BORING LOG NO. 10-B21

CLIENT:	USACE, Galveston District Galveston, Texas	PROJECT:	Galveston Channel Deepening, TO-0010
BORING LOCATION:	N: 13686621.63 E: 3317644.07	SITE:	San Jacinto Placement Area Galveston, Texas

Approx. Surface Elevation: 11.3 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
	FAT CLAY light brownish gray, bluish gray, with organic matter stains, very soft	1	CH	ST	16		0.0	0.15	56								
		3		ST	24		0.0	0.2			104	31	73	98			
		5		ST	21		0.0	0.1	68								
		7		ST	23		0.0	0.1	67								
		9		ST	19		0.0	0.1			111	30	81	95			
		11		ST	18		0.0	0.1			102	32	70	100			
	-2.2 13.5	13		SS	10	3			48								
	CLAYEY SAND bluish gray and dark bluish gray, with traces of finely broken shell, with clay pockets and thin layers, fine grain, some cohesion, medium dense to dense	15	SC	SS	16	32			26								
		17		SS	8	18			33								
		19		SS	18	32			35					18			
		21		SS	16	32			33								
		23		SS	13	25			34								
	-13.7 25.0	25		SS	12	18			31					16			
	Boring terminated at 25 feet.																

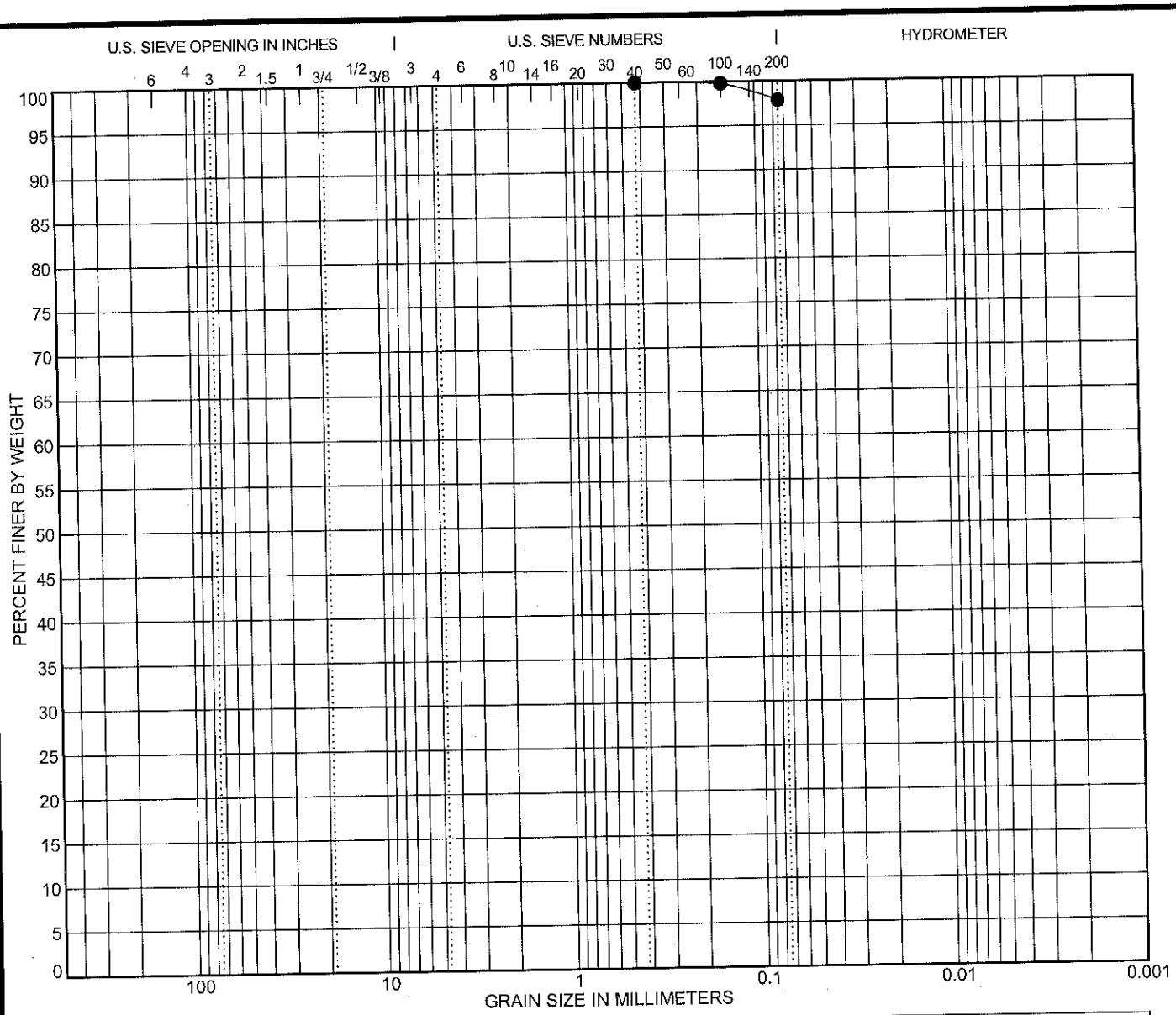
STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION BETWEEN STRATA MAY BE MORE GRADUAL.

REMARKS: **Dry auger to 4 feet; wet rotary thereafter.**

WATER LEVEL OBSERVATIONS			
▽ 3 ft	WS	▼ 1.5 ft	at 5 min
▼ 1 ft	at 10 min	▼ 1 ft	at 15 min

Terracon

DATE DRILLED	Page 1 of 1
4/13/2010	10-B21
PROJECT NUMBER 92105154	EXHIBIT A-21



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● 10-B21	2.0	**FAT CLAY(CH)**	**104**	**31**	**73**		

Percent Passing the Indicated Sieve

Specimen Identification		3/8"	#4	#10	#40	#100	#200
● 10-B21	2.0				**100**	**99.8**	**97.8**

Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 10-B21	2.0	**0.425**				**0.0**	**2.1**	**97.8**	

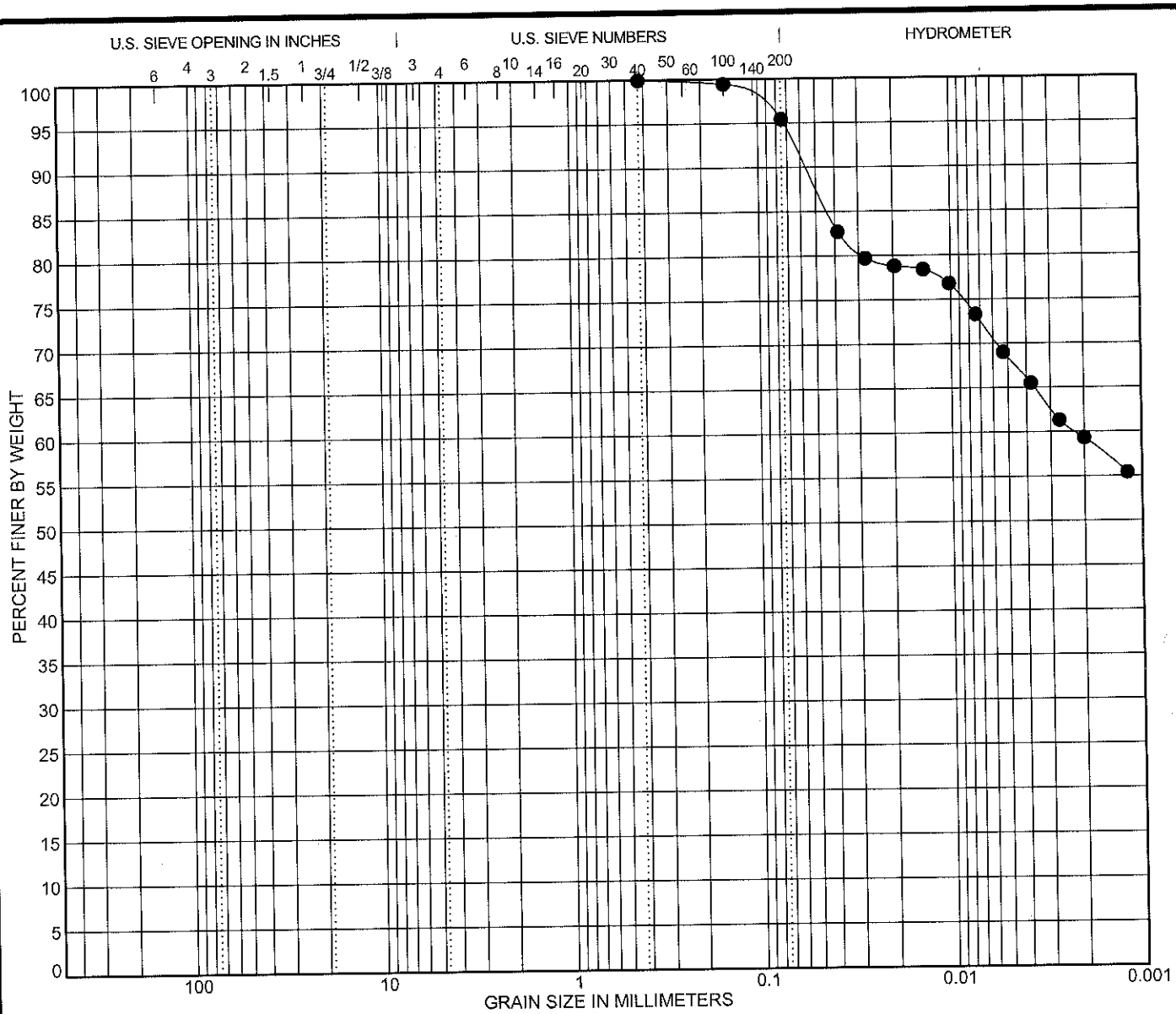
GRAIN SIZE DISTRIBUTION

Galveston Channel Deepening,
TO-0010
Galveston, Texas
Project Number 92105154

Terracon

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

SPECIMEN ID
10-B21, 2.0



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● 10-B21	8.0	**FAT CLAY(CH)**	**111**	**30**	**81**		

Percent Passing the Indicated Sieve

Specimen Identification		3/8"	#4	#10	#40	#100	#200
● 10-B21	8.0				**99.9**	**99.4**	**95.4**

Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 10-B21	8.0	**0.425**				**0.0**	**4.5**	**36.1**	**59.3**

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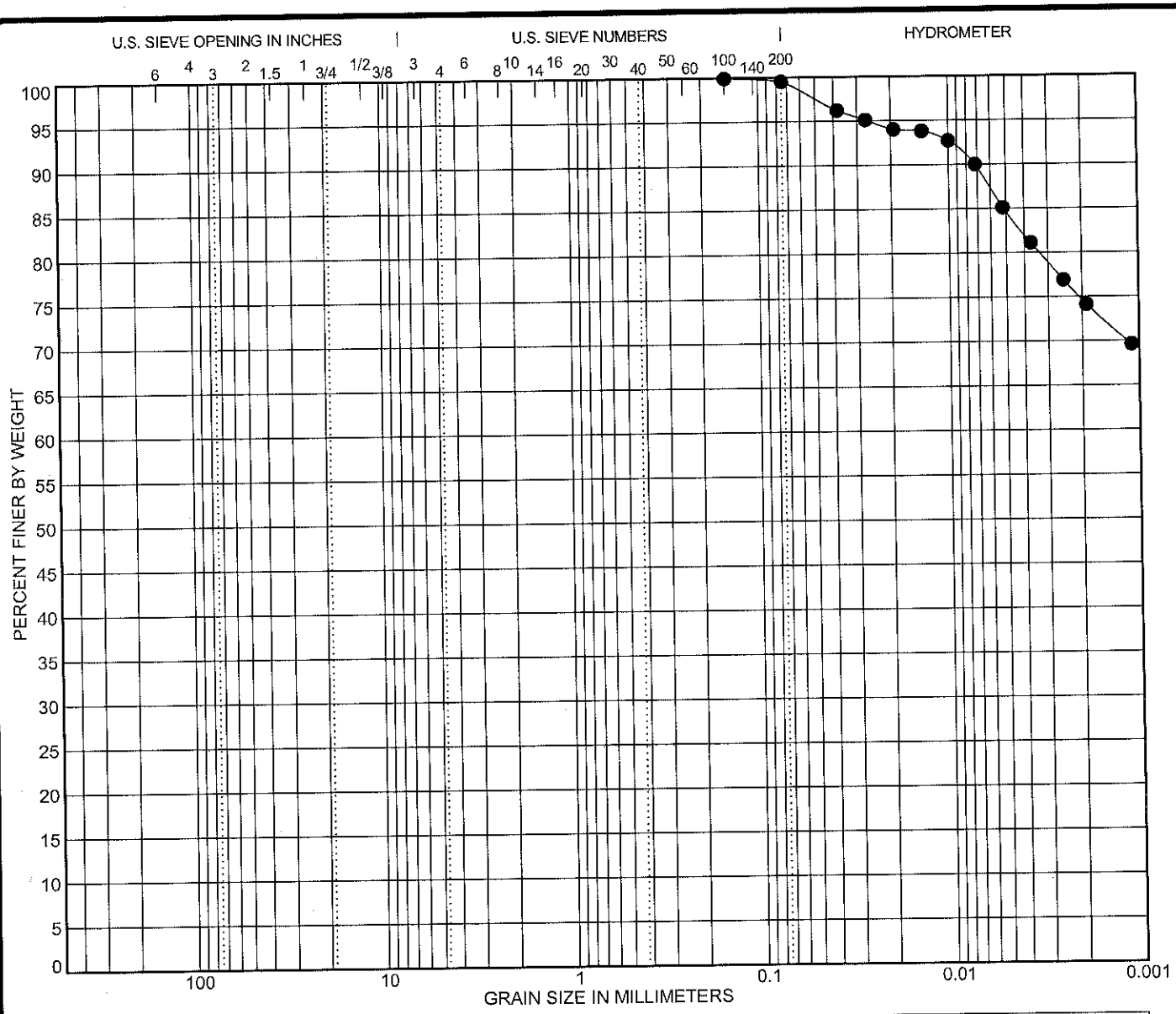
Fax: 713-690-8787

SPECIMEN ID
10-B21, 8.0



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● 10-B21	10.0	**FAT CLAY(CH)**	**102**	**32**	**70**		

Percent Passing the Indicated Sieve

Specimen Identification		3/8"	#4	#10	#40	#100	#200
● 10-B21	10.0					**99.9**	**99.5**

Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 10-B21	10.0	**0.15**				**0.0**	**0.4**	**24.9**	**74.6**

GRAIN SIZE DISTRIBUTION

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TO-0010
Galveston, Texas
Project Number 92105154

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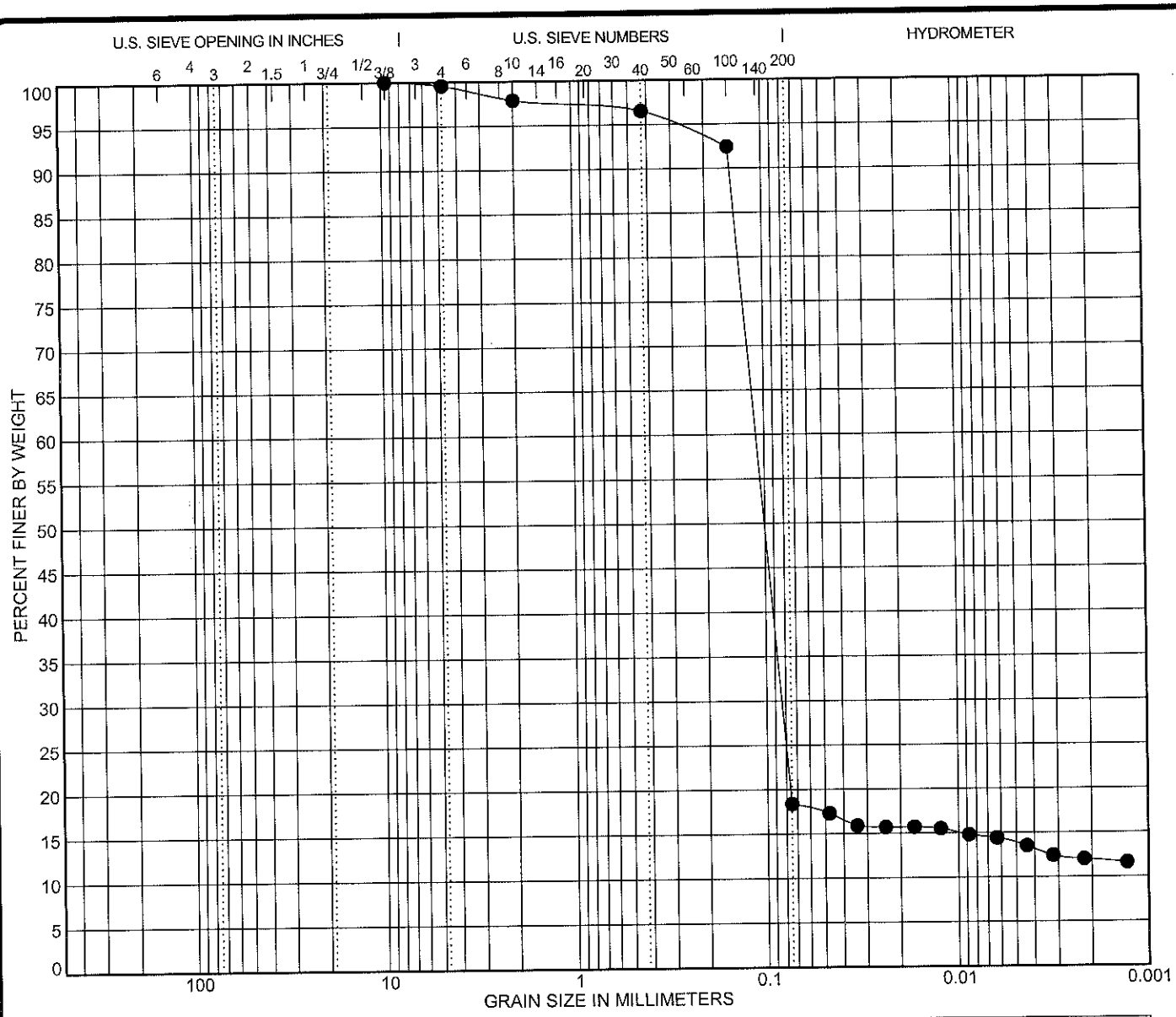
SPECIMEN ID
10-B21, 10.0



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● 10-B21	18.5						

Percent Passing the Indicated Sieve

Specimen Identification		3/8"	#4	#10	#40	#100	#200
● 10-B21	18.5		99.6	97.9	96.5	92.4	18.4

Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 10-B21	18.5	9.52	0.101	0.084		0.4	81.2	6.4	11.9

GRAIN SIZE DISTRIBUTION

Galveston Channel Deepening,
TO-0010
Galveston, Texas
Project Number 92105154

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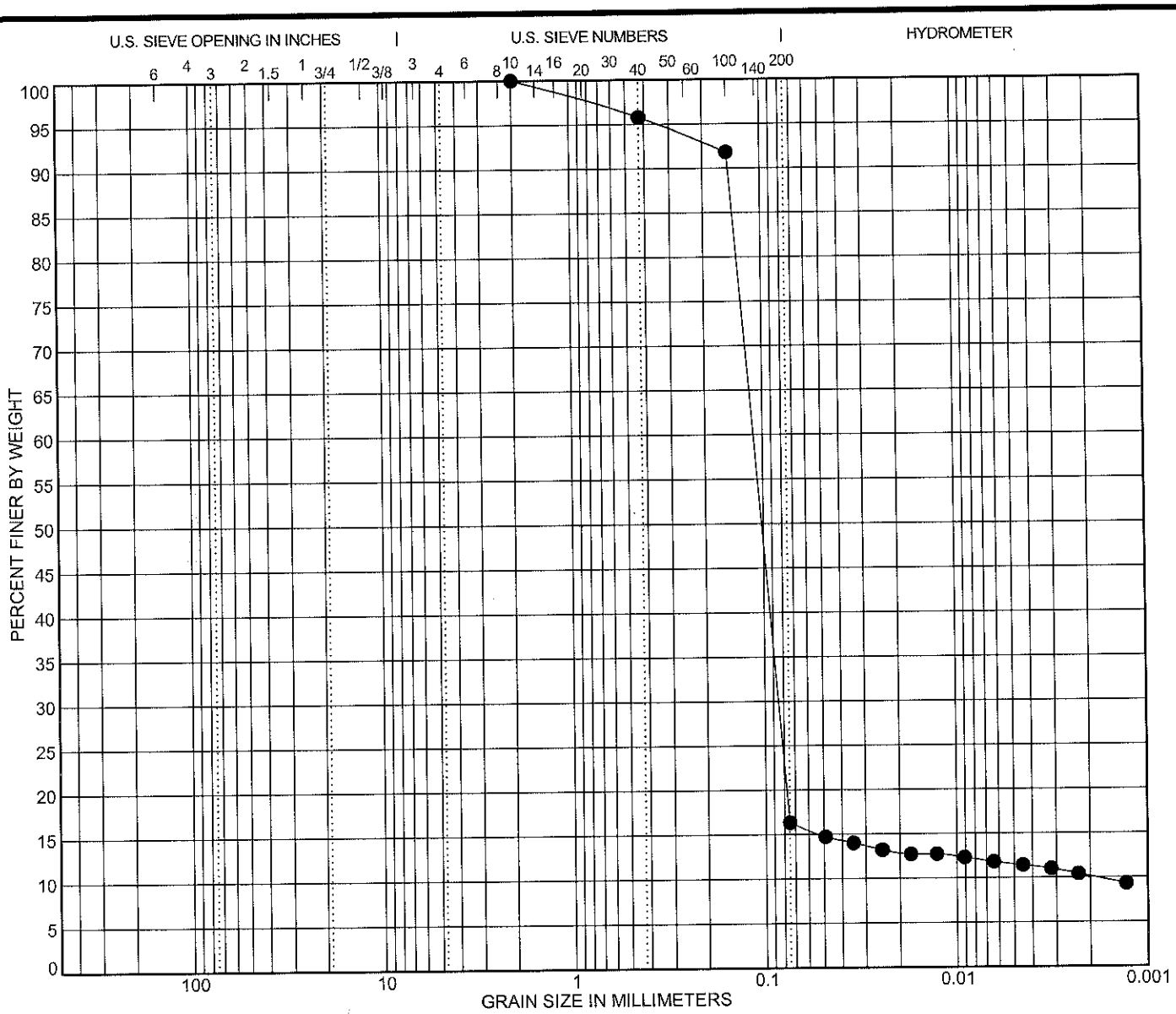
SPECIMEN ID
10-B21, 18.5



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● 10-B21	24.5					34.54	59.92

Percent Passing the Indicated Sieve

Specimen Identification		3/8"	#4	#10	#40	#100	#200
● 10-B21	24.5			100	95.8	91.8	16.3

Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 10-B21	24.5	2	0.102	0.085	0.002	0.0	83.7	6.2	10.1

GRAIN SIZE DISTRIBUTION

Galveston Channel Deepening,
TO-0010
Galveston, Texas
Project Number 92105154

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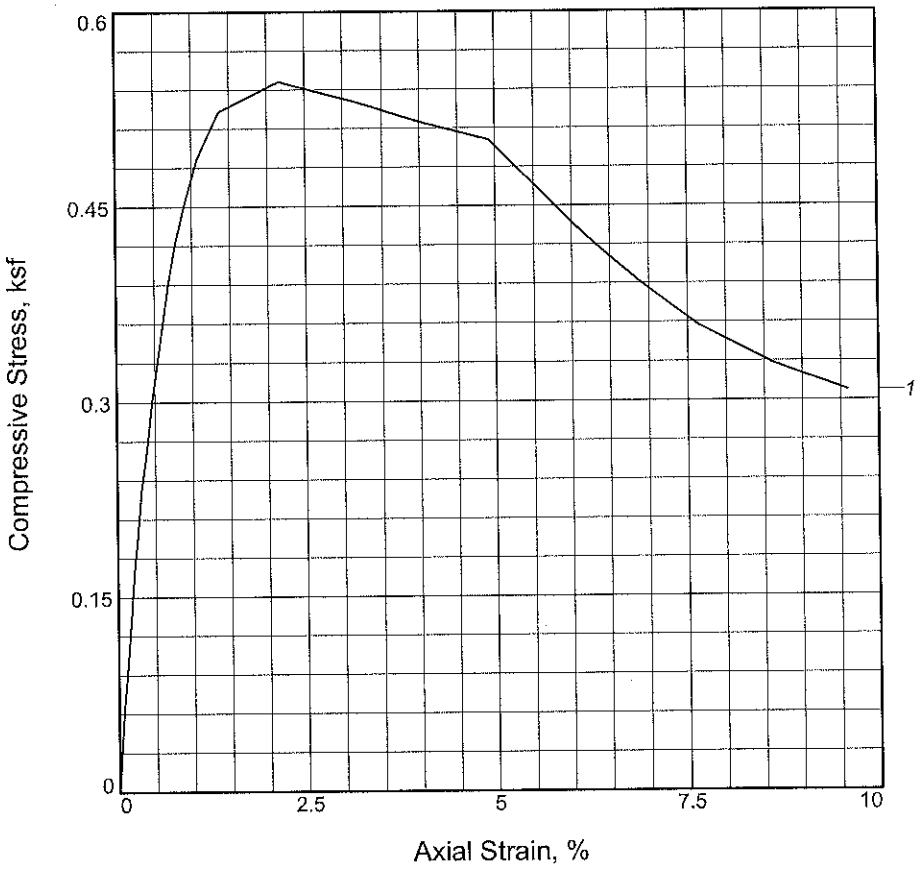
SPECIMEN ID
10-B21, 24.5

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	0.546			
Undrained shear strength, ksf	0.273			
Failure strain, %	2.2			
Strain rate, in./min.	0.055			
Water content, %	57.3			
Wet density, pcf	105.2			
Dry density, pcf	66.9			
Saturation, %	100.6			
Void ratio	1.5657			
Specimen diameter, in.	2.766			
Specimen height, in.	5.894			
Height/diameter ratio	2.13			

Description: Gray and brown Fat Clay

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

Project No.: 92105154

Date Sampled:

Remarks:
ASTM D2166

Client: USACE

Project: Galveston Channel Deepening San Jacinto Placement Area
Contract #W912HY-09-D-0021, Task Order #0010

Location: 10-B21

Sample Number: 2 **Depth:** 2-4 ft.

UNCONFINED COMPRESSION TEST
Terracon, Inc.
Houston, TX

UNCONFINED COMPRESSION TEST

7/22/2010

Date:
Client: USACE
Project: Galveston Channel Deepening San Jacinto Placement Area
Contract #W912HY-09-D-0021, Task Order #0010
Project No.: 92105154
Location: 10-B21
Depth: 2-4 ft. **Sample Number:** 2
Description: Gray and brown 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.	147.450
Moisture content: Dry soil+tare, gms.	111.160
Moisture content: Tare, gms.	47.820
Moisture, %	57.3
Moist specimen weight, gms.	978.45
Diameter, in.	2.766
Area, in.^{2}	6.009
Height, in.	5.894
Wet density, pcf	105.2
Dry density, pcf	66.9
Void ratio	1.5657
Saturation, %	100.6

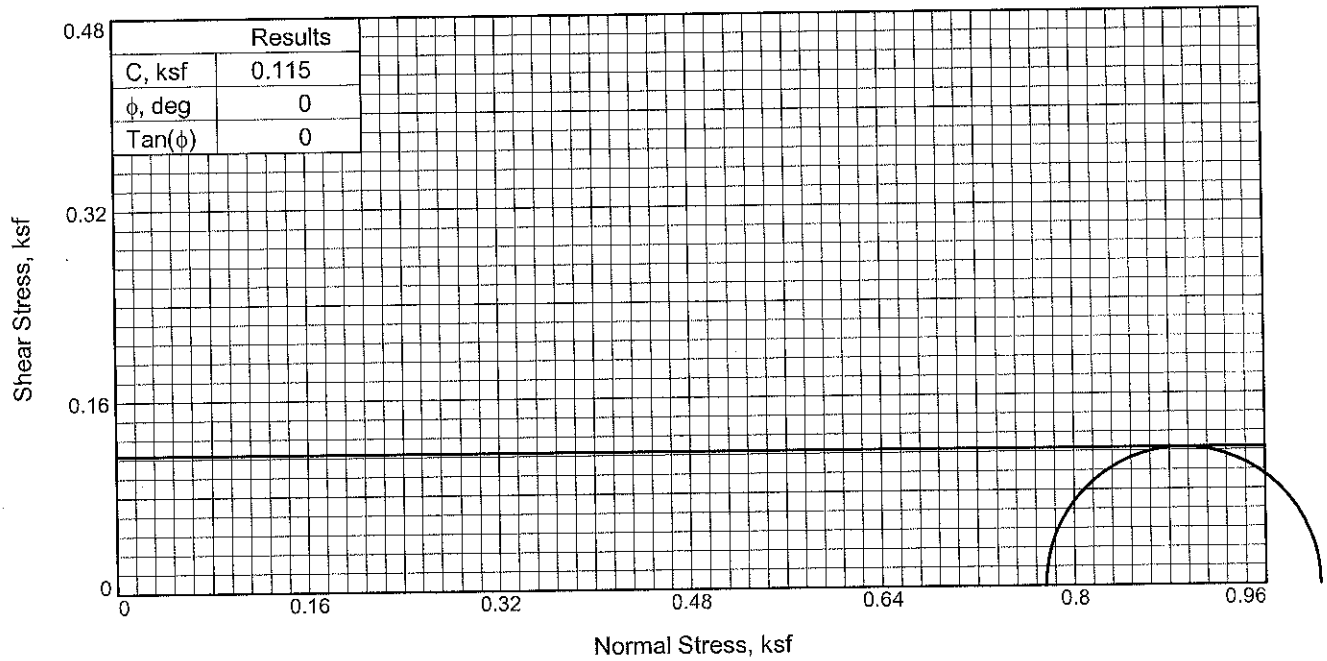
Test Readings for Specimen No. 1

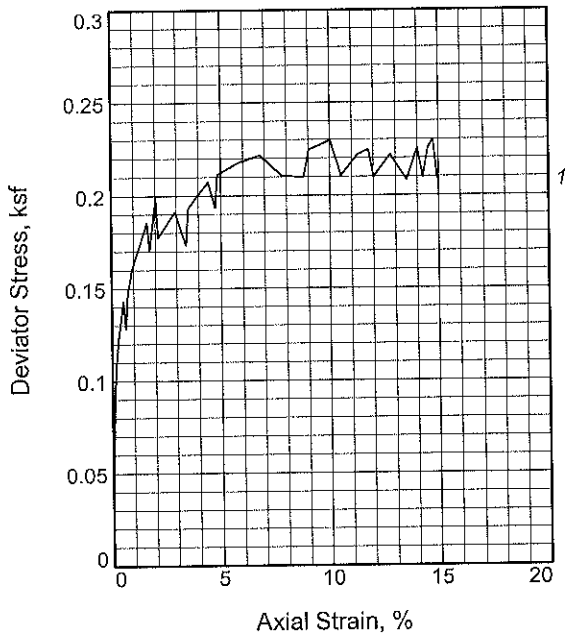
Strain rate, in./min. = 0.055
Unconfined compressive strength = 0.546 ksf **at reading no.** 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
0	0.0000	0.000	0.0	0.0	0.000
1	0.0010	0.500	0.5	0.0	0.012
2	0.0012	0.824	0.8	0.0	0.020
3	0.0042	2.650	2.7	0.1	0.063
4	0.0072	4.007	4.0	0.1	0.096
5	0.0102	5.590	5.6	0.2	0.134
6	0.0127	7.058	7.1	0.2	0.169
7	0.0157	8.265	8.3	0.3	0.198
8	0.0187	9.703	9.7	0.3	0.232
9	0.0232	11.099	11.1	0.4	0.265
10	0.0271	12.600	12.6	0.5	0.301
11	0.0316	13.855	13.9	0.5	0.330
12	0.0361	15.152	15.2	0.6	0.361
13	0.0406	16.442	16.4	0.7	0.391
14	0.0461	17.744	17.7	0.8	0.422
15	0.0536	19.069	19.1	0.9	0.453

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress ksf
16	0.0635	20.546	20.5	1.1	0.487
17	0.0810	22.141	22.1	1.4	0.523
18	0.1273	23.305	23.3	2.2	0.546
19	0.1333	23.256	23.3	2.3	0.545
20	0.1857	22.871	22.9	3.2	0.531
21	0.2375	22.376	22.4	4.0	0.515
22	0.2899	21.987	22.0	4.9	0.501
23	0.3337	20.230	20.2	5.7	0.457
24	0.3626	19.063	19.1	6.2	0.429
25	0.4060	17.518	17.5	6.9	0.391
26	0.4499	16.178	16.2	7.6	0.358
27	0.5077	14.996	15.0	8.6	0.328
28	0.5655	14.197	14.2	9.6	0.308





Sample No.		1
Initial	Water Content, %	65.1
	Dry Density, pcf	61.6
	Saturation, %	100.3
	Void Ratio	1.7854
	Diameter, in.	2.792
	Height, in.	5.930
At Test	Water Content, %	65.1
	Dry Density, pcf	61.6
	Saturation, %	100.3
	Void Ratio	1.7854
	Diameter, in.	2.792
	Height, in.	5.930
Strain rate, in./min.		0.055
Back Pressure, psi		0.000
Cell Pressure, psi		5.390
Fail. Stress, ksf		0.230
Ult. Stress, ksf		
σ_1 Failure, ksf		1.006
σ_3 Failure, ksf		0.776

Type of Test:
Unconsolidated Undrained
Sample Type: Undisturbed
Description: Gray Fat Clay

Assumed Specific Gravity= 2.75
Remarks: ASTM D2850

Client: USACE

Project: Galveston Channel Deepening San Jacinto Placement Area
Contract #W912HY-09-D-0021, Task Order #0010
Location: 10-B21
Sample Number: 5 **Depth:** 8-10 ft.
Proj. No.: 92105154 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT
Terracon, Inc.
Houston, TX

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

7/20/2010
3:05 PM

Date:
Client: USACE
Project: Galveston Channel Deepening San Jacinto Placement Area
Contract #W912HY-09-D-0021, Task Order #0010
Project No.: 92105154
Location: 10-B21
Depth: 8-10 ft. **Sample Number:** 5
Description: Gray Fat Clay
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.	153.580	153.580
Moisture content: Dry soil+tare, gms.	116.070	116.070
Moisture content: Tare, gms.	58.450	58.450
Moisture, %	65.1	65.1
Moist specimen weight, gms.	969.76	
Diameter, in.	2.792	
Area, in.^{2}	6.122	
Height, in.	5.930	
Wet density, pcf	101.8	
Dry density, pcf	61.6	
Void ratio	1.7854	
Saturation, %	100.3	

Test Readings for Specimen No. 1

Cell pressure = 5.390 psi (0.776 ksf)
Back pressure = 0.000 psi (0.000 ksf)
Strain rate, in./min. = 0.055
Fail. Stress = 0.230 ksf **at reading no.** 36

Test Readings for Specimen No. 1

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	0.776	0.776	1.00	0.776	0.000
1	0.0010	1.100	1.1	0.0	0.026	0.776	0.802	1.03	0.789	0.013
2	0.0011	1.700	1.7	0.0	0.040	0.776	0.816	1.05	0.796	0.020
3	0.0031	2.329	2.3	0.1	0.055	0.776	0.831	1.07	0.804	0.027
4	0.0056	3.469	3.5	0.1	0.082	0.776	0.858	1.11	0.817	0.041
5	0.0101	4.462	4.5	0.2	0.105	0.776	0.881	1.13	0.829	0.052
6	0.0179	5.226	5.2	0.3	0.123	0.776	0.899	1.16	0.837	0.061
7	0.0320	6.112	6.1	0.5	0.143	0.776	0.919	1.18	0.848	0.071
8	0.0377	5.492	5.5	0.6	0.128	0.776	0.905	1.17	0.840	0.064
9	0.0427	6.281	6.3	0.7	0.147	0.776	0.923	1.19	0.849	0.073
10	0.0547	6.882	6.9	0.9	0.160	0.776	0.937	1.21	0.856	0.080
11	0.0967	8.021	8.0	1.6	0.186	0.776	0.962	1.24	0.869	0.093
12	0.1030	7.373	7.4	1.7	0.170	0.776	0.947	1.22	0.861	0.085
13	0.1205	8.624	8.6	2.0	0.199	0.776	0.975	1.26	0.876	0.099
14	0.1268	7.716	7.7	2.1	0.178	0.776	0.954	1.23	0.865	0.089
15	0.1745	8.379	8.4	2.9	0.191	0.776	0.967	1.25	0.872	0.096
16	0.2040	7.630	7.6	3.4	0.173	0.776	0.949	1.22	0.863	0.087
17	0.2103	8.513	8.5	3.5	0.193	0.776	0.969	1.25	0.873	0.097
18	0.2635	9.224	9.2	4.4	0.207	0.776	0.983	1.27	0.880	0.104
19	0.2818	8.646	8.6	4.8	0.194	0.776	0.970	1.25	0.873	0.097
20	0.2874	9.444	9.4	4.8	0.211	0.776	0.988	1.27	0.882	0.106
21	0.3439	9.825	9.8	5.8	0.218	0.776	0.994	1.28	0.885	0.109
22	0.4029	10.112	10.1	6.8	0.222	0.776	0.998	1.29	0.887	0.111
23	0.4619	9.715	9.7	7.8	0.211	0.776	0.987	1.27	0.882	0.105
24	0.5209	9.777	9.8	8.8	0.210	0.776	0.986	1.27	0.881	0.105
25	0.5353	10.492	10.5	9.0	0.224	0.776	1.001	1.29	0.888	0.112
26	0.5943	10.847	10.8	10.0	0.230	0.776	1.006	1.30	0.891	0.115
27	0.6238	10.007	10.0	10.5	0.211	0.776	0.987	1.27	0.881	0.105
28	0.6684	10.633	10.6	11.3	0.222	0.776	0.998	1.29	0.887	0.111
29	0.6979	10.814	10.8	11.8	0.224	0.776	1.001	1.29	0.888	0.112
30	0.7123	10.139	10.1	12.0	0.210	0.776	0.986	1.27	0.881	0.105
31	0.7569	10.803	10.8	12.8	0.222	0.776	0.998	1.29	0.887	0.111
32	0.8009	10.225	10.2	13.5	0.208	0.776	0.984	1.27	0.880	0.104
33	0.8304	11.137	11.1	14.0	0.225	0.776	1.001	1.29	0.889	0.113
34	0.8454	10.393	10.4	14.3	0.210	0.776	0.986	1.27	0.881	0.105
35	0.8598	11.200	11.2	14.5	0.225	0.776	1.001	1.29	0.889	0.113
36	0.8749	11.457	11.5	14.8	0.230	0.776	1.006	1.30	0.891	0.115
37	0.8861	10.431	10.4	14.9	0.209	0.776	0.985	1.27	0.880	0.104

SUMMARY TABLE OF LABORATORY TEST DATA

Project name: TO-0010 Galveston Channel Deepening | Client: USACE, Galveston District | Terracon Project # : 92105154

Boring	Depth	Field tests			Atterberg Limits			Grain size Analysis										USCS Symbol	Wc	γd
								% by weight passing sieve					Soil Particle Content							
		PP	TV	SPTn	LL	PL	PI	4	10	40	100	200	gravel	sand	silt	clay	sieve 200			
	ft	tsf	tsf	bl/ft	%	%	%	%	%	%	%	%	%	%	%	%	%		%	pcf
10-B20	18.5-20			61				100	100	100	91	6	0	94	4	2		SP-SM*	25	
	20.5-22			72														SP-SM**	24	
	22.5-24			78														SP-SM**	26	
	24.5-26			21														SP-SM**	26	
	0-2	1.00																CL**	30	
	2-4	0.50	0.25		100	32	68	100	100	100	100	99	0	1	27	72		CH		
	4-6	0.00	0.10															CH**	69	
	6-8	0.00	0.10															CH**	96	
	8-10	0.00	0.10															CH**	82	
	10-12	0.00	0.10		105	30	75	100	100	100	100	93	0	7	29	64		CH	59	
	12.5-14			0														CH**	73	
	14-16	0.00	0.05															CH**	52	
	16.5-18			22				100	100	100	97	49	0	51	29	20		SC*	42	
	18.5-20			22				100	100	97	88	7	0	93	3	4		SP-SM*	26	
	20.5-22			22														SP-SM**	26	
	22.5-24			19														SP-SM**	36	
	24.5-26			4				100	100	99	95	8	0	92	5	3		SP-SM*	26	
10-B21	0-2	0.00	0.15															CH**	56	
	2-4	0.00	0.20		104	31	73	100	100	100	100	98	0	2			98	CH		
	4-6	0.00	0.10															CH**	68	
	6-8	0.00	0.10															CH**	67	
	8-10	0.00	0.10		111	30	81	100	100	100	99	95	0	5	36	59		CH		
	10-12	0.00	0.10		102	32	70	100	100	100	100	100	0	0	25	75		CH		
	12.5-14			3														CH**	48	
	14.5-16			32														SC**	26	
	16.5-18			18														SC**	33	
	18.5-20			32				100	98	97	92	18	0	82	6	12		SC*	35	
	20.5-22			32														SC**	33	
	22.5-24			25														SC**	34	
	24.5-26			18				100	100	96	92	16	0	84	6	10		SC*	31	

Strenght tests

Boring	Depth	Direct Shear Test					Unconfined Compression				UU Triaxial Test				CU Triaxial Test						
		C	φ	Wc	γd	Symbol	C	Wc	γd	Symbol	C	Wc	γd	Symbol	C	φ	c'	φ'	Wc	γd	Symbol
	ft	ksf	°	%	pcf		ksf	%	pcf		ksf	%	pcf		ksf	°	ksf	°	%	pcf	
10-B20	10-12										0.43	59	67	CH**							
10-B21	0-2																				
	2-4						0.27	57	67	CH**											
	8-10										0.12	65	62	CH**							

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.

b - Bag Sample.