

Luce Bayou Interbasin Transfer Project Description

SUMMARY

The Coastal Water Authority (CWA) is a Conservation and Reclamation District established by the Texas Legislature in 1967 with a Board appointed by the Governor of Texas and the City of Houston. The Luce Bayou Interbasin Transfer Project (LBITP) is a regional water supply project proposed to be implemented by CWA that would transfer raw water from the Trinity River Basin to Lake Houston, a major water supply reservoir for the City of Houston. An overall, general project exhibit providing the identification and location of project facilities is provided as *Sheet 1*. The LBITP has been an integral part of Texas state water planning for the past 50 years. The project would ultimately convey by underground pipeline and aboveground canal approximately 500 million gallons per day (MGD) of untreated or raw water from the proposed 90-acre Capers Ridge Pump Station on the Trinity River to supplement existing water supplies in Lake Houston in order to provide necessary water service to the surrounding area. The proposed project would include property acquisition within a 300-foot wide corridor planned for the pipeline, and canal. Intake and discharge structures and construction/maintenance areas and easements would also be part of the LBITP. Nine alternatives were reviewed prior to the identification of a preferred alternative (*Sheet 2*). The LBITP footprint would encompass approximately 1,050 acres in Liberty and Harris Counties, Texas. Approximately 203 acres of waters in the United States, including wetlands, would be impacted by the proposed project. The Sam Houston Electrical Cooperative would supply electric power to the pump station property. Water in the canal would flow by gravity to Lake Houston.

Since 1970, the City of Houston has owned significant water rights in the Trinity River and Lake Livingston. Specific water rights related to this project include the right to divert a maximum rate of 775 cubic feet per second (cfs) from the Trinity River at the LBITP proposed pump station at Capers Ridge. The Capers Ridge Pump Station property was acquired for the LBITP by the City of Houston in 1980 and conveyed to CWA in 2009. The recommended concept for the LBITP includes the proposed pump station installed at the Trinity River, approximately 3 miles of pipeline, a sedimentation basin, approximately 23.5 miles of canal, an equipment maintenance facility, and a discharge structure. The LBITP canal would outfall into the backwaters of Lake Houston on the northeastern shoreline near the confluence with Luce Bayou. Raw water would be treated at the City of Houston owned Northeast Water Purification Plant (NEWPP) and the East Water Purification Plant (EWPP) via the West Canal (*Sheet 1*). The City of Houston is planning a major expansion of the existing NEWPP that treats water from Lake Houston to provide the Houston metropolitan area with water supplies required by existing water supply contracts.

Treatment of water from Lake Houston occurs at the NEWPP and the EWPP. Lake Houston water supplies are vital to providing water to Harris-Galveston Subsidence District (HGSD) Area Three, which is being progressively converted from groundwater to surface water supply sources in compliance with mandated plans to control area subsidence. Regional water authorities have been created in this area to distribute surface water, but sufficient raw water in Lake Houston and the NEWPP treatment capacity is not currently available to meet projected water supply needs for this portion of the Houston area while allowing for the required conversion from groundwater to surface water sources. The LBITP would provide necessary water supplies to meet contracted demands identified by the City of Houston.

2.0 NEED FOR AND PURPOSE OF PROJECT

The LBITP is the interbasin transfer of raw water from the Trinity River to Lake Houston as stipulated by conditions established by an existing water rights permit issued by the Texas Commission on Environmental Quality (TCEQ). The City of Houston currently operates three surface water treatment plans: the NEWPP, the EWPP, and the Southeast Water Purification Plant (SEWPP). Water in Lake Houston is and will continue to be treated at both the NEWPP and the EWPP and distributed to water end users. Trinity River water conveyed by the LBITP to Lake Houston would need to begin no later than 2020. The City of Houston would need to treat water at both the NEWPP and EWPP to meet demands by City of Houston water customers. The LBITP is a long-planned water supply project that is critical to meeting projected growth and increased water demands vital to sustaining the long-term economic health of the Houston metropolitan area and surrounding communities. The permitting and preliminary engineering phases are being financed by a \$28 million Texas Water Development Board (TWDB) Water Infrastructure Fund (WIF) loan.

The need for the LBITP is to meet the projected water demand and to increase available water supplies to comply with contracted, future demands identified by the City of Houston. A secondary objective of the LBITP is to assist with the conversion of groundwater to surface water supply sources to control land subsidence that has occurred from excessive pumping of area groundwater aquifers. The LBITP is a cornerstone in satisfying the mandated groundwater-to-surface water conversion program designed to control subsidence in the Houston area. The conversion to surface water supplies is expected to slow subsidence by 2010. By 2020, subsidence is expected to be controlled and finally halted by 2030. Water levels within the Gulf Coast Aquifer are predicted to rebound by as much as 125 feet through the implementation of the HGSD's groundwater withdrawal reduction plan.

The primary purpose of the LBITP is to meet the anticipated water demands based on population projections and to increase treated water supplies to comply with contracted, future demands identified by the City of Houston. The LBITP is a long-planned water supply project identified by regional water planning efforts performed by the Texas Water Development Board (TWDB). The LBITP has been included as a recommended water management strategy for the last 50 years and, more recently, in the 2006 Region H Water Plan, the initially adopted 2011 Region H Water Plan, the 2007 State Water Plan, and the draft 2012 State Water Plan. A secondary objective is to meet the HGSD's mandated groundwater reduction plan to limit groundwater use by Houston area municipalities by as much as 20 percent of total demand by 2030. The HGSD was established by the State of Texas in 1975 to regulate groundwater pumping in Harris and Galveston Counties. Significant land subsidence has occurred from excessive pumping of area groundwater aquifers. The HGSD and the Fort Bend County Subsidence District have developed regulatory plans that mandate the reduction of groundwater pumping starting in 2010 or 2013, respectively, and continuing through 2030.

Due to uncertainty in future growth and water demand, the LBITP would be designed to accommodate a peak pumping and conveyance capacity of 500 MGD, or 775 cfs; these capacities are also based on the conveyance limits established by the existing water rights permit issued by the TCEQ. To meet forecasted contracted water demand allocations with existing supplies, the LBITP would supply 230 MGD in 2020 and 425 MGD in 2040 to Lake Houston for treatment and conveyance to end users in accordance with contract conditions.

SITE ANALYSIS AND SITE DESCRIPTION

The proposed project begins in central Liberty County along Capers Ridge at the Trinity River and terminates in northeast Harris County near the confluence of Luce Bayou and Lake Houston. The LBITP includes a proposed approximately 90-acre Trinity River pump station

at Capers Ridge, approximately 3 miles of pipeline, a 20-acre sedimentation basin, approximately 23.5 miles of canal, and a discharge structure that would outfall into the backwaters of Lake Houston. The proposed project is comprised of forested areas, agricultural land, grazing land, and public rights-of-way (ROWs). Waters of the United States are interspersed throughout the entire project corridor. *Sheets 4 through 32* present a project layout with delineated wetland boundaries.

3.1 Project Components

The project begins at the Trinity River along Capers Ridge with the construction of the proposed pump station. The CWA-owned pump station tract encompasses approximately 90-acres (*Sheet 4*). The individual elements of the pump station are listed in *Section 4.3*. Water would be removed from the Trinity River via the pump station intake structure and flow into a pipeline located within a 300-foot ROW corridor for approximately 3 miles (*Sheets 9 – 11*). The pipeline would be constructed 6-foot below natural ground and would consist of two, 108-inch pipes constructed 20 feet apart (*Sheet 35*). The pipeline would discharge into a proposed 20-acre sedimentation basin and the water conveyance structure would transition into the proposed canal (*Sheet 12*). The canal would be constructed within a 300-foot ROW (*Sheet 36*). The proposed earthen canal would have a 20-foot wide bottom section with 4:1 side slopes and would be generally 7 feet deep. The top of banks would be approximately 100 feet apart. An access road would be constructed on each side of the proposed canal (*Sheet 36*). The proposed canal is approximately 23.5 miles in length, terminating at the discharge structure at the backwaters of Lake Houston along the northeastern confluence with Luce Bayou. Approximately 700 feet east of the discharge location at Luce Bayou, the canal transitions to a box culvert prior to discharge (*Sheets 32 – 34*). The culvert would be constructed of three 6-foot x 8-foot concrete box culverts and would discharge below the ordinary high water mark (OHWM) of Luce Bayou. A concrete headwall would be constructed at the point where the culvert structure discharges into Luce Bayou.

Water control gates would be constructed to help control water levels in the canal (*Sheet 37*). The gates that would be situated within the canal would raise and lower to allow a greater or smaller volume of water through the canal depending upon conditions outlined by the client. In general, the water level control gate structures would be placed along the canal at locations where a hydraulic drop is necessary to lower the water elevation in the canal. These gate structures would serve to regulate the surface water level by increasing or decreasing the allowable flow through the canal. The gates would operate using hydraulic pressure.

The proposed access road to the Capers Ridge Pump Station would be constructed beginning at FM 1008. The asphalt access road would have an 80-foot ROW (*Sheets 13 – 15*). The road would follow the existing Timberline Road within the existing roadway footprint until reaching the entrance to the Harrison Tract. On the Harrison Tract, the access road would generally follow the existing ranch road traversing along Capers Ridge and providing access to the sedimentation basin and the proposed pump station property. The proposed access road traversing the Harrison Tract is approximately 2.5 miles long encompassing 25 acres before it enters the proposed LBITP ROW. After entering the LBITP ROW, the access road would be contained in the project ROW until the ROW terminates at the proposed pump station. Approximately 2.4 miles of access road would be constructed within the LBITP ROW

3.1.1 Wetland Systems

An investigation for waters of the United States and wetlands was performed on the proposed LBITP corridor and pump station site. The preliminary jurisdictional determination process

has been implemented for the LBITP. During the investigation, identified wetlands and natural drainage features were considered jurisdictional. Man-made upland drainage ditches and ponds excavated from uplands were identified as non-jurisdictional. The investigation resulted in the identification and delineation of approximately 203.10 acres of jurisdictional aquatic resources (*Sheets 4 – 33* and *Sheet 39*). Of this total, approximately 200.95 acres consist of wetlands resources. Approximately 118.93 acres of forested wetlands occur within the project footprint. Approximately 45.26 acres of emergent wetlands, approximately 11.21 acres of an open water wetland, and approximately 25.55 acres of scrub-shrub wetlands occur within the project footprint. All wetlands within the LBITP corridor would be adversely impacted by construction and grading activities. Clearing of the corridor would require the use of mechanized land clearing equipment, which is a considered a regulated fill activity.

Waterbodies

Approximately 2.15 acres of waters of the United States were identified during field investigations. Of these 2.15 acres, approximately 0.18 acre is comprised of small, natural drainages that exhibit an OHWM. The remaining 1.97 acres are comprised of the confluence of Lake Houston and Luce Bayou (0.30 acre) and the Trinity River (1.67 acres) [*Sheets 4 and 32*].

3.1.3 Drainages

The approximate 0.18 acre of small, natural drainages would be excavated within the LBITP corridor footprint. Flows from the portions of these drainages located outside the project footprint would be directed into a small drainage ditch within the corridor. The canal would flow into underground siphons. Small drainage swales would then cross the canal and flow into drainage ditches. Flows would be directed back to ditches within the corridor and returned to the drainages to continue in the original flow path. The siphon areas would also serve as potential wildlife crossings.

3.1.4 Trinity River

The Capers Ridge Pump Station would be constructed at the Trinity River. The construction of the pump station would include impacts below the OHWM of the Trinity River. Approximately up to 1.67 acres of the Trinity River would be impacted during construction. Impacts would include placement of a trash rack, construction of a headwall, construction of concrete slope protection at the base of the headwall, placement of a sluice gate in the headwall, construction of an intake structure, and placement of riprap for erosion protection. Excavation would also occur below the OHWM; the excavation is needed to construct the pump station and associated erosion protection (*Sheets 5 – 8*).

Approximately 330 cubic yards of concrete slope protection (including headwall and concrete toe) and an additional approximate 470 cubic yards of backfill material would be placed below the OHWM at the proposed pump station. This would allow for construction of the sluice gate, trash track, and headwall wall for the pump station. Approximately 1,100 cubic yards of material would be excavated below the OHWM to allow for construction of the pump station and placement of the concrete slope protection and headwall. In addition, riprap would be placed along the banks of the Trinity River upstream and downstream of the intake structure for erosion protection. Approximately, 7,600 cubic yards of riprap would be placed below the OHWM of the Trinity River. To allow for placement of the riprap, approximately 6,000 cubic yards of material would be excavated below the OHWM of the Trinity River.

3.1.5 Lake Houston Near Luce Bayou

The proposed canal would discharge into the backwaters of Lake Houston along the northeast shoreline downstream of the confluence with Luce Bayou. The canal would

discharge below the OHWM through three box culverts. The dimensions of each of the three culverts are 6-foot by 8-foot (*Sheets 32 – 34*). The culverts would terminate at a concrete headwall. Through erosion analysis it was determined that erosion protection is needed at the discharge point. Approximately 975 cubic yards of riprap would be placed below the OHWM. Construction of the concrete headwall and placement of erosion protection would impact approximately 0.30 acre below the OHWM.

3.1.6 Temporary Construction Impacts at the Trinity River and Lake Houston

Portions of both the Trinity River and the backwater area of Lake Houston near the confluence of Luce Bayou would be dewatered to allow for construction and equipment access. Certain portions of the proposed for the LBITP, namely the river bank stabilization, pump station intake, and canal outfall must be constructed within river boundaries. Other structures, such as the pump bay, will be constructed further inland, but will still be in areas that are heavily influenced by groundwater and river water. Contractors will have to implement construction strategies to control and redirect water around the construction area, and maintain a dry, safe working area. The means and methods of construction are traditionally left up to the contractor and not dictated by the engineer, unless special circumstances necessitate direction. For this reason, a specific definition of the in-river construction methods cannot be provided; however, a general description of means and methods that have been successfully implemented on countless similar projects can be discussed.

Contractors will construct a coffer dam using steel sheet piling to secure the area in which the excavation will be made. Earthen coffer dams are sometimes constructed in lieu of sheet pile coffer dams; however, an earthen coffer dam is not anticipated to be used for this application due to the narrow, quick-moving river conditions. A sheet pile coffer dam consists of a series of panels with interlocking connections, driven into the ground with impact or vibratory hammers to form an impermeable barrier. Sheet piling is typically driven to a depth that is twice as deep as its exposed face. For example, it will have 33 percent of the total length above ground and 67 percent of the total length below ground. Contractors will place sheet piling on three sides of the excavation leaving the inland face open (free of sheet piling) or partially open. Sheet piling will be placed five to ten feet beyond the boundary of the proposed structures to leave working space and room for concrete forms. The height of the sheet piling will be determined by the contractor based on the water surface elevation of periodic storm events within the river. Once the sheet piling is put in place, the contractor will begin to dewater and excavate within the coffer dam.

Piezometric dewatering wells will be constructed prior to or immediately after constructing the coffer dam and will continue to be used throughout construction in order control the influx of groundwater. Sump pumps will also be used throughout the entire construction process within the coffer dam. The depth of the excavation will be approximately five feet below the bottom of the proposed structure. Once the sheet piling is in place and the excavation is complete, the contractor will construct the structure within the dry, secure workspace similarly to how the structure would be constructed above ground, using forms, concrete, and rebar. Barges may be occasionally used by the contractor to provide a floating surface within the river on which to place cranes and pile driving equipment. All of the sheet piling will be removed by the contractor once the structure and bank stabilization is complete and ready to be submerged.

Land Use Compatibility

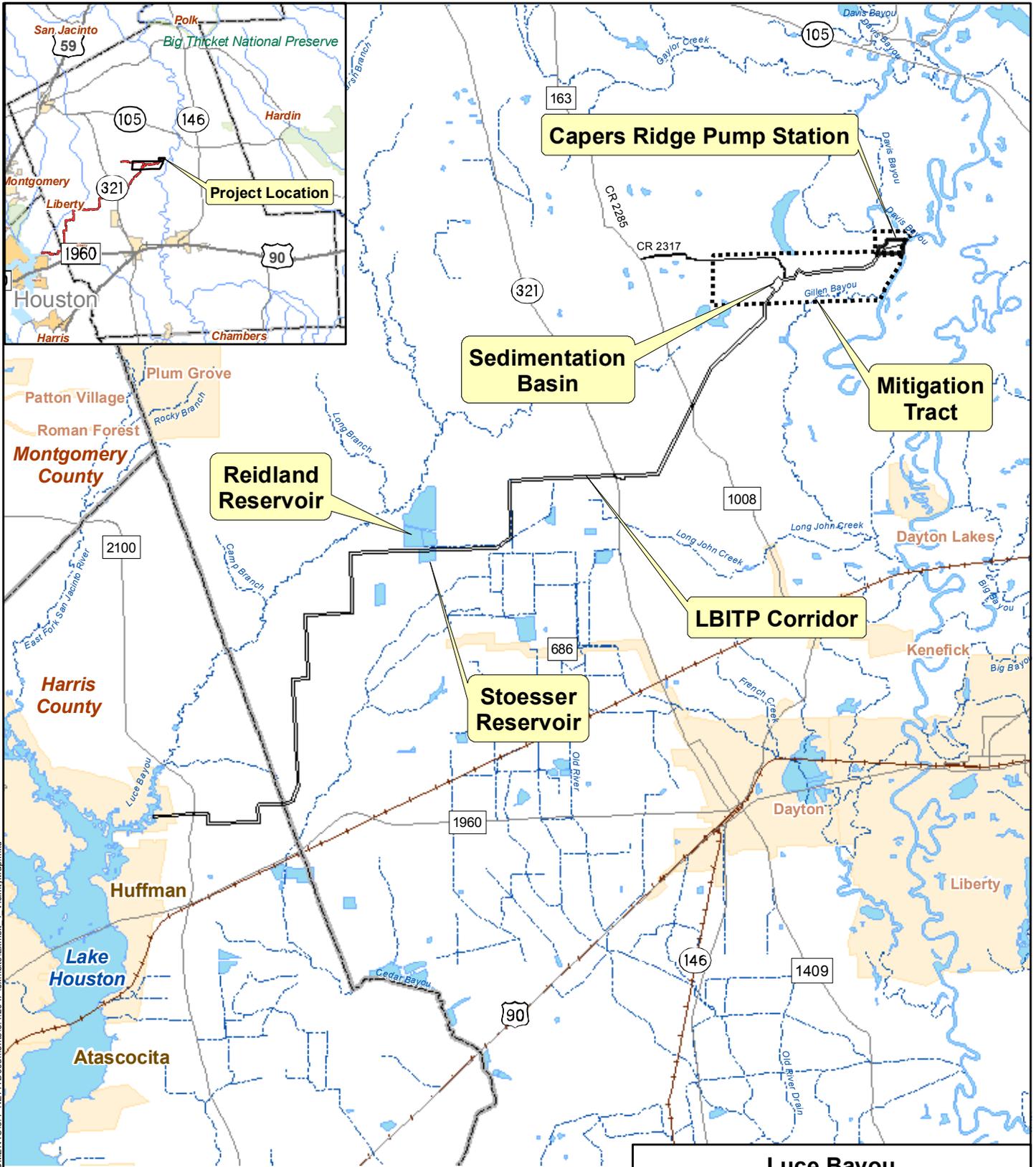
The LBITP corridor traverses timberland, agricultural land, and rural residential land in Liberty and Harris Counties. The canal would primarily be constructed in forested areas and agricultural land. The forested areas are generally in remote areas with limited human access. The agricultural land exhibits an extensive canal and drainage network for irrigating and draining agricultural fields. The proposed LBITP canal would be a feature on the landscape somewhat similar to the existing agricultural ditches and canals that currently exist within or immediately adjacent to the proposed LBITP. The Dayton Canal is approximately 12 miles to the south of the proposed LBITP canal and similar in nature and extent.

Site Acreage

The proposed LBITP footprint would encompass approximately 1,050 acres and include the canal/pipeline corridor, pump station tract, sedimentation basin, access road, and maintenance area. The LBITP acreage is the minimum amount needed to construct and operate the proposed project.

Transportation Access

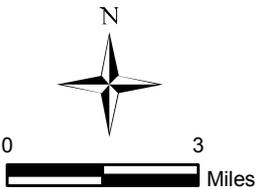
Numerous roadways intersect the proposed LBITP; major roadway crossings include SH 321, FM 2100, and FM 1008. The proposed project would not eliminate or change access to any public roadways. Chain-link fencing would be constructed at the major road crossings as security to prevent public access. Safety barriers would be constructed to aid in the prevention of automobiles entering the canal during traffic accidents. During construction and maintenance of the proposed canal, access to construction areas would be via existing roadways or CWA-owned property. The proposed canal would have a maintenance road on each side of the canal. One maintenance/access road would be constructed outside the footprint of the proposed canal corridor; it would be constructed on the proposed mitigation tract. This road would follow an existing unimproved ranch road that would be widened and improved. The maintenance road would provide access to the Capers Ridge Pump Station and the sedimentation basin. The LBITP would not interrupt area utilities.



Basemap Source: ESRI 2008 StreetMap data.

Legend

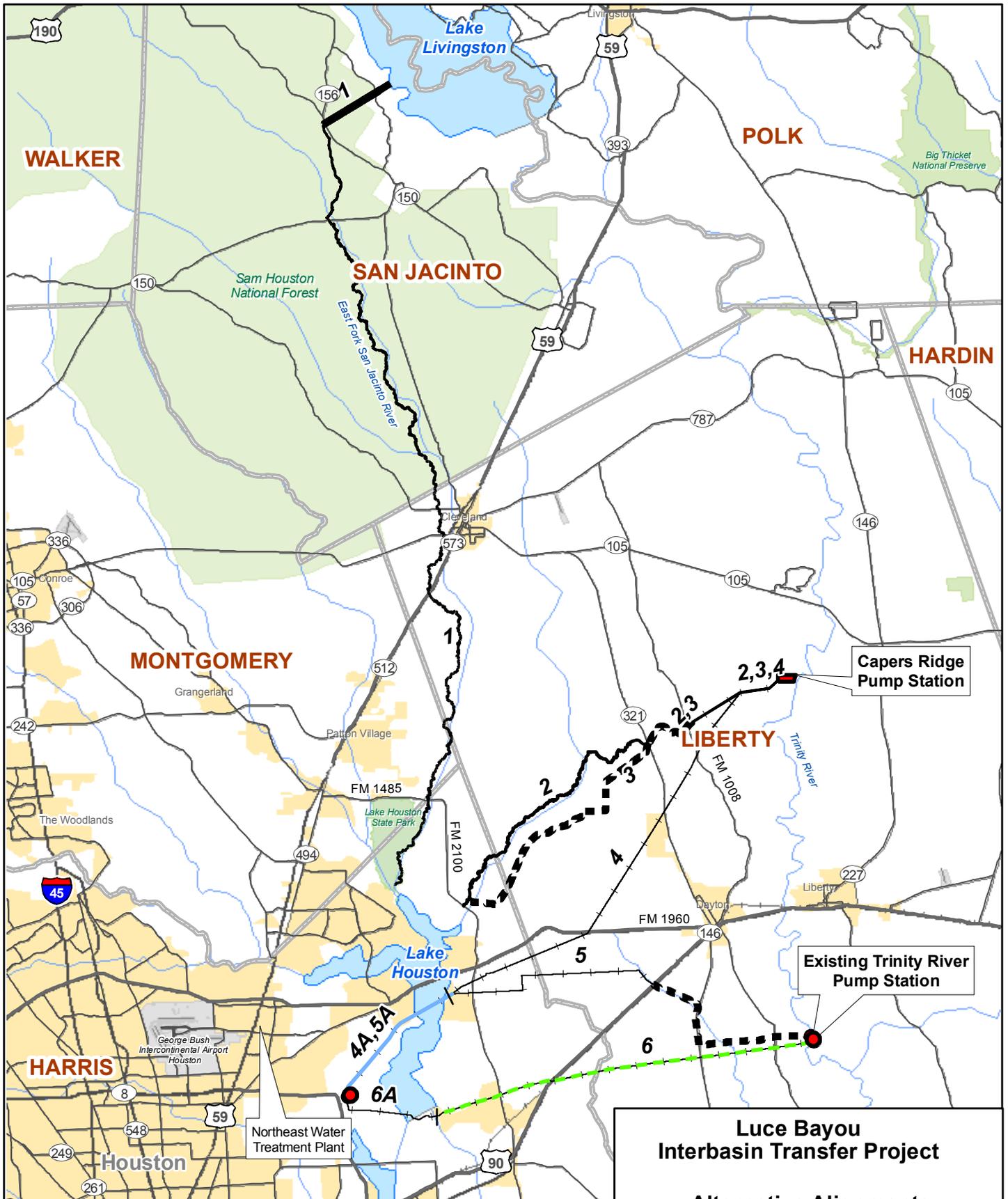
-  Proposed ROW
-  Harrison Tract
-  Capers Ridge Pump Station Tract



**Luce Bayou
Interbasin Transfer Project
Vicinity Map**

Counties: Liberty & Harris State: Texas
 USACE Permit No. : SWG 2009-00188
 Application By: Coastal Water Authority
 Sheet 1 of 44 Date: March 2010

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Source - ESRI (2002)

Legend

- County Boundary
- Pipeline
- Canal
- Existing Natural Channel
- Facilities

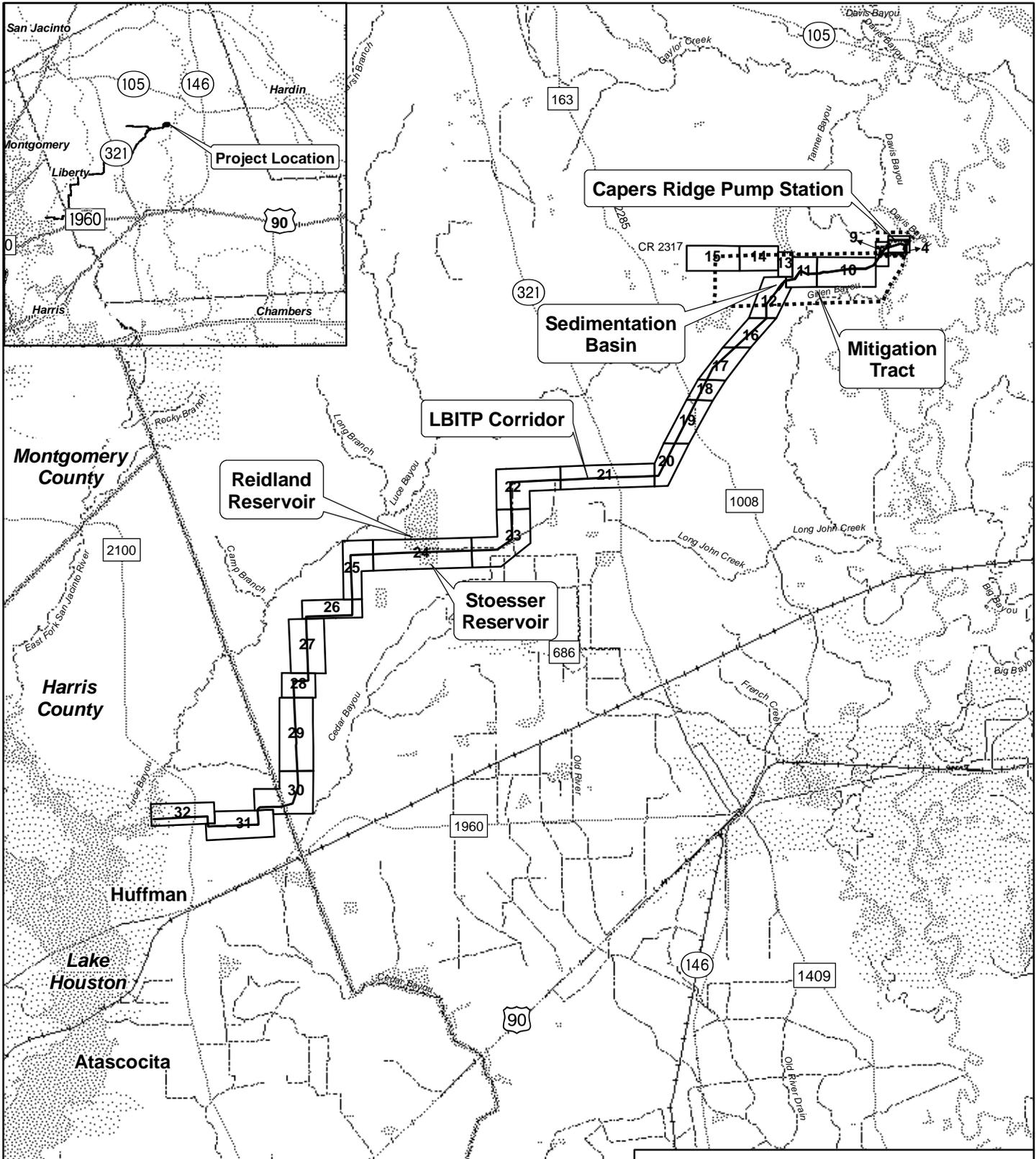


0 35,000 Feet

**Luce Bayou
Interbasin Transfer Project
Alternative Alignments**

Counties: Liberty & Harris State: Texas
 USACE Permit No. : SWG 2009-00188
 Application By: Coastal Water Authority
 Sheet 2 of 44 Date: March 2010

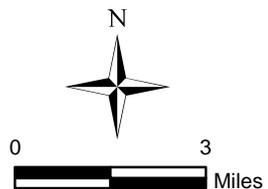
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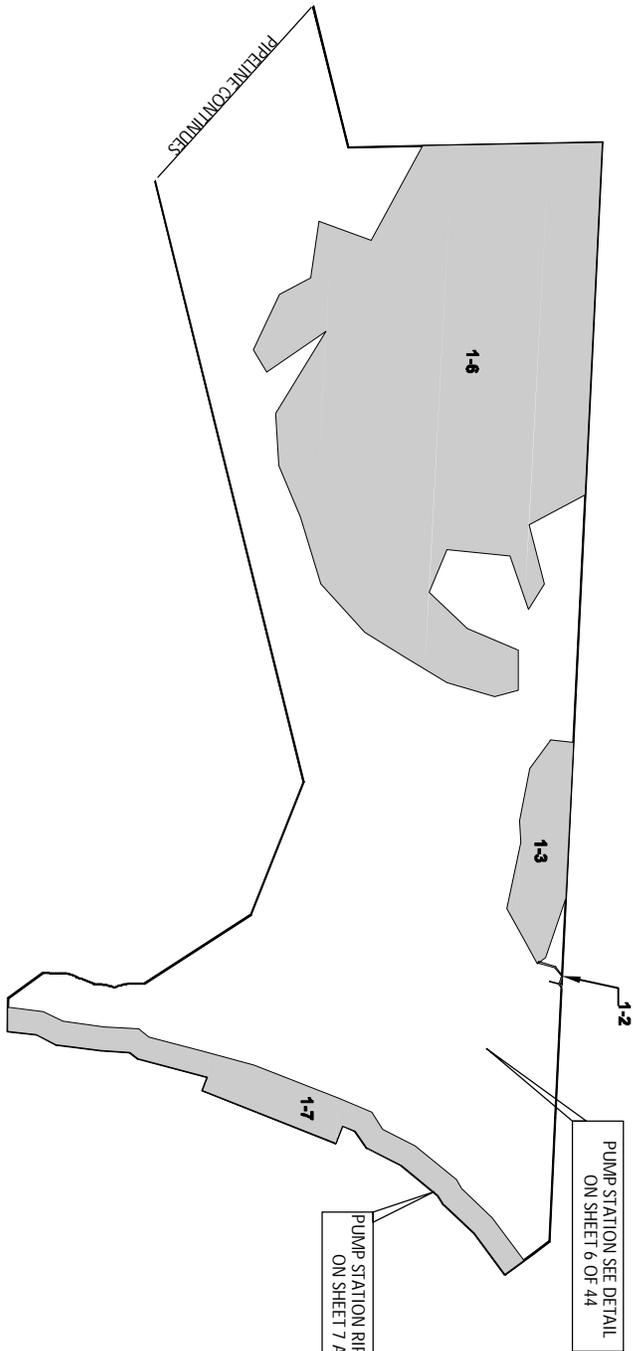
Basemap Source: ESRI 2008 StreetMap data.

Legend

-  Proposed Alignment
-  Harrison Tract
-  Capers Ridge Pump Station

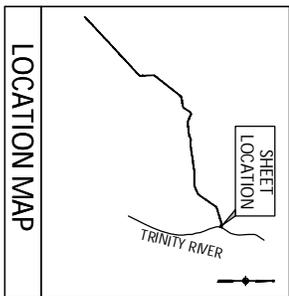
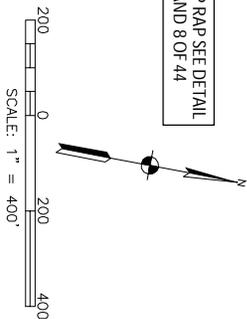


Luce Bayou Interbasin Transfer Project	
Wetland Impacts Page Layout	
Counties: Liberty & Harris	State: Texas
USACE Permit No. : SWG 2009-00188	
Application By: Coastal Water Authority	
Sheet 3 of 44	Date: March 2010



WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
1-2	0.01	Drainage
1-3	0.58*	Forested Mosaic
1-6	5.69**	Forested Mosaic
1-7	1.67	Trinity River
*Forested Mosaic- 1-3 (Total acreage 0.96, 60.5% Wetland)		
**Forested Mosaic- 1-6 (Total acreage 12.87, 44.2% Wetland)		

CAPERS RIDGE PUMP
STATION TRACT



LUCE BAYOU INTERBASIN
TRANSFER PROJECT
PROJECT PLANVIEW AND
WETLAND IMPACTS

COUNTY: HARRIS AND LIBERTY

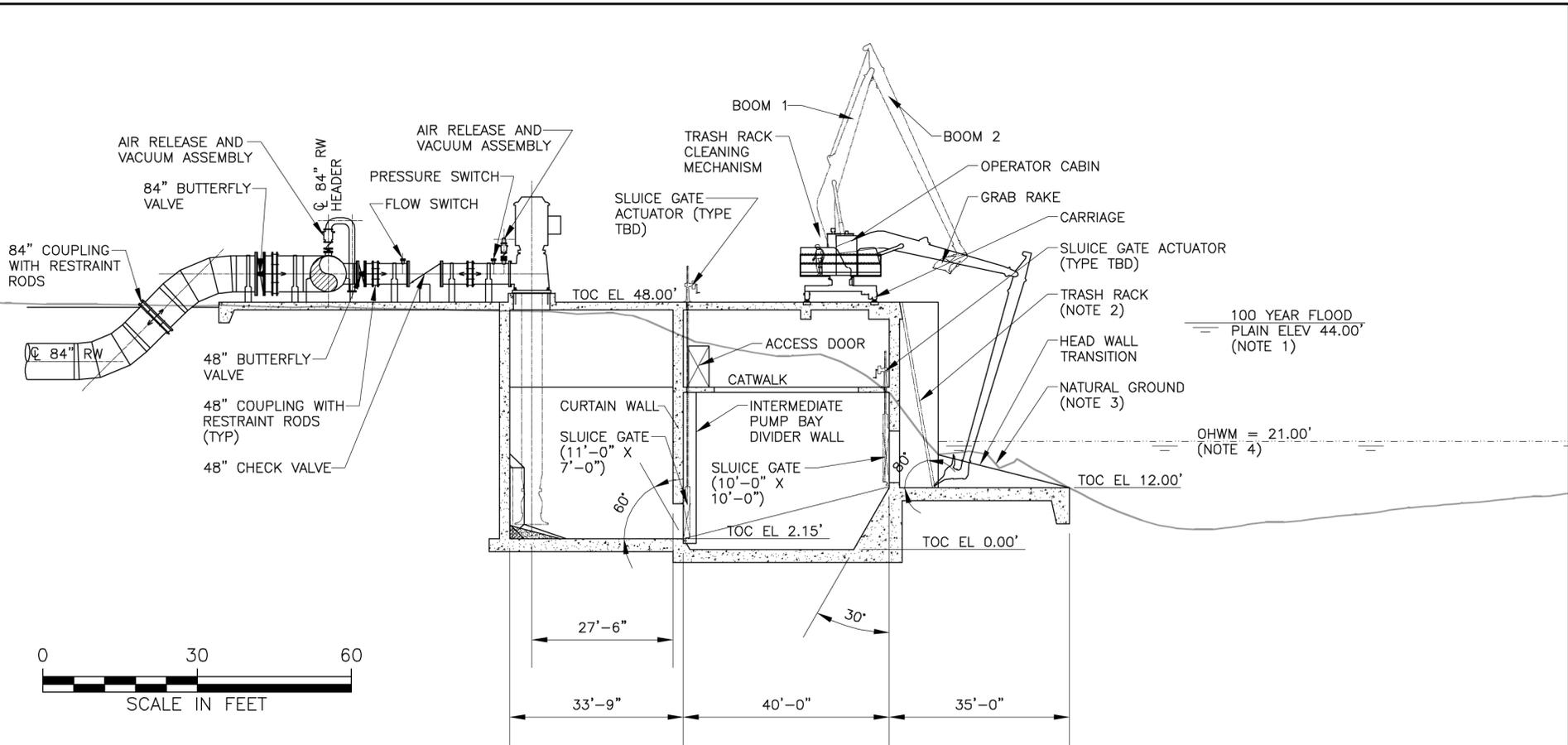
USACE PERMIT No.: SWG 2009-00188

APPLICATION BY: COASTAL WATER AUTHORITY

SHEET NO. 4 OF 44

DATE: MARCH 2010

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Fill Volume = 800 Cubic yards of concrete
 Excavation Volume = 1,100 Cubic yards

Fill Area = 0.10 Acre
 Excavation Area = 0.10 Acre

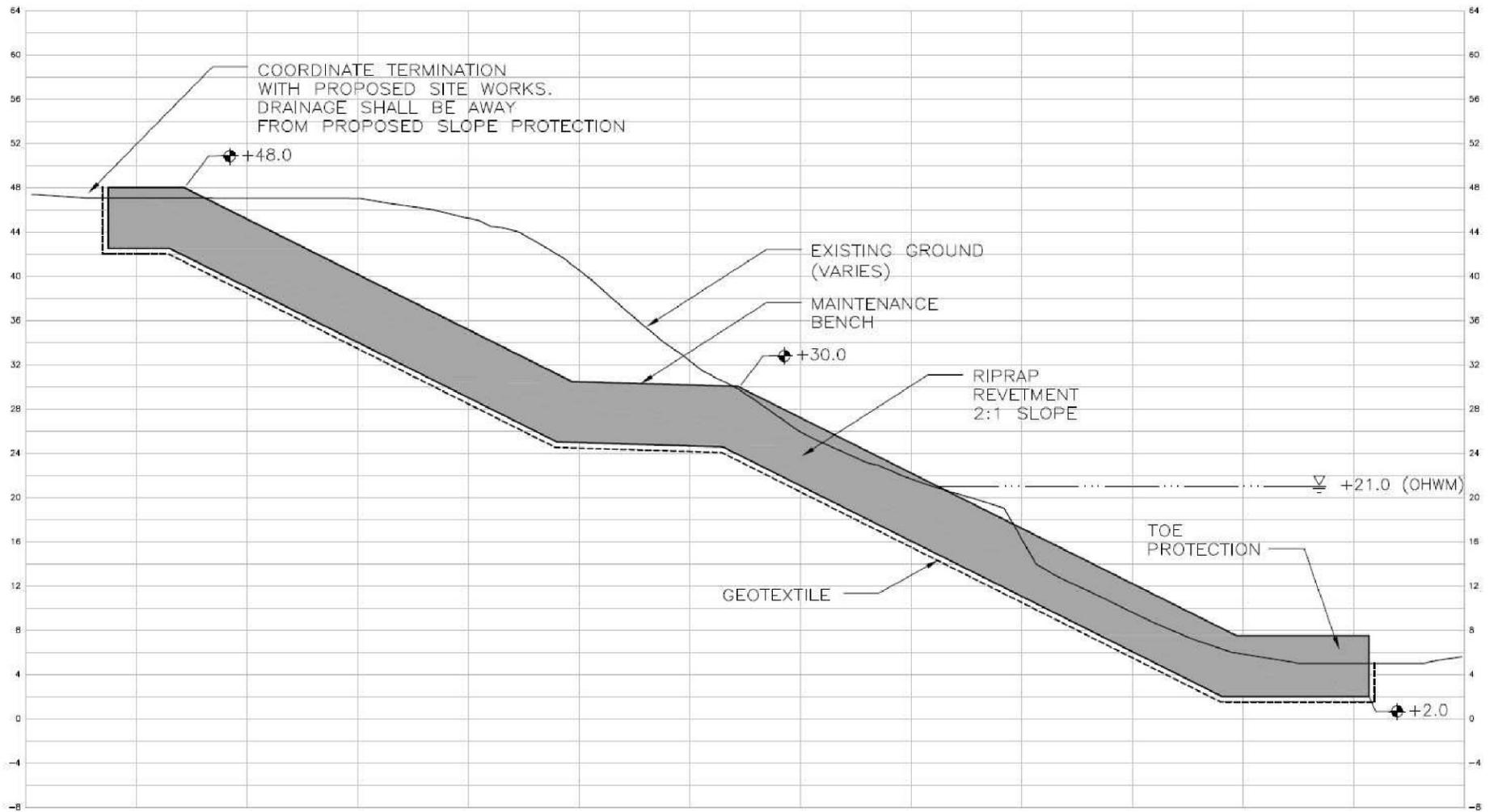
**Luce Bayou
 Interbasin Transfer Project
 Caper's Ridge Pump Station
 Cross Section**

Counties: Liberty & Harris State: Texas
 USAGE Permit No. : SWG 2009-00188
 Application By: Coastal Water Authority
 Sheet 6 of 44 Date: March 2010

NOTES:

1. 100 YEAR FLOOD PLAIN ELEVATION AS SHOWN BASED ON FIRM PANEL 48291C0325C, EFFECTIVE DATE: MAY 2, 2008, REFERENCED TO NAGVD 88, 2001 ADJUSTMENT.
2. PRELIMINARY TRASH RACK DESIGN CONSIST OF 1/2" WIDE BARS SPACED 2-INCHES APART (OUTSIDE EDGE TO OUTSIDE EDGE). DEPTH AND HORIZONTAL BRACING TO BE DETERMINED LATER.
3. NATURAL GROUND ELEVATION SHOWN AT CENTERLINE OF PUMP STATION. REFERENCED TO NAGVD 88, 2001 ADJUSTMENT.
4. OHWM = ORDINARY HIGH WATER MARK.
5. TOC = TOP OF CONCRETE.

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1 TYPICAL CROSS SECTION
2 ALTERNATIVE 1:- REVETMENT



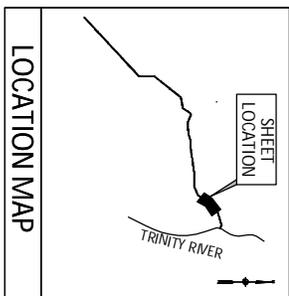
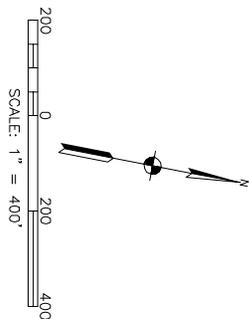
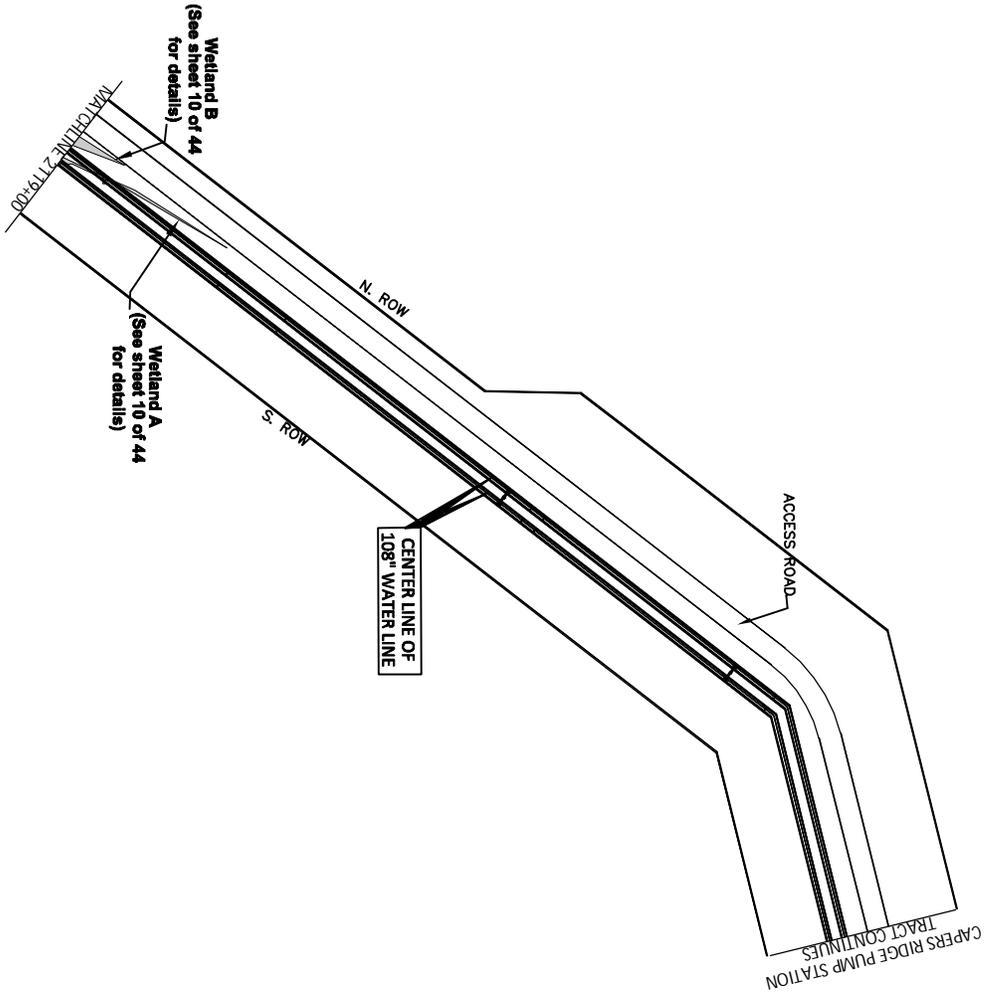
Fill Volume = 7,600 Cubic yards of riprap
Excavation Volume = 6,000 Cubic yards

Fill Area = 1.57 Acres
Excavation Area = 1.57 Acres

**Luce Bayou
Interbasin Transfer Project
Capers Ridge Pump Station
Slope Protection Alternative
Profile**

Counties: Liberty & Harris State: Texas
USAGE Permit No. : SWG 2009-00188
Application By: Coastal Water Authority
Sheet 8 of 44 Date: March 2010

PIPELINE PLANVIEW



LUCE BAYOU INTERBASIN
 TRANSFER PROJECT
 PROJECT PLANVIEW AND
 WETLAND IMPACTS

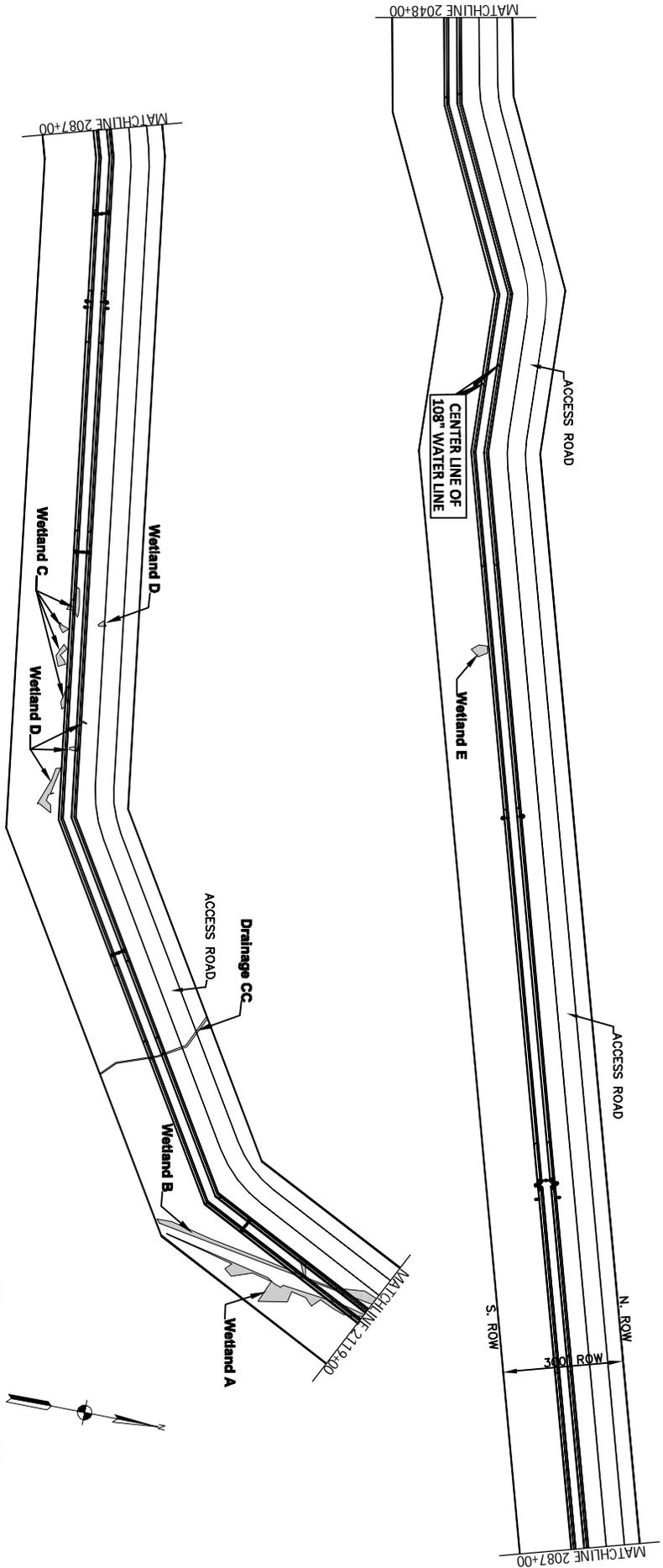
COUNTY: HARRIS AND LIBERTY

USACE PERMIT No.: SWG 2009-00188

APPLICATION BY: COASTAL WATER AUTHORITY

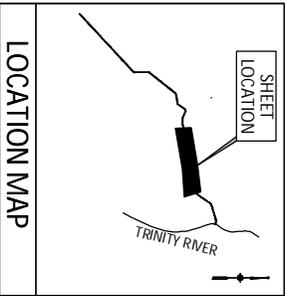
SHEET NO. 9 OF 44

DATE: MARCH 2010



WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
Drainage CC	0.02	Drainage
Wetland A	0.21	Emergent
Wetland B	0.16	Emergent
Wetland C	0.06	Emergent
Wetland D	0.05	Emergent
Wetland E	0.02	Emergent

PIPELINE PLANVIEW



LUCE BAYOU INTERBASIN TRANSFER PROJECT

PROJECT PLANVIEW AND WETLAND IMPACTS

COUNTY: HARRIS AND LIBERTY

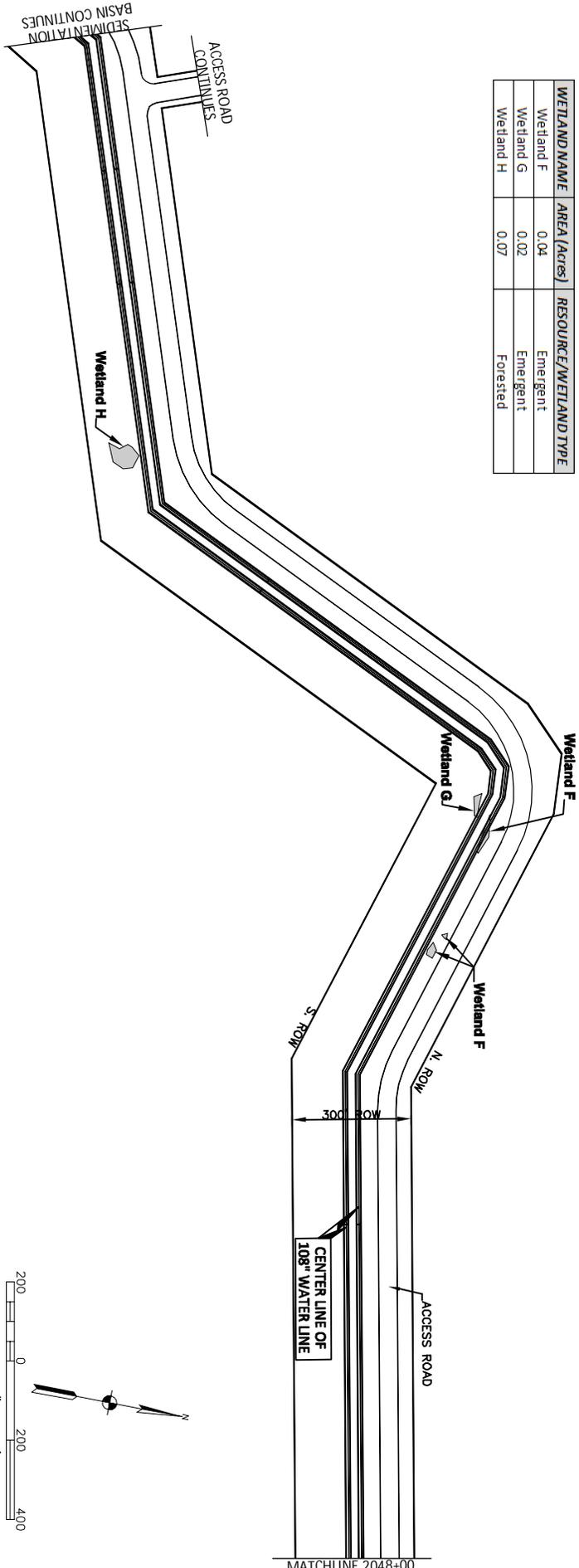
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APPLICATION BY: COASTAL WATER AUTHORITY

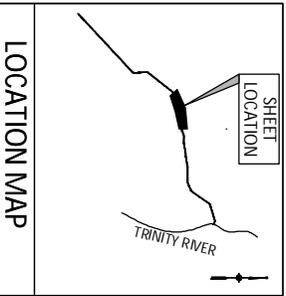
SHEET NO. 10 OF 44

DATE: MARCH 2010

WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
Wetland F	0.04	Emergent
Wetland G	0.02	Emergent
Wetland H	0.07	Forested

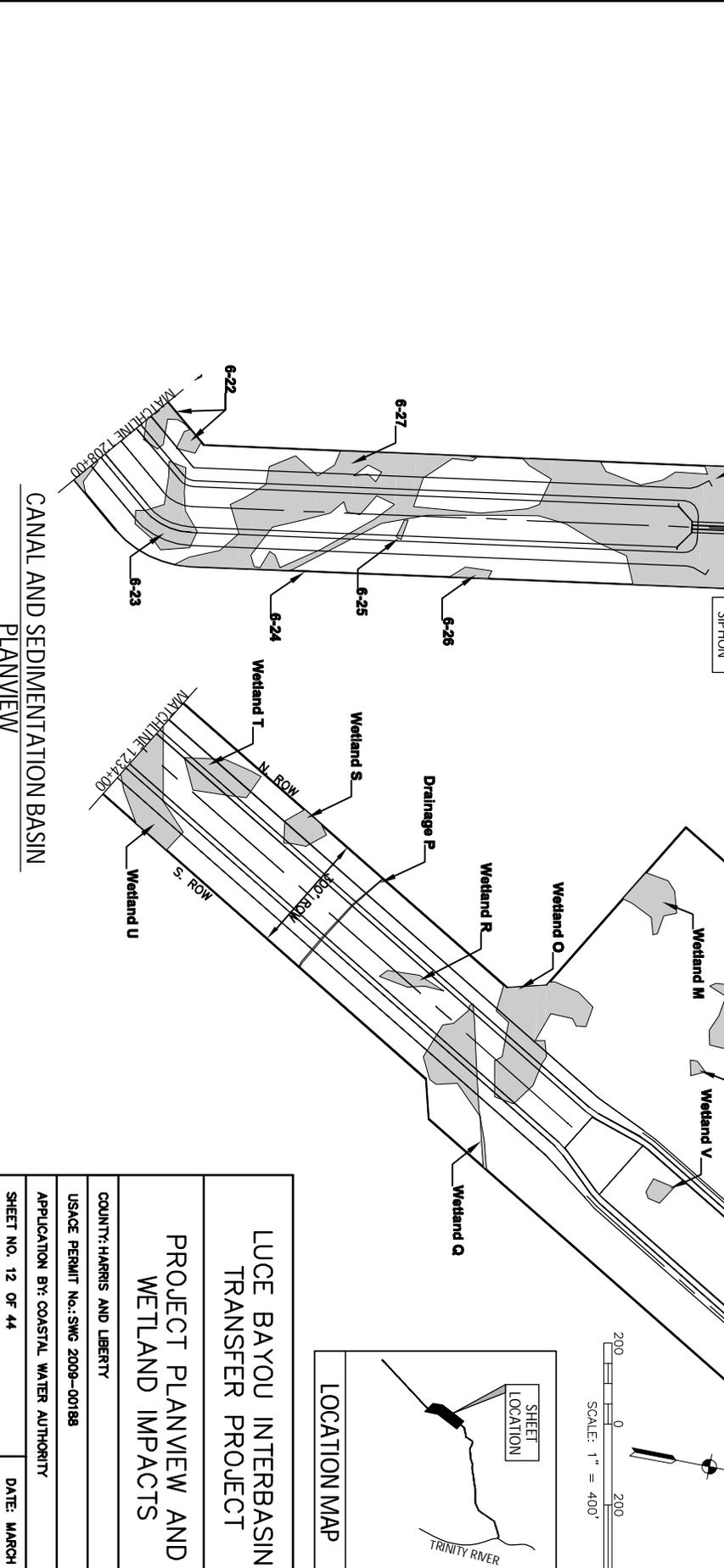


PIPELINE PLANVIEW



LUCE BAYOU INTERBASIN TRANSFER PROJECT PROJECT PLANVIEW AND WETLAND IMPACTS	
COUNTY: HARRIS AND LIBERTY USACE PERMIT No.: SWG 2009-00188 APPLICATION BY: COASTAL WATER AUTHORITY	
SHEET NO. 11 OF 44	DATE: MARCH 2010

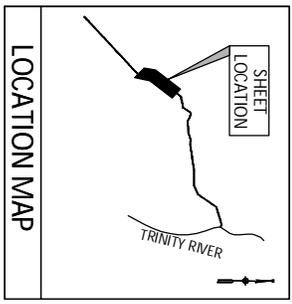
WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
6-22	0.20	Forested
6-23	0.38	Forested
6-24	0.01	Forested
6-25	0.01	Forested
6-26	0.04	Forested
6-27	5.04	Forested
Drainage P	0.02	Drainage
Wetland I	0.55	Forested
Wetland J	0.31	Forested
Wetland K	0.73	Emergent
Wetland L	0.02	Forested
Wetland M	0.24	Forested
Wetland N	0.39	Forested
Wetland O	0.84	Forested
Wetland Q	0.47	Forested
Wetland R	0.07	Forested
Wetland S	0.15	Forested
Wetland T	0.30	Forested
Wetland U	6.41	Forested
Wetland V	0.05	Forested



CANAL AND SEDIMENTATION BASIN
 PLANVIEW

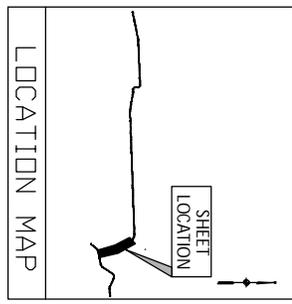
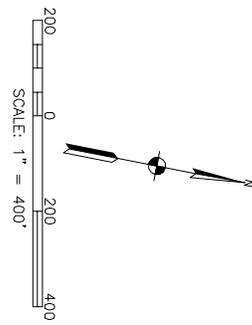
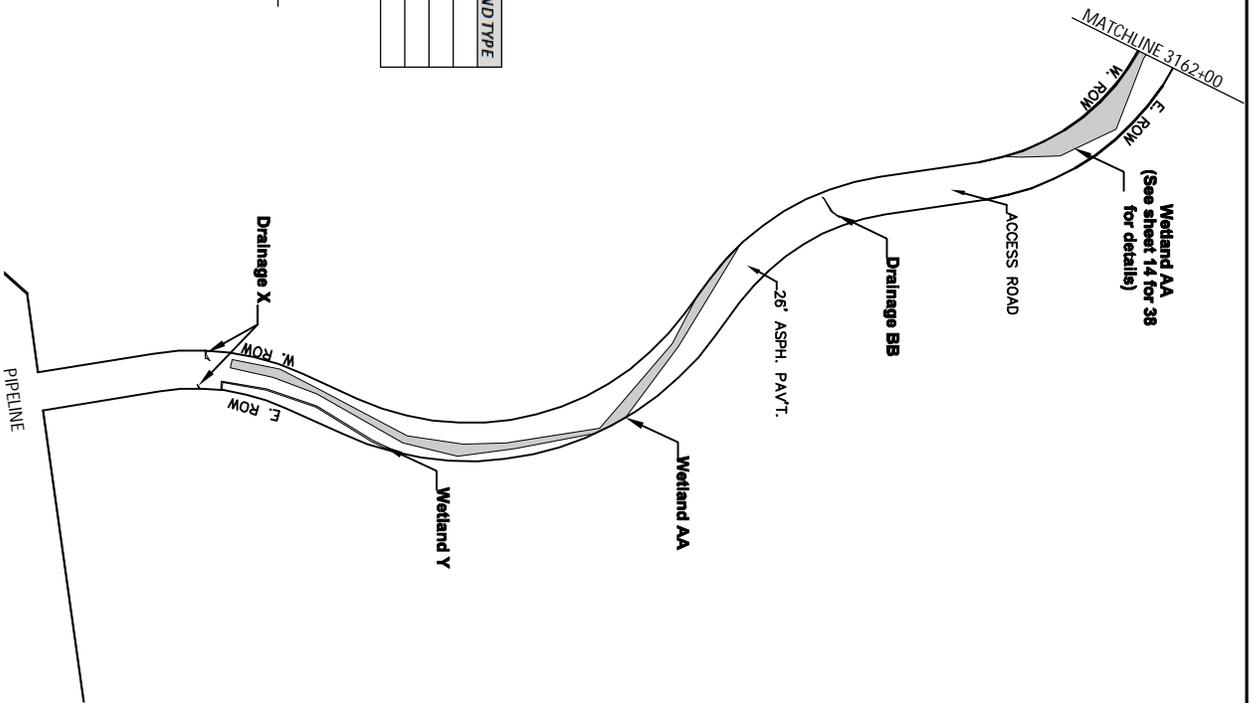
LUCE BAYOU INTERBASIN
 TRANSFER PROJECT
 PROJECT PLANVIEW AND
 WETLAND IMPACTS

COUNTY: HARRIS AND LIBERTY
 USACE PERMIT No.: SWG 2008-00188
 APPLICATION BY: COASTAL WATER AUTHORITY
 SHEET NO. 12 OF 44
 DATE: MARCH 2010

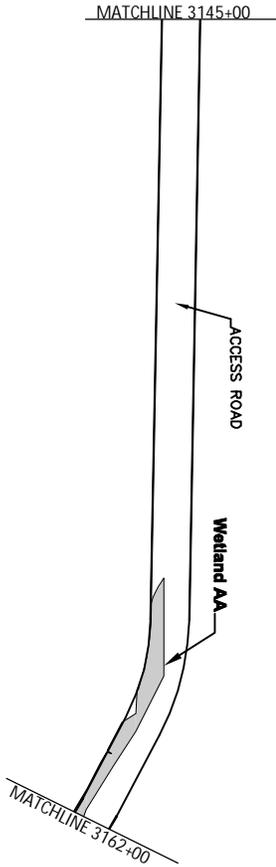
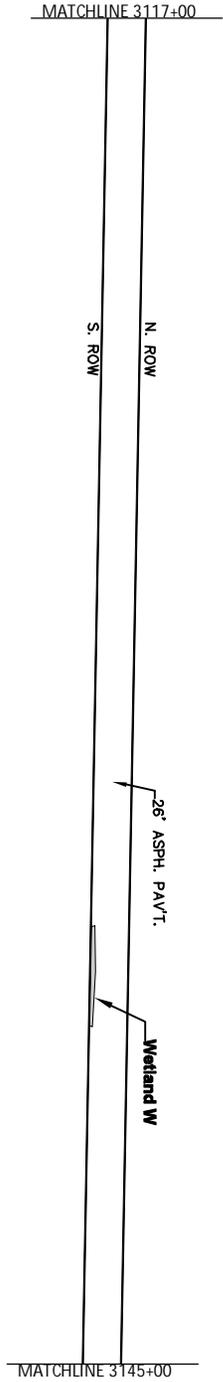


WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
Drainage X	0.01	Drainage
Drainage BB	0.01	Drainage
Wetland Y	0.03	Emergent
Wetland AA	0.50	Emergent

ACCESS ROAD PLANVIEW

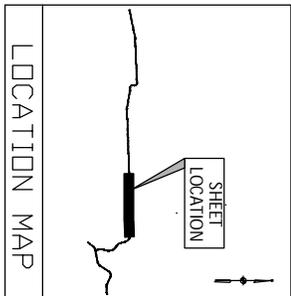
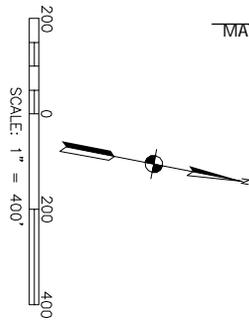


LUCE BAYOU INTERBASIN TRANSFER PROJECT PROJECT PLANVIEW AND WETLAND IMPACTS	
COUNTY: HARRIS AND LIBERTY	
USACE PERMIT No.: SWG 2009-00188	
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WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
Wetland W	0.05	Forested
Wetland AA	0.65	Emergent

ACCESS ROAD PLANVIEW



LUCE BAYOU INTERBASIN
 TRANSFER PROJECT
 PROJECT PLANVIEW AND
 WETLAND IMPACTS

COUNTY: HARRIS AND LIBERTY

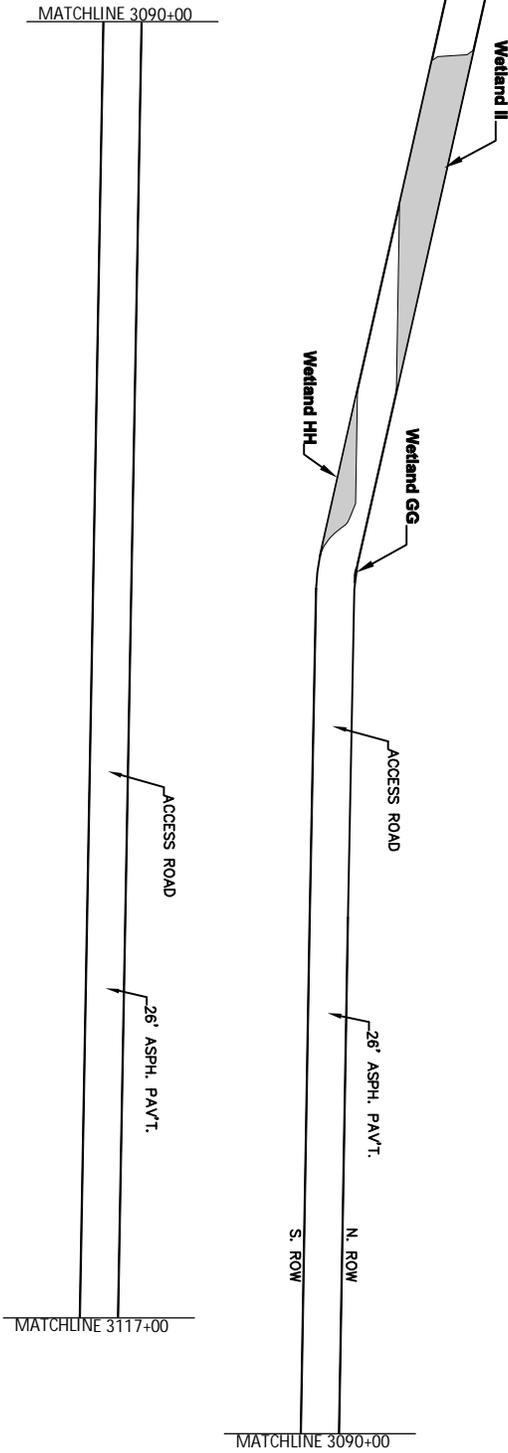
USACE PERMIT No.: SWG 2008-00188

APPLICATION BY: COASTAL WATER AUTHORITY

SHEET NO. 14 OF 44

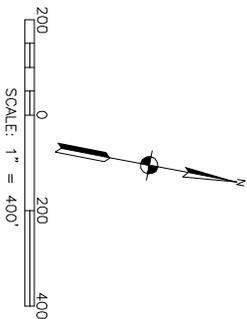
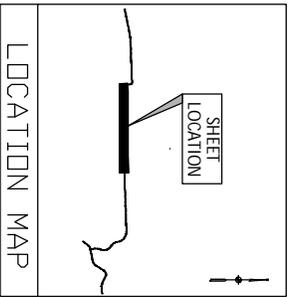
DATE: MARCH 2010

HARRISON TRACT
 FRONT GATE



WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
Wetland GG	0.01	Forested
Wetland HH	0.20	Forested
Wetland II	0.96	Forested

ACCESS ROAD PLANVIEW



LUCE BAYOU INTERBASIN
 TRANSFER PROJECT
 PROJECT PLANVIEW AND
 WETLAND IMPACTS

COUNTY: HARRIS AND LIBERTY

USACE PERMIT No.: SWG 2008-00188

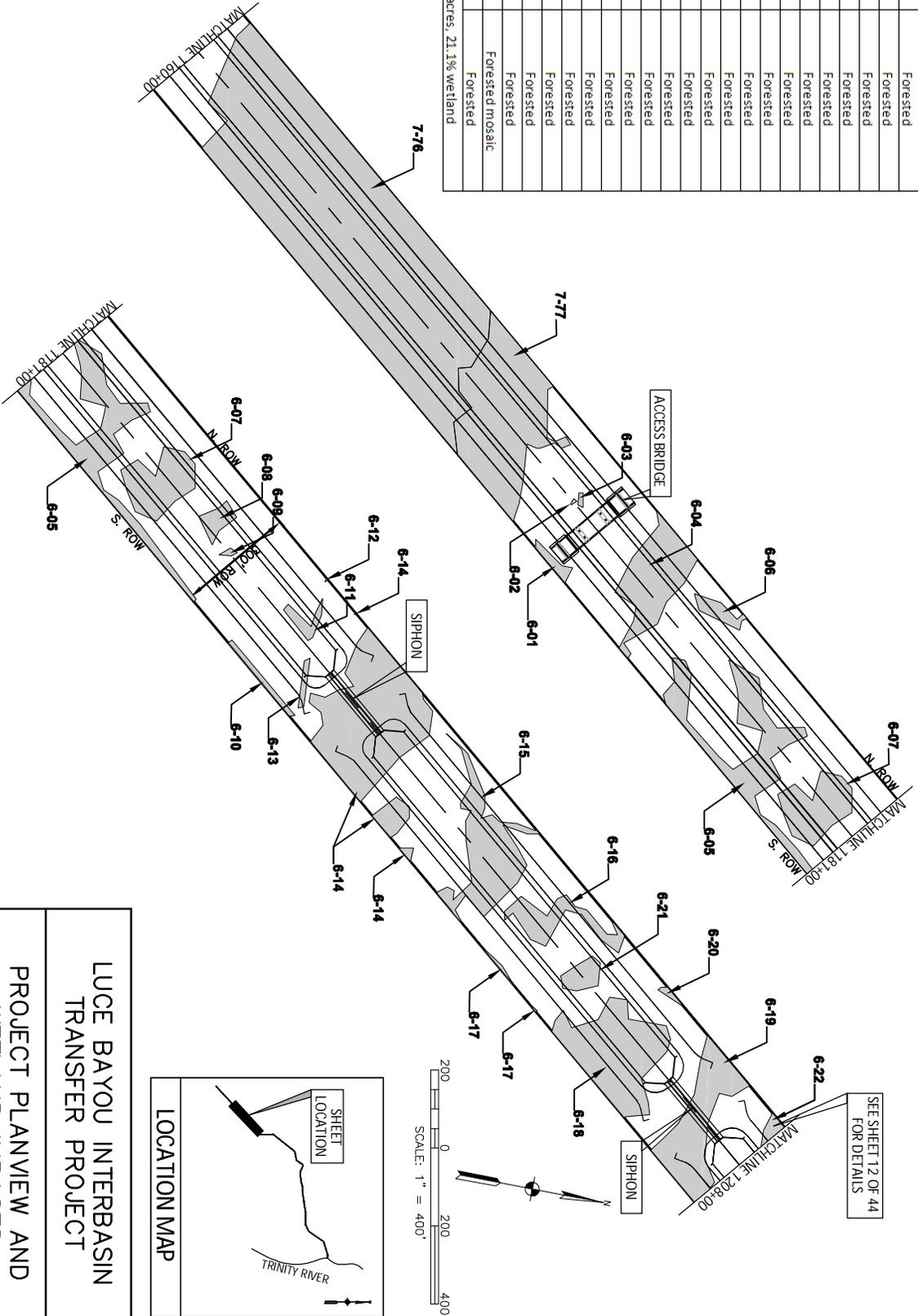
APPLICATION BY: COASTAL WATER AUTHORITY

SHEET NO. 15 OF 44

DATE: MARCH 2010

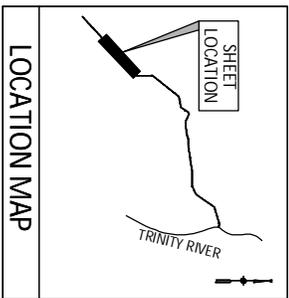
WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
6-01	0.06	Forested
6-02	0.01	Forested
6-03	0.01	Forested
6-04	0.75	Forested
6-05	0.99	Forested
6-06	0.11	Forested
6-07	0.50	Forested
6-08	0.11	Forested
6-09	0.01	Forested
6-10	0.07	Forested
6-11	0.08	Forested
6-12	0.01	Forested
6-13	0.04	Forested
6-14	1.86	Forested
6-15	0.83	Forested
6-16	0.34	Forested
6-17	0.02	Forested
6-18	1.11	Forested
6-19	0.84	Forested
6-20	0.02	Forested
6-21	0.14	Forested
7-76*	1.44	Forested mosaic
7-77	1.76	Forested

*Total Acreage 6.80 acres, 21.1% wetland



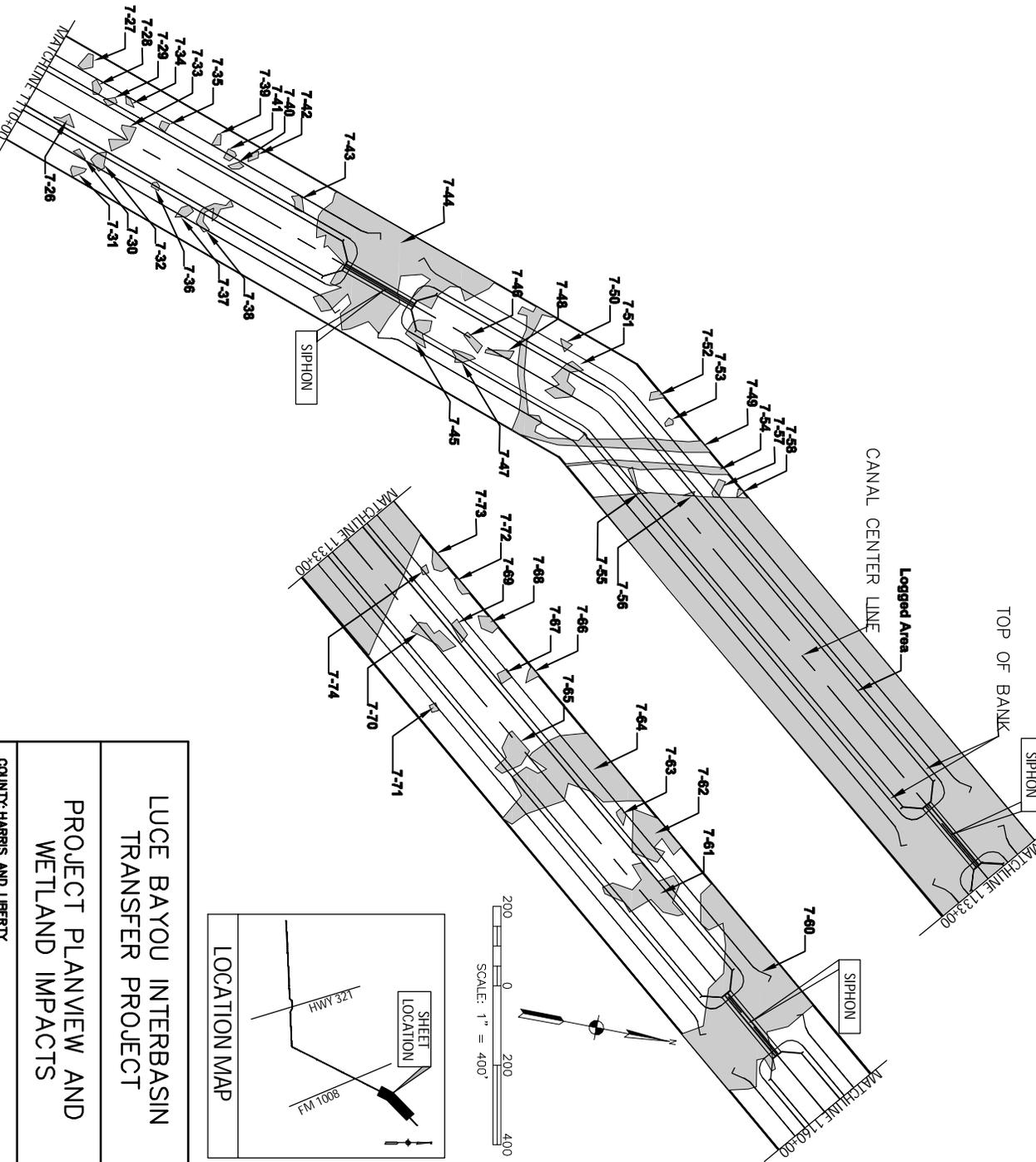
CANAL PLANVIEW

LUCE BAYOU INTERBASIN
 TRANSFER PROJECT
 WETLAND IMPACTS



COUNTY: HARRIS AND LIBERTY USACE PERMIT No.: SWG 2009-00188 APPLICATION BY: COASTAL WATER AUTHORITY SHEET NO. 16 OF 44	
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WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
7-26	0.02	Forested
7-27	0.02	Forested
7-28	0.01	Forested
7-29	0.01	Forested
7-30	0.01	Forested
7-31	0.01	Forested
7-32	0.03	Forested
7-33	0.04	Forested
7-34	0.01	Forested
7-35	0.01	Forested
7-36	0.01	Forested
7-37	0.02	Forested
7-38	0.05	Forested
7-39	0.01	Forested
7-40	0.01	Forested
7-41	0.01	Forested
7-42	0.01	Forested
7-43	0.02	Forested
7-44	1.65	Forested
7-45	0.06	Forested
7-46	0.02	Forested
7-47	0.02	Forested
7-48	0.02	Forested
7-49	0.43	Forested
7-50	0.01	Forested
7-51	0.09	Forested
7-52	0.01	Forested
7-53	0.01	Forested
7-54	0.13	Forested
7-55	0.04	Forested
7-56	0.01	Forested
7-57	0.01	Forested
7-58	0.01	Forested
7-60	1.72	Forested
7-61	0.27	Forested
7-62	0.21	Forested
7-63	0.01	Forested
7-64	0.84	Forested
7-65	0.11	Forested
7-66	0.01	Forested
7-67	0.02	Forested
7-68	0.03	Forested
7-69	0.02	Forested
7-70	0.07	Forested
7-71	0.01	Forested
7-72	0.02	Forested
7-73	0.03	Forested
7-74	0.01	Forested
Logged Area*	2.84	Forested mosaic

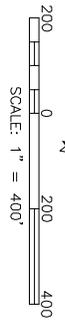
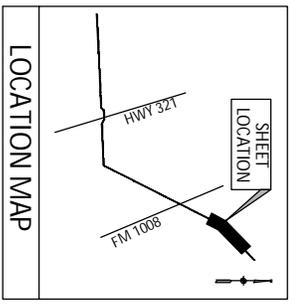


CANAL PLANVIEW

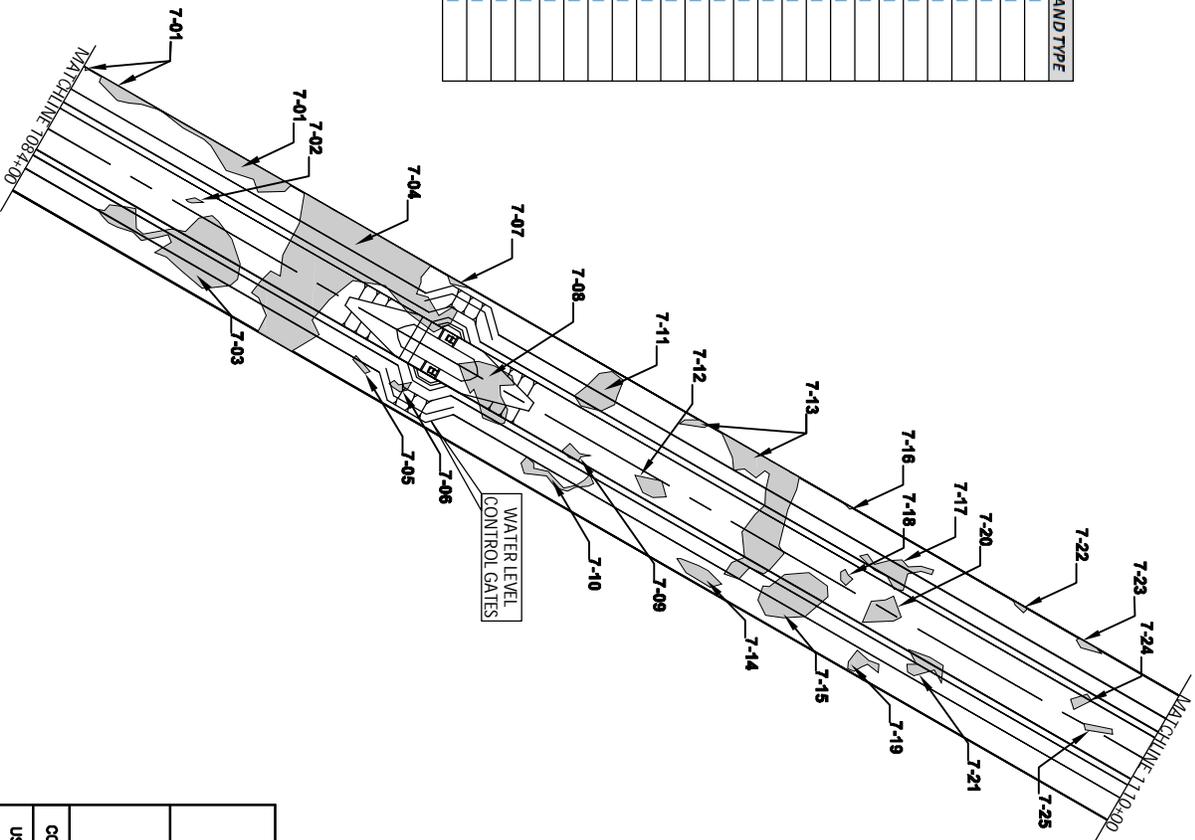
LUCE BAYOU INTERBASIN
 TRANSFER PROJECT
 WETLAND IMPACTS

COUNTY: HARRIS AND LIBERTY
 USACE PERMIT No.: SWG 2008-00188
 APPLICATION BY: COASTAL WATER AUTHORITY

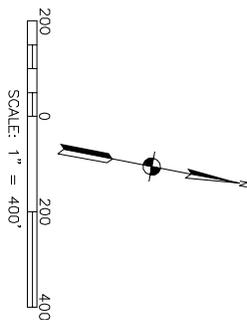
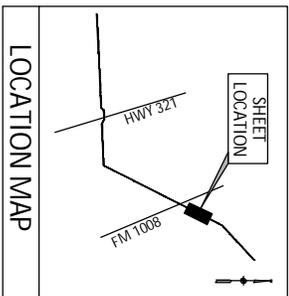
SHEET NO. 17 OF 44 DATE: MARCH 2010



WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
7-01	0.20	Forested
7-02	0.01	Forested
7-03	0.47	Forested
7-04	1.34	Forested
7-05	0.01	Forested
7-06	0.01	Forested
7-07	0.01	Forested
7-08	0.19	Forested
7-09	0.02	Forested
7-10	0.05	Forested
7-11	0.11	Forested
7-12	0.04	Forested
7-13	0.47	Forested
7-14	0.05	Forested
7-15	0.22	Forested
7-16	0.01	Forested
7-17	0.09	Forested
7-18	0.01	Forested
7-19	0.03	Forested
7-20	0.07	Forested
7-21	0.06	Forested
7-22	0.01	Forested
7-23	0.01	Forested
7-24	0.02	Forested
7-25	0.02	Forested



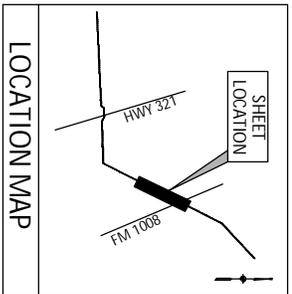
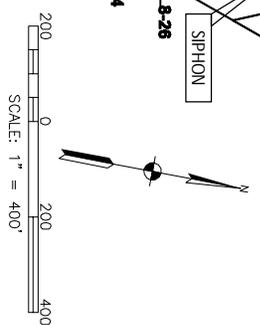
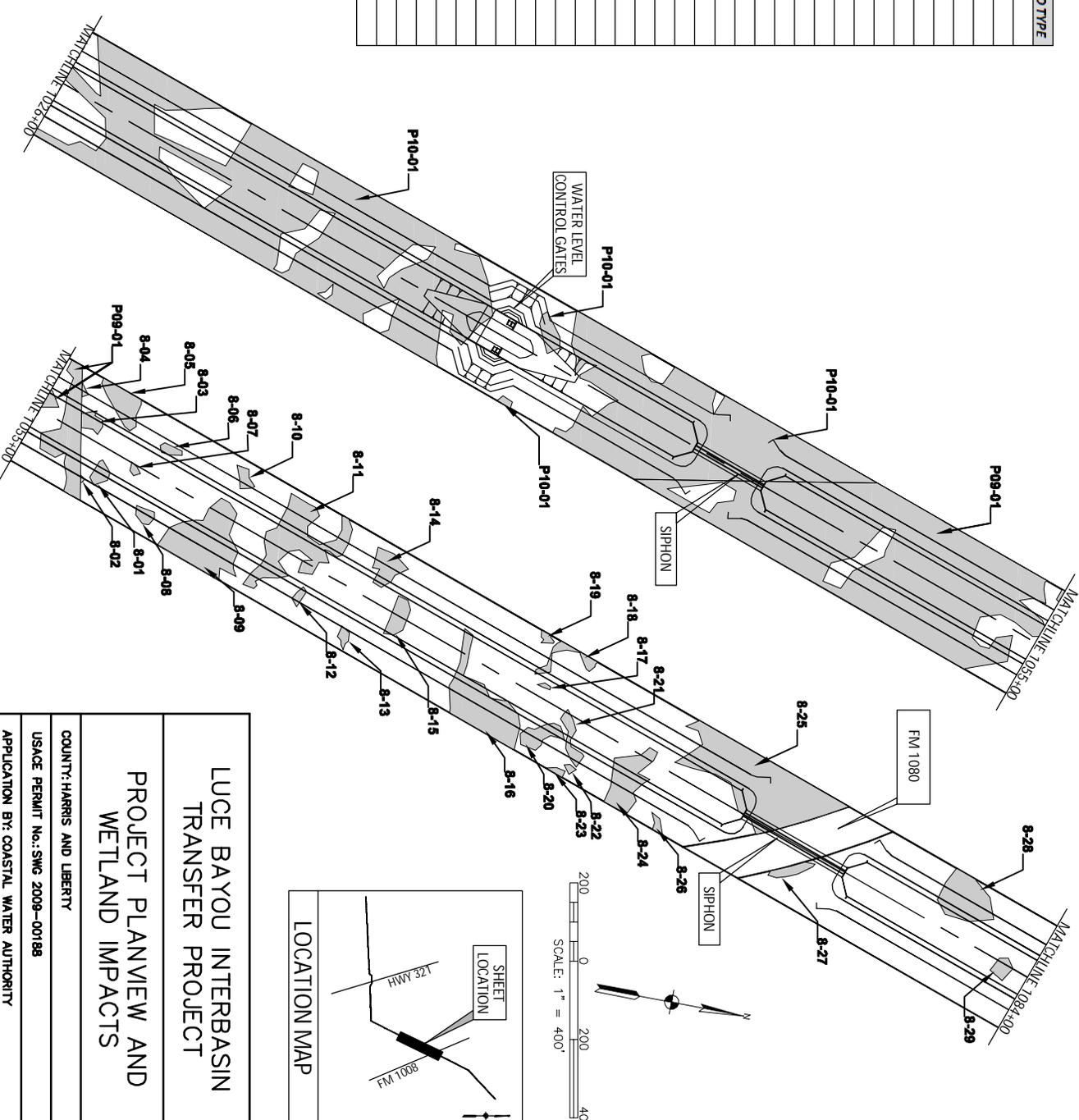
CANAL PLANVIEW



LUCE BAYOU INTERBASIN TRANSFER PROJECT PROJECT PLANVIEW AND WETLAND IMPACTS	
COUNTY: HARRIS AND LIBERTY	
USACE PERMIT No.: SWG 2009-00188	
APPLICATION BY: COASTAL WATER AUTHORITY	
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WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
8-01	0.04	Forested
8-02	0.01	Forested
8-03	0.05	Forested
8-04	0.01	Forested
8-05	0.14	Forested
8-06	0.02	Forested
8-07	0.01	Forested
8-08	0.03	Forested
8-09	0.54	Forested
8-10	0.04	Forested
8-11	0.55	Forested
8-12	0.02	Forested
8-13	0.02	Forested
8-14	0.12	Forested
8-15	0.09	Forested
8-16	0.49	Forested
8-17	0.01	Forested
8-18	0.07	Forested
8-19	0.02	Forested
8-20	0.10	Forested
8-21	0.07	Forested
8-22	0.01	Forested
8-23	0.01	Forested
8-24	0.26	Forested
8-25	1.10	Forested
8-26	0.02	Forested
8-27	0.05	Forested
8-28	0.29	Forested
8-29	0.05	Forested
P09-01	4.81	Forested
P09-01	0.39	Forested
P10-01	0.08	Scrub-shrub
P10-01	3.42	Scrub-shrub
P10-01	0.01	Scrub-shrub

CANAL PLANVIEW



**LUCE BAYOU INTERBASIN
TRANSFER PROJECT**

**PROJECT PLANVIEW AND
WETLAND IMPACTS**

COUNTY: HARRIS AND LIBERTY

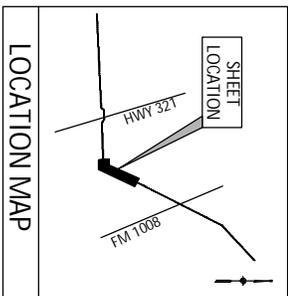
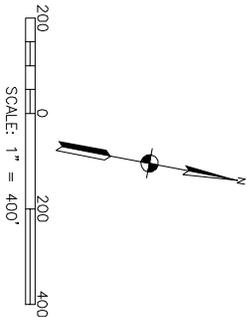
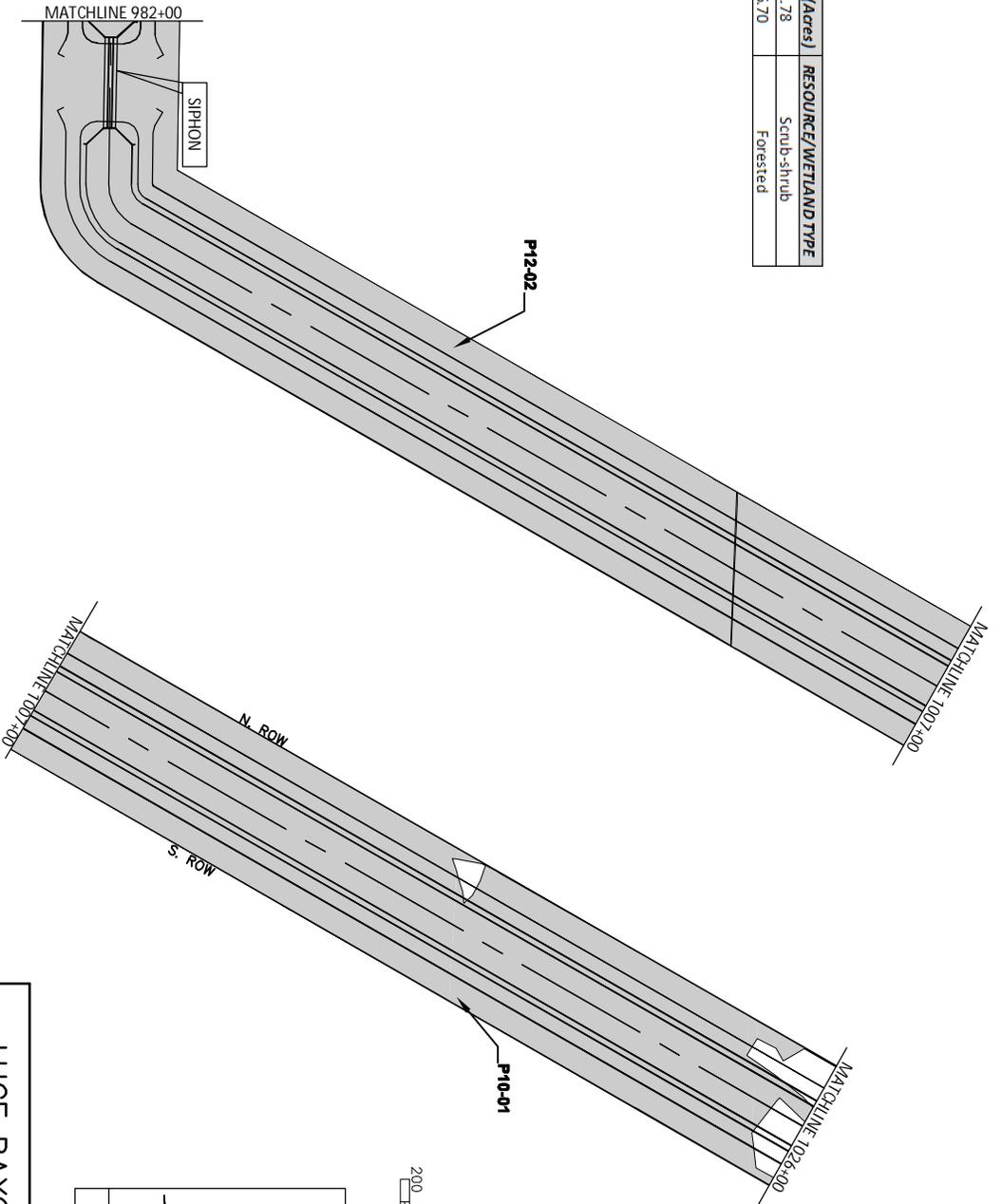
USACE PERMIT No.: SWG 2008-00188

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WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
P10-01	21.78	Scrub-shrub
P12-02	16.70	Forested



**LUCE BAYOU INTERBASIN
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 PROJECT PLANVIEW AND
 WETLAND IMPACTS**

COUNTY: HARRIS AND LIBERTY

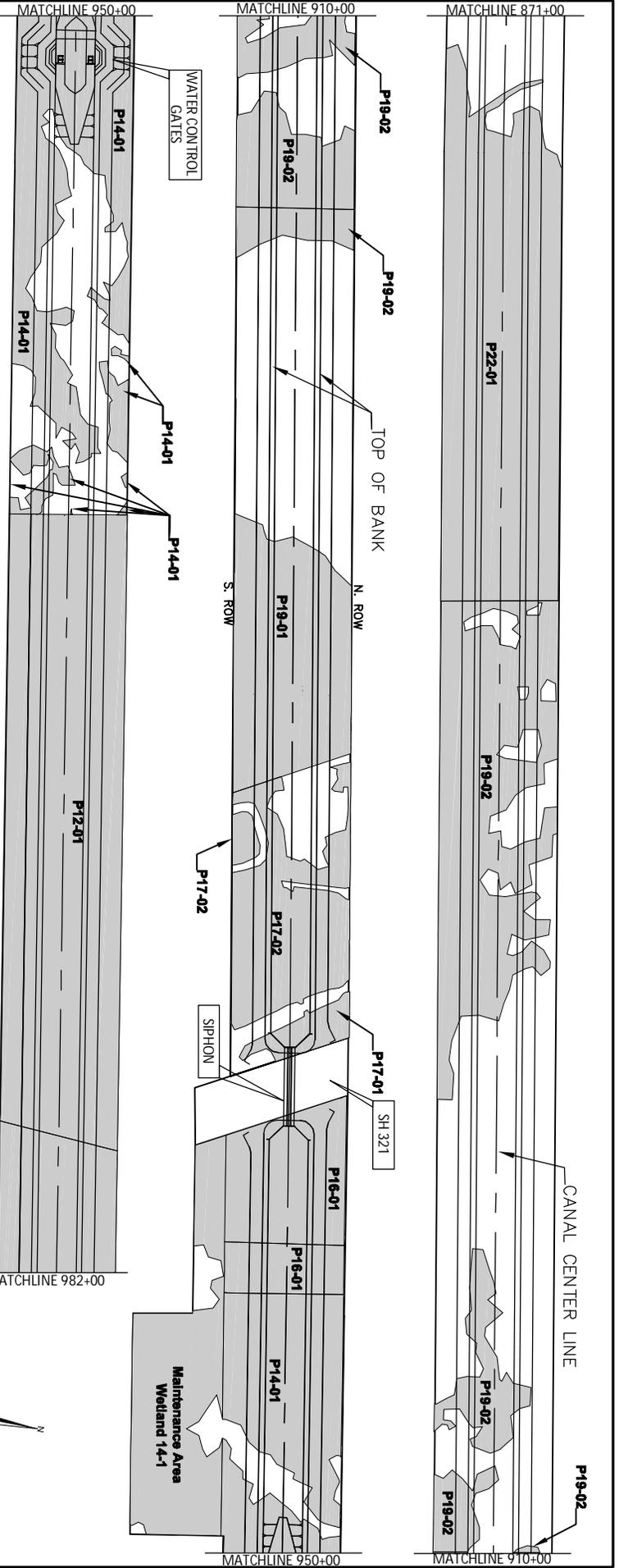
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CANAL PLANVIEW

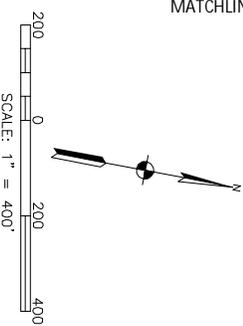
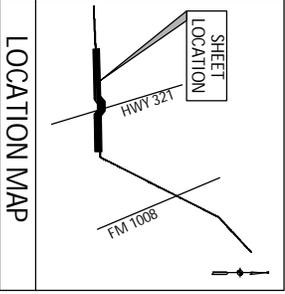


WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
Maintenance Area Wetland 14-1	3.38	Forested
P12-01*	5.77	Forested
P14-01	0.01	Forested
P14-01	5.77	Forested
P14-01	2.77	Forested
P14-01	0.25	Forested
P14-01	0.02	Forested
P14-01	0.01	Forested
P14-01	0.28	Forested
P14-01	0.01	Forested
P14-01	0.01	Forested
P16-01	2.89	Forested
P16-01	0.75	Forested

WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
P17-01	0.49	Emergent
P17-02	2.88	Emergent
P17-02	0.18	Emergent
P19-01	4.06	Forested
P19-02	5.87	Emergent
P19-02	0.71	Emergent
P19-02	1.58	Emergent
P19-02	0.75	Emergent
P19-02	1.41	Emergent
P22-01	8.67	Emergent

*Forested Mosaic- P12-01: (Total acreage 10.93, 52.77% Wetland)

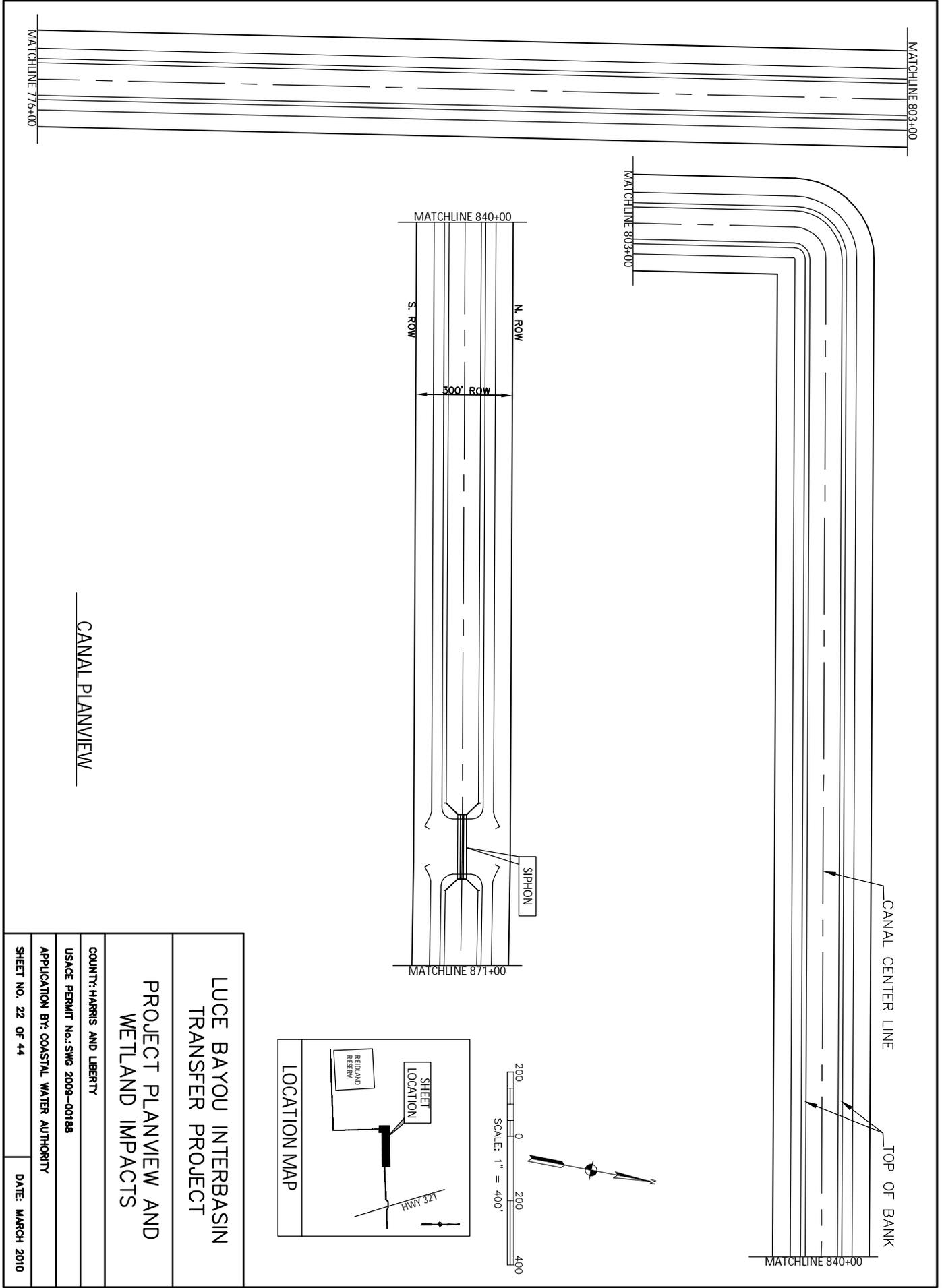
CANAL PLANVIEW



**LUCE BAYOU INTERBASIN
TRANSFER PROJECT**

**PROJECT PLANVIEW AND
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COUNTY: HARRIS AND LIBERTY
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CANAL PLANVIEW

LUCE BAYOU INTERBASIN
 TRANSFER PROJECT
 PROJECT PLANVIEW AND
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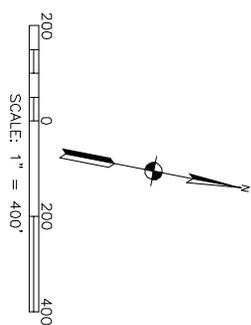
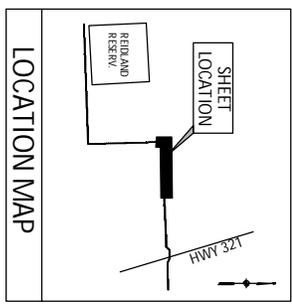
COUNTY: HARRIS AND LIBERTY

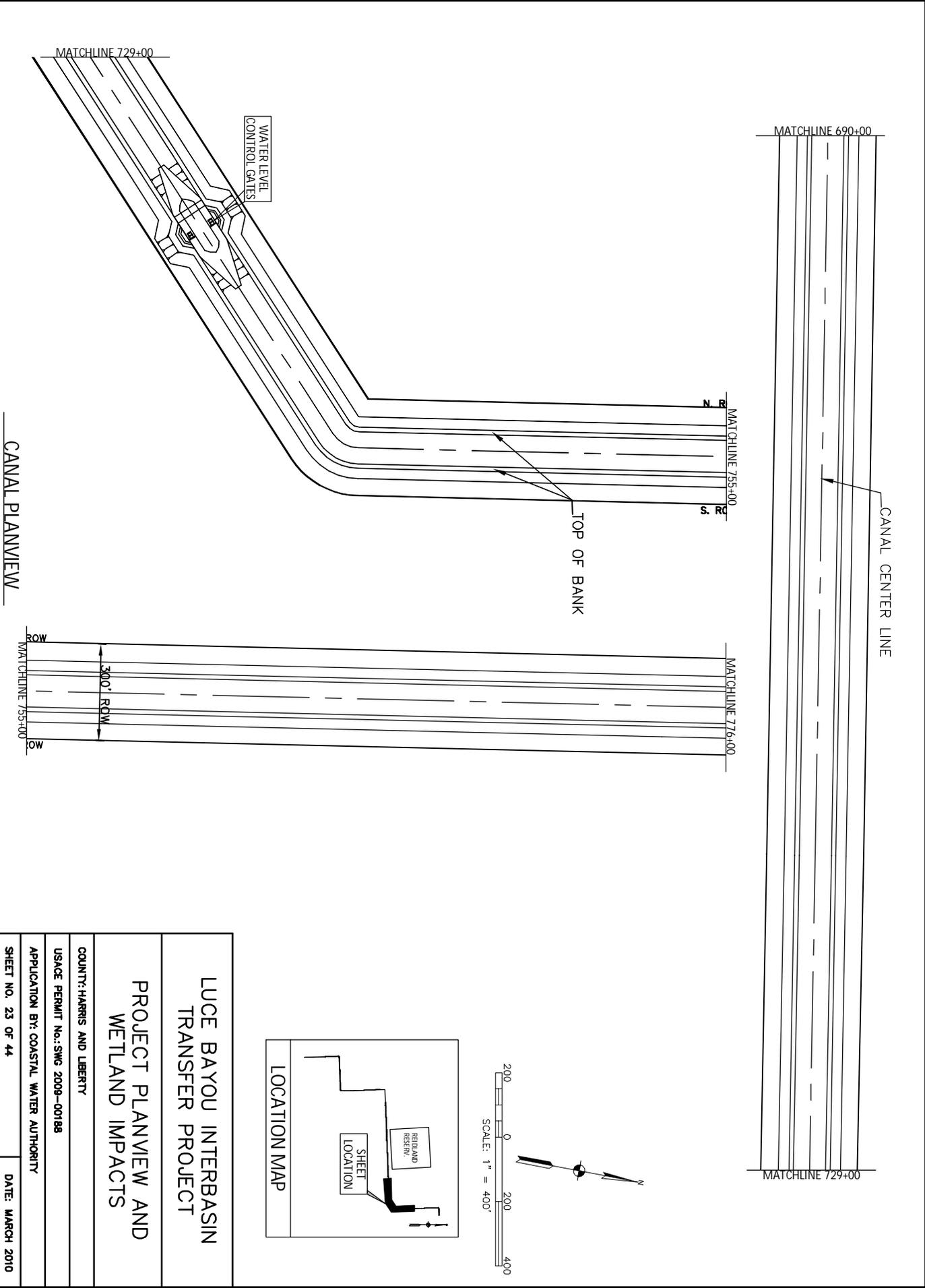
USACE PERMIT No.: SWG 2009-00188

APPLICATION BY: COASTAL WATER AUTHORITY

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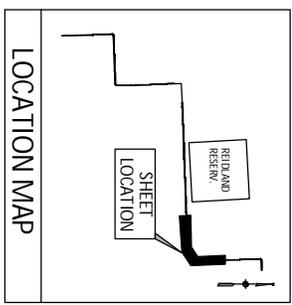
DATE: MARCH 2010





CANAL PLANVIEW

<p>LUCE BAYOU INTERBASIN TRANSFER PROJECT</p> <p>PROJECT PLANVIEW AND WETLAND IMPACTS</p>	
<p>COUNTY: HARRIS AND LIBERTY</p>	
<p>USACE PERMIT No.: SWG 2009-00188</p>	
<p>APPLICATION BY: COASTAL WATER AUTHORITY</p>	
<p>SHEET NO. 23 OF 44</p>	<p>DATE: MARCH 2010</p>



MATCHLINE 652+00 MATCHLINE 614+00 MATCHLINE 576+00

300' ROW

CANAL CENTER LINE

TOP OF BANK

28-1

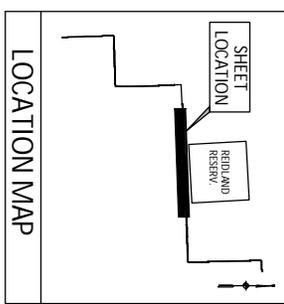
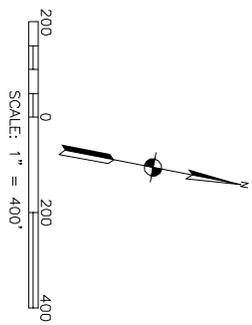
S. ROW

N. ROW

MATCHLINE 690+00 MATCHLINE 652+00 MATCHLINE 614+00

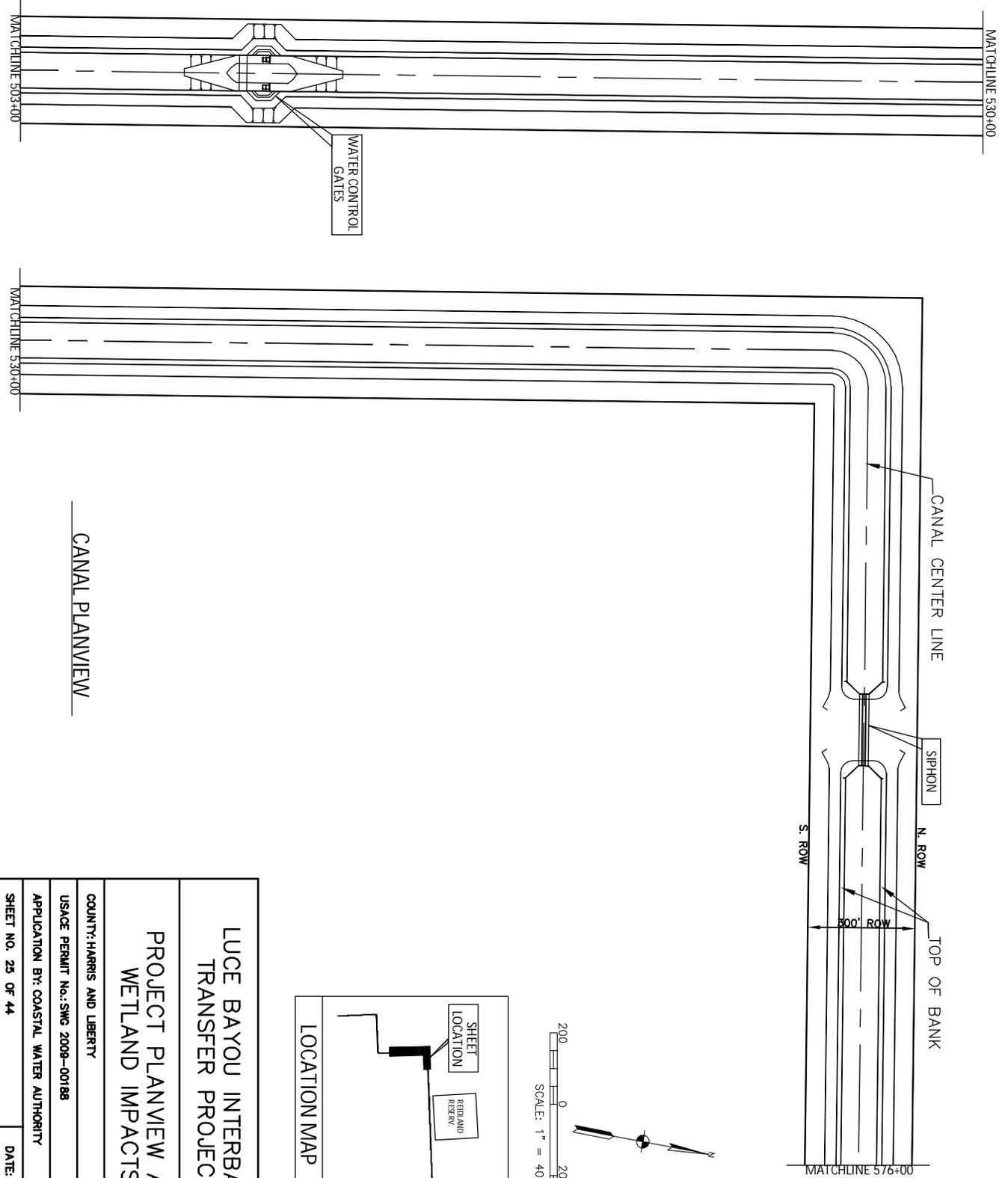
WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
28-1	11.21	Open Water

CANAL PLANVIEW

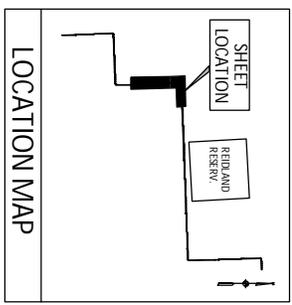


LUCE BAYOU INTERBASIN
 TRANSFER PROJECT
 PROJECT PLANVIEW AND
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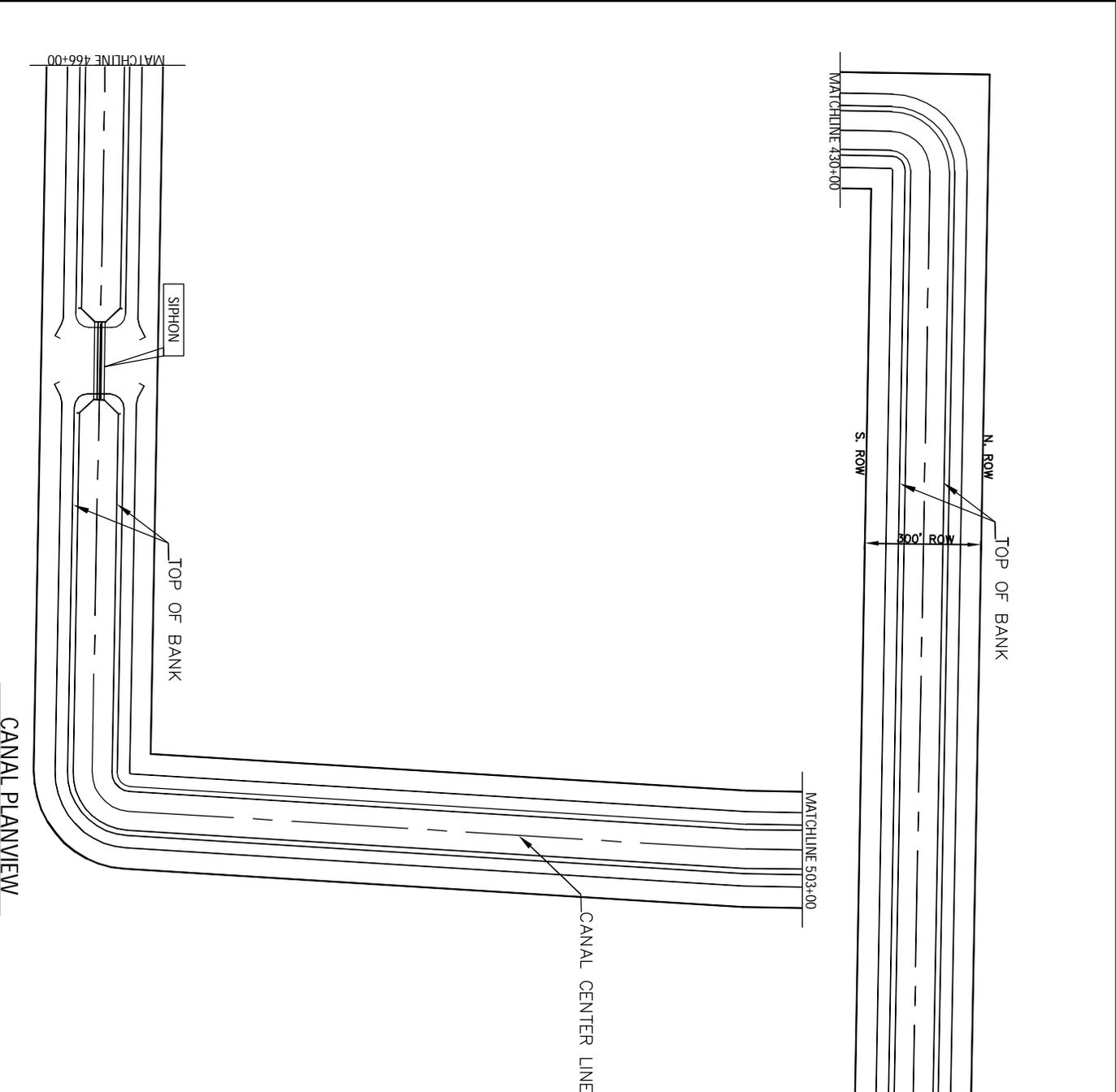
COUNTY: HARRIS AND LIBERTY
 USACE PERMIT No.: SWG 2009-00188
 APPLICATION BY: COASTAL WATER AUTHORITY
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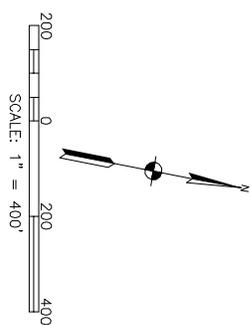
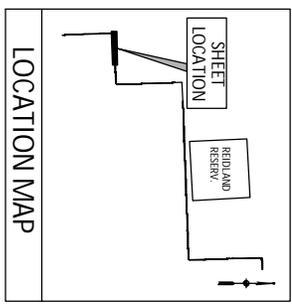


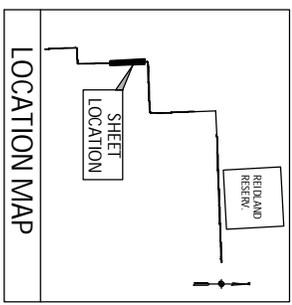
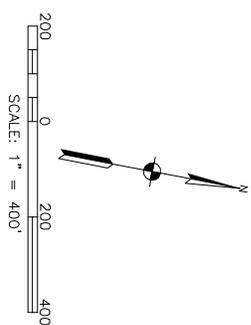
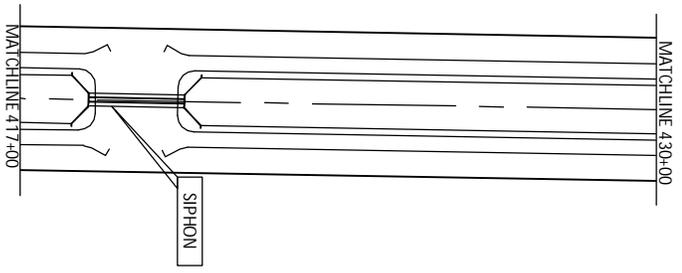
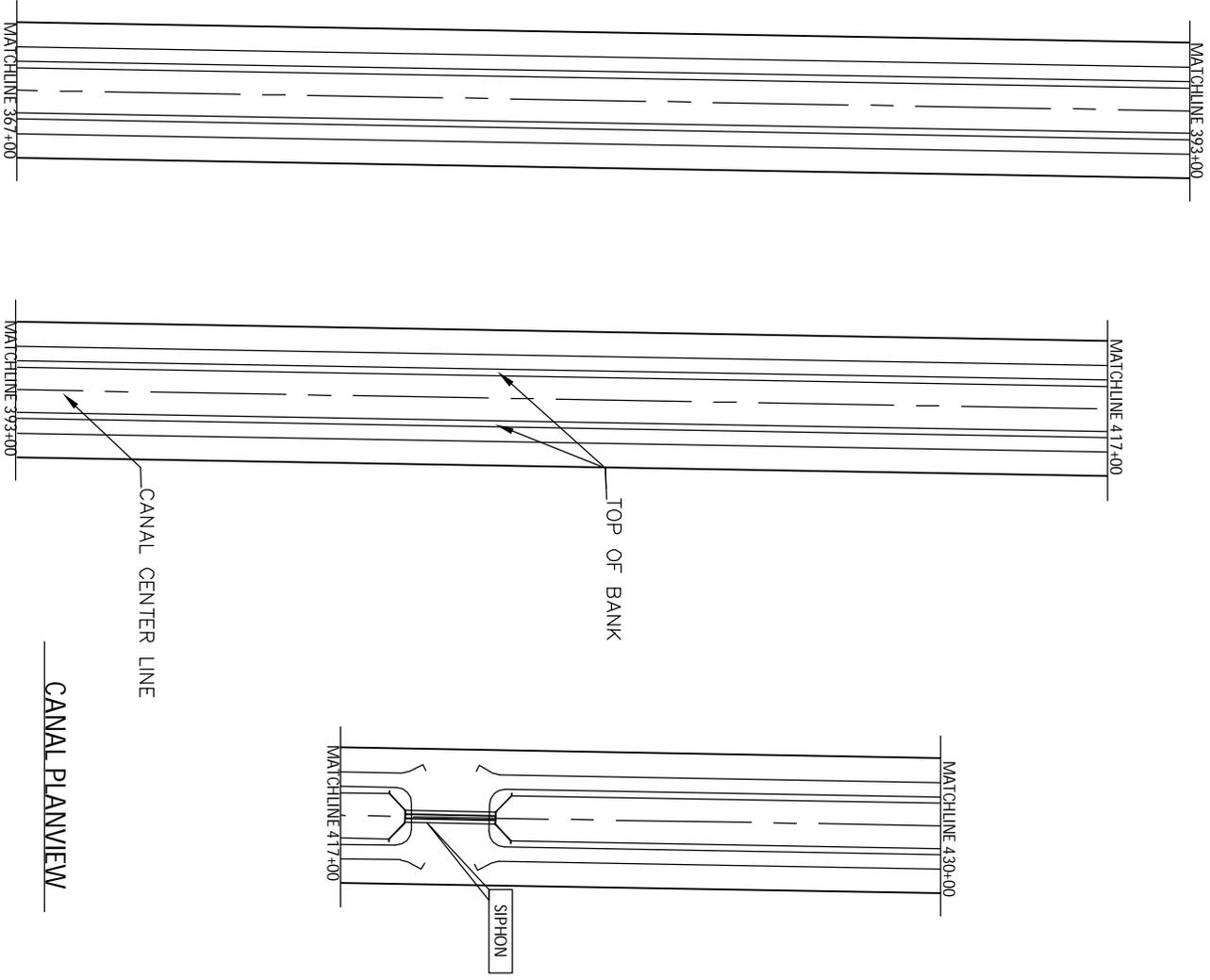
LUCE BAYOU INTERBASIN TRANSFER PROJECT	
PROJECT PLANVIEW AND WETLAND IMPACTS	
COUNTY: HARRIS AND LIBERTY	
USACE PERMIT No.: SWG 2009-00188	
APPLICATION BY: COASTAL WATER AUTHORITY	
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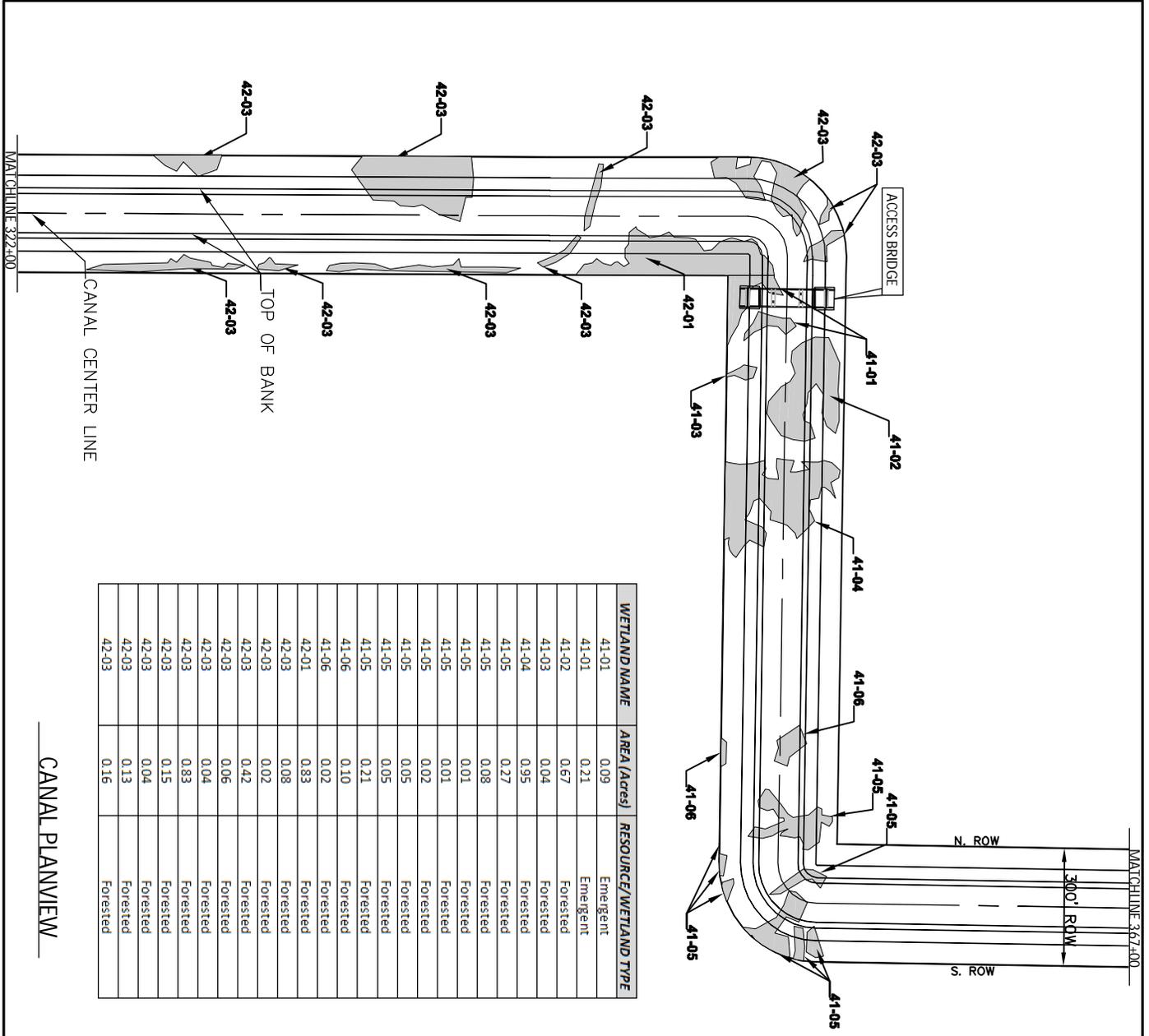
CANAL PLANVIEW

<p>LUCE BAYOU INTERBASIN TRANSFER PROJECT</p>	
<p>PROJECT PLANVIEW AND WETLAND IMPACTS</p>	
<p>COUNTY: HARRIS AND LIBERTY</p>	
<p>USACE PERMIT No.: SWG 2008-00188</p>	
<p>APPLICATION BY: COASTAL WATER AUTHORITY</p>	
<p>SHEET NO. 28 OF 44</p>	<p>DATE: MARCH 2010</p>



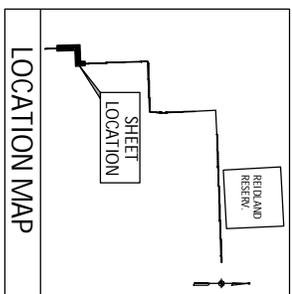
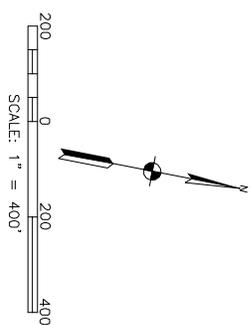


<p>LUCE BAYOU INTERBASIN TRANSFER PROJECT</p>	
<p>PROJECT PLANVIEW AND WETLAND IMPACTS</p>	
<p>COUNTY: HARRIS AND LIBERTY</p>	
<p>USACE PERMIT No.: SWG 2009-00188</p>	
<p>APPLICATION BY: COASTAL WATER AUTHORITY</p>	
<p>SHEET NO. 27 OF 44</p>	<p>DATE: MARCH 2010</p>



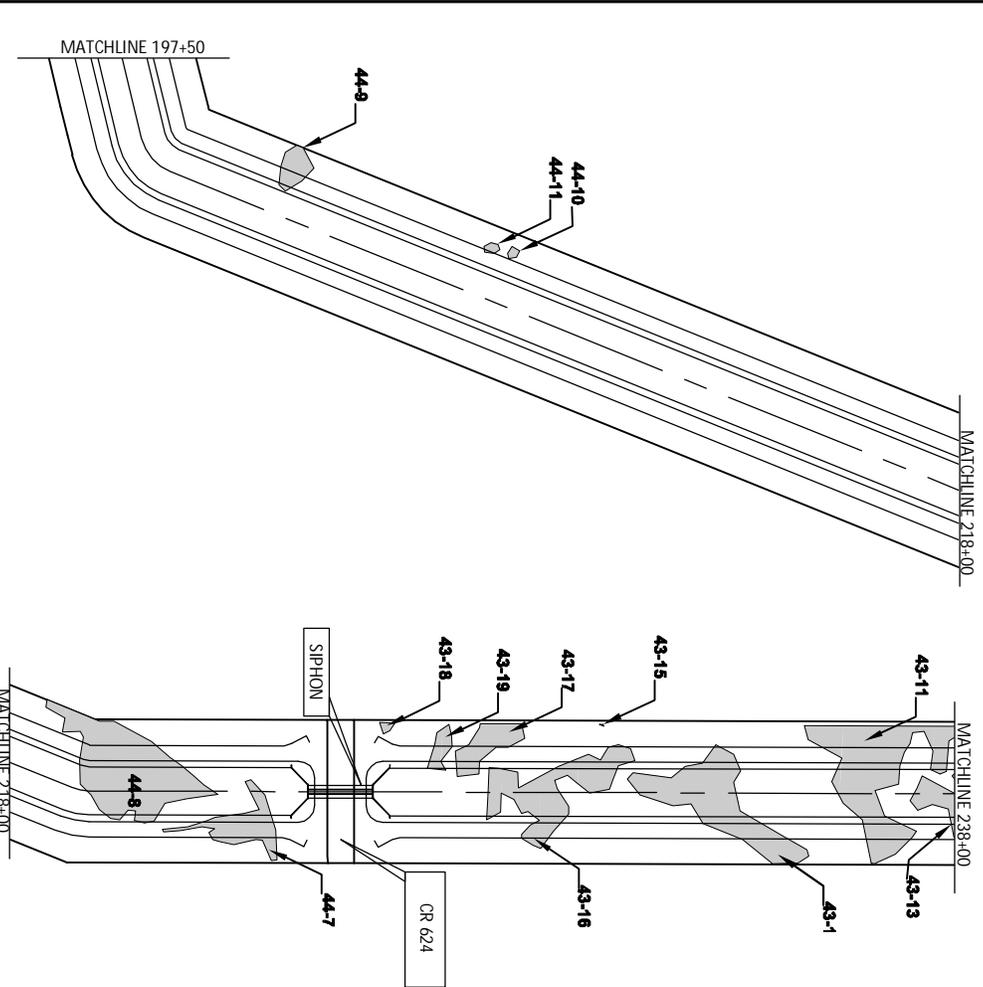
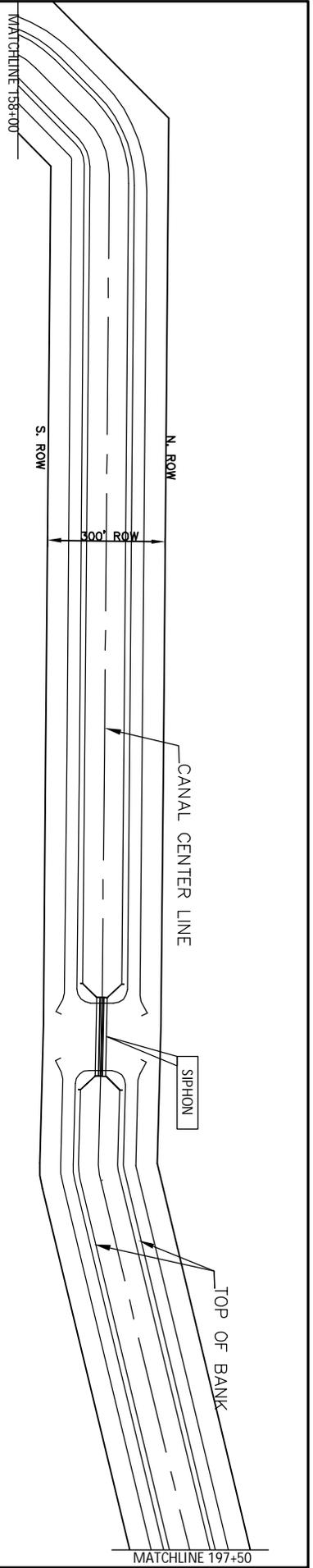
WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
41-01	0.09	Emergent
41-01	0.21	Emergent
41-02	0.67	Forested
41-03	0.04	Forested
41-04	0.95	Forested
41-05	0.27	Forested
41-05	0.08	Forested
41-05	0.01	Forested
41-05	0.01	Forested
41-05	0.02	Forested
41-05	0.05	Forested
41-05	0.21	Forested
41-05	0.05	Forested
41-06	0.10	Forested
41-06	0.02	Forested
42-01	0.83	Forested
42-03	0.08	Forested
42-03	0.02	Forested
42-03	0.42	Forested
42-03	0.06	Forested
42-03	0.04	Forested
42-03	0.83	Forested
42-03	0.15	Forested
42-03	0.04	Forested
42-03	0.13	Forested
42-03	0.16	Forested

CANAL PLANVIEW



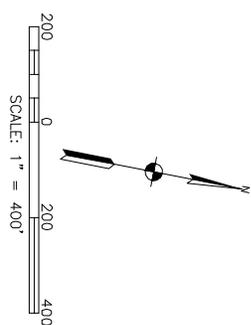
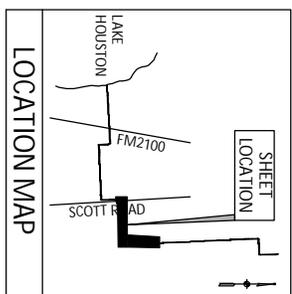
**LUCE BAYOU INTERBASIN
 TRANSFER PROJECT
 WETLAND PLANVIEW AND
 IMPACTS**

COUNTY: HARRIS AND LIBERTY
USACE PERMIT No.: SWG 2009-00188
APPLICATION BY: COASTAL WATER AUTHORITY
SHEET NO. 28 OF 44
DATE: MARCH 2010



WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
43-11	0.93	Forested
43-13	0.14	Forested
43-14	0.68	Forested
43-15	0.01	Forested
43-16	0.55	Emergent
43-17	0.20	Emergent
43-18	0.02	Emergent
43-19	0.06	Emergent
44-7	0.25	Scrub-shrub
44-8	0.88	Emergent
44-9	0.10	Emergent
44-10	0.01	Emergent
44-11	0.01	Emergent

CANAL PLANVIEW



**LUCE BAYOU INTERBASIN
TRANSFER PROJECT**

**PROJECT PLANVIEW AND
WETLAND IMPACTS**

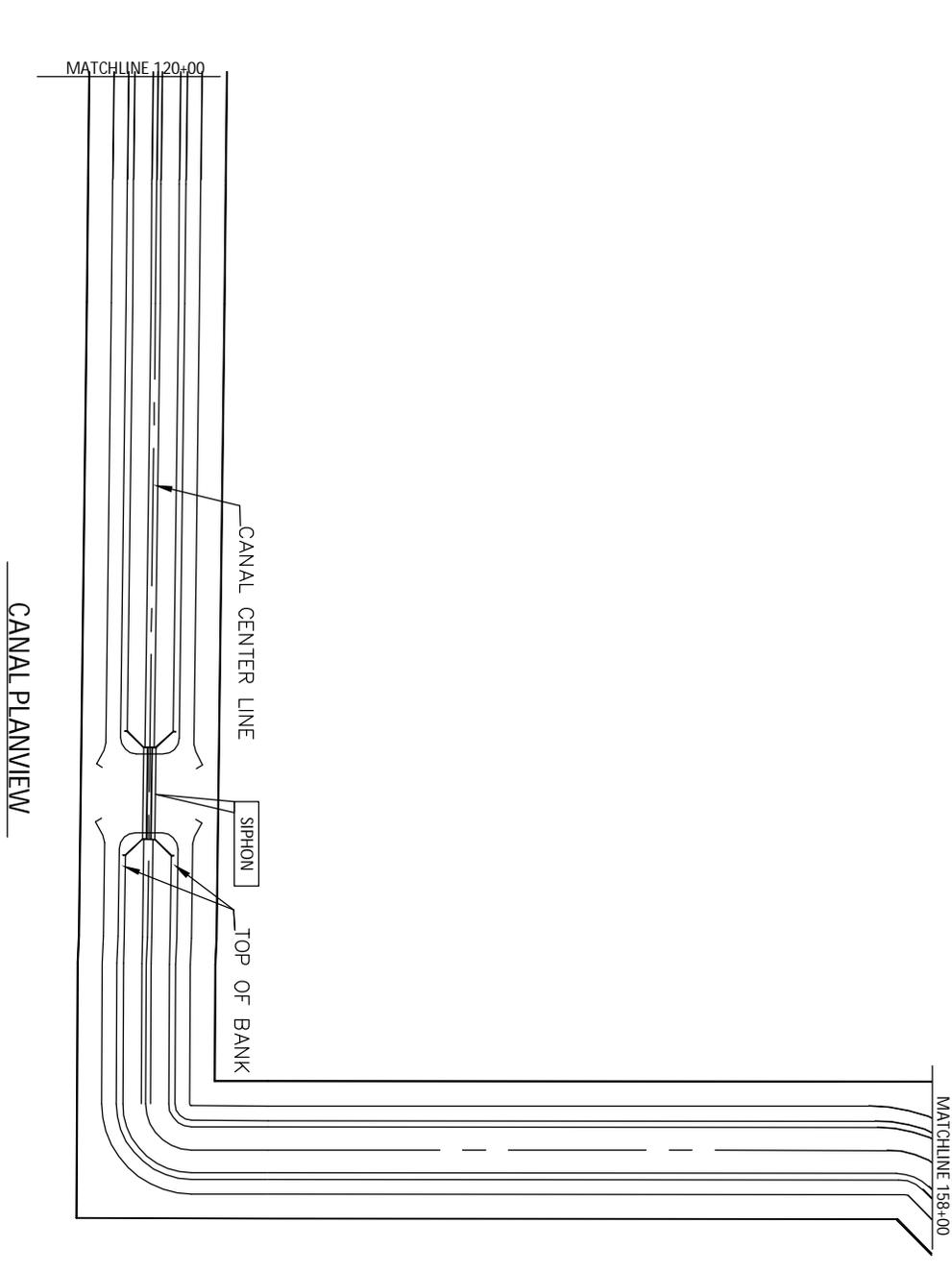
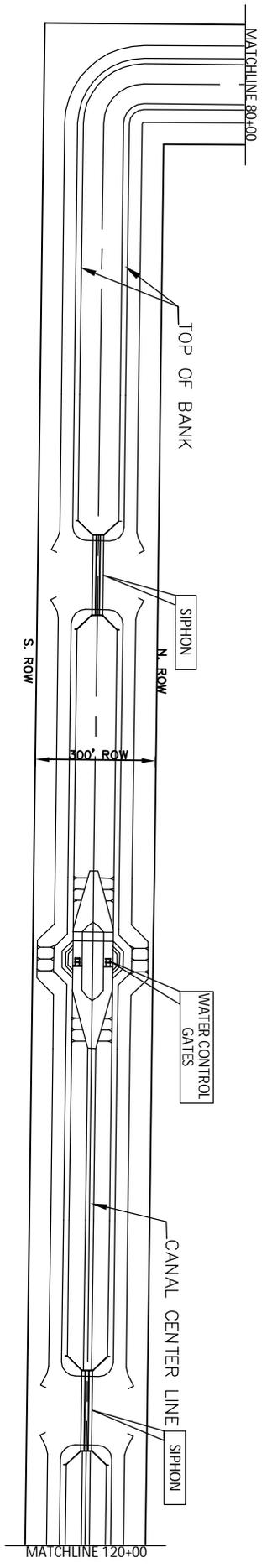
COUNTY: HARRIS AND LIBERTY

USACE PERMIT No.: SWG 2008-00188

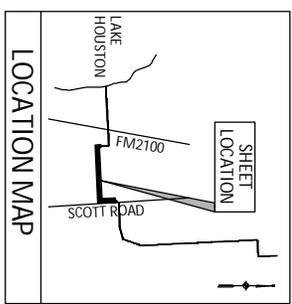
APPLICATION BY: COASTAL WATER AUTHORITY

SHEET NO. 30 OF 44

DATE: MARCH 2010

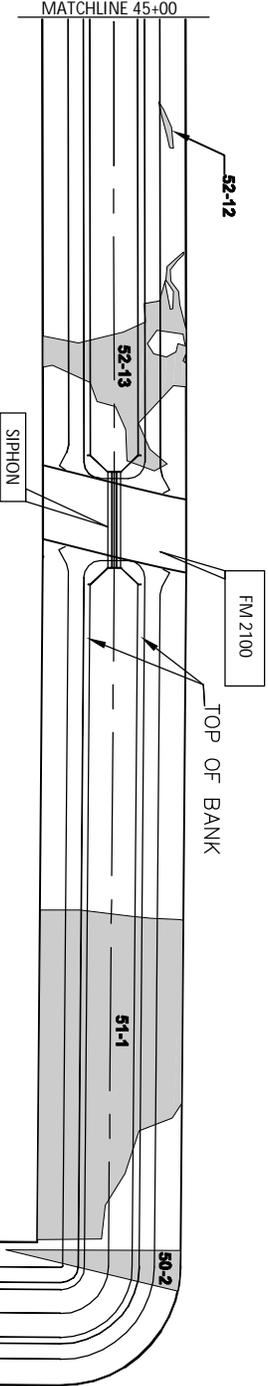
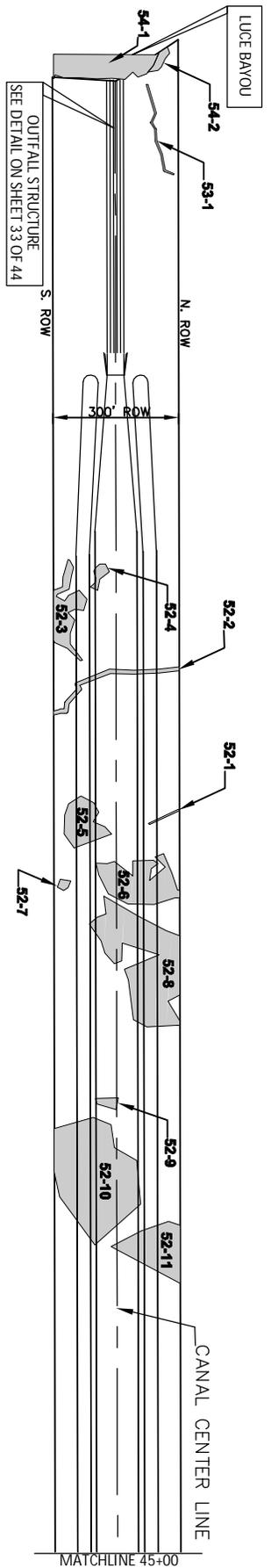


CANAL PLANVIEW

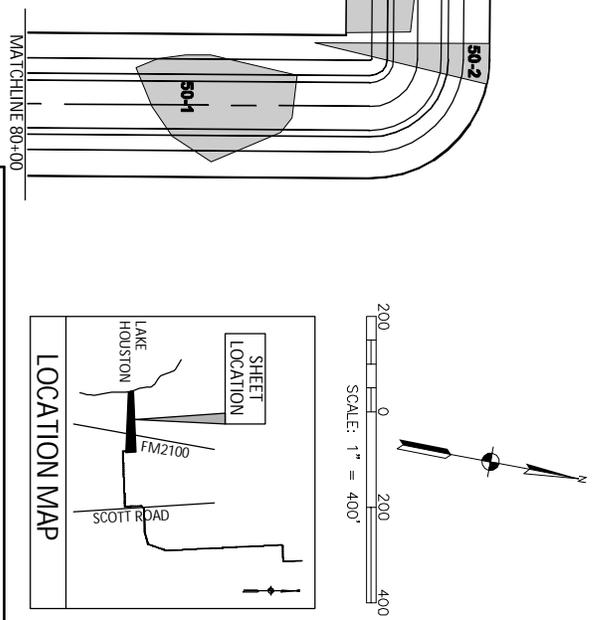


LUCE BAYOU INTERBASIN
 TRANSFER PROJECT
 PROJECT PLANVIEW AND
 WETLAND IMPACTS

COUNTY: HARRIS AND LIBERTY
 USACE PERMIT No.: SWG 2009-00188
 APPLICATION BY: COASTAL WATER AUTHORITY
 SHEET NO. 31 OF 44
 DATE: MARCH 2010



WETLAND NAME	AREA (Acres)	RESOURCE/WETLAND TYPE
50-1	1.19	Forested
50-2	0.36	Forested
51-1	3.96	Forested
52-1	0.01	Drainage
52-2	0.08	Drainage
52-3	0.19	Emergent
52-4	0.03	Forested
52-5	0.19	Emergent
52-6	0.35	Emergent
52-7	0.01	Emergent
52-8	0.79	Emergent
52-9	0.02	Emergent
52-10	0.98	Emergent
52-11	0.30	Emergent
52-12	0.02	Forested
52-13	1.04	Emergent
53-1	0.02	Drainage
54-1	0.30	Lake Houston
54-2	0.03	Forested

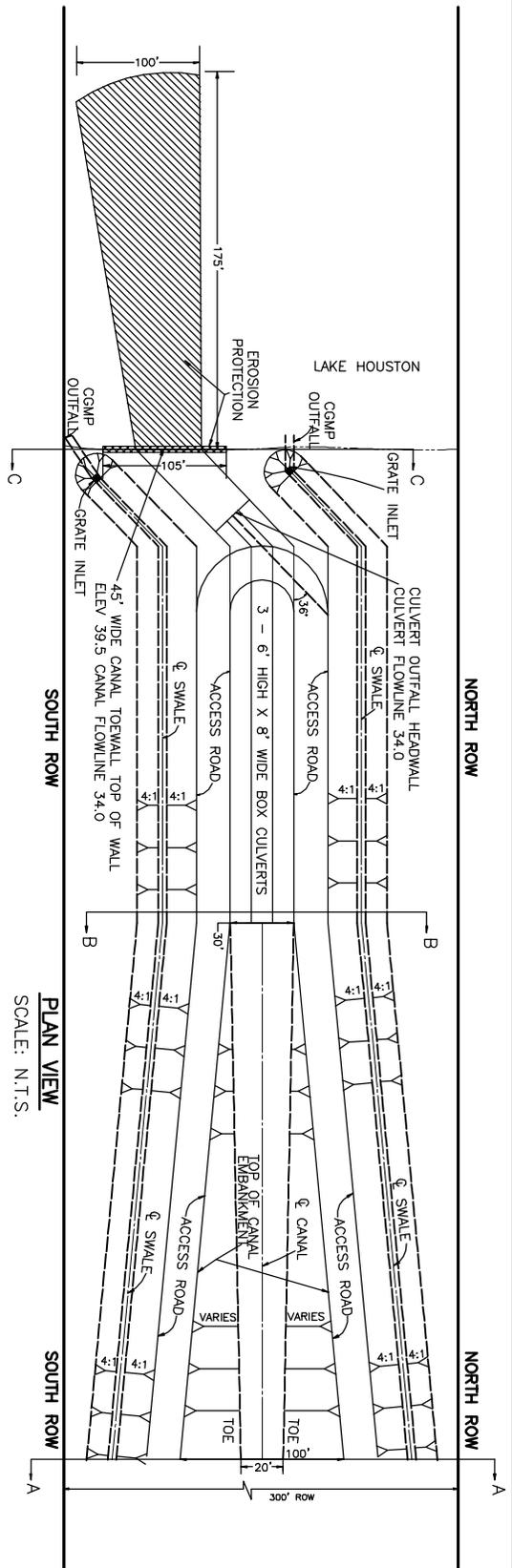


CANAL PLANVIEW

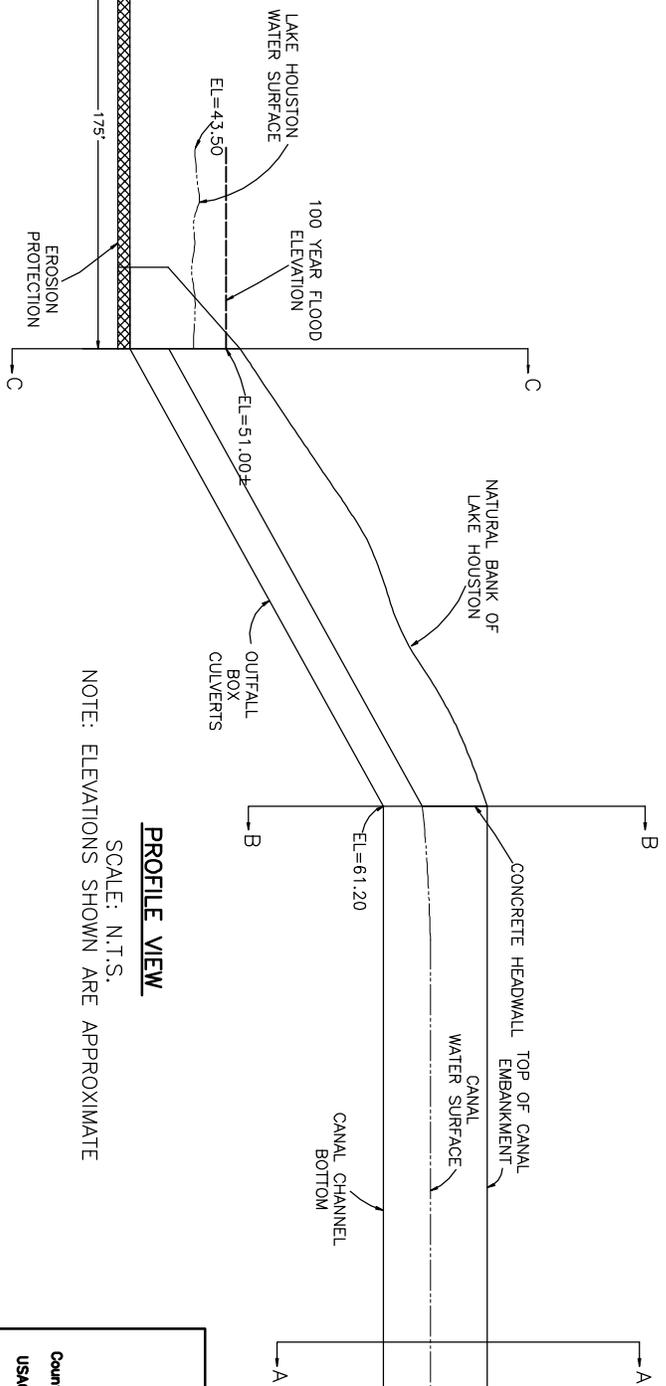
LUCE BAYOU INTERBASIN
 TRANSFER PROJECT
 WETLAND IMPACTS

COUNTY: HARRIS AND LIBERTY
 USAGE PERMIT No.: SWG 2009-00188
 APPLICATION BY: COASTAL WATER AUTHORITY
 SHEET NO. 32 OF 44 Total Exhibits

DATE: MARCH 2010



PLAN VIEW
SCALE: N.T.S.



PROFILE VIEW
SCALE: N.T.S.
NOTE: ELEVATIONS SHOWN ARE APPROXIMATE

Area of fill below
O.H.W. 0.30 acre
Volume of fill below O.H.W.
975 Cubic Yards

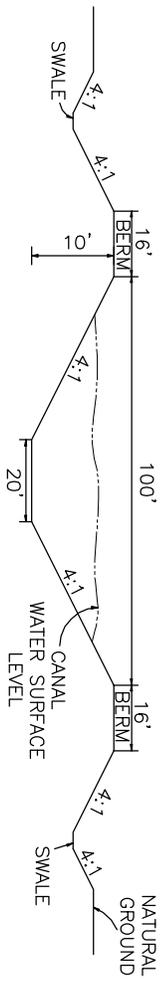
xxxx & xxxx, P.E.
TEXAS REGISTRATION NO. xxxxxx
INTERNAL SUBMITTAL
NOT FOR CONSTRUCTION PURPOSES

Luce Bayou
Interbasin Transfer Project
Outfall Structure Plan View
and Profile

Counties: Liberty & Harris
USACE Permit No.: SWG 2009-00188
Application By: Coastal Water Authority

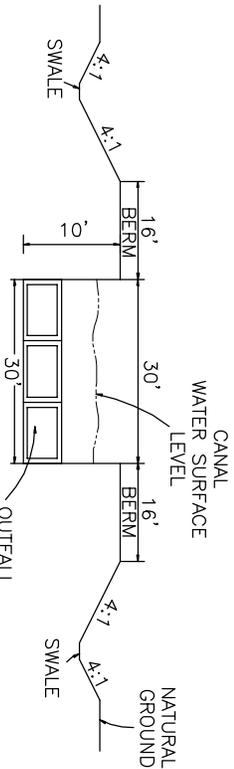
State: Texas
Date: March 2010

Sheet 33 of 44



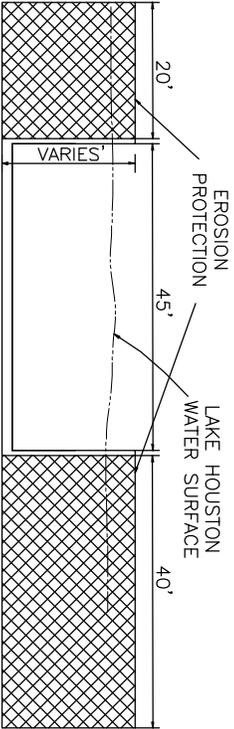
SECTION A-A

SCALE: N.T.S.



SECTION B-B

SCALE: N.T.S.



SECTION C-C

SCALE: N.T.S.

xxxx x, xxxx, P.E.
 TEXAS REGISTRATION NO. xxxxxx
 INTERNAL SUBMITTAL
 NOT FOR CONSTRUCTION PURPOSES

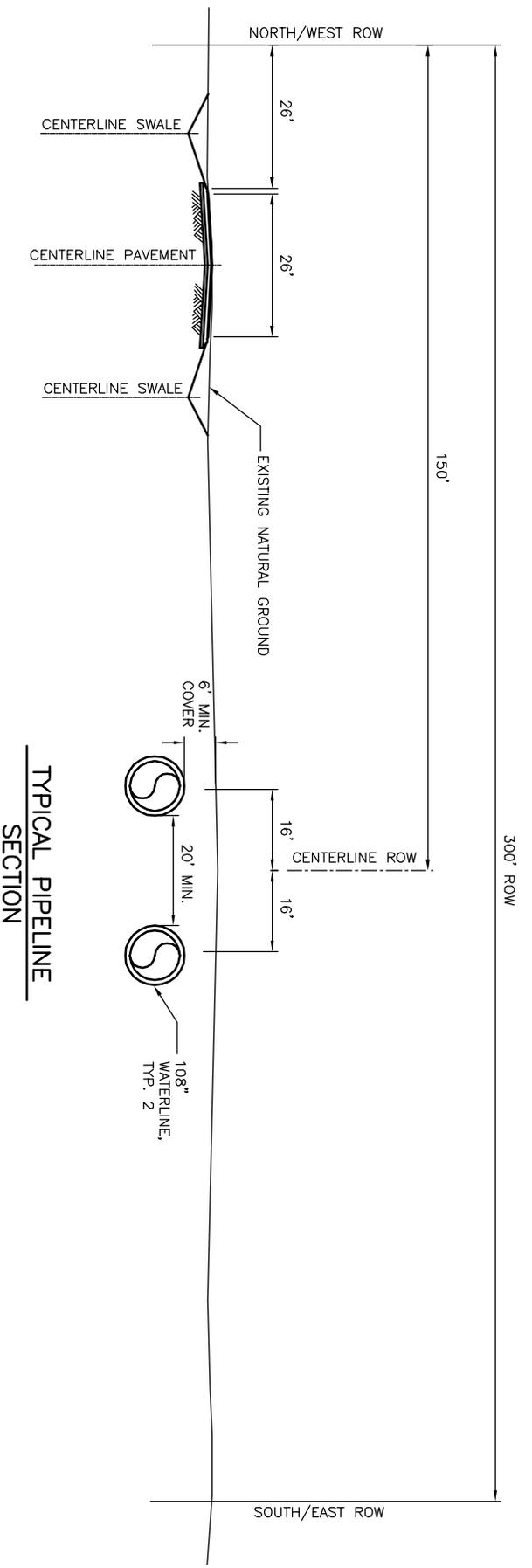
Area of fill below O.H.W. 0.30 acre
 Volume of fill below O.H.W. 975 Cubic Yards

Luce Bayou
Interbasin Transfer Project
Outfall Structure Plan View
and Profile

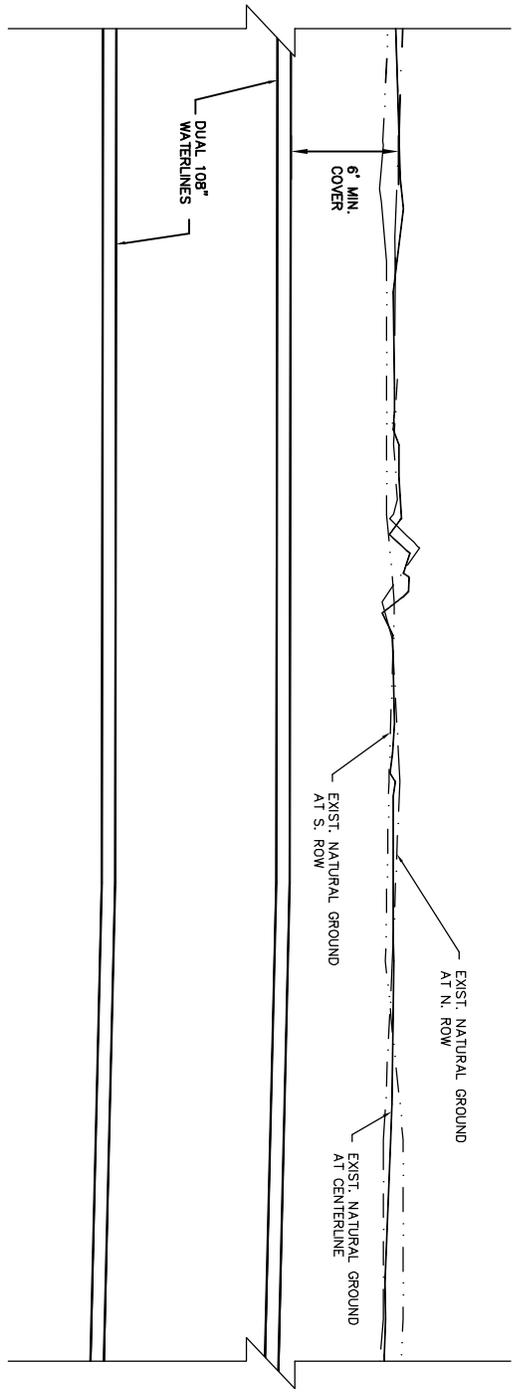
Counties: Liberty & Harris
 State: Texas
 USACE Permit No. : SWG 2008-00188
 Application By: Coastal Water Authority

Date: March 2010

Sheet 34 of 44



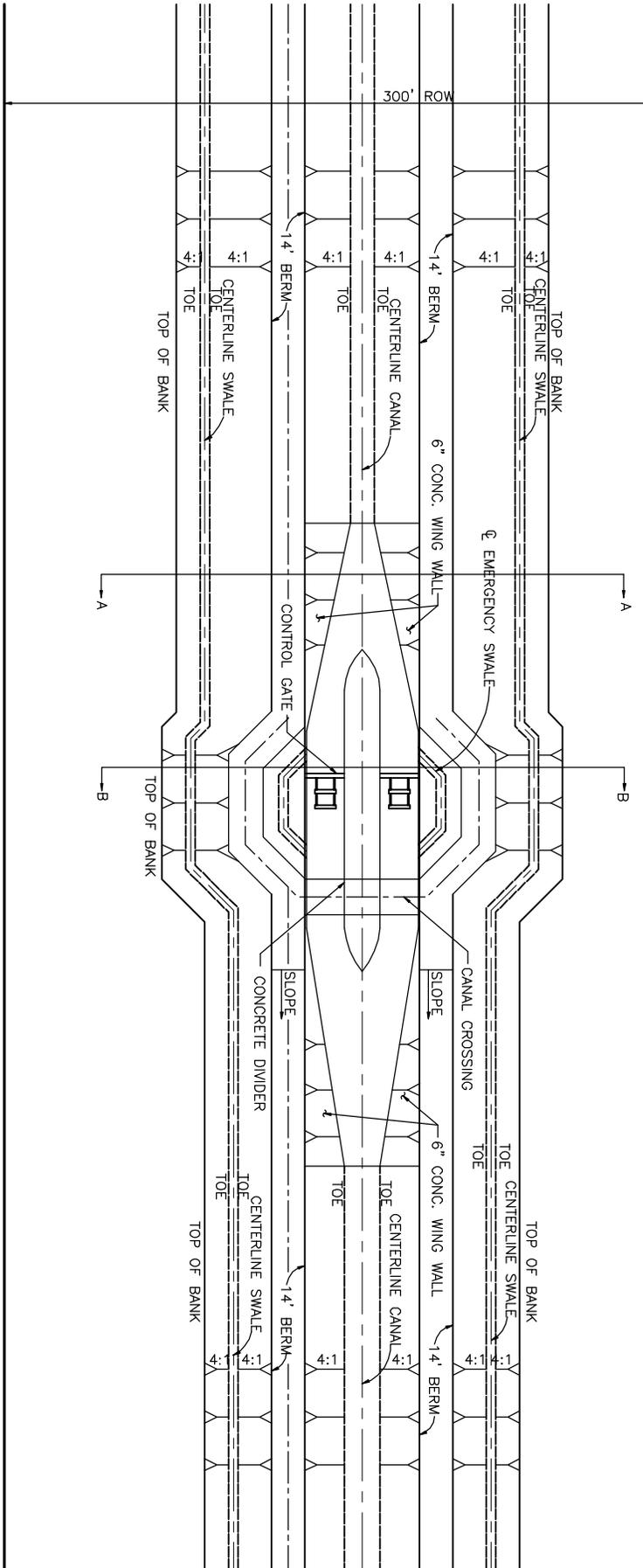
TYPICAL PIPELINE SECTION



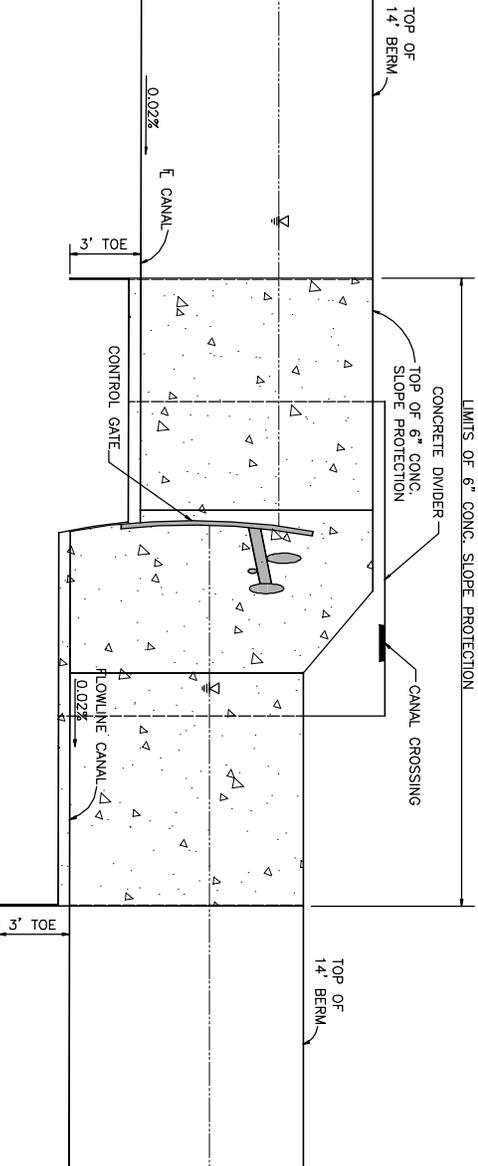
TYPICAL PIPELINE PROFILE

Luce Bayou
 Interbasin Transfer Project
 Typical Pipeline Section
 and Profile

Counties: Liberty & Harris
 USACE Permit No. : SWG 2009-00188
 Application By: Coastal Water Authority
 State: Texas
 Sheet 35 of 44
 Date: March 2010



PLAN VIEW



PROFILE VIEW

Luce Bayou
 Interbasin Transfer Project
 Water Level Control Gate
 Plan and Profile View

Courtesy: Liberty & Harris

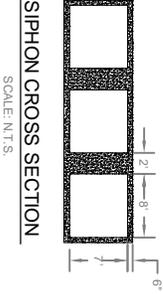
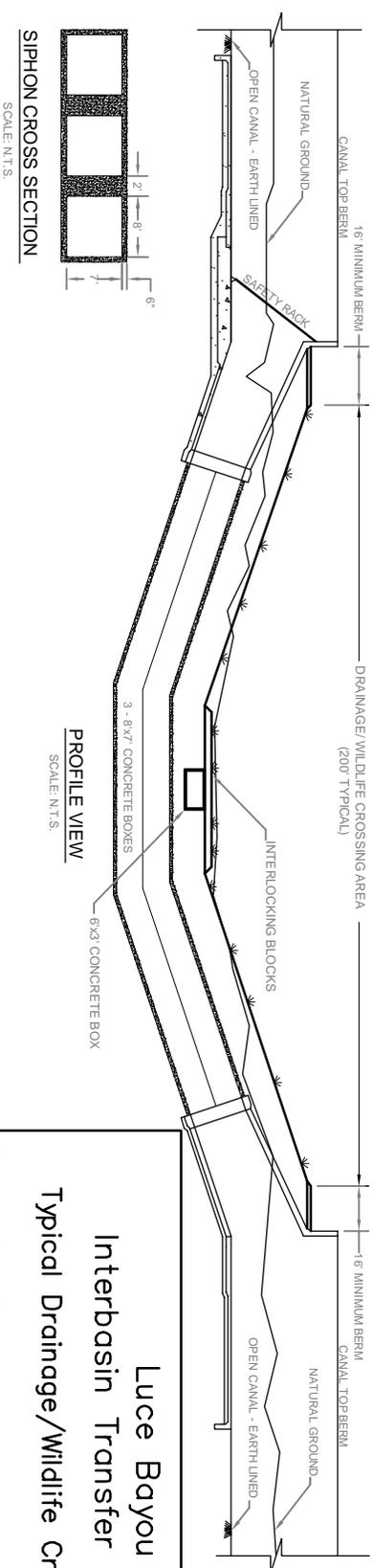
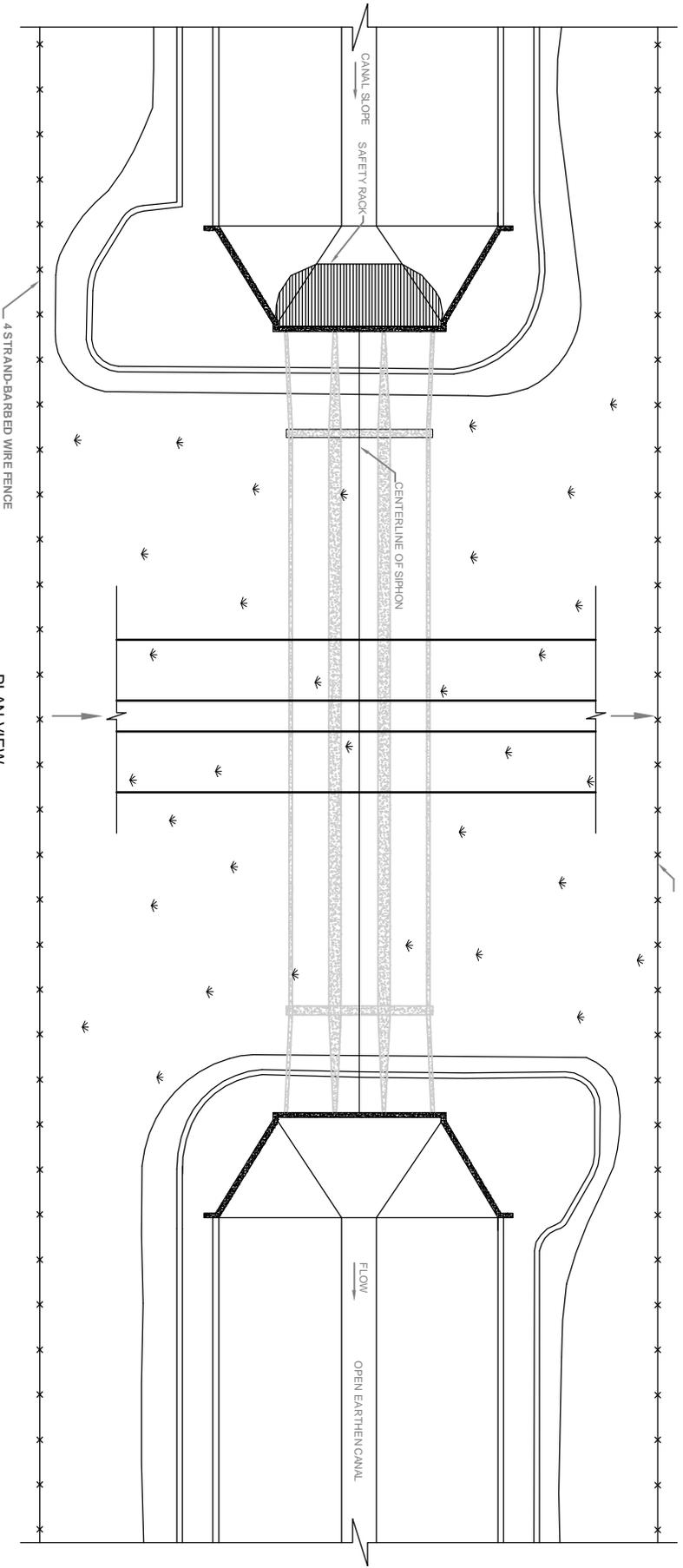
State: Texas

USACE Permit No. : SWG 2009-00188

Application By: Coastal Water Authority

Sheet 37 of 44

Date: March 2010



**Luce Bayou
 Interbasin Transfer Project
 Typical Drainage/Wildlife Crossing Area**

Countries: Liberty & Harris

USACE Permit No. : SWG 2009-00188

Application By: Coastal Water Authority

State: Texas

Sheet 38 of 44

Date: March 2010

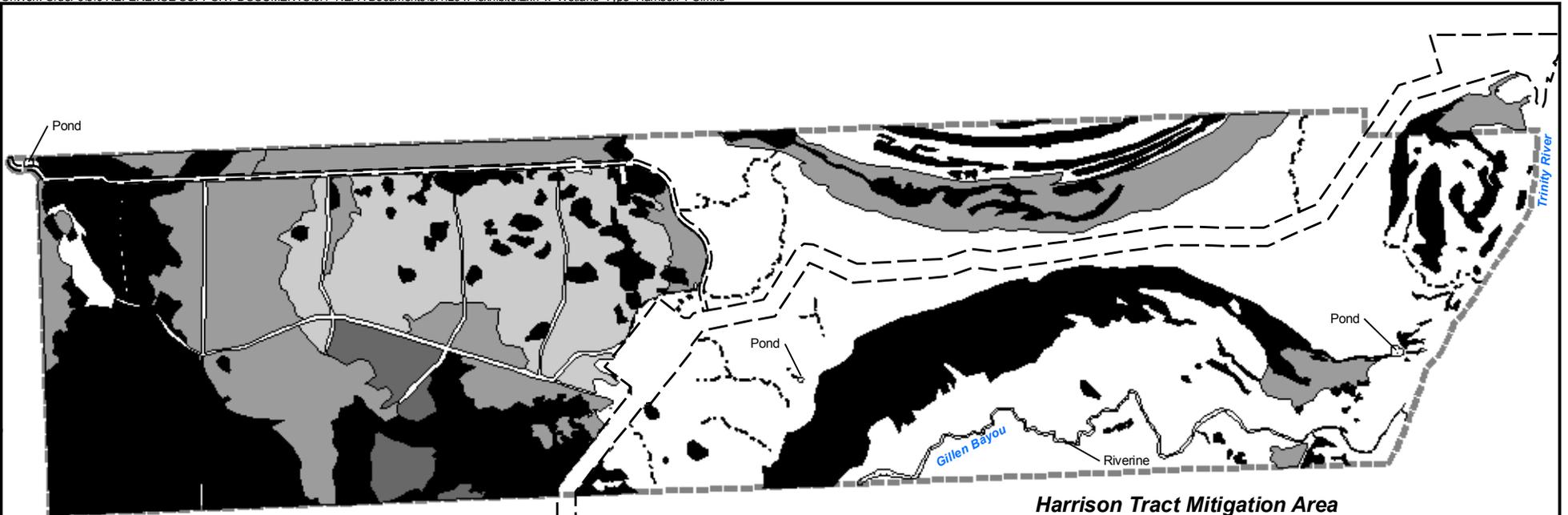
Sheet 39. Jurisdictional Aquatic Resources and Type Within LBITP ROW

Aquatic Resource Type	Acres
Total Forested Wetlands	118.93
Total Emergent Wetlands	45.26
Total Scrub-Shrub Wetlands	25.55
Total Open Water Wetland	11.21
Wetlands Subtotal:	200.95
Total Drainages	0.18
Total Trinity River	1.67
Total Lake Houston	0.30
River/Lake/Drainage Subtotal:	2.15
Total Jurisdictional Aquatic Resources:	203.10

**Luce Bayou
Interbasin Transfer Project**

**Jurisdictional Aquatic Resources
and Type Within LBITP ROW**

Counties: Liberty & Harris State: Texas
 USACE Permit No. : SWG 2009-00188
 Application By: Coastal Water Authority
 Sheet 39 of 44 Date: March 2010



Harrison Tract Mitigation Area

Pump Station Mitigation Area

Upland Resources	Acres
Total Upland Forested	19.34
Total Mosaic Forested Upland	9.02
Total Upland:	28.36
Aquatic Resources	Acres
Total PFO	10.84
Total Wetlands:	10.84

Upland Resources	Acres
Total Upland Forested	840.68
Total Upland Scrub-Shrub	60.92
Total Upland Prairie	327.00
Total Mosaic Forested Upland	469.70
Total Mosaic Scrub-Shrub Upland	40.00
Total Upland:	1,738.30

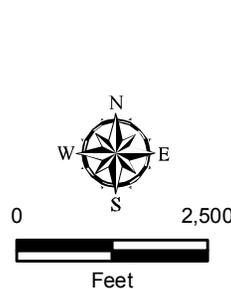
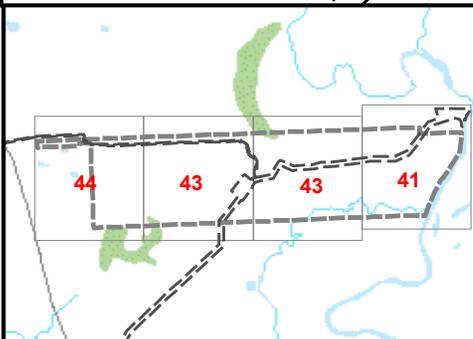
Aquatic Resources	Acres
Total PEM	6.10
Total PFO	955.71
Total PSS	25.19
Total PFO/PEM/PSS	212.50
Total Wetlands:	1,199.50

Total ROW: 156.40

Total Drainages	3.70
Total Ponds	1.20
Gillen Bayou	10.90
Total Drainages/Ponds:	15.80
Total Aquatic Resources:	1,215.30

PEM Emergent Wetland
 PFO Forested Wetland
 PSS Scrub-Shrub Wetland

* Please see Sheets 41 - 44 for details.



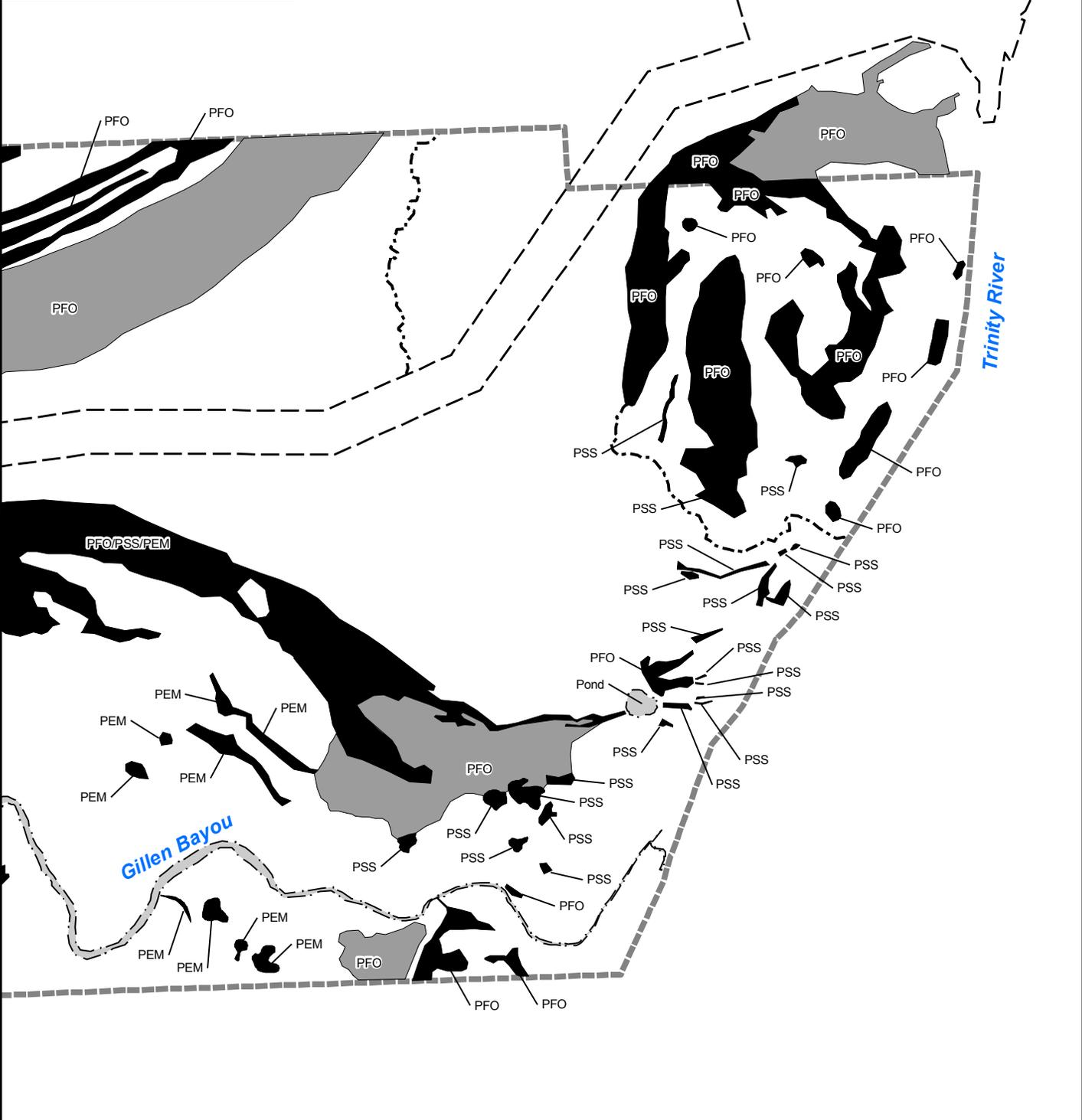
Legend

- Harrison Tract
- Project Footprint
- Drainage
- Wetland Percentage**
- 1% - 30% (Mosaic)
- 30% - 60% (Mosaic)
- 60% - 99% (Mosaic)
- 100% Wetland

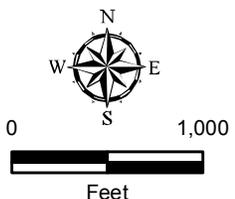
* Areas not shaded are either within the Project Footprint or consist of Uplands/Roads.

**Luce Bayou Interbasin Transfer Project
 Mitigation Area Wetlands
 Site Map**

Counties: Liberty & Harris State: Texas
 USACE Permit No.: SWG 2009-00188
 Application By: Coastal Water Authority
 Sheet 40 of 44 Date: March 2010



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Legend

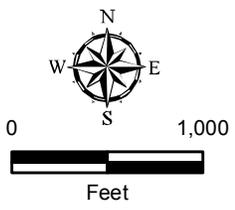
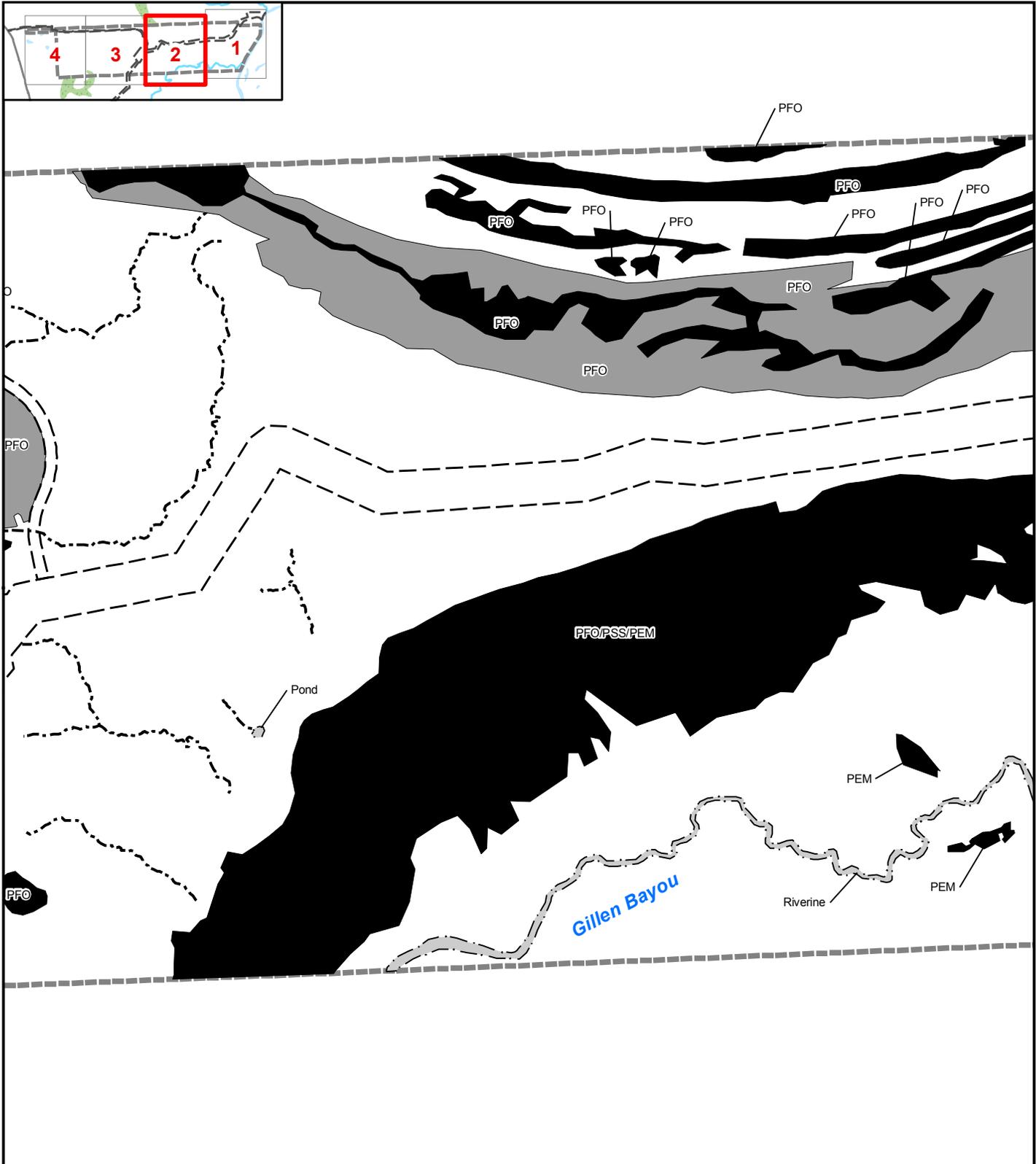
Harrison Tract	Wetland Percentage
Project Footprint	1% - 30% (Mosaic)
Drainage	30% - 60% (Mosaic)
	60% - 99% (Mosaic)
	100% Wetland
	PEM Emergent Wetland
	PFO Forested Wetland
	PSS Scrub-Shrub Wetland

* Areas not shaded are either within the Project Footprint or consist of Uplands/Roads.

**Luce Bayou
Interbasin Transfer Project
Mitigation Area Wetlands
Site Map**

Counties: Liberty & Harris State: Texas
 USACE Permit No.: SWG 2009-00188
 Application By: Coastal Water Authority
 Sheet 41 of 44 Date: March 2010

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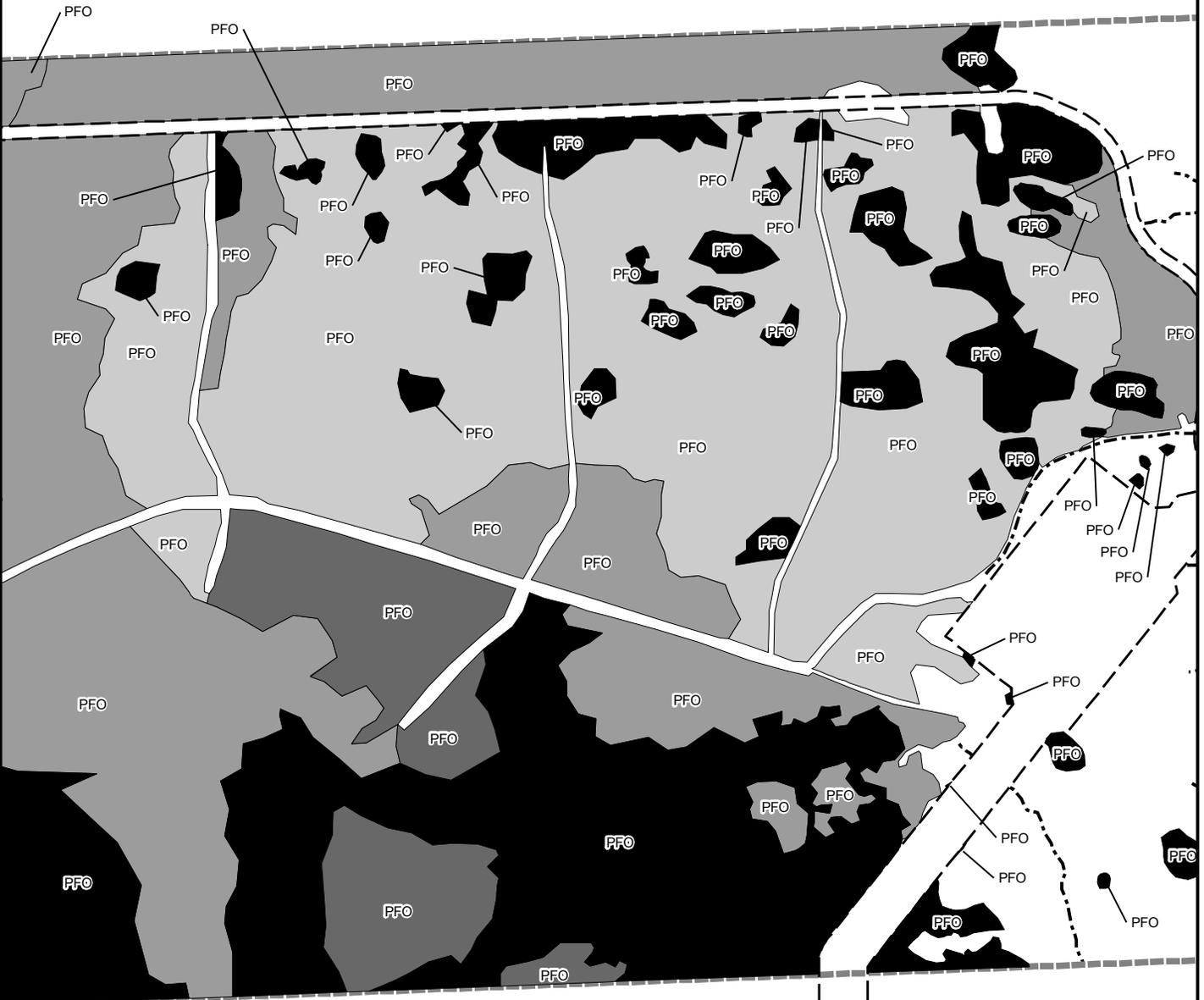


Legend	
	Harrison Tract
	Project Footprint
	Drainage
	1% - 30% (Mosaic)
	30% - 60% (Mosaic)
	60% - 99% (Mosaic)
	100% Wetland
	PEM Emergent Wetland
	PFO Forested Wetland
	PSS Scrub-Shrub Wetland

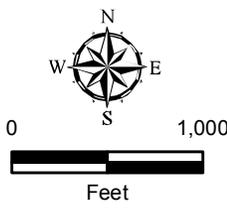
* Areas not shaded are either within the Project Footprint or consist of Uplands/Roads.

Luce Bayou Interbasin Transfer Project Mitigation Area Wetlands Site Map

Counties: Liberty & Harris State: Texas
 USACE Permit No.: SWG 2009-00188
 Application By: Coastal Water Authority
 Sheet 42 of 44 Date: March 2010



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Legend

Harrison Tract	Wetland Percentage
Project Footprint	1% - 30% (Mosaic)
Drainage	30% - 60% (Mosaic)
	60% - 99% (Mosaic)
	100% Wetland
	PEM Emergent Wetland
	PFO Forested Wetland
	PSS Scrub-Shrub Wetland

* Areas not shaded are either within the Project Footprint or consist of Uplands/Roads.

**Luce Bayou
Interbasin Transfer Project
Mitigation Area Wetlands
Site Map**

Counties: Liberty & Harris State: Texas
 USACE Permit No.: SWG 2009-00188
 Application By: Coastal Water Authority

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