



**State of Louisiana
Coastal Protection and Restoration Authority**

2012 Operations, Maintenance, and Monitoring Report

for

Channel Armor Gap Crevasse (MR-06)

State Project Number MR-06
Priority Project List 3

August 2012
Plaquemines Parish

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Suggested Citation:

Gossman, B. 2012. *2012 Operations, Maintenance, and Monitoring Report for Channel Armor Gap Crevasse (MR-06)*, Coastal Protection and Restoration Authority of Louisiana, New Orleans, Louisiana. 28pp.



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Preface

This report includes monitoring data collected through December 2011.

The 2012 Operations, Maintenance, & Monitoring (OM&M) Report is the third in a series that includes some monitoring data and analyses presented previously in the 2004 and 2008 OM&M reports (Rodrigue 2004, Kaintz 2008), plus additional project-specific and CRMS data collected since the previous report. For additional information on lessons learned, recommendations and project effectiveness please refer to the 2004 and 2008 OM&M Reports at the following website: http://sonris.com/direct.asp?path=/sundown/cart_prod/cart_bms_avail_documents_f

I. Introduction

Channelization of the Mississippi River (MR) has had negative impacts on the hydrography of the river and its wetland-building processes. The prolonged existence of artificial levees has caused rapid sedimentation onto the continental shelf and seaward progradation of the river mouth at rates up to 328 ft/yr (100 m/yr) within the past several decades. An abundance of small, bifurcating distributaries throughout the Mississippi River Delta (MRD) has caused a loss in stream gradient, which is critical to efficient sediment transport. Growth of the MRD has not been limited by the size of the receiving basin, but by insufficient sediment delivery. The MR currently delivers 50 to 60 percent less sediment to the delta than it did in the early 1900's (Wells and Coleman 1987). Much of this sediment loss has been due to the trapping of coarse sediment material, essential to building subaerial land, in upstream dams and reservoirs. Better conservation practices by farmers in the Arkansas, Missouri, and Ohio River basins have also decreased river sediment availability in the MRD.

Rapid wetland deterioration in the MRD is likely due to a combination of the above factors in conjunction with eustatic sea-level rise, which is estimated to be 0.37 in/yr (0.94 cm/yr) (Penland and Ramsey 1990). The subsidence rate for the entire MRD, approximately 0.43 in/yr (1.1 cm/yr; Day and Templet 1989), is exacerbated by frequent canal dredging for navigation purposes and mining of mineral resources. The most recent land loss rate estimate for the MRD is 0.6 mi²/yr (Barras et al. 2003).

The MR levee south of Venice, Louisiana has been reinforced with stone over the last few decades. Some shallow gaps were left in the river-bank armor to assist in crevasse development and the subsequent overflow of freshwater into adjacent marshes during periods of high water. Crevasses provide sediment-laden river water to shallow interdistributary ponds creating subaerial land (or deltaic splays) that become colonized with marsh vegetation over time. A natural crevasse splay has a life span of 20 to 175 years, depending on the size of the crevasse and adjacent parent pass, water discharge, sediment volume, and wind and tidal influences (Wells and Coleman 1987). Between 1750 and 1927, regularly occurring crevasse splays were responsible for building more than 80% of the MRD wetlands (Davis 1993).

Since the early 1980s, artificial crevasses have been used as a management tool to combat wetland loss in the MRD. Artificial crevasses emulate the natural process of deltaic splay formation and marsh creation. The Louisiana Department of Natural Resources, Coastal



Restoration Division (LDNR/CRD) constructed three crevasses within the Pass-a-Loutre Wildlife Management Area in 1986 that produced over 657 acres (266 hectares) of emergent marsh from 1986 to 1991, and four crevasses in 1990 that produced over 400 acres (162 hectares) of emergent marsh in three years (LDNR 1993; Trepagnier 1994). Results from the LDNR Small Sediment Diversions project indicate that land gains from 1986 to 1993 from thirteen artificial crevasses ranged from 28 to 103 acres (11.3 to 41.7 hectares) for older crevasses (4 to 10 years old) and 0.5 to 12 acres (0.2 to 4.9 hectares) for younger crevasses (0 to 2 years old) (LDNR 1996).

Crevasse construction is recognized as both cost-effective and highly successful at creating new wetlands. The average cost per crevasse constructed by LDNR in 1990 was approximately \$48,800, or \$433/acre of wetland created. Boyer et al. (1997) reported that the average cost per area of land gain for 24 constructed crevasses in Delta National Wildlife Refuge declines with age as new land builds and may be only \$19/acre if all the receiving bays revert to marsh.

The Channel Armor Gap Crevasse project area is located in the MRD, south of Venice in Plaquemines Parish, Louisiana, and is within the boundary of the Delta National Wildlife Refuge between Mississippi River and Main Pass (Figure 1). The crevasse is located on the left descending bank of the MR at mile 4.7 above Head of Passes. Based on the 1996 land/water analysis, the project receiving bay (Mary Bowers Pond) comprises 70% of the total 1,567 acres (634 hectares) in the project area.

The natural gap in the Mississippi River channel bank armor was enlarged to a length of 3,400 ft (1,036 m), a bottom width of 80 ft (24 m), a top width of 130 ft (40 m), and a minimum depth of -4.0 ft (-1.2 m) NGVD. The crevasse channel is estimated to allow an average flow of 2,400 cfs (68 cms) to enter the outfall area. Approximately 70,000 yd³ (53,522 m³) of material was excavated from the outfall channel. The dredged material was deposited in a non-continuous fashion adjacent to the channel at an elevation not exceeding +4.0 ft (1.2 m) above existing surface elevations with several 50-ft wide gaps. Construction of the crevasse was completed in October 1997. The MR-06 project is part of CWPPRA Project Priority List 3. The federal sponsor for the project is the U. S. Army Corps of Engineers.

II. & III. Maintenance and Operation Activity

No maintenance or operations were planned or budgeted for this project.



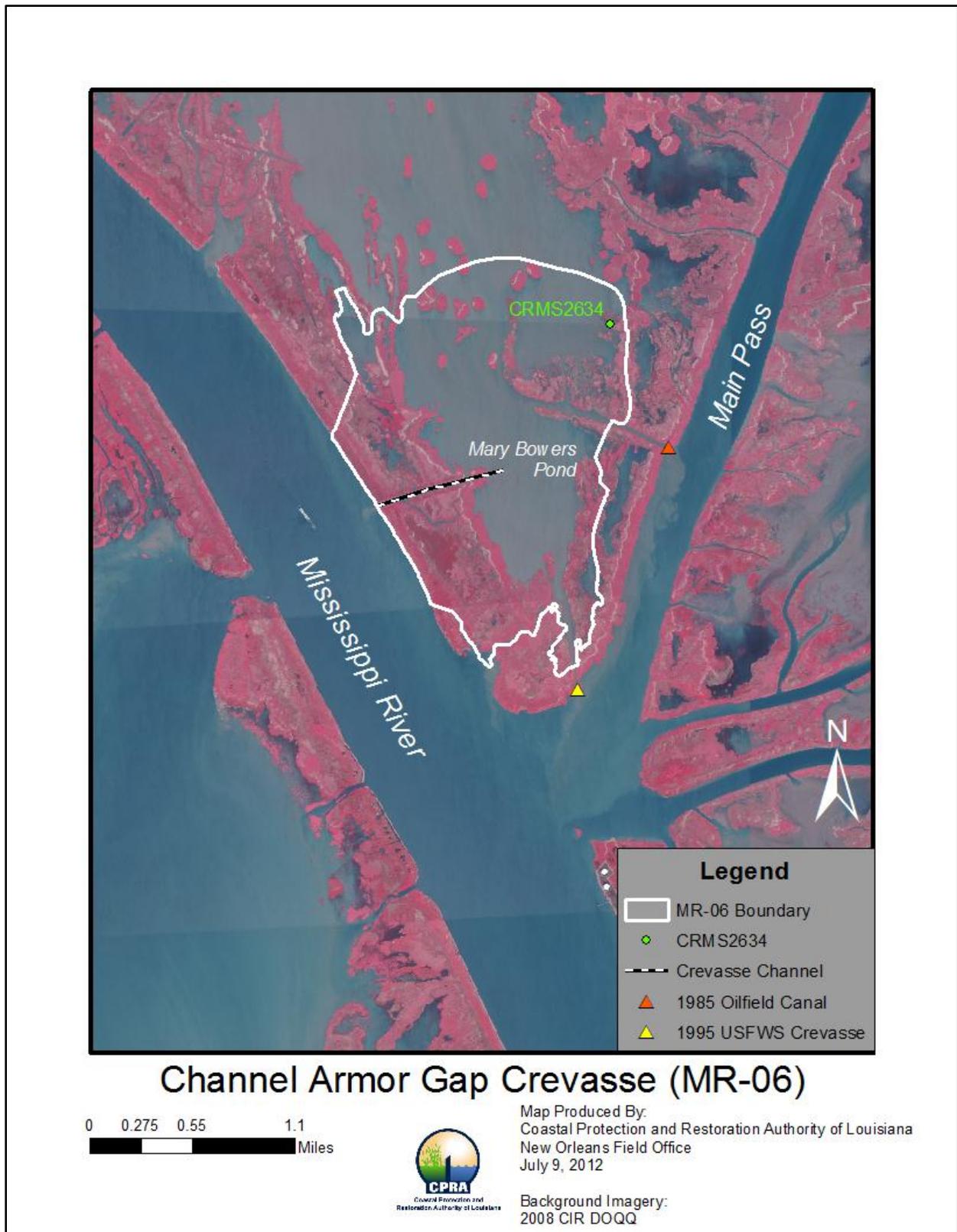


Figure 1. Channel Armor Gap Crevasse (MR-06) project location.

IV. Monitoring Activity

a. Monitoring Goals

The objective of this project is to promote formation of emergent freshwater marsh in place of the shallow, open water area of Mary Bowers Pond by increasing the flow of sediment-laden river water into the receiving bay.

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

1. To increase sediment elevation in the project area.
2. To increase cover of emergent wetland vegetation within the project area.

b. Monitoring Elements

Water Discharge and Suspended Sediments

Based on a CWPPRA Task Force decision, monitoring of suspended sediment and discharge was discontinued after 1998. Results of discharge and suspended sediment monitoring can be found in the first progress report for this project (Troutman 1999), and will not be reported here.

Sediment Elevation

Elevation, reported in North American Vertical Datum of 1988 (NAVD), was surveyed in the receiving bay in November, 1997 to determine preconstruction elevation in the project area. Postconstruction surveys were conducted in October, 2001 and March, 2008. According to the monitoring plan, this survey was scheduled for 2007; however, due to funding issues, it was postponed until the spring of 2008. It will be referred to as the 2007 elevation survey in this report.

In the 1997 survey, eleven transect lines were established perpendicular to the crevasse channel, 500 ft (152 m) apart, and extended the entire length of the open water areas in the receiving bay (Figure 2). Land elevations were not measured during this survey. Elevations were recorded at 500-ft intervals along each transect and at any significant change in elevation within those intervals. In the 2001 and 2007 surveys, the same transect lines were used, but elevations were recorded at 200-ft intervals and at any significant change in elevation within those intervals (Figure 2). Elevations of the entire project area (open water and land) were collected during the 2001 and 2007 surveys. However, only the immediate receiving bay was used to compare the mean elevations among all three years.

This method differed from previous analyses and was done to avoid using any elevation data that could have been influenced by other channels and natural cuts. In addition, elevations from all three years could be compared using this smaller receiving area. ArcMap[®] Version 9.2 was used to draw the polygon in the immediate receiving bay,

calculate mean elevations, and to create all elevation images. SAS[®] Version 9.1 (SAS institute 2003) was used to compare mean elevations among years.

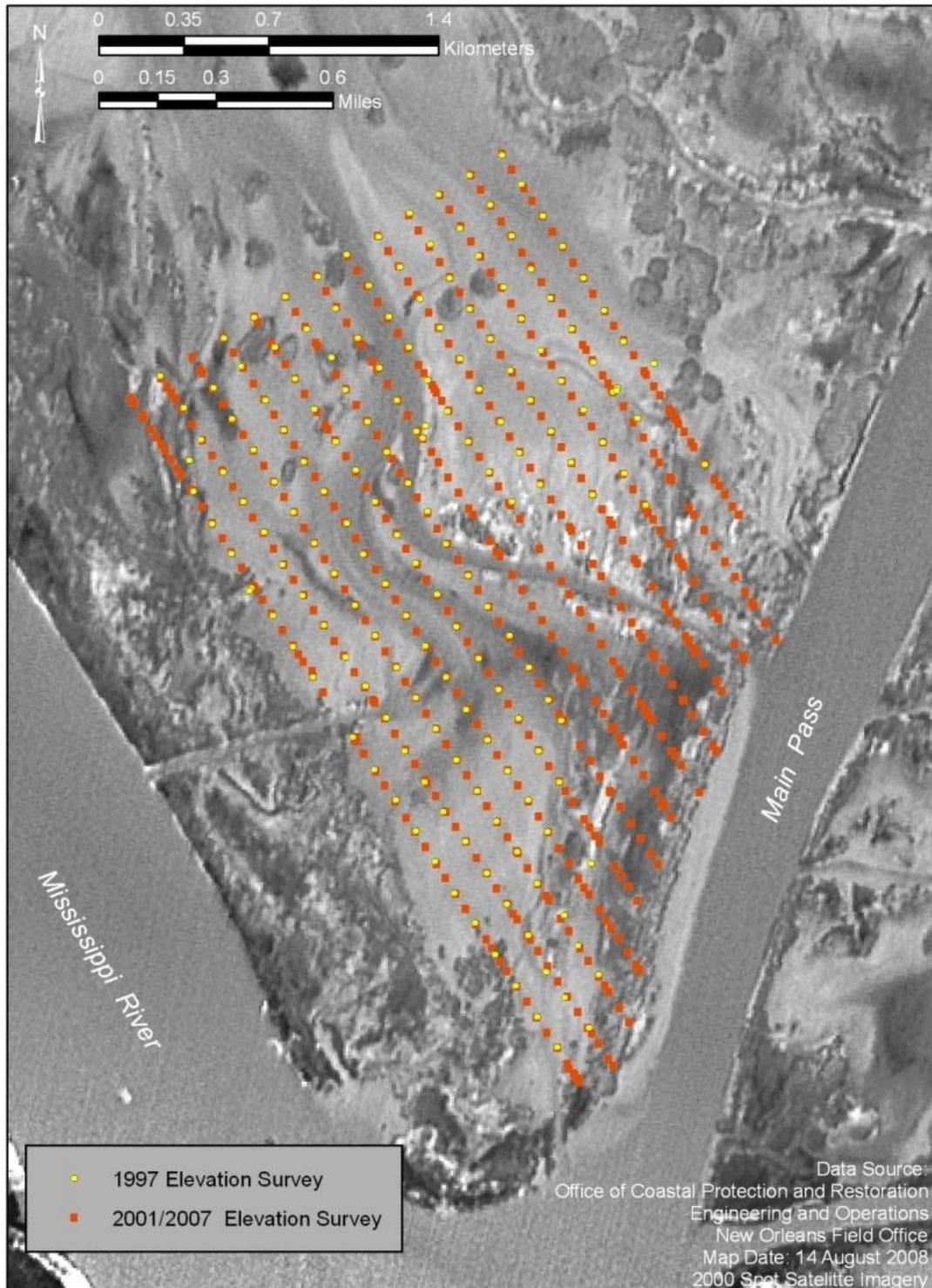


Figure 2. Schematic diagram of elevation sampling station locations in 1997 (yellow triangles) and 2001/2007 (red squares) in the Channel Armor Gap Crevasse (MR-06) project area.

Land/Water Analysis and Habitat Mapping

Distribution of habitat types and the land to open water ratio were determined from aerial photography (infrared, 1:12,000 scale) that was taken of the project area in January, 1996 (preconstruction), December, 2001 (postconstruction), and December, 2007. At the U.S. Geological Survey's National Wetlands Research Center (NWRC), the aerial photographs were scanned at 300 pixels per inch and georectified with ground control data collected with a differential global positioning system (DGPS) capable of sub-meter accuracy. Individual georectified frames were then mosaicked to produce a single image of the project area. To determine habitat types and their distributions, the photomosaic was interpreted by NWRC personnel and classified to the subclass level using the National Wetlands Inventory (NWI) classification system (Anderson et al. 1976). Habitat classifications were then transferred to 1:12,000 scale Mylar base maps, digitized, and checked for quality and accuracy. In addition, the photomosaic was classified according to pixel value and analyzed to calculate the land to water ratio of the project area. All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, aquatic beds, and nonvegetated mud flats were classified as water.

Vegetation

Plant species composition, percent cover, and relative abundance were evaluated to document vegetation succession on the newly created crevasse splay and to ground-truth aerial photograph interpretations. Vegetation surveys followed the Braun-Blanquet method (Folse et al. 2012). Transects were established once the splay islands became subaerial, at locations where all major plant communities were intersected. Sample stations along each transect were established to represent the major plant communities of interest (*S. nigra*, *S. deltarum*, mixed marsh, pioneer marsh, and *Sagittaria* spp.), with at least five plots in each community. Additional transects and sample stations were established over time as new land was created. Annual vegetation surveys began in October, 2001, after the first subaerial crevasse splay formed, and continued through 2010.

CRMS Supplemental

Additional data were collected at CRMS-*Wetlands* stations, 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 the 1-km² area encompassing the station (Folse et al. 2012). For this report, vegetation data from one CRMS site inside the project area (CRMS2634, Figure 1) were used to assess project goals. Additionally, percent land change data from the CRMS Project Level Report Card for MR-06 (available from the CRMS website <http://www.lacoast.gov/crms>) were used.

c. Preliminary Monitoring Results and Discussion

Sediment Elevation

Average elevation of the immediate receiving bay in 1997 (preconstruction) was - 3.39 NAVD 88 (ft; Figure 3 and 4). The average elevation of the receiving bay in the 2001 (post construction) elevation survey was - 0.41 NAVD 88 (ft; Figure 3 and 5) and 0.16 NAVD 88 (ft) in the 2007 elevation survey (Figure 3 and 6). There was a significant increase in elevation among all three years ($p < 0.0001$). Elevations ranged from -4.70 to -2.30 NAVD 88 (ft) in 1997, -2.10 to 0.50 NAVD 88 (ft) in 2001, and from 1.8 to 1.15 NAVD 88 (ft) in 2007. There was a greater increase in elevation from 1997 to 2001 than from 2001 to 2007, possibly a result of intense storm activity in 2005. Differences in elevation ranged from 1.2 to 4.0 NAVD 88 (ft) from 1997 to 2001 (Figure 7) and from - 0.09 to 2.0 NAVD 88 (ft) from 2001 to 2007 (Figure 8). Sediment elevations increased in most of the receiving bay between 1.64 and 4.92 NAVD 88 (ft) from 1997 to 2007 (Figure 9). The channel that had been forming in the center of the receiving bay is still evident; however, it appears to be filling in. The change in elevation across the entire project area from 1997 to 2007 is shown in Figure 10. Differences in elevation ranged from -4 to 8 NAVD 88 (ft).

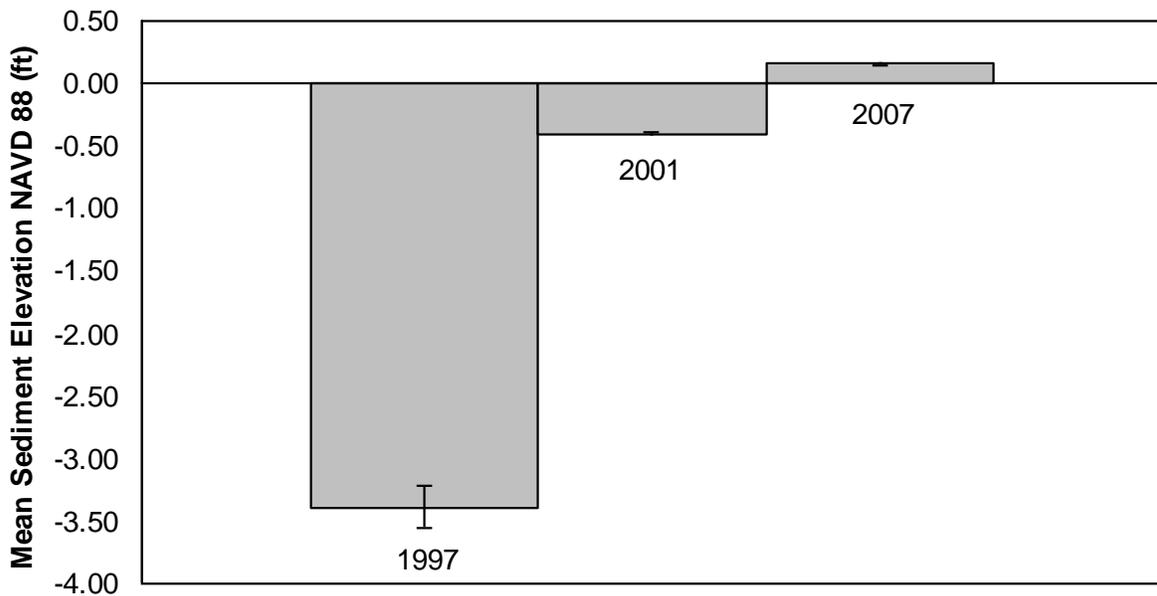


Figure 3. Mean sediment elevation (NAVD 88) (ft) in the immediate project area in 1997 (preconstruction), 2001 (post construction), and 2007 for the Channel Armor Gap Crevasse (MR-06) project.

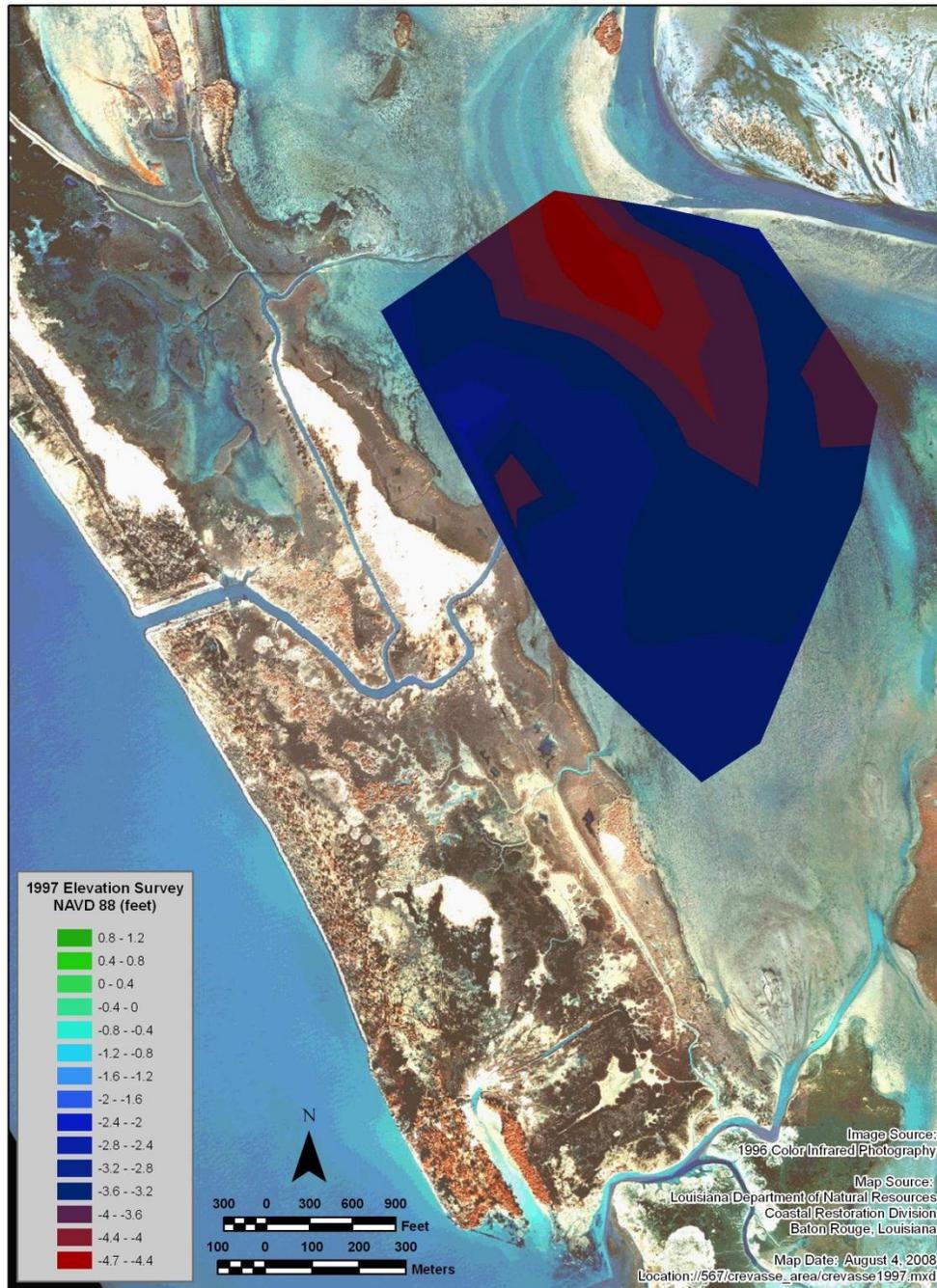


Figure 4. Preconstruction (1997) elevation (ft) within the receiving bay (Mary Bowers Pond) of the Channel Armor Gap Crevasse (MR-06) project area.

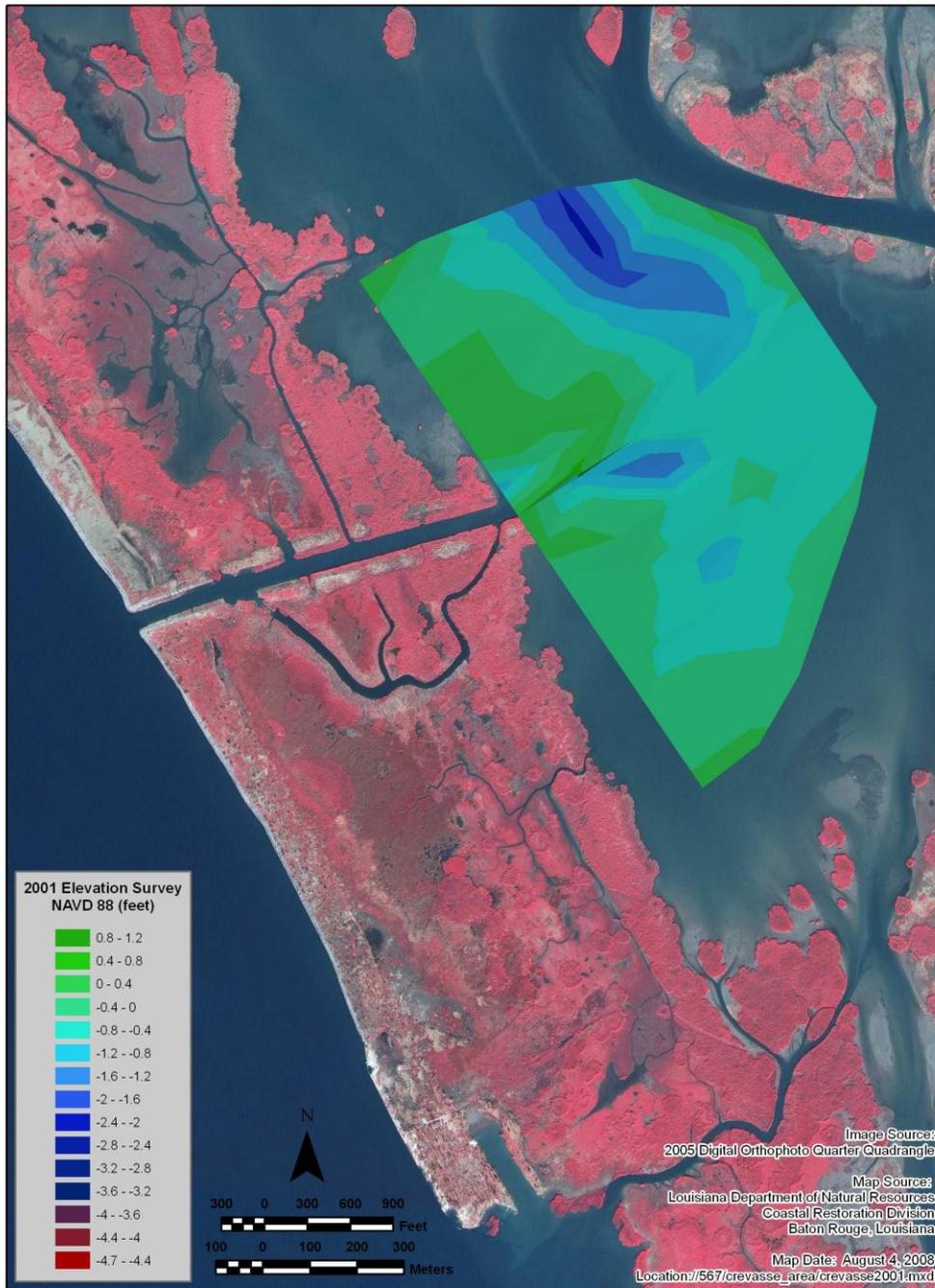


Figure 5. Post construction (2001) elevation (ft) within the receiving bay (Mary Bowers Pond) of the Channel Armor Gap Crevasse (MR-06) project area.

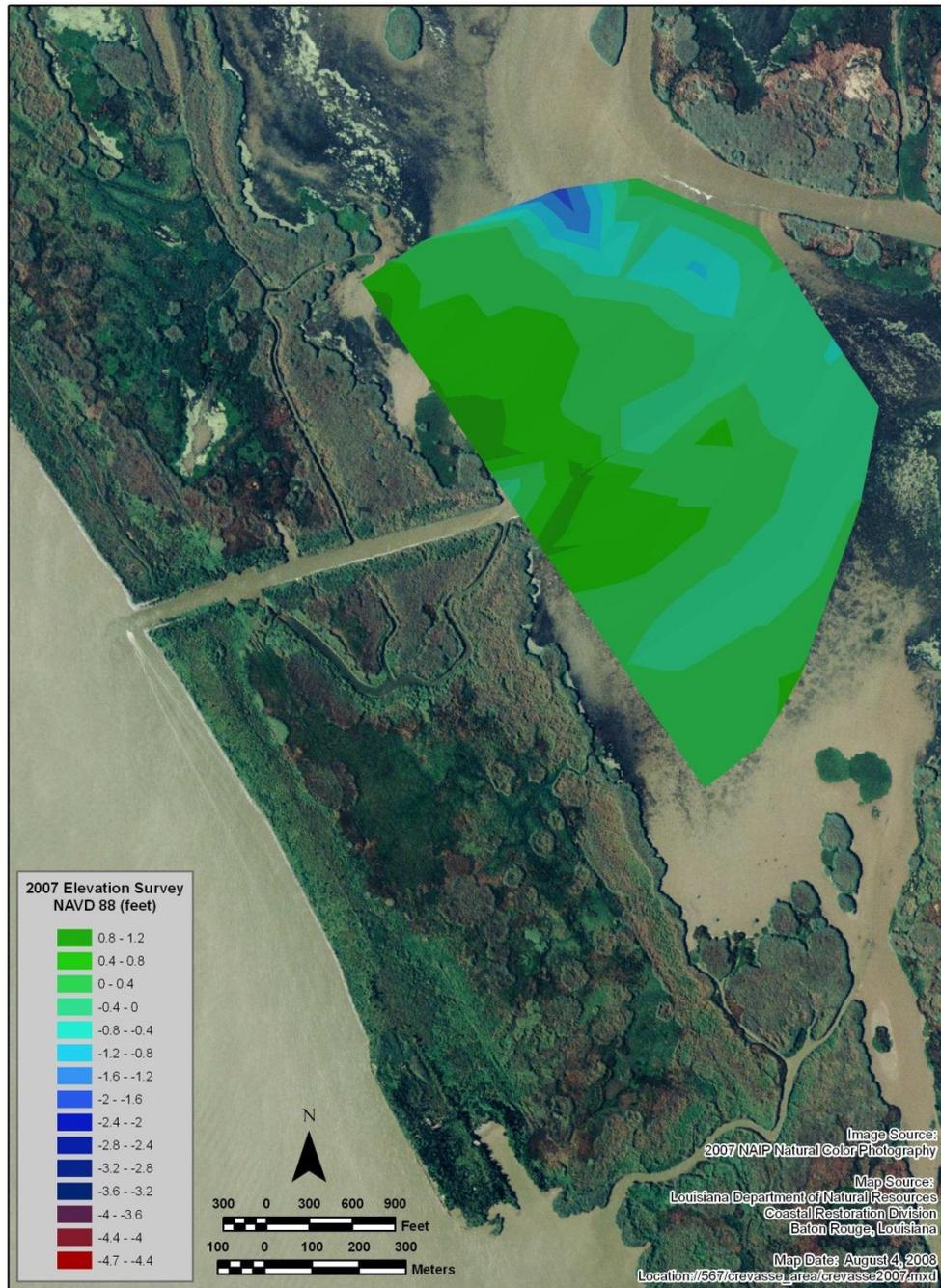


Figure 6. Post construction (2007) elevation (ft) within the receiving bay (Mary Bowers Pond) of the Channel Armor Gap Crevasse (MR-06) project area.

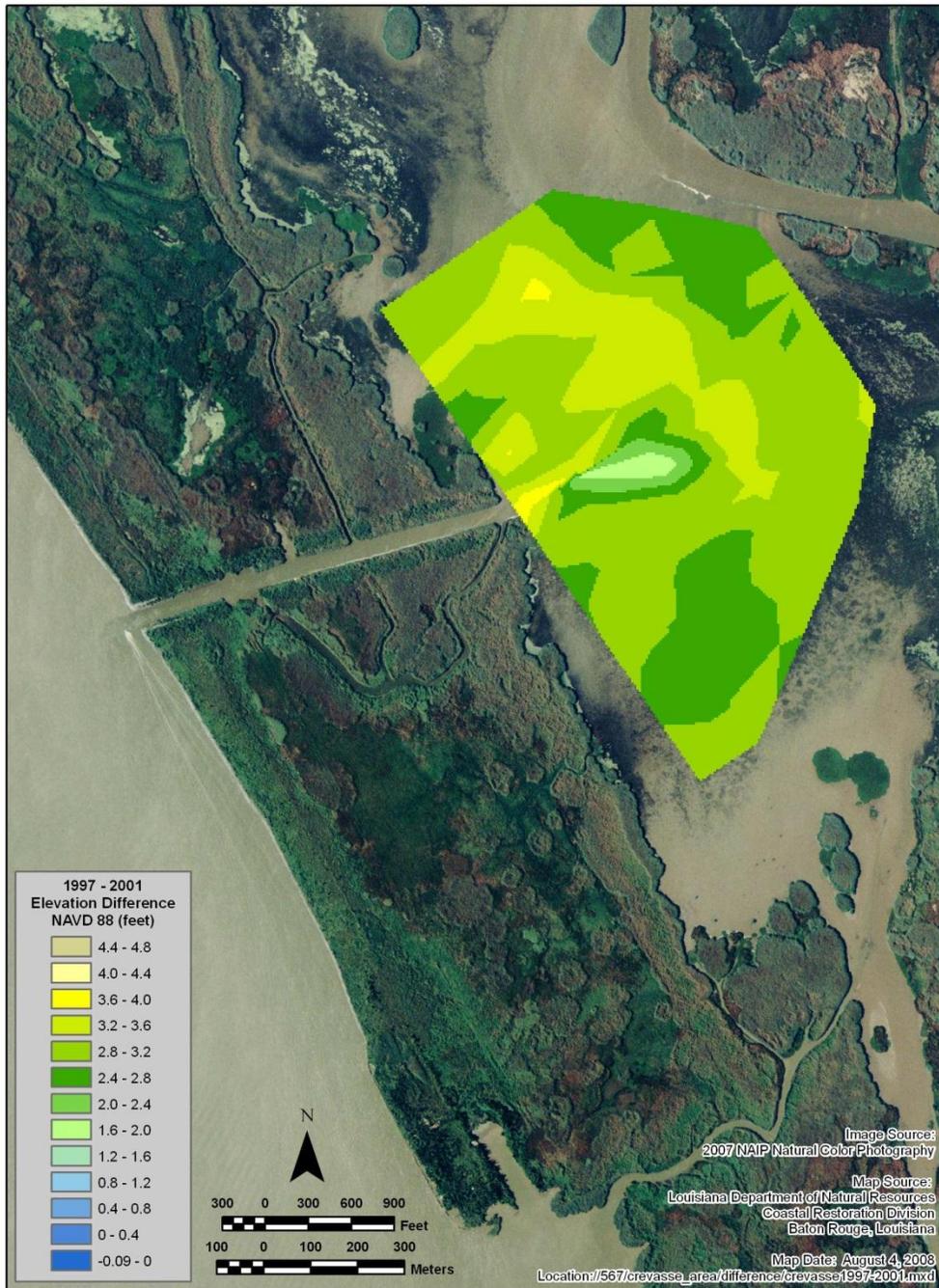


Figure 7. Sediment elevation change (ft) within the receiving basin between 1997 and 2001 in the Channel Armor Gap Crevasse (MR-06) project area.



Figure 8. Sediment elevation change (ft) within the receiving basin between 1997 and 2007 in the Channel Armor Gap Crevasse (MR-06) project area.

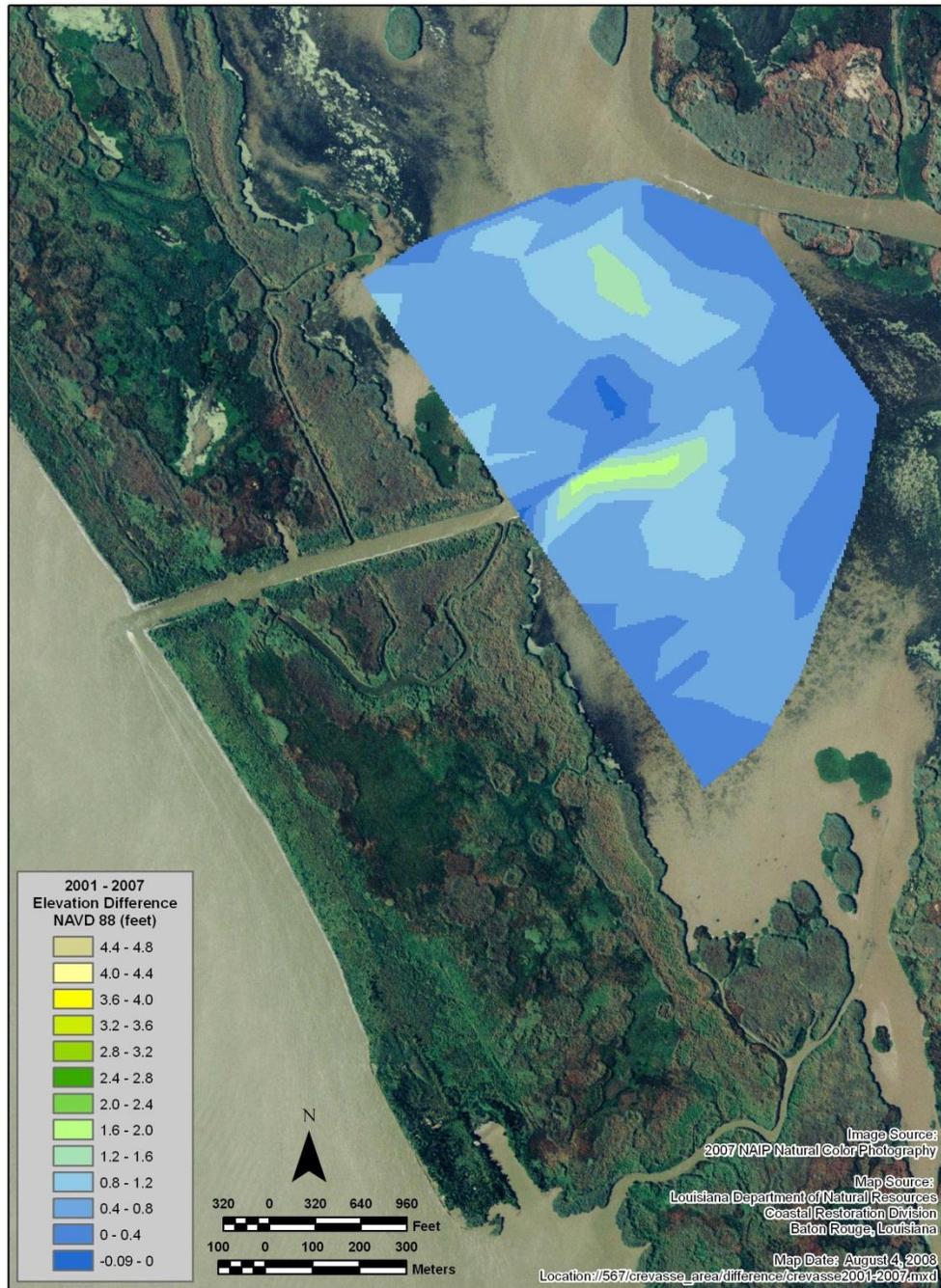


Figure 9. Sediment elevation change (ft) within the receiving basin between 2001 and 2007 in the Channel Armor Gap Crevasse (MR-06) project area.

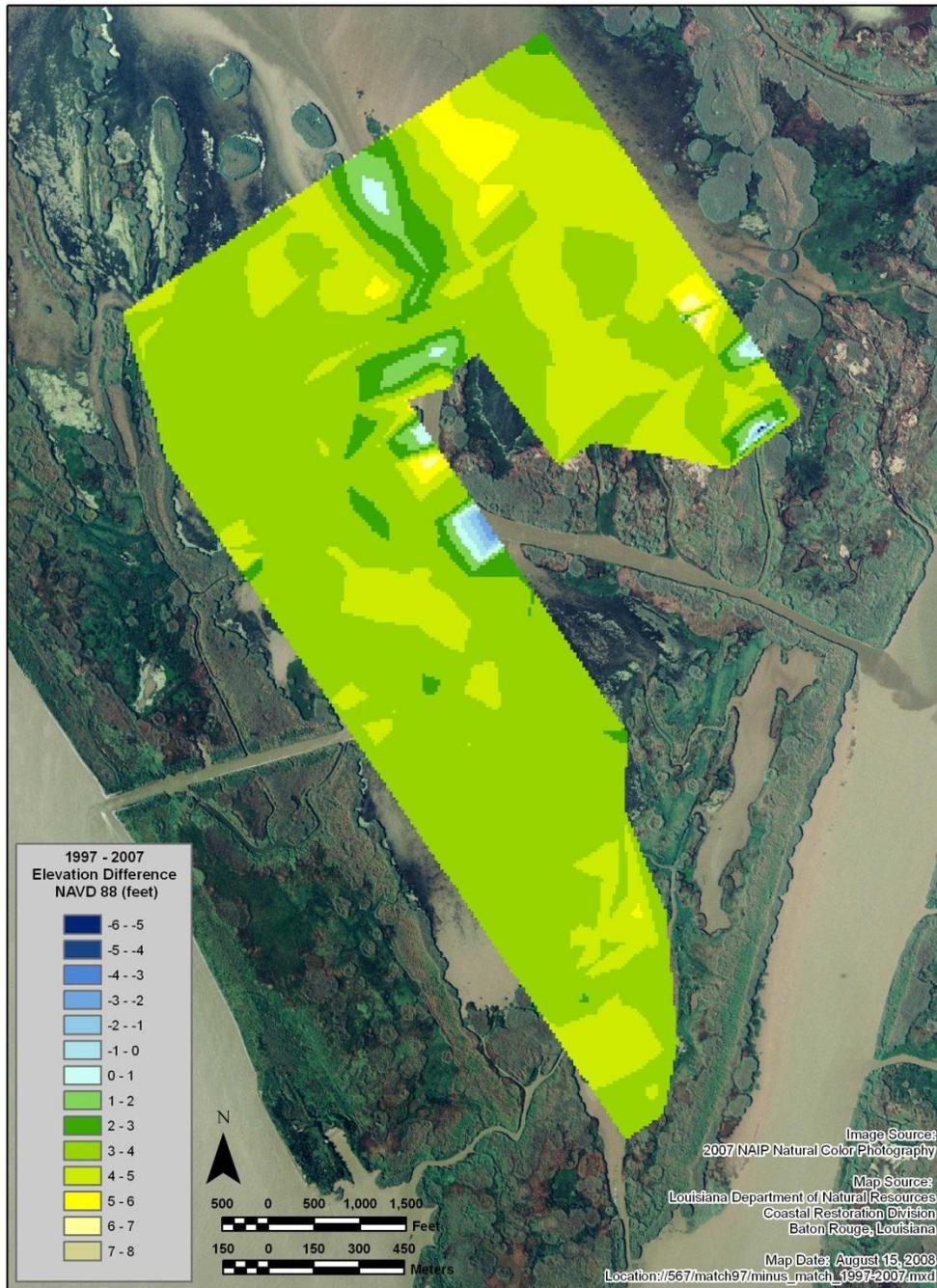


Figure 10. Sediment elevation change (ft) between 1997 and 2007 in the Channel Armor Gap Crevasse (MR-06) project area.

Land/Water Analysis and Habitat Mapping

Results from the 1996 preconstruction land/water analysis indicated that 474 acres (191.8 hectares) of the project area were land, and 1,091.8 acres (442 hectares) were open water, a ratio of 30% land to 70% open water (Figure 11). In the 2001 analysis, 526.4 acres (213 hectares) were land and 1,039.8 acres (420.8 hectares) were open water, increasing the ratio to 34 % land to 66 % open water (Figure 12). In the 2007 analysis, 667 acres were classified as land and 899 acres were open water, increasing the ratio to 43% land to 57% open water (Figure 13).

Since construction, the land area within the MR-06 project area has increased by 41%; a total of 193 acres. It is important to note, however that very little of this land has formed in the immediate crevasse receiving bay. The majority of the new land has formed in the vicinity of two other crevasses that feed into the project; one at the southern end and the other on the eastern side entering from Main Pass (Figure 1). The success of these two crevasses in creating new land can likely be attributed to two factors: age and location within the receiving bay. The crevasse on the eastern side of the project area was created in 1985 by the Superior and Mobile Oil Company and re-dredged in 1995 by USFWS. In the 1996 pre-construction land/water analysis for MR-06, land formation from this crevasse (12 years old at the time) was already evident. The crevasse at the southern end of the receiving bay was created in 1995 by the U.S. Army Corps of Engineers. Although only 2 years older than MR-06, this crevasse has been successful in creating land, mostly through the expansion of the marsh on the southern and eastern edges of the project area. As noted in the first progress report for MR-06 (Troutman 1999), the area adjacent to this crevasse is the shallowest in the receiving bay.

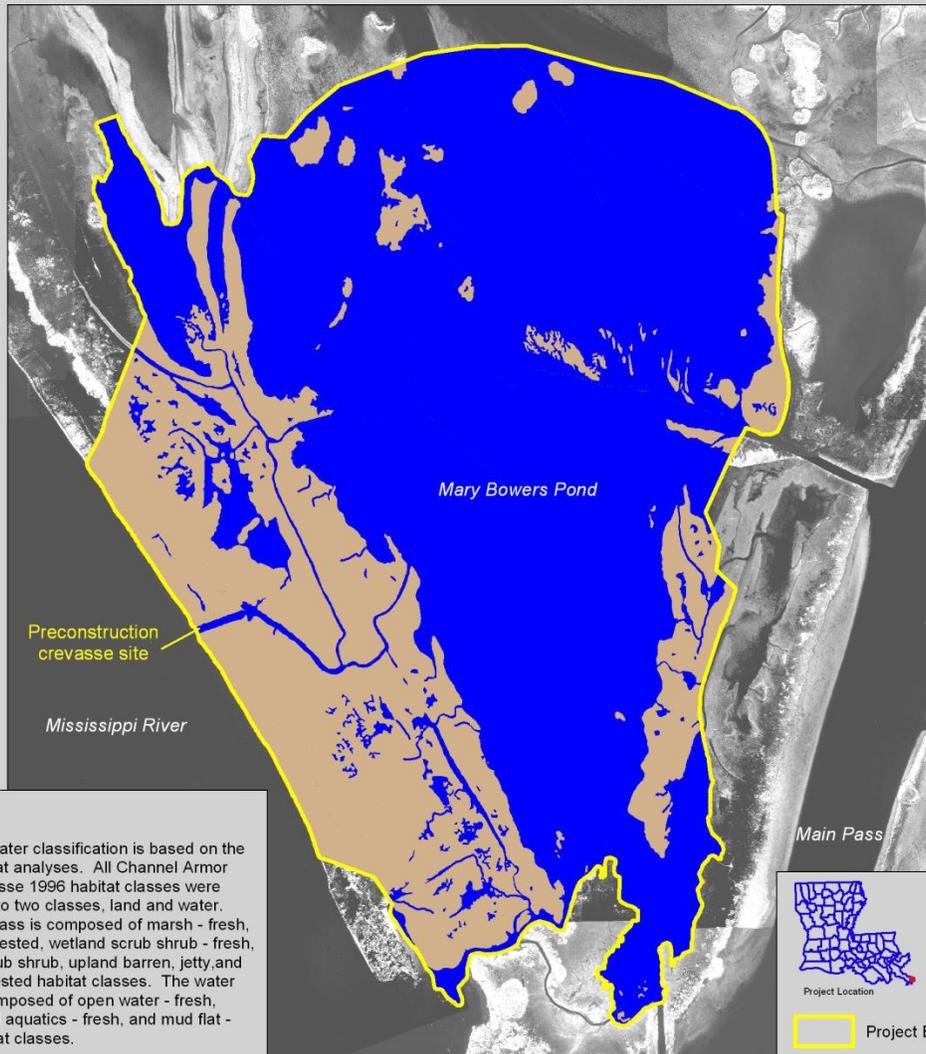
Habitat analysis of the 1996 aerial photographs indicated seven habitat classes (Figure 14). Approximately two thirds of the project area consisted of fresh open water, including 0.3 acres of submerged aquatic vegetation. Fresh marsh made up the majority of the remaining acreage. Most fresh marsh was located on the western side of the project area, as were nearly all of the wetland forest and scrub-shrub habitats. Upland barren and jetty made up the remaining 4.2 acres (1.7 hectares). Habitat analysis of the 2001 aerial photographs yielded seven habitat classes (Figure 15). Most of the fresh marsh increase was adjacent to two, previously constructed, crevasses on the eastern and southern fringes of the project area. Forested wetlands decreased from 35.3 acres (14.3 hectares) to 23.7 acres (9.6 hectares), and fresh wetland scrub shrub increased from 18.9 acres (7.6 hectares) to 37.9 acres (15.3 hectares). Upland scrub shrub, jetty, and forested uplands made up the remaining 9.7 acres (3.9 hectares).

Habitat mapping indicates that the vegetative community types remained largely unchanged in the early years following crevasse construction. The majority of the project area was fresh marsh prior to and following construction. The 2001 analysis indicated that a 6.2 ac of upland scrub shrub habitat had formed on either side of the crevasse channel, likely the result of spoil placement from crevasse

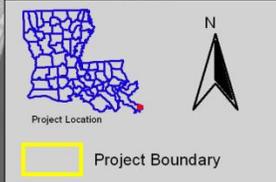
construction. Since habitat mapping was discontinued after the 2001 analysis, it is unknown if this upland community is still present, however it is likely that it has or will convert to wetland vegetation as the spoil material consolidates and subsides.



Channel Armor Gap Crevasse (MR-06)
 Coastal Wetlands Planning, Protection and Restoration Act
 1996 Land-Water Classification



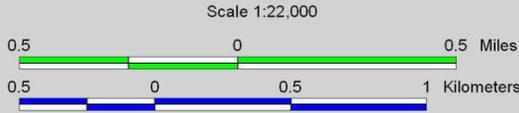
Method:
 The land-water classification is based on the 1996 habitat analyses. All Channel Armor Gap Crevasse 1996 habitat classes were grouped into two classes, land and water. The land class is composed of marsh - fresh, wetland forested, wetland scrub shrub - fresh, upland scrub shrub, upland barren, jetty, and upland forested habitat classes. The water class is composed of open water - fresh, submerged aquatics - fresh, and mud flat - fresh habitat classes.



Class	1996 Acres
Land	474.0
Water	1091.8
Total	1565.8

Source:
 The habitat data were derived from 1:12,000 scale color-infrared photography shown here at 1:24,000 scale. Preconstruction color-infrared photography was obtained on January 9, 1996. Habitat classes are based on "Classification of Wetlands and Deepwater Habitats of the United States" (Cowardin and others, 1979, FWS/OBS - 79/31) as modified for the National Wetlands Inventory mapping conventions.

Prepared by:
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 U.S. Geological Survey
 National Wetlands Research Center
 Lafayette, LA
 and
 Louisiana Department of Natural Resources
 Coastal Restoration Division
 New Orleans Field Office



Federal Sponsor:



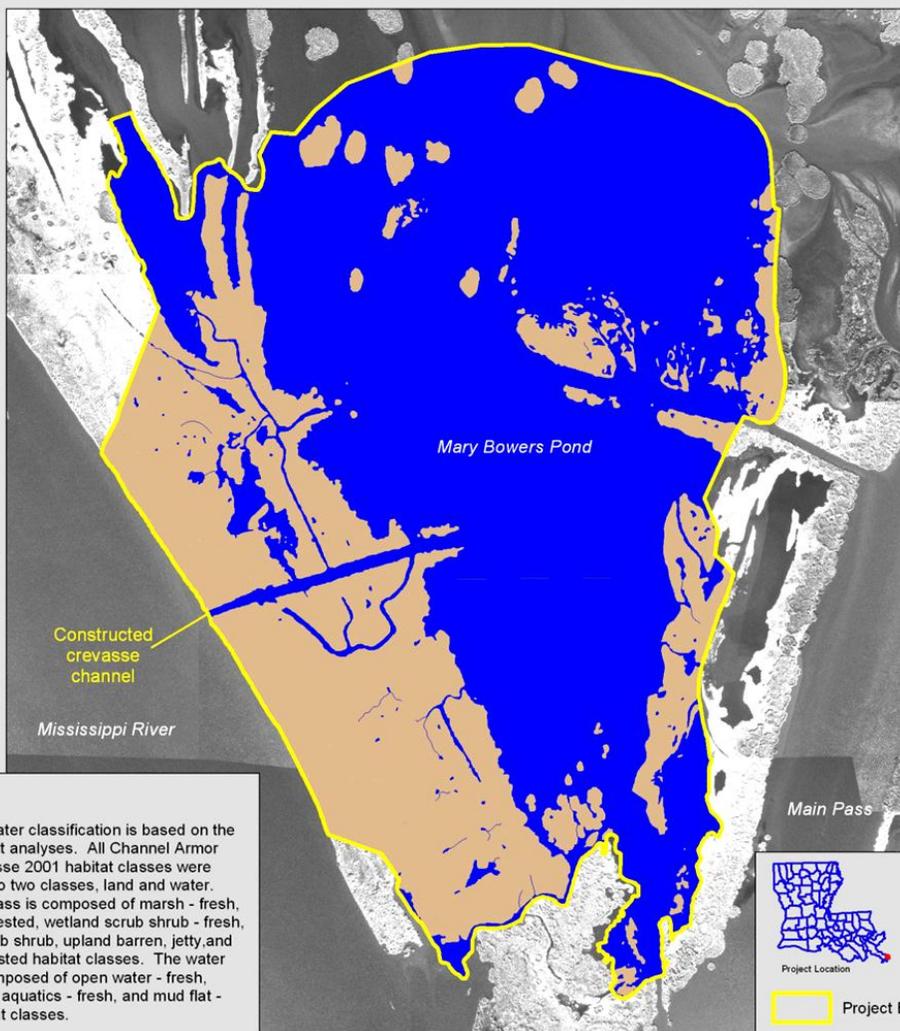
Map ID: USGS-NWRC 2003-02-0091

Figure 11. 1996 (preconstruction) land/water analysis of the Channel Armor Gap Crevasse (MR-06) project area.





Channel Armor Gap Crevasse (MR-06) Coastal Wetlands Planning, Protection and Restoration Act 2001 Land-Water Classification

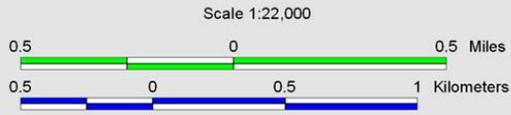


Method:
The land-water classification is based on the 2001 habitat analyses. All Channel Armor Gap Crevasse 2001 habitat classes were grouped into two classes, land and water. The land class is composed of marsh - fresh, wetland forested, wetland scrub shrub - fresh, upland scrub shrub, upland barren, jetty, and upland forested habitat classes. The water class is composed of open water - fresh, submerged aquatics - fresh, and mud flat - fresh habitat classes.

Class	2001 Acres
Land	526.4
Water	1039.4
Total	1565.8

Source:
The habitat data were derived from 1:12,000 scale color-infrared photography shown here at 1:24,000 scale. Postconstruction color-infrared photography was obtained on December 19, 2001. Habitat classes are based on "Classification of Wetlands and Deepwater Habitats of the United States" (Cowardin and others, 1979, FWS/OBS - 79/31) as modified for the National Wetlands Inventory mapping conventions.

Prepared by:
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U.S. Geological Survey
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and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office



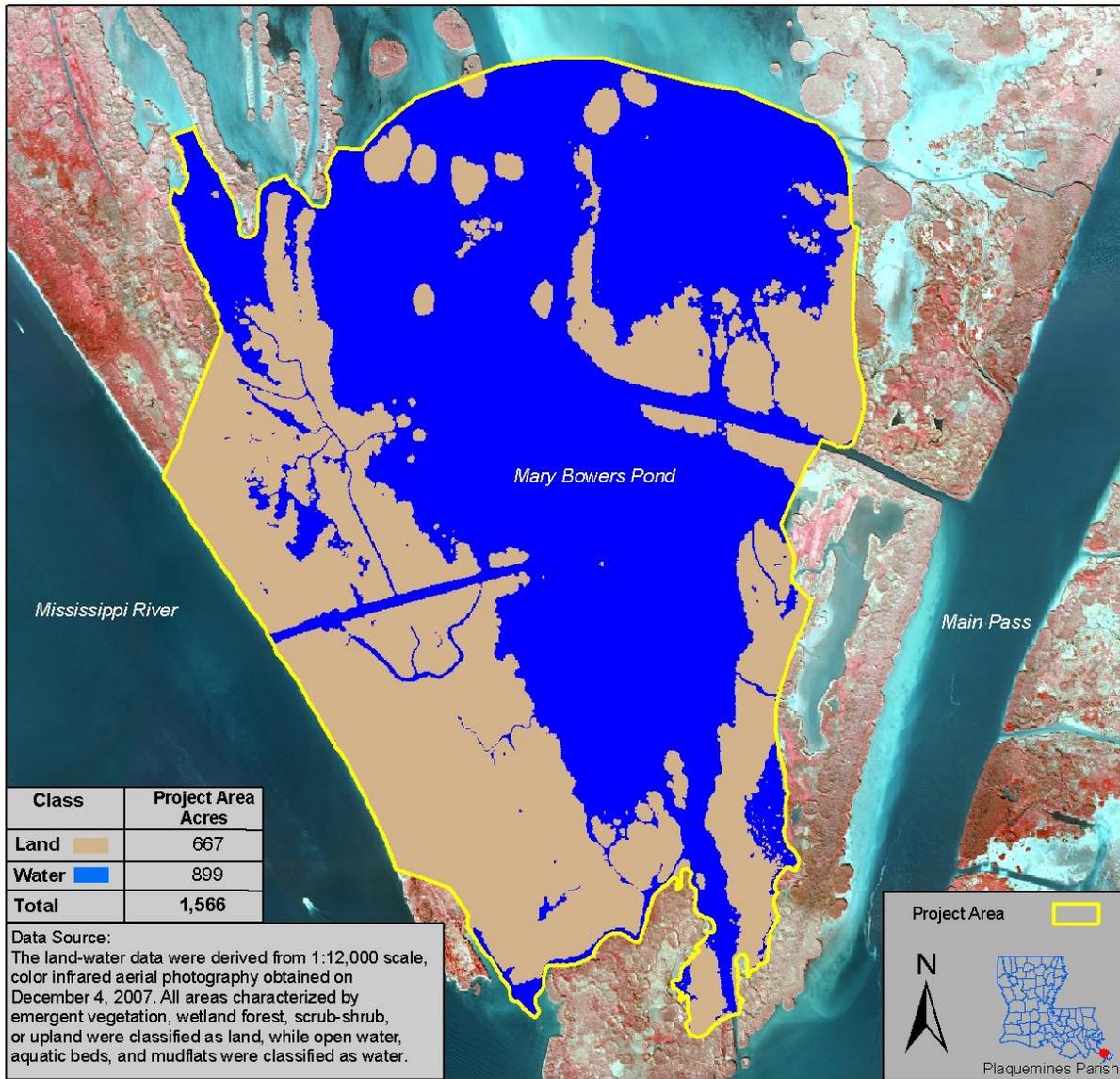
Map ID: USGS-NWRC 2003-02-0092

Figure 12. 2001 (post construction) land/water analysis of the Channel Armor Gap Crevasse (MR-06) project area.

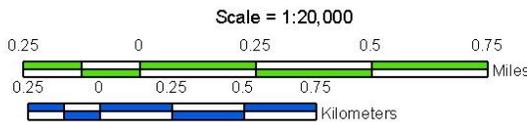




Channel Armor Gap Crevasse (MR-06)
 Coastal Wetlands Planning, Protection and Restoration Act
 2007 Land-Water Analysis



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 Field Office



Federal Sponsor:
 U.S. Army Corps of Engineers



Map ID: USGS-NWRC 2008-02-0721

Figure 13. 2007 land/water analysis of the Channel Armor Gap Crevasse (MR-06) project area.



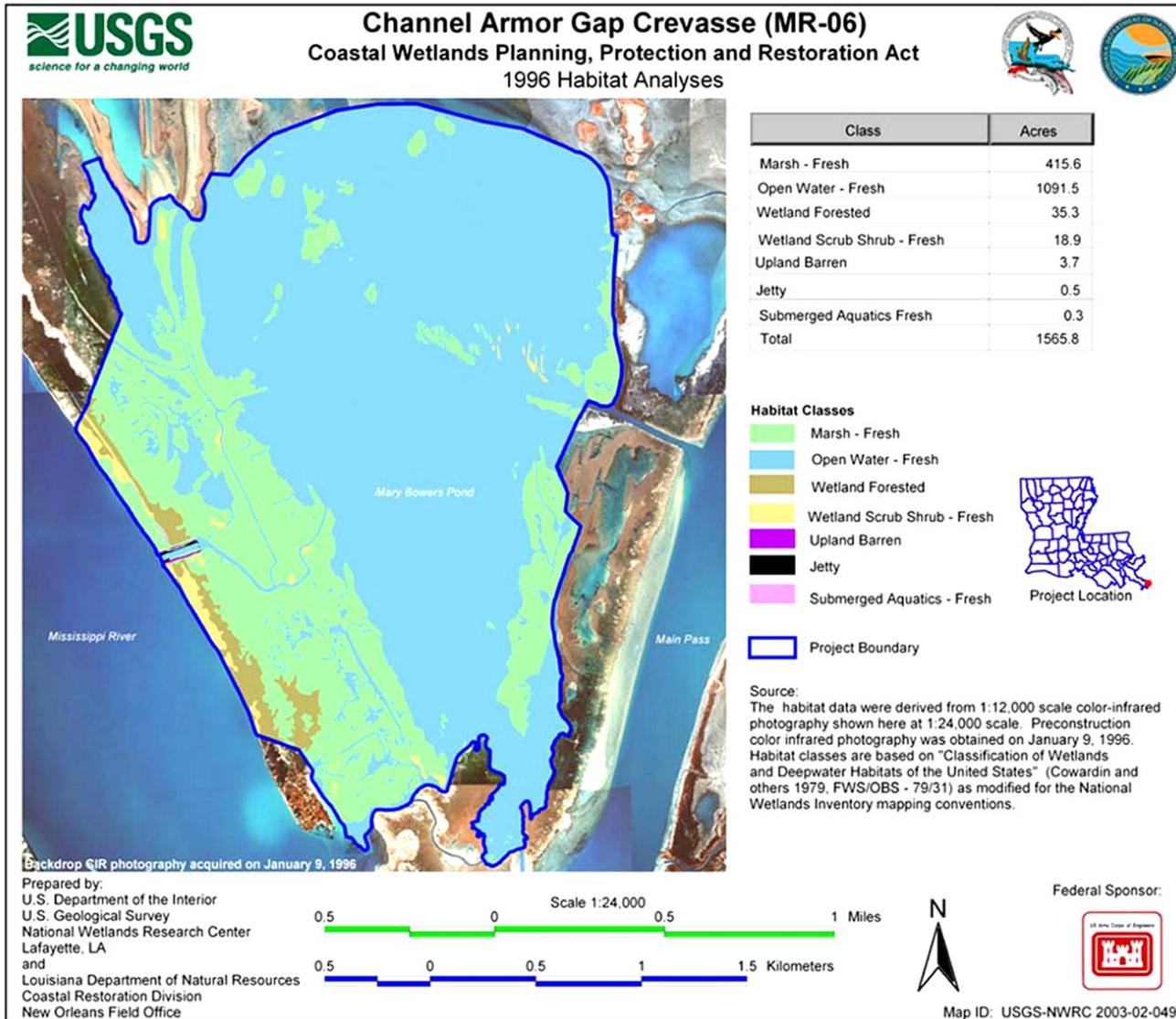


Figure 14. Preconstruction habitat analysis of the Channel Armor Gap (MR-06) project area.

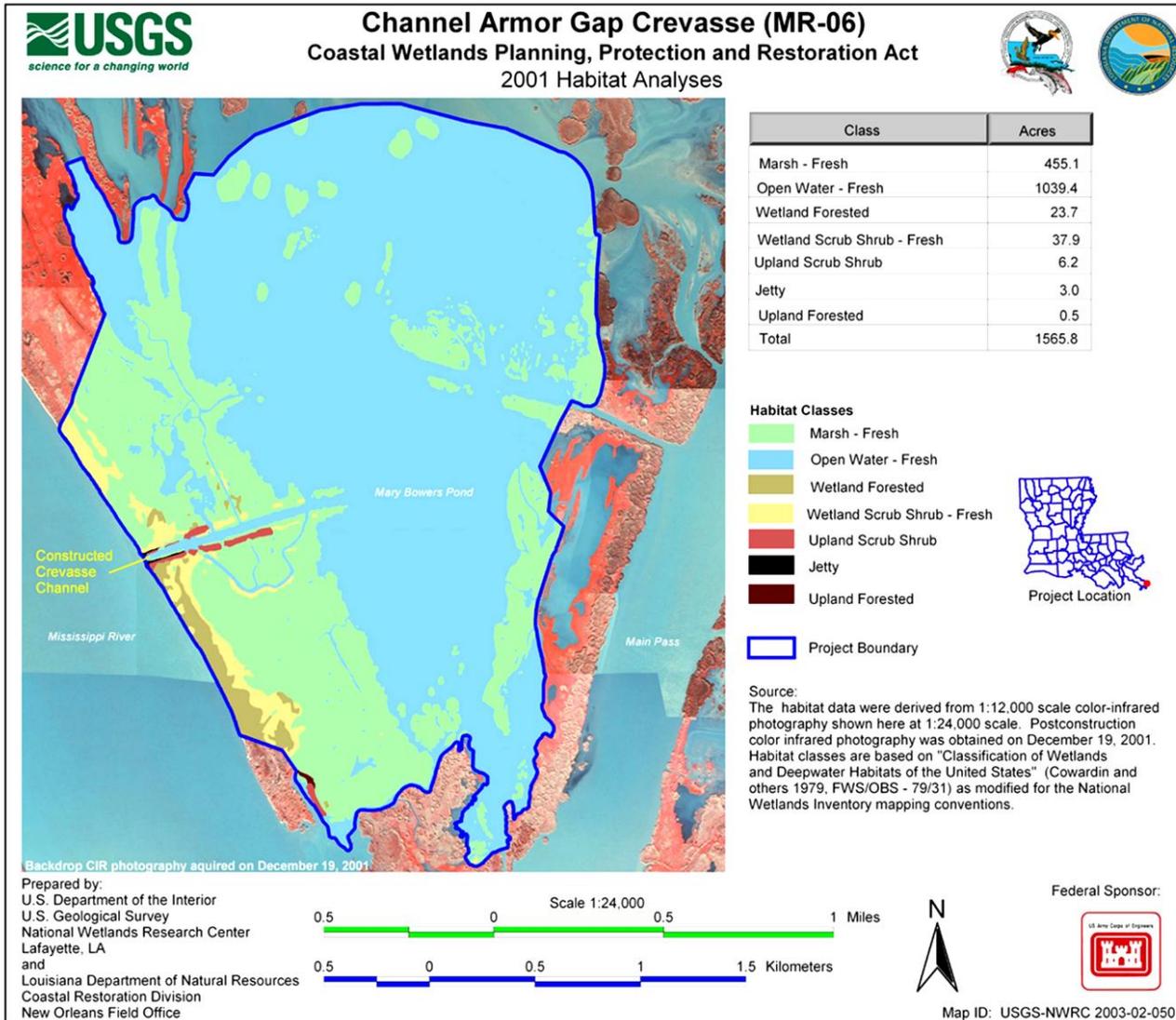


Figure 15. Post construction habitat analysis of the Channel Armor Gap (MR-06) project area.

Vegetation

The first two vegetation stations were established in October, 2001 when subaerial land was first observed adjacent to the end of the crevasse channel. These stations were placed in Transect 1, which is oriented perpendicular to and near the end of the crevasse channel. Station MR06-0101, located on the southeast side of the crevasse channel, had 75% coverage of *Sagittaria* sp. (bulltongue) and station MR06-0102, located on the northwest side of the crevasse channel, had 60% coverage of *Sagittaria* sp. (Figure 16). During the 2002 survey however, no subaerial land or emergent vegetation was observed in the area adjacent to the crevasse channel where vegetation stations had been established the previous year.

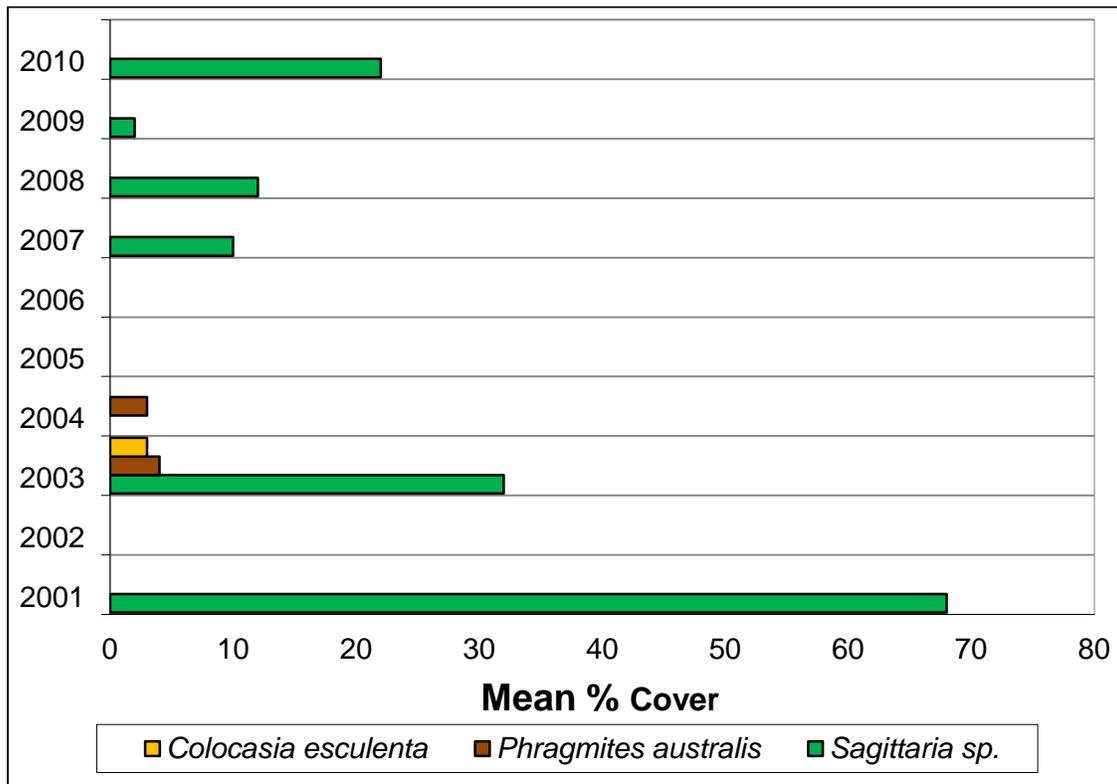


Figure 16. Mean percent cover of emergent vegetation species from 2001 to 2010 (2001 – 2002 n=2; 2003 – 2007 n=7; 2008 – 2009 n=8; 2010 n=9). No vegetation was observed in 2002, 2005, or 2006.

Five new vegetation stations and a second transect were established during the 2003 survey due to an increase in emergent vegetation near the mouth of the crevasse channel. Transect 2 is located parallel to Transect 1 farther out in the receiving bay. Vegetation was present in 6 of the 7 vegetation stations. Most of the observed vegetation was *Sagittaria* sp., but *Phragmites australis* (common reed) and *Colocasia esculenta* (elephant ear) were also present. In 2004, there was a marked decrease in vegetative cover, with vegetation present at only 1 station. In the 2005 and 2006 surveys, no vegetation was observed.

Vegetative cover recovered somewhat in the 2007 – 2010 surveys, although in each of these years vegetation was found in 2 or fewer plots. Mean percent cover ranged from 2% to 22% (Figure 16) across all stations. One new station was added to Transect 1 in 2008, along with another in 2010; both were located on the northern end of the transect. The only species observed during these surveys was *Sagittaria* sp.

Since the establishment of the first plots, vegetative cover has been inconsistent in the receiving bay. For example, in several cases stations were established during one survey, only to have no vegetation present in any subsequent surveys. Much of this inconsistency can likely be attributed to the numerous disturbances that affected the area during the monitoring period. Most of the vegetation surveys in which vegetation was absent occurred following disturbances. For example, no vegetation was observed during the 2002 survey, which followed the passage of Tropical Storm Isidore and Hurricane Lili earlier the same year. Low vegetative coverage in 2004 was most likely caused by Hurricane Ivan. Hurricanes Katrina and Rita heavily impacted the area in 2005. Vegetation was absent in the 2005 and 2006 surveys. Until the crevasse has sufficient time to generate a stable vegetative community; storm events will likely impede any forward progress. Newly established vegetation cannot survive the combination of wind, wave action, and, salt water intrusion from a significant storm without a well-developed root mass.

CRMS Supplemental

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.

FQI scores at CRMS2634 remained relatively stable from 2007 to 2011, ranging from a low of 43 in 2010 to a high of 58 in 2007 (Figure 17). Total mean percent cover values showed a general upward trend for the same period, with the highest values seen in 2009 and 2011. There was also a shift in the species composition, from a community dominated by *Schoenoplectus deltarum* (delta bulrush) and *Sagittaria* sp. (bulltongue) to one dominated by *Phragmites australis* (common reed) and *Typha domingensis* (southern cattail). FQI scores for the MR-06 project area were consistently higher than other fresh marsh CRMS project and reference sites within the MRD hydrologic basin from 2007 to 2011 (Figure 18).

Floristic Quality Index for Fresh Marsh, Site CRMS2634

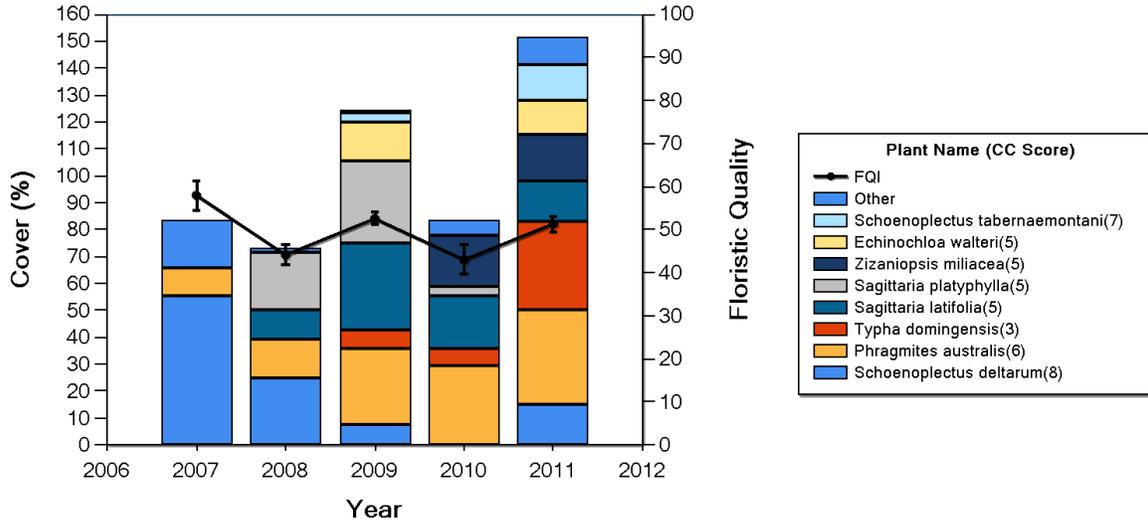


Figure 17 Mean % cover of major species and FQI score at CRMS2634 vegetation plots in years 2007 through 2011.

Project Scale: MR06 - 2007 through 2011

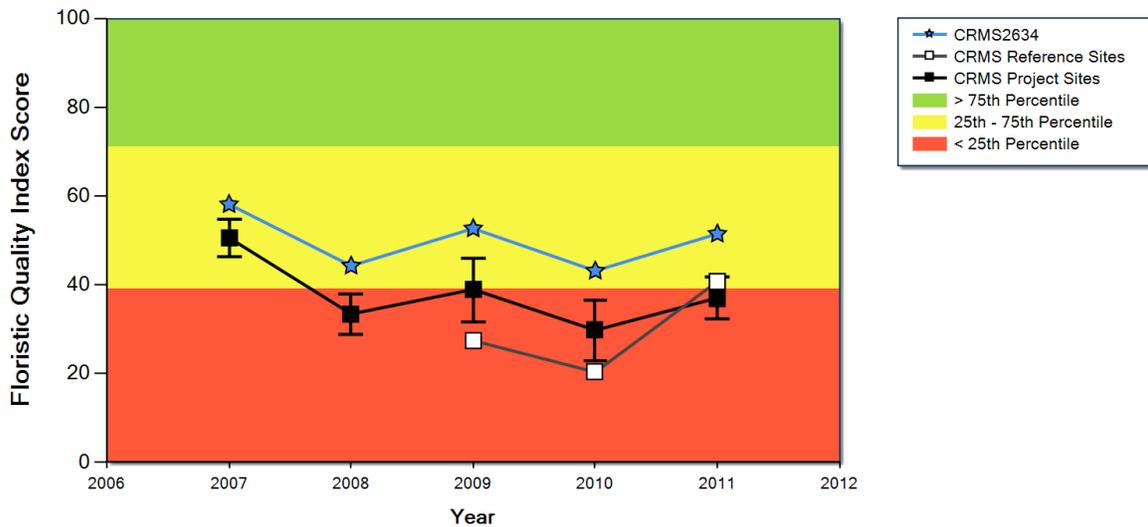


Figure 18. FQI scores of CRMS sites within the MR-06 project area (blue stars) are shown over time relative to all other fresh marsh CRMS sites within the Mississippi River Delta hydrologic basin. Black squares represent CRMS sites located within restoration projects; white squares are CRMS reference sites outside of restoration projects. Project and reference site scores are the mean (\pm SE) FQI scores by year for all sites with similar marsh types within Mississippi River Delta Basin.

Percent land trends were calculated using Landsat Thematic Mapper (TM) data for 1985 - 2010. Linear regressions were calculated for the period of record excluding the 2005 and 2008 dates. Post-hurricane images were excluded from analysis because they do not represent average conditions and exclusion was an effort to reduce the influence of

transitory storm effects. The variability in percent land data points around the slope illustrates the influence of various sources of environmental variance or classification error. Positive slopes indicate increasing percent land or historical land gain and negative slopes indicate decreasing percent land or historical land loss (Couvillion et al., 2011). The positive slope of the regression line for MR-06 indicates that land gain is occurring in the project area (Figure 19). This is consistent with the project-specific land/water analysis. When the same data are separated into pre- and post-construction time periods a more complete picture emerges. The pre-construction percent land trend was negative (Figure 20), however this trend was reversed post-construction.

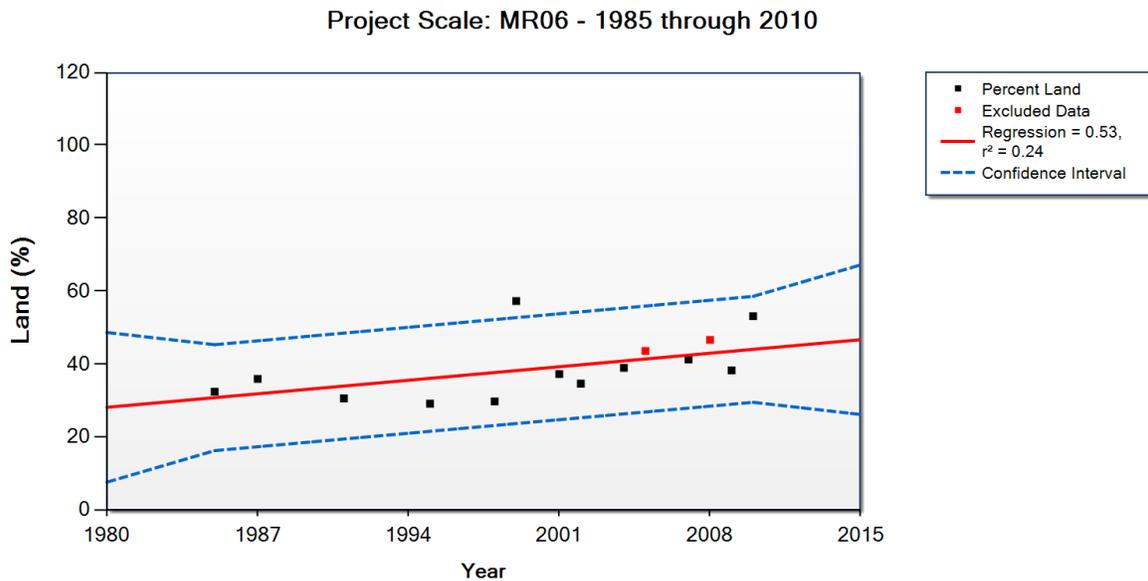


Figure 19. Project scale percent land change for MR-06. Percent land values are displayed for all cloud free TM images available for 1984 – 2010. The red line depicts the percent land trend for the entire period of record. Percent land calculated as percent land of total project area. Data points were excluded immediately following the hurricanes of 2005 and 2008 because they do not represent average conditions.

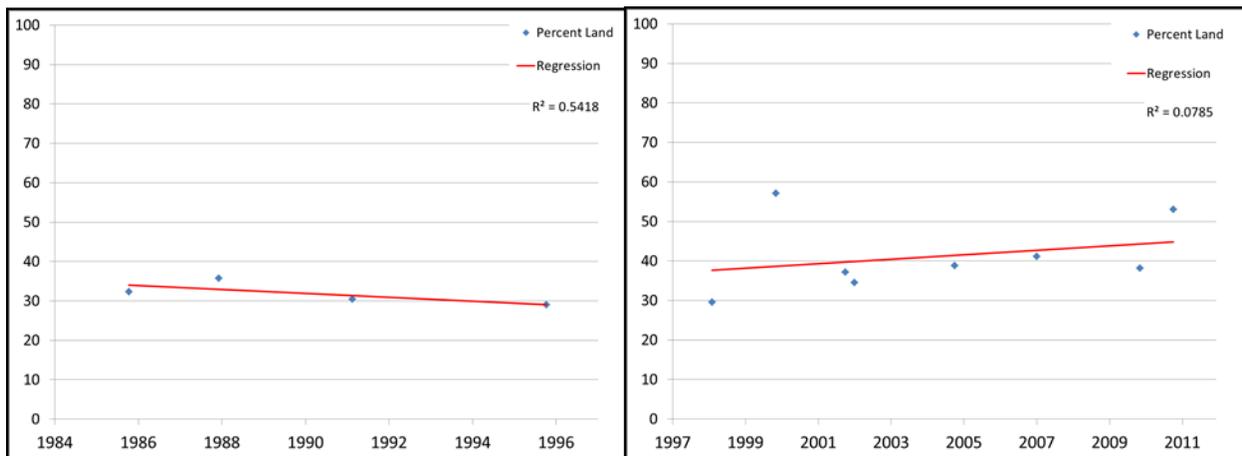


Figure 20. Pre-construction (left, N=4) and post-construction (right, N=8) percent land change for MR-06. The red line depicts the percent land trend for the period. Percent land calculated as percent land of total project area.

V. Conclusions

a. Project Effectiveness

Sediment elevation has significantly increased within the entire project area since project construction was completed in 1997. It is clear that the goal of increasing sediment elevation is being met. Also, using only the immediate receiving bay for elevation analyses has eliminated concern regarding how much sediment was a direct result of the MR-06 project. Land area has increased by 41% (193 ac.) within the MR-06 project area, although it is unknown how much of this can be directly attributed to the project due to multiple freshwater and sediment inputs into the receiving area. Emergent wetland vegetative cover has been slow to develop, possible due to the influence of frequent disturbances from storms.

b. Recommended Improvements

Suspended sediment and discharge measurements were dropped because their sampling frequency was not sufficient to give us accurate and reliable data. However, we suggest that funding for these variables be provided for future projects. The quantity and quality of sediment being transported into the project area can be combined with land gain data, modeled, and used to increase predictive capabilities of crevasse splay development.

c. Lessons Learned

In this project, more time was required for subaerial land to appear than in previously studied crevasses. Mary Bower's Pond was a relatively deep receiving area, averaging nearly 3.5 ft deep prior to construction. Subaerial expression of crevasse splays may be delayed with increasing pre-construction water depth. More sediment is required to fill a relatively deep receiving basin as opposed to shallower basins. Furthermore, many factors affect the rate of sediment retention and sediment distribution in receiving basins. Measuring and modeling sediment elevation is an effective short-term indicator of project success rather than relying solely on aerial photography to monitor visible land gain.

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