

Appendix B contains discussions of analytical procedures used in our engineering analyses. Appendix C contains a positioning report by Fugro Chance, Inc., of Lafayette, Louisiana.

For the purposes of discussion and presentation, "driven pipe pile" is used in this report to represent foundation piles, caissons and conductors, unless otherwise specified.

## 2.2 FIELD AND LABORATORY INVESTIGATIONS

The field investigation was performed on July 4 through 6, 2008, from the R/V *Seaprobe*. The soil conditions were determined by performing four exploratory borings, two at each SPM location with one boring at a selected anchor leg location, and one boring at the proposed PLET location. Enterprise Field Services selected the boring locations. These borings were drilled to a penetration of 131-ft below mudline. The water depths at the boring locations ranged from 123 to 125 ft. A chronological summary of field operations is presented in Appendix A.

### 2.2.1 Exploratory Borings

FMMG personnel drilled the soil borings with a DMX drill rig positioned over the centerwell of the R/V *Seaprobe*. The vessel was anchored at the boring location by a 4-point mooring system. Soil conditions at the site were explored by drilling a group of four soil borings to 131-ft penetration below the seafloor. The final coordinates for the boring locations are presented in Table 2-1. A plan of borings within Block A-59, of the Galveston Area is presented on Plate 2-1. Fugro Chance, Inc., of Lafayette, Louisiana, conducted surveying utilizing STARFIX and DGPS, and performed a 360-degree scanning sonar survey. The positioning report, prepared by Fugro Chance, is presented in Appendix C. The scanning sonar reports are available from Fugro Chance upon request.

**Table 2-1: Final Boring Coordinates**  
(Texas South Central Zone Coordinates)

FMMG Boring Designation	Fugro Chance Boring Designation	Proposed Boring Coordinates	Final Boring Coordinates	Boring Termination Depth (ft)
SPM #1 PLET	Core 3	X = 3,258,627.75 ft Y = 236,494.60 ft	X = 3,258,640 ft Y = 236,466 ft	131
SPM #1 ANCHOR LEG #2	Core 1	X = 3,257,224.19 ft Y = 236,057.66 ft	X = 3,257,200 ft Y = 236,056 ft	131
SPM #2 PLET	Core 4	X = 3,265,632.42 ft Y = 240,337.08 ft	X = 3,265,647 ft Y = 240,318 ft	131
SPM #2 ANCHOR LEG #6	Core 2	X = 3,266,735.50 ft Y = 241,308.73 ft	X = 3,266,758 ft Y = 241,331 ft	131

Samples were obtained through 5.0-in.-OD, 4.5-in.-IF drill pipe at all the locations. Samples were spaced at 3-ft intervals to 20-ft penetration, at 5-ft intervals to 68-ft penetration, and at 10-ft intervals thereafter to the final boring depth at the SPM #1 ANCHOR LEG #2 and SPM #2 PLET locations. Sampling intervals at the SPM #1 PLET location was completed as follows: 3-ft intervals to 20-ft penetration, 5-ft intervals to 66-ft penetration, and 10-ft intervals thereafter to the final boring depth. Sampling intervals at the SPM #2 ANCHOR LEG #6 location was completed as follows: 3-ft intervals to 20-ft penetration, 5-ft

intervals to 65-ft penetration, and 10-ft intervals thereafter to the final boring depth. The drilling and sampling techniques used to complete this boring are explained in detail in Appendix A.

Two water depths were measured at each boring using a seafloor sensor seated in the drill bit. The water depth measurements are tabulated in Table 2-2. The water depth measurements are intended for the purpose of the geotechnical investigation only, and are not corrected for tidal or other variations. If utilized for other purposes, the water depth measurement should be adjusted to account for meteorological tide and datum corrections. The water depths measuring procedures are explained in detail in Appendix B.

**Table 2-2: Measured Water Depths**

Boring Designation	Water Depth (ft)	Time and Date of Measurement	Supplemental Water Depth (ft)	Time and Date of Measurement
SPM #1 PLET	123	0240 hours on July 5, 2008	123	0720 hours on July 5, 2008
SPM #1 ANCHOR LEG #2	123	1440 hours on July 4, 2008	122	2200 hours on July 4, 2008
SPM #2 PLET	125	1135 hours on July 5, 2008	125	1650 hours on July 5, 2008
SPM #2 ANCHOR LEG #6	124	0220 hours on July 6, 2008	124	0655 hours on July 6, 2008

## 2.2.2 Field and Laboratory Tests

The soil testing program was designed to evaluate pertinent index and engineering properties of the foundation soils. During the field operation, all samples were extruded from the sampler and classified by the soil technician or field engineer. Unit weight, Torvane, pocket penetrometer, miniature vane and unconsolidated-undrained triaxial compression tests were performed in the field on selected cohesive samples. All of the samples were shipped to Fugro's Houston laboratory where Atterberg limit tests, water content tests, and grain-size analyses, as well as additional density tests, unconsolidated-undrained triaxial compression tests, and miniature vane tests, were performed.

A description of relevant laboratory procedures is provided in Appendix A. The strength and classification test results are presented graphically on the Logs of Boring and Test Results in Section 3. Grain-size distribution curves from sieve-analysis and stress-strain curves from triaxial compression tests are presented in Appendix A.

## 2.3 GENERAL SOIL CONDITIONS

### 2.3.1 Soil Stratigraphy

The soil stratigraphy at each of the boring locations disclosed by the field and laboratory investigations is presented in Section 3. The soil stratigraphy is based on the classification of soil samples recovered from the boring and observations made during drilling operations. Detailed soil descriptions, for each location, that include textural variations and inclusions are noted on the respective boring log



8/19/08

Date:

AW

Drawn By:

8/17/08

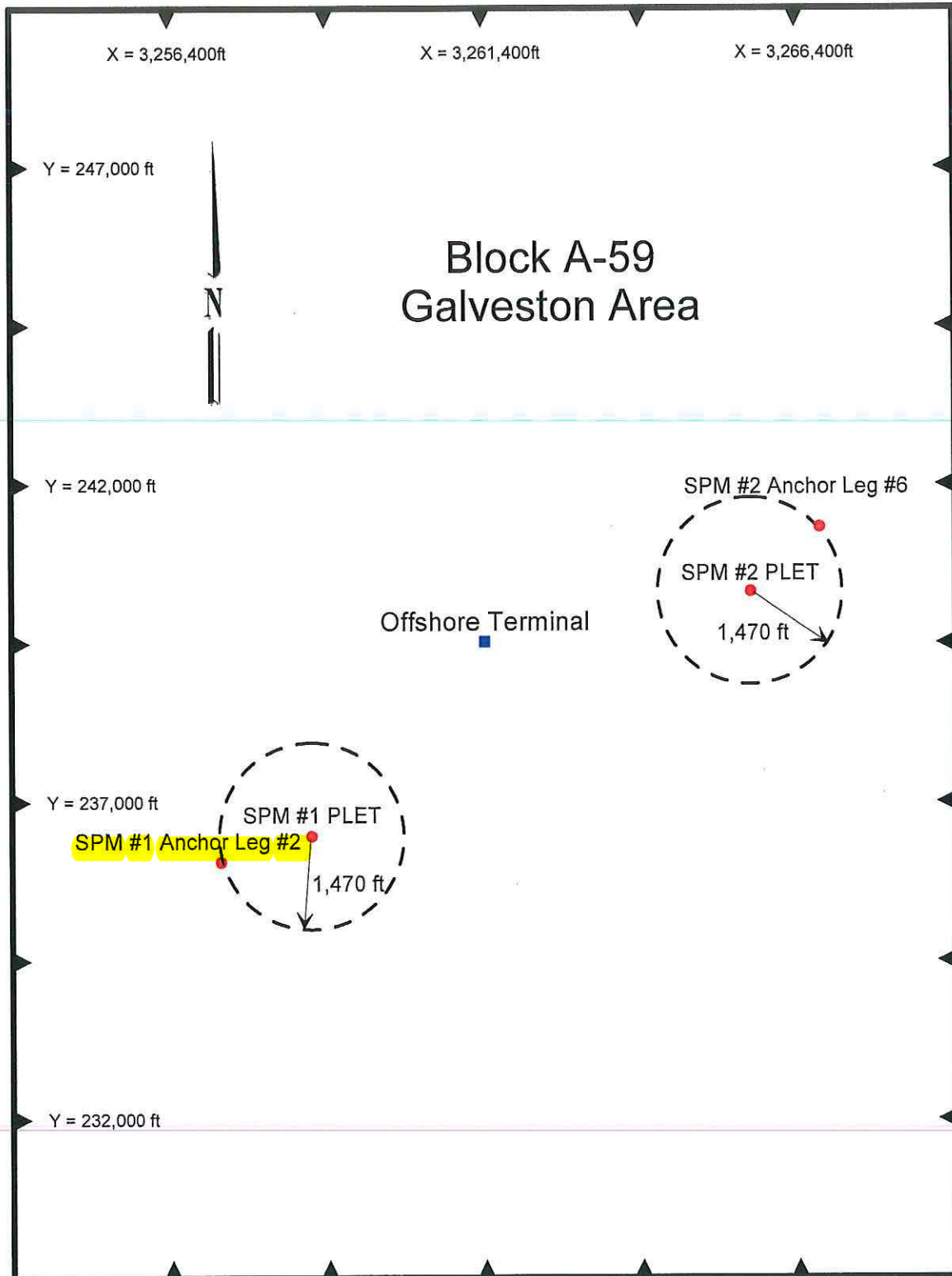
Date:

Date:

AS

Checked By:

Approved By:



Projection: Texas South Central Zone Coordinates

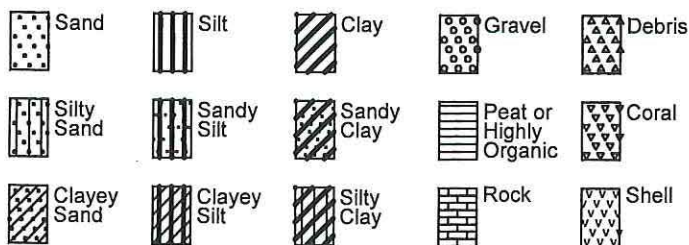
## PLAN OF BORINGS

Texas Offshore Port System  
Block A-59, Galveston Area

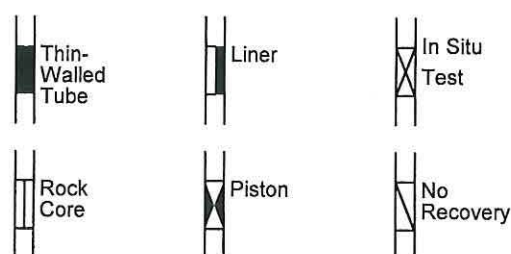


## TERMS AND SYMBOLS USED ON BORING LOG

### SOIL TYPES



### SAMPLER TYPES



### SOIL GRAIN SIZE U.S. STANDARD SIEVE

6"	3"	3/4"	4	10	40	200		
BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		
152	76.2	19.1	4.76	2.00	0.420	0.074		0.002
SOIL GRAIN SIZE IN MILLIMETERS								

### STRENGTH OF COHESIVE SOILS<sup>(1)</sup>

Consistency	Undrained Shear Strength, Kips Per Sq Ft
Very Soft.....	less than 0.25
Soft.....	0.25 to 0.50
Firm.....	0.50 to 1.00
Stiff.....	1.00 to 2.00
Very Stiff.....	2.00 to 4.00
Hard.....	greater than 4.00

### DENSITY OF GRANULAR SOILS<sup>(2,3)</sup>

Descriptive Term	*Relative Density, %
Very Loose.....	less than 15
Loose.....	15 to 35
Medium Dense.....	35 to 65
Dense.....	65 to 85
Very Dense.....	greater than 85

\*Estimated from sampler driving record

### SOIL STRUCTURE<sup>(1)</sup>

Slickensided.....	Having planes of weakness that appear slick and glossy. The degree of slickensidedness depends upon the spacing of slickensides and the ease of breaking along these planes.
Fissured.....	Containing shrinkage or relief cracks, often filled with fine sand or silt, usually more or less vertical.
Pocket.....	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting.....	Inclusion less than 1/8 inch thick extending through the sample.
Seam.....	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer.....	Inclusion greater than 3 inches thick extending through the sample.
Laminated.....	Soil sample composed of alternating partings or seams of different soil types.
Interlayered.....	Soil sample composed of alternating layers of different soil types.
Intermixed.....	Soil sample composed of pockets of different soil types and layered or laminated structure is not evident.
Calcareous.....	Having appreciable quantities of carbonate.

### REFERENCES:

- (1) ASTM D 2488
- (2) ASCE Manual 56 (1976)
- (3) ASTM D 2049

Information on each boring log is a compilation of subsurface conditions and soil or rock classifications obtained from the field as well as from laboratory testing of samples. Strata have been interpreted by commonly accepted procedures. The stratum lines on the log may be transitional and approximate in nature. Water level measurements refer only to those observed at the times and places indicated in the text, and may vary with time, geologic condition or construction activity.



Report No. 0201-6505



## 3.2 SPM #1 ANCHOR LEG #2 LOCATION

### 3.2.1 Introduction

The field investigation at the location designated as SPM #1 ANCHOR LEG #2 was performed on July 4, 2008. Soil sampling was performed to 131-ft penetration at Texas South Central Zone Coordinates X = 3,257,200 ft and Y = 236,056 ft. The measured water depth ranged from 122 to 123 ft.

### 3.2.2 Soil Stratigraphy

The soil stratigraphy disclosed by the field and laboratory investigations is presented on the boring log, Plate 3-12. The soil stratigraphy is based on the classification of soil samples recovered from the boring and observations made during drilling operations. A generalized summary of the major soil strata is tabulated below.

Stratum	Penetration, ft		Description
	From	To	
I	0	2	Very soft sandy silty clay
II	2	15	Medium dense fine sand
III	15	30	Loose sandy silt to silty fine sand interlayered with sandy silty clay
IV	30	131	Firm to very stiff clay

Detailed soil descriptions that include textural variations and inclusions are noted on the boring log. A key to the terms and symbols used on the boring log is presented on Plate 2-2. The Roman numeral representing each stratum is also shown on the boring log and on relevant plates. The variation in soil stratigraphy across this site is indicated in a comparison (integration) of the geophysical and geotechnical soil information presented on Plate 3-13.

#### 3.2.2.1 Interpretation of Soil Properties

The shear strength and submerged unit weight profiles shown on Plates 3-14 and 3-15, respectively, best represent the assembled test results plotted on the boring log. These profiles were used in the engineering analyses.

### 3.2.3 Pile Design Information

The pile design information developed for this study includes ultimate axial capacities, axial load-pile movement data, and lateral soil resistance-pile deflection (p-y) characteristics. The analytical methods used to develop this information are presented briefly in Section 2.5 and in more detail in Appendix B.

#### 3.2.3.1 Axial Pile Design

**Ultimate Axial Capacity.** The unit skin friction and unit end bearing values plotted on Plates 3-16 and 3-17, respectively, was calculated using the API RP 2A methods described in Appendix B. These values were used to calculate the ultimate axial compressive and tensile capacities for 42-in.-diameter pipe piles, driven to final penetration at the boring location. Capacity curves for driven pipe piles (conductors, caissons and foundation piles) are presented on Plate 3-18.

API RP 2A recommends that pile penetrations be selected using appropriate factors of safety or pile resistance factors. These factors are discussed in Section 2.5.1 of this report.

**Axial Load Transfer Data.** Axial load-pile movement analyses are usually performed using a computer solution based on methods developed by Reese (1964) or Matlock, et al. (1976). Plates 3-19 and 3-20 present the results as side load-side movement (t-z) and tip load-tip movement (Q-z) data for 42-in.-diameter driven pipe piles, respectively. The Q-z data should be used for foundation piles and neglected for caissons and conductor design. In developing the axial load transfer data in the cohesive soils, a post-peak adhesion ratio of 0.90 was utilized.

### **3.2.3.2 Lateral Pile Design Data**

The soil resistance-pile deflection (p-y) characteristics of the soils at the boring location were developed for individual 42-in.-diameter driven pipe piles. These data may be used in lateral load analyses of driven piles, conductors and caissons. The p-y data for cyclic loading were developed to 100-ft penetration using procedures that have been outlined in API RP 2A and briefly explained in Appendix B. The stratigraphy and parameters used to develop the p-y data are presented on Plate 3-21. The p-y data for 42-in.-diameter driven pipe piles are presented on Plate 3-22. P-y values presented at 100-ft penetration may be used for lateral load analyses at greater depths.





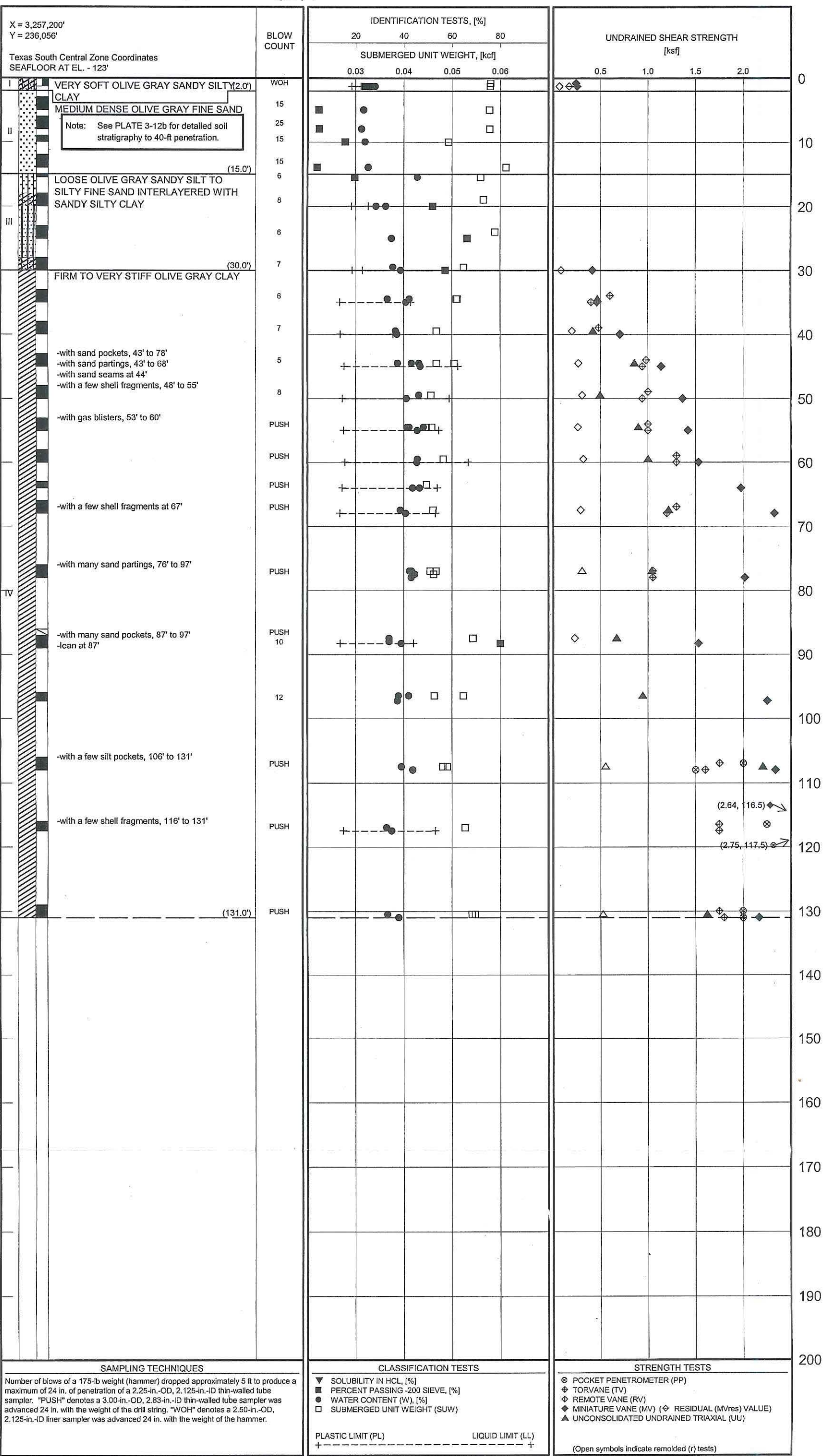
Report No. 0201-6505

Penetration Below Seafloor, [feet]

PLATE 3-12a

Checked By: *AW* Date: *7/11/07*  
Approved By: *DL* Date: *9/11/07*

Drawn By: *hcl* Date: *7/11/07*



Penetration Below Seafloor, [feet]

LOG OF BORING AND TEST RESULTS  
Texas Offshore Port System, SPM #1 Anchor Leg #2  
Block A-59, Galveston Area





hecke  
Approved By: *an*

Date: 2/1/01  
Date: 9/18/01

By: T

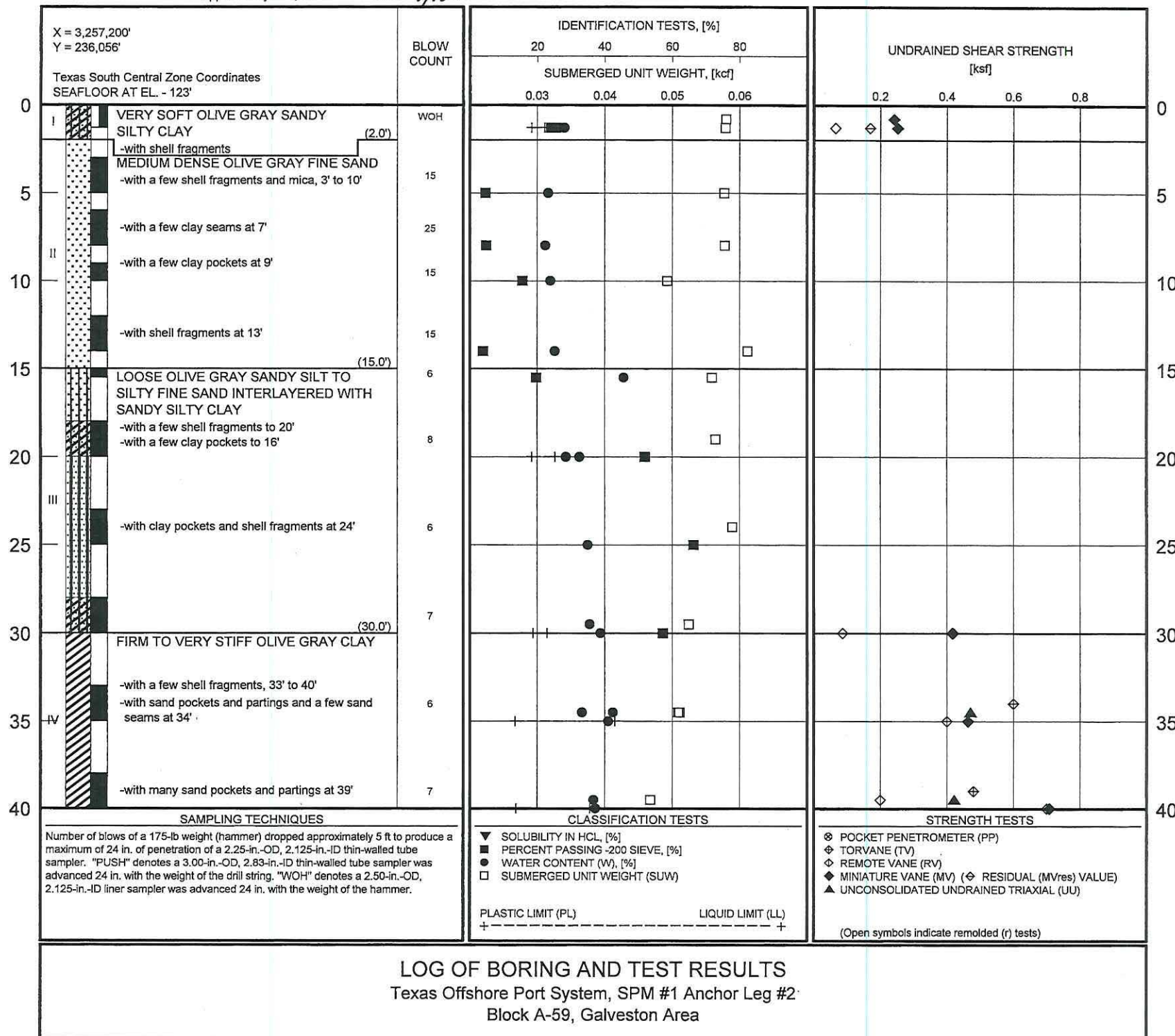
0/21/01

Report No. 0201-6505

Penetration Below Seafloor, [feet]

PLATE 3-12b

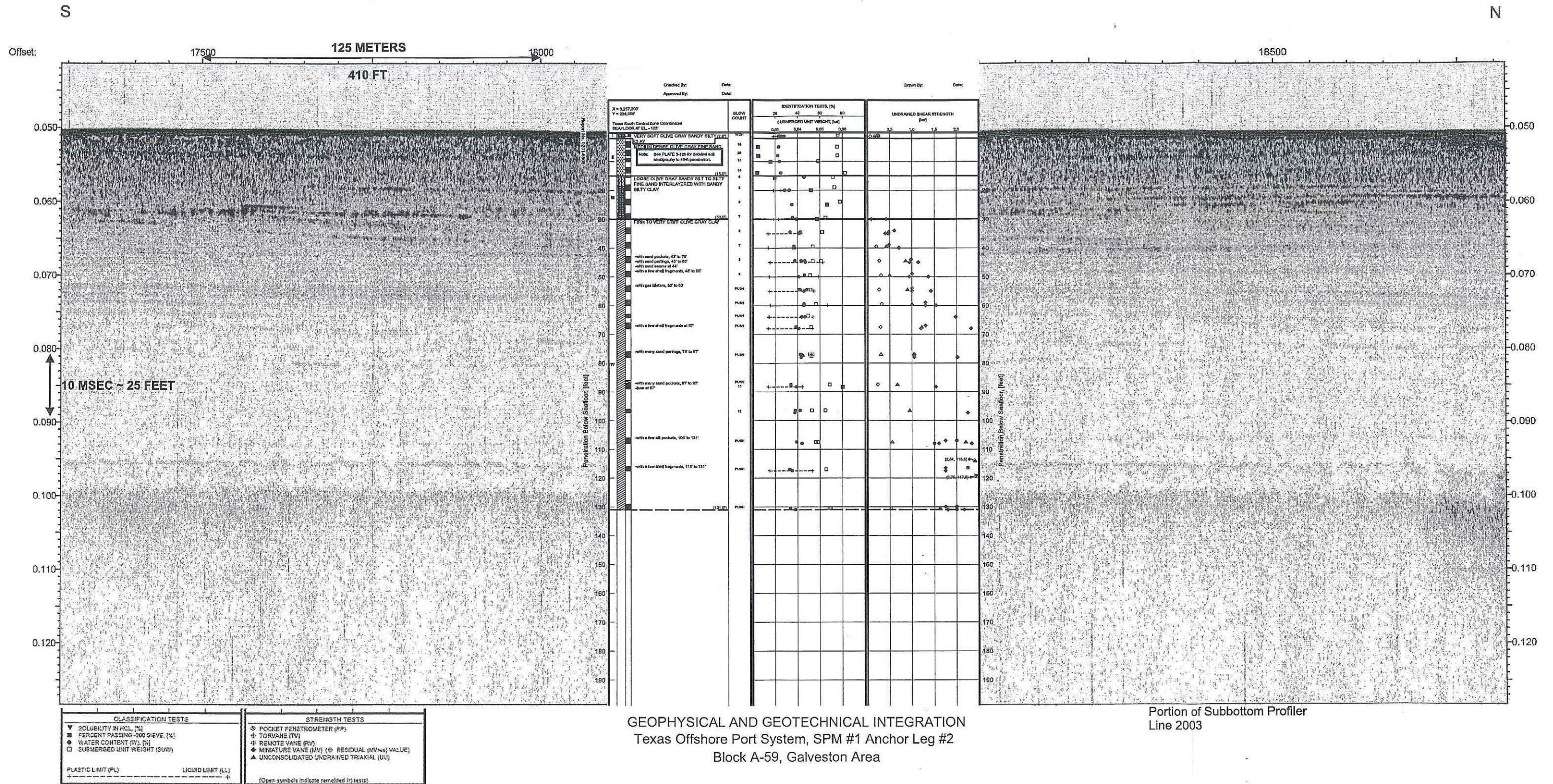
Penetration Below Seafloor, [feet]



**LOG OF BORING AND TEST RESULTS**  
Texas Offshore Port System, SPM #1 Anchor Leg #2  
Block A-59, Galveston Area









8/21/04

Date:

AW

Drawn By:

8/25/08

Date:

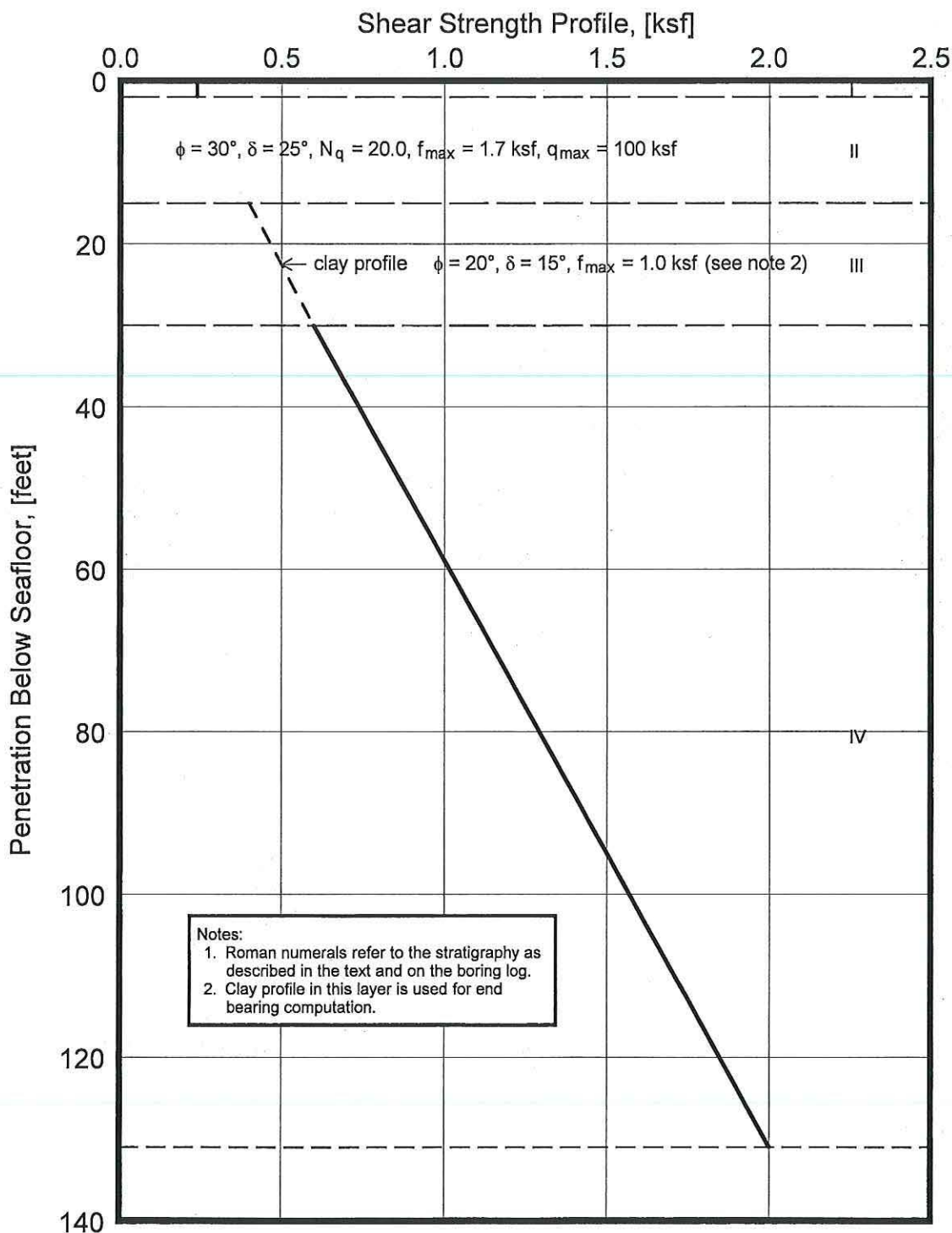
9/18/08

Date:

PM/LS

Checked By:

Approved By: DM



### DESIGN STRENGTH PARAMETERS

Texas Offshore Port System, SPM #1 Anchor Leg #2  
Block A-59, Galveston Area

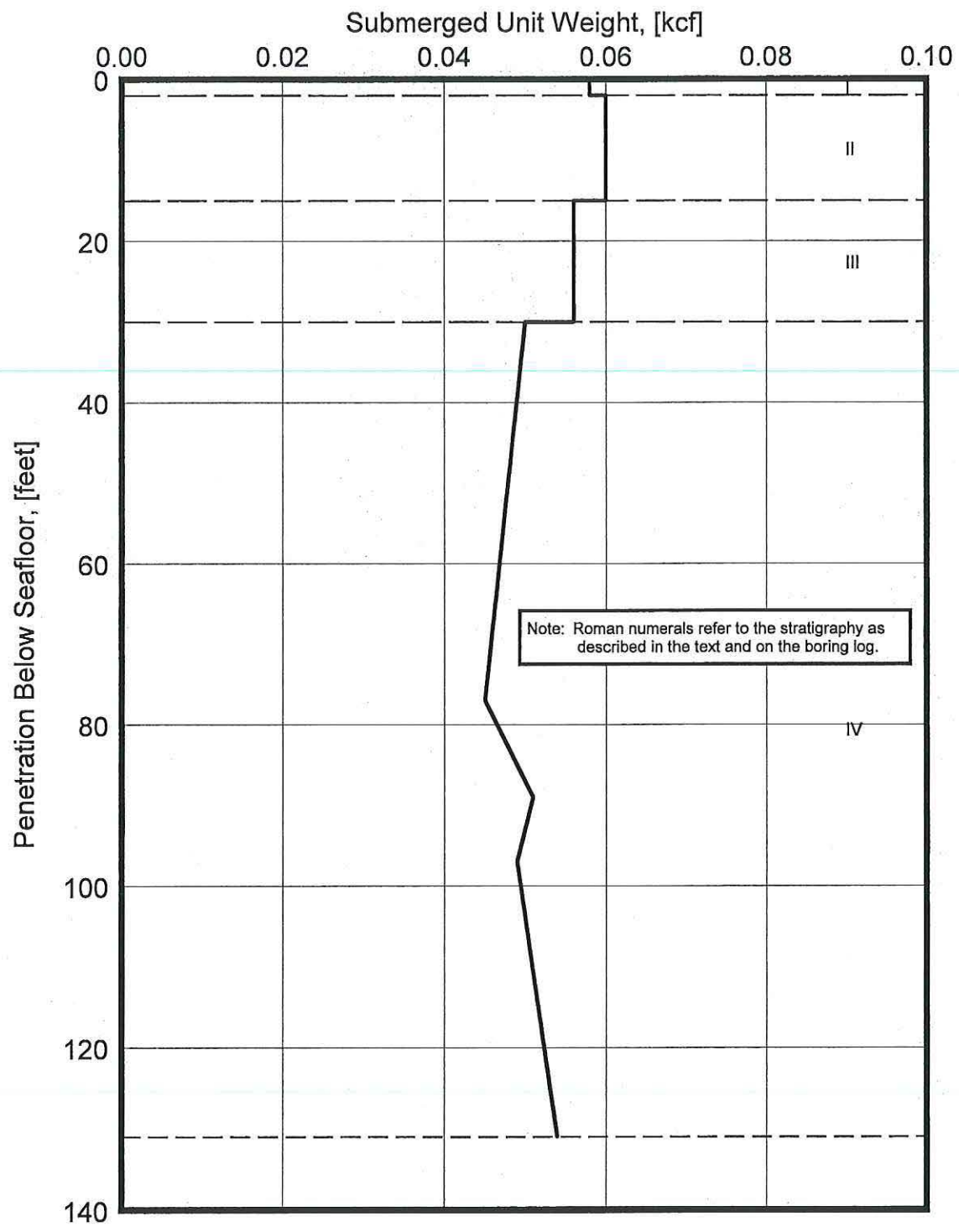


Date: 8/21/08

Drawn By: [Signature]

Date: 8/25/08

Checked By: PMP/CS  
Approved By: [Signature]



### DESIGN SUBMERGED UNIT WEIGHT

Texas Offshore Port System, SPM #1 Anchor Leg #2  
Block A-59, Galveston Area

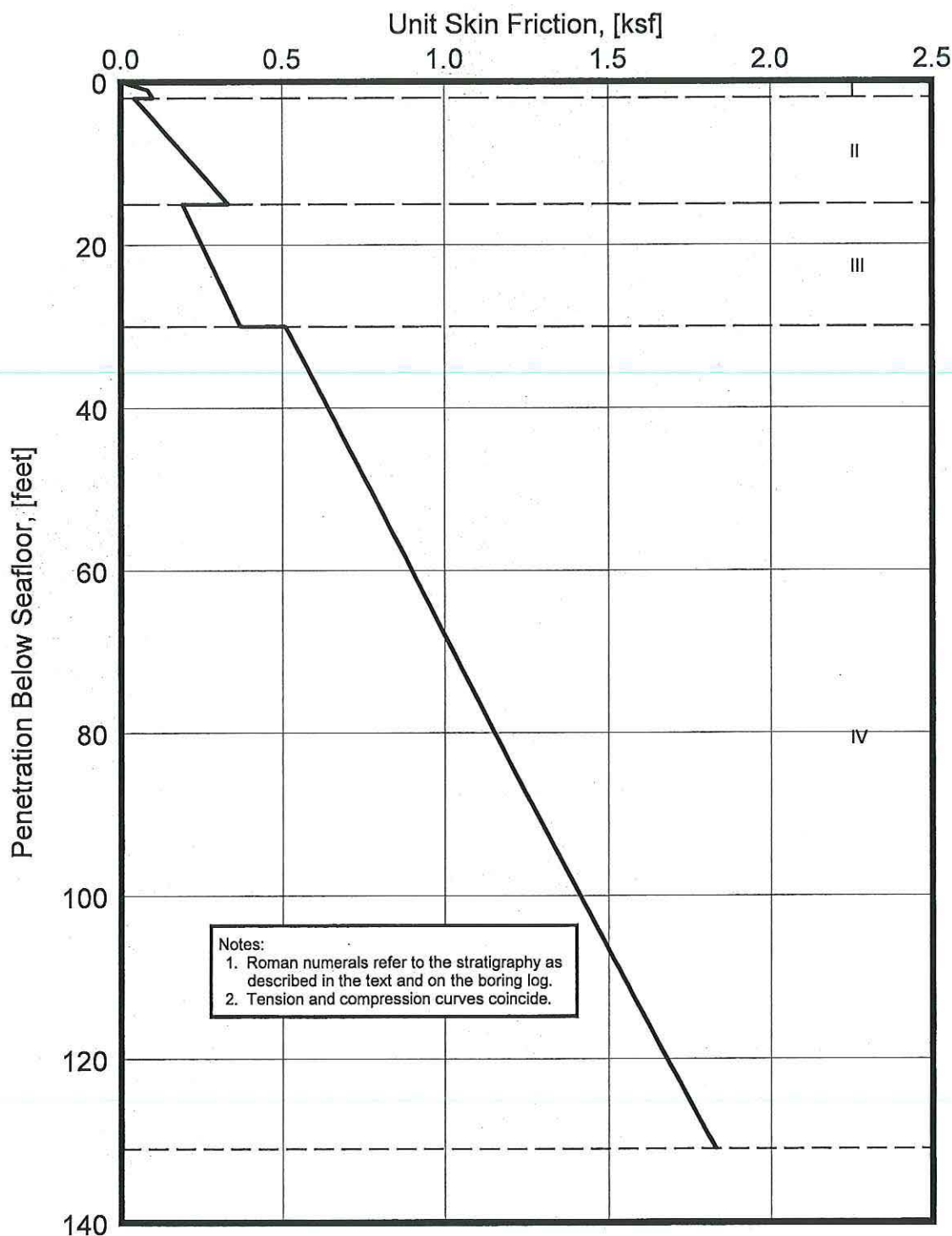




Date: 8/21/08

Drawn By: AW

Checked By: PMP/LS  
 Date: 8/25/08  
 Approved By: [Signature]  
 Date: 9/10/08



### UNIT SKIN FRICTION API RP 2A (2000) Method

Texas Offshore Port System, SPM #1 Anchor Leg #2  
 Block A-59, Galveston Area



Date: 8/21/08

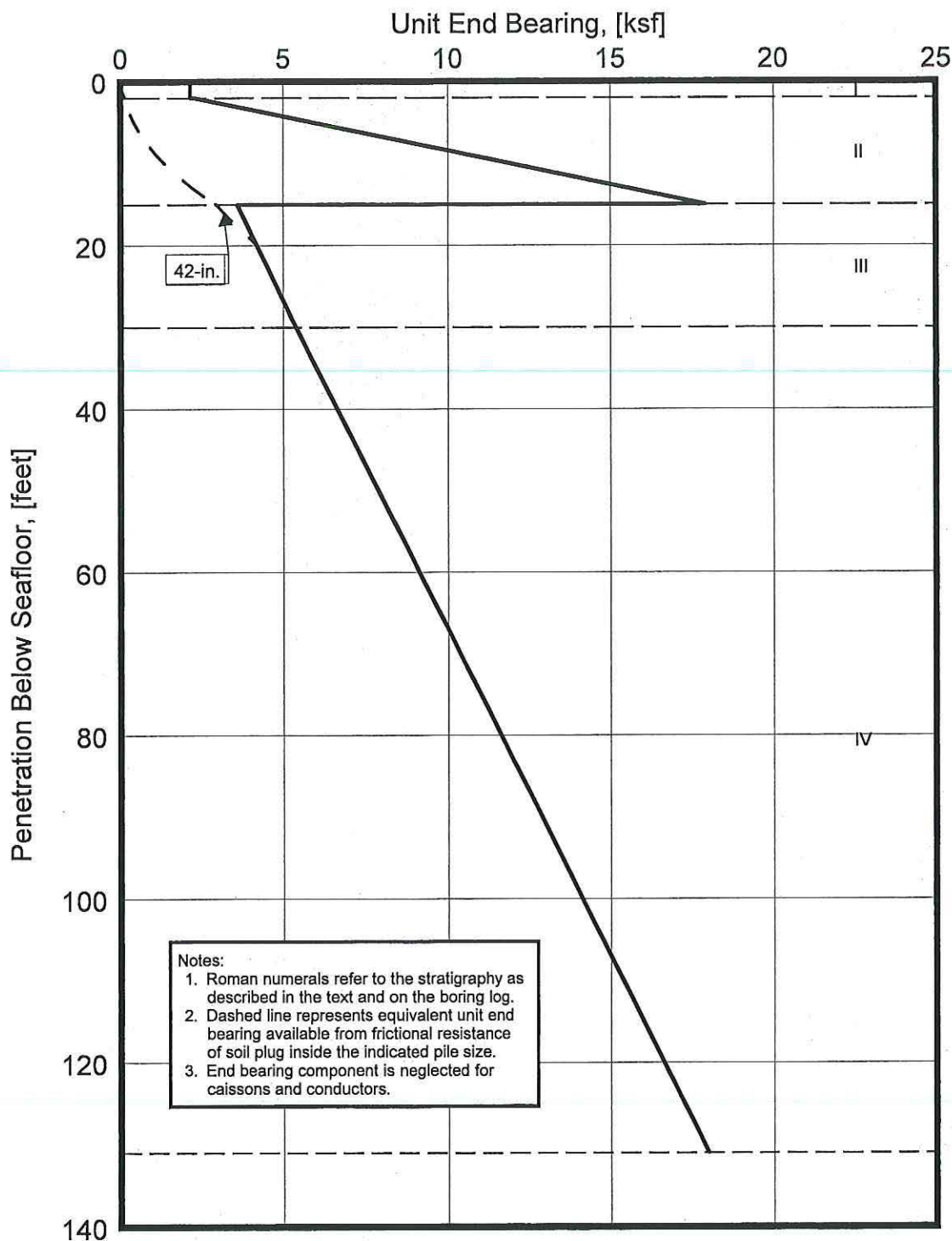
Drawn By: AW

Checked By: DWP/LS

Date: 8/25/08

Date: 9/18/08

Approved By: n

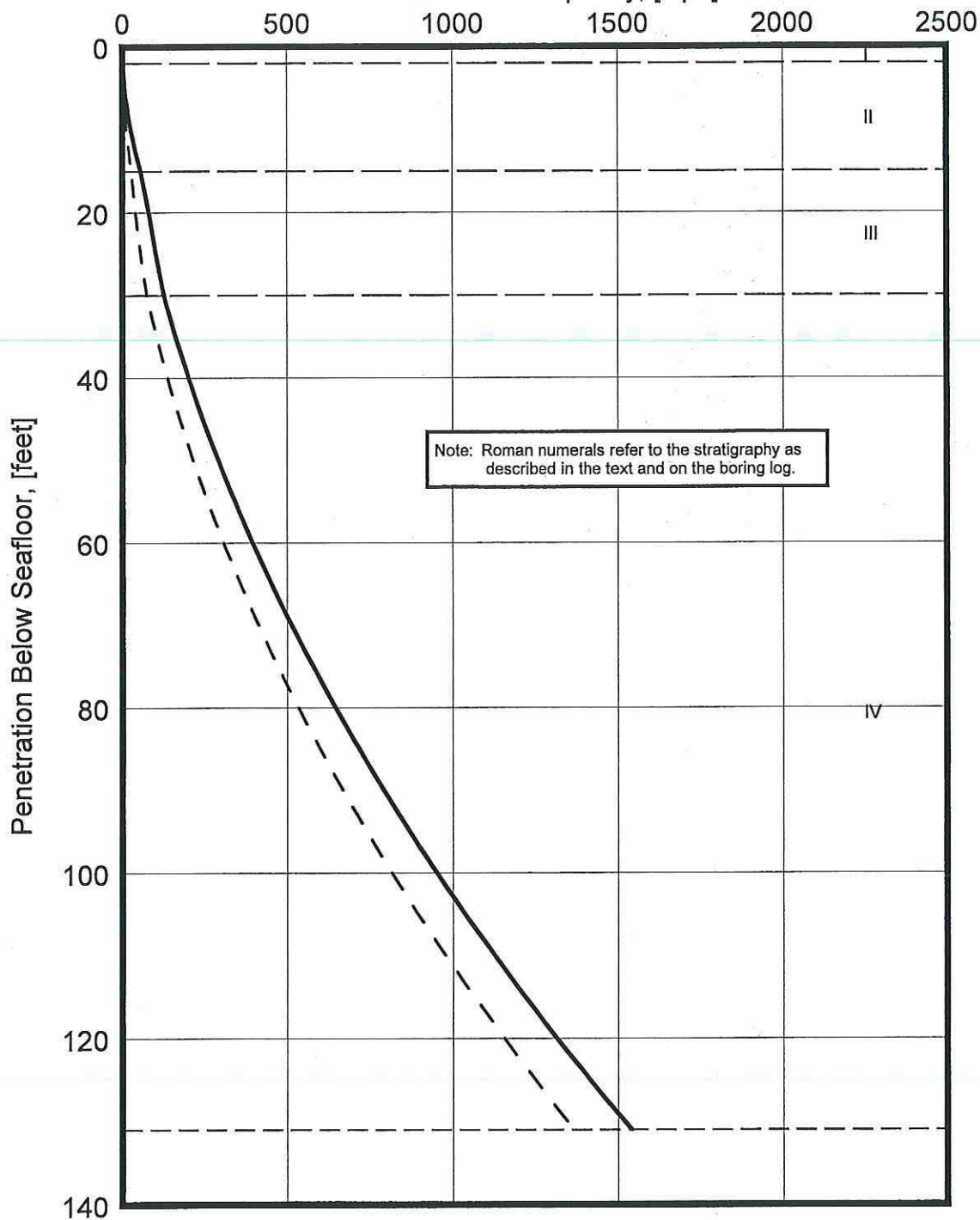


### UNIT END BEARING API RP 2A (2000) Method

Texas Offshore Port System, SPM #1 Anchor Leg #2  
Block A-59, Galveston Area



Ultimate Axial Capacity, [kips]



### ULTIMATE AXIAL CAPACITY

API RP 2A (2000) Method

42-in.-Diameter Driven Pipe Piles

Texas Offshore Port System, SPM #1 Anchor Leg #2

Block A-59, Galveston Area



Date: 8/21/08

Drawn By: AD

Date: 8/25/08

Checked By: PMP/LS

Date: 8/18/08

Approved By: [Signature]



Drawn By: *mms* Date: *9/19/08*

Checked By: *LS* Date: *9/19/08*  
 Approved By: *DA* Date: *9/18/06*

PENETRATION BELOW MUDLINE (feet)		CURVE POINTS							
		1	2	3	4	5	6	7	8
0.0	t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	z	0.00	0.07	0.13	0.24	0.34	0.42	0.84	42.00
1.0	t	0.00	0.03	0.04	0.06	0.08	0.08	0.08	0.08
	z	0.00	0.07	0.13	0.24	0.34	0.42	0.84	42.00
2.0	t	0.00	0.03	0.05	0.08	0.09	0.10	0.09	0.09
	z	0.00	0.07	0.13	0.24	0.34	0.42	0.84	42.00
2.0	t	0.00	0.04	0.04					
	z	0.00	0.10	42.00					
15.0	t	0.00	0.33	0.33					
	z	0.00	0.10	42.00					
15.0	t	0.00	0.19	0.19					
	z	0.00	0.10	42.00					
30.0	t	0.00	0.37	0.37					
	z	0.00	0.10	42.00					
30.0	t	0.00	0.15	0.26	0.38	0.46	0.51	0.46	0.46
	z	0.00	0.07	0.13	0.24	0.34	0.42	0.84	42.00
77.0	t	0.00	0.33	0.56	0.84	1.00	1.11	1.00	1.00
	z	0.00	0.07	0.13	0.24	0.34	0.42	0.84	42.00
89.0	t	0.00	0.38	0.63	0.95	1.14	1.27	1.14	1.14
	z	0.00	0.07	0.13	0.24	0.34	0.42	0.84	42.00
97.0	t	0.00	0.41	0.69	1.03	1.24	1.37	1.24	1.24
	z	0.00	0.07	0.13	0.24	0.34	0.42	0.84	42.00
100.0	t	0.00	0.42	0.71	1.06	1.27	1.41	1.27	1.27
	z	0.00	0.07	0.13	0.24	0.34	0.42	0.84	42.00
131.0	t	0.00	0.55	0.91	1.37	1.65	1.83	1.65	1.65
	z	0.00	0.07	0.13	0.24	0.34	0.42	0.84	42.00

Notes: 1. "t" is mobilized soil-pile adhesion, [ksf].  
 2. "z" is axial pile displacement, [in.].  
 3. Data for tension and compression coincide.

### AXIAL LOAD TRANSFER DATA (T-Z DATA)

API RP 2A (2000) Method  
 42-in.-Diameter Driven Pipe Piles  
 Texas Offshore Port System, SPM #1 Anchor Leg #2  
 Block A-59, Galveston Area



PENETRATION BELOW MUDLINE (feet)	CURVE POINTS							
		1	2	3	4	5	6	7
30.0	Q	0	13	26	39	47	52	52
	z	0.00	0.08	0.55	1.76	3.07	4.20	42.00
131.0	Q	0	43	87	130	156	173	173
	z	0.00	0.08	0.55	1.76	3.07	4.20	42.00

Notes: 1. "Q" is mobilized end bearing capacity, [kips].  
2. "z" is axial tip displacement, [in.].

**AXIAL LOAD TRANSFER DATA**  
(Q-Z DATA)

API RP 2A (2000) Method  
42-in.-Diameter Driven Pipe Piles  
Texas Offshore Port System, SPM #1 Anchor Leg #2  
Block A-59, Galveston Area

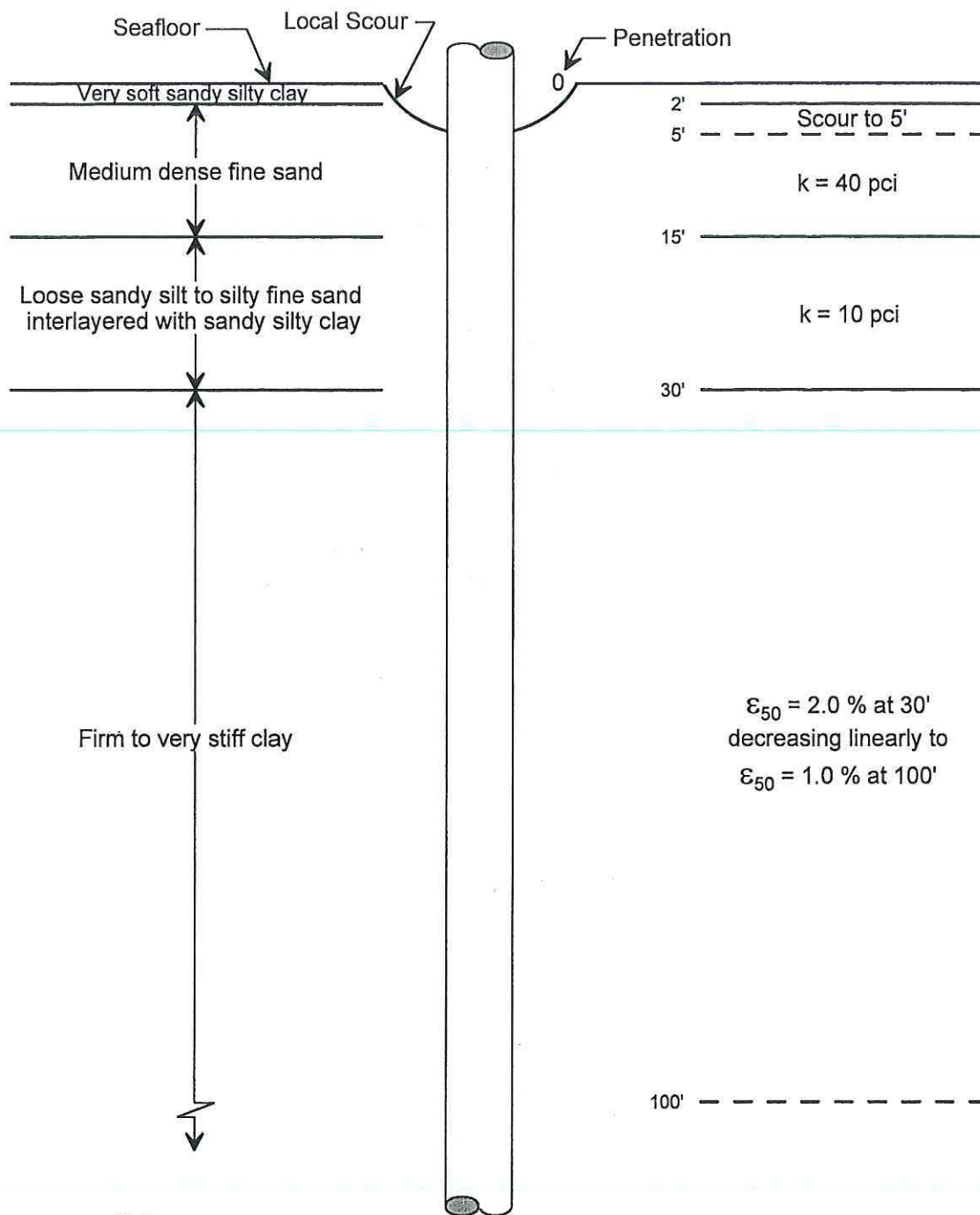
Date: 8/21/08

Drawn By: JAW

Checked By: PMP/LS Date: 8/25/08

Approved By: on Date: 9/18/08





Notes:

1.  $\epsilon_{50}$  is axial strain at half of peak deviator stress for cohesive soils.
2. Soil strength parameters are shown on Plate 3-14.
3. Submerged unit weight profile is shown on Plate 3-15.
4.  $k$  is the modulus of horizontal subgrade reaction for granular soils.

**STRATIGRAPHY AND PARAMETERS FOR P-Y DATA**

Texas Offshore Port System, SPM #1 Anchor Leg #2  
Block A-59, Galveston Area

Drawn By: *AW* Date: 8/25/08

Checked By: *MM* Date: 8/25/08  
Approved By: *AW* Date: 9/1/08



Date: 8/21/08

Drawn By: MW

Checked By: PMP/LS  
 Date: 8/25/08  
 Approved By: [Signature]  
 Date: 9/10/08

PENETRATION BELOW MUDLINE (feet)	CURVE POINTS								
		1	2	3	4	5	6	7	8
0.0	p y	0 0.00	0 42.00						
5.0	p y	0 0.00	0 42.00						
9.0	p y	0 0.00	164 0.06	273 0.11	361 0.15	454 0.23	519 0.35	541 0.51	547 42.00
12.0	p y	0 0.00	404 0.08	674 0.15	890 0.22	1119 0.32	1281 0.50	1334 0.72	1348 42.00
15.0	p y	0 0.00	745 0.11	1242 0.19	1640 0.28	2062 0.42	2360 0.64	2459 0.93	2484 42.00
15.0	p y	0 0.00	329 0.19	549 0.34	724 0.49	911 0.74	1042 1.13	1086 1.64	1097 42.00
19.0	p y	0 0.00	499 0.23	831 0.40	1097 0.58	1380 0.87	1579 1.34	1646 1.93	1662 42.00
23.0	p y	0 0.00	690 0.26	1150 0.46	1518 0.66	1909 0.99	2185 1.53	2277 2.21	2300 42.00
30.0	p y	0 0.00	1098 0.31	1830 0.56	2415 0.81	3038 1.21	3477 1.86	3623 2.69	3660 42.00
30.0	p y	0 0.00	236 0.06	362 0.21	535 0.63	787 2.10	1134 6.30	1134 42.00	
100.0 (and below)	p y	0 0.00	618 0.03	948 0.10	1401 0.31	2061 1.05	2967 3.15	2967 42.00	

Notes: 1. "p" is soil resistance, [lb/in.].  
 2. "y" is lateral deflection, [in.].

**P-Y DATA**  
 (CYCLIC LOADING)  
 API RP 2A (2000) Method  
 42-in.-Diameter Driven Pipe Piles  
 Texas Offshore Port System, SPM #1 Anchor Leg #2  
 Block A-59, Galveston Area



<u>Date</u>	<u>Time</u>		<u>Description of Activities</u>
	<u>From</u>	<u>To</u>	
July 4, 2008	****	0950	Arrive in Block A-59, Galveston Area, SPM #1 Anchor Leg #2 location onboard the vessel <i>R/V Seaprobe</i> .
	0950	1200	Wait on weather. (Seas: 6 ft, Winds: 45 mph gusts.)
	****	1130	Conduct pre-shift safety meeting.
	1200	1340	Set 4-pt anchor spread.
	****	1245	Conduct task change safety meeting.
	1340	1400	Rig up to drill and sample.
	****	1400	Estimate water depth of 118 ft with vessel's echo sounder and 122 ft using wireline technique.
	1400	1420	Run scanning sonar
	1420	1440	Run drill pipe to mudline.
	****	1440	Measure water depth of 123 ft with the bottom sensor/pipe tally and 122.3 ft with pressure transducer.
	1440	2130	Drill and sample. Boring terminated at 131-ft penetration.
	2130	2200	Pull drill pipe above mudline and reposition vessel.
	****	2200	Measure supplemental water depth of 122 ft with the bottom sensor/pipe tally and 120.5 ft with pressure transducer.
	2200	2225	Pull drill pipe to deck and secure equipment for travel.
	2225	2340	Pull anchors.
	2340	****	Depart location.

### SUMMARY OF FIELD OPERATIONS

Texas Offshore Port System, SPM #1 Anchor Leg #2  
Block A-59, Galveston Area





Checked By: *AW* Date: *9/5/08*  
 Approved By: *pn* Date: *9/12/08*

Drawn By: *Tanel* Date: *9/15/08*

## Summary of Test Results

Job No.: 0201-6505-1

05-Sep-2008 (Ver. #5)

Boring: Texas Offshore Port System, SPM #1 Anchor Leg #2

Block: A-59

Area: Galveston

Sample No.	Depth (ft)	Identification Tests						Strength Estimate (ksf)		Miniature Vane Tests (ksf)			Compression Tests									
		Liquidity Index	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%)	Submerged Unit Weight (pcf)	Passing No. 200 Sieve	Penetrometer	Torvane	Undisturbed	Remolded	Residual	Type Test	Moisture Content (%)	Confining Pressure (psi)	Undisturbed Strength (ksf)	Remolded Strength (ksf)	ε <sub>50</sub> Strain (%)	Submerged Unit Weight (pcf)	Failure Strain (%)	Type of Failure	
1	0.30																					
2	0.80					58				0.24												
3	1.30				28	58	24			0.25		0.17										
3	1.30				27						0.07											
3	1.30	2.01	22	18	26																	
4	5.00				23	58	5															
5	8.00				22	58	5															
6	10.00				24	49	16															
7	14.00				25	61	4															
8	15.50				46	56	20															
9	19.00					56																
10	20.00				33		52															
10	20.00	1.46	25	18	29																	
11	24.00					59																
12	25.00				35		66															
13	29.00																					
14	29.50				36	52																
15	30.00										0.09											
15	30.00	4.75	23	19	39		57		0.42	0.42												
16	34.00								0.60													
17	34.50				42	51							UU	33	120	0.47		2.4	51	14	A	
18	35.00	.93	43	13	41				0.40	0.46												

### NOTES:

#### TYPE OF TEST

U - Unconfined Compression  
 UU- Unconsolidated-Undrained Triaxial  
 CU- Consolidated-Undrained Triaxial

#### TYPE OF FAILURE

A - Bulge  
 B - Single Shear Plane  
 C - Multiple Shear Plane  
 D - Vertical Fracture

Plus Signs [+] denote tests which exceeded the capacity of the measuring device.

NP = Non Plastic Material

Checked By: *AW* Date: *9/5/08*  
 Approved By: *D* Date: *9/8/08*

Drawn By: *Tomol* Date: *9/5/08*

Job No.: 0201-6505-1

05-Sep-2008 (Ver. #5)

Boring: Texas Offshore Port System, SPM #1 Anchor Leg #2

Block: A-59

Area: Galveston

## Summary of Test Results

Sample No.	Depth (ft)	Identification Tests						Strength Estimate (ksf)		Miniature Vane Tests (ksf)			Compression Tests								
		Liquidity Index	Liquid Limit (%)	Plastic Limit (%)	Moisture Content (%)	Submerged Unit Weight (pcf)	Passing No. 200 Sieve	Penetrometer	Torvane	Undisturbed	Remolded	Residual	Type Test	Moisture Content (%)	Confining Pressure (psi)	Undisturbed Strength (ksf)	Remolded Strength (ksf)	$\epsilon_{50}$ Strain (%)	Submerged Unit Weight (pcf)	Failure Strain (%)	Type of Failure
19	39.00								0.48												
20	39.50												UU	37	120	0.42		2.3	47	17	A
20	39.50										0.20										
21	40.00	1.07	36	14	37				0.70	0.71											
22	44.00								0.98												
23	44.50				37						0.27										
23	44.50				46	50							UU	43	120	0.86		2.0	47	7	A
24	45.00	.67	63	15	47				0.94	1.14											
25	49.00								1.00												
26	49.50												UU	46	120	0.50		1.8	46	12	A
26	49.50										0.31										
27	50.00	.60	59	15	41				0.94	1.37											
28	54.00								1.00												
29	54.50				41	45							UU	42	120	0.90		0.5	46	3	AC
29	54.50				48						0.26										
30	55.00	.77	55	15	46				1.00	1.42											
31	59.00								1.30												
32	59.50										0.32										
32	59.50												UU	46	119	1.00		1.2	48	4	C
33	60.00	.58	67	16	45				1.30	1.53											
34	63.50					45															
35	64.00				46					1.98											

### NOTES:

#### TYPE OF TEST

U - Unconfined Compression  
 UU- Unconsolidated-Undrained Triaxial  
 CU- Consolidated-Undrained Triaxial

#### TYPE OF FAILURE

A - Bulge  
 B - Single Shear Plane  
 C - Multiple Shear Plane  
 D - Vertical Fracture

Plus Signs [+] denote tests which exceeded the capacity of the measuring device.

NP = Non Plastic Material



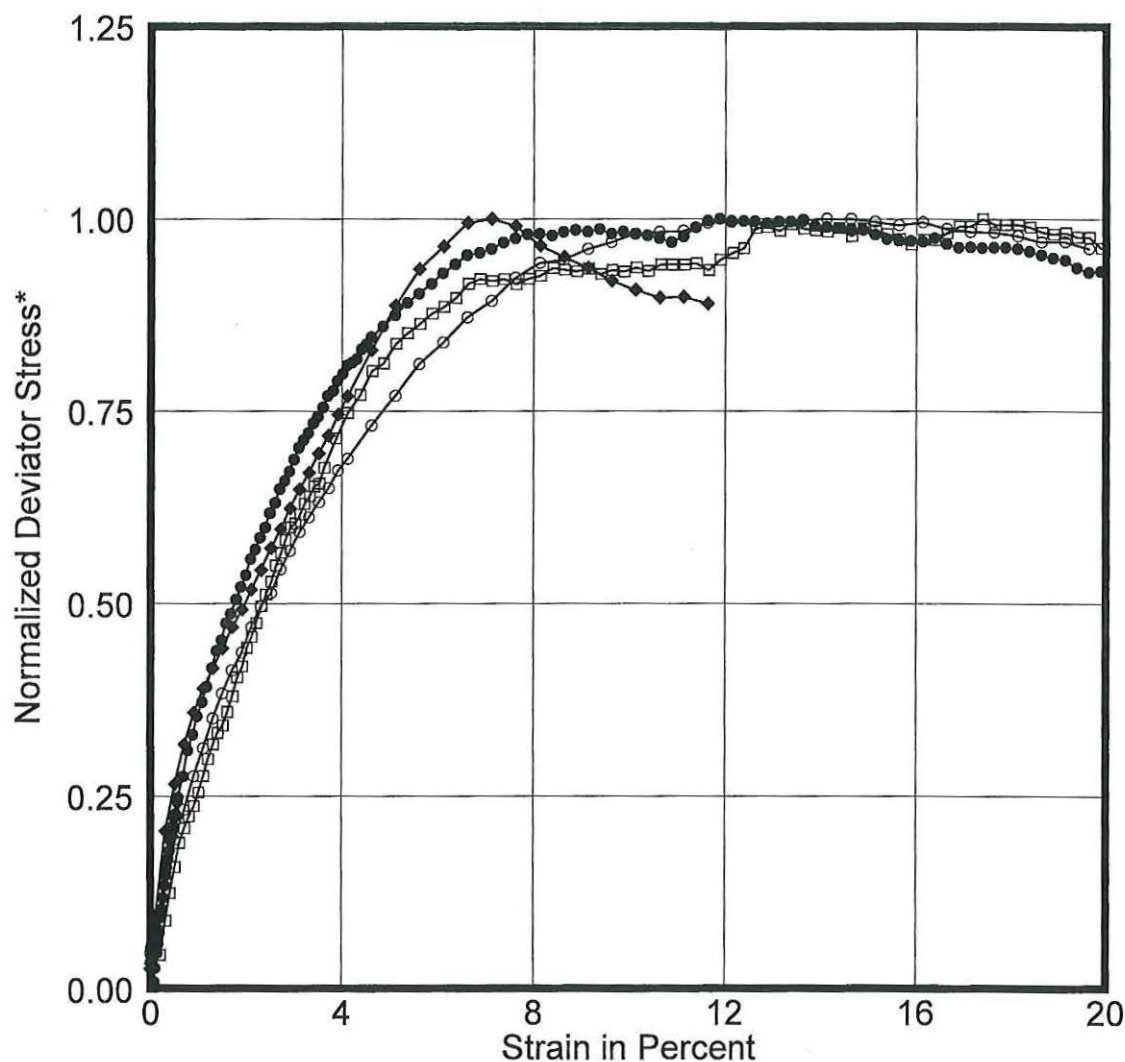
Drawn By: Teneo Date: 9/15/08

Date: 9/15/08

Checked By: HAW

Date: 9/19/08

Approved By: P



Curve	Sample No.	Depth [ft]	Test Type	Confining Pressure [psi]	Maximum Deviator Stress [ksf]	$\epsilon_{50}$ [%]
○—○	17	34.50	UU	120.2	0.94	2.4
□—□	20	39.50	UU	119.6	0.84	2.3
◆—◆	23	44.50	UU	120.3	1.72	2.0
●—●	26	49.50	UU	120.1	0.99	1.8

\* Normalized with respect to maximum deviator stress.

# **STRESS-STRAIN CURVES** Unconsolidated-Undrained Triaxial Compression Test Texas Offshore Port System, SPM #1 Anchor Leg #2 Block A-59, Galveston Area

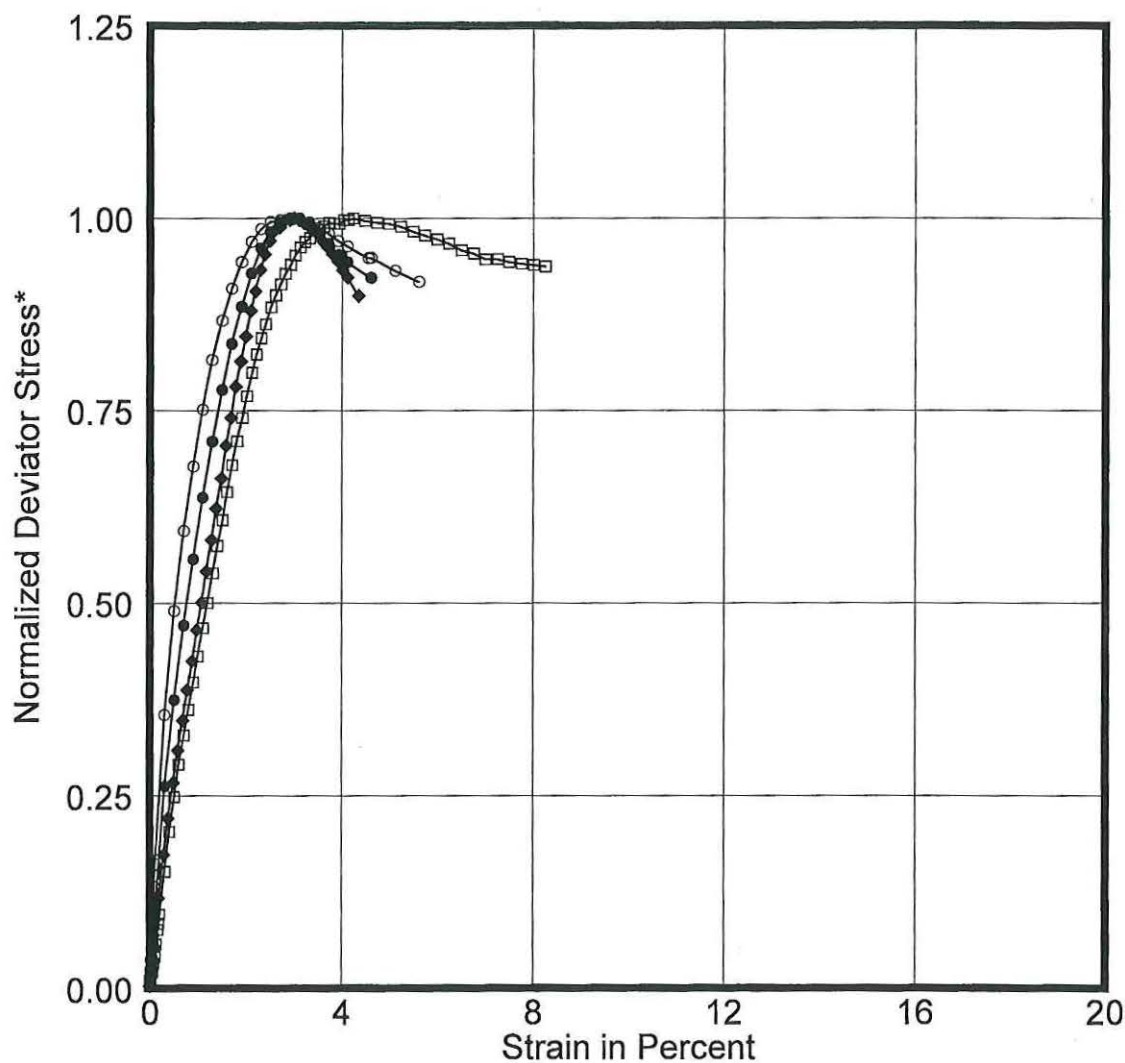


Drawn By: T-mel Date: 9/5/08

Date: 9/5/08

Checked By: AW

Date: 9/18/08  
Approved By: DL



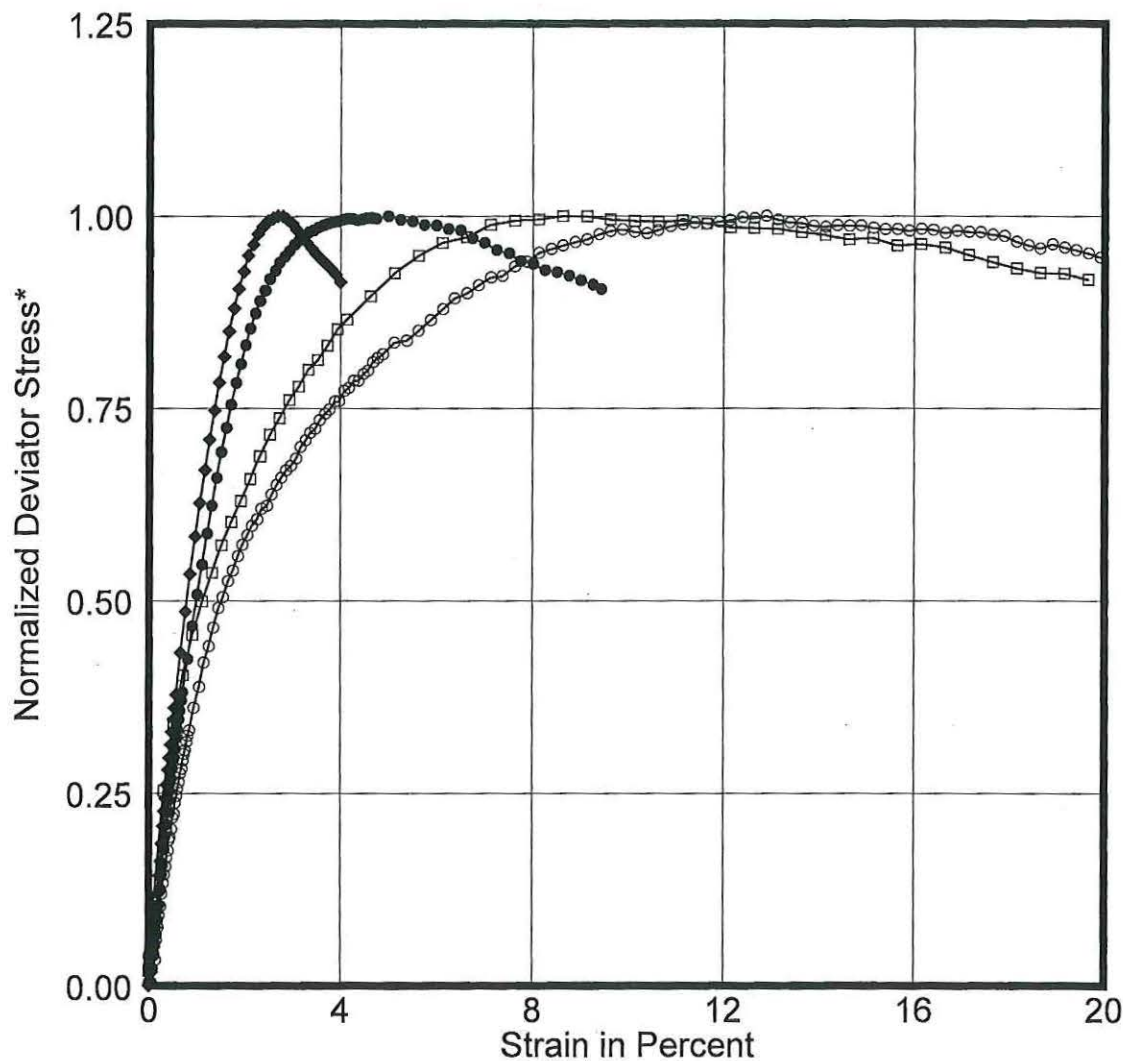
Curve	Sample No.	Depth [ft]	Test Type	Confining Pressure [psi]	Maximum Deviator Stress [ksf]	$\epsilon_{50}$ [%]
○—○	29	54.50	UU	120.2	1.80	0.5
□—□	32	59.50	UU	119.5	2.00	1.2
◆—◆	37	67.50	UU	120.5	2.43	1.1
●—●	39	77.00	UU	120.1	2.08	0.8

\* Normalized with respect to maximum deviator stress.

**STRESS-STRAIN CURVES**  
 Unconsolidated-Undrained Triaxial Compression Test  
 Texas Offshore Port System, SPM #1 Anchor Leg #2  
 Block A-59, Galveston Area



Drawn By: Ttemot Date: 9/15/08



Curve	Sample No.	Depth [ft]	Test Type	Confining Pressure [psi]	Maximum Deviator Stress [ksf]	$\epsilon_{50}$ [%]
○—○	42	87.50	UU	119.4	1.34	1.5
□—□	45	96.50	UU	120.0	1.89	1.1
◆—◆	48	107.50	UU	121.1	4.41	0.8
●—●	54	130.50	UU	118.5	3.25	1.0

\* Normalized with respect to maximum deviator stress.

**STRESS-STRAIN CURVES**  
 Unconsolidated-Undrained Triaxial Compression Test  
 Texas Offshore Port System, SPM #1 Anchor Leg #2  
 Block A-59, Galveston Area



Date: 9/15/08  
 Date: 9/19/08  
 Checked By: HCU  
 Approved By: an

# ENTERPRISE FIELD SERVICES, LLC

## SOIL BORINGS

### TEXAS OFFSHORE PORT SYSTEM

#### SPM #1 and SPM #2

#### GALVESTON AREA BLOCK A59

#### 1. INTRODUCTION:

**Fugro Chance Inc. (CHANCE)** was contracted by Fugro-McClelland Marine Geosciences, Inc. to position the M/V "Seaprobe" for a soil boring in Galveston Area, Block A59, Offshore Texas.

#### 2. REQUIREMENTS:

Positioning requirements were transmitted, via e-mail, to Mr. Tony Parker of **CHANCE** by Mr. Frank Ortiz of Fugro-McClelland Marine Geosciences, Inc. A "Survey Request" form dated June 25, 2008 e-mailed to Mr. Manuel Lopez of Enterprise Field Services, LLC, confirmed these requirements. A copy of this form was also e-mailed to Mr. Frank Ortiz.

Requirements were as follows:

##### A) Proposed Location – SPM #1 and SPM #2

The Texas South Zone Coordinates are:

##### CORE 1 (Leg #2 – West)

Y = 236,057.66'  
X = 3,257,224.19'

##### CORE 2 (Leg #6 – East)

Y = 241,308.73'  
X = 3,266,735.50'

##### CORE 3 (PLET #1)

Y = 236,494.60'  
X = 3,258,627.75'

##### CORE 4 (PLET #2)

Y = 240,337.08'  
X = 3,265,632.42'

#### 3. CHANCE PERSONNEL:

Party Chief - C. Evans

#### 4. EQUIPMENT AND METHOD:

##### A) Primary Positioning System - **STARFIX® Satellite Positioning System**

Continuous dynamic positioning through the use of Navstar GPS with differential signals from multiple reference stations corrected for ionospheric and tropospheric effects transmitted via the **STARFIX®** equatorial geosynchronous satellite.

##### B) Secondary Positioning System - **Differential Global Positioning System (DGPS)**

DGPS utilizes the Navstar Satellite Constellation with data from selected reference sites transmitted via LF radio-link for enhanced accuracy through differential techniques.



C) **STARFIX.NAV®**

**STARFIX.NAV®** is an on board computer graphic system interfaced to the primary positioning system capable of displaying real time position of a vessel in relation to known hazards, fairways, proposed location, etc. **DRONE®** units when used on anchor handling vessels utilize Differential GPS transmitted to the master station via radio telemetry link to display in real time the position of that vessel.

D) Vessel orientation by Sperry SR 50 Mod 1 North Seeking Gyro or a S. G. Brown Meridian North Seeking Gyro

North seeking Gyro compass. Accuracy  $\pm 2^\circ$  after 4 hours initial spin up.

E) Scanning Sonar

Simrad MS1000 High Resolution Sonar

5. **RESULTS:**

Geographic positions are based on Clarke 1866 Spheroid, North American Datum 1927. Grid coordinates are based on Texas South Central Zone Lambert, NAD 27.

Field operations were conducted from July 4, 2008 to July 7, 2008 with the following results:

A) **STARFIX®** position derived by averaging readings over a one hour period at an update rate of 750 ms. per reading.

**CORE 1 (Leg #2 - West)**

Y = 236,056.44'

X = 3,257,200.14'

Latitude: 28° 25' 28.968" N

Longitude: 95° 05' 17.113" W

This location being 6,376.44' FSL and 3,164.33' FWL of Block A59, Galveston Area

**CORE 2 (Leg #6 - East)**

Y = 241,330.78'

X = 3,266,758.05'

Latitude: 28° 26' 17.984" N

Longitude: 95° 03' 28.137" W

This location being 4,189.22' FNL and 3,117.76' FEL of Block A59, Galveston Area

CORE 3 (PLET #1)

Y = 236,466.44'  
X = 3,258,639.61'

Latitude: 28° 25' 32.548" N  
Longitude: 95° 05' 00.846" W

This location being 6,786.44' FSL and 4,603.80' FWL of Block A59, Galveston Area

CORE 4 (PLET #2)

Y = 240,317.51'  
X = 3,265,646.77'

Latitude: 28° 26' 08.328" N  
Longitude: 95° 03' 40.960" W

This location being 5,202.49' FNL and 4,229.04' FEL of Block A59, Galveston Area

**6. CONFIRMATION:**

DGPS was used for confirmation.

The results were as follows:

CORE 1 (Leg #2 - West)

Y = 236,057'  
X = 3,257,200'

CORE 2 (Leg #6 - East)

Y = 241,331'  
X = 3,266,757'

CORE 3 (PLET #1)

Y = 236,467'  
X = 3,258,640'

CORE 4 (PLET #2)

Y = 240,318'  
X = 3,265,648'

**7. HSE INCIDENTS:**

No incidents.

**8. CHRONOLOGY:**

July 4, 2008

1000 Conducted job change in field; aboard "Seaprobe" on standby at location GA. A59 due to weather; start time for job  
1200 Preparing to set out anchors at proposed Core 1 location  
1203 PB #1 Anchor on bottom  
1217 PB #1 Anchor removed from bottom; will re-set per Captain



1218 PB #1 Anchor on bottom  
1236 SB #2 Anchor on bottom  
1250 SS #3 Anchor on bottom  
1304 PS #4 Anchor on bottom  
1340 Vessel on location; deployed Sonar; conducting site investigation at proposed Core #1 site  
1355 Archiving Sonar data on proposed core site  
1431 Sonar on deck; starting final tie; drill crew performing soil boring  
1531 Final tie at Core #1 complete; emailing Lafayette office for final tie confirmation  
1550 Received final tie confirmation; soil boring continues  
2240 Core #1 complete; preparing to start anchor recovery  
2251 SS #3 Anchor off bottom  
2311 PS #4 Anchor off bottom  
2320 SB #2 Anchor off bottom  
2333 PB #1 Anchor off bottom; anchor recovery complete  
2345 En route to proposed Core #3 site 1500' away  
2354 At proposed Core #3 site; PB #1 Anchor on bottom  
2400 Continuing to set out anchors at proposed Core 3 location

July 5, 2008

0001 Continuing to set out anchors  
0006 SB #2 Anchor on bottom  
0022 SS #3 Anchor on bottom  
0047 PS #4 Anchor on bottom; moving onto location  
0106 Vessel on location; preparing to deploy Sonar  
0126 Deployed Sonar; conducting site investigation at proposed Core #3 site  
0205 Sonar on deck; starting final tie  
0305 Final tie at Core #3 complete  
0330 Received final tie confirmation; drill crew performing soil boring  
0745 Core #3 complete; preparing to start anchor recovery  
0756 PS #4 Anchor off bottom  
0811 SS #3 Anchor off bottom  
0822 SB #2 Anchor off bottom  
0831 PB #1 Anchor off bottom; anchor recovery complete  
0845 En route to proposed Core #4 site  
0854 At proposed Core #4 location; PB #1 Anchor on bottom  
0907 SB #2 Anchor on bottom  
0921 SS #3 Anchor on bottom  
0937 PS #4 Anchor on bottom; moving onto location  
1015 Vessel on location; deployed Sonar  
1018 Conducting site investigation at proposed Core #4 site  
1031 Sonar on deck; starting final tie; drill crew performing soil boring  
1131 Final tie at Core #4 complete; emailing Lafayette office for final tie confirmation  
1300 Received final tie confirmation from office; soil boring continues  
1730 Core #4 complete; preparing to start anchor recovery  
1747 SS #3 Anchor off bottom  
1759 PS #4 Anchor off bottom  
1809 SB #2 Anchor off bottom  
1818 PB #1 Anchor off bottom; anchor recovery complete

FINAL SOIL BORINGS						
LOCATION	CALLS	CALLEW	X COORDINATE	Y COORDINATE	LATITUDE	LONGITUDE
CORE 1	6,376.44' FSL	3,164.33' FWL	3,257,200.14'	236,056.44'	28° 25' 28.968"N	95° 05' 17.113"W
CORE 2	4,189.22' FNL	3,117.76' FEL	3,266,758.05'	241,330.78'	28° 26' 17.984"N	95° 03' 28.137"W
CORE 3	6,786.44' FSL	4,603.80' FWL	3,258,639.61'	236,466.44'	28° 25' 32.548"N	95° 05' 00.846"W
CORE 4	5,202.49' FNL	4,229.04' FEL	3,265,646.77'	240,317.51'	28° 26' 08.328"N	95° 03' 40.960"W



I HEREBY CERTIFY THAT THE ABOVE FINAL SOIL BORINGS ARE CORRECT.

**NOTES:**

1) SURVEYED COORDINATES TRANSFORMED FROM NAD83 (CPS DATUM) TO NAD27 (CHART DATUM) USING NADCON VERSION 2.1.

**DIGITAL COPY**  
ORIGINAL PLAT SIGNED 7/7/08

REC. PROFESSIONAL LAND SURVEYOR NO. 4903  
STATE OF LOUISIANA

Printed: 7/7/08

**ENTERPRISE FIELD SERVICES, LLC**

**FINAL SOIL BORINGS  
NO LEASE NUMBER (PROP. ANC & PLET)**

BLOCK A59  
GALVESTON AREA  
GULF OF MEXICO

**FUGRO CHANCE INC.**

200 Dallas Dr. Lafayette, Louisiana 70508-3101 (337) 237-1300



GEODETIC DATUM: NAD27  
PROJECTION: TEXAS SOUTH CENTRAL  
GRID UNITS: US SURVEY FEET

SCALE 0 2,000'  
IN FEET

Job No.: 08-01931 Date: 7/7/08 Drwn: TCG  
Dwgfile: O:\WellPermit\TXsc\GA\Permit\A59\_CORE\_NO LEASE\_0801931

Chart: Of:  
1 1