Geotechnical Investigation Data Report

PO-104 Bayou Bonfouca Marsh Creation Project
Expanded Borrow Area Investigation
St. Tammany Parish, Louisiana

for

State of Louisiana
Coastal Protection and Restoration Authority

February 24, 2015

GeoEngineers
Earth Science + Technology

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February 24, 2015

GeoEngineers
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PO-104 Bayou Bonfouca Marsh Creation Project
Expanded Borrow Area Investigation
St. Tammany Parish, Louisiana

File No. 16715-023-03

February 24, 2015

Prepared for:

State of Louisiana
Coastal Protection and Restoration Authority
P.O. Box 44027
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INTRODUCTION

This report provides geotechnical engineering data for the Expanded Borrow Area Investigation of the PO-104 Bayou Bonfouca Marsh Creation Project and is prepared in accordance with the scope of services presented in the Coastal Protection and Restoration (CPRA) request dated April 2014 and our proposal dated June 5, 2014. This data report contains a site plan with boring locations, laboratory test results (including self-weight consolidation and settling column test results), and daily reports from the field exploration period. All elevations are referenced to the North American Vertical Datum of 1988 (NAVD 88). Figure 1 shows the project vicinity in relation to the surrounding area and the state of Louisiana.

PROJECT UNDERSTANDING AND SITE CONDITIONS

The expanded borrow area of the Bayou Bonfouca Marsh Creation Project is located in northeastern Lake Pontchartrain, immediately south of the originally proposed borrow area, and southwest of the city of Slidell. The Bayou Bonfouca Marsh Creation project is located west of Slidell in open-water and degraded marsh areas of Big Branch Marsh Wildlife Refuge. The project plan calls for the creation of approximately 522 acres of marsh and nourishment of about 42 acres of existing marsh by hydraulically pumping dredged sediment from the bottom of Lake Pontchartrain into the marsh creation and nourishment areas and planting marsh grass in the newly created marsh. Concerns about impacts to nesting sturgeons in the original borrow area during borrow dredge operations called for the expansion of the borrow area to reduce the likelihood of sturgeon habitat disruption.

FIELD EXPLORATION

CPRA obtained Coastal Use Authorization from the Louisiana Department of Natural Resources Office of Coastal Management (C.U.P No. 20131659) and the U.S. Army Corps of Engineers (Programmatic General Permit, Category I, File MVN 2013-03035) in 2013 for the expanded borrow area sediment study to evaluate material at the mudline in the expanded borrow area. These permits also cover the explorations presented in this report. Survey information and a magnetometer sweep of the borrow area was provided to CPRA by C & C Technologies. The results of these surveys were communicated to us prior to drill mobilization. All boring locations were approved by CPRA. In order to ensure field operations would not impact the Collins/Exxon product pipeline to the west of the borrow area, Exxon and GeoEngineers representatives met in the field and reviewed the boring locations prior to commencing drilling operations.

Soil conditions were evaluated in the expanded borrow area by advancing six (6) soil borings (14-1 through 14-6) to a depth of 20 feet below the mudline with a pontoon barge-mounted drill rig. A GeoEngineers engineer managed the drilling on a full-time basis, examined and classified the soils encountered, obtained representative samples, and prepared a log of each borehole to record soil descriptions, water depths, and other pertinent information. Water depth in the expanded borrow area ranged from 10.5 feet to 13.5 feet during field operations. Soil boring locations are shown in Figure 2 and summarized in the table on the page below along with borehole mudline and water surface elevations during field operations.

SOIL BORING SUMMARY

Boring ID	Total Depth (below mudline) (feet)	Latitude	Longitude	Mudline Elevation (ft)	Water Surface Elevation during Exploration (ft)
14-1	20	N 30°13' 22.3"	W 89° 52' 22.6"	-10	0.5
14-2	20	N 30°13' 20.6"	W 89° 52' 04.5"	-10	0.5
14-3	20	N 30°13' 01.9"	W 89° 52' 25.6"	-12.2	0.8
14-4	20	N 30°13' 00.1"	W 89° 52' 07.6"	-12.5	1.0
14-5	20	N 30°12' 41.5"	W 89° 52' 28.5"	-13	0.5
14-6	20	N 30°13' 40.0"	W 89° 52' 10.6"	-13	0.5

Note: Soil borings 14-1 and 14-3 were interrupted due to weather. Samples collected from the bottom of the boring were collected at an offset of more than 10 feet from the samples collected from the top of the boring. Coordinates listed for 14-1 and 14-3 are the final coordinates of the borings.

Borehole sampling was conducted in general accordance with applicable ASTM specifications. High quality, undisturbed soil specimens were obtained using a 30-inch long, 3-inch outside diameter thin-walled steel Shelby tube sampler. The sample was hydraulically pushed into the ground a distance no greater than 24 inches per specimen. In cases were no soil was recovered by the Shelby tube sampler, a split-barrel spoon sampler was pushed to collect a disturbed specimen.

Immediately upon recovery, each sample was classified by our engineer based on the soil exposed at either end of the Shelby tube. Each Shelby tube was then sealed with caps and tape and stored in a vertical position with the bottom down. Shelby tube samples were secured bottom down during transportation to our soil mechanics laboratory to minimize sample disturbance. Split-barrel spoon samples were stored in plastic bags to preserve moisture during transportation and prior to testing. Detailed boring logs are include in Appendix A of this report.

LABORATORY TESTING

Laboratory testing was completed on selected soil samples to determine material characteristics such as moisture content, Atterberg limits, grain size distribution, and unit weight. Lab results are included on the boring logs in Appendix A and on the summary tables and figures in Appendix B.

Four composite samples were created for self-weight consolidation testing from the six borrow area soil borings: two composite samples covering from the mudline to about 10 feet below mudline, and two composite samples covering the full borehole depth. A single composite sample of all soil specimens was created for settling column testing. Settling column testing was provided by SCTCS at their Baton Rouge laboratory. Results for self-weight consolidation and settling column testing are included in Appendix B.

LIMITATIONS

The information presented in this report is based on the soil borings and soil testing completed for this study, and judgments made by the certifying engineers. This report is specific to this site and should not be used other than for the design of the PO-104 Bayou Bonfouca Marsh Creation Project located in St. Tammany Parish, Louisiana. We have provided the requested information for the geotechnical investigation data report in this volume. A detailed engineering report and other project related information will be provided under separate cover. Limitations and guidelines for use of this report are further described in Appendix D.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, expressed or implied, should be understood.

CLOSING

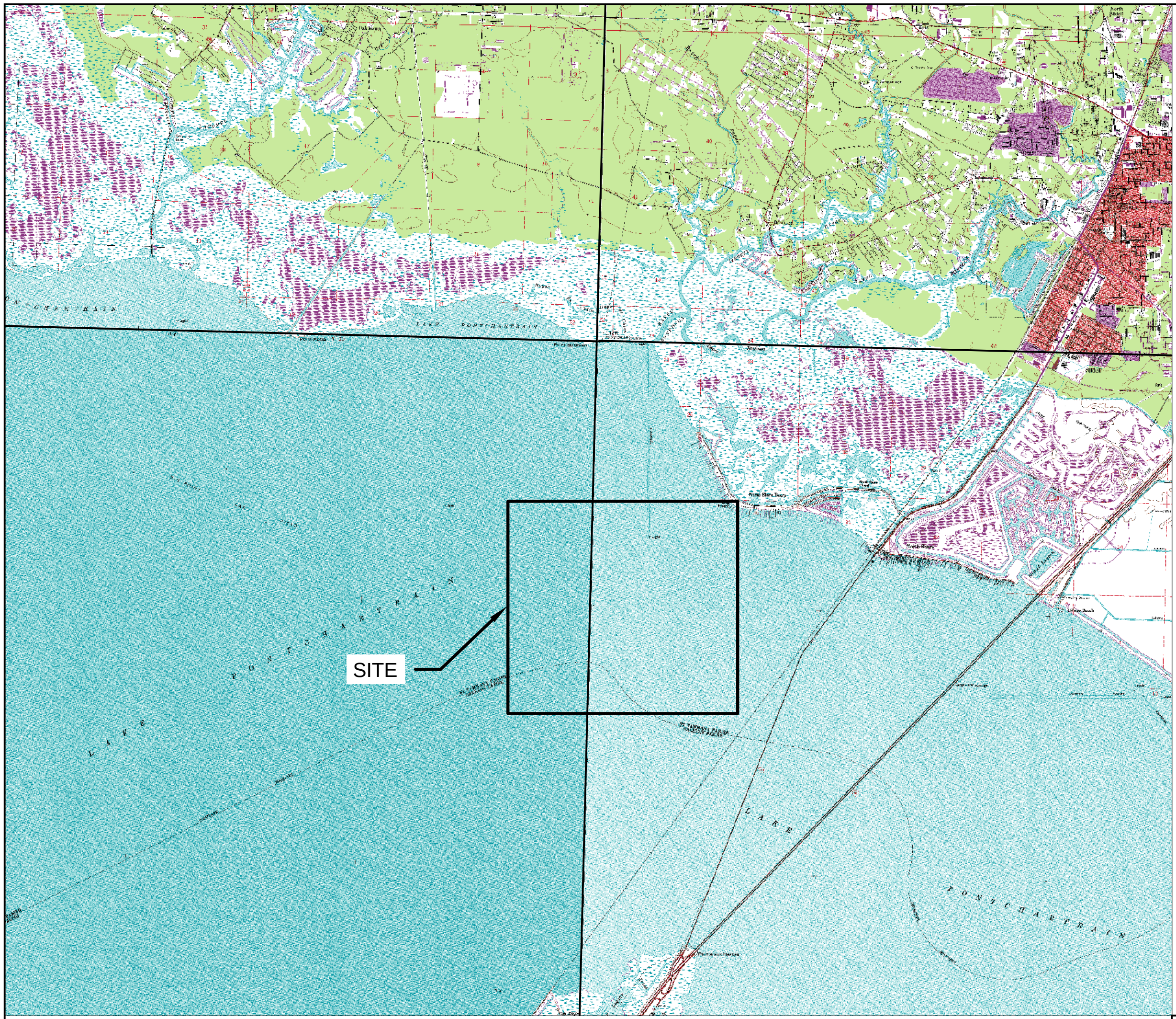
GeoEngineers appreciates the opportunity to work with CPRA on this project. If there are questions regarding the content of this document, please contact us at 225.293.2460.

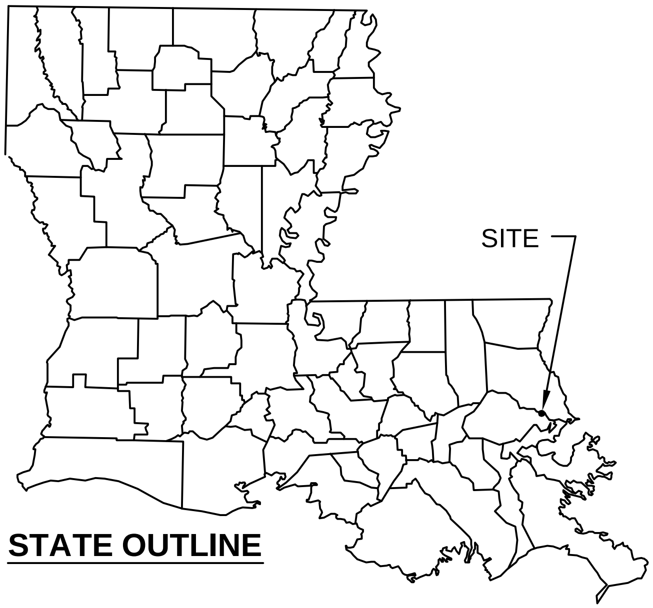
FIGURES

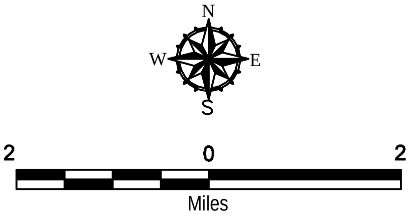
GeoEngineers

P:\16\16715023\03\CAD\Vicinity Map.dwg\TAB:Layout1 modified on Jun 20, 2014 - 2:27pm

JMP : KMC







Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Topographic map taken from USGS, 24K Template, Quads: North Shore, South Point, Slidell and Lacombe, Dated: 1994

VICINITY MAP

PO-104 Bayou Bonfouca Marsh Creation
Expanded Borrow Area Investigation
St. Tammany Parish, Louisiana

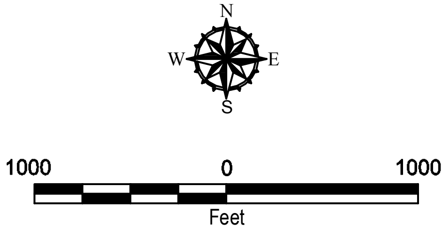
GEOENGINEERS

Figure 1

BORING DETAILS		
BORING #	**LATITUDE**	**LONGITUDE**
14-1	N30° 13' 22.39"	W89° 52' 22.56"
14-2	N30° 13' 20.69"	W89° 52' 04.71"
14-3	N30° 13' 01.97"	W89° 52' 25.60"
14-4	N30° 12' 59.97"	W89° 52' 07.79"
14-5	N30° 12' 41.55"	W89° 52' 28.63"
14-6	N30° 12' 39.85"	W89° 52' 10.78"

LEGEND

◒	B-1	Boring Location



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Aerial image was taken from Google Earth Pro., Licensed to GeoEngineers, Inc., Imagery dated: 11/29/2011

BORING LOCATION PLAN

PO-104 Bayou Bonfouca Marsh Creation
Expanded Borrow Area Investigation
St. Tammany Parish, Louisiana

GEOENGINEERS

Figure 2

P:\16\1671502303\CAD\Borehole Location.dwg\TAB:Layout1 (5) modified on Feb 18, 2015 - 3:07pm

JMP : KMC

APPENDICES

APPENDIX A

Field Exploration

APPENDIX A
FIELD EXPLORATION

Soil conditions were evaluated in the expanded borrow area between June 26 and June 30,2014 by advancing six (6) soil borings (14-1 through 14-6) to a depth of 20 feet below the mudline with a pontoon barge-mounted drill rig with a support boat. A GeoEngineers engineer managed the drilling on a full-time basis, examined and classified the soils encountered, obtained representative samples, and prepared a log of each borehole. Water depth in the expanded borrow area ranged from 10.5 feet to 13.5 feet during field operations. Soil boring locations are shown in Figure 2. Details of daily activities are available in Appendix C.

Borehole sampling was primarily conducted in general accordance with ASTM D 1587, Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes. High quality, undisturbed soil specimens were obtained using a 30-inch long, 3-inch outside diameter thin-walled steel Shelby tube sampler. The sample was hydraulically pushed into the ground a distance no greater than 24 inches per specimen. In cases were no soil was recovered by the Shelby tube sampler, a split-barrel spoon sampler was pushed to collect a disturbed specimen.

Immediately upon recovery, each sample was classified by our engineer based on the soil exposed at either end of the Shelby tube. Each Shelby tube was then sealed with caps and tape, labeled, and stored in a vertical position with the bottom down, then transported in the same manner during transportation to our soil mechanics laboratory to minimize sample disturbance. Split-barrel spoon samples were stored in plastic bags to preserve moisture during transportation and prior to testing. Detailed boring logs are included in this appendix.

SOIL CLASSIFICATION CHART

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

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS		TYPICAL DESCRIPTIONS
GRAPH	LETTER	
▤	CC	Cement Concrete
■	AC	Asphalt Concrete
▩	CR	Crushed Rock/ Quarry Spalls
⁂	TS	Topsoil/ Forest Duff/Sod

▼ **Measured groundwater level in exploration, well, or piezometer**

▽ **Groundwater observed at time of exploration**

≡ **Perched water observed at time of exploration**

Graphic Log Contact

—— **Distinct contact between soil strata or geologic units**

／ **Approximate location of soil strata change within a geologic soil unit**

Material Description Contact

—— **Distinct contact between soil strata or geologic units**

– – – – **Approximate location of soil strata change within a geologic soil unit**

Sampler Symbol Descriptions

☒ **Standard Penetration Test (SPT)**

■ **Shelby tube**

▤ **Piston**

◧ **Direct-Push**

◫ **Bulk or grab**

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

A "P" indicates sampler pushed using the weight of the drill rig.

Laboratory / Field Tests

%F	**Percent fines**
AL	**Atterberg limits**
CA	**Chemical analysis**
CP	**Laboratory compaction test**
CS	**Consolidation test**
DS	**Direct shear**
HA	**Hydrometer analysis**
MC	**Moisture content**
MD	**Moisture content and dry density**
OC	**Organic content**
PM	**Permeability or hydraulic conductivity**
PP	**Pocket penetrometer**
SA	**Sieve analysis**
TX	**Triaxial compression**
UC	**Unconfined compression**
VS	**Vane shear**

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

KEY TO EXPLORATION LOGS

GEOENGINEERS

FIGURE A-1

Drilled	Start 6/26/2014	End 6/26/2014	Total Depth (ft) 31.5	Logged By JMP Checked By JMP	Driller Specialized Environmental Resources, LLC	Drilling Method Wet Rotary

Surface Elevation (ft) Vertical Datum: -10.0

Hammer Data: Cathead/Safety Hammer 140 (lbs) / 30 (in) Drop

Drilling Equipment: Pontoon-Mounted Drill Rig

Latitude: N30° 13' 22.3"
Longitude: W89° 52' 22.6"

System: Geographic
Datum: NAD83 (feet)

Groundwater

Date Measured	Depth to Water (ft)	Elevation (ft)
6/26/2014	1.0	-11.0

Notes: See Figure A-1 for explanation of symbols.
Elevations estimated from Bathymetric survey provided by CPRA

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	Recovered (in)	Blows/foot or Pocket Pen (TSF)	**Collected Sample**	Sample Name	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	LABORATORY DATA: Water Content, %	Dry Density, (pcf)	Compressive Strength (TSF) [1]	Confining Pressure (KSF)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Pocket Pen (TSF)	Passing No. 200 Sieve, %
	0									One foot from boat deck to water surface									
							▽												
-15	5																		
-20	10																		
										Mudline 10.5 feet below water surface									
			20			1			SP-SC	Gray clayey sand with clay and shells	26								9
						2			CL	Gray sandy clay with clay pockets	25								72
-25	15																		
			7			3				Tan and gray sandy clay with shells									
		■	11			4				Stiff tan and gray silty clay with shells	24	101.2							
		■	7			5			CH	Stiff tan and gray clay with 5" shell layer	39					86	54		
-30	20	■	6			6				Stiff tan and gray clay with 8.5" shell layer	38								
		■	5.5			7				Stiff tan and gray clay with silt lenses	42	78.8				59	32		
		■	11			8				Stiff tan and gray clay with silt lenses	34								
-35	25	■																	
		■	8.5			9				Stiff tan and gray clay with silt lenses	39					51	31		
		■	11			10				Stiff tan and gray clay with silt lenses	47								
-40	30	■	9			11				Medium gray clay with silt lenses	50								

*Remolded sample used for strength testing.
Confidential Information: Privileged and Confidential Work Product

Baton Rouge: Date:2/18/15 Path:P:\16\16715023\03\GINT\LDNR - PO-104 BAYOU BONFOUCA MARSH CREATION EXPANDED INVESTIGATION BORING LOGS.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_LAB

Log of Boring 14-1

GEOENGINEERS

Project: Bayou Bonfouca Marsh Creation Investigation (PO-104)
Project Location: St. Tammany Parish, Louisiana
Project Number: 16715-023-03

Figure A-2
Sheet 1 of 1

Drilled	Start	End	Total Depth (ft)	Logged By / Checked By	Driller	Drilling Method
Drilled	6/30/2014	6/30/2014	31	Logged By JMP Checked By JMP	Specialized Environmental Resources, LLC	Wet Rotary

Surface Elevation (ft) Vertical Datum	-10.0	Hammer Data	Cathead/Safety Hammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Pontoon-Mounted Drill Rig
Latitude Longitude	N30° 13' 20.6" W89° 52' 04.5"	System Datum	Geographic NAD83 (feet)	Groundwater	

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
6/30/2014	0.5	-10.5

Notes: See Figure A-1 for explanation of symbols.
Elevations estimated from Bathymetric survey provided by CPRA

		FIELD DATA									LABORATORY DATA								
Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot or Pocket Pen (TSF)	**Collected Sample**	Sample Name	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Water Content, %	Dry Density, (pcf)	Compressive Strength (TSF) ^{1}	Confining Pressure (KSF)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Pocket Pen (TSF)	Passing No. 200 Sieve, %
	0						∇			0.5 feet from boat deck to water surface									
-15	5																		
-20	10									Mudline 10.5 feet below water surface									
		■	7.5			1		▨	SP-SC	Gray sand with clay and gravel	21								10
		■	9			2		▨		Gray clayey sand with shells and gray and tan clay layer at bottom	46								15
-25	15	■	12			3		▨	CH	Medium tan and gray clay with sand pockets	35					55	33		
		■	10.5			4		▨		Medium tan and gray clay with shells	37	87.6							
		■	9			5		▨		Stiff tan and gray clay with sand pockets	37								
-30	20	■						▨											
		■	12			6		▨		Stiff tan and gray clay with silt lenses	38					68	39		
		■	11			7		▨		Stiff tan and gray clay with silt lenses	39	85.1							
-35	25	■	10			8		▨		Stiff tan and gray clay with silt lenses	45								
		■	10			9		▨		Stiff tan and gray clay with silt lenses	36								
		■	9.5			10		▨		Stiff tan and gray clay	46								
-40	30	■						▨											

*Remolded sample used for strength testing.
Confidential Information: Privileged and Confidential Work Product

Log of Boring 14-2

GeoEngineers

Project: Bayou Bonfouca Marsh Creation Investigation (PO-104)
Project Location: St. Tammany Parish, Louisiana
Project Number: 16715-023-03

Figure A-3
Sheet 1 of 1

Drilled	Start 6/27/2014	End 6/27/2014	Total Depth (ft) 34	Logged By JMP Checked By JMP	Driller Specialized Environmental Resources, LLC
Drilling Method	Wet Rotary				
Surface Elevation (ft) Vertical Datum	-12.2	Hammer Data	Cathead/Safety Hammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Pontoon-Mounted Drill Rig
Latitude Longitude	N30° 13' 01.9" W89° 52' 25.6"	System Datum	Geographic NAD83 (feet)		

Notes: See Figure A-1 for explanation of symbols.
Elevations estimated from Bathymetric survey provided by CPRA

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
6/27/2014	1.0	-13.2

FIELD DATA										LABORATORY DATA									
Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot or Pocket Pen (TSF)	**Collected Sample**	Sample Name	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Water Content, %	Dry Density, (pcf)	Compressive Strength (TSF) 1	Confining Pressure (KSF)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Pocket Pen (TSF)	Passing No. 200 Sieve, %
	0						▽			One foot from boat deck to water surface									
										Mudline 13 feet below water surface									
			6.5			1			SC -SM	Gray silty clayey sand/sandy clay with shells	29	86.8				29	12		44
			10			2			CL	Soft gray very silty clay with shells	32					24	9		
			8.5			3				Medium gray very sandy clay	22					31	19		
			10			4				Soft gray silty clay with shells	33								
			9			5			CH	Stiff tan and gray clay with silt lenses	38	86.2							
			11			6				Stiff tan and gray clay with silt lenses	37					73	46		
			9.5			7				Stiff tan and gray clay with silt lenses	45								
			10			8				Stiff tan and gray clay	43					92	69		
			11			9				Stiff gray clay	39								
			10			10			CL	Stiff black and gray silty clay with organic matter	78								

Depth (feet): 0, 5, 10, 15, 20, 25, 30
Elevation (feet): -15, -20, -25, -30, -35, -40, -45

*Remolded sample used for strength testing.
Confidential Information: Privileged and Confidential Work Product

Log of Boring 14-3

GEOENGINEERS

Project: Bayou Bonfouca Marsh Creation Investigation (PO-104)
Project Location: St. Tammany Parish, Louisiana
Project Number: 16715-023-03

Figure A-4
Sheet 1 of 1

Drilled	Start 6/30/2014	End 6/30/2014	Total Depth (ft) 34	Logged By JMP Checked By JMP	Driller Specialized Environmental Resources, LLC	Drilling Method Wet Rotary
Surface Elevation (ft) Vertical Datum	-12.5	Hammer Data	Cathead/Safety Hammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Pontoon-Mounted Drill Rig
Latitude Longitude	N30° 13' 00.1" W89° 52' 07.6"	System Datum	Geographic NAD83 (feet)	Groundwater	
				Date Measured 6/30/2014	Depth to Water (ft) 0.5	Elevation (ft) -13.0

Notes: See Figure A-1 for explanation of symbols.
Elevations estimated from Bathymetric survey provided by CPRA

		FIELD DATA									LABORATORY DATA								
Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot or Pocket Pen (TSF)	**Collected Sample**	Sample Name	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Water Content, %	Dry Density, (pcf)	Compressive Strength (TSF) ¹	Confining Pressure (KSF)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Pocket Pen (TSF)	Passing No. 200 Sieve, %
	0						∇			0.5 feet from boat deck to water surface									
-15																			
	5																		
-20																			
	10																		
-25																			
										Mudline 13.5 feet below water surface									
			8.5			1			ML	Gray sandy silt with shell fragments	44					18	3		56
	15																		
			10			2			SM	Gray silty sand with shells	21								22
-30																			
			10			3			CL	Soft gray silty clay with sand	27	89.7							
	20		9.5			4			CH	Stiff gray clay with silt lenses and sand pockets	27					67	44		
-35			7.5			5				Stiff tan and gray clay	39								
			8			6				Stiff tan and gray clay with silt lenses and shells	40								
	25																		
			9.5			7				Stiff tan and gray clay with silt lenses	43	80.4				77	47		
-40																			
			9			8				Stiff tan and gray clay	31								
	30		6			9				Stiff tan and gray clay	44								
-45			8			10				Stiff tan and gray clay	31								

*Remolded sample used for strength testing.
Confidential Information: Privileged and Confidential Work Product

Log of Boring 14-4

GEOENGINEERS

Project: Bayou Bonfouca Marsh Creation Investigation (PO-104)
Project Location: St. Tammany Parish, Louisiana
Project Number: 16715-023-03

Figure A-5
Sheet 1 of 1

Drilled	Start 6/30/2014	End 6/30/2014	Total Depth (ft) 34	Logged By JMP Checked By JMP	Driller: Specialized Environmental Resources, LLC
Drilling Method	Wet Rotary				
Surface Elevation (ft) Vertical Datum	-13.0	Hammer Data	Cathead/Safety Hammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Pontoon-Mounted Drill Rig
Latitude Longitude	N30° 12' 41.5" W89° 52' 28.5"	System Datum	Geographic NAD83 (feet)		

Notes: See Figure A-1 for explanation of symbols.
Elevations estimated from Bathymetric survey provided by CPRA

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
6/30/2014	0.5	-13.5

Elevation (feet)	Depth (feet)	FIELD DATA Interval	Recovered (in)	Blows/foot or Pocket Pen (TSF)	Collected Sample	Sample Name	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	LABORATORY DATA Water Content, %	Dry Density, (pcf)	Compressive Strength (TSF) ¹	Confining Pressure (KSF)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Pocket Pen (TSF)	Passing No. 200 Sieve, %
	0						▽			0.5 feet from boat deck to water surface									
										Mudline 13.5 feet below water surface									
			7			1			SC	Gray clayey sand with shell fragments	27								39
			10			2			CH	Soft gray clay with sand pockets and shells	61					70	50		
			9.5			3			CL	Soft gray sandy clay	36	96.5							
			10			4				Soft gray sandy clay	23								
			10.5			5				Soft tan and gray very sandy clay	19					28	13		
			11			6			CH	Stiff gray clay with silt lenses	19	111.5							
			7.5			7				Stiff gray clay with silt lenses	25								
			9.5			8				Stiff tan and light gray clay with sand pockets	23					50	36		
			10.5			9				Stiff tan and gray clay	35								
			11			10				Stiff tan and gray clay	33								

*Remolded sample used for strength testing.
Confidential Information: Privileged and Confidential Work Product

Log of Boring 14-5

GEOENGINEERS

Project: Bayou Bonfouca Marsh Creation Investigation (PO-104)
Project Location: St. Tammany Parish, Louisiana
Project Number: 16715-023-03

Figure A-6
Sheet 1 of 1

Drilled	Start	End	Total Depth (ft)	Logged By	Checked By	Driller	Drilling Method
	6/30/2014	6/30/2014	34	JMP	JMP	Specialized Environmental Resources, LLC	Wet Rotary

Surface Elevation (ft) Vertical Datum: -13.0

Hammer Data: Cathead/Safety Hammer 140 (lbs) / 30 (in) Drop

Drilling Equipment: Pontoon-Mounted Drill Rig

Latitude: N30° 12' 40.0"
Longitude: W89° 52' 10.6"

System: Geographic
Datum: NAD83 (feet)

Notes: See Figure A-1 for explanation of symbols.
Elevations estimated from Bathymetric survey provided by CPRA

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
6/30/2014	0.5	-13.5

Elevation (feet)	Depth (feet)	FIELD DATA Interval	Recovered (in)	Blows/foot or Pocket Pen (TSF)	Collected Sample	Sample Name	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	LABORATORY DATA Water Content, %	Dry Density, (pcf)	Compressive Strength (TSF) [1]	Confining Pressure (KSF)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Pocket Pen (TSF)	Passing No. 200 Sieve, %
	0						▽			0.5 feet from boat deck to water surface									
-15	5																		
-20	10																		
-25										Mudline 13.5 feet below water surface									
	15	■	15			1			SM	Gray silty sand	25								24
-30		■	8			2				Gray silty sand	24								28
		■	10			3			CH	Soft gray clay with silt lenses	58	71.5							
	20	■	10			4				Stiff gray clay	26					54	36		
-35		■	10			5			CL	Soft gray silty clay	54								
	25	■	7.5			6				Stiff gray clay with silt	30					49	33		
-40		■	10			7			CH	Stiff tan and gray clay with silt lenses	29	98.5							
		■	9			8			CL	Stiff tan and gray silty clay with silt lenses	30					38	14		
	30	■	10			9			CH	Stiff tan and gray clay with silt lenses	34								
-45		■	9.5			10				Stiff gray clay with silt lenses	42								

*Remolded sample used for strength testing.
Confidential Information: Privileged and Confidential Work Product

Baton Rouge: Date:2/18/15 Path:P:\16\16715023\03\GINT\LDNR - PO-104 BAYOU BONFOUCA MARSH CREATION EXPANDED INVESTIGATION BORING LOGS.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_LAB

Log of Boring 14-6

GEOENGINEERS

Project: Bayou Bonfouca Marsh Creation Investigation (PO-104)
Project Location: St. Tammany Parish, Louisiana
Project Number: 16715-023-03

Figure A-7
Sheet 1 of 1

APPENDIX B

Results of Laboratory Testing

APPENDIX B
LABORATORY TEST RESULTS

Once they were received by our laboratory, samples were extruded from their sampling tubes, visually classified in general accordance with ASTM D 2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), to confirm or modify field classification, and preserved for further testing. An engineer then assigned lab tests for selected samples based on descriptions given during sample extrusion. Because borrow area samples will be disturbed in order to fill the marsh creation area, no strength tests were completed. Instead, material characteristic tests, such as moisture content, Atterberg limit, unit weight, and particle size distribution determination tests were completed. Four composite samples were created for self-weight consolidation testing. These samples consisted of approximately equal volume specimens from each sample in soil borings 14-1, 14-4, and 14-5 (Composite Samples (CS) #1 and #3) and in soil borings 14-2, 14-3, and 14-6 (CS #2 and #4). CS #1 and #2 were compiled using samples from approximately the top 10 feet below mudline. CS #3 and #4 were compiled using samples from the entire depth of the borings. A single composite sample was created for use in the settling column test using the remaining sample material from all boring locations in order to provide enough soil to run the test. Descriptions of the tests are included below.

Moisture Content

All specimens were tested to determine in situ moisture content in general accordance with ASTM D2216, Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass. Moisture contents are reported on the boring logs in Appendix A at the depth of each sample and on the laboratory summary tables in this appendix.

Atterberg Limits

Select specimens were tested to assess the plastic behavior of cohesive and semi-cohesive soils in general accordance with ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils. Atterberg Limit test results are reported at the appropriate depths on the boring logs in Appendix A and on the laboratory summary tables in this appendix.

Unit Weight

Select specimens were tested to determine the in-place unit weight of the soil in general accordance with the unit weight measurement instructions found in ASTM D2166, Standard Test Method for Unconfined Compressive Strength of Cohesive Soil. Dry unit weights are reported on the boring logs in Appendix A at the applicable depths for each tested sample, and unit weights are included on the lab summary tables in this appendix.

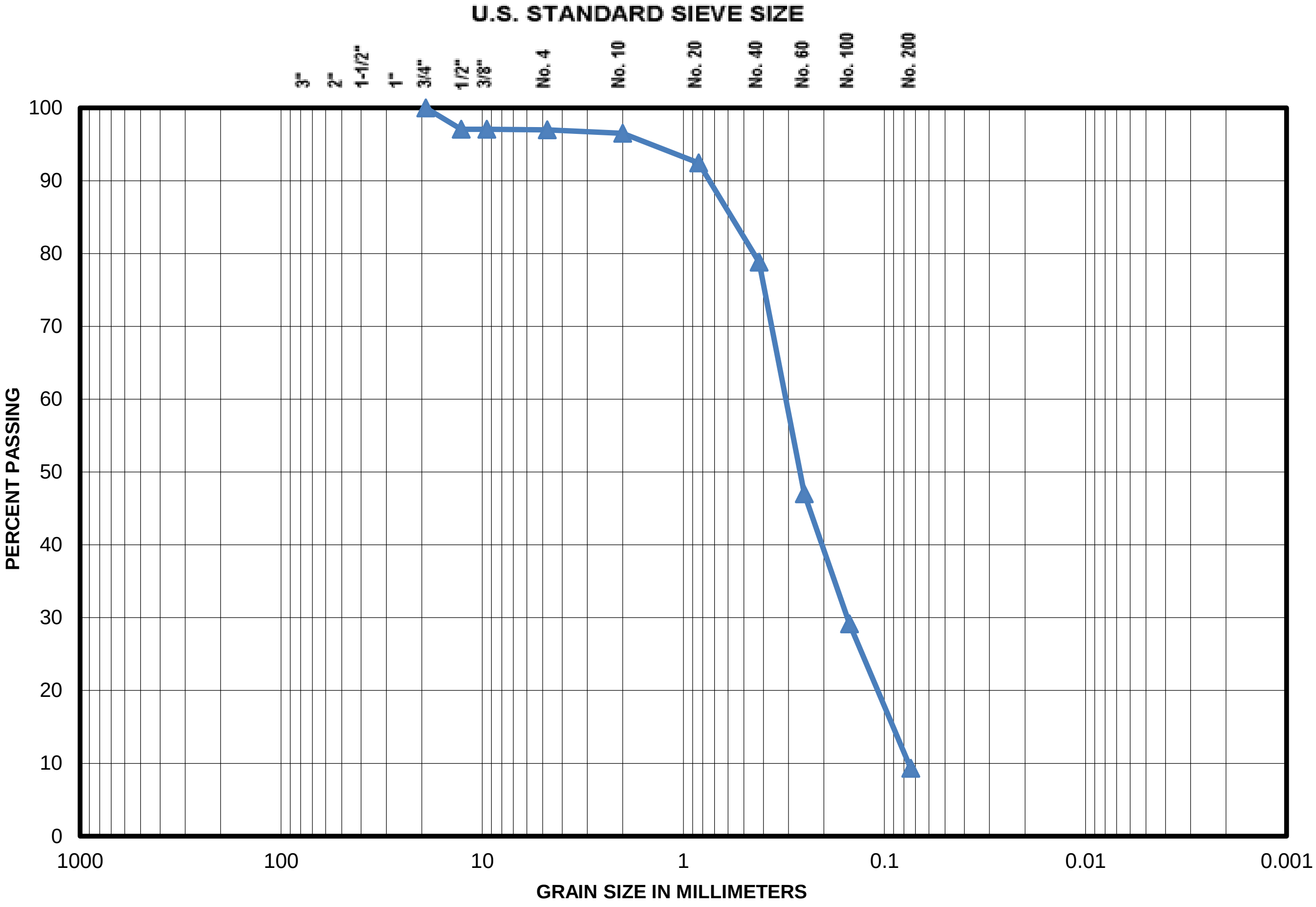
Particle Size Distribution and Granular versus Fine Material

Particle size distribution was determined for select samples in accordance with ASTM C136, Test Methods for Sieve Analysis of Fine and Coarse Aggregates, and the fines content was determined in accordance with ASTM D1140, Standard Test Methods for Determining the Amount of Material Finer than 75-μm (No. 200) Sieve in Soils by Washing. The percentage of material passing the No. 200 sieve is reported on the boring logs and percent sand and fines is listed on the laboratory summary tables in this appendix.

Specialized Testing of Composite Soil Samples

The settling column test and the self-weight consolidation test are specialized tests that involve mixing the soil sample with water into a slurry and testing for certain properties. The settling column test evaluates how the soil settles through a column of water. The self-weight consolidation test is a very low pressure oedometer (one-dimensional consolidation test device) test that bears resemblance to ASTM D2435, Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading. Reports for each of these tests is included in this appendix, and a description of the standards and methods used to run the tests is included in each report.

A number of index tests were completed as part of the self-weight consolidation test procedure. These complimentary tests included grain size distribution of the composite sample using the hydrometer method (ASTM D4221), specific gravity of composite samples (ASTM D854), and Atterberg limits (ASTM D4318). Results of these index tests are included in the test report.



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

Coarse Gravel %	0.0	**Medium Sand %**	17.7		
Fine Gravel %	3.0	**Fine Sand %**	69.5		
Coarse Sand %	0.5	**Fines (Silt & Clay) %**	9.3		
USC Classification	SP-SC	C_U	na	C_C	na
Description (D 2488)	Sand with clay				

Individual Sieve Data - % Passing			
3"	#N/A	**No. 4**	97.0
2"	#N/A	**No. 10**	96.5
1 1/2"	#N/A	**No. 20**	92.4
1"	#N/A	**No. 40**	78.8
3/4"	100.0	**No. 60**	47.0
1/2"	97.1	**No. 100**	29.1
3/8"	97.1	**No. 200**	9.3

Project	LDNR - PO-104 Bayou Bonfouca Marsh Creation Expa	**Date Tested**	7/10/2014
Project No.	16715-023-03	**Tested By**	JRB
Boring No.	14-1	**Checked By**	SLC
Source/Depth (feet)	11.5 - 13.5	**Sieve Type**	Dry Sieve

NOTE: Test was performed in general accordance with the referenced test method. Test results are applicable only to the specific sample on which they were performed, and should not be interpreted as representative of any other samples obtained at other times, depths or locations or generated by separate operations or processes. This report may not be reproduced, except in full, without written approval of GeoEngineers, Inc.

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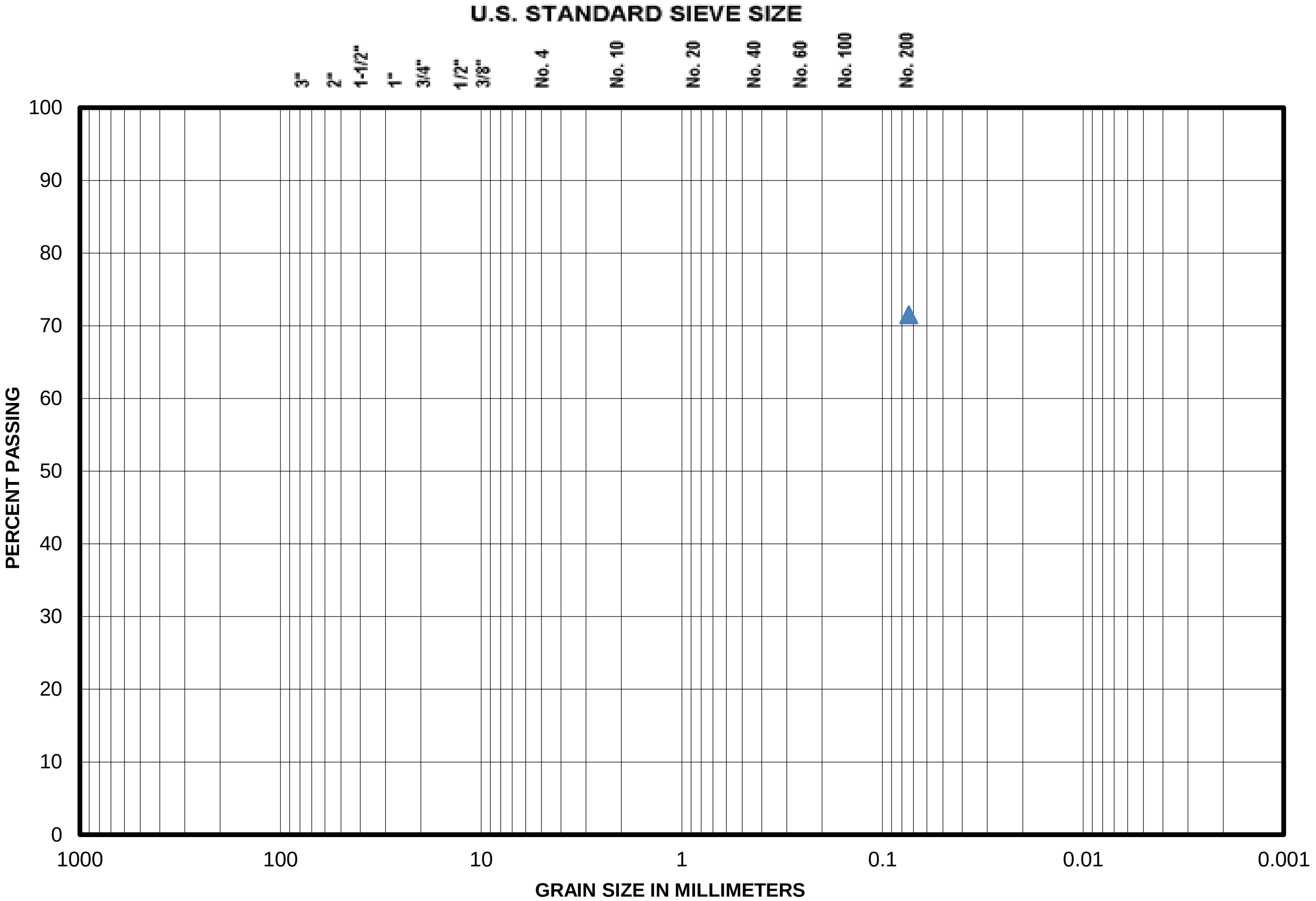
ASTM D 6913 SOIL PARTICLE-SIZE GRADATION SIEVE ANALYSIS

LDNR - PO-104 Bayou Bonfouca Marsh Creation Expanded Borrow Area Investigation

FIGURE B-1



<table>
<tr><td rowspan="2">COBBLES</td><td colspan="2">GRAVEL</td><td colspan="3">SAND</td><td colspan="2">FINES</td></tr>
<tr><td>COARSE</td><td>FINE</td><td>COARSE</td><td>MEDIUM</td><td>FINE</td><td>SILT</td><td>CLAY</td></tr>
</table>

Sand %	28.5	**Fines (Silt & Clay) %**	71.5

USC Classification	(CL)	C_U	na	C_C	na
Description (D 2488)	Gray sandy clay with clay pockets (CL)				

Individual Sieve Data - % Passing			
3"	#N/A	**No. 4**	#N/A
2"	#N/A	**No. 10**	#N/A
1 1/2"	#N/A	**No. 20**	#N/A
1"	#N/A	**No. 40**	#N/A
3/4"	#N/A	**No. 60**	#N/A
1/2"	#N/A	**No. 100**	#N/A
3/8"	#N/A	**No. 200**	71.5

Project	LDNR - PO-104 Bayou Bonfouca Marsh Creation Expa	**Date Tested**	7/10/2014
Project No.	16715-023-03	**Tested By**	SRD
Boring No.	14-1	**Checked By**	SLC
Source/Depth (feet)	13.5 - 15.5	**Sieve Type**	200 Wash

Method B was used for the 200 Wash

NOTE: Test was performed in general accordance with the referenced test method. Test results are applicable only to the specific sample on which they were performed, and should not be interpreted as representative of any other samples obtained at other times, depths or locations or generated by separate operations or processes. This report may not be reproduced, except in full, without written approval of GeoEngineers, Inc.

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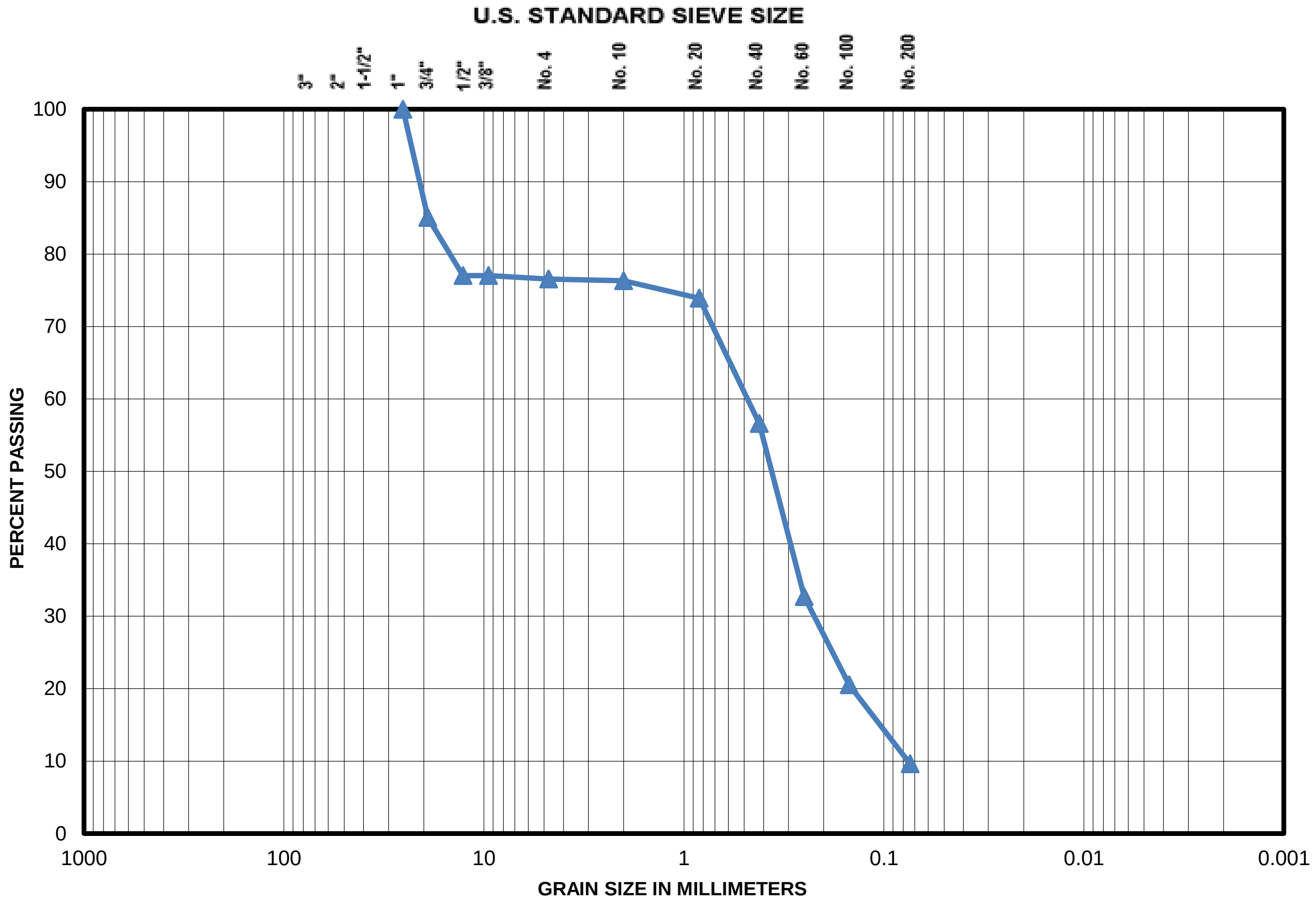
ASTM D 1140 ANALYSIS OF SOIL FINER THAN No. 200 SIEVE

LDNR - PO-104 Bayou Bonfouca Marsh Creation Expanded Borrow Area Investigation

FIGURE B-2



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

Coarse Gravel %	14.9	**Medium Sand %**	19.7		
Fine Gravel %	8.5	**Fine Sand %**	46.9		
Coarse Sand %	0.3	**Fines (Silt & Clay) %**	9.7		
USC Classification	SP-SC	**C_U**	na	**C_C**	na
Description (D 2488)	Sand with clay and gravel				

Individual Sieve Data - % Passing

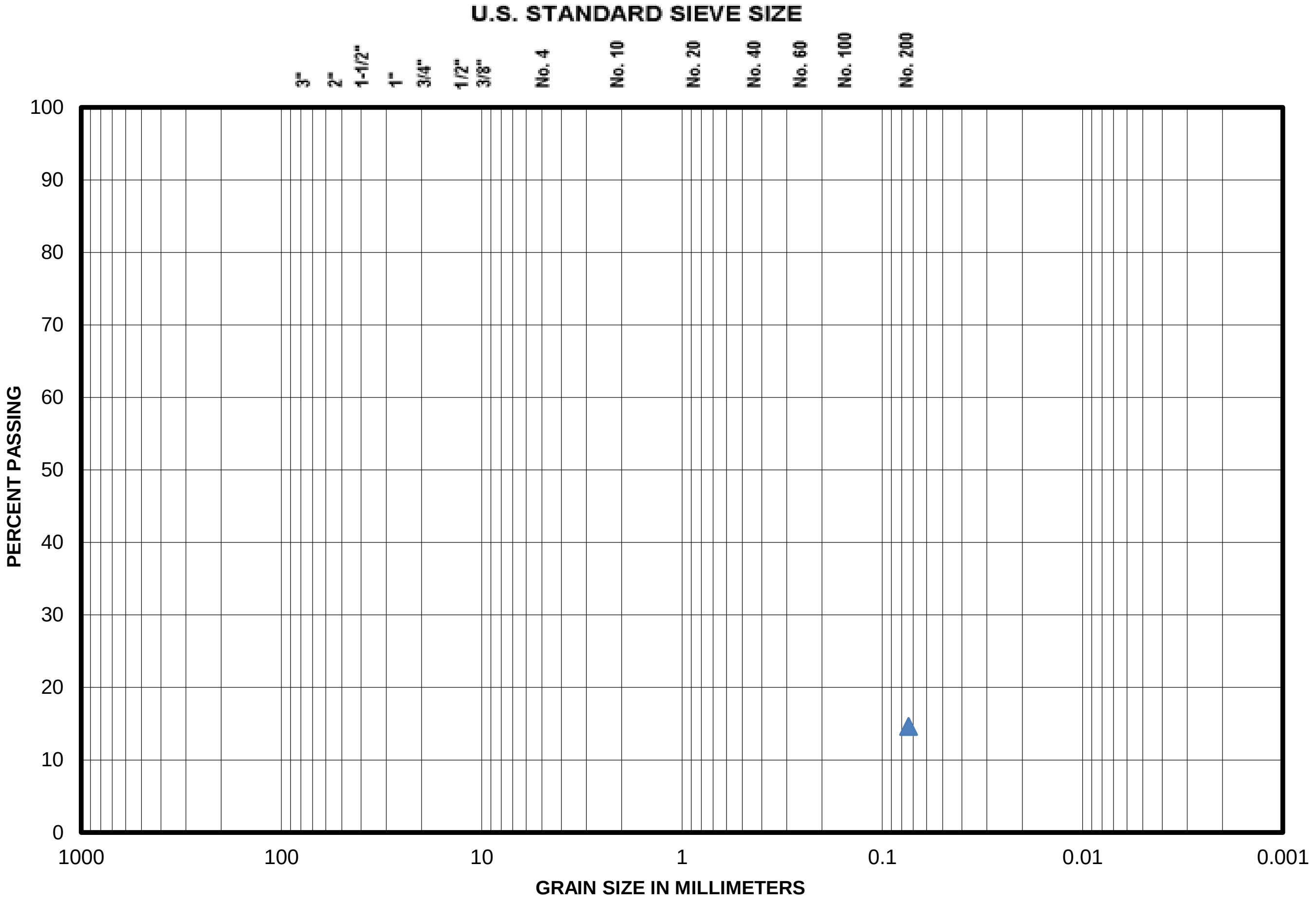
3"	#N/A	**No. 4**	76.6
2"	#N/A	**No. 10**	76.3
1 1/2"	#N/A	**No. 20**	73.9
1"	100.0	**No. 40**	56.6
3/4"	85.1	**No. 60**	32.7
1/2"	77.0	**No. 100**	20.5
3/8"	77.0	**No. 200**	9.6

Project	LDNR - PO-104 Bayou Bonfouca Marsh Creation Expa	**Date Tested**	7/10/2014
Project No.	16715-023-03	**Tested By**	JRB
Boring No.	14-2	**Checked By**	SLC
Source/Depth (feet)	11 - 13	**Sieve Type**	Dry Sieve

ASTM D 6913 SOIL PARTICLE-SIZE GRADATION SIEVE ANALYSIS

LDNR - PO-104 Bayou Bonfouca Marsh Creation Expanded Borrow Area Investigation

FIGURE B-3



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

Sand %	85.4	**Fines (Silt & Clay) %**	14.6

USC Classification	SC	C_U	na	C_C	na
Description (D 2488)	Clayey sand				

Individual Sieve Data - % Passing

3"	#N/A	**No. 4**	#N/A
2"	#N/A	**No. 10**	#N/A
1 1/2"	#N/A	**No. 20**	#N/A
1"	#N/A	**No. 40**	#N/A
3/4"	#N/A	**No. 60**	#N/A
1/2"	#N/A	**No. 100**	#N/A
3/8"	#N/A	**No. 200**	14.6

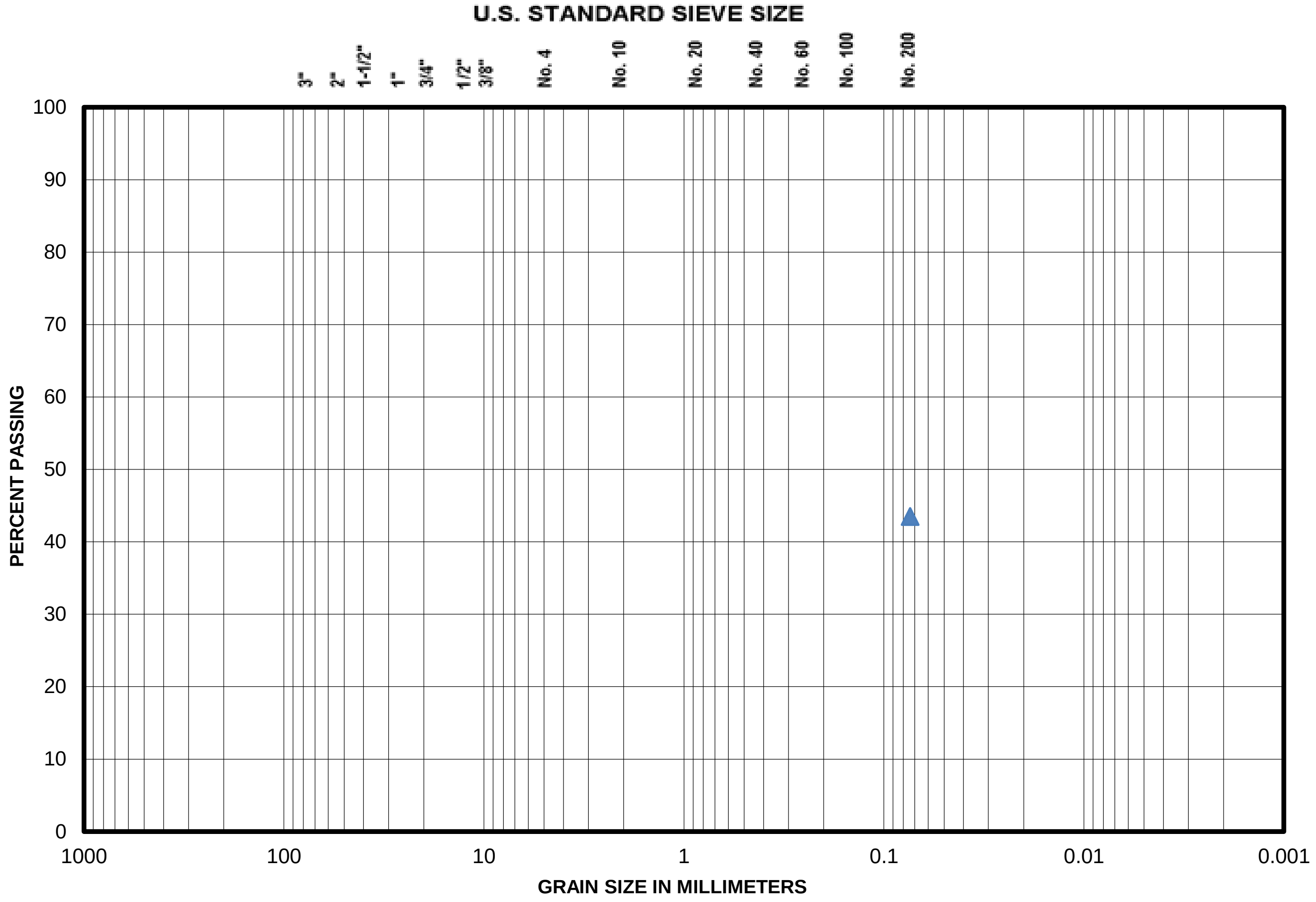
Project	LDNR - PO-104 Bayou Bonfouca Marsh Creation Expa	**Date Tested**	7/10/2014
Project No.	16715-023-03	**Tested By**	JRB
Boring No.	14-2	**Checked By**	SLC
Source/Depth (feet)	13 - 15	**Sieve Type**	200 Wash

Method B was used for the 200 Wash

ASTM D 1140 ANALYSIS OF SOIL FINER THAN No. 200 SIEVE

LDNR - PO-104 Bayou Bonfouca Marsh Creation Expanded Borrow Area Investigation

FIGURE B-4



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

Sand %	56.5	**Fines (Silt & Clay) %**	43.5

USC Classification	SC-SM	C_U	na	C_C	na
Description (D 2488)	Silty, clayey sand				

Individual Sieve Data - % Passing			
3"	#N/A	**No. 4**	#N/A
2"	#N/A	**No. 10**	#N/A
1 1/2"	#N/A	**No. 20**	#N/A
1"	#N/A	**No. 40**	#N/A
3/4"	#N/A	**No. 60**	#N/A
1/2"	#N/A	**No. 100**	#N/A
3/8"	#N/A	**No. 200**	43.5

Project	LDNR - PO-104 Bayou Bonfouca Marsh Creation Expa	**Date Tested**	7/9/2014
Project No.	16715-023-03	**Tested By**	SRD
Boring No.	14-3	**Checked By**	SLC
Source/Depth (feet)	14 - 16	**Sieve Type**	200 Wash

Method B was used for the 200 Wash

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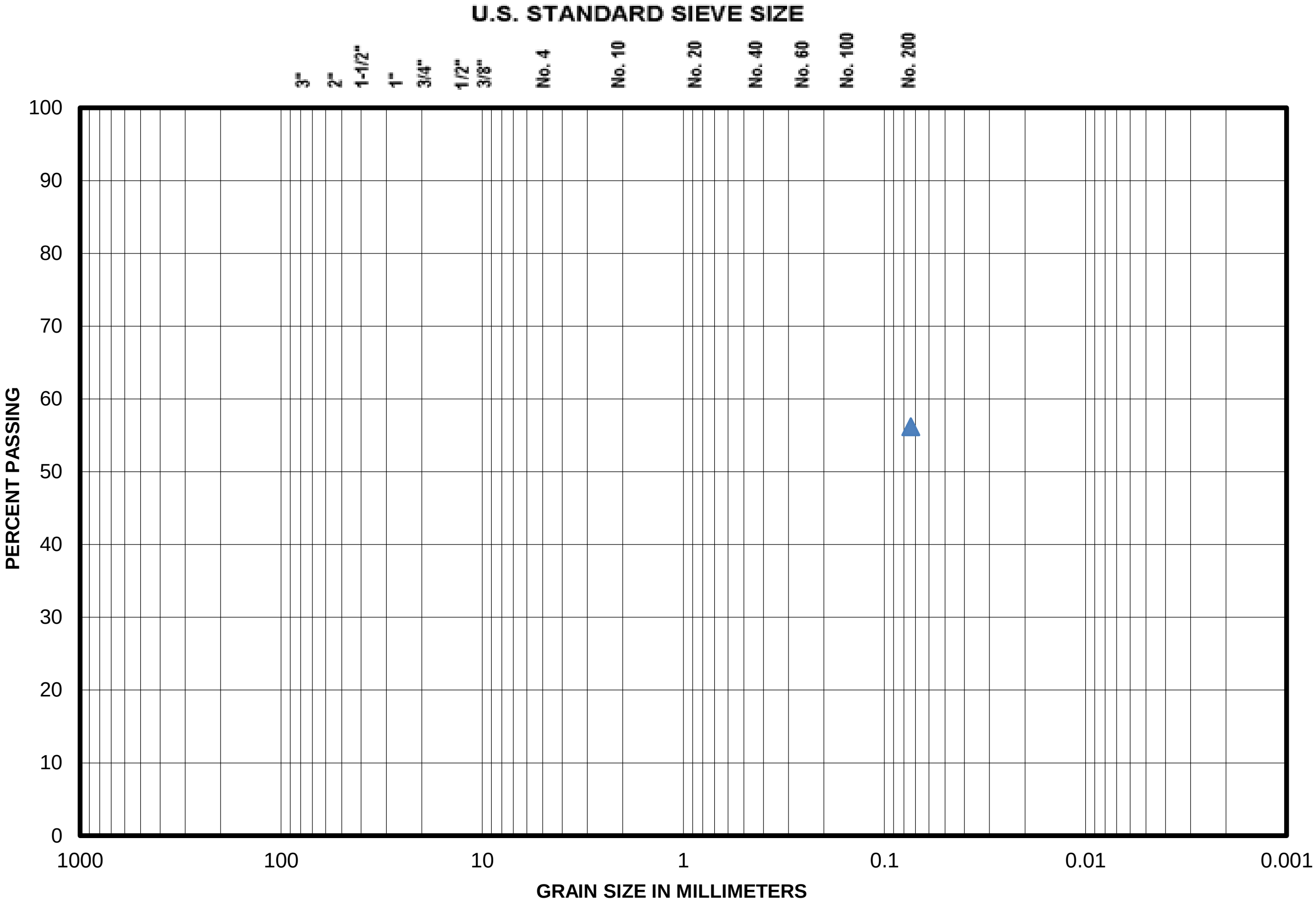
ASTM D 1140 ANALYSIS OF SOIL FINER THAN No. 200 SIEVE

LDNR - PO-104 Bayou Bonfouca Marsh Creation Expanded Borrow Area Investigation

FIGURE B-5



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

Sand %	43.8	**Fines (Silt & Clay) %**	56.2

USC Classification	(ML)	**C_U**	na	**C_C**	na
Description (D 2488)	Soft gray sandy silt with shell fragments (ML)				

Individual Sieve Data - % Passing			
3"	#N/A	**No. 4**	#N/A
2"	#N/A	**No. 10**	#N/A
1 1/2"	#N/A	**No. 20**	#N/A
1"	#N/A	**No. 40**	#N/A
3/4"	#N/A	**No. 60**	#N/A
1/2"	#N/A	**No. 100**	#N/A
3/8"	#N/A	**No. 200**	56.2

Project	LDNR - PO-104 Bayou Bonfouca Marsh Creation Expa	**Date Tested**	7/9/2014
Project No.	16715-023-03	**Tested By**	SRD
Boring No.	14-4	**Checked By**	SLC
Source/Depth (feet)	14 - 16	**Sieve Type**	200 Wash

Method B was used for the 200 Wash

NOTE: Test was performed in general accordance with the referenced test method. Test results are applicable only to the specific sample on which they were performed, and should not be interpreted as representative of any other samples obtained at other times, depths or locations or generated by separate operations or processes. This report may not be reproduced, except in full, without written approval of GeoEngineers, Inc.

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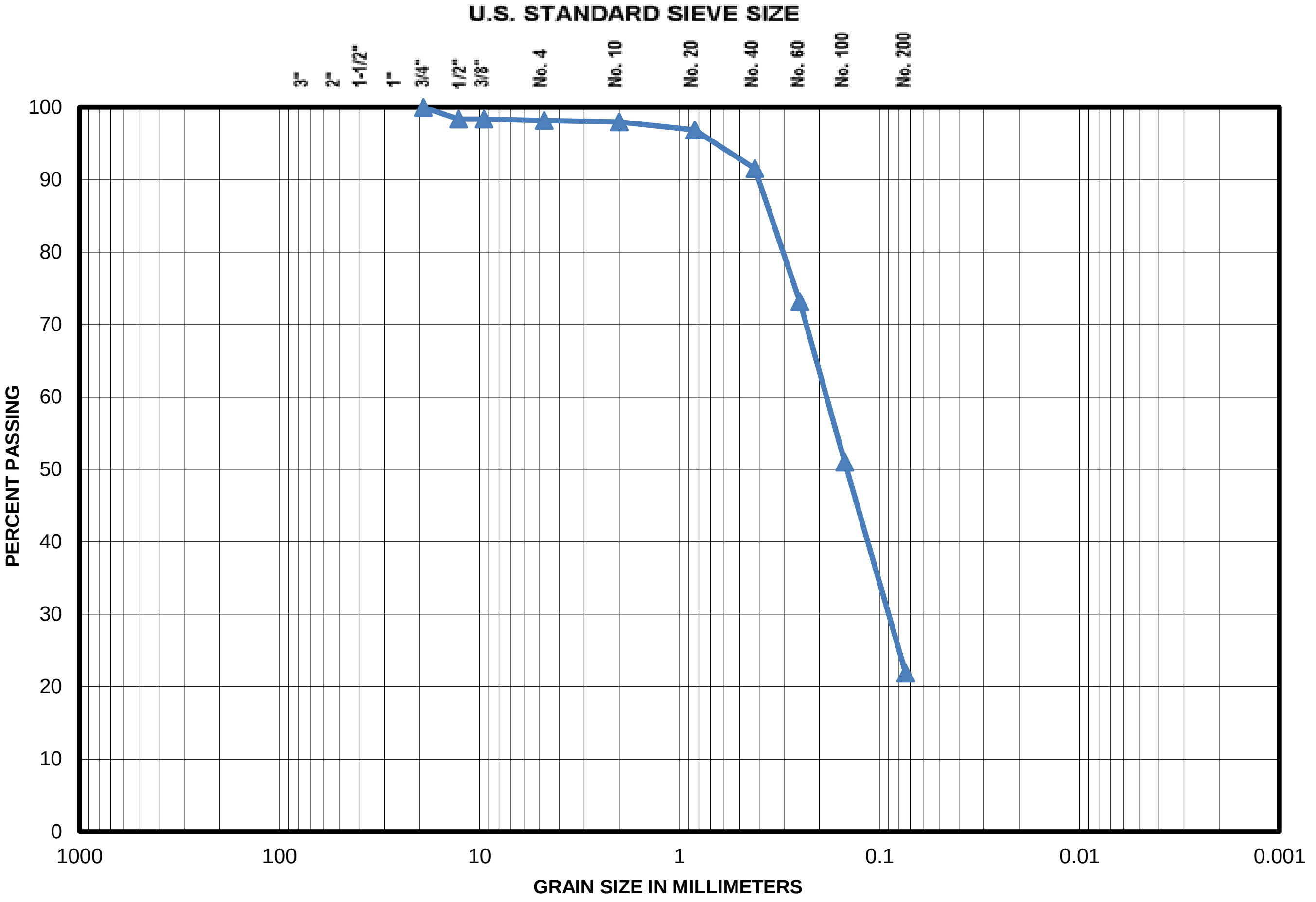
ASTM D 1140 ANALYSIS OF SOIL FINER THAN No. 200 SIEVE

LDNR - PO-104 Bayou Bonfouca Marsh Creation Expanded Borrow Area Investigation

FIGURE B-6



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

Coarse Gravel %	0.0	**Medium Sand %**	6.4
Fine Gravel %	1.8	**Fine Sand %**	69.7
Coarse Sand %	0.2	**Fines (Silt & Clay) %**	21.9
USC Classification	SM	**C_U** na	**C_C** na
Description (D 2488)	Silty sand		

Individual Sieve Data - % Passing			
3"	#N/A	**No. 4**	98.2
2"	#N/A	**No. 10**	98.0
1 1/2"	#N/A	**No. 20**	96.9
1"	#N/A	**No. 40**	91.5
3/4"	100.0	**No. 60**	73.2
1/2"	98.3	**No. 100**	51.0
3/8"	98.3	**No. 200**	21.9

Project	LDNR - PO-104 Bayou Bonfouca Marsh Creation Expa	**Date Tested**	7/10/2014
Project No.	16715-023-03	**Tested By**	JRB
Boring No.	14-4	**Checked By**	SLC
Source/Depth (feet)	16 - 18	**Sieve Type**	Dry Sieve

NOTE: Test was performed in general accordance with the referenced test method. Test results are applicable only to the specific sample on which they were performed, and should not be interpreted as representative of any other samples obtained at other times, depths or locations or generated by separate operations or processes. This report may not be reproduced, except in full, without written approval of GeoEngineers, Inc.

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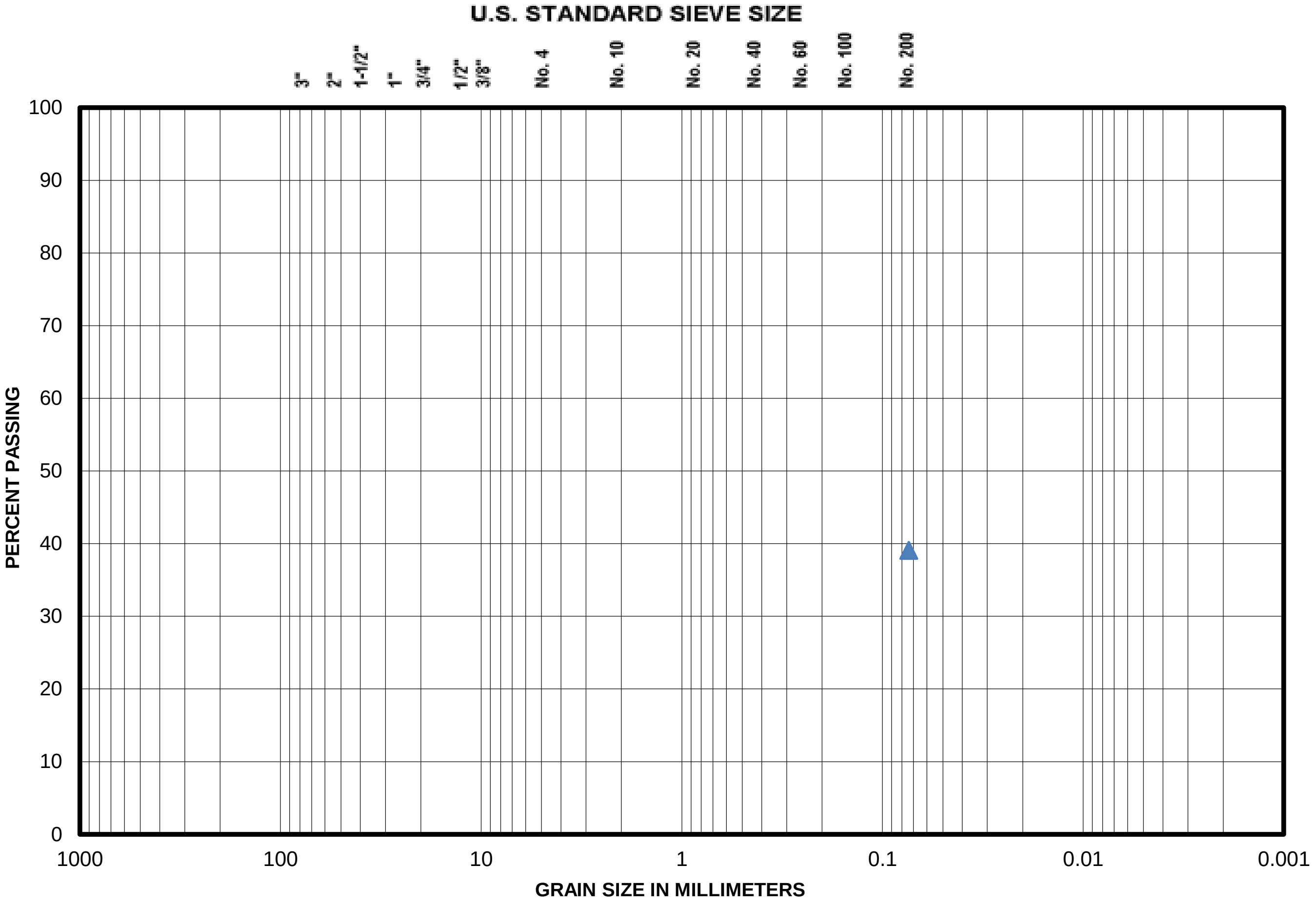
ASTM D 6913 SOIL PARTICLE-SIZE GRADATION SIEVE ANALYSIS

LDNR - PO-104 Bayou Bonfouca Marsh Creation Expanded Borrow Area Investigation

FIGURE B-7



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

Sand %	61.0	**Fines (Silt & Clay) %**	39.0

USC Classification	SC	C_U	na	C_C	na
Description (D 2488)	Clayey sand				

Individual Sieve Data - % Passing			
3"	#N/A	**No. 4**	#N/A
2"	#N/A	**No. 10**	#N/A
1 1/2"	#N/A	**No. 20**	#N/A
1"	#N/A	**No. 40**	#N/A
3/4"	#N/A	**No. 60**	#N/A
1/2"	#N/A	**No. 100**	#N/A
3/8"	#N/A	**No. 200**	39.0

Project	LDNR - PO-104 Bayou Bonfouca Marsh Creation Expa	**Date Tested**	7/10/2014
Project No.	16715-023-03	**Tested By**	JRB
Boring No.	14-5	**Checked By**	SLC
Source/Depth (feet)	14 - 16	**Sieve Type**	200 Wash

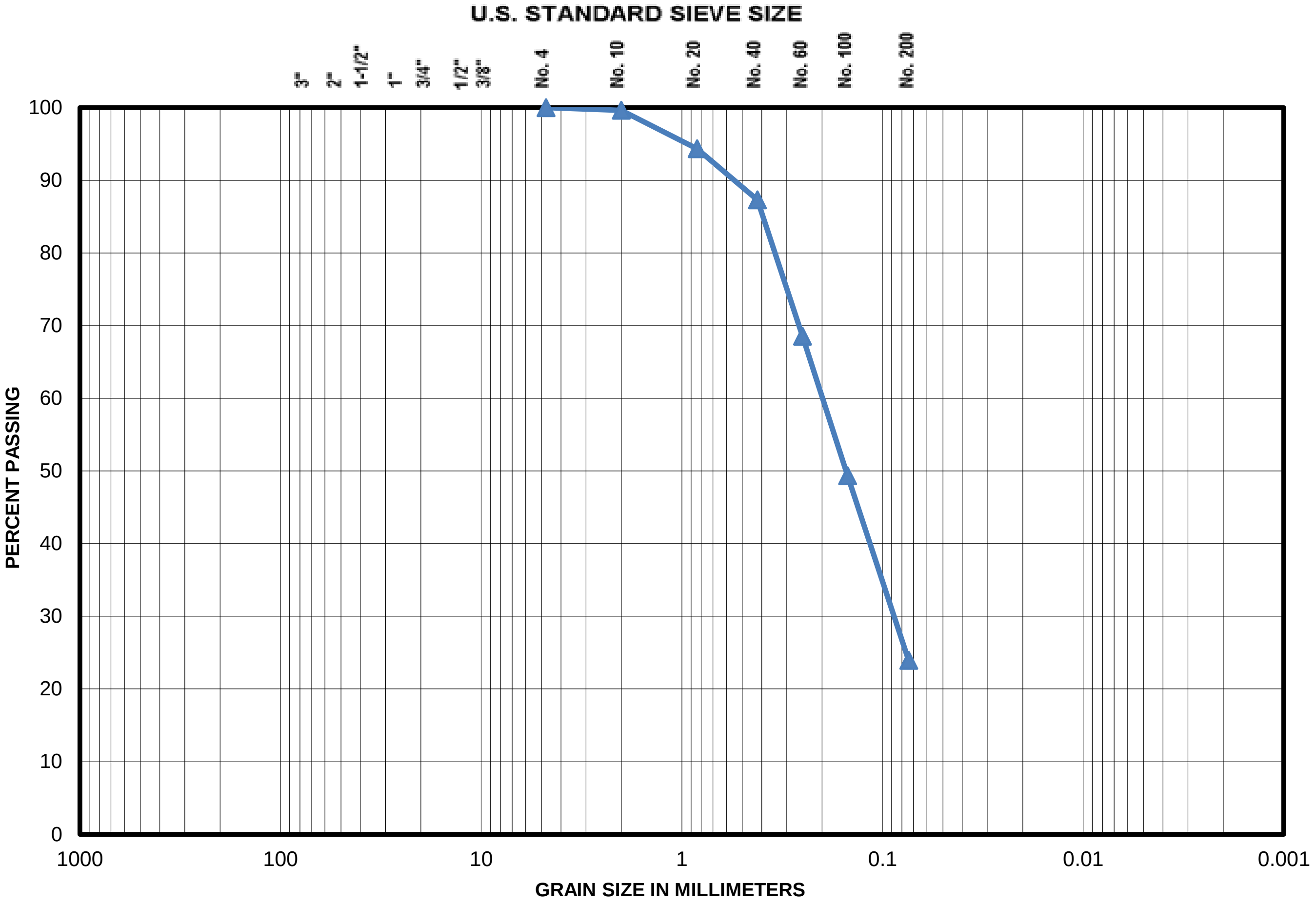
Method B was used for the 200 Wash

NOTE: Test was performed in general accordance with the referenced test method. Test results are applicable only to the specific sample on which they were performed, and should not be interpreted as representative of any other samples obtained at other times, depths or locations or generated by separate operations or processes. This report may not be reproduced, except in full, without written approval of GeoEngineers, Inc.

ASTM D 1140 ANALYSIS OF SOIL FINER THAN No. 200 SIEVE

LDNR - PO-104 Bayou Bonfouca Marsh Creation Expanded Borrow Area Investigation

FIGURE B-8



<table>
<tr><td rowspan="2">COBBLES</td><td colspan="2">GRAVEL</td><td colspan="3">SAND</td><td colspan="2">FINES</td></tr>
<tr><td>COARSE</td><td>FINE</td><td>COARSE</td><td>MEDIUM</td><td>FINE</td><td>SILT</td><td>CLAY</td></tr>
</table>

<table>
<tr><td>Coarse Gravel %</td><td>0.0</td><td colspan="2">Medium Sand %</td><td colspan="2">12.3</td></tr>
<tr><td>Fine Gravel %</td><td>0.0</td><td colspan="2">Fine Sand %</td><td colspan="2">63.4</td></tr>
<tr><td>Coarse Sand %</td><td>0.4</td><td colspan="2">Fines (Silt & Clay) %</td><td colspan="2">23.9</td></tr>
<tr><td>USC Classification</td><td>SM</td><td>C_U</td><td>na</td><td>C_C</td><td>na</td></tr>
<tr><td>Description (D 2488)</td><td colspan="5">Silty sand</td></tr>
</table>

Individual Sieve Data - % Passing

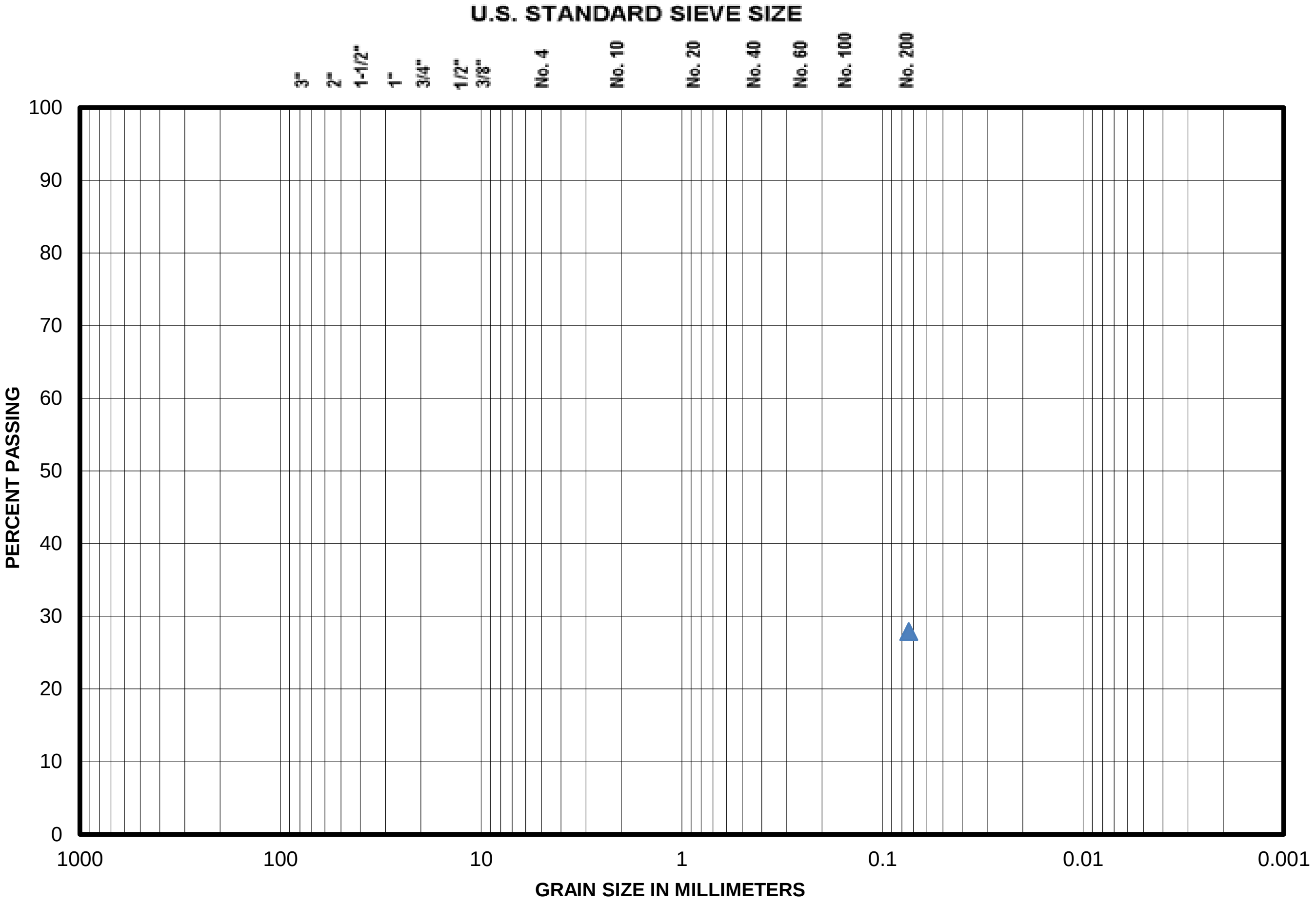
3"	#N/A	**No. 4**	100.0
2"	#N/A	**No. 10**	99.6
1 1/2"	#N/A	**No. 20**	94.4
1"	#N/A	**No. 40**	87.3
3/4"	#N/A	**No. 60**	68.5
1/2"	#N/A	**No. 100**	49.3
3/8"	#N/A	**No. 200**	23.9

Project	LDNR - PO-104 Bayou Bonfouca Marsh Creation Expa	**Date Tested**	7/10/2014
Project No.	16715-023-03	**Tested By**	JRB
Boring No.	14-6	**Checked By**	SLC
Source/Depth (feet)	14 - 16	**Sieve Type**	Dry Sieve

ASTM D 6913 SOIL PARTICLE-SIZE GRADATION SIEVE ANALYSIS

LDNR - PO-104 Bayou Bonfouca Marsh Creation Expanded Borrow Area Investigation

FIGURE B-9



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

Sand %	72.1	**Fines (Silt & Clay) %**	27.9

USC Classification	SM	C_U	na	C_C	na
Description (D 2488)	Silty sand				

Individual Sieve Data - % Passing			
3"	#N/A	**No. 4**	#N/A
2"	#N/A	**No. 10**	#N/A
1 1/2"	#N/A	**No. 20**	#N/A
1"	#N/A	**No. 40**	#N/A
3/4"	#N/A	**No. 60**	#N/A
1/2"	#N/A	**No. 100**	#N/A
3/8"	#N/A	**No. 200**	27.9

Project	LDNR - PO-104 Bayou Bonfouca Marsh Creation Expa	**Date Tested**	7/9/2014
Project No.	16715-023-03	**Tested By**	SRD
Boring No.	14-6	**Checked By**	SLC
Source/Depth (feet)	16 - 18	**Sieve Type**	200 Wash

Method B was used for the 200 Wash

NOTE: Test was performed in general accordance with the referenced test method. Test results are applicable only to the specific sample on which they were performed, and should not be interpreted as representative of any other samples obtained at other times, depths or locations or generated by separate operations or processes. This report may not be reproduced, except in full, without written approval of GeoEngineers, Inc.

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ASTM D 1140 ANALYSIS OF SOIL FINER THAN No. 200 SIEVE

LDNR - PO-104 Bayou Bonfouca Marsh Creation Expanded Borrow Area Investigation

FIBURE B-10

GeoEngineers
Earth Science + Technology

Laboratory Test Results

Project Name: LDNR - PO-104 Bayou Bonfouca Marsh Creation
Expanded Borrow Area Investigation

Project ID: 16715-023-03

Technical Responsibility: Cathy J. Peak

Title: LAB MANAGER

Date: 2-24-15

BORING NUMBER	DEPTH (FT)	SOIL DESCRIPTION	MOISTURE %	UNIT WEIGHT (PCF)		ATTERBERG LIMITS			COMPRESSION TEST				TEST TYPE	COMMENTS
	FROM - TO			WET	DRY	LL	PL	PI	TSF	STRAIN %	CONFINING PRESSURE (KSF)	TYPE FAILURE		
14-1	11.5 - 13.5	Gray clayey sand with clay and shells (SP-SC)	26										MC,Dry Sieve	3.0% shells / 87.7% sand / 9.3% fines
14-1	13.5 - 15.5	Gray sandy clay with clay pockets (CL)	25										MC,M200	28.5% sand / 71.5% fines
14-1	15.5 - 17.5	Stiff tan and gray silty clay with shells (CL)	24	125.9	101.2								UC	
14-1	17.5 - 19.5	Stiff tan and gray clay with 5" shell layer (CH)	39			86	32	54					MC,AL	
14-1	19.5 - 21.5	Stiff tan and gray clay with 8.5" shell layer (CH)	38										MC	
14-1	21.5 - 23.5	Stiff tan and gray clay with silt lenses (CH)	42	111.4	78.8	59	27	32					UC,AL	
14-1	23.5 - 25.0	Stiff tan and gray clay with silt lenses (CH)	34										MC	
14-1	25.5 - 27.5	Stiff tan and gray clay with silt lenses (CH)	39			51	20	31					MC,AL	
14-1	27.5 - 29.5	Stiff tan and gray clay with silt lenses (CH)	47										MC	
14-1	29.5 - 31.5	Medium gray clay with silt lenses (CH)	50										MC	
14-2	11.0 - 13.0	Gray sand with clay and shells (SP-SC)	21										MC,Dry Sieve	23.4% shells / 66.9% sand / 9.7% fines
14-2	13.0 - 15.0	Gray clayey sand with shells and gray and tan clay layer at bottom (SC)	46										MC,M200	85.4% sand / 14.6% fines
14-2	15.0 - 17.0	Medium tan and gray clay with sand pockets (CH)	35			55	22	33					MC,AL	
14-2	17.0 - 19.0	Medium tan and gray clay with shells (CH)	37	120.0	87.6								UC	
14-2	19.0 - 21.0	Stiff tan and gray clay with sand pockets (CH)	37										MC	
14-2	21.0 - 23.0	Stiff tan and gray clay with silt lenses (CH)	38			68	29	39					MC,AL	
14-2	23.0 - 25.0	Stiff tan and gray clay with silt lenses (CH)	39	118.1	85.1								UC	
14-2	25.0 - 27.0	Stiff tan and gray clay with silt lenses (CH)	45										MC	
14-2	27.0 - 29.0	Stiff tan and gray clay with silt lenses (CH)	36										MC	
14-2	29.0 - 31.0	Stiff tan and gray clay (CH)	46										MC	
14-3	14.0 - 16.0	Gray silty clayey sand with shells (SC-SM)	29	111.6	86.8	29	17	12					UC,AL,M200	56.5% sand / 43.5% fines

Soil Description: ASTM(D2487) AASHTO(M145) **Moisture Content:** ASTM(D2166) AASHTO(T265)
Unit Weight: ASTM(D2166) AASHTO(T310) **Atterberg Limit:** ASTM(D4318) AASHTO(T89,T90)
Compression: ASTM(D2166,D2850) AASHTO(T208,T296)

Laboratory Test Results

Project Name: LDNR - PO-104 Bayou Bonfouca Marsh Creation
Expanded Borrow Area Investigation

Project ID: 16715-023-03

Technical Responsibility:

Title: LAB MANAGER

Date: 2-24-15

BORING NUMBER	DEPTH (FT)	SOIL DESCRIPTION	MOISTURE %	UNIT WEIGHT (PCF)		ATTERBERG LIMITS			COMPRESSION TEST				TEST TYPE	COMMENTS
	FROM - TO			WET	DRY	LL	PL	PI	TSF	STRAIN %	CONFINING PRESSURE (KSF)	TYPE FAILURE		
14-3	16.0 - 18.0	Soft gray very silty clay with shells (CL)	32			24	15	9					MC,AL	
14-3	18.0 - 20.0	Medium gray very sandy clay (CL)	22			31	12	19					MC,AL	
14-3	20.0 - 22.0	Soft gray silty clay with shells (CL)	33										MC	
14-3	22.0 - 24.0	Stiff tan and gray clay with silt lenses (CH)	38	118.7	86.2								UC	
14-3	24.0 - 26.0	Stiff tan and gray clay with silt lenses (CH)	37			73	27	46					MC,AL	
14-3	26.0 - 28.0	Stiff tan and gray clay with silt lenses (CH)	45										MC	
14-3	28.0 - 30.0	Stiff tan and gray clay (CH)	43			92	23	69					MC,AL	
14-3	30.0 - 32.0	Stiff gray clay (CH)	39										MC	
14-3	32.0 - 34.0	Stiff black and gray silty clay with organic matter (CL)	78										MC	
14-4	14.0 - 16.0	Gray sandy silt with shell fragments (ML)	44			18	15	3					MC,AL,M200	43.8% sand / 56.2% fines
14-4	16.0 - 18.0	Gray silty sand with shells (SM)	21										MC,Dry Sieve	1.8% shells / 76.3% sand / 21.9% fines
14-4	18.0 - 20.0	Soft gray silty clay with sand (CL)	27	114.1	89.7								UC	
14-4	20.0 - 22.0	Stiff gray clay with silt lenses and sand pockets (CH)	27			67	23	44					MC,AL	
14-4	22.0 - 24.0	Stiff tan and gray clay (CH)	39										MC	
14-4	24.0 - 26.0	Stiff tan and gray clay with silt lenses and shells (CH)	40										MC	
14-4	26.0 - 28.0	Stiff tan and gray clay with silt lenses (CH)	43	114.6	80.4	77	30	47					UC,AL	
14-4	28.0 - 30.0	Stiff tan and gray clay (CH)	31										MC	
14-4	30.0 - 32.0	Stiff tan and gray clay (CH)	44										MC	
14-4	32.0 - 34.0	Stiff tan and gray clay (CH)	31										MC	
14-5	14.0 - 16.0	Gray clayey sand with shell fragments (SC)	27										MC,M200	61.0% sand / 39.0% fines
14-5	16.0 - 18.0	Soft gray clay with sand pockets and shells (CH)	61			70	20	50					MC,AL	
14-5	18.0 - 20.0	Soft gray sandy clay (CL)	36	131.6	96.5								UC	
14-5	20.0 - 22.0	Soft gray sandy clay (CL)	23										MC	

Soil Description: ASTM(D2487) AASHTO(M145) **Moisture Content:** ASTM(D2166) AASHTO(T265)
Unit Weight: ASTM(D2166) AASHTO(T310) **Atterberg Limit:** ASTM(D4318) AASHTO(T89,T90)
Compression: ASTM(D2166,D2850) AASHTO(T208,T296)

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Laboratory Test Results

Project Name: LDNR - PO-104 Bayou Bonfouca Marsh Creation Expanded Borrow Area Investigation

Project ID: 16715-023-03

Technical Responsibility:

Title: LAB MANAGER

Date: 2-24-15

BORING NUMBER	DEPTH (FT)	SOIL DESCRIPTION	MOISTURE %	UNIT WEIGHT (PCF)		ATTERBERG LIMITS			COMPRESSION TEST				TEST TYPE	COMMENTS
	FROM - TO			WET	DRY	LL	PL	PI	TSF	STRAIN %	CONFINING PRESSURE (KSF)	TYPE FAILURE		
14-5	22.0 - 24.0	Soft tan and gray very sandy clay (CL)	19			28	15	13					MC,AL	
14-5	24.0 - 26.0	Stiff gray clay with silt lenses (CH)	19	132.8	111.5								UC	
14-5	26.0 - 28.0	Stiff gray clay with silt lenses (CH)	25										MC	
14-5	28.0 - 30.0	Stiff tan and light gray clay with sand pockets (CH)	23			50	14	36					MC,AL	
14-5	30.0 - 32.0	Stiff tan and gray clay (CH)	35										MC	
14-5	32.0 - 34.0	Stiff tan and gray clay (CH)	33										MC	
14-6	14.0 - 16.0	Gray silty sand (SM)	25										MC,Dry Sieve	76.1% sand / 23.9% fines
14-6	16.0 - 18.0	Gray silty sand (SM)	24										MC,M200	72.1% sand / 27.9% fines
14-6	18.0 - 20.0	Soft gray clay with silt lenses (CH)	58	113.1	71.5								UC	
14-6	20.0 - 22.0	Stiff gray clay (CH)	26			54	18	36					MC,AL	
14-6	22.0 - 24.0	Soft gray silty clay (CL)	54										MC	
14-6	24.0 - 26.0	Stiff gray clay with silt (CL)	30			49	16	33					MC,AL	
14-6	26.0 - 28.0	Stiff tan and gray clay with silt lenses (CH)	29	127.2	98.5								UC	
14-6	28.0 - 30.0	Stiff tan and gray silty clay with silt lenses (CL)	30			38	24	14					MC,AL	
14-6	30.0 - 32.0	Stiff tan and gray clay with silt lenses (CH)	34										MC	
14-6	32.0 - 34.0	Stiff gray clay with silt lenses (CH)	42										MC	

Soil Description: ASTM(D2487) AASHTO(M145) **Moisture Content:** ASTM(D2166) AASHTO(T265)
Unit Weight: ASTM(D2166) AASHTO(T310) **Atterberg Limit:** ASTM(D4318) AASHTO(T89,T90)
Compression: ASTM(D2166,D2850) AASHTO(T208,T296)

Final Report:

Settling Properties of Fine-Grained Sediments for Bayou Bonfouca, Slidell, LA
(GeoEngineers Project No. 16715-023-03)

Submitted to:

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December 5, 2014

1.0 Introduction, Scope, and Objectives

The objective of the testing reported here was to evaluate the settling properties of fine-grained sediments which may be hydraulically dredged from Bayou Bonfouca, Slidell, LA (GeoEngineers Project No. 16715-023-03).

2.0 Experimental Procedures and Results

A large plastic tote containing composited, homogenized sediment and two five-gallon buckets of water from the proposed dredging location were provided by GeoEngineers, Inc. for laboratory testing. The average salinity of the water provided for testing, measured in terms of total dissolved solids (TDS) following *Standard Methods*[1], was 1.5 g/L (with water from the separate buckets containing TDS concentrations of 1.4 and 1.6 g/L, respectively).

Slurry was prepared using the homogenized sediment, water provided for testing, and additional water supplemented with synthetic sea salts (Instant Ocean) to match the salinity of site water. Slurry containing the fine-grained fraction of sediments was obtained by thoroughly mixing the slurry and then allowing coarse grained materials (e.g., sand and shells), to separate by differential settling as described in the US Army Corps of Engineers Manual No. 1110-2-5027[2]. The fine-grained sediment slurry was loaded into a large-scale (8.0 inch ID) column while mixing with air sparging as described in the US Army Corps of Engineers Manual No. 1110-2-5027[2]. Solids concentrations in the slurry at the start of the settling test were measured in samples collected along the height of the column at one foot intervals. The total particulate concentration at the start of the settling test was 144.2 g/L.

A clear sediment-water interface was observed shortly after the start of the settling test (<30 minutes), indicating zone settling. The height of the sediment-water interface above the bottom of the column was measured and recorded over a period lasting more than 15 days as depicted in Figure 1 (see Appendix A for tabulated data).

Water samples were collected from the clarified layer above the sediment-water interface for measurement of TSS as described in the US Army Corps of Engineers Manual No. 1110-2-5027[2]. The first of these samples was collected 7.0 hours after the start of settling when the sediment-water interface was sufficiently below the uppermost sample port to allow sample collection. Because the TSS concentrations in the samples collected for characterization of flocculent settling in the zone above the sediment-water interface were low, the mass of suspended solids retained on the filters was lower than the 5 mg recommended by the US Army Corps of Engineers Manual No. 1110-2-5027[2]. Based on the data collected, the TSS concentration in all samples from the flocculent settling above the sediment-water interface are reported here as <50 mg/L (calculated as the minimum residue mass required for acceptable analysis, 5 mg, divided by the sample volume filtered, 0.10 L).

As shown in Figure 1, zone settling was observed during the first portion of the settling test, followed by compression settling thereafter.

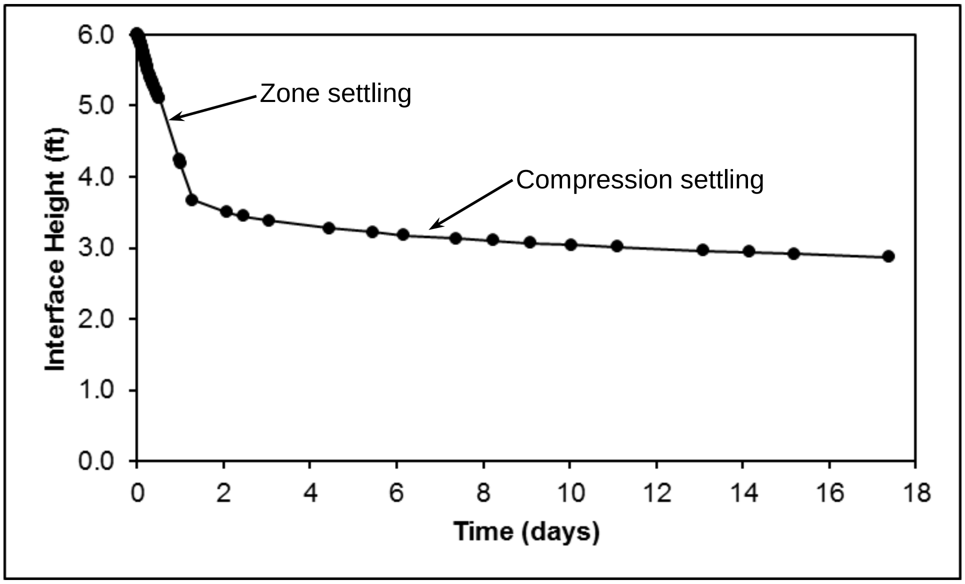

Figure 1: Interface height as a function of time during the pilot-scale settling test.

Data for the first 32 hours of the settling test, during which zone settling was observed, is depicted separately in Figure 2. A linear regression was performed with the resulting equation and correlation coefficient depicted on the graph. The slope of the regression line, which corresponds to the zone settling velocity, was 0.077 ft/hr (1.85 ft/day).

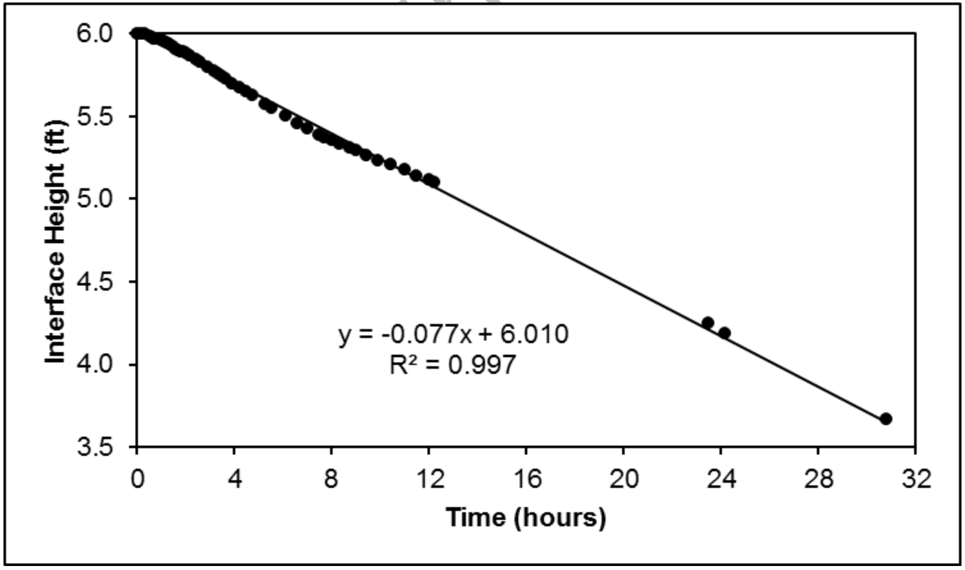

Figure 2: Interface height as a function of time during the zone settling portion of the pilot-scale settling test.

For the portion of the settling test during which compression settling was observed, the concentration in the settled solids at each time interval was calculated using the following equation (equation 3-11 in ref. 2).

$$C = \frac{C_o H_i}{H_t}$$

Where:

C = slurry suspended solids concentration at time t (g/L)
C_o = initial slurry suspended solids concentration (g/L)
H_i = initial slurry height (ft)
H_t = height of the interface at time t (ft)

The corresponding suspended solids concentration as a function of time during compression settling is depicted in Figure 3.

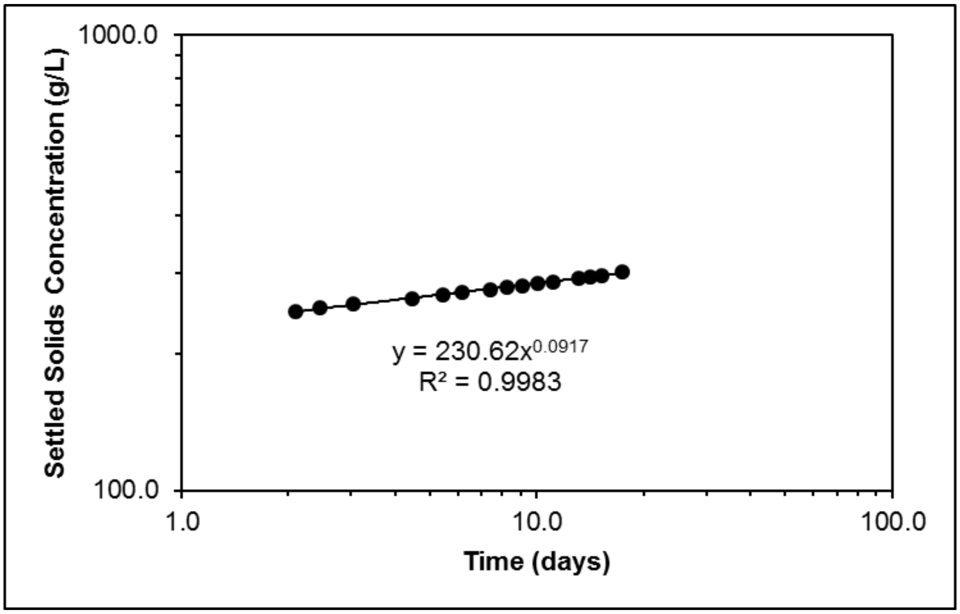

Figure 3: Concentration of settled solids as a function of time during the compression settling portion of the pilot-scale settling test.

3.0 References

[1] American Public Health Association (1998) *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, American Water Works Association, Water Pollution Control Federation, Washington, DC.

[2] US Army Corps of Engineers (1987) *Engineering and Design - Confined Disposal of Dredged Material*, Engineer Manual No. 1110-2-5027.

Appendix A: Interface height as a function of time during the pilot-scale column settling test.

The height of the sediment-water interface above the bottom of the column was recorded as a function of time as summarized in the table below.

Elapsed Time (hr)	Elapsed Time (days)	Solids Interface Height (ft)	Head height (ft)	Settled Solids Conc. (g/L)[a]
0.00	0.00	6.000	6.000	144.2
0.17	0.01	6.000	6.000	144.2
0.33	0.01	5.996	6.000	144.3
0.52	0.02	5.983	6.000	144.6
0.63	0.03	5.975	6.000	144.8
0.72	0.03	5.971	6.000	144.9
0.88	0.04	5.967	6.000	145.0
1.00	0.04	5.958	6.000	145.2
1.13	0.05	5.950	6.000	145.4
1.23	0.05	5.942	6.000	145.6
1.35	0.06	5.933	6.000	145.8
1.47	0.06	5.921	6.000	146.1
1.57	0.07	5.908	6.000	146.4
1.68	0.07	5.900	6.000	146.6
1.80	0.08	5.892	6.000	146.9
1.88	0.08	5.888	6.000	147.0
2.00	0.08	5.879	6.000	147.2
2.15	0.09	5.867	6.000	147.5
2.42	0.10	5.842	6.000	148.1
2.62	0.11	5.825	6.000	148.5
2.90	0.12	5.800	6.000	149.2
3.15	0.13	5.775	6.000	149.8
3.33	0.14	5.758	6.000	150.3
3.50	0.15	5.742	6.000	150.7
3.67	0.15	5.725	6.000	151.1
3.93	0.16	5.700	6.000	151.8
4.20	0.18	5.675	6.000	152.5
4.48	0.19	5.650	6.000	153.1
4.75	0.20	5.625	6.000	153.8
5.25	0.22	5.575	6.000	155.2
5.52	0.23	5.550	6.000	155.9

[a] Calculated using equation 3-11 in ref. 2 based on the measured particulate concentrations at t=0 and the height of the sediment-water interface at each time interval.

Appendix A: Continued from previous page.

Elapsed Time (hr)	Elapsed Time (days)	Solids Interface Height (ft)	Head height (ft)	Settled Solids Conc. (g/L) [a]
6.10	0.25	5.500	6.000	157.3
6.62	0.28	5.458	6.000	158.5
7.00	0.29	5.425	6.000	159.5
7.50	0.31	5.388	5.967	160.6
7.70	0.32	5.375	5.967	161.0
8.03	0.33	5.354	5.950	161.6
8.35	0.35	5.333	5.950	162.2
8.77	0.37	5.308	5.950	163.0
9.00	0.38	5.292	5.950	163.5
9.42	0.39	5.267	5.950	164.3
9.92	0.41	5.233	5.950	165.3
10.42	0.43	5.208	5.950	166.1
11.00	0.46	5.175	5.950	167.2
11.50	0.48	5.142	5.950	168.3
12.00	0.50	5.113	5.950	169.2
12.25	0.51	5.100	5.950	169.6
23.50	0.98	4.250	5.950	203.6
24.17	1.01	4.188	5.933	206.6
30.82	1.28	3.671	5.933	235.7
50.17	2.09	3.504	5.933	246.9
59.00	2.46	3.442	5.933	251.4
73.25	3.05	3.379	5.933	256.0
106.7	4.45	3.275	5.933	264.2
131.0	5.46	3.217	5.933	269.0
148.0	6.17	3.179	5.933	272.1
177.4	7.39	3.133	5.933	276.1
197.5	8.23	3.100	5.933	279.1
218.1	9.09	3.071	5.925	281.7
241.3	10.05	3.042	5.925	284.4
266.6	11.11	3.013	5.925	287.2
314.0	13.08	2.963	5.925	292.1
339.8	14.16	2.938	5.917	294.5
364.8	15.20	2.917	5.900	296.6
417.5	17.40	2.871	5.900	301.4

[a] Calculated using equation 3-11 in ref. 2 based on the measured particulate concentrations at t=0 and the height of the sediment-water interface at each time interval.

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January 30, 2015

State of Louisiana
Coastal Protection and Restoration Authority
P.O. Box 44027
Baton Rouge, Louisiana, 70804-4027

Attention: Cody Bruhl

Subject: Sediment Geotechnical Properties Report
Self-weight Consolidation of Expanded Borrow Area Soils
PO-104 Bayou Bonfouca Marsh Creation Project
St. Tammany Parish, Louisiana
File No. 16715-023-03

INTRODUCTION

This document presents the results of laboratory testing to determine the index and self-weight consolidation properties of hydraulic fill material to be used for the PO-104 Bayou Bonfouca Marsh Creation Project. These tests were conducted on four (4) composite samples that were homogenized from Shelby tube samples collected from PO-104 expanded borrow area borings 14-1 through 14-6 and labeled Composite Sample #1 through #4. Two composite samples were created to represent fill generated by hydraulically dredging the top 10 feet below mudline. The other two samples were created to represent fill generated by hydraulically dredge the top 20 feet below the mudline.

TEST PROCEDURE

Equal volume specimens from each tube sample in the required depth range were homogenized to create four composite samples for use in testing, as shown on Table 1. Sufficient mixing of each composite sample was performed before testing was commenced.

TABLE 1. COMPOSITE SAMPLE SOURCE SUMMARY

Composite Sample Id.	Soil Borings	Depth Range (ft, below mudline)
Composite Sample #1	14-1, 14-4, and 14-5	0 to 10 feet
Composite Sample #2	14-2, 14-3, and 14-6	0 to 10 feet
Composite Sample #3	14-1, 14-4, and 14-5	0 to 20 feet
Composite Sample #4	14-2, 14-3, and 14-6	0 to 20 feet

Basic index properties, including specific gravity, Atterberg limits, and particle size distribution were determined for each composite sample using the appropriate ASTM standards.

Self-weight consolidation tests were performed on the four composite samples following the methods specified in the U.S. Army Corps of Engineers Manual No. 1110-2-5027 (USACE, 1987) and the University of Texas Method (Pederson, 2001). A low-pressure loading system was employed to run the tests. In order to simplify sample preparation, a slurry was created for each composite sample by diluting the homogenized sample to approximately three to four times its liquid limit (3.0 – 4.0 x LL) to allow free flow of the soil. One-dimensional incremental loading was used for consolidation of the samples, with stresses ranging from 5 psf to 640 psf, with stress doubling between each load increment. The Casagrande (Log of time) method was utillized to determine the coefficient of consolidation, c_v.

RESULTS

Index properties of each composite sample are summarized in Table 2. Particle size distributions for each composite sample are shown in Figures 1 and 2.

TABLE 2. SUMMARY OF COMPOSITE SAMPLE INDEX PROPERTIES

Composite Sample Id.	Specific Gravity	Atterberg Limits		Grain Size Distribution		
		Liquid Limit, LL	Plasticity Index, PI	Sand (D>0.075 mm)	Silt (0.075 mm >D >0.005 mm)	Clay (D<0.005 mm)
Composite Sample #1	2.647	39	26	42.4	23.1	34.5
Composite Sample #2	2.652	44	29	32.5	29.0	38.5
Composite Sample #3	2.647	58	39	21	26.4	52.6
Composite Sample #4	2.684	52	37	26	27.9	46.1

Note that the deeper samples have higher Atterberg limits and clay content than the shallower samples. This was expected due to the relatively small amount of sand observed in the deeper samples. Self-weight consolidation results for each composite sample are given on the following pages in tabular (Tables 3 through 6 for Composite Samples #1 through #4, respectively) and graphical form (Figures 3a through 6d for Composite Samples #1 through #4, respectively). Figures #a and #b are strain vs. stress and void ratio vs. stress graphs, respectively, for each composite sample. Figures #c and #d are stress vs. coefficient of consolidation (c_v) and void ratio vs. hydraulic conductivity (k) graphs, respectively, for each composite sample.

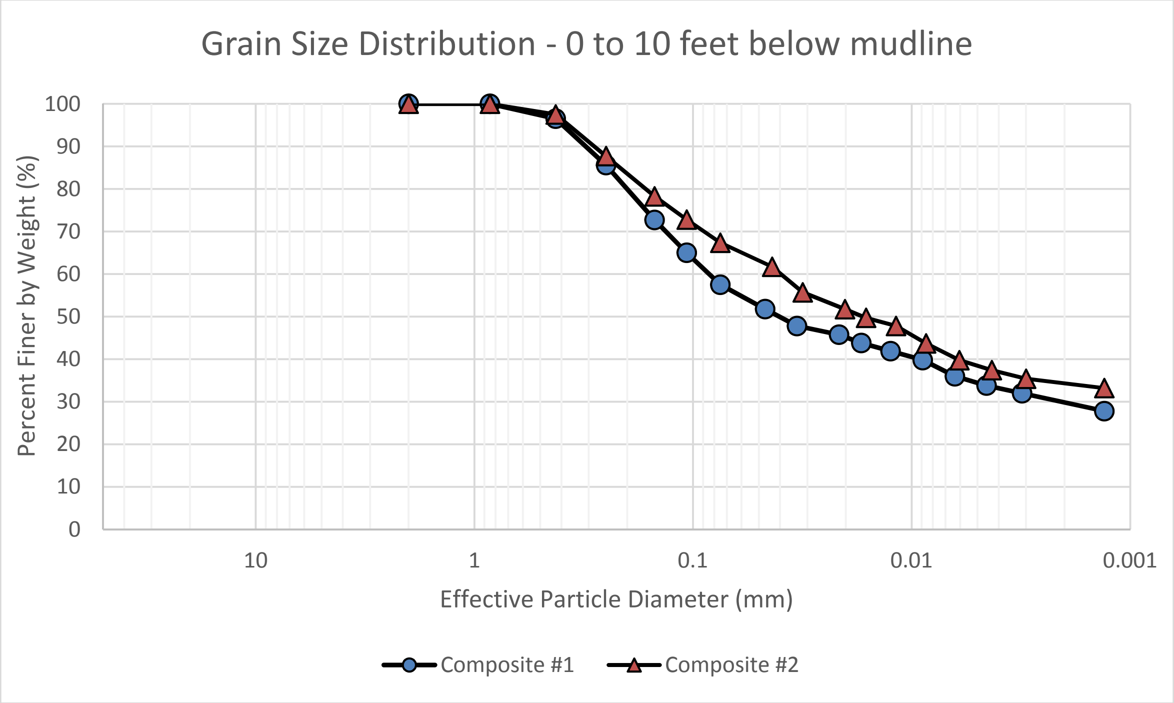

Figure 1 Particle Size Distribution for Shallow Composite Samples

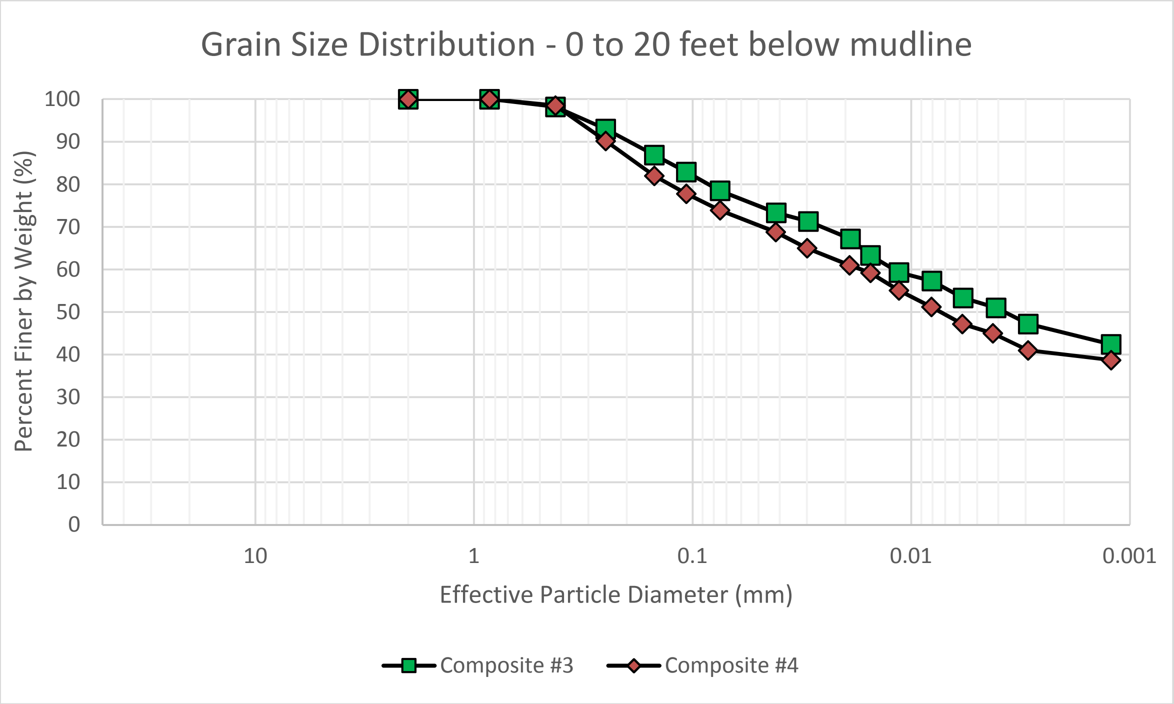

Figure 2 Particle Size Distribution for Deep Composite Samples

TABLE 3. SELF-WEIGHT CONSOLIDATION TEST RESULTS FOR COMPOSITE SAMPLE #1

σ'_v	δ_{100}	e_0	e_{100}	ε_{100}	C_c	$C_{\alpha e}$	t_{50}	Hdr	c_v	k
(psf)	(in)	5.486		(%)	1.504		(min)	(in)	(ft^2/day)	(ft/day)
5	-0.1151		6.237	-11.59		0.011	150	0.525	0.0036	0.004953
10	-0.0011		5.493	-0.108		0.020	6.8	0.522	0.0788	0.106699
20	0.0184		5.365	1.856		0.003	100	0.488	0.0047	0.000580
40	0.0630		5.074	6.345		0.009	9.61	0.476	0.0464	0.006777
80	0.2189		4.056	22.05		0.118	83.6	0.423	0.0042	0.001204
160	0.2789		3.664	28.09		0.050	50	0.368	0.0053	0.000335
320	0.3199		3.396	32.22		0.019	40	0.345	0.0059	0.000135
640	0.3529		3.181	35.54		0.014	28	0.327	0.0075	0.000074

TABLE 4. SELF-WEIGHT CONSOLIDATION TEST RESULTS FOR COMPOSITE SAMPLE #2

σ'_v	δ_{100}	e_0	e_{100}	ε_{100}	C_c	$C_{\alpha e}$	t_{50}	Hdr	c_v	k
(psf)	(in)	5.232		(%)	1.455		(min)	(in)	(ft^2/day)	(ft/day)
5	-0.0052		5.384	-2.449		0.011	8.5	0.500	0.0580	0.01751
10	0.0134		5.153	1.259		0.008	16.5	0.497	0.0295	0.013559
20	0.0483		4.963	4.315		0.016	24	0.484	0.0192	0.003765
40	0.1089		4.594	10.23		0.102	130	0.460	0.0032	0.000637
80	0.2743		3.548	27.01		0.046	45	0.403	0.0071	0.002289
160	0.3322		3.168	33.12		0.010	40	0.347	0.0059	0.000405
320	0.3792		2.899	37.43		0.030	23	0.321	0.0088	0.000229
640	0.4192		2.656	41.34		0.015	20	0.299	0.0088	0.000111

TABLE 5. SELF-WEIGHT CONSOLIDATION TEST RESULTS FOR COMPOSITE SAMPLE #3

σ'_v	δ_{100}	e_0	e_{100}	ε_{100}	C_c	$C_{\alpha e}$	t_{50}	Hdr	c_v	k
(psf)	(in)	5.490		(%)	1.649		(min)	(in)	(ft^2/day)	(ft/day)
5	0.0160		5.411	1.597		0.015	150	0.493	0.0080	0.001606
10	0.0610		5.071	6.101		0.033	6.8	0.477	0.0064	0.003749
20	0.1295		4.613	12.96		0.066	100	0.447	0.0046	0.002187
40	0.2160		4.067	21.62		0.091	9.61	0.408	0.0020	0.000669
80	0.3015		3.476	30.18		0.095	83.6	0.364	0.0029	0.000517
160	0.3865		2.953	38.68		0.043	50	0.321	0.0033	0.000332
320	0.4460		2.572	44.64		0.038	40	0.287	0.0037	0.000145
640	0.4536		2.547	45.40		0.001	28	0.271	0.0016	0.000004

TABLE 6. SELF-WEIGHT CONSOLIDATION TEST RESULTS FOR COMPOSITE SAMPLE #4

σ'_v	δ_{100}	e_0	e_{100}	ε_{100}	C_c	$C_{\alpha e}$	t_{50}	Hdr	c_v	k
(psf)	(in)	4.188		(%)	1.388		(min)	(in)	(ft²/day)	(ft/day)
5	-0.0337		4.363	-3.375		0.004	250	0.506	0.0020	0.000832
10	0.0125		4.123	1.249		0.010	0.45	0.500	1.0941	0.624799
20	0.0537		3.909	5.373		0.003	35	0.477	0.0128	0.003412
40	0.0970		3.684	9.708		0.017	28.55	0.457	0.0144	0.002106
80	0.2475		2.903	24.77		0.021	76.86	0.409	0.0043	0.001215
160	0.3450		2.397	34.53		0.042	80	0.347	0.0030	0.00032
320	0.4300		1.955	43.04		0.027	41	0.301	0.0043	0.000236
640	0.4870		1.659	48.75		0.026	32.11	0.265	0.0043	0.000088

Despite being wet to a moisture content 3 to 5 times the liquid limit, all but one of the composite samples increased in volume when subject to a load of 5 pounds per square foot (psf), shown on Tables 3 through 6 by the negative number in the deformation column of the table (δ). This is demonstrated in the figures below by negative strains and void ratios above the initial void ratio listed in the self-weight consolidation test result tables. The self-weight consolidation result figures presented in this document include best-fit logarithmic trend lines with correlation equations and correlation strength indicated on the plot.

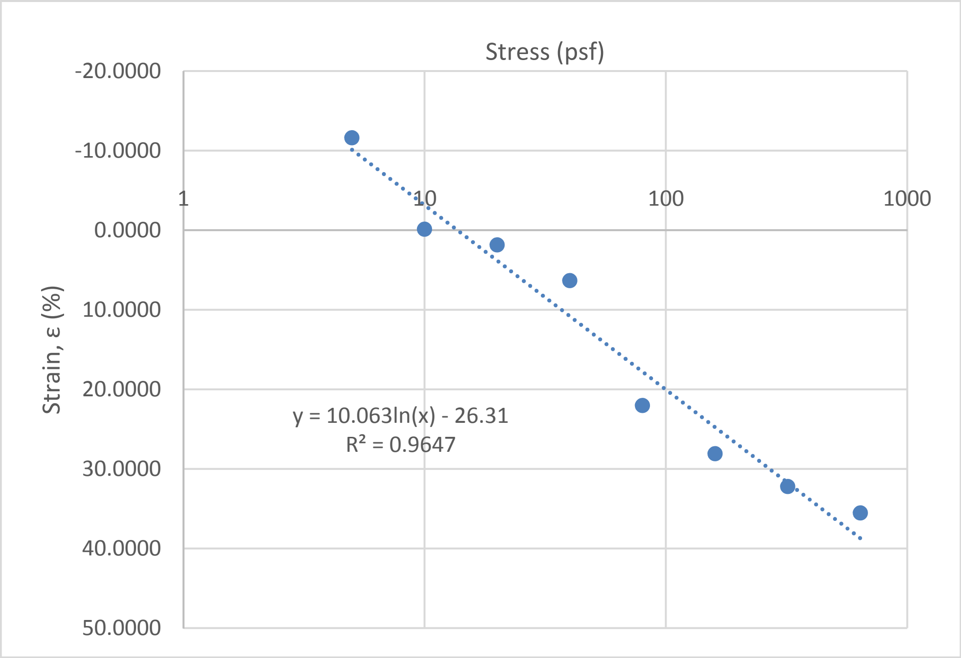

Figure 3a Axial Strain vs. Stress Plot for Composite Sample #1

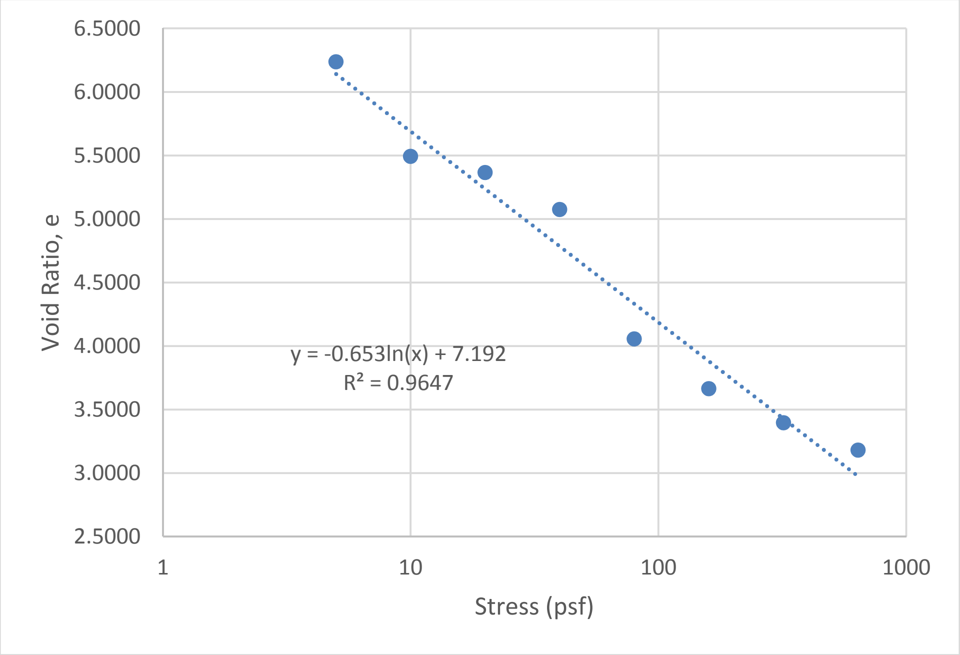

Figure 3b Void Ratio vs. Stress Plot for Composite Sample #1

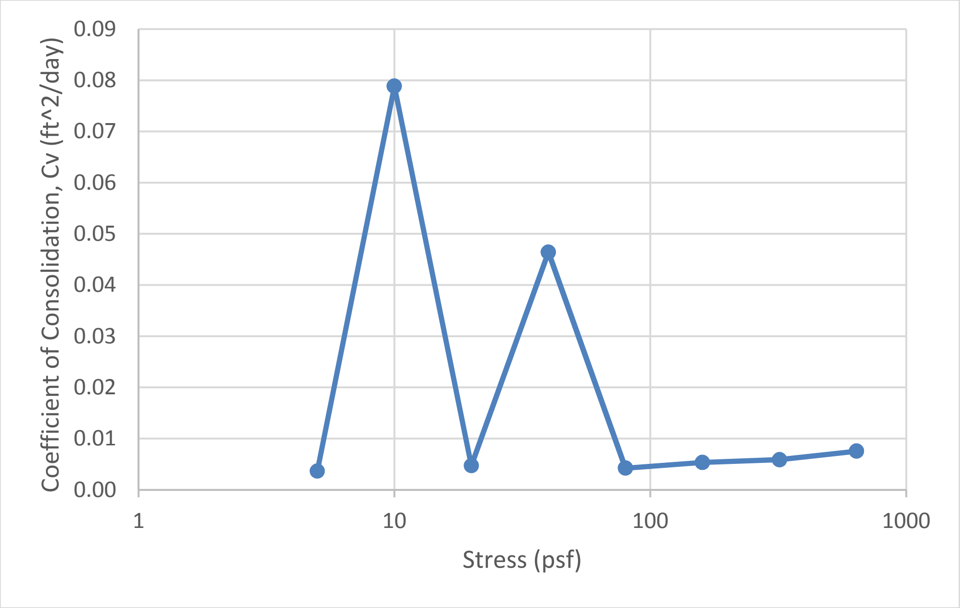

Figure 3c Coefficient of Consolidation vs. Stress Plot for Composite Sample #1

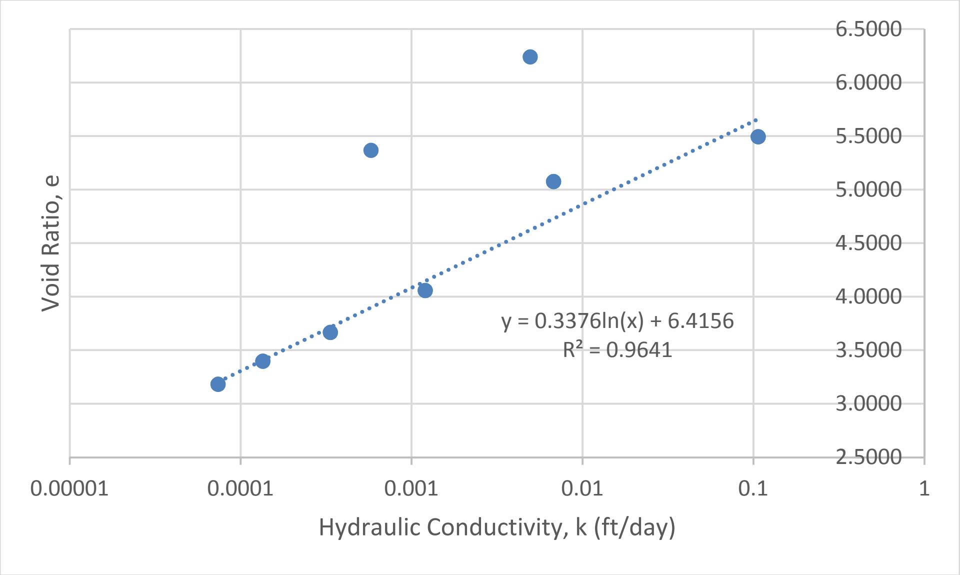

Figure 3d. Hydraulic Conductivity vs. Void Ratio Plot for Composite Sample #1

Note in Figure 3d that the best-fit trend line does not consider two of the points in the test. These points were ignored because they deviate significantly from what appears to be a strongly correlated general trend between void ratio and hydraulic conductivity.

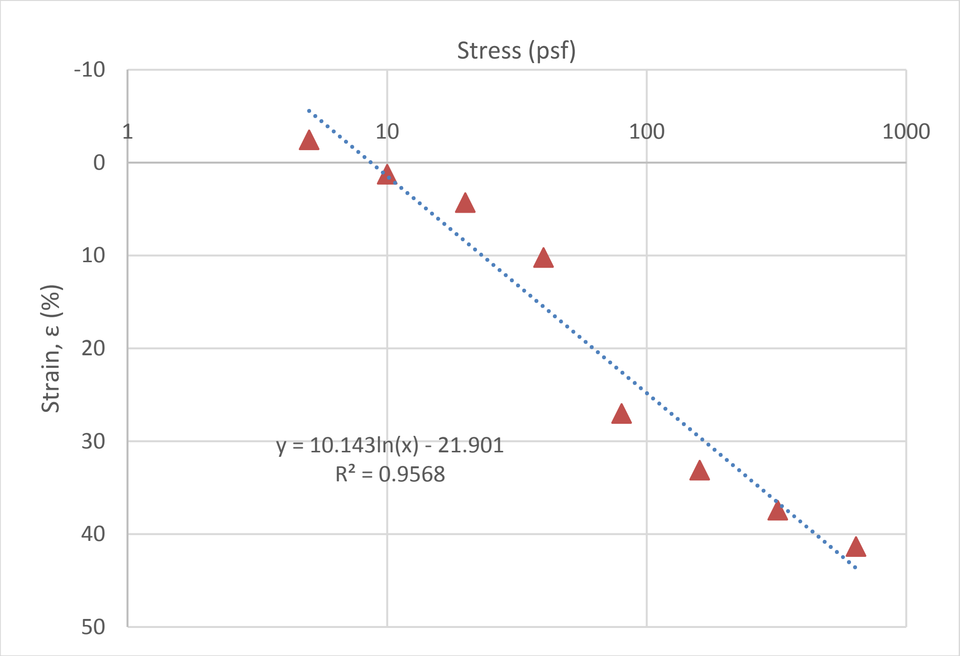

Figure 4a Axial Strain vs. Stress Plot for Composite Sample #2

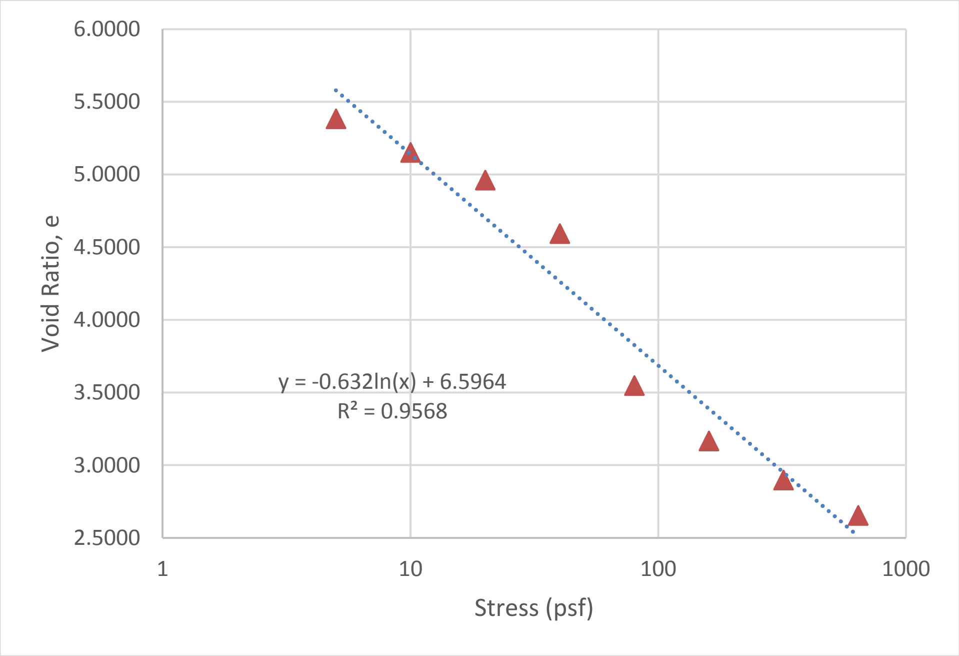

Figure 4b Void Ratio vs. Stress Plot for Composite Sample #2

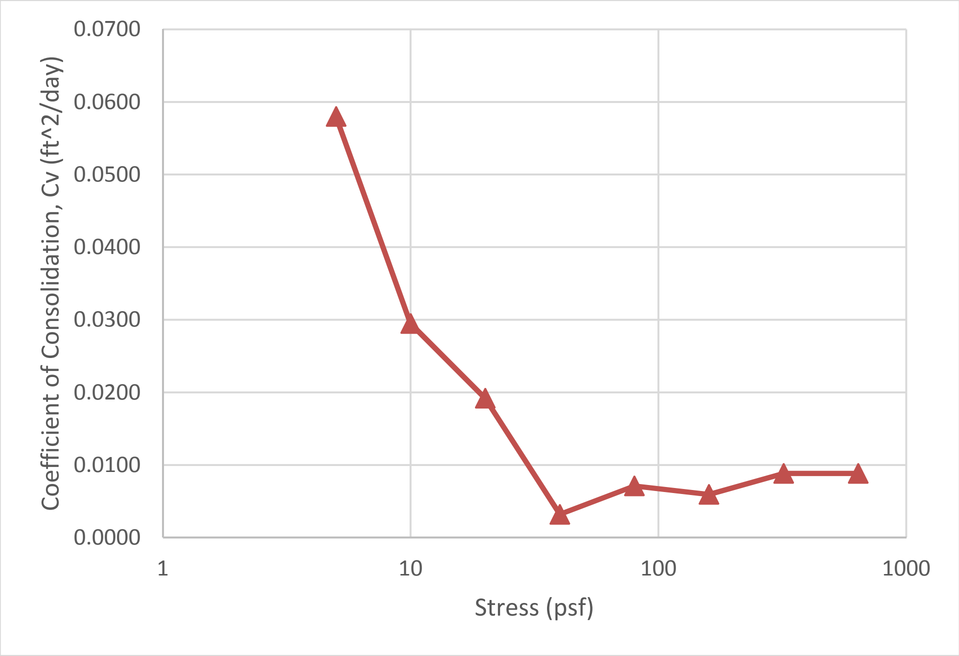

Figure 4c Coefficient of Consolidation vs. Stress Plot for Composite Sample #2

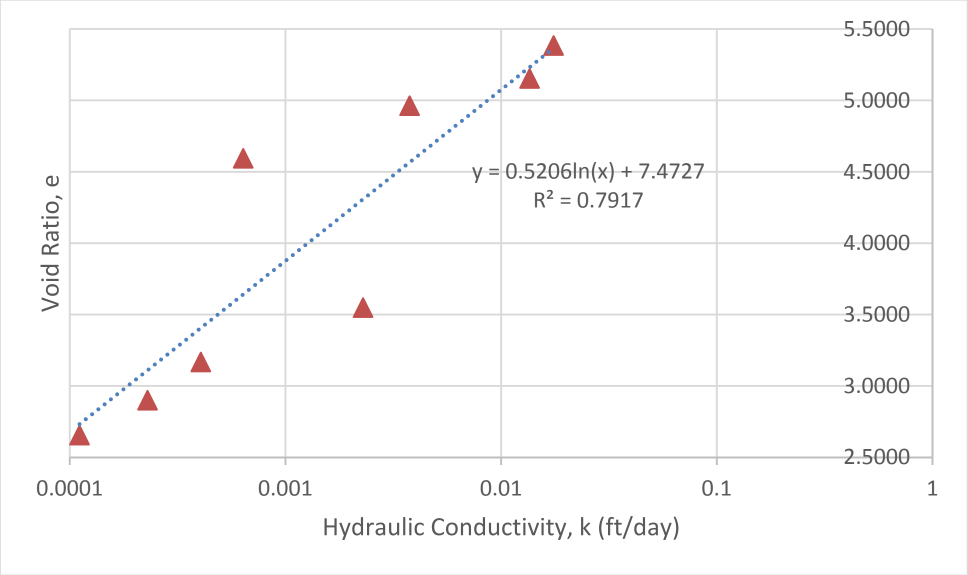

Figure 4d. Hydraulic Conductivity vs. Void Ratio Plot for Composite Sample #2

Figure 4d has a couple points that deviate from the general best-fit trend; however, the two points frame the trend line and appear to have little impact on the trend, other than to weaken the correlation somewhat. The remaining figures are for samples representing the full depth of the borrow area borings.

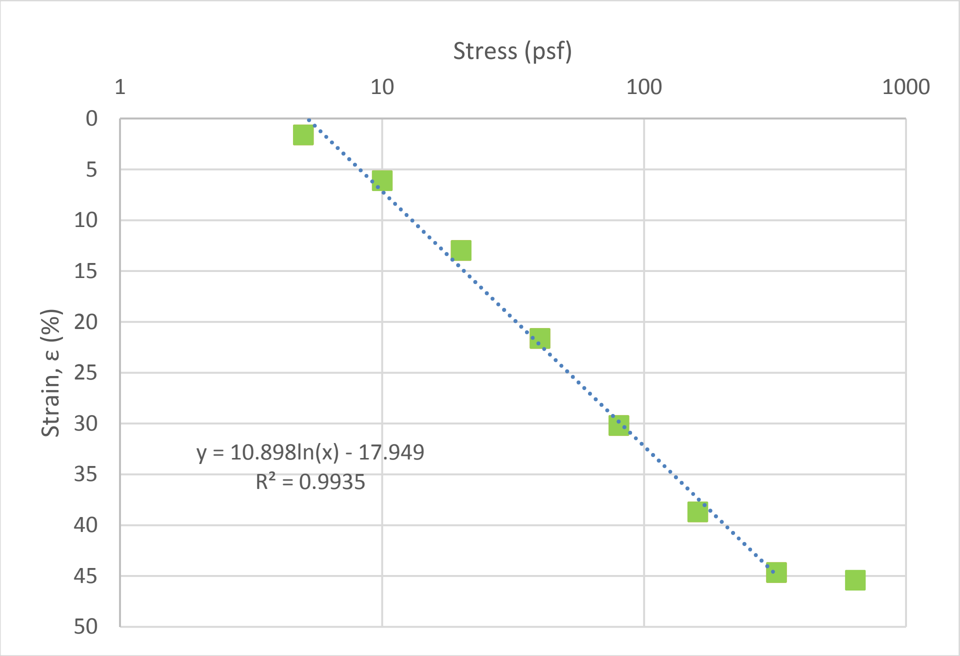

Figure 5a Axial Strain vs. Stress Plot for Composite Sample #3

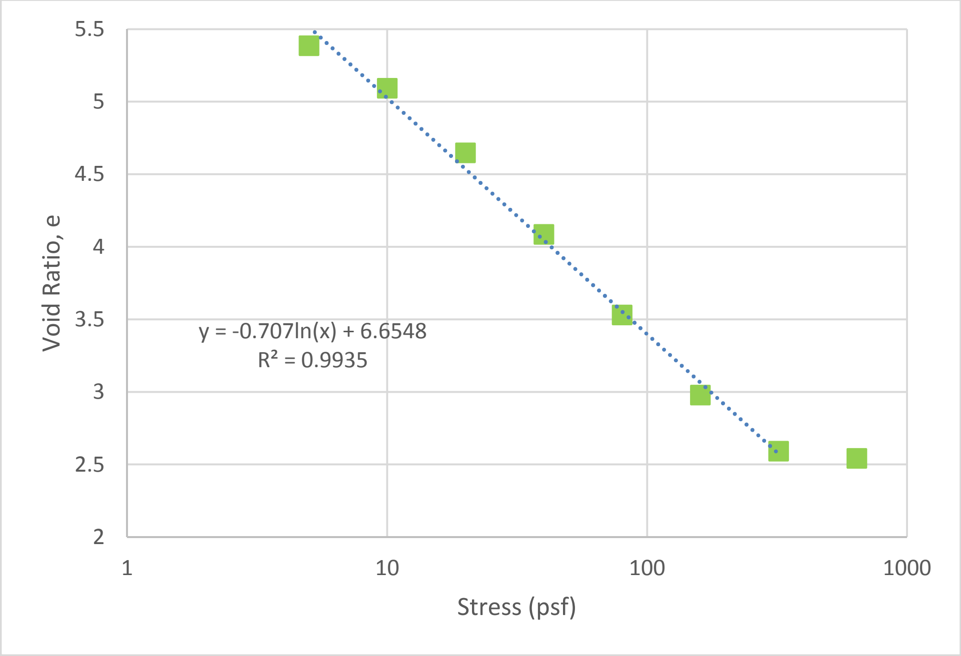

Figure 5b Void Ratio vs. Stress Plot for Composite Sample #3

Note that for the displacement plots, the best-fit trend line omits the final stress point. The test data for this point appeared to be erroneous and was difficult to reduce. As a result, it has been ignored for self-weight consolidation calculation purposes.

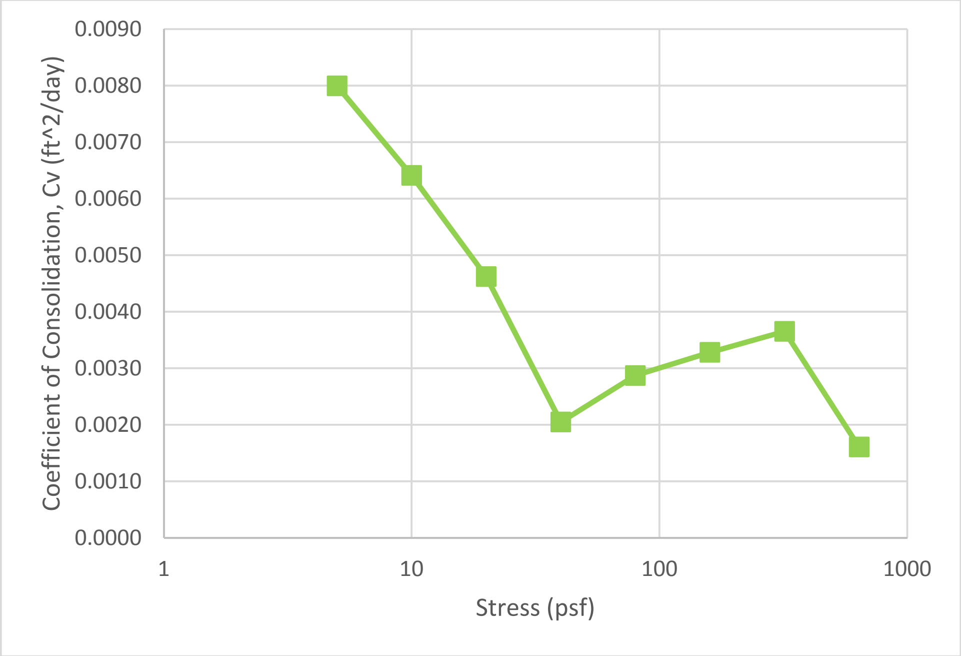

Figure 5c Coefficient of Consolidation vs. Stress Plot for Composite Sample #3

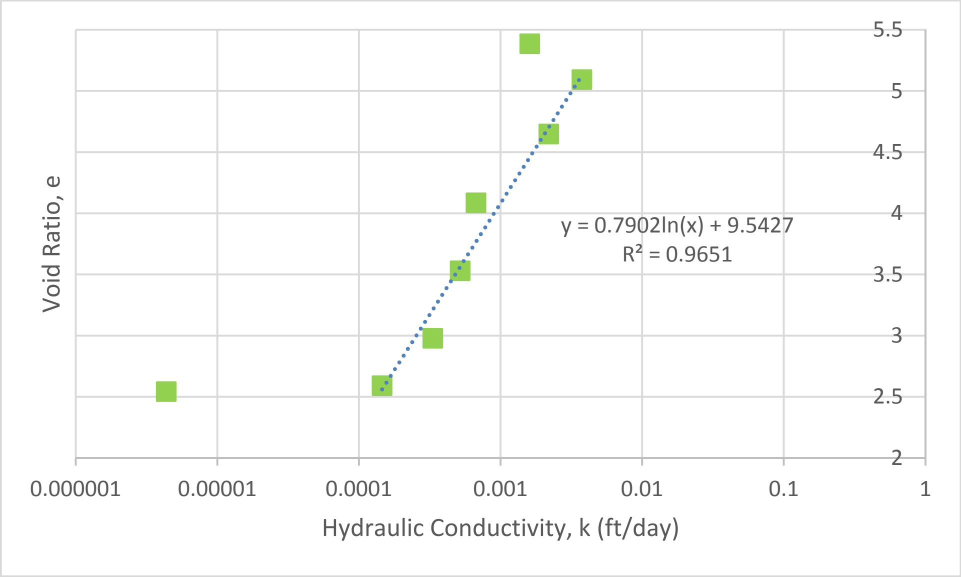

Figure 5d. Hydraulic Conductivity vs. Void Ratio Plot for Composite Sample #3

Note in Figure 5d that the best-fit trend line does not consider two of the points in the test. These points were ignored because they deviate significantly from what appears to be a strongly correlated general trend between void ratio and hydraulic conductivity. The outlier points left out of the trend include the point left out of the displacement plot trend lines, as discussed on the previous page.

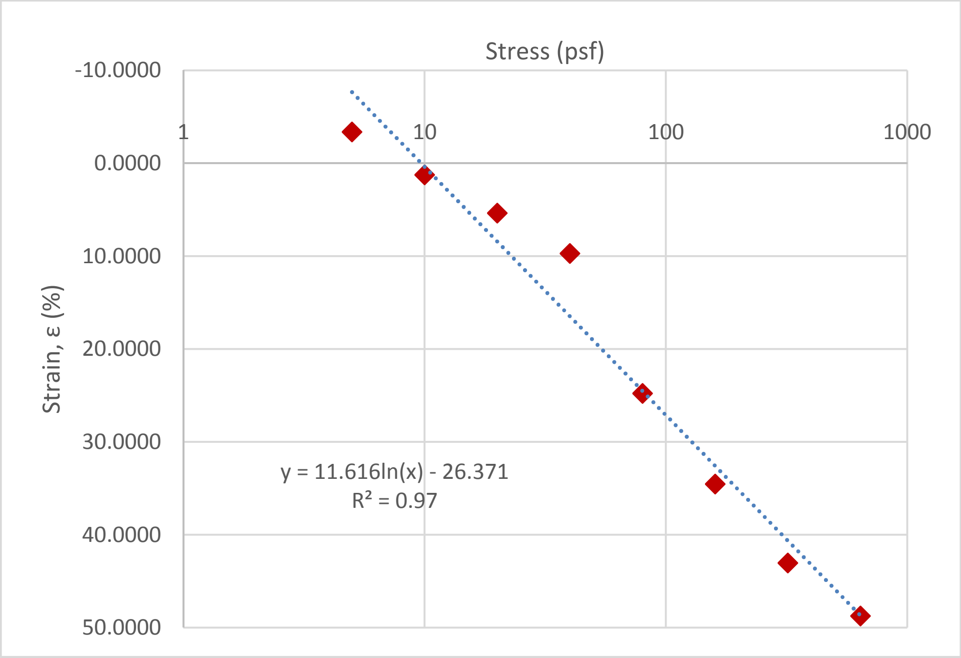

Figure 6a Axial Strain vs. Stress Plot for Composite Sample #4

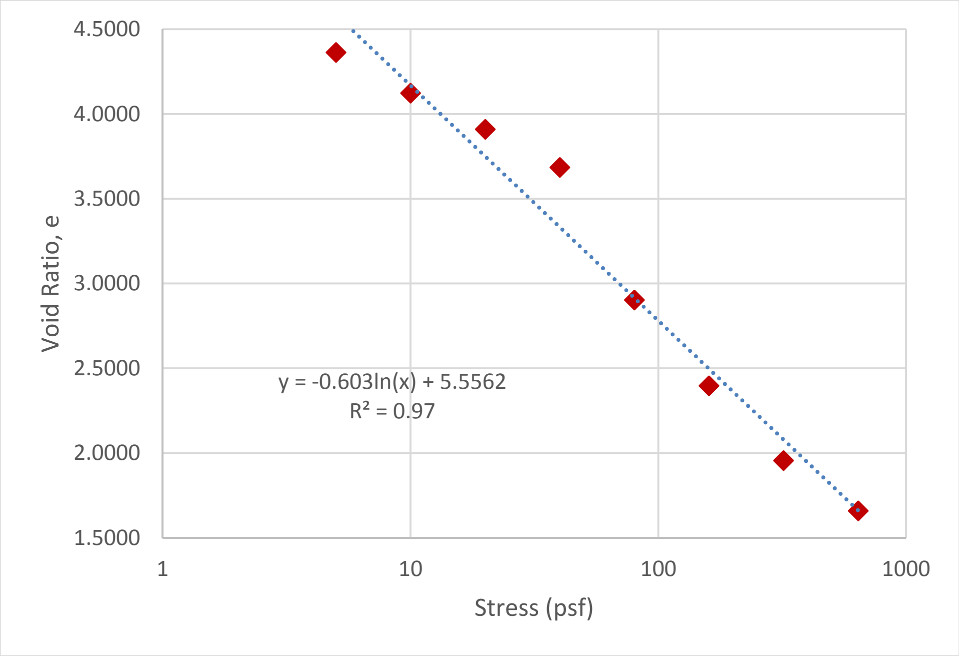

Figure 6b Void Ratio vs. Stress Plot for Composite Sample #4

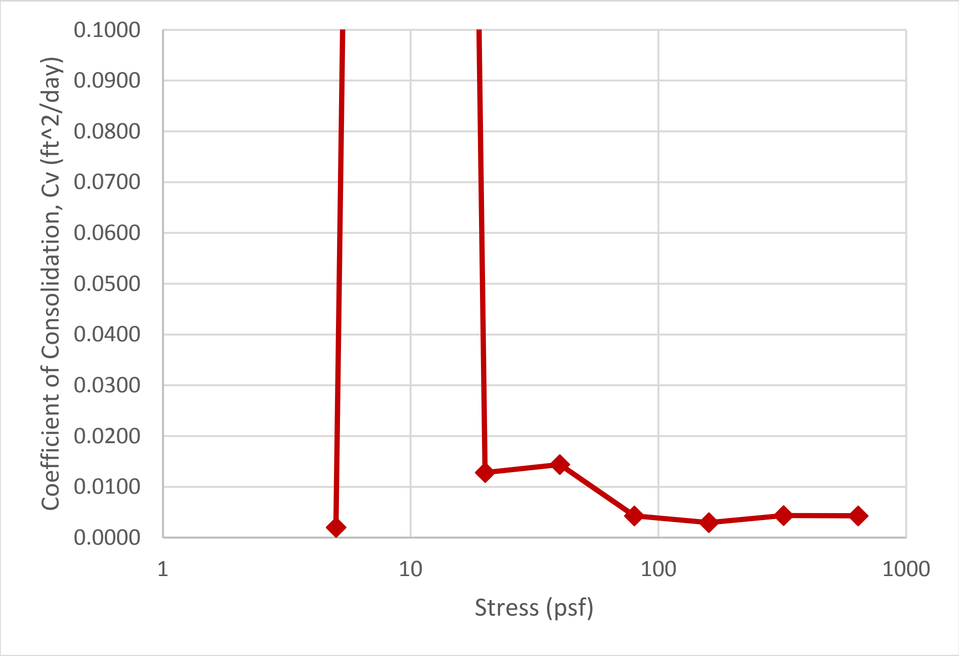

Figure 6c Coefficient of Consolidation vs. Stress Plot for Composite Sample #4

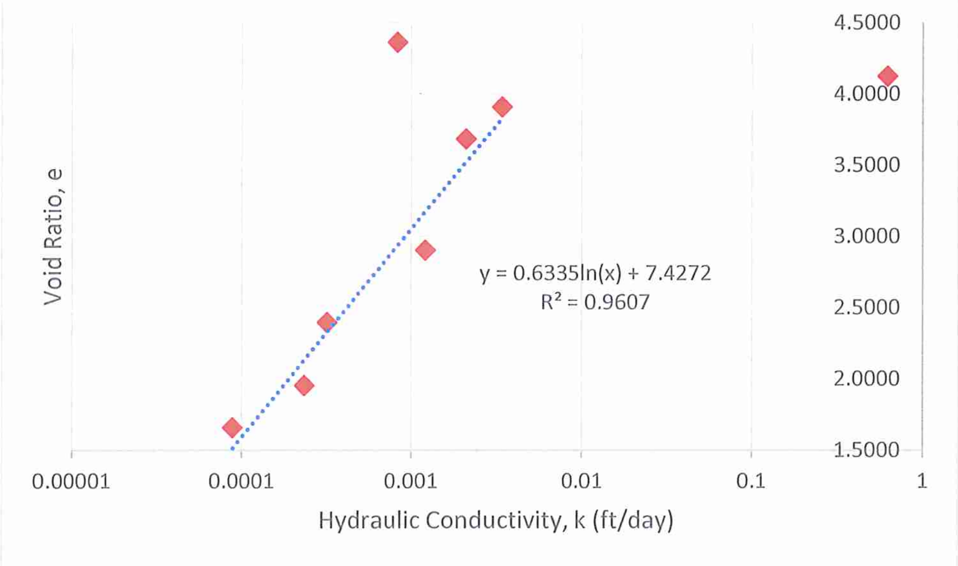

Figure 6d. Hydraulic Conductivity vs. Void Ratio Plot for Composite Sample #4

Note in Figure 6d that the best-fit trend line does not consider two of the points in the test. One of these points is reflected in Figure 6c as having a c_v value several orders of magnitude higher than the other points. The data from this test point resulted in a fairly typical displacement, but the time component did not make sense. These points were ignored because they deviate significantly from what appears to be a strongly correlated general trend between void ratio and hydraulic conductivity.

CONCLUSION

Self-weight consolidation testing was conducted on 4 composite samples from the expanded borrow area in Lake Pontchartrain for the PO-104 Bayou Bonfouca Marsh Creation Project. Test results and commentary on the tests have been provided in this document. The data generally appear fit for use in marsh creation hydraulic fill computations.

CLOSING

GeoEngineers appreciates the opportunity to work with the State of Louisiana on this project. If there are questions about the contents of this document, please contact us at 225.293.2460.

Sincerely,
GeoEngineers, Inc.

Charles L. Eustis

Joshua M. Pruett, PE
Engineer

Charles L. Eustis, PE
Principal

JMP:CLE:lb

APPENDIX C
Daily Field Reports

GeoEngineers

FIELD REPORT

File Number: 16715-23-03

11955 Lakeland Park Blvd.,
Suite 100
Baton Rouge, LA 70806
(225) 293-2460

Project: PO-104 Bayou Bonfouca Marsh Creation Expanded Borrow Area Investigation

Date: June 26, 2014

Location: St. Tammany Parish, LA

Client: Coastal Protection and Restoration Authority

Day: Thursday

Report Number: 1

Prepared by: Josh Pruett

Contractor: Specialized Environmental Resources, LLC

Weather: Mix of clear and clouds, thunderstorms

Page: Page 1 of 3

EXPLORATORY BORINGS	DEPTH (Feet Below Mud Line)	TODAY (Feet)	TO DATE (Feet)	COMPLETION PERCENTAGE
14-1	20	12	12	60
14-2	20			
14-3	20			
14-4	20			
14-5	20			
14-6	20			

Summary of Daily Activities:

We traveled to the launch and mobilized “SER PT #1”, the pontoon drill rig, and “Mr. Kody”, the support boat to soil boring 14-1. We commence sampling at 14-1, but encounter difficulty proceeding due to lost recovery in sand and shell, then borehole collapse as we transitioned to Pleistocene clay. Rain moves in, then thunder and lightning. We return to the landing for shelter. The SER crew goes to pick up supplies to prepare for sampling tomorrow. I search for a hotel room.

Crew Members/Rig Type:

Joshua Pruett: Engineer (GeoEngineers)
Kody Winch: Drill Operator (Specialized Environmental Resources)
Al Fournier: Roughneck (Specialized Environmental Resources)
Trent Gremillion: Roughneck/Ski Barge operator (Specialized Environmental Resources)

Pontoon barge-mounted drill rig (SER PT#1) with cathead operated 140-lb hammer (30-inch drop) with ski barge support boat (the “Mr. Kody”). Osterberg piston sampler for collecting soft soils.

One Call Numbers:

140265073

Observations:

0815 – 0948: I, Josh Pruett of GeoEngineers, depart the GeoEngineers office in Baton Rouge, Louisiana and travel to Bayou Liberty Marina in Slidell, Louisiana. On the way, I speak with Steven Lacoste of Exxon Pipeline. He will meet us in the Lake to discuss our position relative to the pipeline.

0948 – 1020: I meet with Kody Winch (Driller), Al Fournier, and Trent Gremillion (helpers and boat operators) of Specialized Environmental Resources. The pontoon drill rig (SER PT#1) and support boat (the “Mr. Kody”) are already in the water and tied together ready to go. We transfer sampling tubes and logging supplies to the boat and hold a tailgate safety meeting.

1020 – 1135: We travel to soil boring location 14-1. There is no stake at the geodetic coordinates. The crew spuds down the pontoon barge in preparation for drilling activities.

1135 – 1155: Kody and I head to other soil boring locations to see if any have been marked. I phone Brandon Herpin of CEC to confirm the soil boring locations were marked when they came out last week. There is a labeled cane pole marking soil boring 14-1, but we did not see other poles. We return to the drill rig. I phone Steven Lacoste to arrange a meeting and confirm that we can start our field activities. He is on the lake checking the pipeline and will meet us when he is done.

1155 – 1215: The crew sets up the mast and prepares for drilling activities. The geodetic coordinates above the moonpool are:

N 30° 13’ 22.4”
W 89° 52’ 22.7”

Depth from barge deck to water is about a foot and water depth is about 10.5 feet. Site pictures are below.

From Left to Right: (top) L – Facing west towards soil boring 14-1, R – Facing north towards soil boring 14-1; (bottom) L – Facing east at soil boring 14-1, R – Facing south at soil boring 14-1.

1215 – 1245: Steven Lacoste and Jesse B. of Exxon pipeline stop by and discuss our location to the pipeline. Our closest location (boring 14-1) is 2,200 feet from the line. We should be ok. Steven and Jesse depart and we commence drilling activities at soil boring 14-1. The piston sampler has difficulty keeping sample in the tube. The crew dismantles the sampler to diagnose the problem.

1245 – 1300: We try to diagnose the problem with the piston sampler. Nothing appears to be out of place or missing. I decide we will proceed for the time being by pushing a split spoon in order to capture sample from about 3 feet below mudline to about 4 feet below mudline.

1300 – 1350: The split spoon comes up with very loose consistency sand and shell at the top and stiff to very stiff clay for the bottom seven inches. We transition to Shelby tube sampling. A near surface layer of shell appears to collapse into the hole between each sample, making sample recovery difficult. We successfully sample at two-foot intervals to about 12 feet below the mudline after several attempts. It starts to rain. We cease activities to discuss how to achieve better, more consistent recovery and we hear thunder.

1350 – 1435: The crew pulls the spuds and puts the mast down and we travel with the pontoon drill to the mouth of Bayou Bonfouca. We leave the pontoon barge at the bank of the bayou near the confluence of Bayous Liberty and Bonfouca and continue Bayou Liberty Marina in the ski barge.

1435 – 1450: We arrive at Bayou Liberty Marina and load the ski barge onto the trailer. We discuss meeting times and preparations for tomorrow. We plan to meet at the marina at 7 am.

1450 – 1550: The SER crew departs for supplies to make tomorrow's drilling activities more productive. I have not made reservations at a local hotel, so I head into town to find a room.

1550 I check into the La Quinta in Slidell, Louisiana.

Tomorrow's objective is to complete the soil borings in the borrow area. Weather may be an issue tomorrow, so we are hoping today's preparations expedite the work tomorrow. We will meet at the marina at 7 tomorrow morning and proceed from there.

THIS FIELD REPORT IS PRELIMINARY A preliminary report is provided solely as evidence that field observation was performed. Observations and/or conclusions and/or recommendations conveyed in the final report may vary from and shall take precedence over those indicated in a preliminary report.	**FIELD REPRESENTATIVE** **DATE** Josh Pruett June 26, 2014
[✓ **THIS FIELD REPORT IS FINAL**] A final report is an instrument of professional service. Any conclusions drawn from this report should be discussed with and evaluated by the professional involved.	**REVIEWED BY** **DATE** Charles L. Curtis 7/3/14

GEOENGINEERS	**FIELD REPORT**		File Number: 16715-23-03
11955 LAKELAND PARK BLVD., SUITE 100 BATON ROUGE, LA 70806 (225) 293-2460	Project: PO-104 Bayou Bonfouca Marsh Creation Expanded Borrow Area Investigation		Date June 27, 2014
	Location: St. Tammany Parish, LA	Client: Coastal Protection and Restoration Authority	Day: Friday Report Number: 2
Prepared by: Josh Pruett	Contractor: Specialized Environmental Resources, LLC	Weather: Mix of clear and clouds, windy	Page: Page 1 of 3

EXPLORATORY BORINGS	DEPTH (Feet Below Mud Line)	TODAY (Feet)	TO DATE (Feet)	COMPLETION PERCENTAGE
14-1	20	8	20	100
14-2	20	8	8	40
14-3	20			
14-4	20			
14-5	20			
14-6	20			

Summary of Daily Activities:

We traveled to the launch and traveled to the location of "SER PT #1", the pontoon drill rig, where we tied the rig to the support boat, "Mr. Kody", and remobilized to soil boring 14-1. We completed sampling at 14-1 and moved to boring 14-3. We terminated our efforts at 14-3 prematurely because of deep water and rough lake conditions. We returned to the shore, leaving the pontoon rig at the junction of Bayou Liberty and Bayou Bonfouca. We returned to the marina for shelter and we decided that, due to the deep water and expected lake conditions over the next few days, we will shut down for the weekend and come back Monday. The SER crew left to bring the pontoon rig to shelter and I traveled to Baton Rouge.

Crew Members/Rig Type:

Joshua Pruett: Engineer (GeoEngineers)
Kody Winch: Drill Operator (Specialized Environmental Resources)
Al Fournier: Roughneck (Specialized Environmental Resources)
Trent Gremillion: Roughneck/Ski Barge operator (Specialized Environmental Resources)

Pontoon barge-mounted drill rig (SER PT#1) with cathead operated 140-lb hammer (30-inch drop) with ski barge support boat (the "Mr. Kody"). Osterberg piston sampler for collecting soft soils.

One Call Numbers:

140265073

Observations:

0636 – 0725: I, Josh Pruett of GeoEngineers, start to leave the hotel to travel, but stop to talk to Kody Winch of SER about the plan for the day. I travel to the launch. SER arrives about 5 minutes after me and proceeds to launch the support boat, the ski barge "Mr. Kody".

0725 – 0748: We hold a safety meeting and board the support boat.

0748 – 0827: We travel to the pontoon rig, “SER PT#1”, and tie the rig to the boat. We tow the rig to the location of soil boring 14-1 and prepare to complete sampling by washing down to 12 feet in preparation to collect the 12 to 14 foot below mudline sample. The location of the final portion of 14-1 is:

N 30° 13’ 22.3”
W 89° 52’ 22.6”

0827 – 0905: We complete sampling at soil boring 14-1 and prepare to mobilize the rig southward to soil boring 14-3.

0905 – 0911: We travel to 14-3 and prepare for drilling operations. The location of 14-3 is:

N 30° 13’ 01.7”
W 89° 52’ 25.7”

Pictures of 14-3 and its surroundings are included below:

From Left to Right: (top) L – Facing south at soil boring 14-3, R – Facing west towards soil boring 14-3; (bottom) L – Facing north at soil boring 14-3, R – Facing east at soil boring 14-3.

0911 – 1000: We sample from soil boring 14-3. We encounter difficulty recovering the 4 to 6 feet below mudline sample, so I have the crew rotate the boat and wash to 4 feet. After we collect the sample from 6 to 8 feet below mudline, conditions are too rough to continue. There is 2 foot or higher chop that has been lifting the pontoon rig off the hole and the wind only appears to be increasing. We pull off the hole to travel to shelter. The bow side spud is bent from the wave action.

1000 – 1055: We travel to the marina, leaving the pontoon rig at the confluence of bayous Liberty and Bonfouca.

1055 – 1245: The SER crew tries to straighten the bent spud, then departs to return the excess casing they purchased in preparation for today's activities. It does not appear that we will need it to finish collecting samples, but we have kept 40 feet just in case we need it. I phone several individuals at the GeoEngineers office to get a better understanding of the expected conditions through the weekend and discuss options for how to proceed. It does not appear that lake conditions will improve enough to continue our work until Monday, June 30. I decide that it would be better to return on Monday. When the SER crew returns, I discuss this option with Kody and he clears it with his superiors.

1245 – 1300: Kody obtains permission to keep the pontoon rig in the side canal at the marina over the weekend and to store the support boat in the marina yard. We will shut down operations for the weekend and return to pick up where we left off on Monday.

1300 – 1510: The crew prepares to retrieve the pontoon rig and I depart. I travel to Baton Rouge, stopping at home to clean up and change clothes. When I arrive at the GeoEngineers office, I unload the samples we have collected so far and secure the supplies in the truck.

Sampling efforts will continue Monday, June 30. Monday's objective is to complete collecting samples for the remaining soil borings.

THIS FIELD REPORT IS PRELIMINARY A preliminary report is provided solely as evidence that field observation was performed. Observations and/or conclusions and/or recommendations conveyed in the final report may vary from and shall take precedence over those indicated in a preliminary report.	**FIELD REPRESENTATIVE** Josh Pruett	**DATE** July 1, 2014
[✓ **THIS FIELD REPORT IS FINAL**] A final report is an instrument of professional service. Any conclusions drawn from this report should be discussed with and evaluated by the professional involved.	**REVIEWED BY** Charles L. Eustis	**DATE** 7/3/14

GEOENGINEERS

FIELD REPORT

File Number: 16715-23-03

11955 LAKELAND PARK BLVD.,
SUITE 100
BATON ROUGE, LA 70806
(225) 293-2460

Project: PO-104 Bayou Bonfouca Marsh Creation Expanded Borrow Area Investigation

Date: June 30, 2014

Location: St. Tammany Parish, LA

Client: Coastal Protection and Restoration Authority

Day: Monday

Report Number: 3

Prepared by: Josh Pruett

Contractor: Specialized Environmental Resources, LLC

Weather: Clear, mostly calm, hot

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EXPLORATORY BORINGS	DEPTH (Feet Below Mud Line)	TODAY (Feet)	TO DATE (Feet)	COMPLETION PERCENTAGE
14-1	20		20	100
14-2	20	12	20	100
14-3	20	20	20	100
14-4	20	20	20	100
14-5	20	20	20	100
14-6	20	20	20	100

Summary of Daily Activities:

I traveled to Bayou Liberty Marina and met the SER crew. We mobilized to 14-3 and completed sampling from 8 feet to 20 feet below mudline. We moved the rig to 14-5 and completed sampling from the mudline to 20 feet below mudline. We moved to 14-6 and completed sampling from the mudline to 20 feet below mudline. We moved to 14-4 and completed sampling from the mudline to 20 feet below mudline. We moved to 14-2 and completed sampling from the mudline to 20 feet below mudline and collected water samples. We then demobilized the rig to the marina, unloaded samples and supplies, and I traveled to my house in Baton Rouge. On Tuesday, July 1, I traveled with the samples to the Baton Rouge office.

Crew Members/Rig Type:

Joshua Pruett: Engineer (GeoEngineers)
Kody Winch: Drill Operator (Specialized Environmental Resources)
Al Fournier: Roughneck (Specialized Environmental Resources)
Trent Gremillion: Roughneck/Ski Barge operator (Specialized Environmental Resources)

Pontoon barge-mounted drill rig (SER PT#1) with cathead operated 140-lb hammer (30-inch drop) with ski barge support boat (the “Mr. Kody”). Osterberg piston sampler for collecting soft soils.

Soil borings were located using Garmin 76CX handheld GPS receiver.

One Call Numbers:

140265073

Observations:

0600 – 0725: I, Josh Pruett of GeoEngineers, travel from the GeoEngineers office in Baton Rouge, Louisiana to Bayou Liberty Marina in Slidell, Louisiana.

0725 – 0815: The Specialized Environmental Resources (SER) crew arrives. The yard where the support boat is stored is locked and doesn’t open until 0800. The crew hooks the truck to the boat trailer and launches into the bayou.

0815 – 1010: We hold a safety meeting, tie onto the pontoon rig and mobilize to the location of 14-3. Water is about 13.5 feet deep, which only leaves the spuds about 3 or so feet into the mudline. Due to the possibility of movement during sampling, we explore various options for sampling, including using the wash barrel to collect and extrude samples. I speak with Dave Eley and Greg Adams at the GeoEngineers office to explore those options. The crew fills the pontoons on the rig to stabilize the rig and lower the deck a little and we start sampling by washing to 8 feet below the mudline and taking a sample from 8 to 10 feet below mudline. The location of 14-3 is below:

N 30° 13' 01.9"
W 89° 52' 25.6"

1010 – 1050: We complete sampling at soil boring 14-3 and start moving the rig to soil boring 14-5.

1050 – 1115: We travel to 14-5 and prepare for drilling operations. The location of 14-5 is:

N 30° 12' 41.5"
W 89° 52' 28.5"

Water depth at 14-5 is about 13.5 feet. Pictures of 14-5 and its surroundings are included on the following page:

1115 – 1210: We complete sampling from the mudline to 20 feet below the mudline and prepare to mobilize the rig to soil boring 14-6.

1210 – 1220: We mobilize the rig to soil boring 14-6 and prepare to commence drilling and sampling activities. The location of 14-6 is:

N 30° 12' 40.0"
W 89° 52' 10.6"

Water depth at 14-6 is about 13.5 feet. No pictures were taken at the location of soil boring 14-6.

1220 – 1305: We complete drilling and sampling at 14-6 and prepare to move to soil boring 14-4.

1305 – 1325: We travel to the location of soil borings 14-4 and prepare to start drilling and sampling activities. The location of 14-4 is:

N 30° 13' 00.1"
W 89° 52' 07.6"

Water depth at 14-4 is about 13.5 feet. No pictures were taken at the location of soil boring 14-4.

1325 – 1400: We complete drilling and sampling at 14-4 and prepare to move to soil boring 14-2.

1400 – 1412: We travel to soil boring 14-2 and prepare to start drilling and sampling activities. The location of 14-2 is:

N 30° 13' 01.7"
W 89° 52' 25.7"

Water depth at 14-2 is about 10.5 feet. Pictures at 14-2 are included on page 4 of this document.

1412 – 1520: We complete drilling and sampling at soil boring 14-2. The crew completes housekeeping and preparations to demobilize the rig. I collect samples of water from the lake for use in settling column and self-weight consolidation testing.

1520 – 1601: We tow the rig from 14-2 to Bayou Liberty Marina. The crew starts pumping the water from the pontoons and has to use one of the buckets of sample water to reprime the pump. They refill the buck with water from the lake near the mouth of Bayou Bonfouca. I expect that this water will be a little fresher than the water from the soil boring location.

1601 – 1623: We transfer samples and supplies from the support boat to my truck.

1623 – 1756: I travel from the marina to my house in Baton Rouge.

July 1, 2014
0813 – 0823: I travel from my house to the GeoEngineers office.

From Left to Right: (top) L – Facing north at soil boring 14-5, R – Facing west towards soil boring 14-5; (bottom) L – Facing south at soil boring 14-5, R – Facing east at soil boring 14-5.

From Left to Right: (top) L – Facing west at soil boring 14-2, R – Facing north towards soil boring 14-2; (bottom) L – Facing east at soil boring 14-2, R – Facing south at soil boring 14-2.

THIS FIELD REPORT IS PRELIMINARY
A preliminary report is provided solely as evidence that field observation was performed. Observations and/or conclusions and/or recommendations conveyed in the final report may vary from and shall take precedence over those indicated in a preliminary report.

FIELD REPRESENTATIVE **DATE**
Josh Pruett July 1, 2014

X THIS FIELD REPORT IS FINAL
A final report is an instrument of professional service. Any conclusions drawn from this report should be discussed with and evaluated by the professional involved.

REVIEWED BY **DATE**
Charles L. Euster 7/3/14

APPENDIX D
Report Limitations and Guidelines for Use

APPENDIX D
REPORT LIMITATIONS AND GUIDELINES FOR USE

This appendix provides information to help you manage your risks with respect to the use of this report.

Geotechnical Services Are Performed for Specific Purposes, Persons and Projects

This report has been prepared for the State of Louisiana Coastal Protection and Restoration Authority and its authorized agents and regulatory agencies. The information contained herein is not applicable to other sites.

GeoEngineers structures our services to meet the specific needs of our clients. No party other than the State of Louisiana Coastal Protection and Restoration Authority may rely on the product of our services unless we agree to such reliance in advance and in writing. This is to provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and generally accepted geotechnical practices in this area at the time this report was prepared. Use of this report is not recommended for any purpose or project except the one originally contemplated.

A Geotechnical Engineering or Geologic Report Is Based on a Unique Set of Project-Specific Factors

This report has been prepared for Expanded Borrow Area Investigation of the Bayou Bonfouca Marsh Creation Project (PO-104), in St. Tammany Parish, Louisiana. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

For example, changes that can affect the applicability of this report include those that affect:

- the function of the proposed structure;
- elevation, configuration, location, orientation or weight of the proposed structure;
- composition of the design team; or
- project ownership.

If important changes are made after the date of this report, we recommend that GeoEngineers be given the opportunity to review our interpretations and recommendations. Based on that review, we can provide written modifications or confirmation, as appropriate.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Most Geotechnical and Geologic Findings Are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies the specific subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied our professional judgment to render an informed opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

Geotechnical Engineering Report Recommendations Are Not Final

The construction recommendations included in this report are preliminary and should not be considered final. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers is unable to assume responsibility for the recommendations in this report without performing construction observation.

We recommend that you allow sufficient monitoring, testing and consultation during construction by GeoEngineers to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions.

A Geotechnical Engineering or Geologic Report Could Be Subject to Misinterpretation

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. The logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Photographic or electronic reproduction is acceptable, but separating logs from the report can create a risk of misinterpretation.

Give Contractors a Complete Report and Guidance

To help prevent costly problems associated with unanticipated subsurface conditions, we recommend giving contractors the complete geotechnical engineering or geologic report, but preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report's accuracy is limited. In addition, encourage them to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer.

Contractors Are Responsible for Site Safety on Their Own Construction Projects

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and adjacent properties.

Read These Provisions Closely

It is important to recognize that the geoscience practices (geotechnical engineering, geology and environmental science) are less exact than other engineering and natural science disciplines. Without this understanding, there may be expectations that could lead to disappointments, claims and disputes. GeoEngineers includes these explanatory "limitations" provisions in our reports to help reduce such risks. Please confer with GeoEngineers if you need to know more how these "Report Limitations and Guidelines for Use" apply to your project or site.

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants, and no conclusions or inferences should be drawn regarding Biological Pollutants as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria and viruses, and/or any of their byproducts.

A Client that desires these specialized services is advised to obtain them from a consultant who offers services in this specialized field.