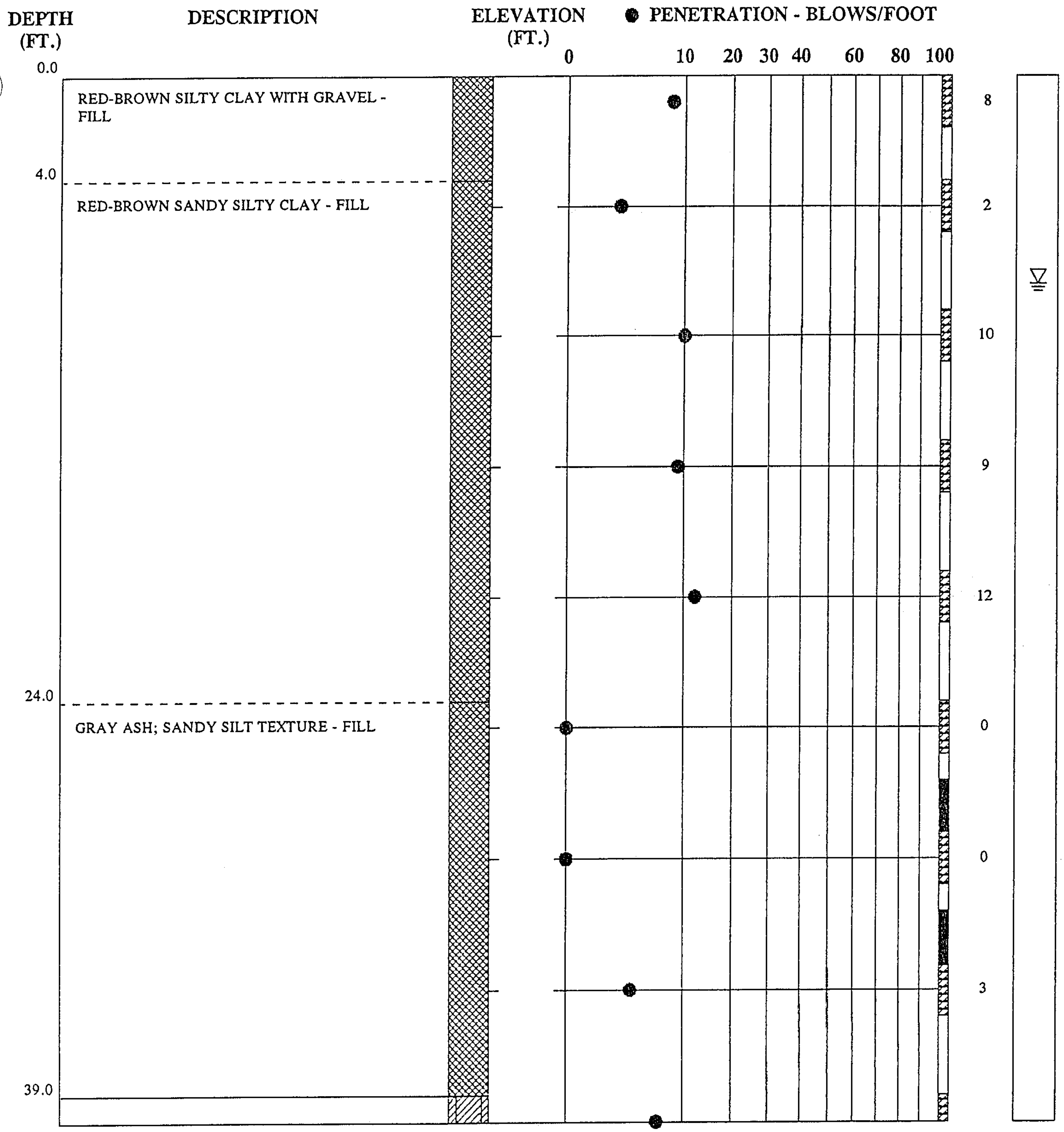
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94-3
DATE DRILLED	August 18, 1994
PROJECT NUMBER	385 94467 01
PROJECT	John Sevier Fossil Fuel Ash Pile

PAGE 2 OF 2

LAW ENGINEERING



REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

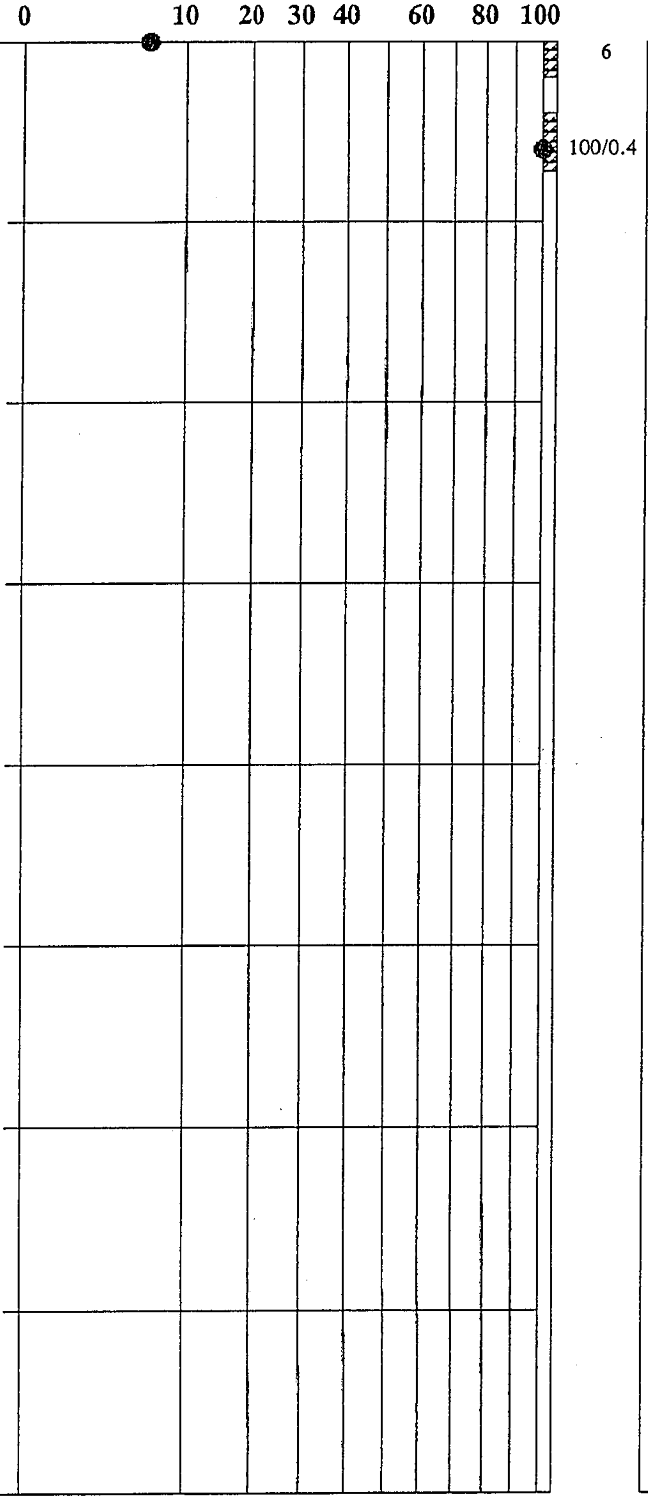
TEST BORING RECORD

BORING NUMBER	94-4
DATE DRILLED	August 19, 1994
PROJECT NUMBER	385 94467 01
PROJECT	John Sevier Fossil Fuel Ash Pile

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)
	FIRM TO VERY HARD BROWN AND GRAY WEATHERED SHALE - RESIDUUM	
43.6	AUGER REFUSAL	

● PENETRATION - BLOWS/FOOT



REMARKS:

TOPOGRAPHIC DATA WAS NOT AVAILABLE AT THE TIME OF THE EXPLORATION.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	94-4
DATE DRILLED	August 19, 1994
PROJECT NUMBER	385 94467 01
PROJECT	John Sevier Fossil Fuel Ash Pile

PAGE 2 OF 2

LAW ENGINEERING

APPENDIX C

MOISTURE CONTENT
LABORATORY TEST RESULTS

TVA John Sevier Plant
Law Engineering Job Number 385 94467 01

Boring Number	Sample Depth (ft)	Moisture Content
94-1	0-2	12.4
	0-2	20.0
	4-6	19.1
	4-6	23.8
	9-11	15.8
	14-16	18.0
	14-16	17.7
	14-16	20.4
	19-21	18.7
	19-21	19.8
	24-26	18.3
	24-26	15.2
	29-31	21.1
	29-31	19.6
	34-36	19.0
	34-36	20.4
	39-41	20.7
	39-41	30.1
	44-45.5	22.8
	44-45.5	23.9
	49-51	15.9
	49-51	19.5
	54-56	16.9
	54-56	15.2
	59-61	23.6
	59-61	22.5
	64-66	40.0
	64-66	15.9
	69-71	7.3

Boring Number	Sample Depth (ft)	Moisture Content
94-2	0-2	20.1
	0-2	25.3
	4-6	18.2
	4-6	17.8
	9-11	23.8
	9-11	25.4
	14-16	26.7
	14-16	27.2
	19-21	16.9
	19-21	18.9
	24-26	19.7
	24-26	29.0
	29-31	32.5
	29-31	29.0
	34-36	45.5
	34-36	47.9
	39-41	55.8
	39-41	38.6
	44-46	45.4
	44-46	54.2
	49-51	56.2
	54-56	58.4
	49-51	42.6
	54-56	43.8
	59-61	21.3
	59-61	21.8
	64-66	22.7
	64-66	23.1
	69-71	17.5
	69-71	12.3
	74-76	15.8
	74-76	9.3

Boring Number	Sample Depth (ft)	Moisture Content
94-3	0-1.5	15.4
	1.5-3	25.5
	4-5.5	18.5
	4-5.5	19.0
	9-10.5	26.8
	9-10.5	25.8
	14-15.5	29.8
	14-15.5	27.4
	19-20.5	31.2
	19-20.5	35.1
	24-25.5	56.7
	24-25.5	55.0
	29-30.5	39.9
	29-30.5	45.8
	34-35.5	48.3
	34-35.5	21.4
	39-40.5	23.1
	39-40.5	21.0
	44-45.5	24.4
	44-45.5	16.0
	49-50.5	9.4
	49-50.5	34.2
	54-55.5	10.8

Boring Number	Sample Depth (ft)	Moisture Content
94-4	0-1.5	17.7
	0-1.5	25.1
	4-5.5	17.1
	4-5.5	25.6
	9-10.5	24.2
	14-15.5	16.1
	14-15.5	17.9
	19-20.5	16.0
	19-20.5	15.6
	24-25.5	62.0
	24-25.5	55.5
	29-30.5	50.3
	29-30.5	38.6
	34-35.5	38.3
	34-35.5	40.8
	39-40.5	29.5
	39-40.5	24.4
	42-43.5	14.2

Tested by: CLG
Date: 09/18/94

Reviewed by: Hb
Date: 9/29/94

Law Job No. 5740144004
Job Name John Sevier Fossil Fuel

TP-4A: UNIT WEIGHT OF SAMPLE
"TYPICAL"

Sample:
Boring No.: 94-2
Depth: 59-61 Ft.
Sample ID: Jar sample

MEASUREMENTS (Nominal 6-inch cut sample height):

TOTAL SAMPLE HEIGHT (inches)		INSIDE DIAMETER OF CUT TUBE (inches)	
1	1.674		
2	1.668	top	1.500
3	1.670	bottom	1.495
Avg.	1.671 (H)	Avg.	1.498 (D)

MOISTURE CONTENT DETERMINATION

MOISTURE CONTENT	
Tare No.	V-79
Tare Weight	16.47 gm
Wet Wt. + Tare	118.00 gm
Dry Wt. + Tare	99.90 gm
Wt. of Water	18.10 gm
Dry Weight	83.43 gm
Moisture Content, *w*	21.7 %

TOTAL WEIGHT OF SOIL + TUBE SECTION	W_{s+t} =	101.62 gm
WEIGHT OF CLEAN, DRY TUBE SECTION	W_t =	0 gm
WET WEIGHT OF SOIL, $[(W_{s+t} - W_t)/454]$	W_s =	0.224 lbs
VOLUME OF SAMPLE, $[(pi*D^2/4)*H/1728]$	V =	0.002 ft^3
WET DENSITY, $[W_s/V]$	D_w =	131.4 pcf
DRY DENSITY, $[D_w/(1+w/100)]$	D_D =	108.0 pcf

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Tested by: CLG
Date: 09/18/94

Reviewed by:
Date: 9/29/94

Law Job No. 5740144004
Job Name John Sevier Fossil Fuel

TP-4A: UNIT WEIGHT OF SAMPLE
"TYPICAL"

Sample: Boring No.: 94-3
Depth: 39-40 Ft.
Sample ID: Jar sample

MEASUREMENTS (Nominal 6-inch cut sample height):

TOTAL SAMPLE HEIGHT (inches)		INSIDE DIAMETER OF CUT TUBE (inches)	
1	2.154		
2	2.160	top	1.452
3	2.155	bottom	1.461
Avg.	2.156 (H)	Avg.	1.457 (D)

MOISTURE CONTENT DETERMINATION

MOISTURE CONTENT	
Tare No.	K-62
Tare Weight	16.16 gm
Wet Wt. + Tare	141.91 gm
Dry Wt. + Tare	118.79 gm
Wt. of Water	23.12 gm
Dry Weight	102.63 gm
Moisture Content, *w*	22.5 %

TOTAL WEIGHT OF SOIL + TUBE SECTION	W_{s+t} =	125.75 gm
WEIGHT OF CLEAN, DRY TUBE SECTION	W_t =	0 gm
WET WEIGHT OF SOIL, $[(W_{s+t} - W_t)/454]$	W_s =	0.277 lbs
VOLUME OF SAMPLE, $[(pi*D^2/4)*H/1728]$	V =	0.002 ft^3
WET DENSITY, $[W_s/V]$	D_w =	133.2 pcf
DRY DENSITY, $[D_w/(1+w/100)]$	D_D =	108.7 pcf

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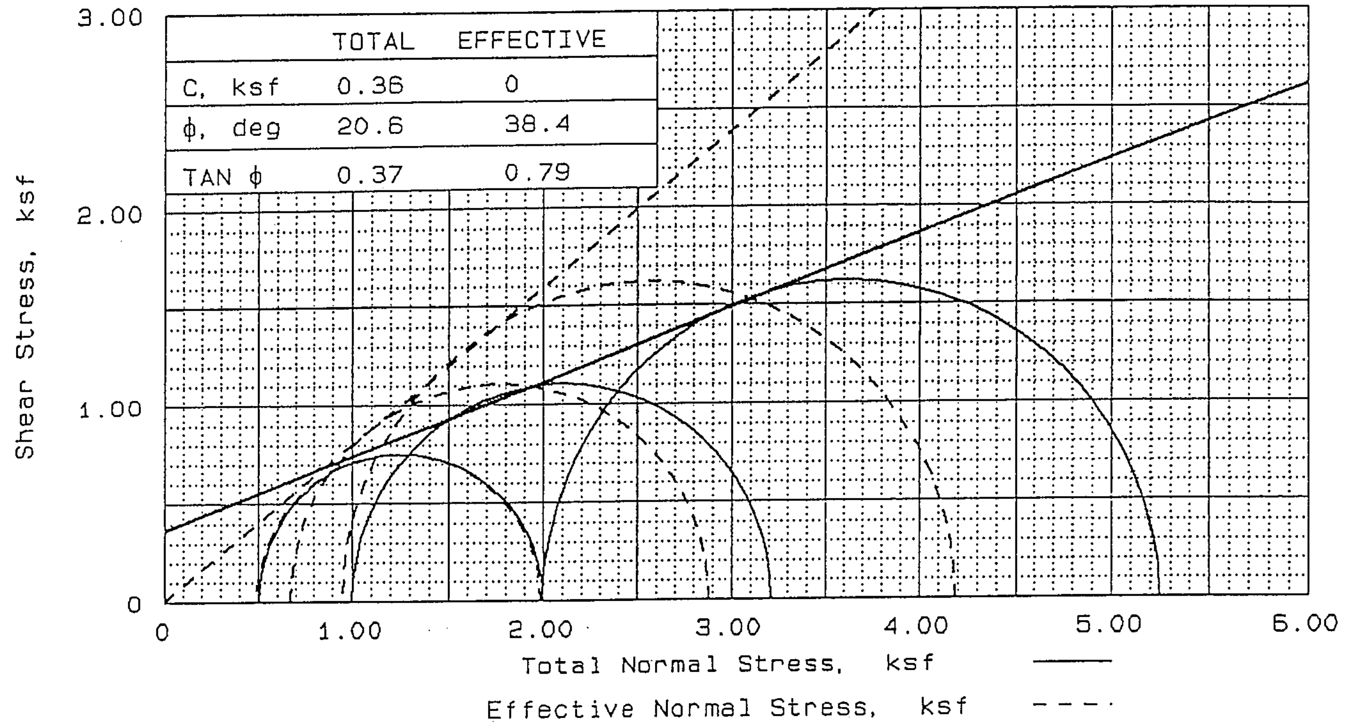
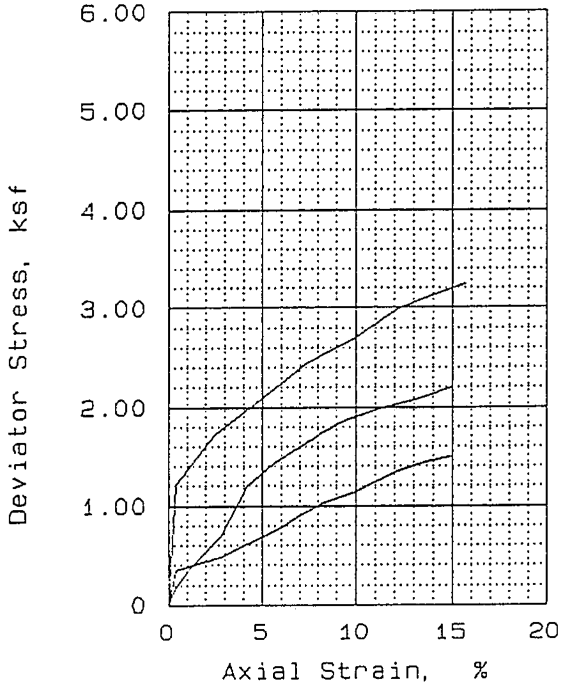


	TOTAL	EFFECTIVE
C, ksf	0.36	0
ϕ, deg	20.6	38.4
TAN ϕ	0.37	0.79



SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	20.6	20.8	20.5
	DRY DENSITY, pcf	107.0	107.1	106.1
	SATURATION, %	97.1	98.8	99.4
	VOID RATIO	0.570	0.568	0.554
	DIAMETER, in	1.43	1.43	1.43
	HEIGHT, in	2.87	2.87	2.87
AT TEST	WATER CONTENT, %	21.1	20.8	19.5
	DRY DENSITY, pcf	107.1	107.7	110.2
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.568	0.560	0.524
	DIAMETER, in	1.43	1.43	1.42
	HEIGHT, in	2.87	2.87	2.87
BACK PRESSURE, ksf		4.18	4.18	6.05
CELL PRESSURE, ksf		4.68	5.18	8.05
FAILURE STRESS, ksf		1.50	2.21	3.24
PORE PRESSURE, ksf		4.19	4.51	7.10
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		1.99	2.88	4.19
$\bar{\sigma}_3$ FAILURE, ksf		0.49	0.67	0.95

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Remolded
DESCRIPTION: Tan Clayey Silt

LL= PL= PI=
SPECIFIC GRAVITY= 2.69
REMARKS: Tested by: CLG

Reviewed by: HD

FIG. NO.

CLIENT:

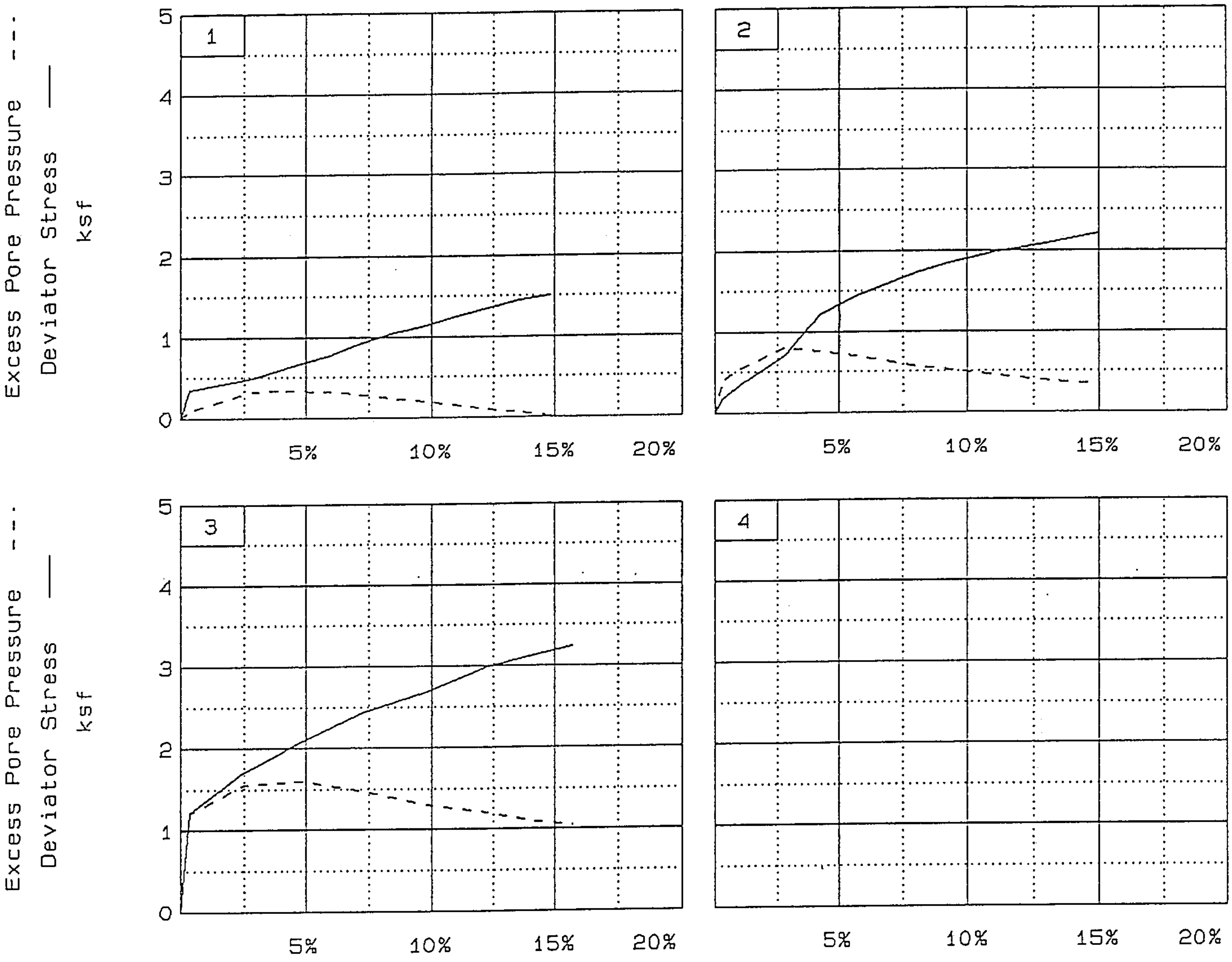
PROJECT: John Sevier Fossil Fuel

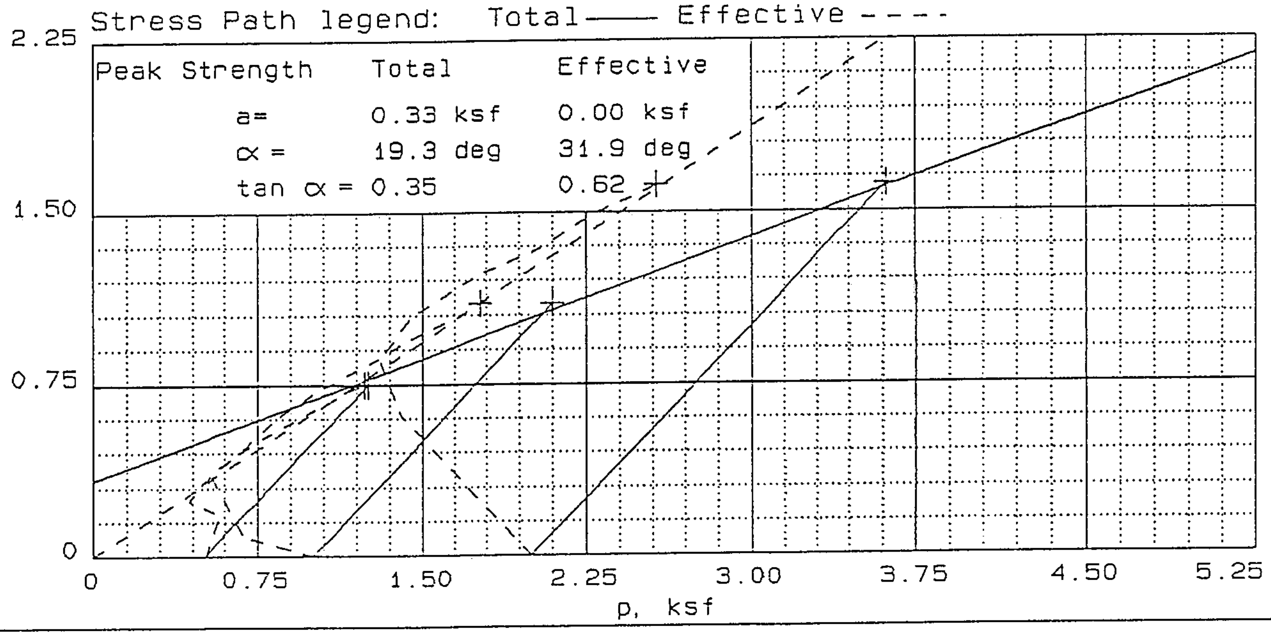
SAMPLE LOCATION: Composite (Jar samples)

PROJ. NO.: 5740144004 DATE: 09/29/94

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.





Peak Strength	Total	Effective
a=	0.33 ksf	0.00 ksf
α =	19.3 deg	31.9 deg
tan α =	0.35	0.62

Client:

Project: John Sevier Fossil Fuel

Location: Composite (Jar samples)

File: 4004A Project No.: 5740144004 Page 2/2 Fig. No. ____

TRIAXIAL COMPRESSION TEST
CU with pore pressures

9-29-1994
2:01 pm

Project Data

Project No.: 5740144004   Date: 09/29/94   Data file: 4004A
Client:
Project: John Sevier Fossil Fuel
Sample location: Composite (Jar samples)
Sample description: Tan Clayey Silt
Remarks: Tested by:
Reviewed by: Fig No.

Sample No. 1 Data

Type of sample: Remolded
Specific Gravity= 2.69   LL=   PL=   PI=

Sample Parameters	Before Test	At Testing	After Test
Diameter, in	1.43	1.43	
Height change, in		0.00	
Height, in	2.87	2.87	
Weight, grams	156.1		
Water volume change, cc		-0.70	
Moisture, %	20.6	21.1	21.1
Dry density, pcf	107.0	107.1	
Saturation, %	97.1	100.0	
Void ratio	0.570	0.568	

Test Data

Deformation dial constant= 1 in per input unit
Primary load ring constant= 1 lbs. per input unit
Secondary load ring constant= 0 lbs. per input unit
Crossover reading for secondary load ring= 0 input units
Rate of strain= 0.100 % per minute
Consolidation cell pressure = 32.5 psi
Consolidation back pressure = 29 psi
Consolidation effective confining stress = 0.504 ksf
Peak deviator stress = 1.50 ksf at reading no. 11
Ult. deviator stress =

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.00	0.0	0.0	0.00	0.50	0.50	1.00	29.0	0.50	0.00
1	0.0100	0.010	4.00	4.0	0.3	0.36	0.40	0.76	1.89	29.7	0.58	0.18
2	0.0800	0.080	5.60	5.6	2.8	0.49	0.19	0.68	3.61	31.2	0.43	0.24
3	0.1200	0.120	7.20	7.2	4.2	0.62	0.17	0.79	4.58	31.3	0.48	0.31
[illegible]	0.1700	0.170	9.20	9.2	5.9	0.78	0.19	0.96	5.14	31.2	0.58	0.39
5	0.2000	0.200	10.80	10.8	7.0	0.90	0.22	1.12	5.17	31.0	0.67	0.45

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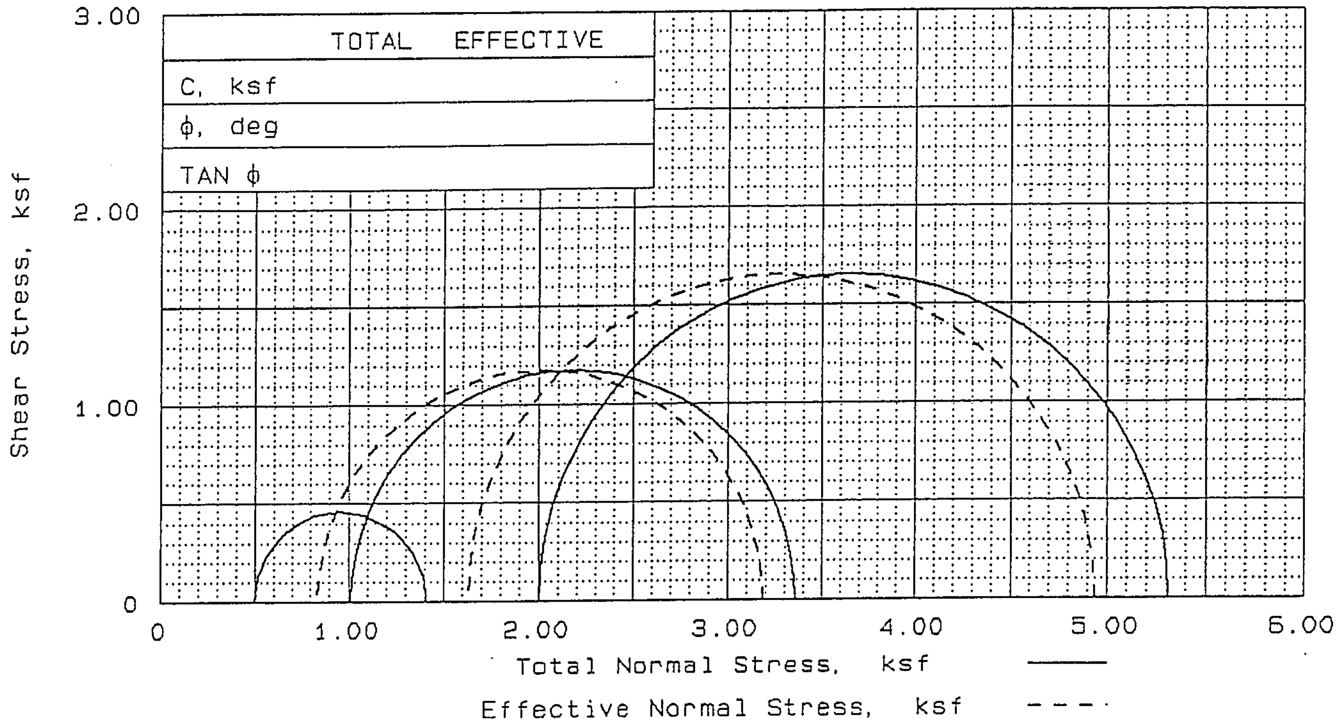
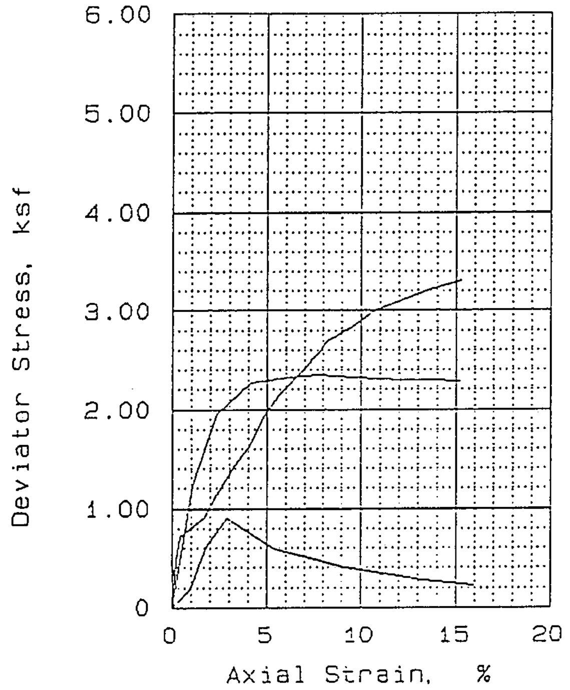
No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
	0.2400	0.240	12.60	12.6	8.4	1.03	0.26	1.29	4.99	30.7	0.78	0.52
7	0.2800	0.280	14.00	14.0	9.8	1.13	0.30	1.43	4.74	30.4	0.87	0.57
8	0.3200	0.320	15.80	15.8	11.2	1.26	0.36	1.62	4.50	30.0	0.99	0.63
9	0.3500	0.350	17.20	17.2	12.2	1.35	0.40	1.76	4.36	29.7	1.08	0.68
10	0.3900	0.390	18.60	18.6	13.6	1.44	0.45	1.89	4.23	29.4	1.17	0.72
11	0.4250	0.425	19.60	19.6	14.8	1.50	0.49	1.99	4.06	29.1	1.24	0.75





	SAMPLE NO.	1	2	3
INITIAL	WATER CONTENT, %	20.4	19.7	19.6
	DRY DENSITY, pcf	66.7	65.1	64.7
	SATURATION, %	42.6	39.4	38.8
	VOID RATIO	1.041	1.090	1.104
	DIAMETER, in	2.87	2.87	2.87
	HEIGHT, in	5.60	5.60	5.60
AT TEST	WATER CONTENT, %	46.7	49.6	50.4
	DRY DENSITY, pcf	67.4	65.4	64.9
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.019	1.081	1.098
	DIAMETER, in	2.86	2.87	2.87
	HEIGHT, in	5.58	5.59	5.59
	BACK PRESSURE, ksf	4.75	5.33	4.90
	CELL PRESSURE, ksf	6.75	6.34	5.40
	FAILURE STRESS, ksf	3.31	2.35	0.91
	PORE PRESSURE, ksf	5.13	5.50	4.90
	STRAIN RATE, %/min.	0.100	0.100	0.100
	ULTIMATE STRESS, ksf			
	PORE PRESSURE, ksf			
	$\bar{\sigma}_1$ FAILURE, ksf	4.94	3.16	1.41
	$\bar{\sigma}_3$ FAILURE, ksf	1.63	0.84	0.5

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: UD
DESCRIPTION: Ash

LL= PL= PI=
SPECIFIC GRAVITY= 2.18
REMARKS: Tested by:

Reviewed by: CCG

FIG. NO.

CLIENT:

PROJECT: John Sevier Fossil Fuel

SAMPLE LOCATION: S4-2

PROJ. NO.: 5740144004 DATE: 09/26/94

TRIAXIAL COMPRESSION TEST

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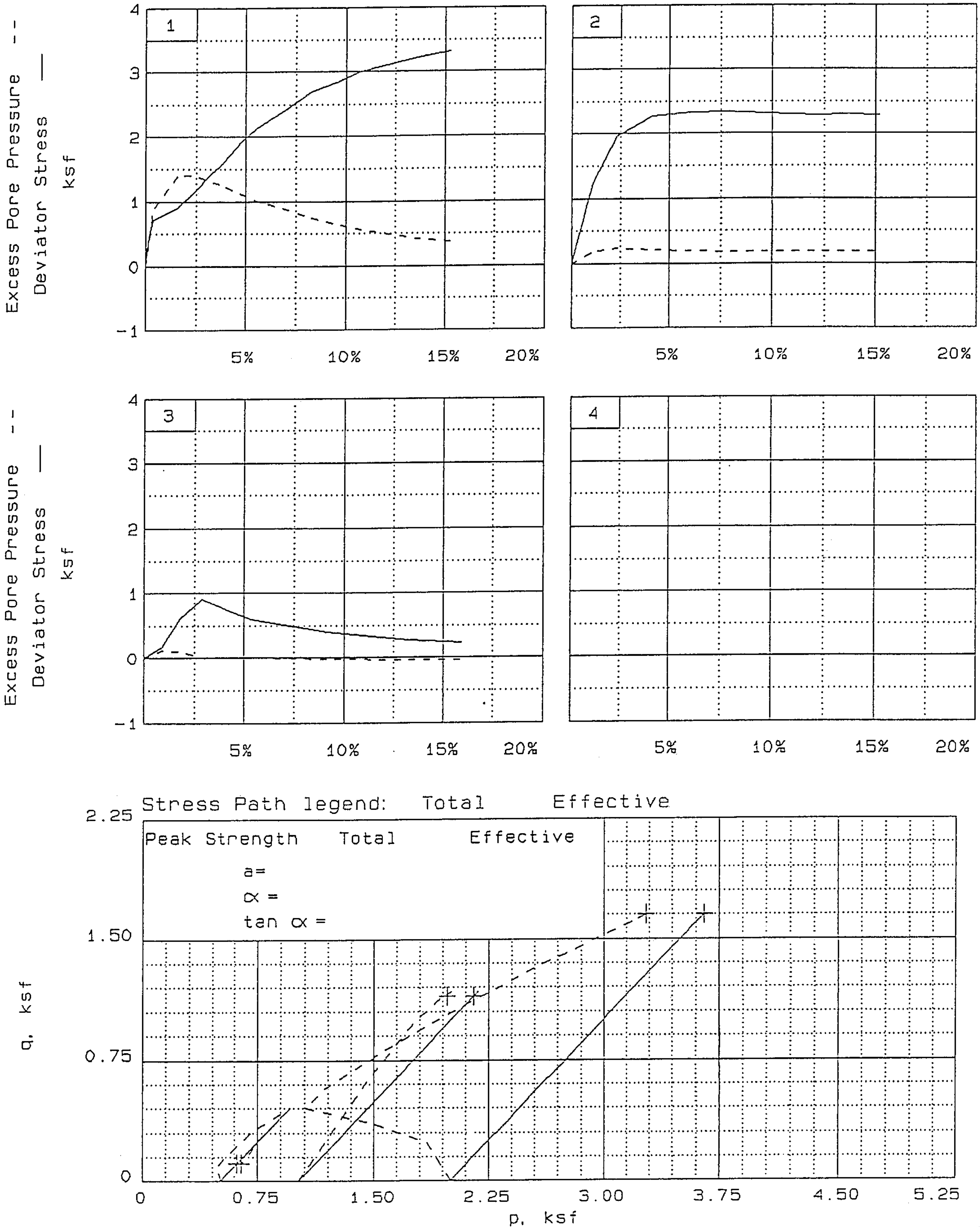


Client:

Project: John Sevier Fossil Fuel

Location: 94-2

File: 5744004 Project No.: 5740144004 Page 2/2 Fig. No. ____

TRIAXIAL COMPRESSION TEST
CU with pore pressures

9-29-1994
2:18 pm

Project Data

Project No.: 5740144004 Date: 09/26/94 Data file: 5744004
Client:
Project: John Sevier Fossil Fuel
Sample location: 94-2
Sample description: Ash
Remarks: Tested by: CLC
Reviewed by: HD Fig No.

Sample No. 2 Data

Type of sample: UD
Specific Gravity= 2.18 LL= PL= PI=

Sample Parameters	Before Test	At Testing	After Test
Diameter, in	2.87	2.87	
Height change, in		0.01	
Height, in	5.60	5.59	
Weight, grams	741.4		
Water volume change, cc		%-185.07	
Moisture, %	19.7	49.6	49.6
Dry density, pcf	65.1	65.4	
Saturation, %	39.4	100.0	
Void ratio	1.090	1.081	

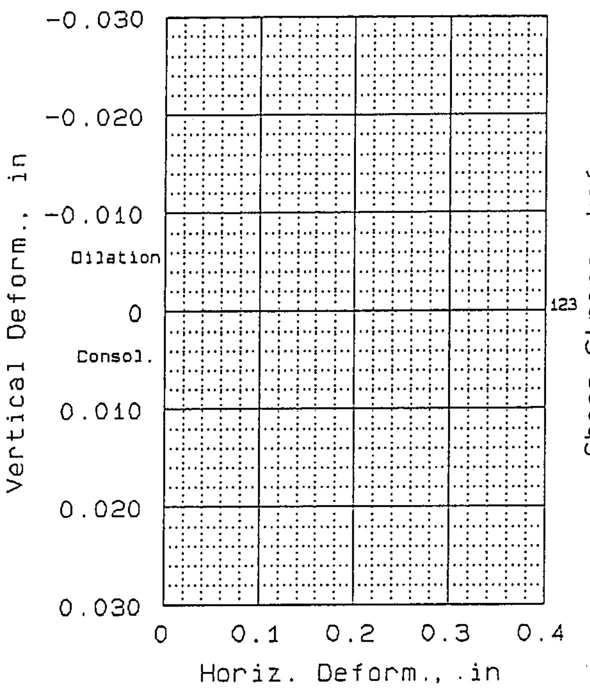
Test Data

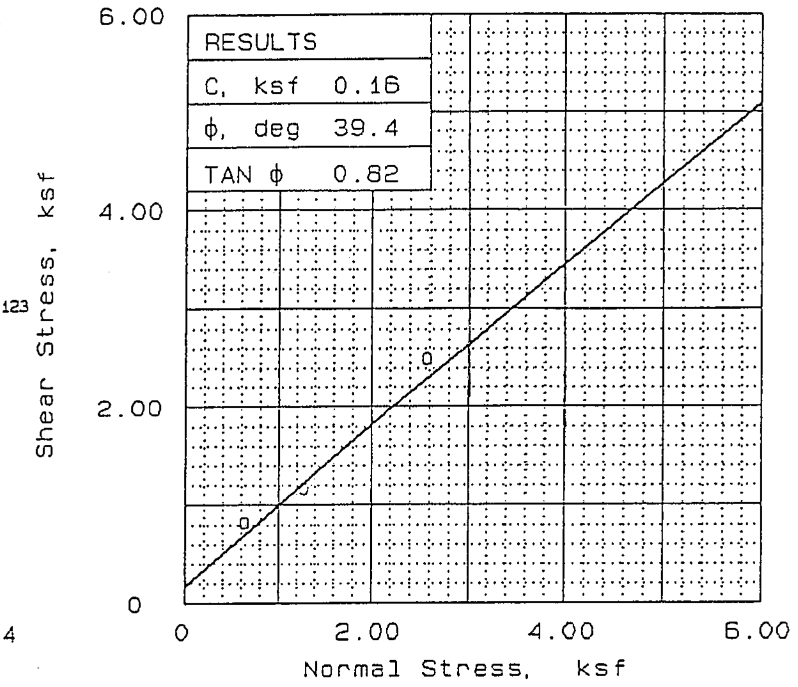
Deformation dial constant= 1 in per input unit
Primary load ring constant= 1 lbs. per input unit
Secondary load ring constant= 0 lbs. per input unit
Crossover reading for secondary load ring= 0 input units
Rate of strain= 0.100 % per minute
Consolidation cell pressure = 44 psi
Consolidation back pressure = 37 psi
Consolidation effective confining stress = 1.008 ksf
Peak deviator stress = 2.35 ksf at reading no. 5
Ult. deviator stress =

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress ksf	Effective Stresses Minor ksf	Major ksf	1:3 Ratio	Pore Pres. psi	P ksf	Q ksf
0	0.0000	0.000	0.00	0.0	0.0	0.00	1.01	1.01	1.00	37.0	1.01	0.00
1	0.0600	0.060	56.00	56.0	1.1	1.24	0.84	2.07	2.48	38.2	1.45	0.62
2	0.1300	0.130	90.00	90.0	2.3	1.96	0.78	2.74	3.52	38.6	1.76	0.98
3	0.2300	0.230	106.00	106.0	4.1	2.27	0.81	3.07	3.81	38.4	1.94	1.13
	0.3400	0.340	111.00	111.0	6.1	2.33	0.82	3.15	3.83	38.3	1.98	1.16
5	0.4300	0.430	114.00	114.0	7.7	2.35	0.84	3.18	3.81	38.2	2.01	1.17

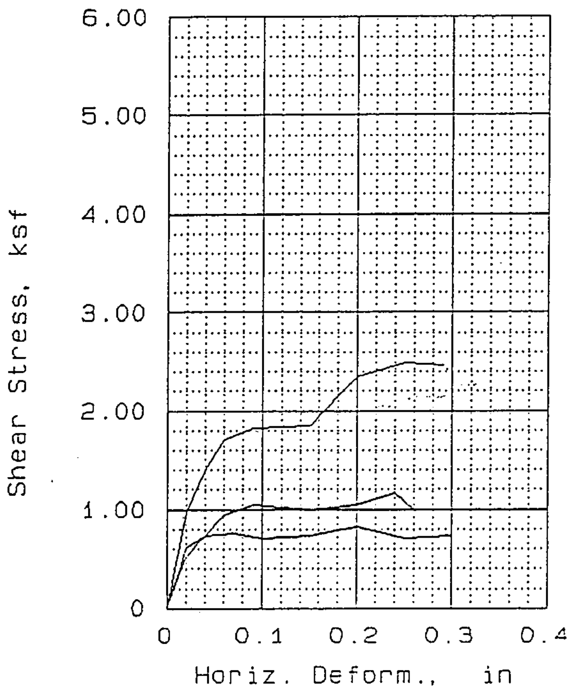
LAW ENGINEERING, INC.

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs.	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
	0.5400	0.540	115.00	115.0	9.7	2.32	0.84	3.15	3.78	38.2	1.99	1.16
7	0.6800	0.680	117.00	117.0	12.2	2.29	0.84	3.13	3.75	38.2	1.98	1.15
8	0.7600	0.760	119.00	119.0	13.6	2.29	0.84	3.13	3.75	38.2	1.98	1.15
9	0.8500	0.850	121.00	121.0	15.2	2.29	0.84	3.12	3.74	38.2	1.98	1.14





RESULTS	
C, ksf	0.16
ϕ, deg	39.4
TAN ϕ	0.82



	SAMPLE NO.	1	2	3
INITIAL	WATER CONTENT, %	31.3	31.4	32.4
	DRY DENSITY, pcf	86.2	84.1	84.3
	SATURATION, %	117.9	110.7	115.0
	VOID RATIO	0.578	0.618	0.614
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
AT TEST	WATER CONTENT, %	31.9	31.4	32.4
	DRY DENSITY, pcf	86.2	84.1	84.3
	SATURATION, %	120.1	110.7	115.0
	VOID RATIO	0.578	0.618	0.614
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
	NORMAL STRESS, ksf	2.60	1.30	0.65
	MAX. SHEAR, ksf	2.49	1.17	0.82
	STRAIN RATE, %/min.	2.400	2.400	2.400
	ULT. SHEAR, ksf			

SAMPLE DATA

SAMPLE TYPE: Remolded

DESCRIPTION: Ash

LL= PL= PI=

SPECIFIC GRAVITY= 2.18

REMARKS: Tested by:

Reviewed by:

FIG. NO.

CLIENT:

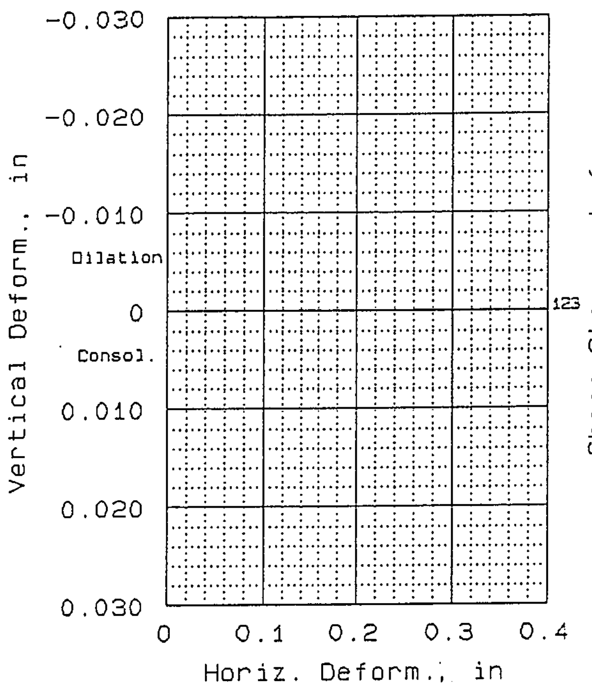
PROJECT: John Sevier Fossil Fuel

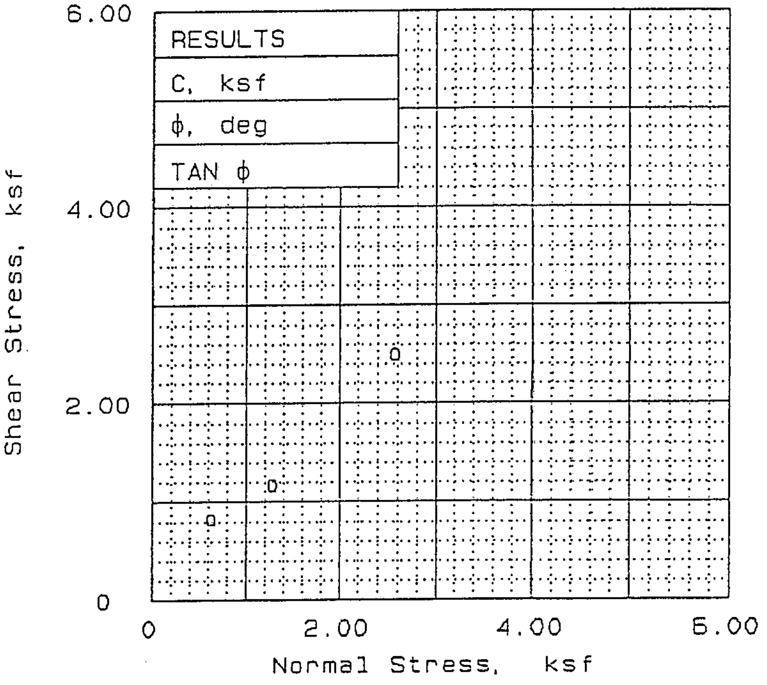
SAMPLE LOCATION: Ash

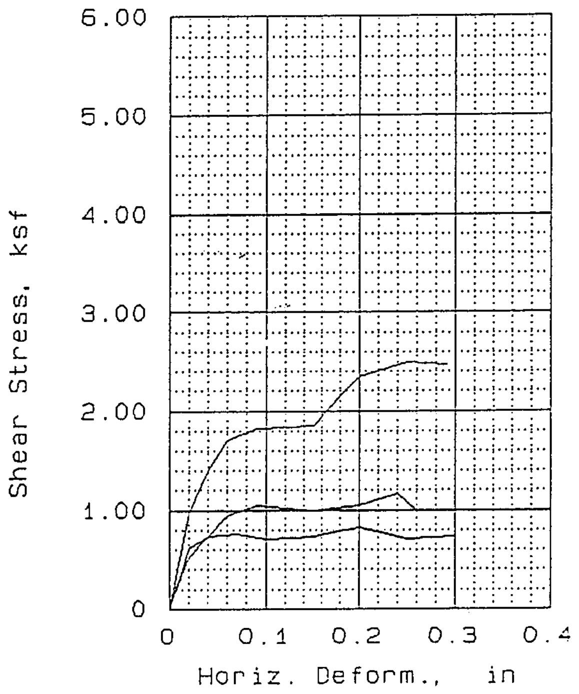
PROJ. NO.: 5740144004 DATE: 09/26/94

DIRECT SHEAR TEST

LAW ENGINEERING, INC.







	SAMPLE NO.	1	2	3
INITIAL	WATER CONTENT, %	31.3	31.4	32.4
	DRY DENSITY, pcf	86.2	84.1	84.3
	SATURATION, %	117.9	110.7	115.0
	VOID RATIO	0.578	0.618	0.614
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
AT TEST	WATER CONTENT, %	31.9	31.4	32.4
	DRY DENSITY, pcf	86.2	84.1	84.3
	SATURATION, %	120.1	110.7	115.0
	VOID RATIO	0.578	0.618	0.614
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
	NORMAL STRESS, ksf	2.60	1.30	0.65
	MAX. SHEAR, ksf	2.49	1.17	0.82
	STRAIN RATE, %/min.	2.400	2.400	2.400
	ULT. SHEAR, ksf			

SAMPLE DATA

SAMPLE TYPE: Remolded

DESCRIPTION: Ash

LL= PL= PI=

SPECIFIC GRAVITY= 2.18

REMARKS: Tested by:

Reviewed by:

FIG. NO.

CLIENT:

PROJECT: John Savier Fossil Fuel

SAMPLE LOCATION: Ash

PROJ. NO.: 5740144004 DATE: 09/26/94

DIRECT SHEAR TEST

LAW ENGINEERING, INC.

DIRECT SHEAR TEST 9-27-1994

Project Data

Project No.: 5740144004 Date: 09/26/94 Data file: 4004
Client:
Project: John Sevier Fossil Fuel
Sample location: Ash
Sample description: Ash
Remarks: Tested by:
Reviewed by: Fig No.

Sample No. 1 Data

Type of sample: Remolded
Specific Gravity= 2.18 LL= PL= PI=

Sample Parameters	Before Test	At Testing
Diameter, in	2.50	
Height, in	0.81	0.81
Weight, grams	118.1	
Moisture, %	31.3	31.9
Dry density, pcf	86.2	
Saturation, %	117.9	
Void ratio	0.578	

Test Data

Deformation dial constant= 1 in per input unit
Primary load ring constant= 1 lbs. per input unit
Secondary load ring constant= 0 lbs. per input unit
Crossover reading for secondary load ring= 0 input units
Rate of strain= 2.400 % per minute
Normal Stress= 2.6 ksf

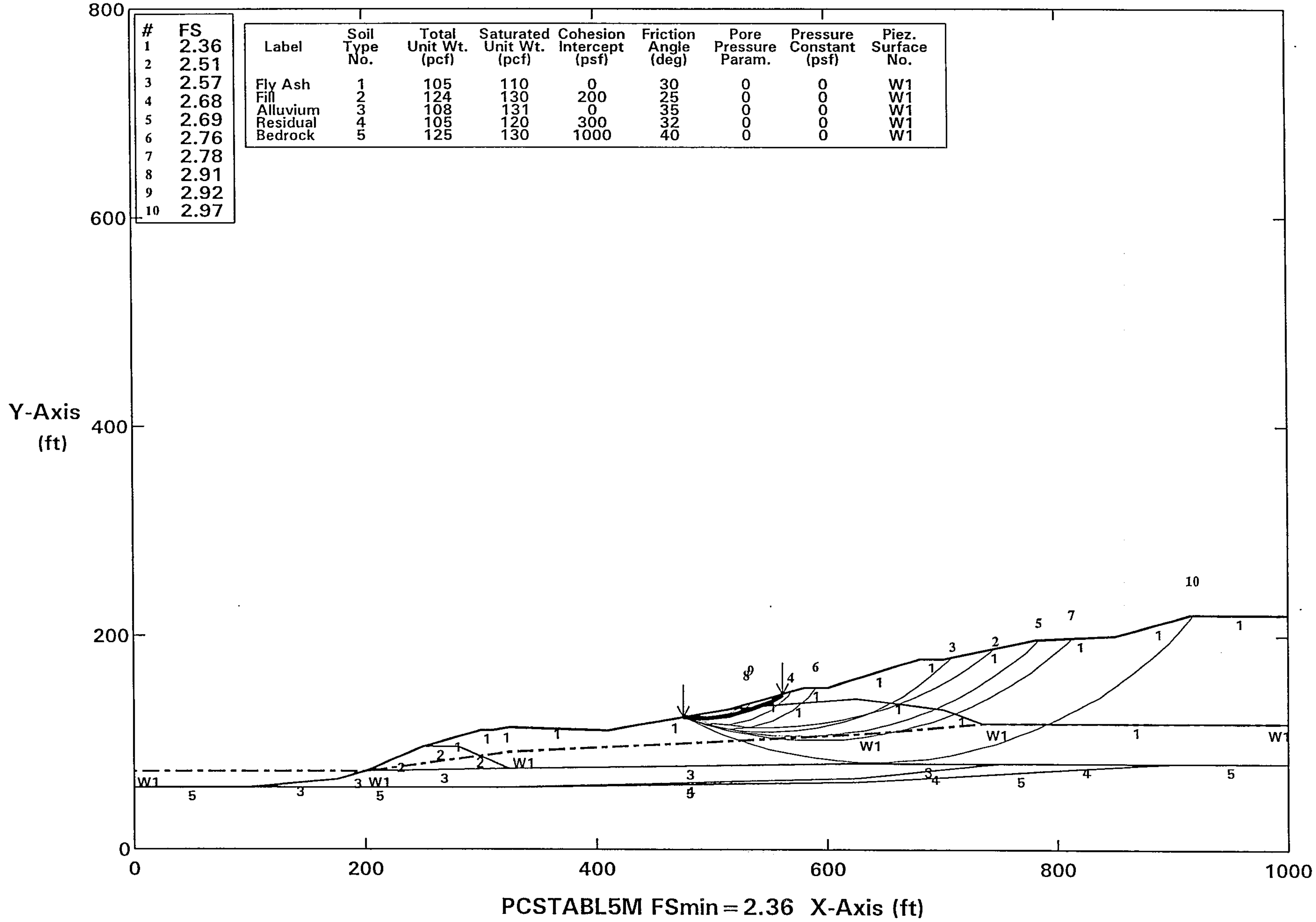
No.	HORIZONTAL		Load	Load	Shear	VERTICAL	
	Dial Reading	Def. in	Dial Units	lbs.	Stress ksf	Dial Reading	Def. in
0	0.0000	0.000	0.00	0.0	0.00	0.0000	0.0000
1	0.0200	0.020	33.00	33.0	0.97	0.0000	0.0000
2	0.0400	0.040	48.00	48.0	1.41	0.0000	0.0000
3	0.0600	0.060	58.00	58.0	1.70	0.0000	0.0000
4	0.0900	0.090	62.00	62.0	1.82	0.0000	0.0000
5	0.1500	0.150	63.00	63.0	1.85	0.0000	0.0000
6	0.2000	0.200	80.00	80.0	2.35	0.0000	0.0000
7	0.2500	0.250	85.00	85.0	2.49	0.0000	0.0000
8	0.2900	0.290	84.00	84.0	2.46	0.0000	0.0000

LAW ENGINEERING, INC.

APPENDIX D

TVA - JOHN SEVIER (Proposed East) (File Sevier.PE)

Ten Most Critical. C:SEVIER.PLT By: DAN GROGAN 09-29-94 5:12pm



#	FS
1	2.36
2	2.51
3	2.57
4	2.68
5	2.69
6	2.76
7	2.78
8	2.91
9	2.92
10	2.97

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Fly Ash	1	105	110	0	30	0	0	W1
Fill	2	124	130	200	25	0	0	W1
Alluvium	3	108	131	0	35	0	0	W1
Residual	4	105	120	300	32	0	0	W1
Bedrock	5	125	130	1000	40	0	0	W1

```
                       ** PCSTABL5M **

                             by
                      Purdue University
----------------------------------------------------------------------

                --Slope Stability Analysis--
            Simplified Janbu, Simplified Bishop
               or Spencer's Method of Slices


        Run Date:                  09-29-94
        Time of Run:               5:12pm
        Run By:                    DAN GROGAN
        Input Data Filename:       C:SEVIER.PE
        Output Filename:           C:SEVIER.OUT
        Plotted Output Filename:   C:SEVIER.PLT



        PROBLEM DESCRIPTION   TVA - JOHN SEVIER (Proposed East)
                              (File Sevier.PE)



        BOUNDARY COORDINATES

           17 Top   Boundaries
           33 Total Boundaries

        Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
          No.         (ft)       (ft)        (ft)       (ft)     Below Bnd

           1           .00      58.00      100.00      58.00         5
           2        100.00      58.00      175.00      65.00         3
           3        175.00      65.00      200.00      73.00         3
           4        200.00      73.00      250.00      95.00         2
           5        250.00      95.00      300.00     110.00         1
           6        300.00     110.00      310.00     110.00         1
           7        310.00     110.00      325.00     112.00         1
           8        325.00     112.00      410.00     110.00         1
           9        410.00     110.00      515.00     130.00         1
          10        515.00     130.00      580.00     150.00         1
          11        580.00     150.00      600.00     150.00         1
          12        600.00     150.00      680.00     178.00         1
          13        680.00     178.00      700.00     178.00         1
          14        700.00     178.00      780.00     196.00         1
          15        780.00     196.00      850.00     200.00         1
          16        850.00     200.00      915.00     220.00         1
          17        915.00     220.00     1000.00     220.00         1
          18        515.00     130.00      625.00     140.00         1
          19        625.00     140.00      700.00     130.00         1
          20        700.00     130.00      735.00     116.00         1
          21        735.00     116.00     1000.00     116.00         1
          22        250.00      95.00      280.00      95.00         2
```

```
      23        280.00        95.00       325.00        75.00          2
      24        200.00        73.00       325.00        75.00          3
      25        325.00        75.00       625.00        80.00          3
      26        625.00        80.00       750.00        80.00          3
      27        750.00        80.00       900.00        80.00          4
      28        900.00        80.00      1000.00        80.00          5
      29        100.00        58.00       325.00        58.00          5
      30        325.00        58.00       625.00        66.00          4
      31        625.00        66.00       750.00        80.00          4
      32        325.00        58.00       625.00        63.00          5
      33        625.00        63.00       900.00        80.00          5
------------------------------------------------------------------------------

         ISOTROPIC SOIL PARAMETERS

          5 Type(s) of Soil

          Soil   Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
          Type Unit Wt. Unit Wt.  Intercept  Angle   Pressure Constant  Surface
           No.   (pcf)    (pcf)     (psf)    (deg)    Param.    (psf)     No.

            1    105.0    110.0        .0     30.0     .00        .0       1
            2    124.0    130.0     200.0     25.0     .00        .0       1
            3    108.0    131.0        .0     35.0     .00        .0       1
            4    105.0    120.0     300.0     32.0     .00        .0       1
            5    125.0    130.0    1000.0     40.0     .00        .0       1
------------------------------------------------------------------------------

          1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

          Unit Weight of Water =   62.40

          Piezometric Surface No.   1 Specified by   6 Coordinate Points

            Point        X-Water      Y-Water
             No.           (ft)         (ft)

              1             .00        73.00
              2          200.00        73.00
              3          325.00        90.00
              4          625.00       106.00
              5          735.00       116.00
              6         1000.00       116.00
------------------------------------------------------------------------------

          A Critical Failure Surface Searching Method, Using A Random
          Technique For Generating Circular Surfaces, Has Been Specified.
```

```
         100 Trial Surfaces Have Been Generated.


          50 Surfaces Initiate From Each Of  2 Points Equally Spaced
         Along The Ground Surface Between    X = 100.00 ft.
                                       and   X = 475.00 ft.


         Each Surface Terminates Between     X = 475.00 ft.
                                      and    X = 950.00 ft.


         Unless Further Limitations Were Imposed, The Minimum Elevation
         At Which A Surface Extends Is  Y =    .00 ft.


         20.00 ft. Line Segments Define Each Trial Failure Surface.

--------------------------------------------------------------------------------

         Following Are Displayed The Ten Most Critical Of The Trial
         Failure Surfaces Examined.  They Are Ordered - Most Critical
         First.


         * * Safety Factors Are Calculated By The Modified Bishop Method * *


         Failure Surface Specified By  6 Coordinate Points


           Point        X-Surf        Y-Surf
            No.          (ft)          (ft)

             1          475.00        122.38
             2          494.99        121.70
             3          514.84        124.15
             4          534.07        129.66
             5          552.20        138.10
             6          561.37        144.27

         Circle Center At X =  489.4 ; Y =  246.8  and Radius,  125.3

               ***     2.358   ***



              Individual data on the      7  slices

                                Water    Water      Tie      Tie     Earthquake
                                Force    Force     Force    Force      Force   Surcharge
 Slice   Width     Weight        Top      Bot      Norm      Tan     Hor      Ver     Load
  No.    Ft(m)    Lbs(kg)    Lbs(kg)  Lbs(kg)   Lbs(kg)  Lbs(kg) Lbs(kg)  Lbs(kg)  Lbs(kg)
```

```
   1     20.0   4705.1       .0      .0       .0      .0      .0      .0      .0
   2     19.8  10735.6       .0      .0       .0      .0      .0      .0      .0
   3       .2     98.3       .0      .0       .0      .0      .0      .0      .0
   4     19.1  12019.1       .0      .0       .0      .0      .0      .0      .0
   5      5.5   3352.9       .0      .0       .0      .0      .0      .0      .0
   6     12.6   5740.7       .0      .0       .0      .0      .0      .0      .0
   7      9.2   1612.3       .0      .0       .0      .0      .0      .0      .0

         Failure Surface Specified By 16 Coordinate Points


           Point         X-Surf        Y-Surf
            No.           (ft)          (ft)

             1          475.00        122.38
             2          494.49        117.88
             3          514.24        114.73
             4          534.16        112.94
             5          554.15        112.51
             6          574.13        113.45
             7          594.00        115.76
             8          613.66        119.42
             9          633.02        124.42
            10          652.00        130.73
            11          670.50        138.33
            12          688.44        147.17
            13          705.73        157.22
            14          722.30        168.43
            15          738.05        180.75
            16          746.68        188.50

         Circle Center At X =   550.4 ; Y =   403.9  and Radius,   291.4


               ***      2.513   ***



--------------------------------------------------------------------------------

         Failure Surface Specified By 14 Coordinate Points


           Point         X-Surf        Y-Surf
            No.           (ft)          (ft)

             1          475.00        122.38
             2          493.98        116.08
             3          513.48        111.61
             4          533.31        109.02
             5          553.30        108.32
             6          573.26        109.52
             7          593.02        112.61
             8          612.40        117.56
             9          631.22        124.33
            10          649.31        132.85
            11          666.51        143.06
            12          682.66        154.85
```

```
Circle Center At X =  574.3 ; Y =  389.4  and Radius,   284.9

      ***     2.688    ***



Failure Surface Specified By  8 Coordinate Points

  Point        X-Surf       Y-Surf
   No.          (ft)         (ft)

    1          475.00       122.38
    2          493.41       114.58
    3          513.13       111.19
    4          533.09       112.42
    5          552.24       118.18
    6          569.57       128.17
    7          584.14       141.87
    8          589.53       150.00
Circle Center At X =  517.7 ; Y =  196.8  and Radius,    85.8

      ***     2.756    ***
```

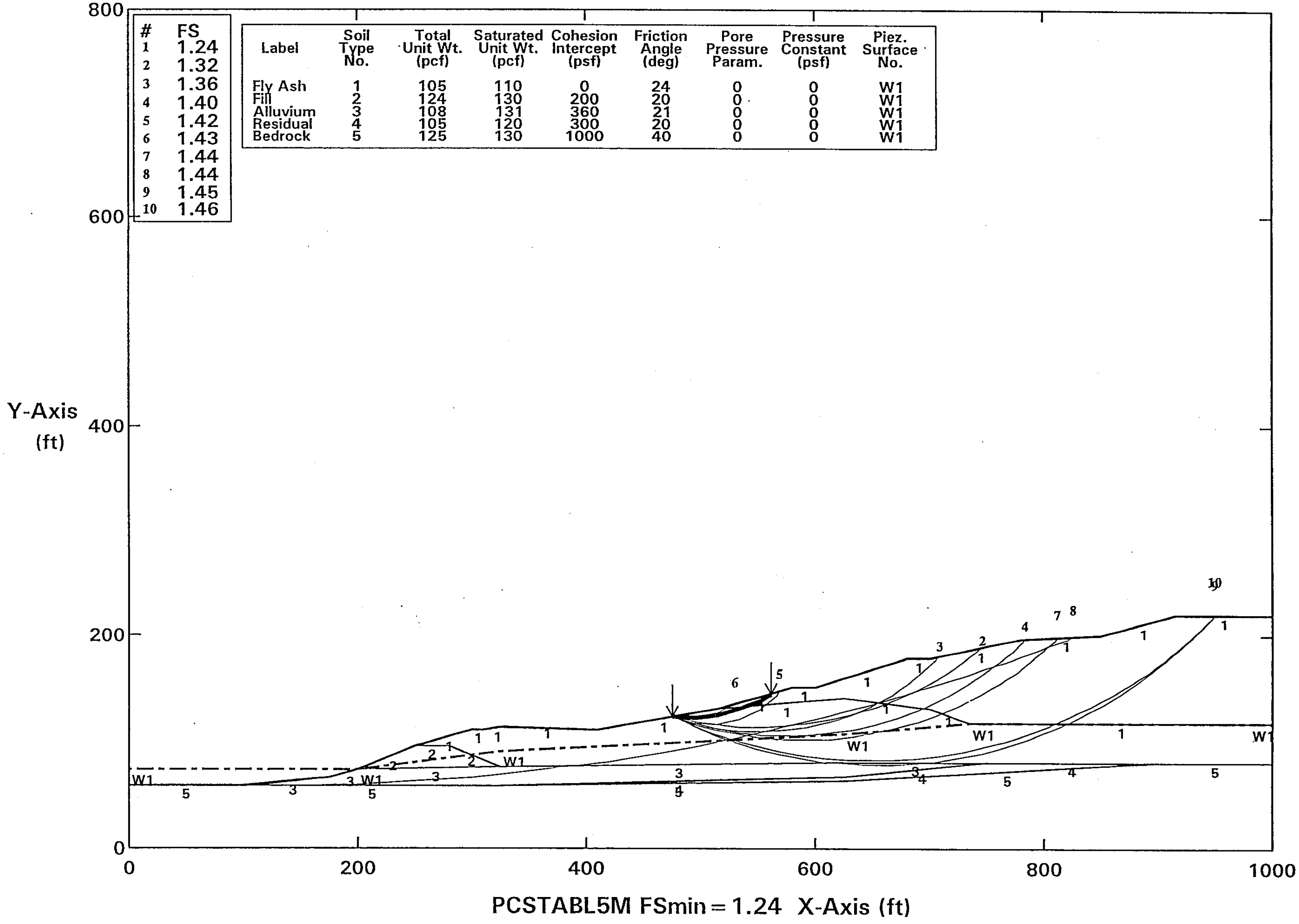
```
----------------------------------------------------------------------------------------

Failure Surface Specified By 20 Coordinate Points

  Point        X-Surf       Y-Surf
   No.          (ft)         (ft)

    1          475.00       122.38
    2          493.81       115.60
    3          513.03       110.05
    4          532.57       105.77
    5          552.34       102.76
    6          572.26       101.04
    7          592.26       100.63
    8          612.24       101.51
    9          632.12       103.69
   10          651.82       107.16
   11          671.25       111.91
   12          690.33       117.90
   13          708.98       125.12
   14          727.12       133.54
   15          744.67       143.13
   16          761.57       153.83
   17          777.73       165.61
   18          793.10       178.41
   19          807.60       192.19
```

```
   20        812.86      197.88

 Circle Center At X =   588.6 ; Y =   407.7  and Radius,    307.1

      ***     2.782   ***


 Failure Surface Specified By  4 Coordinate Points

   Point        X-Surf       Y-Surf
    No.          (ft)         (ft)

     1          475.00       122.38
     2          495.00       122.15
     3          514.48       126.68
     4          530.44       134.75

 Circle Center At X =   485.9 ; Y =   203.8  and Radius,     82.2

      ***     2.906   ***

-------------------------------------------------------------------------

 Failure Surface Specified By  5 Coordinate Points

   Point        X-Surf       Y-Surf
    No.          (ft)         (ft)

     1          475.00       122.38
     2          494.89       120.25
     3          514.49       124.19
     4          532.00       133.86
     5          533.86       135.80

 Circle Center At X =   491.9 ; Y =   185.9  and Radius,     65.7

      ***     2.923   ***


 Failure Surface Specified By 26 Coordinate Points

   Point        X-Surf       Y-Surf
    No.          (ft)         (ft)

     1          475.00       122.38
     2          492.87       113.40
```

```
      3         511.23        105.47
      4         530.02         98.61
      5         549.17         92.84
      6         568.62         88.19
      7         588.31         84.67
      8         608.16         82.28
      9         628.13         81.05
     10         648.13         80.96
     11         668.10         82.03
     12         687.97         84.25
     13         707.69         87.61
     14         727.18         92.10
     15         746.38         97.71
     16         765.22        104.42
     17         783.64        112.20
     18         801.59        121.02
     19         819.00        130.87
     20         835.81        141.71
     21         851.97        153.49
     22         867.42        166.19
     23         882.11        179.76
     24         896.00        194.15
     25         909.04        209.32
     26         917.20        220.00

 Circle Center At X =  639.5 ; Y =  427.5  and Radius,  346.6

       ***     2.974    ***
```

TVA - JOHN SEVIER (Proposed East) (File Sevier.PEE-EQ)

Ten Most Critical. C:SEVIER.PLT By: DAN GROGAN 09-29-94 5:18pm



#	FS
1	1.24
2	1.32
3	1.36
4	1.40
5	1.42
6	1.43
7	1.44
8	1.44
9	1.45
10	1.46

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Fly Ash	1	105	110	0	24	0	0	W1
Fill	2	124	130	200	20	0	0	W1
Alluvium	3	108	131	360	21	0	0	W1
Residual	4	105	120	300	20	0	0	W1
Bedrock	5	125	130	1000	40	0	0	W1

```
                        ** PCSTABL5M **

                              by
                       Purdue University
--------------------------------------------------------------------------

                  --Slope Stability Analysis--
              Simplified Janbu, Simplified Bishop
                 or Spencer's Method of Slices


      Run Date:                  09-29-94
      Time of Run:               5:18pm
      Run By:                    DAN GROGAN
      Input Data Filename:       C:SEVIER.PEE
      Output Filename:           C:SEVIER.OUT
      Plotted Output Filename:   C:SEVIER.PLT


      PROBLEM DESCRIPTION    TVA - JOHN SEVIER (Proposed East)
                             (File Sevier.PEE-EQ)


      BOUNDARY COORDINATES

         17 Top   Boundaries
         33 Total Boundaries

      Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
         No.        (ft)       (ft)        (ft)       (ft)     Below Bnd

          1           .00      58.00     100.00      58.00        5
          2        100.00      58.00     175.00      65.00        3
          3        175.00      65.00     200.00      73.00        3
          4        200.00      73.00     250.00      95.00        2
          5        250.00      95.00     300.00     110.00        1
          6        300.00     110.00     310.00     110.00        1
          7        310.00     110.00     325.00     112.00        1
          8        325.00     112.00     410.00     110.00        1
          9        410.00     110.00     515.00     130.00        1
         10        515.00     130.00     580.00     150.00        1
         11        580.00     150.00     600.00     150.00        1
         12        600.00     150.00     680.00     178.00        1
         13        680.00     178.00     700.00     178.00        1
         14        700.00     178.00     780.00     196.00        1
         15        780.00     196.00     850.00     200.00        1
         16        850.00     200.00     915.00     220.00        1
         17        915.00     220.00    1000.00     220.00        1
         18        515.00     130.00     625.00     140.00        1
         19        625.00     140.00     700.00     130.00        1
         20        700.00     130.00     735.00     116.00        1
         21        735.00     116.00    1000.00     116.00        1
         22        250.00      95.00     280.00      95.00        2
```

```
     23        280.00      95.00     325.00      75.00          2
     24        200.00      73.00     325.00      75.00          3
     25        325.00      75.00     625.00      80.00          3
     26        625.00      80.00     750.00      80.00          3
     27        750.00      80.00     900.00      80.00          4
     28        900.00      80.00    1000.00      80.00          5
     29        100.00      58.00     325.00      58.00          5
     30        325.00      58.00     625.00      66.00          4
     31        625.00      66.00     750.00      80.00          4
     32        325.00      58.00     625.00      63.00          5
     33        625.00      63.00     900.00      80.00          5
-------------------------------------------------------------------------------


  ISOTROPIC SOIL PARAMETERS


   5 Type(s) of Soil


  Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
  Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
   No.  (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)     No.

    1   105.0    110.0        .0      24.0     .00        .0      1
    2   124.0    130.0     200.0      20.0     .00        .0      1
    3   108.0    131.0     360.0      21.0     .00        .0      1
    4   105.0    120.0     300.0      20.0     .00        .0      1
    5   125.0    130.0    1000.0      40.0     .00        .0      1
-------------------------------------------------------------------------------


  1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED


  Unit Weight of Water =  62.40


  Piezometric Surface No.  1 Specified by  6 Coordinate Points


    Point       X-Water      Y-Water
     No.          (ft)         (ft)

      1            .00        73.00
      2         200.00        73.00
      3         325.00        90.00
      4         625.00       106.00
      5         735.00       116.00
      6        1000.00       116.00


  A Horizontal Earthquake Loading Coefficient
  Of .100 Has Been Assigned

  A Vertical Earthquake Loading Coefficient
```

```
Of .100 Has Been Assigned

Cavitation Pressure =      .0 psf
------------------------------------------------------------------------------


A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.


100 Trial Surfaces Have Been Generated.


 50 Surfaces Initiate From Each Of  2 Points Equally Spaced
Along The Ground Surface Between  X = 100.00 ft.
                             and  X = 475.00 ft.


Each Surface Terminates Between   X = 475.00 ft.
                            and   X = 950.00 ft.


Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =   .00 ft.


20.00 ft. Line Segments Define Each Trial Failure Surface.


------------------------------------------------------------------------------

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined.  They Are Ordered - Most Critical
First.


* * Safety Factors Are Calculated By The Modified Bishop Method * *


Failure Surface Specified By  6 Coordinate Points


  Point       X-Surf      Y-Surf
   No.         (ft)        (ft)

    1         475.00      122.38
    2         494.99      121.70
    3         514.84      124.15
    4         534.07      129.66
    5         552.20      138.10
    6         561.37      144.27

Circle Center At X =  489.4 ; Y =  246.8  and Radius,  125.3

      ***     1.237   ***
```

```
              Individual data on the      7  slices

                                   Water   Water       Tie       Tie      Earthquake
                                   Force   Force      Force     Force         Force    Surcharge
 Slice   Width     Weight           Top     Bot        Norm      Tan       Hor        Ver       Load
  No.    Ft(m)     Lbs(kg)     Lbs(kg) Lbs(kg)    Lbs(kg)   Lbs(kg)   Lbs(kg)    Lbs(kg)    Lbs(kg)
   1      20.0      4705.1          .0       .0         .0        .0     470.5      470.5         .0
   2      19.8     10735.6          .0       .0         .0        .0    1073.6     1073.6         .0
   3        .2        98.3          .0       .0         .0        .0       9.8        9.8         .0
   4      19.1     12019.1          .0       .0         .0        .0    1201.9     1201.9         .0
   5       5.5      3352.9          .0       .0         .0        .0     335.3      335.3         .0
   6      12.6      5740.7          .0       .0         .0        .0     574.1      574.1         .0
   7       9.2      1612.3          .0       .0         .0        .0     161.2      161.2         .0
          Failure Surface Specified By 16 Coordinate Points


            Point          X-Surf         Y-Surf
             No.            (ft)           (ft)

              1            475.00         122.38
              2            494.49         117.88
              3            514.24         114.73
              4            534.16         112.94
              5            554.15         112.51
              6            574.13         113.45
              7            594.00         115.76
              8            613.66         119.42
              9            633.02         124.42
             10            652.00         130.73
             11            670.50         138.33
             12            688.44         147.17
             13            705.73         157.22
             14            722.30         168.43
             15            738.05         180.75
             16            746.68         188.50

          Circle Center At X =   550.4 ; Y =   403.9  and Radius,   291.4


               ***     1.319    ***



 --------------------------------------------------------------------------------


          Failure Surface Specified By 14 Coordinate Points


            Point          X-Surf         Y-Surf
             No.            (ft)           (ft)

              1            475.00         122.38
              2            493.98         116.08
```

```
      3         513.48       111.61
      4         533.31       109.02
      5         553.30       108.32
      6         573.26       109.52
      7         593.02       112.61
      8         612.40       117.56
      9         631.22       124.33
     10         649.31       132.85
     11         666.51       143.06
     12         682.66       154.85
     13         697.62       168.13
     14         708.62       179.94

 Circle Center At X =  550.6 ; Y =  318.3  and Radius,  210.0

         ***     1.362   ***



 Failure Surface Specified By 18 Coordinate Points

    Point       X-Surf       Y-Surf
     No.         (ft)         (ft)

      1         475.00       122.38
      2         493.98       116.08
      3         513.36       111.12
      4         533.03       107.53
      5         552.91       105.33
      6         572.89       104.53
      7         592.88       105.13
      8         612.78       107.13
      9         632.50       110.52
     10         651.92       115.28
     11         670.96       121.39
     12         689.53       128.83
     13         707.53       137.54
     14         724.88       147.50
     15         741.48       158.65
     16         757.26       170.93
     17         772.15       184.29
     18         783.69       196.21
 Circle Center At X =  574.3 ; Y =  389.4  and Radius,  284.9

         ***     1.404   ***

---------------------------------------------------------------------

 Failure Surface Specified By  7 Coordinate Points
```

```
       Point        X-Surf       Y-Surf
        No.          (ft)         (ft)

         1          475.00       122.38
         2          494.04       116.27
         3          514.02       115.29
         4          533.57       119.51
         5          551.36       128.65
         6          566.18       142.08
         7          569.13       146.65

   Circle Center At X =  507.7 ; Y =  191.7  and Radius,   76.6

         ***     1.420   ***


   Failure Surface Specified By  4 Coordinate Points

       Point        X-Surf       Y-Surf
        No.          (ft)         (ft)

         1          475.00       122.38
         2          495.00       122.15
         3          514.48       126.68
         4          530.44       134.75

   Circle Center At X =  485.9 ; Y =  203.8  and Radius,   82.2

         ***     1.430   ***

---------------------------------------------------------------------------

   Failure Surface Specified By 20 Coordinate Points

       Point        X-Surf       Y-Surf
        No.          (ft)         (ft)

         1          475.00       122.38
         2          493.81       115.60
         3          513.03       110.05
         4          532.57       105.77
         5          552.34       102.76
         6          572.26       101.04
         7          592.26       100.63
         8          612.24       101.51
         9          632.12       103.69
        10          651.82       107.16
        11          671.25       111.91
        12          690.33       117.90
        13          708.98       125.12
```

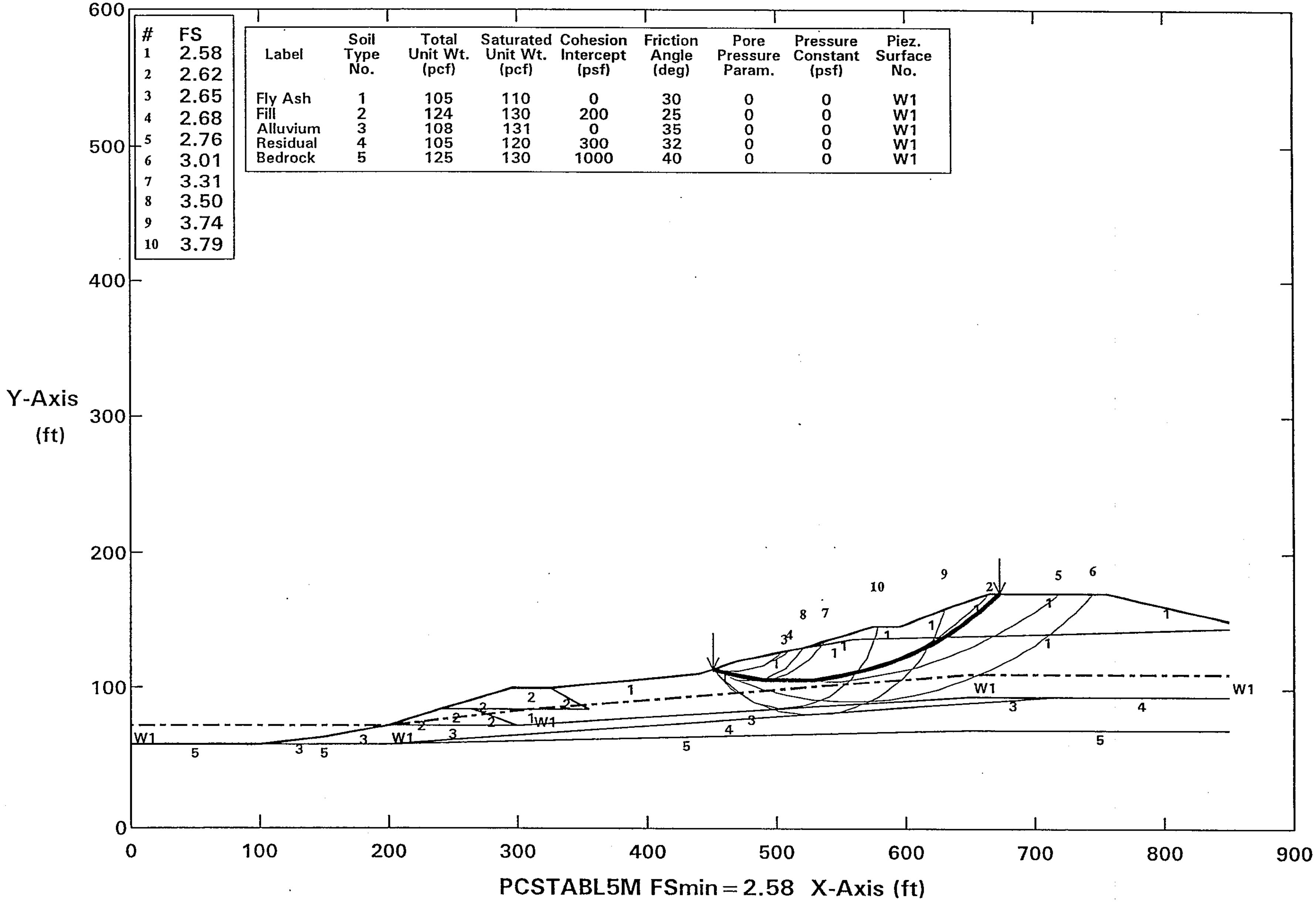
```
     14          727.12       133.54
     15          744.67       143.13
     16          761.57       153.83
     17          777.73       165.61
     18          793.10       178.41
     19          807.60       192.19
     20          812.86       197.88

 Circle Center At X =  588.6 ; Y =  407.7  and Radius,  307.1


        ***      1.436   ***




 Failure Surface Specified By 39 Coordinate Points


    Point        X-Surf       Y-Surf
     No.          (ft)         (ft)

      1          100.00        58.00
      2          120.00        57.71
      3          140.00        57.66
      4          160.00        57.82
      5          179.99        58.22
      6          199.98        58.84
      7          219.97        59.69
      8          239.94        60.76
      9          259.89        62.06
     10          279.84        63.59
     11          299.76        65.34
     12          319.66        67.32
     13          339.54        69.53
     14          359.39        71.96
     15          379.21        74.61
     16          399.01        77.49
     17          418.76        80.59
     18          438.49        83.92
     19          458.17        87.47
     20          477.81        91.24
     21          497.41        95.23
     22          516.96        99.45
     23          536.46       103.89
     24          555.91       108.55
     25          575.30       113.43
     26          594.64       118.52
     27          613.92       123.84
     28          633.14       129.38
     29          652.30       135.13
     30          671.38       141.10
     31          690.40       147.28
     32          709.35       153.69
     33          728.23       160.30
     34          747.02       167.13
     35          765.74       174.17
     36          784.38       181.42
```

```
       37          802.94       188.89
       38          821.41       196.56
       39          826.26       198.64

     Circle Center At X =   135.2 ; Y = 1822.2  and Radius, 1764.5


           ***     1.441    ***



------------------------------------------------------------------------------

     Failure Surface Specified By 28 Coordinate Points


        Point          X-Surf        Y-Surf
         No.            (ft)          (ft)

          1            475.00        122.38
          2            492.87        113.40
          3            511.19        105.37
          4            529.91         98.33
          5            548.97         92.28
          6            568.33         87.25
          7            587.92         83.25
          8            607.70         80.29
          9            627.61         78.38
         10            647.59         77.52
         11            667.59         77.72
         12            687.55         78.98
         13            707.42         81.29
         14            727.14         84.65
         15            746.65         89.04
         16            765.90         94.46
         17            784.84        100.89
         18            803.41        108.31
         19            821.56        116.70
         20            839.25        126.04
         21            856.42        136.30
         22            873.02        147.46
         23            889.01        159.47
         24            904.34        172.32
         25            918.97        185.95
         26            932.86        200.34
         27            945.97        215.44
         28            949.52        220.00

     Circle Center At X =   653.8 ; Y =   455.6  and Radius,   378.1

           ***     1.450    ***



     Failure Surface Specified By 28 Coordinate Points
```

```
 Point        X-Surf        Y-Surf
  No.          (ft)          (ft)

   1          475.00        122.38
   2          493.18        114.05
   3          511.77        106.65
   4          530.69        100.20
   5          549.93         94.71
   6          569.41         90.19
   7          589.10         86.66
   8          608.93         84.13
   9          628.88         82.60
  10          648.87         82.07
  11          668.86         82.56
  12          688.81         84.05
  13          708.65         86.55
  14          728.34         90.04
  15          747.84         94.52
  16          767.08         99.97
  17          786.02        106.39
  18          804.61        113.75
  19          822.81        122.05
  20          840.57        131.25
  21          857.85        141.33
  22          874.59        152.27
  23          890.76        164.04
  24          906.32        176.60
  25          921.22        189.94
  26          935.43        204.01
  27          948.92        218.78
  28          949.93        220.00

Circle Center At X =  649.2 ; Y =  478.8  and Radius,  396.7

     ***     1.455   ***
```

TVA - JOHN SEVIER (Proposed West) (File Sevier.PW)

Ten Most Critical. C:SEVIER.PLT By: DAN GROGAN 09-29-94 5:01pm



#	FS
1	2.58
2	2.62
3	2.65
4	2.68
5	2.76
6	3.01
7	3.31
8	3.50
9	3.74
10	3.79

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Fly Ash	1	105	110	0	30	0	0	W1
Fill	2	124	130	200	25	0	0	W1
Alluvium	3	108	131	0	35	0	0	W1
Residual	4	105	120	300	32	0	0	W1
Bedrock	5	125	130	1000	40	0	0	W1

```
                      ** PCSTABL5M **

                            by
                      Purdue University
------------------------------------------------------------------------------

               --Slope Stability Analysis--
             Simplified Janbu, Simplified Bishop
               or Spencer's Method of Slices


      Run Date:                    09-29-94
      Time of Run:                 5:01pm
      Run By:                      DAN GROGAN
      Input Data Filename:         C:SEVIER.PW
      Output Filename:             C:SEVIER.OUT
      Plotted Output Filename:     C:SEVIER.PLT



      PROBLEM DESCRIPTION   TVA - JOHN SEVIER (Proposed West)
                             (File Sevier.PW)



      BOUNDARY COORDINATES

         15 Top   Boundaries
         29 Total Boundaries


      Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
         No.        (ft)       (ft)        (ft)       (ft)     Below Bnd

          1           .00      60.00      100.00      60.00        5
          2        100.00      60.00      150.00      65.00        3
          3        150.00      65.00      200.00      73.00        3
          4        200.00      73.00      240.00      85.00        2
          5        240.00      85.00      295.00     100.00        2
          6        295.00     100.00      325.00     100.00        2
          7        325.00     100.00      440.00     110.00        1
          8        440.00     110.00      470.00     120.00        1
          9        470.00     120.00      520.00     130.00        1
         10        520.00     130.00      575.00     146.00        1
         11        575.00     146.00      595.00     146.00        1
         12        595.00     146.00      635.00     160.00        1
         13        635.00     160.00      665.00     170.00        1
         14        665.00     170.00      755.00     170.00        1
         15        755.00     170.00      850.00     150.00        1
         16        520.00     130.00      560.00     136.00        1
         17        560.00     136.00      850.00     145.00        1
         18        325.00     100.00      355.00      85.00        2
         19        240.00      85.00      265.00      85.00        2
         20        265.00      85.00      355.00      85.00        1
         21        265.00      85.00      300.00      73.00        2
         22        200.00      73.00      300.00      73.00        3
```

```
        23        300.00      73.00     650.00      95.00        3
        24        650.00      95.00     715.00      95.00        3
        25        715.00      95.00     850.00      95.00        4
        26        100.00      60.00     200.00      60.00        5
        27        200.00      60.00     715.00      95.00        4
        28        200.00      60.00     650.00      70.00        5
        29        650.00      70.00     850.00      70.00        5
--------------------------------------------------------------------------------


     ISOTROPIC SOIL PARAMETERS


      5 Type(s) of Soil

      Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
      Type Unit Wt. Unit Wt. Intercept  Angle   Pressure Constant  Surface
       No.  (pcf)    (pcf)     (psf)    (deg)    Param.   (psf)      No.

        1   105.0    110.0       .0     30.0      .00       .0        1
        2   124.0    130.0    200.0     25.0      .00       .0        1
        3   108.0    131.0       .0     35.0      .00       .0        1
        4   105.0    120.0    300.0     32.0      .00       .0        1
        5   125.0    130.0   1000.0     40.0      .00       .0        1
--------------------------------------------------------------------------------


      1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED


      Unit Weight of Water =  62.40


      Piezometric Surface No.  1 Specified by  5 Coordinate Points


        Point       X-Water     Y-Water
         No.          (ft)        (ft)

          1            .00       73.00
          2         200.00       73.00
          3         310.00       85.00
          4         650.00      110.00
          5         850.00      110.00
--------------------------------------------------------------------------------


      A Critical Failure Surface Searching Method, Using A Random
      Technique For Generating Circular Surfaces, Has Been Specified.


       40 Trial Surfaces Have Been Generated.


       20 Surfaces Initiate From Each Of  2 Points Equally Spaced
      Along The Ground Surface Between  X = 100.00 ft.
```

```
                                   and   X = 450.00 ft.

         Each Surface Terminates Between   X = 450.00 ft.
                                  and   X = 750.00 ft.

         Unless Further Limitations Were Imposed, The Minimum Elevation
         At Which A Surface Extends Is  Y =   .00 ft.

         20.00 ft. Line Segments Define Each Trial Failure Surface.

--------------------------------------------------------------------------------

         Following Are Displayed The Ten Most Critical Of The Trial
         Failure Surfaces Examined.  They Are Ordered - Most Critical
         First.

         * * Safety Factors Are Calculated By The Modified Bishop Method * *


         Failure Surface Specified By 13 Coordinate Points

           Point        X-Surf       Y-Surf
            No.          (ft)         (ft)

             1          450.00       113.33
             2          469.56       109.15
             3          489.40       106.62
             4          509.38       105.76
             5          529.36       106.58
             6          549.21       109.06
             7          568.77       113.20
             8          587.93       118.96
             9          606.53       126.31
            10          624.45       135.18
            11          641.57       145.53
            12          657.76       157.27
            13          672.52       170.00

         Circle Center At X =  509.6 ; Y =  344.4  and Radius,  238.7

               ***     2.581   ***


              Individual data on the    20  slices

                              Water  Water    Tie     Tie     Earthquake
                              Force  Force   Force   Force       Force    Surcharge
```

```
 Slice   Width    Weight     Top      Bot      Norm      Tan      Hor      Ver      Load
  No.    Ft(m)   Lbs(kg)  Lbs(kg)  Lbs(kg)  Lbs(kg)  Lbs(kg)  Lbs(kg)  Lbs(kg)  Lbs(kg)
   1     19.6   10988.5      .0       .0        .0       .0       .0       .0       .0
   2       .4     501.1      .0       .0        .0       .0       .0       .0       .0
   3     19.4   28681.9      .0       .0        .0       .0       .0       .0       .0
   4     20.0   41305.6      .0       .0        .0       .0       .0       .0       .0
   5     10.6   25606.8      .0       .0        .0       .0       .0       .0       .0
   6      9.4   24554.3      .0       .0        .0       .0       .0       .0       .0
   7     19.8   57911.3      .0       .0        .0       .0       .0       .0       .0
   8     10.8   33843.4      .0       .0        .0       .0       .0       .0       .0
   9      8.8   28230.8      .0       .0        .0       .0       .0       .0       .0
  10      6.2   20237.1      .0       .0        .0       .0       .0       .0       .0
  11     12.9   39338.8      .0       .0        .0       .0       .0       .0       .0
  12      7.1   19045.0      .0       .0        .0       .0       .0       .0       .0
  13     11.5   29037.4      .0       .0        .0       .0       .0       .0       .0
  14     17.9   42202.8      .0       .0        .0       .0       .0       .0       .0
  15      4.9   10573.2      .0       .0        .0       .0       .0       .0       .0
  16      5.6   11338.7      .0       .0        .0       .0       .0       .0       .0
  17      6.6   12100.8      .0       .0        .0       .0       .0       .0       .0
  18     16.2   22925.2      .0       .0        .0       .0       .0       .0       .0
  19      7.2    6387.8      .0       .0        .0       .0       .0       .0       .0
  20      7.5    2561.2      .0       .0        .0       .0       .0       .0       .0

         Failure Surface Specified By 13 Coordinate Points


           Point         X-Surf        Y-Surf
            No.           (ft)          (ft)

             1          450.00        113.33
             2          469.52        108.95
             3          489.34        106.35
             4          509.33        105.53
             5          529.30        106.51
             6          549.11        109.28
             7          568.59        113.81
             8          587.58        120.08
             9          605.94        128.03
            10          623.50        137.59
            11          640.14        148.69
            12          655.71        161.24
            13          664.65        169.88

         Circle Center At X =  508.4 ; Y =  328.0  and Radius,  222.5

               ***      2.624   ***


------------------------------------------------------------------------------

         Failure Surface Specified By  4 Coordinate Points


           Point         X-Surf        Y-Surf
            No.           (ft)          (ft)
```

```
           1         450.00       113.33
           2         469.98       112.53
           3         489.38       117.40
           4         506.08       127.22

       Circle Center At X =  462.8 ; Y =  182.0  and Radius,   69.9


             ***     2.649   ***



       Failure Surface Specified By  5 Coordinate Points


         Point       X-Surf       Y-Surf
          No.         (ft)         (ft)

           1         450.00       113.33
           2         469.98       112.42
           3         489.52       116.70
           4         507.28       125.89
           5         509.48       127.90

       Circle Center At X =  463.5 ; Y =  188.8  and Radius,   76.6


             ***     2.676   ***


 ---------------------------------------------------------------------------

       Failure Surface Specified By 16 Coordinate Points


         Point       X-Surf       Y-Surf
          No.         (ft)         (ft)

           1         450.00       113.33
           2         469.60       109.34
           3         489.41       106.57
           4         509.35       105.04
           5         529.34       104.74
           6         549.32       105.68
           7         569.20       107.86
           8         588.91       111.27
           9         608.37       115.89
          10         627.50       121.71
          11         646.24       128.70
          12         664.51       136.84
          13         682.24       146.10
          14         699.36       156.44
          15         715.80       167.82
          16         718.57       170.00

       Circle Center At X =  524.1 ; Y =  426.8  and Radius,  322.1
```

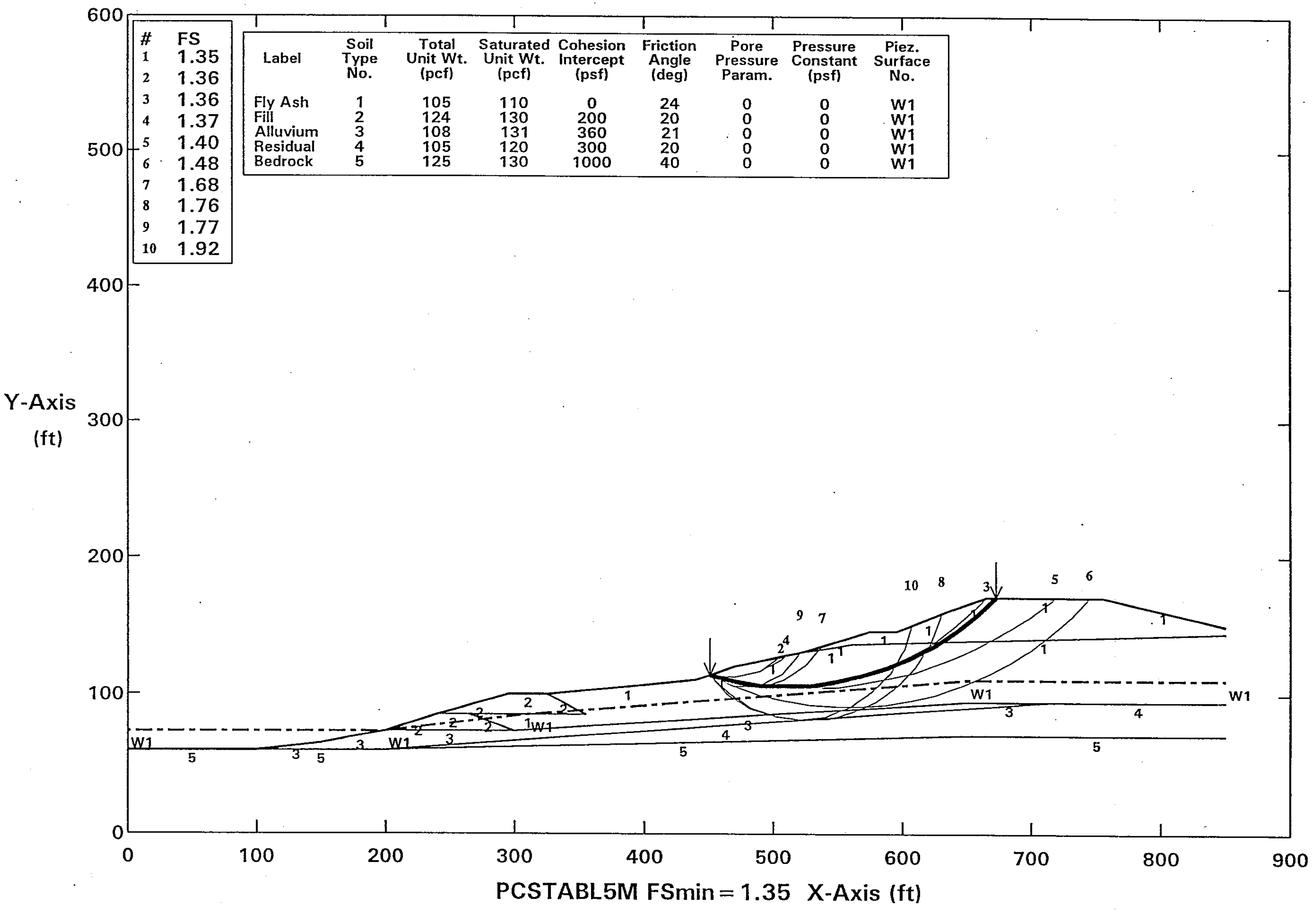
```
        ***      2.757    ***



     Failure Surface Specified By 17 Coordinate Points

       Point       X-Surf       Y-Surf
        No.         (ft)         (ft)

         1        450.00       113.33
         2        468.57       105.92
         3        487.66        99.93
         4        507.14        95.41
         5        526.91        92.38
         6        546.85        90.86
         7        566.85        90.86
         8        586.79        92.38
         9        606.56        95.40
        10        626.05        99.92
        11        645.13       105.90
        12        663.71       113.32
        13        681.67       122.12
        14        698.91       132.26
        15        715.33       143.67
        16        730.83       156.31
        17        745.25       170.00

     Circle Center At X =  556.9 ; Y =  354.0  and Radius,  263.4

        ***      3.010    ***


-------------------------------------------------------------------------

     Failure Surface Specified By  6 Coordinate Points

       Point       X-Surf       Y-Surf
        No.         (ft)         (ft)

         1        450.00       113.33
         2        468.69       106.20
         3        488.65       105.06
         4        508.03       110.02
         5        524.99       120.61
         6        537.25       135.02

     Circle Center At X =  482.3 ; Y =  169.8  and Radius,   65.0

        ***      3.313    ***
```

```
     Failure Surface Specified By  6 Coordinate Points


        Point        X-Surf       Y-Surf
         No.          (ft)         (ft)

          1          450.00       113.33
          2          468.56       105.89
          3          488.56       106.31
          4          506.79       114.54
          5          520.34       129.25
          6          520.67       130.20

     Circle Center At X =  477.5 ; Y =  154.8  and Radius,    49.7


             ***     3.500   ***


--------------------------------------------------------------------------------

     Failure Surface Specified By 13 Coordinate Points


        Point        X-Surf       Y-Surf
         No.          (ft)         (ft)

          1          450.00       113.33
          2          465.32       100.48
          3          482.75        90.66
          4          501.68        84.22
          5          521.48        81.37
          6          541.46        82.22
          7          560.95        86.72
          8          579.27        94.73
          9          595.81       105.98
         10          609.99       120.08
         11          621.34       136.55
         12          629.47       154.82
         13          630.31       158.36

     Circle Center At X =  526.9 ; Y =  189.5  and Radius,  108.2


             ***     3.744   ***



     Failure Surface Specified By 10 Coordinate Points


        Point        X-Surf       Y-Surf
         No.          (ft)         (ft)
```

```
     1         450.00       113.33
     2         464.54        99.60
     3         482.27        90.35
     4         501.86        86.30
     5         521.81        87.75
     6         540.60        94.59
     7         556.81       106.30
     8         569.21       122.00
     9         576.86       140.48
    10         577.50       146.00

Circle Center At X =  506.4 ; Y =  158.2  and Radius,   72.1

      ***     3.787   ***
```

TVA - JOHN SEVIER (Proposed West) (File Sevier.PWE-EQ)

Ten Most Critical. C:SEVIER.PLT By: DAN GROGAN 09-29-94 5:06pm



#	FS
1	1.35
2	1.36
3	1.36
4	1.37
5	1.40
6	1.48
7	1.68
8	1.76
9	1.77
10	1.92

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Fly Ash	1	105	110	0	24	0	0	W1
Fill	2	124	130	200	20	0	0	W1
Alluvium	3	108	131	360	21	0	0	W1
Residual	4	105	120	300	20	0	0	W1
Bedrock	5	125	130	1000	40	0	0	W1

```
                       ** PCSTABL5M **

                             by
                      Purdue University
--------------------------------------------------------------------

                 --Slope Stability Analysis--
             Simplified Janbu, Simplified Bishop
               or Spencer's Method of Slices


      Run Date:                     09-29-94
      Time of Run:                  5:06pm
      Run By:                       DAN GROGAN
      Input Data Filename:          C:SEVIER.PWE
      Output Filename:              C:SEVIER.OUT
      Plotted Output Filename:      C:SEVIER.PLT



      PROBLEM DESCRIPTION    TVA - JOHN SEVIER (Proposed West)
                             (File Sevier.PWE-EQ)



      BOUNDARY COORDINATES

         15 Top   Boundaries
         29 Total Boundaries


      Boundary     X-Left     Y-Left     X-Right     Y-Right    Soil Type
        No.         (ft)       (ft)       (ft)        (ft)      Below Bnd

         1            .00      60.00     100.00       60.00         5
         2         100.00      60.00     150.00       65.00         3
         3         150.00      65.00     200.00       73.00         3
         4         200.00      73.00     240.00       85.00         2
         5         240.00      85.00     295.00      100.00         2
         6         295.00     100.00     325.00      100.00         2
         7         325.00     100.00     440.00      110.00         1
         8         440.00     110.00     470.00      120.00         1
         9         470.00     120.00     520.00      130.00         1
        10         520.00     130.00     575.00      146.00         1
        11         575.00     146.00     595.00      146.00         1
        12         595.00     146.00     635.00      160.00         1
        13         635.00     160.00     665.00      170.00         1
        14         665.00     170.00     755.00      170.00         1
        15         755.00     170.00     850.00      150.00         1
        16         520.00     130.00     560.00      136.00         1
        17         560.00     136.00     850.00      145.00         1
        18         325.00     100.00     355.00       85.00         2
        19         240.00      85.00     265.00       85.00         2
        20         265.00      85.00     355.00       85.00         1
        21         265.00      85.00     300.00       73.00         2
        22         200.00      73.00     300.00       73.00         3
```

```
         23        300.00       73.00      650.00       95.00          3
         24        650.00       95.00      715.00       95.00          3
         25        715.00       95.00      850.00       95.00          4
         26        100.00       60.00      200.00       60.00          5
         27        200.00       60.00      715.00       95.00          4
         28        200.00       60.00      650.00       70.00          5
         29        650.00       70.00      850.00       70.00          5
--------------------------------------------------------------------------------

     ISOTROPIC SOIL PARAMETERS


       5 Type(s) of Soil


      Soil   Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
      Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant  Surface
       No.   (pcf)    (pcf)     (psf)    (deg)   Param.    (psf)     No.

        1    105.0    110.0        .0     24.0     .00        .0       1
        2    124.0    130.0     200.0     20.0     .00        .0       1
        3    108.0    131.0     360.0     21.0     .00        .0       1
        4    105.0    120.0     300.0     20.0     .00        .0       1
        5    125.0    130.0    1000.0     40.0     .00        .0       1
--------------------------------------------------------------------------------


      1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED


      Unit Weight of Water =  62.40


      Piezometric Surface No.  1 Specified by  5 Coordinate Points


        Point       X-Water      Y-Water
         No.          (ft)         (ft)

          1            .00        73.00
          2         200.00        73.00
          3         310.00        85.00
          4         650.00       110.00
          5         850.00       110.00


      A Horizontal Earthquake Loading Coefficient
      Of .100 Has Been Assigned

      A Vertical Earthquake Loading Coefficient
      Of .100 Has Been Assigned

      Cavitation Pressure =     .0 psf
--------------------------------------------------------------------------------
```

```
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.


 40 Trial Surfaces Have Been Generated.


 20 Surfaces Initiate From Each Of  2 Points Equally Spaced
Along The Ground Surface Between  X = 100.00 ft.
                             and  X = 450.00 ft.


Each Surface Terminates Between   X = 450.00 ft.
                            and   X = 750.00 ft.


Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =   .00 ft.


20.00 ft. Line Segments Define Each Trial Failure Surface.

--------------------------------------------------------------------------

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined.  They Are Ordered - Most Critical
First.


* * Safety Factors Are Calculated By The Modified Bishop Method * *


Failure Surface Specified By 13 Coordinate Points


  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)

    1         450.00       113.33
    2         469.56       109.15
    3         489.40       106.62
    4         509.38       105.76
    5         529.36       106.58
    6         549.21       109.06
    7         568.77       113.20
    8         587.93       118.96
    9         606.53       126.31
   10         624.45       135.18
   11         641.57       145.53
   12         657.76       157.27
   13         672.52       170.00

Circle Center At X =  509.6 ; Y =  344.4  and Radius,  238.7
```

```
          ***      1.345    ***



          Individual data on the    20  slices


                              Water  Water     Tie     Tie     Earthquake
                              Force  Force    Force   Force       Force   Surcharge
Slice  Width     Weight        Top    Bot     Norm     Tan     Hor     Ver     Load
 No.   Ft(m)     Lbs(kg) Lbs(kg) Lbs(kg) Lbs(kg) Lbs(kg) Lbs(kg) Lbs(kg) Lbs(kg)
  1     19.6   10988.5       .0      .0       .0      .0  1098.9  1098.9      .0
  2       .4     501.1       .0      .0       .0      .0    50.1    50.1      .0
  3     19.4   28681.9       .0      .0       .0      .0  2868.2  2868.2      .0
  4     20.0   41305.6       .0      .0       .0      .0  4130.6  4130.6      .0
  5     10.6   25606.8       .0      .0       .0      .0  2560.7  2560.7      .0
  6      9.4   24554.3       .0      .0       .0      .0  2455.4  2455.4      .0
  7     19.8   57911.3       .0      .0       .0      .0  5791.1  5791.1      .0
  8     10.8   33843.4       .0      .0       .0      .0  3384.3  3384.3      .0
  9      8.8   28230.8       .0      .0       .0      .0  2823.1  2823.1      .0
 10      6.2   20237.1       .0      .0       .0      .0  2023.7  2023.7      .0
 11     12.9   39338.8       .0      .0       .0      .0  3933.9  3933.9      .0
 12      7.1   19045.0       .0      .0       .0      .0  1904.5  1904.5      .0
 13     11.5   29037.4       .0      .0       .0      .0  2903.7  2903.7      .0
 14     17.9   42202.8       .0      .0       .0      .0  4220.3  4220.3      .0
 15      4.9   10573.2       .0      .0       .0      .0  1057.3  1057.3      .0
 16      5.6   11338.7       .0      .0       .0      .0  1133.9  1133.9      .0
 17      6.6   12100.8       .0      .0       .0      .0  1210.1  1210.1      .0
 18     16.2   22925.2       .0      .0       .0      .0  2292.5  2292.5      .0
 19      7.2    6387.8       .0      .0       .0      .0   638.8   638.8      .0
 20      7.5    2561.2       .0      .0       .0      .0   256.1   256.1      .0
      Failure Surface Specified By  4 Coordinate Points


        Point        X-Surf        Y-Surf
         No.          (ft)          (ft)

          1          450.00        113.33
          2          469.98        112.53
          3          489.38        117.40
          4          506.08        127.22

      Circle Center At X =  462.8 ; Y =  182.0  and Radius,   69.9


          ***      1.358    ***


-----------------------------------------------------------------------------

      Failure Surface Specified By 13 Coordinate Points


        Point        X-Surf        Y-Surf
         No.          (ft)          (ft)
```

```
           1         450.00       113.33
           2         469.52       108.95
           3         489.34       106.35
           4         509.33       105.53
           5         529.30       106.51
           6         549.11       109.28
           7         568.59       113.81
           8         587.58       120.08
           9         605.94       128.03
          10         623.50       137.59
          11         640.14       148.69
          12         655.71       161.24
          13         664.65       169.88

      Circle Center At X =   508.4 ; Y =   328.0  and Radius,    222.5

            ***      1.363    ***



      Failure Surface Specified By  5 Coordinate Points

         Point        X-Surf       Y-Surf
          No.          (ft)         (ft)

           1         450.00       113.33
           2         469.98       112.42
           3         489.52       116.70
           4         507.28       125.89
           5         509.48       127.90

      Circle Center At X =   463.5 ; Y =   188.8  and Radius,     76.6

            ***      1.366    ***

----------------------------------------------------------------------------

      Failure Surface Specified By 16 Coordinate Points

         Point        X-Surf       Y-Surf
          No.          (ft)         (ft)

           1         450.00       113.33
           2         469.60       109.34
           3         489.41       106.57
           4         509.35       105.04
           5         529.34       104.74
           6         549.32       105.68
           7         569.20       107.86
           8         588.91       111.27
```

```
    9         608.37       115.89
   10         627.50       121.71
   11         646.24       128.70
   12         664.51       136.84
   13         682.24       146.10
   14         699.36       156.44
   15         715.80       167.82
   16         718.57       170.00

Circle Center At X =  524.1 ; Y =  426.8  and Radius,  322.1


      ***     1.402   ***



Failure Surface Specified By 17 Coordinate Points


   Point       X-Surf       Y-Surf
    No.         (ft)         (ft)

    1         450.00       113.33
    2         468.57       105.92
    3         487.66        99.93
    4         507.14        95.41
    5         526.91        92.38
    6         546.85        90.86
    7         566.85        90.86
    8         586.79        92.38
    9         606.56        95.40
   10         626.05        99.92
   11         645.13       105.90
   12         663.71       113.32
   13         681.67       122.12
   14         698.91       132.26
   15         715.33       143.67
   16         730.83       156.31
   17         745.25       170.00

Circle Center At X =  556.9 ; Y =  354.0  and Radius,  263.4


      ***     1.478   ***


----------------------------------------------------------------------------------

Failure Surface Specified By  6 Coordinate Points


   Point       X-Surf       Y-Surf
    No.         (ft)         (ft)

    1         450.00       113.33
    2         468.69       106.20
```

```
     3          488.65       105.06
     4          508.03       110.02
     5          524.99       120.61
     6          537.25       135.02

  Circle Center At X =   482.3 ; Y =   169.8  and Radius,    65.0

        ***      1.678    ***


  Failure Surface Specified By 13 Coordinate Points

    Point       X-Surf       Y-Surf
     No.         (ft)         (ft)

      1         450.00       113.33
      2         465.32       100.48
      3         482.75        90.66
      4         501.68        84.22
      5         521.48        81.37
      6         541.46        82.22
      7         560.95        86.72
      8         579.27        94.73
      9         595.81       105.98
     10         609.99       120.08
     11         621.34       136.55
     12         629.47       154.82
     13         630.31       158.36

  Circle Center At X =   526.9 ; Y =   189.5  and Radius,   108.2

        ***      1.756    ***

---------------------------------------------------------------------

  Failure Surface Specified By  6 Coordinate Points

    Point       X-Surf       Y-Surf
     No.         (ft)         (ft)

      1         450.00       113.33
      2         468.56       105.89
      3         488.56       106.31
      4         506.79       114.54
      5         520.34       129.25
      6         520.67       130.20

  Circle Center At X =   477.5 ; Y =   154.8  and Radius,    49.7
```

```
     ***     1.768    ***


   Failure Surface Specified By 11 Coordinate Points

     Point         X-Surf         Y-Surf
      No.           (ft)           (ft)

       1           450.00         113.33
       2           464.65          99.72
       3           481.92          89.63
       4           500.98          83.55
       5           520.90          81.78
       6           540.73          84.39
       7           559.51          91.26
       8           576.34         102.07
       9           590.41         116.28
      10           601.03         133.22
      11           607.05         150.22

  Circle Center At X =   519.0 ; Y =   172.9  and Radius,    91.1

     ***     1.917    ***
```