Coastal Protection and Restoration Authority of Louisiana

2012 Operations, Maintenance, and Monitoring Report

for

Delta Management at Fort St. Philip (BS-11)

State Project Number BS-11
Priority Project List 10

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Plaquemines Parish

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Preface

This report includes monitoring data and annual maintenance inspections collected through July 2012.

The 2012 report is the first OM&M report for this project. For additional information on lessons learned, recommendations, and project effectiveness please refer to the annual inspection reports on CWPPRA's website at www.lacoast.gov.

I. Introduction

The Delta Management at Fort St. Philip (BS-11) project was authorized under the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) on the tenth (10^{th}) Priority Project List, and is sponsored by the United States Fish and Wildlife Service (USFWS). The project area is situated at the southern end of the Breton Sound Basin, which is a remnant of the St. Bernard Delta, an abandoned Mississippi River delta lobe (Figure 1). It is located within two separate areas across the Mississippi River from Fort Jackson at River Mile 19.5 AHP in Plaquemines Parish, LA. The western-most area, denoted as "Subarea 1" is north of Fort St. Philip in Bay Denesse. Subarea 1 contains 856 acres with 19,600 linear feet of terraces and three (3) dredged crevasses. Subarea 2 is located near Little Coquille Bay approximately 4.5 miles east of Area 1. It consists of 490 acres with three (3) dredged crevasses.

Subsidence and sediment deprivation are natural characteristics of abandoned deltas (Neill and Deegan 1986, Coleman and Gagliano 1964, Kolb and Van Lopik 1966, Coleman 1988, Wells and Coleman 1987, Penland et al. 1990). These characteristics may be significantly accelerated by anthropogenic activities such as leveeing. Historically, the basin received fresh water and sediment inputs from the Mississippi River – during flood events – and its distributaries – through crevasses formed by scouring channels through the bank (Baumann et al. 1984, Cahoon 1991, Penland et al. 1990, Coleman 1988).

Crevasse formation along the lower Mississippi River and its distributaries is the major process that supplies sediment, fresh water, and nutrients to surrounding marsh during high river stages. Once a crevasse is formed, sediment will accrete near the mouth of the crevasse forming a 'splay' within the receiving bay (Boyer et al. 1997). This newly formed "splay" provides the substrate for rapid colonization of emergent vegetation, which in turn stabilizes the sediment and increases the rate of accretion (White 1993). Over time, the splay will grow as the crevasse channel undergoes a series of bifurcations, eventually forming a 'sub-delta'. The main crevasse channel loses efficiency for sediment delivery as it begins to fill with sediment. In an attempt to recreate this marsh-building process, artificial crevasses have been utilized as a marsh-management tool in the Mississippi River delta in recent decades (Kelley 1996, Boyer et al. 1997, Marin 1996, Troutman and MacInnes 1999, Louisiana Department of Natural Resources [LDNR] 1993, LDNR 1999a, Trepagnier 1994). This process is recognized as a successful and cost-effective way to combat land loss.

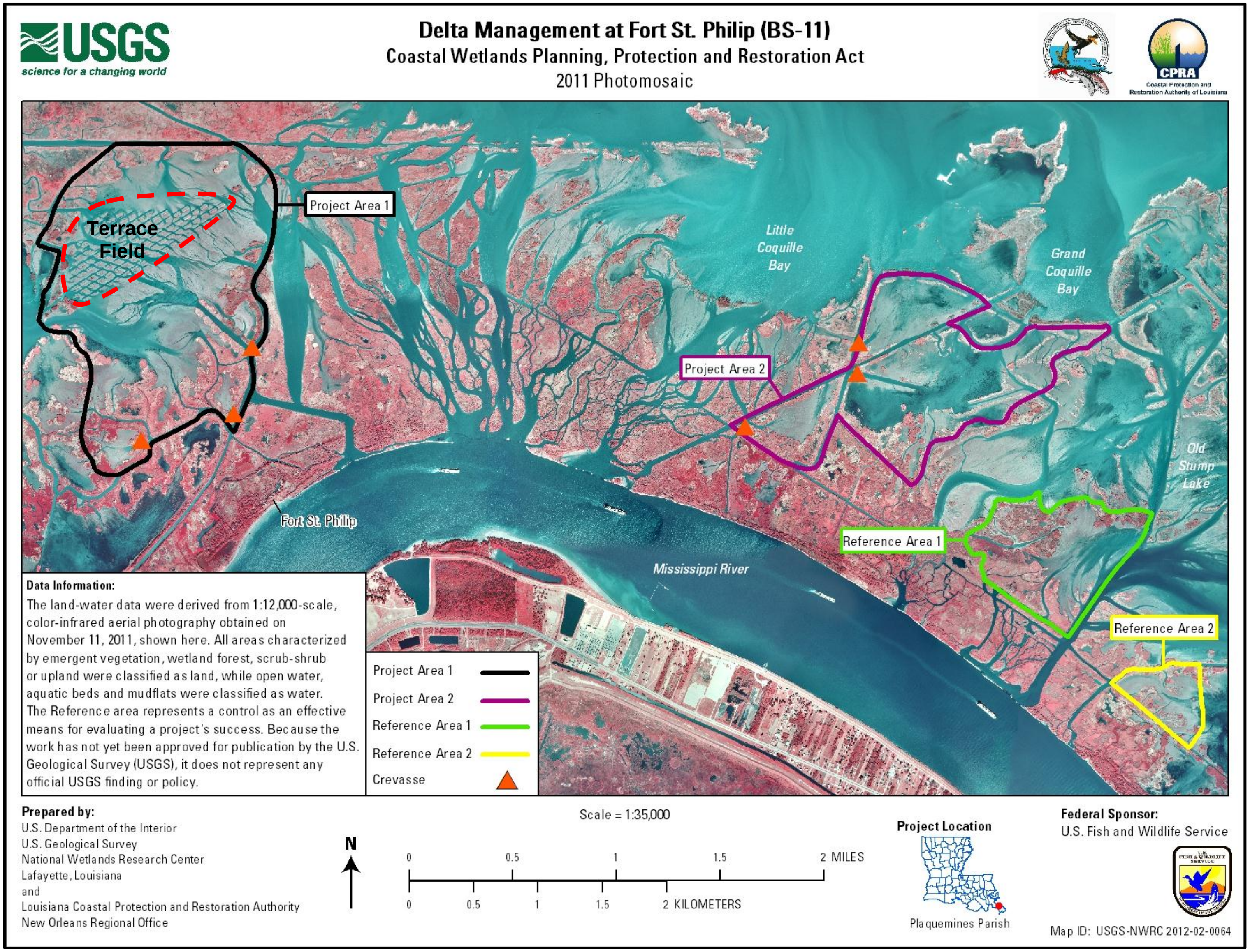


Figure 1. Delta Management at Fort St. Philip (BS-11) project and reference areas.

Marsh terracing is used to build marsh and reduce erosion rates. This restoration technique uses existing bottom sediments to create a pattern of terraces or ridges that maximize the intertidal edge and minimize wave fetch (Rozas and Minello 2001). The terraces can then be planted or seeded with marsh vegetation. The main goal of terrace-field construction is to increase sedimentation, marsh-edge habitat, and marsh productivity. Terraces have been shown to reduce erosion rates in adjacent marshes and to provide habitat for fishery species. Habitat value also increases proportionally within the newly created marsh in the terrace field (Rozas and Minello 2001). In 1990, the state successfully used marsh terracing at the Sabine National Wildlife Refuge, Louisiana (LDNR 1999b). Since that time, marsh terracing has been utilized in several CWPPRA-funded projects, including the Little Vermilion Bay Sediment Trapping (TV-12), Pecan Island Terracing (ME-14), and Four-Mile Canal Terracing and Sediment Trapping (TV-18) projects (Miller and Aucoin 2011, Thibodeax and Guidry 2009, Castellanos and Aucoin 2004). This is the first CWPPRA project to combine marsh terracing with an artificial crevasse feature.

Marshes surrounding the BS-11 project area have experienced a rapid transition from nearly unbroken marsh in 1956 to a highly fragmented marsh by 1990 (Roy 2002). In the American Bay mapping unit, in which the BS-11 project area is contained, more than 12% of the total marsh acreage was lost between 1932 and 1974. Primary contributors to this land loss included dredging, wind/wave erosion, and subsidence (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority [LCWCRTF and WCRA] 1999). In 1949 and 1968, the marshes surrounding this area were classified as brackish adjacent to the river and saline near Breton Sound (LCWCRTF and WCRA 1999). In the 1973 flood a natural crevasse formed causing intermediate marsh to establish between Area 1 and 2 by 1978 (Chabreck and Linscombe 1978). By 1988, a band of fresh and intermediate marsh had formed adjacent to the river, with the remainder of the area classified as brackish and saline (Chabreck and Linscombe 1988). Moreover, the natural crevasse lowered the rate of marsh loss between 1974 and 1990 to 10.7%. Although the crevasse has caused some marsh loss from scouring in the immediate outfall area, aerial photography has indicated that marsh loss in the area has decreased considerably. Many areas that had converted to open water were now filling with sediment (Roy 2002). However, shorelines exposed to high wave energies continued to erode, and subsidence continued to occur. An estimated 14,000 acres (5,600 hectares) was projected to be underwater by the year 2050 had no project been constructed (LCWCRTF and WCRA 1999).

In 1997 the entire area was classified as fresh and intermediate marsh, with the two project subareas being entirely intermediate marsh (Chabreck and Linscombe 1997). The marshes within the project area support a diverse assemblage of vegetative species representing a broad salinity gradient due to the influences of both the Mississippi River and Breton Sound. Species present in the project area include elephant-ear (*Colocasia esculenta*), common reed (*Phragmites australis*), bulltongue arrowhead (*Sagittaria lancifolia*), delta arrowhead (*Sagittaria platyphylla*), alligatorweed (*Alternanthera philoxeroides*), common rush (*Juncus effusus*), needlegrass rush (*Juncus roemerianus*), smartweed (*Polygonum* sp.), Walter's millet (*Echinochloa walteri*), saltmeadow cordgrass (*Spartina patens*), smooth cordgrass (*Spartina alterniflora*), Olney's threesquare (*Schoenoplectus americanus*), common threesquare (*Schoenoplectus pungens*), saltmarsh bulrush (*Schoenoplectus maritimus*), torpedo grass (*Panicum repens*), giant cutgrass (*Zizaniopsis miliacea*), hairypod cowpea (*Vigna luteola*), cattail (*Typha* sp.), and poisonbean (*Sesbania drummondii*) (Roy 2002). Submerged and floating aquatic species in the project area include spike watermilfoil (*Myriophyllum spicatum*), southern waternymph (*Najas guadalupensis*), sago pondweed (*Stuckenia pectinatus*), curly pondweed (*Potamogeton crispus*), and water stargrass (*Heteranthera dubia*) (Roy 2002).

Project Goals

The following goals and strategies for the Delta Management at Fort St. Philip project were provided by the U.S. Fish and Wildlife Service in the Environmental Assessment (Roy 2002) and the Ecological Review (Banks 2001).

Project goals are as follows:

1) By the end of the 20 year project life, create 244 additional acres (1-km^2) of emergent marsh through the construction of crevasses. It should be noted that 174 acres (0.7-km^2) of emergent marsh are projected to accrete naturally without the proposed project, thus a net gain of 418 acres (1.7-km^2) is expected within the project area by the end of the 20 year project life.

2) Create 25-acres (0.1-km^2) of emergent marsh through terrace construction. Terrace building will directly account for 16.5 acres (0.07-km^2) of emergent marsh, and the projected expansion of the vegetated terraces over the 20 year project life will account for the remaining 8.5 acres (0.03-km^2).

Project Strategies:

1) Reintroduction of alluvial sediments through six constructed crevasses.

2) Marsh creation and sediment trapping through the construction of earthen terraces with vegetative plantings.

This project aims to utilize the land-building potential of crevasses and wave reducing characteristics of terrace mounds to halt the extensive loss of marsh in the area. The objective is to enhance natural marsh growth by diverting fresh, sediment-laden water through the dredged crevasses into shallow, open-water receiving areas. The earthen terraces constructed in Subarea 1 are designed to reduce the fetch distance for wind-induced waves while also trapping sediment, thereby promoting the marsh-building processes.

Project Features

The Delta Management at Fort St. Philip project features 19,600 linear feet of terraces and six (6) artificial crevasses.

A. **Terraces –** *Subarea 1 (Figure 2).*

- A total of 98 terraces were constructed, each 200 ft in length, with a 50-ft separation between the ends of each terrace.
- Each terrace was built with a crown width of 10 ft, tapering at a slope of 1 vertical to 6 horizontal to a base width of 52 ft.
- Terraces were built to an initial elevation of +3.5 ft (NAVD 88), with a target settled elevation of +3.0 ft (NAVD 88).
- The aggregate length of constructed terraces was 19,600 linear ft.
- The minimum distance to the existing shoreline was 50 ft and minimum pipeline clearance was 50 ft. Within these constraints, the locations of individual terraces were left to the discretion of the construction manager. In order to maintain the minimum clearance from the existing pipelines, three of the terraces were scaled down by a total of 100 ft.

B. **Crevasse 1A –** *Subarea 1 (Figure 2).* 2000 ft long x 75 ft base width x -8.0 ft (NAVD 88). Marsh elevation was assumed to be +1.5 ft (NAVD 88). The crevasse, dredged from the center of the channel, passes through a reference point defined by the pre-construction shoreline (X = 3,875,963.63 ft, Y = 322,516.09 ft NAD 83), and extends along a quadrant bearing of N47^{o}W. Dredge material was placed between 25-175 feet on either side of the crevasse to a maximum elevation of +5.0 ft (NAVD 88).

C. **Crevasse 1B –** *Subarea 1 (Figure 2).* 400 ft long x 75 ft base width x -6.0 ft (NAVD 88). Marsh elevation was assumed to be +1.5 ft (NAVD 88). The crevasse, dredged from the center of the channel, passes through a reference point defined by the pre-construction shoreline (X = 3,875,557.544 ft., Y = 320,705.6253 ft NAD 83), and extends along a quadrant bearing of N22^{o}W. Dredge material was placed between 25-175 feet on either side of the crevasse to a maximum elevation of +5.0 ft (NAVD 88).

D. **Crevasse 1C –** *Subarea 1 (Figure 2).* 700 ft long x 75 ft base width x -6.0 ft (NAVD 88). Marsh elevation was assumed to be +1.5 ft (NAVD 88). The crevasse, dredged from the center of the channel, passes through a reference point defined by the pre-construction shoreline (X = 3,873,382.42 ft, Y = 320,246.83 ft NAD 83), and extends along a quadrant bearing of S77oW. Dredge material was placed between 25-175 feet on either side of the crevasse to a maximum elevation of +5.0 ft (NAVD 88).

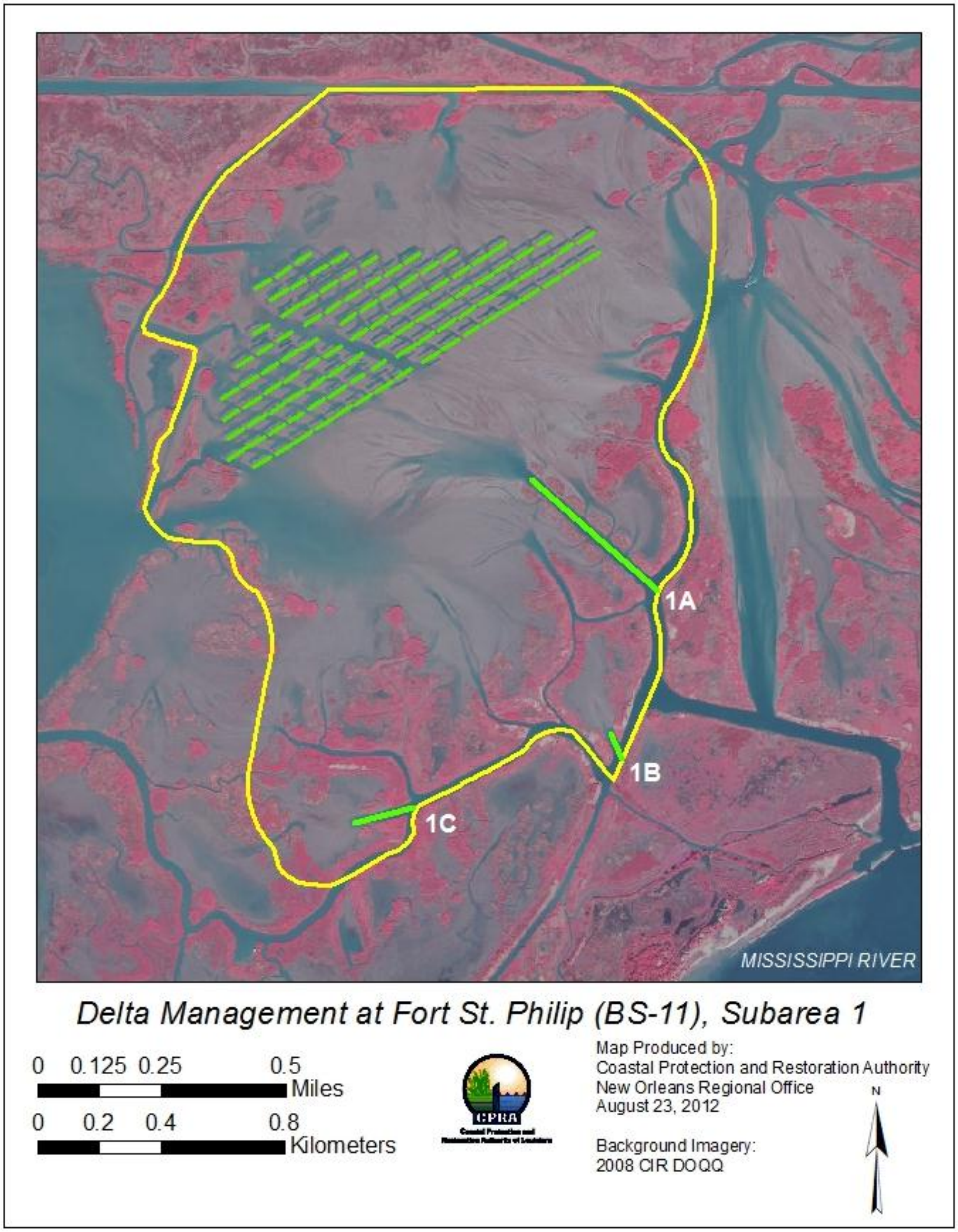


Figure 2. Project features within Subarea 1 of the Delta Management at Fort St. Philip (BS-11) project.

E. **Crevasse Alt. 2A** – *Subarea 2 (Figure 3)*. 732 ft long x 75 ft base width x -8.0 ft (NAVD 88). Crevasse 'Alt 2A' replaced the proposed Crevasse '2A' located further north along the pipeline canal. Marsh elevation was assumed to be +1.5 ft (NAVD 88). The crevasse, dredged from the center of the channel, passes through a reference point defined by the pre-construction shoreline (X = 3,891,269.92 ft, Y = 322,243.99 ft NAD 83), and extends along a quadrant bearing of N50^{o}E. Dredge material was placed between 25-175 feet on either side of the crevasse.

F. **Crevasse 2B** – *Subarea 2 (Figure 3)*. 500 ft long x 75 ft base width x -6.0 ft (NAVD 88). Marsh elevation was assumed to be +1.5 ft (NAVD 88). The crevasse, dredged from the center of the channel, passes through a reference point defined by the pre-construction shoreline (X = 3,888,519.61 ft, Y = 320,569.13 ft NAD 83), and extends along a quadrant bearing of S69^{o}E. Dredge material was placed within 175 ft and no closer than 25 ft on either side of the crevasse to a maximum elevation of +5.0 ft NAVD 88.

G. **Crevasse 2C** – *Subarea 2 (Figure 3)*. 2000 ft long x 75 ft base width x -6.0 ft (NAVD 88). Marsh elevation was assumed to be +1.5 ft (NAVD 88). The crevasse, dredged from the center of the channel, passes through a reference point defined by the pre-construction shoreline (X = 3,891,138.38 ft, Y = 321,807.44 ft NAD 83), and extends along a quadrant bearing of S77^{o}E. Dredge material was placed between 25-175 feet on either side of the crevasse to a maximum elevation of +5.0 ft (NAVD 88).

The Coastal Protection and Restoration Authority (CPRA) and the United States Fish and Wildlife Service (USFWS) inspect all crevasses annually to ensure continued sediment transport to the receiving bays. Due to shallow water depths (1.5 to 2.0-ft) and reduced fetch, significant erosion of the terraces was not expected to occur. Also, terraces are not subject to maintenance or rehabilitation under the Cost Sharing Agreement or permits. Therefore, no maintenance of the terraces was proposed.

In November 2006, approximately 18,000 vegetative plugs of smooth cordgrass (*Spartina alterniflora* 'Vermilion') were planted along the edges of the newly constructed terraces and 4,900 4-inch containers of seashore paspalum (*Paspalum vaginatum* 'Brazoria') were planted along the upper edge of the terraces. Vegetative plantings on the terraces were contracted out separately from the construction contract and are not subject to maintenance or rehabilitation by CPRA or USFWS.

All crevasses except 1B were constructed at a 60-degree angle from the parent pass using a barge-mounted, bucket dredge. Crevasse 1B was constructed at a 120-degree angle from the parent pass. Dredge material from crevasse construction was placed into adjacent disposal areas up to a height of +5.0 ft (NAVD88).

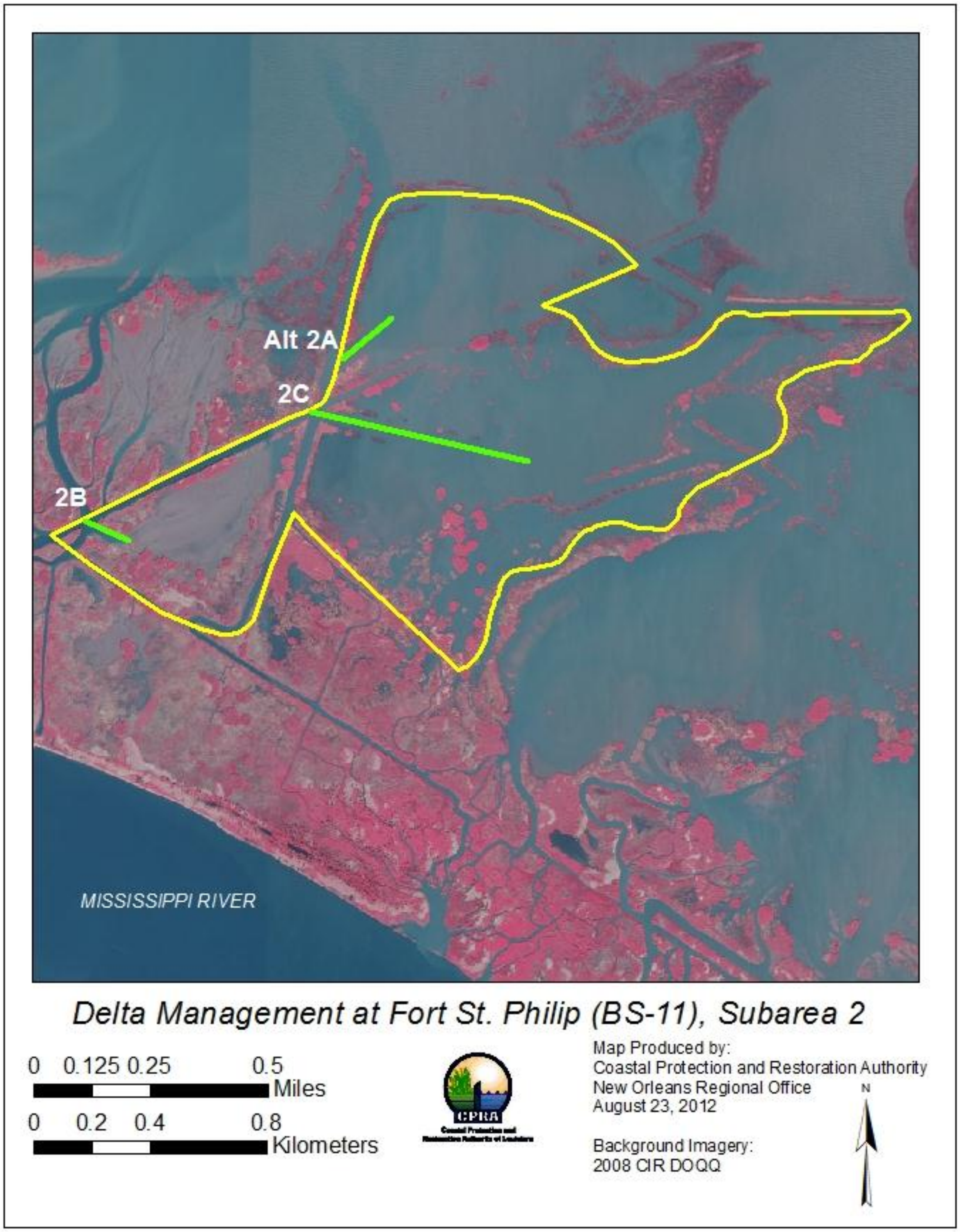


Figure 3. Project features within Subarea 2 of the Delta Management at Fort St. Philip (BS-11) project.

II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the Delta Management at Fort St. Philip Project (BS-11) is to evaluate the constructed project features and identify any deficiencies. The CPRA assesses the urgency of any necessary repairs and provides a detailed cost estimate for the engineering, design, supervision, inspection, and construction contingencies (O&M Plan May 13, 2007). Any recommended corrective actions are detailed in the annual inspection report. The annual inspection report also contains a summary of project maintenance and an estimated projected budget for operation, maintenance, and rehabilitation for the upcoming three (3) years.

The most recent annual inspection of the Delta Management at Fort St. Philip Project (BS-11) was held on May 22, 2012. Melissa Hymel and Kyle Breaux of CPRA and Kevin Roy of USFWS were in attendance. Winds were out of the WNW at 5 mph and skies were clear. At 8:00 AM the Mississippi River Gage at the Venice, La. station recorded +2.39 ft NAVD 88. Photographs of the inspection and the three-year budget projection are included in Appendices A and B.

b. Inspection Results

i. **Terraces:** Terraces built on the northeastern side with soft, unsuitable material have developed washout areas through the terraces. Terraces on the southern end – at the end of crevasse 1A – are degrading due to their placement as the front row of the terrace field. Their original constructed elevations have slightly decreased. Vegetation densely covers each terrace.

ii. **Crevasse 1A:** This crevasse funnels river water directly into the Bay Denesse terrace field. The crevasse has created a splay that has defined distributaries off the main crevasse. An elevation survey conducted in November 2011 indicates that this crevasse has deepened since construction.

iii. **Crevasse 1B:** Grasses have sprouted on an island formed in the crevasse after the 2011 high river event. Mudflats within the receiving bay are visible above the water surface.

iv. **Crevasse 1C:** The 2011 survey indicates this crevasse has begun infilling. The channel outfall shows colonization of emergent vegetation.

v. **Crevasse Alt. 2A:** Flow is maintained within the channel. The channel has filled to 1'-3' deep.

vi. **Crevasse 2B:** Flow is maintained within the channel. Sporadic vegetated islands are emerging within the receiving bay. The channel has begun filling in; the deepest part of the channel runs along the northern bank.

vii. **<u>Crevasse 2C:</u>** The channel has begun infilling, but flow is maintained within the channel. The receiving bay floor is supporting SAV along with vegetated mudflats.

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs

There are no immediate or emergency repairs needed at this time.

ii. Programmatic/ Routine Repairs

Elevation surveys from October 2011 indicate that shoaling is occurring within the crevasses. Results from this survey will be discussed in further detail in Section IV. CPRA will evaluate the deposition patterns and determine best use of the maintenance funds available. If CPRA determines crevasse clean-outs are the best alternative, they will submit a cost estimate for the first round of maintenance dredging of the crevasses.

d. Maintenance History

There has been no maintenance performed on this project to date.

III. Operation Activity

a. Operation Plan

An Operation Plan is not required for this project.

b. Actual Operations

Operations are not required for this project.

III. Monitoring Activity

Pursuant to a CWPPRA Task Force decision on August 14, 2003, the Coastwide Reference Monitoring System-*Wetlands* (CRMS) was adopted, which established a network of monitoring stations across the Louisiana coast. There is one CRMS site located in the project area, CRMS0139, which will be used to supplement existing project-specific data.

a. Monitoring Goals

Monitoring strategies for the Delta Management at Fort St. Philip project address both the sediment diversion and the sediment trapping features of this project. They focus on evaluating project effects on land/water ratios, bathymetry/topography, and emergent vegetation. Analysis of land/water ratios in the project and reference areas will be used to determine the effects of the constructed crevasses and terraces on the acreage of subaerial land. Periodic elevation surveys of the crevasse receiving bays and of the terrace field will be performed in conjunction with Operations and Maintenance to monitor project effects on vertical accretion of sediment. Surveys of emergent vegetation within the crevasse receiving bays and terrace field will determine if the project is effectively creating marsh substrate for colonizing vegetation.

The specific measurable goals established to evaluate the effectiveness of the project are:

- Determine the effects of the project on land/water ratios in the project area.
- Determine the changes in the elevation within the crevasse receiving bays and the terrace field as a result of the creation of sub-aerial land.
- Determine the changes in emergent vegetation within the crevasse receiving bays and the terrace field.

b. Monitoring Elements

The following monitoring elements will provide the information necessary to evaluate the specific goals listed above:

Elevation

Elevation surveys were conducted within the project area in 2002 (pre-construction), 2006 (as-built), and 2011 (year 5). Transect lines were established within the dredged crevasse channels to verify as-built specifications and to determine the need for maintenance dredging at years 5 and 15. Transect lines were established within the terrace field and receiving bays to document changes in elevation as it relates to the creation of sub-aerial land. Two reference monuments, "HYD-1" and "HYD-2", were established in 2002 prior to construction and were utilized for all three survey events. Lowe Engineers, Inc., under contract by the CPRA, utilized the volume calculation tools within AutoDesk Civil 3D 2012 for comparison of data from all survey years. Lowe created Digital Terrain Models (DTM) in Hypack and Bentley InRoads software. These terrain modeling packages are robust and leverage superior methods of generating Triangular Irregular Networks (TINs). The DTM and/or TIN were generated in three dimensions and were suitable for use in Civil 3D 2012 without loss of data.

Crevasse Channels: The six crevasse channels were surveyed in 2002 (pre-construction), 2006 (as-built), and 2011 (year 5). Survey points at each cross-section within the dredged crevasse channels were taken every 20 ft along evenly spaced lines, perpendicular to the crevasse centerline (Figure 4, Crevasse 1A). The DTM from 2011 data was overlaid on the 2002 and 2006 surfaces, and volumetric comparisons were made for the entire surface. Lowe calculated volume changes in AutoCAD using the average end-area method.

Receiving Bays: All receiving bays were surveyed in 2002; however, only Crevasses 1A and Alt 2A were surveyed in 2011 due to the limitations of the monitoring budget. The receiving bays were not included in the 2006 survey. Within the receiving bays, three transect lines spaced 500 ft apart were established perpendicular to each crevasse centerline (Figure 4, Crevasse 1A). Elevations were recorded every 250 ft or at any significant change in elevation. The DTM derived from the 2002 survey data served as a baseline for the analysis. The DTM from the 2011 survey was then overlaid on the baseline surface and volumetric comparisons were made for the entire surface. Lowe calculated volume changes in AutoCAD using the average end-area method.

Terrace Field: The terrace field was surveyed in 2002, 2006, and 2011 (Figure 4). In 2002, a grid of points was surveyed within the area of the proposed terrace field. Grid lines were spaced 500-ft (152.4-m) apart, and elevations were recorded at points every 100-ft (30.5-m) along each grid line. In 2006 (as-built), elevations were surveyed along 18 transects spaced 250 ft apart, running perpendicular to the terraces. Elevations were recorded approximately every 20 ft along the transect lines. Due to monitoring budget limitations, a subset of the 2006 transects was surveyed in 2011. A total of 9 transects spaced 500 ft apart were surveyed, and elevations were recorded at 50-ft intervals as well as at the crown of each intercepted terrace. The lack of variation in elevation of the 2002 grid dataset made it suitable as a baseline surface for comparison with the 2006 and 2011 datasets. The DTMs from 2006 and 2011 data were then overlaid and reviewed to determine where comparisons were appropriate. Area calculations were made among pairings of the three DTMs. However, due to data coverage limitations within the highly irregular terrace field surface, volumetric calculations were not suitable as a means of comparison.

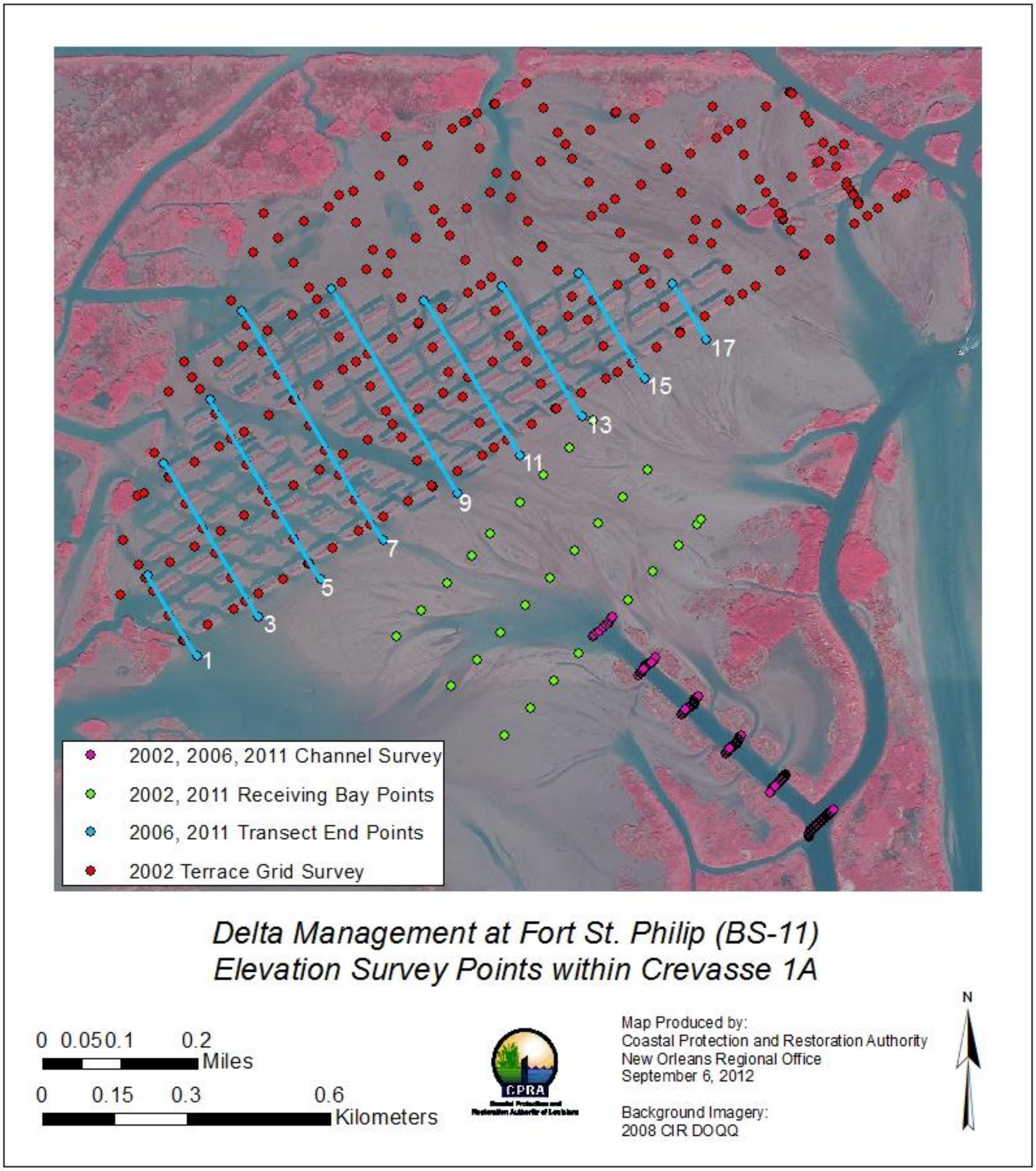


Figure 4. Layout of elevation survey points in Crevasse 1A of the Delta Management at Fort St. Philip (BS-11) project.

Photography

Color-infrared aerial photography (1:12,000 scale) was obtained of the project and reference areas in 2002 (pre-construction), 2006 (as-built), and 2011 (Year 5). Photography will be obtained again in years 2021 (Year 15) and 2026 (Year 20). The acquired photography was geo-rectified, photo-interpreted, and analyzed to determine land/water ratios using standard operating procedures documented in Steyer et al. (1995, revised 2000).

Vegetation

Species composition, percent cover, and relative abundance were evaluated within the terrace field at 18 4-m^2 plots using a modified Braun-Blanquet sampling method (Mueller-Dombois and Ellenberg 1974) in 2007 and 2011 (Figure 5). According to the monitoring plan, two receiving bays (one in each subarea) were to be chosen for vegetation sampling at years 5, 10, and 15. Crevasse 1A was chosen from Subarea 1 and crevasse Alt 2A was chosen from Subarea 2. Vegetation plots were to be chosen from the survey points located along the elevation survey transects; however, vegetation was not found at any of these survey points in 2011 (year 5). The splay in crevasse 1A is sub-aerial during low tide and sparse, isolated patches of *Sagittaria* (arrowhead) were observed at some locations within the receiving bay. The survey points within these two receiving bays will continue to be monitored during annual inspection trips and will be sampled at year 10 if emergent vegetation is present. Vegetation surveys will be conducted again within the terrace field and crevasses 1A and Alt 2A in 2016 (Year 10) and 2021 (Year 15).

Emergent marsh vegetation has also been sampled annually at CRMS0139 since 2007. Ten 2-m x 2-m sampling plots were randomly located along a 288-m transect and were sampled using the same method described above (Figure 5). Percent coverage data from the terrace field stations and CRMS stations were summarized according to the Floristic Quality Index (FQI) method utilized by CRMS (Cretini et al. 2011), where cover is qualified by scoring species according to their tolerance to disturbance and stability within specific habitat types.

CRMS Supplemental

Additional data was collected at CRMS0139 which can be used as supporting or contextual information for this project. Data types collected at CRMS sites include hydrologic, emergent vegetation, physical soil characteristics, discrete porewater salinity, marsh surface elevation change, vertical accretion, and land:water analysis of 1 km^2 area encompassing the station (Folse et al. 2008, revised 2012).

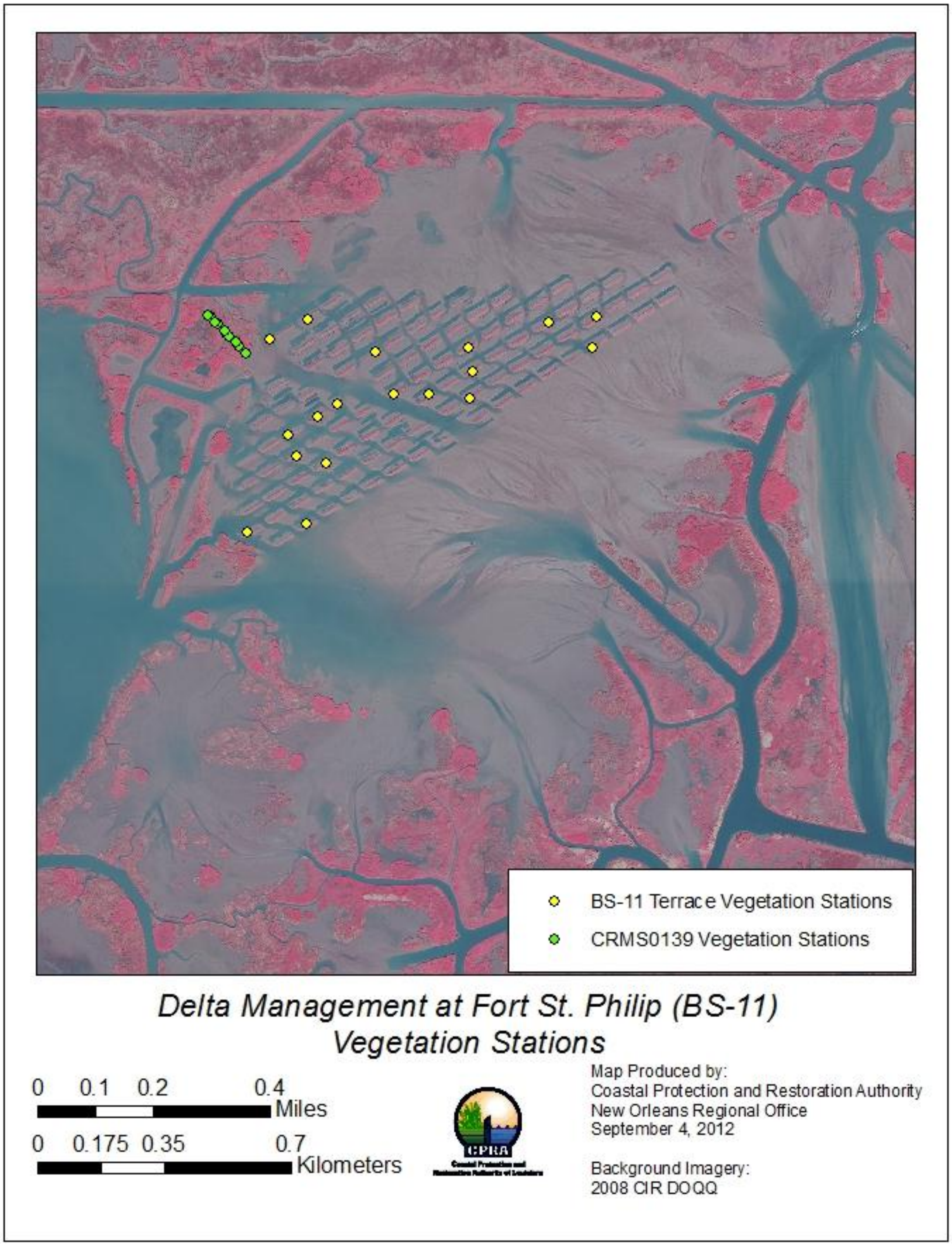


Figure 5. Vegetation stations within the Delta Management at Fort St. Philip project area.

c. Preliminary Monitoring Results and Discussion

Elevation

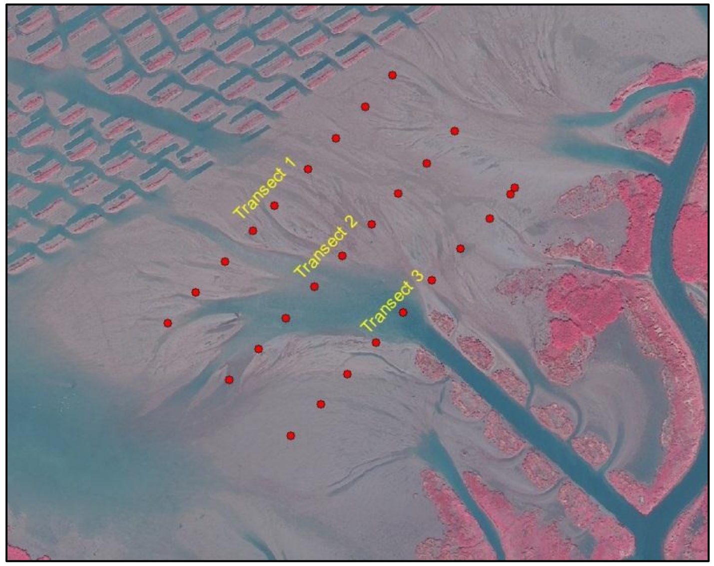
Crevasse Channels: Results indicate that the crevasse channels are filling in with the exception of crevasse 1A, which has deepened. Recorded depths varied from 1-5 feet below the constructed depth. Table 1 displays the amount of sediment deposition experienced within each channel. Results from the 2011 survey show 10,000 yd^3 were scoured from the Crevasse 1A channel since construction. All other crevasses have accreted more sediment than was removed within the original design footprint. Crevasse 1C contains 143% more material than was removed within the design boundaries. Project inspection trips confirm that the crevasse cuts can still be identified, but the subaqueous land is shallow.

Table 1. Sediment removal (2006) and deposition (2006-2011) within dredged crevasses (yd^3).

Crevasse	Angle	Width	2006 Change	2011 Change	% Change
1A	60°	Narrow	-32,386.00	-10,005.84	-30.90%
1B	120°	Narrow	-8,914.28	8,331.42	93.46%
1C	60°	Narrow	-5,864.50	8,409.70	143.40%
Alt 2A	60°	Narrow	-9,456.62	9,692.53	102.49%
2B	60°	Narrow	-6,076.63	1,945.75	32.02%
2C	60°	Narrow	-22,690.29	25,264.65	111.35%
Average			-14,231.39	7,273.04	75%

Receiving Bays: Receiving bay 1A showed a net loss of -1,142.39 cubic yards (yd^3) of material from 2002 (pre-construction) to 2011 (year 5). Much of this loss can be attributed to the extension of the crevasse channel into the receiving bay. The profile drawings of transects 1 and 2 show some sediment accumulation on the sides of the channel (Figure 6). The deepening and extension of the crevasse channel may be depositing the sediment load beyond the boundaries of the survey transects. The terrace field also covers much of the northern half of this receiving bay, which traps a large quantity of the sediment load.

Receiving bay Alt 2A showed a net loss of -1,176.16 cubic yards (yd^3) of sediment from 2002 (pre-construction) to 2011 (year 5). The profile drawings show relatively small changes in elevation between pre-construction and year 5 (Figure 7). Elevation was highest along Transect 3 which is closest to the crevasse channel, and there was no scouring due to the crevasse channel inflow as seen in crevasse 1A. The channel survey, however, indicated a gain of 9,692.53 cubic yards (yd^3) from 2006 to 2011. Infilling of the channel appears to be hindering the accumulation of sediment in the receiving bay of crevasse Alt 2A.



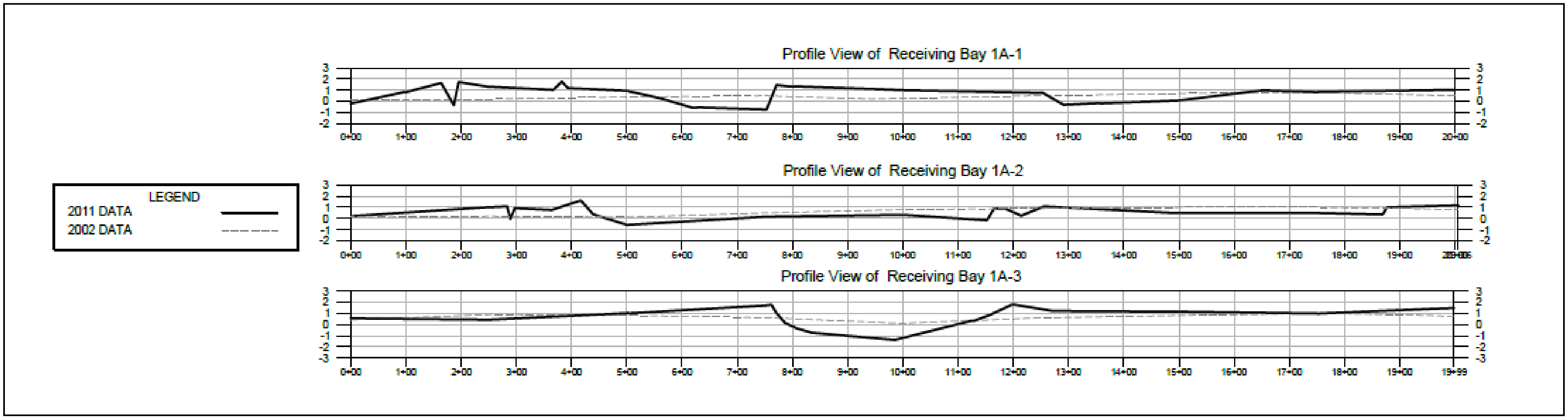


Figure 6. Profile view of elevation survey transects within the receiving bay of crevasse 1A of the Delta Management at Fort St. Philip (BS-11) project.

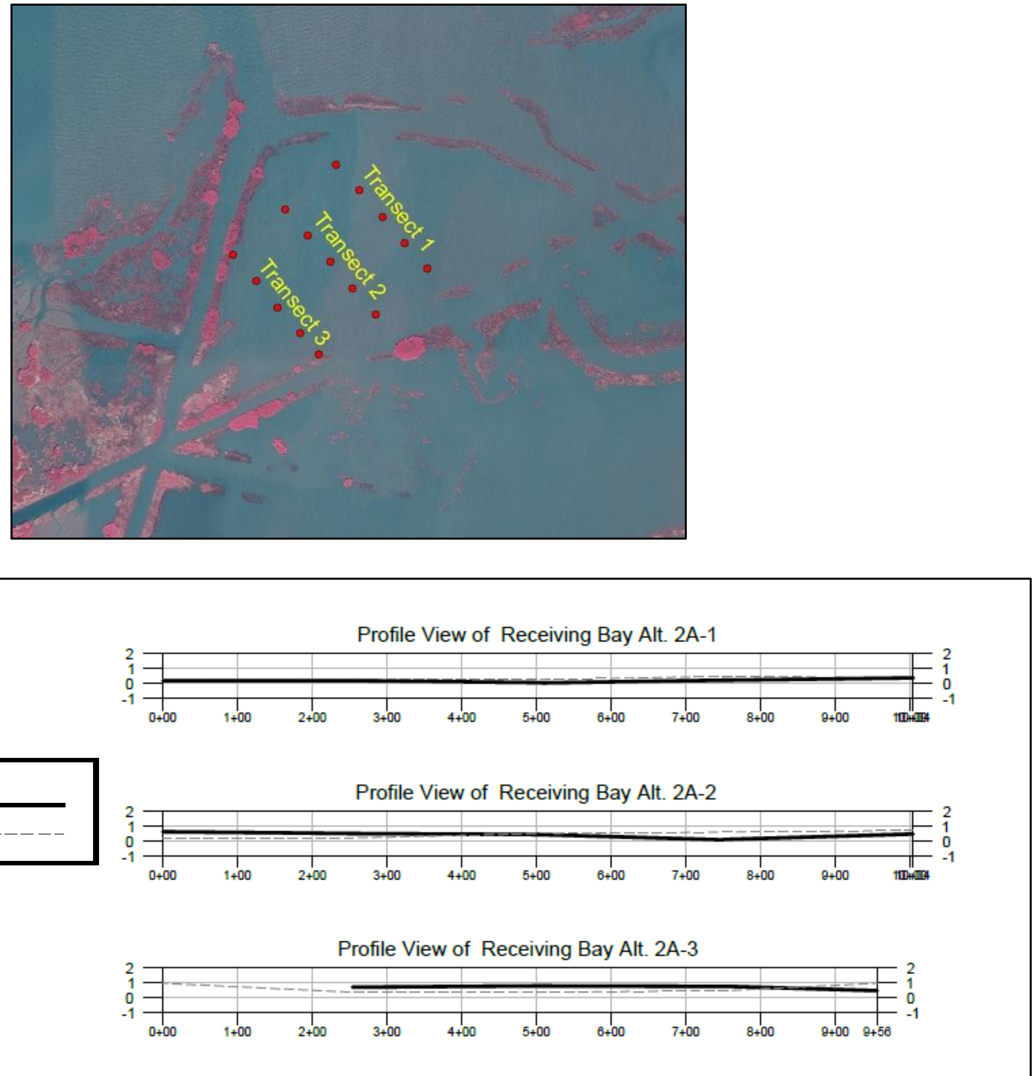


Figure 7. Profile view of elevation survey transects within the receiving bay of crevasse Alt 2A of the Delta Management at Fort St. Philip (BS-11) project.

Terraces: Nine (9) transects were surveyed across the terrace field in 2011 (Figure 4) and were compared to the 2002 and 2006 survey data. Survey transects were identical in the 2006 and 2011 surveys; however, discrepancies in the 2006 data were immediately identified. The 2006 survey reflects a terrace crown elevation even where transects crossed directly between two adjacent terraces, whereas the 2011 survey accurately reflects a low elevation in these locations (Figure 8). The erosion of some terraces is therefore exaggerated upon comparison of the two datasets. Presumably, the points were taken at terrace peaks where necessary in 2006 to indicate as-built specifications, and then snapped to the transect line during post-processing. Unfortunately, unmanipulated datasets from 2006 could not be obtained from the surveyor. As a result, sediment losses calculated from 2006 to 2011 for selected transects may be overestimated.

The 2011 profile of the terrace field transects indicate a general 'flattening' of the 2006 profile, due to infilling of the borrow channels and erosion/subsidence of the terraces (Figure 8). The profile views show the terrace crowns subsiding about one foot on average from 2006 to 2011. Loss of terrace height was even greater at points along the terrace edges, where scouring and erosion occurred. Significant shoaling, however, was seen within the borrow areas around the terraces, which affirms that sediment is being retained within the terrace field.

Volumetric comparisons could not be made within the terrace field due to the highly irregular surface between the survey transects. Area calculations, however, showed that the terrace field experienced a net loss of sediment along all nine transects from 2002 to 2006 due to construction of the terraces (Figure 8, Table 2). The total net loss of sediment along all transects due to construction was 3,480.98 ft^2. By 2011, the terrace field experienced a net gain of 4127.66 ft^2 along all nine transects. Due to the anomalies in the 2006 data, both of these values may be underestimated. The comparison between the 2002 (pre-construction) and 2011 (year 5) is the most valid because it does not include the anomalous data from 2006. This comparison showed a net gain along six out of the nine transects, for a total net gain of 794.76 ft^2. Rough approximations of sediment volume using the average end area method of estimation show that 71,037 yd^3 of sediment was gained from 2006 to 2011, while the net volume gained overall from 2002 to 2011 was 14,464 yd^3. In the five years since construction, most of the gain in sediment replaced sediment lost to construction. Net sediment gain at year 5 is modest compared to pre-construction conditions; however, the terraces remain subaerial and will continue to capture material as designed.

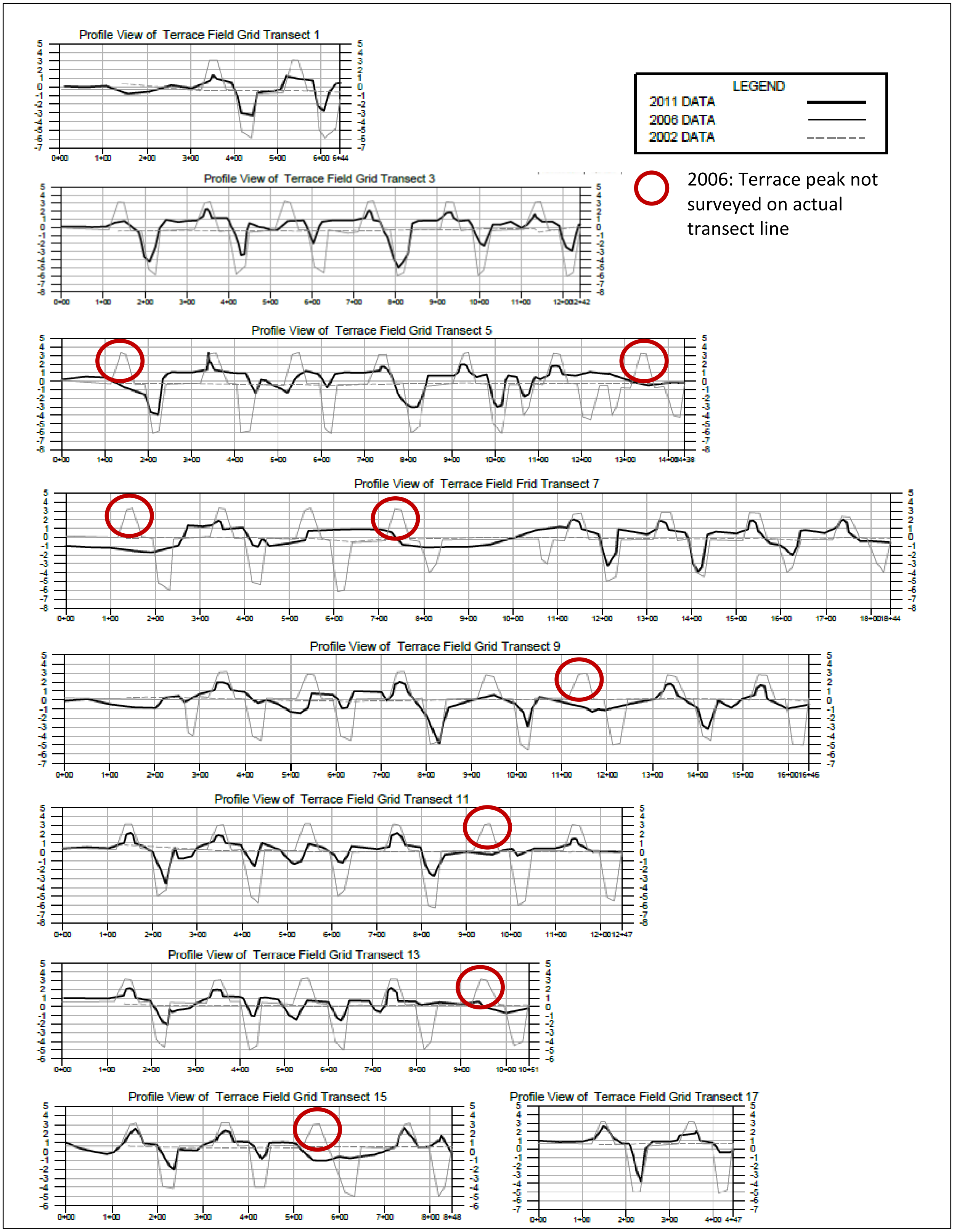


Figure 8. Profile view of surveyed transects within the terrace field of the Delta Management at Fort St. Philip project in 2002, 2006, and 2011.

Table 2. Comparison of loss/gain and net change in area of sediment (ft^2) along nine terrace field transects surveyed in 2002, 2006, and 2011 within the Delta Management at Fort St. Philip (BS-11) project.

	2002 VS 2006			2006 VS 2011			2002 VS 2011		
TRANSECT	**LOSS (ft^2)**	**GAIN (ft^2)**	**NET CHANGE (ft^2)**	**LOSS (ft^2)**	**GAIN (ft^2)**	**NET CHANGE (ft^2)**	**LOSS (ft^2)**	**GAIN (ft^2)**	**NET CHANGE (ft^2)**
1	-487.03	261.19	-225.84	-176.74	457.15	280.41	-172.71	193.53	20.82
3	-1,070.01	697.11	-372.90	-387.53	1,126.14	738.61	-511.04	867.35	356.31
5	-1,383.78	838.03	-545.75	-590.55	1,720.96	1,130.41	-435.91	984.86	548.95
7	-1,407.62	824.92	-582.70	-986.37	1,569.34	582.97	-723.24	918.25	195.01
9	-1,263.86	812.13	-451.73	-934.03	956.82	22.79	-793.14	419.32	-373.82
11	-1,102.55	611.12	-491.43	-505.46	986.47	481.01	-372.57	363.88	-8.69
13	-774.44	571.11	-203.33	-471.88	792.95	321.07	-263.12	348.16	85.04
15	-731.28	372.02	-359.26	-368.42	635.81	267.39	-319.07	273.63	-45.44
17	-395.98	147.94	-248.04	-40.10	343.10	303.00	-129.36	155.94	26.58
TOTAL	-8,616.55	5,135.57	**-3,480.98**	-4,461.08	8,588.74	**4,127.66**	-3,720.16	4,524.92	**804.76**

Photography

One of the specific monitoring goals for the Delta Management at Fort St. Philip project was to determine the effects of the project on land/water ratios. To evaluate land changes within the project and reference areas, land/water analyses were conducted on photography collected in 2002 (pre-construction), 2006 (as-built), and 2011 (year 5) (See Appendix D for complete map set). All areas characterized by emergent vegetation, wetland forest, scrub-shrub, or upland were classified as land, while open water, aquatic beds, and mudflats were classified as water.

The project area gained 75 acres of land from 2002 to 2006 and 15 acres of land from 2006 to 2011 for a net gain of 90 acres from 2002 to 2011 (Table 3). More land was gained within each receiving area from 2002 to 2006 than from 2006 to 2011, due in part to project construction which created subaerial land along the crevasse channels and within the terrace field.

Table 3. Summary of 2002, 2006, and 2011 land-water analyses, BS-11 project and reference areas.

		2002-2006		2006-2011		2002-2011	
Crevasse	Total Acreage	Land Change (acres)	% of Total Acreage Gained/Lost	Land Change (acres)	% of Total Acreage Gained/Lost	Land Change (acres)	% of Total Acreage Gained/Lost
1A	775	50	6%	8	1%	58	7%
1B	31	2	6%	1	3%	3	10%
1C	50	8	16%	6	12%	14	28%
Alt 2A	98	2	2%	-3	-3%	-1	-1%
2B	87	11	13%	2	2%	13	15%
2C	305	2	<1%	1	<1%	3	1%
TOTAL	**1346**	**75**	**6%**	**15**	**1%**	**90**	**7%**
Reference 1	228	12	5%	29	13%	41	18%
Reference 2	67	3	4%	4	6%	7	10%
TOTAL	**295**	**15**	**5%**	**33**	**11%**	**48**	**16%**

Some land gain was expected to occur naturally within the project area, with the WVA assuming a natural growth rate of 1.8 ac/yr in Subarea 1 and 0.5 ac/yr in Subarea 2. Overall, Crevasse 1C experienced the greatest percent of total acreage gained. Crevasse Alt 2A was the only area to lose land in the post-construction period with an overall net loss of 1%.

The reference areas and project areas experienced similar gains in acreage from 2002 to 2006, but Reference Area 1 gained more land from 2006 to 2011 than any of the project receiving bays. The Jurjevich Canal, which runs along its eastern side of Reference Area 1, appears to be supplying significant sediment input. Total percent of acreage gained in Reference Area 2 from 2006 to 2011 was also greater than five of the six receiving bays.

The reference areas are located slightly downriver from the project areas – flow from the river travels a shorter, more direct route to the reference areas. There are no pre-construction elevation surveys of the reference areas to compare whether the receiving areas were shallower than the project receiving areas.

Multiple regression analyses were performed before project construction to determine the relationship between several crevasse parameters and the growth rate of emergent marsh in the project area (Banks 2001). Crevasse parameters used to predict growth rates included parent channel order, parent channel width, crevasse cross-sectional area, crevasse age, and receiving bay area. Growth rates predicted for the 20-yr project life were considerably higher than the actual rates observed for years 1 through 5 of the project (Table 4). If land growth continues at the rate observed in years 1-5 then only 60 acres would be gained by year 20 of the project, as compared to the predicted gain of 222 acres.

Much of the sedimentation in years 1 to 5 served to decrease depths within the open water receiving areas and may just now be reaching subaerial levels. The 2011 photomosaic shows numerous mudflats throughout the project areas.. As these mudflats become subaerial, emergent vegetation will begin colonizing more open areas of the receiving bays, which was observed during the 2012 inspection (Figure 9). Once vegetated, these areas will then be classified as 'land'. The 2011 survey of the crevasse channels showed extensive shoaling, which is likely preventing sediment from reaching the receiving bays.. Maintenance dredging of the crevasses is currently being planned to improve future project performance.

Table 4. Predicted vs. actual growth rates (acres/yr) of vegetated land within the BS-11 project area.

	Growth Rate (acres/yr)	
Crevasse	Predicted*	Actual (2006-2011)
1A	4.34	1.60
1B	1.15	0.20
1C	-0.09	1.20
Alt 2A	0.67	-0.60
2B	2.07	0.40
2C	2.95	0.20
TOTAL	**11.09**	**3**
Acreage after 20 yrs	222	60

*Source: Banks 2001

Figure 9. Colonization of *Colocasia esculenta* (elephant ear) on a mudflat located in Crevasse 1B of the Delta Management at Fort St Philip (BS-11) project.

Vegetation

Vegetation surveys were conducted in year 1 (2007) and year 5 (2011) at 18 4-m^2 plots within the terrace field (Figure 5). The coverage and diversity of vegetation on the terraces increased significantly during the first growing season following construction and planting in 2006. In August 2007, 28 species were documented on the surveyed terraces (Table 5). Dominant species included the planted species, *Spartina alterniflora* and *Paspalum vaginatum*, as well as *Echinochloa walterii, Vigna luteola,* and *Polygonum spp.* (Figure 10). The planting schematic remained evident in 2007 with thick growth of *Spartina alterniflora* around the terrace edges; however, the planted *P. vaginatum* appeared to be becoming displaced on many of the terraces, particularly by *E. walterii*.

Notable changes in species composition and cover occurred within the terrace field from 2007 (year 1) to 2011 (year 5). The total number of species observed decreased from 28 in 2007 to 16 in 2011 (Table 5). A greater number of species associated with disturbance were observed in 2007, such as various *Cyperus* (flatsedge) species, which were not observed in 2011. Several species were observed in 2011 that were not observed in 2007, such as *Colocasia esculenta, Panicum repens, Schoenoplectus robustus,* and *Schoenoplectus tabernaemontani*. Stands of *Phragmites australis* were also observed in the terrace field in 2011, but were not captured in any of the sampling plots.

The dominant species in 2011 were *S. alterniflora* and *P. puncatum* (Figure 10). *S. alterniflora* was the only species found in or near every plot sampled. A large decrease in percent cover of *E. walterii,* as well as the artificially planted species, *P. vaginatum*, was observed in 2011. Alternatively, an increase in the percent coverage of *Polygonum spp., V. luteola,* and *Schoenoplectus americanus* was observed in 2011. The percent coverage of *S. alterniflora* was 27% in both sampling years. Overall, the vegetation on the terraces appeared vigorous, and the changes in species composition were mostly typical of a post-disturbance (i.e., construction) event. Although some terraces have subsided, all are still supporting vegetative cover.

Vegetation was also surveyed annually at CRMS0139 from 2007 to 2011. This site is located to the northwest of the terrace field area, and may be considered a natural reference marsh for comparison with the vegetation on the constructed terraces. Average marsh elevation at this site is 1.4 ft NAVD 88. Ten 4-m^2 plots were sampled along a transect within a 200-m^2 area at this CRMS site (Figure 5). Species composition and abundance was relatively stable at CRMS0139 from 2007 to 2011 with co-dominant species being *Alternanthera philoxeroides*, *P. australis,* and *S. alterniflora* (Figure 11). Other commonly occurring species were *V. luteola*, and *P. repens*. The most obvious difference in vegetation between CRMS0139 and the terrace sites would be the absence of *P. australis* and lower coverage of *A. philoxeroides* within the terrace field. *P. australis* was observed within the terrace field in 2011; however, this species tends to be highly localized and mono-specific where it occurs and was not represented in any of the plots. *A. philoxeroides* is an undesirable, invasive species which may be less abundant in the terrace field due to the higher elevation of the terraces.

Table 5. All species observed during the Delta Management at Fort St. Philip terrace vegetation surveys in 2007 and 2011. This includes all species found inside and within 15-ft outside of the 18 4-m^2 plots.

Scientific Name	Common Name	2007	2011
Alternanthera philoxeroides	alligatorweed	X	X
Amaranthus sp.	amaranth	X	
Ammannia latifolia	pink redstem	X	
Colocasia esculenta	coco yam / elephant ear		X
Cuscuta indecora	bigseed alfalfa dodder	X	
Cyperus difformis	variable flatsedge	X	
Cyperus odoratus	fragrant flatsedge	X	
Cyperus strigosus	strawcolored flatsedge	X	
Cyperus sp. #1	flatsedge	X	
Cyperus sp. #2	flatsedge	X	
Distichlis spicata	seashore saltgrass	X	
Echinochloa walteri	coast cockspur	X	X
Eclipta prostrata	false daisy	X	
Kosteletzkya virginica	virginia saltmarsh mallow	X	
Ludwigia grandiflora	large-flower primrose-willow	X	
Panicum repens	torpedo grass		X
Paspalum vaginatum	seashore paspalum	X	X
Pluchea odorata	sweetscent	X	
Polygonum sp.	smartweed	X	X
Sagittaria lancifolia	bulltongue	X	
Sagittaria platyphylla	delta arrowhead	X	X
Schoenoplectus americanus	olney bulrush	X	X
Schoenoplectus californicus	California bulrush	X	X
Schoenoplectus robustus	sturdy bulrush		X
Schoenoplectus tabernaemontani	softstem bulrush		X
Sesbania drummondii	poisonbean	X	X
Spartina alterniflora	smooth cordgrass	X	X
Spartina patens	marshhay cordgrass	X	
Strophostyles helvola	amberique-bean	X	
Symphyotrichum tenuifolium	perennial saltmarsh aster		X
Typha domingensis	cattail	X	X
Vigna luteola	hairypod cowpea	X	X
Xanthium strumarium	rough cockleburr	X	
TOTAL SPECIES:		**28**	**16**

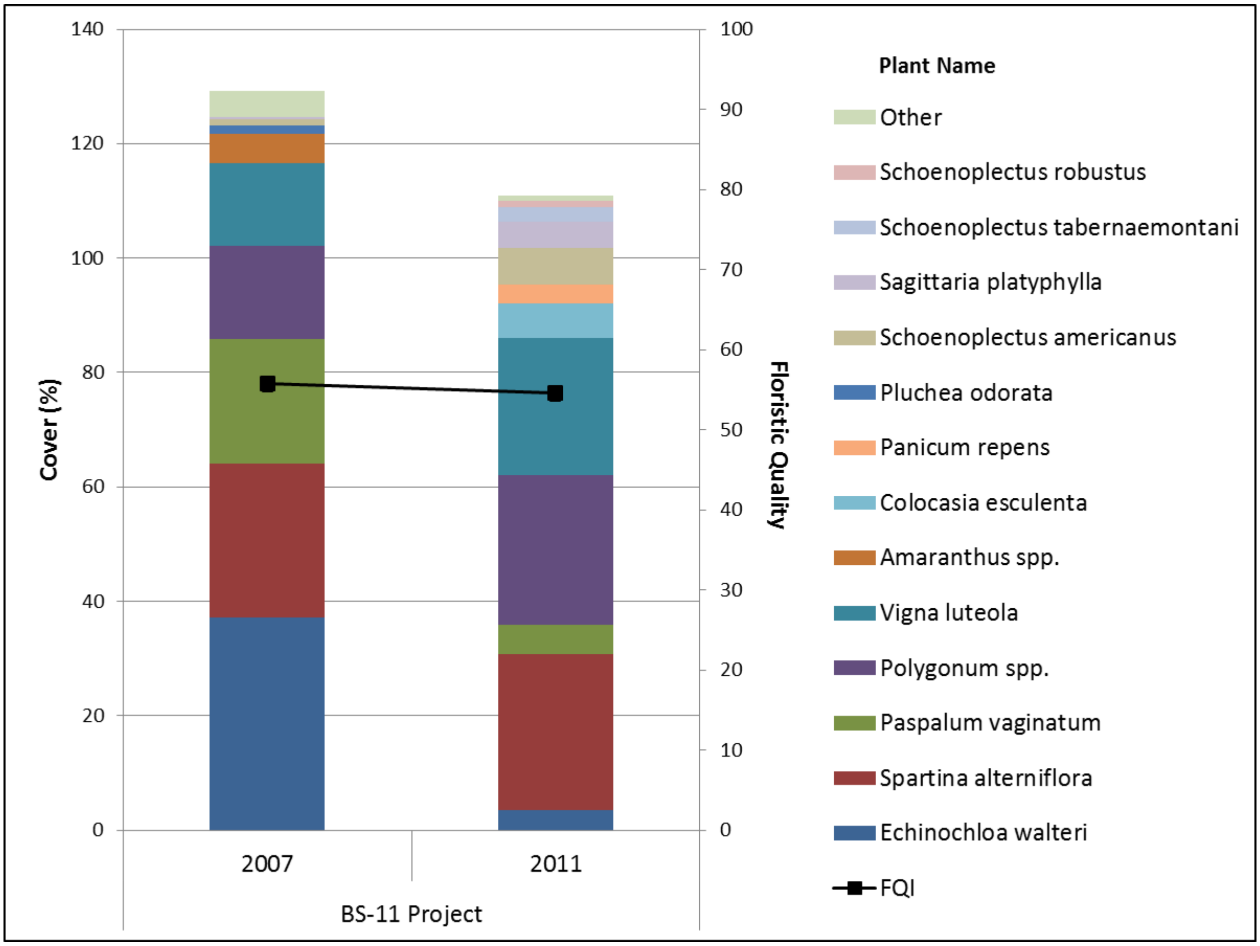


Figure 10. Mean percent cover of species within the BS-11 terrace field and the Floristic Quality Index (FQI) score for 2007 and 2011.

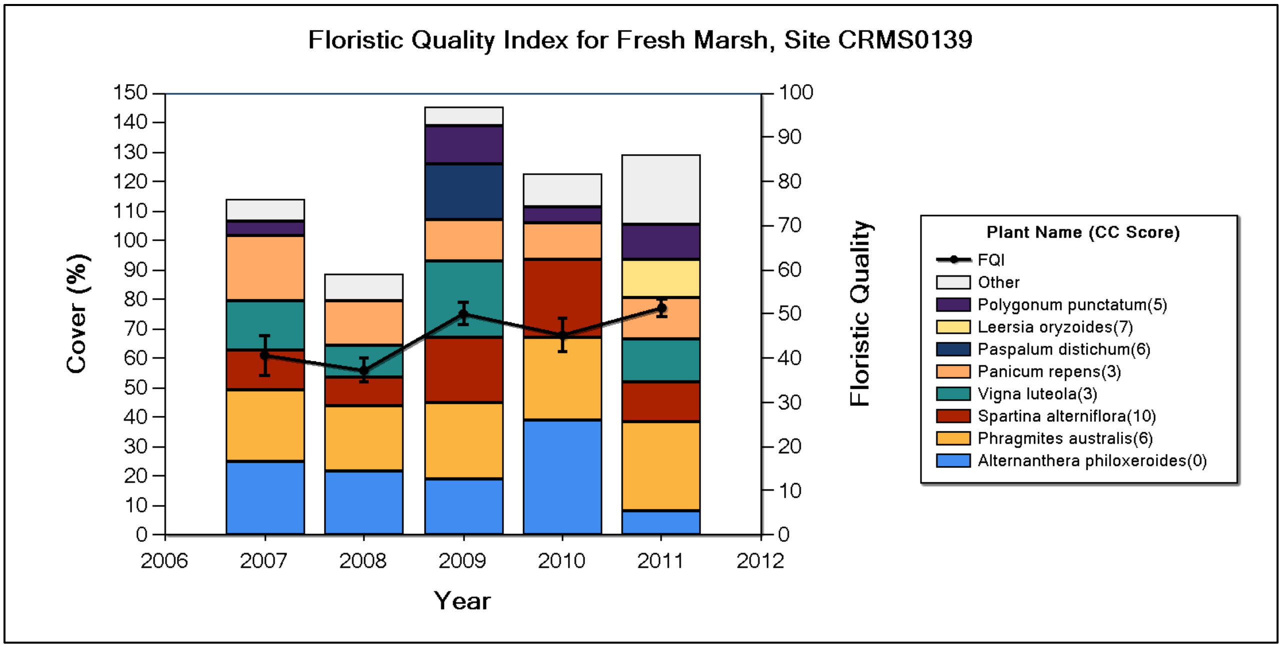


Figure 11. Mean percent cover of species and the Floristic Quality Index (FQI) score at CRMS0139 from 2007 to 2011.

One tool that has been used to assess the quality of the vegetation community at the CRMS sites is the Floristic Quality Index (FQI) (Cretini et al. 2011). The FQI is calculated by assigning each species a CC score, or coefficient of conservatism, which is scaled from 1 to 10 and reflects a species' tolerance to disturbance and habitat specificity. A modified FQI was developed by the CRMS Vegetation Analytical Team, which assembled a team of experts to assign CC scores to Louisiana's wetland plant species. The modified FQI equation takes into account not only the CC scores, but also the percent covers of species at a site, and the resulting score is scaled from 0 to 100. Mean FQI scores were calculated for the BS-11 terrace sites and CRMS139 sites for each of the sampling years. FQI scores for the BS-11 sample years were essentially the same in both sample years dropping from 56 in 2007 to 55 in 2011 (Figure 10). The FQI scores were slightly lower at CRMS0139, fluctuating between 37 and 51 from 2007 to 2011 (Figure 11). The lower FQI at the CRMS site is likely due to the greater presence of *A. philoxeroides*, which is assigned the lowest CC score of 0. Based on the FQI scores, it appears that the terraces are supporting an emergent vegetation community that is equally as stable as the surrounding natural marsh.

CRMS Supplemental

Hydrographic Data. Salinity and water level have been sampled hourly at CRMS0139 from June 2007 to present using methods described in Folse et al. (2008, revised 2012) (Figure 12). A continuous recorder is serviced approximately once every month to clean and calibrate the recorder and to download the data. A staff gauge is installed next to the continuous recorder to compare recorded water levels to a known datum (NAVD88). During processing, the data are examined for accuracy and loaded to the CPRA database, and are available for download from the CRMS website (http://www.lacoast.gov/crms2). The mean salinity recorded at CRMS0139 was 0.62 ppt. Large spikes in salinity up to 19 ppt were associated with fronts and storm events but were generally brief in duration. Mean water level was 1.59 ft NAVD and ranged from 0.92 to 2.22 ft NAVD. Based on an average marsh elevation of 1.4 ft NAVD, it is estimated that the marsh at CRMS0139 is flooded 62% of the year.

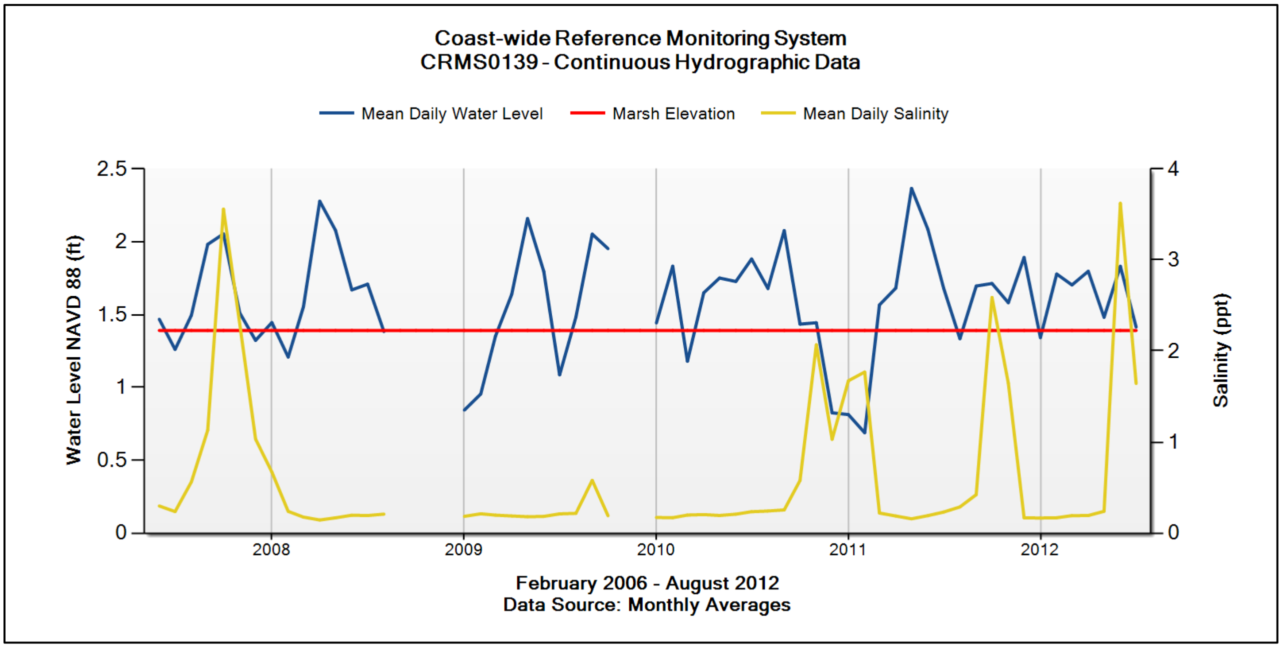


Figure 12. Monthly mean salinity (ppt) and water level (ft NAVD 88) collected at CRMS0139 from 2007 to present.

Soil Analysis. Three soil cores were extracted at CRMS0139 on June 27, 2007 and were analyzed for bulk density and % organic content in 4-cm increments down to 24 cm. Percent organic matter was less than 20%, while bulk density ranged between 0.4 and 0.6 g cm^{-3} (Figure 13). Marsh elevation change and vertical accretion data are also being collected at CRMS0139, but the current estimates are preliminary and will not be presented until sufficient data has been collected.

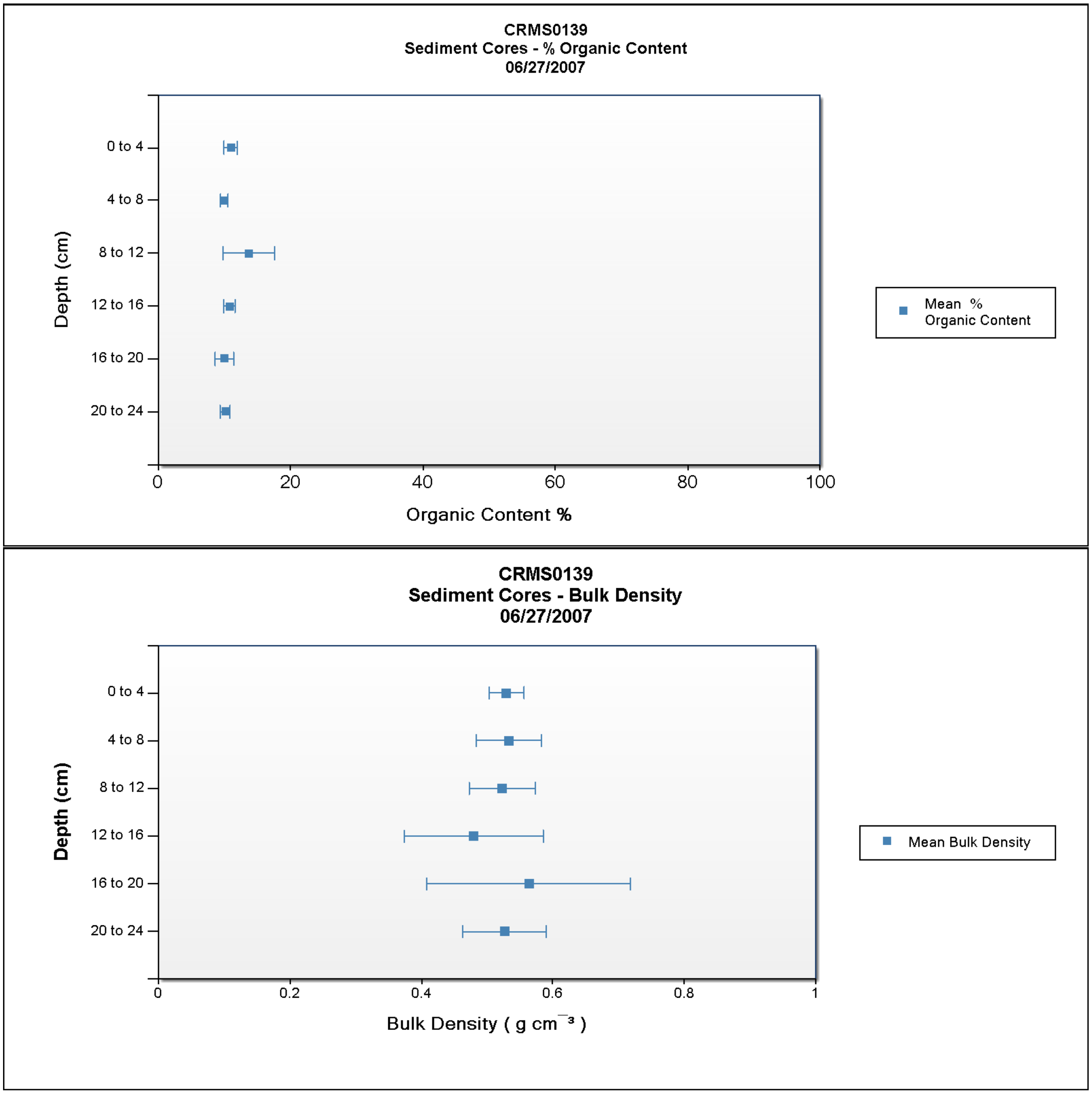


Figure 13. Percent organic content (%) and bulk density (g cm^{-3}) of the CRMS0139 baseline soil samples collected in June 2007 within the Delta Management at Fort St. Philip (BS-11) project.

V. Conclusions

a. Project Effectiveness

Five years after construction, the Delta Management at Fort St. Philip project appears to be capturing sediment and building subaerial land, although land gains are less than anticipated within some crevasses. Although 4,128 ft^2 of sediment was gained along the terrace field transects since construction, there was a net gain of only 804 ft^2 due to loss during construction. Land/water analyses showed that 50 acres of land were created within crevasse 1A in the period from 2002 to 2006, due in part to terrace construction; however, only 8 acres were gained from years 1 to 5 post-construction. Overall, Crevasse 1C experienced the greatest percent gain of total land acreage of 28% from 2002 to 2011. The crevasses in Subarea 2 showed no net increase in land acreage from 2006-2011. The 2011 survey showed a net loss of 1,176.16 yd^3 within the Alt 2A receiving bay (Figure 7), while the channel has gained 102.49% of the amount of sediment removed. Two channels – approximately 20-30 ft deep – bypass crevasses Alt 2A and 2C, and may be conveying much of the sediment load beyond the project area. All crevasses except 1A showed infilling of the crevasse channel due to sediment deposition. Infilling of the channel was 93% or greater at crevasses 1B, 1C, Alt 2A, and 2C, which is preventing heavier sediment from reaching the receiving bays. Excavation of some crevasse channels is needed in order for sediment accumulation to continue within the receiving bays. The appearance of numerous mudflats indicates that land gains may increase as subaerial land becomes vegetated.

b. Recommended Improvements

Re-dredging of crevasse channels within Subarea 2 (Alt 2A, 2B, and 2C) is required to open the conveyance channels for sediment deposition in the receiving bays. Although crevasse channels at 1B and 1C have infilled, re-dredging may be cost-prohibitive since 1C is exhibiting sufficient land gains and 1B only has 15 acres of open water remaining. CPRA will evaluate the deposition patterns and determine if re-dredging of the Subarea 2 channels is the only maintenance needed to achieve the project goal of 244 acres of emergent marsh by year 20. Operations and Maintenance will submit a cost estimate for the first round of maintenance dredging of the crevasses by the spring of 2013. Future elevation surveys of the crevasses will initiate at the crevasse inlet to obtain greater accuracy in determining deposition/scour volumes.

c. Lessons Learned

This is the first CWPPRA project to combine marsh terracing with an artificial crevasse feature. Results confirmed that the terraces are capturing sediment and supporting healthy, vegetative cover. However, sediment loss during construction due to excavation of the borrow channel offset much of the sediment gains from years 1 to 5. Net gain in sediment is expected to increase as additional sediment is retained within the terrace field, which will be resurveyed in year 15.

Unlike MR-09, this project does not demonstrate a correlation between the crevasse cut angle, parent channel order and sediment deposition rates. The overflow from the

Mississippi River into the project area is segregated amongst many bayous and channels, thereby reducing available sediment loads for the project area receiving bays.

Monitoring budgets sometimes rely on pre-construction or as-built elevation surveys funded through design or construction. Layout and methodology of as-built surveys may need to be modified when they are to provide vital baseline data for comparison with future surveys. For accurate monitoring post-construction, baseline surveys must acknowledge long-term monitoring goals. Communication between monitoring and construction managers is vital when planning elevation surveys with shared goals.

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Appendix A
(Inspection Photographs)

Terrace Field (12/08/2011)

Terrace Field (9/24/2012)

Channel 1-A exiting the Terrace Field in Bay Denesse

Terrace Field in Bay Denesse

Crevasse 1-B Channel shoaling

Crevasse 1-C

Crevasse Alt 2-A Channel with vegetated spoil bank

Crevasse 2-B Channel outlet, spoil bank marsh growth.

Crevasse 2-C Interior marsh growth

Crevasse 2-C Interior marsh growth

Appendix B
(Three Year Budget Projection)

Current Approved O&M Budget June 2011	Year - 0 FY07	Year - 1 FY08	Year -2 FY09	Year -3 FY10	Year -4 FY11	*Year -5 FY12*	*Year -6 FY13*	*Year -7 FY14*	Year -8 FY15	Year -9 FY16	Year -10 FY17	Year -11 FY18	Year -12 FY19	Year -13 FY20	Year -14 FY21	Year -15 FY22	Year -16 FY23	Year - 17 FY24	Year -18 FY25	Year -19 FY26	OCPR Project Project Life Budget	CWPPRA Allocated Currently Funded (Sum YR 0 to YR 19)
State O&M	$4,500	$4,617	$4,737	$4,860	$209,909	$5,116	$5,249	$5,386	$5,526	$245,546	$5,817	$5,968	$6,123	$6,282	$287,238	$6,613	$6,785	$6,962	$7,143	$7,328	$841,706	$841,706
Corps Admin																					$20,039	$20,039
Federal S&A																					$0	$0
Total																					$861,745	$861,745

Projected O&M Expenditures	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	Remaining Project Life	***Current 3 year Request (FY13,***
Maintenance Insp	$4,500	$4,617	$4,737	$4,860	$209,909	$5,116	$5,249	$5,386	$5,526												$249,900	$16,161
General Maintenance																					$0	$0
Structure Operation																					$0	$0
Federal S&A																					$0	$0
State S&A																					$0	$0
E&D								$15,000													$15,000	$15,000
Surveys						$31,058		$25,000													$25,000	$25,000
Construction								$ 400,000													$400,000	$400,000
Construction Oversight								$5,500													$5,500	$5,500
Total						$36,175	$5,249	$450,886	$5,526	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$695,400	$461,661

Total O&M Expenditures from COE Report (Incept	$8,421.48	From Lana Report
State O&M Expenditures not submitted for in-kin	$0	
Federal Sponsor MIPRs (if applicable)		
Total Estimated O&M Expenditures (as of May 20	**$8,421.48**	

Current O&M Budget less COE Admin *(State O&M Currently Funded + Fed S&A Currently Funded)*	$841,706	
Remaining Available O&M Budget *(Current O&M - Total Est. O&M Expenditures)*	$833,285	
Incremental Funding Request Amount FY12-FY14	**$ (371,623.79)**	Negative = surplus

Current Project Life Budget less COE Admin *(State O&M Porject Life Budget + Fed S&A Project Life Bu*	$841,706
Total Projected Project Life Budget *(Remaining Project Life + Total Estimated O&M Expendi*	$703,821
Project Life Budget Request Amount	**-$137,885**

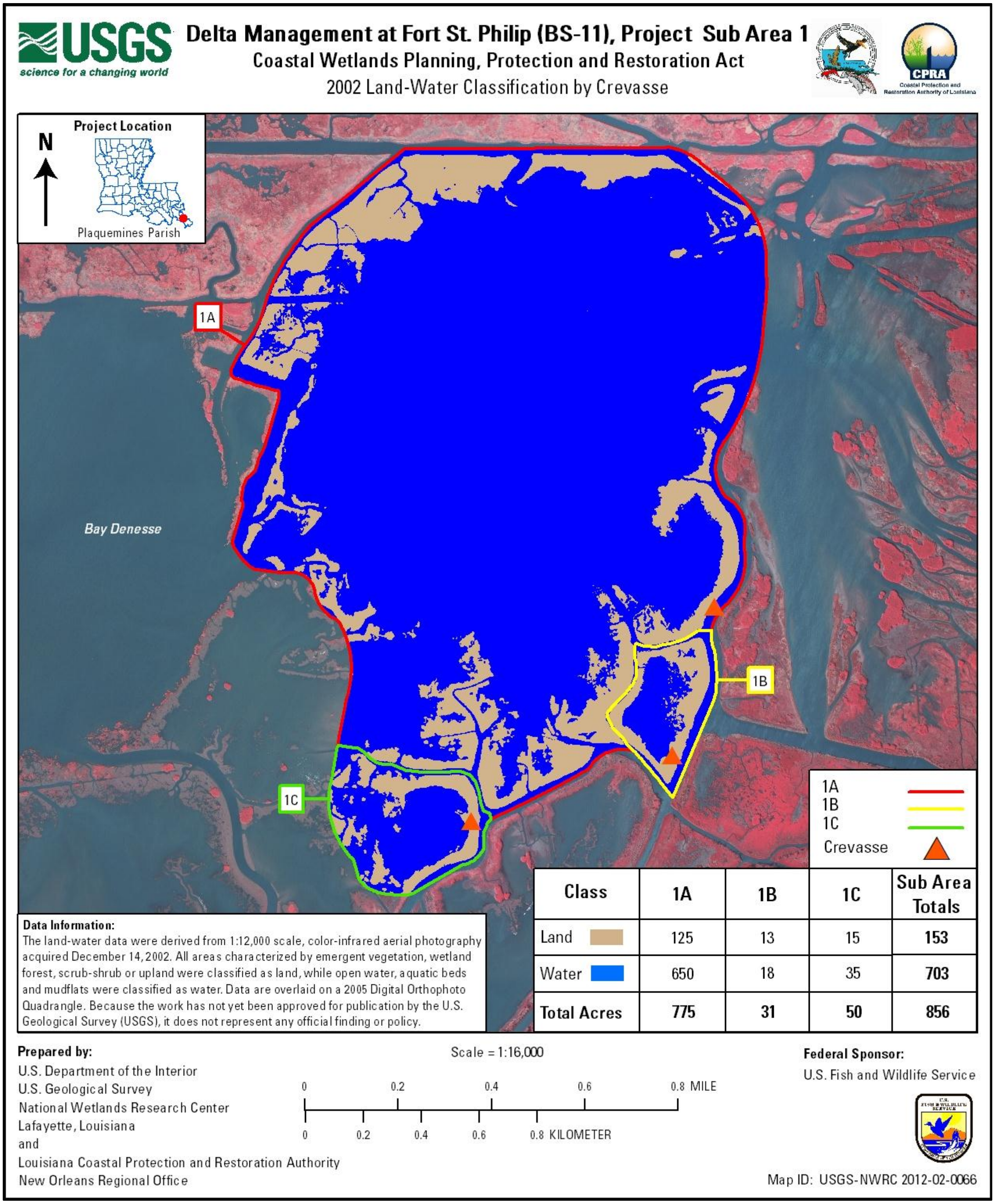
Appendix C
(Field Inspection Notes)

FIELD INSPECTION CHECK SHEET

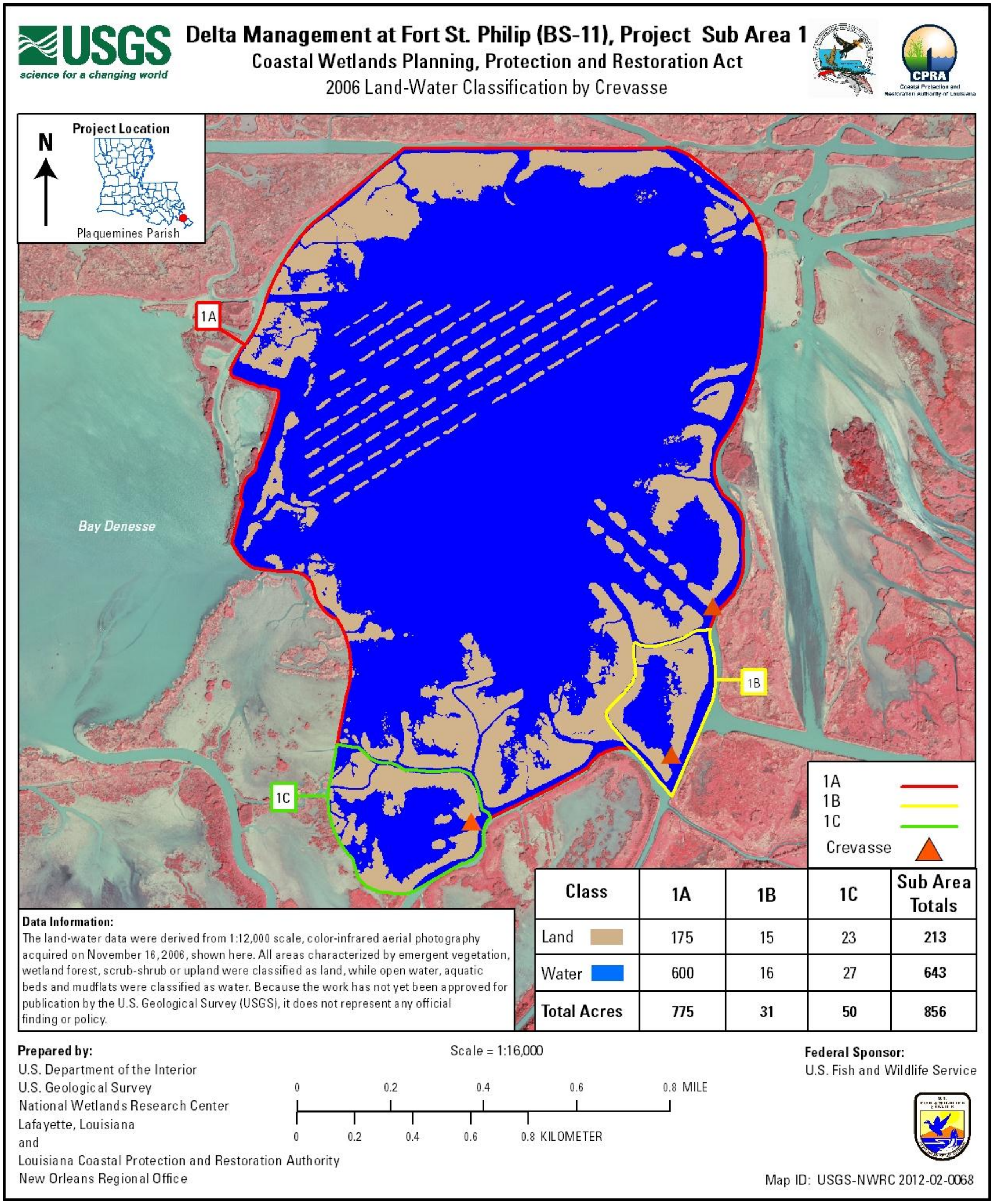
Project No. / Name:	Delta Mgt. at Ft. St. Phillip, BS-11	Date of Inspection:	May 22, 2012	Time: 10:00 AM
Crevasse No.	**See Report Section III**	Inspector(s):	CPRA:Kyle Breaux, Melissa Hymel USFWS: Kevin Roy	
Crev. / Terr. Specs.	See Report Section III	Water Level:	2.39' NAVD 88 at Venice, La.	Time: 8:00 AM
Type of Inspection:	2012 Annual Inspection	Weather Conditions:	Sunny, Wind WNW @ 5 mph	

Item	Condition	Physical Damage	Dimensions	Photo	Observations and Remarks
Crevasse # 1A	Excellent	None	2,000 ft X 75 ft by 8.0' NAVD 88	Appendix B	This crevasse is the longest of all, and funnels river water directly into the Bay Denesse terrace field. Currents through this crevasse were swift and appeared to be carrying plenty of river sediment. The November 2011 survey indicates that this crevasse has deepened since construction.
Crevasse # 1B	Poor	None	400 ft X 75 ft by 6.0' NAVD 88	Appendix B	This crevasse, which is the shortest of all, feeds a small area of marsh. Grasses have sprouted on the island formed in the crevasse after the 2011 high river event. Mudflats within the receiving bay are visible above the water surface.
Crevasse # 1C	Good	None	700 ft X 75 ft by 6.0' NAVD 88		The 2011 survey indicates this crevasse has begun infilling. The channel outfall shows emergent vegetation, active with wildlife.
Crevasse # Alt. 2A	Excellent	None	732 ft X 75 ft by 8.0' NAVD 88	Appendix B	Flow is maintained within the channel. The channel has begun infilling. The SAV blooms throughout the receiving area are evidence of sediment deposits filling in the bay.
Crevasse # 2B	Good	None	500 ft X 75 ft by 6.0' NAVD 88	Appendix B	Flow is maintained within the channel. Sporadic vegetated islands are emerging within the receiving bay. The channel has begun filling in; the deepest part of the channel runs along the northern bank.
Crevasse # 2C	Good	None	2,000 ft X 75 ft by 6.0' NAVD 88	Appendix B	The channel has begun infilling, but flow is maintained within the channel. As more sediment gets deposited, grass growth is becoming more visible throughout much of the receiving bay.
Terraces	Very Good	None	98 Terraces Length 200 ft. Width 52 ft. Height 3.5 ft. Total Length= 19,500 Lin. Ft.	Appendix B	Terraces built on the northeastern side with soft, unsuitable material have developed some washout areas within some terraces. The terraces on the southern end – at the end of crevasse 1A – are degrading due to their placement as the front row of the terrace field. Their original constructed elevations have slightly decreased. Vegetation densely covers each terrace.

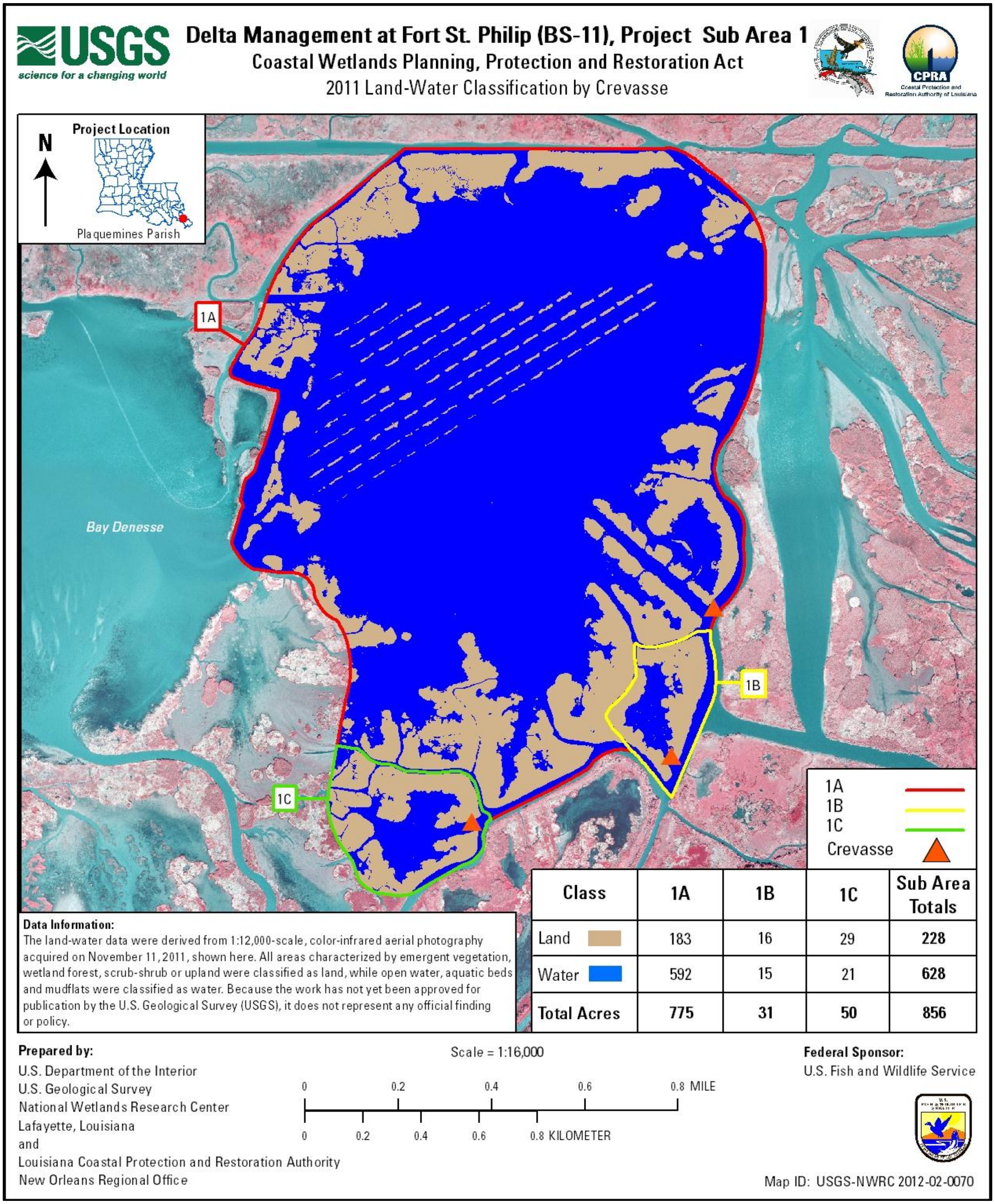
Appendix D
(Land-Water Analyses)



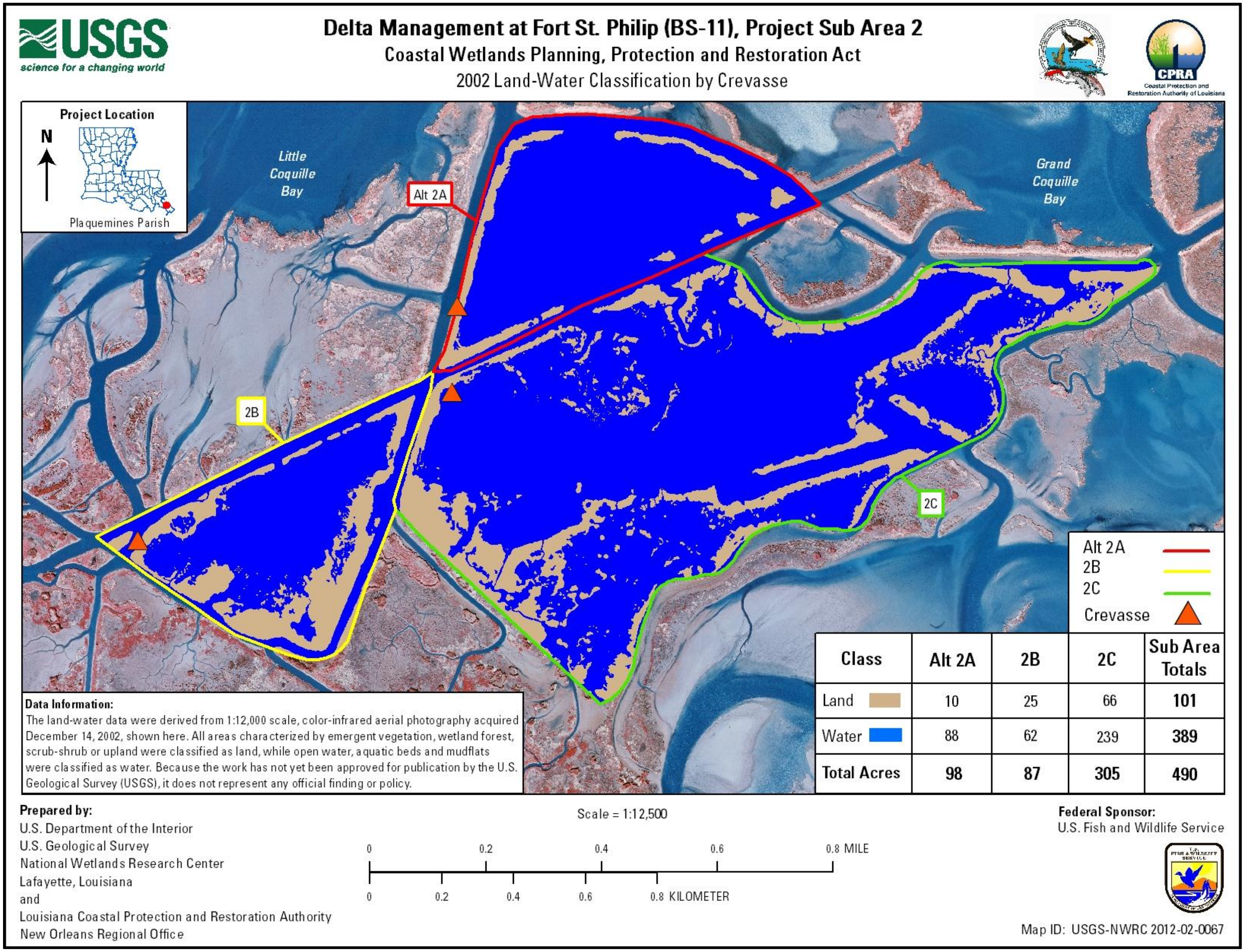
Class	1A	1B	1C	Sub Area Totals
Land	125	13	15	153
Water	650	18	35	703
Total Acres	775	31	50	856



Class	1A	1B	1C	Sub Area Totals
Land	175	15	23	213
Water	600	16	27	643
Total Acres	775	31	50	856



Class	1A	1B	1C	Sub Area Totals
Land	183	16	29	**228**
Water	592	15	21	**628**
Total Acres	**775**	**31**	**50**	**856**

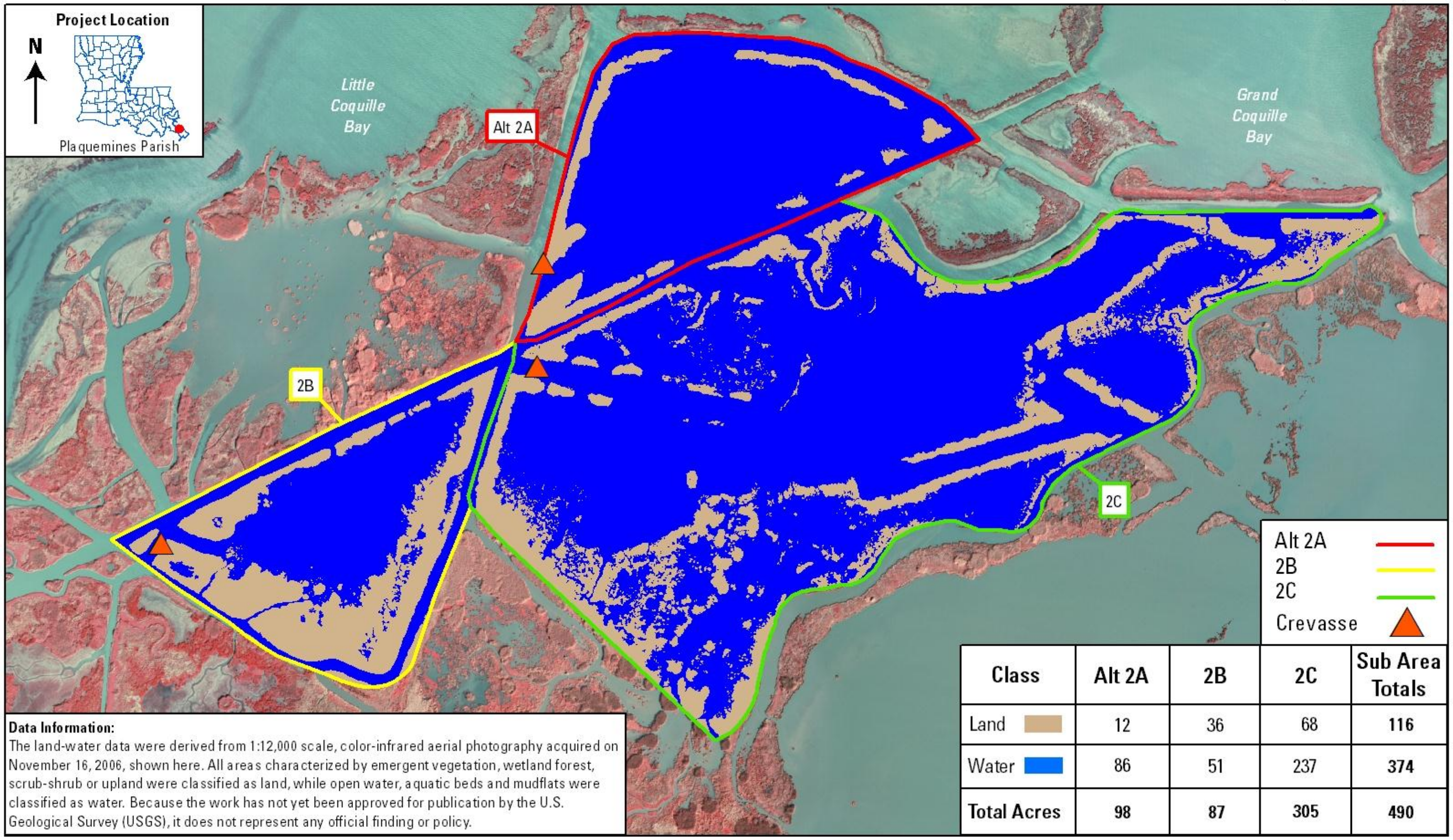


Class	Alt 2A	2B	2C	Sub Area Totals
Land	10	25	66	101
Water	88	62	239	389
Total Acres	98	87	305	490

Delta Management at Fort St. Philip (BS-11), Project Sub Area 2

Coastal Wetlands Planning, Protection and Restoration Act

2006 Land-Water Classification by Crevasse



Class	Alt 2A	2B	2C	Sub Area Totals
Land	12	36	68	**116**
Water	86	51	237	**374**
Total Acres	**98**	**87**	**305**	**490**

Data Information:
The land-water data were derived from 1:12,000 scale, color-infrared aerial photography acquired on November 16, 2006, shown here. All areas characterized by emergent vegetation, wetland forest, scrub-shrub or upland were classified as land, while open water, aquatic beds and mudflats were classified as water. Because the work has not yet been approved for publication by the U.S. Geological Survey (USGS), it does not represent any official finding or policy.

Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Coastal Protection and Restoration Authority
New Orleans Regional Office

Scale = 1:12,500

0 0.2 0.4 0.6 0.8 MILE

0 0.2 0.4 0.6 0.8 KILOMETER

Federal Sponsor:
U.S. Fish and Wildlife Service

Map ID: USGS-NWRC 2012-02-0069

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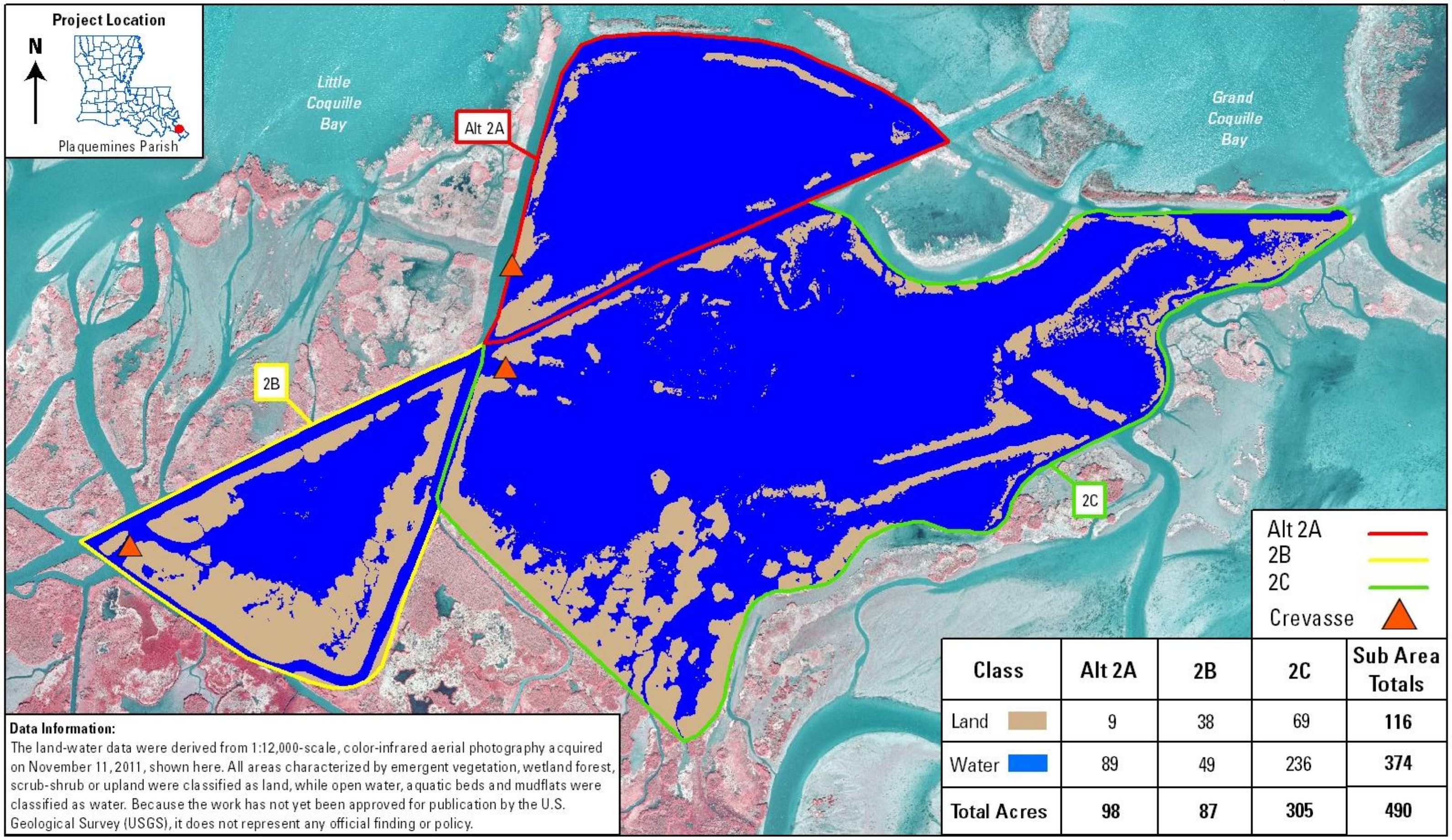
Delta Management at Fort St. Philip (BS-11), Project Sub Area 2

Coastal Wetlands Planning, Protection and Restoration Act

2011 Land-Water Classification by Crevasse

CPRA
Coastal Protection and Restoration Authority of Louisiana



Class	Alt 2A	2B	2C	Sub Area Totals
Land	9	38	69	**116**
Water	89	49	236	**374**
Total Acres	**98**	**87**	**305**	**490**

Data Information:
The land-water data were derived from 1:12,000-scale, color-infrared aerial photography acquired on November 11, 2011, shown here. All areas characterized by emergent vegetation, wetland forest, scrub-shrub or upland were classified as land, while open water, aquatic beds and mudflats were classified as water. Because the work has not yet been approved for publication by the U.S. Geological Survey (USGS), it does not represent any official finding or policy.

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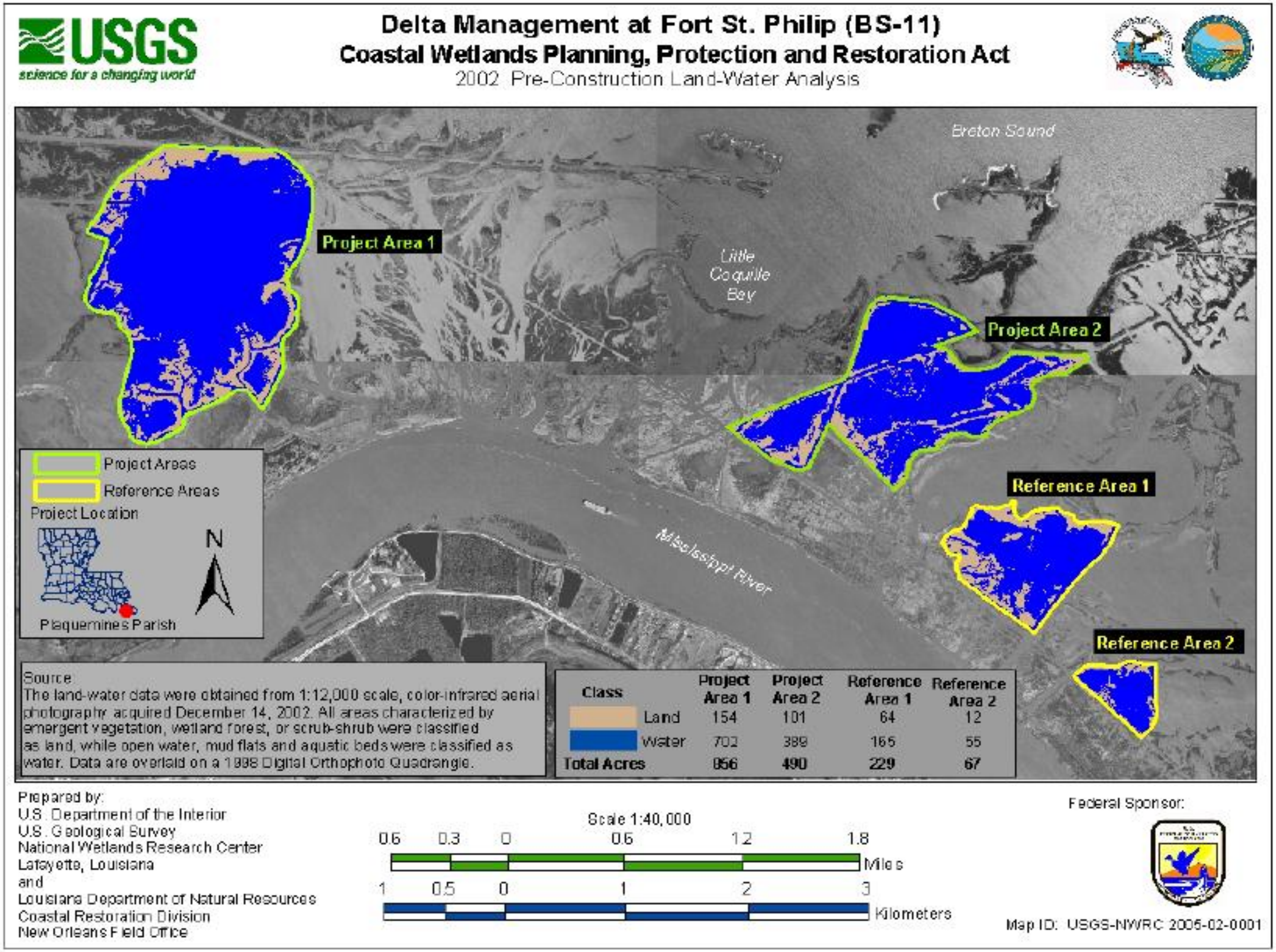
Scale = 1:12,500

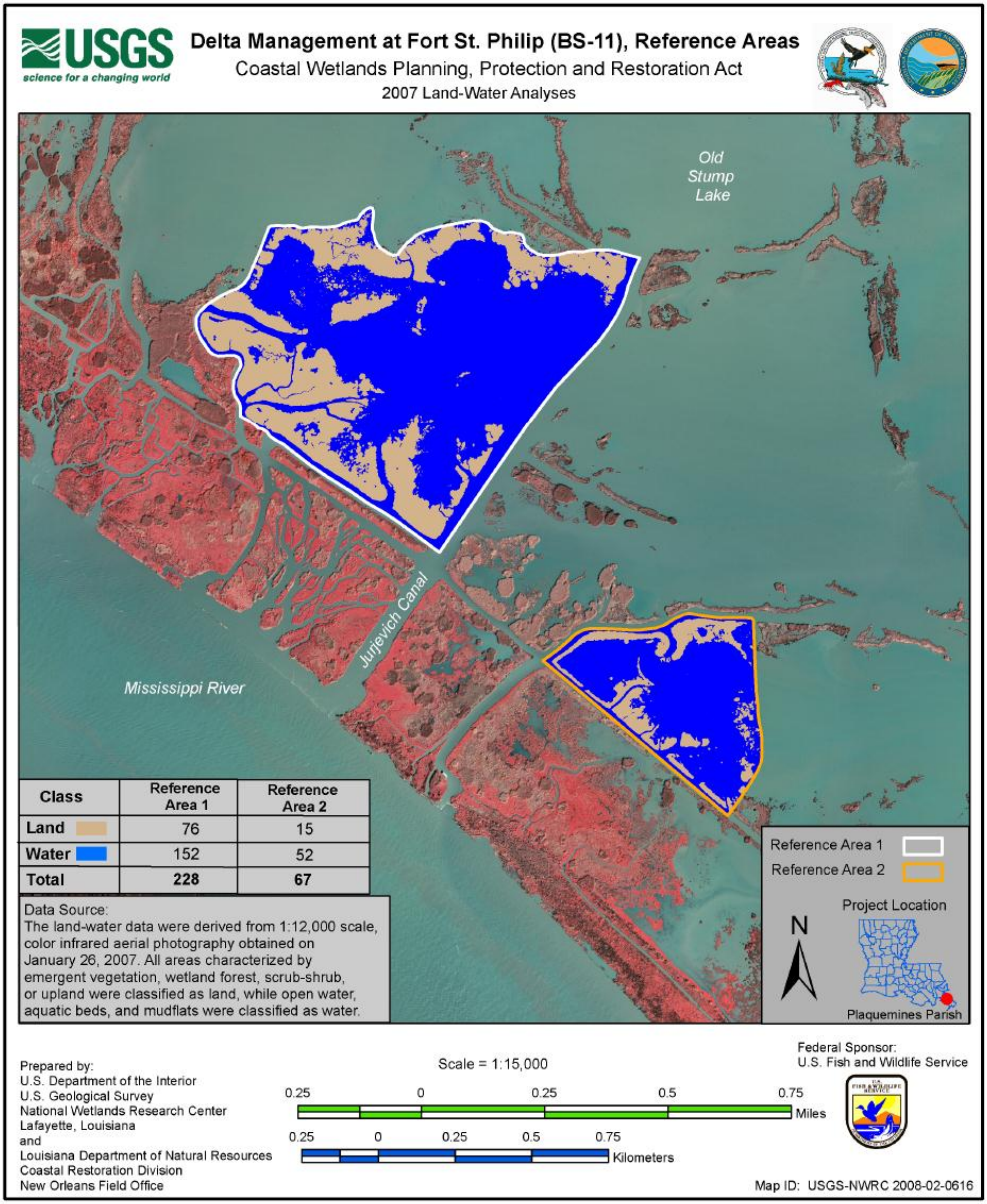
0 0.2 0.4 0.6 0.8 MILE
0 0.2 0.4 0.6 0.8 KILOMETER

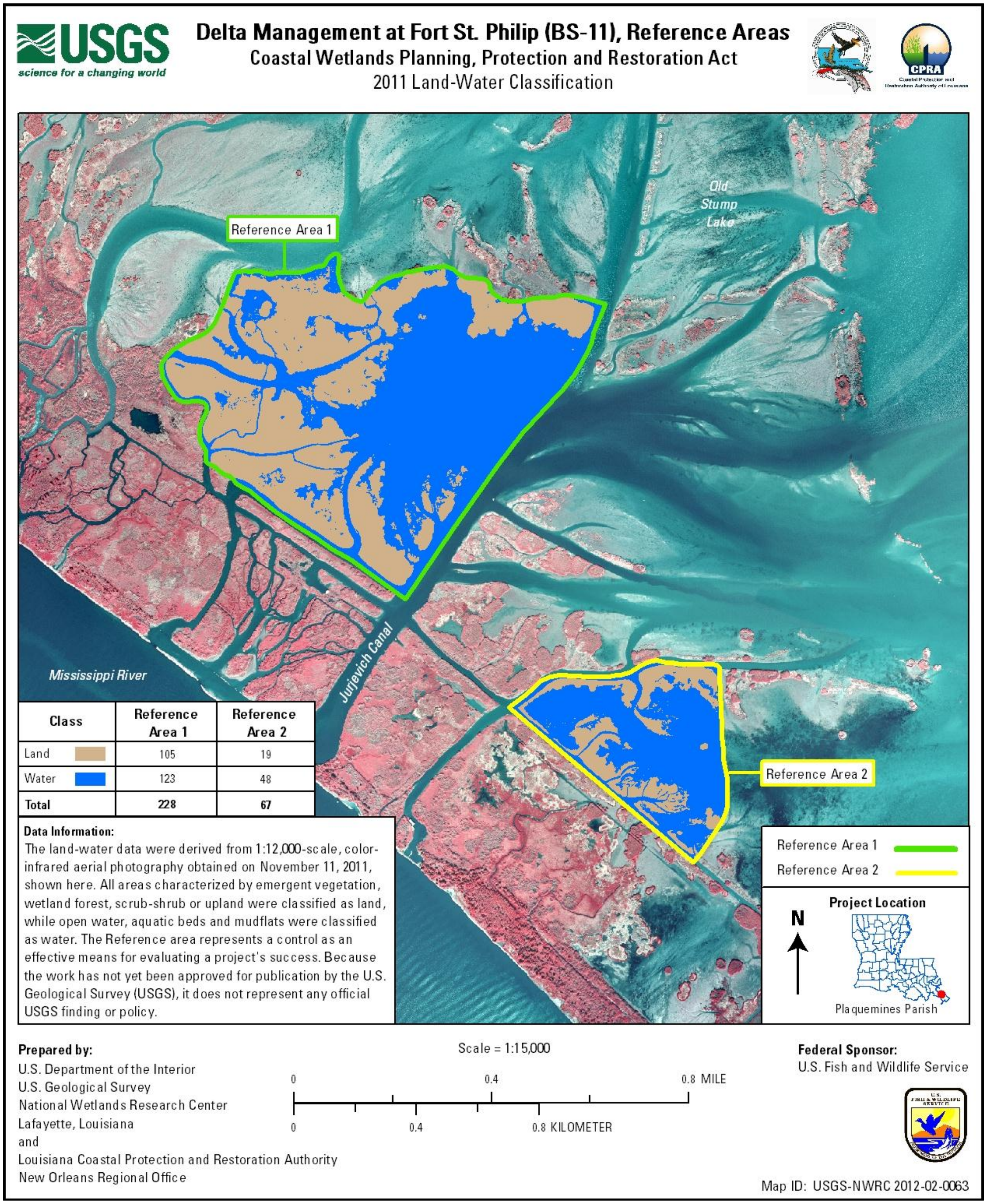
Federal Sponsor:
U.S. Fish and Wildlife Service

Map ID: USGS-NWRC 2012-02-0071



Class	Project Area 1	Project Area 2	Reference Area 1	Reference Area 2
Land	154	101	64	12
Water	702	389	165	55
Total Acres	856	490	229	67


USGS
science for a changing world
Delta Management at Fort St. Philip (BS-11), Reference Areas
Coastal Wetlands Planning, Protection and Restoration Act
2007 Land-Water Analyses
Old Stump Lake
Jurjevich Canal
Mississippi River
Class | Reference Area 1 | Reference Area 2
Land | 76 | 15
Water | 152 | 52
Total | 228 | 67
Data Source:
The land-water data were derived from 1:12,000 scale, color infrared aerial photography obtained on January 26, 2007. All areas characterized by emergent vegetation, wetland forest, scrub-shrub, or upland were classified as land, while open water, aquatic beds, and mudflats were classified as water.
Reference Area 1
Reference Area 2
Project Location
N
Plaquemines Parish
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
Scale = 1:15,000
0.25 0 0.25 0.5 0.75
Miles
0.25 0 0.25 0.5 0.75
Kilometers
Federal Sponsor:
U.S. Fish and Wildlife Service
Map ID: USGS-NWRC 2008-02-0616



Class	Reference Area 1	Reference Area 2
Land	105	19
Water	123	48
Total	**228**	**67**