Carmen Johnson
Fac/Perm/Co ID # 44-01 | Date 4/17/12 | Doc ID# | DIN

LAW ENGINEERING
TESTING COMPANY

Report of Geotechnical Exploration and Evaluation
and Conceptual Site Development Recommendations
Landfill No. 6
Champion Papers
Canton, North Carolina
LETCo. Job No. CH 4507

North Carolina Department of Natural Resources & Community Development
James B. Hunt, Jr., Governor
Joseph W. Grimsley, Secretary

DIVISION OF ENVIRONMENTAL MANAGEMENT
GROUNDWATER SECTION

September 24, 1981

RECEIVED
SOLID & HAZARDOUS WASTE MANAGEMENT BRANCH
SEP 28 1981

MEMORANDUM

TO: Mr. J. Gordon Layton
Division of Health Services
Solid and Hazardous Waste Branch

FROM: Don Link, Regional Hydrologist DL
Asheville Regional Office

SUBJECT: Landfill No. 6
Champion Paper Company
Haywood County, North Carolina

After reviewing the plans for Landfill No. 6, I have no objections to the plans as proposed. However, I would like to be present when the location of the monitoring wells and the upstream and downstream sampling sites are selected.

DL:ar

cc: Perry Nelson
Larry Griffin

LAW ENGINEERING TESTING COMPANY
geotechnical, environmental & construction materials consultants
501 MINUET LANE
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May 28, 1981

Champion Papers
Canton Mill
Canton, North Carolina 28716

Attention: Mr. Jack Harrell
Mill Engineer

Subject: Report of Geotechnical Exploration and Evaluation and Conceptual Site Development Recommendations
Landfill No. 6
Champion Papers
Canton, North Carolina
LETCo. Job No. CH 4507

Gentlemen:

As authorized by your Purchase Order Number 70569 dated October 3, 1980, Law Engineering Testing Company has completed a geotechnical exploration and evaluation and prepared conceptual site development plans for Champion Papers' proposed Landfill No. 6.

The attached report discusses the following:

1. site conditions, including geotechnical and hydrological aspects affecting potential landfill development

2. engineering evaluation of site conditions and landfill development considerations

3. recommended conceptual development plans for the entire waste disposal site

4. recommended plans for initial site development of solid waste disposal areas.

The report also describes the testing procedures and presents the field and laboratory data.

SUMMARY

The following paragraphs summarize our observations and findings as well as our evaluations and recommendations. Details are contained in the body of the accompanying report.

The 235-acre site, designated as Champion Papers Landfill No. 6, is located northwest of Canton. The site is immediately south of I-40, north of the Pigeon River and between State Roads 1513 and 1550. Several draws and/or ravines produce a rolling to steeply sloping topography on this mostly cleared site. Springs were observed flowing in four of the draws. One draw near the northwest corner has water flowing through it from off-site. Bowen Branch flows in a large ravine on the eastern side of the property.

Alluvial soils consisting of clays, silts and sands were encountered in the lower reaches of the draws to depths of about 3 to 12 ft below the ground surface. Below the alluvium and on the hillsides, residual soils were encountered. Generally, the residual soils, which are very micaceous sandy silts and silty sands, become harder or denser with depth until partially weathered rock or rock is encountered. Groundwater was encountered near the surface in the lower reaches of the draws and as deep as 72 ft below the surface in the ridges.

Several site-specific characteristics must be evaluated to determine a site's suitability for development as a potential waste disposal area. Proposed site development must address and perhaps modify or control certain site features. The surface water flowing from off-site should be diverted or otherwise separated from the completed landfill areas. Springs occurring on-site will be routed into underground granular drains constructed of natural materials and maintained at least 5 ft below the landfill bottom; thus, they will "act" more as groundwater than surface water. Groundwater will be separated from the landfill bottom by at least 5 ft of soil. Surface runoff water will be routed away from the landfilling areas by ditches and piping.

Although very micaceous, it is our opinion that the soils at this site are suitable for use in landfill development. The high mica content in the soils will increase the potential for erosion; thus, additional erosion/sedimentation control measures may be required. If the dikes (up to 60 ft high) are designed and constructed as recommended in this report, a factor of safety against failure for steady-state operating conditions of 1.41 or more can be achieved for the downstream slopes. There will be an excess of available borrow materials within the proposed landfill areas.

The proposed site development scheme divides the site into five major sludge landfilling areas connected by a main access road. Individual draws would be enlarged by excavation and confining dikes constructed across the open end of the draws. In addition, small disposal areas for solid waste may be constructed at several locations by trenching or developing individual small draws. Potential development of Bowen Branch ravine is not considered in this report.

The five large areas (A, B, C, D and E) designated for sludge waste disposal will provide about 7.7 million cubic yards of storage capacity. The sludge areas will be landfilled by compartments and a final soil cover placed and grassed as landfilling advances. The surface of the closed out sludge disposal areas will slope at about 10 percent and at every 50 ft change in elevation will have a 50 ft wide bench. Any leachate consolidated out of the sludge or runoff water that contacts the sludge will be removed from the landfill area for treatment. The method of treatment and type of transport (if needed) has not been selected at this time. There will be approximately 1.3 million cubic yards of excess cut material from these areas.

As requested by Champion Papers the initial site development will be limited to solid waste (excluding sludge) disposal areas. Two proposed solid waste disposal areas (F and G) are designated for initial development and will have an estimated storage capacity of 235,000 cubic yards. An additional 500,000 cubic yards of solid waste could be placed in other trenches (similar to Area G) at various locations on the site. The final cover in the solid waste disposal areas will be placed on about 20 percent grade and will also have 50 ft wide benches at every 50 ft change in elevation. Any runoff water occurring within the active disposal area will be routed through a sedimentation pond and then discharged as uncontaminated runoff water. There will be approximately 100,000 cubic yards of excess cut material from Areas F and G (75,000 cubic yards from G).

Groundwater monitoring wells should be installed and surface water monitoring stations established prior to landfill construction. Water samples should be routinely taken and tested to detect any changes in the groundwater regime that may affect landfill operations. The monitoring should continue after landfill closure.

In our opinion, based on the data obtained during this exploration, our general landfill related experience and the recommendations discussed in this report, this site is suitable for development as a landfill site for waste produced at the Champion Papers' Canton Mill.

Law Engineering appreciates the opportunity to provide our professional services on this project. If you have any questions concerning this report or if we may be of further assistance, please contact us.

Very truly yours,

LAW ENGINEERING TESTING COMPANY

Robert M. Pitts, Jr.

Robert M. Pitts, Jr., E.I.T.
Staff Geotechnical Engineer

Raymond J. Lawing

Raymond J. Lawing, P. E.
Water Resources Engineer

Jimmy N. Smith

Jimmy N. Smith, P. E.
Senior Geotechnical Engineer

NORTH CAROLINA PROFESSIONAL SEAL 7964 ENGINEER JIMMY N. SMITH

RMP/RJL/JNS/tmc

Attachments

Report of Geotechnical Exploration and Evaluation
and Conceptual Site Development Recommendations
Landfill No. 6
Champion Papers
Canton, North Carolina
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INTRODUCTION

Champion Papers is in the process of preparing plans for development of a landfill site suitable for disposal of the papermill sludge and solid waste generated at their Canton Mill. The 235-acre site is located northwest of Canton in Haywood County, North Carolina (see Drawing No. 1 - Site Vicinity Map) and has been designated Landfill No. 6. The site is bordered on the north by I-40, on the south by the Pigeon River, on the east by the ridge running between Thickety Creek and Bowen Branch and on the west by privately-owned property.

Champion Papers constructed an approved landfill, Landfill No. 5-B, in 1979 and is constructing another approved landfill, No. 5-C; both located south of Interstate 40 at Beaverdam Creek northeast of Canton. Law Engineering performed geotechnical explorations and prepared development plans for both of these landfills. To date Landfill No. 5-B appears to be functioning as designed. The proposed development of Landfill No. 6 incorporates the experience gained during the design, permitting, construction and operation of these landfills.

Based on visual reconnaissance-type site inspection, Law Engineering performed preliminary site evaluations of the six individual parcels contained in the Landfill No. 6 site (LETCo. Job Nos. CH 4386 and CH 4414 dated February 1 and April 7, 1980). Based on these evaluations, it was our opinion that the site appeared suitable for landfill development and was worthy of further consideration.

Champion Papers and Law Engineering jointly decided that a preliminary subsurface exploration was needed to confirm the subsurface conditions assumed in the preliminary site evaluations. This preliminary exploration (LETCo. Job No. CH 4429 dated May 30, 1980) consisted of eight soil test borings, 14 laboratory classification tests and an engineering evaluation of the conditions encountered. The depths to rock and groundwater at the boring locations were within the range assumed in the preliminary site evaluations. Based on the preliminary exploration, we recommended that a more detailed site exploration be done and conceptual development plans be prepared.

We understand that the State has made a reconnaissance-type site inspection and has reviewed the preliminary exploration report. The State indicated that if certain site-specific conditions were properly designed for, it appeared the site would be suitable for the intended landfill use.

The purpose of this report is to provide conceptual plans and geotechnical engineering recommendations relative to the overall development of Landfill No. 6. An exploration and evaluation of the major site characteristics (soil, groundwater, and surface water conditions) that will affect potential landfill development has been made. The site data obtained during the exploration, information provided by Champion Papers, our general landfill design experience, and interpretation of current regulatory positions were utilized to develop the conceptual development plans for Landfill No. 6.

Drawings referred to in this report are included in Appendix I. The boring logs and field testing procedures are contained in Appendix II. Appendix III presents the results of the laboratory testing and the procedures for these tests.

SITE EXPLORATION

The geotechnical exploration (LETCo. Job No. CH 4507) reported herein consists of a review of the data previously obtained, additional field exploration, laboratory testing and engineering evaluation of the site geotechnical and hydrologic conditions which may affect landfill development.

The additional field exploration consisted of more thorough site reconnaissance by Mr. Ray Lawing, Water Resources Engineer; Mr. Bob Pitts, Staff Geotechnical Engineer; and Mr. Jim Smith, Senior Geotechnical Engineer, all of Law Engineering; of eleven soil test borings, some with observation wells; and of undisturbed and bulk sampling of the foundation and borrow soils. The boring locations were surveyed and elevations measured by Webb A. Morgan and Associates, P. A. Unless otherwise noted, all elevations in this report are referenced to the National Geodetic Vertical Datum (NGVD), previously known as Mean Sea Level (MSL). Both boring locations and ground surface elevations at the borings are shown on the Boring Location Plan (Drawing No. 2). The auger borings for undisturbed and bulk sampling are not shown on the Boring Location Plan but are generally within 5 to 10 ft of the original soil test boring.

The additional laboratory testing for this exploration included nine grain size distribution analyses, four compaction tests of potential borrow soils, three triaxial shear tests on foundation soils and three triaxial shear tests on remolded samples of the potential borrow material. These triaxial shear tests were used to determine general design strength parameters of the embankment and foundation soils.

The field and laboratory data obtained from the previously performed preliminary exploration at this site are included in the Appendices and are discussed and evaluated along with the data obtained in this exploration.

SITE CONDITIONS

Site Description

Most of the approximately 235-acre site is open pastureland with a few scattered trees, except for several central and northern areas which are wooded. Much of the timber has recently been cut. Several structures (houses, barns, sheds) are located within the site boundaries; some are occupied and some are abandoned.

Topographically, the site is rolling to rather steeply sloping. Bowen Branch flows through a ravine on the eastern side of the property in a generally north-south direction. The northern half of the site is divided by two relatively large knolls located near the central part of the property. The northeastern portion is dominated by a large draw extending off of Bowen Branch toward the north and northwest. The northwestern part of the site slopes down to the north and northwest to a draw which is oriented in a generally northeast-southwest direction. The southern half of the site consists of one large draw in the southwest and several small draws in the southeast. All of the draws in the southern half of the site have a general north-south direction. The maximum elevation difference across the site is on the order of 285 ft (elevation 2810 ft on the north central knolls to elevation 2525 ft along the Pigeon River). The ground surface slopes range from about 3 to 15 percent in the ravine and draw bottoms and along the ridge tops to 25 to 50 percent on the hillsides.

Surface Water

Approximately 50 percent of the site surface drains directly southward to the Pigeon River. The northeastern 30 to 40 percent of the site is tributary to Bowen Branch. The northwestern portion of the site drains to a creek located west of the site, which in turn discharges into the Pigeon River downstream of this site. Bowen Branch has an off-site watershed area of approximately 1200 acres north of I-40 in Brown Cove and Sorrels Cove. Bowen Branch enters the property by way of a twin-7 by 9 ft box culvert that is located under I-40. The draw located along the northwestern portion of the site has an off-site watershed of approximately 10 to 15 acres north of I-40. The runoff from this area passes under I-40 through a 36-inch corrugated metal pipe culvert, discharges into the draw and is then routed off the west side of the property. There is no off-site watersheds for the draws located on the south side of the property.

The Pigeon River and its flood plain border the site on the south side. Based on the Tennessee Valley Authority study "Floods on the Pigeon River, Vicinity of Canton and Clyde, North Carolina", the maximum probable flood elevation along this stretch of the river is approximately 2557 to 2564 feet. The 2564 ft contour line appears to range from about 75 to 225 ft from the river onto the site.

During the visual site inspections, flowing water was observed in the draws located in the northeast (Wet Drainage Feature, WDF, III) and northwest (WDF I) portions of the site and in two of the draws (WDF II and WDF IV) located on the southern portion of the property. These wet drainage features are shown on the attached Boring Location Plan (Drawing No. 2). All of the other draws had no running water or evidence of intermittent stream activity, springs, seeps or the occurrence of high groundwater. Groundwater in the flood plain and adjacent areas would be controlled by the river and may at times be considerably higher than at the time of our site visits. Because of the steepness of the ground surface immediately beyond the flood plain area, temporary fluctuations in the river level are not expected to affect groundwater levels on a significant portion of the site.

Area Geology

The site of the proposed project is located in the Blue Ridge Physiographic Province of North Carolina, an area underlain by ancient igneous and metamorphic rocks. The virgin soils encountered in this area are the residual product of in-place chemical weathering of rock which was similar to the rock presently underlying the site. The typical residual soil profile consists of clayey soils near the surface where soil weathering is more advanced, underlain by sandy silts and silty sands that generally become harder with depth to the top of parent bedrock. The boundary between soil and rock is often not sharply defined. This transitional zone termed "partially weathered rock" is normally found overlying the parent bedrock. Partially weathered rock is defined, for engineering purposes, as residual material with standard penetration resistances in excess of 100 blows per foot. Weathering is facilitated by fractures, joints and by the presence of less resistant rock types. Consequently, the profile of the partially weathered rock and hard rock is quite irregular and erratic, even over short horizontal distances. Also, it is not unusual to find lenses and boulders of hard rock and zones of partially weathered rock within the soil mantle, well above the general bedrock level.

Alluvial soils, eroded by surface water from the hillsides, often blanket the residual soils and weathered rock in the valleys. Colluvial soils, sloughed from the hillsides, often collect on the lower hillsides and at the base of the slopes. Both alluvial and colluvial soils are usually soft and compressible, because they have never experienced overburden pressures in excess of their own weight. They may also contain entrapped organic matter.

Soil Description

The subsurface conditions described in this section and the following section concerning groundwater are presented in the Summary of Subsurface Conditions, page 8 and are illustrated on Drawing Nos. 3 and 4, Subsurface Profiles.

About half of the 19 soil test borings (LETCo. Job Nos. CH 4429 and CH 4507) encountered two to six inches of grass and topsoil. Boring B-9 encountered approximately 1.5 ft of topsoil and other organic debris. Eight of the borings, drilled in the lower reaches of the draws, encountered alluvium or possible alluvium to depths ranging from about 3 to 12 ft below the existing ground surface. The average depth of alluvial soils in the eight borings was approximately 6 to 6.5 feet. The alluvial soils encountered consist of soft to very stiff sandy silty clays, clayey sandy silts and sandy silts and of very loose to firm clayey silty sands and silty sands. Boring B-6, drilled about mid-way up a draw, encountered possible colluvium to a depth of 12 ft below the surface. This possible colluvium consists of firm sandy silts and loose silty sands. The colluvium could be from a geologically recent landslide. Disturbed material was encountered in borings B-4, B-5 and B-14 and extended to depths ranging from about one to two feet below the existing ground surface. The disturbed material encountered was a clayey sandy silt.

Below the topsoil, alluvium, possible colluvium and disturbed material, all of the borings encountered residual soils. The residual soils consist of soft to hard sandy silty clays, clayey sandy silts and sandy silts and loose to very dense silty sands. In general, the more clayey and silty soils are nearer the surface and the sand content increases with depth. Most of the residual soils are very micaceous, some with as much as 60 percent mica. The upper more clayey and silty soils are less micaceous than the deeper sands. In general, the soil consistencies increase with depth; however, in some borings there are rather abrupt increases and decreases in consistency. Typically, the higher consistencies indicate less weathering or the inclusion of less weathered fragments.

Residual soil hard enough to be termed partially weathered rock was encountered in all borings except B-1, B-6, B-11, B-16 and B-17. Relatively continuous partially weathered rock was encountered at depths ranging from 6.5 to 52 ft below ground surface. Generally, the borings on top of ridges and on hillsides encountered partially weathered rock at greater depths than the borings near the bottom of draws. Seams and layers of partially weathered rock, ranging in thickness from several inches to seven or eight feet, were encountered in some of the borings. Refusal to the soil drilling equipment was encountered at depths below existing ground surface ranging from about 7.3 to 71 feet. The refusal depths varied in a similar manner with regard to location as did the depths to continuous partially weathered rock. Diamond core drilling procedures are required to determine the nature and continuity of refusal material. No core drilling was done for this exploration.

Groundwater Conditions

Groundwater levels in the borings were measured at the time of boring and in all but B-8 and B-12 after a stabilization period of at least 24 hours. Neither boring B-8 nor B-12 encountered groundwater at the time of boring and both were backfilled because of traffic (cattle and human) in the immediate vicinity of the borings. Two-inch diameter PVC observation wells were installed in the borings which encountered groundwater so that future groundwater measurement could be made. Groundwater levels were checked again on March 11, 1981 in the following borings: B-1, B-6, B-7, B-9, B-10, B-11 B-14, B-15, B-16, B-17 and B-19. Generally, the borings drilled in the lower reaches of the draws encountered groundwater while those drilled on the hillsides and ridges did not. No groundwater was encountered in borings B-2, B-4, B-5, B-8, B-12 and B-13. Borings B-10 and B-18, both drilled near the top of ridges, encountered groundwater at depths of 65 and 72 ft, respectively. In the remainder of the borings, groundwater was encountered at depths ranging from about 2 to 18.5 feet.

At the time borings B-1 through B-8 were drilled, April 1980, the groundwater levels in this area should have been near the seasonal high levels. Conversely, borings B-9 through B-19 were drilled in November and December, 1980 when the groundwater levels should have been near the seasonal low levels. The groundwater levels measured in the two groups of borings are similar and the variations fall within the common range of fluctuation, several feet between late winter and spring (highest) and late summer and fall (lowest). It is important to note that at both times, spring and fall of 1980, rainfall for the area was below normal. During periods of normal or heavy rainfall, the general groundwater levels will probably be somewhat higher than at the time of our measurements.

As previously stated, the Pigeon River is not anticipated to have a significant influence on the groundwater levels over much of the site due to the relatively steep slopes adjacent to the river.

The above descriptions provide a general summary of the subsurface conditions encountered. The attached Test Boring Records contain detailed information recorded at each boring location. These Test Boring Records represent our interpretation of the field logs based on engineering examination of the field samples. The lines designating the interfaces between various strata represent approximate boundaries and the transition between strata may be gradual. Field testing procedures are described in Appendix II.

SUMMARY OF SUBSURFACE CONDITIONS
LANDFILL 6
CHAMPION PAPERS
CANTON, NORTH CAROLINA
LETCo. JOB NO. CH 4507

BORING NUMBER[1]	GROUND SURFACE[2] ELEVATION (FT)	DEPTH TO[3,4] GROUNDWATER (FT)	GROUNDWATER[3,4] ELEVATION (FT)	DEPTH TO[5] PARTIALLY WEATHERED ROCK (FT)	PARTIALLY[5] WEATHERED ROCK ELEVATION (FT)	DEPTH TO[6] REFUSAL (FT)	REFUSAL[6] ELEVATION (FT)	THICKNESS OF[7] NON-RESIDUAL SOIL (FT)	BOTTOM ELEVATION[7] NON-RESIDUAL SOIL (FT)
B-1	2640.	5.5	2634.5	--	--	BT @ 15.	BT @ 2625.	6.	2634.
B-2	2754.	NGWE	NGWE	45.	2709.	50.	2704.	--	--
B-3	2626.	5.	2621.	18.	2608.	BT @ 19.	BT @ 2607.	4.5	2621.5
B-4	2734.5	NGWE	NGWE	9.5/42.5	2725./2692.	BT @ 49.	BT @ 2685.5	1.5	2733.
B-5	2709.5	NGWE	NGWE	46.5	2663.	47.5	2662.	1.	2708.5
B-6	2663.	18.5	2644.5	--	--	BT @ 25.	BT @ 2638.5	12.	2651.
B-7	2565.	6.	2559.	8.-11.5	2557.-2553.5	BT @ 15.	BT @ 2550.	6.	2559.
B-8	2646.5	NGWE	NGWE	19.	2627.5	26.5	2620.	--	--
B-9	2591.	6.	2585.	13.	2578.	14.5	2576.5	6.	2585.
B-10	2651.5	65.	2586.5	27.	2624.5	71.	2580.5	--	--
B-11	2665.	11.	2654.	--	--	BT @ 20.	BT @ 2645.	--	--
B-12	2736.	NGWE	NGWE	34.	2702.	37.5	2698.5	--	--
B-13	2699.5	NGWE	NGWE	6.5	2693.	7.5	2692.	--	--
B-14	2695.5	14.	2681.5	14.5	2681.	18.	2677.5	2.	2693.5
B-15	2566.	8.5	2557.5	11.	2555.	BT @ 15.	BT @ 2551.	7.5	2558.5
B-16	2607.	2.	2605.	--	--	BT @ 15.	BT @ 2592.	6.	2601.
B-17	2702.	12.0	2690.	--	--	BT @ 20.	BT @ 2682.	3.	2699.
B-18	2707.	72.	2635.	37./52.	2670./2655.	BT @ 74.	BT @ 2655.	--	--
B-19	2536.	6.5	2529.5	14.5	2521.5	15.	2531.	12.	2524.

1 BORINGS B-1 THROUGH B-8 DRILLED IN APRIL AND MAY 1980 WITH CME 45 RIG - BORINGS B-9 THROUGH B-19 DRILLED IN NOVEMBER AND DECEMBER 1980 WITH ACKER AD II RIG.

2 BORING LOCATIONS AND ELEVATIONS SURVEYED BY WEBB A MORGAN AND ASSOCIATES, P.A. JUNE 20, 1980, REVISED FEBRUARY 16, 1981

3 NGWE = NO GROUNDWATER ENCOUNTERED

4 MINIMUM DEPTH BASED ON SEVERAL GROUNDWATER READINGS.

5 BORING B-4 PWR 9.5-17. FT AND 42.5 FT - BT @ 49 FT
B-7 PWR LENSE 8.-11.5 FT
B-19 PWR 37.-42. FT AND 52. FT - BT @ 74 FT

6 BT IS BORING TERMINATED - POWER AUGER REFUSAL NOT ENCOUNTERED WITHIN DEPTH DRILLED

7 NON RESIDUAL SOIL IS ALLUVIUM EXCEPT IN B-4, B-5 AND B-14 IT IS DISTURBED MATERIAL AND IN B-6 IT IS POSSIBLE COLLUVIUM

NOTE: ALL DEPTHS AND ELEVATIONS ROUNDED OFF TO NEAREST 0.5 FT.

ENGINEERING EVALUATIONS AND RECOMMENDATIONS

Several site-specific characteristics must be evaluated to determine a site's suitability for development as a potential waste disposal area. In addition, several major aspects of potential site development are related to site features and must be evaluated. Some of the more fundamental considerations are discussed below.

Surface Water

Four sources of surface water exists on this site: off-site drainage flow, on-site springs, on-site storm runoff and the Pigeon River.

Off-site drainage flow consists of Bowen Branch and the small creek, WDF I (wet drainage feature in the northwest draw). As previously stated, Bowen Branch has an off-site watershed of approximately 1200 acres. The access road across Bowen Branch will require either a bridge or a culvert, appropriately designed to maintain flow and road use. An embankment with a properly sized culvert may be more desirable with respect to possible future development of this ravine for landfilling. However, no development plans are currently proposed for the Bowen Branch ravine.

The small creek, WDF I, has an off-site watershed area of about 10 to 15 acres. Development of this northwest draw will require diversion of this flow. The flow can be channelled around the northwest corner of the proposed landfill area by extending the existing 36-inch diameter culvert under I-40 (see Drawing No. 10). Culvert placement outside the landfill area will require cut depths as much as 25 ft deep, but this location will allow access to the pipe for future maintenance or repairs that may be required without having to disrupt the landfill.

On-site springs which form small creeks are located in WDF II, III, and IV. To permit development of the draws, provisions must be made to isolate these creeks from future landfilling. Schemes for containing and channelling the water through the landfill area could include piping as previously described for the off-site drainage. However, to minimize future maintenance concerns, we recommend intercepting springs at their seep location and channelling the water into a granular drainage system along the draw bottom. The drains would consist of a blanket of washed stone surrounded by a graded sand filter to prevent clogging. The gravel would be sized and the drain dimensioned to accommodate anticipated flows; however, several small diameter (2 to 4-inch) pipes may be added to provide additional flow capacity (see Drawing No. 12). Such drainage systems are constructed of natural materials (except for the small diameter pipes, if used) and thus, should not require future maintenance like conventional piping systems. The drain system would be separated from the landfill bottom by a minimum of 5 ft of compacted soil. Thus, the spring water is suppressed and from the landfill bottom appears like groundwater flowing in a natural subsurface granular layer.

Storm runoff must be controlled during the construction, operation and closure stages of the landfilling. The uncontaminated runoff should be collected and channelled in such a way that it remains separated from the leachate and that erosion is minimized. The runoff can be channelled by use of standard open ditches around the landfill areas and along the access roads and through pipe culverts where it must traverse the roadway and dike embankments.

The flood levels of the Pigeon River must be considered as well as the normal flow levels for any development along the river. The Tennessee Valley Authority publication "Floods on Pigeon River - Vicinity of Canton and Clyde, North Carolina" indicates that the maximum probable flood level at the site would range between elevation 2557 and 2564 ft, NGVD. Based on information presented in this publication, we estimate that the 100 year flood level for the site will range between 2554 and 2560 NGVD. Any construction, such as dike or roadway embankments, below the 100 year flood level will require protection, such as rip rap placed on a filter blanket. If construction is limited to areas above this level, no flood protection is required.

Allowable Excavation Depths

Generally, it is desirable to excavate as much soil from within a landfill area as possible to create additional waste storage volume. Two factors limit the extent of excavation, groundwater and rock (or hard partially weathered rock). State regulations require a minimum of 5 ft of soil be maintained between the waste material and the groundwater or rock (fractures in the rock can provide direct paths to the groundwater). Based on the soil test borings drilled at this site, excavations on the ridges may extend to depths of 40 to 50 ft before water, rock or hard partially weathered rock is encountered. The allowable excavation depths will generally decrease with decreases in surface elevations. To meet the 5 ft separation criteria, some of the draw bottoms will require placement of fill, especially where spring water is present.

General excavations within materials having penetration resistances less than about 50 blows per foot should present no major excavation difficulties. Ripping is usually required to loosen those soils having penetration resistances greater than about 50 blows per foot. The upper surface of hard rock is often knobby and uneven; thus, general excavation depths may extend below some high rock ridges or peaks that might occur. If the hard materials are somewhat seamy in nature, they can usually be removed with heavy ripping equipment. Any rock exposed in the landfill bottom should be covered with 5 ft of compacted fill.

A slope of 1.5 to 1 (horizontal to vertical) is recommended for cuts which will eventually be covered by the landfilling. For permanent cuts, slopes of 2 to 1 (H to V) are recommended.

There appears to be much more excavatable (borrow) material available at this site than is necessary for site development and eventual site closure. Practically, excavation depths may be limited because of excess borrow material unless stockpiling or disposal areas are available. Permanent disposal of most of the excess borrow material could probably be accomplished by increasing the thickness of the closure soil cover and/or filling in small draws which are of marginal landfilling use.

Suitability of On-Site Soils for Landfill Development

Based on standard grain size classification tests, most of the soils sampled were classified as very micaceous silty sands. However, many of the sand-sized grains were actually mica flakes; the high mica content (up to 60 percent) of these soils will probably cause them to "act" more as a silt than a sand.

Compaction and general workability of the very micaceous soils during construction and landfilling operations may be affected more by moisture changes than less micaceous soils. Quite possibly, compacted surfaces left exposed for even short periods of time would have to be recompacted prior to placing additional fill material.

Permeability of the deeper, more sandy soils generally would be high when compacted and thus, may require some blending or mixing with some of the upper, more clayey soils before being used as final cover material. Blending would certainly increase the cost of the cover. It may be desirable to stockpile the more clayey soils for use as the final cover material, especially at areas where the soils at the lower depths of proposed excavation are very sandy.

The high mica content in the soils will probably increase the potential for erosion from surface water runoff. Thus, more care may be required to assure adequate erosion protection than for less micaceous soils. In addition, the potential for near-surface "fluffing" or rebounding of the very micaceous soils may require flatter dike slopes.

Although the residual soils are very micaceous, it is our opinion that with proper design and construction, these soils are suitable for use in landfill development. The alluvial soils encountered in the lower reaches of the draws are not considered suitable for use in landfill development except for landscaping.

Erosion/Sedimentation Control

The topography of the site, with the many draws separated by ridges, is conducive to compartmentalized landfill activities. If existing topography is utilized, the "active" landfilling area may be separated hydrologically from the remainder of the site. Surface water runoff entering the active area and the runoff water from the active area would be minimized and more easily controlled by virtue of being somewhat confined. This enhances the ability to control sedimentation and its access to the Pigeon River. Erosion protection and sedimentation control will be required at the lower reaches of the active landfilling areas and perhaps on previously landfilled areas.

The soils at this site are highly susceptible to erosion. To minimize erosion from rainfall and runoff, it is recommended that the completed slopes be immediately grassed to establish a protective cover. To prevent loss of seed during the germination period, it may be necessary to utilize a straw or hay mulch anchored with a film spray of asphalt emulsion or a degradable erosion control fabric. The grassed slopes should be maintained so that brush and trees do not become established.

Retention Dike Design

Landfilling in the draws will generally require construction of retention dikes at the lower reaches of the draws for waste containment. Retention dike design has three major but interrelated components; location, geometry and stability. Other important elements of dike design include internal dike drains, pipes through the dike, and dike foundation preparation. These items are discussed individually below.

Dike Location - Location refers to the dike's position on the site which affects its dimensions and thus, the volume of embankment fill. In addition, location affects the necessary foundation preparation and the potential need for flood protection. The leachate collection and treatment system layout will be affected by and will have some effect on the dike locations. Each proposed dike location should be examined carefully prior to construction to determine if the general design criteria discussed in this report are valid, or if conditions exist that warrant special design considerations.

Dike Geometry - The geometry of a dike is determined by the crest width, height and face slopes. The crest width is usually a function of whether or not the crest will be used as an access road. The height is typically based on the desire to optimize the storage capacity of the waste disposal area. Generally, the available storage capacity of a draw increases as the height of the confinement dike increases. The angle of the face slopes is basically a function of stability (resistance to failure). To a lesser degree, the face slopes are determined by erosion protection and maintenance considerations. If the height and slopes of a proposed dike is greater and steeper, respectively than the dikes evaluated in this report, the stability of the proposed dike should be evaluated prior to construction.

Dike Stability - The stability of a slope is defined in terms of the embankment's factor of safety against failure. The safety factor is the ratio of the forces or moments resistng failure divided by the forces or moments tending to produce failure. The weight of soil and waste material is the major force tending to produce failure, while the shearing resistance of the soil is the major force resisting failure. Thus, the stability of a confinement dike is dependent upon its height, the slope (grade) of its faces, the level of waste material, the water level (both internal and retained) and the strength of the fill and foundation soils.

Strength parameters for the fill and foundation soils were developed from the results of triaxial shear tests performed as part of our geotechnical exploration of the site. Strength properties of both the papermill sludge and the lime waste were developed from a single triaxial shear test on the paper-mill sludge and a review of current literature on similar waste materials. The strength parameters for the foundation and fill soils are presented on Drawing Nos. 5 and 6, respectively. Total stress parameters are used for the end of construction analyses and effective stress parameters are used for the steady state analyses. The slope stability is usually checked for three conditions - end of construction, steady state operation and rapid draw-down. The rapid draw-down condition would apply only to embankments subjected to flooding and was not checked for the proposed development. Conventionally, two methods of analysis are utilized to check stability; circular arc rotation and sliding wedge. The downstream slopes of several generalized dike sections were analyzed for both the end of construction and steady state conditions by the circular arc method and for the steady state condition by the sliding wedge method. The upstream slopes were analyzed for the end of construction condition by the circular arc method. The slope stability analysis of the generalized dike section utilized in the conceptual and initial site development schemes are summarized on Drawing Nos. 7 and 8.

Internal Drains - To improve the operational stability of an embankment, internal drainage is needed to maintain the phreatic surface (saturation line) in the soil below the downstream slope and to reduce seepage through the foundation. This avoids saturation and softening of the downstream slope surface and increases the effective strength of the foundation soils. We recommend that downstream "comb" drains as illustrated on Drawing No. 12 be used for dike embankments. The zoned drain should be placed on the prepared foundation surface beneath the downstream slope, exit the downstream toe and extend into the embankment at least one-third the dike foundation width. The portion of the comb drain that is parallel to the embankment axis (the "back") should be at least 10 ft in width. The portions of the drain perpendicular to the embankment axis (the "teeth") should be approximately 2.5 ft in width and spaced no farther apart than 50 ft center to center. The fine filter (sand) should be placed in layers at least 6 inches thick and the coarse filter (gravel) should be at least 18 inches thick such that the fine filter forms an envelope around the central coarse filter. The perforated pipe should be 6 inches in diameter and have a maximum perforation dimension of 3/8 inch, and be placed with the perforations downward. The gradation of the fine and coarse filters is shown on Drawing No. 9. Extreme field care must be exercised in the placement of the filter drains so as to provide continuous and distinct filter layers of compacted material. It is also important that the connecting sections of the perforated pipe provide a continuous path to the toe of the embankment to permit free drainage. If the drains are not placed properly or are damaged by equipment during placement and subsequently fail to function properly, stability problems and possible slope failure could result.

Pipes Through Dike - Any pipes through or under dike embankments are potential sources of leakage and thus dike stability concerns. All pipes through the dikes should be surrounded by a graded filter system along the downstream third to reduce the potential for piping (soil movement). To minimize contact seepage along their outer surface, seepage collars should be installed immediately upstream of the pipe filter system. Recommended details of placing a pipe through a dike is illustrated on Drawing No. 12.

Foundation Preparation - The general recommendations for foundation preparation of the embankment dikes are listed below.

1) Foundation areas should be stripped of all organic litter, root mats, and topsoil with over 5 percent by weight of fibrous organic matter. This material should be wasted or stockpiled outside the landfill area for use in landscaping.

2) The area where the dike crosses a natural wet drainage feature should be stripped of all organic matter and unsuitable soils. A key-way approximately 12 ft wide and 3 ft deep should be excavated conforming to the drainage feature contour along the dike centerline. The excavated key-way and stripped creek ditch area should then be backfilled with properly compacted fill material.

3) Observation of loaded pans, normally associated with the construction operation, moving over the foundation area may provide adequate proofrolling to detect any localized soft surface soils requiring further undercutting. A 25 to 35-ton, rubber-tired roller should be available for proofrolling if the geotechnical engineer determines one is needed. Depending on the depth of undercutting, it may be necessary to dewater the foundation area. Dewatering has been accomplished at similar sites utilizing a series of ditches and/or gravel lined sumps.

4) Once inspected and approved by a geotechnical engineer the foundation should be disced to provide a bond with the first layer of compacted fill.

5) The abutments on the existing hillsides should be prepared by stripping and cutting away any vegetation or soft, disturbed or otherwise unsuitable material. A key-way approximately 12 ft wide and at least 3 ft deep should then be excavated along the centerline of the proposed embankment down the slope of the existing hillside. The key-way should be inspected by a geotechnical engineer. As the new embankment is raised, the abutment surface should be scarified ahead of placement of the fill layers.

Leachate Collection, Removal and Treatment

The papermill waste (sludge) currently produced at the Canton Mill is substantially drier than before the utilization of the Tait Andrite filter belt press dewatering machine. However, the sludge still has a very high moisture content when delivered to the landfill. After placement in the landfill, some water (leachate) is known to be consolidated out of the sludge under the load of its own weight and the weight of the final soil cover. In addition, any rainfall or surface water that comes in contact with the sludge material must be considered as leachate. In fact, the majority of the leachate produced will be from runoff.

The active landfilling area should be as small as practical to minimize the amount of runoff water coming in contact with the sludge material. The leachate will be collected in a collection system of pipes and gravel drains. The collected leachate will be removed from the active landfilling area by sealed pipe.

The leachate collected from the papermill sludge will be treated on-site or removed for off-site treatment. Off-site treatment would consist of transporting the leachate by pipeline or tanker truck to the Canton Mill for treatment at the waste water treatment facility. On-site treatment could possibly be accomplished by either conventional treatment methods or by land application. Conventional treatment might be performed utilizing a portable package plant or a small stationary treatment facility. Land application would involve spraying the leachate on an area not actively engaged in landfilling. This area would be cultivated in a specific crop that would readily absorb a significant portion of the leachate constituents.

Determination of the most feasible alternative will depend on the volume of leachate produced and its strength. Experience gained during the operation of Landfill 5-C will be incorporated into this evaluation.

Access Road

The location of the access road system is somewhat dependent upon placement of the site entrance. Entrance placement will specifically affect the approach, both vertical and horizontal, of the access road to the landfilling areas. Some discussion of possibly constructing a site access bridge across the Pigeon River has been made and we understand that the concept may be further evaluated. However, for the purpose of this report, a more conventional site entrance is anticipated. The routes connecting individual landfill areas are anticipated to be basically the same for most entrance locations.

The maximum allowable grade will significantly affect the route and length of the roads into the site and connecting the landfilling areas. The grade which a loaded truck can negotiate is controlled to a certain degree by the surface material of the road. A truck can climb a steeper grade on a paved surface than on a gravel surface since the former offers better traction. Champion has indicated that grades up to 7 percent on paved surfaces are acceptable.

Landfill No. 6 may be in operation for more than fifteen years. This longer operational life may justify a somewhat more elaborate access road system than constructed at Landfills 5-B and 5-C. Thus, wider, paved and better drained roads may be practical and economical. The advantages and disadvantages of different access road plans should be evaluated in the context of initial cost and annual maintenance cost.

General Site Evaluation

It is our opinion that based on the data obtained during this exploration, our general landfill related experience and the above discussed recommendations, this site is suitable for development as a potential landfill for the papermill sludge and solid waste generated by Champion Paper's Canton Mill. Development of individual areas of the site will likely require some additional exploration and evaluation to finalize design; however, the general design scheme presented in this report is expected to be applicable.

OVERALL SITE CONCEPTUAL DEVELOPMENT AND OPERATIONAL PLAN

The site is divided into five major landfilling areas designated for sludge disposal (Area A through E) and connected by a main access road. However, any of these areas could be used for solid waste disposal, if desired. Areas F and G are designated for initial solid waste disposal. In addition, several smaller areas of the site should be suitable for trench disposal of solid waste (similar to Area G). The proposed overall development of this site is illustrated on the attached Conceptual Site Development Plan (Drawing No. 10). Section and detail schematics illustrating proposed waste disposal area development are presented on Drawing Nos. 11 and 12.

The potential development of the Bowen Branch ravine is not considered in this report. A development plan that would meet the regulatory requirements would be very expensive; however, it may be economically feasible at some future time.

As requested by Champion, the initial site development will be located in the northeast portion of the site, Areas F and G. Development and operation of landfills on this part of the site may be visible from I-40; thus a screen to provide a visual barrier between I-40 and Areas F and G may be required. In addition, special care during operation may be required to prevent fly ash dust clouds from occurring near Interstate 40. After the initial site development, subsequent areas will be developed as needed.

Several aspects of potential site development are common for both the sludge and solid waste disposal areas. These items are discussed below. Following this discussion, items pertaining to the development of either sludge or solid waste disposal areas are discussed.

Individual Area Development

As stated earlier, the general configuration and topography of the ridges and draws on this site are thought to be conducive to development as a potential landfill site. The individual draws could be excavated or "reamed out" and confining dikes constructed across the open end of the draws. The confining dike across each draw would be constructed with the soil excavated from within the draw, if possible. Some intermediate dikes may be utilized within these disposal areas. Trenches for solid waste disposal would require excavating approximately as much soil as the storage volume desired. These trenches could be located where site conditions prevent more efficient development. The bottom elevations of the landfill areas would be determined by maintaining a minimum distance of 5 ft above the groundwater table and rock and by excavation conditions. The excavation contours shown on the attached Conceptual Site Development Plan (Drawing No. 10) are approximate and may be confirmed, if desired, by additional exploration prior to the start of construction for an individual area. In addition, individual confining dikes should be evaluated and designed for adequate stability at each location, based on more detailed site studies.

The separate draws could be developed individually or jointly to form several landfill areas or activities. Based on subsurface data obtained from our exploration, it appears the individual ridges could be excavated to rather substantial depths before rock or water is encountered and that the excavated material would generally be suitable for landfill construction. Although several of the draws have flowing surface water most do not have a significant enough volume to seriously inhibit landfill development.

Access Road

The main entrance to the site is expected to be near the northeast corner. The main access road will have a maximum grade of about 7 percent, as instructed by Champion Papers. The access road should be at least 20 to 25 ft wide to allow two of the waste hauling trucks to pass each other. Since the site has an expected landfill life of about 15 years, it may be desirable to pave the main access road to improve travel time and conditions and decrease maintenance. A 7 by 9 ft twin concrete box culvert is proposed at the crossing of Bowen Branch. This is the same size culvert Bowen Branch flows through under Interstate 40.

Erosion Control

A sufficient stand of grass should be developed and maintained to control erosion in the entire area disturbed by the landfill development. During landfilling operations when enough final soil cover (area) has been placed to make seeding feasible, the cover should be repaired where needed and grassed. Each subsequent area covered should also be seeded as soon as feasible. Temporary sedimentation controls, such as silt fences will be required around any areas of exposed soil (virgin or fill) until an adequate stand of grass is developed. Minor repairs and reseeding operations should be anticipated during the operational period of the landfill. The dikes, the undeveloped areas within the perimeter roads and the grassed portions of the final soil cover should be mowed periodically during the growing season (spring, mid-summer and early fall) to allow for ongoing visual inspection.

Monitoring

A system of groundwater monitoring wells and surface water monitoring stations should be designed and established to detect changes in the groundwater regime that may affect landfill operations and to evaluate groundwater and surface water for potential contamination. A minimum of four groundwater quality monitoring wells should be installed prior to the start of landfilling operations. At least one well should be located up gradient of the initial disposal area and three wells should be located down gradient from the area. As subsequent landfill areas are developed, additional monitoring wells must be installed. The number and location of the monitoring wells are subject to the approval of the North Carolina Division of Health Services.

The water quality monitoring wells should be installed using methods and procedures which will not introduce extraneous, outside contaminants or cross contaminate the wells. Drawing No. 13 illustrates a typical monitoring well installation.

During landfilling operations, the groundwater quality in the monitoring wells and the surface water quality from the uncontaminated runoff lines and in Bowen Branch and the Pigeon River should be routinely checked. Appropriate indicator tests determined by Champion and/or required by the State should be performed on these samples to identify potential contamination. The results of these tests should be correlated to background information developed for each sampling location prior to the start of nearby landfilling operations.

Sludge Disposal Areas

Sludge Waste Material - The development and operational plan presented in this section is based on the assumption that the majority of the sludge waste will be similar to that currently produced by the Tait Andrite filter belt press dewatering machines. The sludges are expected to range between 30 and 40 percent solids content (by weight). Reportedly, sludges in this range can temporarily be stacked on slopes of 2 or 3 horizontal to 1 vertical. Based on review of literature addressing similar sludges, limited shear strength testing and stability analyses, it appears that the Tait Andrite Sludge can stand on a finished slope of approximately 10 to 1 (horizontal to vertical).

General Development and Operational Plan - The papermill sludge will be transported to the landfill by truck. Initially, the trucks will end dump from ramps off the perimeter road. Utilizing such ramps permits the entire dumping operation to occur off the perimeter road or dike and thus facilitates better control of potential spillage from the trucks during dumping. The dumping end of the ramp should be about 3 ft below the proposed closure elevation. To facilitate scraping any spillage from the trucks into the landfill, the dumping end should not be graveled. As landfilling continues, temporary access roads can be extended out over the sludge from the ramps to the working slope. The end dump ramp can be constructed of compacted cinders, fly ash and/or soil fill. The top of the ramps should tie into the perimeter road and extend at a maximum of 5 to 10 percent grade to the dumping end. The ramp should be approximately 20 ft wide at the top and have side slopes on the order of 2 to 1 (horizontal to vertical).

A bulldozer will work the active face of the landfill to control final placement and to accomplish some compaction of the waste material. With compaction during placement, a sludge volume reduction on the order of 15 to 20 percent may be achieved. Another dozer, working the top surface of the compartment, will aid the dozer working the slope by moving the dumped sludge into its general vicinity and will shape the waste to the proposed final contours and spread the soil cover over the completed portions of the landfill. Every 50 ft or so of elevation change in the completed sludge surface, a 50 ft wide bench will be made. We anticipate the dozer working on the active face can perform efficiently on a working slope of about 5 to 1 (horizontal to vertical).

Temporary berms will be used to separate the active portion of the landfill from the undeveloped portions, thus reducing the contaminated area exposed and the volume of leachate to be treated. Berm locations should be such that the active landfilling compartment will not be greater than about 5 acres in area so that contaminated runoff based on a 100-year storm will not exceed the leachate pumping and storage capacities. The berms should be constructed of well-compacted soil fill, available from on-site borrow areas. The crest of the berm should be about 4 feet above the surrounding area. Side slopes of about 2 to 1 (horizontal to vertical) should be utilized. The berm should be grassed as soon after construction as is feasible. Until an adequate stand of grass is developed, the berm will require temporary sedimentation control measures.

Uncontaminated Runoff Water - As previously stated uncontaminated runoff outside the active compartment will be isolated from the leachate runoff by a termporary berm. The uncontaminated runoff will be routed through corrugated metal pipes and discharged outside the landfill area. Depending on the landfilling sequence, the uncontaminated runoff pipe may be extended up-gradient when the temporary berm is removed to its next location. A minimum of 5 ft of compacted soil cover should be maintained between the waste material and the uncontaminated runoff line. Temporary sedimentation controls such as silt fences and hay bales will be required at the pipe inlet at each subsequent location. The temporary soil berm and any area disturbed during relocation should be promptly grassed to prevent erosion of the berm and related sedimentation problems.

Leachate Collection, Removal and Treatment - Leachate produced from the sludge will be from two sources - runoff from the active face of the sludge and liquid consolidated out of the sludge under the load of its own weight and the weight of the final soil cover. The leachate collected will be piped to a leachate holding pond from which it will be removed for treatment. If the leachate is treated on-site, any effluent will be discharged into Bowen Branch or the Pigeon River. Such discharge would likely require a NPDES permit. If the leachate is treated off-site, it may be removed by tanker trucks or it may be routed through a pipe line to the mill's treatment facility.

The leachate from runoff will flow down the working slope and across the bottom of the active compartment to an inlet box. The inlet box should be designed to permit sedimentation of any large solids from the leachate runoff and to prevent the formation of stagnant pools of leachate. The box may also be designed so that it can be moved from one location to the next as the landfill progresses from one compartment to another.

If the landfilling sequence is from the lower to upper reaches of the draws, the leachate produced by consolidation of the sludge will be collected by a wash stone leachate collection system. This system consists of "strip drains" which extend across the landfill bottom at about 100 ft on center from a "toe drain" on the upstream side of the main dike. In the "toe drain" the leachate is collected by a perforated "header" pipe which is attached through a four way connection to the sealed leachate pipe (see Drawing No. 12). The "strip drains" should be about 5 ft wide by 2 ft high in cross sectional dimensions and the "toe drain" should be about 10 ft wide by 2 ft high. The system should be graded to provide positive drainage.

If the landfilling sequence is from the upper to lower reaches of the draws, the leachate produced by consolidation of the sludge will flow by gravity from the active face and will be collected in the runoff inlet box for removal. However, the final compartment (adjacent to the upstream slope of the dike) will require a collection system similar to that discussed above.

Cover Placement - As stated above, the bulldozer working the top surface of the sludge will spread the final soil cover as the sludge is brought to final grade. When a compartment is completed and dumping moves to another compartment, any part of the working slope that might not be extended for several weeks or more should be covered with a temporary soil cover to minimize infiltration of runoff into the sludge (thus reducing leachate production) and also to minimize environmental impact. The temporary cover should have a minimum thickness of 6 inches and the final cover should have a minimum thickness of 3 feet. At economically feasible intervals the final soil cover should be grassed. Until a sufficient stand of grass is developed, exposed areas of the soil cover will require sedimentation control, such as a silt fence down gradient. The soil cover at the top of the working slope should be graded to form a small berm or swale to direct uncontaminated runoff water away from the active sludge face, thus reducing the leachate volume.

Construction and Storage Volumes - Construction of the five sludge areas (A through E) as illustrated on the Conceptual Site Development Plan (Drawing No. 10) will require approximately 1.7 million cubic yards of compacted fill (including cover material). However, an excess of about 1 million cubic yards of cut material is anticipated from within these areas. The total estimated sludge storage capacity is approximately 7.7 million cubic yards (including a 15 percent reduction factor). The storage capacity available, fill volume required, cover volume and excess cut volume for each sludge disposal area is listed below.

Area	Storage Volume Available, Cubic Yards	Fill Volume Required, Cubic Yards	Cover Volume, Cubic Yards	Excess Cut Volume, Cubic Yards
A	2,630,000	385,000	130,000	45,000
B	685,000	180,000	55,000	175,000
C	265,000	225,000	55,000	30,000
D	3,220,000	185,000	150,000	645,000
E	950,000	260,000	60,000	65,000

Solid Waste Disposal Areas

Solid Waste Material - The solid waste (excluding sludge) currently produced by Champion and designated for landfilling consist of lime waste and fly ash and cinders. Co-disposal methods are used with the fly ash and cinders typically placed as a cover layer on top of the lime. Usually this solid waste material will temporarily stand on about 2 to 1 (horizontal to vertical) slopes; however, long term or permanent faces are considered stable at slopes of 5 to 1 or flatter. When placed on a firm base, the solid waste material will support trucks hauling the waste material.

General Development and Operational Plan - The solid waste material will be transported to the landfill by trucks. The trucks will end dump from the perimeter road, starting at the upper reaches of the disposal area. A bulldozer will push the waste material downslope on a grade no steeper than about 20 percent.

Runoff Water Control - A temporary earthen berm will be constructed downgradient of the active face of the landfill to collect runoff water from the active face (Drawing No. 12). A pipe under the temporary berm will route the water from the area after any solids have settled out. As solids accumulate behind the temporary berm, they can be removed to the active face of the landfill. As the active face advances downslope, the temporary berm will be moved.

The runoff water occurring downslope of the temporary berm and water discharged through the pipe under the temporary berm will flow down to the main confining dike. If this concentrated flow causes excessive erosion in the landfill area it may have to be routed through a conduit to the main confining dike. This uncontaminated water will be removed from the landfill area by a conduit through the main confining dike.

Cover Placement - As the landfill advances downslope, a 3 ft minimum thickness final soil cover will be placed on the finished sections. Surface runoff water from the closed out sections will be channelled around the active landfilling area by surface drainage control ditches.

Construction and Storage Volumes - Construction of the two initial solid waste disposal areas (F and G) illustrated on the Conceptual Site Development Plan (Drawing No. 10) and on the Initial Site Development Plan (Drawing No. 14) will require approximately 20,000 cubic yards of compacted fill. An additional 30,000 cubic yards of fill will be required for the final soil cover. About 100,000 cubic yards of excess cut material will have to be wasted. Based on the development scheme illustrated, approximately 235,000 cubic yards of solid waste material could be placed in the two initial disposal areas. It is estimated that an additional 0.5 million cubic yards of solid waste material could be placed in trenches, similar to Area G, at various areas on the site. The amount of excavation required to construct these trenches would be approximately equal to their available waste storage capacity.

INITIAL SITE DEVELOPMENT

Champion Papers has indicated that the initial site development would be to accommodate only solid waste material (excluding sludge). We were requested to prepare a plan for initial site development that would provide approximately 12 to 16 months or 150,000 to 245,000 cubic yards of solid waste storage capacity. In addition, the access roads to the initial solid waste disposal areas will be required to serve for only the operational life of the disposal area, and thus, have not been designed as part of the permanent main access road across the site.

As illustrated on the attached Initial Site Development Plan (Drawing No. 14), Areas E and G are proposed for initial site development. The available storage capacity is approximately 150,000 cubic yards in the northeast corner (Area F) and 85,000 cubic yards in the trench (Area G). As stated above, the proposed access road to this area should be considered temporary. Portions of it will be eliminated when the permanent main access road is constructed, when all of Champion's landfilling activities are located at this site.

CLOSURE PLANS

The closed-out landfill will appear as terraced, grassed hillsides with benches above the crest of the main dikes. The following paragraphs present the recommended landfill closure plans. These plans are illustrated on Drawing Nos. 10 and 11.

Final Contours

The main embankments, access roads and cut slopes will probably remain at the same grades and contours as during the operational stage unless conditions warrant a change. The final soil cover on the sludge waste areas should be sloped away from the interior edge of the perimeter roads at a maximum grade of 10 percent with benches at 50 ft vertical or approximately 500 ft horizontal increments. The final soil cover on the solid waste areas should be sloped at a maximum grade of 20 percent with benches at 50 ft vertical or approximately 250 ft horizontal increments. The benches should be about 50 ft wide and be sloped at about 1 percent to provide positive drainage. The benches will help control the velocity of runoff and thus reduce erosion potential. In this context, the dike crests also function as benches.

The finished landfill faces should be graded so that runoff is not concentrated but is dispersed evenly. This dispersion will help prevent erosion of the final covers and of the main embankments.

Erosion Control

Once landfilling is completed, any necessary erosion repairs or reseeding should be performed. Care should be taken to insure that the entire area filled with waste material has the required 3 ft (or more) thickness of soil cover. Temporary sedimentation controls such as silt fences downgradient of bare spots or hay bales in drainage ditches will be required until a sufficient stand of grass can develop over the entire site. Drainage ditches should be maintained to channel runoff and prevent water flow from becoming concentrated on fill slopes to minimize the potential for erosion. Periodic mowing of the main embankments and the landfill covers will permit routine visual inspection of these areas.

Uncontaminated Runoff and Leachate Pipe Lines

Before filling the final compartment of a sludge landfilling area (no undeveloped or inactive portions remaining), the uncontaminated runoff water line(s) should be plugged by grouting the entire length through the dike. Thus, the only outlets for drainage from the landfilled area will be through the leachate removal line(s). Once landfilling is completed and the leachate produced results entirely from consolidation (no runoff leachate), the quantity of leachate will decrease until the flow becomes negligible. When this condition exists, the leachate removal line(s) through the dike may be plugged by grouting. After plugging the leachate line(s), any leachate produced (expected to be a very small amount) will be contained by the landfill area (embankment, cut slopes and bottom) and the soil cover.

Monitoring

After landfilling operations have been completed and the landfill is closed-out, the groundwater quality in the monitoring wells and the surface water quality in Bowen Branch and the Pigeon River should continue to be checked by routine sampling. The samples collected should be subjected to the appropriate indicator tests determined by Champion Papers and/or required by the State. These tests will help identify any possible contamination resulting from the landfill. The results of these tests should be correlated to background information developed prior to landfilling to insure accurate representation of conditions.

CONSTRUCTION CONTROL

The quality control monitoring for construction should include inspection of the foundation preparation and compaction monitoring of embankment materials. The foundation should be inspected by an experienced geotechnical engineer during and after completion of the undercutting of organic or soft surficial soils. Approval by the engineer should be given before placement of embankment materials in any area.

The compaction of any structural fill should be monitored by an experienced soils technician working under the direct supervision of a geotechnical engineer. The following recommendations for fill placement are:

(1) The compacted fill should be placed in approximately horizontal layers with a loose lift thickness not exceeding 8 inches.

(2) The soil fill should be free of rocks having a dimension greater than 6 inches. Rocks larger than 6 inches should be removed from the borrow area or from the fill prior to compaction. If the fill contains many rocks, a rubber-tired roller should be available to compact the fill.

(3) The fill surface should rise at approximately the same rate at all points with the exception of a crown or cross-slope maintained to provide surface drainage.

(4) The groundwater table should be maintained at least 3 ft below the general working surface of main embankments at all times.

(5) Each layer of soil placed should be compacted by approved compaction equipment to at least 95 percent of the standard Proctor maximum dry density.

(6) If the moisture content of the borrow soils is too wet for proper compaction, then these soils may have to be spread and dried under the sun and wind in order to efficiently obtain the recommended degree of compaction. If the borrow soils are too dry to obtain the proper compaction, sprinkling and discing may be required to increase the moisture content.

Testing should be peformed during construction of a dike as required to identify materials, to determine compaction characteristics of materials that may differ from those already tested and reported herein, to determine moisture content, and to determine density of the in-place fill. Any variable or new borrow soils should have triaxial shear tests made to determine their strength parameters for comparison with soil strengths utilized in embankment stability analyses. To verify the attainment of the specified degree of compaction, in-place field density tests should be performed according to the procedures of either ASTM D 2937 or D 1556. This compaction test monitoring of the structural fill should be accomplished for every borrow area, each change in soil type, and for main embankments on a frequency of at least every 2000 cubic yards placed, or for no more than a 2 ft thick accumulation of fill.

QUALIFICATION OF REPORT

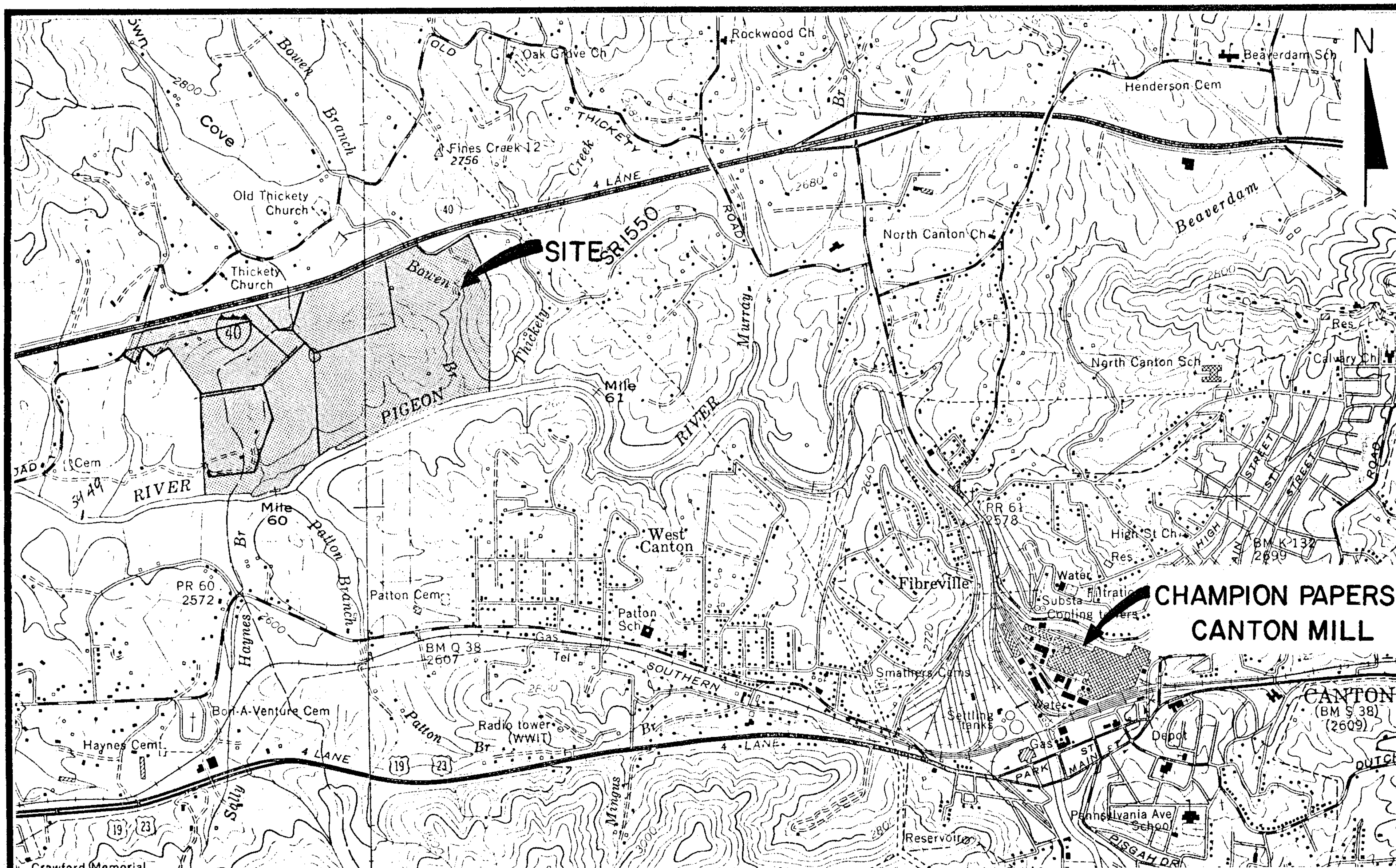
The exploratory activities, testing procedures, and evaluative approaches used in this investigation have been consistent with those normally employed in geotechnical engineering for landfills and earth dikes of the type in this report. In a very real sense, however, the information obtained is fragmentary. The dispersed borings and assigned tests represent an extremely small sampling from the reference area and soil volume about which information is needed. Although fragmentary, useful design guidelines have been developed from this data.

Major subsurface discontinuities or soil quality changes that can affect the performance and construction of the landfill can occur within very short lateral and vertical distances. It is unlikely that the dispersed sampling used in this investigation will identify all variant conditions; also, there could be a bias in the representation of prevailing or average conditions. In addition, the constructed product may not fully achieve the intent of the plans and specifications. Appropriate field engineering observations during construction will provide the best format for identification of variant conditions and for initiating proper remedial action.

The state-of-the-art in geotechnical engineering is such that the risks cannot be accurately defined for an efficient and economical landfill of the size and extent proposed. Accordingly, we do not warrant or in any way guarantee that the project will function without problems. Qualified engineering during design and construction together with post-construction performance checks constitute the owner's best resource for identifying and minimizing problems before they become critical and minimizing future costs by maximizing design. Since any type of problem correction is likely to have associated costs or time delays, we recommend that the owner's budget and planning consider this possibility.

APPENDIX I

DRAWINGS



Ref: USGS Topographical Maps, Canton and Clyde Quadrangles, 7.5 Minute Series Dated 1967

LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

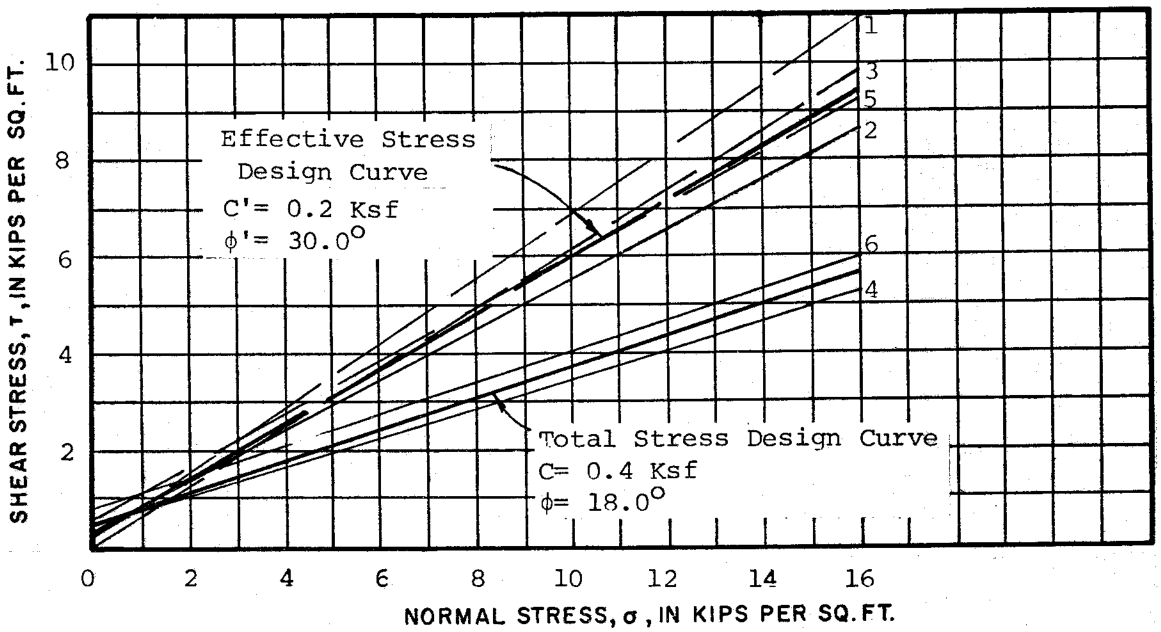
SITE VICINITY MAP
LANDFILL NO. 6 SITE
CHAMPION PAPERS - CANTON, NORTH CAROLINA

CHAMPION PAPERS
CANTON, NORTH CAROLINA

DWN. BY	MH		SCALE: 1"=2000'
CKD. BY	RMP		DRAWING NO. 1
APPR'D.	JNS		CH 4507

DUNCAN-PARNELL, INC., CHARLOTTE 680

Drawings Under Seperate Cover



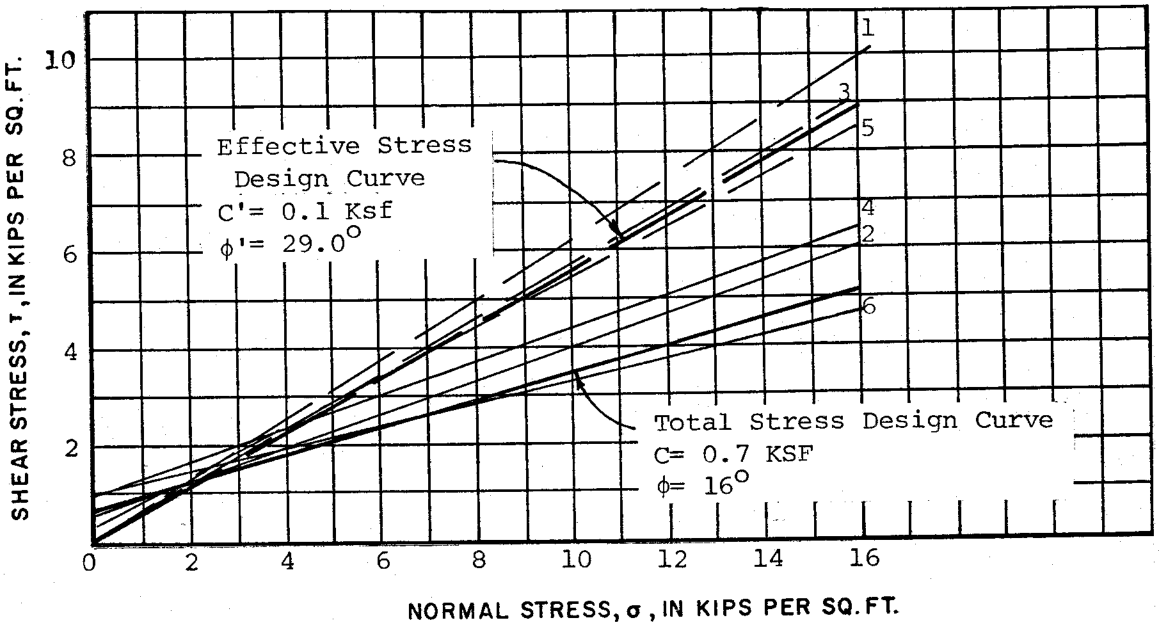
Legend	Stress Type	Boring Number	Depth (Ft)	Material
1	Effective	B-8	9-11	Very Micaceous Fine to Coarse Sandy Silt
2	Total			
3	Effective	B-10	13-15	Slightly Micaceous Fine to Medium Sandy Silt
4	Total			
5	Effective	B-11	8-10	Micaceous Silty Fine to Coarse Sand
6	Total			

Note: Results of Saturated Consolidated Undrained Triaxial Shear Test With Pore Pressure Measurements. Slope Stability Analyses Utilize Total Stress for End of Construction Condition and Effective Stress, Which Approximates Consolidated Drained Results for Steady State Condition.

LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

FOUNDATION SOILS
CONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST
CHAMPION PAPERS LANDFILL NO. 6
CANTON, NORTH CAROLINA

JOB NO. CH 4507 | DRAWING NO. 5



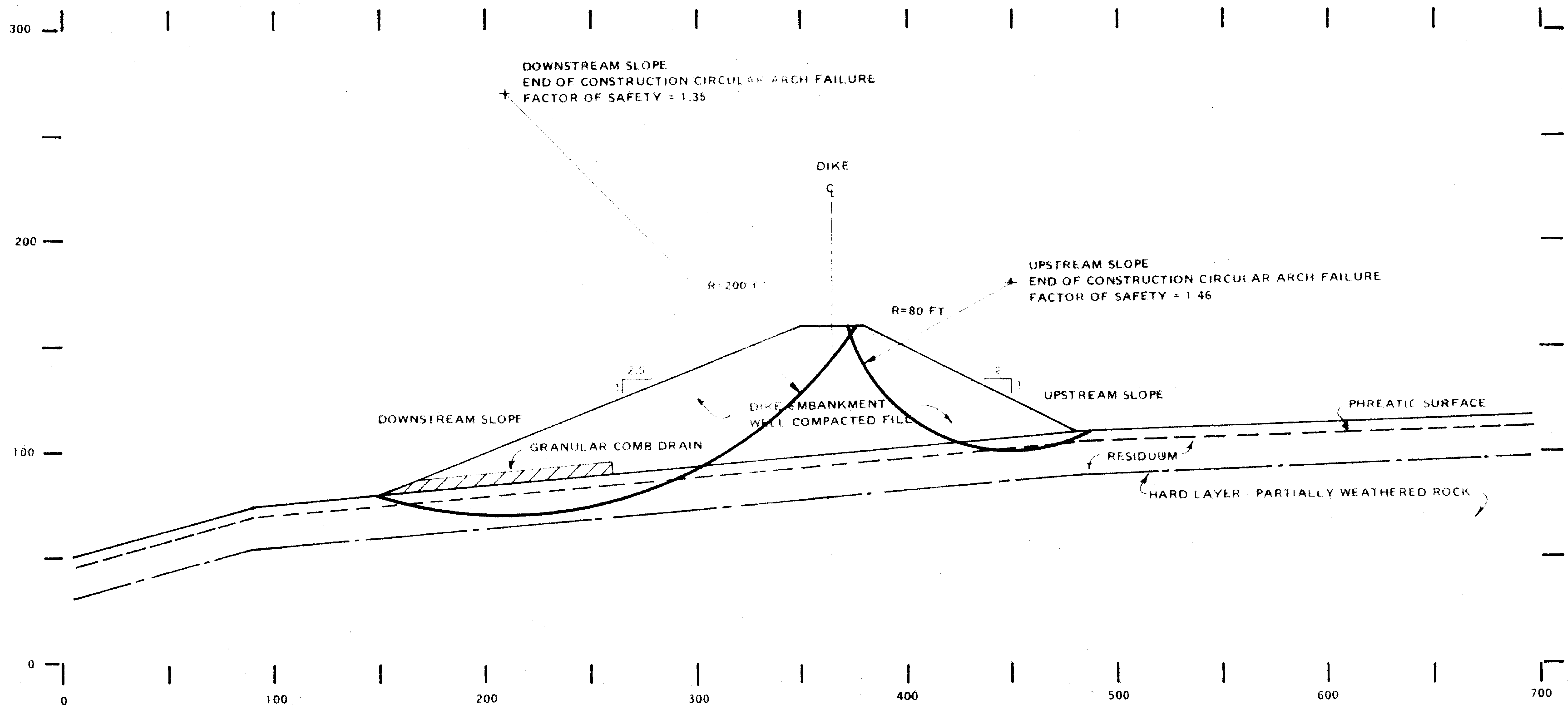
Legend	Stress Type	Boring Number	Depth (Ft)	Material
1	Effective	B-10	1-8	Micaceous Fine to Coarse Sandy Silt
2	Total			
3	Effective	B-18	1-8	Micaceous Fine to Medium Sandy Silt
4	Total			
5	Effective	B-18	18-23	Slightly Micaceous Fine to Medium Sandy Silt
6	Total			

Note: Results of Saturated Consolidated Undrained Triaxial Shear Test with Pore Pressure Measurements. Slope Stability Analysis Utilize Total Stress for End of Construction Condition and Effective Stress, Which Approximates Consolidated Drained Results for Steady State Condition.

LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

EMBANKMENT SOILS
CONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST
CHAMPION PAPERS LANDFILL NO. 6
CANTON, NORTH CAROLINA

JOB NO. CH 4507 | DRAWING NO. 6



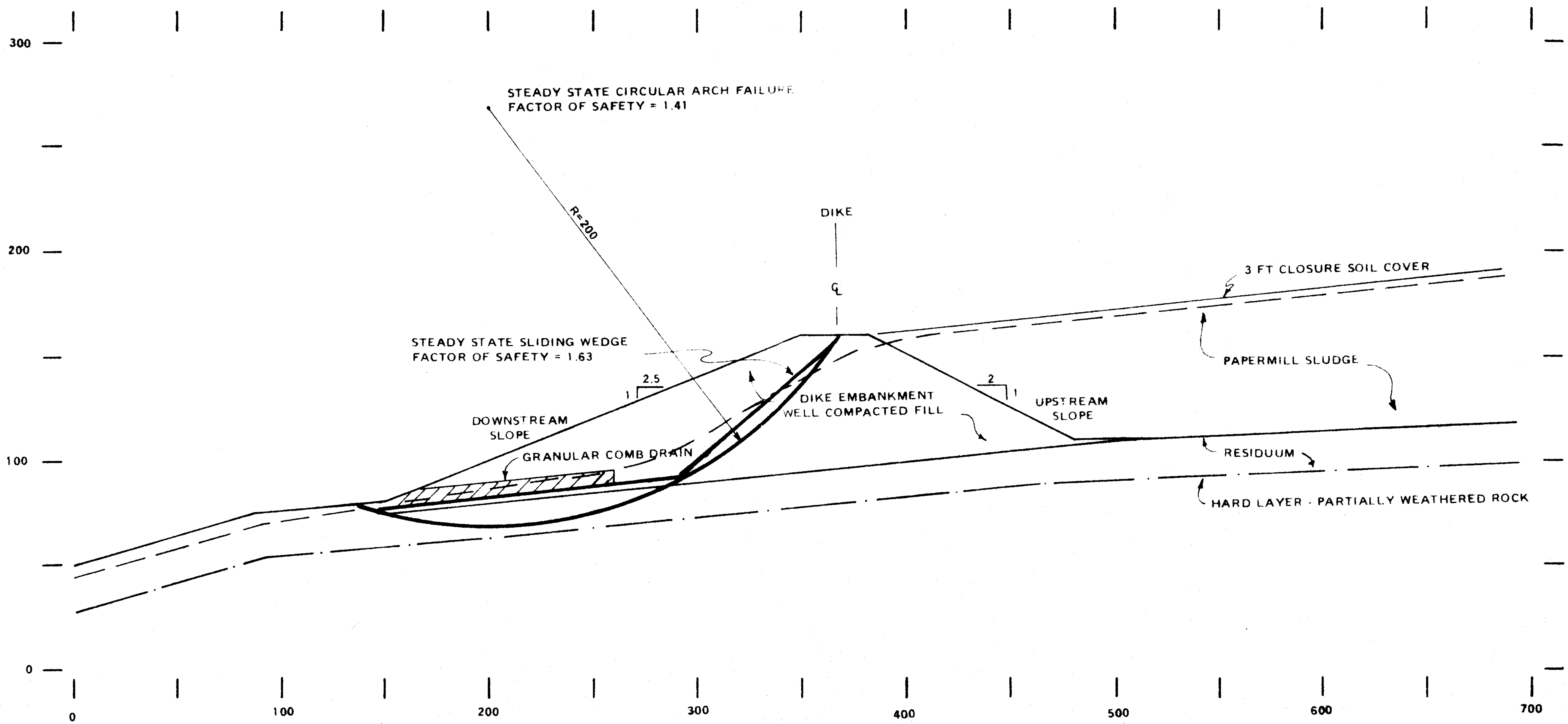
PROPERTIES USED IN ANALYSES

SOIL TYPE	γ_w	ϕ	C
FILL	125 pcf	16°	700 psf
RESIDUUM	115 pcf	18°	400 psf

LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

SLOPE STABILITY ANALYSES
GENERALIZED DIKE SECTION
END OF CONSTRUCTION CONDITION

JOB NO. CH 4507 | DRAWING NO. 7



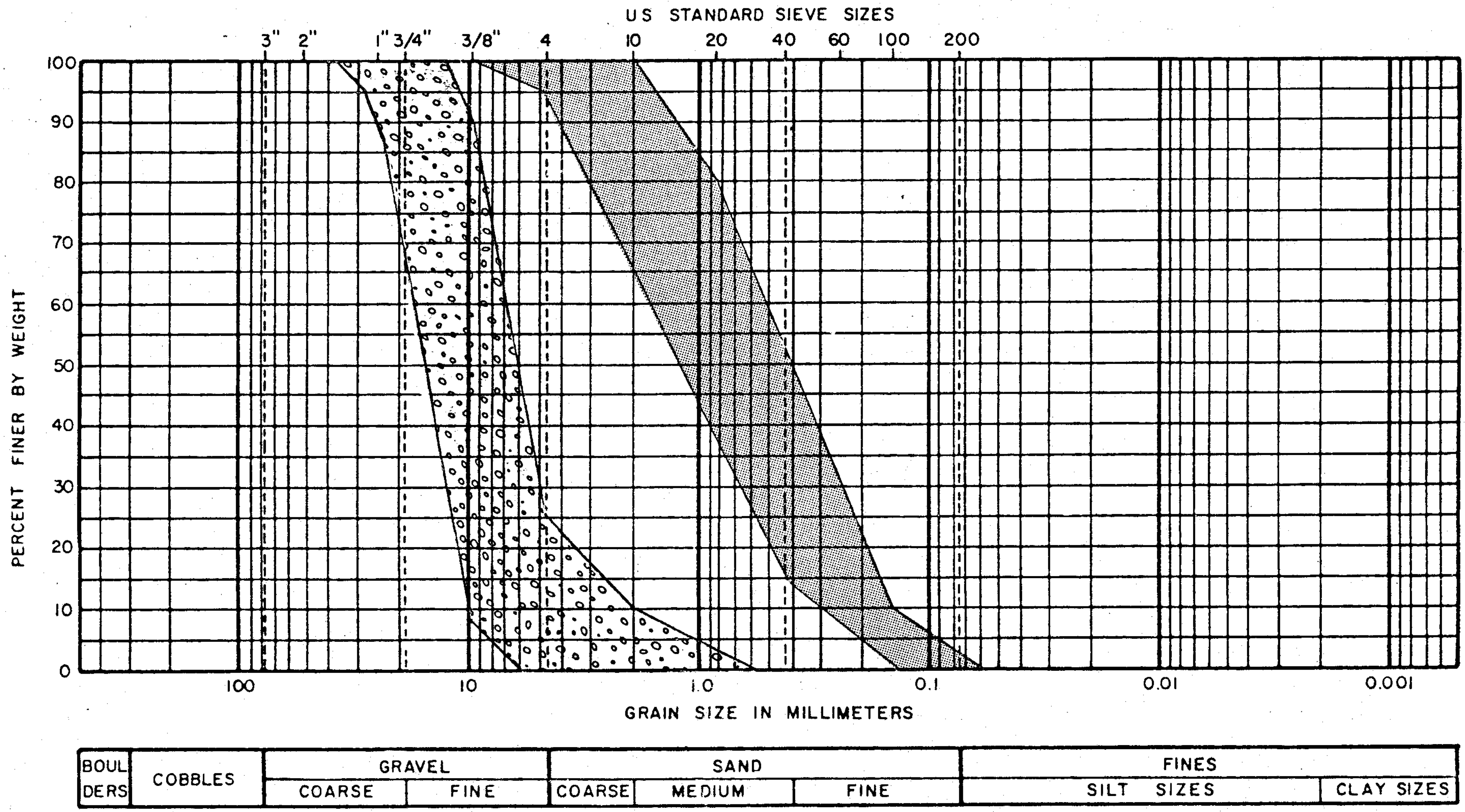
PROPERTIES USED IN ANALYSES

MATERIAL	γ_w	γ_s	ϕ'	C'
SLUDGE	[illegible] pcf	[illegible] pcf	45°	50 psf
FILL	125 pcf	132 pcf	29°	100 psf
RESIDUUM	115 pcf	121 pcf	30°	200 psf

LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

SLOPE STABILITY ANALYSES
GENERALIZED DIKE SECTION
STEADY STATE CONDITION

JOB NO. CH 4507	DRAWING NO. 8



APPROXIMATE GRADATION LIMITS FOR COARSE FILTER

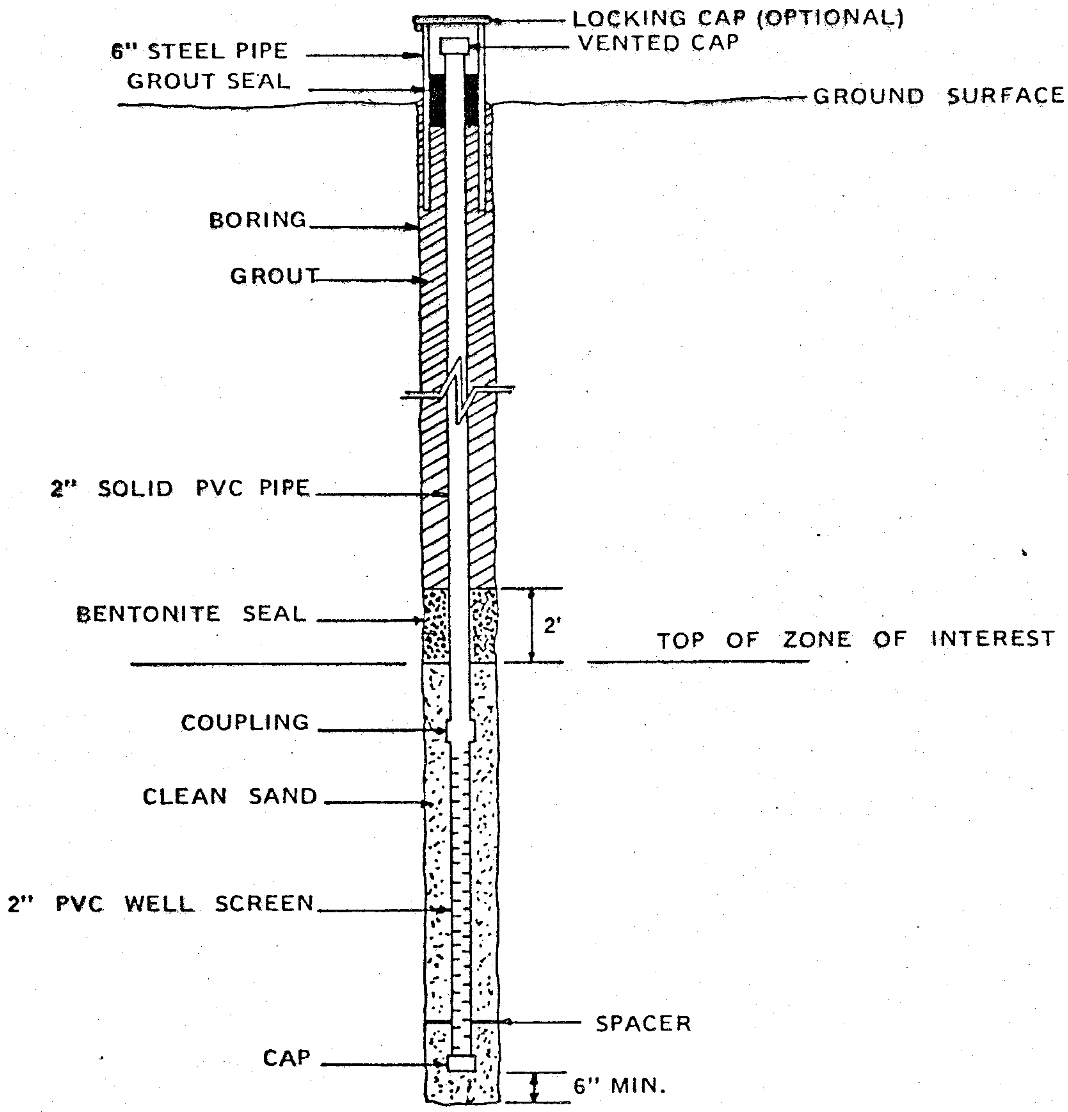
APPROXIMATE GRADATION LIMITS FOR FINE FILTER

LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

GRAIN SIZE GRADATION FOR
FINE AND COARSE FILTERS

JOB NO. CH 4507	DRAWING NO. 9

Drawings Under Seperate Cover



NOTE: CERTAIN WASTE CONSTITUENTS MAY REQUIRE THE USE OF SCREWED CONNECTIONS FOR THE PVC PIPE

LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

CHAMPION PAPERS LANDFILL NO. 6
TYPICAL WATER QUALITY MONITORING
WELL INSTALLATION

JOB NO. CH 4507	DRAWING NO. 13

Drawing Under Seperate Cover

APPENDIX II

FIELD TESTING PROCEDURES AND RESULTS

Site Reconnaissance

The surface conditions at the site of the proposed Champion Papers Landfill No. 6 were investigated on several occasions by visual reconnaissance of the area by Ray Lawing, Hydrologist; Jim Smith, Senior Geotechnical Engineer; and Bob Pitts, Staff Geotechnical Engineer, all of Law Engineering Testing Company. The purpose of the site reconnaissance was to observe the general site topography and to note any outstanding surface features that might affect the construction of the proposed project. A more accurate evaluation of the subsurface conditions and possible construction problems and an increased awareness of the overall site conditions are obtained when visual site reconnaissance data are used in conjunction with the field and laboratory test results.

Soil Test Borings

In all, nineteen soil test borings and six offset auger borings to obtain undisturbed and bulk samples were made at the site. The approximate boring locations are shown on the Boring Location Plan (Drawing No. 2) in Appendix I. The borings were surveyed in the field and ground surface elevation determined by representatives of Webb A. Morgan & Associates, P. A.

The borings were made by mechanically twisting a continuous flight steel auger into the soil. Soil sampling and penetration testing were performed in general accordance with ASTM D 1586. At regular intervals, soil samples were obtained with a standard 1.4-inch I. D., 2-inch O. D., split-tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings, and then driven an additional 12 inches with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final 12 inches was recorded and is designated the "penetration resistance". The penetration resistance, when properly evaluated, is an index to the soil's strength and foundation supporting capability.

Representative portions of the soil samples, thus obtained, were placed in glass jars and transported to the laboratory. In the laboratory, the samples were examined by a geotechnical engineer to verify the driller's field classifications. Test Boring Records are attached, showing the soil descriptions and penetration resistances.

Undisturbed Sampling

Split-barrel samples are suitable for visual examination and classification tests but are not sufficiently intact for quantitative laboratory tests. Therefore, relatively undisturbed samples were obtained in selected borings by drilling to the desired depth and hydraulically forcing a section of 3-inch O. D., 16 gauge steel tubing into the soil. The sampling procedure is described by ASTM D 1587. Each tube, together with the encased soil, was carefully removed from the ground, made airtight and transported to the laboratory. The depths of undisturbed samples are shown on the appropriate Test Boring Records.

Bag Samples

Representative loose bulk samples of soils from potential on site borrow areas were obtained. These bulk samples were obtained as auger cuttings from the desired depths in selected borings. The soil was placed in cloth sacks and along with a jar sample, was returned to the laboratory for storage.

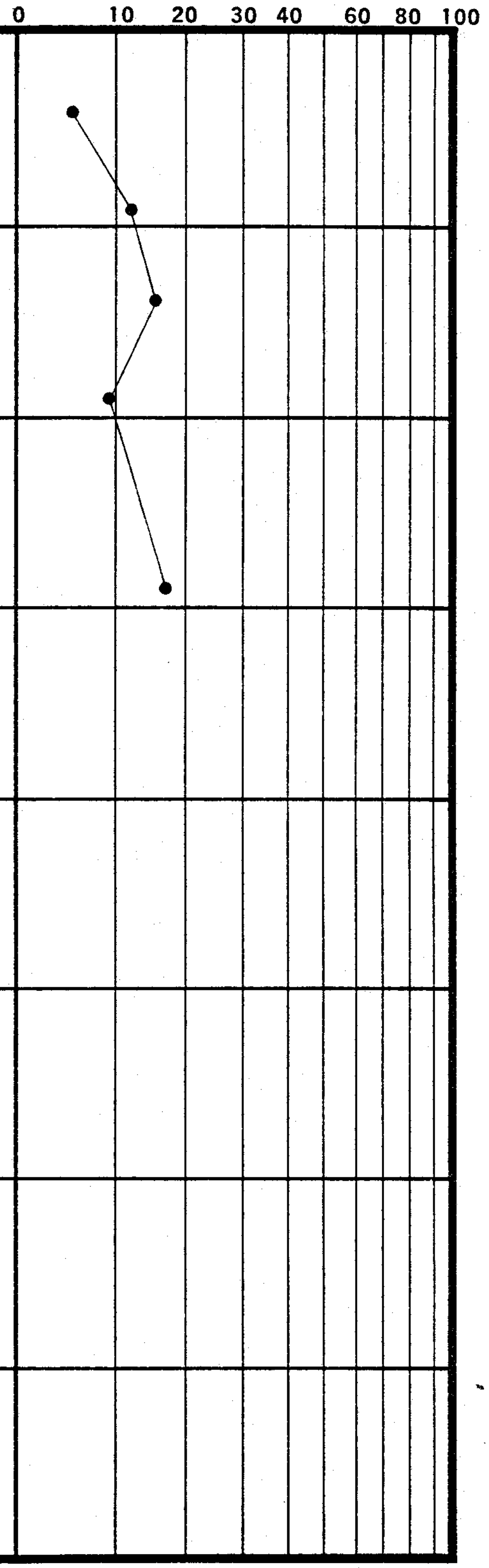
Groundwater Level Readings

Groundwater level readings were recorded at the time of boring. These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. At most of the boring locations, water table readings were taken again a minimum of 24 hours after the borings were completed to permit stabilization of the groundwater table which has been locally disrupted by the drilling operation.

Observation Wells

Observation wells were installed at twelve boring locations using 2-inch diameter PVC pipe set in the 6-inch diameter borings. The bottom 5 ft or more of the pipe was slotted, lowered to the bottom of the borehole, and the annular space backfilled with graded sand to a level above the slotted section. The remaining space was backfilled with soil to approximately the ground surface. The exposed tops of the observation wells were marked for identification in the field. The groundwater level in all but one of these wells was checked on March 11, 1981. The only well not checked, B-3, had been trampled by cattle grazing in the area.

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0		2640
3"	*	
	Alluvium - Firm Brown Gray Micaceous Fine to Medium Sandy Silt With Small Gravel	
3.0	Alluvium - Stiff Gray Tan Micaceous Fine Sandy Silty Clay	2635
6.0	Residuum - Loose to Firm Brown Gray Very Micaceous Silty Fine to Medium Sand	2630
		2625
15.0	Boring Terminated at 15.0 Feet	



Groundwater at 5.5 Feet After 24 Hours

Observation Well Set to 13.5 Feet

Groundwater at 7.2 Feet, March 11, 1981

*Grass and Topsoil

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-1

DATE DRILLED 4/23/80

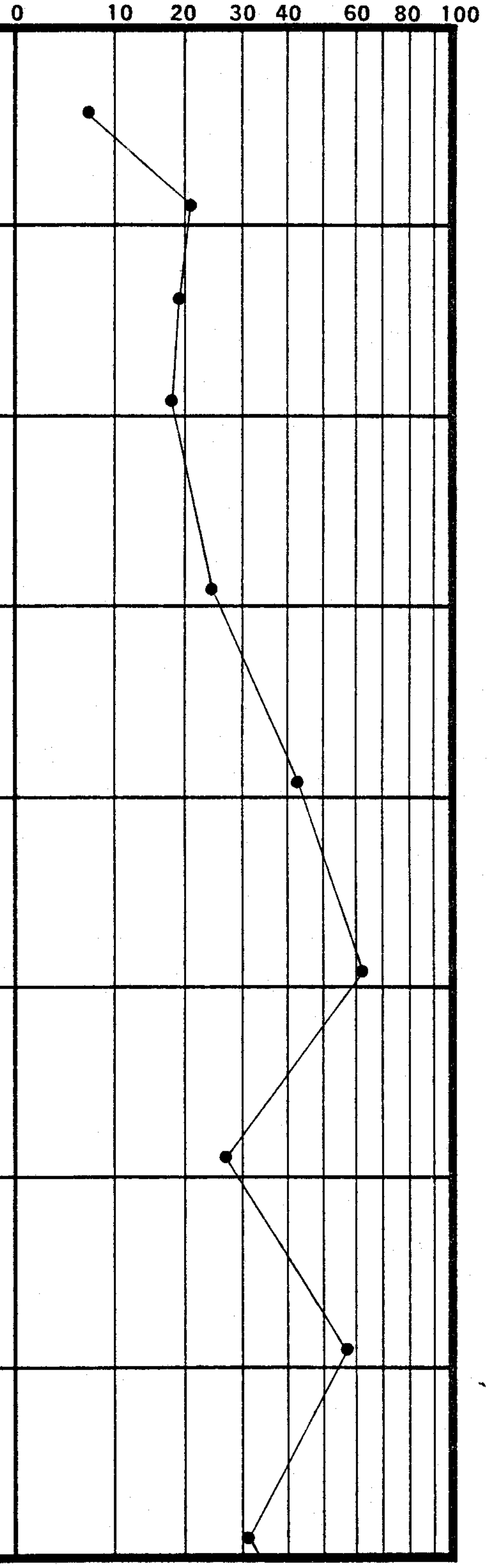
JOB NO. CH 4429

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0	Residuum - Firm Brown Red Tan Micaceous Fine to Medium Sandy Silt	2754
3.0	Very Stiff Red Brown White Micaceous Fine to Medium Sandy Silt	2749
8.0	Very Stiff Red Brown Gray Very Micaceous Fine to Medium Very Sandy Silt*	2744
		2739
18.0	Dense to Very Dense Brown Gray Very Micaceous Silty Fine to Coarse Sand With Quartz Fragments*	2734
		2729
26.5	Very Stiff Purple White Very Micaceous Fine to Medium Sandy Silt*	2724
32.0	Dense to Very Dense Brown Gray Very Micaceous Silty Fine to Coarse Sand With Rock Fragments*	2719
40.0		2714

● PENETRATION-BLOWS PER FT.



*Sand Sized Particles Are Predominately Mica

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-2

DATE DRILLED 4/24/80

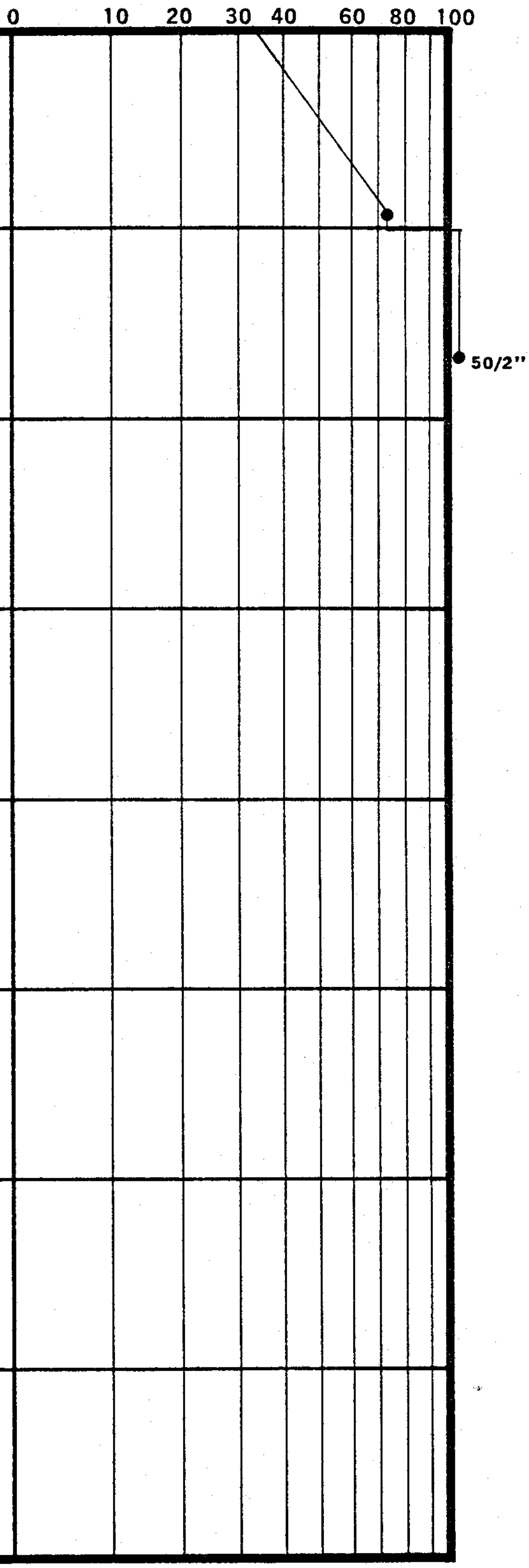
JOB NO. CH 4429

PAGE 1 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
40.0	Dense to Very Dense Brown Gray Very Micaceous Silty Fine to Coarse Sand With Rock Fragments*	2714
45.0	Partially Weathered Rock That Becomes Brown Black Very Micaceous Silty Fine to Coarse Sand When Sampled	2709
50.0	Auger Refusal at 50.0 Feet Boring Terminated at 50.0 Feet No Groundwater Encountered After 24 Hours	2704

● PENETRATION-BLOWS PER FT.



*Sand Sized Particles Are Predominately Mica

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-2

DATE DRILLED 4/24/80

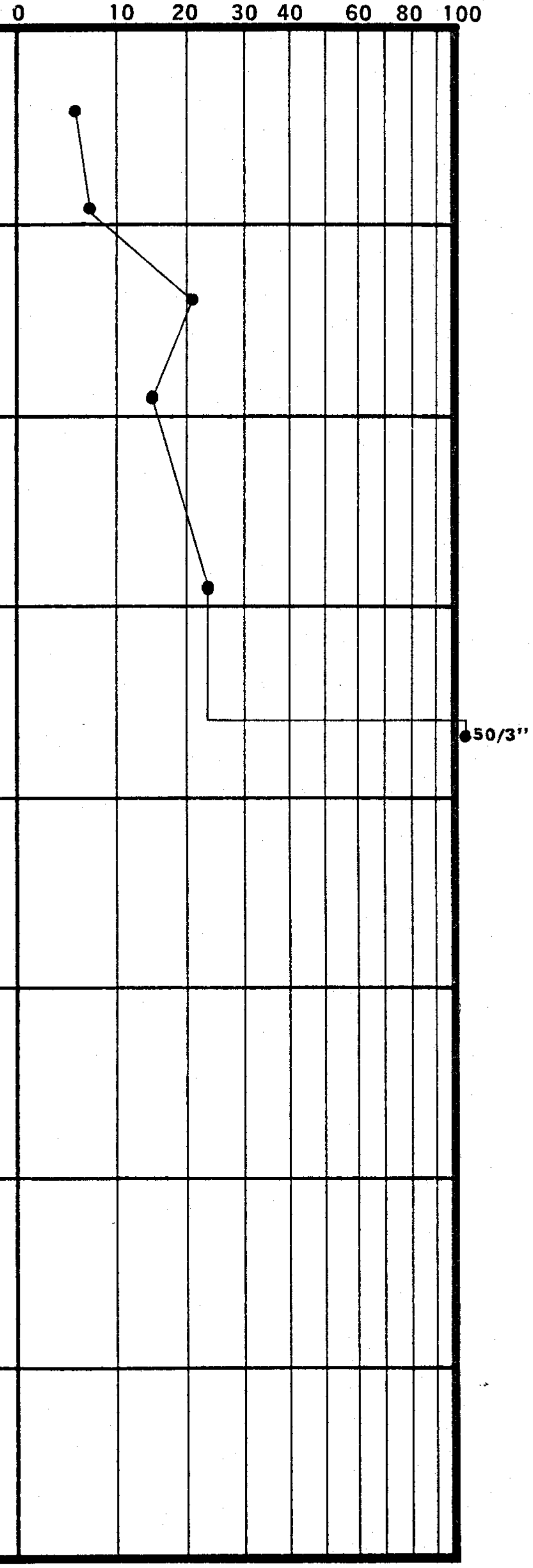
JOB NO. CH 4429

PAGE 2 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0		2626
2"	**	
	Alluvium - Firm Brown Gray Micaceous Fine to Medium Sandy Silt With Small Gravel	
4.5	Residuum - Firm Gray Brown Micaceous Fine to Medium Sandy Silt	2621
6.0	Firm Brown Gray Very Micaceous Silty Fine to Corase Sand*	
		2616
		2611
18.0	Partially Weathered Rock That***	
19.0	Boring Terminated at 19.0 Feet	2606
	Groundwater at 5.0 Feet After 24 Hours	
	Observation Well Set to 17.5 Feet	

● PENETRATION-BLOWS PER FT.



*Sand Sized Particles Are Predominately Mica

**Grass and Topsoil

***Becomes Gray Very Micaceous Silty Fine to Coarse Sand With Rock Fragments When Sampled*

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-3

DATE DRILLED 4/22/80

JOB NO. CH 4429

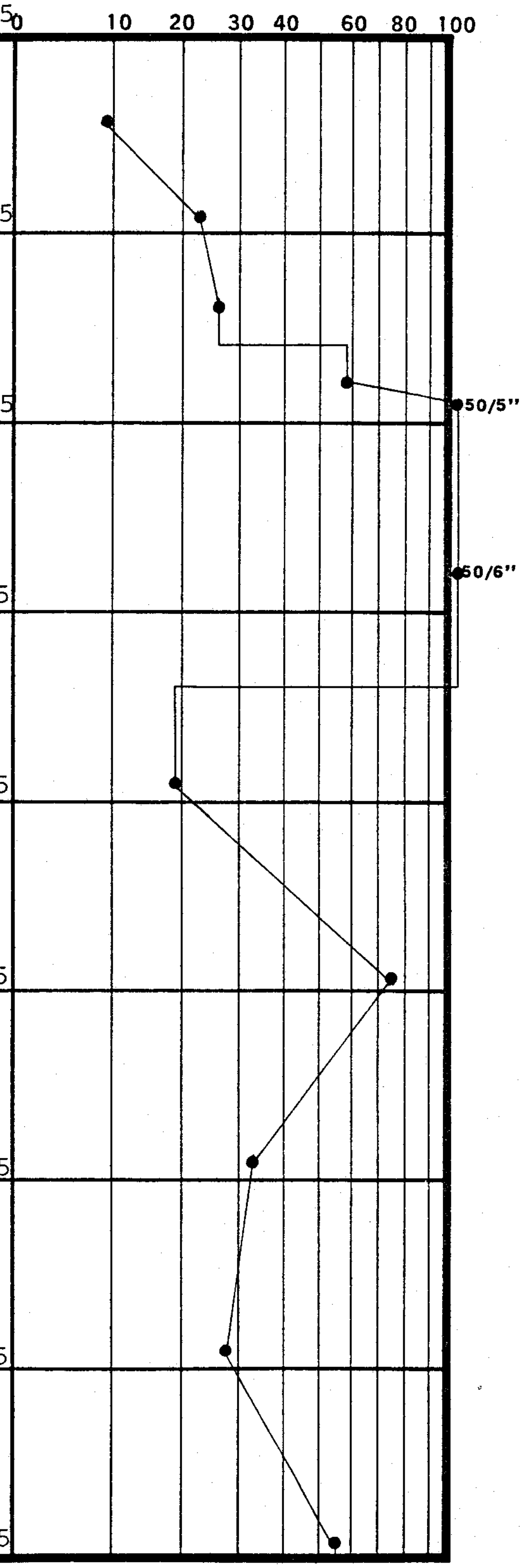
PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION
0	Grass and Topsoil
5"	Disturbed - Brown Red Clayey Sandy Silt
1.5	Residuum - Stiff Brown Micaceous Clayey Fine to Medium Sandy Silt
3.0	Firm Gray Brown Very Micaceous Silty Fine to Coarse Sand*
9.5	Partially Weathered Rock That Becomes Brown Gray Very Micaceous Silty Fine to Coarse Sand When Sampled*
17.0	Firm Brown Gray Very Micaceous Silty Fine to Coarse Sand*
21.5	Very Dense Brown Gray Very Micaceous Silty Fine to Coarse Sand*
28.0	Dense Gray Brown Very Micaceous Silty Fine to Coarse Sand*
32.0	Firm Red Brown White Very Micaceous Silty Fine to Coarse Sand*
37.0	Very Dense Brown Gray Very Micaceous Silty Fine to Coarse Sand*
40.0	

Approx. Elev., Ft.: 2734.5, 2729.5, 2724.5, 2719.5, 2714.5, 2709.5, 2704.5, 2699.5, 2694.5

● PENETRATION-BLOWS PER FT.



*Sand Sized Particles Are Predominately Mica

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-4

DATE DRILLED 4/24/80

JOB NO. CH 4429

PAGE 1 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)
40.0	Very Dense Brown Gray Very Micaceous Silty Fine to Coarse Sand*	2694.5	
42.5	Partially Weathered Rock That Becomes Brown Gray Very Micaceous Silty Fine to Coarse Sand When Sampled*	2689.5	50/5½"
			50/3"
49.0	Boring Terminated at 49.0 Feet No Groundwater Encountered After 24 Hours	2684.5	

*Sand Sized Particles Are Predominately Mica

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

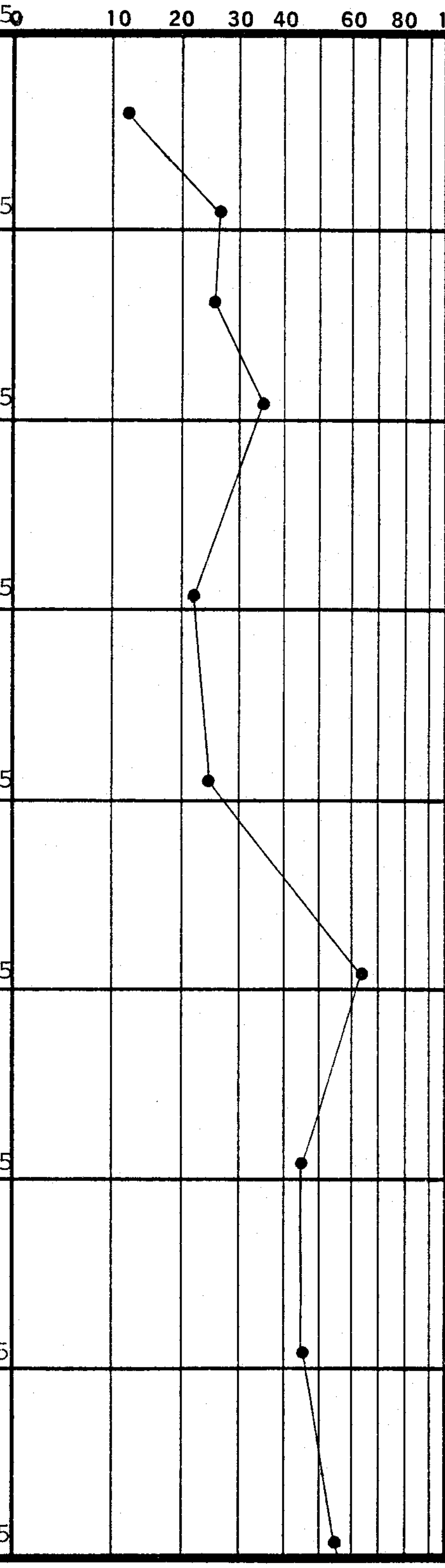
BORING NO. B-4

DATE DRILLED 4/24/80

JOB NO. CH 4429

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0	Disturbed - Brown Black Micaceous Clayey Sandy Silt	2709.5
1.0	Residuum - Stiff Brown Red Black Micaceous Fine to Medium Sandy Silt	
3.0	Firm Brown Gray Very Micaceous Silty Fine to Coarse Sand*	2704.5
8.0	Firm to Dense Brown Gray Very Micaceous Silty Fine to Coarse Sand*	2699.5
		2694.5
		2689.5
21.5	Very Dense Brown Gray Very Micaceous Silty Fine to Coarse Sand*	2684.5
28.0	Dense Tan Brown Gray Very Micaceous Very Silty Fine to Medium Sand*	2679.5
33.0	Dense to Very Dense Brown Gray Very Micaceous Silty Fine to Coarse Sand*	2674.5
40.0		2669.5



*Sand Sized Particles Are Predominately Mica

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-5

DATE DRILLED 4/22/80

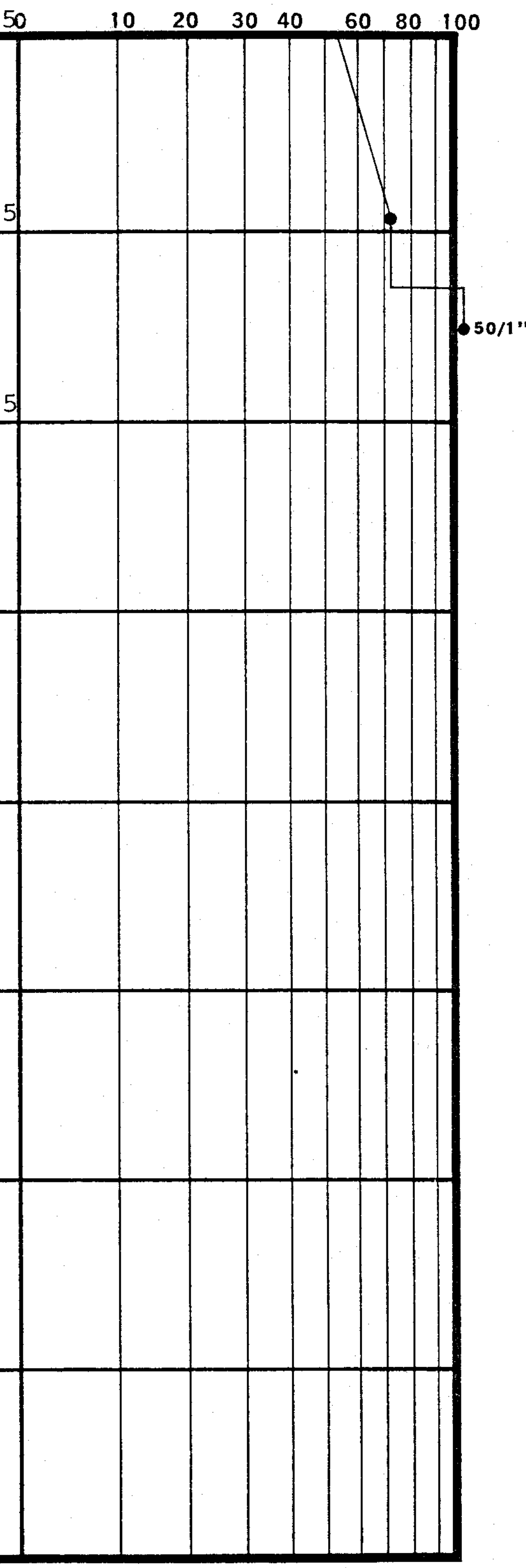
JOB NO. CH 4429

PAGE 1 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
40.0	Dense to Very Dense Brown Gray Very Micaceous Silty Fine to Coarse Sand*	2669.5
		2664.5
46.5	Partially Weathered Rock That Becomes**	
47.5	Auger Refusal at 47.5 Feet	
	Boring Terminated at 47.5 Feet	2659.5
	No Groundwater Encountered After 24 Hours	

● PENETRATION-BLOWS PER FT.



*Sand Sized Particles are Predominately Mica

**Gray White Very Micaceous Silty Fine Sand When Sampled*

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-5

DATE DRILLED 4/22/80

JOB NO. CH 4429

LAW ENGINEERING TESTING COMPANY

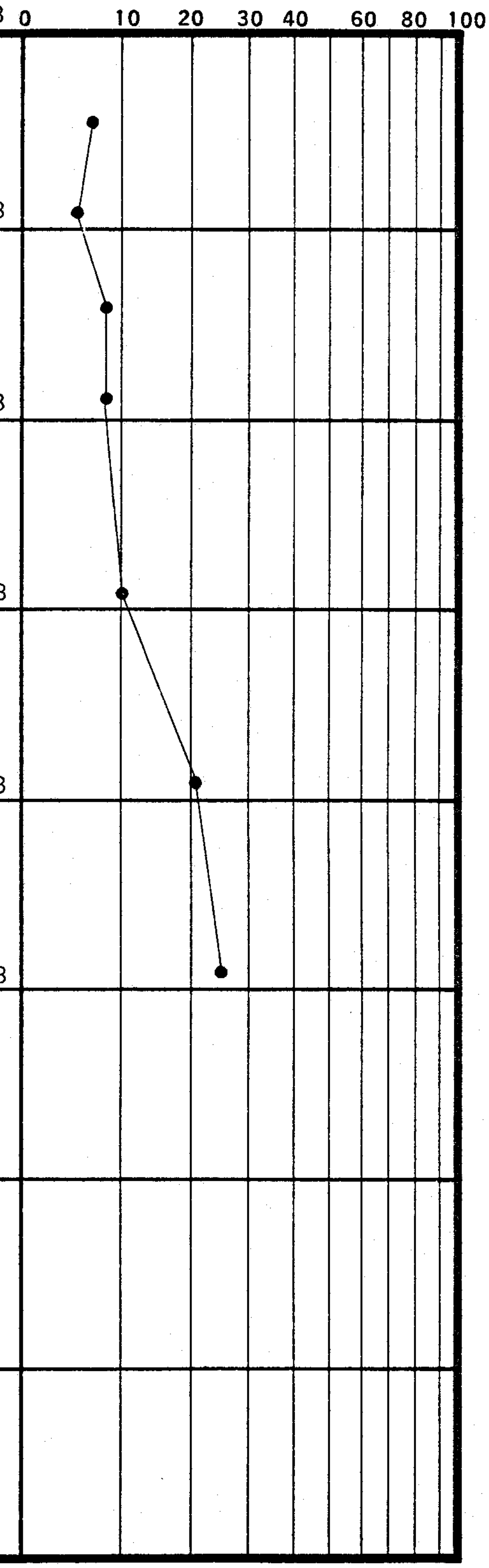
DEPTH FT.	DESCRIPTION
0	Grass and Topsoil
5"	Possible Colluvium - Firm Red Brown Micaceous Fine to Medium Sandy Silt
3.0	Possible Colluvium - Loose Brown Red Very Micaceous Silty Fine to Coarse Sand
12.0	Residuum - Stiff Brown Gray Very Micaceous Fine to Medium Very Sandy Silt
19.5	Firm Gray Brown Very Micaceous Silty Fine to Coarse Sand*
25.0	Boring Terminated at 25.0 Feet

Groundwater at 18.5 Feet After 24 Hours

Observation Well Set to 23.0 Feet

Boring Caved and Wet at 21.9 Feet, March 11, 1981

Approx. Elev., Ft.: 2663, 2658, 2653, 2648, 2643, 2638



*Sand Sized Particles Are Predominately Mica

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-6

DATE DRILLED 4/23/80

JOB NO. CH 4429

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0		2565
5"	Grass and Topsoil	
	Alluvium - Firm Brown Micaceous Fine to Medium Sandy Silt	
4.0	Possible Alluvium - Stiff Brown Black Micaceous Clayey Fine to Medium Sandy Silt	2560
6.0	Residuum-Stiff Black Gray Brown Micaceous Fine to Medium Sandy Silty**	
8.0	Partially Weathered Rock That Becomes Gray Tan Very Micaceous Silty Fine to Coarse Sand When Sampled*	2555
11.5	Firm Gray Green Very Micaceous Silty Fine to Coarse Sand*	2550
15.0	Boring Terminated at 15.0 Feet	

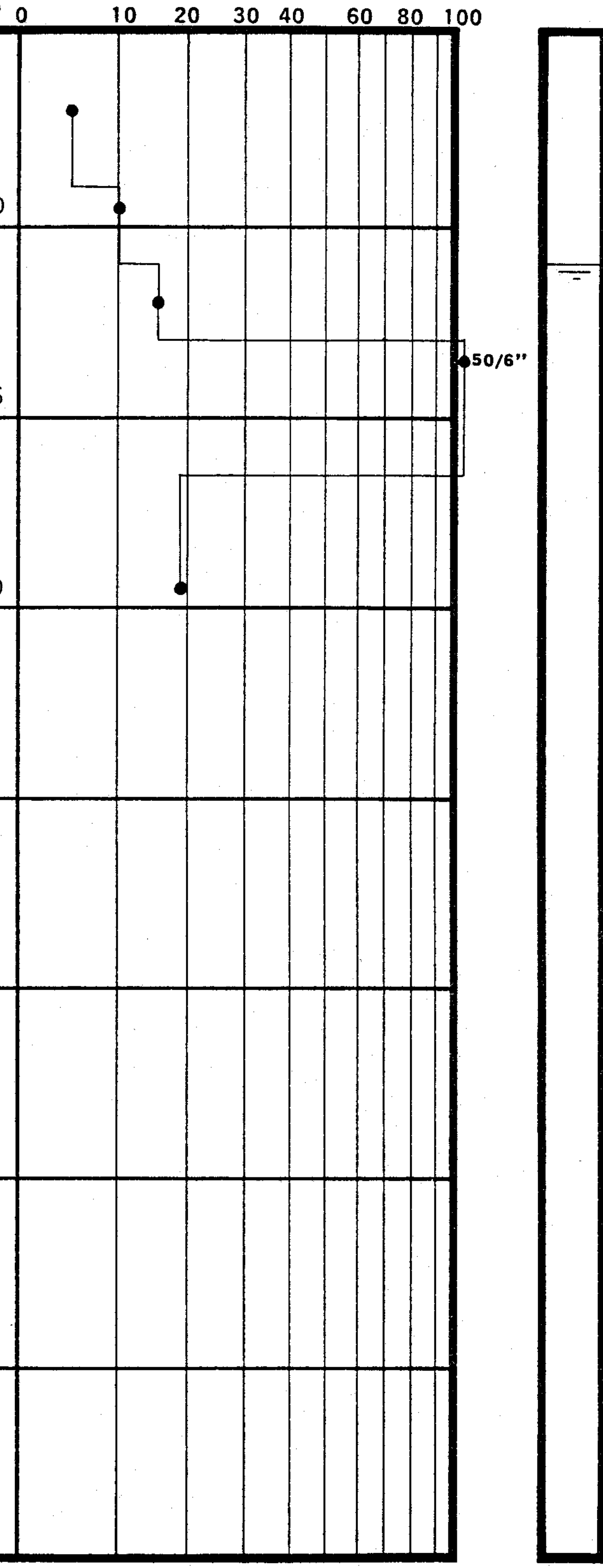
Groundwater at 6.0 Feet After 24 Hours

Observation Well Set to 14.0 Feet

Groundwater at 9.0 Feet, March 11, 1981

*Sand Sized Particles Are Predominately Mica
**Clay With Rock Fragments

● PENETRATION-BLOWS PER FT.



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-7

DATE DRILLED 4/22/80

JOB NO. CH 4429

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0		2646.5
5"	Grass and Topsoil	
	Residuum - Soft Brown Gray Very Micaceous Fine to Medium Sandy Silt	
3.0	Stiff Brown Gray Very Micaceous Fine to Coarse Very Sandy Silt With Some Rock Fragments *	2641.5
		2636.5
12.0	Firm Brown Tan Very Micaceous Silty Fine to Coarse Sand With Rock Fragments*	2631.5
19.0	Partially Weathered Rock That Becomes Black Brown Very Micaceous Silty Fine to Coarse Sand With Rock Fragments When Sampled*	2626.5
		2621.5
26.5	Auger Refusal at 26.5 Feet	

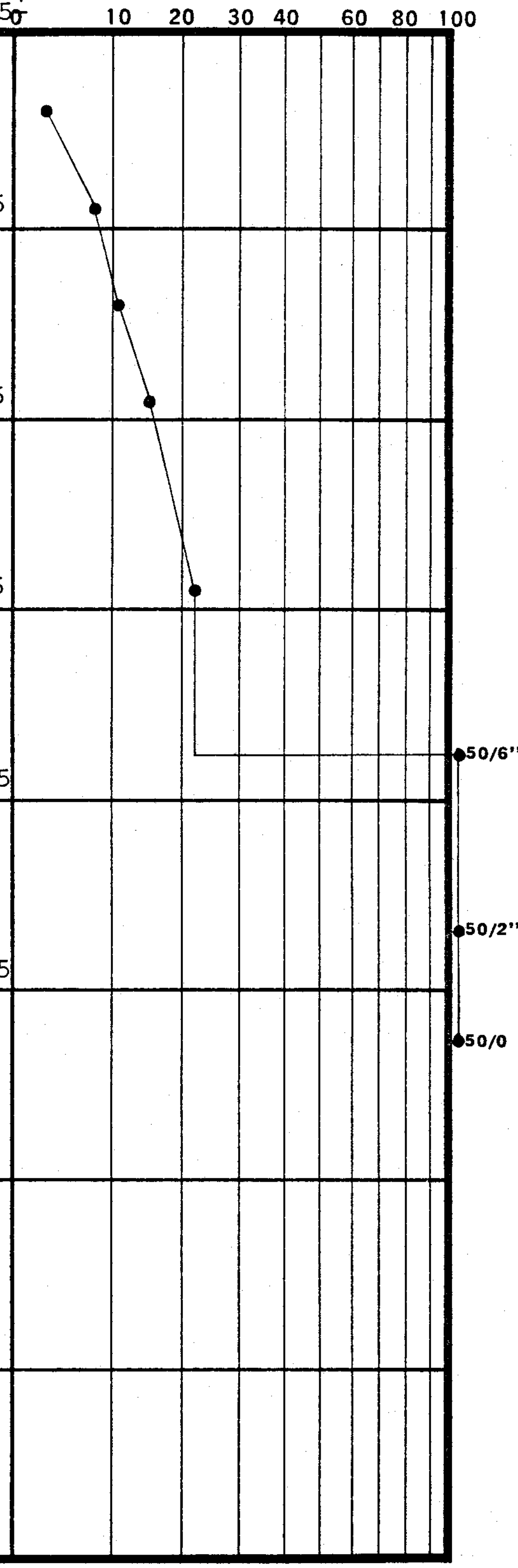
Boring Terminated at 26.5 Feet

No Groundwater Encountered at Time of Boring

Bulk "Bag" Sample 3.0 to 12.0 Feet and Undisturbed Sample 9.0 to 11.0 Feet from Adjacent Boring

Note: Boring Filled In After Drilling; Thus, No 24-Hour Water Measurement Made.

● PENETRATION-BLOWS PER FT.



*Sand Sized Particles Are Predominately Mica

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-8

DATE DRILLED 4/25/80

JOB NO. CH 4429

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0		2591
	Topsoil and Other Organic Material	
1.5	Alluvium - Loose Brown Micaceous Silty Fine to Medium Sand with Clayey Silt Seams	
3.5	Alluvium - Soft Brown Gray Clayey Fine to Coarse Sandy Silt with Small Roots and Rock Fragments	2586
6.0	Residuum - Firm Brown Gray Slightly Micaceous Silty Fine to Medium Sand with Small Rock Fragments	
8.0	Very Stiff Dark Brown Micaceous Fine Very Sandy Silt	2581
13.0	Partially Weathered Rock - No Sample Recovery at 14.5 Feet	
14.5		2576

Power Auger Refusal at 14.5 Feet

Boring Terminated at 14.5 Feet

Groundwater Encountered at 6.0 Feet at Time of Boring

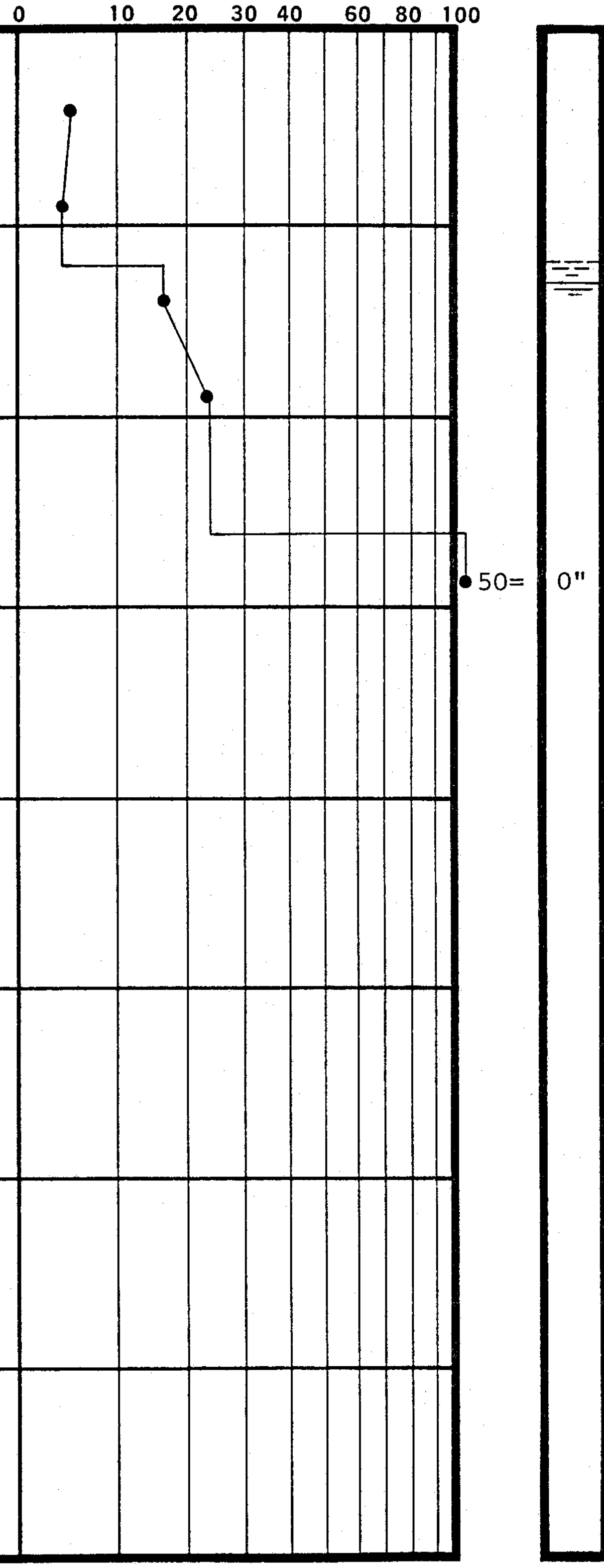
Installed Observation Well to 14.5 Feet

Groundwater at 6.5 Feet After 1 Week

Undisturbed Samples From Adjacent Boring 2.0 to 4.0 Feet (No Recovery) and 6.0 to 8.0 Feet

Groundwater at 6.4 Feet, March 11, 1981.

● PENETRATION-BLOWS PER FT.



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-9

DATE DRILLED 11/14/80

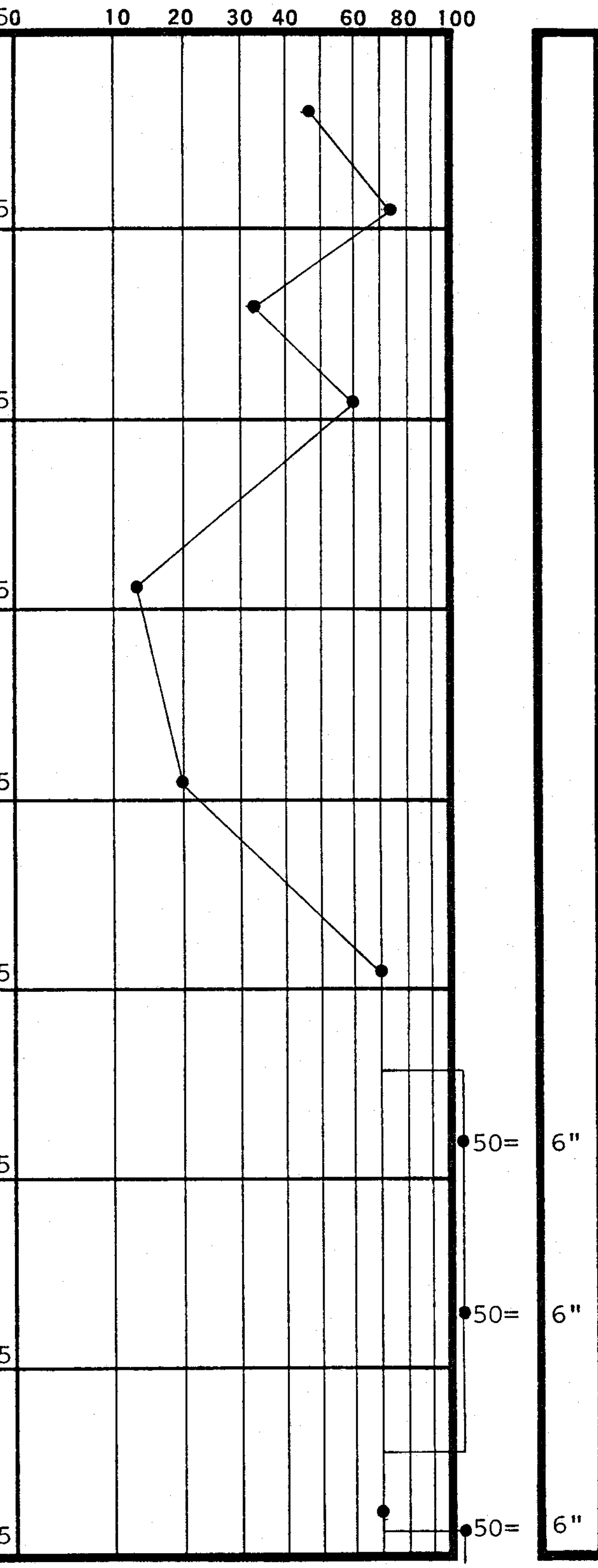
JOB NO. CH 4507

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0		2651.50
0.3	*	
2.5	Residuum - Hard Red Brown Slightly Micaceous Fine to Medium Sandy Silt	
5.5	Hard Brown and Black Micaceous Fine Sandy Silt	2646.5
12.0	Hard Red Brown White and Black Slightly Micaceous Slightly Clayey Fine to Coarse Sandy Silt	2641.5
22.0	Stiff to Very Stiff Red Brown and Black Slightly Micaceous Fine to Medium Sandy Silt	2636.5 2631.5
27.0	Very Dense Red Brown Slightly Micaceous Silty to Very Silty Fine to Coarse Sand	2626.5
32.0	Partially Weathered Rock That Becomes Light Gray and Brown Slightly Micaceous Fine to Medium Sandy Silt When Sampled	2621.5
37.0	Partially Weathered Rock That Becomes Light Brown and Brown Slightly Micaceous Silty Fine to Coarse Sand When Sampled	2616.5
40.0	Partially Weathered Rock That Becomes Light and Dark Brown Slightly Micaceous Fine to Medium Sandy Silt When **	2611.5

● PENETRATION-BLOWS PER FT.



*Topsoil **Sampled - Interlayered with Some Thin Soil Lenese

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-10

DATE DRILLED 11/14/80

JOB NO. CH 4507

PAGE 1 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft. 2611.5	PENETRATION-BLOWS PER FT. (10 20 30 40 60 80 100)	
40.0	Partially Weathered Rock That Becomes Light and Dark Brown Slightly Micaceous Fine to Medium Sandy Silt**			
42.0	Partially Weathered Rock That Becomes Gray Brown Slightly Micaceous Slightly Silty Fine to Coarse Sand With Small Rock Fragments When Sampled	2606.5	50=	3"
47.0	Partially Weathered Rock That Becomes Brown Micaceous Very Silty Fine to Coarse Sand When Sampled	2601.5	50=	6"
53.0	Residuum - Hard Brown and Black Micaceous to Very Micaceous Fine to Medium Sandy to Very Sandy Silt	2596.5		
57.0	Partially Weathered Rock That Becomes Brown Slightly Micaceous Fine to Coarse Sandy Silt When Sampled - Interlayered with Some Thin Soil Lenses No Sample Recovery at 68.5 Feet	2591.5	50=	4"
		2586.5	50=	6"
		2581.5	50=	2"
71.0	Power Auger Refusal at 71.0 Feet Boring Terminated at 71.0 Feet Groundwater Encountered at 66.0 Feet at Time of Boring Installed Observation Well to 71.0 Feet Groundwater at 65.0 Feet After 1 Week Groundwater at 66.6 Feet, March 11, 1981. Bulk "Bag" Sample 1.0-8.0 Feet and Undisturbed Sample 13.0-15.0 Feet From Adjacent Boring			

**When Sampled - Interlayered with Some Thin Soil Lenses

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-10

DATE DRILLED 11/14/80

JOB NO. CH 4507

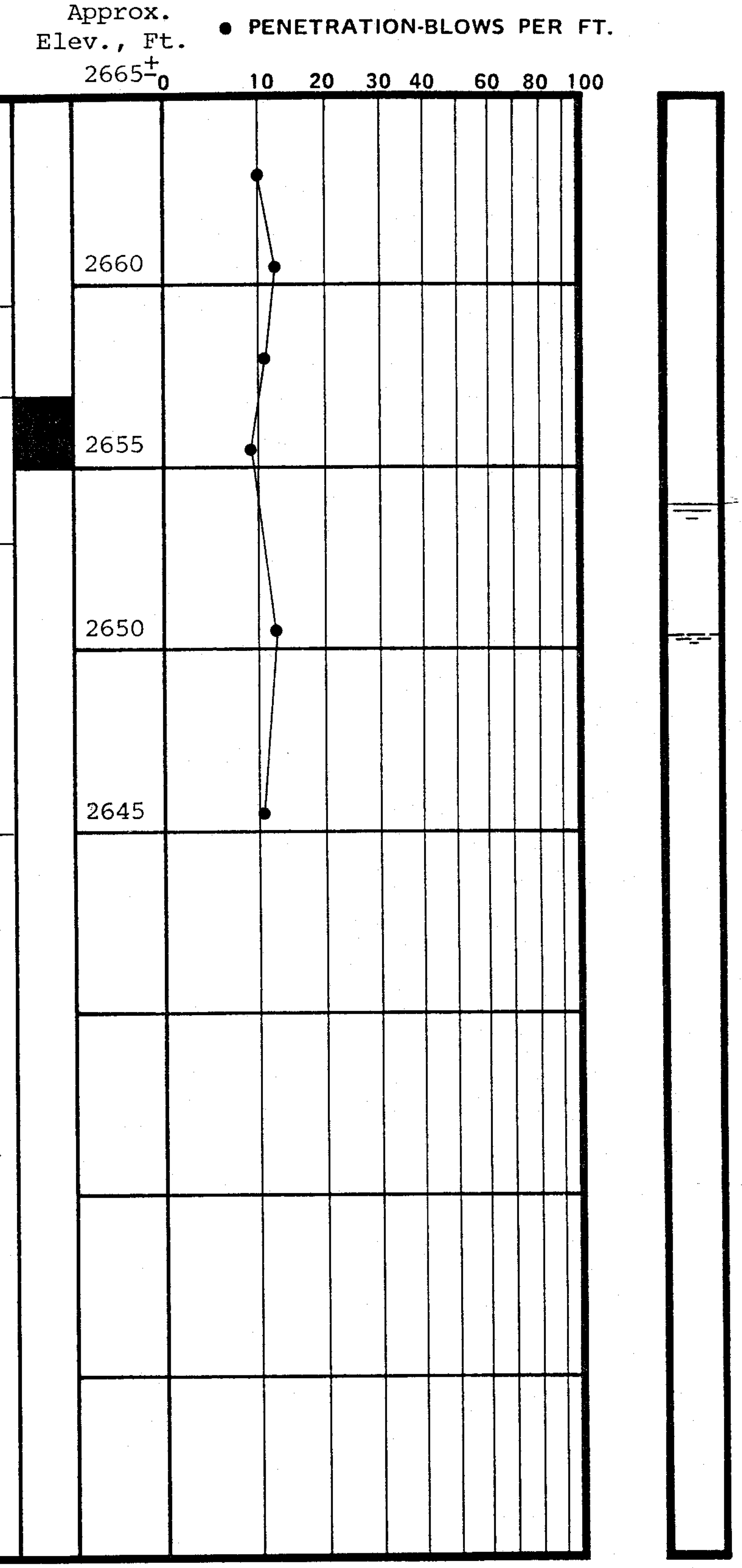
LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION
0	Residuum - Stiff Brown and Dark Brown Slightly Micaceous Slightly Clayey Fine to Medium Sandy Silt with Some Small Roots in Sample 1.0-2.5 Feet
5.5	Stiff Gray Brown Slightly Micaceous Slightly Clayey Fine to Coarse Very Sandy Silt
8.0	Stiff Brown and Black Micaceous Silty Fine to Coarse Sand with Thin Vertical Mica Seams
12.0	Stiff Brown Slightly Micaceous to Micaceous Slightly Clayey Fine to Coarse Sandy to Very Sandy Silt
20.0	Boring Terminated at 20.0 Feet

Groundwater Encountered at 14.6 Feet at Time of Boring

Installed Observation Well to 19.0 Feet

Groundwater at 11.0 Feet After 1 Week
Groundwater at 11.2 feet, March 11, 1981
Undisturbed Sample 8.0 to 10.0 Feet from Adjacent Boring



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE — WATER TABLE, 24 HR.
WATER TABLE, 1 HR.
50 % ROCK CORE RECOVERY — LOSS OF DRILLING WATER

TEST BORING RECORD

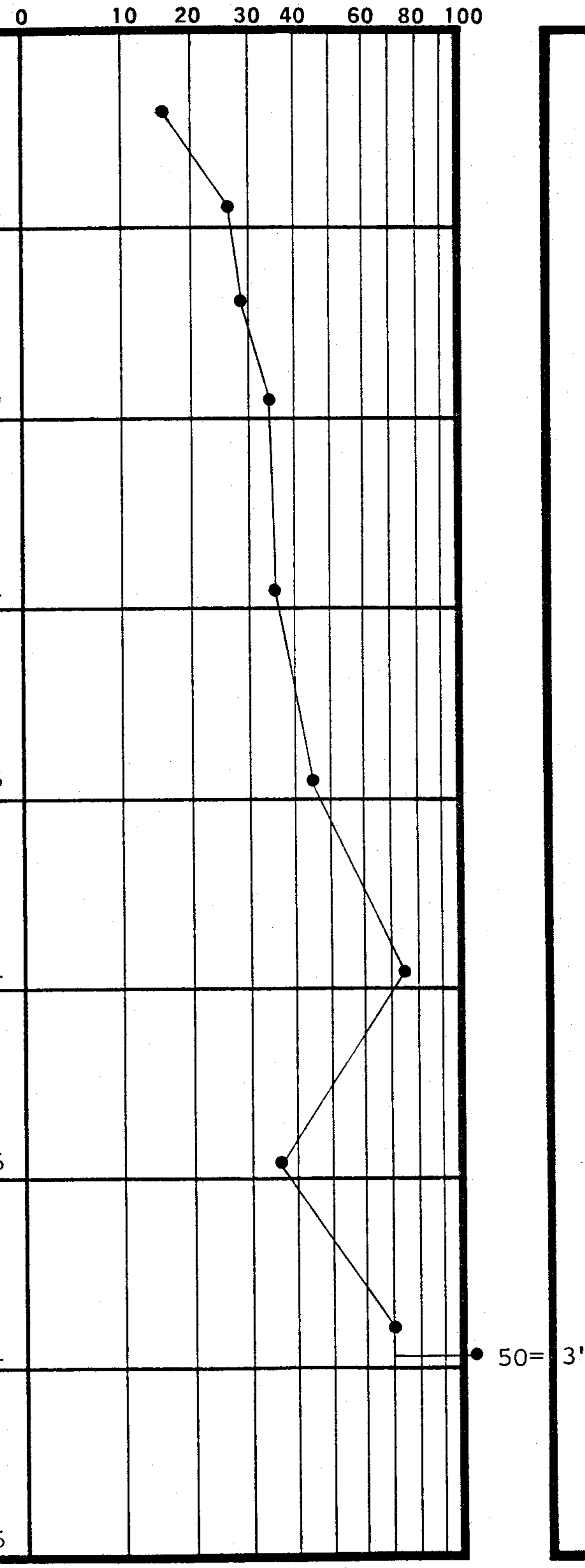
BORING NO. B-11
DATE DRILLED 11/25/80
JOB NO. CH 4507

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0		2736
0.3	*	
	Residuum - Firm Red Brown Slightly Micaceous to Micaceous Slightly Clayey Silty Fine to Medium Sand	2731
5.5	Very Stiff to Hard Red Brown Black and White Slightly Micaceous to Micaceous Slightly Clayey to Clayey Fine to Coarse Sandy Silt	2726
		2721
17.0	Dense to Very Dense Red Brown White and Black Slightly Micaceous to Micaceous Silty Fine to Coarse Sand with Rock Fragments - Possible Slickenside Zone Noted in Sample 18.5-20.0 Feet	2716
		2711
27.0	Hard Yellow Brown Slightly Micaceous Slightly Clayey Fine to Medium Sandy Silt	2706
32.0	Very Dense Brown Gray Slightly Micaceous Slightly Silty to Silty Fine to Medium Sand	2701
34.0	Partially Weathered Rock That Becomes Brown Gray Slightly Micaceous Slightly Silty Fine to Medium Sand When Sampled	
37.5	Power Auger Refusal at 37.5 Feet Boring Terminated at 37.5 Feet Dry at Time of Boring	2696

● PENETRATION-BLOWS PER FT.



*Topsoil

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-12

DATE DRILLED 12/5/80

JOB NO. CH 4507

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.	● PENETRATION-BLOWS PER FT.	
0	Residuum - Stiff Red Brown Slightly Micaceous Fine to Medium Sandy Silt with Some Small Roots and Rock Fragments	2699.5		
4.5	Stiff Dark Brown Slightly Micaceous Slightly Clayey Fine to Medium Sandy Silt	2694.5		
6.5	Partially Weathered Rock That Becomes*		●50=	4"
7.3	Power Auger Refusal at 7.3 Feet	2689.5		
	Boring Terminated at 7.3 Feet			
	Offset 10 Feet West Auger to Refusal at 6.0 Feet			
	Dry at Time of Boring and After 1-1/2 Weeks			
	No Groundwater Encountered at Time of Boring or 1 Week			
	*Brown Slightly Micaceous Slightly Clayey Fine to Coarse Sandy Silt When Sampled			

Penetration scale: 0 10 20 30 40 60 80 100

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-13

DATE DRILLED 11/25/80

JOB NO. CH 4507

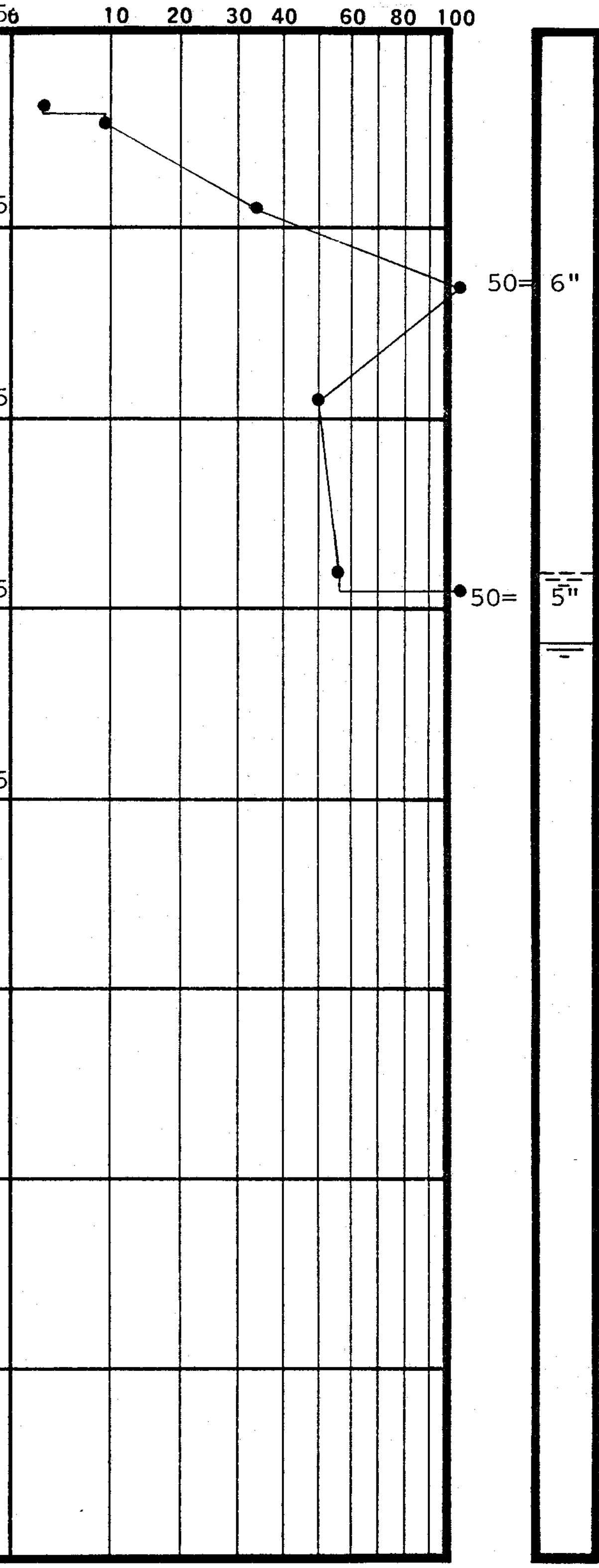
PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0	Disturbed - Brown Clayey Fine to Medium Sandy Silt With Some Small*	2695.56
2.0	Residuum - Stiff Brown Clayey Fine**	
3.0	Dense Brown and Gray Silty Fine to Coarse Sand with Large Rock Fragments	2689.5
5.5	Very Dense Brown and Gray Slightly Micaceous to Micaceous Silty Fine to Coarse Sand with Small Rock Fragments and Partially Weathered Rock Lenses	2684.5
12.0	Very Dense Dark Brown Very Micaceous Silty Fine to Medium Sand	
14.5	Partially Weathered Rock That Becomes Dark Brown Very Micaceous Silty Fine to Medium Sand with Numerous Rock Fragments When Sampled	2679.5
18.0	Power Auger Refusal at 18.0 Feet	2674.5
	Boring Terminated at 18.0 Feet	
	Groundwater Encountered at 14.0 Feet at Time of Boring	
	Installed Observation Well to 18.0 Feet	
	Groundwater at 15.8 Feet After 2 Days	
	Groundwater at 16.0 Feet March 11, 1981	

*Roots
**to Medium Sandy Silt

● PENETRATION-BLOWS PER FT.



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
WATER TABLE, 24 HR.
WATER TABLE, 1 HR.
LOSS OF DRILLING WATER

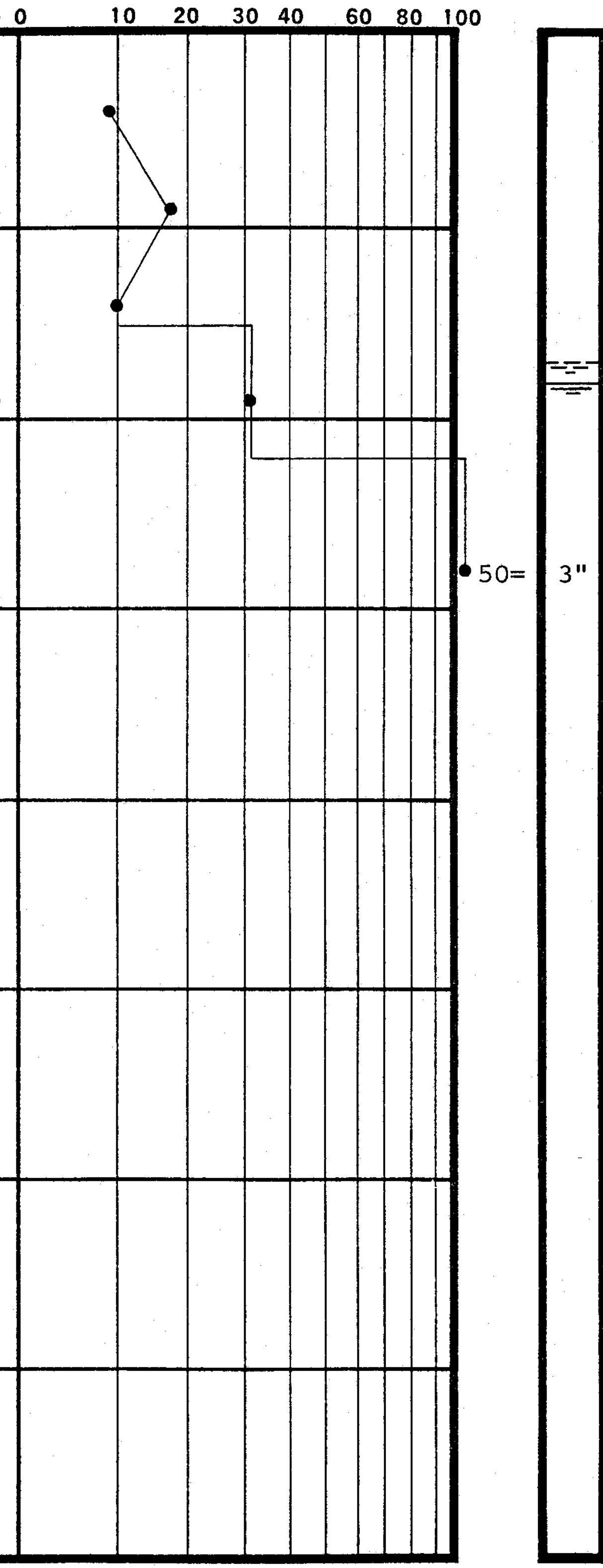
TEST BORING RECORD

BORING NO. B-14
DATE DRILLED 12/3/80
JOB NO. CH 4507
PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0	Alluvium - Stiff to Very Stiff Brown Slightly Micaceous Fine to Medium Sandy to Very Sandy Silt with Some Small Roots and Rock Fragments	2566
		2561
7.5	Residuum - Dense Brown and Black Micaceous Silty Fine to Coarse Sand with Rock Fragments	2556
11.0	Partially Weathered Rock That Becomes Slightly Micaceous Slightly Silty to Silty Fine to Coarse Sand with Rock Fragments When Sampled	2551
15.0		

● PENETRATION-BLOWS PER FT.



Boring Terminated at 15.0 Feet

Groundwater Encountered at 8.5 Feet at Time of Boring

Installed Observation Well to 15.0 Feet

Groundwater at 9.0 Feet After 2 Weeks

Groundwater at 9.1 Feet, March 11, 1981

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-15

DATE DRILLED 11/20/80

JOB NO. CH 4507

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0	Alluvium - Firm Gray Micaceous Clayey Silty Fine to Coarse Sand with Fine Gravel	2607
2.5	Alluvial Gravel - No Sample Recovery	
3.5	Alluvium - Stiff Brown Slightly Micaceous Fine to Medium Slightly Clayey Sandy Silt with Roots and *	2602
6.0	Residuum - Very Stiff Brown Micaceous Fine to Medium Very Sandy Silt	
8.0	Stiff to Very Stiff Gray Brown and Black Slightly Micaceous to Micaceous Fine Sandy Silt	2597
15.0		2592

Boring Terminated at 15.0 Feet

Groundwater Encountered at 2.8 Feet at Time of Boring

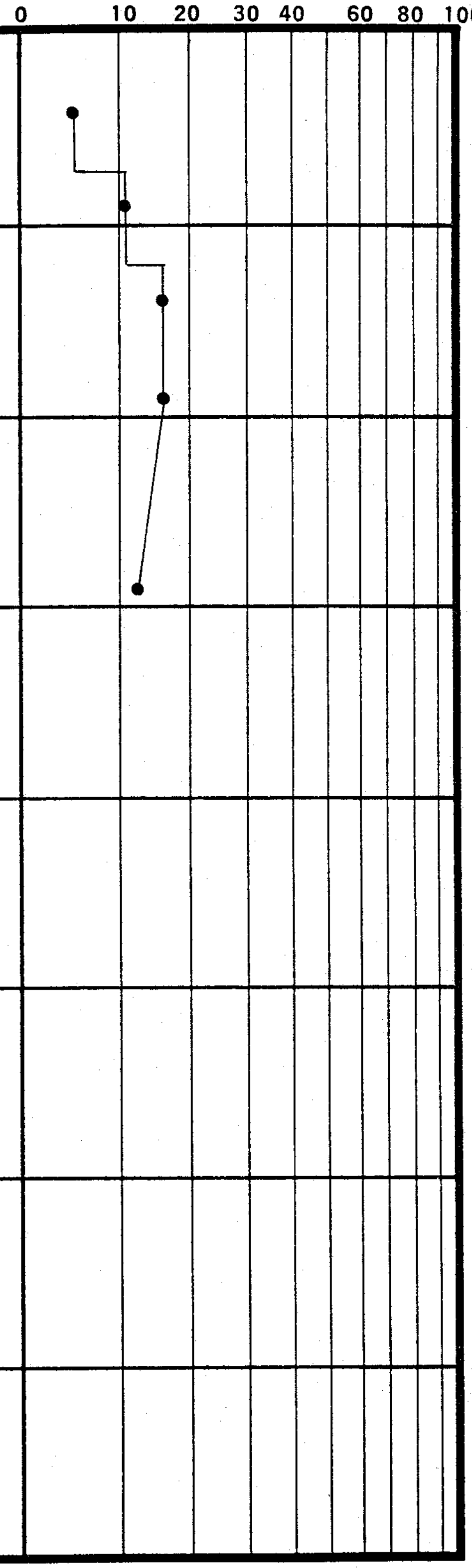
Installed Observation Well to 13.5 Feet

Groundwater at 2.0 Feet After 2 Weeks
Groundwater at 1.9 Feet, March 11, 1981

Undisturbed Sample 1.0 to 3.0 Feet from Adjacent Boring

*Rock Fragments

● PENETRATION-BLOWS PER FT.



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE — WATER TABLE, 24 HR.
WATER TABLE, 1 HR.
50 % ROCK CORE RECOVERY — LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-16

DATE DRILLED 11/21/80

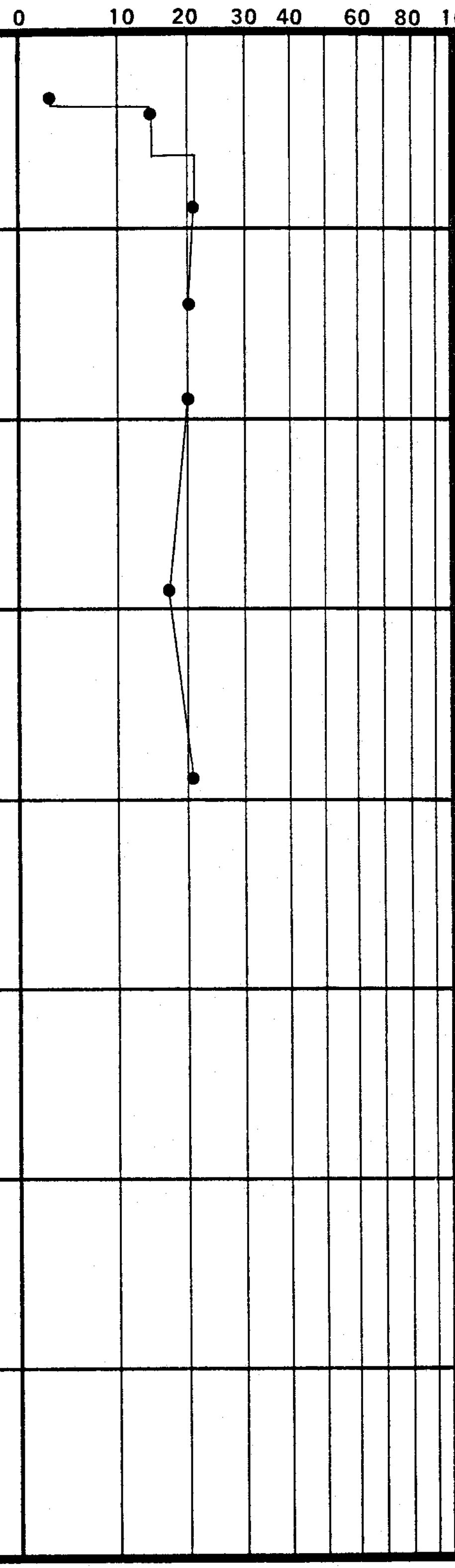
JOB NO. CH 4507

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0		2702
2.0	Alluvium - Soft Light Brown Clayey Fine to Coarse Very Sandy Silt with Small Roots and Rock Fragments	
3.0	Alluvium - Firm Brown Slightly*	
5.5	Residuum - Very Stiff Yellow Brown Slightly Micaceous Clayey Fine to Coarse Sandy Silt	2697
8.0	Firm Brown Slightly Micaceous Silty Fine to Medium Sand with Small Rock Fragments	
17.0	Firm Brown and Gray Micaceous Silty Fine to Coarse Sand with Rock Fragments in Sample 13.5 to 15.0 Feet Sand Size Particles are Predominately Mica	2692 2687
20.0	Firm Gray Brown Slightly Micaceous Silty Fine to Medium Sand	2682

● PENETRATION-BLOWS PER FT.



Boring Terminated at 20.0 Feet

Groundwater Encountered at 13.0 Feet at Time of Boring

Installed Observation Well to 18.5 Feet

Groundwater at 12.3 Feet After 1-1/2 Weeks

Groundwater at 12.2 Feet March 11, 1981

*Micaceous Silty Fine to Coarse Sand with Rock Fragments

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-17

DATE DRILLED 11/26/80

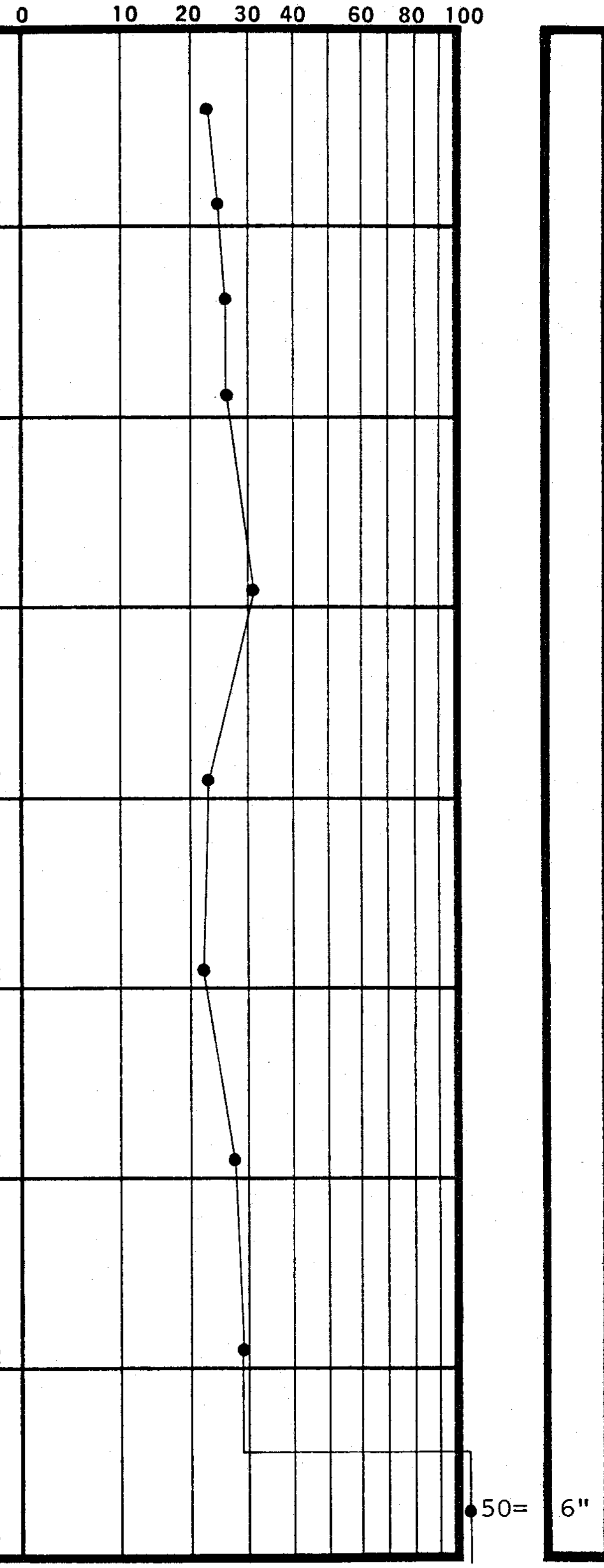
JOB NO. CH 4507

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0		2707
0.5	Topsoil	
2.0	Residuum - Very Stiff Red Brown Fine Sandy Clayey Silt with Rock Fragments	
	Very Stiff Red Brown and White Micaceous Fine to Coarse Sandy Silt	2702
		2697
12.0	Dense Red Brown Slightly Micaceous to Micaceous Very Silty Fine to Medium Sand	2692
17.0	Very Stiff Red Light Brown and White Slightly Micaceous Fine to Medium Sandy Silt with Rock Fragments	2687
22.0	Very Stiff Red Brown Black and White Micaceous Fine to Coarse Sandy Silt	2682
		2677
		2672
37.0	Partially Weathered Rock That Becomes Gray Brown Micaceous to Very Micaceous Fine to Coarse Sandy Silt When Sampled	
40.0		2667

● PENETRATION-BLOWS PER FT.



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
WATER TABLE, 24 HR.
WATER TABLE, 1 HR.
LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-18

DATE DRILLED 11/20/80

JOB NO. CH 4507

PAGE 1 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION
40.0	Partially Weathered Rock That Becomes Gray Brown Micaceous to Very Micaceous Fine to Coarse Sandy Silt When Sampled
42.0	Residuum - Hard Light Gray Brown and Dark Brown Slightly Micaceous Clayey Fine to Medium Sandy Silt
52.0	Partially Weathered Rock That Becomes Light Gray Brown Slightly Clayey Fine to Coarse Sandy to Very Sandy Silt When Sampled
57.0	Partially Weathered Rock That Becomes Gray Brown Silty to Very Silty Fine to Coarse Sand When Sampled
67.0	Partially Weathered Rock That Becomes Brown Slightly Micaceous to Micaceous Fine to Medium Sandy Silt When Sampled
72.0	Partially Weathered Rock That Becomes Light Brown Black and White Micaceous Silty Fine to Coarse Sand With Rock*
73.9	Boring Terminated at 73.9 Feet Dry at Time of Boring Groundwater at 72 Feet After 24 Hours Bulk "Bag" Sample 1.0 to 8.0 Feet and 18.0 to 23.0 Feet

Approx. Elev., Ft.: 2667, 2662, 2657, 2652, 2647, 2642, 2637, 2632

● PENETRATION-BLOWS PER FT.: 0, 10, 20, 30, 40, 60, 80, 100

Approx. Elev.	Penetration
2652	50= 6"
2647	50= 6"
2642	50= 6"
2637	50= 4"
2632	50= 4"

*Fragments When Sampled

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-18

DATE DRILLED 11/20/80

JOB NO. CH 4507

PAGE 2 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION
0	Alluvium - Very Loose to Loose Brown and Gray Slightly Micaceous to Micaceous Silty Fine to Medium Sand
8.0	Alluvium - Firm Gray Slightly Micaceous Slightly Silty Fine to Coarse Sand with Gravel
12.0	Residuum - Very Stiff Brown Micaceous Fine to Coarse Sandy to Very Sandy Silt
14.5	*
15.0	

Power Auger Refusal at 15.0 Feet

Boring Terminated at 15.0 Feet

Groundwater Encountered at 10.8 Feet at Time of Boring

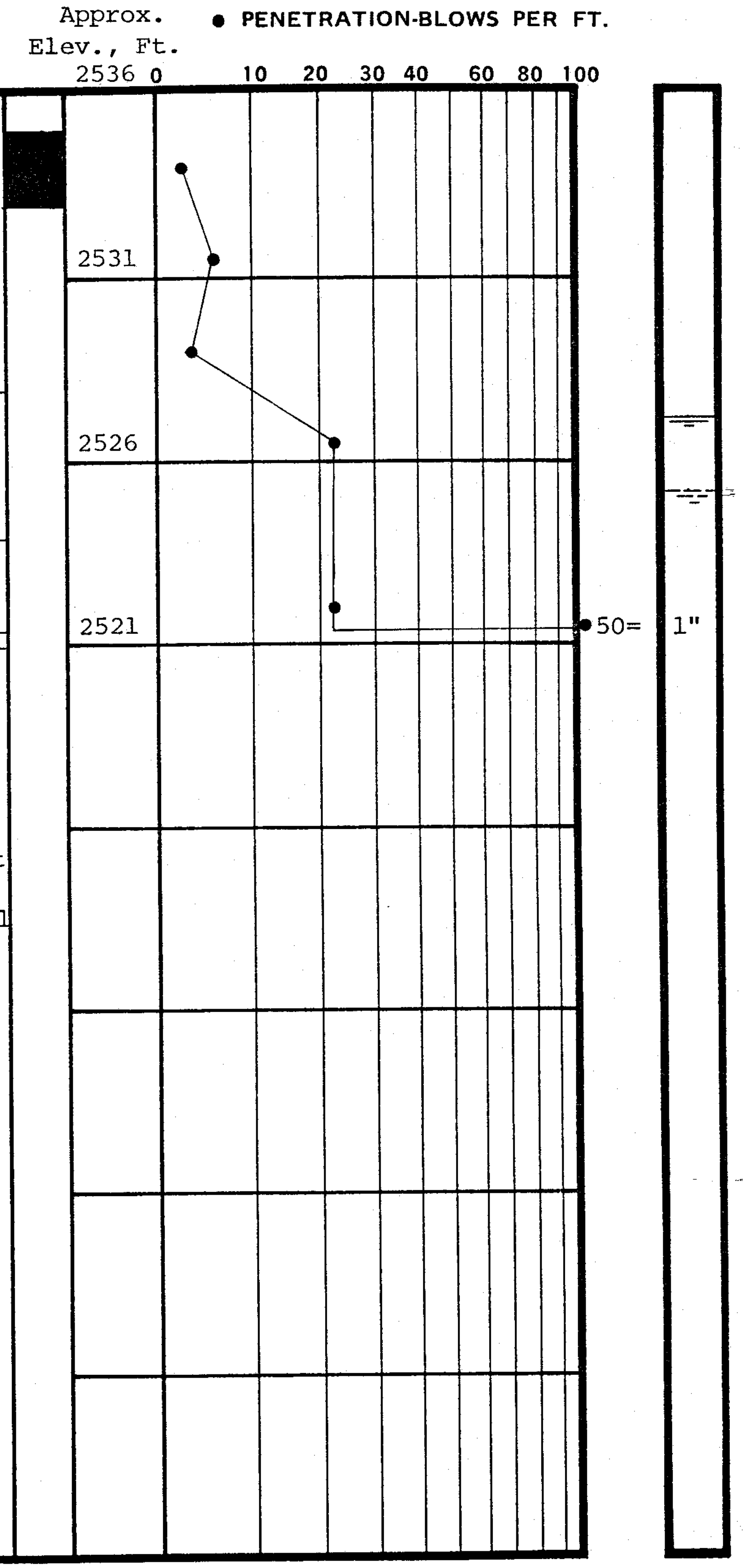
Installed Observation Well to 13.5 Feet

Groundwater at 8.8 Feet After 2 Weeks

Groundwater at 8.4 Feet, March 11, 1981

Undisturbed Sample 1.0 to 3.0 Feet from Adjacent Boring

*Partially Weathered Rock



BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE — WATER TABLE, 24 HR.

50 % ROCK CORE RECOVERY — WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-19

DATE DRILLED 11/21/80

JOB NO. CH 4507

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

APPENDIX III

LABORATORY TESTING PROCEDURES AND RESULTS

Grain Size Distribution

Grain size tests were performed on representative soil samples to determine the particle size distribution of these materials. After initial drying, the samples were washed over a U. S. standard No. 200 sieve to remove the fines (particles finer than a No. 200 mesh sieve). The samples were then dried and sieved through a standard set of nested sieves. This test was performed in a manner similar to that described by ASTM D 422. The results are presented as percent finer by weight versus particle size curves on the attached Grain Size Distribution sheets.

Soil Plasticity

During the preliminary exploration, representative samples of the upper clayey soils were selected for Atterberg Limits testing to determine their soil plasticity characteristics. The soil's Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). The LL is the moisture content at which the soil will flow as a heavy viscous fluid and is determined in accordance with ASTM D 423. The PL is the moisture content at which the soil begins to lose its plasticity and is determined in accordance with ASTM D 424. The data obtained are presented on the attached Summary of Plasticity Tests Data.

Natural Moisture Content

The natural moisture content of selected samples was determined in accordance with ASTM D 2216. The moisture content of the soil is the ratio, expressed as a percentage, of the weight of water in a given mass of soil to the weight of the soil particles. The results are presented on the attached laboratory data sheets.

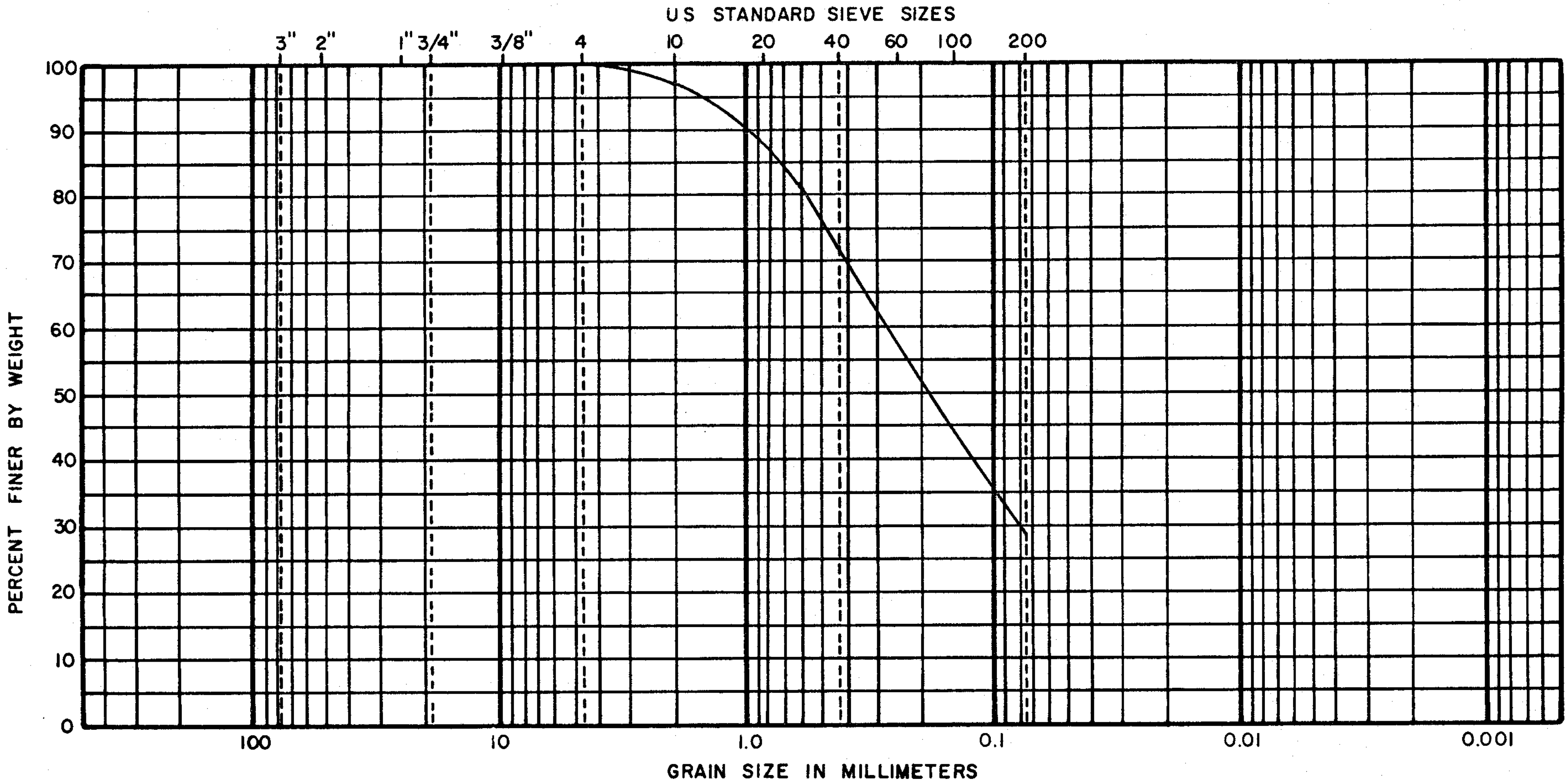
Compaction Test

Representative loose samples of potential borrow soils from the project site were collected, placed in cloth sacks and returned to the laboratory for compaction testing. Standard Proctor compaction tests (ASTM D 698) were performed on selected samples to determine their compaction characteristics, including their maximum dry density and optimum moisture content. Test results are presented on the attached Compaction Test sheets.

Triaxial Shear

Selected bulk samples of on-site borrow material were remolded and undisturbed samples of potential foundation soils were trimmed into cylinders approximately 2.4 inches in diameter and 6 inches in length and encased in rubber membranes. Each was then placed in a compression chamber and confined by isotropic fluid pressure. The samples were also saturated under back pressure to simulate the conditions that will exist after the dike has been saturated by the landfilling.

Consolidated undrained triaxial shear tests with pore pressure measurements ($\overline{R}$) were conducted on these samples. In this type of test, drainage is allowed from the sample under the confining stress until equilibrium is reached, but no drainage is allowed during loading to failure. The results obtained can be used to approximate strength parameters obtained from a consolidated drained test(s). Results are presented on the attached Triaxial Shear Test Sheets.



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

BORING NO.	B-1
DEPTH OR ELEV.	8.5' - 10'
MOISTURE %	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTICITY INDEX	

DESCRIPTION OR CLASSIFICATION

Brown Gray Very Micaceous Silty Fine to Medium Sand

GRAIN SIZE DISTRIBUTION

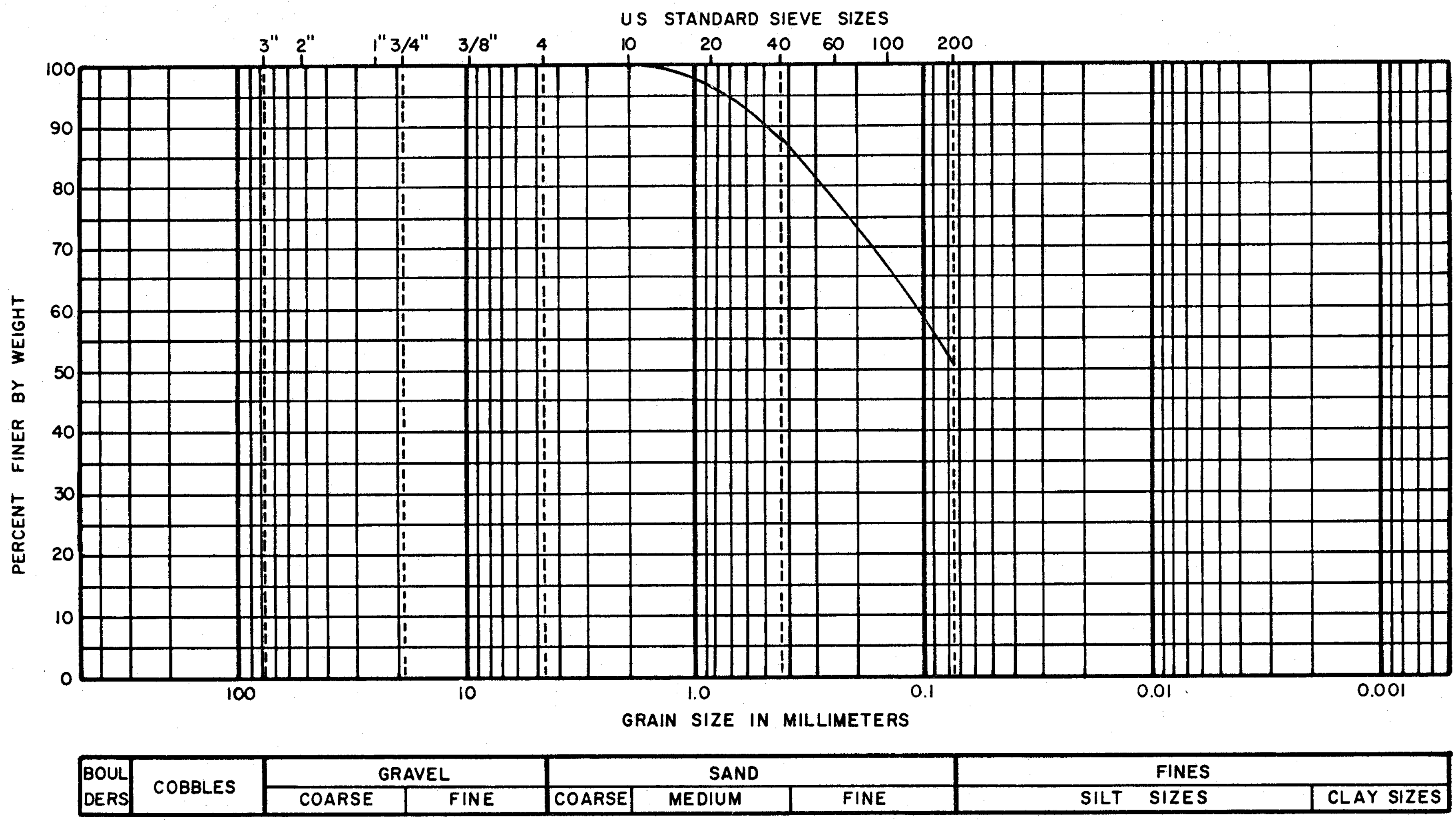
JOB NO. CH 4429

LAW ENGINEERING TESTING COMPANY

DUNCAN-PARNELL, INC., CHARLOTTE 779

SUMMARY OF PLASTICITY TESTS DATA

Boring Number	Sample Depth, Ft.	Soil Description	Natural Moisture Content (%)	Atterberg Limits		
				Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
B-1	3.5 - 5.0	Gray Tan Micaceous Fine Sandy Silty Clay	21	30	21	9
B-7	6.0 - 7.5	Black Gray Brown Micaceous Fine to Medium Sandy Silty Clay	18	35	21	14



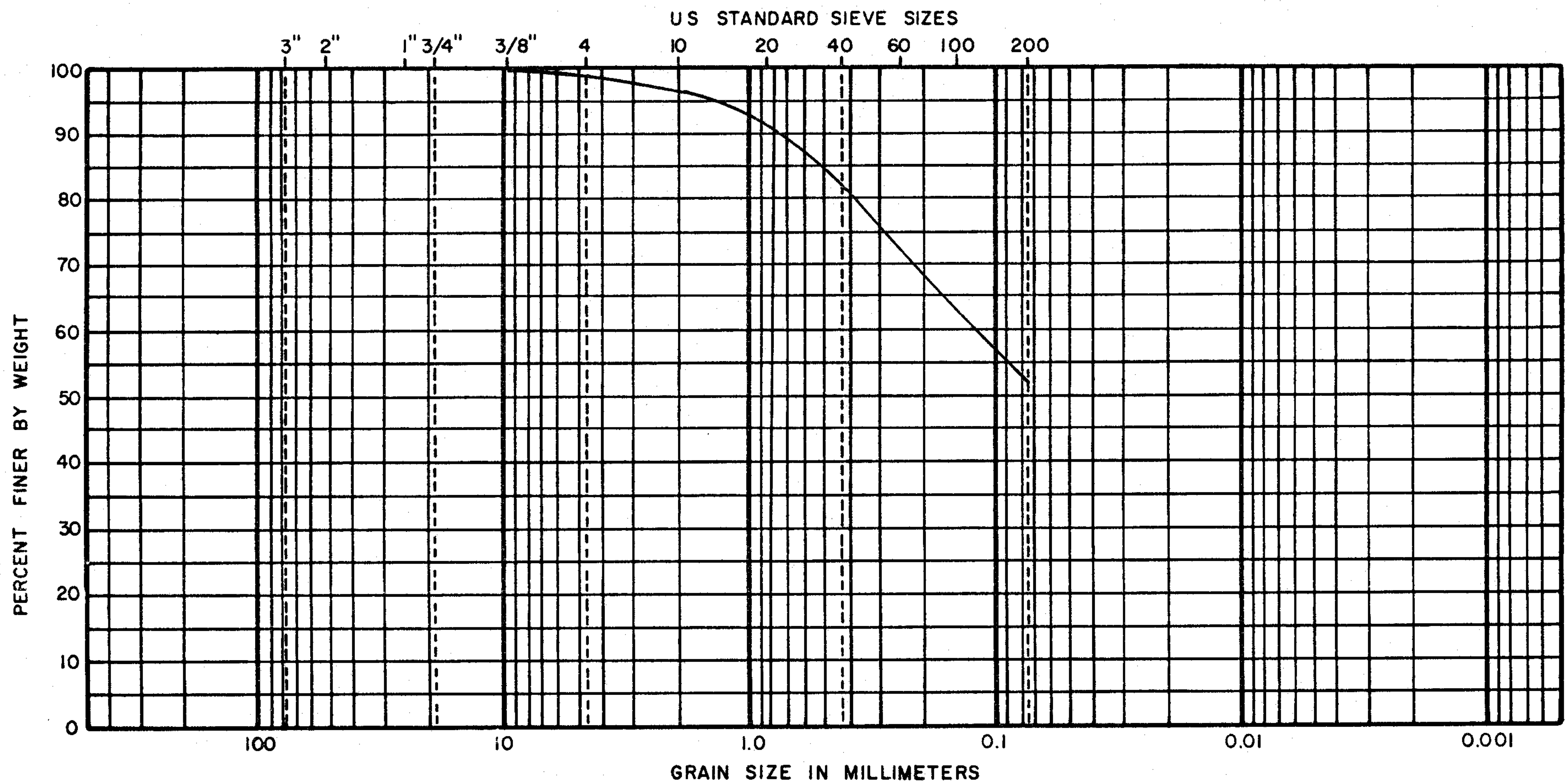
		DESCRIPTION OR CLASSIFICATION
BORING NO.	B-2	Purple White Very Micaceous Fine to Medium Sandy Silt Sand Sized Particles Are Predominately Mica
DEPTH OR ELEV.	28.5'-30'	
MOISTURE %		
LIQUID LIMIT		
PLASTIC LIMIT		
PLASTICITY INDEX		

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4429

LAW ENGINEERING TESTING COMPANY

DUNCAN-PARNELL, INC., CHARLOTTE 779



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

		DESCRIPTION OR CLASSIFICATION
BORING NO.	B-2	Red Brown White Micaceous Fine to Medium Sandy Silt
DEPTH OR ELEV.	3.5' - 5'	
MOISTURE %		
LIQUID LIMIT		
PLASTIC LIMIT		
PLASTICITY INDEX		

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4429

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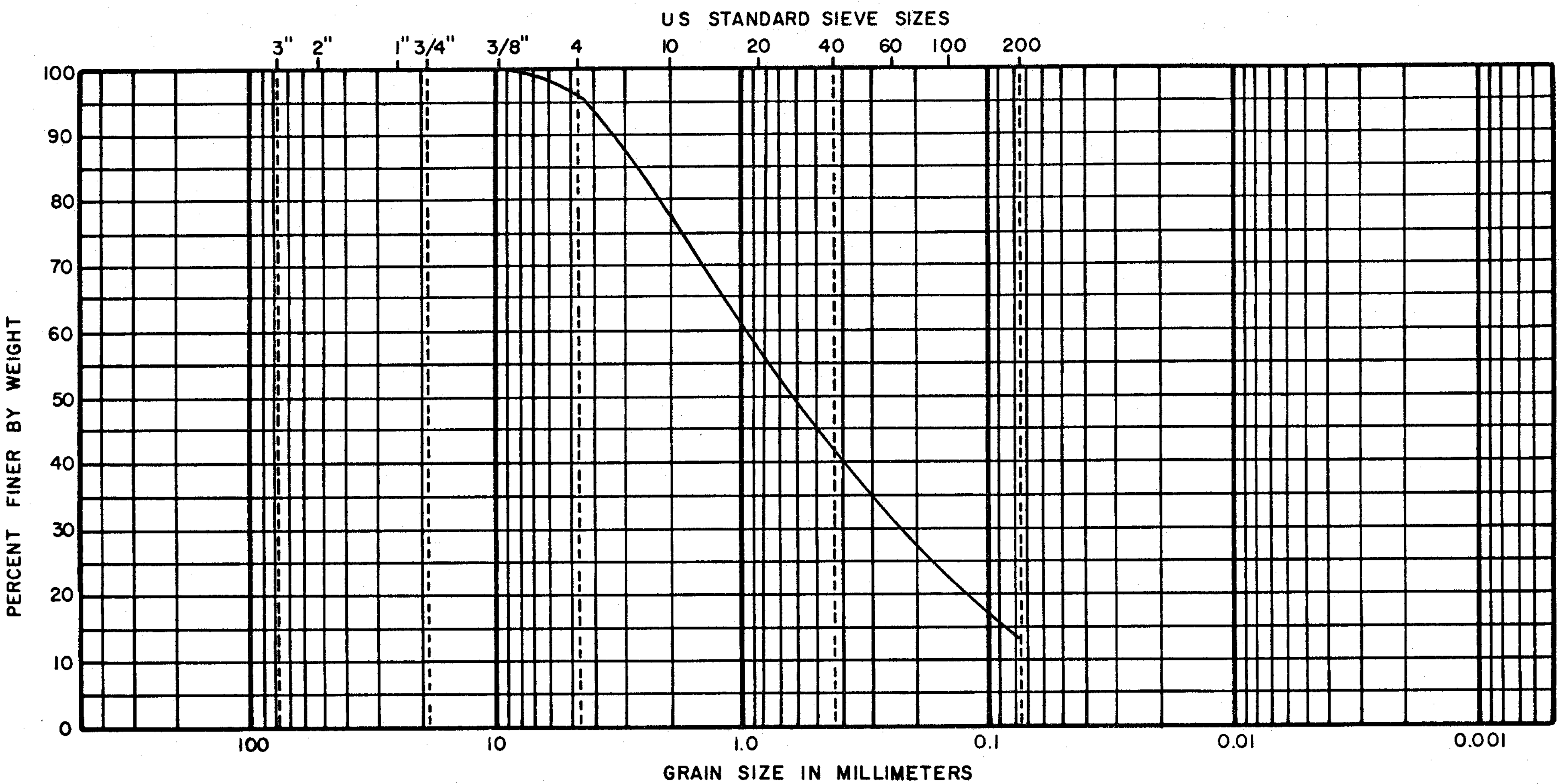
DUNCAN-PARNELL, INC., CHARLOTTE 779



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

BORING NO.	B-3
DEPTH OR ELEV.	6' - 7.5'
MOISTURE %	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTICITY INDEX	

DESCRIPTION OR CLASSIFICATION

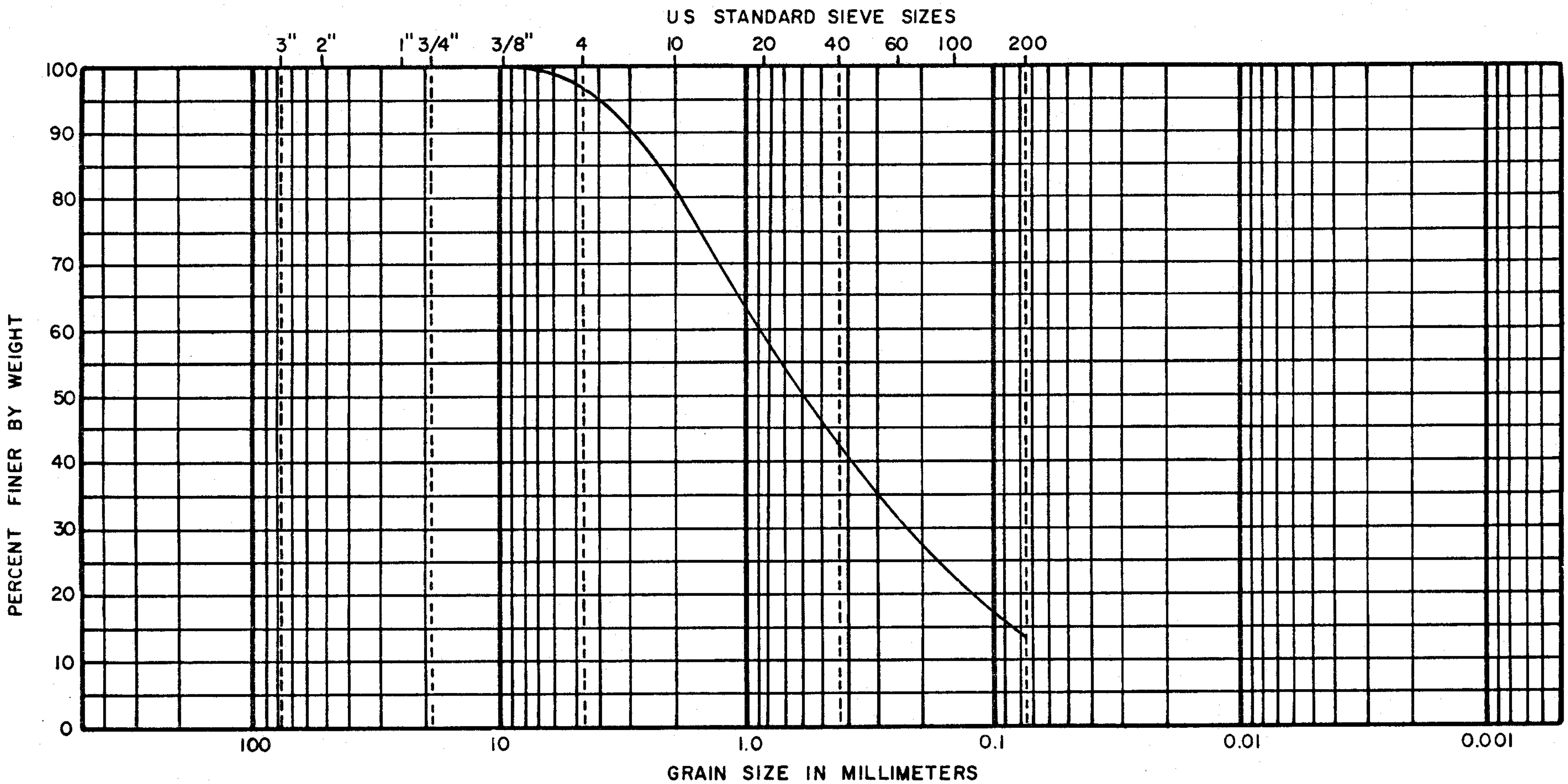
Brown Gray Very Micaceous Silty Fine to Coarse Sand
Sand Sized Particles Are Predominately Mica

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4429

LAW ENGINEERING TESTING COMPANY

DUNCAN-PARNELL, INC., CHARLOTTE 779



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

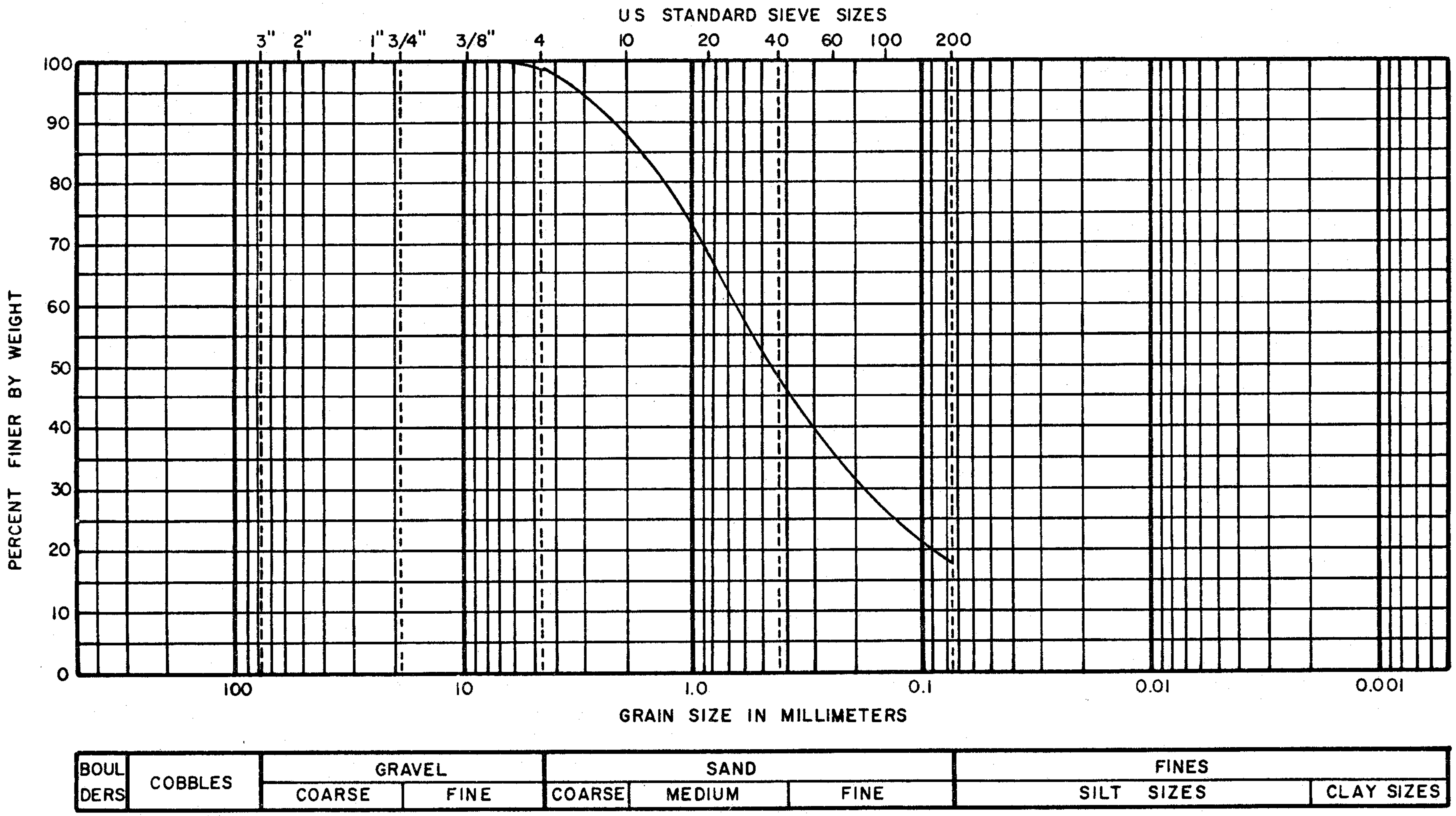
		DESCRIPTION OR CLASSIFICATION
BORING NO.	B-3	Brown Gray Very Micaceous Silty Fine to Coarse Sand Sand Sized Particles Are Predominately Mica
DEPTH OR ELEV.	13.5' - 15'	
MOISTURE %		
LIQUID LIMIT		
PLASTIC LIMIT		
PLASTICITY INDEX		

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4429

LAW ENGINEERING TESTING COMPANY

DUNCAN-PARNELL, INC., CHARLOTTE 779



BORING NO.	B-4
DEPTH OR ELEV.	3.5' - 5'
MOISTURE %	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTICITY INDEX	

DESCRIPTION OR CLASSIFICATION

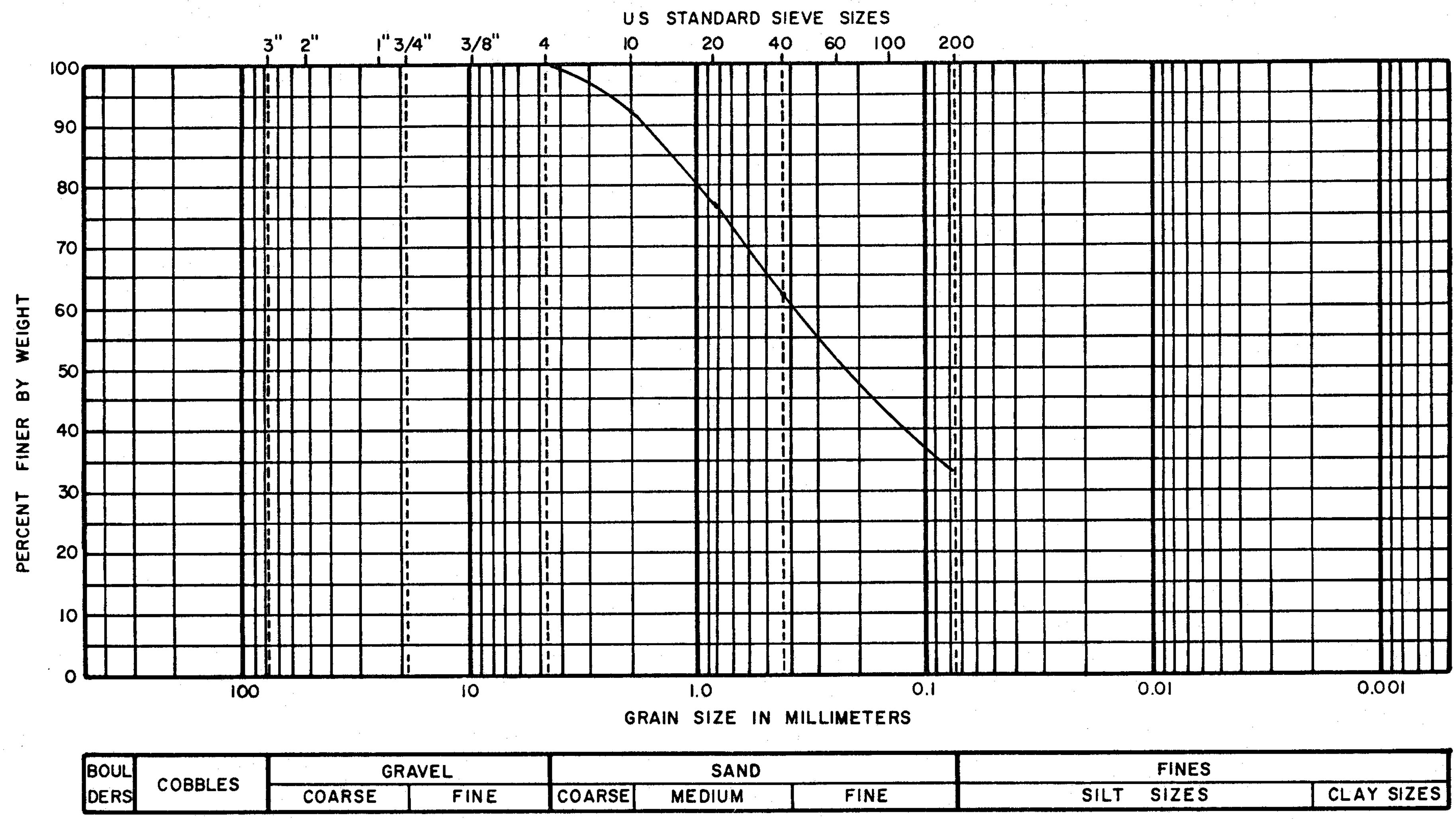
Gray Brown Very Micaceous Silty Fine to Coarse Sand

Sand Sized Particles Are Predominately Mica

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4429

LAW ENGINEERING TESTING COMPANY



		DESCRIPTION OR CLASSIFICATION
BORING NO.	B-4	Red Brown White Very Micaceous Silty Fine to Coarse Sand Sand Sized Particles Are Predominately Mica
DEPTH OR ELEV.	33.5' - 35'	
MOISTURE %		
LIQUID LIMIT		
PLASTIC LIMIT		
PLASTICITY INDEX		

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4429

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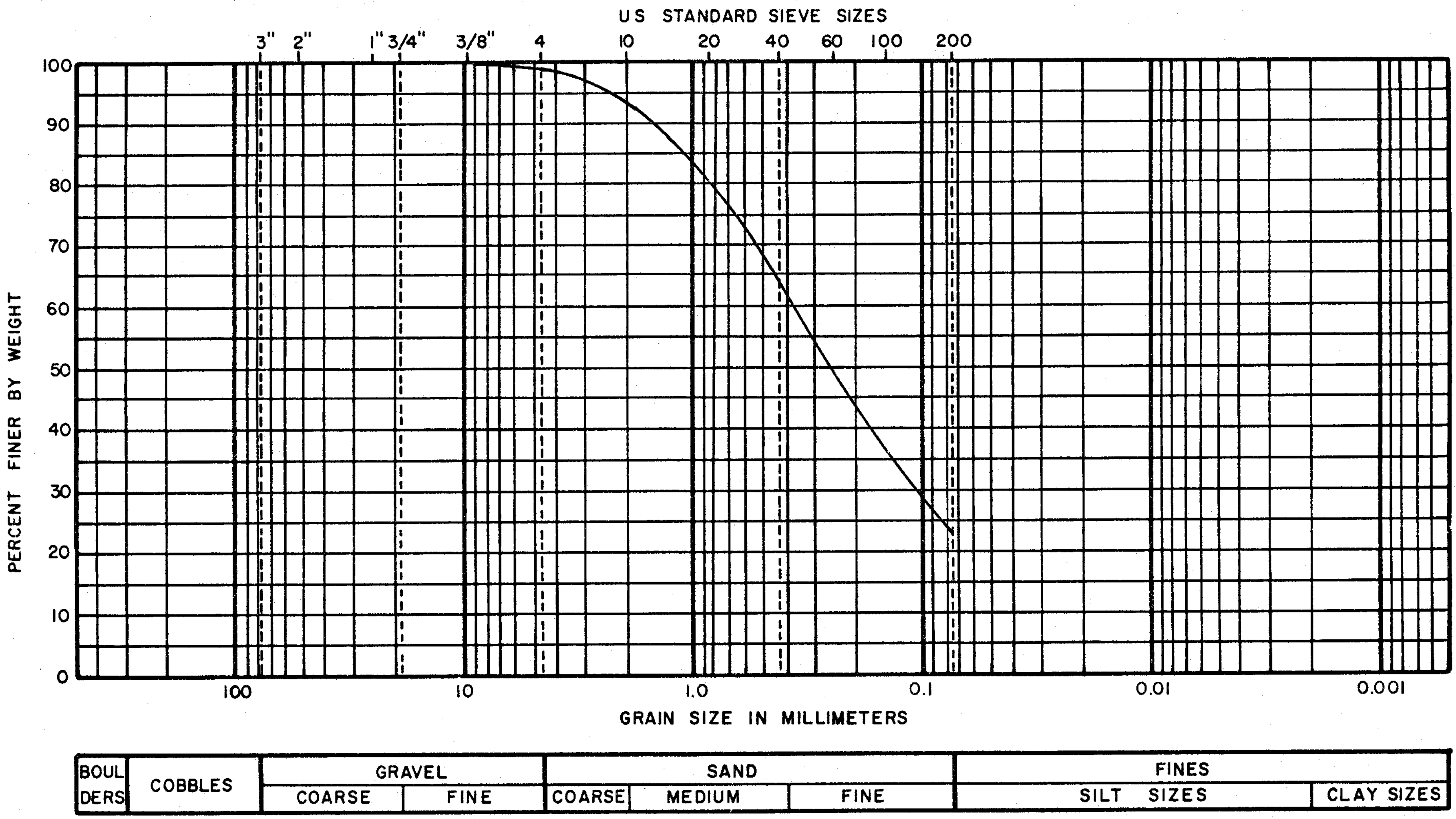
DUNCAN-PARNELL, INC., CHARLOTTE 779



GRAIN SIZE DISTRIBUTION

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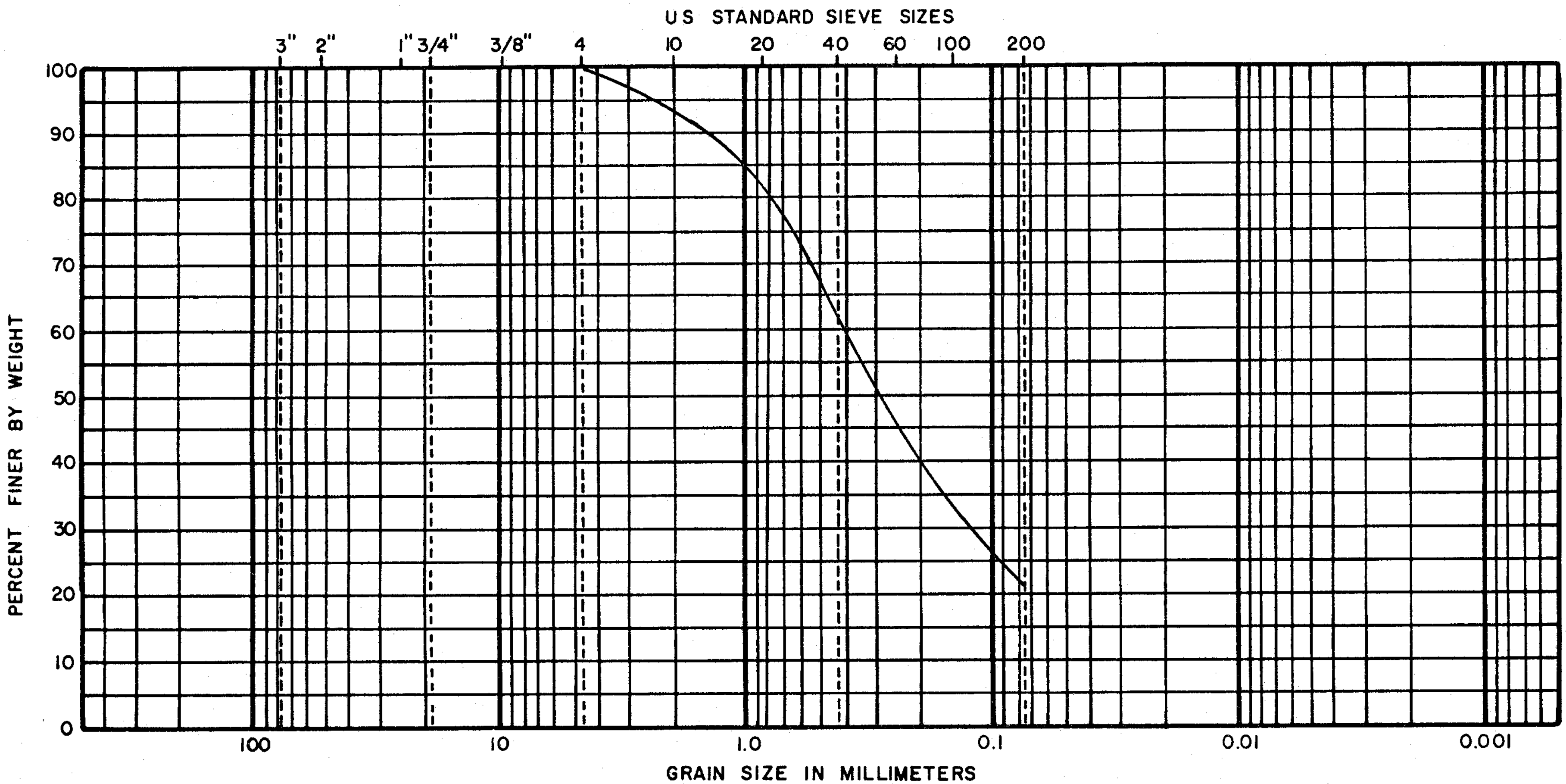
BORING NO.	B-5
DEPTH OR ELEV.	6' - 7.5'
MOISTURE %	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTICITY INDEX	

DESCRIPTION OR CLASSIFICATION

Brown Gray Very Micaceous Silty Fine to Coarse Sand
Sand Sized Particles Are Predominately Mica

GRAIN SIZE DISTRIBUTION



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

BORING NO.	B-5
DEPTH OR ELEV.	23.5' - 25'
MOISTURE %	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTICITY INDEX	

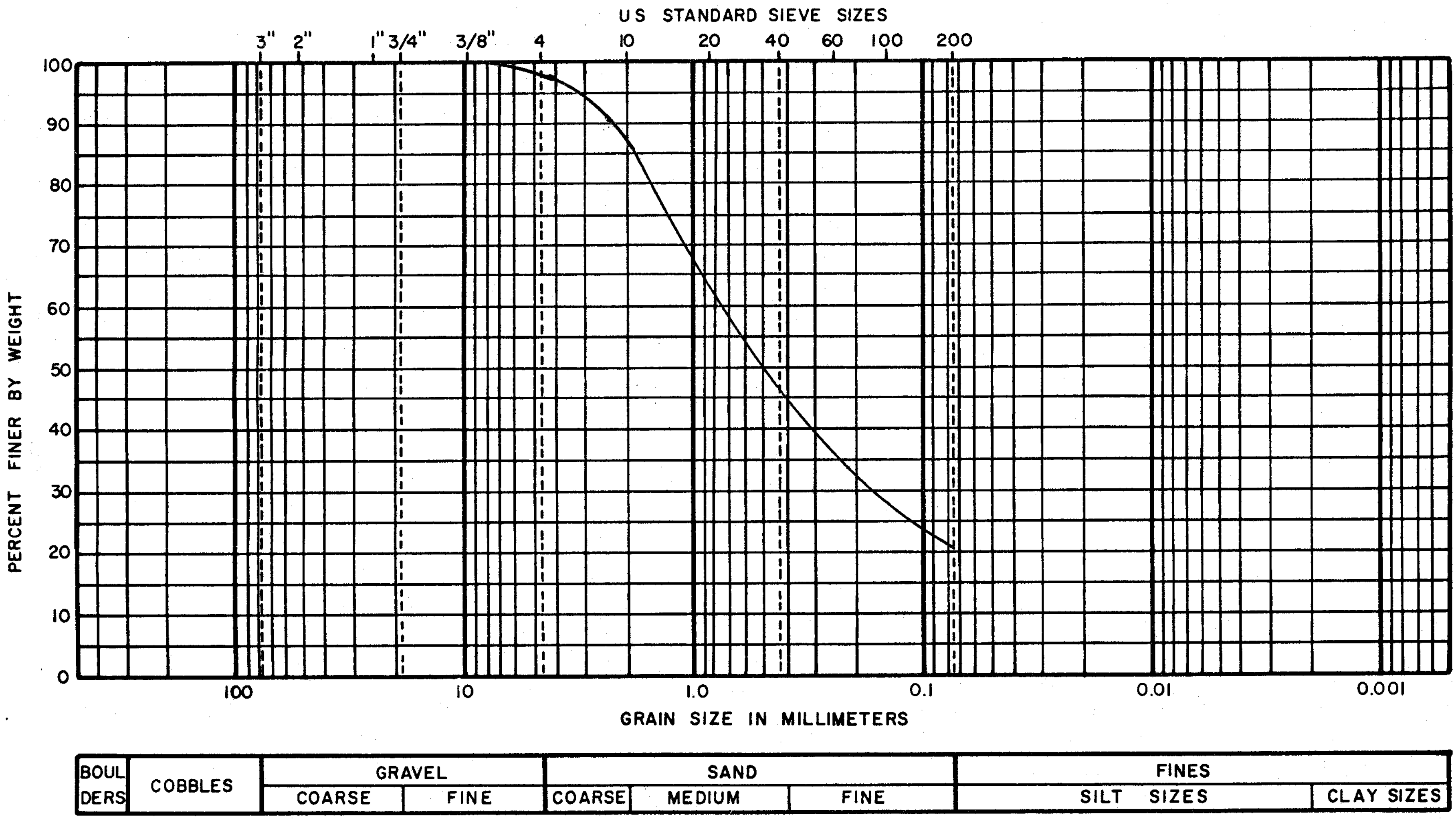
DESCRIPTION OR CLASSIFICATION

Brown Gray Very Micaceous Silty Fine to Coarse Sand

Sand Sized Particles Are Predominately Mica

JOB NO. CH 4429

LAW ENGINEERING TESTING COMPANY



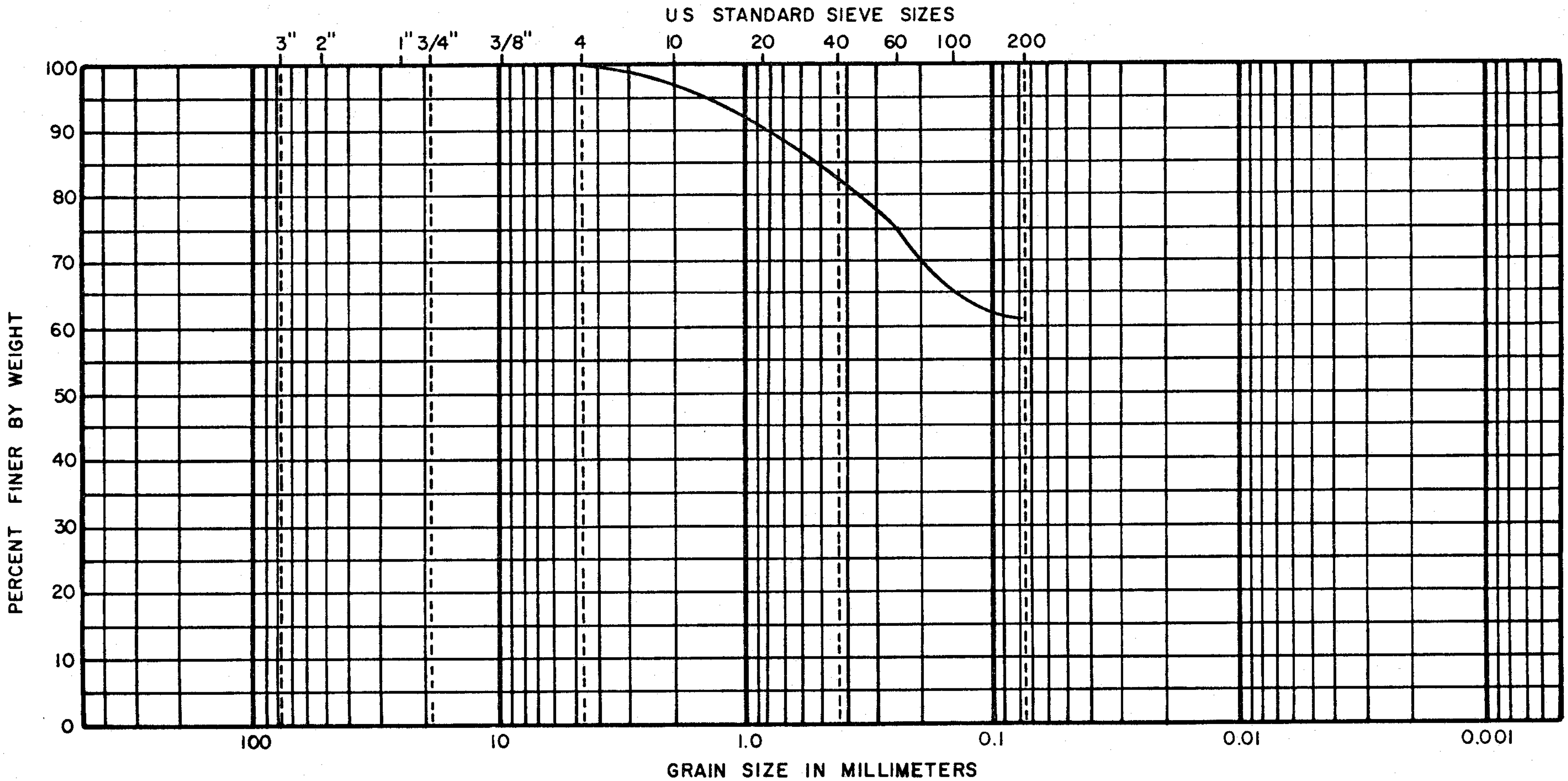
		DESCRIPTION OR CLASSIFICATION
BORING NO.	B-6	Brown Red Very Micaceous Silty Fine to Coarse Sand
DEPTH OR ELEV.	6' - 7.5'	
MOISTURE %		
LIQUID LIMIT		
PLASTIC LIMIT		
PLASTICITY INDEX		

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4429

LAW ENGINEERING TESTING COMPANY

DUNCAN-PARNELL, INC., CHARLOTTE 779



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

BORING NO.	B-8
DEPTH OR ELEV.	Bag 1-8 Ft.
MOISTURE %	14.0
LIQUID LIMIT	--
PLASTIC LIMIT	--
PLASTICITY INDEX	--

DESCRIPTION OR CLASSIFICATION

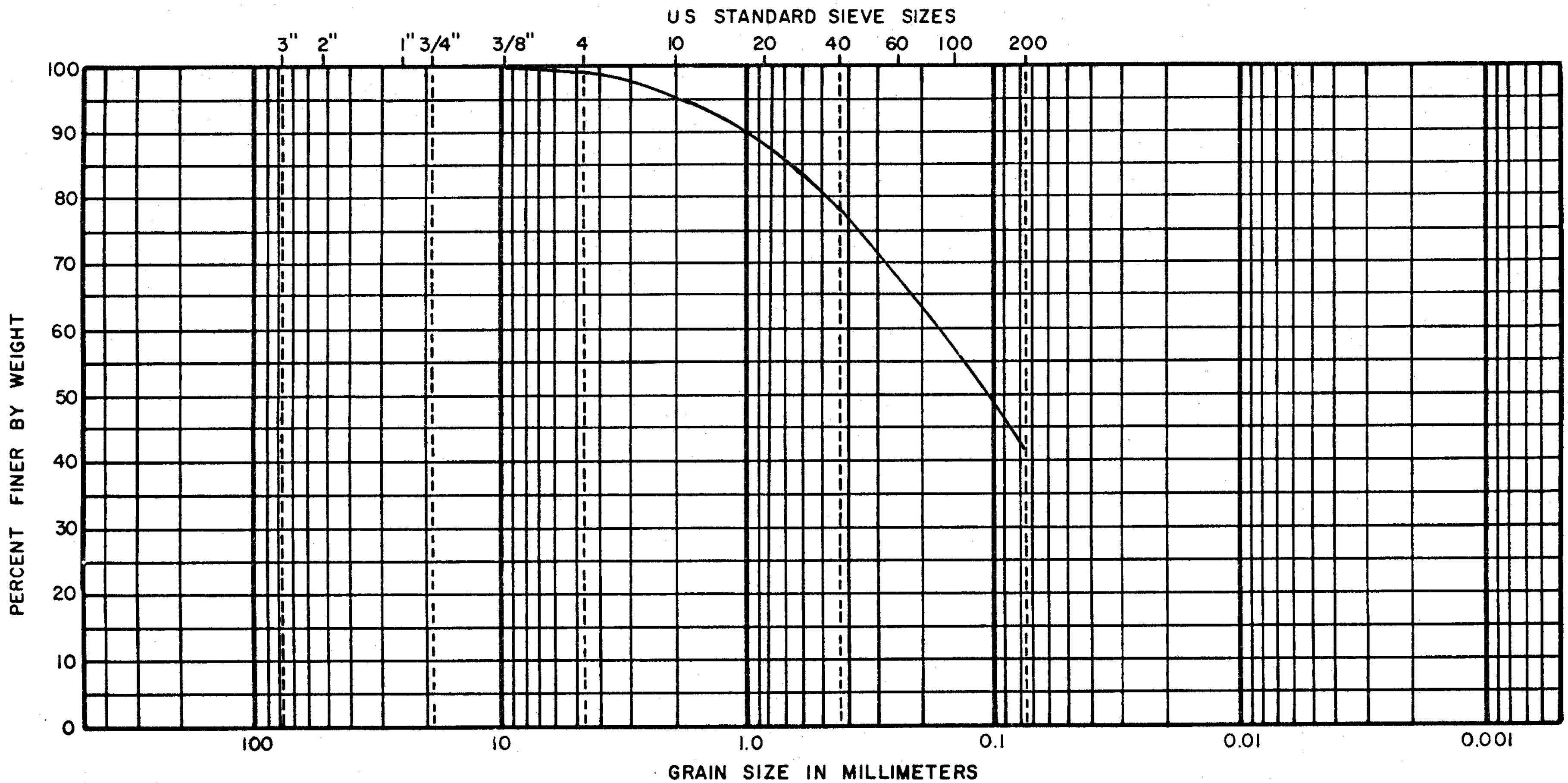
Light Brown Micaceous Fine to Coarse Sandy Silt

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4507

LAW ENGINEERING TESTING COMPANY

GRAIN SIZE DISTRIBUTION



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

BORING NO.	B-8
DEPTH OR ELEV.	6' - 7.5'
MOISTURE %	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTICITY INDEX	

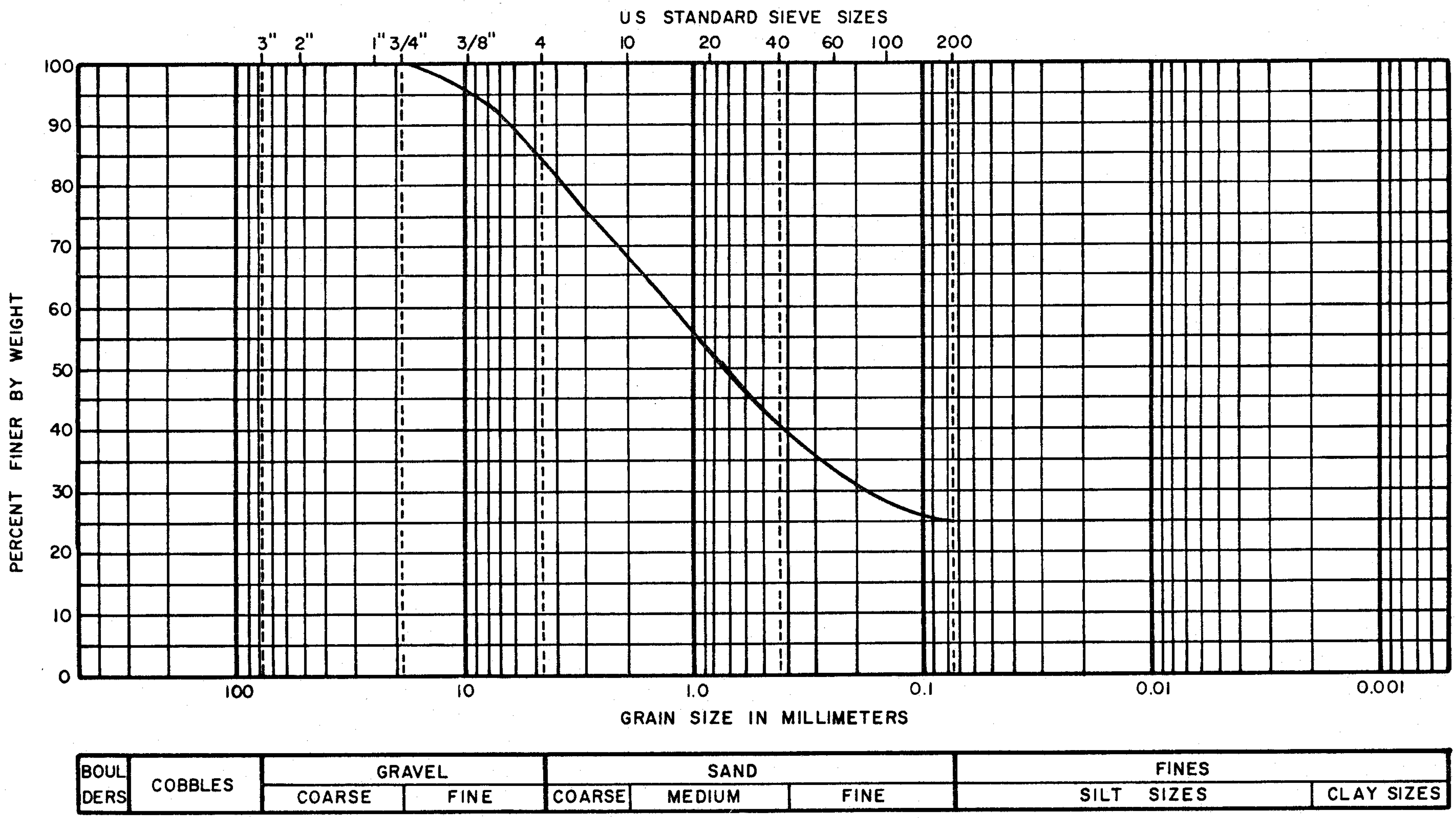
DESCRIPTION OR CLASSIFICATION

Brown Gray Very Micaceous Very Silty Fine to Coarse Sand
Sand Sized Particles Are Predominately Mica

JOB NO. CH 4429

LAW ENGINEERING TESTING COMPANY

DUNCAN-PARNELL, INC., CHARLOTTE 779

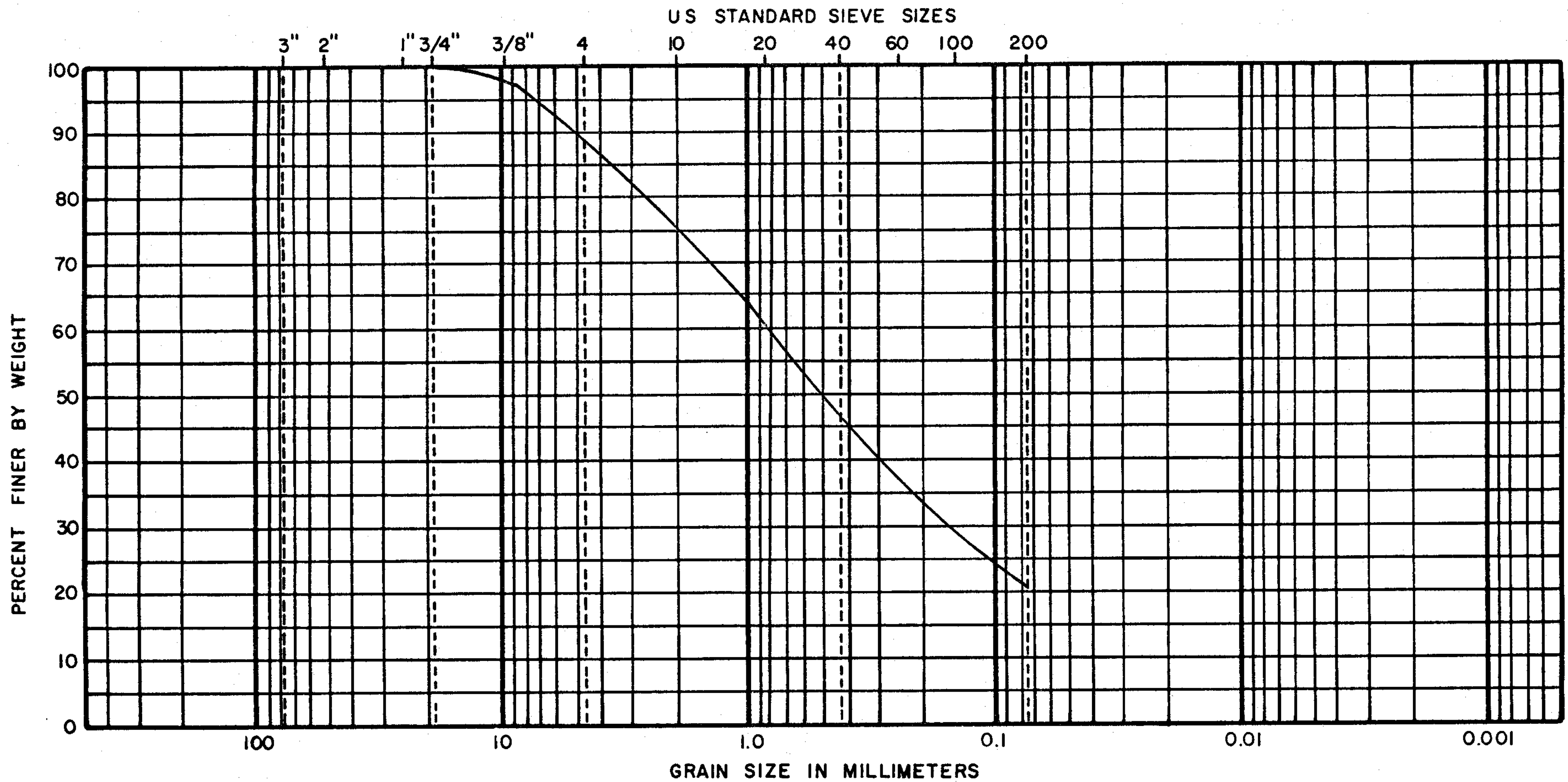


		DESCRIPTION OR CLASSIFICATION
BORING NO.	B-8	Red Brown Very Micaceous Silty Fine to Coarse Sand With Rock Fragments
DEPTH OR ELEV.	UD 9-11 ft	(Most Sand Size Particles are Mica)
MOISTURE %	13.2	
LIQUID LIMIT	-	
PLASTIC LIMIT	-	
PLASTICITY INDEX	-	

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4507

LAW ENGINEERING TESTING COMPANY



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

		DESCRIPTION OR CLASSIFICATION
BORING NO.	B-8	Brown Tan Very Micaceous Silty Fine to Coarse Sand With Rock Fragments Sand Sized Particles Are Predominately Mica
DEPTH OR ELEV.	18.5' - 20'	
MOISTURE %		
LIQUID LIMIT		
PLASTIC LIMIT		
PLASTICITY INDEX		

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4429

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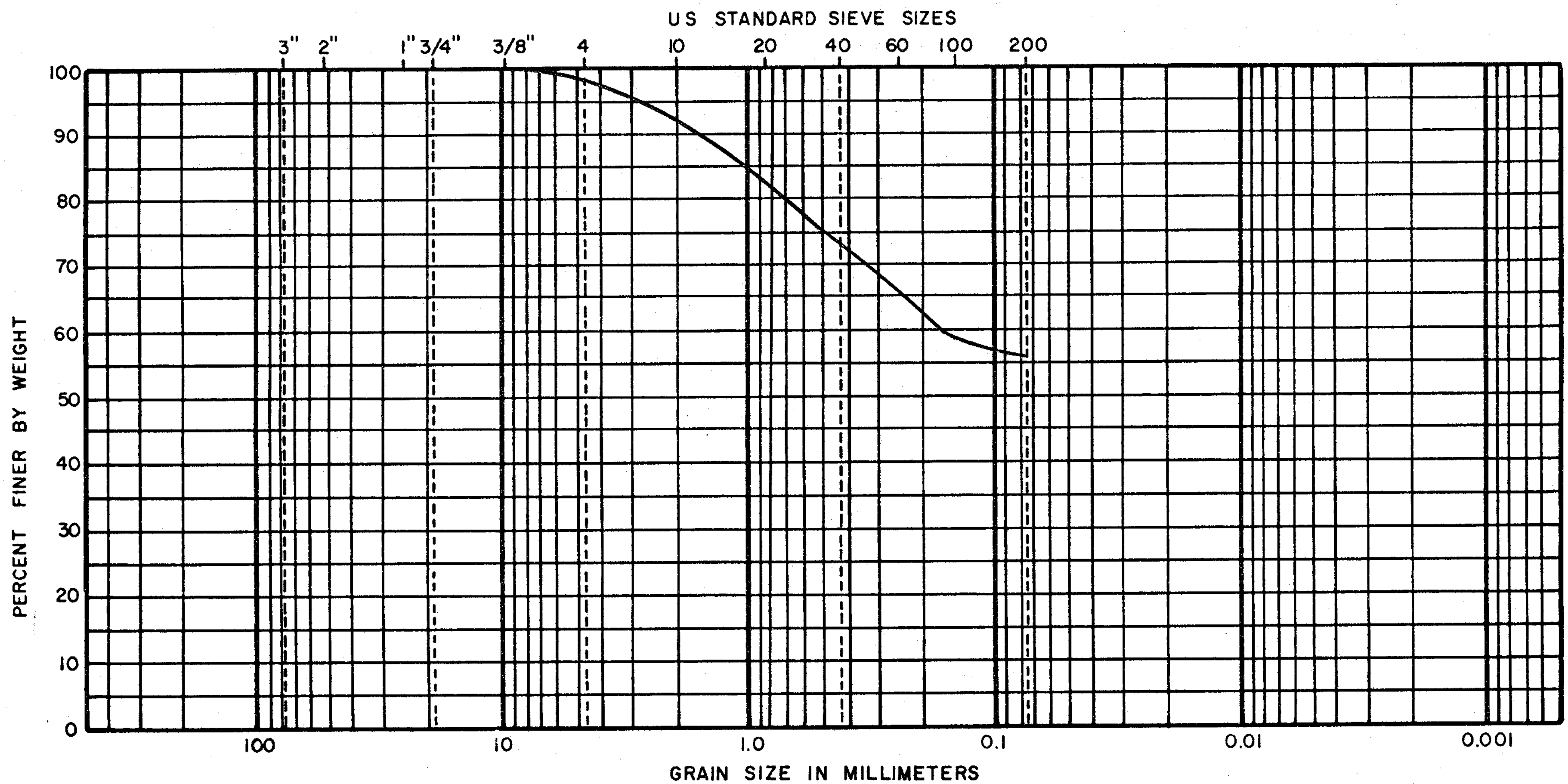
DUNCAN-PARNELL, INC., CHARLOTTE 779



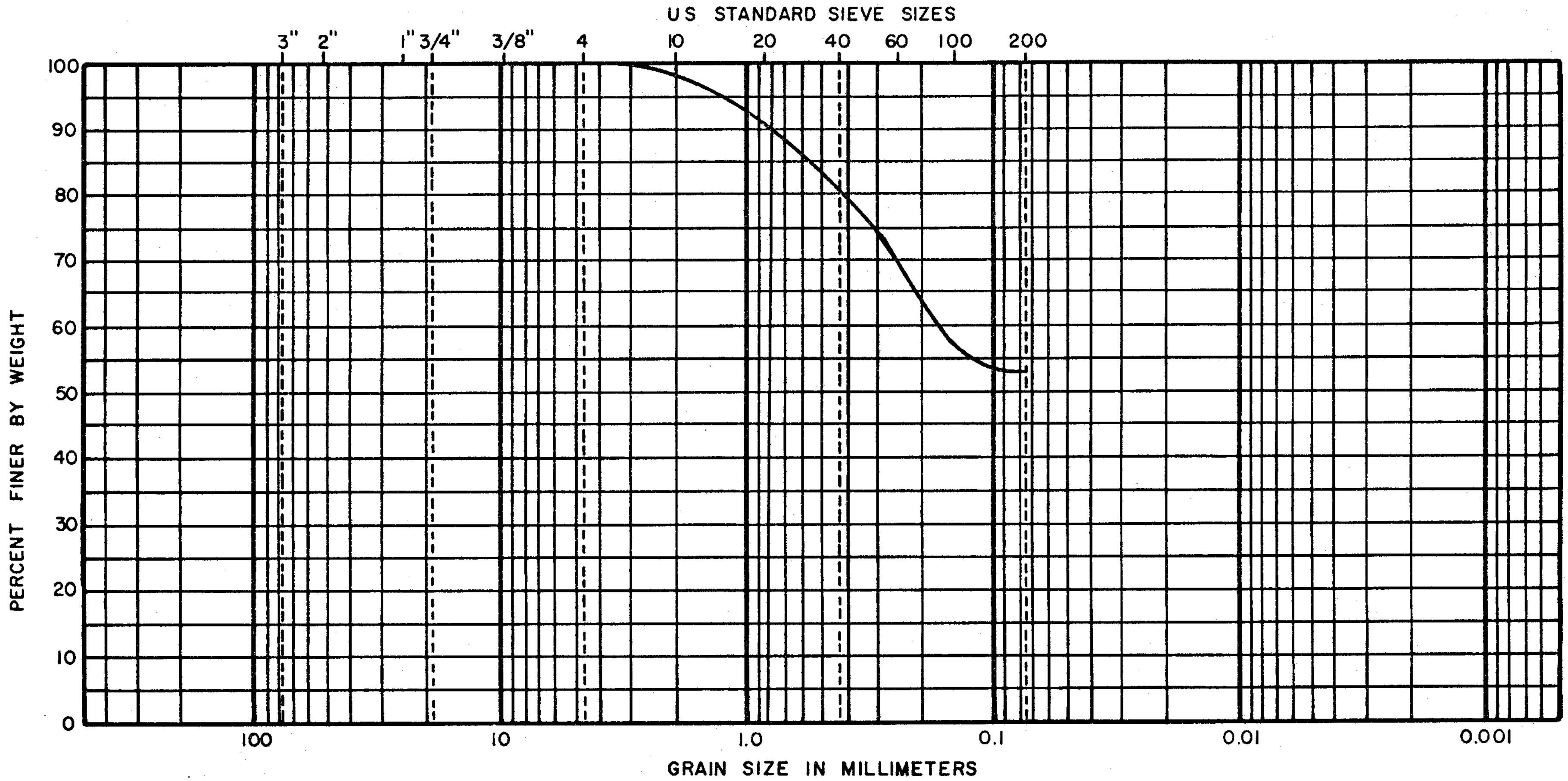
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

		DESCRIPTION OR CLASSIFICATION
BORING NO.	B-10	Brown Micaceous Fine to Coarse Sandy Silt (Most Sand Size Particles are Mica)
DEPTH OR ELEV.	Bag 1-8ft	
MOISTURE %	13.7	
LIQUID LIMIT	-	
PLASTIC LIMIT	-	
PLASTICITY INDEX	-	

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4507

LAW ENGINEERING TESTING COMPANY



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

		DESCRIPTION OR CLASSIFICATION
BORING NO.	B-10	Red Brown Slightly Micaceous Fine to Medium Sandy Silt
DEPTH OR ELEV.	UD 13-15 ft	
MOISTURE %	19.7	
LIQUID LIMIT	-	
PLASTIC LIMIT	-	
PLASTICITY INDEX	-	

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4507

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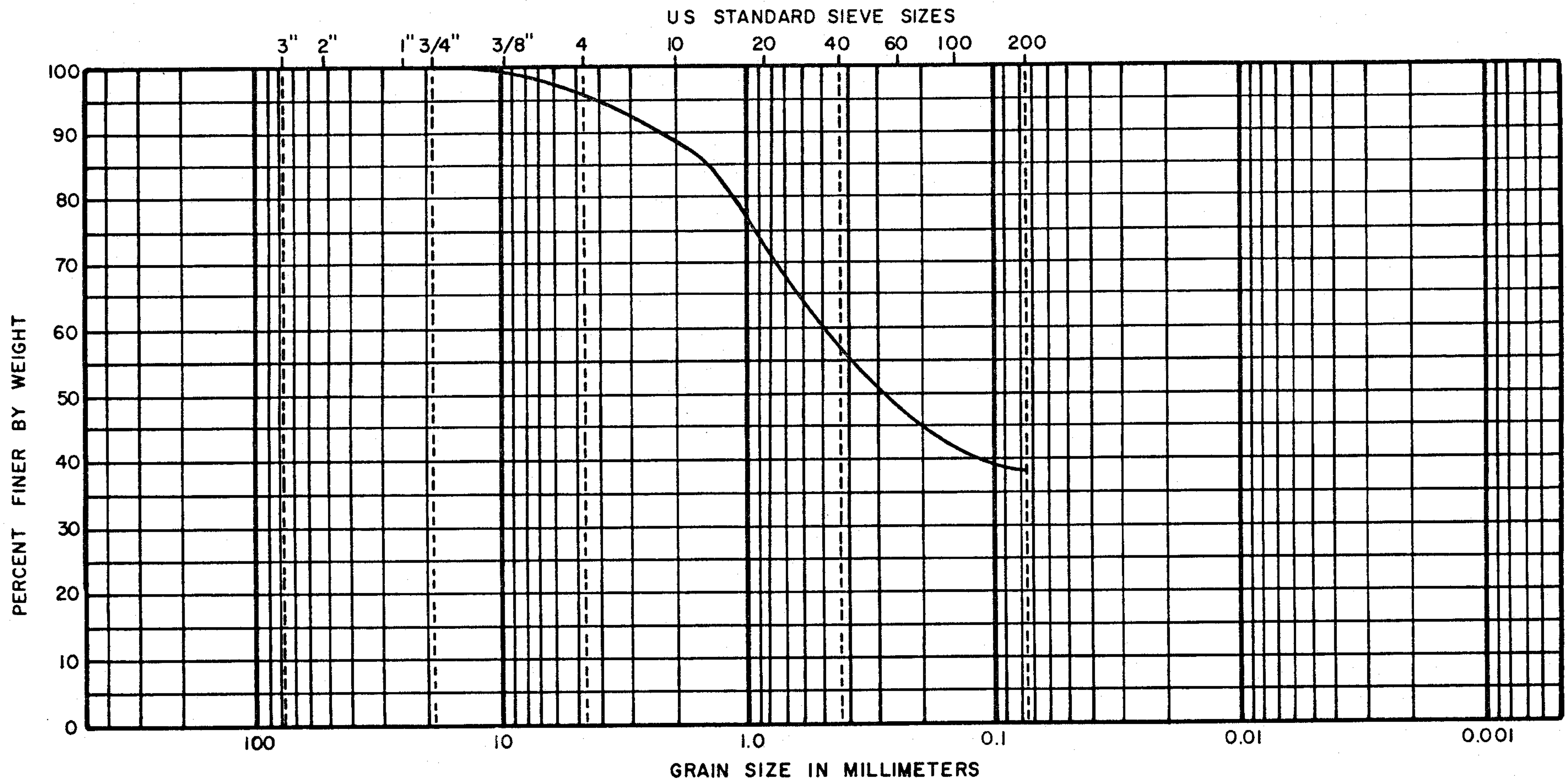

BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

		DESCRIPTION OR CLASSIFICATION
BORING NO.	B-11	Light Brown Very Micaceous Silty Fine to Coarse Sand (Most Sand Size Particles are Mica)
DEPTH OR ELEV.	UD 8-10 ft	
MOISTURE %	28.3	
LIQUID LIMIT	-	
PLASTIC LIMIT	-	
PLASTICITY INDEX	-	

GRAIN SIZE DISTRIBUTION

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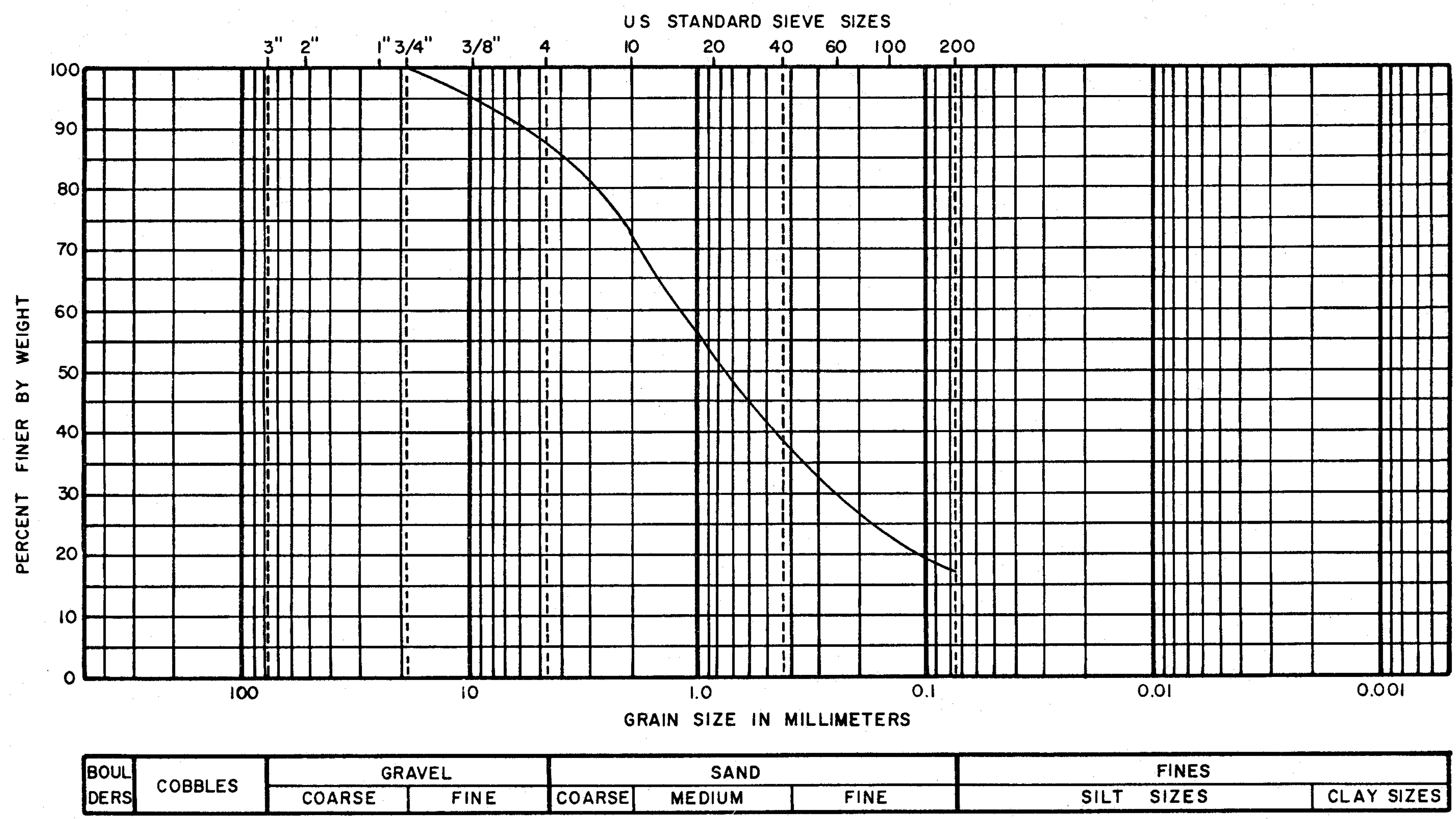


BORING NO.	B-16
DEPTH OR ELEV.	UD 1 to 3 ft
MOISTURE %	27.0
LIQUID LIMIT	-
PLASTIC LIMIT	-
PLASTICITY INDEX	-

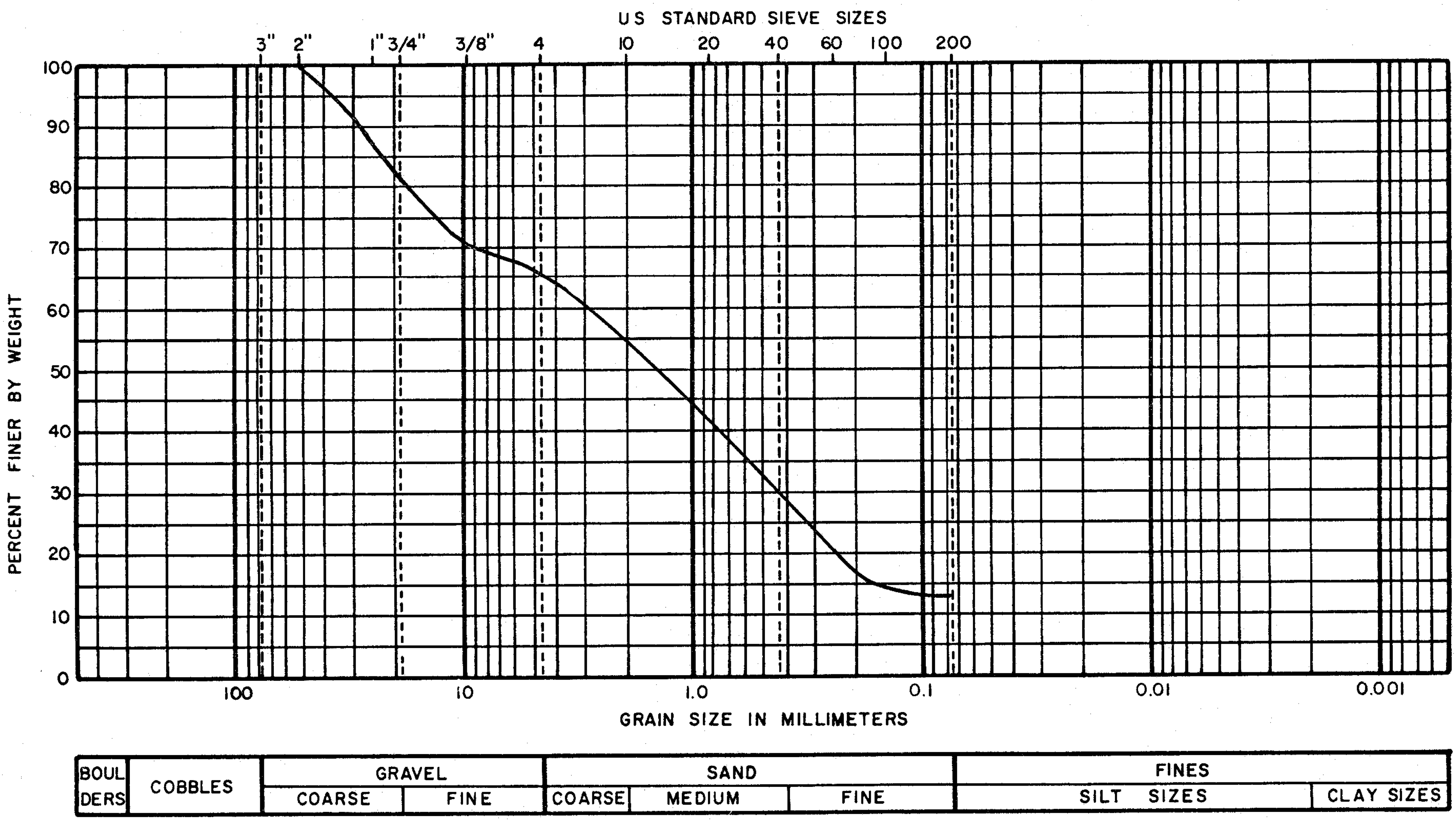
DESCRIPTION OR CLASSIFICATION

Gray Micaceous Silty Fine to Coarse Sand with Fine Gravel

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4507

LAW ENGINEERING TESTING COMPANY



		DESCRIPTION OR CLASSIFICATION
BORING NO.	B-16	Gray Micaceous Silty Fine to Coarse Sand with Fine to Coarse Gravel
DEPTH OR ELEV.	UD 1-3 ft	
MOISTURE %	27.0	
LIQUID LIMIT	-	
PLASTIC LIMIT	-	
PLASTICITY INDEX	-	

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4507

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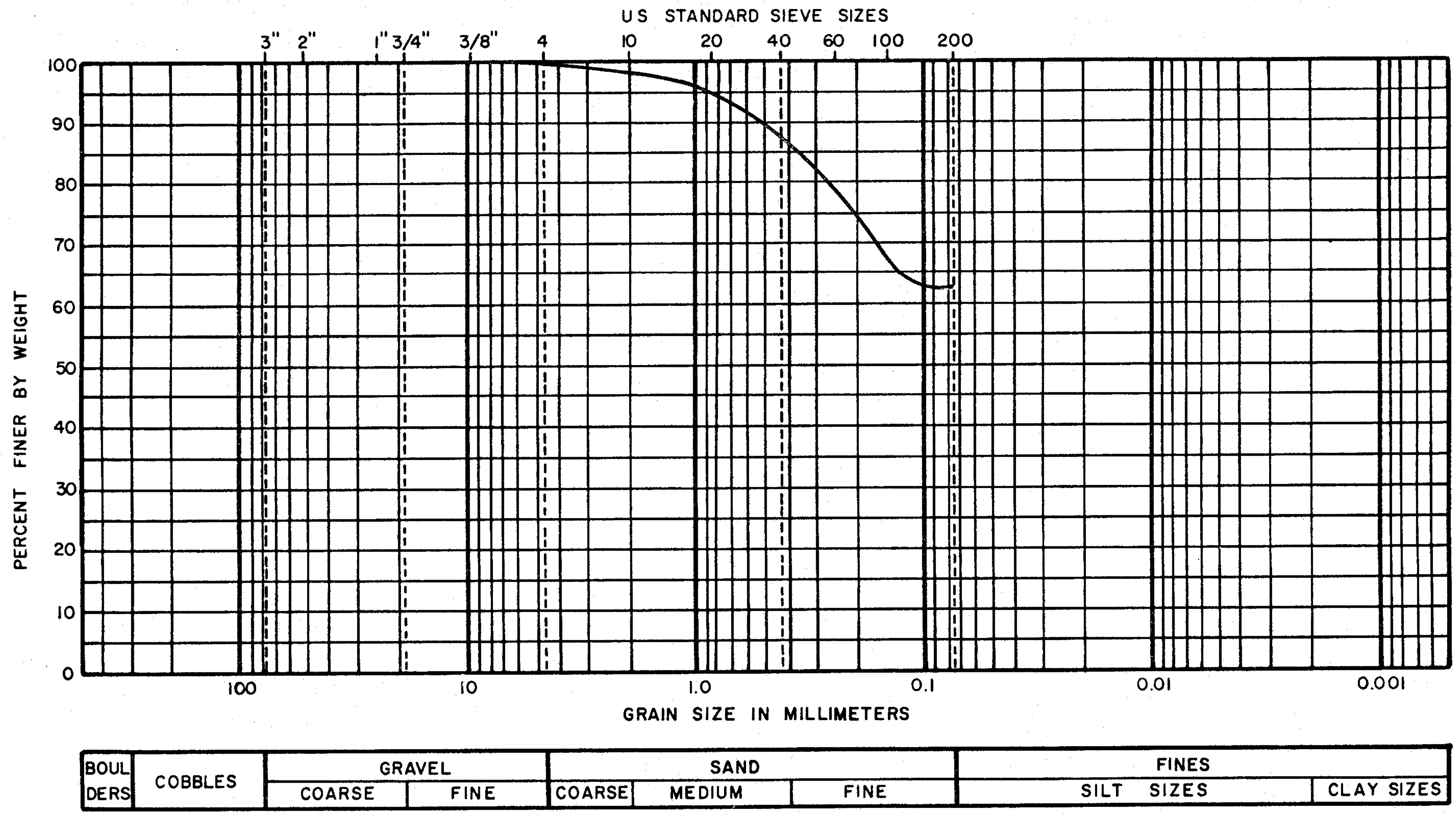

BORING NO.	B-18	DESCRIPTION OR CLASSIFICATION
DEPTH OR ELEV.	Bag 1-8 ft	Red Brown Micaceous Fine to Medium Sandy Silt
MOISTURE %	11.5	
LIQUID LIMIT	-	
PLASTIC LIMIT	-	
PLASTICITY INDEX	-	

GRAIN SIZE DISTRIBUTION

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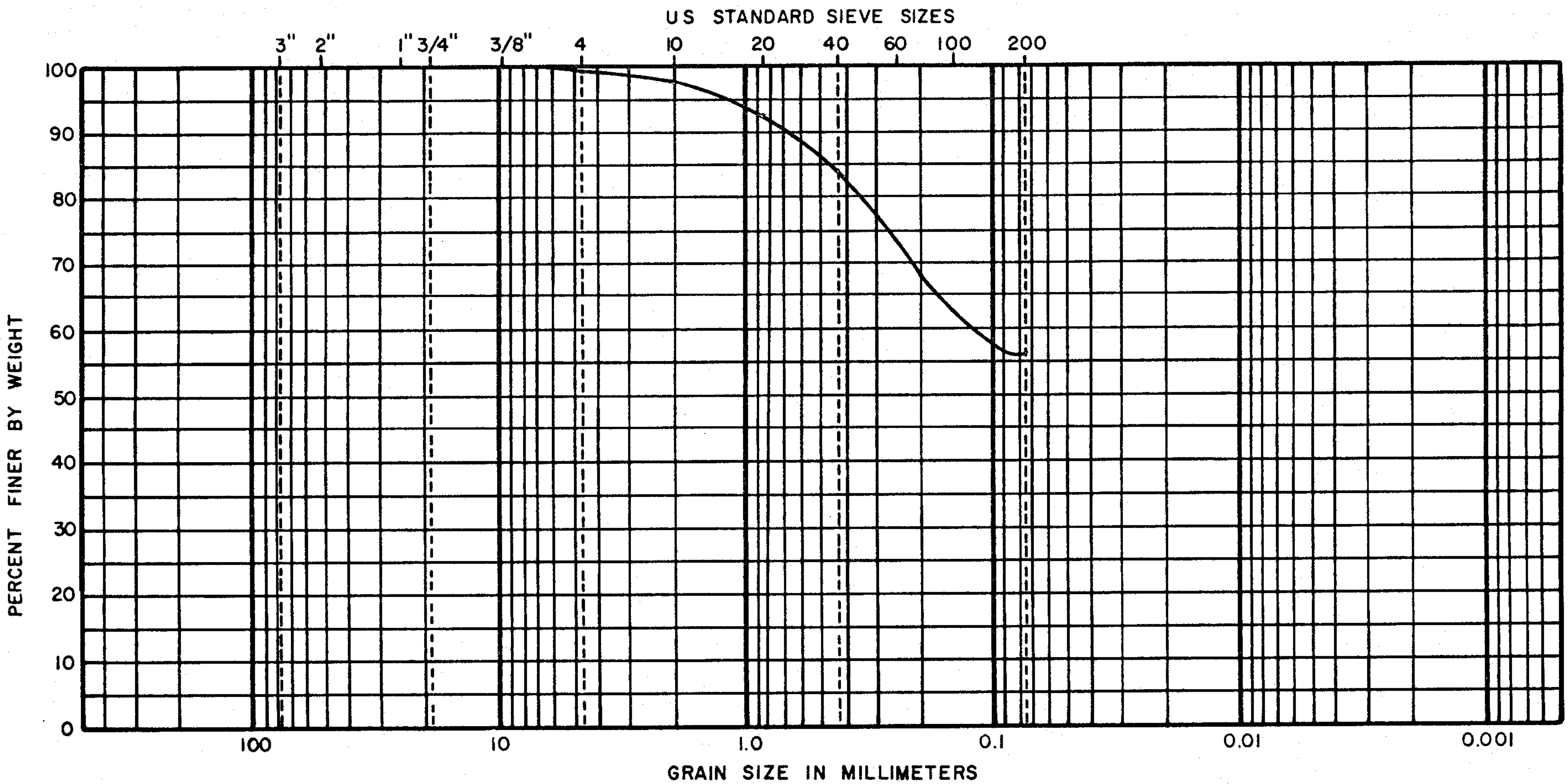


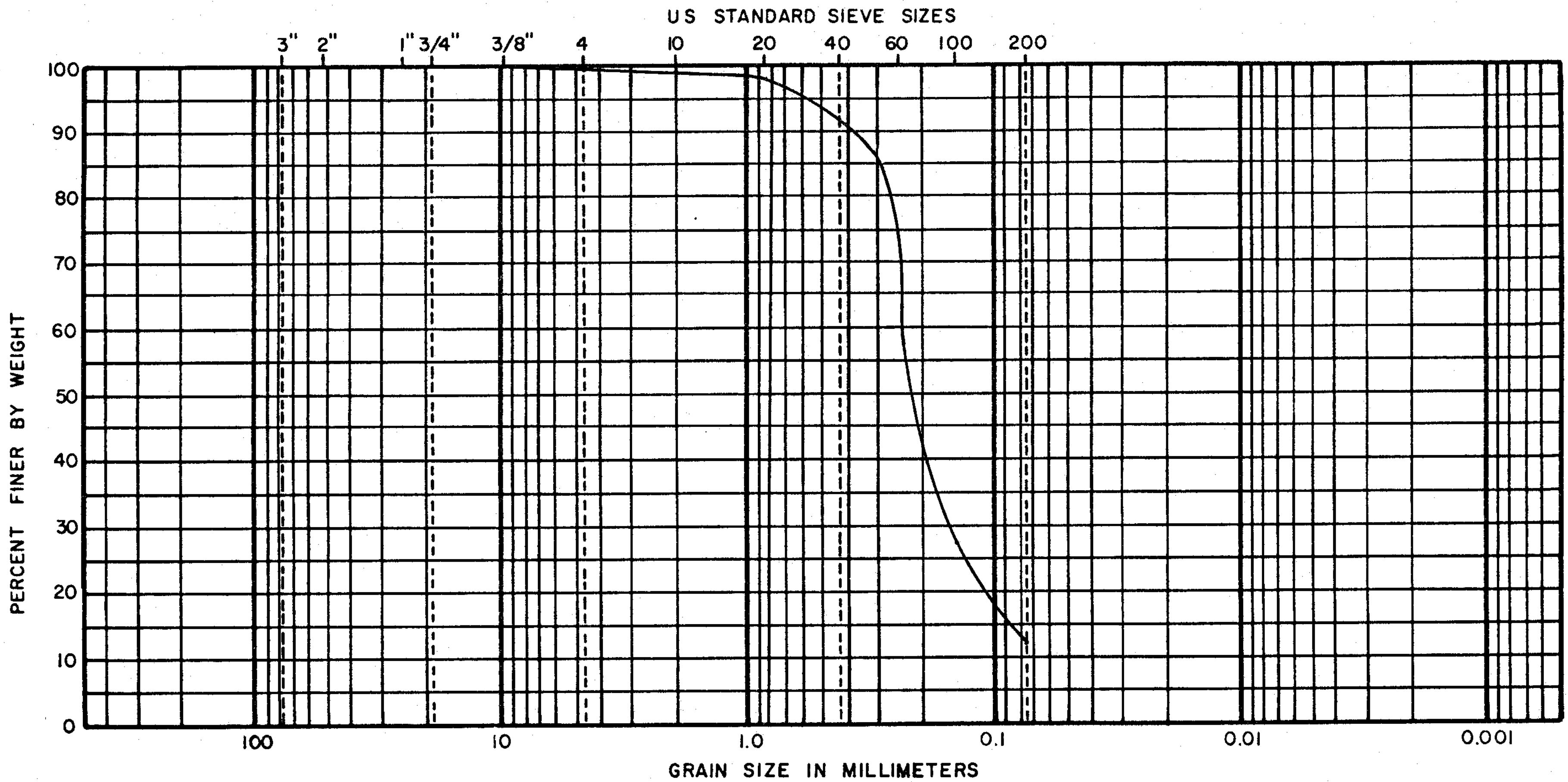
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

		DESCRIPTION OR CLASSIFICATION
BORING NO.	B-18	Red Brown Slightly Micaceous Fine to Medium Sandy Silt
DEPTH OR ELEV.	Bag 18-23 Ft	
MOISTURE %	14.9	
LIQUID LIMIT	--	
PLASTIC LIMIT	--	
PLASTICITY INDEX	--	

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4507

LAW ENGINEERING TESTING COMPANY



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

		DESCRIPTION OR CLASSIFICATION
BORING NO.	B-19	Gray Slightly Micaceous to Micaceous Silty Fine to Medium Sand
DEPTH OR ELEV.	UD 1 to 3 ft	
MOISTURE %	7.3	
LIQUID LIMIT	-	
PLASTIC LIMIT	-	
PLASTICITY INDEX	-	

GRAIN SIZE DISTRIBUTION

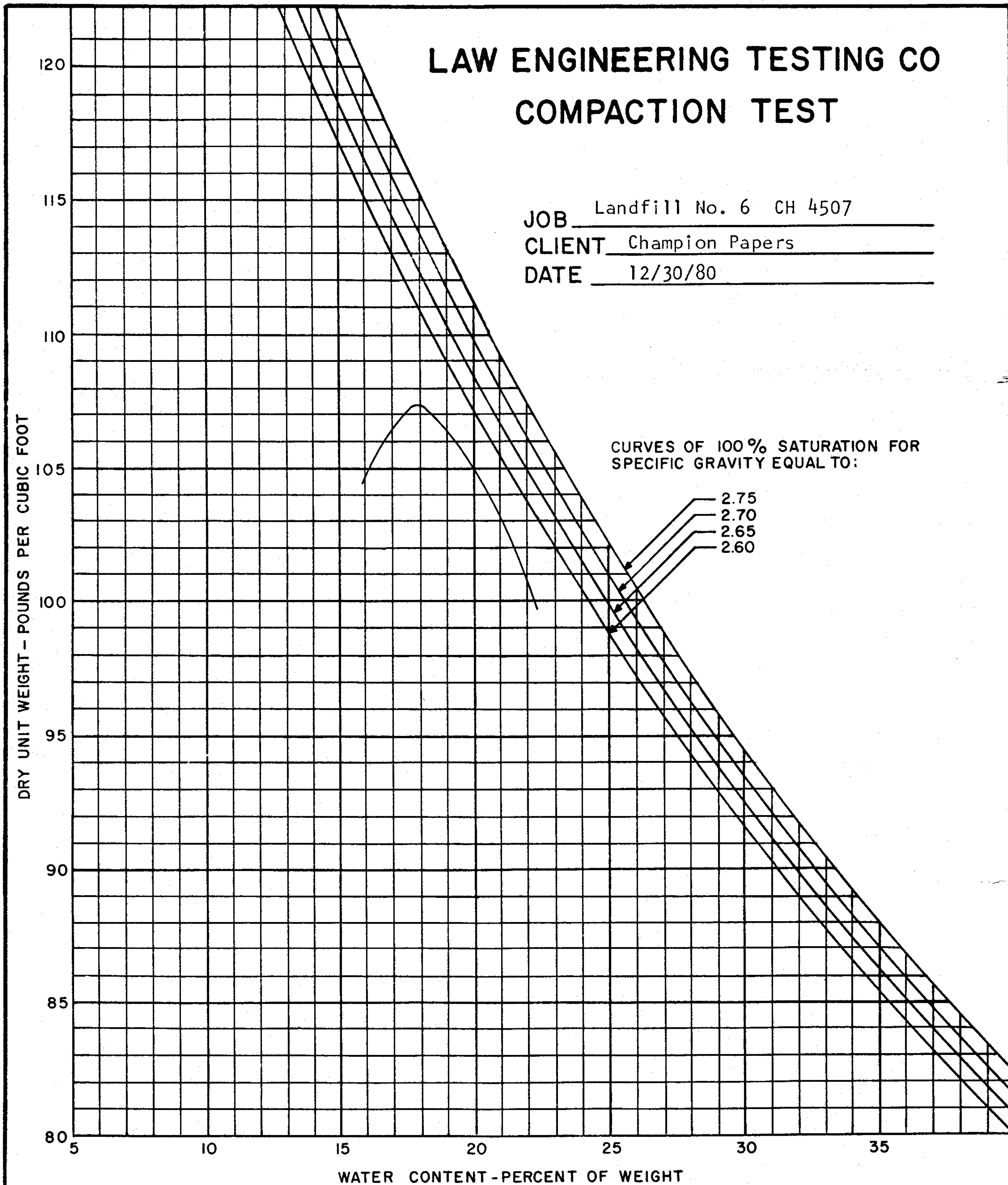
JOB NO. CH 4507

LAW ENGINEERING TESTING COMPANY

DUNCAN-PARNELL, INC., CHARLOTTE 779

LAW ENGINEERING TESTING CO
COMPACTION TEST

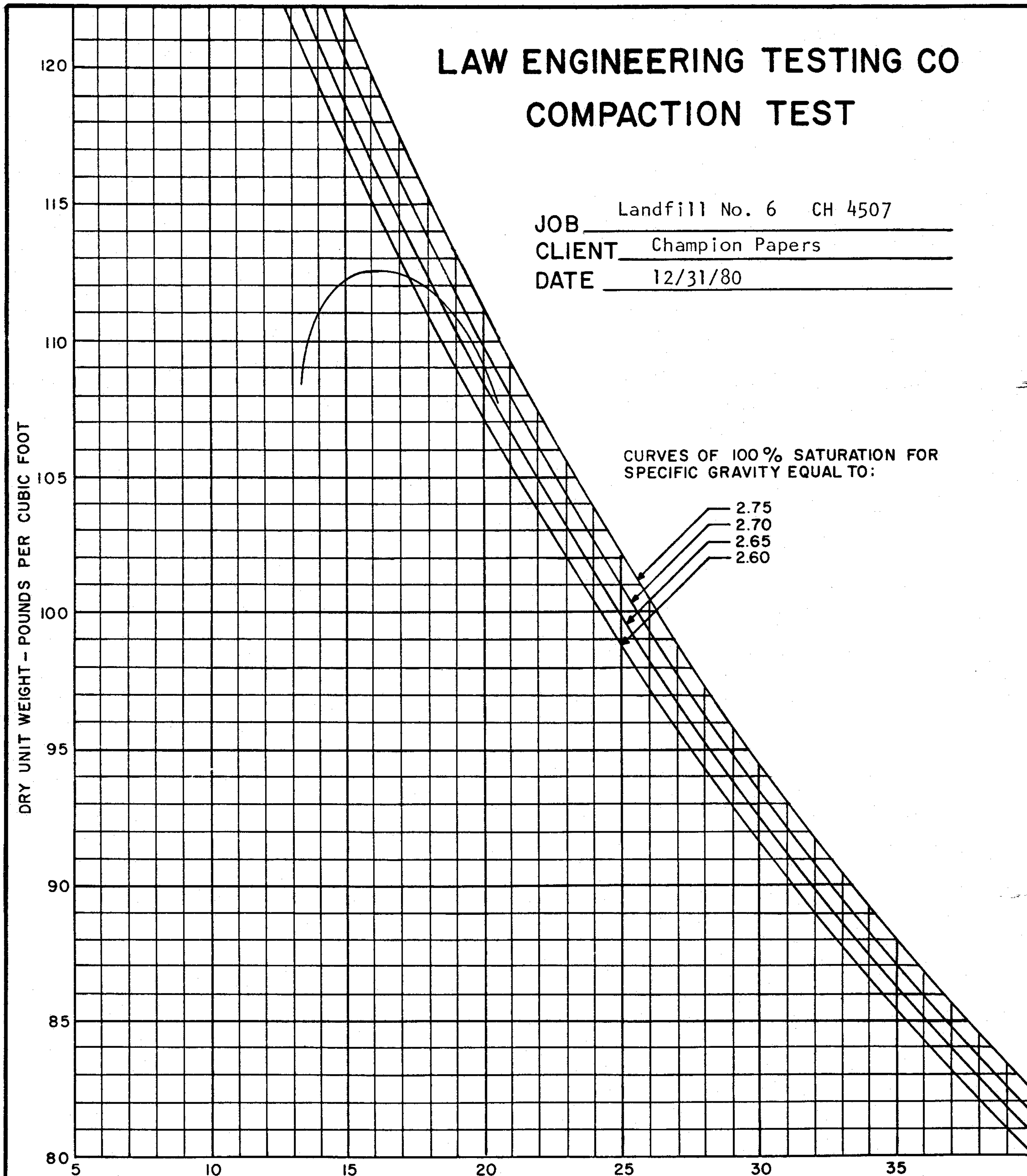
JOB Landfill No. 6 CH 4507
CLIENT Champion Papers
DATE 12/30/80



MOISTURE DENSITY RELATION	METHOD OF TEST	MAX. DRY DENSITY PCF	OPTIMUM MOISTURE CONTENT %	SOIL DESCRIPTION OR CLASSIFICATION AND SAMPLE LOCATION
1	Standard Proctor ASTM D698	107.4	17.9	Light Brown Micaceous Fine to Coarse Sandy Silt Sampled from Boring B-8 3 to 12 Ft.

LAW ENGINEERING TESTING CO
COMPACTION TEST

JOB Landfill No. 6 CH 4507
CLIENT Champion Papers
DATE 12/31/80

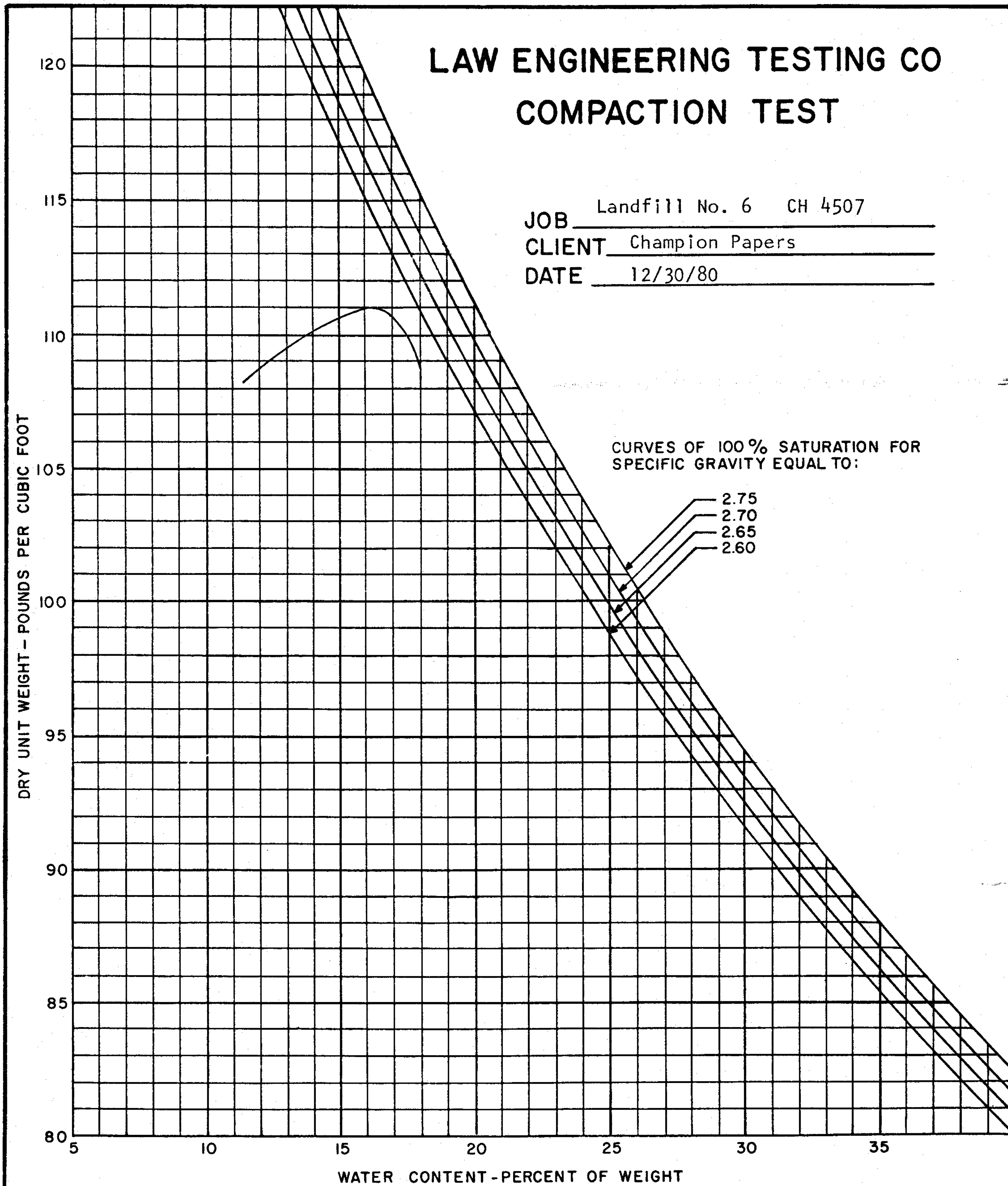


MOISTURE DENSITY RELATION	METHOD OF TEST	MAX. DRY DENSITY PCF	OPTIMUM MOISTURE CONTENT %	SOIL DESCRIPTION OR CLASSIFICATION AND SAMPLE LOCATION
2	Standard Proctor ASTM D698	112.6	16.3	Brown Micaceous Fine to Coarse Sandy Silt (Most of Sand Size Particles are Mica) Sampled from Boring B-10 1 to 8 Ft.

DUNCAN-PARNELL, INC., CHARLOTTE 1278

LAW ENGINEERING TESTING CO
COMPACTION TEST

JOB Landfill No. 6 CH 4507
CLIENT Champion Papers
DATE 12/30/80



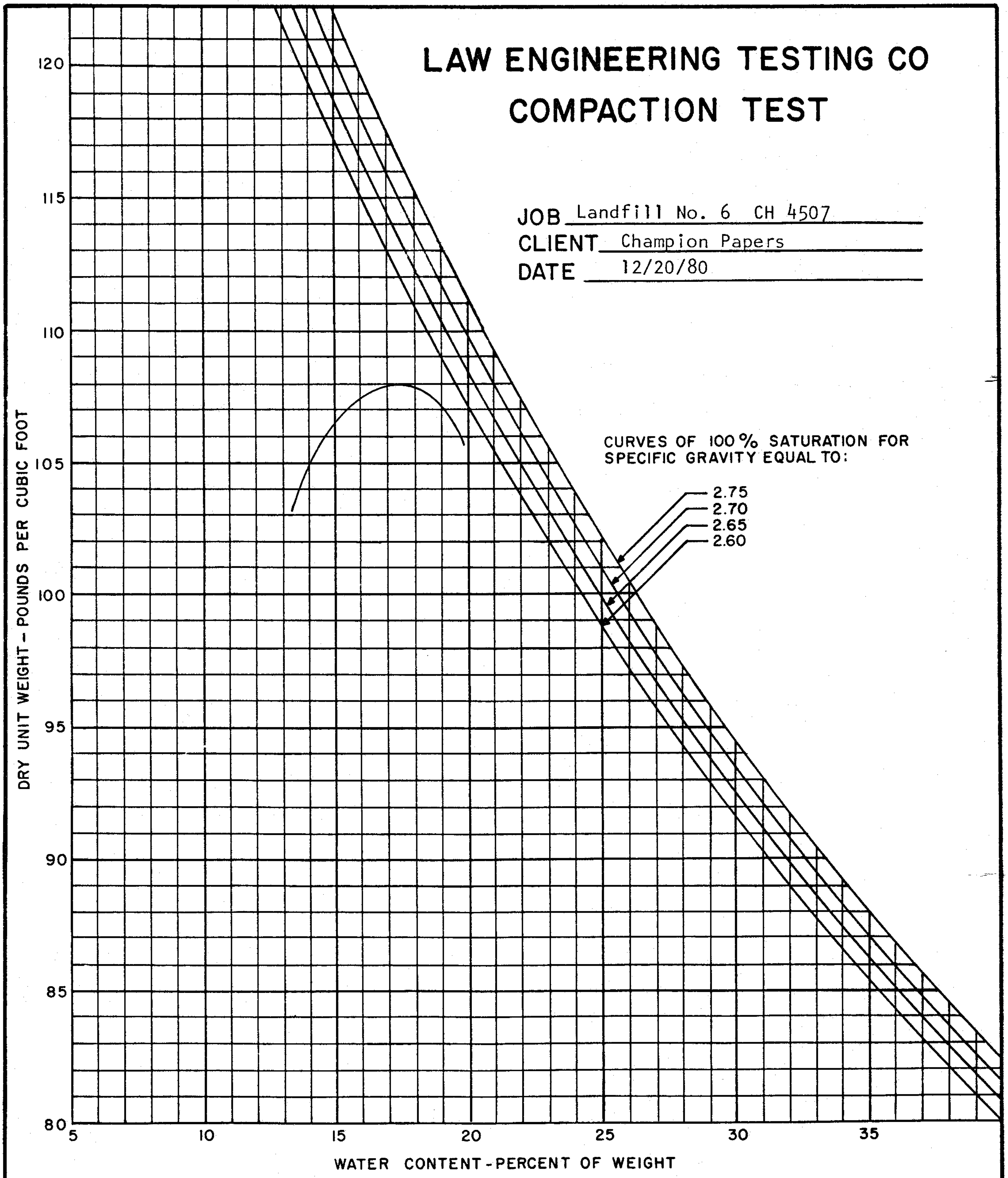
MOISTURE DENSITY RELATION	METHOD OF TEST	MAX. DRY DENSITY PCF	OPTIMUM MOISTURE CONTENT %	SOIL DESCRIPTION OR CLASSIFICATION AND SAMPLE LOCATION
3	Standard Proctor ASTM D698	111.0	16.3	Red Brown Micaceous Fine to Medium Sandy Silt Sampled from Boring B-18 1 to 8 Ft.

LAW ENGINEERING TESTING CO
COMPACTION TEST

JOB Landfill No. 6 CH 4507

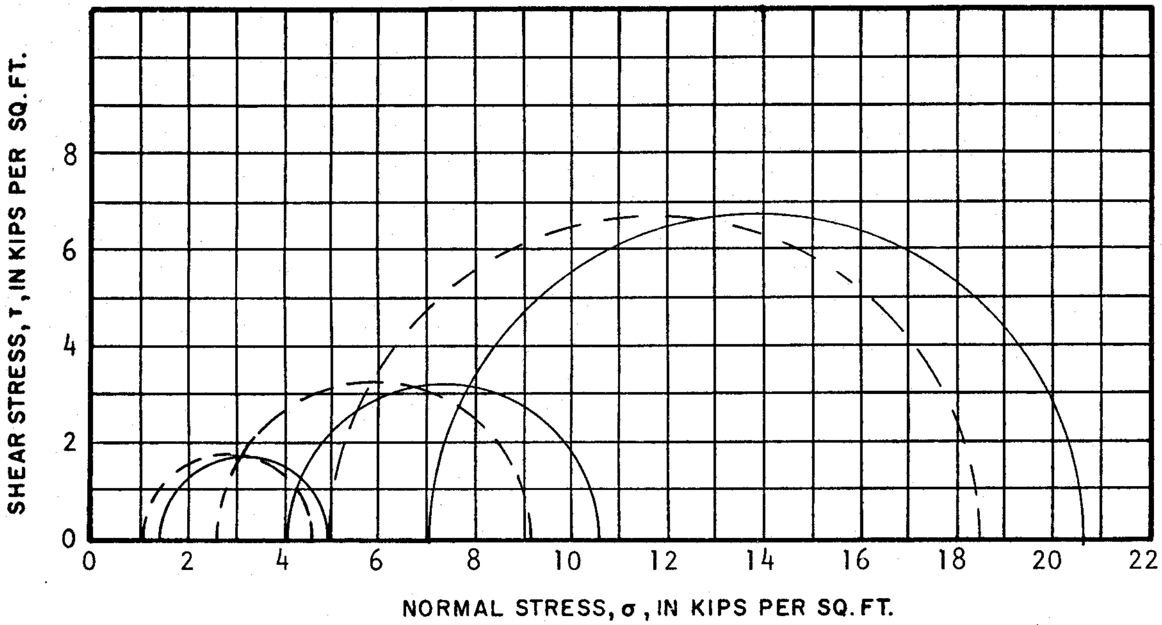
CLIENT Champion Papers

DATE 12/20/80



MOISTURE DENSITY RELATION	METHOD OF TEST	MAX. DRY DENSITY PCF	OPTIMUM MOISTURE CONTENT %	SOIL DESCRIPTION OR CLASSIFICATION AND SAMPLE LOCATION
4	Standard Proctor ASTM D698	108.0	17.3	Red Brown Slightly Micaceous Fine to Medium Sandy Silt Sampled from Boring B-18 18 to 23 Ft.

LAW ENGINEERING TESTING COMPANY

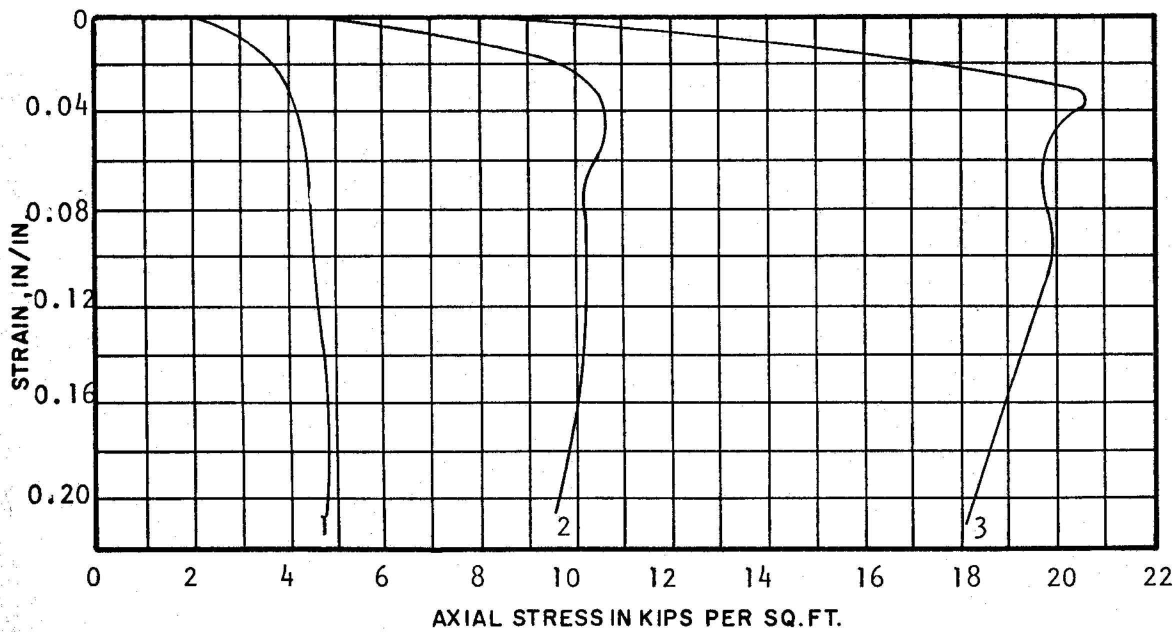


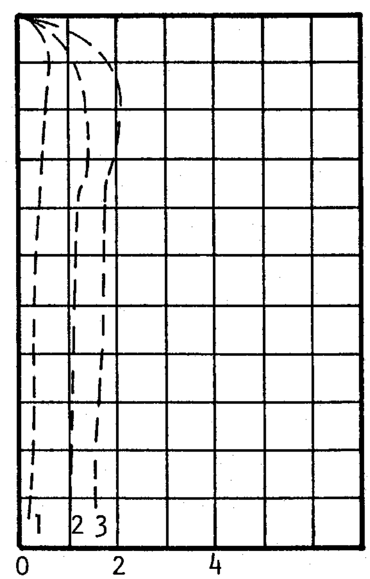
MOHR DIAGRAMS

EFFECTIVE COHESION, c' 0.2 KSF
EFFECTIVE SHEAR ANGLE, φ' 34.0°
TOTAL COHESION, c 0.3 KSF
TOTAL SHEAR ANGLE, φ 27.5°

INITIAL PROPERTIES:	①	②	③	AVG.	
UNIT WEIGHT γ	118.6	116.9	116.7	117.4	pcf
WATER CONTENT, w	14.0	13.1	12.4	13.2	%
VOID RATIO, e	0.637	0.648	0.640	0.642	
SATURATION, s	60.2	55.2	52.9	56.1	%

FINAL PROPERTIES:	①	②	③	AVG.	
UNIT WEIGHT, γ	128.7	129.4	130.7	129.6	pcf
WATER CONTENT, w	23.0	22.4	21.3	22.2	%
VOID RATIO, e	0.629	0.610	0.581	0.607	
SATURATION, s	100.0	100.0	100.0	100.0	%





STRESS-STRAIN AND PORE PRESSURE-STRAIN CURVES

SAMPLE DESCRIPTION:
Red Brown Very Micaceous
Fine to Coarse Sandy Silt
With Rock Fragments

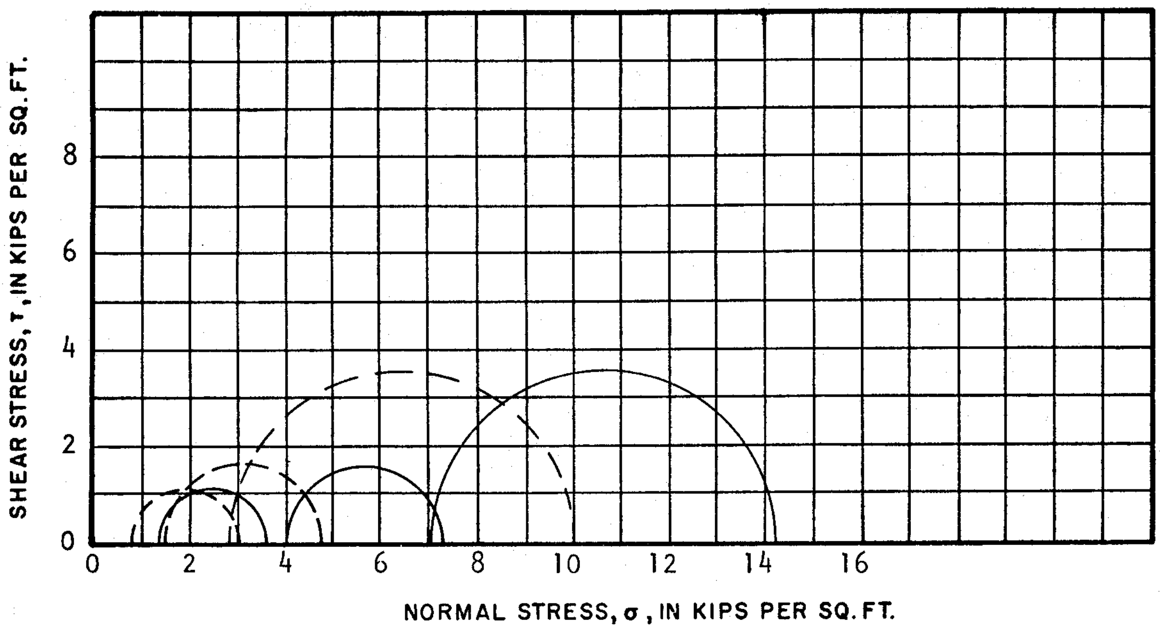
TOTAL STRESSES 4.8 10.6 20.7
EFECTIVE STRESSES 4.5 9.2 18.6

SATURATED, CONSOLIDATED, UNDRAINED TRIAXIAL SHEAR TEST WITH PORE PRESSURE MEASUREMENTS

JOB NO. CH 4507 BORING NO. B-8
DEPTH 9'-11' SAMPLE TYPE UD

DUNCAN-PARNELL, INC., CHARLOTTE 780

LAW ENGINEERING TESTING COMPANY



MOHR DIAGRAMS

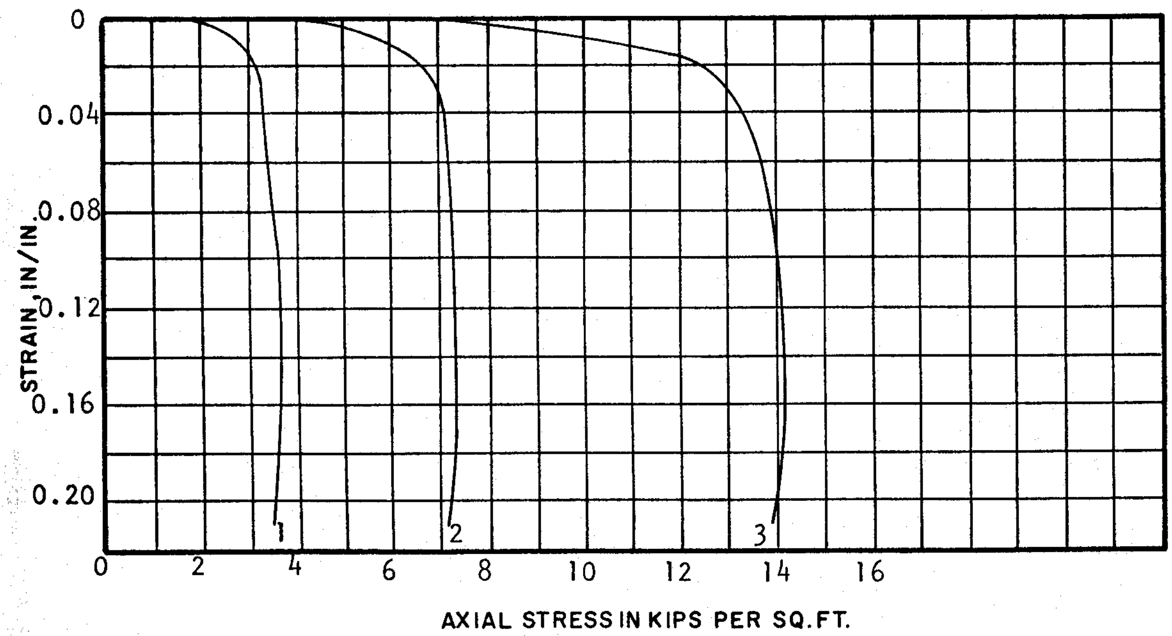
EFFECTIVE COHESION, c' 0.1 KSF
EFFECTIVE SHEAR ANGLE, φ' 31.5°
TOTAL COHESION, c 0.4 KSF
TOTAL SHEAR ANGLE, φ 16.5°

INITIAL PROPERTIES:	①	②	③	AVG.	
UNIT WEIGHT γ	108.4	102.3	101.7	104.1	pcf
WATER CONTENT, w	25.5	17.1	16.4	19.7	%
VOID RATIO, e	0.884	0.864	0.862	0.870	
SATURATION, s	75.1	51.7	49.5	58.8	%

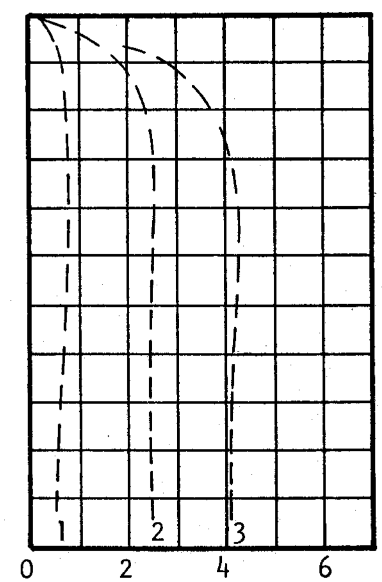
FINAL PROPERTIES:	①	②	③	AVG.	
UNIT WEIGHT, γ	116.1	118.7	119.1	118.0	pcf
WATER CONTENT, w	33.4	30.1	29.6	31.0	%
VOID RATIO, e	0.870	0.784	0.772	0.809	
SATURATION, s	100.0	100.0	100.0	100.0	%

SAMPLE DESCRIPTION:
Red Brown Slightly
Micaceous Fine to Medium
Sandy Silt

TOTAL STRESSES 3.6 7.4 14.3
EFECTIVE STRESSES 3.0 4.8 10.1



EXCESS PORE PRESSURE IN KIPS PER SQ.FT.

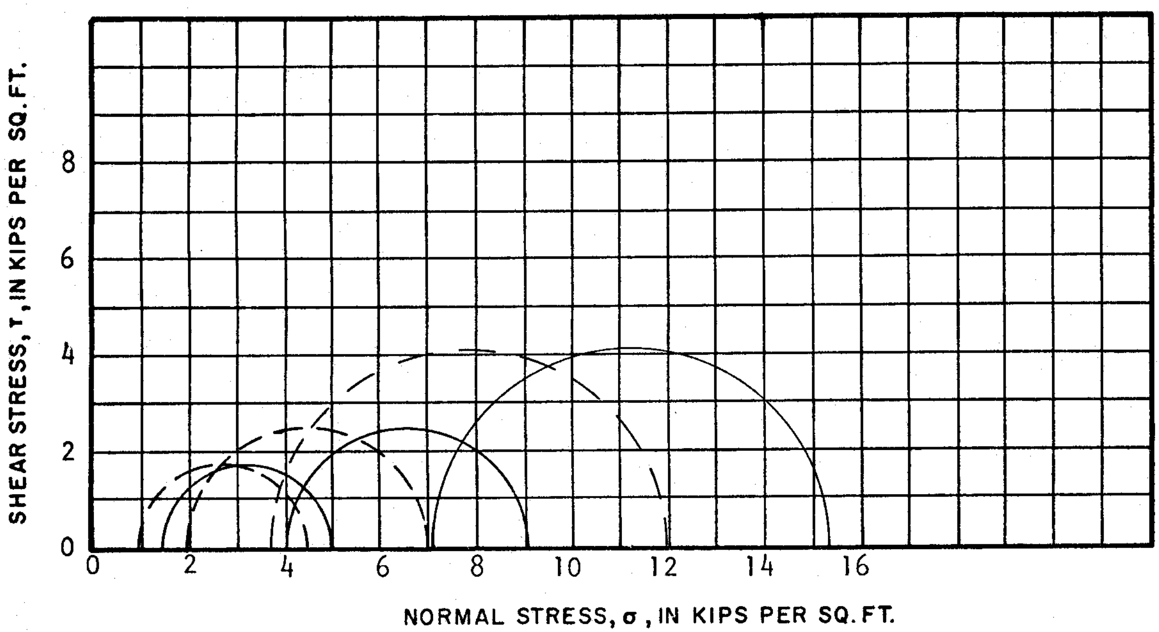


STRESS - STRAIN AND PORE PRESSURE - STRAIN CURVES

SATURATED, CONSOLIDATED, UNDRAINED TRIAXIAL SHEAR TEST WITH PORE PRESSURE MEASUREMENTS

JOB NO. CH 4507
DEPTH 13'-15'
BORING NO. B-10
SAMPLE TYPE UD

LAW ENGINEERING TESTING COMPANY



MOHR DIAGRAMS

EFFECTIVE COHESION, c' 0.6 KSF
EFFECTIVE SHEAR ANGLE, φ' 28.5°
TOTAL COHESION, c 0.8 KSF
TOTAL SHEAR ANGLE, φ 17.5°

INITIAL PROPERTIES:

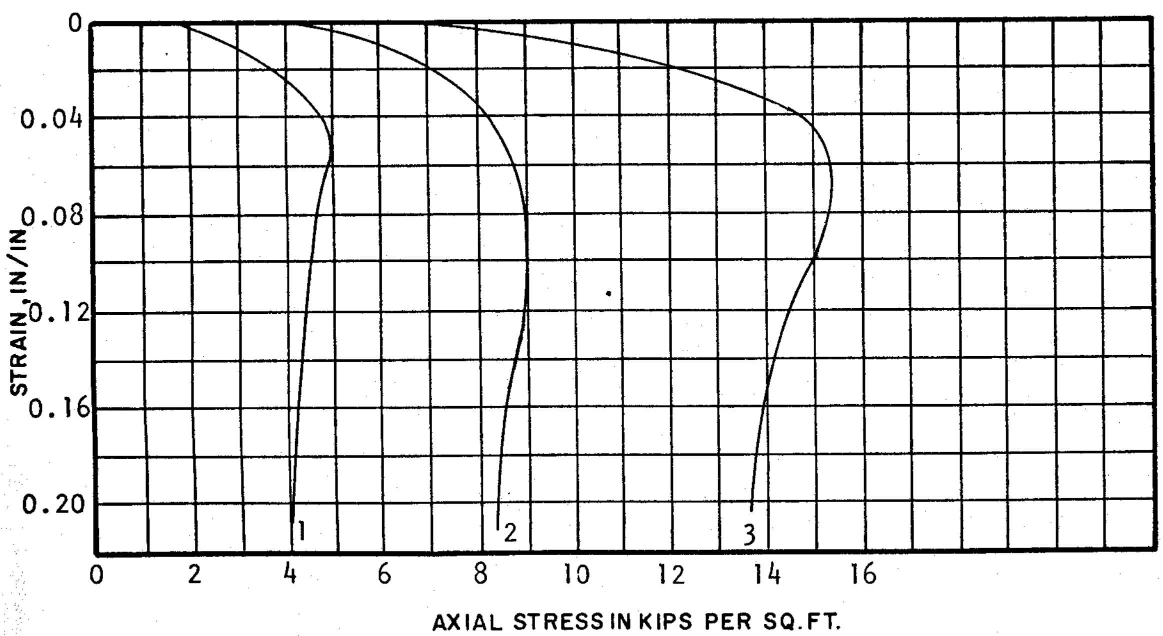
	①	②	③	AVG.	
UNIT WEIGHT γ	124.1	122.3	126.1	124.2	pcf
WATER CONTENT, w	30.7	28.5	25.7	28.3	%
VOID RATIO, e	0.728	0.725	0.637	0.697	
SATURATION, s	100+	100+	100+	100+	%

FINAL PROPERTIES:

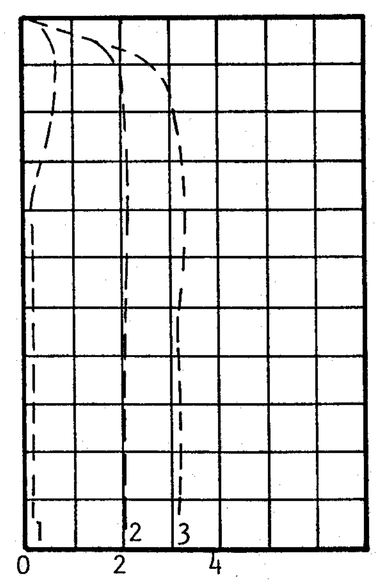
	①	②	③	AVG.	
UNIT WEIGHT, γ	121.3	123.7	128.7	124.6	pcf
WATER CONTENT, w	27.7	25.1	20.3	24.4	%
VOID RATIO, e	0.728	0.660	0.535	0.641	
SATURATION, s	100.0	100.0	100.0	100.0	%

SAMPLE DESCRIPTION:
Light Brown Micaceous
Silty Fine to Coarse
Sand

TOTAL STRESSES 4.9 9.0 15.3
EFECTIVE STRESSES 4.5 6.9 12.0



EXCESS PORE PRESSURE IN KIPS PER SQ. FT.

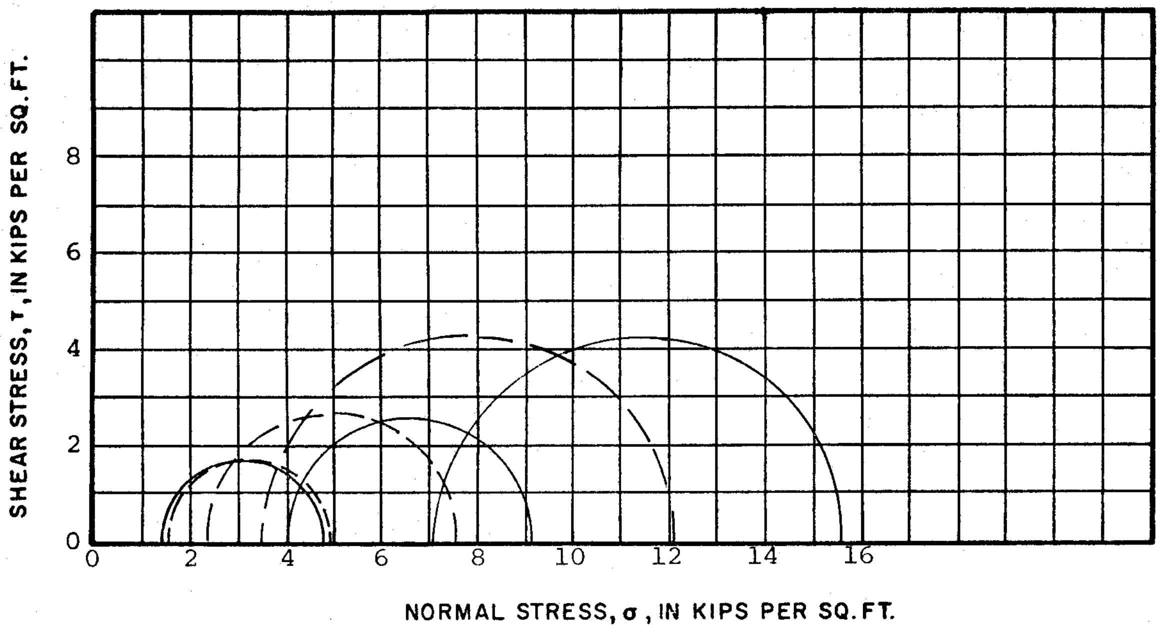


STRESS-STRAIN AND PORE PRESSURE-STRAIN CURVES

SATURATED, CONSOLIDATED, UNDRAINED TRIAXIAL SHEAR TEST WITH PORE PRESSURE MEASUREMENTS

JOB NO. CH 4507
DEPTH 8'-10'
BORING NO. B-11
SAMPLE TYPE UD

LAW ENGINEERING TESTING COMPANY



MOHR DIAGRAMS

EFFECTIVE COHESION, c'	0			
EFFECTIVE SHEAR ANGLE, φ'	32.0°			
TOTAL COHESION, c	0.6 Ksf			
TOTAL SHEAR ANGLE, φ	19.0°			

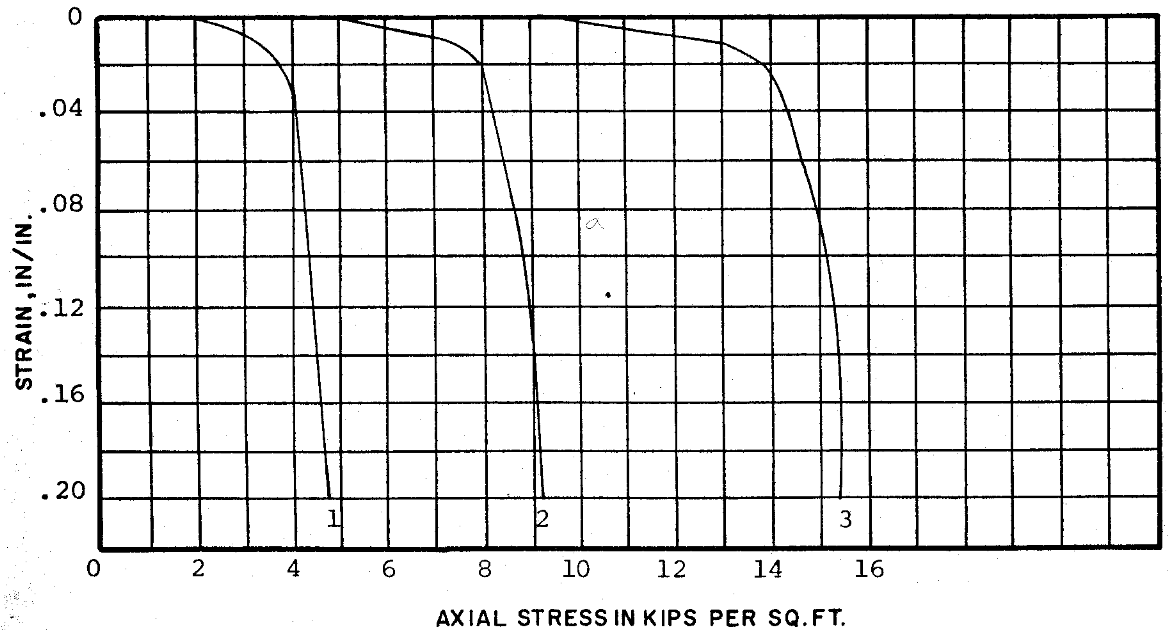
INITIAL PROPERTIES:	①	②	③	AVG.	
UNIT WEIGHT γ	126.7	126.7	126.7	126.7	pcf
WATER CONTENT, w	17.8	17.7	17.6	17.7	%
VOID RATIO, e	0.688	0.688	0.686	0.687	
SATURATION, s	75.2	74.9	74.7	74.9	%

FINAL PROPERTIES:	①	②	③	AVG.	
UNIT WEIGHT, γ	133.2	134.4	136.6	134.7	pcf
WATER CONTENT, w	23.5	22.5	20.8	22.3	%
VOID RATIO, e	0.684	0.655	0.606	0.648	
SATURATION, s	100	100	100	100	%

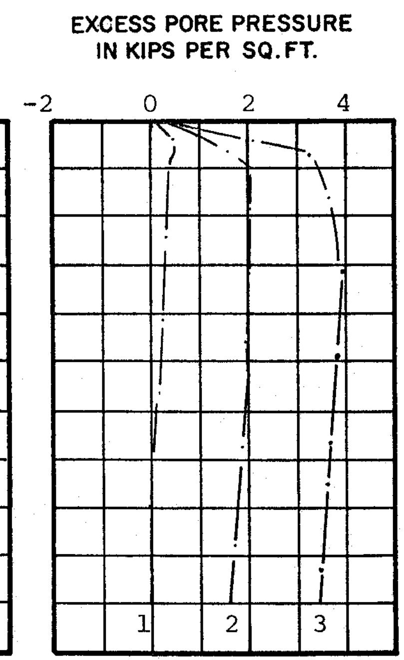
SAMPLE DESCRIPTION:
Brown Micaceous Fine to Coarse Sandy Silt (Most Sand Size Particles are Mica)

TOTAL STRESSES 4.8 9.2 15.7

EFECTIVE STRESSES 4.9 7.6 12.1



STRESS - STRAIN AND PORE PRESSURE - STRAIN CURVES



SATURATED, CONSOLIDATED, UNDRAINED TRIAXIAL SHEAR TEST WITH PORE PRESSURE MEASUREMENTS

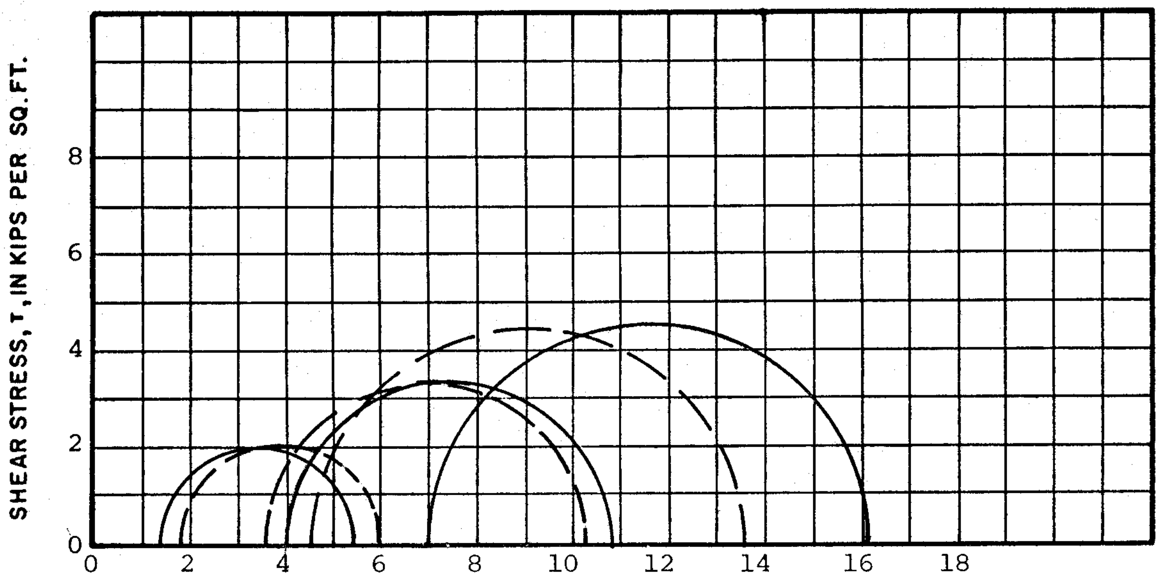
JOB NO. CH 4507 BORING NO. B-10

DEPTH 1 - 8 ft SAMPLE TYPE Remolded

Average Compaction: 95.5% Standard Proctor Maximum Dry Density

DUNCAN-PARNELL, INC., CHARLOTTE 780

LAW ENGINEERING TESTING COMPANY



MOHR DIAGRAMS

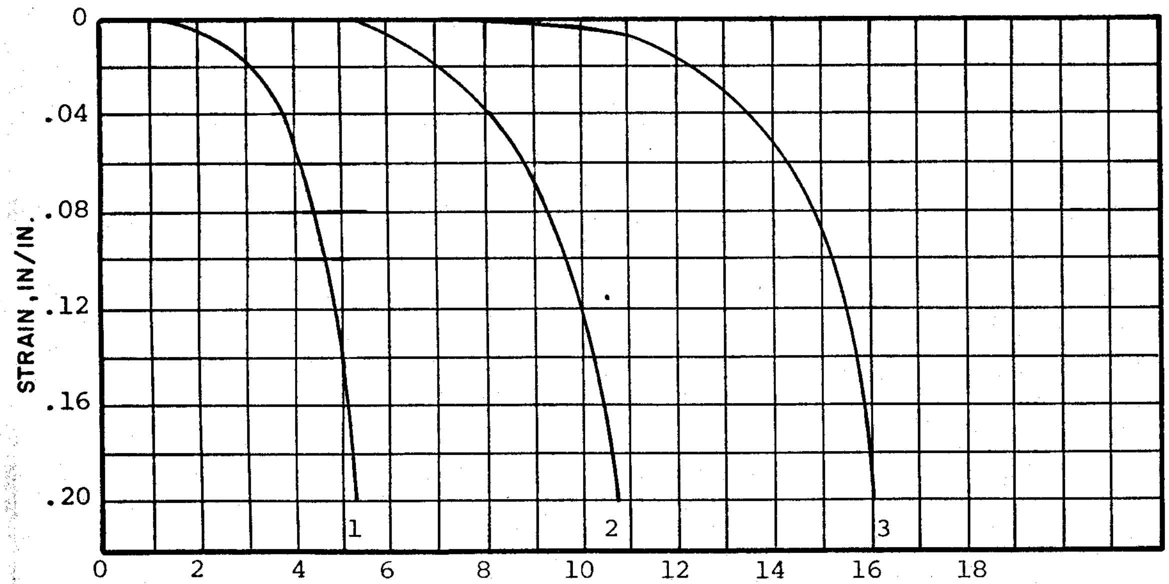
EFFECTIVE COHESION, c' 0
EFFECTIVE SHEAR ANGLE, φ' 30.0°
TOTAL COHESION, c 0.9 Ksf
TOTAL SHEAR ANGLE, φ 19.0°

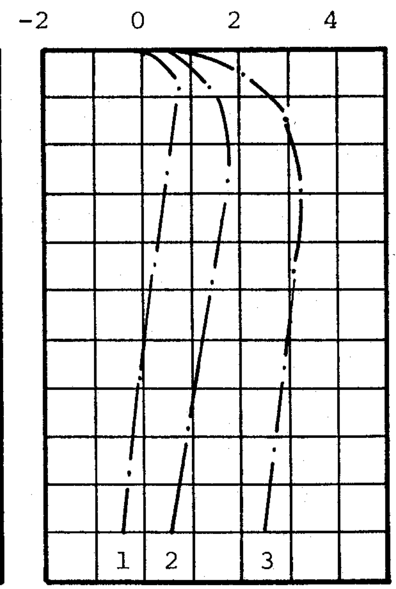
INITIAL PROPERTIES:	①	②	③	AVG.	
UNIT WEIGHT γ	124.2	124.2	124.2	124.2	pcf
WATER CONTENT, w	17.6	17.6	17.6	17.6	%
VOID RATIO, e	0.600	0.601	0.601	0.601	
SATURATION, s	79.3	79.3	79.3	79.3	%

FINAL PROPERTIES:	①	②	③	AVG.	
UNIT WEIGHT, γ	120.3	130.7	131.5	130.5	pcf
WATER CONTENT, w	21.9	20.7	20.1	20.9	%
VOID RATIO, e	0.594	0.562	0.545	0.567	
SATURATION, s	100	100	100	100	%

SAMPLE DESCRIPTION:
Red Brown Micaceous Fine to Medium Sandy Silt

TOTAL STRESSES 5.5 10.8 16.1
EFECTIVE STRESSES 5.9 10.3 13.6



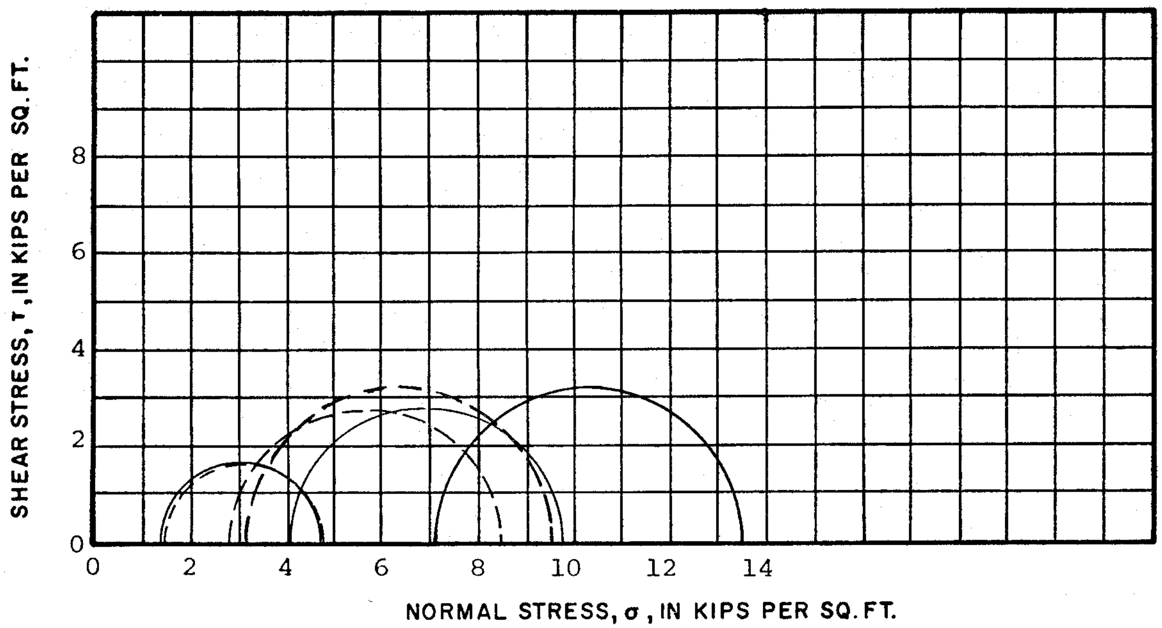


STRESS-STRAIN AND PORE PRESSURE-STRAIN CURVES

SATURATED, CONSOLIDATED, UNDRAINED TRIAXIAL SHEAR TEST WITH PORE PRESSURE MEASUREMENTS

JOB NO. CH 4507 BORING NO. B-18
DEPTH 1.0 - 8.0 ft SAMPLE TYPE Remolded
Average Compaction: 97.8% Standard Proctor Maximum Dry Density

LAW ENGINEERING TESTING COMPANY

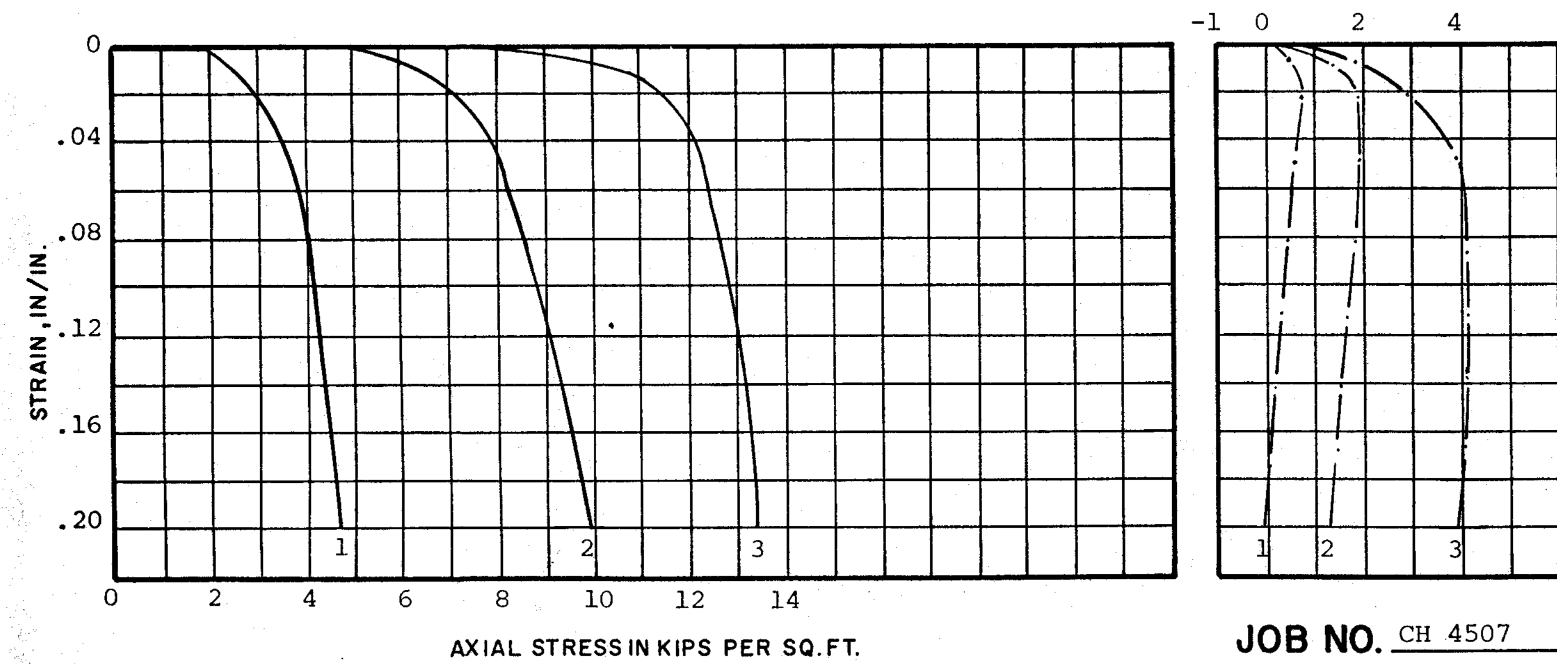


MOHR DIAGRAMS

EFFECTIVE COHESION, c' 0.3 Ksf
EFFECTIVE SHEAR ANGLE, φ' 27.5°
TOTAL COHESION, c 1.0 Ksf
TOTAL SHEAR ANGLE, φ 13.0°

INITIAL PROPERTIES:	(1)	(2)	(3)	AVG.	
UNIT WEIGHT γ	122.5	122.5	122.5	122.5	pcf
WATER CONTENT, w	19.2	19.7	19.4	19.4	%
VOID RATIO, e	0.688	0.695	0.691	0.691	
SATURATION, s	77.6	78.7	78.1	78.1	%

FINAL PROPERTIES:	(1)	(2)	(3)	AVG.	
UNIT WEIGHT, γ	128.5	129.5	132.1	130.0	pcf
WATER CONTENT, w	24.5	23.5	21.3	23.1	%
VOID RATIO, e	0.680	0.653	0.593	0.642	
SATURATION, s	100	100	100	100	%



STRESS-STRAIN AND PORE PRESSURE-STRAIN CURVES

SAMPLE DESCRIPTION:
Red Brown Slightly
Micaceous Fine to
Medium Sandy Silt

TOTAL STRESSES 4.7 9.7 13.5
EFECTIVE STRESSES 4.8 8.4 9.6

SATURATED, CONSOLIDATED, UNDRAINED TRIAXIAL SHEAR TEST WITH PORE PRESSURE MEASUREMENTS

JOB NO. CH 4507 **BORING NO.** B-18
DEPTH 18 - 23 ft **SAMPLE TYPE** Remolded

Average Compaction: 95% Standard Proctor Maximum Dry Density