Geotechnical Investigation Data Report Addendum 1

Island Road Marsh Creation and Nourishment (TE-117) Phase II
Terrebonne Parish, Louisiana

for

Louisiana Coastal Protection and Restoration Authority

April 24, 2018

GeoEngineers
Earth Science + Technology

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Terrebonne Parish, Louisiana

for
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April 24, 2018

GeoEngineers

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Geotechnical Investigation Data Report
Addendum 1

Island Road Marsh Creation and Nourishment (TE-117) Phase II
Terrebonne Parish, Louisiana

File No. 16715-040-03

April 24, 2018

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INTRODUCTION AND PROJECT UNDERSTANDING

GeoEngineers, Inc. (GeoEngineers) is pleased to present this addendum Geotechnical Investigation Data Report to the Louisiana Coastal Protection and Restoration Authority (CPRA) for our study of the proposed borrow area for the Island Road Marsh Creation and Nourishment (TE-117) project. Our original Geotechnical Investigation Data Report was submitted February 1, 2017, for the marsh creation area investigation of the TE-117 project. Our services described herein for the borrow area were performed under our contract between CPRA and GeoEngineers (CPRA Contract No. 4400010334 "Geotechnical Services for CPRA") and were authorized by the Revised Notice to Proceed document dated January 4, 2018, for Task 1, Amendment No. 1.

The project borrow area is located in Lake Tambour which is in southeast Terrebonne Parish approximately 10 miles southeast of Montegut, Louisiana, and about 5 miles south of the Isle de Jean Charles marina on Island Road. A project vicinity map is shown in Figure 1.

Discussions of our geotechnical exploration and laboratory testing for the borrow area samples are included herein. Our engineering recommendations will be presented under separate cover. All elevations described in this report, including figures and appendices, are referenced to the North American Vertical Datum of 1988 (NAVD88), Geoid 12A.

FIELD EXPLORATION

Field exploration for the borrow area of the TE-117 project consisted of eight soil borings drilled to a depth of 20 feet each below the mudline on February 19 and 20, 2018. The exploration locations are shown in Figure 2, and subsurface profiles are provided in Figures 3 and 4. Further details of our field exploration are discussed in Appendix A. The soil boring logs and laboratory testing results are provided in Appendix B and C, respectively.

Prior to our geotechnical field exploration, boring locations were surveyed and staked in the field by Lonnie G. Harper and Associates (LGH). LGH performed a magnetometer survey around each proposed exploration point before placing the location stake. A copy of LGH's survey report is included in Appendix D.

Prior to our field exploration, Matrix New World Engineering (Matrix) prepared and sent notification letters to oyster leaseholders whose oyster leases were within 500 feet of our soil boring locations. During our field exploration, Matrix provided an oyster biologist who rode on the support boat behind the vessel with the drilling equipment to document and record our travel paths as we traveled from the dock to each boring location and then back to the dock. A copy of Matrix's report is included in Appendix E. A DVD is also included that contains video footage of the vessel's travel.

LABORATORY TESTING

Intact soft to medium semi-cohesive and cohesive samples were subjected to laboratory torvane shear testing prior to extrusion. Upon extrusion, each sample was examined to confirm or modify field classifications. The moisture content was measured for each Shelby tube sample. Unconsolidated-undrained triaxial tests, unit weight tests, and grain size distribution tests were performed on select soil samples.

Composite samples were mixed for each soil boring to the approximate depth of dredging based on guidance from CPRA (no deeper than elevation -20 feet) and the surveyed mudline elevations. A suite of tests including: moisture content, Atterberg limits, hydrometer, grain size distribution, organic content, and specific gravity were run on each composite sample. In addition, 4 self-weight (low stress) consolidation tests were performed using samples composited as follows:

- Borings B-2, B-2a, B-3, and B-4, depths 0 to 16 feet;
- Borings B-1, B-5, B-6, and B-7, depths 0 to 16 feet;
- All borings, depths 0 to 16 feet; and,
- All borings, depths 0 to 4 feet.

Two settling column tests were also performed by SCTCS Group, LLC (SCTCS). Details of the samples and settling column test results are presented in the SCTCS report in Appendix C. Composite sample test results are presented in tabular format in Appendix C.

VARIATIONS

Interpretations of soil conditions, as described in the soil boring logs and summary tables, are based on field and laboratory data described in this report. Variations in soil conditions are likely to exist between the exploration locations and seasonal variation in surface water conditions will occur. Tidal influence should be expected in the project area and must be considered in the project design and construction.

LIMITATIONS

The information presented in this report is based on field explorations completed for this study and judgements made by GeoEngineers. This report is specific to this site and should not be used other than for the design of the Island Road Marsh Creation and Nourishment (TE-117) project located in Terrebonne Parish, Louisiana. We have provided the requested information for the addendum geotechnical data report in this document.

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.

Please refer to Appendix F titled “Report Limitations and Guidelines for Use” for additional information pertaining to use of this report.

FIGURES

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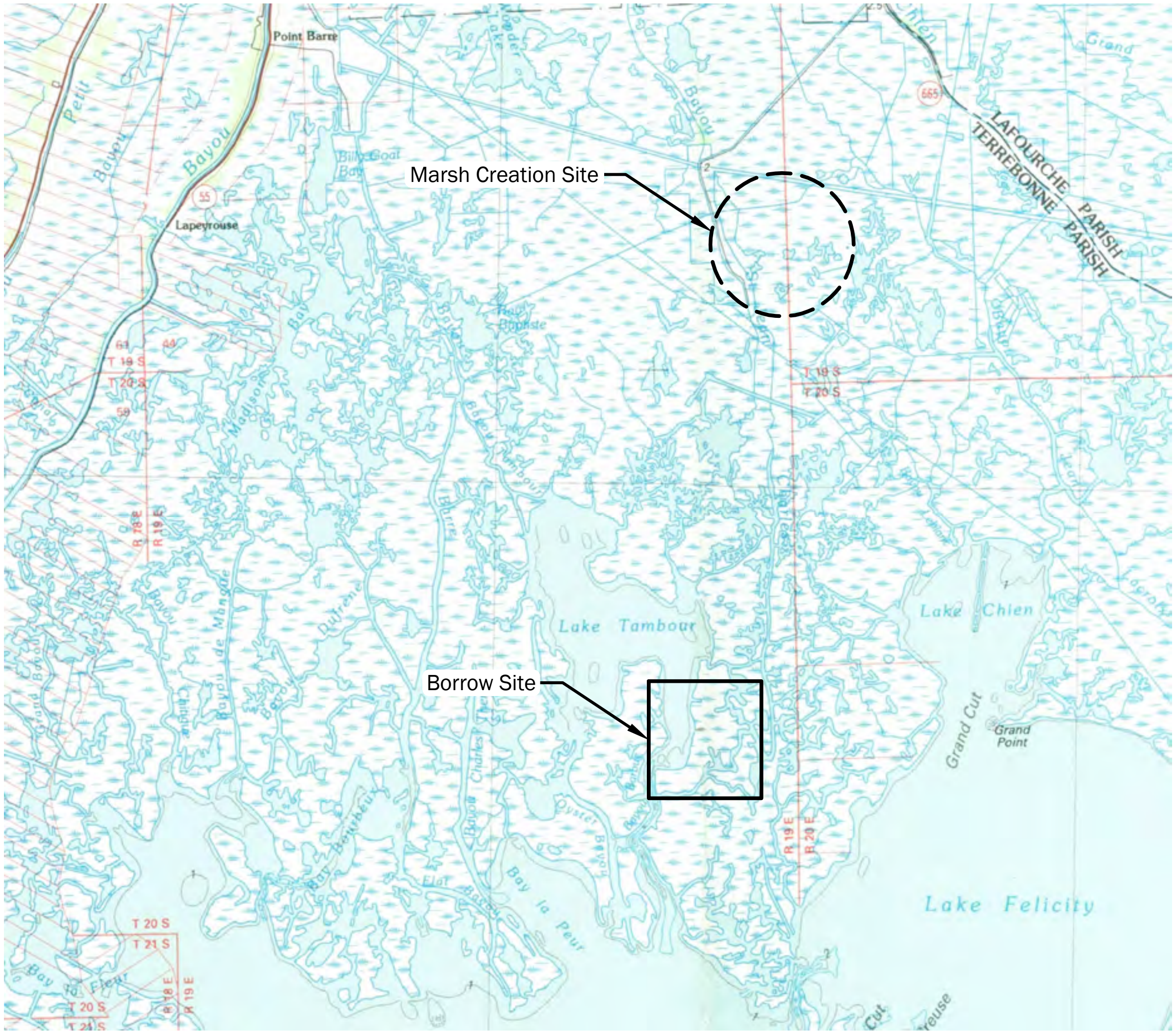
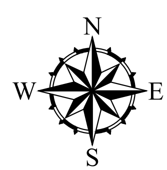


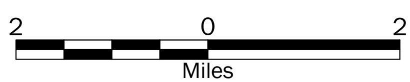
Notes:

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. cannot 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.
3. Details of field exploration and lab testing for the marsh creation site were included in GeoEngineers File No. 16715-040-01, dated February 1, 2017

Data Source: Topograghic image was taken from USGS, Terrebonne Bay, Dated: 1983

Projection: LA State Plane, South Zone, NAD83, US Foot





Vicinity Map

Island Road Marsh Creation & Nourishment (TE-117)
Terrebonne Parish, Louisiana

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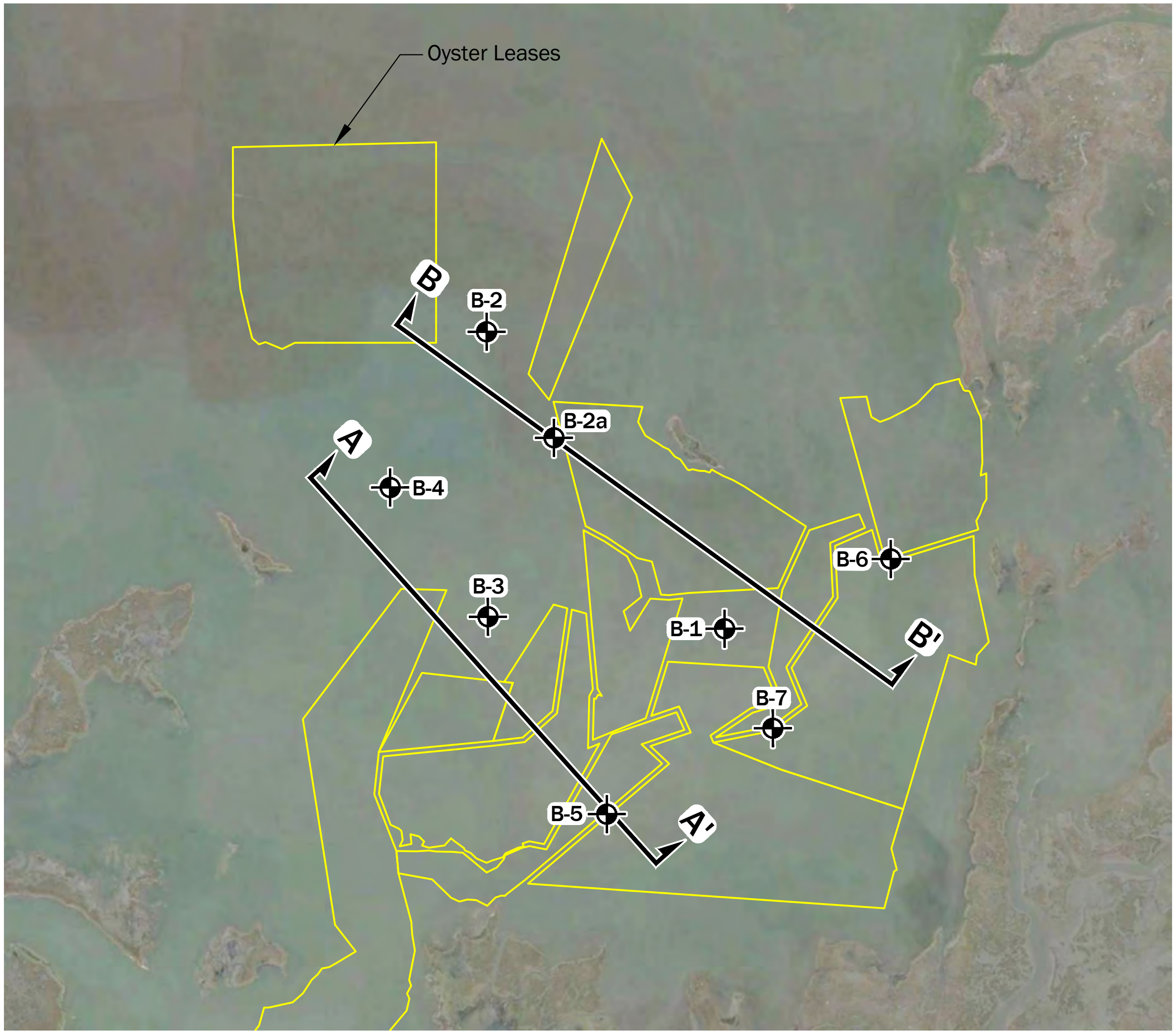
Figure 1



Legend

- B-1 Boring by GeoEngineers, 2018
- Oyster Leases
- A A' Cross Section 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. cannot 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.

Data Source:

1. Aerial was taken from Google Earth Pro, Imagery Dated: 1/25/2015
2. Oyster leases were taken from SONRIS, Date Downloaded: 5/18/2017

Projection: NAD83 Louisiana State Planes, Southern Zone, US Foot

N
W E
S

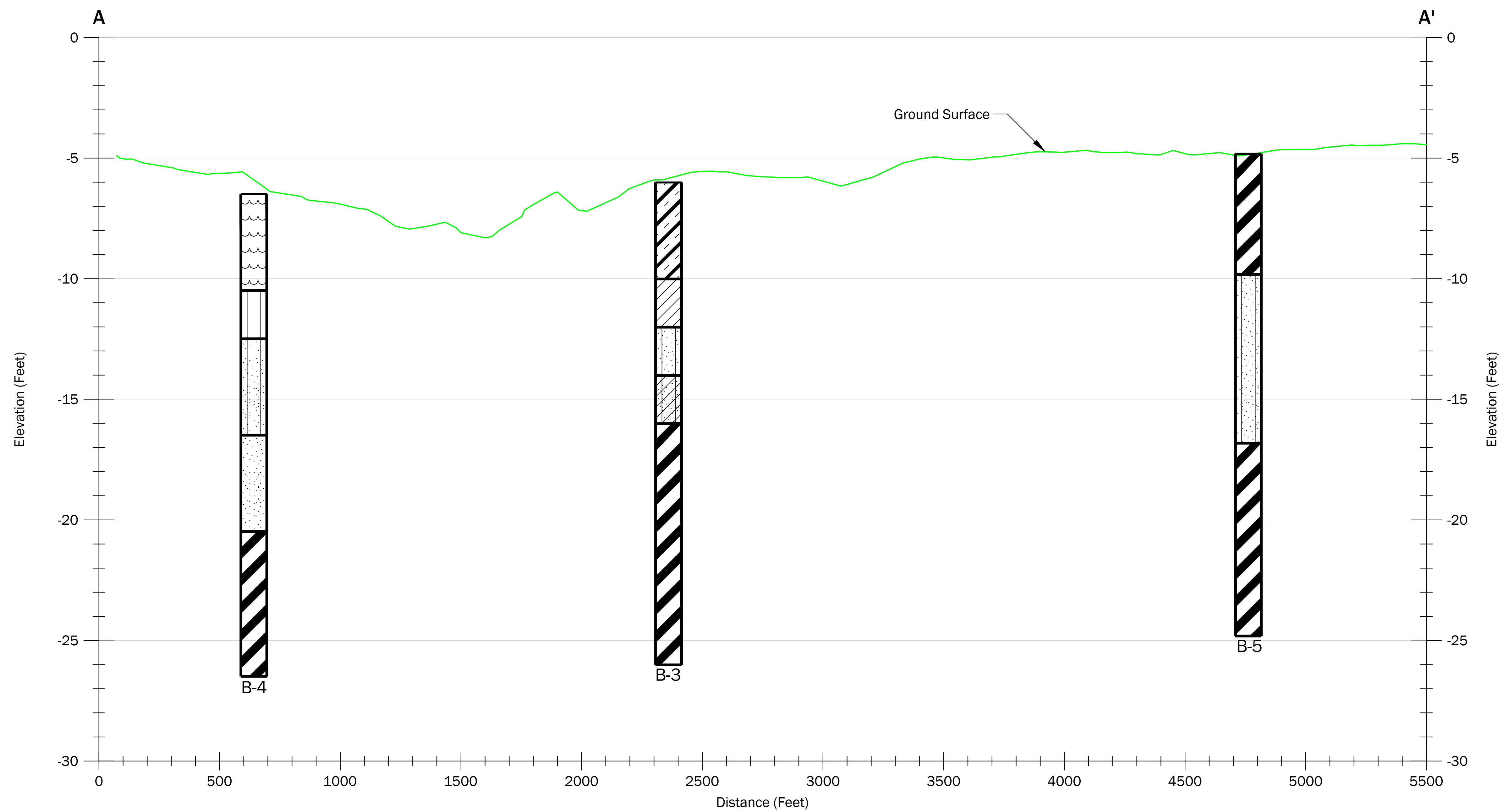
2000 0 2000
Feet

Borrow Area Boring Locations

Island Road Marsh Creation & Nourishment (TE-117)
Terrebonne Parish, Louisiana

GeoEngineers

Figure 2



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. cannot 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.

Data Source: Elevation data was taken from Fenstermaker, Dated 2/28/2017

Projection: NAD83 Louisiana State Planes, Southern Zone, US Foot

Legend

- Peat
- Silt
- Sand w/ Silt
- Sand
- Clay
- Silty Clay
- Organic Clay
- Silty Clayey Sand

500 0 500
Horizontal Scale in Feet
5 0 5
Vertical Scale in Feet
Vertical Exaggeration: 100X

Subsurface Profile
A-A'

Island Road Marsh Creation & Nourishment (TE-117)
Terrebonne Parish, Louisiana

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Figure 3

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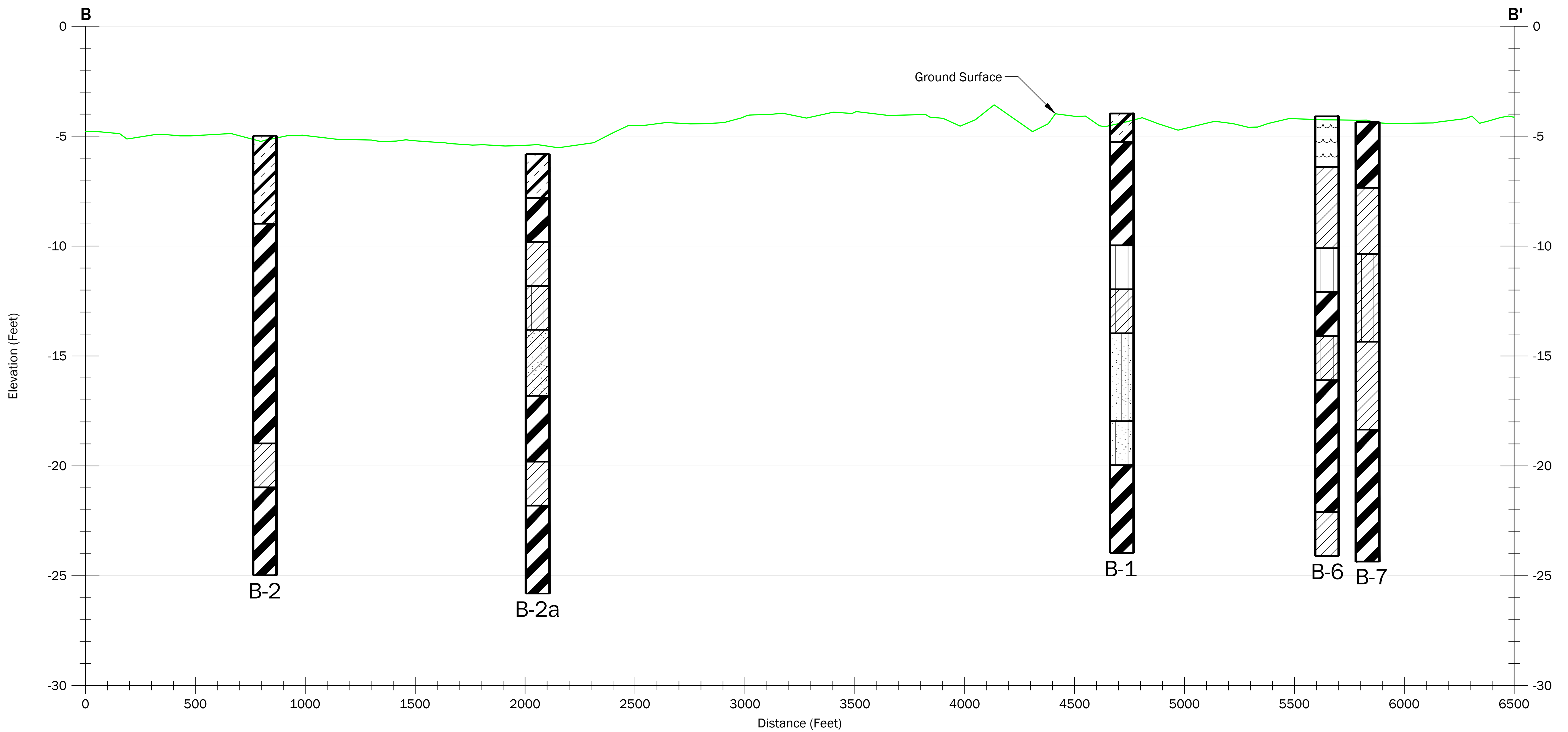

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers,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

Data Source: Elevation data was taken from Fenstermaker, Dated 2/28/2017

Projection: NAD83 Louisiana State Planes, Southern Zone, US Foot

Legend

- Peat
- Silt
- Sand w/ Silt
- Sand
- Silty Sand
- Sand w/ Clay
- Clay
- Silty Clay
- Organic Clay
- Silty Clayey Sand
- Sandy Clayey Silt

500 0 500
Horizontal Scale in Feet

5 0 5
Vertical Scale in Feet
Vertical Exaggeration: 100X

Subsurface Profile
B-B'

Island Road Marsh Creation & Nourishment (TE-117)
Terrebonne Parish, Louisiana

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Figure 4

P:\16\16715040\CAD\03\Geotech - Final\16715040003_F02_Boring Location Plan.dwg TAB:F04 - Section BB Date Exported: 04/23/18 - 14:41 by kcook

APPENDICES

APPENDIX A
Details of Field Exploration

APPENDIX A
DETAILS OF FIELD EXPLORATION

This appendix provides additional information regarding the field exploration completed for the borrow area for the Island Road Marsh Creation and Nourishment (TE-117) project in Terrebonne Parish, Louisiana.

Exploration Coordination

GeoEngineers notified "Louisiana One-Call" for utility locating prior to performing the field exploration. CPRA provided the required Coastal Use Permit to GeoEngineers for conducting our field exploration. Prior to our mobilization to the borrow area, LGH performed a magnetometer survey to clear the exploration locations of subsurface utilities and stake the locations in the field. In addition, Matrix prepared and sent notification letters prior to our mobilization to oyster leaseholders whose oyster leases were within 500 feet of our soil boring locations.

Soil Borings

Initially we began our field exploration on February 19, 2018 using an airboat-mounted drill rig. After drilling borings B-5 and B-7, it was decided the water was too rough and drilling conditions were unsafe using the airboat drill. Therefore, the remainder of our soil borings were drilled on February 20, 2018 using a pontoon-mounted drill rig. Soil borings were completed to depths of 20 feet below the existing mudline. The soil borings were advanced in open water. Coordinates and water depths at each boring location are included on the boring logs in Appendix B.

Sampling was conducted in general accordance with applicable ASTM standards, including collecting undisturbed-type cohesive and semi-cohesive samples with a three-inch outside diameter steel Shelby tube sampler using an Osterberg piston sampler.

Immediately upon retrieval from the subsurface, each sample was examined by our field engineer and field classified. Samples collected with Shelby tubes were examined at the bottom end of the sample for field classification. The tubes were then plugged, capped, labeled, and stored upright to reduce the likelihood of sample disturbance during transport to the GeoEngineers soil mechanics laboratory in Baton Rouge, Louisiana.

APPENDIX B
Soil Boring Logs

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% RETAINED ON NO. 200 SIEVE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	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
MORE THAN 50% PASSING NO. 200 SIEVE	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 GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Water level observed at time of exploration

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Sampler Symbol Descriptions

2.4-inch I.D. split barrel

Standard Penetration Test (SPT)

Shelby tube

Piston

Direct-Push

Bulk or grab

Continuous Coring

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.

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

"WOH" indicates sampler pushed using the weight of the hammer.

Laboratory / Field Tests

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

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

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

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Figure B-1

Drilled	Start 2/20/2018	End 2/20/2018	Total Depth (ft)	20	Logged By ECK / Checked By JEA	Driller	Specialized Environmental Resources, LLC	Drilling Method	Wet Rotary

Surface Elevation (ft) / Vertical Datum	-4 / NAVD88	Hammer Data	Safety Hammer/Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Pontoon-Mounted Drill Rig
Latitude / Longitude	29.316526 / -90.488514	System Datum	Geographic NAD83 (feet)	Depth of water to mudline at time of exploration (ft)	5.0

Notes:

Elevation (feet)	Depth (feet)	Recovered (in)	Blows/foot or Pocket Pen (TSF)	Collected Sample	Sample Name	Water Level	Group Classification	MATERIAL DESCRIPTION	Water Content, %	Dry Density, (pcf)	Shear Strength, (KSF)	Confining Pressure, (PSI)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Passing No. 200 Sieve, %	Torvane Shear Strength (TSF)
-4	0	25			1		OH	Dark gray organic clay	205	28.1							0.04
-5					2		CH	Gray clay with organic matter	40								
		17			3			Gray clay with organic matter	81								0.03
		23			4			Gray clay with trace organic matter and silt partings	76	57							0.05
-10	5	18			5		ML	Gray sandy silt with sandy clay layers	30								
		15			6		CL-ML	Gray sandy clayey silt	35							53	
-15	10	20.5			7		SP-SM	Gray sand with silt	27								
		9.5			8			Gray sand with silt and clay pockets	23							9	
		12.5			9		SM	Gray silty sand with silt fissures at bottom	30								
-20	15	22			10		CH	Gray clay with 2 inch sand layer at top and silt lenses	80								0.06
		22			11			Gray clay with silt lenses	76								0.06
	20																

Note: See Figure B-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey, Vertical approximated based on Locational Survey
*Indicates a remold was used for strength testing.

Log of Boring B-1

GeoEngineers

Project: Island Road Marsh Creation and Nourishment (TE-117)
Project Location: Terrebonne Parish, Louisiana
Project Number: 16715-040-03

Figure B-2
Sheet 1 of 1

Date:4/23/18 Path:P:\16\1671504\GINT\1671504003.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_LAB_MUDLINE

Drilled	Start 2/20/2018	End 2/20/2018	Total Depth (ft)	20	Logged By ECK / Checked By JEA	Driller	Specialized Environmental Resources, LLC	Drilling Method	Wet Rotary

Surface Elevation (ft) / Vertical Datum	-5 / NAVD88	Hammer Data	Safety Hammer/Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Pontoon-Mounted Drill Rig
Latitude / Longitude	29.325258 / -90.496372	System / Datum	Geographic / NAD83 (feet)	Depth of water to mudline at time of exploration (ft)	6.5

Notes:

Elevation (feet)	Depth (feet)	Recovered (in)	Blows/foot or Pocket Pen (TSF)	Collected Sample	Sample Name	Water Level	Group Classification	MATERIAL DESCRIPTION	Water Content, %	Dry Density, (pcf)	Shear Strength, (KSF)	Confining Pressure, (PSI)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Passing No. 200 Sieve, %	Torvane Shear Strength (TSF)
	0	23			1		OH	Gray organic clay with sand pockets, shell fragments, and sand seams	85								0.02
		17.5			2			Dark gray organic clay with shell fragments	203	28.1							0.03
		18			3		CH	Gray clay with silt lenses and organic matter	102								0.02
-10	5																
		10.5			4			Gray clay with silt lenses, sand lenses, and organic matter	58								0.014
		18			5			Gray clay with silt lenses and sand lenses	40								0.04
-15	10	17			6			Gray clay with silt lenses	63								0.04
		19			7			Gray clay	85	58.7							0.04
		19			8		CL	Gray silty clay	46								0.04
-20	15																
		18			9		CH	Gray clay with silt lenses	66								0.065
		18			10			Gray clay with silt lenses	57								0.06
-25	20																

Note: See Figure B-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey, Vertical approximated based on Locational Survey
*Indicates a remold was used for strength testing.

Log of Boring B-2

GeoEngineers

Project: Island Road Marsh Creation and Nourishment (TE-117)
Project Location: Terrebonne Parish, Louisiana
Project Number: 16715-040-03

Figure B-3
Sheet 1 of 1

Date:4/23/18 Path:P:\16\16715040\GINT\1671504003.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_LAB_MUDLINE

Drilled	Start	End	Total Depth (ft)	Logged By	Checked By	Driller	Drilling Method
	2/20/2018	2/20/2018	20	ECK	JEA	Specialized Environmental Resources, LLC	Wet Rotary

Surface Elevation (ft) Vertical Datum	-5.8 NAVD88	Hammer Data	Safety Hammer/Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Pontoon-Mounted Drill Rig
Latitude Longitude	29.322131 -90.494147	System Datum	Geographic NAD83 (feet)	Depth of water to mudline at time of exploration (ft)	7.0

Notes:

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)	Shear Strength, (KSF)	Confining Pressure, (PSI)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Passing No. 200 Sieve, %	Torvane Shear Strength (TSF)
	0		19			1			OH	Dark gray organic clay with silt	154								0.04
			18.5			2			CH	Gray clay with organic matter	40	80.6							0.045
-10	5		17			3			CL	Gray silty clay with sand and silty sand with clay at bottom	38								0.045
			15			4			CL-ML	Gray sandy clayey silt	31							53	0.02
-15			19			5			SP-SC	Gray sand with clay	27								
	10		21			6				Gray sand with clay									
									CH	Gray clay with silt lenses	50								0.03
			19.5			7				Gray clay with silt lenses	67	66.2							0.075
-20	15		21			8			CL	Gray silty clay	54								0.07
			16			9			CH	Gray clay	81								0.04
-25	20		16			10				Gray clay with shell fragments	74								0.08

Note: See Figure B-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey, Vertical approximated based on Locational Survey
*Indicates a remold was used for strength testing.

Log of Boring B-2a

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Project: Island Road Marsh Creation and Nourishment (TE-117)
Project Location: Terrebonne Parish, Louisiana
Project Number: 16715-040-03

Figure B-4
Sheet 1 of 1

Date:4/23/18 Path:P:\16\16715040\GINT\1671504003.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_LAB_MUDLINE

Drilled	Start 2/20/2018	End 2/20/2018	Total Depth (ft)	20	Logged By ECK Checked By JEA	Driller	Specialized Environmental Resources, LLC	Drilling Method	Wet Rotary

Surface Elevation (ft) Vertical Datum	-5.5 NAVD88	Hammer Data	Safety Hammer/Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Pontoon-Mounted Drill Rig
Latitude Longitude	29.316929 -90.496412	System Datum	Geographic NAD83 (feet)	Depth of water to mudline at time of exploration (ft)	7.0

Notes:

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)	Shear Strength, (KSF)	Confining Pressure, (PSI)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Passing No. 200 Sieve, %	Torvane Shear Strength (TSF)
	0		20.5			1			OH	Black organic clay	134								0.02
			22			2				Gray organic clay (very soft)	144	40.1	0.06	5	6				0.02
-10			18			3			CL	Gray clay with silt and sand lenses	41								0.035
	5																		
			16			4			SM	Gray silty sand	33								0.02
			8			5			SC-SM	Gray silty clayey sand	28							14	0.02
-15																			
	10		20			6			CH	Gray clay with silt lenses	96								0.04
			16			7				Gray clay (very soft)	81	55.4	0.18	5.2	4				0.06
-20			15			8				Gray clay	85								0.04
	15																		
			7			9				Gray clay with shells	72								0.035
-25			15			10				Gray clay with shell fragments	79								0.085
	20																		

Note: See Figure B-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey, Vertical approximated based on Locational Survey
*Indicates a remold was used for strength testing.

Log of Boring B-3

GeoEngineers

Project: Island Road Marsh Creation and Nourishment (TE-117)
Project Location: Terrebonne Parish, Louisiana
Project Number: 16715-040-03

Figure B-5
Sheet 1 of 1

Date:4/23/18 Path:P:\16\16715040\GINT\1671504003.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_LAB_MUDLINE

Drilled	Start 2/20/2018	End 2/20/2018	Total Depth (ft)	20	Logged By / Checked By	ECK / JEA	Driller	Specialized Environmental Resources, LLC	Drilling Method	Wet Rotary

Surface Elevation (ft) Vertical Datum	-6.5 NAVD88	Hammer Data	Safety Hammer/Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Pontoon-Mounted Drill Rig
Latitude Longitude	29.320732 -90.499657	System Datum	Geographic NAD83 (feet)	Depth of water to mudline at time of exploration (ft)	7.0

Notes:

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)	Shear Strength, (KSF)	Confining Pressure, (PSI)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Passing No. 200 Sieve, %	Torvane Shear Strength (TSF)
	0		20			1			PT	Dark gray peat with gray clay (very soft)	292	20.1	0.08	5	13				0.03
-10			20			2				Brown peat	394								0.04
	5		18			3			ML	Gray sandy silt with 3 inch clay layer in center	46							77	0.07
			16			4			SM	Gray silty sand with clay layers	85								0.015
-15			9			5				Gray silty sand	28								0.035
	10		4			6			SP	Gray sand	23							4	0.015
-20			4			7				Gray sand	22								0.02
	15		20			8			CH	Gray clay (very soft)	84	54.1	0.18	6	3				0.06
			16			9				Gray clay with silt lenses	48								0.07
-25			11			10				Gray clay with silt lenses and shell fragments	66								0.05
	20																		

Note: See Figure B-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey, Vertical approximated based on Locational Survey
*Indicates a remold was used for strength testing.

Log of Boring B-4

GeoEngineers

Project: Island Road Marsh Creation and Nourishment (TE-117)
Project Location: Terrebonne Parish, Louisiana
Project Number: 16715-040-03

Date:4/23/18 Path:P:\16\16715040\GINT\1671504003.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_LAB_MUDLINE

Drilled — Start: 2/19/2018 — End: 2/19/2018	Total Depth (ft): 20	Logged By: ECK Checked By: JEA	Driller: Specialized Environmental Resources, LLC	Drilling Method: Wet Rotary
Surface Elevation (ft): -4.3 Vertical Datum: NAVD88		Hammer Data: Safety Hammer/Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment: Airboat-Mounted Drill Rig
Latitude: 29.311132 Longitude: -90.492496		System: Geographic Datum: NAD83 (feet)		Depth of water to mudline at time of exploration (ft): 5.0

Notes:

Elevation (feet): -5, -10, -15, -20
Depth (feet): 0, 5, 10, 15, 20

FIELD DATA									LABORATORY DATA								
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)	Shear Strength, (KSF)	Confining Pressure, (PSI)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Passing No. 200 Sieve, %	Torvane Shear Strength (TSF)
	24			1			CH	Dark gray clay with organic matter	80								
	22			2				Gray clay with organic matter (very soft)	58	67.5	0.05	5	7				
	21			3				Gray clay with silt lenses (very soft)	51	68.7	0.06	5	7				
				4			SM	Gray silty sand with trace clay	28								
	14			5				Gray silty sand with clay lenses	29							40	
	14.5			6				Gray silty sand with clay lenses	25								
	14			7				Gray silty sand with 2 inch clay layer	25								
	20			8			CH	Gray clay with silt lenses (very soft)	64	60.6	0.11	5.2	7				
	20			9				Gray clay with silty sand lenses and shells	84								
	21			10				Gray clay with silt pockets, silt seams, and shell fragments (soft)	60	61.1	0.3	6.8	6				
	4			11				Gray clay with organic matter and shells	95								

Note: See Figure B-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey, Vertical approximated based on Locational Survey
*Indicates a remold was used for strength testing.

Log of Boring B-5

GeoEngineers

Project: Island Road Marsh Creation and Nourishment (TE-117)
Project Location: Terrebonne Parish, Louisiana
Project Number: 16715-040-03

Date:4/23/18 Path:P:\16\16715040\GINT\1671504003.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_LAB_MUDLINE

Drilled	Start: 2/20/2018	End: 2/20/2018	Total Depth (ft)	20	Logged By	ECK	Driller	Specialized Environmental Resources, LLC	Drilling Method	Wet Rotary
					Checked By	JEA				

Surface Elevation (ft) / Vertical Datum	-4.1 / NAVD88	Hammer Data	Safety Hammer/Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Pontoon-Mounted Drill Rig
Latitude / Longitude	29.318524 / -90.482984	System / Datum	Geographic / NAD83 (feet)	Depth of water to mudline at time of exploration (ft)	5.0

Notes:

Elevation (feet): -5, -10, -15, -20; Depth (feet): 0, 5, 10, 15, 20

Recovered (in)	Blows/foot or Pocket Pen (TSF)	Collected Sample	Sample Name	Water Level	Group Classification	MATERIAL DESCRIPTION	Water Content, %	Dry Density, (pcf)	Shear Strength, (KSF)	Confining Pressure, (PSI)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Passing No. 200 Sieve, %	Torvane Shear Strength (TSF)
24.5			1		PT	Dark gray peat with clay	186								
			2			Dark gray peat with organic clay (very soft)	336	17.6	0.11	5	14				0.03
23.5			3			Gray peat	180								0.04
					CL	Gray silty clay with organic matter									
18.5			4			Gray silty clay with sandy silt lenses and layers (very soft)	37	85.8	0.1	5	15				0.03
16			5		ML	Gray sandy silt with clay layers	39								0.02
14			6		CH	Gray clay with silty sand layers	58							92	
17.5			7		CL-ML	Gray clayey silt with sand	40								0.03
14			8		CH	Gray clay with silt seams (very soft)	80	54	0.16	5.2	5				0.04
18			9			Gray clay with sandy silt layers	62								0.04
12			10			Gray clay (very soft)	77	57.8	0.11	6.8	12				0.03
2			11		CL	Gray silty clay with shell fragments	39								

Note: See Figure B-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey, Vertical approximated based on Locational Survey
*Indicates a remold was used for strength testing.

Log of Boring B-6

GEOENGINEERS

Project: Island Road Marsh Creation and Nourishment (TE-117)
Project Location: Terrebonne Parish, Louisiana
Project Number: 16715-040-03

Date:4/23/18 Path:P:\16\16715040\GINT\1671504003.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_LAB_MUDLINE

Drilled	Start 2/19/2018	End 2/19/2018	Total Depth (ft)	20	Logged By ECK / Checked By JEA	Driller	Specialized Environmental Resources, LLC	Drilling Method	Wet Rotary

Surface Elevation (ft) / Vertical Datum	-4.4 / NAVD88	Hammer Data	Safety Hammer/Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Airboat-Mounted Drill Rig
Latitude / Longitude	29.313612 / -90.486936	System / Datum	Geographic / NAD83 (feet)	Depth of water to mudline at time of exploration (ft)	5.0

Notes:

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)	Shear Strength, (KSF)	Confining Pressure, (PSI)	Strain, %	Liquid Limit (LL), %	Plasticity Index (PI), %	Passing No. 200 Sieve, %	Torvane Shear Strength (TSF)
-5	0		18.5			1			CH	Dark brown clay with organic matter and shells	75								
			20			2				Dark gray clay with organic matter and shells	86								
						3			CL	Dark gray sandy clay with shells and a silty sand layer	42								
						4				Dark gray silty clay									
-10	5																		
			20			5			CL-ML	Gray sandy clayey silt	44								
			15			6				Gray sandy clayey silt	30							61	
-15	10		21			7			CL	Gray sandy clay	37								
			17			8				Gray silty clay with silty sand layers and shell fragments	29	87.9							0.02
			20.5			9			CH	Gray clay with sand seams	63								0.06
-20	15									Gray clay with silt seams									
			17.5			10				Gray clay with silt seams	77								0.06
			20			11				Gray clay with silt lenses, sand lenses, and shell fragments	89								0.06
	20																		

Note: See Figure B-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Locational Survey, Vertical approximated based on Locational Survey
*Indicates a remold was used for strength testing.

Date:4/23/18 Path:P:\16\16715040\GINT\1671504003.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_LAB_MUDLINE

Log of Boring B-7

GeoEngineers

Project: Island Road Marsh Creation and Nourishment (TE-117)
Project Location: Terrebonne Parish, Louisiana
Project Number: 16715-040-03

APPENDIX C
Laboratory Testing Results

APPENDIX C
LABORATORY TESTING

This appendix provides additional information regarding the laboratory testing completed for the borrow area of the Island Road Marsh Creation and Nourishment (TE-117) project in Terrebonne Parish, Louisiana.

General

Soil samples obtained from the explorations were transported to our soil mechanics laboratory in Baton Rouge, Louisiana, and examined to confirm or modify field classifications. The moisture content was measured for each Shelby tube sample. Unconsolidated-undrained triaxial tests, unit weight tests, and grain size distribution tests were performed on select soil samples. Composite samples were mixed to evaluate the index properties of each soil boring to the proposed dredge depth and also for self-weight (low-stress) consolidation tests and settling column tests. The laboratory testing procedures are discussed in more detail below.

Moisture Content

Moisture content tests were completed for representative samples from each Shelby tube in general accordance with ASTM D2216. The results of these tests are presented on the logs at the respective sample depths. In addition, moisture content tests were performed on composite samples of each soil boring and for the self-weight consolidation and settling column tests, which are presented in the tabular Summary of Lab Results presented in this appendix.

Unit Weight

Unit weight was measured for select samples in general accordance with ASTM D2166. The results of these tests are presented on the logs at the respective sample depths and in the tabular Summary of Lab Results presented in this appendix.

Specific Gravity

Specific gravity tests were performed on representative composite samples for each soil boring and for the self-weight consolidation and settling column tests in general accordance with ASTM D854. The results of these tests are presented in the tabular Summary of Lab Results presented in this appendix.

Organic Content

Organic content tests were completed for representative composite samples for each soil boring and for the self-weight consolidation and settling column tests in general accordance with ASTM D2974. The results of these tests are presented in the tabular Summary of Lab Results presented in this appendix.

Atterberg Limits

Atterberg Limits tests were performed on representative composite samples for each soil boring and for the self-weight consolidation and settling column tests in general accordance with ASTM D4318. The tests were used to classify the soil as well as to evaluate its index properties. The results of the Atterberg Limits testing are presented in the tabular Summary of Lab Results presented in this appendix.

Sieve Analysis

Sieve analyses were performed on select coarse-grained samples and representative composite samples for each soil boring and for the self-weight consolidation and settling column tests in general accordance with ASTM D422. The results of the sieve analyses were plotted and classified in general accordance with the Unified Soil Classification System (USCS) and are included with this appendix. The percentage passing the U.S. No. 200 sieve of select samples is shown on the logs at the respective sample depths. The percentage passing the U.S. No. 200 sieve of composite samples is shown in the tabular Summary of Lab Results presented in this appendix.

Unconsolidated Undrained Triaxial Tests

Unconsolidated undrained (UU) triaxial tests were performed on select cohesive soil samples obtained from the borings. The tests were used to evaluate shear strength characteristics and were completed in general accordance with ASTM D2850. The results of the testing are presented on the logs at their respective sample depths and also in the tabular Summary of Lab Results presented in this appendix. In addition, stress-strain curves for each test are included in this appendix.

Self-weight (Low stress) Consolidation Tests

Self-weight consolidation tests were performed on four composite samples as previously described. The tests were performed in accordance with the methods specified in USACE Manual No. 1110-2-5027 (USACE, 1987) and the University of Texas Method (Pederson, 2001). Further details of the test method and the test results are included in the report included in this appendix.

Settling Column Tests

Two settling column tests were performed by SCTCS on composite soil samples in general accordance with the method specified in USACE Manual No. 1110-2-5027. Further details regarding the sample composition and test results are presented in the SCTCS report included in this appendix.

Soil Boring ID	Depth Interval (ft)	D2488 Visual Description	Test Type	D2216 Moisture (%)	D2166/D2850 Unit Weight (PCF) Wet	Dry	D4318 Atterberg Limits LL	PL	PI	D422/D1140 /D6913 %<#200 Sieve	D2166/D2850 Shear Strength (KSF)	Remolded Strength (KSF)	Failure Strain (%)	Confining Pressure (PSI)	Failure Type	D4648 Mini Vane Shear Strength (KSF)	Comments
B-1	0.0 - 1.3	Dark gray organic clay (OH)	UDW	204.7	85.5	28.1											TV=0.04
B-1	1.3 - 2.0	Gray clay with organic matter (CH)	EXT_MC	39.5													
B-1	2.0 - 4.0	Gray clay with organic matter (CH)	EXT_MC	80.8													TV=0.03
B-1	4.0 - 6.0	Gray clay with trace organic matter (CH)	UDW	75.9	100.2	57.0											TV=0.05
B-1	6.0 - 8.0	Gray sandy silt with sandy clay layers (ML)	EXT_MC	29.7													TV=N/A
B-1	8.0 - 10.0	Gray sandy clayey silt (CL-ML)	SV	35.1						53.4							TV=N/A
B-1	10.0 - 12.0	Gray sand with silt (SM)	EXT_MC	26.9													TV=N/A
B-1	12.0 - 14.0	Gray sand with silt and clay pockets (SP-SM)	SV	22.9						9.0							TV=N/A
B-1	14.0 - 16.0	Gray silty sand with silt fissures at bottom (SM)	EXT_MC	29.8													TV=N/A
B-1	16.0 - 18.0	Gray clay with 2" sand layer at top and silt lenses (CH)	EXT_MC	79.8													TV=0.06
B-1	18.0 - 20.0	Gray clay with silt lenses (CH)	EXT_MC	75.6													TV=0.06

Disclaimer: The results presented relate only to those samples tested.
Note: ASTM standard identification numbers shown above each test description.

Multiple Shear = MS Vertical Shear = VS Angle Shear = AS
Slickensided = SLS Bulge = B Crumble = C

AASHTO ACCREDITED

Technical Responsibility: Karen Allen
Title: QAM
Date: 4/23/18

Summary of Lab Results
Project No.: 16715-040-03

Island Road Marsh Creation and Nourishment (TE-117)
Terrebonne Parish, LA

GeoEngineers

Soil Boring ID	Depth Interval (ft)	D2488 Visual Description	Test Type	D2216 Moisture (%)	D2166/D2850 Unit Weight (PCF) Wet	Dry	D4318 Atterberg Limits LL	PL	PI	D422/D1140/D6913 %<#200 Sieve	D2166/D2850 Shear Strength (KSF)	Remolded Strength (KSF)	Failure Strain (%)	Confining Pressure (PSI)	Failure Type	D4648 Mini Vane Shear Strength (KSF)	Comments
B-2	0.0 - 2.0	Gray organic clay with sand pockets, shell fragments, and sand seams (OH)	EXT_MC	85.0													TV=0.02
B-2	2.0 - 4.0	Dark gray organic clay with shell fragments (OH)	UDW	203.0	85.1	28.1											TV=0.03
B-2	4.0 - 6.0	Gray clay with silt lenses and organic matter (CH)	EXT_MC	102.0													TV=0.02
B-2	6.0 - 8.0	Gray clay with silt lenses, sand lenses, and organic matter (CH)	EXT_MC	57.6													TV=0.014
B-2	8.0 - 10.0	Gray clay with silt lenses and sand lenses (CH)	EXT_MC	39.9													TV=0.04
B-2	10.0 - 12.0	Gray clay with silt lenses (CH)	EXT_MC	63.1													TV=0.04
B-2	12.0 - 14.0	Gray clay (CH)	UDW	85.4	108.9	58.7											TV=0.04
B-2	14.0 - 16.0	Gray silty clay (CL)	EXT_MC	45.6													TV=0.04
B-2	16.0 - 18.0	Gray clay with silt lenses (CH)	EXT_MC	65.5													TV=0.065
B-2	18.0 - 20.0	Gray clay with silt lenses (CH)	EXT_MC	56.7													TV=0.06

Disclaimer: The results presented relate only to those samples tested.
Note: ASTM standard identification numbers shown above each test description.

Multiple Shear = MS Vertical Shear = VS Angle Shear = AS
Slickensided = SLS Bulge = B Crumble = C

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Technical Responsibility: Karen Allen
Title: QAM
Date: 4/23/18

Summary of Lab Results
Project No.: 16715-040-03

Island Road Marsh Creation and Nourishment (TE-117)
Terrebonne Parish, LA

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Soil Boring ID	Depth Interval (ft)	D2488 Visual Description	Test Type	D2216 Moisture (%)	D2166/D2850 Unit Weight (PCF)		D4318 Atterberg Limits			D422/D1140 /D6913	D2166/D2850					D4648	Comments
					Wet	Dry	LL	PL	PI	%<#200 Sieve	Shear Strength (KSF)	Remolded Strength (KSF)	Failure Strain (%)	Confining Pressure (PSI)	Failure Type	Mini Vane Shear Strength (KSF)	
B-2a	0.0 - 2.0	Dark gray organic clay with silt (OH)	EXT_MC	154.1													TV=0.04
B-2a	2.0 - 4.0	Gray clay with organic matter (CH)	UDW	40.3	113.1	80.6											TV=0.045
B-2a	4.0 - 6.0	Gray silty clay with sand and silty sand with clay at bottom (CL)	EXT_MC	37.9													TV=0.045
B-2a	6.0 - 8.0	Gray sandy clayey silt (CL-ML)	SV	30.6						53.0							TV=0.02
B-2a	8.0 - 10.0	Gray sand with clay (SP-SC)	EXT_MC	27.0													TV=0
B-2a	11.0 - 12.0	Gray clay with silt lenses (CH)	EXT_MC	50.0													TV=0.03
B-2a	12.0 - 14.0	Gray clay with silt lenses (CH)	UDW	66.6	110.2	66.2											TV=0.075
B-2a	14.0 - 16.0	Gray silty clay (CL)	EXT_MC	53.9													TV=0.07
B-2a	16.0 - 18.0	Gray clay (CH)	EXT_MC	81.4													TV=0.04
B-2a	18.0 - 20.0	Gray clay with shell fragments (CH)	EXT_MC	73.6													TV=0.08

Disclaimer: The results presented relate only to those samples tested.
Note: ASTM standard identification numbers shown above each test description.

Multiple Shear = MS Vertical Shear = VS Angle Shear = AS
Slickensided = SLS Bulge = B Crumble = C

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Title: QAM

Date: 4/23/18

Summary of Lab Results

Project No.: 16715-040-03

Island Road Marsh Creation and Nourishment (TE-117)

Terrebonne Parish, LA

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Soil Boring ID	Depth Interval (ft)	D2488 Visual Description	Test Type	D2216 Moisture (%)	D2166/D2850 Unit Weight (PCF)		D4318 Atterberg Limits			D422/D1140 /D6913	D2166/D2850					D4648	Comments
					Wet	Dry	LL	PL	PI	%<#200 Sieve	Shear Strength (KSF)	Remolded Strength (KSF)	Failure Strain (%)	Confining Pressure (PSI)	Failure Type	Mini Vane Shear Strength (KSF)	
B-3	0.0 - 2.0	Black organic clay (OH)	EXT_MC	133.9													TV=0.02
B-3	2.0 - 4.0	Very soft gray organic clay (OH)	UU	143.7	97.7	40.1					0.06		5.6	5.0	MS		TV=0.02
B-3	4.0 - 6.0	Gray clay with silt and sand lenses (CL)	EXT_MC	41.3													TV=0.035
B-3	6.0 - 8.0	Gray silty sand (SM)	EXT_MC	32.6													TV=0.02
B-3	8.0 - 10.0	Gray silty clayey sand (SC-SM)	SV	27.7						14.3							TV=0.02
B-3	10.0 - 12.0	Gray clay with silt lenses (CH)	EXT_MC	95.8													TV=0.04
B-3	12.0 - 14.0	Very soft gray clay (CH)	UU	80.5	100.0	55.4					0.18		3.7	5.2	B		TV=0.06
B-3	14.0 - 16.0	Gray clay (CH)	EXT_MC	84.9													TV=0.04
B-3	16.0 - 18.0	Gray clay with shells (CH)	EXT_MC	72.4													TV=0.035
B-3	18.0 - 20.0	Gray clay with shell fragments (CH)	EXT_MC	79.4													TV=0.085

Disclaimer: The results presented relate only to those samples tested.
Note: ASTM standard identification numbers shown above each test description.

Multiple Shear = MS Vertical Shear = VS Angle Shear = AS
Slickensided = SLS Bulge = B Crumble = C

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Technical Responsibility: Karen Allen

Title: QAM

Date: 4/23/18

Summary of Lab Results
Project No.: 16715-040-03

Island Road Marsh Creation and Nourishment (TE-117)
Terrebonne Parish, LA

GeoEngineers

Soil Boring ID	Depth Interval (ft)	D2488 Visual Description	Test Type	D2216 Moisture (%)	D2166/D2850 Unit Weight (PCF) Wet	Dry	D4318 Atterberg Limits LL	PL	PI	D422/D1140/D6913 %<#200 Sieve	D2166/D2850 Shear Strength (KSF)	Remolded Strength (KSF)	Failure Strain (%)	Confining Pressure (PSI)	Failure Type	D4648 Mini Vane Shear Strength (KSF)	Comments
B-4	0.0 - 2.0	Very soft dark gray peat with gray clay (PT)	UU	291.7	78.6	20.1					0.08		12.8	5.0	B		TV=0.03
B-4	2.0 - 4.0	Brown peat (PT)	EXT_MC	394.1													TV=0.04
B-4	4.0 - 6.0	Gray sandy silt with 3" clay layer in center (ML)	SV	46.2						77.2							TV=0.07
B-4	6.0 - 8.0	Gray silty sand with clay layers (SM)	EXT_MC	84.6													TV=0.015
B-4	8.0 - 10.0	Gray silty sand (SM)	EXT_MC	27.7													TV=0.035
B-4	10.0 - 12.0	Gray sand (SP)	SV	22.7						3.8							TV=0.015
B-4	12.0 - 14.0	Gray sand (SP)	EXT_MC	22.4													TV=0.02
B-4	14.0 - 16.0	Very soft gray clay (CH)	UU	84.0	99.5	54.1					0.18		3.1	6.0	B		TV=0.06
B-4	16.0 - 18.0	Gray clay with silt lenses (CH)	EXT_MC	48.3													TV=0.07
B-4	18.0 - 20.0	Gray clay with silt lenses and shell fragments (CH)	EXT_MC	66.0													TV=0.05

Disclaimer: The results presented relate only to those samples tested.
Note: ASTM standard identification numbers shown above each test description.

Multiple Shear = MS Vertical Shear = VS Angle Shear = AS
Slickensided = SLS Bulge = B Crumble = C

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Title: QAM
Date: 4/23/18

Summary of Lab Results
Project No.: 16715-040-03

Island Road Marsh Creation and Nourishment (TE-117)
Terrebonne Parish, LA

GEOENGINEERS

Soil Boring ID	Depth Interval (ft)	D2488	Test Type	D2216	D2166/D2850		D4318			D422/D1140 /D6913	D2166/D2850					D4648	Comments
		Visual Description		Moisture (%)	Unit Weight (PCF)		Atterberg Limits			%<#200 Sieve	Shear Strength (KSF)	Remolded Strength (KSF)	Failure Strain (%)	Confining Pressure (PSI)	Failure Type	Mini Vane Shear Strength (KSF)	
					Wet	Dry	LL	PL	PI								
B-5	0.0 - 2.0	Dark gray clay with organic matter (CH)	EXT_MC	80.2													
B-5	2.0 - 4.0	Very soft gray clay (CH)	UU	57.9	106.5	67.5					0.05		7.3	5.0	B		
B-5	4.0 - 5.0	Very soft gray clay with silt lenses (CH)	UU	50.7	103.5	68.7					0.06		6.8	5.0	B		
B-5	5.0 - 6.0	Gray silty sand with trace clay (SM)	EXT_MC	28.2													
B-5	6.0 - 8.0	Gray silty sand with clay lenses (SM)	SV	29.2						40.4							
B-5	8.0 - 10.0	Gray silty sand with clay lenses (SM)	EXT_MC	24.6													
B-5	10.0 - 12.0	Gray silty sand with 2" clay layer (SM)	EXT_MC	25.3													
B-5	12.0 - 14.0	Very soft gray clay with silt lenses (CH)	UU	64.2	99.4	60.6					0.11		6.8	5.2	B		
B-5	14.0 - 16.0	Gray clay with silty sand lenses and shells (CH)	EXT_MC	84.2													
B-5	16.0 - 18.0	Soft gray clay with silt pockets, silt seams and shell fragments (CH)	UU	60.4	98.1	61.1					0.30		6.3	6.8	B		
B-5	18.0 - 20.0	Gray clay with organic matter and shells (CH)	EXT_MC	95.3													

Disclaimer: The results presented relate only to those samples tested.
Note: ASTM standard identification numbers shown above each test description.

Multiple Shear = MS Vertical Shear = VS Angle Shear = AS
Slickensided = SLS Bulge = B Crumble = C

AASHTO ACCREDITED

Technical Responsibility: Karen Allen
Title: QAM
Date: 4/23/18

Summary of Lab Results
Project No.: 16715-040-03

Island Road Marsh Creation and Nourishment (TE-117)
Terrebonne Parish, LA

GeoEngineers

Soil Boring ID	Depth Interval (ft)	D2488 Visual Description	Test Type	D2216 Moisture (%)	D2166/D2850 Unit Weight (PCF)		D4318 Atterberg Limits			D422/D1140/D6913 %<#200 Sieve	D2166/D2850 Shear Strength (KSF)	Remolded Strength (KSF)	Failure Strain (%)	Confining Pressure (PSI)	Failure Type	D4648 Mini Vane Shear Strength (KSF)	Comments
					Wet	Dry	LL	PL	PI								
B-6	0.0 - 1.0	Dark gray peat with gray clay (PT)	EXT_MC	186.0													TV=0.03
B-6	1.0 - 2.0	Very soft dark gray peat with organic gray clay (PT)	UU	336.4	76.6	17.6					0.11		14.1	5.0	B		TV=0.03
B-6	2.0 - 2.3	Gray peat (PT)	EXT_MC	179.8													TV=0.04
B-6	4.0 - 6.0	Very soft gray silty clay with sandy silt lenses and layers (CL)	UU	37.2	117.7	85.8					0.10		15.0	5.0	B		TV=0.03 HT to DIA Ratio is 1.66
B-6	6.0 - 8.0	Gray sandy silt with clay layers (ML)	EXT_MC	38.7													TV=0.02
B-6	8.0 - 10.0	Gray clay with silty sand layers (CH)	SV	57.9						91.9							TV=N/A
B-6	10.0 - 12.0	Gray clayey silt with sand (CL-ML)	EXT_MC	39.7													TV=0.03
B-6	12.0 - 14.0	Very soft gray clay with silt seams (CH)	UU	79.7	97.0	54.0					0.16		4.7	5.2	B		TV=0.04
B-6	14.0 - 16.0	Gray clay with sandy silt layers (CH)	EXT_MC	61.7													TV=0.04
B-6	16.0 - 18.0	Very soft gray clay (CH)	UU	76.9	102.3	57.8					0.11		11.6	6.8	B		TV=0.03
B-6	18.0 - 20.0	Gray silty clay with shell fragments (CL)	EXT_MC	39.1													TV=N/A

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Multiple Shear = MS Slickensided = SLS Vertical Shear = VS Bulge = B Angle Shear = AS Crumble = C

AASHTO ACCREDITED

Technical Responsibility: Karen Allen

Title: QAM

Date: 4/23/18

Summary of Lab Results
Project No.: 16715-040-03

Island Road Marsh Creation and Nourishment (TE-117)
Terrebonne Parish, LA

GEOENGINEERS

Soil Boring ID	Depth Interval (ft)	D2488 Visual Description	Test Type	D2216 Moisture (%)	D2166/D2850 Unit Weight (PCF) Wet	Dry	D4318 Atterberg Limits LL	PL	PI	D422/D1140/D6913 %<#200 Sieve	D2166/D2850 Shear Strength (KSF)	Remolded Strength (KSF)	Failure Strain (%)	Confining Pressure (PSI)	Failure Type	D4648 Mini Vane Shear Strength (KSF)	Comments
B-7	0.0 - 2.0	Dark brown clay with organic matter and shells (CH)	EXT_MC	75.1													
B-7	2.0 - 3.0	Dark gray clay with organic matter and shells (CH)	MC	86.1													
B-7	3.0 - 4.0	Dark gray sandy clay with shells (CL)	EXT_MC	41.8													
B-7	6.0 - 8.0	Gray sandy clayey silt (CL-ML)	EXT_MC	44.3													
B-7	8.0 - 10.0	Gray sandy clayey silt (CL-ML)	SV	30.3						61.0							
B-7	10.0 - 12.0	Gray sandy clay (CL)	EXT_MC	36.5													PPen=2.5
B-7	12.0 - 14.0	Gray silty clay with silty sand layers and shell fragments (CL)	UDW	28.7	113.2	87.9											TV=0.02, Voids in side
B-7	14.0 - 16.0	Gray clay with sand seams (CH)	EXT_MC	62.7													TV=0.06
B-7	16.0 - 18.0	Gray clay with silt seams (CH)	EXT_MC	76.8													TV=0.06
B-7	18.0 - 20.0	Gray clay with silt lenses, sand lenses, and shell fragments (CH)	EXT_MC	89.1													TV=0.06

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Slickensided = SLS Bulge = B Crumble = C

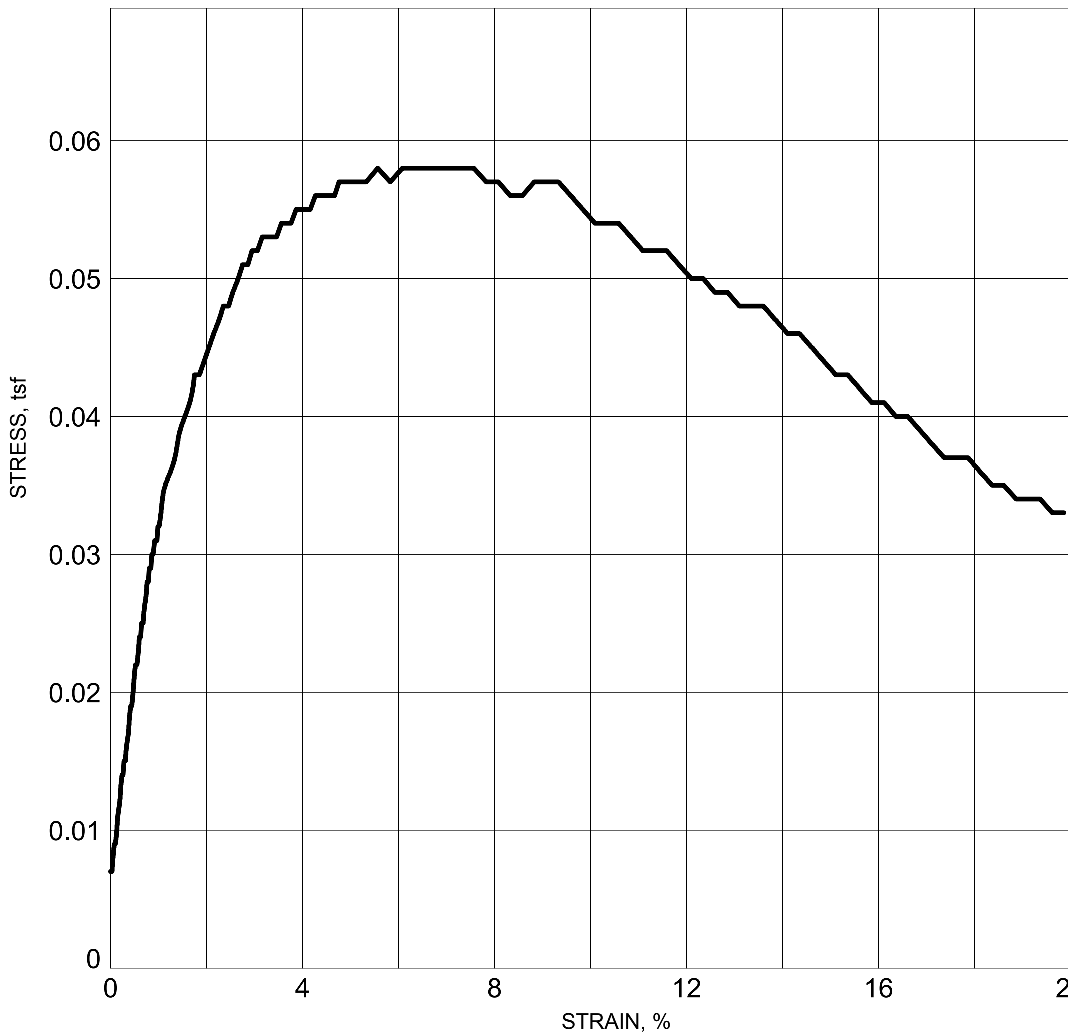
AASHTO ACCREDITED

Technical Responsibility: Karen Allen
Title: QAM
Date: 4/23/18

Summary of Lab Results
Project No.: 16715-040-03

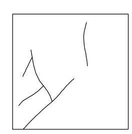
Island Road Marsh Creation and Nourishment (TE-117)
Terrebonne Parish, LA

GeoEngineers



Boring ID	B-3
Depth (ft)	2-4
Water Content, %	143.7
Wet Density, pcf	97.7
Dry Density, pcf	40.1
Saturation, %	120.6
Void Ratio	3.27
Specimen Diameter	2.666
Specimen Height	5.996
Height/diameter ratio	2.25
Deviator Stress, tsf	0.058
Strain, %	5.6
Confining Pressure (psi)	5.0

Multiple Shear



Failure Sketch

LL = PL = PI =

% 200= % Organic= Assumed Gs=2.74

Description: Very soft gray organic clay (OH)

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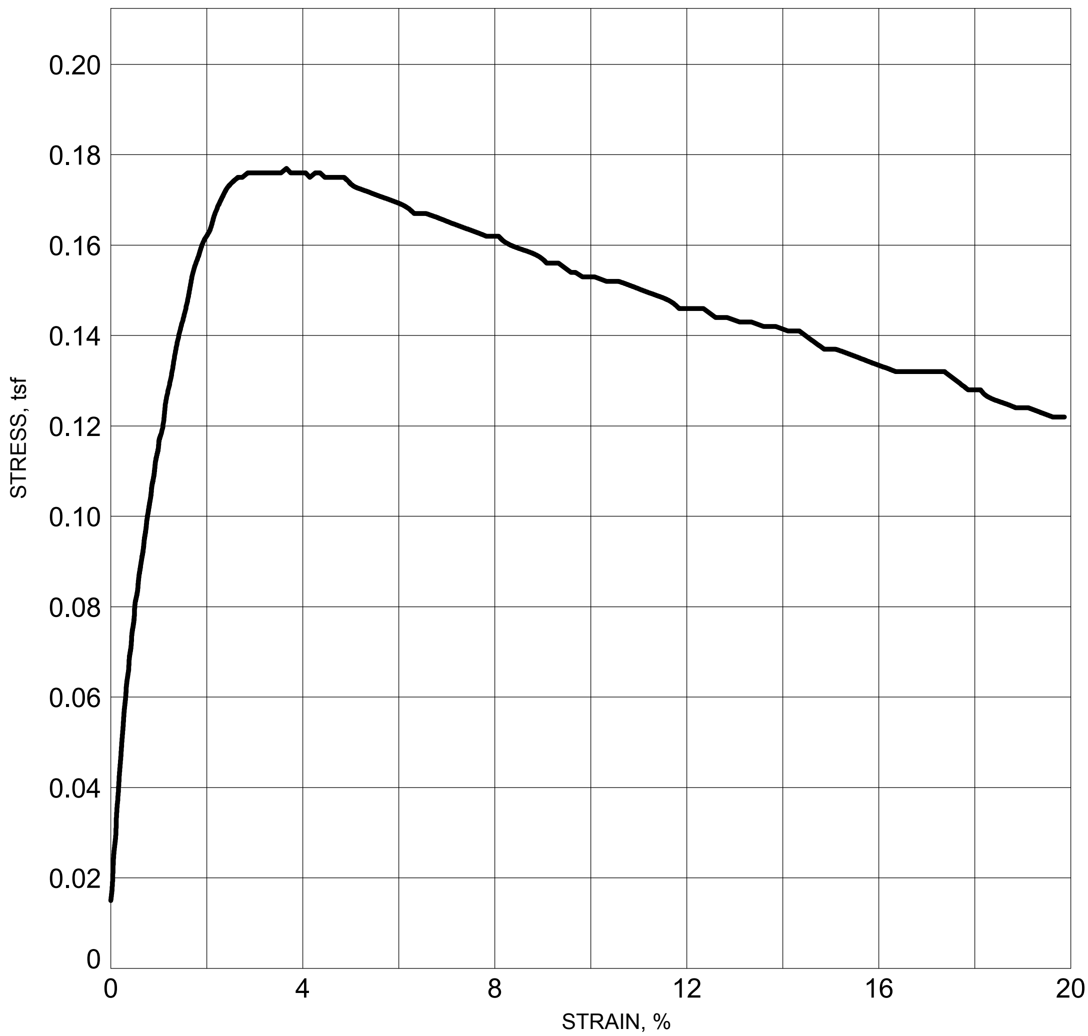
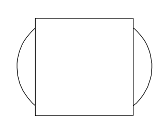
Tested By: CLP/SRT	Date Tested: 3/5/2018	**UNCONSOLIDATED UNDRAINED COMPRESSION TEST ASTM D2850**	**Island Road Marsh Creation and Nourishment (TE-117) Terrebonne Parish, LA**
Reviewed By: Karen Allen	Date Reviewed: 3/6/2018	**Project No.: 16715-040-03**	GEOENGINEERS



Boring ID	B-3
Depth (ft)	12-14
Water Content, %	80.5
Wet Density, pcf	100.0
Dry Density, pcf	55.4
Saturation, %	105.7
Void Ratio	2.09
Specimen Diameter	2.775
Specimen Height	6.019
Height/diameter ratio	2.17
Deviator Stress, tsf	0.177
Strain, %	3.7
Confining Pressure (psi)	5.2

Bulge



Failure Sketch

LL = PL = PI =

% 200= % Organic= Assumed Gs=2.74

Description: Very soft gray clay (CH)

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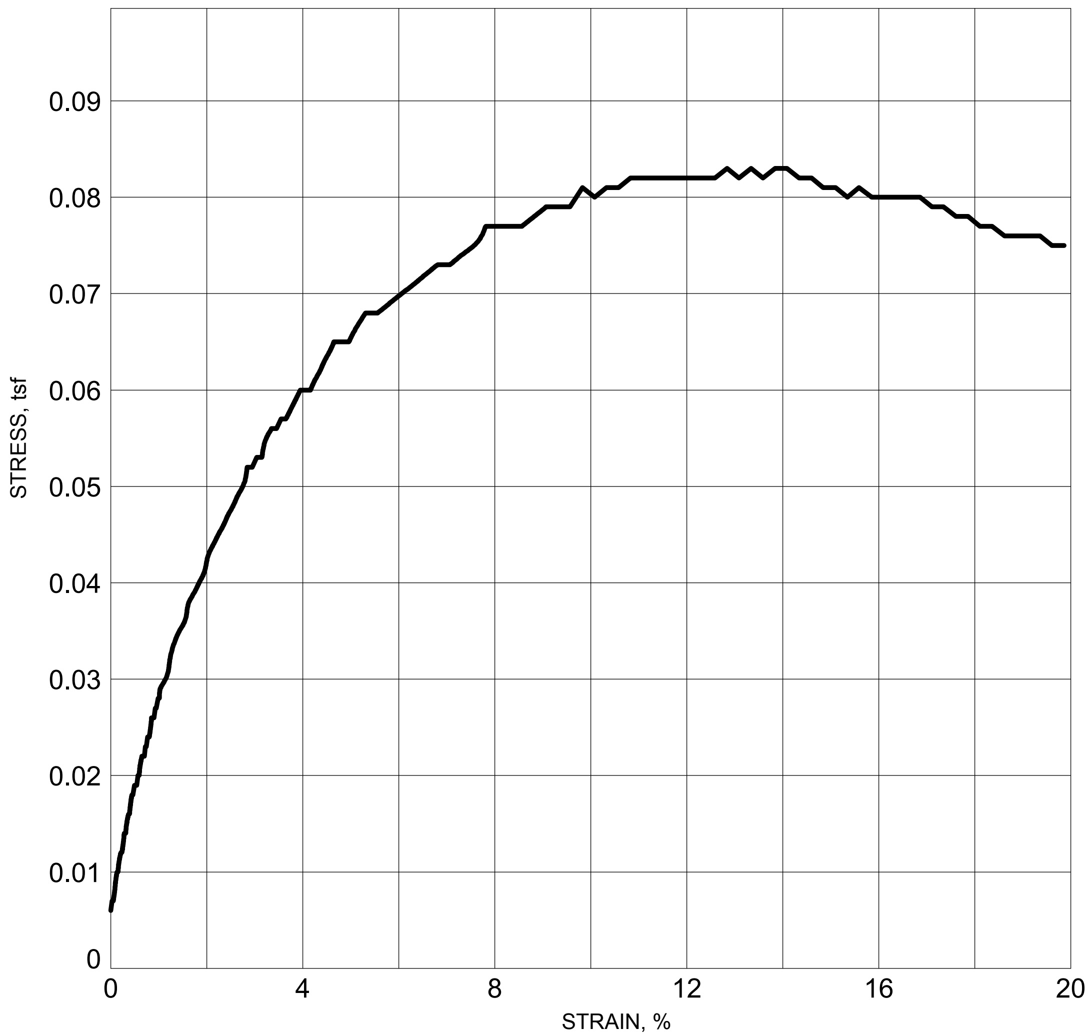
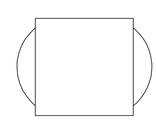
Tested By: CLP/SRT	Date Tested: 3/5/2018	**UNCONSOLIDATED UNDRAINED COMPRESSION TEST ASTM D2850**	**Island Road Marsh Creation and Nourishment (TE-117)** **Terrebonne Parish, LA**
Reviewed By: Karen Allen	Date Reviewed: 3/6/2018	**Project No.: 16715-040-03**	GeoEngineers

GEI-UNCONSOLIDATED UNDRAINED GRAPH - GEO TEMPLATE WITH LAB.GDT - 4/19/18 14:00 - P:\16\16715040\03\LAB\GINT LAB\16715-040-03 BR LAB.GPJ



Boring ID	B-4
Depth (ft)	0-2
Water Content, %	291.7
Wet Density, pcf	78.6
Dry Density, pcf	20.1
Saturation, %	106.2
Void Ratio	7.52
Specimen Diameter	2.791
Specimen Height	6.013
Height/diameter ratio	2.15
Deviator Stress, tsf	0.083
Strain, %	12.8
Confining Pressure (psi)	5.0

Bulge



Failure Sketch

LL = PL = PI =

% 200= % Organic= Assumed Gs=2.74

Description: Very soft dark gray peat with gray clay (PT)

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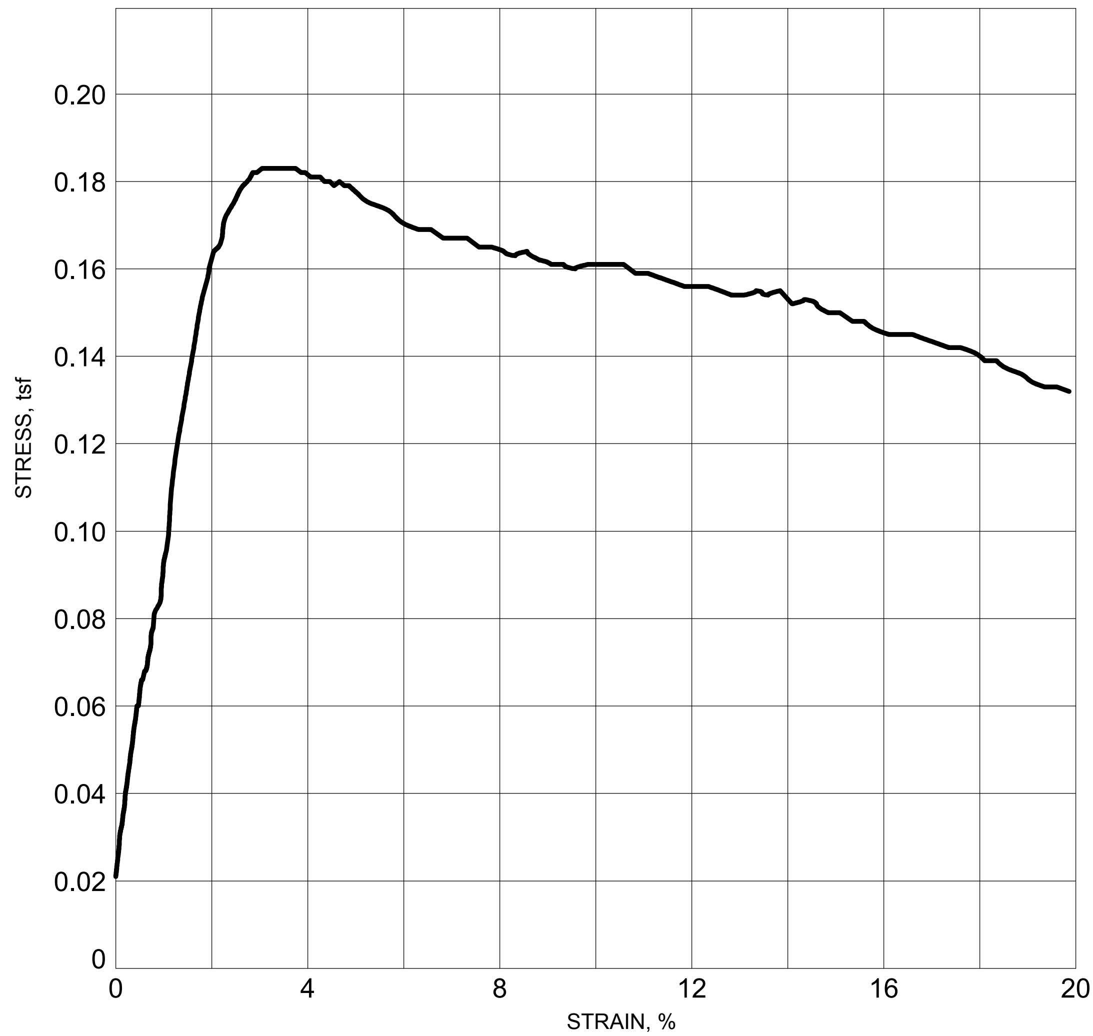
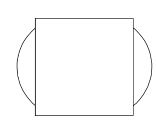
Tested By: CLP/SRT	Date Tested: 3/5/2018	**UNCONSOLIDATED UNDRAINED COMPRESSION TEST ASTM D2850**	**Island Road Marsh Creation and Nourishment (TE-117) Terrebonne Parish, LA**
Reviewed By: Karen Allen	Date Reviewed: 3/6/2018	**Project No.: 16715-040-03**	GEOENGINEERS



Boring ID	B-4
Depth (ft)	14-16
Water Content, %	84.0
Wet Density, pcf	99.5
Dry Density, pcf	54.1
Saturation, %	106.5
Void Ratio	2.16
Specimen Diameter	2.799
Specimen Height	6.028
Height/diameter ratio	2.15
Deviator Stress, tsf	0.183
Strain, %	3.1
Confining Pressure (psi)	6.0

Bulge



Failure Sketch

LL = PL = PI =

% 200= % Organic= Assumed Gs=2.74

Description: Very soft gray clay (CH)

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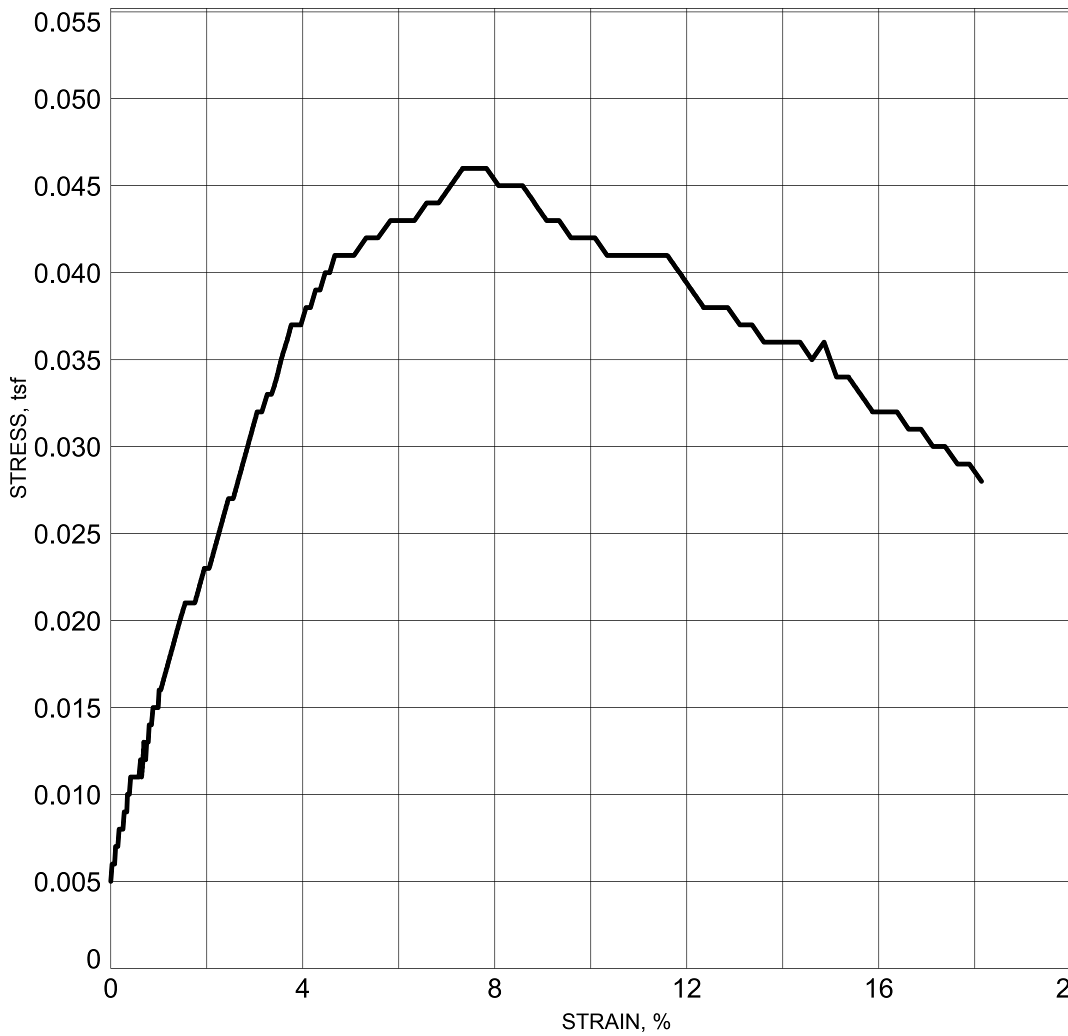
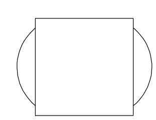
Tested By: CLP/SRT	Date Tested: 3/5/2018	**UNCONSOLIDATED UNDRAINED COMPRESSION TEST ASTM D2850**	**Island Road Marsh Creation and Nourishment (TE-117)** **Terrebonne Parish, LA**
Reviewed By: Karen Allen	Date Reviewed: 3/6/2018	**Project No.: 16715-040-03**	GEOENGINEERS



Boring ID	B-5
Depth (ft)	2-4
Water Content, %	57.9
Wet Density, pcf	106.5
Dry Density, pcf	67.5
Saturation, %	103.3
Void Ratio	1.53
Specimen Diameter	2.845
Specimen Height	5.706
Height/diameter ratio	2.01
Deviator Stress, tsf	0.046
Strain, %	7.3
Confining Pressure (psi)	5.0

Bulge



Failure Sketch

LL = PL = PI =

% 200= % Organic= Assumed Gs=2.74

Description: Very soft gray clay (CH)

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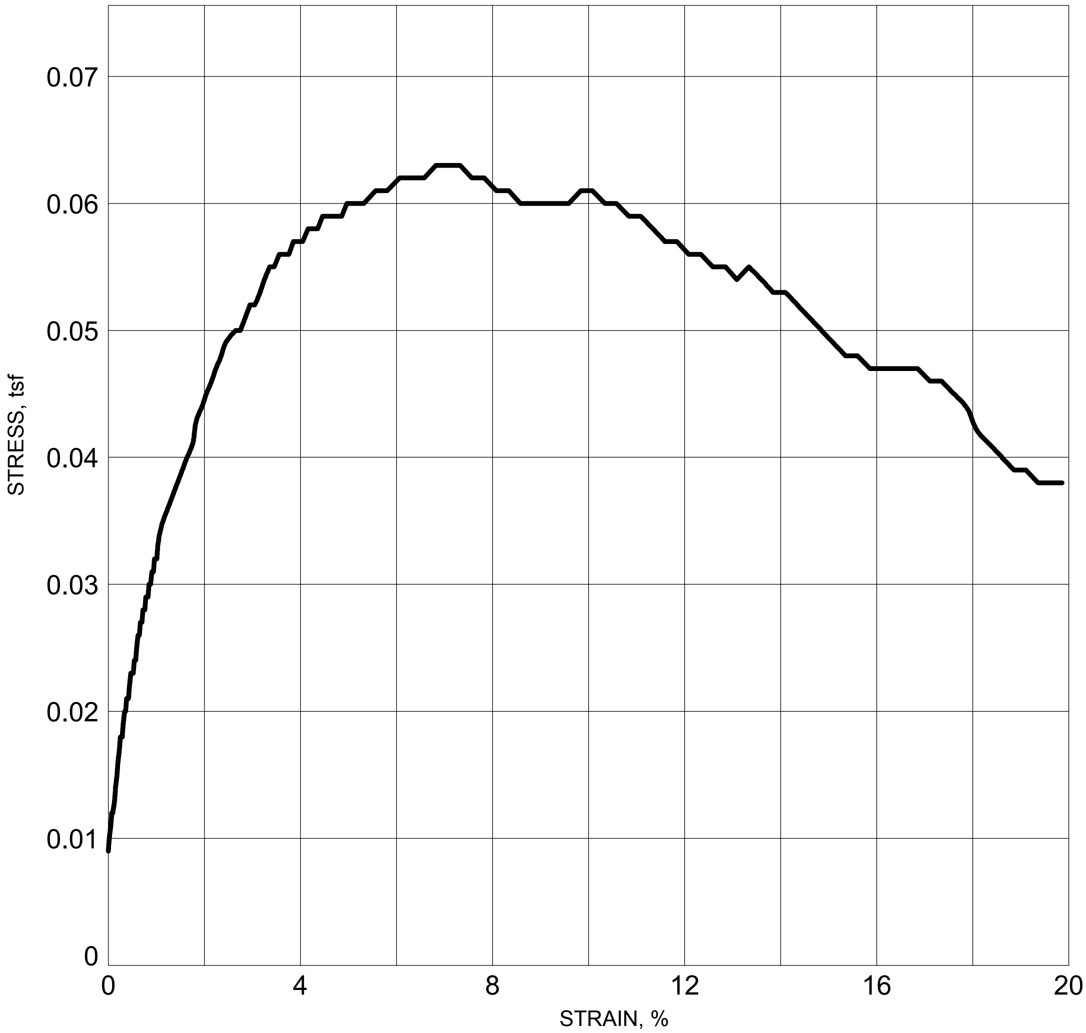
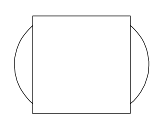
Tested By: SRT	Date Tested: 3/6/2018	**UNCONSOLIDATED UNDRAINED COMPRESSION TEST ASTM D2850**	**Island Road Marsh Creation and Nourishment (TE-117) Terrebonne Parish, LA**
Reviewed By: Karen Allen	Date Reviewed: 3/7/2018	**Project No.: 16715-040-03**	GEOENGINEERS



Boring ID	B-5		
Depth (ft)	4-5		
Water Content, %	50.7		
Wet Density, pcf	103.5		
Dry Density, pcf	68.7		
Saturation, %	93.3		
Void Ratio	1.49		
Specimen Diameter	2.809		
Specimen Height	5.993		
Height/diameter ratio	2.13		
Deviator Stress, tsf	0.063		
Strain, %	6.8		
Confining Pressure (psi)	5.0		

Bulge



Failure Sketch

LL = PL = PI =

% 200= % Organic= Assumed Gs=2.74

Description: Very soft gray clay with silt lenses (CH)

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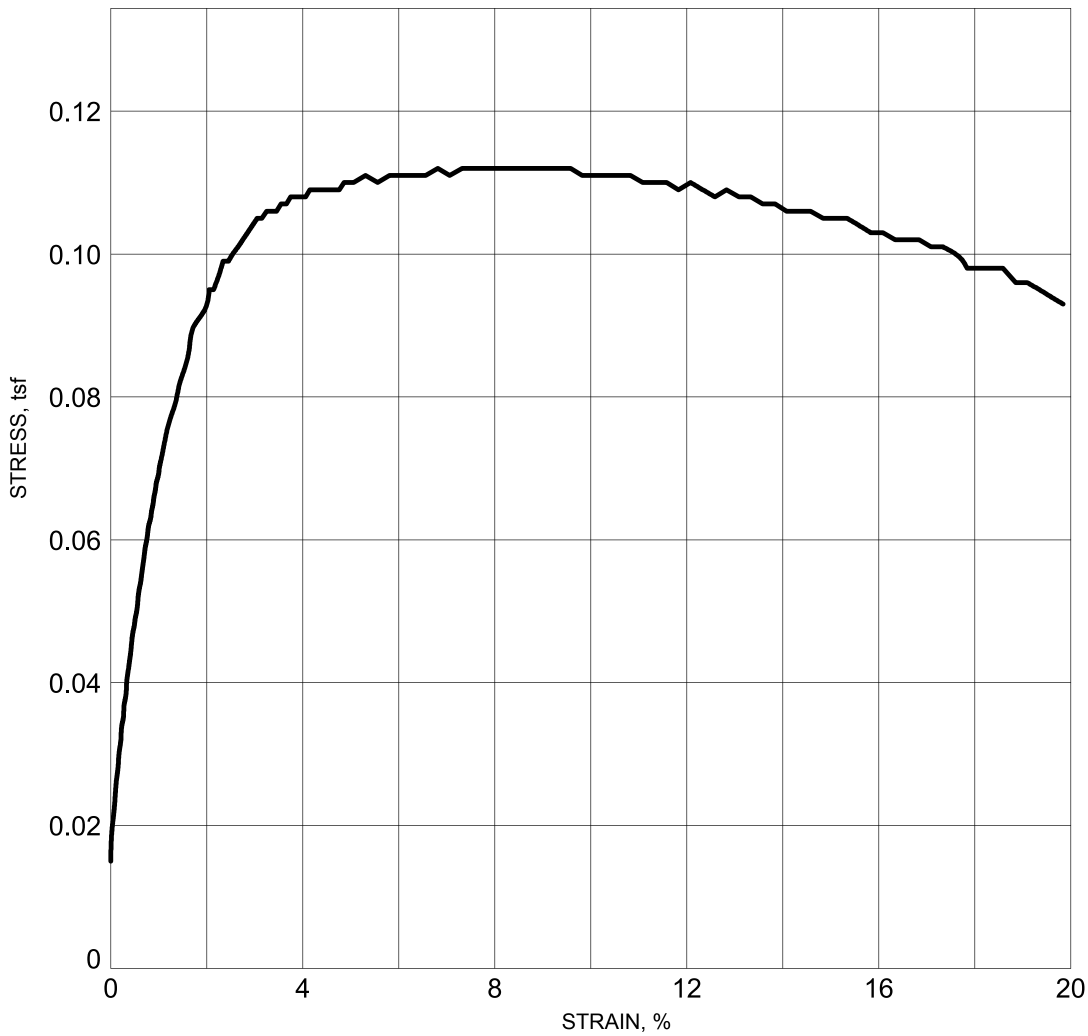
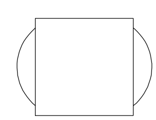
Tested By: SRT	Date Tested: 3/6/2018	**UNCONSOLIDATED UNDRAINED COMPRESSION TEST ASTM D2850**	**Island Road Marsh Creation and Nourishment (TE-117)** **Terrebonne Parish, LA**
Reviewed By: Karen Allen	Date Reviewed: 3/7/2018	**Project No.: 16715-040-03**	GEOENGINEERS

GEI-UNCONSOLIDATED UNDRAINED GRAPH - GEO TEMPLATE WITH LAB.GDT - 4/19/18 14:00 - P:\16\16715040\03\LAB\GINT LAB\16715-040-03 BR LAB.GPJ



Boring ID	B-5
Depth (ft)	12-14
Water Content, %	64.2
Wet Density, pcf	99.4
Dry Density, pcf	60.6
Saturation, %	96.5
Void Ratio	1.82
Specimen Diameter	2.807
Specimen Height	6.026
Height/diameter ratio	2.15
Deviator Stress, tsf	0.112
Strain, %	6.8
Confining Pressure (psi)	5.2

Bulge



Failure Sketch

LL = PL = PI =

% 200= % Organic= Assumed Gs=2.74

Description: Very soft gray clay with silt lenses (CH)

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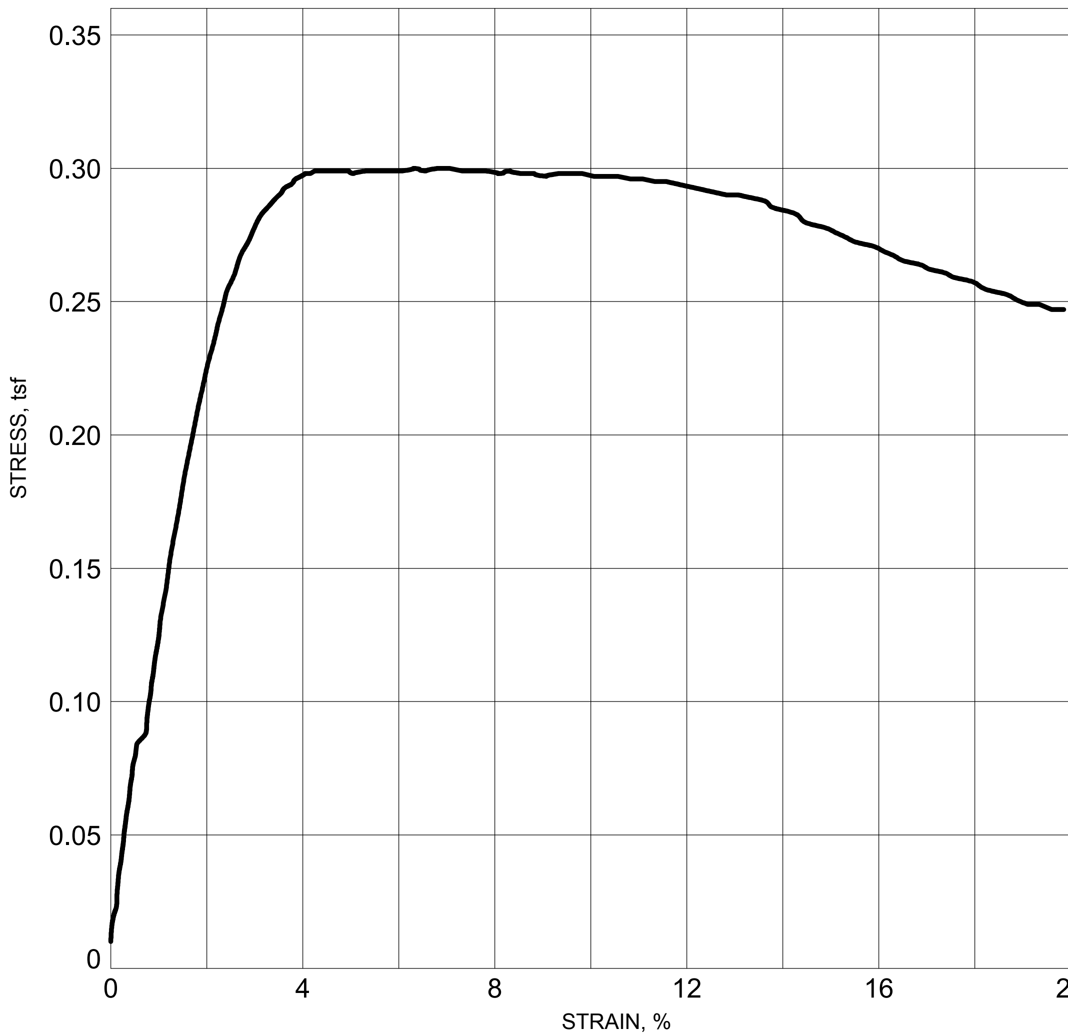
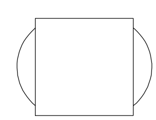
Tested By: SRT	Date Tested: 3/6/2018	**UNCONSOLIDATED UNDRAINED COMPRESSION TEST ASTM D2850**	**Island Road Marsh Creation and Nourishment (TE-117)** **Terrebonne Parish, LA**
Reviewed By: Karen Allen	Date Reviewed: 3/7/2018	**Project No.: 16715-040-03**	GEOENGINEERS

GEI-UNCONSOLIDATED UNDRAINED GRAPH - GEO TEMPLATE WITH LAB.GDT - 4/19/18 14:00 - P:\16\16715040\03\LAB\GINT LAB\16715-040-03 BR LAB.GPJ



Boring ID	B-5
Depth (ft)	16-18
Water Content, %	60.4
Wet Density, pcf	98.1
Dry Density, pcf	61.1
Saturation, %	92.1
Void Ratio	1.80
Specimen Diameter	2.820
Specimen Height	6.018
Height/diameter ratio	2.13
Deviator Stress, tsf	0.300
Strain, %	6.3
Confining Pressure (psi)	6.8

Bulge



Failure Sketch

LL = PL = PI =

% 200= % Organic= Assumed Gs=2.74

Description: Soft gray clay with silt pockets, silt seams and shell fragments (CH)

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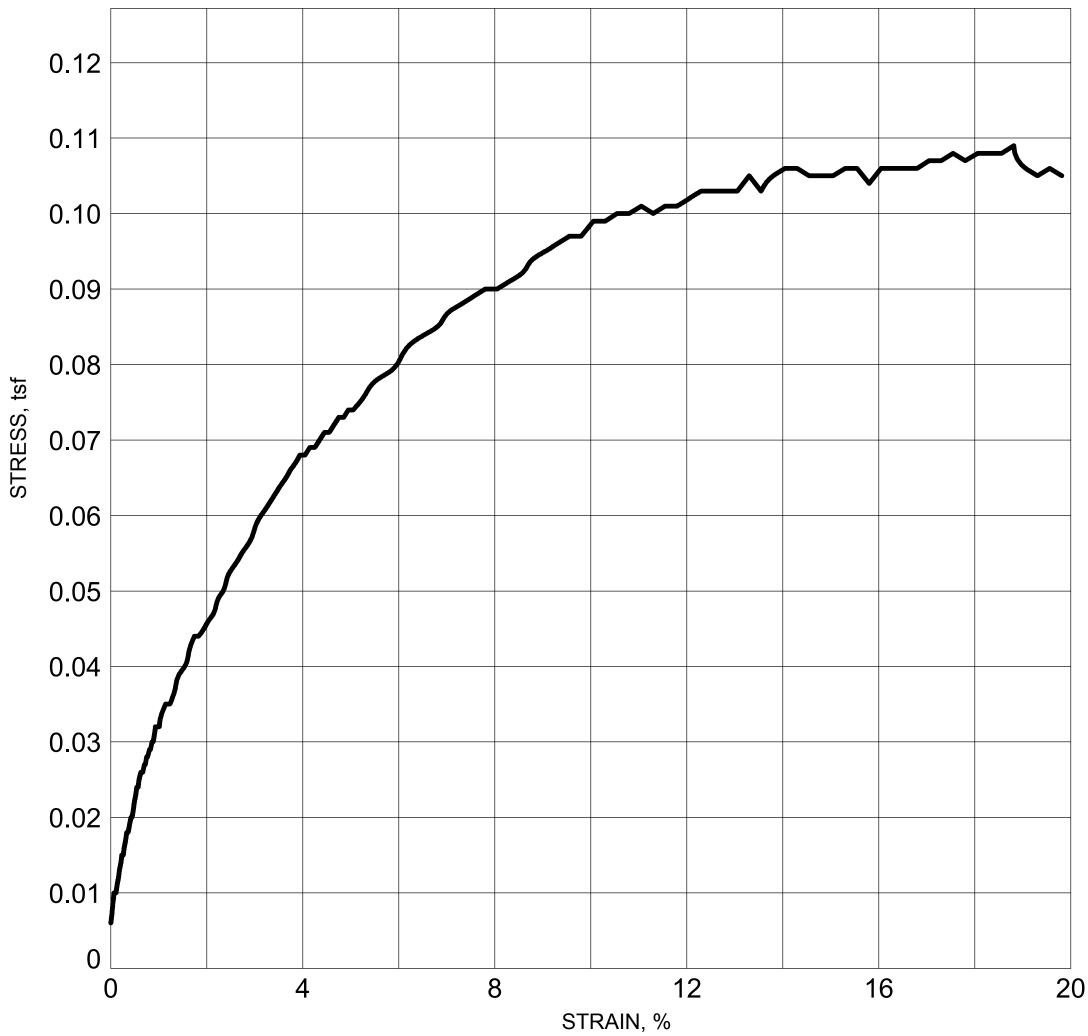
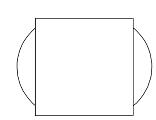
Tested By: SRT	Date Tested: 3/6/2018	**UNCONSOLIDATED UNDRAINED COMPRESSION TEST ASTM D2850**	**Island Road Marsh Creation and Nourishment (TE-117)** **Terrebonne Parish, LA**
Reviewed By: Karen Allen	Date Reviewed: 3/7/2018	**Project No.: 16715-040-03**	GEOENGINEERS



Boring ID	B-6
Depth (ft)	1-2
Water Content, %	336.4
Wet Density, pcf	76.6
Dry Density, pcf	17.6
Saturation, %	105.5
Void Ratio	8.74
Specimen Diameter	2.764
Specimen Height	6.010
Height/diameter ratio	2.17
Deviator Stress, tsf	0.106
Strain, %	14.1
Confining Pressure (psi)	5.0

Bulge



Failure Sketch

LL = PL = PI =

% 200= % Organic= Assumed Gs=2.74

Description: Very soft dark gray peat with organic gray clay (PT)

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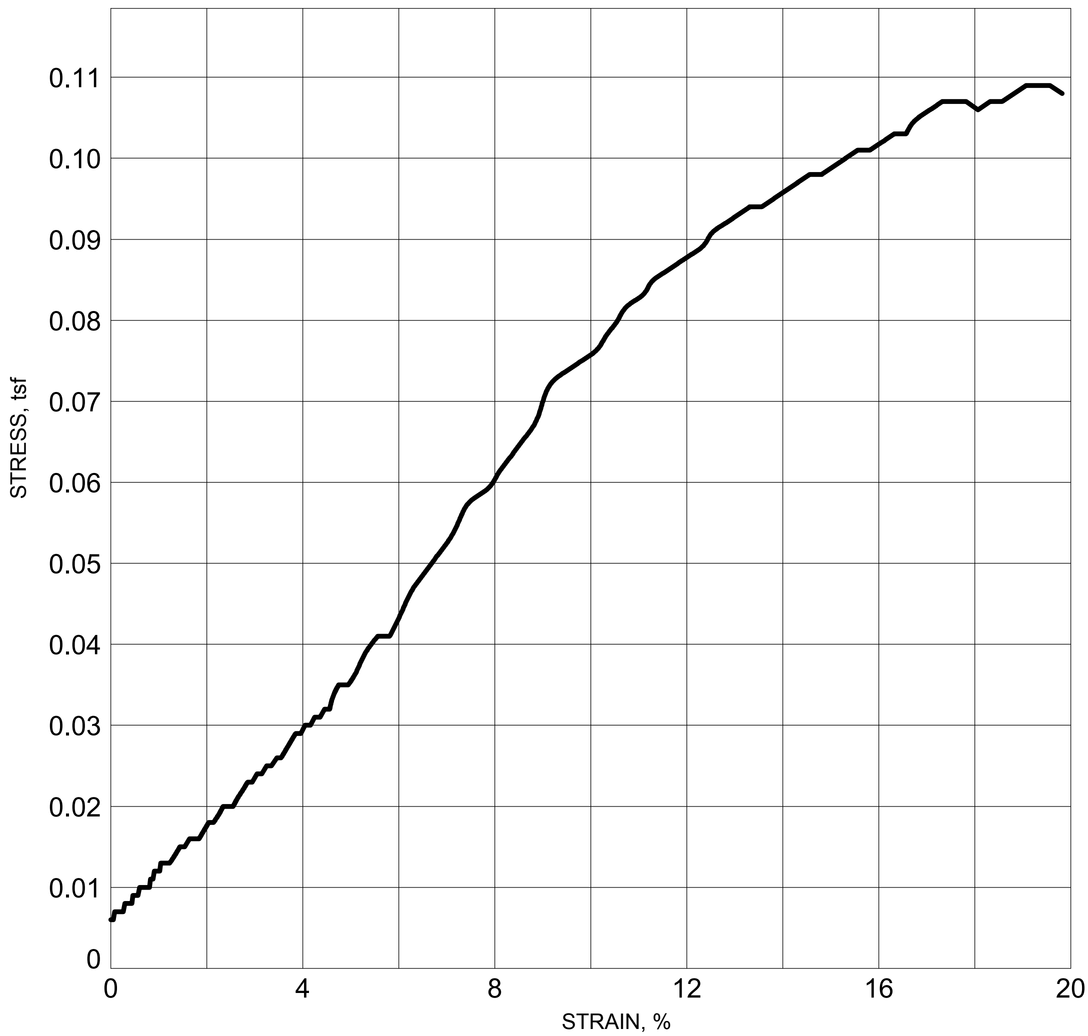
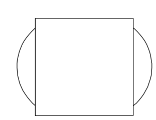
Tested By: CLP	Date Tested: 3/6/2018	**UNCONSOLIDATED UNDRAINED COMPRESSION TEST ASTM D2850**	**Island Road Marsh Creation and Nourishment (TE-117) Terrebonne Parish, LA**
Reviewed By: Karen Allen	Date Reviewed: 3/7/2018	**Project No.: 16715-040-03**	GEOENGINEERS



Boring ID	B-6
Depth (ft)	4-6
Water Content, %	37.2
Wet Density, pcf	117.7
Dry Density, pcf	85.8
Saturation, %	102.8
Void Ratio	0.99
Specimen Diameter	2.774
Specimen Height	4.610
Height/diameter ratio	1.66
Deviator Stress, tsf	0.099
Strain, %	15.0
Confining Pressure (psi)	5.0

Bulge



Failure Sketch

LL = PL = PI =

% 200= % Organic= Assumed Gs=2.74

Description: Very soft gray silty clay with sandy silt lenses and layers (CL)

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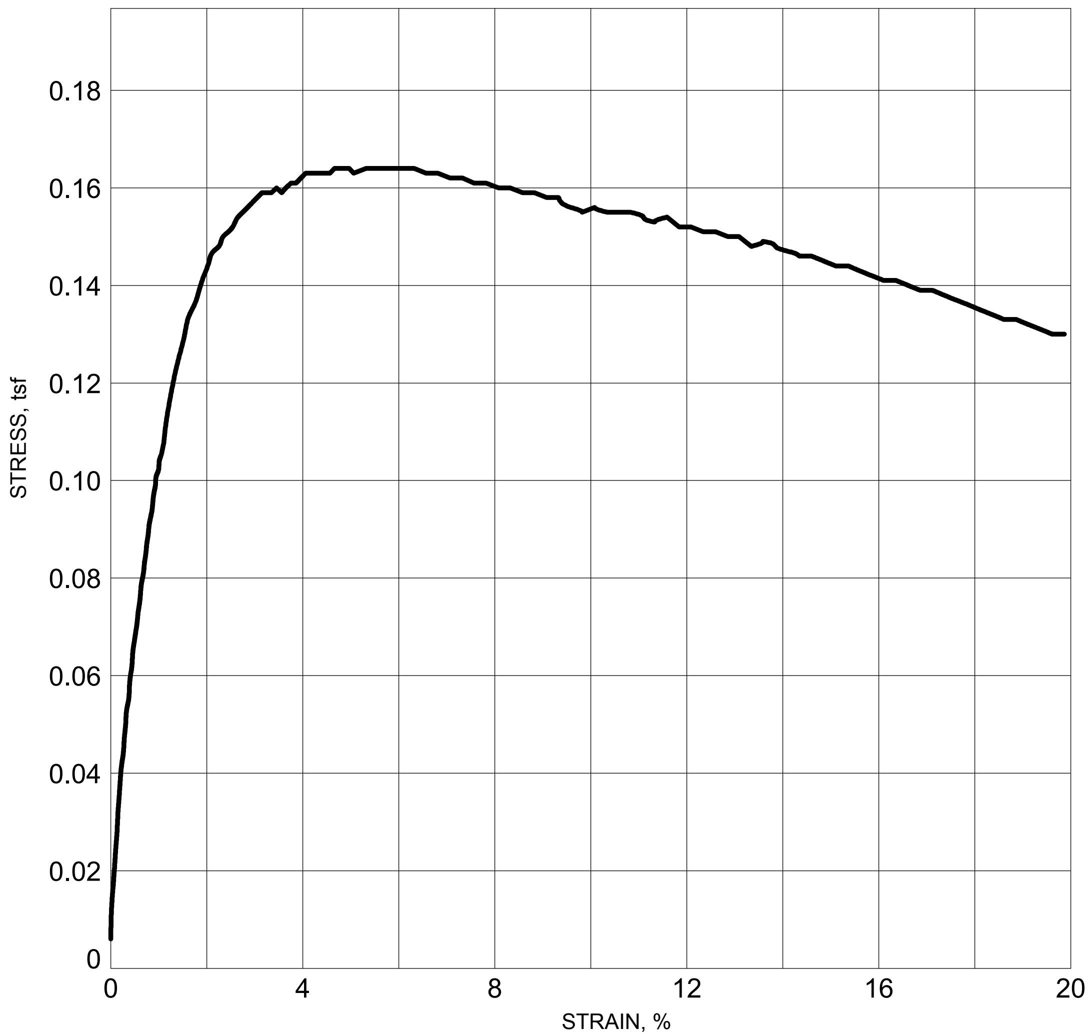
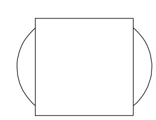
Tested By: CLP	Date Tested: 3/5/2018	**UNCONSOLIDATED UNDRAINED COMPRESSION TEST ASTM D2850**	**Island Road Marsh Creation and Nourishment (TE-117)** **Terrebonne Parish, LA**
Reviewed By: Karen Allen	Date Reviewed: 3/6/2018	**Project No.: 16715-040-03**	GeoEngineers



Boring ID	B-6
Depth (ft)	12-14
Water Content, %	79.7
Wet Density, pcf	97.0
Dry Density, pcf	54.0
Saturation, %	100.8
Void Ratio	2.17
Specimen Diameter	2.818
Specimen Height	6.027
Height/diameter ratio	2.14
Deviator Stress, tsf	0.164
Strain, %	4.7
Confining Pressure (psi)	5.2

Bulge



Failure Sketch

LL = PL = PI =

% 200= % Organic= Assumed Gs=2.74

Description: Very soft gray clay with silt seams (CH)

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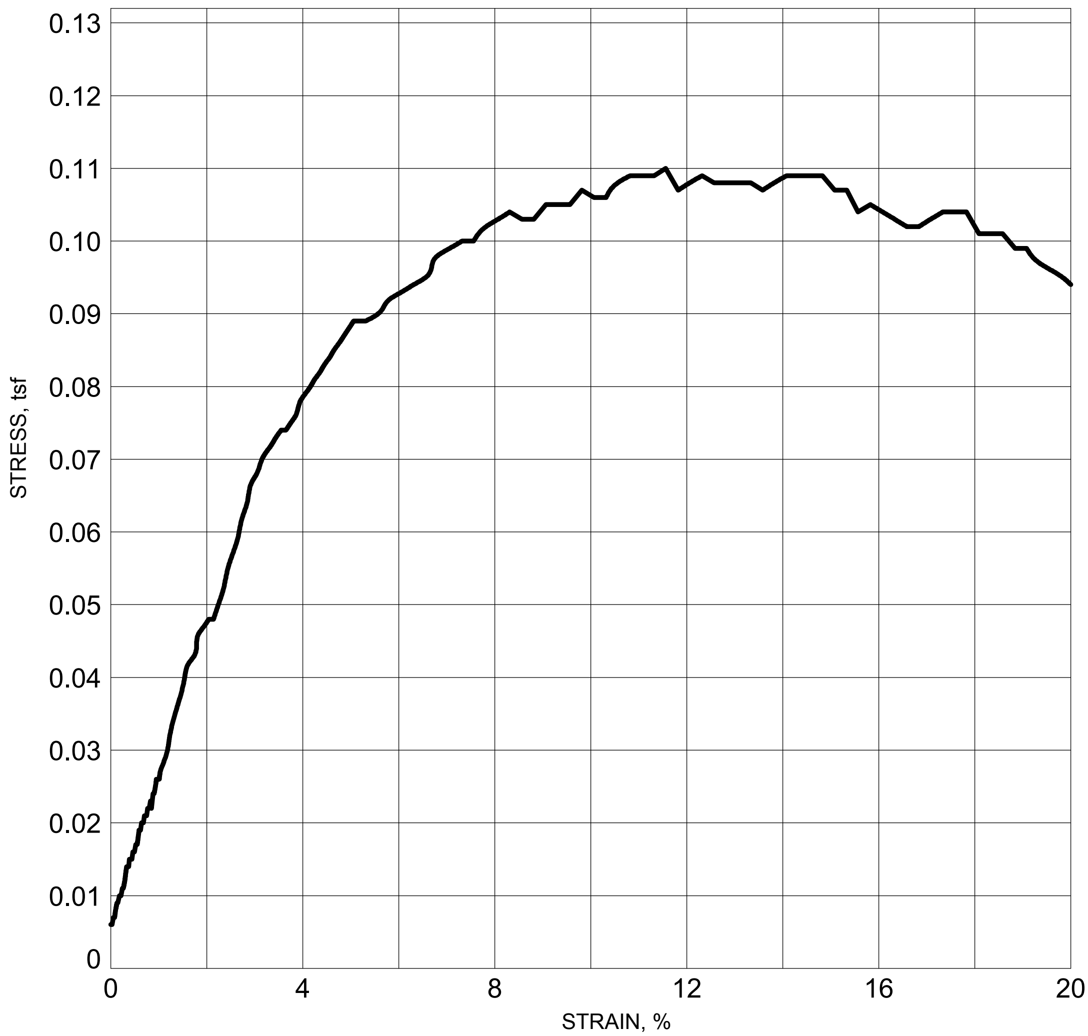
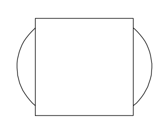
Tested By: SRT	Date Tested: 3/6/2018	**UNCONSOLIDATED UNDRAINED COMPRESSION TEST ASTM D2850**	**Island Road Marsh Creation and Nourishment (TE-117)** **Terrebonne Parish, LA**
Reviewed By: Karen Allen	Date Reviewed: 3/7/2018	**Project No.: 16715-040-03**	GEOENGINEERS

GEI-UNCONSOLIDATED UNDRAINED GRAPH - GEO TEMPLATE WITH LAB.GDT - 4/19/18 14:00 - P:\16\16715040\03\LAB\GINT LAB\16715-040-03 BR LAB.GPJ



Boring ID	B-6
Depth (ft)	16-18
Water Content, %	76.9
Wet Density, pcf	102.3
Dry Density, pcf	57.8
Saturation, %	107.7
Void Ratio	1.96
Specimen Diameter	2.842
Specimen Height	5.955
Height/diameter ratio	2.10
Deviator Stress, tsf	0.110
Strain, %	11.6
Confining Pressure (psi)	6.8

Bulge



Failure Sketch

LL = PL = PI =

% 200= % Organic= Assumed Gs=2.74

Description: Very soft gray clay (CH)

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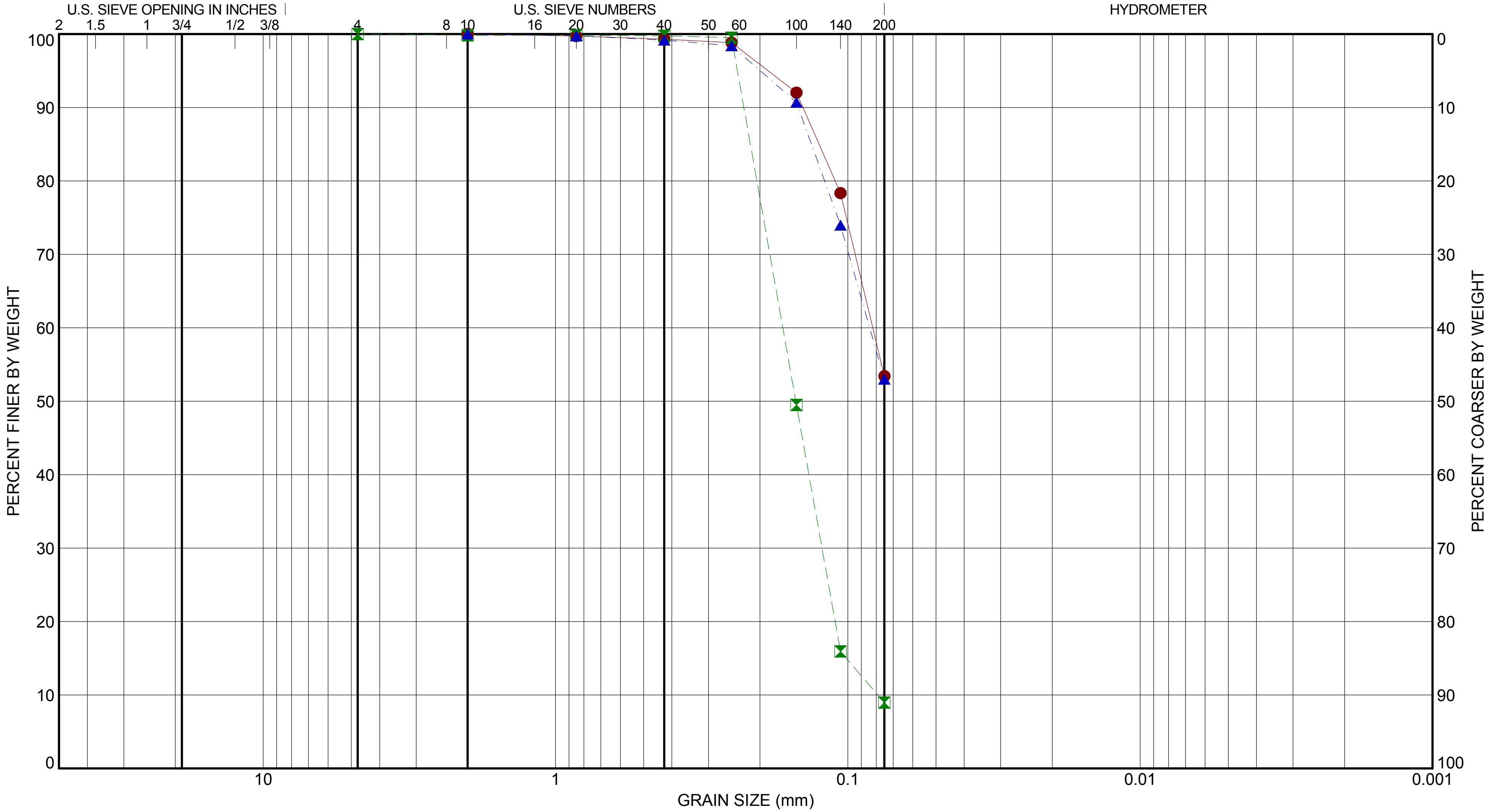
Tested By: SRT	Date Tested: 3/6/2018	UNCONSOLIDATED UNDRAINED COMPRESSION TEST ASTM D2850	Island Road Marsh Creation and Nourishment (TE-117) Terrebonne Parish, LA
Reviewed By: Karen Allen	Date Reviewed: 3/7/2018	Project No.: 16715-040-03	GEOENGINEERS

GEI-UNCONSOLIDATED UNDRAINED GRAPH - GEO TEMPLATE WITH LAB.GDT - 4/19/18 14:00 - P:\16\16715040\03\LAB\GINT LAB\16715-040-03 BR LAB.GPJ

Soil Boring ID	Depth (ft)	Classification	%Gravel	%Sand	%Silt	%Clay	D90	D60	D50	D30	D10	Cc	Cu	LL	PL	PI
● B-1	8.0	Gray sandy clayey silt (CL-ML)	0.0	46.6	53.4		0.142	0.082								
⧗ B-1	12.0	Gray sand with silt and clay pockets (SP-SM)	0.0	91.0	9.0		0.227	0.167	0.151	0.123	0.079	1.14	2.12			
▲ B-2a	6.0	Gray sandy clayey silt (CL-ML)	0.0	47.0	53.0		0.148	0.084								



GRAVEL		SAND			SILT OR CLAY
coarse	fine	coarse	medium	fine	

Tested By: NLP	Date Tested: 3/5/2018	**GRAIN SIZE DISTRIBUTION** **ASTM D422/D1140/D6913/T88**
Reviewed By: Karen Allen	Date Reviewed: 3/12/2018	**Project No.: 16715-040-03**

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Island Road Marsh Creation and Nourishment (TE-117)
Terrebonne Parish, LA

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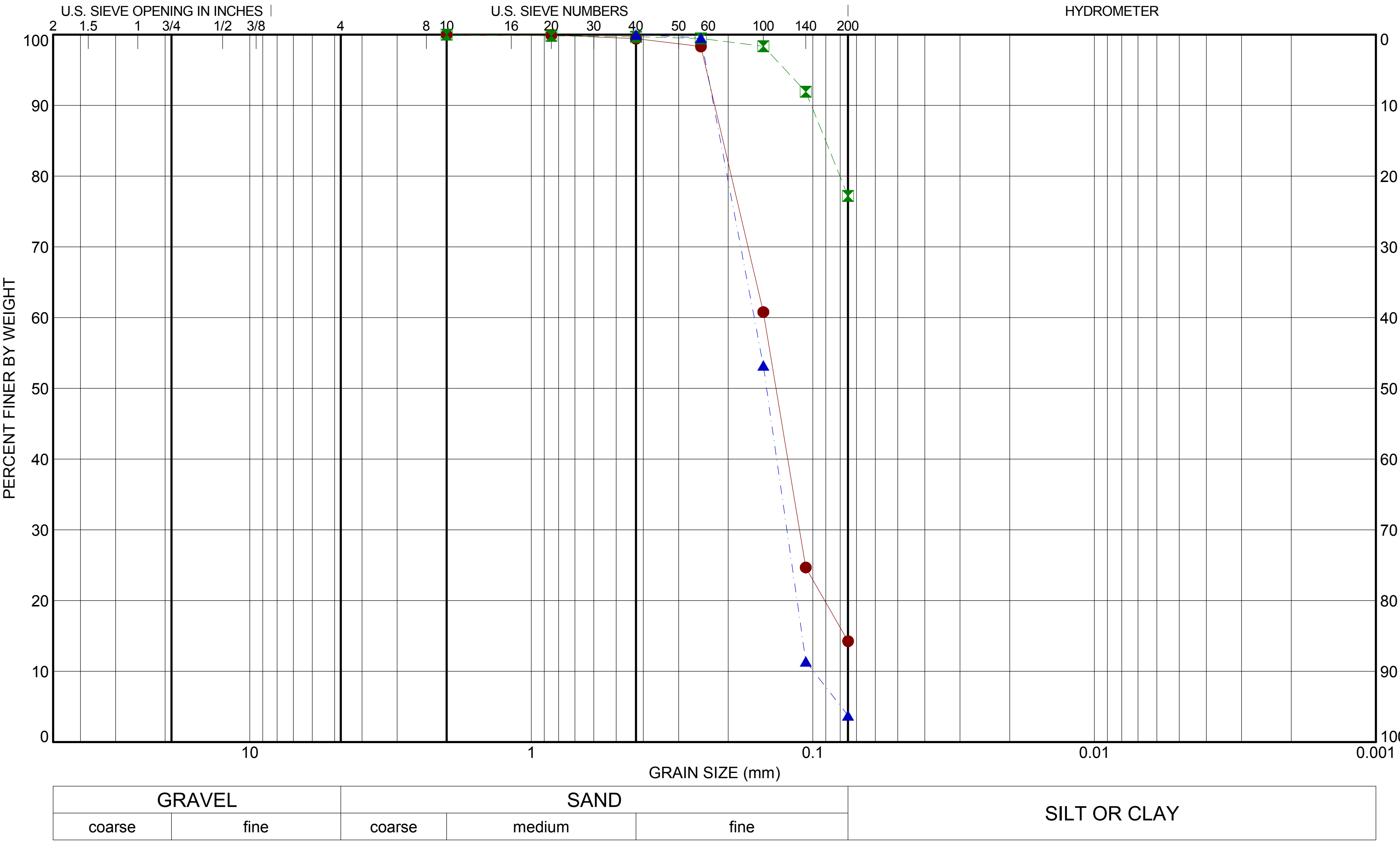
GEI - GRAIN SIZE - GEO TEMPLATE WITH LAB.GDT - 3/26/18 10:40 - P:\16\16715040\03\LAB\GINT LAB\16715-040-03 BR LAB.GPJ

	Soil Boring ID	Depth (ft)	Classification	%Gravel	%Sand	%Silt	%Clay	D90	D60	D50	D30	D10	Cc	Cu	LL	PL	PI
●	B-3	8.0	Gray silty clayey sand (SC-SM)	0.0	85.7	14.3		0.223	0.149	0.135	0.112						
⧗	B-4	4.0	Gray sandy silt with 3" clay layer in center (ML)	0.0	22.8	77.2		0.101									
▲	B-4	10.0	Gray sand (SP)	0.0	96.2	3.8		0.225	0.162	0.146	0.124	0.099	0.95	1.62			



GEI - GRAIN SIZE - GEO TEMPLATE WITH LAB.GDT - 3/26/18 10:40 - P:\16\16715040\03\LAB\GINT LAB\16715-040-03 BR LAB.GPJ

Tested By: NLP	Date Tested: 3/5/2018	**GRAIN SIZE DISTRIBUTION** **ASTM D422/D1140/D6913/T88**	**Island Road Marsh Creation and Nourishment (TE-117)** **Terrebonne Parish, LA**
Reviewed By: Karen Allen	Date Reviewed: 3/12/2018	**Project No.: 16715-040-03**	GeoEngineers

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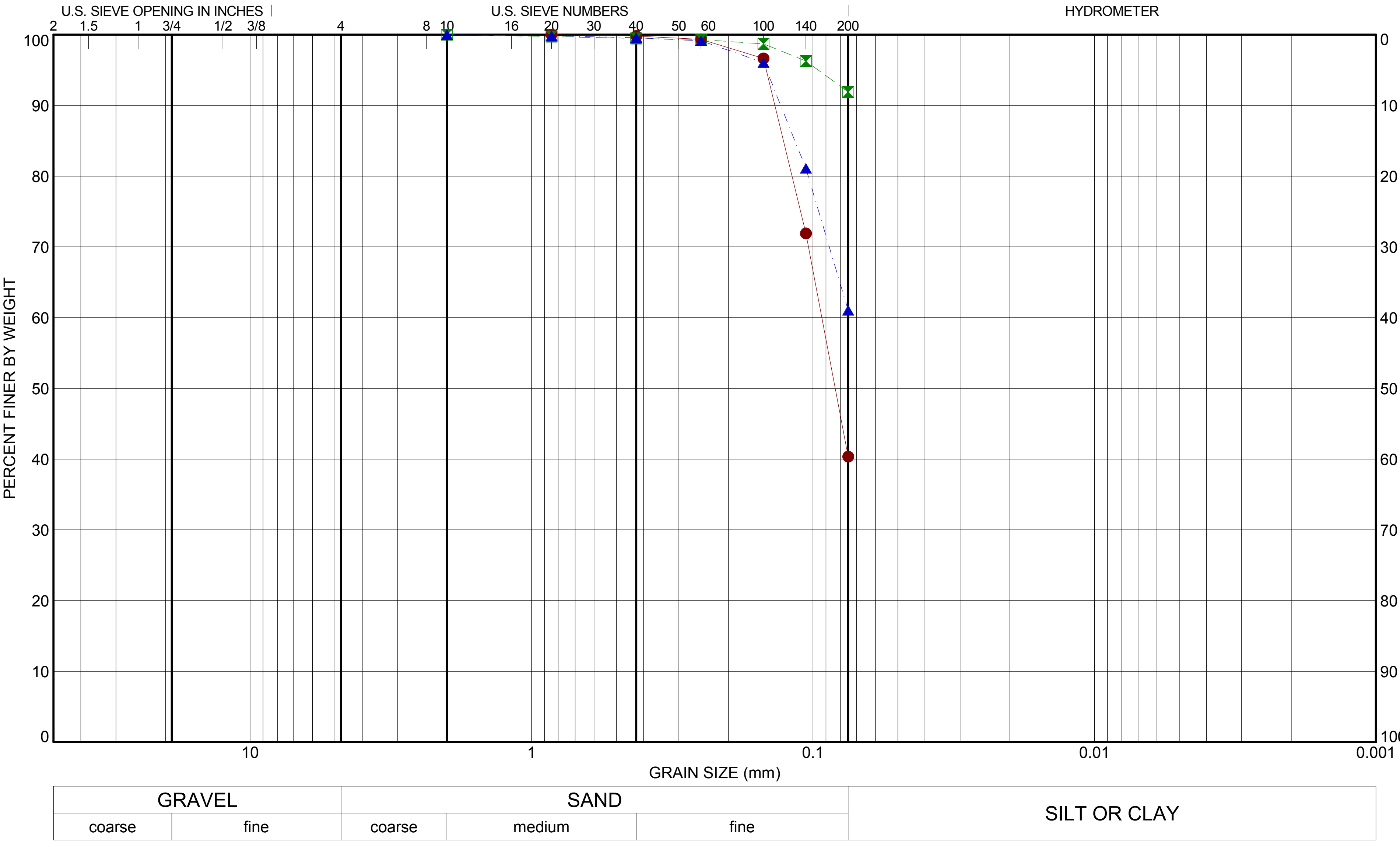
	Soil Boring ID	Depth (ft)	Classification	%Gravel	%Sand	%Silt	%Clay	D90	D60	D50	D30	D10	Cc	Cu	LL	PL	PI
●	B-5	6.0	Gray silty sand with clay lenses (SM)	0.0	59.6	40.4		0.137	0.093	0.083							
⧗	B-6	8.0	Gray clay with silty sand layers (CH)	0.0	8.1	91.9											
▲	B-7	8.0	Gray sandy clayey silt (CL-ML)	0.0	39.0	61.0		0.13									



Tested By:	Date Tested:
NLP	3/7/2018
Reviewed By:	**Date Reviewed:**
Karen Allen	3/12/2018

GRAIN SIZE DISTRIBUTION

ASTM D422/D1140/D6913/T88

Project No.: 16715-040-03

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Island Road Marsh Creation and Nourishment (TE-117)

Terrebonne Parish, LA

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GEI - GRAIN SIZE - GEO TEMPLATE WITH LAB.GDT - 3/26/18 10:40 - P:\16\16715040\03\LAB\GINT LAB\16715-040-03 BR LAB.GPJ

Soil Boring ID	Depth Interval (ft)	D2488	Test Type	D2216	D2166/D2850		D4318			D422/D1140/D6913	D2166/D2850					D4648	Comments
		Visual Description		Moisture (%)	Unit Weight (PCF)		Atterberg Limits			%<#200 Sieve	Shear Strength (KSF)	Remolded Strength (KSF)	Failure Strain (%)	Confining Pressure (PSI)	Failure Type	Mini Vane Shear Strength (KSF)	
					Wet	Dry	LL	PL	PI								
Composite B-1	0.0 - 16.0	Gray clayey sand (Composite) (SC)	AL HYD SG ORG MC	50.8			35	18	17	39.3							OC=2.81%, SG=2.785
Composite B-2	0.0 - 16.0	Gray clay with sand (Composite) (CH)	AL HYD SG ORG MC	65.0			51	18	33	73.6							OC=3.76%, SG=2.823
Composite B-2a	0.0 - 14.0	Gray sandy clay (Composite) (CL)	AL HYD SG ORG MC	55.0			43	17	26	66.2							OC=3.27%, SG=2.756
Composite B-3	0.0 - 16.0	Gray clay with sand (Composite) (CH)	AL HYD SG ORG MC	62.6			51	21	30	75.7							OC=3.50%, SG=2.695
Composite B-4	0.0 - 14.0	Gray silty sand (Composite) (SM)	AL HYD SG ORG MC	51.5			NP	NP	NP	37.5							OC=2.80%, SG=2.683
Composite B-5	0.0 - 16.0	Gray sandy clay (Composite) (CL)	AL HYD SG ORG MC	53.7			40	17	23	69.7							OC=2.88%, SG=2.710
Composite B-6	0.0 - 16.0	Gray clay (Composite) (CH)	AL HYD SG ORG MC	83.2			70	26	44	96.5							OC=4.64%, SG=2.729
Composite B-7	0.0 - 16.0	Gray silty clay with sand, organic matter and shell fragments (Composite) (CL)	AL HYD SG ORG MC	47.2			41	21	20	80.8							OC=2.75%, SG=2.715

Disclaimer: The results presented relate only to those samples tested.
Note: ASTM standard identification numbers shown above each test description.

Multiple Shear = MS Vertical Shear = VS Angle Shear = AS
Slickensided = SLS Bulge = B Crumble = C

AASHTO ACCREDITED

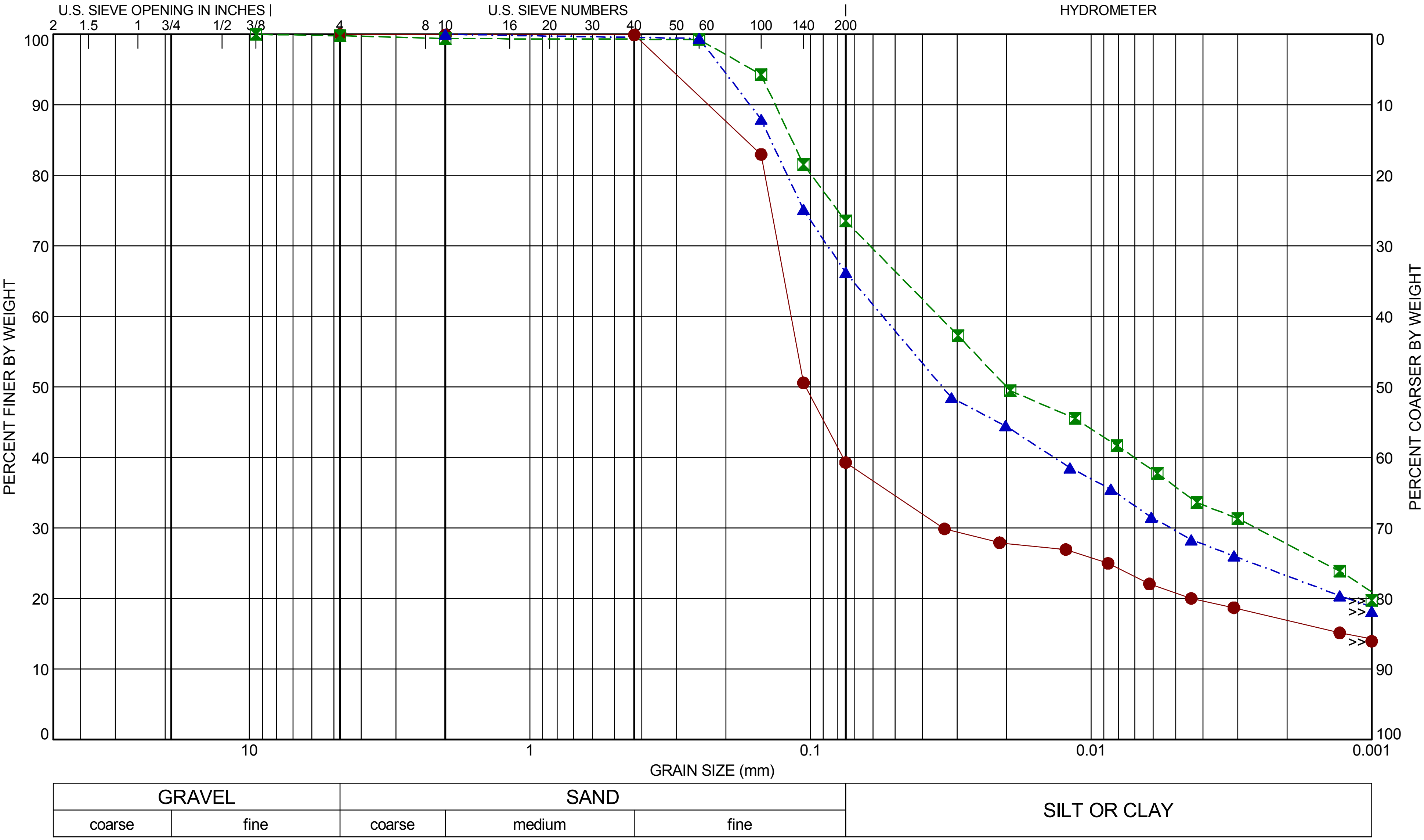
Technical Responsibility: Karen Allen
Title: QAM
Date: 4/23/18

Summary of Lab Results
Project No.: 16715-040-03

Island Road Marsh Creation and Nourishment (TE-117)
Terrebonne Parish, LA

GEOENGINEERS

	Soil Boring ID	Depth (ft)	Classification	%Gravel	%Sand	%Silt	%Clay	D90	D60	D50	D30	D10	Cc	Cu	LL	PL	PI
●	Composite B-1	0.0	Gray clayey sand (Composite) (SC)	0.0	60.7	18.5	20.8	0.231	0.117	0.104	0.034				35	18	17
⊠	Composite B-2	0.0	Gray clay with sand (Composite) (CH)	0.2	26.2	37.7	35.8	0.134	0.035	0.02	0.003				51	18	33
▲	Composite B-2a	0.0	Gray sandy clay (Composite) (CL)	0.0	33.8	36.6	29.6	0.164	0.055	0.034	0.005				43	17	26



Tested By: NLP	Date Tested: 3/16/2018	GRAIN SIZE DISTRIBUTION	Island Road Marsh Creation and Nourishment (TE-117) Terrebonne Parish, LA
Reviewed By: Karen Allen	Date Reviewed: 3/26/2018	ASTM D422/D1140/D6913/T88 Project No.: 16715-040-03	GEOENGINEERS

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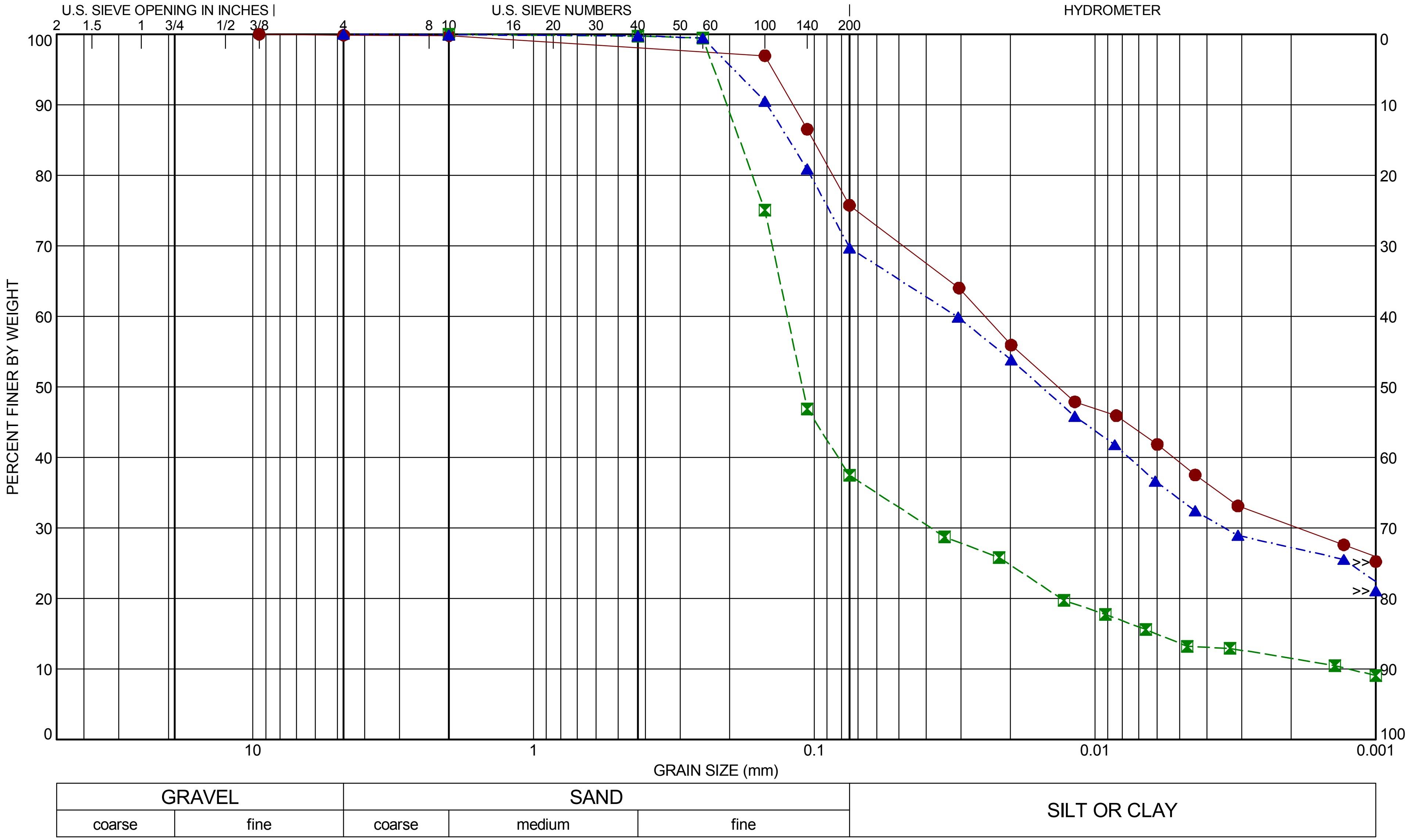
GEI - GRAIN SIZE - GEO TEMPLATE WITH LAB.GDT - 4/23/18 11:15 - P:\16\16715040\03\LAB\GINT LAB\16715-040-03 BR LAB.GPJ

	Soil Boring ID	Depth (ft)	Classification	%Gravel	%Sand	%Silt	%Clay	D90	D60	D50	D30	D10	Cc	Cu	LL	PL	PI
●	Composite B-3	0.0	Gray clay with sand (Composite) (CH)	0.1	24.1	36.5	39.3	0.119	0.025	0.014	0.002				51	21	30
⊠	Composite B-4	0.0	Gray silty sand (Composite) (SM)	0.0	62.5	23.8	13.6	0.205	0.125	0.11	0.038	0.001	9.49	99.83	NP	NP	NP
▲	Composite B-5	0.0	Gray sandy clay (Composite) (CL)	0.0	30.3	35.6	34.1	0.147	0.031	0.016	0.003				40	17	23



Tested By: NLP	Date Tested: 3/16/2018
Reviewed By: Karen Allen	Date Reviewed: 3/26/2018

GRAIN SIZE DISTRIBUTION
ASTM D422/D1140/D6913/T88

Project No.: 16715-040-03

Island Road Marsh Creation and Nourishment (TE-117)

Terrebonne Parish, LA

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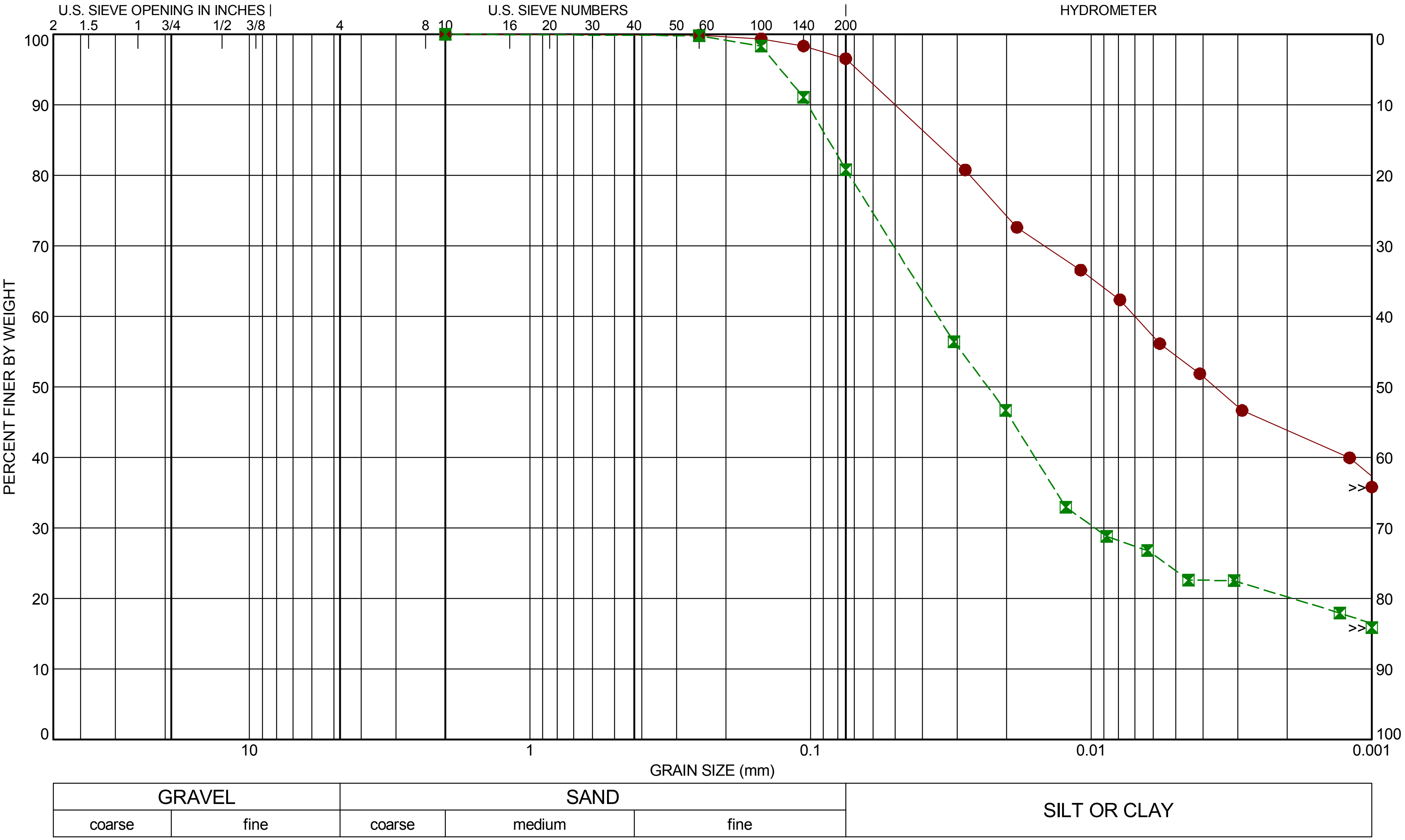
GEI - GRAIN SIZE - GEO TEMPLATE WITH LAB.GDT - 4/23/18 11:15 - P:\16\16715040\03\LAB\GINT LAB\16715-040-03 BR LAB.GPJ

	Soil Boring ID	Depth (ft)	Classification	%Gravel	%Sand	%Silt	%Clay	D90	D60	D50	D30	D10	Cc	Cu	LL	PL	PI
●	Composite B-6	0.0	Gray clay (Composite) (CH)	0.0	3.5	42.1	54.4	0.05	0.007	0.004					70	26	44
⊠	Composite B-7	0.0	Gray silty clay with sand, organic matter and shell fragments (Composite) (OL)	0.0	19.2	56.9	23.9	0.102	0.035	0.023	0.01				41	21	20



Tested By: NLP	Date Tested: 3/16/2018
Reviewed By: Karen Allen	Date Reviewed: 3/26/2018

GRAIN SIZE DISTRIBUTION
ASTM D422/D1140/D6913/T88

Project No.: 16715-040-03

Island Road Marsh Creation and Nourishment (TE-117)
Terrebonne Parish, LA

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GeoEngineers
11955 Lakeland Park Boulevard, Suite 100
Baton Rouge, Louisiana 70809
225.293.2460

April 24, 2018

State of Louisiana
Louisiana Coastal Protection and Restoration Authority
150 Terrace Avenue
Baton Rouge, Louisiana, 70802

Attention: Brad A. Miller

Subject: Sediment Geotechnical Properties Report
Low-Stress Consolidation of Borrow Area Soils
TE-117 Island Road Marsh Creation and Nourishment
Terrebonne Parish, Louisiana
File No. 16715-040-03

INTRODUCTION

This document presents the results of laboratory testing to determine the index and low-stress consolidation properties of hydraulic fill material to be used for the TE-117 Island Road Marsh Creation and Nourishment Project. These tests were conducted on four (4) composite samples homogenized from Shelby tube soil cores collected from the TE-117 borrow area borings B-1 through B-7 in Lake Tambour, Terrebonne Parish, Louisiana and labeled Composite Sample No. 1 through No. 4. The composite samples combined specimens from various borings as described in Table 1, below.

TEST PROCEDURE

Equal volume specimens from each Shelby tube sample in the required depth range were homogenized to create four composite samples for use in low-stress consolidation testing, as shown in 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 of Composite Sample (feet below mudline)
Composite Sample No. 1	B-2, B-2a, B-3, and B-4	0 to 20
Composite Sample No. 2	B-1, B-5, B-6, B-7	0 to 20
Composite Sample No. 3	B-1 through B-7	0 to 16
Composite Sample No. 4	B-1 through B-7	0 to 4

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

Low-stress consolidation tests were performed on these samples following the U.S. Army Corps of Engineers Manual No. 1110-2-5027 (USACE, 1987) and the University of Texas Method (Pederson, 2001) methods. To simplify sample preparation, each homogenized composite sample was diluted to 2 to 3 times its liquid limit to allow free flow of the soil. One-dimensional incremental loading was used to consolidate the samples, with stresses ranging from about 1 psf to 640 psf, with stress doubling between each load increment. The coefficient of consolidation, c_v, was determined using the square root of time method.

RESULTS

Index properties of each composite sample are summarized in Table 2. Particle size distributions for each composite sample are shown in the attached grain size distribution chart.

TABLE 2. SUMMARY OF COMPOSITE SAMPLE INDEX PROPERTIES

Composite Sample Id.	Specific Gravity	Slurry Moisture Content (%)	Atterberg Limits		Grain Size Distribution		
			Liquid Limit, LL	Plasticity Index, PI	Sand (>0.075 mm)	Silt (0.075 mm - 0.005 mm)	Clay (<0.005 mm)
1	2.700	136.2	44	25	44.4	28.7	26.9
2	2.710	154.5	45	27	21.0	44.4	34.6
3	2.662	188.1	51	31	29.5	37.2	33.3
4	2.671	418.0	134	96	5.5	32.1	62.3

Low-stress consolidation results are given below in tabular (Tables 3 through 6 for Composite Samples No. 1 through No. 4, respectively) and graphical form (Figures 1a through 4d for Composite Samples No. 1 through No. 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. 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.

Composite Sample No. 1 Results

TABLE 3. SELF-WEIGHT CONSOLIDATION TEST RESULTS FOR COMPOSITE SAMPLE NO. 1

σ'_v	δ_{100}	e_0	e_{100}	ε_{100}	C_c	$C_{\alpha e}$	t_{90}	Hdr	c_v	k
(psf)	(in)	3.805		(%)	0.951		(min)	(in)	(ft²/day)	(ft/day)
1	0.138		3.142	13.80		0.29	864	0.461	0.0021	0.0193
2	0.195		2.869	19.47		0.05	640	0.411	0.0022	0.0095
5	0.262		2.544	26.24		0.13	335	0.381	0.0037	0.0067
10	0.343		2.156	34.31		0.05	210	0.343	0.0048	0.0069
20	0.408		1.842	40.84		0.05	144	0.309	0.0056	0.0037
30	0.497		1.415	49.74		0.00	210	0.253	0.0026	0.0025
40	0.508		1.363	50.83		0.02	566	0.248	0.0009	0.0001
80	0.555		1.137	55.51		0.03	69	0.232	0.0066	0.0010
160	0.593		0.955	59.30		0.01	96	0.210	0.0039	0.0003
320	0.626		0.796	62.62		0.02	42	0.193	0.0075	0.0002
640	0.658		0.644	65.78		0.01	34	0.176	0.0171	0.0003

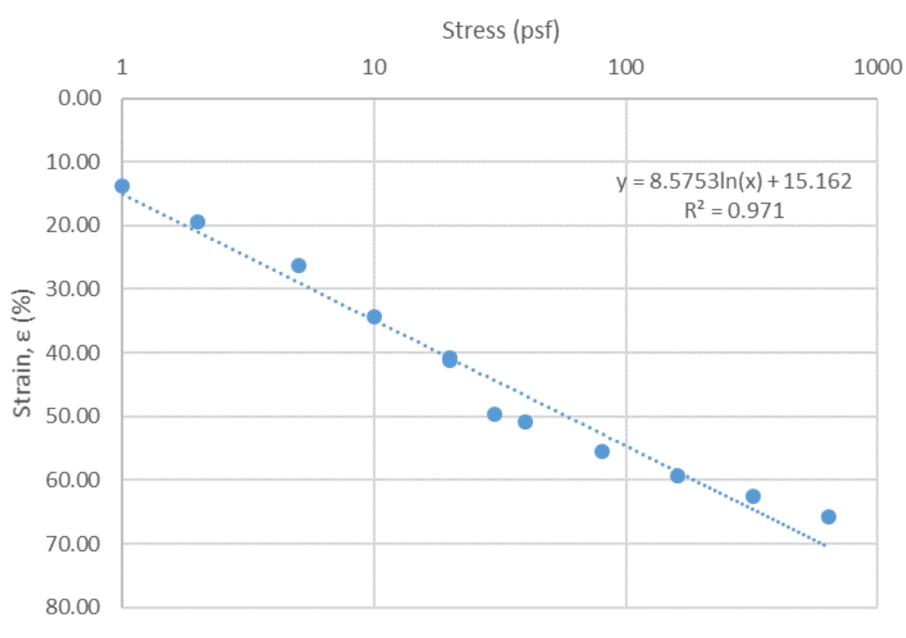


Figure 1a Axial Strain vs. Stress Plot for Composite Sample No. 1

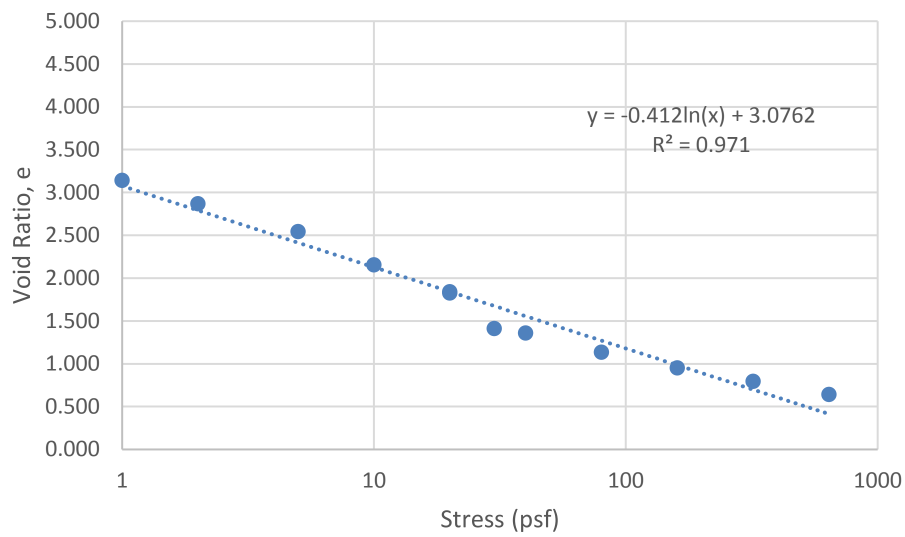


Figure 1b Void Ratio vs. Stress Plot for Composite Sample No. 1

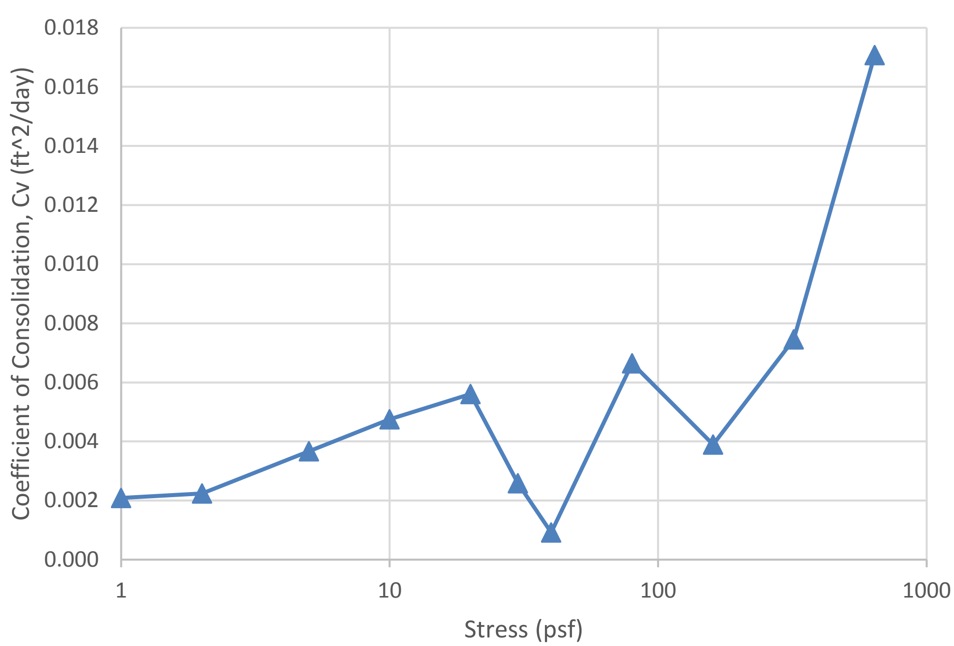


Figure 1c Coefficient of Consolidation vs. Stress Plot for Composite Sample No. 1

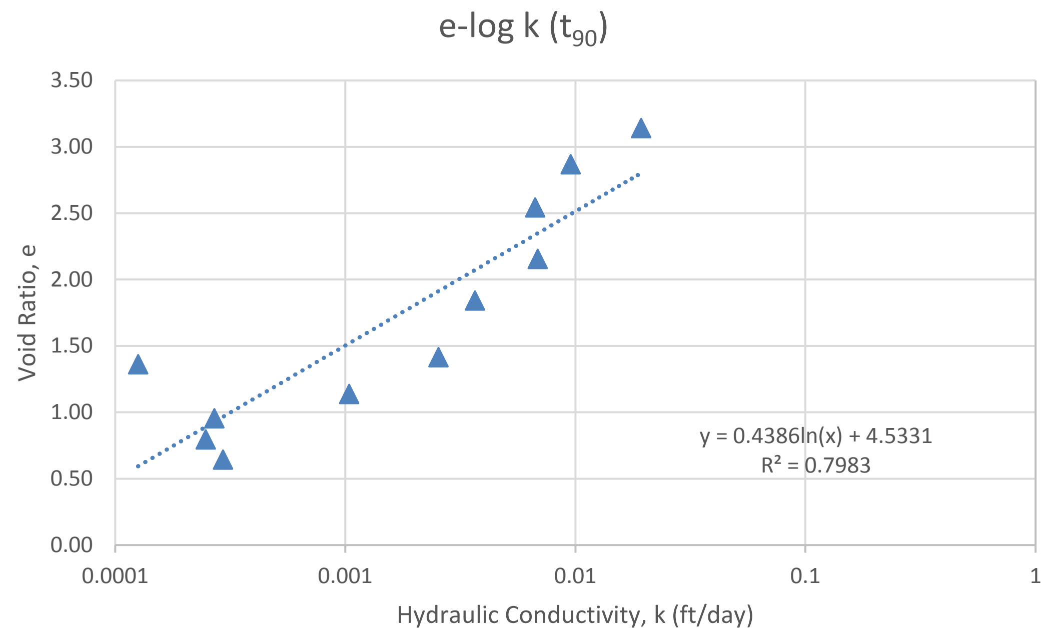


Figure 1d Hydraulic Conductivity vs. Void Ratio Plot for Composite Sample No. 1

Composite Sample No. 2 Results

TABLE 4. SELF-WEIGHT CONSOLIDATION TEST RESULTS FOR COMPOSITE SAMPLE NO. 2

σ'_v	δ_{100}	e_0	e_{100}	ε_{100}	C_c	$C_{\alpha e}$	t_{50}	Hdr	c_v	k
(psf)	(in)	4.562		(%)	0.797		(min)	(in)	(ft^2/day)	(ft/day)
1	0.204		3.430	20.35		0.13	610	0.446	0.0028	0.0390
2	0.275		3.033	27.49		0.11	650	0.376	0.0018	0.0108
5	0.348		2.628	34.77		0.05	400	0.344	0.0025	0.0055
10	0.391		2.385	39.14		0.03	400	0.313	0.0021	0.0018
20	0.438		2.123	43.85		0.03	289	0.290	0.0025	0.0012
30	0.481		1.887	48.09		0.00	144	0.262	0.0041	0.0026
40	0.493		1.821	49.28		0.02	566	0.256	0.0010	0.0001
80	0.524		1.648	52.40		0.02	66	0.245	0.0077	0.0008
160	0.555		1.476	55.49		0.02	37	0.228	0.0119	0.0006
320	0.583		1.319	58.31		0.01	20	0.213	0.0191	0.0005
640	0.609		1.173	60.94		0.01	22	0.200	0.0335	0.0004

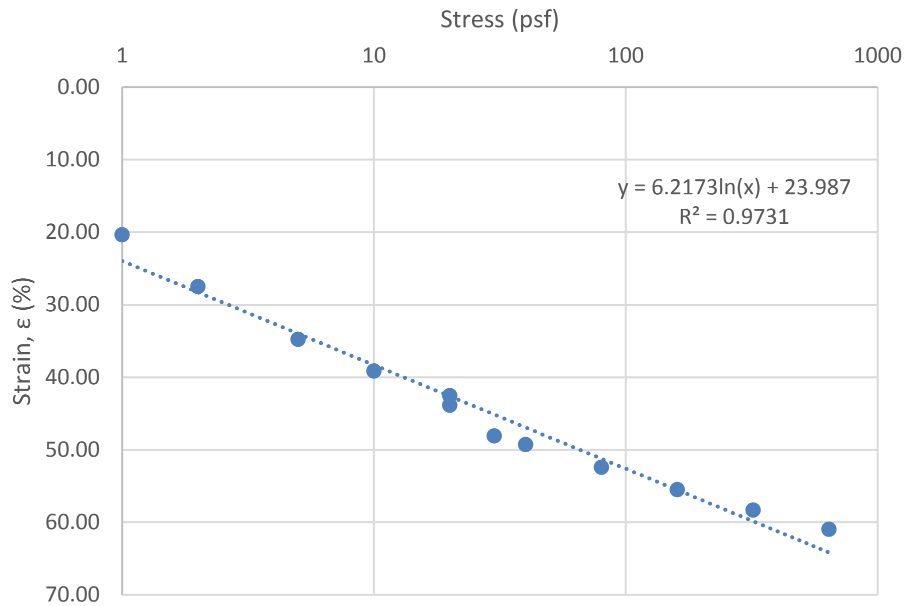


Figure 2a Axial Strain vs. Stress Plot for Composite Sample No. 2

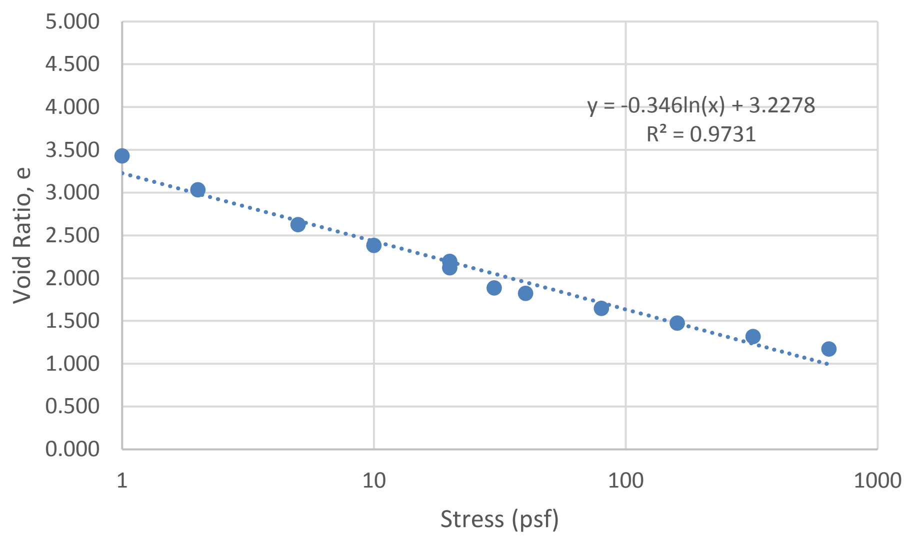


Figure 2b Void Ratio vs. Stress Plot for Composite Sample No. 2

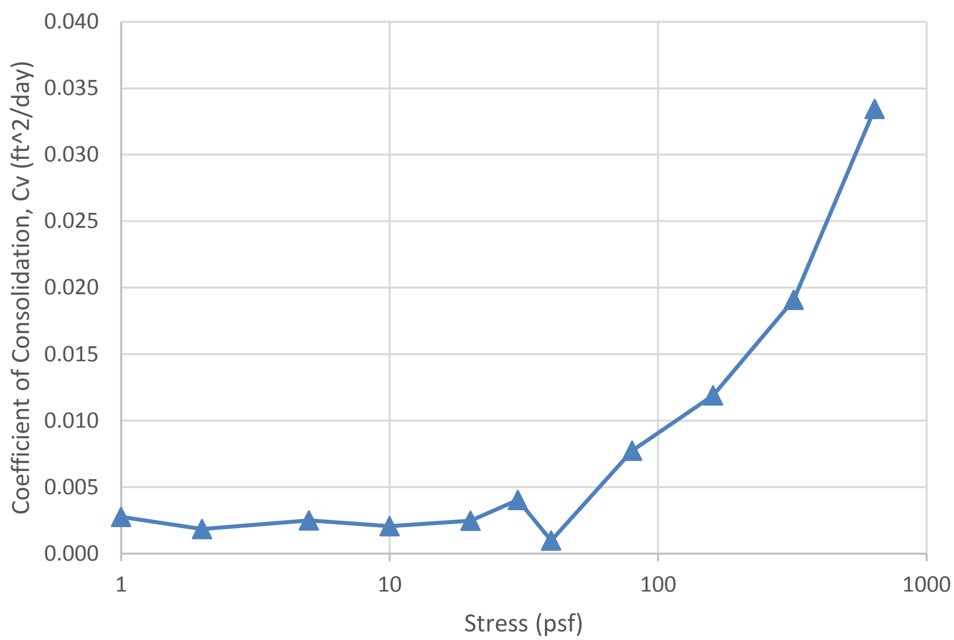


Figure 2c Coefficient of Consolidation vs. Stress Plot for Composite Sample No. 2

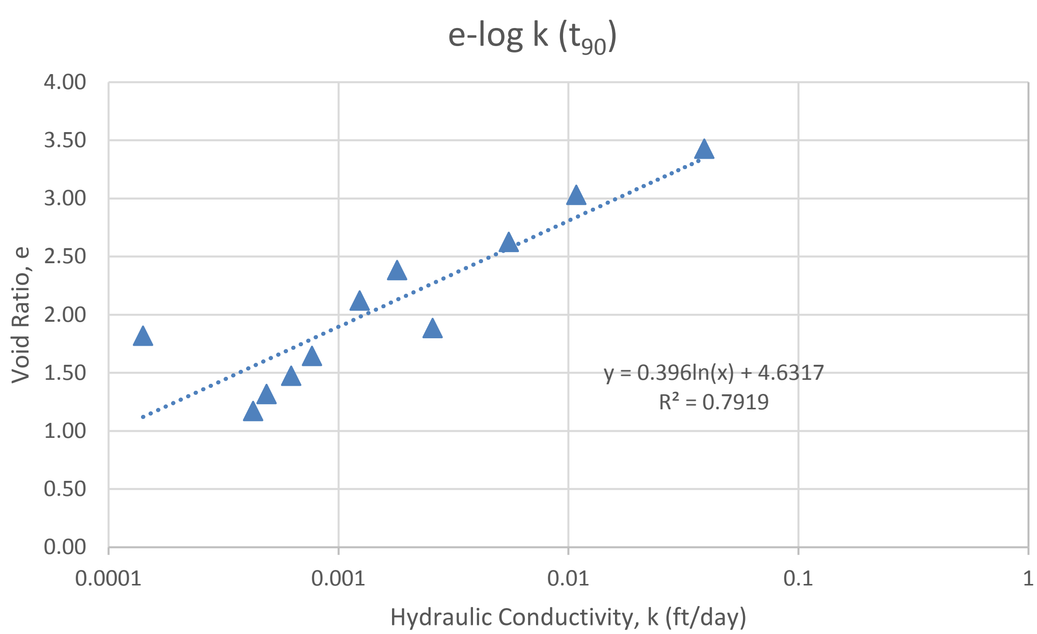


Figure 2d. Hydraulic Conductivity vs. Void Ratio Plot for Composite Sample No. 2

Composite Sample No. 3 Results

TABLE 5. SELF-WEIGHT CONSOLIDATION TEST RESULTS FOR COMPOSITE SAMPLE NO. 3

σ'_v	δ_{100}	e_0	e_{100}	ε_{100}	C_c	$C_{\alpha e}$	t_{50}	Hdr	c_v	k
(psf)	(in)	5.730		(%)	1.211		(min)	(in)	(ft²/day)	(ft/day)
1	0.218		4.263	21.80		0.43	906	0.441	0.0018	0.0278
2	0.281		3.841	28.06		0.08	743	0.370	0.0016	0.0081
5	0.345		3.410	34.47		0.11	493	0.339	0.0020	0.0038
10	0.416		2.927	41.64		0.09	437	0.305	0.0018	0.0026
20	0.479		2.508	47.87		0.04	61	0.273	0.0104	0.0073
30	0.557		1.984	55.65		0.00	1232	0.224	0.0003	0.0004
40	0.571		1.890	57.05		0.01	986	0.216	0.0004	0.0001
80	0.606		1.650	60.62		0.02	77	0.203	0.0045	0.0006
160	0.642		1.407	64.24		0.02	50	0.184	0.0057	0.0004
320	0.671		1.215	67.09		0.01	36	0.169	0.0067	0.0002
640	0.697		1.041	69.68		0.01	27	0.156	0.0166	0.0003

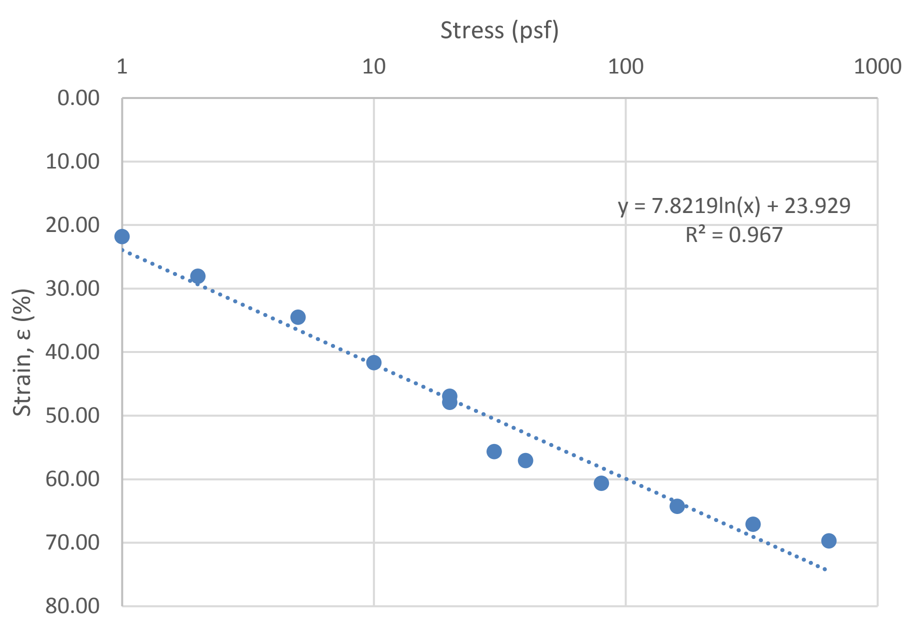


Figure 3a Axial Strain vs. Stress Plot for Composite Sample No. 3

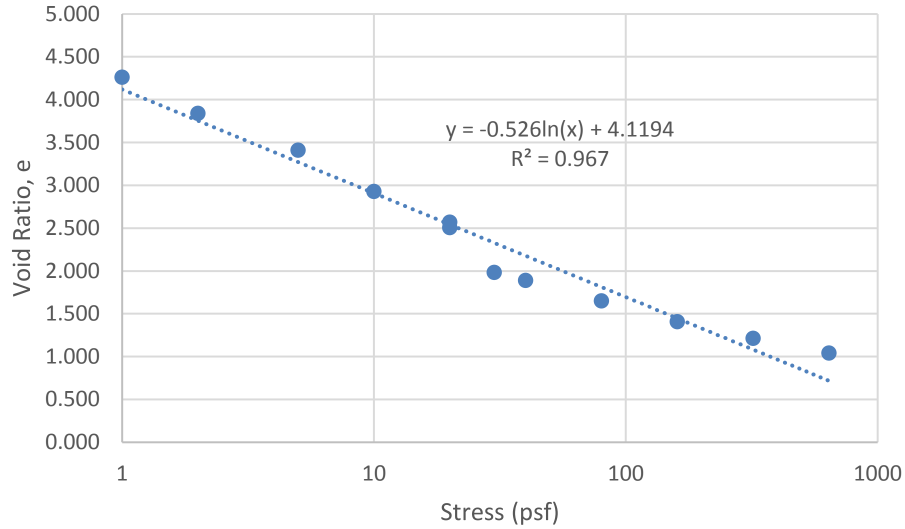


Figure 3b Void Ratio vs. Stress Plot for Composite Sample No. 3

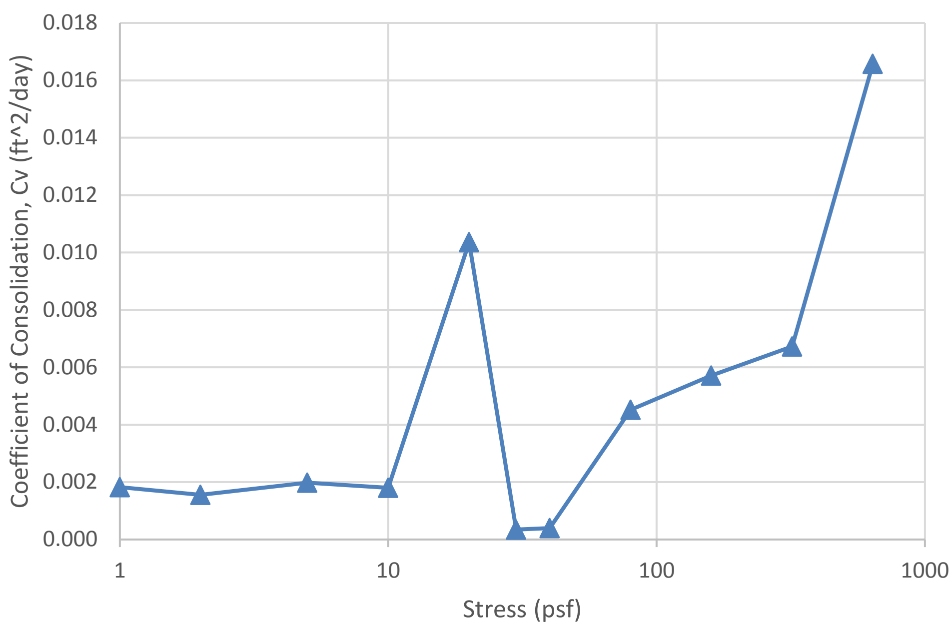


Figure 3c Coefficient of Consolidation vs. Stress Plot for Composite Sample No. 3

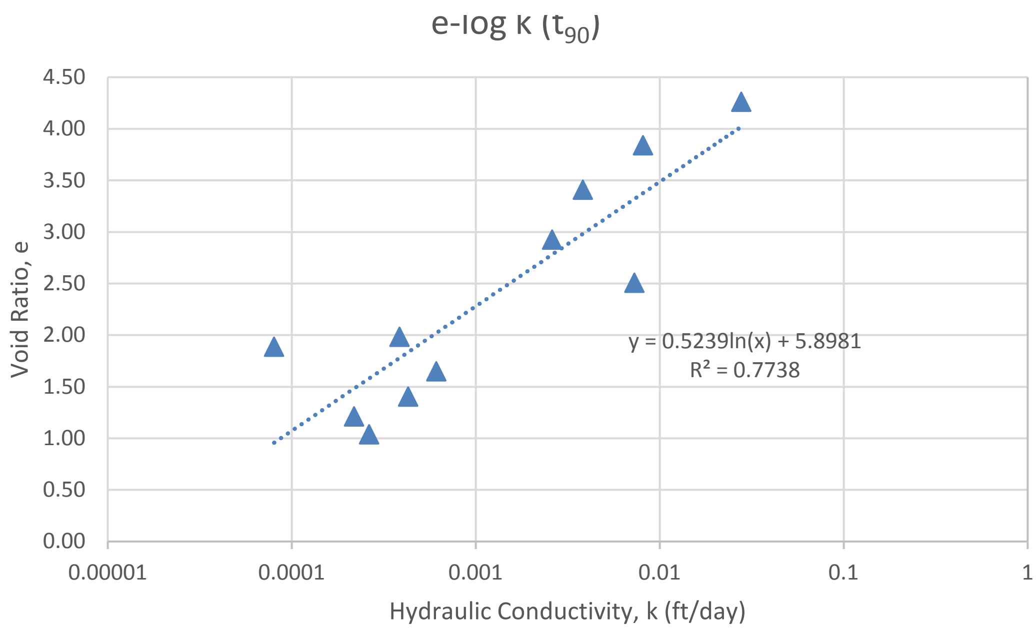


Figure 3d Hydraulic Conductivity vs. Void Ratio Plot for Composite Sample No. 3

Composite Sample NO. 4 Results

TABLE 6. SELF-WEIGHT CONSOLIDATION TEST RESULTS FOR COMPOSITE SAMPLE NO. 4

σ'_v	δ_{100}	e_0	e_{100}	ε_{100}	C_c	$C_{\alpha e}$	t_{50}	Hdr	c_v	k
(psf)	(in)	12.74		(%)	2.521		(min)	(in)	(ft^2/day)	(ft/day)
1	0.271		9.016	27.10		1.48	1289	0.426	0.0012	0.0233
2	0.347		7.976	34.67		0.29	655	0.338	0.0015	0.0101
5	0.410		7.112	40.96		0.23	506	0.306	0.0016	0.0033
10	0.493		5.960	49.34		0.23	256	0.268	0.0024	0.0046
20	0.564		4.989	56.41		0.05	54	0.231	0.0083	0.0078
30	0.617		4.269	61.65		0.00	72	0.196	0.0045	0.0061
40	0.630		4.086	62.98		0.06	590	0.188	0.0005	0.0001
80	0.668		3.558	66.82		0.10	88	0.173	0.0029	0.0005
160	0.708		3.008	70.83		0.06	61	0.152	0.0032	0.0003
320	0.742		2.547	74.18		0.05	54	0.134	0.0028	0.0001
640	0.771		2.150	77.07		0.05	34	0.119	0.0077	0.0002

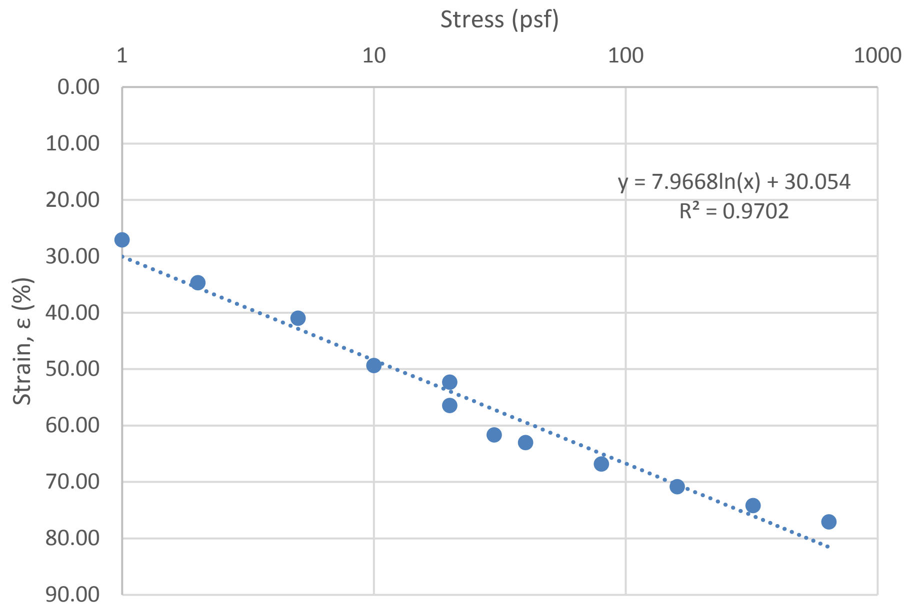


Figure 4a Axial Strain vs. Stress Plot for Composite Sample No. 4

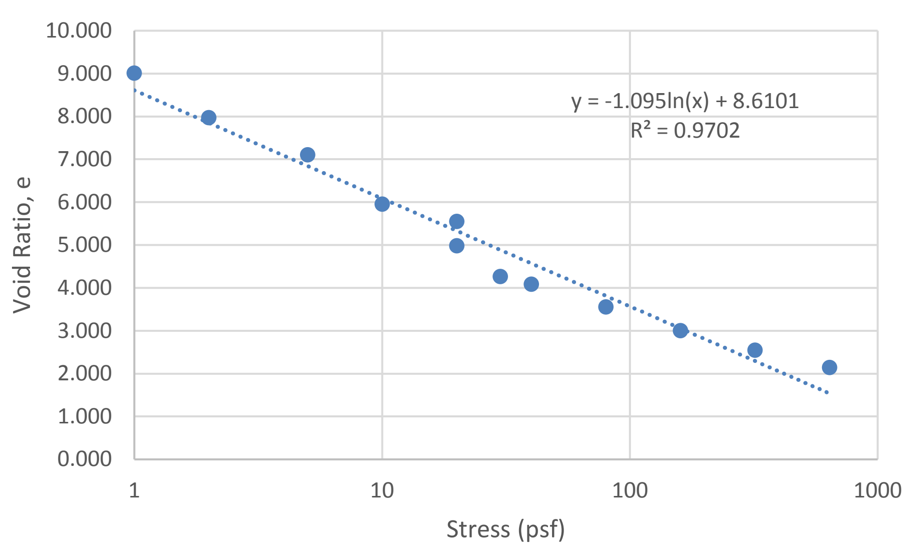


Figure 4b Void Ratio vs. Stress Plot for Composite Sample No. 4

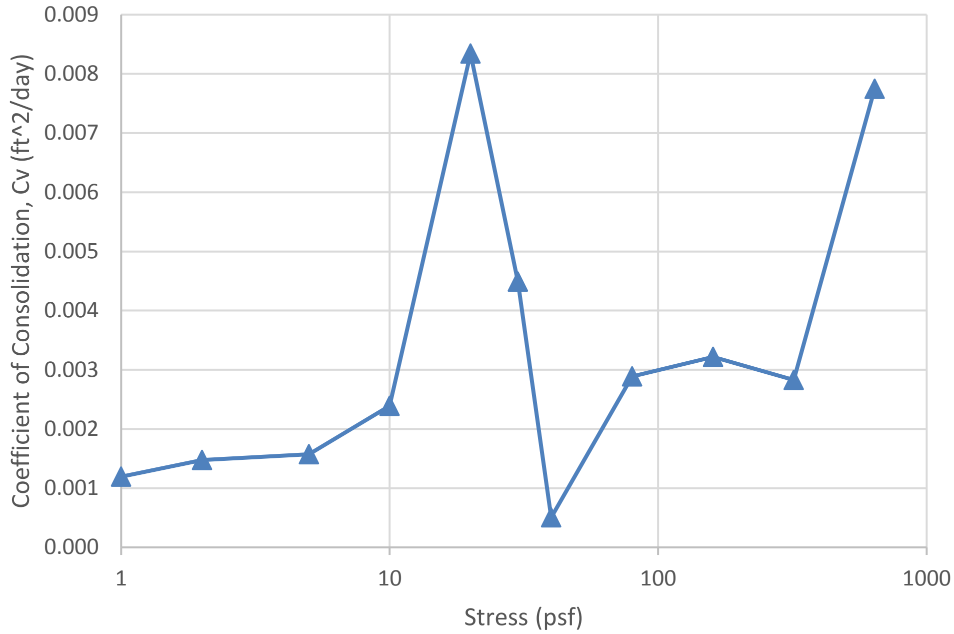


Figure 4c Coefficient of Consolidation vs. Stress Plot for Composite Sample No. 4

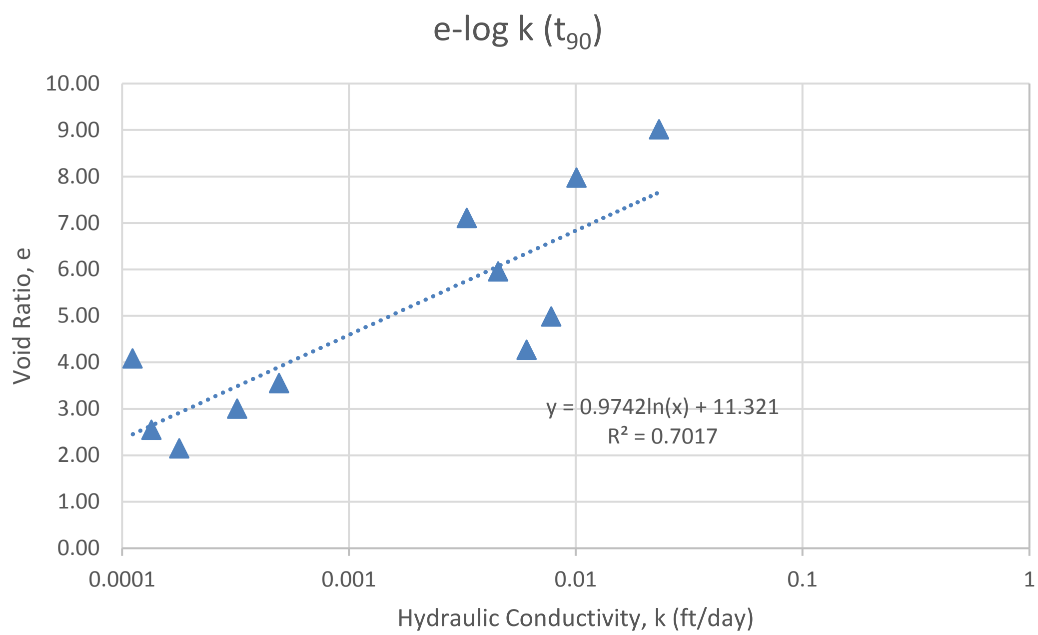


Figure 4d Hydraulic Conductivity vs. Void Ratio Plot for Composite Sample No. 4

CONCLUSION

Self-weight consolidation testing was conducted on 4 composite samples from the TE-117 borrow area in Lake Tambour for the TE-117 Island Road Marsh Creation and Nourishment 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.

Joshua M. Pruett, P.E.
Engineer

David S. Eley, P.E.
Principal

STATE OF LOUISIANA
DAVID S. ELEY
REG. No. 26373
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING
4-24-2018

JMP:DSE:cc

Attachment:
Grain Size Distribution report for Low-Stress Consolidation Samples

Disclaimer: Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

Soil Boring ID	Depth Interval (ft)	D2488 Visual Description	Test Type	D2216 Moisture (%)	D2166/D2850 Unit Weight (PCF) Wet	Dry	D4318 Atterberg Limits LL	PL	PI	D422/D1140/D6913 %<#200 Sieve	D2166/D2850 Shear Strength (KSF)	Remolded Strength (KSF)	Failure Strain (%)	Confining Pressure (PSI)	Failure Type	D4648 Mini Vane Shear Strength (KSF)	Comments
SWC Sample 1	0.0 - 16.0	Gray sandy clay (Composite from B-2, B-2a, B-3, B-4) (CL)	AL HYD CONS SG ORG	136.2	84.6	35.8	44	19	25	55.6							OC=3.68%, SG=2.700
SWC Sample 2	0.0 - 16.0	Gray clay with sand (Composite from B-1, B-5, B-6, B-7) (CL)	AL HYD CONS SG ORG	154.5	77.8	30.5	45	18	27	79.0							OC=2.97%, SG=2.710
SWC Sample 3	0.0 - 16.0	Gray clay with sand (Composite B-1 through B-7) (CH)	AL HYD CONS SG ORG	188.1	73.1	25.4	51	20	31	70.5							OC=3.40%, SG=2.662
SWC Sample 4	0.0 - 4.0	Gray clay (Composite from top 4 feet of all borings) (CH)	AL HYD CONS SG ORG	418.0	95.8	18.5	134	38	96	94.5							OC=5.14%, SG=2.671

Disclaimer: The results presented relate only to those samples tested.
Note: ASTM standard identification numbers shown above each test description.

Multiple Shear = MS Vertical Shear = VS Angle Shear = AS
Slickensided = SLS Bulge = B Crumble = C

AASHTO ACCREDITED

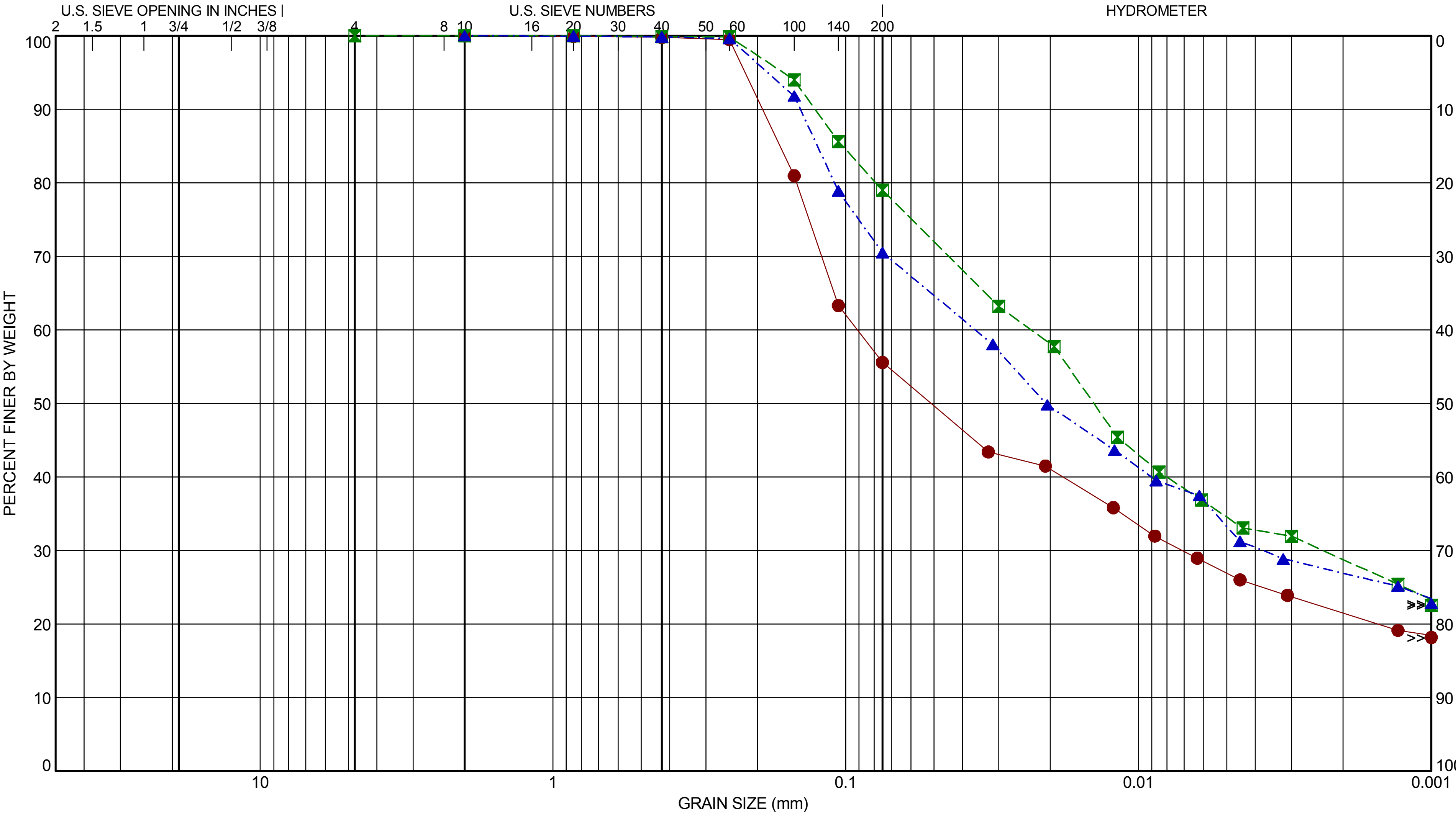
Technical Responsibility: Karen Allen
Title: QAM
Date: 4/23/18

Summary of Lab Results
Project No.: 16715-040-03

Island Road Marsh Creation and Nourishment (TE-117)
Terrebonne Parish, LA

GEOENGINEERS

	Soil Boring ID	Depth (ft)	Classification	%Gravel	%Sand	%Silt	%Clay	D90	D60	D50	D30	D10	Cc	Cu	LL	PL	PI
●	SWC Sample 1	0.0	Gray sandy clay (Composite from B-2, B-2a, B-3, B-4) (CL)	0.0	44.4	28.7	26.9	0.193	0.091	0.051	0.007				44	19	25
⊠	SWC Sample 2	0.0	Gray clay with sand (Composite from B-1, B-5, B-6, B-7) (CL)	0.0	21.0	44.4	34.6	0.127	0.023	0.014	0.002				45	18	27
▲	SWC Sample 3	0.0	Gray clay with sand (Composite B-1 through B-7) (CH)	0.0	29.5	37.2	33.3	0.143	0.036	0.021	0.004				51	20	31



GRAVEL		SAND			SILT OR CLAY
coarse	fine	coarse	medium	fine	

Tested By: NLP	Date Tested: 3/19/2018	**GRAIN SIZE DISTRIBUTION** **ASTM D422/D1140/D6913/T88**	**Island Road Marsh Creation and Nourishment (TE-117)** **Terrebonne Parish, LA**
Reviewed By: Karen Allen	Date Reviewed: 3/26/2018	**Project No.: 16715-040-03**	GEOENGINEERS

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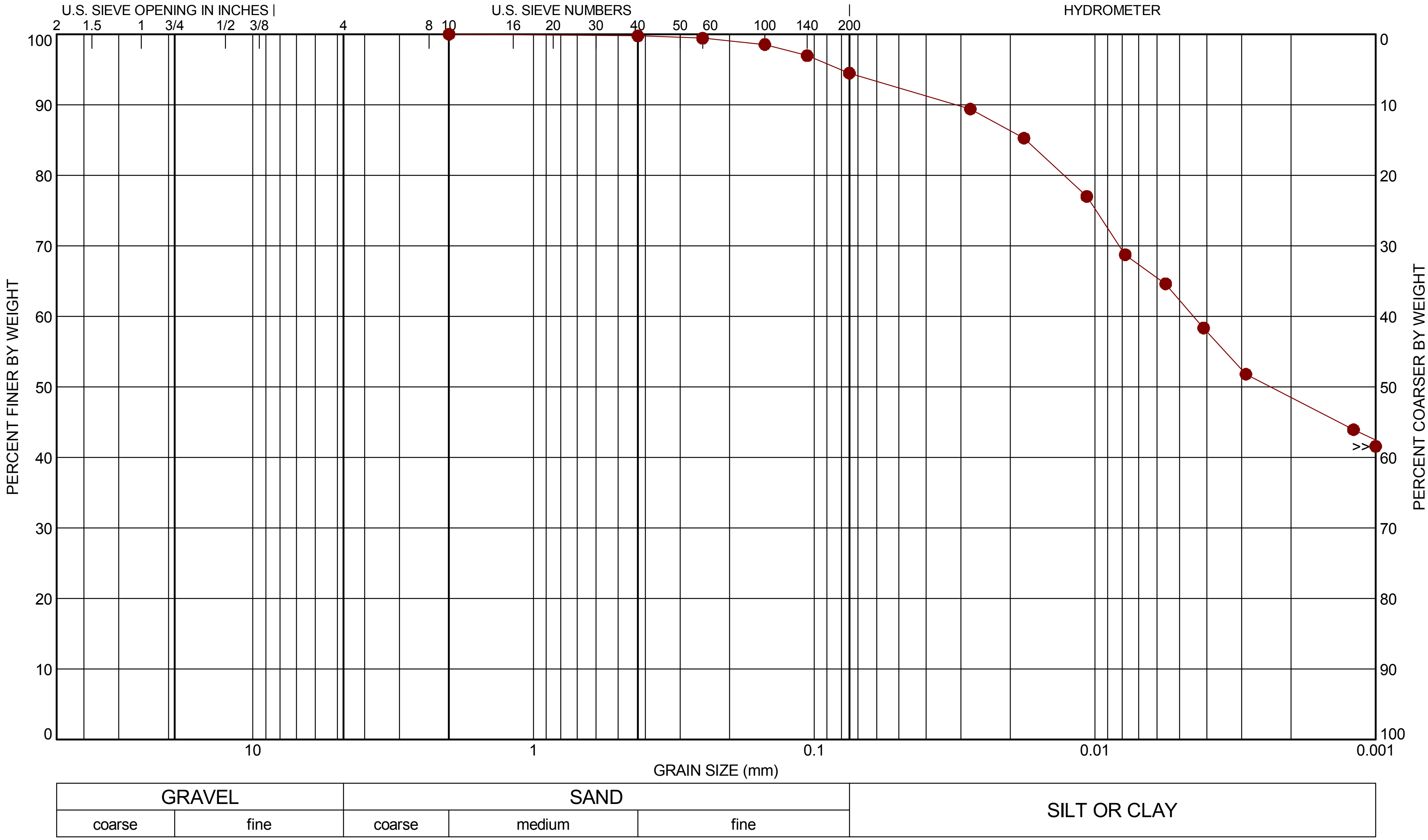
GEI - GRAIN SIZE - GEO TEMPLATE WITH LAB.GDT - 4/23/18 11:16 - P:\16\16715040\03\LAB\GINT LAB\16715-040-03 BR LAB.GPJ

	Soil Boring ID	Depth (ft)	Classification	%Gravel	%Sand	%Silt	%Clay	D90	D60	D50	D30	D10	Cc	Cu	LL	PL	PI
●	SWC Sample 4	0.0	Gray clay (Composite from top 4 feet of all borings) (CH)	0.0	5.5	32.1	62.3	0.031	0.004	0.002					134	38	96



Tested By:	Date Tested:
NLP	3/16/2018
Reviewed By:	Date Reviewed:
Karen Allen	3/26/2018

GRAIN SIZE DISTRIBUTION

ASTM D422/D1140/D6913/T88

Project No.: 16715-040-03

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Island Road Marsh Creation and Nourishment (TE-117)

Terrebonne Parish, LA

GeoEngineers

Final Report:

Settling Properties of Fine-Grained Sediments: LDNR-CPRA Island Road Marsh Creation and Nourishment (TE-117) Phase II (GeoEngineers Project No. 016715-040-03)

Submitted to:

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April 6, 2018

SCTCS
GROUP LLC

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 in support of the LDNR-CPRA Island Road Marsh Creation and Nourishment (TE-117) Phase II project (GeoEngineers Project No. 016715-040-03).

2.0 Experimental Procedures and Results

2.1 Materials Provided for Testing

Sediment core samples from eight borings labelled as shown in Table 1 from the proposed dredging area were provided by GeoEngineers, Inc. for pilot-scale settling column testing (see Appendix A for chain of custody form).

Table 1. Sediment core samples used to prepare fine-grained sediment slurry for pilot-scale settling column testing

Sediment Sample Boring ID
16715-040-03, B-1
16715-040-03, B-2
16715-040-03, B-2a
16715-040-03, B-3
16715-040-03, B-4
16715-040-03, B-5
16715-040-03, B-6
16715-040-03, B-7

Eight five-gallon buckets of water from the proposed dredging area, labelled as shown in Tables 2 and 3, were also provided by GeoEngineers, Inc. for laboratory testing. The salinity of the eight water samples was measured gravimetrically with drying at 180 ºC[1]. Results, grouped by samples that were composited for testing, are reported in Tables 2 and 3 in units of parts per thousand (ppt).

Table 2. Water samples used to prepare fine-grained sediment slurry for pilot-scale settling column test Sample 1

Water Bucket ID	Salinity (ppt)
16715-040-03, B-2	24.4
16715-040-03, B-2a	24.4
16715-040-03, B-3	24.2
16715-040-03, B-4	24.2
Average	24.3

Table 3. Water samples used to prepare fine-grained sediment slurry for pilot-scale settling column test Sample 2

Water Bucket ID	Salinity (ppt)
16715-040-03, B-1	24.4
16715-040-03, B-5	23.1
16715-040-03, B-6	24.2
16715-040-03, B-7	23.0
Average	23.6

2.2 Pilot-Scale Settling Column Test Results for Sample 1 (Composite of sediment from boring ID numbers B-2, B-2a, B-3, and B-4)

As requested by GeoEngineers, two settling column tests were performed using composited sediment samples. The first test, hereafter referred to as Sample 1, utilized sediment composited from boring IDs B-2, B-2a, B-3, and B-4. The sediment from each boring was placed into a separate container and homogenized via mechanical mixing. Then, a composite sample was created by transferring an equal mass (wet basis) from each of the separate borings B-2, B-2a, B-3, and B-4 to a mixing barrel to create a composite sample. Slurry was then prepared by mixing an equal volume of water from each of the B-2, B-2a, B-3, and B-4 sampling locations plus tap water supplemented with synthetic sea salts (Instant Ocean) to match the average salinity of the four water samples (average salinity of 24.3 parts per thousand (ppt) – see Table 2).

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[1].

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[1]. 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 (see Table B1 in Appendix B for tabulated data). The average particulate concentration at the start of the settling test was 147.3 g/L.

A readily visible sediment-water interface was observed shortly (<20 minutes) after the start of the settling test, 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 Table C1 in Appendix C for tabulated data). As shown in Figure 1, zone settling was observed during the first portion of the settling test, followed by compression settling thereafter.

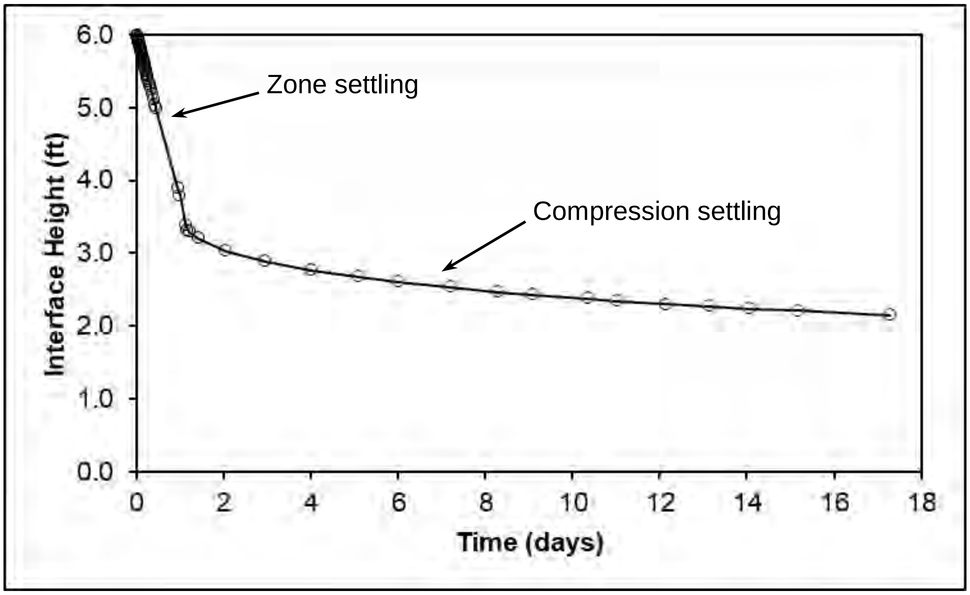


Figure 1. Interface height as a function of time during the pilot-scale settling test with Sample 1 (composite of sediment from boring B-2, B-2a, B-3, and B-4).

Data for the first 28 hours of the settling test are depicted separately in Figure 2. A linear regression was performed for settling data in the time interval of 0 to 28 hours (during which zone settling was observed) with the resulting equation and correlation coefficient shown on the graph. The slope of the regression line, which corresponds to the zone settling velocity, was 0.095 ft/hr (2.29 ft/day).

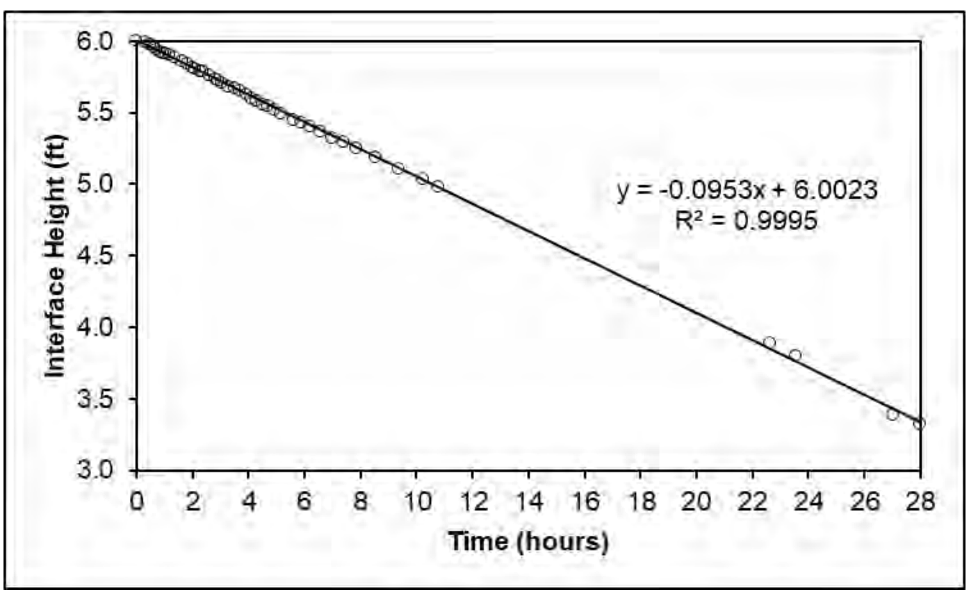


Figure 2. Interface height as a function of time during the zone settling portion of the pilot-scale settling test with Sample 1 (composite of borings B-2, B-2a, B-3, and B-4).

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. 1).

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

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.

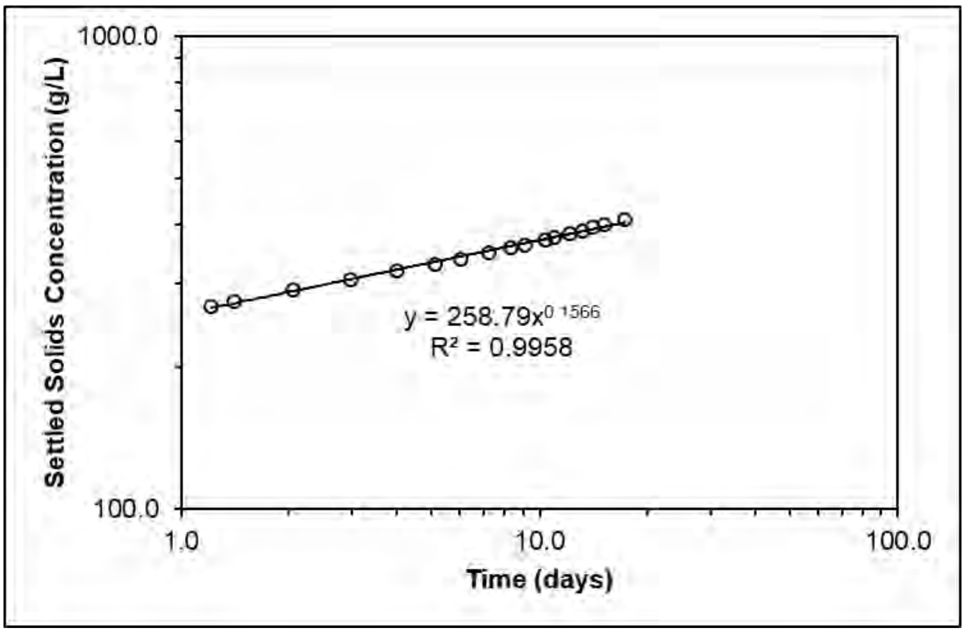


Figure 3. Concentration of settled solids as a function of time during the compression settling portion of the pilot-scale settling test with sample 1 (composite of borings B-2, B-2a, B-3, and B-4).

For analysis of flocculent settling as described in the US Army Corps of Engineers Manual No. 1110-2-5027[1], water samples were collected from the clarified layer above the sediment-water interface for measurement of total suspended (TSS) following Standard Method 2450D[2]. The first of these samples, collected 6.0 hours after the start of settling when the sediment-water interface was sufficiently below the uppermost sample port (height of 5.5 ft) to allow sample collection, had a TSS concentration of 58 mg/L. Concentrations decreased over time during the first day and were <25 mg/L after 23 hours (see Table D1 in Appendix D for tabulated data).

2.3 Pilot-Scale Settling Column Test Results for Sample 2 (Composite of sediment from boring ID numbers B-1, B-5, B-6, and B-7)

The second pilot-scale settling column test, hereafter referred to as Sample 2, utilized sediment composited from boring IDs B-1, B-5, B-6, and B-7. The sediment from each boring was placed into a separate container and homogenized via mechanical mixing. Then, a composite sample was created by transferring an equal mass (wet basis) from each of the separate borings B-1, B-5, B-6, and B-7 to a mixing barrel to create a composite sample. Slurry was then prepared by mixing an equal volume of water from each of the B-1, B-5, B-6, and B-7 sampling locations plus tap water supplemented with synthetic sea salts (Instant Ocean) to match the average salinity of the four water samples (average salinity of 23.6 parts per thousand (ppt) – see Table 3). 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[1]. The particulate concentration in the initial fine-grained sediment slurry, which utilized all of the material available from boring B-5, was below the target concentration of 150 g/L. To achieve a concentration near the target level of 150 g/L, additional sediment was added to the initial slurry preparation to increase the particulate concentration. Because additional sediment was not available from boring B-5, the additional sediment was not an equal amount of sediment from each boring. As requested by GeoEngineers, the shortfall in material from B-5 was compensated by adding equal masses of material from borings B-1 and B-7. Masses of sediment (wet basis) from each boring utilized in preparing the final fine-grained slurry employed in the Sample 2 pilot-scale settling column test is summarized in Table 4.

Table 4. Sediment (wet mass basis) added to prepare fine-grained sediment slurry for pilot-scale settling column test Sample 2

Sediment boring ID	Initial sediment mass added (kg)	Additional sediment mass added (kg)	Total sediment mass (kg)	Mass percent from the boring in the final composite (%)
16715-040-03, B-1	4.55	6.00	10.55	30.8
16715-040-03, B-5	4.55	0	4.55	13.3
16715-040-03, B-6	4.55	4.00	8.55	25.0
16715-040-03, B-7	4.55	6.00	10.55	30.8

After the second addition of sediment to the previously prepared slurry, the slurry was thoroughly remixed and then coarse grained materials were separated by differential settling as described in the US Army Corps of Engineers Manual No. 1110-2-5027[1]. The fine-grained sediment slurry was then 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[1]. 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 (see Table B2 in Appendix B for tabulated data). The average particulate concentration at the start of the settling test was 151.3 g/L.

A readily visible sediment-water interface was observed shortly (<30 minutes) after the start of the settling test, 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 4 (see Table C2 in Appendix C for tabulated data). As shown in Figure 4, zone settling was observed during the initial portion of the settling test, followed by compression settling.

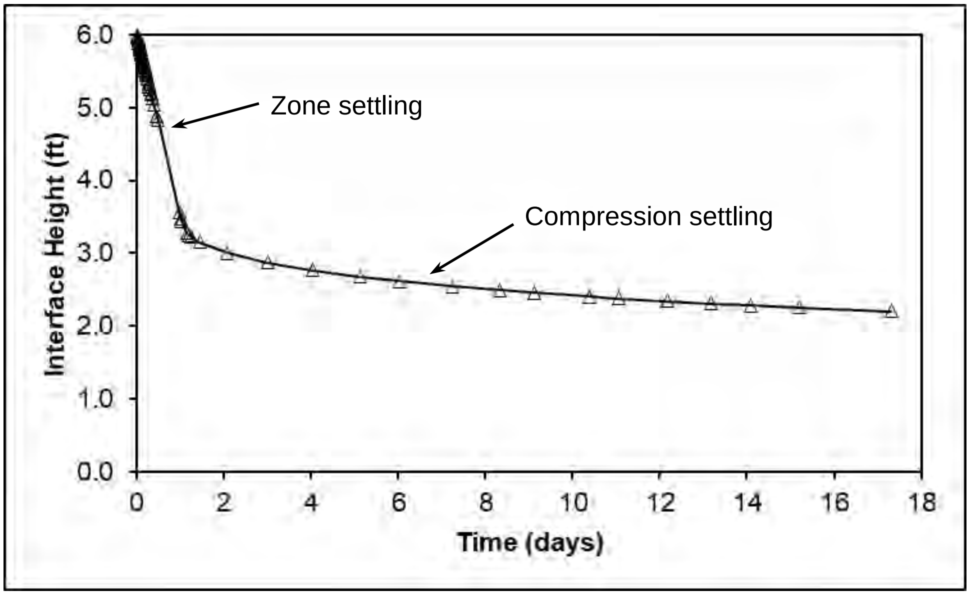


Figure 4. Interface height as a function of time during the pilot-scale settling test with Sample 2 (composite of sediment from boring B-1, B-5, B-6, and B-7).

Data from the first 25 hours of the settling test are depicted separately in Figure 5. A linear regression was performed for settling data in the time interval of 0 to 25 hours (during which zone settling was observed) with the resulting equation and correlation coefficient shown on the graph. The slope of the regression line, which corresponds to the zone settling velocity, was 0.105 ft/hr (2.52 ft/day).

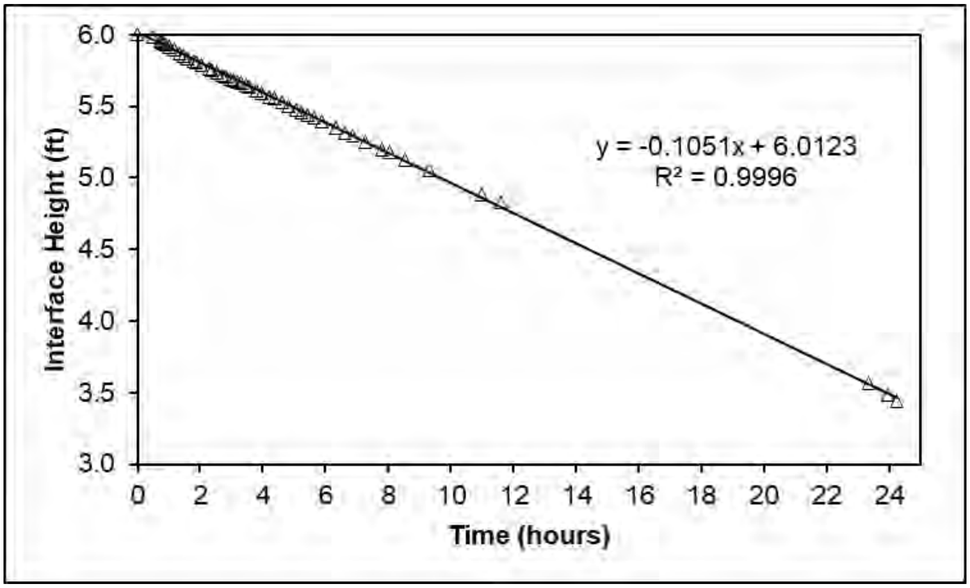


Figure 5. Interface height as a function of time during the zone settling portion of the pilot-scale settling test with Sample 2 (composite of borings B-1, B-5, B-6, and B-7).

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. 1).

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

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 6.

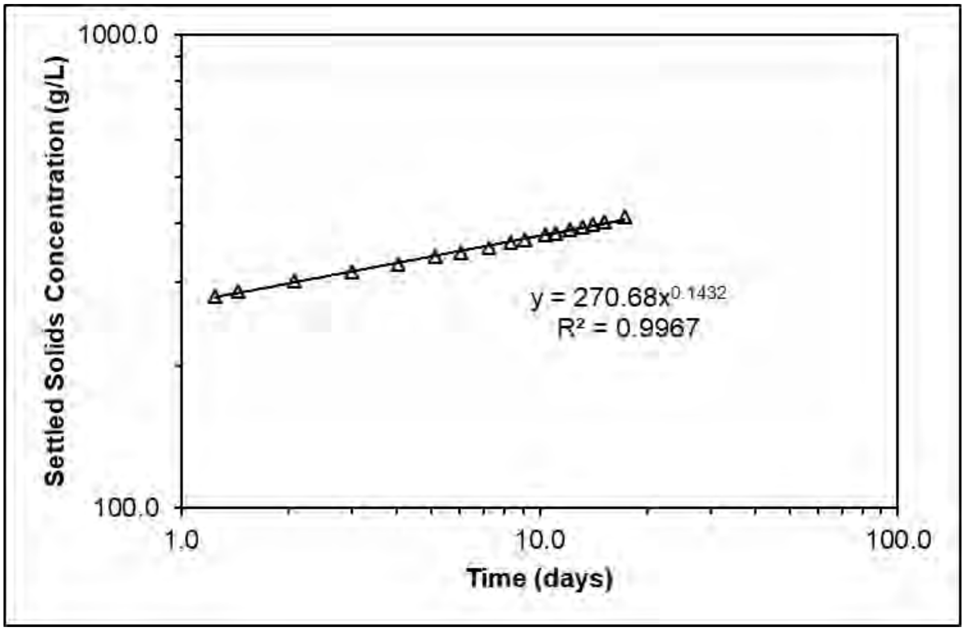


Figure 6: Concentration of settled solids as a function of time during the compression settling portion of the pilot-scale settling test with Sample 2 (composite of borings B-1, B-5, B-6, and B-7).

For analysis of flocculent settling as described in the US Army Corps of Engineers Manual No. 1110-2-5027[1], water samples were collected from the clarified layer above the sediment-water interface for measurement of total suspended (TSS) following Standard Method 2450D[2]. The first of these samples, collected 5.7 hours after the start of settling when the sediment-water interface was sufficiently below the uppermost sample port (height of 5.5 ft) to allow sample collection, had a TSS concentration of 56 mg/L. Concentrations decreased during the first day of settling and were <25 mg/L after 24 hours (see Table D2 in Appendix D for tabulated data).

2.4 Data Comparisons

For comparison purposes, the settling behavior observed during the zone settling interval for Sample 1 [composited sediment from borings B-2, B-2a, B-3, and B-4 (C_o=147.3 g/L)] is shown in comparison with the data from the zone settling portion of the data collected during testing of Sample 2 [composited sediment from borings B-1, B-5, B-6, and B-7 (C_o=151.3 g/L)]. As shown in Figure 7, the zone settling behavior was similar for both samples but with slightly faster zone settling in Sample 2.

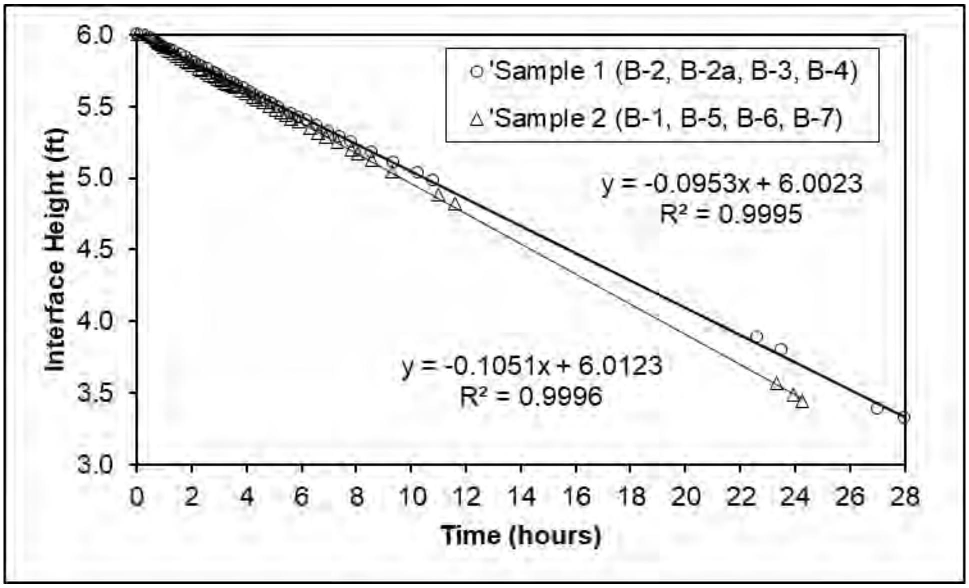


Figure 7: Interface height as a function of time during the zone settling portion of pilot-scale settling column tests with Samples 1 and 2.

Also for comparison purposes, the compression settling behavior of the settled solids in the two pilot-scale settling column tests is shown below in Figure 8. As shown in the figure, the two composited sediment samples exhibited very similar compression settling.

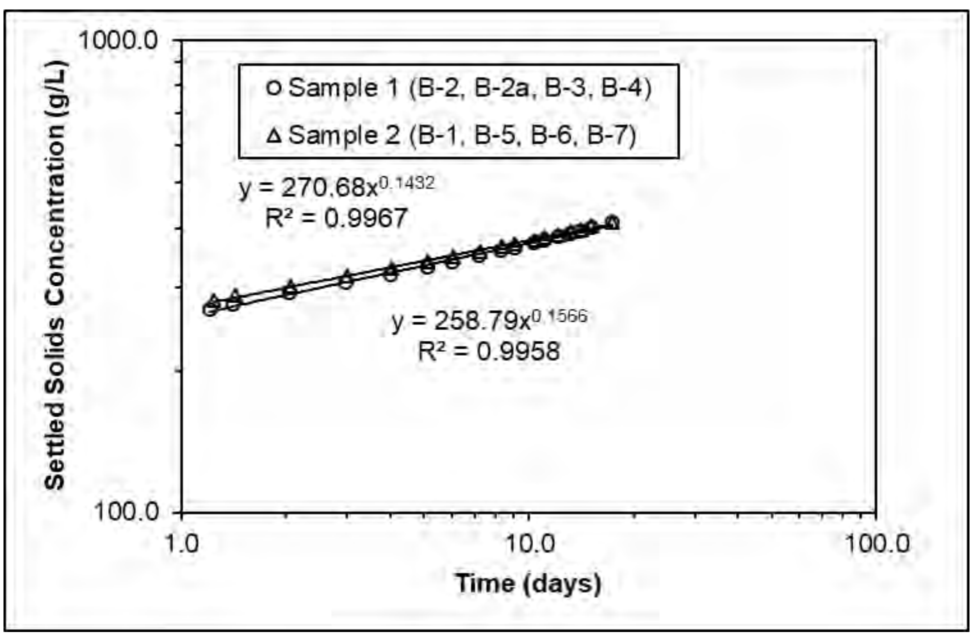


Figure 8: Concentration of settled solids as a function of time during the compression settling portion of the pilot-scale settling tests conducted with fine-grained sediment slurry.

3.0 References

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

[2] 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.

Appendix A

GEOTECHNICAL CHAIN OF CUSTODY FORM

Project Name:	Island Road Marsh creation	Project Manager:	Jennie Aguettant
Project Number:	16715-040-03	Laboratory:	Baton Rouge
Date:	3/7/2018	Page:	1 of 1

Notes:

Please see below for laboratory testing assignments. Please save all samples and return the samples to GeoEngineers after testing.

Boring Number	Depth							Settling Column	
B-1									
B-2									
B-2a									
B-3	8 CRATES								
B-4									
B-5									
B-6									
B-7									
(8) BUCKETS OF SITE WATER									
S#1	Composite		B-2,	B-2a,	B-3,	B-4		X	
S#2	Composite		B-1,	B5,	B-6,	B-7		X	

Report to: Jennifer Aguettant
jaguettant@geoengineers.com
ph # 225-439-9124 or 663-1511

Test Type
~~UU = Unconsolidated - Undrained Triaxial~~
~~U = Unconfined Compression~~
~~MC = Moisture Content~~
~~AL = Atterberg Limit~~
~~Sieve Analysis = Particle Size Analysis~~
~~200 = #200 Wash~~

Settling Column Test

Released by: [signature] Date: 3/7/18

Accepted by: William Moe Date: 3/7/18

Released by: Date:

Accepted by: Date:

GeoEngineers

Appendix B

Table B1. Particulate concentrations measured in samples collected from side ports at the start (t=0) of the pilot-scale settling column test for Sample 1 (composited sediment from borings B-2, B-2a, B-3, and B-4).

Port height (ft)[a]	Particulate Conc. (g/L)
1.0	147.7
2.0	149.3
3.0	147.5
4.0	148.0
5.0	146.4
6.0	145.2
Average	**147.3**

[a] As measured from the bottom of the column

Table B2. Particulate concentrations measured in samples collected from side ports at the start (t=0) of the pilot-scale settling column test for Sample 2 (composited sediment from borings B-1, B-5, B-6, and B-7).

Port height (ft)[a]	Particulate Conc. (g/L)
1.0	152.3
2.0	152.4
3.0	151.1
4.0	150.3
5.0	151.0
6.0	150.6
Average	**151.3**

[a] As measured from the bottom of the column

Appendix C

Table C1. Interface height as a function of time during the pilot-scale column settling test for Sample 1 (borings B-2, B-2a, B-3, and B-4).

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	0.000	6.000	6.000	147.3
0.30	0.013	5.992	6.000	147.5
0.48	0.020	5.975	6.000	147.9
0.63	0.026	5.958	6.000	148.3
0.73	0.031	5.942	6.000	148.7
0.85	0.035	5.925	6.000	149.2
0.95	0.040	5.917	6.000	149.4
1.02	0.042	5.908	6.000	149.6
1.18	0.049	5.900	6.000	149.8
1.33	0.056	5.883	6.000	150.2
1.62	0.067	5.858	6.000	150.9
1.80	0.075	5.842	6.000	151.3
2.00	0.083	5.817	6.000	151.9
2.10	0.088	5.808	6.000	152.2
2.25	0.094	5.792	6.000	152.6
2.35	0.098	5.783	6.000	152.8
2.58	0.108	5.758	6.000	153.5
2.82	0.117	5.733	6.000	154.2
2.90	0.121	5.725	6.000	154.4
3.05	0.127	5.708	6.000	154.8
3.28	0.137	5.683	6.000	155.5
3.50	0.146	5.667	6.000	156.0
3.67	0.153	5.650	6.000	156.4
3.90	0.163	5.625	6.000	157.1
4.12	0.172	5.600	6.000	157.8
4.28	0.178	5.583	6.000	158.3
4.50	0.188	5.558	6.000	159.0
4.68	0.195	5.542	6.000	159.5

[a] Calculated using equation 3-11 in ref. 1 based on the measured particulate concentrations at t=0 and the height of the sediment-water interface at each time interval.

Table C1. Continued from previous page.

Elapsed Time (hr)	Elapsed Time (days)	Solids Interface Height (ft)	Head height (ft)	Settled Solids Conc. (g/L) [a]
4.92	0.205	5.517	6.000	160.2
5.17	0.215	5.492	6.000	160.9
5.62	0.234	5.450	6.000	162.2
5.88	0.245	5.425	6.000	162.9
6.18	0.258	5.400	5.975	163.7
6.57	0.274	5.367	5.975	164.7
7.00	0.292	5.325	5.975	166.0
7.40	0.308	5.292	5.958	167.0
7.83	0.326	5.250	5.958	168.3
8.55	0.356	5.183	5.950	170.5
9.38	0.391	5.108	5.950	173.0
10.25	0.427	5.033	5.950	175.6
10.80	0.450	4.983	5.933	177.4
22.63	0.943	3.892	5.933	227.1
23.53	0.981	3.800	5.858	232.6
27.02	1.126	3.388	5.858	260.9
28.00	1.167	3.325	5.858	265.8
29.00	1.208	3.292	5.858	268.5
33.75	1.406	3.204	5.858	275.8
49.00	2.042	3.033	5.858	291.4
71.12	2.963	2.888	5.858	306.1
96.22	4.009	2.771	5.858	319.0
122.43	5.101	2.679	5.858	329.9
144.38	6.016	2.608	5.858	338.8
172.83	7.201	2.533	5.858	348.9
199.33	8.306	2.471	5.858	357.7
218.05	9.085	2.433	5.858	363.2
248.88	10.370	2.375	5.858	372.1
264.70	11.029	2.346	5.858	376.8
291.28	12.137	2.304	5.858	383.6
315.58	13.149	2.271	5.858	389.2
337.72	14.072	2.242	5.858	394.3
364.42	15.184	2.208	5.858	400.2
415.02	17.292	2.154	5.858	410.3

[a] Calculated using equation 3-11 in ref. 1 based on the measured particulate concentrations at t=0 and the height of the sediment-water interface at each time interval.

Table C2. Interface height as a function of time during the pilot-scale column settling test for Sample 2 (borings B-1, B-5, B-6, and B-7).

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	0.000	6.000	6.000	151.3
0.48	0.020	5.983	6.000	151.7
0.72	0.030	5.958	6.000	152.4
0.78	0.033	5.950	6.000	152.6
0.83	0.035	5.942	6.000	152.8
0.90	0.038	5.933	6.000	153.0
1.02	0.042	5.917	6.000	153.4
1.18	0.049	5.892	6.000	154.1
1.35	0.056	5.867	6.000	154.7
1.47	0.061	5.850	6.000	155.2
1.60	0.067	5.833	6.000	155.6
1.82	0.076	5.817	6.000	156.1
1.88	0.078	5.808	6.000	156.3
2.03	0.085	5.792	6.000	156.7
2.28	0.095	5.758	6.000	157.6
2.35	0.098	5.750	6.000	157.9
2.53	0.106	5.733	6.000	158.3
2.70	0.113	5.717	6.000	158.8
2.80	0.117	5.708	6.000	159.0
2.98	0.124	5.692	6.000	159.5
3.07	0.128	5.683	6.000	159.7
3.18	0.133	5.667	6.000	160.2
3.30	0.138	5.658	6.000	160.4
3.48	0.145	5.642	6.000	160.9
3.55	0.148	5.633	6.000	161.1
3.78	0.158	5.608	6.000	161.9
3.97	0.165	5.592	6.000	162.3
4.22	0.176	5.567	6.000	163.1
4.38	0.183	5.550	6.000	163.6
4.60	0.192	5.525	6.000	164.3

[a] Calculated using equation 3-11 in ref. 1 based on the measured particulate concentrations at t=0 and the height of the sediment-water interface at each time interval.

Table C2. Continued from previous page.

Elapsed Time (hr)	Elapsed Time (days)	Solids Interface Height (ft)	Head height (ft)	Settled Solids Conc. (g/L)[a]
4.83	0.201	5.500	6.000	165.1
5.05	0.210	5.475	6.000	165.8
5.23	0.218	5.458	6.000	166.3
5.42	0.226	5.442	6.000	166.8
5.63	0.235	5.417	6.000	167.6
5.90	0.246	5.392	5.975	168.4
6.33	0.264	5.350	5.975	169.7
6.62	0.276	5.317	5.975	170.7
6.87	0.286	5.292	5.967	171.6
7.28	0.303	5.250	5.967	172.9
7.80	0.325	5.200	5.950	174.6
8.05	0.335	5.175	5.950	175.4
8.55	0.356	5.125	5.950	177.1
9.30	0.388	5.050	5.942	179.8
10.98	0.458	4.883	5.942	185.9
11.58	0.483	4.825	5.892	188.1
23.33	0.972	3.567	5.892	254.5
23.95	0.998	3.483	5.892	260.6
24.25	1.010	3.442	5.842	263.8
27.73	1.156	3.275	5.842	277.2
28.75	1.198	3.254	5.842	279.0
29.75	1.240	3.233	5.842	280.8
34.47	1.436	3.158	5.842	287.4
49.70	2.071	3.008	5.842	301.8
71.83	2.993	2.871	5.842	316.2
96.93	4.039	2.763	5.842	328.6
123.13	5.131	2.675	5.842	339.4
145.08	6.045	2.617	5.842	346.9
173.57	7.232	2.550	5.842	356.0
200.05	8.335	2.492	5.842	364.3
218.75	9.115	2.458	5.842	369.3
249.58	10.399	2.404	5.842	377.6

[a] Calculated using equation 3-11 in ref. 1 based on the measured particulate concentrations at t=0 and the height of the sediment-water interface at each time interval.

Table C2. Continued from previous page.

Elapsed Time (hr)	Elapsed Time (days)	Solids Interface Height (ft)	Head height (ft)	Settled Solids Conc. (g/L)[a]
265.40	11.058	2.379	5.842	381.6
292.00	12.167	2.346	5.842	387.0
316.30	13.179	2.308	5.842	393.3
338.43	14.101	2.283	5.842	397.6
365.13	15.214	2.254	5.842	402.7
415.73	17.322	2.200	5.842	412.6

[a] Calculated using equation 3-11 in ref. 1 based on the measured particulate concentrations at t=0 and the height of the sediment-water interface at each time interval.

Appendix D

Table D1. Total suspended solids (TSS) concentrations measured above the sediment-water interface for characterization of flocculent settling during the Sample 1 pilot-scale column settling test (composited sediment from borings B-2, B-2a, B-3, and B-4).

Sample Extraction Time (hr)	Port Height (ft)[a]	Head Height (ft)[a]	Depth of Sample Extraction (ft)[b]	TSS (mg/L)
6.0	5.50	6.00	0.50	58
7.0	5.50	5.98	0.48	37
8.0	5.50	5.96	0.46	31
10.5	5.50	5.95	0.45	25
23	5.50	5.93	0.43	<25[c]
23	5.00	5.93	0.93	<25[c]
23	4.50	5.93	1.43	<25[c]
23	4.00	5.93	1.93	<25[c]

[a] As measured from the bottom of the column

[b] Relative to the top liquid level

[c] The mass of dry residue retained on the filter was less than 2.5 mg (the minimum required for an acceptable analysis). The result is reported here as <25 mg/L [calculated as the minimum residue mass required for acceptable analysis, 2.5 mg, divided by the sample volume filtered (0.10 L)].

Table D2. Total suspended solids (TSS) concentrations measured above the sediment-water interface for characterization of flocculent settling during the Sample 2 pilot-scale column settling test (composited sediment from borings B-1, B-5, B-6, and B-7).

Sample Extraction Time (hr)	Port Height (ft)[a]	Head Height (ft)[a]	Depth of Sample Extraction (ft)[b]	TSS (mg/L)
5.7	5.50	6.00	0.50	56
6.7	5.50	5.98	0.48	46
7.7	5.50	5.97	0.47	41
8.7	5.50	5.95	0.45	36
11	5.50	5.94	0.44	<25[c]
11	5.00	5.94	0.94	25
24	5.50	5.89	0.39	<25[c]
24	5.00	5.89	0.89	<25[c]
24	4.50	5.89	1.39	<25[c]
24	4.00	5.89	1.89	<25[c]

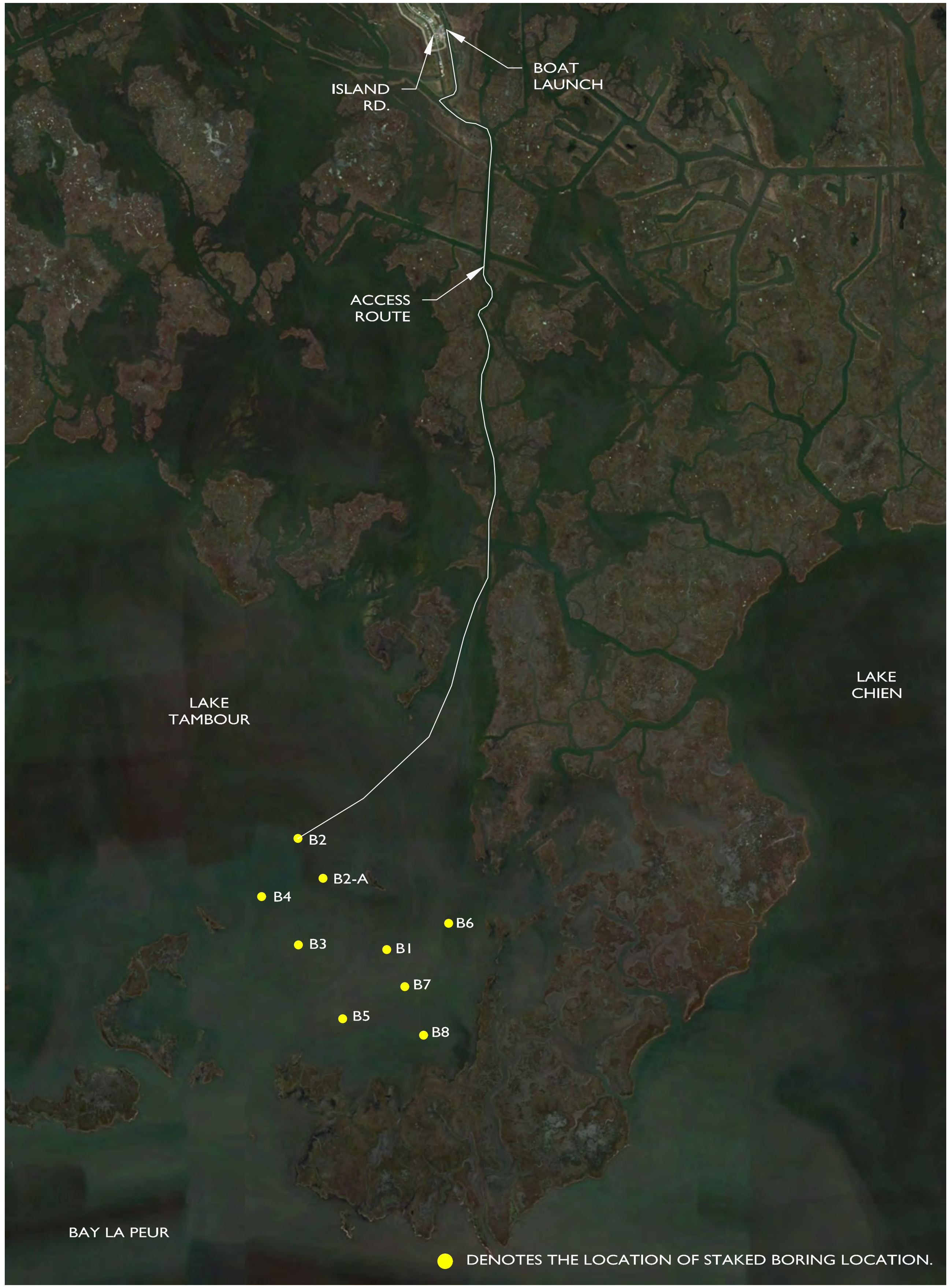
[a] As measured from the bottom of the column

[b] Relative to the top liquid level

[c] The mass of dry residue retained on the filter was less than 2.5 mg (the minimum required for an acceptable analysis). The result is reported here as <25 mg/L [calculated as the minimum residue mass required for acceptable analysis, 2.5 mg, divided by the sample volume filtered (0.10 L)].

APPENDIX D
Lonnie G. Harper and Associates Survey Report

TERREBONNE PARISH
LOUISIANA



1 BORING LOCATIONS
SCALE: 1" = 4,000'

POINT NUMBER	NORTHING (US SURVEY FEET)	EASTING (US SURVEY FEET)	LATTITUDE (NORTH)	LONGITUDE (WEST)	WATER BOTTOM ELEVATION	WATER DEPTH
B1	297,938.72	3,550,075.64	29° 18'59.49299"	90° 29' 18.64995"	-3.97	4.06
B2	301,095.81	3,547,548.02	29° 19' 30.92983"	90° 29' 46.94034"	-4.98	5.07
B2-A	299,963.83	3,548,265.59	29° 19' 19.67197"	90° 29' 38.92794"	-5.81	5.9
B3	298,066.75	3,547,557.60	29° 19' 00.94333"	90° 29' 47.08204"	-5.47	5.56
B4	299,442.26	3,546,513.27	29° 19' 14.63538"	90° 29' 58.76534"	-6.49	6.58
B5	295,967.86	3,548,821.00	29° 18' 40.07407"	90° 29' 32.98516"	-4.28	4.37
B6	298,678.53	3,551,832.66	29° 19' 06.68798"	90° 28' 58.74143"	-4.1	4.19
B7	296,882.75	3,550,586.19	29° 18' 49.00225"	90° 29' 12.97111"	-4.35	4.44
B8	295,502.77	3,551,119.49	29° 18' 35.30229"	90° 29' 07.06273"	-3.54	3.63

AVERAGE TOP OF WATER ELEVATION OBSERVED DURING FIELD SURVEY WAS +0.09 FT, NAVD 88.

GENERAL NOTES

1. ALL DISTANCES AND ELEVATIONS ARE EXPRESSED IN TERMS OF FEET UNLESS OTHERWISE DENOTED.
2. THE HORIZONTAL COORDINATES AND ELEVATIONS ON THIS SURVEY ARE REFERENCED TO THE NATIONAL SPATIAL REFERENCE SYSTEM AND WERE DERIVED BY RECENT GPS OBSERVATIONS. THE HORIZONTAL AND VERTICAL DATUMS FOR THIS REFERENCE SYSTEM ARE NAD 83 AND NAVD 88, RESPECTIVELY. THE REFERENCE FRAME FOR NAD 83 AND NAVD 88 IS CURRENTLY 2011, MA11, PA11 (EPOCH 2010). THE NAVD 88 ELEVATIONS ARE BASED ON GEOID 12B. BASIS OF BEARINGS IS SPC LSZ-1702.
3. ALL COORDINATE CONVERSIONS FROM NAD 83 TO WGS84 LAT. & LONG. WERE PERFORMED USING NGS NADCON UTILITY SOFTWARE.
4. NO EASEMENTS OR UNDERGROUND UTILITIES WERE DETERMINED OR LOCATED DURING THIS SURVEY.
5. A MAGNETOMETER SURVEY WAS PERFORMED AROUND EACH OF THE BORING LOCATIONS SHOWN. NO UNDERGROUND UTILITIES OR OIL/GAS WELLS WERE DETECTED WITHIN 50 FEET OF THE LOCATIONS SHOWN.

NORTH ARROW

REVISION DATE	REVISED BY	DESCRIPTION

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

BORING LOCATIONS

GEOENGINEERS, INC.
TE-117 ISLAND ROAD PROJECT
TERREBONNE PARISH, LOUISIANA

SEAL
STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
LAND SURVEYOR
02/16/2018

LONNIE G. HARPER, P.L.S.
REG. NO. 4326
LONNIE G. HARPER & ASSOC., INC.
GRAND CHENIER, LOUISIANA

DRAWN BY: C.L.W.	DATE: 02/16/2018
DESIGNED BY: C.L.W.	HOR. SCALE: 1" = 4,000'
APPROVED BY: L.G.H.	VERT. SCALE: N.A.
PROJECT NO.: 2018-09	SHEET: 01 OF 01

APPENDIX E
Matrix New World Engineering Report

Matrix New World Engineering, Land Surveying and
Landscape Architecture, PC
4451 Bluebonnet Blvd., Suite E
Baton Rouge, LA 70809
www.Matrixneworld.com WBE/DBE/SBE
MATRIXNEWORLD
Engineering Progress

VIA ELECTRONIC MAIL
Jaguettant@geoengineers.com

February 22, 2018

Ms. Jennifer Aguettant, P.E.
Senior Geotechnical Engineer
GeoEngineers, Inc.
11955 Lakeland Park Blvd., Suite 100
Baton Rouge, LA 70809

Re: Geotechnical Drill Vessel Tracking across LDWF Oyster Leases for the Collection of Eight (8) 3"-Diameter Soil Boring Locations within the Proposed Borrow Location for Island Road Marsh Creation and Nourishment (TE-0117) project in Lake Tambour Area, Terrebonne Parish, Louisiana for GeoEngineers, Inc. (LDNR CUP# 20170975)
Matrix Project No. 17-789

Dear Ms. Aguettant:

Matrix New World Engineering (Matrix) is submitting this vessel tracking report to GeoEngineers, Inc. (GeoEngineers) to document the tracking of geotechnical drilling equipment and vessels in relation to potential oyster lease liabilities of the above-mentioned project. The drilling equipment and vessels provided by Specialized Environmental Resources, Inc. (SER) accessed the eight (8) previously proposed and permitted core sample locations on February 19 and 20, 2018 from the Isle De Jean Charles Marina located near the end of Island Road in Terrebonne Parish, Louisiana. Matrix provided an Oyster Lease Damage Evaluation Board (OLDEB) certified oyster biologist, who utilized a Hemisphere A101 DGPS to collect real-time track data with Chesapeake SonarWiz 7.0 software. The biologist also took photographs and video, and logged the movements of the vessels across the oyster leases and access routes. Attached are **Figures 1** and **2**, which show the tracks taken by the vessels each day. **Attachments A** and **B** provide photographs and log notes, respectively.

Geotechnical Drilling at Sites B5 and B7 - February 19th, 2018

On February 19th, three (3) airboats were used to perform the geotechnical boring. One airboat was designed to carry the drilling apparatus, while the second and third airboats were utilized as support vessels carrying additional supplies and crew. Upon leaving the dock, all vessels tracked behind one another and followed the same track into the first sediment boring location, B5. The Matrix biologist rode and recorded the track from the lead airboat. The airboats created no visible disturbance to the water bottom during access or while moving onto the B5 location. Upon arrival at the previously surveyed and staked sample location, the drill vessel utilized pole spuds to anchor into position and prepared to drill. During the drilling process, water and sediments were brought to the surface and onto the drill vessel with insignificant amounts of sediment being washed overboard throughout the sample collection process. Each core sample collected was transferred from the drill vessel to the support vessel and logged, plugged and capped by a GeoEngineers engineer. Upon completion of the sample collection at the B5 location, the vessels moved northeast to the B7 location. The drilling process remained the same and only negligible amounts of sediment were washed back into the lake during the drilling process. The winds were picking up throughout the day and wave heights were increasing. Also, with a water depth of approximately 5 feet, the airboats became unstable for drilling and maneuverability of the vessels was declining. The captains of the airboats decided the winds and water depths created an unsafe environment for the use of airboats and determined that the remaining sampling locations needed to be accessed with different vessels. After completing the sample collection at B7, the vessels returned to the launch. Times of travel and the vessel tracks are provided in the attached figures and log notes.

Geotechnical Drilling at Sites B6, B1, B3, B4, B2a and B2 - February 20th, 2018

The following day, February 20th, a 30'x8' pontoon deck boat, powered by two Suzuki 175 horsepower outboard engines, was used to pull (in a side-tow) a second 25'x8' pontoon drill barge. These vessels drafted approximately 1.5 to 2.0 feet and were a more stable option when drilling in water depths of 5 feet. The Matrix biologist rode and recorded the track of the deck boat. Access was made to Lake Tambour following the same route taken the day prior. The first drill location was B6 and again the drill barge was anchored at this location using two pole spuds. The drilling process remained the same as previously described and the remaining locations were accessed and sampled in the following order: B6, B1, B3, B4, B2a, and finally B2. Upon completion of the final sample collection, the vessels returned to the launch following the same route previously used. Times of travel and the vessel tracks are provided in the attached figures and log notes.

Biologist Observations

No water bottom impacts were observed by the biologist while the vessels were moving across oyster leases within the sample collection area. The access route from the dock to the sample collection area is a well-traveled navigable waterway (Bayou St. Jean Charles), in which oyster leases are also located. No water bottom impacts were observed by the biologist while the vessels traversed these leases. No oystermen or vessels approached the project area during drilling or moving between locations. Portions of the access route and vessel tracks were also recorded on video and will be included on a DVD with this report.

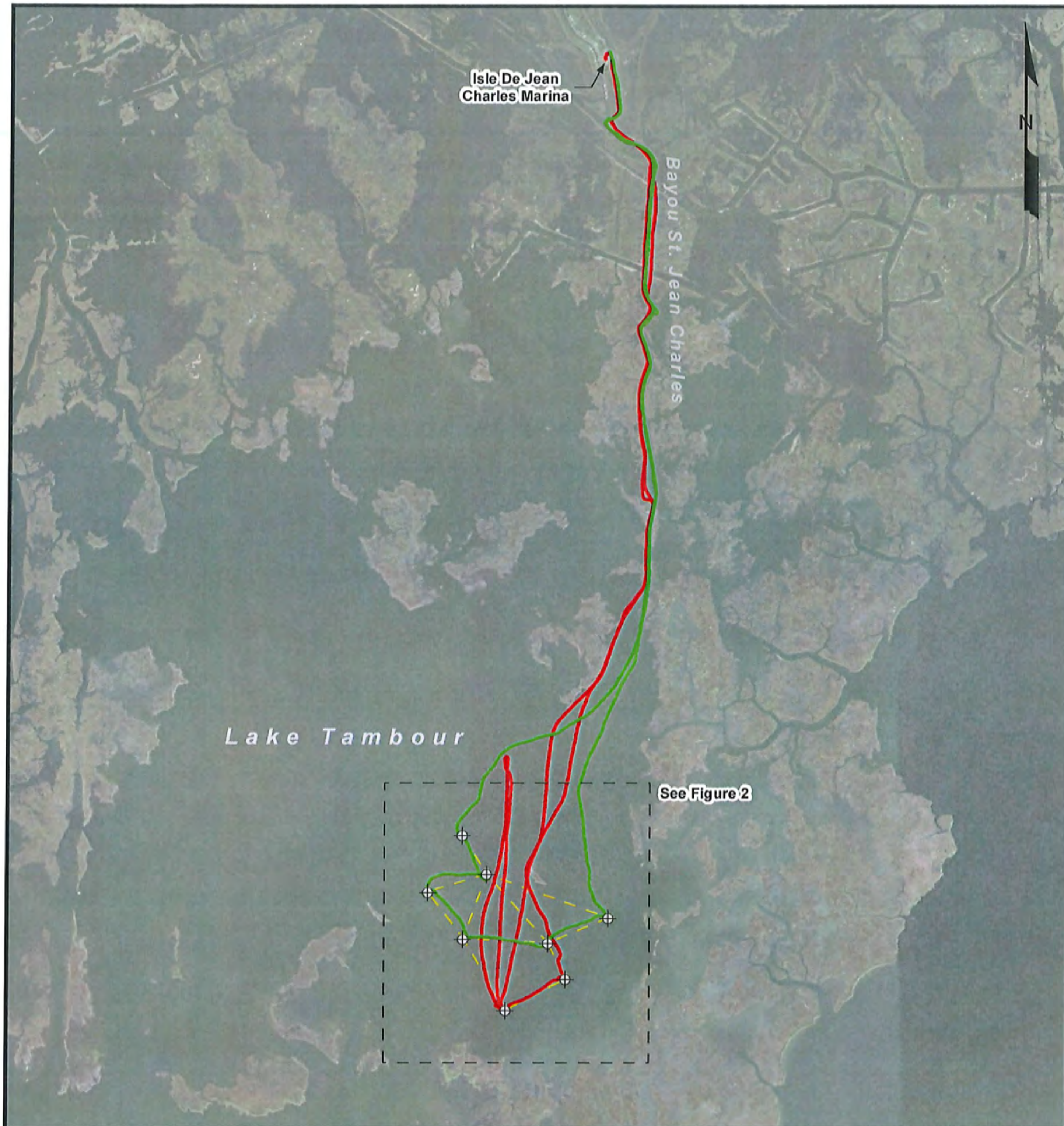
Matrix appreciates the opportunity to assist GeoEngineers with this project. If you have any questions regarding the recorded vessels tracks, daily log or require additional information, please do not hesitate to contact me at (225) 304-1563 or by email sroy@matrixneworld.com.

Sincerely,

Sarah K. Roy

Sarah Roy
Marine Services Manager

FIGURES



Legend

- Geotechnical Drilling Rig Track (2/19/2018)
- Geotechnical Drilling Rig Track (2/20/2018)
- Permitted Access Routes
- Boring Location

Source: Base map comprised of ESRI World Imagery.

Access Overview Map

Geotechnical Drilling Rig Track Across Lake Tambour
Lake Tambour Area, Terrebonne Parish, Louisiana

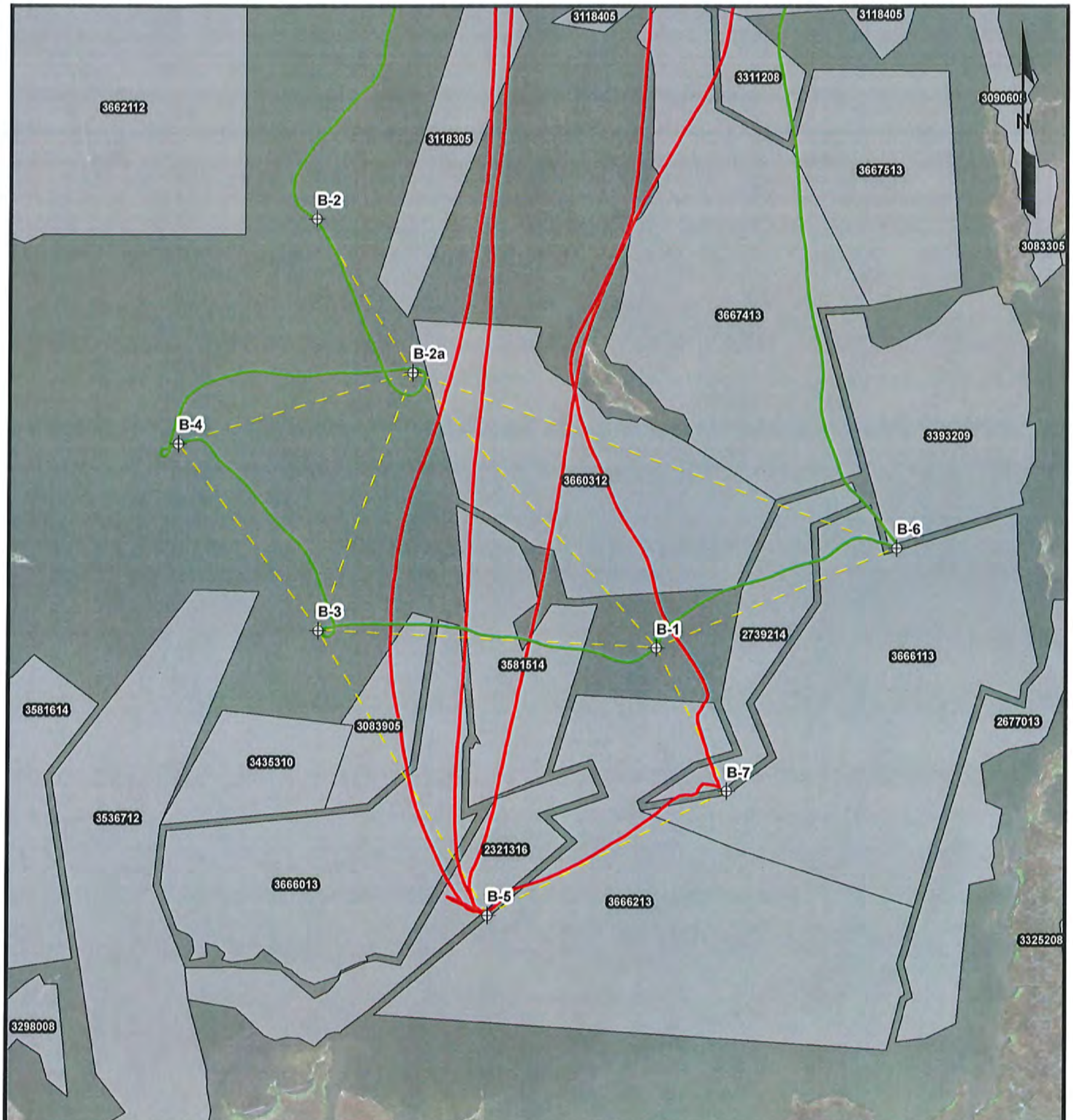
GeoEngineers, Inc.

Island Road Marsh Creation Project (TE-0117)

4,000 2,000 0 4,000 Feet

MATRIXNEWORLD
Engineering Progress

Approved By	SKR	1
Date	2/21/2018	
Drawing No.	17-789-A003	Figure No.



Legend

- Geotechnical Drilling Rig Track (2/19/2018)
- Geotechnical Drilling Rig Track (2/20/2018)
- Permitted Access Routes
- Boring Locations
- Oyster Leases

Source: Base map comprised of ESRI World Imagery.

Access Detail Map

Geotechnical Drilling Rig Track Across Lake Tambour
Lake Tambour Area, Terrebonne Parish, Louisiana

GeoEngineers, Inc.

Island Road Marsh Creation Project (TE-0117)

1,000 500 0 1,000 Feet

MATRIXNEWORLD
Engineering Progress

Approved By	SKR	2
Date	2/21/2018	
Drawing No.	17-789-A004	Figure No.

ATTACHMENT A
PHOTOGRAPHS

MATRIXNEWORLD
Engineering Progress

	GEOENGINEERS, INC.
Site Name:	Island Road Marsh Creation Project (TE-0117) Sediment Boring Vessel Track
Site Location:	Lake Tambour, Terrebonne Parish, Louisiana
Date:	February 19, 2018

Photograph: 1

Direction:

South

Comments:

Heading down Bayou St. Jean Charles.

Photograph: 2

Direction:

Northeast

Comments:

Looking at drill airboat and support airboat moving onto location at B7.

MATRIXNEWORLD
Engineering Progress

GEOENGINEERS, INC.

Site Name:	Island Road Marsh Creation Project (TE-0117) Sediment Boring Vessel Track
Site Location:	Lake Tambour, Terrebonne Parish, Louisiana
Date:	February 19, 2018

Photograph: 3

Direction:

Southwest

Comments:

Drill airboat and support airboat on location at B7.

Photograph: 4

Direction:

West

Comments:
Drill airboat moving from B7 to B5 location.

	GEOENGINEERS, INC.
Site Name:	Island Road Marsh Creation Project (TE-0117) Sediment Boring Vessel Track
Site Location:	Lake Tambour, Terrebonne Parish, Louisiana
Date:	February 20, 2018
Photograph: 5 **Direction:** Southwest **Comments:** View of larger pontoon boat (Lillian B) with smaller drill barge tied to starboard side in tow from Isle De Jean Charles Marina.	
Photograph: 6 **Direction:** North **Comments:** View of Lillian B pontoon boat wake as it is headed south into Bayou St. Jean Charles.	

	GEOENGINEERS, INC.
Site Name:	Island Road Marsh Creation Project (TE-0117) Sediment Boring Vessel Track
Site Location:	Lake Tambour, Terrebonne Parish, Louisiana
Date:	February 20, 2018

Photograph: 7

Direction:

Northeast

Comments:

View of Lillian B pontoon boat wake as it is headed down Bayou St. Jean Charles.

Photograph: 8

Direction:

West

Comments:

View of Lillian B pontoon boat wake as it is crossing leases from B6 to B1.

MATRIXNEWORLD
Enabling Progress

ATTACHMENT B

VESSEL TRACK DAILY LOG

Oyster Biologist Log Record of Vessel Track for GeoEngineers, Inc. 8 Sediment Boring Locations in Lake Tambour, Terrebonne Parish, LA for CPRA Island Road Marsh Creation (TE-0117) Borrow Area

Entered By	Entry Date	Latitude	Longitude	Log Entry
S. Roy	2/19/18	29° 18.66867' N	090° 29.55397' W	0845 mobilized with GeoEngineers (Erich), 3 SER Airboats (1 driller, 2 support), SER employees at Isle De Jean Charles Marina
S. Roy	2/19/18	29° 18.66828' N	090° 29.55423' W	0909 Left Isle De Jean Charles Marina, headed to B5 location
S. Roy	2/19/18	29° 18.66856' N	090° 29.55386' W	0930 arrived at B5 location
S. Roy	2/19/18	29° 18.66861' N	090° 29.55448' W	0945 Left B5 location to go get lost bucket - back to B5 location, drilling to begin at B5
S. Roy	2/19/18	29° 18.67536' N	090° 29.56980' W	1033 Finished at B5 location move to B7 location
S. Roy	2/19/18	29° 18.82002' N	090° 29.22042' W	1047 arrived and begin drill at B7
S. Roy	2/19/18	29° 18.82052' N	090° 29.22032' W	1123 finished at B7, winds picking up, unsafe to continue drilling today, headed back to dock
S. Roy	2/19/18	29° 23.29594' N	090° 28.95715' W	1151 arrived at dock, work today cancelled due to unsafe conditions
S. Roy	2/20/18	29° 23.30663' N	090° 28.95912' W	0943 mobilized @ Isle De Jean Charles Marina dock with the 30x8 pontoon vessel Lillian B (2 Suzuki Outboard 175hp motors) and a 25'x10' drill barge (pontoon) will be towed along side Lillian B. All vessels owned and operated by SER.
S. Roy	2/20/18	29° 19.11407' N	090° 28.97630' W	1043 arrived and begin drill at B6
S. Roy	2/20/18	29° 19.11363' N	090° 28.97636' W	1124 finished at B6 location, moving to B1
S. Roy	2/20/18	29° 18.99298' N	090° 29.30625' W	1135 arrived and begin drill at B1
S. Roy	2/20/18	29° 18.99021' N	090° 29.31278' W	1206 finished at B1, headed to B3
S. Roy	2/20/18	29° 19.01584' N	090° 29.78072' W	1211 arrived and begin drill at B3
S. Roy	2/20/18	29° 19.01153' N	090° 29.76261' W	1242 finished at B3, headed to B4
S. Roy	2/20/18	29° 19.24299' N	090° 29.97648' W	1246 arrived and begin drill at B4

Oyster Biologist Log Record of Vessel Track for GeoEngineers, Inc. 8 Sediment Boring Locations in Lake Tambour, Terrebonne Parish, LA for CPRA Island Road Marsh Creation (TE-0117) Borrow Area

Entered By	Entry Date	Latitude	Longitude	Log Entry
S. Roy	2/20/18	29° 19.23797' N	090° 29.99491' W	1328 finished at B4, headed to B2a
S. Roy	2/20/18	29° 19.33257' N	090° 29.64710' W	1333 arrived and begin drill at B2a
S. Roy	2/20/18	29° 19.32757' N	090° 29.63561' W	1417 finished at B2a, headed to B2
S. Roy	2/20/18	29° 19.51634' N	090° 29.78807' W	1421 arrived and begin drill at B2
S. Roy	2/20/18	29° 19.51667' N	090° 29.78943' W	1453 finished at B2, all drill sites accessed and completed, returning to dock
S. Roy	2/20/18	29° 23.29562' N	090° 28.95286' W	1539 returned to dock, tracks saved and project complete

APPENDIX F
Report Limitations and Guidelines for Use

APPENDIX F
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 Coastal Protection and Restoration Authority (CPRA). 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 CPRA, 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 the Island Road Marsh Creation and Nourishment (TE-117) project located in Terrebonne 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 hurricanes, 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.

Have we delivered World Class Client Service?

Please let us know by visiting **www.geoengineers.com/feedback**.

GeoEngineers