Mobile Bay National Estuary Program Restoration of the Northern End of Mon Louis Island

Fowl River, Mobile County, Alabama

June 4, 2014

Thompson Engineering Project: 13-1101-0242



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ALTERNATIVES EVALUATION REPORT

RESTORATION OF THE NORTHERN END OF MON LOUIS ISLAND FOWL RIVER, MOBILE COUNTY, ALABAMA

JUNE 4, 2014

DRAFT

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Thompson Engineering Project No.: 13-1101-0242

TABLE OF CONTENTS

Section		Page
No.	<u>Title</u>	No.
1.0	INTRODUCTION	1
2.0	GENERAL APPROACH FOR EVALUATION	
	OF ALTERNATIVES	
2.1	General Considerations	
2.2	Shoreline Stabilization (Breakwater) Alignments	
2.3	Shoreline Stabilization Methods	5
2.4	Sources of Fill for Marsh Creation	5
3.0	DISCUSSION AND COST OPINIONS OF ALTERNATIVES	7
4.0	CONCLUSIONS AND RECOMMENDATIONS	16
5.0	REFERENCES CITED	17
LIST OF	FIGURES	
No.	<u>Title</u>	
1	Vicinity Map	2.
2	Alternate Alignments for Shoreline Stabilization	
3	Soil Boring and Vibracore Locations	
4	Continuous Rock Dike Typical Section	
5	Typical Segmented Breakwater Layout	
6	OysterBreak TM Typical Section	
7	Maximum Fetch and Wind Rose of Southeasterly Winds	
8	Pre- and Post-Project Mon Louis Island Wave Climates, Plotted Against	t
	Wave Levels Tolerable for Spartina Wetland Vegetation	14
LIST OF	TABLES	
<u>No.</u>	<u>Title</u>	
1	Summary of Alternatives and Cost Opinions	7
2	Calculated Northeasterly Wind/Wave Climate for Mon Louis Island	
3	Structure Parameters for Alternatives 1 and 3	
4	Theoretical Transmitted Wave Heights for Alternatives 1 and 3	14

TABLE OF CONTENTS (Continued)

APPENDICES

Appendix A	Preliminary Opinions of Probable Costs
Appendix B	Preliminary Drawings
Appendix C	Summary Report: Compilation and Review of Existing Information for the Restoration of the Northern End of Mon Louis Island, Fowl River, Mobile County, Alabama. Royal Engineers and Consultants, LLC, May 2014
Appendix D	Geotechnical Data Report, Mon Louis Island – Marsh Creation and Shoreline Stabilization Project, Theodore, Mobile County, Alabama. Thompson Engineering, Inc., May 27, 2014

1.0 INTRODUCTION

Purpose and Objectives

The purpose of this Alternatives Evaluation is to assist the Mobile Bay National Estuary Program (MBNEP) make an informed decision on which design alternative best meets their goals, while taking into account budgetary and constraints. MBNEP has established the overall goals for the restoration to be: (1) stabilize the shoreline along the bay side of the northern tip of Mon Louis Island and (2) create/enhance aquatic, wetland, and upland habitats to the extent possible. A range of options has been considered for the restoration including marsh creation (possibly using dredge materials for wetland fill) as well as shoreline reclamation and stabilization. The objective of the Alternatives Evaluation phase of this project is to develop preliminary budgetary estimates for a range of options; assess the feasibility of those options; and determine to what extent the options will meet MBNEP's aforementioned overall goals.

Scope

The Thompson Team (Thompson Engineering, Inc., Royal Engineers and Consultants, LLC, and Barry A. Vittor & Associates, Inc.) has reviewed relevant information and data pertaining to Mobile Bay, Fowl River, and the local area surrounding Mon Louis Island (see Figure 1 – Vicinity Map). A detailed literature review was conducted that included coastal processes and data, living shorelines data, and US Army Corps of Engineers (USACE) dredging information. To supplement existing information and data available from literature review, field investigations were conducted to acquire site-specific survey information (bathymetric, topographic, and boundary) and geotechnical (soils, sediments) data.

Conceptual design alternatives were developed and include: alternative breakwater/living shoreline designs; alternative marsh creation configuration (size, location); and alternative borrow sources and fill placement methods. The alternative borrow sources included consideration of hydraulic dredging from the Fowl River navigation channel and other potential borrow sites south of the channel, beneficial use of dredged material from Blakely Island (or other sources) that could be delivered by barge and mechanically placed, and/or the use of conventional borrow material sources.



Source: USGS 7.5-minute Quadrangle, Bellefontaine, Ala. (1956, latest photorevision 1985)

Figure 1: Vicinity Map

2.0 GENERAL APPROACH FOR EVALUATION OF ALTERNATIVES

2.1 General Considerations

As noted previously, the Mon Louis Island restoration project goals are: (1) stabilize the shoreline along the bay side of the northern tip of Mon Louis Island, and (2) create/enhance aquatic, wetland, and upland habitats to the extent possible. The evaluation of alternatives to address these goals has included:

- Alternate breakwater alignments (and marsh creation configuration)
- Alternate breakwater / living shoreline designs
- Alternate borrow sources and fill placement methods (for marsh creation fill)

Each is generally discussed in the subsections below. Following in Section 3 is a presentation of specific alternatives that were evaluated in more detail, including a summary tabulation of budgetary construction cost estimates. More detailed cost itemizations are contained in Appendix A. Preliminary drawings of the alternatives are included in Appendix B. A report of the literature review of coastal processes information and data relevant to site conditions is included as Appendix C. The complete geotechnical data report is contained in Appendix D.

It is noted that the budgetary cost information summarized in Section 3 and itemized in Appendix A are preliminary opinions of probable construction costs, and do not include related engineering (design, construction oversight) or permitting costs.

Certain alternatives require transport of materials and/or equipment to the site by barges that, when optimally loaded, require a typical draft on the order of 6 feet or more. Where needed, the cost estimates include provision for an access channel from the existing Fowl River navigation channel to the project work site. However, it is noted that the Fowl River navigation channel itself is presently "shoaled" to controlling depths of 3 to 4 feet. The alternative cost comparisons in this evaluation do not include allowance for dredging of the navigation channel itself.

2.2 Shoreline Stabilization (Breakwater) Alignments

Alternate alignments evaluated for shoreline stabilization (and marsh creation configuration) are depicted in Figure 2. As depicted, the alignments generally correspond to previous historical shorelines:

- Alignment A 2006 shoreline (parallels existing shoreline)
- Alignment B 1997 shoreline
- Alignment C 1979 shoreline

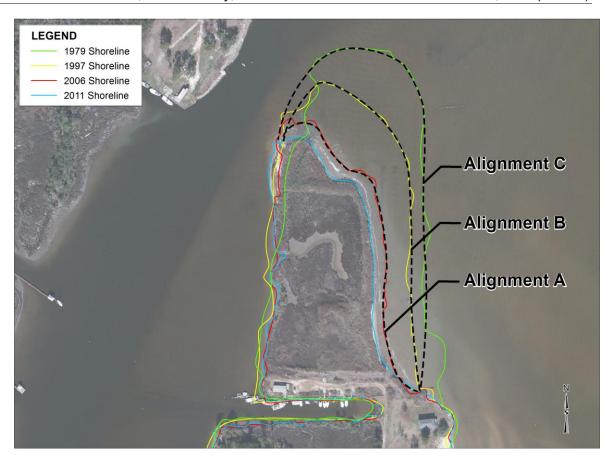


Figure 2: Alternate Alignments for Shoreline Stabilization

Primary features of the project varying with the alignment alternates are summarized below:

•	Alignment A:	Fill Quantity (in place)	- 11,400 CY
		Dredge Quantity	- 17,000 CY
		Total Shoreline Stabilization Length	- 1,450 ft.
		Fill Area (Marsh Creation)	- 2 acres
•	Alignment B:	Fill Quantity (in place)	- 43,100 CY
	C	Dredge Quantity	- 65,000 CY
		Total Shoreline Stabilization Length	- 1,640 ft.
		Fill Area (Marsh Creation)	- 6 acres
•	Alignment C:	Fill Quantity (in place)	- 71,800 CY

Alignment C: Fill Quantity (in place) - 71,800 CY
Dredge Quantity - 108,000 CY
Total Shoreline Stabilization Length - 1,990 ft.
Fill Area (Marsh Creation) - 9 acres

Quantity estimates are approximate and based on certain assumptions which will require further examination during design. For example, fill quantities assume a 1-foot

consolidation of underlying soils, and dredge quantities incorporate a 1.5 "cut-to-fill" factor.

2.3 Shoreline Stabilization Methods

Three alternative breakwater / living shoreline concepts were selected for comparison, and evaluated for each of the alignments:

- Alternative 1 Continuous Rock Dike Breakwater
- Alternative 2 Segmented Rock Dike Breakwaters
- Alternative 3 Continuous OysterBreak TM Breakwater

Alternatives 1 and 2 represent conventional "rubble mound" breakwater construction. Alternative 3 represents a type of "living shoreline" breakwater. The selection of this particular living shoreline approach for detailed cost comparison does not preclude consideration during design of other living shoreline construction methods that would prove to be of equal or better wave attenuation characteristics, and satisfy other required project specifications.

2.4 Sources of Fill for Marsh Creation

Initial project conceptualization envisioned that hydraulic dredging of sediments from the Fowl River navigation channel would be the most cost-effective fill source, if material characteristics proved suitable for land reclamation / marsh creation. Permitting and related issues would also be minimized. Therefore, the initial geotechnical investigations included "vibracore" borings of channel sediments, as well as standard soil test borings at the proposed shoreline stabilization / marsh creation site. Figure 3 displays the soil test boring and vibracore locations. The complete test results are provided in the geotechnical data report (Appendix D). Unfortunately, the sediments tested from all channel vibracore locations were determined to be "fat clays" with very low sand content, and generally unsuitable for land reclamation at the site.

Although the northern tip of Mon Louis Island is accessible by land, the access (Old Shipyard Road) is very narrow and winds through a residential area. Therefore, delivery of large quantities of fill materials by haul truck was ruled out because of the expected public opposition, as well as the potential for damages to the roadway itself.

Transport and delivery of fill materials to the site by barge, with mechanical unloading and placement on the site was considered for several possible sources of fill. These included commercial "borrow pit" sources, USACE dredged material management areas on Blakeley and Pinto Islands, and an Alabama State Port Authority (ASPA) dredged material area at the head of the Theodore barge canal. All of these scenarios require duplicative handling of the materials (load to truck, transport and offload to barge, transport and offload at site) which substantially increases costs. Even though the fill material itself may be "free" or of nominal cost, transport and delivery costs were estimated on the order of \$30 to \$45 per cubic yard, and such fill sources were ruled out.



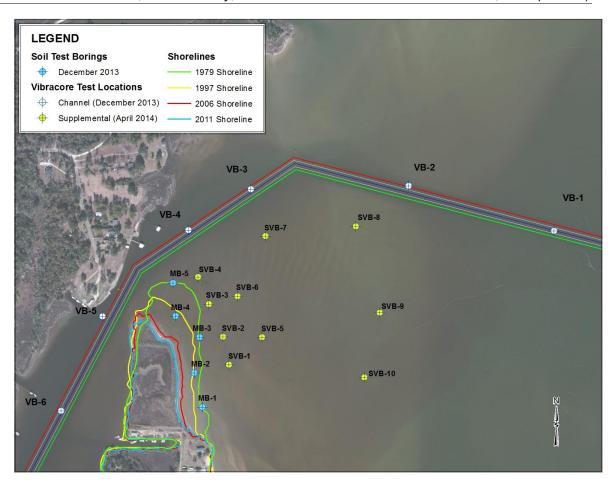


Figure 3: Soil Boring and Vibracore Locations

Considering the above, it was decided to perform supplemental vibracore borings to search for better quality (sandier) sediments that could possibly serve as a borrow source for hydraulic dredging. The supplemental vibracore locations are depicted as such on Figure 3. Generally, sandier materials were encountered in surficial sediments (from 2-ft. to 6-ft. in thickness) at the easternmost vibracore locations (SVB-7, 8, 9, and 10), and use of this area as a hydraulic dredging borrow source was assumed for the cost comparisons. However, since this area has not been dredged in the past, increased regulatory review and possible permitting issues should be anticipated should an alternative requiring its use be selected.

3.0 DISCUSSION AND COST OPINIONS OF ALTERNATIVES

Preliminary investigations of several alternatives/alignments for the Restoration of the North End of Mon Louis Island Project have been performed. Whenever possible, quoted prices were compared to identical items on bid tabs from recent projects similar in nature to ensure cost reasonableness. The primary objective of this section of the report is to provide the Mobile Bay National Estuary Program some budgetary numbers as a screening tool by which each alternative can be evaluated and to establish an overall budget that should be sufficient. A summary comparison of the investigated alternatives/alignments and associated cost opinions are provided below in *Table 1: Summary of Alternatives and Cost Opinions*. The three alternatives described below were developed at each alignment depicted previously and in the attached drawings. See Appendix A for more detailed cost itemizations and Appendix B for all drawings. Quantity variations are realized for each alternative at each of the alignments and are depicted in the cost breakdowns.

Table 1: Summary of Alternatives and Cost Opinions

Alignment	Description	Cost Opinion
No.		
Α	1. CONTINUOUS ROCK DIKE	\$ 1,223,849
Α	2. SEGMENTED ROCK BREAKWATERS	\$ 1,001,970
Α	3. CONTINUOUS OYSTERBREAK ARMOR	\$ 1,091,508
	UNITS	
В	1. CONTINUOUS ROCK DIKE	\$ 1,711,674
В	2. SEGMENTED ROCK BREAKWATERS	\$ 1,436,524
В	3. CONTINUOUS OYSTERBREAK ARMOR	\$ 1,518,370
	UNITS	
С	1. CONTINUOUS ROCK DIKE	\$ 1,970,364
С	2. SEGMENTED ROCK BREAKWATERS	\$ 1,630,777
С	3. CONTINUOUS OYSTERBREAK ARMOR	\$ 1,746,714
	UNITS	

Alternative No. 1 – Continuous Rock Dike:

The first alternative evaluated includes using DOTD Class 130 lb. riprap to construct a continuous dike that follows the alternative alignments outward from the Northern End of Mon Louis Island. The dike would be constructed over DOTD Class D Woven Geotextile Fabric and a bedding stone along the project length. Typical proposed dimensions of the dike are 20 ft. wide at the base and 4 ft wide at the top with side slopes of 1:1.5 (V:H). The constructed elevation of the dike is to be +4.10 ft. NAVD 88 (Figure 4), with a final design elevation of the dike at +3.10 ft. NAVD88, due to settlement, which dictates an average dike height of about 6 feet. Given these dimensions, the

quantity of riprap and geotextile fabric that would be required has been calculated for each alternative. Preliminary geotechnical engineering indicates approximately 1 ft. of settlement. Final design of the selected shoreline protection alternative will include a detailed geotechnical analysis, which will be incorporated into the final construction documents.

The construction of such a dike will require digging an access channel to allow for passage of construction equipment. The channel is recommended to be dredged at a minimum of 6 ft. deep, with an 80 ft. top width. This dictates that a certain amount of material will be removed and stockpiled. The material excavated from this access channel will be stockpiled on the side of the channel opposite the dike. After placement of all riprap is complete, a portion of the stockpile may be used to create marsh on the side of the dike opposite the access channel (see *Appendix B*). The design anticipates the use of all stockpiled material for marsh creation behind the dike. However, amount of material used to create marsh behind the dike will be subject to what funding and permitting allows. Any material not used for marsh creation behind the dike must be used to fill the access channel. A breakdown of costs for Alternative No. 1 is attached in Appendix A: *Preliminary Opinion of Probable Costs*.

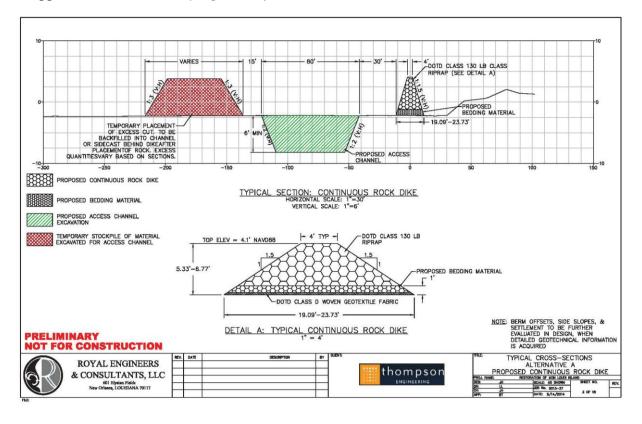


Figure 4: Continuous Rock Dike Typical Section

Alternative No. 2 - Segmented Rock Breakwaters:

The second alternative calls for Segmented Rock Breakwaters. The segments are equally spaced at 75 feet. In Alternative No. 2, the breakwater system configuration is designed to reduce the transmitted wave energy and aid in protecting the shoreline and reduce shoreline erosion. The Segmented Rock Breakwaters will be constructed over DOTD Class D Geotextile Fabric over a bedding stone with a base length of each segment equal to the gap spacing of 75 feet (Figure 5), and a top berm width of 4 ft., side slopes of 1:1.5 (V: H), and an elevation of +4.10 ft. NAVD88. These dimensions are subject to variation upon completion of a more detailed geotechnical and hydraulic study. For this alternative an access channel as described in Alternative 1 will be utilized. This alternative will require riprap, bedding stone and of geotextile fabric. Preliminary design options anticipate the use of all stockpiled material for creating marsh behind the Breakwaters. However, the amount of material used for this will be subject to what funding and permitting allows. Any material not used for marsh creation behind the dike must be used to fill the access channel. A breakdown of costs for Alternative No. 2 is also attached in Appendix A: *Preliminary Opinion of Probable Costs*.

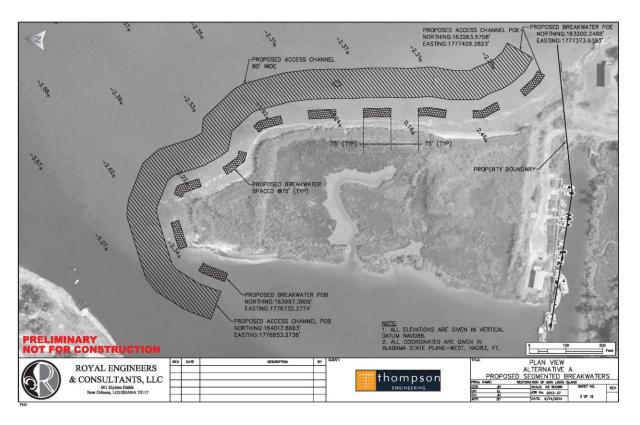


Figure 5: Typical Segmented Breakwater Layout (Alternative No.2)

Alternative No. 3 - Continuous OysterBreakTM:

The third alternative evaluated consisted of a Continuous OysterBreak TM Breakwater that follows the alternative alignments outward from the northern end of Mon Louis Island Shoreline. This alternative also calls for a base preparation of the woven geotextile and a bedding stone to be installed. The OysterBreak TM is an artificial oyster reef, designed to provide a structural coastal protection for coastal estuary shorelines. The design of OysterBreak varies according to project location, and size of project. Alternative No. 3 calls for a design OysterBreak of two layers of 58 in OD and 46 in ID for each with the top layer interlocked into the base layer. The crest elevation of the OysterBreak Armor Unit falls between 40 to 48 inches. (See Figure 6 OysterBreak Typical Section.)

The total length in feet of OysterBreakTM will be constructed over DOTD Woven Geotextile Fabric of 120 inches width plus Bedding Stone to a depth of -1ft NAVD88 with a base width of 10.33 ft. The placement of the OysterBreakTM will not require an access channel. The final height of the top berm will be +3.10 ft NAVD 88. A breakdown of costs for Alternative No. 3 is also attached in Appendix A: *Preliminary Opinion of Probable Costs*.

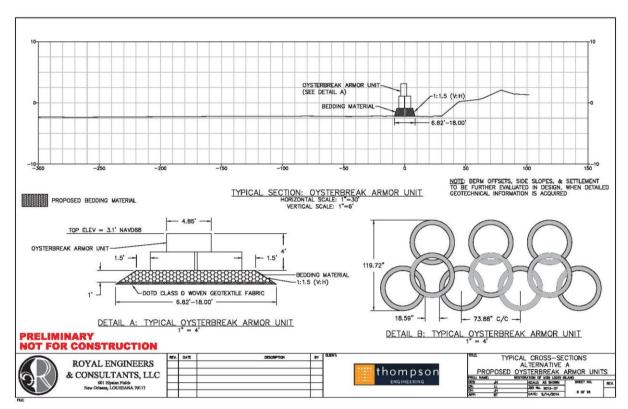


Figure 6: OysterBreak Typical Section

Shoreline Protection Pros/Cons

Alternatives 1 and 3: Continuous Rock Dike and OysterBreakTM Alternatives

Alternatives 1 and 3, the continuous Rock Dike and OysterBreakTM alternatives are expected to perform comparably in terms of shoreline protection. Both can be classified as low-crested permeable structures and will provide the highest level of wave protection of the three alternatives by fully enclosing the project area.

The anticipated levels of shoreline protection offered by Alternatives 1 and 3 may be qualified by comparison with a 2005 study by Roland and Douglass, who empirically determined a threshold of allowable wave activity for survival of vegetated shoreline wetland systems in coastal Alabama. To that end, a preliminary estimate of pre- and post-project wave climatologies was developed for the northeastern tip of Mon Louis Island for Alternatives 1 and 3, to determine if these proposed structures will provide the protection conducive to healthy shoreline vegetation (*Spartina alterniflora*), based on the criteria determined by Roland and Douglass (2005).

To develop the pre-project wave climatology, two-dimensional steady-state wave fields were calculated with the numerical model STWAVE across a 24-mile fetch from the southeastern end of Bon Secour Bay to the northeastern tip of Mon Louis Island (Figure 7). Historic winds blowing along this northwest trajectory were extracted from a ~20 year data set (1992-2014) of continuous 10-minute winds at Dauphin Island, Al. These winds (from meteorological direction 1122.5° to 157.5°) were fit to a long-term Gumbel probability distribution, the statistical results of which were input as forcing conditions into the STWAVE model.

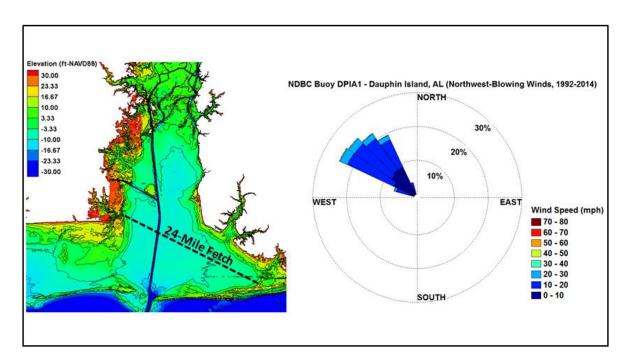


Figure 7: Maximum Fetch (Left) and Wind Rose (Right) of Southeasterly Winds

The resulting wind/wave distribution values are shown in Table 2 below. For the range of occurrence probabilities shown, the corresponding wind speed and simulated incident significant wave height (Hi) are given. Note: these wind/wave distributions are specific to the southeasterly (northwest-blowing) direction.

Table 2: Calculated Northeasterly Wind/Wave Climate for Mon Louis Island

Frequency	Wind	Incident	Peak
of	Speed	Wave	Incident
Occurrence	(mph)	Height,	Wave
(% less		Hi (ft)	Period,
than)			Tp
			(sec)
10%	5.54	0.10	0.6
20%	7.16	0.66	2.2
30%	8.48	0.85	2.6
40%	9.72	0.98	2.8
50%	10.98	1.08	2.9
60%	12.37	1.15	3.1
70%	14.00	1.25	3.2
80%	16.12	1.35	3.4
90%	19.53	1.44	3.7

Using wave transmission formulae for low-crested permeable structures (d'Agremond et al., 1996), theoretical transmitted wave heights on the shore-side of Alternatives 1 and 3 were then calculated, according to Equation 1 below.

$$K_t = -0.4 \frac{R_c}{H_i} + 0.64 \left(\frac{B}{H_i}\right)^{-0.31} \left(1 - e^{-0.5\zeta}\right)$$
(1)

where: K_t = wave transmission coefficient (0.075 $\leq K_t \leq$ 0.80)

 R_c = crest freeboard

 H_i = incident wave height

B = crest width

 $\zeta = \text{breaker parameter} = \tan \alpha / (s_{op})^{0.5}$

 α = seaward slope of structure

 s_{op} = wave steepness = $2\pi H_i/(gT_p^2)$

g = acceleration due to gravity = 32.2 ft/sec²

 T_p = peak wave period

and:
$$H_t = (K_t)(H_i)$$
 (2)

where: H_t = transmitted wave height (shoreward of structure)

At a still-water elevation at mean high water of +1.41' NAVD88 (Royal, 2014) and a proposed long-term (settled) crest elevation of +3.10' NAVD88, the structure parameters needed for the solution of Equation for Alternatives 1 and 3 are summarized in Table 3.

Table 3: Structure Parameters for Alternatives 1 and 3

Parameter	Alt. 1:	Alt. 3:
	Rock Dike	OysterBreak
Rc (ft)	1.77	1.77
B (ft)	4.00	5.00
α	33.69	39.61
(degrees)		

Solution of Equation 1 for these structure parameters yields the following transmitted wave heights for Alternatives 1 and 3:

Table 4: Theoretical Transmitted Wave Heights for Alternatives 1 and 3

Frequency of	Alt. 1:	Alt. 3:
Occurrence (%	Ht_{rubble}	$Ht_{oystrbrk}$
less than)	(ft)	(ft)
10%	0.01	0.01
20%	0.05	0.05
30%	0.06	0.06
40%	0.07	0.07
50%	0.08	0.08
60%	0.09	0.09
70%	0.09	0.09
80%	0.10	0.10
90%	0.11	0.11

The calculated pre- and post-project wave climates summarized in Tables 2 and 4 were plotted over data digitized from Roland and Douglass (2005), in order to characterize the pre- and post-project Mon Louis Island wave climates in terms of tolerable levels for spartina vegetation. This plot is shown in Figure 8.

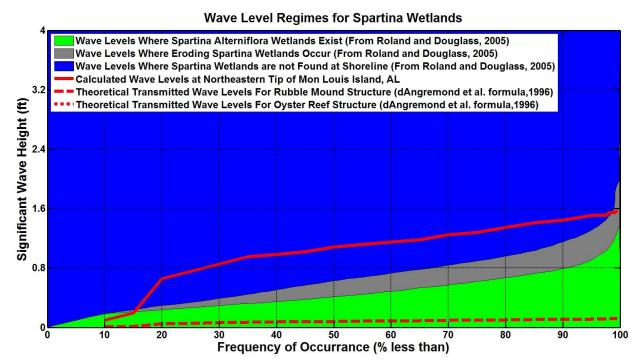


Figure 8: Pre- and Post-Project Mon Louis Island Wave Climates, Plotted Against Wave Levels Tolerable for *Spartina* Wetland Vegetation (Roland and Douglass, 2005)

Figure 8 indicates that, except for the low-energy end of the probability curve (< 15% occurrence), the existing wave climate incident to the Mon Louis Island shoreline exceeds the levels tolerable for a stable, vegetated wetland. This finding is intuitive, given the rates of shoreline erosion observed in recent decades (Royal, 2014). However, the theoretical (post-project) transmitted wave levels for both the rock dike and oyster reef structures are below the threshold at which shoreline *Spartina* wetlands have been found to exist. Therefore, both Alternatives 1 and 3 are deemed to be acceptable for shoreline protection at Mon Louis Island. However, it is worth noting that the Alternative 3 oyster ring structure is more conducive to oyster growth, which will decrease both the structure permeability and the transmitted wave height over time, making it even more effective as a shoreline protection feature. The use of the oyster shell structures might be preferable to rock, if only because of the greater benefit to settling oysters. There had been substantial oyster reefs to the north, so there is a good likelihood that there will be a source of spat for the peninsula area.

Alternative 2: Segmented Breakwater Alternative

Segmented breakwaters are designed to function within a sediment-rich system by trapping sediment behind each structure, causing the shoreline to prograde toward the breakwaters in an undulating fashion (e.g. by the formation of salients/tombolos). This promotion of sediment deposition behind each structure, however, comes at the cost of potentially increased erosion between the structures, caused by the focusing of wave energy and nearshore currents through the segment gaps. In a sediment-starved system, the little sediment that is available will be trapped behind the up drift breakwaters in the series, causing increased erosion further downshore. While a detailed local sediment budget has not been developed specifically for this project area, it is qualitatively surmised that the northern end of Mon Louis Island is a sediment-starved system, due to observed shoreline retreat in recent decades and the array of structures along the Mobile Bay shoreline. Therefore, the presence of segmented breakwaters will likely result in increased erosion in some areas of the project site, if sediment nourishment is not included as a project component and re-nourishment intervals, i.e. maintenance events, based on a detailed sediment budget analysis (volumetric change over time) are not designed.

4.0 CONCLUSIONS AND RECOMMENDATIONS

[to be added after review of 6-4-2014 Draft]

5.0 REFERENCES CITED

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Roland, R.M., Douglass, S.L., 2005. Estimating wave tolerance of *Spartina alterniflora* in coastal Alabama. Journal of Coastal Research 21, 453-463.

Royal Engineers and Consultants, LLC, 2014. Summary report: compilation and review of existing information for the restoration of the northern end of Mon Louis Island, Fowl River, Mobile County, Alabama. [included as Appendix C]

Thompson Engineering, Inc., May 27, 2014. Geotechnical Data Report, Mon Louis Island – Marsh Creation and Shoreline Stabilization Project, Theodore, Mobile County, Alabama. [included as Appendix D]

APPENDIX A PRELIMINARY OPINIONS OF PROBABLE COSTS

Mon Louis Island Shoreline Protection: Alignment A **Preliminary Opinion of Probable Construction Cost**

ALTERNATIVE NO. 1 - CONTINUOUS ROCK DIKE							
SIDE SLOPES (V:H) = 1:1.5, TOP BERM WIDTH = 4', TOP BERM ELEVATION = 4.10' NAVD88							
Item No.	Item Description	Unit of	Estimated	Estimated	Estimated		
item No.		Measure	Quantity	Unit Price	Cost		
1.0	Mob/Demob	lump sum	1	\$300,000	\$ 300,000		
2.0	Survey	lump sum	1	\$ 40,000	\$ 40,000		
3.0	Project Access Channel	linear foot	1,606	\$ 30	\$ 48,180		
4.0	Vegetative (Marsh) Plantings	acre	2	\$ 12,000	\$ 24,000		
5.0	Geotextile Fabric	square yards	4,817	\$ 7	\$ 33,719		
6.0	Bedding Stone	tons	2,409	\$ 40	\$ 96,360		
7.0	Rip-Rap	tons	4691	\$ 65	\$ 304,915		
8.0	Settlement Plate	each	3	\$ 2,700	\$ 8,100		
9.0	Warning Sign (Perm)	each	3	\$ 4,200	\$ 12,600		
10.0	Warning Sign (Temp)	each	3	\$ 2,500	\$ 7,500		
11.0	Marsh Creation Fill	cubic yards	17,000	\$ 8.5	\$ 144,500		
Subtotal \$ 1,019,874							

Miscellaneous Contingency (20%) TOTAL ESTIMATED CONSTRUCTION COST \$ 1,223,849 **ALTERNATIVE NO. 2 - SEGMENTED RUBBLE MOUND BREAKWATERS**

203,975

SIDE SLOPES (V:H) = 1:1.5, TOP BERM WIDTH = 4', TOP BERM ELEVATION = 4.10' NAVD88 Unit of **Estimated Estimated Estimated** Item No. **Item Description** Measure Quantity **Unit Price** Cost Mob/Demob \$300,000 300,000 1.0 lump sum 2.0 1 \$ 40,000 \$ 40,000 Survey lump sum Project Access Channel 1,606 \$ 48,180 3.0 linear foot 30 4.0 Vegetative (Marsh) Plantings 2 \$ 12,000 24,000 acre 5.0 Geotextile Fabric 2,770 7 19,390 square yards 6.0 **Bedding Stone** tons 1,385 \$ 40 55,400 7.0 Rip-Rap tons 2697 \$ 65 175,305 8.0 Settlement Plate 3 \$ 2,700 8,100 each 9.0 3 \$ 4,200 12,600 Warning Sign (Perm) each 10.0 \$ Warning Sign (Temp) 2,500 7,500 each 11.0 Marsh Creation Fill cubic yards 17,000 \$ 8.5 \$ 144,500 **Subtotal** 834,975 **Miscellaneous Contingency (20%)** 166,995 TOTAL ESTIMATED CONSTRUCTION COST | \$ 1 001 970

	TOTAL ESTIMATED CONSTRUCTION COST					1,001,970
58" (ALTERNATIVE NO. 3 - CONTINUOUS OYSTERBREAK TM ARMOR UNITS 58" OD RINGS, STACKED 2 HIGH, TOP WIDTH = 5.0', TOP BERM ELEVATION = 3.10' NAVD88					
Item No.	Item Description	Unit of	Estimated	Estimated	E	stimated
	· ·	Measure	Quantity	Unit Price		Cost
1.0	Mob/Demob	lump sum	1	\$ 200,000	\$	200,000
2.0	Survey	lump sum	1	\$ 40,000	\$	40,000
3.0	Geotextile Fabric	square yards	2,091	\$ 7.00	\$	14,637
4.0	Bedding Stone	tons	1,090	\$ 40.00	\$	43,600
5.0	OysterBreak [™] Rings	linear foot	1,450	\$ 282.45	\$	409,553
6.0	Settlement Plate	each	3	\$ 2,700	\$	8,100
7.0	Warning Sign (Perm)	each	3	\$ 4,200	\$	12,600
8.0	Warning Sign (Temp)	each	3	\$ 4,200	\$	12,600
9.0	Marsh Creation Fill	cubic yards	17,000	\$ 8.5	\$	144,500
10.0	Vegetative (Marsh) Plantings	acre	2	\$ 12,000	\$	24,000
	Subtotal					909,590
	Miscellaneous Contingency (20%)				\$	181,918
	TOTAL ESTIMATED CONSTRUCTION COST				\$:	1,091,508

Mon Louis Island Shoreline Protection: Alignment B Preliminary Opinion of Probable Construction Cost

ALTERNATIVE NO. 1 - CONTINUOUS ROCK DIKE							
SIDE SLOPES (V:H) = 1:1.5, TOP BERM WIDTH = 4', TOP BERM ELEVATION = 4.10' NAVD88							
Item No.	o. Item Description	Unit of	Estimated	Estimated	Estimated		
item No.		Measure	Quantity	Unit Price	Cost		
1.0	Mob/Demob	lump sum	1	\$300,000	\$ 300,000		
2.0	Survey	lump sum	1	\$ 40,000	\$ 40,000		
3.0	Project Access Channel	linear foot	1,886	\$ 30	\$ 56,580		
4.0	Vegetative (Marsh) Plantings	acre	6	\$ 12,000	\$ 72,000		
5.0	Geotextile Fabric	square yards	5,685	\$ 7	\$ 39,795		
6.0	Bedding Stone	tons	2,843	\$ 40	\$ 113,720		
7.0	Rip-Rap	tons	5940	\$ 65	\$ 386,100		
8.0	Settlement Plate	each	3	\$ 2,700	\$ 8,100		
9.0	Warning Sign (Perm)	each	3	\$ 4,200	\$ 12,600		
10.0	Warning Sign (Temp)	each	3	\$ 2,500	\$ 7,500		
11.0	Marsh Creation Fill	cubic yards	65,000	\$ 6	\$ 390,000		
	Subtotal \$ 1,426,395						
	Miscellaneous Contingency (20%) \$ 285,279						

TOTAL ESTIMATED CONSTRUCTION COST \$ 1,711,674

ALTERNATIVE NO. 2 - SEGMENTED RUBBLE MOUND BREAKWATERS SIDE SLOPES (V:H) = 1:1.5, TOP BERM WIDTH = 4', TOP BERM ELEVATION = 4.10' NAVD88					
Item No.	Item Description	Unit of Measure	Estimated Quantity	Estimated Unit Price	Estimated Cost
1.0	Mob/Demob	lump sum	1	\$300,000	\$ 300,000
2.0	Survey	lump sum	1	\$ 40,000	\$ 40,000
3.0	Project Access Channel	linear foot	1,886	\$ 30	\$ 56,580
4.0	Vegetative (Marsh) Plantings	acre	6	\$ 12,000	\$ 72,000
5.0	Geotextile Fabric	square yards	3,269	\$ 7	\$ 22,883
6.0	Bedding Stone	tons	1,635	\$ 40	\$ 65,400
7.0	Rip-Rap	tons	3416	\$ 65	\$ 222,040
8.0	Settlement Plate	each	3	\$ 2,700	\$ 8,100
9.0	Warning Sign (Perm)	each	3	\$ 4,200	\$ 12,600
10.0	Warning Sign (Temp)	each	3	\$ 2,500	\$ 7,500
11.0	Marsh Creation Fill	cubic yards	65,000	\$ 6	\$ 390,000
	Subtotal				\$ 1,197,103
	Miscellaneous Contingency (20%)				\$ 239,421
	TOTAL ESTIMATED CONSTRUCTION COST				\$ 1,436,524

	ψ 2, 100, 2				
ALTERNATIVE NO. 3 - CONTINUOUS OYSTERBREAK TM ARMOR UNITS 58" OD RINGS, STACKED 2 HIGH, TOP WIDTH = 5.0', TOP BERM ELEVATION = 3.10' NAVD88					
Item No.	Unit of Estimated Estimated		Estimated		
item No.	Item Description	Measure	Quantity	Unit Price	Cost
1.0	Mob/Demob	lump sum	1	\$ 200,000	\$ 200,000
2.0	Survey	lump sum	1	\$ 40,000	\$ 40,000
3.0	Geotextile Fabric	square yards	2,369	\$ 7.00	\$ 16,583
4.0	Bedding Stone	tons	1,234	\$ 40.00	\$ 49,360
5.0	OysterBreak [™] Rings	linear foot	1,643	\$ 282.45	\$ 464,065
6.0	Settlement Plate	each	3	\$ 2,700	\$ 8,100
7.0	Warning Sign (Perm)	each	3	\$ 4,200	\$ 12,600
8.0	Warning Sign (Temp)	each	3	\$ 4,200	\$ 12,600
9.0	Marsh Creation Fill	cubic yards	65,000	\$ 6	\$ 390,000
10.0	Vegetative (Marsh) Plantings	acre	6	\$ 12,000	\$ 72,000
	Subtotal				\$ 1,265,308
	Miscellaneous Contingency (20%)				\$ 253,062
	TOTAL ESTIMATED CONSTRUCTION COST			\$ 1,518,370	

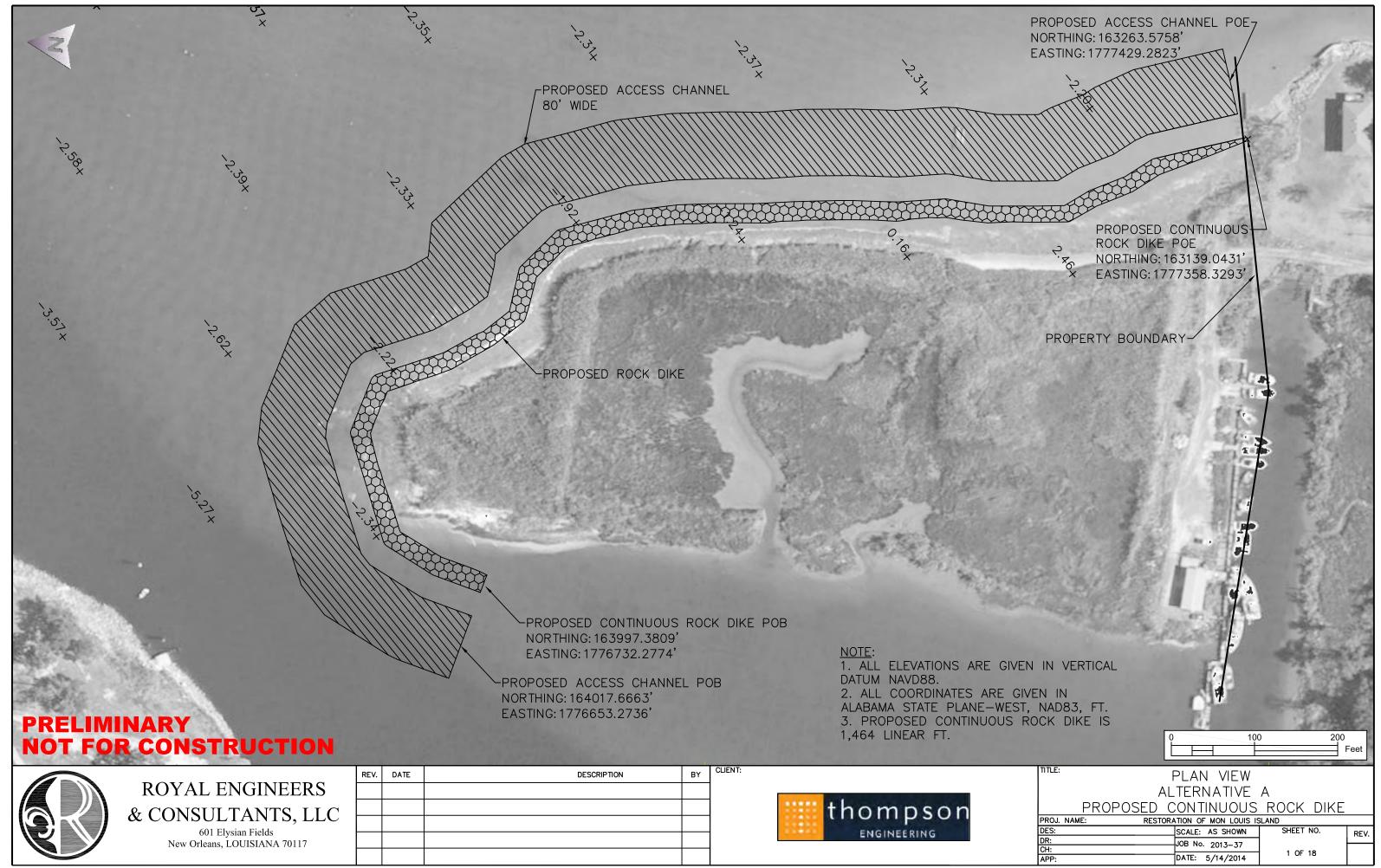
Mon Louis Island Shoreline Protection: Alignment C Preliminary Opinion of Probable Construction Cost

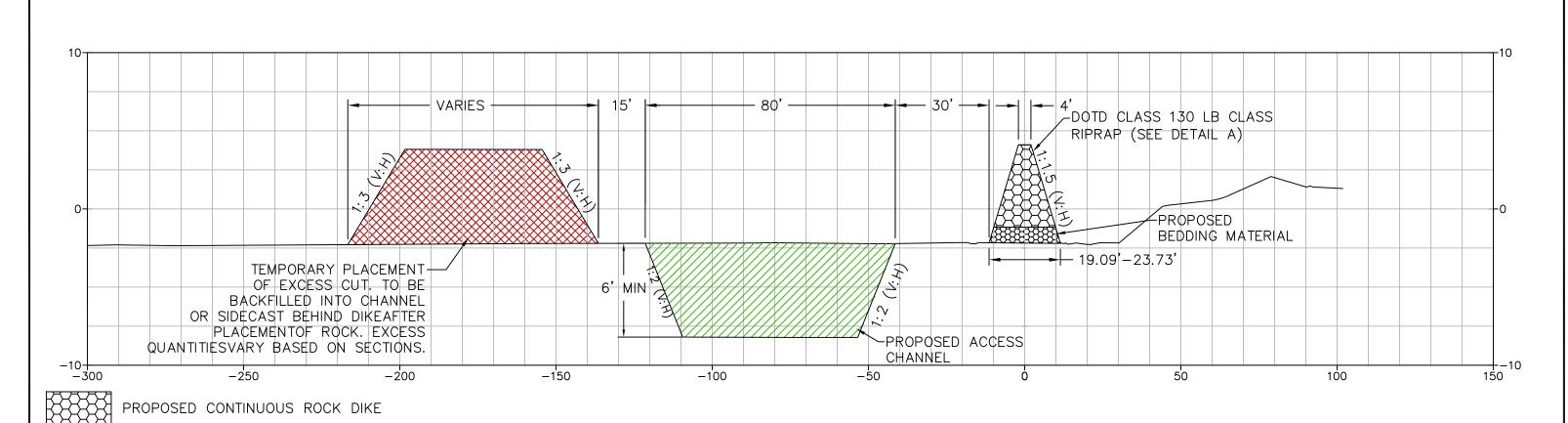
	ALTERNATIVE NO. 1 - CONTINUOUS ROCK DIKE						
SID	SIDE SLOPES (V:H) = 1:1.5, TOP BERM WIDTH = 4', TOP BERM ELEVATION = 4.10' NAVD88						
Item No.	Item Description	Unit of	Estimated	Estimated	Estimated		
item No.	item bescription	Measure	Quantity	Unit Price	Cost		
1.0	Mob/Demob	lump sum	1	\$300,000	\$ 300,000		
2.0	Survey	lump sum	1	\$ 40,000	\$ 40,000		
3.0	Project Access Channel	linear foot	2,263	\$ 30	\$ 67,890		
4.0	Vegetative (Marsh) Plantings	acre	9	\$ 12,000	\$ 108,000		
5.0	Geotextile Fabric	square yards	6,910	\$ 7	\$ 48,370		
6.0	Bedding Stone	tons	3,455	\$ 40	\$ 138,200		
7.0	Rip-Rap	tons	7374	\$ 65	\$ 479,310		
8.0	Settlement Plate	each	3	\$ 2,700	\$ 8,100		
9.0	Warning Sign (Perm)	each	3	\$ 4,200	\$ 12,600		
10.0	Warning Sign (Temp)	each	3	\$ 2,500	\$ 7,500		
11.0	Marsh Creation Fill	cubic yards	108,000	\$ 4	\$ 432,000		
				Subtotal	\$ 1,641,970		
		Miscella	neous Conting	ency (20%)	\$ 328,394		
	TO	OTAL ESTIMATI	ED CONSTRUC	TION COST	\$ 1,970,364		

ALTERNATIVE NO. 2 - SEGMENTED RUBBLE MOUND BREAKWATERS SIDE SLOPES (V:H) = 1:1.5, TOP BERM WIDTH = 4', TOP BERM ELEVATION = 4.10' NAVD88					
Item No.	Item Description	Unit of Measure	Estimated Quantity	Estimated Unit Price	Estimated Cost
1.0	Mob/Demob	lump sum	1	\$300,000	\$ 300,000
2.0	Survey	lump sum	1	\$ 40,000	\$ 40,000
3.0	Project Access Channel	linear foot	2,263	\$ 30	\$ 67,890
4.0	Vegetative (Marsh) Plantings	acre	9	\$ 12,000	\$ 108,000
5.0	Geotextile Fabric	square yards	3,973	\$ 7	\$ 27,811
6.0	Bedding Stone	tons	1,987	\$ 40	\$ 79,480
7.0	Rip-Rap	tons	4240	\$ 65	\$ 275,600
8.0	Settlement Plate	each	3	\$ 2,700	\$ 8,100
9.0	Warning Sign (Perm)	each	3	\$ 4,200	\$ 12,600
10.0	Warning Sign (Temp)	each	3	\$ 2,500	\$ 7,500
11.0	Marsh Creation Fill	cubic yards	108,000	4	\$ 432,000
	Subtotal			\$ 1,358,981	
	Miscellaneous Contingency (20%)				\$ 271,796
	TO	OTAL ESTIMAT	ED CONSTRUC	TION COST	\$ 1,630,777

ALTERNATIVE NO. 3 - CONTINUOUS OYSTERBREAK TM ARMOR UNITS 58" OD RINGS, STACKED 2 HIGH, TOP WIDTH = 5.0', TOP BERM ELEVATION = 3.10' NAVD						
Item No.	Item Description	Unit of	Estimated	Estimated	Estimated	
itelli No.	itelli Description	Measure	Quantity	Unit Price	Cost	
1.0	Mob/Demob	lump sum	1	\$ 200,000	\$ 200,000	
2.0	Survey	lump sum	1	\$ 40,000	\$ 40,000	
3.0	Geotextile Fabric	square yards	2,871	\$ 7.00	\$ 20,097	
4.0	Bedding Stone	tons	1,496	\$ 40.00	\$ 59,840	
5.0	OysterBreak [™] Rings	linear foot	1,991	\$ 282.45	\$ 562,358	
6.0	Settlement Plate	each	3	\$ 2,700	\$ 8,100	
7.0	Warning Sign (Perm)	each	3	\$ 4,200	\$ 12,600	
8.0	Warning Sign (Temp)	each	3	\$ 4,200	\$ 12,600	
9.0	Marsh Creation Fill	cubic yards	108,000	\$ 4	\$ 432,000	
10.0	Vegetative (Marsh) Plantings	acre	9	\$ 12,000	\$ 108,000	
				Subtotal	\$ 1,455,595	
		Miscella	neous Conting	ency (20%)	\$ 291,119	
	TO	\$ 1,746,714				

APPENDIX B PRELIMINARY DRAWINGS





PROPOSED BEDDING MATERIAL

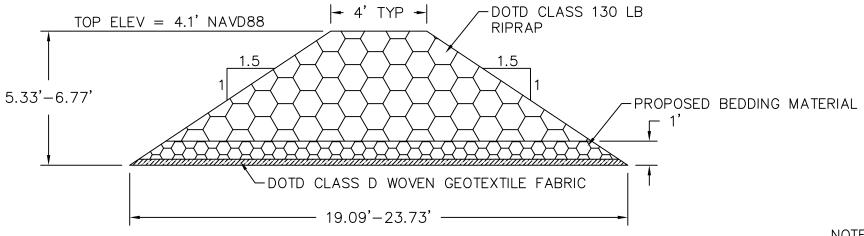
PROPOSED ACCESS CHANNEL EXCAVATION



TEMPORARY STOCKPILE OF MATERIAL EXCAVATED FOR ACCESS CHANNEL

TYPICAL SECTION: CONTINUOUS ROCK DIKE

HORIZONTAL SCALE: 1"=30' VERTICAL SCALE: 1"=6'



DETAIL A: TYPICAL CONTINUOUS ROCK DIKE

1" = 4'

PRELIMINARY NOT FOR CONSTRUCTION

ROYAL ENGINEERS & CONSULTANTS, LLC

601 Elysian Fields New Orleans, LOUISIANA 70117

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NOTE: BERM OFFSETS, SIDE SLOPES, & SETTLEMENT TO BE FURTHER EVALUATED IN DESIGN, WHEN DETAILED GEOTECHNICAL INFORMATION IS ACQUIRED

TYPICAL CROSS—SECTIONS

ALTERNATIVE A

PROPOSED CONTINUOUS ROCK DIKE

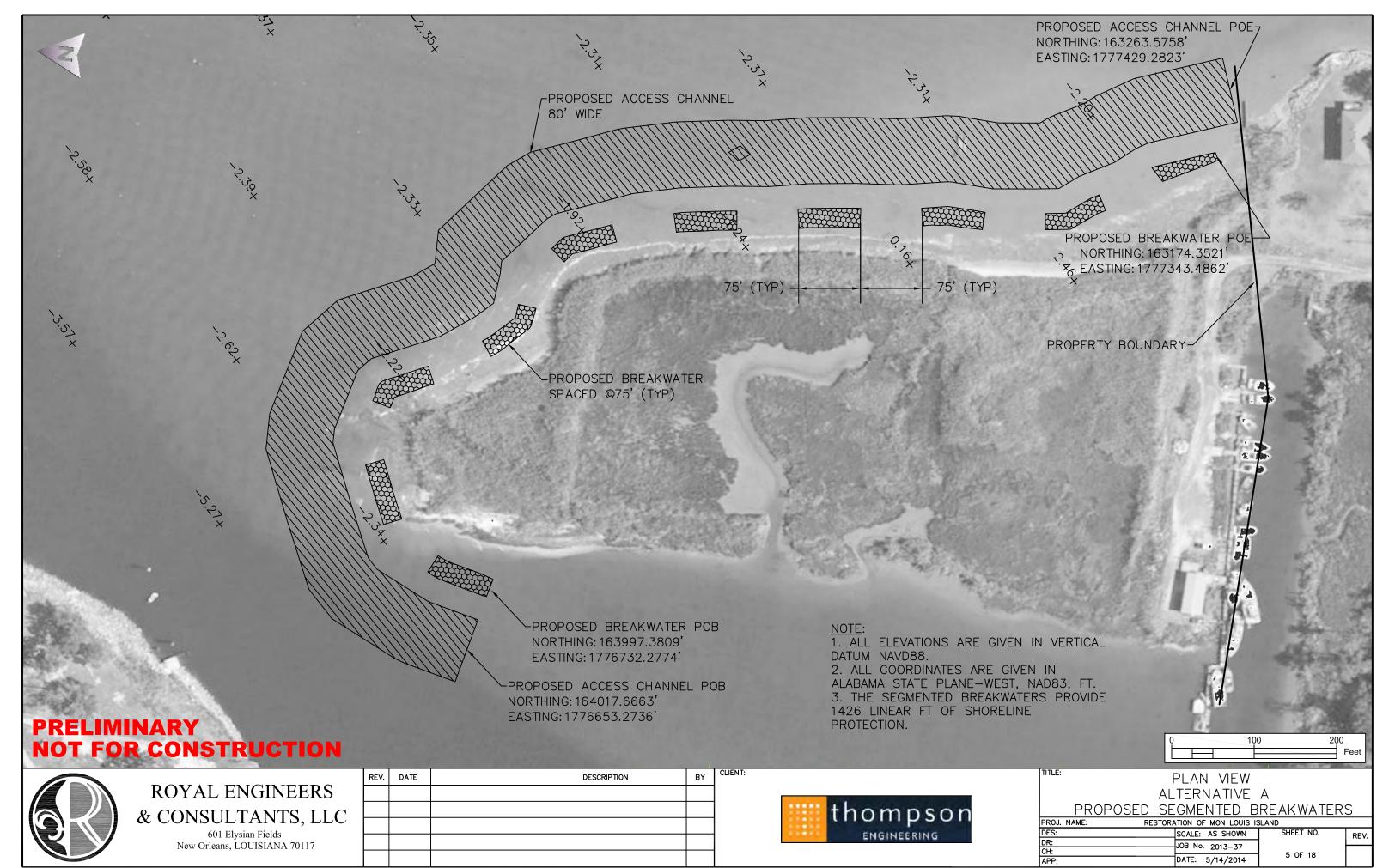
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 RESTORATION OF MON LOUIS ISLAND

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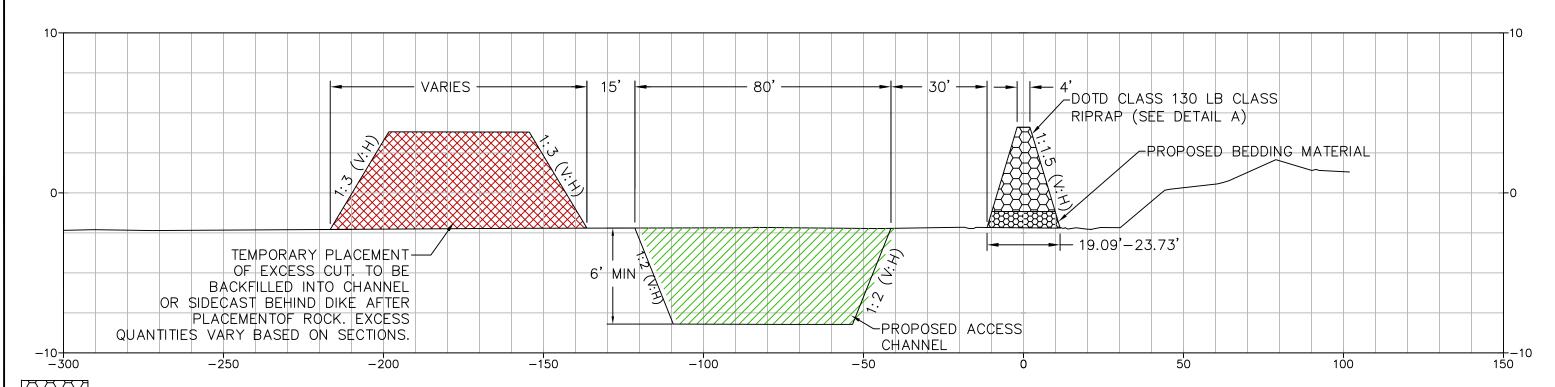
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FILE



PROPOSED BREAKWATER

PROPOSED BEDDING MATERIAL

PROPOSED ACCESS CHANNEL EXCAVATION



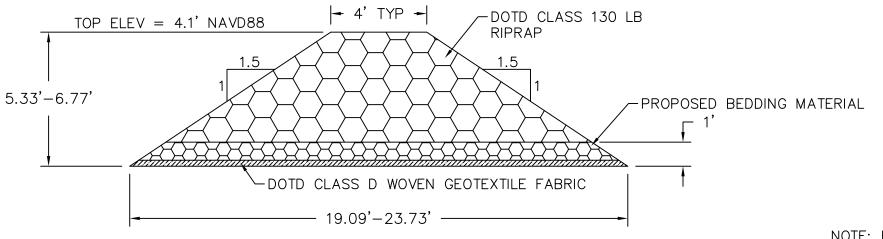
TEMPORARY STOCKPILE OF MATERIAL EXCAVATED FOR ACCESS CHANNEL

TYPICAL SECTION: SEGMENTED BREAKWATER HORIZONTAL SCALE: 1"=30"

ORIZONTAL SCALE: 1"=30
VERTICAL SCALE: 1"=6'

DETAIL A: TYPICAL SEGMENTED BREAKWATER

1" = 4'



PRELIMINARY NOT FOR CONSTRUCTION

ROYAL ENGINEERS & CONSULTANTS, LLC

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NOTE: BERM OFFSETS, SIDE SLOPES, & SETTLEMENT TO BE FURTHER EVALUATED IN DESIGN, WHEN DETAILED GEOTECHNICAL INFORMATION IS ACQUIRED

TYPICAL CROSS—SECTIONS

ALTERNATIVE A

PROPOSED SEGMENTED BREAKWATERS

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 RESTORATION OF MON LOUIS ISLAND

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& CONSULTANTS, LLC

601 Elysian Fields New Orleans, LOUISIANA 70117

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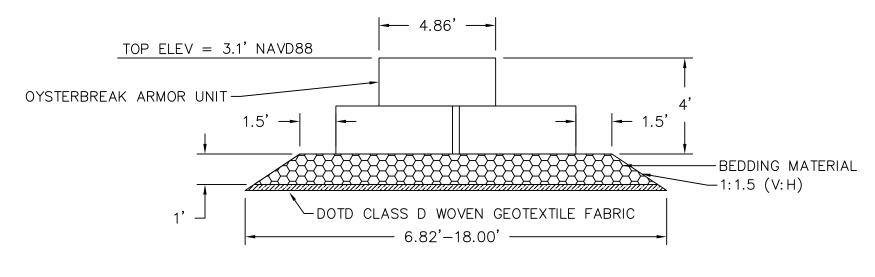
RESTORATION OF MON LOUIS ISLAND PROJ. NAME: SCALE: AS SHOWN JOB No. 2013-37 5 OF 18 DATE: 5/14/2014



PROPOSED BEDDING MATERIAL

TYPICAL SECTION: OYSTERBREAK ARMOR UNIT

HORIZONTAL SCALE: 1"=30' VERTICAL SCALE: 1"=6' NOTE: BERM OFFSETS, SIDE SLOPES, & SETTLEMENT TO BE FURTHER EVALUATED IN DESIGN, WHEN DETAILED GEOTECHNICAL INFORMATION IS ACQUIRED



DETAIL A: TYPICAL OYSTERBREAK ARMOR UNIT

1" = 4"

PRELIMINARY NOT FOR CONSTRUCTION



ROYAL ENGINEERS & CONSULTANTS, LLC

601 Elysian Fields New Orleans, LOUISIANA 70117

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119.72" 18.59" — 73.88" C/C —

DETAIL B: TYPICAL OYSTERBREAK ARMOR UNIT

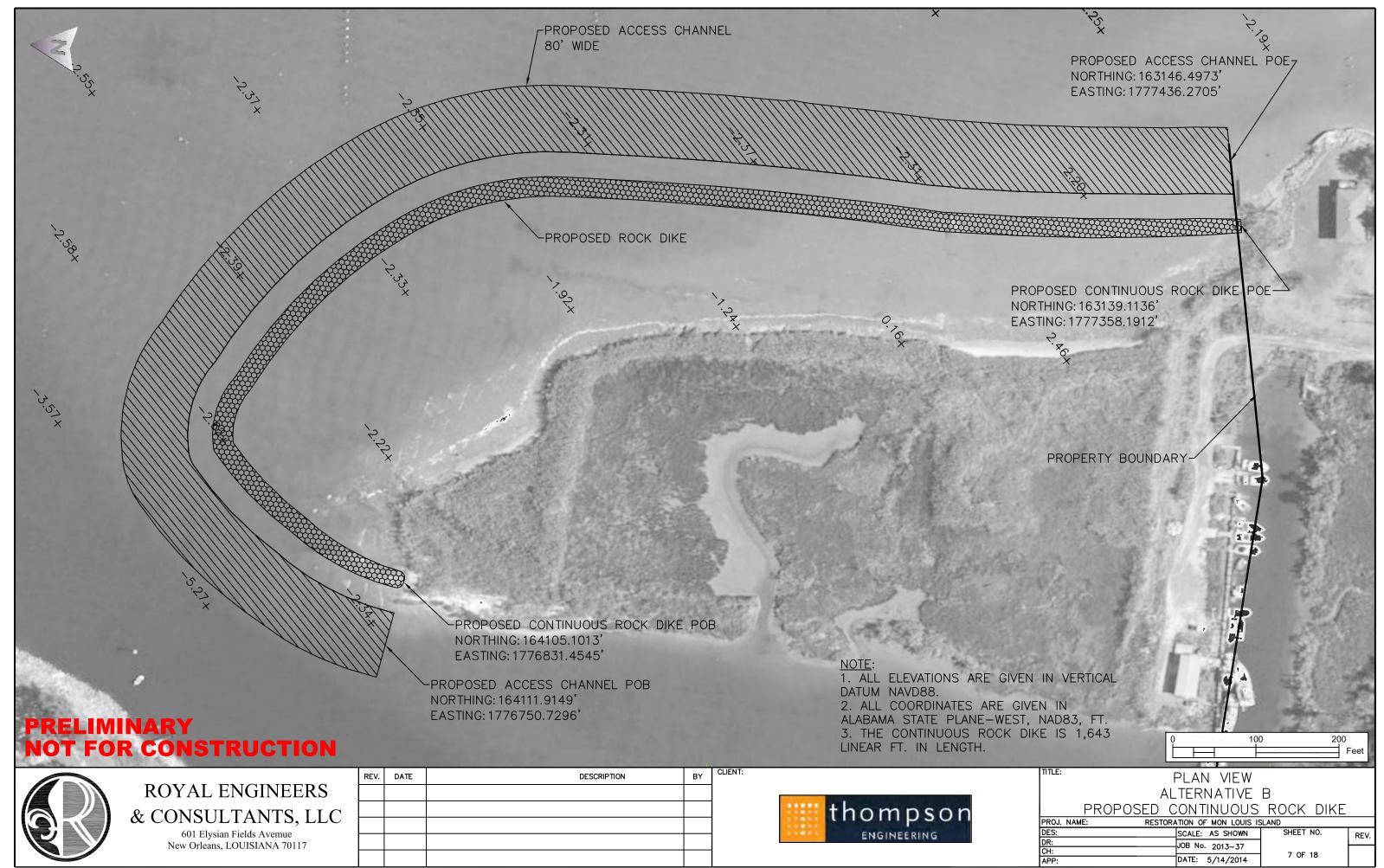
TYPICAL CROSS—SECTIONS

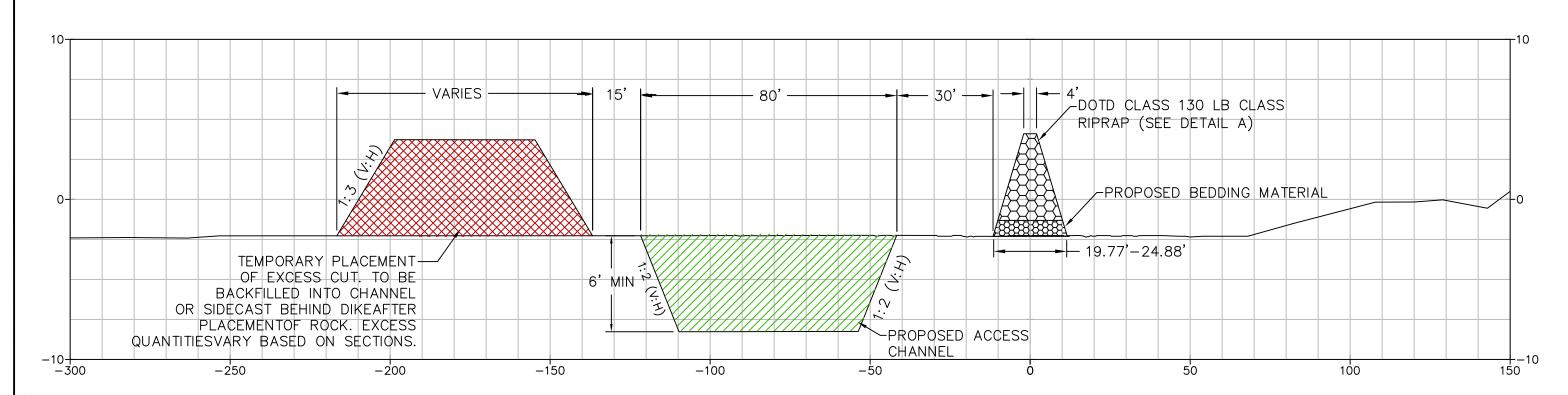
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POROSED OYSTERBREAK ARMOR HAUT

PROPOSED OYSTERBREAK ARMOR UNITS
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PROPOSED ROCK DIKE

PROPOSED BEDDING MATERIAL

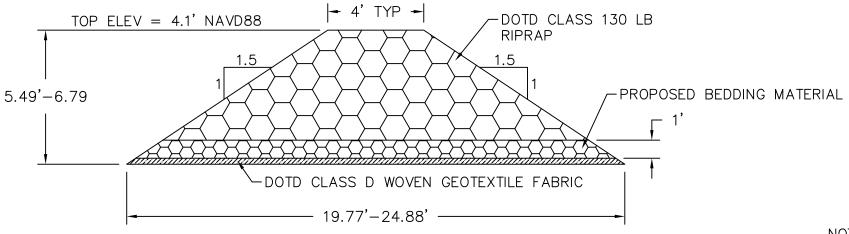
PROPOSED ACCESS CHANNEL EXCAVATION



TEMPORARY STOCKPILE OF MATERIAL EXCAVATED FOR ACCESS CHANNEL

TYPICAL SECTION: CONTINUOUS ROCK DIKE

HORIZONTAL SCALE: 1"=30' VERTICAL SCALE: 1"=6'



DETAIL A: TYPICAL CONTINUOUS ROCK DIKE

1" = 4'

PRELIMINARY NOT FOR CONSTRUCTION

ROYAL ENGINEERS
& CONSULTANTS, LLC
601 Elysian Fields Avenue

New Orleans, LOUISIANA 70117

REV. DATE DESCRIPTION BY CLIENT:



NOTE: BERM OFFSETS, SIDE SLOPES, & SETTLEMENT TO BE FURTHER EVALUATED IN DESIGN, WHEN DETAILED GEOTECHNICAL INFORMATION IS ACQUIRED

TYPICAL CROSS—SECTIONS

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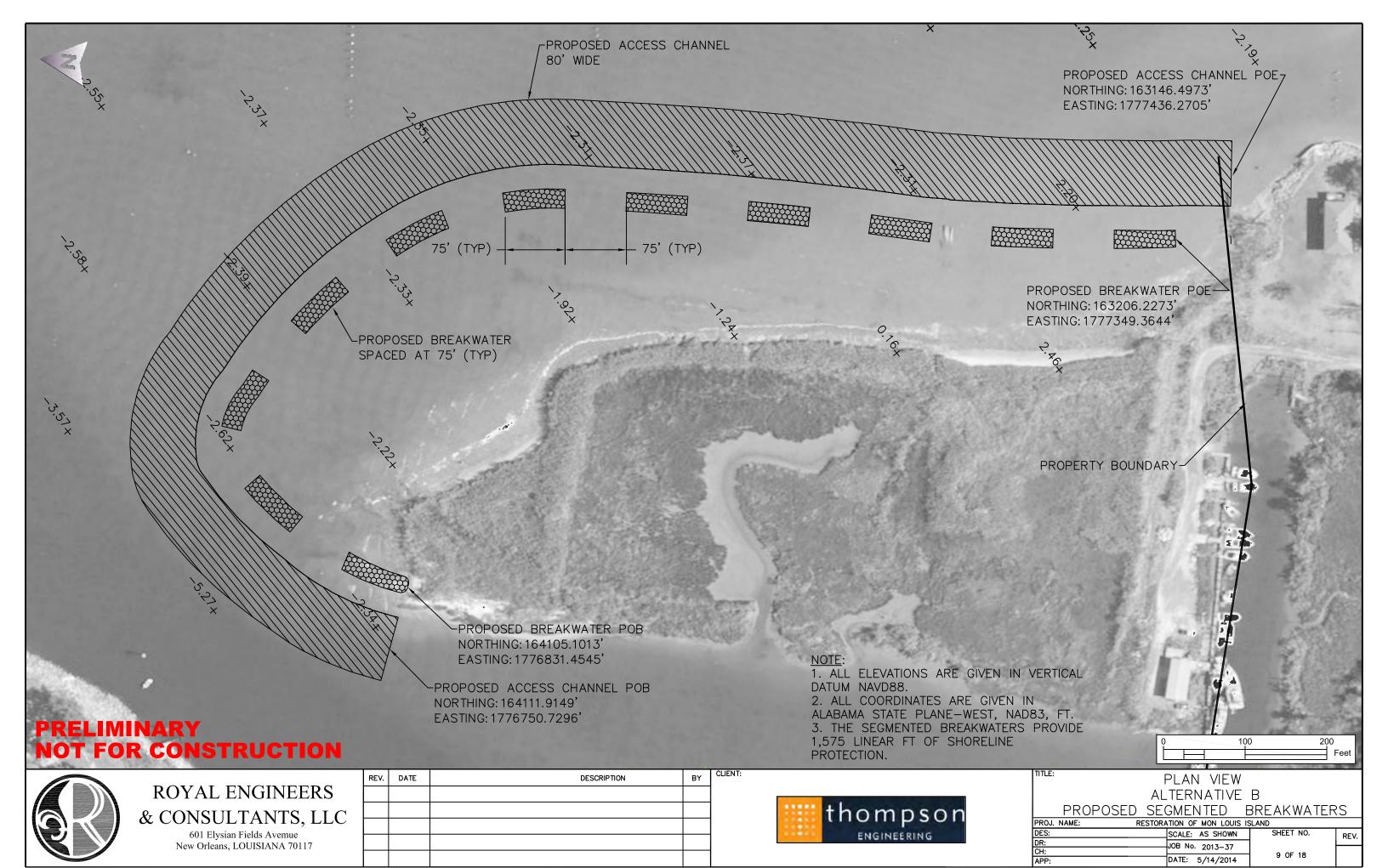
PROPOSED CONTINUOUS ROCK DIKE

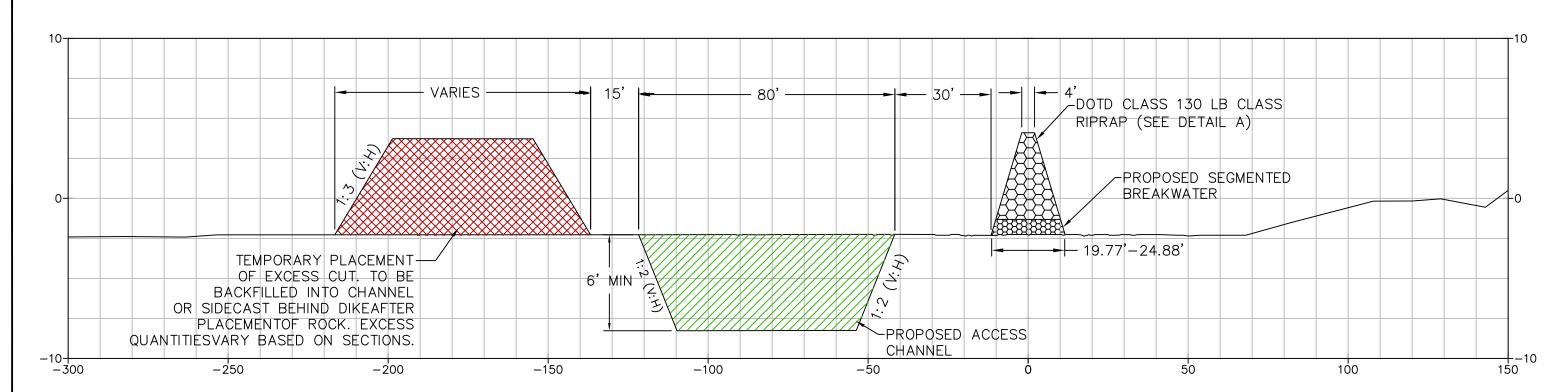
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PROPOSED SEGMENTED BREAKWATER

PROPOSED BEDDING MATERIAL



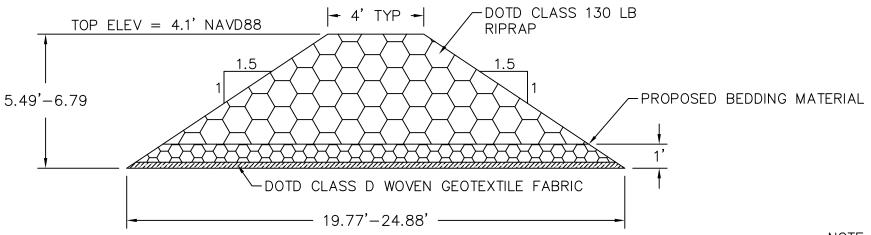
PROPOSED ACCESS CHANNEL **EXCAVATION**



TEMPORARY STOCKPILE OF MATERIAL EXCAVATED FOR ACCESS CHANNEL

TYPICAL SECTION: SEGMENTED BREAKWATER

HORIZONTAL SCALE: 1"=30' VERTICAL SCALE: 1"=6'



DETAIL A: TYPICAL SEGMENTED BREAKWATER 1" = 4'

NOTE: BERM OFFSETS, SIDE SLOPES, & SETTLEMENT TO BE FURTHER EVALUATED IN DESIGN, WHEN DETAILED GEOTECHNICAL INFORMATION IS ACQUIRED



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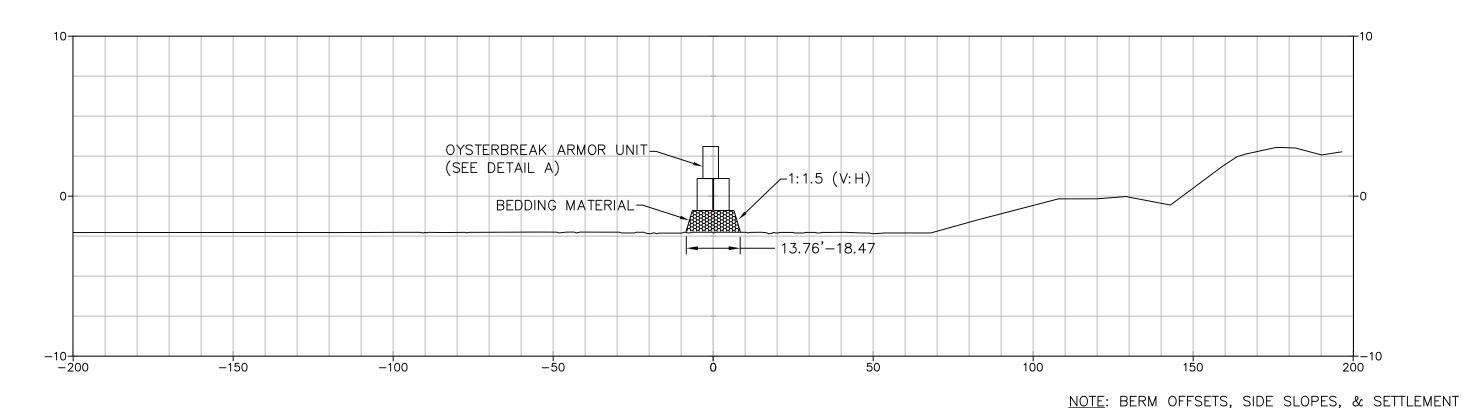


TYPICAL CROSS-SECTIONS ALTERNATIVE B PROPOSED SEGMENTED BREAKWATERS

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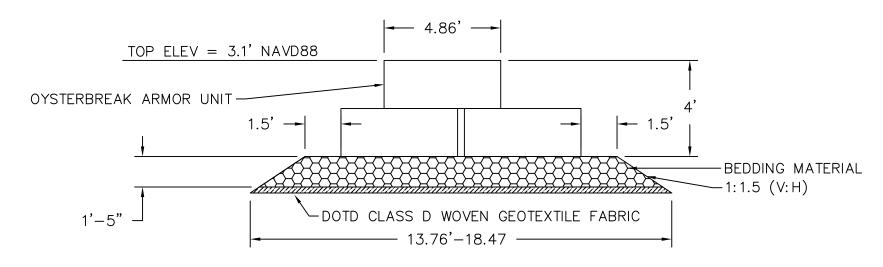


TYPICAL SECTION: OYSTERBREAK ARMOR UNIT

TO BE FURTHER EVALUATED IN DESIGN, WHEN DETAILED GEOTECHNICAL INFORMATION IS ACQUIRED

PROPOSED BEDDING MATERIAL HORI

HORIZONTAL SCALE: 1"=30' VERTICAL SCALE: 1"=6'



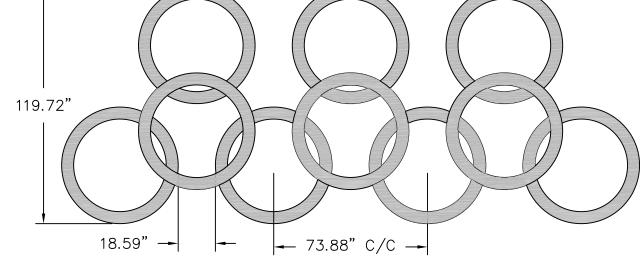
DETAIL A: TYPICAL OYSTERBREAK ARMOR UNIT

1" = 4"

PRELIMINARY NOT FOR CONSTRUCTION



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DETAIL B: TYPICAL OYSTERBREAK ARMOR UNIT

1" = 4"

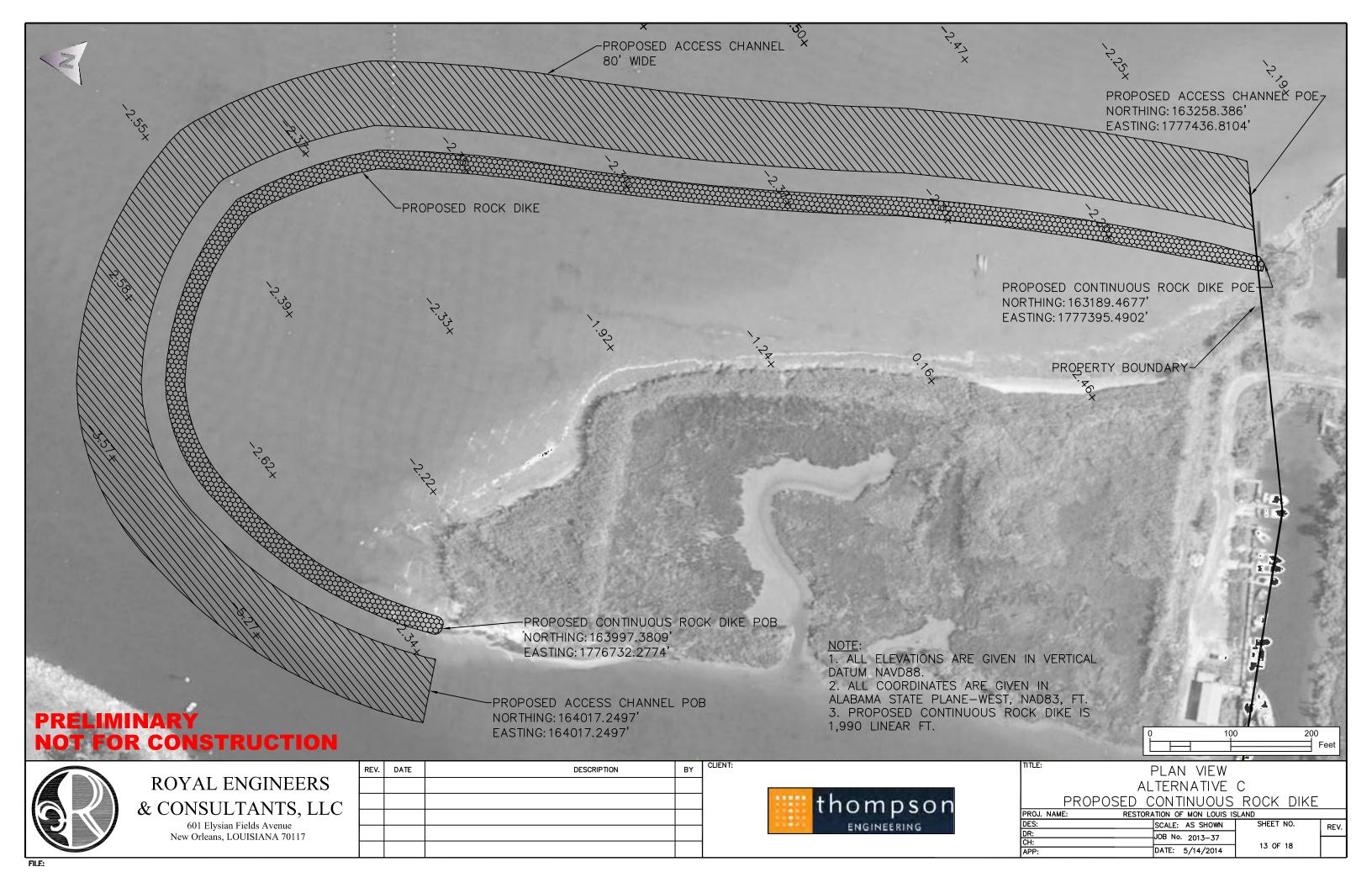


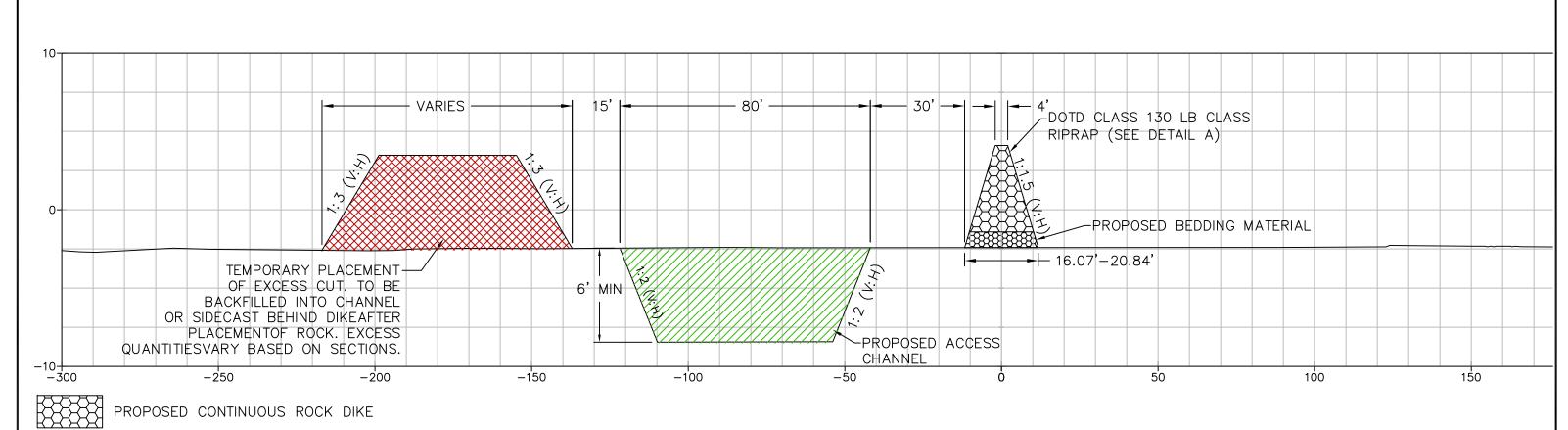
TYPICAL CROSS—SECTIONS

ALTERNATIVE B

PROPOSED OYSTERBREAK ARMOR UNITS

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TYPICAL SECTION: CONTINUOUS ROCK DIKE

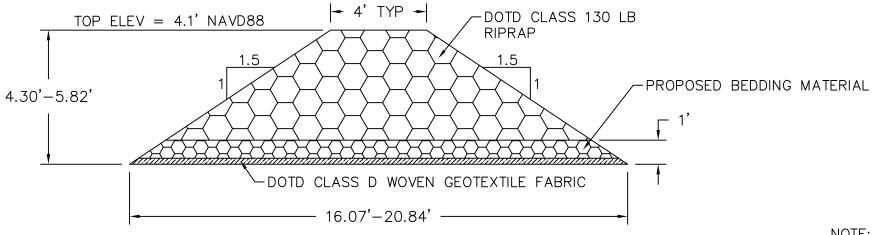
HORIZONTAL SCALE: 1"=30' VERTICAL SCALE: 1"=6'

PROPOSED ACCESS CHANNEL EXCAVATION

TEMPORARY STOCKPILE OF MATERIAL EXCAVATED FOR ACCESS CHANNEL

NOT FOR CONSTRUCTION

PROPOSED BEDDING MATERIAL



DETAIL A: TYPICAL CONTINUOUS ROCK DIKE 1" = 4"

NOTE: BERM OFFSETS, SIDE SLOPES, & SETTLEMENT TO BE FURTHER EVALUATED IN DESIGN, WHEN DETAILED GEOTECHNICAL INFORMATION IS ACQUIRED

PRELIMINARY

ROYAL ENGINEERS & CONSULTANTS, LLC

601 Elysian Fields Avenue New Orleans, LOUISIANA 70117

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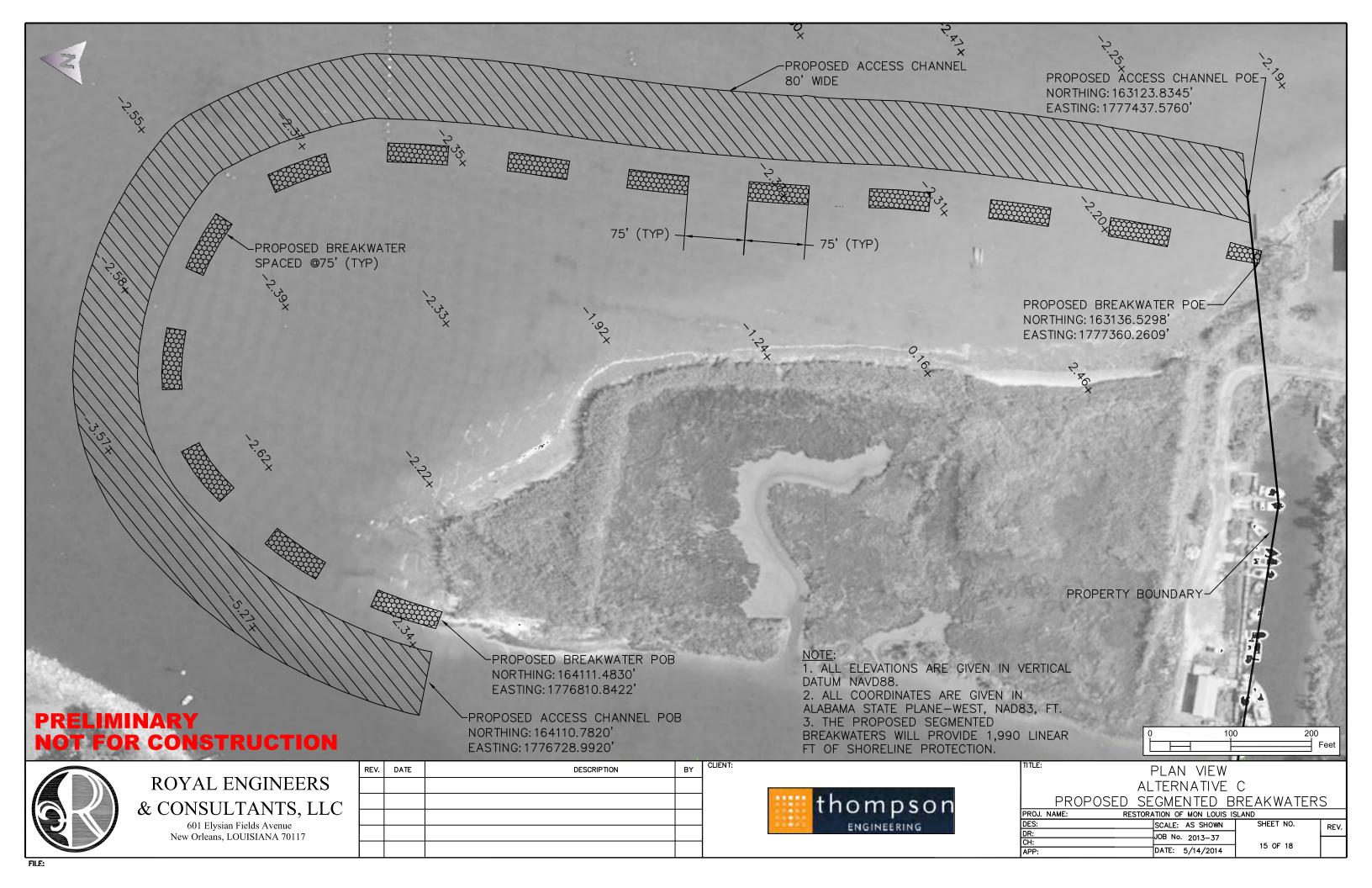


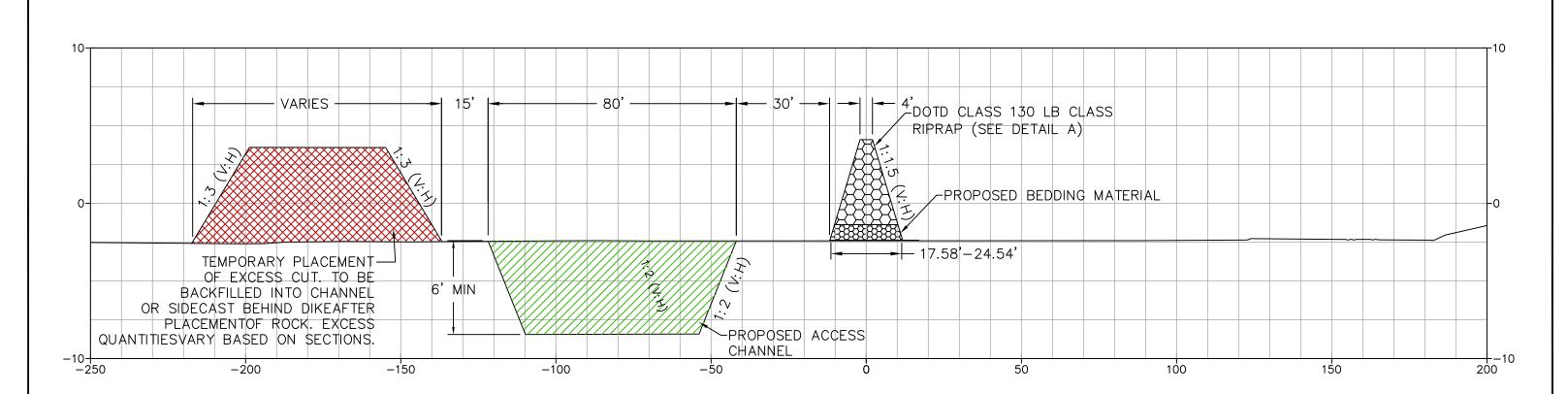
TYPICAL CROSS—SECTIONS

ALTERNATIVE C

PROPOSED CONTINUOUS ROCK DIKE

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PROPOSED BREAKWATER

PROPOSED BEDDING MATERIAL



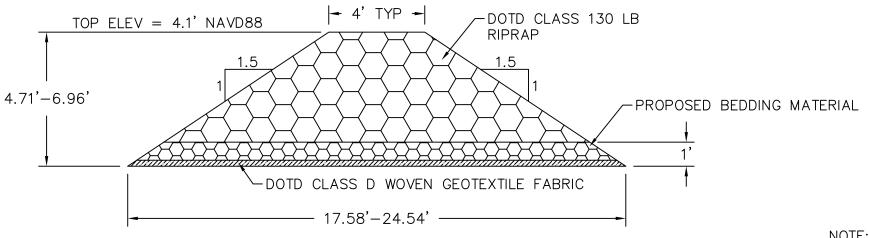
PROPOSED ACCESS CHANNEL EXCAVATION



TEMPORARY STOCKPILE OF MATERIAL EXCAVATED FOR ACCESS CHANNEL

TYPICAL SECTION: SEGMENTED BREAKWATER

HORIZONTAL SCALE: 1"=30' VERTICAL SCALE: 1"=6'



DETAIL A: TYPICAL SEGMENTED BREAKWATER 1" = 4"

NOTE: BERM OFFSETS, SIDE SLOPES, & SETTLEMENT TO BE FURTHER EVALUATED IN DESIGN, WHEN DETAILED GEOTECHNICAL INFORMATION IS ACQUIRED

PRELIMINARY NOT FOR CONSTRUCTION



ROYAL ENGINEERS & CONSULTANTS, LLC

601 Elysian Fields Avenue New Orleans, LOUISIANA 70117

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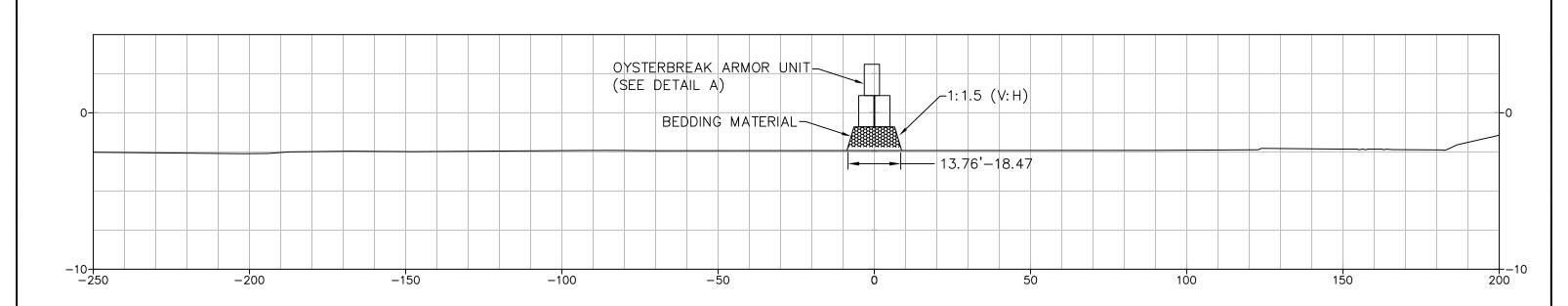
TYPICAL CROSS—SECTIONS

ALTERNATIVE C

PROPOSED SEGMENTED BREAKWATERS

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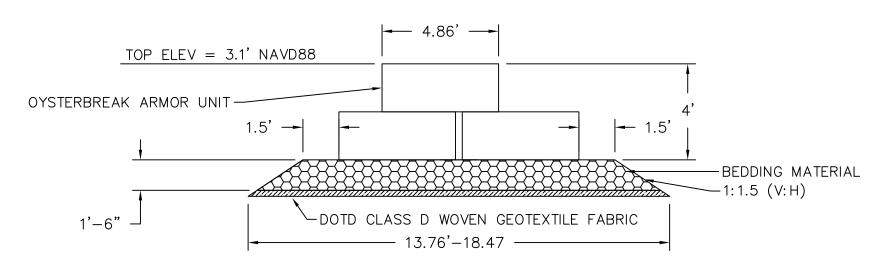
TYPICAL SECTION: OYSTERBREAK ARMOR UNIT

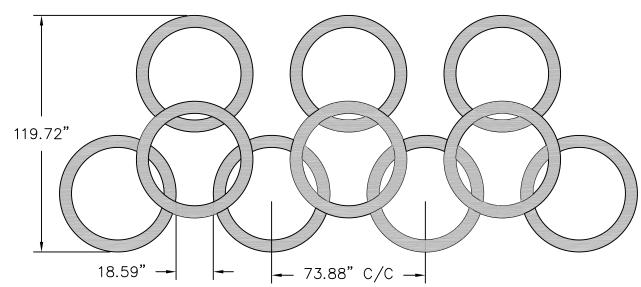
TO BE FURTHER EVALUATED IN DESIGN, WHEN DETAILED GEOTECHNICAL INFORMATION IS ACQUIRED

NOTE: BERM OFFSETS, SIDE SLOPES, & SETTLEMENT

PROPOSED BEDDING MATERIAL

HORIZONTAL SCALE: 1"=30' VERTICAL SCALE: 1"=6'





DETAIL A: TYPICAL OYSTERBREAK ARMOR UNIT

1" = 4"

PRELIMINARY NOT FOR CONSTRUCTION

ROYAL ENGINEERS
& CONSULTANTS, LLC

601 Elysian Fields Avenue
New Orleans, LOUISIANA 70117

REV.	DATE	DESCRIPTION	BY	CLI



DETAIL B: TYPICAL OYSTERBREAK ARMOR UNIT 1" = 4"

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PROPOSED	OYSTERBREAK	ARMOR	UNITS

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 RESTORATION OF MON LOUIS ISLAND

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 SCALE: AS SHOWN
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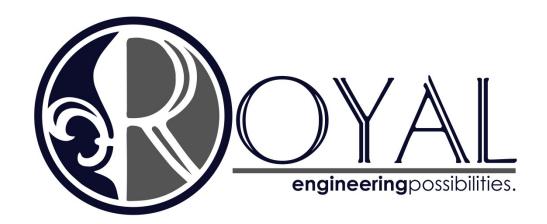
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 JOB No. 2013-37

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 DATE: 5/14/2014
 18 OF 18

APPENDIX C

Summary Report: Compilation and Review of Existing Information for the Restoration of the Northern End of Mon Louis Island, Fowl River, Mobile County, Alabama.

Royal Engineers and Consultants, LLC



SUMMARY REPORT

COMPILATION AND REVIEW OF EXISTING INFORMATION

FOR

RESTORATION OF THE NORTHERN END OF MON LOUIS ISLAND

FOWL RIVER, MOBILE COUNTY, ALABAMA

ROYAL PROJECT NO. 2013-37

PREPARED FOR

THOMPSON ENGINEERING, INC. 2970 COTTAGE HILL ROAD, SUITE 190 MOBILE, ALABAMA, 36606

PREPARED BY

ROYAL ENGINEERS AND CONSULTANTS, LLC 601 ELYSIAN FIELDS AVENUE NEW ORLEANS, LOUISIANA, 70117 PHONE: (504) 309-4129 FAX: (504) 309-3983

JUNE 2014

TABLE OF CONTENTS

1.0	INTRODUCTION	1
2.0	BACKGROUND	1
3.0	LITERATURE AND DATA REVIEW	1
	3.1 LOCAL WATER LEVEL INFORMATION	1
	3.2 LOCAL WIND AND WAVE INFORMATION	2
	3.3 LOCAL BATHYMETRY AND TOPOGRAPHY	4
	3.4 LOCAL SEDIMENT BUDGETS	5
	3.5 LOCAL GEOTECHNICAL INFORMATION	7
	3.6 LOCAL SHORELINE CHANGE INFORMATION	9
	3.7 LOCAL SUBSIDENCE AND SEA LEVEL RISE INFORMATION	10
4.0	REFERENCES	10



1.0 INTRODUCTION

Royal Engineers and Consultants, LLC (Royal) is pleased to submit to Thompson Engineering, Inc. (Thompson) this summary report of the compilation and review of existing information for the Restoration of the Northern End of Mon Louis Island, located in Mobile County, Alabama.

2.0 BACKGROUND

The Mobile Bay National Estuary (MBNEP) has established the overall goals for the Restoration of the Northern End of Mon Louis Island to be (1) stabilization of the shoreline along the bay side of the northern tip of Mon Louis Island and (2) creation/enhancement of aquatic, wetland, and upland habitats to the extent possible. These two goals will be achieved, respectively, through a shoreline protection component and a marsh creation component of the project. The purpose of this data gathering effort is to compile existing information and data that will be utilized in the design of these two components.

3.0 LITERATURE AND DATA REVIEW

Royal gathered the following data and information related to the project area.

3.1 LOCAL WATER LEVEL INFORMATION

TIDES

Tidal datums for the northern end of Mon Louis Island were estimated using NOAA's VDATUM software (NOAA, 2008). VDATUM performs vertical transformations among tidal, orthometric, and ellipsoidal datums at user-specified locations. VDATUM version 3.2 was used to transform long-term tidal datums (according to the 1983-2001 epoch) to the North American Vertical Datum of 1988 (NAVD88) at a location of 30°26'58.98"N, 88°06'26.90"W, approximately 100 feet offshore of the northeastern end of Mon Louis Island (Table 1).

Datum	Elevation (NAVD88/GEOID09)
Mean Higher High Water	1.41'
Mean High Water	1.34'
Mean Tide Level	0.65'
Local Mean Sea Level	0.66'
Mean Low Water	-0.03'
Mean Lower Low Water	-0.08'

Table 1: Estimated Tidal Datums at Mon Louis Island, AL

RETURN PERIOD WATER LEVELS

Return period water levels are reported by Webb (2011), based on a long-term statistical analysis of gage observations at Dauphin Island, AL (Table 2).



Return Period (years)	Annual Chance (%)	Water Level (NAVD88)	
2	50	3.2'	
5	20	3.6'	
10	10	4.4'	
25	4	5.3'	
50	2	6.0'	
100	1	6.6'	

Table 2: Return Period Water Levels (Webb, 2011)

3.2 LOCAL WIND AND WAVE INFORMATION

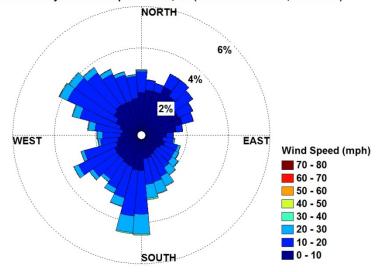
WIND INFORMATION

The largest inventory of historic wind data near Mobile Bay has been collected at Dauphin Island, AL. Continuous (10-minute) data from the National Buoy Data Center's (NDBC) station DPIA1 at Dauphin Island are available for download from web from 1992 through 2014 the January March (http://www.ndbc.noaa.gov/station history.php?station=dpia1).

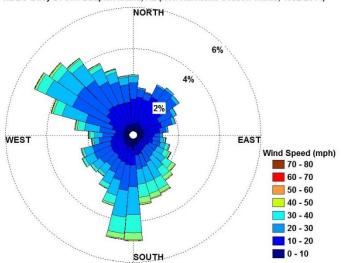
The anemometer for station DPIA1 is located at a height of 13.5 meters above mean sea level. Royal processed this data to: (1) remove false measurements; (2) partition the data into hurricane-season and non-hurricane-season measurements; and (3) convert the wind magnitudes to their standard 10-meter heights above mean sea level, for future use in wave hindcasting calculations or wave modeling. Wind roses of this processed data are shown in Figure 1, and display the *vector* direction of the winds as opposed to the meteorological direction. Hurricane-season winds are those that occur between the months of June and November; non-hurricane-season winds are those that occur between the months of December and May.



NDBC Buoy DPIA1: Dauphin Island, AL (Entire Data Record, 1992-2014)



NDBC Buoy DPIA1: Dauphin Island, AL (Non-Hurricane Season Winds, 1992-2014)



NDBC Buoy DPIA1: Dauphin Island, AL (Hurricane Season Winds, 1992-2014)

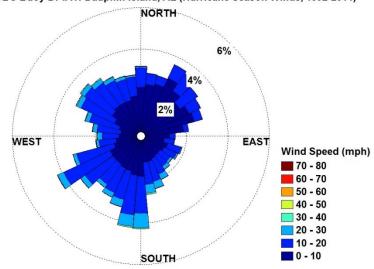


Figure 1: Wind Roses of Continuous Observations at DPIA1 - Dauphin Island, AL



Wind magnitudes from the data record at station DPIA1 were statistically analyzed to determine exceedance probabilities of discrete 10-minute wind occurrences. The data was fit to a Gumbel probability distribution, resulting in the wind magnitudes shown below in Table 3.

10-Minute Windspeeds at NDBC Station DPIA1 Dauphin Island, AL, 1992-2014 (mph)						
Exceedance Probability	50%	20%	10%	5%	2%	1%
Entire Data Record:	10.29	15.61	19.13	22.51	26.88	30.15
Non-Hurricane-Season Only:	11.22	16.98	20.79	24.45	29.19	32.74
Hurricane Season Only:	9.43	14.60	18.02	21.30	25.55	28.74

Table 3: DPIA1 Probability of Wind Occurrences

Additionally, Webb (2011) provides storm-condition wind magnitudes (and associated storm surge), shown in Table 4 below.

Storm	Wind Speed	Storm Surge	Damage	Return
Category	(mph)	(ft)		Period (yrs)
I	74-95	4-5	Minimal	10
II	96-110	6-8	Moderate	21
III	111-130	9-12	Extensive	33
IV	131-155	13-18	Extreme	62
V	>155	>18	Catastrophic	140

Table 4: Return Period Storms (Webb, 2011)

WAVE INFORMATION

Regional wave climatologies within Mobile Bay are presented by Webb (2011 and 2012). However, for information on local waves incident to the project site on the northeastern end of Mon Louis Island, site-specific calculations will need to be performed during the design phase of this project.

3.3 LOCAL BATHYMETRY AND TOPOGRAPHY

Recent bathymetric/topographic surveys of the northern tip of Mon Louis Island and a portion of the East Fowl River have been performed by Thompson. Color contours of this survey information are shown in Figure 2.



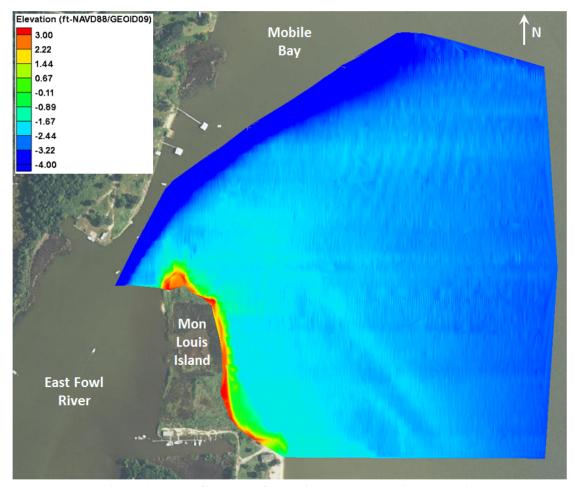


Figure 2: Local Survey Information at Mon Louis Island, AL

3.4 LOCAL SEDIMENT BUDGETS

Webb (2011) and Byrnes et al (2013) provide sediment budget information near the project area (Figure 3).



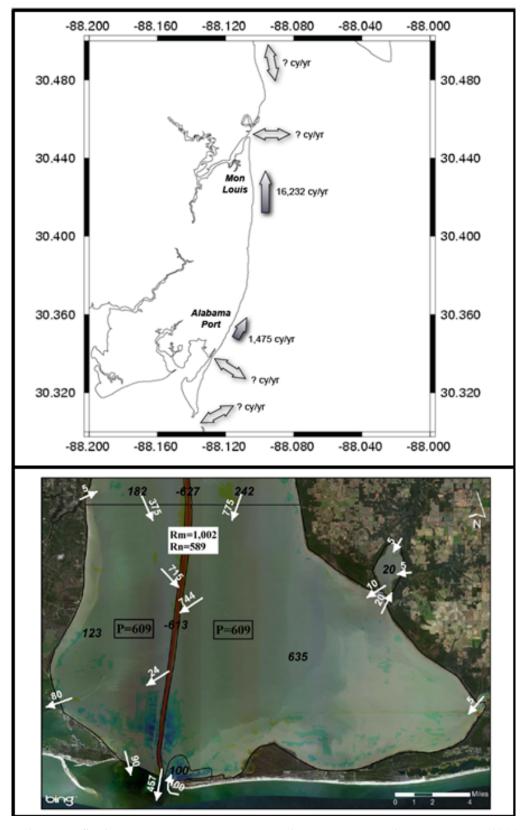


Figure 3: Local Sediment Budgets Near Mon Louis Island Determined by Webb (2011, Top) and Byrnes et al (2013, Bottom)



Net sediment transport into Mobile Bay from the Fowl River, around the northern tip of Mon Louis Island, is approximately 5,000 cubic yards per year (Byrnes et al, 2013). Net sediment transport along the eastern shoreline of Mon Louis Island is approximately 16,232 cubic yards per year (Webb, 2011).

3.5 LOCAL GEOTECHNICAL INFORMATION

Geotechnical data was collected by Thompson in December 2013 and April 2014 near the project area. A layout of the sampling plan is shown in Figure 4 (from Thompson, 2014).

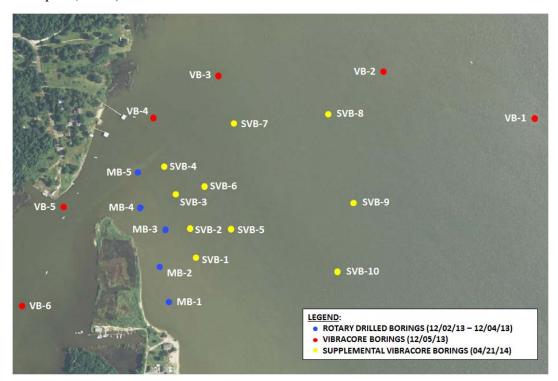


Figure 4: Geotechnical Sampling Layout (From Thompson, 2014)

GRAIN SIZE & MATERIAL CLASSIFICATION

Grain size distributions were determined by Thompson (2014) for the six vibracore samples taken within the East Fowl River channel. A summary of the median grain sizes determined from the reported curves are provided in Table 5.

Boring ID	D50 (mm)	D50 Wentworth	USCS Classification	% Sand
		Classification	of Boring Material	
VB-1	0.0037	Coarse Clay	СН	1.5%
VB-2	0.0060	Very Fine Silt	СН	8.9%
VB-3	0.0037	Coarse Clay	СН	3.5%
VB-4	0.0035	Coarse Clay	СН	5.5%
VB-5	0.0101	Fine Silt	СН	11.9%
VB-6	0.0090	Fine Silt	СН	15.8%

Table 5: Median Grain Diameter (D50) and Classification of Vibracore Samples



Table 5 shows that the median grain sizes are smaller on the bay side of the East Fowl River channel (Figure 4, borings VB-1 to VB-4) than within the portion of the channel enclosed by its banks (Figure 4, borings VB-5 and VB-6). However, although this variability exists among the median grain sizes, the USCS classification for the material in all six borings is uniformly a high-plasticity clay (CH).

The ten supplemental vibracore borings (Figure 4, borings SVB-1 to SVB-10) were split and visually classified, but not laboratory-tested for particle size distributions. Upper portions of these supplemental borings indicate sands from the surface to as much as six feet deep.

IN-SITU WATER CONTENT

In-situ water content is an important property of borrow-area material that will be hydraulically dredged because it is directly related to the material's bulk density. The bulk density (or bulk specific gravity) is useful in predicting the material's resistance to being excavated, as well as calculating the cut-to-fill factor and the total volume of borrow material required for a dredging project.

The in-situ water contents measured by Thompson, as well as the corresponding bulk specific gravities calculated by Royal, of material from each of the six vibracore borings are shown in Table 6 below. The bulk specific gravities were calculated assuming a sediment specific gravity of 2.650 and a saltwater specific gravity of 1.015.

Boring ID	In-Situ Water Content	Bulk Specific Gravity
VB-1	172.9%	1.31
VB-2	127.2%	1.39
VB-3	122.4%	1.40
VB-4	120.9%	1.41
VB-5	144.3%	1.36
VB-6	111.6%	1.43

Table 6: In-Situ Water Content and Bulk Specific Gravity of Vibracore Borings

VANE SHEAR STRENGTH

Laboratory vane shear strength tests were performed on selected clay samples from two of the borings off of the east side of Mon Louis Island in order to determine undrained shear strength of the specimens. The results are summarized in Table 7.



Sample ID	Sample	Vane Shear Strength	Vane Shear Strength
-	Description	(psf) Undisturbed	(psf) Re-Molded
B-4 T-1	Dark gray,	260	176
10.0'-12.0'	CLAY		
B-4 T-2	Dark gray,	189	134
15.0'-17.0'	CLAY		
B-4 T-3	Dark gray,	290	184
20.0'-22.0'	CLAY		
B-4 T-4	Gray,	180	146
25.0'-27.0'	CLAY		
B-5 T-1	Dark gray,	205	113
10.0'-12.0'	CLAY		
B-5 T-2	Gray,	49	32
20.0'-22.0'	CLAY		
B-5 T-3	Dark gray,	108	113
25.0'-27.0'	CLAY		

Table 7: Sediment Boring Vane Shear Strength Results (Thompson, 2014)

CONSOLIDATION TEST DATA

Consolidation testing was performed on a clay specimen from boring MB-4 off the east side of Mon Louis Island. Results of the consolidation test are summarized in Table 8.

Index	Load Sequence	Cumulative	Specimen	Vertical Strain
	(ksf)	ΔHeight (in)	Height (in)	(%)
0	0.000	0.0000	0.9990	0.00
1	0.250	0.0479	0.9511	4.79
2	0.500	0.0946	0.9044	9.47
3	1.000	0.1665	0.8325	16.67
4	2.000	0.2592	0.7398	25.94
5	4.000	0.3444	0.6546	34.48
6	8.000	0.4165	0.5825	41.69
7	16.000	0.4694	0.5296	46.99
8	4.000	0.4485	0.5505	44.90
9	1.000	0.4077	0.5913	40.81
10	0.250	0.3730	0.6260	37.34

Table 8: Consolidation Test Results (Thompson, 2014)

3.6 LOCAL SHORELINE CHANGE INFORMATION

Historic shoreline information for Mon Louis Island was reviewed by Thompson using imagery available from the City of Mobile GIS Department and other public sources. Utilizing recognized landmarks for approximate georeferencing, relative shoreline location changes for the years 1979, 1997, 2006 and 2011 are depicted on Figure 5. As evidenced by the relative shoreline locations from these years, the northeastern corner of the island has experienced the largest erosion rates.





Figure 5: Historic Shorelines of Mon Louis Island (From Thompson, 2014)

3.7 LOCAL SUBSIDENCE AND SEA LEVEL RISE INFORMATION

Current eustatic sea level rise within the Gulf of Mexico has been estimated as 0.21 ± 0.026 cm/year (FHA, 2012). Site-specific subsidence rates at Mon Louis Island will likely be determined during the design phase of the project.

4.0 REFERENCES

- Byrnes, M. R., Berlinghoff, J. L., & Griffee, S. F. (2013). Sediment Dynamics in Mobile Bay, Alabama: Development of an Operational Sediment Budget, Final Report.
- FHA. (2012). Climate Variability and Change in Mobile, Alabama. Final Report, Task 2. Report number FWHA-HEP-12-053.
- NOAA. (2008). VDATUM for the Northeast Gulf of Mexico From Mobile Bay, Alabama, to Cape San Blas, Florida: Tidal Datum Modeling and Population of the Marine Grids. Silver Springs, Maryland.
- Thompson Engineering, Inc. (2014). Geotechnical Data Report: Mon Louis Island Marsh Creation and Shoreline Stabilization Project.
- Webb, B. M. (2011). Mon Louis Island Community Base Restoration Meeting Presentation.



Webb, B. M. (2012). Evaluation of Coastal Process and Structure Design Methodologies for The Nature Conservancy's Restoration Activities in Alabama's Coastal Waters.



APPENDIX D

Geotechnical Data Report, Mon Louis Island – Marsh Creation and Shoreline Stabilization Project, Theodore, Mobile County, Alabama. Thompson Engineering, Inc., May 27, 2014



Geotechnical Data Report

Mon Louis Island – Marsh Creation and Shoreline Stabilization Project

Theodore, Mobile County, Alabama

Thompson Project No.: 13-1101-0242

May 27, 2014



knowledge-ideas-impact

thompson



May 27, 2014

Mobile Bay National Estuary Program

118 N. Royal Street, Suite 601 Mobile, Alabama 36602

Attention: Ms. Roberta Swann, Executive Director

Subject: Geotechnical Data Report

Mon Louis Island - Marsh Creation and Shoreline Stabilization Project

Theodore, Mobile County, Alabama Thompson Project No.: 13-1101-0242

Dear Ms. Swann:

Thompson Engineering (Thompson) is pleased to present this geotechnical data report in accordance with the Technical Work Plan dated November 12, 2013. This report presents data collected as part of the field and laboratory testing programs which may be used in support of project design and construction activities. Details on exploration protocols and test results are presented below and in the attached Appendices.

Project Description: Mon Louis Island is located in South Mobile County near the mouth of Fowl River. The subject project consists of the creation of up to 7 acres of marsh on the east side of Mon Louis Island. As part of the marsh creation and to provide wave attenuation and erosion protection, shoreline stabilization measures will be constructed along the east shoreline of the proposed marsh area. Initially, maintenance dredging within the Fowl River navigation channel was being considered as a potential borrow source for the fill required to create the new marsh area. The investigation was later expanded to consider potential borrow sources south of the channel.

Scope of Services: The scope of geotechnical testing services deemed appropriate for this study, in light of the project requirements, our understanding of the project, and with reliance on our knowledge of the local geology and our past experience near this project site and with similar project parameters, included the following:

- Five standard penetration test (SPT) borings extended to a maximum depth of 30 feet below the mudline within the proposed footprint of the Marsh Island reclamation.
- Vibracore sampling to a maximum depth of 9 feet below the mudline at 6 locations within the Fowl River ship channel and 10 locations within Mobile Bay east of the project site.
- Laboratory testing program including visual and laboratory data-based classifications of recovered soil specimens.

2970 Cottage Hill Road, Ste. 190 Mobile, AL 36606 251.666.2443 ph. / 251.666.6422 fax www.thompsonengineering.com **Subsurface Exploration Program:** Geotechnical data collection activities for this project incorporated standard penetration test (SPT) and vibracore sampling protocols; all the work was completed working from a purpose-specific vessel. The overall intent of the subsurface exploration program was to establish a site-specific subsurface conditions database. Five borings and 6 vibracore samples were advanced to selected depths below the mudline.

Boring and sample depths were based on our local experience and anticipated depth of soil influence from surface loads. Handheld GPS was used to determine boring locations in the field. Mudline elevations were determined based on water depths at the time of drilling and data from nearby tidal gauges.

The initial subsurface exploration program was started on December 2, 2013 and completed on January 4, 2014. Supplemental vibracore sampling was performed on April 21, 2014. The approximate test locations are presented on the appended Test Location Plan. Brief descriptions of sampling protocols are presented below:

Soil Test Borings: Mud rotary drilling techniques with fluid return were utilized to advance the boreholes. SPT sampling was performed on 5 foot intervals in general accordance with ASTM D-1586. Undisturbed Shelby tube sampling was performed in cohesive soils in accordance with ASTM D-1587. Table 1 indicates the location of the soil test borings. Representative portions of the subsurface soil samples recovered from the boreholes were transported to Thompson's geotechnical laboratory facility.

The recovered soil specimens were visually classified by an experienced geotechnical engineer. The results of the classification and stratification are shown on the appended Records of Test Boring (RTB). Some variations in subsurface soil conditions between soil test boring locations may be anticipated from those shown on the appended documents. Recovered samples were not examined, either visually or analytically, for chemical composition or environmental hazards.

Boring	Date / W	ater Dept	h / Time	Latitude	Longitude	Mudline Elevation*
MB-1	12/02/13	1.2 Ft	11:40 AM	30.447841	88.106446	- 1.4 ft. MLLW
MB-2	12/03/13	1.7 Ft	9:00 AM	30.448656	88.106675	- 0.5 ft. MLLW
MB-3	12/03/13	2.3 Ft	12:30 PM	30.449509	88.106539	-2.5 ft. MLLW
MB-4	12/04/13	2.2 Ft	12:30 PM	30.450010	88.107192	-2.3 ft. MLLW
MB-5	12/04/13	2.3 Ft	9:30 AM	30.450797	88.107266	-1.1 ft. MLLW

Table 1 – Soil Test Boring Locations and Water Depth

• **Vibracore Sampling:** Vibracore sampling was performed using a pneumatic drive head to advance a 3-inch diameter tube sampler below the existing mudline. Sampling was performed on 12/5/2013 and on 4/21/14. **Table 2** indicates the vibracore test locations and water depths. Soil samples were transported to Thompson's geotechnical laboratory facilty for extrusion, classification and testing.

^{*} Mudline elevation based on water depth and NOAA tide data for East Fowl River Bridge

3.1 ft.

3.4 ft.

3.3 ft.

3.3 ft.

3.6 ft.

3.8 ft.

4.1 ft.

SVB-4

SVB-5

SVB-6

SVB-7

SVB-8

SVB-9

SVB-10

04/21/14

04/21/14

04/21/14

04/21/14

04/21/14

04/21/14

04/21/14

4 ft.

1.5 ft.

5.5 ft.

7.5 ft.

4.7 ft.

4.8 ft.

4.8 ft.

Table 2 – Vibracore Test Locations and Water Depths

Sample ID	Date / W	ater Dent	h / Time	Latitude	Longitude	Mudline	Core Depth below
Sumple 15	Dute / 11	ист Берт	., m.c	Lacreace	Longitude	Elevation*	mudline
VB-1	12/05/13	5.3 ft.	11:00 AM	30.45209	88.09681	- 3.9 ft. MLLW	7.5 ft.
VB-2	12/05/13	3.4 ft.	11:45 AM	30.45314	88.10081	- 2.2 ft. MLLW	9.1 ft.
VB-3	12/05/13	5.7 ft.	10:00 AM	30.45304	88.10515	- 4.0 ft. MLLW	7.0 ft.
VB-4	12/05/13	6.8 ft.	9:05 AM	30.45206	88.10686	- 5.0 ft. MLLW	7.8 ft.
VB-5	12/05/13	10.4 ft.	12:30 PM	30.44999	88.10921	- 9.4 ft. MLLW	7.9 ft.
VB-6	12/05/13	7.4 ft.	1:00 PM	30.44774	88.11033	- 6.5 ft. MLLW	7.0 ft.
SVB-1	04/21/14	2.7 ft.	7:55 AM	30.44886	-88.10572	-2.6 ft. MLLW	6.7 ft.
SVB-2	04/21/14	2.8 ft.	8:45 AM	30.44952	-88.10590	-2.7 ft. MLLW	2.3 ft.
SVB-3	04/21/14	3.0 ft.	1:15 PM	30.45030	-88.10628	-2.2 ft. MLLW	5.3 ft.

30.45095

30.44952

30.45049

30.45193

30.45217

30.45012

30.44857

-88.10659

-88.10482

-88.10550

-88.10474

-88.10226

-88.10159

-88.10200

-2.2 ft. MLLW

-3.1 ft. MLLW

-3.1 ft. MLLW

-3.1 ft. MLLW

-3.5 ft. MLLW

-3.3 ft. MLLW

-3.5 ft. MLLW

2:20 PM

11:00 AM

10:20 AM

9:40 AM

8:20 AM

11:45 AM

Within the channel vibracore samples taken on 12/5/2013, no significant variation was noted within each respective vibracore sample. The soil descriptions presented on the appended Grain Size Test Reports are representative of each entire channel vibracore sample.

After review of the results of the Soil Test Borings and the channel vibracore samples, supplemental vibracore samples (SVB) were taken at selected locations within Mobile Bay just east of the project site on 4/21/2014. An RTB has been prepared for each of these vibracore samples. Soil descriptions indicated on the supplemental vibracore RTBs are based on visual classification. To date, no laboratory testing has been performed on the supplemental vibracore samples.

Laboratory Testing Program: The soil samples were classified in general accordance with the guidelines of ASTM D-2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System) and ASTM D-2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). The quantity and type of laboratory tests performed for this geotechnical study were determined and adjusted by Thompson's engineering personnel based on the uniformity and character of the subsurface soil conditions encountered, and our experience and knowledge of local soil conditions.

Laboratory soil tests were performed to aid in the classification of the soils, and to assist in the evaluation of engineering characteristics of the soils. Representative soil samples recovered from the soil test borings were selected for percent finer #200 sieve, moisture content, Atterberg Limits, organic content, vane shear strength, and consolidation tests. Test protocols were in accordance with ASTM Procedures. The test results are presented on the appended documents.

^{12:30} PM Mudline elevation based on water depth and NOAA tide data for East Fowl River Bridge

General: A geotechnical engineering report is scheduled for publication during the design phase of this project. The report will provide conclusions and recommendations addressing soil subsidence and stability matters.

We appreciate the opportunity to continue to assist the Mobile Bay National Estuary Program with project-related geotechnical matters. Please do not hesitate to contact our office with any questions concerning this submittal.

Respectfully,

THOMPSON ENGINEERING, INC

Cameron Crigler, P.E.

Senior Geotechnical Engineer

Blake Betbeze, P.E.

Project Geotechnical Engineer

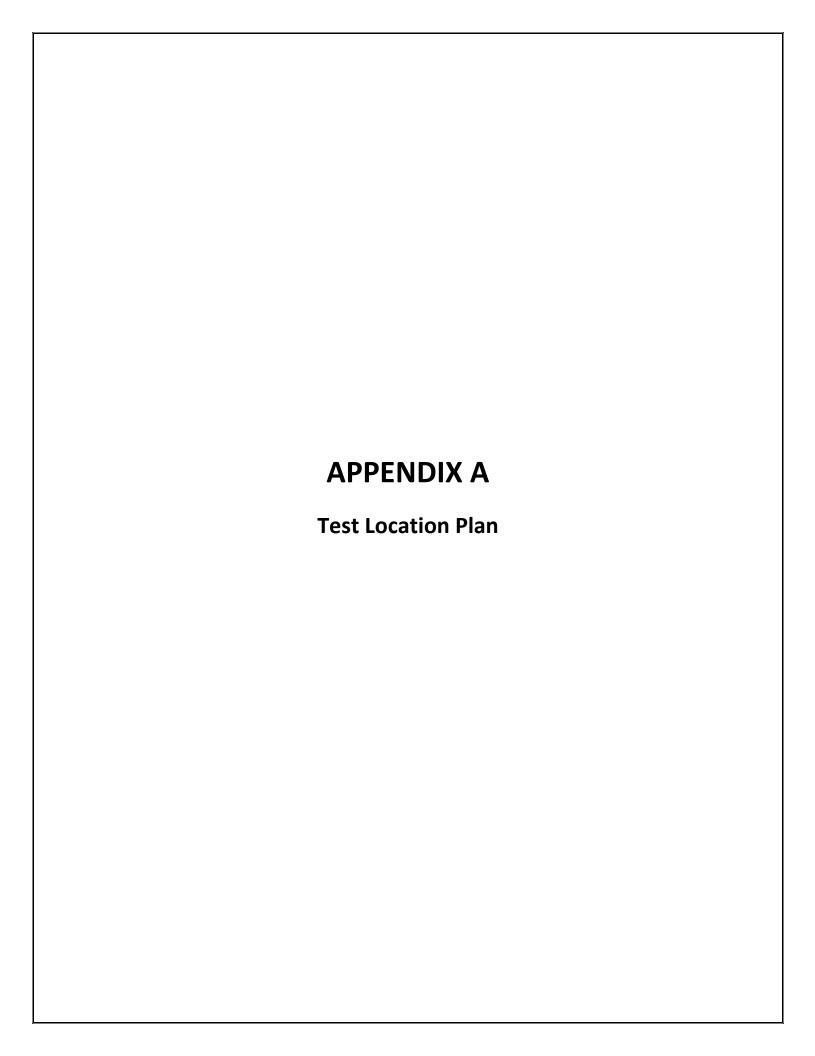
Attachments: Appendix A – Test Location Plan

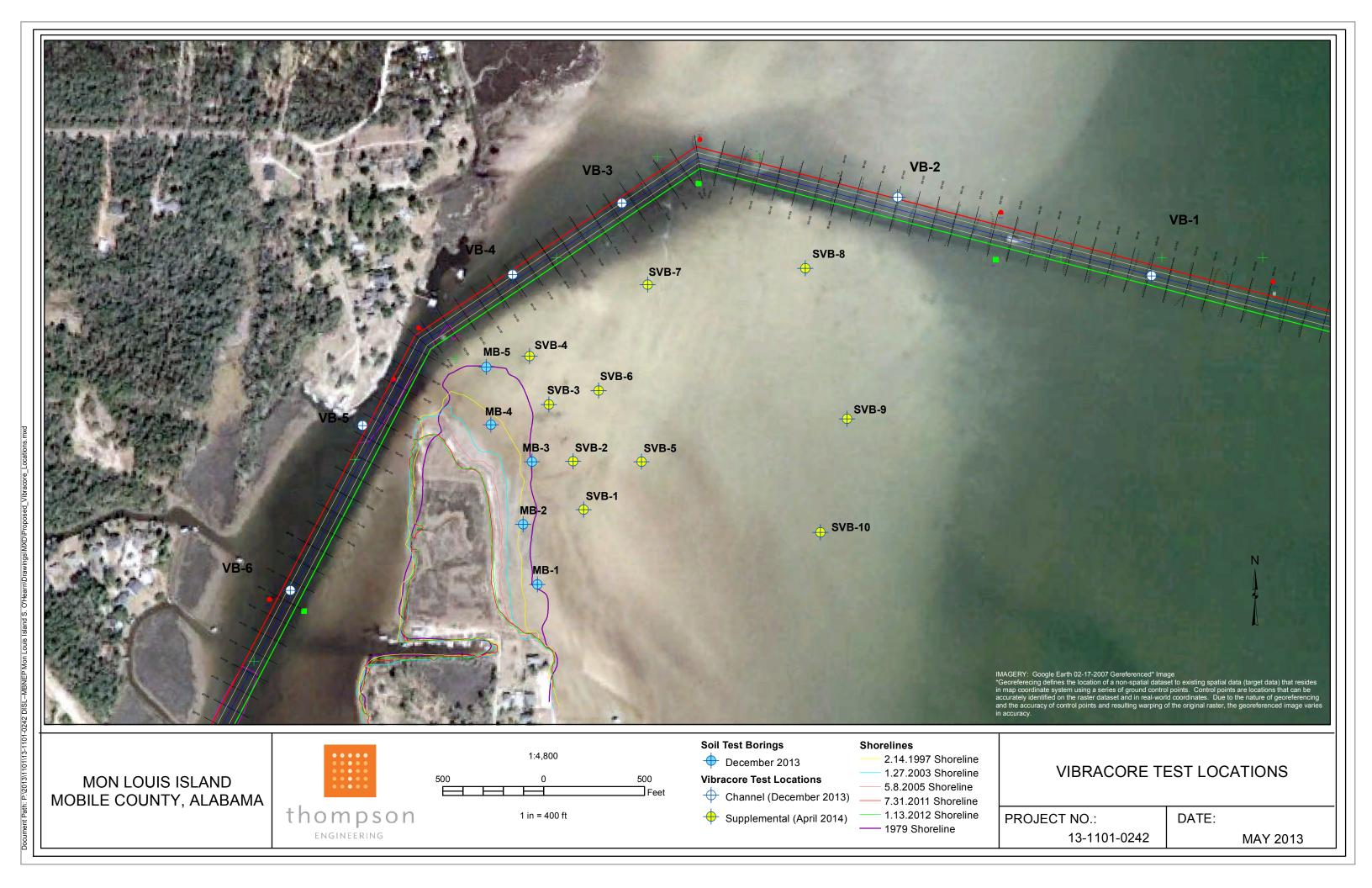
Appendix B – Records of Test Boring for Marine Borings

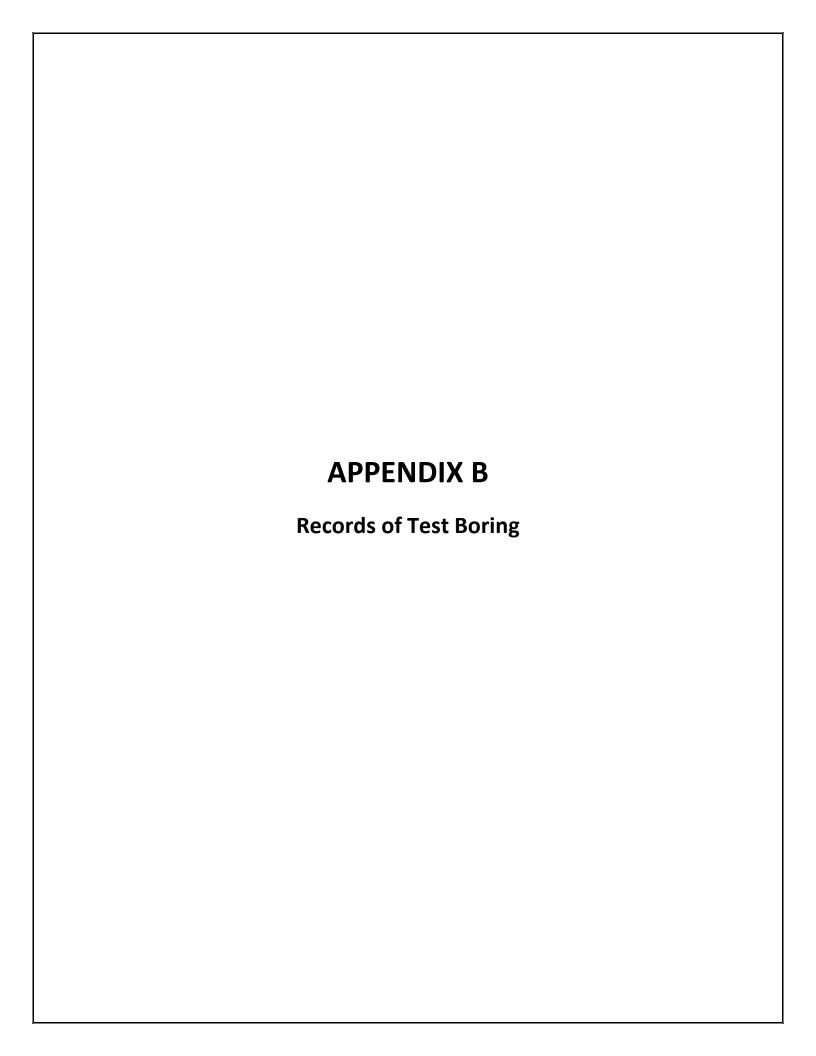
Appendix C – Grain Size Test Results for Fowl River Channel Vibracore Samples

Appendix D – Records of Test Boring for Supplemental Vibracore Samples

Appendix E – Laboratory Test Results









PROJECT: DISL/MBNEP Mon Louis Island

Mon Louis Island, Mobile County, Alabama

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program **LOCATION:** Refer to boring location plan

ENGINEER: C. Crigler

SAMPLE METHOD: ASTM D1586

TYPE BORING: Mud Rotary DRILLER: J. Thompson

DRILL RIG: Barge-SIMCO 2400

WATER DEPTH: 1.2 ft.

BORING NO.: MB-1

PAGE: 1 of 1 LAT.: 88°106.446 LONG.: 30°447.841 DATE: 12/02/13

WEATHER: Clear

ELEVATION: -1.4 ft. MLLW

DEPTH/ ELEV.	SYMBOL	SPT	SAMPLE I.D. NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	N	%F	мс	LL	PI	uw	ос	UU	UC	PP	vs	FS
0		WOR WOR WOR	S-1		Very soft, dark gray, with trace organics (wood)	WOR											
5		WOH WOH	S-2		Very soft, with trace organics (wood)	WOH	56.7										
10		WOH WOH	S-3		Very soft	WOH											
15—		WOH WOH	S-4	CLAY (CH)	Very soft	WOH											
20 -		WOH WOH WOH	S-5		Very soft	WOH	70.9										
		WOH WOH	S-6		very soft	WOH	-										
-30		2 4 5	S-7	SILTY SAND (SM)	Loose, fine to medium grained, gray and brown, with trace clay Boring terminated at 30 ft.	9											
					ditional information. This Rec										·		



PROJECT: DISL/MBNEP Mon Louis Island

Mon Louis Island, Mobile County, Alabama

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program **LOCATION:** Refer to boring location plan

ENGINEER: C. Crigler

SAMPLE METHOD: ASTM D1586

TYPE BORING: Mud Rotary DRILLER: J. Thompson

DRILL RIG: Barge-SIMCO 2400

WATER DEPTH: 1.7 ft.

BORING NO.: MB-2

PAGE: 1 of 1 LAT.: 88°106.675 LONG.: 30°448.656 DATE: 12/03/13

WEATHER: Clear

ELEVATION: -0.5 ft. MLLW

ENGI	NEEF	₹: (C. Cri	gler								ELE	VAT	ION:	-0.51	t. ML	LW	
DEPTH/ ELEV.	SYMBOL	SAMPLER	SPT BLOWS	SAMPLE I.D. NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	N	%F	мс	LL	PI	uw	ос	UU	uc	PP	vs	FS
		X	WOH WOH	S-1	CLAY (CH)	Very soft, dark gray, with sand	WOH	63.5	j									
5 — -5			WOH WOH WOH	S-2		Very loose, gray	WOH	31.5	255	203	148		25.7					
			WOH WOH WOH		ORGANIC SILT (OL)	Very loose	WOH	-										
-15 15			WOH WOH WOH	S-4	CLAY (CH)	Very soft, gray, with trace shell	WOH	-										
			WOH WOH 2	S-5		Very loose, fine to medium grained, gray	2	31.6	j									
-25		X	7 8 8	S-6	SILTY SAND (SM)	Medium dense	16	-										
-30		X	16 22 28	S-7		Dense, brown Boring terminated at 32 ft.	50	_										
efer to	Notes	 s an	id Le	gend (I on separate sheet for add	ditional information. This Rec	ord of	<u>L</u> Test	<u>Bori</u>	na is	part	of the	l e proi	ect Ge	ı eoteci	nnica	l Rer	$\frac{L}{2}$



PROJECT: DISL/MBNEP Mon Louis Island

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program **LOCATION:** Refer to boring location plan

SAMPLE METHOD: ASTM D1586

Mon Louis Island, Mobile County, Alabama **TYPE BORING:** Mud Rotary **DRILLER:** J. Thompson DRILL RIG: Barge-SIMCO 2400

WATER DEPTH: 2.3 ft.

BORING NO.: MB-3

PAGE: 1 of 1 **LAT.:** 88°106.538 **LONG.:** 30°449.509 **DATE:** 12/03/13

WEATHER: Clear

FI FVATION: -2 5 ft MILLW

DEPTH/ ELEV.	SYMBOL	- 1 1		SAMPLE I.D. NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	N	%F	мс	LL	PI	uw	ос	UU	uc	PP	vs	FS
5			WOH WOH WOH	S-1	ORGANIC SILT (OL)	Very loose, black and dark brown	WOH	13.4										
5-10			3 3 5	S-2	SILTY SAND (SM)	Loose, fine grained, gray	8	16.6										
- - - - - - - - - - - - - - - - - - -			2 3 4	S-3	SLIGHTLY SILTY	Loose, light gray	7	13.2										
20			3 3 3	S-4	SAND (SP-SM)	Loose	6	5.6										
		X	2 2 2	S-5		Very loose, with trace clay	4											
- - - - - - - - - - - - -		X	10 18 23	S-6	SILTY SAND (SM)	Dense, fine to medium grained, brown	41											
1		X	15 15 22	S-7		Dense, yellowish brown Boring terminated at 32 ft.	37											



PROJECT: DISL/MBNEP Mon Louis Island

Mon Louis Island, Mobile County, Alabama

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program

LOCATION: Refer to report text

ENGINEER: C. Crigler

SAMPLE METHOD: ASTM D1586&1587

TYPE BORING: Mud Rotary
DRILLER: J. Thompson

DRILL RIG: Barge-SIMCO 2400

WATER DEPTH: 2.2 ft.

BORING NO.: MB-4

PAGE: 1 of 1 **LAT.:** 88°107.192 **LONG.:** 30°450.010

DATE: 12/04/13
WEATHER: Clear

ELEVATION: -2.3 ft. MLLW

DEPTH/ ELEV.	SYMBOL	SPT SPT BLOWS	SAMPLE I.D. NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	N	%F	мс	LL	PI	UW	ос	υυ	UC	PP	vs	FS
0		WOH WOH	S-1		Very soft, gray	WOH	65.6	61.0				3.9					
5		WOH WOH WOH	S-2		Very soft	WOH											
10		PUSH	T-1		Gray	PUSH	75.9	144.7	1137	105							
15 —		PUSH	T-2	CLAY (CH)	Gray	PUSH											
20 -		PUSH	T-3		Gray	PUSH	87.6										
25 —		PUSH	T-4		Gray	PUSH											
30 -		3 3 5	S-3	SILTY SAND (SM)	Loose, fine grained, gray Boring terminated at 31 ft.	8											
Refer to	Notes a	and Le	gend	on separate sheet for add	ditional information. This Rec	cord of	Test	Bori	na is	part	of the	e proi	ect Ge	eotec	hnica	l Rer	oort.



PROJECT: DISL/MBNEP Mon Louis Island

Mon Louis Island, Mobile County, Alabama

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program **LOCATION:** Refer to boring location plan

ENGINEER: C. Crigler

SAMPLE METHOD: ASTM D1586&1587

TYPE BORING: Mud Rotary DRILLER: J. Thompson

DRILL RIG: Barge-SIMCO 2400

WATER DEPTH: 2.3 ft.

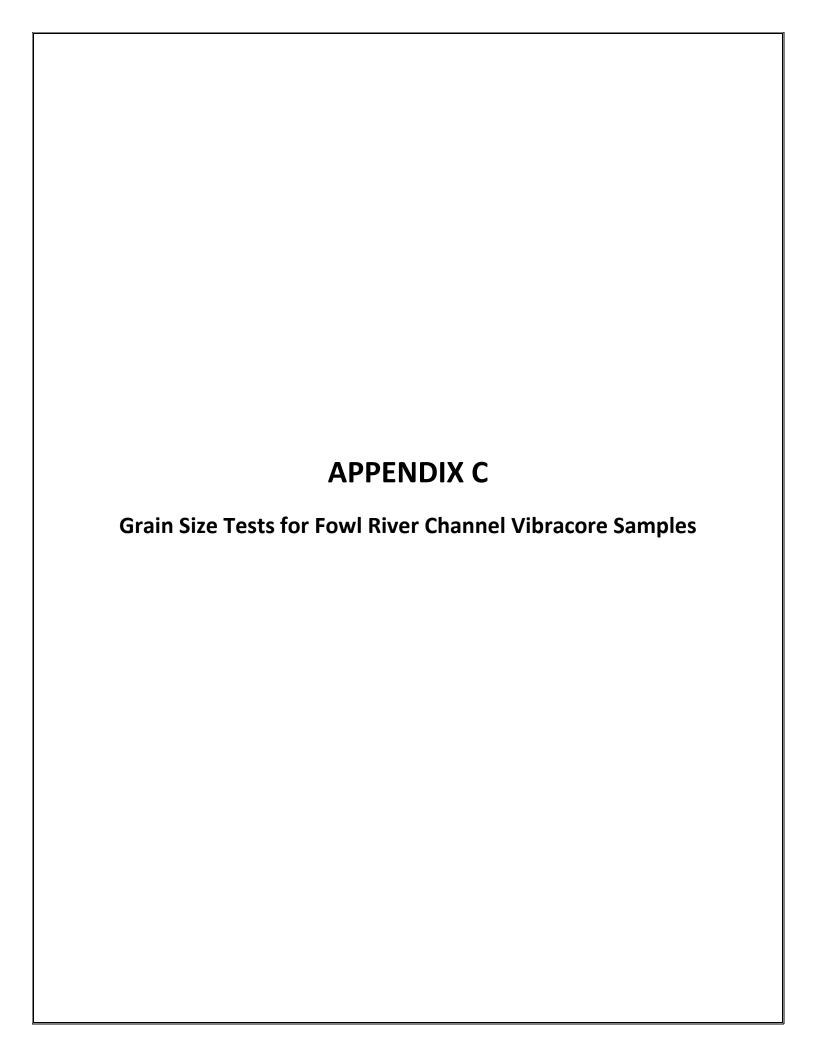
BORING NO.: MB-5

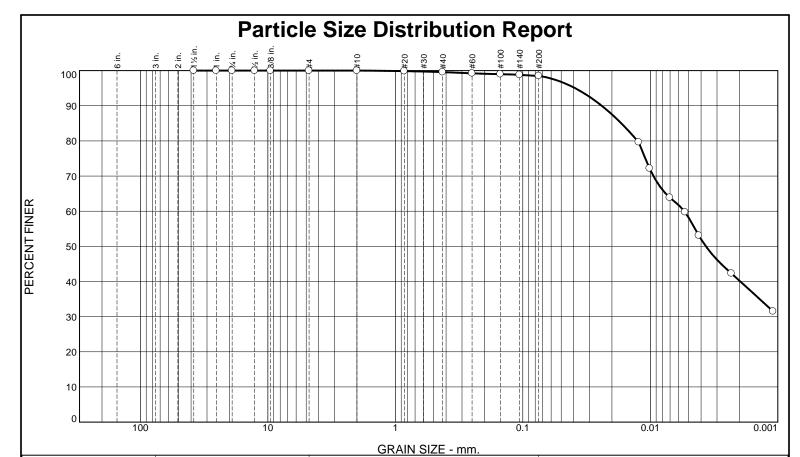
PAGE: 1 of 1 LAT.: 88°107.266 LONG.: 30°450.797 DATE: 12/04/13

WEATHER: Clear

ELEVATION: -1.1 ft. MLLW

LINGII							1	_	_					ION.				
DEPTH/ ELEV.	SYMBOL	SAMPLER SPT	BLOWS	SAMPLE I.D. NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	N	%F	мс	LL	PI	uw	ос	υυ	uc	PP	vs	FS
0	:: :: \ :: :: :: :: :: ::	X w	OH OH OH	S-1	SLIGHTLY SILTY SAND (SP-SM)	Very loose, fine grained, gray	WOH	11.4										
		W W	OH OH OH	S-2	SILTY SAND (SM)	Very loose, with trace shell	WOH	14.8										
10		PU	ISH	T-1		Gray	PUSH	66.7	78.2	86	66							
 _ -15		PL	ISH	T-2		Gray	PUSH											
15 —		X w	OH OH OH	S-3	CLAY (CH)	Very soft	WOH	-										
20		■ PU	ISH	T-2		Gray	PUSH	_										
25 — - 25 — -		PU	JSH	T-3		Gray	PUSH	81.0	89.0	108	82							
30			2 3 4	S-4	SILTY SAND (SM)	Loose, fine grained, gray Boring terminated at 32 ft.	7	-										
Refer to Actual st	Notes a	and ange	Leg es r	jend c	on separate sheet for add e gradual over depth.	ditional information. This Rec	cord of	Test	Bori	ng is	part	of the	e proj	ect Ge	eotec	nnica	l Rep	oort.





% +3"		% Gravel			% Sand			% Fines			
		Coar	se	Fine	Coarse		Medium	Fine	Silt	Clay	
	0.0		0.0)	0.0	0.0		0.4	1.1	40.4	58.1
	SIEVE PERCENT SPEC.* P		PASS?			Mat	erial Description				

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1.5	100.0		
1.0	100.0		
.75	100.0		
.50	100.0		
.375	100.0		
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.6		
#60	99.2		
#100	99.0		
#140	98.8		
#200	98.5		

Atterhera Limits	

LL= 126 PL= 32 PI= 94 Classification AASHTO= USCS= CH

Remarks

A-7-5(109)

Natural Moisture: 172.9%

Gray, olive, and Black CLAY (CH)

(no specification provided)

Location: VB-1 Depth: Core Depth 7.5' **Date:** 1/06/14

Thompson Engineering

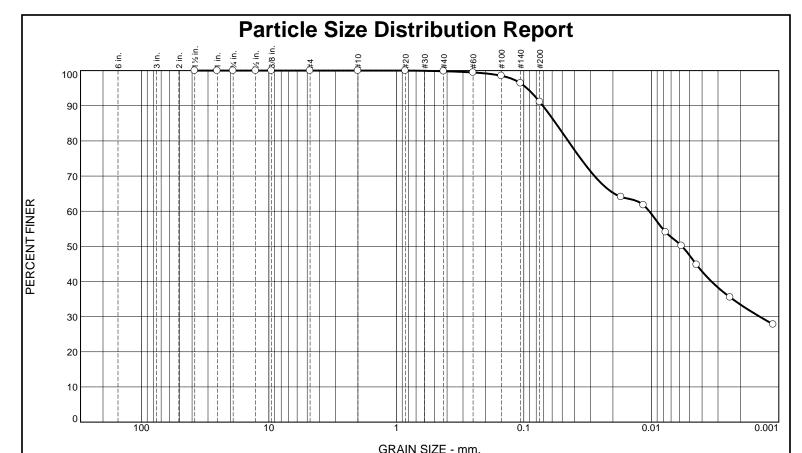
Client: Mobile Bay National Estuary Program

Project: DISL/MBNEP Mon Louis Island

Mobile, Alabama

Mon Louis Island, Mobile County, Alabama

Project No: 13-1101-0242 **Figure**



OTO WIT OILL THINK								
0/ .3"	% Gravel		% Sand			% Fines		
% +3"	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	
0.0	0.0	0.0	0.0	0.2	8.7	43.7	47.4	

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1.5	100.0		
1.0	100.0		
.75	100.0		
.50	100.0		
.375	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.8		
#60	99.5		
#100	98.5		
#140	96.4		
#200	91.1		

	<u>Material De</u>	<u>escription</u>
Gray oliv	e and black CLAV (CE	1/

 $\begin{array}{ccc} & & & \underline{\textbf{Classification}} \\ \textbf{USCS=} & \textbf{CH} & & \textbf{AASHTO=} & \textbf{A-7-5} (104) \end{array}$

<u>Remarks</u>

Natural Moisture: 127.2%

(no specification provided)

 Location: VB-2
 Depth: Core Depth 9.1'
 Date: 1/06/14

Thompson Engineering

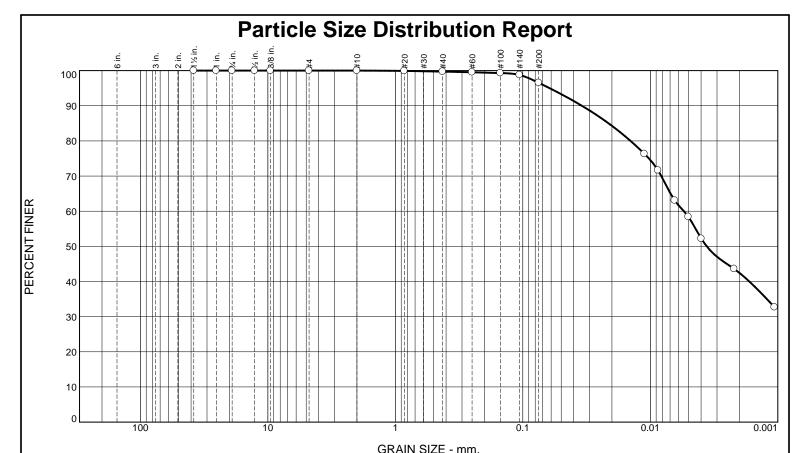
Client: Mobile Bay National Estuary Program
Project: DISL/MBNEP Mon Louis Island

Mon Louis Island, Mobile County, Alabama

Mobile, Alabama

Project No: 13-1101-0242

Figure



OTO WIT OILL THINK								
0/ .3"	% Gravel		% Sand			% Fines		
% +3"	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	
0.0	0.0	0.0	0.0	0.3	3.2	38.2	58.3	

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1.5	100.0		
1.0	100.0		
.75	100.0		
.50	100.0		
.375	100.0		
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.7		
#60	99.5		
#100	99.3		
#140	98.8		
#200	96.5		

Material	Descri	ption
-		

USCS= CH Classification AASHTO= A-7-5(126)

Remarks

Natural Moisture: 122.4%

(no specification provided)

 Location: VB-3
 Depth: Core Depth 7.0'
 Date: 1/06/14

Thompson Engineering

Client: Mobile Bay National Estuary Program

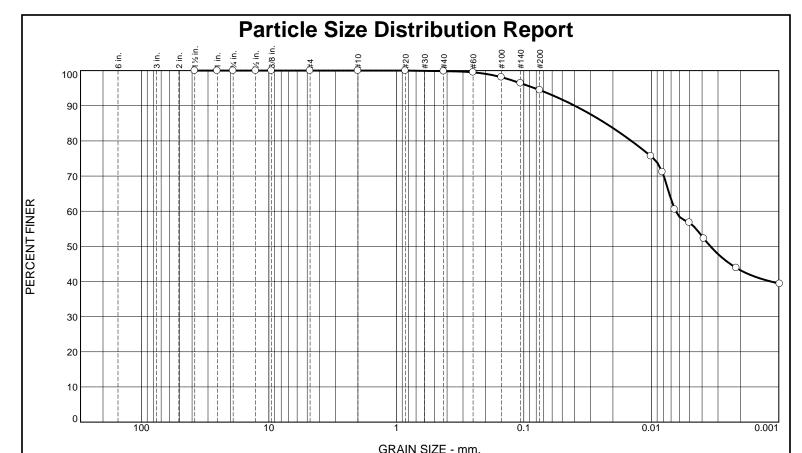
Project: DISL/MBNEP Mon Louis Island

Mon Louis Island, Mobile County, Alabama

Mobile, Alabama

Project No: 13-1101-0242

Figure



0/ 0"	% G	ravel	% Sand			% Fines	
% + 3"	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	5.3	37.8	56.7

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1.5	100.0		
1.0	100.0		
.75	100.0		
.50	100.0		
.375	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.8		
#60	99.5		
#100	98.1		
#140	96.4		
#200	94.5		

Material	Description

 $\begin{array}{ccc} & & & \underline{\textbf{Classification}} \\ \textbf{USCS=} & \textbf{CH} & & \textbf{AASHTO=} & \textbf{A-7-6} \\ \end{array}$

Remarks

Natural Moisture: 120.9%

(no specification provided)

 Location: VB-4
 Depth: Core Depth 7.8'
 Date: 1/06/14

Thompson Engineering

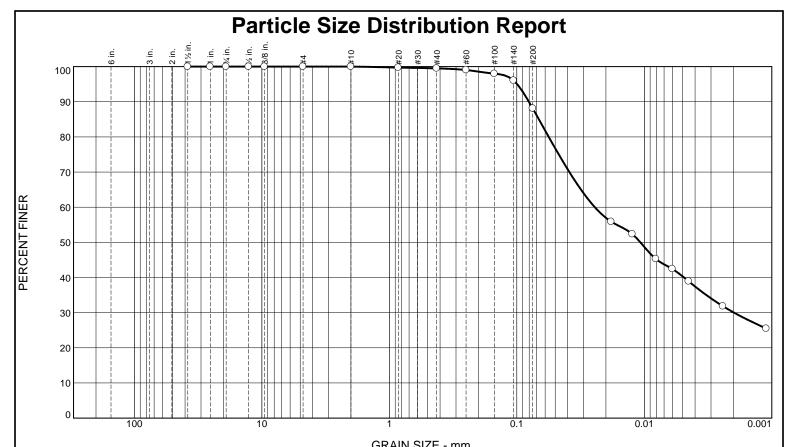
Client: Mobile Bay National Estuary Program
Project: DISL/MBNEP Mon Louis Island

Mon Louis Island, Mobile County, Alabama

Mobile, Alabama

Project No: 13-1101-0242

Figure



				GRAIN SIZE	= - mm.		
9/ .3"	% G	ravel		% Sand		% Fines	
% +3"	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.5	11.4	47.8	40.3

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1.5	100.0		
1.0	100.0		
.75	100.0		
.50	100.0		
.375	100.0		
#4	100.0		
#10	100.0		
#20	99.7		
#40	99.5		
#60	99.0		
#100	98.0		
#140	96.1		
#200	88.1		
ı	I	l .	1

		<u>Material Description</u>	
Trov	مانين	and block CLAV (CU)	

Atterberg Limits
LL= 109 PL= 27 PI= 82

Classification AASHTO= USCS= CH A-7-6(81)

Remarks

Natural Moisture: 144.3%

(no specification provided)

Location: VB-5 Depth: Core Depth 7.9'

Date: 1/06/14

Thompson Engineering

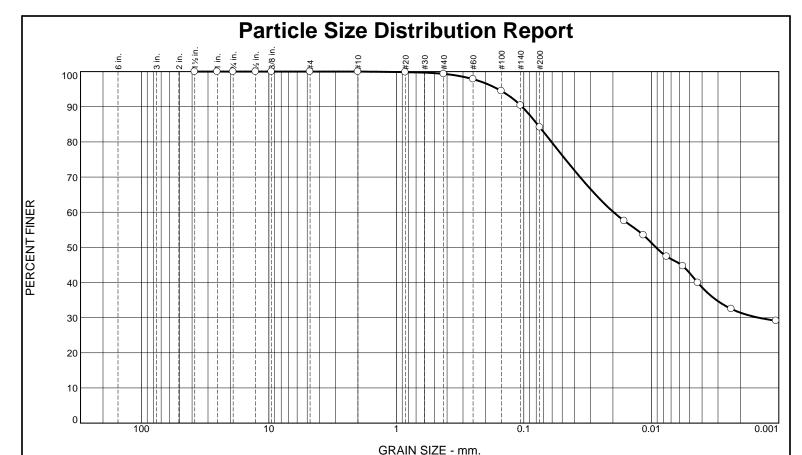
Client: Mobile Bay National Estuary Program Project:

DISL/MBNEP Mon Louis Island

Mobile, Alabama

Mon Louis Island, Mobile County, Alabama

Project No: 13-1101-0242 **Figure**



9/ .2"	% G	ravel		% Sand		% Fines	
% + 3"	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.6	15.2	41.5	42.7

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1.5	100.0		
1.0	100.0		
.75	100.0		
.50	100.0		
.375	100.0		
#4	100.0		
#10	100.0		
#20	99.8		
#40	99.4		
#60	97.9		
#100	94.5		
#140	90.4		
#200	84.2		

Material Description	
Gray, olive, and black CLAY (CH)	

Atterberg Limits
LL= 112 PL= 23 PI= 89

Classification AASHTO= USCS= CH A-7-6(82)

Remarks

Natural Moisture: 111.6%

(no specification provided)

Location: VB-6 Depth: Core Depth 7.0' **Date:** 1/06/14

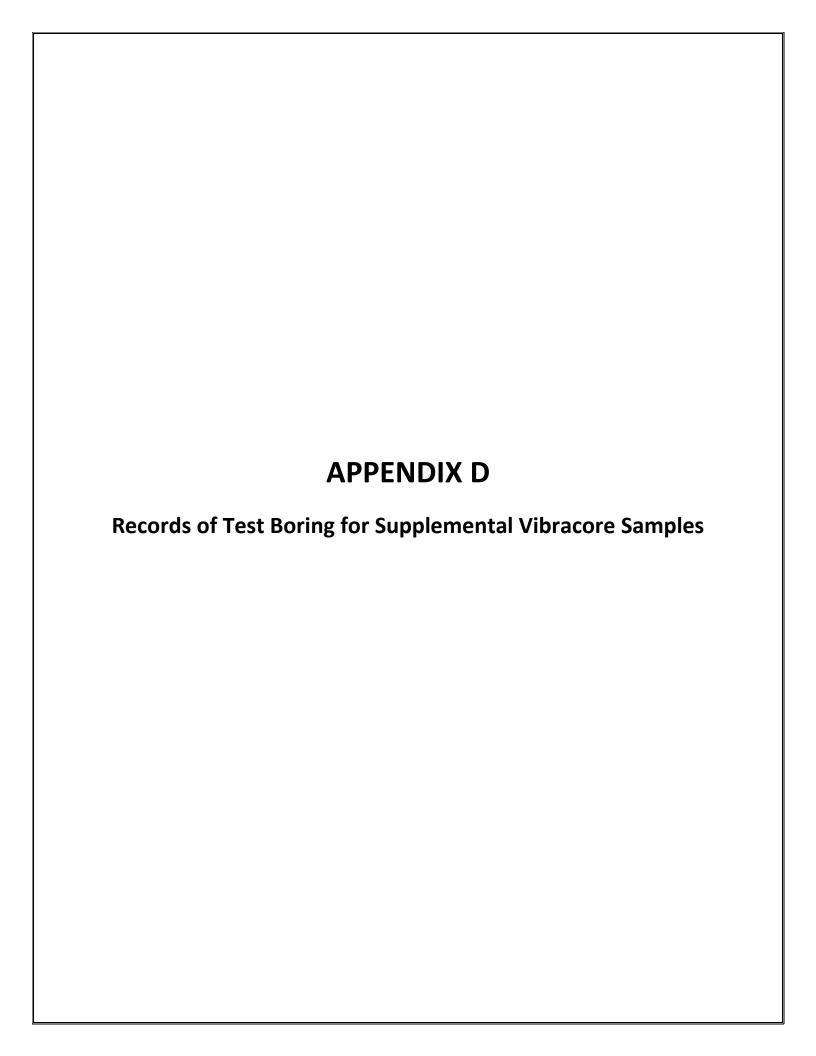
Thompson Engineering

Client: Mobile Bay National Estuary Program Project: DISL/MBNEP Mon Louis Island

Mon Louis Island, Mobile County, Alabama

Mobile, Alabama

Project No: 13-1101-0242 **Figure**





PROJECT: DISL/MBNEP Mon Louis Island

Mon Louis Island, Mobile County, Alabama

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program **LOCATION:** Refer to boring location plan

ENGINEER: C. Crigler

SAMPLE METHOD:
TYPE BORING: Vibracore
DRILLER: J. Thompson
DRILL RIG: Pontoon Vibracore Rig

WATER DEPTH: -2.7 ft.

BORING NO.: SVB-1

PAGE: 1 of 1 LAT.: -88.10572 LONG.: 30.44886 DATE: 04/21/14

WEATHER: ELEVATION: ---

ENGI	NEER:											ELE	VAT	ION:				
DEPTH/ ELEV.	SYMBOL	SAMPLER	SAMPLE	I.D. NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	N	%F	мс	LL	PI	uw	ос	UU	UC	PP	vs	FS
0			S-1	1		Gray, with trace organics												
					CLAY (CH)													
			S-2	2 		Dark brown, highly organic												
2																		
-																		
-																		
-					CLAY (CL)													
4 —																		
-																		
6 —																		
_																		
·						Refusal at 80 inches.												
D-f				\perp		distance l'extreme d' This D				<u> </u>								
Refer to	NOTES	and I	eaena	no r	senarate sheet for ac	ditional information. This Rec	ora of	rest	Hori	ทศ เร	nart	of the	nroi	ect (ie	otecl	nnica	ıKer	า∩rt

Refer to Notes and Legend on separate sheet for additional information. This Record of Test Boring is part of the project Geotechnical Report. Actual strata changes may be gradual over depth.



PROJECT: DISL/MBNEP Mon Louis Island

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program **LOCATION:** Refer to boring location plan

SAMPLE METHOD: Mon Louis Island, Mobile County, Alabama **TYPE BORING:** Vibracore **DRILLER:** J. Thompson DRILL RIG: Pontoon Vibracore Rig

WATER DEPTH: -2.8 ft.

BORING NO.: SVB-2

PAGE: 1 of 1 **LAT.:** -88.10590 **LONG.:** 30.44952

DATE: 04/21/14 **WEATHER:**

ENGI	NEER				д р							ELE	VAT	ION:				
DEPTH/ ELEV.	SYMBOL	SAMPLER	SPT BLOWS	SAMPLE I.D. NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	N	%F	мс	LL	PI	uw	ос	UU	uc	PP	vs	FS
-				S-1	CLAY (CH)	Light gray and red												
2-		1		S-2	SANDY CLAY (CL)	Light gray and red		-										
-		1			CANDI CLAI (CL)	Refusal at 26 inches.		1										
Refer to	Notes	an	d Le	nend (on senarate sheet for add	ditional information. This Rec	ord of	Test	Bori	na is	nart	of the	nroi	ect Ge	otec	hnica	l Rer	ort

Refer to Notes and Legend on separate sheet for additional information. This Record of Test Boring is part of the project Geotechnical Report. Actual strata changes may be gradual over depth.



PROJECT: DISL/MBNEP Mon Louis Island

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program **LOCATION:** Refer to boring location plan

ENGINEER: C. Crigler

SAMPLE METHOD: Mon Louis Island, Mobile County, Alabama **TYPE BORING:** Vibracore **DRILLER:** J. Thompson **DRILL RIG:** Pontoon Vibracore Rig

WATER DEPTH: -3.0 ft.

BORING NO.: SVB-3

PAGE: 1 of 1 **LAT.:** -88.10628 **LONG.:** 30.45030 **DATE:** 04/21/14

WEATHER: ELEVATION: ---

ENGII				gier								ELE	VAI	ION:				
DEPTH/ ELEV.	SYMBOL	SAMPLER	SPT BLOWS	SAMPLE I.D. NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	N	%F	мс	LL	PI	uw	ос	UU	uc	PP	vs	FS
0	///			S-1	CLAYEY SAND (SC)	Gray and light brown												
-	7			S-2	PEAT (PT)	Dark brown, organic		-										
2				S-3	SAND (SP)	Light gray		-										
						Refusal at 47 inches.		-										
Defente	Natas		-11			ditional information. This Rec			Dari			26 412					I Day	

Refer to Notes and Legend on separate sheet for additional information. This Record of Test Boring is part of the project Geotechnical Report. Actual strata changes may be gradual over depth.



PROJECT: DISL/MBNEP Mon Louis Island

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program **LOCATION:** Refer to boring location plan

ENGINEER: C. Crigler

SAMPLE METHOD: Mon Louis Island, Mobile County, Alabama **TYPE BORING:** Vibracore **DRILLER:** J. Thompson

> DRILL RIG: Pontoon Vibracore Rig WATER DEPTH: -3.1 ft.

BORING NO.: SVB-4

PAGE: 1 of 1 **LAT.:** -88.10659 **LONG.:** 30.45095 **DATE:** 04/21/14

WEATHER: ELEVATION: ---

ENGI	NEEK:												VAI	ION:				
DEPTH/ ELEV.	SYMBOL	SAMPLER	BLOWS	SAMPLE I.D. NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	N	%F	мс	LL	PI	uw	ос	UU	uc	PP	vs	FS
-				S-1	SAND (SP)	Light brown, with gray clay lense												
2-				S-2	CLAYEY SAND (SC)	Gray, with shell												
-	<i></i>					Refusal at 32 inches.												
Dofor to	Notoo	<u> </u>		000	l	ditional information. This Rec	ord of	L	Dori	00.10	nort	of the	L proi	oot Co	l otool	hnioo	I Day	L

Refer to Notes and Legend on separate sheet for additional information. This Record of Test Boring is part of the project Geotechnical Report. Actual strata changes may be gradual over depth



PROJECT: DISL/MBNEP Mon Louis Island

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program **LOCATION:** Refer to boring location plan

ENGINEER: C. Crigler

SAMPLE METHOD: Mon Louis Island, Mobile County, Alabama **TYPE BORING:** Vibracore **DRILLER:** J. Thompson

DRILL RIG: Pontoon Vibracore Rig

WATER DEPTH: -3.4 ft.

BORING NO.: SVB-5

PAGE: 1 of 1 **LAT.:** -88.10482 **LONG.:** 30.44952

DATE: 04/21/14 **WEATHER: ELEVATION: ---**

ENGII				-								CLE	VAI	ION:				
DEPTH/ ELEV.	SYMBOL	SAMPLER	SPT BLOWS	SAMPLE I.D. NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	N	%F	МС	LL	PI	UW	ос	UU	UC	PP	vs	FS
0	//	П				Gray and black												
-				S-2		Light gray, red and yellow												
					CLAY (CH)													
					, ,													
						Refusal at 17 inches.												
Dofor to	Notoo	on	4 1 6	~ ~ ~ d	on agnorate about for add	Nitional information This Rec	ard of	Toot	Daris	<u> </u>	nort	of the	nroi	oot Co	0+00	hnioo	I Day	\ o =+

Refer to Notes and Legend on separate sheet for additional information. This Record of Test Boring is part of the project Geotechnical Report. Actual strata changes may be gradual over depth.



PROJECT: DISL/MBNEP Mon Louis Island

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program **LOCATION:** Refer to boring location plan

ENGINEER: C. Crigler

SAMPLE METHOD: Mon Louis Island, Mobile County, Alabama

TYPE BORING: Vibracore **DRILLER:** J. Thompson DRILL RIG: Pontoon Vibracore Rig

WATER DEPTH: -3.3 ft.

BORING NO.: SVB-6

PAGE: 1 of 1 **LAT.:** -88.10550 **LONG.:** 30.45049

DATE: 04/21/14 **WEATHER: ELEVATION: ---**

ENGI	NEEK:											VAI	ION:				
DEPTH/ ELEV.	SYMBOL	SAMPLER	SAMPLE I.D. NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	N	%F	мс	LL	PI	uw	ос	υυ	UC	PP	vs	FS
0			S-1	SILTY SAND (SM)	Black												
-			S-2	CLAY (CH)	Light gray and red												
-			S-3	SILTY SAND (SM)			1										
-			S-4		Light gray and red												
2-				CLAY (CH)													
-			S-5	SANDY CLAY (CL)	Light gray and yellow		-										
4_			S-6	SILTY SAND (SM)	Light gray and red												
					Refusal at 48 inches.												
Dofor to	Notoo	and L	odond	on concrete about for ad	ditional information. This Rec	ord of	Toot	Dori	00.10	nort	of the		ant C	otool	hnioo	I Dor	0 "*

Refer to Notes and Legend on separate sheet for additional information. This Record of Test Boring is part of the project Geotechnical Report. Actual strata changes may be gradual over depth



PROJECT: DISL/MBNEP Mon Louis Island

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program **LOCATION:** Refer to boring location plan

ENGINEER: C. Crigler

SAMPLE METHOD: Mon Louis Island, Mobile County, Alabama **TYPE BORING:** Vibracore **DRILLER:** J. Thompson **DRILL RIG:** Pontoon Vibracore Rig

WATER DEPTH: -3.3 ft.

BORING NO.: SVB-7

PAGE: 1 of 1 **LAT.:** -88.10474 **LONG.:** 30.45193 **DATE:** 04/21/14

WEATHER: ELEVATION: ---

ENGII	NEEK:			jier								ELE	VAI	ION:				
DEPTH/ ELEV.	SYMBOL	SAMPLER	BLOWS	SAMPLE I.D. NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	N	%F	мс	LL	PI	uw	ос	UU	uc	PP	vs	FS
0				S-1	SAND (SP)	Light brown												
-					CLAYEY SAND (SC)	Gray												
2-				S-3		Yellow												
4					SAND (SP)													
6—						Refusal at 77 inches.		-										
Defent	Mata					ditional information. This Rec			De ::'			-£11-					I D -	

Refer to Notes and Legend on separate sheet for additional information. This Record of Test Boring is part of the project Geotechnical Report. Actual strata changes may be gradual over depth.



PROJECT: DISL/MBNEP Mon Louis Island

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program **LOCATION:** Refer to boring location plan

ENGINEER: C. Crigler

SAMPLE METHOD: Mon Louis Island, Mobile County, Alabama
TYPE BORING: Vibracore DRILLER: J. Thompson

> DRILL RIG: Pontoon Vibracore Rig WATER DEPTH: -3.6 ft.

BORING NO.: SVB-8

PAGE: 1 of 1 **LAT.:** -88.10226 LONG.: 30.45217

DATE: 04/21/14 **WEATHER:**

ELEVATION: ---SAMPLER SPT BLOWS SAMPLE I.D. NO. SYMBOL DEPTH/ **MAJOR SOIL OTHER COMPONENTS** %F MC LL ы UW OC UU UC PP vs FS Ν ELEV. COMPONENT S-1 Light gray SAND (SP) S-2 Brown and gray, with **SANDY CLAY (CL)** organics S-3 Light gray CLAY (CH) Refusal at 44 inches.

Refer to Notes and Legend on separate sheet for additional information. This Record of Test Boring is part of the project Geotechnical Report. Actual strata changes may be gradual over depth



PROJECT: DISL/MBNEP Mon Louis Island

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program **LOCATION:** Refer to boring location plan

ENGINEER: C. Crigler

SAMPLE METHOD: Mon Louis Island, Mobile County, Alabama **TYPE BORING:** Vibracore **DRILLER:** J. Thompson DRILL RIG: Pontoon Vibracore Rig

WATER DEPTH: -3.8 ft.

BORING NO.: SVB-9

PAGE: 1 of 1 **LAT.:** -88.10159 **LONG.:** 30.45012 **DATE:** 04/21/14

WEATHER: ELEVATION: ---

DEPTHY ELEV. 18 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	ENGI	NEEK:											ELE	VAI	ION:				
SAND (SP) SAND (SP) S-2 CLAY (CH) Gray, with trace organics Refusal at 46 inches.	DEPTH/ ELEV.	SYMBOL	SAMPLER	BLOWS	SAMPLE I.D. NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	N	%F	мс	LL	PI	uw	ос	UU	uc	PP	vs	FS
Refusal at 46 inches.	-				S-1		Light brown												
Refusal at 46 inches.	-				S-2	CLAY (CH)	Gray, with trace organics												
	'					OLAT (OII)	Refusal at 46 inches.												
Defeate Nation and Largery as a secret for additional information. This December 17-12 Decimals and 18-12 De																			
	Doford	Notes				on concrete about facilities	ditional information. This De-	0.4 -1.	L	Der'		n.c.:'	06 414	<u> </u>	0.01.0	L	hn:	LDa	

Refer to Notes and Legend on separate sheet for additional information. This Record of Test Boring is part of the project Geotechnical Report. Actual strata changes may be gradual over depth



PROJECT: DISL/MBNEP Mon Louis Island

PROJECT NO.: 13-1101-0242

CLIENT: Mobile Bay National Estuary Program **LOCATION:** Refer to boring location plan

Actual strata changes may be gradual over depth.

ENGINEER: C. Crigler

SAMPLE METHOD: Mon Louis Island, Mobile County, Alabama TYPE BORING: Vibracore **DRILLER:** J. Thompson

DRILL RIG: Pontoon Vibracore Rig

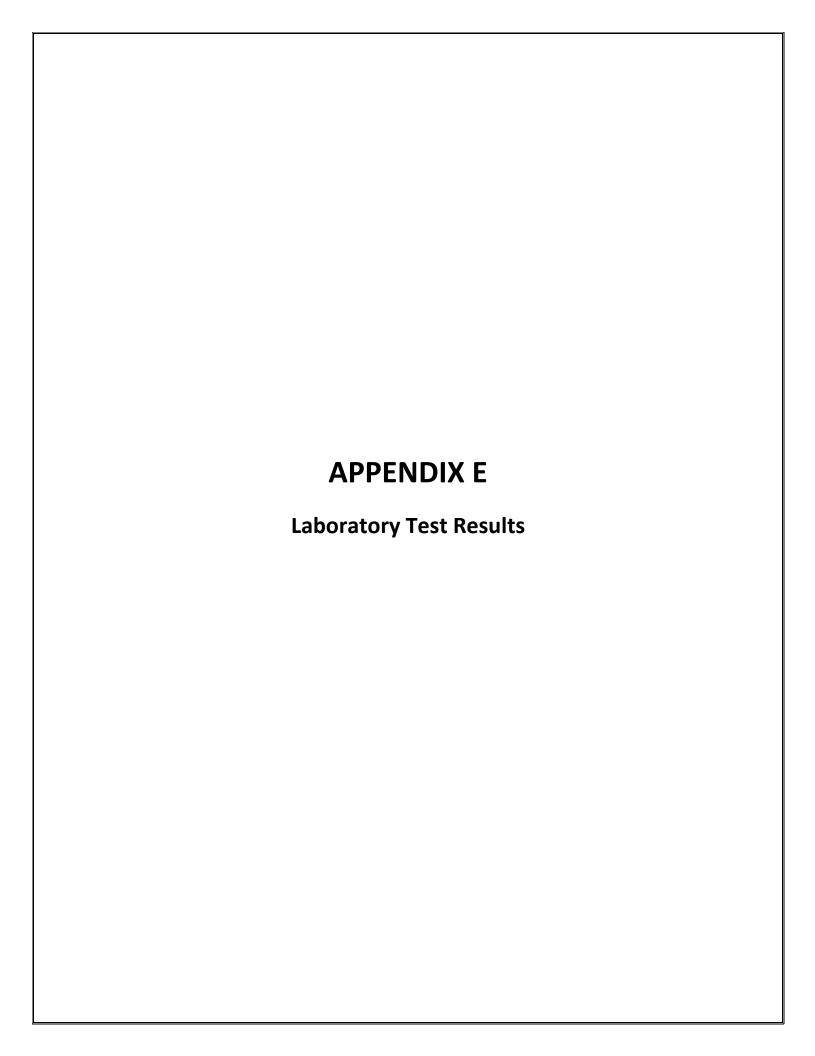
WATER DEPTH: -4.1 ft.

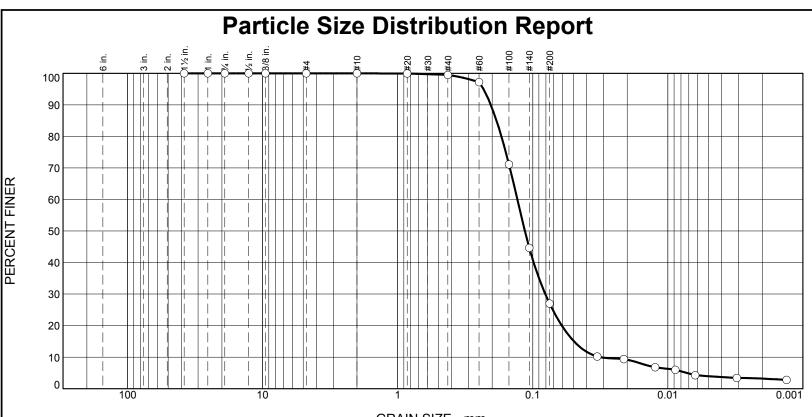
BORING NO.: SVB-10

PAGE: 1 of 1 **LAT.:** -88.10200 LONG.: 30.44857 **DATE:** 04/21/14

WEATHER: FI EVATION: ---

ENGI	NEER:	C. Cr	igler								ELE	VAT	ION:				
DEPTH/ ELEV.	SYMBOL	SPT BLOWS	SAMPLE I.D. NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	N	%F	мс	LL	PI	uw	ос	UU	uc	PP	vs	FS
-			S-1	SLIGHTLY SILTY SAND (SP-SM)	Gray												
2-			S-2	SANDY CLAY (CL)	Gray, with sand lenses												
4_			S-3	SILTY SAND (SM)	Gray												
					Refusal at 48 inches.												
Deferte	Notes	and I c	gend	on congrete cheet for a	ditional information. This Rec	ord of	Toot	Bori-	ng is	DO"	of the	nro:	oct Ca	notos!	onico	I Da	nort.





GRAIN SIZE - mm.										
% +3"	% Gı	ravel		% Sand		% Fines				
76 T3	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay			
0.0	0.0	0.0	0.0	0.5	72.5	23.1	3.9			

	TEST RE	SULTS	
Opening	Percent	Spec.*	Pass?
Size	Finer	(Percent)	(X=Fail)
1.5	100.0		
1.0	100.0		
.75	100.0		
.50	100.0		
.375	100.0		
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.5		
#60	97.2		
#100	71.1		
#140	44.7		
#200	27.0		
0.0333 mm.	10.2		
0.0212 mm.	9.3		
0.0124 mm.	6.8		
0.0088 mm.	5.9		
0.0063 mm.	4.2		
0.0031 mm.	3.4		
0.0013 mm.	2.8		

Material Description								
Fine grained, light	Fine grained, light brown, SILTY SAND							
<u>A1</u> PL=	terberg Limits (AST	M D 4318) PI=						
PL-								
HCCC (D 0407)-	Classification							
USCS (D 2487)=) (M 145)=						
D 0.2042	<u>Coefficients</u>							
D₉₀= 0.2043 D₅₀= 0.1143 D₁₀= 0.0319	D ₈₅ = 0.1854	D₆₀= 0.1300 D₁₅= 0.0495 C_c= 1.57						
D ₁₀ = 0.0319	D ₃₀ = 0.0808 C _u = 4.08	$C_c = 1.57$						
- -	Remarks	-						
	Kemarks							
Date Received:	Date	Tested: 4/18/14						
Tested By:								
•								
_	Checked By: C. Dugger							
Title: Materials Engineering Lab								

Source of Sample: MB-3 Sample Number: S-2 Depth: 5.0 Date Sampled:

Thompson Engineering

Mobile, Alabama

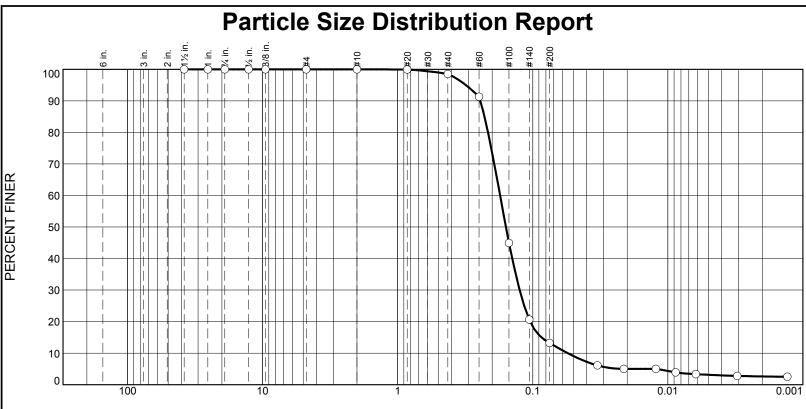
Client: Mobile Bay National Estuary ProgramProject: DISL/MBNEP Mon Louis Island

Mon Louis Island, Mobile County, Alabama

With Eduis Island, Woone County, Madama

Project No: 13-1101-0242 **Figure**

⁽no specification provided)



0/ ₄ +3"	% G	ravel		% Sand		% Fines			
76 +3	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay		
0.0	0.0	0.0	0.0	1.5	85.3	10.1	3.1		

PL=

	TEST R	ESULTS	
Opening	Percent	Spec.*	Pass?
Size	Finer	(Percent)	(X=Fail)
1.5	100.0		
1.0	100.0		
.75	100.0		
.50	100.0		
.375	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	98.5		
#60	91.3		
#100	44.9		
#140	20.6		
#200	13.2		
0.0332 mm.	6.1		
0.0212 mm.	5.0		
0.0123 mm.	5.0		
0.0087 mm.	3.9		
0.0062 mm.	3.3		
0.0031 mm.	2.8		
0.0013 mm.	2.5		
* .			

Material Description Fine grained, light gray, SILTY SAND

Atterberg Limits (ASTM D 4318)

LL= PI=

Classification

USCS (D 2487)= SM AASHTO (M 145)=

Remarks

Date Received: Date Tested: 4/18/14

Tested By: B. Hak

Checked By: C. Dugger

Title: Materials Engineering Lab

(no specification provided)

Source of Sample: MB-3 Sample Number: S-3 Depth: 10.0 Date Sampled:

Thompson Engineering

Client: Mobile Bay National Estuary ProgramProject: DISL/MBNEP Mon Louis Island

Mon Louis Island, Mobile County, Alabama

Mobile, Alabama

Project No: 13-1101-0242 **Figure**



January 17, 2014

CLIENT: Mobile Bay National Estuary Program JOB #: 13-1101-0242 PROJECT: DISL/MBNEP - Mon Louis Island LAB #: 6931

REPORT OF: LABORATORY MOTORIZED VANE SHEAR TEST - ASTM D 4648

SAMPLE I.D.	SAMPLE DESCRIPTION	VANE SHEAR STRENGTH (PSF) UNDISTURBED	VANE SHEAR STRENGTH (PSF) RE-MOLDED
B-4 T-1 10.0'-12.0'	Dark gray, CLAY	260	176
B-4 T-2 15.0'-17.0'	Dark gray, CLAY	189	134
B-4 T-3 20.0'-22.0'	Dark gray, CLAY	290	184
B-4 T-4 25.0'-27.0'	Gray, CLAY	180	146
B-5 T-1 10.0'-12.0'	Dark gray, CLAY	205	113
B-5 T-2 20.0'-22.0'	Gray, CLAY	49	32
B-5 T-3 25.0'-27.0'	Dark gray, CLAY	108	113

Chris Dugger

MATERIALS ENGINEERING LABORATORY



CLIENT: Mobile Bay National Estuary Program JOB #: 13-1101-0242

PROJECT: DISL/MBNEP - Mon Louis Island LAB #: 6931

REPORT OF: MOISTURE, ASH, AND ORGANIC MATTER OF PEAT AND OTHER ORGANIC SOILS ASTM D 2974

SAMPLE IDENTIFICATION: MD-2 S-2

DATES TECHNICIAN

SAMPLED: SAMPLED: J. Thompson TESTED: 1/6/2014 TESTED: R.BYRD

>>>> LABORATORY RESULTS <<<<

MOISTURE CONTENT:	
TARE WEIGHT(g):	19.29
TARE AND WET WEIGHT(g):	59.68
TARE AND DRY WEIGHT(g):	30.66
OVEN-DRIED MOISTURE CONTENT (%):	255.2

TARE WEIGHT(g):	11.9100
TARE WT. AND DRIED SAMPLE AT 110 DEGREES CENTIGRADE (g):	21.1300
TARE WT. AND ASHED SAMPLE AT 440 DEGREES CENTIGRADE (g):	18.7600
SPECIMEN DRIED WEIGHT AT 110 DEGREES CENTIGRADE (g):	9.2200
SPECIMEN ASHED WEIGHT AT 440 DEGREES CENTIGRADE (g):	6.8500
LOSS ON IGNITION AT 440 DEGREES CENTIGRADE (g):	2.3700
PERCENTAGE OF ASH "UNBURNED MATTER"	74.30
PERCENTAGE OF ORGANIC MATTER (%):	25.70

Chris Dugger

MATERIALS ENGINEERING LABORATORY



CLIENT: Mobile Bay National Estuary Program JOB #: 13-1101-0242

PROJECT: DISL/MBNEP - Mon Louis Island LAB #: 6931

REPORT OF: MOISTURE, ASH, AND ORGANIC MATTER OF PEAT AND OTHER

ORGANIC SOILS ASTM D 2974

SAMPLE IDENTIFICATION: MD-4 S-1

DATES TECHNICIAN

SAMPLED: SAMPLED: J. Thompson TESTED: 1/6/2014 TESTED: R.BYRD

>>>> LABORATORY RESULTS <<<<

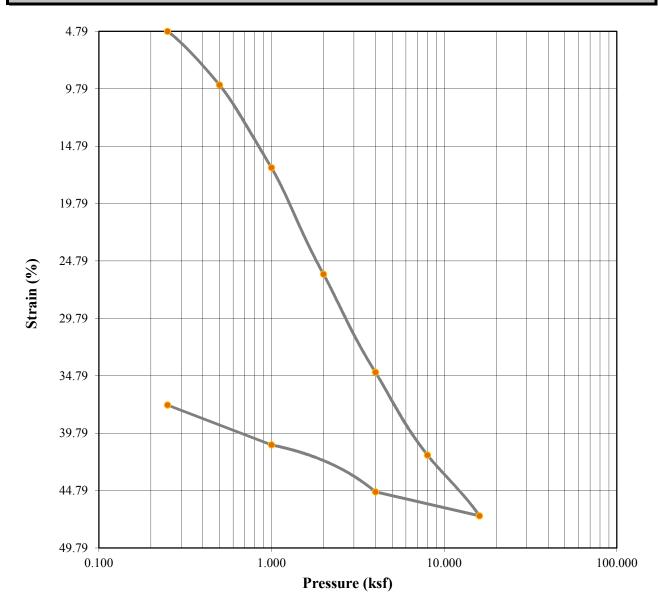
IMOISTURE CONTENT:	
TARE WEIGHT(g):	18.28
TARE AND WET WEIGHT(g):	70.26
TARE AND DRY WEIGHT(g):	50.57
OVEN DDIED MOISTI DE CONTENT (%):	61.0

TARE WEIGHT(g):	12.5700
TARE WT. AND DRIED SAMPLE AT 110 DEGREES CENTIGRADE (g):	25.2900
TARE WT. AND ASHED SAMPLE AT 440 DEGREES CENTIGRADE (g):	24.8000
SPECIMEN DRIED WEIGHT AT 110 DEGREES CENTIGRADE (g):	12.7200
SPECIMEN ASHED WEIGHT AT 440 DEGREES CENTIGRADE (g):	12.2300
LOSS ON IGNITION AT 440 DEGREES CENTIGRADE (g):	0.4900
PERCENTAGE OF ASH "UNBURNED MATTER"	96.15
PERCENTAGE OF ORGANIC MATTER (%):	3.85

Chris Dugger

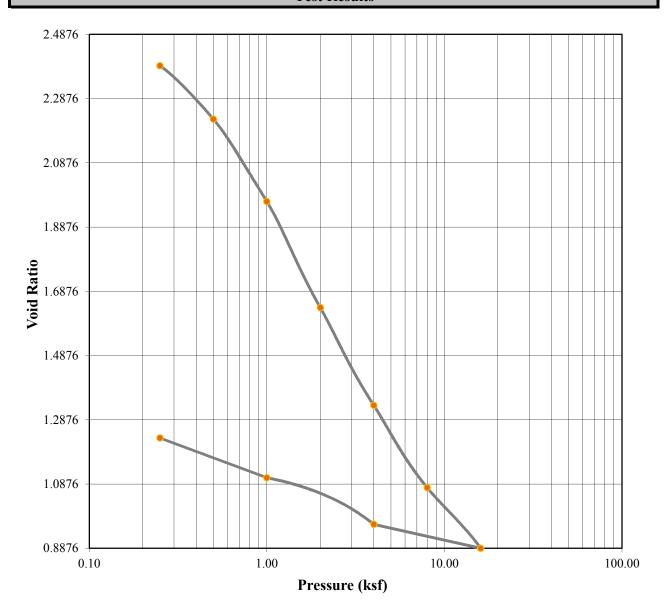
MATERIALS ENGINEERING LABORATORY





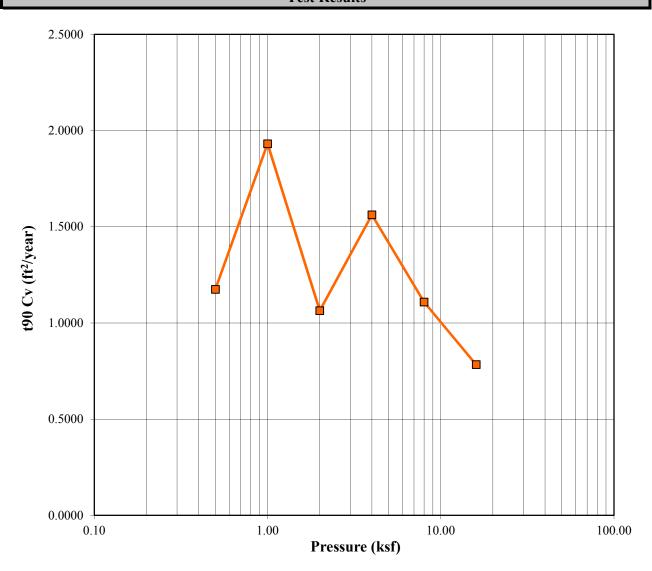
		Before	After	Liquid Limits:	137	Test Date:	1-6-14
Moisture (%):		99.49	47.79	Plastic Limits:	32		
Dry Density (pe	cf):	46.55	75.33	Plasticity Index (%):	105		
Saturation (%)):	103.09	105.54				
Void Ratio:		2.5603	1.2310	Specific Gravity:	2.660	Assumed	
Sample Descrip	otion:	Dark Gray Cla	ıy (CH)				
Project Numbe	er:	Lab - 6931		Depth: 10.0-12.0 ft.	Remarks:		
Sample Number	er:	T-1	Borii	ng Number: MB-4			
Project: DISL/MBNEP - Mon Louis Island							
Client:	Mobile Bay N	Nat'l Estuary					
Location:	Soils Lab						





		Before	After	Liquid Limits:	137	Test Date:	1-6-14
Moisture (%):		99.49	47.79	Plastic Limits:	32		
Dry Density (po	ef):	46.55	75.33	Plasticity Index (%):	105		
Saturation (%)	:	103.09	105.54				
Void Ratio:		2.5603	1.2310	Specific Gravity:	2.660	Assumed	
Soil Description	n:	Dark Gray Cla	ay (CH)				
Project Numbe	r:	Lab - 6931		Depth: 10.0-12.0 ft.	Remarks:		
Sample Numbe	er:	T-1	Borii	ng Number: MB-4			
Project:	DISL/MBNE	P - Mon Louis	Island				
Client:	Mobile Bay N	lat'l Estuary					
Location:	Soils Lab						

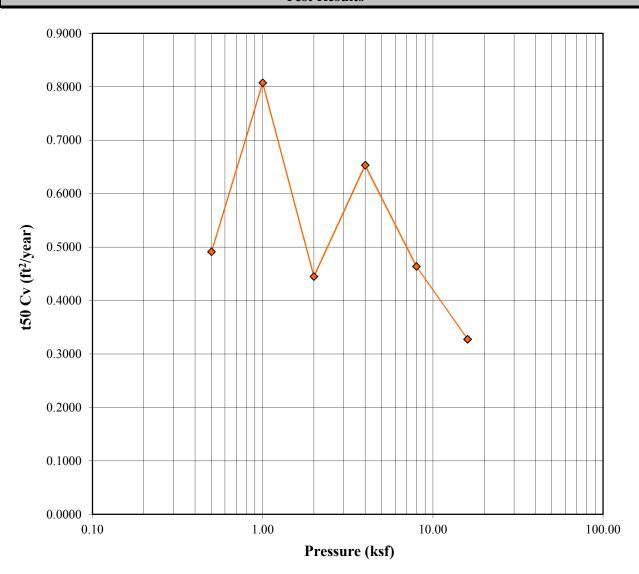






		Before	After	Liquid Limits:	137	Test Date:	1-6-14
Moisture (%):		99.49	47.79	Plastic Limits:	32		
Dry Density (p	ocf):	46.55	75.33	Plasticity Index (%):	105		
Saturation (%):	103.09	105.54				
Void Ratio:		2.5603	1.2310	Specific Gravity:	2.660	Assumed	
Soil Description	n:	Dark Gray Cla	ıy (CH)				
Project Numb	er:	Lab - 6931		Depth: 10.0-12.0 ft.	Remarks:		
Sample Numb	er:	T-1	Borin	ng Number: MB-4			
Project:	DISL/MBNI	EP - Mon Louis	Island				
Client:	Mobile Bay	Nat'l Estuary					
Location:	Soils Lab						

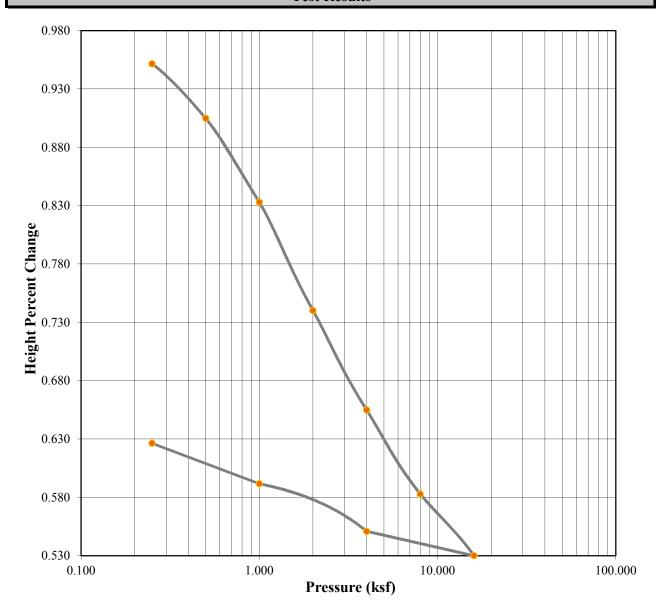






		Before	After	Liquid Limits:	137	Test Date:	1-6-14
Moisture (%)	:	99.49	47.79	Plastic Limits:	32		
Dry Density (pcf):	46.55	75.33	Plasticity Index (%):	105		
Saturation (%	6):	103.09	105.54				
Void Ratio:		2.5603	1.2310	Specific Gravity:	2.660	Assumed	
Soil Descripti	on:	Dark Gray Clay	y (CH)				
Project Numb	er:	Lab - 6931		Depth: 10.0-12.0 ft.	Remarks:		
Sample Numl	ber:	T-1	Borir	ng Number: MB-4	<u> </u>		
Project:	DISL/M	BNEP - Mon Louis	Island				
Client:	Mobile I	Bay Nat'l Estuary					
Location:	Soils La	b					





		Before	After	Liquid Limits:	137	Test Date:	1-6-14
Moisture (%):		99.49	47.79	Plastic Limits:	32		
Dry Density (p	cf):	46.55	75.33	Plasticity Index (%):	105		
Saturation (%)):	103.09	105.54				
Void Ratio:		2.5603	1.2310	Specific Gravity:	2.660	Assumed	
Soil Descriptio	n:	Dark Gray Cla	ıy (CH)				
Project Number	er:	Lab - 6931		Depth: 10.0-12.0 ft.	Remarks:		
Sample Number	er:	T-1	Borii	ng Number: MB-4			
Project:	DISL/MBNE	P - Mon Louis	Island				
Client:	Mobile Bay N	Nat'l Estuary					
Location:	Soils Lab						



Consolidation Test Results Summary

Project: DISL/MBNEP - Mon Louis Island **Project Number:** Lab - 6931

Location: Soils Lab

Job Number: 13-1101-0242

Sample Number:T-1Sample Description:Boring Number:MB-4Dark Gray Clay (CH)

Depth: 10.0-12.0 ft. Remarks: Test Number:

Sample Type: Undisturbed Test Date: 1-6-14

Index	Load Sequence (ksf)	Cummulative Change in Height (in)	Specimen Height (in)	Height of Void (in)	Vertical Strain (%)	Void Ratio	t90 Fitting Time (min)	t50 Fitting Time (min)	t90 Cv (ft2/year)	t50 Cv (ft2/year)
0	0.000	0.0000	0.9990	0.7184	0.00	2.5607	0.000	0.000	0.000	0.000
1	0.250	0.0479	0.9511	0.6705	4.79	2.3900	0.000	0.000	0.000	0.000
2	0.500	0.0946	0.9044	0.6239	9.47	2.2236	538.708	* 299.2822	1.175	0.491
3	1.000	0.1665	0.8325	0.5519	16.67	1.9673	277.682	* 154.2676	1.931	0.808
4	2.000	0.2592	0.7398	0.4593	25.94	1.6369	398.006	* 221.1147	1.064	0.445
5	4.000	0.3444	0.6546	0.3740	34.48	1.3330	212.186	* 117.8810	1.562	0.653
6	8.000	0.4165	0.5825	0.3019	41.69	1.0761	236.710	* 131.5055	1.109	0.464
7	16.000	0.4694	0.5296	0.2490	46.99	0.8876	277.021	* 153.9006	0.783	0.328
8	4.000	0.4485	0.5505	0.2699	44.90	0.9621	0.000	0.000	0.000	0.000
9	1.000	0.4077	0.5913	0.3107	40.81	1.1075	0.000	0.000	0.000	0.000
10	0.250	0.3730	0.6260	0.3454	37.34	1.2312	0.000	0.000	0.000	0.000

Predicted value indicated with *

Tested By: B. Hak

Checked By: C. Dugger



Consolidation Test Consolidation Specimen Information

Project: DISL/MBNEP - Mon Louis Island Project Number: Lab - 6931

Location: Soils Lab

Job Number: 13-1101-0242 **Test Date:** 1-6-14

Sample Number:T-1Sample Description:Boring Number:MB-4Dark Gray Clay (CH)

Depth: 10.0-12.0 ft. **Remarks:**

Sample Type: Undisturbed

Test Number:

Liquid Limit:137.0000Initial Void Ratio:2.5603Initial Height (in):0.9990Plastic Limit:32.0000Plasticity Index (%):105.0000Initial Diameter (in):2.5010

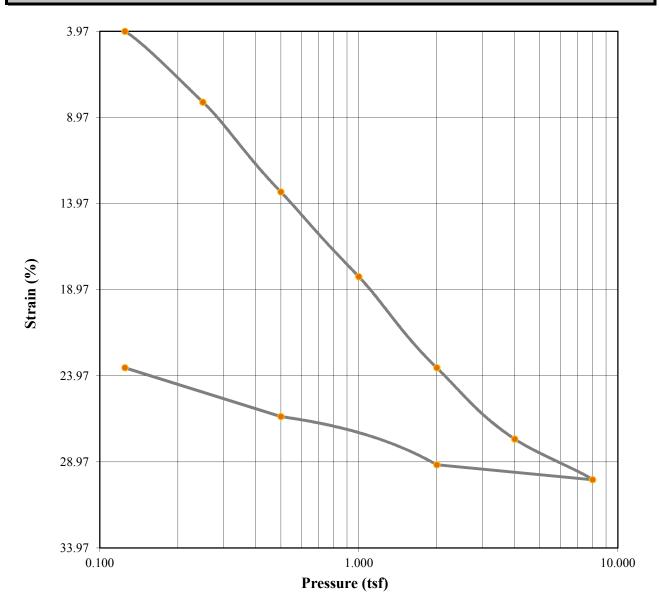
Specific Gravity: 2.6600 Weight of Ring (g): 110.7600

Assumed

Parameters	Initial Specimen	Final Specimen
Moist Weight + Container (g)	110.05	202.94
Dry Soil + Container (g)	70.73	174.02
Weight of Container (g)	31.21	113.50
Moisture Content (%)	99.49	47.79
Void Ratio	2.5603	1.2310
Saturation (%)	103.09	105.54
Dry Density (pcf)	46.55	75.33

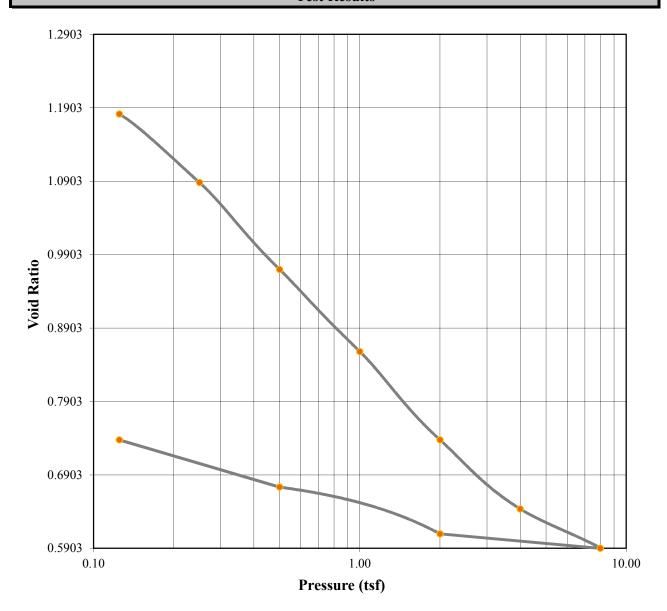
Tested By: B. Hak Checked By: C. Dugger





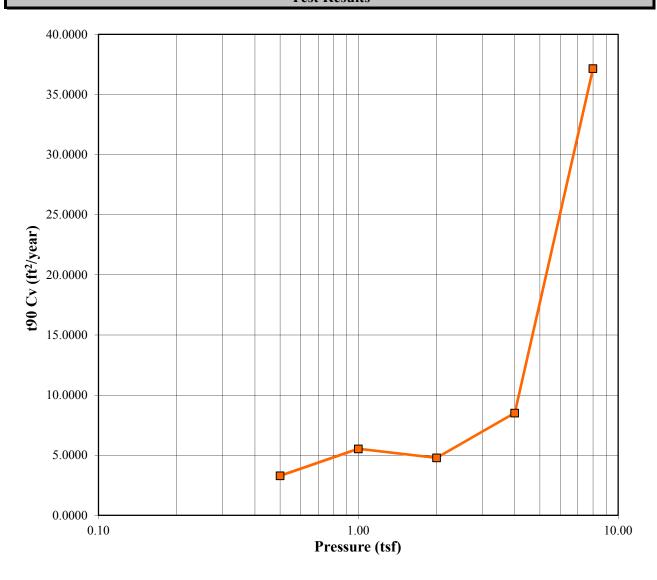
	Before	After	Liquid Limits:	108	Test Date:	1-15-14
Moisture (%):	43.11	41.13	Plastic Limits:	26		
Dry Density (pcf):	72.68	83.37	Plasticity Index (%):	82		
Saturation (%):	89.51	110.73				
Void Ratio:	1.2709	0.7370	Specific Gravity:	2.650	Assumed	
Sample Description	n: Dark Gray Cl	ay (CH)				
Project Number:	Lab# 6931		Depth: 25.0-27.0 ft.	Remarks:		
Sample Number:	T-3	Borin	ng Number: MB-5			
Project: DIS	SL/MBNEP - Mon Louis					
Client: Mo	bile Bay Nat'l Estuary					
Location: Soi	ls Lab					

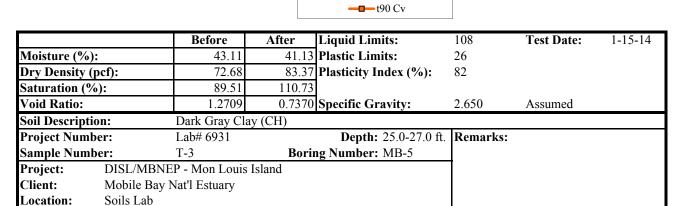




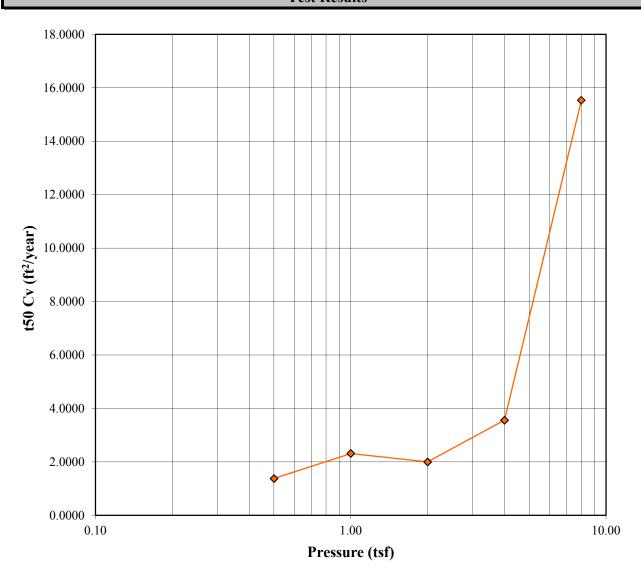
		Before	After	Liquid Limits:	108	Test Date:	1-15-14
Moisture (%):		43.11	41.13	Plastic Limits:	26		
Dry Density (p	ocf):	72.68	83.37	Plasticity Index (%):	82		
Saturation (%):	89.51	110.73				
Void Ratio:		1.2709	0.7370	Specific Gravity:	2.650	Assumed	
Soil Description	n:	Dark Gray Cla	ıy (CH)				
Project Number	er:	Lab# 6931		Depth: 25.0-27.0 ft.	Remarks:		
Sample Numb	er:	T-3	Borii	ng Number: MB-5			
Project:	DISL/MBNE	P - Mon Louis	Island				
Client: Mobile Bay N		Nat'l Estuary					
Location:	Soils Lab						







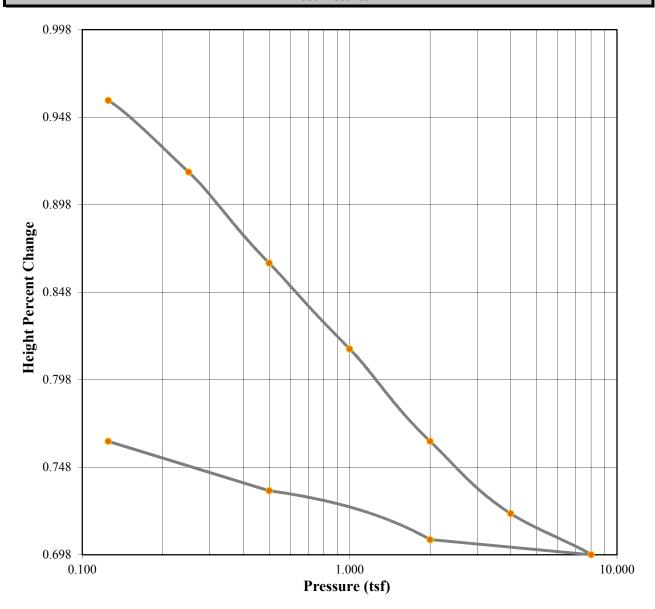






		Before	After	Liquid Limits:	108	Test Date:	1-15-14
Moisture (%)	:	43.11	41.13	Plastic Limits:	26		
Dry Density (pcf):	72.68	83.37	Plasticity Index (%):	82		
Saturation (%	b):	89.51	110.73				
Void Ratio:		1.2709	0.7370	Specific Gravity:	2.650	Assumed	
Soil Descripti	on:	Dark Gray Cla	y (CH)				
Project Numb	er:	Lab# 6931		Depth: 25.0-27.0 ft.	Remarks:		
Sample Numb	er:	T-3	Borir	ng Number: MB-5	<u> </u>		
Project:	DISL/ME	BNEP - Mon Louis	Island				
Client:	Mobile B	ay Nat'l Estuary					
Location:	Soils Lab						





		Before	After	Liquid Limits:	108	Test Date:	1-15-14
Moisture (%):		43.11	41.13	Plastic Limits:	26		
Dry Density (p	ocf):	72.68	83.37	Plasticity Index (%):	82		
Saturation (%):	89.51	110.73				
Void Ratio:		1.2709	0.7370	Specific Gravity:	2.650	Assumed	
Soil Description	n:	Dark Gray Cla	ıy (CH)				
Project Numb	er:	Lab# 6931		Depth: 25.0-27.0 ft.	Remarks:		
Sample Numb	er:	T-3	Borii	ng Number: MB-5	1		
Project:	DISL/MBNEP - Mon Louis Island						
Client:	Mobile Bay N	Nat'l Estuary					
Location:	Soils Lab						



Consolidation Test Results Summary

Project: DISL/MBNEP - Mon Louis Island **Project Number:** Lab# 6931

Location: Soils Lab

Job Number: 13-1101-0242

Sample Number:T-3Sample Description:Boring Number:MB-5Dark Gray Clay (CH)

Depth: 25.0-27.0 ft. Remarks: Test Number:

Sample Type: Undisturbed Test Date: 1-15-14

Index	Load Sequence (tsf)	Cummulative Change in Height (in)	Specimen Height (in)	Height of Void (in)	Vertical Strain (%)	Void Ratio	t90 Fitting Time (min)	t50 Fitting Time (min)	t90 Cv (ft2/year)	t50 Cv (ft2/year)
0	0.000	0.0000	0.9970	0.5582	0.00	1.2722	0.000	0.000	0.000	0.000
1	0.125	0.0396	0.9574	0.5186	3.97	1.1819	0.000	0.000	0.000	0.000
2	0.250	0.0806	0.9164	0.4776	8.08	1.0885	0.000	0.000	0.000	0.000
3	0.500	0.1326	0.8644	0.4257	13.30	0.9701	175.685	* 97.6025	3.291	1.376
4	1.000	0.1816	0.8154	0.3766	18.22	0.8583	93.033	* 51.6848	5.530	2.312
5	2.000	0.2344	0.7626	0.3238	23.51	0.7380	94.188	* 52.3269	4.778	1.998
6	4.000	0.2757	0.7213	0.2826	27.65	0.6439	47.294	* 26.2743	8.513	3.560
7	8.000	0.2992	0.6978	0.2590	30.01	0.5903	10.141	* 5.6341	37.155	15.537
8	2.000	0.2905	0.7065	0.2677	29.14	0.6100	0.000	0.000	0.000	0.000
9	0.500	0.2626	0.7344	0.2956	26.34	0.6737	0.000	0.000	0.000	0.000
10	0.125	0.2344	0.7626	0.3238	23.51	0.7380	0.000	0.000	0.000	0.000

Predicted value indicated with *

Tested By: B. Hak

Checked By: C. Dugger



Consolidation Test Consolidation Specimen Information

Project: DISL/MBNEP - Mon Louis Island Project Number: Lab# 6931

Location: Soils Lab

Job Number: 13-1101-0242 **Test Date:** 1-15-14

Sample Number:T-3Sample Description:Boring Number:MB-5Dark Gray Clay (CH)

Depth: 25.0-27.0 ft. **Remarks:**

Sample Type: Undisturbed

Test Number:

Liquid Limit:108.0000Initial Void Ratio:1.2709Initial Height (in):0.9970Plastic Limit:26.0000Plasticity Index (%):82.0000Initial Diameter (in):2.4990

Specific Gravity: 2.6500 Weight of Ring (g): 110.7600

Assumed

Parameters	Initial Specimen	Final Specimen
Moist Weight + Container (g)	139.12	469.78
Dry Soil + Container (g)	106.62	436.33
Weight of Container (g)	31.23	355.00
Moisture Content (%)	43.11	41.13
Void Ratio	1.2709	0.7370
Saturation (%)	89.51	110.73
Dry Density (pcf)	72.68	83.37

Tested By: B. Hak **Checked By:** C. Dugger