BENEFICIAL USE OF DREDGED MATERIAL MONITORING PROGRAM

Results of Monitoring the Beneficial Use of Dredged Material at the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Lower Atchafalaya River - Horseshoe

Base Year 1985 through January 2001

Prepared for

U.S. Army Corps of Engineers
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INTRODUCTION

Beneficial Use of Dredged Material Monitoring Program (BUMP)

The U.S. Army Corps of Engineers New Orleans District (USACE-NOD) maintains thirteen major navigation channels in Louisiana that require regular maintenance dredging (Figure 1). More than 90 million cubic yards of sediment is dredged annually and the USACE-NOD coordinates with state and federal natural resource agencies to determine the most appropriate methods for the disposal of dredged material and, where possible, to beneficially use this material to create or enhance wetlands and other habitats. The USACE-NOD has developed long-term disposal plans incorporating beneficial use for each of these navigation channels. In 1994, the USACE-NOD, working in cooperation with Louisiana State University - Center for Coastal, Energy and Environmental Resources (LSU), implemented a large-scale monitoring program to quantify the amount of new habitat created and to improve dredged material placement techniques to maximize beneficial use. A contract was awarded to the University of New Orleans in 2000 to continue the monitoring program that is known as the USACE-NOD Beneficial Use of dredged material Monitoring Program (BUMP).

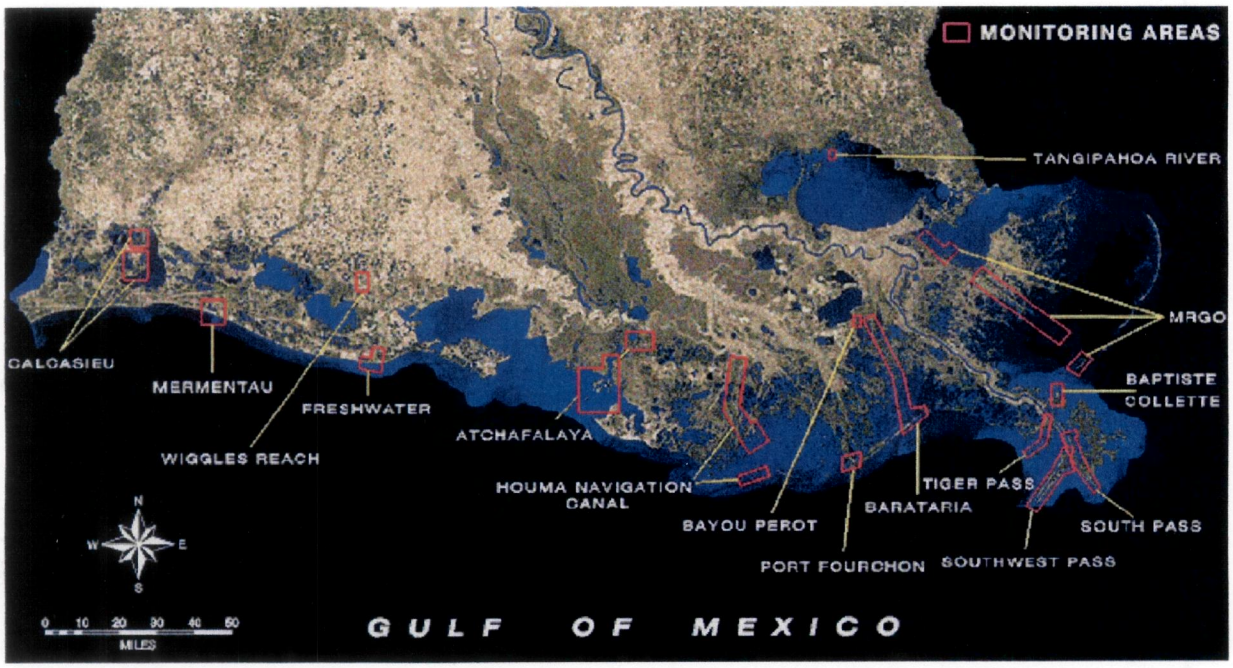


Figure 1. Locations of the beneficial use of dredged material monitoring areas.

Each year, vertical photography is acquired and digital mosaics are produced for each of the study sites listed on Figure 1. GIS habitat analysis and field surveys are conducted on only those sites specified by the USACE-NOD each year. The work products for the sites selected for full monitoring include dredging history maps, habitat maps for the base year, habitat maps for the selected monitoring years, and habitat change maps. From this analysis, coastal change data quantifies the creation of new coastal lands and other habitats at selected navigation channel locations. The field program includes ground truthing operations to verify and update the habitat maps and field surveys to collect information about vegetation and elevations.

The Lower Atchafalaya River and Horseshoe Cut Area

The Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Lower Atchafalaya River - Horeseshoe navigational channel is located 20 miles south of Morgan City, in the south central part of Louisiana (Figure 2). This area is dominated by the riverine influence of the Atchafalaya River and is characterized by vast cypress swamps, willow swamps, and freshwater marshes.

The U.S. Army Corps of Engineers - New Orleans District (USACE-NOD) maintains the navigational channel 20-ft deep and 400-ft wide with annual dredging through the prograding Atchafalaya delta complex.

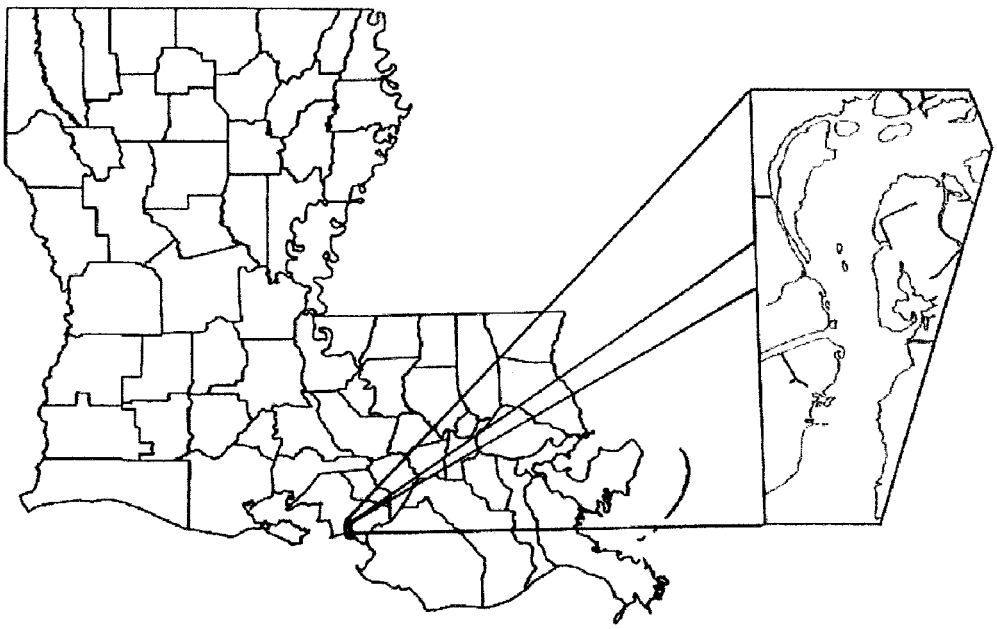


Figure 2. The location of the Lower Atchafalaya River - Horseshoe BUMP study area in Louisiana.

BUMP at the Lower Atchafalaya River - Horseshoe

The USACE-NOD's Beneficial Use of dredged material Monitoring Program (BUMP) is documenting the disposal and beneficial use of dredged material using aerial photography, geographical information system (GIS) analysis, and field surveys. BUMP results are provided in map series, annual reports, and scientific literature.

Since maintenance of the Lower Atchafalaya River began in 1968, dredged material has been deposited unconfined in open water and unconfined in open water adjacent to the existing riverbanks for wetlands development. No dredged material has been placed on the existing shoreline. (See following section on disposal history for details).

This report presents the results of continued monitoring along the Lower Atchafalaya River - Horseshoe navigation channel, representing monitoring results through January 2001.

The natural and man-made habitats in the study area were classified using aerial photography acquired December 1985, October 1995, November 1996, and January 4, 2001 including the Fiscal Year 2000 (FY00) maintenance event. Through GIS analysis, these areas were measured and changes calculated. Field surveys were conducted in October 1996, and April 2002. Habitats were ground truthed; and survey transects were revisited or established to document vegetation species and stacking elevations as a base for measuring compaction. Figure 3 shows the area of minimum aerial photo-mosaic coverage and the limit of the digitized area.

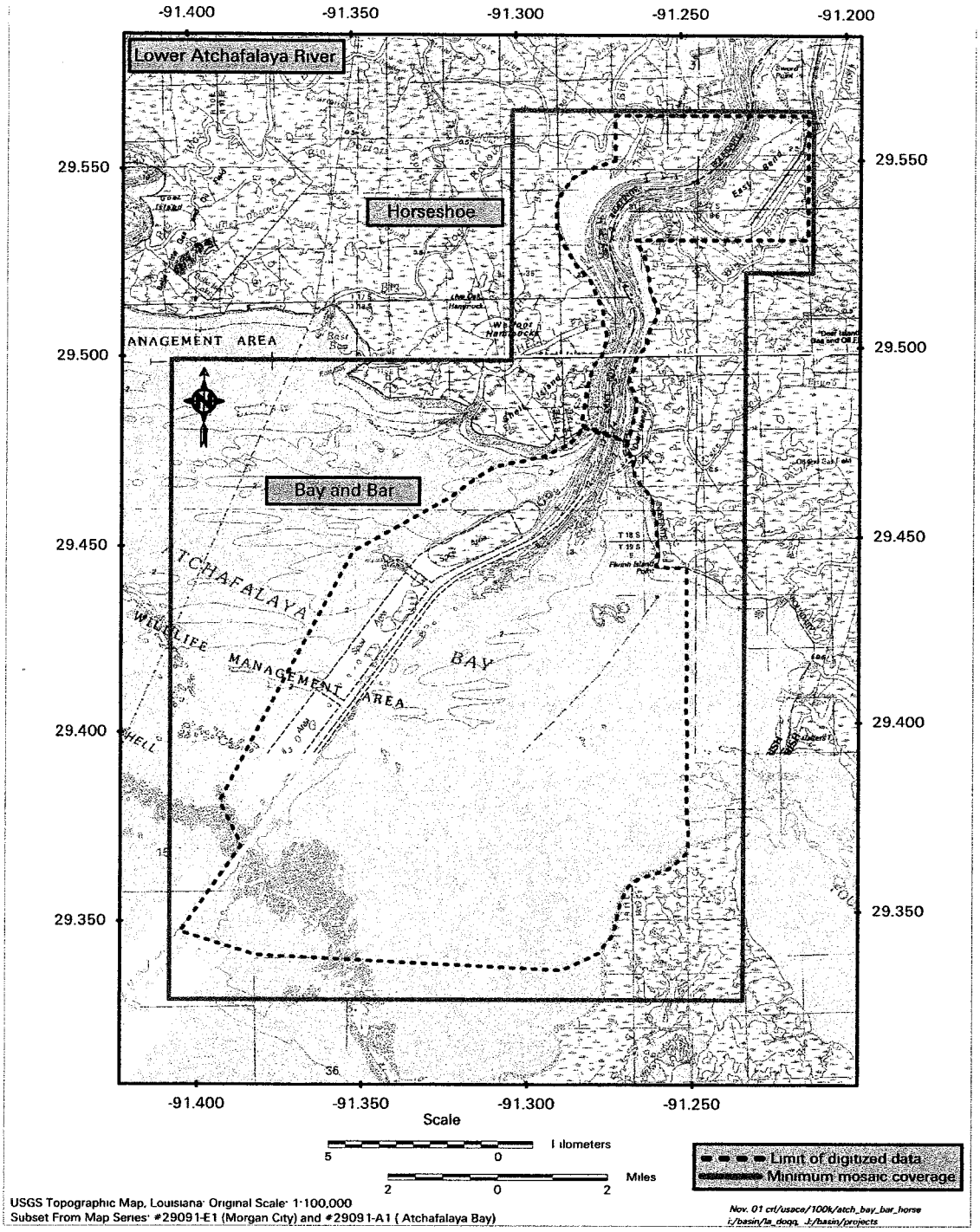


Figure 3. The Lower Atchafalaya River BUMP study areas showing the minimum coverage of the aerial photo-mosaic and limits of the area digitized.

BENEFICIAL USE OF DREDGED MATERIAL DISPOSAL HISTORY
ATCHAFALAYA RIVER AND BAYOUS CHENE, BOEUF AND BLACK, LA
LOWER ATCHAFALAYA RIVER - HORSESHOE REACH
Through FY 2000

The Rivers and Harbors Act of 25 June 1910 authorized the USACE-NOD to construct and maintain a navigational channel through the Atchafalaya River from Morgan City to the Gulf of Mexico with project dimensions 20 feet deep, 200 feet wide and 15.75 miles long from the 20 foot contour in the Atchafalaya Bay, approximately 4 miles beyond the mouth of the Atchafalaya River, to the 20 foot contour in the Gulf of Mexico. Traffic sufficient to warrant maintenance of the authorized navigational channel to full project dimensions did not immediately develop. The channel was progressively enlarged during maintenance events from 10 by 100-feet in 1939 to 20 by 200-feet in 1974.

The Rivers and Harbors Act of 1968 authorized construction and maintenance of the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana project which provided an increase in channel width to 400 feet of the navigational channel in the Lower Atchafalaya River - Horseshoe from the junction of Avoca Island Cutoff Bayou channel to the Atchafalaya Bay. Construction of the channel in the bay and Gulf was initiated in April, 1974 and was completed in December of the same year. Maintenance in Lower Atchafalaya River - Horeseshoe was not required prior to FY 1990 because channel depth historically was in excess of authorized channel dimensions. Dredging records dating back to 1989 indicate discontinuous segments of this reach of the channel or a minor segment of the intersection of Bayou Chene and the Lower Atchafalaya River, have been maintained annually with disposal of dredged material taking place in the Lower Atchafalaya River since FY 1990. Since maintenance of the Lower Atchafalaya River began, dredged material has been deposited unconfined in open water and unconfined in open water adjacent to the existing river banks for wetlands development. No dredged material has been placed on the existing shoreline.

Figure 4 illustrates the dredged material disposal history and USACE-NOD disposal areas for the Lower Atchafalaya River - Horseshoe channel. During FY 1990, material dredged from the Lower Atchafalaya River - Horeseshoe was deposited into open water at a depth in excess of -50 feet National Geodetic Vertical Datum (NGVD) and material dredged from Bayou Chene was deposited into a wetland development site located adjacent to the east bank of the Atchafalaya River. Material was placed in the wetland development site to an elevation of no greater than +5 feet Mean Low Gulf (MLG).

During FY 1991 and FY 1992, material dredged from the Lower Atchafalaya River - Horseshoe was placed into the wetland development site located adjacent to the east bank of the Atchafalaya River, at the intersection of the Lower Atchafalaya River and Bayou Chene, to an elevation of no greater than +5 feet MLG.

During FY 1993, material dredged from the Lower Atchafalaya River - Horseshoe was placed into a wetland development site (Site C) located adjacent to the west bank of the Atchafalaya River. Material was deposited to an elevation of +5 feet MLG.

During FY 1994 (May 27, 1994 - October 16, 1994), material dredged from the Lower Atchafalaya River - Horeseshoe was placed in four wetland development sites (Sites A, C, D and the site at intersection of the Lower Atchafalaya River and Bayou Chene) located adjacent to the east and west banks of the Lower Atchafalaya River- Horseshoe. Material was deposited to an elevation not to exceed +5 feet MLG.
In FY 1995, approximately 1,273,256 cubic yards of dredged material were placed in three wetland development sites (Sites B, D, and E) located adjacent to the east and west banks of the Lower Atchafalaya River - Horeseshoe. Material was deposited to an elevation no higher than +5 feet MLG.

During FY 1996 (April 18, 1996 - May 16, 1996, and August 23, 1996 - October 25, 1996), four wetland development sites (Sites A, B, D, and E) located adjacent to the east and west banks of the Lower Atchafalaya River - Horeseshoe were utilized for dredged material placement. Material was deposited to an elevation of no higher than +5 feet MLG.

During FY 1997 (May 24, 1997 - July 25, 1997 and October 9, 1997 - November 7, 1997), two wetland development sites, Site D located adjacent to the west bank of the Lower Atchafalaya River - Horseshoe and Site B located adjacent to the east were used for dredged material placement. Approximately 1,117,411 cubic yards of dredged material were placed into wetland development Site D and approximately 944,300 cubic yards of material were placed at Site B. The material was deposited to an elevation no higher than +5.0 feet MLG.

Dredged material from both the Avoca Island Cutoff - Bayou Chene reach and the Lower Atchafalaya River - Horseshoe reach were placed into disposal sites within the Lower Atchafalaya River during the FY 1998 maintenance event (May 22, 1998 - October 12, 1998 and September 22, 1998 - December 29, 1998). Approximately 3,291,390 cubic yards of material from the Avoca Island Cutoff - Bayou Chene reach were placed into wetland development Sites G1 and G2 and approximately 748,000 cubic yards of material from the Lower Atchafalaya River - Horseshoe reach were placed into wetland development Site F. The dredged material was placed unconfined to an initial elevation no higher than +5.0 feet MLG.

During the FY 1999 maintenance event (August 30, 1999 - October 23, 1999), approximately 528,769 cubic yards of dredged material were removed form the Lower Atchafalaya River - Horseshoe reach. Approximately 319,069 cubic yards of material were placed into the abandoned shell borrow pit, Site H, and approximately 209,700 cubic yards of material were placed into Site B. At both sites, the dredged material was placed to an initial elevation no higher than +5.0 feet MLG.

There was no maintenance dredging in the Lower Atchafalaya River - Horseshoe reach during FY 2000. Figure 4 illustrates the dredged material disposal history for the study area through FY 2000 (January 2001).

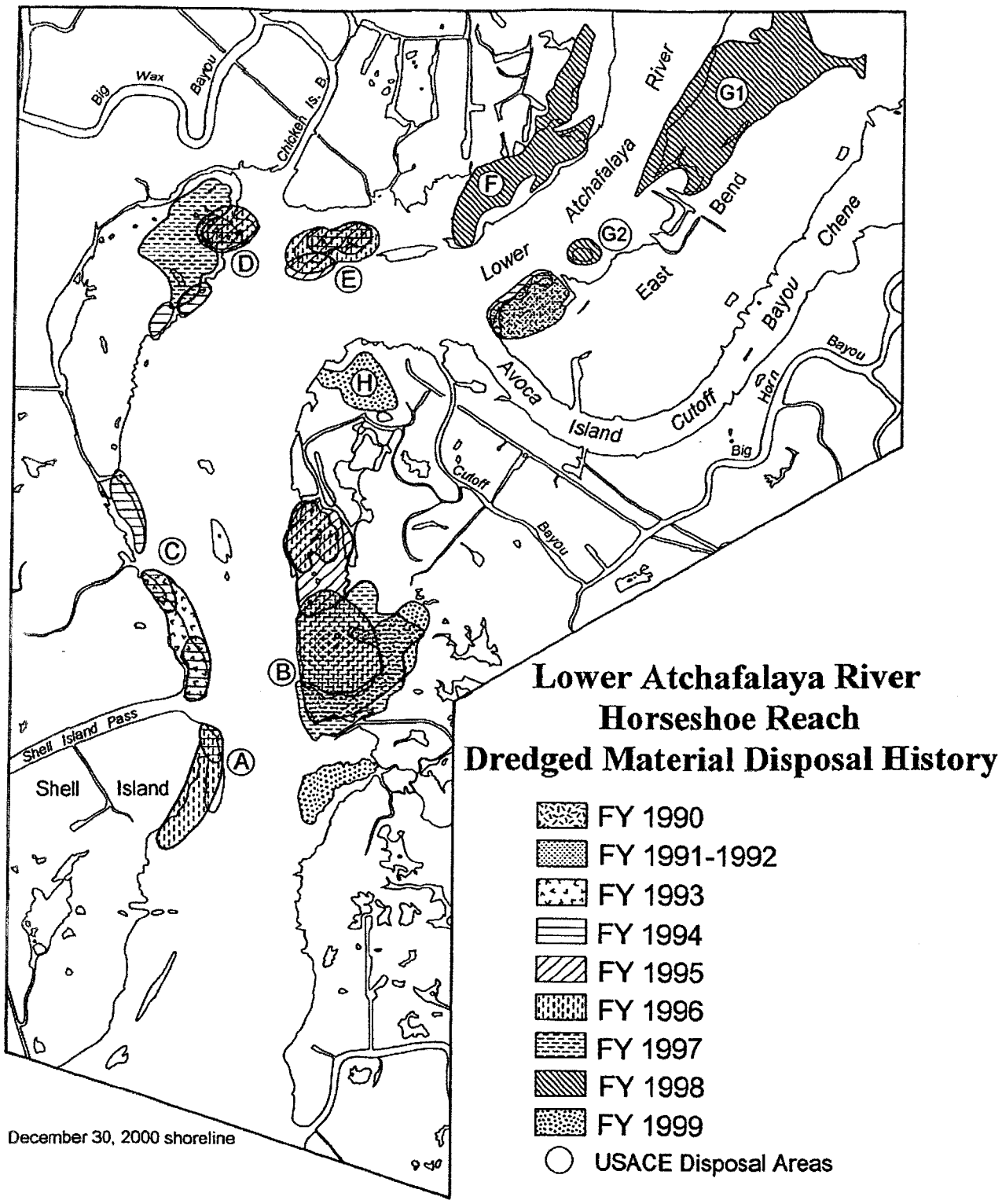


Figure 4. Dredged material disposal history and USACE-NOD disposal areas for the Lower Atchafalaya River - Horeseshoe reach through FY 2000. Data from USACE-NOD and aerial photography.

BASIC METHODOLOGY

Aerial Photographic Analysis and Habitat Determination

The aerial photographic analysis was the basis for all statistics and analyses. For each monitoring site, a base year was selected against which the assessment of changes was made. The base year for the Lower Atchafalaya River - Horseshoe study area was 1985 and the historical 1985 aerial photography was acquired from the U.S. Geological Survey Earth Resources Observation Systems (EROS) Data Center. Color infrared photography was acquired at a scale of 1:24,000 by UNO's air photo contractor on November 1994, November 1995, November 1996, and on January 4, 2001. There was a 60 percent forward overlap of the photography that allowed the use of stereo plotting techniques for better accuracy. Color infrared photography was used for mapping and photo-interpretation because it provided a better definition of vegetation types, habitats, and the land/water interface. A copy of the color infrared photography was archived at UNO/LSU and combined into photo-mosaics. A second set of color infrared photography with mosaic was provided to the USACE-NOD.

The study areas were interpreted and mapped from the base year photography and the color infrared aerial photography using a Bausch and Lomb zoom transfer scope. USGS quadrangle maps were used for the initial ground control to set the interpretations in the state plane coordinate system. The absolute accuracy is $\pm$50' and the relative accuracy is $\pm$10'. Beginning in FY2000, habitats were interpreted using Erdas Imagine™ remote sensing software and interpreted by a supervised classification of spectral reflectance, texture, and tone. The shoreline was interpreted according to the location of the wet/dry beach contact visible on aerial photographs, the outer edge of well-established marsh, or the outer edge of organic beaches. An accurate shoreline was important to area calculations and assessments of trends in erosion, accretion, or effects of dredged material disposal.

The interpretations of habitat type were verified by taking the photography or interpreted map into the field to check specific areas against the actual landscape for positive habitat identification and vegetative community composition. Corrections were made where necessary to the map, and the revised map was then submitted for GIS digitization and final analysis.

Habitat types were important to understanding the result of disposal practices. The Appendix of this report lists the species documented during the field visits, including scientific names, common names, type of vegetation and habitat it prefers. This information verifies the habitat interpretations; helps to further characterize the habitat type, and can give further insight to the type of habitats created by the placement of dredged material. The habitats were broken into simple classes and sub-classes based on the types of vegetation present: water, wetlands (marsh and forested wetlands), and land (beach, bare, dune, upland, shrub/scrub, and forest). These very general characterizations necessarily incorporate many other habitats and transition areas.

The habitat categories used are in quotes below and were delineated using the definitions and criteria defined below.

Water (not included in statistics)

"Open water" is water not completely encircled by land, including some intertidal areas.

"Intertidal" is an indistinct, shallow area that indicates natural sediment deposits or dredge material deposits below normal high tide that does not support emergent vegetation. Some of these areas do support submerged aquatic vegetation or can become colonized by marsh vegetation.

Wetlands

"Marsh" for our purpose, is any unforested, vegetated area normally subject to inundation or tidal action at any time, sufficient to support wetland-dependant, emergent vegetation. *High marsh*, an area above normal high tides but inundated frequently by spring and storm tides or seasonally heavy rainfall, can occur in conjunction with any type of marsh, but is associated most commonly along the coast with saline marshes and is dominated there by *Spartina patens* and *Distichlis spicata*. High marsh associated with fresh or brackish marsh is often represented by grasslands and considered "upland".

"Forested Wetlands" is any forested area normally subject to inundation through part of the growing season, or with permanent or near-permanent standing water. This includes swamps, batture communities, bottomland forest, and riparian forest.

Land

"Beach" is an unvegetated area adjacent to open water that is subject to direct wave action at some time during the daily tidal cycle or during average storm surges. This can be sand, shell, organic, or a mixture of sediment types. This area is unlikely to permanently support vegetation because of frequent reworking by wave action. Most colonization occurs on the upper beach area less frequently affected by waves.

"Dune" is an area above the high water line formed by aeolian deposition of sand into ridges or hummocks.

"Bare land" encompasses the areas that are unvegetated and not normally subject to direct wave action. It may be adjacent to open water but in a more sheltered orientation not subject to active wave reworking. Usually it indicates areas of freshly deposited dredged material or recent natural sediment deposition.

It may include areas of sparse plant colonizations that may become either upland or marsh.

"Upland" is a natural area or dredged material deposition area that is elevated and not subject to tidal action or inundation under normal circumstances so that upland species (non-marsh species) thrive. For this study, it includes barrier island habitats as well as inland habitats, does not include significant shrub or tree coverage, and usually denotes a grassland, meadow, natural levee or elevated area within a marsh, or some types of agricultural or artificially altered land. Natural succession may lead to shrub/scrub in some areas.

"Shrub/scrub" is an area dominated by shrubs or small trees under 20 feet tall. This may be within an upland area or within a marsh area. Within a marsh, shrubs usually occupy elevated areas, marking natural levees or areas artificially elevated. Natural succession may eventually lead to forest or forested swamp in some areas.

"Forest" is any area dominated by trees, that is not normally subject to inundation during the growing season or is only periodically influenced by flooding. For this study it includes bottomland hardwood areas as well as oak or pine woods.

Field Program

The field program supported the air photo-interpretation and GIS analysis tasks. The field program was comprised of two work efforts. Ground-truthing, verified the interpretation of habitat type based on the density and types of vegetation present, and verified surface morphology from the aerial photographic analysis. Field monitoring, recorded changes in elevation, vegetative species and cover, geomorphic character, and surface texture at selected beneficial use sites in order to assess the best disposal practices. Both ground-truthing and monitoring for this report were conducted during April 2002.

The objective of the field monitoring is to clarify the habitat types by identifying dominant vegetative communities, and to document the results of disposal elevation and placement configuration to assist in the evaluation of the habitat benefits. Monitoring changes in elevation, habitat type and surface morphology at a disposal site identifies the important processes of the specific area. Understanding the relationships between change and process and between habitat and elevation will facilitate better predictions of the potential habitat benefits associated with different placement elevations and configurations.

The field monitoring yielded an updated vegetation list, elevation profiles, and vegetation profiles. The elevation profiles were compared to previous data to illustrate and measure

compaction, erosion, and sediment transport. Vegetation profiles were compared to previous data to illustrate habitat succession as the new landscape matures and continues to evolve in response to changing conditions.

Geographic Information System (GIS) Analysis

Once the photography was acquired and interpreted for each site, the digital files were imported into the GIS, ground truthed, and referenced to its true geographic position. The line work was checked for gaps, overshoots and other digitizer errors and edited accordingly. A project schema was created to organize data attributes: area, habitat type, and perimeter. After corrected digital data sets were generated for each USACE-NOD beneficial placement site, two primary forms of GIS analysis were used to quantify and characterize wetland conditions at selected sites. The first form of analysis was the extraction of area measures for each habitat type. Values were generated per type for each year and location. The second form of GIS analysis was the creation of change detection maps and tables for interim periods. These illustrated primary trends in geomorphic change by comparing shoreline configurations and total areas of habitat for the different time periods.

World Wide Web Site

To facilitate the transfer of information to the natural resource trustees and other interested parties, UNO has a World Wide Web site for the dissemination of the beneficial use of dredged material monitoring data. A home page allows the user to click (hyperlink) through data on the beneficial use of dredged material, including scanned aerial photographic mosaics, habitat maps, habitat change maps, habitat data spread sheets, and the results of field investigations. The web site is updated periodically after data has been checked and approved by the USACE-NOD. The site can be found at:

http://www.BUMP.uno.edu

FIELD SURVEY RESULTS

The peninsula on the east side of the Lower Atchafalaya River - Horseshoe, Disposal Area B, was selected as the BUMP monitoring site by the USACE-NOD (Figure 5). This peninsula was constructed during the FY95 and FY96 maintenance events and additional area was added during the FY97 and FY99 maintenance events (figure 4).

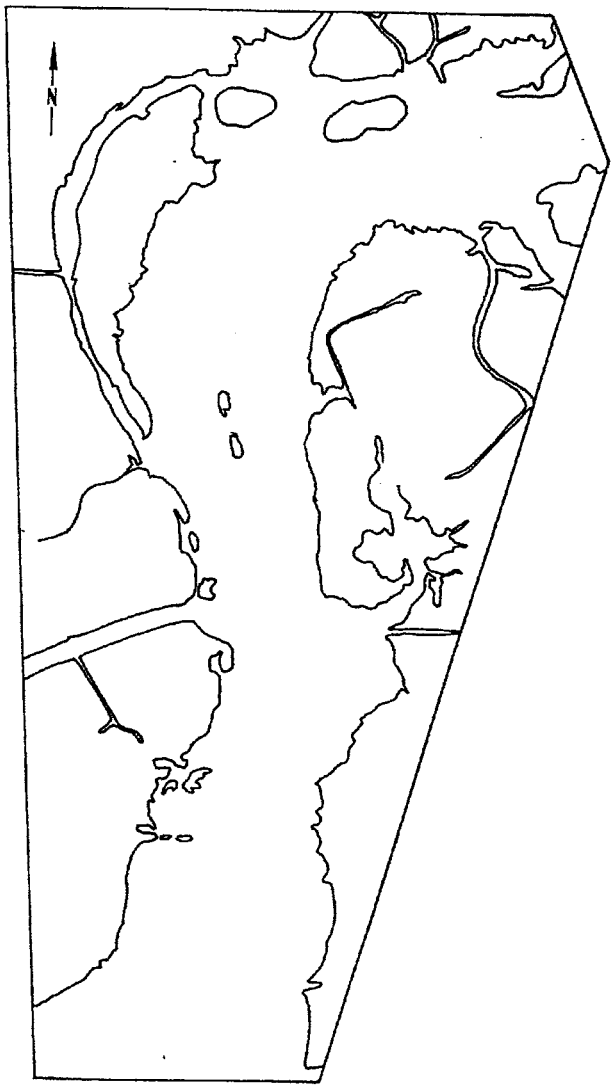


Figure 5. Location of the 1996 transect at the Lower Atchafalaya River - Horseshoe BUMP study area.

Methodology

The collection of the elevation and vegetation survey data was made in two phases. Phase-I involved assessing the characteristics of various beneficial use disposal areas to determine the most appropriate site to document the beneficial use of dredged material through habitat development. This was accomplished by discussion with the USACE-NOD, reviewing vertical aerial photography, reviewing dredging schedules and history, and defining varying vegetation and site morphology. Based on these factors, one site was selected on the east side of the channel in "Disposal Area B" to be representative of the area. Access to the site was by small boat, and by hiking through the brush along an old dirt track.

In October 1996, two stakes were positioned across the selected Horseshoe BUMP study area, oriented to traverse habitats near perpendicular to the river shoreline. Permanent 1-inch diameter by 6-foot galvanized stakes were driven approximately 3.5-feet into the ground and secured with concrete. The stakes were positioned 40-feet apart and defined spatially using a Global Positioning System (GPS). Temporary white, ten-foot PVC poles with flagging and neon orange paint were slipped over the galvanized stakes to make profile sighting and re-location easier.

Phase-II involved the actual collection of profile datum. In October 1996 and April 2002, elevation and vegetation data was collected along the transect defined by the stakes placed during phase-I. Survey datum was collected using a Topcon GTS-300_{DPG} Total-Station, tri-prism, and TDS48 Data Collection System. The horizontal accuracy of the GTS-300 is 0.25 ft $\forall$ 0.0125 ft., and has a vertical accuracy of 0.45 ft $\forall$ 0.0125 ft. The maximum horizontal range with tri-prism is 3,525 ft. A Pathfinder Professional MC-5 global positioning system (GPS) device was used to record the horizontal positions of each stake, instrument location, and the position and exact orientation of each transect line. The transect datum collected were processed, referenced to the tide gage at Point Au Fer and entered into a graphic software program to produce topographic profiles (Figure 4).

The topographic profile for the Lower Atchafalaya River - Horseshoe BUMP study site was constructed from the data collected in reference to the tide gage at Point Au Fer, Atchafalaya, Louisiana (29E20' N / 91E21' W). The mean diurnal tidal range for tide gage location is published as 2.1 feet, but this area is influenced more by the Atchafalaya River flood stage.

Due to 6 years of vegetative growth, the 2002 field effort required an extensive amount of time clearing the transect of trees and vegetation that obscured the survey instrument line-of-sight (Figure 8).

Field monitoring for vegetative species composition and habitat verification was initially done in October 1996. The site was revisited in April 2002. Species composition was determined within an approximate six-foot swath along each profile, and major divisions between vegetative communities were entered as points on the elevation profile. No submerged aquatic species were considered for this report. Plants were identified in the field with only representative specimens

taken for confirmation by taxonomic keys and/or verification by the LSU Department of Plant Biology. The better specimens, and uncommon specimens were entered into the LSU herbarium collection; all others were archived by the contractor. The percent composition of each species was visually estimated in order to determine the relative abundance and dominance of species for habitat determinations. These percentages were not intended to provide scientific ratios or statistics.

The species list included in the Appendix of this report is not complete; it reflects only those species that were readily observed during the profiling period. Some plants can only be identified during a short flowering period that may not have coincided with the ground truthing or the profile data collection, and therefore can not be included in the list other than by a broad classification. Many opportunistic annuals may be present in large numbers one year and absent the next. Therefore, revisited transects can exhibit vast differences in species composition along the vegetation profiles.

Profile at Disposal Site "B"

The field monitoring area was a wide peninsula created by dredged material deposition on the east side of the Lower Atchafalaya River - Horseshoe channel (Figure 5). Because the FY96 deposition was in progress during the time of the initial survey, the survey transect was established across material that was placed before and during FY95. The sediment deposited is reported in the FY95 *as-built* as 90% silt and 10% sand. During FY98, the placement of dredged material filled in the waterway at the eastern end of the transect. Subsequent plant colonization of this new area resulted in a soft-substrate, extensive fresh marsh.

The 1996 transect was established with two permanent 1-inch diameter by 6-foot galvanized stakes, set 40-feet apart, driven approximately 3.5 feet into the ground and secured with concrete.

Figure 6 shows the approximate transect location on January 2001 infrared photography. On April 10, 2002, both stakes placed in 1996 were located (Figure 7). Due to 6 years of vegetative growth, the transect line had to be cleared of trees and other vegetation that obscured the survey line-of-sight (Figure 8).

The profile at Lower Atchafalaya River - Horeseshoe in 2002 had a lateral length of 1248 feet. The maximum elevation was 8.0 feet MLG (7.2 feet NGDV), with an average elevation of 6.5 feet MLG (5.7 feet NGVD). The habitats and dominant vegetative species are indicated on the profiles referenced to the elevation (Figure 9). Even though the elevation sounds rather high, the area is influenced more by the river level than sea level, and the river level at this time period was approximately 6.1 feet MLG (5.3 feet NGVD). Put into perspective, the maximum elevation was only 2 feet above the river water level and the average elevation was less than a half a foot above the river water level.

A comparison of the elevation data collected in 1996 and 2002 shown in figure 10 reveals the relative stability of the area, other than the erosion along the channel end or the placement of material at the eastern end. The profile in 1996 was 1450 feet in length with a maximum elevation of 8.0 feet MLG (7.2 feet NGVD) and average elevation of 6.3 feet MLG (5.5 feet NGVD). This is a 13.9% decrease in overall length between 1996 and 2002 and an insignificant 3.6% decrease in average elevation. The greatest change in profile elevation was at either end, where the western, channel shore was eroded and scoured, and the eastern end was evened out and eased into the new deposits. The decrease in transect length between 1996 and 2002 was due to erosion and scour on the channel side.

The profile was well vegetated throughout the transect, except for the dry open grass area of the channel-side stake, where the instrument was placed. The landscape was dominated by willow swamp, shrub thicket, fresh marsh, and wetland border species. The fresh marsh was mostly cattail, wild rice, elephant ears, scirpus, or grasses. Trees observed in the area were willow (*Salix nigra* and *Salix interior*) with an occasional cypress (*Taxodium distichum*) seedling or small cottonwood (*Populus deltoides*). The shrubs were predominately groundsel bush (*Baccharis halimifolia)* and wax myrtle *(Myrica cerifera)*. The higher elevations were occupied by grassland/meadow species.

A comparison of the vegetation data collected in 1996 and 2002 at transect 1-0 is shown in figure 11 to illustrate the changes that took place in the general distribution of habitats. Changes were observed in vegetative cover as annuals and opportunistic species changed between profile periods, and plant competition and succession processes progressed. Vegetative succession for a 6-year period was pronounced. Some bare areas had been colonized, and habitats have become more established or shifted as the elevation varied over time. The increase in the height and stature of the willow trees was the most obvious change. In 1996, this transect traversed on the channel-side from fresh marsh, willow "shrub" thicket, upland vine-terrace, to bare areas, willow "shrub" thicket and fresh marsh on the land-side. In 2002, the transect traversed on the channel-side from willow swamp, shrub thickets, narrow grassland/meadow with some shrubs to extensive willow swamp and fresh marsh on the land-side. Photographs taken during the monitoring events illustrate changes in vegetation as a result of plant succession between 1996 and 2002 (Figures 12-16).

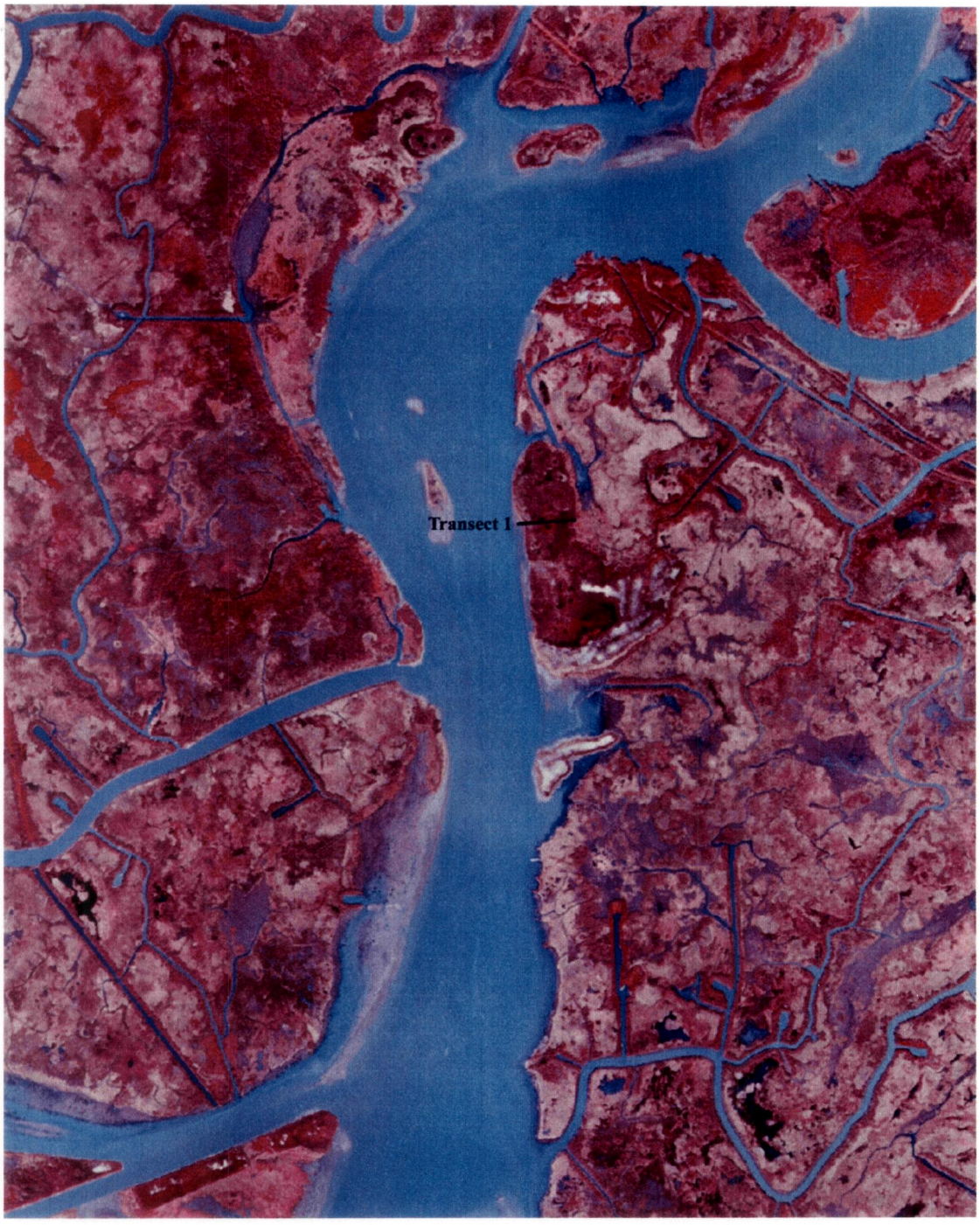


Figure 6. Infrared vertical aerial photography taken on January 4, 2001 of the Lower Atchafalaya River - Horseshoe BUMP study area showing the approximate location of the transect revisited in 2002. Notice the marsh at the eastern end of Transect 1.

A

B

Figure 7. Photographs taken along the "vehicle track" at the Lower Atchafalaya River - Horseshoe study area showing the changes in the landscape after 6 years of vegetative growth.

Figure 8. Due to 6 years of vegetative growth, the 2002 field effort required time clearing the transect of trees and vegetation that obscured the survey line-of-sight. Photograph taken April 10, 2002.

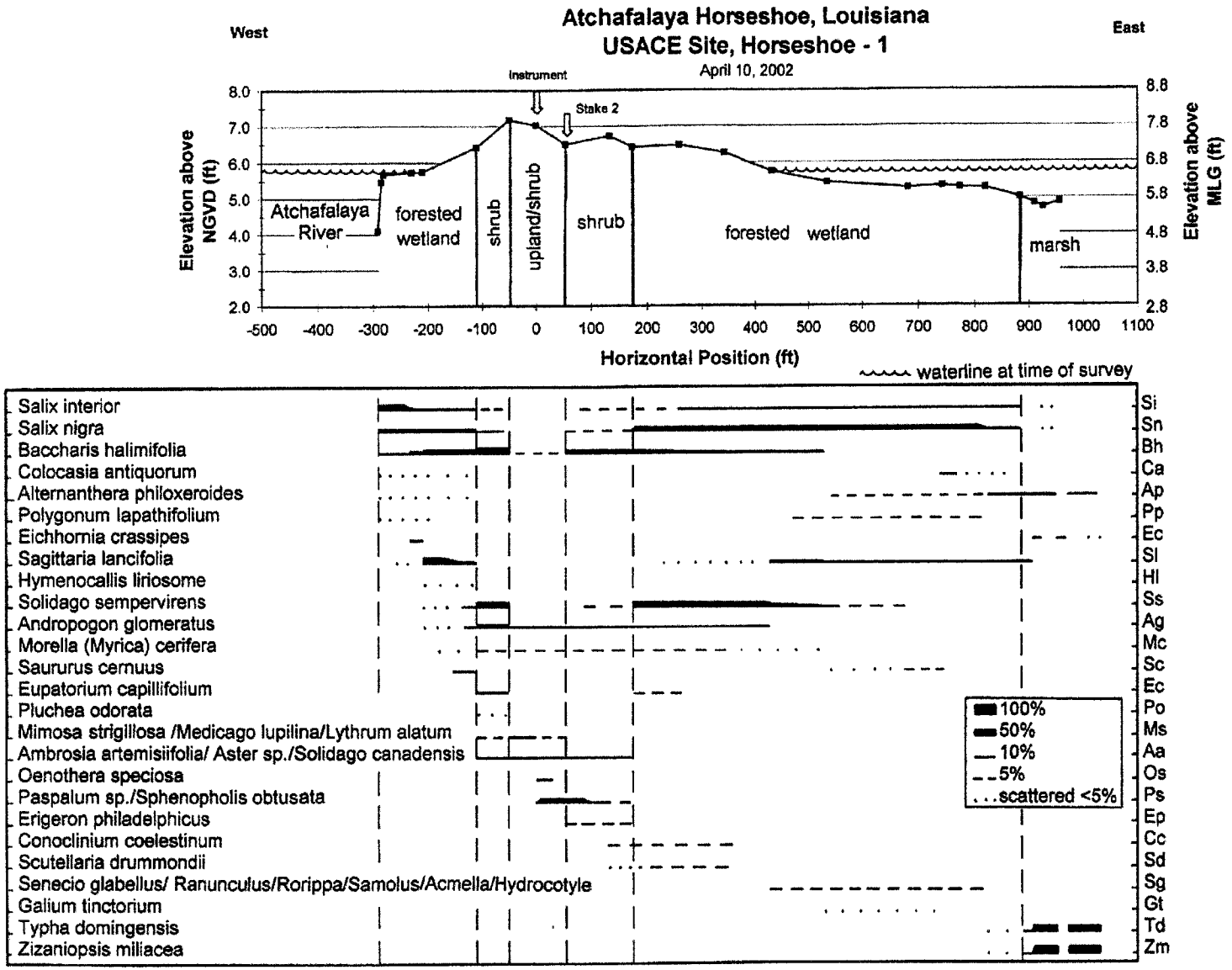


Figure 9. Elevation profile for transect 1 at the Lower Atchafalaya River - Horseshoe BUMP study site with vegetation data illustrated.

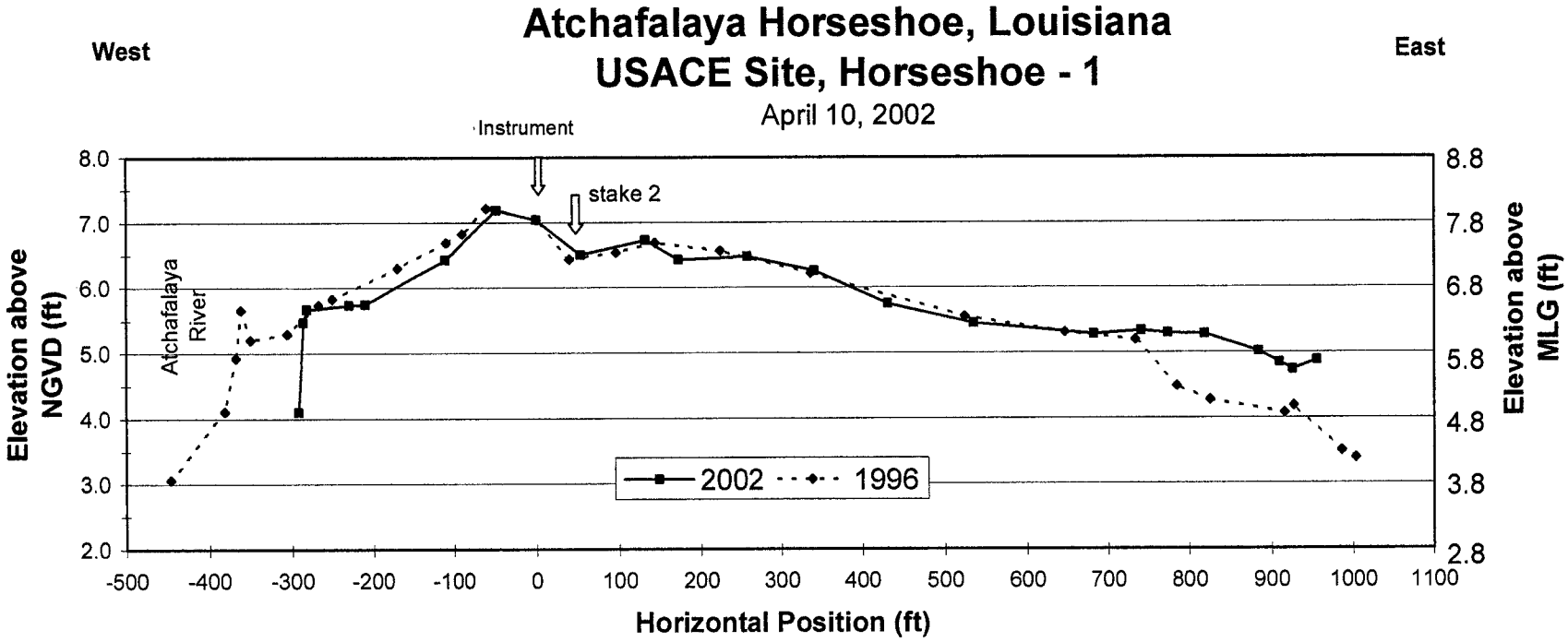


Figure 10. A comparison of 1996 and 2002 elevation data at in the Lower Atchafalaya River - Horseshoe BUMP study area.

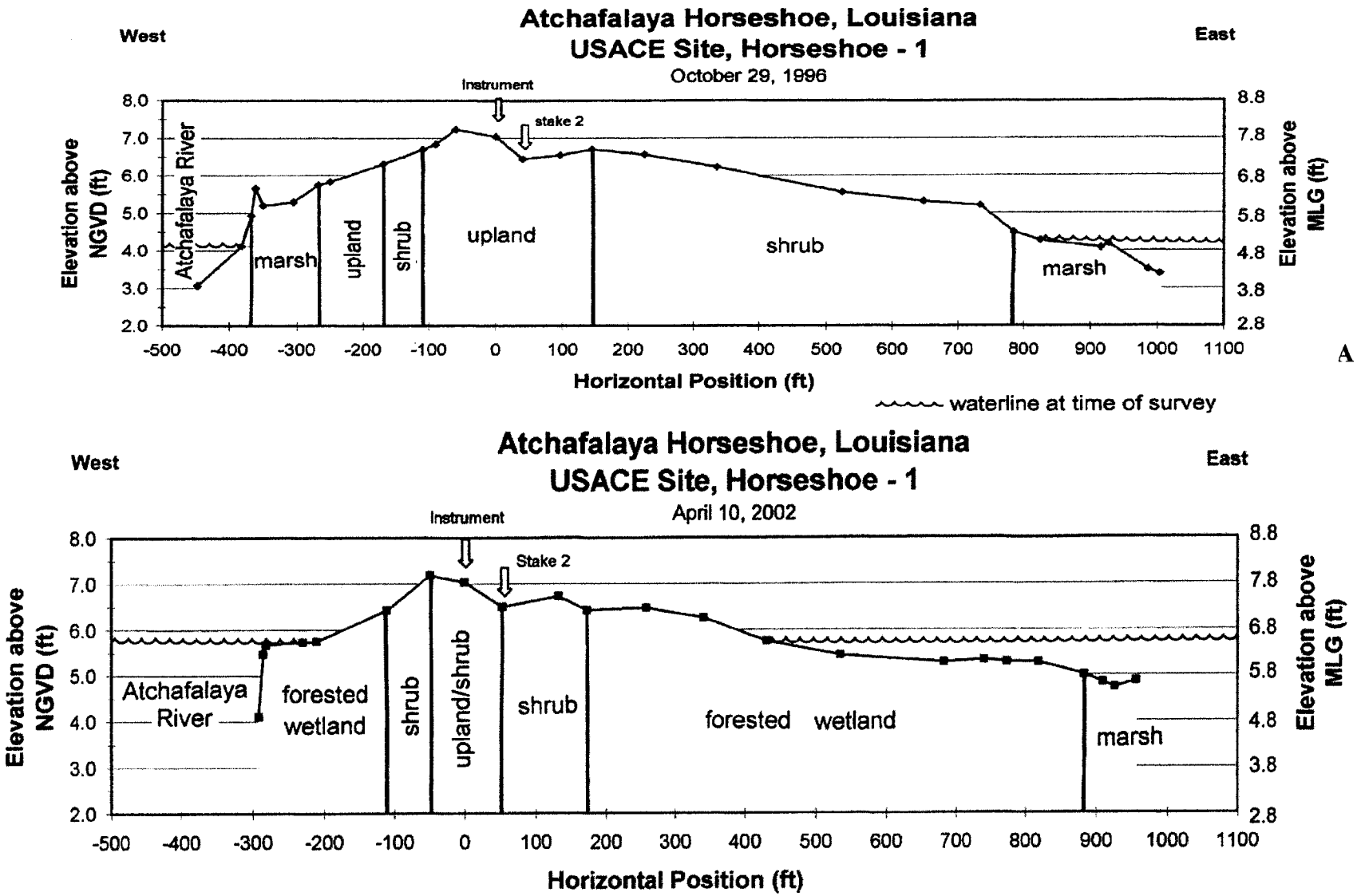


Figure 11. Elevation profile at the Lower Atchafalaya River - Horseshoe BUMP study area showing habitat distribution changes. A) 1996 data. B) 2002 data.

A

Figure 12. Photographs of the western end of the transect looking north along the Atchafalaya River - Horseshoe navigation channel, eastern shoreline; A) October 29, 1996. B) April 10, 2002.

Figure 13. Photographs from the western end of the transect looking east along the transect toward the instrument. In A) 1996, the survey rod was taller than the willows. In B) 2002, the line of sight had to be cleared.

A

B

Figure 14. Photographs looking west along the transect to the instrument placed on the first stake. In A) 1996, the area was a wide vine-terrace, and in B) 2002, it had become a narrow grassland/meadow or "upland/shrub."

A

B

Figure 15. Photographs comparing a stand of willows toward the east end of the transect. A) October 29, 1996. B) April 10, 2002.

A

B

Figure 16. A) A photograph of the fresh marsh at the eastern end of the transect taken on October 29, 1996. B) The same spot 6 years later with willows grown and marsh extended.

Vegetative Character

General Description

The Lower Atchafalaya River supports a freshwater dependant vegetative system. Within the BUMP study area, this is predominately fresh marsh, shrub and forested wetland communities dominated by black willow, and upland/grassland habitats. The lower river area is exposed to the daily tides as well as to elevated water levels during high river conditions. Source material for plant species colonization is predominantly from the extensive Atchafalaya River swamp system that surrounds and lies upstream from the dredged material disposal sites. Aeolian transport of some vegetative material could be expected from other nearby areas.

Each plant species has a habitat preference, and when taken as a community, the type of vegetation present is an indication of habitat type. Major changes in plant communities delineate boundaries between habitats. The study site in 2002 exhibited four basic zones of plant communities indicative of the predominant moisture regime. As one moved from the drier elevated central zone to the shoreline, one traversed from a grassland/meadow through a shrub zone then through an extensive willow swamp thicket to fresh marsh. There was a significant overlap of plant communities across these zones. Erosion or wave energy along the channel shoreline removed or precluded marsh development at the western end of the transect.

Vegetative Community Types in the Lower Atchafalaya River

Most of the plants observed within the study site are of riparian or wetland habits (See specific species habitat descriptions in the Appendix). Other species are listed as occupying "disturbed" or "waste" places and are species that take advantage of newly created or exposed ground with rapid growth and can withstand some inundation by fresh water. Opportunistic species will occupy a new area quickly, but will eventually be replaced by plants more suited for long term survival in a specific habitat.

"Marsh" species within the study site occurred most commonly at an elevation below 5.3 feet MLG (5 feet NGVD). The fresh marsh was represented by cattail (*Typha* spp) and wild rice *(Zizania aquatica)*, alligator weed *(Alternanthera philoxeroides)* and elephant ears (*Colocasia antiquorum*) most often, with occasional stands of bulltongue (*Sagittaria* spp.). Marsh-margin species *Cyperus* sp., *Ranunculus sceleratus*, *Polygonum* spp., *Rorippa palustris*, and *Senecio glabellus*, were also locally abundant and scattered throughout low areas. The extended low relief of the study sites allowed a complex mixing of various species types. Very little fresh marsh other than water hyacinth *(Eichhornia crassipes)* was found along the erosional, channel shoreline on the west end of the transect. An extensive fresh marsh dominated by wild rice and cattails was encountered past the willow swamp at the

inland (eastern) end of the transect, and extended much further than the transect could be taken.

"Forested Wetland" indicated by willow trees (*Salix nigra* and *Salix interior*) seemed to dominate the landscape throughout the study area, making thickets with other shrubs, scattered in many areas of the marsh, along low energy beaches, or within grassland areas. Fresh marsh formed the understory at the lower elevations, and shrubs and grasses occured at the higher elevations. Closely spaced willow trees in extensive shallow, inundated areas shaded out most fresh marsh species in some areas. The willow "forested wetland" zone occurred most commonly at an elevation between 5.8 and 8.3 feet MLG (5 and 7.5 feet NGVD, $\pm$ 0.5 feet). An occasional cypress seedling (*Taxodium distichum)* was also discovered along the transect, but not in significant numbers or stature.

"Shrub" communities usually indicate older, more stable, elevated areas. In the Atchafalaya area, this community overlaps greatly with the willow "forested wetland" zone, and the species present must be able to withstand periods of inundation. Young willows below 15 ft tall are also considered "shrubs." Groundsel bush (*Baccharis halimifolia*) occurred throughout the profile, but it attained its most dense presence usually between 2.5 and 4 ft of elevation. Wax myrtle (*Myrica cerifera*) seemed to prefer less soil moisture and occurred along the more elevated parts of the shrub zone, above 3.5 feet, and scattered across the upper elevations. The understory toward lower elevations held bulltongue (*Sagittaria* sp), butterweed (*Senecio glabellus)*, willow-weed (*Polygonum* spp.), and elephants ear (*Colocasia antiquorum*), and the upper elevations held goldenrod (*Solidago spp.),* broomsedge *(Andropogon glomeratus*), thoroughwort (*Eupatorium capillifollium*), and grasses.

"Upland" areas within the study site were represented by occasional grasslands, herbaceous meadows, and shrub/scrub. *Andropogon glomeratus*, *Sphenopholis obtusa*, and *Paspalum* spp. tend to be the most common grass species, with *Aster* spp, *Eupatorium capillifolium*, *Solidago spp.*, *Lythrum alatum*, *Mimosa strigullosa* and *Ambrosia artemisiifolia* as common herbaceous plants. Even though the dominant vegetation was considered marsh-margin, this area was designated "upland" because it supported some upland species and few wetland obligates. An occasional cottonwood tree (*Populus deltoides*) was discovered near the transect on higher elevations, but not enough to be considered "forested land."

GIS ANALYSIS RESULTS

Shoreline Changes: 1985-January 2001

Figure 17 graphs the spatial history of the Lower Atchafalaya River - Horseshoe BUMP study area between December 1985 and January 2001, also shown in Table 1 and illustrated in Figure 18. The Horseshoe study area in December 1985 was measured at 3,104.1 acres, and in November 1996, was measured at 4,034.1 acres. Between December 1985 and November 1996 the Lower Atchafalaya River - Horseshoe BUMP study area increased by 930.0 acres. This is a 30 percent increase over 10.9 years or 85.3 acres per year.

In January 2001, the area was measured at 4,225.5 acres. Between 1996 and January 2001, there was an area increase of 191.4 acres or an increase in area of 5 percent at a rate of 38.3 acres per year. Between 1985 and January 2001, there was an area increase of 1,121.4 acres or an increase in area of 36 percent at a rate of 74.8 acres per year. The primary areas of progradation took place along the margins of the navigation channel due to the beneficial placement of dredged material.

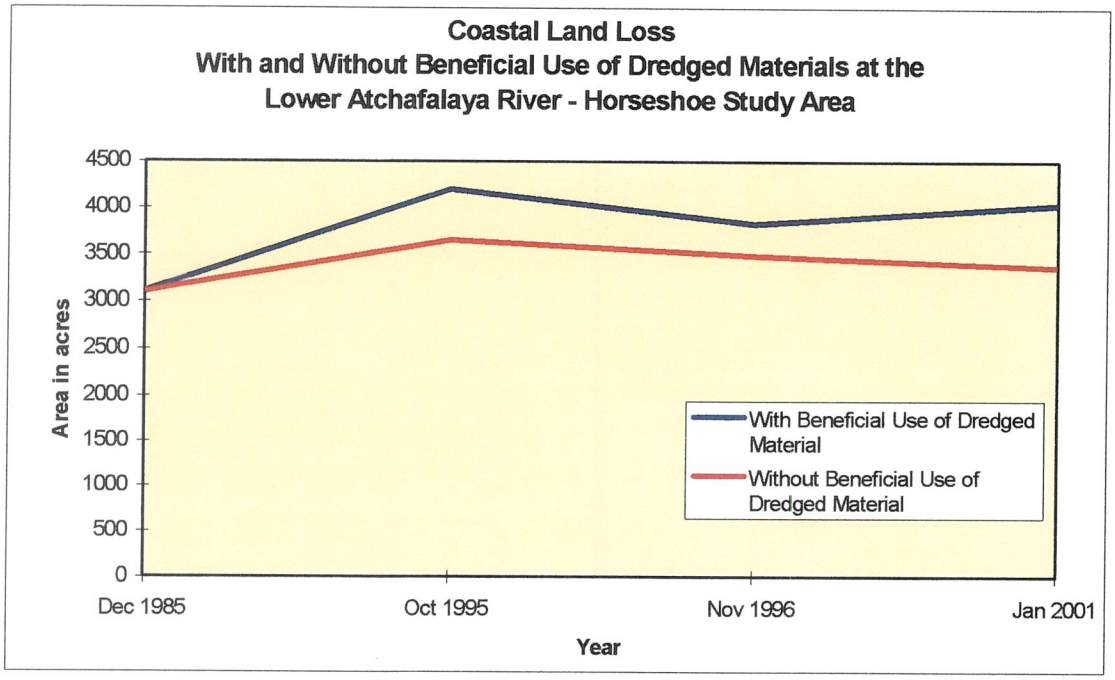


Figure 17. Graph of the area of the Lower Atchafalaya River - Horseshoe BUMP study area over time, with and without the placement of dredged material.

Table 1. Lower Atchafalaya River - Horseshoe BUMP study area: 1985 – January 2001.

Area in Acres	Dec 1985	Nov 1996	Jan 2001
Natural Areas	2,903.8	3,487.6	3,361.6
Other Man-made Areas	200.3	206.5	195.1
BUMP-made Areas	0	340.0	668.8
Total	3,104.1	4,034.1	4,225.5

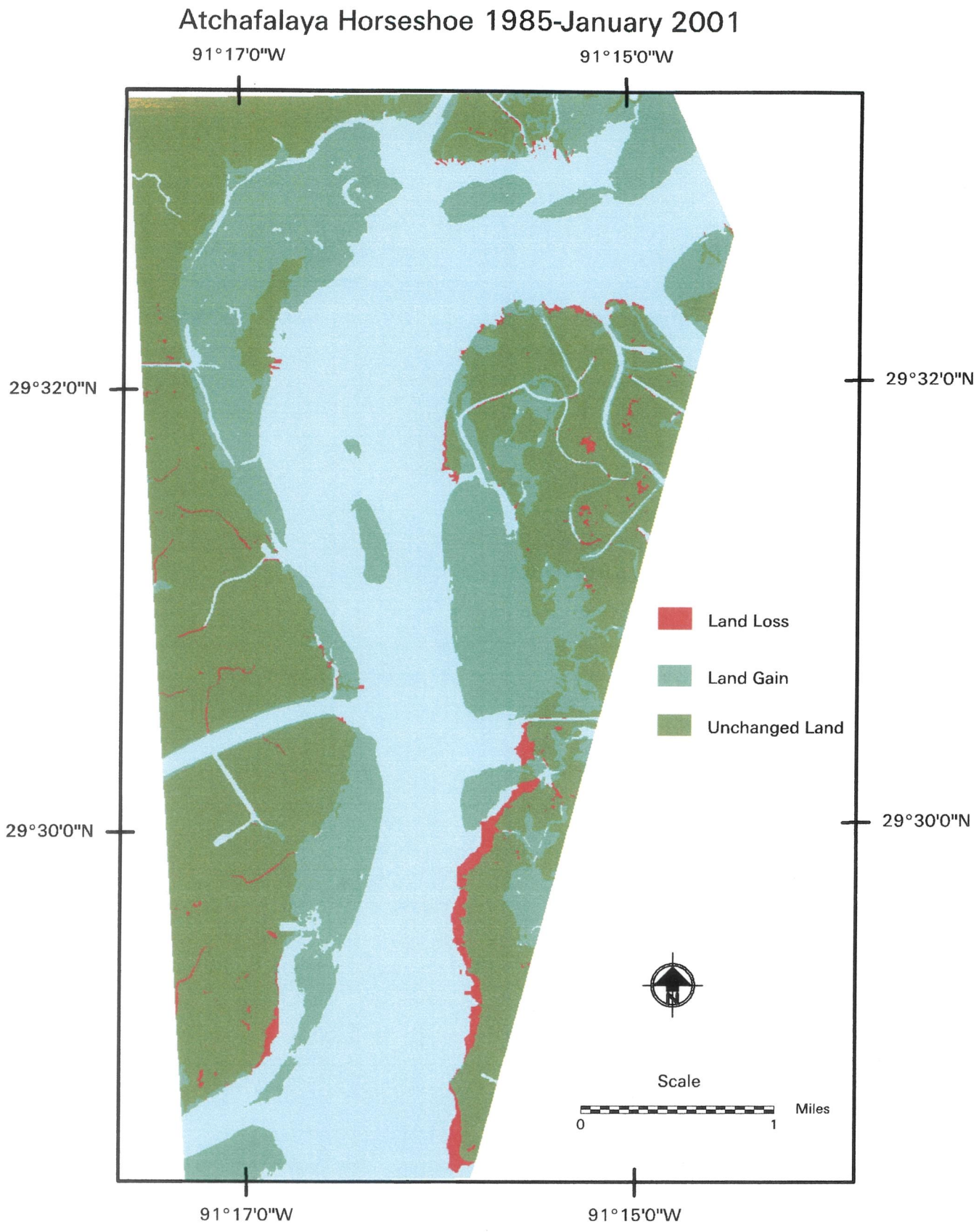


Figure 18 Land loss/Land gain map of Lower Atchafalaya River - Horseshoe BUMP study area between December 1985 and January 2001.

Habitat Inventory

The aerial photographic interpretation combined with field surveys identified six major habitat types in the Lower Atchafalaya River - Horseshoe BUMP study area. These habitats are further classified as natural, BUMP man-made, and other man-made. The natural class identifies habitats created by natural riverine and deltaic processes. The BUMP man-made (BUMP-made) class identifies the habitats created by the beneficial placement of dredged materials by the USACE-NOD. The non-BUMP man-made class (other-made) separates areas created that were not part of the BUMP effort, such as areas created in association with the oil industry access and pipeline canals. On the habitat maps presented in this report, an intertidal class is included to indicate nearshore topography. Because the seaward extent of these areas is not clearly defined, the area of this class is not calculated or included in the inventory.

Table 2 lists the areas of the three habitat types found in the Horseshoe study area in December 1985. The location and arrangement of these habitats are presented in figure 19. The total area of the study area was 3,104.1 acres. Of this total, 2,903.8 acres were natural and 200.3 acres were man-made or 93.5 percent were natural and 6.5 percent were man-made. There were no areas identified as BUMP in December 1985. In order of decreasing size and importance the largest habitat found was natural fresh marsh (2,532.9 acres) followed by natural forested wetland (322.4 acres), other-made forested wetland (200.3 acres), and natural shrub/scrub (48.5 acres).

In terms of habitat totals, fresh marsh (2,532.9 acres or 81.6%) dominated the Horseshoe study area landscape.

Table 2. December 1985 Habitat Inventory of the Lower Atchafalaya River - Horseshoe.

HABITAT	TOTAL	NATURAL	NON-BUMP MAN-MADE
Fresh Marsh	2,532.9	2,532.9	0
Shrub/Scrub	48.5	48.5	0
Forested Wetland	522.7	322.4	200.3
Habitat Total	3,104.1	2,903.8	200.3

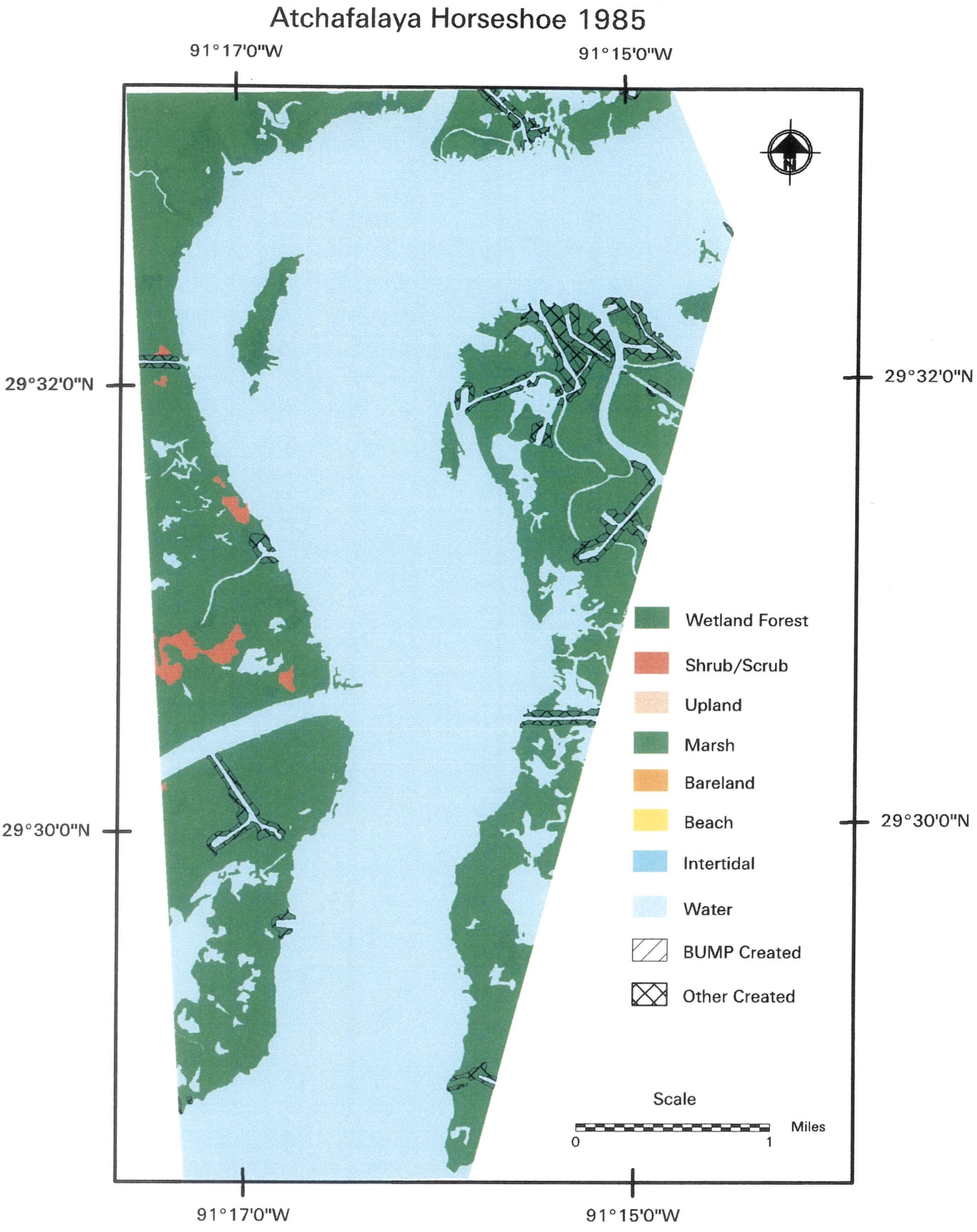


Figure 19 Habitat inventory map of the Lower Atchafalaya River - Horseshoe BUMP study area in December 1985.

Table 3 lists the areas of the six habitats found in the Horseshoe study area in November 1996. The location and arrangement of these habitats is presented in figure 20. In 1996, the total area of the study area was calculated at 4,034.1 acres. Of this total, 3,487.6 acres were natural and 546.5 acres were man-made including 206.5 acres of other-made and 340.0 acres of BUMP-made, or 86.5 percent was natural, 5.1 percent was other-made, and 8.4 percent was BUMP-made. In order of decreasing size and importance, the largest habitat found was natural fresh marsh (2,934.1 acres) followed by natural forested wetland (339.8 acres), other-made forested wetland (204.9 acres), natural shrub/scrub (58.7 acres), BUMP-made fresh marsh (130.6 acres), BUMP-made bare land (126.3 acres), natural bare land (45.3 acres), BUMP-made shrub/scrub (34.9 acres), BUMP-made beach (30.6 acres), and BUMP-made upland (17.6 acres).

In terms of total area, fresh marsh (3,065.8 acres or 76.0%) dominated the Horseshoe landscape.

Table 3. November 1996 Habitat Inventory of the Lower Atchafalaya River - Horseshoe

HABITAT	TOTAL	NATURAL	OTHER MAN-MADE	BUMP MAN-MADE
Marsh	3,065.8	2,934.1	1.1	130.6
Upland	19.3	1.7	0	17.6
Shrub/Scrub	193.6	158.7	0	34.9
Forested Wetland	544.7	339.8	204.9	0.0
Bare	172.1	45.3	0.5	126.3
Beach	38.6	8.0	0	30.6
Habitat Total	4,034.1	3,487.6	206.5	340.0

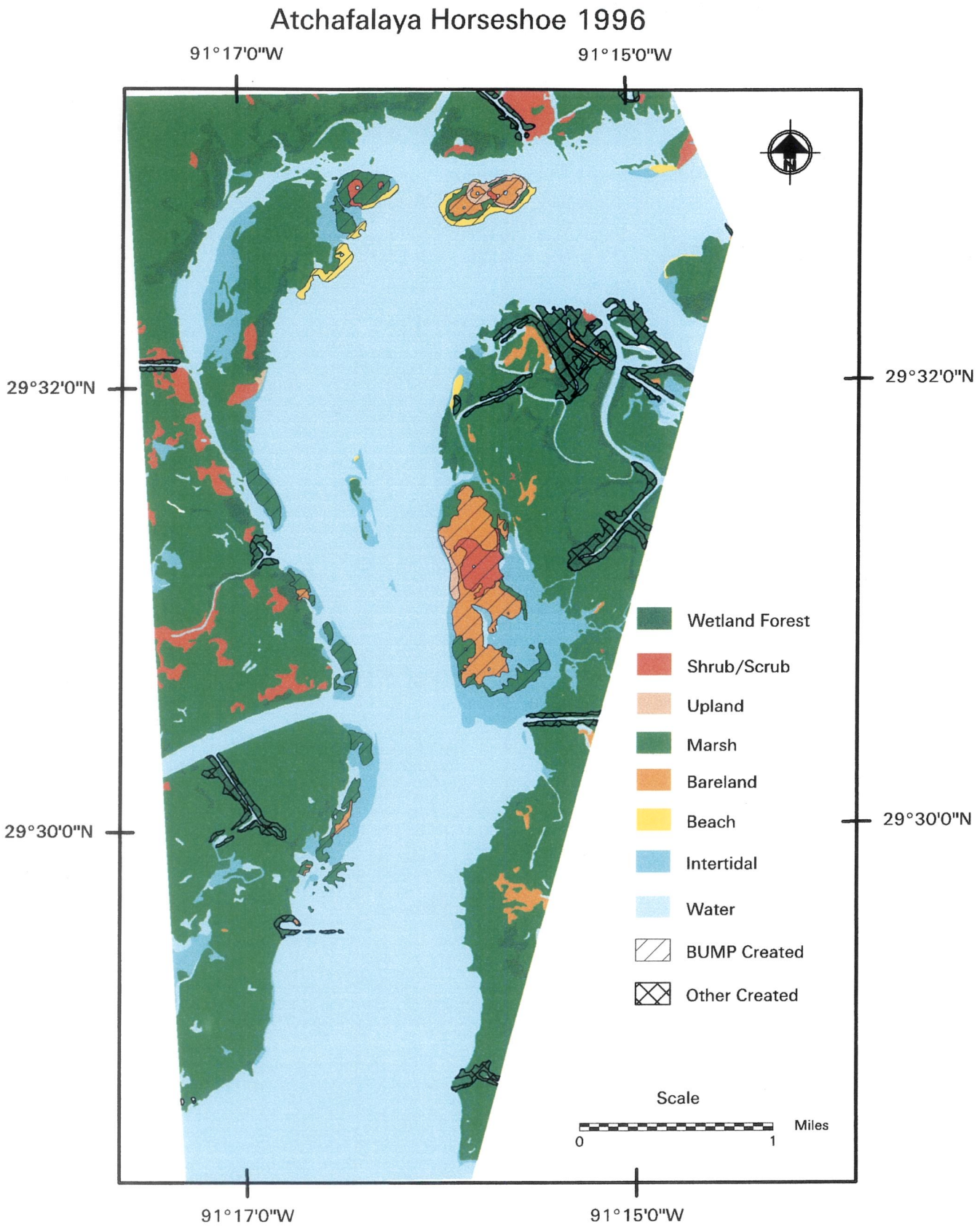


Figure 20 Habitat inventory map of the Lower Atchafalaya River - Horseshoe BUMP study area in November 1996.

Table 4 lists the areas of the six habitats found in the Horseshoe study area in January 2001. The location and arrangement of these habitats is presented in figure 21. In 2001, the total area of the study area was calculated at 4,225.5 acres. Of this total, 3,361.6 acres were natural and 863.9 acres were man-made including 195.1 acres of other-made and 668.8 acres of BUMP-made, or 79.6 percent was natural, 4.6 percent was other-made, and 15.8 percent was BUMP-made. In order of decreasing size and importance, the largest habitat found was natural fresh marsh (2,268.5 acres) followed by natural forested wetland (948.1 acres), BUMP-made marsh (325.3 acres), BUMP-made forested wetland (277.4 acres), other-made forested wetland (187.8 acres), natural bare land (102.7 acres), natural shrub/scrub (41.4 acres), BUMP-made bare land (41.0 acres), and BUMP-made shrub/scrub (15.0 acres).

In terms of total area, fresh marsh (2,600.5 acres or 61.5%) dominated the Horseshoe landscape.

Table 4. January 2001 Habitat Inventory of the Lower Atchafalaya River - Horseshoe

HABITAT	TOTAL	NATURAL	OTHER MAN-MADE	BUMP MAN-MADE
Marsh	2,600.5	2,268.5	6.7	325.3
Upland	9.3	0.9	0	8.4
Shrub/Scrub	56.4	41.4	0	15.0
Forested Wetland	1,413.3	948.1	187.8	277.4
Bare	144.3	102.7	0.6	41.0
Beach	1.7	0	0	1.7
Habitat Total	4,225.5	3,361.6	195.1	668.8

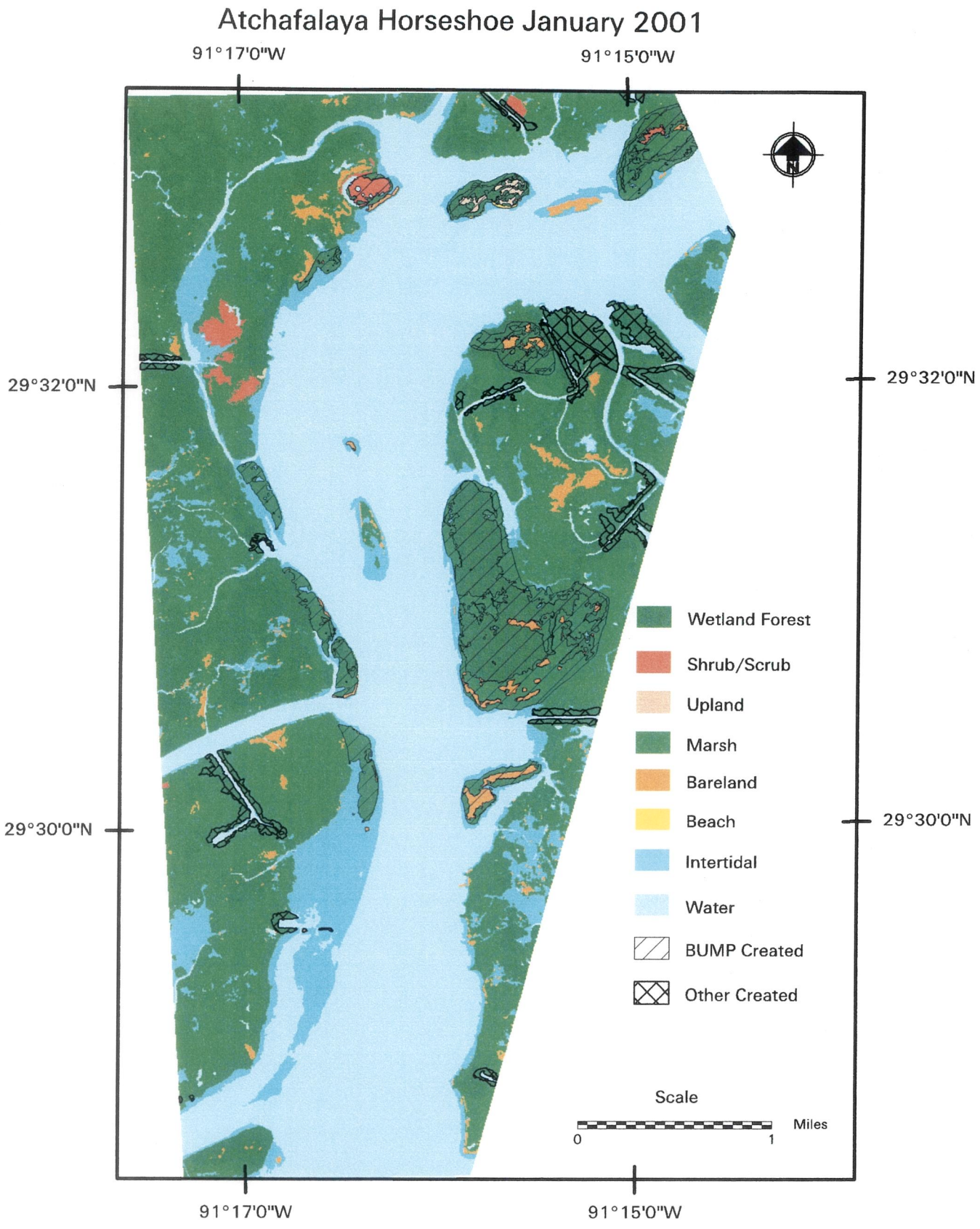


Figure 21 Habitat inventory map of the Lower Atchafalaya River - Horseshoe BUMP study area in January 2001.

Habitat Change

Figure 22 shows the cumulative creation of new habitat, including natural, other man-made and BUMP man-made, in the Lower Atchafalaya River - Horseshoe study area between December 1985 and January 2001. The total area increased by 1,121.4 acres which represents a 36 percent increase in area between 1985 and January 2001. Of this increase in area, 457.8 acres were natural, 668.8 acres were BUMP-made, and a decrease of –5.2 acres were other-made. Table 5 lists the major habitat changes during the period between December 1985 and January 2001.

The major habitat-increase between December 1985 and January 2001 was by beneficial placement of dredged material. Over this 15 year period, there was a +668.8 acre increase of BUMP-made habitats. Of the BUMP-made habitats, marsh (+325.3 acres) and forested wetland (+277.4 acres) were the largest created. Natural forested wetlands also increased (+625.7 acres), however natural marsh decreased by –264.4 acres.

Figure 23 shows a time series of habitat changes in the Lower Atchafalaya River - Horseshoe study area. Figure 23A graphs the natural habitat changes over time. Natural forested wetland development dominates the natural habitat class. Figure 23B graphs the man-made habitat changes. Forested wetland and fresh marsh dominate the man-made class.

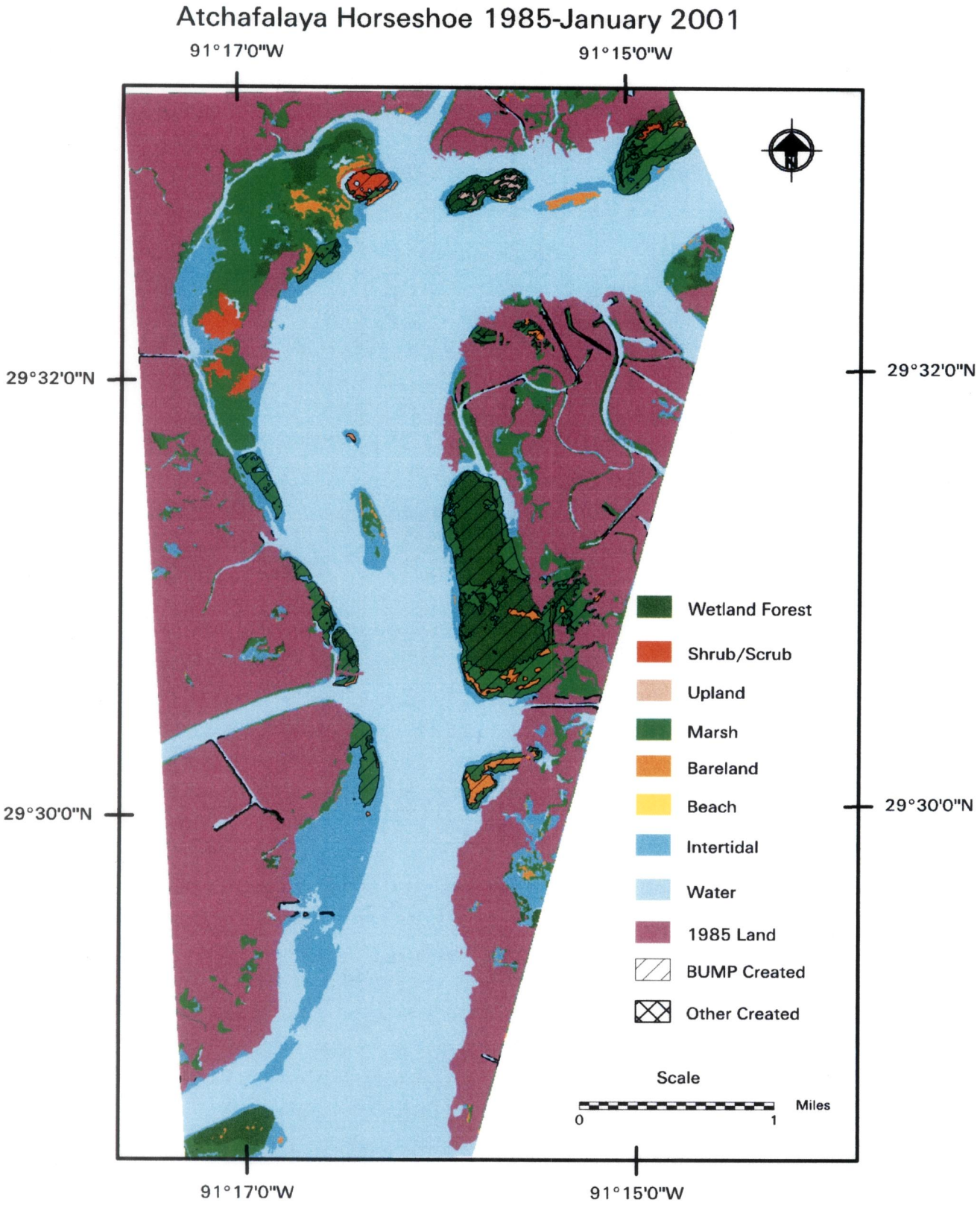
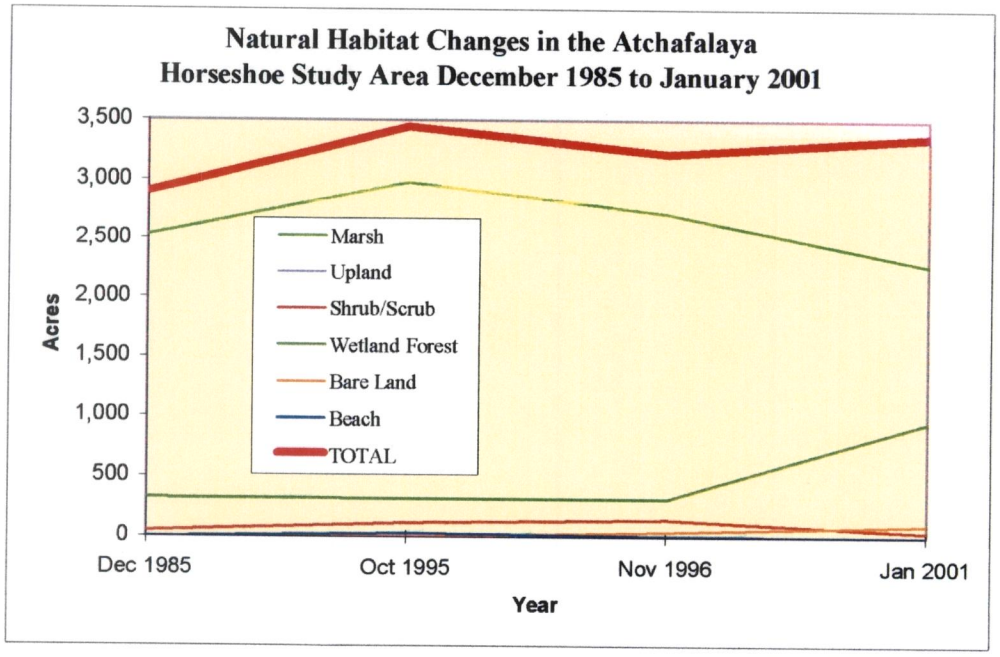


Figure 22 Map of the Lower Atchafalaya River - Horseshoe BUMP study area showing the new habitats that developed between December 1985 and January 2001.

Table 5. Changes in Total Acres of Each Habitat in the Lower Atchafalaya River - Horseshoe between December 1985 and January 2001.

HABITAT	1985[1]	Jan 2001[1]	1985-Jan 2001[1]
Natural Fresh Marsh	2,532.9	2268.5	-264.4
Natural Upland	-	0.9	+0.9
Natural Shrub/Scrub	48.5	41.4	-7.1
Natural Forested Wetland	322.4	948.1	+625.7
Natural Bare Land	-	102.7	+102.7
Total Natural Habitats	2,903.8	3361.6	+457.8
Other-made Fresh Marsh	-	6.7	+6.7
Other-made Forested Wetland	200.3	187.8	-12.5
Other-made Bare Land	-	0.6	+0.6
Total Other-made Habitats	200.3	195.1	-5.2
BUMP-made Marsh	-	325.3	+325.3
BUMP-made Upland	-	8.4	+8.4
BUMP-made Shrub/scrub	-	15.0	+15.0
BUMP-made Forested Wetland	-	277.4	+277.4
BUMP-made Bare Land	-	41.0	+41.0
BUMP-made Beach	-	1.7	+1.7
Total BUMP-made Habitats	-	668.8	+668.8
HABITAT TOTAL	3,104.1	4,225.5	+1,121.4

[1] in acres



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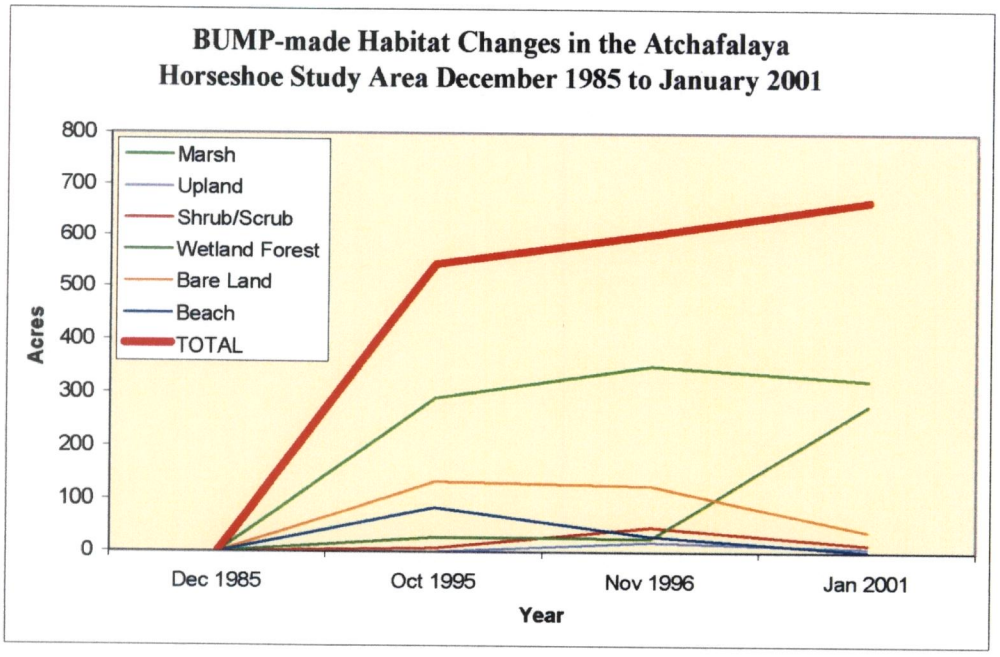

B

Figure 23. Time series showing the changes in total area of each habitat in the Lower Atchafalaya River - Horseshoe BUMP study area between 1985 and January 2001. A) natural habitat changes. B) BUMP-made habitat changes.

CONCLUSIONS

1. The Lower Atchafalaya River - Horseshoe BUMP study area beneficial use is dominated by forested wetlands, freshwater marshes, shrub/scrub, and upland vegetation. Field surveys indicate the elevation most conducive to freshwater marsh development varies due to seasonal river stages but is generally below 5.8 feet MLG (+5 feet NGVD). Forested wetlands develop between 5.8 and 8.3 feet MLG (+5 and +7.5 feet NGVD).

2. The Horseshoe study area increased in area by +1,121.4 acres between 1985 and January 2001 at a rate of +74.8 acres per year. Between 1985 and 1996, the area of the Horseshoe increased by +930 acres followed by an increase between 1996 and January 2001 of +191.4 acres.

3. Between 1985 and January 2001, natural processes accounted for 40 percent of the cumulative increase, beneficial use of dredged material processes accounted for 59 percent of the increase, and other human processes decreased by –5.2 acres.

4. For natural areas, the greatest contributions to area increases were from forested wetland (625.7 acres) followed by bare land (102.7 acres).

5. For the beneficial use areas, the greatest contributions to area increase were from fresh marsh (325.3 acres), followed by forested wetland (277.4 acres), bare land (41.4 acres), and shrub/scrub (15.0 acres).

6. In the Horseshoe study area, 49 percent of the area created by beneficial use of dredged material was fresh marsh and 41 percent was forested wetland.

REFERENCES

U.S. Army Corps of Engineers, New Orleans District and Louisiana State University, Coastal Institute. 1997. Beneficial Use of Dredged Material Monitoring Program: 1996 Annual Report (Base Year through FY 1996). U.S. Army Corps of Engineers, New Orleans District, New Orleans, LA.

APPENDIX

LIST OF VEGETATIVE SPECIES AT THE LOWER ATCHAFALAYA RIVER - HORSESHOE BUMP STUDY SITE

LIST OF VEGETATIVE SPECIES
IN THE LOWER ATCHAFALAYA RIVER - HORSESHOE

An alphabetical list of observed and collected plant species follows. This list is not complete, but is meant to establish vegetative character and indicate habitat types as indicated by the species observed. The list includes the species name, alternate scientific names, common names, and general habitat description for each plant. The habitat information was taken from the Manual of the Vascular Flora of the Carolinas, The Smithsonian Guide to Seaside Plants of the Gulf and Atlantic Coasts, or Louisiana Trees and Shrubs. Common names were from a variety of sources, including the National List of Plant Species that occur in Wetlands Region 2 - Southeast. This list has been compiled from two different field efforts in 1996 and 2002. The superscript indicates the year the plant was observed along the transect.

[96, 02] **Acmella oppositifolia** (Lam.) R.K. Jansen var. **repens** ..... creeping Spotflower
(Spilanthes americana)
colonial perennial; wet pastures, swamp forests, river banks

[96] **Aeschynomene indica** L. ..... joint-vetch shrub
annual; swamps, marshes, and ditches

[02] **Agrostis hyemalis** (Walter) BSP ..... winter bent grass
Tufted annual:fields, meadows and roadsides

[96, 02] **Alternanthera philoxeroides** (Mart.) Griseb. ..... alligator-weed
perennial; fresh or intermediate aquatic or very wet habitats

[02] **Amaranthus cannabinus** (L) JD Sauer ..... water-hemp, tidemarsh amaranth
stout, dioecious herb; brackish marshes

[96, 02] **Amaranthus tuberculatus** (Moq) JD Sauer ..... rough-fruit amaranth
stout, dioecious herb; margins of swamps and fresh marshes

[02] **Ambrosia artemisiifolia** L. ..... annual ragweed
annual herb; fields, pastures, roadsides and waste places

02 **Ampelopsis arborea** (L.) Koehne ..... pepper vine
high-climbing perennial vine; low woods and marshes

96, 02 **Andropogon glomeratus** (Walt.) B.S.P ..... bushy broomsedge
tufted perennial; moist to wet places in the open, swales, ditches, meadows, freshwater marshes, margins of brackish marshes, depressions

96 **Aster** sp. (see **Symphyotrichum**) ..... asters

96, 02 **Baccharis halimifolia** L. ..... groundselbush
shrub or small tree; elevated sites in fresh to saline marshes

96 **Bidens laevis** (L.) B.S.P. ..... bur-marigold, smooth beggar tick
perennial; fresh marsh and stream banks

96, 02 **Colocasia esculenta** (L.) Schott ..... elephantsear, coco yam
(Colocasia antiquorum)
perennial; freshwater marsh, pond and stream margins

02 **Conoclinium coelestinum** (L.) DC ..... blue mistflower, Ageratum
perennial herb; low woods, wet meadows, and ditches

02 **Cryptotaenia canadensis** (L.) DC ..... Canada honewort
perennial herb; moist woods, woodland margins and stream banks

96 **Cynodon dactylon** (L.) Pers ..... Bermuda grass
rhizomatous perennial; fields, roadsides, waste places

96 **Echinochloa walteri** (Pursh) Heller ..... Walter's millet
coarse annual; fresh and intermediate marshes and low waste places

96 **Eclipta prostrata** (L.) L. (Eclipta alba) ..... Yerba de Tajo
annual herb; pond shores, alluvial meadows, marshes, low woods and bogs

96, 02 **Eichhornia crassipes** Kunth ..... water hyacinth
floating aquatic; freshwater ponds and waterways

96, 02 **Erigeron philadelphicus** L. ..... daisy fleabane
perennial herb; old fields, meadows and waste ground

96, 02 **Eupatorium capillifolium** (Lam.) Small ..... thouroughwort, dog fennel
annual; fields, meadows, pastures and disturbed woods

[96] **Eupatorium dubium** Willd. ex Poir .....purple mist flower, Joe- Pye-weed
perennial; marshes, meadows and open woodlands

[96, 02] **Galium tinctorium** L..... dye bedstraw
annual; swamps, meadows, marshes and wet ditches

[96] **Gaillardia pulchella** Foug. .....Indian blanket, fire- wheel
annual or short-lived perennial herb; sandy fields, roadsides
and beach dunes

[96, 02] **Hydrocotyle bonariensis** Lam. .....sand pennywort
creeping perennial; among beach dunes, moist open sandy areas

[02] **Hydrocotyle ranunculoides** L.f. .....pennywort
aquatic or semi-aquatic perennial; seepage areas, pools, stream margins and swamps

[96, 02] **Hydrocotyle umbellata** L. .....marsh pennywort
creeping perennial; low or moist areas

[02] **Hydrocotyle verticillata** Thunberg. ..... whorled pennywort
creeping perennial; bogs, swamps, and swamp forests

[02] **Hymenocallis liriosome** (Raf.) Shinners ..... spring spider lily
perennial bulb; marshes, ditches, low pastures, low woods and bogs

[96, 02] **Leersia oryzoides** (L.) Swartz.....cut grass
week rhizomatous perennial; marshes, ditches, and low woods

[96] **Ludwigia leptocarpa** (Jacp.) Raven..... yellow seed box
short-lived perennial; marshes and ditches

[96] **Ludwigia peploides** (Kuntze) Shinners.....seed-box
creeping or floating perennial; pools and ditches

[96] **Ludwigia uruguayensis** (Camb.) Hara ..... primrose-willow, seed-box
creeping or floating perennial; marshes, ponds, sloughs, ditches, swamps

[02] **Lycopus americanus** Muhl. ex Barton.....American bugleweed
perennial stoloniferous herbs; marshes, wet woods and pond margins

02 **Lythrum alatum** var. **lanceolatum** Ell. ..... winged loosestrife
perennial herb; marshes, ditches, and low woods

02 **Medicago lupilina** L. ..... black medic
annual herb; fields, roadsides and waste places

96, 02 **Mikania scandens** (L.) Willd. ..... climbing hempweed
perennial vine; woods, thickets, marshes and bogs, usually very wet habitats

02 **Mimosa strigillosa** T&G ..... herbaceous mimosa, powderpuff
prostrate perennial; sandy soils in thin woods or open grasslands, hammocks roadsides

02 **Morella (Myrica) cerifera** (l.) Small ..... wax myrtle
woody shrub; sandflats, pinelands and low woods

02 **Oenothera speciosa** Nutt. ..... pink ladies
perennial herb; fields, roadsides and waste places

96, 02 **Panicum repens** L. ..... dogtooth grass
perennial grass; fresh and intermediate marsh , slightly elevated sites ..... torpedo grass

96 **Panicum virgatum** L. ..... Switch grass
rhizomatous perennial; savannah, marshes and waste places

96 **Panicum capillare** L. ..... mist grass
tufted annual; fields, roadsides and waste places

96 **Paspalum distichum** L.. ..... Joint Paspalum
mat-forming perennials;

96, 02 **Paspalum repens** Bergius ..... water paspalum
(Paspalum fluitans)
weak, decumbent or creeping annual; seepage areas in swamp forests

96 **Phragmites communis** ..... roseau cane
tall, rhizomatous perennial reed; fresh marsh or elevated sites in other marshes

96 **Pluchea camphorata** (L.) DC ..... marsh fleabare
annual or short-lived perennial; pastures, bogs, ditches and woodlands,
usually in wet soil

96 **Polygonum lapathifolium** L. ..... willow-weed, curlytop knotweed
annual; alluvial fields, river banks, disturbed habitats

02 **Polygonum punctatum** Ell. ..... dotted smartweed
annual or rhizomatous perennial; alluvial woods, swamp forests or marshes

02 **Populus deltoides** Bartr. ..... eastern cottonwood
large tree; swamp forests

02 **Ranunculus sceleratus** L. ..... celery-leaf buttercup
succulent annual; marshes and ditches

02 **Rorippa palustris** (L.) Besser ..... bog yellow cress
biennial or perennial herbs; wet habitats about ponds, lakes, and streams

02 **Sabatia calycina** (Lam.) Heller ..... coast rose-gentian
perennial herb; swamp forests and river banks

02 **Sacciolepis striata** (L.) Nash ..... American cupscale
creeping perennial; marshes, swales, sloughs, ditches, pond margins, depressions

96, 02 **Sagittaria lancifolia** L. ..... Bull-tongue arrowhead
perennial; shallow water of fresh swamps and ponds

96, 02 **Sagittaria graminea** var. **platyphyla** Engelm ..... duck potato
emersed perennial; fresh water marshes

96, 02 **Sagittaria latifolia** (Willd.) ..... duck potato, Wapato
emersed perennial; low fresh marsh, pond edges, swamps, sloughs, ditches

02 **Salix interior** Rowlee ..... sandbar willow
tree; temporary sandbars, borrow pits, Mississippi floodplain

96, 02 **Salix nigra** Marshall ..... black willow
tree; streambeds and low moist areas

02 **Samolus valerandi** spp. **parviflorus** Raf. ..... water pimpernel
annual or perennial; wet habitats, fresh or brackish

02 **Saururus cernuus** L. ..... lizard's tail
aquatic perennial herb; streams, lake margins, marshes, swamps and low woodlands

[96, 02] **Schoenoplectus americanus** Pers. ..... American bulrush,
(Scirpus americanus) ..... freshwater three-square
perennial; fresh to intermediate marsh, sandy lake and bayshore

[96] **Schoenoplectus validus** Vahl. ..... softstem bulrush
(Scirpus validus; S. tabernaemontani K.G. Gmel)
creeping perennial; marshes and rocky streambeds

[02] **Scutellaria drummondii** Benth var.**drummondii** ..... Drummond's skullcap
perennial herb; low woods, wet meadows, and ditches

[02] **Senecio glabellus** Poir..... butterweed
annual; alluvial woods, swamp forests and wet pastures

[02] **Solidago canadensis** L..... Canada goldenrod
perennial herb; old fields, pastures and meadows

[96, 02] **Solidago sempervirens** L. ..... seaside goldenrod
perennial herbs; brackish marsh or saline sand

[02] **Sphenopholis obtusata** (Michaux.) Scribner..... prairie wedgegrass
tufted perennial; roadsides and waste places

[96, 02] **Spilanthes americana** (see **Acmella**)..... creeping spotflower

[96] **Strophosteles helvola** (L.) Ell..... trailing wild bean
trailing or twinning annual vine; beaches; open woods and clearings

[02] **Symphyotrichum divaricatum** (Nutt.) Nesom..... annual saltmarsh aster
(Aster subulatus)
annual; white to lavender flowers; fresh to brackish marsh

[02] **Symphyotrichum puniceum** (L.) A.&D. Love..... purplestem aster, swamp aster
(Aster puniceus)
perennial; blue to violet, sometimes white flowers; wet meadows, bogs, marshes and low woods

[02] **Symphyotrichum tenuifolium** (L.) Nesom ..... perennial saltmarsh aster
(Aster tenuifolius)
perennial; yellow to red flowers; brackish marshes

[96, 02] **Taxodium distichum** (L.) Richard..... bald cypress, swamp cypress
large tree; freshwater swamps

96, 02 **Typha domingensis** Persoon..... broad leaved cattail
aquatic or paludal rhizomatous perennial; alkaline brackish marshes or swamps

96, 02 **Zizaniopsis miliacea** (Michx.) Doell & Asch..... southern wild rice, water millet
rhizomatous perennial; brackish and freshwater marshes