

SURSOIL INVESTIGATION

# EIGHT (8) STORAGE TANKS

STOLTHAVEN TERMINAL

BRAITHWAITE, LOUISIANA

PROJECT NO. 8069

---

FOR

STOLTHAVEN TERMINAL DIVISION

BRAITHWAITE, LOUISIANA

GORE ENGINEERING, INC.  
SOIL AND FOUNDATION INVESTIGATIONS  
METAIRIE, LOUISIANA

# GORE ENGINEERING, INC.

## SOIL AND FOUNDATION INVESTIGATIONS

LAWRENCE W. GILBERT, D. ENGR.  
REG. C.E.

BORINGS  
ANALYSES

TESTING  
REPORTS

3613 HESSMER AVENUE  
P. O. BOX 8867  
METAIRIE, LOUISIANA 70011

JAMES R. GORE  
(1925 - 1991)

12 September, 2002

(504) 888-8690  
FAX: (504) 888-8827

Stolthaven Terminal Division  
2444 English Turn Road  
Braithwaite, Louisiana 70040

Subsoil Investigation  
Eight (8) Storage Tanks  
Stolthaven Terminal  
Braithwaite, Louisiana

Gentlemen:

Herein is our report on the results of a subsoil foundation investigation  
made for the subject project.

Yours very truly,

GORE ENGINEERING, INC.

---

Lawrence W. Gilbert

LWG:sd

SUBSOIL INVESTIGATION

**EIGHT (8) STORAGE TANKS**

**STOLTHAVEN TERMINAL**

**BRAITHWAITE, LOUISIANA**

**PROJECT NO. 8069**

---

FOR

**STOLTHAVEN TERMINAL DIVISION**

**BRAITHWAITE, LOUISIANA**

**GORE ENGINEERING, INC.**  
**SOIL AND FOUNDATION INVESTIGATIONS**  
**METAIRIE, LOUISIANA**

## TABLE OF CONTENTS

	<u>Page No.</u>
INTRODUCTION .....	1
SOIL BORINGS.....	1
Field Exploration .....	1
LABORATORY TESTS .....	2
SUBSOIL CONDITIONS.....	3
Subsoil Description.....	3
Borings B-1 thru B-4 .....	3
Borings B-5 thru B-8.....	4
Groundwater.....	5
FOUNDATION ANALYSIS.....	5
Pile Foundations.....	6
Estimated Pile Load Capacities.....	6
Drag Load .....	8
Group Effect.....	8
Estimated Settlements.....	9
Pile Driving .....	9
FIGURES.....1 thru 9.....Following.....	10

**SUBSOIL INVESTIGATION  
EIGHT (8) STORAGE TANKS  
STOLTHAVEN TERMINAL  
BRAITHWAITE, LOUISIANA**

**INTRODUCTION**

1. This report contains the results of a subsoil foundation investigation made at the subject site. Instructions to proceed with the investigation were received on August 13, 2002 from Ronald S. Luebbe, Manager, Engineering and Regulatory Affairs, Stolthaven Terminal Division.

2. The study included the drilling of soil test borings to determine subsurface conditions and stratification and the performance of soil mechanics laboratory tests on samples obtained from the borings to evaluate their physical characteristics. Engineering analyses were made, based on the borings and test data to develop criteria to be used in foundation design.

**SOIL BORINGS**

**Field Exploration**

3. Eight (8) undisturbed sample type soil test borings (B-1 thru B-8) were drilled to depths of 80 to 120 ft. on August 19-27, 2002. The borings were made with a truck mounted drill rig at designated locations approximately as shown in plan on Figure 1. Undisturbed sampling was performed continuously in all cohesive or semi-cohesive materials

with a three inch diameter thin wall tube sampler. Representative samples were cut from the cores and placed in moisture proof containers for preservation until laboratory testing could be performed.

4. When cohesionless material was encountered, which could not be sampled by undisturbed methods, the Standard Penetration Test was performed. This test consists of driving a two inch diameter splitspoon sampler 1 ft. (after first seating it 6 inches) with a 140 lb. hammer falling 30 inches. The number of blows required to drive the sampler gives an indication of the density of the material.

#### LABORATORY TESTS

5. In order to develop the physical properties of the soils, soil mechanics laboratory tests were performed on samples obtained from the borings. This testing consisted primarily of Natural Moisture Content, Unit Weight and Unconfined Compression. Triaxial Shear and Grain Size (percent passing the No. 200 Sieve) tests were performed on some of the more granular materials and Atterberg Limits were performed on selected cohesive samples. The results of all the laboratory tests are tabulated along side the boring logs at the appropriate sample and depth on Figures 2 thru 9.

6. The Unconfined Compression and Triaxial Shear tests are used in analyses to determine soil bearing values for spread footing foundations. They also give a measure of "skin friction" values used to estimate pile load capacities. The Atterberg Limits

along with the Natural Moisture Content tests give an indication of the compressibility of the soils and are used empirically to estimate settlements. The Grain Size tests are used to classify the more granular soils.

### **SUBSOIL CONDITIONS**

7. A subsoil profile developed from the borings showing the general stratification and character of the soils is given on Figure 1. Logs of the individual borings showing the detailed stratification and sample depths are given on Figures 2 thru 9.

#### **Subsoil Description**

8. **Borings B-1 thru B-4** Reference to subsoil profile "A" and logs of borings B-1 thru B-4 shows that beginning at the ground surface in borings B-1 and B-2 there is stiff brown or brown and tan clay to the 1 to 4 ft. depth. Below this and underlying 6 inches of limestone (fill) in boring B-4 there is medium stiff brown and gray, brown or brown and tan clay or silty clay that extends to the 4 to 7 ft. depth. This is generally underlain by medium stiff tan and gray clay or silty clay to the 10 to 13½ ft. depth. Below this there is soft gray clay or silty clay to the 17 to 19 ft. depth and then soft to medium stiff brown organic clay to the 22½ to 26 ft. depth. This organic clay stratum is followed by very soft to soft gray clay to the 27½ to 29½ ft. depth and then by loose to medium dense gray silty fine sand that continues to the 37 to 42 ft. depth.

9. Beginning at the 37 to 42 ft. depth there is generally soft to medium stiff gray clay with silt lenses and layers. This stratum continues to the 76 ft. depth in boring B-2 and to at least the 80 ft. depth in the other three (3) borings where they were terminated. Beginning at the 76 ft. depth in boring B-2 there is soft gray sandy clay to the 80 ft. depth and then medium dense to dense gray fine sand to 87 ft. This is underlain by loose gray clayey fine sand to the 93 ft. depth and then by stiff brown organic clay to the 103½ ft. depth. Below this there is stiff gray clay to the 106 ft. depth and then medium compact gray sandy silt to 109 ft. This sandy silt stratum is followed by medium dense gray silty fine sand to the 116 ft. depth and then by medium stiff gray silty clay that extends to at least the 120 ft., the maximum depth penetrated by boring B-2.

10. Borings B-5 thru B-8 Reference to subsoil profile and "B" and logs of borings B-5 thru B-8 shows that beginning at the ground surface in boring B-5 and underlying 1 ft. of limestone (fill) in boring B-6 there is stiff to very stiff brown and tan clay to the 1 to 4 ft. depth. Below this and underlying 6 inches of loose tan fine sand (fill) in boring B-7 and 2 ft. of limestone (fill) in boring B-8 there is medium stiff to stiff tan and gray or gray and tan clay to the 4 to 10 ft. depth. This is generally underlain by very soft to medium stiff tan and gray, gray or gray and brown clay or silty clay that extends to the 18½ to 26½ ft. depth. Below this there is very soft to medium stiff brown or gray organic clay, humus or clay with organic that continues to the 22½ to 27 ft. depth. This is underlain in all of the borings except B-6 by very soft to medium stiff gray clay with silt to the 32 to 33 ft. depth.

11. Beginning at the 32 to 33 ft. depth there is loose to medium dense gray silty fine sand or sand that continues to the 42 to 46½ ft. depth. This is followed by soft to medium stiff gray clay with silt. Borings B-5, B-7 and B-8 were terminated in this stratum at the 80 ft. depth, but it extends to the 81½ ft. depth in the deeper, boring B-6. Beginning at the 81½ ft. depth in boring B-6 there is dense gray fine sand that continues to the 92½ ft. depth. This is followed by stiff brown organic clay to the 97 ft. depth and then by medium stiff to stiff gray clay to the 111½ ft. depth where the geologically identified Pleistocene Age soils were first encountered. These soils consist of stiff greenish gray clay that extend to at least the 120 ft. depth, the maximum depth explored.

12. Groundwater At the time of making the borings, groundwater was measured at depths ranging from 3.1 to 6.8 ft. below the existing ground surface elevation. Groundwater was measured shortly after making the borings and may not have become fully static at the time of measurement. In any event, groundwater could fluctuate due to seasonal precipitation, drainage, prolonged drought and the stage of the adjacent Mississippi River. If groundwater is important to construction, it should be measured at that time.

#### FOUNDATION ANALYSIS

13. It is understood that the proposed construction will consist of eight (8) Storage Tanks in the area of borings B-1 thru B-8 and approximately as shown in plan on Figure 1. All of the tanks will be 48 ft. high and will be designed for a specific gravity of 1.0. The four (4) tanks in the area of borings B-1 thru B-4 will range from 62 to 68 ft. in

diameter. The other four (4) tanks in the area of borings B-5 thru B-8 will range from 90 to 114 ft. in diameter.

14. In view of the magnitude of the loads imposed by the fully loaded tanks and in order to minimize long term settlements, it is understood that piles will be used for structural support. Consequently, analyses were made with regard to piles and the results are given in the following section.

#### File Foundations

15. Analyses were made based on the borings and laboratory test data to estimate the load carrying capacities of several types and lengths of piles. These include Class "B" timber (or composite) piles, 12 inch diameter steel pipe piles and 12 and 14 inch square prestressed concrete piles. The piles will generally receive their support through "skin friction" along their embedded length. Some additional "point" support would develop for piles driven to firm embedment into the dense sands that were encountered at the 80½ and 81½ ft. depths in the deeper borings, B-2 and B-6, respectively.

16. Estimated Pile Load Capacities The results of analyses to estimate pile load capacities in compression are given in the following tables. Pile lengths given are as measured from the existing ground surface elevation at the boring locations, but a pile cutoff of 2 ft. should be of no consequence.

### B-1 THRU B-4

<u>LENGTH OF PILE IN FEET</u>	<u>ESTIMATED SINGLE PILE LOAD CAPACITY IN TONS      FACTOR OF SAFETY = 2.0</u>			
	<u>Class "B"</u>	<u>12" Dia.</u>	<u>12" Sq.</u>	<u>14" Sq.</u>
	<u>Timber</u>	<u>Pipe</u>	<u>Conc.</u>	<u>Conc.</u>
60	18	21	27	31½
65	20	24	30	35
70	22	26	32½	38
75	23½	28	35	41
80	25	30	37½	44
82±*	--	40	50	60
90	--	39	50	58
95	--	42	54	63
100	--	45	58	68
105	--	49	63	74
110	--	53	67	78

### B-5 THRU B-8

<u>LENGTH OF PILE IN FEET</u>	<u>ESTIMATED SINGLE PILE LOAD CAPACITY IN TONS      FACTOR OF SAFETY = 2.0</u>			
	<u>Class "B"</u>	<u>12" Dia.</u>	<u>12" Sq.</u>	<u>14" Sq.</u>
	<u>Timber</u>	<u>Pipe</u>	<u>Conc.</u>	<u>Conc.</u>
60	18½	22	28½	33
65	21	25	31½	37
70	23	27	34½	40
75	25	29½	37½	44
80	--	32	41	48
84±*	--	40	55	65
95	--	47	60	70
100	--	51	65	76
105	--	55	70	82
110	--	59	75	87

\* Pile tips driven to firm embedment into sand.

19. **Estimated Settlements** Analyses were made to estimate long term consolidation settlements that should be expected to occur. They are based on the tank diameters and height given above and assume that they contain a product with a specific gravity of 1.0. Based on the above, long term settlements are estimated to be on the order of 3 to 5 inches at the center of the loaded area and 2 to 3 at the edge. The analyses assume a "flexible" foundation. The differential from center to edge could be reduced if a rigid concrete foundation is used for support.

20. **Pile Driving** Some discussion with regard to pile driving appears warranted. In general, driving of Class "B" timber piles should be limited to the rate of 25 blows per foot using a Vulcan No. 1 hammer or equivalent. Driving of the steel pipe and prestressed concrete piles should be limited to the rate of 50 to 75 blows per ft. using a hammer developing about 20,000 to 30,000 ft. lbs. of energy per blow. These recommendations are given in order to minimize possible damage to the piles.

21. Piles with tips above the dense sands (80½ to 81½ ft. depth) should be able to be driven with normal effort not exceeding the above limitations. Driving of piles into the underlying sand could be erratic. If piles with tips in the sand are selected for design, it is recommended that probe types piles be driven throughout the site to establish driving characteristics and pile lengths. While it is believed the piles could be driven several feet into the sand without severe damage, the piles should be closely observed and, if "refusal" or little or no penetration under several successive blows occurs, driving should be ceased. In view of

the limited thickness of the sand stratum, care should be taken so as not to drive the piles through the sand stratum.

22. If longer piles with tips below the sand stratum are selected for design, it may be necessary to predrill through the upper sand stratum to facilitate pile installation without damaging the piles. For this case, the drill bit should not exceed about two-thirds (2/3) of the pile tip diameter or width. Predrilling should be ceased as soon as the upper sand is fully penetrated and the piles then driven with normal driving effort to the desired pile tip depth.

23. Vibrations due to pile driving activities should be expected and they should be monitored during the driving of probe piles and job piles. In general, vibrations should be limited to about 0.25 inch/sec. (peak particle velocity) at all existing nearby sensitive structures. If this value is exceeded, further consideration should be given to the effects of vibrations.

GORE ENGINEERING, INC.

---

Lawrence W. Gilbert

### Minimum Pile Spacing

$$\text{SPAC} = 0.05 L_1 + 0.025 L_2 + 0.0125 L_3 \text{ (Min. 3.0 ft.)}$$

SPAC = Center to center spacing of piles (ft.)

$L_1$  = Pile penetration in ft. up to 100 ft.

$L_2$  = Pile penetration in ft. from 101 to 200 ft.

$L_3$  = Pile penetration in ft. from 200 to 300 ft.

### Allowable Group Capacity\*

$$Q_a = \frac{P \times L \times c}{\text{FSF}} + \frac{2.6q_u (1 + 0.2 \frac{w}{b}) A}{\text{FSB}}$$

P = Perimeter distance of pile group (ft.)

L = Length of pile (ft.)

c = Average (weighted) shear strength ( $\frac{1}{2}q_u$ ) of soil throughout pile length (lbs./sq.ft.)

$q_u$  = Unconfined compressive strength of soils below pile tips (lbs./sq.ft.)

w = Width of base of pile group (ft.)

b = Length of base of pile group (ft.)

A = Base area of pile group (sq. ft.)

FSF = Factor of safety for friction area = 2

FSB = Factor of safety for base area = 3

\*In no case should the recommended single pile load capacity be exceeded.

Appendix "A"

# GORE ENGINEERING, INC.

Job No. 8069

Soil and Foundation Investigations  
Metairie, Louisiana

## LOG OF BORING AND TEST RESULTS

Date Boring Drilled: 19 August 2002

Boring No. B-1

Project: **EIGHT (8) STORAGE TANKS - STOLTHAVEN TERMINALS - BRAITHWAITE, LOUISIANA**  
**FOR: STOLTHAVEN TERMINAL DIVISION - BRAITHWAITE, LOUISIANA**

Recorded By: D.A. Hill

Sample No.	SAMPLE Depth in Feet		STRATUM Depth in Feet	VISUAL CLASSIFICATION	* Blows per Foot	Symbol Log	Scale (feet)	UNCONFINED COMPRESSION (Qu) (lbs./sq.ft.)	WATER CONTENT (percent)	UNIT WEIGHT (lbs./cu.ft.)		ATTERBERG LIMITS				
	From	To								DRY	WET	L.L.	P.L.	P.I.		
			0				0									
1	0	5		STIFF BROWN CLAY W/ SAND & SHELL				2515	19.7	95.1	113.8					
2	2.5	3.0	4.0	MEDIUM STIFF BROWN & GRAY CLAY W/ SHELL				1535	25.1	84.3	105.5	48	15	33		
3	5.5	6.0	7.0	MEDIUM STIFF GRAY SILTY CLAY W/ SHELL				1735	35.3	79.3	107.3					
4	8.5	9.0	10.0	MEDIUM STIFF TAN & GRAY CLAY W/ SILT			10	1005	43.2	73.3	104.9					
5	11.5	12.0	13.5	SOFT GRAY CLAY W/ WOOD				535	83.5	48.9	89.7	118	35	83		
6	14.5	15.0	17.0	MEDIUM STIFF BROWN ORGANIC CLAY W/ HUMUS			20	1035	356.5	14.7	66.9					
7	19.5	20.0	22.5	VERY SOFT GRAY CLAY W/ SILT				415	54.1	63.6	98.0					
8	24.5	25.0	27.5				30	990*	32.3	84.5	111.8					
9	29.5	30.0		LOOSE TO MEDIUM DENSE GRAY SILTY FINE SAND				1100*	23.6	93.9	116.1					
10	34.5	35.0	37.0				40	505	51.8	66.6	101.1	52	28	24		
11	39.5	40.0		SOFT GRAY CLAY W/ SILT				880	51.6	67.2	101.9					
12	44.5	45.0	47.0				50	1010	42.4	75.9	108.1					
13	49.5	50.0						700	54.9	64.8	100.4					
14	54.5	55.0					60	665	58.6	61.5	97.6					
15	59.5	60.0		SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT				1180	61.5	61.8	99.8	91	26	65		
16	64.5	65.0					70	1165	55.4	63.2	98.2					
17	69.5	70.0						1010	59.6	61.5	98.2					
18	74.5	75.0					80	1130	61.7	59.2	95.8					
19	79.5	80.0	80.0													
							90									
							100									
							110									
							120									

CLAY   
 SILT   
 SAND   
 ORGANIC  
 \* 140 lb. hammer dropped 30 inches on 2 inch splitspoon sampler after first being seated 6 inches.

REMARKS:  
 \* equivalent Qu from 1-point triaxial test

# GORE ENGINEERING, INC.

Job No. 8069

Soil and Foundation Investigations  
Metairie, Louisiana

## LOG OF BORING AND TEST RESULTS

Date Boring Drilled: 21 August 2002

Boring No. B-2

Subject: EIGHT (8) STORAGE TANKS - STOLTHAVEN TERMINALS - BRAITHWAITE, LOUISIANA  
FOR: STOLTHAVEN TERMINAL DIVISION - BRAITHWAITE, LOUISIANA

Recorded By: D.A. Hill

Sample No.	SAMPLE Depth in Feet		STRATUM Depth in Feet	VISUAL CLASSIFICATION	* Blows per Foot	Symbol Log	Scale (feet)	UNCONFINED COMPRESSION (Qu) (lbs./sq.ft.)	WATER CONTENT (percent)	UNIT WEIGHT (lbs./cu.ft.)		ATTERBERG LIMITS			
	From	To								DRY	WET	L.L.	P.L.	P.I.	
1	0	0.5	1.0	STIFF BROWN & TAN CLAY W/ SILT			0								
2	1.5	2.0	4.5	MEDIUM STIFF BROWN & GRAY CLAY W/ SILT			10	1470	21.9	81.5	99.4				
3	5.5	6.0		MEDIUM STIFF				1900	26.1	91.4	115.2				
4	8.5	9.0	10.0	TAN & GRAY CLAY				1080	45.4	69.9	101.7				
5	11.5	12.0		SOFT GRAY CLAY											
6	14.5	15.0	17.5	W/ SILT				745	80.2	51.8	93.4				
7	19.5	20.0	23.0	MEDIUM STIFF BROWN ORGANIC CLAY				1035	140.2	33.2	79.7				
8	24.5	25.0	28.5	SOFT GRAY CLAY W/ SILT				665	53.6	66.2	101.7				
9	29.5	30.0		MEDIUM DENSE				1070*	28.5	85.9	110.4				
10	32.0	33.5		GRAY SILTY FINE SAND	18				21.0						
11	35.0	36.5	37.0		17				22.3						
12	39.5	40.0						1270	43.3	74.3	106.5				
13	44.5	45.0						1085	42.4	74.8	106.5				
14	49.5	50.0						1255	35.8	81.4	110.6				
15	54.5	55.0		MEDIUM STIFF GRAY CLAY W/ SILT											
16	59.5	60.0						1165	55.9	64.3	100.3	77	20	57	
17	64.5	65.0													
18	69.5	70.0						1020	60.4	59.7	95.7				
19	74.5	75.0	76.0												
20	79.5	80.0		SOFT GRAY SANDY CLAY W/ SHELL FRAGMENTS											
21	80.5	82.0	80.5					745	29.0	84.0	108.3				
22	83.5	85.0	83.5	DENSE GRAY FINE SAND W/ SHELL	30 = .8'										
23	89.5	90.0	87.0	MEDIUM DENSE GRAY FINE SAND W/ SHELL	19										
24	94.5	95.0		LOOSE GRAY CLAYEY FINE SAND				715	35.9	77.8	105.7	26	--	NP	
25	99.5	100.0	93.0												
26	104.5	105.0		STIFF BROWN ORGANIC CLAY											
27	108.5	109.0	103.5					3435	112.5	40.0	85.0				
28	109.0	110.5	106.0	STIFF GRAY CLAY W/ SILT											
29	113.5	115.0	109.0	MEDIUM COMPACT GRAY SANDY SILT				2520	28.4	90.0	115.6				
30	119.5	120.0	116.0	MEDIUM DENSE GRAY SILTY FINE SAND	20										
				MEDIUM STIFF GRAY SILTY CLAY W/ SOME SAND	16										
			120.0					1275	25.8	89.0	112.0				

CLAY SILT SAND ORGANIC

\* 140 lb. hammer dropped 30 inches on 2 inch splitspoon sampler after first being seated 6 inches.

REMARKS: Water Table Depth = 5.6 ft (See Text)

\* equivalent Qu from 1-point triaxial test

# GORE ENGINEERING, INC.

Job No. 8069

Soil and Foundation Investigations  
Metairie, Louisiana

## LOG OF BORING AND TEST RESULTS

Date Boring Drilled: 19 August 2002

Boring No. B-3

Project: EIGHT (8) STORAGE TANKS - STOLTHAVEN TERMINALS - BRAITHWAITE, LOUISIANA  
FOR: STOLTHAVEN TERMINAL DIVISION - BRAITHWAITE, LOUISIANA

Recorded By: D.A. Hill

Sample No.	SAMPLE Depth in Feet		STRATUM Depth in Feet	VISUAL CLASSIFICATION	*Blows per Foot	Symbol Log	Scale (feet)	UNCONFINED COMPRESSION (Qu) (lbs./sq.ft.)	WATER CONTENT (percent)	UNIT WEIGHT (lbs./cu.ft.)		ATTERBERG LIMITS			
	From	To								DRY	WET	L.L.	P.L.	P.I.	
	0	0.5	0	MEDIUM STIFF BROWN & TAN CLAY W/ SAND			0								
1	0	2.5	1.0	MEDIUM STIFF BROWN & TAN CLAY W/ SAND				1360	23.8	84.2	104.3	34	20	14	
2	2.5	3.0		MEDIUM STIFF BROWN & TAN CLAY W/ SAND											
3	5.5	6.0	7.0	BROWN SILTY CLAY				1095	21.4	82.4	100.0				
4	8.5	9.0		MEDIUM STIFF TAN & GRAY CLAY W/ SILT			10	1515	51.2	68.9	104.2				
5	11.5	12.0	10.0	MEDIUM STIFF TAN & GRAY CLAY W/ SILT				975	65.5	58.7	97.1	46	25	21	
6	14.5	15.0		SOFT GRAY SILTY CLAY W/ CLAY LAYERS				735	103.5	43.0	87.6				
7	19.5	20.0	19.0	SOFT BROWN ORGANIC CLAY			20	835	156.6	30.2	77.4				
8	24.5	25.0		SOFT BROWN ORGANIC CLAY				840	193.7	25.7	75.6				
9	26.5	27.0	25.5	SOFT GRAY CLAY				605	61.6	60.5	97.8				
10	29.5	30.0	29.0	SOFT GRAY CLAY			30	1020*	28.3	85.7	109.9				
11	34.5	35.0		LOOSE TO MEDIUM DENSE GRAY SILTY FINE SAND W/ SOME CLAY				1110*	25.2	88.3	110.6				
12	39.5	40.0		LOOSE TO MEDIUM DENSE GRAY SILTY FINE SAND W/ SOME CLAY			40	810*	30.3	83.7	109.0				
13	44.5	45.0	42.0	SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT LENSES & LAYERS				625	39.2	74.7	104.0	36	24	12	
14	49.5	50.0		SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT LENSES & LAYERS			50								
15	54.5	55.0		SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT LENSES & LAYERS				945	52.2	66.2	100.7				
16	59.5	60.0		SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT LENSES & LAYERS			60	670	61.6	59.6	96.3				
17	64.5	65.0		SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT LENSES & LAYERS				950	67.2	57.2	95.6				
18	69.5	70.0		SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT LENSES & LAYERS			70								
19	74.5	75.0		SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT LENSES & LAYERS				1010	63.7	58.5	95.8				
20	79.5	80.0	80.0	SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT LENSES & LAYERS			80	880	64.6	57.1	94.0				
							90								
							100								
							110								
							120								

CLAY  
 SILT  
 SAND  
 ORGANIC  
 Predominant Type Bold. Modifying Type Light.

\* 140 lb. hammer dropped 30 inches on 2 inch splitspoon sampler after first being seated 6 inches.

REMARKS: Water Table Depth = 6.8 ft (See Text)  
\* equivalent Qu from 1-point triaxial test

# GORE ENGINEERING, INC.

Job No. 8069

Soil and Foundation Investigations  
Metairie, Louisiana

## LOG OF BORING AND TEST RESULTS

Date Boring Drilled: 22 August 2002

Boring No. B-4

Project: **EIGHT (8) STORAGE TANKS - STOLTHAVEN TERMINALS - BRAITHWAITE, LOUISIANA  
FOR: STOLTHAVEN TERMINAL DIVISION - BRAITHWAITE, LOUISIANA**

Recorded By: D.A. Hill

Sample No.	SAMPLE Depth in Feet		STRATUM Depth in Feet	VISUAL CLASSIFICATION	*Blows per Foot	Symbol Log	Scale (feet)	UNCONFINED COMPRESSION (Qu) (lbs./sq.ft.)	WATER CONTENT (percent)	UNIT WEIGHT (lbs./cu.ft.)		ATTERBERG LIMITS				
	From	To								DRY	WET	L.L.	P.L.	P.I.		
1	0	0.5	0	LIMESTONE (FILL)			0									
2	2.5	3.0	0.5	MEDIUM STIFF BROWN & GRAY SILTY CLAY			0	1750	27.8	84.4	107.8					
3	5.5	6.0	4.0	MEDIUM STIFF			0	1540	23.3	88.6	109.2	55	23	32		
4	8.5	9.0	10.0	TAN & GRAY SILTY CLAY			10	1115	42.0	73.7	104.7					
5	11.5	12.0	10.0	SOFT GRAY CLAY			10	965	74.5	56.1	97.9					
6	14.5	15.0	18.0	W/ SILT			10	720	75.2	54.7	95.9					
7	19.5	20.0	18.0	SOFT TO MEDIUM STIFF			20	920	163.2	29.4	77.4	82	54	28		
8	24.5	25.0	26.0	BROWN ORGANIC CLAY			20	1035	203.6	24.7	74.9					
9	27.0	27.5	26.0	SOFT GRAY CLAY W/ SILT			20	670	59.6	61.6	98.3					
10	29.5	30.0	29.5	MEDIUM DENSE			20	1210*	26.6	88.2	111.6					
11	34.5	35.0	37.5	GRAY SILTY FINE SAND			20	1050*	25.3	91.5	114.7					
12	39.5	40.0	42.5	VERY SOFT			40	475	36.1	79.9	108.8					
13	44.5	45.0	42.5	GRAY SILTY CLAY			40	675	43.9	73.6	105.9	53	19	34		
14	49.5	50.0	50				50									
15	54.5	55.0	50				50	1060	40.2	76.7	107.6					
16	59.5	60.0	60	SOFT TO MEDIUM STIFF GRAY CLAY			60	1070	67.9	56.5	94.8					
17	64.5	65.0	60	W/ SILT			60	760	64.0	59.8	98.1	85	29	56		
18	69.5	70.0	70				70									
19	74.5	75.0	70				70	1570	63.4	59.5	97.3					
20	79.0	79.5	77.0	SOFT GRAY SANDY CLAY W/ SHELL			80	725	27.1	80.6	102.4					
			80.0				80									
							90									
							100									
							110									
							120									

CLAY   
 SILT   
 SAND   
 ORGANIC   
 \*140 lb. hammer dropped 30 inches on 2 inch splitpoon sampler after first being seated 6 inches.   
 REMARKS: Water Table Depth = 4.9 ft (See Text)   
 Free Water Depth = 12.0 ft (See Text)   
 \*equivalent Qu from 1-point triaxial test

# GORE ENGINEERING, INC.

Job No. 8069

Soil and Foundation Investigations  
Metairie, Louisiana

## LOG OF BORING AND TEST RESULTS

Date Boring Drilled: 27 August 2002

Boring No. B-5

Project: **EIGHT (8) STORAGE TANKS - STOLTHAVEN TERMINALS - BRAITHWAITE, LOUISIANA**  
**FOR: STOLTHAVEN TERMINAL DIVISION - BRAITHWAITE, LOUISIANA**

Recorded By: D.A. Hill

Sample No.	SAMPLE Depth in Feet		STRATUM Depth in Feet	VISUAL CLASSIFICATION	*Blows per Foot	Symbol Log	Scale (feet)	UNCONFINED COMPRESSION (Qu) (lbs./sq.ft.)	WATER CONTENT (percent)	UNIT WEIGHT (lbs./cu. ft.)		ATTERBERG LIMITS			
	From	To								DRY	WET	L.L.	P.L.	P.I.	
	0	0.5	0	STIFF BROWN & TAN CLAY			0								
1	2.5	3.0	1.0	MEDIUM STIFF TAN & GRAY CLAY W/ WOOD				1130	46.2	72.0	105.2				
2	5.5	6.0	4.0	SOFT TAN & GRAY SILTY CLAY				620	33.3	84.6	112.8				
3	8.5	9.0	7.0	VERY SOFT TO SOFT GRAY SILTY CLAY			10	380	37.2	79.4	108.9				
4	11.5	12.0						500	39.0	78.3	108.8	41	23	18	
5	14.5	15.0						435	40.6	78.0	109.6				
6	19.5	20.0	19.0	SOFT BROWN ORGANIC CLAY			20	935	399.0	12.7	63.2				
7	24.5	25.0	22.5	VERY SOFT GRAY CLAY W/ SILT				380	37.8	76.4	105.3	39	25	14	
8	29.5	30.0	28.5	SOFT GRAY CLAY W/ TRACE ORGANIC			30	620	82.0	51.1	93.0				
9	34.5	35.0	32.0	LOOSE TO MEDIUM DENSE GRAY SILTY FINE SAND				1310	30.0	86.3	112.2				
10	39.5	40.0					40	970*	28.6	87.9	113.1				
11	44.5	45.0	42.0	SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT				875	53.6	67.4	103.6				
12	49.5	50.0					50	1000	56.4	64.8	101.4				
13	54.5	55.0						910	51.4	68.1	103.1	64	29	35	
14	59.5	60.0					60	760	52.3	66.9	101.9				
15	64.5	65.0					70	1615	64.7	59.6	98.1				
16	69.5	70.0						900	62.9	59.2	96.4				
17	74.5	75.0					80								
18	79.5	80.0	80.0												
19							90								
							100								
							110								
							120								

CLAY   
 SILT   
 SAND   
 ORGANIC  
 Predominant Type Bold. Modifying Type Light.

\* 140 lb. hammer dropped 30 inches on 2 inch split spoon sampler after first being seated 6 inches.

REMARKS: Water Table Depth = 3.7 ft (See Text)  
Free Water Depth = 9.0 ft (See Text)  
\* equivalent Qu from 1-point triaxial test

Fig. 6

# GORE ENGINEERING, INC.

Job No. 8069

Soil and Foundation Investigations  
Metairie, Louisiana

## LOG OF BORING AND TEST RESULTS

Date Boring Drilled: 22 August 2002

Boring No. B-6

Project: **EIGHT (8) STORAGE TANKS - STOLTHAVEN TERMINALS - BRAITHTWAITE, LOUISIANA**  
**FOR: STOLTHAVEN TERMINAL DIVISION - BRAITHTWAITE, LOUISIANA**

Recorded By: **D.A. Hill**

Sample No.	SAMPLE Depth in Feet		STRATUM Depth in Feet	VISUAL CLASSIFICATION	*Blows per Foot	Symbol Log	Scale (feet)	UNCONFINED COMPRESSION (Qu) (lb./sq. ft.)	WATER CONTENT (percent)	UNIT WEIGHT (lb./cu. ft.)		ATTERBERG LIMITS				
	From	To								DRY	WET	L.L.	P.L.	P.I.		
			0	<b>LIMESTONE (FILL)</b>			0									
1	0.5	1.0	1.0	<b>VERY STIFF BROWN &amp; TAN CLAY W/ SILT</b>				4655	28.1	91.4	117.1					
2	2.5	3.0	4.0	<b>STIFF TAN &amp; GRAY CLAY W/ SILT</b>				2370	41.3	76.9	108.6					
3	5.5	6.0	7.5	<b>MEDIUM STIFF TAN &amp; GRAY SILTY CLAY</b>				1330	31.7	84.6	111.4					
4	8.5	9.0	10.0	<b>MEDIUM STIFF GRAY CLAY W/ SILT</b>				1165	41.3	77.2	109.1	61	20	41		
5	11.5	12.0	17.0	<b>VERY SOFT BROWN SILTY CLAY</b>				455	40.6	74.5	104.7	47	26	21		
6	14.5	15.0	26.5	<b>SOFT GRAY CLAY W/ ORGANIC</b>				905	102.0	43.2	87.3					
7	19.5	20.0	33.0	<b>LOOSE GRAY SILTY FINE SAND</b>				920*	25.1	87.3	109.2					
8	24.5	25.0	42.0	<b>SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT</b>				950	45.6	72.5	105.6					
9	29.5	30.0	50.0	<b>SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT</b>				960	51.3	66.2	100.2	68	24	44		
10	34.5	35.0	60.0	<b>SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT</b>				1260	45.6	72.4	105.4	63	22	41		
11	39.5	40.0	70.0	<b>SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT</b>				1040	59.9	62.4	99.8					
12	44.5	45.0	75.0	<b>SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT</b>				1770	62.2	61.7	100.1					
13	49.5	50.0	80.0	<b>SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT</b>				1405	57.5	63.5	100.0					
14	54.5	55.0	81.5	<b>DENSE GRAY FINE SAND</b>					20.6							
15	59.5	60.0	83.0	<b>DENSE GRAY FINE SAND</b>	30 = .7'											
16	64.5	65.0	83.5	<b>DENSE GRAY FINE SAND</b>	30 = .9'											
17	69.5	70.0	88.5	<b>DENSE GRAY FINE SAND</b>	29				26.2							
18	74.5	75.0	92.5	<b>STIFF BROWN ORGANIC CLAY W/ WOOD</b>				3905	257.2	18.9	67.6					
19	79.5	80.0	97.0	<b>MEDIUM STIFF TO STIFF GRAY CLAY W/ ORGANIC</b>				1900	71.5	56.2	96.4					
20	81.5	83.0	104.5	<b>MEDIUM STIFF TO STIFF GRAY CLAY W/ ORGANIC</b>				2625	40.6	78.7	110.7					
21	83.5	85.0	109.5	<b>MEDIUM STIFF TO STIFF GRAY CLAY W/ ORGANIC</b>												
22	88.5	90.0	111.5	<b>STIFF GREENISH GRAY CLAY W/ SILT</b>				2650	32.4	84.7	112.2					
23	94.5	95.0	114.5	<b>STIFF GREENISH GRAY CLAY W/ SILT</b>												
24	99.5	100.0	119.5	<b>STIFF GREENISH GRAY CLAY W/ SILT</b>				2265	29.8	86.7	112.5					
25	104.5	105.0	120.0	<b>STIFF GREENISH GRAY CLAY W/ SILT</b>												

CLAY
 SILT
 SAND
 ORGANIC

\* 140 lb. hammer dropped 30 inches on 2 inch splitspoon sampler after first being seated 6 inches. **REMARKS:** Water Table Depth = 3.1 ft (See Text)

Dominant Type Bold. Modifying Type Light.
\* equivalent Qu from 1-point triaxial test

Fig. 7

# GORE ENGINEERING, INC.

Job No. 8069

Soil and Foundation Investigations  
Metairie, Louisiana

## LOG OF BORING AND TEST RESULTS

Date Boring Drilled: 26 August 2002

Boring No. B-7

Project: EIGHT (8) STORAGE TANKS - STOLTHAVEN TERMINALS - BRAITHWAITE, LOUISIANA  
FOR: STOLTHAVEN TERMINAL DIVISION - BRAITHWAITE, LOUISIANA

Recorded By: D.A. Hill

Sample No.	SAMPLE Depth in Feet		STRATUM Depth in Feet	VISUAL CLASSIFICATION	Blows per Foot	Symbol Log	Scale (feet)	UNCONFINED COMPRESSION (qs) (lbs./sq.ft.)	WATER CONTENT (percent)	UNIT WEIGHT (lbs./cu.ft.)		ATTERBERG LIMITS					
	From	To								DRY	WET	L.L.	P.L.	P.I.			
	0	0.5	0	LOOSE TAN FINE SAND (FILL)			0										
1	2.5	3.0	3.0	STIFF GRAY & TAN CLAY W/ SILT				3220	34.0	86.4	115.8	61	22	39			
2	5.5	6.0	7.0	MEDIUM STIFF GRAY & TAN CLAY W/ SILT				1510	51.2	67.3	101.8						
3	8.5	9.0	10.0	MEDIUM STIFF TAN & GRAY CLAY			10	1340	47.0	70.7	104.0						
4	11.5	12.0		SOFT TO MEDIUM STIFF GRAY CLAY W/ SILT & WOOD				1020	36.3	80.5	109.7	46	26	20			
5	14.5	15.0						740	61.8	60.0	97.1						
6	19.5	20.0	18.5	MEDIUM STIFF BROWN HUMUS			20	1205	359.7	14.2	65.3						
7	24.5	25.0	24.0	VERY SOFT GRAY CLAY W/ SILT				430	66.8	57.8	96.4	141	51	90			
8	29.5	30.0						470	54.1	65.9	101.5						
9	34.5	35.0	33.0	MEDIUM DENSE GRAY SILTY FINE SAND W/ SOME CLAY				1180	29.5	84.0	108.8						
10	39.5	40.0						1065	22.8	83.1	102.0			(12)			
11	44.5	45.0	46.5														
12	49.5	50.0		MEDIUM STIFF GRAY CLAY W/ SILT				1260	38.0	77.0	106.2						
13	54.5	55.0						1410	46.1	71.0	103.8						
14	59.5	60.0						1450	48.6	69.4	103.2						
15	64.5	65.0						1235	53.0	66.1	101.2	81	27	54			
16	69.5	70.0															
17	74.5	75.0						1490	65.2	62.0	102.5						
18	79.5	80.0	80.0				80	1045	61.2	59.7	96.3						
							90										
							100										
							110										
							120										

NOTE: VALUES IN PARENTHESES ( ) INDICATE PERCENT PASSING NO. 200 SIEVE.

CLAY  
 SILT  
 SAND  
 ORGANIC  
 Determinant Type Bold. Modifying Type Light.

\*140 lb. hammer dropped 30 inches on 2 inch splitspoon sampler after first being seated 6 inches. REMARKS: Water Table Depth = 3.7 ft (See Text)

Fig. 8

# GORE ENGINEERING, INC.

Job No. 8069

Soil and Foundation Investigations  
Metairie, Louisiana

## LOG OF BORING AND TEST RESULTS

Date Boring Drilled: 23 August 2002

Boring No. B-8

Project: **EIGHT (8) STORAGE TANKS - STOLTHAVEN TERMINALS - BRAITHWAITE, LOUISIANA  
FOR: STOLTHAVEN TERMINAL DIVISION - BRAITHWAITE, LOUISIANA**

Recorded By: D.A. Hill

Sample No.	SAMPLE Depth in Feet		STRATUM Depth in Feet	VISUAL CLASSIFICATION	*Blows per Foot	Symbol Log	Scale (feet)	UNCONFINED COMPRESSION (Qu) (lbs./sq. ft.)	WATER CONTENT (percent)	UNIT WEIGHT (lbs./cu. ft.)		ATTERBERG LIMITS					
	From	To								DRY	WET	L.L.	P.L.	P.I.			
			0				0										
1	.5	1.0	2.0	LIMESTONE (FILL)													
2	2.5	3.0		STIFF TAN & GRAY CLAY				2510	27.7	84.3	107.6						
3	5.5	6.0		W/ SILT				2130	47.6	71.3	105.2						
4	8.5	9.0	7.0	MEDIUM STIFF TAN & GRAY CLAY			10	1630	48.8	66.0	98.2						
5	11.5	12.0	10.0	SOFT GRAY SILTY CLAY				545	36.5	80.7	110.1						
6	14.5	15.0	13.5	SOFT GRAY CLAY				880	48.7	70.7	105.1						
			18.0	W/ WOOD													
7	19.5	20.0	21.0	SOFT BROWN & GRAY CLAY			20	640	98.2	44.7	88.6						
			27.0	W/ WOOD													
8	24.5	25.0		VERY SOFT BROWN HUMUS				485	577.0	8.5	57.8						
			33.0	W/ WOOD													
9	29.5	30.0		MEDIUM STIFF GRAY CLAY			30	1160	107.9	41.6	86.5						
			36.0	W/ SILT													
10	34.5	35.0		LOOSE GRAY FINE SAND				870*	28.3	83.4	107.0						
11	36.0	37.5		MEDIUM DENSE	23				25.1								(18)
12	38.5	40.0		GRAY SILTY FINE SAND	25		40										
			45.5	W/ SOME CLAY													
13	43.5	45.0			12				29.1								
			50.0				50										
14	49.5	50.0						1085	53.2	66.4	101.7						
15	54.5	55.0						820	41.6	76.3	108.1	80	22	58			
16	59.5	60.0					60										
17	64.5	65.0		SOFT TO MEDIUM STIFF GRAY CLAY				1465	56.9	64.1	100.5						
			70.0	W/ SILT													
18	69.5	70.0					70	1245	53.9	65.3	100.5	79	21	58			
19	74.5	75.0															
20	79.5	80.0	80.0				80	1035	59.7	61.1	97.6						
			90				90										
			100				100										
			110				110										
			120				120										

NOTE: VALUES IN PARENTHESES ( ) INDICATE PERCENT PASSING NO. 200 SIEVE.

CLAY  
 SILT  
 SAND  
 ORGANIC

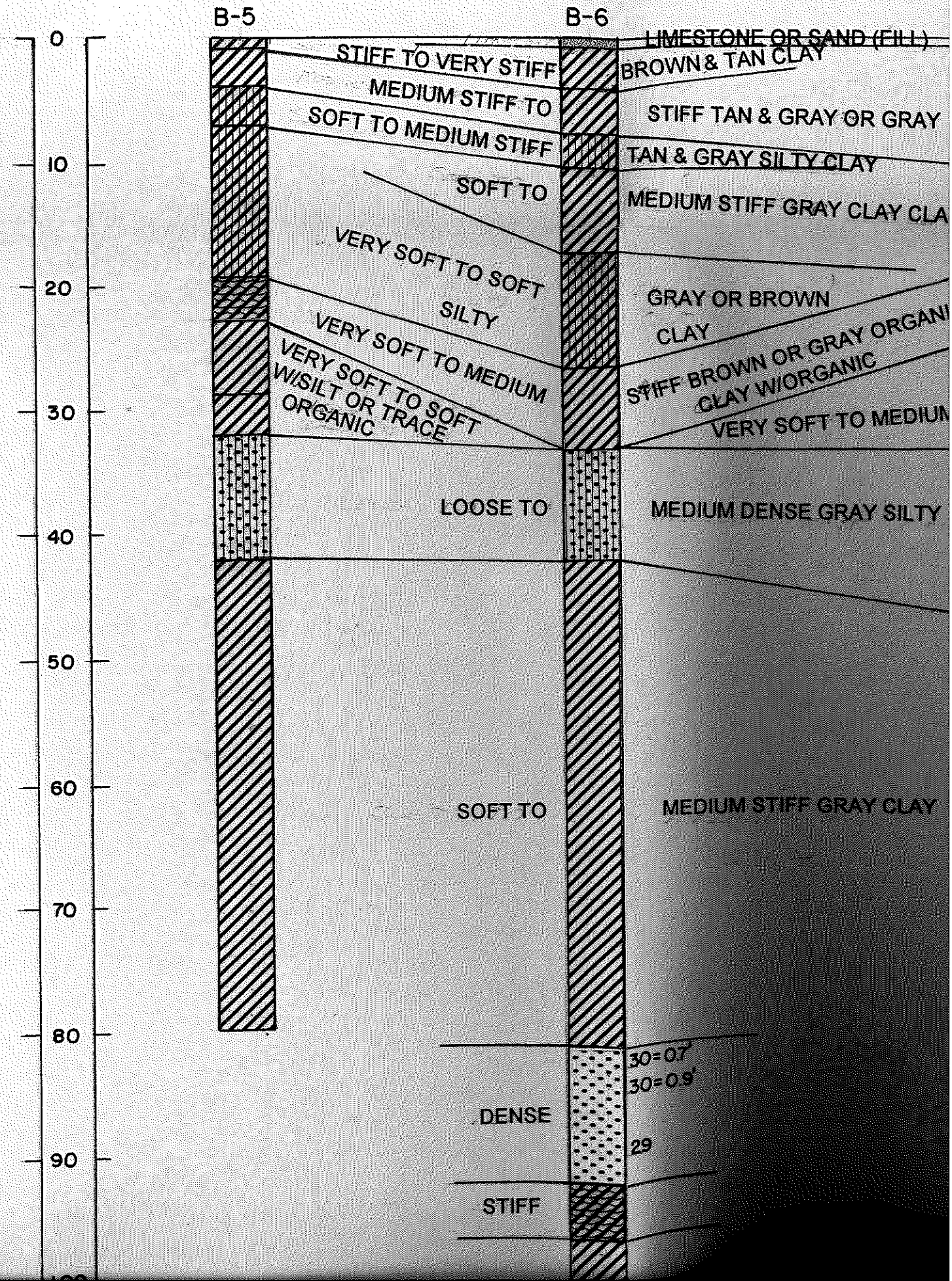
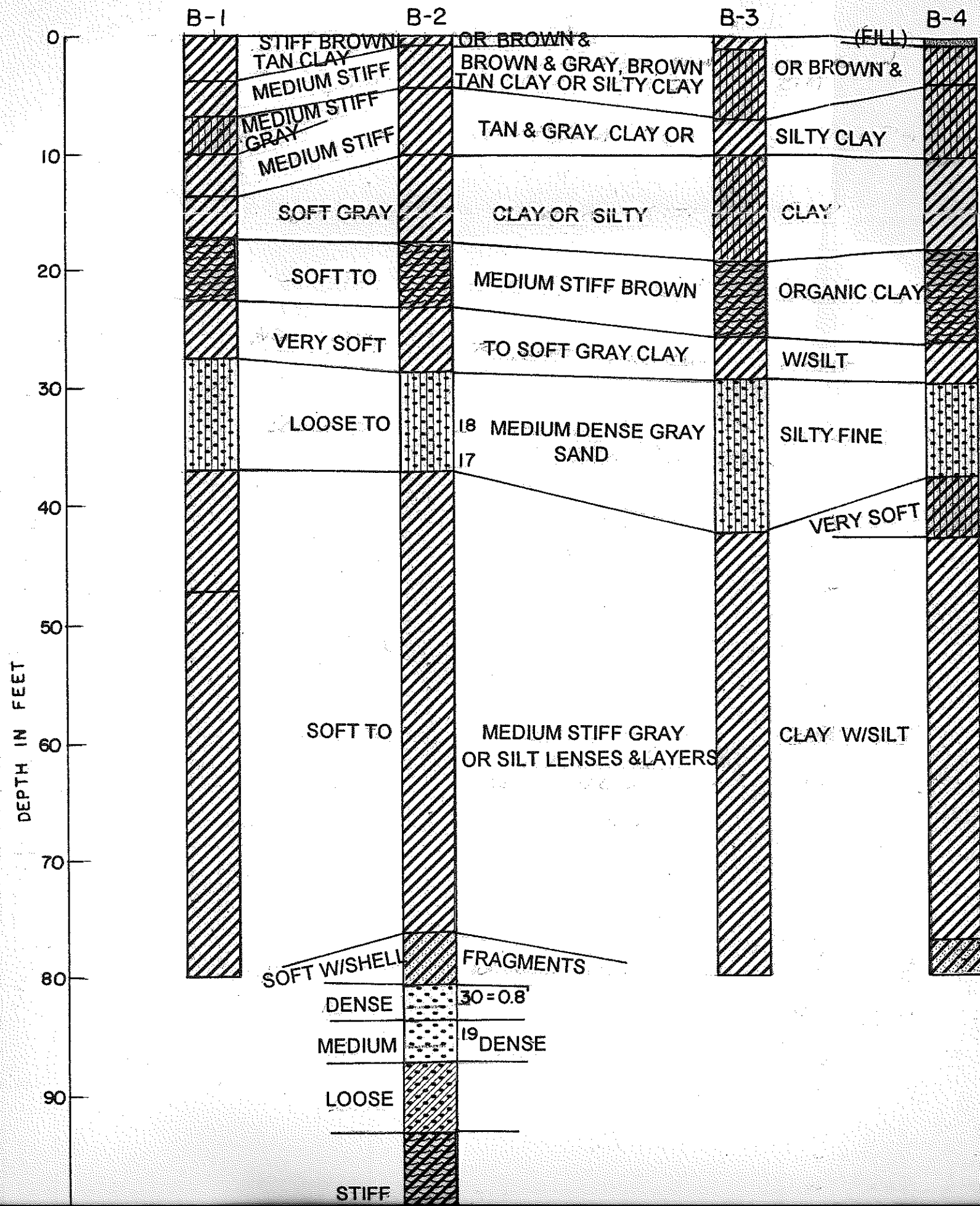
Predominant Type Bold. Modifying Type Light.

\* 140 lb. hammer dropped 30 inches on 2 inch splitspoon sampler after first being seated 6 inches.

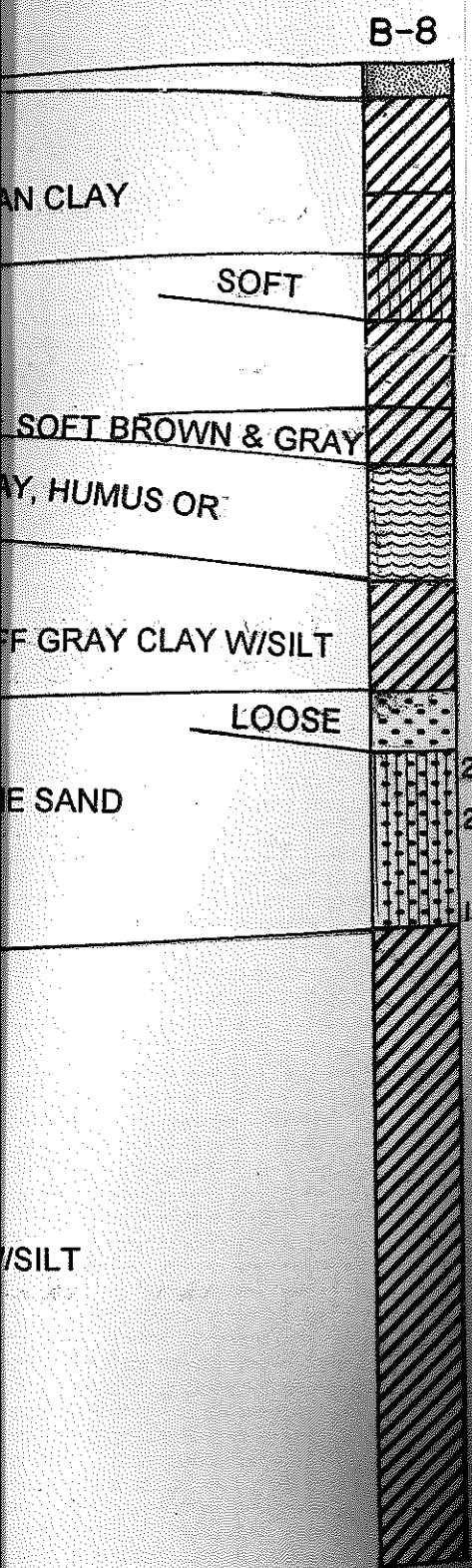
REMARKS: Water Table Depth = 3.5 ft (See Text)

\* equivalent Qu from 1-point triaxial test

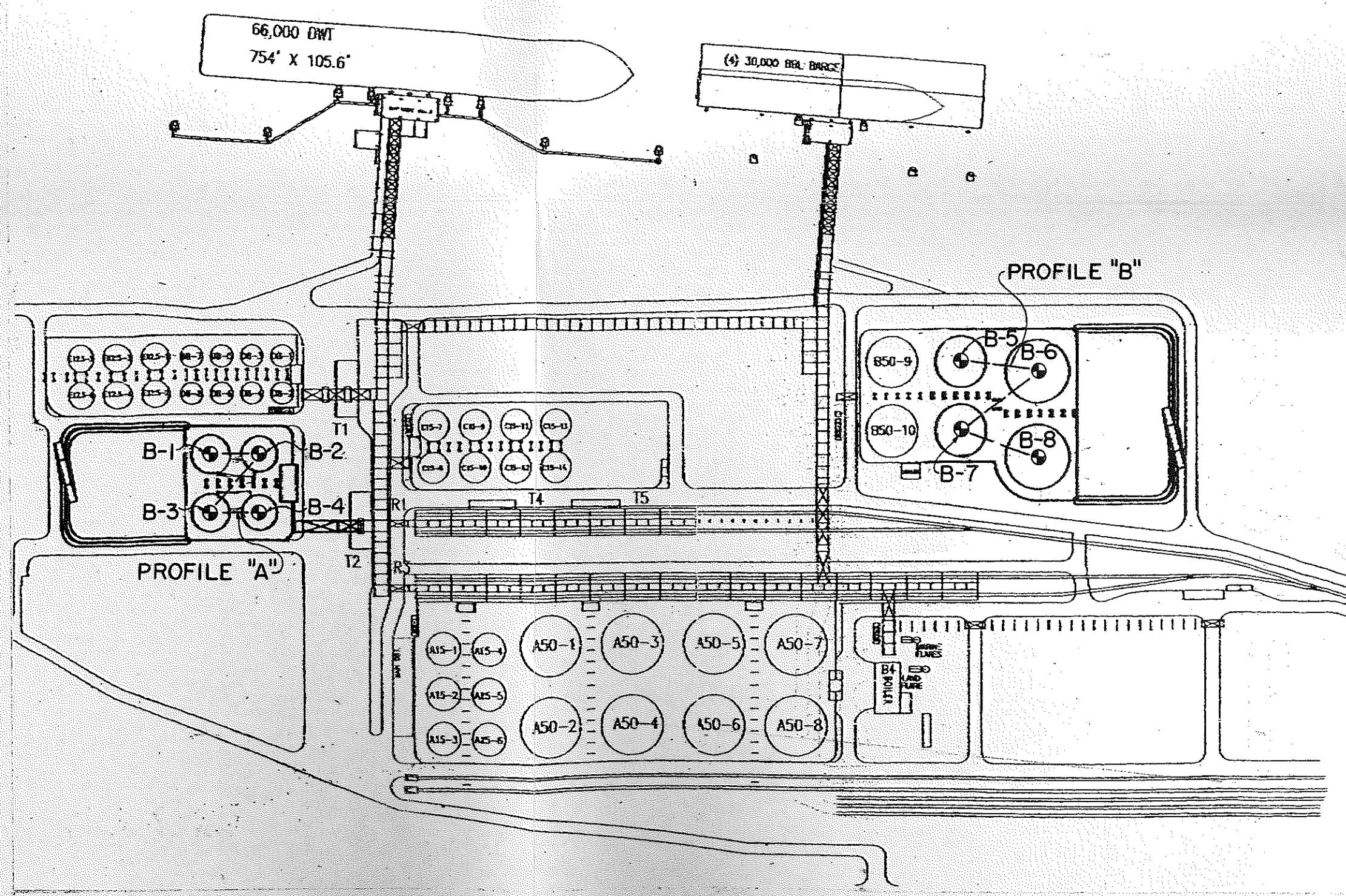
Fig. 9



MISSISSIPPI RIVER

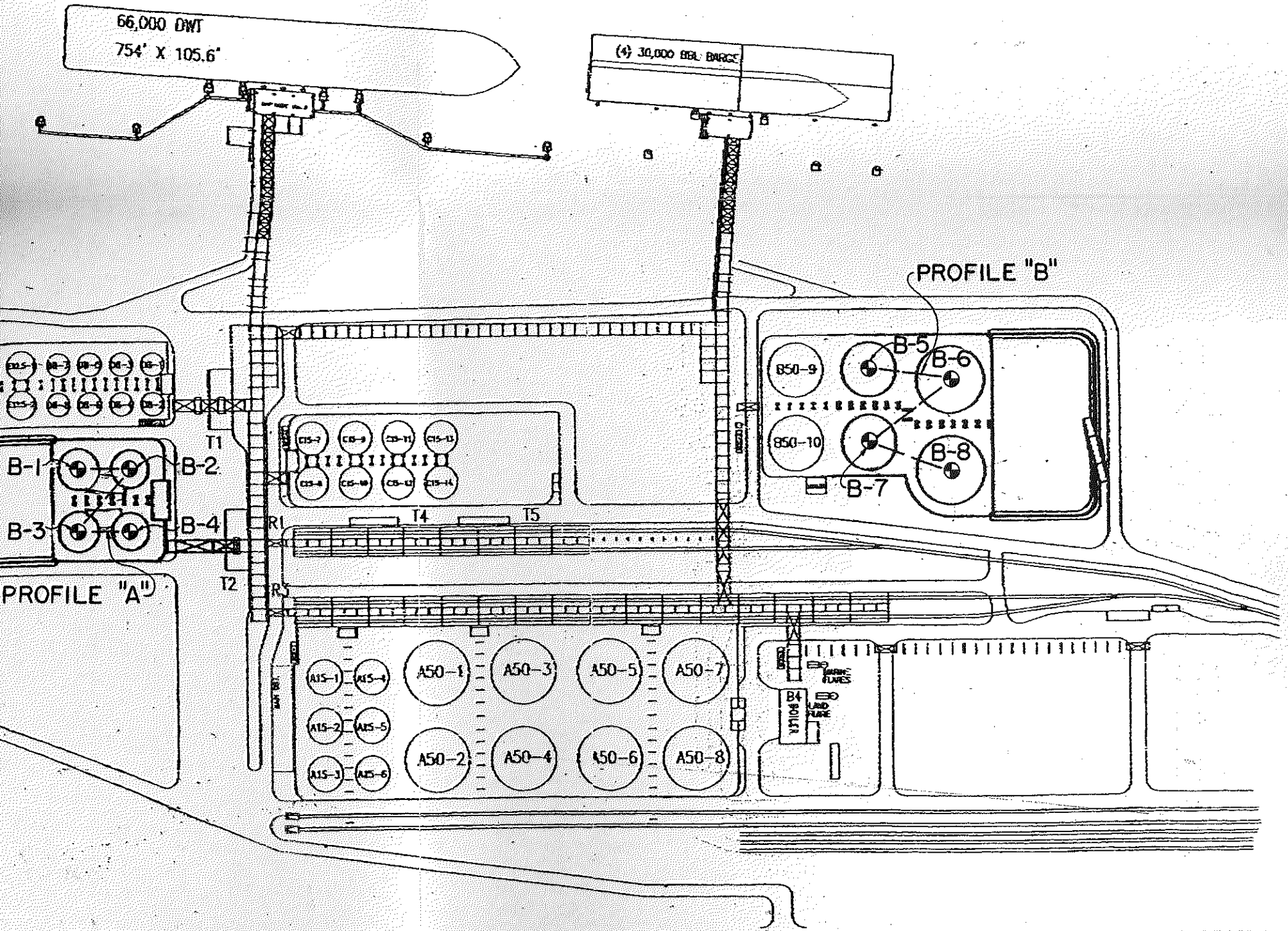


DEPTH IN FEET



BORING LOCATIONS  
SCALE: 1" = 200'

MISSISSIPPI RIVER

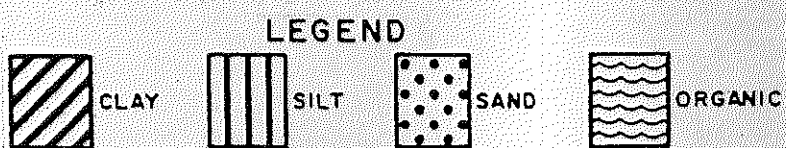


**BORING LOCATIONS**  
SCALE: 1" = 200'

SUBSOIL INVESTIGATION  
**EIGHT (8) STORAGE TANKS**  
STOLTHAVEN TERMINAL  
BRAITHWAITE, LOUISIANA

**BORING LOCATIONS AND SUBSOIL PROFILE**

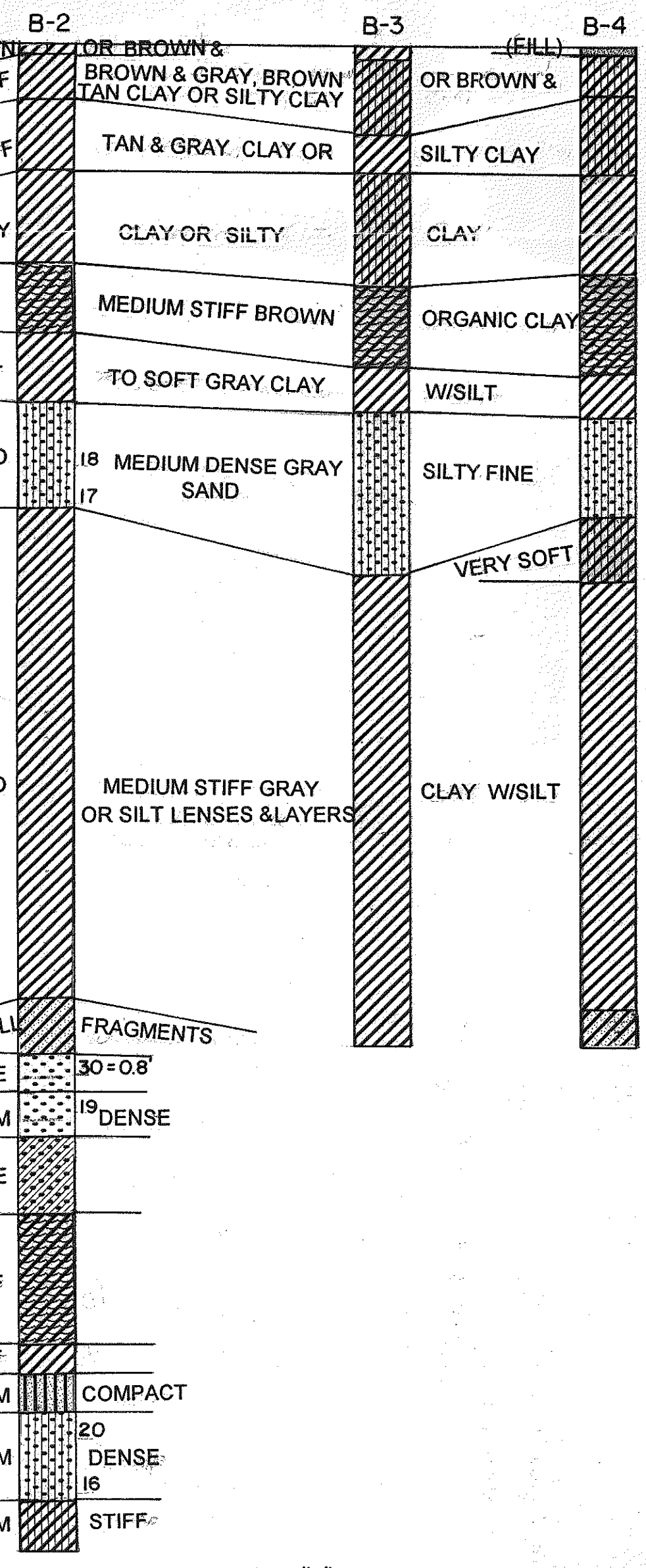
FOR  
STOLTHAVEN TERMINAL DIVISION  
BRAITHWAITE, LOUISIANA



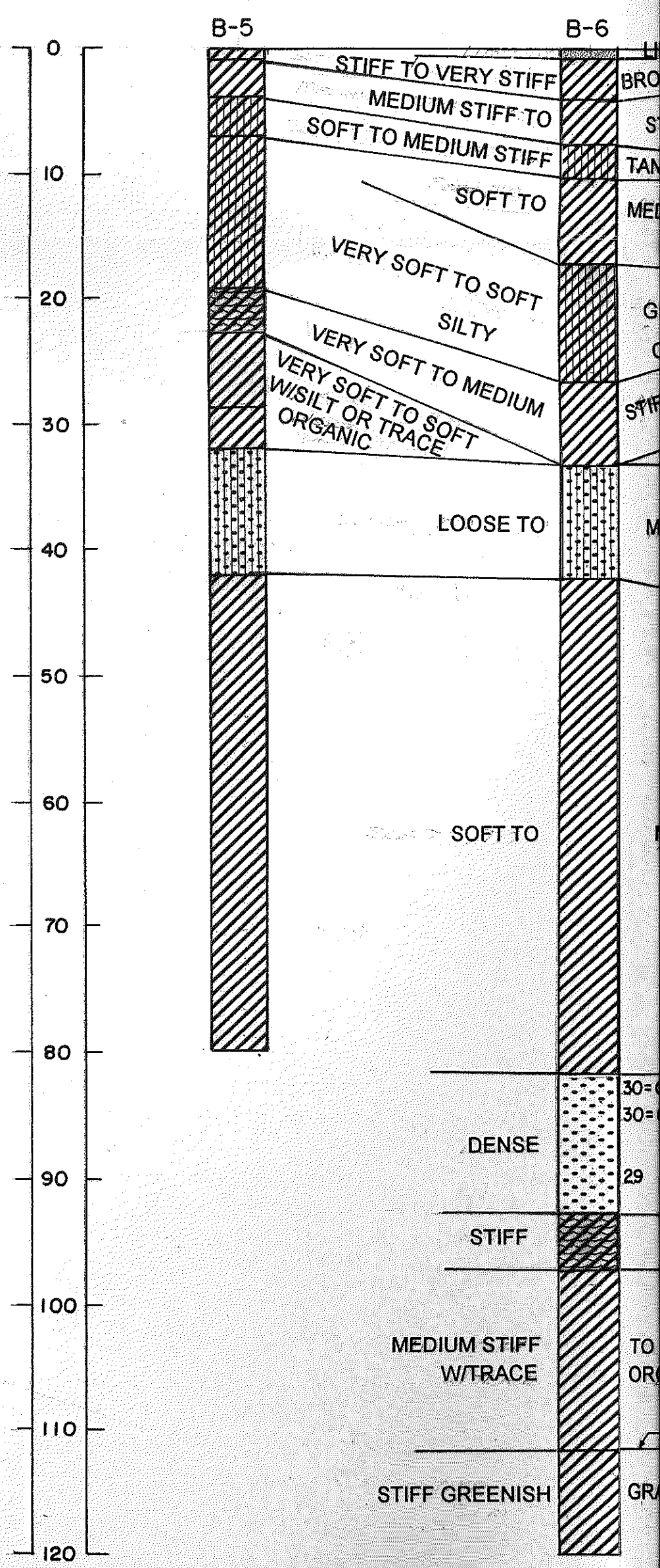
PREDOMINANT TYPE HEAVY  
MODIFYING TYPE LIGHT

FIGURES BESIDE BORINGS ARE BLOWS OF 140lb. HAMMER  
FALLING 30in. TO DRIVE A 2in. DIA. SAMPLER ONE FOOT.

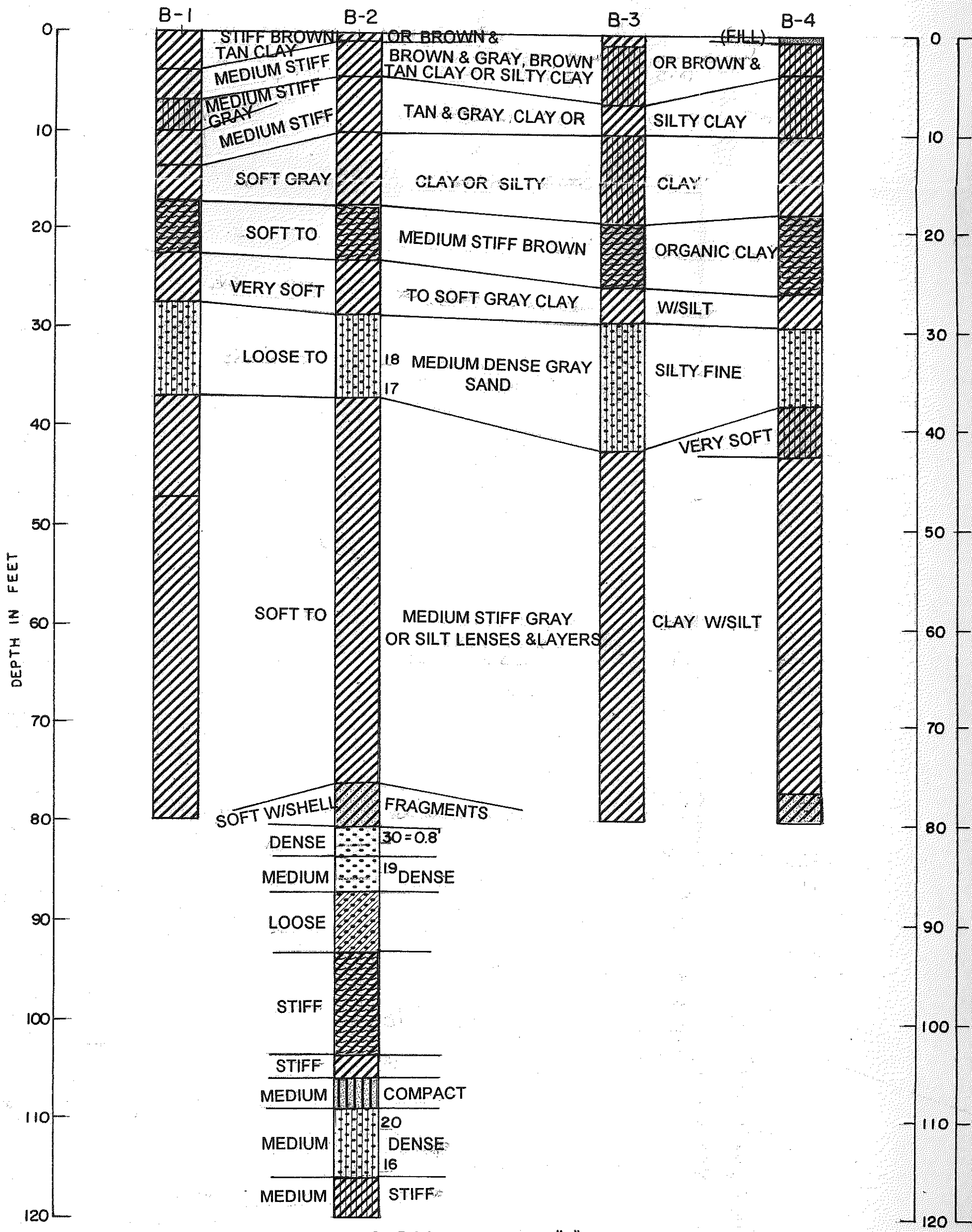




SUBSOIL PROFILE "A"



SUB



SUBSOIL PROFILE "A"