Final (95%) Design Report
North Lake Boudreaux Basin Freshwater Introduction and Hydrologic Management Project (TE-32a)

for

Office of Coastal Protection and Restoration

450 Laurel Street, STE 1200
Baton Rouge, LA 70801

and

U.S. Fish & Wildlife Service

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Submitted by:

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May 7, 2010

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I North Lake Boudreaux Basin Freshwater Introduction Project (TE-32a) Project Information Sheet for WVA, April 2010

J LaDNR Recording Gage – HNC@Dulac MHW MLW

ABBREVIATIONS KEY

CWPPRA	Coastal Wetlands Protection & Preservation Restoration Act
OCPR	Office of Coastal Protection and Restoration (formerly La.DNR)
LDNR	Louisiana Department of Natural Resources
HNC	Houma Navigation Canal
GIWW	Gulf Intracoastal Waterway
BGC	Bayou Grand Caillou
IDFR	Interim Draft Final Report
CDR	Conceptual Design Report
CDRA	Conceptual Design Report Addendum
TBS	T. Baker Smith, Inc.
TPCG	Terrebonne Parish Consolidated Government
R/W	Right-of-way
PWCS	Primary Water Control Structure
CWWD#1	Consolidated Waterworks District No. 1
SLECA	South Louisiana Electric Cooperative Association
AT&T	Atlantic Telephone & Telegraph
LDEQ	Louisiana Department of Environmental Quality
LDOTD	Louisiana Department of Transportation & Development
USFW	United States Fish & Wildlife Services
GSP	Gulf South Pipeline
SNG	Southern Natural Gas Pipeline
CZM	Coastal Zone Management
CC	Charter Communications
SCG	South Coast Gas Co.
MCC	Motor Control Center
PLC	Programmable Logic Controller
COE	Corps of Engineers
CRS	Cultural Resource Survey
DCRS	Draft Cultural Resource Survey
SHPO	State Historic Preservation Office

EXECUTIVE SUMMARY

This report discusses project issues such as land rights, data acquisition, geotechnical considerations, project design constraints, affected existing infrastructure, project feasibility, preliminary project design, and preliminary construction cost.

Although a significant amount of land rights has been completed to date, some permanent and temporary construction servitudes remain. Contact with landowners from which permanent right-of-way is required was positive. No contact has been made with landowners from which temporary construction servitudes are required.

Data acquisition was controlled by La. Department of Natural Resources (LDNR) horizontal and vertical control network. LA One Call was used for locating buried infrastructure.

Ardaman &Associates, Inc. conducted the geotechnical program. There were no significant or unusual conditions identified. The report did, however, recommend the use of a braced cofferdam to install the Primary Water Control Structure (PWCS).

Coastal Environments, Inc. (CEI) conducted a cultural resource survey and results indicate no significant artifacts or sites located within the project footprint.

At this stage of the design, there are no apparent project design constraints.

Effects to existing local, state and private infrastructure are minimal. Utility owners/operators have been cooperative. Local, state and federal permits are required. They include:

ENTITY	PERMIT/APPROVALS REQUIRED
Terrebonne Parish Consolidated Government (TPCG)	Construction Permit
Consolidated Waterworks District No. 1 (CWWD#1)	Board approval for removal & replacement of water lines
South Coast Gas Co. (SCG)	None required, South Coast will relocate their line.
Charter Communications (CC)	None required, Charter will relocate their line.
South La. Electric Cooperative Association (SLECA)	None required, SLECA will relocate their line.
La. Department of Transportation & Development (LDOTD)	Permit required to remove & temporarily relocate Highway 57
Coastal Zone Management (CZM)	Coastal Use Permit
Corps of Engineers (COE) Section 404 Permit CZM	Section 404 Permit

Hydrologic modeling indicates that maximum diversion flow rates ranging between 800 cfs and 916 cfs are attainable at BGC. At these flow rates, the project is considered feasible.

The basic diversion concept is to divert seasonally available freshwater from the Houma Navigation Canal (HNC) through Bayou Pelton and across the BGC Ridge into the marshes east of Highway 57. In order to achieve this, a 1,200 square foot cross section in Bayou Pelton will be hydraulically dredged. A six (6) barrel (10' X 10' X 100') array of box culverts with electric motor-operated slidegates will convey water across Highway 57. A new 800 square foot cross section conveyance channel east of Highway 57 will be bucket dredged. It will begin at the Highway 57 box culvert structure and extend easterly a distance of 8,400 linear feet and terminate at the intersection of two Gulf South Pipeline canals. Other project features include a water control structure with three (3) 48" flapgates with stop logs on the new conveyance channel (North Trenasse Water Control Structure), a fixed crest weir with boat bay on the north/south Gulf South Pipeline near Bayou Butler, and an earthen plug repair near the fixed crest weir. Final plans and specifications reflecting 95% design completion accompany this report.

The estimated construction cost is now $10,431,320. The cost to complete land acquisition is estimated to be $350,000. Other costs include $1 million for Parish drainage and a recommended 10% contingency of $1,043,132. The total cost of construction, land rights, contingency and parish drainage is $12,824,452. This is 2.3% more than the 30% Design Report estimate and 15.6% more than the 2007 Conceptual Design Report Addendum (CDRA) cost of $11,089.991. The detailed construction cost estimate is located in Appendix G and the project budget is in Section 10.0, Page 79 of this report.

Section 1.0

INTRODUCTION

1.1 General Information

Lake Boudreaux Basin Freshwater Introduction Project (TE-32a), hereinafter called the Project, is a Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) 6th Priority List project. The federal sponsor is the U. S. Fish & Wildlife Service (USFW). The project is located in Section 11, T18S-R17E, Terrebonne Parish, Louisiana. Exhibit A is a USGS quadrangle vicinity map showing the beginning and end of the preferred alignment.

1.2 Summary of Design Tasks

T. Baker Smith, Inc.'s (TBS) current task order from the Office of Coastal Protection & Restoration (OCPR), formerly LDNR, is to provide professional services through the 95% Design Phase. That notice was issued effective 9/01/09 under LDNR Contract No. 2503-08-13, "Surveying Services and Engineering Assistance for Coastal Restoration Projects." The Scope of Services includes survey and geotechnical data gathering, preliminary engineering and design, final engineering and design, and permitting assistance.

Topographic, bathymetric and magnetometer surveys are all controlled by La. Coordinate System South Zone North American Datum of 1983 (NAVD 83) and the North American Vertical Datum of 1988 (NAVD 88). All surveys are performed to third order vertical accuracy and third order, class one, horizontal accuracy. All survey work has been performed and processed by a licensed Louisiana Professional Land Surveyor. All elevations referenced henceforth are based upon NAVD88.

Geotechnical investigation was approved by OCPR and was conducted per ASTM protocol. The geotechnical proposal was performed by Ardaman & Associates, Inc. under subcontract with TBS. Dr. Larry Gilbert, P.E. designed the program and supervised all field and office sampling, testing, and engineering analysis.

Coastal Environments, Inc. conducted a cultural resource survey during the final design phase. The results of that survey are included in Appendix H.

The Scope of Work for this 95% Final Design Report requires a description of the recommended project features, presentation of engineering and design surveys, presentation of engineering and design geotechnical investigations, summary of past modeling efforts and results, address landrights issues, a revised project budget and complete plans and specifications.

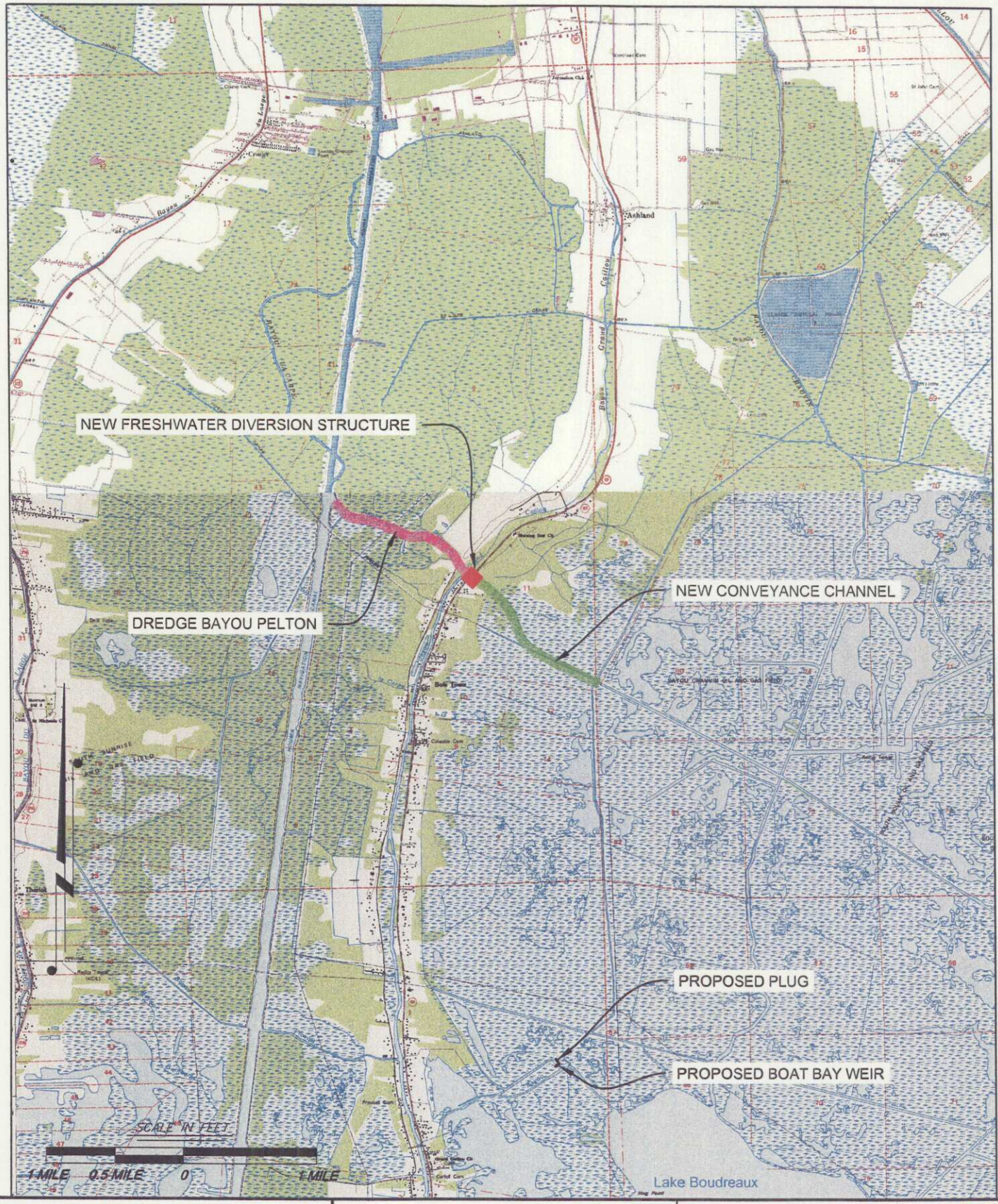

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EXHIBIT "A"

VICINITY MAP

DRAWING NAME: EXHIBIT A.DWG

JOB NUMBER: 2008.1742

SCALE: 1" = 1 MILE

DATE: 25JUNE2009

1.3 Project Description

This freshwater introduction project will convey upwards of 916 cfs of freshwater seasonally from the HNC through Bayou Pelton across Highway 57 and the BGC Ridge. Crossing Highway 57 and the BGC Ridge involves construction of a PWCS at Highway 57 and the dredging of a new conveyance channel eastward, and terminating at the intersection of the east/west and north/south GSP canals. Exhibit B reflects typical stage data recorded in Morgan City during high Atchafalaya River stages. It is mostly during these periods of high and moderate river stages that freshwater flows easterly toward Houma through the Gulf Intracoastal Waterway (GIWW) and thence south through the HNC.

1.4 Project Purpose

The objective of the project is to reduce deterioration and loss of area marshes north of Lake Boudreaux by seasonally introducing freshwater from the HNC.

These historically freshwater marsh areas have suffered from saltwater intrusion and extreme tidal velocities and variations. Freshwater reintroduction is a recognized restoration strategy, with the purpose of reversing conditions of vegetation stress loss by addressing the problems of freshwater and starvation that have lead to subsidence and saltwater intrusion. Reducing salinity and introducing nutrients and minerals transported by freshwater reduces plant stress and increases plant productivity. Increased plant productivity is thought to result in reduced wetland loss. The introduction of nutrients will also aid in increasing plant productivity. Mississippi River water has been shown to contain relatively high amounts of iron. When that water is introduced into coastal wetlands, the iron reacts with hydrogen sulfide (a potent plant toxin produced in anaerobic soil conditions) and neutralizes it and hereby increasing plant productivity. The project is not expected to introduce enough suspended sediments to result in marsh building, however, some minor amounts of suspended sediment may be introduced.

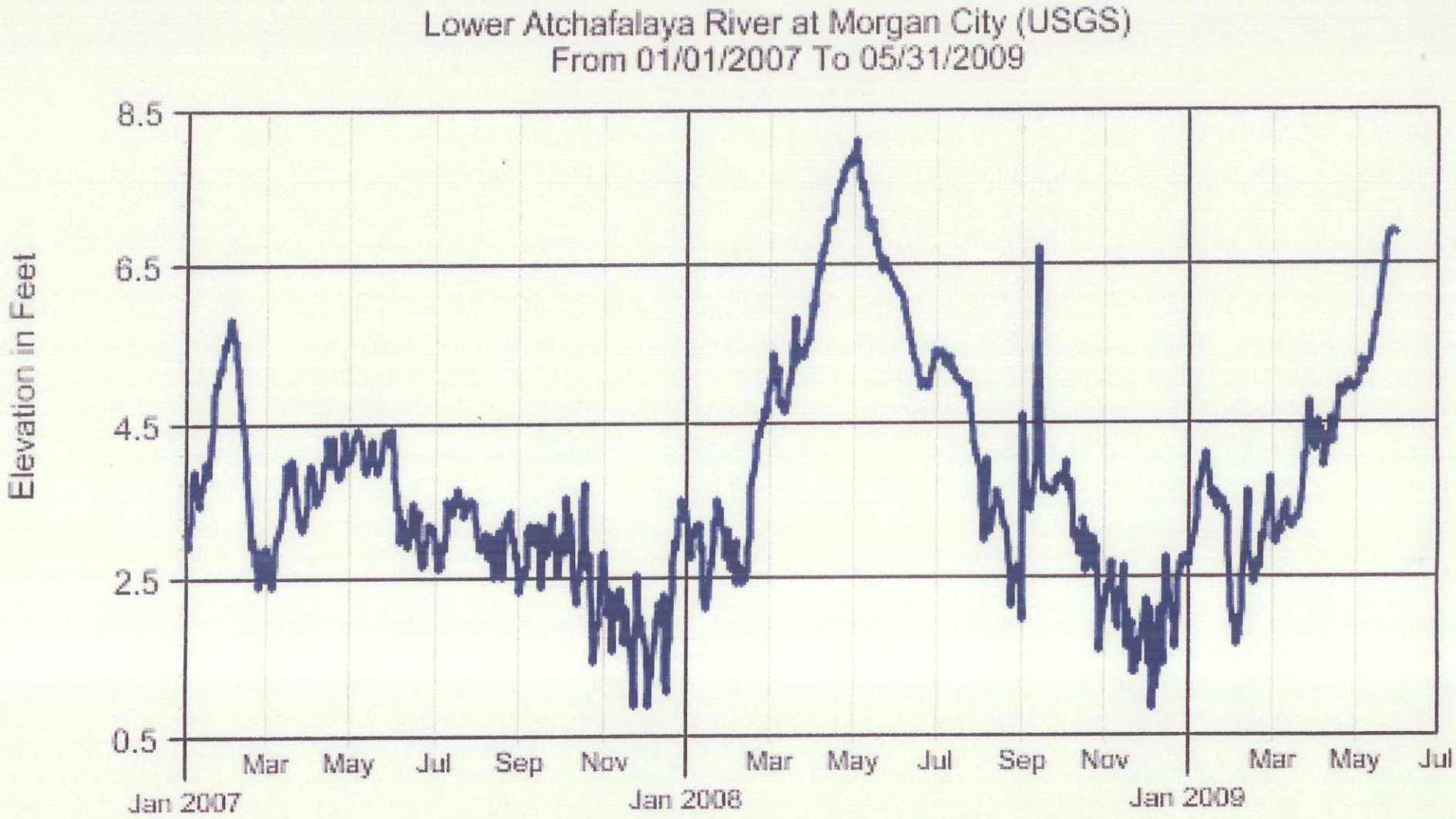
Lower Atchafalaya River at Morgan City (USGS)
From 01/01/2007 To 05/31/2009
Elevation in Feet
8.5
6.5
4.5
2.5
0.5
Mar
May
Jul
Sep
Nov
Mar
May
Jul
Sep
Nov
Mar
May
Jul
Jan 2007
Jan 2008
Jan 2009

EXHIBIT B 6

Virtually every coastal wetland restoration plan developed has endorsed freshwater and sediment diversion as a major restoration strategy in the Deltaic Plain. Among the more prominent such plans are the CWPPRA Main Report (1993), Coastal 2050: Toward a Sustainable Coastal Louisiana (1998), and Louisiana's Comprehensive Master Plan for A Sustainable Coast (2007). It should be noted that freshwater and sediment diversion techniques are understood to be techniques that restore the natural processes that can correct causes of wetland loss and achieve coastal wetland sustainability, while most other restoration techniques simply treat the symptoms of wetland loss without addressing the fundamental causes of wetland loss.

1.5 Prior Studies

Since the late 90's, three reports were commissioned by LDNR. Those reports were identified as:

* 2001 Interim Draft Final Report (IDFR)
* 2002 Conceptual Design Report (CDR)
* 2007 Conceptual Design Report Addendum (CDRA)

Prepared by GEC, Inc., the IDFR presented preliminary modeling which indicated that there are at certain periods of the year substantial amounts of freshwater flowing south through the HNC. Correlating stage data from the monitoring stations located in Bayou Grand Caillou and the east/west GSP Canal (Figure 2, Section 8.14, Page 59) showed that in spite of the tide cycles, sufficient head conditions prevailed to flow some of that freshwater eastward into the marshes north of Lake Boudreaux.

Prepared by TBS, the CDR's purpose was to perform detailed hydrologic modeling along several channel alignments east of Highway 57. TBS used subcontractor FTN Associates, Ltd. to perform the hydrologic modeling. The results are summarized in Section 7, Page 29 of this design report.

Prepared by TBS, the CDRA updated the CDR. The purpose of this report addendum was to update construction and other project costs. In doing so, an alternative type of PWCS was investigated. That alternative featured precast reinforced concrete box culverts with automated slide gates to allow conveyance of freshwater under Highway 57 and eastward. All previous reports proposed using tainter gates to control the diversion.

Section 2.0
LAND OWNERSHIP AND ALIGNMENT

2.1 Introduction

Between 2002 and 2005, LDNR's land rights group focused its attention on the land rights associated with the excavation of the new conveyance channel east of Highway 57. They identified seventeen (17) tracts across which the preferred alternative would cross. A total of 58 landowners held interest in one or more of these tracts. Exhibit C shows these tracts superimposed on the preferred alignment.

2.2 Land Rights Acquisition

In 2005, the TPCG and LDNR entered into a cooperative agreement providing TPCG with authority and funds to acquire the land rights for the new conveyance channel. In 2006, The TPCG contracted with TBS to acquire the servitudes. By February, 2007, all 58 landowners had executed a document entitled "Contract and Agreement to Sell Temporary Easement, Servitude, and Right-of-way" hereinafter called the "Contract." This document is a promissory document which was worded in such a manner as to obligate the landowners to execute the final agreement provided 100% of the landowners executed the Contract. TPCG and the State Land Rights Office collaborated on the preparation of two right-of-way instruments. TBS prepared the map exhibits that accompanied them. Besides the document described above, a second document entitled "Temporary Easement, Servitude and Right-of-way Agreement" hereinafter referred to as the "Agreement" was prepared. Landowners of three of the seventeen tracts signed both documents. As an inducement to sign the Contract document, earnest money was offered. The earnest money was a small percentage of the tract value. The earnest money offered and accepted was taken from the funds provided by the state. It is non-refundable, meaning if the project is not constructed, the landowner retains the earnest money. Appendix A contains an executed copy of one of the Contract documents and an unexecuted copy of the Agreement document.

Prior right-of-way (r/w) efforts were based upon out of town appraisers. With the Parish tasked to acquire r/w, they elected to have a second local appraiser perform an appraisal. Using the highest values assigned to marsh, swamp and developed land, several

HOUMA NAVIGATION CANAL

EAST TERREBONNE PROPERTIES
TOMMY HEBERT

PROPOSED 300' RIGHT-OF-WAY

ENTERGY

BAYOU PELTON

HUGH BABIN

BILL CHAMBERLAIN

R04-26749
JOSEPH CHRISTIANA, JR.

GULF SOUTH PIPELINE

BAYOU GRAND CAILLOU

CAILLOU GROVE ESTATES ADDN #3

CAILLOU GROVE ESTATES ADDN #1

HWY 57

UNIMPROVED ROAD

LEBLANC FAMILY (SEE ASSESSOR AERIALS)

MID STATE LAND & TIMBER CO.

MARIE LOUISE WURZLOW CULL

RONALD LEBLANC & WAYNE LEBLANC

SYLVIA MATHERNE PITRE ET AL

ORA PICOU

CONRAD PICOU ET AL

CAILLOU GROVE L.L.C.

PROPOSED 275'
RIGHT-OF-WAY

CHARLES MOOREHEAD

CHARLES LUKE ET AL

IRVIN P. CARLOS

BESSIE W. WAGUESPACK

LOUIS P. WHITNEY

SHAYNE ROBERT MATHES

STANLEY BOUDREAUX ET AL

RONALD LIBERTI, SR.

LOUIS GUIDRY

TROY W. MARCEL

CHARLES LUKE

ROBERT BOUDREAUX ET AL

TRACT 1
TRACT 2
TRACT 3
TRACT 4
TRACT 5
TRACT 6
TRACT 7
TRACT 8
TRACT 9
TRACT 10
TRACT 11
TRACT 12
TRACT 13
TRACT 14
TRACT 15
TRACT 16
TRACT 17

NORTH/SOUTH GULF
SOUTH PIPELINE CANAL

PRIMO
VOISIN
R04-28600

RUFFIN BOURG

EDWIN JOSEPH VOISIN, JR.

IRVIN P. CARLOS ET AL

NFW CONVEYANCE CHANNEL

CANE BRAKE
SUBDIVISION

EXISTING FORCED
DRAINAGE SYSTEM

EAST/WEST GULF
SOUTH PIPELINE

ROBERT BOUDREAUX ET AL

PROPOSED 275'
RIGHT-OF-WAY

LEGEND:

- NEW 24" FLAP GATED CROSS DRAIN
- WATER CONTROL STATION LA. 87
- PARISH PUMP STATION
- PRIMARY WATER CONTROL STUCTURE
- PROPERTY LINE
- ELECTRIC LINE

SCALE IN FEET
500 250 0 500 1000 1500

DATE	REVISIONS	DRAWN BY	APPROVED BY

REVISIONS

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BATON ROUGE, LOUISIANA 70801

DRAWN BY: BEA
DESIGNED BY: BJK

LAKE BOUDREAUX FRESHWATER
INTRODUCTION PROJECT (TE-32a)

STATE PROJECT NUMBER: TE-32a
FEDERAL PROJECT NUMBER: N/A
APPROVED BY: MJR

EXHIBIT C
LAND OWNERSHIP

DATE: 4/3/09

land tract values were determined by the actual area to be acquired and the estimated acres severed. Since no geotechnical analysis was performed, conservative estimates of the r/w widths were estimated. Table 2.1 shows the r/w widths proposed in the agreement in 2006 for various project features.

TABLE 2.1

Right-of-way Requirements

Estimated

Feature	Recommended Right-of-way Width
Bayou Pelton	300' or 150' either side of the centerline
Primary Water Control Structure (PWCS)	275' east of Highway 57
New Conveyance Channel	
Bayou Grand Caillou to Highway 57	230'
New Conveyance Channel	
East of Highway 57	275'

2.3 Government Right-of-way Bayou Pelton

During the acquisition process, it was necessary to perform some title work to verify changes in ownership since LDNR's acquisition efforts. The result of that title work inadvertently uncovered two 1934 U. S. Government r/w documents from Bayou Pelton adjacent landowners. The rs/w were granted from the centerline of Bayou Pelton because the water bottoms of Bayou Pelton are not claimed by the State. Since that discovery, the ownership on both sides of Bayou Pelton has changed. The landowner to the south (Bill Chamberlain) insists that the government r/w south of Bayou Pelton centerline is invalid because, according to title research he paid for, the people who executed it were not the legal landowners at the time. Fortunately, Mr. Chamberlain has been cooperative and to date is agreeable to granting 150 feet of r/w for the needed improvements to the south side of Bayou Pelton between the HNC and BGC. In return for the r/w, Mr. Chamberlain would like the spoil placed in open water areas of his property south of Bayou Pelton and north of the GSP Canal between the HNC and BGC.

The two landowners on the north side of the centerline of Bayou Pelton are East Terrebonne Properties, represented by Tommy Hebert, and Hugh Babin, a private landowner. The legitimacy of the government r/w on the north side is still in doubt. It is our understanding that OCPR is researching this issue to resolve that r/w question. While OCPR works to complete its title research, we have contacted and met with Mr. Hebert and Mr. Babin concerning acquisition of 150' of r/w from them. Both have expressed a desire to cooperate, provided they receive excavated material removed from their land in Bayou Pelton.

2.4 Other Right-of-way Considerations

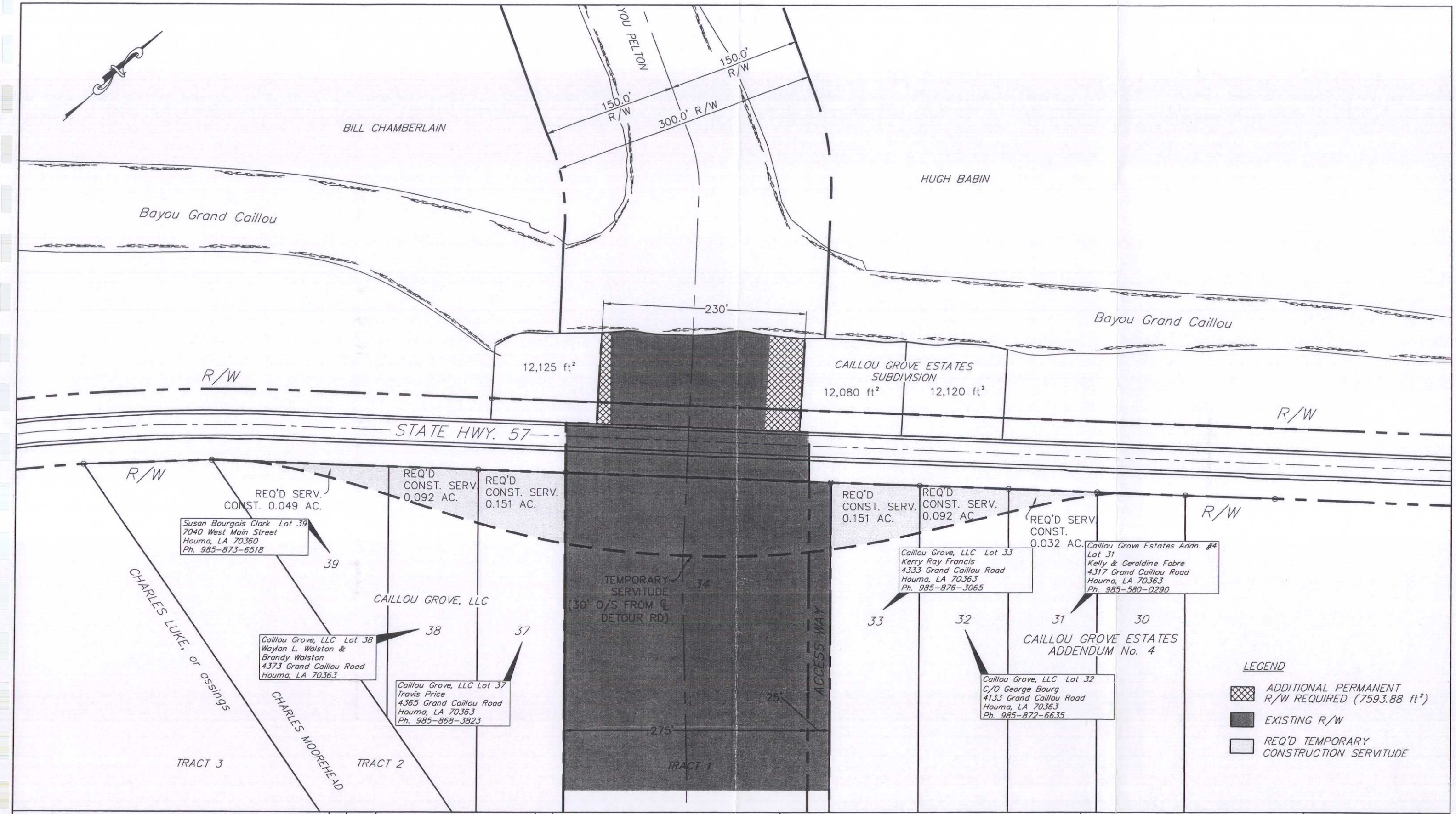
As a result of the design process to date, the geotechnical analysis is forcing some changes in the permanent land rights acquired. Most notably, between BGC and the PWCS (where 175' r/w was granted by Caillou Grove, LLC) at least 230 feet is now necessary to provide sufficient area for project features such as maintenance and operation building, parking, and storage of gate maintenance needles. Caillou Grove, LLC has granted a 175' r/w in the agreement. This additional r/w width is driven by the recommended channel side slopes from the geotechnical report. The estimated additional r/w cost has been included in Section 10.0, Page 79. Caillou Grove, LLC has been contacted and according to them, the additional r/w is available.

The temporary re-routing of Highway 57 to facilitate the installation of the primary water control structure requires the acquisition of six (6) temporary construction servitudes from adjacent landowners. See Exhibit D for details on these temporary construction servitudes. These landowners have not yet been contacted.

It is coincidental that the old government r/w and the recommended geotechnical required cross section of Bayou Pelton are both a minimum of 150' r/w on either side of Bayou Pelton centerline. No additional r/w is needed east of Highway 57 for the new conveyance channel. Exhibit D shows the additional permanent servitude required and the temporary construction servitude required.

The 230' permanent servitude for the entrance channel to the PWCS must be obtained from Caillou Grove, LLC represented by George Bourg. Mr. Bourg has indicated that he is willing to sell additional permanent r/w. Located in Appendix B are copies of the 1934

government 300' r/w document and correspondence from Mr. Bourg indicating the availability of additional r/w.



SCALE IN FEET

100' 50' 0' 100' 200'

REV.	DATE	DESCRIPTION	BY

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BATON ROUGE, LOUISIANA 70801

DRAWN BY: ALH | DESIGNED BY: MJR

LAKE BOUDREAUX FRESHWATER INTRODUCTION PROJECT (TE-32a)

STATE PROJECT NUMBER: TE-32a

FEDERAL PROJECT NUMBER: N/A

APPROVED BY: MJR

REQUIRED PERMANENT & TEMPORARY RIGHT-OF-WAY
EXHIBIT D

DATE: 03/23/09

Section 3.0
SURVEY DATA ACQUISITION

3.1 Introduction

Preliminary design data used in the 30% design phase of the Lake Boudreaux Freshwater Introduction Project was collected from the period of October 2008 through January 2009. This data included topographic and bathymetric surveys, property boundary location and utility location surveys. A more detailed summary of data collection procedures and methodology is located in Appendix C "Data Collection Report."

3.2 Survey Control

The primary Survey control monument used for data collection and project design was Benchmark TE32-SM-03. Additionally, Benchmark TE32-SM-04, was used for data collection and project control at the Bayou Butler site. Both of these benchmarks are a part of LDNR's Secondary Control Network. These benchmarks were chosen because they are located within acceptable RTK GPS range of all project features, and are easily accessible by land from Highway 57. The horizontal datum for all project data and design drawings is Louisiana State Plane, South Zone (1702), NAD 83, in U.S. Survey feet. The vertical datum for all project related data is NAVD 88, utilizing GEOID 99, in U.S. Survey feet. GEOID 99 was used to translate orthometric heights because the relationship between the orthometric heights at the above benchmarks were defined using this GEOID. Datasheets for the above referenced benchmarks can be seen in Appendix C.

3.3 Ongoing Data Acquisition

In addition to the completed surveys and data acquisition presented in the project *Data Collection Report*, there are no other critical items required to complete the project design. At the diversion on Bayou Grand Caillou, Mean High Water and Mean Low Water Values are estimated to be +1.5' NAVD 88 and +.31 NAVD 88 based upon the LaDNR stage data recorded at a LaDNR recording gage HNC@ Dulac. This is the same recording gage that was used by FTN to obtain stage data for modeling the project. Refer to Page 31, Section 7.2 of this report. Also refer to Appendix J for information received from FTN. Because the modeling only considered the relative head differential and since the structure gates are to be controlled by relative head differential, salinity and flow direction as measured by probes at the structure (Exhibit O, Page 62). MHW and MLW are of no

consequence except that MLW was used to set the top of culvert at 0.0 NAVD 88 so as to have a full flow in the diversion. Once project rights-of-way are finalized with property owners adjacent to Bayou Pelton, surveys will be required to determine the final boundary of disposal areas and the extent of containment required.

3.4 Negative Finding Report of a Phase I Cultural Resource Survey

Coastal Environments, Inc. (CEI) has completed a cultural resource survey. The DCRS is included in Appendix H. The survey area included the footprint of Bayou Pelton (300'), New Conveyance Channel (275'), and Forced Drainage Levees/Berms/Canal (175'). Results of the survey will be incorporated into the project environmental assessment being prepared by USFW. The cultural resource survey results showed that there were no significant cultural and/or historic artifacts or sites within the project footprint. The DCRS was submitted to SHPO on 1/24/10. To date, no comments have been received.

Section 4.0
GEOTECHNICAL INVESTIGATION

4.1 Introduction

Ardaman & Associates, Inc., under subcontract with TBS, performed subsurface geotechnical field and office investigations. A copy of the geotechnical report is located in Appendix D.

4.2 Geotechnical Program Elements

The elements of the geotechnical program include field sampling, laboratory testing and engineering analysis.

* A field sampling program that consists of sixteen (16) undisturbed sample type soil borings (B1 thru B16). Table 4.1 lists each along with the depth. Exhibit E, Page 17 of the report, shows the location and coordinates of each core hole. With the exception of B9 and B10 which were obtained using conventional truck-mounted rig, all others were taken from a marsh buggy platform. All undisturbed field samples were performed continuously in all cohesive or semi-cohesive materials with a three (3") inch diameter thin wall tube sampler. Representative samples were cut from the cores and placed in moisture-proof containers for preservation.
* Laboratory tests were performed that included material moisture content, unit weight and unconfined compression, Atterburg Limits and organic content.
* These test results were used to perform engineering analysis to determine soil bearing values, pile capacities, side slope analysis of levees and canals, berm and levee stability analysis, behavior and consolidation of hydraulic and bucket-dredged materials, construction excavation as regards dewatering and cofferdam use.

SCALE IN FEET

1000' 500' 0' 1000' 2000'

REV.	DATE	DESCRIPTION	BY

T. BAKER SMITH
PROFESSIONAL CONSULTANTS SINCE 1913
(985) 868-1050 www.tbsmith.com

OFFICE OF COASTAL PROTECTION & RESTORATION
ENGINEERING BRANCH
450 LAUREL STREET
BATON ROUGE, LOUISIANA 70801

DRAWN BY: BEA
DESIGNED BY: BJK

LAKE BOUDREAUX FRESHWATER INTRODUCTION PROJECT (TE-32a)

STATE PROJECT NUMBER: TE-32a

FEDERAL PROJECT NUMBER: N/A

APPROVED BY: MJR

EXHIBIT E
CORE HOLE LOCATIONS

DATE: 4/3/09

TABLE 4.1

Undisturbed Core Hole Number and Depth

Core ID	Depth
B1	15
B2	15
B3	15
B4	15
B5	15
B6	15
B7	15
B8	15
B9	100
B10	40
B11	60
B12	100
B13	60
B14	40
B15	60
B16	40

4.3 Permitting Requirements

No regulatory permits were obtained for field coring activities.

4.4 Field Data Collection

Bayou Pelton and new conveyance channel cores were obtained using drilling equipment mounted on floating track marsh buggy equipment. Cores in the vicinity of the primary water control structure were taken off of standard truck-mounted drilling rig. All cores were 3-inch standard, and all cores were backfilled in accordance with accepted standards.

4.5 Geotechnical Design Recommendations

Soil Bearing Capacity Boring at B-9 which is in the vicinity of the PWCS shows an ultimate soil bearing capacity of 2,500 lbs/sf. Using a safety factor of 2.0, which is standard of practice, gives an allowable soil bearing capacity for design purposes of 1,250 lb/sf @ approximately -12.0.

For a non-pile supported structure, long term settlements of 1 to 2 inches are estimated according to Ardaman, Page 8, Appendix D. For dewatering associated with future

maintenance, settlements will increase on the order of 1 to 2 inches for every 12-inch drop in water table. These, too, are long term and should not affect periodic maintenance dewatering. To account for uplift, however, during such maintenance periods, provisions have been made. For a discussion of this, refer to Section 8.8.

The geotech report recommends using a cofferdam with dewatering to facilitate installation of the PWCS. The limits of the cofferdam will be identified on our plans and the contractor will be required to provide a design stamped by a licensed engineer.

Slope stability analysis for dredged canals, levees, and berms were performed using the Wedge Method of Plans to estimate factors of safety for side slopes varying from 1H:1V to 4H:1V. Five (5) cases were analyzed, and the results are shown in Table 4.2. Table 4.2 contains slope recommendations for conveyance channel guide levees and side slopes and Bayou Pelton side slopes and berm widths. The cross section on the plans for the hydraulic dredging of Bayou Pelton takes into account recommendations from Page 17 of this report regarding sloughing. This section, including the berm, was used to determine 150 feet of the right-of-way needed north and south of the bayou centerline.

TABLE 4.2

	MINIMUM FACTORS OF SAFETY				
	CASES				
SLOPE* OF CUT (N)	**Case 1** Grd. @ El. +2	**Case 2** Grd. @ El. +3	**Case 3** Grd. @ El. +4	**Case 4** 30 ft. Berm@ El. +2	**Case 5** No Berm Slopes to El. +8
1.0	1.11	0.93	0.81	1.11	1.12
1.5	1.32	1.09	0.96	1.20	1.16
2.0	1.38	1.17	1.03	1.25	1.21
2.5	1.46	1.24	1.08	1.30	1.25
3.0	1.56	1.33	1.17	1.35	1.29
3.5	--	--	1.25	--	1.33
4.0	--	--	1.33	--	--

* IV on (N)H

Conveyance channel guide levee design was based upon a finished construction height of +6.0, 10-foot crown, and side slopes of 1V to 3H. This should result in a finished levee height of +4.0 twelve (12) months after construction. Table 4.3 shows berm widths and safety factors associated with each.

The use of hydraulically dredged soils from Bayou Pelton, though feasible, will not result in significant elevation gain due to the character of the soils. Existing subgrade upon which this material will be placed is expected to consolidate as much as 2 inches per 12 inches of fill. Hydraulically dredged material, however, from east of Highway 57 will stack higher initially but will also have the same effect of subgrade soil

TABLE 4.3

DISTANCE FROM LEVEE TOE TO TOP OF BANK	MINIMUM FACTOR OF SAFETY
30	1.25
40	1.35
50	1.45
60	1.55
70	1.66

Section 5.0
PROJECT DESIGN CONSTRAINTS

5.1 Introduction

This section briefly discusses the technical, environmental, infrastructure, and fiscal constraints impacting the project. A detailed discussion of these will follow in Section 8.0.

5.2 Technical and Geographical Constraints

Technical constraints include the technical feasibility of the project with emphasis on the ability of the project to function as modeled. The challenge in this regard is to optimize the amount of freshwater flow delivered east across the BGC Ridge. Factors affecting this include open channel cross sections and flow characteristics such as velocity and head structure head losses including entrance and friction losses.

5.3 Environmental Constraints

Potential diversion-related environmental constraints might include:

- Excessive wetland inundation – This concern occurs for Mississippi River diversions where there may be a 5-foot or more head differential (i.e., Caernarvon or Davis Pond). The proposed project has a maximum head differential of roughly half a foot, which is insufficient to completely inundate the receiving area marshes.
- Siltation related navigation impacts – Suspended sediment concentrations of introduced water are low and are not expected to cause navigation problems.
- Fisheries impacts associated with freshening – Much of the receiving area was formerly fresh to intermediate marsh, and portions even consisted of cypress swamp. The proposed project would restore salinities appropriate for those habitat types. By restoring the salinity gradient that once existed, fishes and shellfishes will be able to select their preferred salinity range, whereas, the low-salinity conditions may not currently be present. Also, many of the estuarine-dependent fishes and shellfishes that utilize intermediate and low salinity brackish marshes can also tolerate freshwater conditions. We do not expect the project to cause adverse impacts to estuarine fisheries. At Caernarvon, fisheries productivity for most species was found to increase despite freshening.
- Tables 5.1 to 5.4 show a summary of the estimated permanent/temporary impacts to various habitats identified. Permanent impacts include those associated with the freshwater diversion elements and the associated forced drainage system. Table 5.1 shows

the permanent diversion impacts at 60.06 acres. Table 5.2 shows the permanent forced drainage impacts at 30.76 acres.

- Temporary impacts are those that will affect wetlands during construction only. They are associated with containment dikes needed to contain beneficial fill for the diversion project only. The temporary impacts will affect 2.89 acres as shown in Table 5.1. All new containment dikes will be degraded as part of the freshwater diversion construction project.

- In addition to permanent and temporary impacts, the forced drainage systems will affect a total of 119.07 enclosed wetland habitats as shown in Table 5.2. To maintain this wetland hydrology in these areas, two features are proposed. Pump off elevations are to be set at +1.25 NGVD and in the event of drought conditions, a 24" bypass with slidegate will be installed in each system that will allow water to be reintroduced into the system if water levels fall below the +1.25 NGVD and salinity levels of the water being introduced are sufficiently low enough not to adversely impact the enclosed habitats. It is recommended that when acquiring r/w from the landowners that the document be structured to create a conservation easement in addition to granting r/w for drainage improvements.

- Nourishment/fill areas along Bayou Pelton are estimated to raise existing marsh levels by approximately 6 inches (0.5'). This will greatly reduce the periodic inundation and submergence impacts associated with subsidence, sea level rise, and saltwater inundation associated with storm surges." It is estimated that approximately 350,000 c.y. of beneficial fill will be deposited in open water areas north and south of Bayou Pelton.

TABLE 5.1

Permanent/Temporary Habitat Impacts
Diversion Project Elements Only

Permanent Habitat Impacts	Bayou Pelton Enlargement (ACS)	New Conveyance Channel (ACS)	Containment Dikes	Habitat Totals (ACS)
Hardwoods	.99	0	0	.99
Scrub/Shrub	.52	2.68	0	3.20
Marsh	7.70	25.79	0	33.49
Water	6.20	9.01	0	15.21
Developed	0	3.72	0	3.72
Spoil Bank	0	3.45	0	3.45
Subtotal	15.41	44.65	0	60.06
Temporary Habitat Impacts				
Hardwoods	0	0	.43	.43
Scrub/Shrub	0	0	1.24	1.24
Marsh	0	0	.81	.81
Water	0	0	0	0
Developed	0	0	0	0
Spoil Bank	0	0	.41	.41
Subtotal	0	0	2.89	2.89

TABLE 5.2

Permanent/Enclosed Habitat Impacts
North and South Forced Drainage Systems Only

Permanent Habitat Impacts	**North System (ACS)**	**South System (ACS)**	**Habitat Totals (ACS)**
Hardwoods	0	0	0
Scrub/Shrub	1.87	1.56	3.43
Marsh	10.47	6.75	17.22
Water	4.65	1.27	5.92
Developed	0	0	0
Spoil Bank	3.15	1.04	4.19
Subtotal	20.14	10.62	30.76
Enclosed Habitat Affected			
Hardwoods	.60	0	.60
Scrub/Shrub	29.45	12.15	41.60
Marsh	21.84	32.43	54.27
Water	1.13	4.53	5.66
Developed	0	0	0
Spoil Bank	3.4	0	3.4
Dirt Pit	10.35	0	10.35
Pasture	3.19	0	3.19
Subtotal	69.96	49.11	119.07

TABLE 5.3

Summary of Total
Permanent/Temporary Habitat Impacts
Diversion & Drainage

Permanent Habitat Impacts	**Diversion (ACS)**	**Drainage (ACS)**	**Habitat Totals (ACS)**
Hardwoods	.99	0	.99
Scrub/Shrub	3.20	3.43	6.63
Marsh	33.49	17.22	50.71
Water	15.21	5.92	21.13
Developed	3.72	0	3.72
Spoil Bank	3.45	4.19	7.64
Dirt Pit	0	0	0
Pasture	0	0	0
Subtotal	60.06	30.76	90.82
Temporary Habitat Affected			
Hardwoods	.43	0	.43
Scrub/Shrub	1.24	0	1.24
Marsh	.81	0	.81
Water	0	0	0
Developed	0	0	0
Spoil Bank	.41	0	.41
Dirt Pit	0	0	0
Pasture	0	0	0
Subtotal	2.89	0	2.89

TABLE 5.4

Summary of Nourishment – Fill Areas Along Bayou Pelton

	Area (ACS)				
Habitat Type	**1**	**2**	**3**	**4**	**Totals**
Hardwoods	0	0	0	1.52	1.52
Marsh	49.02	23.87	4.24	3.18	80.31
Scrub/Shrub	6.74	.36	0	7.95	15.05
Water	.68	0	2.31	.30	3.29
Subtotal	56.44	24.23	6.55	12.95	100.17

5.4 Infrastructure Constraints

Typically such projects impact local infrastructure such as roads, water, gas, sewer, power, and communications. Fortunately, there are no oil and gas pipelines nor railway crossing impacted by the project. One state highway (Highway 57) will require temporary relocation. Local utilities such as water, gas, communication, and power that are located adjacent and parallel to Highway 57 will also be temporarily relocated. These relocations will not result in any unusual or difficult solutions. Some minor inconvenience will result.

5.5 Fiscal Constraints

This 6th Priority Project is over ten (10) years old. Construction costs have risen over this decade as a result of inflation and past hurricane effects. Trying to keep construction costs down has meant looking at an alternative water control structure at Highway 57, eliminating some minor water control structures, and working closely with the dredging industry to avoid specifying costly dredging techniques.

The CDRA of 10/07 listed the construction cost of the project at an estimated $8,728,923. This 95% design report estimates the construction cost at $10,431,320, an increase of 19.5%. These costs do not include contingencies, funds committed to TPCG and balance of land rights and balance of design engineering and construction phase engineering.

Section 6.0

INFRASTRUCTURE AND UTILITY EVALUATIONS

6.1 Introduction

There are five (5) public utilities and one state highway either directly or indirectly affected by this project.

6.2 Infrastructure and Utility Contacts

Table 6.1 lists the utility and contact information.

TABLE 6.1

UTILITY	CONTACT PERSON	CONTACT INFORMATION
South La. Electric Cooperative Association (SLECA)	Ricky Pitre	(985) 876-6880
AT&T	Sylvia Hebert, PE	(985) 873-1618
South Coast Gas Co. (SCG)	Michael St. Romain	(985) 972-0376
Charter Communications (CC)	Brett Benoit	(985) 493-7710
Consolidated Waterworks District No. 1 (CWWD#1)	Emery R. Chauvin, Jr., PE	(985) 879-2495
La. Department of Transportation & Development (LDOTD)	Lyle LeBlanc, PE	(985) 858-2405

Utility correspondence to date is located in Appendix E. Utility locations are shown on the 95% plan sheets.

6.3 Utility Relocation Summary

All utility companies to date have been very cooperative in working with us in the preliminary and final design phases of this project.

With the exception of CWWD#1, all of the utilities will be temporarily relocated prior to the construction of the primary water control diversion structure by the respective utility. The location of all utilities is shown in the roadway plan and profile drawings of the 95% design plans.

The final plans contain a sheet showing the temporary relocation of CWWD#1 waterlines east and west of Highway 57. This will be the only utility that will be adjusted by the contractor during construction. The plan which is reflected is based upon meetings held

with CWWD#1 engineers. Prior to construction, the plan for relocating CWWD#1 lines and the subsequent replacement of those lines will need to be approved by the Consolidated Waterworks District No. 1 Board. At this time, we do not anticipate any problems in acquiring that approval. Because one of the lines is a 12-inch asbestos cement line, a contractor or subcontractor making that relocation will have to be Louisiana Department of Environmental Quality (LDEQ) certified to handle asbestos cement pipe.

The other four utilities will be relocated on the east side of the temporary Highway 57 by-pass. All relocations will take place outside of the limits of construction for the primary water control diversion structure. Highway 57 will be elevated slightly so as to provide adequate cover for the utilities to be replaced in their original location subsequent to the installation of the primary water control diversion structure.

All utilities will be relocated prior to any construction on the primary water control diversion structure. Again with the exception of CWWD#1 waterline relocations, the other 4 utilities will provide the Contractor with the direct cost for temporary relocation and subsequent replacement of their utility. Included in Appendix E is a letter from the 4 utilities indicating the cost associated with the relocation and replacement of their utility lines. Our budget figure is higher to account for inflation and Contractor mark up. Appendix F contains correspondence with LDOTD regarding temporary relocation of Highway 57 and the proposed freshwater diversion structures.

Section 7.0

HYDROLOGIC MODELING SUMMARY

7.1 A quasi-two-dimensional model (the U. S. Army Corps of Engineers UNET model Version 3.2[1]) was used to simulate the flow in the network of canals and bayous shown in Exhibit F. The UNET representation of the system included:

- 38 bayous/canals/streams,
- 97 channel reaches (bayous/canals/stream segments),
- 41 marsh/swamp/lake areas (ponding areas),
- 31 drainage areas under pump,
- 29 adjacent ponding area interconnections, and
- 586 interconnections between channels and ponding areas.

The study boundaries and model were chosen because: 1) the UNET model includes mathematical representations of all the pertinent physical forces acting on this system of flat interconnected channels and marsh areas and 2) the model had already been successfully applied to the system for the Morganza, LA to the Gulf of Mexico, Hurricane Protection study[2]. Since a functioning model already existed, only a few changes were required in the model input data to evaluate the proposed changes to the channel network. The model boundaries were not reduced to a smaller area closer to the area of interest to ensure that the assumed boundary conditions did not directly influence the results (Exhibit F).

Hydrologic modeling for the project was done in three parts. First, preliminary modeling was done to determine which of seven configurations of channel modifications provided the highest flows into the project area without causing flooding. In the second modeling effort, the preferred channel configurations were refined for the Conceptual Design Report. In the third effort, the model was re-run to determine the impact of an error contained in the UNET program that was discovered after the second modeling effort was completed. These three modeling efforts are summarized in the following sections.

[1] US Army Corps of Engineers Hydrologic Engineering Center, 1997. User Manual for UNET: One-Dimensional Unsteady Flow Through a Full Network of Open Channels. Davis, CA.
[2] US Army Corps of Engineers, New Orleans District, 2001. Mississippi River and Tributaries, Morganza, Louisiana to the Gulf of Mexico, Hurricane Protection. New Orleans, LA.

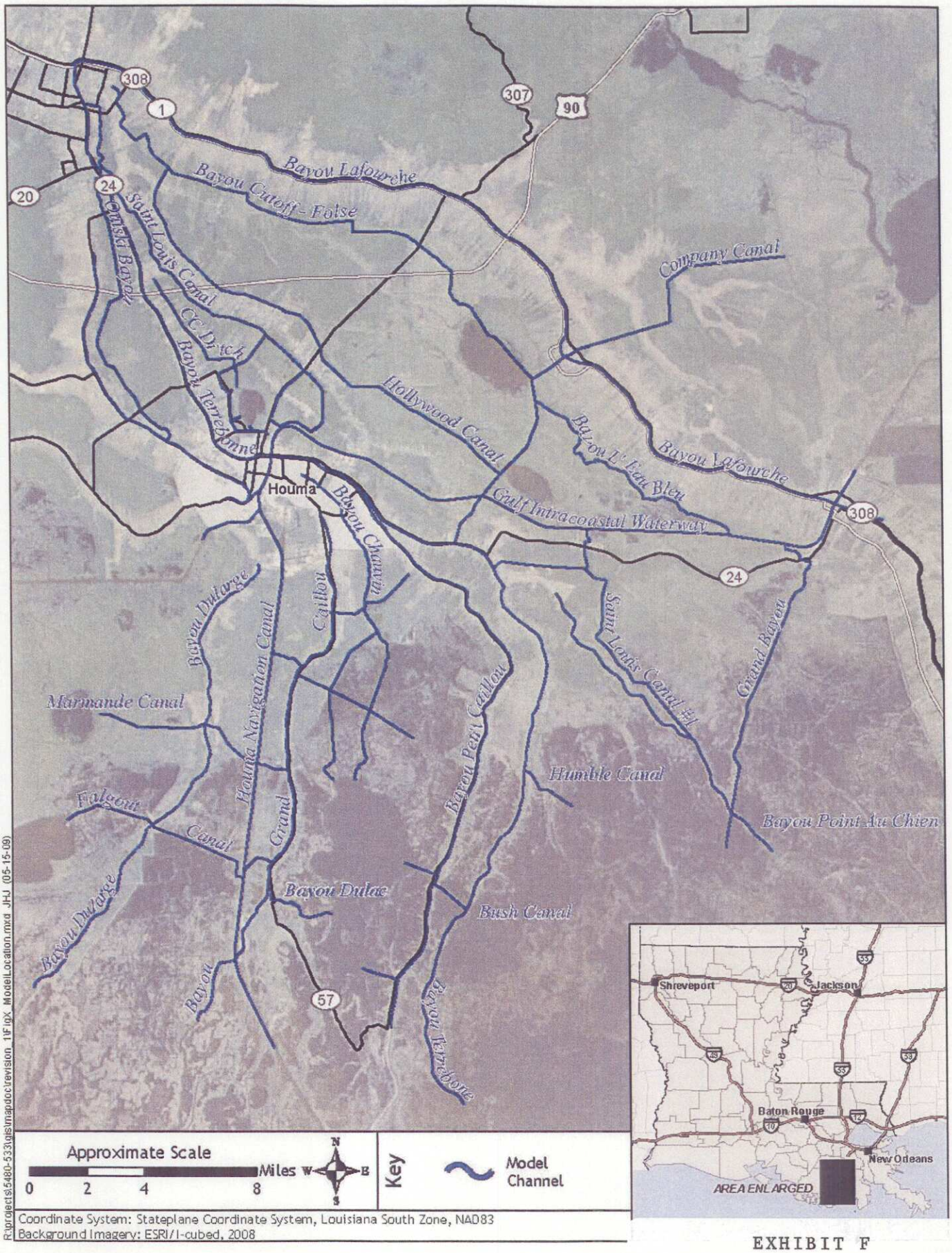

EXHIBIT F

UNET MODEL BOUNDARY MAP

7.2 Preliminary Modeling

In the preliminary modeling done during the period of November 1999 to March 2001, seven different channel configurations were investigated that involved routing flow from the HNC, through either Bayou Pelton or an eastward extension of St Louis Canal to the general project area, and then into the marsh north of Lake Boudreaux near the existing Koch Pipeline Canal. The analyses were done using 4 different tidal periods representing normal and high tide periods taken from historical HNC near Dulac gage data in combination with the 10%, 50% and 90% exceedence flows at the western GIWW boundary (based on a period of record analysis of stages at Morgan City and a USGS-developed regression analysis[3] relating stages at Morgan City to flow in the GIWW west of the HNC). (These flow conditions refer to periods of high, average, and low flow, respectively. In other words, high flows can be expected to be exceeded 10% of the time, average flows 50% of the time, and low flows 90% of the time.) The St. Louis Canal option proved to allow much less flow into the marsh than other options so it was not investigated further.

The modeling confirmed that Bayou Pelton can convey water more efficiently and simulations were made to optimize its size. Simulations showed that the Bayou Pelton channel would need to be increased from its existing size to an rectangular 12 ft depth and 100 ft width channel to deliver the target 800 cfs (the target flow computed by USFWS based on observed head differences between the HNC and Bayou Grand Caillou) to the proposed channels in the marsh ("marsh conveyance channels"). It also showed that water surface elevation along the east side of the BGC Ridge will increase due to the project. The model predicted the increases to be less than 0.35 ft higher adjacent to the Canebrake and Caillou Grove Estates Subdivisions.

7.3 Modeling to Refine Channel Sizes

In 2002 UNET was again used to determine which proposed conveyance channel alignment would divert and distribute the maximum amount of freshwater from the HNC via an improved Bayou Pelton (12 ft x 100 ft rectangular channel) to the upper Lake Boudreaux

[3] Swarzenski , C. M.2003. Surface-Water Hydrology of the Gulf Intracoastal Waterway in South-Central Louisiana, 1996-99 U.S. Geological Survey Professional Paper 1672. Prepared in cooperation with the U.S. Army Corps Of Engineers New Orleans District. Reston, VA.

basin marshes with minimal flooding and minimal wetland destruction results from construction activities. Flow into the Upper Lake Boudreaux Basin marshes would be regulated by a proposed water control structure which would be installed at the Highway 57 crossing over the proposed conveyance channel. Each alternative and the baseline conditions were modeled over a period with the same four tidal cycles and with 10% and 90% exceedance flows in GIWW described in Section 7.1. Flows, stages, and velocities were computed for each alternative at key locations. Initial evaluation of the data showed that the second tidal cycle (June 12-19, 1999) provided consistently higher values for all these characteristics so this was the period during which the results are examined and compared.

7.4 Alternative Conveyance Channel

Four proposed conveyance channel alternatives using an improved Bayou Pelton channel were developed for the modeling analysis. They consisted of:

- Alternative 1: Short channel alignment – 100' x 8' channel with guide levees, 1300 ft long and terminates into the marsh just east of BGC.
- Alternative 2: Parallel conveyance channel alignment configuration #1: 100' x 8' channel, 8400' long, bends south and runs parallel and adjacent to the east/west GSP canal and terminates in the north/south GSP canal at its intersection with the east/west GSP canal.
- Alternative 2: Parallel conveyance channel alignment configuration #2: 100' x 8' channel, 5700' long, runs parallel to and approximately 1500 feet north of the east/west GSP canal, and ties into the north/south GSP canal.
- Alternative 2: Parallel conveyance channel alignment configuration #3: Same as Alternative 2, configuration #2 above but used variable channel widths such as stepping the channel width down from 100 feet to 75 feet.

In addition, St. Louis Canal East and West Alternatives from the previous modeling study were re-run to see if geometry updates (addition of interconnected channels in the marsh) made any difference. Finally, the model was run for the condition in which the gates in the water control structure would be closed.

7.5 Estimated Flows Conceptual Design Report

Of interest is the amount of flow conveyed by the new proposed conveyance channel that reaches the "four corners" area, which is the intersection of east/west GSP canal and north/south GSP canals. The USFW objective is to deliver 75% (600 cfs minimum) of the flow entering the new conveyance channel to the "four corners" area. Additional factors include the maximum stages in BGC, the velocities at the "four corners," net environmental damage, landowners affected, and project cost. After taking all these factors into consideration, Alternative No. 2, Configuration 1 was selected as the preferred alternative. This was chosen because it conveyed the highest flows (633 cfs and 645 cfs under 10% and 90% exceedance, respectively) to the four corners, had acceptable velocities at the four corners, had acceptable stage elevations in BGC, and met the 75% criteria. The only two advantages of Alternative No. 2, Configuration 2 is project cost (3.1% less than the preferred alternative), and land rights (25% fewer tracts affected). Also, even though Alternative 1 had better characteristics overall, it delivered the least amount of freshwater (137 cfs and 143 cfs under 10% and 90% exceedance, respectively) to the four corners area and failed to meet the 75% criteria.

7.6 Modeling to Address UNET Model Program Error

In 2007, subsequent to the 2001-2002 modeling study, it was discovered that there was an error in the UNET program code that impacted the study. Specifically, the specification of the bank profile connecting channels to marsh/swamp areas which allowed for the exchange of water between the two did not work correctly and underpredicted flows when coded as a series of sloping profiles. In order for the correct flow to be computed, the bank profile needed to be specified as a series of stair-stepped level segments. This did not affect all channel-marsh/swamp connections as not all of them were coded in this fashion. However when the affected profiles were corrected, freshwater flows into the study area using the preferred alternatives increased significantly to 916 cfs and 800 cfs under 10% and 90% exceedance, respectively. The results did not affect which alternative was selected because the relative differences remained unchanged between alternatives. Exhibits G and H are schematics showing these and other flows and stage levels between the Houma Navigation Canal and the pipeline intersection.

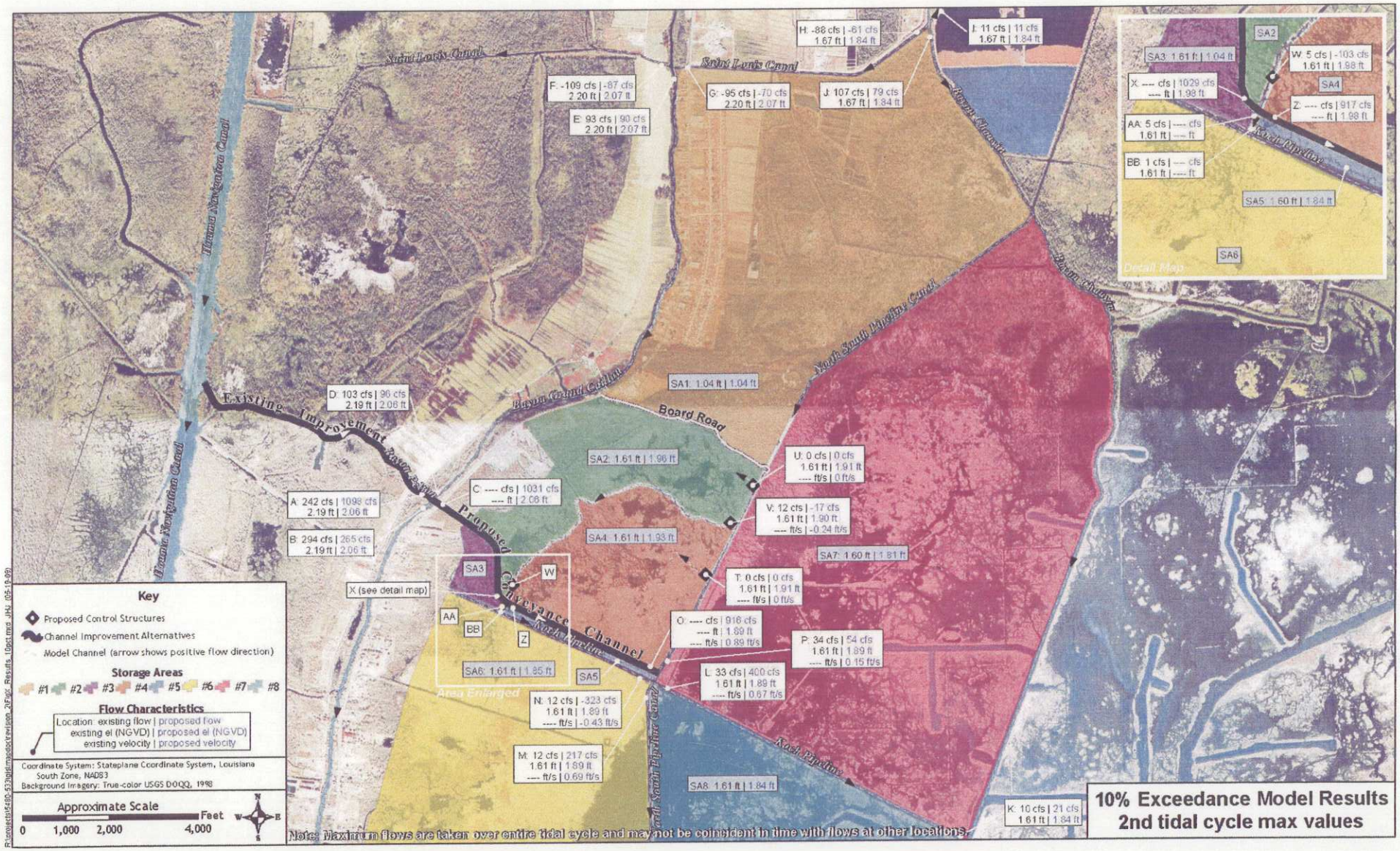

EXHIBIT G

FLOW SCHEMATIC @ 10% EXCEEDENCE

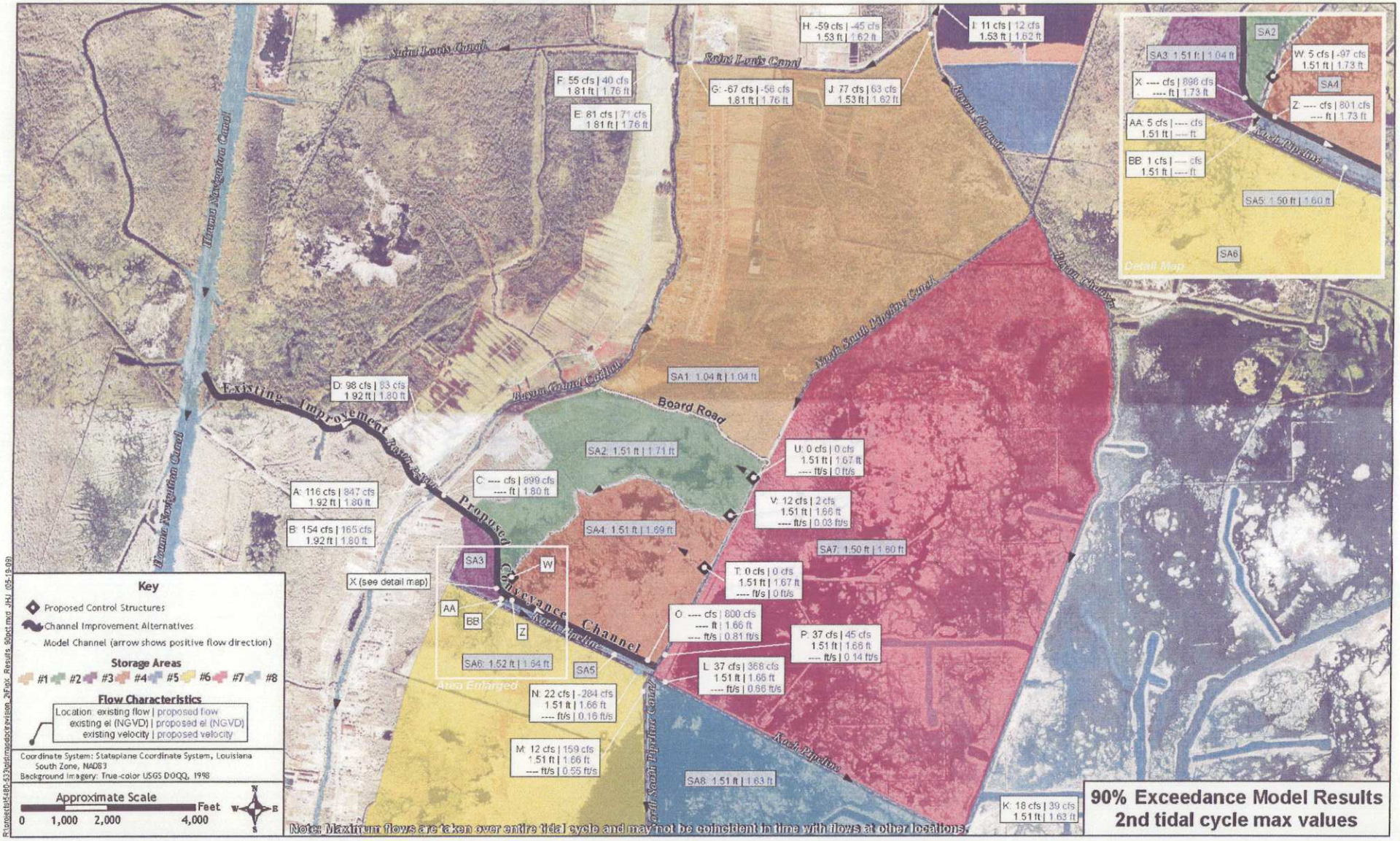

EXHIBIT H

FLOW SCHEMATIC @ 90% EXCEEDENCE

Section 8.0
PROJECT DESIGN

8.1 Introduction

The following paragraphs present a discussion of design parameters and criteria used to develop the 95% design package.

8.2 Dredging Overview

The area located along Bayou Pelton from the HNC to BGC will be hydraulically dredged to provide the desired flow to the PWCS located at Highway 57. To minimize damage to adjacent spoil bank and marsh vegetation, this channel must be constructed using a small cutter-head type dredge. An estimated 235,000 cubic yards of spoil material will be hydraulically dredged from the channel and pumped into four selected disposal areas located adjacent to Bayou Pelton. These disposal areas are shown on Exhibit I. Spread out evenly over the combined area, it is estimated that the elevations in the disposal areas will increase by approximately 1.4 feet before consolidation and settlement. After consolidation and settlement, natural ground elevations are estimated to be 6 inches higher than they currently are. These disposal areas were selected because they have historically fluctuated between open water and emergent marsh and because of landowner cooperation. The horizontal alignment of the new channel in Bayou Pelton was designed to follow a series of best fit curves through the center of the existing bank lines. This alignment was chosen to provide the least possible impacts to the existing bank lines on either side of Bayou Pelton based on the required channel excavation. Because most of the existing banks are well established high areas covered with large trees and vegetation, priority was given to minimize impacts to these forested spoil banks as much as possible.

The new conveyance channel will deliver freshwater from the PWCS to the marshes and canals north of Lake Boudreaux. Because this channel is primarily located in an open marsh environment, and side-cast disposal areas and adjacent levees are required, the preferred method of construction is bucket mechanical dredging. It is estimated that 203,000 cubic yards of dredging will be required to construct this feature. The horizontal alignment of the channel was designed to follow the centerline of the right-of-way which has been pre-defined based on existing right-of-way purchase agreements. This existing right-of-way is 275' in width and curves toward the south, eventually paralleling a GSP canal. In order to

NOTE:

1.) 117,350 C.Y. OF MATERIAL DREDGED FROM BAYOU PELTON WILL BE DEDICATED TO NOURISHMENT-DISPOSIAL AREA 1.
2.) 58,675 C.Y. OF MATERIAL DREDGED FROM BAYOU PELTON WILL BE DEDICATED TO NOURISHMENT-DISPOSIAL AREA 2.
3.) 29,325 C.Y. OF MATERIAL DREDGED FROM BAYOU PELTON WILL BE DEDICATED TO NOURISHMENT-DISPOSIAL AREA 3.
4.) 29,325 C.Y. OF MATERIAL DREDGED FROM BAYOU PELTON WILL BE DEDICATED TO NOURISHMENT-DISPOSIAL AREA 4.
5.) THE CONTRACTOR SHALL CONSTRUCT EARTHEN CONTAINMENT DIKES, AS NECESSARY, ALONG THE PERIMETER OF EACH DISPOSAL AREA SHOWN. CONTAINMENT SHALL BE REQUIRED ALONG ALL DISPOSAL AREA BOUNDARIES THAT DO NOT MEET THE MINIMUM TYPICAL SECTION SHOWN SHEET 24.
6.) THE CONTRACTOR SHALL PROVIDE TEMPORARY FACILITIES, AS NECESSARY, TO DEWATER THE MATERIAL PLACED IN THE DISPOSAL AREAS SHOWN. THE LOCATION OF DEWATERING STRUCTURES SHOWN ON THIS SHEET SHALL BE USED AS A GUIDE. FINAL LOCATIONS SHALL BE VERIFIED IN THE FIELD BY THE ENGINEER.
7.) SEE SHEET 24 FOR TYPICAL SECTIONS OF NOURISHMENT- DISPOSAL AREAS..
8.) DEWATERING STRUCTURE WEIR ELEVATION SHALL MATCH NOURISHMENT-DISPOSAL AREA MAXIMUM FILL ELEVATION.

LEGEND:

NOURISHMENT-DISPOSAL AREA TYPICAL SECTION

LIMITS OF ADEQUATE EXISTING CONTAINMENT AREA

LIMITS OF EXISTING CONTAINMENT AREA WITH ELEVATION TO BE RAISED PER TYPICAL SECTIONS ON SHEET 24.

HOUMA NAVAGATIONAL CANAL

NOURISHMENT-DISPOSAL AREA 1 (62.1 ac.)

NOURISHMENT-DISPOSAL AREA 2 (25.8 ac.)

NOURISHMENT-DISPOSAL AREA 3 (6.9 ac.)

NOURISHMENT-DISPOSAL AREA 4 (13.8 ac.)

RAISE ~3,915 L.F. TO MIN. OF +3.5 EL.

DEWATERING STRUCTURE

RAISE ~30 L.F. TO MIN. OF +3.5 EL.

RAISE ~17 L.F. TO MIN. OF +3.5 EL.

RAISE ~44 L.F. TO MIN. OF +3.5 EL.

RAISE ~240 L.F. TO MIN. OF +3.5 EL.

RAISE ~50 L.F. TO MIN. OF +3.5

RAISE ~1,201 L.F. TO MIN. OF +3.5 EL.

RAISE ~2,574 L.F. TO MIN. OF +4.0 EL.

EXISTING OVERHEAD ELECTRIC LINES

10+00 15+00 20+00 25+00 30+00 35+00 40+00 45+00 50+00 55+00 60+00 65+00 70+00

NOURISHMENT-DISPOSAL AREA 1

P.I. #	NORHTING	EASTING
DA-1	362730.24	3478939.27
DA-2	362832.81	3478981.13
DA-3	362896.94	3478984.73
DA-4	362931.87	3479005.52
DA-5	363053.55	3479103.94
DA-6	363268.82	3479332.03
DA-7	363258.28	3479393.14
DA-8	363264.03	3479454.88
DA-9	363267.16	3479484.08
DA-10	363268.70	3479807.53
DA-11	363286.80	3479928.30
DA-12	363288.18	3479976.09
DA-13	363278.18	3480022.85
DA-14	362988.28	3480918.13
DA-15	362912.25	3481070.25
DA-16	362862.76	3481243.16
DA-17	362740.03	3481485.71
DA-18	362643.78	3481585.91
DA-19	362566.53	3481626.90
DA-20	362479.56	3481617.84
DA-21	362355.24	3481572.15
DA-22	362264.85	3481486.28
DA-23	361953.11	3481426.34
DA-24	361952.54	3481214.96
DA-25	361889.22	3480958.18
DA-26	361832.93	3480516.98
DA-27	361814.42	3480376.57
DA-28	361680.30	3480282.84

NOURISHMENT-DISPOSAL AREA 2

P.I. #	NORHTING	EASTING
DA-29	364816.81	3479235.98
DA-30	364801.11	3479997.11
DA-31	364189.79	3479844.89
DA-32	363833.44	3480106.48
DA-33	363771.42	3480133.46
DA-34	363703.86	3480130.45
DA-35	363456.54	3480063.04
DA-36	363469.08	3480005.60
DA-37	363473.07	3479946.95
DA-38	363447.80	3479540.94
DA-39	363452.12	3479417.39
DA-40	363464.48	3479379.67
DA-41	363490.55	3479349.74
DA-42	363702.54	3479174.42
DA-43	363934.61	3479159.79
DA-44	364180.77	3479075.13
DA-45	364527.93	3479090.43

NOURISHMENT-DISPOSAL AREA 3

P.I. #	NORHTING	EASTING
DA-46	363437.72	3483066.69
DA-47	363332.00	3483270.43
DA-48	363267.27	3483322.09
DA-49	363081.07	3483401.38
DA-50	363019.92	3483415.14
DA-51	362879.12	3483425.39
DA-52	362694.67	3483130.63
DA-53	362733.58	3483017.82
DA-54	362720.84	3482937.31
DA-55	362660.58	3482833.44
DA-56	362731.61	3482723.46
DA-57	362774.00	3482754.35
DA-58	362805.65	3482806.62
DA-59	363131.77	3482991.07
DA-60	363205.62	3482921.73
DA-61	363388.26	3483024.30

NOURISHMENT-DISPOSAL AREA 4

P.I. #	NORHTING	EASTING
DA-62	362521.75	3481777.97
DA-63	362507.08	3481867.02
DA-64	362506.54	3481912.22
DA-65	362519.49	3481955.54
DA-66	362679.40	3482289.61
DA-67	362703.14	3482393.91
DA-68	362669.73	3482495.53
DA-69	362560.81	3482652.20
DA-70	362435.08	3482814.93
DA-71	362181.23	3482811.98
DA-72	361861.60	3482289.00
DA-73	361951.27	3482167.49
DA-74	362112.41	3481851.52
DA-75	362107.17	3481733.54

EXHIBIT I

SCALE IN FEET

400' 200' 0' 400' 800'

REV.	DATE	DESCRIPTION	BY
1	12/31/09	DISPOSAL AREA BOUNDARIES	ALH

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ENGINEERING BRANCH
450 LAUREL STREET
BATON ROUGE, LOUISIANA 70801

DRAWN BY: ALH DESIGNED BY: BJK

NORTH LAKE BOUDREAUX FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT

STATE PROJECT NUMBER: TE-52a

FEDERAL PROJECT NUMBER: TE-52a

APPROVED BY: BJK

BAYOU PELTON NOURISHMENT-DISPOSAL AREAS

DATE: 12.31.09

SHEET 23 OF 36

ensure the required flow is delivered to the target outfall canal and not overly dispersed into immediately adjacent marshes and swamps, small containment or guide levees are required to direct the flow under high water conditions. These guide levees will be constructed using material excavated from the conveyance channel. These guide levees will also serve to reduce conveyance channel-induced saltwater intrusion into adjoining swamps during periods when freshwater is not flowing through the conveyance channel.

8.3 Design Considerations

The hydraulic modeling conditions for this project require that the Bayou Pelton channel have a 1200 sq. ft. channel cross section. The model also requires a bottom elevation of -10.0' and a water surface elevation of +2.0' to meet or exceed the 800 cfs crossing the BGC Ridge as explained in Section 7.0. Because this channel will be constructed using a cutter-head dredge, it is desirable to reduce channel side slopes to as near vertical as possible for ease of construction. As discussed above, it is also a priority to reduce the width of the channel excavation to lessen the impacts on existing bank lines. However, based on the Slope Stability analysis calculated for this area (included on Page 16 of Appendix D), a channel side slope of 1:1 would produce a less than desirable factor of safety against slope failure of existing banks. Therefore, to satisfy the above criteria, the "Case 5" scenario in the geotechnical report (Table 4.2 on was chosen with a 2.5:1 (H:V) side slope and a Factor of Safety of 1.25 against slope failure. This results in a channel with bottom width of 70', top width of 130', with sides sloping at 2.5:1 down to a maximum elevation of -8.0'. This allows for the majority of existing high-banks and trees along Bayou Pelton to remain undisturbed.

The hydraulic modeling conditions require that the conveyance channel have an 800 sq. ft. cross section with a bottom elevation of -10.0' and a water surface elevation of +2.0' to carry the desired flow to the outfall canal. The new conveyance channel cross-section must allow the new guide levees on either side of the channel to fit within the pre-existing 275' Right-of-way. The Slope Stability analysis for the conveyance channel (included on Page 18 of Appendix D) shows that in order to maintain a Factor of Safety of 1.25 against slope failure, the guide levees must be placed a minimum of 30' from the channel side slopes. Since it was already necessary to maintain a 30' berm, and the natural ground

elevation along the conveyance channel is near a +2.0' elevation, the "Case 4" scenario from the geotechnical report was chosen, allowing channel side slopes of 2:1 (H:V).

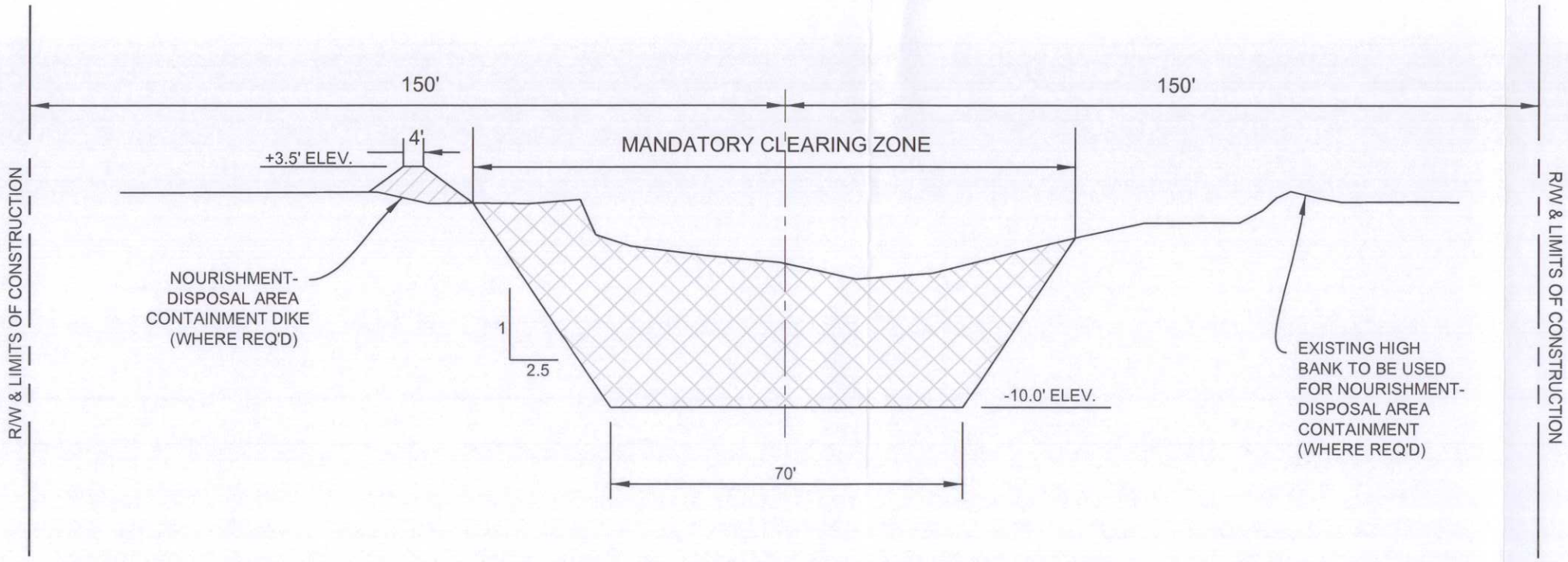
This case requires a 30' berm at a maximum +2.0' elevation on either side of the channel which yields a 1.25 factor of safety against slope failure. Using a 2:1 side slope and the required 800 sq. ft. area, the minimum channel bottom width is 45' at a -10.0' elevation. Exhibit J shows typical sections of both Bayou Pelton and the new conveyance channel.

For 90% exceedance flows, the velocities in Bayou Pelton and the conveyance channel will be 0.66 cfs and 1.0 cfs respectively. These velocities are greater than those modeled for the baseline conditions (present tidal exchange) in the Bayou Pelton / BGC system. Because of these increased velocities, and the minimal amount of suspended sediment present, long term siltation of these channels should be reduced.

8.4 Spoil Disposal

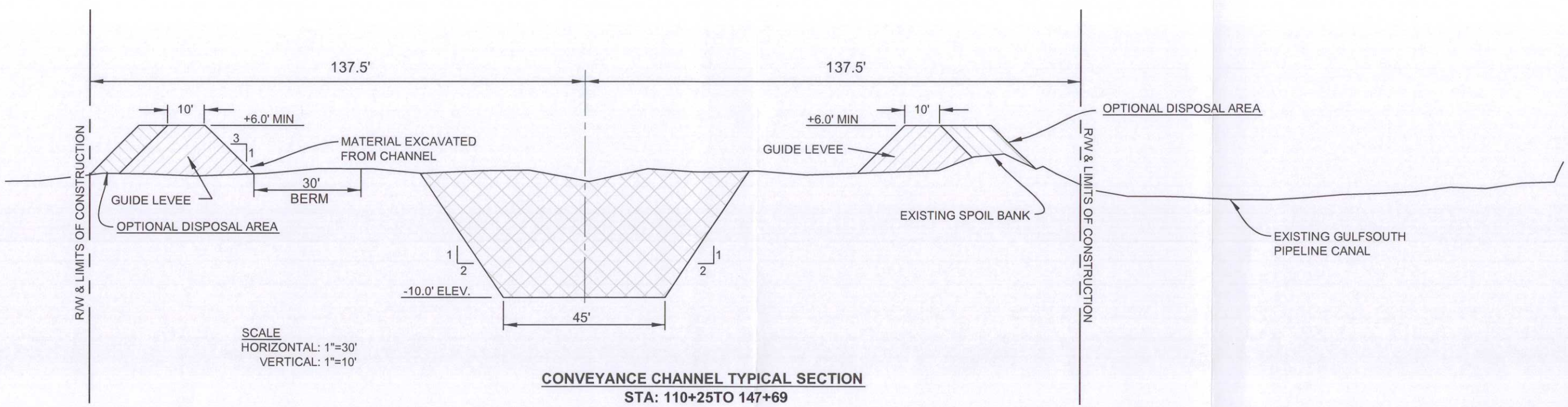
In exchange for the required 300' r/w, it was agreed that each of the three landowners adjacent to Bayou Pelton would receive a portion of the material that is hydraulically dredged from the channel. These landowners identified several candidate sites on their property on which the material could be placed. Of these sites, four of the most feasible sites were selected based on their proximity to the channel and the natural containment features surrounding the site. However, all four of the selected disposal areas will require that containment dikes be constructed in certain areas to form a closed perimeter.

Because the existing material in Bayou Pelton is made up of very soft, organic clays, it is anticipated that this material will not stack up well in the disposal areas. It is also likely that a large portion of this material will remain in suspension and exit through the dewatering facilities, even when large detention times are provided. Consequently, a large portion of the material dredged from Bayou Pelton will not be retained as stacked-fill volume in these areas. However, this highly organic slurry will be a great benefit as nourishment to existing marshes and wetland areas. The larger nourishment-disposal areas will retain a larger volume of sediment as fill because of the increased detention time. The smaller disposal areas should be allowed to pond to a higher elevation to increase volume, thus increasing detention time. In order to retain as much material as possible in the defined nourishment-



SCALE
HORIZONTAL: 1"=30'
VERTICAL: 1"=10'

BAYOU PELTON DREDGE AREA - TYPICAL SECTION
STA: 10+00 TO 75+00



SCALE
HORIZONTAL: 1"=30'
VERTICAL: 1"=10'

CONVEYANCE CHANNEL TYPICAL SECTION
STA: 110+25TO 147+69

EXHIBIT J

disposal areas, and also make use of material remaining in suspension, dewatering structures should be placed as far as possible from the dredge discharge and effluent should be directed into swamps, marshes and pipeline canals surrounding these disposal sites.

Because the existing material in Bayou Pelton is made up of very soft, organic clays, it is anticipated that this material will not stack up well in the disposal areas. It is also likely that a large portion of this material will remain in suspension and exit through the dewatering facilities, even when large detention times are provided. Consequently, a large portion of the material dredged from Bayou Pelton will not be retained as stacked-fill volume in these areas. However, this highly organic slurry will be a great benefit as nourishment to existing marshes and wetland areas. The larger nourishment-disposal areas will retain a larger volume of sediment as fill because of the increased detention time. The smaller disposal areas should be allowed to pond to a higher elevation to increase volume, thus increasing detention time. In order to retain as much material as possible in the defined nourishment-disposal areas, and also make use of material remaining in suspension, dewatering structures should be placed as far as possible from the dredge discharge and effluent should be directed into swamps, marshes and pipeline canals surrounding these disposal sites.

The material required to construct perimeter containment dikes of nourishment-disposal areas will be borrowed from within the boundaries of the disposal areas. Nourishment-Disposal Areas 1 and 2 are both generally comprised of small shallow ponds with sparse vegetation and small cypress trees. Nourishment-disposal area 3 is a shallow, man-made pond surrounded almost completely by pre-existing containment levees. Nourishment-disposal area 4 is comprised of shallow, low-lying, wetland areas, surrounded by hardwood swamps. All four of the nourishment-disposal areas can easily be dewatered by installation of spill-boxes or weirs which will return the effluent back into adjacent wetland areas to provide further nourishment. The use of these particular sites as disposal areas will fill existing open water areas, nourish existing wetlands, and promote growth of new wetland vegetation. It is estimated that in the larger disposal areas, initial fill heights will average 1.5' above existing natural ground. Post-construction consolidation and settlement are estimated to occur over 12 months with final elevations estimated at approximately +2.5 NAVD. Long-term (5 years) consolidation will result in final elevations of +2.0 NAVD.

The majority of spoil material dredged from the new conveyance channel will be used to construct the guide levees along each side of the channel. If excess material remains in the channel once the guide levees have been constructed, any additional spoil may be sidecast behind the guide levees up to the right-of-way. The stacking of this material above a +6.0' elevation will not be allowed, as this will increase the risk of slope failure. As the conveyance channel begins to parallel the existing pipeline canal, the southern guide levee will be constructed just north of the existing pipeline canal spoil bank. It was once an option to use the existing pipeline canal as a disposal area for excess fill removed from the conveyance channel. This would have required the destruction of nearly all vegetation along the existing pipeline canal spoil bank. However, because most of the material dredged from the conveyance channel can be disposed of within the right-of-way, it is not necessary that material be side-cast into the pipeline canal. This will allow the existing spoil bank to remain in-place, with existing trees and vegetation undisturbed. Furthermore, the excess material is insufficient to fill the adjacent GSP Canal.

8.5 Construction Methods

Bayou Pelton is easily accessible via the HNC for flotation access of equipment. Because of the shallow depths in Bayou Pelton, some initial excavation may be required to provide adequate flotation for proper operation of the cutter head dredge. Also, any clearing and snagging of trees, stumps, and vegetation must be performed prior to completing the hydraulic dredging of the channel. Because of the existing shallow depths in Bayou Pelton, this work can be easily accomplished with a marsh-buggy excavator. Once an adequate flotation channel has been excavated, hydraulic dredging operations will begin at the HNC and progress toward BGC. The clearing and snagging operations can proceed while the dredge makes an initial channel cut toward BGC. After the dredge has made the initial pass, any stockpiled material from flotation excavation can be swept back into the channel. This material will then be pumped by the dredge on the final pass back to the HNC. Woody debris from snagging shall be burned in accordance with applicable local ordinances.

Initial flotation access excavation and nourishment-disposal area containment dike construction are considered incidental to the hydraulic dredging of Bayou Pelton because 1) the quantity of new containment needed for the disposal areas is minimal. Existing natural features and spoil banks are mostly adequate for containment. What gaps need closure can

be closed using borrow from existing spoil banks thereby avoiding excavation in wetlands. The contractor may choose alternate methods and procedures for producing the required channel cross-section. Payment for all of the above work, with the exception of clearing, will be paid for at the unit price bid for "Hydraulic Dredging" as measured by the net cross-sectional volume removed in the channel r/w. It is desired that a small (10" to 12") cutter-head dredge be used for the dredging of Bayou Pelton. A smaller dredge will require less flotation excavation, and will also provide smaller pumping rates (less than 4000 GPM). Smaller pumping rates will allow for greater retention of material in the nourishment-disposal areas through larger detention times.

The only feasible option for construction of the new conveyance channel is to haul a disassembled dragline to the site by truck, assemble the equipment on land, and begin dredging the conveyance channel from land near the PWCS. Once an adequate channel has been dredged that will provide flotation of equipment, a "Flexi Float" sectional barge could be assembled in the channel on which the dragline would be loaded. The channel would then be dredged in flotation from west to east. Initially, it was thought that a second option may have been to float in barge-mounted equipment through Lake Boudreaux, north into Bayou Chauvin, and west in the GSP Canal until reaching the project site. However, surveys of the numerous pipelines located in and around this canal revealed inadequate clearance for flotation of barged equipment. The GSP Canal requires a minimum 50' clearance between any dredging and their pipeline, which eliminates this option as a possible method of access.

The conveyance channel alignment is known to cross a remnant cypress swamp, which contains numerous dead trees and stumps. Any trees, logs, or stumps encountered within the channel area shall be removed and disposed of between the guide levees and the right-of-way. This debris will be covered with any excess spoil material placed behind the guide levees. Material removed from the surface of the new conveyance channel, such as vegetation and undesirable organics, will also be disposed of between the guide levees and channel right-of-way. It is anticipated that the use of a marsh-buggy excavator will most likely be required for compaction and shaping of containment levees and clearing operations. Construction of the conveyance channel guide levees will be considered incidental to the dredging of the channel. Therefore, payment for all above work, with the exception of

clearing, will be paid for at the unit price bid for "Bucket Dredging" as measured by the net cross-sectional volume removed in the channel right-of-way.

The target crown elevation for the majority of the conveyance channel guide levees is a +4.0', which will ensure more than adequate freeboard against the highest flow conditions. According to the geotechnical analysis, 1 to 2 inches of settlement can be expected for each foot of dredged material placed on the existing soils. Therefore, the containment levees will be constructed to a +6.0' crown elevation in order to achieve the long term target elevation of +4.0'. The first 3200' of south guide levee from the PWCS toward the existing pipeline canal will be constructed to a target elevation of +8.0'. This levee will also serve as a forced drainage levee which will tie into the new forced drainage system being constructed to the south of this project. Similarly, the first 640' of north guide levee will also be constructed to a target elevation of +8.0'. This levee will tie into a new forced drainage system to the north of the new conveyance channel. Exhibit U shows the locations of the future forced drainage systems which will tie-in to the conveyance channel guide levees.

8.6 Primary Water Control Structure Cofferdam

The construction of the culvert structure beneath Highway 57 and the inlet and outlet headwalls shall require the installation of a temporary excavation cofferdam owing to the soft consistency of the cohesive soils in the proximity of the proposed diversion structure. Due to the depth of the proposed structure, it is anticipated that the cofferdam will be comprised of braced sheetpile bulkheads working in combination with stepped slopes and embankments engineered to provide sufficient stability and to minimize lateral soil movements within the limits of excavation required for the total structure. Although the means, methods and sequence of the construction excavation and sheetpile cofferdam bulkheads should ultimately be the responsibility of the general contractor who should be experienced in this type of excavation and dewatering, a general cofferdam layout plan will be incorporated into the final plans in order that the placement of the cofferdam system will not interfere with the projected layout of the bypass road along Highway 57.

In conjunction with the placement and maintenance of the cofferdam system, the contractor shall also be responsible for the methods and means of dewatering throughout the project. Although it is generally believed that the structure excavation may be effectively dewatered with sumps and normal pump equipment, the method used shall be entirely up to

the discretion of the contractor. Regardless of the method selected by the contractor for dewatering, however, it is recommended that construction on the diversion structure should proceed as quickly as practical and the excavation be backfilled as soon as feasible to avoid long-term pumping which could result in a lowering of the surrounding water table and the inducement of areal settlement. Exhibit K shows the layout of the PWCS at Highway 57.

8.7 Primary Water Control Structure Foundation

The proposed foundation base for the six (6) 10-ft. square concrete box culverts crossing beneath Highway 57 shall not be pile supported; it has been determined that a minimum amount of settlement beneath the culvert structure is acceptable in order to prevent excessive differential settlement along the finished roadway surface above the culverts and the roadway approaches immediately to the north and south. Based on the soil boring data contained in the subsoil investigation report prepared by Ardaman & Associates, Inc., dated March 2009 and based upon the geotechnical report and our engineering analysis under maximum load conditions, the subsoils are capable of supporting the proposed culverts in conjunction with a prepared foundation. As recommended in the soils report, it is proposed that the six concrete culverts be supported on a common concrete mat foundation, approximately 30" in thickness, suitably reinforced to provide the proper rigidity beneath the six (6) concrete box culverts. Based on an ultimate soil bearing capacity of 2,500 psf, the mat foundation shall be designed using a minimum factor of safety of at least 2.0 against failure.

To prevent erosion beneath the previously discussed concrete mat foundation, a steel sheetpile cutoff wall, at least 20-ft. in length, shall also be constructed at both the east and west ends of this mat foundation. This cutoff wall should include the perimeter wing walls and aprons of both the inlet and outlet headwall as the purpose of this sheetpile cutoff wall is to prevent scour beneath any portion of these headwall structures.

Beneath the reinforced concrete mat foundation, it is proposed that a compacted aggregate base be constructed at least 36" in thickness, utilizing graded crushed limestone. A geotextile filter fabric shall be placed beneath the aggregate base to act as a separator between the bedding materials and the underlying subsoils. It is also recommended that the uppermost 10" subsoil layer immediately below the proposed aggregate base be compacted

to at least 95 percent of maximum dry density at optimum moisture content according to ASTM D-698. In addition, the Contractor shall use all precautions during construction to provide adequate dewatering and minimize disturbance of the subsoils in the vicinity of the foundation base.

The monolith foundations at both the inlet and outlet headwall structures are proposed to be pile supported; owing to the design of the foundations, it is not necessary to provide tension piles to prevent uplift of the monoliths during those periods when dewatering will be necessary to perform maintenance on the sluice gates. The reinforced concrete foundations shall be approximately 30" in thickness, and a 4" thick concrete stabilization base shall be poured prior to forming operations on the monolith foundations. A steel sheetpile cutoff wall, at least 20-ft. in length, shall also be installed along the north and south sides of the inlet and outlet monolith slabs, as well as the western edge of the entrance monolith and the eastern edge of the outlet monolith slab. All support piles, whether used in tension or compression, shall be precast, pre-stressed, concrete piles, 14-inch square each. The length and number of piles required shall be based on the load bearing capacities set forth in the geotechnical report provided by Ardaman & Associates, Inc. The piles will generally receive their support through "skin friction" along their embedded length as there are no subsoils present at the site which would offer additional "point" support.

INLET CHANNEL AT BAYOU GRAND CAILLOU

NORTH

DRAINAGE R/W (APPROX. LOC.)

PERIMETER SECURITY FENCE (7' HEIGHT)

225.7'

49.0' | 103.0' | 73.7'

29.0' | 20.0' | 10.0' | 13.5' | 14.0' | 14.0' | 14.0' | 14.0' | 13.5' | 10.0' | 20.0' | 53.7'

Slope 2H:1V

10' Rad

BAY 1 | BAY 2 | BAY 3 | BAY 4 | BAY 5 | BAY 6

Sheetpile Wingwall

Galvanized Steel Trash Screens

14'

16'

Concrete Rack for storage of dewatering needles

63.00'

CONTROL & MAINTENANCE BUILDING

Pre-Cast Concrete Deck Slabs

5'x14' Concrete Approach Ramp on each side

Proposed Limestone Aggregate Surfacing

Galvanized Steel Walkway

Raised Concrete Platform

LOT 1 | LOT 2 | LOT 3 | LOT 4 | LOT 5

EXIST WATERLINE

EXIST TELEPHONE LINE

80' HWY R/W

Proposed Limestone Aggregate Surfacing

PROPOSED (6) 10'X10' RCB'S

PROP. SHOULDER

EXIST SHOULDER

40' ROW

50.00'

TRAVEL LANE

BASELINE

℄ LA HWY 57 (BASELINE)

TRAVEL LANE

EXIST SHOULDER

PROP. SHOULDER

80' HWY R/W

EXIST SEWER LINE (TO REMAIN)

EXIST WATERLINE

BAY 1 | BAY 2 | BAY 3 | BAY 4 | BAY 5 | BAY 6

EXIST SEWER LINE (TO REMAIN)

℄ HWY. 57 TEMPORARY

EXIST TREE (TO BE REMOVED)

EXIST TREE (TO REMAIN)

LOT 37

LOT 34

EXIST TREE (TO BE REMOVED)

PROP. RIPRAP WITHIN CONVEYANCE CHANNEL

LOT 33

EXIST TREE (TO BE REMOVED)

DRAINAGE R/W (APPROX. LOC.)

DRAINAGE R/W (APPROX. LOC.)

PROPOSED STRUCTURE SITE PLAN

PLAN VIEW

40' 20' 0 40'

EXHIBIT K

LEGEND

- ASPHALT DRIVEWAY
- AGGREGATE DRIVEWAY
- EXIST WATER LINE
- EXIST TELEPHONE LINE
- TELEPHONE BOX

REV.	DATE	DESCRIPTION	BY
	05/20/09	OCPR COMMENTS	KPR

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DRAWN BY: JB | DESIGNED BY: T. Baker Smith

NORTH LAKE BOUDREAUX FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT

STATE PROJECT NUMBER: TE-32a

FEDERAL PROJECT NUMBER: TE-32a

APPROVED BY: LJD

PRIMARY WATER CONTROL STRUCTURE

DATE: 4/1/09

SHEET 20 OF 38

8.8 Primary Water Control Structure Box Culverts and Headwall

The six (6) reinforced concrete box culverts (10-ft. square each) are proposed to consist of precast units in lengths of approximately 10-ft. each; the units shall be constructed of 4000 psi minimum compressive strength concrete. Each precast unit shall be 3-sided as the bottom of the culvert segments will be comprised of the reinforced concrete mat foundation as previously outlined. The vertical sides of each of the precast culvert sections shall be made to fit into a keyway recessed into the mat foundation, and the voids around this keyway shall be grouted (high-strength grout) once the precast culvert segments have been placed to proper grade on the monolith concrete slab. The precast culvert segments shall be anchored to the mat foundation with steel tiedown rods so as to form an integral part of the finished culvert structure. As was explained earlier, the mat foundation is not pile supported, and once the precast culvert units are anchored to the mat foundation, the resulting dead loads from the combined weight of the mat foundation as well as the precast concrete box culverts shall be designed to be sufficient to prevent any upward movement of the finished culvert structure during dewatering maintenance cycles.

The reinforced concrete headwalls and monolith sections at both the inlet and outlet sides of the proposed diversion structure shall be pile supported, as previously discussed. All support piles, whether tension or compression, shall be 14-inch square precast, pre-stressed concrete piles. Although the concrete headwalls and monolith sections shall be pile supported, as previously discussed the concrete mat foundation beneath the culvert structure is not pile supported and therefore some mechanism must be provided for "differential" settlement between the headwalls and the culvert foundation. Our design will provide for an "interlocking" joint at the interfaces of the headwall with the culvert structure; this joint will allow for vertical displacement of the culvert mat foundation while at the same time restraining any lateral movement of the culvert structure with respect to the concrete headwalls at either end of the diversion structure.

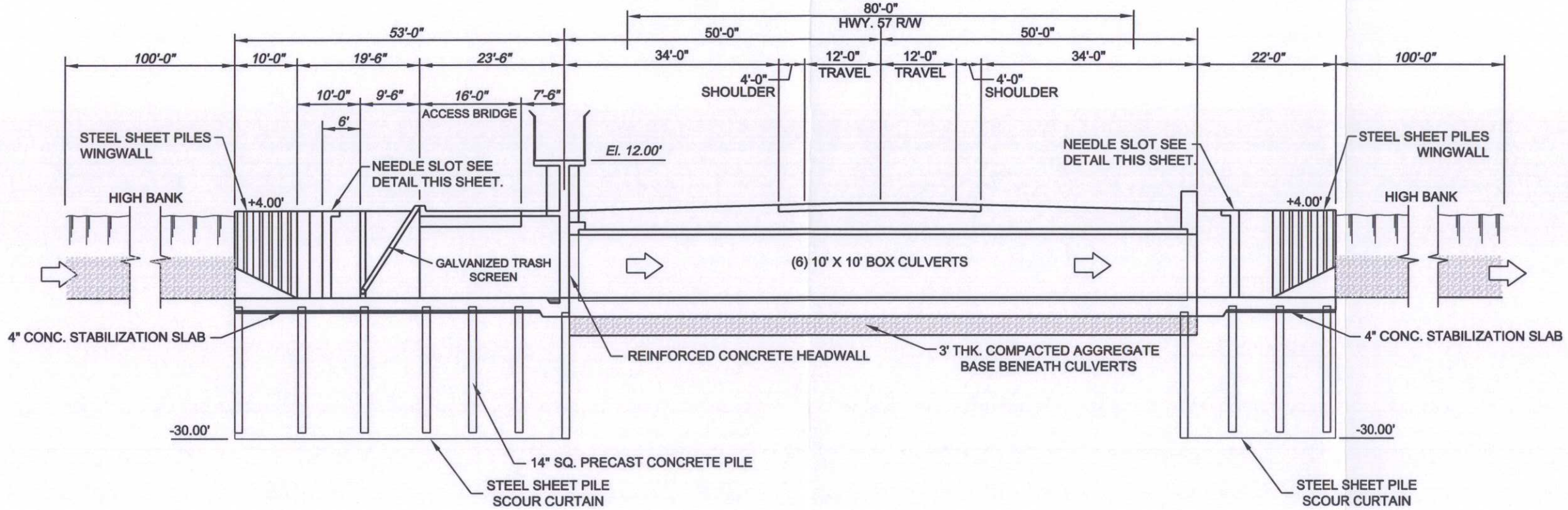
In addition to providing adequate support for the 10-ft. square sluice gates (6 required), the inlet headwall shall also provide for a raised concrete platform along the length of the headwall for the inspection, maintenance and emergency operation of the six (6) sluice gates. The headwall on the inlet side of the diversion structure shall therefore have a greater

height than that of the outlet headwall. This feature is more aptly depicted on the typical cross-section through the structure (see Exhibit L).

8.9 Primary Water Control Structure Heavy Duty Sluice Gates and Operators

The freshwater diversion structure shall be equipped with six (6) heavy duty resilient seated sluice gates (10-ft. x 10-ft. each culvert) which can be opened or closed by means of electric motor operated gate lifts to control the flow through the diversion structure. The sluice gates shall be designed to withstand 10 feet seating and unseating head conditions, with a leakage rate of no more than .001 gallons per minute per perimeter foot of gate opening. The gates, frames and guide rails shall be constructed of cast iron; the gate top and side wedges shall be manganese bronze and the seating faces shall be naval bronze. All gate-anchoring hardware shall be Stainless Steel Type 304; the gate stem shall also be constructed of Type 304 Stainless Steel. The stem guide and lift pedestal shall be cast iron with bronze bushings, and the stem shall be provided with a clear plastic stem cover with a mylar strip indicator.

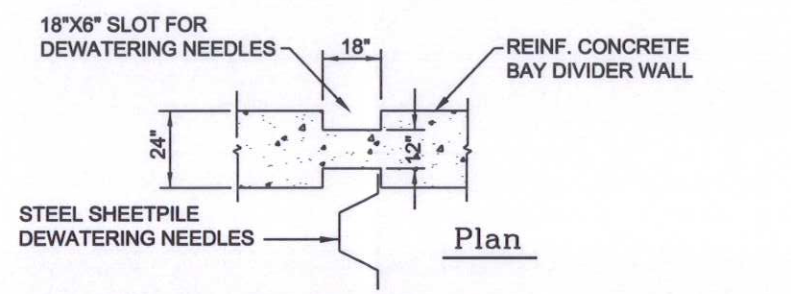
Each sluice gate shall be opened and closed by means of an electrically operated actuator mounted to the cast iron lift pedestal specified for the specific make of sluice gate selected for use on this project. The electric actuators shall include the motors, actuator unit gearing, limit switch gearing, position limit switches, torque switches, stem nut, declutch lever, compartment heater, and handwheel to provide a self-contained unit. The actuators shall be sized to have sufficient capacity to raise or lower the gate at a speed of 9 to 15 inches per minute against the operating head conditions specified. Power to the gate actuators shall be 460V-3PH-OHZ and each valve actuator motor and enclosure shall be NEMA 4 (watertight) and NEMA 6 (submersible to six foot head for 30 minutes).



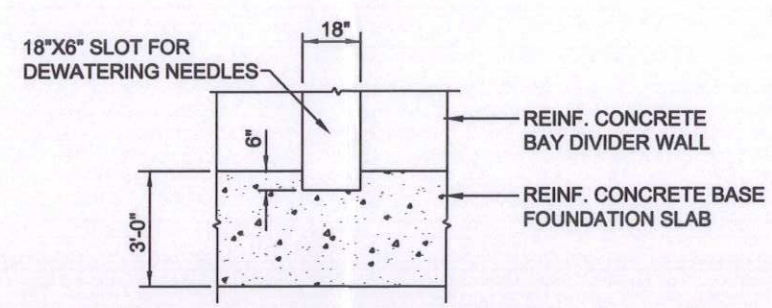
TYPICAL LONG. SECTION THRU STRUCTURE

1 / 20

SCALE: 1" = 20"



Plan



Elevation

Needle Slot Detail

SCALE: 1" = 5'

EXHIBIT L

REV.	DATE	DESCRIPTION	BY
	05/20/09	OCPR COMMENTS	KPR

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DRAWN BY: JB | DESIGNED BY: T. Baker Smith

NORTH LAKE BOUDREAUX
FRESHWATER INTRODUCTION
AND HYDROLOGIC MANAGEMENT

STATE PROJECT NUMBER: TE-32a

FEDERAL PROJECT NUMBER: TE-32a

APPROVED BY: LJD

PRIMARY WATER
CONTROL STRUCTURE

DATE: 4/1/09

SHEET 21 OF 38

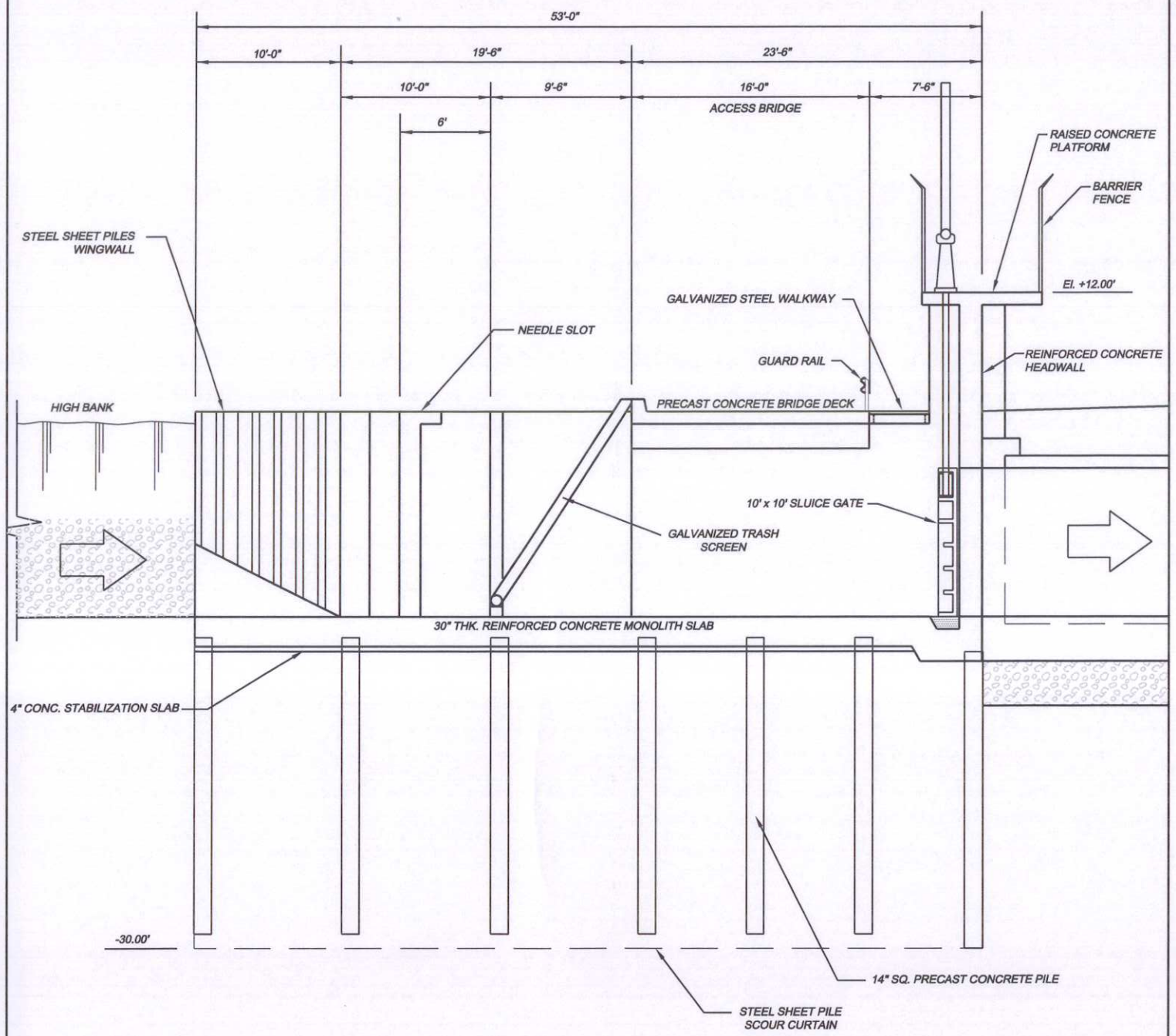
8.10 Trash Screens

Each bay on the inlet side of the diversion structure shall be furnished with a galvanized steel trash screen to prevent the inflow of logs, trash, and other floating debris into the Lake Boudreaux project basin. Each trash screen shall be constructed of galvanized steel and shall be sloped at an angle of approximately 30 degrees from vertical to allow for easy access for periodic cleaning. The trash screens shall be designed for easy removal by providing recessed slots into the vertical bay divider walls; each trash screen shall be designed so as to easily slip into these slots and then recline against the concrete access bridge for horizontal support and anchorage. Exhibit M illustrates this concept more clearly and also shows the position of the trash screens in relation to the sluice gates and the access bridge.

Cleaning of the trash screens shall be accomplished with a tire-mounted "Gradall" excavator operating from the concrete access bridge; removed debris can be directly loaded into dump trucks for removal to offsite disposal areas. The access bridge shall be constructed of precast concrete panels designed for the equipment and dead loads to be imposed on the structure; the access bridge is to be supported at each panel end directly on the vertical divider bay walls. At each end of the access bridge, the reinforced concrete sidewalls of the entrance monolith structure shall provide the vertical support for the bridge panels. A raised concrete curb shall run the entire length of the bridge on the trash screen side, and a suitable metal traffic barrier shall be placed along the opposite side to maintain traffic passage.

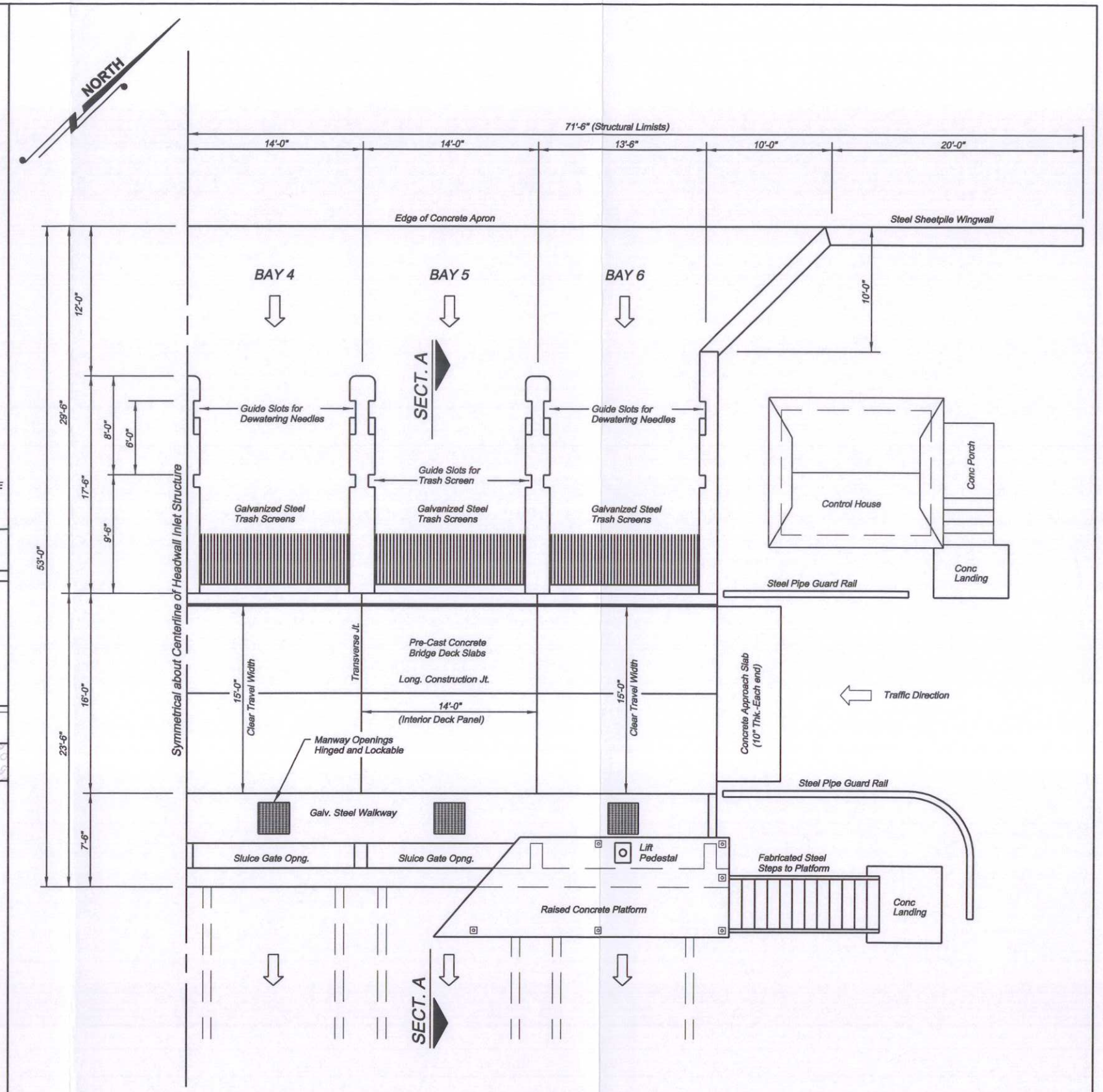
8.11 Primary Water Control Structure Dewatering Needles

As periodic cleaning and maintenance of the sluice gates, bays and culverts will be required; provisions have been made in the design of the diversion structure to provide for



SECT. A - TYPICAL LONG. SECTION THRU INLET HEADWALL STRUCTURE

SCALE: 3/16" = 1'-0"



HALF-PLAN INLET HEADWALL STRUCTURE

SCALE: 3/16" = 1'-0"

EXHIBIT M

dewatering of the structure. On both the inlet and outlet ends of the diversion structure, steel sheetpile needles can be inserted into the recessed slots of the vertical bay walls to provide for a watertight enclosure on each individual culvert segment. Following the insertion of the sheetpile needles on each end of the structure, the individual bays can then be pumped dry manually by means of portable pumping equipment. The bays can be dewatered one at a time or two or more bays can be dewatered simultaneously; it is our recommendation, however, that no more than 3 bays be dewatered concurrently during any maintenance cycle.

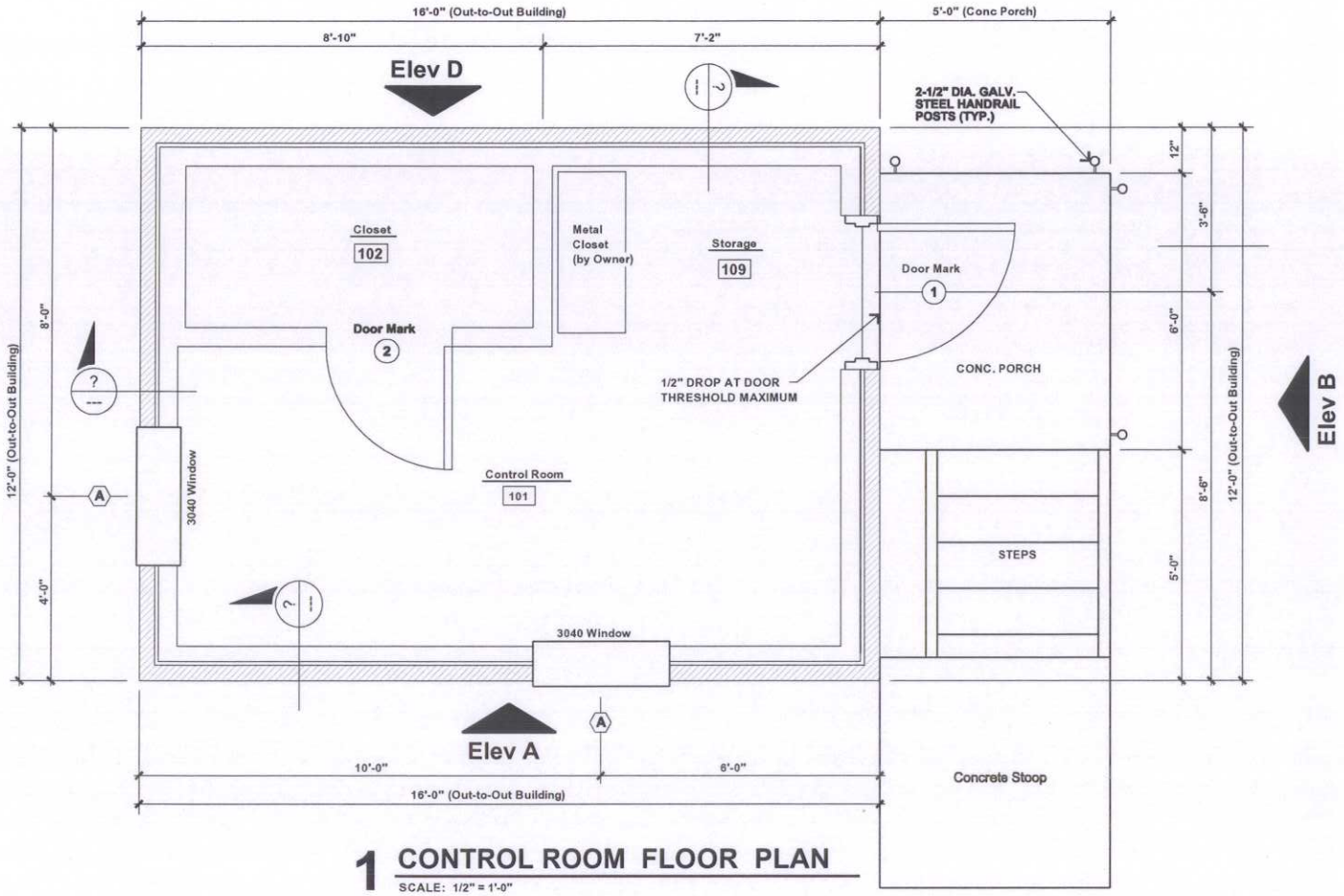
The dewatering needles shall be "Z-type" steel sheetpile of a type commonly used for dewatering of cofferdams; the interlocks of the sheetpile needles shall be of the "ball and socket" type. This project will include the acquisition of a sufficient number of steel sheetpile needles to permit dewatering of the diversion structure for periodic maintenance. The needles shall be stored onsite on a pile supported rack for easy access by maintenance and operation personnel in the future.

8.12 Maintenance and Electrical Control Building

This project will include the construction of a 12' x 16' maintenance/control building onsite (see Exhibit N) for the operation of the automated sluice gates and temporary shelter for operations personnel. The building will be standard wood-framed construction with brick veneer walls; the roof shall be standing seam metal over plywood sheathing. Interior walls and ceiling shall be FRP (Fiberglass Reinforced Plastic) panels applied over moisture-proof gypsum board sheathing. The building will serve as the control room for the operation of the sluice gates, storage of records, and place of shelter for operations personnel. Additionally, all electrical equipment and control panels will be housed in this building.

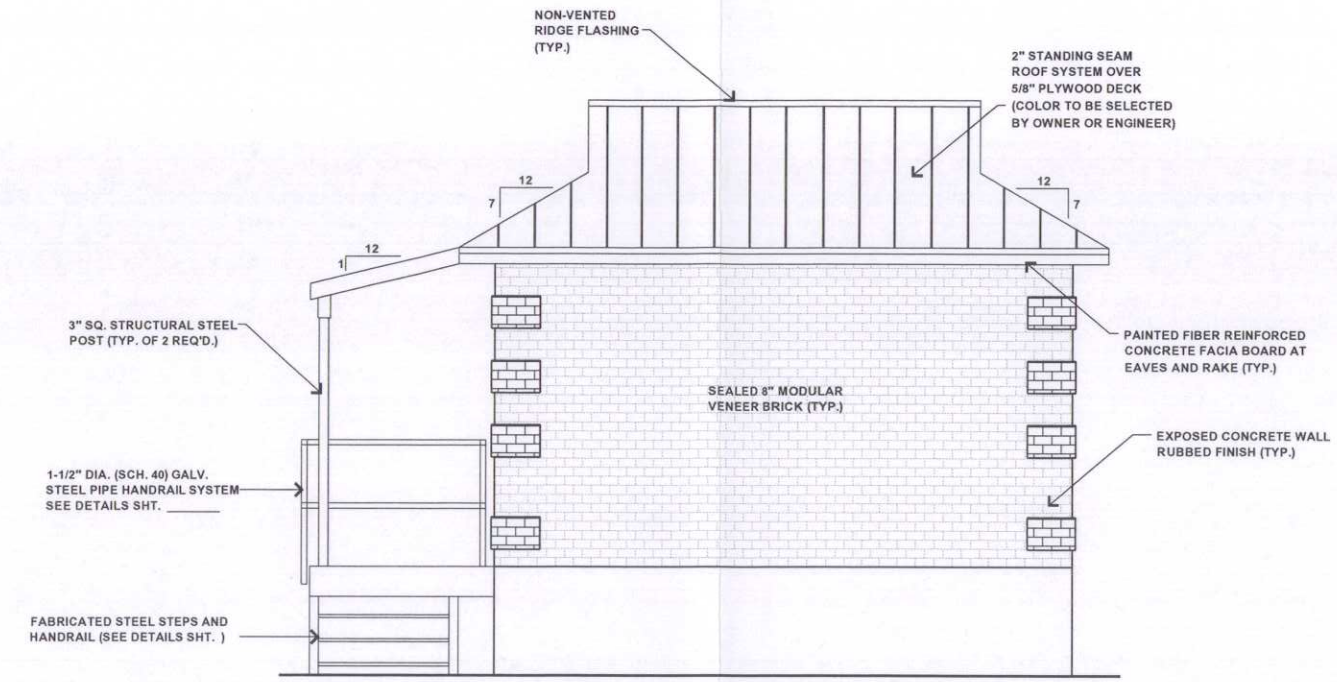
8.13 Auxiliary Gate Actuators

In the event of power outage or electrical equipment failure, standby portable gasoline powered actuators shall be available to open or close the sluice gates as may be required. Two portable, two-cycle, gasoline engine actuators shall be furnished as part of this contract with all the necessary adaptors to drive the gates specified. Maximum output torque shall be less than 80 foot-pounds and the drive unit shall incorporate a direct drive design only. The entire portable actuator unit shall weigh less than 40 pounds. One unit



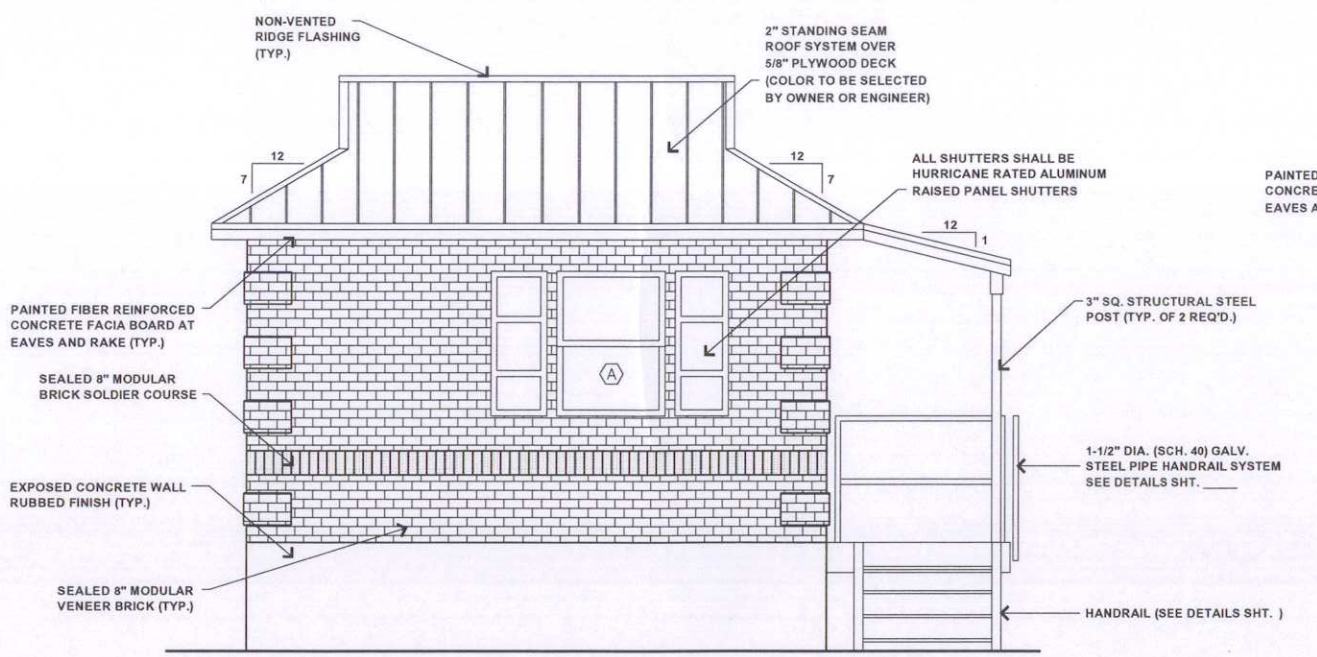
1 CONTROL ROOM FLOOR PLAN

SCALE: 1/2" = 1'-0"



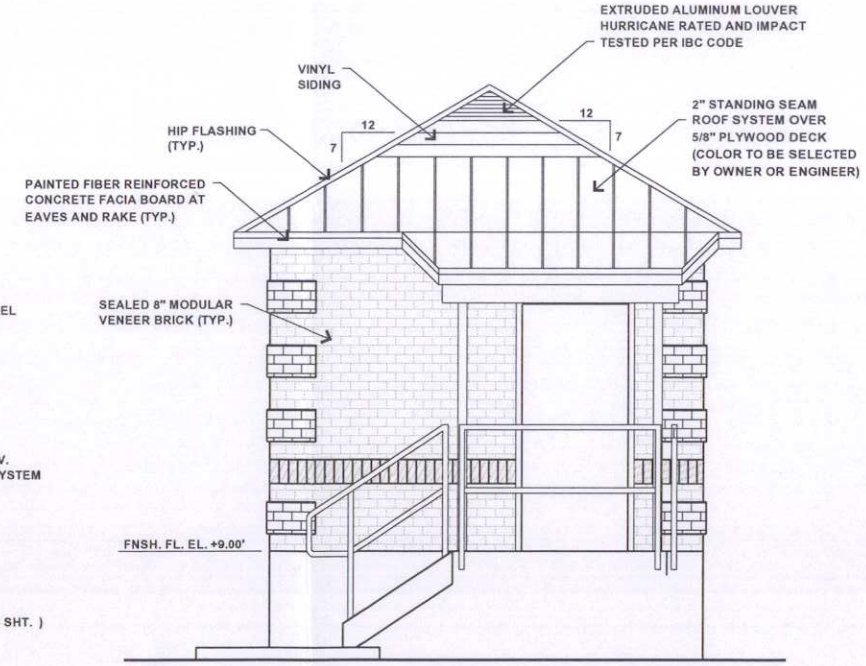
D ELEVATION: West Side Building

SCALE: 3/8" = 1'-0"



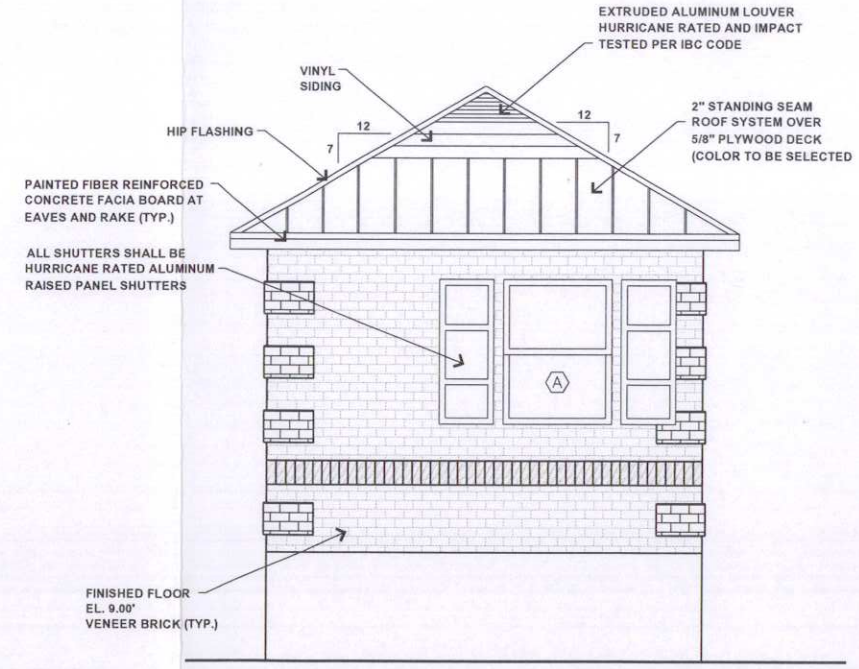
A ELEVATION: East Side Building

SCALE: 3/8" = 1'-0"



B ELEVATION: North Side Building

SCALE: 3/8" = 1'-0"



C ELEVATION: South Side Building

SCALE: 3/8" = 1'-0"

EXHIBIT N

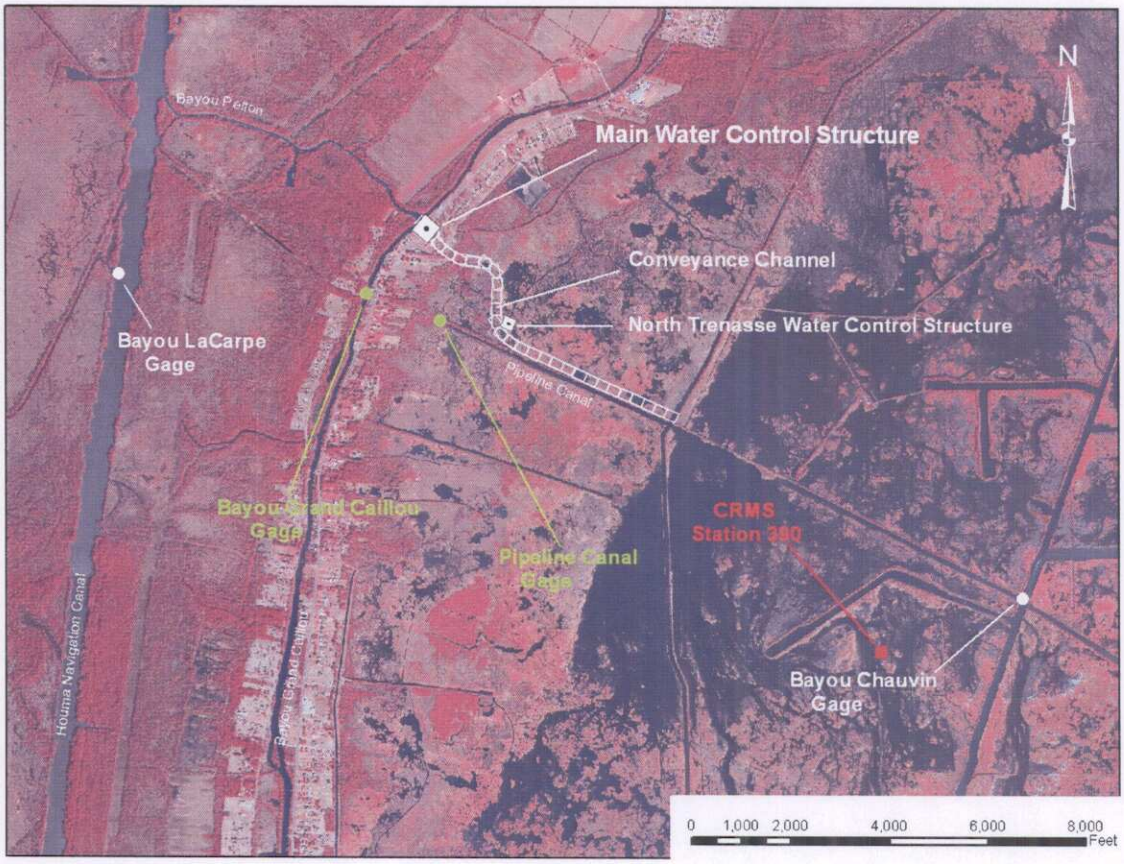
shall be stored in the maintenance building for ready access by operations personnel and the other in a location to be designated later.

8.14 Primary Water Control Structure Operation Plan (11/25/09)

Main Conveyance Channel Water Control Structure

The main water control structure consists of six 10-foot-square concrete culverts with sluice gates on the inlet (HNC) side of the culverts. Each sluice gate will be motorized and operated by a logic controller programmed to open or close based on specific water level, water flow, and/or salinity conditions measured at the control structure. This control structure will be located in the conveyance channel, beneath Louisiana Highway 57 (Figure 1). The structure will be operated to introduce seasonally available fresh water from

Figure 1. Map delineating the location of the main control structure and gaging stations.



the Houma Navigation Canal (HNC) into the marshes north of Lake Boudreaux. Because the average head difference across the structure is often less than 0.5 feet, the gates of the main water control structure must be raised out of the water to avoid reducing freshwater inflows.

Also, because of the large tidal amplitude on the HNC, low tide conditions there may induce introduced fresh water to backflow out of the Lake Boudreaux Basin and into the HNC. Such conditions will likely occur more frequently during low tides coinciding with periods of low Atchafalaya River discharge, when elevated water level conditions do not occur within the HNC due to the lack of Atchafalaya River influence. During such conditions, positive head differential occurs only during the HNC high tide.

To prevent freshwater backflow, the logic controller will be programmed to close all gates to prevent backflow whenever the flow sensors detect slight reverse flow currents. When the structure is closed, the logic controller will re-open all gates when the water level sensors reveal that a positive head differential occurs. To avoid introducing brackish water, the inlet sensors located on the main control structure will monitor salinity 18" above the channel bottom. When the inlet sensors detect salinities of 1.0 parts per thousand (ppt) or more 18" above the channel bottom, all sluice gates will be closed until those salinities fall below 1.0 ppt.

However, following drought and/or storm surge inundation, special Flushing Operations may be conducted at the discretion of the manager, to expedite the dilution or flushing of brackish water from the receiving area marshes, and to decrease associated stress on wetland vegetation. Flushing Operations are intended to be infrequent, and not a normal operation mode. Flushing Operations will be achieved by manually programming the salinity set points of the controller to open gates at a higher set point level provided that inflows are 2 to 3 ppt less than the salinity at the CRMS # 390 monitoring station (Figure 1).

Upon the discretion of the operator, flushing operations may be continued as long as inflow salinities are 2-3 ppt less than salinities measured at CRMS # 390. The operator's decision to conduct or halt Flushing Operations should consider predicted Atchafalaya River stage, rainfall, tidal conditions, drought, and other factors.

North Trenasse Water Control Structure

The north trenasse water control structure (Type 1) consists of one eight foot (8') diameter stop log fixed crest weir for regulating water exchange. This control structure will be located in the north conveyance channel spoil bank (Figure 1) and will be operated to introduce fresh water northward into the existing trenasse. The stop logs will be installed such that they flow water northward into the marsh. During periods of low Atchafalaya

River discharge, brackish waters may move into the project area from Lake Boudreaux. To prevent channel-induced saltwater intrusion into the swamps north of the conveyance channel, the stop logs will be placed in each of the stoplog bays to halt all water exchange when fresh water is no longer consistently available within the HNC. The flapgates will also be lower into operating position. All stoplogs will be removed when the manager, at his discretion, believes that freshwater has become consistently available within the HNC due to increasing Atchafalaya River discharges. At the same time, the manager will remove all stoplogs, and raise and lock each flapgate in the open position to improve northward freshwater flow. Because this structure is manually operated, changing the configuration of this structure is anticipated to be conducted as few as 2 to 4 times per year.

Table 8.1

Summary of Main Water Control Structure Operations

Main Water Control Structure Operations – Normal Operation Mode

Inlet Salinity[1]	Outlet Salinity	Head Differential[2]	Gate Position
< 1.0 ppt		+	all gates open
< 1.0 ppt		-	all gates closed
> 1.0 ppt		+ or -	all gate closed

1 Surface and bottom salinity measured on the HNC side of the structure
2 Positive head differential would move water from west to east

Main Water Control Structure Operations – Flushing Operation Mode

Inlet Salinity[1]	CRMS Sta. No. 390[2]	Head Differential[3]	Gate Position
>CRMS[5] Set Point	2 or 3 ppt greater than inlet salinity	+	gates may be opened upon manager's discretion[4]
> CRMS[5] Set Point	2 or 3 ppt greater than inlet salinity	-	all gates closed

1 Surface and bottom salinity measured on the west side of the structure
2 Surface salinity measured at the CRMS # 390 station
3 Positive head differential would move water from west to east
4 Gates may remain open provided average inlet salinities decrease over the 72 hour period.
As long as inlet salinities remain 2 – 3 ppt less than CRMS # 390 salinities, the manager may at his discretion opt to continue Flushing Operations.
5 Manual programming inlet set point

Anticipated Frequency of Main Control Structure Gate Operations

Stage data collected in BGC, and in the pipeline canal near Bayou Grand Caillou (see Figure 1 for gage locations), reveal that the BGC tidal amplitude (due to HNC influence) is much greater than that measured within the Lake Boudreaux Basin at the pipeline canal (Figure 2). BGC water levels during high tide exceed those within the pipeline canal. Conversely, the BGC water levels during low tide are less than those within the pipeline canal (Figure 2). These data were collected during a period of relatively high Atchafalaya River discharge (358,000 cfs on 5/15/06, increasing to 440,000 cfs on 6/8/06, then decreasing to 183,000 cfs on 7/15/06). Based on these data, the main water control structure would operate for an average of 14 hours, followed by an average closure period of 11 hours. Based on this data, the gates would be operated an average of once every 24 hours.

However, those data likely do not reflect future-with-project conditions as the extensive mud flats in Bayou Pelton obstruct the flow of HNC water into BGC. Project implementation (i.e, dredging of Bayou Pelton) is expected to increase BGC stages at Bayou Pelton by up to 2.9 inches. Hence, project construction will likely increase stages at the inlet side of the main water control structure. When HNC stages at Bayou LaCarpe (approximately 0.75 miles south of Bayou Pelton) are plotted against receiving area stages in Bayou Chauvin (Figure 3), it appears that there would be greater head differential and fewer instances of backflow. During moderate Atchafalaya River discharge conditions[1] (discharge between 170,000 to 208,000 cfs), there were only 1.4 % of the hourly readings when backflow conditions would occur. During moderately low Atchafalaya River conditions (130,000 to 169,000 cfs), backflow would have occurred during 3% of the hourly readings. During low Atchafalaya River discharge conditions (<130,000 cfs), backflow conditions would have occurred during approximately 14% of the hourly readings. As seasonal saltwater intrusion up the HNC would likely occur during low Atchafalaya River discharge conditions, the gate operations would likely be substantially less than 14% of the time due to saltwater in the HNC. A worst-case frequency during low Atchafalaya River discharges might be once a day, as indicated in Figure 2. During high Atchafalaya River discharges, there may be periods lasting a week or more during which backflow conditions would never occur.

[1] *Based on 1974 – 2004 Atchafalaya River daily discharges measured at Simmesport, Louisiana, the 20% exceedence discharge is 338,000 cfs, the 50% exceedence discharge is 212,000 cfs, and the 80% exceedence discharge is 122,000 cfs.*

Figure 2. Bayou Grand Caillou and Pipeline Canal actual water level data.

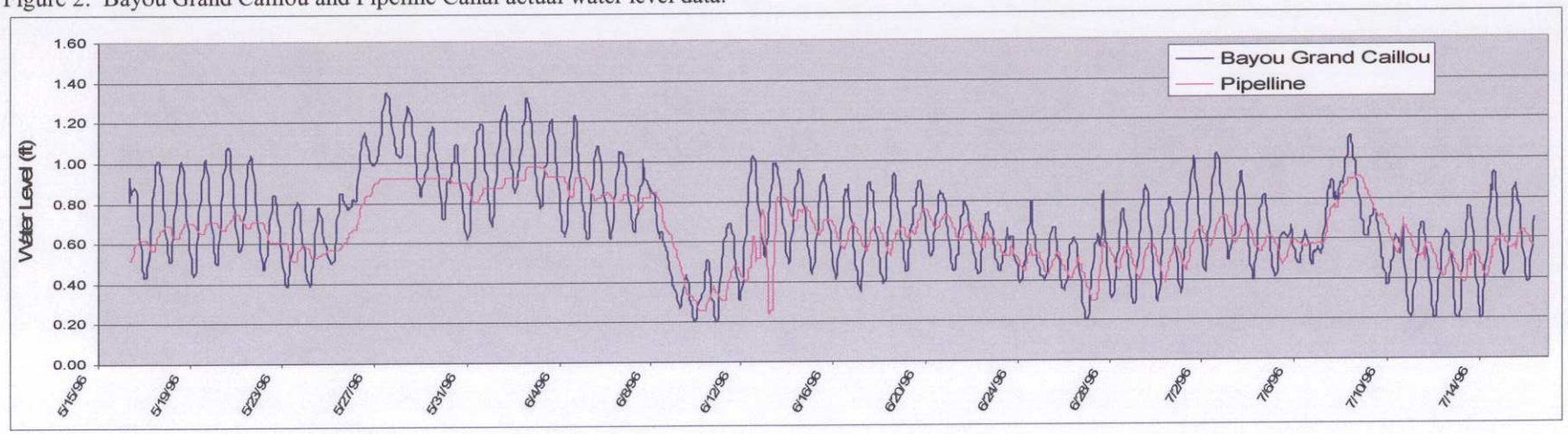


Figure 3. HNC and Bayou Chauvin actual water level data (2003).

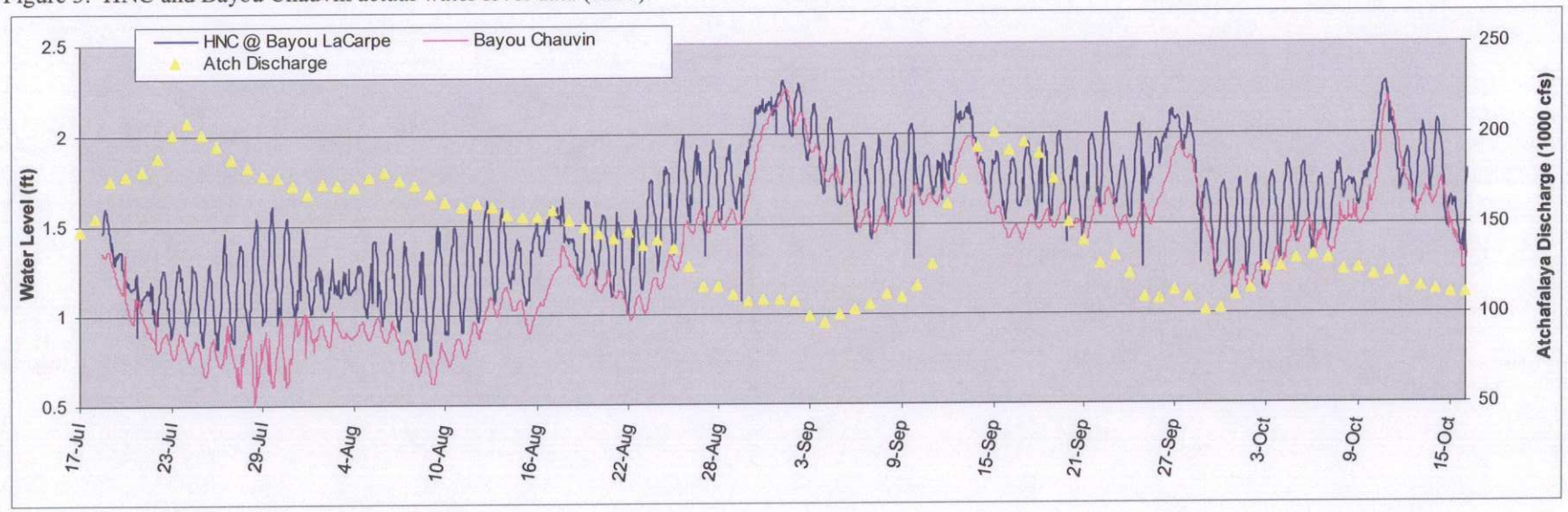


TABLE 8.2

Summary of North Trenasse Water Control Structure Operations.

Consistently available HNC freshwater

- all stoplogs removed

Freshwater not consistently available in the HNC

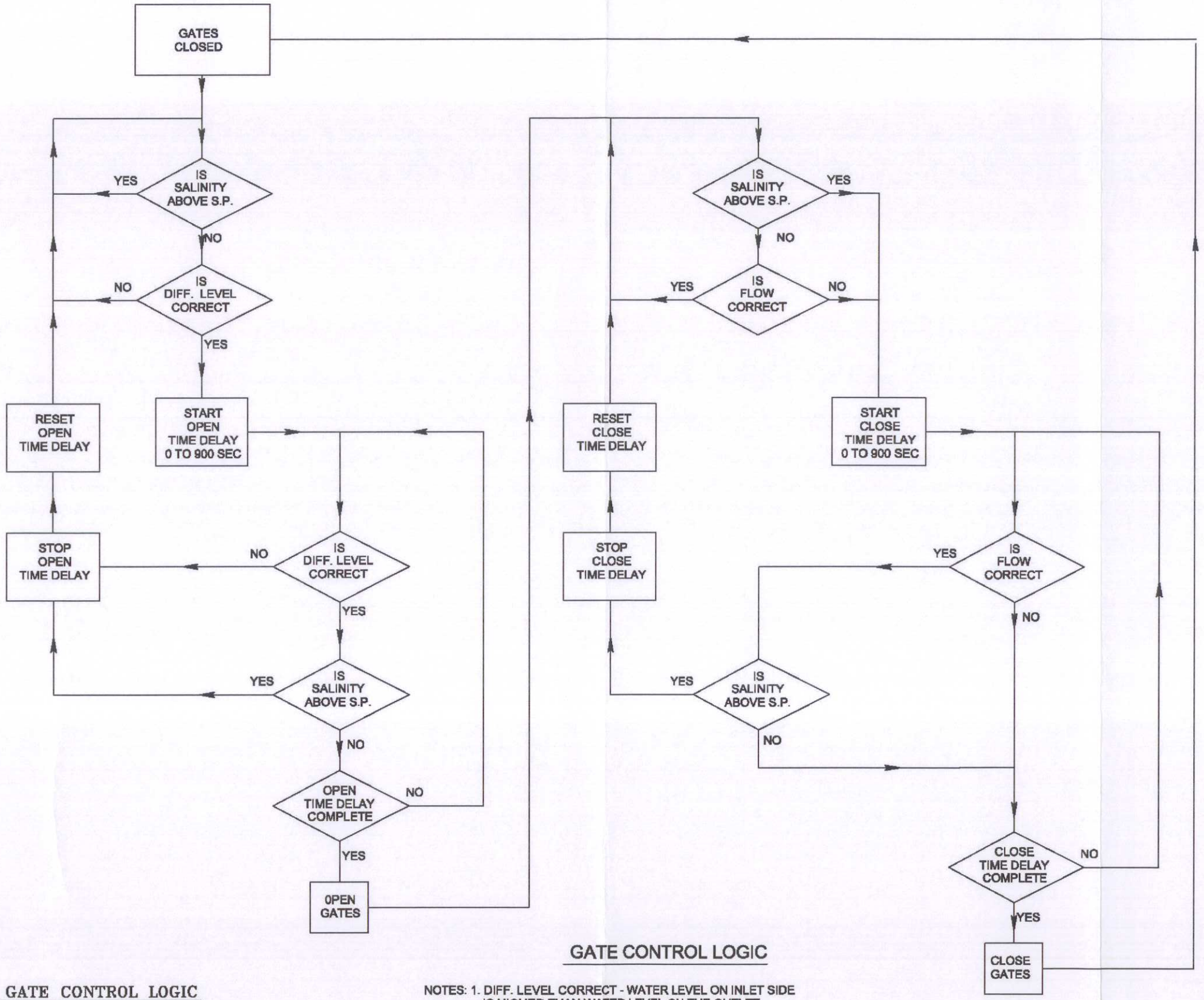
- stoplogs inserted in all bays to a +2.0 elevation

Power Requirements for the PWCS include the following:

* Power wiring to the sluice gate motors, area lighting, lighting within the control building, and complete controls to measure salinity water levels and the direction of channel flow. A Motor Control Center (MCC) will be provided for motor control of the sluice gates. A Programmable Logic Controller (PLC) will be incorporated into the design to monitor the following data points:
* Salinity probes on the HNC and BGC sides of the sluice structure.
* Channel water level probe on the HNC and Bayou Grand Caillou sides of the sluice structure.
* Channel direction of the flow probe on the HNC side of the sluice structure.
* The PLC shall open all sluice gates when the following conditions occur:
    - The salinity level is below set point.
    - The differential channel level is above set point or the direction of channel flow is toward Lake Boudreaux.
* The PLC shall close all sluice gates under either of the following conditions:
    - The salinity level is above set point.
    - The channel flow is toward the HNC.
* The salinity probes and the channel level probes shall be installed on both sides of the sluice structure. The channel flow direction probe shall be installed in the channel on HNC side of the sluice structure. Exhibit O is a diagram of the control logic.

8.15 Highway 57

Temporary Detour Road - Due to the fact that a portion of Highway 57 will have to be removed for the installation of reinforced concrete box culverts, a temporary detour road must be constructed to route traffic around the construction area. A preliminary design coordination meeting was held with both OCPR and LDOTD District 02 personnel on January 26, 2009. The eastern side of the highway was determined to be the appropriate location for the detour road based on the layout of the drainage structure and the lot depth on the western side, which is bounded by BGC. Temporary Traffic Control was discussed in detail and a construction signage layout was developed as a result of the meeting. As a follow-up to the meeting, drafts of both the detour roadway plan/profile and construction signage layout were reviewed and approved by LDOTD District 02. As requested, a note



GATE CONTROL LOGIC

1 E3 SLUICE GATE CONTROL LOGIC
N.T.S.

NOTES: 1. DIFF. LEVEL CORRECT - WATER LEVEL ON INLET SIDE IS HIGHER THAN WATER LEVEL ON THE OUTLET SIDE OF THE SLUICE STRUCTURE.
2. CORRECT FLOW - WATER FLOW IS FROM THE INLET SIDE TO THE OUTLET SIDE OF THE SLUICE STRUCTURE.

EXHIBIT O

95% CONSTRUCTION DOCUMENTS PHASE SUBMITTAL

REV.	DATE	DESCRIPTION	BY
	05/20/09	OCPR COMMENTS	KPR

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NORTH LAKE BOUDREAUX FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT

ELECTRICAL AND CONTROLS

STATE PROJECT NUMBER: TE-32a

FEDERAL PROJECT NUMBER: TE-32a

DATE: 11/13/09

DRAWN BY: RJB/SPB | DESIGNED BY: Ronald J. Boudreaux, P.E., Inc | APPROVED BY: RJB | SHEET OF

was added to each of the plan sheets indicating that the contractor shall notify DOTD district office to ball-bank the detour road prior to opening, for verification of the speed to be posted. See Appendix F for copies of communications to date with DOTD.

Horizontal Alignment - An Average Daily Traffic (ADT) of 5000 was provided by LDOTD District 02 Engineers. Based on the ADT, Figure 4-15 - Detour Design Criteria of the LDOTD Roadway Design Manual - Edition shows that a Type "C" Detour Road is warranted. Therefore Figure 4-17 – Type "C" Typical Detour and a Design Speed of 40 MPH was used for the basis of the horizontal geometry of the Temporary Detour Road provided in the Preliminary Plans.

Vertical Alignment - Vertical geometry for the detour road transitions the 1.5 ft difference in elevation between the existing grades of Highway 57 at each of the tie-in points. For the first 100 ft from each tie-in point the detour road grade is set at 0.00% to allow for a smooth roadway connection. The grade is 0.5% from that point until reaching an elevation of +5.0 ft, to be held constant for the majority of the alignment. The average natural ground elevation through the alignment is approximately +4.3 ft which will allow the majority of the detour road to be constructed within 1 ft of existing grade while minimizing impact to the adjacent property owners.

Typical Section - The typical roadway section provided in Figure 4-17– Type "C" Typical Detour was used as a basis for design and modified to an increased pavement section including 3 ½" of asphalt and 9" of Class II Base Course, as requested by District 02 Engineers. The 12 ft. lane widths, 4 ft. shoulder widths and 2:1 embankment slopes are as indicated in the Figure but a one-way tangent crown with a 2.5% cross-slope is used to provide a smooth transition at the tie-in points and a small amount of superelevation in the curves.

Construction Signage - Traffic control and public safety during the construction of the proposed drainage structure is provided for in the construction signage layout, which was developed in coordination with the District 02 Engineers and in accordance with the Manual of Uniform Traffic Control Devices (MUTCD). Figure 8-56 – Detour Signing Layout of the LDOTD Roadway Design Manual was also used as a reference in plan preparation. Among the typical Detour Ahead and Road Closed signs, reflective barrels and delineators, Type III Barricades and staggered concrete barriers at 45 degree angles block the existing Highway

57 alignment to keep motorists from driving into the construction zone. Additional concrete barriers are called for along the full length of the structure side of the detour road.

Temporary Drainage - The roadside ditches on the eastern side of the highway currently drain to two separate existing 24" cross-drain culverts located near the detour road tie-in points. The cross-drain culverts and western roadside ditches currently drain to existing lateral culverts on the western side and outfall directly into BGC. During construction the existing drainage patterns will be maintained by directing runoff to the existing cross-drain culverts by the use of temporary roadside ditches, culvert extensions and junction boxes, as shown in the drainage and utility relocation plan sheets of the preliminary plans.

Temporary Construction Servitude - A temporary construction servitude will be necessary for the construction of the detour road. It was determined that the roadway section and temporary drainage will fit within the area provided between a 30' offset of the proposed detour road centerline to the east and the existing Highway 57 r/w. Approximately 300 ft of the alignment is within the acquired drainage r/w for the conveyance channel. Therefore, it will only be necessary to negotiate a total of approximately 0.6 acres of temporary construction servitude with the adjacent property owners, as shown on the detour road plan/profile sheet of the preliminary plans.

Highway 57 reconstruction - approximately 450 ft of Highway 57 will be removed and replaced after installation of the reinforced concrete box culverts. The highway is to be reconstructed along the existing alignment using a typical section that is equivalent to the existing. The vertical alignment will need to be adjusted slightly to allow for the minimum depth of cover over relocated utility lines, which will lay across the top of the drainage structure. In general, the temporary drainage and temporary utility relocations will be restored to the original state. Traffic control will be similar to what is existing as well, mainly consisting of speed limit and curve ahead signs.

Horizontal Alignment - The existing horizontal alignment and apparent r/w for the highway was surveyed during the data collection phase of this project. In addition, the as-built plans for the highway were provided by the LDOTD District 02 Engineers and used as a reference for the highway geometry. The centerline alignment of existing Highway 57 is the baseline for the roadway portion of the project and the data is provided on the Highway 57

& detour alignment sheet of the preliminary plans. Stationing for the alignment is centered to have Station 50+00 occur at the intersection with the centerline of the channel and drainage structure alignment.

Vertical Alignment - Vertical geometry for Highway 57 includes three vertical curves to allow for a 0.5 ft increase in elevation at the crest over the drainage structure crossing. This increase in elevation is necessary to provide a 3' minimum depth of cover for the permanent relocation of the 12" waterline, which will lay across the top of the drainage structure. The current posted speed on Highway 57 is 55 MPH and a design speed of 65 was used for the calculation of vertical curve lengths. Vertical curve calculations were performed in accordance with AASHTO Geometric Design of Highway and Streets Edition (Green Book) and the LDOTD Roadway Design Manual Figure 4-10 – General Properties of a Parabolic Vertical Curve. The maximum algebraic grade difference is 0.44% in the sag curves and 0.90% for the crest curve. The total length of the vertical alignment adjustment is approximately 420 ft and an additional 15 ft for each of the roadway tie-ins is anticipated for construction, as shown on the Highway 57 Plan/Profile in the preliminary plans.

Typical Section - The existing Highway 57 Roadway Section includes 2-12' lanes with 4' paved shoulders on a normal crown. The pavement section is estimated to consist of 6" Asphalt Surfacing over 10" Class II Base Course and 10" Lime Treatment. The dimensions of the proposed roadway and pavement section are designed to match the existing. The LDOTD Design Standards for rural arterial roads was used as a reference in developing the section. The design cross-slopes are 2.5% for the travel lanes and 5% for the shoulders. The maximum earthwork slopes are 6:1 fore slopes and 4:1 back slopes. The intent of the design section is to match the existing and tie-in with existing roadside ditches where possible.

Traffic Control - Traffic control upon completion of construction will match what is existing within the project area and all replacements of signs, striping and pavement markers will be installed in accordance with the Manual of Uniform Traffic Control Devices (MUTCD). Cross-drain delineators will be added on each side of the drainage structure. In addition, District 02 Engineers will be consulted for recommendations in the development of a Traffic Control Plan for the reconstructed Highway 57.

Drainage - The roadside ditches on the eastern side of the highway currently drain to two separate existing 24" cross-drain culverts located near the detour road tie-in points. The cross-drain culverts and western roadside ditches currently drain to existing lateral culverts on the western side and outfall directly into BGC. Any re-routing of drainage by temporary roadside ditches, culvert extensions and junction boxes installed during construction will be removed and the existing open-ditch drainage system will be reconstructed where necessary. All driveways and driveway culverts that were temporarily relocated will be restored after construction of the PWCS. The design roadway and grades for roadside drainage will crest at the center of the proposed drainage structure and runoff will be directed to the roadside ditches north and south of the crest.

8.16 Secondary Water Control Structures

- Bayou Butler Structures

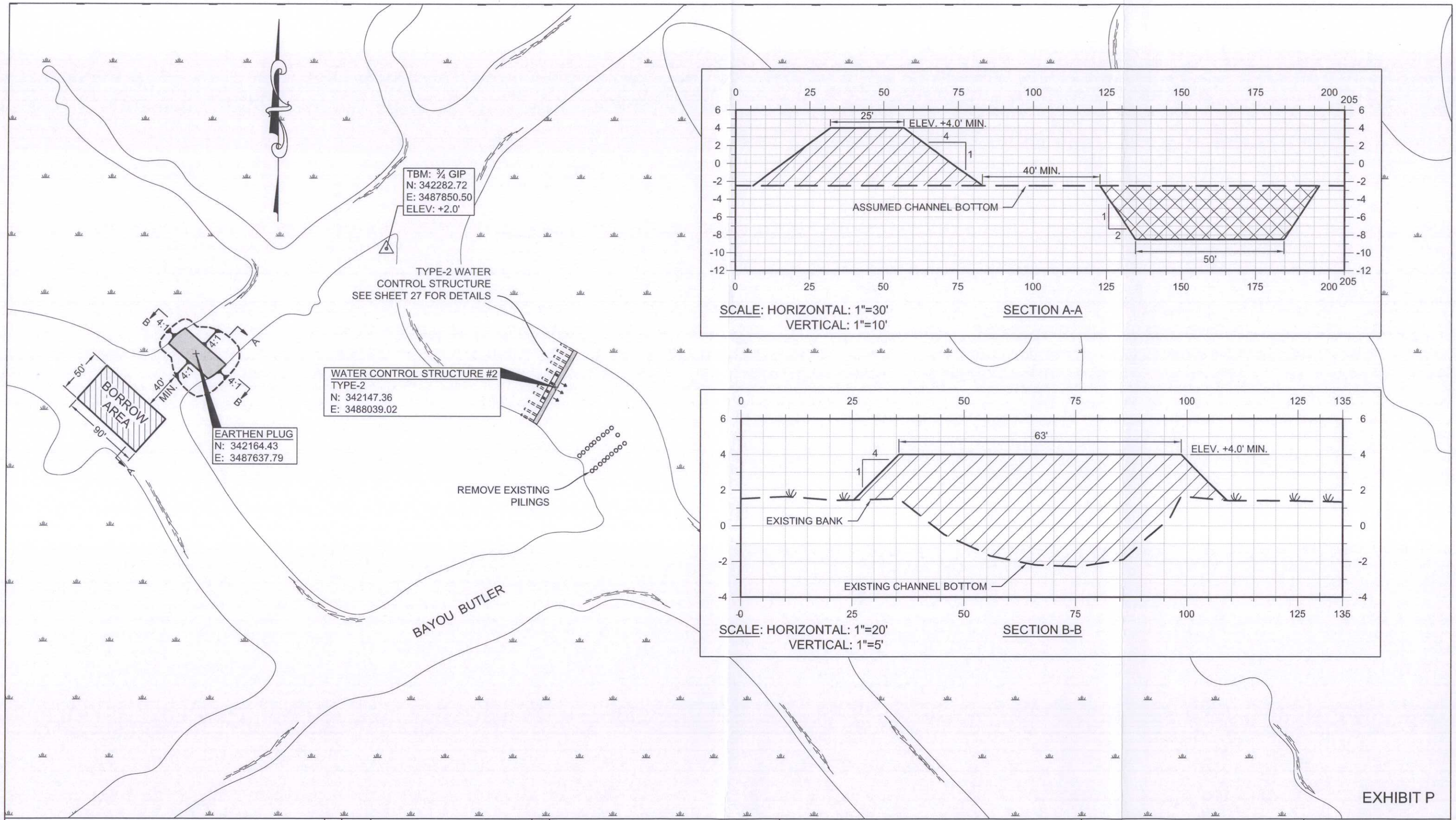
Two structures are proposed in the vicinity of Bayou Butler. One is an earthen plug with a crown elevation of +6.0 and crown width of 10 feet. Erosion control matting, seeding and fertilization of the slopes and crown will be included. The other is a timber boat weir with low sill at -2.0. The purpose of these structures is to prevent short circuiting of freshwater through the north/south GSP Canal. Construction of these structures will require access dredging. Details of these structures are shown on Exhibits P and Q herein.

- North Trenasse Water Control Structure

A Type 1 fixed crest weir with stop log weirs are proposed to manage introduction and removal of freshwater for the marsh area north of the new conveyance channel and west of the north/ south Gulf South Pipeline. Land rights to construct these structures have already been acquired. Exhibit R shows the location of it on the new conveyance channel.

- North Boundary Cross Drains

Eight (8) 24" X 40' aluminum flap gated cross drains to replace existing cross drains along an existing aggregate roadway will prevent interchange to the north, but allow water to flow south. Construction of these structures will be included in the plans for the North Forced Drainage Project.



SCALE IN FEET

100' 50' 0' 100' 200'

REV.	DATE	DESCRIPTION	BY

T. BAKER SMITH
PROFESSIONAL CONSULTANTS SINCE 1913
(985) 868-1050 www.tbsmith.com

OFFICE OF COASTAL PROTECTION & RESTORATION
ENGINEERING BRANCH
450 LAUREL STREET
BATON ROUGE, LOUISIANA 70801

NORTH LAKE BOUDREAUX
FRESHWATER INTRODUCTION
AND HYDROLOGIC MANAGEMENT

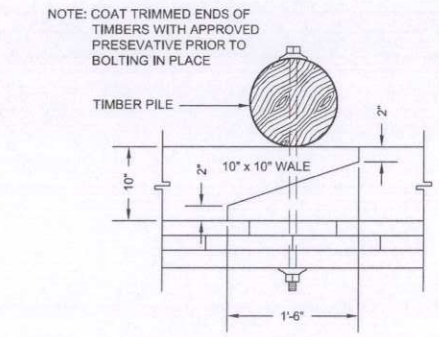
STATE PROJECT NUMBER: TE-32a

FEDERAL PROJECT NUMBER: TE-32a

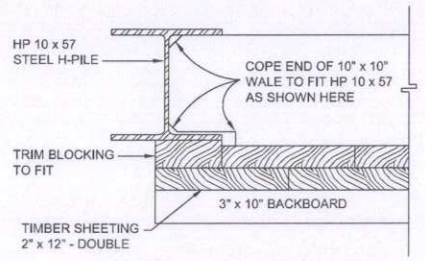
WATER CONTROL
STRUCTURE #2

DATE: 12/31/09

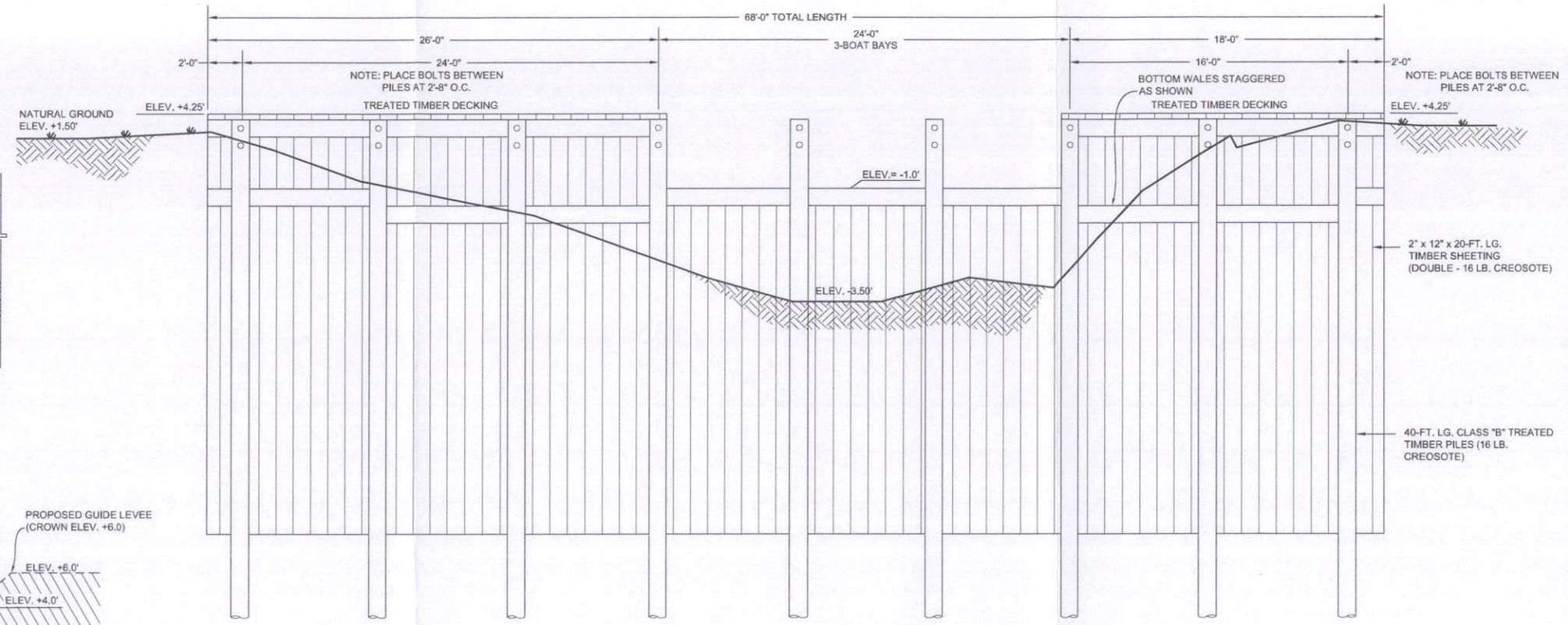
DRAWN BY: ALH | DESIGNED BY: BJK | APPROVED BY: BJK | SHEET 26 OF 36



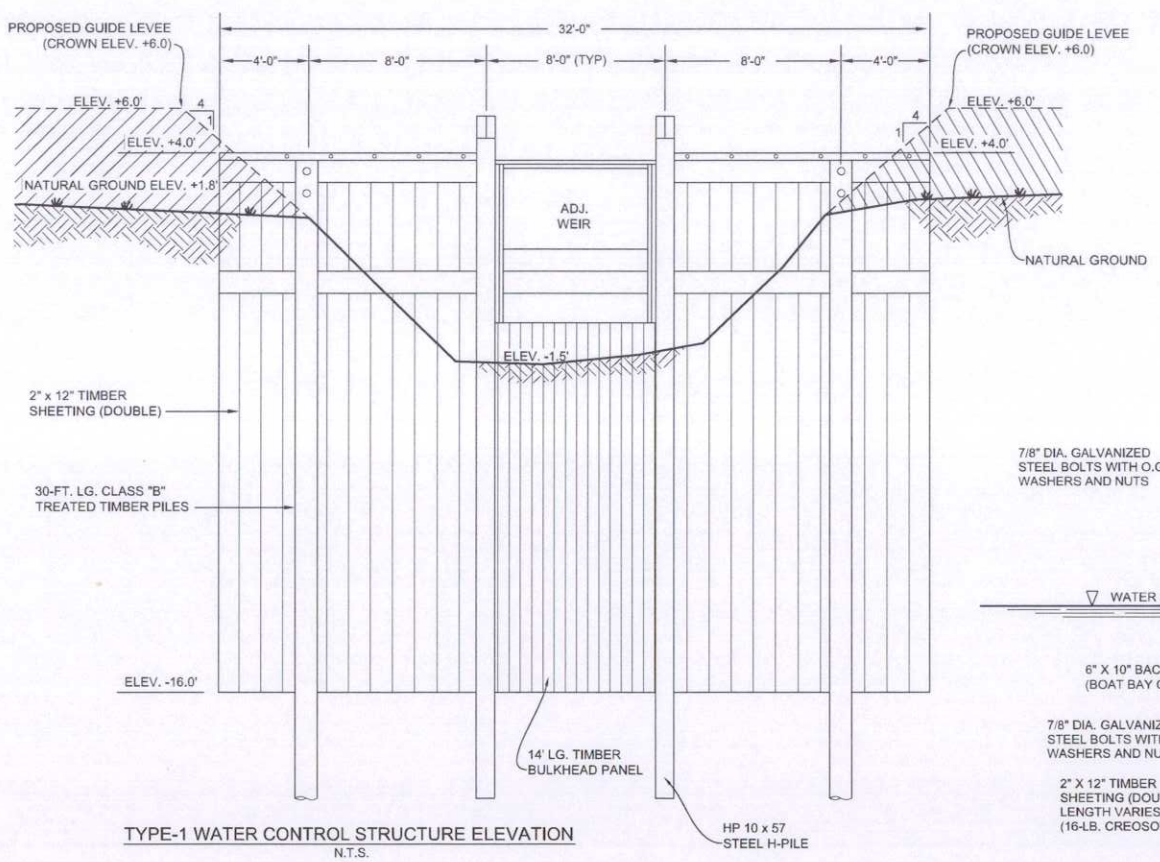
TYPICAL WALE SPLICE DETAIL
N.T.S.



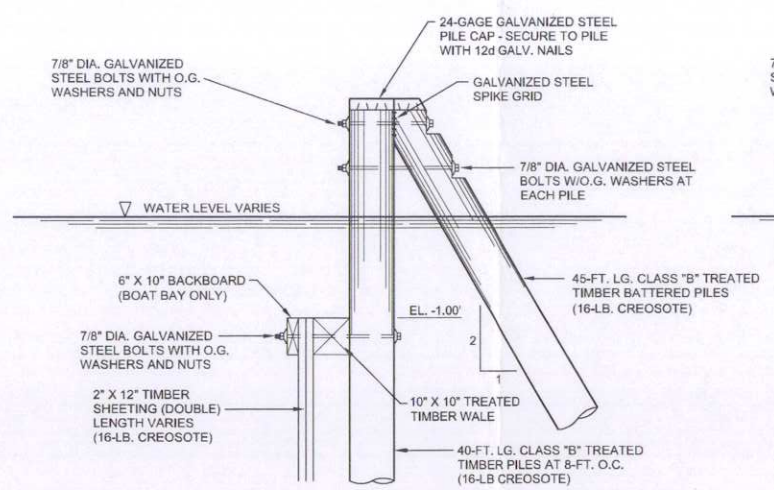
TYPICAL WALE CONN DETAIL
N.T.S.



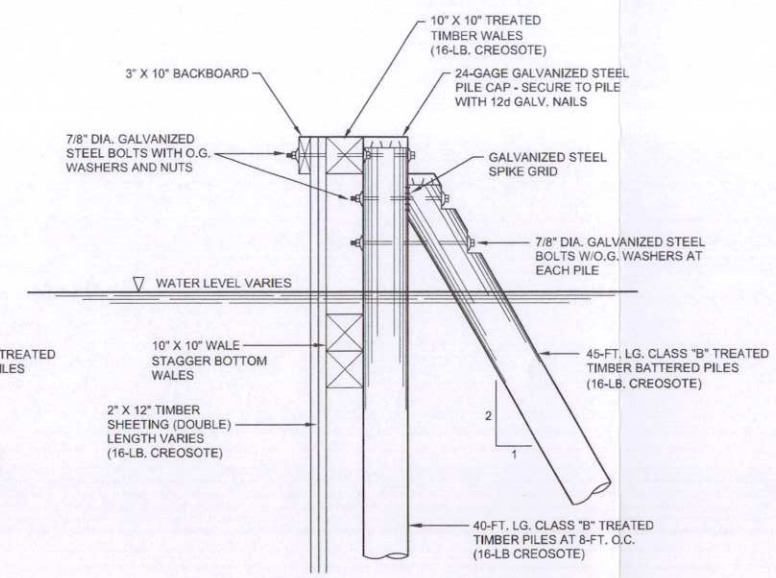
TYPE-2 WATER CONTROL STRUCTURE ELEVATION
N.T.S.



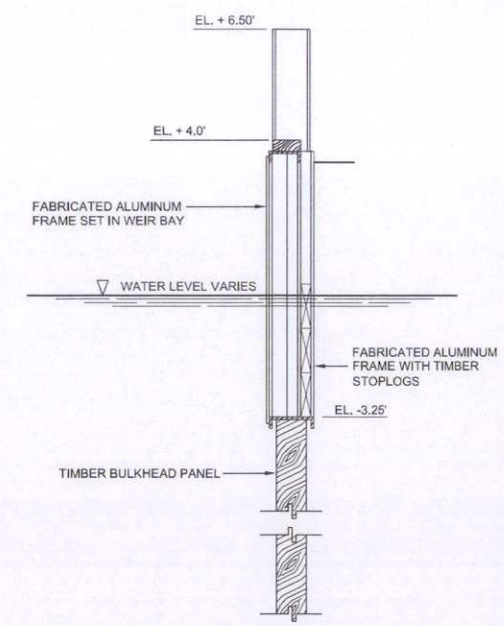
TYPE-1 WATER CONTROL STRUCTURE ELEVATION
N.T.S.



TYPICAL SECTION THRU BOAT BAY
AT WATER CONTROL STRUCTURE TYPE-2
N.T.S.



TYPICAL SECTION THRU TIMBER WHARF-TYPE-2
N.T.S.



TYPICAL SECTION THRU WEIR BAY
AT WATER CONTROL STRUCTURE TYPE-1
N.T.S.

EXHIBIT Q

NOT TO SCALE

REV.	DATE	DESCRIPTION	BY

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NORTH LAKE BOUDREAUX FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT

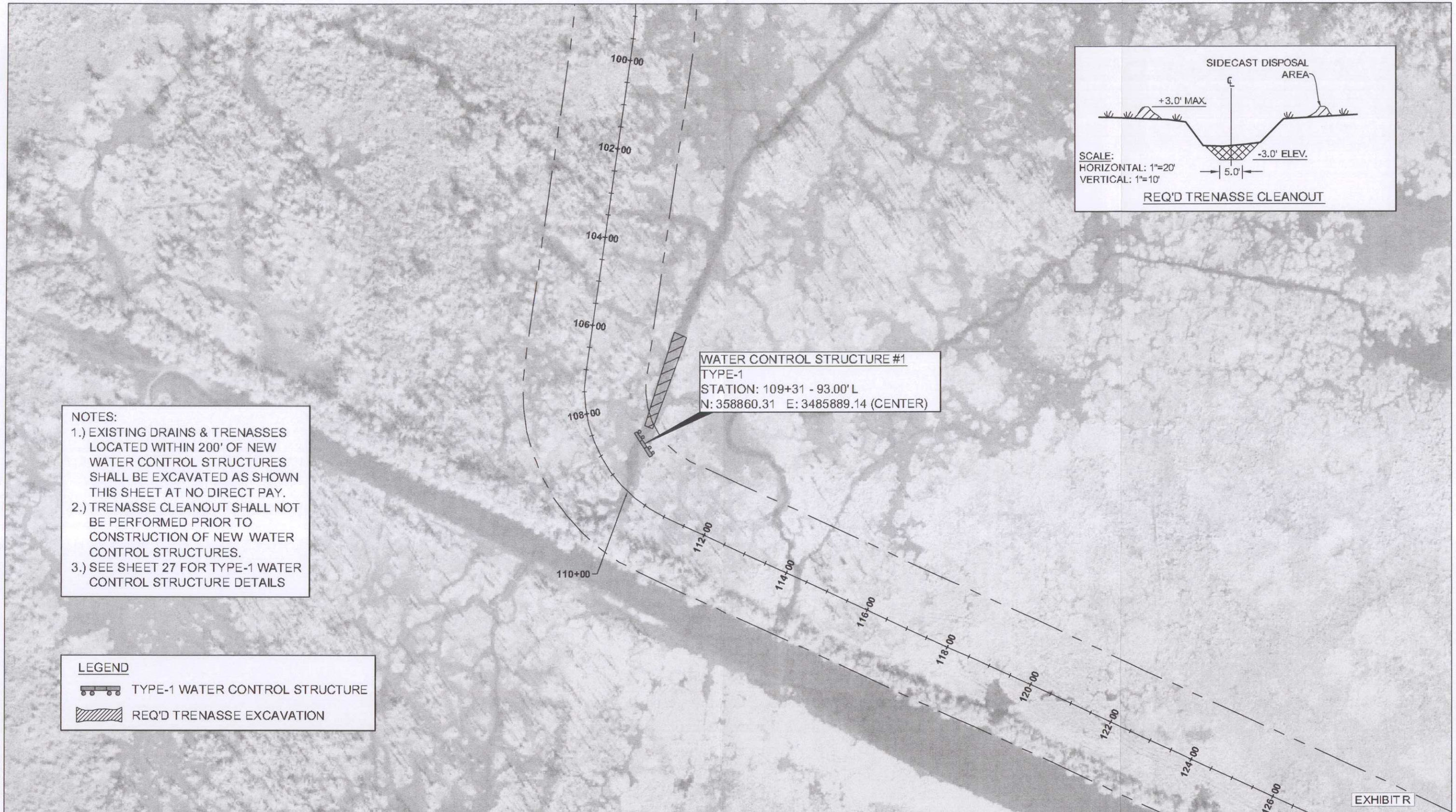
STATE PROJECT NUMBER: TE-32a

FEDERAL PROJECT NUMBER: TE-32a

TYPE-1 & TYPE-2 WATER CONTROL STRUCTURE DETAILS

DATE: 12/31/09

DRAWN BY: ALH | DESIGNED BY: BJK | APPROVED BY: BJK | SHEET 27 OF 36



SCALE IN FEET

600' 300' 0' 600' 1200'

REV.	DATE	DESCRIPTION	BY

T. BAKER SMITH
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BATON ROUGE, LOUISIANA 70801

DRAWN BY: ALH DESIGNED BY: BJK

NORTH LAKE BOUDREAUX FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT

STATE PROJECT NUMBER: TE-32a

FEDERAL PROJECT NUMBER: TE-32a

APPROVED BY: BJK

WATER CONTROL STRUCTURES #1

DATE: 12.31.09

SHEET 25 OF 36

SECTION 9.0
PARISH DRAINAGE

9.1 Background Information

Prior to completion of the CDR, TPCG expressed concern that the freshwater diversion would create backwater flooding on the east side of Highway 57. If the modeling confirmed this, the Parish requested that those properties be protected.

The CDR modeling results predicted that water levels north of the project could rise as much as 0.46 feet and south of the project as much as 0.61 feet under maximum stage data differences. These water surface increases were only a local phenomena at the four corners; the difference dissipating farther eastward.

Because of this, the Parish and the State entered into a cooperative agreement wherein the State would contribute $1 million to the Parish for the Parish to construct drainage protection for the affected properties.

9.2 North Drainage System

Exhibit S shows the current alignment of the proposed north levee and pump station to provide flood protection to property north of the diversion. This alignment has not changed since the CDR. The east drainage system boundary utilizes approximately 5,000 feet of a former agricultural canal and levee system paralleling and east of Highway 57. The west boundary is the BGC Ridge just east of Highway 57, the southern boundary is the guide levee from the new diversion channel and the north boundary is on existing aggregate road which links Highway 57 to the N/S GSP Canal. The area encompasses approximately 130 acres and analysis of earlier aerial photography shows it clearly to be prior converted. Exhibit T shows a typical section of the existing old drainage canal and levee with the improvements superimposed. Geotechnical considerations may affect the final section characteristics. Exhibit U shows a plan of the pump station with two (2) 30-inch diesel-driven pumps. The discharge is directly into adjacent cypress swamps across the levee.

9.3 South Drainage System

Exhibit V shows the current alignment of the proposed south levee/canal and pump station to provide flood protection to property south of the diversion. This alignment has changed since the CDR.

NOTES:

DATE	REVISIONS	DRAWN BY	APPROVED BY

REVISIONS

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PROFESSIONAL CONSULTANTS SINCE 1913
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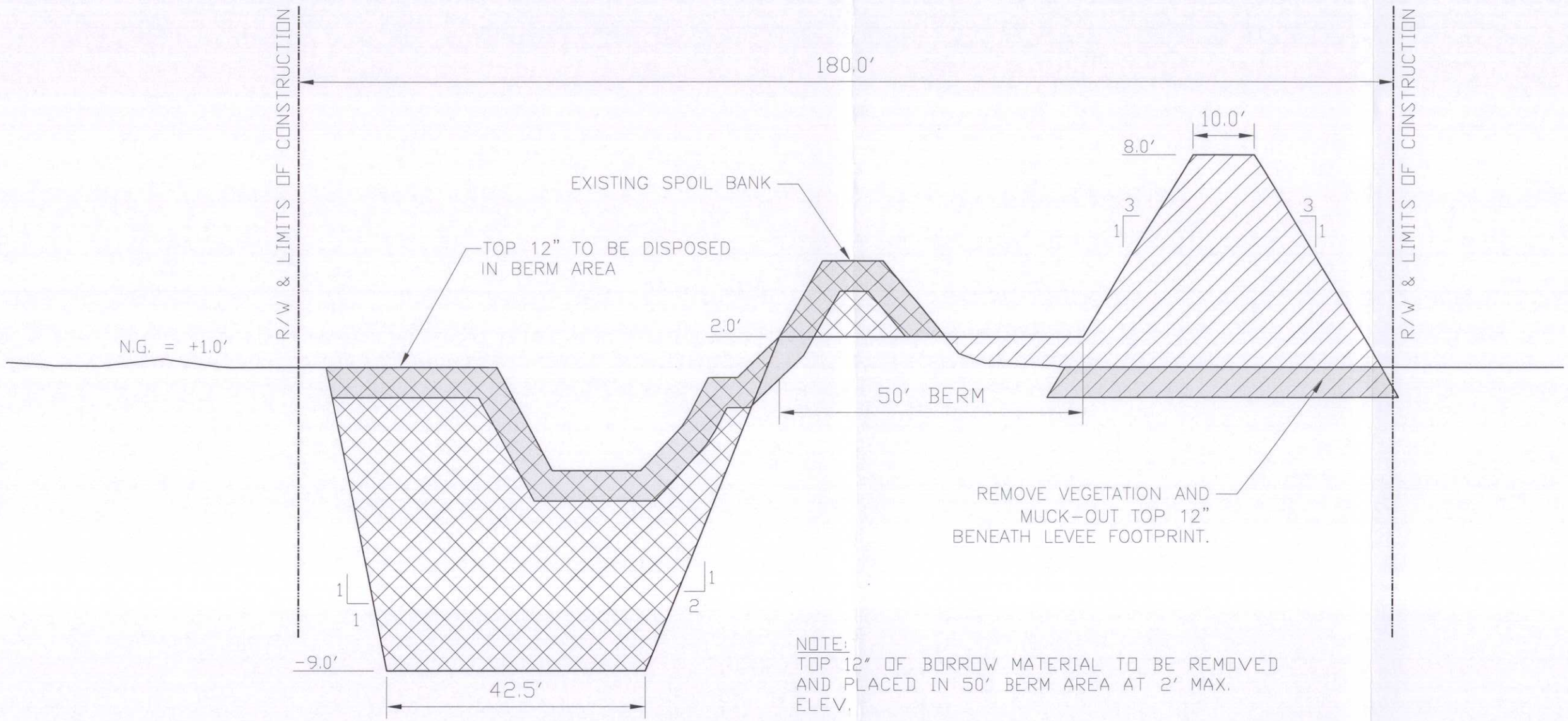
FILE NAME:	EXHIBIT U
TBS NO.:	2008.1742
DATE:	12/31/09
PLOT SCALE:	1 = 1000
DRAWN BY:	ALH
APPROVED:	MJR
MAP NO.	

NORTH DRAINAGE SYSTEM

LA. DEPARTMENT OF NATURAL RESOURCES
LAKE BOUDREAUX BASIN
FRESHWATER DIVERSION PROJECT
TE-32a

SHEET NO. 1 OF 1



NOTE:
TOP 12" OF BORROW MATERIAL TO BE REMOVED AND PLACED IN 50' BERM AREA AT 2' MAX. ELEV.

NORTH SYSTEM TYPICAL SECTION
STA: 100+00 TO STA: 151+90

SCALE:
HORIZONTAL: 1"=20'
VERTICAL: 1"=5'

EXHIBIT T

CONTROL POINTS

POINT	X COORD	Y COORD
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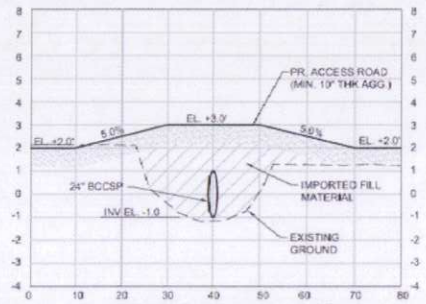
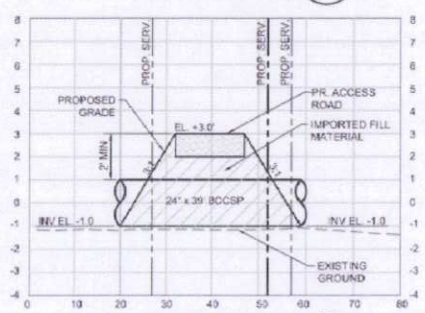
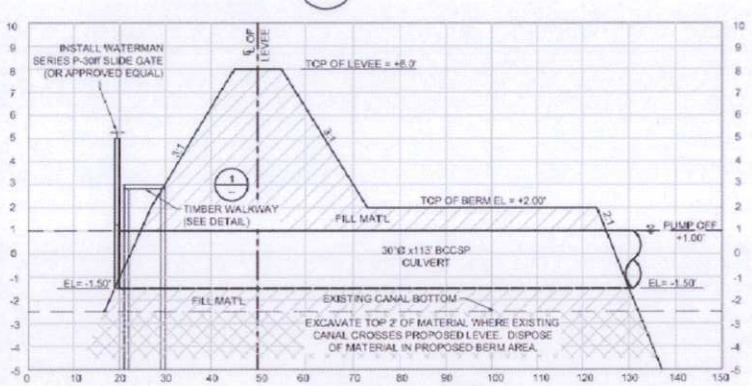
B	3487101.92	361734.60
C	3487121.68	361719.70
D	3487078.32	361662.22



SECTION VIEW C
SCALE: 1"=20' (H), 1"=4' (V)

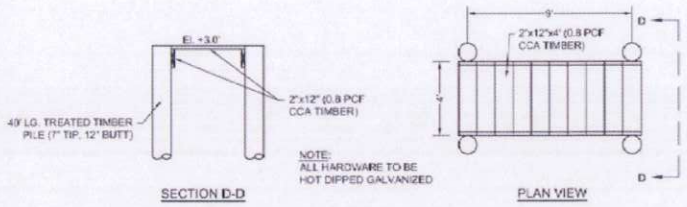


SECTION VIEW B
SCALE: 1"=20' (H), 1"=4' (V)



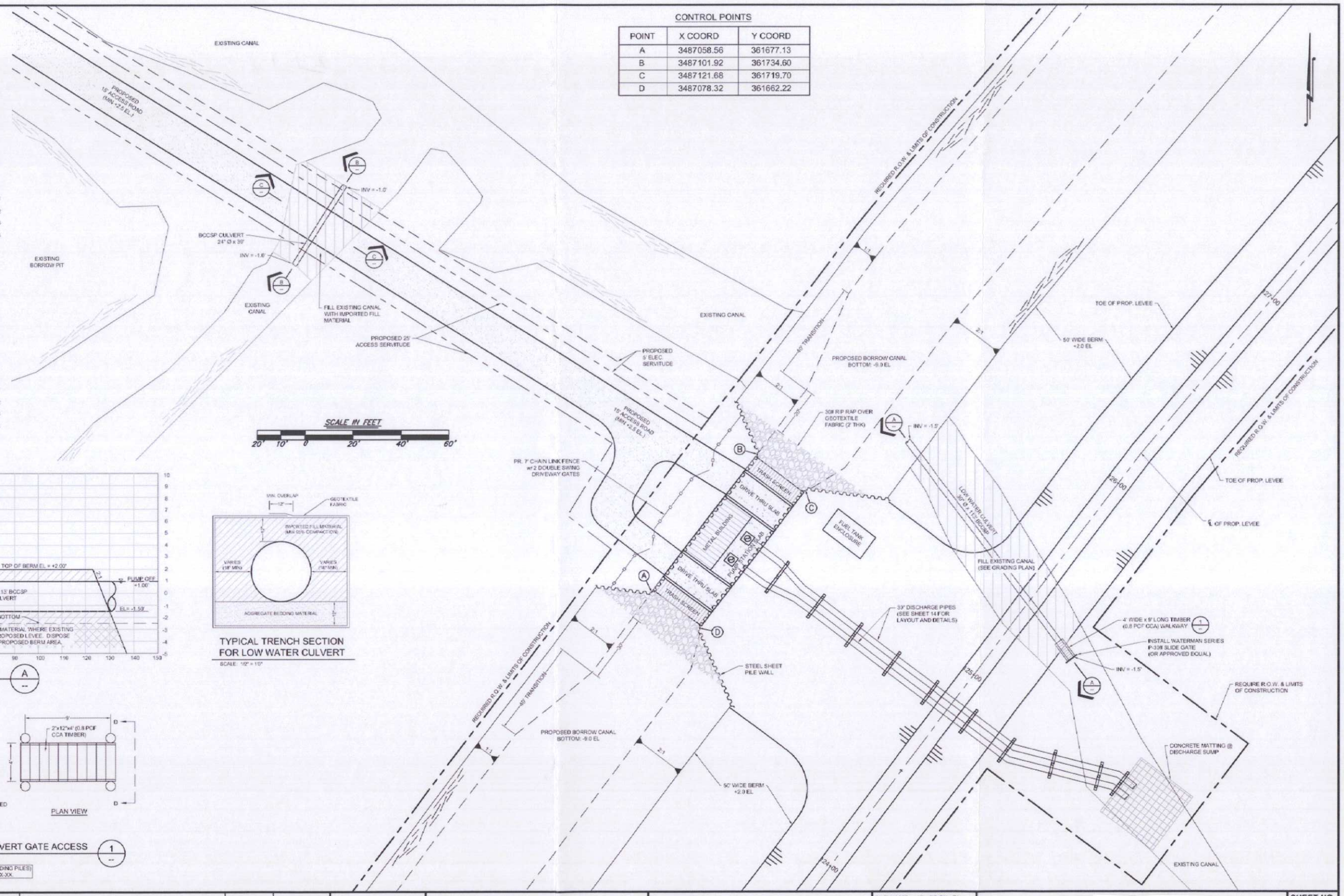
SECTION VIEW A
SCALE: 1"=20' (H), 1"=4' (V)

TYPICAL TRENCH SECTION FOR LOW WATER CULVERT
SCALE: 1/2" = 1'0"



TIMBER WALKWAY DETAIL FOR CULVERT GATE ACCESS
SCALE: 1" = 5'

NOTE: TREATED TIMBER (EXCLUDING PILES) TO BE PAID UNDER BID ITEM XXX-XX.



NOTES:

DATE	REVISIONS	DRAWN BY	APPROVED BY

REVISIONS

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TERREBONNE PARISH

NOT FOR BIDDING PURPOSES

FILE NAME:	7 - PS Site Plan
TBS NO.:	2009.0656
DATE:	3/29/2010
PLOT SCALE:	1" = 20'
DRAWN BY:	KCO
APPROVED:	BJK
MAP NO.	

EXHIBIT U

NORTH LAKE BOUDREAUX
FORCED DRAINAGE PROJECT
NORTH PUMP STATION AND LEVEE IMPROVEMENTS
FOR THE
TERREBONNE PARISH CONSOLIDATED GOVERNMENT

SHEET NO. 7 OF 25

NOTES:

DATE	REVISIONS	DRAWN BY	APPROVED BY

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FILE NAME:	EXHIBIT U
TBS NO.:	2008.1742
DATE:	12/31/09
PLOT SCALE:	1 = 1000
DRAWN BY:	ALH
APPROVED:	MJR
MAP NO.	

SOUTH DRAINAGE SYSTEM

LA. DEPARTMENT OF NATURAL RESOURCES
LAKE BOUDREAUX BASIN
FRESHWATER DIVERSION PROJECT
TE-32a

SHEET NO. 1 OF 1

Two problems with the CDR alignment were landowner dissatisfaction but more importantly runoff would be hydrologically trapped between the new conveyance channel containment levee and the original CDR drainage levee alignment because the land elevation on the west end of the GSP Canal is approximately 2 feet higher than along the conveyance channel containment levee. This difference would prevent water from flowing across the GSP canal south.

The current 2,000 foot alignment encompasses approximately 70 acres. It utilizes portions of the existing GSP Canal levee and the new conveyance channel containment levee as its southern, eastern and northern boundary. The remaining east, south and west boundaries are a 2,000-foot section of new canal/levee, Cane Brake Subdivision Levee and Highway 57. Exhibit W shows a typical section through the new canal/levee. Geotechnical considerations may affect the final section characteristics. Exhibit X shows a plan of the pump station with two (2) 24-inch diesel-driven pumps. The discharge is directly into the Gulf South Pipeline Canal.

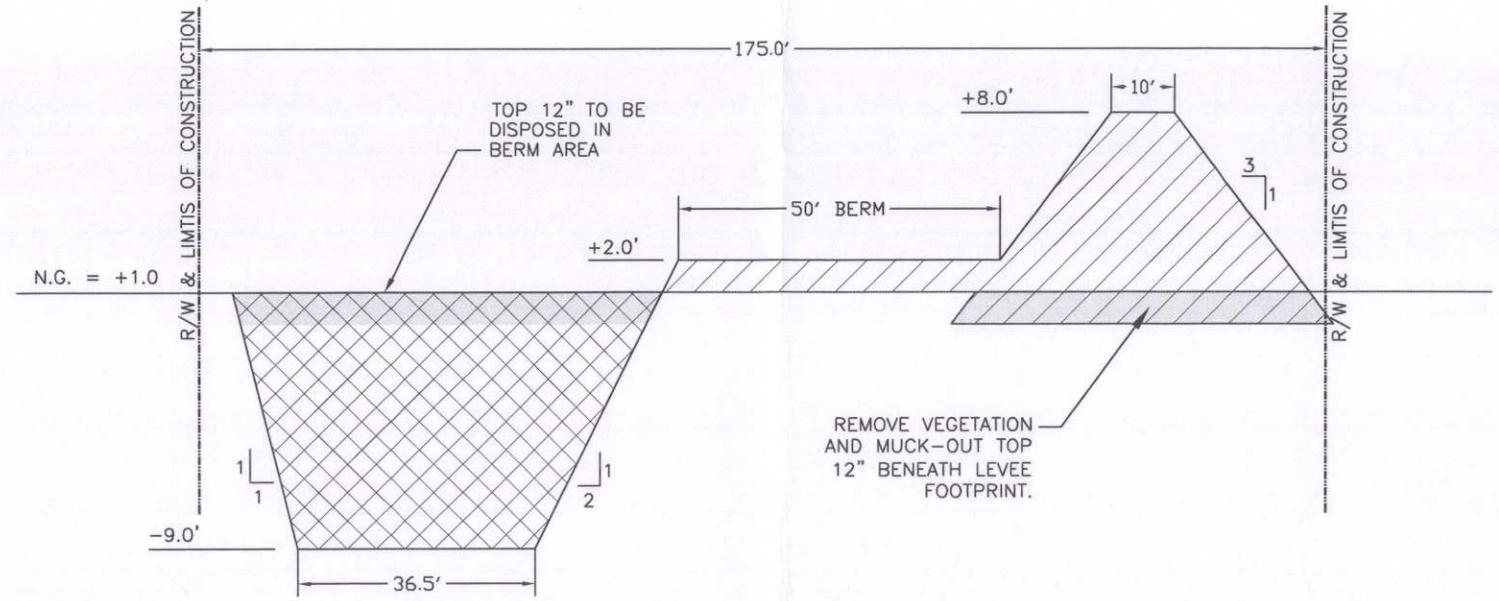
9.4 Environmental and Permitting Considerations

So as to minimize impacts to encompassed wetlands, both the north and south drainage systems are proposed to have a regulated controlled drawdown. The pump off elevation will be established in the permit and the Parish will be required to maintain that level. Preliminary discussions with USFW have this level set at +1.0 NAVD. Provisions to introduce water into the pump area will be built into each pump station in the event of drought or over pumping. To facilitate this, each station will have a 48" X 48" opening with a hand-operated sluice gate for that express purpose. In the event that the system is flooded from storm surge, the same gate can be opened to release flood waters.

The north drainage system requires obtaining right-of-way from one landowner. There are several required for the south system. It may also be possible when negotiating these rights-of-way to have the landowners agree to designate the encompassed wetlands as a conservation easement.

The south drainage system's current levee/canal alignment through impounding 28 more acres than the CDR alignment will have less (3.0 acres) direct impact to wetlands because it has 1,200 linear feet less new levee/canal.

It is recommended that the diversion and drainage systems be permitted under the same permit application. However, the construction of the drainage systems will be separate and apart from construction of the freshwater diversion project.

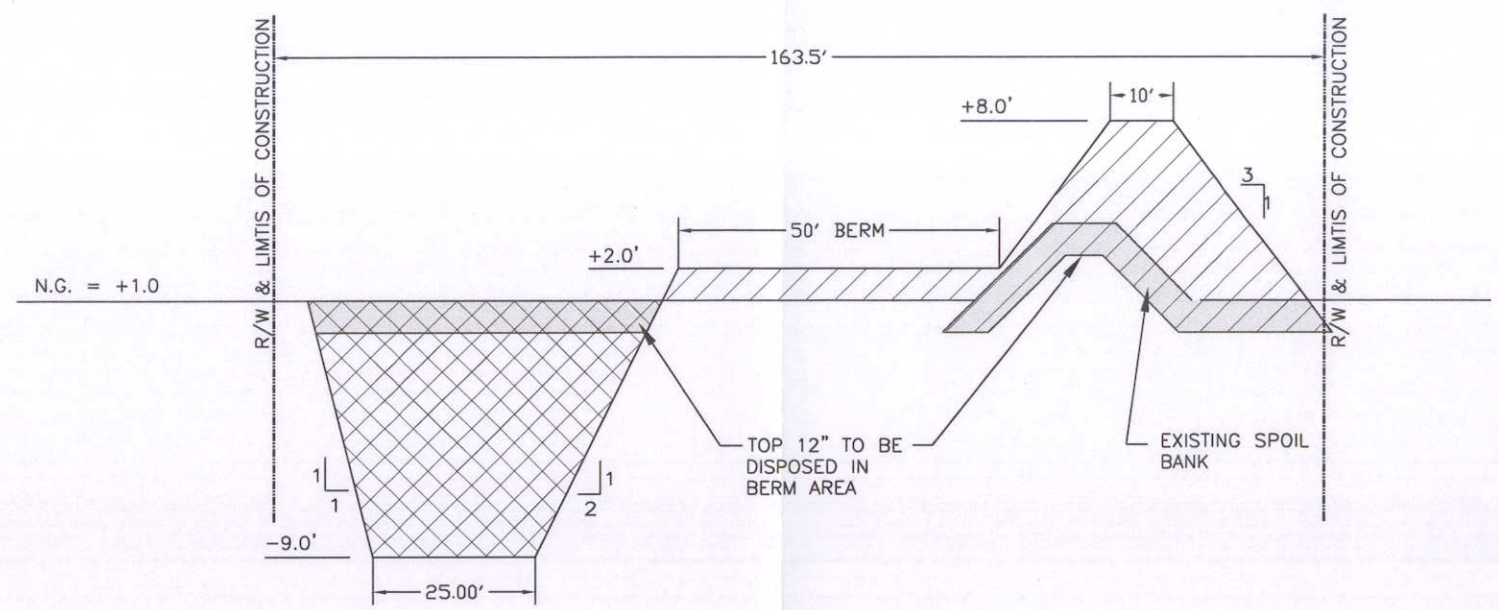


NOTE:
TOP 12" OF BORROW MATERIAL TO BE REMOVED AND PLACED IN 50' BERM AREA AT 2' MAX. ELEV.

SOUTH SYSTEM TYPICAL SECTION

STA: 10+33 TO 25+66

SCALE:
HORIZONTAL: 1"=20'
VERTICAL: 1"=5'



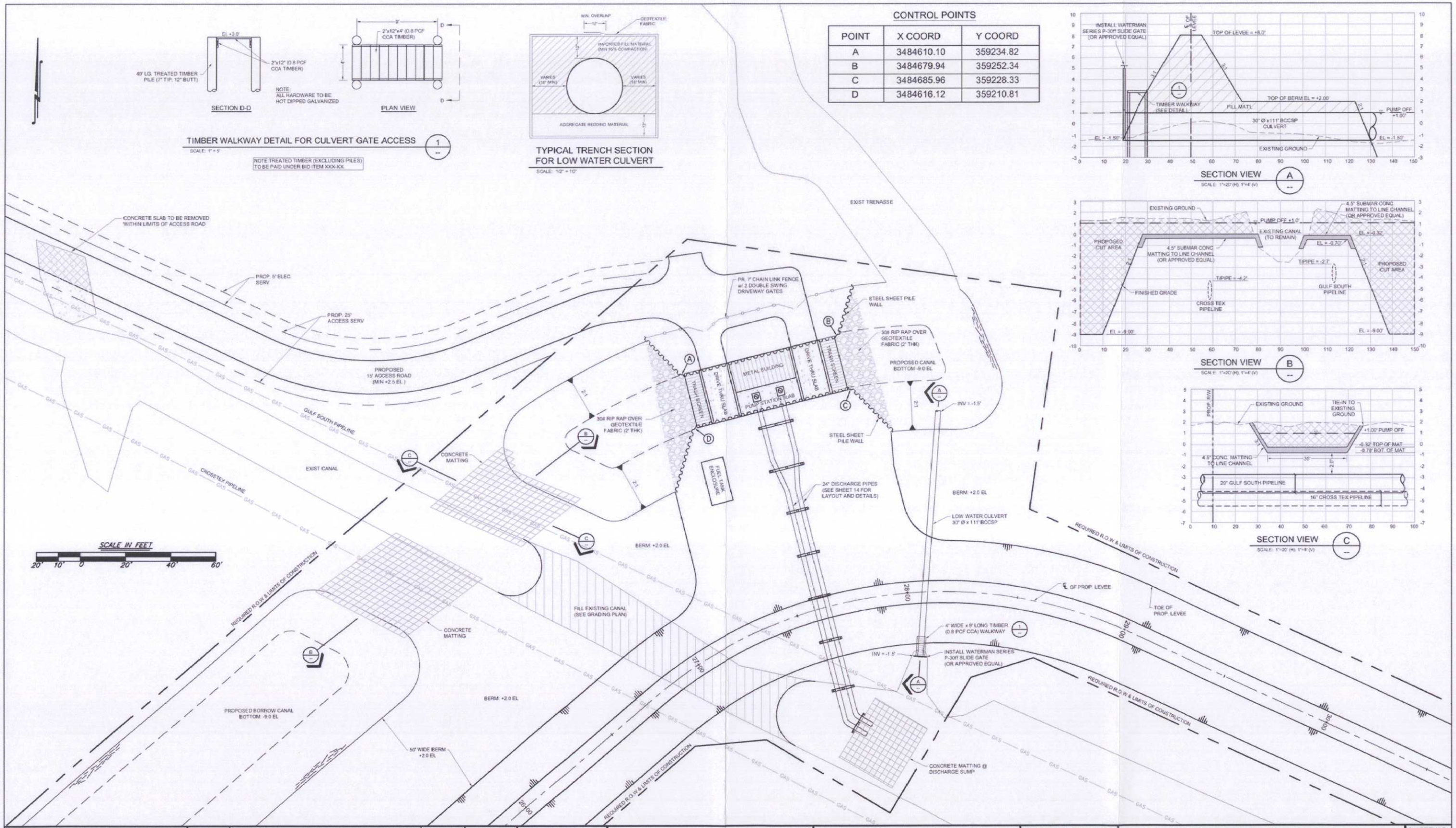
NOTE:
TOP 12" OF BORROW MATERIAL TO BE REMOVED AND PLACED IN 50' BERM AREA AT 2' MAX. ELEV.

SOUTH SYSTEM TYPICAL SECTION

STA: 27+17 TO 40+40

SCALE:
HORIZONTAL: 1"=20'
VERTICAL: 1"=5'

EXHIBIT W



CONTROL POINTS

POINT	X COORD	Y COORD
A	3484610.10	359234.82
B	3484679.94	359252.34
C	3484685.96	359228.33
D	3484616.12	359210.81

NOTES:

DATE	REVISIONS	DRAWN BY	APPROVED BY

REVISIONS

T. BAKER SMITH
PROFESSIONAL CONSULTANTS SINCE 1913
(985) 868-1050 www.tbsmith.com

TERREBONNE PARISH

NOT FOR BIDDING PURPOSES

FILE NAME:	5 - PS Plan View
TBS NO.:	2009.0656
DATE:	3/29/2010
PLOT SCALE:	1 = 20'
DRAWN BY:	KCO
APPROVED:	BJK
MAP NO.	

EXHIBIT X

NORTH LAKE BOUDREAUX
FORCED DRAINAGE PROJECT
SOUTH PUMP STATION AND LEVEE IMPROVEMENTS
FOR THE
TERREBONNE PARISH CONSOLIDATED GOVERNMENT

SHEET NO. 7 OF 22

SECTION 10.0

FINAL (95%) COST ESTIMATE

10.1 Cost Estimate Assumptions

Cost estimating was based upon recent bidding activities, LDOTD database for recent lettings, equipment supplier estimates, utility company provided relocation cost, and contractor markup. All construction costs are based on current unit prices and have not been inflated. Appendix G contains backup and details for the budget in this section and a detailed breakdown of the construction cost by bid item pursuant to the 95% plans.

10.2 Project Cost Estimate

Table 10.1 shows the current estimated costs such as construction cost, land rights costs, and other costs compared to previous cost estimates. The current project cost is 25% above the 2007 project estimate for the same cost categories.

TABLE 10.1
Preliminary Project Cost

Item	2010 95% Design Report	2009 30% Design Report	2007 Conceptual Design Report Addendum	2002 Conceptual Design Report	PPL6 Cost Estimate	% Increase from 30% Design Report
Construction Cost						
Dredging New Conveyance Channel	$ 931,415	$1,031,240				
Dredging Bayou Pelton	$1,262,500	$1,175,000				
Roadwork	$664,800	$564,800				
Primary Water Control Structure	$6,344,005	$6,144,005				
Minor Water Control Structures[1]	$207,000	$157,000				
Utility Relocations	$236,600	$186,600				
Mobilization	$630,000	$630,000				
Data Collection Equipment	$35,000	$35,000				
Electrical	$120,000	$84,700				
Miscellaneous		$153,000				
Subtotal	**$10,431,320**	**$10,161,345**	**$8,728,923**	**$7,337,984**		**2.6%**
Land Rights[2]	$350,000	$350,000	$350,000	$350,000		
Parish Drainage	$1,000,000	$1,000,000	$1,000,000	$1,000,000		
Construction Contingency	$1,043,132	$1,017,395	$1,011,048	$912,753		**2.3%**
Est. Project Cost	**$12,824,452**	**$12,528,720**	**$11,089,991**	**$9,600,737**	**$9,831,300[3]**	

[1] Bayou Butler Plug, Weir and Boat Bay and North Trenasse Water Control Structure
[2] See Appendix G.
[3] Fully funded total cost.

Appendix G contains a detailed construction cost estimate showing all bid items proposed for the project.

SECTION 11.0
REFERENCES

11.1 Design References

Design references for this project include the following:

- DOTD Roadway Design Manual
- AASHTO Geometric Design of Highways and Streets (green book)
- ACI 318
- OSHA
- American Disabilities Act
- ASI Steel Construction Manual
- 2006 International Building Code
- Life Safety Code 101 2006 edition
- Louisiana State Uniform Construction Code Council

SECTION 12.0

95% FINAL PLANS AND SPECIFICATIONS

12.1 Final Plans and Specifications

95% final plans and specifications accompany this report as separate documents. They were delivered to OCPR in 12/09.

APPENDIX A

SAMPLE RIGHT-OF-WAY DOCUMENTS

T. BAKER SMITH, INC.
PROFESSIONAL CONSULTANTS SINCE 1913

412 South Van Avenue Houma, Louisiana 70363 • Post Office Box 2266 Houma, Louisiana 70361
Main Line: (985) 868-1050 • Toll Free: 1 (866) 357-1050 • Fax: (985) 868-5843 • Online: www.tbsmith.com

May 15, 2007

Mr. & Mrs. Charles Luke
106 Evest St.
Dulac, LA 70353

Dear Mr. & Mrs. Luke:

RE: Lake Boudreaux Freshwater Introduction
Land Rights Acquisition Project TE-32

Enclosed for you and Linda are copies of the executed Contract and Agreement to Sell Temporary Servitude and Right-of-way document between TPCG and you and also the document between Barataria Terrebonne Estuary Foundation and you. Attached to each document is a check. From Terrebonne Parish Consolidated Government for you and Linda are checks in the amount of $125.00 each, which represents you and your wife's half of the good faith payment for executing the Contract and Agreement to Sell Temporary Servitude and Right-of-way document. Also enclosed is a W9 form which must be signed by you and Linda and returned to me for further handling in the addressed, stamped envelope. The Parish requires this form. Please fill in your Social Security Number too.

Attached to your copy of the recorded document between you and Linda and BTEP is a good faith check in the amount of $500.00 for executing that document.

In accordance with Connelly's instructions, we are transmitting a copy of his executed document with attached check in his package.

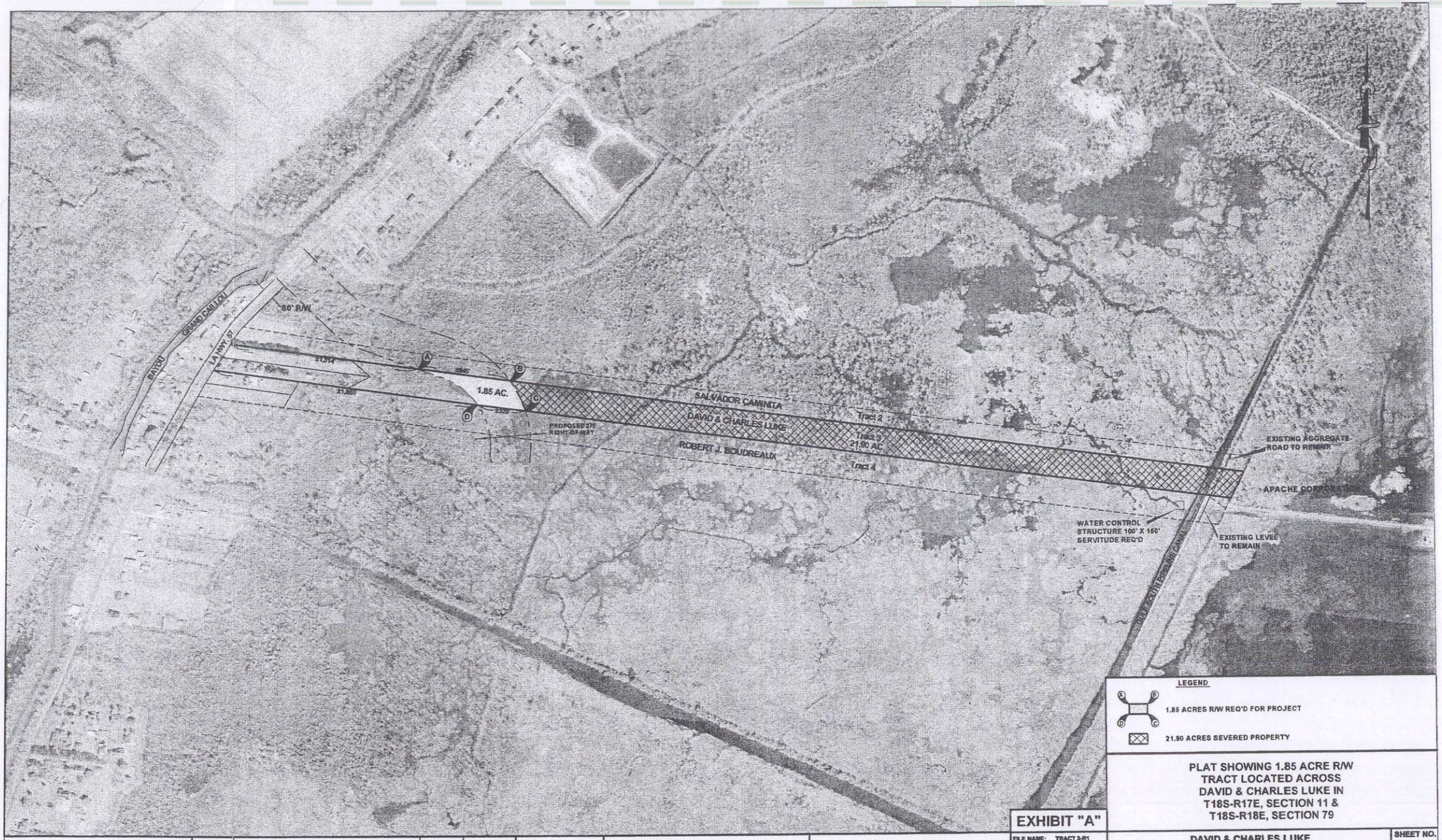
If you have any questions or need additional information, please call me. For your information, we now have 100% of all contracts executed. At some point in the future, we will be contacting you to execute the actual Temporary Servitude, Easement and Right-of-way document with TPCG and the document with BTEP. At that time, the balance due to you from the Parish and BTEP will be presented. As the project progresses, we will keep you informed.

Sincerely yours,

T. BAKER SMITH, INC.

Marc J. Rogers, Sr., P.E.

MJR/pdb
Enc.



PLAT SHOWING 1.85 ACRE R/W
TRACT LOCATED ACROSS
DAVID & CHARLES LUKE IN
T18S-R17E, SECTION 11 &
T18S-R18E, SECTION 79

EXHIBIT "A"

NOTES:

DATE	REVISIONS	DRAWN BY	APPROVED BY

T. BAKER SMITH
PROFESSIONAL CONSULTANTS SINCE 1913
(985) 876-1050 www.tbsmith.com

SCALE IN FEET
600' 300' 0 600'

FILE NAME:	TRACT 3-R1
TBS NO.:	2006.1065
DATE:	2/21/06
PLOT SCALE:	1"=600'
DRAWN BY:	STB
APPROVED:	DFB
MAP NO.	

DAVID & CHARLES LUKE
TRACT 3

LA. DEPARTMENT OF NATURAL RESOURCES
LAKE BOUDREAUX BASIN
FRESHWATER DIVERSION PROJECT
TE-32a

SHEET NO.
OF

P.O. BOX 6097
HOUMA, LOUISIANA 70361
(985) 868-5050

P.O. BOX 2768
HOUMA, LOUISIANA 70361
(985) 868-3000

TERREBONNE PARISH CONSOLIDATED GOVERNMENT

May 8, 2007

Elaine L. Luke
106 West Street
Dulac, Louisiana 70353

RE: Lake Boudreaux Freshwater Introduction
Land Rights Acquisition Project TE-32
Seller: Charles M. and Linda F. Luke &
Stanley David and Elaine L. Luke
Buyer: Terrebonne Parish Consolidated Government

Dear Ms. Luke:

Enclosed is a check for $125 and a fully executed copy of the above referenced document for your file.

The document was recorded with the Terrebonne Parish Clerk of Court under Entry No. 1265643 on May 8, 2007.

Sincerely,

TERREBONNE PARISH GOVERNMENT

Vicki Summers
Executive Secretary

Enclosure
Cc: Marc Rogers
Administration File

REMITTANCE SCHEDULE

Fund Number	Invoice Number	Amount	Fund Number	Invoice Number	Amount	Fund Number	Invoice Number	Amount
659	TEMP ROW	125.00						

TERREBONNE PARISH
CONSOLIDATED GOVERNMENT
Houma, Louisiana

Vendor Number	Check Date	Check Number	Total Invoices	Total Amount
74462	5/09/07	30279	1	125.00

For Reorder Phone PEREGRINE Corporation (337) 234-4372 Toll Free (877) 234-4372

U.S. Pat.# 6,095,407

▼ DETACH CHECK ALONG PERFORATION ▼ ▼ DETACH CHECK ALONG PERFORATION ▼

THIS CHECK IS VOID WITHOUT A GREEN BACKGROUND AND AN ARTIFICIAL WATERMARK - HOLD AT ANGLE TO VIEW WATERMARK ON BACK OF CHECK

TERREBONNE PARISH
CONSOLIDATED GOVERNMENT
HOUMA, LOUISIANA
(800)354-6862 (985)868-3000

BANK ONE Houma Louisiana 84-13 / 654

Check Date: 5/09/07

Check Number: 30279

VOID AFTER 120 DAYS

Amount: $125.00

ACCOUNTS PAYABLE CLEARING ACCOUNT

PAY EXACTLY ******125 DOLLARS AND .00 CENTS

PAY TO THE ORDER OF
LUKE, ELAINE L.
106 WEST STREET
DULAC, LA 70353

SIGNATURE HAS ACCOLADE BACKGROUND • BORDER CONTAINS MICROPRINTING

⑈30279⑈ ⑆065400137⑆ 1588866929⑈

C560625-2

P.O. BOX 6097
HOUMA, LOUISIANA 70361
(985) 868-5050

P.O. BOX 2768
HOUMA, LOUISIANA 70361
(985) 868-3000

TERREBONNE PARISH CONSOLIDATED GOVERNMENT

May 8, 2007

Stanley David Luke
106 West Street
Dulac, Louisiana 70353

RE: Lake Boudreaux Freshwater Introduction
Land Rights Acquisition Project TE-32
Seller: Charles M. and Linda F. Luke &
Stanley David and Elaine L. Luke
Buyer: Terrebonne Parish Consolidated Government

Dear Mr. Luke:

Enclosed is a check for $125 and a fully executed copy of the above referenced document for your file.

The document was recorded with the Terrebonne Parish Clerk of Court under Entry No. 1265643 on May 8, 2007.

Sincerely,

TERREBONNE PARISH GOVERNMENT

Vicki Summers
Executive Secretary

Enclosure
Cc: Marc Rogers
Administration File

REMITTANCE SCHEDULE

Fund Number	Invoice Number	Amount	Fund Number	Invoice Number	Amount	Fund Number	Invoice Number	Amount
659	TEMP ROW	125.00						

TERREBONNE PARISH
CONSOLIDATED GOVERNMENT
Houma, Louisiana

Vendor Number	Check Date	Check Number	Total Invoices	Total Amount
74460	5/09/07	30278	1	125.00

For Reorder Phone PEREGRINE Corporation (337) 234-4372 Toll Free (877) 234-4372

U.S. Pat.# 6,095,407

▼ DETACH CHECK ALONG PERFORATION ▼ ▼ DETACH CHECK ALONG PERFORATION ▼

THIS CHECK IS VOID WITHOUT A GREEN BACKGROUND AND AN ARTIFICIAL WATERMARK - HOLD AT ANGLE TO VIEW WATERMARK ON BACK OF CHECK

TERREBONNE PARISH
CONSOLIDATED GOVERNMENT
HOUMA, LOUISIANA
(800)354-6862 (985)868-3000

BANK ONE
Houma Louisiana
84-13
654

Check Date
5/09/07

Check Number
30278

VOID AFTER 120 DAYS

Amount
$125.00

ACCOUNTS PAYABLE
CLEARING ACCOUNT

PAY EXACTLY ******125 DOLLARS AND .00 CENTS

PAY TO THE ORDER OF
LUKE, STANLEY DAVID
106 WEST STREET
DULAC, LA 70353

SIGNATURE HAS A COLORED BACKGROUND • BORDER CONTAINS MICROPRINTING

⑈30278⑈ ⑆065400137⑆ 158886692 9⑈

CS60625-2

P.O. BOX 6097
HOUMA, LOUISIANA 70361
(985) 868-5050

P.O. BOX 2768
HOUMA, LOUISIANA 70361
(985) 868-3000

TERREBONNE PARISH CONSOLIDATED GOVERNMENT

May 8, 2007

Charles M. Luke
106 West Street
Dulac, Louisiana 70353

RE: Lake Boudreaux Freshwater Introduction
Land Rights Acquisition Project TE-32
Seller: Charles M. and Linda F. Luke &
Stanley David and Elaine L. Luke
Buyer: Terrebonne Parish Consolidated Government

Dear Mr. Luke:

Enclosed is a check for $125 and a fully executed copy of the above referenced document for your file.

The document was recorded with the Terrebonne Parish Clerk of Court under Entry No. 1265643 on May 8, 2007.

Sincerely,

TERREBONNE PARISH GOVERNMENT

Vicki Summers
Executive Secretary

Enclosure
Cc: Marc Rogers
Administration File

REMITTANCE SCHEDULE

Fund Number	Invoice Number	Amount	Fund Number	Invoice Number	Amount	Fund Number	Invoice Number	Amount
659	TEMP ROW	125.00						

TERREBONNE PARISH CONSOLIDATED GOVERNMENT Houma, Louisiana	Vendor Number	Check Date	Check Number	Total Invoices	Total Amount
	74458	5/09/07	30273	1	125.00

For Reorder Phone PEREGRINE Corporation (337) 234-4372 Toll Free (877) 234-4372

U.S. Pat.# 6,095,407

▼ DETACH CHECK ALONG PERFORATION ▼ ▼ DETACH CHECK ALONG PERFORATION ▼

THIS CHECK IS VOID WITHOUT A GREEN BACKGROUND AND AN ARTIFICIAL WATERMARK - HOLD AT ANGLE TO VIEW WATERMARK ON BACK OF CHECK

TERREBONNE PARISH
CONSOLIDATED GOVERNMENT
HOUMA, LOUISIANA
(800)354-6862 (985)868-3000

BANK ONE Houma Louisiana 84-13/654

Check Date
5/09/07

Check Number
30273

VOID AFTER 120 DAYS

Amount
$125.00

ACCOUNTS PAYABLE CLEARING ACCOUNT

PAY EXACTLY ******125 DOLLARS AND .00 CENTS

PAY TO THE ORDER OF
LUKE, CHARLES M.
106 WEST STREET
DULAC, LA 70353

SIGNATURE ON A COLORED BACKGROUND • BORDER CONTAINS MICROPRINTING

⑈30273⑈ ⑆065400137⑆ 1588866929⑈

C560625-2

P.O. BOX 6097
HOUMA, LOUISIANA 70361
(985) 868-5050

P.O. BOX 2768
HOUMA, LOUISIANA 70361
(985) 868-3000

TERREBONNE PARISH CONSOLIDATED GOVERNMENT

May 8, 2007

Linda F.. Luke
106 West Street
Dulac, Louisiana 70353

RE: Lake Boudreaux Freshwater Introduction
Land Rights Acquisition Project TE-32
Seller: Charles M. and Linda F. Luke &
Stanley David and Elaine L. Luke
Buyer: Terrebonne Parish Consolidated Government

Dear Ms. Luke:

Enclosed is a check for $125 and a fully executed copy of the above referenced document for your file.

The document was recorded with the Terrebonne Parish Clerk of Court under Entry No. 1265643 on May 8, 2007.

Sincerely,

TERREBONNE PARISH GOVERNMENT

Vicki Summers
Executive Secretary

Enclosure
Cc: Marc Rogers
Administration File

REMITTANCE SCHEDULE

Fund Number	Invoice Number	Amount	Fund Number	Invoice Number	Amount	Fund Number	Invoice Number	Amount
659	TEMP ROW	125.00						

TERREBONNE PARISH
CONSOLIDATED GOVERNMENT
Houma, Louisiana

Vendor Number	Check Date	Check Number	Total Invoices	Total Amount
74459	5/09/07	30272	1	125.00

For Reorder Phone PEREGRINE Corporation (337) 234-4372 Toll Free (877) 234-4372

U.S. Pat. # 6,095,407

▼ DETACH CHECK ALONG PERFORATION ▼ ▼ DETACH CHECK ALONG PERFORATION ▼

THIS CHECK IS VOID WITHOUT A GREEN BACKGROUND AND AN ARTIFICIAL WATERMARK - HOLD AT ANGLE TO VIEW WATERMARK ON BACK OF CHECK

TERREBONNE PARISH
CONSOLIDATED GOVERNMENT
HOUMA, LOUISIANA
(800)354-6862 (985)868-3000

BANK ONE
Houma Louisiana
84-13
654

Check Date
5/09/07

Check Number
30272

VOID AFTER 120 DAYS

Amount
$125.00

ACCOUNTS PAYABLE
CLEARING ACCOUNT

PAY EXACTLY ******125 DOLLARS AND .00 CENTS

PAY TO THE ORDER OF
LUKE, LINDA F.
106 WEST STREET
DULAC, LA 70353

SIGNATURE HAS A COLORED BACKGROUND • BORDER CONTAINS MICROPRINTING

⑈30272⑈ ⑆065400137⑆ 1588866929⑈

C50625-2

T. BAKER SMITH, INC.
PROFESSIONAL CONSULTANTS SINCE 1913

412 South Van Avenue Houma, Louisiana 70363 • Post Office Box 2266 Houma, Louisiana 70361
Main Line: (985) 868-1050 • Toll Free: 1 (866) 357-1050 • Fax: (985) 868-5843 • Online: www.tbsmith.com

May 15, 2007

Mr. & Mrs. Charles Luke
106 Evest St.
Dulac, LA 70353

Dear Mr. & Mrs. Luke:

RE: Lake Boudreaux Freshwater Introduction
Land Rights Acquisition Project TE-32

Enclosed for you and Linda are copies of the executed Contract and Agreement to Sell Temporary Servitude and Right-of-way document between TPCG and you and also the document between Barataria Terrebonne Estuary Foundation and you. Attached to each document is a check. From Terrebonne Parish Consolidated Government for you and Linda are checks in the amount of $125.00 each, which represents you and your wife's half of the good faith payment for executing the Contract and Agreement to Sell Temporary Servitude and Right-of-way document. Also enclosed is a W9 form which must be signed by you and Linda and returned to me for further handling in the addressed, stamped envelope. The Parish requires this form. Please fill in your Social Security Number too.

Attached to your copy of the recorded document between you and Linda and BTEP is a good faith check in the amount of $500.00 for executing that document.

In accordance with Connelly's instructions, we are transmitting a copy of his executed document with attached check in his package.

If you have any questions or need additional information, please call me. For your information, we now have 100% of all contracts executed. At some point in the future, we will be contacting you to execute the actual Temporary Servitude, Easement and Right-of-way document with TPCG and the document with BTEP. At that time, the balance due to you from the Parish and BTEP will be presented. As the project progresses, we will keep you informed.

Sincerely yours,

T. BAKER SMITH, INC.

Marc J. Rogers, Sr., P.E.

MJR/pdb
Enc.

Terrebonne Parish Recording Page

I. Robert "Bobby" Boudreaux
Clerk Of Court
P.O. Box 1569
Houma, La 70361-1569
(985) 868-5660

Received From :
TERREBONNE PARISH CONSOLIDATED GOVT
P.O. BOX 6097
ATTN; ADMINISTRATION
HOUMA, LA 70361

First VENDOR
LUKE, CHARLES M

First VENDEE
TERREBONNE PARISH CONSOL GOVERNMENT

Index Type : Conveyances

File # : 1265643

Type of Document : Agreement

Book : 2029 **Page :** 813

Recording Pages : 12

Recorded Information

I hereby certify that the attached document was filed for registry and recorded in the Clerk of Court's office for Terrebonne Parish, Louisiana

Clerk Of Court

On (Recorded Date) : 05/08/2007

At (Recorded Time) : 10:59:44:000 AM

Doc ID - 005385250012

Return To :
TERREBONNE PARISH CONSOLIDATED GOVT
P.O. BOX 6097
ATTN; ADMINISTRATION
HOUMA, LA 70361

Do not Detach this Recording Page from Original Document

CONTRACT AND AGREEMENT TO SELL
TEMPORARY EASEMENT, SERVITUDE, AND RIGHT-OF-WAY

STATE OF LOUISIANA
PARISH OF TERREBONNE

This Contract and Agreement is entered into on the date set forth below by and between

Charles M. and Linda F. Luke and Stanley David and Elaine L. Luke, residents of Parish of Terrebonne Parish, Louisiana, whose mailing address is ~~4407~~ Grand Caillou Road, Houma, 70363 (hereinafter referred to as "SELLER")" and 4415

TERREBONNE PARISH CONSOLIDATED GOVERNMENT, herein represented by its President, Donald Schwab, pursuant to the attached Resolution (BUYER)

WITNESSETH:

Seller agrees to sell, convey and deliver by act of Temporary Easement, Servitude, and Right-of-Way Agreement unto Buyer, who agrees to purchase a Temporary Easement, Servitude, and Right-of-Way Agreement over the following described property, hereinafter referred to as said lands:

A certain tract of land located along the left descending bank of Bayou Grand Caillou as depicted on the plat prepared by T. Baker Smith, Inc. entitled "Lake Boudreaux Basin Freshwater Diversion Project No. TE-32a" dated 2/21/06 as Tract No. 3.

Said servitude on Tract No. 3 having an approximate width of 275 feet; containing an approximate area of 1.85 acres encompassed by Points A, B, C, and D.

The parties to this Contract and Agreement to Sell understand and agree that the Temporary Easement, Servitude, and Right-of-Way (Temporary Servitude) that will be executed will be in the form of, and will include the terms and conditions included in, the document attached hereto entitled Temporary Easement, Servitude and Right-of-way Agreement.

Seller hereby warrants that Seller understands the Lake Boudreaux Freshwater Introduction Project TE-32 (the Project) and accepts any and all impact to said lands resulting from construction and implementation of the Project.

Seller does not warrant title to said lands.

Buyer may assign or transfer, in whole or in part, any or all of its rights hereunder, but only to the extent necessary to implement the purposes of the Project.

The consideration for the sale of the Temporary Servitude associated with said tract shall be the sum of Ten Thousand, Two Hundred Fifty-one and no/100ths ($10,251.00) Dollars, paid cash at the time of execution of the Temporary Servitude.

Buyer now delivers to the Seller the sum of Five Hundred and No/100ths ($500.00) Dollars, receipt of which is hereby acknowledged by Seller to secure the purchase price of the Temporary Servitude. At the time of the execution of the Temporary Servitude, Buyer is to be given credit for the earlier payment of this amount.

Seller accepts the Five Hundred and No/100ths ($500.00) Dollars from the Buyer to secure the purchase price of the Temporary Servitude, pending the acquisition of necessary property rights from all other property owners affected by the Lake Boudreaux Freshwater Introduction Project TE-32.

Thus done and signed at Houma, Louisiana this 28th day of Feb., ~~2006~~ 2007, in the presence of the undersigned witnesses:

WITNESSES:

Marc J. Rogers
Print: Marc J. Rogers, Sr.

Bruce J. Pellegrin
Print: Bruce J. Pellegrin

By: Charles M. Luke
Charles M. Luke 437-60-0442

Marc J. Rogers
Print: Marc J. Rogers, Sr.

Bruce J. Pellegrin
Print:

Lynda F. Luke
Lynda F. Luke 434-64-8500

Marc J. Rogers
Print: Marc J. Rogers, Sr.

Bruce J. Pellegrin
Print: Bruce J. Pellegrin

Stanley David Luke
Stanley David Luke 438-58-8876

Marc J. Rogers
Print: Marc J. Rogers, Sr.

Bruce J. Pellegrin
Print: Bruce J. Pellegrin

Elaine L. Luke
Elaine L. Luke 434-74-3514

Mona Kramer
Print: Mona Kramer

Violet Summers
Print: Violet Summers

TERREBONNE PARISH
CONSOLIDATED GOVERNMENT

By: Donald Schwab

DONALD SCHWAB
Title: Parish President

Date: May 8, 2007

ACKNOWLEDGMENT

STATE OF LOUISIANA

PARISH OF TERREBONNE

BEFORE ME, the undersigned authority, duly commissioned and qualified in and for said Parish/County and State aforesaid, on this 28th day of February, 2007, personally came and appeared Charles M. Luke et al, to me known, who, being by me duly sworn, declared and acknowledged to me, Notary, that they, as GRANTORS, executed the foregoing instrument, as their free and voluntary act and deed, and for the object and purposes therein set forth.

Peggy D. Bourg
NOTARY PUBLIC
Print: Peggy D. Bourg
Notary/Bar # 14860

My commission expires: with life
(SEAL)

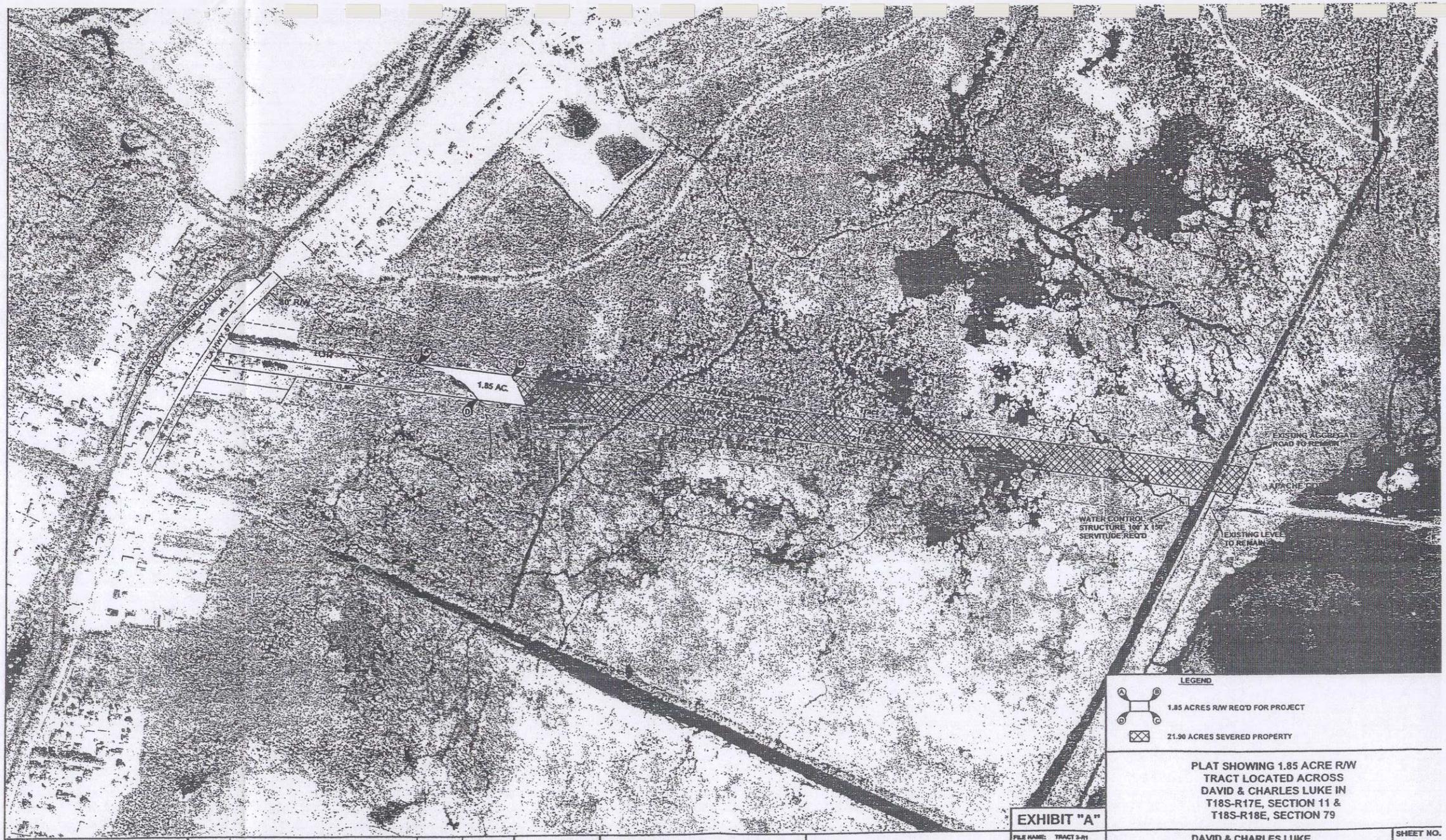
STATE OF LOUISIANA

PARISH OF TERREBONNE

BEFORE ME, the undersigned authority, duly commissioned and qualified in and for said Parish/County and State aforesaid, on this 8th day of May, 2007, personally came and appeared Don Schwab, to me known, who, being by me duly sworn, declared and acknowledged to me, Notary, that he is the Parish President of TERREBONNE PARISH CONSOLIDATED GOVERNMENT, that as such duly authorized officer, by and with authority of the Board of Directors of said corporation, he signed, executed the foregoing instrument, as the free and voluntary act and deed of said corporation, for and on behalf of said corporation, and for the object and purposes therein set forth.

Michelle L. Hoychick
NOTARY PUBLIC
Print: Michelle L. Hoychick
Notary/Bar # 27607

My commission expires: with life
(SEAL)



LEGEND

1.85 ACRES R/W REQ'D FOR PROJECT

21.90 ACRES SEVERED PROPERTY

PLAT SHOWING 1.85 ACRE R/W
TRACT LOCATED ACROSS
DAVID & CHARLES LUKE IN
T18S-R17E, SECTION 11 &
T18S-R18E, SECTION 79

EXHIBIT "A"

FILE NAME:	TRACT 3-R1
TBS NO.:	2045.1055
DATE:	3/21/06
PLOT SCALE:	1"=600'
DRAWN BY:	STB
APPROVED:	DFB
MAP NO.	

NOTES:

DATE	REVISIONS	DRAWN BY	APPROVED BY

REVISIONS

T. BAKER SMITH
PROFESSIONAL CONSULTANTS SINCE 1952
(985) 868-1050 www.tbsmith.com

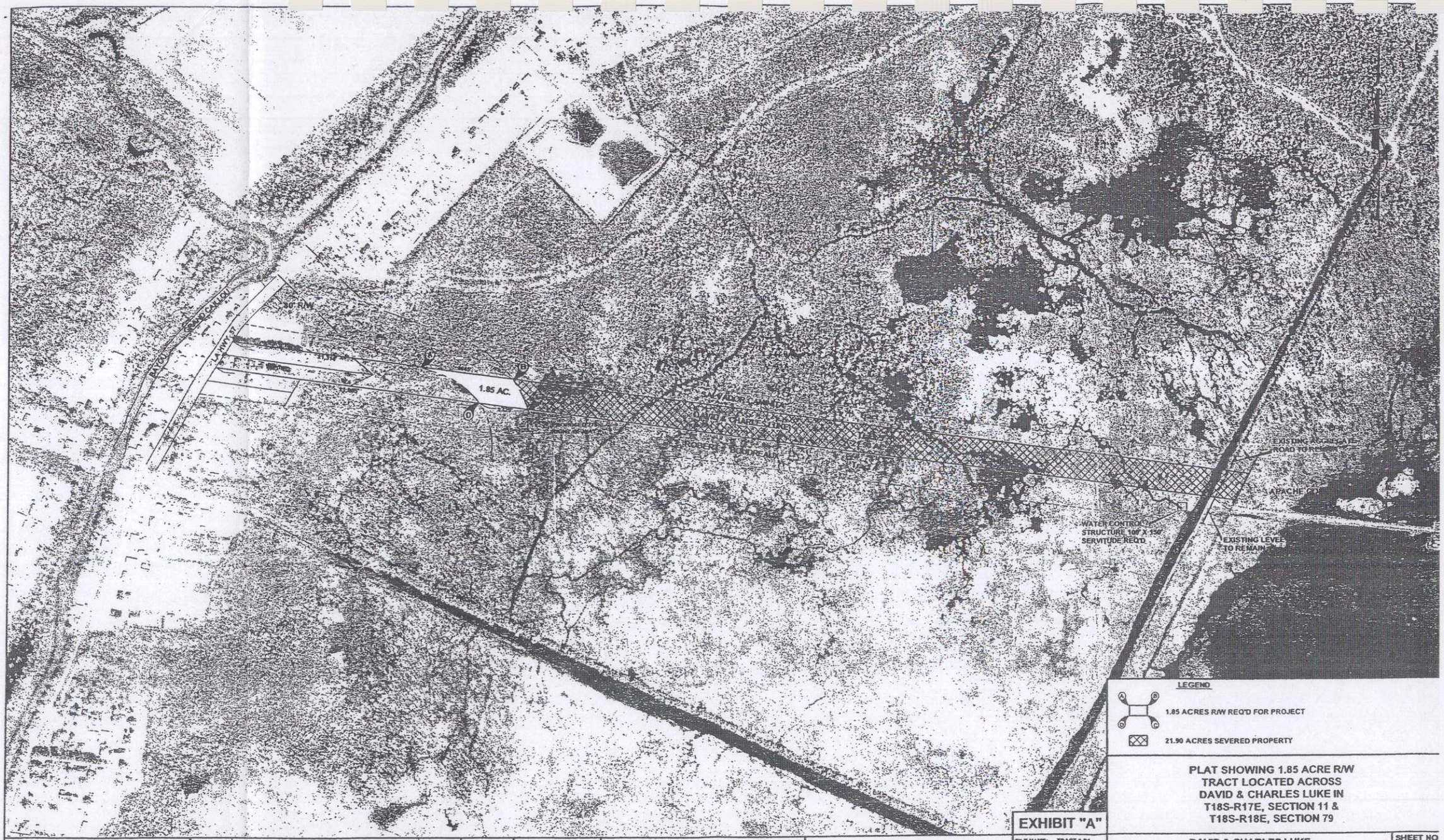
SCALE IN FEET
600' 300' 0 600'

DAVID & CHARLES LUKE
TRACT 3

LA. DEPARTMENT OF NATURAL RESOURCES
LAKE BOUDREAUX BASIN
FRESHWATER DIVERSION PROJECT
TE-32a

SHEET NO.

OF



LEGEND

1.85 ACRES R/W REQ'D FOR PROJECT

21.90 ACRES SEVERED PROPERTY

PLAT SHOWING 1.85 ACRE R/W
TRACT LOCATED ACROSS
DAVID & CHARLES LUKE IN
T18S-R17E, SECTION 11 &
T18S-R18E, SECTION 79

EXHIBIT "A"

NOTES:

DATE	REVISIONS	DRAWN BY	APPROVED BY

T. BAKER SMITH
PROFESSIONAL CONSULTANTS SINCE 1943
(985) 868-1050 www.tbsmith.com

SCALE IN FEET
600' 300' 0 600'

FILE NAME:	TRACT 3-R1
TBS NO.:	3005.1056
DATE:	3/21/06
PLOT SCALE:	1"=400'
DRAWN BY:	STB
APPROVED:	DFB

DAVID & CHARLES LUKE
TRACT 3

LA. DEPARTMENT OF NATURAL RESOURCES
LAKE BOUDREAUX BASIN
FRESHWATER DIVERSION PROJECT
TE-32a

SHEET NO

OF

Exhibit 1

TEMPORARY EASEMENT, SERVITUDE AND RIGHT-OF-WAY AGREEMENT

LAKE BOUDREAUX FRESHWATER DIVERSION PROJECT
TERREBONNE PARISH, LOUISIANA

STATE OF LOUISIANA
PARISH OF

THIS AGREEMENT, made and entered into this _____ day of _____, 20____, by and between: (Charles M. and Linda F. Luke and Stanley David and Elaine L. Luke) a _____corporation, tax identification number_____with the business address of _____herein represented by its _____ hereinafter called the "GRANTOR" (whether one or more), as owner(s) of the below described property; and the STATE OF LOUISIANA through its DEPARTMENT OF NATURAL RESOURCES ("DNR"), herein represented by its _____, hereinafter called the "STATE".

WITNESSETH: For and in consideration of the promises and undertakings by STATE to GRANTOR herein, and further for other good and valuable consideration, including the potential benefits to GRANTOR'S lands resulting from the hereinafter described project, the receipt and adequacy of which are hereby acknowledged, GRANTOR hereby grants unto STATE, its successors, assigns or transferees, the temporary rights-of-way, servitudes and easements (hereinafter called "the Agreement"), together with the right to enter in, on, and over, GRANTOR'S property, for the purposes of planning, constructing, operating, maintaining, and monitoring of conservation and restorative measures, structures and/or appurtenances as part of the Lake Boudreaux Freshwater Diversion Project (hereinafter called the Project") located on GRANTOR'S property. The Project will be publicly funded and shall be located on the following described property, including expressly, but not limited to, any lands or water-covered lands which might be owned by GRANTOR (hereinafter called "said Lands"), to-wit:

A certain tract of land located along the left descending bank of Bayou Grand Caillou as depicted on the plat prepared by T. Baker Smith, Inc. entitled "Lake Boudreaux Basin Freshwater Diversion Project No. TE-32a" dated 2/21/06 as Tract No. 3.

Said servitude on Tract No. 3 having an approximate width of 275 feet; containing an approximate area of 1.85 acres encompassed by Points A, B, C, and D as shown on Exhibit A attached to this document.

GRANTOR hereby warrants that GRANTOR understands the Project and accepts any and all impacts to said Lands resulting from construction and implementation of the Project.

I. This Agreement includes the rights to enter said Lands at the sites or locations identified on the attached Exhibit A map to perform construction, operation, modification, monitoring, and maintenance activities for the purposes authorized by Federal (16 U.S.C. 3951, et seq.) and State (R.S. 49:213-214) law pursuant to the Project, which activities are described on Exhibit B, attached hereto.

II. STATE agrees to give reasonable notice to GRANTOR prior to initiation of access to the said Lands which is required to implement, construct, operate, modify, monitor, and maintain the Project.

III. STATE agrees to indemnify and hold GRANTOR harmless against and from any loss or liability on account of injuries to (including the death of) persons or to the property of others, including reasonable attorney's fees; provided that such indemnity is limited to loss or liability that results from STATE's operations hereinunder on said Lands. In the event any suit is brought against GRANTOR to recover for or on account of any such damage, injury or death, resulting from STATE's operations hereunder, STATE will, at GRANTOR's written request, appear and defend said suit at STATE's own sole cost, risk and expense, and STATE will be responsible for any judgment that may be entered against GRANTOR therein when said suit is finally determined to the extent that such judgment is attributable to loss or liability that results from STATE's operations hereunder on said Lands. GRANTOR shall have no liability to STATE for any damage done to structures or to the Project as a result of the activities of third persons.

IV. STATE shall be responsible for repair in like manner of any fences, bridges, roads, and other similar facilities and appurtenances located on said Lands which may be damaged or destroyed by STATE, or its designees while on said Lands, but such repair shall be to that

condition which existed immediately prior to STATE's activities. STATE shall remove or dispose of all debris associated with construction, operation and maintenance of the Project.

V. STATE acknowledges that La. R.S. 49:213.8 provides that no rights whatsoever shall be created in the public, whether such rights be in the nature of ownership, servitude or use, with respect to any private lands or waters utilized, enhanced, created, or otherwise affected by activities of any governmental agency, local, state, or federal, or any person contracting with same for the performance of any activities, funded in whole or in part, by expenditures from the Wetlands Conservation and Restoration Fund.

VI. It is understood GRANTOR shall retain the limits of its title and all property rights (subject to the rights of STATE herein) in and to said Lands, and all minerals in, on and under said Lands are not affected in any way hereby. However, no structures and/or appurtenances constructed hereunder pursuant to the Project on said Lands shall be adjusted, removed and/or interfered with by GRANTOR, or anyone holding rights by, through or under GRANTOR. Specifically, no wheeled or motorized vehicles of any kind will be allowed on the conveyance channel levee; foot traffic, however, is allowed on the conveyance channel levee. In addition to the aforementioned prohibition, no swimming, construction of boat pull-over ramps, bridges or any other construction is allowed in the conveyance channel or on the conveyance channel levee, or anywhere on the easement herein described. GRANTOR retains the right to use pirogues or other non-motorized watercraft under the length of 16 feet in the conveyance channel for the express purpose of crossing from one side of GRANTOR'S property to the other. In connection with such limited use, GRANTOR agrees to indemnify, defend, and hold STATE harmless from any and all loss, claims, liability, cost, actions, or expense on account of any property damage, loss, or destruction, and on account of injury or death of any person or persons including, without limitation, any agents, employees, and invitees of GRANTOR, or to any third parties, that arises out of GRANTOR's use of the conveyance channel.

VII. Subject to the above, in its exercise of the rights herein granted, STATE agrees not to unreasonably interfere with lawful activities now occurring, or authorized to occur, on said Lands, provided, however, that such use, occupation, and enjoyment shall not unreasonably interfere with the lawful activities of STATE pursuant to this Agreement. As an exception to the prohibitions described in VI above, STATE authorizes GRANTOR the right to construct and utilize a temporary small boat dock on either side of the conveyance channel for ease of access. This temporary authorization is granted with the understanding that GRANTOR has already obtained a personal right of entry across land owned by Caillou Grove, LLC and would have a similar agreement with the Caminita Heirs except that the Caminita Estate is in succession and there is no one with power of attorney at this time to execute such an access agreement. temporary easement will be granted for one year after the canal crosses the property listed above. The easement will take effect permanently after one year unless a personal right of entry with the Caminita Family is executed within the time frame listed above. If the agreement is executed with in one year of the canal crossing the property listed above the GRANTOR agrees to remove any and all improvements within one year.

VIII. GRANTOR does not warrant title. GRANTOR specifically does not warrant or represent the correctness of any survey, or any of the plats attached hereto which purport to show the location of said Lands.

IX. STATE may assign or transfer, in whole or in part, any or all of its rights hereunder, but only to the extent necessary to implement the purposes of the Project on the said Lands.

X. This Agreement shall become effective upon the date of the signature of STATE, and shall remain in effect for a term of twenty-five (25) years unless sooner released by STATE; and, provided further, that if STATE should fail to commence work or improvements on said Lands to implement the Project within five (5) years of STATE'S execution hereof, this servitude shall automatically terminate and STATE shall have no further rights hereunder.

XI. This Agreement shall be binding upon, and inure to the benefit of, the parties hereto, their heirs, successors in interest, transferees and assigns.

XII. This Agreement may be executed in any number of counterparts, each of which shall constitute an original document which shall be binding upon any of the parties executing same.

XIII. This Agreement does not confer or waive any rights except as provided herein.

IN WITNESS WHEREOF, GRANTOR(S) has executed this Agreement in the presence of the undersigned witnesses on the date below:

WITNESSES:	GRANTOR(S):
_____	_____
Print name: _____	*Print name:* Charles M. Luke Date: _____
_____	
Print name: _____	
_____	_____
Print name:	*Print Name:* Linda F. Luke
Print name: _____	Date: _____
_____	_____
Print name: _____	*Print name:* Stanley David Luke Date: _____
_____	
Print name: _____	
_____	_____
Print name:	*Print Name:* Elaine F. Luke
Print name: _____	Date: _____

IN WITNESS WHEREOF, STATE has executed this Agreement in the presence of the undersigned witnesses on the date below:

WITNESSES:	STATE OF LOUISIANA DEPARTMENT OF NATURAL RESOURCES DNR General Counsel _____
_____	
Print: _____	By: _____
_____	Scott A. Angelle Title: Secretary
Print: _____	Date: _____

ACKNOWLEDGMENTS
INDIVIDUAL ACKNOWLEDGMENT

STATE OF
PARISH/COUNTY OF

BEFORE ME, the undersigned authority, duly commissioned and qualified in and for said Parish/County and State aforesaid, on this _____ day of _____, 20_____, personally came and appeared Charles M. and Linda F. Luke and Stanley David and Elaine L. Luke to me known to be the person/persons described in and who executed the foregoing instrument acknowledged that he/she/they executed same as his/her/their individual free act and deed.

_____

Print: _____
NOTARY PUBLIC

Notary Number: _____
My commission expires: with life
(SEAL)

FEDERAL AGENCY ACKNOWLEDGMENT

STATE OF _____
PARISH/COUNTRY OF_____

BEFORE ME, the undersigned authority, duly commissioned and qualified in and for said Parish/County and State aforesaid, on this _____ day of _____, 20____, personally came and appeared_____, to me known, who declared that he/she is the _____of the _____, that he/she executed the foregoing instrument on behalf of said Federal Agency and that the instrument was signed pursuant to the authority granted to him/her by said Federal Agency and that he/she acknowledged the instrument to be the free act and deed of said Federal Agency.

_____

*Print name:*_____
NOTARY PUBLIC

Notary Number: _____
My commission expires: with life
(SEAL)

WITNESS ACKNOWLEDGMENT

STATE OF _____
PARISH/COUNTY OF _____

BEFORE ME, the undersigned authority, on this day personally appeared who stated under oath that he/she was one of the subscribing witnesses to the foregoing instrument and that the same was signed by _____ in his/her presence and in the presence of the other subscribing witness or witnesses.

_____

*Print name:*_____
WITNESS

SWORN TO AND SUBSCRIBED before me this _____ day of _____, 20__.

_____

*Print name:*_____
NOTARY PUBLIC

Notary Number: _____
My commission expires: with life
(SEAL)

STATE OF LOUISIANA
PARISH OF EAST BATON ROUGE

BEFORE ME, the undersigned authority, duly commissioned and qualified in and for said Parish/County and State aforesaid, on this _____ day of _____, 20____, personally came and appeared _____, me known, who declared that he is the Secretary of the **Department of Natural Resources, State of Louisiana,** that he executed the foregoing instrument on behalf of said State Agency and that the instrument was signed pursuant to the authority granted to him by said State Agency and that he acknowledged the instrument to be the free act and deed of said State Agency.

_____

*Print name:*_____John F. Parker_____
NOTARY PUBLIC

Notary Number: 01117
My commission expires: with life
(SEAL)

SERVITUDE AGREEMENT
EXHIBIT "B"

a) The right to construct (including the necessary excavation and/or filling), operate, maintain and monitor water control structures including all appurtenances thereto, in, over and across the said Land;

b) The right to plant or cause the growth of vegetation in, on, over and across said Lands, including the right to nourish, replenish and maintain said vegetation at locations shown on Exhibit A;

c) The right to borrow, excavate, grade, and remove soil, vegetation and associated materials from the said Land;

d) The right to construct, operate, maintain and monitor channel improvements on, over and across said Lands, including the right to enlarge, improve, deepen or realign existing channels, canals, ditches or other waterway;

e) The right to relocate, alter, replace or remove appropriate pipelines, utility lines, facilities or other structures in, on, under, and across said Land;

f) The right to construct, locate, maintain and service required monitoring devices and equipment on said Lands as may be owned by GRANTOR

g) The right to post warning signs or notices on or near appropriate Project features on said Lands, as may be deemed necessary by STATE;

h) The right to alter or remove structures and/or appurtenances constructed on said Lands by STATE pursuant to the Project;

i) The right to enter said Lands for the purpose(s) of conducting surveys, inspections and investigations required by STATE to evaluate the effectiveness of the Project and Project features, including maintaining/improving wetland and/or restored land quantity and quality;

j) The right to enter and traverse said Lands to access Project features located on adjacent Lands;

k) The right to make modifications to the above, but only insofar as changes pertain to materials for Project features and minor changes to project feature locations, as may be deemed necessary by STATE to fully and properly implement and maintain the Project.

APPENDIX B

1934, 300' GOVERNMENT RIGHT-OF-WAY

BAYOU PELTON

for the Parish of Terrebonne, State of Louisiana, and in the presence of Elward Wright and Harry Hellier who are good and competent witnesses, residing in the Parish and State aforesaid:-

PERSONALLY CAME AND APPEARED:-

1 - Mrs.Phyllis Ellender, wife of Josh Chauvin,
2 - Carl Ellender, husband of Elda Chouest,
3 - John Ellender, husband of Marjorie Exnicious, and
3- Lawrence Ellender, a divorced man whose wife's name was Eva Olivier,

all residents of the Parish of Terrebonne, Louisiana, who declared that in consideration of the natural love which they have for and bear unto their mother,Mrs.EMILY CHAUVIN, widow of the late DAVID ELLENDER , they do by these presents give, grant, alien,confirm and donate, intervivos, unto the said Mrs.EMILY CHAUVIN-ELLENDER, here present and accepting with gratitude, for herself, her heirs and assigns, and acknowledging due delivery and possession thereof, all of their rights,titles and interests, which is a one-eighth (1/8) each ,or one-half (1/2) collectively, of the following described property, to-wit:-

A certain tract of land,situated in the Parish of Terrebonne at about fourteen (14) miles below the City of Houma,La., located on the left descending bank of Bayou Terrebonne,carved out of the original Hardscrabble Plantation, measuring a front on said bayou of four (4) arpents by a depth between parallel lines of Six (6) arpents; bounded above by property of Carl Ellender and below by property of John Ellender.

Together with all the buildings and improvements thereon and all the rights,ways,privileges and servitudes thereto belonging.

To have and to hold the said described property unto the said donee, her heirs and assigns, forever, with full subrogation in and to all of the rights and actions in warranty of said doners against all former owners and vendors of said property. The interest in the property herein donated being valued at One Thousand Dollars ($1000.00).

The certificate of mortgage that the law requires is dispensed with by the parties, who exonerate me, said Notary, from any responsibiltiy in the premises.

In faith whereof, the parties, witnesses and I,said Notary Public, have signed these presents at my office in the City of Houma,Louisiana, on the day,month and year first above written, after a due reading of the whole.

(SIGNED)

WITNESSES:

Elward Wright

Harry Hellier

Mrs. Phyllis Chauvin
Carl Ellender
John Ellender
Lawrence Ellender

Mrs.David Ellender

(SEAL) Claude Ellender,
Notary Public.

Filed for record June 25th., 1934, at 9 o'clock a.m.
(Signed)- H.C. Wurzlow,
D'ty Clerk of Court.

Recorded June 25th., A.D., 1934.

B.H. Payet, Clerk.

oOo---oOo---oOo---oOo

Now Robert Neil

No.16394. (136)

LeCarpe

RIGHT OF WAY.

JOHN THIBODAUX

TO

UNITED STATES OF AMERICA

RIGHT-OF-WAY

STATE OF LOUISIANA,

PARISH OF TERREBONNE.

BE IT KNOWN that on this 2nd day of January, in the year of our Lord, one thousand nine hundred and thirty-four,

BEFORE ME,CALVIN WURZLOW, a Notary Public duly commissioned and qualified within and for the Parish of Terrebonne,State of Louisiana, and in the presence of the two subscribing witnesses,

PERSONALLY CAME AND APPEARED :-

JOHN THIBODAUX, a married man, whose wife's name is Florence Luke, and with whom he is now living and residing, resident of the Parish of Terrebonne, Louisiana.

PERSONALLY CAME AND APPEARED

a corporation organized under the laws of the state of duly authorized by resolution of the Board of Directors adopted at a meeting held on

WHO DECLARED that for the consideration and on the terms and conditions hereinafter expressed he did, and does, by these presents, grant, bargain, give, donate, convey, transfer, assign, set over and deliver unto THE UNITED STATES OF AMERICA, appearing herein through W.B. Smith,

its successors and assigns, for its use in constructing, improving and maintaining Bayou Grand Caillou, La., and Bayou LaCarpe between Bayou Grand Caillou and the Intracoastal waterway in accordance with a project duly authorized by Congress, the perpetual right, servitude or easement to enter upon said land and remove or cut away and remove or dredge or otherwise after work of improvement, or any enlargement thereof, and to maintain the portion so cut away and removed as a part of the navigable waters of the United States; and with said grant is also granted the further perpetual right, servitude or easement to enter upon, occupy and use such portion of said tract of land not so cut away and converted into public navigable waters as aforesaid, as may be required for the deposit of dredge material or earth, and for such other purposes as may be needful in the preservation and maintenance of said work of improvement, reserving however to the grantor, his heirs and assigns, grantor, its successors and assigns, all such rights and privileges in said tract of land as may be used and enjoyed without interferring with or abridging the rights and easements hereby conveyed to THE UNITED STATES OF AMERICA, the tract of land over which servitude is granted being described as follows:

A certain tract of land situated in the Parish of Terrebonne, fronting on Bayou Pelton having a depth of one hundred and fifty (150') feet from the center line of Bayou Pelton, the full width of property belonging to grantor between the Bayou Grand Caillou and property of the South Coast Company.

Also a dumping privilege on the property of grantor bounded North by Bayou Cypre, South by Bayou Pelton, East by Bayou Grand Caillou, and West by South Coast Company.

The said dumping privilege to be exercised only on uncultivated lands at the time the privilege is exercised. No buildings to be interferred with.

TO HAVE AND TO HOLD the said servitudes and all rights and privileges granted hereunder unto THE UNITED STATES OF AMERICA, its successors and assigns, for the purposes aforesaid, forever, free and clear of all liens, mortgages and encumbrances of any nature or kind whatsoever, and with full and general warranty of title, and with full subrogation and substitution to all rights and actions in warranty held by the grantor.

THIS GRANT, transfer and donation is made and accepted for and in consideration of the price and sum of

and the further benefits to accrue to the grantor in the added convenience for the use of said canal and the enhanced value that will result to adjacent lands, as the result of the construction and maintenance of said canal.

THUS DONE AND PASSED at my office in the Parish of Terrebonne, on the day and date first above written, in the presence of Frank Wurzlow, Jr. and Miss Lucile Watkins, lawful witnesses, who have signed with said appearer and me, Notary, after due reading of the whole.

(SIGNED)

John Thibodaux

WITNESSES:

Frank Wurzlow, Jr.
Lucile Watkins

UNITED STATES OF AMERICA
BY W. B. Smith

(SEAL) Calvin Wurzlow,
NOTARY PUBLIC.

Filed for record June 26th., 1934, at 11 o'clock a.m.
(Signed)- H.C. Wurzlow,
Dy Clerk of Court.

Recorded June 26th., A.D., 1934.

B. B. Payne, Clerk.

ooo---ooo---ooo---ooo

East Terrebonne Properties (current owner)

Now East Terrebonne Properties

No. 16412.

B.LoCarpe (8)

RIGHT-OF-WAY.

THE SOUTH COAST COMPANY

TO

THE UNITED STATES OF AMERICA

RIGHT-OF-WAY

STATE OF LOUISIANA,

PARISH

BE IT KNOWN that on this the day of February in the year of our Lord, One Thousand nine hundred and thirty-four;

BEFORE ME, CALVIN WURZLOW, a Notary Public, duly commissioned and qualified within and for the Parish of Terrebonne, State of Louisiana, and in the presence of the two subscribing witnesses,

PERSONALLY CAME AND APPEARED

whose wife is and with whom he is now living and residing, resident of the Parish of

PERSONALLY CAME AND APPEARED: Carl F.Dahlberg and Jules Godchaux, Co-Receivers of The South Coast Company, a corporation organized under the laws of the State of Delaware, duly authorized by resolution of the Board of Directors adopted at a meeting held on

WHO DECLARED that for the consideration and on the terms and conditions hereinafter expressed did, and does, by these presents, grant, bargain, give, donate, convey, transfer, assign, set over and deliver unto THE UNITED STATES OF AMERICA, appearing herein through W.B.Smith,

its successors and assigns, for its use in constructing, improving and maintaining Bayou Grand Caillou, La., and Bayou LeCarpe between Bayou Grand Caillou and the Intracoastal Waterway in accordance with a project duly authorized by Congress, the perpetual right, servitude or easement to enter upon, dig, excavate or cut away and remove any or all of such of the hereinafter described tract of land as may be required at any time in the prosecution of the aforesaid work of improvement, or any enlargement thereof, and to maintain the portion so cut away and removed as a part of the navigable waters of the United States; and with said grant is also granted the further perpetual right, servitude or easement to enter upon, occupy and use such portion of said tract of land not so cut away and converted into public navigable waters as aforesaid, as may be required for the deposit of dredged material or earth, and for such other purposes as may be needful in the preservation and maintenance of said work of improvement, reserving however to the grantor, heirs and assigns, grantor, its successors and assigns, all such rights and privileges in said tract of land as may be used and enjoyed without interferring with or abridging the rights and easements hereby conveyed to THE UNITED STATES OF AMERICA, the tract of land over which servitude is granted beind described as follows:

THAT CERTAIN TRACT OF LAND, situated in the Parish of Terrebonne, State of Louisiana, measuring one hundred fifty feet (150') in width on each side of the center line of Bayou Pelton and/or Bayou LeCarpe, said Bayou running in a Northerly direction from its junction with Bayou Grand Caillou, and traversing the lands of The South Coast Company in Sections 2, 15, 40 and 41 in Township 18 South, Range 17 East and Section 47, Township 17 South, Range 17 East in the Southeastern Land District of Louisiana, West of the Mississippi River.

Also the right, privilege, power and authority to deposit such earth or spoils, or other material excavated in the construction and maintenance of said Bayou Pelton and/or LeCarpe upon the property of The South Coast Company above described.

The dumping privilege to be exercised only upon the uncultivated portion of said lands of the South Coast Company at the time said privilege is exercised. None of the buildings on said property are to be disturbed.

This donation of said property and of the servitude is hereby given subject to any mortgages resting against said property and without prejudice to the rights of said mortgage creditors.

TO HAVE AND TO HOLD the said servitude and all rights and privileges granted hereunder unto THE UNITED STATES OF AMERICA, its successors and assigns, for the purposes aforesaid, forever, free and clear of all liens, mortgages and encumbrances of any nature or kind whatsoever, and with full and general warranty of title, and with full subrogation and substitution to all rights and actions in warranty held by the grantor.

THIS GRANT, transfer and donation is made and accepted for and in consideration of the price and sum of and the further benefits to accrue to the grantor in the added convenience for the use of said canal and the enhanced value that will result to adjacent lands, as the result of the construction and maintenance of said canal.

THUS DONE AND PASSED at my office in the Parish of on the day and date first above written, in the presence of and lawful witnesses, who have signed with said appearer and me, Notary, after due reading of the whole.

(Signed)- THE SOUTH COAST COMPANY By C. F.Dahlberg, Jules Godchaux, Co-Receivers; UNITED STATES OF AMERICA BY: W.B. Smith; WITNESSES : Esther N.Ehrhart; Lucile Watkins; (L.S.) Calvin Wurzlow, Notary Public.

Filed for record June 26th., 1934, at 2 o'clock p.m.
(Signed)- H.O.Wurzlow,
D'y Clerk of Court.

Recorded June 26th., A.D., 1934.

B.B.Gazet, Clerk.

ooo---ooo---ooo---ooo

CAILLOU GROVE, LLC
4133 Grand Caillou Road
Houma, Louisiana 70363
Ph.(985)872-6635 Fax(985)872-6635
Email: gsbourg@bellsouth.net

FAX TRANSMITTAL

DATE: March 11, 2009 FAX: 868-5843

TO: MARK ROGERS

COMPANY: T-BAKER SMITH & SON

FROM: GEORGE

TOTAL PAGES TO BE TRANSMITTED: ONE

INSTRUCTIONS

MARK, ON THE NORTH SIDE OF THE DIVIRSION, MOVING TO THE LOT LINE OF LOT 3 IS OK. TWO WHOLE LOTS WILL REMAIN. PLEASE CALCULATE THE EXTRA PAYMENT. ON THE SOUTH END LOT 4 AND THE REMINDER OF LOT 1 (MEASURED FROM THE EDGE OF THE ASPHALT) IS IN EXCESS OF 13,000 SQFT. YOU COULD REDUCE IT TO 12,000 SQ FT BUT NO MORE. YOUR PLAN WOULD LEAVE BEHIND APPROX 7,500 SQFT. YOUR COST FOR THIS AQUISITION WOULD HAVE TO BE ELEVATED TO REFLECT THE REMAINING LOT 4 WOULD NOLONGER BE RESIDENTIAL.

George

CAILLOU GROVE, LLC
4133 Grand Caillou Road
Houma, Louisiana 70363
Ph.(985)872-6635 Fax(985)872-6635
Email: gsbourg@bellsouth.net

FAX TRANSMITTAL

DATE: 03/24/09 FAX: 868-5843

TO: MARC ROGERS

COMPANY: T. BAKER SMITH

FROM: GEORGE S. BOURG

TOTAL PAGES TO BE TRANSMITTED: ONE

INSTRUCTIONS

YOUR MAP DATED 03/20/09

#2008.1742 1OF1 IS

OK WITH ME.

George S Bourg

APPENDIX C

DATA COLLECTION REPORT

LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION PROJECT NO. TE-32A

DATA COLLECTION REPORT

PREPARED FOR:

LOUISIANA DEPARTMENT OF NATURAL RESOURCES
COASTAL ENGINEERING DIVISION
and
UNITED STATES FISH AND WILDLIFE SERVICE

JANUARY 29, 2009

SUBMITTED BY:

TBS T. BAKER SMITH
PROFESSIONAL CONSULTANTS SINCE 1913

LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION PROJECT NO. TE-32A

DATA COLLECTION REPORT

Prepared for: Louisiana Department of Natural Resources
Coastal Engineering Division
P.O. Box 44027
Baton Rouge, LA 70808-4207

United States Fish and Wildlife Service
646 Cajundome Boulevard, Suite 400
Lafayette, LA 70506

Submitted By: T. Baker Smith, Inc
412 S. Van Ave.
Houma, LA 70363

Ardaman & Associates, Inc.
1305 Distributors Row, Suite 1
Jefferson, LA 70123

January 29, 2009

LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION
PROJECT NO. TE-32A

DATA COLLECTION REPORT

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- 3.2 LA HWY 57 SURVEYS 2
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LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION
PROJECT NO. TE-32A

DATA COLLECTION REPORT

APPENDICES

APPENDIX 1---- Survey Control Monument Datasheet
APPENDIX 2---- Project Survey Layout Drawing
APPENDIX 3---- LA Hwy. 57 Survey Drawing
APPENDIX 3---- Bayou Pelton & H.N.C. Cross Sections
APPENDIX 4---- Ardaman & Associates, Inc. - *Preliminary Subsoil Investigation Report*
APPENDIX 5 --- Ardaman & Associates, Inc. – Soil Boring Logs

Digital Appendix (presented on accompanying CD)

- Data Collection Report file (PDF format)
- Project digital drawing files (AutoCad and PDF formats)
- Topographic and Bathymetric digital survey point data (ASCI II format)
- Ardaman & Associates, Inc.'s *Preliminary Subsoil Investigation Report* (PDF format)

DATA COLLECTION REPORT

LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION PROJECT NO. TE-32A

1.0 INTRODUCTION

The purpose of the data collection tasks summarized in this report is to provide critical support information for the design of various project features and to facilitate the construction of the Lake Boudreaux Basin Freshwater Introduction Project (TE-32a). T. Baker Smith, Inc. (TBS), as the prime consultant for the Louisiana Department of Natural Resources on this project, was responsible performing all topographic and bathymetric field data collection, related data processing, and the organization of all data into a workable format for design purposes. Ardaman & Associates, Inc., was responsible for all Geotechnical field data collection and analysis.

2.0 PROJECT OVERVIEW

The Lake Boudreaux Basin Freshwater Introduction Project is an authorized Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) Project. The project is being administered by the Louisiana Department of Natural Resources (DNR), Coastal Engineering Division (Local Sponsor), and the United States Fish and Wildlife Service (Federal Sponsor).

The primary purpose of this project is to divert fresh water from the Houma Navigational Canal easterly through Bayou Pelton, across Bayou Grand Caillou, and La. Highway 57 into the Upper Lake Boudreaux Basin. This will be done by increasing the capacity of Bayou Pelton and dredging a new Conveyance Channel from La Hwy 57 eastward to the Lake Boudreaux Basin. Under normal operating conditions, water will enter Bayou Pelton, flow easterly toward Bayou Grand Caillou, and enter the new Conveyance Channel through a new control structure at La Hwy. 57 comprised of six (6)

10' X 10' Concrete Box Culverts. The Goal of this project is to re-vitalize area marshes which are currently starved of nutrients and suffering from increased salinity levels.

3.0 DATA COLLECTION SUMMARY

During the period of October 2008 through January 2009, T. Baker Smith, Inc. (TBS) and Ardaman & Associates, Inc. collected field data throughout the project area. Data collection consisted of topographic and bathymetric cross-sections along numerous channels and outlets, topographic surveys and utility locations along La. Hwy. 57, property surveys, topographic surveys of potential dredge disposal sites, and geotechnical borings and laboratory testing.

3.1 BAYOU PELTON AND CONVEYANCE CHANNEL SURVEYS

The proposed channel areas along Bayou Pelton and the new Conveyance Channel alignment were surveyed at 200' intervals perpendicular to the proposed centerline. The cross-sections extended 50' on either side of the high bank along Bayou Pelton and across the entire width of the right-of-way (300') for the Conveyance Channel. Additionally, Four (4) Bathymetric cross-sections were surveyed across the Houma Navigational Canal at its intersection with Bayou Pelton. These Cross-Sections will be used for channel design and dredge volume calculations. Several representative cross-sections can be seen in Appendix 4.

3.2 LA HWY. 57 SURVEYS

In order to support the design of the new outlet structure and associated detour roadway, detailed topographic surveys were performed along approximately 2000 feet of La Hwy 57. Cross-Sections were taken at 100' intervals from 1000 feet south of the proposed outlet structure to 1000' feet north of the structure. These Cross-Sections extended from the Easternmost LA Hwy. 57 Right-of-way line westward to the bankline of Bayou Grand Caillou. Additionally, detailed features such as underground utilities, powerpoles, telephone pedestals, driveways, drainage structures, mailboxes, fences, etc.

were surveyed within the Hwy 57 Right-of-way. La One Call was notified prior to attempting to located underground utilities. Although not all of the utility companies responded to the request, most either marked their utility or provided detailed maps for the area. A detailed topographic survey drawing of the LA Hwy. 57 Right-of-way can be seen in Appendix 3.

3.3 WATER CONTROL STRUCTURE SURVEYS

Seven (7) water control structure locations were surveyed for the design of potential weir structures. Cross-Sections of the waterway and detailed bankline information were collected for each area. Some of these candidate sites were found to have existing dilapidated weir structures. Detailed survey information was collected for all existing structures encountered.

3.4 DREDGE DISPOSAL AREA SURVEYS

Cross-Sections of candidate disposal sites for material hydraulically dredged from Bayou Pelton were surveyed at adequate locations as to provide a general representation of volume that can be contained. Natural containment such as levees, canal banks, and spoil banks were also surveyed. Each of the areas surveyed are located on the property adjacent to the south bank of Bayou Pelton. The location of these surveys can be seen in Appendix 2.

3.5 GEOTECHNICAL DATA COLLECTION

Sixteen (16) soil test borings were drilled along Bayou Pelton and the new Conveyance Channel Alignment. A preliminary subsoil investigation report, boring logs, and a boring layout prepared by Ardaman & Associates, Inc. can be found in Appendix 5 & 6.

4.0 METHODOLOGY

4.1 SURVEY CONTROL AND DATUM INFORMATION

The horizontal and vertical survey control used for all data collection on this project was Benchmark **TE32-SM-03**, also called "David". This benchmark is part of LDNR's Secondary GPS Network, and is located approximately 1-1/4 miles north of the intersection of Bayou Pelton and Bayou Grand Caillou. The published data for this benchmark can be seen in Appendix 1. Before this Benchmark was used for control purposes, the published elevation and horizontal coordinates were verified from another LDNR Secondary mark, TE32-SM-04 or "GOD", using RTK GPS. The horizontal datum for all survey data collected is Louisiana State Plane, South Zone (1702), NAD 83, in U.S. Survey feet. The vertical datum for all data is NAVD 88, in U.S. Survey feet.

4.2 TOPOGRAPHIC SURVEYS

Topographic Surveys were performed using a standard three-man survey crew, accessing the survey area either by truck or by airboat. In areas with a clear, unobstructed view of the sky, a Trimble© model R7/R8 GPS RTK unit was used to collect the topographic field data. The manufacturer's stated accuracy of this unit is 2-3 cm horizontal, and 3-4 cm vertical. All RTK GPS Survey information was stored digitally using a Trimble TSC-2 Data Collector.

In areas where tree canopy or other obstructions made RTK GPS impractical, the survey crew used conventional survey methods to collect the topographic data. Typically, two control points were set with RTK GPS in an unobstructed area. A 200' surveyors tape and level were then used to reference the surveyed point to the control points. Handwritten field notes were used to document all conventional survey data.

Topographic survey data was downloaded from the Trimble TSC-2 Data Collector into the Trimble Geomatics Office software for processing. This software allows for QA/QC of GPS data, and was used to check for instrument setup errors, antenna height errors, and other blunders. Once the topographic survey data was processed, it was exported to AutoCAD – Civil 3D for for grouping, management, and

further QA/QC. The processed survey data was then exported to a digital text file containing point numbers, X, Y, Z coordinates, and point descriptions.

4.3 BATHYMETRIC SURVEYS

Bathymetric Surveys were performed using a standard three-man survey crew aboard the 24' Survey Vessel "Surveyor X." The bathymetric data was collected using a *Hydrotrac* digital echosounder interfaced with the *HYPACK MAX* survey navigation software in conjunction with the Trimble RTK GPS unit previously mentioned. Real - time position data was output from the GPS receiver to the *HYPACK* software 10 times each second. Digital water depth data was also output from the depth sounder 20 times each second. The *HYPACK* software is able to use the above information to display course corrections to help the surveyor navigate the predefined track line. The software is also able to compute a precise, centimeter level, position of each sounding.

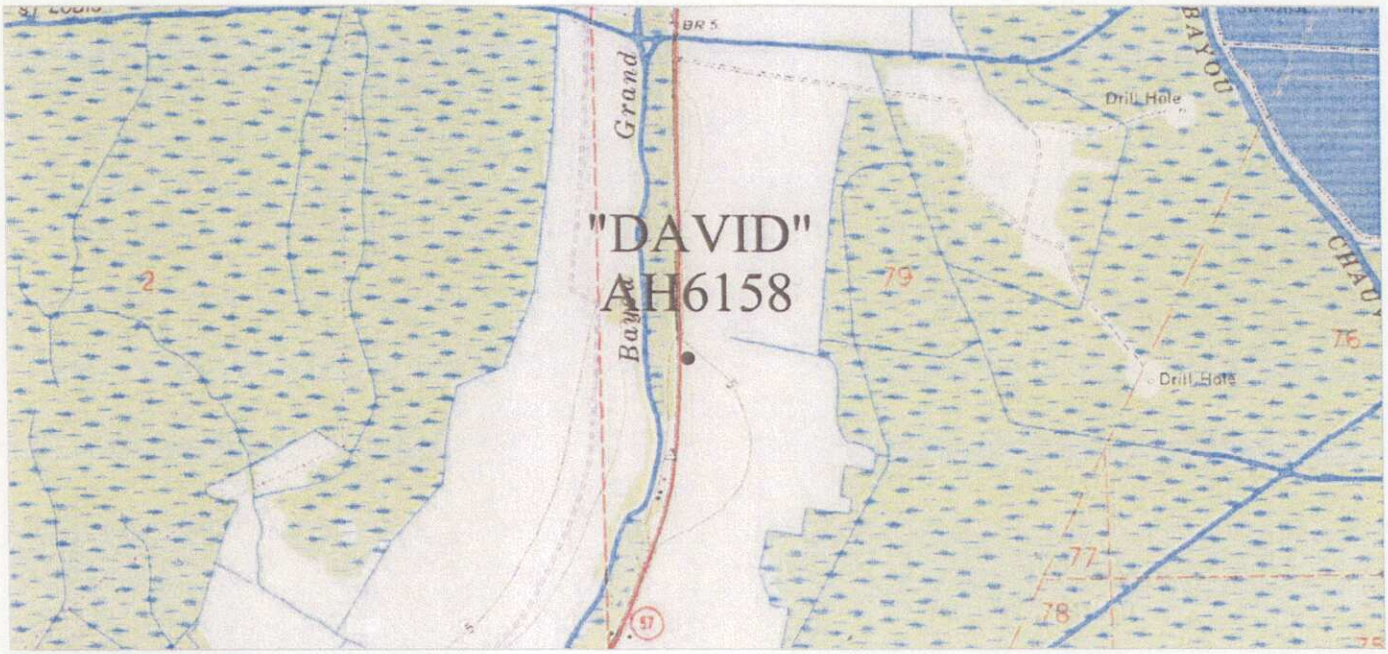
In order to ensure accurate measurements were being recorded, equipment checks and calibrations were performed several times each day. The digital depthsounder was calibrated several times a day for sound velocity corrections. This is performed by lowering an acoustic target, with precisely measured marks, below the transducer to the desired survey depth. The depthsounder's sound velocity correction factor is then adjusted so that the depthsounder reads the precise depth of the acoustic target. The measurements of the onboard GPS system were also checked by observing navigation checkpoints, or "Nav-checks", set throughout the project area.

In areas where the above methods were impractical, Bathymetric data was collected by taking hand soundings using a Standard 25' Stadia Rod with a 6" diameter bottom plate. The soundings were referenced to an RTK GPS observed tide reading for elevation reduction.

Bathymetric survey data was transferred from the onboard laptop computer to the office for processing. The processing was accomplished by using Hypack's Single Beam Editor. The *HYPACK* software allowed a profile-type review of the data, where any position or sounding outliers were manually removed. Once the data was processed and reviewed, points spaced at 5' intervals along the line were exported in X,Y,Z format.

4.4 GEOTECHNICAL DATA COLLECTION

A description of the equipment and procedures used to collect and analyze the soil borings can be found in Appendix 5.



VICINITY MAP Scale: 1" = 2000' Reproduced from USC&GS "Houma" Quadrangle

Station Name: "TE32-SM-03"

Location: The monument stamped "DAVID" is located in Terrebonne Parish, just south of Houma, Louisiana. From the intersection of La. State Hwy. 57 (Grand Caillou Rd) and East Tunnel Blvd. in Houma proceed south on Hwy. 57 for 6.0 mi. to the junction with David Drive. The monument is on the left in the median of David Drive. The monument is 80 ft. east of the centerline of Hwy 57, 25.8 ft. east from the centerline of the Ashland South sign, 53.7 ft. southeast from the fire hydrant, 56.7 feet southeast from the power pole with a light, 12.0 ft. south from the centerline of David Drive, and 63.7 ft. northeast from the power pole.

Monument Description: NGS style floating sleeve monument; datum point set on 9/16" stainless steel sectional rods driven 60 feet to refusal, set in sand filled 6" PVC pipe with access cover set in concrete, flush with ground.

Stamping: DAVID

Installation Date: 1995 **Date of Survey:** May 15-16, 2003

Monument Established By: Morris P. Hebert, Inc.

For: *Louisiana Department of Natural Resources, CRD*

Adjusted NAD 83 Geodetic Position
Lat. 29°30' 33.16156" N
Long. 90°40' 31.25377" W

Adjusted NAD 83 Datum LSZ (1702) Feet
N= 367616.95
E= 3490130.28

Adjusted NAVD88 Height
Elevation = 6.41 feet (1.953 mtrs.)

Geoid99 Height = -25.192 mtrs.
Ellipsoid Height = -23.239 mtrs.

Adjusted Position Established for Louisiana Department of Natural Resources, Coastal Restoration Division

VICINITY MAP Scale: 1" = 2000' Reproduced from USC&GS "Dulac" Quadrangle

Station Name: "TE32-SM-04"

Location: The monument stamped "GOD" is located in Dulac, Louisiana. From the intersection of La. State Hwy. 57 (Grand Caillou Road) and East Tunnel Blvd. in Houma, Louisiana proceed south on Hwy. 57 for 11.00 miles to the monument on the left. The monument is located 31.2 ft. east from the centerline of Hwy. 57, 65.0 ft. south from a power pole, 109.2 ft. west from the southwest corner of a metal building, 43.0 ft. northwest of power pole #62, and 17.8 ft. north from the centerline of a shell driveway.

Monument Description: NGS style floating sleeve monument; datum point set on 9/16" stainless steel sectional rods driven 60 feet to refusal, set in sand filled 6" PVC pipe with access cover set in concrete, flush with ground.

Stamping: GOD

Installation Date: 1995 **Date of Survey:** May 15-16, 2003

Monument Established By: Morris P. Hebert, Inc.

For: *Louisiana Department of Natural Resources, CRD*

Adjusted NAD 83 Geodetic Position
Lat. 29°26' 49.12497" N
Long. 90°42' 08.32045" W

Adjusted NAD 83 Datum LSZ (1702) Feet
N= 344938.38
E= 3481678.41

Adjusted NAVD88 Height
Elevation = 2.39 feet (.728 mtrs)

Geoid99 Height = -25.059 mtrs.
Ellipsoid Height = -24.331 mtrs.

Adjusted Position Established for Louisiana Department of Natural Resources, Coastal Restoration Division

APPENDIX E

GEOTECHNICAL REPORT

ARDAMAN & ASSOCIATES, INC.

APPENDIX D

GEOTECHNICAL REPORT

ARDAMAN & ASSOCIATES, INC.

SUBSOIL INVESTIGATION
LAKE BOUDREAUX
FRESHWATER DIVERSION,
DNR PROJECT TE-32A
TERREBONNE PARISH, LOUISIANA
AAI REPORT NO. 08-L3266

FOR
LA. DEPT. OF NATURAL RESOURCES

Ardaman & Associates, Inc.

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American Society for Testing and Materials
Florida Institute of Consulting Engineers

Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

27 March 2009

La. Department of Natural Resources
c/o T. Baker Smith, Inc.
P. O. Box 2266
Houma, Louisiana 70361

Attention: Marc Rogers

Subsoil Investigation
Lake Boudreaux
Freshwater Diversion
DNR Project TE-32A
Terrebonne Parish, Louisiana
AAI Project No. 08-L3266

Gentlemen:

Herein is our report on the results of a subsoil foundation investigation made for the subject project. We appreciate the opportunity to serve you. Please contact us should you have any questions.

Yours very truly,

ARDAMAN & ASSOCIATES, INC.

LAWRENCE W. GILBERT, P.E.,D.Engr.
Senior Vice President

Reviewed By:

REDA M. BAKEER, PhD., P.E.
Vice President/Chief Engineer

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SUBSOIL INVESTIGATION
LAKE BOUDREAUX
FRESHWATER DIVERSION
DNR PROJECT TE-32A
TERREBONNE PARISH, LOUISIANA
AAI PROJECT NO. 08-L3266

1.0 INTRODUCTION

This report contains the results of a subsoil foundation investigation made at the subject site. Instructions to proceed with the investigation were received on October 14, 2008 from Marc Rogers of T. Baker Smith, Inc. The study was made for the Louisiana Department of Natural Resources. A statement of limitations is provided following the text of this report.

The study included the drilling of soil test borings to determine subsurface conditions and stratification and the performance of soil mechanics laboratory tests on samples obtained from the borings to evaluate their physical characteristics. Engineering analyses were made based on the borings and laboratory test data to develop geotechnical criteria for use in design of the Lake Boudreaux Freshwater Diversion.

2.0 SOIL BORINGS

2.1. Field Exploration

Sixteen (16) undisturbed sample type soil test borings (B-1 thru B-16) were drilled to depths of 15 ft, 40 ft., 60 ft. and 100 ft. on December 1 thru December 8, 2008. The borings were made with a marsh buggy type drill rig at designated locations accessible to

our drilling equipment and approximately as shown in plan on Figure 1. The soil boring locations were identified in the field by others. Borings B-1 thru B-8 were completed on the west side of Bayou Grand Caillou near the centerline of Bayou Pelton. Boring B-9 was made at Highway 57 where box culverts and headwalls will be installed. Borings B-10 thru B-16 were completed on the east side of Bayou Grand Caillou. Logs of borings B-1 thru B-16 showing the detailed stratification and sample depths are given in the Appendix.

Undisturbed sampling was performed continuously in all cohesive or semi-cohesive materials with a three inch diameter thin wall tube sampler. Representative samples were cut from the cores and placed in moisture proof containers for preservation until laboratory testing could be performed.

3.0 LABORATORY TESTS

In order to develop the physical properties of the soils, soil mechanics laboratory tests were performed on samples obtained from the borings. This testing consisted primarily of Natural Moisture Content, Unit Weight and Unconfined Compression. Atterberg Limits tests and Organic Content tests were performed on selected cohesive samples. The results of all the laboratory tests are tabulated along side the boring logs at the appropriate sample and depth in the Appendix.

The Unconfined Compression strength tests are used in analyses to determine soil bearing values for surface bearing foundations. They also give a measure of "skin friction" values used to estimate axial pile load capacities. The Atterberg Limits along with the Natural Moisture Content tests give an indication of the compressibility of the soils and are used empirically to estimate settlements. The Organic Content tests give an indication of how much organic material is present in the samples tested.

4.0 SUBSOIL CONDITIONS

4.1. Subsoil Description

Borings B-1 thru B-8 Borings B-1 thru B-8 were drilled west of Highway 57. The borings were made near the center of Bayou Pelton and were drilled through about 6 inches to 2½ ft. of water. Reference to the logs of these borings shows that beginning at the ground surface there is very soft gray or dark gray clay or organic clay that extends to the 8 to 12 ft. depth in borings B-2, B-3, B-6 and B-8 and to at least the 15 ft. depth in the remaining borings where they were terminated. The remainder of the explored depth of 15 ft. in borings B-2, B-3, B-6 and B-8 consists of very soft gray silty clay to at least the 15 ft. depth where these borings were terminated.

Boring B-9 Boring B-9 was made near Highway 57 where the drainage culverts and headwalls will be constructed. Reference to the log of the boring shows that beginning at the ground surface there is medium stiff to stiff brown silty clay that extends to

the 8 ft. depth. Below this there is a relatively homogeneous stratum of soft gray silty clay that continues to the 42 ft. depth. Beginning at this depth there is soft gray clay to the 67 ft. depth and then medium stiff to stiff gray clay that extends to at least the 100 ft. depth, the maximum depth explored.

Borings B-10 thru B-16 Reference to the logs of borings B-10 thru B-16 shows that beginning at the ground surface there is generally very soft to medium stiff gray clay or silty clay that extends to at least the maximum depth explored of 40 to 100 ft. Very soft black peat was interbedded within this clay stratum between about the 27 and 42 ft. depths in borings B-12 thru B-16.

4.2. Groundwater

Borings B-1 thru B-8 were drilled near the centerline of Bayou Pelton and were drilled through about 6 inches to 2½ ft. of water. In borings B-9 thru B-16, groundwater fluctuated from the existing ground surface to the 4 ft. depth. Groundwater was measured shortly after drilling and may not have become fully static at the time of measurement. In any event, groundwater could fluctuate due to seasonal precipitation, drainage, prolonged, drought and the water level in the adjacent bayous. If groundwater is important to construction, it should be measured at that time.

5.0 FOUNDATION ANALYSIS

It is understood that the project includes dredging Bayou Pelton into a conveyance channel between the Houma Navigational Canal and Bayou Grand Caillou, the construction of a 6-barrel freshwater diversion structure at Bayou Grand Caillou with slide gates and the excavation of a new conveyance channel between Bayou Grand Caillou and the intersection of two Gulf South Pipelines in the area of borings B-1 thru B-16 and approximately as shown in plan on Figure 1.

Bayou Pelton will be dredged from the Houma Navigation Canal to Highway 57 to an invert at Elev. -10 with a 1,200 sq. ft. cross-section. The dredged material will be deposited to the south of Bayou Pelton and will generally be bounded by natural or existing containments. It is anticipated that this dredging will be accomplished with a hydraulic dredge. There are existing spoil banks on both sides of Bayou Pelton. Analysis will be made to determine what side slopes should be considered to minimize the effects of sloughing of the banks, since the hydraulic dredge will probably result in near vertical cuts. Analyses will also be made to determine how far the vertical cuts should be from the existing spoil banks to minimize disturbance of the spoil banks during construction.

Slide gates will be constructed where the conveyance channel crosses Highway 57. This will consist of a series of six (6) 10 ft. by 10 ft. precast box culverts. It is anticipated that the culverts will be supported on a prepared base, probably consisting of about

3 ft. of limestone, or equivalent, bedding material. This bedding should be underlain by a geotextile fabric to act as a separator from the underlying natural subgrade. The box culverts should be backfilled with a good quality clay material to minimize problems related to erosion. There will be concrete headwalls on both east and west sides of the culverts. Pile capacities will be developed for possible use in supporting of the headwalls. Piles may also be needed to support the box culverts, particularly if settlements are intolerable.

East of Highway 57, a new conveyance channel will be excavated to an invert at Elev. -10 and will also have a 1,200 sq. ft. cross-section. It is anticipated that a bucket dredge will be used for some of this excavation up to where the marsh area begins. Some of this material may be excavated "in the dry" for use as levee embankment fill material. As discussed above, channel side slopes will be determined based on slope stability analyses. The conveyance channel east of Highway 57 will be bounded with levees on both sides. It is anticipated that the finished grade of the levees will be at Elev. +4, allowing for levee fill shrinkage and long term consolidation settlements. Where it exists, an existing pipeline spoil bank to the south will be used as part of the containment levee. It is anticipated that some of the excess dredged material will be used to fill in the pipeline canal.

Based on the above, slope stability analyses were performed using the Wedge Method or Method of Planes to estimate the factor of safety for the enlarged Bayou Pelton west of Highway 57 and for the new containment channel east of Highway 57. These analyses were

made to estimate the minimum factor of safety for various excavated side slopes and using various typical furnished cross-sections. Analyses were also made to develop foundation recommendations for the foundation of the box culverts and headwalls at Highway 57.

5.1. Drainage Culverts and Headwalls

It is understood that six (6) 10 ft. square concrete box culverts and headwalls will be constructed where the conveyance channel crosses Highway 57. Based on furnished information, the invert of these structures will be about 15 ft. below the top of the existing Highway 57 roadway. Based on boring B-9, made in the area of the culverts and headwalls, the subsoils encountered at this depth are only fair in bearing quality. However, they are believed capable of supporting the proposed culverts and headwalls when placed on prepared a foundation. Consequently, analyses were made in this regard and the results are given in the subsequent section.

Soil Bearing Capacity Based on analysis of boring B-9, an ultimate soil bearing capacity of 2,500 lbs. per. sq. ft. is available for design of the culverts and headwalls. This assumes a structure about 100 ft. in width with its invert located at about 15 ft. below the existing ground surface elevation at the boring location. This further assumes that the structure is seated on a prepared bedding foundation, as will be discussed. The ultimate soil bearing capacity indicates where failure is imminent and a factor of safety of at least 2.0 should be

assured based on the weight of the empty structure. The bearing capacity increases as backfill is placed around the sides of the structure and the construction case is believed to be most critical.

If the culverts and headwalls are to be soil supported, it is recommended that they be placed on a common concrete mat foundation with concrete ribs or grade beams to assure good rigidity to the structure foundation. The concrete mat should extend outward from the edge of the headwalls to provide sufficient soil bearing area to safely support the entire structure. Consideration should also be given to providing a steel sheet pile cutoff wall, at least 30 ft. in length, under both the east and west edges of the mat foundation. This would minimize adverse effects of erosion or undermining of the mat foundation that could otherwise occur if there were no cutoff wall.

Estimated Settlements After construction of the culverts and headwalls, the net increase in load on the underlying subsoils should be relatively small. While no detailed settlement analyses were made, long term settlements on the order of 1 to 2 inches should be allowed for. Also, as the groundwater table is lowered, the upper soils are transformed from a buoyant weight to a total weight. This additional load would cause consolidation of the underlying cohesive subsoils. These settlements are estimated to be on the order of 1 to 2 inches for every foot that the water table is lowered. The probability of these settlements is noted so that consideration could be given to these estimated settlements at sensitive locations, particularly where the soil-supported culverts may adjoin pile-supported headwalls.

Bedding The soil boring and laboratory test data indicate that soft cohesive soils exist at the anticipated invert of the box culverts and headwall foundation. In view of this, it is recommended that a bedding of at least 3 ft. of mechanically tamped well graded limestone (or crushed concrete) underlie the structure foundation. A geotextile fabric should underlie the limestone bedding to act as a separator between the bedding materials and underlying subsoils. In addition, all precautions should be undertaken during construction to minimize disturbance of the subsoils and to provide adequate dewatering, as will be discussed. Reworking of the subsoils at the base of the structures or poor dewatering control could result in loss of bearing support of the subsoils.

The material properties of the well graded limestone bedding should be in accordance with the State of Louisiana, Standard Specifications for Roads and Bridges, Latest Edition. Adequate dewatering should be provided to control infiltration of groundwater into the bedding material during construction, as will be discussed.

In areas where the drainage structure will underlie new pavement, the remaining backfill (excluding pavement improvement and roadway base) could consist of "sugar" sand or "pumped" sand having less than 10 percent fines passing the No. 200 Sieve. It should be compacted to at least 95 percent of Maximum Dry Density at Optimum Moisture Content according to ASTM D-698. The remaining backfill in areas away from pavement improvement could consist of this type sand fill or good quality excavated clay material, free from organic,

roots, deleterious materials, etc. This should be compacted to a density equal to, or greater than, that of the natural subsoils in order to minimize long term settlements.

5.2. Construction Conditions

Excavation Cofferdams It is our opinion that the methods, means and sequence of the construction excavation for installation of the culverts and headwalls should be the responsibility of the general contractor who should be experienced in this type construction. No detailed analyses were made with regard to construction excavation cofferdam. However, considering the soft consistency of the cohesive soils encountered in boring B-9 and the close proximity of the excavation to the existing Highway 57, the excavation for construction of the culverts and headwalls should be sheeted and internally braced, as needed, to assure good stability and to minimize lateral soil movements. The design of the cofferdam system should be the responsibility of the contractor and their engineers.

Dewatering It is our opinion that the methods, means and sequence of dewatering should also be the responsibility of the general contractor who should be experienced in this type construction. However, the following general discussion with regard to dewatering is offered. As discussed previously, the subsoils encountered at the invert of the proposed drainage structures are subject to a loss in shear strength due to reworking or poor groundwater control. The soft cohesive soils that were encountered at the 15 to 20 ft. depth in boring B-9 are relatively impermeable. Therefore, it is believed that the structure excavation

could be effectively unwatered with normal sumps and pumps. In any event, it is recommended that construction should proceed as quickly as possible and that the excavation be backfilled as soon as practical to avoid long term pumping which could result in a general lowering of the water table and associated areal settlements.

5.3. Pile Foundations

Analyses were made based on boring B-9 to estimate the load carrying capacities of several types and lengths of piles for possible use in support of the concrete headwalls and the precast box culverts where the conveyance channel crosses Highway 57. Analyses were made based on Class "B" timber piles (ASTM D-25) having a 7 inch diameter tip, 12 inch diameter steel pipe piles and 12 and 14 inch square precast concrete piles. The piles will generally receive their support through "skin friction" along their embedded length, since no stratum was encountered that would offer good additional "point" support. Therefore, the load carrying capacity of the piles will depend upon their embedded length.

The results of analyses to estimate pile load capacities in compression are given in the following table. Pile lengths are as measured from the bottom of the base slab of the concrete headwalls and box culverts. This assumes that the base will be about 15 to 20 ft. below the ground surface elevation at boring B-9.

LENGTH OF* PILE IN FEET	ESTIMATED SINGLE PILE LOAD CAPACITY IN TONS FACTOR OF SAFETY = 2.0			
	Class "B" Timber	12" Dia. Pipe	12" Sq. Conc.	14" Sq. Conc.
40	11	--	--	--
45	12	--	--	--
50	13½	16	20	24
55	16	19	24	28
60	19	22	28	33
65	21	25	32	37
70	23	28	36	42
75	25	32	41	48
80	--	38	48	57

* Pile lengths are as measured from the base of the headwalls and box culvert foundation which was assumed at about the 15 to 20 ft. depth below the ground surface elevation at boring B-9.

The foregoing estimated pile load capacities contain a factor of safety of 2.0 against failure in compression which is recommended for design. They do not consider tension capacities, drag load, group effect or settlements, as will be discussed.

Tension Capacities The capacities given in the foregoing table are axial capacities of vertical piles. For piles used in tension or uplift, the compression capacities should be reduced by one-third (1/3). This would assure a factor of safety of 3.0 against failure in tension, or uplift, which is recommended for design.

Lateral Capacity The capacities given above are axial capacities of vertical piles. The lateral capacity of vertical timber piles should be limited to 1 ton per pile. The

lateral capacity for the steel pipe and precast concrete piles should be limited to 2 tons per pile. If greater lateral capacity is needed, the piles could be driven on a batter. For this case, the lateral capacity of the piles could be calculated as the horizontal component of the axial load capacity, depending upon the batter selected.

Drag Load When fill is placed on the site, the underlying compressible soils consolidate, resulting in surface settlement. As the compressible soils consolidate, "negative skin friction" or downdrag may be imparted on piles. This could result in an extraneous load, additive to any structural load, on the piles and could increase settlements of the structure. It is our opinion that drag load is dependent on the thickness of fill, compressibility of the soils, time-rate of consolidation and pile length. If 2 ft. of fill or less is required, drag load should be unimportant to design. However, it is recommended that this fill be placed as soon as practical prior to construction, If more than 2 ft. of fill is required, further consideration should be given to the effects of drag load.

Group Effect The effect of pile grouping on the single pile load capacities is dependent on pile spacing, pile lengths and soil characteristics throughout the pile length and below the pile tips. Assuming a minimum center to center spacing of 3 ft., group effect should be unimportant for pile clusters of less than 6 piles. Group effect could become important for larger clusters and should be evaluated when actual pile layouts are known as outlined in the criteria given on Figure 2.

Estimated Settlements No detailed settlement analyses were made since design structural loads are not known at this time. However, settlements of piles used in single widely spaced rows or in clusters of up to 6 to 8 piles are estimated to be on the order of ¾ to 1 inch. Settlements would increase with the size of the pile cluster and, if larger clusters of closely spaced piles are needed for support, detailed settlement analyses should be made. Consideration should be given to the estimated settlements at sensitive locations, particularly where pile-supported structures may adjoin soil-supported structures.

Pile Driving Some discussion with regard to pile driving appears warranted. In general, driving of Class "B" timber piles should be limited to the rate of 25 blows per foot using a Vulcan No. 1 hammer or equivalent. Driving of the steel pipe and prestressed concrete piles should be limited to the rate of 50 to 75 blows per ft. using a hammer developing about 20,000 to 30,000 ft-lbs. of energy per blow. These recommendations are given in order to minimize possible damage to the piles.

Vibrations due to pile driving activities should be expected and they should be monitored during the driving of probe piles and job piles. In general, vibrations should be limited to about 0.25 inch/sec. (peak particle velocity) at all existing nearby sensitive structures. If this value is exceeded, further consideration should be given to the effects of vibrations.

5.4. Conveyance Channel

As discussed above, Bayou Pelton will be dredged from the Houma Navigation Canal to Highway 57 to an invert at Elev. -10 with a 1,200 sq. ft. cross-section. East of Highway 57, a new conveyance channel will be excavated to an invert at Elev. -10 and will also have a 1,200 sq. ft. cross-section. Slope stability analyses were made to evaluate the stability of various excavated side slopes based on furnished typical channel cross-sections. Five (5) different cases were analyzed, depending upon the ground surface elevation and bank configuration. Cases 1 thru 3 assume horizontal ground surfaces at Elev. +2, +3 and +4, respectively. Case 4 is for a ground surface and spoil bank as indicated on furnished cross-section BP-1. This cross-section has a 30 ft. berm at Elev. +2 with a spoil bank then rising to Elev. +6. Case 5 is based on a furnished cross-section at Station 14+16. This cross-section had essentially no berm, but the spoil bank slopes up to Elev. +8 at a distance of about 100 ft. landward of the top of bank. The furnished cross-sections for Cases 4 and 5 are given on Figure 3. In all cases, it was assumed that the low water level in Bayou Pelton and the conveyance channel will be at Elev. 0.

Slope Stability Analyses Analyses were made based on the Wedge Method or Method of Planes to estimate the factors of safety against failure for various side slopes ranging from 1 vertical on 1 horizontal to 1 vertical on 4 horizontal. The soils strength and densities used in the analyses are based on the soil borings made east of Highway 57. It should be noted that the soil borings west of Highway 57 were drilled within Bayou Pelton and

through several feet of standing water. It is our opinion that the soil strengths determined from the soil borings on the east side of Highway 57 best represent the soil conditions under the spoil banks along Bayou Pelton.

Results of Analyses The results of the slope stability analyses for the five (5) cases described above are summarized in the following table.

SLOPE* OF CUT (N)	MINIMUM FACTORS OF SAFETY				
	CASES				
	Case 1 Grd. @ El. +2	Case 2 Grd. @ El. +3	Case 3 Grd. @ El. +4	Case 4 30 ft. Berm@ El. +2	Case 5 No Berm Slopes to El. +8
1.0	1.11	0.93	0.81	1.11	1.12
1.5	1.32	1.09	0.96	1.20	1.16
2.0	1.38	1.17	1.03	1.25	1.21
2.5	1.46	1.24	1.08	1.30	1.25
3.0	1.56	1.33	1.17	1.35	1.29
3.5	--	--	1.25	--	1.33
4.0	--	--	1.33	--	--

*1V on (N)H

In general, a minimum factor of safety of 1.3 is believed needed to assure good stability against a deep seated slope type failure. However, lesser factors of safety on the order of 1.2 could be considered if the risks associated with localized bank instability of excavated side slopes are relatively small. Detailed results for the five (5) cases with a factor of safety of about 1.2 are also given on Figures 4 thru 8.

Construction Excavations It is anticipated that the excavation of Bayou Pelton will be accomplished with a hydraulic dredge. Consideration should be given to the effects of bank sloughing, particularly if the hydraulic dredging results in near vertical cuts. In this regard, an allowance should be made for the sloughing by considering the side slopes discussed above that are needed to assure an adequate factor of safety against slope stability type failure. Even though this slope area may not be physically excavated, sufficient right-of-way should be provided to account for instability of the steeper hydraulic side slopes. Also, consideration should be given to initially dredging near the center of Bayou Pelton and progressing gradually toward both banks with successive passes. In this manner, the potential for sloughing of the side slopes can be better evaluated prior to nearing the limits of the top of bank and right-of-way.

5.5. Conveyance Channel Levee

The conveyance channel east of Highway 57 will be bounded with containment levees on both sides. An existing pipeline spoil bank on the south side will be used as a part of the containment levee. The finished grade of the levee will be at Elev. +4, after allowing for levee fill shrinkage and long term consolidation settlements. Stability analyses were made using the Wedge Method or Method of Planes to determine the side slopes of the levee and the minimum distance that the levee should be away from the conveyance channel in order to maintain an adequate factor of safety against failure.

Analyses were made based on borings B-10 thru B-16 to estimate the levee stability. It was assumed that the low water level in the conveyance channel would be at Elev. 0. It was also assumed that the levee fill material would be constructed of a cohesive material using "semi-compacted" effort in order to minimize shrinkage related settlements and to assure an adequate strength of the levee fill material.

Based on semi-compacted type compaction effort and considering for long term consolidation of the soil subgrade, it is recommended that the levee be initially constructed to Elev. + 6 with a 10 ft. wide crown and 1 vertical on 3 horizontal side slopes. For this case and assuming a ground surface at Elev. 0, a factor of safety of 1.77 is indicated for the stability of the levee, itself. With regard to the location of the levee with regard to the top of bank of the conveyance channel, additional stability analyses were made to calculate the factor of safety for various berm distances from the levee toe to the top of the conveyance channel bank. These are summarized in the following table.

DISTANCE FROM LEVEE TOE TO TOP OF BANK	MINIMUM FACTOR OF SAFETY
20	1.14
30	1.25
40	1.35
50	1.45

Detailed results of the analysis for a berm width of 50 ft. are given on Figure 9.

In general, a minimum factor of safety of 1.3 is believed needed to assure adequate stability. However, it is recommended that the levee be positioned as far as practical away from the conveyance channel while staying within the available right-of-way to assure a higher factor of safety and to allow for some excavation "in the dry" to provide suitable levee fill material.

With regard to levee construction by side cast methods, it is recommended that the construction excavation of the conveyance channel begin near the center of the conveyance channel and proceed toward the edges. In this manner, the initial excavation could be made "in the dry" and stability of the excavation side slopes during initial construction could be evaluated. Construction of the final side slopes around the edges of the conveyance channel could be made as the last step in construction. For this case, it is recommended that the conveyance channel be flooded prior to degrading the final side slopes.

Temporary stockpiles along the landside edge of the conveyance channel should not be allowed, as this was not considered in the stability analyses. If practical, the excavated material should be placed directly within the levee section and compacted in place. Our office would be available to further evaluate the stability of the conveyance channel and levee side slopes during construction, if desired.

5.6. Character of Dredged Material

It was requested that some discussion be given with regard to the character of the dredged material relative to long term shrinkage of the fill and consolidation of the underlying subsoils. Based on borings B-1 thru B-8, the subsoil within Bayou Pelton are generally cohesive and very soft to soft in character. Hydraulic dredging of these soils would result in the initially poor consistency of the material further degrading to a "slurry" consistency. This material will undergo significant decrease in volume with time due to desiccation and drying where it is deposited above the water table. In addition, consolidation related settlement due to the load imposed by the dredged material on the existing subgrade soils would result in about 1 to 2 inches of settlement for each foot of dredged material thickness.

Hydraulic dredging on the east side of Highway 57 will generally be within the natural levee of Bayou Grand Caillou. These soils are significantly more competent and may develop small clay balls, since the distance of pumping will be relatively short. In any event, better retention and a firmer character of the dredged material would be expected. Even though, shrinkage related volume change could be on the order of 25 percent or more of the total volume of dredged material placed. Further loss of material due to consolidation settlement of the subgrade would still be on the order of 1 to 2 inches for every foot of dredged material thickness.

The behavior of bucket dredged material would be expected to be much better with regard to fill retention. In general, there would initially be little or no loss of material as a result of bucket dredging, particularly where bucket dredging is performed "in the dry". With time, shrinkage related volume change could be on the order of 10 to 15 percent. Again, the loss of volume due to consolidation of the subsoils would be expected to be about 1 to 2 inches for every foot of dredge material thickness.

ARDAMAN AND ASSOCIATES, INC.

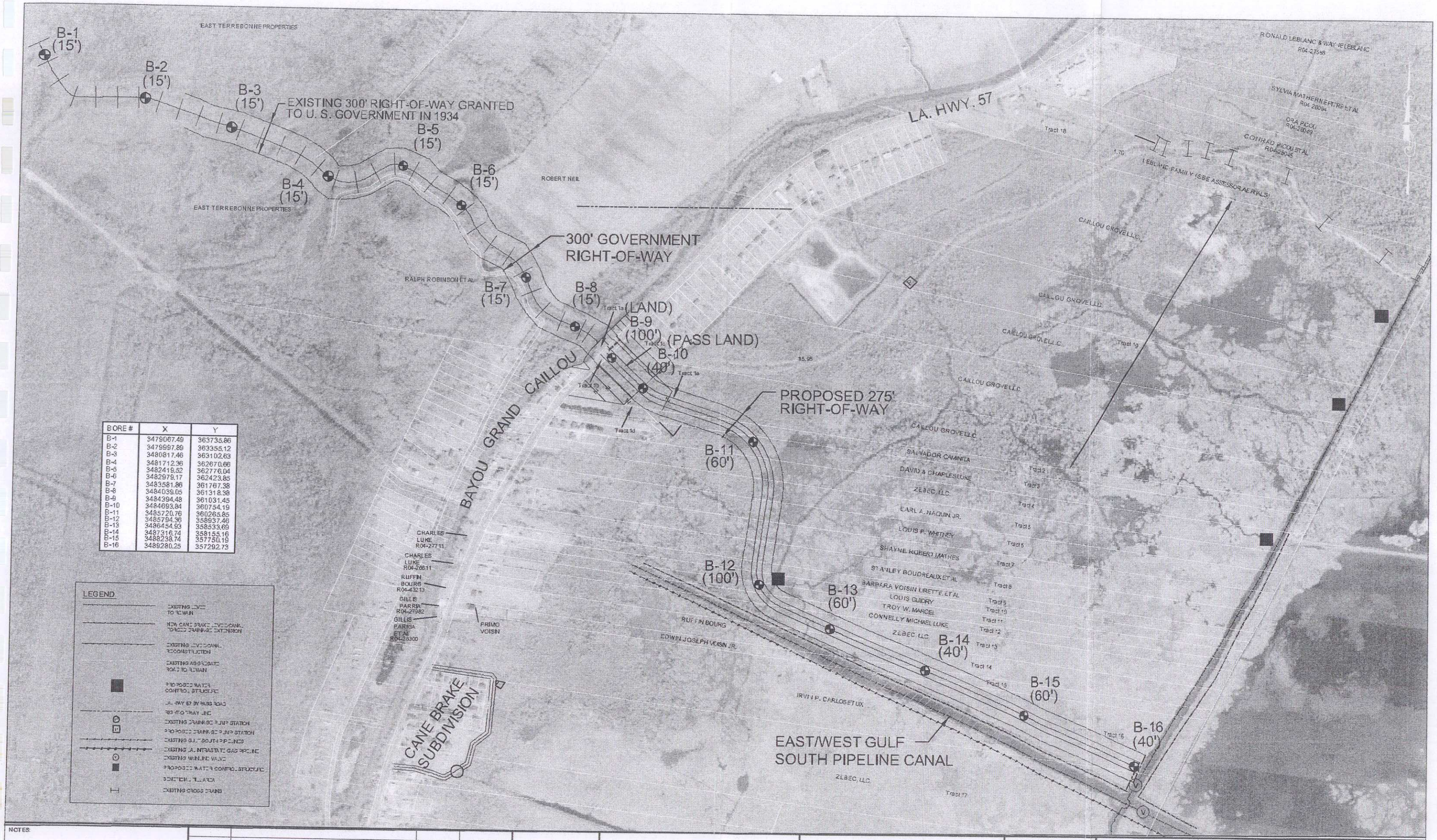
STATE OF LOUISIANA
LAWRENCE W GILBERT
License No. 16218
PROFESSIONAL ENGINEER
IN
CIVIL ENGINEERING

LAWRENCE W. GILBERT, D.Eng., P.E.
Senior Vice President

LIMITATIONS AND CONDITIONS

The analyses and recommendations presented in this report are based on the provided project information and the results of the investigation. While it is not likely that conditions will differ greatly from those observed in the soil borings it is always possible that variations can occur away from the borehole locations. If it becomes apparent during construction that subsurface conditions differing significantly from those observed in our borings are being encountered, this office should be notified at once so their effects can be determined and any remedial measures necessary can be prescribed. Also, should the nature of the project change, the recommendations provided in this report may have to be re-evaluated.

This report has been prepared for the exclusive use of T. Baker Smith, Inc. and its clients for the purpose of constructing the proposed project features as generally described in this report. The recommendations provided in this report are site specific and are not intended for use at any other site or for any other facility. This report provides recommendations for design and construction and should not be used as construction specifications.



BORE #	X	Y
B-1	3479067.49	363735.86
B-2	3479997.89	363355.12
B-3	3480817.46	363102.63
B-4	3481712.36	362670.66
B-5	3482418.52	362776.04
B-6	3482979.17	362423.85
B-7	3483581.86	361767.38
B-8	3484039.05	361318.38
B-9	3484394.48	361031.45
B-10	3484693.84	360754.19
B-11	3485720.76	360265.85
B-12	3485794.36	358937.46
B-13	3486454.93	358533.69
B-14	3487316.74	358155.16
B-15	3488238.74	357750.19
B-16	3489280.25	357292.73

NOTES:

DATE	REVISIONS	DRAWN BY	APPROVED BY

REVISIONS

TBS T. BAKER SMITH
PROFESSIONAL CONSULTANTS SINCE 1915
(800) 960-7000 www.tbsmith.com

SCALE: 1" = 400'

Ownership Base Map
06/07/05
REVISED 6/21/05
REVISED 2/21/06
REVISED 4/06/06

FILE NAME:	LANDOWNERS
TBS NO.:	2005.1055
DATE:	4/28/05
PLOT SCALE:	1 = 400
DRAWN BY:	KSP
APPROVED:	MJR
MAP NO.	

ALTERNATE 2 - PARALLEL CHANNEL CONFIGURATION 1

LA. DEPARTMENT OF NATURAL RESOURCES
LAKE BOUDREAUX BASIN
FRESHWATER DIVERSION PROJECT
TE-32a

PAGE NO.
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Minimum Pile Spacing

$$SPAC = 0.05\ L_1 + 0.025\ L_2 + 0.0125\ L_3$$

SPAC(ft.) = Center to center spacing of piles = (Min. 3.0 ft.)

L_1 = Pile penetration in ft. up to 100 ft.

L_2 = Pile penetration in ft. from 101 to 200 ft.

L_3 = Pile penetration in ft. from 201 to 300 ft.

Allowable Group Capacity*

$$Q_a = \frac{P \times L \times c}{FSF} + \frac{2.6 \times q_u \times (1 + 0.2\ {}^{w}/_{b}) \times A}{FSB}$$

P = Perimeter distance of pile group (ft.)

L = Length of pile (ft.)

c = Average (weighted) shear strength (½ q_u) of soil throughout pile length (lbs./sq. ft.)

q_u = Unconfined compressive strength of soils below pile tips (lbs./sq.ft.)

w = Width of base of pile group (ft.)

b = Length of base of pile group (ft.)

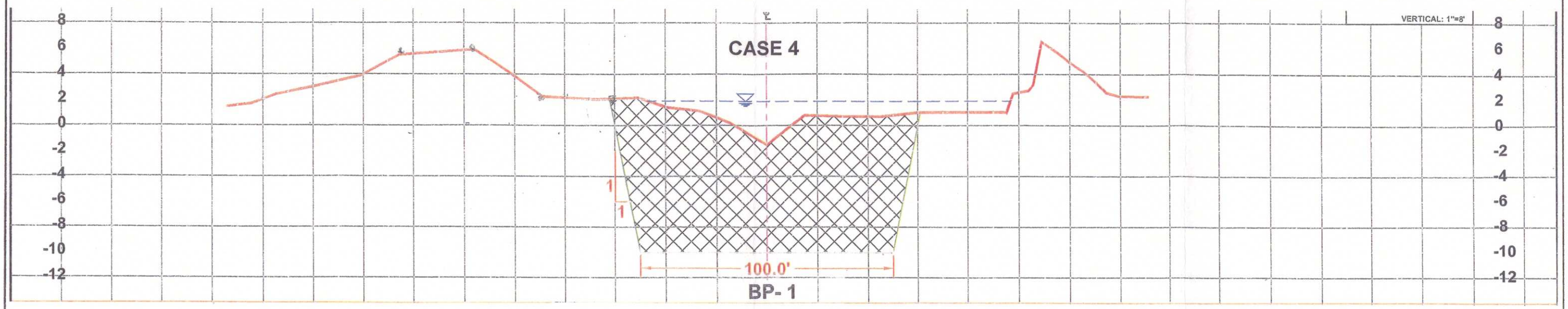
A = Base area of pile group (sq. ft.)

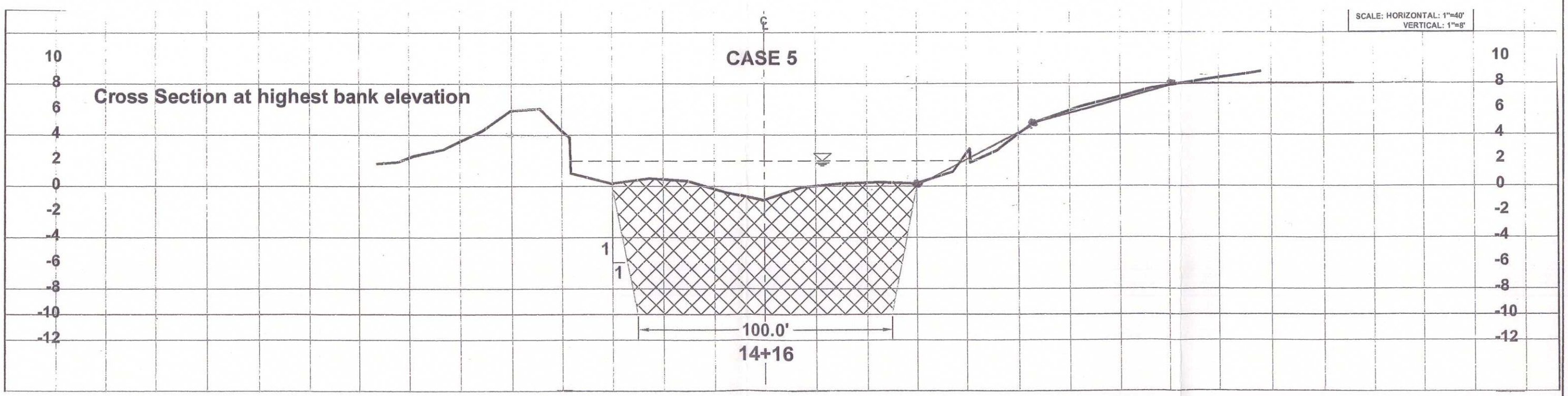
FSF = Factor of safety for friction area = 2

FSB = Factor of safety for base area = 3

*In no case should the recommended single pile load capacity be exceeded.

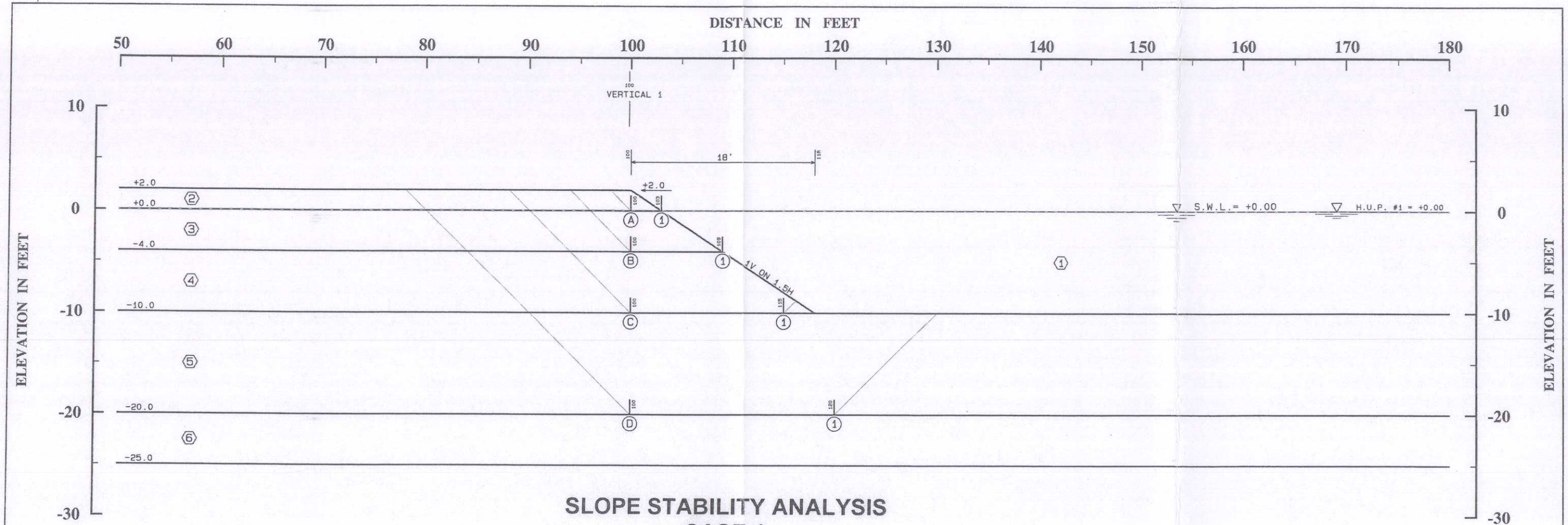
Figure 2





08-L3266

FIG. 3



SLOPE STABILITY ANALYSIS
CASE 1
(GROUND AT EL. +2)

STRATUM NUMBER	SOIL TYPE	UNIT WEIGHT (POUNDS PER CUBIC FOOT)	UNIT COHESION (POUNDS PER SQUARE FOOT)		FRICTION ANGLE (DEGREES)
			AVERAGE	BOTTOM OF STRATUM	
		VERTICAL 1	VERTICAL 1	VERTICAL 1	
1		62.0	0.0	0.0	0.0
2		106.0	100.0	100.0	0.0
3		106.0	100.0	100.0	0.0
4		106.0	160.0	160.0	0.0
5		102.0	200.0	200.0	0.0
6		102.0	200.0	200.0	0.0

S.W.L. :: SURFACE WATER LEVEL

H.U.P. :: HYDROSTATIC UPLIFT PROFILE

ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NUMBER		ELEVATION	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	0.00	399	300	0	211	0	699	211	3.31
B	1	-4.00	1199	900	0	1904	496	2099	1408	1.49
C	1	-10.00	3119	2400	384	7625	3153	5903	4472	1.32
D	1	-20.00	7119	4000	4000	25439	14400	15119	11039	1.37

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

ARDAMAN & ASSOCIATES, INC.

Geotechnical, Environmental and Materials Consultants

SLOPE STABILITY ANALYSIS

LAKE BOUDREAUX FRESHWATER DIVERSION PROJECT

TERREBONNE PARISH, LOUISIANA

J#08-L3266

CASE 2 * SLOPE = 1:1.5

SCALE : 1 INCH = 10 FEET

GEOTECHNICAL DATA FILE : L3266.2

PLOT DATA FILE : P3266.2

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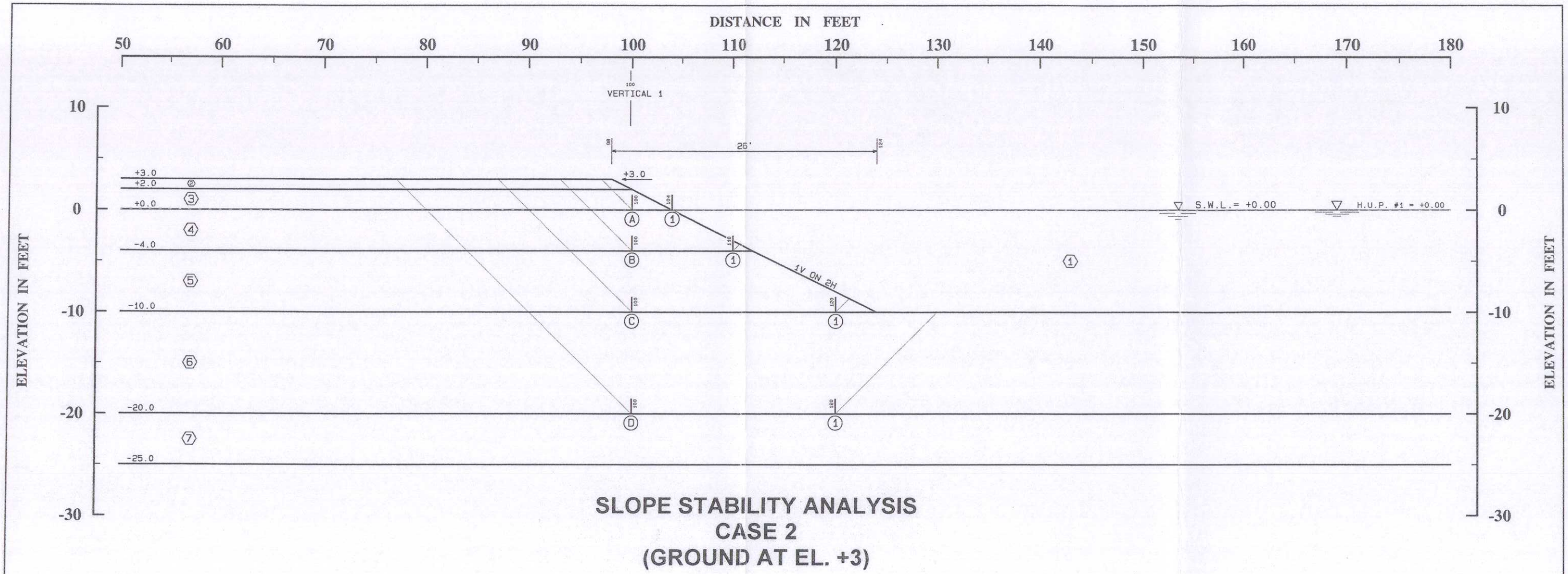
FIG. 4



SLOPE STABILITY ANALYSIS
CASE 2
(GROUND AT EL. +3)

STRATUM NUMBER	SOIL TYPE	UNIT WEIGHT (POUNDS PER CUBIC FOOT)	UNIT COHESION (POUNDS PER SQUARE FOOT)		FRICTION ANGLE (DEGREES)
			AVERAGE	BOTTOM OF STRATUM	
		VERTICAL 1	VERTICAL 1	VERTICAL 1	
1		62.0	0.0	0.0	0.0
2		110.0	200.0	100.0	0.0
3		106.0	100.0	100.0	0.0
4		106.0	100.0	100.0	0.0
5		106.0	160.0	160.0	0.0
6		102.0	200.0	200.0	0.0
7		102.0	200.0	200.0	0.0

S.W.L. :: SURFACE WATER LEVEL

H.U.P. :: HYDROSTATIC UPLIFT PROFILE

ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NUMBER		ELEVATION	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	0.00	798	400	0	376	0	1198	376	3.19
B	1	-4.00	1598	1000	133	2510	511	2731	1999	1.37
C	1	-10.00	3518	3200	426	8891	3159	7144	5732	1.25
D	1	-20.00	7519	4000	4000	27806	14575	15519	13231	1.17

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

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SLOPE STABILITY ANALYSIS

LAKE BOUDREAUX FRESHWATER DIVERSION PROJECT

TERREBONNE PARISH, LOUISIANA

J#08-L3266

CASE A-3 * SLOPE = 1:2.0

TOP SURFACE HORIZONTAL AT +3.0 FT ELEVATION

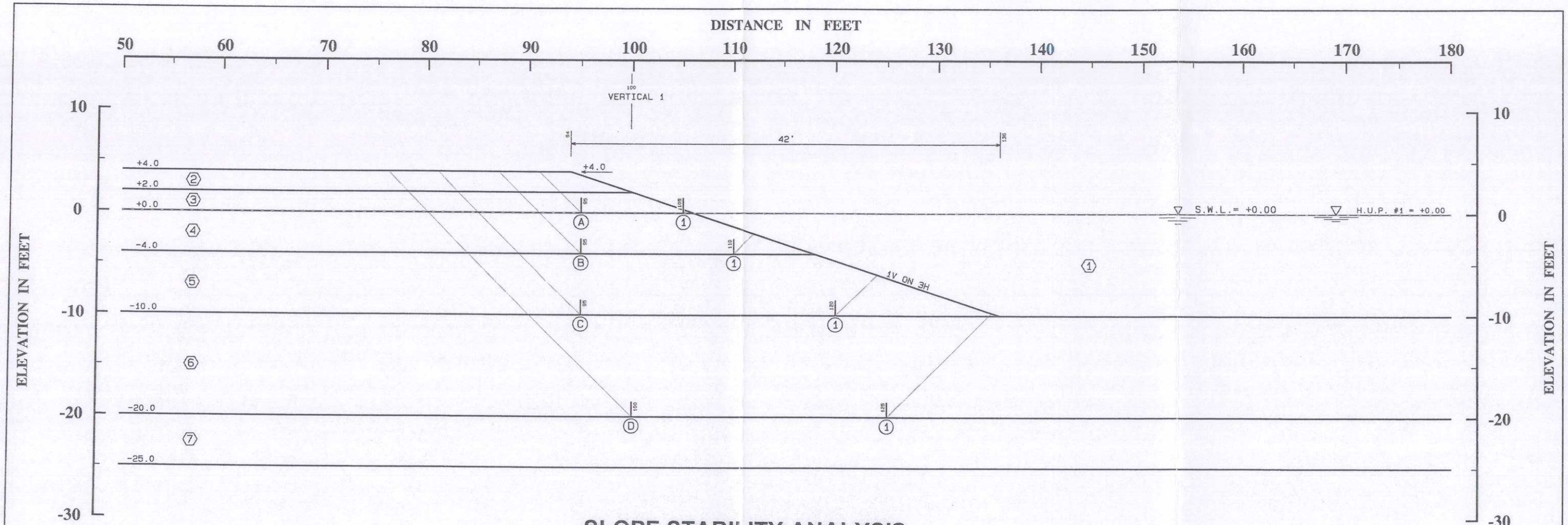
SCALE : 1 INCH = 10 FEET

GEOTECHNICAL DATA FILE : L3266.A3

PLOT DATA FILE : P3266.A3

DIRECTORY : C:\ULWEDGE

FIG. 5



SLOPE STABILITY ANALYSIS
CASE 3
(GROUND AT EL. +4)

STRATUM NUMBER	SOIL TYPE	UNIT WEIGHT (POUNDS PER CUBIC FOOT)	UNIT COHESION (POUNDS PER SQUARE FOOT)		FRICTION ANGLE (DEGREES)
			AVERAGE	BOTTOM OF STRATUM	
		VERTICAL 1	VERTICAL 1	VERTICAL 1	
1		62.0	0.0	0.0	0.0
2		110.0	200.0	100.0	0.0
3		106.0	100.0	100.0	0.0
4		106.0	100.0	100.0	0.0
5		106.0	160.0	160.0	0.0
6		102.0	200.0	200.0	0.0
7		102.0	200.0	200.0	0.0

S.W.L. :: SURFACE WATER LEVEL

H.U.P. :: HYDROSTATIC UPLIFT PROFILE

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NUMBER	ELEVATION	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	0.00	1199	1000	50	852	4	2249	848	2.65
B 1	-4.00	1999	1500	400	3427	613	3899	2814	1.39
C 1	-10.00	3919	4000	1280	10469	3569	9199	6900	1.33
D 1	-20.00	7919	5000	4080	29844	15281	16999	14563	1.17

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

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SLOPE STABILITY ANALYSIS

LAKE BOUDREAUX FRESHWATER DIVERSION PROJECT

TERREBONNE PARISH, LOUISIANA

J#08-L3266

CASE B-5 * SLOPE = 1:3.0

TOP SURFACE HORIZONTAL AT +4.0 FT ELEVATION

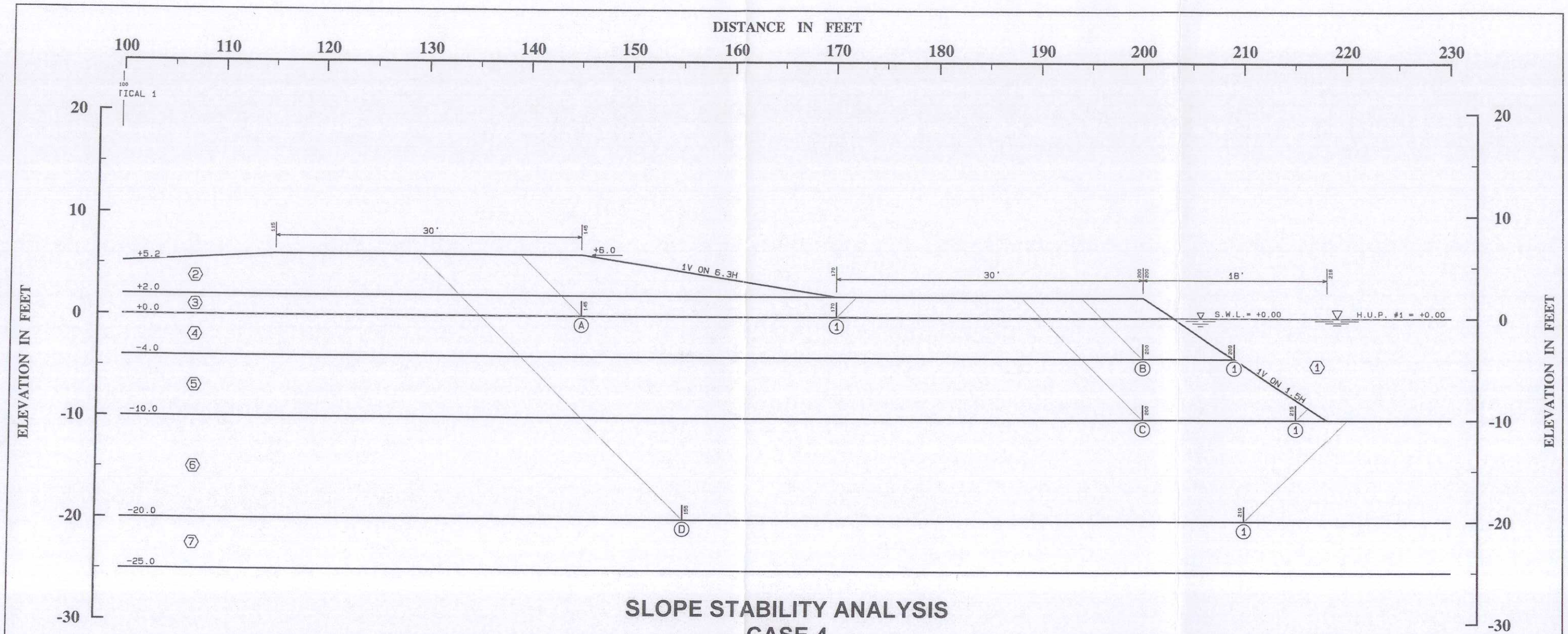
SCALE : 1 INCH = 10 FEET

GEOTECHNICAL DATA FILE : L3266.B5

PLOT DATA FILE : P3266.B5

DIRECTORY : C:\ULWEDGE

FIG. 6



SLOPE STABILITY ANALYSIS
CASE 4
(30 FT. BERM AT EL. +2)

STRATUM NUMBER	SOIL TYPE	UNIT WEIGHT (POUNDS PER CUBIC FOOT)	UNIT COHESION (POUNDS PER SQUARE FOOT)		FRICTION ANGLE (DEGREES)
			AVERAGE	BOTTOM OF STRATUM	
		VERTICAL 1	VERTICAL 1	VERTICAL 1	
1		62.0	0.0	0.0	0.0
2		110.0	200.0	100.0	0.0
3		106.0	100.0	100.0	0.0
4		106.0	100.0	100.0	0.0
5		106.0	160.0	160.0	0.0
6		102.0	200.0	200.0	0.0
7		102.0	200.0	200.0	0.0

S.W.L. :: SURFACE WATER LEVEL

H.U.P. :: HYDROSTATIC UPLIFT PROFILE

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NUMBER	ELEVATION	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	0.00	2000	2500	400	1971	212	4900	1759	2.79
B 1	-4.00	1200	900	0	1905	496	2100	1409	1.49
C 1	-10.00	3120	2400	384	7629	3153	5904	4476	1.32
D 1	-20.00	8720	11000	4000	35128	15337	23720	19791	1.20

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

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SLOPE STABILITY ANALYSIS

LAKE BOUDREAUX FRESHWATER DIVERSION PROJECT

TERREBONNE PARISH, LOUISIANA

J#08-L3266

CASE C-2 * SLOPE = 1:1.5

30 FOOT BERM AT +2.0 FT ELEVATION

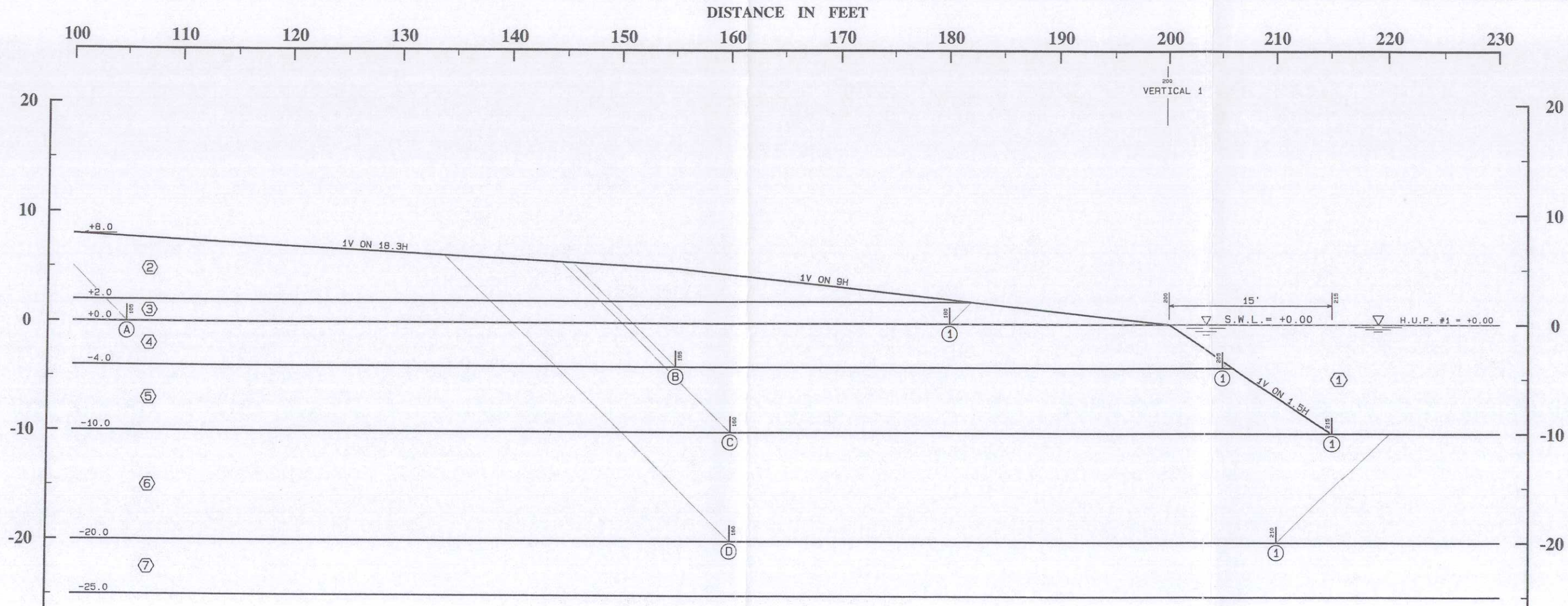
SCALE : 1 INCH = 10 FEET

GEOTECHNICAL DATA FILE : L3266.C2

PLOT DATA FILE : P3266.C2

DIRECTORY : C:\ULWEDGE

FIG. 7



SLOPE STABILITY ANALYSIS
CASE 5
(NO BERM/SLOPE TO EL. +8)

STRATUM NUMBER	SOIL TYPE	UNIT WEIGHT (POUNDS PER CUBIC FOOT)	UNIT COHESION (POUNDS PER SQUARE FOOT)		FRICTION ANGLE (DEGREES)
			AVERAGE	BOTTOM OF STRATUM	
		VERTICAL 1	VERTICAL 1	VERTICAL 1	
1		62.0	0.0	0.0	0.0
2		110.0	200.0	100.0	0.0
3		106.0	100.0	100.0	0.0
4		106.0	100.0	100.0	0.0
5		106.0	160.0	160.0	0.0
6		102.0	200.0	200.0	0.0
7		102.0	200.0	200.0	0.0

S.W.L. :: SURFACE WATER LEVEL

H.U.P. :: HYDROSTATIC UPLIFT PROFILE

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NUMBER	ELEVATION	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	0.00	2800	7500	400	3437	236	10700	3201	3.34
B 1	-4.00	2607	5000	79	4639	502	7686	4137	1.86
C 1	-10.00	4550	8800	0	12250	3100	13350	9150	1.46
D 1	-20.00	8781	10000	4000	34320	14766	22781	19554	1.17

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

ARDAMAN & ASSOCIATES, INC.

Geotechnical, Environmental and Materials Consultants

SLOPE STABILITY ANALYSIS

LAKE BOUDREAUX FRESHWATER DIVERSION PROJECT

TERREBONNE PARISH, LOUISIANA

J#08-L3266

CASE D-2 * SLOPE = 1:1.5

NO BERM * SURFACE SLOPES TO +8.0 FT ELEVATION

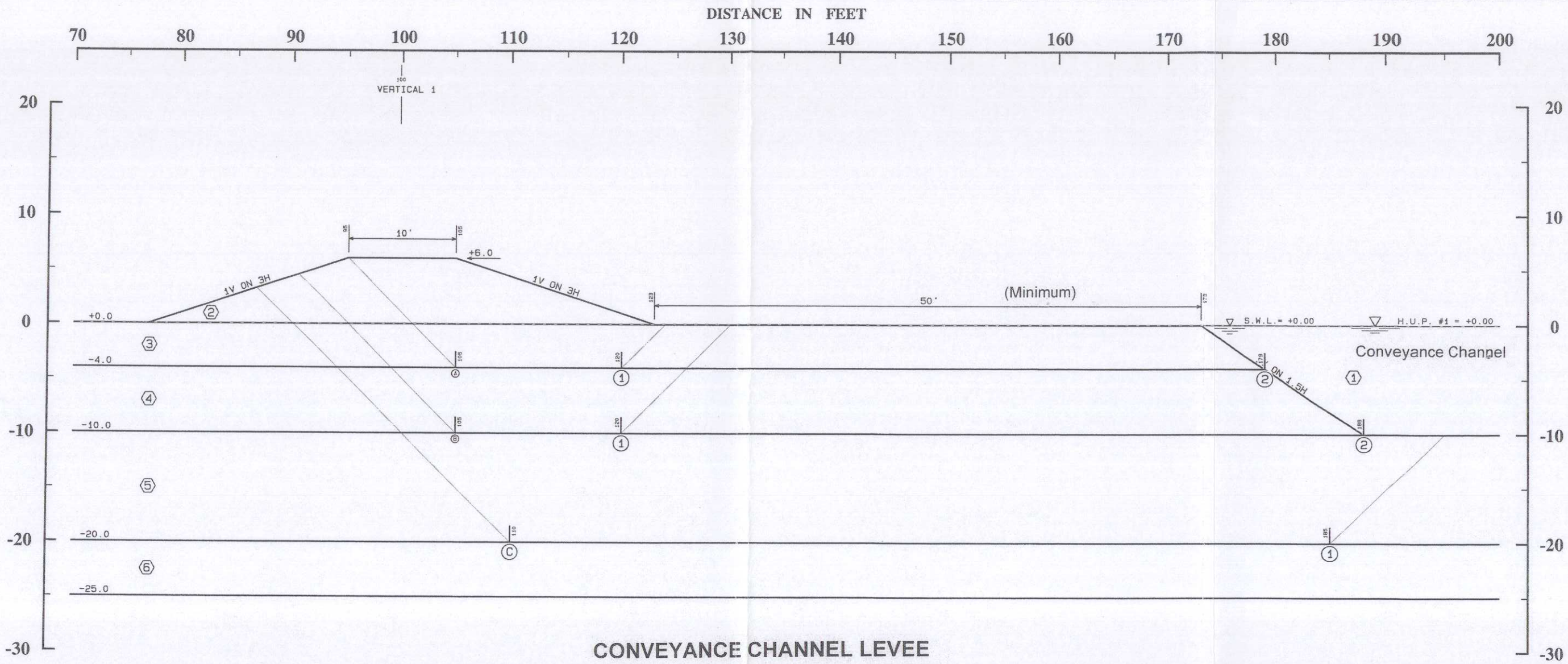
SCALE : 1 INCH = 10 FEET

GEOTECHNICAL DATA FILE : L3266.D2

PLOT DATA FILE : P3266.D2

DIRECTORY : C:\ULWEDGE

FIG. 8



CONVEYANCE CHANNEL LEVEE

STRATUM NUMBER	SOIL TYPE	UNIT WEIGHT (POUNDS PER CUBIC FOOT)	UNIT COHESION (POUNDS PER SQUARE FOOT)		FRICTION ANGLE (DEGREES)
			AVERAGE	BOTTOM OF STRATUM	
		VERTICAL 1	VERTICAL 1	VERTICAL 1	
1		62.0	0.0	0.0	0.0
2		110.0	400.0	100.0	0.0
3		106.0	100.0	100.0	0.0
4		106.0	160.0	160.0	0.0
5		102.0	200.0	200.0	0.0
6		102.0	200.0	200.0	0.0

S.W.L. :: SURFACE WATER LEVEL H.U.P. :: HYDROSTATIC UPLIFT PROFILE

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NUMBER	ELEVATION	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-4.00	5600	1500	800	5467	1013	7900	4454	1.77
A 2	-4.00	5600	7400	-1	5467	496	12999	4971	2.61
> B 1	-10.00	6320	2400	2720	13384	5465	11440	7919	1.44 <
B 2	-10.00	6320	13280	0	13384	3100	19600	10284	1.91
C 1	-20.00	9321	15000	4000	34056	14531	28321	19525	1.45

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

ARDAMAN & ASSOCIATES, INC.

Geotechnical, Environmental and Materials Consultants

SLOPE STABILITY ANALYSIS

LAKE BOUDREAUX FRESHWATER DIVERSION PROJECT

TERREBONNE PARISH, LOUISIANA

J#08-L3266 * CASE 8-E

SEMI-COMPRESSED FILL

LEVEE CROWN AT + 6.0 FT ELEVATION

50 FT FROM TOE OF LEVEE TO TOP OF BANK

SCALE : 1 INCH = 10 FEET GEOTECHNICAL DATA FILE : L3266-2.8E PLOT DATA FILE : P3266-2.8E DIRECTORY : C:\ULWEDGE

FIG. 9

APPENDIX

BORING LOGS

DESCRIPTION OF TERMS AND SYMBOLS USED ON SOIL BORING LOG

FIELD DATA				LABORATORY DATA								
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	PL	PI	Other	Soil Type	DESCRIPTION

5

10

15

20

25

30

35

40

Ground Water Levels

Long-Term Depth
Depth to water after boring is completed (time noted).

Short-Term Depth
Depth to water after initial water encountered prior to proceeding with boring (time noted).

Initially Encountered
Depth where free water was initially encountered during augering.

Sampling/Field Data

3.5 (P) — **Undisturbed**
3" dia. Tube sample

Pocket Penetrometer (P)
Penetration resistance (tons/sq. ft.).

Torvane (T)
Shearing resistance (tons/sq. ft.)

13 b/f (3-7-6) — **Split Spoon**
Std. penetration test

Std. Penetration
No. of blows per foot (blows per each six inch increments).

Auger
Disturbed (auger) collected in accordance with ASTM D-1452.

No Recovery
Sampling attempted but no sample retrieved.

DESCRIPTION

Description
Classifications are based on visual observations by field & lab representatives as well as results of laboratory data (when available).

Laboratory Data

Compressive Strength
Value based on peak compressive strength. Determined by unconfined compression test unless otherwise noted.

Dry Unit Weight
As determined by method similar to ASTM D-2937.

Water Content
As determined by pertinent portions of ASTM D-2216.

Atterberg Limits
LL : Liquid Limit
PL : Plastic Limit
PI : Plasticity Index
(= Liquid Limit - Plastic Limit)

Other
Results of other tests such as consolidation, permeability, grain size or notes associated with testing program.

Soil Type
Graphical representation of soil type. In accordance with USCS Symbols.

Ground Water Level Data	Boring Advancement Method	Notes
	Boring Abandonment Method	

Form LOGTERMS

Strata Boundaries May Not Be Exact

Lake Boudreaux
Freshwater Diversion
Terrebonne Parish, LA

LOG OF SOIL BORING B-01

Ardaman & Associates, Inc.

Sheet 1 of 1

Baton Rouge Geotechnical Laboratory
AASHTO Accredited Laboratory , LELAP Certificate No. 02052,
USACE Validated

T. Baker Smith, Inc.
Houma, LA

File: 08-L3266
Date: 12/02/09
Logged by: J. Kelley
Driller: S. E. R.
Rig: Swamp Buggy

Location: Lat. 29° 29' 55.02"
Long. 90° 41' 36.48"
Surface Elevation: N/A (ft., NAVD)

FIELD DATA				LABORATORY DATA									
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	PL	PI	Percent Passing #200 Sieve	Other	Soil Type	Description
☒			0.25 (P)		103								
			0.25 (P)		89		59	28	31				
	5		0.25 (P)	0.21	53	65							
			0.25 (P)		76		95	31	64				
			0.25 (P)	0.07	78	53							
	10												
			0.25 (P)		83		64	27	37				
	15												Boring completed at 15 ft.
	20												
	25												
	30												
	35												
	40												

Ground Water Level Data	Boring Advancement Method	Notes
☒ No free water encountered to 15 ft.	4" Nom. Dia. Short Flight Auger: 0 to 15 ft.	
	Boring Abandonment Method	

Strata Boundaries May Not Be Exact

ARD LOG01 01R 083266.GPJ LOG01R.GDT 01/08/09

Lake Boudreaux
Freshwater Diversion
Terrebonne Parish, LA

LOG OF SOIL BORING B-02

Ardaman & Associates, Inc.

Sheet 1 of 1

Baton Rouge Geotechnical Laboratory
AASHTO Accredited Laboratory , LELAP Certificate No. 02052,
USACE Validated

File: 08-L3266
Date: 12/02/09
Logged by: J. Kelley
Driller: S. E. R.
Rig: Swamp Buggy

T. Baker Smith, Inc.
Houma, LA

Location: Lat. 29° 29' 51.54"
Long. 90° 42' 26.22"

Surface Elevation: N/A (ft., NAVD)

FIELD DATA				LABORATORY DATA									
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Percent Passing #200 Sieve	Other	Soil Type	Description
☒			0.25 (P)		89		79	32	47				
			0.25 (P)		99								
	5		0.25 (P)		95		106	38	68				
			0.5 (P)	0.05	103	42							
			0.75 (P)	0.24	43	81	46	24	22				
	10												
			0.75 (P)	0.42	32	92							
	15												Boring completed at 15 ft.
	20												
	25												
	30												
	35												
	40												

Ground Water Level Data	Boring Advancement Method	Notes
☒ No free water encountered to 15 ft.	4" Nom. Dia. Short Flight Auger: 0 to 15 ft.	
	Boring Abandonment Method	

Strata Boundaries May Not Be Exact

Lake Boudreaux
Freshwater Diversion
Terrebonne Parish, LA

LOG OF SOIL BORING B-03

Ardaman & Associates, Inc.

Sheet 1 of 1

Baton Rouge Geotechnical Laboratory
AASHTO Accredited Laboratory , LELAP Certificate No. 02052,
USACE Validated

T. Baker Smith, Inc.
Houma, LA

File: 08-L3266
Date: 12/02/09
Logged by: J. Kelley
Driller: S. E. R.
Rig: Swamp Buggy

Location: Lat. 29° 29' 48.96"
Long. 90° 42' 16.92"
Surface Elevation: N/A (ft., NAVD)

FIELD DATA				LABORATORY DATA									
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Percent Passing #200 Sieve	Other	Soil Type	Description
☒			0.25 (P)		100								
			0.25 (P)		95	47	67	31	36				
	5		0.25 (P)	0.06	99	48							
			0.25 (P)		119		118	38	80				
			0.25 (P)	0.04	110	41							
	10												
			0.25 (P)	0.12	62	67	32	26	6				
	15												Boring completed at 15 ft.
	20												
	25												
	30												
	35												
	40												

Ground Water Level Data	Boring Advancement Method	Notes
☒ No free water encountered to 15 ft.	4" Nom. Dia. Short Flight Auger: 0 to 15 ft.	
	Boring Abandonment Method	

Strata Boundaries May Not Be Exact

Lake Boudreaux
Freshwater Diversion
Terrebonne Parish, LA

LOG OF SOIL BORING B-04

Ardaman & Associates, Inc.

Sheet 1 of 1

Baton Rouge Geotechnical Laboratory
AASHTO Accredited Laboratory , LELAP Certificate No. 02052,
USACE Validated

File: 08-L3266
Date: 12/02/09
Logged by: J. Kelley
Driller: S. E. R.
Rig: Swamp Buggy

T. Baker Smith, Inc.
Houma, LA

Location: Lat. 29° 29' 44.7"
Long. 90° 42' 6.9"
Surface Elevation: N/A (ft., NAVD)

FIELD DATA				LABORATORY DATA									
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Percent Passing #200 Sieve	Other	Soil Type	Description
☒			0.25 (P)		106		88	32	56				
			0.25 (P)		112								
	5		0.25 (P)	0.03	132	37	111	36	75				
			0.25 (P)	0.03	132	37							
			0.25 (P)		79								
	10												
			0.25 (P)	0.06	74	55	108	32	76				
	15												Boring completed at 15 ft.
	20												
	25												
	30												
	35												
	40												

Ground Water Level Data	Boring Advancement Method	Notes
☒ No free water encountered to 15 ft.	4" Nom. Dia. Short Flight Auger: 0 to 15 ft.	
	Boring Abandonment Method	

Strata Boundaries May Not Be Exact

Lake Boudreaux
Freshwater Diversion
Terrebonne Parish, LA

LOG OF SOIL BORING B-05

Ardaman & Associates, Inc.

Sheet 1 of 1

Baton Rouge Geotechnical Laboratory
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USACE Validated

T. Baker Smith, Inc.
Houma, LA

File: 08-L3266
Date: 12/03/09
Logged by: J. Kelley
Driller: S. E. R.
Rig: Swamp Buggy

Location: Lat. 29° 29' 45.66"
Long. 90° 41' 58.86"
Surface Elevation: N/A (ft., NAVD)

FIELD DATA				LABORATORY DATA									
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Percent Passing #200 Sieve	Other	Soil Type	Description
☒			0.25 (P)		91								
			0.25 (P)	0.03	94	48	94	31	63				
	5		0.25 (P)	0.03	100	43							
			0.25 (P)		107		100	33	67				
			0.25 (P)		105								
	10												
			0.25 (P)		77		88	39	49				
	15												Boring completed at 15 ft.
	20												
	25												
	30												
	35												
	40												

Ground Water Level Data	Boring Advancement Method	Notes
☒ No free water encountered to 15 ft.	4" Nom. Dia. Short Flight Auger: 0 to 15 ft.	
	Boring Abandonment Method	

Strata Boundaries May Not Be Exact

Lake Boudreaux
Freshwater Diversion
Terrebonne Parish, LA

LOG OF SOIL BORING B-06

Ardaman & Associates, Inc.

Sheet 1 of 1

Baton Rouge Geotechnical Laboratory
AASHTO Accredited Laboratory , LELAP Certificate No. 02052,
USACE Validated

File: 08-L3266
Date: 12/03/09
Logged by: J. Kelley
Driller: S. E. R.
Rig: Swamp Buggy

T. Baker Smith, Inc.
Houma, LA

Location: Lat. 29° 29' 42.24"
Long. 90° 41' 52.38"

Surface Elevation: N/A (ft., NAVD)

FIELD DATA				LABORATORY DATA									
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Percent Passing #200 Sieve	Other	Soil Type	Description
☒													
			0.25 (P)	0.06	77	51							
	5		0.25 (P)	0.04	109	41	105	33	72				
			0.25 (P)	0.21	42	78							
			0.75 (P)	0.21	44	79	46	24	22				
	10												
			0.5 (P)	0.21	35	84	36	19	17				
	15												Boring completed at 15 ft.
	20												
	25												
	30												
	35												
	40												

Ground Water Level Data	Boring Advancement Method	Notes
☒ No free water encountered to 15 ft.	4" Nom. Dia. Short Flight Auger: 0 to 15 ft.	
	Boring Abandonment Method	

Strata Boundaries May Not Be Exact

Lake Boudreaux
Freshwater Diversion
Terrebonne Parish, LA

LOG OF SOIL BORING B-07

Ardaman & Associates, Inc.

Sheet 1 of 1

Baton Rouge Geotechnical Laboratory
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T. Baker Smith, Inc.
Houma, LA

File: 08-L3266
Date: 12/01/09
Logged by: J. Kelley
Driller: S. E. R.
Rig: Swamp Buggy

Location: Lat. 29° 29' 35.76"
Long. 90° 41' 45.48"
Surface Elevation: N/A (ft., NAVD)

FIELD DATA				LABORATORY DATA									
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Percent Passing #200 Sieve	Other	Soil Type	Description
☒			0.25 (P)		125								
			0.25 (P)		110		92	31	61				
	5		0.25 (P)	0.03	95	47							
			0.25 (P)	0.03	113	45	90	30	60				
			0.25 (P)	0.06	90	52							
	10												
			0.25 (P)		60		66	24	42				
	15												Boring completed at 15 ft.
	20												
	25												
	30												
	35												
	40												

Ground Water Level Data	Boring Advancement Method	Notes
☒ No free water encountered to 15 ft.	4" Nom. Dia. Short Flight Auger: 0 to 15 ft.	
	Boring Abandonment Method	

Strata Boundaries May Not Be Exact

Lake Boudreaux
Freshwater Diversion
Terrebonne Parish, LA

LOG OF SOIL BORING B-09

Ardaman & Associates, Inc.

Baton Rouge Geotechnical Laboratory
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USACE Validated

T. Baker Smith, Inc.
Houma, LA

File: 08-L3266
Date: 12/08/09
Logged by: J. Kelley
Driller: S. E. R.
Rig: Swamp Buggy

Location: Lat. 29° 29' 28.08"
Long. 90° 41' 36.48"
Surface Elevation: N/A (ft., NAVD)

FIELD DATA				LABORATORY DATA									
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Percent Passing #200 Sieve	Other	Soil Type	Description
	45		GRAB										
	50		0.5 (P)	0.34	48	74							
	55		0.5 (P)										
	60		1.0 (P)		48		79	27	52				
	65		0.5 (P)										
	70		1.0 (P)	0.89	47	74							
	75		1.0 (P)										
	80		1.0 (P)	0.65	48	73							

Continued Next Page

Ground Water Level Data

Free water first encountered

Boring Advancement Method

4" Nom. Dia. Short Flight Auger:
0 to 10 ft.
4" Dia. Rotary Wash:
10 to 100 ft.

Boring Abandonment Method

Borehole grouted with cement/ bentonite upon completion

Notes

Strata Boundaries May Not Be Exact

Lake Boudreaux
Freshwater Diversion
Terrebonne Parish, LA

LOG OF SOIL BORING B-09

Ardaman & Associates, Inc.

Sheet 3 of 3

Baton Rouge Geotechnical Laboratory
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T. Baker Smith, Inc.
Houma, LA

File: 08-L3266
Date: 12/08/09
Logged by: J. Kelley
Driller: S. E. R.
Rig: Swamp Buggy

Location: Lat. 29° 29' 28.08"
Long. 90° 41' 36.48"
Surface Elevation: N/A (ft., NAVD)

FIELD DATA				LABORATORY DATA									
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	PL	PI	Percent Passing #200 Sieve	Other	Soil Type	Description
	85	■	1.5 (P)										
	90	■	1.5 (P)	1.47	119	49	99	32	67				
	95	■	1.0 (P)										
	100	■	1.0 (P)	0.79	32	93							
	105												Boring completed at 100 ft.
	110												
	115												
	120												

Ground Water Level Data	Boring Advancement Method	Notes
▽ Free water first encountered	4" Nom. Dia. Short Flight Auger: 0 to 10 ft. 4" Dia. Rotary Wash: 10 to 100 ft.	
	Boring Abandonment Method	
	Borehole grouted with cement/ bentonite upon completion	Strata Boundaries May Not Be Exact

Lake Boudreaux
Freshwater Diversion
Terrebonne Parish, LA

LOG OF SOIL BORING B-13

Ardaman & Associates, Inc.

Baton Rouge Geotechnical Laboratory
AASHTO Accredited Laboratory , LELAP Certificate No. 02052,
USACE Validated

T. Baker Smith, Inc.
Houma, LA

File: 08-L3266
Date: 12/06/09
Logged by: J. Kelley
Driller: S. E. R.
Rig: Swamp Buggy

Location: Lat. 29° 29' 3.3"
Long. 90° 41' 13.02"
Surface Elevation: N/A (ft., NAVD)

FIELD DATA				LABORATORY DATA									
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Percent Passing #200 Sieve	Other	Soil Type	Description
	45	■	0.5 (P)										
	50	■	0.25 (P)	0.13	60	64							
	55	■	0.5 (P)										
	60	■	0.5 (P)	0.33	57	68							
	65												Boring completed at 60 ft.
	70												
	75												
	80												

Ground Water Level Data	Boring Advancement Method	Notes
☒ No free water encountered to 10 ft.	4" Nom. Dia. Short Flight Auger: 0 to 10 ft. 4" Dia. Rotary Wash: 10 to 60 ft.	
	Boring Abandonment Method Borehole grouted with cement/ bentonite upon completion	Strata Boundaries May Not Be Exact

Lake Boudreaux
Freshwater Diversion
Terrebonne Parish, LA

LOG OF SOIL BORING B-14

Ardaman & Associates, Inc.

Sheet 1 of 1

Baton Rouge Geotechnical Laboratory
AASHTO Accredited Laboratory , LELAP Certificate No. 02052,
USACE Validated

File: 08-L3266
Date: 12/06/09
Logged by: J. Kelley
Driller: S. E. R.
Rig: Swamp Buggy

T. Baker Smith, Inc.
Houma, LA

Location: Lat. 29° 28' 59.52"
Long. 90° 41' 3.36"

Surface Elevation: N/A (ft., NAVD)

FIELD DATA				LABORATORY DATA									
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Percent Passing #200 Sieve	Other	Soil Type	Description
☒			0.25 (P)	0.15	55	69							
			0.25 (P)	0.26	44	75							
	5		0.75 (P)	0.56	46	74							
			0.75 (P)	0.38	96	26							
			0.5 (P)	0.16	123	40							
	10												
			0.25 (P)	0.13	87	49							
	15												
			0.25 (P)										
	20												
			0.25 (P)	0.12	150	34							
	25												
			0.25 (P)										
	30												
			0.75 (P)	0.19	290	18							
	35												
			0.5 (P)										
	40												Boring completed at 40 ft.

Ground Water Level Data	Boring Advancement Method	Notes
☒ No free water encountered to 10 ft.	4" Nom. Dia. Short Flight Auger: 0 to 10 ft. 4" Dia. Rotary Wash: 10 to 40 ft.	
	Boring Abandonment Method	
	Borehole grouted with cement/ bentonite upon completion	Strata Boundaries May Not Be Exact

ARD LOG01 01R 083266.GPJ LOG01R.GDT 01/08/09

Lake Boudreaux
Freshwater Diversion
Terrebonne Parish, LA

LOG OF SOIL BORING B-15

Ardaman & Associates, Inc.

Baton Rouge Geotechnical Laboratory
AASHTO Accredited Laboratory , LELAP Certificate No. 02052,
USACE Validated

T. Baker Smith, Inc.
Houma, LA

File: 08-L3266
Date: 12/07/09
Logged by: J. Kelley
Driller: S. E. R.
Rig: Swamp Buggy

Location: Lat. 29° 28' 55.38"
Long. 90° 40' 53.28"
Surface Elevation: N/A (ft., NAVD)

FIELD DATA				LABORATORY DATA									
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Percent Passing #200 Sieve	Other	Soil Type	Description
☒													
			0.25 (P)	0.09	63	61							
	5		0.25 (P)	0.16	61	66							
			0.5 (P)	0.16	61	65	91	29	62				
			0.5 (P)		74								
	10												
	15												
				0.13	107	43							
	20												
			0.25 (P)										
	25												
			0.5 (P)	0.20	519	9	739	474	265				
	30												
			0.25 (P)										
	35												
			0.25 (P)	0.18	71	61							
	40												

Continued Next Page

Ground Water Level Data

☒ No free water encountered to 10 ft.

Boring Advancement Method

4" Nom. Dia. Short Flight Auger:
0 to 10 ft.
4" Dia. Rotary Wash:
10 to 60 ft.

Boring Abandonment Method

Borehole grouted with cement/ bentonite upon completion

Notes

Strata Boundaries May Not Be Exact

Lake Boudreaux
Freshwater Diversion
Terrebonne Parish, LA

LOG OF SOIL BORING B-15

Ardaman & Associates, Inc.

Baton Rouge Geotechnical Laboratory
AASHTO Accredited Laboratory , LELAP Certificate No. 02052,
USACE Validated

File: 08-L3266
Date: 12/07/09
Logged by: J. Kelley
Driller: S. E. R.
Rig: Swamp Buggy

T. Baker Smith, Inc.
Houma, LA

Location: Lat. 29° 28' 55.38"
Long. 90° 40' 53.28"

Surface Elevation: N/A (ft., NAVD)

FIELD DATA				LABORATORY DATA									
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Percent Passing #200 Sieve	Other	Soil Type	Description
	45	■	0.25 (P)										
	50	■	0.25 (P)	0.13	55	67							
	55	■	0.25 (P)										
	60	■	0.5 (P)	0.26	69	71							
	65												Boring completed at 60 ft.
	70												
	75												
	80												

Ground Water Level Data	Boring Advancement Method	Notes
☒ No free water encountered to 10 ft.	4" Nom. Dia. Short Flight Auger: 0 to 10 ft. 4" Dia. Rotary Wash: 10 to 60 ft.	
	Boring Abandonment Method Borehole grouted with cement/ bentonite upon completion	Strata Boundaries May Not Be Exact

Lake Boudreaux
Freshwater Diversion
Terrebonne Parish, LA

LOG OF SOIL BORING B-16

Ardaman & Associates, Inc.

Sheet 1 of 1

Baton Rouge Geotechnical Laboratory
AASHTO Accredited Laboratory , LELAP Certificate No. 02052,
USACE Validated

T. Baker Smith, Inc.
Houma, LA

File: 08-L3266
Date: 12/07/09
Logged by: J. Kelley
Driller: S. E. R.
Rig: Swamp Buggy

Location: Lat. 29° 28' 51.24"
Long. 90° 40' 41.76"
Surface Elevation: N/A (ft., NAVD)

FIELD DATA				LABORATORY DATA									
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	PL	PI	Percent Passing #200 Sieve	Other	Soil Type	Description
			0.25 (P)		642								
	5		0.25 (P)	0.14	61	65							
			0.25 (P)	0.13	67	63							
			0.25 (P)	0.13	68	62							
	10												
			0.5 (P)										
	15												
			0.25 (P)	0.15	103	45							
	20												
			0.25 (P)	0.09	109	44							
	25												
			0.25 (P)										
	30												
			0.5 (P)	0.16	448	11							
	35												
			0.5 (P)										
	40												

Boring completed at 40 ft.

Ground Water Level Data

Free water first encountered

Water level after 15 mins.

Boring Advancement Method

4" Nom. Dia. Short Flight Auger:
0 to 10 ft.
4" Dia. Rotary Wash:
10 to 40 ft.

Boring Abandonment Method

Borehole grouted with cement/ bentonite upon completion

Notes

Strata Boundaries May Not Be Exact

APPENDIX E

CORRESPONDENCE WITH UTLITIES

Marc J. Rogers

From: Guidry, Kent J [kg2688@att.com]

Sent: Wednesday, March 25, 2009 10:30 AM

To: Marc J. Rogers

Subject: at&t billing estimate for the Lake Boudreaux Basin Project on Hwy 57

Kent Guidry

AT&T Southeast Region
MGR OSP PLNG & DESIGN SE / CA
Office: 985-580-7165
Fax: 985-580-7166
kent.guidry@att.com

AT&T – Southeast Region T: 985-580-7165
Specialist – OSP Facility Design F: 985-580-7166
Network Operations S. La.
5565 Hwy 311
Houma, La. 70359

March 25, 2009

T. Baker Smith, Inc.
P.0. Box 2266
Houma, La. 70361

Dear Sir:

Billing for the Lake Boudreaux Basin Freshwater Diversion Project TE-32a on Hwy 57. Estimated cost to relocate existing buried at&t facilities.

Total Estimated Cost = $20,804.45

Yours truly,

Kent J. Guidry
Specialist – OSP Facility Design
AT&T

USA Proud Sponsor of the U.S. Olympic Team

South Coast Gas Co., Inc.

DISTRIBUTING NATURAL GAS

Established 1944

P.O. BOX 470
RACELAND, LOUISIANA
70394

PHONES:
RACELAND 537-5281
THIBODAUX 446-1384
HOUMA 872-0376
GOLDEN MEADOW 475-5771

MARTIN J. ST. ROMAIN, II
PRESIDENT

March 25, 2009

T Baker Smith
P O Box 2266
Houma, LA 70361

Attn: Marc J Rogers, Sr., P.E.

RE: DNR Project TE-32A
Lake Boudreaux Freshwater Introduction Project

Dear Mr Smith:

Enclosed you will find a proposal for the relocation and reinstallation of the gas main for the Lake Boudreaux Freshwater Introduction Project. If any additional information is needed, please do not hesitate to call me at 985 537-5281.

Yours Truly,

Michael St. Romain

Michael St Romain
Vice President
South Coast Gas Co., Inc

Attachment

South Coast Gas Co., Inc.

Raceland, LA

(985) 537-5281

03/25/2009

Hwy 57
Lake Boudreaux Freshwater Introduction Project

Material:

1,180 '	Pipe - Plastic - 3"	3.00	3,540.00
1,180 '	Wire - #12	0.09	106.20
2	Valve - 3" Plastic	271.75	543.50
4	Elbow - Plastic - 3"	9.12	36.48
4	Collar - Plastic - 3"	13.04	52.16
2	Valve Box	47.14	94.28
1	Pipeline Markers	19.09	19.09
			4,391.71

Labor & Equipment	9,462.04
Supervision & Overhead	2,803.92
TOTAL	16,657.67

Date Started: _____

Date Completed: _____

Foreman: _____

Approved By: _____

Michael St. Romain

Michael St. Romain

SLECA

South Louisiana Electric Cooperative Association
P.O. Box 4037, Houma, LA. 70361

Facsimile Transmission

March 19, 2009

Attention: Mr. Mark Rogers
Company: T. Baker Smith & Son
Telephone#:
Fax#: 868-5843
Subject: SLECA Electric Line Removal & Reinstall Hwy 57 @ Lake Boudreaux freshwater diversion project

---

Sender: Rickie Pitre
Sender Telephone#: (985) 876-6880 Ext. 223
Sender Fax#: (985) 851-3644

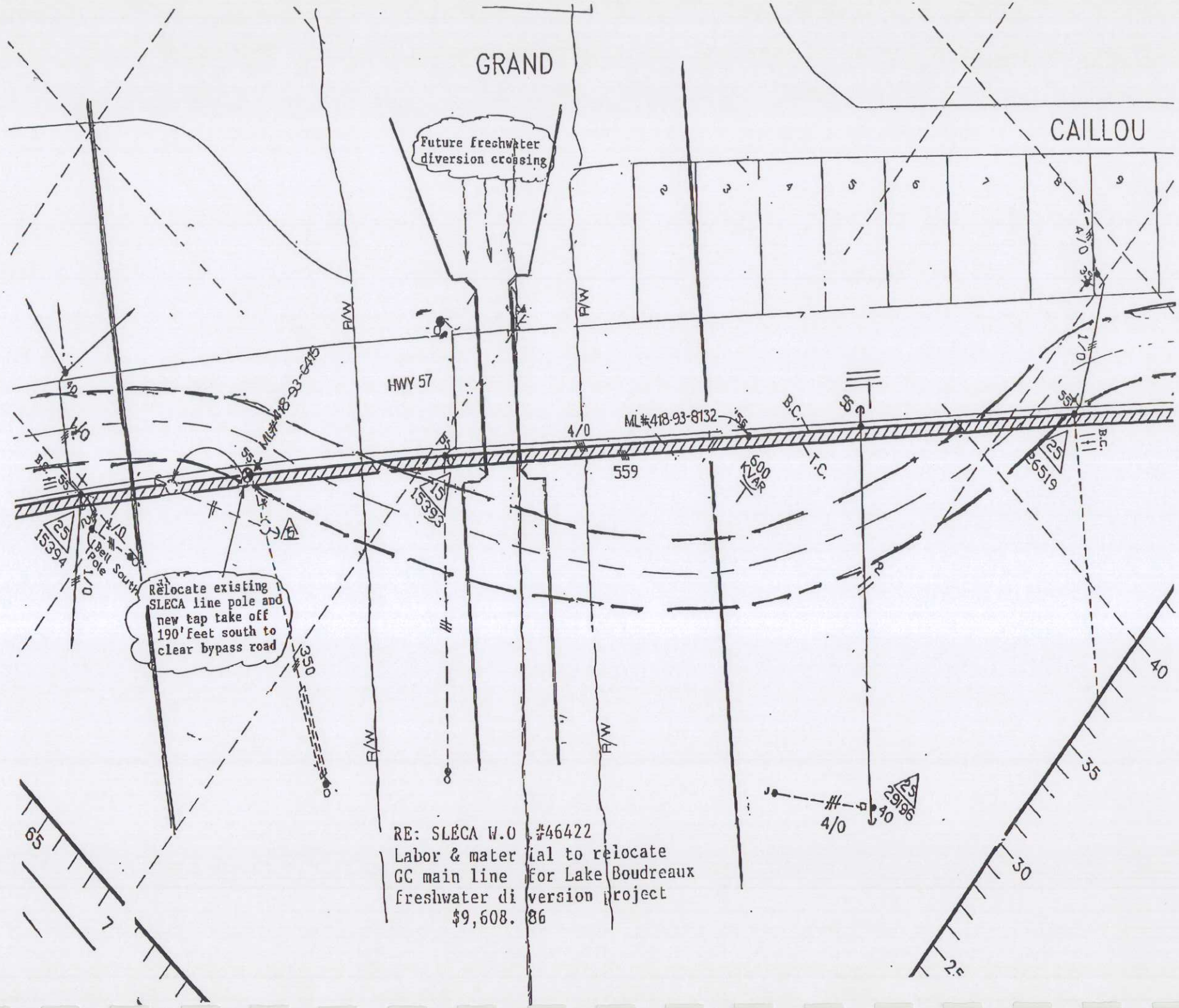
You should receive **2** pages
Please call if you do not receive all pages

COMMENTS:

Dear Mr. Rogers: Per your request, cost information to have SLECA remove its existing electric lines to clear the Lake Bourdreaux/Hwy 57 bypass project area is $9,608.86 to remove existing lines, establish temporary by-pass route, maintain existing electric services to (2) two homes and then re-establish original route once project is completed.

Thanks

Rickie Pitre


GRAND
CAILLOU
Future freshwater diversion crossing
HWY 57
ML#418-93-8415
ML#418-93-8132
B.C.
T.C.
R/W
4/0
559
600 KVAR
15393
15394
6519
2986
Bell South Pole
Relocate existing SLECA line pole and new tap take off 190' feet south to clear bypass road
350
RE: SLECA W.O #46422
Labor & material to relocate
GC main line for Lake Boudreaux
freshwater diversion project
$9,608.86

T. BAKER SMITH & SON, INC.

TELEPHONE: (985) 868-1050
NEW ORLEANS PHONE: (504) 586-8222
FAX: (985) 868-5843
WEBSITE: www.tbsmith.com

412 SOUTH VAN AVE.
HOUMA, LOUISIANA 70363
P.O. BOX 2266
HOUMA, LOUISIANA 70361

December 19, 2001

Gulf South Pipeline
P. O. Box 4095
Houma, LA 70361

Attention: Mr. Gerald P. Roser, Jr., Area Business Leader

Dear Mr. Roser:

Re: Lake Boudreaux Freshwater Diversion Project
TE-32a

We appreciate your efforts and the time you and the staff at Gulf South Pipeline (GSP) afforded us last week. We thought the meeting was very informative and this correspondence will hopefully document the results of it.

The following are requirements of GSP as regards the project.

- Notify GSP 48 hours in advance of equipment operating in pipeline canals.
- Provide GSP with plans of project with emphasis on water velocities and pipeline/ pipeline canal erosion protection.
- Be responsible for GSP costs associated with project coordination such as engineering plan review, legal services to prepare and/or review right-of-way and/or permits to operate within GSP right-of-way, and on-site representation during construction activities requiring GSP inspectors.

Gulf South Pipeline will:

- Provide as-built information on main line valve risers.
- Provide copies of rights-of-way for its pipelines.
- Allow fill to be deposited within its existing pipeline canals and/or rights-of-way provided it is done in a manner that will not harm the integrity of the pipelines and subject to project plan review and approval by GSP.

The primary benefits resulting from the project will be reduction in saltwater intrusion by introduction of freshwater, construction of water control structures, and beneficial dredge material placement.

Secondary benefits may include increased pipeline protection and minimization of existing spoil bank erosion resulting from beneficial dredge material placement.

Again, thanks for the meeting. If you have any questions concerning the contents of this letter, please call us. We feel that by working together closely on this project, many more benefits besides the ones listed may be realized.

Sincerely yours,

T. BAKER SMITH & SON, INC.

Marc J. Rogers, Sr., P. E.

MJR/pdb

Cc/Mr. Dan Llewellyn
Cc/Mr. Ronnie Paille

T. BAKER SMITH, INC.
PROFESSIONAL CONSULTANTS SINCE 1913

412 South Van Avenue Houma, Louisiana 70363 • Post Office Box 2266 Houma, Louisiana 70361
Main Line: 985.868.1050 • Toll Free: 1.866.357.1050 • Fax: 985.868.5843 • Online: www.tbsmith.com

February 17, 2009

Mr. Emery R. Chauvin, Jr., P. E.
Consolidated Waterworks District No. 1
P. O. Box 630
Houma, LA 70361

Dear Mr. Chauvin:

Re: DNR Project TE-32A
Lake Boudreaux Freshwater Introduction Project

Pursuant to our meeting last week, transmitted for your review and consideration is a proposed sequence of construction with attached sketches for the installation and removal of a temporary 8" and 12" by-pass. The temporary by-pass will allow for construction of a freshwater diversion structure along La. Hwy. 57. All relocation costs will be paid for by DNR.

Your comments and questions would be greatly appreciated.

Sincerely yours,

T. BAKER SMITH, INC.

Marc J. Rogers, Sr., P.E.

MJR/pdb

Enc.

Cc w/enc.:Jeff Loup, P.E.

08174213

LAKE BOUDREAUX FRESHWATER INTRODUCTION PROJECT
DNR Project TE-32A

TEMPORARY WATERLINE RELOCATION
SEQUENCE OF CONSTRUCTION FOR 8-INCH CI & 12-INCH AC
February 17, 2009

1) Contact Consolidated Waterworks District No. 1 (CWD#1) prior to beginning. CWD#1 will open and close main line valves to facilitate 8-inch & 12-inch by-pass installations.

2) Cut-in locations to be field determined.

3) Contractor shall use a Department of Environmental Quality certified subcontractor or shall have DEQ certification for working on Asbestos Cement Pipe cut-ins and removal/disposal. Proof of certification is required.

4) After cutting in on each end, pressure test, disinfect and flush in accordance with technical specifications. Provide negative sample before placing new lines in services.

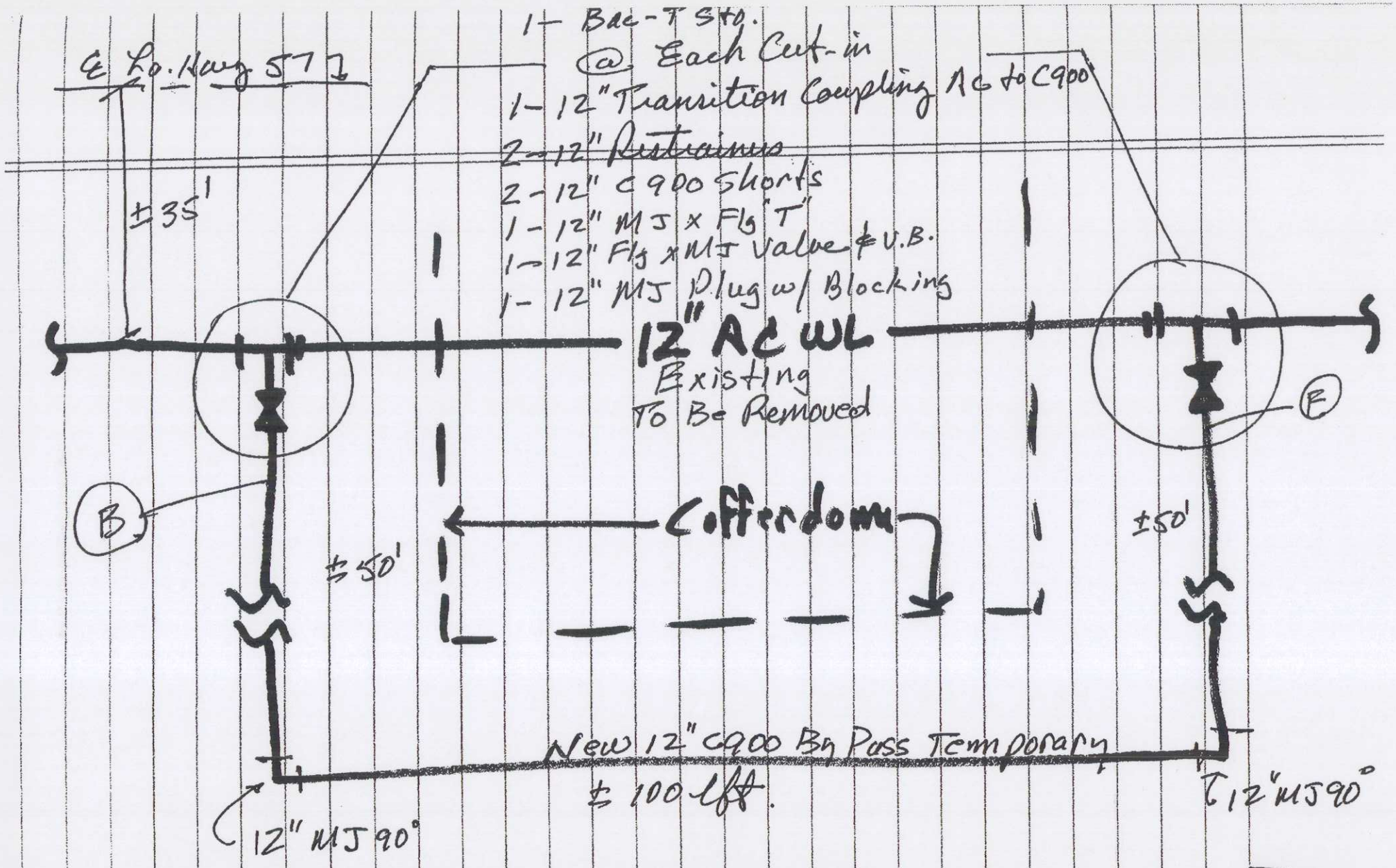
5) Remove 8-inch CI and/or 12-inch Asbestos Cement between cut-ins and install 8-inch CI and/or 12-inch MJ Plug with blocking.

6) Place temporary 8-inch and/or 12-inch C900 on line and transfer any services to new 12-inch C900. CWD#1 will tap new 12-inch C900 and relocate meter. Contractor shall be responsible for reconnection on customer's side of meter. Contractor shall bear the cost of the service transfer on each side of the meter.

7) Subsequent to construction of the water control structure, contact CWD#1 and coordinate removal of temporary 8-inch CI and/or 12-inch C900 by-pass and installation of new 8-inch CI and/or 12-inch C900 waterline across water control structure.

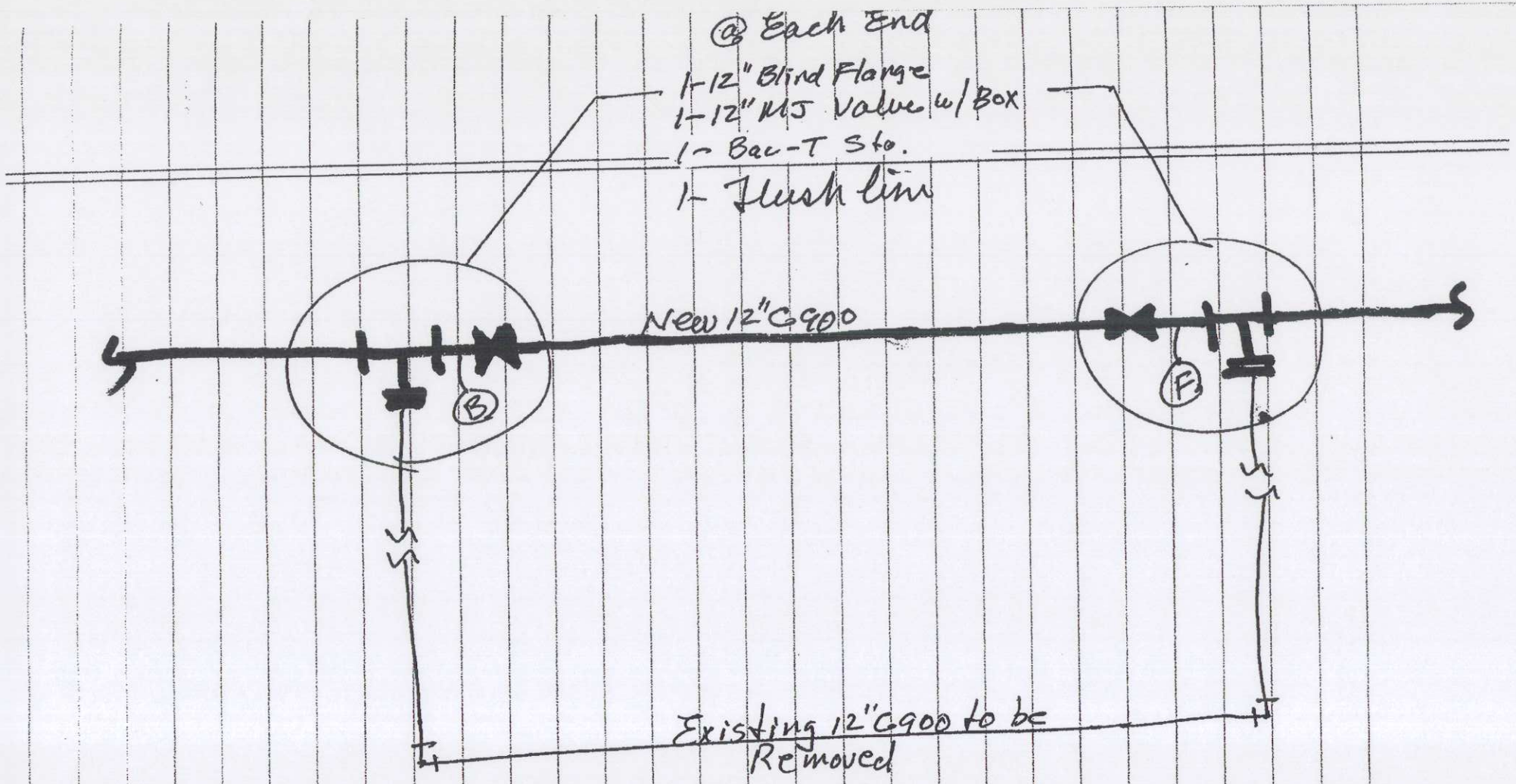
8) Cut-in 8-inch CI and/or 12-inch MJ Valves and install Bac-"T" stations and flushing lines. Pressure test, disinfect and sample new 8-inch CI and/or 12-inch C900 waterlines.

9) With assistance from CWD#1, remove 12-inch Flg x MJ Valves & Boxes and install 12-inch blind flanges. Remove 8-inch CI and/or 12-inch C900 by-pass. All pipe and valves removed remain the property of CWD#1. Contractor to deliver all materials to CWD#1 yard at Howard Avenue.



Configuration during Construction

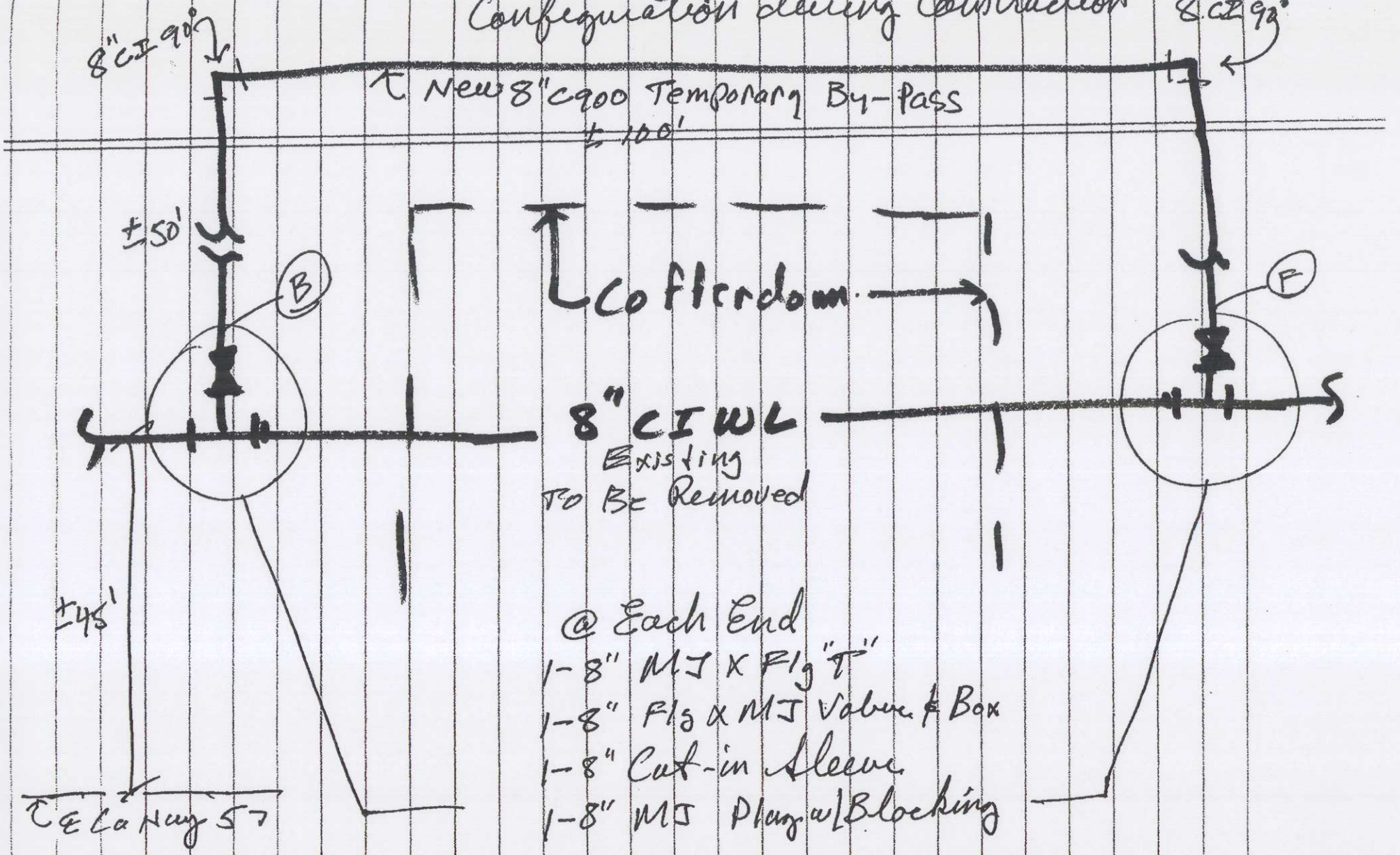
(B) Bac-T sto. (F) Flush line



Configuration after Construction

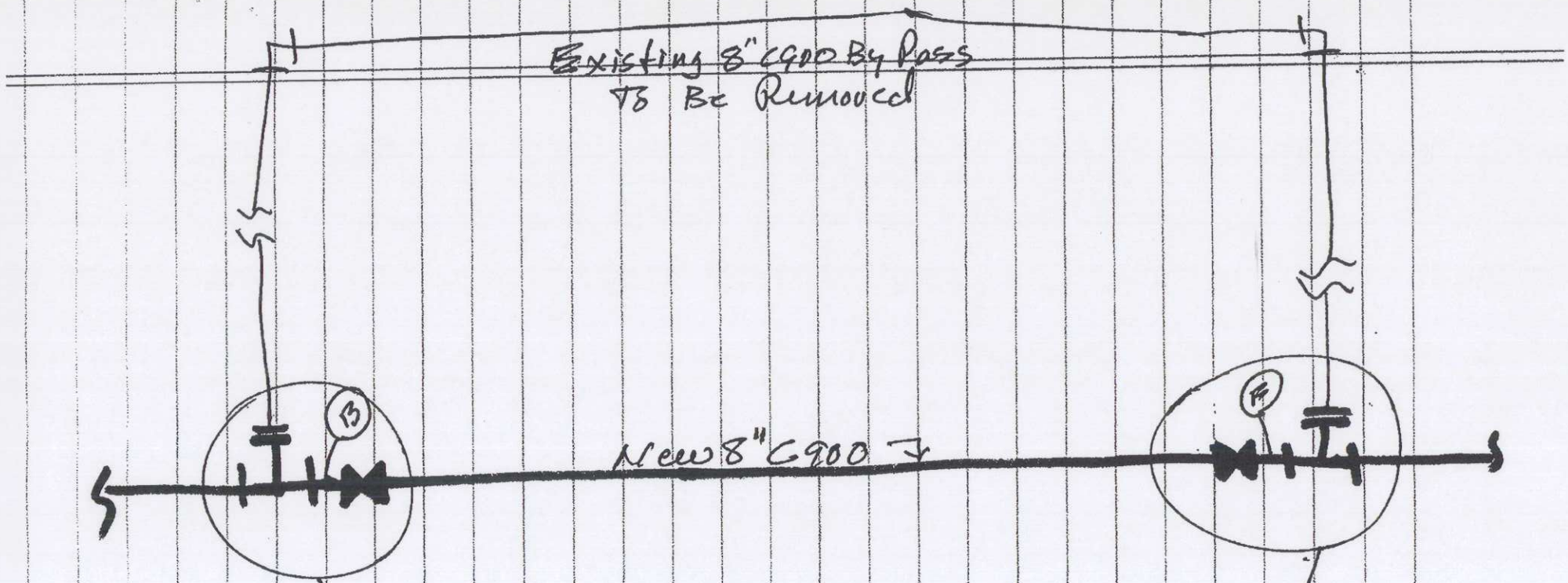
(B) Bac-T station (F) flush line

Configuration during Construction



NTS

Configuration after Construction



@ Each End

1 - 8" MJ Valve & Box
1 - 8" Blind Flange
1 - Box-T Station
1 - Flush line

(B) Box-T Station
(F) Flush line

APPENDIX F

LaDOTD COMMUNICATIONS

T. BAKER SMITH, INC.
PROFESSIONAL CONSULTANTS SINCE 1913

17534 Old Jefferson Highway, Suite C-1 Prairieville, Louisiana 70769 • Post Office Box 508 Prairieville, Louisiana 70769-0508
Main Line: 225.744.2100 • Toll Free: 1.866.357.1050 • Fax: 225.673.6550 • Online: www.tbsmith.com

January 26, 2009

MEMO TO: Maury Chatellier, P. E. and Andrew Beall, P. E.

FROM: Marc J. Rogers, Sr., P.E.

RE: Lake Boudreaux Freshwater Introduction Project (TE-32a)

This memo is a record of the meeting held on Thursday, January 22, 2009 at the DOTD District Office on Lakeshore Drive in New Orleans. Attached is a copy of the attendance list.

In the meeting, discussions generally revolved around the preliminary detour road drawing prepared for the meeting by TBS. The geometry and typical roadway section were discussed as well as the use of construction signage and concrete barricades. In addition, there was some discussion of the need for guard rails, maintenance drive, double gates and fencing for the maintenance of the 6-10'x10' RCBs cross-drain structure, automated sluice gates and trash screen. The dredge channel alignment and beneficial fill areas, as shown in Exhibit D of the Addendum to the Conceptual Design Report, were discussed in general as well.

The following are action items for T. Baker Smith, Inc.

1) Send preliminary detour road drawing in pdf format to DOTD District contacts: Lyle LeBlanc, Ennis Johnson & Glenn Richard.
2) Additional drawings for detour road plans include: detour signage plan and sequencing of construction drawings.
3) Confirm ADT and existing posted speed limit.
4) Distribute meeting notes to attendees for comments.

The following other topics and actions were discussed:

1) We plan to have the Data Collection Report delivered by the end of January.
2) We plan to have the 30% Design Submittal delivered by April 1, 2009.

MJR/jjl

Attachment (1)

Copied for: Maury Chatellier, Andrew Beall, John Monzon, Glenn Richard, Lyle LeBlanc, Bruce Perdue and Ennis Johnson.

Peggy D. Bourg

From: Marc J. Rogers
Sent: Wednesday, March 11, 2009 11:40 AM
To: Jeff Loup
Subject: Fw:

From: DennisHebert@dotd.la.gov
To: Marc J. Rogers
Sent: Wed Mar 11 10:40:15 2009
Subject:

Marc

I reviewed the revised copy of the signing plan for the Lake Boudreaux Freshwater Introduction Project (TE-32a) and find it to be correct and complete.

Dennis Hebert
District Traffic

Operations Engineer

STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

MEETING SIGN-IN SHEET

State Project No.

Date: 1/22/09

Name: Lake Boudreaux Basin Freshwater Diversion project

Parish: TERREBONNE

Attendees

Name	Org./Dept/Agency	Phone No.	E-mail
Ennis Johnson	LADOTD(02)	504-816-7311	EnnisJohnson@dotd.la.gov
Marc Rogers	TBS	985 223 9230	Marcr@tbsmith.com
Jeff Long	TBS	225 603 6440	jeffl@tbsmith.com
W Bruce Perque	DOTD	504 437-3103	wperque@DOTD.LA.GOV
John Manzon	OCPR	225-342-459	John.Manzone LA.gov
Lyle LeBlanc	DOTD	985-858-2405	lyle.j.leblanc@LA.gov

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Main Line: 225.744.2100 • Toll Free: 1.866.357.1050 • Fax: 225.673.6550 • Online: www.tbsmith.com

February 20, 2009

Mr. Lyle Leblanc, P.E.
Houma Area Engineer
Louisiana Department of Transportation and Development
P. O. Box 1270
Gray, LA 70359-1270

Dear Mr. Leblanc:

Re: DNR Project TE-32A
Lake Boudreaux Freshwater Introduction Project

Pursuant to our meeting on January 22nd at the DOTD District Office on Lakeshore Drive in New Orleans, transmitted for your review and consideration is a draft of the proposed Construction Signage Layout for the above referenced project. The temporary by-pass will allow for construction of a freshwater diversion structure along La. Hwy. 57.

Your comments and questions would be greatly appreciated. Please send a copy of any comments to Marc Rogers, Sr., P.E. at 412 South Van Avenue Houma, LA 70363.

Sincerely yours,

T. BAKER SMITH, INC.

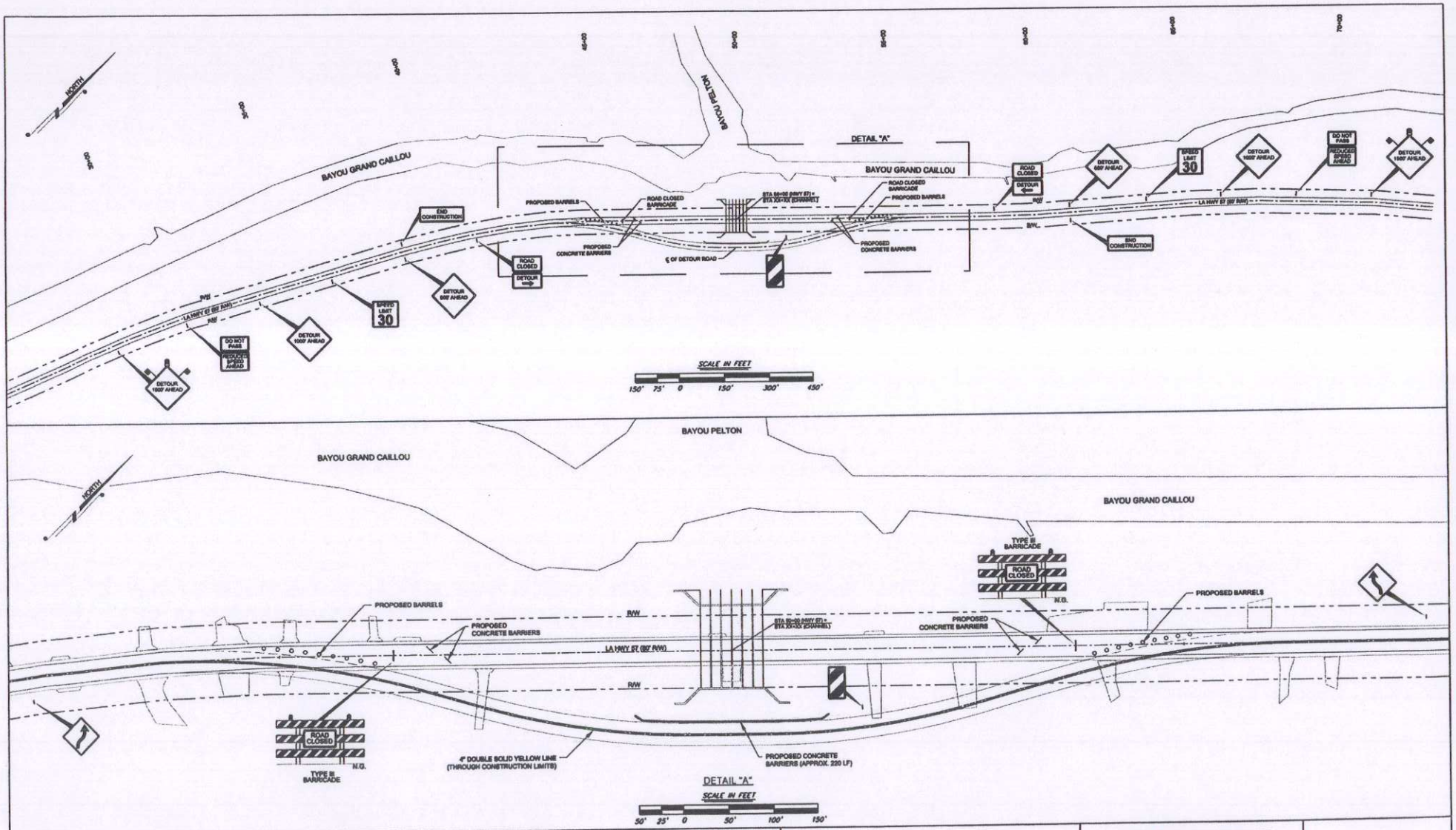
Jeff Loup, P.E.

JJL/cg

Enc.

Cc w/enc.:
Michael Stack, P.E., DOTD District Engineer Administrator
Marc Rogers, P.E., T. Baker Smith, Inc. Engineering Vice President

081742t7



NOTES:
1) ALL STRIPES AND SIGNAGE TO BE INSTALLED IN ACCORDANCE WITH LATEST "MUTCD" STANDARDS.

REV	DATE	DESCRIPTION	BY

T. BAKER SMITH
PROFESSIONAL CONSULTANTS SINCE 1912
(985) 868-1050 www.tbsinfo.com

OFFICE OF COASTAL PROTECTION & RESTORATION
ENGINEERING BRANCH
450 LAUREL STREET
BATON ROUGE, LOUISIANA 70801

DRAWN BY: KSB
DESIGNED BY: T. BAKER SMITH

LAKE BOUDREAUX FRESHWATER INTRODUCTION PROJECT (TE-32a)

STATE PROJECT NUMBER: 435-800671
FEDERAL PROJECT NUMBER: TE-32A
APPROVED BY JJL

CONSTRUCTION SIGNAGE LAYOUT

DATE 2/17/09
SHEET X OF X

APPENDIX G

DETAILED COST ESTIMATE

PROBABLE PROJECT CONSTRUCTION COST
NORTH LAKE BOUDREAUX FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
OFFICE OF COASTAL PROTECTION & RESTORATION

I. Base Bid Items

Item No.	Spec. No.	Description	Quantity	Unit	Unit Price	Total Price
1	TS-1	Mobilization & Demobilization	1	LUMP	$ 630,000.00	$ 630,000
2	TS-2	Surveys	1	LUMP	$ 175,000.00	$ 175,000
3	TS-3	30-Lb. Class Rock	330	TON	$ 95.00	$ 31,350
4	TS-3	55-Lb. Class Rock	2,800	TON	$ 95.00	$ 266,000
5	TS-5	Earthen Plug	1	LUMP	$ 12,600.00	$ 12,600
6	TS-4	Containment Dikes	7,900	LF	$ 16.00	$ 126,400
7	TS-6	Mechanical Dredging	203,000	CY	$ 4.00	$ 812,000
8	TS-7	Hydraulic Dredging	235,000	CY	$ 5.00	$ 1,175,000
9	TS-8	Water Control Structures Type.-1	1	EA	$ 25,000.00	$ 25,000
10	TS-9	Water Control Structures Type -2	1	EA	$ 100,000.00	$ 100,000
11	TS-10	Structural Excavation	20,000	CY	$ 15.00	$ 300,000
12	TS-10	Cofferdam	1	LUMP	$ 600,000.00	$ 600,000
13	TS-11	Heavy Duty Sluice Gates	6	EA	$ 183,000.00	$ 1,098,000
14	TS-12	Portable Actuators	2	EA	$ 3,000.00	$ 6,000
15	TS-13	Precast Concrete Access Bridge	1	LUMP	$ 210,000.00	$ 210,000
16	TS-14	Galvanized Steel Trash Screens	6	EA	$ 30,000.00	$ 180,000
17	TS-15	Metal Handrails	190	LF	$ 90.00	$ 17,100
18	TS-16	Steel Guard Railing	35	LF	$ 60.00	$ 2,100
19	TS-17	Galvanized Steel Walkways	1	LUMP	$ 35,000.00	$ 35,000
20	TS-18	Galvanized Steel Steps	1	LUMP	$ 6,000.00	$ 6,000
21	TS-19	Dewatering Sheetpile Needles and Storage Rack	1	LUMP	$ 60,000.00	$ 60,000
22	TS-20	Control Room	1	LUMP	$ 75,000.00	$ 75,000
23	TS-21	Electrical	1	LUMP	$ 120,000.00	$ 120,000
24	TS-22	Water Line Relocation	1	LUMP	$ 117,600.00	$ 117,600
25	TS-22	SLECA Power Line Relocation	1	LUMP	$ 12,000.00	$ 12,000
26	TS-22	AT&T Communications Line Relocation	1	LUMP	$ 25,000.00	$ 25,000
27	TS-22	Charter Communications Line Relocation	1	LUMP	$ 12,000.00	$ 12,000
28	TS-22	South Coast Gas Line Relocation	1	LUMP	$ 20,000.00	$ 20,000
29	201-01	Clearing & Grubbing	42	AC	$ 4,500.00	$ 189,000
30	202-02	Removal of Surfacing & Stabilizing Base	1,540	SY	$ 6.00	$ 9,240
31	203-01	General Excavation	90	CY	$ 19.00	$ 1,710
32	203-02	Drainage Excavation (Detour Road)	100	CY	$ 20.00	$ 2,000
33	203-03	Embankment (LA Hwy. 57)	300	CY	$ 23.00	$ 6,900
34	203-07	Borrow (Vehicular Measurement)	4,200	CY	$ 20.00	$ 84,000
35	203-08	Geotextile Fabric	3,450	SY	$ 2.50	$ 8,625
36	301-02	Class I Base Course (36" thick)	1,000	SY	$ 70.00	$ 70,000
37	302-02	Class II Base Course (10" thick)	1,540	SY	$ 36.00	$ 55,440
38	304-02	Lime Treatment (Type B)(10" thick)	1,540	SY	$ 4.50	$ 6,930
39	401-02	Aggregate Surface Course (Adj. Veh. Measurement)	600	CY	$ 60.00	$ 36,000
40	502-01	Superpave Asphaltic Concrete	525	TON	$ 80.00	$ 42,000
41	702-01	Junction Boxes	2	EA	$ 5,340.00	$ 10,680
42	702-02	Combination Mesh and Barbed Wire Fence	600	LF	$ 25.00	$ 15,000
43	705-05	Double Swinging Driveway Gates	2	Dbl. Gate	$ 1,200.00	$ 2,400
44	717-01	Seeding	1,260	LB.	$ 9.00	$ 11,340
45	718-01	Fertilizer	42,000	LB.	$ 0.50	$ 21,000
46	725-01	Temporary Detour Road	3,350	SY	$ 58.00	$ 194,300
47	729-01	Traffic Signs & Devices	1	LUMP	$ 30,000.00	$ 30,000
48	730-18	Service Pole	1	EA	$ 605.00	$ 605
49	740-01	Construction Layout	1	LUMP	$ 25,000.00	$ 25,000
50	803-03(a)	Steel Sheetpile Wall (Retaining Walls)	6,120	SF	$ 60.00	$ 367,200
51	803-03(b)	Steel Sheetpile Wall (Scour Curtain Walls)	8,790	SF	$ 50.00	$ 439,500
52	804-01(a)	Precast Concrete Piles (12" Square)	640	LF	$ 50.00	$ 32,000
53	804-01(b)	Precast Concrete Piles (14" Square)	5,785	LF	$ 60.00	$ 347,100
54	804-02	Treated Timber Piles	520	LF	$ 25.00	$ 13,000
55	804-05	Precast Concrete Test Piles	2	EA	$ 35,000.00	$ 70,000
56	805-01	Class A Concrete	1,800	CY	$ 800.00	$ 1,440,000
57	805-06	Class R Concrete	120	CY	$ 400.00	$ 48,000
58	805-12	Reinforced Concrete Box Culverts (10' X 10')	600	LF	$ 1,000.00	$ 600,000
59	813-01	Concrete Approach Slabs	16	SY	$ 200.00	$ 3,200
		Subtotal				**$ 10,431,320**

Contingency	10%	$ 1,043,132
TOTAL		**$ 11,474,452**

BAYOU PELTON SIDE CHANNEL CUT VOLUMES				
STATION	DISTANCE ft	CUT ft²	AVG AREA ft²	VOLUME yd³
12+19		752.28		
	197.0		850.59	6,206.12
14+16		948.89		
	200.0		1,006.99	7,459.15
16+16		1,065.08		
	205.0		1,047.48	7,953.09
18+21		1,029.88		
	227.0		1,059.27	8,905.71
20+48		1,088.66		
	181.0		1,079.20	7,234.64
22+29		1,069.74		
	203.0		1,071.86	8,058.76
24+32		1,073.97		
	210.0		1,068.38	8,309.58
26+42		1,062.78		
	200.0		1,064.48	7,885.00
28+42		1,066.17		
	201.0		1,059.87	7,890.11
30+43		1,053.56		
	198.0		1,032.18	7,569.28
32+41		1,010.79		
	201.0		1,012.18	7,535.12
34+42		1,013.57		
	200.0		1,016.68	7,530.93
36+42		1,019.78		
	200.0		1,006.24	7,453.59
38+42		992.69		
	202.0		1,000.43	7,484.70
40+44		1,008.17		
	202.0		1,003.84	7,510.17
42+46		999.50		
	199.0		1,001.41	7,380.76
44+45		1,003.32		
	204.0		1,009.26	7,625.52
46+49		1,015.20		
	200.0		1,025.75	7,598.15
48+49		1,036.30		
	18.0		1,035.99	690.66
50+47		1,035.68		
	200.0		1,025.72	7,597.93
52+47		1,015.76		
	201.0		992.09	7,385.52
54+48		968.41		
	199.0		984.09	7,253.07
56+47		999.76		
	203.0		998.56	7,507.69
58+50		997.36		
	197.0		988.83	7,214.76
60+47		980.29		
	209.0		977.19	7,564.17
62+56		974.09		
	202.0		969.96	7,256.74
64+58		965.83		
	207.0		941.30	7,216.60
66+65		916.76		
	201.0		957.21	7,125.90
68+66		997.66		
	194.0		995.32	7,151.52
70+60		992.97		
	191.0		979.93	6,932.06
72+51		966.88		
	204.0		921.87	6,965.20
74+55		876.85		
	77.0		874.35	2,493.50
75+32		871.84		
	155.0		1,174.91	6,744.85
76+87		1,477.98		
TOTAL BAYOU PELTON CHANNEL CUT (yd³)=				**234,690.56**

DREDGING QUANTITIES

BAYOU PELTON CHANNEL		
Length (ft)	Channel Volume (yd³)	
6,532.00	234,690.56	
Total Volume =	**234,690.56**	
CONEYANCE CHANNEL		
Length (ft)	Channel Volume (yd³)	Berm Volume (yd³)
6,884.53	201,319.83	1,603.41
Total Volume =	**202,923.24**	

OK

CONVEYANCE CHANNEL VOLUMES				
STATION	DISTANCE ft	CUT ft²	AVG AREA ft²	VOLUME yd³
78+60		1,030.00	1,028.57	
	130.00			4952.35
79+90		1,027.13		
	201.0		986.12	7,341.08
81+91		945.10		
	200.0		883.23	6,542.41
83+91		821.35		
	199.0		802.85	5,917.27
85+90		784.34		
	200.0		785.09	5,815.48
87+91		785.84		
	200.0		756.61	5,604.48
89+91		727.37		
	200.0		741.22	5,490.52
91+91		755.07		
	200.0		757.03	5,607.59
93+91		758.98		
	202.0		713.05	5,334.63
95+93		667.11		
	202.0		674.04	5,042.78
97+95		680.96		
	202.0		700.47	5,240.52
99+97		719.97		
	198.0		741.91	5,440.64
101+95		763.84		
	200.0		766.67	5,679.00
103+95		769.49		
	199.0		775.12	5,712.88
105+94		780.74		
	202.0		768.55	5,749.89
108+06		756.36		
	228.0		788.32	6,656.92
110+34		820.28		
	213.0		794.30	6,266.11
112+47		768.31		
	199.0		803.53	5,922.28
114+46		838.74		
	201.0		827.09	6,157.23
116+47		815.44		
	196.0		800.35	5,809.95
118+43		785.26		
	205.0		789.44	5,993.90
120+48		793.62		
	200.0		804.02	5,955.70
122+48		814.42		
	197.0		817.56	5,965.12
124+45		820.69		
	199.0		715.99	5,277.11
126+44		611.29		
	201.0		669.77	4,986.03
128+45		728.24		
	205.0		762.24	5,787.38
130+50		796.24		
	196.0		795.51	5,774.81
132+46		794.78		
	204.0		812.71	6,140.48
134+50		830.64		
	195.0		823.01	5,943.96
136+45		815.38		
	202.0		731.10	5,469.71
138+47		646.82		
	199.0		616.86	4,546.49
140+46		586.9		
	199.0		699.02	5,152.04
142+45		811.14		
	201.0		813.11	6,053.12
144+46		815.07		
	199.0		823.29	6,067.92
146+45		831.5		
	200.0		799.48	5,922.07
147+45		767.46		
TOTAL CONVEYANCE CHANNEL CUT (yd³)=				**201,319.83**

CONVEYANCE CHANNEL BERM VOLUMES				
STATION	DISTANCE ft	CUT ft²	AVG AREA ft²	VOLUME yd³
78+60		132.00		
	130.0		132.00	635.56
79+90		132.22		
	201.0		98.14	730.60
81+91		64.06		
	200.0		32.03	237.26
83+91		0.00		
	199.0		0.00	0.00
85+90		0.00		
	200.0		0.00	0.00
87+91		0.00		
	200.0		0.00	0.00
89+91		0.00		
	200.0		0.00	0.00
91+91		0.00		
	200.0		0.00	0.00
93+91		0.00		
	202.0		0.00	0.00
95+93		0.00		
	202.0		0.00	0.00
97+95		0.00		
	202.0		0.00	0.00
99+97		0.00		
	198.0		0.00	0.00
101+95		0.00		
	200.0		0.00	0.00
103+95		0.00		
	199.0		0.00	0.00
105+94		0.00		
	202.0		0.00	0.00
108+06		0.00		
	228.0		0.00	0.00
110+34		0.00		
	213.0		0.00	0.00
112+47		0.00		
	199.0		0.00	0.00
114+46		0.00		
	201.0		0.00	0.00
116+47		0.00		
	196.0		0.00	0.00
118+43		0.00		
	205.0		0.00	0.00
120+48		0.00		
	200.0		0.00	0.00
122+48		0.00		
	197.0		0.00	0.00
124+45		0.00		
	199.0		0.00	0.00
126+44		0.00		
	201.0		0.00	0.00
128+45		0.00		
	205.0		0.00	0.00
130+50		0.00		
	196.0		0.00	0.00
132+46		0.00		
	204.0		0.00	0.00
134+50		0.00		
	195.0		0.00	0.00
136+45		0.00		
	202.0		0.00	0.00
138+47		0.00		
	199.0		0.00	0.00
140+46		0.00		
	199.0		0.00	0.00
142+45		0.00		
	201.0		0.00	0.00
144+46		0.00		
	199.0		0.00	0.00
146+45		0.00		
	200.0		0.00	0.00
147+45		0.00		
TOTAL CONVEYANCE CHANNEL CUT (yd³)=				**1,603.41**

RONALD J. BOUDREAUX, P.E., INC.

CONSULTING & DESIGN ENGINEER
ELECTRICAL & CONTROL SYSTEMS

118 DOUBLE H DRIVE
RACELAND, LA 70394
P.O. B0X 1158
RACELAND, LA 70394

FAX (985) 537-1313
E-MAIL rjbpe@bellsouth.net

OFFICE (985) 537-5656

April 2, 2009

cors/lakeboudreaux/02

Mr. Marc Rogers, P.E.
T. Baker Smith, Inc.
P.O. Box 2266
Houma, LA 70361

RE: Lake Boudreaux Basin Freshwater Introduction
And Hydrologic Management
Project TE-32a
OCPR Contract 2503-08-13

Dear Marc:

As per your request, I submit the following Preliminary Opinion of Probable Electrical Construction Cost:

Lake Boudreaux Basin Freshwater Introduction
And Hydrologic Management
Project TE-32a
OCPR Contract 2503-08-13

DESCRIPTION	COST
MOTOR CONTROL CENTER/GATE WIRING	$ 25,000
CONTROLS/PLC PROGRAMMING	$ 25,000
EXTERIOR LIGHTING	$ 12,000
BUILDING LIGHTING/WIRING	$ 5,000
ELECTRICAL SERVICE ENTRANCE	$ 10,000
10% CONTINGENCY	$ 7,700
PRELIMINARY OPINION OF PROBABLE COST	**$ 84,700**

Should you have any questions, please call at any time.

Very truly yours,

Ronald J. Boudreaux, P.E.
President

RJB/spb

LAND RIGHTS COST
4/1/2009

TRACT	OWNER(S)	EARNEST MONEY	REMAINING	
1	Caillou Grove, LLC	$1,000	$184,214	
2	Charles Moorehead	$500	$10,492	
3	Charles Luke et al	$500	$9,751	
4, 13 & 17	Zebec, LLC	$500	$23,023	
5	Earl Naquin	$500	$8,812	
6	Louis P. Whitney	$500	$9,191	
7	Shayne R. Mathes	$250	$9,979	
8	Stanley Boudreaux et al	$500	$9,274	
9	Ronald Lirette	$250	$6,915	
10	Louis Guidry et ux	$250	$6,906	
11	Stevie Guthrie	$500	$7,297	
12	Connelly M. Luke	$500	$7,243	
14	Ruffin Bourg et al	$2,250	$9,417	
15	Edwin J. Voisin	$500	$4,419	
16	Irvin P. Carlos et ux	$500	$16,382	
				$323,315
	Additional Permanent Right-of-way			$8,000
	Acquisition Cost R/w Documents #2			$18,685
	Estimated Land Rights Cost Remaining			**$350,000**

prepared by:
T. Baker Smith, Inc.

081742Landrightscost

ESTIMATED CONSTRUCTION PHASE COST
4/1/2009

1	**CONSTRUCTION ADMINISTRATION**			
	52 weeks @ 5 days/week @ 1 hr./day @	$90	/hr.	$23,400
2	**INSPECTION**			
	52 weeks @ 8 hrs./day @ 5 days/week @	$60	/hr.	$124,800
3	**REIMBURSABLES**			
	Vehicle 52 weeks @ 5 days/week @ 8 hrs./day @	$18	/hr.	$37,440
	MISCELLANEOUS			**$14,360**
	ESTIMATED COST			$200,000

081742const

prepared by:
T. Baker Smith, Inc.

Seq 70081742

State of Louisiana

BOBBY JINDAL
GOVERNOR

CPRA
Coastal Protection and Restoration Authority of Louisiana

September 18, 2008

Mr. Marc Rogers, P.L.S.
T. Baker Smith, Inc.
412 South Van Avenue
P.O. Box 2266
Houma, LA 70363

Re: DNR Contract No. 2503-08-13, "Surveying Services and Engineering Assistance for Coastal Restoration Projects"
Revised Notice to Proceed – Lake Boudreaux Freshwater Introduction Project (TE-32a) Design

Dear Mr. Rogers:

The Office of Coastal Protection and Restoration (OCPR) is in receipt of your proposal to perform the referenced tasks pertaining to professional services for the captioned project. You are hereby authorized to begin work in an amount not to exceed $872,937.00. This represents an increase of $860,574.00 from the amount previously authorized. **Written authorization from me is required prior to performing any work which would exceed this authorized amount.**

Please note that the work authorized by this Notice to Proceed is subject to the attached **Technical Memorandum No. 1** dated November 1, 2004 concerning "Dissemination of Information and Release of Data."

If there are any questions, please contact me at (225) 342-6871.

Sincerely,

Christopher P. Knotts, P.E.
Chief, Engineering and Operations Division

cc: Maury Chatellier, P.E., Task Manager
Contract No. 2503-08-13

Post Office Box 448027 • Baton Rouge, Louisiana 70804-4027 • 617 North Third Street • 10th Floor • Baton Rouge, Louisiana 70802
(225) 342-7308 • Fax (225) 342-9417 • http://www.lacpra.org/
An Equal Opportunity Employer

T. BAKER SMITH, INC.
PROFESSIONAL CONSULTANTS SINCE 1913

412 South Van Avenue Houma, Louisiana 70363 • Post Office Box 2266 Houma, Louisiana 70361
Main Line: (985) 868-1050 • Toll Free: 1 (866) 357-1050 • Fax: (985) 868-5843 • Online: www.tbsmith.com

June 13, 2008

Mr. Maury O. Chatellier, P.E.
Engineering Supervisor
Coastal Engineering Division
La. Dept. of Natural Resources
P. O. Box 44027
Baton Rouge, LA 70804-4027

Dear Mr. Chatellier:

Re: DNR Project TE-32A
Lake Boudreaux Freshwater Introduction Project

Pursuant to your 5/27/08 request, we are transmitting for your review and consideration our engineering fees estimate for the Scope of Services provided on the referenced project. The rates on these estimates should match our Contract No. 2503-08-13 for T. Baker Smith, Inc., FTN Associates, and Ardaman & Associates. The TBS estimate is provided in four (4) spreadsheets. Each spreadsheet represents the fees associated with the projects listed in Table E of the Addendum to the Design Conceptual Report dated 10/22/07, except that the budgets for the Bayou Butler and miscellaneous water control structures were combined. Our modeling and geotechnical subcontract estimates are separate too. Our estimate is based upon preparing plans and specifications for one construction contract.

If you have any questions, please feel free to call me at 985-223-9230 or 985-852-3434 (cell phone).

Sincerely yours,

T. BAKER SMITH, INC.

Marc J. Rogers, Sr., P.E.

MJR/pdb
Enc.
emailed

Louisiana Department of Natural Resources
DNR Cooperative Agreement No. 2503-08-13
Lake Boudreaux Freshwater Introduction Project (TE-32a)

TBS Job No. 2008.0000

		Contract Value
3.1 Data Acquisition		
3.1.1	Surveys	
3.1.1.1	Topographic	$ 66,163.00
3.1.1.2	Bathymetric	$ 12,513.00
3.1.1.3	Magnetometer	$ 18,399.00
3.1.1.4	Cross-sections	$ 55,820.00
3.1.1.5	Control Work	$ 30,039.00
3.1.2	Geotechnical Investigation	$ 136,013.00
	Totals	**$ 318,947.00**
4.0 Preliminary Design Review		
4.1	Preliminary Design Report	$ 64,541.00
4.2	Identify Affected Landowners	$ 14,092.00
4.3	Preliminary Design Plans and Specifications	$ 100,806.00
4.4	Draft Permit Drawings and Supporting Data	$ 23,932.00
	Totals	**$ 203,371.00**
5.0 Final Design Review		
5.1	Final Design Report	$ 69,479.00
5.2	Final Design Plans and Specifications	$ 236,111.00
	Totals	**$ 305,590.00**
6.0 Final Design Package		$ 32,666.00
	Totals	**$ 32,666.00**
Totals		**$ 860,574.00**

Danielle,

Please revise task 5 to reflect the accurate amount of $860,574.00. The $916,246 is inaccurate.

Thanks

Maury O. Chatellier, P.E.
Engineer Manager
Office of Coastal Protection and Restoration
225-342-5944
maury.chatellier@la.gov

-----Original Message-----
From: Maury Chatellier
Sent: Wednesday, November 05, 2008 7:47 AM
To: Danielle Stafford
Subject: RE: Contract # 2503-08-13

I hope to have you something by lunch.....

Maury O. Chatellier, P.E.
Engineer Manager
Office of Coastal Protection and Restoration
225-342-5944
maury.chatellier@la.gov

Per Maury, The Notice to Proceed needs to be back dated to 9/18/2008 for preliminary work started once amendment was approved. Oversight in issuance of NTP in September. DBS

-----Original Message-----
From: Danielle Stafford
Sent: Wednesday, November 05, 2008 7:22 AM
To: Maury Chatellier
Subject: RE: Contract # 2503-08-13

Maury,

The cost proposal that I had to go along with the amendment is a draft. I need a finalized cost estimate in order to issue a Notice to Proceed to increase this task.

FYI – I will be leaving at noon tomorrow and will not return until next Wednesday. If you can't get this information to me before then, please send it to Barry Zeringue and he can handle it in my absence.

Thanks!

-----Original Message-----
From: Maury Chatellier
Sent: Monday, November 03, 2008 2:49 PM
To: Danielle Stafford
Subject: Contract # 2503-08-13

Danielle,

I just processed an invoice for T. Baker Smith on the North Lake Boudreaux project (Task 5 on their IDIQ). $916,246 should be added to Task 5 to cover the new design effort – the recent $1,000,000 amendment will cover this.

Contract # 2503-08-13

Thanks,

Maury O. Chatellier, P.E.
Engineer Manager
Office of Coastal Protection and Restoration
225-342-5944
maury.chatellier@la.gov

DNR Contract No. 2503-08-13
T. Baker Smith & Son, Inc.
"Surveying and Engineering Assistance for Coastal Restoration Projects"
09/01/07 - 08/31/09

			Wes LeBlanc	Daniel Dearmond							Dain Gillen	Billy Wall	Brian Babin	Steve Melton	Brian Babin	Jerry Carroll	
		2503/11E03/1 Cameron Parish Wetlands Survey Project	2512/F31/1 Cameron Parish Wetlands Survey Phase II	2511/0F16/1 Cameron Parish Road Elev Inspection Services	2511/12F/1 Shoreline Protection Demo	2511/0F16/1 Boudreaux Freshwater	2511/4F13/3 Grand Bayou Control Structure Operations	2512/0F13/1 Shoreline Protection Project	Calcasieu Hydrologic Restoration (BA-20)	2514/9E10/2 Beach Cleanup Along the Cameron Jurisdictional Parish	2514/8E07/2 Shoreline Protection Pilot Project	Brady Canal (11-23) Structure Operations March 2008	2503/08E3/25 MRGO Closure Structure	2511/2F02/3 Cameron Hydrologic (BA-20) Structure Operations	2511/04F4/2 Mid-Bay Island Back Barrier Marsh Creation	2503/HAD6 Acreage	
		TASK 7	TASK 8	TASK 9	TASK 10	TASK 11	TASK 12	TASK 13	TASK 14	TASK 15	TASK 16	TASK 17	TASK 18	TASK 19	TASK 20	Interfund	
TITLE	DATE															INCREASE/(DECREASE)	BALANCE
Original Contract	07/19/2007(OCR)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		$350,000.00
Task #1	8/23/2007	$71,616.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		($71,616.00)
Task #2	8/27/2007	$0.00	$19,953.17	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		($19,953.17)
Task #3	8/29/2007	$0.00	$0.00	$7,720.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		($7,720.00)
Task #4	8/29/2007	$0.00	$0.00	$0.00	$146,138.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		($146,138.00)
Task #5	9/13/2007	$0.00	$0.00	$0.00	$0.00	$12,363.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		($12,363.00)
Task #6	9/17/2007	$0.00	$0.00	$0.00	$0.00	$0.00	$11,269.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		($11,269.00)
Task #7	10/5/2007	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$41,391.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		($41,391.00)
Task #8	11/1/2007	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6,783.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		($6,783.00)
Amendment #1	01/25/2008 (OCR)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$148,350.00	$0.00	$0.00	$0.00	$0.00	$0.00		$275,000.00
Task #9	02/11/08	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$99,852.00	$0.00	$0.00	$0.00	$0.00		($148,350.00)
Task #10	02/11/08	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$11,240.00	$0.00	$0.00	$0.00		($99,852.00)
Task #3 Amendmt	02/20/08	$0.00	$0.00	$4,029.50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$27,330.00	$0.00	$0.00		($4,029.50)
Task #11	03/13/08	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6,783.00	$0.00		($11,240.00)
Task #12	03/13/08	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		($27,330.00)
Task #13	04/24/08	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		($6,783.00)
Amendment #2	08/14/2008 (OCR)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7,500.00		$1,000,000.00
Task #14	Pend NTP	$0.00	$0.00	$0.00	$0.00	$860,574.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		($7,500.00)
Task #5 Amdmt	Pend NTP	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		($860,574.00)
Totals		$71,616.00	$19,953.17	$11,749.50	$146,138.00	$872,937.00	$11,269.00	$41,391.00	$6,783.00	$148,350.00	$99,852.00	$11,240.00	$27,330.00	$6,783.00	$0.00		$142,108.33

APPENDIX H

NEGATIVE FINDINGS REPORT

OF A

PHASE I CULTURAL RESOURCE SURVEY

Coastal Environments , Incorporated

Services:

Applied Science & Planning

Environmental Restoration & Monitoring

Cultural Resources Management

Geographic Information (GIS) Services

Litigation Services

Website:

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4 March 2010

Mark Rogers
T. Baker Smith, Inc.
412 S. Van Avenue
Houma, LA 70363-6759

Re: *Lake Boudreaux Basin Freshwater Diversion Project (TE-32a)*

Dear Mr. Rogers,

Enclosed please find five copies of the final report entitled *Negative Finding Report of a Phase I Cultural Resources Survey of the Lake Boudreaux Basin Freshwater Diversion Project (TE-32a) Study Area, Terrebonne Parish, Louisiana*. Also enclosed is a DVD with a PDF version of the report for your files.

In order to fulfill the requirements of the Division of Archaeology (DOA) Department of Culture, Recreation and Tourism, CEI will submit two bound copies of the final report, one unbound copy of the final report, a CD with a PDF version of the report, a CD with field photographs and copies of associated field records directly to the DOA. We will submit those records either Friday (5 March 2010) or Monday (8 March 2010). I will send you a copy of that letter of submittal under separate cover. If you have any questions, please contact me or Dr. David Kelley by email (thahn@coastalenv.com, dkelley@coastalenv.com).

Sincerely,

Thurston Hahn III

Thurston Hahn III
Archaeologist

Enclosures

NEGATIVE FINDING REPORT OF A PHASE I CULTURAL RESOURCES SURVEY OF THE LAKE BOUDREAUX BASIN FRESHWATER DIVERSION PROJECT (TE-32A) STUDY AREA TERREBONNE PARISH, LOUISIANA

FINAL REPORT

PREPARED BY

THURSTON H.G. HAHN III

SUBMITTED TO

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ON BEHALF OF

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David Kelley

DAVID B. KELLEY
PRINCIPAL INVESTIGATOR

MARCH 2010

ABSTRACT

Coastal Environments, Inc., (CEI) was contracted by T. Baker Smith, Inc., of Houma, Louisiana, to conduct a Phase I Cultural Resources Survey of the proposed Louisiana Office of Coastal Protection and Restoration Lake Boudreaux Basin Freshwater Diversion Project (TE-32a) in Terrebonne Parish, Louisiana. The Federal sponsor for the construction project is the United States Fish and Wildlife Service (USFWS) and the local sponsor is the Louisiana Office of Coastal Protection and Restoration.

The approximately 43.91 ha (108.51 ac) project area is spread over the banks of Bayou Grand Caillou and its adjacent swamps and marshes a short distance south of Houma, Louisiana. Much of the project area follows man-made waterways and natural waterways that have been dramatically altered during the historic period. The survey revealed one spot find consisting of a light scatter of late twentieth century cultural material on the north shore of Bayou Pelton near its juncture with Bayou Grand Caillou. No archaeological sites or standing structures over 50 years in age were encountered during the course of these examinations. As these investigations did not reveal any archaeological sites or standing structures over 50 years in age, no further work is recommended in regard to the Lake Boudreaux Basin Freshwater Diversion Project.

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ACKNOWLEDGEMENTS

Coastal Environments, Inc., (CEI) would like to thank Mr. Mark Rogers of T. Baker Smith, Inc., of Houma, Louisiana, for attaining access to the various land holdings within the project area. A seemingly minor action, Mr. Rogers' efforts saved the field crew a great deal of time and energy in contacting land owners. CEI's field crew for the cultural resources survey consisted of Patrick Brogan, Jonathan Decker, Thurston Hahn III, Walker Wilson, and Lukas Zarychta. Benji Guempel was responsible for manipulating all GIS data. Dr. David Kelley served as the Principal Investigator for this project. This work has been conducted for T. Baker Smith on behalf of the Louisiana Office of Coastal Protection and Restoration. The Federal sponsor for the construction project is the United States Fish and Wildlife Service (USFWS).

CHAPTER 1

INTRODUCTION

Coastal Environments, Inc., (CEI) was contracted by T. Baker Smith, Inc., of Houma, Louisiana, to conduct a Phase I Cultural Resources Survey of the proposed Lake Boudreaux Basin Freshwater Diversion Project (TE-32a) in Terrebonne Parish, Louisiana (Figure 1-1). The Federal sponsor for the construction project is the United States Fish and Wildlife Service (USFWS) and the local sponsor is the Louisiana Office of Coastal Protection and Restoration. The construction project consists of dredging Bayou Pelton and an existing canal on the east bank of Bayou Grand Caillou as well as excavating a new diversion canal between Bayou Grand Caillou and the North/South Gulf South Pipeline Canal. Concomitant with these excavations, several existing spoil banks/levees will be upgraded and a short length of new levee constructed on the east bank of Bayou Grand Caillou. The primary goal of this Office of Coastal Protection and Restoration project is to introduce freshwater from the Houma Navigation Canal into the marshes surrounding Lake Boudreaux, but could also be used to divert high water from the Lake Boudreaux Basin into the Houma Navigation Canal (Fruge 2002). The introduction of freshwater into the Lake Boudreaux system is necessary to counteract salt water intrusion into the area's swamps and marshes, which has led to a decline in those systems.

Specifically, the construction project entails dredging Bayou Pelton between the Houma Navigation Canal and Bayou Grand Caillou and depositing the dredge spoil on either bank of the bayou (see Figure 1-1). On the east bank of Bayou Grand Caillou, an outflow canal will be excavated between the bayou and the North/South Gulf South Pipeline Canal. The new canal will generally parallel the existing East/West Gulf South Pipeline Canal.

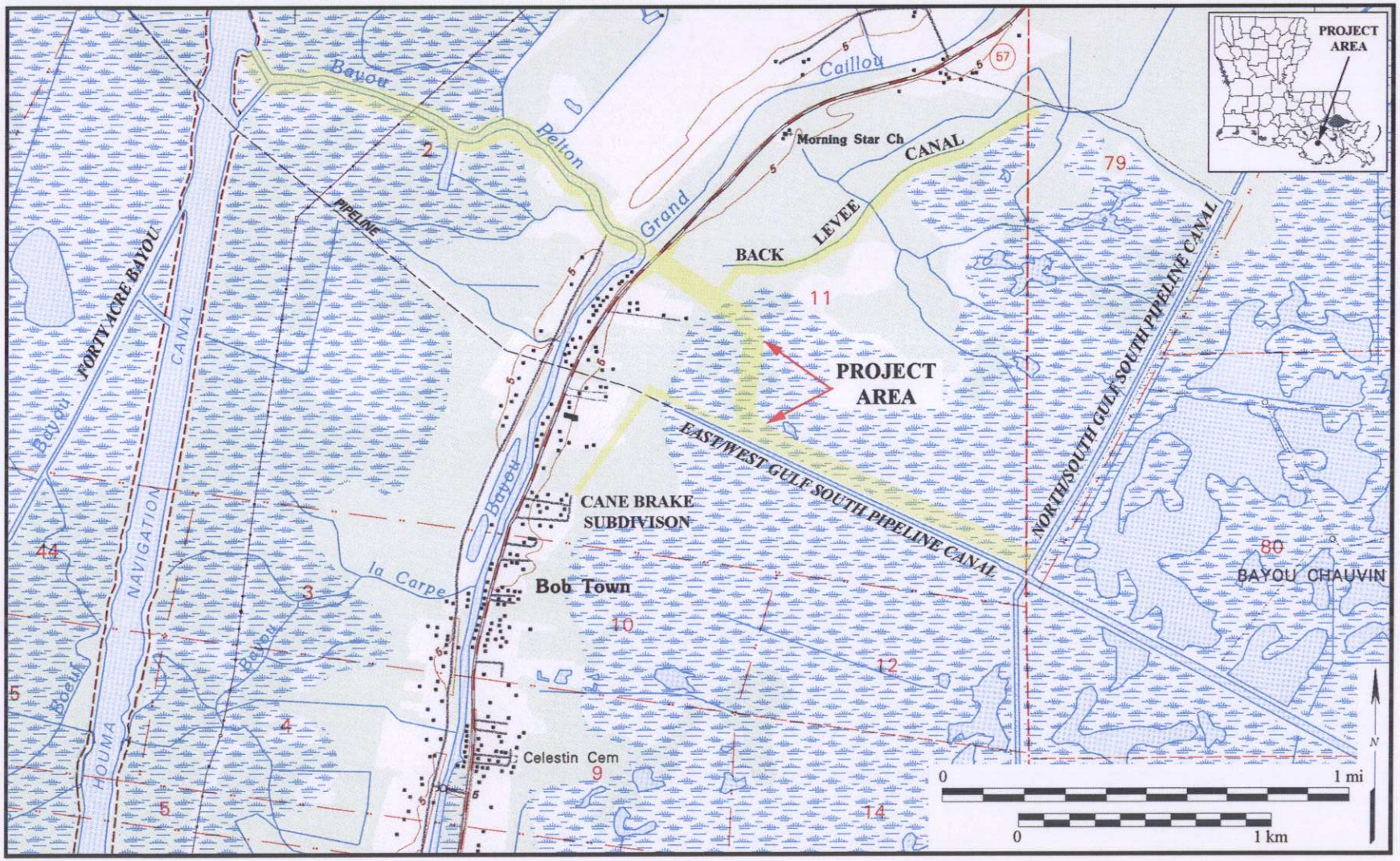

Figure 1-1. The Lake Boudreaux Basin Freshwater Diversion Project (TE-32a) study area overlaid on a detail of the *Dulac, Louisiana*, 1:24,000 quadrangle (USGS 1994).

Some spoil from that excavation will be used to upgrade a portion of an existing spoil bank along the north side of the East/West Gulf South Pipeline Canal so that it may serve as a back protection levee. Additional spoil will be used to build a new back protection levee connecting that spoil bank/levee to an existing high water levee that currently encircles nearby Cane Brake Subdivision to the south. In addition, an existing levee/spoil bank that roughly parallels Bayou Grand Caillou to the north will be enlarged. Fill material for that improvement will be excavated by dredging the adjacent canal. To control water flow through the system, a gated control structure will be installed on the east bank of Bayou Grand Caillou. The construction of that gate will require Louisiana Highway 57 to be shifted slightly to the east.

The irregularly-shaped project area varies in width from 30.48 to 83.83 m (100 to 275 ft) and covers an area of approximately 43.91 ha (108.51 ac) spread over the banks of Bayou Grand Caillou in Sections 2 and 11 of Township 18 South, Range 17 East, and Section 79 of Township 18 South, Range 16 East of the Southeastern District, West of the Mississippi River. Though the project area crosses the natural levees on both sides of Bayou Grand Caillou, most of the project area follows dredged bayous and canals that pass through degraded cypress swamps and marshes (Figure 1-2).

All fieldwork for the project was completed by a three-person field crew during the course of three days of field examinations conducted between 19 November and 3 December 2009. Pedestrian survey, boat survey and shovel testing revealed one spot find located near the juncture of Bayous Pelton and Grand Caillou. Consisting of a dispersed trash dump dating circa 1960–1980, no further work is recommended in its regard.

Report Layout

This report is divided into four chapters, not including the introduction. Chapter 2 provides an overview of the geologic and environmental setting of the area while Chapter 3 provides a description of the field methodology employed for this project and its results. Chapter 4 presents the conclusions and recommendations resulting from these investigations.

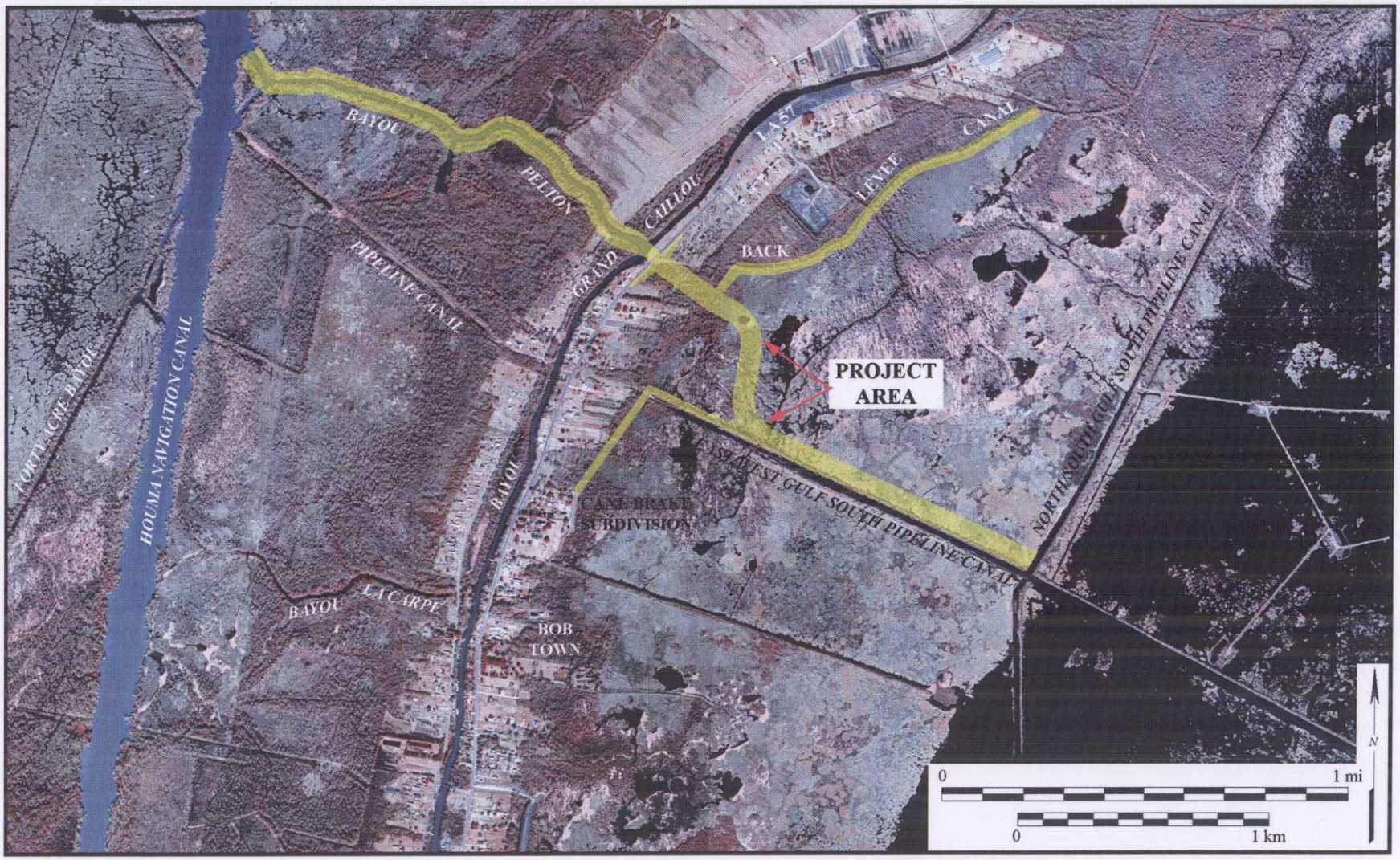

Figure 1-2. The Lake Boudreaux Basin Freshwater Diversion Project study area overlaid on a detail of the *Dulac, Louisiana*, DOQQ.

CHAPTER 2

ENVIRONMENTAL SETTING

The present study area lies within the Mississippi River deltaic plain of south central Louisiana. The delta plain includes the lower portion of the present Mississippi River, its present delta, and areas occupied by former deltaic systems of the river. This is an area characterized by both fluvial and deltaic features, such as natural levees; abandoned and relict distributaries; interdistributary basins, vast areas of saline, brackish and fresh marshes; large saline and brackish bays; and coastal lakes, beach ridges and barrier islands. The dynamic nature of this deltaic environment placed considerable constraints on the timing, distribution, and functional nature of human habitation within the region. The following discussion focuses on those aspects of the environment most critical to understanding human adaptation to the area over time.

Geology

The Mississippi River delta plain is a massive wedge of alluvial and deltaic sediments extending for almost 320 km (198 mi) along the coast of Louisiana and over 100 km (62 mi) inland. Its geologic history is related to a sequence of episodes of delta building and deterioration resulting from the progradation and subsequent abandonment of the present and former Mississippi River courses and deltas over the past 9,000 years or so. Thus, the Mississippi delta plain is a composite geomorphic feature consisting of numerous coalesced delta complexes, which themselves are composed of numerous smaller units—commonly referred to as delta lobes. The surface morphology of each delta plain and lobe is similar, consisting of a network of distributaries that radiate out from an abandoned or active trunk

channel and are separated by interdistributary troughs consisting of vast areas of marsh, swamp, ponds and lakes.

Between about 9,000 years ago and the present, the Mississippi River built several delta complexes, each consisting of several delta lobes. The delta complexes represent major shifts in the course of the Mississippi River. Drawing from Frazier's (1967) earlier work, and relying on more recent archaeological data, Weinstein and Gagliano (1985:Fig. 1) identified the following major delta complexes from oldest to youngest: Maringouin, Teche, Metairie, LaLoutre (St. Bernard), Lafourche-Terrebonne, Plaquemines and Belize—the modern delta complex (Figure 2-1).

The advance or retreat of shorelines is caused by the change in balance between rates of sediment deposition and effects of subsidence and erosion by the sea. Deltas and shorelines advance at the mouths of active streams that transport sediments seaward. Erosion occurs near the mouths of inactive streams that cannot transport sufficient sediment to sustain their position (Gagliano et al. 1975:9-15). Barrier islands are formed along delta margins as a delta lobe goes through deterioration after abandonment. As a delta lobe is abandoned and the deltaic surface begins to submerge through subsidence, the sand deposits that had been distributed along the delta margin often remain as a series of barrier beaches or barrier islands, separated from the retreating delta shoreline by a shallow bay or estuary (Williams et al. 1992). With continued subsidence, the barrier sediments become subject to redistribution, characterized by an inland migration of the island coupled with loss of sediment and a decrease in the size of individual islands

The present project area falls within the abandoned Lafourche-Terrebonne delta complex (see Figure 2-1). The most recent geological evidence indicates that the Lafourche-Terrebonne delta complex began as a distributary (present day Bayou Lafourche) off of the main trunk of the Mississippi River approximately 1,500 years ago (Tornquist et al. 1996). This date is later than that proposed by earlier geological studies, but is in line with currently available archaeological data from the Lafourche-Terrebonne region (Pearson and Davis 1995; Weinstein and Kelley 1992). Possibly after only about 500 years of progradation, flow

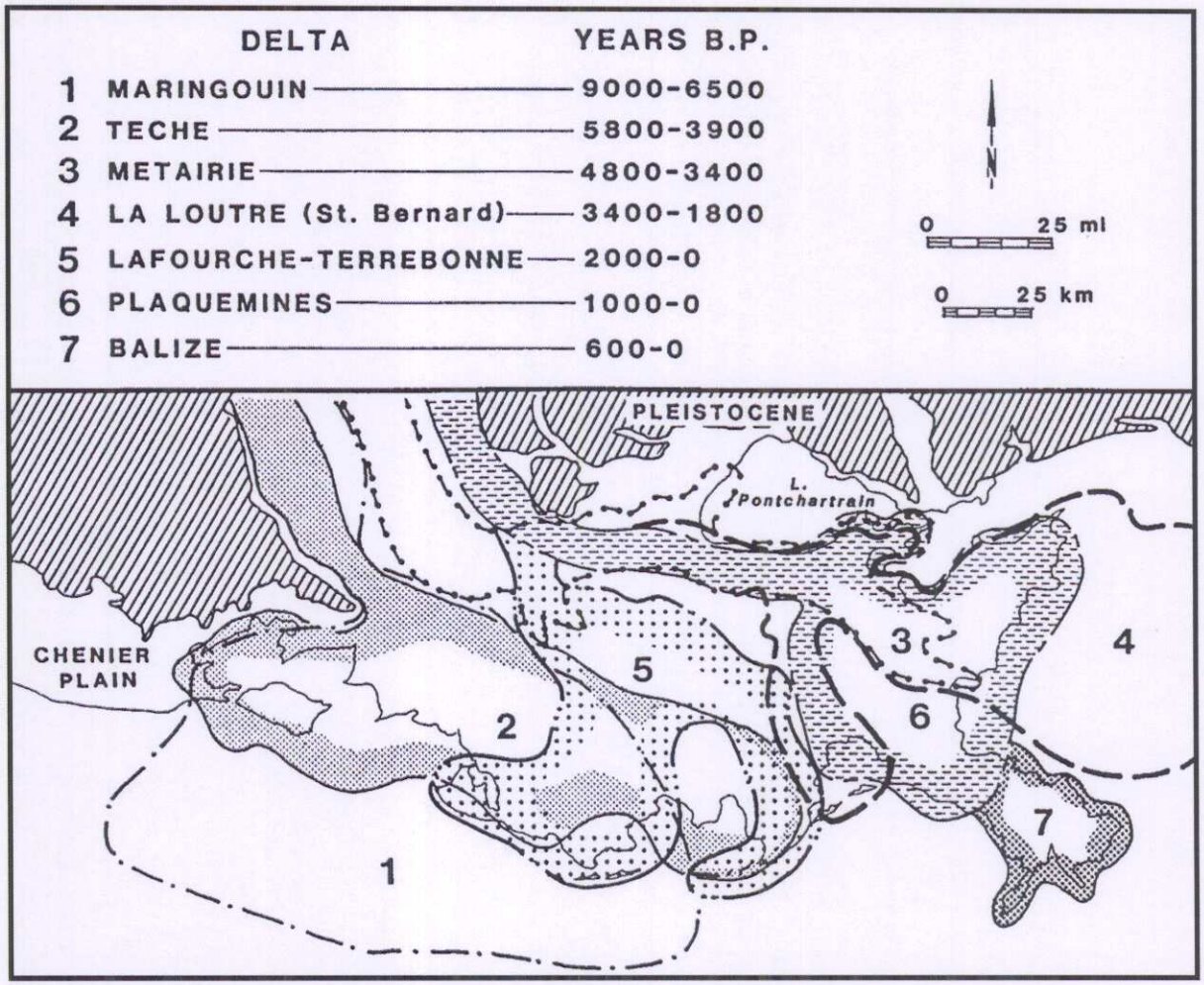

Figure 2-1. Mississippi River deltaic complexes (Weinstein and Gagliano 1985:Fig. 1).

into the Lafourche-Terrebonne system from the main trunk of the Mississippi River began to decrease, and the system began to deteriorate. Bayous Petit Caillou and Terrebonne, which empty into Terrebonne Bay, constitute two now-relict channels that were components the Lafourche-Terrebonne system. As the margins of the delta began to erode, barrier islands were formed. The Timbalier Islands were created over only the last 300 years as erosion from the Caminada-Moreau Headland at the mouth of Bayou Lafourche supplied sand for barrier development. The Isles Dernieries are older and were formed by the erosion of the Bayou Petit Caillou headland and beach ridges over the last 600 to 800 years (Williams et al. 1992:4).

Geomorphology

The landforms located at or near the surface in the study region have been formed by deltaic activity within the past 9,000 years (Fisk 1952; Frazier 1967). The earliest episode of delta building occurred between about 9,000 and 6,500 years ago when sea level was 40 to 60 ft below its present elevation. This delta, known as the Maringouin, once extended 40 to 50 mi beyond the present shoreline, but with subsequent sea level rise it was transgressed and gradually eroded back (see Figure 2-1). Much of the onshore remnant of the Maringouin Delta is now deeply buried beneath later deltaic deposits; however, Weinstein and Gagliano (1985:122) have suggested that a relict beach ridge partially exposed west of Lake Penchant may represent a reworked portion of the early delta. Other researchers have argued that this feature is associated with the next stage of delta building and is therefore substantially younger (Smith et al. 1986:64).

By about 5,800 years ago, sea level had risen to approximately its present level, and the Mississippi began prograding a new delta, known as the Teche, into the shallow Gulf. The trunk channel of this system has been reoccupied by bayous Teche, Boeuf, L'Ourse, and Black. Its natural levees, composed of grayish brown silts and silty clays, have subsided somewhat, but are still extant as surface exposures approximately one-half to one mile wide.

While the age and content of the Teche Delta are known in general terms, questions remain concerning the period during which it was active and the location of its eastern limits.

Smith et al. (1986:61-62) suggest that deposition in the Terrebonne marsh area occurred between 4,500 and 3,500 years ago and that the easternmost deposits are found in the vicinity of Houma. Weinstein and Gagliano (1985:123) argue for a somewhat earlier period of activity, 5800 to 3900 B.P., and, following previous researchers such as Russell (1940:1203) and Fisk (1944), place the eastern margin of the Teche Delta about 30 mi east of Houma. They identify several southwest trending distributaries including Bayou du Large, Bayou Mauvais Bois and Small Bayou La Point, as having been initially formed by the Teche Delta. Smith and his co-authors (1986:64-67) assign these to a later episode of delta building.

About 4,800 years ago, the Mississippi River began shifting out of the Teche course and creating a new delta in the area of present-day New Orleans. Variously known as the Cocodrie (Fisk 1944), Metairie (Weinstein and Gagliano 1985), or an early stage of the St. Bernard Delta (Frazier 1967), it initially received only partial flow as a portion of the Mississippi's discharge continued down the Teche, building new distributaries now occupied by Bayous Sale and Cypremort. As the Mississippi's flow gradually shifted to the east, the Red River, which had intersected the Mississippi south of the Marksville Prairie, occupied the old Teche course and discharged directly into the Gulf through its distributaries. Several authors have commented on the narrow and relatively steep Red River natural levees which may be seen within the broad, gray levees of the Teche-Mississippi (Landreth in Newton 1985:111; Russell 1940:1205).

The duration of the Red's occupation of the Teche course is not well established at present. Russ (1975:163-166) suggests that the Red followed the Teche course only a short time after the Mississippi abandoned it. He argues that the Red then shifted into a new meander belt, occupied it for a time, and then abandoned it in favor of the Teche course once again. Unfortunately, Russ has no absolute dates for any of these events. Archaeological data from two widely separated localities bear on this problem. One of the localities is the Gibson site (16TR5), located west of the present study area. McIntire (1958:63-64) took several cores from the site and encountered a Marksville-age shell midden intermixed with reddish silts that he interpreted as Red River deposits. Based on these findings, McIntire suggested that the Red was still occupying the Teche course at the time that the midden was

deposited (ca. A.D. 1 to 400). The other piece of archaeological evidence comes from the modern Red River meander belt through Moncla Gap. Previous researchers have generally placed the age of this meander belt at less than 1,000 years (Fisk 1944; Saucier 1974:Fig. 3), but Pearson (1986) has recently noted that the apparent association of several early Marksville sites with this feature argues for a considerably earlier date of establishment, on the order of A.D. 1 to 200. Thus two sets of archaeological data suggest that the Red River abandoned the Teche course about 1,800 to 1,900 years ago.

While the Red River continued to occupy the Teche course, the Mississippi began diverting out of the St. Bernard Delta and gradually shifted its flow down Bayou Lafourche. The Lafourche system reached its peak flow about 2,000 years ago, creating new delta lobes east of the present study area and reoccupying old Teche distributaries such as Bayou Black and Bayou L'Ourse.

About 1,000 years ago the Mississippi River again began shifting its course to the eastern portion of the deltaic plain and building the Plaquemines Delta. A small amount of flow continued down the Lafourche system, but this was probably not responsible for any significant land formation within the present study area. This diminished flow continued until 1904, when the source of Bayou Lafourche was artificially closed. After about 1000 B.P., subsidence and marine transgression became the dominant processes at work within the Terrebonne marsh system.

Depositional Environments

The complex geomorphic history of the study area has resulted in an intricate and constantly changing mosaic of environmental zones. Recent human activities have, in some cases, dramatically altered the condition of these environmental zones (e.g., the clearing of forests from natural levees), and in other cases they have accelerated the change from one environmental type to another (e.g., the shift from fresh to brackish marsh). The study of depositional environments has proven an effective method of reconstructing environmental zones of the past. Depositional environments can generally be identified from maps or

remote imagery and often have distinctive lithological characteristics that can be identified in subsurface borings and excavations. These environments can likewise be dated by a variety of relative and absolute dating techniques.

One group of depositional environments found within the study region consists of a series of fluvial features which include natural levees, point bars, abandoned channels, abandoned courses, and distributary channels (Smith et al. 1986:10-16). In regard to the present project, the most important of these are natural levees and distributary channels. Natural levees are ridges formed through vertical accretion as a result of overbank flooding along a stream. They parallel the channel and slope away from it. Natural levees are presently exposed in parts of the study area, but they also occur in the shallow subsurface, having been buried by subsidence beneath more recent swamp and marsh deposits. Distributary channels are simply small stream channels that diverge from the trunk channel of a deltaic system. Like the larger channels of the delta, they have associated natural levees, but these have often subsided completely beneath the marsh. Bayou Grand Caillou represents one of these smaller distributary channels, having once been a distributary of Bayou Terrebonne, which, in turn, was a distributary of Bayou Lafourche.

Other depositional environments found within the study area include inland swamps, and marshes. Inland swamps are poorly drained areas bordered by natural levees that support swamp-forest communities. Though extensive swamps once existed along both banks of Bayou Grand Caillou, those on the east side of the bayou have degraded considerably due to salt water intrusion and have largely been replaced by marshes. Marshes support vegetation composed predominantly of grasses and range in salinity from fresh to brackish to saline. Because fresh water predominates on the west side of Bayou Grand Caillou, they are not wide spread in that area.

Modern Setting

The present conditions affecting the study area are an ongoing part of the evolution of the Lafourche-Terrebonne delta system, though much of that evolution has been driven by

human alteration. Historically, Bayou Grand Caillou was used to connect the inland port community of Houma and other smaller communities, plantations and farms with the Gulf of Mexico. While the bayou continues to be used by recreational and commercial traffic (primarily shrimp and fishing boats), much of the commercial traffic now travels along navigation canals constructed in this century—particularly the Houma Navigation Canal.

With reduced flow, Bayou Grand Caillou has degraded considerably during the historic period (compare Figure 2-2 to Figure 1-1). Conversely, Bayou Pelton has been substantially modified over the years and is now much larger than it once was.

Originally, Bayou Pelton was a minor stream (see Figure 2-2) that probably formed as a small crevasse off of Bayou Grand Caillou. Depending on local water levels, however, Bayou Pelton probably also served to drain the backswamps lying between Bayous Grand Caillou and du Large back into Bayou Grand Caillou. Never carrying a large flow, Bayou Pelton did not develop its own natural levees.

By the late nineteenth century, Bayou Pelton was apparently cut off from Bayou Grand Caillou by a back protection levee that was erected along the west side of the latter stream (Figure 2-3). With its flow even further reduced, Bayou Pelton was barely large enough to be recorded by the USGS in 1891 (USGS 1894).

The September 1909 hurricane devastated the riverine system below Houma, clogging all the channels, many with silt as well as trees and debris. Using a prior emergency appropriation authority, the U.S. Army Corps of Engineers dredged portions of Bayou Terrebonne and Little Bayou Caillou. The Rivers and Harbors Act of 25 June 1910, meanwhile, created a new project to dredge Bayou Terrebonne, apparently ignoring the other waterways. The purpose of the new program was to dredge a six-foot channel down Bayou Terrebonne from Houma to deep water (Annual Report of the Chief of Engineers [ARCE] 1912). During the later part of 1915, a channel from the St. Louis Cypress Company bridge in Houma to Bush Canal was excavated (ARCE 1916:2449). The Intracoastal Waterway (IWW) was constructed through Houma in 1923 and later extended to Bayou Lafourche in

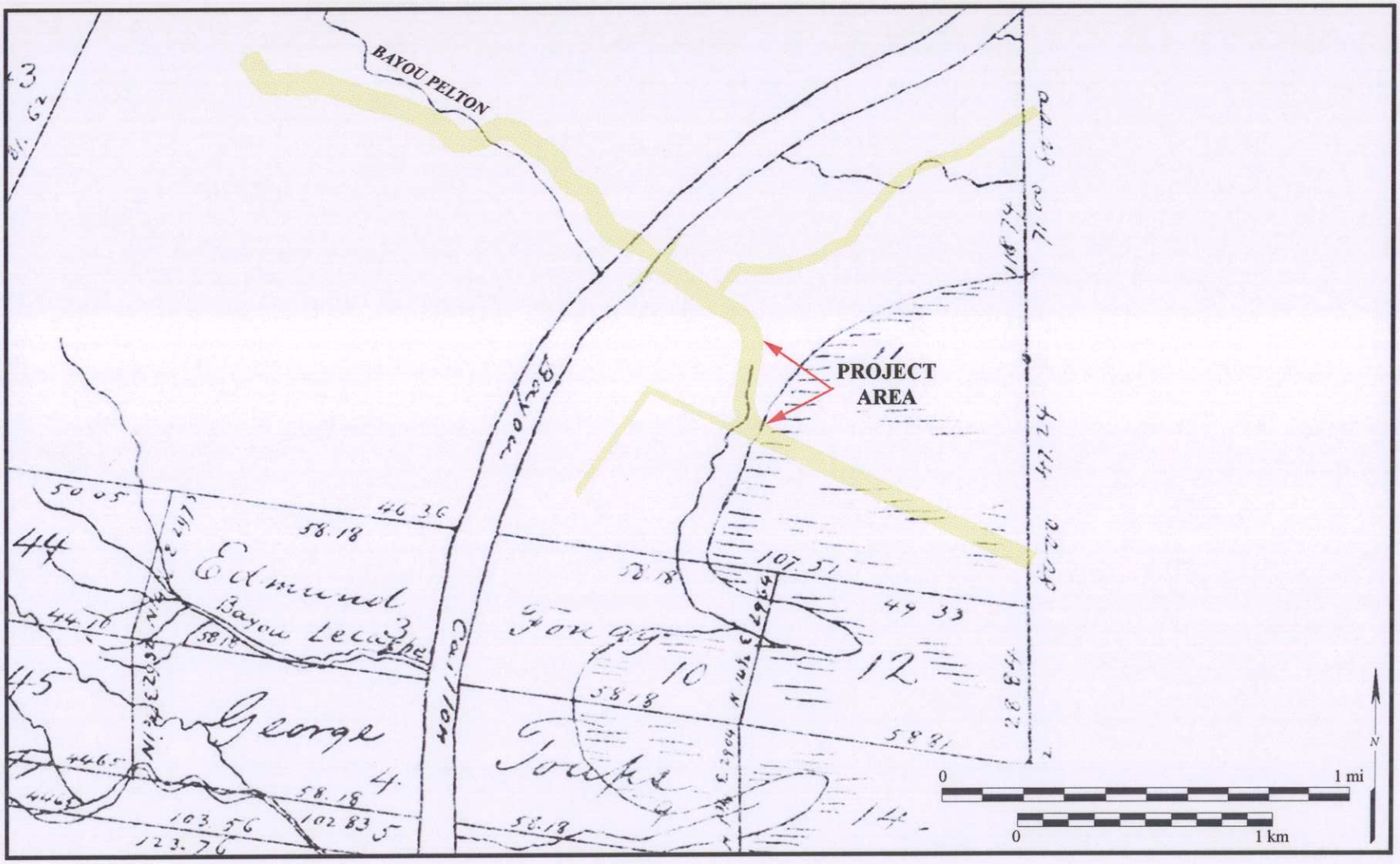

Figure 2-2. The Lake Boudreaux Basin Freshwater Diversion Project study area overlaid on a detail of an 1831 plat map of Township 18 South, Range 17 East, of the Southeastern District, West of the Mississippi River (16 April 1831 manuscript plat map entitled "T. XVIII. R. XVII. E.." by A.F. Rightor, Louisiana State Land Office, Baton Rouge, Louisiana). Note the relative sizes of Bayous Pelton and Grand Caillou.

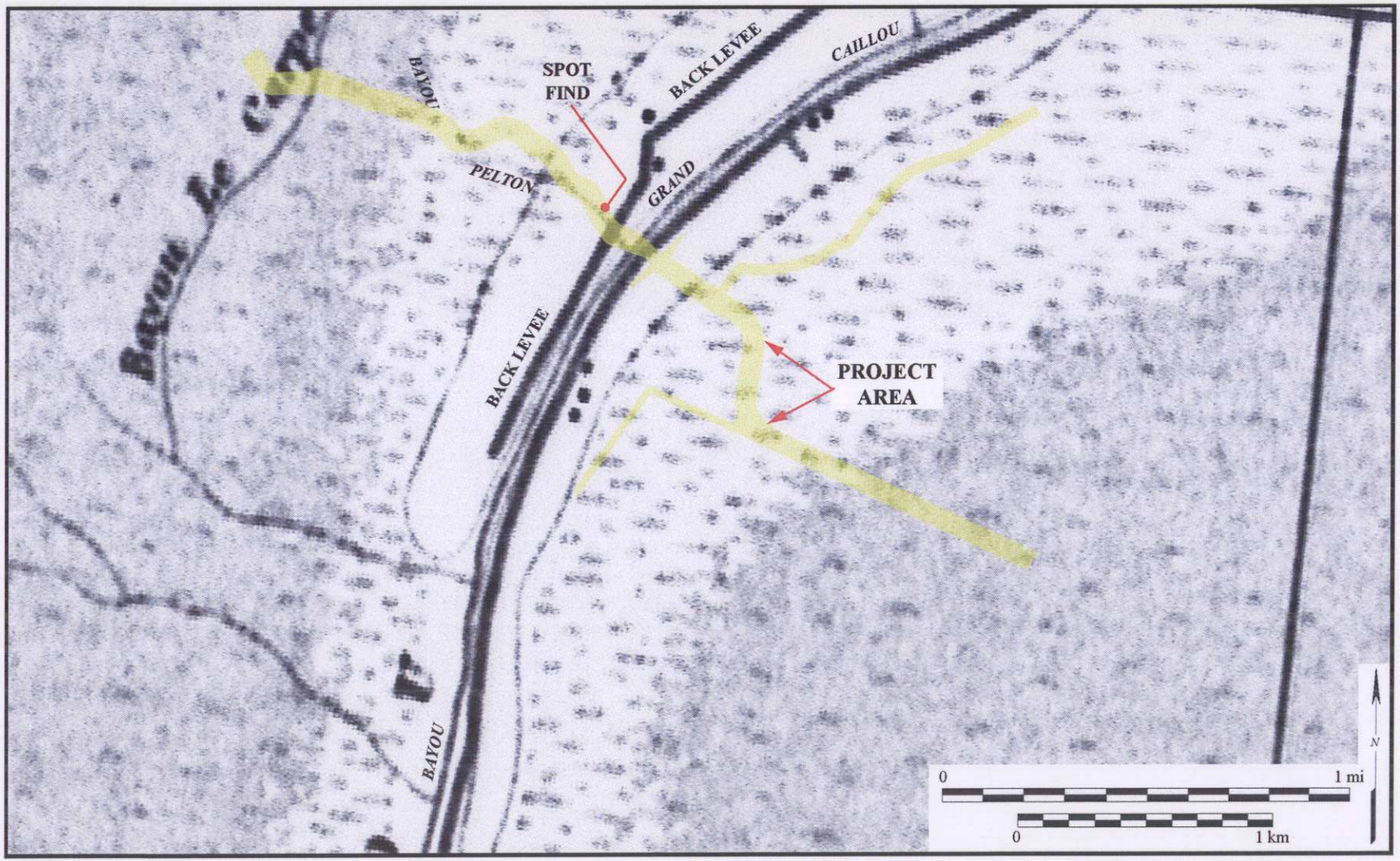

Figure 2-3. The Lake Boudreaux Basin Freshwater Diversion Project study area overlaid on a detail of the 1894 USGS *Dulac, Louisiana*, quadrangle. Note the back protection levee on the west bank of Bayou Grand Caillou and location of a spot find. Depicted information is from 1891.

Lafourche Parish (Barton et al. 2003). The waterway, however, did not immediately provide deep water access to Houma.

In 1930, business leaders convened another meeting to pressure the U.S. Army Corps of Engineers to provide a deep-water channel from Houma to the Gulf (U.S. Congress 1931:5). Major R.F. Fowler prepared a survey and plan for dredging a channel down Bayou Le Carpe to Bayou Pelton and then to Bayou Grand Caillou. That bayou was then to be dredged as far south as Dulac. Congress approved the dredging project in the River and Harbor Act of 30 August 1935. The project was for a five-foot channel extending from the intersection of Bayou La Carpe with the Intracoastal Waterway at Houma southward within the bayou, utilizing Bayou Le Carpe, Bayou Pelton, and Bayou Grand Caillou (ARCE 1936:712-3).

Originally only about 1.5 mi (2.4 km) long (16 April 1831 manuscript plat map entitled "T. XVIII. R. XVII. E.." by A.F. Rightor, Louisiana State Land Office, Baton Rouge, Louisiana), by 1931 Bayou Pelton had been connected to the Bayou Le Carpe system and was over 6 mi (9.67 km) long (Odom 1931). Though Bayou Le Carpe was presumably larger, the waterway soon became known as Bayou Pelton. Spoil from the 1930–1931 channelization of Bayou Pelton seems to have been deposited primarily on the south side of the bayou in the project area vicinity (USGS 1944). Obviously, this work resulted in Bayou Pelton becoming much enlarged and required the removal of at least some of the earlier back protection levee.

Possibly before that work was undertaken, a series of small drainages were channelized and interconnected by canals between Bayous Grand Caillou and du Large. Part of that manmade waterway followed the 40 arpent line of several properties that faced Bayou du Large to the west (USGS 1944). Consequently, the waterway became known as Forty Acre Bayou—despite the fact that the system was more canal than bayou. Providing access to the timber-rich swamps between Bayous Grand Caillou and du Large, Forty Acre Bayou was extensively used to log area backswamps. To bring the cut timber to market, Forty Acre Bayou was connected to Bayou Pelton (Figure 2-4) near the western terminus of the present

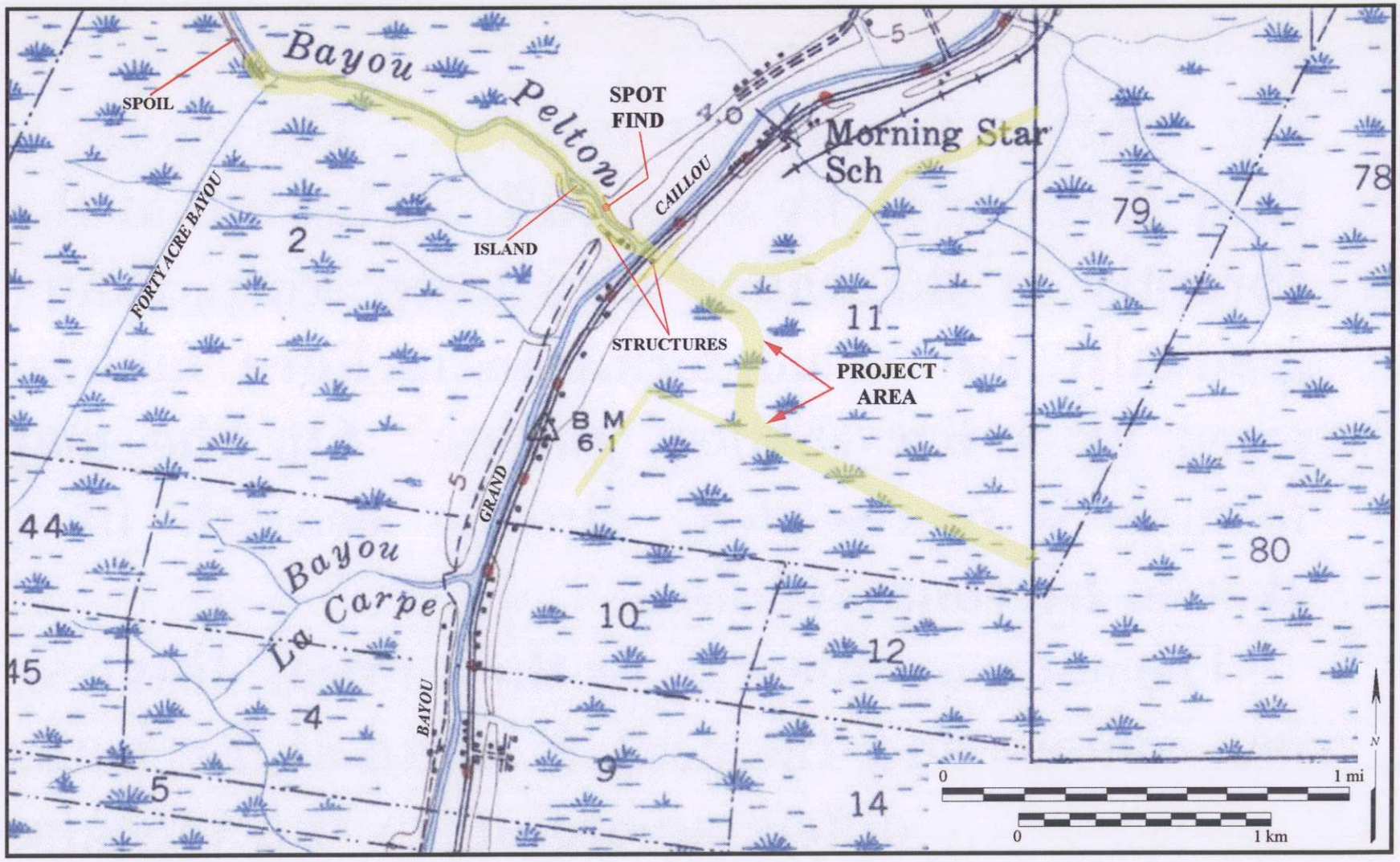

Figure 2-4. The Lake Boudreaux Basin Freshwater Diversion Project study area overlaid on a detail of the 1944 USGS *Dulac, Louisiana*, quadrangle. Note the structures located along the bayous and that Bayou Pelton and Forty Acre Bayou had been dredged by the 1940s. Depicted information is from 1939.

project area. From there, timber could be floated out to Bayou Grand Caillou or, possibly, up to Houma. Pullboat scars associated with early-twentieth century logging activity are clearly visible along Forty Acre Bayou in 1950s aerial photography of the area (Figure 2-5).

The mid-twentieth century saw the introduction of oil and gas exploration in the Bayou Pelton area. With that exploration came the need for increased access into formerly inaccessible areas. To provide this access, Bayou Pelton was dredged once again and an oil field canal dredged to the immediate northwest of the western terminus of the project area (see Figure 2-5). The dredging of Bayou Pelton in the mid-twentieth century greatly increased the width of the bayou and resulted in the removal of a small island created during the earlier channelization of the stream near its intersection with Bayou Grand Caillou (see Figure 2-4) (Ammann International Corporation 1956; USGS 1944). The widening of Bayou Pelton may have resulted in the removal of several structures that had been erected along its south bank in the early twentieth century.

Bayou Grand Caillou was similarly altered during the mid-twentieth century as well. Roughly contemporaneous with that work, a pipeline canal was excavated on either side of Bayou Grand Caillou a short distance south of Bayou Pelton. That pipeline canal is now known as the East/West Gulf South Pipeline Canal and intersects with the North/South Gulf South Pipeline Canal, which forms the eastern terminus of the project area.

In 1935 a group of Houma businessmen again got together to promote the construction of a ship channel south to the Gulf. Two years later the Houma Harbor and Terminal District issued a report urging the construction of a canal (Frederic R. Harris, Inc. 1937). A further effort was made in February 1939 when the Board of Commissioners of the Houma Harbor and Terminal District issued a flyer arguing the case for the canal (Houma Harbor and Terminal District 1939). Planning for the Houma ship canal, however, was placed on hold during World War II, and it was not until 1954 that pro-canal forces coalesced once again. Though the U.S. Army Corps of Engineers was interested in the project, local leaders wanted to take advantage of the rapidly growing oil industry and passed a bond issue in December 1955 to fund the project (*The Waterways Journal* 1962:19). After securing aid

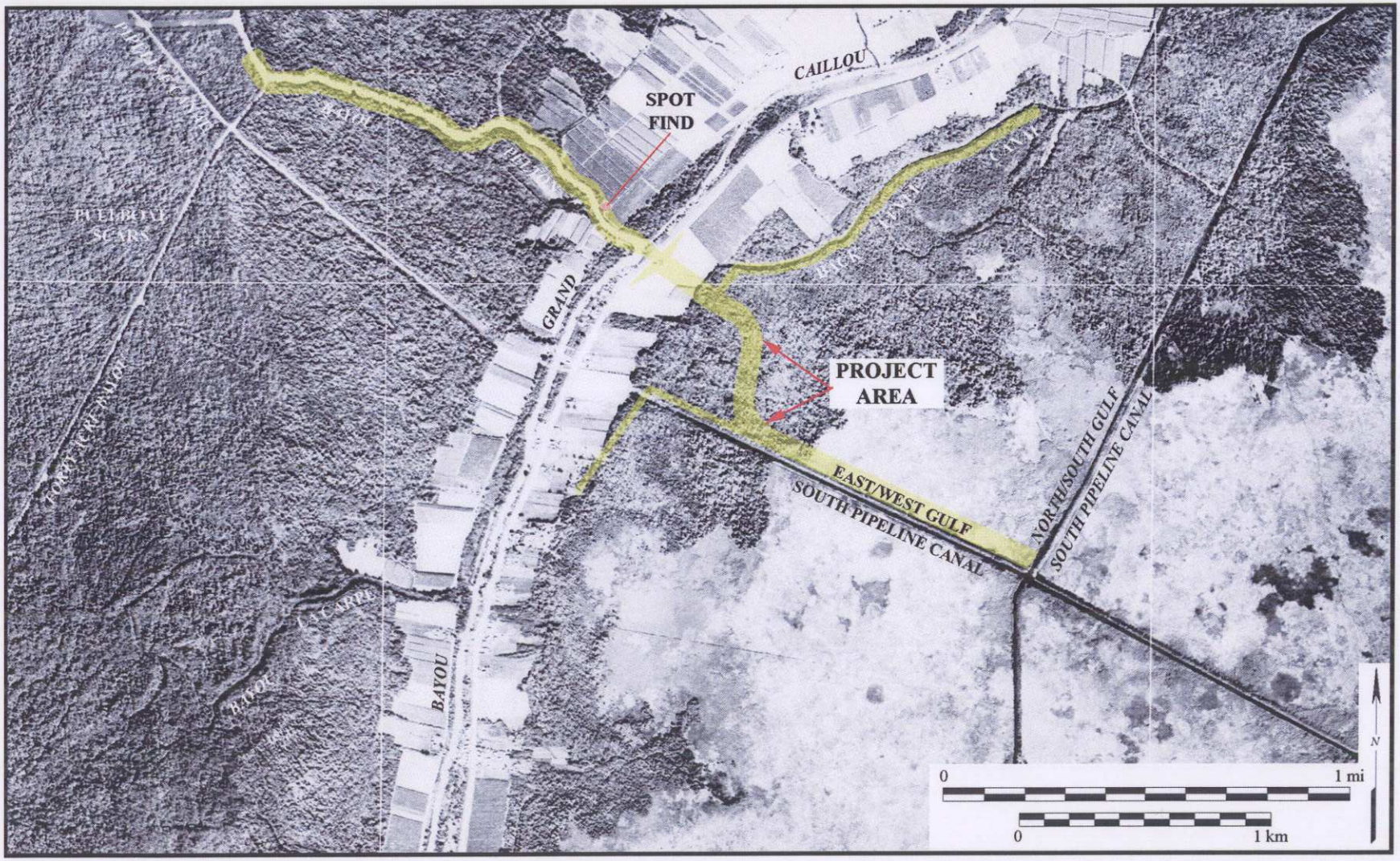

Figure 2-5. The Lake Boudreaux Basin Freshwater Diversion Project study area overlaid on a detail of Ammann International Corporation's 1956 aerial photomosaic of the project area. Note the recent excavations of the East/West Gulf South Pipeline Canal and the North/South Gulf South Pipeline Canal.

from the State Department of Public Works and an Army Corps of Engineers dredging permit, the canal was dredged over a period of six months over the winter of 1957-1958. The new canal was initially dug with a 300-foot top width, 150-foot bottom width and a 16-foot depth and was officially opened as the Houma Navigation Canal in June 1962.

Unlike the sinuous 1930 Bayou Pelton waterway excavation, the new canal was quite straight (Figure 2-6). Replacing the 1930 waterway, the Houma Navigation Canal intersected both Bayou Pelton and Forty Acre Bayou near their juncture at the western terminus of the project area—forming a small triangular island in the process. Spoil from the 1957–1958 excavation was deposited along both banks of the canal. As spoil from the 1930 excavation of Bayou Pelton was piled on the south side of the bayou, the new spoil was simply added on top of it, creating a relatively high area on the newly created island.

In the late 1960s or 1970s, another oil or gas well was drilled to the immediate south of Bayou Pelton (USGS 1964, 1980) (see Figure 1-1). To provide access to that well, Bayou Pelton was apparently dredged yet again. On that occasion, dredge spoil was apparently placed along the north side of the bayou.

Though not as altered as the Bayou Pelton segment of the project area, the eastern half of the study area has also seen a number of landscape modifications over the past century. By the mid-nineteenth century, the natural levees of Bayou Grand Caillou were under sugar cultivation. Sometime in the early twentieth century, a structure was erected along the east bank of Bayou Grand Caillou opposite the mouth of Bayou Pelton (see Figure 2-4) (USGS 1944). Standing along the east side of Grand Caillou Road, the structure may have been moved back when Grand Caillou Road was improved in the 1940s or early 1950s. Probably serving as a residence, it was joined by a secondary building by the mid 1950s (Ammann International 1956). Both structures were removed by 1964 (see Figure 2-6) (USGS 1964).

In addition to the construction and subsequent removal of those structures, the East/West Gulf South Pipeline was constructed through the area sometime between 1939 and

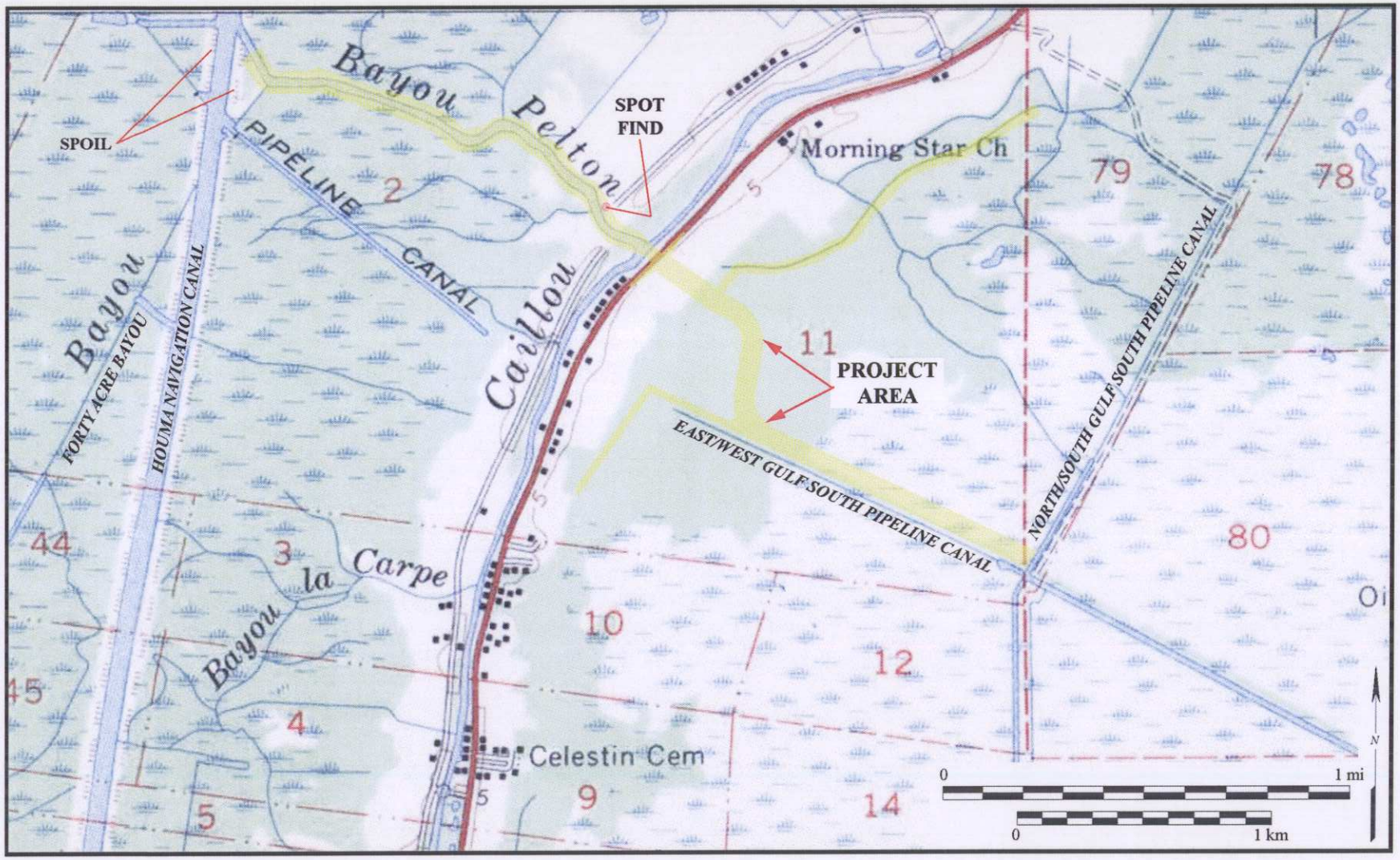

Figure 2-6. The Lake Boudreaux Basin Freshwater Diversion Project study area overlaid on a detail of the 1964 USGS *Dulac, Louisiana*, quadrangle. Note the recent excavation of the Houma Navigation Canal and the canal and back protection levee near Morning Star Church.

1956 (Ammann International Corporation 1956; USGS 1944) (see Figures 2-4 and 2-5). The North/South Gulf South Pipeline was likely laid about the same time. As noted above, the present project area closely follows the former canal and terminates at the latter. These were not the only excavations to occur in the area during this period. A back protection levee was also constructed behind the agricultural fields to the north of the East/West Gulf South Pipeline canal. The soil for the levee was obtained by digging an adjacent drainage canal along the east side of the levee. Both the levee and adjacent canal will be improved as part of the current project.

Since the mid twentieth century, there has been considerable salt water intrusion into the marshes and swamps between Lake Boudreaux and Bayou Grand Caillou. As a result, areas that were covered in marsh in the 1950s are now open water while the cypress swamps that flanked the natural levee of Bayou Grand Caillou have degraded considerably (compare Figures 1-2 and 2-5). In addition, there has been general subsidence throughout the region. Indeed, former agricultural fields in the vicinity of the project area are now often innundated and palmetto stands may be found in former sugarcane fields. Land loss has been particularly pronounced in the aftermath of Hurricane Katrina (Figure 2-7).

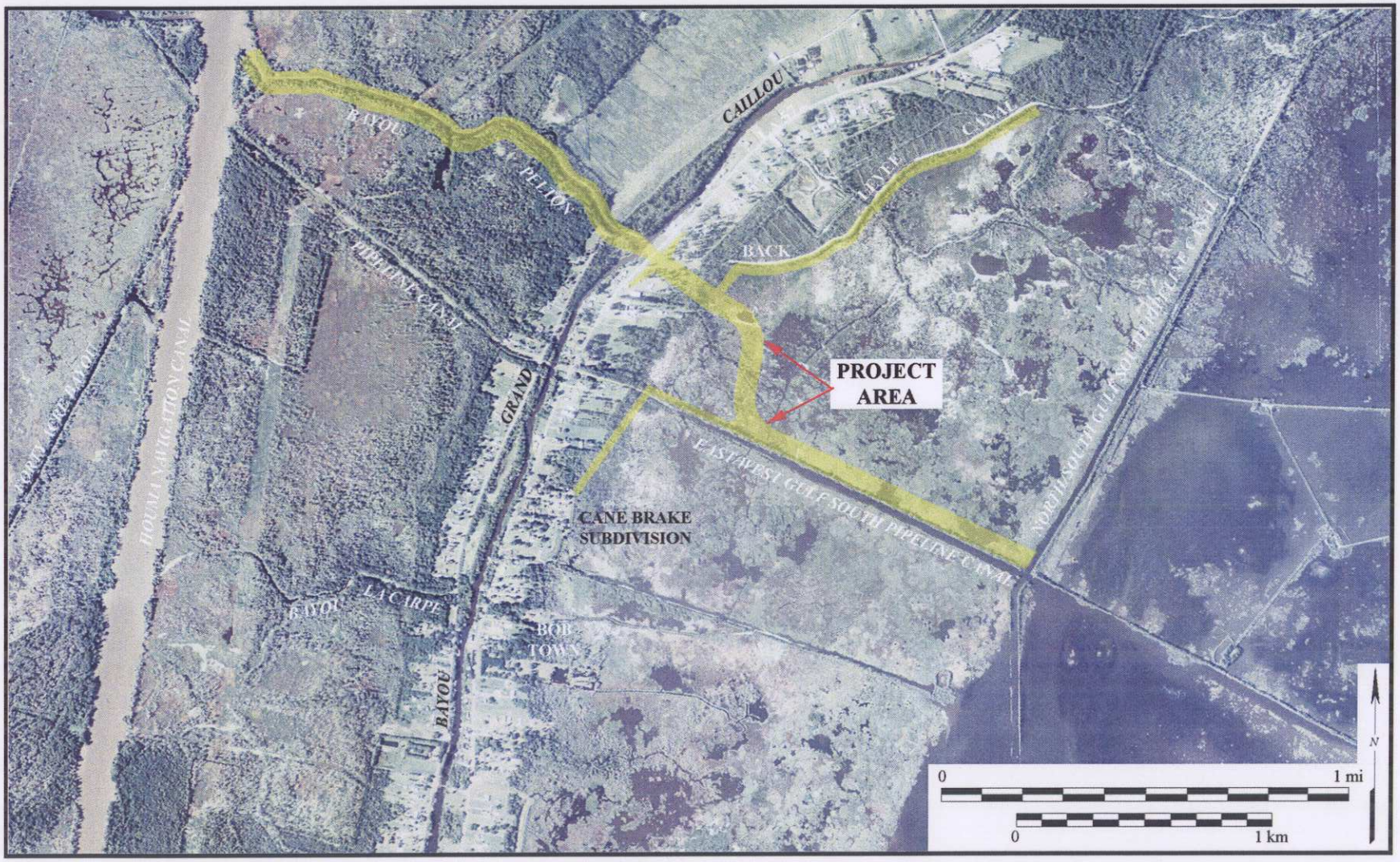

Figure 2-7. The Lake Boudreaux Basin Freshwater Diversion Project study area overlaid on a detail of the 2009 USGS *Dulac, Louisiana*, quadrangle. Note the degradation of the area's swamps and marshes (compare to Figure 2-5).

CHAPTER 3

ARCHAEOLOGICAL INVESTIGATIONS

Prior to the initiation of the field investigations, a brief archaeological and historical background study was conducted to determine what types of cultural resources might be encountered during the survey. Towards these ends, archaeological site forms on file at the Division of Archaeology, Louisiana Department of Culture, Recreation and Tourism, were consulted to determine how many known archaeological sites had been previously recorded within one mi (1.6 km) of the project area. That research revealed that only one site—the Indian Mound-Grand Caillou site (16TR38)—is located within one mile of the present project area, and then only barely.

The Indian Mound-Grand Caillou site (16TR38) is a Plaquemine period, multi-mound group located on the west bank of Bayou Grand Caillou, approximately .95 mi (1.53 km) south of the current project area (Figure 3-1). The site was initially identified by Randolph Bazet in 1936 and was visited by William McIntire and Fred Kniffen in 1952. At that time, the site (then known as the Bayou la Carpe site) was described as "three earthen temple mounds. One is 17' high, flat-topped, and 60' square on top, oriented N-S. North of this mound in a cane field is a smaller mound and W in the woods is another mound completing the mound complex. Much Pottery was reported to have been in the plowed fields adjacent to the mound complex" (xerographic copy of 13 August 1952 Louisiana State University site card for site "Terrebonne Parish, TR-38," copy on file at CEI, Baton Rouge). The "Pottery" noted by McIntire and Kniffen apparently refers to that collected in 1936 by Bazet.

In the 1960s, the land owner leveled the northernmost of the three mounds to increase his acreage for sugar cane cultivation. In the process, an unknown number of skeletal

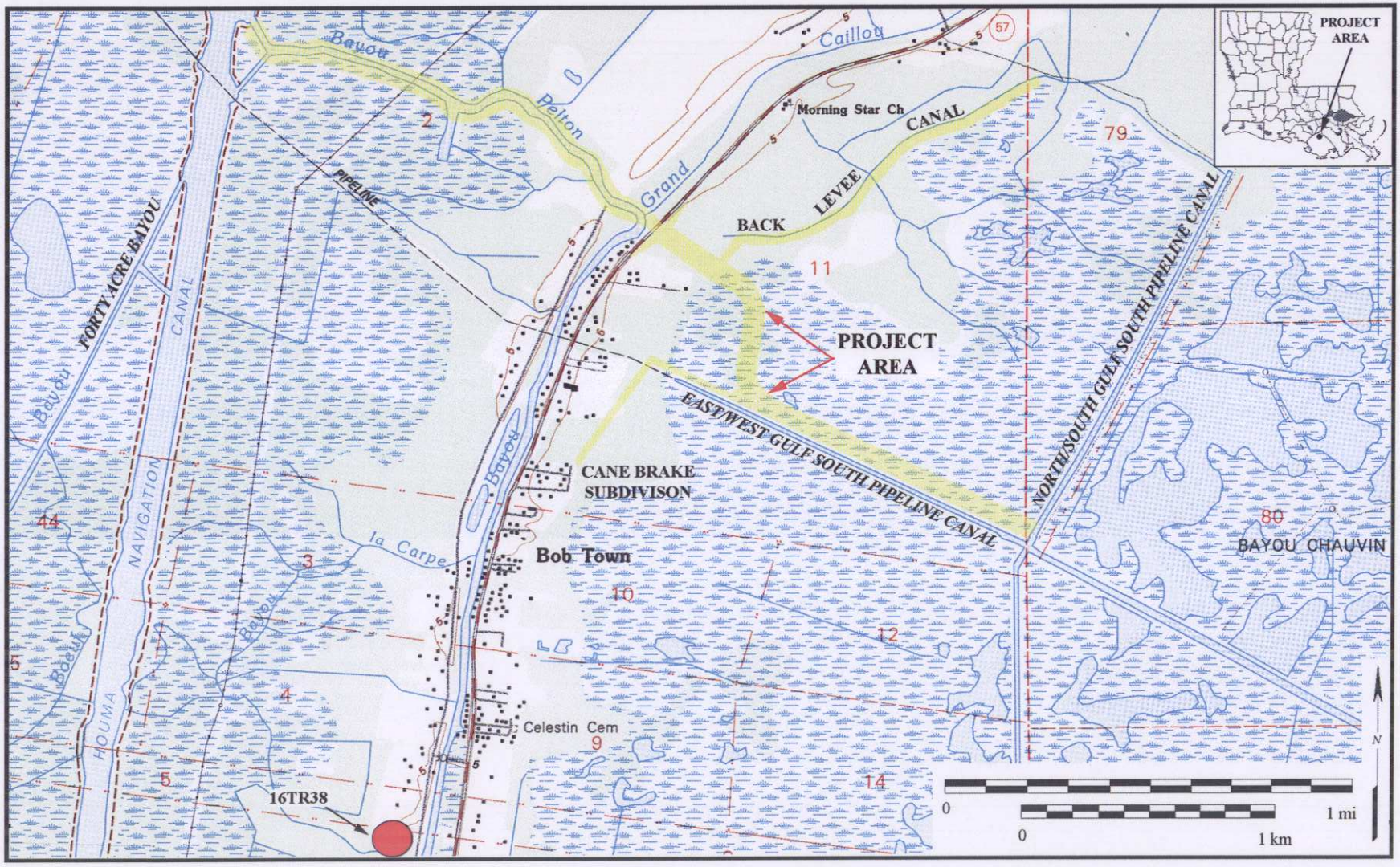

Figure 3-1. One previously identified archaeological site—the Indian Mound-Grand Caillou site (16TR38)—is located within one mile of the Lake Boudreaux Basin Freshwater Diversion Project study area.

fragments associated with one individual were exposed, which were retained by the land owner. In 1978, the same individual told Jeffery Altschul (1978:77) that Louisiana State University had conducted a field school at the site. That work reportedly consisted of the excavation of a trench from the base of the largest surviving mound to its summit. While Altschul noted that the trench was still clearly visible in the mound, he could not locate any record of those excavations. Hence, it is not known when that work occurred or what materials were recovered.

While Neuman (1974) briefly mentioned the site as part of an Environmental Impact Statement (EIS) study, it was not until Altschul (1978:77-83) visited the site in 1978 that subsurface archaeological investigations were conducted there—at least for which the results are known. In addition to mapping the site, Altschul made surface collections at 16TR38 as well as conducting limited shovel testing and excavating three 1-by1-m test pits. Based on his work, Altschul confirmed that the site dated to the Plaquemine period and that while site 16TR38 had been heavily disturbed, the two remaining mounds were worthy of further study. Though the site was revisited by the South Central Planning and Development Commission in 1982, no other investigations have been conducted there. At the time of the latter visit, it was noted that the site was threatened by its use as a dirt bike trail. Though the local police jury was interested in creating a park around the site and enclosing the area with a fence in 1982, the park apparently was never established and the current condition of the site is unknown (DOA Site Files).

In addition to examining existing archaeological site data, various cartographic sources were examined in an effort to determine how many, if any, improvements had been made in the project area vicinity during the historic period. To more fully understand historic development in the area, limited background research was also conducted to frame the historic setting of the project area. Much of that information is presented in Chapter 2.

Based on collected cartographic and historic data, there is a very low potential for cultural remains along the present channel of Bayou Pelton. Bayou Pelton was dammed by the late nineteenth century, cut into by Forty Acre Bayou at the turn of the twentieth century,

dredged and channelized in 1930–1931 and again in the 1940s or 1950s, crosscut by the Houma Navigation Canal in 1957–1958, and dredged yet again in the 1960s or 1970s. Very little, if any, of the original channel remains. Regardless of the degree of disturbance, Bayou Pelton was never substantial enough to have its own natural levees, and, hence, no land surfaces available for human occupation.

Unlike Bayou Pelton, Bayou Grand Caillou was a large enough stream to develop its own natural levees. As such, there is a high potential (Figure 3-2) for human occupation along its banks. Primarily used for agriculture during the historic period, a structure is known to have stood within the project area on the east bank of Bayou Grand Caillou in the early twentieth century (see Figure 2-4). When Grand Caillou Road was upgraded in the 1940s or early 1950s, however, the road apparently was straightened somewhat and the required ROW took in that house location. Though the home was apparently moved back and joined by another structure, both were removed in about 1960 (see Figure 2-5) (Ammann International Corporation 1956; USGS 1944, 1964).

Across Bayou Grand Caillou and on the south side of Bayou Pelton were several structures in the late 1930s (see Figure 2-4). Those structures were likely taken when Bayou Pelton was enlarged in the mid-nineteenth century. One structure may have survived that event, but was removed by 1964 (Ammann International Corporation 1956; USGS 1944, 1964).

Relatively low lying, occupation of the natural levees of Bayou Grand Caillou was probably limited to those areas very near the bayou itself. Indeed, areas beyond about 200 m (656 ft) from the bayou are inundated and have a low probability of containing cultural remains.

Both banks of Bayou Grand Caillou were deemed to have a high probability of containing cultural remains and were subjected to a pedestrian survey and shovel testing at 30-m intervals along 30-m transects (Figure 3-3). Outside of those areas, shovel testing was limited to those areas that were not inundated (Figure 3-4)—which were very limited (Figures 3-5 and 3-6). In inundated areas that were not amenable to pedestrian survey,

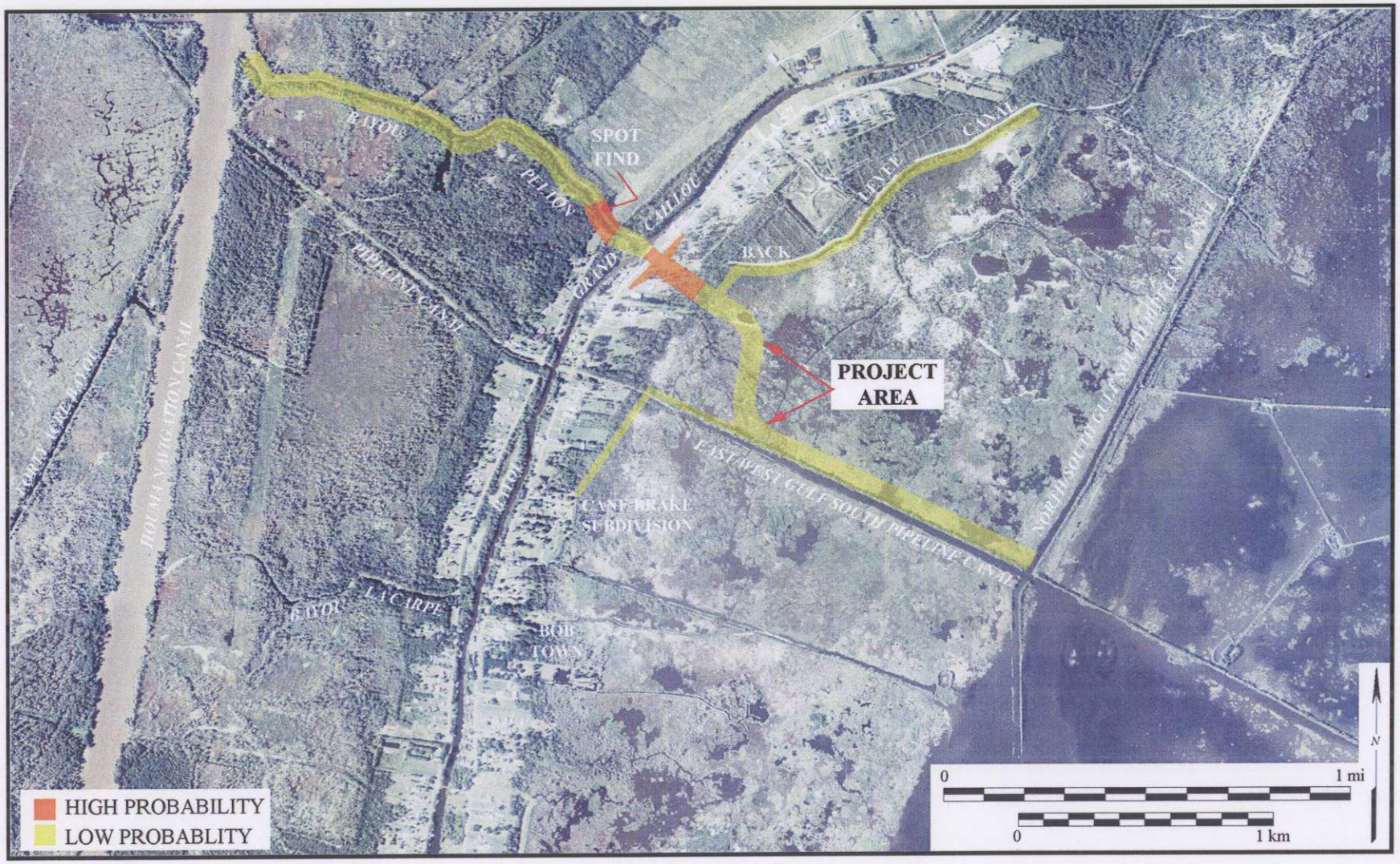

Figure 3-2. The Lake Boudreaux Basin Freshwater Diversion Project study area overlaid on a detail of the 2009 USGS *Dulac*, Louisiana, quadrangle showing high probability areas and the location of a spot find.

Figure 3-3. Shovel testing along the east bank of Bayou Grand Caillou. Pink flaggon marks the centerline of the Lake Boudreaux Basin Freshwater Diversion Project. Vegetation line in background consists mostly of palmetto and marks the edge of lands that are often inundated. View is to the southeast.

Figure 3-4. Shovel testing along the proposed ROW for the back protection levee connecting the East/West Gulf South Pipeline Canal to Cane Brake Subdivision. Note the wet conditions and abundant palmetto. View is to the east.

Figure 3-5. View along the proposed channel ROW for the Lake Boudreaux Basin Freshwater Diversion Project on the east bank of Bayou Grand Caillou. Note the standing water, palmetto and cypress trees that line the natural levee of the bayou. View is to the southeast.

Figure 3-6. View along the proposed ROW for the back protection levee to be constructed between the East/West Gulf South Pipeline Canal and Cane Brake Subdivision. Note the wet conditions and abundant palmetto. View is to the south-southwest.

an air boat was used to traverse the project area and a visual inspection made of those areas (Figure 3-7). A boat survey was also made along the waterways that pass through and adjacent to the project area (Bayou Pelton, the back levee canal, and the East/West Gulf South Pipeline Canal) so that a visual inspection could be made of the banks of those waterways (Figures 3-8 and 3-9). In addition, a pedestrian survey was conducted along the spoil banks of those waterways where possible (Figure 3-10). All shovel testing was conducted until sterile subsoil was encountered and all excavated material hand troweled and closely examined for cultural material (the heavy clays of the area precluded the use of ¼-in hard mesh screen). Representative soil profiles were taken across the project area (Figure 3-11). The location of every shovel test was recorded through the use of a Trimble GPS (Figure 3-12).

In terms of standing structures, virtually all of the buildings in the project area vicinity post-date 1994 (compare Figures 1-1 and 2-7). One of the few exceptions is a residence located on the east bank of Bayou Grand Caillou approximately 70 m (230 ft) south of the project area. Even that dwelling, however, apparently post dates 1964 (USGS 1964). There are no structures 50 years old or more within or immediately adjacent to the proposed project area.

Ultimately, only three areas were amenable to shovel testing: the triangular island formed by the juncture of Bayou Pelton, Forty Acre Bayou, and the Houma Navigation Canal; the west bank natural levee of Bayou Grand Caillou; and the east bank natural levee of Bayou Grand Caillou. Each of these three areas is discussed below. The remaining portions of the project area consist of inundated lands and spoil banks.

Triangular Island

The triangular island formed by the juncture of Bayou Pelton, Forty Acre Bayou, and the Houma Navigation Canal is a man-made feature formed by the accumulation of dredge spoil excavated from those waterways (Figure 3-13). As discussed in the previous chapter, the formation of the triangular island likely began with the excavation of Forty Acre Bayou.

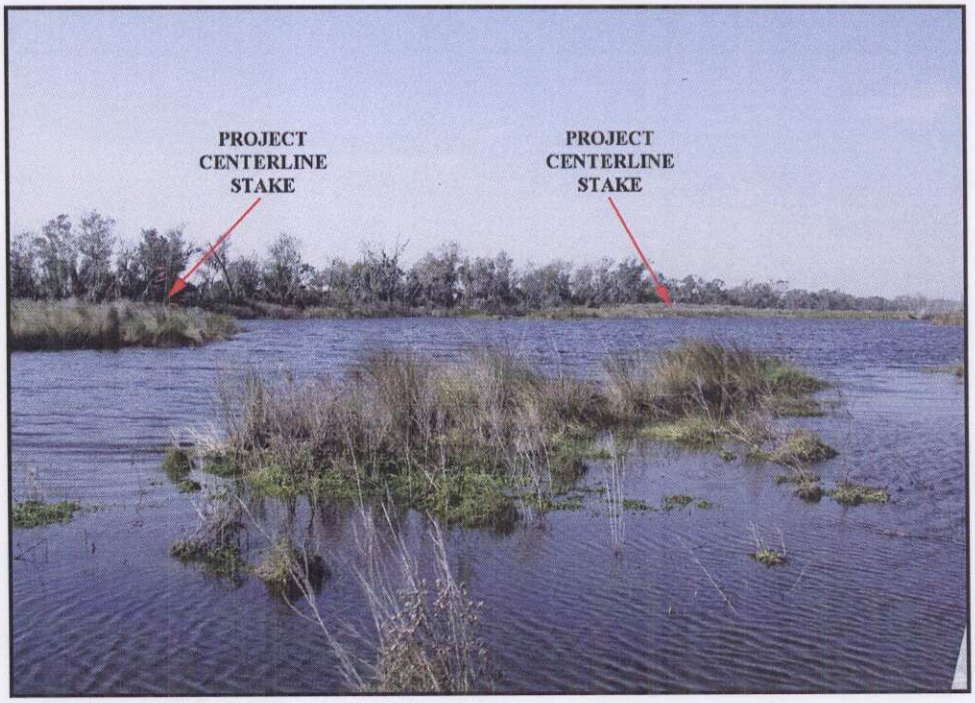

Figure 3-7. Open water in the marshes along the proposed channel ROW for the Lake Boudreaux Basin Freshwater Diversion Project. The tree line follows the spoil bank of the East/West Gulf South Pipeline Canal.

Figure 3-8. View of the Back Levee Canal. Spoil from the dredging of the canal was placed on its east (right) side. The canal will be redredged and the spoil bank upgraded to serve as a back protection levee. View is to the east-northeast.

Figure 3-9. View down the East/West Gulf South Pipeline Canal. Trees along the north (left) side of the canal are growing on the canal's spoil bank. View is to the east-southeast.

Figure 3-10. Surveying along the spoil bank of the Back Levee Canal. View is to the northeast.

Figure 3-11. Shovel testing the triangular island formed by the juncture of Bayou Pelton, Forty Acre Bayou, and the Houma Navigation Canal.

Figure 3-12. Recording the GPS location of a shovel test excavated near the juncture of Bayous Pelton and Grand Caillou. Bayou Pelton lies on the other side of the tree line visible in background of the photograph. View is to the northeast.

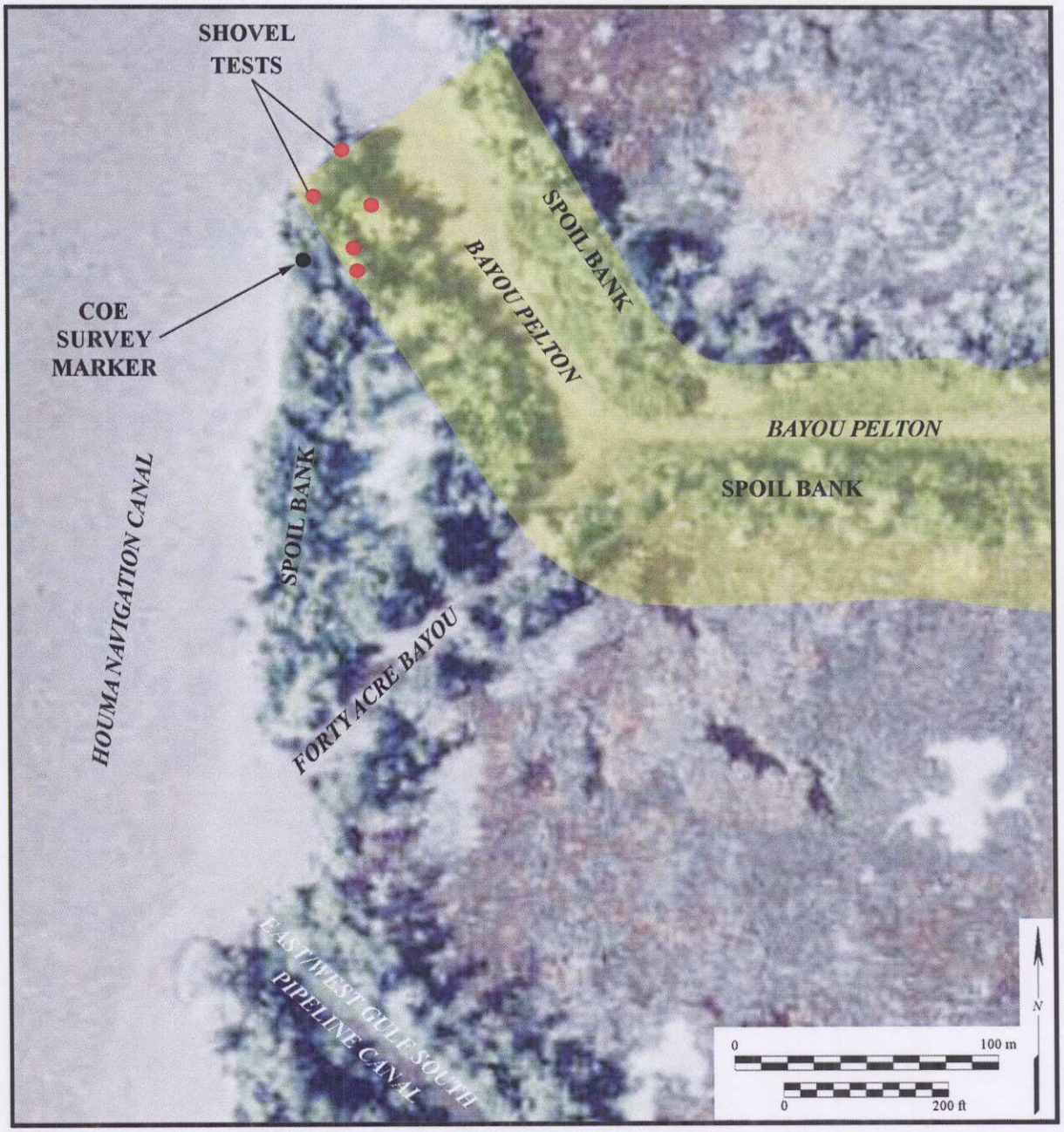

Figure 3-13. The Lake Boudreaux Basin Freshwater Diversion Project study area overlaid on a detail of the 2009 USGS *Dulac, Louisiana*, quadrangle depicting the locations of shovel tests excavated on the small, man-made, triangular island formed by the juncture of Bayou Pelton, Forty Acre Bayou, and the Houma Navigation Canal. All shovel tests were negative.

Though the date of that excavation is not precisely known, the man-made "bayou" was extant by the 1930s. In 1930–1931, Bayou Pelton was channelized and dredge spoil from that work deposited on the south side of the bayou. In 1957–1958, dredge spoil from the excavation of the Houma Navigation Canal was deposited on top of the 1930–1931 dredge spoil—creating the island that exists today (see Figures 2-6 and 3-13).

Eroded back along the Houma Navigation Canal, the accumulated dredge spoil is quite impressive along that waterway (Figure 3-14). Within the Houma Navigation Canal cutbank are large quantities of rangia *cuneata*. Draped throughout the cutbank, the rangia are obviously redeposited—almost certainly from the excavation of that waterway. Close examination of those deposits (Figure 3-15) revealed that there are a number of large articulated shells within them, suggesting that they are from a natural deposit rather than from a culturally deposited midden. Examination of the cutbank failed to locate any cultural material, further supporting the supposition that they are from a natural deposit.

Five shovel tests were excavated on the northern tip of the island (see Figure 3-13). All were excavated in dredge spoil. The typical shovel test in this area encountered up to 46 cm of very dark grayish brown (10YR 3/2) clay mixed with dark grayish brown (10YR 4/2) clay mixed with rangia and oyster hash (Figure 3-16). Underlying that material to a depth of 58 cm (the base of excavation) was an oxidized, sterile dark grayish brown (10YR 4/2) clay. With the exception of a modern encampment on the island, no cultural material was found either in the shovel tests or during the course of the pedestrian survey.

West Bank Natural Levee of Bayou Grand Caillou

As noted above, Bayou Pelton has undergone numerous alterations during the historic period. Even along the natural levee of Bayou Grand Caillou there has been considerable alteration of the channel. Not only has the bayou been dredged on multiple occasions, spoil from those activities was piled along the north side of the bayou. In addition, a road following the west bank of Bayou Grand Caillou has its turn-around at Bayou Pelton within the present project area and a mobile home has been placed nearby on the south side of

Figure 3-14. Exposed cutbank along the Houma Navigation Canal at the triangular island formed by the juncture of Bayou Pelton, Forty Acre Bayou, and the Houma Navigation Canal. Note the draped deposits of the dredge spoil and the copious amounts of *Rangia cuneata*. No artifacts were found in this area. The COE survey marker on the top bank (right) roughly marks the southern boundary of the project area. View is to the east.

Figure 3-15. Examining the exposed cutbank along the Houma Navigation Canal at the triangular island formed by the juncture of Bayou Pelton, Forty Acre Bayou, and the Houma Navigation Canal. Note the COE survey marker on top bank directly above fieldcrew member. View is to the northeast.

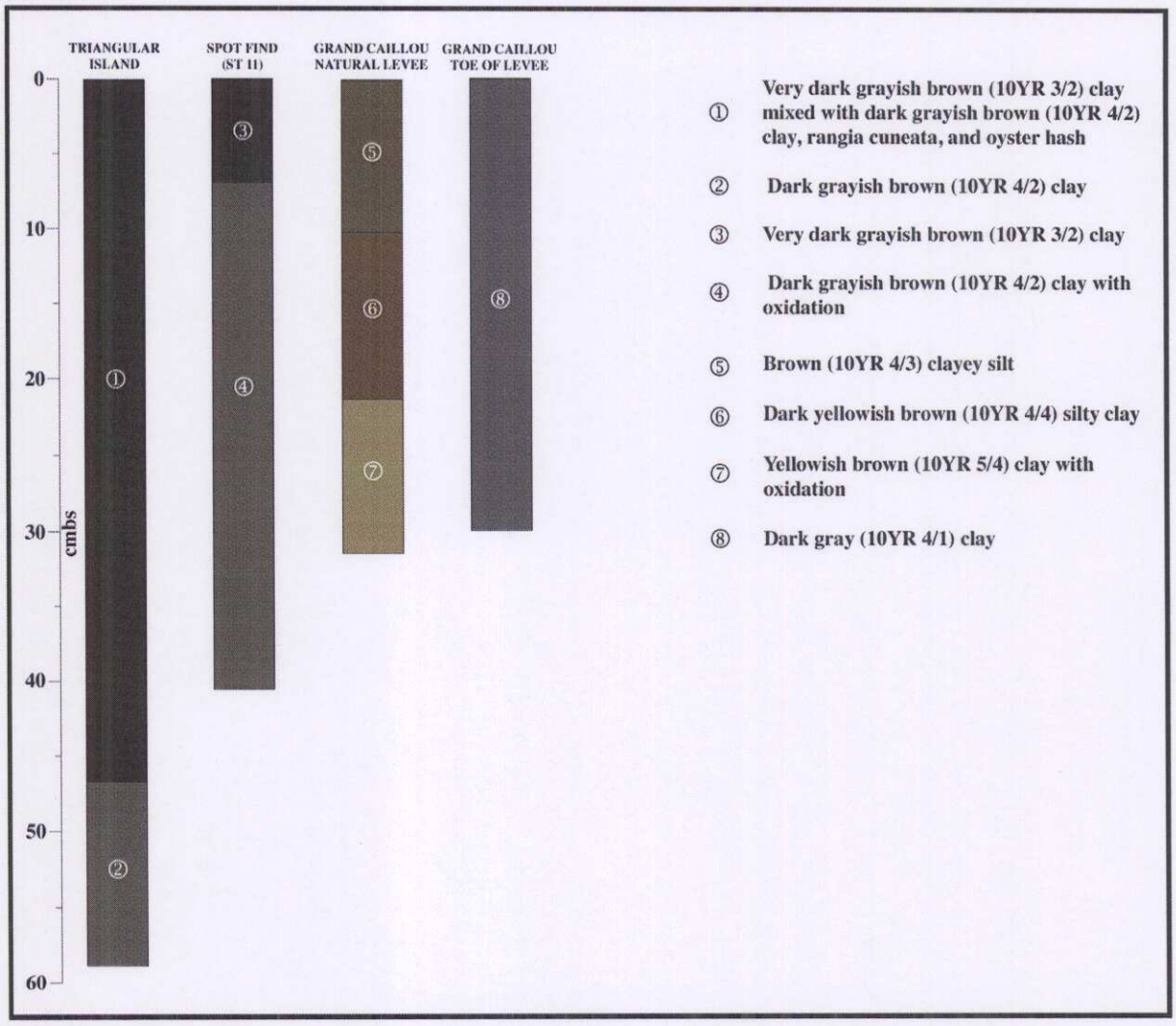

Figure 3-16. Typical profiles of shovel tests excavated within the Lake Boudreaux Basin Freshwater Diversion Project study area.

Bayou Pelton. The latter area has also been altered by the excavation of assorted drainages and an apparent oil field road.

Ten shovel tests were excavated along the south side of Bayou Pelton on the natural levee of Bayou Grand Caillou (Figure 3-17). None of those shovel tests encountered cultural material despite the fact that several structures are known to have stood in that general area during the mid-twentieth century. As noted above, the widening of Bayou Pelton between 1939 and 1956 may have resulted in the removal of those structures. One structure may have survived into the 1950s (Figure 3-18). However, the aforementioned street turn-around is located at that particular locality. Low lying and covered with a scatter of modern debris and trash, shovel testing was not conducted in the filled channel of Bayou Grand Caillou.

While conducting shovel testing along the north side of Bayou Pelton, one of the systematic shovel tests (Shovel Test 7) revealed cultural material—a shard of modern green bottle glass (i.e., Sprite bottle), a shard of a clear glass bottle and a small brick fragment—between 0 and 25 cmbs. Though the recovered glass appeared to be of relatively recent manufacture, the area was grided off into 10-m squares and shovel testing commenced on that grid (Figure 3-19). In all, 22 shovel tests were excavated in that area (not including six shovel tests excavated on the 30-m grid), seven of which yielded cultural material. In addition to the aforementioned items, three pieces of whiteware, two pieces of ferrous metal, a clear glass bottle fragment, another brick fragment, and four oyster shells were recovered from depths of up to 35 cmbs. A piece of plastic was also recovered from a depth of 25 cmbs from Shovel Test 8.

Generally, the shovel tests excavated in this area revealed from 6 to 17 cm of very dark grayish brown (10YR 3/2) clay overlying sterile oxidized, dark grayish brown (10YR 4/2) clays, regardless of whether the upper stratum of the test was positive or negative (see Figure 3-16). Excavated in a low lying area, many of the shovel tests, particularly those excavated more than 20 m from Bayou Pelton (Figure 3-20), quickly filled with ground water. The slight difference in elevation between those shovel tests excavated nearer the water's edge is probably due to dredge spoil that was dumped along the edge of the bayou.

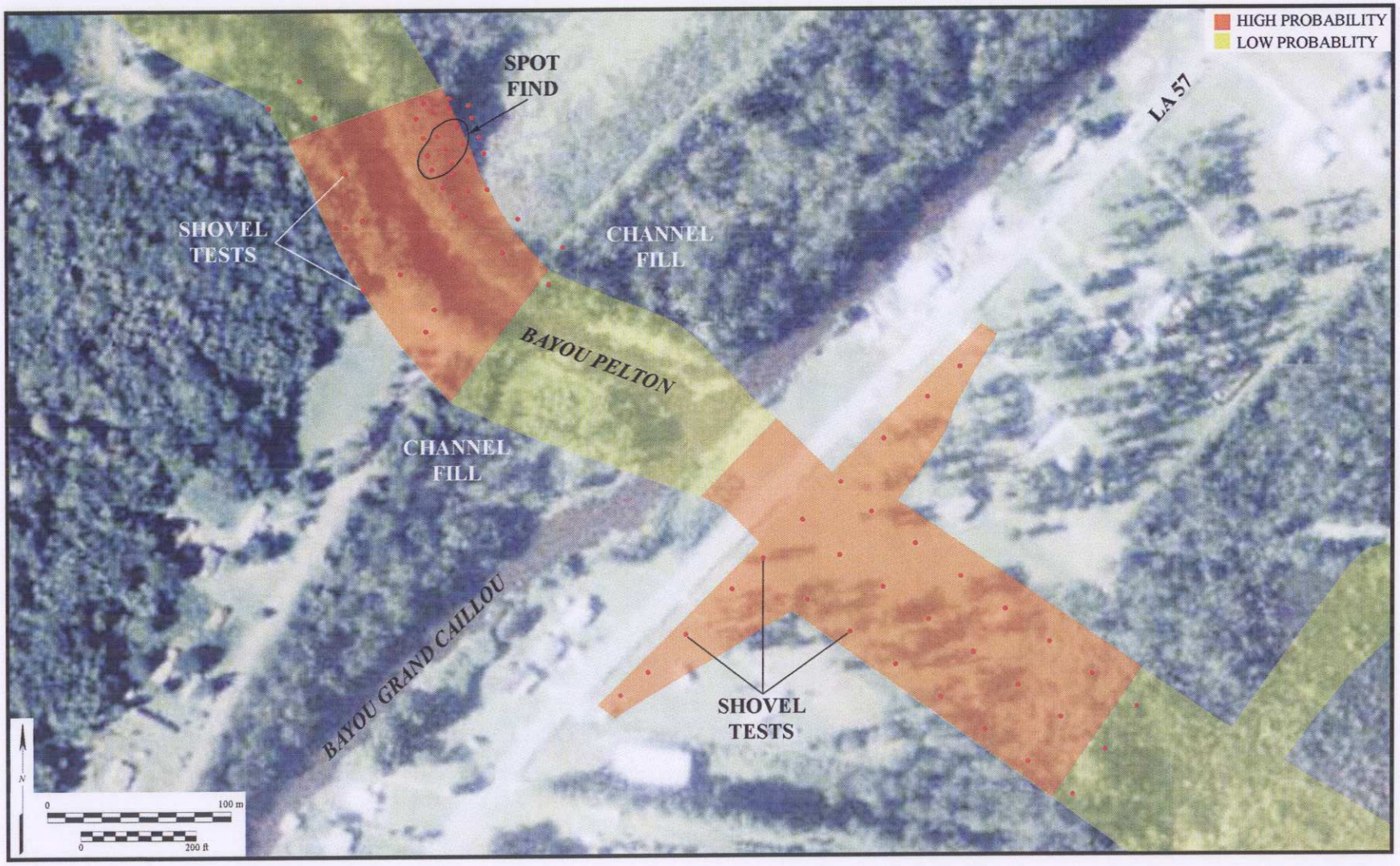

Figure 3-17. The Lake Boudreaux Basin Freshwater Diversion Project study area overlaid on a detail of the 2009 USGS *Dulac, Louisiana*, quadrangle depicting the locations of shovel tests excavated along the natural levees of Bayou Grand Caillou. All shovel tests were negative, except for those within the limits of the Spot Find (see Figure 3-19 for detail drawing).

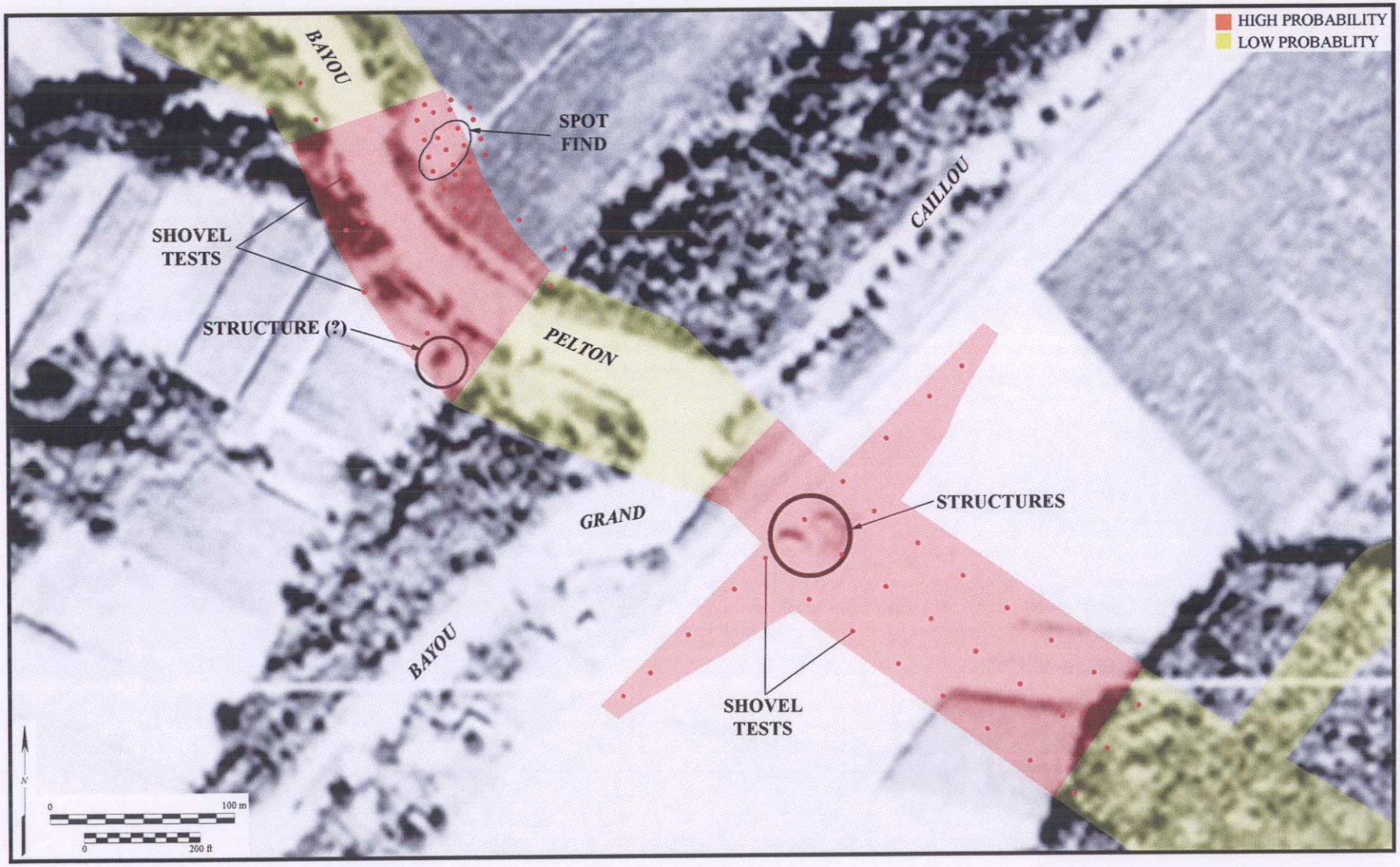

Figure 3-18. The Lake Boudreaux Basin Freshwater Diversion Project study area overlaid on a detail of Ammann International Corporation's 1956 aerial photomosaic of the juncture of Bayous Pelton and Grand Caillou depicting the locations of shovel tests excavated along the natural levees of Bayou Grand Caillou. Note the structures along the two bayous.

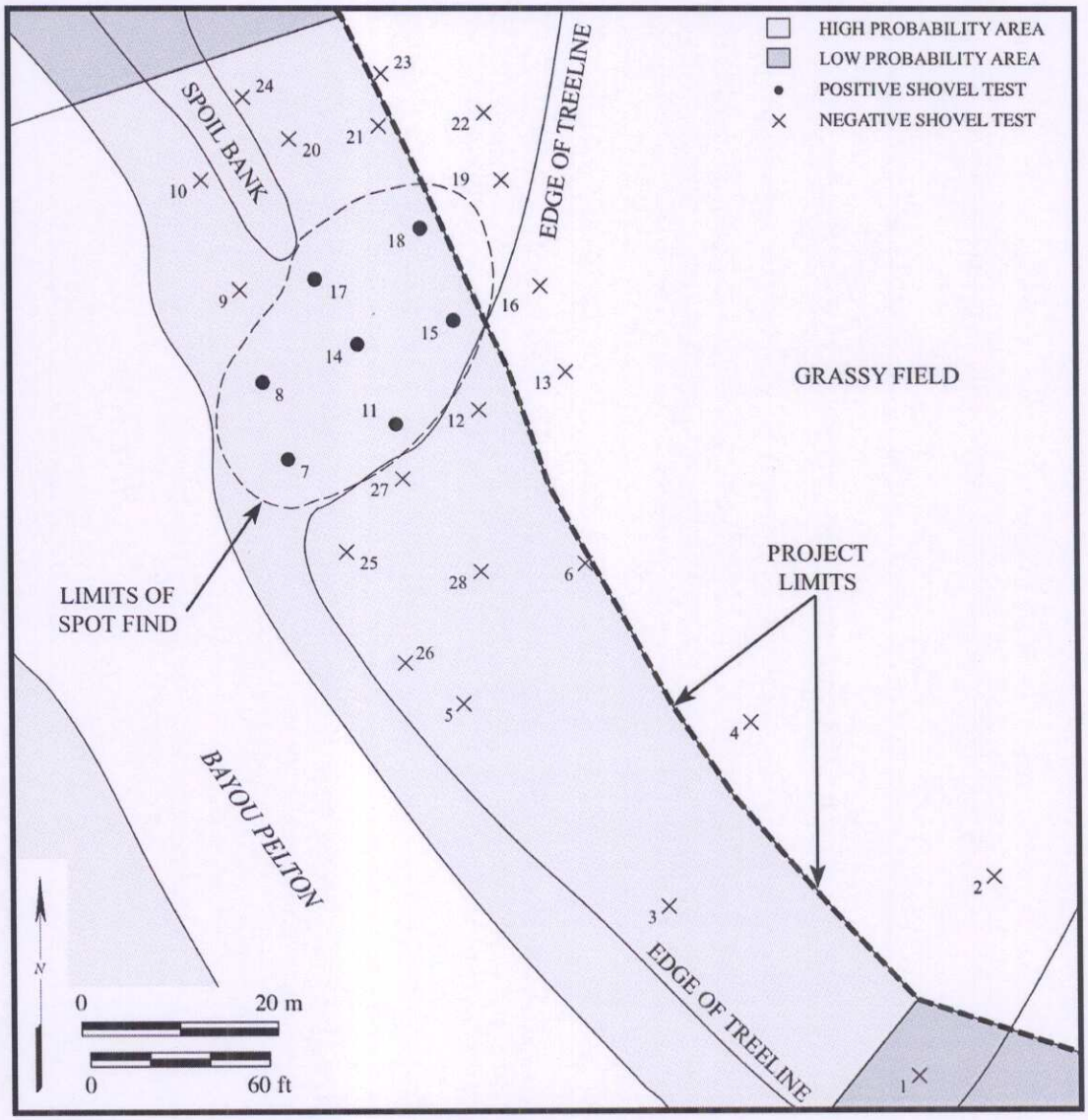

Figure 3-19. Sketch map of the spot find located near the juncture of Bayous Pelton and Grand Caillou.

Figure 3-20. General view of the spot find located on north bank of Bayou Pelton (extreme left). Note that the surface of Bayou Pelton is less than 20 cm below the ground surface, despite the fact that this is the highest area in the immediate vicinity. View is to the north-northwest.

Although there was not a noticeable spoil bank in the area of the positive shovel tests, a spoil bank was extant to their immediate north (see Figure 3-19). All of the positive shovel tests were located a short distance within the tree line that borders Bayou Pelton.

None of the numerous historic maps of the area depict any improvements along the north side of Bayou Pelton—with the exception of a late nineteenth century levee (see Chapter 2). Though not precluding the presence of improvements, the cartographic data strongly suggests that the area was unimproved during the second half of the twentieth century—the apparent time period of the few recovered artifacts. Low and wet (see Figure 3-20), the area is not particularly amenable for habitation. Opportunistically located at the end of a field road in the 1960s (see Figure 2-6), however, the area would have served as a convenient trash disposal area. Indeed, some of the material is likely even more recent. Noted on the ground surface of the area, but not collected, were several modern shotgun shells and animal skeletons. The skeletons indicate that the area is still used for refuse disposal while the shotgun shells suggest the area is sometimes used for "plinking." Because none of the recovered cultural material is necessarily greater than 50 years old and the two items that could be reasonably dated (plastic and modern green glass) are of relatively modern manufacture, this deposit is considered to be a spot find and not an archaeological site.

East Bank Natural Levee of Bayou Grand Caillou

A total of 31 shovel tests were excavated along the east bank natural levee of Bayou Grand Caillou (see Figures 3-17 and 3-18). Seven of those shovel tests were excavated within the additional ROW needed to realign LA 57, the remainder within the ROW for the channel of the diversion canal. Shovel testing was not conducted beyond 200 m from Bayou Grand Caillou as the area was inundated (see Figure 3-5). Nearer Bayou Grand Caillou, the typical shovel test encountered 10 cm of brown (10YR 4/3) clayey silt overlying a dark yellowish brown (10YR 4/4) silty clay. The second stratum extended down to a depth of 21cmbs and overlay an oxidized yellowish brown (10YR 5/4) clay. The third stratum extended to the base of excavations at 31 cmbs. Farther from the river, the shovel tests

encountered only dark gray (10YR 4/1) clay to the base of excavations, which quickly filled with water. None of the shovel tests excavated along the east bank natural levee of Bayou Grand Caillou yielded cultural material, despite the fact that several shovel tests straddled the area that was occupied by two structures in the mid twentieth century (see Figure 3-18). The lack of artifactual material is likely due in part to the short period of occupation—no more than 20 years. The clean soils of the area combined with the very flat landform suggests that the area may have been graded as well. Similarly there was no artifactual evidence of the earlier structure in this area, probably because that locality is under the existing roadway.

In addition to the above shovel tests, five shovel tests were excavated along the ROW for the back protection levee connecting the East/West Gulf South Pipeline Canal to Cane Brake Subdivision (see Figure 3-4). That area was very wet and the shovel tests immediately filled with water. In fact, the shovel tests filled so rapidly that it was not possible to record the soil types. None of the shovel tests excavated along the East/West Gulf South Pipeline Canal to Cane Brake Subdivision yielded artifactual material.

CHAPTER 4

RESULTS

CEI was contracted by T. Baker Smith, of Houma, Louisiana, to conduct a Phase I Cultural Resources Survey of the proposed Lake Boudreaux Basin Freshwater Diversion Project (TE-32a) in Terrebonne Parish, Louisiana (see Figure 1-1). That survey revealed one spot find consisting of a light scatter of late twentieth century cultural material on the north shore of Bayou Pelton near its juncture with Bayou Grand Caillou. No archaeological sites or standing structures over 50 years in age were encountered during the course of these examinations.

The lack of cultural remains within the project area is due in part to its location and in part to the number of disturbances that have occurred there over the years. The Lake Boudreaux Basin Freshwater Diversion Project is located in an area that is largely inundated. Trending roughly perpendicular to the area's streams, the only natural levee crossed by the project area is along Bayou Grand Caillou. However, much of the project area closely follows Bayou Pelton, including at its intersection with Bayou Grand Caillou. Bayou Pelton has been drastically modified over the past 100 years, probably destroying whatever cultural resources there may have been along its banks. Similarly, Bayou Grand Caillou has been dredged on numerous occasions, also potentially impacting area cultural resources. In addition to waterway maintenance, the construction of roadways along Bayou Grand Caillou has been detrimental to the preservation of cultural resources—former house sites now lie under roadways. With the exception of Bayou Grand Caillou's natural levees, there simply are no landforms available for human occupation, past or present. As these investigations did not reveal any archaeological sites or standing structures over 50 years in age, no further work is recommended in regard to the Lake Boudreaux Basin Freshwater Diversion Project.

All records, photographs, and field notes associated with the project will be curated with:

State of Louisiana
Department of Culture, Recreation, and Tourism
Division of Archaeology
P.O. Box 44247
Baton Rouge, Louisiana 70804-4247
(225) 342-8170

in the curation facility at:

Galvez Building
602 N. Fifth Street
Baton Rouge, Louisiana 70802
(225) 342-4475

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APPENDIX I

NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION

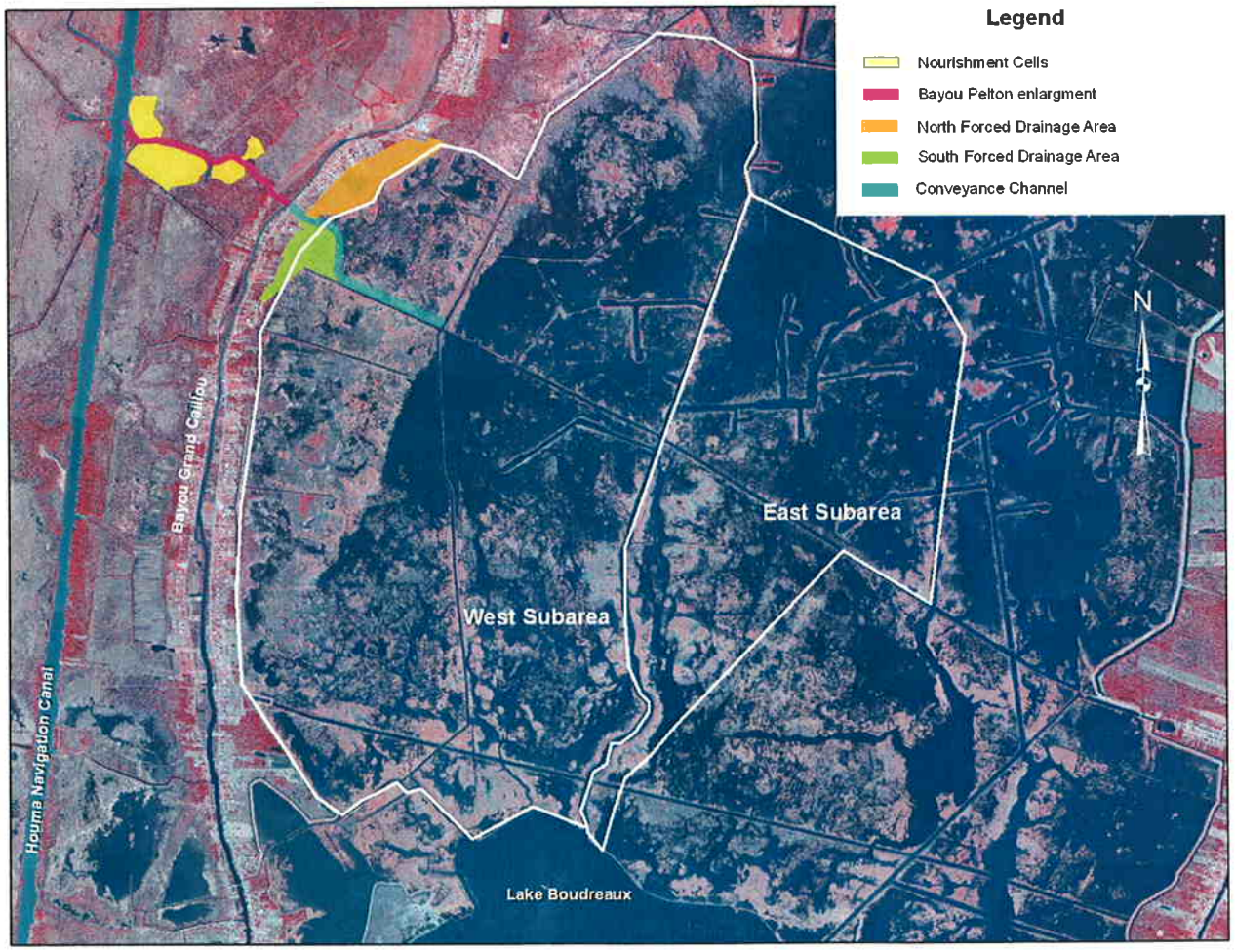
PROJECT (TE-32a)

PROJECT INFORMATION SHEET FOR WVA, April 2010

North Lake Boudreaux Basin Freshwater Introduction Project (TE-32a)
Project Information Sheet for Revised WVA
April 2010

The North Lake Boudreaux Basin Freshwater Introduction Project (TE-32a) was authorized by the CWPPRA Task Force on April 24, 1997, as part of the 6th Priority Project List. The project, sponsored by the U.S. Fish and Wildlife Service and the Louisiana Dept. of Natural Resources, would affect 9,600 acres of cypress swamp, intermediate and brackish marshes located in Terrebonne Parish. The project area extends northward from Bayou Butler and the north shore of Lake Boudreaux to the treatment lagoons of the South Terrebonne Water Treatment Plant, and between Bayou Chauvin to the east and Bayou Grand Caillou to the west (Figure 1).

Figure 1. Map depicting areas affected by the proposed project.



Project Justification Marsh loss within the project area has been high throughout the 1980's and 1990's due to subsidence, hydrologic alterations, and subsequent saltwater intrusion. The organic freshwater marshes in this area have converted to open water and intermediate to brackish marshes. Cypress swamps and wax myrtle thickets have also experienced substantial losses. Given the very organic nature of area soils, high marsh loss rates are expected to continue unless salinities can be lowered and stabilized. Based on marsh loss rates from 1983-1990, an additional 1,100 acres of

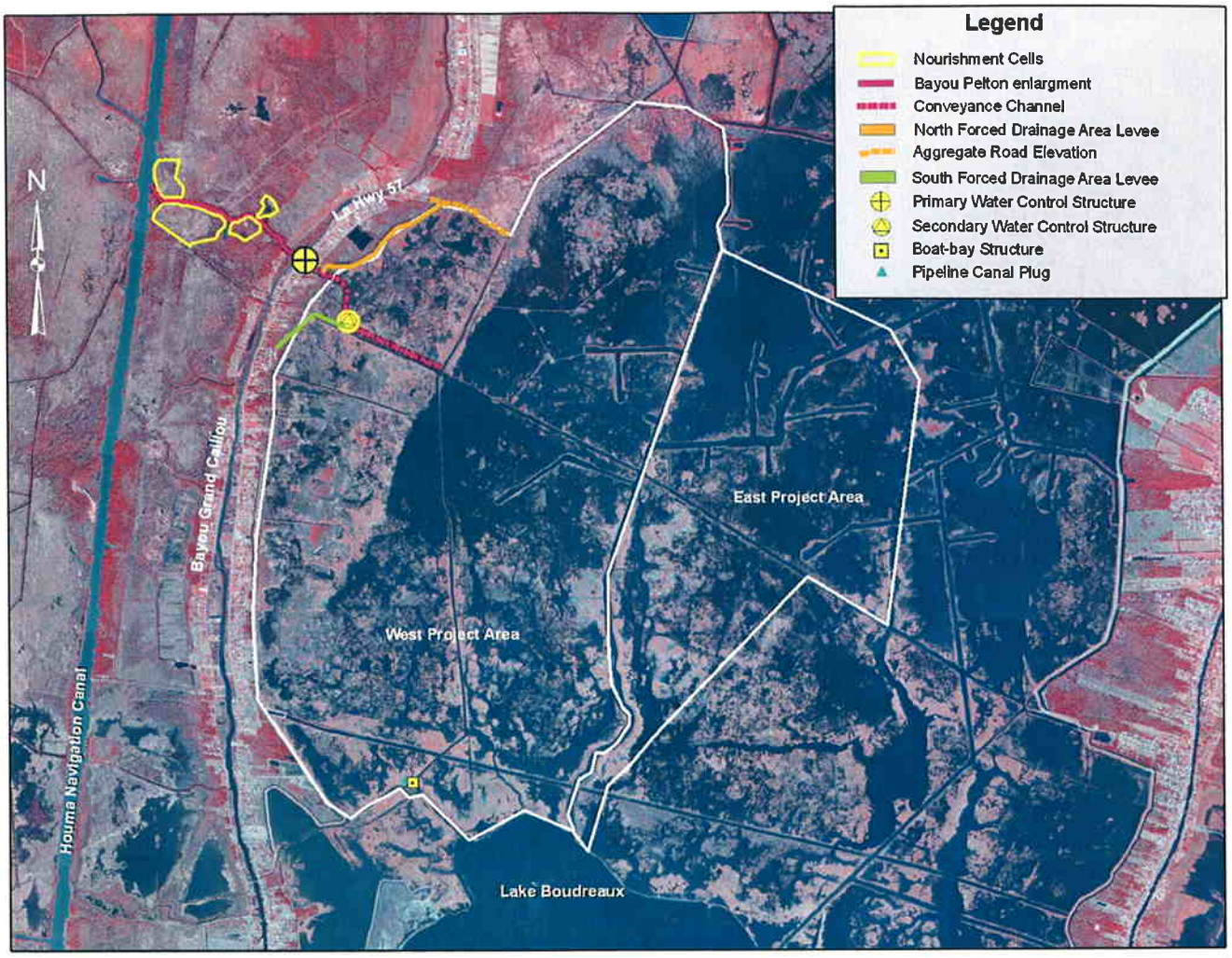
marsh in the project area will be lost over the next 20 years, and in 50 years, virtually all the marshes north of Lake Boudreaux may be lost.

The Proposed Project The project has been designed to achieve the Coast 2050 Regional Strategy #4, "Enhance Atchafalaya River influence to Terrebonne marshes, excluding upper Penchant marshes"). Specifically, the project introduce fresh water from the Houma Navigation Canal (HNC), when available. During periods of moderate to high Atchafalaya River flow, fresh water from the Lower Atchafalaya River flows eastward through the Gulf Intracoastal Waterway to the HNC, and then southward down the HNC to the Gulf of Mexico. Continuous salinity data from the HNC near Bayou Pelton, reveal that at that location, fresh water conditions occurred at least 75 percent of the time during 1994 through 1999. On high tide, water levels in Bayou Grand Caillou range up to 6 inches higher than the brackish waters within the marshes north of Lake Boudreaux. The nutrients, sediments, and dissolved minerals in this water will enhance the growth of stressed marsh vegetation, promote revegetation of shallow water areas, make area vegetation more tolerant of seasonal brackish water conditions, and reduce plant die-offs. The introduced fresh water should also improve the health of the remaining cypress trees and fresh to intermediate marshes in the northwestern portion of the Lake Boudreaux Basin. A large (Primary Water Control Structure) gated water control structures will be installed on the conveyance channel to prevent freshwater drainage from the upper Lake Boudreaux Basin, and to prevent saltwater intrusion into the basin

Project Features The following is a list of planned project features (Figure 2).

1. Enlarge Bayou Pelton, and portions of Bayou Grand Caillou, to approximately 120' wide by 10' deep to bring fresh water from the HNC to the proposed conveyance channel. Spoil will be placed in 4 adjoining wetland nourishment cells.
2. Construct a conveyance channel (approximately 100' wide by 8' deep) from Bayou Grand Caillou to the east/west running Gulf South Pipeline Canal located north of Lake Boudreaux. Continuous spoil banks will be constructed on both sides of this channel.
3. At Hwy 57, install Primary Water Control Structure in the conveyance channel to prevent freshwater backflow or saltwater intrusion into the project area from the HNC. This structure, consisting of six 10ft by 10ft concrete box culverts, will be mechanized to open and close automatically to admit fresh water when appropriate.
4. Rebuild Highway 57 on top of the main control structure
5. Install a boat bay structure (24-ft-wide by 2-ft-deep) on the wash-around channel connecting the north/south Gulf South Pipeline Canal with Bayou Butler. This structure will help to direct freshwater flows eastward toward Bayou Chauvin (see Type 2 structure – Appendix E).
6. Install an earthen plug on the Gulf South Pipeline Canal at Bayou Butler to ensure proper functioning of the Bayou Butler boat bay structure.
7. Construct a forced drainage system from Canebrake northward to St. Louis Canal to prevent project-induced higher water levels in the freshwater introduction area from aggravating flooding of developed properties along the east side of Bayou Grand Caillou. This includes possibly raising the existing aggregate road along the north boundary and replacing culverts under that road.
8. Install an 8-ft-wide by 2.5-ft-deep flapgated, variable-crest weir in the conveyance channel spoil bank to discharge fresh water northward via a large trenasse, into the degraded swamps north of the conveyance channel (see Type 1 structure – Appendix E)

Figure 2. Map of project features.



Revision of the March 31, 2008 WVA was needed to assess construction impacts identified after completion of the 95% project designs. The 2008 WVA assessed benefits and construction impacts for the proposed conveyance channel only. Impacts associated with the forced drainage areas and Bayou Pelton enlargement were not previously determined. Provided below is information regarding each of the January 2010 WVAs conducted and associated major assumptions.

1. East Subarea Receiving Marsh. This WVA is essentially the same as that of March 2008, except that the TY0 year was pushed back to 2011 for this and all WVAs. Therefore, TY0 acreage and percent marsh have changed.

2. West Subarea Receiving Marsh. Construction impacts associated with the entire North Forced Drainage Levee, 50% of the levee berm acreage, and the conveyance channel impacts were included within this assessment. Marshes impacted by the South Forced Drainage area and levee were removed from this WVA and addressed via a separate WVA. The acreage of spoil banks and levees created via construction of the North Forced Drainage Levee/Berm and the spoil bank acreage of the Conveyance Channel has been removed from the FWP project area; and the marsh acres impacted by these features, plus the borrow canal acreage, have been removed from the TY1 FWP marsh acreage. Estimated freshwater introduction flows remain the same as per the March 31, 2008 WVA.

3. North Forced Drainage Area Marsh. This area was not included within the USGS project area boundary for the receiving area marshes. Impacts to this area were determined via separate WVA.

4. North Forced Drainage Area bottomland hardwoods WVA. Impacts to enclosed forested and shrub-scrub areas were assessed in this model. Conveyance channel construction impacts to forested and shrub-scrub areas adjoining this forced drainage area are included in this WVA.

5. South Forced Drainage Area. Because this area is partly within the USGS project area boundary, the enclosed area and associated levee impacts were evaluated via a separate WVA (FWOP and FWP). Consequently, those impacted areas have been removed from the West Subarea in order to fully address them under the South Forced Drainage area WVA.

6. South Forced Drainage Area bottomland hardwoods WVA. Impacts due to construction of the levee enclosing this area, plus impacts to forested and enclosed shrub-scrub areas were assessed in this model.

7. Bayou Pelton marsh WVA. Construction impacts to marshes within the bayou were assessed in this WVA.

8. Bayou Pelton bottomland hardwoods WVA. This WVA assessed construction impacts to existing forested habitats along the bayou banks. Shrub-scrub was lumped together with hardwoods in this WVA.

9. Bayou Pelton Nourishment Cells marsh WVA. This WVA assessed impacts to marshes in the 4 cells that will receive material dredged from Bayou Pelton. It is assumed that after consolidation, fill area elevations will be raised up to 6 inches.

10. Bayou Pelton Nourishment Cells bottomland hardwood WVA. This WVA assessed impacts to hardwoods and shrub-scrub areas within the 4 cells that will receive material dredged from Bayou Pelton. It is assumed that after consolidation, fill area elevations will be raised up to 6 inches.

Information on the above-mentioned WVAs follows below:

East and West Subarea Receiving Marshes WVA. Marsh acreages and wetland loss rates were obtained using the standard wetland loss formula/methods. Field observations indicate that in 2008, the West Subarea consisted primarily of INT marsh. Likewise the East Subarea was primarily BR marsh. According to 2006 USGS data:

West Subarea (2006)	East Subarea (2006)
Total Area = 6,782 ac	Total Area = 2,822 ac
Water Area = 2,612 ac	Water Area = 1,645 ac
Marsh Area = 4,170	Marsh Area = 1,177 ac

Because 30 acres of West Subarea marsh & water are located in the portion of the South Forced Drainage Area located within the USGS project boundary for the West Subarea, that acreage was removed from the project area. Because 24.6 acres of that removed area was marsh, 24.6 acres were removed from the TY0 marsh acreage. The revised West Subarea baseline data are as follows:

Revised West Subarea Total Area = 6,782 – 30 = 6,752 acres
Revised West Subarea TY0 marsh = 3,706 – 24.6 = 3,681 acres

Construction of the North Forced Drainage Levee/Berm converts 9.21 acres of project area marsh to non-wetlands, and construction of the Conveyance Channel converts 17.21 ac of marsh & water to non-wetland

spoil bank. Hence, the FWP project area was reduced by 26.42 ac to 6,726 acres. Likewise, total construction marsh impacts of 35.0 acres were subtracted from the TY1 marsh acreage (9.21 ac - forced drainage levee/berm, plus 25.79 ac - conveyance channel construction).

Table 1. FWOP and FWP marsh acres, West Subarea receiving marshes.

Project:	TE32a - West Subarea (with construction impacts)					Begin Year	Ending Year	Begin Year Acres	End Year Acres	Loss Rate
	Total Acres		2006 Marsh Acres		2006 Water Acres	1988	2006	6,379	4,170	-0.023
	6,752		4,170		2,582	FWP Land Loss Reduction			0.16	

	FWOP					FWP					Net Marsh acres
Year	TY	Loss Rate	Marsh (acres)	% Marsh (V1)	Water (acres)	TY	Loss Rate	Marsh (acres)	% Marsh (V1)	Water (acres)	
2006	-5		4,170	62%	2,582	-5		4,170	62%	2,582	0
2007	-4	-0.0233	4,073	60%	2,679	-4	-0.0233	4,073	60%	2,679	0
2008	-3	-0.0233	3,978	59%	2,774	-3	-0.0233	3,978	59%	2,774	0
2009	-2	-0.0233	3,885	58%	2,867	-2	-0.0233	3,885	58%	2,867	0
2010	-1	-0.0233	3,794	56%	2,958	-1	-0.0233	3,794	56%	2,958	0
2011	0	-0.0233	3,681	55%	3,071	0	-0.0233	3,681	55%	3,071	0
2012	1	-0.0233	3,595	53%	3,157	1	-0.0196	**3,574**	53%	3,178	-21
2013	2	-0.0233	3,511	52%	3,241	2	-0.0196	3,504	52%	3,248	-7
2014	3	-0.0233	3,429	51%	3,323	3	-0.0196	3,435	51%	3,317	6
2015	4	-0.0233	3,349	50%	3,403	4	-0.0196	3,368	50%	3,384	18
2016	5	-0.0233	3,271	48%	3,481	5	-0.0196	3,302	49%	3,450	31
2017	6	-0.0233	3,195	47%	3,557	6	-0.0196	3,237	48%	3,515	42
2018	7	-0.0233	3,120	46%	3,632	7	-0.0196	3,173	47%	3,579	53
2019	8	-0.0233	3,047	45%	3,705	8	-0.0196	3,111	46%	3,641	64
2020	9	-0.0233	2,976	44%	3,776	9	-0.0196	3,050	45%	3,702	74
2021	10	-0.0233	2,907	43%	3,845	10	-0.0196	2,990	44%	3,762	84
2022	11	-0.0233	2,839	42%	3,913	11	-0.0196	2,932	44%	3,820	93
2023	12	-0.0233	2,773	41%	3,979	12	-0.0196	2,874	43%	3,878	101
2024	13	-0.0233	2,708	40%	4,044	13	-0.0196	2,818	42%	3,934	110
2025	14	-0.0233	2,645	39%	4,107	14	-0.0196	2,762	41%	3,990	118
2026	15	-0.0233	2,583	38%	4,169	15	-0.0196	2,708	40%	4,044	125
2027	16	-0.0233	2,523	37%	4,229	16	-0.0196	2,655	39%	4,097	132
2028	17	-0.0233	2,464	36%	4,288	17	-0.0196	2,603	39%	4,149	139
2029	18	-0.0233	2,406	36%	4,346	18	-0.0196	2,552	38%	4,200	146
2030	19	-0.0233	2,350	35%	4,402	19	-0.0196	2,502	37%	4,250	152
2031	20	-0.0233	2,295	34%	4,457	20	-0.0196	2,453	36%	4,299	158

Table 2. FWOP and FWP marsh acres, East Subarea receiving marshes.

Project:	TE32a - East Subarea				Begin Year	Ending Year	Begin Year Acres	End Year Acres	Loss Rate
Total Acres		2006 Marsh Acres		2006 Water Acres	1988	2006	2,493	1,177	-0.041
2,822		1,177		1,645	FWP Land Loss Reduction			0.05	

	FWOP					FWP					
Year	TY	Loss Rate	Marsh (acres)	% Marsh (V1)	Water (acres)	TY	Loss Rate	Marsh (acres)	% Marsh (V1)	Water (acres)	Net Marsh acres
2006	-5		1,177	41.7%	1,645	-5		1,177	41.7%	1,645	0
2007	-4	-0.0408	1,129	40.0%	1,693	-4	-0.0408	1,129	40.0%	1,693	0
2008	-3	-0.0408	1,083	38.4%	1,739	-3	-0.0408	1,083	38.4%	1,739	0
2009	-2	-0.0408	1,039	36.8%	1,783	-2	-0.0408	1,039	36.8%	1,783	0
2010	-1	-0.0408	996	35.3%	1,826	-1	-0.0408	996	35.3%	1,826	0
2011	0	-0.0408	956	33.9%	1,866	0	-0.0408	956	33.9%	1,866	0
2012	1	-0.0408	916	32.5%	1,906	1	-0.0389	918	32.5%	1,904	2
2013	2	-0.0408	879	31.2%	1,943	2	-0.0389	883	31.3%	1,939	4
2014	3	-0.0408	843	29.9%	1,979	3	-0.0389	848	30.1%	1,974	5
2015	4	-0.0408	809	28.7%	2,013	4	-0.0389	815	28.9%	2,007	7
2016	5	-0.0408	776	27.5%	2,046	5	-0.0389	784	27.8%	2,038	8
2017	6	-0.0408	744	26.4%	2,078	6	-0.0389	753	26.7%	2,069	9
2018	7	-0.0408	714	25.3%	2,108	7	-0.0389	724	25.6%	2,098	10
2019	8	-0.0408	684	24.3%	2,138	8	-0.0389	696	24.7%	2,126	11
2020	9	-0.0408	657	23.3%	2,165	9	-0.0389	669	23.7%	2,153	12
2021	10	-0.0408	630	22.3%	2,192	10	-0.0389	643	22.8%	2,179	13
2022	11	-0.0408	604	21.4%	2,218	11	-0.0389	618	21.9%	2,204	14
2023	12	-0.0408	579	20.5%	2,243	12	-0.0389	594	21.0%	2,228	14
2024	13	-0.0408	556	19.7%	2,266	13	-0.0389	571	20.2%	2,251	15
2025	14	-0.0408	533	18.9%	2,289	14	-0.0389	548	19.4%	2,274	15
2026	15	-0.0408	511	18.1%	2,311	15	-0.0389	527	18.7%	2,295	16
2027	16	-0.0408	490	17.4%	2,332	16	-0.0389	506	17.9%	2,316	16
2028	17	-0.0408	470	16.7%	2,352	17	-0.0389	487	17.3%	2,335	16
2029	18	-0.0408	451	16.0%	2,371	18	-0.0389	468	16.6%	2,354	17
2030	19	-0.0408	433	15.3%	2,389	19	-0.0389	450	15.9%	2,372	17
2031	20	-0.0408	415	14.7%	2,407	20	-0.0389	432	15.3%	2,390	17

Generally, the diversion would operate during periods of high and medium Atchafalaya River discharge when freshwater conditions usually exist within upper reaches of the Houma Navigation Canal (HNC). Based on 1994-1999 salinity data from the HNC at the Bayou LaCarpe gage (located 1.4 miles south of the Bayou Pelton – HNC junction), salinities are less than 1.0 ppt for an average of 242 days/yr, and between 1.0 and 2.0 ppt for an additional 44 days per year. It is assumed that the diversion will be operated whenever HNC salinities are less than 2.0 ppt (286 days per year).

FWP wetland acreages were generated through the use of the Boustany Diversion Benefits

Model. Discharge inputs to that model were obtained from UNET modeling conducted during the project's engineering and design phase. As part of that effort, maximum and minimum discharges were reported for 4 input tidal cycles at 90% exceedance (low Atchafalaya River flow conditions) and 10% exceedance (high Atchafalaya River flows).

Based on the HNC salinity data referenced above, the diversion would operate between the 0 percent and 78 percent exceedance conditions (286 days/yr). However, model-estimated diversion discharges (cfs) are available for only 10% and 90% exceedance conditions as shown below.

Tabel 3. Model-predicted high Atchafalaya River flow conditions – 10% Exceedance

FLOWS	1st tidal cycle		2nd tidal cycle		3rd tidal cycle		4th tidal cycle	
Station	Max	Min	Max	Min	Max	Min	Max	Min
C	992	683	1031	62	846	492	684	334

Table 4. Model-predicted low flow conditions – 90% Exceedance

FLOWS	1st tidal cycle		2nd tidal cycle		3rd tidal cycle		4th tidal cycle	
Station	Max	Min	Max	Min	Max	Min	Max	Min
C	775	-245	899	-247	706	-450	392	-503

Station C is located on the conveyance channel just east of Bayou Grand Caillou. Flows at that location represent the total amount of water that would be introduced into the upper Lake Boudreaux Basin. From the above model outputs the following average discharges have been calculated as follows:

10% Exceedance:
Ave Max Q = **888 cfs**
Ave Min Q = 0 cfs ** *assume zero as per Fig. 1 WL data & to simplify analysis* **
Average Q = 444 cfs

90% Exceedance:
Ave Max Q = **693 cfs**
Ave Min Q = 0 cfs **neg.Qs replaced w "0" due to control structure operations* **
Average Q = 347 cfs

The average diversion discharge could be estimated by the mean flows of the predicted 10% exceedance through 70% exceedance flows. As the model output provided only the 10% Max exceedance flows, the 20% through 70% Max exceedance flows were estimated from the difference between the 10% and 90% exceedance flows. In all cases, Ave Min flows were assumed to be zero.

The following exceedance flow values used to calculate average flow are as follows:

Ave Max 10% Exc Q = 888 cfs	Ave Min Q = 0	Average 10% Exc Q = 444 cfs
Ave Max 20% Exc Q = 864 cfs	Ave Min Q = 0	Average 20% Exc Q = 432 cfs
Ave Max 30% Exc Q = 839 cfs	Ave Min Q = 0	Average 30% Exc Q = 420 cfs
Ave Max 40% Exc Q = 815 cfs	Ave Min Q = 0	Average 40% Exc Q = 408 cfs
Ave Max 50% Exc Q = 791 cfs	Ave Min Q = 0	Average 50% Exc Q = 396 cfs
Ave Max 60% Exc Q = 766 cfs	Ave Min Q = 0	Average 60% Exc Q = 383 cfs
Ave Max 70% Exc Q = 742 cfs	Ave Min Q = 0	Average 60% Exc Q = 371 cfs

Annual average flow = average of the above 10% - 70% average exceedence flows such that:
Annual Average Diversion Discharge = 408 cfs

The proposed conveyance channel discharges directly into the west subarea. Water reaching the east subarea would flow through the west subarea to get there. To apply the Boustany Model under these circumstances,

a portion of the average discharge is assumed to benefit only the west subarea and the remainder assumed to affect only the east subarea. This assumed flow distribution was determined by multiplying the maximum diversion-related stage increases (Table 1 and Figure 1) by the water acreage of each subarea to estimate the volume of water added to each subarea due to the diversion.

Table 5. Model-predicted maximum project area stages.

Area	10% Exceedance With-Project Max Stage (2nd tidal cycle)	10% Exceedance Baseline Max Stage (2nd tidal ycle)	**Overall Stage Diff (ft)**
SA2	1.96	1.61	**0.35**
SA4	1.93	1.61	**0.32**
SA5	1.84	1.60	**0.24**
SA6	1.85	1.61	**0.24**
SA7	1.81	1.60	**0.21**
SA8	1.84	1.61	**0.23**

The only stage increase output for the east subarea (LB3 storage area – see Figure 2), is a 0.21 foot maximum increase over baseline conditions. This value, when multiplied by the 1,866 water acres (TY0) of the east subarea, yields 392 acre-ft of additional water. Similarly determined maximum stage increases within the west subunit storage areas for SA6 = 0.24 ft, for SA7 = 0.21 ft, and for SA8= 0.23 ft. Those storage areas contain the great majority of west subunit water areas. Water acreages for those storage areas are visually estimated as: SA6 = 24% SA7 = 38% SA8 = 38%.

Multiplying those percentages by the total west subunit TY1 water acreage of 3,071 acres, allows the estimation of storage area water acreages. Multiplication of those acreages by the above-listed storage area stage increases, allows one to estimate the volume of additional water as follows:

SA6-	0.24 x 3,071 ac = 737 ac	x	0.24 ft =	177 acre-ft	(26%)
SA7-	0.38 x 3,071 ac = 1167 ac	x	0.21 ft =	245 acre-ft	(35%)
SA8-	0.38 x 3,071 ac = 1167 ac	x	0.23 ft =	268 acre-ft	(39%)
				---	
				690 acre-ft	

Summing the volume increases for each subarea allows the calculation of total volume increase and percent volume increase. Percent flow distribution is assumed to equal the percent volume increases.

East subarea volume increase = 392 acre-ft (36%)
West subarea volume increase = 690 acre-ft (64%)

1082 acre-ft

If the average diversion discharge is 408 cfs, then . . .

the east subarea would receive 408 cfs * 0.36 = 147 cfs
the west subarea would receive 408 cfs * 0.64 = 261 cfs

Because the proposed diversion would not flow continuously during the days it operates, the number of operation days (286) was multiplied by the fraction of hours per day during which diversion would occur (12.9/24 – based on 1996 water level data). The result is a flow equivalent of 154 days of continuous 24-hour-a-day introduction. Information on other Boustany Model inputs are provided below.

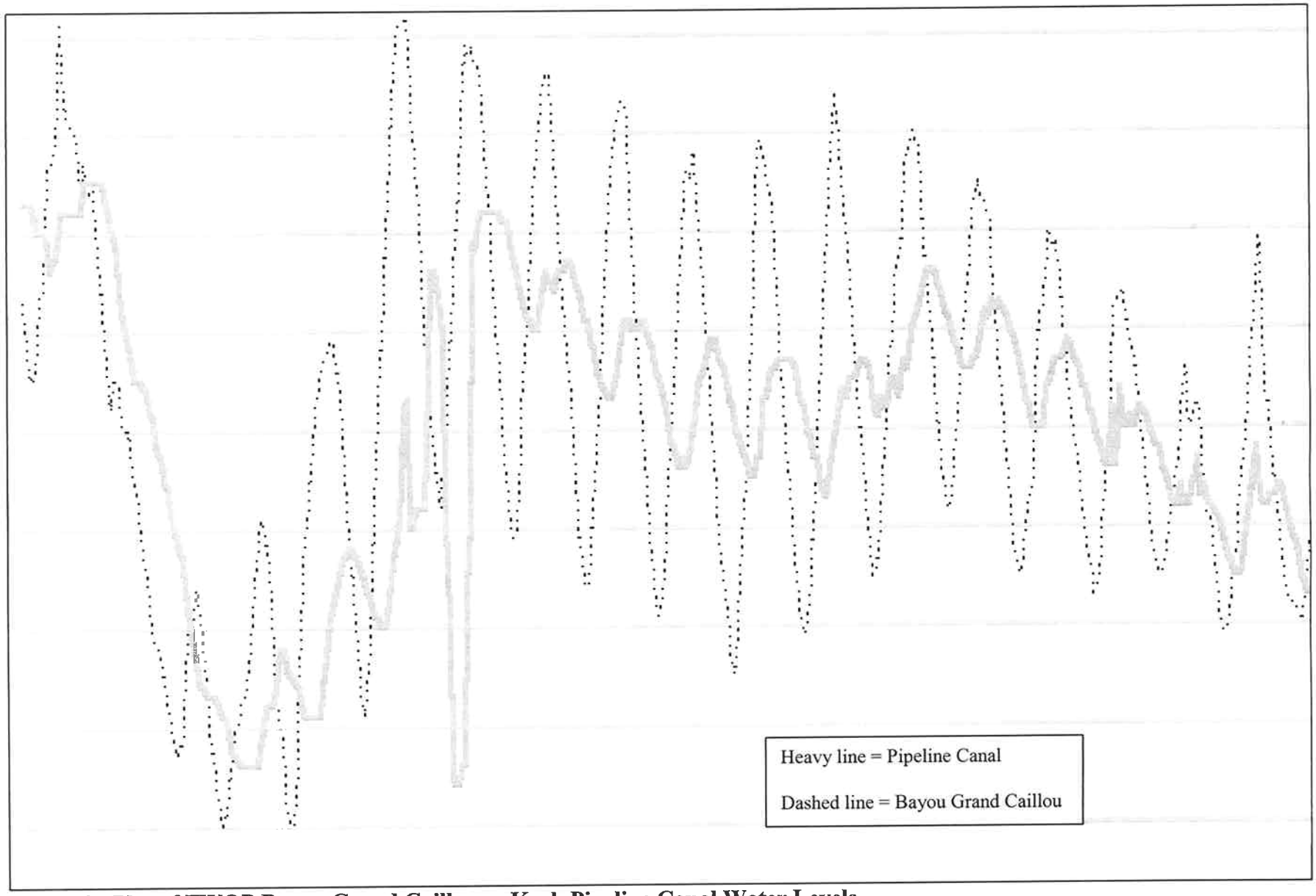
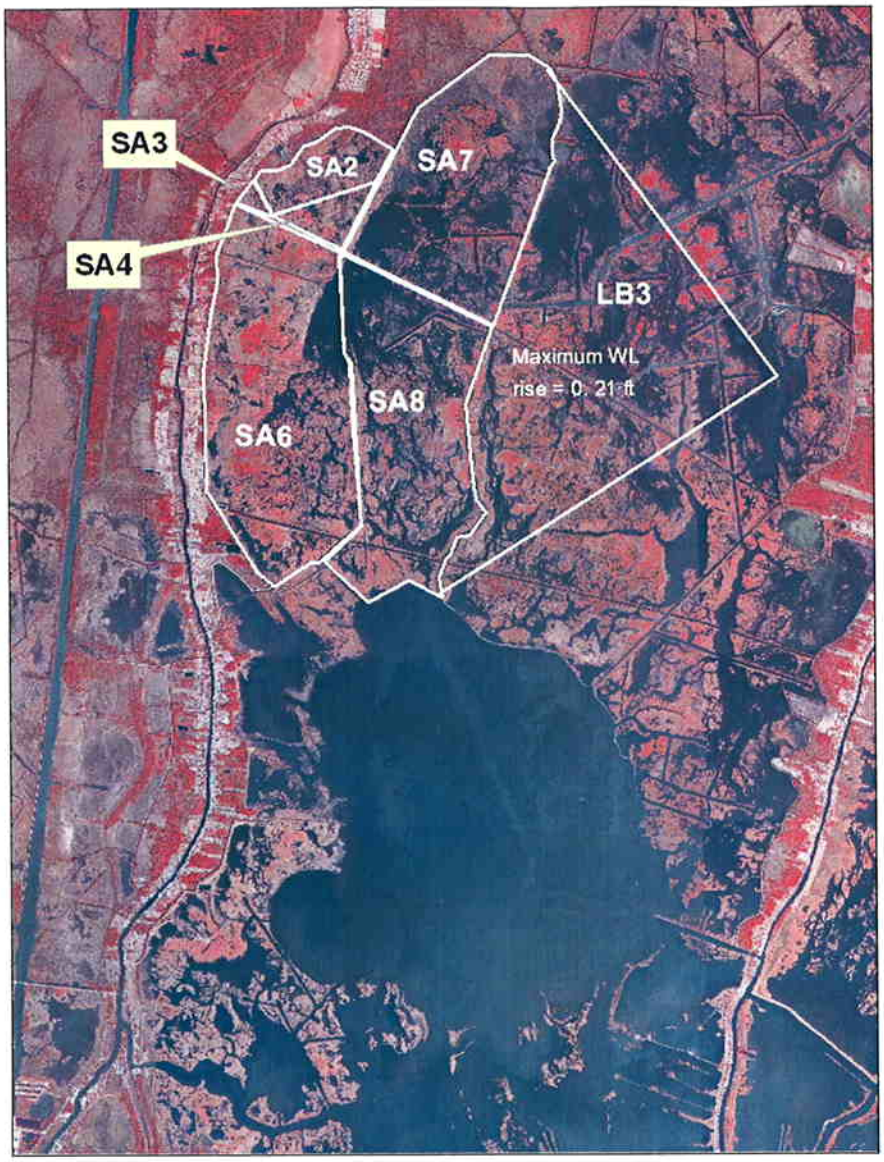


Figure 3. Plot of FWOP Bayou Grand Caillou vs Koch Pipeline Canal Water Levels

Figure 4. Map depicting modeled water storage areas.

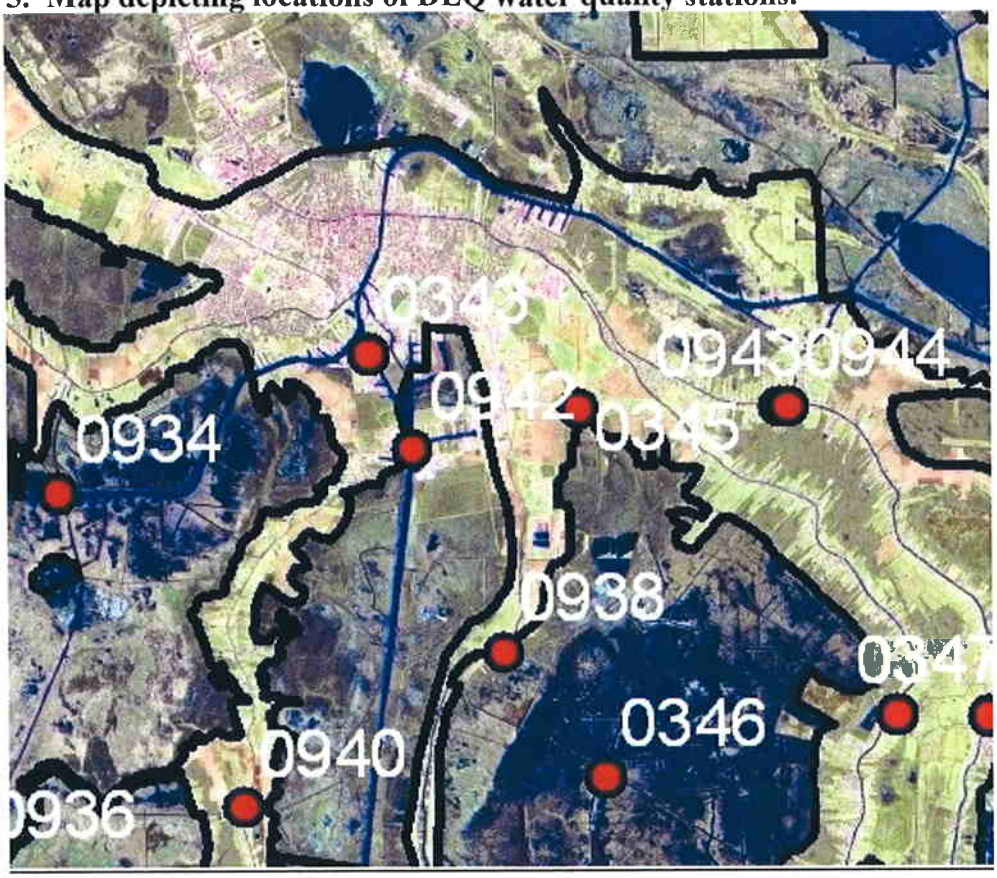


Nutrient Concentration:
Nitrogen and phosphorus data from DEQ station 0942 (Figure 5) in ppm were averaged for all dates available resulting in an average input concentration of **1.2 mg/l.**

Sediments
TSS data was calculated by averaging all TSS data from DEQ station 0942 and equaled **29.8 mg/l**. This value was reduced to zero for the East Subarea since water is not introduced directly into this area.

Bulk Density (g/cm^3)
Bulk Density values for INT marsh ($0.08\ g/cm^{3)}$ was used for the West Subarea. Bulk Density values for BR marsh ($0.16\ g/cm^{3)}$ was used for the East Subarea.

Figure 5. Map depicting locations of DEQ water quality stations.



Average Depth (ft)

Based on depths measured during the Oct. 17, 2007, field trip, average depths were assumed to be **2.0 feet** in both subareas.

% Nutrient Retention

As the percent nutrient retention value is specific only to nutrient uptake by emergent marshes, the percent marsh acreage (see page 1) was used as an estimate of % Nutrient Retention.

FWP TY1 West Subarea % marsh = **53%**
FWP TY1 East Subarea % marsh = **33%**

% Sediment Retention

Percent sediment retention was estimated assuming that the marsh in this case was 100% effective in trapping TSS, large open water areas were 50% effective in trapping TSS, and small open water areas were 75% effective in trapping TSS. For the west subarea, a GIS analysis of the 6,726 acre subarea (FWP TY1) shows that under baseline conditions, large open water areas occupied an estimated 900 acres (Appendix C):

Marsh	= 3,585 ac =	53.0%	Therefore:	0.53 x	1.00 retention	=	0.530
Small OW =	2,241 ac =	33.3%	Therefore:	0.333 x	0.75 retention	=	0.250
Large OW =	900 ac =	13.7%	Therefore:	0.137 x	0.50 retention	=	0.0685
					Total West Subarea	=	0.85 %

To account for channelization losses the following protocol was used.

Channelization Loss = 0% Condition: No bayous or man-made channels to export introduced water out of area
Channelization Loss = 15% Condition: One shallow bayou available to export introduced water out of the project area
Channelization Loss = 30% Condition: Two shallow bayous available to carry introduced water out of the project area
Channelization Loss = 50% Condition: Discharge directly into maintained oil-field canals or similar-sized canals
Channelization Loss = 90% Condition: Diversion discharge directly into a deep-draft navigation channel

Assuming that the 30% loss condition is applicable to the project's west subarea, the total TSS retention was calculated as: 85% * 0.70 = **59% TSS retention**

Construction Impacts

According to design information provided by T. Baker Smith, Inc., construction of the conveyance channel and the north forced drainage levee would result in a TY1 loss of 35.00 acres of marsh within the West Subarea. This acreage was removed from the FWP TY1 acreage (Table 1 on page 2. There were no construction impacts to East Subarea marshes.

See Table 6 for Boustany Model inputs sheets and results. Resulting FWP land loss rate reductions have been applied to the land loss worksheet shown in Tables 1 and 2.

WVA Inputs:

V1 values should be taken from Tables 1 and 2 (pages 2 and 3).

V2 – Submerged Aquatic Vegetation (both subareas)

FWOP	TY0 and TY1 = 5%	FWP	TY1 = 35%
	TY20 = 5%		TY20 = 45%

V3 – Interspersion (via use of interspersion "calculator")

West Subarea FWOP			West Subarea FWP	
	TY0	TY1	TY20	TY1	TY20
Class 2 –	28%	25%	0%	25%	0%
Class 3 –	63%	64%	36%	63%	55%
Class 4 –	9%	11%	64%	12%	45%

V3 – Interspersion (via use of interspersion "calculator") – continued.

East Subarea FWOP				East Subarea FWP	
	TY0	TY1	TY20	TY1	TY20
Class 3 –	36%	30%	0%	48%	0%
Class 4 –	64%	70%	31%	52%	60%
Class 5-	0%	0%	69%	0%	40%

V4 – Percent Shallow Open Water

West Subarea FWOP			West Subarea FWP		East Subarea FWOP			East Subarea FWP	
TY0	TY1	TY20	TY1	TY20	TY0	TY1	TY20	TY1	TY20
20%	20%	15%	20%	16%	15%	15%	10%	15%	12%

V5 – Salinity (ppt)

Discrete salinities were measured bi-monthly (Figure 6) from May 1998 – March 2001.

Table 6. Boustany model inputs and results for the West and East Subarea receiving marshes.

Site: LkBoud W	FWOP	FWP
NSED2 Model		
Flow Rate (cfs)		261
Number of days		154
Acre-ft of water		80388
Volume of water (L)		9.92E+10
Nutrients		
Nutrient Concentration (mg/l)		1.2
Bulk Density (g cm^{-3})		0.08
% Organic BD		32.5%
Productivity Rate (gdw m^{-2} y^{-1})		1416
% of Productivity in BD		18.36%
Retention Factor (A_m/A_t)		53%
% NP in Organic Fraction		1.5%
Bulk Density (Nutrient Fraction only) (g cm^{-3})		0.00039
% Nutrient Retention in BD		9.7%
Average Depth (ft)		2.0
Total NP (Available) (g)		1.19E+08
Nutrient Potential Acres (acres-ft y^{-1})		247.4
Nutrient Acres		12.0
Sediments		
TSS Concentration (mg/l)		29.752
Bulk Density (g cm^{-3})		0.835
% Mineral BD		68%
BD (Mineral Fraction only) (g cm^{-3})		0.563625
% Mineral Retention in BD		59%
Average Depth (ft)		2.0
TSS (g) (Available)		2.95E+09
Sediment Potential Acres (acre-ft y^{-1})		4.2
Sediment Acres		1.3
TY1 Acres (Gross Annual Acres)	0	13.3
TY20 Acres		266
TY100 Acres		1329
Area (acres)	3573	3573
Annual Land Loss Rate (FWOP)	-2.33%	-2.33%
Annual Land Loss (FWOP)	-83.2509	-83.2509
Adjusted Annual Net Acres (FWP)	-83.3	-70.0
Adjusted Land Change Rate (FWP)	-2.33%	-1.96%
Percent land loss rate reduction =	15.96%	

East Subunit	FWOP	FWP
NSED2 Model		
Flow Rate (cfs)		147
Number of days		154
Acre-ft of water		45276
Volume of water (L)		5.59E+10
Nutrients		
Nutrient Concentration (mg/l)		1.2
Bulk Density (g cm^{-3})		0.16
% Organic BD		17.6%
Productivity Rate (gdw m^{-2} y^{-1})		2653
% of Productivity in BD		10.61%
Retention Factor (A_m/A_t)		34%
% NP in Organic Fraction		1.5%
Bulk Density (Nutrient Fraction only) (g cm^{-3})		0.0004224
% Nutrient Retention in BD		3.6%
Average Depth (ft)		2.5
Total NP (Available) (g)		6.70E+07
Nutrient Potential Acres (acres-ft y^{-1})		128.6
Nutrient Acres		1.9
Sediments		
TSS Concentration (mg/l)		0
Bulk Density (g cm^{-3})		0.835
% Mineral BD		82%
BD (Mineral Fraction only) (g cm^{-3})		0.68804
% Mineral Retention in BD		40%
Average Depth (ft)		2.5
TSS (g) (Available)		0.00E+00
Sediment Potential Acres (acre-ft y^{-1})		0.0
Sediment Acres		0.0
TY1 Acres (Gross Annual Acres)	0	1.9
TY20 Acres		37
TY100 Acres		186
Area (acres)	956	956
Annual Land Loss Rate (FWOP)	-4.08%	-4.08%
Annual Land Loss (FWOP)	-39.0048	-39.0048
Adjusted Annual Net Acres (FWP)	-39.0	-37.1
Adjusted Land Change Rate (FWP)	-4.08%	-3.89%
Percent land loss rate reduction =	-4.76%	

Figure 6. Discrete project area salinity monitoring stations.

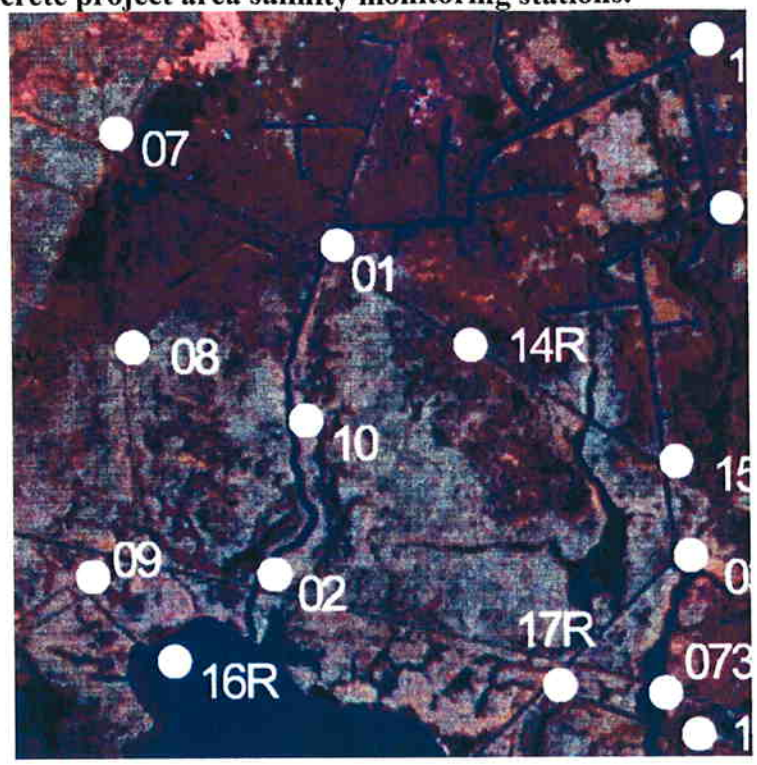


Table 6. Salinity data project area discrete monitoring stations.

Station	Annual Mean	Growing Season Mean
01	7.2	6.99
02	8.5	8.86
07	6.6	6.48
09	7.7	7.75
10	8.4	8.63
14R	7.8	7.14
Average	7.91	7.75

Intermediate marshes of the West Subarea are represented by an average of stations 07, 09, 01, 10, and 02 (avg. = 7.75 ppt). The predominantly BR marshes of the east area were represented by an average of stations 01, 02, 10, and 14R (avg. = 7.91 ppt).

FWP West Subarea: A salinity box model was used to estimate FWP for both subareas combined. During the 242-day (8-month) freshwater introduction period, the salinity of introduced water was assumed = 0.38 ppt (average 1994-1999 HNC @ Bayou LaCarpe salinities < 1.0 ppt = 0.38 ppt). Bayou LaCarpe salinities range from 1.0 to 2.0 ppt for an average of 44 days per year (i.e., 1.5 months), consequently, it was assumed that introduction of 2.0 ppt water would occur for 2 months (Sept and Dec). It was also assumed that no HNC water would be introduced for 2 months and that during this time FWP salinities would equal FWOP salinities. A daily tidal amplitude of 0.19 feet was obtained from 2.5 years of continuous data provided by DNR sonde TE-32-01. Tide and receiving area salinities were assumed to be equal to the above calculated annual average salinity of 7.91 ppt. The receiving area acreage of 4,937 acres is the TY0 total project area water acreage.

With those inputs, the project area salinity would be reduced to 3.13 ppt during the 8-month-long freshwater introduction period (Figure 7)

Figure 7. Salinity box model inputs for the 8-month-long introduction of 0.38 ppt water.

Salinity Box Model
Site: Sample

Source Salinity (ppt)	**0.38**
Source Flow Rate (cfs) (average daily)	**408**
Source Volume (acre-ft)	816
Volume of water (L)	1.01E+09
Tide Salinity	**7.91**
Tidal Amplitude (ft)	**0.2**
Tide Volume (acre-ft)	469.015
Volume of water (L)	5.79E+08
Receiver Salinity (ppt)	**7.91**
Receiver Area (water acres)	**4937**
Mean Depth (ft)	**2.0**
Receiver Volume (acre-ft)	9874
Total Volume	11159.015

Salinity	
Initial Salinity	7.91
Final Salinity	3.13
diff	4.78
%diff	60.5%

For the 2-month-long introduction of 2.0 ppt water, project area salinities would be reduced to 4.16 ppt (Figure 8).

Figure 8. Salinity box model inputs for the 2-month-long introduction of 2.00 ppt water.

Salinity Box Model
Site: Sample

Source Salinity (ppt)	**2.0**
Source Flow Rate (cfs) (average daily)	**408**
Source Volume (acre-ft)	816
Volume of water (L)	1.01E+09
Tide Salinity	**7.91**
Tidal Amplitude (ft)	**0.2**
Tide Volume (acre-ft)	469.015
Volume of water (L)	5.79E+08
Receiver Salinity (ppt)	**7.91**
Receiver Area (water acres)	**4937**
Mean Depth (ft)	**2.0**
Receiver Volume (acre-ft)	9874
Total Volume	11159.015

Salinity	
Initial Salinity	7.91
Final Salinity	4.16
diff	3.75
%diff	47.4%

Using the above box model results, a FWP West Subarea average growing season (March through November) salinity of 4.27 ppt is obtained by averaging the highlighted values below:

	FW0P West Subarea	FWP West Subarea (TY1 –20)
Jan	Mean Sal = 7.75 ppt	Mean Sal = 3.13 ppt
Feb	Mean Sal = 7.75 ppt	Mean Sal = 3.13 ppt
Mar	Mean Sal = 7.75 ppt	Mean Sal = 3.13 ppt
Apr	Mean Sal = 7.75 ppt	Mean Sal = 3.13 ppt
May	Mean Sal = 7.75 ppt	Mean Sal = 3.13 ppt
Jun	Mean Sal = 7.75 ppt	Mean Sal = 3.13 ppt
Jul	Mean Sal = 7.75 ppt	Mean Sal = 3.13 ppt
Aug	Mean Sal = 7.75 ppt	Mean Sal = 3.13 ppt
Sep	Mean Sal = 7.75 ppt	Mean Sal = 4.16 ppt
Oct	Mean Sal = 7.75 ppt	Mean Sal = 7.75 ppt
Nov	Mean Sal = 7.75 ppt	Mean Sal = 7.75 ppt
Dec	Mean Sal = 7.75 ppt	Mean Sal = 4.16 ppt
	---	---
	Average = 7.75 ppt	4.27 ppt = average growing season salinity

East Subarea: For the brackish East Subarea, an average annual salinity of 4.10 ppt was calculated as illustrated below:

	FW0P East Subarea	FWP East Subarea (TY1 –20)
Jan	Mean Sal = 7.91 ppt	Mean Sal = 3.13 ppt
Feb	Mean Sal = 7.91 ppt	Mean Sal = 3.13 ppt
Mar	Mean Sal = 7.91 ppt	Mean Sal = 3.13 ppt
Apr	Mean Sal = 7.91 ppt	Mean Sal = 3.13 ppt
May	Mean Sal = 7.91 ppt	Mean Sal = 3.13 ppt
Jun	Mean Sal = 7.91 ppt	Mean Sal = 3.13 ppt
Jul	Mean Sal = 7.91 ppt	Mean Sal = 3.13 ppt
Aug	Mean Sal = 7.91 ppt	Mean Sal = 3.13 ppt
Sep	Mean Sal = 7.91 ppt	Mean Sal = 4.16 ppt
Oct	Mean Sal = 7.91 ppt	Mean Sal = 7.91 ppt
Nov	Mean Sal = 7.91 ppt	Mean Sal = 7.91 ppt
Dec	Mean Sal = 7.91 ppt	Mean Sal = 4.16 ppt
	---	---
Average Annual =	7.91 ppt	4.10 ppt

V6 - Aquatic Organism Access

East Subarea: Several fixed-crest weirs exist in the project area. However, numerous spoil bank breaks render those weirs ineffective in restricting water exchange. Consequently, baseline fisheries access is considered to be unrestricted (SI = 1.0). This value will not change with project implementation.

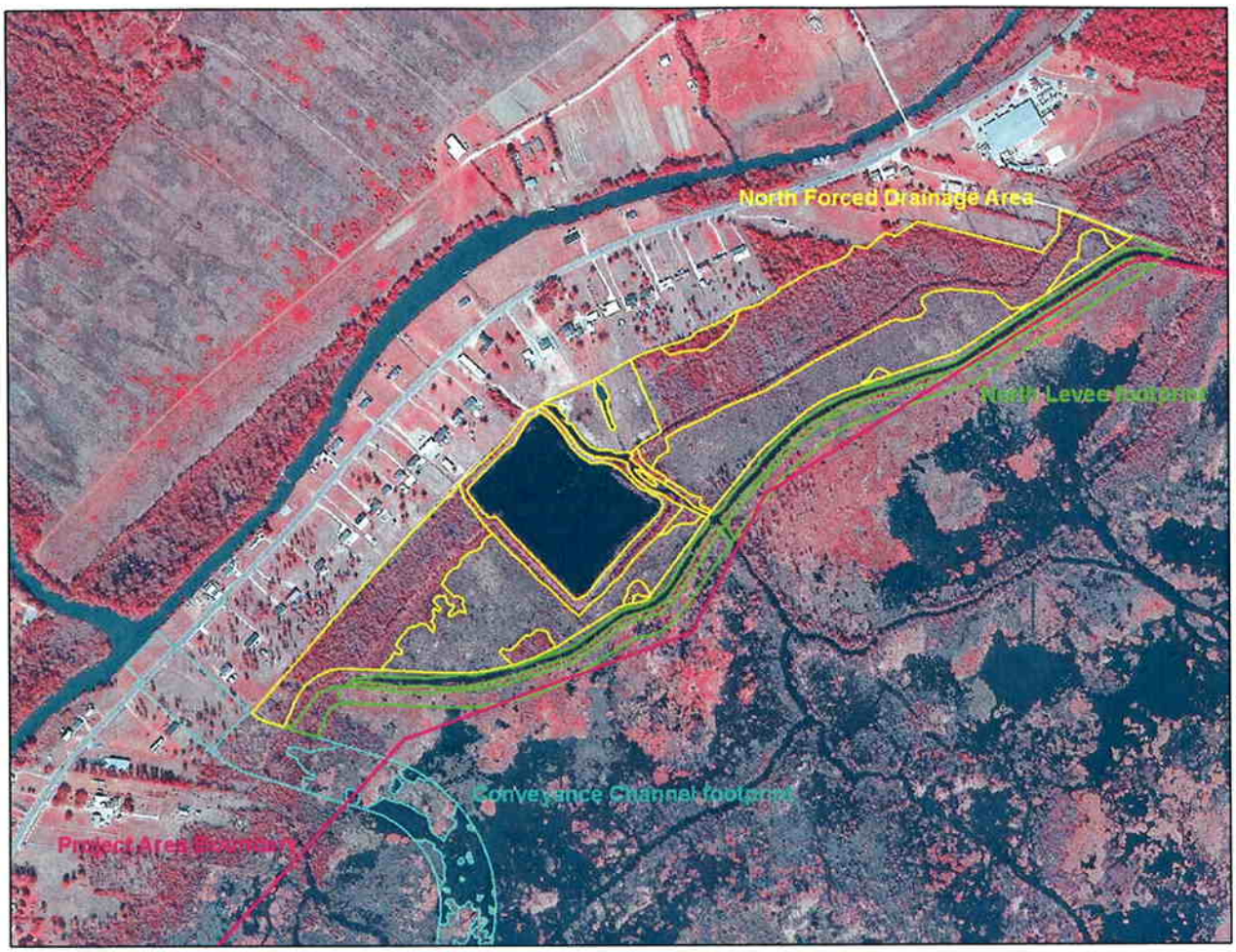
West Subarea: The construction of a boat bay type outfall management structure (8-foot-wide by 2-foot-deep) in the north-south pipeline canal at Bayou Butler would restrict fisheries access through that canal. Assuming that this pipeline canal provides 35% of the access and Bayou Chauvin provides 65% of the access, FWP V6 was calculated as follows:

Pipeline Canal:	0.35	* 0.5 rating	=	0.175
Bayou Chauvin:	0.65	* 1.0 rating	=	0.650

0.825

<u>North Forced Drainage Area Marsh WVA</u>. This evaluation assesses impacts to intermediate marshes within the proposed forced drainage area. Impacts covered include enclosure impacts plus borrow canal impacts to existing marshes (Figure 9).

Figure 9. Map depicting North Forced Drainage Levee and wetlands enclosed by that levee.



According to GIS analysis:	FWOP Total Project Area	=	22.97 acres
	Project area marshes	=	21.84 acres (95.1%)
	Project area water	=	1.13 acres

FWP construction of the pump station access road converts 0.03 acres of marsh to road, hence, that acreage is removed from the FWP project area:

FWP Total Project Area = 22.9 acres

V1 - Percent Marsh:

FWOP- as no natural marsh loss has occurred within the area, assume no FWOP marsh loss.

FWP TY1 construction impacts = 4.88 acres of borrow canal impacts
0.03 acres of pump station access road impacts
4.91 acres Total TY1 construction impacts

TY1 marsh = 21.84 – 4.91 acres = 16.93 ac (16.93/22.9 = 73.9%)

FWP: with water surface pump-down to +1.0 ft = marsh level (see 95% design elevation transects), and exclusion of salinity, assume no FWP loss (landowner to place permanent conservation easement on enclosed forested and marsh habitat to preserve for wildlife habitat).

V2 – Submerged Aquatic Vegetation

FWOP all TYs – 0%
FWP all TYs – 0%

V3 – Interspersion

FWOP and FWP is a "carpet" marsh: 100% class 3.

V4 – Percent Shallow Open Water

Assumed all water consists of ditches FWOP and FWP, therefore V4 = 0%

V5 – Salinity

FWOP: assumed area salinity = 50 % of 7.75 ppt (West Subarea growing season ave) = 3.9 ppt
FWP: assumed area salinity = 0 ppt

V6 – Fish Access:

FWOP: unrestricted access, V6 = 1.00
FWP: all access precluded, V6 = 0.00

North Forced Drainage Area bottomland hardwoods WVA. This assessment covers bottomland hardwoods and shrub-scrub habitats that would be enclosed within the north forced drainage area (Figures 10 and 11), plus the forested/shrub-scrub habitats that would be impacted by construction of the conveyance channel (see Figure 3). Dead tree tops and numerous dead trees indicate that woody vegetation within these areas is severely stressed by inundation and salts. Project Area = 32.73 acres.

V1 – Tree Species Association

Due to presence of green ash and red maple: FWOP TY1 = class2
Assume continued death of trees results in: FWOP TY20 = class1

FWP Aug-Nov pump operations: pump#1 on elevation = +1.75 ft
pump#2 on elevation = + 2.00 ft
pumps off elevation = +1.25 ft

FWP Dec-July pump operations: pump#1 on elevation = +1.50 ft
pump#2 on elevation = + 2.00 ft
pumps off elevation = +1.00 ft

Should drought occur to reduce water levels below +1.0 ft, sluice gate will be open to restore water levels provided salinity at or below 1.0 ppt. Therefore, assume that FWP species composition is maintained.

V2 – Stand Maturity. *See dbh worksheet attached to the WVA worksheet.*

FWOP: assumed very minimal growth rates FWOP due to high stress and mortality.

FWP: assumed growth 50% of average bottomland hardwoods due to FWP wetness.

V3 – Understory/Midstory. *Based on field observations.*

FWOP: TY0 =TY1 = Understory 70% and Midstory = 30%

FWOP: TY20 = Understory 90% and Midstory =15%

FWP: TY0 = TY1 = Understory 70% and Midstory = 30%

FWP: TY20 = Understory 65% and Midstory = 40%

Figure 10. Deteriorating shrub-scrub habitat at the north end of the North Forced Drainage Area.

Figure 11. Example of deteriorating bottomland hardwood forest in the North Forced Drainage

V4 – Hydrology: Pump#1-on stage would be 1.5 ft, pump#2-on stage would be 2.0 ft, and pump off stage would be 1.0 ft. However, to preclude excessive dewatering during August through November, pump#1-on stage would be raised to 1.75 feet and off stage raised to 1/25 ft.

FWOP: all TYs = Class 1 (high water table causing waterlogging impacts): SI = 0.1
FWP: TY1- TY20 = Class 2 (water table lowered): SI = 0.5

V5 – Size of Contiguous Forest Area (applied to only hardwoods acreage)
FWOP: all TYs = Class1
FWP: all TYs = Class1

V6 – Surrounding Land Uses
FWOP & FWP: 25% =Forest/marsh and 75% =Development

V7- Disturbance
FWOP & FWP: Type = Class 2 Distance = Class 2

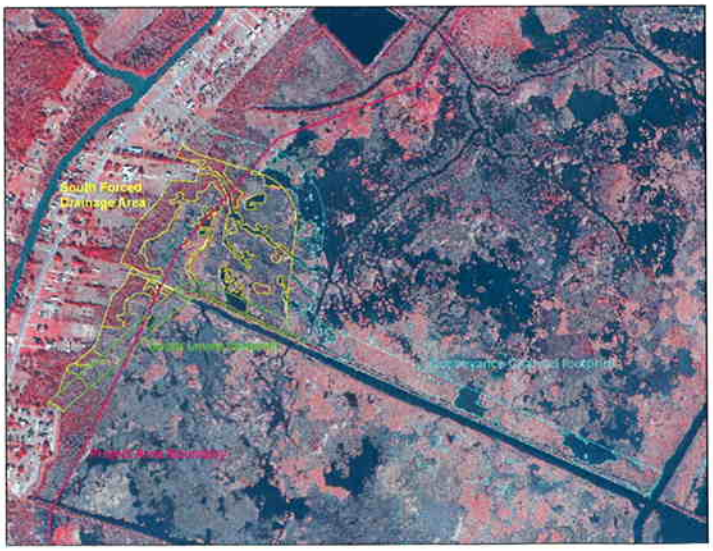
FWOP Acreage:	TY0 = 32.73 ac	
	TY1 = 32.73 ac	
	TY20 = 16.37	*assume 50% decrease in area due to waterlogging*
FWP Acreage:	TY1 = 30.05 ac	(2.68 ac conveyance channel construction impact)
	TY20 = 30.05 ac	*Permanent conservation easement on remaining area*

South Forced Drained Area Marsh WVA. This evaluation assesses impacts to intermediate marshes within the proposed forced drainage area. Evaluated impacts include enclosure impacts plus marsh impacts due to construction of the forced drainage levee and berm (Figure 12).

According to GIS analysis: FWOP Total Project Area = 44.98 acres
Project area marshes = 39.18 acres (87.1%)
Project area water = 5.80 acres

FWP construction impacts include: 0.2 acres due the pump station access road and 4.4 ac due to levee/berm, for a total of 4.6 acres. FWP Total Project Area = 44.04 acres

Figure 12. Map depicting South Forced Drainage Levee and wetlands enclosed by that levee.



V1 - Percent Marsh:

FWOP- as little natural marsh loss has occurred within the area, assume no FWOP marsh loss.

FWP TY1 construction impacts = 3.1 acres of borrow canal impacts
0.2 acres of pump station access road impacts
3.7 acres of levee/berm
7.0 acres Total TY1 construction impacts

TY1 marsh = 39.18 – 7.0 acres = 32.18 ac (32.18/40.4 = 79.7%)

FWP: with water surface pump-down to +1.0= marsh level (see 95% design elevation transects), and exclusion of salinity, assume no FWP loss other than a 25% development loss which occurs at TY20 (remaining marsh = 24.14 ac or 59.74%).

V2 – Submerged Aquatic Vegetation

FWOP all TYs – 0%
FWP all TYs – 0%

V3 – Interspersion

FWOP and FWP is 100% class 2.

V4 – Percent Shallow Open Water

FWOP: assumed 40% water is shallow = 2.32 ac
FWP TY1: Total water area = 8.2 ac, shallow water unchanged at 2.32 ac, V4 = **28%**
FWP TY20: same as TY1

V5 – Salinity

FWOP: assumed area salinity = 50 % of 7.75 ppt (West Subarea growing season ave) = 3.9 ppt
FWP: assumed area salinity = 0 ppt

V6 – Fish Access:

FWOP: unrestricted access, V6 = 1.00
FWP: all access precluded, V6 = 0.00

South Forced Drained Area bottomland hardwoods WVA. This evaluation assesses impacts to bottomland hardwoods and shrub-scrub wetlands within the proposed forced drainage area. Impacts covered include enclosure impacts plus impacts due to construction of the forced drainage levee and berm (Figure 13). Project area was formerly hardwoods, but now is 100% shrub-scrub = 12.15 acres consisting primarily of palmettos a few live oaks and other dead/dying trees.

V1 – Tree Species Association

FWOP and FWP = Class1

V2 – Stand Maturity. *See dbh worksheet attached to the WVA worksheet.*

FWOP: assumed very minimal growth rates FWOP due to high stress and mortality.

FWP Aug-Nov pump operations: pump#1 on elevation = +1.75 ft
pump#2 on elevation = + 2.00 ft
pumps off elevation = +1.25 ft

FWP Dec-July pump operations: pump#1 on elevation = +1.50 ft
pump#2 on elevation = + 2.00 ft
pumps off elevation = +1.00 ft

Should drought occur to reduce water levels below +1.0 ft, sluice gate will be open to restore water levels provided salinity at or below 1.0 ppt. Assumed that FWP growth is 50% of average due to FWP wetness.

Figure 13. Shrub-scrub habitat in the area to be enclosed by the South Forced Drainage Levee.

V3 – Understory/Midstory. *Based on field observations.*

FWOP: TY0 =TY1 = Understory 30% and Midstory = 50%
FWOP: TY20 = Understory 90% and Midstory =15%
FWP: TY0 = TY1 = Understory 30% and Midstory = 50%
FWP: TY20 = Understory 30% and Midstory = 45%

V4 – Hydrology: Pump#1-on stage would be 1.5 ft, pump#2-on stage would be 2.0 ft, and pump off stage would be 1.0 ft. However, to preclude excessive dewatering during August through November, pump#1-on stage would be raised to 1.75 feet and pump off stage would be raised to 1.25 ft.

FWOP: all TYs = Class 1 (high water table causing waterlogging impacts): SI = 0.1
FWP: TY1- TY20 = Class 2 (water table lowered): SI = 0.5

V5 – Size of Contiguous Forest Area (hardwoods only)
FWOP: all TYs = Class1
FWP: all TYs = Class1

V6 – Surrounding Land Uses
FWOP & FWP: 25% =Forest/marsh and 75% =Development

V7- Disturbance
FWOP & FWP: Type = Class 2 Distance = Class 2

FWOP Acreage:	TY0 = 12.2 ac	
	TY1 = 12.2 ac	
	TY20 = 6.1	*assume 50% decrease in area due to waterlogging*
FWP Acreage:	TY1 = 12.2 ac	
	TY20 = 9.1 ac	*assume 25% decrease in area due to development*

Bayou Pelton Marshes WVA. Impacts to marshes associated with enlargement of Bayou Pelton are assessed here (Figure 14). According to GIS analysis:

FWOP Total Project Area	=	13.9 acres
Project area marshes	=	7.7 acres (55.4%)
Project area water	=	6.2 acres

V1 - Percent Marsh:
FWOP - as the marsh area has increased over time, assume a 0.5 ac increase at TY20
TY0 = 7.7 ac
TY1 = 7.7 ac
TY20 = 8.2 ac

FWP all TYs = 0.0 ac (all marsh converted to enlarged bayou channel)

V2 – Submerged Aquatic Vegetation
FWOP all TYs = 65%
FWP all TYs = 0%

V3 – Interspersion
FWOP all TYs: marsh is a "carpet" marsh: 100% class 3.
FWP all TYs: 100% class5

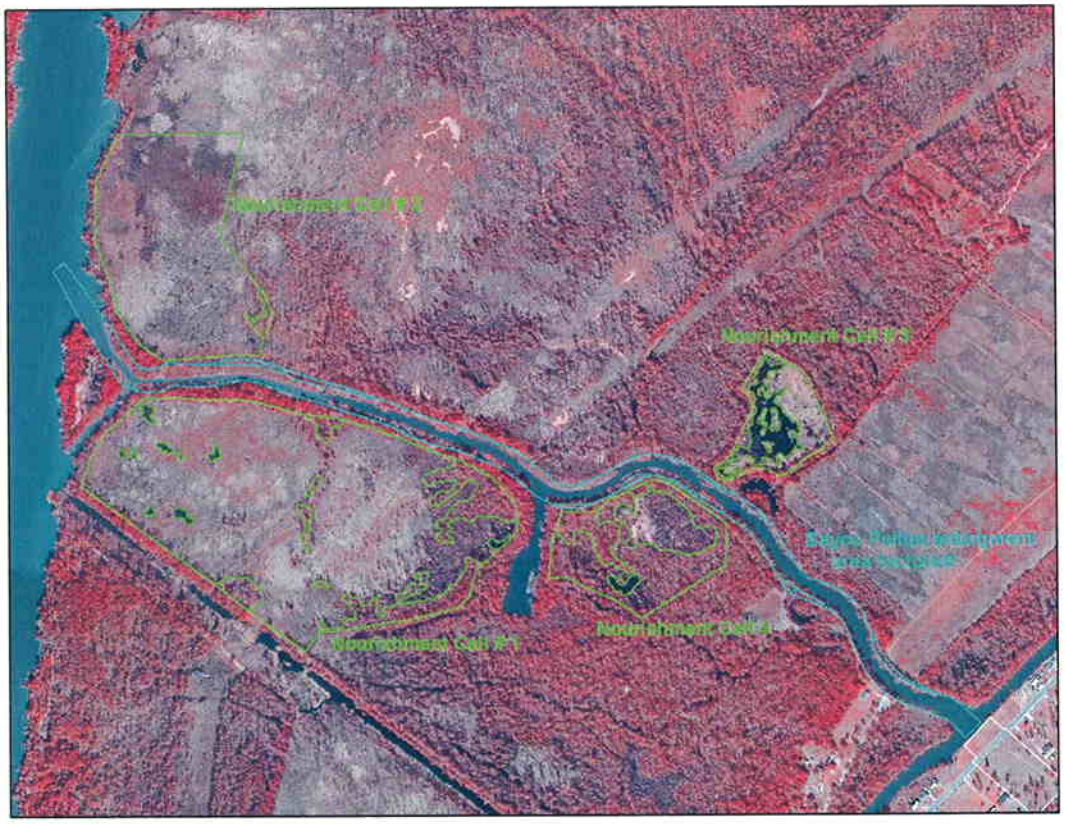
V4 – Percent Shallow Open Water
FWOP all TYs: 70%
FWP all TYs: 0%

V5 – Salinity
FWOP TY0 and TY1: V5 = 0.79 ppt (LCA modeling average of B2 area in yr 2015)

FWOP TY20: V5 = 0.58 ppt (LCA modeling average of B2 area in yr 2025)
FWP = same as FWOP

V6 – Fish Access:
FWOP and FWP: unrestricted access, V6 = 1.00

Figure 14. Map of the Bayou Pelton enlargement footprint and adjoining nourishment areas.



<u>Bayou Pelton bottomland hardwoods WVA</u>. Impacts to bottomland hardwoods and shrub-scrub habitats along the banks of Bayou Pelton are assessed here. Impacts include 0.99 acres bottomland hardwoods and 0.52 acres shrub-scrub habitat. The total project area = 1.51 acres.

V1 – Tree Species Association
FWOP all TYs = class5
FWP all TYs = class1 (lowest possible score)

V2 – Stand Maturity. *See dbh worksheet attached to the WVA worksheet.*
FWOP: assumed growth 50% of average bottomland hardwoods due to FWP wetness.
FWP: all trees removed – used 0 dbh

V3 – Understory/Midstory. *Based on field observations.*

FWOP: TY0 =TY1 = Understory = 20% and Midstory = 35%
FWOP: TY20 = Understory = 15% and Midstory = 25%
FWP: TY1 = Understory 0% and Midstory 0%
FWP: TY20 = Understory 0% and Midstory 0%

V4 – Hydrology: FWOP and FWP: all TYs = Class 2

V5 – Size of Contiguous Forest Area

FWOP and FWP: all TYs = Class 1

V6 – Surrounding Land Uses: FWOP & FWP: 100% =Forest/marsh

V7- Disturbance

FWOP & FWP: Type = Class 3 Distance = Class 1

FWOP Acreage:	TY0	= 1.51 ac
	TY1	= 1.51 ac
	TY20	= 1.51 ac
FWP Acreage:	TY1	= 0.0 ac
	TY20	= 0.0 ac

Bayou Pelton Nourishment Cells marsh WVA. The combined acreage of the 4 nourishment cells are evaluated here. Based on design estimates, the placement and consolidated of fill will raise elevations within these cells by up to 6 inches. Containment dikes will be degraded one year after construction.

According to GIW Analysis: marsh acreage = 80.30 (96.1 %)
water acreage = 3.29
Total acreage = 83.59

V1 - Percent Marsh:

FWOP: assume no marsh loss, V1 = 96.1 %
FWP: assume all water areas converted to marsh, V1 = 100%

V2 – Submerged Aquatic Vegetation

FWOP and FWP, all TYs = 0

V3 – Interspersion: FWOP and FWP: all TYs: marsh is a "carpet" marsh: 100% class 3.

V4 – Percent Shallow Open Water: FWOP and FWP: all TYs: 100%

V5 – Salinity

FWOP TY0 and TY1: V5 = 0.79 ppt (LCA modeling average of B2 area in yr 2015)
FWOP TY20: V5 = 0.58 ppt (LCA modeling average of B2 area in yr 2025)
FWP = same as FWOP

V6 – Fish Access:

FWOP:	unrestricted access,	V6 = 1.00
FWP:	TY1	V6 = 0
FWP:	TY20	V6 = 1.0

Bayou Pelton Nourishment Cells bottomland hardwoods WVA. Effects on enclosed bottomland hardwoods and shrub-scrub habitats are assessed in this WVA. Based on design estimates, the placement

and consolidation of fill will raise elevations within these cells by up to 6 inches. Containment dikes will be degraded one year after construction.

According to GIS analysis:

shrub-scrub	= 15.05 ac
Bottomland hardwoods	= 1.52 ac
Total Area	= 16.57 ac

V1 – Tree Species Association

FWOP all TYs = class1 (lowest possible score)

V2 – Stand Maturity. *See dbh worksheet attached to the WVA worksheet.*

FWOP: assumed no growth of bottomland hardwoods due to FWOP wetness.

FWP: assumed growth 50% of normal growth

V3 – Understory/Midstory. *Based on field observations.*

FWOP: TY0 =TY1 = Understory = 60% and Midstory = 50%

FWOP: TY20 = Understory = 65% and Midstory = 55%

FWP: TY1 = Understory = 60% and Midstory = 50%

FWP: TY20 = Understory = 40% and Midstory = 55%

V4 – Hydrology. *Assume that forest health is limited by excessive wetness and that wetness will become more optimal with nourishment*

FWOP all TYs = Class 2

FWP all TYs = Class 3

V5 – Size of Contiguous Forest Area: FWOP and FWP: all TYs = Class 1

V6 – Surrounding Land Uses

FWOP & FWP: 100% =Forest/marsh

V7- Disturbance

FWOP & FWP: Type = Class 4 Distance = Class 3

FWOP Acreage: TY0 = 16.57 ac
TY1 = 16.57 ac
TY20 = 16.57 ac

FWP Acreage: TY1 = 16.57 ac
TY20 = 16.57 ac

Table 7. Summary of Project Benefits/Impacts

Benefit/Impact Area	Hardwoods Net AAHUs	Hardwoods Net TY20 Acres	Marsh Net AAHUs	Marsh Net TY20 Acres
East Boudreaux Basin Receiving Marshes			137.68	17.15
West Boudreaux Basin Receiving Marshes			459.17	157.58
North Forced Drainage Area Marshes			-5.23	-4.91
North Forced Drainage Area Hardwoods	1.95	13.69		
South Forced Drainage Area Marshes			-11.63	-6.96
South Forced Drainage Area Hardwoods	1.10	3.04		
Bayou Pelton Marshes			-3.96	-8.20
Bayou Pelton Bottomland Hardwoods	-0.64	-1.51		
Bayou Pelton Nourishment Cells Marshes			-2.23	3.29
Bayou Pelton Nourishment Cells Hardwoods	1.29	0.00		
TOTAL	**3.70**	**15.21**	**573.81**	**157.95**

Appendix A

2006 Habitat Data

10/28/2006	West 1	West 2	East	TOTAL
Out	3	1	0	4
Swamp	599	3	0	602
Developed Ag Other	33	23	0	56
Fresh Marsh	998	4	0	1002
Intermediate Marsh	2	2258	132	2392
Brackish Marsh	0	306	1045	1351
Saline Marsh	0	0	0	0
Swamp Water	223	4	0	227
Developed Ag Other Water	1	0	0	1
Fresh Marsh Water	106	3	0	109
Intermediate Marsh Water	0	1925	118	2043
Brackish Marsh Water	0	351	1527	1878
Saline Marsh Water	0	0	0	0
	1965	**4878**	**2822**	**9665**
Project Area =	1,928	4,854	2,822	9,609

	West 1 + 2
Sw + FM =	1604
Int + BR =	2566
	4170

	East
BR =	1177

1988 Habitat Data

Oct 1988 data	West 1	West 2	East	TOTAL
Out	3	1	0	4
Aquatic Bed Floating	6	37	0	43
Aquatic Bed Submerged	0	0	7	7
Fresh Water	2	1	0	3
Estuarine Water	2	329	321	652
Fresh Marsh	2	0	0	2
Intermediate Marsh	722	2067	1300	4089
Brackish Marsh	0	1805	1037	2842
Saline Marsh	0	0	0	0
Estuarine Marsh	0	0	0	0
Cypress Forest	566	76	2	644
Bottomland Forest	304	27	32	363
Dead Forest	0	0	0	0
Bottomland Shrub/Scrub	334	476	122	932
Shore/Flat	0	0	0	0
Agriculture/Pasture	0	0	0	0
Upland Barren	0	0	0	0
Upland Forest	3	15	0	18
Developed	1	8	1	10
Upland Shrub/Scrub	20	36	0	56
	1965	**4878**	**2822**	**9665**

	West 1 + 2
FM + Sw =	1785
INT + BR =	4594
	6379

	East
Sw + INT + BR =	2493

Appendix B

10% Exceedance Model Outputs (cfs)

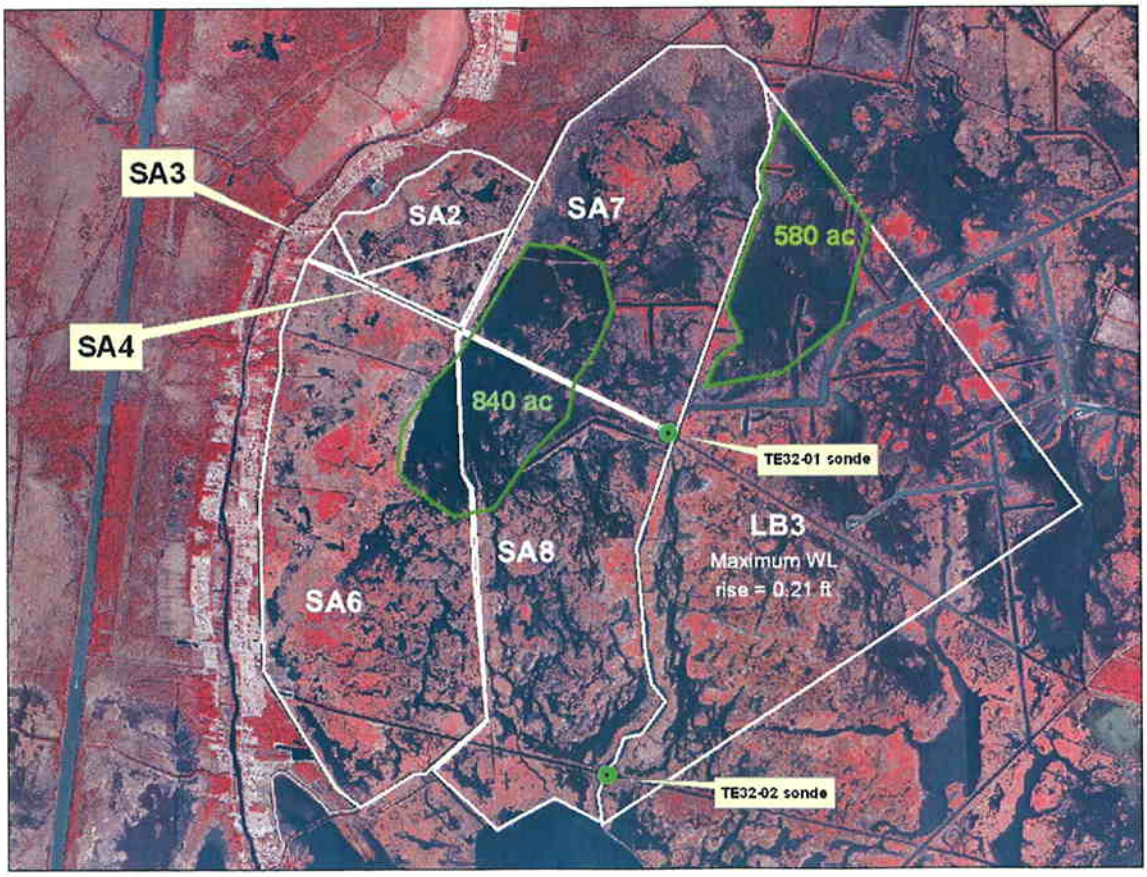
FLOWS	1st tidal cycle		2nd tidal cycle		3rd tidal cycle		4th tidal cycle		All Tidal Cycles	
Location	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
A	1066	836	1098	792	976	673	823	523	1098	523
B	240	71	265	16	279	151	289	194	289	16
C	**992**	**683**	**1031**	**62**	**846**	**492**	**684**	**334**	**1031**	**62**

90% Exceedance Model Outputs (cfs)

FLOWS	1st tidal cycle		2nd tidal cycle		3rd tidal cycle		4th tidal cycle		All Tidal Cycles	
Location	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
A	734	-172	847	-162	674	-369	439	-436	847	-436
B	149	-108	165	-142	169	-92	164	17	169	-142
C	775	-245	899	-247	706	-450	392	-503	899	-503

Appendix C

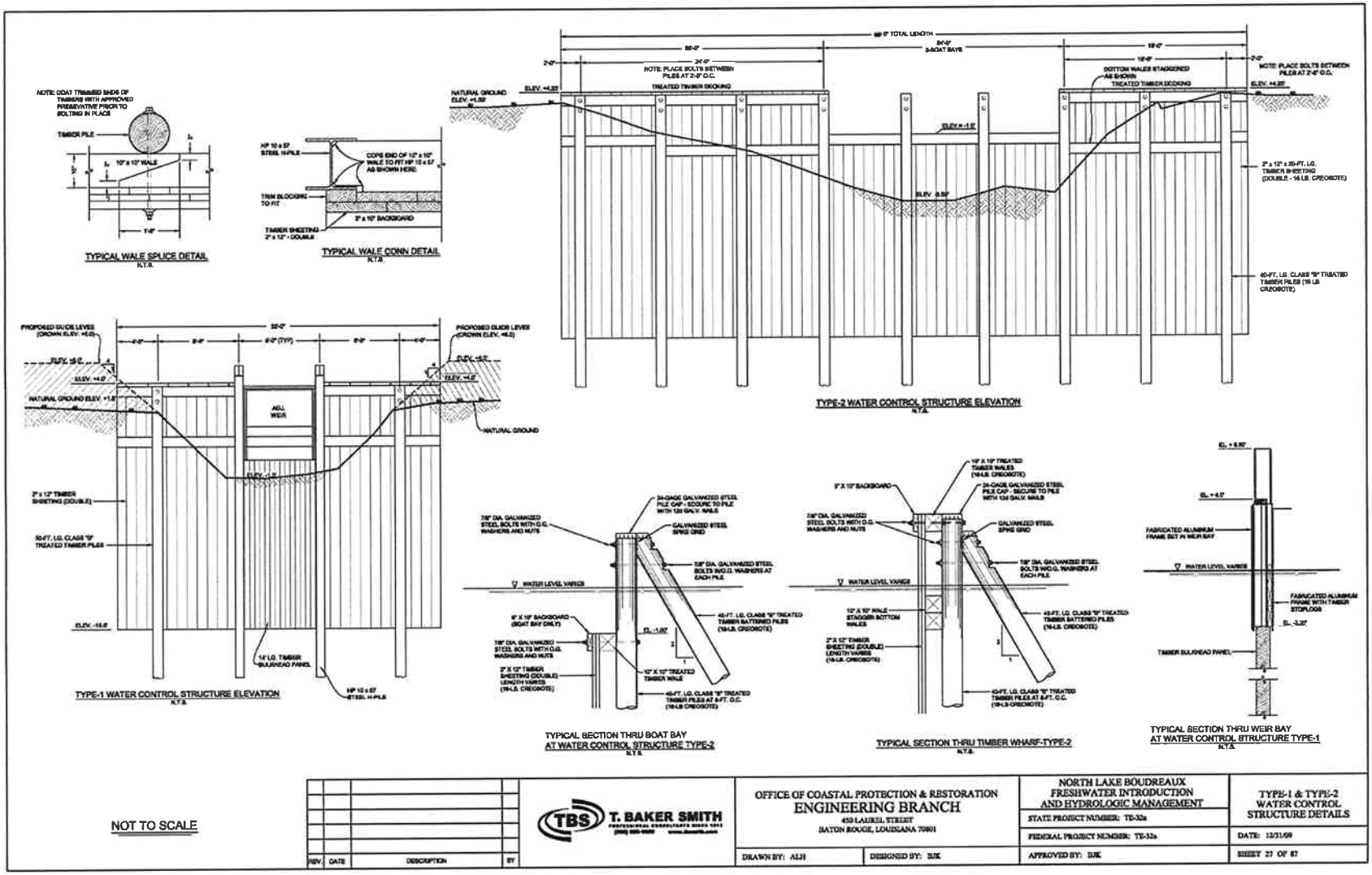
Figure C-1. Map showing large open water zones of each subarea.

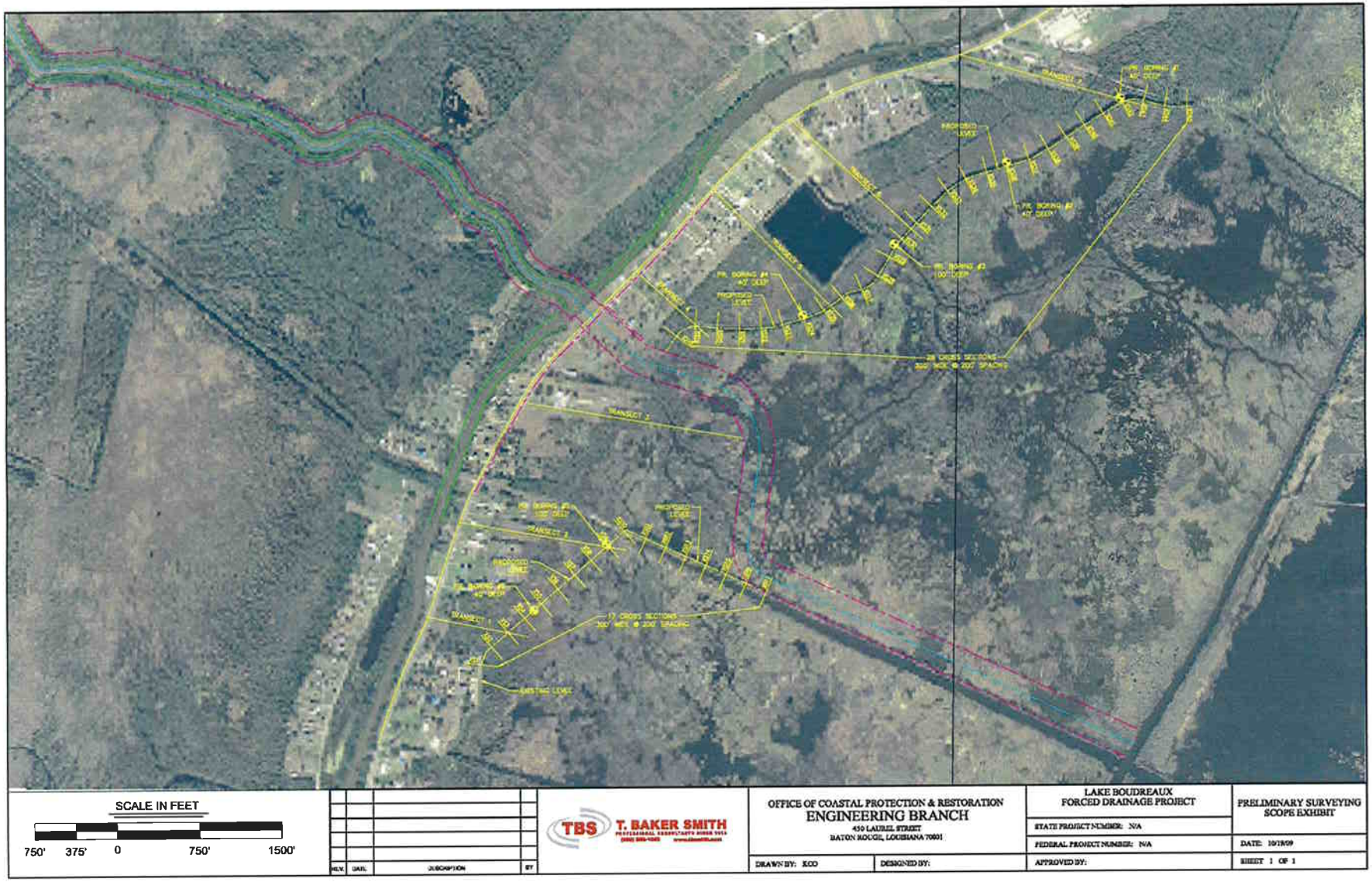


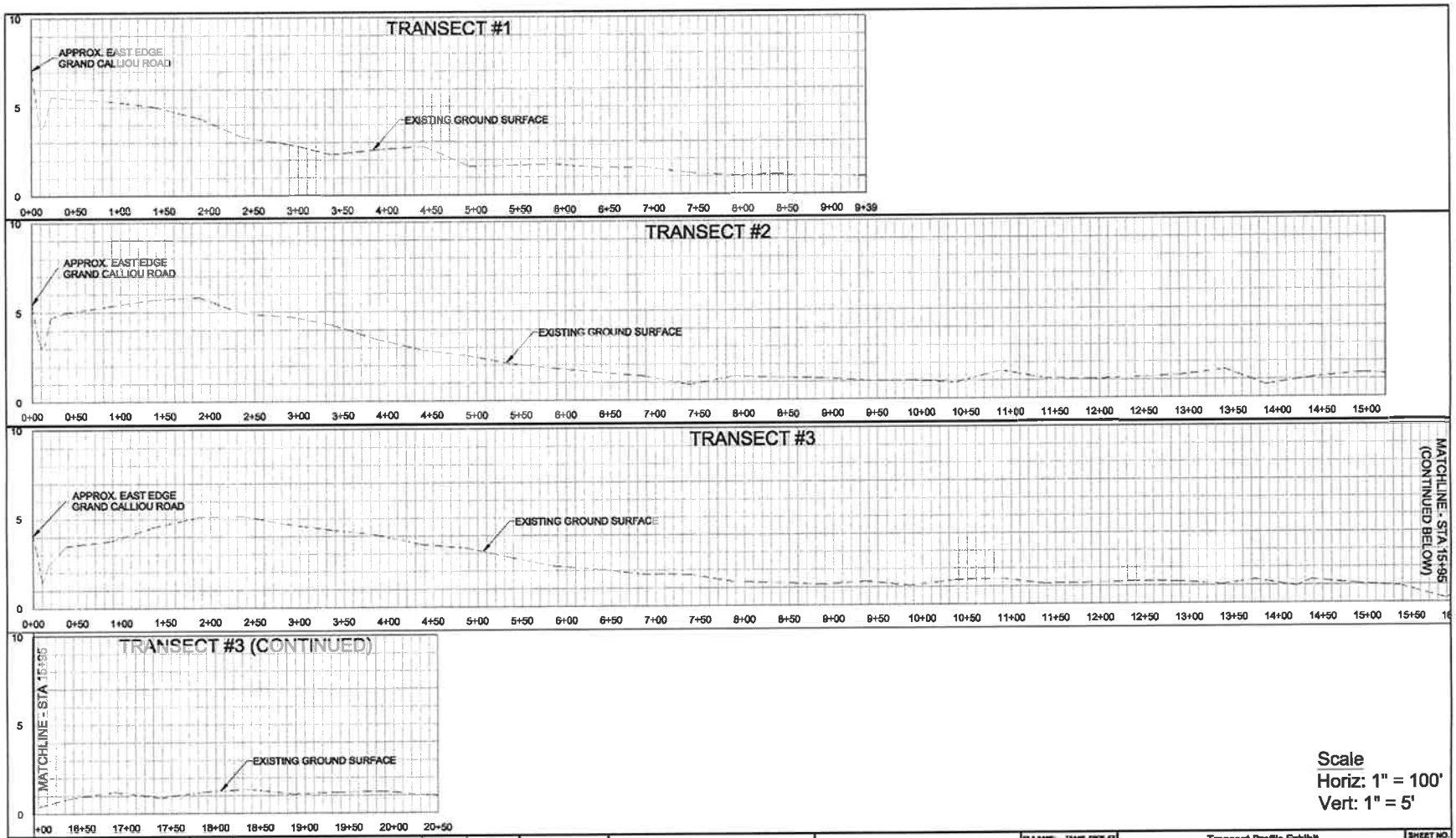
Appendix D

Permanent Habitat Impacts		Temporary Habitat Impacts		Forced Drainage Enclosure Habitat Effects		Nourishment-Fill Area Effects	
Bayou Pelton enlargement		Containment Dikes		North Enclosed Area		Area 1	
hardwoods	0.99	hardwoods	0.43	Dirt pit	10.35	marsh	49.02
shrub-scrub	0.52	marsh	0.81	Hrdwds	0.60	shrub-scrub	6.74
marsh	7.70	shrub-scrub	1.24	marsh	21.84	water	0.68
water	6.20	spoil bank	0.41	pasture	3.19		
		water	0.00	shrub-scrub	29.45	Area 2	0.00
Conveyance Channel construction				spoil bank	3.40	marsh	23.87
marsh	25.79			water	1.13	shrub-scrub	0.36
shrub-scrub	2.68						
spoil bank	3.45			South Enclosed Area		Area 3	0.00
developed	3.72			marsh	32.43	marsh	4.24
water	9.01			shrub-scrub	12.15	water	2.31
				water	4.53		
Forced Drainage North Levee							
marsh	10.47					Area 4	
shrub-scrub	1.87					hrdwds	1.52
spoil bank	3.15					marsh	3.18
water	4.65					shrub-scrub	7.95
						water	0.30
Forced Drainage South Levee							
marsh	6.75						
shrub-scrub	1.56						
spoil bank	1.04						
water	1.27						
TOTAL		TOTAL		TOTAL		TOTAL	
developed	3.72	hardwoods	0.43	Dirt pit	10.35	hrdwds	1.52
hardwoods	0.99	marsh	0.81	Hrdwds	0.60	marsh	80.30
marsh	50.70	shrub-scrub	1.24	marsh	54.28	shrub-scrub	15.05
shrub-scrub	6.63	spoil bank	0.41	pasture	3.19	water	3.29
spoil bank	7.64	water	0.00	shrub-scrub	41.60		
water	21.13			spoil bank	3.40		
				water	5.65		

Appendix E


TYPICAL WALE SPLICE DETAIL
TYPICAL WALE CONN DETAIL
TYPE-2 WATER CONTROL STRUCTURE ELEVATION
TYPE-1 WATER CONTROL STRUCTURE ELEVATION
TYPICAL SECTION THRU BOAT BAY
AT WATER CONTROL STRUCTURE TYPE-2
TYPICAL SECTION THRU TIMBER WHARF-TYPE-2
TYPICAL SECTION THRU WEIR BAY
AT WATER CONTROL STRUCTURE TYPE-1
NOT TO SCALE
T. BAKER SMITH
OFFICE OF COASTAL PROTECTION & RESTORATION
ENGINEERING BRANCH
450 LAUREL STREET
BATON ROUGE, LOUISIANA 70801
NORTH LAKE BOUDREAUX
FRESHWATER INTRODUCTION
AND HYDROLOGIC MANAGEMENT
STATE PROJECT NUMBER: TE-32a
FEDERAL PROJECT NUMBER: TE-32a
TYPE-1 & TYPE-2
WATER CONTROL
STRUCTURE DETAILS
DATE: 12/31/09
SHEET 23 OF 87
DRAWN BY: ALH
DESIGNED BY: BJK
APPROVED BY: BJK
REV.
DATE
DESCRIPTION
BY


SCALE IN FEET
750' 375' 0 750' 1500'
TBS
T. BAKER SMITH
OFFICE OF COASTAL PROTECTION & RESTORATION
ENGINEERING BRANCH
450 LAUREL STREET
BATON ROUGE, LOUISIANA 70801
DRAWN BY: KCO
DESIGNED BY:
LAKE BOUDREAUX
FORCED DRAINAGE PROJECT
STATE PROJECT NUMBER: N/A
FEDERAL PROJECT NUMBER: N/A
APPROVED BY:
PRELIMINARY SURVEYING
SCOPE EXHIBIT
DATE: 10/19/09
SHEET 1 OF 1



NOTES:

DATE	REVISIONS	DRAWN BY	APPROVED BY

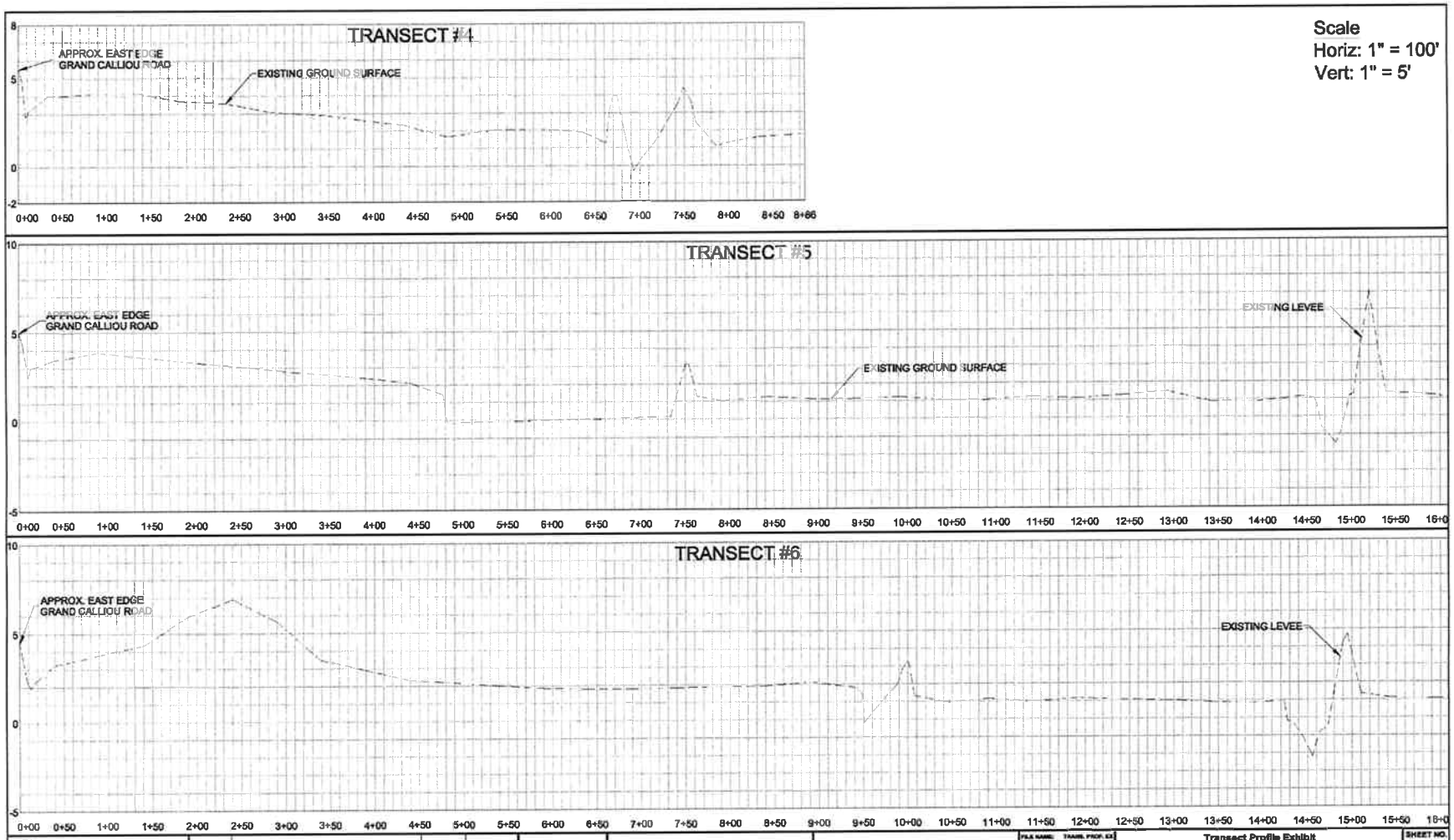
T. BAKER SMITH

FILE NAME: TRANS. PROF. EX
TBS NO.:
DATE:
PLOT SCALE:
DRAWN BY: KDO
APPROVED: BJK
MAP NO.

Transect Profile Exhibit
Transects #1 - #3

NORTH LAKE BOUDREAUX
FORCED DRAINAGE PROJECT
PUMP STATIONS AND LEVEE IMPROVEMENTS
FOR THE
TERREBONNE PARISH CONSOLIDATED GOVERNMENT

SHEET NO. 1 OF 3



Scale
Horiz: 1" = 100'
Vert: 1" = 5'

NOTES:

DATE	REVISIONS	DRAWN BY	APPROVED BY

REVISIONS

T. BAKER SMITH

FILE NAME: TRANS. PROF. EX
TBS NO.:
DATE:
PLOT SCALE:
DRAWN BY: KDD
APPROVED: BJK
MAP NO.

Transect Profile Exhibit
Transects #4 - #6

NORTH LAKE BOUDREAUX
FORCED DRAINAGE PROJECT
PUMP STATIONS AND LEVEE IMPROVEMENTS
FOR THE
TERREBONNE PARISH CONSOLIDATED GOVERNMENT

SHEET NO. 2 OF 3

APPENDIX J

LADNR RECORDING GAGE – HNC@DULAC MHW MLW

Marc J. Rogers

From: Cliff Li [chl@ftn-assoc.com]
Sent: Tuesday, May 11, 2010 2:07 PM
To: Marc J. Rogers
Cc: Marc Johnson
Subject: HNC @ Dulac datum info (Lake Boudreaux)

Marc,

As best as I can determine, here are the tidal gage datums for the HNC @ Dulac gage:

Mean High Water (MHW) = 1.52 ft NAVD88
Mean Low Water (MLW) = 0.31 ft NAVD88
--

Cliff H. Li - Hydrologist * chl@ftn-assoc.com
FTN Associates Ltd. * http://www.ftn-assoc.com
3 Innwood Circle #220 * (501)225-7779 (voice)
Little Rock, AR 72211 * (501)225-6738 (fax)