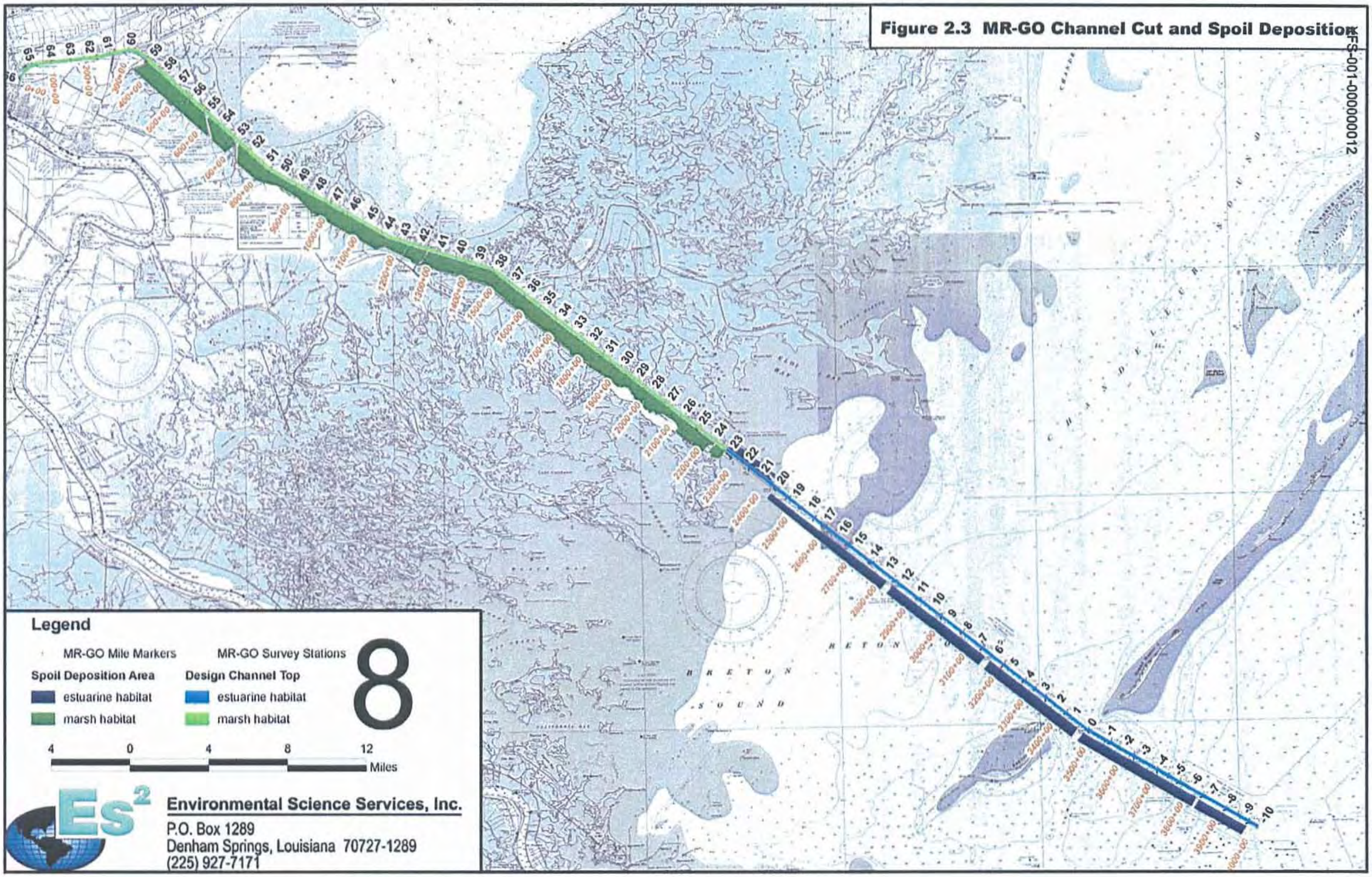
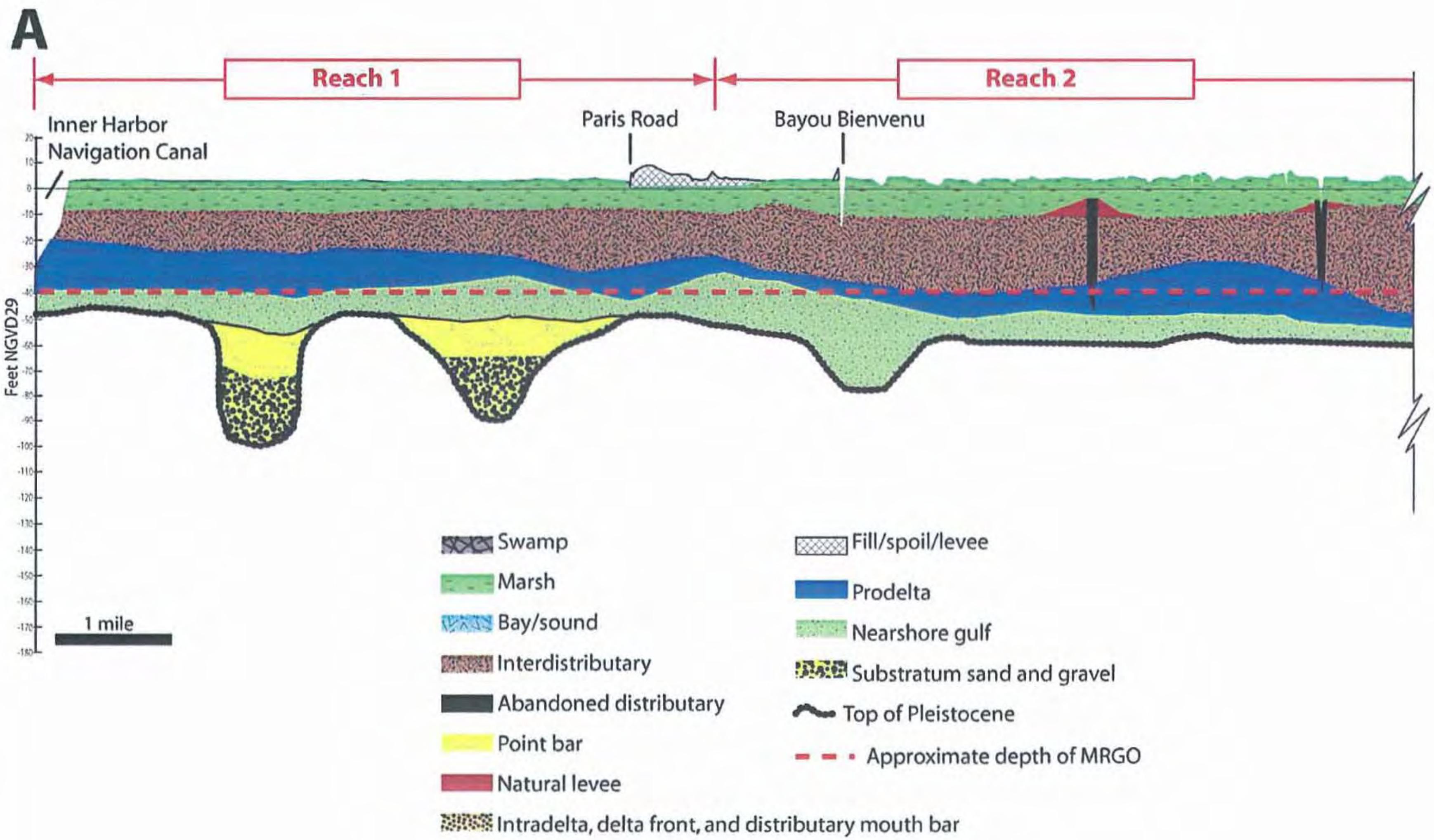

Greater New Orleans
Flood Protection System
N
W
E
S
N.O. East Levee
Lakefront Levee
N.O. East Backlevee
IHNC
Citrus Backlevee
MRGO Reach 1
40 Arpent
MRGO Reach 2
New Orleans
Arabi
Chalmette
Meraux
Gretna
Terrytown
Harvey
Violet
Timberlane
Poydras
Saint Clair
Braithwaite
Caernarvon
Saint Bernard
Toca
Verret
Belle Chasse
Scarsdale
Verret Levee (Chalmette Extension)
Satellite imagery dated October 10, 2005
3
0
3
Miles
04/16/09c

Graphic No. 2.

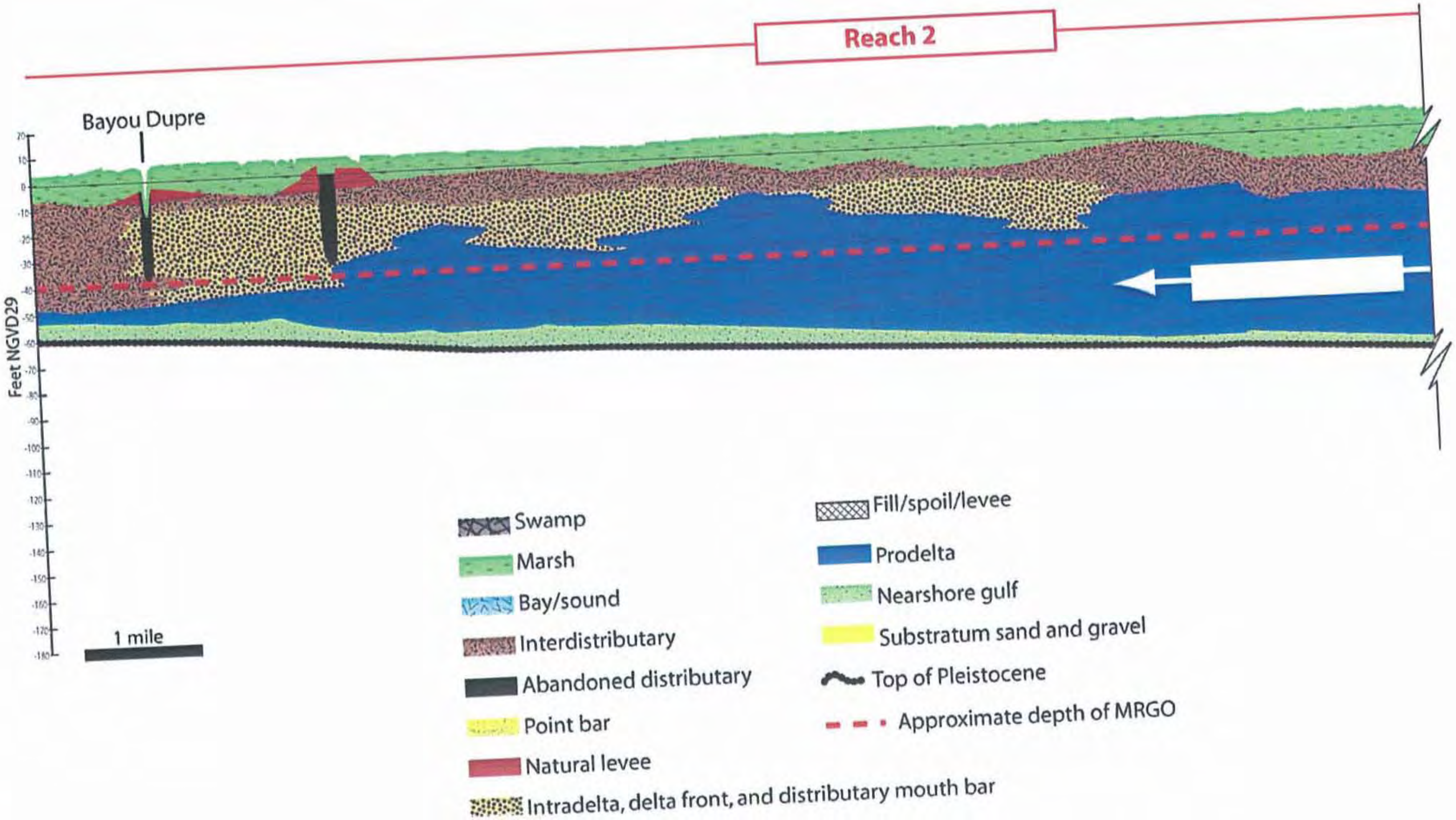


XFS-001-000000012

Graphic No 3A.



Graphic No 3B.



MONTHLY SALINITY RANGE

Hopedale

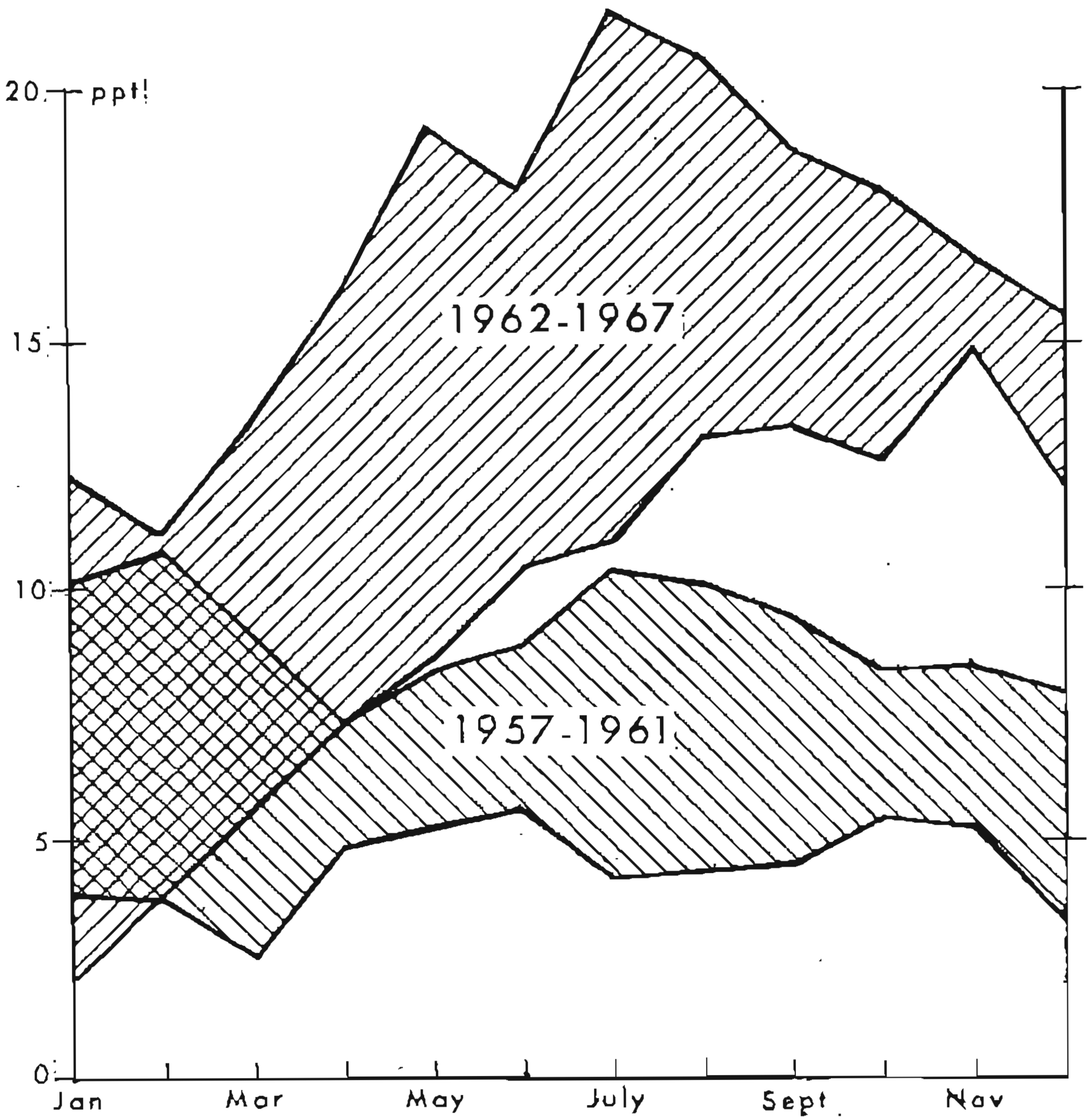


Fig. 4.5 Comparison of monthly salinity ranges at Hopedale for periods before and after construction of MRGO. Data from New Orleans District, U.S. Army Corps of Engineers.

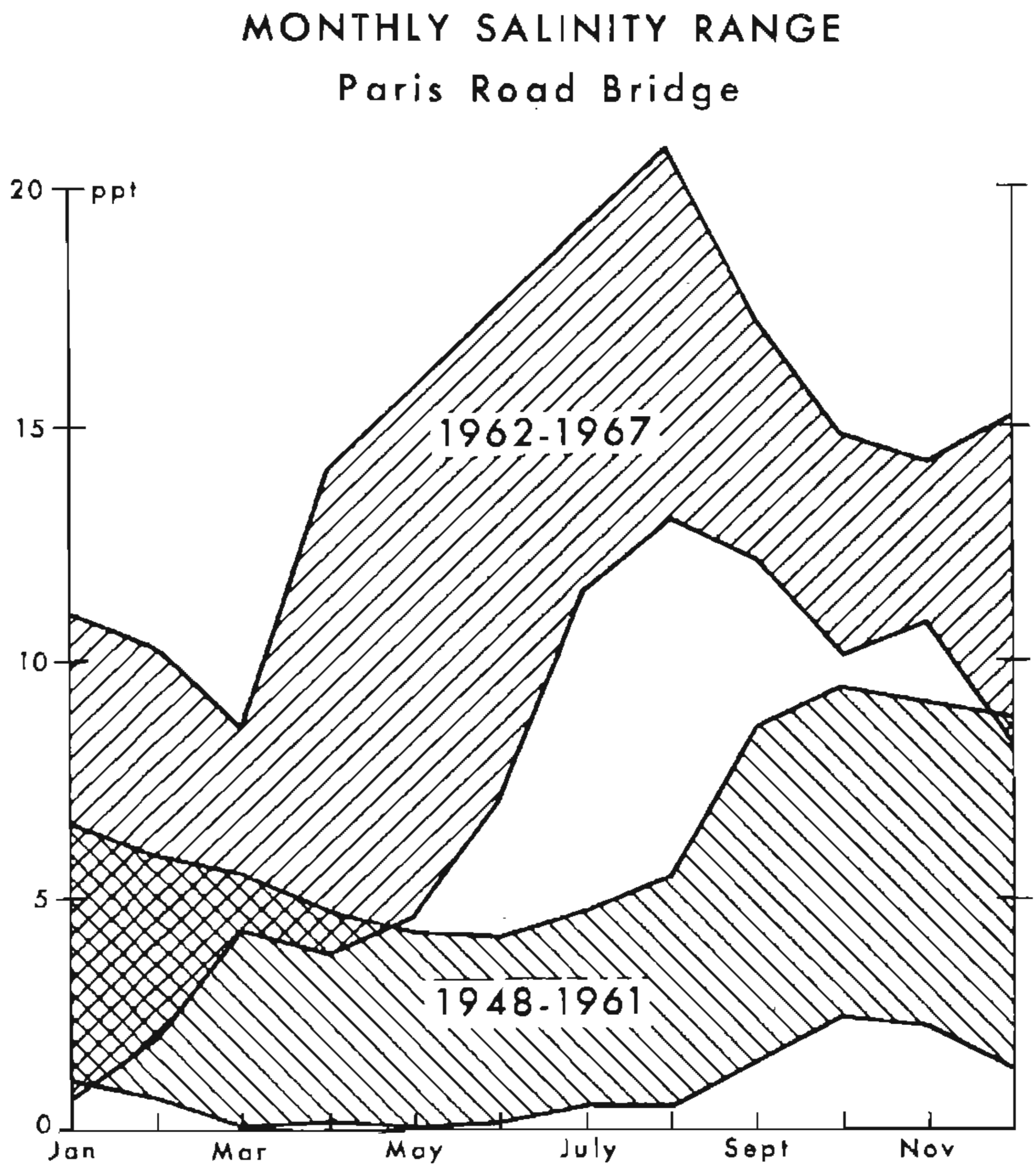


Fig. 4.6 Comparison of monthly salinity ranges at Paris Road Bridge for periods before and after construction of MRGO. Data from New Orleans District, U.S. Corps of Engineers.

Graphic No. 5.

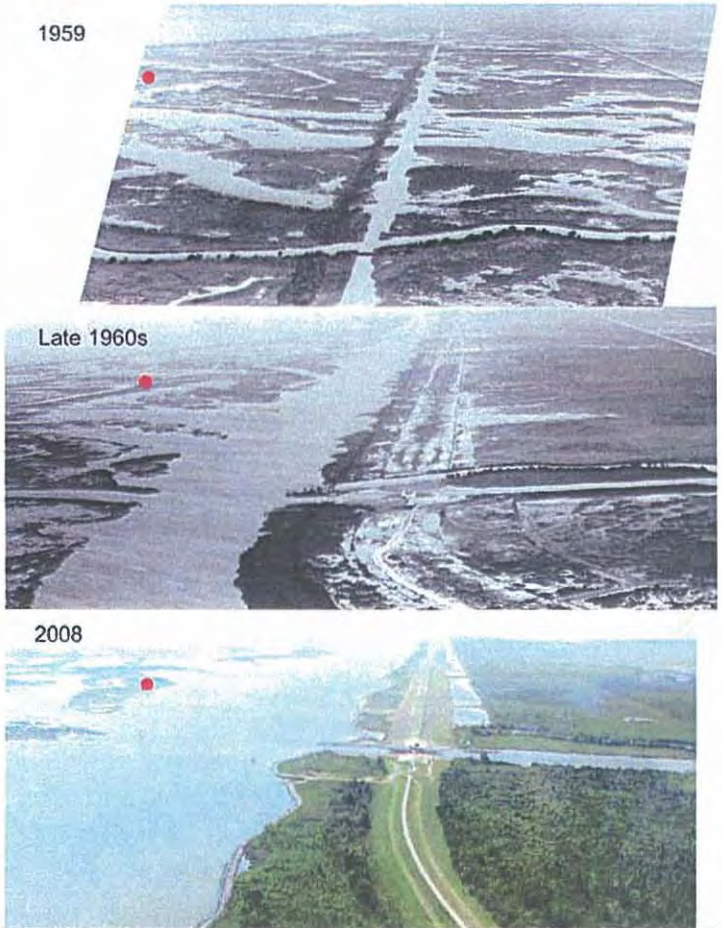


Figure 2.9 Access canal (1959), post-construction channel (late 1960s) and current channel (2008) at MR-GO Station 376 looking southeast across Bayou Bienvenue. Red dot shows same location on all photos.

Figure 2.10 Approximate MR-GO station 490 looking southeast over Bayou Mercier. The channel has widened considerably in this area. Red dot marks same location on both images.

Graphic No. 6.

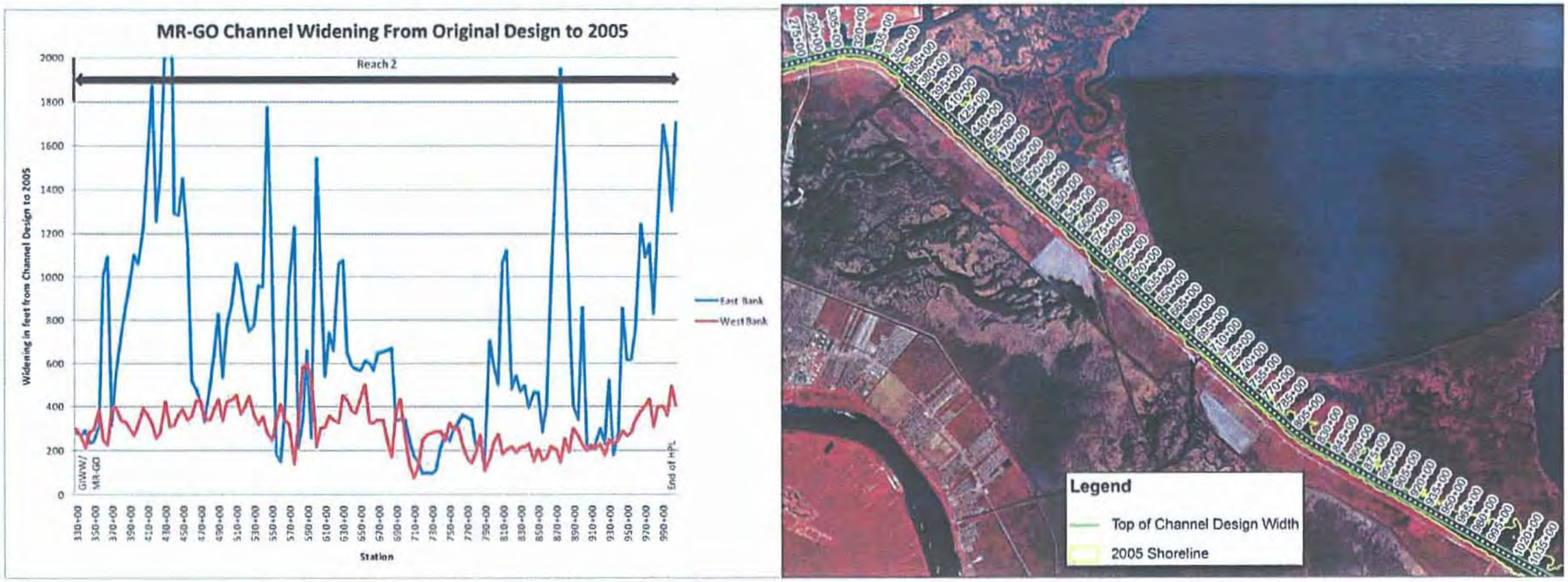
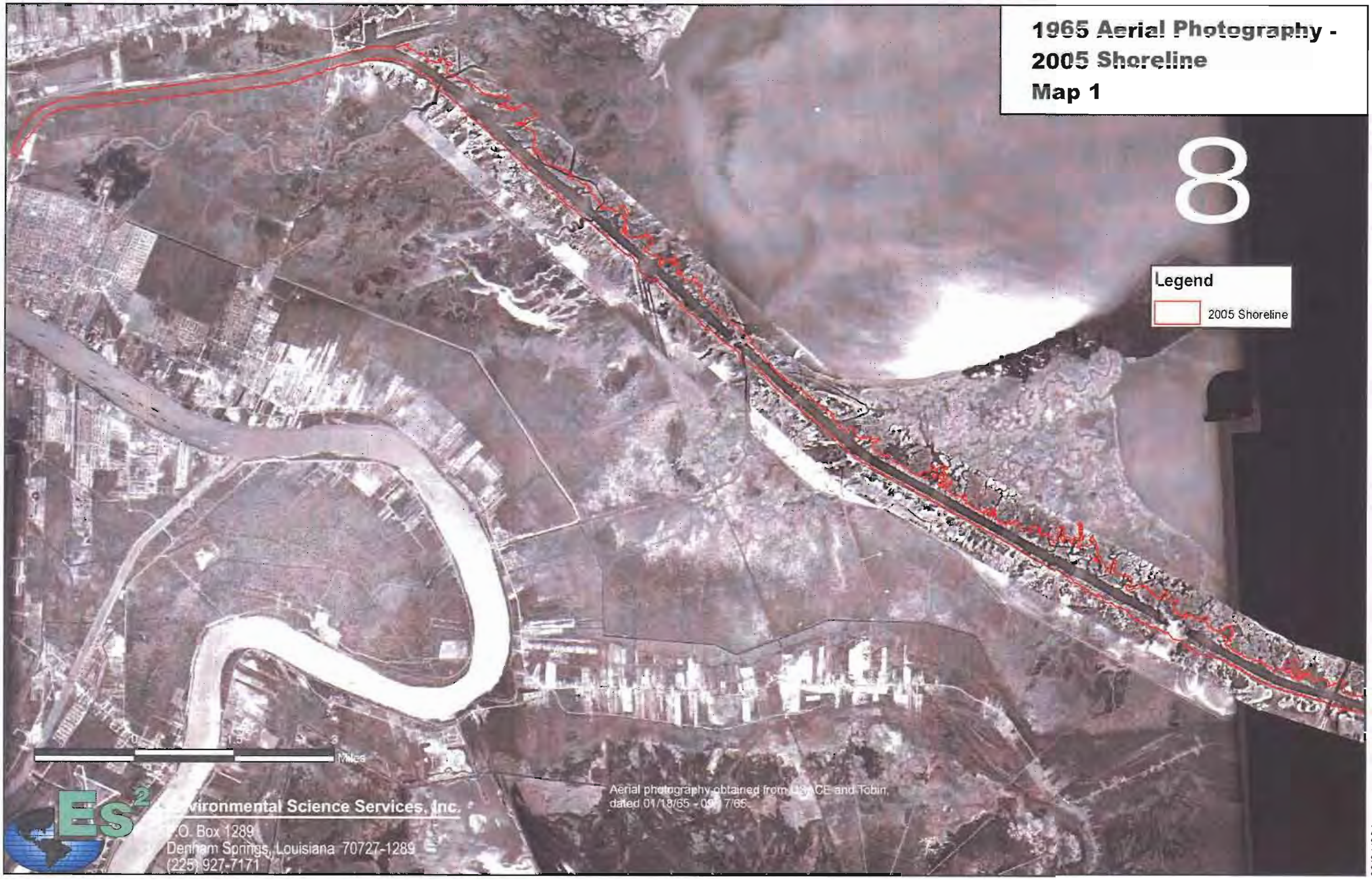


Figure 2.16 Reach 2 from intersection of GIWW to end of hurricane protection levee. MR-GO channel widening from original design top-of-channel width to 2005.

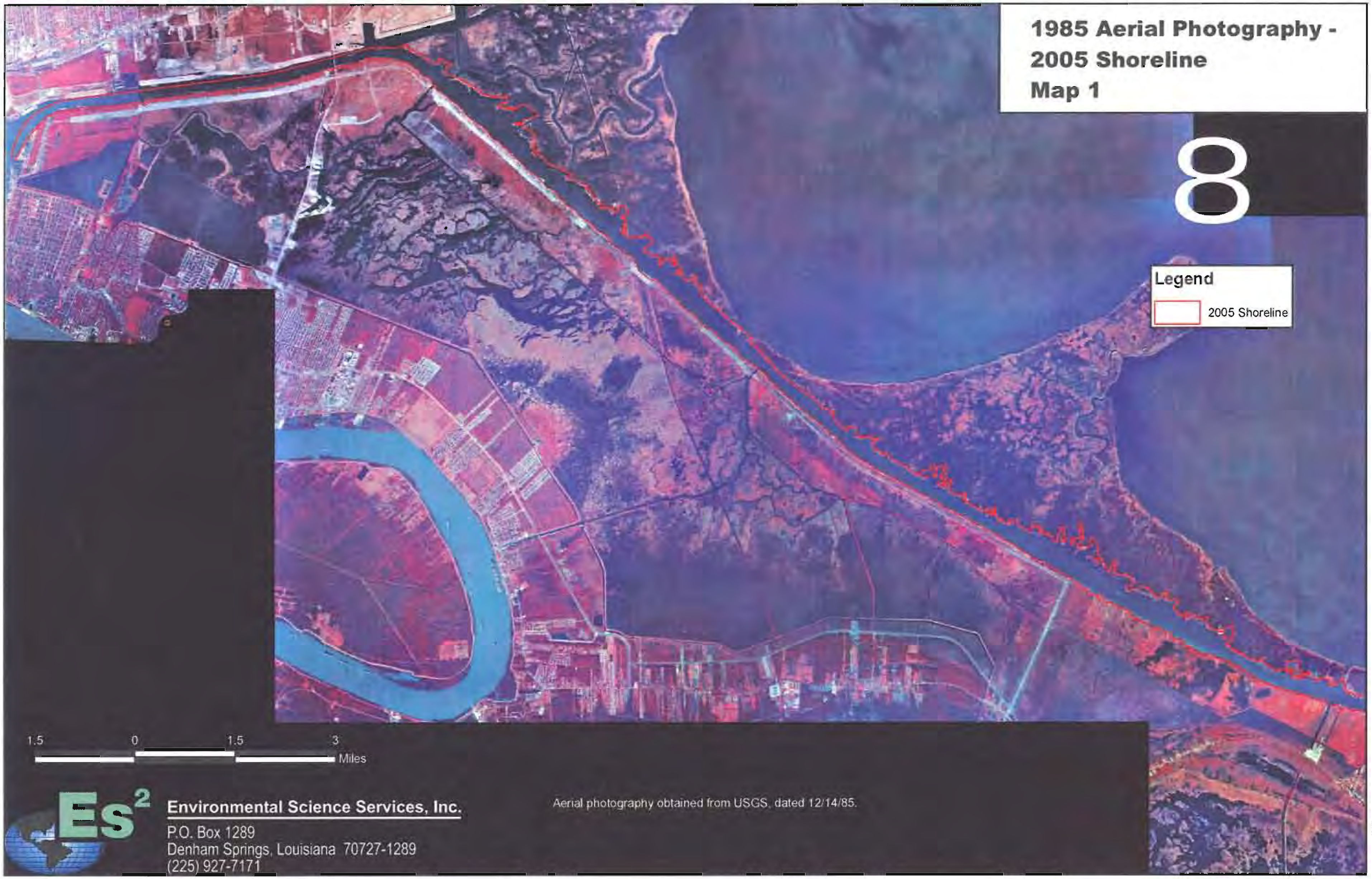

1958-59 Aerial Photography -
2005 Shoreline
Map 1
8
Legend
2005 Shoreline
1.5 0 1.5 3 Miles
Aerial photography obtained from USACE and Tobin,
dated 10/25/58 - 12/15/59.
Environmental Science Services, Inc.
P.O. Box 1289
Denham Springs, Louisiana 70727-1289
(225) 927-7171
03/01/08A

PX096.28


1965 Aerial Photography -
2005 Shoreline
Map 1
8
Legend
2005 Shoreline
0
1.5
3
Miles
Aerial photography obtained from
dated 01/18/65 -
vironmental Science Services, Inc.
.O. Box 1289
Denham Springs, Louisiana 70727-1289
(225) 927-7171
03/01/08A

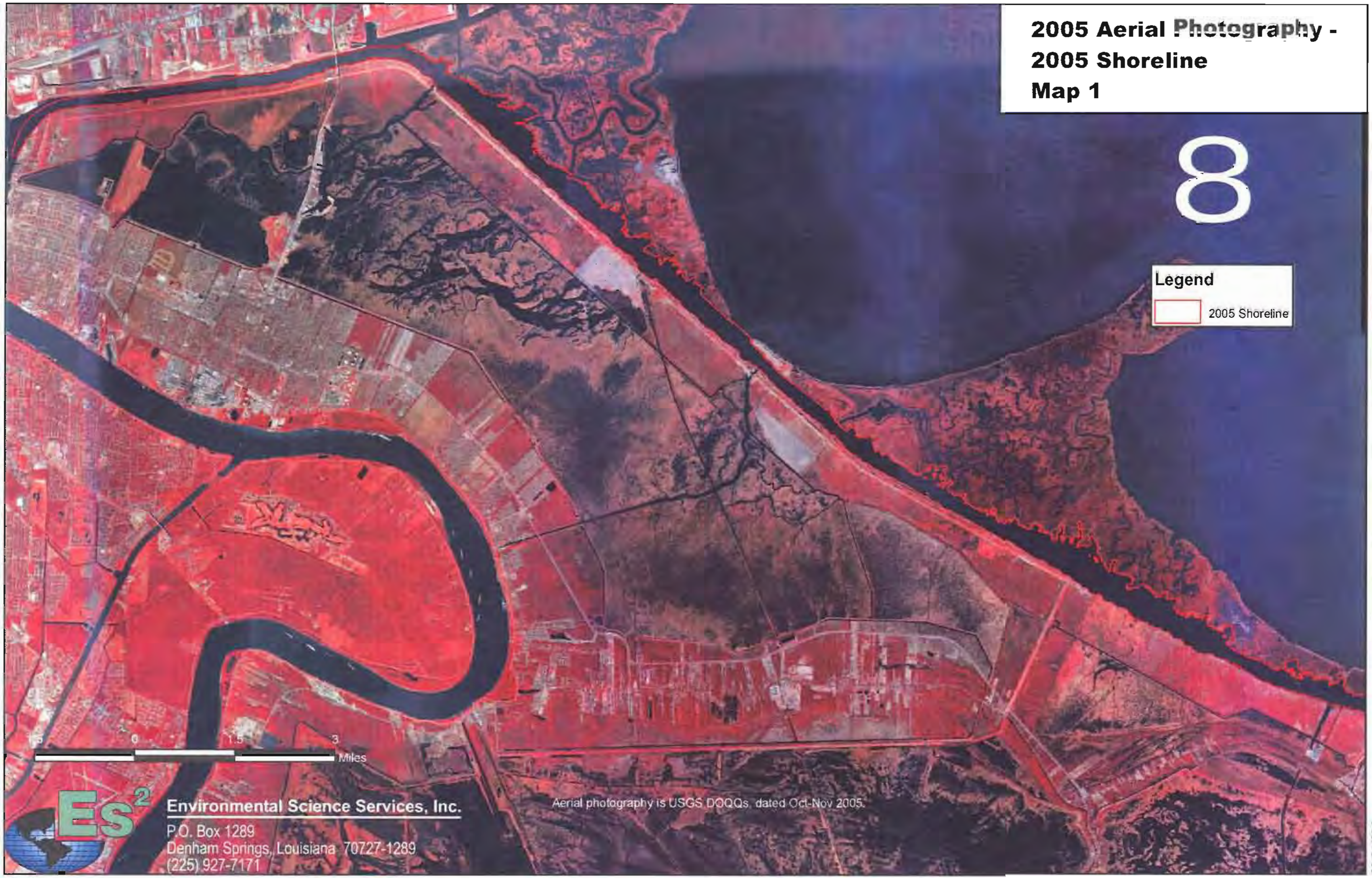

1976 Aerial Photography -
2005 Shoreline
Map 1
8
Legend
2005 Shoreline
1.5 0 1.5 3
Miles
Environmental Science Services, Inc.
P.O. Box 1289
Denham Springs, Louisiana 70727-1289
(225) 927-7171
Aerial photography obtained from USACE dated 10/11/76.
03/01/08A

Graphic No. 7D.




1998 Aerial Photography -
2005 Shoreline
Map 1
8
Legend
2005 Shoreline
Aerial photography is USGS DOQQs dated Jan-Mar, 1998.
1.5 0 1.5 3
Miles
Es2
Environmental Science Services, Inc.
P.O. Box 1289
Denham Springs, Louisiana 70727-1289
(225) 927-7171
03/01/08A

Graphic No 7F.



30. Figure 26 presents a historic timeline of the levee crest elevation at Station 497+00 from 1966 to 2007. At the time Hurricane Katrina hit the MR-GO area, the levee crest elevation had settled approximately 1.5 feet below the target crest elevation of +17.5 feet (NGVD). Also included on this plot are approximations of storm surge elevations (high water marks) near Station 497+00 from observations following Hurricanes Betsy (USACE, 1965) and Camille (USACE, 1970).

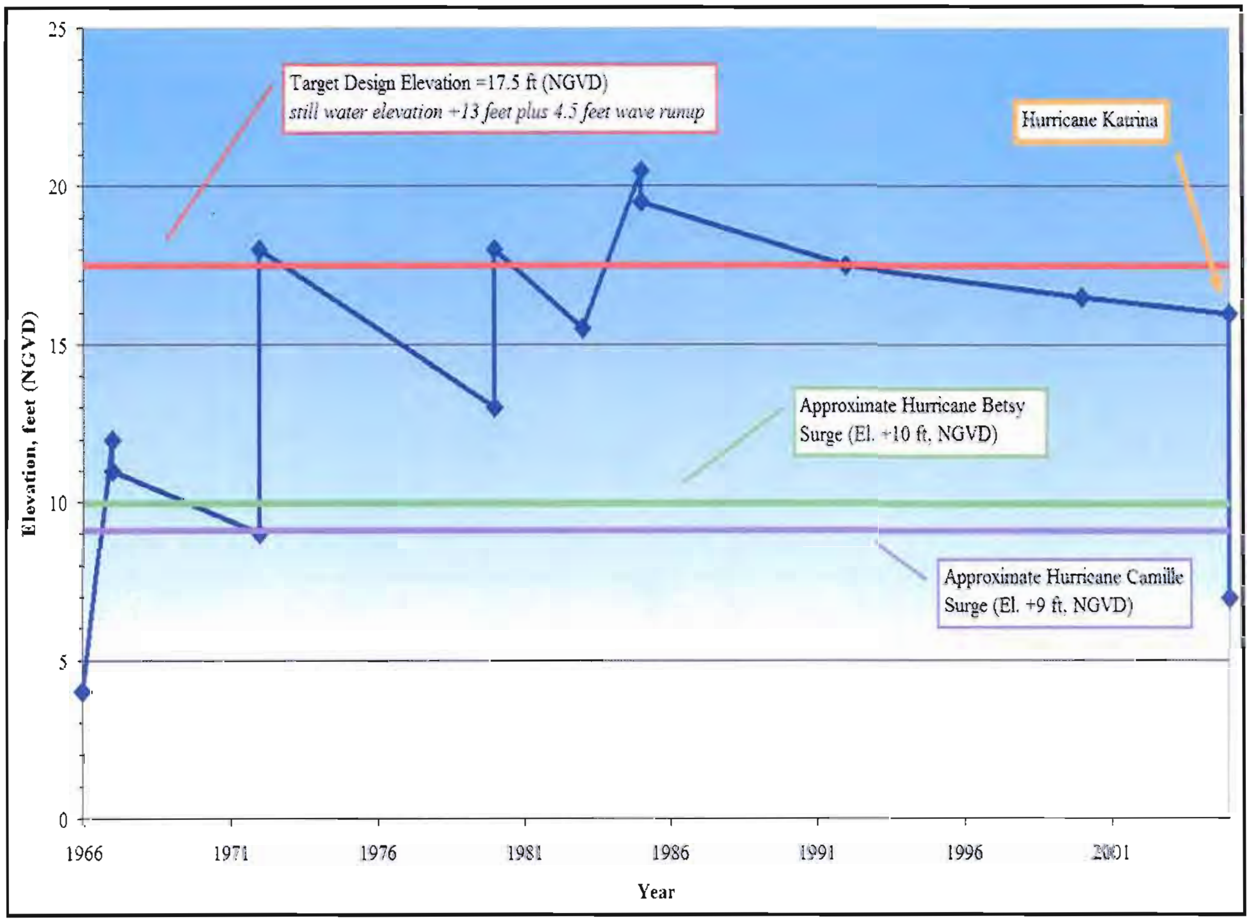


Figure 26: Plot of levee crest elevation from 1966 to 2007, when Hurricane Katrina hit New Orleans (Bea and Storesund 2008).

113. Fitzgerald et al continue (Figure 10):

"Conceptual model for lateral displacement of the interdistributary deposits into the MR-GO channel excavation due to overburden loading and the high-angle of channel walls as built by the USACE. This phenomenon was predicted prior to construction by USACE (1958) and resulted in the need for continual channel maintenance dredging as noted in USACE (1976). The migration of sediments into the channel from the underlying interdistributary deposits results in subsidence of the land surface and increases rates of landloss along the channel. Waves produced by wind and the passage of large oceangoing vessels accelerate the rate of bank failure and landloss within the marsh deposits."

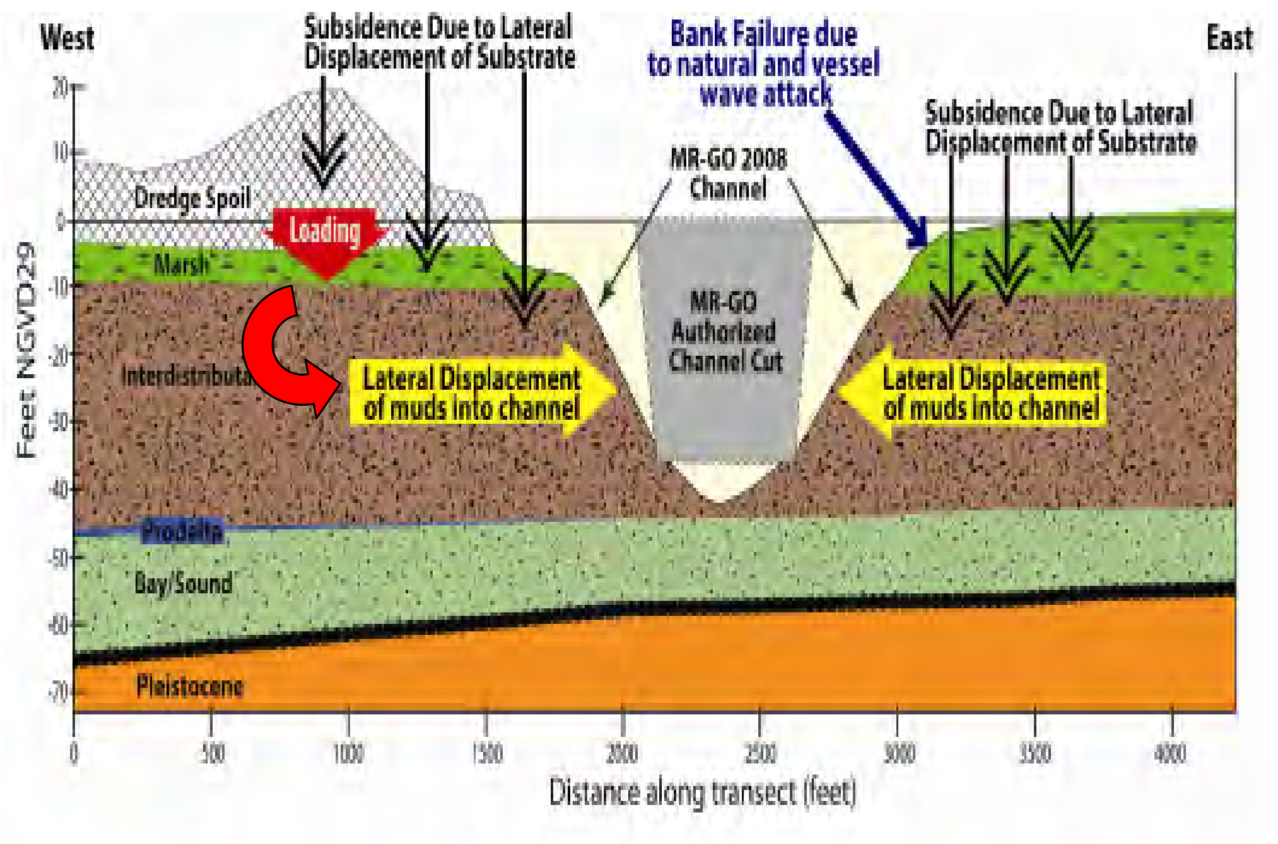
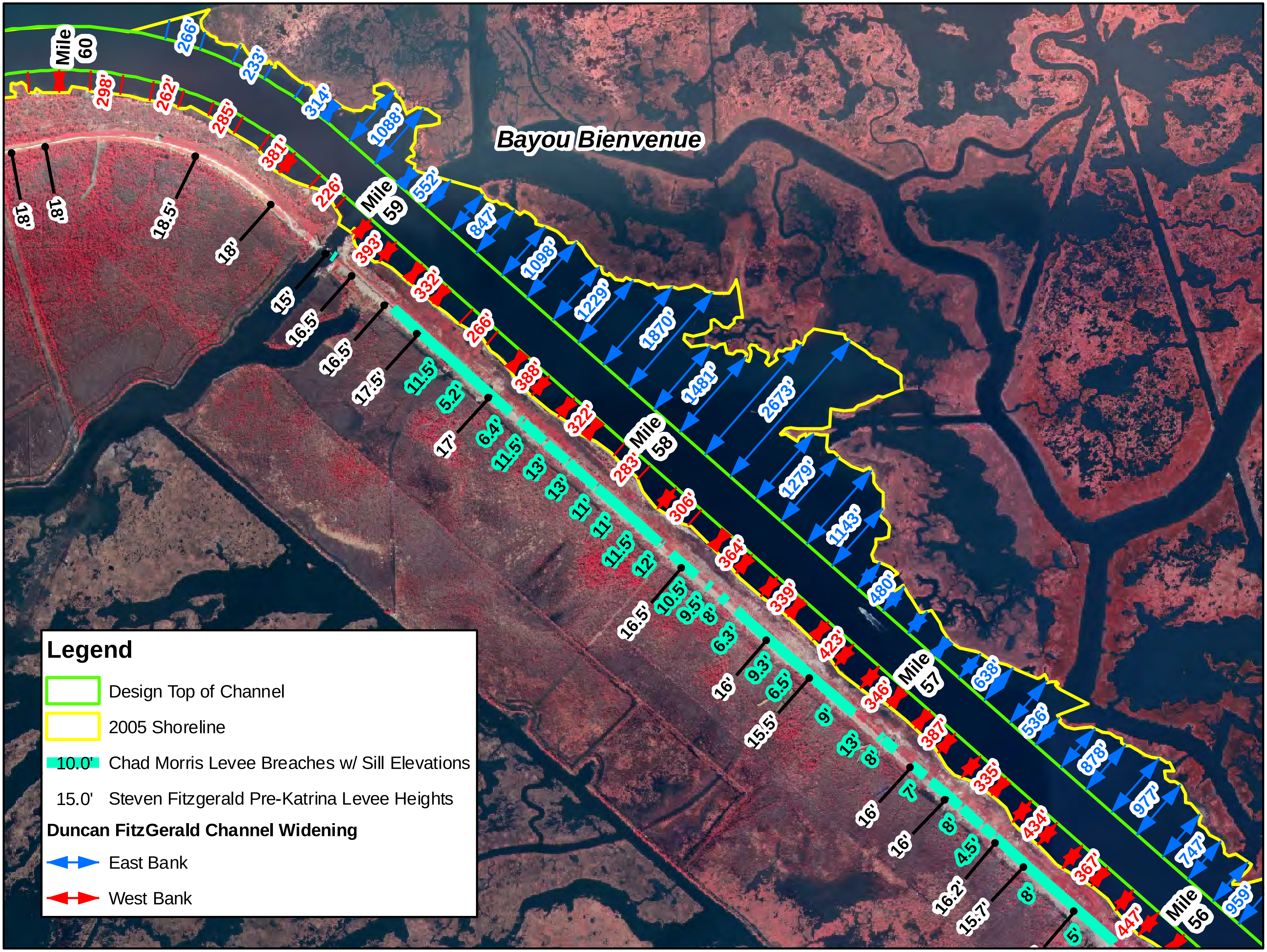


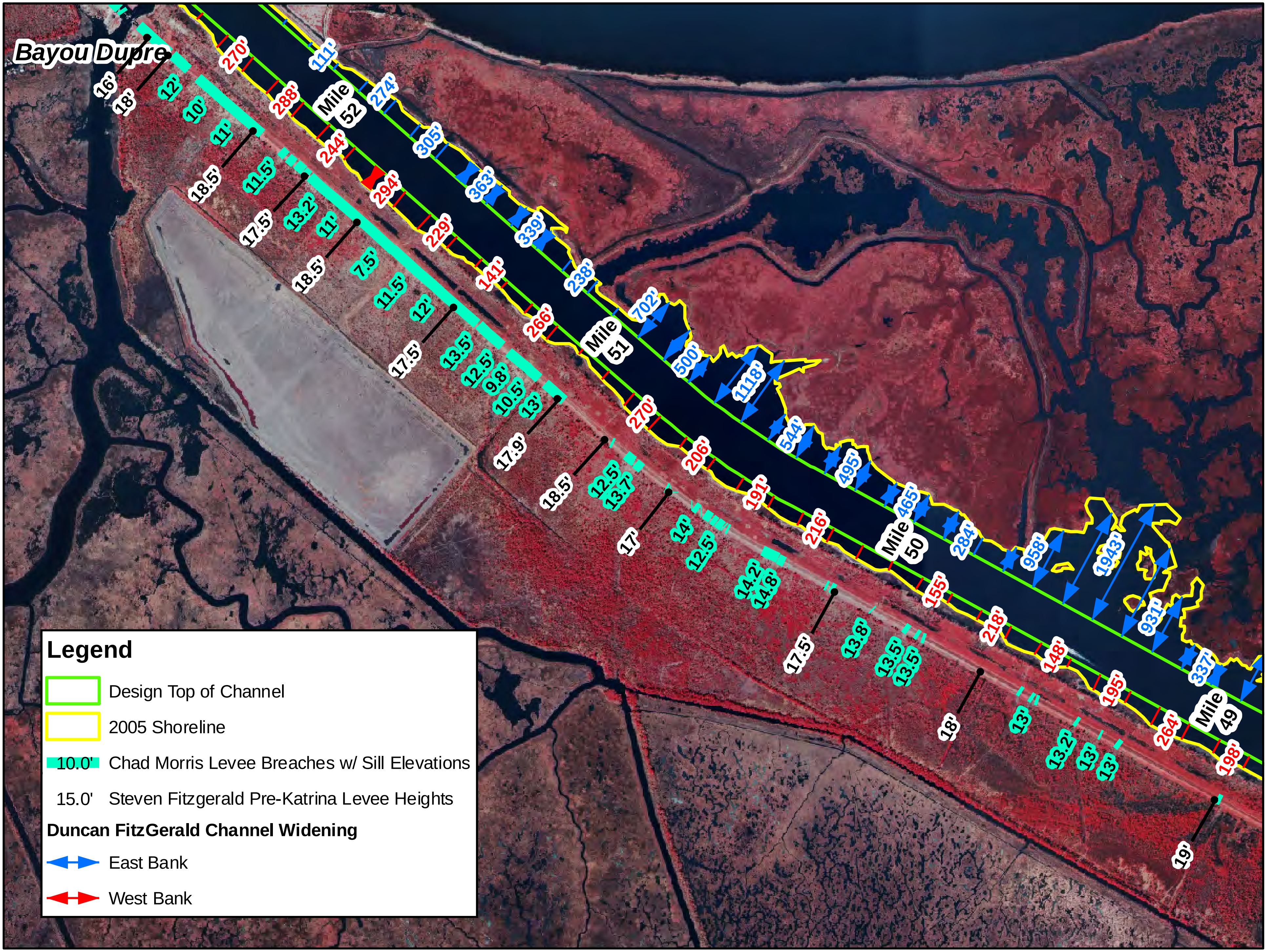
Figure 10: Model for lateral displacement of interdistributary deposits into the MR-GO channel excavation due to overburden loading (after Fitzgerald et al 2008).

Graphic No. 10A.

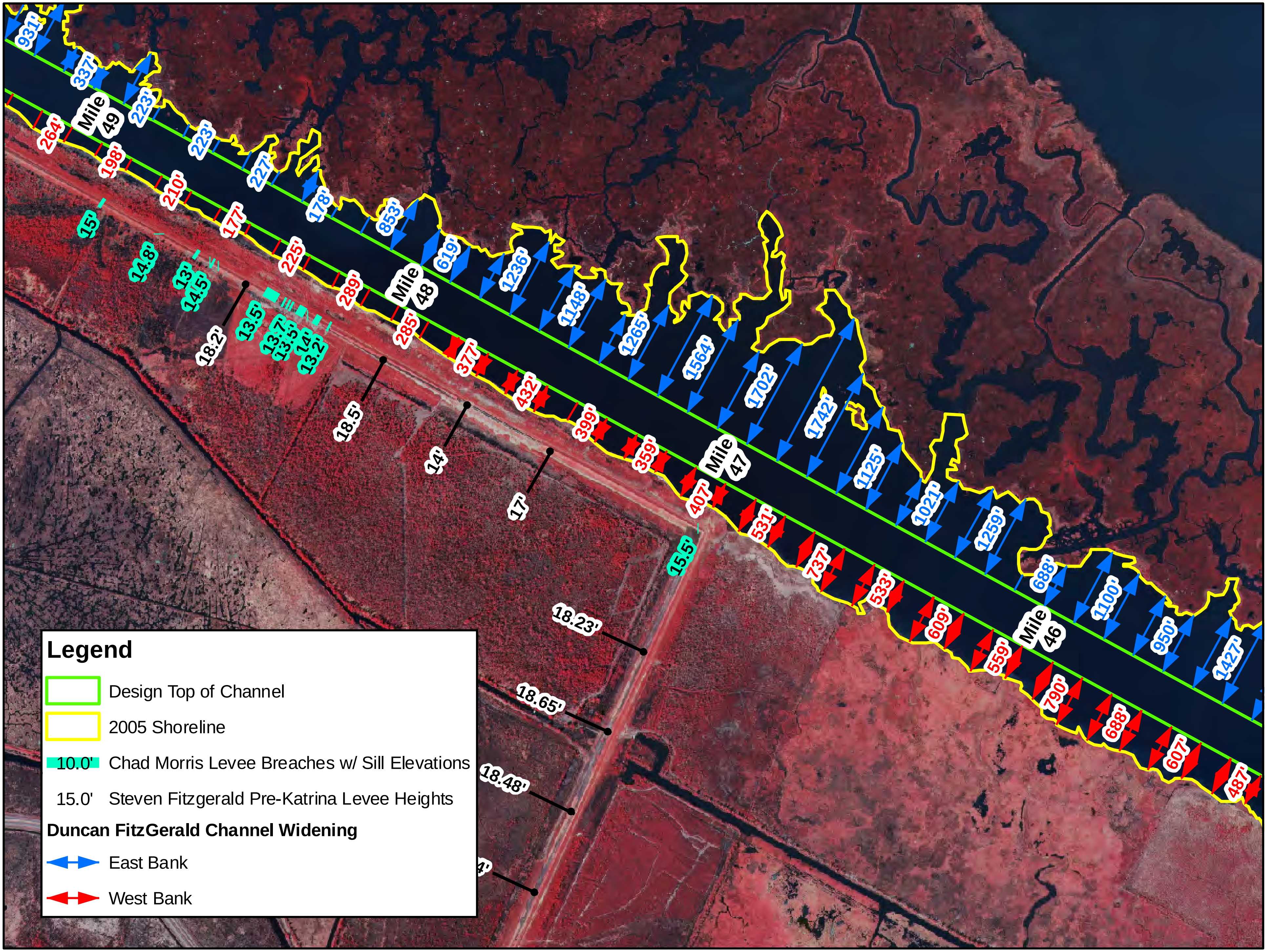


Graphic No. 10B.

Graphic No 10C.



Graphic No 10D.



Graphic No 10.5A.

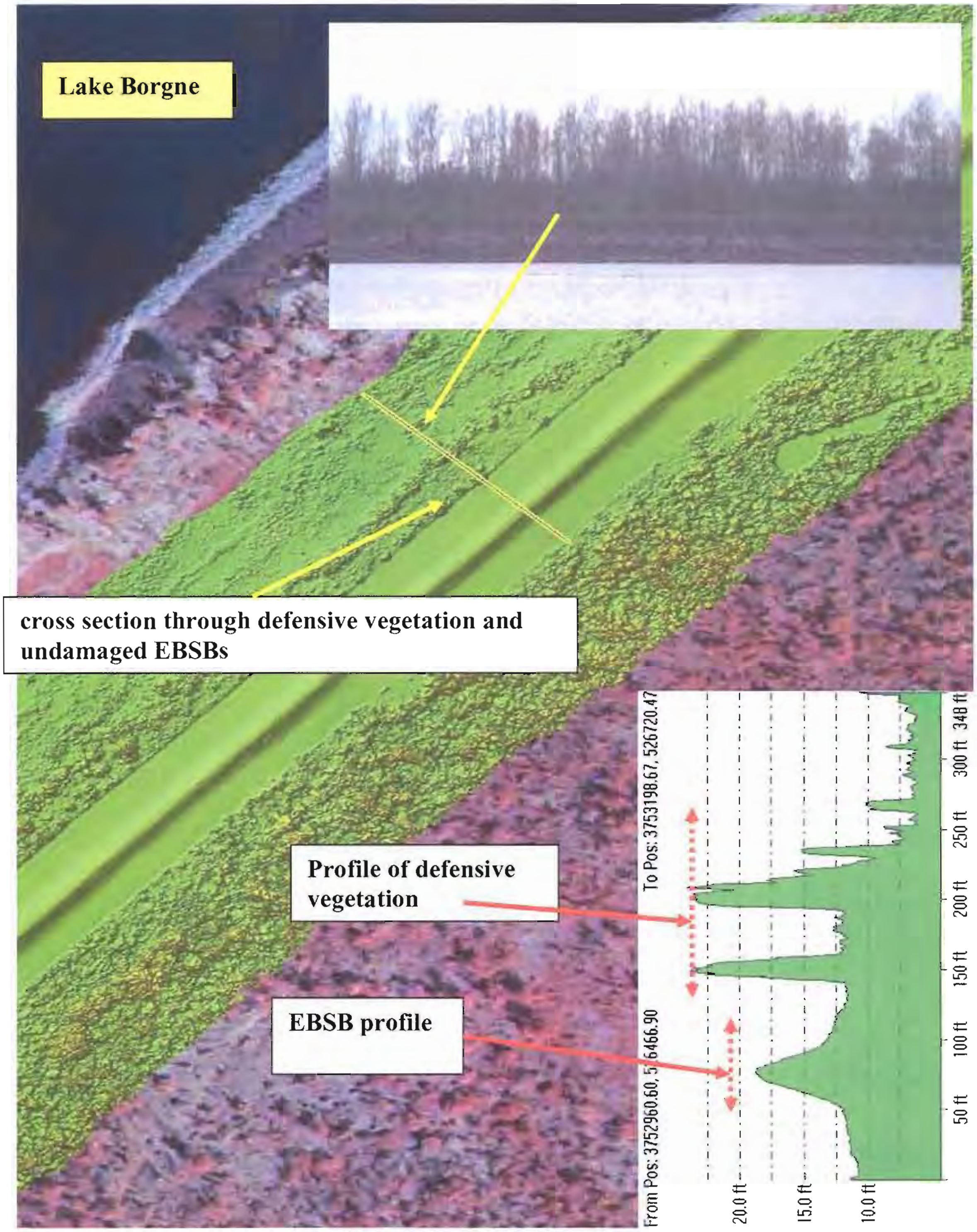


Figure 45: Processed LiDAR post-Hurricane Katrina survey data showing the substantial defensive line of vegetation outboard of the MR-GO Reach 2 EBSBs and the undamaged profile of the EBSBs in this section of the alignment (Morris 2008).

Graphic 10.5B.

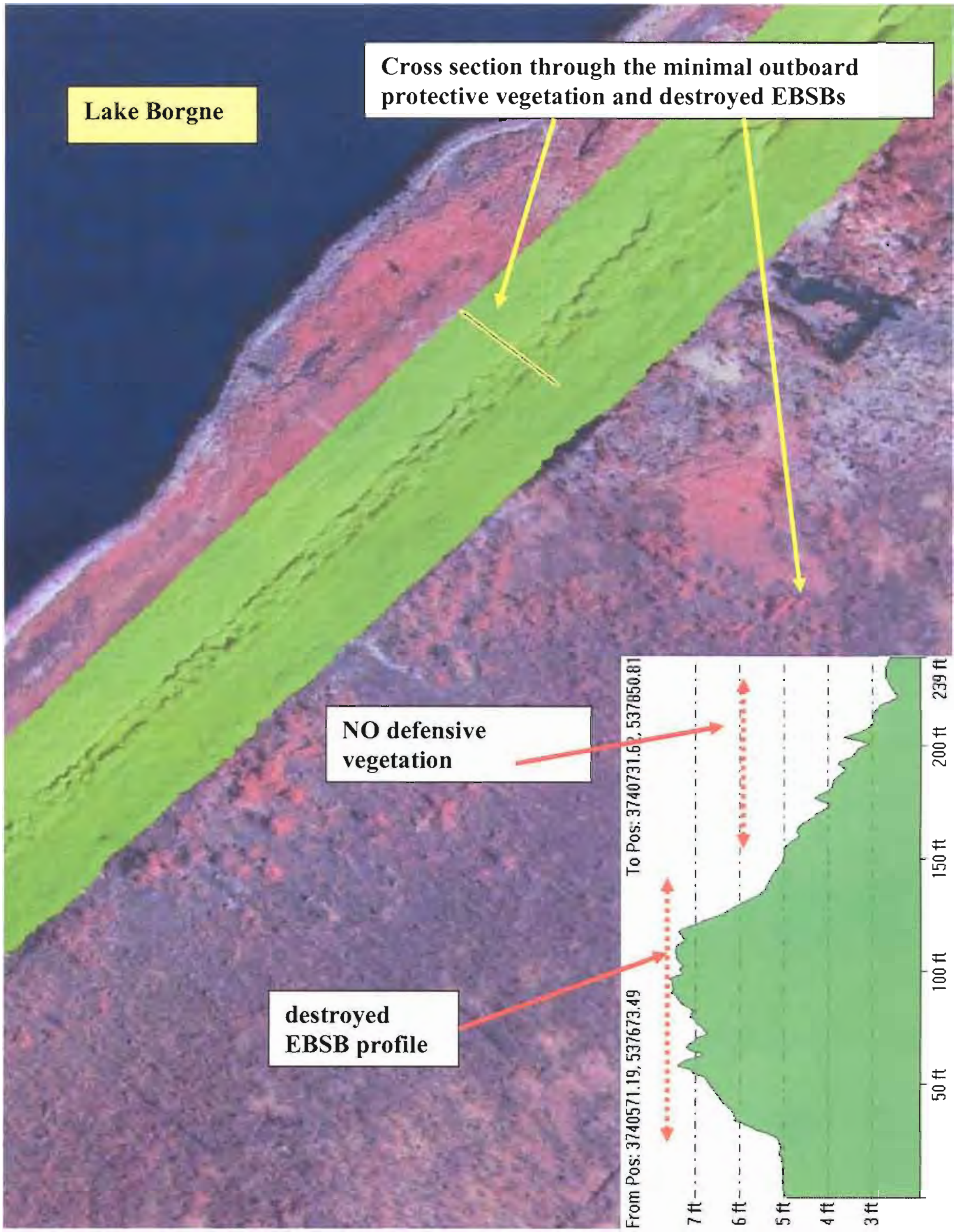


Figure 46: Processed LiDAR post-Hurricane Katrina survey data showing NO defensive line of vegetation outboard of the MR-GO Reach 2 EBSBs and the breached profile of the EBSBs in this section of the alignment (Morris 2008).

TU Delft
Delft University of Technology

Date : 27 January 2009
Subject : Comparison flood depth development between Katrina event and Scenario 2C
From : ir. B. Maaskant, dr.ir. M. Kok
To : Joe Bruno

Comparison flood depth development between Katrina event and Scenario 2C

The flooding of the bowls in New Orleans has been simulated with the use of the 1D2D flood simulation program SOBEK, see Kok et al. (2007). In that report three bowls have been distinguished, the Orleans Metro bowl, the New Orleans East bowl and the Saint Bernard bowl. For the three bowls flood simulations are constructed. Following on that report this memorandum will present the flood depth development over time for five specific locations. These locations are all situated in the Saint Bernard bowl (figure 1). In the table and picture below the five locations are shown.

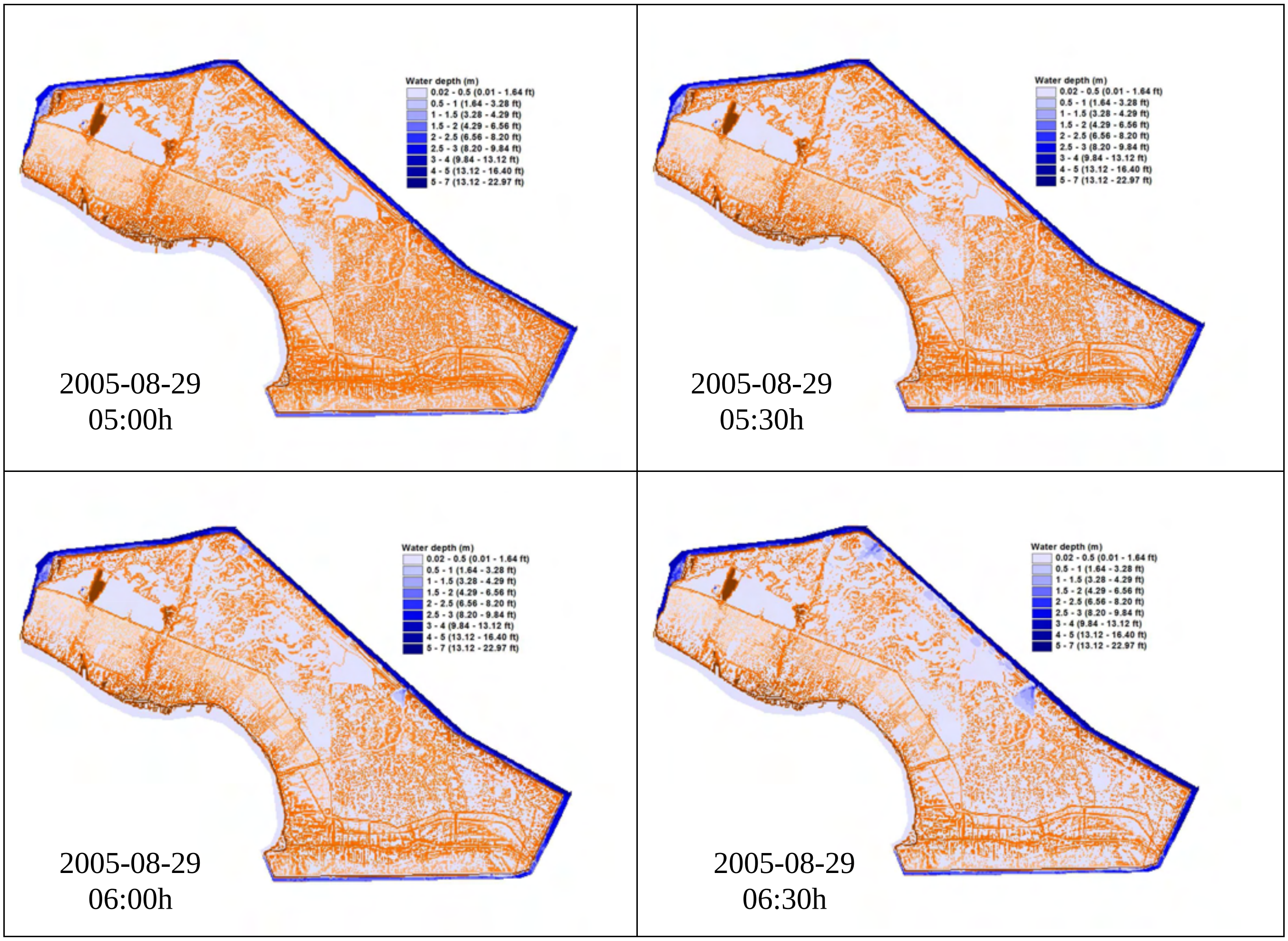
Table 1: The five considered locations

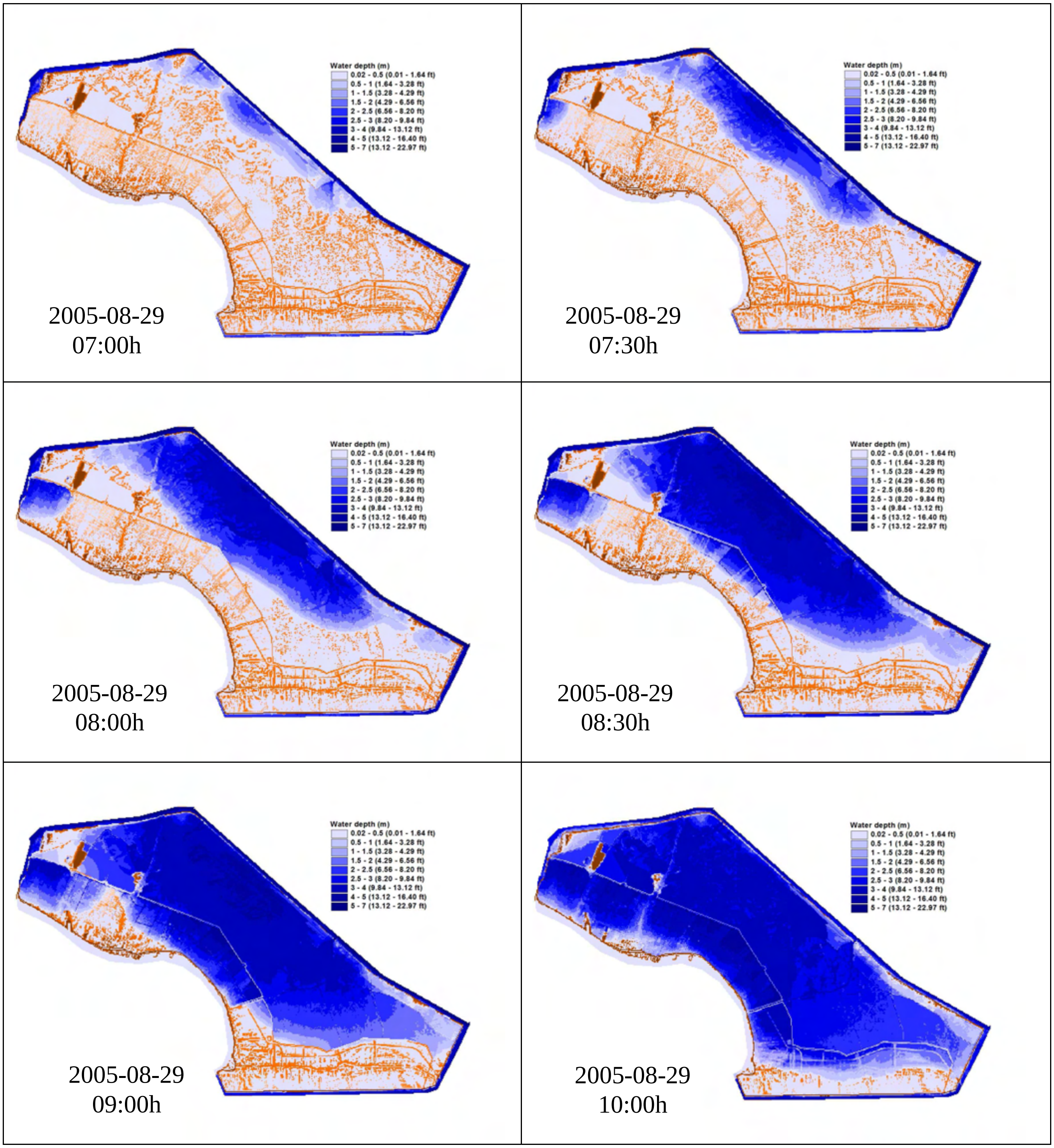
	X	Y	ELEV		LATITUDE	LONGITUDE	LABEL	ADDRESS
1	3701833.15	558522.32	-7,06	-2,15	30° 01' 44.79" N	90° 00' 10.35" W	Norman Robinson	6965 Mayo Blvd
2	3711112.77	526786.89	5,02	1,53	29° 56' 29.58" N	89° 58' 29.07" W	Kent Lattimore	2100 Marcelle Dr
3	3710323.83	526941.93	4,32	1,32	29° 56' 31.20" N	89° 58' 38.02" W	Lattimore & Associates	9117 W Saint Bernard Hwy
4	3723163.88	530081.29	0,72	0,22	29° 57' 00.75" N	89° 56' 11.64" W	Tanya Smith	3920 Despaux Dr
5	3698969.91	533470.55	1,53	0,47	29° 57' 37.14" N	90° 00' 46.21" W	Lucille and Anthony Franz	5926 Saint Claude Ave

Figure 1: Visual representation of the five locations

Because the locations 'Lattimore & Associates' and 'Kent Lattimore' are close together and the 50 by 50 meter grid that is used in the simulations these two locations will be considered as one.

In our model simulations no overtopping occurs before 7:00am, and the two breaches start at 7:00am. Therefore no water, except rain water, prior to 7:00am is visible inside the Lower 9th Ward in the simulation results. ILIT gives an alternative explanation for the early water mentioned by eye witness reports in IPET. ILIT mentions under seepage, water migrating from the channel, under pressure, beneath the IHNC floodwalls as a possible explanation for the early flood water in the Lower 9th Ward. Under seepage through a levee is not captured in the simulation.




Water depth (m)
0.02 - 0.5 (0.01 - 1.64 ft)
0.5 - 1 (1.64 - 3.28 ft)
1 - 1.5 (3.28 - 4.29 ft)
1.5 - 2 (4.29 - 6.56 ft)
2 - 2.5 (6.56 - 8.20 ft)
2.5 - 3 (8.20 - 9.84 ft)
3 - 4 (9.84 - 13.12 ft)
4 - 5 (13.12 - 16.40 ft)
5 - 7 (13.12 - 22.97 ft)
2005-08-29 07:00h
2005-08-29 07:30h
2005-08-29 08:00h
2005-08-29 08:30h
2005-08-29 09:00h
2005-08-29 10:00h

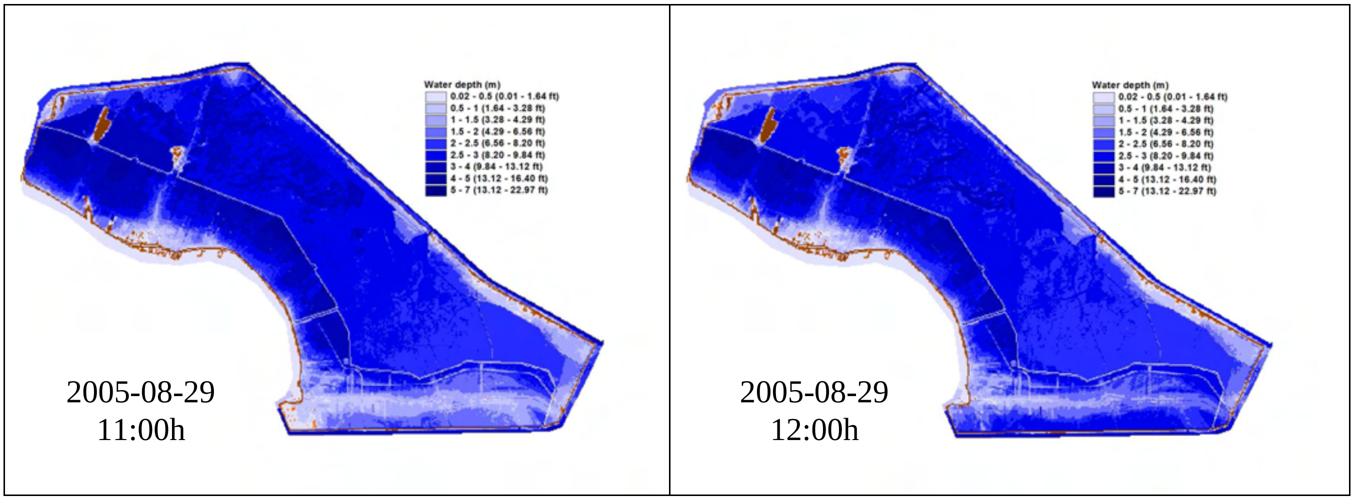
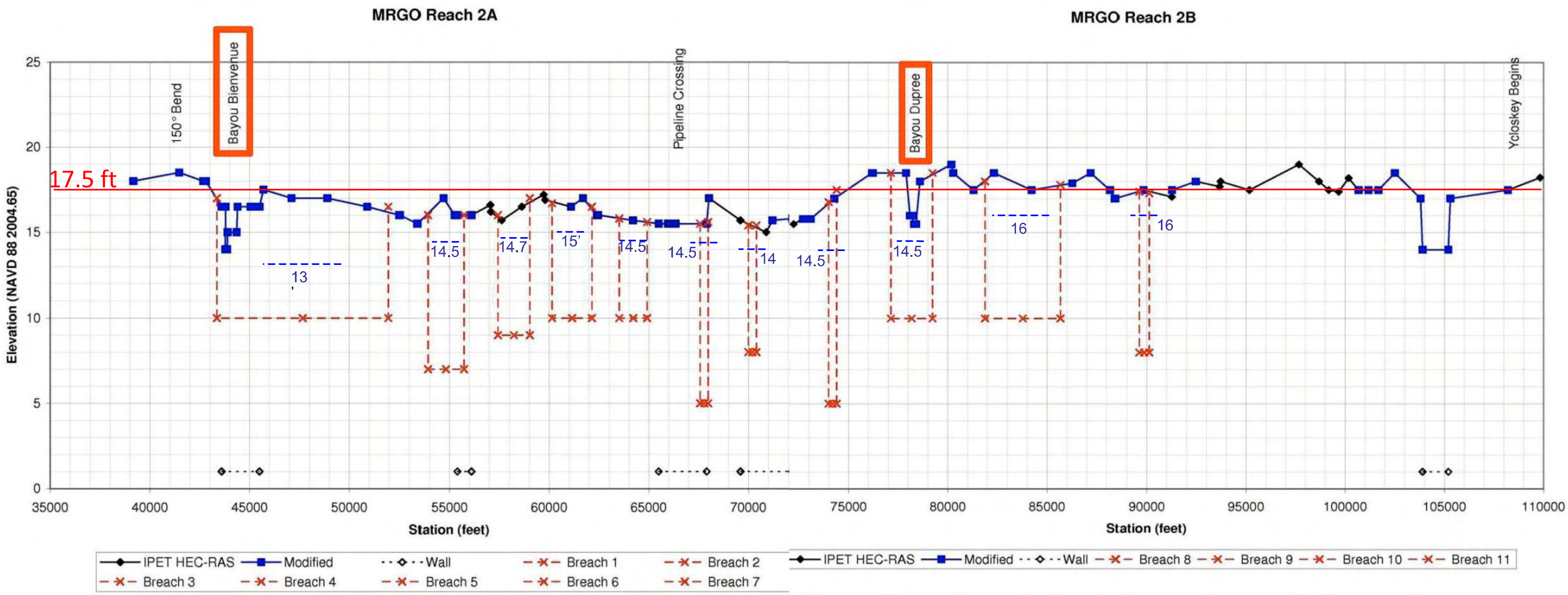


Figure 5.2 Progressing snapshots of the computed internal flooding water depth inside the St. Bernard bowl

Figure 5.2 shows the calculated maximum internal flooding depths in the St. Bernard bowl as a consequence of the breaches and overtopping initiated by hurricane Katrina. Figure 5.4 shows the comparison between our computed internal flood hydrographs and those presented by IPET for the St. Bernard bowl. The locations of the hydrographs are indicated in figure 5.1, location A corresponds with Lower 9th Ward NW., B with Lower 9th Ward E. and C with Chalmette. IPET based its hydrographs on eye witness accounts, stopped clock times and time/date stamped digital photographs. Our computed flood hydrographs are very similar to the data presented by IPET. The predicted peak flood level is within a foot of IPET's measurements. The peak in the model is a couple of hours earlier and the water level starts to decrease earlier than in the IPET hydrographs. The final water descent rate in the model is about equal to the IPET hydrograph.

As discussed previously, in extreme events such as Katrina is difficult if not impossible to get direct measurement of some input data such as water levels at the time of a breach, especially right at the breach location. However, the differences between the computer model results and the calibration data are fully acceptable. For the purpose of this study the model results are very credible.

Graphic No. 13.

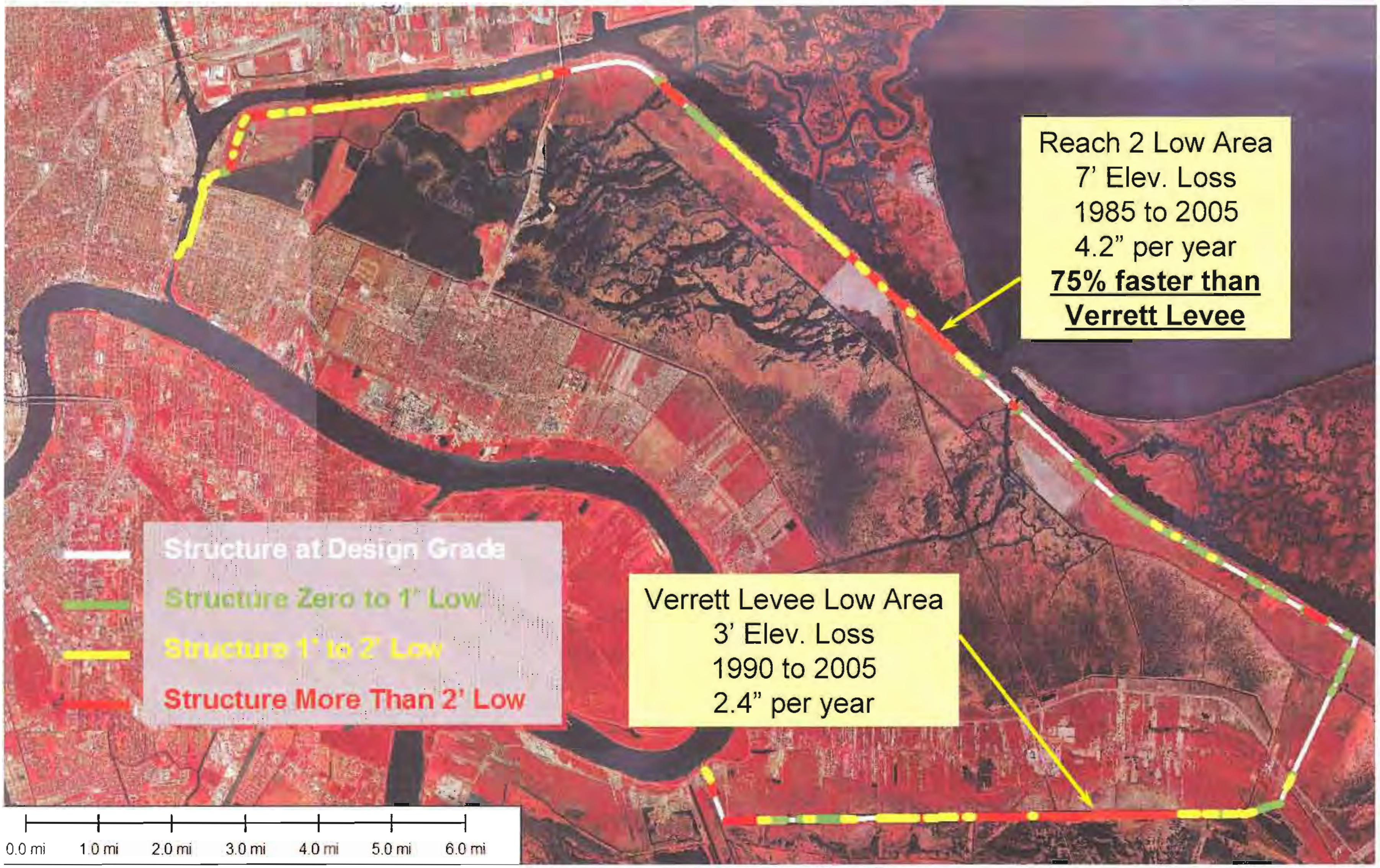


Design Grade

Breach Trigger

PX 2138.3

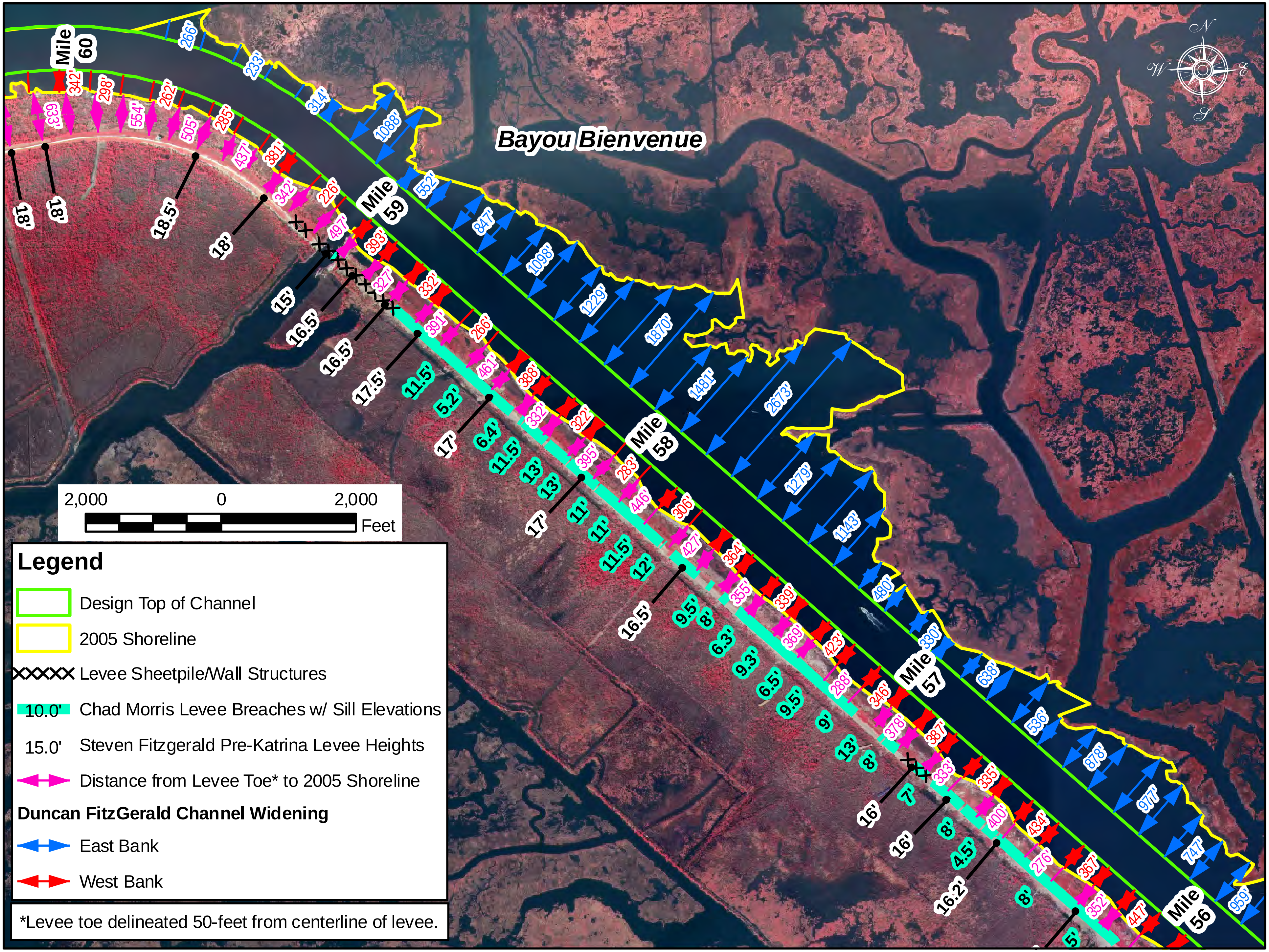
Graphic No. 14.



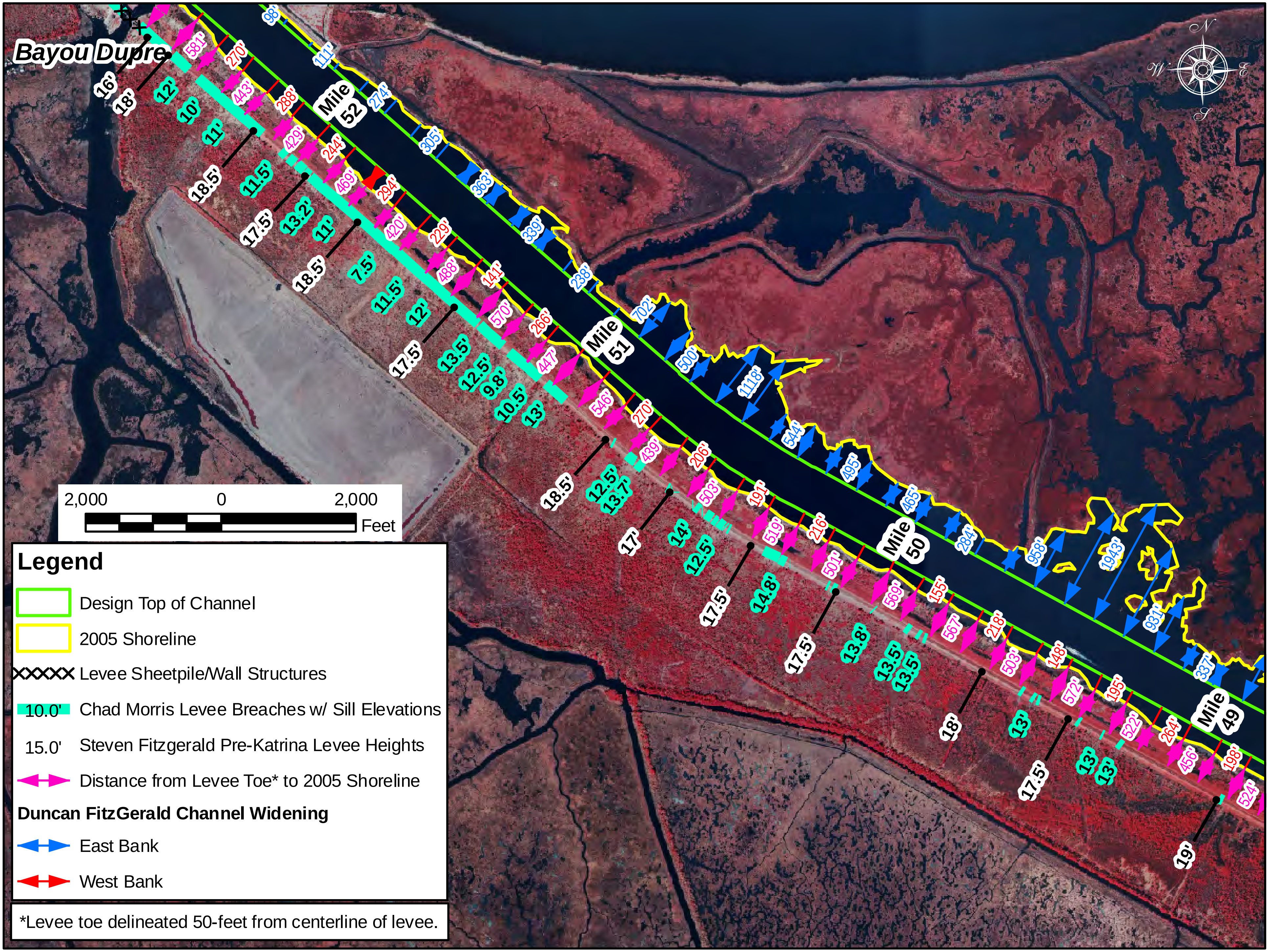
Reach 2 1985 Elevation at Station 630+00 = 20.5 Levee 2nd Enlargement Dwg. 4 of 11 (PX1153)
2005 Ground Elev. at Sheet Pile 13.5' Based on Pre-Katrina 1' Lidar (PX1851)

Verrett Levee 1990 Elevation 1300+00 = 17.5' Verrett to Caernarvon, 2nd Enlargement, Dwg 3 of 13
2005 Ground Elev. 14.5' Based on Pre-Katrina 1' Lidar (PX1851)

PX98.20

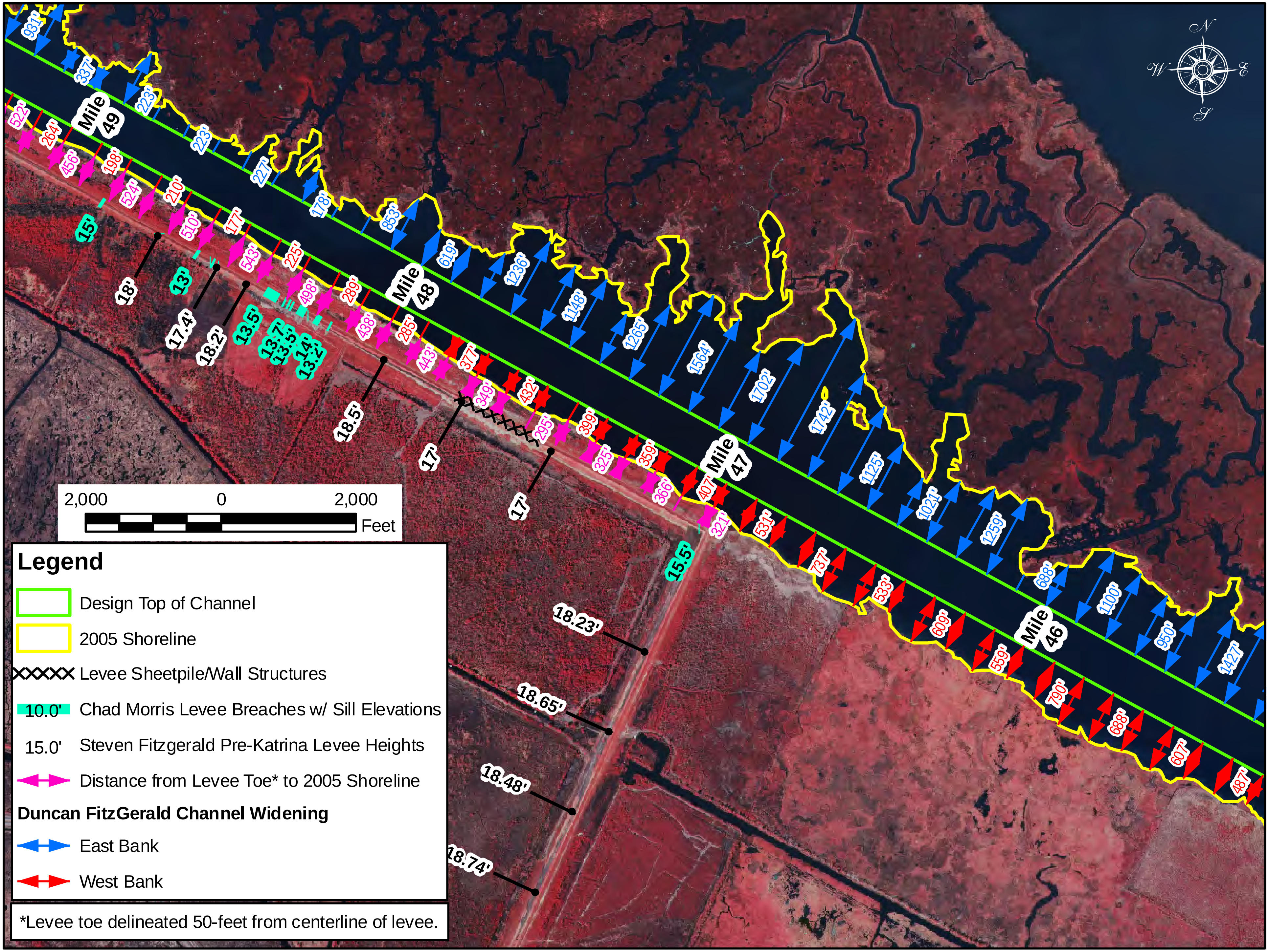

Bayou Bienvenue
Mile 60
Mile 59
Mile 58
Mile 57
Mile 56
2,000
0
2,000
Feet
Legend
Design Top of Channel
2005 Shoreline
Levee Sheetpile/Wall Structures
10.0'
Chad Morris Levee Breaches w/ Sill Elevations
15.0'
Steven Fitzgerald Pre-Katrina Levee Heights
Distance from Levee Toe* to 2005 Shoreline
Duncan FitzGerald Channel Widening
East Bank
West Bank
*Levee toe delineated 50-feet from centerline of levee.


Mile 56
Mile 55
Mile 54
Mile 53
Bayou Dupre
N
W
E
S
2,000
0
2,000
Feet
Legend
Design Top of Channel
2005 Shoreline
Levee Sheetpile/Wall Structures
10.0' Chad Morris Levee Breaches w/ Sill Elevations
15.0' Steven Fitzgerald Pre-Katrina Levee Heights
Distance from Levee Toe* to 2005 Shoreline
Duncan FitzGerald Channel Widening
East Bank
West Bank
*Levee toe delineated 50-feet from centerline of levee.

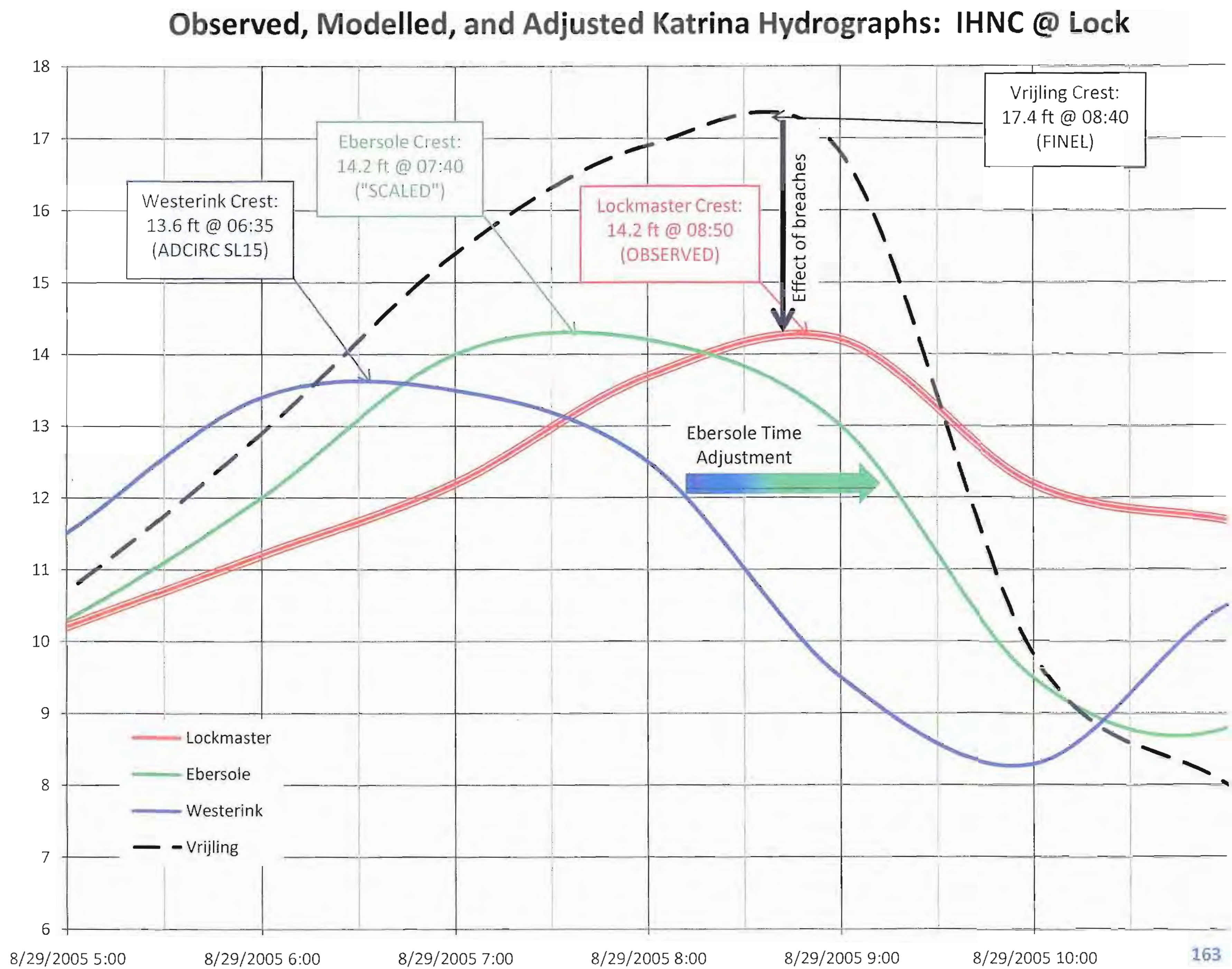


GIS Data from: PX1818, PX1819, PX1820, PX1823, PX1825, PX1849, PX1851, PX1863; and S. Fitzgerald levee crest elevation from PX2138.3

Graphic No. 15D.



GIS Data from: PX1818, PX1819, PX1820, PX1823, PX1825, PX1849, PX1851, PX1863; and S. Fitzgerald levee crest elevation from PX2138.3


Observed, Modelled, and Adjusted Katrina Hydrographs: IHNC @ Lock
Vrijling Crest:
17.4 ft @ 08:40
(FINEL)
Ebersole Crest:
14.2 ft @ 07:40
("SCALED")
Westerink Crest:
13.6 ft @ 06:35
(ADCIRC SL15)
Lockmaster Crest:
14.2 ft @ 08:50
(OBSERVED)
Effect of breaches
Ebersole Time
Adjustment
Lockmaster
Ebersole
Westerink
Vrijling
18
17
16
15
14
13
12
11
10
9
8
7
6
8/29/2005 5:00
8/29/2005 6:00
8/29/2005 7:00
8/29/2005 8:00
8/29/2005 9:00
8/29/2005 10:00