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<td>11</td>
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<td>12</td>
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</tr>
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<td>16</td>
</tr>
</tbody>
</table>
1.0 INTRODUCTION

G.E.C., Inc. (GEC) was contracted by the Baton Rouge Area Foundation to perform data collection as a preliminary phase to the development of a Baton Rouge Lakes Master Plan. Based on an evaluation of the 2008 Feasibility Study conducted by the City of Baton Rouge, East Baton Rouge Parish, and the U.S. Army Corps of Engineers (USACE), it was determined that supplemental data would benefit the development of the Master Plan. Specifically, additional topographic and bathymetric survey data, along with geotechnical data, were required. This data report provides a summary of the methods utilized to collect the data, an analysis of the results, and a summary of the findings.

1.1 Study Area

The Baton Rouge lakes are located near Louisiana State University (LSU) near the east bank of the Mississippi River (Figure 1-1). The lake system consists of six urban lakes (University, City Park, Crest, Campus, College, and Erie lakes) with a cumulative area of approximately 273 acres. The project area is bounded on the north by City Park and on the south, east, and west by the shoreline and adjacent property of the Baton Rouge Lakes system.

1.2 Site Conditions

The Baton Rouge Lakes were formed in the early 1920s with the timbering of old Perkins Swamp and the damming of Bayou DuPlantier (Figure 1-1). Numerous cypress stumps are still present on the lake bottoms, remnants of these timbering activities. During the 2008 study, a layer of organic material was observed over the lake bottoms. This unconsolidated layer is a high water content flocculent layer that has built up over time. The thickness of the unconsolidated layer was estimated during 2008 field investigations. Hydraulic control structures located along Stanford Avenue and May Street control water levels for University, City Park, Crest, and Erie Lakes. College and Campus Lakes are hydraulically isolated from the other system lakes.

1.3 Ecosystem Problems

Studies have shown that the LSU Lakes System suffers from water quality issues stemming from manmade impacts and land use around the lakes. Hypereutrophic conditions have led to poor fishery and wildlife habitat and periodic fish kills. The 2008 Feasibility Study provides background information on these problems and some proposed solutions. The 2008 data could be utilized during development of the Master Plan and the design of recommended actions.

1.4 Data Needs

1.4.1 Geotechnical Data Needs

Soil Boring Logs

Computer generated boring logs depicting material classification and characteristics provide an overall understanding of the material profile below the lakes. These data are also useful in detecting sand layers, if present. The logs describe geotechnical properties of the lake bottoms to a designated depth below ground surface.

Sand Layers

The presence of permeable sand layers with hydraulic connectivity to other water bodies, such as the Mississippi River, could present issues during construction. If encountered during excavation of the lake bottom, such geologic features could impact the lake’s ability to hold water or drain during low and high stages on the Mississippi River, respectively. Similar features have been observed in ponds and lakes within ten miles of the study area. An evaluation of soil boring data would help determine if
permeable layers exist, so these layers could be avoided or properly mitigated by adding non-permeable material.

**Soil Strength and Settlement Properties**

Field and laboratory testing of sampled material would provide a general understanding of the settlement and strength properties of the lake substrate. The shear strength of material to be dredged would help determine strength characteristics of dredged material and the feasibility of proposed actions during development of the Master Plan. The anticipated settlement of the unconsolidated layer, if a lake is drained, would help estimate quantities of material to be excavated under proposed actions.

1.4.2 Survey Data Needs

**Bathymetric Data**

A more accurate depiction of water depths is needed for all six lakes. Excavation will most likely be the high-quantity cost item proposed by the Master Plan. Therefore, baseline water depths are needed to identify project needs, achieve project goals, estimate excavation quantities, and increase the accuracy of cost estimates.

**Topographic Data**

The weirs along May Street and Stanford Avenue set pool stage for four of the six system lakes. The elevations of these structures are essential to determine the current storage capacity of those lakes and help determine if the structures are operating as intended.

**Terrain Model**

A digital terrain model could be developed by integrating bathymetric survey data into Geographic Information System software to provide a visual depiction of lake depths relative to the water surface. Proposed actions could be evaluated using the terrain model to estimate material availability and excavation required to achieve a desired depth.

**Unconsolidated Layer**

The relationship between the unconsolidated layer and overall lake depths can be evaluated based on onsite survey and geotechnical data and data from the 2008 study. The geotechnical information could provide an estimate of how the unconsolidated layer would react to dewatering during implementation of proposed actions in the Master Plan. These changes in layer thickness could be applied to existing data from the bathymetric survey to estimate adjusted lake depths to use in evaluations of proposed actions, as well as quantity and cost calculations.

2.0 DATA COLLECTION METHODS

FUGRO Consultants, Inc. and John Chance Land Surveys, Inc. (subcontractor) were contracted to collect geotechnical and topographic/bathymetric survey data, respectively.

2.1 Topographic and Bathymetric Surveys

Bathymetric and topographic surveys were performed in City Park, University, Crest, Erie, College, and Campus Lakes on April 15–17, 2014. Water depths were recorded using single beam sonar technology. Water elevations were adjusted to the North American Vertical Datum of 1988 (NAVD88). Horizontal data were based on the North American Datum of 1983 (NAD83) in Louisiana South State Plane coordinates. Topographic data on exposed land sections were collected using Real-Time Kinematic technology (RTK). The vessel traveled along predetermined transects with variable spacing (Figure 1-2). Sonar beams were
utilized to collect a lateral width of data along the transects. A raw data file and Survey Report were provided by the subcontractor (Appendix A).

2.2 Geotechnical Investigations

2.2.1 Field Sampling

Disturbed and undisturbed soil samples were collected in University and City Park Lakes from April 22–25, 2014. Twelve Geoprobes and one land-based soil boring were collected in the two lakes (Figure 1-2). Eight Geoprobes were collected in University Lake and four were collected in City Park Lake. The Geoprobes (G1–G-12) were collected to a depth of 20 feet below lake bottom and the land-based boring (B-1) was drilled to a depth of 50 feet below existing grade. Geoprobes were collected using marsh buggies and the land-based boring was collected using truck-mounted equipment. Land-based borings used dry-auger and wet-rotary drilling methods.

At Boring B-1, undisturbed soil samples were collected at about 2-foot intervals from the ground surface to a depth of 16 feet and at about 5-foot intervals thereafter to the boring completion depth. Samples were extruded in the field and visually classified by geotechnical personnel. Field estimates of the undrained shear strength of the recovered samples were measured using a calibrated hand penetrometer and/or torvane. The field estimates of strength are presented in the Geotechnical Report (Appendix B). Portions of each recovered soil sample were placed into appropriate containers for transportation to the laboratory.

At the Geoprobe locations, soil samples were taken at 4-foot intervals from the lake bottom to the Geoprobe completion depth. Disturbed samples were collected in a clear, plastic sleeve and were labeled and packaged for transportation to the laboratory.

2.2.2 Laboratory Testing

Classification properties of the subsurface soils were evaluated in the laboratory. Classification tests included tests for natural moisture content, liquid and plastic limits (Atterberg Limits), and grain size distribution. These tests aid in classifying the soils and are used to correlate the results of other tests performed on samples taken from different borings and/or different depths. Results of the classification tests are presented in the Geotechnical Report in Appendix B. The laboratory testing program is summarized in Table 2-1.

<table>
<thead>
<tr>
<th>Type of Test</th>
<th>Number of Tests</th>
<th>Information Provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture Content</td>
<td>46</td>
<td>Potential for settlement</td>
</tr>
<tr>
<td>Atterberg Limits</td>
<td>36</td>
<td>Defines soil properties under ranges of moisture content</td>
</tr>
<tr>
<td>Percent Fines</td>
<td>12</td>
<td>Classifies the soil</td>
</tr>
<tr>
<td>Hydrometer Analysis</td>
<td>3</td>
<td>Classifies fine grained sediment such as silts and clays</td>
</tr>
</tbody>
</table>
PROPOSED SOIL BORING COORDINATES

G-1 LAT=30.42900000 LONG=91.16747222 Y=701183.81 X=3333108.35
G-2 LAT=30.42494445 LONG=91.16730555 Y=699981.67 X=3333162.62
G-3 LAT=30.42327778 LONG=91.16914444 Y=699356.28 X=3333828.93
G-4 LAT=30.42253333 LONG=91.16758333 Y=699193.54 X=3333076.21
G-5 LAT=30.42036111 LONG=91.16883333 Y=698404.97 X=3332683.35
G-6 LAT=30.41621313 LONG=91.16722101 Y=696896.87 X=3333035.79
G-7 LAT=30.41844444 LONG=91.16591111 Y=697709.24 X=3333621.21
G-8 LAT=30.41594444 LONG=91.16459556 Y=696710.21 X=3333384.00
G-9 LAT=30.41472222 LONG=91.16111111 Y=696267.27 X=3333543.81
G-10 LAT=30.41327778 LONG=91.15611111 Y=695799.35 X=3333702.89
G-11 LAT=30.40972222 LONG=91.16377778 Y=694628.92 X=3334282.44
G-12 LAT=30.40833889 LONG=91.16690500 Y=694051.70 X=3333343.84
B-1 LAT=30.42145543 LONG=91.16939344 Y=698803.50 X=3333652.82

BASE MAP
BATHYMETRIC SURVEY
POST- PLOT GRID AREA
3.0 RESULTS

3.1 Survey Results

Hydraulic Control Structures -- Water elevations for each lake were measured in feet during the data collection period (Table 3-1). The control elevation of the hydraulic control structures at May Street and Stanford Avenue varied by 1.2 feet. The weir at May Street has a control elevation of 21.7 feet and the weir on Stanford Avenue has a control elevation of 20.5 feet (NAVD88). As anticipated, water elevations for hydraulically connected City Park and Erie Lakes, along with hydraulically connected University and Crest Lakes were similar. The University Lake and City Park Lake water level elevations coincided with the pool stage elevations dictated by the control structures. Therefore, the control structures appear to be functioning as intended.

Table 3-1. Water Elevations (NAVD88) during Period of Data Collection

<table>
<thead>
<tr>
<th>Lake</th>
<th>Water Surface Elevation</th>
<th>Control Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>University</td>
<td>20.6</td>
<td>21.5</td>
</tr>
<tr>
<td>City Park</td>
<td>21.7</td>
<td>21.7</td>
</tr>
<tr>
<td>Campus</td>
<td>20.2</td>
<td>N/A</td>
</tr>
<tr>
<td>College</td>
<td>21.6</td>
<td>N/A</td>
</tr>
<tr>
<td>Crest</td>
<td>20.7</td>
<td>21.5</td>
</tr>
<tr>
<td>Erie</td>
<td>21.6</td>
<td>21.7</td>
</tr>
</tbody>
</table>

Digital Terrain Model and Lake Depths -- The bathymetric and topographic surveys produced over 500,000 data points within the six lakes. These data were processed with ArcGIS software. This allowed a digital terrain model to be generated depicting the depths for the six lakes within the Baton Rouge Lakes system (Figures 3-1 to 3-6). The vessels used to measure lake depths were unable to collect data for certain areas of the lakes (Figures 3-1 through 3-6). To estimate the excluded areas for use in the calculations of average lake depths, a weighted average of collected data and estimated data was used. An estimate of average lake depth was made, based on bathymetry data adjacent to the excluded area and an assumed shoreline depth of 0.2 feet, for the areas excluded from data collection.

The depths assumed for the excluded portion of each lake and the survey depth limits are provided in Appendix C. The resulting weighted average lake depths are presented in Table 3-2. Lake depths were referenced to water levels measured during the data collection period. It should be noted that lake depths depicted in the terrain model would periodically fluctuate with changes in water level elevation from events such as prolonged drought conditions or recent rainfall.

Table 3-2. Weighted Average Lake Depths

<table>
<thead>
<tr>
<th>Lake</th>
<th>Weighted Average Depth (Ft.)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>University</td>
<td>4.0</td>
</tr>
<tr>
<td>City Park</td>
<td>2.8</td>
</tr>
<tr>
<td>Campus</td>
<td>3.4</td>
</tr>
<tr>
<td>College</td>
<td>5.6</td>
</tr>
<tr>
<td>Crest</td>
<td>4.7</td>
</tr>
<tr>
<td>Erie</td>
<td>2.2</td>
</tr>
</tbody>
</table>

* Referenced to water level
UNIVERSITY LAKE DEPTHS
East Baton Rouge Parish
Baton Rouge Area Foundation

UNIVERSITY LAKE DEPTHS
East Baton Rouge Parish
Baton Rouge Area Foundation

Legend
* Overview Terrain Elevation in Feet
-2.0 to -1.1
-3.0 to -2.0
-4.0 to -3.0
-5.0 to -4.0
-6.0 to -5.0
-7.0 to -6.0
-7.0
Depth Data Not Collected

Figure: 3-1
Date: June 2014
Scale: 1:8,600
Source: ESRI/JohnChance/GEC
Map ID: 279602001000-3131
ERIE LAKE DEPTHS
East Baton Rouge Parish
Baton Rouge Area Foundation

Legend
* Overview Terrain Elevation in Feet
-1.0 - -0.4
-1.5 - -1.0
-2.0 - -1.5
-2.5 - -2.0
-3.0 - -2.5
-3.3 - -3.0

Depth Data Not Collected

Source: ESRI/JohnChance/GEC
Map ID: 279602001000-3131
Figure: 3-6
Date: June 2014
Scale: 1:2,000

Service Layer Credits: Imagery: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Depth Grid Source: John Chance Surveyors
**University Lake** – University Lake is the largest lake in the system (196 acres) and has an average depth of 4.0 feet. Lake depths range from approximately seven feet to less than half a foot; deeper areas are near the center of the lake (Figure 3-1). Small isolated areas of the lake are less than a foot deep. The contours displayed in the model are consistent with the perceived dredging activities in the early 1980s. Overall, the average lake depth is greater than anticipated, but it falls a foot below the five-foot benchmark provided by the Louisiana Department of Wildlife and Fisheries (LDWF) required for optimal water quality and aquatic habitat.

**City Park Lake** – City Park Lake is the second largest lake in the system at 54 acres. The lake has an average depth of 2.8 feet, significantly lower than University Lake. Lake depths range from approximately five feet to less than half a foot; deeper areas are near the center of the lake (Figure 3-2). Very little of the lake is deeper than five feet and significant areas near the north and south banks are about one foot deep. The center of the lake adjacent to the I-10 overpass is also shallower, likely because it was excluded from the 1980s dredging activates, due to dredging restrictions near the bridge pilings. City Park Lake is over two feet below the LDWF requirement of an average depth of five feet.

**Campus Lake** – Campus Lake, along with College Lake, is not hydraulically connected to the other four lakes within the Baton Rouge Lakes system. The lake has an average depth of 3.4 feet. Lake depths range from over 6 feet to less than half a foot; deeper areas are near the eastern end of the lake and extremely shallow areas in western end (Figure 3-3). Emergent vegetation has been observed in the western portion of the seven-acre lake and this area of the lake is the shallowest. The lake’s average depth is over a foot below the LDWF requirement of an average depth of five feet.

**College Lake** – College Lake is just over four acres in size and is not hydraulically connected to any other lake in the system. The lake has the greatest average depth of all the lakes in the system at 5.6 feet, exceeding the five-foot LDWF requirement. Lake depths range from over 6 feet to less than half a foot; deeper areas (greater than 5 feet) are located across a large portion of the lake (Figure 3-4).

**Crest Lake** – Crest Lake is nine acres in size and is hydraulically connected with University Lake. The lake has an average depth of 4.7 feet; just below the five-foot LDWF requirement. A large interior portion of the lake is five or more feet deep. Lake depths range from over six feet to less than half a foot (Figure 3-5).

**Erie Lake** – Erie Lake is just over three acres in size and is hydraulically connected to City Park Lake. The lake has an average depth of 2.2 feet; the lowest of all lakes in the system and well below the five-foot LDWF requirement. Lake depths range from over three feet to less than half a foot (Figure 3-6). Most of the lake is less than three feet deep and few areas are greater than three feet. In general, the lake deepens from the north to south.

**Unconsolidated Layer** -- The unconsolidated layer of material that covers much of the lake bottoms was studied during the 2008 Feasibility Study. As part of the study, in October of 2007, depth measurements were recorded at various points throughout the system to obtain a general idea of the bathymetry. These measurements were collected by hand using a collapsible survey rod to the clay bottom of University and City Park Lake. More data were collected when it was determined that an unconsolidated layer covered the entire lake bottom.

Therefore, in October 2007, additional depths were recorded (to the unconsolidated layer). A long metered dowel mounted to a perpendicular piece of plywood, was used to detect the soft upper layer. Depth measurements from the water surface were collected at 560 points in University and City Park Lake. Confined soil samples were also collected to measure the depth of this layer (Figure 3-7). Based on the data collected during the study, the unconsolidated layer had an average depth of approximately 2.1 and 2.0 feet for University and City Park Lakes, respectively. The thickness of the unconsolidated layer tended to increase in deeper portions of the lakes (Figures 3-8 and 3-9).
Figure 3-7. Core Representing the Unconsolidated Layer (2008, USACE)
THICKNESS OF UNCONSOLIDATED LAYER IN UNIVERSITY LAKE
East Baton Rouge Parish
Baton Rouge Area Foundation

Service Layer Credits: Imagery: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Geoalan, GDEOS, MapLab, and the GIS User Community

Depth Grid Source: John Chance Surveyors

Figure: 3-8
Date: June 2014
Scale: 1:8,600
Source: ESRI/IGEC
Map ID: 279602001000-3131
3.2 Geotechnical Results

Soil conditions within the study area generally consisted of cohesive material from the ground surface/mudline to the completion depth of the boring and Geoprobes. Cohesive materials were generally classified as Fat Clay, Lean Clay, and Organic Clay.

Material on the surface or the upper portions of the borings was more organic. The amount of organic material generally increased from the northern portion of City Park Lake to the southern portion of University Lake. The borings did not contain granular material layers or lenses (i.e., sand) within the cohesive materials. Based on the field estimates of the undrained shear strength of the recovered samples in Boring B-1, the consistency of the cohesive material varied from soft to stiff with shear strengths ranging from 400 to 1,600 pounds per square foot (psf). Detailed soil descriptions, approximate strata interfaces, classification test results, and undrained shear strengths are presented on the boring logs on Plates 2 through 14 and the Summary of Tests Results on Plates 17a through 17m of the Geotechnical Report (Appendix B).

Based on the results of the field and laboratory operations, and professional experience, it is anticipated that the settlement of the unconsolidated material in the lakes would be approximately 15 percent of the thickness of material height when the lakes are drained. The depth of the unconsolidated sediment layer to the natural lake bottom could not be distinguished by the sonar equipment. Therefore, data from the 2008 study were used to estimate this information. A 15 percent reduction in thickness is believed to provide a reasonable idea of the reduced unconsolidated soil layer thickness after dewatering. The estimated reduction in average thickness of the unconsolidated layer for University and City Park Lakes, along with the reduction of the weighted average lake depths are shown in Table 3-3. Based on the estimates, dewatering the lakes prior to construction would increase the depth of University and City Park Lakes by 0.3 feet.

<table>
<thead>
<tr>
<th>Lake</th>
<th>Average Layer Thickness (2008 - Ft.)</th>
<th>Weighted Average Lake Depths (Ft.)</th>
<th>Dewatered Layer Thickness (Ft.)</th>
<th>Adjusted Weighted Average Lake Depths (Ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>University</td>
<td>2.1</td>
<td>4.0</td>
<td>1.8</td>
<td>4.3</td>
</tr>
<tr>
<td>City Park</td>
<td>2.0</td>
<td>2.8</td>
<td>1.7</td>
<td>3.1</td>
</tr>
</tbody>
</table>

The strength of the dredged materials disposed along the shoreline will be a function of a number of factors such as placement methods, water drainage, soil classification, organic content, and compaction effort. The range of soil strength could vary significantly depending on these factors. The shear strength of dredged material placed in controlled lifts and compacted to 90 to 95 percent standard proctor dry density and moisture content within 3 percent of optimum may be on the order of 500 psf. The soil strength of hydraulic material dredged and placed with limited drainage and no compactive effort will be less than 100 psf.

4.0 CONCLUSIONS

Ecosystem -- The results of the data collection effort show that based on LDWF benchmarks for water quality and aquatic habitat, and the potential for reduction in the unconsolidated layer described by the geotechnical results, deepening of University and City Park Lakes would benefit the ecosystem. If the nature of the unconsolidated layer is assumed to be similar among all lakes, then Campus, Crest, and Erie Lakes would benefit from deepening as well. Although the average depth of College Lake exceeds LDWF criteria, deepening would provide benefits and ensure that the lake’s aquatic function remains optimal for an extended period.
Constructability -- No sand layers were identified within the study area and both control structures are operating as intended. Therefore, the risk of seepage occurring during excavation of the lakes is minimal. Additionally, the higher-resolution data provided by the bathymetric and topographic surveys indicate that University, College, Crest, and Campus Lakes are deeper than reported by the 2008 study, indicating that less excavation may be required to achieve depth benchmarks within those lakes (Table 4-1).

City Park and Campus Lakes appear to be shallower than previously anticipated, thereby resulting in the potential for increased excavation requirements. It should be noted that the quantity of material required for excavation will vary depending on the scope and construction methodology recommended by the Baton Rouge Lakes Master Plan. The information provided in this data report should be used in the development, evaluation, and design of all recommended actions provided by the Master Plan.

### Table 4-1. Comparison of Measured Average Lake Depths from 2008 to Present

<table>
<thead>
<tr>
<th>Lake</th>
<th>Average Depth (Ft.)*</th>
<th>2008 Study (Ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>University</td>
<td>4.0</td>
<td>3.8</td>
</tr>
<tr>
<td>City Park</td>
<td>2.8</td>
<td>3.5</td>
</tr>
<tr>
<td>Campus</td>
<td>3.4</td>
<td>4.0</td>
</tr>
<tr>
<td>College</td>
<td>5.6</td>
<td>4.0</td>
</tr>
<tr>
<td>Crest</td>
<td>4.7</td>
<td>4.0</td>
</tr>
<tr>
<td>Erie</td>
<td>2.2</td>
<td>2.0</td>
</tr>
</tbody>
</table>

* Referenced to water level

Dredged Material Usage -- The geotechnical report stipulates that the strength of material to be dredged from the lake bottoms and placed within the system, as stipulated by the Master Plan, will depend on the placement method, water drainage, soil classification, organic content, and compaction effort. It is recommended that the appropriate construction techniques are used during dredged material placement to increase the strength of disposed material and allow the flocculent material within the unconsolidated layer to properly dewater before placement. It is also recommended that if the lake system is drained and excavated material is placed onsite, proper dewatering and compaction methods are used prior to placement of the material.
Prepared By:

BATHYMETRIC SURVEY
FOR
CITY PARK, UNIVERSITY LAKE, CREST LAKE,
ERIE LAKE, CAMPUS LAKE & COTTAGE LAKE
East Baton Rouge Parish, Louisiana

Prepared For:
G.E.C., INC.
Jonathan E. Puls, P.E. Project Manager
Email: jpuls@gecinc.com
Direct Phone: (225) 612-4249| Fax (225) 612-4270
8282 Goodwood Blvd. Baton Rouge, LA 70806
Baton Rouge, LA 70806

John Chance Land Surveys, Inc.
200 Dulles Drive
Lafayette, Louisiana 70506

JCLS Project No. 2014-0170

May 8, 2014
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   2. Bathymetric Unit
   3. Static GPS Survey combined with Real-time Kinematic (RTK) Survey

B  VICINITY MAPS

C  PICTURES
1.0 INTRODUCTION

John Chance Land Surveys, Inc. was contracted by G.E.C., INC. to perform a bathymetric survey in City Park, University Lake, Crest Lake, Erie Lake, Campus Lake & Cottage. This survey was performed in East Baton Rouge Parish, Louisiana. The survey location is shown on the attached survey maps along with the survey results in NAD88 Louisiana South State Plane.

The survey was performed on April 15-17, 2014 aboard a Fugro vessel. Data acquisition was accomplished using the HYPACK® System. Single beam data was obtained using an Odom Hydrotrac to determine water depths. Water depths were tide adjusted to NAVD 88 using HYPACK® RTK tides.

2.0 SYSTEM DESCRIPTION AND METHODOLOGY

Exposed land sections were surveyed using RTK methods. Single beam data was obtained using an Odom Hydrotrac to determine water depths. Water depths were taken from soundings and echo sounder.

3.0 SURVEY CONTROL

Survey monument was established near the survey area of the lakes. The horizontal coordinates are referenced to the North American Datum of 1988, Lambert Projection Clarke, 1866 Spheroid and Louisiana South Zone. Vertical control was referenced to N.A.V.D. 88 using (RTK) with base station set on monument #100 with a Y= 694,263.61 and X= 3334274.407 and elevation of 23.49'.

APPENDICES

A. EQUIPMENT DESCRIPTIONS

1. HYPACK® Navigation and Acquisition Software

HYPACK, Inc. develops Windows-based software for the hydrographic and dredging industry and is one of the most successful worldwide providers of hydrographic and navigation software. HYPACK® is one of the most widely used hydrographic surveying packages in the world, with over 4,000 users. It provides the surveyor with all of the tools needed to design their survey, collect data, process it, reduce it, and generate final products.

2. Bathymetric Units

Water depths are measured with a Hydrotrac echo sounder, which collects analog paper records as well as digitized depth information for output to a data logger. Digital depth data can be logged direct to the navigation computer along with date, time, and position for later post processing and mapping. The system can be deployed on a small workboat or inflatable, and includes a recording unit with built in digitizer and transceiver, and a side mounted transducer.
3. **Static GPS Survey combined with Real-time Kinematic (RTK) Survey**

Upon setting up the RTK base station at the unknown GPS point and initializing the rover unit, a QC shot was measured near the base monument to verify that the system was operational and delivering corrected positions. The GPS Base Station performed a static session at the monument.

Upon returning to the office, the GPS Static data was downloaded and post-processed utilizing National Geodetic Survey’s Online User Positioning Service (OPUS) on the Web to determine the 3-D Position relative to datum’s used. The OPUS Solution for the GPS Base Point was then used to post-process the RTK data, relative to the base with sub-centimeter relative accuracy.

4. **Scanning Sonar Imaging Survey**

The Simrad MS1000 High Resolution Scanning Sonar System was utilized to scan the sea floor in a 360-degree panoramic view at a maximum scan range of 100 meters. The 360-degree sonar revolves on a tripod standing 3 feet above the sea floor using a frequency of 675 kHz. Acoustic responses are translated onto a color monitor and digitally recorded for future reference.

The scanning sonar data showed scattered tree stump in six (6) of twelve (12) proposed soil boring locations. Also observed were mud mound. Please note that the scanning sonar is only capable of detecting features on or above the lake floor. Otherwise, no significant sonar and anomaly contacts were observed in the area survey. Note see Pictures for details.
B. VICINITY MAPS

Baton Rouge
() Lakes Survey
East Baton Rouge Parish, Louisiana

Survey Area

Figure 1
C. PICTURES

Proposed Soil Boring #1

![Picture 1]

Proposed Soil Boring #2

![Picture 2]
Proposed Soil Boring #3

Proposed Soil Boring #4
Proposed Soil Boring #5

Picture 5

Proposed Soil Boring #6

Picture 6
Proposed Soil Boring #7

Proposed Soil Boring #8
Proposed Soil Boring #9

Picture 9

Proposed Soil Boring #10

Picture 10
Proposed Soil Boring #11

Picture 11

Proposed Soil Boring #12

Picture 12
GEOTECHNICAL SERVICES
LSU LAKES
BATON ROUGE, LOUISIANA

GEC, INC.
BATON ROUGE, LOUISIANA
Introduction

Fugro Consultants, Inc. (Fugro) is pleased to present this report of our geotechnical services for the above referenced project. Our services were requested by Mr. Jonathan Puls, with Gulf Engineers and Consultants, Inc. (GEC), during a phone conversation and subsequent e-mail to Ms. Brenda Novoa, P.E., with Fugro, on July 29, 2013. GEC authorized our services on March 27, 2014 by signing our proposal. Our services were performed in general accordance with our Proposal No. 04.55134077, dated February 5, 2014.

Project Description. We understand that GEC is assisting the Baton Rouge Area Foundation in a study of a series of several lakes in Baton Rouge collectively designated the “LSU Lakes.” This study will aid in the planning of proposed dredging of the lakes to provide additional hydraulic capacity while also creating additional recreational space near the existing shoreline of the lakes. In order to evaluate the existing water depth and subsurface conditions, GEC requested Fugro perform a geotechnical exploration and bathymetric survey within designated areas of the lakes. No engineering services were requested for this project.

Scope of Services. Our scope of services for the project consisted of the following:

- performing a bathymetric survey
- performing twelve (12) Geoprobes to a depth of about 20-ft each below the existing mudline elevation; eight (8) in University Lake and four (4) in City Park Lake (total of 240 lineal feet);
- drilling one (1) land-based soil boring to a depth of about 50-ft below existing grade in the area between University and City Park Lake;
- performing laboratory tests on selected soil samples to evaluate classification properties of the subsurface soils; and,
• preparing this report summarizing our data collection and observations.

Environmental assessment, compliance with state and federal regulatory requirements, assessment of potential migration, and/or environmental analyses, including the investigation, detection, or design related to biological pollutants such as mold, fungus, spores, etc., were beyond the scope of this exploration. A fault study was also beyond the scope of our services.

**Applicability of Report.** The explorations for this project were selected or developed by Fugro based on our understanding of the project. The observations presented in this report may not apply to locations not explored by our borings or areas outside the project boundaries.

We have prepared this report exclusively for Gulf Engineers and Consultants, Inc. to present geotechnical information related to the LSU lakes study discussed herein. We have performed our services using the standard level of care and diligence normally practiced by recognized engineering firms now performing similar services under similar circumstances. We intend for this report, including all illustrations, to be used in its entirety. This report should be made available for information only and not as a warranty of subsurface conditions.

**Field Exploration**

Our field exploration is discussed in this section. We have included a discussion on the drilling methods and boring locations, sampling methods and borehole completion methods used in our exploration. In addition, we have included a discussion of the bathymetric survey performed for this project.

**Drilling Methods and Boring Locations.** The soil boring and 12 Geoprobes for this exploration were performed between April 22, 2014 and April 25, 2014. The locations of the boring and Geoprobes were selected and located in the field by Fugro. The soil boring is designated B-1. The Geoprobes are designated G-1 through G-12. The coordinates of the soil boring and Geoprobes are included on the boring logs (Plates 2 through 14) attached to this report. The approximate locations of the soil boring and Geoprobes are shown on the Plan of Borings/Geoprobes and Site/Vicinity Map on Plate 1.

The soil boring was drilled using truck-mounted drilling equipment. Dry-auger drilling techniques were used from a depth of 0- to 16-ft in an effort to measure the depth to water in the open borehole. Free water was not encountered during the dry-auger drilling interval. Drilling then continued to the boring completion depth using wet-rotary methods.

The Geoprobes were performed using marsh-buggy-mounted Geoprobe equipment. The Geoprobe uses static and percussion methods to drive a sampler into the ground to obtain disturbed soil samples.
Soil Sampling Methods. At the location of Boring B-1, soil samples were taken at about 2-ft intervals from the ground surface to a depth of 16-ft and at about 5-ft intervals thereafter to the completion depth of the boring. Undisturbed samples of cohesive soils were obtained by hydraulically pushing a 3-inch-diameter, thin-walled tube a distance of about 24-inches. Our field procedure for cohesive soil sampling was conducted in general accordance with the Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587). The samples were extruded in the field and visually classified by one of our geotechnical personnel. We obtained field estimates of the undrained shear strength of the recovered samples using a calibrated hand penetrometer and/or torvane. The field estimates of strength are presented on the boring log on Plate 2 and on the Summary of Test Results on Plates 17a through 17m. Portions of each recovered soil sample were placed into appropriate containers for transportation to our laboratory.

At the Geoprobe locations, soil samples were taken at 4-ft intervals from the ground surface to the completion depth of the Geoprobes. The samples were collected in a clear, plastic sleeve and were labeled and packaged for transportation to our laboratory.

Borehole Completion. The soil boring B-1 for this exploration was backfilled upon completion with cement-bentonite grout. We grouted the borehole from the bottom up. When grout returned to the surface, we topped off the borehole by pouring grout from the surface.

Bathymetric Survey. John Chance Land Surveys, Inc. (Chance) performed a bathymetric survey in City Park Lake, University Lake, Erie Lake, Cottage Lake, Crest Lake, and Campus Lake. The bathymetric survey was performed between April 15 and 17, 2014. The results of the bathymetric survey are included in Appendix A at the end of this report.

Laboratory Testing

The laboratory testing program for this exploration was directed toward evaluating the classification properties of the subsurface soils. Our laboratory tests were performed in general accordance with the appropriate standards as tabulated at the end of this section. The results of our laboratory tests are presented on the boring logs on Plates 2 through 14, the grain size distribution curves on Plate 16 and on the Summary of Test Results on Plates 17a through 17m. A key to the terms and symbols used on the boring logs is presented on Plates 15a and 15b.
Classification Tests. The classification tests included tests for natural moisture content, liquid and plastic limits (collectively termed Atterberg Limits), and grain size distribution. These tests aid in classifying the soils and are used to correlate the results of other tests performed on samples taken from different borings and/or different depths. The results of the classification tests are presented on the boring logs on Plates 2 through 14, the grain size distribution curves on Plate 16, and the Summary of Test Results on Plates 17a through 17m.

Summary of Test Methods. The laboratory testing program conducted for this exploration is summarized in the table below. The results of our laboratory tests are presented on the boring logs on Plates 2 through 14, the grain size distribution curves on Plate 16, and the Summary of Test Results on Plates 17a through 17m.

<table>
<thead>
<tr>
<th>Type of Test</th>
<th>Number of Tests</th>
<th>Test Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture Content</td>
<td>46</td>
<td>ASTM D2216</td>
</tr>
<tr>
<td>Atterberg Limits</td>
<td>36</td>
<td>ASTM D4318</td>
</tr>
<tr>
<td>Percent Fines</td>
<td>12</td>
<td>ASTM D1140</td>
</tr>
<tr>
<td>Hydrometer Analysis</td>
<td>3</td>
<td>ASTM D422</td>
</tr>
</tbody>
</table>

General Subsurface Conditions. The subsurface soil conditions at the site, as discussed herein, were explored by drilling 1 soil boring to a depth of about 50-ft below existing grade and 12 Geoprobes, to a depth of about 20-ft each below the existing mudline elevation. Based on a review of the field and laboratory tests performed on the soils collected at the site, the soil conditions at the site generally consist of cohesive material from the ground surface/mudline to the completion depth of the boring and Geoprobes. The cohesive materials were generally described as Fat Clay, Lean Clay and Organic Clay. The surficial layers were significantly more organic in the southern half of University Lake compared to the northern half and City Park Lake. Granular material layers or lenses, i.e. sand, were not found within the cohesive materials. Additional information related to stratigraphy is included on the generalized subsurface profiles on Plate 18. Based on the field estimates of the undrained shear strength of the recovered samples in Boring B-1, the consistency of the cohesive material varied from soft to stiff with shear strengths ranging from 0.4 to 1.6 ksf. Detailed soil descriptions, approximate strata interfaces, classification test results, SPT N-values, and undrained shear strengths are presented on the boring logs on Plates 2 through 14 and the Summary of Tests Results on Plates 17a through 17m. A key identifying the terms and symbols used on the boring logs is presented on Plates 15a and 15b.

Unconsolidated Material Anticipated Settlement and Strength

Based on the results of our field and laboratory operations and our experience, we anticipate the settlement of the unconsolidated material found in the lakes to be about 15% of the thickness of
unconsolidated material height when the lakes are drained. The depth to the interface of recent, unconsolidated sediments and the natural lake bottom could not be distinguished in our study. The thickness of the compressible zone should be taken as the distance between the mudline and the depth to which the ground water is lowered. We believe this 15% reduction in thickness will provide a reasonable idea of the reduced unconsolidated soil layer thickness after dewatering.

The strength of the dredged materials disposed along the shoreline will be a function of a number of factors like placement methods, water drainage, soil classification, organic content and compaction effort. The range of soil strength could vary significantly depending on the above-mentioned factors. For dredged material placed in controlled lifts and compacted to 90 to 95% standard proctor dry density and a moisture content within 3% of optimum, the shear strength may be on the order of 500 psf. For hydraulic material dredged and placed with limited drainage and no compactive effort, the soil strength will be less than 100 psf.
The following illustrations are attached and complete this report:

<table>
<thead>
<tr>
<th>Illustration</th>
<th>Plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan of Borings and Site/Vicinity Map</td>
<td>1</td>
</tr>
<tr>
<td>Boring Logs</td>
<td>2 through 14</td>
</tr>
<tr>
<td>Key to Terms and Symbols on the Boring Logs</td>
<td>15a and 15b</td>
</tr>
<tr>
<td>Grain Size Distribution Curves</td>
<td>16</td>
</tr>
<tr>
<td>Summary of Test Results</td>
<td>17a through 17m</td>
</tr>
<tr>
<td>Generalized Subsurface Profile</td>
<td>18</td>
</tr>
<tr>
<td>Bathymetric Survey</td>
<td>Appendix A</td>
</tr>
</tbody>
</table>

Closing

We appreciate the opportunity to be of service to Gulf Engineers and Consultants, Inc. Please contact us if you have any questions or comments concerning this report, or when we may be of further assistance.

Sincerely,

FUGRO CONSULTANTS, INC.

Dillon Braud, E.I.
Project Professional

Brenda Novoa, P.E.
Senior Professional

Copies Submitted: 1 – E-mail (jpuls@gecinc.com)
REFERENCE:
Images by Google Earth Pro.
**STRATUM DESCRIPTION**

**FAT CLAY (CH),** firm to stiff, brown and gray
- with roots from 2' to 8'
- soft at 8'
- gray below 8'
- with organics at 10'
- with ferrous nodules from 13' to 16'
- with roots at 18'

**ORGANIC CLAY (OH),** firm to stiff, gray
- with roots from 2 to 8'

---

**NOTES:**
1. Terms and symbols defined on Plates 15a and 15b.
2. Water was not encountered during dry-auger drilling interval.
<table>
<thead>
<tr>
<th>STRATUM DESCRIPTION</th>
<th>WATER CONTENT, %</th>
<th>PLASTICITY INDEX (PI)</th>
<th>UNCONFINED SHEAR STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORGANIC CLAY (OH), firm to stiff, gray</td>
<td>29</td>
<td>48</td>
<td>15</td>
</tr>
<tr>
<td>LEAN CLAY (CL), firm to stiff, gray</td>
<td>33</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
1. Terms and symbols defined on Plates 15a and 15b.
2. Water was not encountered during dry-auger drilling interval.

**COMPLETION DATE:** April 22, 2014
**TOTAL DEPTH:** 50’
**CAVED DEPTH:** Not Applicable
**DRY AUGER:** 0’ to 16’
**WET ROTARY:** 16’ to 50’
**BACKFILL:** Cement-Bentonite Grout
**LOGGER:** D. Braud
### Log of Boring No. G-1

**LOCATION:** See Plate 1

**COORDINATES:** N 30° 25' 40.8”
W 91° 10' 02.9”

**SURFACE EL.:** 0.0’ Not Available

**DEPTH, FT**

<table>
<thead>
<tr>
<th>STRATUM DESCRIPTION</th>
<th>WATER LEVEL</th>
<th>SYMBOL</th>
<th>PASSING NO. 200 %</th>
<th>UNIT DRY WT.</th>
<th>CONDUCTIVITY %</th>
<th>PLASTIC LIMIT</th>
<th>LIQUID LIMIT</th>
<th>SHEAR STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>FATTY CLAY (CH), brown and gray</td>
<td>0.5</td>
<td>1.0</td>
<td>1.5</td>
<td>2.0</td>
<td>2.5</td>
<td>Penetrometer</td>
<td>Unconfined</td>
<td>Torvane</td>
</tr>
<tr>
<td>FAT CLAY (CH), greenish gray</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- with calcareous nodules at 12’
- with ferrous staining below 13’
- with silt traces at 16’
- with calcareous nodules below 18’ |
| LEAN CLAY (CL), dark gray, with organics |
| FAT CLAY (CH), brown and gray |

**NOTES:**
1. Terms and symbols defined on Plates 15a and 15b.

**COMPLETION DATE:** April 25, 2014

**TOTAL DEPTH:** 20’

**CAVED DEPTH:** Not Applicable

**DRY AUGER:** Not Applicable

**WET ROTARY:** Not Applicable

**BACKFILL:** Not Applicable

**LOGGER:** J. Ator

**LSU Lakes**

**LOG OF BORING NO. G-1**

**Fugro Consultants, Inc.**

**Baton Rouge, Louisiana**

**Project No.** 04.55134077

**PLATE 3**
<table>
<thead>
<tr>
<th>STRATUM DESCRIPTION</th>
<th>WATER CONTENT, %</th>
<th>PLASTICITY INDEX (PI)</th>
<th>SHEAR STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEAN CLAY (CL), dark gray</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- brown and gray below 4'</td>
<td>- with organics below 4'</td>
<td>- with silt traces from 5' to 7'</td>
<td></td>
</tr>
<tr>
<td>FAT CLAY (CH), tan and light gray</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- with ferrous staining from 12' to 14'</td>
<td>- reddish brown below 14'</td>
<td>- with sand traces and calcareous nodules below 15'</td>
<td></td>
</tr>
<tr>
<td>LEAN CLAY (CL), light gray and brown, with organics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- with ferrous staining below 17'</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### NOTES:
1. Terms and symbols defined on Plates 15a and 15b.

### LOG OF BORING NO. G-2

**LSU Lakes**

**Fugro Consultants, Inc.**

**Location:** Baton Rouge, Louisiana

**Project No.:** 04.55134077

**Plate:** 4

**Completion Date:** April 25, 2014

**Total Depth:** 20'

**Caved Depth:** Not Applicable

**Dry Auger:** Not Applicable

**Wet Rotary:** Not Applicable

**Backfill:** Not Applicable

**Logger:** J. Ator
FAT CLAY (CH), gray, with organics

- dark gray and brown from 8' to 10'

- brown and gray below 16'

COMPLETION DATE: April 24, 2014
TOTAL DEPTH: 20'
CAVED DEPTH: Not Applicable
DRY AUGER: Not Applicable
WET ROTARY: Not Applicable
BACKFILL: Not Applicable
LOGGER: J. Ator

NOTES:
1. Terms and symbols defined on Plates 15a and 15b.
**LOCATION:** See Plate 1  
**COORDINATES:** N 30° 25' 21.1"  
W 91° 10' 03.3"  
**SURFACE EL.:** 0.0' Not Available

**STRATUM DESCRIPTION**

<table>
<thead>
<tr>
<th>Depth, FT</th>
<th>Water Level, FT</th>
<th>Symbol</th>
<th>Samples</th>
<th>Blows Per Foot</th>
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<tbody>
<tr>
<td>0.0</td>
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</tr>
<tr>
<td>6.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ORGANIC CLAY (OH), dark gray**

**FAT CLAY (CH), gray, with organics**

- with calcareous nodules from 4' to 6'

**CLASSIFICATION**

<table>
<thead>
<tr>
<th>Stratum</th>
<th>Depth, FT</th>
<th>Plasticity Index (PI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORGANIC CLAY (OH)</td>
<td>1.0</td>
<td>229</td>
</tr>
<tr>
<td>FAT CLAY (CH)</td>
<td>1.0</td>
<td>159</td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td>46</td>
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<tr>
<td></td>
<td>3.0</td>
<td>113</td>
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**SHEAR STRENGTH**

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<tr>
<th>Kips Per Sq Ft</th>
<th>0.5</th>
<th>1.0</th>
<th>1.5</th>
<th>2.0</th>
<th>2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unconfined</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torvane</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triaxial</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miniature Vane</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

1. Terms and symbols defined on Plates 15a and 15b.

**COMPLETION DATE:** April 24, 2014  
**TOTAL DEPTH:** 20'  
**CAVED DEPTH:** Not Applicable  
**DRY AUGER:** Not Applicable  
**WET ROTARY:** Not Applicable  
**BACKFILL:** Not Applicable  
**LOGGER:** J. Ator

---

**LSU Lakes**

**Fugro Consultants, Inc.**

Baton Rouge, Louisiana

**LOG OF BORING NO. G-4**

**Project No.** 04.55134077  
**PLATE 6**
**Location:** See Plate 1  
**Coordinates:** N 30° 25' 13.3"  
W 91° 10' 07.8"  
**Surface El.:** Not Available  

**Log of Boring No. G-5**  
**From:** Fugro Consultants, Inc.  
**To:** LSU Lakes, Baton Rouge, Louisiana  
**Project No.:** 04.55134077  
**Date:** April 23, 2014  
**Total Depth:** 20'  
**Caved Depth:** Not Applicable  
**Dry Auger:** Not Applicable  
**Wet Rotary:** Not Applicable  
**Backfill:** Not Applicable  
**Logger:** J. Ator

<table>
<thead>
<tr>
<th>Depth, Ft</th>
<th>Stratum Description</th>
<th>Wet Content, %</th>
<th>Plasticity Index (PI)</th>
<th>Shear Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>FAT CLAY (CH), gray, with organics</td>
<td>62</td>
<td>98</td>
<td>32</td>
</tr>
<tr>
<td>5-10</td>
<td>- brown and gray from 4' to 12'</td>
<td>41</td>
<td>87</td>
<td>27</td>
</tr>
<tr>
<td>10-20</td>
<td>- with ferrous staining from 7' to 12'</td>
<td>99</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td></td>
<td></td>
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</tbody>
</table>

**Notes:**  
1. Terms and symbols defined on Plates 15a and 15b.
<table>
<thead>
<tr>
<th>DEPTH, FT</th>
<th>WATER LEVEL SYMBOL</th>
<th>SAMPLES</th>
<th>BLOWS PER FOOT</th>
<th>STRATUM DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>ORGANIC CLAY (OH), brown and gray</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>- gray below 12'</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
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<tr>
<td>20</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>STRATUM DEPTH, FT</th>
<th>CLASSIFICATION</th>
<th>SHEAR STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
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<tr>
<td>5</td>
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<tr>
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<td>15</td>
<td></td>
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<tr>
<td>20</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>STRATUM DEPTH, FT</th>
<th>WATER CONTENT, %</th>
<th>PLASTICITY INDEX (PI)</th>
<th>SHEAR STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>20</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMPLETION DATE:** April 23, 2014  
**TOTAL DEPTH:** 20'  
**CAVED DEPTH:** Not Applicable  
**DRY AUGER:** Not Applicable  
**WET ROTARY:** Not Applicable  
**BACKFILL:** Not Applicable  
**LOGGER:** J. Ator

**NOTES:**  
1. Terms and symbols defined on Plates 15a and 15b.
<table>
<thead>
<tr>
<th>STRATUM DESCRIPTION</th>
<th>WATER CONTENT, %</th>
<th>PLASTICITY INDEX (PI)</th>
<th>SHEAR STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORGANIC CLAY (OH), gray</td>
<td>143</td>
<td>117</td>
<td>31</td>
</tr>
<tr>
<td>- with ferrous staining at 12'</td>
<td>99</td>
<td>71</td>
<td>113</td>
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</table>

**NOTES:**
1. Terms and symbols defined on Plates 15a and 15b.

**COMPLETION DATE:** April 23, 2014
**TOTAL DEPTH:** 20'
**CAVED DEPTH:** Not Applicable
**DRY AUGER:** Not Applicable
**WET ROTARY:** Not Applicable
**BACKFILL:** Not Applicable
**LOGGER:** J. Ator
FAT CLAY (CH), brown and gray, with organics
- gray below 8'

ORGANIC CLAY (OH), gray

LEAN CLAY (CL), gray, with organics

WATER CONTENT, %

PLASTICITY INDEX (PI)

SHEAR STRENGTH CLASSIFICATION

Unconfined

WATER LEVEL

SAMPLES

BLOWS PER FOOT

PASSING NO. 200 SIEVE, %

UNITS DRY WT, PCF

LIQUID LIMIT

PLASTIC LIMIT

PLASTICITY INDEX (PI)

TOTAL DEPTH: 20'

TOTAL DRY WT, Not Applicable

CATHED DEPTH: Not Applicable

BLOWFILL: Not Applicable

DRAIN AUGER: Not Applicable

WET AUGER: Not Applicable

LOCATION: See Plate 1

SURFACE EL.: 0.0' Not Available

DEPTH, FT

COORDINATES:

LOCATION: See Plate 1

STRATUM DESCRIPTION

STRATUM DEPTH, FT

DEPTH, FT

WALKING DATE: April 24, 2014

RECORDS: Fugro Consultants, Inc.

FCBR_LOG (FINAL) 04.55134077.GPJ  FUGRO DATA TEMPLATE 042610.GDT  05/23/14

NOTES:
1. Terms and symbols defined on Plates 15a and 15b.
**ORGANIC CLAY (OH), brown and gray**
- gray below 16'
- with ferrous staining at 16'
- with organics below 17'

**LEAN CLAY (CL), brown and gray**
- gray below 16'
- with ferrous staining at 16'

<table>
<thead>
<tr>
<th>STRATUM DESCRIPTION</th>
<th>WATER CONTENT, %</th>
<th>PLASTICITY INDEX (PI)</th>
<th>SHEAR STRENGTH</th>
<th>UNCONFINED UN ( \geq 2 )</th>
<th>PENETROMETER</th>
<th>TORVANE</th>
<th>TRIAXIAL</th>
<th>HAND VANE</th>
<th>MINIATURE VANE</th>
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</thead>
<tbody>
<tr>
<td>ORGANIC CLAY (OH)</td>
<td>96</td>
<td>85</td>
<td>137</td>
<td>41</td>
<td>96</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lean Clay (CL)</td>
<td>160</td>
<td>212</td>
<td>73</td>
<td>139</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>159</td>
<td>187</td>
<td>44</td>
<td>143</td>
<td></td>
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**Notes:**
1. Terms and symbols defined on Plates 15a and 15b.

**Completion Date:** April 23, 2014
**Total Depth:** 20'
**Caved Depth:** Not Applicable
**Dry Auger:** Not Applicable
**Wet Rotary:** Not Applicable
**Backfill:** Not Applicable
**Logger:** J. Ator
<table>
<thead>
<tr>
<th>STRATUM DESCRIPTION</th>
<th>WATER CONTENT, %</th>
<th>PLASTICITY INDEX (PI)</th>
<th>SHEAR STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORGANIC CLAY (OH), greenish gray and gray</td>
<td>91</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>- gray below 4'</td>
<td>103</td>
<td>125</td>
<td>37</td>
</tr>
<tr>
<td>- brown at 12'</td>
<td>142</td>
<td>142</td>
<td>34</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Terms and symbols defined on Plates 15a and 15b.

**LOCATION:** See Plate 1

**COORDINATES:** N 30° 24' 46.9"
W 91° 09' 56.2"

**SURFACE EL.:** 0.0' Not Available

**COMPLETION DATE:** April 24, 2014

**TOTAL DEPTH:** 20'

**CAVED DEPTH:** Not Applicable

**DRY AUGER:** Not Applicable

**WET ROTARY:** Not Applicable

**BACKFILL:** Not Applicable

**LOGGER:** J. Ator
<table>
<thead>
<tr>
<th>STRATUM DESCRIPTION</th>
<th>WATER CONTENT, %</th>
<th>PLASTICITY INDEX (PI)</th>
<th>SHEAR STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORGANIC CLAY (OH), brown and dark gray</td>
<td>160</td>
<td>205</td>
<td>0.5</td>
</tr>
<tr>
<td>- gray below 9'</td>
<td>179</td>
<td>174</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>179</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>179</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>111</td>
<td>131</td>
<td>2.5</td>
</tr>
</tbody>
</table>

**LOCATION:** See Plate 1

**COORDINATES:** N 30° 24' 35.9”
W 91° 09' 49.6”

**SURFACE EL.:** 0.0’ Not Available

**COMPLETION DATE:** April 22, 2014

**TOTAL DEPTH:** 20’

**CAVED DEPTH:** Not Applicable

**DRY AUGER:** Not Applicable

**WET ROTARY:** Not Applicable

**BACKFILL:** Not Applicable

**LOGGER:** J. Ator

**NOTES:**
1. Terms and symbols defined on Plates 15a and 15b.
### Stratum Description

**ORGANIC CLAY (OH), brown and gray**

- gray below 4'

---

### Table: Classification and Shear Strength

<table>
<thead>
<tr>
<th>STRATUM DESCRIPTION</th>
<th>WATER CONTENT, %</th>
<th>PLASTIC LIMIT</th>
<th>PENETRATION INDEX (PI)</th>
<th>SHEAR STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Table: Water Level Samples

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PASSING NO. 200 SIEVE, %</th>
<th>UNIT DRY WT. PCF</th>
<th>LIQUID LIMIT</th>
<th>STRATUM DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes:

1. Terms and symbols defined on Plates 15a and 15b.

---

**COMPLETION DATE:** April 22, 2014

**TOTAL DEPTH:** 20'

**CAVED DEPTH:** Not Applicable

**DRY AUGER:** Not Applicable

**WET ROTARY:** Not Applicable

**BACKFILL:** Not Applicable

**LOGGER:** J. Ator

---

**Fugro Consultants, Inc.**

**LSU Lakes**

**LOG OF BORING NO. G-12**

---

**Project No.**

**PLATE 14**
SOIL TYPES

- Fat clay, high plasticity
- Lean clay, low to moderate plasticity
- Silty Clay
- Fill (made ground)
- Low to moderate plasticity silt
- Silty Sand
- Clean sand, poorly graded
- Organics or clayey silts
- Organic Silts or Clayey Silts
- Layer
- Laminated
- Slickensided
- Fissured
- Pocket
- Parting
- Seam
- Interlayered
- Intermixed
- Calcareous
- Carbonate

SAMPLE TYPES

- Auger
- Thin-walled Tube
- Partial Recovery w/ Tube
- Pitcher
- Split-barrel
- No Recovery
- Piston
- Geoprobe
- Liner

SOIL GRAIN SIZE

<table>
<thead>
<tr>
<th>Boulders</th>
<th>Cobble</th>
<th>Gravel</th>
<th>Sand</th>
<th>Silt</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

U.S. Standard Sieve

<table>
<thead>
<tr>
<th>Size</th>
<th>Coarse</th>
<th>Fine</th>
<th>Coarse</th>
<th>Medium</th>
<th>Fine</th>
<th>Silt</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>152</td>
<td>19.0</td>
<td>4.75</td>
<td>2.00</td>
<td>0.425</td>
<td>0.075</td>
<td>0.005</td>
<td></td>
</tr>
</tbody>
</table>

PLASTICITY CHART

SOIL STRUCTURE

- Slickensided: Having planes of weakness that appear slick and glossy.
- Fissured: Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
- Pocket: Inclusion of material of different texture that is smaller than the diameter of the sample.
- Parting: Inclusion less than 1/8 inch thick extending through the sample.
- Seam: Inclusion 1/8 inch to 3 inches thick extending through the sample.
- Layer: Inclusion greater than 3 inches thick extending through the sample.
- Laminated: Soil sample composed of alternating partings or seams of different soil type.
- Interlayered: Soil sample composed of alternating layers of different soil type.
- Intermixed: Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
- Calcareous: Having appreciable quantities of carbonate.
- Carbonate: Having more than 50% carbonate content.

SOIL CLASSIFICATION (1 of 2)

TERMS AND SYMBOLS USED ON BORING LOGS
STANDARD PENETRATION TEST (SPT)
A 2-in.-OD, 1-3/8-ID split spoon sampler is driven 1.5 ft into undisturbed soil with a 140-pound hammer free falling 30 in. After the sampler is seated 6 in. into undisturbed soil, the number of blows required to drive the sampler the last 12 in. is the Standard Penetration Resistance or "N" value, which is recorded as blows per foot as described below.

SPLIT-BARREL SAMPLER DRIVING RECORD

<table>
<thead>
<tr>
<th>Blows Per Foot</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>25 blows drove sampler 12 inches, after initial 6 inches of seating.</td>
</tr>
<tr>
<td>50/7*</td>
<td>50 blows drove sampler 7 inches, after initial 6 inches of seating.</td>
</tr>
<tr>
<td>Ref/3*</td>
<td>50 blows drove sampler 3 inches during initial 6-inch seating interval.</td>
</tr>
</tbody>
</table>

NOTE: To avoid damage to sampling tools, driving is limited to 50 blows during or after seating interval.

DENSITY OF GRANULAR SOILS

<table>
<thead>
<tr>
<th>Descriptive Term</th>
<th>*Relative Density, %</th>
<th>**Blows Per Foot (SPT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Loose</td>
<td>&lt; 15</td>
<td>0 to 4</td>
</tr>
<tr>
<td>Loose</td>
<td>15 to 35</td>
<td>5 to 10</td>
</tr>
<tr>
<td>Medium Dense</td>
<td>35 to 65</td>
<td>11 to 30</td>
</tr>
<tr>
<td>Dense</td>
<td>65 to 85</td>
<td>31 to 50</td>
</tr>
<tr>
<td>Very Dense</td>
<td>&gt; 85</td>
<td>&gt; 50</td>
</tr>
</tbody>
</table>

*Estimated from sampler driving record.
**Requires correction for depth, groundwater level, and grain size.

STRENGTH OF COHESIVE SOILS

<table>
<thead>
<tr>
<th>Term</th>
<th>Undrained Shear Strength, ksf</th>
<th>Blows Per Foot (SPT) (approximate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Soft</td>
<td>&lt; 0.25</td>
<td>0 to 2</td>
</tr>
<tr>
<td>Soft</td>
<td>0.25 to 0.50</td>
<td>2 to 4</td>
</tr>
<tr>
<td>Firm</td>
<td>0.50 to 1.00</td>
<td>4 to 8</td>
</tr>
<tr>
<td>Stiff</td>
<td>1.00 to 2.00</td>
<td>8 to 16</td>
</tr>
<tr>
<td>Very Stiff</td>
<td>2.00 to 4.00</td>
<td>16 to 32</td>
</tr>
<tr>
<td>Hard</td>
<td>&gt; 4.00</td>
<td>&gt; 32</td>
</tr>
</tbody>
</table>

SHEAR STRENGTH TEST METHOD

U = Unconfined     Q = Unconsolidated - Undrained Triaxial
P = Pocket Penetrometer     T = Torvane     V = Miniature Vane     F = Field Vane

HAND PENETROMETER CORRECTION

Our experience has shown that the hand penetrometer generally overestimates the in-situ undrained shear strength of over consolidated Pleistocene Gulf Coast clays. These strengths are partially controlled by the presence of macroscopic soil defects such as slickensides, which generally do not influence smaller scale tests like the hand penetrometer. Based on our experience, we have adjusted these field estimates of the undrained shear strength of natural, overconsolidated Pleistocene Gulf Coast soils by multiplying the measured penetrometer reading by a factor of 0.6. These adjusted strength estimates are recorded in the "Shear Strength" column on the boring logs. Except as described in the text, we have not adjusted estimates of the undrained shear strength for projects located outside of the Pleistocene Gulf Coast formations.

Information on each boring log is a compilation of subsurface conditions and soil or rock classifications obtained from the field as well as from laboratory testing of samples. Strata have been interpreted by commonly accepted procedures. The stratum lines on the logs may be transitional and approximate in nature. Water level measurements refer only to those observed at the time and places indicated, and can vary with time, geologic condition, or construction activity.
<table>
<thead>
<tr>
<th>Boring Number</th>
<th>Sample Number</th>
<th>Depth (ft)</th>
<th>Material Description</th>
<th>%Gravel</th>
<th>%Sand</th>
<th>%Silt</th>
<th>%Clay</th>
<th>D100</th>
<th>D60</th>
<th>D30</th>
<th>D10</th>
<th>Cc</th>
<th>Cu</th>
<th>LL</th>
<th>PL</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-1</td>
<td>2</td>
<td>4-5</td>
<td>LEAN CLAY (CL), brown and gray, with organics</td>
<td>0.0</td>
<td>2.7</td>
<td>38.3</td>
<td>59.0</td>
<td>2</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G-4</td>
<td>4</td>
<td>8-9</td>
<td>FAT CLAY (CH), gray, with organics</td>
<td>0.0</td>
<td>1.8</td>
<td>58.9</td>
<td>39.3</td>
<td>2</td>
<td>0.013</td>
<td>0.002</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G-9</td>
<td>7</td>
<td>17-18</td>
<td>LEAN CLAY (CL), gray, with organics</td>
<td>0.0</td>
<td>0.1</td>
<td>82.0</td>
<td>17.9</td>
<td>2</td>
<td>0.023</td>
<td>0.012</td>
<td></td>
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</tr>
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</table>

**USA Standard Sieve Sizes (meets ASTM E11)**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>G-1</th>
<th>G-4</th>
<th>G-9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/16&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/32&quot;</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1/64&quot;</td>
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</tr>
<tr>
<td>1/128&quot;</td>
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</table>

**Hydrometer Analysis**

<table>
<thead>
<tr>
<th>Percent Finer by Weight</th>
<th>D100</th>
<th>D60</th>
<th>D30</th>
<th>D10</th>
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<tbody>
<tr>
<td>100</td>
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<td></td>
</tr>
<tr>
<td>90</td>
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<td>70</td>
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</tr>
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<td>60</td>
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<tr>
<td>50</td>
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<td>40</td>
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<tr>
<td>10</td>
<td></td>
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</tr>
</tbody>
</table>

**Percent Coarser by Weight**

<table>
<thead>
<tr>
<th>Effective Particle Size (mm)</th>
<th>0.1</th>
<th>0.05</th>
<th>0.01</th>
<th>0.005</th>
<th>0.001</th>
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**Material Description**

- Lean Clay (CL), brown and gray, with organics
- Fat Clay (CH), gray, with organics
- Lean Clay (CL), gray, with organics

**Depth (ft)**

- G-1: 4-5
- G-4: 8-9
- G-9: 17-18

**Testing Information**

- Tested By: Eddie Lobell
- Date Tested: 5/14/2014
- Reviewed By: Justin Ator
- Date Reviewed: 5/15/2014
- Project No.: 04.55134077
- Plate: 16

**ASTM D422/D6913/C136**

**PS0.0059.00.012GSA LANDSCAPE 04.55134077.GPJ FUGRO DATA TEMPLATE 0410.GDT 052314**
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Notes:
- TYPE OF TEST:
  - U - Unconfined Compression
  - UU - Unconsolidated - Undrained Triaxial
  - CU - Consolidated - Undrained Triaxial

- TYPE OF FAILUR:
  - A - Bulge
  - B - Single Shear Plane
  - C - Multiple Shear Plane
  - D - Vertical Fracture

- NP = Non-Plastic Material
- "Corrected as described on Terms and Symbols Used on Boring Logs."
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<th>Sample No.</th>
<th>Depth (ft)</th>
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<th>Miniature Vane Tests</th>
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Notes:
NP = Non-Plastic Material
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TYPE OF TEST
U - Unconfined Compression
UU - Unconsolidated - Undrained Triaxial
CU - Consolidated - Undrained Triaxial

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

**SUMMARY OF TEST RESULTS - BORING G-1**

**LELAP Lab ID #10001**

**Baton Rouge, Louisiana**
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<th>Sample No.</th>
<th>Depth (ft)</th>
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Notes:

- NP = Non-Plastic Material
- *Corrected as described on Terms and Symbols Used on Boring Logs.

TYPE OF TEST
- U - Unconfined Compression
- UU - Unconsolidated - Undrained Triaxial
- CU - Consolidated - Undrained Triaxial

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

SUMMARY OF TEST RESULTS - BORING G-2

LSU Lakes

Baton Rouge, Louisiana

Fugro Consultants, Inc

Project No. 04.55134077

PLATE 17c

LELAP Lab ID #10001
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Notes:
- TYPE OF TEST
  - U - Unconfined Compression
  - UU - Unconsolidated - Undrained Triaxial
  - CU - Consolidated - Undrained Triaxial
- TYPE OF FAILURE
  - A - Bulge
  - B - Single Shear Plane
  - C - Multiple Shear Plane
  - D - Vertical Fracture

NP = Non-Plastic Material
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**Notes:**
- **TYPE OF TEST**
  - U - Unconfined Compression
  - UU - Unconsolidated - Undrained Triaxial
  - CU - Consolidated - Undrained Triaxial

- **TYPE OF FAILURE**
  - A - Bulge
  - B - Single Shear Plane
  - C - Multiple Shear Plane
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**Notes:**
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**SUMMARY OF TEST RESULTS - BORING G-4**

Fugro Consultants, Inc

Baton Rouge, Louisiana
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TYPE OF FAILURE
- A - Bulge
- B - Single Shear Plane
- C - Multiple Shear Plane
- D - Vertical Fracture

SUMMARY OF TEST RESULTS - BORING G-5

LSU Lakes

Fugro Consultants, Inc

Baton Rouge, Louisiana
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<th>Penetrometer* (ksf)</th>
<th>Torvane (ksf)</th>
<th>Remolded Shear Strength (ksf)</th>
<th>Type Test</th>
<th>Moisture Content (%)</th>
<th>Confining Pressure (psi)</th>
<th>Shear Strength (ksf)</th>
<th>Remolded Shear Strength (ksf)</th>
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**TYPE OF FAILURE**
- A - Bulge
- B - Single Shear Plane
- C - Multiple Shear Plane
- D - Vertical Fracture

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**SUMMARY OF TEST RESULTS - BORING G-6**

LELAP Lab ID #10001

**Project No.**

04.55134077

**PLATE 17g**
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TYPE OF TEST
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UU - Unconsolidated - Undrained Triaxial
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TYPE OF FAILURE
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B - Single Shear Plane
C - Multiple Shear Plane
D - Vertical Fracture

LSU Lakes

SUMMARY OF TEST RESULTS - BORING G-7

LELAP Lab ID #10001

Project No. 04.55134077 PLATE 17h

Fugro Consultants, Inc

Baton Rouge, Louisiana
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<td>28</td>
</tr>
</tbody>
</table>

Notes:
- NP = Non-Plastic Material
- Corrected as described on Terms and Symbols Used on Boring Logs.
- "U" = Unconfined Compression
- "UU" = Unconsolidated - Undrained Triaxial
- "CU" = Consolidated - Undrained Triaxial
- "A" = Bulge
- "B" = Single Shear Plane
- "C" = Multiple Shear Plane
- "D" = Vertical Fracture

SUMMARY OF TEST RESULTS - BORING G-8

LELAP Lab ID #10001
<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Depth (ft)</th>
<th>Identification Tests</th>
<th>Field Shear Strength Estimate</th>
<th>Miniature Vane Tests</th>
<th>Compression Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Liquid Index</td>
<td>Liquid Limit (%)</td>
<td>Plastic Limit (%)</td>
<td>Moisture Content (%)</td>
</tr>
<tr>
<td>1</td>
<td>0-1</td>
<td>0.46</td>
<td>137</td>
<td>41</td>
<td>85</td>
</tr>
<tr>
<td>2</td>
<td>4-5</td>
<td>0.63</td>
<td>212</td>
<td>73</td>
<td>160</td>
</tr>
<tr>
<td>4</td>
<td>9-10</td>
<td>0.80</td>
<td>187</td>
<td>44</td>
<td>159</td>
</tr>
<tr>
<td>7</td>
<td>17-18</td>
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<td></td>
<td></td>
<td></td>
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<td>8</td>
<td>18-19</td>
<td>0.84</td>
<td>35</td>
<td>21</td>
<td>33</td>
</tr>
</tbody>
</table>

Notes:
NP = Non-Plastic Material
*Corrected as described on Terms and Symbols Used on Boring Logs.

TYPE OF TEST
U - Unconfined Compression
UU - Unconsolidated - Undrained Triaxial
CU - Consolidated - Undrained Triaxial

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

LSU Lakes
Baton Rouge, Louisiana

SUMMARY OF TEST RESULTS - BORING G-9

LELAP Lab ID #10001
Project No. 04.55134077 PLATE 17J
<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Depth (ft)</th>
<th>Identification Tests</th>
<th>Field Shear Strength Estimate</th>
<th>Miniature Vane Tests</th>
<th>Compression Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Liquidity Index</td>
<td>Liquid Limit (%)</td>
<td>Plastic Limit (%)</td>
<td>Moisture Content (%)</td>
</tr>
<tr>
<td>1</td>
<td>0-1</td>
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<td>91</td>
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<td>4-5</td>
<td>0.76</td>
<td>125</td>
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<td>103</td>
</tr>
</tbody>
</table>

Notes:
- **NP** = Non-Plastic Material
- *Corrected as described on Terms and Symbols Used on Boring Logs.*

**SUMMARY OF TEST RESULTS - BORING G-10**

**TYPE OF TEST**
- U - Unconfined Compression
- UU - Unconsolidated - Undrained Triaxial
- CU - Consolidated - Undrained Triaxial

**TYPE OF FAILURE**
- A - Bulge
- B - Single Shear Plane
- C - Multiple Shear Plane
- D - Vertical Fracture

**LSU Lakes**

Fugro Consultants, Inc

Baton Rouge, Louisiana

LELAP Lab ID #10001

Project No. 04.55134077

PLATE 17k
<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Depth (ft)</th>
<th>Identification Tests</th>
<th>Field Shear Strength Estimate</th>
<th>Miniature Vane Tests</th>
<th>Compression Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Liquidity Index</td>
<td>Liquid Limit (%)</td>
<td>Plastic Limit (%)</td>
<td>Moisture Content (%)</td>
</tr>
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<td>0-1</td>
<td>1.41</td>
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<td>49</td>
<td>205</td>
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</table>

Notes:
- **TYPE OF TEST**
  - U - Unconfined Compression
  - UU - Unconsolidated - Undrained Triaxial
  - CU - Consolidated - Undrained Triaxial

- **TYPE OF FAILURE**
  - A - Bulge
  - B - Single Shear Plane
  - C - Multiple Shear Plane
  - D - Vertical Fracture

**LSU Lakes**

**SUMMARY OF TEST RESULTS - BORING G-11**

**LELAP Lab ID #10001**

**Baton Rouge, Louisiana**

**Fugro Consultants, Inc**

**Project No. 04.55134077**

**PLATE 17I**
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<th>Field Shear Strength Estimate</th>
<th>Miniature Vane Tests</th>
<th>Compression Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Liquidity Index (%)</td>
<td>Liquid Limit (%)</td>
<td>Plastic Limit (%) (%)</td>
<td>Moisture Content (%)</td>
</tr>
<tr>
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<td>1-2</td>
<td>1.44</td>
<td>115</td>
<td>32</td>
<td>152</td>
</tr>
<tr>
<td>14</td>
<td>13-14</td>
<td>0.86</td>
<td>199</td>
<td>41</td>
<td>177</td>
</tr>
<tr>
<td>18</td>
<td>17-18</td>
<td>219</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
- **NP** = Non-Plastic Material
- *Corrected as described on Terms and Symbols Used on Boring Logs.*
APPENDIX A

BATHYMETRIC SURVEY
BATHYMETRIC SURVEY
FOR
CITY PARK, UNIVERSITY LAKE, CREST LAKE, ERIE LAKE, CAMPUS LAKE & COTTAGE LAKE
East Baton Rouge Parish, Louisiana

Prepared For:
G.E.C., INC.
Jonathan E. Puls, P.E. Project Manager
Email: jpuls@gecinc.com
Direct Phone: (225) 612-4249| Fax (225) 612-4270
8282 Goodwood Blvd. Baton Rouge, LA 70806
Baton Rouge, LA 70806

John Chance Land Surveys, Inc.
200 Dulles Drive
Lafayette, Louisiana 70506

JCLS Project No. 2014-0170

May 8, 2014
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2.0 SYSTEM DESCRIPTION AND METHODOLOGY

3.0 SURVEY CONTROL

4.0 SCANNING SONAR IMAGING SURVEY

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   1. HYPACK
   2. Bathymetric Unit
   3. Static GPS Survey combined with Real-time Kinematic (RTK) Survey

B  VICINITY MAPS

C  PICTURES
1.0 INTRODUCTION

John Chance Land Surveys, Inc. was contracted by G.E.C., INC. to perform a bathymetric survey in City Park Lake, University Lake, Crest Lake, Erie Lake, Campus Lake & Cottage Lake. This survey was performed in East Baton Rouge Parish, Louisiana. The survey location is shown on the attached survey maps along with the survey results in NAD88 Louisiana South State Plane.

The survey was performed on April 15-17, 2014 aboard a Fugro vessel. Data acquisition was accomplished using the HYPACK® System. Single beam data was obtained using an Odom Hydrotrac to determine water depths. Water depths were tide adjusted to NAVD 88 using HYPACK® RTK tides.

2.0 SYSTEM DESCRIPTION AND METHODOLOGY

Exposed land sections were surveyed using RTK methods. Single beam data was obtained using an Odom Hydrotrac to determine water depths. Water depths were taken from soundings and echo sounder.

3.0 SURVEY CONTROL

Survey monument was established near the survey area of the lakes. The horizontal coordinates are referenced to the North American Datum of 1983, Lambert Projection Clarke, 1866 Spheroid and Louisiana South Zone. Vertical control was referenced to N.A.V.D. 88 using (RTK) with base station set on monument #100 with a Y= 694,263.61 and X= 3334274.407 and elevation of 23.49'.

APPENDICES

A. EQUIPMENT DESCRIPTIONS

1. HYPACK® Navigation and Acquisition Software

HYPACK, Inc. develops Windows-based software for the hydrographic and dredging industry and is one of the most successful worldwide providers of hydrographic and navigation software. HYPACK® is one of the most widely used hydrographic surveying packages in the world, with over 4,000 users. It provides the surveyor with all of the tools needed to design their survey, collect data, process it, reduce it, and generate final products.

2. Bathymetric Units

Water depths are measured with a Hydrotrac echo sounder, which collects analog paper records as well as digitized depth information for output to a data logger. Digital depth data can be logged directly to the navigation computer along with date, time, and position for later post processing and mapping. The system can be deployed on a small workboat or inflatable, and includes a recording unit with built in digitizer and transceiver, and a side mounted transducer.
3. **Static GPS Survey combined with Real-time Kinematic (RTK) Survey**

Upon setting up the RTK base station at the unknown GPS point and initializing the rover unit, a QC shot was measured near the base monument to verify that the system was operational and delivering corrected positions. The GPS Base Station performed a static session at the monument.

Upon returning to the office, the GPS Static data was downloaded and post-processed utilizing National Geodetic Survey’s Online User Positioning Service (OPUS) on the Web to determine the 3-D Position relative to datum’s used. The OPUS Solution for the GPS Base Point was then used to post-process the RTK data, relative to the base with sub-centimeter relative accuracy.

4. **Scanning Sonar Imaging Survey**

The Simrad MS1000 High Resolution Scanning Sonar System was utilized to scan the lake floor in a 360-degree panoramic view at a maximum scan range of 100 meters. The 360-degree sonar revolves on a tripod standing 3 feet above the lake floor using a frequency of 675 kHz. Acoustic responses are translated onto a color monitor and digitally recorded for future reference.

The scanning sonar data showed scattered tree stumps in six (6) of twelve (12) proposed soil boring locations. Also observed were mud mounds. Please note that the scanning sonar is only capable of detecting features on or above the lake floor. Otherwise, no significant sonar and anomaly contacts were observed in the area survey. Note: see Pictures for details.
B. VICINITY MAPS

Baton Rouge
() Lakes Survey
East Baton Rouge Parish, Louisiana

Survey Area

Figure 1
C. PICTURES

Proposed Soil Boring #G-1

Proposed Soil Boring #G-2
Proposed Soil Boring #G-3

Proposed Soil Boring #G-4
Proposed Soil Boring #G-5

Picture 5

Proposed Soil Boring #G-6

Picture 6
Proposed Soil Boring #G-7

Picture 7

Proposed Soil Boring #G-8

Picture 8
Proposed Soil Boring #G-9

Picture 9

Proposed Soil Boring #G-10

Picture 10
Proposed Soil Boring #G-11

Picture 11

Proposed Soil Boring #G-12

Picture 12
PROPOSED SOIL BORING COORDINATES

G-1  LAT=30.42900000 LONG=-91.167222 Y=701183.81 X=3333108.35
G-2  LAT=30.42994445 LONG=-91.1670555 Y=699981.67 X=3333215.21
G-3  LAT=30.42972222 LONG=-91.16714444 Y=698404.97 X=3333258.35
G-4  LAT=30.42957778 LONG=-91.16766667 Y=697193.54 X=3333296.62
G-5  LAT=30.42933333 LONG=-91.16763333 Y=696693.54 X=3333329.79
G-6  LAT=30.42900000 LONG=-91.16753333 Y=696193.54 X=3333362.95
G-7  LAT=30.42866667 LONG=-91.16722222 Y=695793.54 X=3333396.11
G-8  LAT=30.42833333 LONG=-91.16766667 Y=695393.54 X=3333429.28
G-9  LAT=30.42799999 LONG=-91.16722222 Y=694993.54 X=3333462.44
G-10 LAT=30.42766667 LONG=-91.16766667 Y=694593.54 X=3333495.61
G-11 LAT=30.42733333 LONG=-91.16722222 Y=694193.54 X=3333528.78

BASE MAP
BATHYMETRIC SURVEY
POST- PLOT GRID AREA

GEC
JOHN CHANCE
LAND SURVEYS, INC.
A MEMBER OF THE FUGRO GROUP OF COMPANIES

DATUM: WGS_84
ELLIPSOID: WGS_84
PROJECTION: LAMBERT
ZONE: LA SOUTH
GRID UNITS: US Survey Feet

Job No.: 140170
File: 140170.apr (Layout1)
By: ADRIAN SALAS
PRINT: May 16, 2014

SHEET NO. 1 OF 1
Appendix C

LAKE DEPTHS and SURVEY DEPTH LIMITS
Legend

- Estimated Depth Data (ft)

CITY PARK LAKE EXCLUDED AREA DEPTHS
East Baton Rouge Parish
Baton Rouge Area Foundation

Service Layer Credits: Imagery: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Depth Grid Source: John Chance Surveyors

Figure: C-2
Date: June 2014
Scale: 1:5,000
Source: ESRI/JohnChance/GEC
Map ID: 279602001000-3131
CREST LAKE EXCLUDED AREA DEPTHS

East Baton Rouge Parish
Baton Rouge Area Foundation

Legend
Estimated Depth Data (ft)

Service Layer Credits: Imagery: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Depth Grid Source: John Chance Surveyors

Source: ESRI/JohnChance/GEC
Map ID: 279602001000-3131