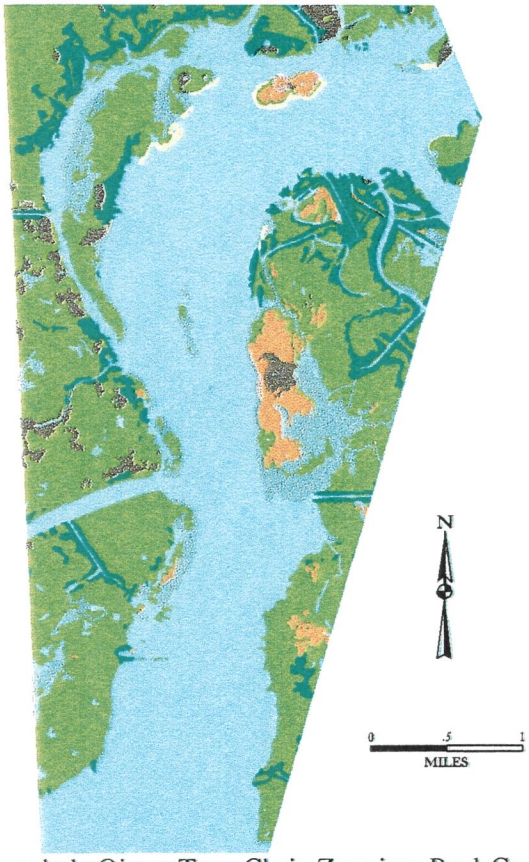
U.S. Army Corps of Engineers - New Orleans District
Louisiana State University - Coastal Studies Institute

BENEFICIAL USE OF DREDGED MATERIAL MONITORING PROGRAM 1996 ANNUAL REPORT

Part 8: 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 Fiscal Year 1996



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INTRODUCTION

The Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Lower Atchafalaya River Horseshoe (Horseshoe) navigation channel is located 20 miles south of Morgan City, Louisiana (Figure 1). This area is dominated by the riverine influence of the Atchafalaya River. The U.S. Army Corps of Engineers - New Orleans District (USACE-NOD) maintains this navigation channel through the prograding Atchafalaya delta complex.

The Beneficial Use Monitoring Program (BUMP) at Louisiana State University - Coastal Studies Institute (LSU-CSI) is documenting the disposal and beneficial use of dredged material using aerial photography, geographical information system (GIS) analysis, and field surveys through the sponsorship of the USACE-NOD. BUMP results are provided in map series, annual reports, and scientific literature.

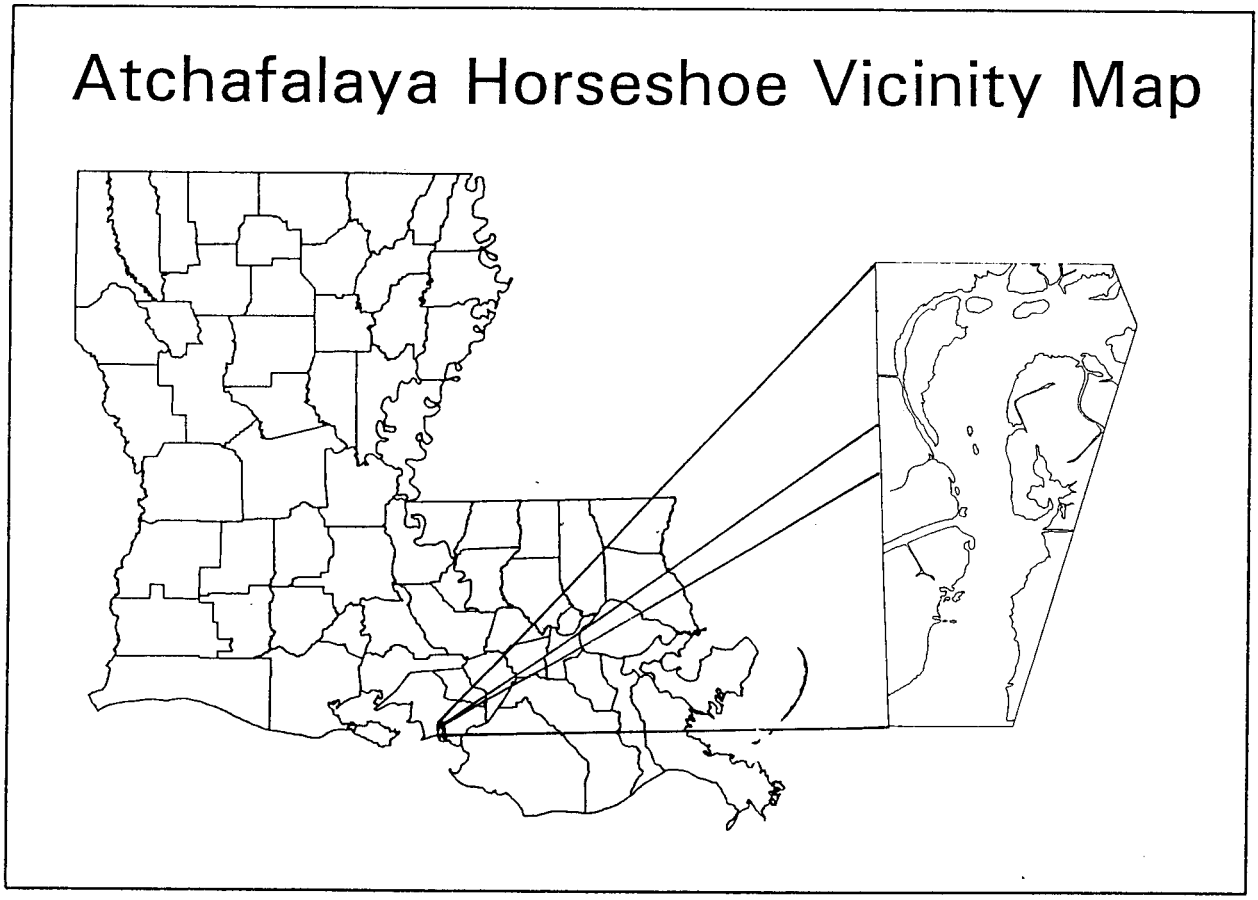


Figure 1. The location of the Lower Atchafalaya Horseshoe BUMP study area in Louisiana.

In this report, LSU presents the first results of the BUMP analysis at the Lower Atchafalaya River Horseshoe navigation channel. This is the eighth part of the nine part Beneficial Use of dredged material Monitoring Program (BUMP), 1995 Final Report, representing monitoring results through the USACE-NOD Fiscal Year 1996. The nine parts are:

Part 1: Introduction and Methodology
Part 2: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Gulf Outlet, Louisiana - Inland Reach Vicinity Mile 60-50
Part 3: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Gulf Outlet, Louisiana - Jetties Reach
Part 4: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Gulf Outlet, Louisiana - Breton Island
Part 5: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Outlet, Venice, Louisiana - Baptiste Collette Bayou
Part 6: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana - Southwest Pass
Part 7: Results of Monitoring the Beneficial Use of Dredged Material at the Houma Navigation Channel, Louisiana - Terrebonne Bay Reach
Part 8: Results of Monitoring the Beneficial Use of Dredged Material at the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Lower Atchafalaya River Horseshoe
Part 9: Results of Monitoring the Beneficial Use of Dredged Material at the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Atchafalaya Bay/Delta and Bar Channel

Using aerial photography, LSU classified the natural and man-made habitats in the study area for December 1985, October 1995, and November 1996 including the Fiscal Year (FY) 1996 maintenance event. Through the GIS analysis, these areas were calculated and changes documented between 1985 and 1996. Field surveys were conducted in October 1996 on a peninsula created/constructed through the beneficial use of the dredged material removed during routine maintenance operations in 1995. Habitats were ground truthed and survey transects were established to document vegetation species, stacking elevations, and compaction/subsidence. Figure 2 shows the area of minimum aerial photo-mosaic coverage and the limit of the digitized area.

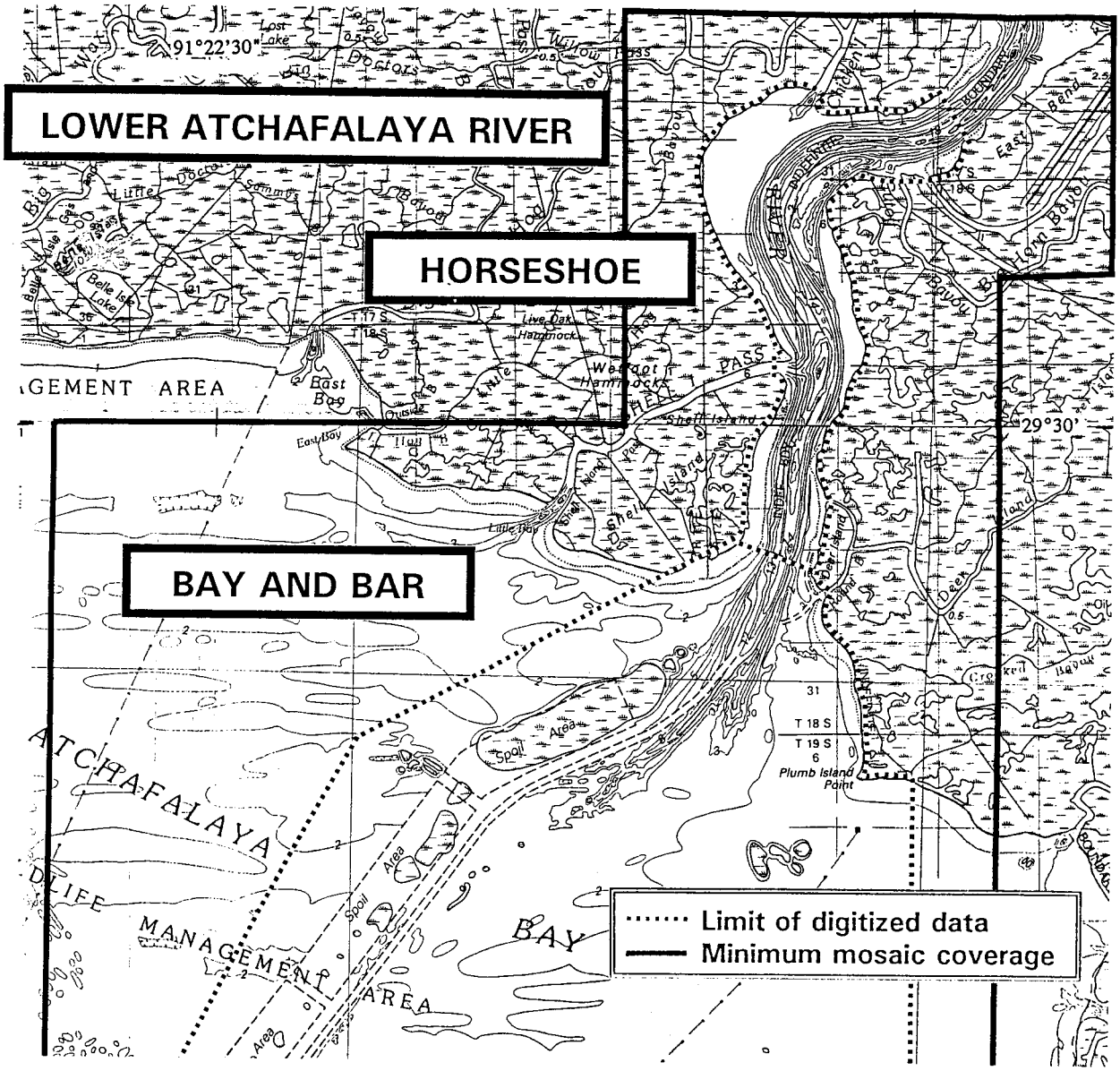


Figure 2. The Lower Atchafalaya River Horseshoe BUMP study area showing the minimum coverage of the aerial photo-mosaic and limits of the area digitized.

DREDGED MATERIAL DISPOSAL HISTORY

The Rivers and Harbors Act of 25 June 1910 authorized the USACE-NOD to construct and maintain a navigation 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 navigation 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 navigation 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-Horseshoe 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 was placed on the existing shoreline.

Figure 3 illustrates the dredged material disposal history and USACE-NOD disposal areas for the Lower Atchafalaya River Horseshoe navigation channel. During FY 1990, material dredged from the Lower Atchafalaya River-Horseshoe was deposited into open water at a depth in excess of -50 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 Mean Sea Level (MSL).

During FY 1993, material dredged from the Lower Atchafalaya River- Horseshoe was placed into a wetland development site located adjacent to the west bank of the Atchafalaya River. Material was deposited to an elevation of +3 feet MLG.

During FY 1994, material dredged from the Lower Atchafalaya River-Horseshoe was placed in four wetland development sites (Sites A, C, D and 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, three wetland development sites (Sites B, D, and E) located adjacent to the east and west banks of the Lower Atchafalaya River-Horseshoe were utilized for dredged material placement. Material was deposited to an elevation of no higher than +5 feet MLG.

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

During FY 1997, one wetland development site (Site B) located adjacent to the east bank of the Lower Atchafalaya River-Horseshoe was being utilized for dredged material placement. At the time of this report, FY 1997 dredging operations were on-going.

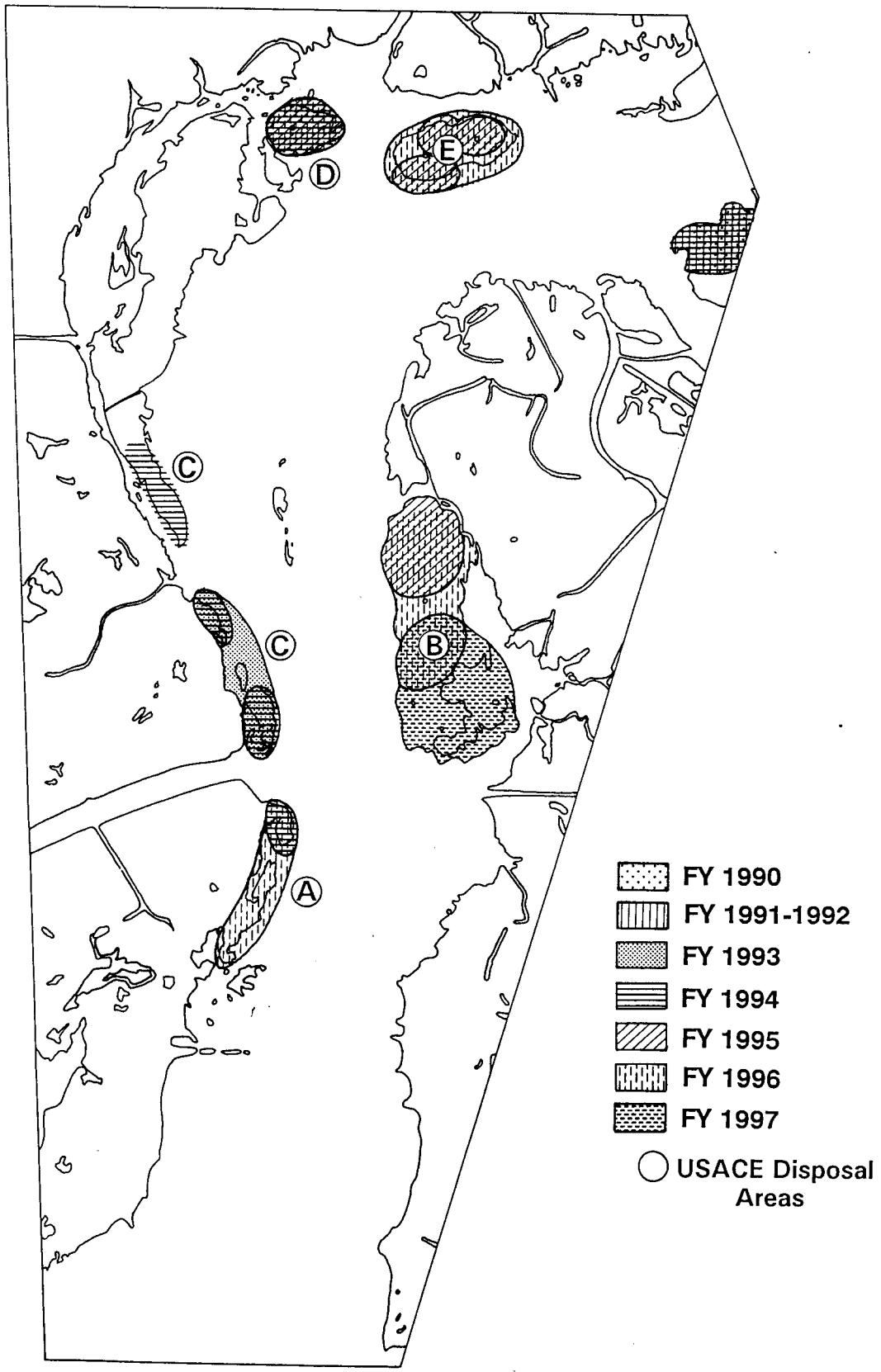


Figure 3. Dredged material disposal history and USACE-NOD disposal areas for the Lower Atchafalaya River Horseshoe navigation channel through 1996. Data from USACE - NOD.

FIELD SURVEY RESULTS

Methodology

Elevation Profile Surveys

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 4). Disposal occurred at this site during FY 1995, 1996, and 1997.

The collection of the survey profile was made in two phases. Phase-I involved assessing the characteristics of each site to determine the most applicable position to setup a long-term monitoring program that would best document habitat evolution. This was accomplished using vertical aerial photography, reviewing dredging schedules and history, ground truthing each site, and defining varying vegetation and site morphology. Based on these factors, two stakes were positioned across the 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).

Phase-II involved the actual collection of profile datum. In October 1996, the profile survey was conducted along the transect defined by the stakes placed during phase-I. Survey datum were 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 $\pm$ 0.0125 ft., and has a vertical accuracy of 0.45 ft $\pm$ 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 nearest tide gage, and entered into a graphic software program to produce topographic profiles (Figure 4).

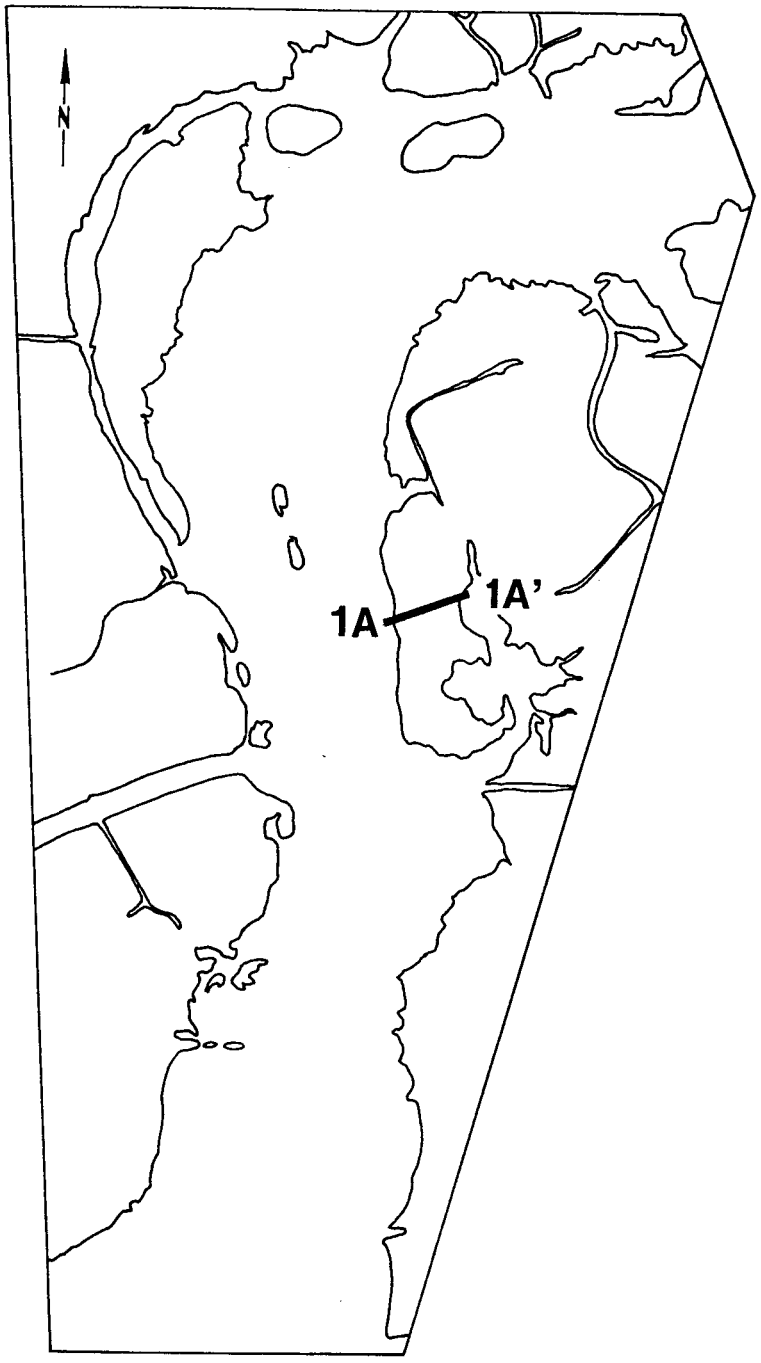


Figure 4. Location of the transect at the Lower Atchafalaya River Horseshoe BUMP study site.

Vegetation Surveys

Ground truthing for vegetative species composition and habitat verification of the Lower Atchafalaya River Horseshoe BUMP study site was done in October 1996. Species composition was determined within an approximate six- foot swath along the profile, and boundaries 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 author. 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 *list of vegetative species* was compiled of all species observed and/or collected along the study and includes habitat preferences of each (Appendix 8A). This list is not complete; it reflects only those species that were readily observed and identified during the profiling period. Some plants can only be identified during a short flowering period which may not have occurred at the time of the profile, and therefore can not be included in the list other than by a broad classification

Profile

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 4). Because the FY 96 deposition was in progress during the time of the survey, the survey transect was established across material that was placed before and during FY 95. The profile elevations were taken during a period of high water for the Atchafalaya delta. The sediment deposited is reported in the FY 95 *as-built* as 90% silt and 10% sand.

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. The far side of the site was colonized by 15-foot willow trees and the transect had to be placed so that the survey instrument had line of sight. One stake was placed to the east of a vehicle track used by the dredging crews to transport earth moving equipment to the site currently under deposition. The second stake was placed along the transect before the willow tree area. This transect traversed fresh marsh, willow tree thicket, upland vine-terrace, bare and beach areas (Figure 5 and 6).

One topographic profile for Horseshoe was constructed from the data collected in reference to the tide gage at Point Au Fer, Atchafalaya, Louisiana (29°20' N / 91°21' W). The mean diurnal tidal range for the tide gage location is published as 2.1 feet, but this area is influenced more by the Atchafalaya River flood stage. The profile was 1450 feet in length with a maximum relief of 3.97 feet and average relief of 2.21 feet (Figure 7).

Figure 5. Photograph of fresh marsh along the transect at the Lower Atchafalaya River Horseshoe BUMP study area taken on October 29, 1996.

Figure 6. Photograph of vine-terrace along the transect at the Lower Atchafalaya River Horseshoe BUMP study area taken on October 29, 1996.

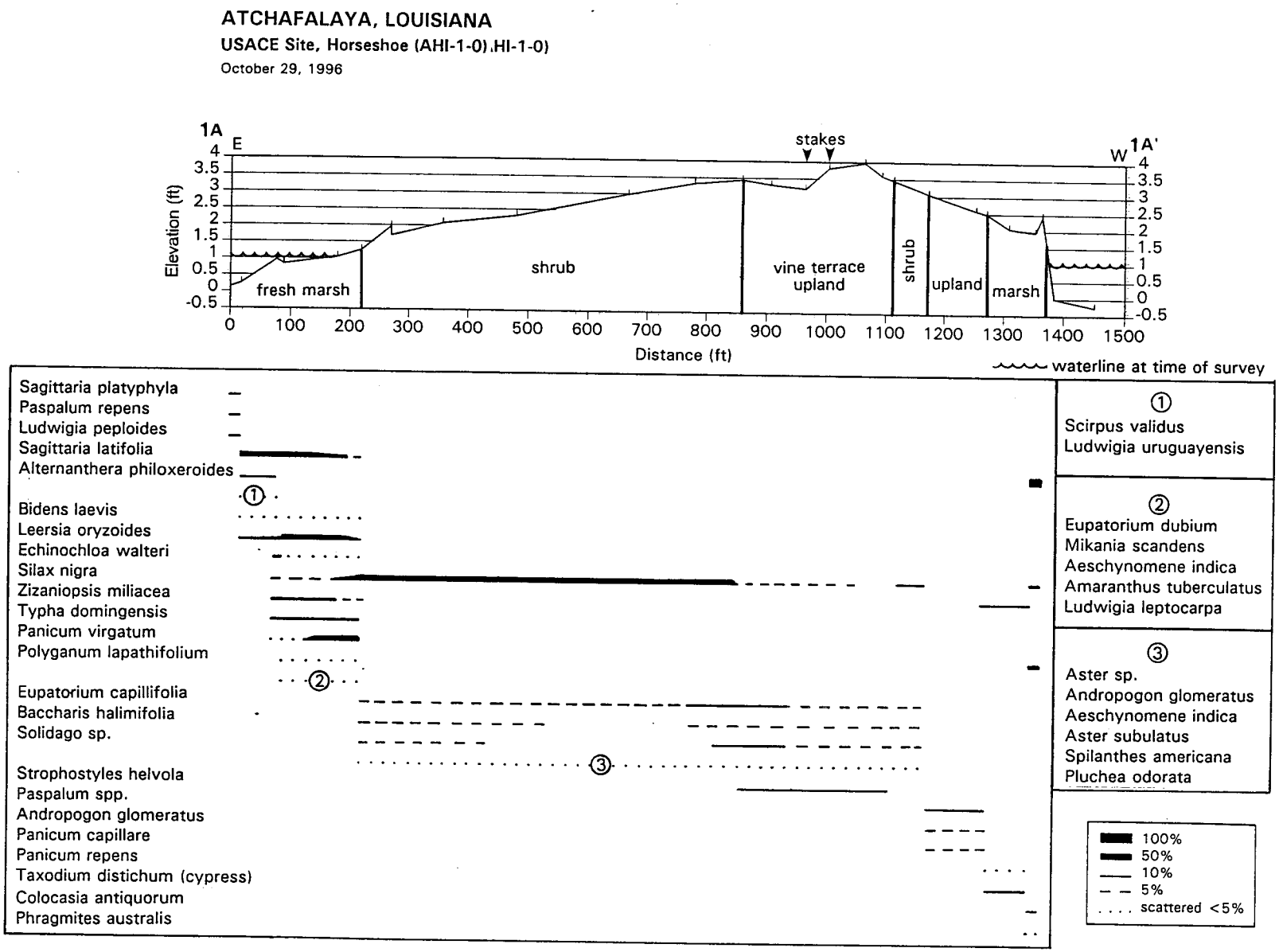


Figure 7. Elevation profile of the Lower Atchafalaya River Horseshoe BUMP study site with vegetation data illustrated.

Vegetative Character

General Description

The Atchafalaya River supports a freshwater vegetation system. Within the BUMP study area, there 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 colonization is predominantly from the extensive Atchafalaya River swamp system that lies upstream from the dredged material disposal sites. Aeolian transport of some vegetative material could be expected from other nearby areas.

Vegetative Community Types in the Atchafalaya Lower River

Most of the plants observed within the study site at the Lower Atchafalaya River Horseshoe area are of riparian or wetland habits (See habitat descriptions in Appendix 8A). 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. These opportunistic species will occupy a new area quickly, but most will eventually be replaced by plants more suited to long term survival at this specific habitat.

Marsh species within the study site occurred most commonly at an elevation below 2 feet MSL. Dominant species of the low fresh marsh included duck-potato (*Sagittaria latifolia*, *Sagittaria platyphyla*), *Paspalum repens*, alligator weed (*Alternanthera philoxeroides*), and flowering *Ludwigia* spp. Significant species of the high marsh were wild rice (*Zizaniopsis miliacea*), cattails (*Typha latifolia*), and Walter's millet (*Echinochloa walterii*). Numerous young willow trees (*Salix nigra*) and a few cypress seedlings (*Taxodium distichum*) were present, scattered in many areas of the marsh, but were too small to be considered a forested wetland habitat. Water hyacinth (*Eichhornia crassipes)* was found along the shore, rafted against the windward side and stranded thickly by a previous high water event.

Upland areas within the study site were represented by grasslands, herbaceous meadows, vine terraces, and potential shrub/scrub. *Panicum capillare*, *Andropogon glomeratus*, and *Paspalum* spp. tend to be the most common grass species, with *Aster* spp, *Eupatorium capillifolium*, *Solidago* sp., as common herbaceous plants, with a profusion of *Strophostyles helvola* vines twining over all. Older deposits support additional species and the beginnings of shrub habitats.

Shrubs are defined for this study as woody plants under 20 feet tall, and shrub communities usually indicate older, more stable, elevated areas. In the Atchafalaya area, this is almost exclusively *Salix nigra* or black willow. Since *Salix* also forms a forested wetland habitat, shrub/scrub is not a good indicator of elevation in the delta, but does indicate stable areas. Young willows were profusely represented along the survey transect, scattered in many areas of the marsh, along low energy beaches, or within the grasslands. A few cypress seedlings (*Taxodium distichum*) were present in the upper marshes. *Baccharis halimifolia* was the only other shrub species found along the study profile.

GIS ANALYSIS RESULTS

Shoreline Changes: 1985-1996

Figure 8 graphs the spatial history of the Lower Atchafalaya River Horseshoe BUMP study area between December 1985 and November 1996 shown in Table 1 and illustrated in Figure 9. The study area in December 1985 was measured at 3104.1 acres. The study area in November 1996 was measured at 3967.0 acres. This is an area increase of 862.9 acres or an increase in area of 27.8 percent for this 10.9 year time period. The primary areas of progradation took place along the margins of the navigation channel due to beneficial placement of dredged materials and natural accreation. However, beneficial use of dredged material did not occur until 1989 or FY 1990, which was in the middle of the period of measurement. Heavy growths of water hyacinth that were indiscernible from marsh within waterways and ponds may cause some error in the data, and result in small errors in the location or area of land loss or land gain on the maps.

Figure 10 shows the shoreline change history of the Horseshoe study area between December 1985 and November 1995. The total area of Horseshoe increased by +980.3 acres at a rate of +99.0 acres per year for this 9.9 year period. The primary areas of progradation took place within USACE Disposal Areas A, B, C, D and E and the natural area betwee Disposal Areas C and D (Figure 4).

Figure 11 shows the shoreline change history of the Horseshoe study area between November 1995 and November 1996. The total area decreased by -117.7 acres. The BUMP areas slightly increased by +29.3 acres. The majority of land loss occurred in the natural areas due to edge margin erosion and interior ponds enlarging. The primary areas of land progradation took place within USACE Disposal Areas B and E (Figure 4).

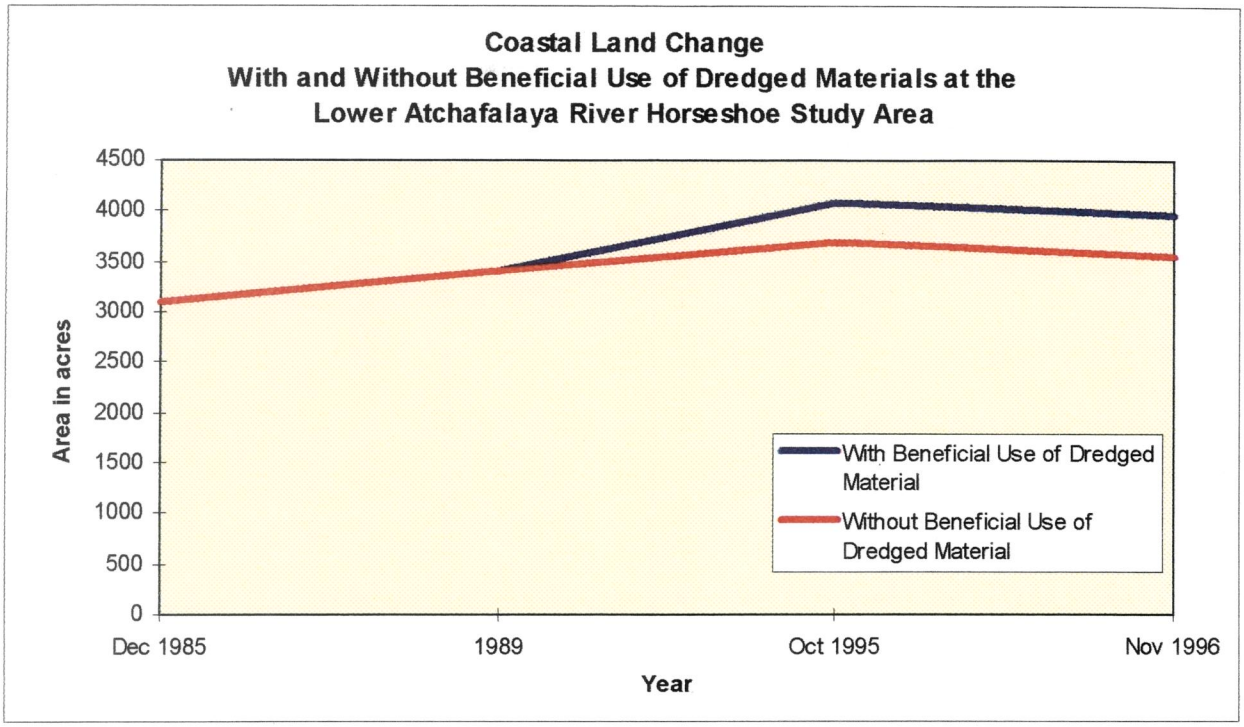


Figure 8. Graph of the area of the Lower Atchafalaya River Horseshoe BUMP study area over time, with and without the placement of dredged material.

TABLE 1
Atchafalaya/Horseshoe Area: 1985 - 1996

Area in Acres	Dec 1985	Oct 1995	Nov 1996
Natural Areas	2903.8	3508.6	3359.9
Other Man-made Areas	200.3	198.5	200.5
BUMP-made Areas	0	377.3	406.6
Total	3104.1	4084.4	3967.0

Note: Numbers are subject to some error due to the presence of water hyacinth that can be indiscernible from marsh within waterways and ponds.

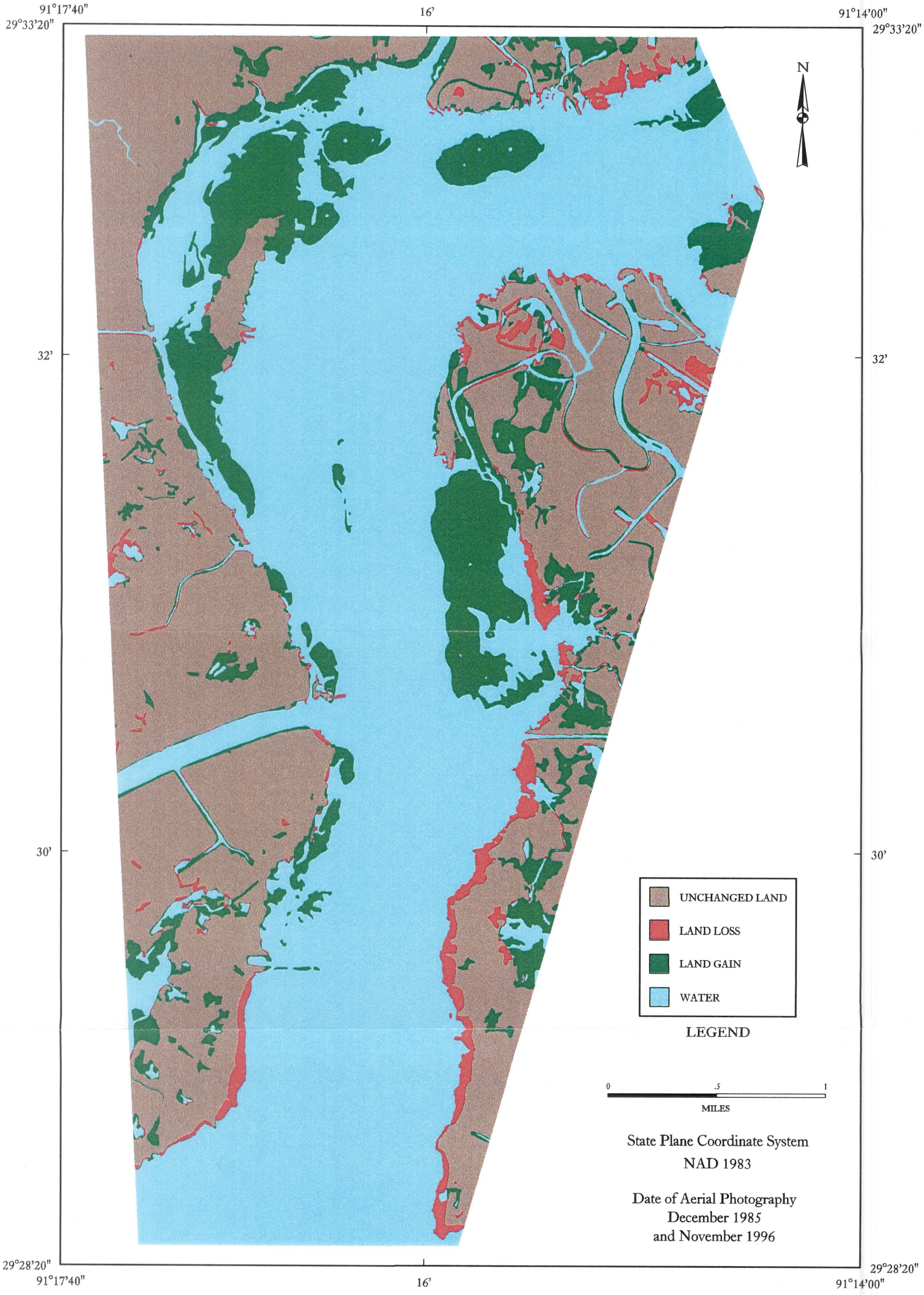
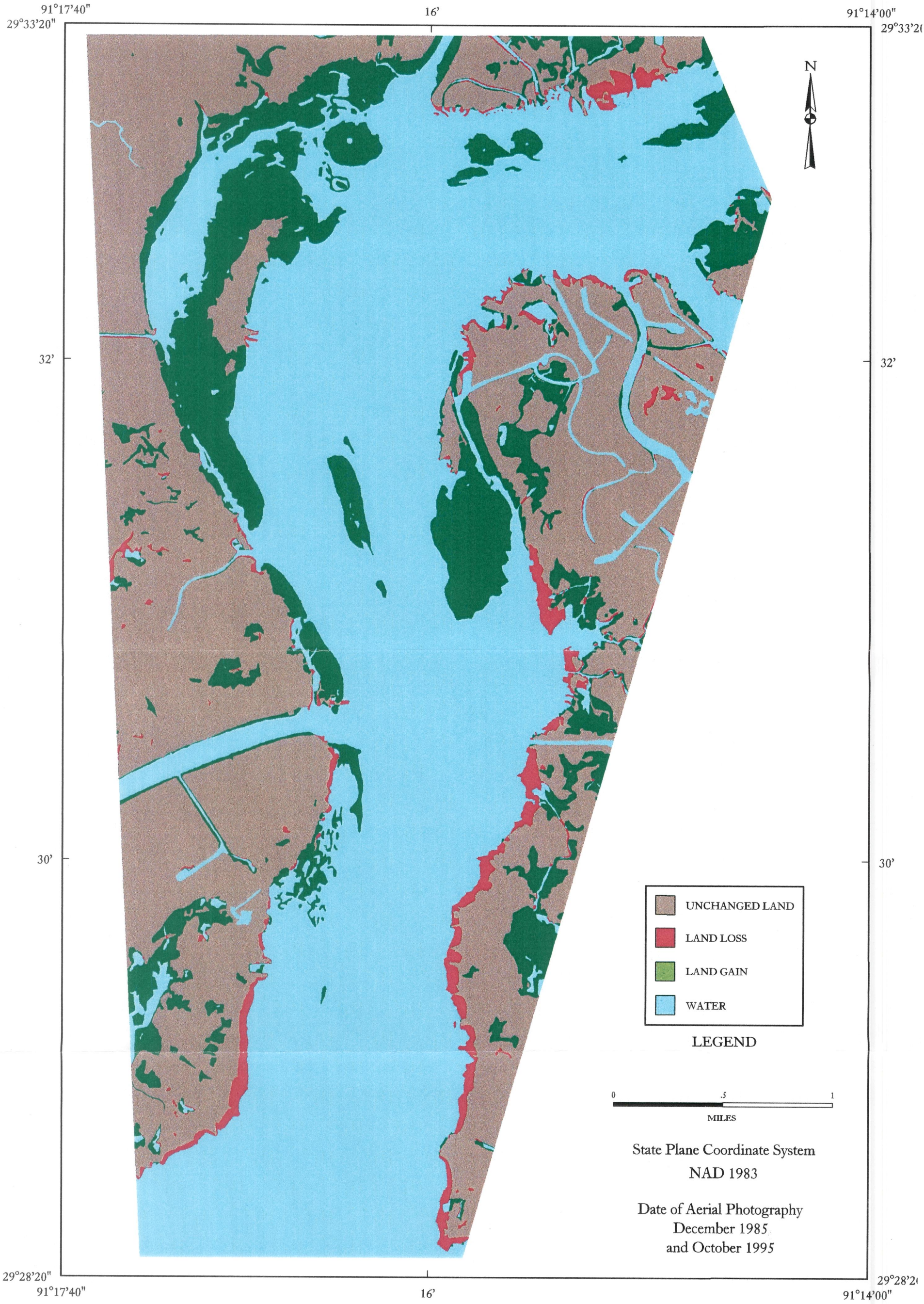


Figure 9. Shoreline changes of the Lower Atchafalaya Horseshoe BUMP study area between December 1985 and November 1996. Heavy growths of water hyacinth indiscernible from marsh within waterways and ponds may cause some error in the marsh area data and in locations of land loss or gain.



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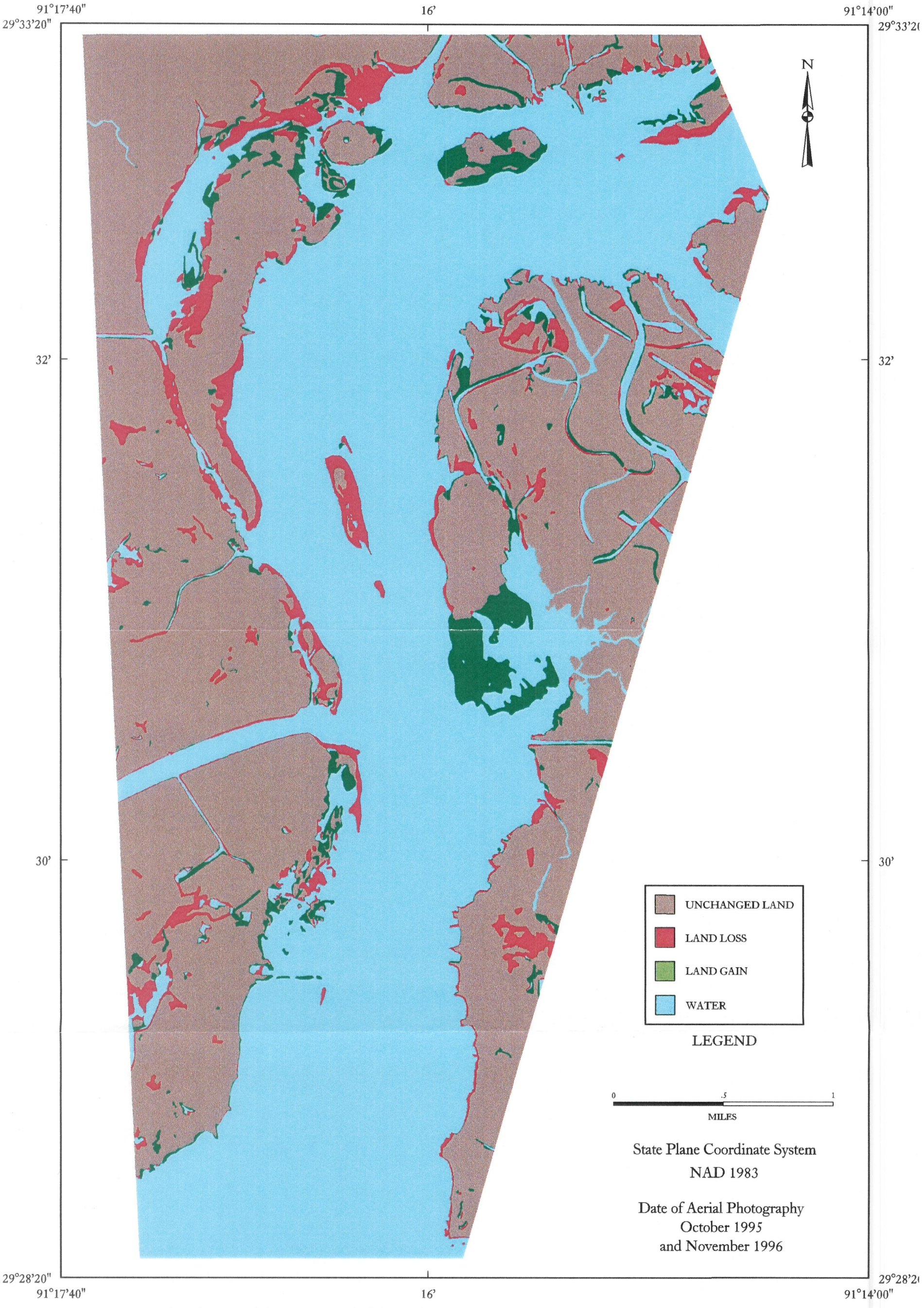


Figure 11. Shoreline changes of the Lower Atchafalaya River Horseshoe BUMP study area between October 1995 and November 1996. Heavy growths of water hyacinth indiscernible from marsh within waterways and ponds may cause some error in the marsh area data and in locations of land loss or gain.

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 12. The total area of the study area was 3104.1 acres. Of this total, 2903.8 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 (2532.9 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 (2532.9 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	OTHER-MADE
Fresh Marsh	2532.9	2532.9	0
Shrub/Scrub	48.5	48.5	0
Forested Wetland	522.7	322.4	200.3
Habitat Total	3104.1	2903.8	200.3

Note: Numbers are subject to some error due to the presence of water hyacinth that can be indiscernible from marsh within waterways and ponds.

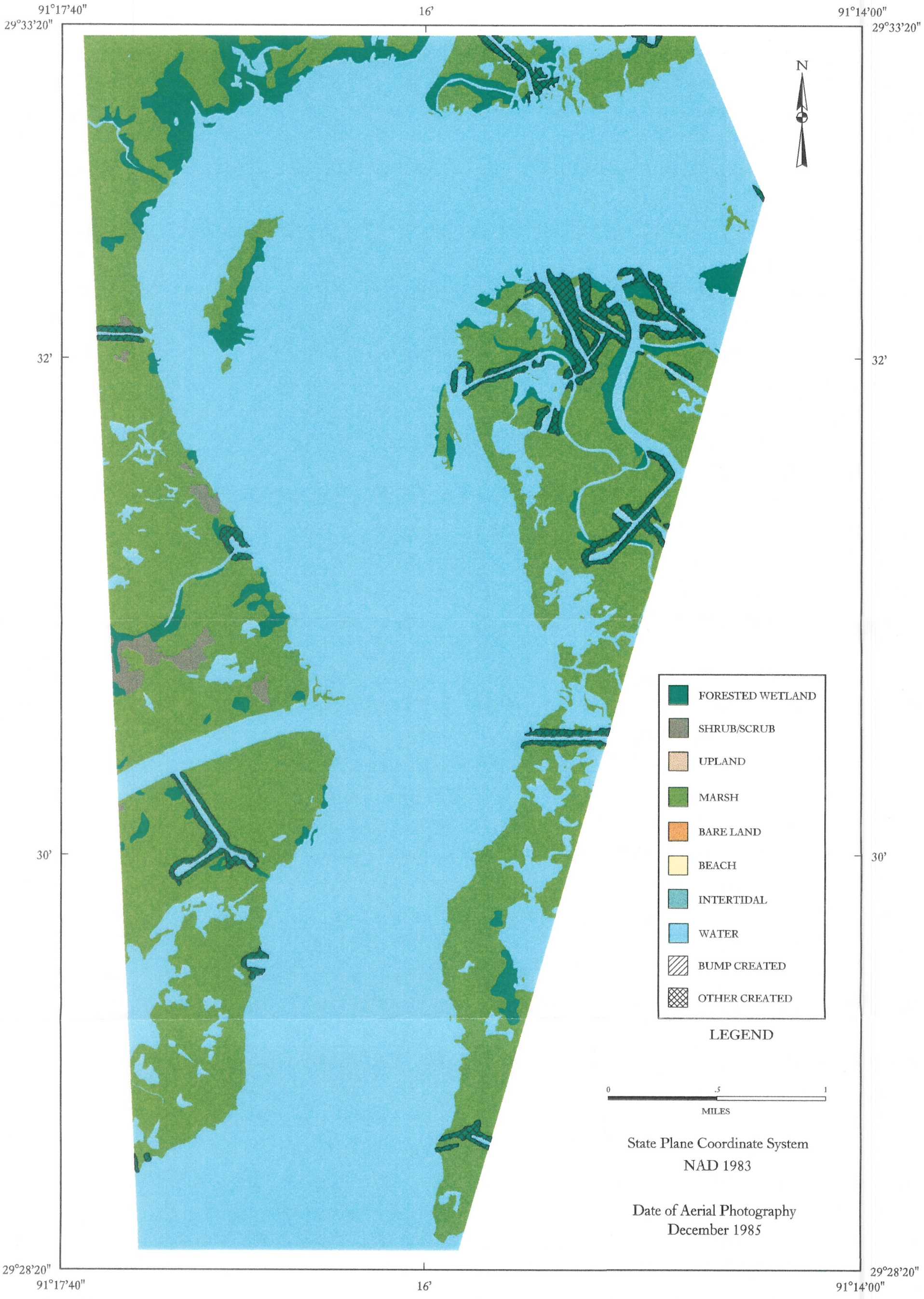


Figure 12. Habitat inventory map of the Lower Atchafalaya River Horseshoe BUMP study area in December 1985. Note: the area and location of marsh habitat are subject to some error due to the presence of water hyacinth that can be indiscernible from marsh within waterways and ponds.

Table 3 lists the areas of the five habitats found in the Horseshoe study area in October 1995. The location and arrangement of these habitats is presented in figure 13. In 1995, the total area of the Horseshoe study area was calculated at 4084.4 acres. Of this total, 3508.6 acres were natural and 575.8 acres were man-made including 198.5 acres of other-made and 377.3 acres of BUMP-made, or 85.9 percent was natural, 4.9 percent was other-made, and 9.2 percent was BUMP-made. In order of decreasing size and importance, the largest habitat found was natural fresh marsh (3013.8 acres) followed by natural trees (345.8 acres), other-made trees (196.4 acres), BUMP-made fresh marsh (157.3 acres), BUMP-made bare land (133.6 acres), natural shrub/scrub (120.9 acres), BUMP-made beach (86.4 acres), natural beach (28.1 acres) and other-made marsh (2.1 acres).

In terms of total area, fresh marsh (3173.2 acres or 77.7%) dominated the Horseshoe landscape.

TABLE 3
October 1995 Habitat Inventory of the Lower Atchafalaya River Horseshoe

HABITAT	TOTAL	NATURAL	OTHER-MADE	BUMP-MADE
Marsh	3,173.20	3013.8	2.1	157.3
Shrub/Scrub	120.90	120.9	0	0
Forested Wetland	542.20	345.80	196.50	0
Bare	133.6	0	0	133.6
Beach	114.50	28.10	0	86.4
Habitat Total	4084.4	3508.6	198.5	377.3

Note: Numbers are subject to some error due to the presence of water hyacinth that can be indiscernible from marsh within waterways and ponds.

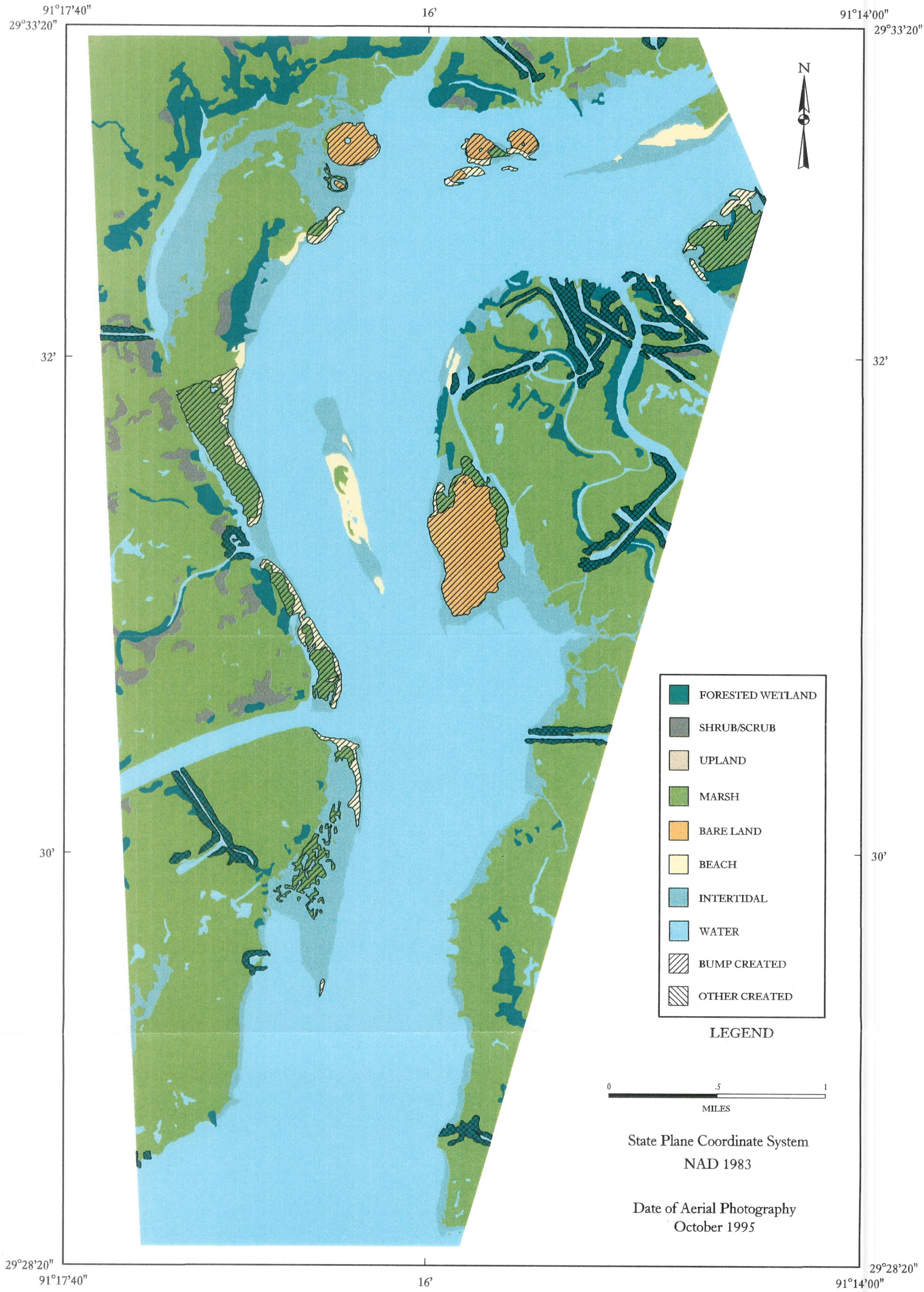


Figure 13. Habitat inventory map of the Lower Atchafalaya River Horseshoe BUMP study area in October 1995. Note: The area and location of marsh habitat are subject to some error due to the presence of water hyacinth that can be indiscernible from marsh within waterways and ponds.

Table 4 lists the areas of the five habitats found in the Horseshoe study area in November 1996. The location and arrangement of these habitats is presented in figure 14. In 1996, the total area of the study area was calculated at 3967.0 acres. Of this total, 3359.9 acres were natural and 607.1 acres were man-made including 200.5 acres of other-made and 406.6 acres of BUMP-made, or 84.7 percent was natural, 5.1 percent was other-made, and 10.2 percent was BUMP-made. In order of decreasing size and importance, the largest habitat found was natural fresh marsh (2809.8 acres) followed by natural forested wetland (378.1 acres), other-made forested wetland (198.9 acres), BUMP-made fresh marsh (198.7 acres), natural shrub/scrub (158.7 acres), BUMP-made bare land (126.4 acres), BUMP-made shrub/scrub (34.9 acres), BUMP-made beach (28.7 acres), BUMP-made upland (17.6 acres), natural beach (9.9 acres), natural upland (1.7 acres), natural bare land (1.7 acres), other-made marsh (1.1 acres), and other-made bare land (0.5 acres) and BUMP-made forested wetland (0.3 acres).

In terms of total area, fresh marsh (3009.6 acres or 75.9%) dominated the Lower Atchafalaya Horseshoe landscape.

TABLE 4
November 1996 Habitat Inventory of the Lower Atchafalaya River Horseshoe

HABITAT	TOTAL	NATURAL	OTHER-MADE	BUMP-MADE
Marsh	3,009.60	2809.8	1.1	198.7
Upland	19.3	1.7	0	17.6
Shrub/Scrub	193.6	158.7	0	34.9
Forested Wetland	577.30	378.10	198.90	0.3
Bare	128.60	1.7	0.5	126.4
Beach	38.6	9.90	0	28.7
Habitat Total	3967.0	3359.9	206.5	406.6

Note: Numbers are subject to some error due to the presence of water hyacinth that can be indiscernible from marsh within waterways and ponds.

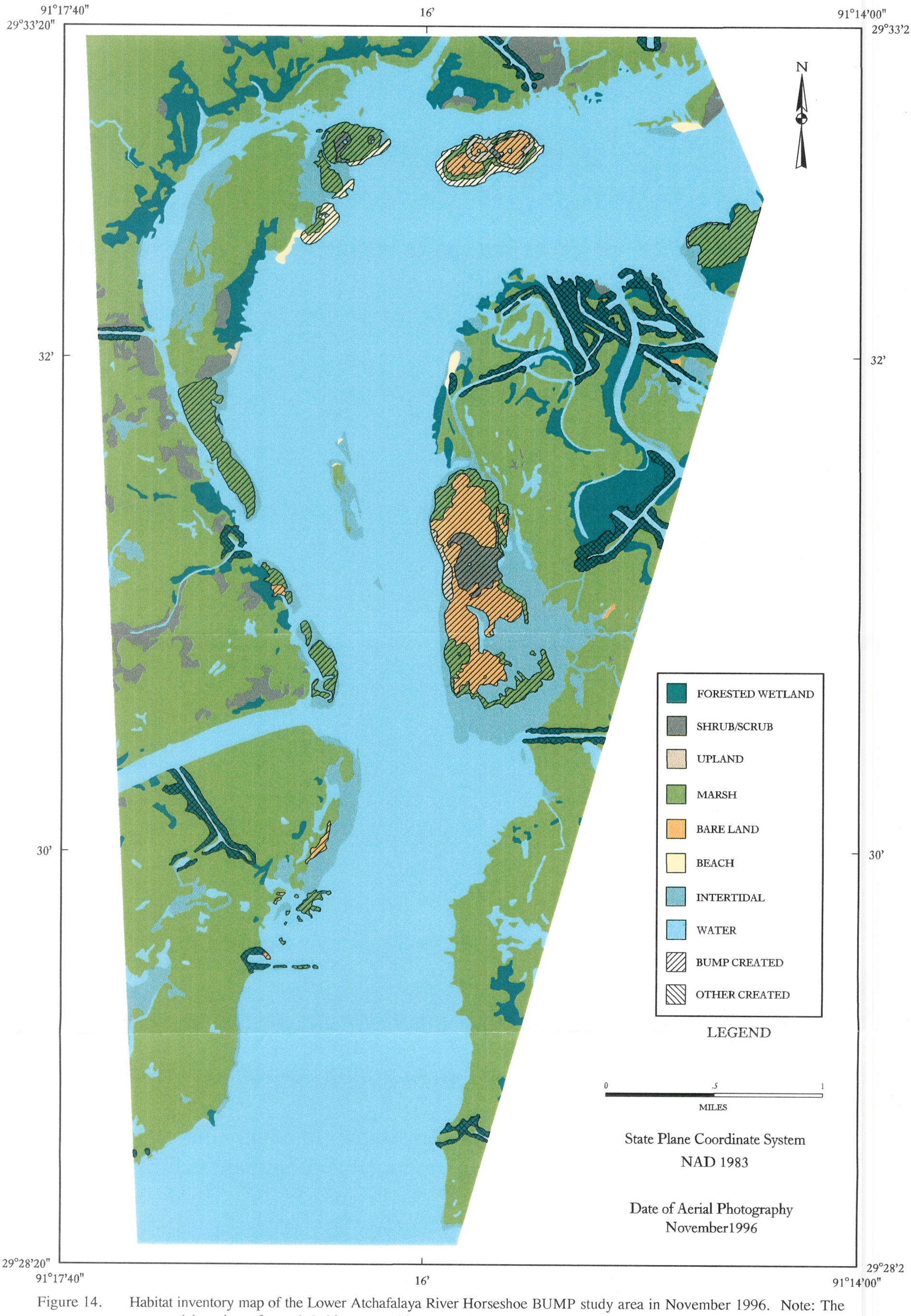


Figure 14. Habitat inventory map of the Lower Atchafalaya River Horseshoe BUMP study area in November 1996. Note: The area and location of marsh habitat are subject to some error due to the presence of water hyacinth that can be indiscernible from marsh within waterways and ponds.

Habitat Change

Figure 15 shows the relative changes in total area of the natural, other-made and BUMP landscapes. Figure 16 shows the cumulative creation of new habitat, including natural, other-made and BUMP-made, in the Lower Atchafalaya River Horseshoe study area between December 1985 and November 1996. However, beneficial use of dredged material in this area did not occur until 1989 or FY 1990. The total area increased by +930.0 acres which represents a 30 percent increase in area between 1985 and 1996. Of this increase in area, 319.6 acres were natural, 6.2 acres were other-made, and 604.2 acres were BUMP-made by the placement of dredged material between 1989 and 1996.

Table 5 lists the major habitat changes during the period between December 1985 and November 1996. The major habitat-increase by natural processes was the cumulative increase in natural fresh marsh (+180.2 acres) over this 10.9-year period. There was an over-all increase of +450.5 acres between 1985 and 1995 which was reduced by -270.3 acres in the one year period between 1995 and 1996. Natural shrub/scrub also had an cumulative increase between 1985 and 1996 of +96.5 acres. The major habitat-increase by man-made processes occurred in the BUMP-made habitats, including fresh marsh (+351.6 acres) and bare land (+126.4 acres).

Figure 17 shows a time series of habitat changes in the Lower Atchafalaya River Horseshoe study area. Figure 17A graphs the natural habitat changes over time. Natural marsh development dominates the natural habitat class. Figure 17B graphs the man-made habitat changes. Forested wetland, fresh marsh, shrub/scrub and bare land dominate the man-made class.

Figure 18 documents the creation of habitats at the Lower Atchafalaya River Horseshoe study area between December 1985 and October 1995. Figure 19 documents the creation of habitats at the Horseshoe between October 1985 and November 1996.

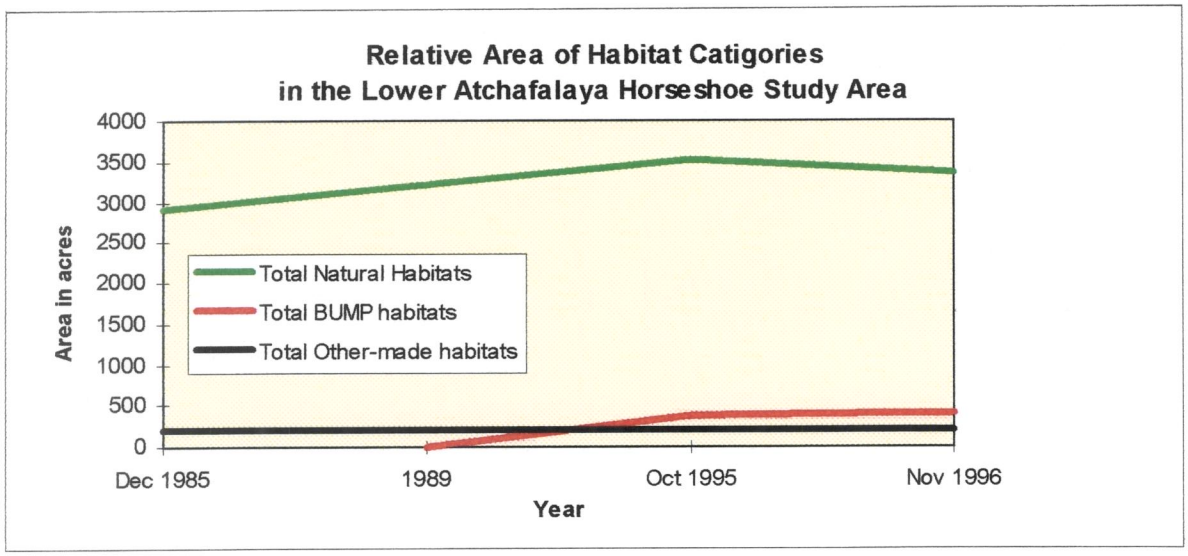


Figure 15. Graph showing the relative changes in total area of the natural, other-made and BUMP landscapes.

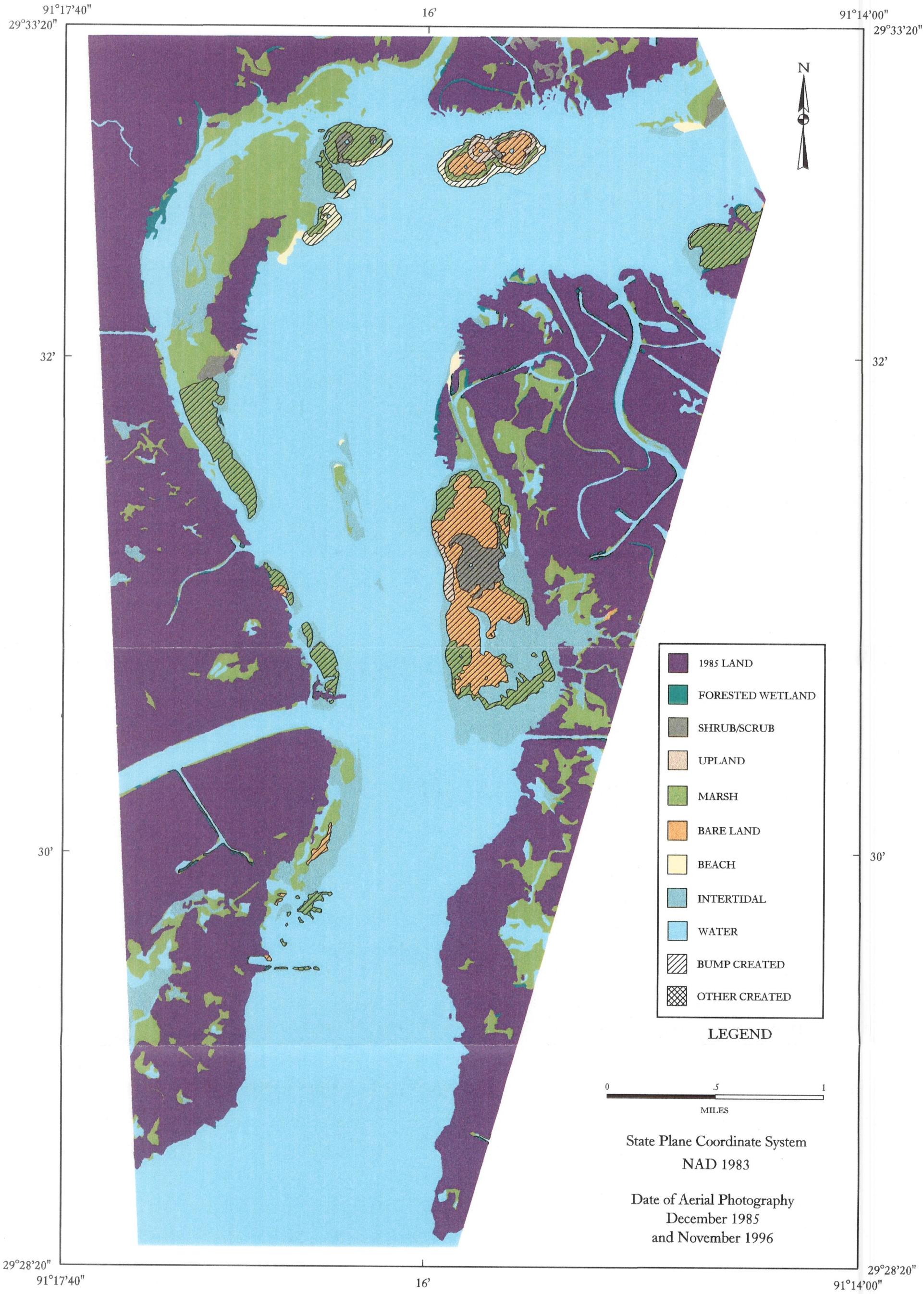


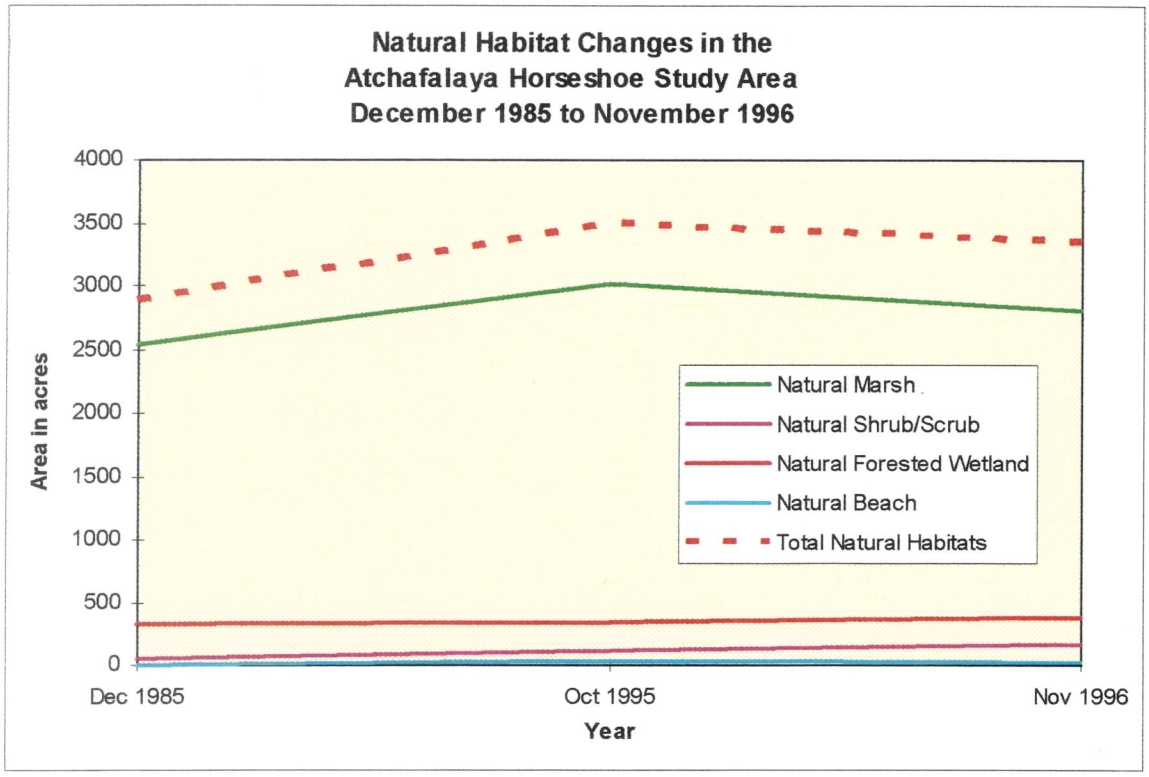
Figure 16. Map of the Lower Atchafalaya River Horseshoe BUMP study area showing the new habitats that developed between December 1985 and November 1996. Note: The area and location of marsh habitat are subject to some error due to the presence of water hyacinth that can be indiscernible from marsh within waterways and ponds.

TABLE 5
Changes in Total Acres of Each Habitat in the Lower Atchafalaya River Horseshoe between December 1985 and November 1996

HABITAT	1985-1995[1]	1995-1996[1]	1985-1996[1]
Natural Fresh Marsh	+480.9	-204.0	+276.9
Natural Upland	--	+1.7	+1.7
Natural Shrub/Scrub	+72.4	+37.8	+110.2
Natural Forested Wetland	+23.4	+32.3	-55.7
Natural Bare Land	--	+1.7	+1.7
Natural Beach	+28.1	-18.2	+9.9
Total Natural Habitats	+604.8	-148.7	+456.1
Other-made Fresh Marsh	+2.1	-1.0	+1.1
Other-made Shrub/Scrub	--	--	--
Other-made Forested Wetland	-3.9	+2.5	-1.4
Other-made Bare Land	--	+0.5	+0.5
Other-made Beach	--	--	--
Total Other-made Habitats	-1.8	+2.0	+0.2
BUMP-made Marsh	+157.3	+41.4	+198.7
BUMP-made Upland	--	+17.6	+17.6
BUMP-made Shrub/scrub	--	+34.9	+34.9
BUMP-made Forested Wetland	--	+0.3	+0.3
BUMP-made Bare Land	+133.6	-7.2	+126.4
BUMP-made Beach	+86.4	-57.70	+28.7
Total BUMP-made Habitats	+377.3	+29.3	+406.6
HABITAT TOTAL	+980.3	-117.4	+862.9

[1] in acres

Note: Numbers are subject to some error due to the presence of water hyacinth that can be indiscernible from marsh within waterways and ponds.



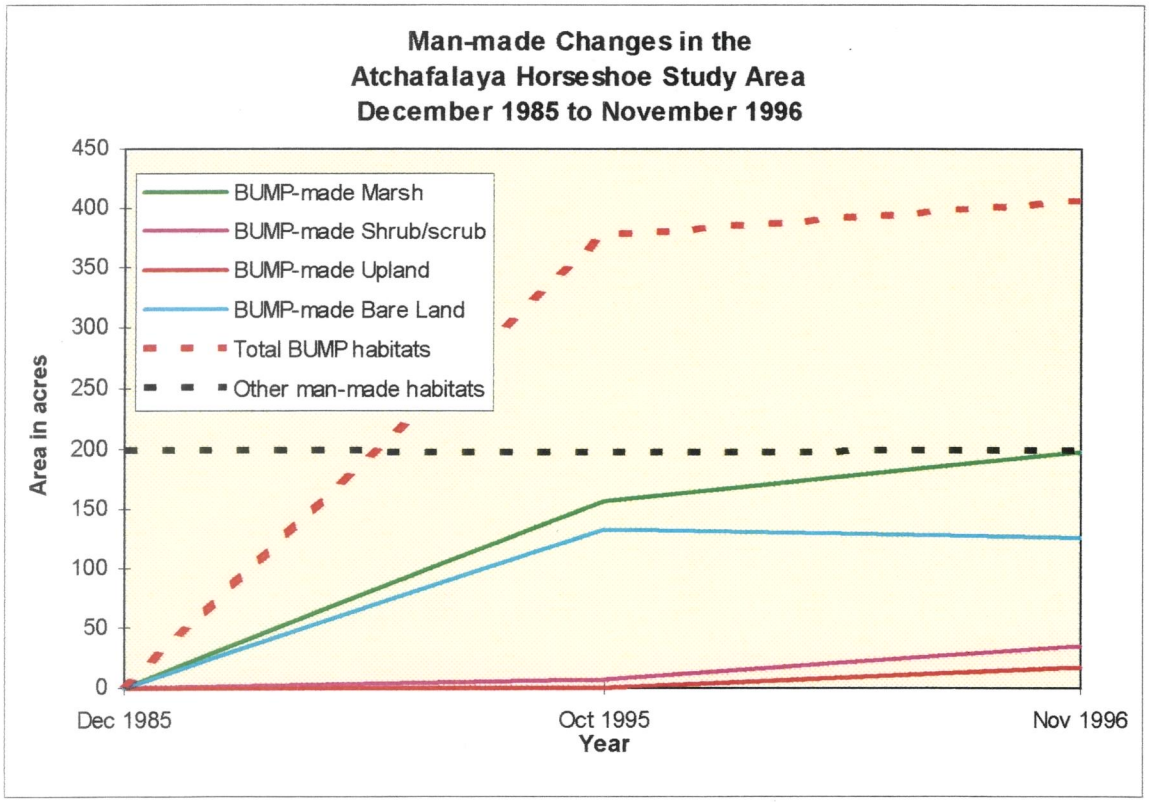


Figure 17. Time series showing the changes in total area of each habitat in the Lower Atchafalaya River Horseshoe BUMP study area between 1985, 1995 and 1996. A) natural habitat changes. B) man-made habitat changes.

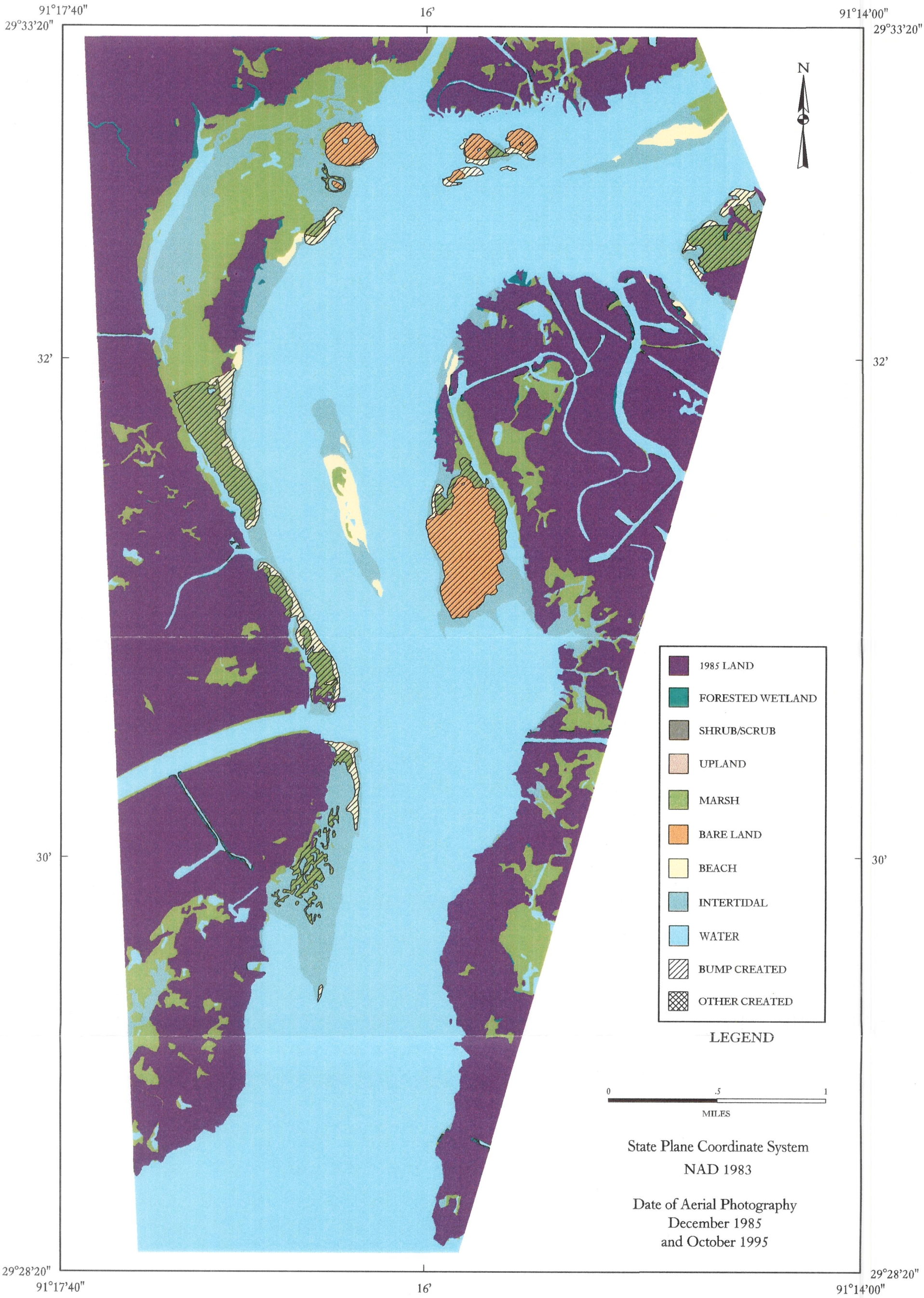


Figure 18. Map of the Lower Atchafalaya River Horseshoe BUMP study area showing the new habitats that developed between December 1985 and October 1995. Note: The area and location of marsh habitat are subject to some error due to the presence of water hyacinth that can be indiscernible from marsh within waterways and ponds.

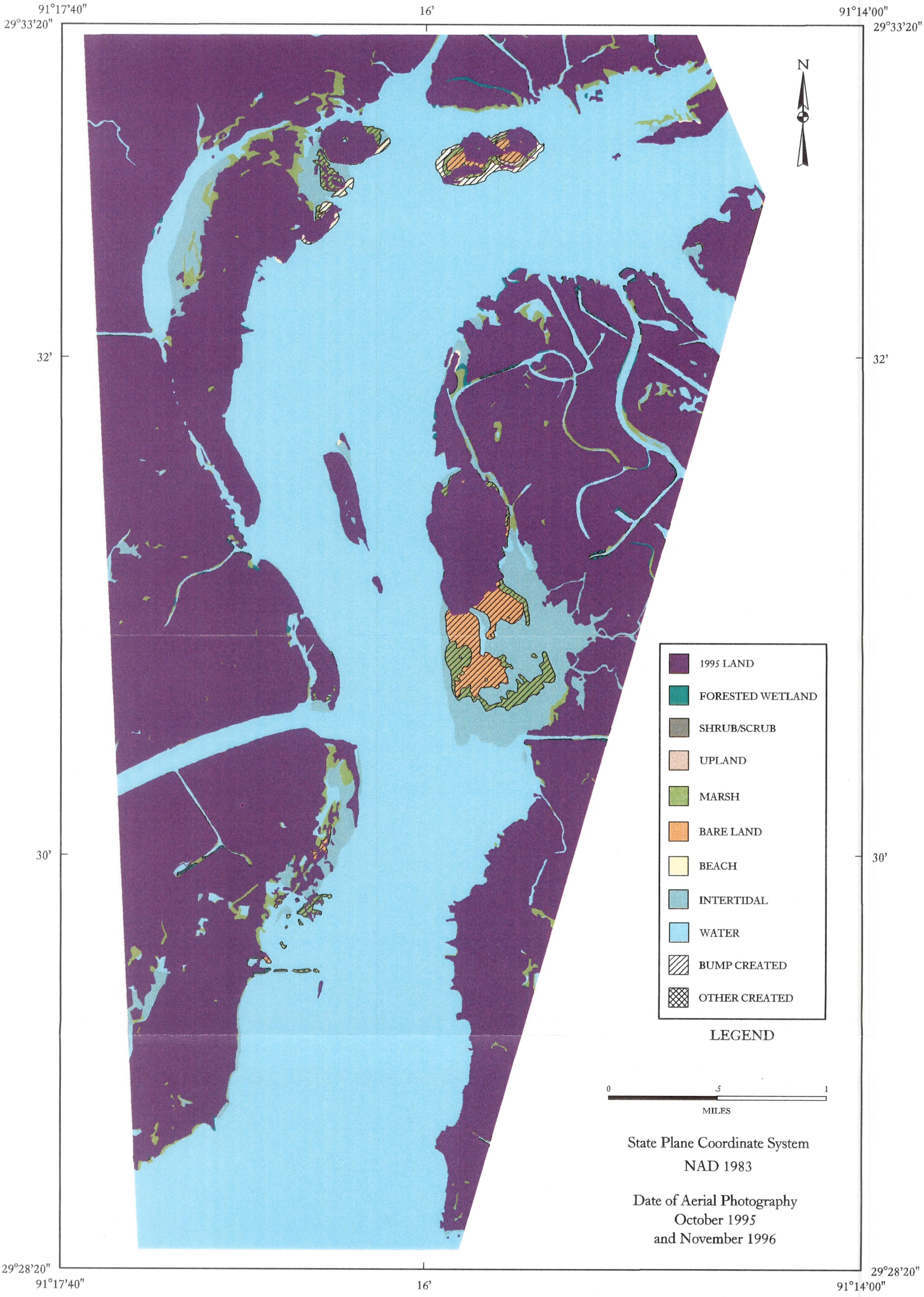


Figure 19. Map of the Lower Atchafalaya River Horseshoe BUMP study area showing the new habitats that developed between October 1995 and November 1996. Note: The area and location of marsh habitat are subject to some error due to the presence of water hyacinth that can be indiscernible from marsh within waterways and ponds.

CONCLUSIONS

1. The Lower Atchafalaya River Horseshoe BUMP study area beneficial use is dominated by freshwater marshes, forested wetlands, 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 +2 feet MLG.

2. The Horseshoe study area increased in area by +862.9 acres between 1985 and 1996 at a rate of +79.2 acres per year. Between 1985 and 1995, the area of the Horseshoe increased by +980.3 acres followed by a decrease between 1995 and 1996 of -117.4 acres. The area decrease is related to channel margin and interior pond changes, some of which can be attributed to the water hyacinth which could not accurately be discerned from marsh in some cases.

3. Natural processes accounted for 52 percent of the cumulative increase, beneficial use of dredged material processes accounted for 47 percent of the increase, and other human processes accounted for 0.02 percent of the increase.

4. For natural areas, the greatest contributions to area increases were from fresh marsh (+276.9 acres) and shrub/scrub (+110.2 acres).

5. For the beneficial use areas, the greatest contributions to area increase were from fresh marsh (+198.7 acres), followed by bare land (+126.4 acres), shrub/scrub(+34.9 acres), beach (+28.7 acres), and upland (+17.6 acres).

6. More than 48.9 percent of the area created by beneficial use of dredged material in the Horseshoe study area was fresh marsh.

REFERENCES

Penland, S. and Westphal, K.A., 1996. 1996 beneficial use monitoring program annual report; Part 1: Methodology. Report to the US Army Corps of Engineers - NOD. 16 pp.

APPENDIX 8A

LIST OF VEGETATIVE SPECIES IN THE LOWER ATCHAFALAYA RIVER HORSESHOE

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 dominant 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 or The Smithsonian Guide to Seaside Plants of the Gulf and Atlantic Coasts. Common names were from a variety of sources.

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

Aeschynomene indica L. ..... joint-vetch shrub
annual; swamps, marshes, and ditches

Alternanthera philoxeroides (Mart.) Griseb. ..... alligator-weed
perennial; fresh or intermediate aquatic or very wet habitats

Amaranthus tuberculatus (Moq.) Sauer ..... water hemp
annual

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

Aster sp. ..... purple aster

Aster subulatus Michx ..... annual saltmarsh aster
annual; fresh to brackish marsh

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

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

Colocasia antiquorum ..... elephantsear
perennial; freshwater marsh, pond and stream margins

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

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

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

Eichhornia crassipes Kunth ..... water hyacinth
floating aquatic; freshwater ponds and waterways

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

Eupatorium capillifolium (Lam.) Small ..... yankee weed, dog fennel
annual; fields, meadows, pastures and disturbed woods

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

Galium tinctorium L. . . . . dye bedstraw
annual; swamps, meadows, marshes and wet ditches

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

Hydrocotyle bonariensis Lam. . . . . sand pennywort
creeping perennial; among beach dunes, moist open sandy areas

Hydrocotyle umbellata L. . . . . marsh pennywort
creeping perennial; low or moist areas

Leersia oryzoides (L.) Swartz . . . . . cut grass
week rhizomatous perennial; marshes, ditches, and low woods

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

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

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

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

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

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

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

Paspalum spp. . . . . .
mat-forming perennials;

Paspalum repens Bergius . . . . . .
(Paspalum fluitans)
weak, decumbent or creeping annual; seepage areas in swamp forests

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

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

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

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

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

Salix nigra Marshall . . . . . black willow
tree; streambeds and low moist areas

Scirpus americanus Pers. . . . . American bulrush, freshwater three-square
perennial; fresh to intermediate marsh, sandy lake and bayshore

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

Solidago sp. . . . . goldenrod
perennial herbs

Spilanthes americana . . . . . creeping spotflower
(Acmella oppositifolia)
colonial perennial; wet pastures, swamp forests, river banks

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

Taxodium distichum (L.) Richard . . . . . bald cypress; swamp cypress
large tree; swamps

Typha domingensis Pers . . . . . broad leaved cattail
aquatic or paludal rhizomatous perennial; alkaline brackish marshes or swamps

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