SOILS AND FOUNDATIONS INVESTIGATION
SANITARY SEWER SYSTEM IMPROVEMENTS
FOR SOUTH ABERDEEN
CITY OF ABERDEEN, WASHINGTON

INTRODUCTION

This report presents the results of our subsurface soils and foundation investigation related to proposed sanitary sewer system improvements in South Aberdeen for the City of Aberdeen, Washington.

We undertook this investigation in accordance with the scope of work detailed in our proposal to the URS Company dated October 8, 1976, for which a subcontract agreement was signed on October 20, 1976 and authorization to proceed was received effective December 30, 1976.

The proposed sanitary sewer system improvements in South Aberdeen consist of replacement of approximately 50,000 linear feet of sewer and manholes, as well as construction of one sanitary pump station and a generator facility for an existing pump station.

Twenty-three hollow-stem auger borings (Borings 112 through 136) were made near proposed sewer lines to depths ranging between 11.5 and 20.5 feet at the locations shown on the Subsurface Exploration Plan, Plate 1 of this report. One rotary wash boring (Boring 230) was made at the location of the proposed pump station to a depth of 44.0 feet. All of these subsurface investigations were observed on a full-time basis by a member of our field engineering staff.

A detailed description of the methods of subsurface exploration is presented in Appendix A of this report. Logs of the boreholes are shown on Plates A-2 through A-26.

Summaries of the results of our extensive laboratory testing program conducted in conjunction with this project are also presented in the appendix.

SUBSURFACE SOIL AND GROUNDWATER CONDITIONS

In most of the borings, the top layer of soil consisted of a loose silty sand with a trace of gravel to a silty gravel. This layer generally ranged

from 0.5 feet to 3 feet in thickness, although the sandy material was about five feet thick in Borings 123, 124 and 131A. Boring 131 showed mostly granular materials to a depth of 12 feet where an obstruction was encountered. It was felt that the granular material may have been backfill placed over an existing undetermined utility, therefore Boring 131A was drilled several feet away in the same vicinity and did not encounter the granular material below a depth of about five feet.

Below the thin granular surface layers described above, we encountered medium stiff to soft clayey silt with a trace of sand and organics which graded to very soft at about 12 to 15 feet deep. Beyond that depth the strength of this material increased slightly with depth. This clayey silt extended to depths greater than the lengths of all of the borings except at Boring 230, where a medium dense silty fine sand layer was encountered at a depth of about 38 feet and extended to a depth in excess of 44 feet.

Observation wells were installed at Borings 112, 120, 124, 127, 132, 134, 136, and 230 as shown on Plate 1, to monitor groundwater levels at these locations. The wells should be operable through the construction period. The results of several sets of readings are shown on Table 1 of this report.

Groundwater level depths during the period of our observations generally varied from about two to three feet below ground level in all of the wells except at Borings 124 and 136, where the groundwater depths appeared to vary between five and eight feet below ground surface. The groundwater levels in borings near the river appeared to be influenced to a minor degree only by tide level fluctuations.

PROPOSED SEWERS

Trench Excavation and Support

Based on the results of the field subsurface explorations and laboratory testing program, we anticipate that almost all sewer trenches will have to be supported from the ground surface down. It should be noted that trenches *greater* than five feet in depth must be shored or otherwise adequately supported and braced in compliance with local, state and federal Occupational Safety and Health Act of 1970 (OSHA) regulations as ammended to date.

Due to the tendency of the existing silty subsurface material to soften, become disturbed and lose strength on wetting, pipe should be placed and backfilling of trenches should proceed in a continuous operation.

No trenches should be allowed to stand open overnight, not even short sections. In addition, due to the very soft and relatively weak nature of the clayey silts in South Aberdeen, we recommend that no material be stockpiled or stacked on the ground surface within a horizontal distance of at least 18 feet from any open trench. Any material, including trench excavation or backfill, piled adjacent to open trenches will increase the stresses in the soft soils at the level of the trench bottom and may cause heave of the trench bottom. In addition, repetitive truck traffic patterns adjacent to open trenches should be prohibited. All three of these restrictions should be rigidly enforced and clearly indicated in the project specifications.

Previous experience in the Grays Harbor area indicates that a large amount of friction can be developed between a rigid "trench box" and the existing cohesive subsoils as the box is moved forward. The force required to move such a support system may lead to disturbance of installed pipe sections and a tendency for separation of the pipe joints. As a result, the contractor should use a trench support system which will:

1) Minimize frictional drag on the trench walls.

2) Assure the required degree of compaction of the pipe bedding and backfill materials after the support system has been removed from specific locations.

3) Preclude drag on installed pipe sections and separation of installed pipe joints.

4) Maintain the design alignment and grade of the pipe.

The last twelve inches of the trench should be excavated by careful use of a smooth bucket with no teeth or by hand to assure a smooth, clean and undisturbed trench bottom.

No problems are anticipated regarding heave of trench bottoms as long as careful and consistent construction procedures are used, except in the area of Borings 112, 113, 114 and 115 in the southeastern portion of South Aberdeen

where the subsoils are considerably softer than at other locations detected in our explorations in South Aberdeen. We recommend a maximum pipe invert depth in this area of 9.5 feet to minimize the potential of trench bottom heaving.

Based on our observations of the samples recovered from the field exploration program, we feel that seepage in trenches can be adequately controlled by the use of sump pumping in most areas.

Rebound of trench bottoms resulting from stress relief due to careful, orderly excavation is anticipated to be less than 0.3 inches in all locations except near Borings 112 through 115. We estimate the trench rebound for a pipe depth of 9.5 feet in this area will be about 0.6 inches or less.

We anticipate that in various areas of South Aberdeen, especially for sewer installations closer to the river, the contractor may encounter obstructions in some of the trenches such as logs and wood. Unfortunately there is no precise way of estimating the extent of this type of problem, but such obstructions have been encountered previously in sewer excavations in Aberdeen.

Pipe Bedding

We recommend that sandy gravel be used as full-trench width bedding material under the pipe, between the pipe and the trench walls for at least six (6) inches above the pipe. The thickness of this bedding material should be at least twelve inches beneath the pipe (please see Plates 2 and 3). This sandy gravel should be placed in layers not exceeding six (6) inches loose measure and compacted to at least 95 percent of the maximum dry density for the material as determined by the ASTM Laboratory Test Designation D 1557, Method D.

The sandy gravel should be free from roots, stumps, wood waste, organics, trash or other deleterious materials and conform to the following gradation limits:

U.S. Standard Sieve Size	Percent Finer, by Weight
1½ - inch	100
3/4 - inch	87 - 100
1/2 - inch	70 - 100
1/4 - inch	40 - 85
No. 4	25 - 65
No. 10	5 - 35
No. 40	0 - 5
No. 100	0 - 3
No. 200	0 - 2

If the trench bottom is not smooth and cleaned of disturbed material, additional hand excavation should be required to obtain a clean bottom on undisturbed natural material.

Compacted Granular Trench Backfill

We recommend that the trenches be backfilled above the compacted sandy gravel around the pipe with a clean, inorganic granular material free from roots, stumps, wood waste, organics, trash or other deleterious materials and conform to the following gradation limits:

U.S. Standard Sieve Size	Percent Finer, by Weight
3 - inches	100
1 - inch	75 - 100
½ - inch	55 - 100
No. 4	25 - 95
No. 10	5 - 70
No. 40	0 - 30
No. 100	0 - 5
No. 200	0 - 3

This granular material should be placed in layers not exceeding eight (8) inches loose measure and compacted to at least 95 percent of the ASTM D 1557, Method D, maximum dry density, up to within six (6) inches of the finished pavement grade under streets and roadways (see Plate 3 of this report), to within four (4) inches of finished surface grade in travelled unpaved alleys (see Plate 2 of this report) and to the finished surface grade in unimproved alleys.

Under streets and roadways we recommend placement of a four-inch thick layer of asphalt-treated base course (ATB) directly above the compacted granular trench backfill, using the sandy gravel specified previously as the aggregate for this layer compacted to 95 percent of the maximum dry density as specified above. The final wearing course should consist of a two-inch thick layer of Class B asphaltic concrete pavement (Washington State Highway Department specifications), as shown on Plate 3.

In travelled unpaved alleys, we recommend that the final four (4) inches of the alley trench backfill consist of compacted pea gravel or crushed rock.

Configuration of Backfill Placement

Previous experience in other locations has shown in areas of relatively soft subsoil conditions that placement of deep backfill directly over the last few sections of pipe laid tends to create stresses in the backfill around the pipe parallel to the pipe, causing separation of the pipe joints. Consequently, we recommend that backfill material be placed by equipment working adjacent to the trench and that a slope of at least 1.5:1 (Horizontal : Vertical) be maintained back from the end of the pipe along the trench centerline to the ground surface.

It should be noted that "water settling" is not an approved method for compaction of any of the trench or manhole backfill materials for this project due to the very silty nature of the native subsurface materials.

SLOUGH CROSSINGS

Slough Crossing No. 1

This crossing is located approximately 70 feet west of Columbus Street in the alley south of Curtis Street. We understand that the proposed pipe invert will be about four (4) feet below the existing slough bottom. We also understand that the slough will probably be filled in sometime in the future to about Elevation 11, about 4.5 feet above the present slough bottom.

We estimate that settlement of the pipe due to future filling as indicated above will be in the order of 1.25 to 1.75 inches at the centerline of the slough. As a result, we recommend that the sewer pipe in the area consist of ductile iron from at least 110 feet west of the centerline of the slough to at least 50 feet east of the slough centerline. Bedding and backfill materials and procedures should conform to those indicated previously in this report for sewers in alleys.

Slough Crossing No. 2

This crossing is located at Columbus Street in the alley south of Wood Street. The proposed sewer invert will be about 1.5 feet below the existing slough bottom. Future fill may be placed approximately five (5) feet above the

slough bottom to about Elevation 10.5.

We estimate that filling in the slough as indicated above will induce settlement of the sewer near the present slough centerline on the order of 1.5 to 2.0 inches. As a result we recommend that ductile iron pipe be installed from at least 55 feet west of the slough centerline to at least 50 feet east of the slough centerline. Bedding and backfilling procedures and materials should conform to those recommended earlier in this report for sewers in alleys.

Careful observations should be made during construction in this area to assure that the trench bottom is overexcavated if necessary to extend through soft unconsolidated black silty muck on the slough bottom to the natural underlying clayey silt.

Slough Crossing No. 3

We estimate the settlement of the sewer where it crosses the slough in the alley south of Scott Street and east of Evans Street will be approximately 0.4 inches as a result of placing approximately four (4) feet of fill in the slough some time in the future. In our opinion this estimated settlement is not large enough to warrant special pipe or construction procedures in this area.

Slough Crossing No. 4

This crossing is located just west of Decatur Street in the alley north of Cushing Street. Preliminary plans indicate that the new sewer invert will be about one (1) foot above the bottom of the existing slough.

We estimate that the settlement of the sewer at this location will be on the order of 1.25 to 1.75 inches due to the weight of future fill placed about five (5) feet above the slough bottom. As a result, we recommend that the trench be overexcavated in this area to penetrate the organic muck on the slough bottom and reach the natural underlying clayey silt. Bedding and backfill materials and procedures should conform to the recommendations made previously for sewers in alleys.

In addition, we recommend that ductile iron pipe be used in this area from at least 45 feet west of the slough centerline to at least 65 feet east of the slough centerline. We also recommend that the pipe itself be supported be-

tween the flanges of an H-section or wide-flanged steel beam extending at least 15 feet either side of the slough centerline to minimize potential breakage or joint separation due to potential differential settlements adjacent to the banks of the existing slough.

PROPOSED MANHOLES

We recommend that manholes be bedded directly on six (6) inches of lean concrete placed on smooth, undisturbed natural materials. The sides of excavations for manholes should be kept as closely as possible to within 15 inches of the exterior manhole dimensions.

In order to isolate local infiltration or seepage from disrupted laterals, should that occur, we recommend that dams be created at manholes by backfilling the manhole excavations evenly in layers not exceeding eight (8) inches loose measure with native silty material derived from trench excavations and approved by the Engineer. This material should be conditioned by wetting or drying to or slightly above the optimum water content for compaction and then compacted using hand held equipment to a density of at least 93 percent of the ASTM D 1557 maximum dry density for the material. Due to the anticipated high water contents of the existing native clayey silt as shown on the boring logs, it will probably be necessary for the contractor to dry this material before placing it. This will be especially true if the material has become wet during or after excavation. Sloppy native material expected to be encountered in trench bottoms near existing sewer pipes or native material with debris or excessively high water contents will not be acceptable for this manhole backfill.

The compacted silty backfill should extend to within 2.5 feet of the finished pavement surface. Above this level the materials, placement and compaction should conform to the criteria indicated previously for compacted granular trench backfill in streets and roadways, as shown on Plate 3.

Construction of manhole sections should not extend more than six (6) feet above the level of compacted backfill around manholes unless one-piece, precast manholes are used. This means that for segmented manholes more than six feet high, manhole construction should stop until a portion of the backfill has been placed and compacted. It is important not to exceed the six-foot limit in

order to minimize manhole settlement or tilting. The backfill must at all times be even on opposite sides of the manhole.

Due to a slight decrease in soil stresses under the manholes after construction, manhole settlements are anticipated to be negligible if careful trench excavation, bracing, bottom cleaning and construction techniques are used. Post-construction settlements of adjacent sewers are estimated to be on the order of 0.4 inches or less for sewers up to eight feet deep. For sewers between 9.5 and 12.5 feet deep the post-construction settlements are estimated to be less than 1.0 to 1.2 inches. To minimize breakage due to differential settlements between the sewer lines and manholes, we recommend that the sewer lines be installed and backfilled as much in advance of completion of manhole construction as possible. In addition, we recommend that flexible joints be incorporated at the manhole-sewer connections and that the first sewer joint be no more than 12 inches away from the exterior of the manhole. We also recommend that short sewer pipe sections, not exceeding four (4) feet in length, be provided within 13 feet of each manhole.

PROPOSED PUMP STATION NO. 2 GENERATOR BUILDING

We understand that is is proposed to add a generator unit and pump to existing pump station No. 2. We also understand that this pump station was installed by caisson construction methods and the total dead weight of the existing unit is somewhat less than the uplift force exerted on it due to a 100-year flood stage at Elevation 15.7, approximately 3.7 feet above the existing ground surface grade. Our observations at the pump station showed a gap of approximately 6 to 12 inches between the original ground level adjacent to the station and the existing ground level. We feel that the station may have lifted relative to the ground surface during a major flood which occurred in that area several years ago.

Due to the very soft and highly compressible nature of the loose silty subsoils beneath the existing pump station, we estimate that the additional weight of the generator, pump, piping and enclosure structure if it were built on top of the existing station would cause settlements of several inches. Consequently, we recommend that the proposed generator unit and ancillary facilities be located at least ten feet away from the existing station.

We understand the total weight of such a structure, including the generator, piping and a structural floor about four feet above existing grade to keep above the predicted 100-year floor elevation, is about 128 kips and the plan dimensions of the building are 13 feet by 16 feet.

In order to minimize settlements of the structure, we recommend that the bottom of the lower floor be placed four (4.0) feet below existing grade and that this floor slab be designed as rigidly as possible to distribute the weight of the structure uniformly below the slab.

The lower slab should be founded on eight (8) inches of granular material meeting the gradation limits specified previously for compacted granular trench backfill and compacted to at least 95 percent of the ASTM D 1557, Method D, maximum dry density for the material.

The basement walls should be backfilled with this same granular material placed uniformly around the structure in layers not exceeding six (6) inches loose measure and compacted to the same 95 percent of maximum dry density criteria.

We recommend that the basement walls be designed for a total horizontal water-plus-earth pressure of 200 pounds per square foot (psf) at the ground surface, increasing linearly with depth to a value of 300 psf at the bottom of the basement slab four feet below ground surface.

We anticipate a maximum total settlement of the structure constructed as recommended above in the order of 0.75 to 1.0 inches. As a precaution against unanticipated differential settlements, we suggest that the connections between the proposed generator building and existing pump station be made as flexible as possible.

Provision should be made in the basement floor or walls, such as an adjustable pressure relief valve or flap valve, to allow inflow of water if the adjacent groundwater level rises to within two feet of the ground surface. Such provisions will counteract the uplift forces on the structure should high water or flood levels be experienced in the future. Provisions should also be included to pump water from the basement after groundwater levels have dropped adjacent to the structure.

PROPOSED RELOCATED PUMP STATION NO. 3

We have recommended that due to the very soft and compressible subsoil conditions existing below a depth of about ten feet in the area of Borings 112, 113, 114, and 115 in the southeastern sector of South Aberdeen, maximum pipe invert depths be kept to less than ten feet to avoid potentially serious trench bottom heave problems during construction. Pump station No. 3 will therefore have to be relocated. We understand that this new site will be at the location of Boring 230, as shown on Plate 1 or this report.

Due to the very soft soils in this area, we recommend that caisson construction procedures be used for installation of the proposed station. The station will have an inner diameter of 6.0 feet, 8-inch thick walls, a 12-inch thick bottom slab and will extend to a depth of 15.5 feet below the existing ground surface. The total weight of the structure, including the pump, piping and maximum normal operating fluid level five feet above the bottom slab will be approximately 61.3 kips. We estimate the total settlement of the structure as described above will be negligible.

To minimize differential settlements between the pump station and adjacent sewer lines, we recommend that the sewer lines be constructed as much in advance of the pump station as possible. We also recommend that flexible joints be installed at the pump station-sewer connections and that the first sewer joint be no more than 12 inches away from the exterior of the station. Short sewer sections, not exceeding four (4) feet in length should be provided within 13 feet of the pump station.

CONSTRUCTION CONTROL

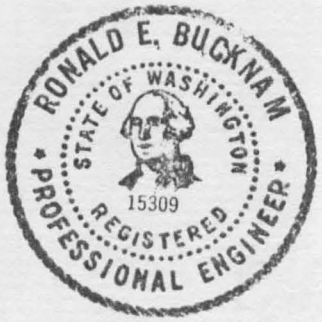
In spite of the design recommendations and specifications compiled for this type of project, the success of the final installation is a function of the construction sequencing and procedures used by the contractor. This in turn is directly related to the contractor's experience and the care with which he conducts the work.

As a consequence, we recommend that samples of all of the materials planned for use be submitted to the Engineer prior to the beginning of construction.

We would be pleased to be involved in any aspect of the construction observation program where we may offer suggestions and be of assistance in achieving the objectives set forth in the plans and specifications.

Respectfully submitted,

ROGER LOWE ASSOCIATES



Ronald E. Bucknam

Ronald E. Bucknam, Associate

Roger A. Lowe

Roger A. Lowe, Principal

REB/RAL/ls
Attachments
25 copies submitted

OBSERVATION WELL READINGS

BORING NUMBER	DATE: 2/12/77 DEPTH (FT.)	3/2/77 DEPTH (FT.)	3/3/77 DEPTH (FT.)	3/17/77 DEPTH (FT.)	3/30/77 DEPTH (FT.)
112	1.0	0.7	0.7	0.7	0.7
120	1.7	1.7	1.7	1.8	2.0
124	7.6	5.8	5.7	6.1	6.5
127	2.2	2.3	2.3	---	---
132	2.5	2.8	2.8	2.9	2.7
134	2.7	2.2	2.2	2.4	2.5
136	6.0	4.8	4.7	4.7	4.8
230	---	---	---	---	1.7

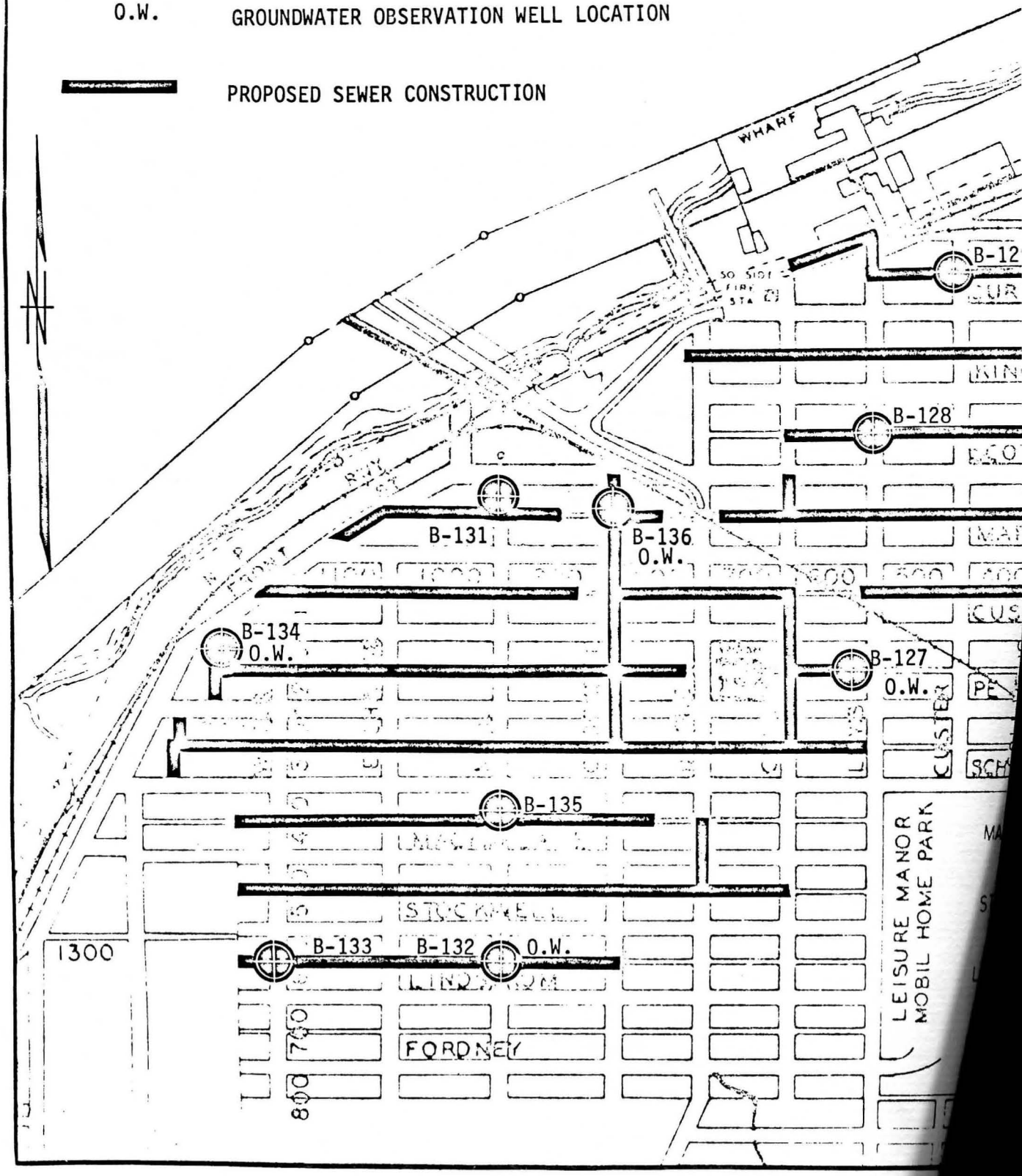
SOUTH ABERDEEN SEWER REPLACEMENT PROJECT

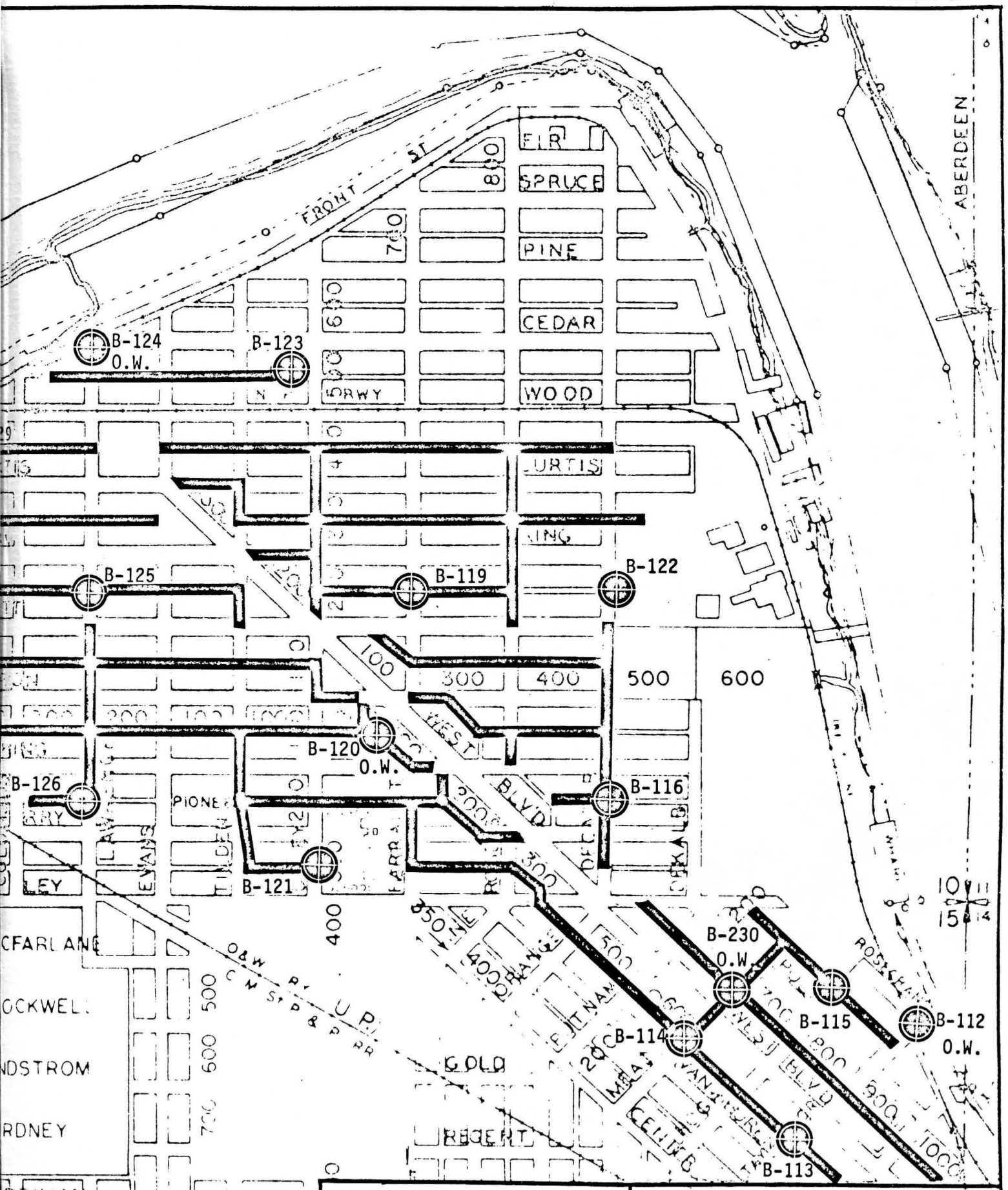
LEGEND

B-112 BORING LOCATION AND NUMBER

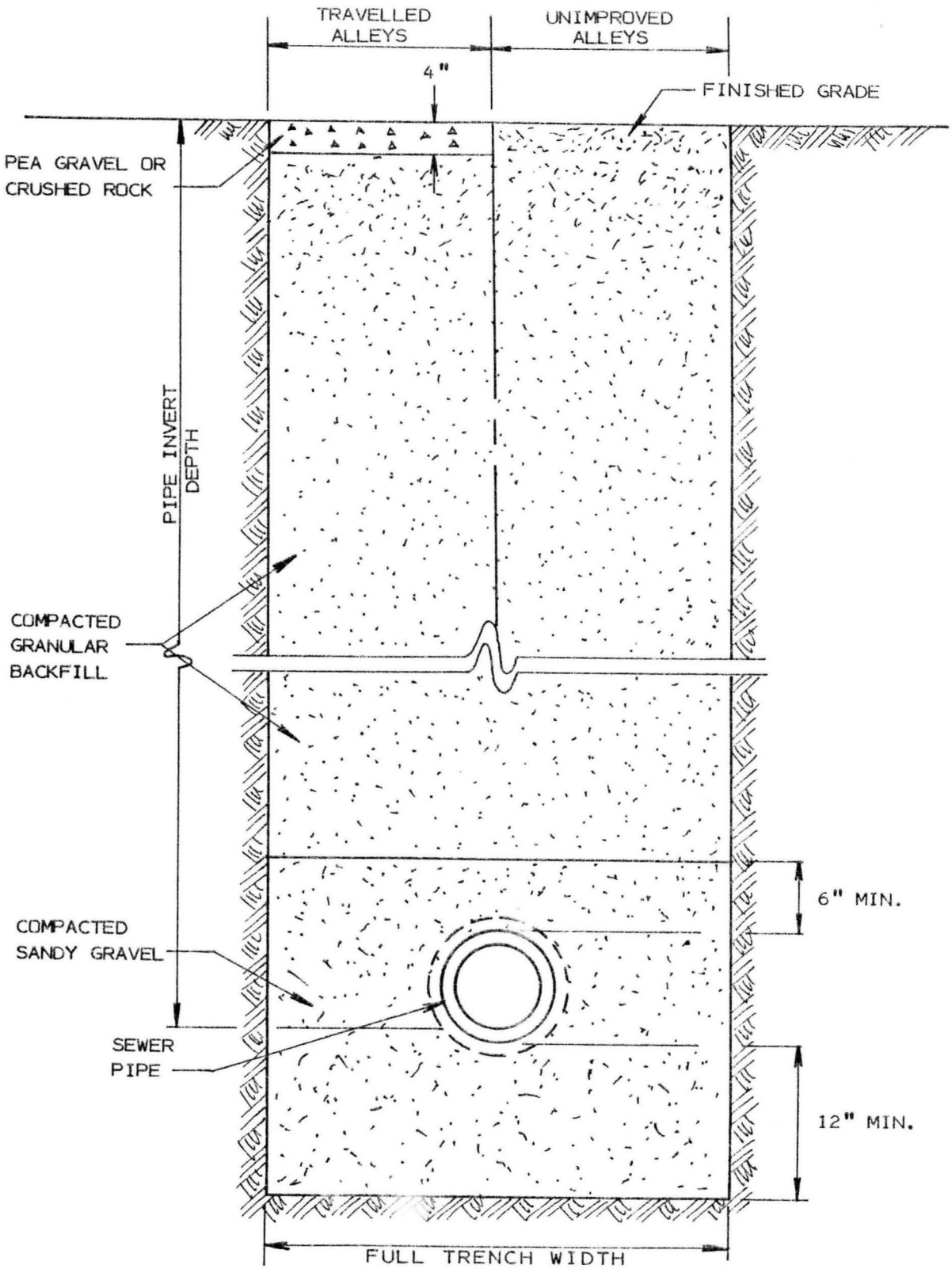
O.W. GROUNDWATER OBSERVATION WELL LOCATION

PROPOSED SEWER CONSTRUCTION





ROGER LOWE ASSOCIATES | SUBSURFACE EXPLORATION PLAN



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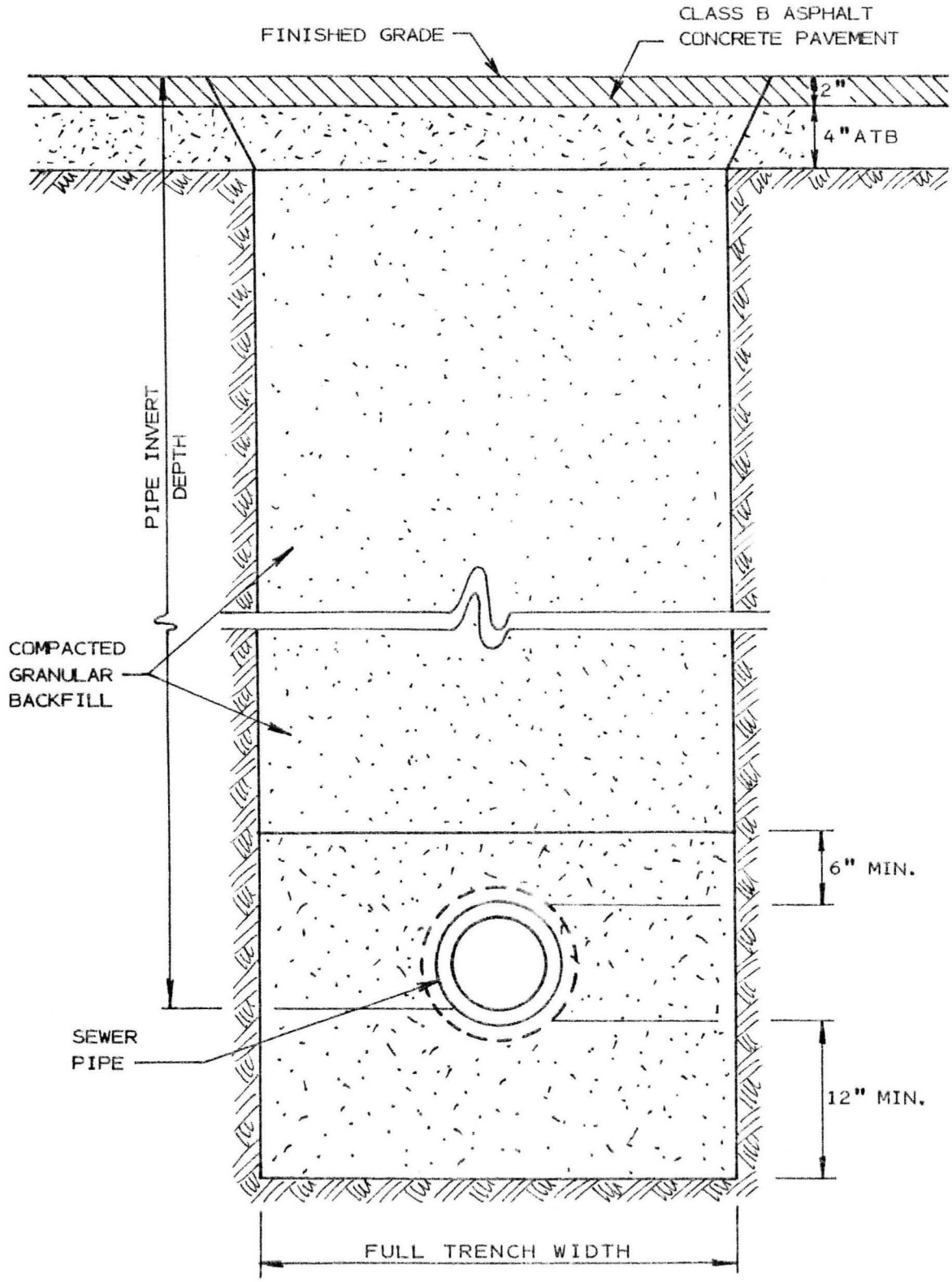
ROGER LOWE ASSOCIATES	RECOMMENDED SECTION IN UNPAVED ALLEYS



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ROGER LOWE ASSOCIATES	RECOMMENDED SECTION UNDER STREETS AND ROADWAYS

APPENDIX A

FIELD EXPLORATIONS AND LABORATORY TESTING
SOUTH ABERDEEN SEWER REPLACEMENT PROJECT

FIELD EXPLORATIONS

The subsurface conditions in South Aberdeen were explored by drilling 24 borings at the locations shown on the Subsurface Exploration Plan. Twenty-three borings were drilled with a truck-mounted continuous flight hollow-stem auger and ranged in depth from 11.5 to 20.5 feet. One boring was drilled using rotary wash methods and extended to a depth of 44.0 feet.

The boring locations were selected and continuously monitored by our representative, who examined and classified the materials recovered, evaluated drilling progress and other drill behavior indicating variations in soil conditions, selected intervals for obtaining representative soil samples, and kept a log of the exploration. The soils were classified in accordance with the Unified System which is described on Plate A-1. The field logs, modified to reflect the results of laboratory examination and testing of samples, are presented on Plates A-2 through A-26.

Relatively undisturbed soil samples were obtained using either a 3-inch outside diameter thin wall "Shelby" sampler, or our 2½-inch inside diameter heavy duty sampler. The heavy duty sampler consists of a heavy steel barrel which holds thin-walled brass rings. The barrel is split and can be disassembled for removal of the sample. In the borings, the samplers were pushed or driven using a 140-pound hammer with a 30-inch fall. The number of blows required to drive the sampler one foot is indicated on the exploration log adjacent to the sample notation.

All samples were sealed to prevent moisture loss, labeled, and returned to our laboratory for testing.

Groundwater observation wells were installed to depths of 10, 12 and 15 feet in eight of the borings. The elevation of the groundwater table at each of these observation wells was monitored by soundings at certain times during a six-week period. The results of these observations are shown on Table 1 of this report.

LABORATORY TESTING

The samples were examined in our laboratory and selected samples tested to determine the field moisture and density, grain size distribution, strength and consolidation characteristics.

The moisture and density data are presented adjacent to the sample notations on the exploration logs.

Strain controlled direct shear tests were performed on fully submerged and consolidated samples. The direct shear test results are presented on Plate A-27.

Consolidation characteristics were evaluated by performing six standard one-dimensional stress-controlled consolidometer tests. These results are shown on Plates A-37 through A-43.

Grain size distribution was determined by mechanical and hydrometer methods and the results are presented on Plates A-31 through A-36.

Shear characteristics under undrained conditions were determined with triaxial testing and the results tabulated on Plates A-28 through A-30.

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			LETTER SYMBOL	DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-SILT MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS, AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS INDICATE BORDERLINE SOIL CLASSIFICATION

KEY TO SAMPLE DATA

25.2 | 91.7 | 35

- 35 → BLOWS REQUIRED TO DRIVE SAMPLER 12 INCHES WITH 140 LB. HAMMER: MAXIMUM STROKE 30 INCHES. (P INDICATES PUSHED)
- 91.7 → DRY DENSITY, (PCF)
- 25.2 → MOISTURE CONTENT, (% OF DRY DENSITY)
- → DEPTH OR ELEVATION (FEET)

SAMPLE RECOVERY

- UNDISTURBED
- DISTURBED
- NO RECOVERY

SAMPLER TYPE

- * HD - 3 INCH SPLIT TUBE SAMPLER
- TW - 3 INCH THIN WALL SAMPLER
- SPT - 2 INCH SPLIT TUBE SAMPLER
- C - ROCK CORE
- B - BULK DISTURBED SAMPLE

GRAPHIC LOG

- SM — LETTER SYMBOL FOR SOIL TYPE
- DISTINCT CONTACT BETWEEN SOIL STRATA
- GRADUAL CHANGE BETWEEN SOIL STRATA
- BOTTOM OF BORING

ROGER LOWE ASSOCIATES

UNIFIED SOIL CLASSIFICATION SYSTEM AND KEY TO SAMPLE DATA

BORING 112

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				ML	DARK GRAY SILT WITH A TRACE OF ORGANICS AND SAND (SOFT, WET)
	74.4	50.6	4		
5	63.8	52.0	2		VERY SOFT
	92.1	48.4	3		
10			PUSH		
	74.3	54.5	4		
15					
20					

BORING TERMINATED AT 15.5 FEET
ON 2/4/77

OBSERVATION WELL INSTALLED AT 10.0 FEET,
SEE TEXT FOR WATER LEVEL READINGS.

BORING 113

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				SP	BROWN GRAVELLY FINE SAND (LOOSE, MOIST)
	118.1		2		
				ML	DARK GRAY SILT WITH A TRACE OF ORGANICS (VERY SOFT, MOIST)
			2		
5					
	112.2	39.0	1		WET
10					
	110.5		PUSH		
			4		SOFT
15					
	80.7	51.9	4		
20					

BORING TERMINATED AT 17.5 FEET
ON 2/8/77

BORING 114

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				GP	BROWN GRAVEL WITH SOME SILT (LOOSE, MOIST)
				SM	BROWN SILTY SAND WITH SOME GRAVEL
	26.2		10		(LOOSE, MOIST)
				ML	
5					GRAY CLAYEY SILT WITH SOME ORGANICS
			2		(VERY SOFT, WET)
	165.3	27.8	1		NO ORGANICS
10					
			2		
	82.8	50.4	1		
15					

BORING TERMINATED AT 15 FEET
ON 2/11/77

BORING 115

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				SM	DARK GRAY SANDY SILT WITH SOME GRAVEL (LOOSE, MOIST)
	66.6		10	ML	GRAY CLAYEY SILT WITH A TRACE OF SAND AND ORGANICS (MEDIUM STIFF, MOIST)
5	101.1	43.8	4		SOFT, WET
	112.9	45.0	5		
10	70.6	52.2	3		
15					

BORING TERMINATED AT 12.5 FEET
ON 2/4/77

BORING 116

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				GM	BROWN SILTY GRAVEL (LOOSE, MOIST)
			15	ML	GRAY CLAYEY SILT WITH TRACE OF SAND (STIFF, MOIST)
	27.3		2		VERY SOFT, WET
5					SOFT
	72.8	56.4	4		
10			4		
	52.5	67.4	3		
15					
	86.3	47.3	4		
20					

BORING TERMINATED AT 17.5 FEET
ON 2/4/77

BORING 119

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				ML	
	92.0	43.1	2		LIGHT BROWN CLAYEY SILT WITH A TRACE OF SAND (VERY SOFT, MOIST)
			6		
5					
	64.0	61.0	4	ML	GRAY CLAYEY SILT (SOFT, WET)
	81.9	49.3	2		
10					
	27.9	62.7	3		
15			PUSH		
			3		
20					

BORING TERMINATED AT 17.5 FEET
ON 2/9/77

BORING 120

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0			11	ML	BROWN SILT WITH SOME GRAVEL AND SAND (MEDIUM STIFF, MOIST)
5			3	ML	DARK BROWN CLAYEY SILT WITH SOME ORGANICS (SOFT, WET)
	14.8		5		
10	150.4	32.7	2		VERY SOFT
15			PUSH		
20					

BORING TERMINATED AT 16.2 FEET
ON 2/9/77

OBSERVATION WELL INSTALLED AT 10.0 FEET,
SEE TEXT FOR WATER LEVEL READINGS.

BORING 121

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0	56.3	59.2	6	ML	LIGHT BROWN SILT WITH TRACE OF ORGANICS AND SAND (MEDIUM STIFF, MOIST)
5	56.4	61.6	6	OL	GRAY CLAYEY SILT WITH SOME LENSES OF ORGANICS (MEDIUM STIFF, WET)
	120.7	39.5	5		
10	86.4	48.7	6	ML	GRAY SILT WITH A TRACE OF ORGANICS AND FINE SAND (MEDIUM STIFF, WET)
15	82.8	51.0	PUSH		
20					

BORING TERMINATED AT 16.2 FEET
ON 2/8/77

BORING 122

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				SP	BROWN GRAVELLY SAND (LOOSE MOIST) (DIRT ROADWAY)
	65.4	54.5	15	ML	LIGHT BROWN SILT (STIFF, MOIST)
5	50.9	63.9	4		SOFT
	103.2	39.8	3	OL	DARK GRAY SILT WITH SOME ORGANICS (VERY SOFT, WET)
10			3		
				ML	DARK GRAY SILT WITH A TRACE OF ORGANICS (VERY SOFT, WET)
15			3		
			3		
20					

BORING TERMINATED AT 18.5 FEET
ON 2/8/77

BORING 123

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				SP	
	15.7		9		BROWN FINE SAND WITH TRACE OF GRAVEL (LOOSE, MOIST)
5	38.3	74.0	5	ML	GRAY SILT WITH A TRACE OF FINE SAND AND ORGANICS (SOFT, WET)
	67.8	55.0	2		
10	60.3	62.8	3		VERY SOFT
	72.8	56.5	2		
15	75.9	54.6	3		
20					

BORING TERMINATED AT 17.5 FEET
ON 2/9/77

BORING 124

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				ML	LIGHT BROWN SANDY SILT (LOOSE, MOIST)
	19.3	94.7	15	SP	LIGHT BROWN GRADING TO GRAY FINE SAND WITH A TRACE OF SILT (LOOSE, MOIST)
5	81.8	55.7	18	ML	GRAY CLAYEY SILT WITH A TRACE OF ORGANICS (SOFT, WET)
			4		
10	87.4	49.7	3		
15	66.7	56.0	3		
	54.8	62.7	4		
20					

BORING TERMINATED AT 18.5 FEET
ON 2/10/77

OBSERVATION WELL INSTALLED AT 15.0 FEET,
SEE TEXT FOR WATER LEVEL READINGS.

BORING 125

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				ML	LIGHT BROWN SILT WITH SOME FINE GRAVEL AND SAND (MEDIUM STIFF, MOIST)
	96.9	43.2	5		
5	59.1	77.6	6		GRAY WITHOUT SAND AND GRAVEL, TRACE OF ORGANICS
	62.5	58.8	4		SOFT
10	68.3	56.3	3		
15	88.0	48.4	4		TRACE OF SAND
	70.0	56.5	4		
20					

BORING TERMINATED AT 18.0 FEET
ON 2/9/77

BORING 126

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				GP	BROWN SANDY GRAVEL (MEDIUM DENSE, MOIST) (ROADWAY FILL)
	49.1		21	ML	
5			2		GRAY SILT WITH A TRACE OF ORGANICS (VERY SOFT, WET)
	173.7	32.6	3		
10			3		
15	91.5	47.4	6		

BORING TERMINATED AT 15.0 FEET
ON 2/9/77

BORING 127

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				SW	SILTY SAND WITH A TRACE OF GRAVEL (MEDIUM DENSE, MOIST) (DIRT ROADWAY)
	39.6	60.3	6	OL	DARK BROWN ORGANIC SILT (SOFT, WET)
	48.2	69.6	4		
5				ML	GRAY SILT (SOFT, WET)
	97.6	45.5	3		
10	90.6	49.2	4		
	73.3	54.1	6		
15					TRACE OF FINE SAND (MEDIUM STIFF)
	74.4	55.6	8	SP	GRAY SILTY FINE SAND (LOOSE, WET)
20					

BORING TERMINATED AT 17.5 FEET
ON 2/9/77

OBSERVATION WELL INSTALLED AT 10.0 FEET,
SEE TEXT FOR WATER LEVEL READINGS.

BORING 128

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				ML	LIGHT BROWN SILT WITH SOME SAND AND A TRACE OF GRAVEL (SOFT, MOIST) (TOPSOIL)
			7	ML	
					GRAY CLAYEY SILT WITH A TRACE OF ORGANICS (SOFT, MOIST)
5	116.5	40.6	3		
					VERY SOFT
	105.2	42.2	2		
10					SOME WOOD FRAGMENTS (SOFT)
	86.7	50.0	4		
	84.5	55.1	7		MEDIUM STIFF
15					

BORING TERMINATED AT 15.0 FEET
ON 2/9/77

BORING 129

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0					
	8.9		12	SM	GRAY SILTY GRAVELLY SAND (MEDIUM DENSE, MOIST)
				ML	GRAY CLAYEY SILT WITH A TRACE OF ORGANICS AND SAND (SOFT, WET)
5	94.3		3		
	91.6	45.7	2		VERY SOFT
10					
	82.5	49.9	2		SOFT
15					

BORING TERMINATED AT 12.0 FEET
ON 2/10/77

BORING 131

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				GP	BROWN SILTY GRAVEL (LOOSE, MOIST)
			38	SP	BROWN SAND WITH SOME SILT (MEDIUM DENSE, MOIST) (FILL)
5	14.0		9		BECOMES GRAY WITH SOME GRAVEL
			6	ML	GRAY SANDY SILT WITH A TRACE OF ORGANICS (MEDIUM STIFF, WET) (FILL)
10	17.8	96.7	10	SP	BROWN SAND WITH SOME SILT AND A TRACE OF GRAVEL (LOOSE, WET) (FILL)
					AUGER REFUSAL AT 12 FEET
15					BORING TERMINATED AT 12.0 FEET ON 2/10/77

BORING 131 A

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				GP	BROWN GRAVEL WITH SOME SAND (MEDIUM DENSE, MOIST) (ROAD SUBGRADE)
	17.5		42	SP	GRAY SAND WITH SOME GRAVEL (MEDIUM DENSE, MOIST)
5	21.9		17	ML	GRAY CLAYEY SILT WITH SOME SAND (VERY SOFT, MOIST)
	92.6	56.5	2		WET
10	91.5		6		MEDIUM STIFF
15			5		
	60.8	63.6	6		
20					

BORING TERMINATED AT 18.5 FEET
ON 2/11/77

BORING 132

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				SM	BROWN GRAVELLY SAND (LOOSE, MOIST)
	72.7	50.0	5	ML	BROWN SILT WITH A TRACE OF SAND AND ORGANICS (MEDIUM STIFF, MOIST)
5	66.8	60.3	4		SOFT
	86.6	48.5	2		VERY SOFT, WET
10	96.8	53.7	2		
15	47.7	70.4	5		MEDIUM STIFF
20					

BORING TERMINATED AT 15.5 FEET
ON 2/10/77

OBSERVATION WELL INSTALLED AT 10.0 FEET,
SEE TEXT FOR WATER LEVEL READINGS.

BORING 133

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				GP	BROWN SANDY COARSE GRAVEL (MEDIUM DENSE, MOIST)
	69.9	49.6	5	ML	GRAY CLAYEY SILT (MEDIUM STIFF, MOIST)
5	80.6	50.7	3		SOFT
	93.3	46.9	1/18"		VERY SOFT
10	64.9	57.9	5		MEDIUM STIFF
15					

BORING TERMINATED AT 11.5 FEET
ON 2/10/77

BORING 134

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				SM	BROWN SILTY SAND WITH SOME GRAVEL (VERY LOOSE, MOIST)
	19.6		6		
				SP	GRAY SAND WITH SOME SILT AND TRACE OF GRAVEL (VERY LOOSE, MOIST)
5	101.3	43.5	2	ML	GRAY CLAYEY SILT WITH ORGANICS (VERY SOFT, WET)
	106.5	42.0	1		
10	237.2	26.9	2		
	82.2	50.6	3		SOFT
15					

BORING TERMINATED AT 15.0 FEET
ON 2/10/77

OBSERVATION WELL INSTALLED AT 10.0 FEET,
SEE TEXT FOR WATER LEVEL READINGS.

BORING 135

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				GP	GRAY SANDY GRAVEL (LOOSE, MOIST)
	25.5		5	SP	BROWN FINE SAND WITH SOME SILT AND A TRACE OF GRAVEL (VERY LOOSE, MOIST)
5	67.6	55.0	2	ML	GRAY SILT WITH SOME SAND (SOFT, MOIST)
	83.3	47.9	3		
10	86.1	45.8	3		SOME ORGANICS, WET
15	67.8	58.8	PUSH		
	74.9	54.7	3		
20					

BORING TERMINATED AT 18.5 FEET
ON 2/10/77

BORING 136

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				SP	BROWN SILTY FINE SAND (LOOSE, MOIST)
	124.1	42.7	4	ML	BROWN SILT WITH A TRACE OF SAND (SOFT, MOIST)
5	47.5	64.9	5		DARK GRAY (MEDIUM STIFF, WET)
	98.8	43.1	2		VERY SOFT
10	72.3	53.7	2		
15	71.7	56.1	PUSH		
	59.3	63.7	5		MEDIUM STIFF
20					

BORING TERMINATED AT 18.5 FEET
ON 2/10/77

OBSERVATION WELL INSTALLED AT 15.0 FEET,
SEE TEXT FOR WATER LEVEL READINGS.

BORING 230

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				ML	LIGHT BROWN SANDY SILT (SOFT, MOIST)
				SM	BROWN SILTY SAND WITH SOME ORGANICS (MEDIUM DENSE, WET)
5			6	ML	GREEN-GRAY SANDY SILT WITH SOME ORGANICS (SOFT, WET)
10			2		SOME SAND AND A TRACE OF ORGANICS
15	53.0		4		SANDY, VERY SOFT
	63.9	60.5	PUSH		
20					
	58.6	65.4	PUSH		
25					
	85.8	49.7	5		TRACE OF SAND AND ORGANICS
30					
	72.9	56.0	5		SOME SAND - NO ORGANICS
35					
			19	SM	GRAY SILTY FINE SAND (MEDIUM DENSE, WET)
40					

BORING 230 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
40				SM	
			21		
45					

BORING TERMINATED AT 44.0 FEET

ON 3/15/77

OBSERVATION WELL INSTALLED AT 12.0 FEET,
SEE TEXT FOR WATER LEVEL READINGS.

ROGER LOWE ASSOCIATES

DIRECT SHEAR TEST RESULTS

EXPLORATION NUMBER	SAMPLE DEPTH (FT)	MOISTURE CONTENT %	DRY DENSITY (LBS/FT2)	CONFINING PRESSURE (LBS/FT2)	SHEAR RATE* (IN./MIN.)	INDICATED STRENGTH (LBS/FT2)	
						YIELD	PEAK
112	11.0	---	---	589		239	354
113	1.0	118.1	---	208		182	325
113	10.0	110.5	---	832		115	191
114	7.5	165.3	27.8	485		134	191
115	11.0	70.6	52.5	1178		230	268
116	10.0	---	---	69		100	144
119	7.0	81.9	49.3	416		163	239
119	10.0	27.9	62.7	624		153	215
120	4.5	---	---	693		172	306
122	8.0	103.2	39.8	485		190	190
126	13.5	91.5	47.4	1385		77	124
127	4.0	48.2	69.6	416		182	239
127	16.0	74.4	55.6	1247		239	651
128	4.5	116.5	40.6	346		277	316
129	10.5	82.5	49.9	693		287	469
131	10.0	17.8	96.7	1004		813	957
131 A	11.0	91.5	---	900		421	718
135	8.0	83.3	47.9	312		249	344

KEY: * ALL TESTS ARE RUN ON SATURATED SAMPLES AT A STRAIN RATE OF 0.05 INCHES PER MINUTE UNLESS NOTED OTHERWISE.

ROGER LOWE ASSOCIATES

TRIAXIAL SHEAR TEST RESULTS

EXPLORATION NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (FT)	MOISTURE CONTENT (%)	DRY DENSITY (LBS/FT^2)	CONFINING PRESSURE (PSI)	FAILURE STRAIN (%)	* SHEAR STRENGTH (LBS/FT^2)
112	3	8.0	92.1	48.4	0	8.2	131
112	4	11.0	---	---	0	3.0	110
113	4	11.0	110.5	---	20	14.8	92
113	4	12.0	110.5	---	0	9.8	136
113	5	13.0	---	---	0	15.6	94
113	6	16.0	80.7	51.9	15	15.0	86
114	3	7.5	165.3	27.8	25	16.5	47
114	5	13.5	82.8	50.4	15	11.1	39
115	1	2.0	66.6	---	10	17.1	619
115	3	8.0	112.9	45.0	20	15.0	224
115	4	11.0	70.6	52.2	25	13.0	144
116	3	7.0	72.8	56.4	30	11.2	291
119	4	7.0	81.9	49.3	20	16.2	126
119	5	10.0	27.9	62.7	30	19.2	185
120	4	10.5	150.4	32.7	15	21.2	82
121	1	1.5	56.3	59.2	5	6.2	90
121	3	7.5	120.7	39.5	10	20.0	168
121	4	10.5	86.4	48.7	10	21.2	90
121	5	13.5	82.8	51.0	15	18.0	173
122	R	11.0	---	---	5.5	12.1	184
123	3	7.0	67.8	55.0	15	14.3	41
123	4	10.0	60.3	62.8	5	20.5	123
123	5	13.0	72.8	56.5	5	14.3	11
123	6	16.0	75.9	54.6	15	16.0	32

ROGER LOWE ASSOCIATES

TRIAXIAL SHEAR TEST RESULTS

EXPLORATION NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (FT)	MOISTURE CONTENT (%)	DRY DENSITY (LBS/FT^2)	CONFINING PRESSURE (PSI)	FAILURE STRAIN (%)	* SHEAR STRENGTH (LBS/FT^2)
124	2	5.0	81.8	55.7	5.9	20.0	305
124	6	17.0	54.8	62.7	8	8.1	414
125	1	2.0	96.9	43.2	5	9.0	252
125	2	5.0	59.1	77.6	10	20.0	420
125	3	8.0	62.5	58.8	15	11.5	359
125	4	11.0	68.3	56.3	20	12.5	269
125	6	17.0	70.0	56.5	20	10.5	263
127	1	1.0	39.6	60.3	2	20.0	282
127	2	4.0	48.2	69.6	4	20.0	270
127	3	7.0	97.6	45.5	5	5.9	245
127	4	10.0	90.6	49.2	7	19.8	159
127	5	13.0	73.3	54.1	8	19.8	82
127	6	16.0	74.4	55.6	9	20.0	122
128	2	4.5	116.5	40.6	4	20.0	153
128	3	7.5	105.2	42.2	6	15.5	114
128	4	10.5	86.7	50.0	8	21.1	33
128	5	13.5	84.5	55.1	10	18.6	55
129	4	10.5	82.5	49.9	10	8.8	267
131 A	3	8.0	92.6	56.5	5	8.8	493
131 A	4	11.0	91.5	---	10	8.8	648
132	3	8.0	86.6	48.5	5	13.3	83
132	4	11.0	96.8	53.7	10	20.0	83
132	5	14.0	47.7	70.4	8	15.8	488
133	1	1.0	69.9	49.6	4	10.6	458

ROGER LOWE ASSOCIATES

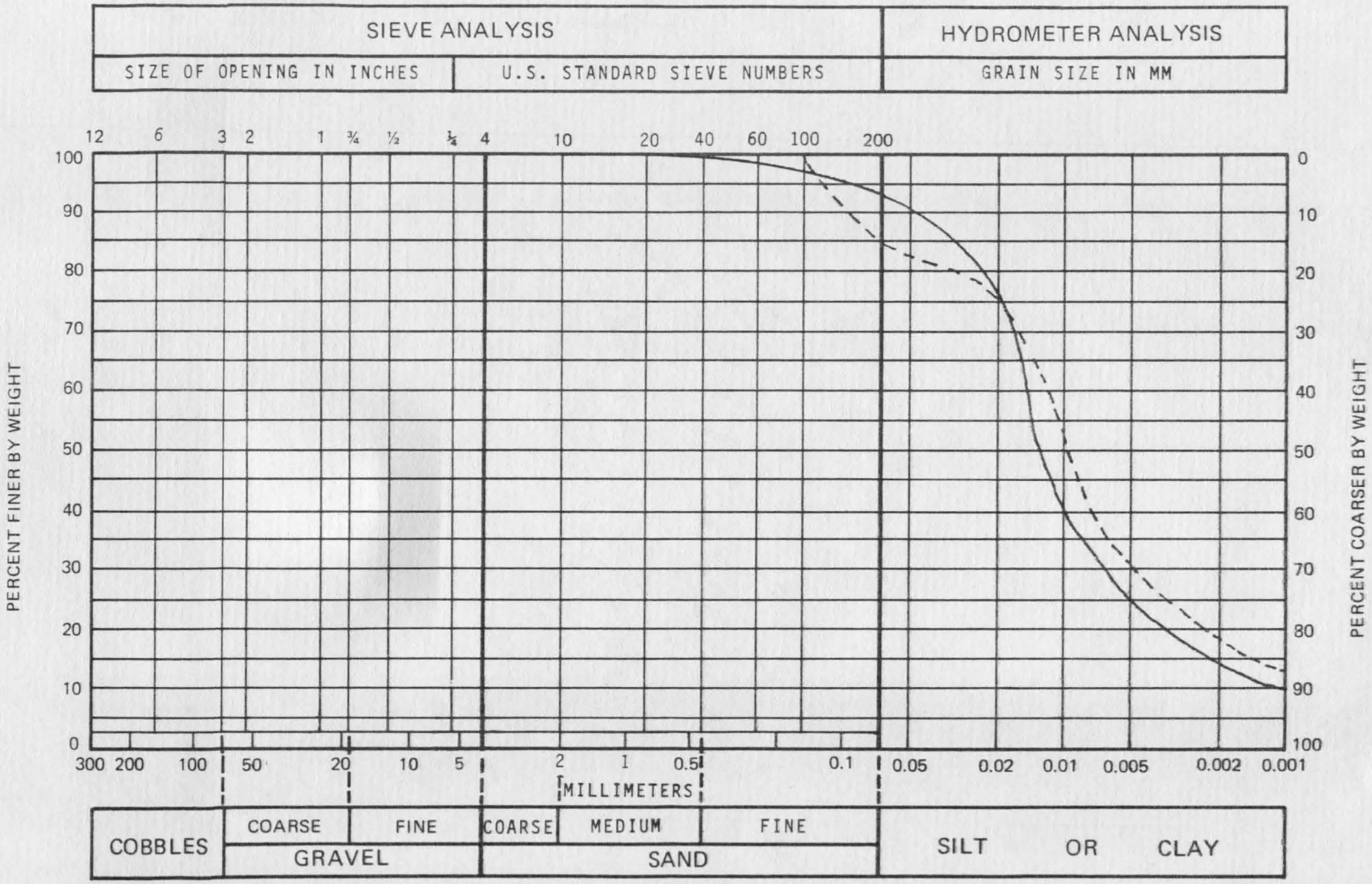
TRIAXIAL SHEAR TEST RESULTS

EXPLORATION NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (FT)	MOISTURE CONTENT (%)	DRY DENSITY (LBS/FT^2)	CONFINING PRESSURE (PSI)	FAILURE STRAIN (%)	* SHEAR STRENGTH (LBS/FT^2)
133	2	4.0	80.6	50.7	6	11.2	245
133	3	7.0	93.3	46.9	8	14.0	183
134	2	4.5	101.3	43.5	4	15.9	247
134	3	7.5	106.5	42.0	5	14.6	227
134	4	10.5	237.2	26.9	6	11.6	424
134	5	13.5	82.2	50.6	8	14.9	189
135	3	8.0	83.3	47.9	15	16.7	355
135	4	11.0	86.1	45.8	10	18.0	232
135	5	14.0	67.8	58.8	5	12.0	433
135	6	17.0	74.9	54.7	5	19.8	133
136	1	2.0	124.1	42.7	5	17.0	371
136	2	5.0	47.5	64.9	10	14.7	240
136	3	8.0	98.8	43.1	5	14.0	245
136	4	11.0	72.3	53.7	10	15.6	154
136	6	17.0	59.3	63.7	15	22.5	249
230	4	17.5	63.9	60.5	5	11.6	447
230	5	22.5	58.6	65.4	6	10.0	326
230	6	27.5	85.8	49.7	8	12.5	293
230	7	32.5	72.9	56.0	10	11.0	208

*ALL RESULTS FROM UNCONSOLIDATED UNDRAINED (UU OR Q) TESTS.

ROGER LOWE ASSOCIATES

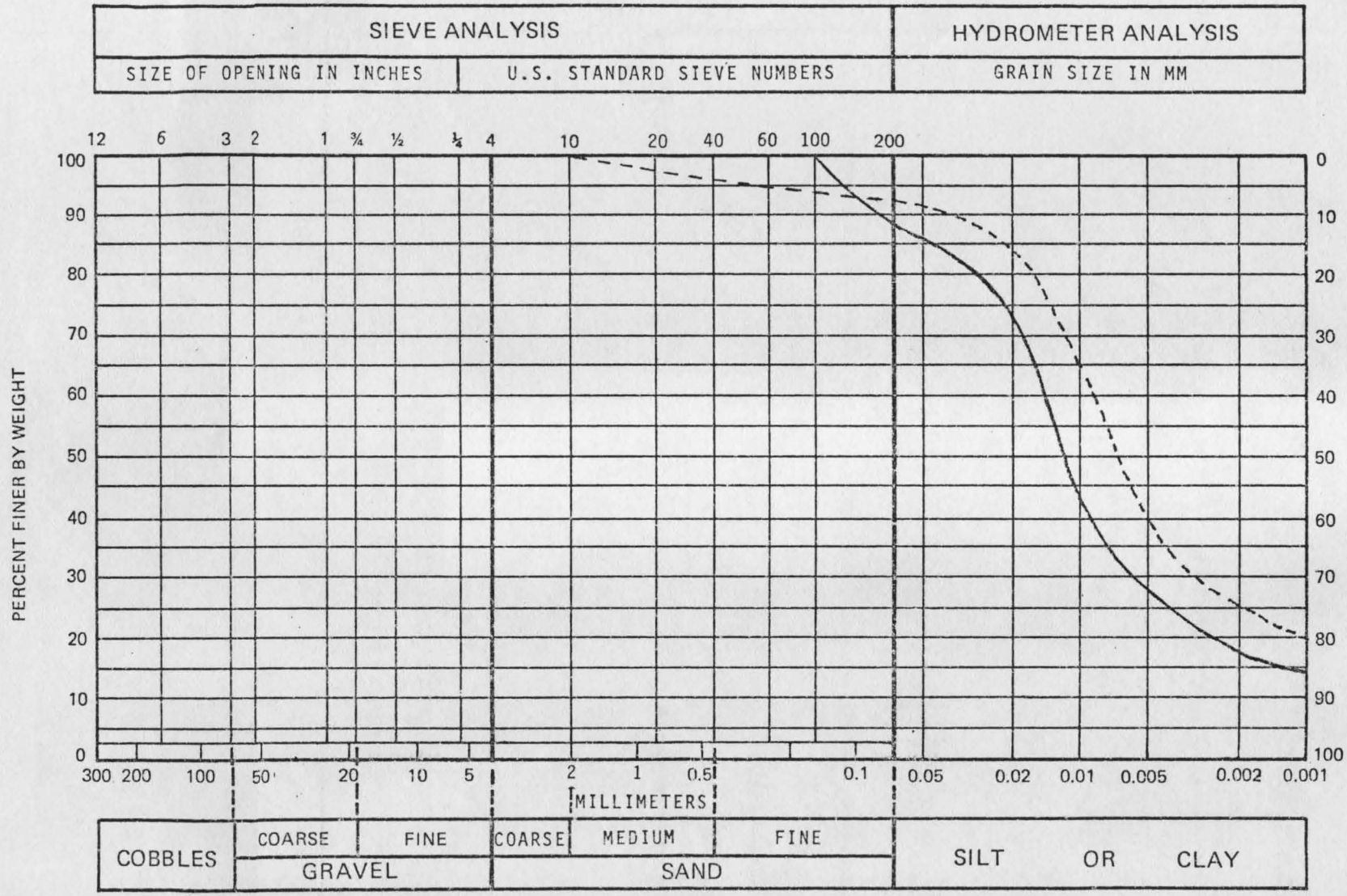
GRADATION ANALYSIS RESULTS



KEY	BORING	DEPTH	SOIL CLASSIFICATION	LL	PL	PI
———	131 A	12.0	M L			
- - - - - - -	135	8.0	M L			

ROGER LOWE ASSOCIATES

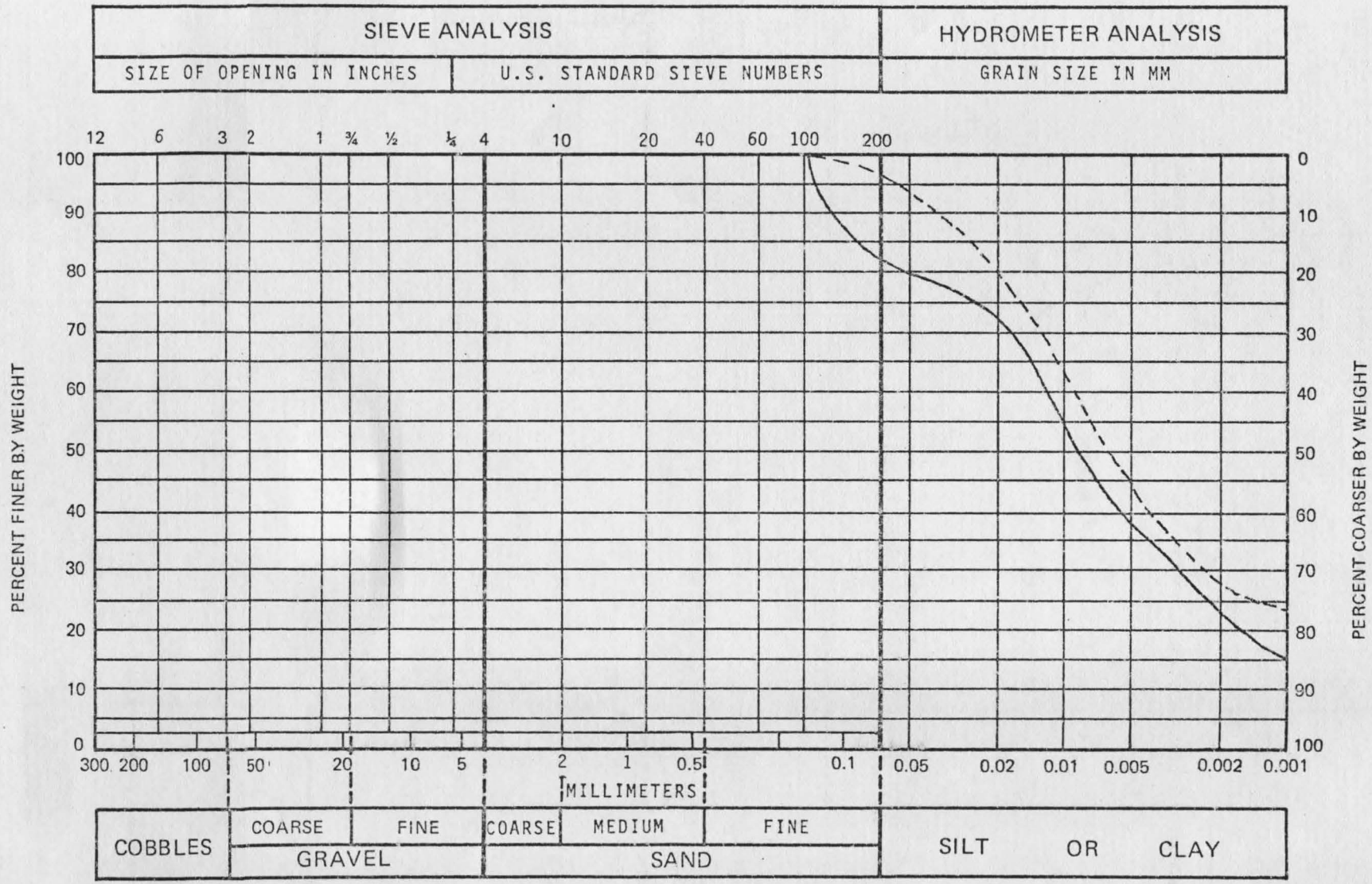
GRADATION ANALYSIS RESULTS



KEY	BORING	DEPTH	SOIL CLASSIFICATION	LL	PL	PI
———	129	7.5	M L			
- - - - -	125	12.0	M L			

ROGER LOWE ASSOCIATES

GRADATION ANALYSIS RESULTS



KEY	BORING	DEPTH	SOIL CLASSIFICATION	LL	PL	PI
———	116	7.5	M L			
- - - - - -	119	6.0	M L			

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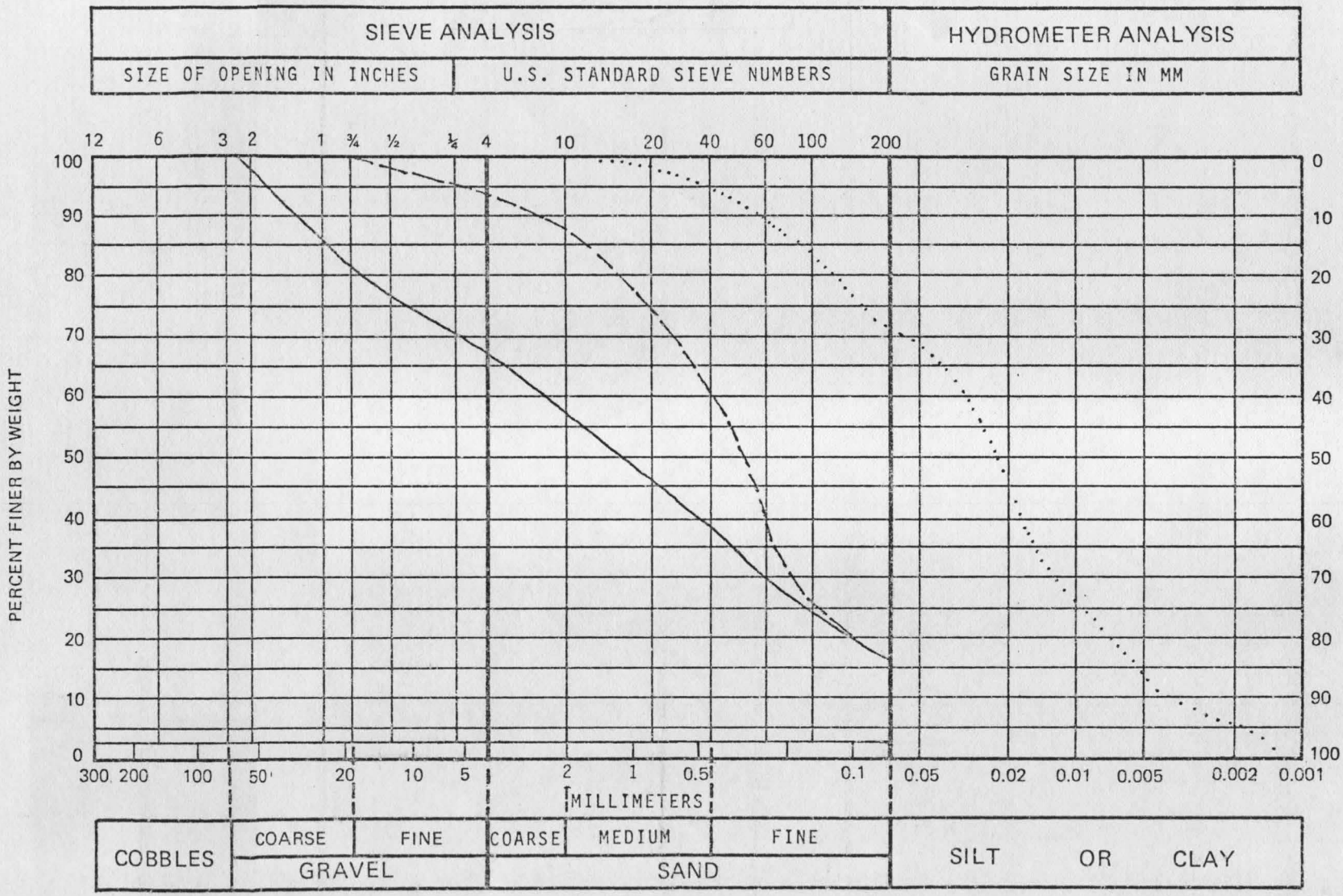
GRADATION ANALYSIS RESULTS



KEY	BORING	DEPTH	SOIL CLASSIFICATION	LL	PL	PI
———	114	1.5	S W			
- - - - -	123	1.0	S P			
.....	121	1.0	M L			

South Aberdeen Sewer Replacement Project

Plate A-34

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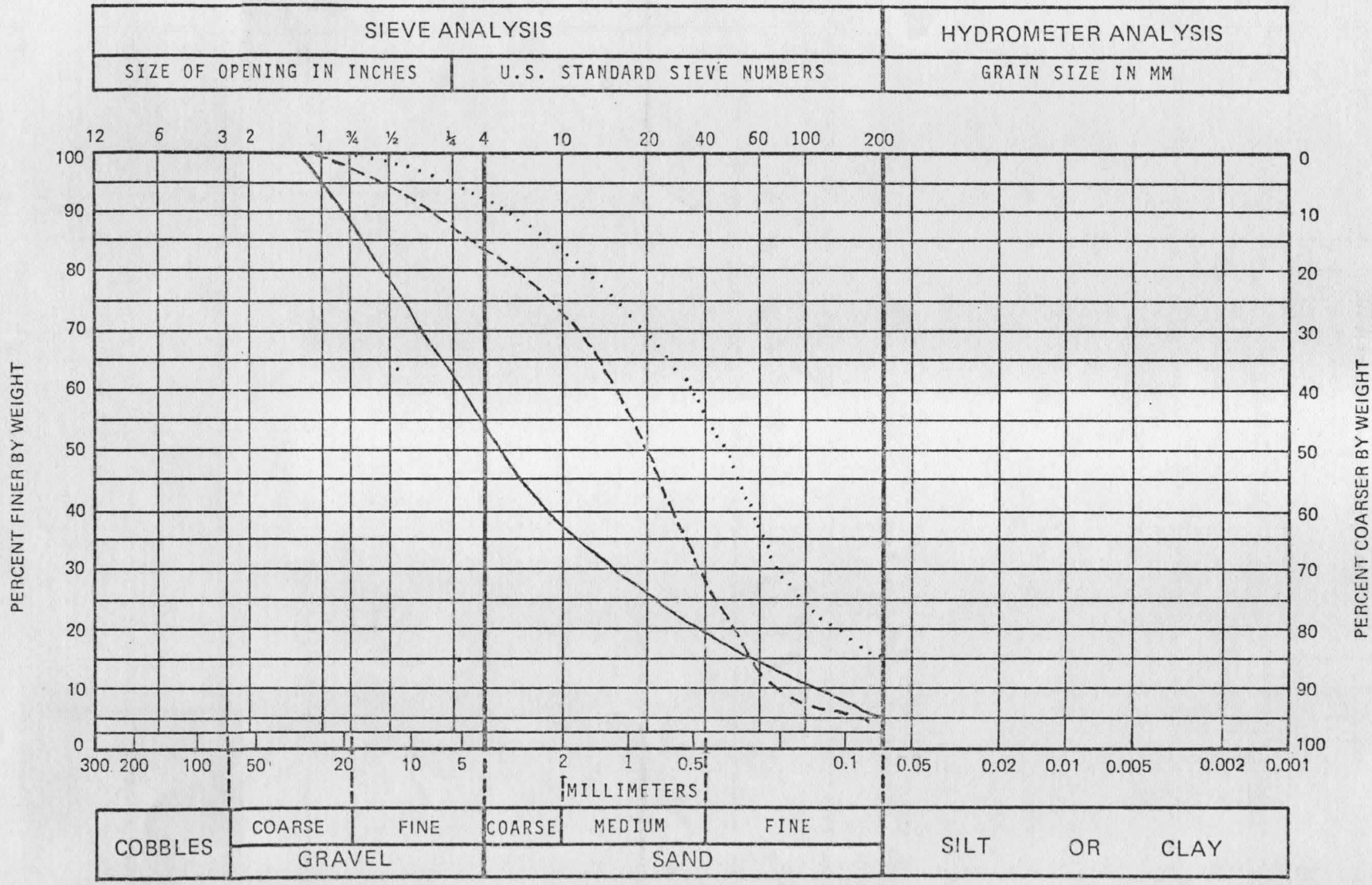
GRADATION ANALYSIS RESULTS



KEY	BORING	DEPTH	SOIL CLASSIFICATION	LL	PL	PI
.....	135	2.0	S W			
- - - - - -	131 A	2.0	S P			
———	129	1.5	S W			

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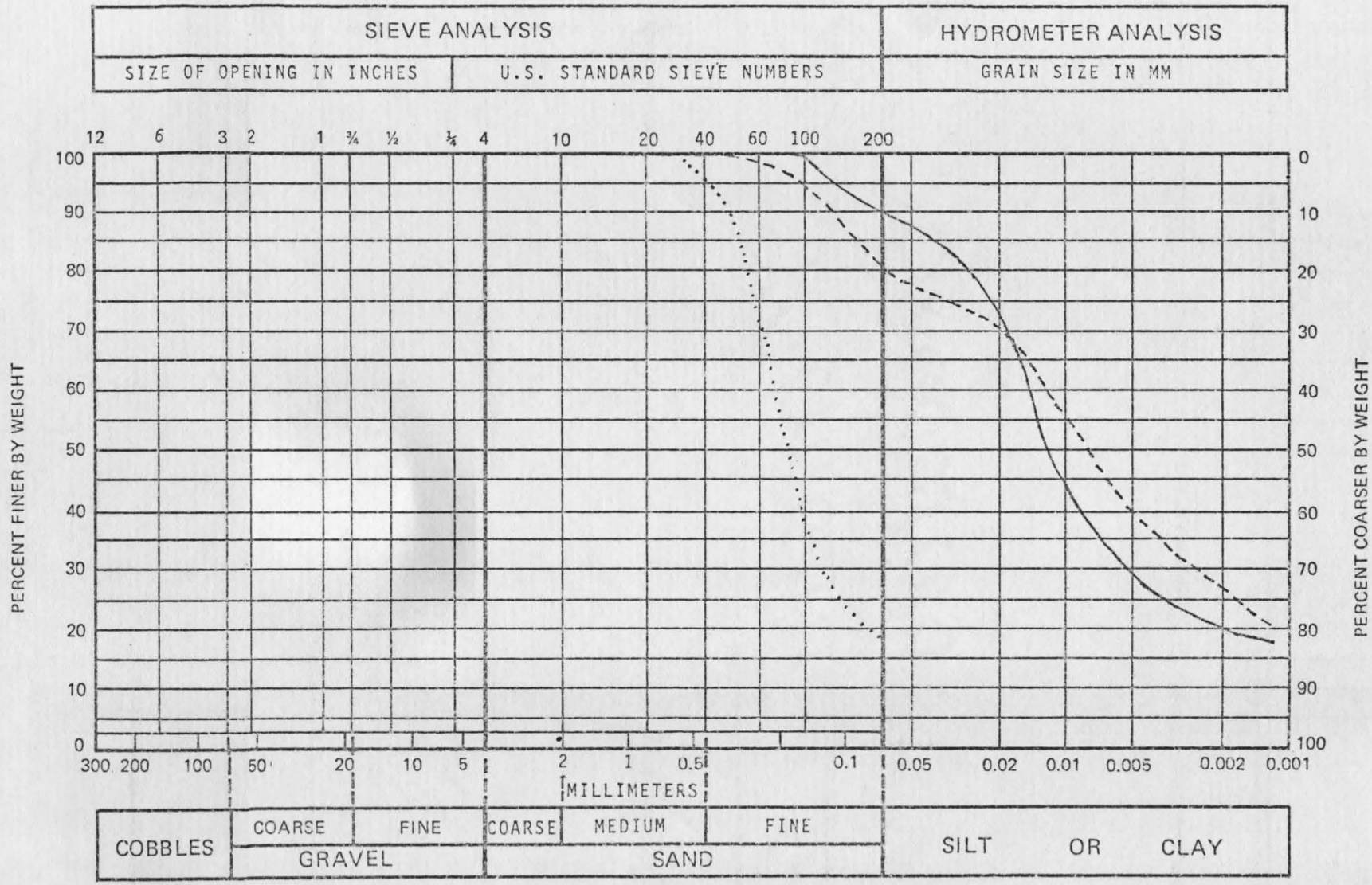
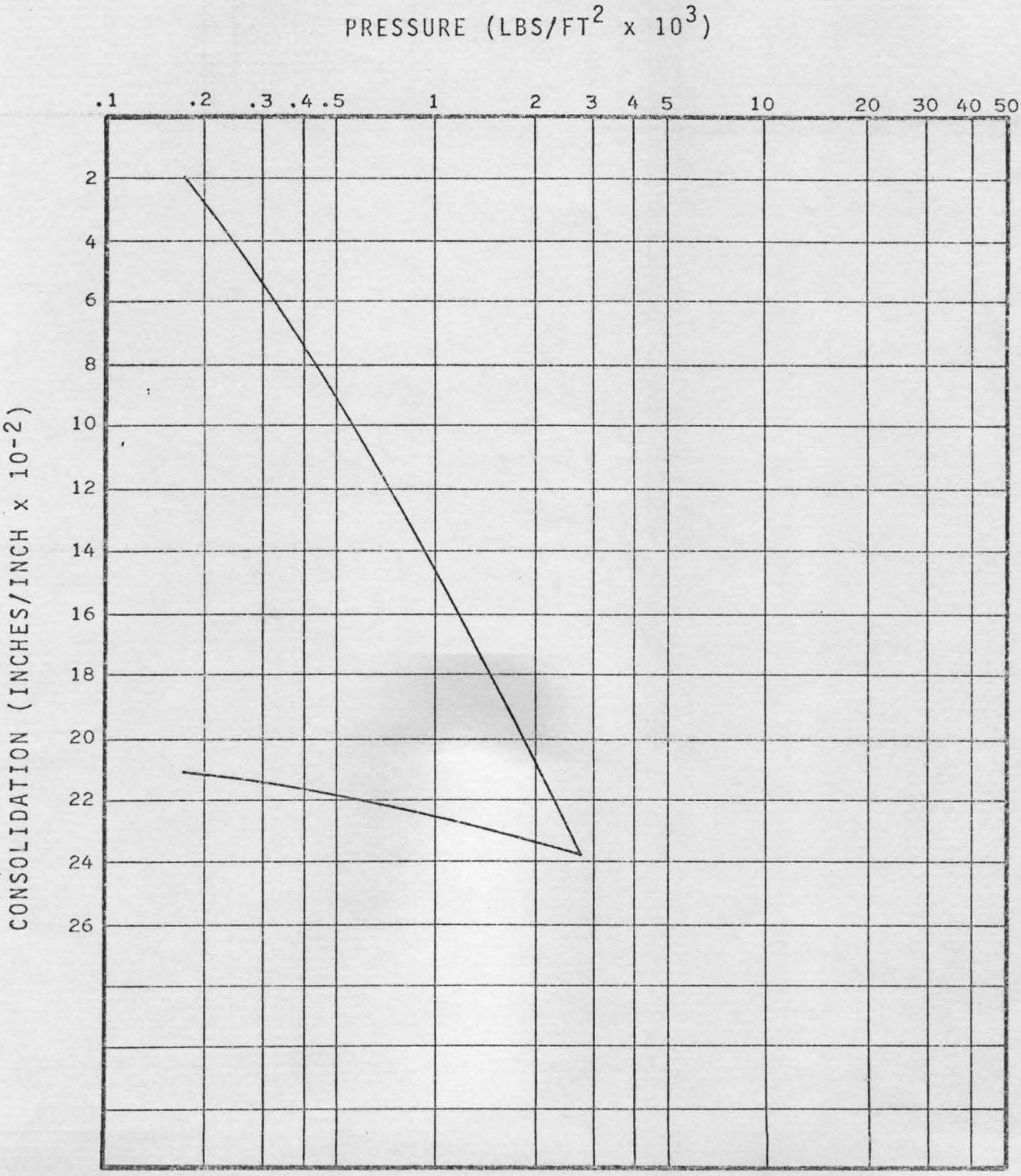
GRADATION ANALYSIS RESULTS



KEY	BORING	DEPTH	SOIL CLASSIFICATION	LL	PL	PI
———	133	4.5	M L			
- - - - - -	127	1.0	M L			
.....	124	2.0	S P			



KEY	BORING NUMBER	SAMPLE DEPTH (FT)	SOIL CLASSIFICATION	MOISTURE CONTENT (%)	DRY DENSITY (LBS/FT^3)
———	112 SAMPLE 4	11.0	M L	108.4	42.0

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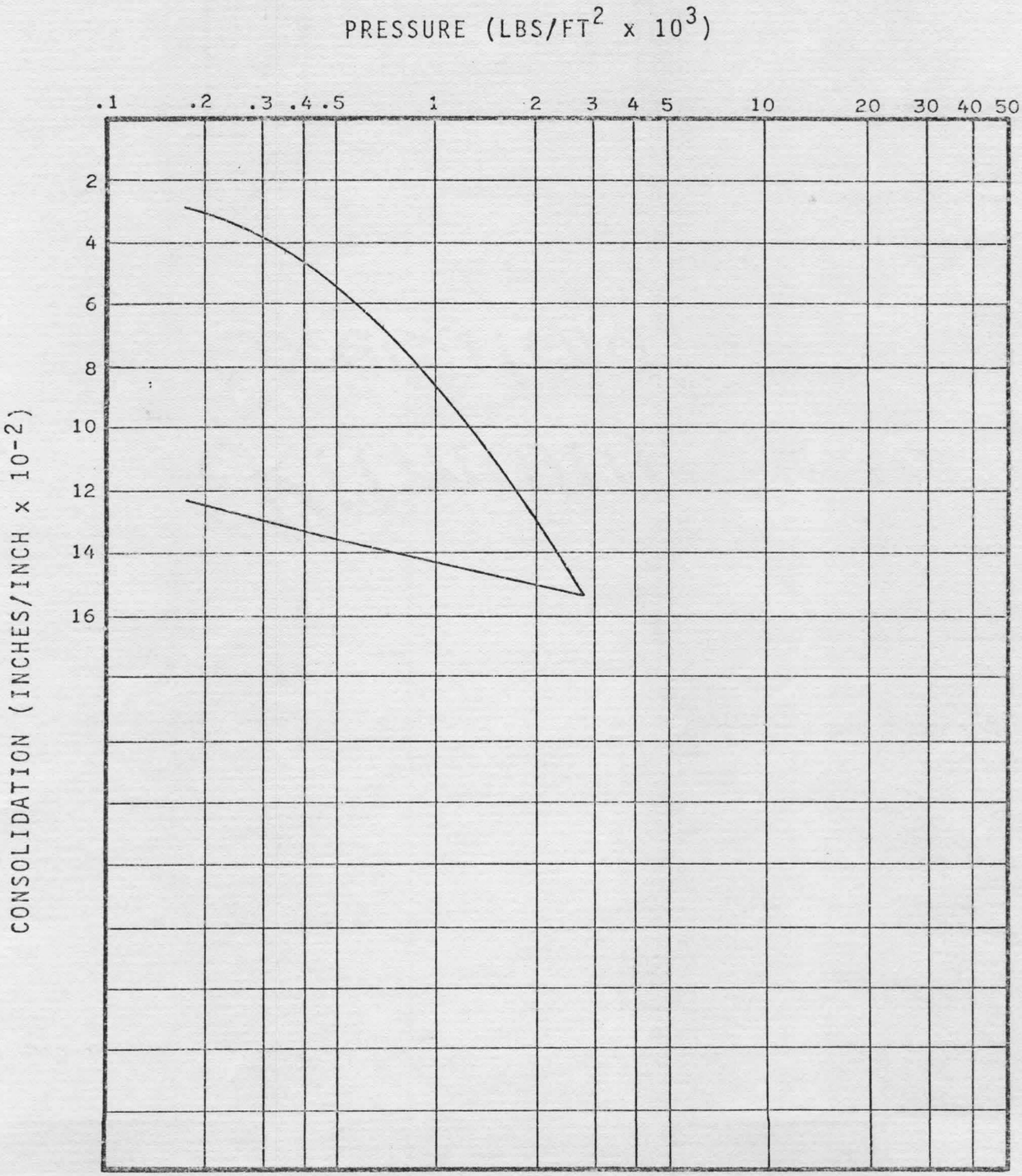
CONSOLIDATION TEST RESULTS



KEY	BORING NUMBER	SAMPLE DEPTH (FT)	SOIL CLASSIFICATION	MOISTURE CONTENT (%)	DRY DENSITY (LBS/FT^3)
———	122 SAMPLE 4	11.0	O L	88.4	53.5

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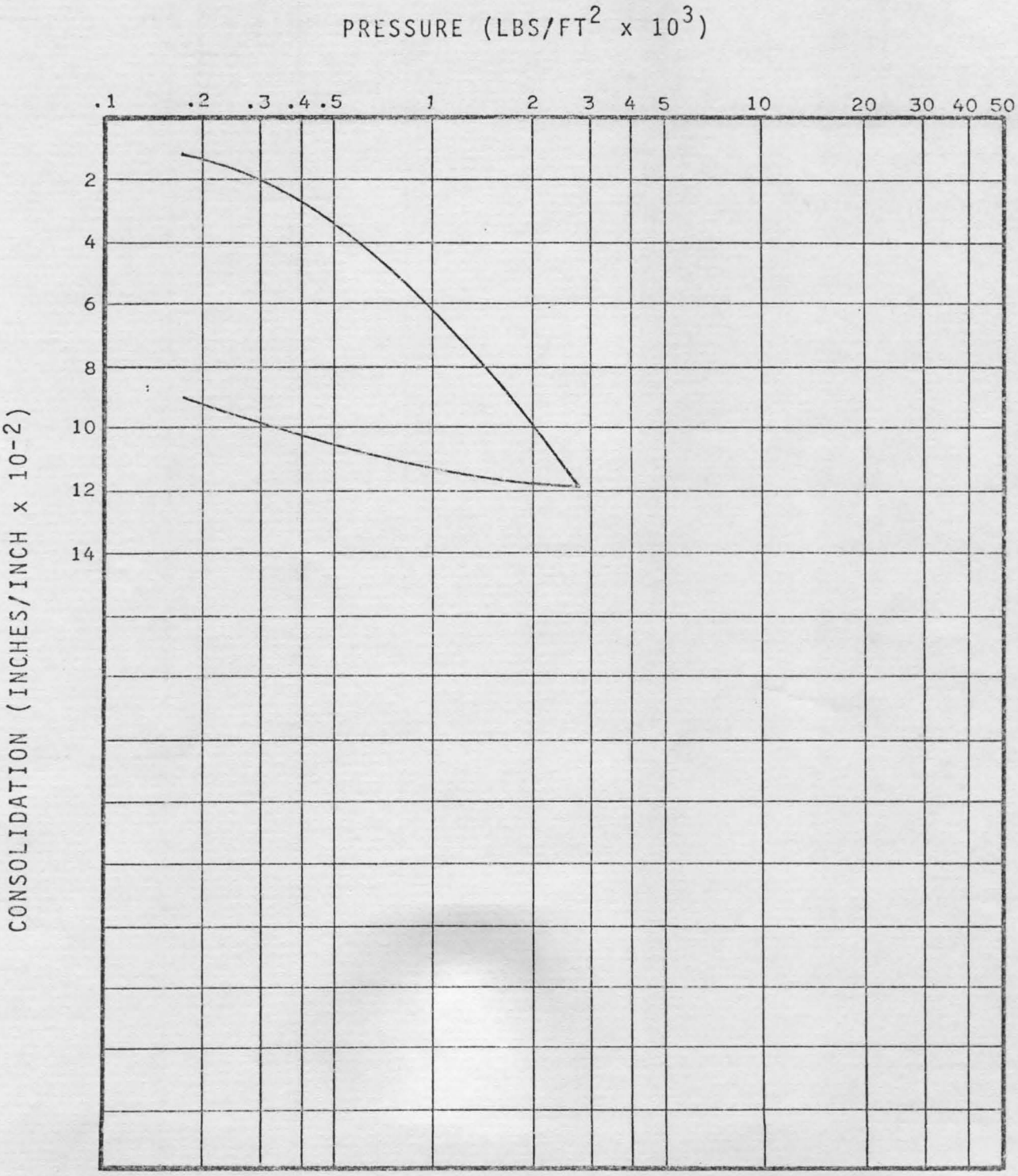
CONSOLIDATION TEST RESULTS



KEY	BORING NUMBER	SAMPLE DEPTH (FT)	SOIL CLASSIFICATION	MOISTURE CONTENT (%)	DRY DENSITY (LBS/FT3)
———	124 SAMPLE 6	17.0	M L	68.9	57.5

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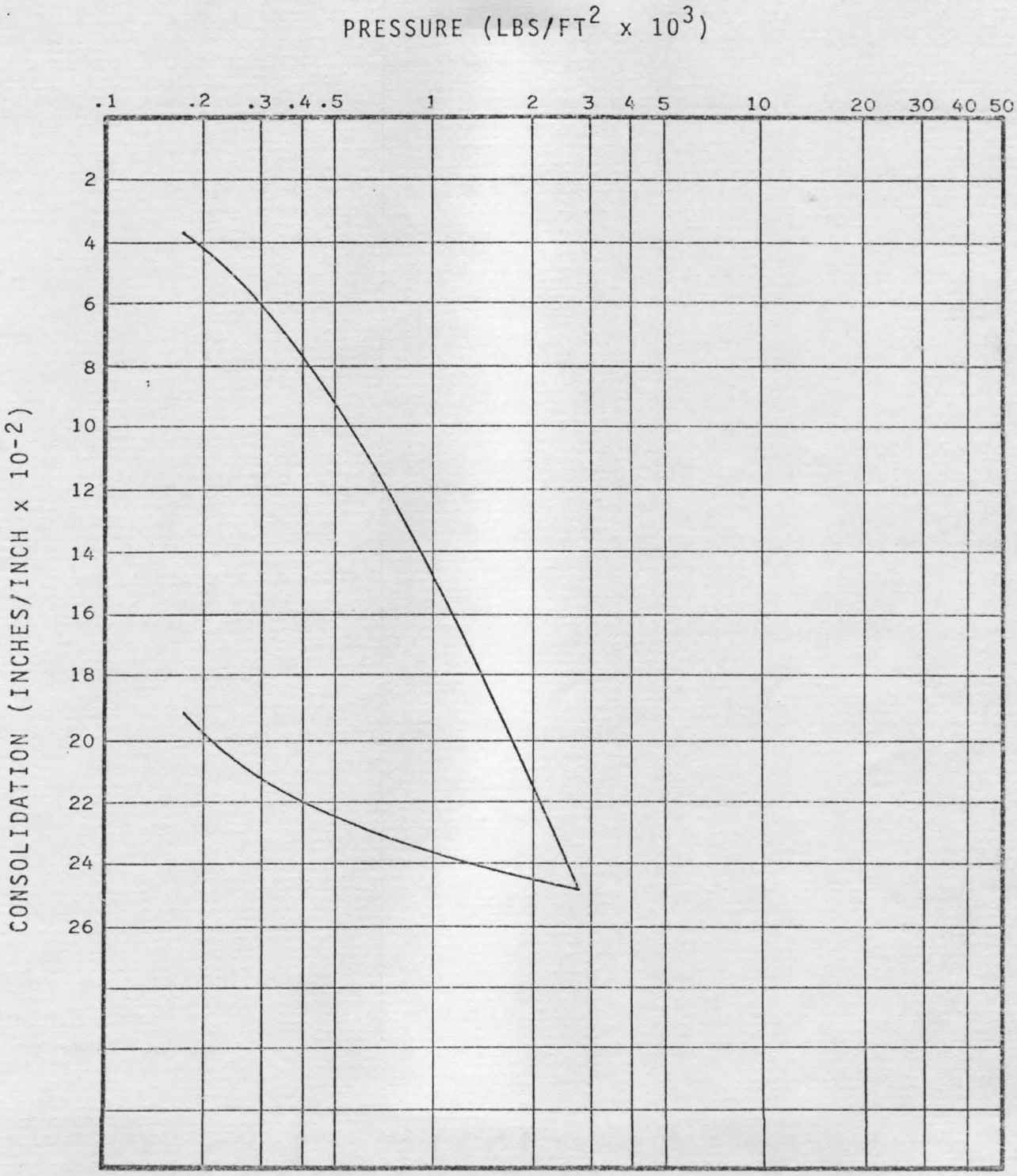
CONSOLIDATION TEST RESULTS



KEY	BORING NUMBER	SAMPLE DEPTH (FT)	SOIL CLASSIFICATION	MOISTURE CONTENT (%)	DRY DENSITY (LBS/FT^3)
————	126 SAMPLE 4	10.5	M L	103.9	43.4

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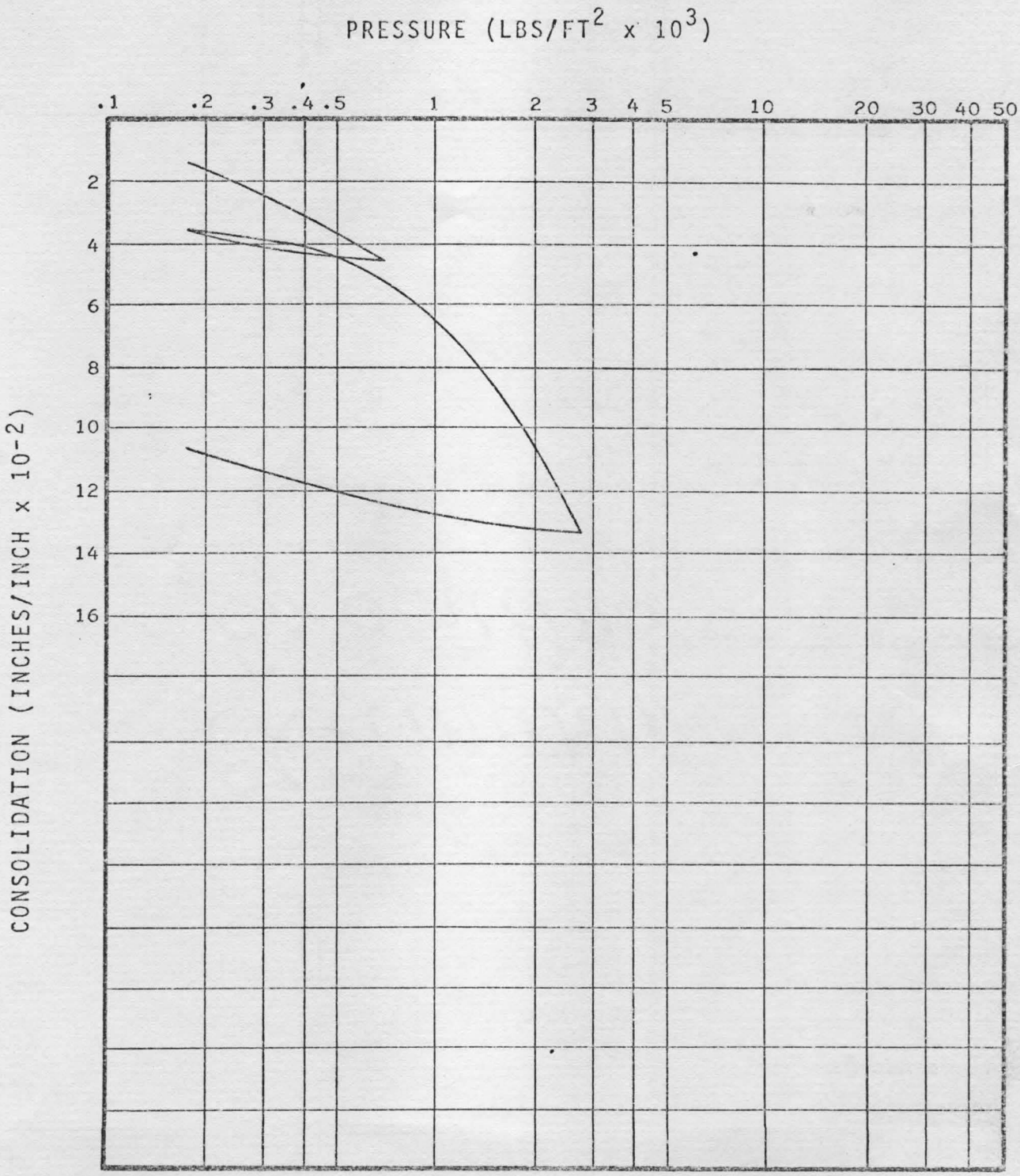
CONSOLIDATION TEST RESULTS



KEY	BORING NUMBER	SAMPLE DEPTH (FT)	SOIL CLASSIFICATION	MOISTURE CONTENT (%)	DRY DENSITY (LBS/FT3)
———	136 SAMPLE 5	14.0	M L	56.9	62.7

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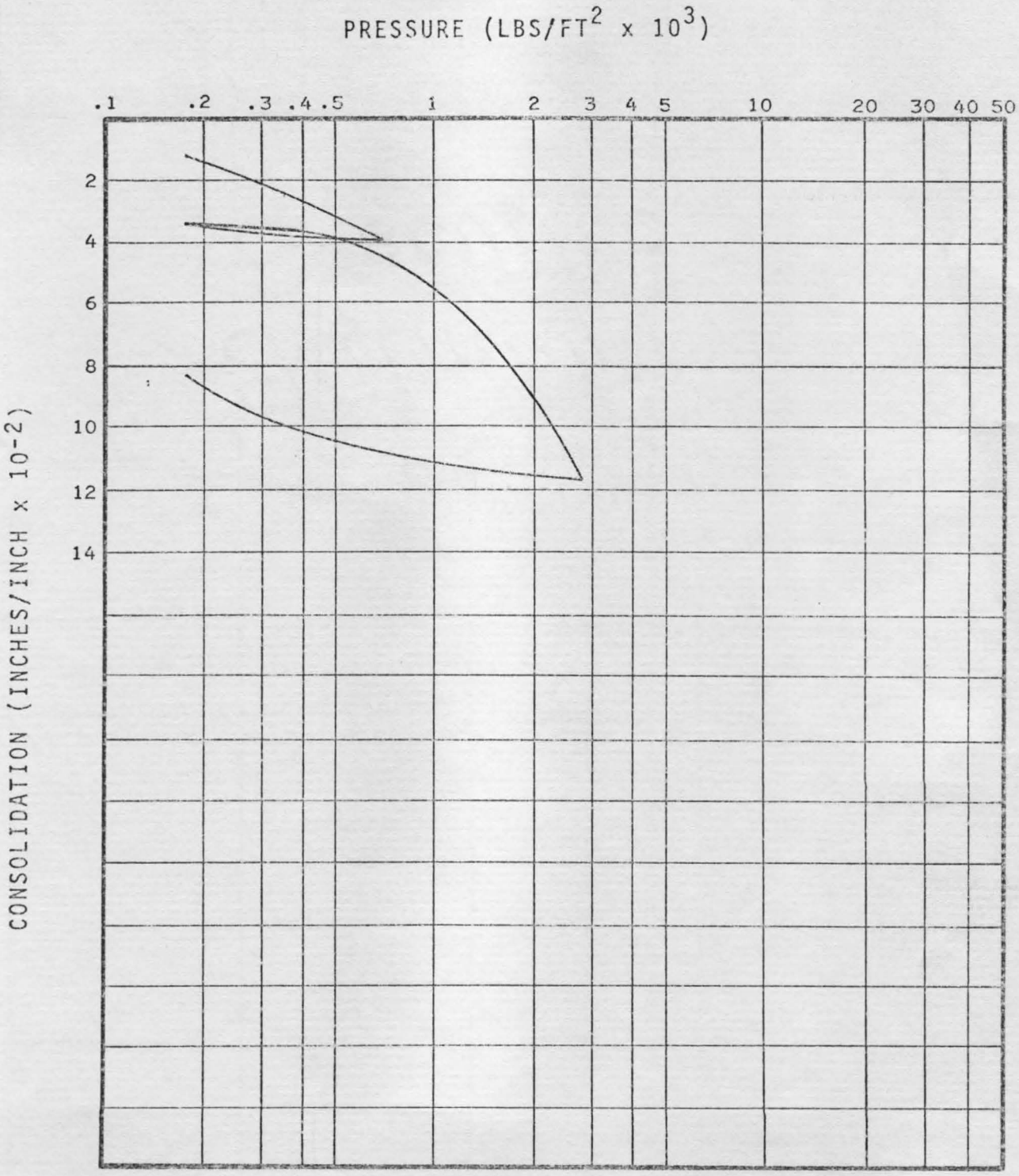
CONSOLIDATION TEST RESULTS



KEY	BORING NUMBER	SAMPLE DEPTH (FT)	SOIL CLASSIFICATION	MOISTURE CONTENT (%)	DRY DENSITY (LBS/FT^3)
————	230 SAMPLE 4	17.5	M L	63.9	60.5

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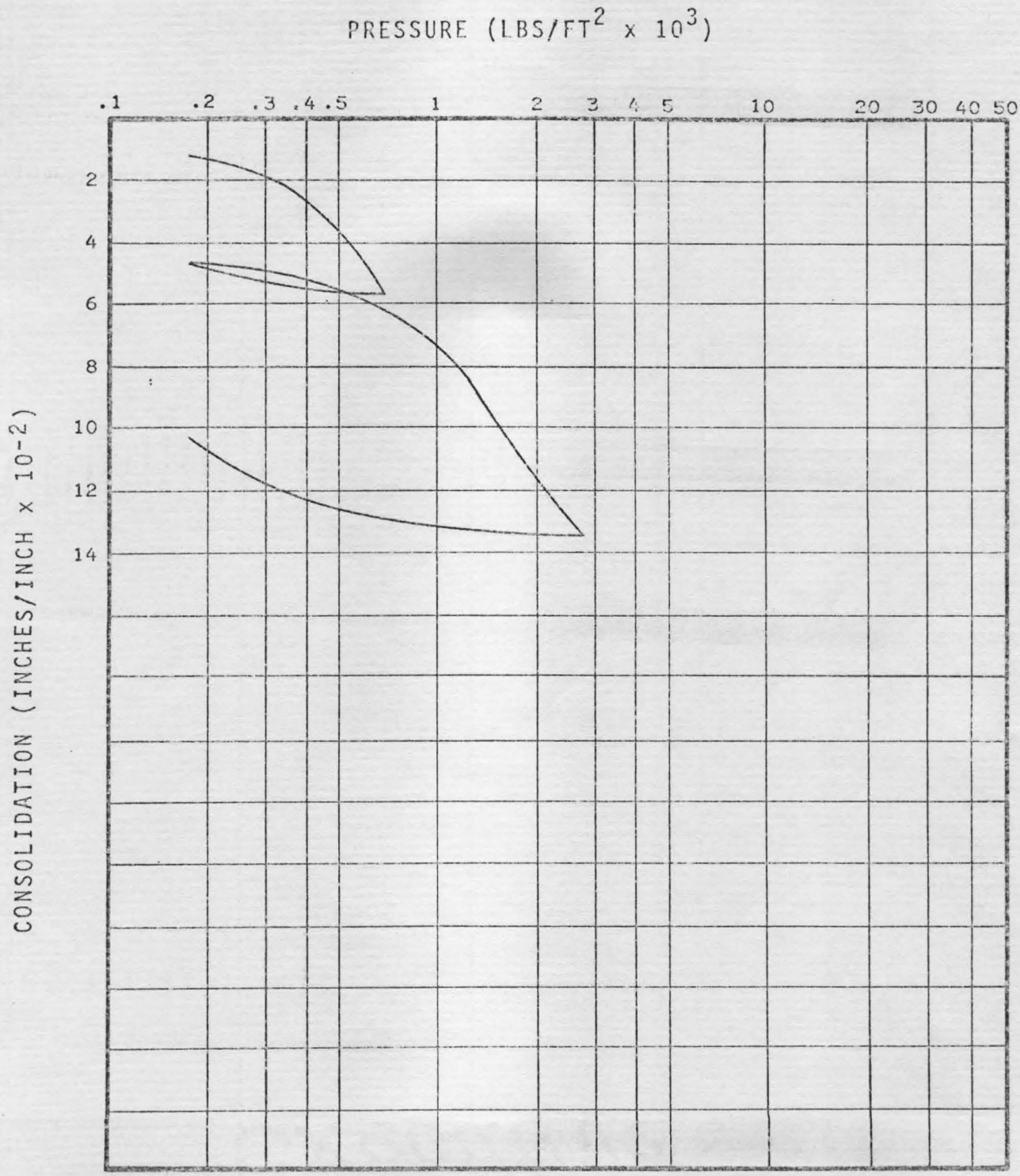
CONSOLIDATION TEST RESULTS



KEY	BORING NUMBER	SAMPLE DEPTH (FT)	SOIL CLASSIFICATION	MOISTURE CONTENT (%)	DRY DENSITY (LBS/FT3)
————	131A	17.0	ML	60.3	60.8

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CONSOLIDATION TEST RESULTS