BS-24
Terracing and Marsh Creation
South of Big Mar
Preliminary Design Report

Prepared By:
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May 2016

PRELIMINARY DESIGN REPORT

Terracing and Marsh Creation South of Big Mar (BS-24)
Plaquemines Parish, Louisiana

May 2016

Prepared for:

Natural Resources Conservation Service
3737 Government Street
Alexandria, La 71302

Attention: Ms. Vicki Supler, Contracting Officer

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CIVIL ENGINEERING AND LAND SURVEYING CONSULTANTS

Table of Contents

APPENDICES

PRELIMINARY DESIGN REPORT
(BS-24) TERRACING AND MARSH SOUTH OF BIG MAR

PROJECT OVERVIEW AND UNDERSTANDING

Through the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA), the Natural Resources Conservation Service (NRCS) is proposing to construct approximately 65,000 linear feet of shallow water earthen terraces and create approximately 334 acres of intermediate marsh in the Breton Sound region, south of Big Mar and west of Lake Lery. See Figure 1.1 below.

Figure 1.1 – Project location

Over the last eighty years, approximately 14,300 acres of vegetated marsh have converted into open water lakes as a result of scouring caused by wave action, subsidence and sea-level rise (referred to herein as relative sea-level rise (RSLR)), and tropical storms and hurricanes. The proposed terraces will not only create a platform for vegetation growth within the marsh, but also reduce wave fetch in these large open water areas. Terraces will also reduce the flow velocity of water entering the project site from the Caernarvon Diversion structure, resulting in increased

sediment deposits within the area. The 334 acres of marsh created by this project will establish a healthy marsh platform conducive to facilitating the growth of submerged aquatic vegetation (SAVs) and other marsh vegetation. This marsh area will also help reinforce the newly constructed western rim of Lake Lery. The design life of the BS-24 project is twenty years, implying that the terraces and marsh creation features will need to provide a suitable platform at, slightly above, marsh elevation for a duration of twenty years after construction has been completed.

DESIGN LIMITATIONS

All calculations performed for the purpose of this report are based on the topographic and bathymetric survey data collected at various times by T. Baker Smith, LLC, NRCS, and Lonnie Harper & Associates, Inc. (LHA) over the last 2.5 years and the recommendations specified in the associated geotechnical investigation reports prepared by GeoEngineers, Inc. The project site is located in an environmentally sensitive area, where site conditions have a tendency to change over fairly short periods of time. The values expressed herein are approximate in nature and will likely vary (significantly in some instances) from the conditions in the field that will exist at the time of construction.

SITE ACCESS

The BS-24 project site(s) will be accessed by traversing across Lake Lery along the predetermined access route shown in Appendix A using marine based equipment. An access channel will be cut through the newly restored lake rim, adjacent to the marsh creation area (MCA), to gain access to the interior marsh to allow for the construction of terraces and the MCA. The access channel is planned to have a maximum bottom width of approximately 60 feet and bottom elevation of -7.00 feet NAVD 88 to provide flotation clearance during the construction phase. The presence of this access channel will affect the means and methods employed by the contractor

during construction as well as result in some additional features to be implemented in order to complete the project. These items will be discussed later in this report.

SELECTED ALTERNATIVE FEATURES

In April 2016, Lonnie G. Harper & Associates, Inc. (LHA) submitted an Alternatives Features Report to the NRCS outlining various alternatives that would potentially meet the goals of the BS-24 project based on the recommendations specified in the geotechnical investigation reports prepared by GeoEngineers, Inc. The marsh creation and terrace designs outlined herein are based solely on the recommended cross-sections, estimated consolidation/settlement calculations, and slope stability analyses performed by GeoEngineers, Inc.

Terrace Design:

After reviewing the design alternatives submitted, the NRCS selected the terrace design "Option 1", which consists of approximately 69,000 linear feet of shallow water earthen terraces configured in a traditional chevron pattern (duck-wing pattern). The terraces will be distributed throughout two terrace cells, referred to a Cell 4 and Cell 2B. Cells 1 and 2 originally planned to facilitate terrace construction had to be omitted from the project due to site access limitations resulting from the presence of shallow lying pipelines in these areas. Cells 4 and 2B are depicted in the figure 1.2 below.

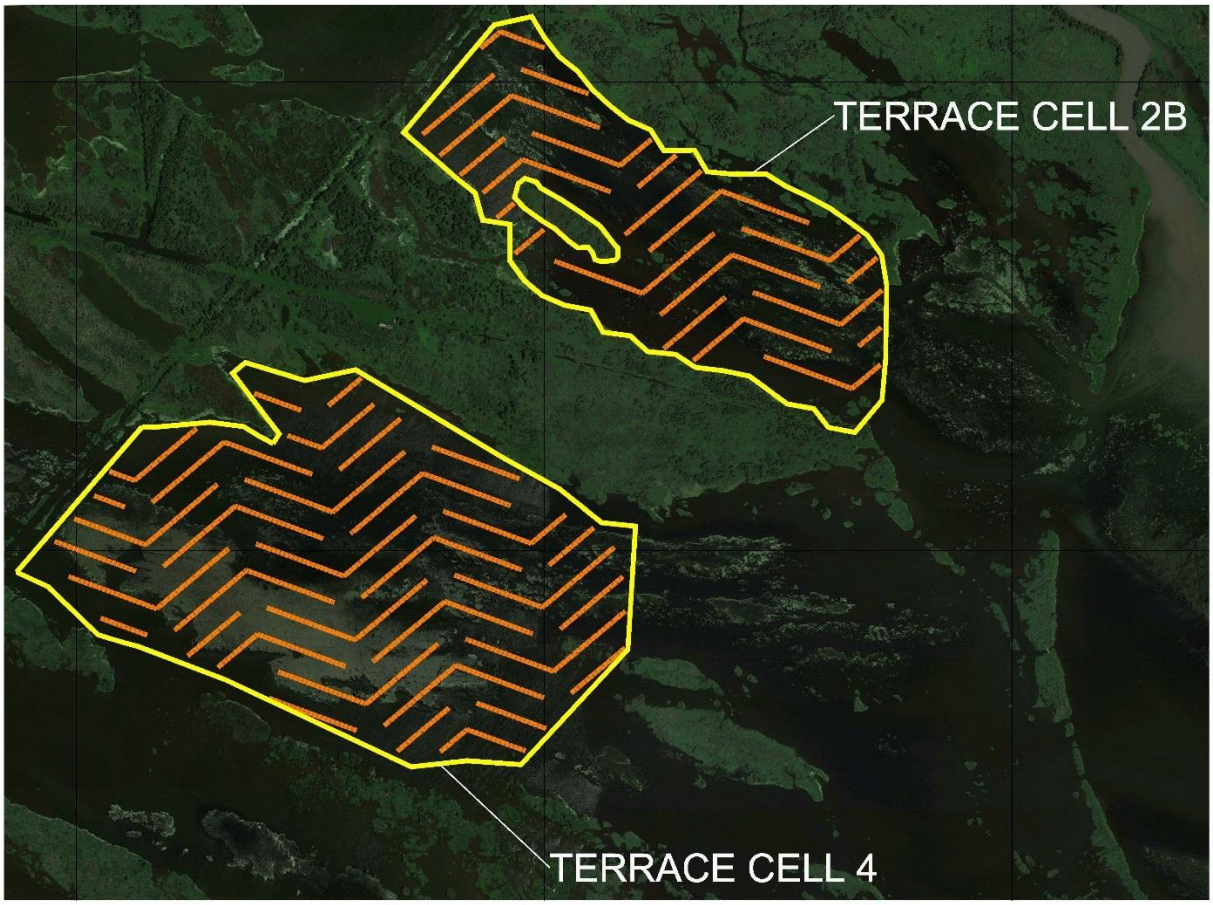

Figure 1.2 – Terrace Cells 2B and 4

The proposed terraces have a top width of fifteen (15) feet and will be built to an elevation of +4.75 feet NAVD 88, Geoid 12A, with side slopes of 5 horizontal to 1 vertical (5H:1V). Berm widths are currently planned to be thirty-five (35) feet in width to provide adequate slope stability and construction space for marine-based construction equipment. See Figure 1.3 below. Any construction equipment placed on the berm shall maintain a fifteen (15) feet wide (minimum) buffer zone between the equipment and the toe of the terrace. No construction equipment will be allowed to occupy the space within the buffer zone at any time during construction.

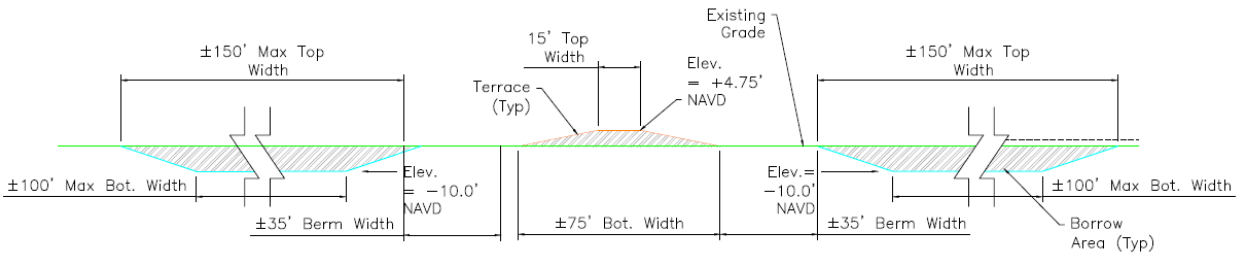

Figure 1.3 – Typical Terrace Cross-Section

It should be noted that GeoEngineers recommended a berm width of twenty-five (25) feet; however, the NRCS has requested that an additional ten (10) feet be added to create a larger buffer zone. Given the geometric design of the terrace and the limited reach capabilities of a marsh machine, it is apparent that the terraces cannot be constructed efficiently with a traditional marsh machine excavator. Draglines mounted on barges will likely be the most effective means of constructing these terraces to the lines and grades specified. Based on the workable reach capabilities of a dragline and geometric characteristics of the terraces and berms, it is likely that a minimum boom length of 200 feet will be required to construct the proposed terraces. [For reference, the workable reach of a dragline is measured horizontally from the center of the machine outward to the end of the boom, with the boom at an angle of 40 degrees from vertical. (e.g. 200 x sin(40) =128.5 feet of reach)] Lesser boom lengths will likely reduce the machine's effectiveness to complete the work.

As a result of using barge mounted draglines for this work, the NRCS has questioned the possibility of reducing the berm width between the terrace and borrow source considering only the slope stability requirements without the equipment surcharge loading conditions. Our firm's experience in working with draglines building levees and/or terraces in the marsh has proven that it is nearly impossible to provide a clean, dressed side slope on earthen features using a dragline, especially one of the size required for this work. If the NRCS is requiring the side slopes of the

terraces to be uniform in shape and provide a nice, smooth finished cross-section, then it is likely that a marsh machine will be needed to perform the final dressing of all terrace side slopes. As a result, the thirty-five feet wide berm would be required such that the smaller equipment can gain access to the terraces. The dragline should be capable of providing a relatively flat surface along the terrace top, within a tolerance of ±0.5 feet of the required grade. LHA feels that a tolerance of ±0.5 feet is acceptable considering the nature and location of the work, type of equipment to be used, and the quality of the soil material.

If the NRCS does not require clean, uniform side slopes on the terraces, then LHA will consult with GeoEngineers, Inc. to determine if the berm width can be reduced such that a shorter boom can be used for construction. The use of a shorter boom will likely allow for more competitive bidding; as not many contractors possess booms 200 feet in length. Furthermore, shorter booms may allow for more efficient construction practices by allowing more material to be placed per placement cycle. (i.e., Shorter booms can lift more weight.) It should be noted that the berm width would have to be reduced by nearly sixty (60) percent to allow for construction with a boom length of 150 feet, which would still only reach to the approximate centerline of the terrace.

Terrace Layout and Volume Calculation:

LHA has taken the proposed terrace configuration consisting of approximately 69,000 linear feet of terraces spaced at 300 feet intervals measured between centerlines, and begun developing preliminary three-dimensional models depicting the existing water bottom overlaid with the proposed construction template. A site plan of Cells 4 and 2B are included in Appendix A. Based on the configuration shown in Appendix A, LHA has calculated the total length of

terraces per cell as well as the corresponding fill volume (in-place measure) required to build the terraces and the amount of borrow material available for construction. See Table 1.1 below.

Table 1.1 – Preliminary Terrace Construction Quantity Summary

Terrace Cell Area	Total length of Terrace, LF	Fill Volume Required, yd^3	Fill Volume Available, yd^3
Cell 4	46,329	437,509	1,718,156
Cell 2B	23,548	244,507	745,396
Total	69,877	682,016	2,463,552

These fill volumes reflect the volume needed to meet the construction template that will be displayed in the construction drawings, but does not account for the construction settlement of the underlying in-situ soils that will occur immediately during construction. According to the geotechnical report, the estimated construction settlement of the underlying in-situ soils will range between 1 to 4 inches. LHA has chosen the more conservative amount of 4 inches, resulting in increased fill volume of approximately 10 percent, or approximately 68,202 cubic yards (750,218 cubic yards total) required to meet the construction template. The volumes expressed herein do not account for any losses resulting from the handling of the material. It is possible that approximately 20 to 30 percent of the material will be lost during placement due to the nature of the material and the means and methods employed by the construction contractor.

Marsh Creation Area Design:

As part of the BS-24 project scope, LHA has been tasked with designing a 334-acre MCA in the interior marsh complex adjacent to the western shoreline of Lake Lery. Spoil material will be hydraulically dredged from a predetermined borrow source located on the western side of Lake Lery and pumped to the MCA shown in Appendix A. LHA's scope of work required alternative designs to be developed and presented to the NRCS and associated agencies, from which they would review and select the most desirable method. During the alternative design phase it was

stipulated by the NRCS that separating the MCA cell into smaller cells for the purpose of making the work more manageable during construction should be determined by the construction contractor as part of their means and methods. The location of the dewatering structures and the size of the dredge would also be determined by the construction contractor. Based on the recommendations outlined in the geotechnical report, the containment dike design(s) were already determined along with the estimated settlement rates; thus limiting LHA's ability to provide a variety of design alternatives. As a result, LHA compiled all the available survey and geotechnical data, incorporated the various stipulations set by the NRCS, and developed a design that would satisfy the requirements of each. The long-term goal of the BS-24 MCA feature is to construct a MCA such that the target marsh platform elevation of +1.0 feet NAVD 88, Geoid12A be realized and maintained through a period of 20 years.

Marsh Platform Elevation Determination:

Based on the estimated settlement rates provided in the geotechnical report, it was agreed upon by the NRCS and the USFWS that the constructed elevation of the MCA should be set at +3.25 feet NAVD 88 and allow for an overbuild of up to 0.5 feet. This value accounts for consolidation settlement only. Elastic settlement is not included in this elevation derivation since it is predicted that elastic settlement will occur instantaneously during construction. However, elastic settlement will be included in the final fill volume calculation for the purpose of estimating the volume of spoil material that will be hydraulically dredged and placed by the construction contractor. The construction platform elevation also does not account for the effects resulting from relative sea level rise that may occur at the site over the 20-year design life. The NRCS is of the opinion that the sediment deposition resulting from the Caernarvon Diversion structure will offset the effects of relative sea level rise; therefore, it has been neglected.

MCA Containment Dike Design:

Based on the recommendations by LHA outlined in the Alternative Features report, the NRCS has elected to proceed with the unreinforced containment dike design due to the increased cost of using the geotextile reinforcement. However, should a situation arise during construction such that material is not stacking as predicted, it may be necessary to utilize geotextile reinforcement to meet the needs of the project. At this time, LHA does not anticipate this being an issue, but reserves the right to modify the design if necessary. Containment dikes will be built to a top elevation of +5.25 feet NAVD 88 and have a top width of five (5) feet, with side slopes planned to be five horizontal to one vertical (5H:1V). Dikes should have a berm width of thirty-five (35) feet minimum as stipulated by the NRCS, with a fifteen (15) feet wide buffer zone measured from the toe of the dike, in which construction equipment will be prohibited for encroaching upon.

MCA Plan and Access Channel Closure:

As mentioned previously, the need to create smaller interior MCA cells for construction purposes will be determined by the construction contractor's means and methods. However, the access channel required to gain access into the interior marsh will have significant impacts on the MCA. The plan view shown in Appendix A shows the access channel dissecting the MCA, resulting in three separate MCA cells, herein referred to as Cells 3A, 3B, and 3C. This configuration will allow for Cells 3A and 3C to be built simultaneously with the terraces. Once theses MCA cells and the terraces are complete and access to the interior marsh is no longer needed, Cell 3B perimeter dikes can be constructed and the associated MCA work can commence. It should be noted that once Cell 3B is constructed, the construction contractor will no longer have barge access to the interior marsh. LHA is of the understanding that the USFWS is currently

considering leaving the access channel open permanently to allow for sediment deposition from the Caernarvon Diversion structure to occur in Lake Lery. This permanent opening would require a revision to the MCA plan but would also allow for continued access to the interior marsh with barge mounted equipment during and after the construction of the BS-24 project. Should the NRCS/USFWS decide to keep this access channel open indefinitely, the total acres of marsh created will be reduced significantly based on the current channel alignment and orientation.

Currently, LHA has been directed to proceed under the assumption that the access channel will be permanently closed and Cell 3B constructed and filled as planned. LHA has expressed concern regarding the means necessary to close the channel and establish a structurally sound perimeter to facilitate the dredge spoil placement activities. As a result, LHA is planning to incorporate a steel sheet pile wall structure to create the exterior boundary of the lake rim; then material can be backfilled on the interior to establish the necessary containment dike. At this time LHA is working with GeoEngineers to develop design parameters for the sheet pile wall based on the geotechnical data collected previously. The specifics of the wall structure are unknown at this time, but the following items are anticipated to be incorporated into the design.

- Heavy gauge steel sheet piles with 0.5-inch flange thickness or greater and CTE coating system (depth of sheet piles to be determined);
- Riprap along lake side to provide erosion/scour protection;
- Battered steel pipe piles for lateral support (size and depth to be determined);
- Any required signage
- Length of wall to be determined at a later date, but will likely be at least 150-200 feet long

Without any definitive information regarding the sheet pile wall design requirements, it is difficult to estimate the anticipated cost of the structure. Within the last decade, LHA has designed similar structures for the Coastal Restoration and Protection Authority of Louisiana (CPRA) that were constructed in Cameron Parish. At that time, the costs of the structures were approximately $6,500 per linear foot. For the purpose of this report and construction estimate, LHA will assume a structure length of 200 feet at a unit cost of $6,500. Any further breakdown of this unit cost would be premature at this point in time and provide little significance to the overall report. LHA will revise the cost estimate as needed once more information becomes available.

MCA Volume Calculations:

LHA has utilized the automated three-dimensional functions of AutoCAD Civil 3D to generate preliminary cut and fill volumes for the containment dike layout depicted in Appendix A. The same methodology has also been used to determine the fill volume needed to obtain the +3.25 feet NAVD 88 elevation of the MCA, by incorporating the existing grade elevations and also accounting for the volume of material used to construct the containment dikes. A summary of the preliminary volumes are shown in Table 1.2 below.

Table 1.2 – Preliminary MCA Construction Quantity Summary

Marsh Creation Cell Area	Total Acreage	Containment Dike Volume, yd3	MCA Volume, yd3
Cell 1A	133	183,130	1,032,693
Cell 1B	80	43,199	557,853
Cell 1C	126	162,152	960,116
Total	339	388,481	2,550,662

The volumes shown in the table above are based on a one-to-one (1:1) cut:fill ratio and do not incorporate any elastic settlement of the soil mass. According to the geotechnical report, it is recommended that a cut:fill ratio of 1.3 to 1.5 be used to determine the actual volume to be placed

to meet the construction template. LHA is currently using a value of 1.5 for the volume calculations associated with this report, but recommends that the actual cut:fill ratio associated with the BS-16 project be evaluated and incorporated into the BS-24 estimation. In addition, the average expected elastic settlement is approximately 0.46 feet based on the soil samples collected and tested by GeoEngineers. This settlement will occur instantly during construction and should be included in the overall volume calculation. The volume of spoil material associated with the elastic settlement equates to a ten percent (10%) volume increase (approximately), bringing the total volume to be hydraulically dredged to approximately 4.1 million cubic yards. (2,550,662 yd^3 x (1.5 + 0.1) = 4,081,059 yd^3)

MCA Construction Monitoring and Measuring:

The characteristics of hydraulically pumped material varies significantly based on many factors including: the size of dredge used, water content, and material quality. Staff gauges should be placed at random locations throughout the MCA for the purpose of monitoring spoil placement heights during construction. Once the elevation has been met, as-built surveys should be performed of the associated MCA to determine its acceptability. Time frames and conditions for post-construction acceptance will be evaluated as information from the BS-16 project becomes available.

MCA Containment Dike Gapping:

After the MCA has been constructed and the rate of settlement has plateaued, it is a common practice to degrade the containment dikes at various locations to allow for the exchange of tidal waters through the MCA. The quantity and location of these degraded areas should be determined based on the conditions of the MCA at the time of degrading. Degrading should occur in areas that will provide hydraulic connectivity to the surrounding water body that will facilitate

a minimal exchange rate. Degrading should be limited to the extent not to cause a sudden influx of water and should not result in a cross-flow through the MCA. Degraded areas should facilitate a gradual rise and subsidence of water levels such that marsh vegetation is not eroded from the MCA. LHA is of the opinion that these gaps should occur at frequent locations and be relatively small in size (approximately 10 feet in width and at 300-500 foot intervals). Based on the settlement analyses performed by GeoEngineers, it is evident that the rate of settlement will stabilize between 1 and 2 years after construction is complete. This is an estimate based on tests performed in a controlled environment. Actual timeframe required could vary in the field.

Preliminary Construction Cost

LHA has updated the construction cost estimate provided previously in the Alternative Feature report to reflect the quantities specified in this report. Based on these quantities, the estimated construction cost has been revised to $27.6 million with an estimated construction time of 1057 calendar days, or approximately 2.9 years. See Appendix B for an itemized breakdown of each work item.

Summary and Conclusion

Based on the concepts and methodologies discussed herein, LHA feels that the 30% Design Phase of the project can continue as planned. At this time, LHA asks that the NRCS consider the issues relating to the final dressing of the terraces and the need to close the access channel through the lake rim and provide direction to LHA on how to proceed with the design of the associated features. LHA will continue to prepare construction drawings and specifications based our current understanding of the project objectives, unless directed otherwise by the NRCS. LHA will continue to consult with GeoEngineers, Inc. to address the items aforementioned and provide

updates to the NRCS as the information becomes available. Should the NRCS feel that additional considerations be evaluated, please notify LHA and the items can be addressed accordingly.

APPENDIX A
PRELIMINARY DRAWINGS

4 Pages

Lake Rim Levee Data Table			
Point No.	Northing	Easting	Radius
LR1	475287.79	3743373.87	
LR2	475225.18	3743337.46	P.C. – 250'
LR3	475193.14	3743318.83	P.I.
LR4	475156.56	3743312.92	P.T. – 250'
LR5	474770.34	3743250.48	P.C. – 250'
LR6	474764.16	3743249.48	P.I.
LR7	474758.05	3743248.09	P.T. – 250'
LR8	474244.22	3743131.63	P.C. – 250'
LR9	474242.41	3743131.22	P.I.
LR10	474240.60	3743130.77	P.T. – 250'
LR11	473662.49	3742988.39	P.C. – 250'
LR12	473660.71	3742987.95	P.I.
LR13	473658.94	3742987.48	P.T. – 250'
LR14	473181.82	3742806.90	P.C. – 250'
LR15	473175.46	3742804.37	P.I.
LR16	473169.02	3742802.07	P.T. – 250'
LR17	472678.89	3742636.11	P.C. – 250'
LR18	472661.72	3742630.30	P.I.
LR19	472643.79	3742627.66	P.T. – 250'

Lake Rim Levee Data Table			
Point No.	Northing	Easting	Radius
LR20	472214.58	3742564.68	P.C. – 250'
LR21	472205.96	3742563.41	P.I.
LR22	472197.27	3742562.90	P.T. – 250'
LR23	471464.07	3742519.83	P.C. – 250'
LR24	471446.99	3742518.83	P.I.
LR25	471429.98	3742520.74	P.T. – 250'
LR26	470907.80	3742579.51	P.C. – 250'
LR27	470891.10	3742581.39	P.I.
LR28	470874.94	3742586.03	P.T. – 250'
LR29	469981.99	3742842.57	P.C. – 250'
LR30	469975.22	3742844.65	P.I.
LR31	469968.53	3742846.96	P.T. – 250'
LR32	469294.89	3743093.31	P.C. – 250'
LR33	469293.41	3743093.86	P.I.
LR34	469291.94	3743094.42	P.T. – 250'
LR35	469083.46	3743174.40	P.C. – 250'
LR36	469069.97	3743179.57	P.I.
LR37	469057.36	3743186.63	P.T. – 250'
LR38	468975.34	3743232.57	

Containment Dike Data Table			
Point No.	Northing	Easting	Radius
CD1	475198.73	3743325.31	
CD2	476094.47	3742737.26	P.C. – 250'
CD3	476122.03	3742719.17	P.I.
CD4	476142.33	3742693.20	P.T. – 250'
CD5	476782.57	3741873.61	P.C. – 250'
CD6	476806.61	3741842.83	P.I.
CD7	476817.30	3741805.27	P.T. – 250'
CD8	476977.53	3741242.75	P.C. – 250'
CD9	476989.17	3741201.87	P.I.
CD10	476983.19	3741159.79	P.T. – 250'
CD11	476954.36	3740957.18	P.C. – 250'
CD12	476930.29	3740787.92	P.I.
CD13	476759.35	3740785.37	P.T. – 250'
CD14	476507.11	3740781.59	P.C. – 250'
CD15	476458.19	3740780.86	P.I.
CD16	476414.46	3740802.79	P.T. – 250'
CD17	475909.49	3741056.06	P.C. – 250'
CD18	475822.42	3741099.73	P.I.
CD19	475734.36	3741058.11	P.T. – 250'
CD20	475458.53	3740927.74	P.C. – 250'
CD21	475420.67	3740909.85	P.I.
CD22	475378.82	3740908.64	P.T. – 250'
CD23	474967.84	3740896.80	P.C. – 250'
CD24	474955.07	3740896.44	P.I.
CD25	474942.45	3740894.45	P.T. – 250'
CD26	474664.59	3740850.65	P.C. – 250'
CD27	474529.32	3740829.33	P.I.
CD28	474460.52	3740947.73	P.T. – 250'
CD29	473918.31	3741994.89	P.C. – 250'
CD30	473916.24	3741998.93	P.I.
CD31	473914.35	3742003.05	P.T. – 250'

Containment Dike Data Table			
Point No.	Northing	Easting	Radius
CD32	473634.82	3742615.31	
CD33	473628.26	3742629.69	P.C. – 250'
CD34	473624.03	3742644.92	P.I.
CD35	473539.47	3742949.52	P.T. – 250'
CD36	473763.87	3740668.69	P.C. – 250'
CD37	473742.44	3740664.36	P.I.
CD38	473720.57	3740664.77	P.T. – 250'
CD39	472615.41	3740685.17	P.C. – 250'
CD40	472607.71	3740685.31	P.I.
CD41	472600.05	3740686.05	P.T. – 250'
CD42	471745.41	3740767.83	P.C. – 250'
CD43	471722.06	3740770.07	P.I.
CD44	471699.86	3740777.64	P.T. – 250'
CD45	471581.09	3740818.18	
CD46	472984.27	3742739.51	
CD47	471808.54	3740891.36	
CD48	471125.03	3740986.97	P.C. – 250'
CD49	471119.10	3740989.39	P.I.
CD50	471113.24	3740991.99	P.T. – 250'
CD51	470154.20	3741437.72	P.C. – 250'
CD52	470133.18	3741447.49	P.I.
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CD59	468650.33	3742029.25	P.T. – 250'
CD60	468630.04	3742779.37	P.C. – 250'
CD61	468627.07	3742889.00	P.I.
CD62	468717.92	3742950.44	P.T. – 250'
CD63	469062.70	3743183.64	

0 350' 700' 1050'

HOR. SCALE

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NOTICE:

72 HOURS BEFORE DIGGING
CALL 1-800-272-3020
TO LOCATE UTILITY LINES

Date	
Designed	Chris Wrest 04/01/16
Drawn	Aaron Harper 04/01/16
Checked	Leonard Harper 04/01/16
Approved	Lonnie Harper 04/01/16

MARSH CREATION AREA
BS–24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 1 of 1
Plaquemines Parish, Louisiana

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No.
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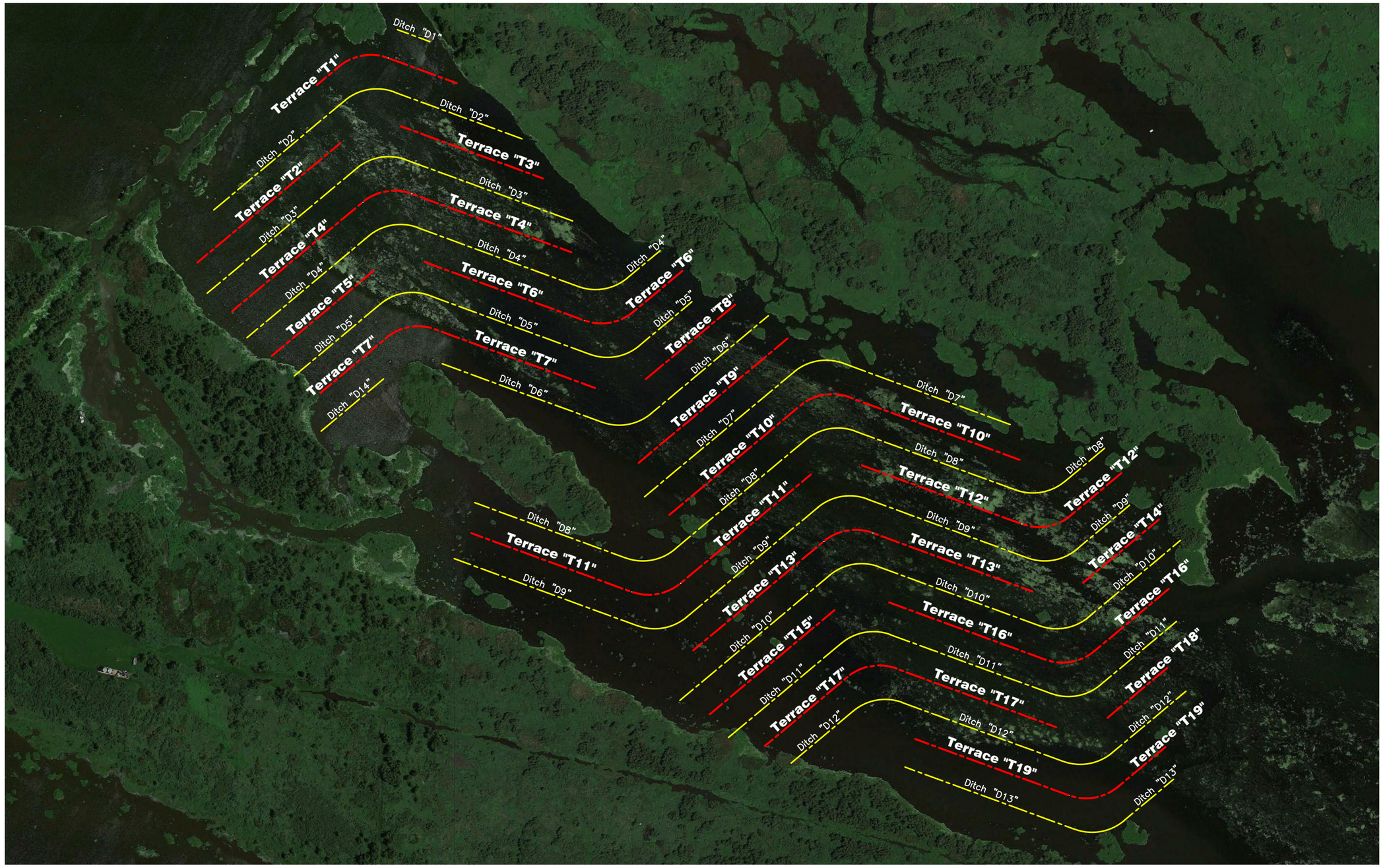
Drawing No.
BS–24
5/13/16 12:39 PM
Sheet *1* of *1*



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0 250' 500' 750'
HOR. SCALE

Date
Designed Chris Wheat 04/01/16
Drawn Aaron Harper 04/01/16
Checked Leonard Harper 04/01/16
Approved Lonnie Harper 04/01/16

TERRACE AREA (CELL 2B) KEY SHEET
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR
Page 3 of 28

Plaquemines Parish, Louisiana

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No.
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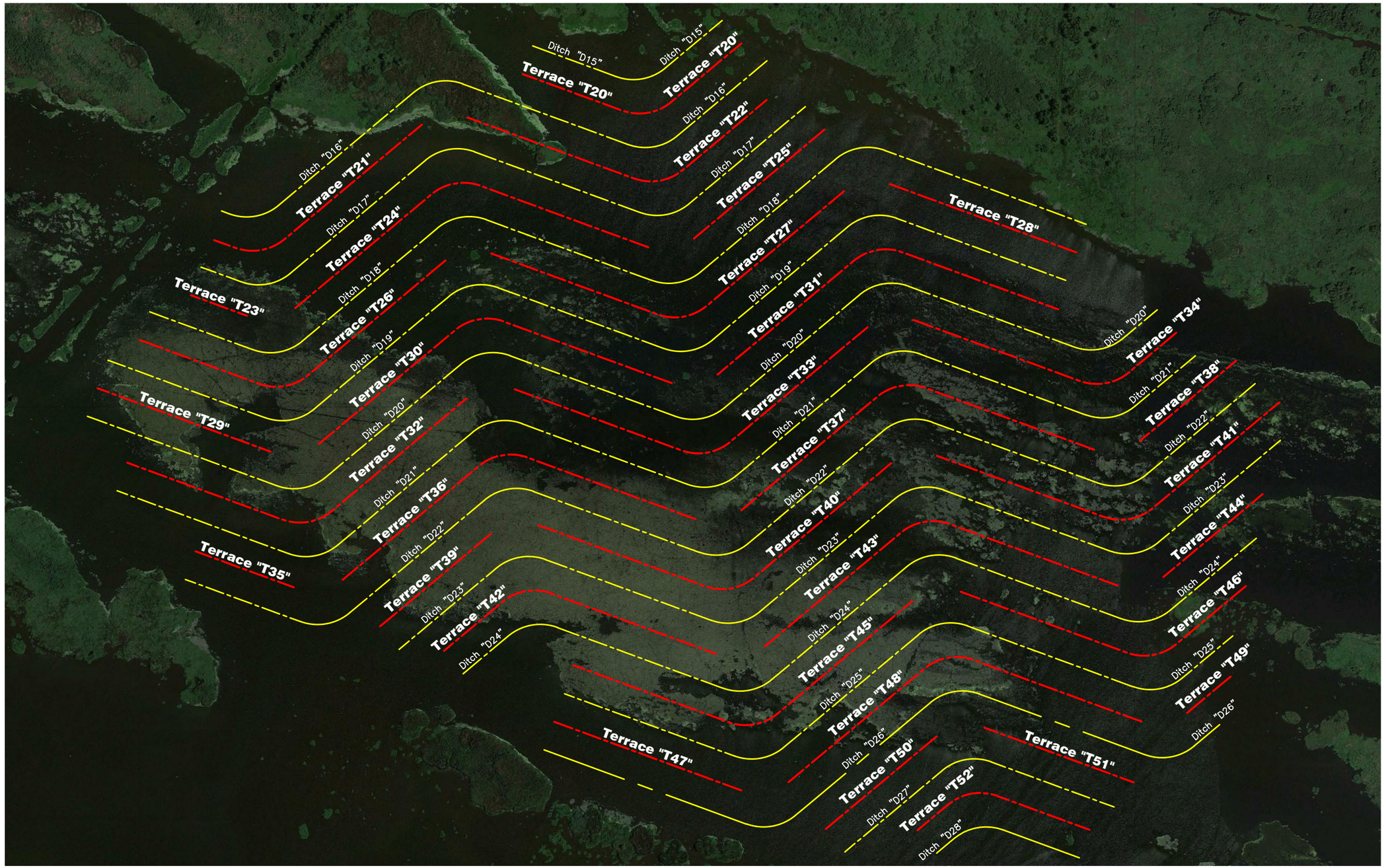
Drawing No.
BS-24
5/13/16 12:34 PM
Sheet *1* of *1*



0 250' 500' 1500'

HOR. SCALE

NOTICE:

72 HOURS BEFORE DIGGING
CALL 1-800-272-3020
TO LOCATE UTILITY LINES

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

0 250' 500' 750'

HOR. SCALE

		Date
Designed	Chris Wheat	04/01/16
Drawn	Aaron Harper	04/01/16
Checked	Leonard Harper	04/01/16
Approved	Lonnie Harper	04/01/16

TERRACE AREA (CELL 4) KEY SHEET
BS-24 TERRACING & MARSH CREATION
SOUTH OF BIG MAR

Page 1 of 1

Plaquemines Parish, Louisiana

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No.
T_4.dwg
Drawing No.
BS-24
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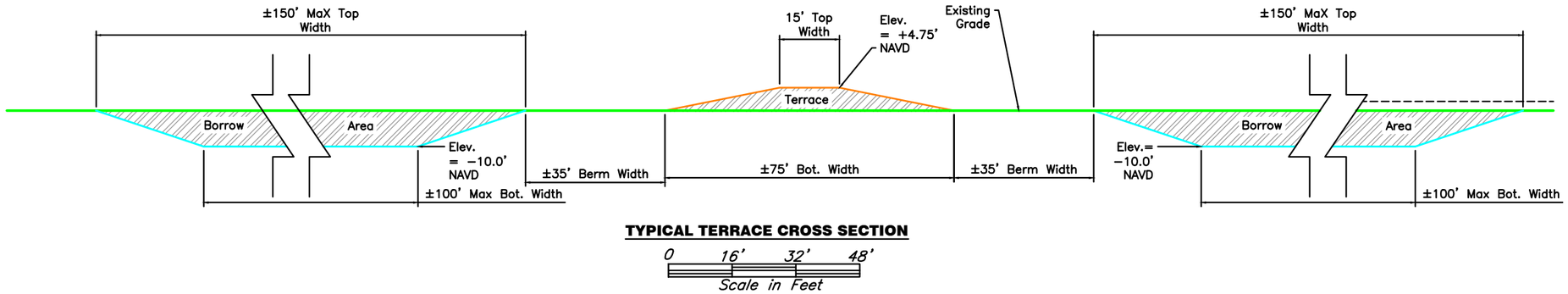
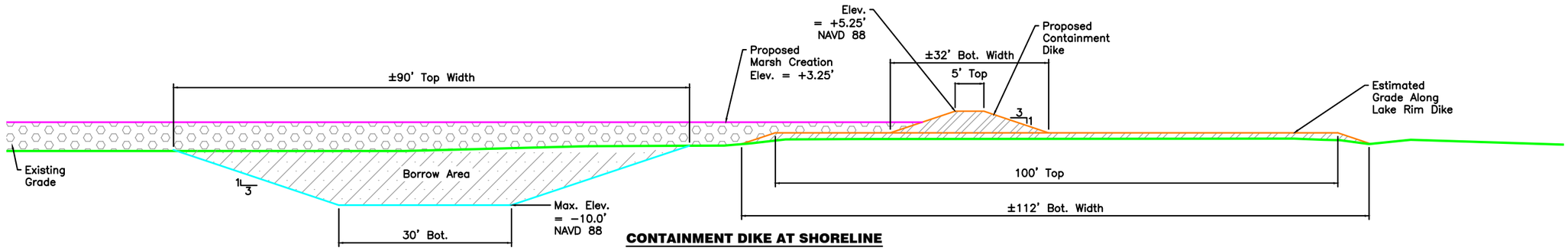
Sheet 1 of 1



TYPICAL TERRACE CROSS SECTION

0 16' 32' 48'

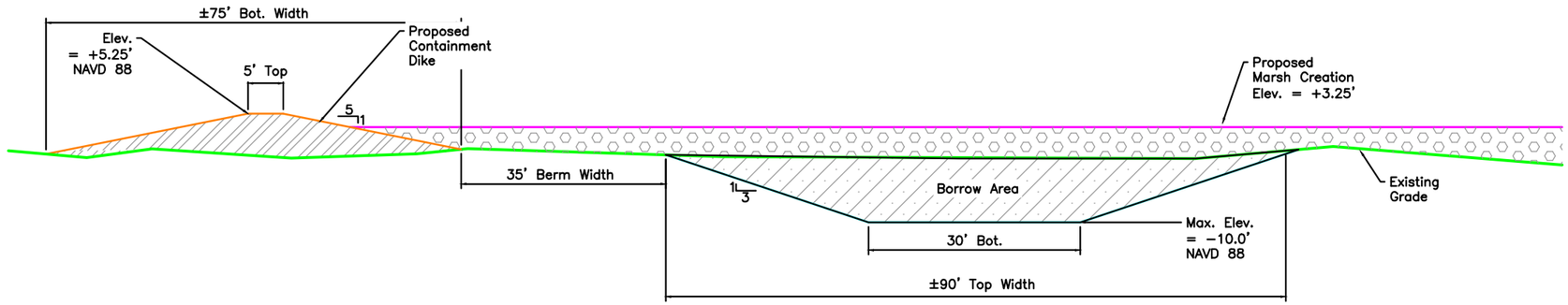
Scale in Feet



CONTAINMENT DIKE AT SHORELINE

0 10' 20' 30'

Scale in Feet



CONTAINMENT DIKE INTERIOR MARSH (NON-REINFORCED)

0 10' 20' 30'

Scale in Feet

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

Date
Designed Chris Wheat 05/13/16
Drawn Aaron Harper 05/13/16
Checked Leonard Harper 05/13/16
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TYPICAL CROSS−SECTIONS
BS−24 TERRACING AND MARSH CREATION SOUTH OF BIG MAR
Page 01 of 01

Plaquemines Parish, Louisiana

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

File No. *TypXSect.dwg*
Drawing No.

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Sheet *01* of *01*

APPENDIX B
PRELIMINARY CONSTRUCTION COST ESTIMATE

5 Pages

ENGINEER'S ESTIMATE

Bid Item: Mobilization and Demobilization

MATERIALS

Item	Material Cost/Unit	Unit	Number	Total Material Cost/Item
Payment and Performance Bond				$513,544.02
Figured at 2% total cost (typical)				
		subtotal		$513,544.02
		Taxes (9.0%)		$0.00
Total Materials				$513,544.02

LABOR

No.	Labor	Labor Rate/hr	Days Spent on Item	Cost
1	Foreman	$45.15	10	$4,515.00
3	Heavy Equip Operator	$48.80	10	$14,640.00
3	Laborer	$35.45	10	$10,635.00
3	Tug Captain	$47.50	10	$14,250.00
Total Labor				$44,040.00

EQUIPMENT

No.	Equipment	Equipment Rate/Hr	Days Spent on Item	Cost
1	excavator	$100.00	10	$10,000.00
1	clam shell	$4.74	10	$474.00
5	truck	$158.00	10	$79,000.00
3	Crane	$145.70	10	$43,710.00
3	3 yd³ Bucket	$5.22	10	$1,566.00
1	Centrifugal Pump	$34.14	10	$3,414.00
50	Suction Hose	$3.00	10	$15,000.00
3000	Discharge Hose	$1.95	10	$585,000.00
1	Pile Hammer/Vibro	$59.15	10	$5,915.00
1	Leads	$4.95	10	$495.00
3	Barges	$20.75	10	$6,225.00
3	Tugs	$158.00	10	$47,400.00
			Total Equipment	$750,799.00

Production Rate

Work	Unit	Rate Unit/Hr	Qty	Hrs/ Item
Mobilize to site	NA	NA	NA	50
Demobilize	NA	NA	NA	50
			Total Hrs	100
			Total Days	10

Subsidiary Item(s)	

Total Materials Cost	$513,544.02
Total Labor Cost	$44,040.00
Total Equipment Cost	$750,799.00
Total Cost of Subsidiary Items	$0.00
subtotal	$1,308,383.02
FOOH (15%) & HOOH (15%)	$392,514.91
subtotal	$1,700,897.93
Profit (10%)	$170,089.79
Total Cost	**$1,870,987.72**
Round Up	**$1,870,988.00**

Bid Item: Pollution Control

MATERIALS

Item	Material Cost/Unit	Unit	Number	Total Material Cost/Item
Misc. Consumables				$2,500.00
		subtotal		$2,500.00
		Taxes (9.5%)		$237.50
Total Materials				$2,737.50

LABOR

No.	Labor	Labor Rate/hr	Days Spent on Item	Cost
1	Foreman	$45.15	106	$47,723.55
2	Laborer	$35.45	106	$74,941.30
Total Labor				$122,664.85

EQUIPMENT

No.	Equipment	Equipment Rate/Hr	Days Spent on Item	Cost
1	truck	$15.20	106	$16,066.40
1	Airboat	$100.00	106	$105,700.00
			Total Equipment	$121,766.40

Production Rate

Work	Unit	Rate Unit/Hr	Qty	Hrs/ Item
Pollution Control	NA			
	NA			
			Total Hrs	
			Total Days	105.7

Pollution Control Measures to be in effect throughout construction. Cost is based on 1 hour per day per pesonnel listed to insure pollution control plan is being adhered to and making any necessary adjustments.

Subsidiary Item(s)	

Total Materials Cost	$2,737.50
Total Labor Cost	$122,664.85
Total Equipment Cost	$121,766.40
Total Cost of Subsidiary Items	$0.00
subtotal	$247,168.75
FOOH (15%) & HOOH (15%)	$74,150.63
subtotal	$321,319.38
Profit (10%)	$32,131.94
Total Cost	**$353,451.31**
Round Up	**$353,452.00**

Bid Item	Construction Surveying													
MATERIALS					LABOR					EQUIPMENT				
Item	Material Cost/Unit	Unit	Number	Total Material Cost/Item	No.	Labor	Labor Rate/hr	Days Spent on Item	Cost	No.	Equipment	Equipment Rate/Hr	Days Spent on Item	Cost
Fuel	$3.75	Gal	500	$1,875.00	1	Party Chief	$57.50	40	$23,000.00	2	truck	$15.20	40	$12,160.00
Consumables	N/A			$5,000.00	1	Instrument Man	$46.20	40	$18,480.00	2	alum. Boat w/outboard	$11.20	40	$8,960.00
					2	Rodman	$43.30	40	$34,640.00	1	Hydrographic Survey	$90.00	40	$36,000.00
					1	PLS	$157.34	40	$62,936.00	3	RTK Base w/ Rover	$60.00	40	$72,000.00
					1	CADD Technician	$89.00	40	$35,600.00					
			subtotal	$6,875.00										
			Taxes (9.5%)	$653.13										
Total Materials				$7,528.13		Total Labor			$174,656.00			Total Equipment		$129,120.00

Production Rate				
Work	Unit	Rate Unit/Hr	Qty	Hrs/ Item
Stake Points				
	NA			
			Total Hrs	0
			Total Days	40

Construction surveying costs estimate

Subsidiary Item(s)	

Total Materials Cost	$7,528.13
Total Labor Cost	$174,656.00
Total Equipment Cost	$129,120.00
Total Cost of Subsidiary Items	$0.00
subtotal	$311,304.13
FOOH (15%) & HOOH (15%)	$93,391.24
subtotal	$404,695.36
Profit (10%)	$40,469.54
Total Cost	**$445,164.90**
Round Up	**$445,165.00**

Bid Item	Contractor Quality Control													
MATERIALS					LABOR					EQUIPMENT				
Item	Material Cost/Unit	Unit	Number	Total Material Cost/Item	No.	Labor	Labor Rate/hr	Days Spent on Item	Cost	No.	Equipment	Equipment Rate/Hr	Days Spent on Item	Cost
					1	QC Manager	$45.15	1057	$477,235.50	1	truck	$15.20	1057	$160,664.00
										1	Airboat	$100.00	1057	$1,057,000.00
			subtotal	$0.00										
			Taxes (9.0%)	$0.00										
Total Materials				$0.00		Total Labor			$477,235.50			Total Equipment		$1,217,664.00

Production Rate				
Work	Unit	Rate Unit/Hr	Qty	Hrs/ Item
Quality Control	N/A	N/A	N/A	N/A
			Total Hrs	
			Total Days	1057

Subsidiary Item(s)	

Total Materials Cost	$0.00
Total Labor Cost	$477,235.50
Total Equipment Cost	$1,217,664.00
Total Cost of Subsidiary Items	$0.00
subtotal	$1,694,899.50
FOOH (15%) & HOOH (15%)	$508,469.85
subtotal	$2,203,369.35
Profit (10%)	$220,336.94
Total Cost	**$2,423,706.29**
Round Up	**$2,423,707.00**

Bid Item	Earthfill, Containment Dikes & Terraces													
MATERIALS					LABOR					EQUIPMENT				
Item	Material Cost/Unit	Unit	Number	Total Material Cost/Item	No.	Labor	Labor Rate/hr	Days Spent on Item	Cost	No.	Equipment	Equipment Rate/Hr	Days Spent on Item	Cost
Fuel	$2.50	Gal	10000	$25,000.00	3	Foreman	$45.15	339	$459,175.50	3	Crane	$145.70	339	$1,481,769.00
					3	Heavy Equip Operator	$48.80	339	$496,296.00	3	3 yd³ Bucket	$5.22	339	$53,087.40
					3	Laborer	$35.45	339	$360,526.50	3	trucks	$15.20	339	$154,584.00
										1				
			subtotal	$25,000.00										
			Taxes (9.5%)	$2,375.00										
Total Materials				$27,375.00		Total Labor			$1,315,998.00			Total Equipment		$1,689,440.40

Production Rate				
Work	Unit	Rate Unit/Hr	Qty	Hrs/ Item
Earthfill	CY	336	1,138,699	3388.99
			Total Hrs	3388.99
			Total Days	338.899

Unit per hour rate derived from RS Means, Heavy Const. 2013 ed., Crew B12-V

Subsidiary Item(s)	

Total Materials Cost	$27,375.00
Total Labor Cost	$1,315,998.00
Total Equipment Cost	$1,689,440.40
Total Cost of Subsidiary Items	$0.00
subtotal	$3,032,813.40
FOOH (15%) & HOOH (15%)	$909,844.02
subtotal	$3,942,657.42
Profit (10%)	$394,265.74
Total Cost	**$4,336,923.16**
Round Up	**$4,336,924.00**

Bid Item	Marsh Creation Dredging													
MATERIALS					LABOR					EQUIPMENT				
Item	Material Cost/Unit	Unit	Number	Total Material Cost/Item	No.	Labor	Labor Rate/hr	Days Spent on Item	Cost	No.	Equipment	Equipment Rate/Hr	Days Spent on Item	Cost
Fuel	$2.50	Gal	40000	$100,000.00	1	Labor Foreman	$45.15	171	$77,206.50	1	Crane	$145.70	171	$249,147.00
					2	Laborers	$35.45	171	$121,239.00	1	Clamshell	$4.74	171	$8,105.40
					1	Heavy Equip Operator	$48.80	171	$83,448.00	1	Centrifugal Pump	$34.14	171	$58,379.40
					1	Light Equip Operator	$45.80	171	$78,318.00	50	Suction Hose	$3.00	171	$256,500.00
					1	Oiler	$42.25	171	$72,247.50	3000	Discharge Hose	$1.95	171	$10,003,500.00
			subtotal	$100,000.00										
			Taxes (9.5%)	$9,500.00										
Total Materials				$109,500.00		Total Labor			$432,459.00			Total Equipment		$10,575,631.80

Production Rate				
Work	Unit	Rate Unit/Hr	Qty	Hrs/ Item
Earthfill	CY	1500	2,550,662	1700.44
			Total Hrs	1700.44
			Total Days	170.04

Production rate of hydraulic dredges can vary greatly. Rate of 15,000 cubic yards per day was selected for this analysis

Subsidiary Item(s)	

Total Materials Cost	$109,500.00
Total Labor Cost	$432,459.00
Total Equipment Cost	$10,575,631.80
Total Cost of Subsidiary Items	$0.00
subtotal	$11,117,590.80
FOOH (15%) & HOOH (15%)	$3,335,277.24
subtotal	$14,452,868.04
Profit (10%)	$1,445,286.80
Total Cost	**$15,898,154.84**
Round Up	**$15,898,155.00**

Bid Item — **Earthfill, Access Channel Dredging**

MATERIALS					LABOR					EQUIPMENT				
Item	Material Cost/Unit	Unit	Number	Total Material Cost/Item	No.	Labor	Labor Rate/hr	Days Spent on Item	Cost	No.	Equipment	Equipment Rate/Hr	Days Spent on Item	Cost
Fuel	$2.50	Gal	10000	$25,000.00	1	Foreman	$45.15	179	$80,818.50	1	Crane	$145.70	179	$260,803.00
					1	Heavy Equip Operator	$48.80	179	$87,352.00	1	3 yd³ Bucket	$5.22	179	$9,343.80
					1	Laborer	$35.45	179	$63,455.50	1	trucks	$15.20	179	$27,208.00
			subtotal	$25,000.00										
			Taxes (9.5%)	$2,375.00										
Total Materials				$27,375.00		Total Labor			$231,626.00			Total Equipment		$297,354.80

Production Rate				
Work	Unit	Rate Unit/Hr	Qty	Hrs/ Item
Earthfill	CY	112	200,000	1785.71
			Total Hrs	1785.71
			Total Days	178.571

Unit per hour rate derived from RS Means, Heavy Const. 2013 ed., Crew B12-V
Volume quantity is estimated.

Subsidiary Item(s)	

Total Materials Cost	$27,375.00
Total Labor Cost	$231,626.00
Total Equipment Cost	$297,354.80
Total Cost of Subsidiary Items	$0.00
subtotal	$556,355.80
FOOH (15%) & HOOH (15%)	$166,906.74
subtotal	$723,262.54
Profit (10%)	$72,326.25
Total Cost	**$795,588.79**
Round Up	**$795,589.00**

Bid Item — **Piling, Access Channel Closure Structure**

MATERIALS					LABOR					EQUIPMENT				
Item	Material Cost/Unit	Unit	Number	Total Material Cost/Item	No.	Labor	Labor Rate/hr	Days Spent on Item	Cost	No.	Equipment	Equipment Rate/Hr	Days Spent on Item	Cost
Sheetpile	$1,500.00	Ton	150	$225,000.00	1	Foreman	$35.45	61	$21,624.50	3	truck	$15.20	61	$27,816.00
Sheet Pile Coating	$2.52	SF	17000	$42,840.00	2	Heavy Equip Operator	$48.80	61	$59,536.00	1	crane	$145.70	61	$88,877.00
Steel Wale Beam	$28.45	LF	400	$11,380.00	6	Laborer	$35.45	61	$129,747.00	1	Pile Hammer/Vibro	$59.15	61	$36,081.50
Steel Pipe Piles	$100.00	LF	1200	$120,000.00	1	Welder (incl. machine)	$144.00	61	$87,840.00	1	Leads	$4.95	61	$3,019.50
										2	Barges	$20.75	61	$25,315.00
			subtotal	$399,220.00										
			Taxes (9.5%)	$37,925.90										
Total Materials				$437,145.90		Total Labor			$298,747.50			Total Equipment		$181,109.00

Production Rate				
Work	Unit	Rate Unit/Hr	Qty	Hrs/ Item
Piling	LF	0.33	200	606.061
			Total Hrs	606.061
			Total Days	60.6061

Unit per hour rate is estimated based on experiences on previous projects.

Subsidiary Item(s)	

Total Materials Cost	$437,145.90
Total Labor Cost	$298,747.50
Total Equipment Cost	$181,109.00
Total Cost of Subsidiary Items	$0.00
subtotal	$917,002.40
FOOH (15%) & HOOH (15%)	$275,100.72
subtotal	$1,192,103.12
Profit (10%)	$119,210.31
Total Cost	**$1,311,313.43**
Round Up	**$1,311,314.00**

Bid Item	Riprap, Type R-700													
MATERIALS					LABOR					EQUIPMENT				
Item	Material Cost/Unit	Unit	Number	Total Material Cost/Item	No.	Labor	Labor Rate/hr	Days Spent on Item	Cost	No.	Equipment	Equipment Rate/Hr	Days Spent on Item	Cost
R-700 Riprap	$49.00	Ton	1,000	$49,000.00	1	Foreman	$45.15	5	$2,257.50	1	truck	$15.20	5	$760.00
					1	Equipment Operator	$48.80	5	$2,440.00	1	excavator	$81.05	5	$4,052.50
					1	Tug Captain	$47.50	5	$2,375.00	1	tug	$158.00	5	$7,900.00
										2	materials barge	$20.75	5	$2,075.00
			subtotal	$49,000.00										
			Taxes (9.5%)	$4,655.00										
Total Materials				$53,655.00		Total Labor			$7,072.50			Total Equipment		$14,787.50

Production Rate				
Work	Unit	Rate Unit/Hr	Qty	Hrs/ Item
Riprap	N/A	N/A	N/A	N/A
			Total Hrs	
			Total Days	5

Subsidiary Item(s)	

Total Materials Cost	$53,655.00
Total Labor Cost	$7,072.50
Total Equipment Cost	$14,787.50
Total Cost of Subsidiary Items	$0.00
subtotal	$75,515.00
FOOH (15%) & HOOH (15%)	$22,654.50
subtotal	$98,169.50
Profit (15%)	$14,725.43
Total Cost	**$112,894.93**
Round Up	**$112,895.00**

Riprap quantity is estimated.

Bid Item	Field Office													
MATERIALS					LABOR					EQUIPMENT				
Item	Material Cost/Unit	Unit	Number	Total Material Cost/Item	No.	Labor	Labor Rate/hr	Days Spent on Item	Cost	No.	Equipment	Equipment Rate/Hr	Days Spent on Item	Cost
Field Office	N/A	LS	1	$50,000.00										
			subtotal	$50,000.00										
			Taxes (9.5%)	$4,750.00										
Total Materials				$54,750.00		Total Labor			$0.00			Total Equipment		$0.00

Production Rate				
Work	Unit	Rate Unit/Hr	Qty	Hrs/ Item
Riprap	N/A	N/A	N/A	N/A
			Total Hrs	
			Total Days	N/A

Subsidiary Item(s)	

Total Materials Cost	$54,750.00
Total Labor Cost	$0.00
Total Equipment Cost	$0.00
Total Cost of Subsidiary Items	$0.00
subtotal	$54,750.00
FOOH (15%) & HOOH (15%)	$16,425.00
subtotal	$71,175.00
Profit (15%)	$10,676.25
Total Cost	**$81,851.25**
Round Up	**$81,852.00**

Riprap quantity is estimated.

Total Days (Critical Path) including adverse weather days	**1057**	**Subtotal**	**$27,630,041.00**
		25% Contingecny	$6,907,510.25
		Total	**$34,537,551.25**