BORING LOG NO. 09-B95

CLIENT:	USACE, Galveston District Galveston, Texas	PROJECT:	TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
BORING LOCATION:	N: 13826584 E: 3260017	SITE:	Cedar Bayou PA6 Baytown, Texas

Approx. Surface Elevation: 11.0 feet

Graphic Log	DESCRIPTION	DEPTH, FEET	USCS SYMBOL	TYPE	RECOVERY, IN	SPT, BLOWS/FT	CALIBRATED HAND PENETROM., TSF	TORVANE, TSF	MOISTURE CONTENT, %	DRY DENSITY, PCF	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX	MINUS #200 SIEVE, %	COMPRESSIVE STRENGTH, TSF	FAILURE STRAIN, %	CONFINING PRESSURE, PSI
	FILL: FAT CLAY light gray and dark gray, very soft to medium stiff, high to very high plasticity, moist to wet - with roots 0 to 2 feet ▼ - with organic matter 4 to 6 feet	1	CH	ST	17		0.25	0.2	51	68	96	28	68	95			
		2															
		3		ST	0												
		4															
		5		ST	17		0.25	0.15	48								
		6															
		7		ST	8		0.25	0.3	31								
	- with organic matter 8 to 10 feet	8															
		9		ST	9		0.25	0.2	54	71	51	18	33	94			
		10															
	-1.0 12.0	11		ST	18		0.25	0.05	47								
	FAT CLAY dark gray, gray, light gray and brown, soft to stiff, very high plasticity, moist - with roots 12 to 14 feet	12	CH														
		13		ST	14		0.5		35								
		14															
		15		ST	12		1.5		30								
		16															
		17		ST	19		1.0		33	91	67	19	48	97			
		18															
	-9.0 20.0	19		ST	13		0.5		35								
	Boring terminated at 20 feet.	20															

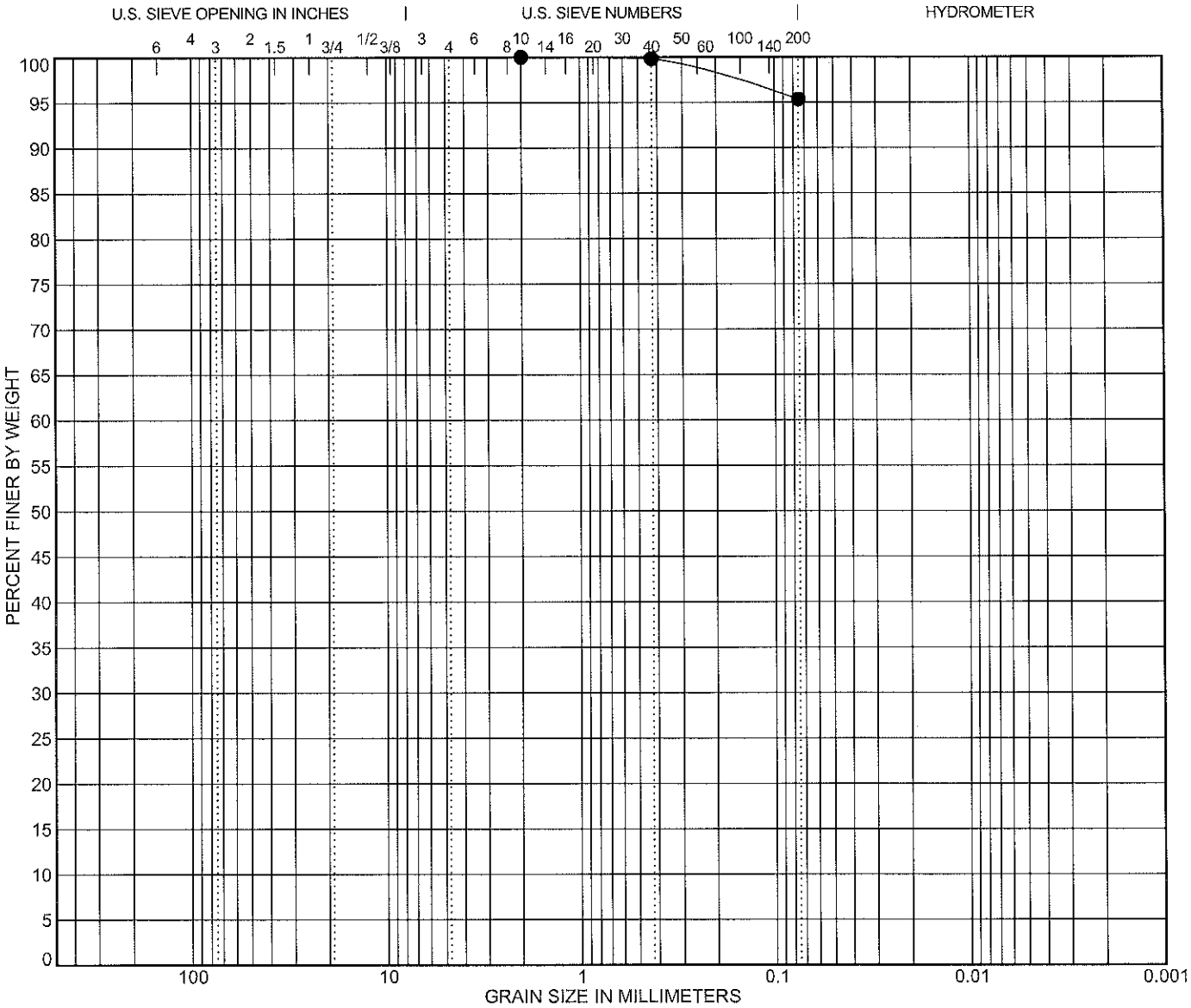
STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION BETWEEN STRATA MAY BE MORE GRADUAL.

REMARKS: Dry augered to 4 feet; wet rotary thereafter.

WATER LEVEL OBSERVATIONS			
▽ 4 ft	WD	▼ 4 ft	at 5 min
▼ 4 ft	at 10 min	▼ 4 ft	at 15 min

Terracon

DATE DRILLED	Page 1 of 1
3/22/2010	09-B95
PROJECT NUMBER 92105186-A	EXHIBIT A-



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**09-B95**	**0.0**	**FAT CLAY(CH)**	**96**	**28**	**68**		

Percent Passing the Indicated Sieve

	Specimen Identification		3/8"	#4	#10	#40	#100	#200
●	**09-B95**	**0.0**			**100**	**99.8**		**95.3**

	Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**09-B95**	**0.0**	**2**				**0.0**	**4.7**	**95.3**	

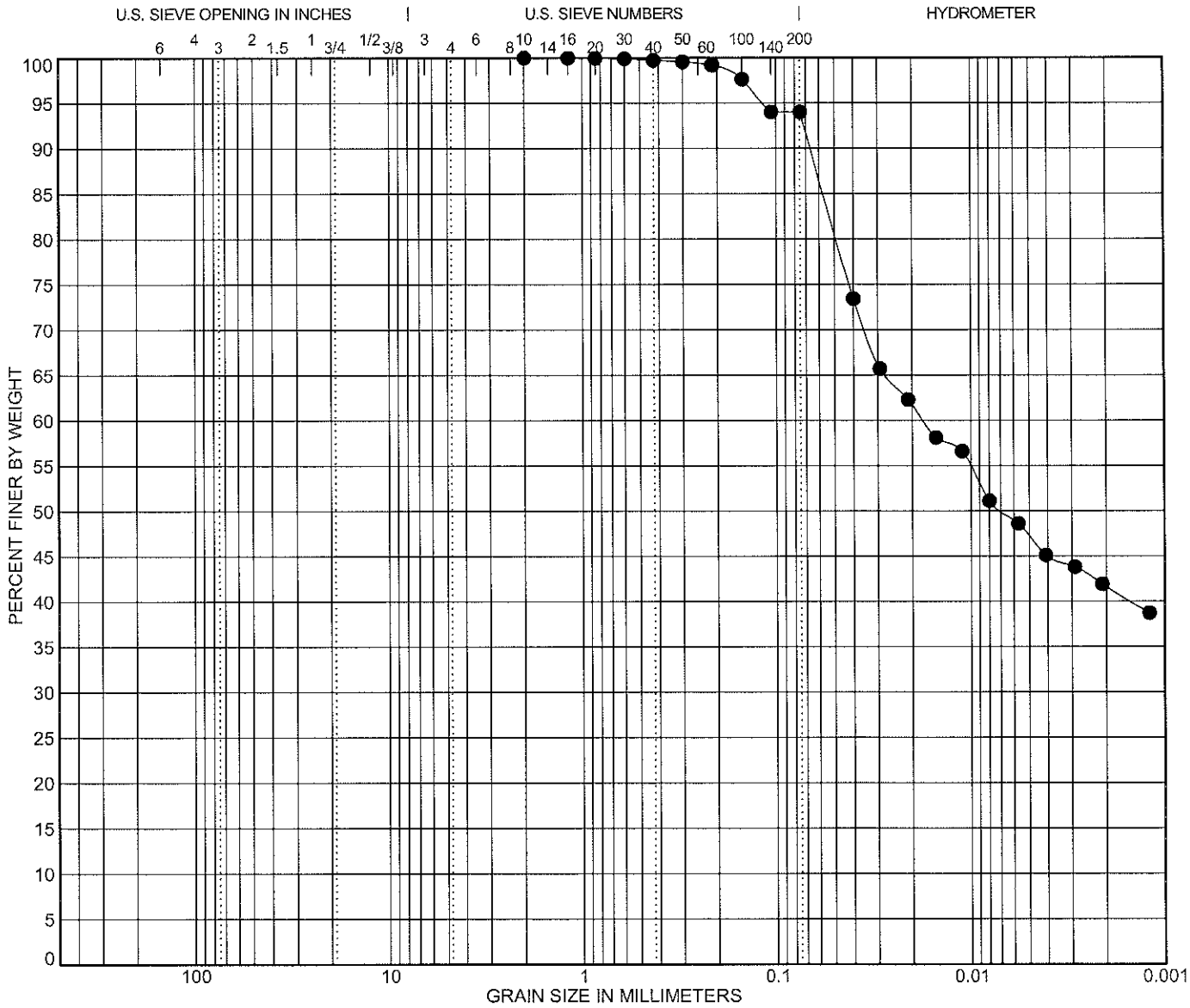
GRAIN SIZE DISTRIBUTION

TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
Baytown, Texas
Project Number 92105186-A

Terracon

Terracon Consultants, Inc.
11555 Clay Road, Suite 100
Houston, Texas 77043
Telephone: 713-690-8989
Fax: 713-690-8787

EXHIBIT
i



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**09-B95**	**8.0**	**FAT CLAY(CH)**	**51**	**18**	**33**		

Percent Passing the Indicated Sieve

	Specimen Identification		3/8"	#4	#10	#40	#100	#200
●	**09-B95**	**8.0**			**100**	**99.7**	**97.6**	**94**

	Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**09-B95**	**8.0**	**2**	**0.007**			**0.0**	**6.0**	**52.4**	**41.6**

GRAIN SIZE DISTRIBUTION

TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
Baytown, Texas
Project Number 92105186-A

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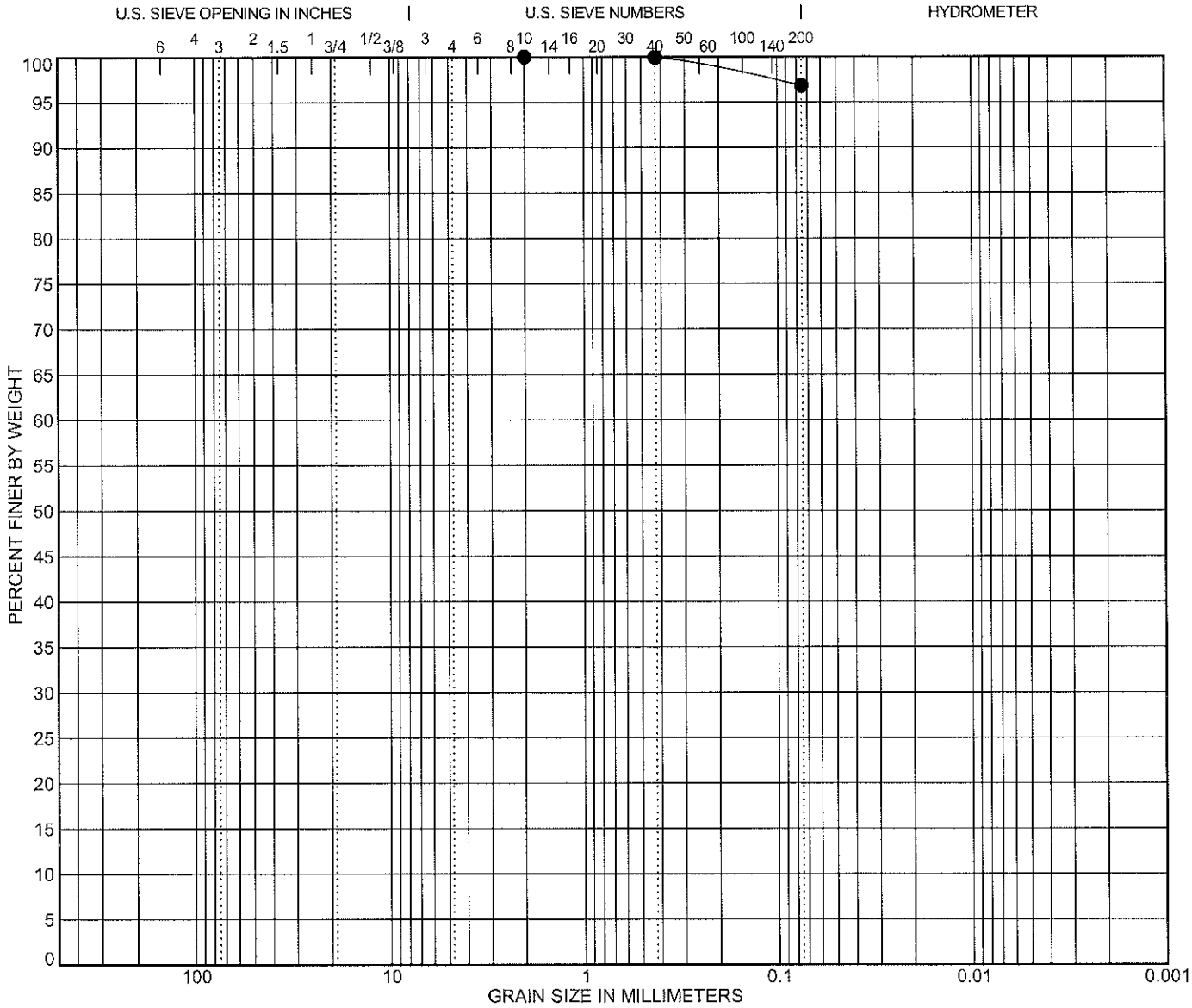
EXHIBIT
I



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● 09-B95	16.0	**FAT CLAY(CH)**	**67**	**19**	**48**		

Percent Passing the Indicated Sieve

Specimen Identification		3/8"	#4	#10	#40	#100	#200
● 09-B95	16.0			**100**	**99.9**		**96.8**

Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 09-B95	16.0	**2**				**0.0**	**3.2**	**96.8**	

GRAIN SIZE DISTRIBUTION

TO-0012 Pipeline Dredging, Cedar Bayou & Anahuac Channel, Volume I
Baytown, Texas
Project Number 92105186-A

Terracon

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Houston, Texas 77043
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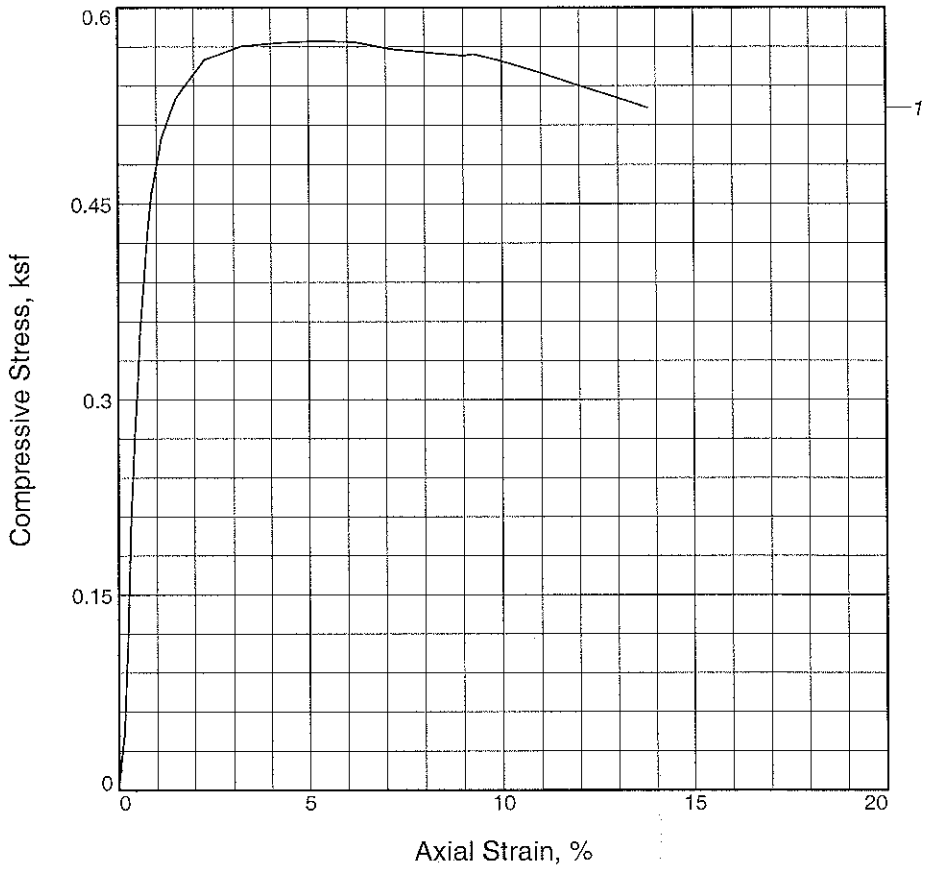
EXHIBIT
I

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	0.574			
Undrained shear strength, ksf	0.287			
Failure strain, %	5.2			
Strain rate, in./min.	0.055			
Water content, %	50.7			
Wet density, pcf	103.0			
Dry density, pcf	68.4			
Saturation, %	92.3			
Void ratio	1.5113			
Specimen diameter, in.	2.646			
Specimen height, in.	5.787			
Height/diameter ratio	2.19			

Description: Gray Clay w/roots

LL =	**PL =**	**PI =**	**Assumed GS=** 2.75	**Type:** undisturbed

Project No.: 92105186-B

Date Sampled:

Remarks:
Undisturbed

Client: USACE

Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16. Contract no. W912HY-09-D-0021, Task Order No. 0012

Location: 09-B95

Sample Number: 1 **Depth:** 0-2 ft.

UNCONFINED COMPRESSION TEST
Terracon, Inc.
Houston, TX

UNCONFINED COMPRESSION TEST

11/5/2010

Date:
Client: USACE
Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16.
Contract no. W912HY-09-D-0021, Task Order No. 0012
Project No.: 92105186-B
Location: 09-B95
Depth: 0-2 ft. **Sample Number:** 1
Description: Gray Clay w/roots
Remarks: Undisturbed
Type of Sample: undisturbed
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**

Parameters for Specimen No. 1

Specimen Parameter	Initial
Moisture content: Moist soil+tare, gms.	156.210
Moisture content: Dry soil+tare, gms.	120.670
Moisture content: Tare, gms.	50.630
Moisture, %	50.7
Moist specimen weight, gms.	860.77
Diameter, in.	2.646
Area, in.^{2}	5.499
Height, in.	5.787
Wet density, pcf	103.0
Dry density, pcf	68.4
Void ratio	1.5113
Saturation, %	92.3

Test Readings for Specimen No. 1

Strain rate, in./min. = 0.055

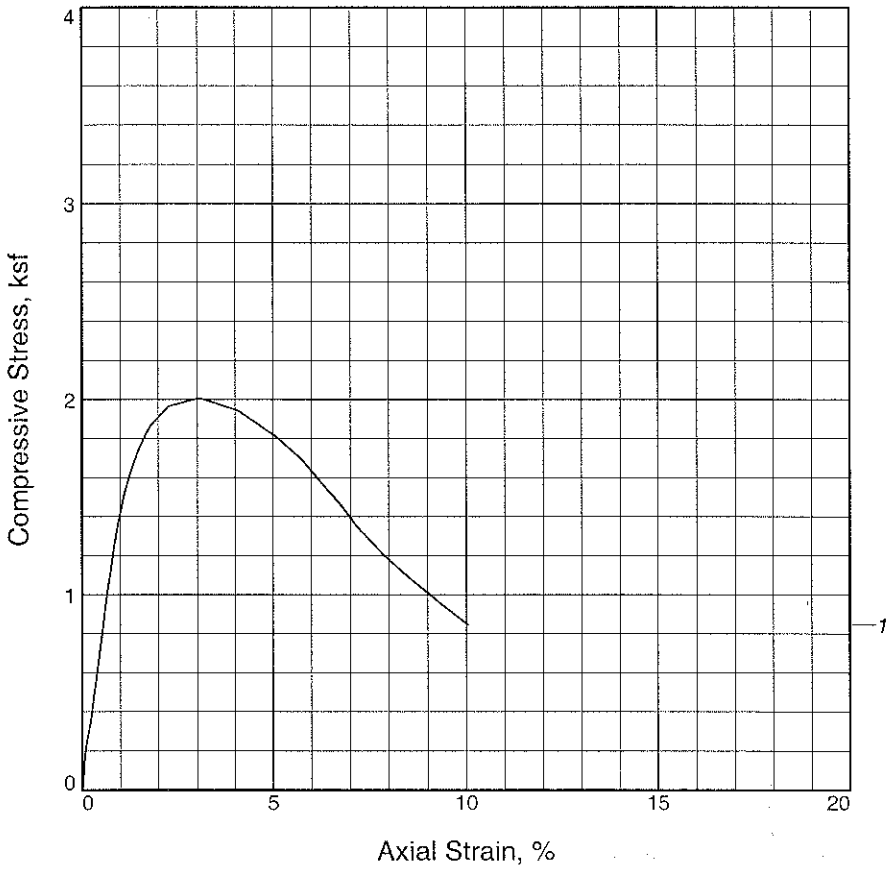
Unconfined compressive strength = 0.574 ksf **at reading no.** 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
0	0.0000	0.000	0.0	0.0	0.000
1	0.0000	0.171	0.2	0.0	0.004
2	0.0082	1.684	1.7	0.1	0.044
3	0.0111	3.152	3.2	0.2	0.082
4	0.0139	4.467	4.5	0.2	0.117
5	0.0162	6.245	6.2	0.3	0.163
6	0.0191	7.979	8.0	0.3	0.208
7	0.0219	9.183	9.2	0.4	0.240
8	0.0248	10.462	10.5	0.4	0.273
9	0.0290	11.940	11.9	0.5	0.311
10	0.0328	13.519	13.5	0.6	0.352
11	0.0385	14.957	15.0	0.7	0.389
12	0.0442	16.295	16.3	0.8	0.423
13	0.0508	17.636	17.6	0.9	0.458
14	0.0659	19.286	19.3	1.1	0.499
15	0.0881	20.557	20.6	1.5	0.530

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
16	0.1321	21.891	21.9	2.3	0.560
17	0.1869	22.514	22.5	3.2	0.571
18	0.2422	22.833	22.8	4.2	0.573
19	0.3027	23.148	23.1	5.2	0.574
20	0.3576	23.350	23.3	6.2	0.574
21	0.4124	23.363	23.4	7.1	0.568
22	0.4677	23.493	23.5	8.1	0.565
23	0.5226	23.639	23.6	9.0	0.563
24	0.5363	23.749	23.7	9.3	0.564
25	0.5774	23.714	23.7	10.0	0.559
26	0.6327	23.605	23.6	10.9	0.551
27	0.6875	23.461	23.5	11.9	0.541
28	0.7428	23.330	23.3	12.8	0.533
29	0.7977	23.176	23.2	13.8	0.523

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	2.006			
Undrained shear strength, ksf	1.003			
Failure strain, %	3.0			
Strain rate, in./min.	0.055			
Water content, %	33.1			
Wet density, pcf	121.4			
Dry density, pcf	91.3			
Saturation, %	103.2			
Void ratio	0.8811			
Specimen diameter, in.	2.755			
Specimen height, in.	5.775			
Height/diameter ratio	2.10			

Description: Dark gray Fat Clay

LL =	**PL =**	**PI =**	**Assumed GS=** 2.75	**Type:** Undisturbed

Project No.: 92105186-B

Date Sampled:

Remarks:
ASTM D2166

Client: USACE

Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16. Contract no. W912HY-09-D-0021, Task Order No. 0012

Location: 09-B95

Sample Number: 9 **Depth:** 16-18 ft.

UNCONFINED COMPRESSION TEST
Terracon, Inc.
Houston, TX

UNCONFINED COMPRESSION TEST

11/5/2010

Date:
Client: USACE
Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16.
Contract no. W912HY-09-D-0021, Task Order No. 0012
Project No.: 92105186-B
Location: 09-B95
Depth: 16-18 ft. **Sample Number:** 9
Description: Dark gray Fat Clay
Remarks: ASTM D2166
Type of Sample: Undisturbed
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**

Parameters for Specimen No. 1

Specimen Parameter	Initial
Moisture content: Moist soil+tare, gms.	178.440
Moisture content: Dry soil+tare, gms.	146.720
Moisture content: Tare, gms.	50.780
Moisture, %	33.1
Moist specimen weight, gms.	1097.37
Diameter, in.	2.755
Area, in.^{2}	5.961
Height, in.	5.775
Wet density, pcf	121.4
Dry density, pcf	91.3
Void ratio	0.8811
Saturation, %	103.2

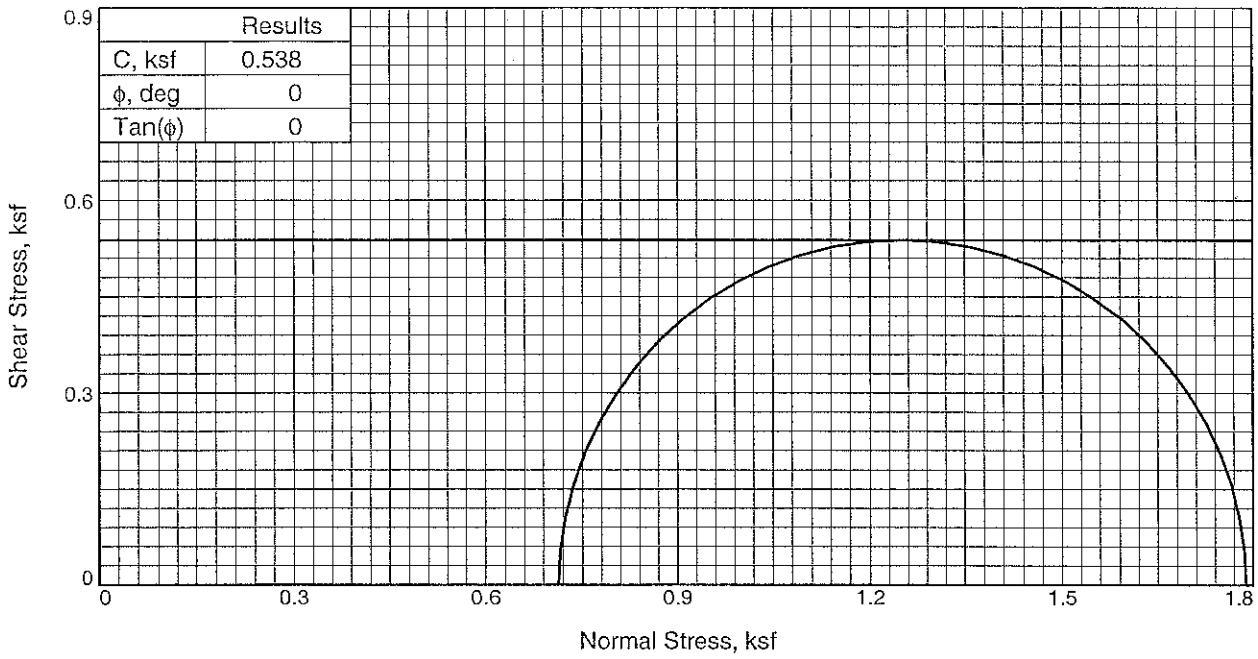
Test Readings for Specimen No. 1

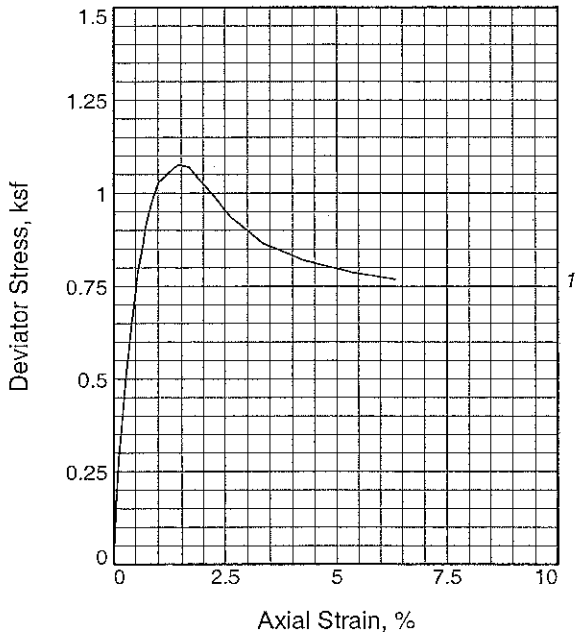
Strain rate, in./min. = 0.055
Unconfined compressive strength = 2.006 ksf **at reading no.** 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
0	0.0120	0.000	0.0	0.0	0.000
1	0.0130	0.200	0.2	0.0	0.005
2	0.0150	4.627	4.6	0.1	0.112
3	0.0178	9.188	9.2	0.1	0.222
4	0.0249	14.358	14.4	0.2	0.346
5	0.0301	19.664	19.7	0.3	0.474
6	0.0343	24.340	24.3	0.4	0.586
7	0.0386	29.475	29.5	0.5	0.709
8	0.0429	34.190	34.2	0.5	0.821
9	0.0466	38.784	38.8	0.6	0.931
10	0.0509	43.199	43.2	0.7	1.036
11	0.0608	52.462	52.5	0.8	1.257
12	0.0660	56.920	56.9	0.9	1.362
13	0.0769	64.117	64.1	1.1	1.531
14	0.0882	69.512	69.5	1.3	1.657
15	0.0991	73.863	73.9	1.5	1.757

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
16	0.1156	78.577	78.6	1.8	1.864
17	0.1431	83.291	83.3	2.3	1.966
18	0.1870	85.643	85.6	3.0	2.006
19	0.1927	85.618	85.6	3.1	2.004
20	0.2475	83.856	83.9	4.1	1.943
21	0.3028	79.159	79.2	5.0	1.816
22	0.3440	74.380	74.4	5.7	1.693
23	0.3714	69.804	69.8	6.2	1.581
24	0.3988	65.373	65.4	6.7	1.473
25	0.4267	60.017	60.0	7.2	1.346
26	0.4678	53.865	53.9	7.9	1.198
27	0.5089	48.631	48.6	8.6	1.074
28	0.5501	43.605	43.6	9.3	0.955
29	0.5917	38.910	38.9	10.0	0.846





Sample No.		1
Initial	Water Content, %	54.2
	Dry Density, pcf	71.0
	Saturation, %	105.1
	Void Ratio	1.4188
	Diameter, in.	2.742
	Height, in.	5.800
At Test	Water Content, %	54.2
	Dry Density, pcf	71.0
	Saturation, %	105.1
	Void Ratio	1.4188
	Diameter, in.	2.742
	Height, in.	5.800
Strain rate, in./min.		0.055
Back Pressure, psi		0.000
Cell Pressure, psi		4.950
Fail. Stress, ksf		1.076
Ult. Stress, ksf		
σ_1 Failure, ksf		1.789
σ_3 Failure, ksf		0.713

Type of Test:
Unconsolidated Undrained

Sample Type: Undisturbed

Description: Gray Clay w/roots

Assumed Specific Gravity= 2.75

Remarks: ASTM D2850

Client: USACE

Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16.
Contract no. W912HY-09-D-0021, Task Order No. 0012

Location: 09-B95

Sample Number: 5 **Depth:** 8-10 ft.

Proj. No.: 92105186-B **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT
Terracon, Inc.
Houston, TX

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

11/8/2010
7:57 AM

Date:
Client: USACE
Project: Pipeline Dredging, Cedar Bayou and Anahuac Channel, PA 16.
Contract no. W912HY-09-D-0021, Task Order No. 0012
Project No.: 92105186-B
Location: 09-B95
Depth: 8-10 ft. **Sample Number:** 5
Description: Gray Clay w/roots
Remarks: ASTM D2850
Type of Sample: Undisturbed
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	139.250	139.250
Moisture content: Dry soil+tare, gms.	107.960	107.960
Moisture content: Tare, gms.	50.260	50.260
Moisture, %	54.2	54.2
Moist specimen weight, gms.	984.13	
Diameter, in.	2.742	
Area, in.^{2}	5.905	
Height, in.	5.800	
Wet density, pcf	109.5	
Dry density, pcf	71.0	
Void ratio	1.4188	
Saturation, %	105.1	

Test Readings for Specimen No. 1

Cell pressure = 4.950 psi (0.713 ksf)
Back pressure = 0.000 psi (0.000 ksf)
Strain rate, in./min. = 0.055
Fail. Stress = 1.076 ksf **at reading no.** 16

Test Readings for Specimen No.

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf	Minor Princ. Stress ksf	Major Princ. Stress ksf	1:3 Ratio	P ksf	Q ksf
0	0.0000	0.000	0.0	0.0	0.000	0.713	0.713	1.00	0.713	0.000
1	0.0000	0.607	0.6	0.0	0.015	0.713	0.728	1.02	0.720	0.007
2	0.0015	3.397	3.4	0.0	0.083	0.713	0.796	1.12	0.754	0.041
3	0.0027	5.993	6.0	0.0	0.146	0.713	0.859	1.20	0.786	0.073
4	0.0055	10.132	10.1	0.1	0.247	0.713	0.960	1.35	0.836	0.123
5	0.0086	13.719	13.7	0.1	0.334	0.713	1.047	1.47	0.880	0.167
6	0.0117	16.224	16.2	0.2	0.395	0.713	1.108	1.55	0.910	0.197
7	0.0161	20.638	20.6	0.3	0.502	0.713	1.215	1.70	0.964	0.251
8	0.0205	23.865	23.9	0.4	0.580	0.713	1.293	1.81	1.003	0.290
9	0.0236	26.332	26.3	0.4	0.640	0.713	1.352	1.90	1.033	0.320
10	0.0280	29.390	29.4	0.5	0.713	0.713	1.426	2.00	1.069	0.357
11	0.0323	32.541	32.5	0.6	0.789	0.713	1.502	2.11	1.107	0.395
12	0.0373	34.792	34.8	0.6	0.843	0.713	1.556	2.18	1.134	0.421
13	0.0418	37.345	37.3	0.7	0.904	0.713	1.617	2.27	1.165	0.452
14	0.0492	40.060	40.1	0.8	0.969	0.713	1.681	2.36	1.197	0.484
15	0.0585	42.589	42.6	1.0	1.028	0.713	1.741	2.44	1.227	0.514
16	0.0837	44.776	44.8	1.4	1.076	0.713	1.789	2.51	1.251	0.538
17	0.0954	44.656	44.7	1.6	1.071	0.713	1.784	2.50	1.248	0.536
18	0.1246	42.185	42.2	2.1	1.007	0.713	1.719	2.41	1.216	0.503
19	0.1535	39.360	39.4	2.6	0.934	0.713	1.647	2.31	1.180	0.467
20	0.1949	36.692	36.7	3.4	0.865	0.713	1.577	2.21	1.145	0.432
21	0.2473	35.088	35.1	4.3	0.819	0.713	1.532	2.15	1.122	0.410
22	0.3090	34.109	34.1	5.3	0.787	0.713	1.500	2.10	1.107	0.394
23	0.3670	33.667	33.7	6.3	0.769	0.713	1.482	2.08	1.097	0.385

Project name: TO-0012 Pipeline Dredging, Volume I, Cedar Bayou PA 6 | Client: USACE, Galveston District | Terracon Project # : 92105186-A

Boring	Depth	Field tests			Atterberg Limits			Grain Size Analysis														USCS Symbol (ASTM 2487)	Wc	γd	Strength tests																					
								Percent Pasing Sieve																	Direct Shear Test					Unconfined Compression				UU Triaxial Test				CU Triaxial Test						
		PP	TV	SPTn	LL	PL	PI	3/4"	3/8"	4	8	10	16	20	30	40	50	70	100	140	200				C	φ	Wc	γd	Symbol	C	Wc	γd	Symbol	C	Wc	γd	Symbol	C	φ	c'	φ'	Wc	γd	Symbol
	ft	tsf	tsf	bl/ft	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%		%	pcf	ksf	°	%	pcf		ksf	%	pcf		ksf	%	pcf		ksf	°	ksf	°	%	pcf	
09-B94	0-2	0.00	0.30																			CH**	60																						
	2-4	0.25	0.05		62	21	41			100		100				100					83	CH	45							0.2	45	78	CH**											
	4-6	0.25	0.30		113	33	80					100				100			99		99	OH	60																						
	6-8	0.25	0.30																			CH**	48																						
	8-10																					CL**	39																						
	10-12	0.25	0.05		48	18	30					100				99					85	CL	39	83																					
	12-14	0.25	0.10																			OH**	78																						
	14-16	1.00																				CL**	26																						
	16-18	0.50																				CL**	33																						
	18-20	0.25	0.30																			CH**	42																						
09-B95	0-2	0.25	0.20		96	28	68					100				100					95	CH	51							0.3	51	68	CH**											
	4-6	0.25	0.15																			CH**	48																						
	6-8	0.25	0.30																			CH**	31																						
	8-10	0.25	0.20		51	18	33					100	100	100	100	100	100	99	98	94	94	CH	54											0.5	54	71	CH**							
	10-12	0.25	0.05																			CH**	47																						
	12-14	0.50																				CH**	35																						
	14-16	1.50																				CH**	30																						
	16-18	1.00			67	19	48					100				100					97	CH	33							1.0	33	91	CH**											
	18-20	0.50																				CH**	35																						
09-B96	0-2	0.25	0.25																			CH**	37																						
	2-4	0.75			83	23	60					100				100					90	CH	41							0.8	41	84	CH**											
	4-6	0.50																				CL-ML**	55																						
	6-8				26	20	6					100	100	100	100	100	99	98	86	51	50	CL-ML	26																						
	10-12	0.50																				CL**	32																						
	12-14	0.75			55	18	37					100				99					88	CH	25	97																					
	14-16	1.75																				CH**	23																						
	16-18	0.75							100	95		93				91					72	CL*	26																						
	18-20	0.75																				CL**	29																						
09-B97	0-2	0.50			88	33	55			100		100				98					95	CH	46	74																					
	2-4	0.50																				CH**	39																						
	4-6	0.50																				CH**	43																						
	6-8	1.50																				CH**	30																						
	8-10	2.50																				CH**	24																						
	10-12	2.25			81	25	56		100	100		100				99					99	CH	29							1.7	29	96	CH**											
	12-14	0.50																				CH**	23																						
	14-16			8																		CL**	27																						
	16-18			7	29	20	9			100		100				98					69	CL	24																						

NOTES:

USCS Symbol - Classification based on laboratory test results.

USCS Symbol* - Classification based partially on laboratory test results together with visual description.

USCS Symbol** - Classification based only on visual descriptions.