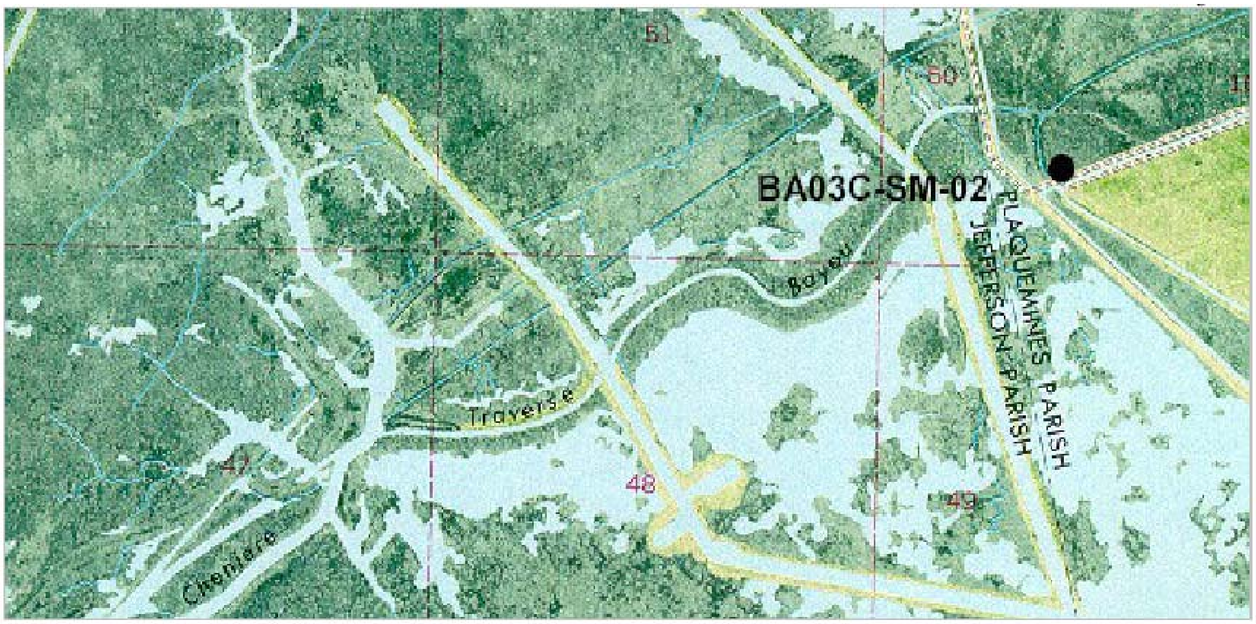
Appendix A – Secondary Monument Data Sheets



VICINITY MAP Scale: 1" = 2000' Reproduced from USC&GS "Lafitte, LA" Quadrangle

Station Name: "BA03C-SM-02"

Location: From La Highway 23 at St. Rosalie, Louisiana, which is located just south of oil storage tanks at Alliance, Louisiana proceed west on West Ravenna Road for approximately 2 miles to the monument on the right.

Monument Description: NGS style floating sleeve monument; datum point set on 9/16" stainless steel sectional rods driven 48 feet to refusal, set in sand filled 6" PVC pipe with access cover set in concrete, flush with ground.

Stamping: BA03C-SM-02

Installation Date: 12/4/02 **Date of Survey:** January 2003

Monument Established By: John Chance Land Surveys, Inc.

For: *Louisiana Department of Natural Resources, CRD*

Adjusted NAD 83 Geodetic Position
Lat. 29° 39' 28.688493" N
Long. 90° 00' 33.422775" W

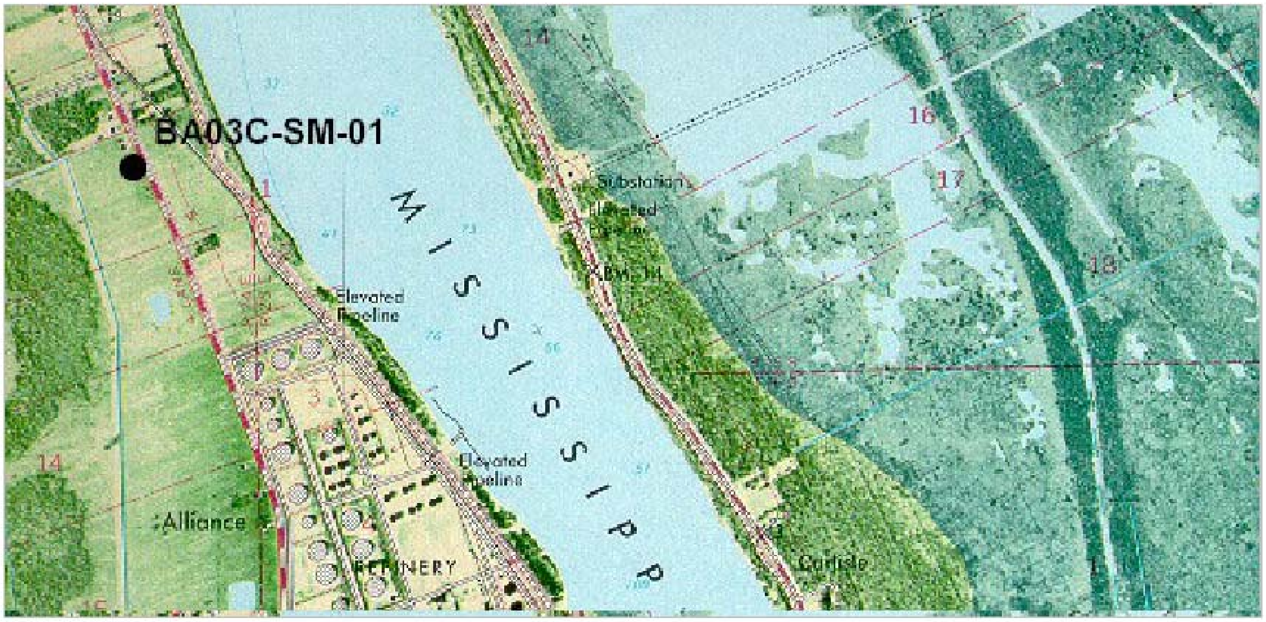
Adjusted NAD 83 Datum LSZ (1702) Feet
N= 423,541.03
E= 3,701,364.99

Adjusted NAVD88 Height
Elevation = -0.67 feet (-0.203 mtrs)

Geoid99 Height = -25.259 mtrs.
Ellipsoid Height = -25.462 mtrs.

Adjusted CORS Height = -0.71 ft (-0.216 mtrs)

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



VICINITY MAP Scale: 1" = 2000' Reproduced from USC&GS "Phoenix, LA" Quadrangle

Station Name: "BA03C-SM-01"

Location: From the oil storage tanks in Alliance, Louisiana, proceed north on La Highway 23 for approximately 0.7 miles to the pipelines on the right crossing over the Mississippi River Levee. Turn around and proceed south in the southbound lane of the Highway to the south side of a ring levee and the monument on the right.

Monument Description: NGS style floating sleeve monument; datum point set on 9/16" stainless steel sectional rods driven 44 feet to refusal, set in sand filled 6" PVC pipe with access cover set in concrete, flush with ground.

Stamping: BA03C-SM-01

Installation Date: 12/5/02 **Date of Survey:** January 2003

Monument Established By: John Chance Land Surveys, Inc.

For: *Louisiana Department of Natural Resources, CRD*

Adjusted NAD 83 Geodetic Position
Lat. 29° 41' 58.771906" N
Long. 89° 59' 13.505879" W

Adjusted NAD 83 Datum LSZ (1702) Feet
N= 438,782.62
E= 3,708,237.23

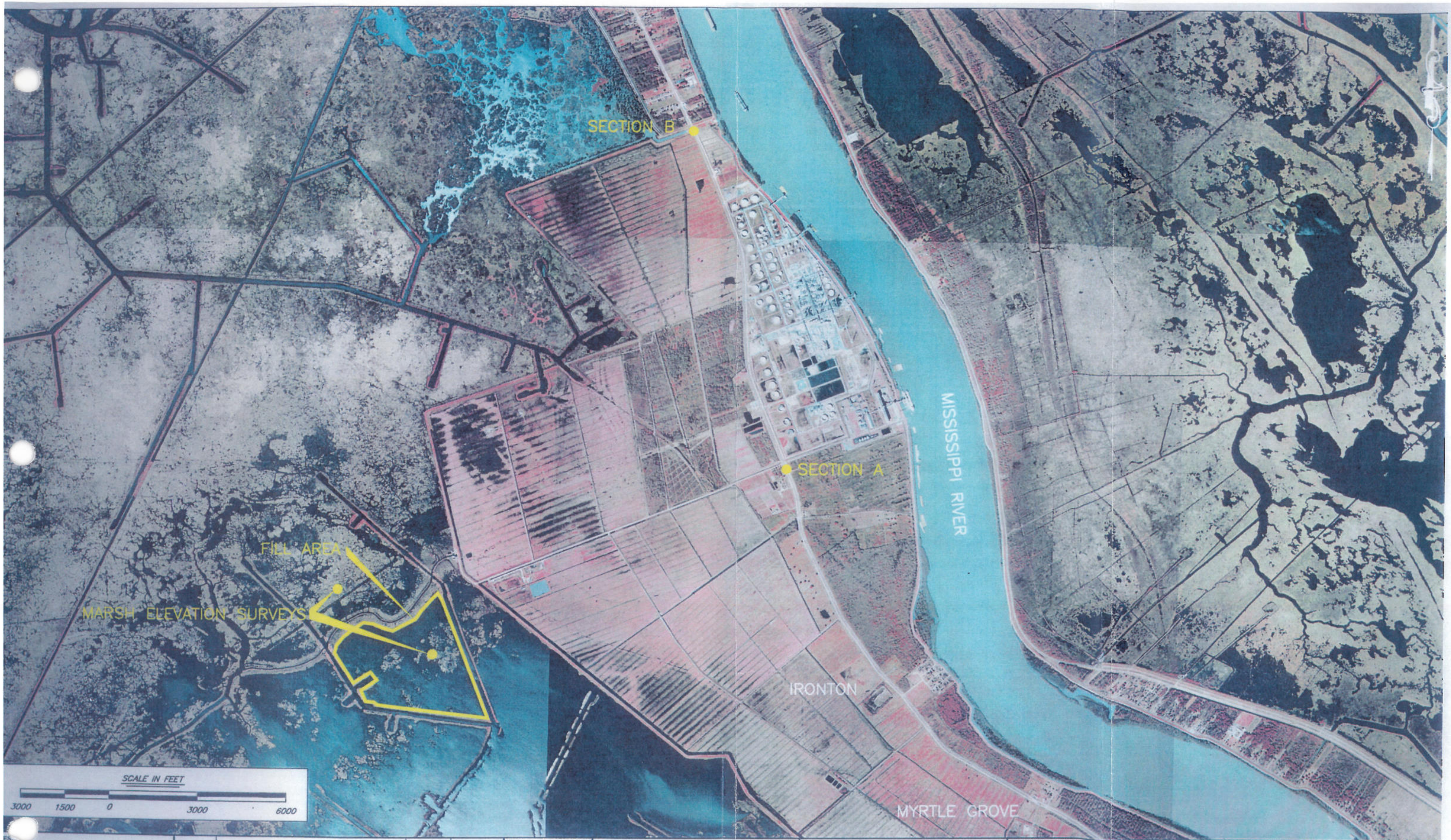
Adjusted NAVD88 Height
Elevation = 2.80 feet (0.854 mtrs)

Geoid99 Height = -25.380 mtrs.
Ellipsoid Height = -24.527 mtrs.

Adjusted CORS Height = 2.76 ft (0.842 mtrs)

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

Appendix B – T. Baker Smith and Son, Inc. and USACE Survey Drawings



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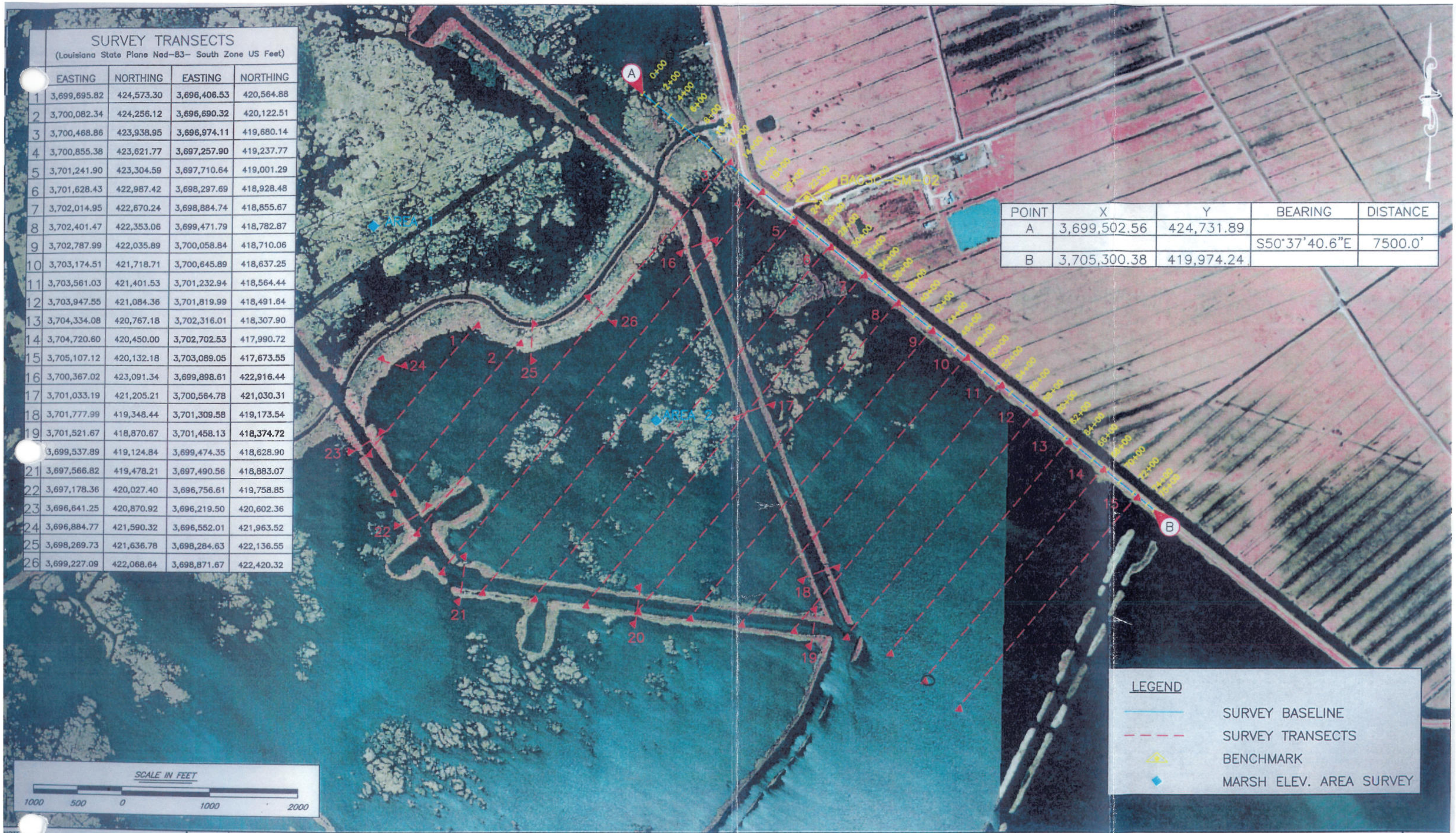
FILE NAME:	04071P01
TBS NO.:	E2004-071
DATE:	3/10/05
PLOT SCALE:	NOTED
DRAWN BY:	KSP
APPROVED:	MJM
MAP NO.	

OVERALL PLAN VIEW

MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT (BA-34)
PLAQUEMINES AND JEFFERSON PARISHES, LOUISIANA

SHEET NO. 1 OF 10



SURVEY TRANSECTS

(Louisiana State Plane Nad-83- South Zone US Feet)

	EASTING	NORTHING	EASTING	NORTHING
1	3,699,695.82	424,573.30	3,696,406.53	420,564.88
2	3,700,082.34	424,256.12	3,696,690.32	420,122.51
3	3,700,468.86	423,938.95	3,696,974.11	419,680.14
4	3,700,855.38	423,621.77	3,697,257.90	419,237.77
5	3,701,241.90	423,304.59	3,697,710.64	419,001.29
6	3,701,628.43	422,987.42	3,698,297.69	418,928.48
7	3,702,014.95	422,670.24	3,698,884.74	418,855.67
8	3,702,401.47	422,353.06	3,699,471.79	418,782.87
9	3,702,787.99	422,035.89	3,700,058.84	418,710.06
10	3,703,174.51	421,718.71	3,700,645.89	418,637.25
11	3,703,561.03	421,401.53	3,701,232.94	418,564.44
12	3,703,947.55	421,084.36	3,701,819.99	418,491.64
13	3,704,334.08	420,767.18	3,702,316.01	418,307.90
14	3,704,720.60	420,450.00	3,702,702.53	417,990.72
15	3,705,107.12	420,132.18	3,703,089.05	417,673.55
16	3,700,367.02	423,091.34	3,699,898.61	422,916.44
17	3,701,033.19	421,205.21	3,700,564.78	421,030.31
18	3,701,777.99	419,348.44	3,701,309.58	419,173.54
19	3,701,521.67	418,870.67	3,701,458.13	418,374.72
	3,699,537.89	419,124.84	3,699,474.35	418,628.90
21	3,697,566.82	419,478.21	3,697,490.56	418,883.07
22	3,697,178.36	420,027.40	3,696,756.61	419,758.85
23	3,696,641.25	420,870.92	3,696,219.50	420,602.36
24	3,696,884.77	421,590.32	3,696,552.01	421,963.52
25	3,698,269.73	421,636.78	3,698,284.63	422,136.55
26	3,699,227.09	422,068.64	3,698,871.67	422,420.32

POINT	X	Y	BEARING	DISTANCE
A	3,699,502.56	424,731.89		
			S50°37'40.6"E	7500.0'
B	3,705,300.38	419,974.24		

NOTE:

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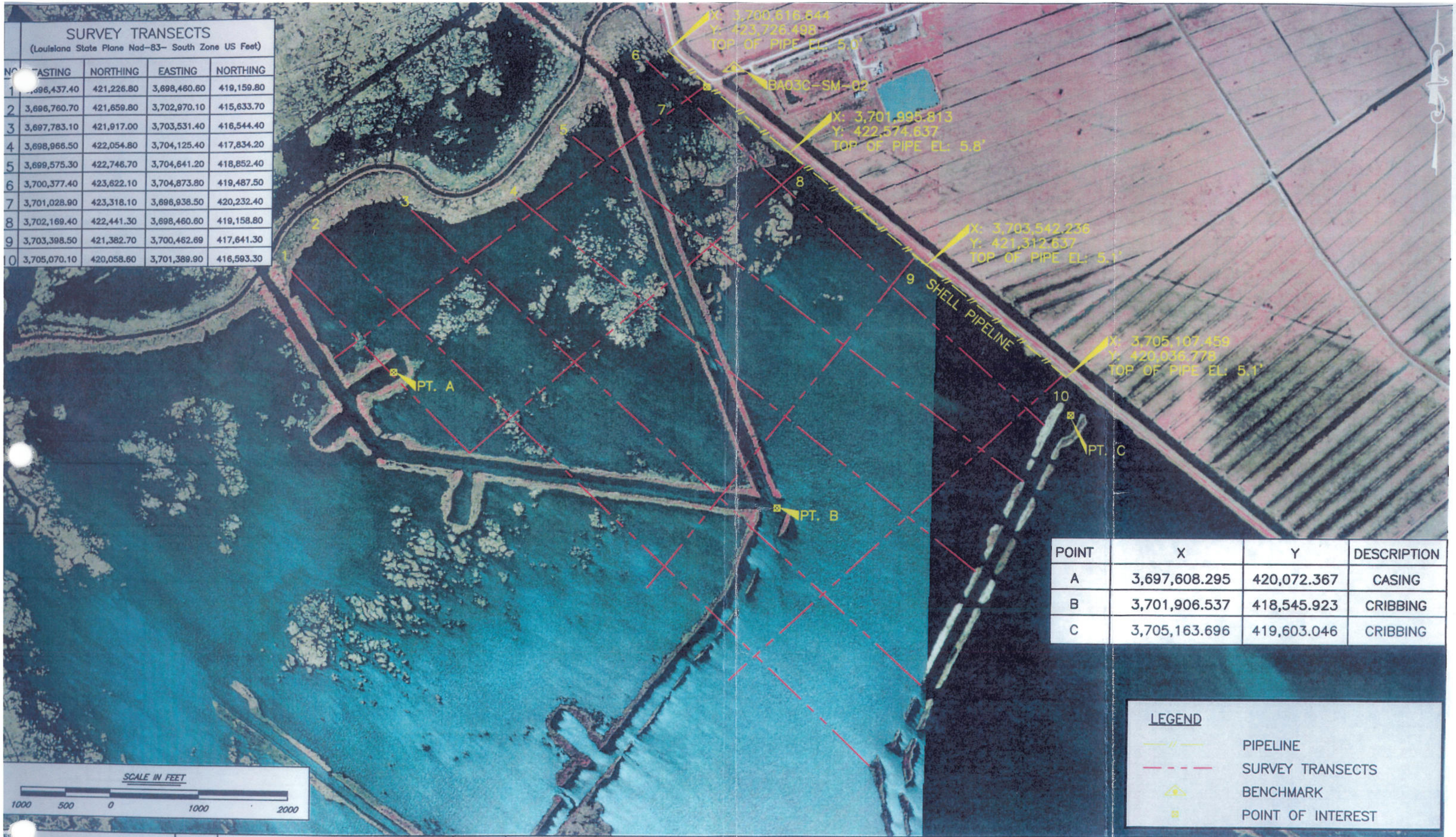
FILE NAME:	04071P02
TBS NO.:	E2004-071
DATE:	3/10/05
PLOT SCALE:	NOTED
DRAWN BY:	KSP
APPROVED:	MJM
MAP NO.	

FILL AREA PLAN VIEW

MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT (BA-34)
PLAQUEMINES AND JEFFERSON PARISHES, LOUISIANA

SHEET NO. 2 OF 10



SURVEY TRANSECTS
(Louisiana State Plane Nad-83- South Zone US Feet)

NO	EASTING	NORTHING	EASTING	NORTHING
1	3,696,437.40	421,226.80	3,698,460.60	419,159.80
2	3,696,760.70	421,659.80	3,702,970.10	415,633.70
3	3,697,783.10	421,917.00	3,703,531.40	416,544.40
4	3,698,966.50	422,054.80	3,704,125.40	417,834.20
5	3,699,575.30	422,746.70	3,704,641.20	418,852.40
6	3,700,377.40	423,622.10	3,704,873.80	419,487.50
7	3,701,028.90	423,318.10	3,696,938.50	420,232.40
8	3,702,169.40	422,441.30	3,698,460.60	419,158.80
9	3,703,398.50	421,382.70	3,700,462.69	417,641.30
10	3,705,070.10	420,058.60	3,701,389.90	416,593.30

POINT	X	Y	DESCRIPTION
A	3,697,608.295	420,072.367	CASING
B	3,701,906.537	418,545.923	CRIBBING
C	3,705,163.696	419,603.046	CRIBBING

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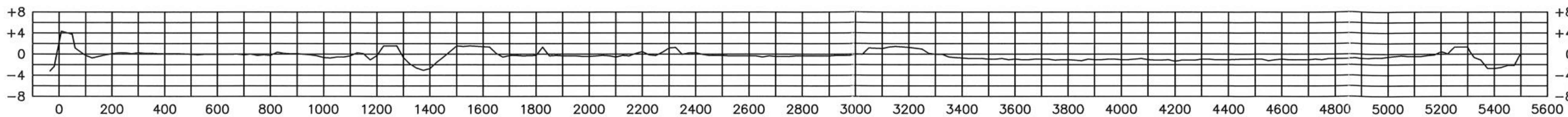
DATE:	3/10/05
PLOT SCALE:	NOTED
DRAWN BY:	KSP
APPROVED:	MJM
MAP NO.	

MAGNOTOMETER SURVEY TRANSECTS
& PIPELINE DATA

MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT (BA-34)
PLAQUEMINES AND JEFFERSON PARISHES, LOUISIANA

SHEET NO
3
OF
10



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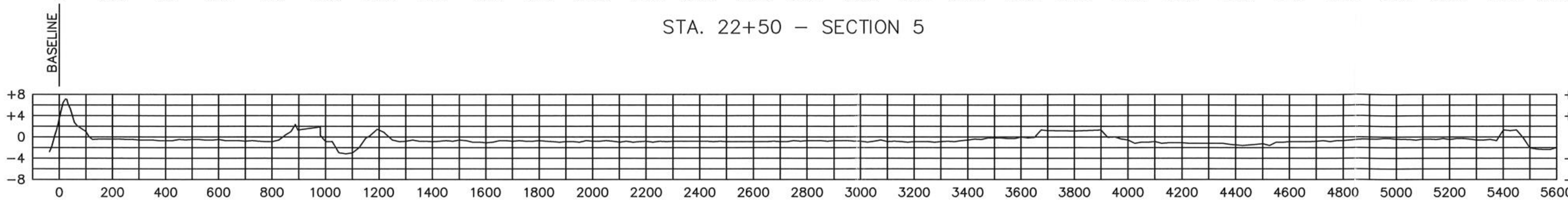

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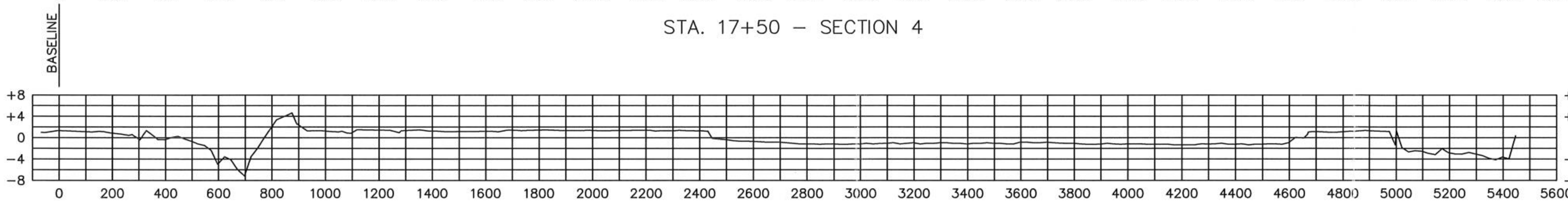

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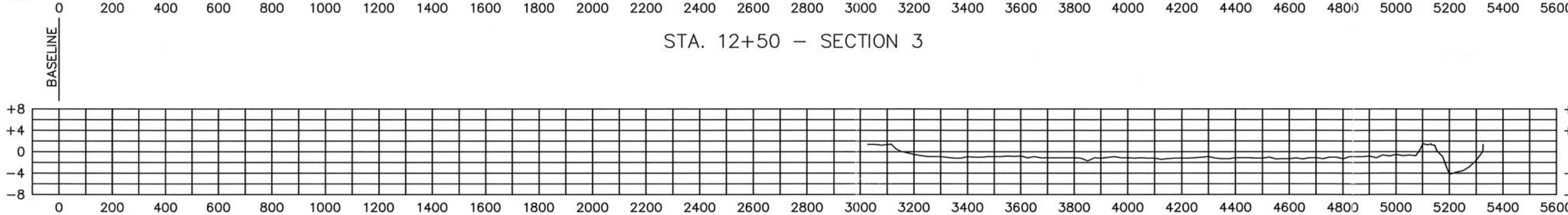

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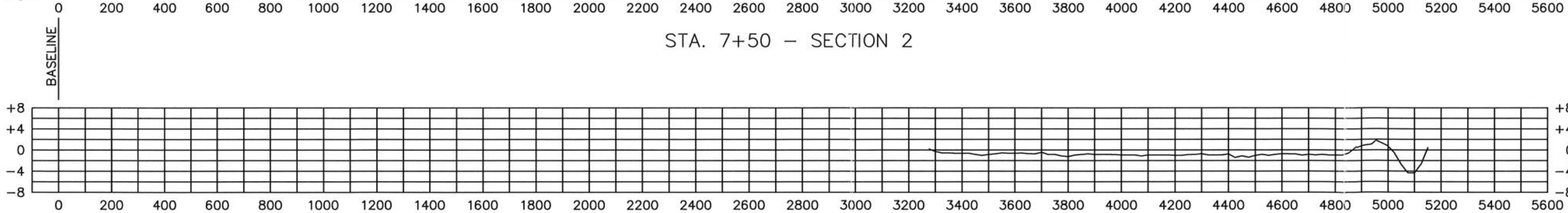

STA. 2+50 – SECTION 1

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VERT 1"=20'

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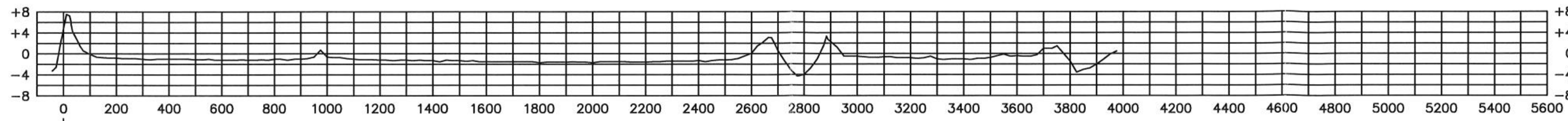
MAP NO.	

FILL AREA TRANSECTS

MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT (BA-34)
PLAQUEMINES AND JEFFERSON PARISHES, LOUISIANA

SHEET NO.
4
OF
10



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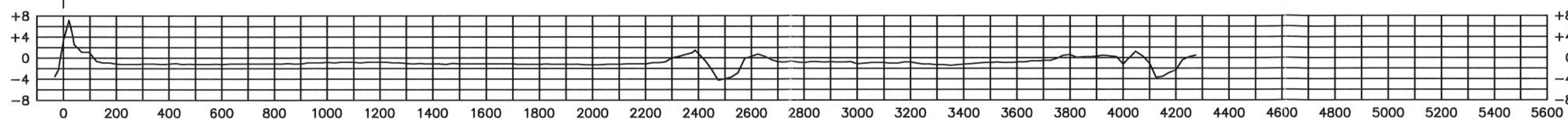

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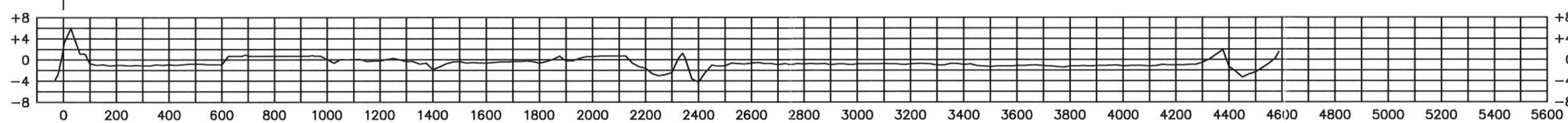

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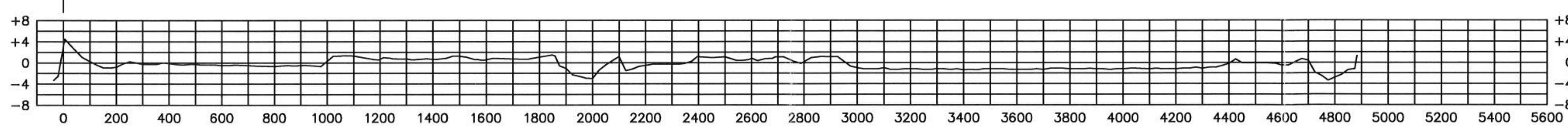

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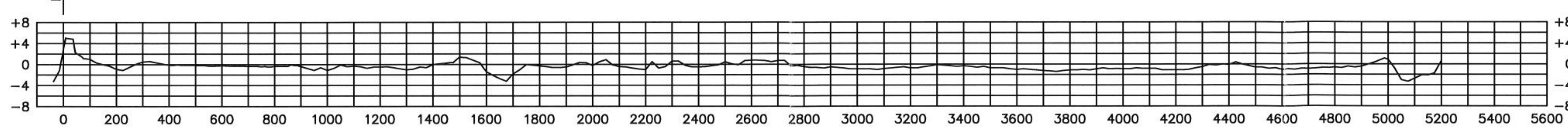

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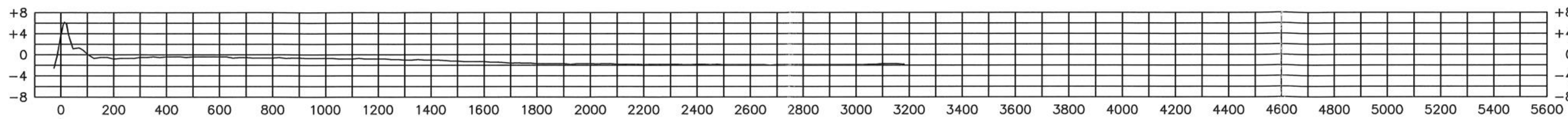
SCALE: HORIZ 1"=400'
VERT 1"=20'

FILE NAME:	04071X02
TBS NO.:	E2004-071
DATE:	3/10/05
PLOT SCALE:	NOTED
DRAWN BY:	KSP
APPROVED:	MJM
MAP NO.	

FILL AREA TRANSECTS

MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT (BA-34)
PLAQUEMINES AND JEFFERSON PARISHES, LOUISIANA

SHEET NO. **5** OF **10**



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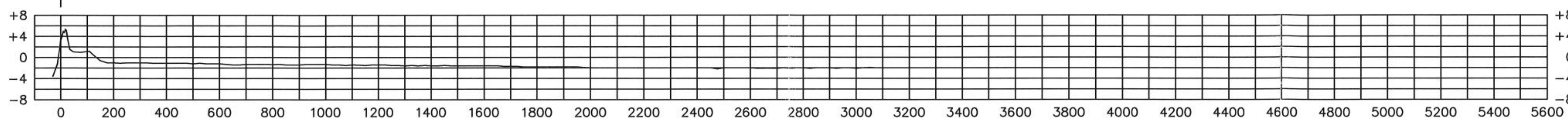

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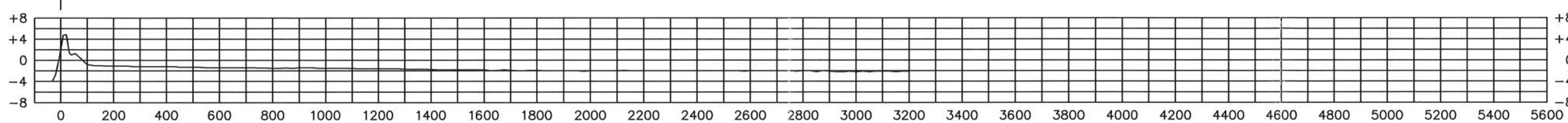

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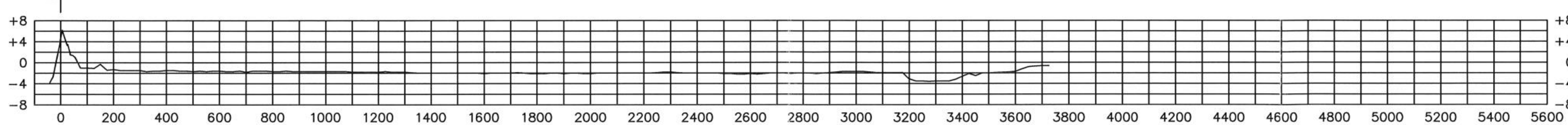

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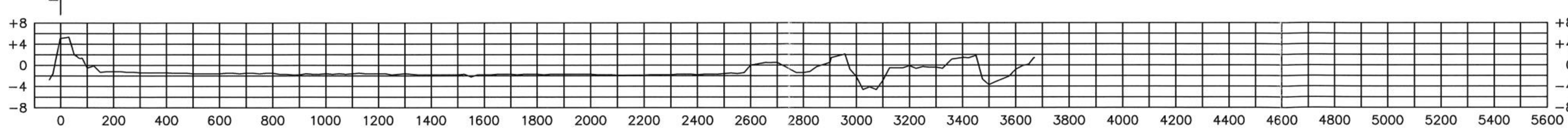

STA. 52+50 – SECTION 11

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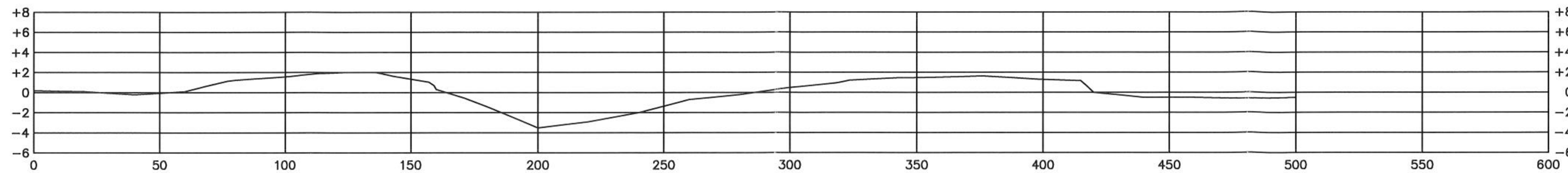
SCALE: HORIZ 1"=400'
VERT 1"=20'

FILE NAME:	04071X03
TBS NO.:	E2004-071
DATE:	3/10/05
PLOT SCALE:	NOTED
DRAWN BY:	KSP
APPROVED:	MJM
MAP NO.	

FILL AREA TRANSECTS

MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT (BA-34)
PLAQUEMINES AND JEFFERSON PARISHES, LOUISIANA

SHEET NO.
6
OF
10



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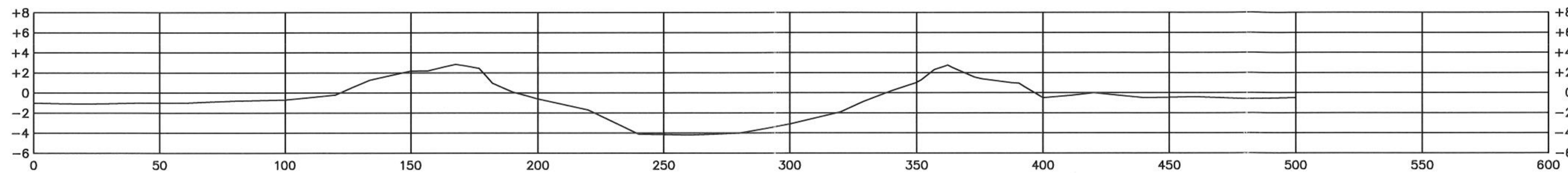

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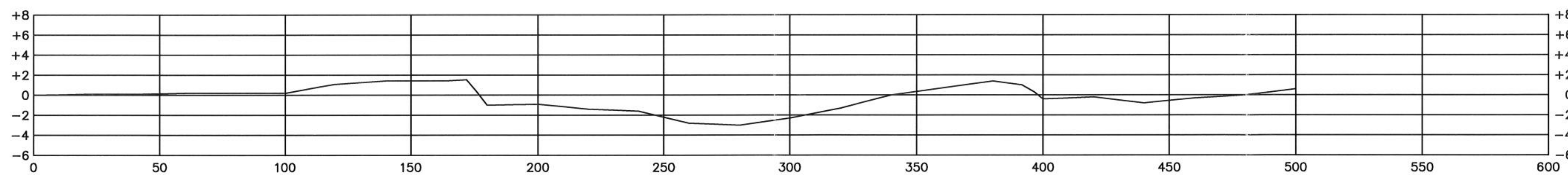

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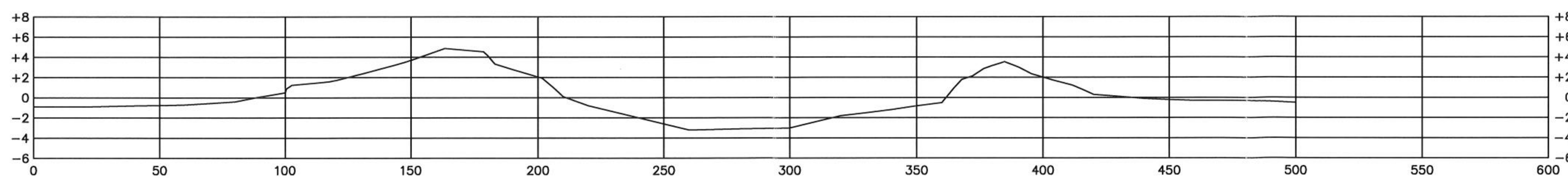

SECTION 16

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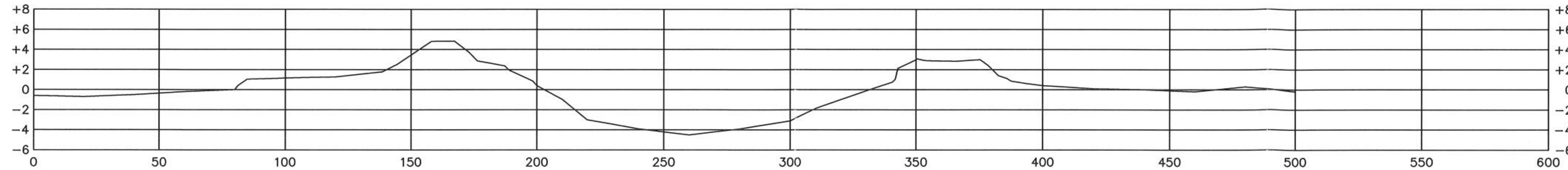
VERT 1"=10'

FILE NAME:	04071X04
TBS NO.:	E2004-071
DATE:	3/10/05
PLOT SCALE:	NOTED
DRAWN BY:	KSP
APPROVED:	MJM
MAP NO.	

FILL AREA TRANSECTS

MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT (BA-34)
PLAQUEMINES AND JEFFERSON PARISHES, LOUISIANA

SHEET NO.
7
OF
10



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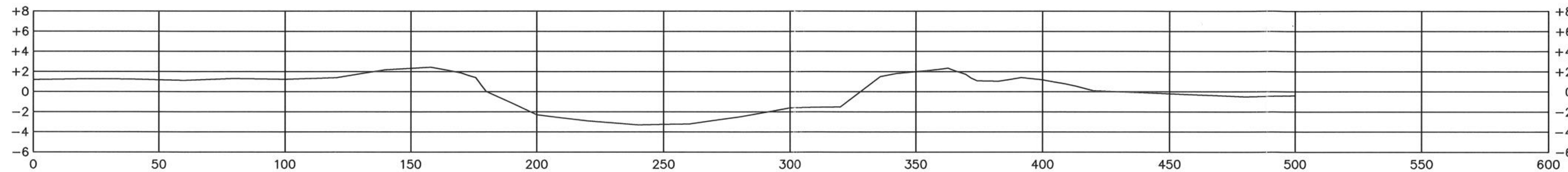

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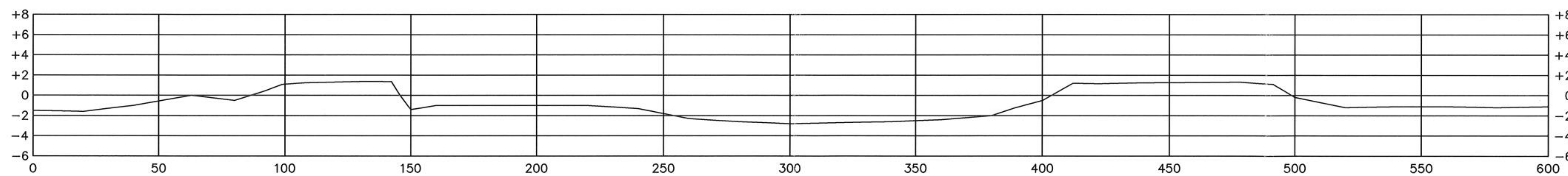

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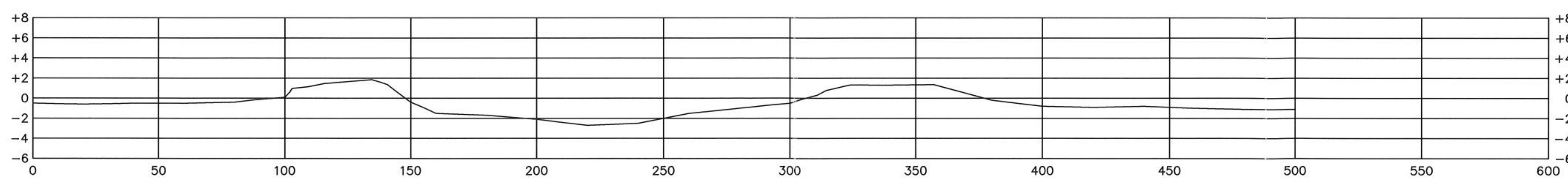

SECTION 20

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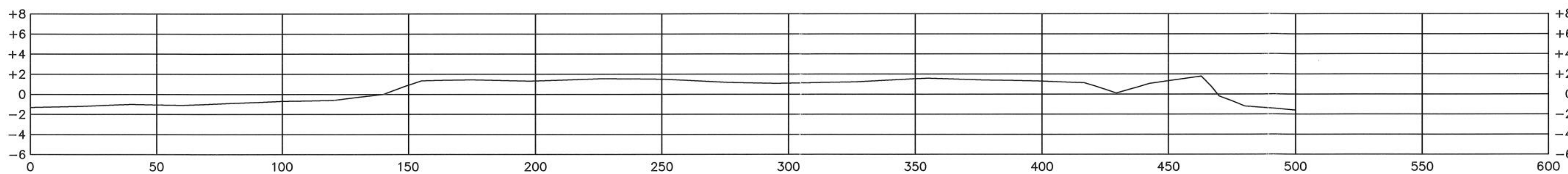
VERT 1"=10'

FILE NAME:	04071X05
TBS NO.:	E2004-071
DATE:	3/10/05
PLOT SCALE:	NOTED
DRAWN BY:	KSP
APPROVED:	MJM
MAP NO.	

FILL AREA TRANSECTS

MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT (BA-34)
PLAQUEMINES AND JEFFERSON PARISHES, LOUISIANA

SHEET NO.
8
OF
10



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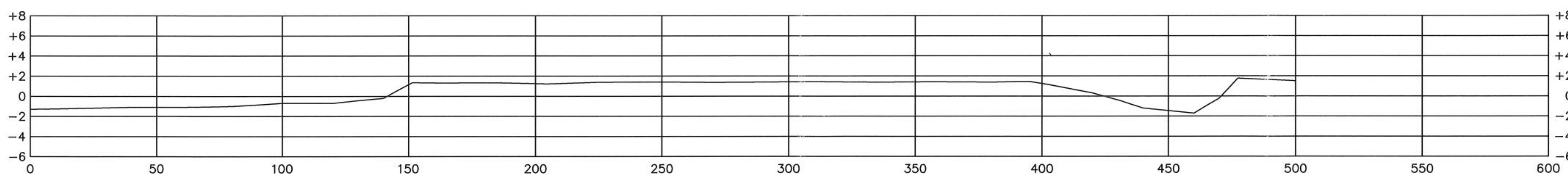

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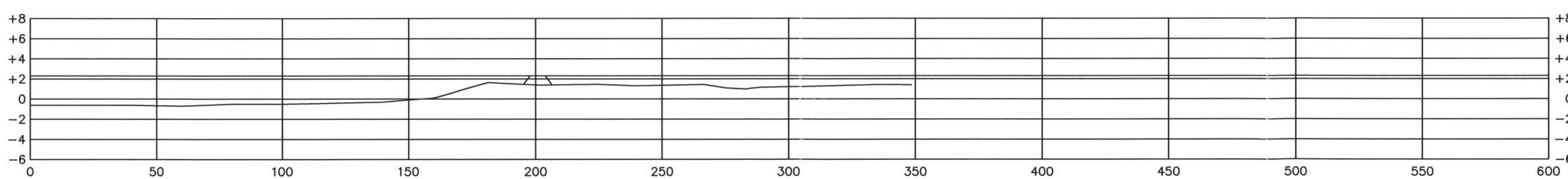

SECTION 24

NOTES:

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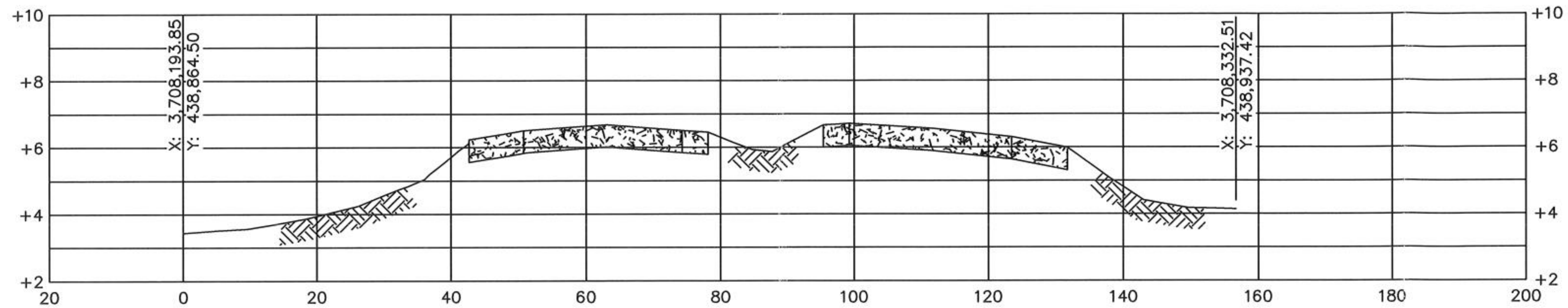
SCALE: HORIZ 1"=40'
VERT 1"=10'

FILE NAME:	04071X06
TBS NO.:	E2004-071
DATE:	3/10/05
PLOT SCALE:	NOTED
DRAWN BY:	KSP
APPROVED:	MJM
MAP NO.	

FILL AREA TRANSECTS

MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT (BA-34)
PLAQUEMINES AND JEFFERSON PARISHES, LOUISIANA

SHEET NO.
9
OF
10



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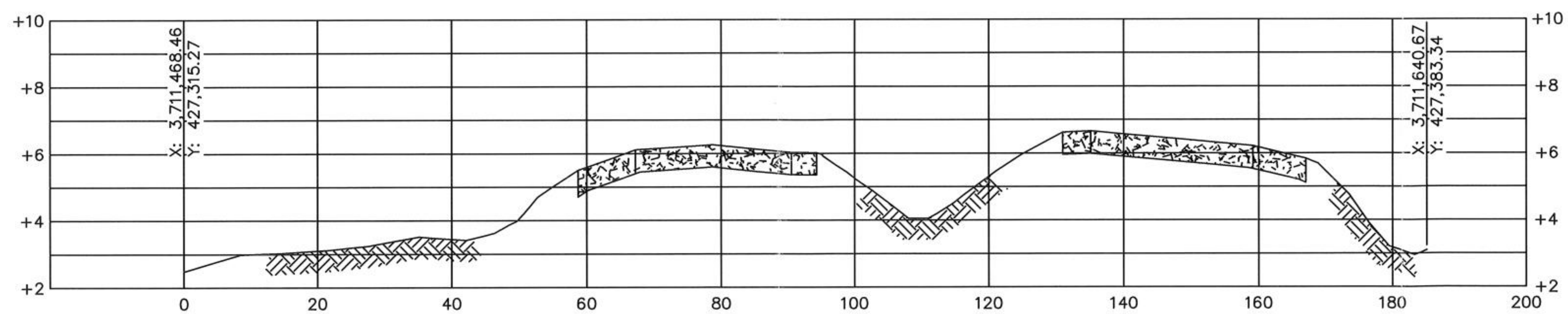

SECTION A

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PLANNING - DESIGN - CONSTRUCTION MANAGEMENT - OPERATIONS COMPLIANCE
SURVEYING - ENGINEERING - ENVIRONMENTAL SERVICES
(985) 868-1050 www.tbsmith.com

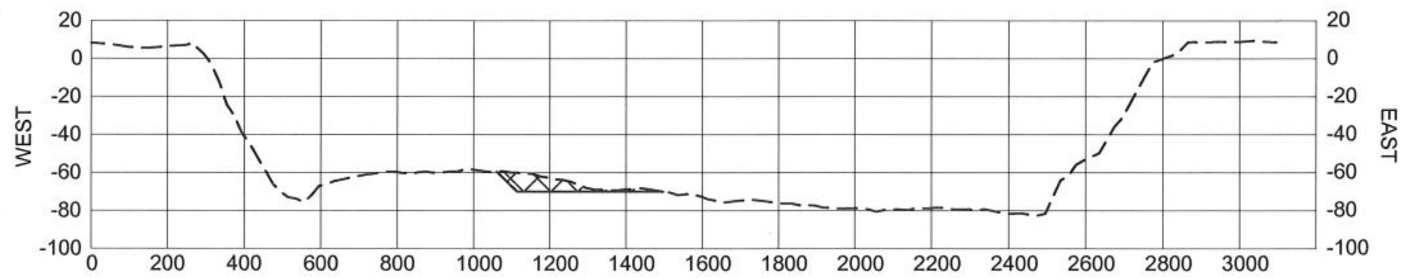
SCALE: HORIZ 1"=20'
VERT 1"=4'

FILE NAME:	04071X07
TBS NO.:	E2004-071
DATE:	3/10/05
PLOT SCALE:	NOTED
DRAWN BY:	KSP
APPROVED:	MJM
MAP NO.	

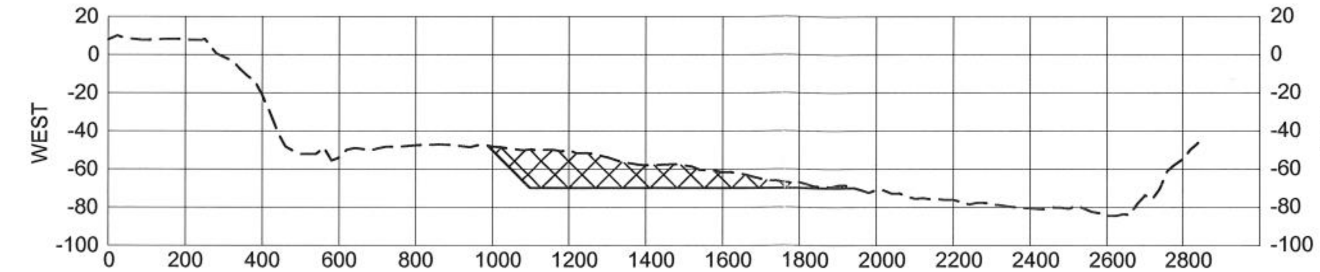
HIGHWAY 23 CROSS SECTIONS

MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT (BA-3A)
PLAQUEMINES AND JEFFERSON PARISHES, LOUISIANA

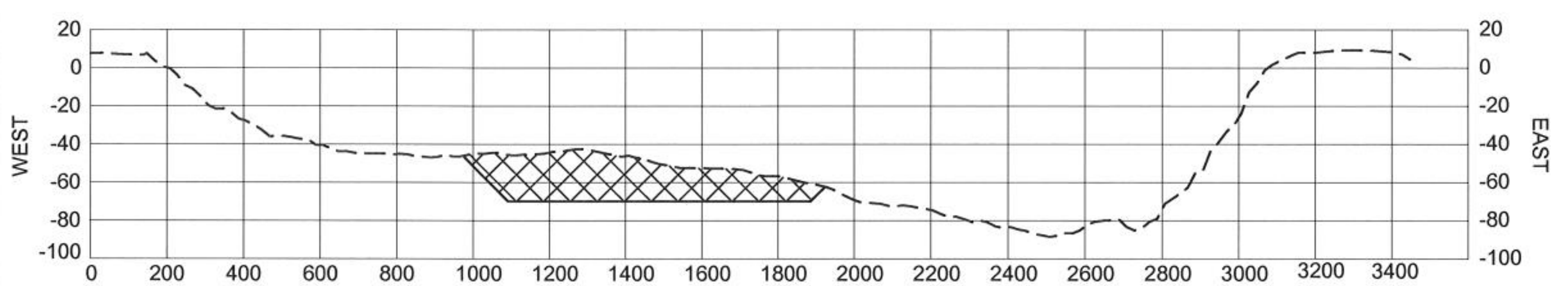
SHEET NO. **10** OF **10**



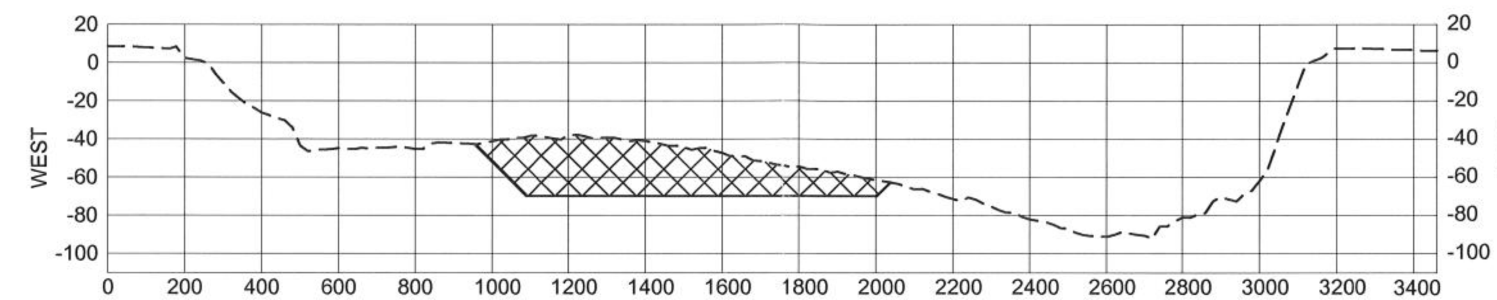
TRANSECT MR 63.4



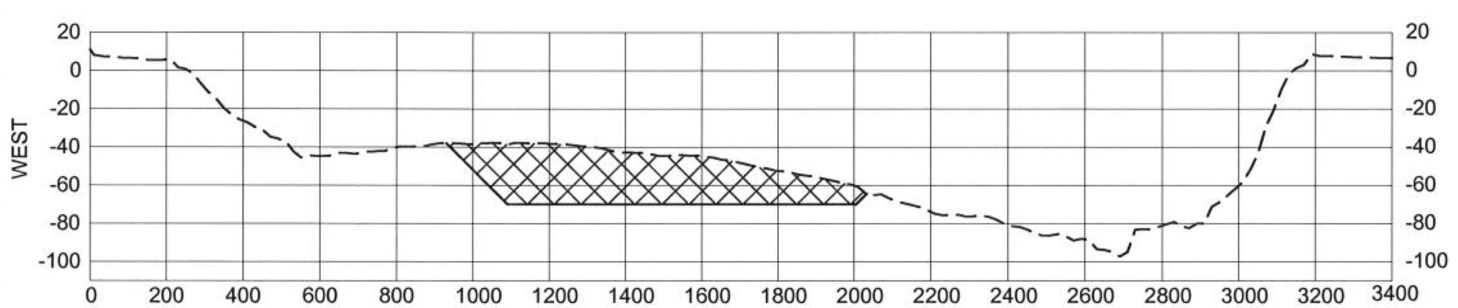
TRANSECT MR 63.5



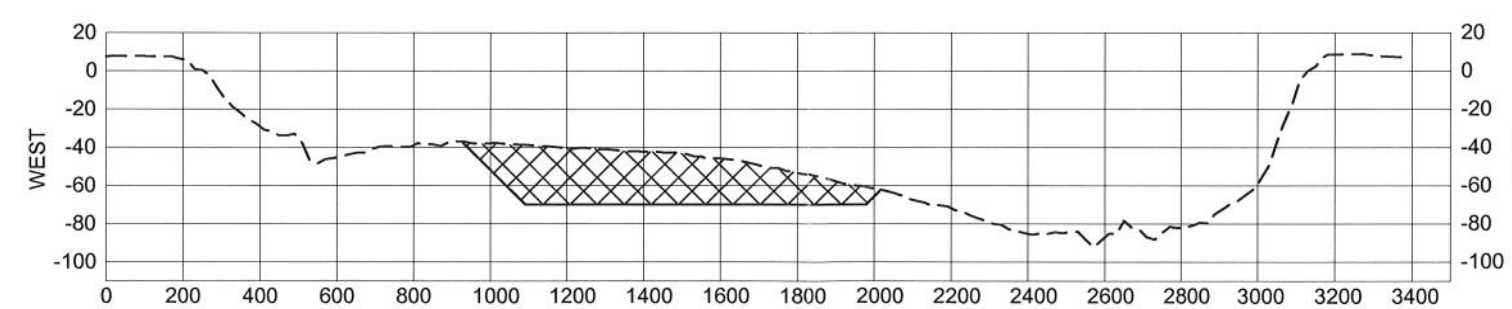
TRANSECT MR 63.7



TRANSECT MR 63.9



TRANSECT MR 64.1



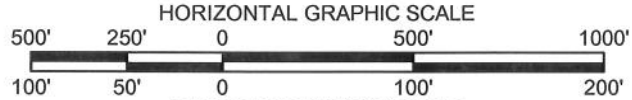
TRANSECT MR 64.3

LEGEND

- EXISTING BOTTOM
- BORROW AREA

NOTE:
ALL ELEVATIONS ARE GIVEN IN THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

HORIZONTAL GRAPHIC SCALE



VERTICAL GRAPHIC SCALE

REV.	DATE	DESCRIPTION	BY

LOUISIANA DEPARTMENT OF NATURAL RESOURCES
COASTAL ENGINEERING DIVISION
617 NORTH 3RD STREET
BATON ROUGE, LOUISIANA 70802

DRAWN BY: KRISTI CANTU
DESIGNED BY: WHITNEY THOMPSON

MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM - BAYOU DUPONT

STATE PROJECT NUMBER: BA-39

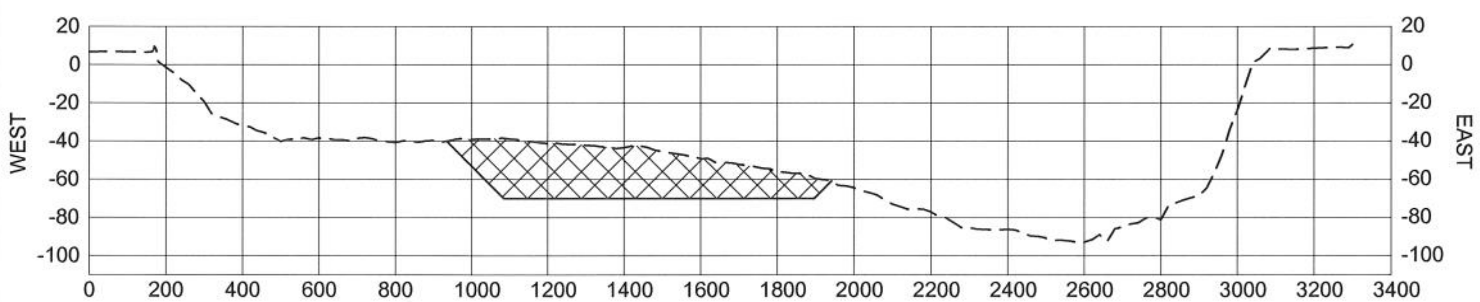
FEDERAL PROJECT NUMBER: BA-39

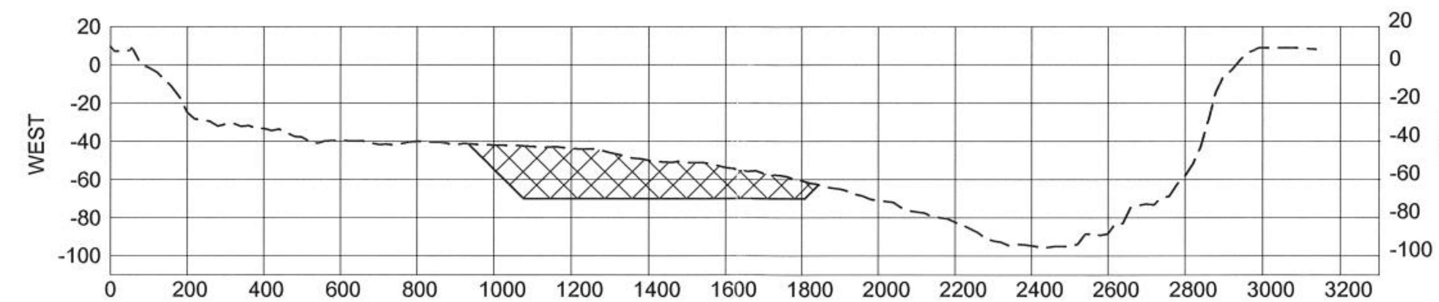
APPROVED BY: LUKE LEBAS, P.E.

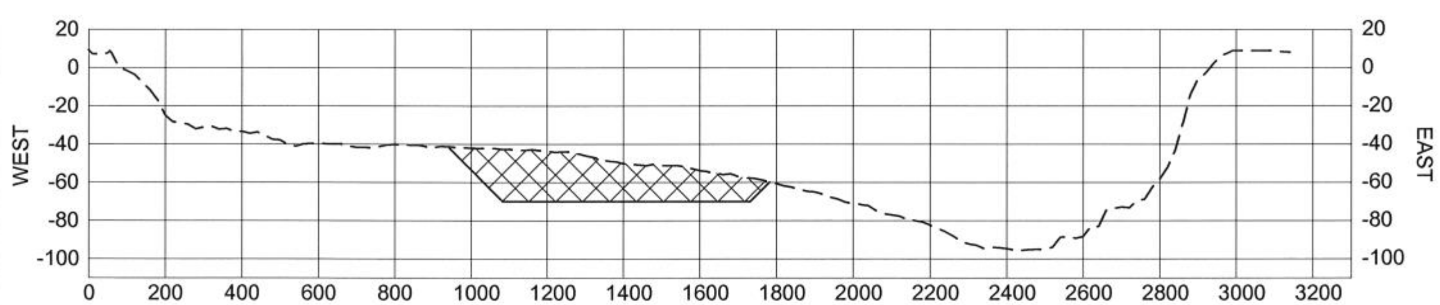
BORROW AREA SECTIONS

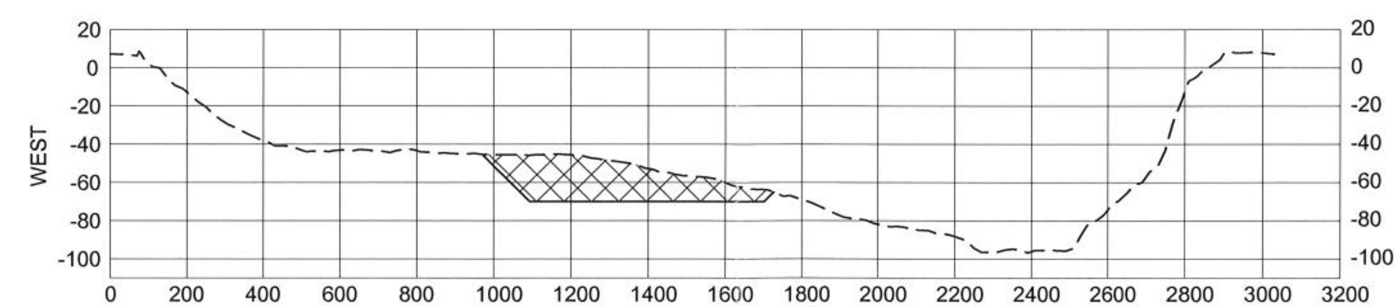
DATE: JUNE 2007

SHEET 1 OF 2





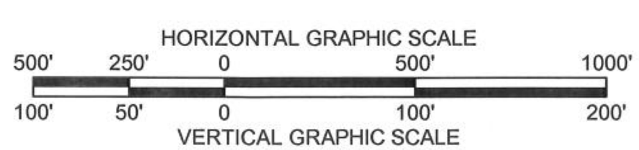




LEGEND

- – – – EXISTING BOTTOM
- ⊠ BORROW AREA

NOTE:
ALL ELEVATIONS ARE GIVEN IN THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).



REV.	DATE	DESCRIPTION	BY

LOUISIANA DEPARTMENT OF NATURAL RESOURCES
COASTAL ENGINEERING DIVISION
617 NORTH 3RD STREET
BATON ROUGE, LOUISIANA 70802

DRAWN BY: KRISTI CANTU
DESIGNED BY: WHITNEY THOMPSON

MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM - BAYOU DUPONT

STATE PROJECT NUMBER: BA-39
FEDERAL PROJECT NUMBER: BA-39
APPROVED BY: LUKE LEBAS, P.E.

BORROW AREA SECTIONS

DATE: JUNE 2007
SHEET 2 OF 2

Appendix C – Eustis Engineering and L. J. Capozzoli Boring Logs

LEGEND AND NOTES FOR LOG OF BORING AND TEST RESULTS

PP	Pocket penetrometer: Resistance in tons per square foot
SPT	Standard Penetration Test: Number of blows of a 140-lb hammer dropped 30 inches required to drive 2-in. O.D., 1.4-in. I.D. sampler a distance of 1 foot into the soil after first seating it 6 inches
SPLR	Type of Sampling: Shelby, SPT, Auger, No sample
SYMBOL	Clay, Silt, Sand, Peat/Humus, Shells, Stone/Gravel Predominant type shown heavy; Modifying type shown light
USC	Unified Soil Classification
DENSITY	Unit weight in pounds per cubic foot

SHEAR TESTS

TYPE

- UC Unconfined compression shear
- OB Unconsolidated undrained triaxial compression shear on one specimen confined at the approximate overburden pressure
- UU Unconsolidated undrained triaxial compression shear
- CU Consolidated undrained triaxial compression shear
- DS Direct shear

- Ø Angle of internal friction in degrees
- c Cohesion in pounds per square foot

ATTERBERG LIMITS

- LL Liquid Limit
- PL Plastic Limit
- PI Plasticity Index

OTHER TESTS

- CON Consolidation
- PD Particle size distribution (sieve and/or hydrometer)
- k Coefficient of permeability in centimeters per second
- SP Swelling pressure in pounds per square foot

Other laboratory test results reported on separate figures

GENERAL NOTES

(1) If a ground water depth is shown on the boring log, these observations were made at the time of drilling and were measured below the existing ground surface. These observations are shown on the boring logs. However, ground water levels may vary due to seasonal fluctuations and other factors. If important to construction, the depth to ground water should be determined by those persons responsible for construction immediately prior to beginning work.

(2) While the individual logs of borings are considered to be representative of subsurface conditions at their respective locations on the dates shown, it is not warranted that they are representative of subsurface conditions at other locations and times.

EUSTIS ENGINEERING COMPANY, INC.

LOG OF BORING AND TEST RESULTS

STATE OF LOUISIANA
COASTAL RESTORATION AND MANAGEMENT
MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT, LOUISIANA

(Sheet 1 of 1)

Ground Elev.: -18.3 **Datum:** NAVD 88 **Gr. Water Depth:** N/A **Job No.:** 19183 **Date Drilled:** 3/01/06 **Boring:** 1 **Refer to "Legends & Notes"**

PP	SPT	Visual Classification	USC	Sample Number	Depth In Feet	Water Content Percent	Density Dry	Density Wet	Shear Tests Type	Shear Tests ø	Shear Tests C	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Misc tests	Other Tests
	1	Loose gray clayey silt	ML	1	0'-1'6"											
	5			2	2'-3'6"	33										
		Loose gray sandy silt	ML	3	5'-6'											
				4	6'-7'											
				5	7'-8'	25	98	122	OB	--	656					
		Very soft gray clay	CH	6	11'-12'	56	67	104	UC	--	114	65	23	42		
		Loose to medium dense gray silty sand w/clay layers	SM	7	13'-14'											
				8	15'-16'											
				9	16'-17'											PD
		Very soft gray clay w/silty sand lenses & layers	CH	10	19'-20'	47	74	109	OB	0	75	72	24	48		
0.25				11	20'-21'											
		Loose brown & gray sandy silt w/clay	ML	12	23'-24'											PD
0.25		Very soft to soft brown & gray clay w/silt lenses & pockets	CH	13	25'-26'											
0.25				14	27'-28'	43	77	111	UC	--	139	70	27	43		
0.25			CH	15	29'-30'											PD
0.25				16	31'-32'											
		Medium compact gray sandy silt	ML	17	32'-34'											
0.50		Soft brown & gray clay w/silt lenses & pockets	CH	18	35'-36'	55	66	102	UC	--	503	64	22	42		
0.25				19	37'-38'											
0.25				20	39'-40'											

Comments: Estimated water surface at el 2.7.
N 29° 39.083'; W 89° 57.560'

EUSTIS ENGINEERING COMPANY, INC.

LOG OF BORING AND TEST RESULTS

STATE OF LOUISIANA
COASTAL RESTORATION AND MANAGEMENT
MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT, LOUISIANA

(Sheet 1 of 1)

Ground Elev.: -33.3 **Datum:** NAVD 88 **Gr. Water Depth:** N/A **Job No.:** 19183 **Date Drilled:** 3/01/06 **Boring:** 2 **Refer to "Legends & Notes"**

Visual Classification	USC
Very soft gray silty clay	CL
Very soft gray clay w/silt lenses & pockets	CH
Loose gray clayey silt	ML
Very soft gray silty clay	CL
Loose gray sandy silt	SM
Loose gray silty fine sand w/clay layers	SM
Very soft gray clay w/silt pockets & lenses	CH
Loose gray silty sand w/clay layers	SM
Very soft gray silty clay w/sand layers	CL
Medium stiff gray silty clay w/silt lenses	CL

PP	SPT	Sample Number	Depth In Feet	Water Content Percent	Density Dry	Density Wet	Shear Tests Type	Shear Tests ø	Shear Tests C	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
		1	0-2	30						50	16	34		
		2	3-4	37	85	116	UC	--	75	40	17	23		
0.25		3	5-6											
0.25		4	7-8											
0.25		5	9-10	53	70	106	OB	0	69	58	22	36		
		6	11-12	56										
		7	13-14	70										
		8	15-16											PD
		9	17-18											
		10	19-20											
		11	21-22	43	76	109	UC	--	81					
		12	22-24											
		13	25-26											
		14	26-28											PD
		15	28-30											
		16	30-32											
		17	32-34	22	101	122	OB	0	1107					
		18	34-36											
		19	36-38											
0.50		20	38-40											

Scale In Feet: 0, 10, 20, 30, 40, 50

Comments: Estimated water surface at el 2.7.
N 29° 39.584'; W 89° 57.628'

EUSTIS ENGINEERING COMPANY, INC.

LOG OF BORING AND TEST RESULTS

STATE OF LOUISIANA
COASTAL RESTORATION AND MANAGEMENT
MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT, LOUISIANA

(Sheet 1 of 1)

Ground Elev.: -27.3 **Datum:** NAVD 88 **Gr. Water Depth:** N/A **Job No.:** 19183 **Date Drilled:** 3/05/06 **Boring:** 3

Refer to "Legends & Notes"

Scale In Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth In Feet	Water Content Percent	Density		Shear Tests			Atterberg Limits				Other Tests
										Dry	Wet	Type	ø	C	LL	PL	PI		
0	0.25				Extremely soft to very soft gray silty clay	CL	1	0-2											
	0.25						2	2-4	48	74	109	UC	--	28					
	0.25						3	4-6											
					Very loose to loose gray sandy silt	ML	4	6-8											
10							5	8-10	30	90	117	OB	0	204					
					Loose gray silty sand w/clay	SM	6	10-12											
							7	12-14											PD
							8	14-16											
							9	16-18											
							10	18-19											
20		8			Medium dense gray silty sand	SM	11	19-20.5											
		10					12	22-23											
		13					13	25-26											
		25					14	28-29											PD
30		24					15	31-32											
		16					16	34-35											
		18					17	37-38											
		20					18	39-40											
40																			
50																			

Comments: Estimated water surface at el 2.7.
N 29° 40.046'; W 89° 57.686'

EUSTIS ENGINEERING COMPANY, INC.

LOG OF BORING AND TEST RESULTS

STATE OF LOUISIANA
COASTAL RESTORATION AND MANAGEMENT
MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT, LOUISIANA

(Sheet 1 of 1)

Ground Elev.: -1.3 **Datum:** NAVD 88 **Gr. Water Depth:** N/A **Job No.:** 19183 **Date Drilled:** 4/03/06 **Boring:** 4 **Refer to "Legends & Notes"**

Scale In Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth In Feet	Water Content Percent	Density		Shear Tests			Atterberg Limits				Other Tests
										Dry	Wet	Type	ø	C	LL	PL	PI		
0	0.00				Very soft gray clay	CH	1	1-2	87	50	93	OB	0	50	109	29	80		
	0.00						2	3-4											
	0.00				Very soft gray organic clay	OH	3	5-6	262	20	74	UC	--	125	267	88	179		
	0.50				Loose gray sandy silt	ML	4	7.0-8							32	25	7		CON
10	0.00				Very soft gray clay w/sandy silt lenses & pockets	CH	5	9-10	76	55	98	OB	0	58					
	0.00				w/sand pockets & shell fragments		6	11-12											
	0.50						7	13-14	63	63	102	UC	--	148					
	0.25						8	15-16											
	0.00						9	17-18											
20	0.25						10	19-20											
	0.50						11	24-25	79	53	95	UC	--	173					
30	0.75						12	29-30											
	0.50						13	34-35											
40	0.50						14	39-40											
50																			

Comments: Estimated water surface at el 0.2.
N 29° 39.078'; 90° 01.346'

EUSTIS ENGINEERING COMPANY, INC.

LOG OF BORING AND TEST RESULTS

STATE OF LOUISIANA
COASTAL RESTORATION AND MANAGEMENT
MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT, LOUISIANA

(Sheet 1 of 2)

Ground Elev.: -1.8 **Datum:** NAVD 88 **Gr. Water Depth:** N/A **Job No.:** 19183 **Date Drilled:** 3/30/06 **Boring:** 5 **Refer to "Legends & Notes"**

Scale In Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth In Feet	Water Content Percent	Density		Shear Tests			Atterberg Limits				Other Tests
										Dry	Wet	Type	ø	C	LL	PL	PI		
0	0.00				Very soft black humus	Pt	1	1-2											
	0.00						2	3-4	664	9	66	OB	0	53.2	672	245	427		
	0.00				Very soft gray clay w/silt lenses & pockets	CH	3	5-6											
	0.25						4	7-8	71	56	96	UC	--	65	150	47	103		
10	0.00						5	9-10											
	0.25				Loose to medium compact gray clayey silt w/ clay layers	ML	6	11-12	34	88	117	OB	0	355	48	21	27		
	0.25						7	13-14											
	0.75						8	15-16											
	0.00				Medium compact gray sandy silt w/clay layers	ML	9	17-18	24	98	122	OB	0	1658	35	26	9		CON
20	0.25						10	19-20											
	0.25				Very soft gray clay	CH	11	24-25	82	52	94	UC	--	160					
30	0.25				w/sandy silt lenses & layers		12	29-30											
	0.25						13	34-35	63	61	99	UC	--	180					
40	0.50						14	39-40											
	0.75				Soft gray clay w/sand lenses	CH	15	44-45	60	63	101	OB	0	392					
50	0.75						16	49-50											

Comments: Estimated water surface at el 0.2.
N 29° 38.887'; W 90° 00.743'

EUSTIS ENGINEERING COMPANY, INC.

LOG OF BORING AND TEST RESULTS

STATE OF LOUISIANA
COASTAL RESTORATION AND MANAGEMENT
MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT, LOUISIANA

Ground Elev.: -1.8 **Datum:** NAVD 88 **Gr. Water Depth:** N/A **Job No.:** 19183 **Date Drilled:** 3/30/06 **Boring:** 5

Refer to "Legends & Notes"

Scale In Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth In Feet	Water Content Percent	Density		Shear Tests			Atterberg Limits				Other Tests
										Dry	Wet	Type	ø	C	LL	PL	PI		
50					Soft gray clay	CH													
	0.50						17	54-55	64	63	102	UC	--	395					
					Medium stiff gray clay	CH													
60	0.75						18	59-60											
70																			
80																			
90																			
100																			

Comments: Estimated water surface at el 0.2.
N 29° 38.887'; W 90° 00.743'

EUSTIS ENGINEERING COMPANY, INC.

LOG OF BORING AND TEST RESULTS

STATE OF LOUISIANA
COASTAL RESTORATION AND MANAGEMENT
MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT, LOUISIANA

(Sheet 1 of 1)

Ground Elev.: -0.3 **Datum:** NAVD 88 **Gr. Water Depth:** N/A **Job No.:** 19183 **Date Drilled:** 4/03/06 **Boring:** 6 **Refer to "Legends & Notes"**

Scale In Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth In Feet	Water Content Percent	Density		Shear Tests			Atterberg Limits				Other Tests
										Dry	Wet	Type	ø	C	LL	PL	PI		
0	0.00				Very soft dark brown humus	Pt	1	1-2											
	0.75				Very soft gray clay w/silt pockets	CH	2	3-4	63	61	100	UC	--	145	88	27	61		CON
	1.00						3	5-6											
	0.75						4	7-8	63	62	100	UC	--	215	81	23	58		
10	0.50						5	9-10											
	1.25				Medium compact gray clayey silt w/clay lenses	ML	6	11-12	38	83	115	OB	0	552					
	1.25						7	13-14											
	0.50				Very soft gray clay w/silt lenses & layers	CH	8	15-16	57	65	102	OB	0	150	68	28	40		
	0.50						9	17-18											
20	0.75						10	19-20											
	0.50				w/sandy silt pockets		11	24-25											
30	1.00						12	29-30	64	61	100	UC	--	233					
	0.75						13	34-35											
40	0.75						14	39-40											
50																			

Comments: Estimated water surface at el 0.2.
N 29° 39.418'; W 90° 00.719'

EUSTIS ENGINEERING COMPANY, INC.

LOG OF BORING AND TEST RESULTS

STATE OF LOUISIANA
COASTAL RESTORATION AND MANAGEMENT
MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT, LOUISIANA

(Sheet 1 of 1)

Ground Elev.: -2.7 **Datum:** NAVD 88 **Gr. Water Depth:** N/A **Job No.:** 19183 **Date Drilled:** 4/03/06 **Boring:** 7 **Refer to "Legends & Notes"**

Scale In Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth In Feet	Water Content Percent	Density		Shear Tests			Atterberg Limits				Other Tests
										Dry	Wet	Type	ø	C	LL	PL	PI		
0	0.00				Very soft black humus	Pt	1	1-2	700	8	64	OB	0	64					
	0.00						2	3-4											
	1.50				Medium compact gray clayey silt	ML	3	5-6											
	0.75						4	7-8	29	93	120	OB	0	616	36	31	5		
10	0.50						5	9-10											
	0.00						6	11-12											
	0.00				Very soft gray clay w/sand lenses & pockets	CH	7	13-14	79	54	97	OB	0	100	80	25	55		
	0.50						8	15-16											
	0.00				w/sand pockets		9	17-18											
20	0.50						10	19-20	74	57	99	UC	--	95					
	0.25						11	24-25											
30	0.50				w/sand lenses & pockets		12	29-30											
	0.75						13	34-35	69	55	96	UC	--	98	74	22	52		CON
					Medium stiff gray clay	CH													
40	1.00						14	39-40											
50																			

Comments: Estimated water surface at el 0.2.
N 29° 38.889'; W 90° 00.290'

EUSTIS ENGINEERING COMPANY, INC.

LOG OF BORING AND TEST RESULTS

STATE OF LOUISIANA
COASTAL RESTORATION AND MANAGEMENT
MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM
BAYOU DUPONT, LOUISIANA

(Sheet 1 of 1)

Ground Elev.: -1.8 **Datum:** NAVD 88 **Gr. Water Depth:** N/A **Job No.:** 19183 **Date Drilled:** 3/31/06 **Boring:** 8 **Refer to "Legends & Notes"**

Scale In Feet	PP	SPT	Visual Classification	USC	Sample Number	Depth In Feet	Water Content Percent	Density Dry	Density Wet	Shear Tests Type	Shear Tests ø	Shear Tests C	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI		Other Tests
0	0.00		Very soft black humus	Pt	1	1-2	528	10	65	UC	--	13					
	0.00				2	3-4											
	0.00				3	5-6											
	0.00		Very soft dark gray humus w/roots and clay layers	Pt	4	7-8	208	25	76	OB	0	57	224	67	157		CON
10	0.00				5	9-10											
	0.50		Very loose gray clayey silt	ML	6	11-12											
	0.00				7	13-14	38	83	115	OB	0	221					
	0.00		Very soft gray clay	CH	8	15-16											
	0.00		w/sand lenses & pockets		9	17-18											
20	0.00				10	19-20	81	52	93	UC	--	155					
	0.00				11	24-25											
30	0.25				12	29-30	57	64	100	UC	--	130					
	0.50				13	34-35											
40	0.50				14	39-40											
50																	

Comments: Estimated water surface at el 0.2.
N 29° 38.593'; W 90° 00.268'

LOG OF BORING LEGEND

LJC&A: 07-110

1.	SPT	=	Standard Penetration Test (4/6/9) where 4 is the blows to seat and 15 is blows (N) for 12 inch penetration.
2.	QU (TSF)	=	Unconsolidated undrained triaxial, one point test 0.05 @ 0.12 is the compressive strength in tsf which is twice the cohesion and @ means the confining pressure at tsf. Note: tests without @ values following are for unconfined Compression shear tests.
3.	WC (%)	=	In situ water content
4.	Dry Wt. (PCF)	=	The dry unit weight of soil
5.	LL	=	Liquid Limit (%)
6.	PI	=	Plasticity Index (%)
7.	MV(KSF)	=	Miniature vane strength test done in end of sample in the Shelby tube and value is the cohesion in KSF.

LOG OF BORING

Project:	Bayou Dupont Plaquemines Parish, Louisiana Louisiana Department of Natural Resources (2503-05-44)	Boring: File:	B-1B 07-110
For:	Sigma Consulting Group Baton Rouge, Louisiana	Date: Technician:	24-May-07 CAL

Undisturbed Sample
Standard Penetration Test
Classification Sample
(SLS) Slickensided

N 29° 42.099'
W 89° 58.799'

Boring Depth: 98 Feet

Depth Feet	SAMPLES	Description	(SPT) Recovery %	UU(TSF)	WC(%)	Dry Wt. (PCF)	LL	PI	MV(KSF)
0		Zero = top of casing, set 62 feet of 8 inch casing 74 feet of 4 inch casing; top of casing to water is 7 feet							
		Water surface El. 5.0 feet NAVD 88 (Estimated)							
		Water depth = 51.5 feet							
		Mudline El. -46.5 feet, NAVD 88							
	SPT	Loose brown sand (SP) 6 blows per foot (2/3/3)	66						
60	SPT	Firm brown sand (SP) 20 blows per foot (10/11/9)	61						
	SPT	Firm brown sand (SP) 23 blows per foot (9/11/12)	100						
65	SPT	Firm brown sand (SP) 20 blows per foot (10/10/10)	70						
	SPT	Firm gray sand (SP) 18 blows per foot (7/9/9)	72						
	SPT	Firm gray sand (SP) 20 blows per foot (5/9/11)	72						
70	SPT	Firm gray sand with clay layer (SP) 20 blows per foot (6/8/12)	100						
	SPT	Very dense gray sand with clay layer, shells, wood, and organic (SP) 58 blows per foot (15/32/26)	70						
75	SPT	Very dense gray sand with organic (SP) 51 blows per foot (19/27/24)	80						
	SPT	Firm gray sand (SP) 14 blows per foot (5/6/8)	53						
	SPT	Firm gray sand (SP) 14 blows per foot (5/6/8)	60						
80	SPT	Firm gray sand (SP) 25 blows per foot (13/12/13)	100						
	SPT	Firm gray sand (SP) 27 blows per foot (13/13/14)	100						
85	SPT	Firm gray sand (SP) 34 blows per foot (15/14/20)	100						
	SPT	Firm gray sand (SP) 15 blows per foot (5/6/9)	90						
	SPT	Firm gray sand (SP) 22 blows per foot (10/12/10)	100						
90	SPT	Firm gray sand (SP) 25 blows per foot (9/11/14)	100						
	SPT	Dense gray sand with organic (SP) 27 blows per foot (10/13/14)	100						
95	SPT	Dense gray sand with organic (SP) 37 blows per foot (11/14/23)	90						
	SPT	Dense gray sand with organic (SP) 46 blows per foot (11/22/24)	100						
100									

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LOG OF BORING

Project:	Bayou Dupont Plaquemines Parish, Louisiana Louisiana Department of Natural Resources (2503-05-44)	Boring:	B-2B
		File:	07-110
For:	Sigma Consulting Group Baton Rouge, Louisiana	Date:	16-May-07
		Technician:	CAL

Undisturbed Sample
Standard Penetration Test
Classification Sample
(SLS) Slickensided

N 29° 42.490'
W 89° 58.992'

Boring Depth: 98 Feet

Depth Feet	SAMPLES	Description	(SPT) Recovery %	UU(TSF)	WC(%)	Dry Wt. (PCF)	LL	PI	MV(KSF)
0		Zero = top of casing, set 62 feet of 8 inch casing; top of casing to water is 7 feet							
		Water surface El. 5.0 feet NAVD 88 (Estimated)							
		Water depth = 51.0 feet							
		Mudline El. -46.0 feet, NAVD 88							
	SPT	Firm brown sand (SP) 14 blows per foot (5/6/8)	44						
60	SPT	Firm brown sand with organic matter (SP) 17 blows per foot (8/9/8)	90						
	SPT	Firm brown sand (SP) 15 blows per foot (4/6/9)	20						
65	SPT	Firm gray sand with organic matter (SP) 23 blows per foot (8/8/15)	80						
	SPT	Firm gray sand (SP) 20 blows per foot (9/10/10)	55						
	SPT	Firm gray sand (SP) 23 blows per foot (9/11/12)	60						
70	SPT	Firm gray sand (SP) 27 blows per foot (13/13/14)	70						
	SPT	Firm gray sand (SP) 27 blows per foot (14/14/13)	80						
75	SPT	Dense gray sand 32 blows per foot (14/15/17)	80						
	SPT	Dense gray sand (SP) 37 blows per foot (17/18/19)	100						
	SPT	Dense gray sand (SP) 33 blows per foot (17/17/16)	100						
80	SPT	Firm gray sand (SP) 25 blows per foot (9/13/12)	70						
	SPT	Firm gray sand (SP) 27 blows per foot (14/14/13)	70						
85	SPT	Firm gray sand (SP) 29 blows per foot (12/14/15)	70						
	SPT	Firm gray sand (SP) 20 blows per foot (9/9/11)	55						
	SPT	Firm gray sand (SP) 13 blows per foot (7/8/5)	55						
90	SPT	Firm gray sand with organic matter (SP) 22 blows per foot (11/11/11)	80						
	SPT	Firm gray sand with organic matter (SP) 29 blows per foot (13/16/13)	100						
95	SPT	Very dense gray sand (SP) 50 blows per foot (18/24/26)	90						
	SPT	Very dense gray sand (SP) 56 blows per foot (19/27/29)	60						
100									

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LOG OF BORING

Project:	Bayou Dupont Plaquemines Parish, Louisiana Louisiana Department of Natural Resources (2503-05-44)	Boring: File:	B-3B 07-110
For:	Sigma Consulting Group Baton Rouge, Louisiana	Date: Technician:	17-May-07 CAL

Undisturbed Sample
Standard Penetration Test
Classification Sample
(SLS) Slickensided

N 29° 42.950'
W 89° 59.203'

Boring Depth: 104 Feet

Depth Feet	SAMPLES	Description	(SPT) Recovery %	UU(TSF)	WC(%)	Dry Wt. (PCF)	LL	PI	MV(KSF)
0		Zero = top of casing, set 64 feet of 8 inch casing; top of casing to water is 7 feet							
		Water surface El. 5.0 feet NAVD 88 (Estimated)							
		Water depth = 57.0 feet							
		Mudline El. -52.0 feet, NAVD 88							
65	SPT	Loose brown sand with wood (SP) 7 blows per foot (3/3/4)	60						
	SPT	Very loose brown sand (SP) 3 blows per foot (2/2/1)	75						
	SPT	Firm gray sand with organic matter (SP) 10 blows per foot (5/5/5)	80						
70	SPT	Firm gray sand (SP) 10 blows per foot (3/4/6)	90						
	SPT	Firm gray sand (SP) 15 blows per foot (8/7/8)	90						
75	SPT	Firm gray sand (SP) 18 blows per foot (6/7/11)	90						
	SPT	Firm gray sand (SP) 26 blows per foot (12/12/14)	100						
	SPT	Firm gray sand (SP) 22 blows per foot (9/11/11)	60						
80	SPT	Firm gray sand (SP) 22 blows per foot (10/11/11)	90						
	SPT	Firm gray sand (SP) 25 blows per foot (13/12/13)	80						
85	SPT	Dense gray sand (SP) 32 blows per foot (16/15/17)	75						
	SPT	Dense gray sand (SP) 37 blows per foot (17/17/20)	60						
	SPT	Dense gray sand (SP) 32 blows per foot (16/15/17)	50						
90	SPT	Firm gray sand (SP) 29 blows per foot (9/13/16)	80						
	SPT	Firm gray sand (SP) 27 blows per foot (15/14/13)	80						
95	SPT	Dense gray sand (SP) 42 blows per foot (18/20/22)	60						
	SPT	Dense gray sand (SP) 49 blows per foot (22/23/26)	50						
	SPT	Very dense gray sand (SP) 56 blows per foot (20/27/29)	50						
100	SPT	Very dense gray sand (SP) 63 blows per foot (20/31/32)	55						
	SPT	Very dense gray sand (SP) 63 blows per foot (30/32/31)	80						
105									

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LOG OF BORING

Project:	Bayou Dupont Plaquemines Parish, Louisiana Louisiana Department of Natural Resources (2503-05-44)	Boring: File:	B-4B 07-110
For:	Sigma Consulting Group Baton Rouge, Louisiana	Date: Technician:	24-May-07 CAL

Depth Feet | SAMPLES

■ Undisturbed Sample
☒ Standard Penetration Test
◫ Classification Sample
(SLS) Slickensided

N 29° 40.120'
W 89° 58.606'

Boring Depth: 40 Feet

Description	(SPT) Recovery %	UU(TSF)	WC(%)	Dry Wt. (PCF)	LL	PI	MV(KSF)
Very stiff tan and gray clay with grass roots and glass (CH)	95	2.22	33	87.5	72	45	--
Stiff tan and gray clay with silt streaks and pockets (CH)	95	1.42	37	84.5	--	--	1.15
Stiff tan and gray clay with ferrous nodules (CH)	90	1.00	37	83.9	--	--	.63
Medium gray silty clay with silt streaks (CL)	90	0.5	43	80.1	40	19	.49
Free water encountered at 8 feet; rose to 5 feet in 10 minutes							
Soft gray clay (CH)	1.00	0.38 @.52	44	80.4	--	--	.46
Soft gray clay (CH)	95	0.47@.65	37	81.4	--	--	.35
Soft gray clay with silt streaks (CH)(SLS)	95	0.32@.75	38	82.0	--	--	.28
Medium gray clay with silt lenses (CH)	100	.60@.86	38	84.6	77	49	.22
Soft gray silty clay (CH)	100	.34@.99	37	80.9	--	--	.06
No sample recovered							
Loose gray very silty clay (CL) 5 blows per foot (1/2/3)	80	--	--	--	--	--	--
Soft gray clay (CH)	100	.25@1.34	39	79.6	--	--	0.33
Soft gray silty clay (CL) with 3" silt layer	50	.27@1.45	46	82.1	35	16	.03
Very loose gray fine sand (SP)	50	1.15@1.56	28	89.6	--	--	--
Firm gray sandy silt (SM) with clay traces	40	1.24@1.68	28	93.3	--	--	0.05
Firm gray sandy silt (SM) with ½" clay layer	100	.55@1.80	27	94.4	--	--	--
Firm gray fine sand (SP)	100	.64@1.92	31	85.8	--	--	--
Firm gray fine sand (SP) with ½" clay layer	65	.50@2.03	27	86.0	--	--	--
Firm gray fine sand with silt traces (SP) 22 blows per foot (5/8/14)	75	--	--	--	--	--	--
Firm gray fine sand with silt traces (SP) 10 blows per foot (6/7/3)	75	--	--	--	--	--	--

Clay encountered at 40 feet

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LOG OF BORING

Project:	Bayou Dupont Plaquemines Parish, Louisiana Louisiana Department of Natural Resources (2503-05-44)	Boring: File:	B-5B 07-110
For:	Sigma Consulting Group Baton Rouge, Louisiana	Date: Technician:	24-May-07 CAL

Undisturbed Sample
Standard Penetration Test
Classification Sample
(SLS) Slickensided

N 29° 42.019'
W 89° 59.218'
Free water encountered at 4 feet; rose to 3 feet in 10 minutes
Boring Depth: 40 Feet

Depth Feet	Description	(SPT) Recovery %	UU(TSF)	WC(%)	Dry Wt. (PCF)	LL	PI	MV(KSF)
0	Stiff brown, tan, and gray slightly silty clay with roots, shells, and sand pockets(CL)	95	1.13	23	99.1	--	--	2.1
	Stiff brown, tan, and gray slightly silty clay (CL)	90	1.06	26	96.1	47	26	.82
5	Medium tan and gray clay (CH) with silt streaks and pockets	90	.54@.32	32	91.5	--	--	.44
	Soft gray slightly silty clay (CL)	50	.35@.40	37	86.9	48	26	--
10	Soft tan and gray silty clay with shells(CL) 2 blows per foot (2/1/1)	100	--	31	--	41	22	--
	Soft gray silty clay (CL)	90	.42@.65	35	92.3	--	--	.23
	Soft gray clay with sand streaks and pockets (CH)	90	.32@.75	46	77.8	--		.16
15	Soft gray clay with organic matter traces (CH)	90	.45@.86	41	77.4	52	29	.25
	Soft gray very silty clay (CL)	100	.28 @ .99	38	81.6	--	--	.15
20	Soft gray very silty clay with 3" sandy silt layer (CL)	90	.48@1.09	35	83.7	--	--	.08
	Soft gray very silty clay with 2½" clayey silt layer (CL)	90	.26@1.22	38	84.1	34	14	.29
	Loose gray silty sand with clay traces (ML)	90	.69@1.34	33	82.0	--	--	--
25	Loose gray clayey silt with 1" clay layer (CL-ML)	95	.49@1.45	36	79.3	--	--	.09
	Soft gray slightly organic clay with silt pockets (OH)	100	.37@1.56	73	57.8	--	--	1.75
30	Medium gray slightly organic clay with shells (OH)	100	.60@1.68	71	56.1	--	--	.32
	Soft gray clay (CH)	90	.30@1.80	50	66.9	--	--	.25
	Medium gray slightly organic clay (OH)	100	.58@1.92	72	57.9	--	--	.45
35	Soft gray clay (CH) (SLS)	100	.46@2.03	64	61.3	93	69	.17
	Medium gray clay (CH)	100	.50@2.15	58	63.6	--	--	.38
40	Medium gray clay with silt lenses (CH)	100	.57@2.26	54	68.0	--	--	.49

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Appendix D – Design Calculations

I. TIDAL DATUM CALCULATIONS

Given:

1. Control Station Gage: NOAA Station #8761724 at Grand Isle, LA
   Coordinates: 29°15'48"N, 89°57'24"W
   Observation Period (19 year tidal epoch): 1/1/1985 to 12/31/2003

2. Subordinate Station Gage: LDNR Gage BA03C-61 near Lafitte, LA
   Coordinates: 29°37'23"N, 90°01'53"W
   Observation Period: 11/1/2000 to 12/31/2003

Variables:

$MHW_{BA03C\text{-}61}$ = observation period mean high water at subordinate station

$MLW_{BA03C\text{-}61}$ = observation period mean low water at subordinate station

MHW_{GI} = observation period mean high water at control station

MLW_{GI} = observation period mean low water at control station

MHW_C = 19 year mean tide level at control station

MTL_C = 19 year mean tide level at control station

MLW_C = 19 year mean low water at control station

MR_C = 19 year mean tide range at control station

TL_C = mean tide level for observation period at control station

R_C = mean tide range for observation period at control station

TL_S = mean tidal level for observation period at subordinate station

R_S = mean tide range for observation period at subordinate station

MHW_S = 19 year mean high water at subordinate station

MTL_S = 19 year mean tide level at subordinate station

MLW_S = 19 year mean low water at subordinate station

MR_S = 19 year mean tide range at subordinate station

Gage Data Calculations:
(Elevations in NAVD88)

$MHW_{BA03C61} := 1.0163ft$

$MLW_{BA03C61} := 0.6475ft$

$MHW_{GI} := 1.5208ft$

$MLW_{GI} := 0.4628ft$

$MHW_{C} := 1.3716ft$

$MLW_{C} := 0.3184ft$

Tidal Datum Calculations:
(Elevations in NAVD88)

$$TL_{S} := \frac{MHW_{BA03C61} + MLW_{BA03C61}}{2} \qquad TL_{S} = 0.832\ ft$$

$$R_{S} := MHW_{BA03C61} - MLW_{BA03C61} \qquad R_{S} = 0.369\ ft$$

$$TL_{C} := \frac{MHW_{GI} + MLW_{GI}}{2} \qquad TL_{C} = 0.992\ ft$$

$$R_{C} := MHW_{GI} - MLW_{GI} \qquad R_{C} = 1.058\ ft$$

$$MTL_{C} := \frac{MHW_{C} + MLW_{C}}{2} \qquad MTL_{C} = 0.845\ ft$$

$$MR_{C} := MHW_{C} - MLW_{C} \qquad MR_{C} = 1.053\ ft$$

$$MR_{S} := \frac{MR_{C} \cdot R_{S}}{R_{C}} \qquad MR_{S} = 0.367\ ft$$

$$MTL_S := TL_S + MTL_C - TL_C \qquad MTL_S = 0.685\ \text{ft}$$

$$MHW_S := MTL_S + \frac{MR_S}{2} \qquad \boxed{MHW_S = 0.869\ \text{ft}}$$

$$MLW_S := MTL_S - \frac{MR_S}{2} \qquad \boxed{MLW_S = 0.502\ \text{ft}}$$

II. FILL AREA DESIGN

Given:

1. Average Marsh Elevation: +0.88 ft NAVD88 in project vicinity (see Section 2 of the Design Report for additional details.)

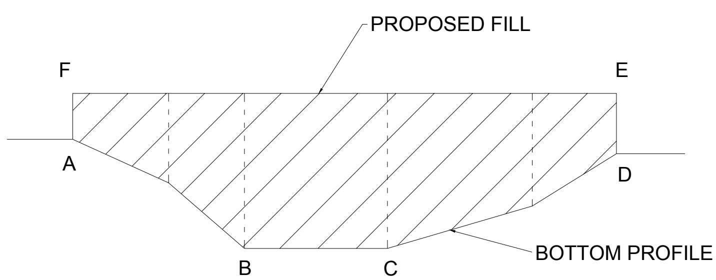
2. Target Fill Elevation: +2.0 ft NAVD88 (see Section 6 of the Design Report for additional details.)

3. Fill Area Survey Data: XYZ coordinates for fill area cross sections

Methodology:

1. Cross Sectional Area Calculations: The XYZ data acquired by taking survey transects throughout the fill areas was used to calculate cross sectional areas.

   Simplified Example:



This cross section is obtained by plotting the XYZ coordinates of the water bottom profile provided by the survey. Line AFED represents the proposed fill height. The cross sectional area can be calculated by incrementally calculating and summing the areas of the subdivisions of the region. The area of the cross section is calculated as if contained by a vertical plane where the containment will be constructed. (See Section III for the integration of the fill volume calculations and the containment dike calculations.) The following equation is used to incrementally calculate the area of the cross section:

$$A_i = \frac{1}{2} [D_i(Z_{i+1}-Z_{i-1})]$$

A_i = incremental area
D_i = cumulative distance from beginning of transect to point i
Z_{i+1} = elevation of previous point

Z_{i-1} = elevation of next point

The cumulative distance is computed by continuously summing the distance between each point, calculated with the distance formula:

$$L_i = [(X_2-X_1)^2 + (Y_2-Y_1)^2 + (Z_2-Z_1)^2]^{½}$$

X = easting
Y = northing
Z = elevation

And

$$D_i = \Sigma L_i$$

The total area of the cross section is then calculated by summing each incremental area. A sample iteration is shown below:

$X_1 := 3697491.3\text{ft}$ $\quad Y_1 := 421886.8\text{ft}$ $\quad Z_1 := -1.02\text{ft}$

$X_2 := 3697475.4\text{ft}$ $\quad Y_2 := 421867.5\text{ft}$ $\quad Z_2 := -0.82\text{ft}$

$X_3 := 3697459.6\text{ft}$ $\quad Y_3 := 421848.1\text{ft}$ $\quad Z_3 := -0.72\text{ft}$

$X_4 := 3697443.7\text{ft}$ $\quad Y_4 := 421828.8\text{ft}$ $\quad Z_4 := -0.52\text{ft}$

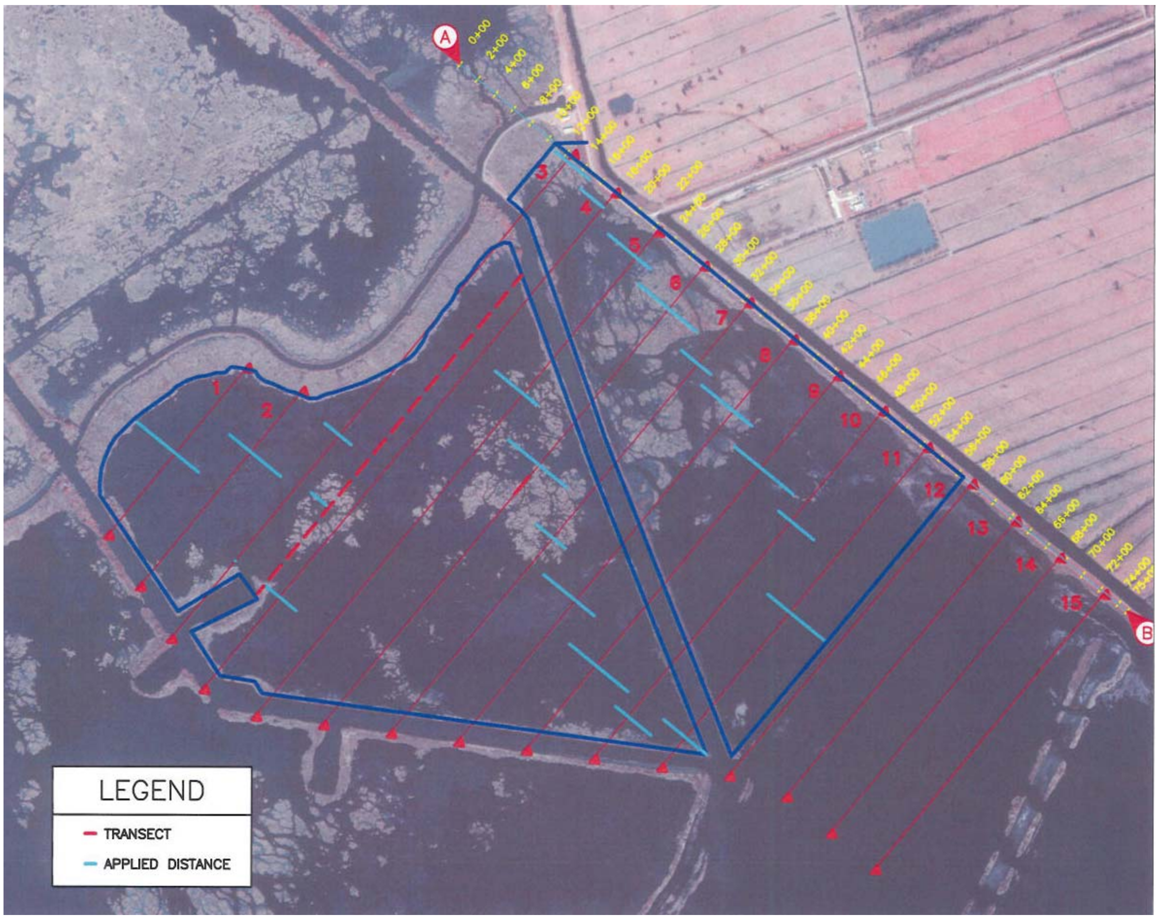
$$L_{1\_2} := \sqrt{(X_2 - X_1)^2 + (Y_2 - Y_1)^2 + (Z_2 - Z_1)^2} \qquad L_{1\_2} = 25.007\ \text{ft}$$

$$L_{2\_3} := \sqrt{(X_3 - X_2)^2 + (Y_3 - Y_2)^2 + (Z_3 - Z_2)^2} \qquad L_{2\_3} = 25.02\ \text{ft}$$

$$D_3 := L_{1\_2} + L_{2\_3} \qquad D_3 = 50.027\ \text{ft}$$

$$A_3 := \frac{1}{2}\left[D_3 \cdot (Z_4 - Z_2)\right] \qquad \boxed{A_3 = 7.504\ \text{ft}^2}$$

2. Distance Between Cross Sections: To calculate the total volume of the fill areas, the distance between each cross section must be measured. These distances were computed from the surveyor's CAD drawing and the 2004 DOQQ imagery. The lateral distances to which each cross section was applied were determined based on the locations where each cross section is the most representative of the environment, as seen below:



3. Volume Calculations: The total volume of each fill area is calculated by multiplying each cross sectional area by its corresponding distance. The incremental volumes are summed to obtain the total volume. The volume formulas are shown below:

$$V_{XS} = (A_{XS})(d)$$

V_{XS} = Cross sectional volume
A_{XS} = Cross sectional area
d = Distance between cross sections

$$V_{TOT} = \Sigma V_{XS}$$

The volume calculations for each fill area are shown on the following pages:

Fill Area Design Volume Calculations:

1. Marsh Fill Area 1:

Cross-Sectional Area (ft^2):	Distance (ft.):
$A_{1.1} := 5159.53ft^2$	$d_{1.1} := 687.25ft$
$A_{1.2} := 6561.83ft^2$	$d_{1.2} := 576.63ft$
$A_{1.3} := 7140.69ft^2$	$d_{1.3} := 296.13ft$
$A_{1.4a} := 10179.56ft^2$	$d_{1.4a} := 203ft$
$A_{1.4b} := 12453.99ft^2$	$d_{1.4b} := 352.63ft$
$A_{1.5} := 10159.46ft^2$	$d_{1.5} := 469.90ft$
$A_{1.6} := 8780.13ft^2$	$d_{1.6} := 654.95ft$
$A_{1.7} := 7297.66ft^2$	$d_{1.7} := 327.16ft$
$A_{1.8} := 6631.61ft^2$	$d_{1.8} := 564.87ft$
$A_{1.9} := 4159.07ft^2$	$d_{1.9} := 656.02ft$
$A_{1.10} := 2334.37ft^2$	$d_{1.10} := 391.40ft$
$A_{1.11} := 468.04ft^2$	$d_{1.11} := 658.20ft$

Calculated Volume (ft^3):

$$V_{1.1} := A_{1.1} \cdot d_{1.1} \qquad V_{1.1} = 131329.1\,yd^3$$

$$V_{1.2} := A_{1.2} \cdot d_{1.2} \qquad V_{1.2} = 140138.8\,yd^3$$

$$V_{1.3} := A_{1.3} \cdot d_{1.3} \qquad V_{1.3} = 78317.5\,yd^3$$

$$V_{1.4a} := A_{1.4a} \cdot d_{1.4a} \qquad V_{1.4a} = 76535.2\,yd^3$$

$$V_{1.4b} := A_{1.4b} \cdot d_{1.4b} \qquad V_{1.4b} = 162653.7\,yd^3$$

$$V_{1.5} := A_{1.5} \cdot d_{1.5} \qquad V_{1.5} = 176812.2\,yd^3$$

$$V_{1.6} := A_{1.6} \cdot d_{1.6} \qquad V_{1.6} = 212983.2\,yd^3$$

$$V_{1.7} := A_{1.7} \cdot d_{1.7} \qquad V_{1.7} = 88426\,yd^3$$

$$V_{1.8} := A_{1.8} \cdot d_{1.8} \qquad V_{1.8} = 138740.6\,yd^3$$

$$V_{1.9} := A_{1.9} \cdot d_{1.9} \qquad V_{1.9} = 101053.1\,yd^3$$

$$V_{1.10} := A_{1.10} \cdot d_{1.10} \qquad V_{1.10} = 33839.7\,yd^3$$

$$V_{1.11} := A_{1.11} \cdot d_{1.11} \qquad V_{1.11} = 11409.8\,yd^3$$

$$V_1 := V_{1.1} + V_{1.2} + V_{1.3} + V_{1.4a} + V_{1.4b} + V_{1.5} + V_{1.6} + V_{1.7} + V_{1.8} + V_{1.9} + V_{1.10} + V_{1.11}$$

Total Volume for Marsh Fill Area 1, $\boxed{V_1 = 1352239.1\ yd^3}$

2. Marsh Fill Area 2

Cross-Sectional Area (ft^2):	Distance (ft.):
$A_{2.3} := 1807.41ft^2$	$d_{2.3} := 386.4ft$
$A_{2.4} := 2281.16ft^2$	$d_{2.4} := 432.63ft$
$A_{2.5} := 2799.26ft^2$	$d_{2.5} := 469.8971ft$
$A_{2.6} := 2964.39ft^2$	$d_{2.6} := 654.9471ft$
$A_{2.7} := 3671.55ft^2$	$d_{2.7} := 327.1647ft$
$A_{2.8} := 5061.13ft^2$	$d_{2.8} := 564.8728ft$
$A_{2.9} := 7544.52ft^2$	$d_{2.9} := 656.0244ft$
$A_{2.10} := 8847.67ft^2$	$d_{2.10} := 391.4046ft$
$A_{2.11} := 10742ft^2$	$d_{2.11} := 658.2ft$

Calculated Volume (ft^3):

$V_{2.3} := A_{2.3} \cdot d_{2.3}$ $V_{2.3} = 25866\,yd^3$

$V_{2.4} := A_{2.4} \cdot d_{2.4}$ $V_{2.4} = 36551.8\,yd^3$

$V_{2.5} := A_{2.5} \cdot d_{2.5}$ $V_{2.5} = 48717.2\,yd^3$

$V_{2.6} := A_{2.6} \cdot d_{2.6}$ $V_{2.6} = 71908.1\,yd^3$

$V_{2.7} := A_{2.7} \cdot d_{2.7}$ $V_{2.7} = 44488.9\,yd^3$

$V_{2.8} := A_{2.8} \cdot d_{2.8}$ $V_{2.8} = 105885\,yd^3$

$V_{2.9} := A_{2.9} \cdot d_{2.9}$ $V_{2.9} = 183310.7\,yd^3$

$V_{2.10} := A_{2.10} \cdot d_{2.10}$ $V_{2.10} = 128260\,yd^3$

$V_{2.11} := A_{2.11} \cdot d_{2.11}$ $V_{2.11} = 261866.1\,yd^3$

$$V_2 := V_{2.3} + V_{2.4} + V_{2.5} + V_{2.6} + V_{2.7} + V_{2.8} + V_{2.9} + V_{2.10} + V_{2.11}$$

Total Volume for Marsh Fill Area 2, $\boxed{V_2 = 906853.8\,yd^3}$

TOTAL BA-39 MARSH FILL VOLUME, $V_{TOT} = V_1 + V_2 = \boxed{2,259,094\ yd^3}$

III. CONTAINMENT DIKE DESIGN

Given:

1. Crown Width: 6 ft.

2. Side Slopes: 1(V):3(H)

3. Freeboard: 1.0 ft. above marsh fill elevation

4. Containment Dike Crown Elevation: +3.0 ft.

5. Total Containment Dike (CD) Length, L_{DIKE} (approximated with CAD):
   i. CD_{1W}=7691 lin. ft.
   ii. CD_{1E}=5079 lin. ft.
   iii. CD_{1N}=4809 lin. ft.
   iv. CD_{2W}=5266 lin. ft.
   v. CD_{2E}=1070 lin. ft.
   vi. CD_{2S}=2906 lin. ft.

6. Survey Data: XYZ coordinates for fill area and existing spoil banks

Methodology:

1. Base Elevation: The survey data was used to determine the base elevation at each containment site. Since the elevation of the terrain is variable along the alignment of each containment dike, each survey transect was evaluated.

2. Dike Height: The height of the containment is computed by subtracting the base elevation from the crown elevation as shown below:

   $H = E_{CROWN}-E_{BASE}$

3. Base Width: The base width is governed by the dike height, the crown width, and the horizontal component of the side slope, S_H (3.0 throughout project area):

   $B = 2(S_H H) + C$

4. Cross-Section Area: The cross-sectional area of each containment dike or enhanced spoil bank differs from site to site and is governed by the base elevation, dike height, and base width at each proposed containment location. Once these variables are determined, the area can be easily calculated by treating the containment section as a trapezoid:

   $A_{DIKE} = ½ [H(C+B)]$

5. Containment Dike Volume: The volume of material required to construct each containment dike is obtained by multiplying the cross sectional area for each section by its corresponding length:

   $V_{DIKE} = A_{DIKE} * L_{DIKE}$

   The average end-area method was used to iteratively calculate the total volume of material required, as in the marsh creation volume calculations. Due to the large number of points representing the containment dike cross sections, a spreadsheet was used for the volume calculations.

1. <u>Containment Dike 1W</u>:

Cross-Sectional Area (ft^2): (by transect)	Length (ft.)
$A_{1W.1} := 64.89 ft^2$	$L_{1W.1} := 542.165 ft$
$A_{1W.2} := 20.89 ft^2$	$L_{1W.2} := 672.455 ft$
$A_{1W.3a} := 53.34 ft^2$	$L_{1W.3a} := 383.4773 ft$
$A_{1W.3b} := 25.32 ft^2$	$L_{1W.3b} := 1305.008 ft$
$A_{1W.4} := 25.31 ft^2$	$L_{1W.4} := 770.5688 ft$
$A_{1W.5} := 22.77 ft^2$	$L_{1W.5} := 514.1705 ft$
$A_{1W.6} := 31 ft^2$	$L_{1W.6} := 587.1587 ft$
$A_{1W.7} := 33.28 ft^2$	$L_{1W.7} := 587.1587 ft$
$A_{1W.8} := 25.33 ft^2$	$L_{1W.8} := 587.1587 ft$
$A_{1W.9} := 29.76 ft^2$	$L_{1W.9} := 587.1587 ft$
$A_{1W.10} := 27.23 ft^2$	$L_{1W.10} := 587.1587 ft$
$A_{1W.11} := 26.81 ft^2$	$L_{1W.11} := 567.2084 ft$

<u>Total Linear Feet:</u>

$$L_{1W} := L_{1W.1} + L_{1W.2} + L_{1W.3a} + L_{1W.3b} + L_{1W.4} + L_{1W.5} + L_{1W.6} \cdots$$
$$+ L_{1W.7} + L_{1W.8} + L_{1W.9} + L_{1W.10} + L_{1W.11}$$

$$\boxed{L_{1W} = 7690.8 ft}$$

Calculated Volume (yd³):

$$V_{1W.1} := A_{1W.1} \cdot L_{1W.1} \qquad V_{1W.1} = 1303\,yd^3$$

$$V_{1W.2} := A_{1W.2} \cdot L_{1W.2} \qquad V_{1W.2} = 520.3\,yd^3$$

$$V_{1W.3a} := A_{1W.3a} \cdot L_{1W.3a} \qquad V_{1W.3a} = 757.6\,yd^3$$

$$V_{1W.3b} := A_{1W.3b} \cdot L_{1W.3b} \qquad V_{1W.3b} = 1223.8\,yd^3$$

$$V_{1W.4} := A_{1W.4} \cdot L_{1W.4} \qquad V_{1W.4} = 722.3\,yd^3$$

$$V_{1W.5} := A_{1W.5} \cdot L_{1W.5} \qquad V_{1W.5} = 433.6\,yd^3$$

$$V_{1W.6} := A_{1W.6} \cdot L_{1W.6} \qquad V_{1W.6} = 674.1\,yd^3$$

$$V_{1W.7} := A_{1W.7} \cdot L_{1W.7} \qquad V_{1W.7} = 723.7\,yd^3$$

$$V_{1W.8} := A_{1W.8} \cdot L_{1W.8} \qquad V_{1W.8} = 550.8\,yd^3$$

$$V_{1W.9} := A_{1W.9} \cdot L_{1W.9} \qquad V_{1W.9} = 647.2\,yd^3$$

$$V_{1W.10} := A_{1W.10} \cdot L_{1W.10} \qquad V_{1W.10} = 592.2\,yd^3$$

$$V_{1W.11} := A_{1W.11} \cdot L_{1W.11} \qquad V_{1W.11} = 563.2\,yd^3$$

Total Volume (yd³):

$$V_{1W} := V_{1W.1} + V_{1W.2} + V_{1W.3a} + V_{1W.3b} + V_{1W.4} + V_{1W.5} + V_{1W.6} \cdots + V_{1W.7} + V_{1W.8} + V_{1W.9} + V_{1W.10} + V_{1W.11}$$

$$\boxed{V_{1W} = 8711.9\,yd^3}$$

2. Containment Dike – 1E

Cross-Sectional Area (ft^2):
(by transect)

Length (ft.)

$A_{1E.3a} := 23.83ft^2$	$L_{1E.3a} := 247.6436ft$
$A_{1E.4} := 27.56ft^2$	$L_{1E.4} := 538.22ft$
$A_{1E.5} := 26.29ft^2$	$L_{1E.5} := 583.0748ft$
$A_{1E.6} := 45.26ft^2$	$L_{1E.6} := 582.669ft$
$A_{1E.7} := 38.09ft^2$	$L_{1E.7} := 575.9481ft$
$A_{1E.8} := 34.06ft^2$	$L_{1E.8} := 571.5545ft$
$A_{1E.9} := 40.92ft^2$	$L_{1E.9} := 571.5545ft$
$A_{1E.10} := 41.3ft^2$	$L_{1E.10} := 571.5545ft$
$A_{1E.11} := 21.2ft^2$	$L_{1E.11} := 837.158ft$

Total Linear Feet:

$$L_{1E} := L_{1E.3a} + L_{1E.4} + L_{1E.5} + L_{1E.6} + L_{1E.7} + L_{1E.8} + L_{1E.9} + L_{1E.10} + L_{1E.11}$$

$$\boxed{L_{1E} = 5079.4\,ft}$$

Calculated Volume (yd^3):

$V_{1E.3a} := A_{1E.3a} \cdot L_{1E.3a}$ $V_{1E.3a} = 218.6\,yd^3$

$V_{1E.4} := A_{1E.4} \cdot L_{1E.4}$ $V_{1E.4} = 549.4\,yd^3$

$V_{1E.5} := A_{1E.5} \cdot L_{1E.5}$ $V_{1E.5} = 567.7\,yd^3$

$V_{1E.6} := A_{1E.6} \cdot L_{1E.6}$ $V_{1E.6} = 976.7\,yd^3$

$V_{1E.7} := A_{1E.7} \cdot L_{1E.7}$ $V_{1E.7} = 812.5\,yd^3$

$V_{1E.8} := A_{1E.8} \cdot L_{1E.8}$ $V_{1E.8} = 721\,yd^3$

$V_{1E.9} := A_{1E.9} \cdot L_{1E.9}$ $V_{1E.9} = 866.2\,yd^3$

$V_{1E.10} := A_{1E.10} \cdot L_{1E.10}$ $V_{1E.10} = 874.3\,yd^3$

$V_{1E.11} := A_{1E.11} \cdot L_{1E.11}$ $V_{1E.11} = 657.3\,yd^3$

Total Volume (yd^3):

$$V_{1E} := V_{1E.3a} + V_{1E.4} + V_{1E.5} + V_{1E.6} + V_{1E.7} + V_{1E.8} + V_{1E.9} + V_{1E.10} + V_{1E.11}$$

$$\boxed{V_{1E} = 6243.8\,yd^3}$$

3. Containment Dike – 1N

Cross-Sectional Area (ft²):
(by transect)

Length (ft.)

$A_{1N.1} := 25.54\,ft^2$ $\quad L_{1N.1} := 808.395\,ft$

$A_{1N.2} := 25.19\,ft^2$ $\quad L_{1N.2} := 730.9817\,ft$

$A_{1N.3} := 25.2125\,ft^2$ $\quad L_{1N.3} := 1934.952\,ft$

$A_{1N.24} := 7.75\,ft^2$ $\quad L_{1N.24} := 1334.728\,ft$

Total Linear Feet:

$$L_{1N} := L_{1N.1} + L_{1N.2} + L_{1N.3} + L_{1N.24}$$

$$\boxed{L_{1N} = 4809.1\,ft}$$

Calculated Volume (yd³):

$V_{1N.1} := A_{1N.1} \cdot L_{1N.1}$ $\qquad V_{1N.1} = 764.7\,yd^3$

$V_{1N.2} := A_{1N.2} \cdot L_{1N.2}$ $\qquad V_{1N.2} = 682\,yd^3$

$V_{1N.3} := A_{1N.3} \cdot L_{1N.3}$ $\qquad V_{1N.3} = 1806.9\,yd^3$

$V_{1N.24} := A_{1N.24} \cdot L_{1N.24}$ $\qquad V_{1N.24} = 383.1\,yd^3$

Total Volume (yd³):

$V_{1N} := V_{1N.1} + V_{1N.2} + V_{1N.3} + V_{1N.24}$

$\boxed{V_{1N} = 3636.6\,yd^3}$

4. Containment Dike – 2W

Cross-Sectional Area (ft^2): (by transect)	Length (ft.)
$A_{2W.3} := 24.02ft^2$	$L_{2W.3} := 496.8289ft$
$A_{2W.4} := 37.05ft^2$	$L_{2W.4} := 551.9444ft$
$A_{2W.5} := 19.58ft^2$	$L_{2W.5} := 584.9948ft$
$A_{2W.6} := 24.62ft^2$	$L_{2W.6} := 582.668ft$
$A_{2W.7} := 21.99ft^2$	$L_{2W.7} := 575.9481ft$
$A_{2W.8} := 34.23ft^2$	$L_{2W.8} := 521.6797ft$
$A_{2W.9} := 19.71ft^2$	$L_{2W.9} := 626.4317ft$
$A_{2W.10} := 18.08ft^2$	$L_{2W.10} := 571.5588ft$
$A_{2W.11} := 15.48ft^2$	$L_{2W.11} := 753.8352ft$

Total Linear Feet:

$$L_{2W} := L_{2W.3} + L_{2W.4} + L_{2W.5} + L_{2W.6} + L_{2W.7} + L_{2W.8} + L_{2W.9} + L_{2W.10} + L_{2W.11}$$

$$\boxed{L_{2W} = 5265.9\,ft}$$

Calculated Volume (yd^3):

$V_{2W.3} := A_{2W.3} \cdot L_{2W.3}$ $\quad$ $V_{2W.3} = 442\,yd^3$

$V_{2W.4} := A_{2W.4} \cdot L_{2W.4}$ $\quad$ $V_{2W.4} = 757.4\,yd^3$

$V_{2W.5} := A_{2W.5} \cdot L_{2W.5}$ $\quad$ $V_{2W.5} = 424.2\,yd^3$

$V_{2W.6} := A_{2W.6} \cdot L_{2W.6}$ $\quad$ $V_{2W.6} = 531.3\,yd^3$

$V_{2W.7} := A_{2W.7} \cdot L_{2W.7}$ $\quad$ $V_{2W.7} = 469.1\,yd^3$

$V_{2W.8} := A_{2W.8} \cdot L_{2W.8}$ $\quad$ $V_{2W.8} = 661.4\,yd^3$

$V_{2W.9} := A_{2W.9} \cdot L_{2W.9}$ $\quad$ $V_{2W.9} = 457.3\,yd^3$

$V_{2W.10} := A_{2W.10} \cdot L_{2W.10}$ $\quad$ $V_{2W.10} = 382.7\,yd^3$

$V_{2W.11} := A_{2W.11} \cdot L_{2W.11}$ $\quad$ $V_{2W.11} = 432.2\,yd^3$

Total Volume (yd^3):

$$V_{2W} := V_{2W.3} + V_{2W.4} + V_{2W.5} + V_{2W.6} + V_{2W.7} + V_{2W.8} + V_{2W.9} + V_{2W.10} + V_{2W.11}$$

$$\boxed{V_{2W} = 4557.6\,yd^3}$$

5. Containment Dike – 2E

Cross-Sectional Area (ft^2):
(by transect)

Length (ft.)

$A_{2E.3} := 30.28\,ft^2$

$L_{2E.3} := 1070.093\,ft$

Total Linear Feet:

$L_{2E} := L_{2E.3}$

$\boxed{L_{2E} = 1070.1\,ft}$

Calculated Volume (yd^3):

$V_{2E.3} := A_{2E.3} \cdot L_{2E.3}$

$V_{2E.3} = 1200.1\,yd^3$

Total Volume (yd^3):

$V_{2E} := V_{2E.3}$

$\boxed{V_{2E} = 1200.1\,yd^3}$

6. Containment Dike – 2S

Cross-Sectional Area (ft^2):
(by transect)

Length (ft.)

$A_{2S.11a} := 94.39ft^2$ $L_{2S.11a} := 588ft$

$A_{2S.11b} := 107.47ft^2$ $L_{2S.11b} := 450ft$

$A_{2S.11c} := 105.43ft^2$ $L_{2S.11c} := 443ft$

$A_{2S.11d} := 108.96ft^2$ $L_{2S.11d} := 1022ft$

$A_{2S.11e} := 115.37ft^2$ $L_{2S.11e} := 403ft$

Total Linear Feet:

$L_{2S} := L_{2S.11a} + L_{2S.11b} + L_{2S.11c} + L_{2S.11d} + L_{2S.11e}$

$\boxed{L_{2S} = 2906\,ft}$

Calculated Volume (yd^3):

$V_{2S.11a} := A_{2S.11a} \cdot L_{2S.11a}$ $V_{2S.11a} = 2055.6\,yd^3$

$V_{2S.11b} := A_{2S.11b} \cdot L_{2S.11b}$ $V_{2S.11b} = 1791.2\,yd^3$

$V_{2S.11c} := A_{2S.11c} \cdot L_{2S.11c}$ $V_{2S.11c} = 1729.8\,yd^3$

$V_{2S.11d} := A_{2S.11d} \cdot L_{2S.11d}$ $V_{2S.11d} = 4124.3\,yd^3$

$V_{2S.11e} := A_{2S.11e} \cdot L_{2S.11e}$ $V_{2S.11e} = 1722\,yd^3$

Total Volume (yd^3):

$$V_{2S} := V_{2S.11a} + V_{2S.11b} + V_{2S.11c} + V_{2S.11d} + V_{2S.11e}$$

$$\boxed{V_{2S} = 11422.9\,yd^3}$$

Total Containment Dike Calculations:

Total Length of Containment (ft.):

$$L_{CD} = L_{1W} + L_{1E} + L_{1N} + L_{2W} + L_{2E} + L_{2S}$$

$$\boxed{L_{CD} = 26821ft}$$

Total Volume of Containment Dikes (yd^3):

$$V_{CD} = V_{1W} + V_{1E} + V_{1N} + V_{2W} + V_{2E} + V_{2S}$$

$$\boxed{V_{CD} = 35773yd^3}$$

Total Borrow Volume for Containment:
(cut:fill ratio of 2.5:1 for mechanical dredging)

$$V_{CD} := 35773\,yd^3$$

$$CF_{MD} := 2.5$$

$$V_{CD\_Borrow} := V_{CD} \cdot CF_{MD}$$

$$\boxed{V_{CD\_Borrow} = 89432.5\,yd^3}$$

Cost per Linear Foot:

$$Rate_{Vol} := \frac{V_{CD\_Borrow}}{L_{CD}}$$

$$\boxed{Rate_{Vol} = 3.3\,\frac{yd^3}{ft}}$$

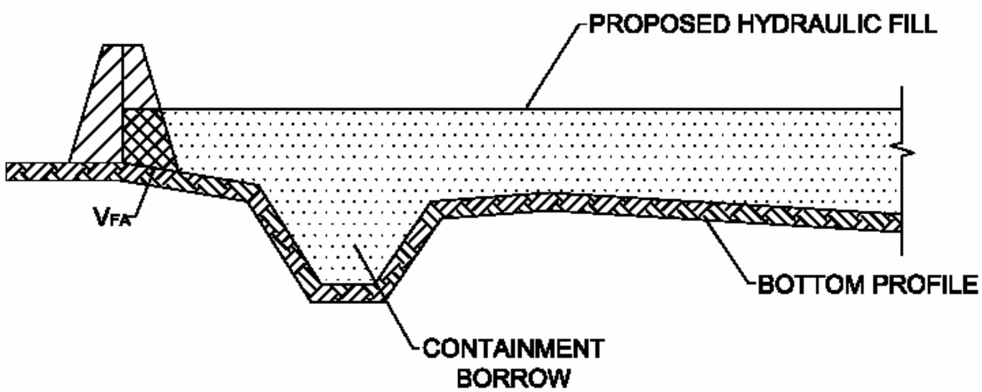
Multiplying the yd^3/ft by an estimated unit rate of \$3.75/yd^3 yields a unit cost of \$12.38 per linear foot for containment dikes.

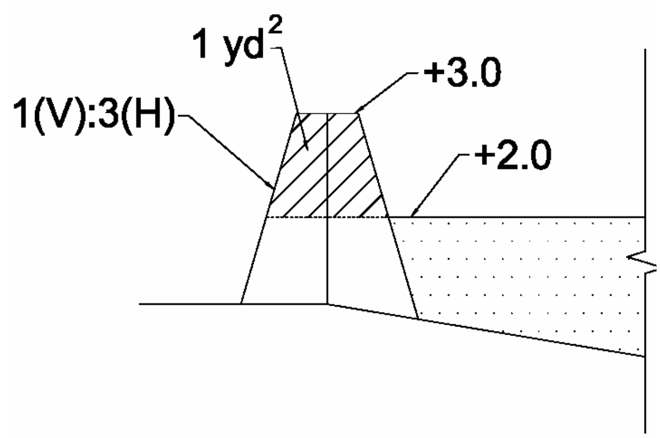
Integrating Containment Dike and Marsh Fill Calculations:

The amount of borrow required for the containment dikes (multiplied by a cut:fill ratio of 1:2.5) is added to the hydraulic fill volume estimate to account for refilling the borrow pit resulting from the construction of the containment dikes. The volume of containment dike that will intrude into the fill area is then subtracted from the total volume of hydraulic fill:

$V_{FA} = ½ [V_{DIKE} – (L_{DIKE} * A_{D+Fill})]$

V_{DIKE} = Total volume of dike
L_{DIKE} = Total length of dike
A_{D+Fill} = Total dike cross sectional area above fill elevation





Total V_{FA} to be subtracted from the total hydraulic fill volume estimate:

$$V_{DIKE} := 35773\,yd^3$$

$$L_{DIKE} := 8940.33\,yd \qquad (=26821\text{ ft.})$$

$$A_{Dfill} := 1\,yd^2$$

$$V_{FA} := \frac{1}{2}\left[V_{DIKE} - \left(L_{DIKE} \cdot A_{Dfill}\right)\right]$$

$$\boxed{V_{FA} = 13416.3\,yd^3}$$

Total amount of borrow required for containment dikes, to be added to hydraulic fill estimate, V_{CD_Borrow}:
(cut:fill ratio of 2.5:1 for mechanical dredging),

$$V_{CD} := 35773\,yd^3$$

$$CF_{MD} := 2.5$$

$$V_{CD\_Borrow} := V_{CD} \cdot CF_{MD}$$

$$\boxed{V_{CD\_Borrow} = 89432.5\,yd^3}$$

Adjustment Factor for Containment Dikes, V_A:
(cut:fill ratio of 1.5:1 for hydraulic dredging)

$$V_A := \left(V_{CD\_Borrow} - V_{FA}\right) \cdot CF_{HD}$$

$$\boxed{V_A = 114024.2\,yd^3}$$

Total Volume Required for Marsh Creation, V_{TOT}:

$$V_{TOT} := 2259094yd^3$$

Total Volume of Hydraulically Dredged Material Required, V_{HF}:
(cut:fill ratio of 1.5:1 for hydraulic dredging)

$$V_{TOT} := 2259094yd^3$$

$$CF_{HD} := 1.5$$

$$V_{HF} := V_{TOT} \cdot CF_{HD}$$

$$\boxed{V_{HF} = 3388641\,yd^3}$$

Total Adjusted Volume of Hydraulically Dredged Material Required, V_{AHF}:

$$V_{AHF} := V_{HF} + V_A$$

$$\boxed{V_{AHF} = 3502665.2\,yd^3}$$

IV. BORROW AREA DESIGN

Given:

1. Fill Volume for Area 1, VF_{A1} = 1,352,240 yd3 (see Section II)
2. Fill Volume for Area 2, VF_{A2} = 906,854 yd3 (see Section II)
3. Cut:Fill Ratio Recommendation (recommended by EEC in Section 4.5 of Design Report), CF = 1.5
4. Assumed Borrow Cut Depth, D_b = -66 NAVD88
5. Borrow Area Survey Data: XYZ coordinates for borrow area cross sections

Methodology:

1. Required Borrow Volume, VI: The borrow volume required to fill the marsh creation areas to the target elevation is calculated by multiplying the volume of the fill areas by the Cut:Fill ratio:

   $$VI = VF * CF$$

2. Borrow Site Delineation: The limits of the borrow areas are governed by the location of the navigation channel, the western levee, and elevation of the mudline, and the elevation of the land west of the levee. Survey data was used to estimate the quantity of material available within these limits. USACE required side slopes of 1(V):5(H) were also applied.

3. Total Available Volume of Sediment: Using the USACE river mining regulations, cross sectional areas of transects throughout the borrow areas were calculated using the XYZ survey coordinates as done in the fill area volume calculations. The volumes are then calculated using the following formulas:

   $$V_{XS} = (A_{XS})(d)$$

   V_{XS} = Cross sectional volume
   A_{XS} = Cross sectional area
   d = Distance between cross sections

   $$V_{TOT} = \Sigma V_{XS}$$

Borrow Area Design Calculations:

CF = 1.5

D_b = -66' NAVD88

VF = 1,352,240 + 906,854 = 2,259,094 yd^3

Required Borrow Volume, VI = VF x CF

2,259,094 x 1.5 = 3,388,641 yd^3

Available Dredgable Volume:

RM	Area ft^2	Distance ft		Volume ft^3	
63.7	14,019.55				
63.9	19,113.23	988.85		16,381,705	
64.1	20,874.30	812.00		16,234,852	
64.3	19,725.95	992.88		20,155,647	
64.4	17,986.20	799.76		15,080,245	
64.8	12,234.39	1,941.57		29,337,659	
65	9,494.67	850.72		9,242,701	
			Sum=	106,432,809	ft^3
				$\boxed{3,941,956}$	yd^3

Appendix E – SHPO letter

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

FEB 0 6 20

Date: 3-1-07
No known archaeological sites or historic properties will be affected by this undertaking. This effect determination could change should new information come to our attention.
Pam Breaux: Pam Breaux
State Historic Preservation Officer

Mr. Duke Rivet
Louisiana Office of Cultural Development
Division of Archeology
P O Box 44247
Baton Rouge, LA 70804-4247

Dear Mr. Rivet:

I am writing to request that you confirm clearance from your office for the project described on the enclosed project fact sheet. We had sent a letter to Dr. Watson (copy furnished) during the early planning phase of this project, and received no indication of issues related to cultural issues.

As Brad Miller, Louisiana Department of Natural Resources, and I discussed with you during a visit to your office last year, the project has been shifted from its original location to the position described on the enclosed fact sheet. The new project site is in the same vicinity, but lies about 4,000 ft. north of the originally proposed project.

Further project details, including plans for dredging sediment from the MS River and conveying this material via pipeline to the marsh restoration site is generally described in the enclosed fact sheet.

Should you require any further information in your review of this revised project, please do not hesitate to call or email me at (214) 665-2151, Ethridge.Beverly@epa.gov . The project description at the Coastal Wetlands Planning Protection and Restoration website still contains the original project description, and is listed under 'projects' as BA-39, Mississippi River Sediment Delivery System.

Thanks for your input on this coastal restoration effort.

Sincerely,

Bev Ethridge

Beverly Ethridge
Life Scientist 6WQ-EM

Appendix F – Wetland Value Assessment

Mississippi River Sediment Delivery System-Bayou Dupont (BA-39)

Coastal Wetlands Planning, Protection and Restoration Act

Proposed by

U.S. Environmental Protection Agency

and

Louisiana Department of Natural Resources

Project Information Sheet for Wetland Value Assessment

Revised October 16, 2007

Wetland Value Assessment Project Information Sheet
Revised October 2007

Note: This is a revised WVA prior to Phase II funding request. It was determined that since the location and size of the project changed, a revised WVA was needed. In addition, the amount of vegetative planting proposed has changed, and new information on water depth in the new project area was available. However, the changes were relatively minor, and are considered to primarily affect V1 and V4.

Project Name: Mississippi River Sediment Delivery System-Bayou Dupont (BA-39)

Sponsoring Agency: U.S. Environmental Protection Agency (EPA)
EnvWG contact - Ken Teague, (214) 665-6687
EngWG contact - Patty Taylor, (214) 665-6403

Project Area: The project area was changed during Phase 1 engineering and design, from the original, approved project area for Phase 1 (EPA 2002). The project area was shifted to the north. The BA-39 project is now located between Bayou Dupont and Cheniere Traverse Bayou, approximately 3.7 miles northwest of Myrtle Grove (Figure 1). The project area encompasses 471 acres, of which approximately 369 acres are open water and 102 acres are brackish marsh. Note that habitat mapping based on 2005 imagery (USGS 2007) demonstrated that the project area (as defined) included 495 ac total, 102 ac of brackish marsh, 9 ac of "developed ag other", 131 ac of brackish marsh water, and 15 ac of "developed ag other water". It was determined that "developed ag other" was probably hurricane protection levee on the project boundary, and that "developed ag other water" was probably the levee borrow canal, and these classifications were removed from the project boundary for the purposes of this WVA.

Problem: The marsh in this area has experienced high loss rates in the past (USGS 2002), and little marsh remains today. Marshes in this section of the Barataria Basin are badly degraded mostly due to anthropogenic modifications that have occurred over the last century. The Mississippi River flood-control levee system has prevented riverine sediment and nutrients from reaching adjacent marsh, thus impairing its ability to keep pace with subsidence (Baumann et al. 1984). In addition, an extensive network of canals dredged for navigation and the oil and gas industry has altered natural hydrology and increased saltwater intrusion resulting in the conversion of large areas of freshwater marsh to open water (Sasser et al. 1986). Because of these impacts, land loss rates in the area are high: 2.59% per year between 1956 and 1993, and 2.94% per year between 1974 and 1990 (U.S. Environmental Protection Agency 2002; Note: These rates were for the original project location. Landloss rates proposed to be used in this revised WVA (taken from the nearby PPL17 Candidate Project, Bayou Dupont Marsh and Ridge Creation (National Marine Fisheries Service 2007) are much lower but still high at1.72 percent/year). The project's proximity to renewable Mississippi River sediment sources provides an excellent opportunity to design a sediment delivery system that will utilize sediment dredged from the river to restore and create wetlands in this area of critical need.

Goals: Restore/create approximately 372 acres, and nourish approximately 99 acres, of emergent marsh in an area that is currently mostly open water.

Project Features:

The following is taken from Lindquist 2007:

Marsh Creation Design

The average elevation of existing marsh in the project area is +0.88 feet NAVD 88 (T. Baker Smith and Son, Inc. 2005). However, this marsh consists of small patches of vegetation surrounded by open water and is not representative of healthy marsh. Consequently, project team members estimated healthy marsh elevation to be approximately +1.3 feet NAVD 88, based on best professional judgment and the local tidal datum. To determine the appropriate construction fill elevation, settlement and self-weight consolidation tests were performed using soil samples collected from the marsh creation and borrow areas, respectively (Eustis Engineering Company, Inc. [EEC] 2006). After evaluating a range of potential elevations, a fill elevation of +2.0 feet NAVD 88 was chosen because it would yield desirable marsh elevations for most of the project life. Filling to this elevation, most of the foundation settlement and self-weight consolidation would occur within two years after construction. The created marsh platforms would settle to +1.3 feet NAVD 88 at year 10, and to +1.2 feet NAVD 88 at the end of the 20-year project life (Figure 2).

Containment Dikes
Eustis Engineering Company, Inc (2006) recommended that containment dikes be built with a crown elevation of +3.0 feet NAVD 88 (allowing one foot of freeboard above the marsh fill), a crown width of 6 feet, and side slopes of 1(V):3(H) to achieve a slope stability factor of 1.64 (Figure 3). The two marsh creation areas are mostly enclosed by pre-existing spoil banks and, therefore, a minimal amount of material will be needed to raise these banks to the recommended elevation. A complete containment dike will be constructed on the southeastern boundary of Area 2. The dikes will be constructed using in-situ material, which will be mechanically-dredged from within the marsh creation areas. Dikes will be degraded to the elevation of the marsh platforms at the end of construction (Whitney Thompson, LDNR, Personal Communication, May 22, 2007).

Borrow Area and Pipeline Corridor

Assuming a cut to fill ratio of 1.5:1, a total of 3,502,665 cubic yards of sediment will be required to fill the marsh creation areas (Thompson 2007). Sufficient dredgeable sediment was found between Mississippi River miles 63.4 and 65.0 on an expanding sand bar (Figure 2). Channel deposits in this area are predominantly fine sand (size range: 0.125-0.25 mm) (EEC 2006). The borrow area was delineated in accordance with U.S. Army Corps of Engineers' Mississippi River dredging restrictions, which are designed to protect bridges, navigation channels, and the adjacent levee system (Thompson 2007). The potential effects such large-scale dredging would have on the river's hydraulics were also considered. Tony Thomas of Mobile Boundary Hydraulics, PLLC evaluated the BA-39 project and concluded that there would be no adverse impacts and modeling of the borrow area would not necessary (Thompson 2007).

Sediment will be hydraulically-dredged from the borrow area and transported to the marsh creation areas via a dredge slurry pipeline. The pipeline will cross the Mississippi River levee in the Plaquemines Parish tract of land surrounding the Naomi Siphon (Figure 2). The pipeline will then pass through steel 36-inch casings that will be installed underneath the New Orleans and Gulf Coast Railroad and Highway 23 (Thompson 2007). At this point, the pipeline will extend south through pastures to West Ravenna Road, where it will be buried underneath a layer of crushed aggregate to accommodate vehicle crossings. The pipeline will then be placed along the southern side of West Ravenna Road to the Plaquemines Parish flood protection levee. After crossing this levee, the pipeline will discharge into the marsh creation areas.

The following section was not taken from Lindquist 2007:

Vegetative Plantings

Appropriate plant species (Spartina patens or Spartina alterniflora) will be planted around the perimeter of the project area shortly after the area is filled. After one year, if natural recruitment is inadequate, we will plant the created marsh platform, to the extent available funds allow. The budget will support planting 72 ac of the marsh platform, including 15 ac of perimeter, based on the CWPPRA Engineering Work Group cost template ($3500/ac). For consistency with CWPPRA assumptions, we use these assumptions in this revised WVA. However, experience has shown that we will get better vegetative cover with these limited funds, than the cost template and WVA assumptions on vegetative success and plantings imply.

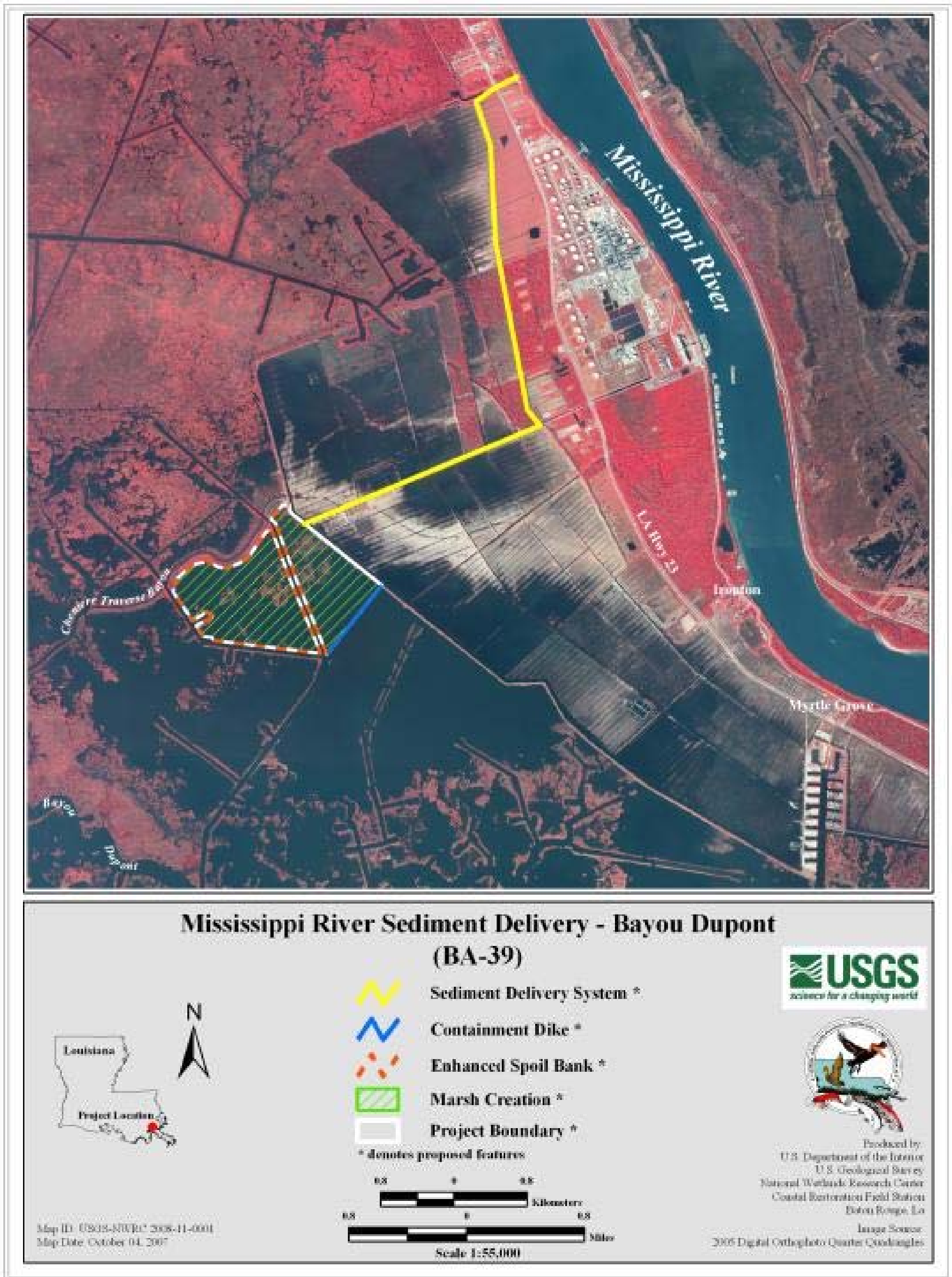


Figure 1. Mississippi River Sediment Delivery System – Bayou Dupont (BA-39) project area and features (from LDNR 2007).

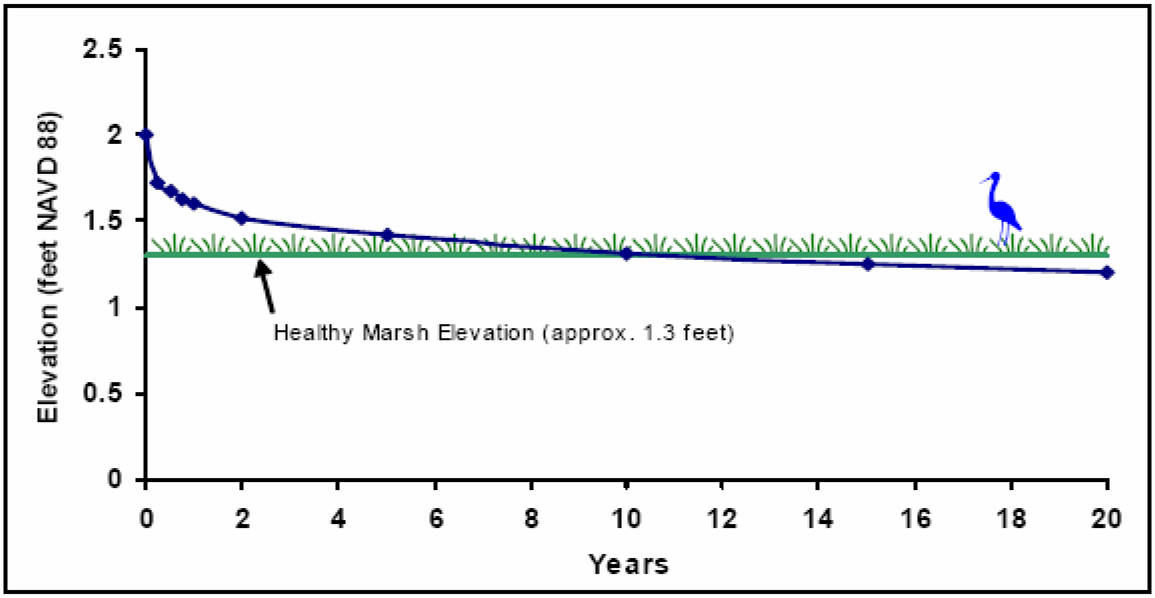


Figure 2. Estimated elevation change of the created marsh platforms over the 20-year project life (from LDNR 2007).

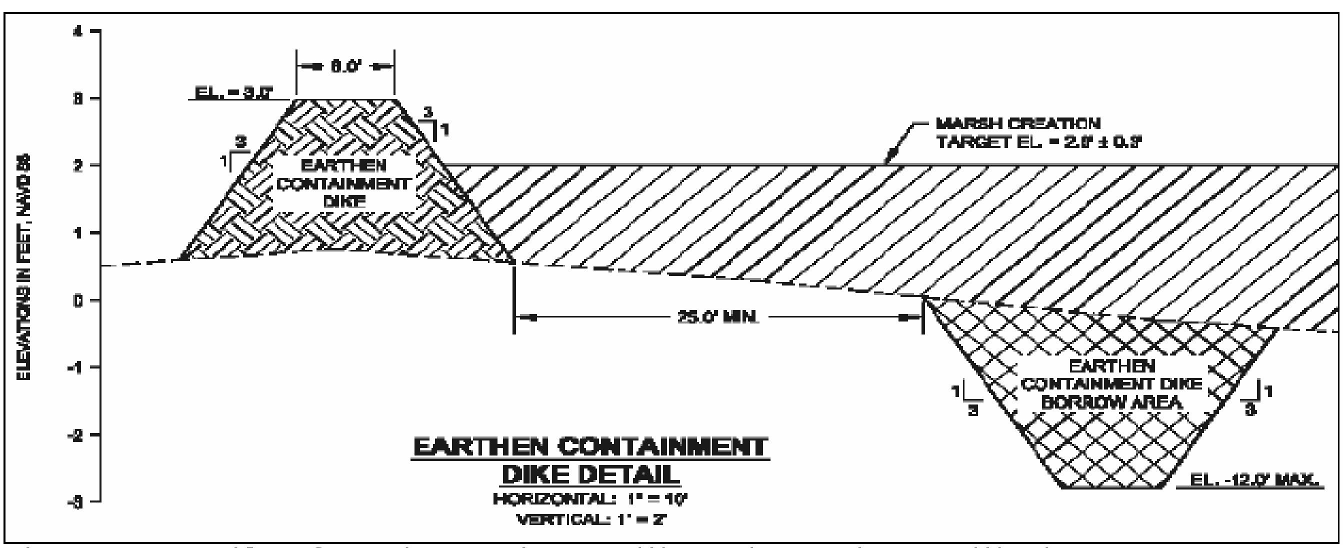


Figure 3. Details of earth containment dike and containment dike borrow area (from LDNR 2007).

The following is taken from Lindquist 2007:

Monitoring Information: Existing project monitoring data utilized include the following:

- The Bayou LaBranche Wetland Creation (PO-17) project, located on the southwestern shore of Lake Pontchartrain, was the first constructed through the CWPPRA program, with construction completed on April 1, 1994. The project was designed to reach a minimum 70% emergent marsh to 30% open-water ratio 5 years after construction. In 1997, the project area was approximately 82% land and 18% water; however, only 51% of the land was emergent marsh with the rest being scrub-shrub and upland habitats (Boshart 2007). The low amount of emergent marsh was attributed to sediment elevations being higher than suitable for emergent vegetation. More recent surveys of the project area have found that elevations have decreased to levels consistent with those of local marsh habitats (i.e., +0.65 to +1.62 feet NAVD 88; Boshart 2007). In addition, soil properties and vegetation communities have continued to develop toward characteristic wetland habitats for the region.

- The Barataria Bay Waterway Wetland Restoration (BA-19) project intended to enlarge Queen Bess Island by creating 9 acres of vegetated wetlands using sediment from maintenance dredging of the waterway. The elevation of the marsh platform was projected to be +1.22 feet NGVD 29 after settlement and consolidation; however, two years after construction the elevation was +0.79 feet NGVD 29 (Curole 2001). Because of the low elevation, the project area is constantly flooded and no appreciable vegetation growth has occurred (Curole 2001).

- The Atchafalaya Sediment Delivery (AT-02) project was designed to utilize sediment dredged from two channels in the Atchafalaya Delta to create islands suitable for the establishment of emergent marsh vegetation (Rapp et al. 2001). However, inaccurate elevation surveys made prior to construction caused the dredged material to be piled too high Raynie and Visser 2002). As a result, the created islands have become dominated by wetland forest vegetation rather than the targeted emergent marsh species that colonized nearby natural crevasse splays. This was attributed to the greater elevation, and therefore lower flooding frequency and duration, of the created islands.

- The goal of the West Belle Pass Headland Restoration (TE-23) project was to reduce the encroachment of Timbalier Bay into the headland by creating 184 acres of marsh using sediment dredged from Bayou Lafourche. Failed containment dikes, though, allowed a large quantity of sediment to be washed out of the marsh creation sites before the material had settled/consolidated. Furthermore, large sections of the project area were filled to levels significantly higher or lower than the targeted +1.7 feet NAVD 88 elevation. As a result, only

31 acres of saline marsh were created by this project, with the remainder being upland, beach/bar/flat, and subaqueous habitats (Curole and Huval 2005).

- The goal of the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project was to create 260 acres of marsh, which would act as a hydrologic barrier between two watersheds in the project area. The marsh platform was designed to have an elevation of +1.5 feet NGVD 29 at construction, and +0.5 feet NGVD 29 (or existing marsh elevation) after settlement/ consolidation. However, portions of the project area were not filled to the correct elevation, and some of the sediment was removed by tidal flow coming through containment dike failures and the dredge pipeline corridor (Raynie and Visser 2002). Consequently, the created marsh has a lower elevation than adjacent natural marsh, leading to more frequent and longer inundation than optimal for healthy marsh. The TE-26 project only created approximately 139.5 acres of new land (Lear and Triche 2007).

- The Sabine Refuge Marsh Creation, Cycle 1 (CS-28-1) project is part of an overall effort to create approximately 1,120 acres of emergent marsh using sediment from maintenance dredging of the Calcasieu Ship Channel. The goal of the first cycle, completed in February 2002, was to create approximately 125 acres. The marsh platforms were designed to have an elevation of +3.08 feet NAVD 88 at construction, and an elevation of +1.08 feet NAVD 88 after five years (Sharp and Juneau 2007). Although post-construction elevation surveys have not been conducted, vegetation surveys found that the marsh platforms were densely covered by emergent vegetation within two years of construction (Sharp and Juneau 2007). Based on aerial photographs, this project appears to have achieved its goal of creating approximately 125 acres of emergent marsh.

Soil Type: The soil type present in the project area is Lafitte muck. The soils of this unit are typical of brackish marshes and have a thick or moderately thick mucky layer and clayey underlying material. Pushdown along the bottom of the marsh creation area ranged from one to three feet.

Note: The remainder of this report is not taken from Lindquist 2007.

V1 - Emergent Vegetation

Historically, project area marshes were classified as fresh marsh (1956; USGS 2002). Hydrologic modifications to the project area (elimination of overbank flooding from the Mississippi River; oil and gas canals) have eliminated most sediment input and increased tidal flushing and salinities. This has resulted in high wetland loss rates and conversion of fresh marsh to brackish marsh over time. At present, project area marshes are classified as brackish. Common plant species observed include: *Spartina alterniflora*, *Spartina patens*, *Setaria geniculata*, *Pluchea camphorata*, and *Vigna luteola*.

The land loss data provided by the Corps for the Phase 0 WVA (EPA 2002) was unable to detect a 1983-1990 land loss rate within the project area, likely because most of the area had already converted to open water, with only minimal emergent acres remaining. The next most recent Corps land loss rate in the Phase 0 land loss analysis was the 1974-1990 rate, which was 2.94% per year. This rate was consistent with the long term 1956-1993 loss rate (2.59% per year) performed using the USGS-provided data (USGS 2002).

For this revised WVA, USGS (2007) provided new habitat data (Fig. 4). Based on 2005 Landsat imagery, USGS (2007) estimates the following:

- 102 ac brackish marsh
- 9 ac developed ag other
- 369 ac brackish water
- 15 ac developed ag other water

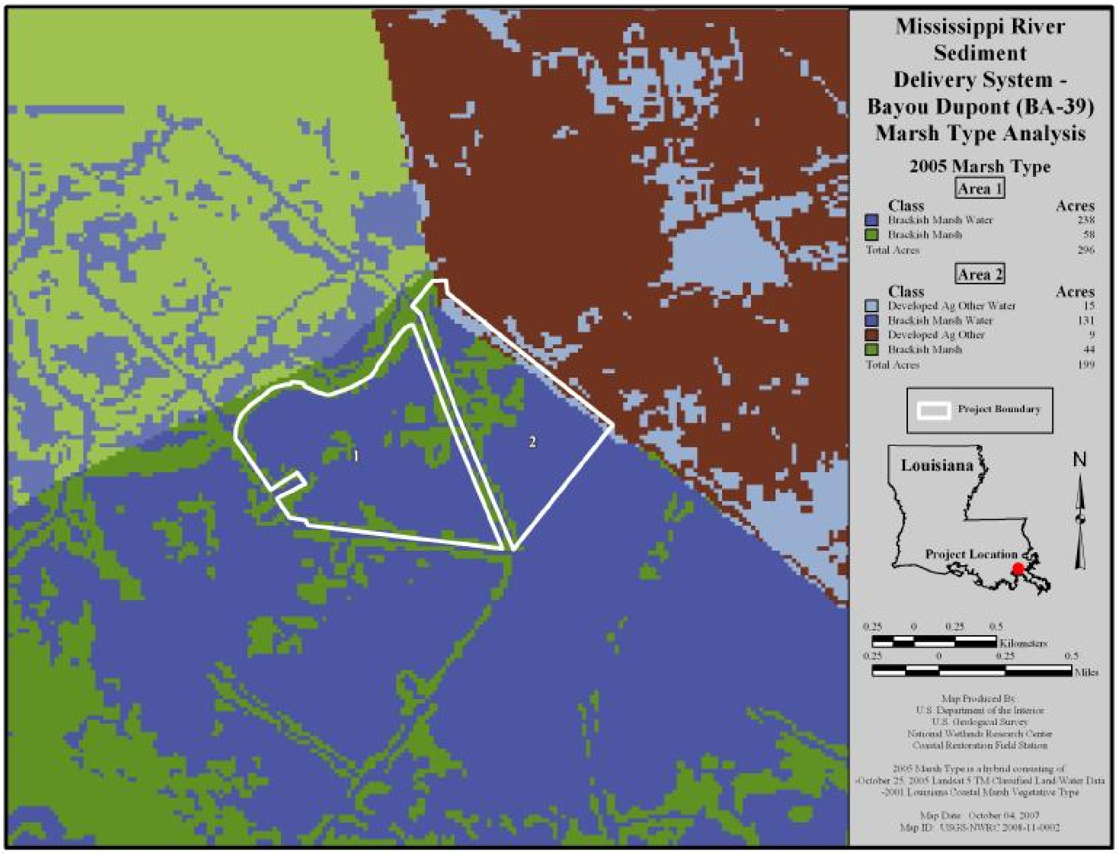


Fig. 4. BA-39 Habitat Analysis (USGS 2007).

After consulting with the EnvWG Chair, it was determined that the 9 ac of "developed ag other" is actually spoil bank/back levee and should be removed from the project area. Similarly, the 15 ac of "developed ag other water" is almost certainly the borrow canal for the back levee, and should be removed from the project area. So, for the purposes of this wva, assume:

- 102 ac brackish marsh
- 369 ac brackish marsh water

Landloss Rates: In consultation with the EnvWork Group Chair, the decision was made to use the landloss rate used for the nearby PPL17 Candidate Project, Bayou Dupont Marsh and Ridge Creation (NMFS 2007), which was based on USGS's habitat analysis of the expanded boundary, 1988-2006. The loss rate was 1.72%/year.

Also, note that the above acreages are based on 2005 imagery, so estimates must be made regarding what they might be at TY0 (assumed to be 2007). Using the land loss spreadsheet, we estimate the following acreages for TY0:

- 99 ac brackish marsh
- 372 ac brackish marsh water

FWOP (from Spreadsheet)

TY0: 21% (99 acres)
TY1: 21% (97 acres)
TY20: 15% (70 acres)

FWP (from Spreadsheet)

TY1: 21% (97 acres)
Build 372 acres of subaerial land - 1 year of loss at 0.86% (369 ac; from Spreadsheet) x (10%+ (20% x 15%=3%)=13%) considered providing vegetative wetland functioning at TY1 = 48 acres;
Nourish 99 acres of existing brackish marsh-1 year of loss at 0.86% (98 ac; from Spreadsheet) x 50% considered providing vegetative wetland functioning at TY1=49 ac.
48 + 49= 97 ac.
* Note: 10% above is the credit given when no planting is done. 20% above is the percentage of the created marsh that could be planted with the project planting budget. 15% is the difference between the 10% credit given without planting and the 25% credit given when planting.

TY3: 54% (255 acres)
372 acres of land built - 3 years of loss at 0.86% per year (362 ac; from Spreadsheet) x (30%+ (20% x 70%=14%)=44%) considered providing vegetative wetland functioning = 159 acres;
Nourish 99 ac of existing brackish marsh – 3 years of loss at 0.86% (96 ac; from Spreadsheet) x 100% considered providing vegetative wetland functioning at TY3=96 ac.
159 + 96=255 ac.
* Note: Similar to above, 30% is the credit given when no planting is done. 20% above is the percentage of the created marsh that could be planted with the project planting budget. 70% is the difference between the 30% credit given without planting and the 100% credit given when planting.

TY5: 96% (451 acres)
372 acres of created vegetated wetlands + nourish 99 ac of existing brackish marsh - 5 years of loss at 0.86% per year (100% considered providing vegetative wetland functioning for both created and nourished marsh) = 451 acres (from Spreadsheet).

TY20: 84% (396 acres)
372 acres of created vegetated wetlands + nourish 99 ac of existing brackish marsh- 20 years of loss at 0.86% per year (100% considered providing vegetative wetland functioning for both created and nourished marsh) = 396 acres (from Spreadsheet).

V2 - Submerged Aquatic Vegetation

EPA and the Environmental Work Group Chairman agreed that it would probably not be necessary to revise V2 since there is no reason to expect the current project area is much different in this respect than the original project area. Therefore, the following is the same as in EPA (2002).

The following is from EPA (2002):

On previous fieldtrips to the project vicinity in 1995, 1996 and 2001, little submerged aquatic vegetation was observed (20-30% coverage). It appears there may be a correlation between weather conditions and/or operation of the Naomi siphon project and growth of SAV in the project area, probably related to the input of fresher water and nutrients. According to project area landowners, in drier years when the siphons are not operating, minimal coverage is noted, versus closer to 70% coverage with Eurasian Water-milfoil and Widgeon grass under current conditions. For FWOP, in the approved Phase 0 WVA, the Environmental Work Group agreed to split the difference and assume higher coverage during fairer weather conditions and siphon operation, and minimal coverage during more extreme periods. The EWG also previously agreed with assuming no change over time FWOP and FWP.

FWOP

TY0: 50%
TY1: 50%
TY20: 50%

FWP

TY0: 50%
TY1: 50%
TY3: 50%
TY5: 50%
TY20: 50%

V3 - Interspersion

The following is mostly the same as in EPA (2002). Differences in land/water between this analysis and that in EPA (2002) don't seem sufficient to justify changes in the agreed interspersion scoring. However, in discussions with the EnvWG Chair, it was noted that the score for FWOP, TY20 should probably be changed. In the original WVA, the EnvWG approved a score of 100% Class 5. Since 15% of the project area is marsh at TY20 FWOP, this did not seem appropriate, and it was decided that a score of 100% Class 4 was most appropriate.

FWOP

TY0: 100% Class 4
TY1: 100% Class 4
TY20: 100% Class 4

FWP

TY0: 100% Class 4
TY1: 100% Class 1
TY3: 100% Class 1
TY5: 100% Class 1
TY20: 60% Class 1
40% Class 2

84% of the project area remains emergent marsh at TY20.

V4 - Shallow Open Water Habitat

LDNR has determined from contractor survey data (2005) of the marsh creation area that 49% of the TOTAL area consisted of average depths greater than -1.5' deep (personal communication, Whitney Thompson, LDNR). The depths she calculated were relative to the mean water level in the marsh creation area. Water level data was evaluated from gage BA03C-CR-61. Considering that the mean water level near the marsh creation area is approximately +0.7' NAVD88, the 49% deep water refers to depths greater than -0.8' NAVD88.

49% of 471 ac=231 ac deep open water. 471 ac – 231 ac= 240 ac of marsh + shallow open water. USGS (2007) analysis of 2005 imagery, indicates 102 ac of marsh. Our TY0 estimate is 99 ac of marsh. 240 ac- 99 ac=141 ac of shallow open water habitat at TY0. 141 ac/372 ac (231 ac deep water + 141 ac shallow water) =38% shallow water habitat at TY0.

Assume that over time shallow water converts to deep water and lost marsh converts to shallow water, at about the same rate in terms of vertical elevation loss. For FWOP, since the acreages and percentages (of the total project area) of shallow water and marsh are not extremely different (141 ac vs 99 ac; 38% vs 21% at TY0), we propose that we assume that conversion of marsh to shallow water will equal conversion of shallow water to deep water. However, even though the acres of shallow water therefore remains the same, since the total acres of water is increasing due to marsh loss, the percentage of shallow open water will decline slightly over time. We assumed the acres of shallow water remained constant and that the acres of water increased by 1.72%/yr (from spreadsheet), and estimated the percent of water that was shallow.

FWP however, this is not the case- there is much more marsh than open water (nearly all marsh at TY1), so the percent of shallow water habitat remains 100% throughout the project life. While we don't have a subsidence rate for this area, we know the subsidence rate for the area around West Pointe a la Hache has been estimated at 0.8 cm/yr. Assuming this subsidence rate is applicable here as well, 0.8 cm/yr x 20 yr=0.4 ft. So, even after 20 years FWP, any marsh that is lost will convert to shallow water, and will remain shallow water during the 20 year project life. In addition, the settlement curve developed for the project (Fig. 2) suggests that all water in the project area throughout the project life will be shallow. However, in discussions with the EnvWG Chair, it was pointed out that generally we assume no more than 80% shallow water habitat at TY20, since we assume that deeper water does develop, whether due to subsidence or hydraulics. Therefore, we propose 80% shallow water habitat at TY20, FWP.

FWOP

TY0: 38% ≤ 1.5' deep (141 ac/372 ac total water, from spreadsheet 2)
TY1: 38% (141 ac/374 ac total water, from spreadsheet 2)
TY20: 35% (141 ac/401 ac total water, from spreadsheet 2)

FWP

TY1: 100% (4 ac water from marsh loss; from spreadsheet)
TY3: 100% (12 ac water from marsh loss; from spreadsheet)
TY5: 100% (20 ac water from marsh loss; from spreadsheet)
TY20: 80% (75 ac water from marsh loss; from spreadsheet)

V5 - Salinity

In the original WVA, the Environmental Work Group had accepted the proposed average annual salinity of 5 ppt as a baseline for the project, based on the recommendation of Erick Swenson. The Environmental Work Group also agreed there would be no change FWOP or FWP.

For this revision, the Environmental Work Group Chair suggested that we use the same salinity data that was used by NMFS in their WVA for the PPL17 candidate project, *Bayou Dupont Marsh and Ridge Creation*. Erick Swenson determined the overall mean salinity = 4.57 ppt, based on the DNR Station BA03C-61, which is the three hour means 1999-2007.

FWOP

TY0: 4.57 ppt
TY1: 4.57 ppt
TY20: 4.57 ppt

FWP

TY1: 4.57 ppt
TY3: 4.57 ppt
TY5: 4.57 ppt
TY20: 4.57 ppt

V6 - Fish Access

FWOP

Material and organism linkages to the project area currently exist as most of the area is open water with some fragmented marsh. This condition is not expected to change FWOP.

TY0: 1.0
TY1: 1.0
TY20: 1.0

FWP

Containment dikes will be created, using existing spoil banks where possible. However, containment dikes will be degraded to marsh elevation at the end of construction.

TY0: 1.0
TY1: 1.0
TY3: 1.0
TY5: 1.0
TY20: 1.0

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Appendix G – Draft OMRR&R Plan

OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION PLAN

MISSISSIPPI RIVER SEDIMENT DELIVERY SYSTEM – Bayou Dupont

(BA-39)

The Louisiana Department of Natural Resources (LDNR) and the United States Environmental Protection Agency (EPA) agree to carry out the terms of this Operation, Maintenance, Repair, Replacement, and Rehabilitation Plan (hereinafter referred to as the "Plan") of the accepted, completed project features in accordance with the Cost Sharing Agreement No. X7-97660401, dated March 8, 2004, with amendments effective March 29, 2006 (Attachment I).

The project features covered by this plan are inclusive of and are identified as the Mississippi River Sediment Delivery System at Bayou Dupont (BA-39). The intention of the provisions of this Plan is to maintain this project in a condition that will generally provide the anticipated benefits that the project was based on. There are no requirements that this project function to any standard beyond the economic life, except that it is not left as a hazard to navigation or a detriment to the environment.

Construction of the Mississippi River Sediment Delivery System at Bayou Dupont (BA-39) by Section 303(a) of Title III Public Law 101-646, the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) enacted on November 29, 1990 as amended. The Mississippi River Sediment Delivery System at Bayou Dupont (BA-39) was approved on the 12th Priority Project List.

1. PROJECT DESCRIPTION, PURPOSE, AND LOCATION

The Mississippi River Sediment Delivery System at Bayou Dupont (BA-39) consists of restoring approximately 493 acres of emergent marsh in an area that is currently mostly open water. This project area lies within a rapidly eroding and subsiding section of the Barataria Landbridge. Now converted to mostly open water, the poor condition of this marsh is likely due to a combination of subsidence, dredging of oil and gas canals, and lack of freshwater input.

The project would involve dredging to mine sediment from the Mississippi River. An appropriate conduit for the dredge discharge pipe to pass through will be jacked and bored under the New Orleans and Gulf Coast Railroad line and LA Highway 230 to deliver the sediments to the project area.

The Project (BA-39) is located in Jefferson and Plaquemines Parishes, near the Conoco-Phillips refinery in Alliance and northwest of the town of Myrtle Grove, LA. The project area is bordered on the east by the Plaquemines Parish flood protection levee and open water, to the north by Cheniere Traverse Bayou, and to the west and south by pipeline canals.

The project has a twenty (20) year economic life, which began in Month 200y. The principal project features include:

- 493 Acres of Marsh Platform
- 26,821 lf of containment

2. CONSTRUCTION COMPLETION

The Mississippi River Sediment Delivery System at Bayou Dupont (BA-39) completion report is included in Attachment III of this Plan. Within this completion report is a summary of information and significant events including: project personnel, final as-built project features and benefit acres, construction cost and CWPPRA project estimates, construction oversight cost, construction activities and change orders, pipeline and utility crossing owner information, and other significant milestone dates and comments.

The project "As-Built" construction drawings updated with all field changes and modifications that occurred during construction are included in Attachment IV.

3. PROJECT PERMITS

Project permit applications were completed and submitted to appropriate agencies, and permits were received prior to construction. These permits and permit amendments are included in Attachment V. Provisions for the renewal of Federal and State permits may be required.

4. ITEMS REQUIRING OPERATION, MAINTENANCE, AND REHABILITATION

The following completed, structural components jointly accepted by LDNR and EPA will require operation, maintenance, repair, and/or rehabilitation throughout the twenty (20) year life of the project.

Settlement Plates

Settlement Plates will be placed during construction at locations where soil borings were taken for monitoring settlement of the base on which the project fill is placed. These plates will be surveyed during installation and during the as-built data collection of the construction phase. After construction these settlement plates will be resurveyed at years 1, 3, and 5 to document the amount and the rate at which the project base settles. The resurveying of the settlement plates will be paid for through the Monitoring Budget. It is estimated that 5 settlement plates will be required.

Vegetative Plantings

After the marsh platform has been accepted, the perimeter of the marsh fill areas will receive vegetative plantings. At year 2 of the O&M phase, the marsh platform will be re-evaluated to determine if more vegetative plantings will be needed. If it is determined that more vegetative plantings are needed, then approximately 30% of the project area will be planted to facilitate further vegetation.

Annual Inspections

Annual Inspections will be performed to monitor the constructed project features.

5. OPERATION AND MAINTENANCE BUDGET

The cost associated with the Operations, Maintenance, and Rehabilitation of the features outlined in Section 4 of this plan for the twenty (20) year project life is included and summarized in Attachment VI.

6. STRUCTURE OPERATIONS

No operation is required for this project. (Attachment VII intentionally blank)

7. RESPONSIBILITIES – MAINTENANCE AND REHABILITATION

A. LDNR will:

1. In accordance with the Cost Sharing Agreement No. ___-______ outlined in Attachment I, assume all responsibilities for maintenance and rehabilitation of the accepted, completed project features identified in Section 4.

2. Conduct joint site inspections with EPA of the project site annually and after major storm events if determined to be necessary by LDNR and/or EPA. LDNR will submit to EPA, a report detailing the condition of the project features and recommendations for any corrective action. If LDNR recommends that corrective actions are needed, the report will include the entire estimated cost for engineering and design, supervision and inspection, construction, contingencies, and the urgency of such action. Annual inspection reports may be compiled under attachment VIII - Annual Inspections.

3. Perform or have performed any corrective actions needed, if such corrective actions have been approved by LDNR and EPA. EPA will participate with LDNR, or its appointed representative, in the

engineering and design phases of the corrective actions for the project. Oversight of engineering and construction of the corrective actions for the project will be the responsibility of LDNR or its appointed representative. At least thirty (30) calendar days prior to the date of formal request for construction bids, LDNR or its appointed representative shall provide EPA with final copies of all project corrective action designs and specifications for review and concurrence by EPA. LDNR or its appointed representative shall approve the final designs and specifications prior to proceeding with bid solicitations on all project corrective action construction contracts in coordination with EPA. Any plan and/or specification change both before and after award of construction contracts shall be approved by LDNR in coordination with EPA.

4. EPA and LDNR representatives shall meet as necessary during the period of construction for corrective actions and shall make such recommendations as they deem necessary.

5. Provide the non-Federal contribution towards operation and maintenance activities as specified in the Cost Sharing Agreement between LDNR and EPA.

B. EPA will:

1. Conduct joint site inspections with LDNR of the project site at least annually and after major storm events if determined to be necessary by LDNR or EPA.

2. Provide guidance for the development of plans and implementation of the project, review final copies of any maintenance and rehabilitation project designs and specifications, and provide review and approval of all planning and construction details prior to formal request for construction bids or any corrective actions for the project.

3. Provide the Federal contribution towards operations and maintenance activities as specified in the Cost Sharing Agreement between LDNR and EPA.

The undersigned parties, acting on behalf of their respective agencies, agree to operate, maintain, and rehabilitate the Mississippi River Sediment Delivery System – Bayou Dupont Project (BA-39) according to this document, referenced Cost Sharing Agreement, plans, and all applicable permits and laws.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

By:____ Date:___________________

Title:_______________________________________

LOUISIANA DEPARTMENT OF NATURAL RESOURCES

By:____ Date:___________________

Title:_______________________________________

Appendix H – Ecological Review

ECOLOGICAL REVIEW
Mississippi River Sediment Delivery System – Bayou Dupont

In August 2000, the Louisiana Department of Natural Resources (LDNR) initiated the Ecological Review to improve the likelihood of restoration project success. This is a process whereby each restoration project's biotic benefits, goals, and strategies are evaluated prior to granting construction authorization. This evaluation utilizes monitoring and engineering information, as well as applicable scientific literature, to assess whether or not, and to what degree, the proposed project features will cause the desired ecological response.

I. Introduction

The objective of the Mississippi River Sediment Delivery System – Bayou Dupont (BA-39) project is to create marsh in a rapidly deteriorating section of the Barataria Basin Landbridge. The Barataria Basin Landbridge, which extends southwest to northeast across the basin between Lake Salvador and Little Lake, hydrologically separates the freshwater-dominated upper basin from the marine-dominated lower basin (Figure 1). The BA-39 project is located between Bayou Dupont and Cheniere Traverse Bayou, approximately 3.7 miles northwest of Myrtle Grove (Figure 2). The project area encompasses 493 acres, of which only 102 acres are remnant brackish marsh.

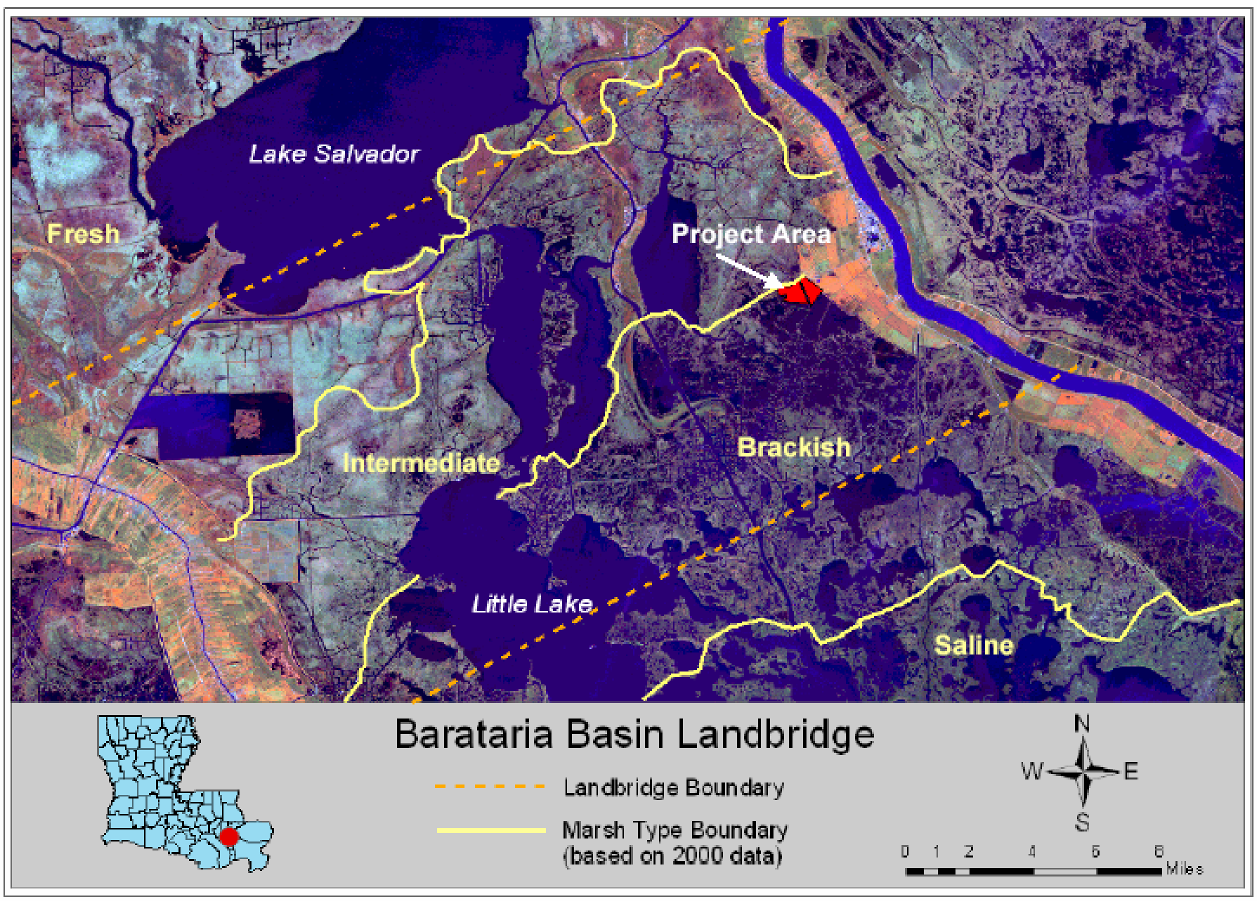

Figure 1. Location of BA-39 project within the Barataria Landbridge.

Marshes in this section of the landbridge are badly degraded mostly due to anthropogenic modifications that have occurred over the last century. The Mississippi River flood-control levee system has prevented riverine sediment and nutrients from reaching adjacent marsh, thus impairing the marsh's ability to keep pace with subsidence (Baumann et al. 1984). In addition, an extensive network of canals dredged for navigation and the oil and gas industry has altered natural hydrology and increased saltwater intrusion resulting in the conversion of large areas of freshwater marsh to open water (Sasser et al. 1986). As open water areas have expanded and fetch has increased, the remaining marsh has been exposed to erosion from wind-generated waves. Because of these impacts, land loss rates in the area are high: 2.59% per year between 1956 and 1993, and 2.94% per year between 1974 and 1990 (Environmental Protection Agency [EPA] 2002). Analyses for more recent time periods have been unable to detect a land loss rate for the area, likely because most of the project area has already converted to open water (EPA 2002). However, analyses for the nearby PPL 17 candidate project, Bayou Dupont Marsh and Ridge Creation, found a land loss rate of 1.72% per year between 1988 and 2006 (National Marine Fisheries Service 2007).

Coast 2050 has identified dedicated dredging of sediment to create marsh as a Region 2 ecosystem strategy that will help stabilize the landbridge and protect freshwater marsh of the upper basin from increased marine/tidal influence (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1999). Because of its proximity to the Mississippi River, the BA-39 project provides an excellent opportunity to design a sediment delivery system that will utilize the river's renewable bedload sediment to create and restore marsh (EPA 2002). The relatively new concept of using river sediment, as opposed to dredging material from adjacent shallow waters, will minimize disturbance to local habitats.

II. Goal Statement

Create 493 acres of marsh, by the end of construction, in an area that is currently open water.

III. Strategy Statement

Marsh creation will be achieved by hydraulically-dredging sediment from the Mississippi River and transporting it via pipeline to fill open water and deteriorated marsh in the project area. The perimeter of the marsh platforms will be planted with native wetland species upon construction completion, and additional plantings may be installed one year after construction depending on the success of colonization (Thompson 2007).

IV. Strategy-Goal Relationship

Sediment dredged from the river will be pumped into two marsh creation areas: Area 1 which encompasses approximately 295 acres, and Area 2 which encompasses approximately 198 acres (Figure 2). As the sediment settles and consolidates, the areas should become established with marsh vegetation resulting in 493 acres of marsh habitat.

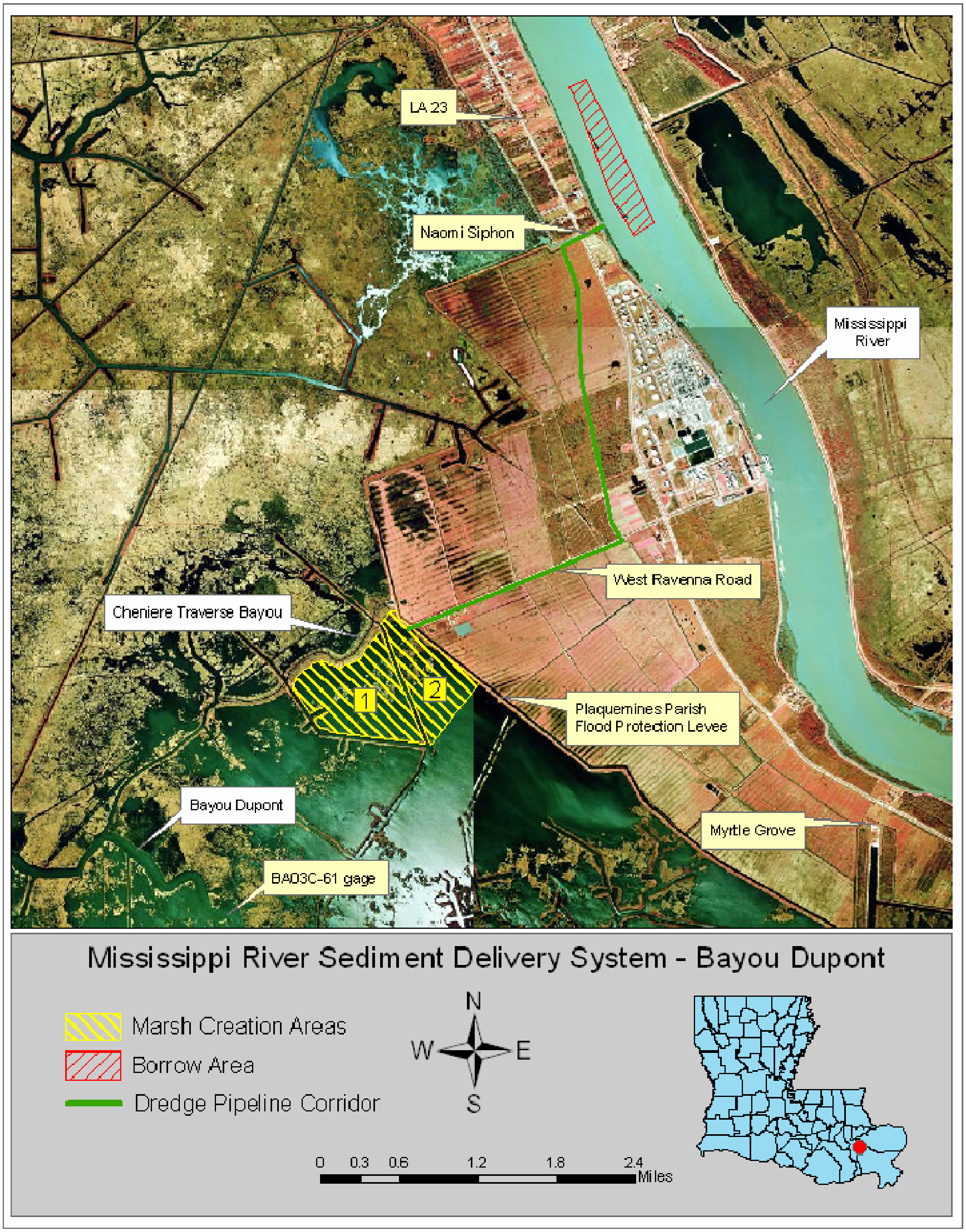

Figure 2. Mississippi River Sediment Delivery System – Bayou Dupont (BA-39) project area and features.

V. Project Feature Evaluation

Marsh Creation Design

The average elevation of existing marsh in the project area is +0.88 feet NAVD 88 (T. Baker Smith and Son, Inc. 2005). However, this marsh consists of small patches of vegetation surrounded by open water and is not representative of healthy marsh. Consequently, project team members estimated healthy marsh elevation to be approximately +1.3 feet NAVD 88, based on best professional judgment and the local tidal datum. In addition, this elevation is nearly equivalent to that of the nearby Bayou Dupont - Dedicated Dredging (LA-01 b) created marsh (elevation: +1.34 feet NAVD 88), which appears to be very healthy (Thompson 2007). To determine the appropriate construction fill elevation, foundation settlement and self-weight consolidation tests were performed using soil samples collected from the marsh creation and borrow areas, respectively (Eustis Engineering Company, Inc. [EEC] 2006; Louis J. Capozzoli and Associates, Inc. [LJC] 2007). After evaluating a range of potential elevations, a fill elevation of +2.0 feet NAVD 88 was chosen because it would yield desirable marsh elevations for most of the project life. Filling to this elevation, most of the foundation settlement and self-weight consolidation would occur within two years after construction. The created marsh platforms would settle to +1.3 feet NAVD 88 at year 10, and to +1.2 feet NAVD 88 at the end of the 20-year project life (Figure 3).

The perimeter of the marsh platforms will be planted with native wetland species upon construction completion. Additional plantings may be installed one-year after construction depending on the success of colonization.

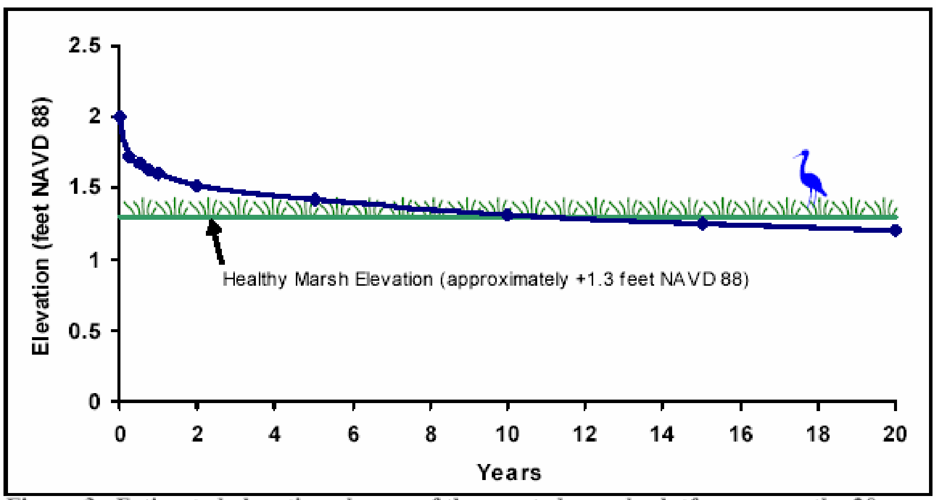

Figure 3. Estimated elevation change of the created marsh platforms over the 20-year project life (Thompson 2007).

Containment Dikes

Eustis Engineering Company, Inc (2006) recommended that containment dikes be built with a crown elevation of +3.0 feet NAVD 88 (allowing one foot of freeboard above the marsh fill), a crown width of 6 feet, and side slopes of 1(V):3(H) producing a slope stability factor of 1.64 (Figure 4). The two marsh creation areas are mostly enclosed by pre-existing spoil banks and, therefore, a minimal amount of material will be needed to raise these banks to the recommended elevation. A complete containment dike, though, will be constructed on the southeastern boundary of Area 2. The dikes will be constructed using material mechanically-dredged from within the marsh creation areas.

Settlement of the containment dikes is estimated to be 1.0 to 1.25 feet over the project life (EEC 2006), which would result in the dikes being about 0.55 to 0.80 feet above the marsh platforms at year 20. Therefore, to achieve a consistent marsh platform elevation, the dikes constructed from existing spoil banks will be degraded to marsh elevation at the end of construction (Thompson 2007). However, the southeast dike of marsh creation Area 2 will remain in place to protect against erosion from wave action generated in the adjacent open water area (Whitney Thompson, LDNR, Personal Communication, October 10, 2007).

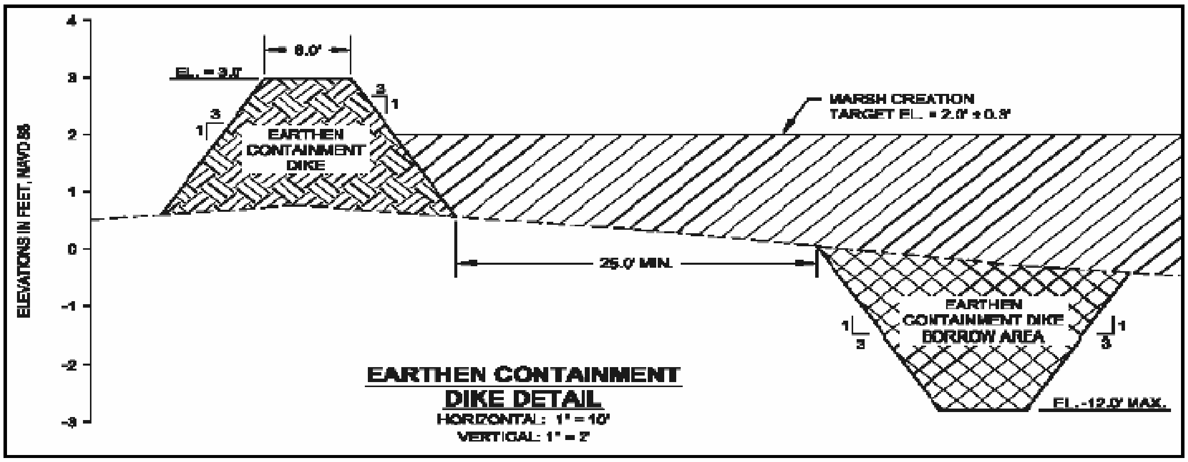

Figure 4. Details of earth containment dike and containment dike borrow area (Thompson 2007).

<u>Borrow Area and Dredge Pipeline Corridor</u>

Assuming a cut to fill ratio of 1.5:1, a total of 3,502,665 cubic yards of sediment will be required to fill the marsh creation areas (Thompson 2007). Sufficient dredgeable sediment was found between Mississippi River miles 63.6 and 65.0 on an expanding sand bar (Figure 2). Channel deposits in this area are predominantly medium and fine sand (median particle size 0.3 mm; LJC 2007). The borrow area was delineated in accordance with U.S. Army Corps of Engineers' Mississippi River dredging restrictions, which are designed to protect bridges, navigation channels, and the adjacent levee system (Thompson 2007). The potential effects such large-scale dredging would have on the river's hydraulics were also considered. Tony Thomas of Mobile Boundary Hydraulics, PLLC evaluated the project's design specifications and concluded that there would be no adverse impacts and modeling of the borrow area would not necessary (Thompson 2007).

Sediment will be hydraulically-dredged from the borrow area and transported to the marsh creation areas via a 30-inch diameter dredge slurry pipeline. The pipeline will cross the Mississippi River levee in Plaquemines Parish's tract of land surrounding the Naomi Siphon (Figure 2). The pipeline will then pass through a 36-inch casing and a 36-inch culvert that will be installed underneath the New Orleans and Gulf Coast Railroad and Highway 23, respectively (Thompson 2007). After these crossings, the pipeline will extend south through pastures to West Ravenna Road, where it will be buried underneath a layer of crushed aggregate to accommodate vehicle crossings. The pipeline will then be placed along the southern side of West Ravenna Road to the Plaquemines Parish flood protection levee. After crossing this levee, the pipeline will discharge into the marsh creation areas.

VI. Assessment of Goal Attainability

When addressing the likelihood that the proposed project features will provide the desired ecological response, it is important to evaluate the lessons learned from scientific research and past projects that are similar in scope to the Mississippi River Sediment Delivery System – Bayou Dupont (BA-39) project. The findings of this review follow.

- The Bayou LaBranche Wetland Creation (PO-17) project, located on the southwestern shore of Lake Pontchartrain, was the first project constructed through the CWPPRA program, with construction completed on April 1, 1994. The project was designed to reach a minimum 70% emergent marsh to 30% open-water ratio 5 years after construction. In 1997, the project area was approximately 82% land and 18% water; however, only 51% of the land was emergent marsh with the rest being scrub-shrub and upland habitats (Boshart 2007). The low amount of emergent marsh was attributed to sediment elevations being higher than suitable for emergent vegetation. The target range of sediment elevation for this project, after five years of consolidation, was estimated at +0.65 to 1.62 feet NAVD (Boshart 2007). As of August 2002, elevation at eleven of the 19 staff gauge stations was within this target range. In addition, soil properties and vegetation communities have continued to develop toward characteristic wetland habitats for the region.

- The Barataria Bay Waterway Wetland Restoration (BA-19) project intended to enlarge Queen Bess Island by creating 9 acres of vegetated wetlands using sediment from maintenance dredging of the waterway. The elevation of the marsh platform was projected to be +1.22 feet NGVD 29 after settlement and consolidation; however, two years after construction the elevation was +0.79 feet NGVD 29 (Curole 2001). This was because it was later realized that the project area was filled to an elevation lower than the design elevation (Smith 2003). As a result, the project area is constantly flooded and no appreciable vegetation growth has occurred.

- The Atchafalaya Sediment Delivery (AT-02) project was designed to utilize sediment dredged from two channels in the Atchafalaya Delta to create islands suitable for the establishment of emergent marsh vegetation (Rapp et al. 2001). However, inaccurate elevation surveys made prior to construction caused the dredged material to be piled too high (Raynie and Visser 2002). As a result, the created islands have become dominated by wetland forest vegetation rather than the targeted emergent marsh species that colonized nearby natural crevasse splays. This was attributed to the greater elevation, and therefore lower flooding frequency and duration, of the created islands.

- The goal of the West Belle Pass Headland Restoration (TE-23) project was to reduce the encroachment of Timbalier Bay into the headland by creating 184 acres of marsh using sediment dredged from Bayou Lafourche. Failed containment dikes, though, allowed a large quantity of sediment to be washed out of the marsh creation sites before the material had settled/consolidated. Furthermore, large sections of the project area were filled to levels significantly higher or lower than the targeted +1.7 feet NAVD 88 elevation. As a result, only 31 acres of saline marsh were created by this project, with the remainder being upland, beach/bar/flat, and subaqueous habitats (Curole and Huval 2005).

- The goal of the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project was to create 260 acres of marsh, which would act as a hydrologic barrier between two watersheds in the project area. The marsh platform was designed to have an elevation of +1.5 feet NGVD 29 at construction, and +0.5 feet NGVD 29 (or existing marsh elevation) after settlement/consolidation. However, portions of the project area were not filled to the correct elevation, and some of the sediment was removed by tidal flow coming through containment dike failures and the dredge pipeline corridor (Raynie and Visser 2002). Consequently, the created marsh has a lower elevation than adjacent natural marsh, leading to more frequent and longer inundation than optimal for healthy marsh. The TE-26 project only created approximately 139.5 acres of new land (Lear and Triche 2007).

- The Sabine Refuge Marsh Creation, Cycle 1 (CS-28-1) project is part of an overall effort to create approximately 1,120 acres of emergent marsh using sediment from maintenance dredging of the Calcasieu Ship Channel. The goal of the first cycle, completed in February 2002, was to create approximately 125 acres. The marsh platforms were designed to have an elevation of +3.08 feet NAVD 88 at construction, and an elevation of +1.08 feet NAVD 88 after five years (Sharp and Juneau 2007). Although post-construction elevation surveys have not been conducted, vegetation surveys found that the marsh platforms were densely covered by emergent vegetation within two years of construction (Sharp and Juneau 2007).

Summary/Conclusions

This review clearly shows that elevation is one of the most important factors dictating the success of marsh creation projects. The elevation of the marsh surface controls its frequency and duration of flooding, which in turn affects vegetation zonation and productivity. For the BA-39 project, the elevation of the marsh platforms would be around +1.2 to +1.3 feet NAVD 88 for much of the project life. At these elevations, the platforms would be inundated approximately 25% of the time, based on five years of water level data from the nearby BA03C-61 gage (29°37'23.30"N, 90°01'53.18"W) (Figure 5). Although this level of inundation is lower than optimal for many species of emergent vegetation, it would be suitable for the locally-dominant *Spartina patens*, which is less tolerant of flooding and more productive in irregularly-inundated habitats (Burdick and Mendelssohn 1987, Broome et al. 1995).

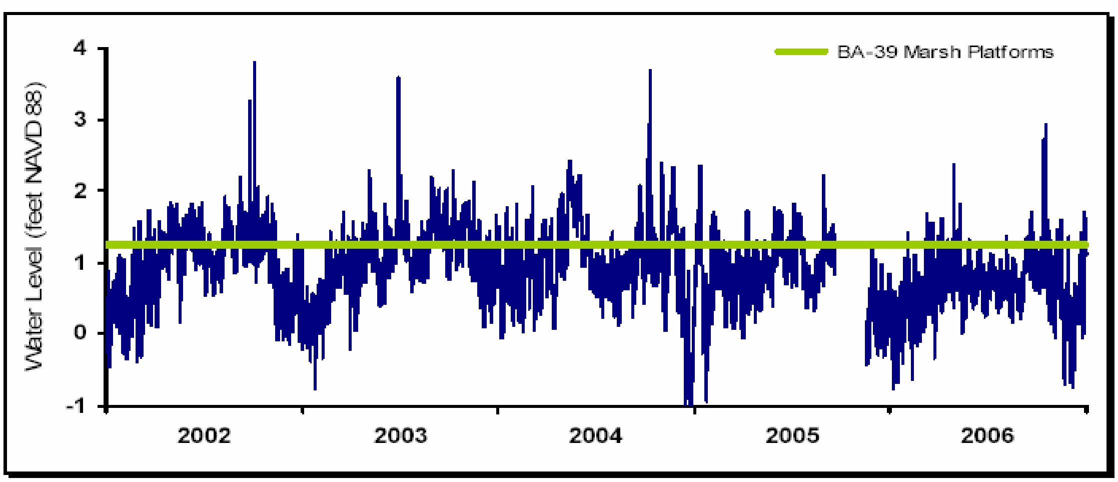

Figure 5. Water level at the BA03C-61 gage for the years 2002 to 2006 (from LDNR data).

It is important to quickly establish vegetation on created marsh platforms to stabilize the sediment and prevent its loss from erosive processes. The rate that marsh vegetation naturally colonizes bare sediment is dependent on substrate characteristics and the availability of recruits (Broome et al. 1988). The borrow material that will be used in the BA-39 project is predominantly medium and fine sand. Such material typically does not have the nutrient concentrations necessary for rapid plant establishment (Broome et al. 1988, Streever 2000). Furthermore, because there is not much marsh near the BA-39 project area, there may be a limited supply of propagules (i.e., seeds or plant fragments) available to colonize the marsh platforms. Under these circumstances, plantings can greatly accelerate vegetative establishment and development (Broome et al. 1988). The BA-39 project proposes to initially plant the perimeter of the created marsh platforms. Once established, these plantings should provide a source of propagules for the remainder of the marsh platform, so that vegetative colonization can occur on a more natural progression. However, if development is inadequate, then further plantings will be warranted.

The long-term sustainability of the created marsh is dependent on maintaining natural hydrologic exchange between the marsh and adjacent water bodies. Levees and canal spoil banks interrupt this exchange resulting in prolonged flooding and drying events, reduced sediment and nutrient inputs, and ultimately marsh degradation and loss (Swenson and Turner 1987, Turner 1987, Kuhn et al. 1999). The BA-39 project area is bounded on two sides by established hydrologic barriers (i.e., the Plaquemines Parish Flood Protection Levee and the Cheniere Traverse Bayou natural ridge, Figure 2); therefore, it is important that hydrologic exchange is unimpeded elsewhere along the perimeter of the created marshes. The project's containment dikes will be degraded to the elevation of the marsh platforms following construction, and they should continue to settle along with the marsh platforms. However, if the dikes do not settle as anticipated and remain above the marsh platforms, then they may act as hydrologic barriers and should be mechanically-gapped.

The BA-39 project represents the first CWPPRA project to propose using Mississippi River bedload sediment to restore marsh. The efficacy of this restoration technique is relatively unknown; therefore, future projects of this kind will greatly benefit from comprehensive documentation and monitoring of the implementation and performance of the BA-39 project.

VII. Recommendations

Based on the evaluation of available ecological, geophysical, and engineering information, and a review of similar restoration projects, the proposed strategies of the Mississippi River Sediment Delivery System – Bayou Dupont project will likely achieve the desired ecological goals. It is recommended that this project progress towards Phase 2 construction authorization pending a favorable 95% Design Review. However, we also recommend that:

- Plans be made to gap the containment dikes if the created marshes become impounded.

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Appendix I – 30% Design Review Comments

30% DESIGN REVIEW COMMENT RESOLUTIONS

Comments Listed by Agency

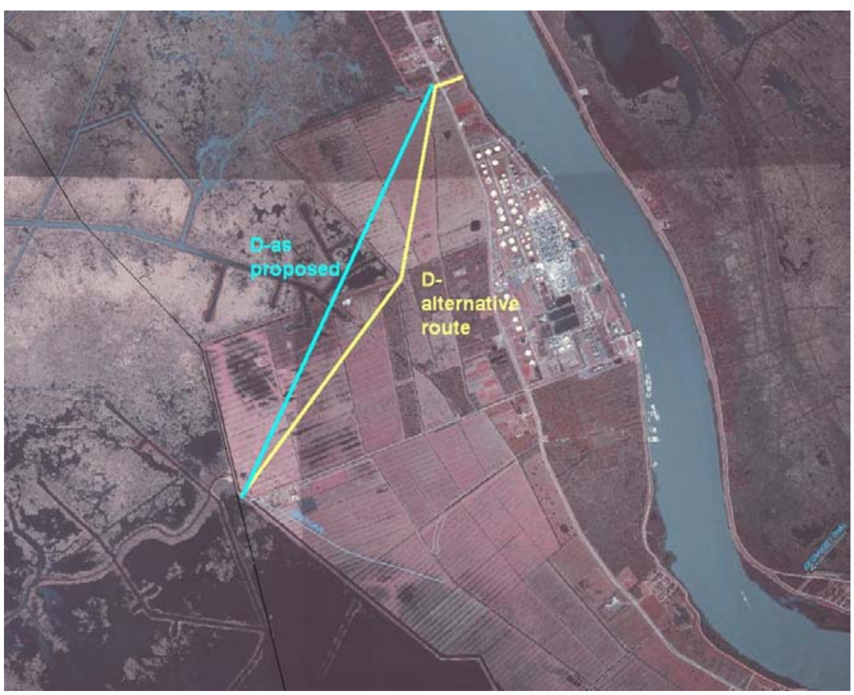
U.S. Army Corps of Engineers (USACE):

Agency/Reviewer/Comment

General Comments

USACE/Lachney/1A. Pipeline right of way: Alterative D was dropped because it went through marsh. Angling it slightly will eliminate the marsh from the pipeline corridor and allow a much shorter route than the preferred alternative. Is there a reason as to why this shorter route would not be preferable? The south side of W. Ravenna Road appears to have a large ditch and a business potentially in the right of way. Will the pipeline interfere with access to the business located on W. Ravenna Road?

- **Response** – The proposed "D-alternative route" is not a practical option for several reasons. The "D-alternative route" has numerous elevation changes, which are inefficient for a hydraulic dredge pipeline corridor, as it crosses several drainage canals. This route also crosses fenced farm land and would impede routine landowner/lessee operations.
- There is no business on the south side of Ravenna Road. There are three gravel driveways connecting the road with existing pasture land. The proposed pipeline crossings are shown in the Plan Set. There is a ditch along the south side of the road and room for the contractor to place the pipeline along the south side of West Ravenna Road.



USACE/Lachney/2A. Plantings: Planting the perimeter of the marsh creation areas is recommended, ensuring the rapid colonization of marsh grasses.

- **Response** – Funding for vegetative plantings has been included in the 30% cost estimate. Planting details are addressed in the 95% design package.

USACE/Lachney/3A. A regulatory site visit will likely be required.

- **Response** – LDNR and EPA appreciate the permitting process recommendations. They will be addressed as we work with the USACE through the permit application process.

Design Comments

USACE/Lachney/1B. General Comment. With a target elevation of +1.3 NAVD88 and a proposed fill height of +2.0 NAVD88, the tolerance allowed to the contractor during construction appears significantly restricted. As stated throughout the report, anticipated fill material consists of fine grain sand, which when pumped to approximated 2' to 3' fill height, will reach the target elevation fairly quickly at the discharge point. As such, continuous moving of the discharge pipeline is anticipated, with envisioned "mounds" of disposal material throughout the marsh creation site. At elevation +2.0 NAVD88, mechanically working of this material would seem to be problematic. Designer should give thought to a higher allowable discharge elevation at the immediate discharge points to better reach long-term goals desired.

- **Response** – As stated in the Plan Set, the vertical tolerance for the marsh fill is ±0.3 feet. The allowable discharge elevation at the immediate discharge points has not been restricted. The immediate elevation of the newly placed marsh fill material is irrelevant as long as the final elevation meets the acceptance requirements of an elevation of +2.0' NAVD88 ±0.3 feet. A relatively precise fill elevation and vertical tolerance is essential for constructing healthy and sustainable marsh. This tolerance has been used on barrier island marsh creation projects.

USACE/Lachney/2B. The methodology for handling effluent waters is not discussed within the design report.

- **Response** – Dewatering methods will be left up to the contractor.

USACE/Lachney/3B. Intercepted Drainage - The proposed alternative for pipeline transport, Dredge Pipeline Corridor F, crosses at least one canal, crosses West Ravenna Road and its roadside ditches, and is near several cattle & dirt road crossings. However, no impacts or analysis is made, if there is any, of intercepted drainage due to construction of the pipeline.

- **Response** – Maintaining sufficient drainage along the pipeline corridor is addressed in the preliminary construction specifications. This will also be evaluated in the contractor's work plan prior to construction.

USACE/Lachney/4B. Borrow Area Evaluation - DNR originally requested to excavate all of the material from the Mississippi River Saltwater Barrier Sill Borrow Area #2 (Mile 64 AHP to Mile 65 AHP) for marsh creation in the Mississippi River Sediment Delivery System-Bayou Dupont (BA-39) Project. Dredging Function evaluated the hydrographic data and surveys immediately after the 1999 Saltwater Sill Construction Project and determined that the Borrow Area #2 most likely would not totally refill within a three month period following complete removal of all its available borrow. In coordination with Hydraulics Branch, Engineering Division, Operations Division Managers, and OD-T Environmental Function, it was concluded that in order for the Corps to remain mission ready in the event the construction of the sill is necessary, a portion of it must be available to the Corps at all times. Thus, DNR may excavate the northern third of Borrow Area #2 from November through February providing approximately 1.5 million cy and have full use of a second smaller Borrow Area at Mile 67 AHP which would provide another 1 million cy. USACE will send a report of its findings to DNR in the near future.

- **Response** – In response to this comment, EPA and DNR have been in coordination with the Corps' Operations Division. We understand the Corps is currently pursuing an alternate location to dredge material, as necessary, for the salt water sill structure. We understand important considerations remain in the Corps' securing of this alternate borrow location and acknowledge our mutual interest in water quality protection and coastal wetland restoration through maximizing use of River sediments as a renewable resource. We agreed to continue to keep one another apprised of our progress toward 95% design and construction authorization for the Bayou Dupont CWPPRA project, as well as the Corps' progress in securing an alternate borrow location for sill construction. We appreciate your coordination with us on this issue.

USACE/Lachney/5B. In the preliminary design report, page 5, it states that the poor condition of the marsh is likely due in part to the lack of freshwater input. As the project scope does not remedy this situation, is this factor included in the project life estimation? Does it pose a project concern in regards to maintaining healthy marsh?

- **Response** – The proposed marsh creation areas are in the outfall boundaries of the existing Naomi Freshwater Siphon. In addition, the alignment for the proposed Myrtle Grove Freshwater Diversion, BA-33 CWPPRA project, is adjacent to the proposed marsh creation areas for BA-39. Upon construction, the fresh water from BA-33 will provide nutrients to sustain the newly created marsh areas.

USACE/Lachney/6B. Page 13 of the design report states that based on analysis of a +2.0 foot target marsh, self weight consolidation would be approximately 0.9 feet. Does this not result in an ultimate marsh elevation of +1.1 NAVD88 without further subsidence considerations? This seems to be below the project goal elevation.

- **Response** – This is a typo and will be revised for the 95% Design Report. The self-weight consolidation is approximately 0.2 feet. In addition to the approximately 0.6 feet of foundation consolidation, the final elevation of the marsh should be approximately +1.2' NAVD88 at project year 20.

USACE/Lachney/7B. Page 14. With the predominantly medium and fine sand (0.3mm) deposits found in the borrow area, we agree that a bulking factor application is not required (1:1). However the application of 1.5 cut-to-fill ration on top of accounting for anticipated settlement in a totally confined disposal area seems excessive. With medium grain sand, minimum losses should be encountered at the dikes. In digging the borrow pit, a greater concern would seem to be material running into the pit as opposed to losses. With (1) the overall size of the borrow pit and (2) the anticipated grain size of borrow material and (3) the natural tendency of the river to shoal at this location; we don't see the rationale for the anticipated 50% losses at the cutterhead.

- **Response** – As stated in the design report, this factor is the upper end of a range based on past projects. The CWPPRA process necessitates conservatism in estimating construction costs.

USACE/Lachney/8B. Page 20. Based on results of comment 4 above, the use of borrow area #1 may indeed be required. A modified borrow plan incorporating the use of both borrow pits is likely needed.

- **Response** – See response to comment 4 above.

USACE/Lachney/9B. To minimize the borrow requirement, has any consideration been given to borrowing outside the disposal area for dike construction?

- **Response** – The quantity required for backfilling the containment dike borrow areas is negligible compared to the total borrow requirement. The premise of this project is to utilize the renewable resource of the Mississippi River, so the project team would prefer not to excavate from within the basin without backfilling.

USACE/Lachney/10B. Page 21. A copy of the referenced report, <u>Review of Mississippi River Sediment Delivery System – Bayou Dupont,</u> is requested for our review.

- **Response** – Said report was provided electronically to Keith O'Cain on July 12, 2007.

USACE/Lachney/11B. While no comments were submitted from our Levee Section regarding the parish flood protection levee, the use of the Plaquemines Parish levee as a project boundary should be coordinated with the local parish officials to remedy any concerns they may have. Additionally, coordination is required with the Project Manager (Mr. Bill Maloz in the Hurricane Protection Office 504-862-2615) of the Improvements to the Non-Federal Levees in Plaquemine Parish adjacent to and actually part of the confinement system for a portion for the proposed marsh creation area to assure no conflicts with schedules and project requirements.

- **Response** – During the coordination of CWPPRA Mississippi River excavation projects with the USACE in April of 2006, the USACE indicated that this levee should be federalized by the projected date of construction. However, since this has not occurred, Plaquemines Parish will be contacted for coordination. Mr. Maloz will also be contacted for coordination.

USACE/Lachney/12B. The next review submittal must provide information on the selected alternative at Naomi Siphon regarding how close the railroad jack and bore operation will be in reference to the levee and the extent of excavation to determine the impact to the levee seepage and stability. Plans must also be provided as to how the dredge pipe will cross the levee crown inspection road which is located along the landside of the levee.

- **Response** – The railroad is located approximately 250 feet from the toe of the Mississippi River levee, as shown in the Plans. Cross sections of the dredge pipeline crossing at the levee crown inspection road are included in the 30% Plan Set. The excavation requirements for the jacking and boring operations will be addressed in the 95% design package in a design detail.

USACE/Lachney/13B. The levee crossing typical section generally conforms to CORPS criteria for temporary crossings. Information needs to be provided as to how long the temporary dredge line crossing will stay in place. If the crossing stays for an extended period, some adjustment will be needed to levee crossing.

- **Response** – The crossing is anticipated to be in place for approximately six to nine months. Please provide guidelines for extended levee crossings.

USACE/Lachney/14B. Drawings. Plans and Access Corridors will like have to be modified to accommodate the use of Disposal Area #1.

- **Response** – This will be evaluated subsequent to addressing comments #4 and #8.

USACE/Lachney/15B. A review of our revetment maps indicates that the extent of the revetment as shown on the plan drawing number 4 is incorrect. Please contact Mr. Don Rawson (504-862-2952) who is in our revetment engineering unit to obtain the precise limits of the revetment so they can be properly shown on the plans and assure that there are no conflicts.

- **Response** – Mr. Rawson provided the files shown on Plan Sheet 4 in July of 2006. If recent revetment has been added to this area of the river, please provide this information.

USACE/Lachney/16B. Request a copy of the Geotechnical Investigation reports prepared by EEC and LJC for our 30% review to be considered complete.

- **Response** – A copy of the EEC geotechnical investigation report will be provided. The geotechnical investigation report from LJC is currently being revised and will be provided once completed.

USACE/Lachney/17B. Since the Borrow Area shown on plan drawing 4 is not a perfect rectangle, more than four points are required to locate the borrow area. Show all necessary points on this drawing.

- **Response** – Coordinates will be added to plan drawings.

USACE/Lachney/18B. Plan drawing 7 shows the borrow pit to El. -3, however, the detail on sheet 8 has the borrow pit depth to El. -12. Correct this inconsistency as appropriate.

- **Response** – Plan sheet 7 shows a typical section based on survey transect number 8. At this location the existing spoil bank will be enhanced, requiring little additional material. The detail on sheet 8 will be changed to reflect a variable excavation elevation.

USACE/Lachney/19B. FYI. An MRL permit will be required prior to construction.

- **Response** – We assume the MRL permit would be processed through the District's Regulatory Branch in coordination with all other appropriate State and Federal authorizations, e.g., Clean Water Act, Rivers and Harbors Act, etc. Please provide contacts and protocol for obtaining an MRL permit so that we may begin this coordinated permit application and review process.

USACE/Lachney/20B. There is a discrepancy between the first and second paragraphs of Section 4.4 entitled *Settlement Analysis*. In the first paragraph it is stated that settlement analyses were based upon published correlations while the second paragraph states that they were based on boring logs for five borings each of which have consolidation tests conducted. Please correct this discrepancy.

- **Response** – Consolidation test parameters were used on soil types in which consolidation tests were taken. These parameters were used on similar soil types based on geotechnical engineering judgment. For soil layers containing no consolidation test data, published correlations for pre-consolidation pressure, coefficients of consolidation, and compression/re-compression indices were used to obtain consolidation indices using shear strength, Atterberg Limits, and moisture content values. Taking consolidation tests for every soil layer for all borings is not a cost effective engineering practice. We will elaborate on this subject in the 95% design report.

USACE/Lachney/21B. Numerous discrepancies exist within the Settlement Analysis Section 4.4. In the second to last sentence on page 13, it is stated that the self-weight consolidation would be 0.9-feet for an El. +2.0 fill, however, the figure 15 of Appendix D shows an anticipated 20-year settlement of 0.2-feet. In the first note of Figure 9 in Appendix D, it is stated that 6-feet of fill is required to meet the target elevation of El. 1.3 at 5-years, however, when looking at the graphs, this is clearly not the case. From Appendix D, it appears that the 20-year foundation settlement of ~ 0.7-feet and the 20-year fill settlement of 0.2-feet would lead to an El. +1.1, slightly deficient of the target El. 1.3. Appendix D and Section 4.4 have to be made consistent throughout.

- **Response** – The stated projected self-weight consolidation on page 13 is a typo as mentioned previously.
- Figure 15 in Appendix D shows only the self-weight consolidation values.
- The first note in Figure 9 in Appendix D is a typo by EEC and was not incorporated into the design of the project.

- Figure 9 shows approximately 0.6 to 0.7 feet of foundation settlement over 20 years. In addition to the approximately 0.2 feet of self weight consolidation, this target fill elevation would achieve approximately the target healthy marsh elevation, or as close as possible to it considering construction methods, for the longest period of time, as discussed in Section 6.2.

USACE/Lachney/22B. In the second paragraph of 4.4, it is stated that a dike El. +4.5 was evaluated. However, the plan drawings show El. +3 for the dike. Please correct this discrepancy.

- **Response** – A dike elevation of +4.5' NAVD88 was evaluated, but the high elevation was determined to be unnecessary based on past construction experience. Therefore a crown elevation of +3' NAVD88 was selected for design.

USACE/Lachney/23B. On boring log of boring 1 taken by Eustis Engineering, there is no cohesion listed for the one-point UU test on Sample 5. Correct this listing error.

- **Response** – Eustis will be contacted for a revised log.

USACE/Lachney/24B. Since all five of the borings in the marsh creation area show fairly thick organic very soft soils, a greater settlement (than 0.7-feet) would have been expected. Show in detail how the settlement, specifically within the marsh deposits, was calculated.

- **Response** – This may be evaluated from the EEC geotechnical investigation report which will be provided.