BENEFICIAL USE OF DREDGED MATERIAL MONITORING PROGRAM

Results of Monitoring the Beneficial Use of Dredged Material at the Atchafalaya River and Bayous Chene, Boeuff and Black, Louisiana - Avoca Island Cutoff

Base Year 1985 thru December 2000

Prepared for:

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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 navigational channels in Louisiana that require regular maintenance dredging (Figure 1). More than 90 million cubic yards of sediment are 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 navigational 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).

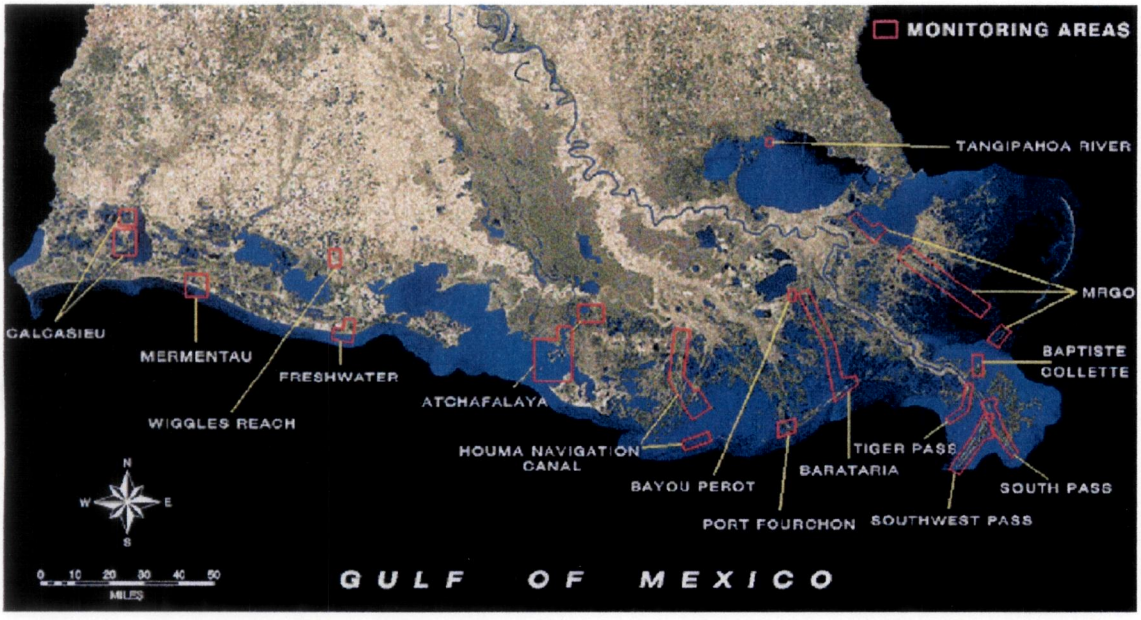

Figure 1. Locations of the beneficial use of dredged material monitoring areas.

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. 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 navigational 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 changes in elevations.

Atchafalaya River and Avoca Island Cutoff

The Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana navigation channel and the Avoca Island deposition site are located 6 - 8 miles south and southwest 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 through the prograding Atchafalaya delta complex.

BUMP at Avoca Island

The USACE-NOD performs essential maintenance dredging of discontinuous reaches of the waterways comprising the Atchafalaya River and Bayous Chene, Boeuf, and Black, LA, project as needed to provide access for marine fabrication and repair facilities in Amelia, LA, and port facilities in and around Morgan City, LA, to the Gulf of Mexico. Maintenance of the Bayous Boeuf, Black, and Avoca Island Cutoff-Bayou Chene reaches has occurred on an eight-year frequency since construction of the project in 1981.

Beneficial use at the Acova Island disposal area began by disposal of material dredged from construction of the project at site 5 in FY 1981. Channel maintenance was conducted in 1988, 1989 and 1998, and the dredged material was placed on Avoca Island at disposal sites 5 and 5a for the creation of marsh and mounds for waterfowl.

This report presents the results of monitoring on Avoca Island through the USACE-NOD Fiscal Year (FY) 1998 maintenance event. No maintenance has occurred in the Avoca Island Cutoff-Bayou Chene reach since that year. The natural and man-made habitats in the study area were classified using aerial photography acquired December 1985 and December 2000. Through GIS analysis, these areas were measured and changes calculated. Field surveys were conducted in December 2001 on the selected beneficial use areas created through FY 1998. Habitats were ground truthed; and survey transects were 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.

Atchafalaya - Avoca Island Cutoff Viscinity Map

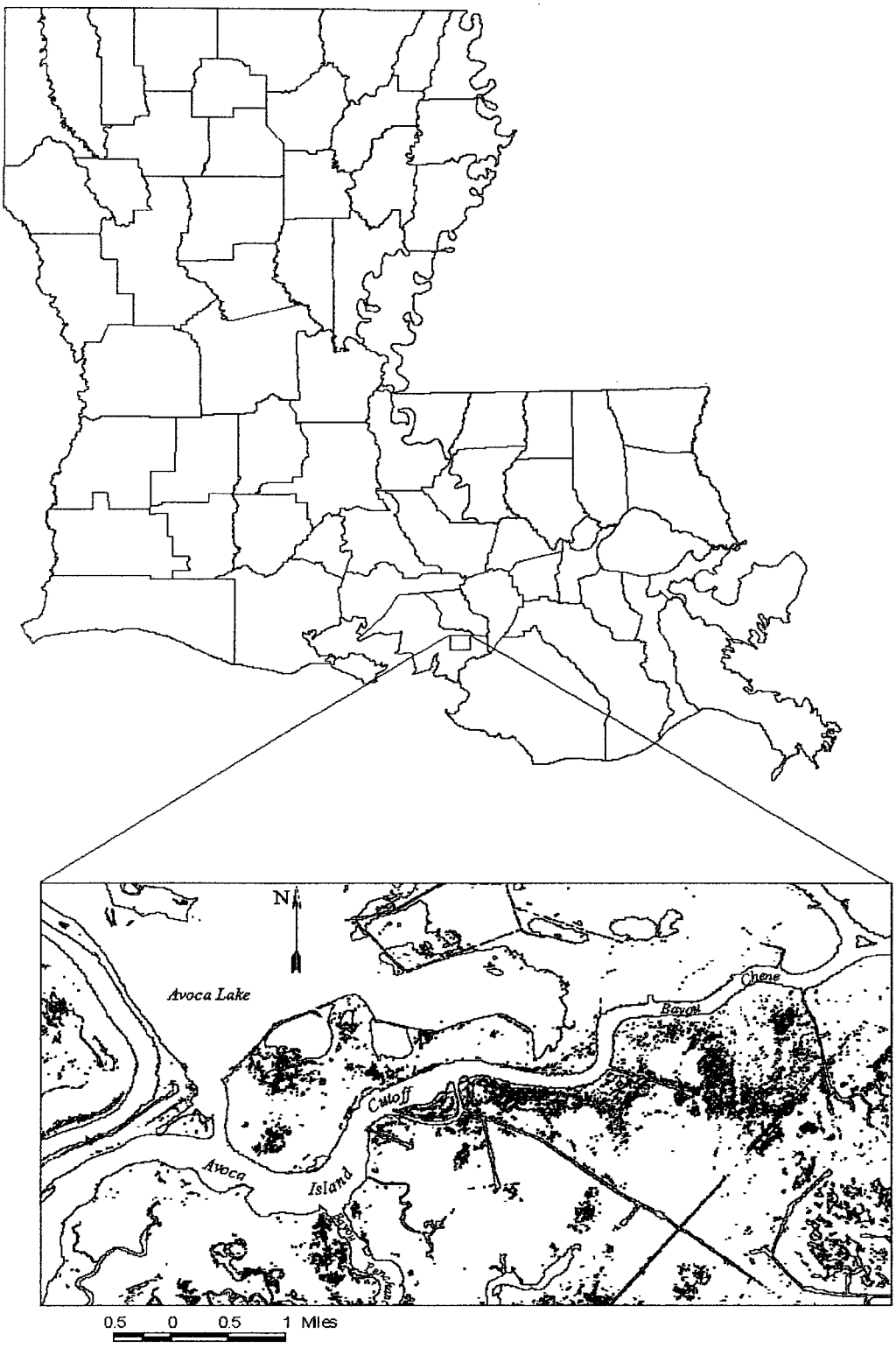

Figure 2. Location map of the Atchafalaya - Avoca Island Cutoff BUMP study area.

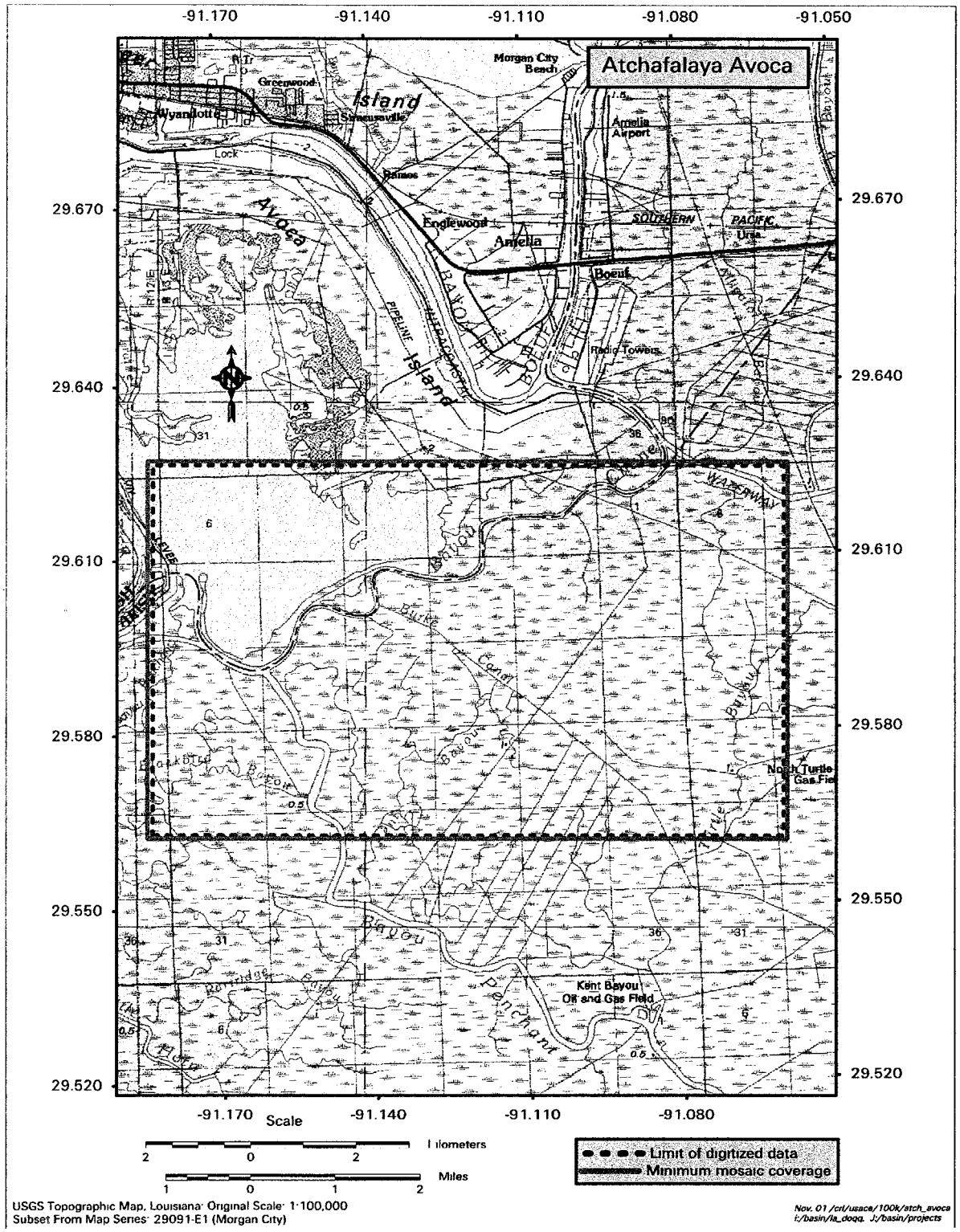

Figure 3. The Atchafalaya – Avoca Island Cutoff BUMP study area showing the minimum coverage of the aerial photo-mosaic and the limits of the area digitized.

BENEFICIAL USE OF DREDGED MATERIAL DISPOSAL HISTORY
ATCHAFALAYA RIVER AND BAYOUS CHENE, BOEUF AND BLACK, LA
AVOCA ISLAND CUTOFF - BAYOU CHENE REACH
Through FY 2000

The Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana, project was authorized by the Rivers and Harbors Act of 1968, House Document 155, 90th Congress, 1st Session. It provided for the improvement of a channel 20 feet deep over a bottom width of 400 feet from the vicinity of the U.S. Highway 90 crossing over Bayou Boeuf to the Gulf of Mexico via the Gulf Intracoastal Waterway (GIWW), Bayou Chene, the Avoca Island Cutoff Bayou Drainage channel, the Lower Atchafalaya River, and the existing project across Atchafalaya Bay. This Act also provided for a 20 by 400 foot channel in Bayou Black and the GIWW from the major shipyard on Bayou Black at U.S. Highway 90 to Bayou Chene.

Construction of the Avoca Island Cutoff-Bayou Chene reach of the navigational channel was performed during the Fiscal Year (FY) 1981, from November 13, 1980 to October 1, 1981. Approximately 17,754,281 cubic yards of dredged material were removed from the channel using a hydraulic cutterhead pipeline dredge. The material was placed in disposal area #5, located on the right descending bank of Bayou Chene on Avoca Island, to a maximum height of +3.0 feet Mean Low Gulf (MLG) for the creation of marsh and mounds for waterfowl habitat.

During the FY 1988 maintenance event (November 15, 1988 to February 15, 1989), approximately 873,000 cubic yards of dredged material were deposited for marsh creation into Avoca Island disposal areas #5 and #5A, located on the right descending bank of Bayou Chene. The dredged material was removed from the channel using a hydraulic cutterhead pipeline dredge, and was placed confined to a maximum elevation of +5.0 feet MLG.

During the FY 1989 maintenance event (May 24, 1989 to August 18, 1989), Bayou Chene curves #2, #4 and #5 were widened using a hydraulic cutterhead pipeline dredge. Material excavated from the curves was placed confined in disposal areas #5 and #5A for marsh creation. Dredged material was placed in mounds in area #5 to an elevation of 3.5 feet MLG. Dredged material in area #5A was placed to a maximum height of +5.0 feet MLG.

During the FY 1998 maintenance event (May 22, 1998 to October 12, 1998), approximately 3,827,625 cubic yards of dredged material were removed from the channel using a hydraulic cutterhead pipeline. Material was deposited confined in Avoca Island disposal areas #5 and #5A for marsh creation. Dredged material was placed to a maximum elevation of +4.5 feet MLG.

There was no maintenance of this reach of the waterway during FY 1999 and FY 2000.

Figure 4 illustrates the dredged material disposal history for the study area through FY 2000.

Atchafalaya
Avoca Island Cutoff- Bayou Chene Reach
Dredged Material Disposal History

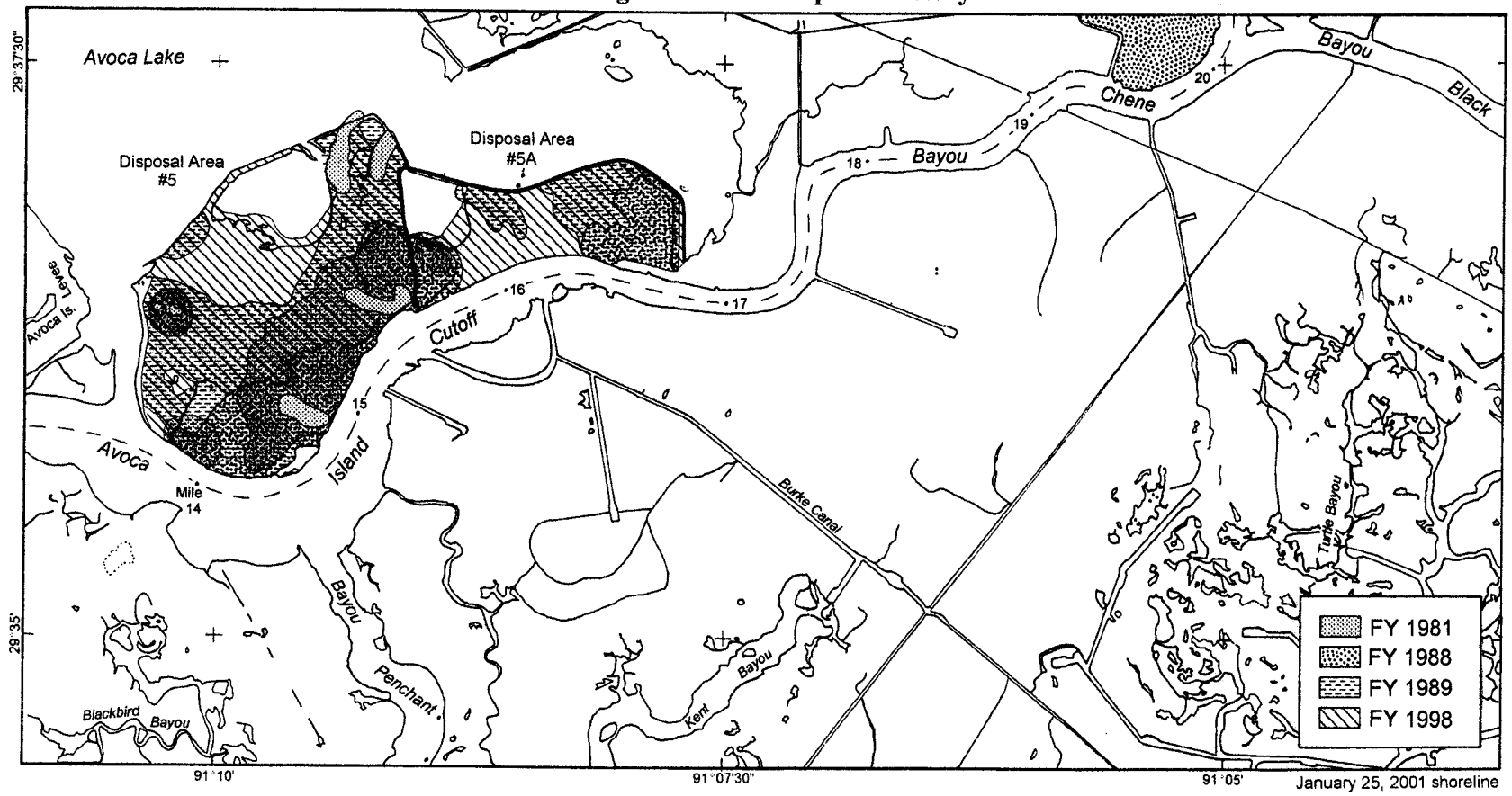

Figure 4. Dredged material disposal history and USACE-NOD disposal areas for the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana: Avoca Island Cutoff - Bayou Chene reach through FY 2000. Data from USACE-NOD and aerial photography.

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 is made. The base year for the Avoca Island Cutoff, Louisiana project was 1985 and the historical 1985 aerial photography was acquired from the U.S. Geological Survey Earth Resources Observation Systems (EROS) Data Center. Photography was acquired by UNO's air photo contractor during December 2000. Color infrared photography was acquired at a scale of 1:24,000. 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 provides a better definition of vegetation types, habitats, and the land/water interface. A copy of the color infrared photography was archived at UNO/LSU. A second set of color infrared photography was provided to the USACE-NOD.

From base year to FY1999, study areas were interpreted and mapped from the base year photography and the color infrared aerial photography using a Bausch and Lomb zoom transfer cope. 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^{TM} remote sensing software and interpreted by a supervised classification of spectral reflectance, texture and tone. Shorelines were 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, habit and preferred habitat. This information verifies the habitat interpretations; helps to further characterize the habitat type; and provides 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 dredged 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***" 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, oak or pine woods, and trees on older ridges and elevated areas created by dredge placement.

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 December 4-7, 2001.

The objective of the field monitoring is to clarify the habitat types by identifying dominant vegetative communities, and to determine 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.

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 Atchafalaya - Avoca Island Cutoff BUMP study site (Figure 5) is located south of Avoca Lake, about 10.5 km southeast of Morgan City. It was created by the deposition of dredged material between 1981 and 1998 (Figure 4).

Methodology

The collection of elevation and vegetation profile surveys was conducted in two phases. Phase-I involved assessing the characteristics of various beneficial use disposal areas to determine the most appropriate sites to document the beneficial use of dredged material and habitat development. This was accomplished in discussion with the USACE-NOD, reviewing vertical aerial photography, reviewing dredging schedules and history, and defining varying vegetation and site morphology. Three transects locations were selected that cross the island in a roughly north-south orientation. The central one would cross the areas of marsh in the central part of the island, and the eastern and western ones would cross the forested areas to either side (Figure 5).

Phase-II involved the actual collection of profile data. Access was by boat from a boat launch in Berwick, LA, across the Atchafalaya River from Morgan City. On December 4-7, 2001, one stake was placed on the top of the dike on the southern containment dike of Avoca Island to define each transect line, recording GPS coordinates of the stakes to assist in relocating the transects should the vegetation become taller or thicker, or should erosion or other action remove the stakes. Permanent 1-inch diameter by 6-foot galvanized stakes were buried approximately 1-foot in the sediment of the dike and secured with concrete.

Three transect profiles were collected from the sites. Survey data were collected using a Topcon GTS-300_{DPG} Total-Station, tri-prism, and TDS48 Data Collection System. Horizontal accuracy of the GTS-300 is 0.25 ft ± 0.0125 ft., with a vertical accuracy of 0.45 ft ± 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 data collected were processed, referenced to the tide gage at Morgan City, and entered into a graphic software program to produce topographic profiles.

Field monitoring for vegetative species composition and habitat verification was done during the same period in December 2001. Species composition was determined within a 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 on the profiles and 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.

Profiles at Avoca Island

The December 2001 profiles were established with one metal pole (stake) on Avoca Island at the top of the southern containment dike, partially buried and anchored with concrete, and extending 2-3 feet from the sediment surface. Transects were constructed perpendicular to the shoreline. Just inland of and paralleling the dike, the borrow ditch had to be crossed with varying degrees of difficulty. The transects are presented below.

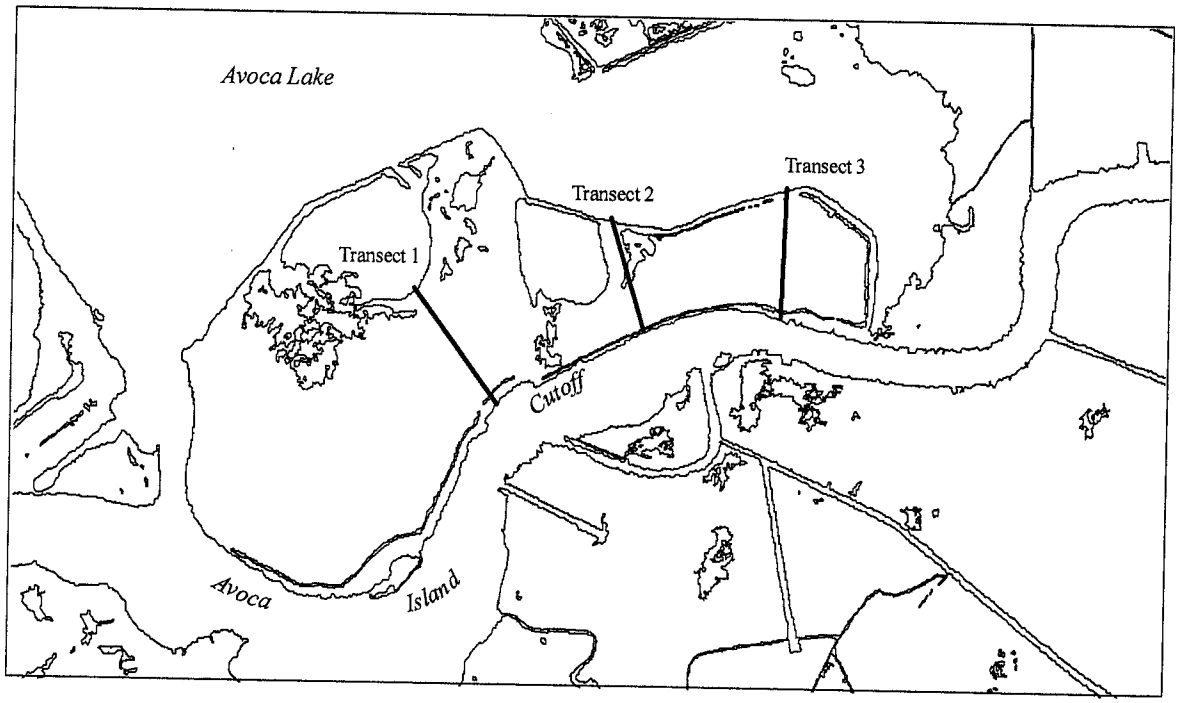

Figure 5. Location of the three elevation and vegetation transect lines at the Atchafalaya – Avoca Island Cutoff BUMP study area

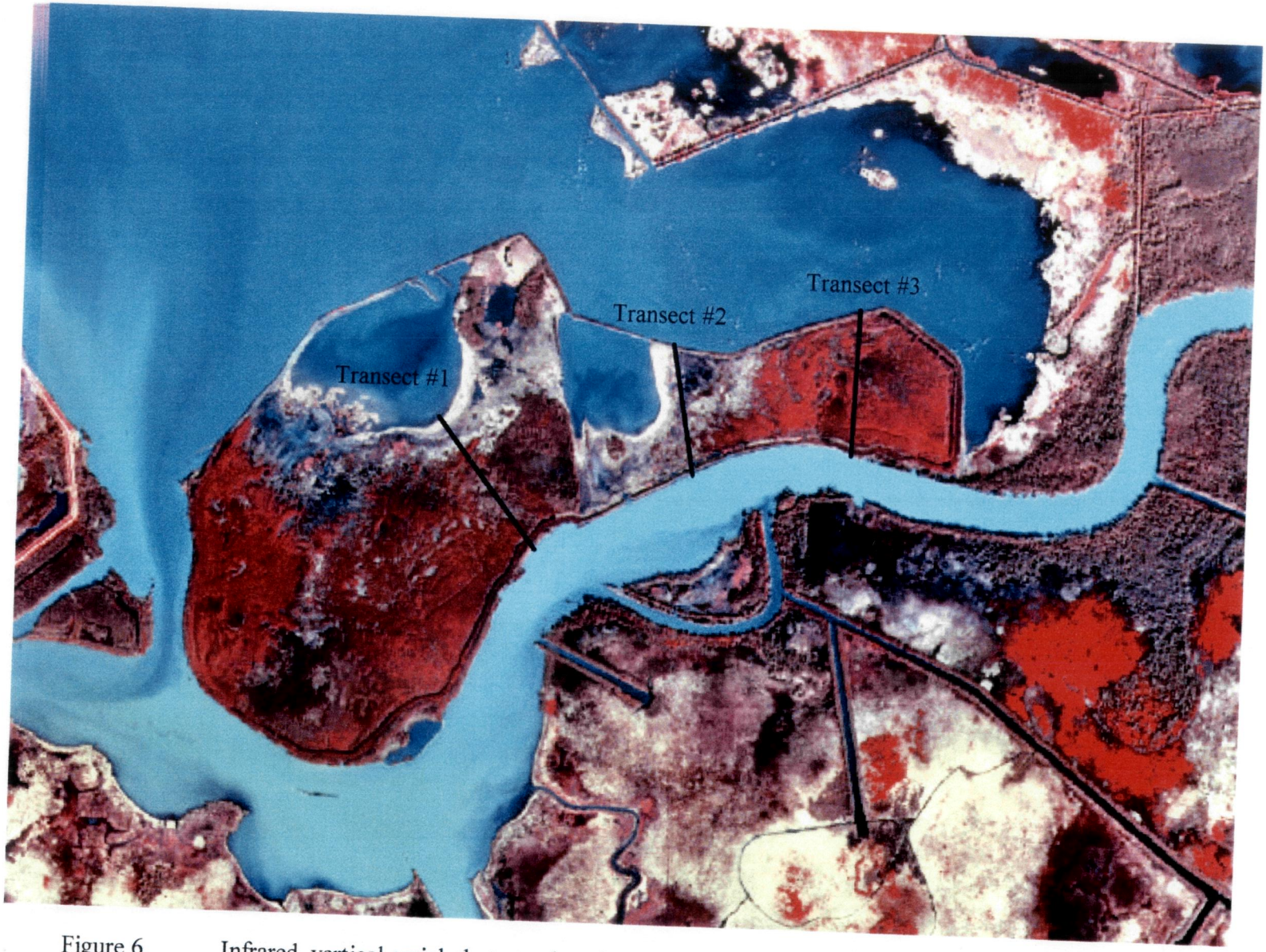

Figure 6. Infrared, vertical aerial photography taken in December 2001 of the Atchafalaya – Avoca Island Cutoff BUMP study area showing the location of the three transects visited in 2002.

Transect #1

Avoca Island transect #1 is located on the forested western part of Avoca Island. It trends NNW to SSE with a bearing of 321° (Figure 6). The elevation and vegetation data were acquired December 4, 2001. The transect was oriented to cross disposal areas as old as 1981 in the area southeast of a large northwestern pond. The transect was delineated by 1 stake on the dike on the southern end of the transect, which was also the instrument location, and a second stake north of the borrow ditch. The dike has been well colonized by shrubs and trees, and the disposal landscape was dominated by forested wetlands (Figures 7 & 8) with a few clearings (Figure 9).

The profile had a length of 2855 ft (Figure 10). The maximum elevation along the transect was 8.69 ft MLG (7.91 ft NGVD), near the location of the stake on the dike, with an average elevation of 4.3 ft MLG (3.5 ft NGVD). The average relief of the transect (not including the dike) was 4.4 ft MLG (3.6 ft NGVD). The published tidal range at Atchafalaya River is 2.2 ft for December 4, 2001.

Figure 7. Photograph taken December 4, 2001 at Avoca Island transect # 1. Photo was taken from near the northern end of the transect looking south through the siteline cut primarily through *Salix nigra* trees with *Baccharus halimifolia* bushes and some *Sapium sebiferum* trees. *Polygonum lapathifolium* is visible near the ground and was the primary groundcover across the majority of the transect.

Figure 8. Photograph taken December 4, 2001 at Avoca Island transect # 1. Photo was taken from near the southern end of the transect looking south through the siteline cut primarily through *Salix nigra* trees with *Baccharus halimifolia* bushes and some *Sapium sebiferum* trees. The dense stands of young willow are visible on either side of the transect line. *Polygonum lapathifolium* is visible near the ground and was the primary groundcover across the majority of the transect. The instrument and operator are visible 570 feet to the south.

Figure 9. Photograph taken December 4, 2001 at Avoca Island transect # 1. Photo was taken from the same position as Figure 8, but looking north into a clearing in the trees at a dense patch of *Polygonum lapathifolium*. This species was the dominant groundcover across the majority of the island at or above 3.8 feet MLG (3 feet NGVD).

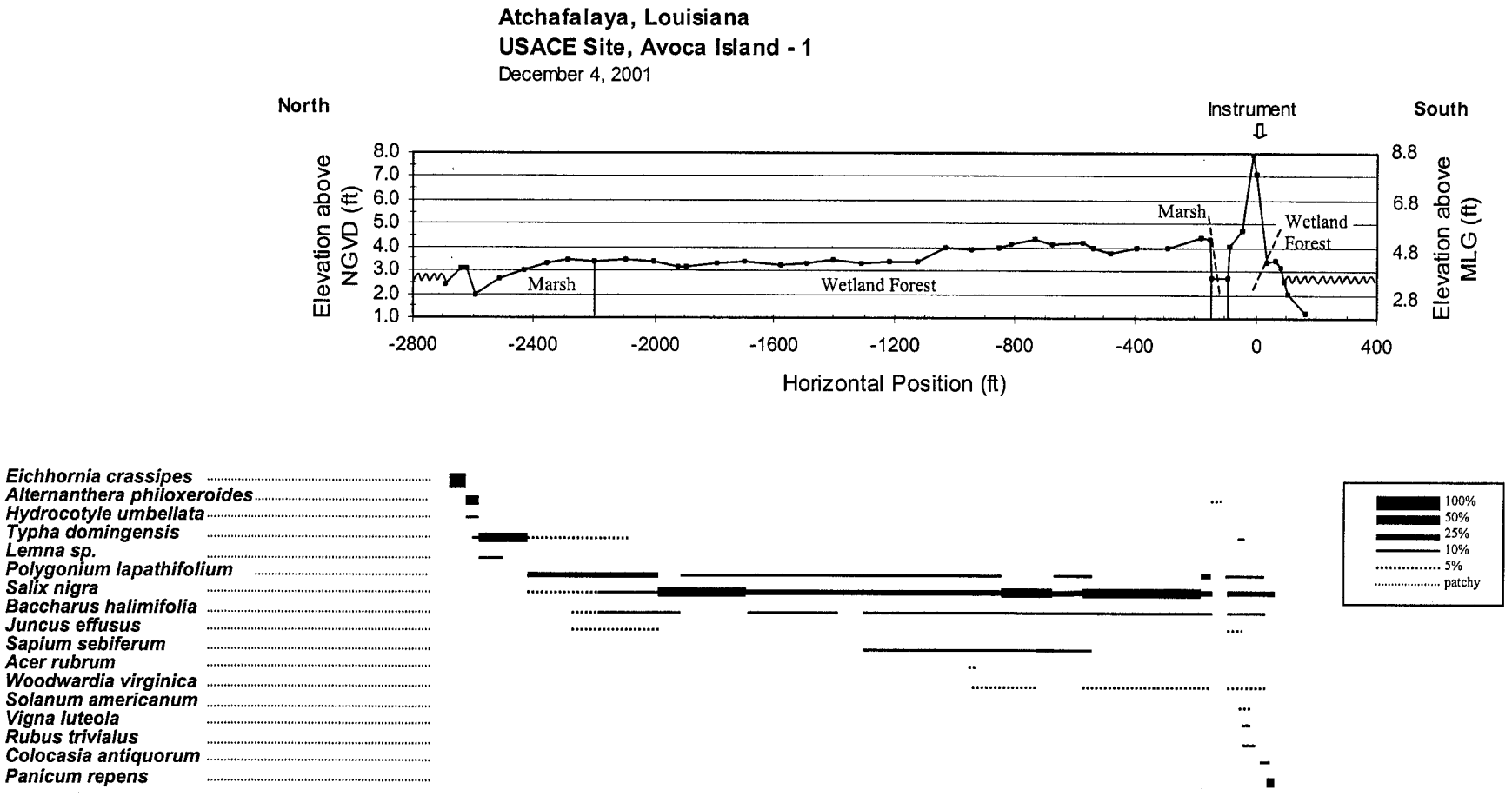

Figure 10. Elevation profile Avoca Island transect #1 with vegetation data illustrated.

Transect #2

Avoca Island transect #2 is located on the central, unforested part of Avoca Island. It trends roughly N to S with a bearing of 349°. (Figure 6). The elevation and vegetation data were acquired December 5, 2001. The transect was oriented to cross recent disposal areas that were deposited during the 1989 and 1998 maintenance events. It extends from Avoca Lake on the north (Figure 11) to Avoca Island Cutoff on the south, and lies just east of a central pond on the island. The transect was delineated by 1 stake on the dike on the southern end of the transect, which was also the instrument location, and a second stake north of the borrow ditch. The dike has been colonized by shrubs and trees, and the disposal landscape was dominated by fresh marsh (Figures 12 & 13).

The profile has a length of 2385 ft (Figure 14). The maximum elevation along the transect was 7.76 ft MLG (6.98 ft NGVD), on the crest of the northern dike, with an average elevation of 3.4 ft MLG (2.6 ft NGVD). The average elevation of the transect (not including the dikes) was 3 ft MLG (2.2 ft NGVD). The published tidal range at Atchafalaya River is 2.0 ft for December 5, 2001.

Figure 11. Photograph taken December 5, 2001 at Avoca Island transect # 2. Photo was taken from the northern end of the transect where the containment dike is eroded to a three-foot scarp. The view is northward into the eastern pocket of Avoca Lake. Several healthy *Taxodium distichum* trees still grow within the shallow lake. *Eichhornia crassipes* is visible in the foreground and fringes the shoreline, floating on the water surface.

Figure 12. Photograph taken December 5, 2001 at Avoca Island transect # 2. Photo was taken about 1000 feet from the northern end of the transect. The view is towards the pond to the west. A thin line of *Salix nigra* trees is visible bordering the far western bank of the pond. The vegetation on the near eastern bank consists of *Alternanthera philoxeroides, Sagittaria lancifolia* and *Hydrocotyl ranunculoides.* Branches of juvenile *Salix nigra* are also visible in the foreground.

Figure 13. Photograph taken December 5, 2001 at Avoca Island transect # 2. Photo was taken about 270 feet north of the instrument. The view is to the south, roughly along the line of the transect. Primary vegetative species were *Polygonum lapathifolium, Peltandra virginica* and *Typha domingensis.* The *Sagittaria lancifolia* - filled ditch (not visible) parallels the line of *Salix nigra* on the containment dike to the south.

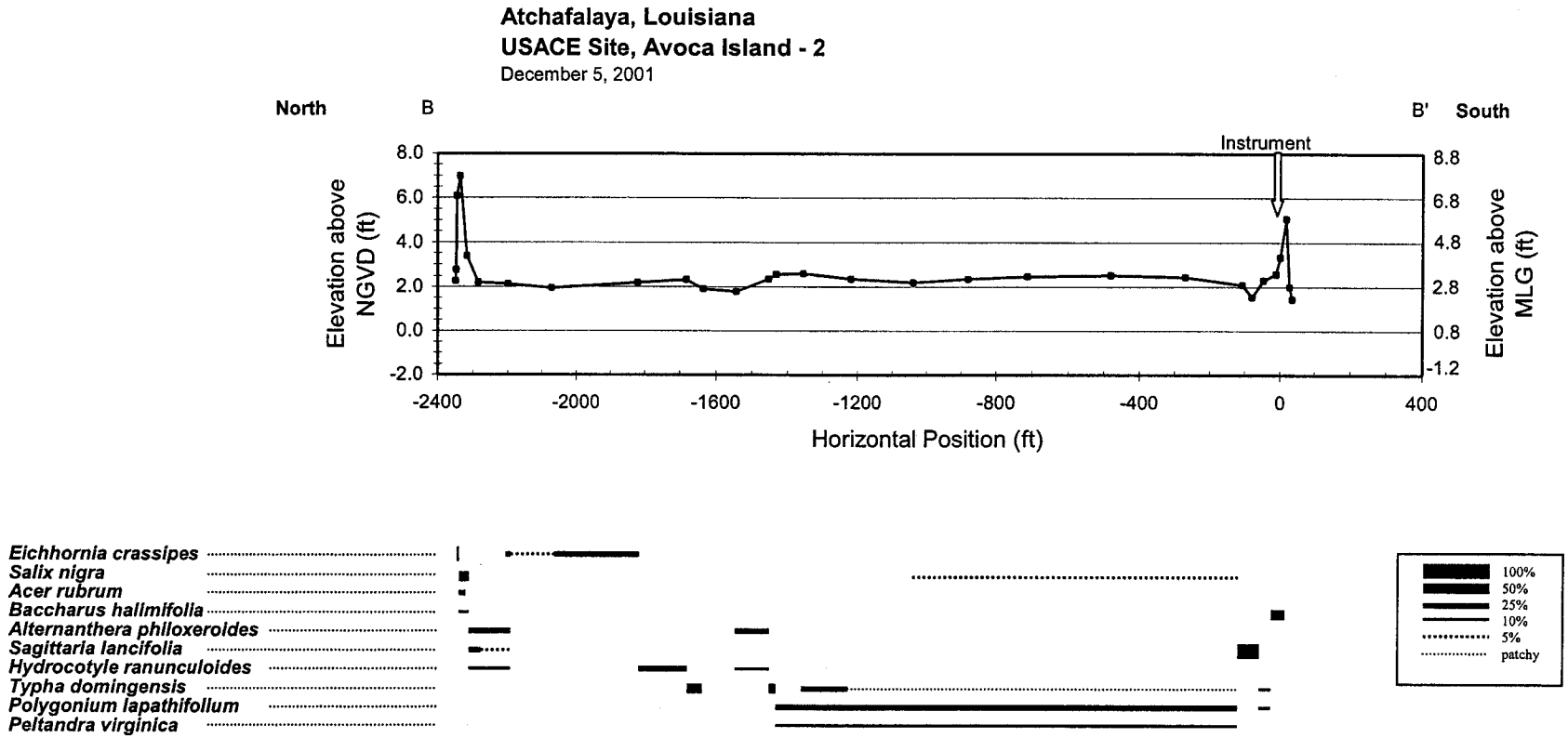

Figure 14. Elevation profile Avoca Island transect #2 with vegetation data illustrated.

Transect #3

Avoca Island transect #3 is located on the forested eastern part of Avoca Island. It trends roughly N to S with a bearing of 2°. (Figure 6). The elevation and vegetation data were acquired December 7, 2001. The transect was oriented to cross sediments that were deposited during the 1988, 1989 and 1998 maintenance events. It extends from Avoca Lake on the north (Figure 15) to Avoca Island Cutoff on the south. The transect was delineated by 1 stake on the dike on the southern end of the transect, which was also the instrument location, and a second stake north of the borrow ditch. The dike has been well colonized by shrubs and trees, and the disposal landscape was dominated by forested wetlands (Figures 15 & 17) with a few clearings (Figure 16).

The profile has a length of 2450 ft (Figure 18). The maximum elevation along the transect was 7.41 ft MLG (6.63 ft NGVD), on the crest of the northern dike, with an average elevation of 4.2 ft MLG (3.4 ft NGVD). The average elevation of the transect (not including the dikes) was 3.9 ft MLG (3.1 ft NGVD). The published tidal range at Atchafalaya River is 1.5 ft for December 7, 2001.

Figure 15. Photograph taken December 7, 2001 at Avoca Island transect # 3. Photo was taken about 350 feet south of the northern end of the transect. The view is to the north, through the trees to the eastern part of Avoca Lake. *Taxodium* distichum are visible in the background in the lake. The siteline is cut primarily through *Salix nigra* trees with *Baccharus halimifolia* bushes; some *Acer rubrum* trees were on the containment dike near the lake. *Polygonum lapathifolium* and some *Solidago sempervirens* make up the low-growing species.

Figure 16. Photograph taken December 7, 2001 at Avoca Island transect # 3. Photo was taken about 1000 feet south of the northern end of the transect. The view is to the north, overlooking a clearing in the trees, towards the siteline to the north. Background trees consist of *Salix nigra* and *Baccharus halimifolia.* Clearing is dominated by *Polygonum lapathifolium,* but also contains *Solidago sempervirens*, *Juncus effuses* and stands of *Typha domingensis.*

Figure 17. Photograph taken December 7, 2001 at Avoca Island transect # 3. Photo was taken about 1000 feet north of the southern end of the transect. The view is to the north, along the siteline cut through the *Salix nigra*, *Baccharus halimifolia* and *Sapium sebiferum*, towards a clearing. Low vegetation is primarily *Polygonum lapathifolium,* but also contains *Solidago sempervirens.*

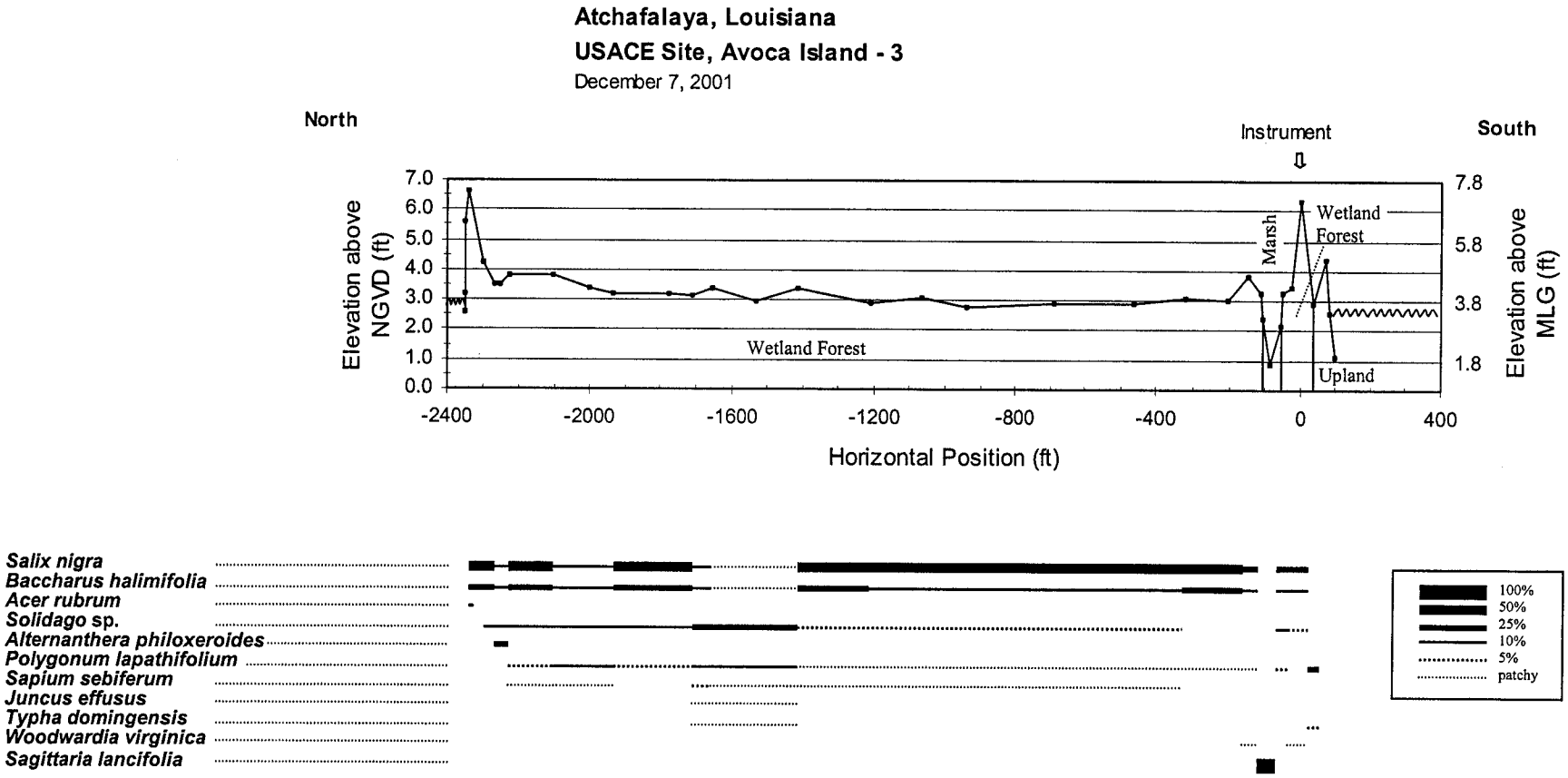

Figure 18. Elevation profile Avoca Island transect #3 with vegetation data illustrated.

Vegetative Character of the Avoca Island study area

General Description

The Lower Atchafalaya River supports a freshwater dependant vegetative system. Within the Avoca Island BUMP study area, this is predominately forested wetland, fresh marsh, and forest communities. The lower river area is exposed to the daily tides as well as to more extreme 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 December 2001 exhibited three basic zones of plant communities indicative of the predominant moisture regime. The forested wetlands, which dominated transects 1 and 3, consisted of extensive dense willow swamp thickets with some groundsel bush mixed in. These forests dominated all areas on the transects above about 3.6 feet MLG (2.8 feet above NGVD). Fresh marsh habitats dominated transect 2, with elevations below 3.6 feet. However, small stands of juvenile willows were present, but did not dominate the landscape. Forest communities were also present, but were limited to the dikes on the northern and southern ends of the transects, out of reach of tide and river stage. Erosion or wave energy along the channel and lake shorelines 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.

"Forested Wetland" indicated by willow trees (*Salix nigra*) seemed to dominate the landscape throughout the study area, making dense thickets with other shrubs and trees, predominantly *Baccharus halimifolia,* but also some *Sapium sebiferum.* Small thin stands of juvenile *Slalix nigra,* possible precursors of forested wetland, were scattered in many areas of the marsh. Fresh marsh formed the understory in the lower regions of forested wetland, but *Polygonum lapathifolium* was the dominant understory plant across the higher regions, which made up the majority of the island. 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 3.8 and 4.8 feet MLG, $\pm$ 0.5 feet.

"Marsh" species within the study site occurred most commonly at an elevation below 3.6 feet MLG. The fresh marsh was represented by alligator weed (*Alternanthera philoxeroides*), bulltongue (*Sagittaria lancifolia*), marsh pennywort (*Hydrocotyle ranunculoides*), southern cattail (*Typha domingensis*), soft rush (*Juncus effuses*), pennywort (*Hydrocotyle ranunculoides*), elephantsear (*Colocasia antiquorum*) and arrow arum (*Peltandra virginica*) with water hyacinth (*Eichhornia crassipes*) common at the shorelines and in ponds. Marsh-margin species such as willow-weed (P*olygonum lapathifolium*) and dogtooth grass (*Panicum repens*) 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 shoreline.

"Forest" communities dominated the levees above the elevations periodically flooded, roughly above 4.8 feet MLG. In addition to willows (*Salix nigra*) and groundsel bush *(Baccharus halimifolia*), which also dominated the forested wetlands, the high forest areas had red maple (*Acer rubrum*), black nightshade (*Solanum americanum*), goldenrod (*Solidago sempervirens*), dear pea (*Vigna luteola*) and Virginia chain fern (*Woodwardia virginica*).

GIS ANALYSIS RESULTS FOR ATCHAFALAYA - AVOCA ISLAND CUTOFF

Shoreline Changes of Atchafalaya - Avoca Island Cutoff: 1985-2000

Figure 19 graphs the spatial history of the Atchafalaya - Avoca Island Cutoff BUMP study area between December 1985 and December 2000. Table 1 documents the shoreline changes and Figure 20 illustrates the changes that took place at Atchafalaya - Avoca Island Cutoff between 1985 and 2000.

In December 1985, the Atchafalaya - Avoca Island Cutoff study area was measured at 12,522.1 acres. The study area in December 2000 measured 13,986.3 acres. This is a cumulative area increase of +1,464.2 acres at a rate of +97.6 acres per year for this 15-year period. The total area of the Atchafalaya - Avoca Island Cutoff BUMP study site increased by 12 percent between 1985 and 2000. There was an overall increase in the area of Avoca Island Cutoff of +431.5 acres in the natural areas. The contribution of BUMP related and other man-made areas accelerated the rate of growth by +1,032.7 acres. BUMP-made land totaled +1,184.2 acres in 2000, with +1,016.6 acres of increase between 1985 and 2000. Other man-made land totaled +799.9 acres, with +16.1 acres having been created between 1985 and 2000. The BUMP-made habitats accounted for 69 percent of the increase in area of the Atchafalaya - Avoca Island Cutoff study area between 1985 and 2000.

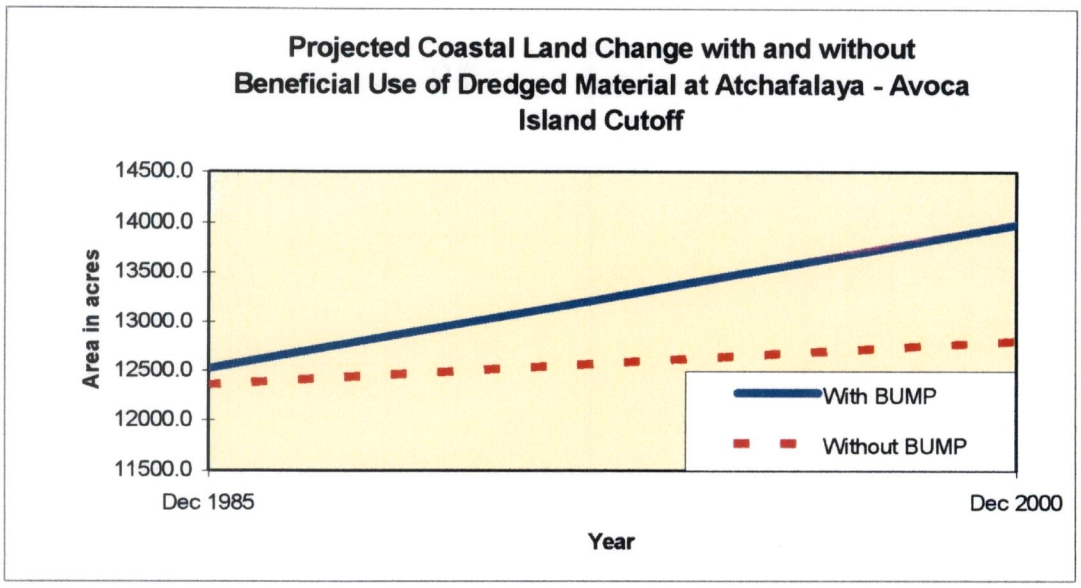

Figure 19. Graph of the area of the Atchafalaya - Avoca Island Cutoff study area over time, showing the contribution of the beneficial use of dredged material.

Table 1. Atchafalaya - Avoca Island Cutoff Area: 1985-2000.

Area (acres)	Dec 1985	Dec 2000	Area Change 1985-2000	Change Rate 1985-2000
Natural Areas	11,570.7	12,002.2	431.5	28.8
Other-made Areas	783.8	799.9	16.1	1.1
BUMP-made Areas	167.6	1,184.2	1,016.6	67.8
Total	12,522.1	13,986.3	1,464.2	97.6

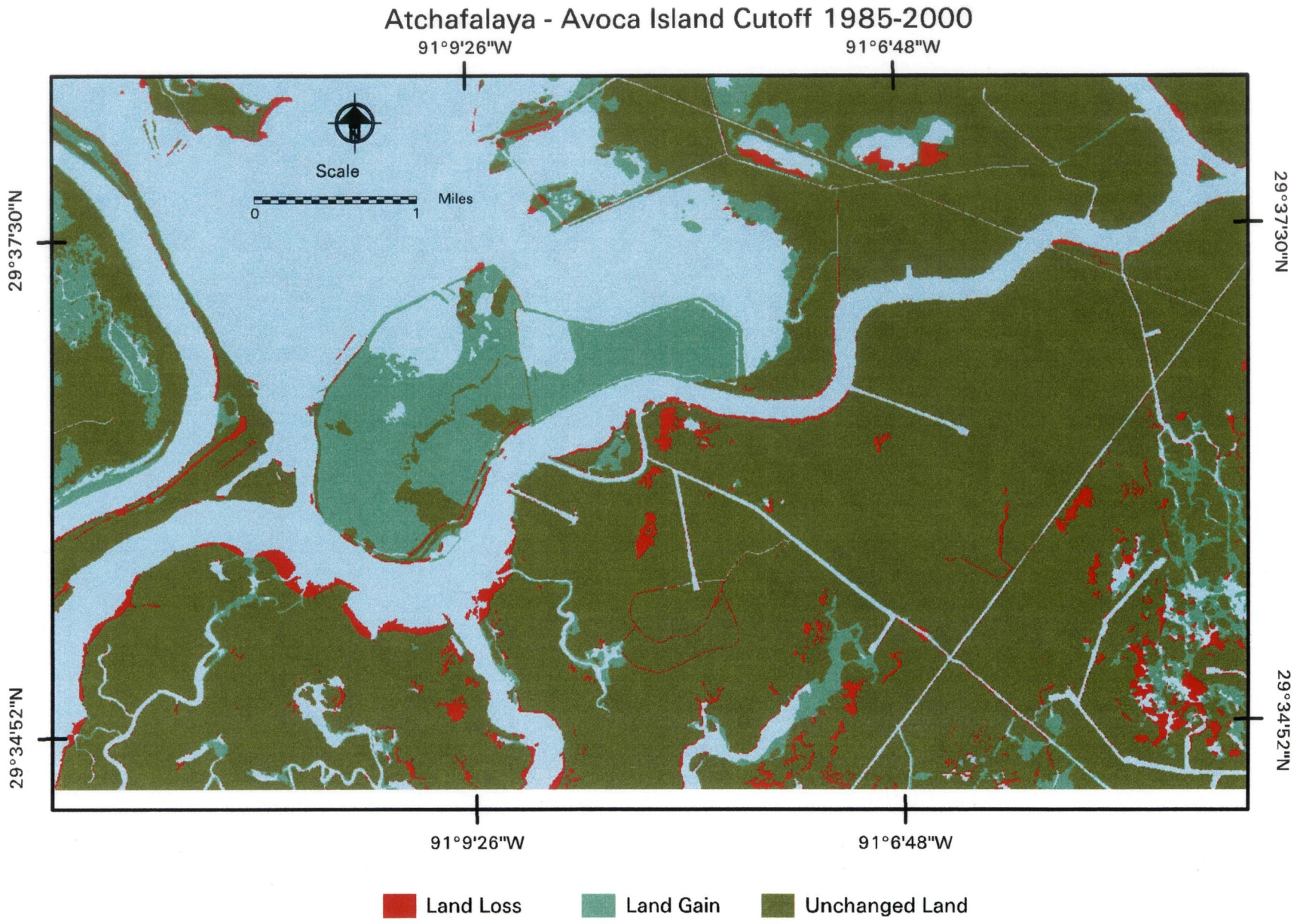

Figure 20 Land loss/Land gain map of Atchafalaya - Avoca Island Cutoff study area between December 1985 and December 2000

Habitat Inventory

The aerial photographic interpretation combined with field surveys identified five major habitat types in the Atchafalaya - Avoca Island Cutoff BUMP study area. These habitats are further classified as natural and man-made. The natural class identifies natural processes as responsible for habitat creation. The BUMP man-made (BUMP-made) class identifies the habitats created by the beneficial- placement of dredged material. The non-BUMP man-made class (Other-made) separates areas created that were not related to the beneficial use of dredged material such as areas created in association with the oil industry access and pipeline canals. Disposal materials reworked by natural processes are most often classified as "natural" unless specifically identified by the USACE-NOD as "BUMP-created." On the habitat maps presented in this report, an intertidal class is included to indicate near shore 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 five habitat types found in the Atchafalaya - Avoca Island Cutoff BUMP study area in December 1985. The location and arrangement of these habitats is presented in figure 21. The total area of the Atchafalaya River Avoca Island Cutoff study site was 12,522.1 acres in 1985. Of this total, 11,570.7 acres were natural and 951.4 acres were man-made, of which 783.8 acres were Other-made and 167.6 acres were BUMP-made. Habitats within the BUMP study site were 92.4 percent natural, 6.3 percent Other-made and 1.3 percent BUMP-made.

In order of decreasing size and importance, the largest habitats found were natural marsh (7,220.5 acres), natural wetland forest (3,740.7 acres), and Other-made wetland forest (700.7 acres). The largest BUMP-made habitat was wetland forest (118.5 acres).

In terms of habitat totals, marsh (7,268.7 acres or 58.0 %) and wetland forest (4,559.9 acres or 36.4 %) dominated the Atchafalaya River Avoca Island Cutoff landscape.

Table 2. December 1985 Habitat Inventory of the Atchafalaya - Avoca Island Cutoff BUMP Study Area[1].

HABITAT	TOTAL	NATURAL	OTHER-MADE	BUMP-MADE
Bare Land	298.4	271.2	19.7	7.5
Marsh	7,268.7	7,220.5	6.6	41.6
Wetland Forest	4,559.9	3,740.7	700.7	118.5
Shrub/Scrub	211.9	211.9	-	-
Upland	183.2	126.4	56.8	-
Habitat Total	12,522.1	11,570.7	783.8	167.6

[1] Area in acres

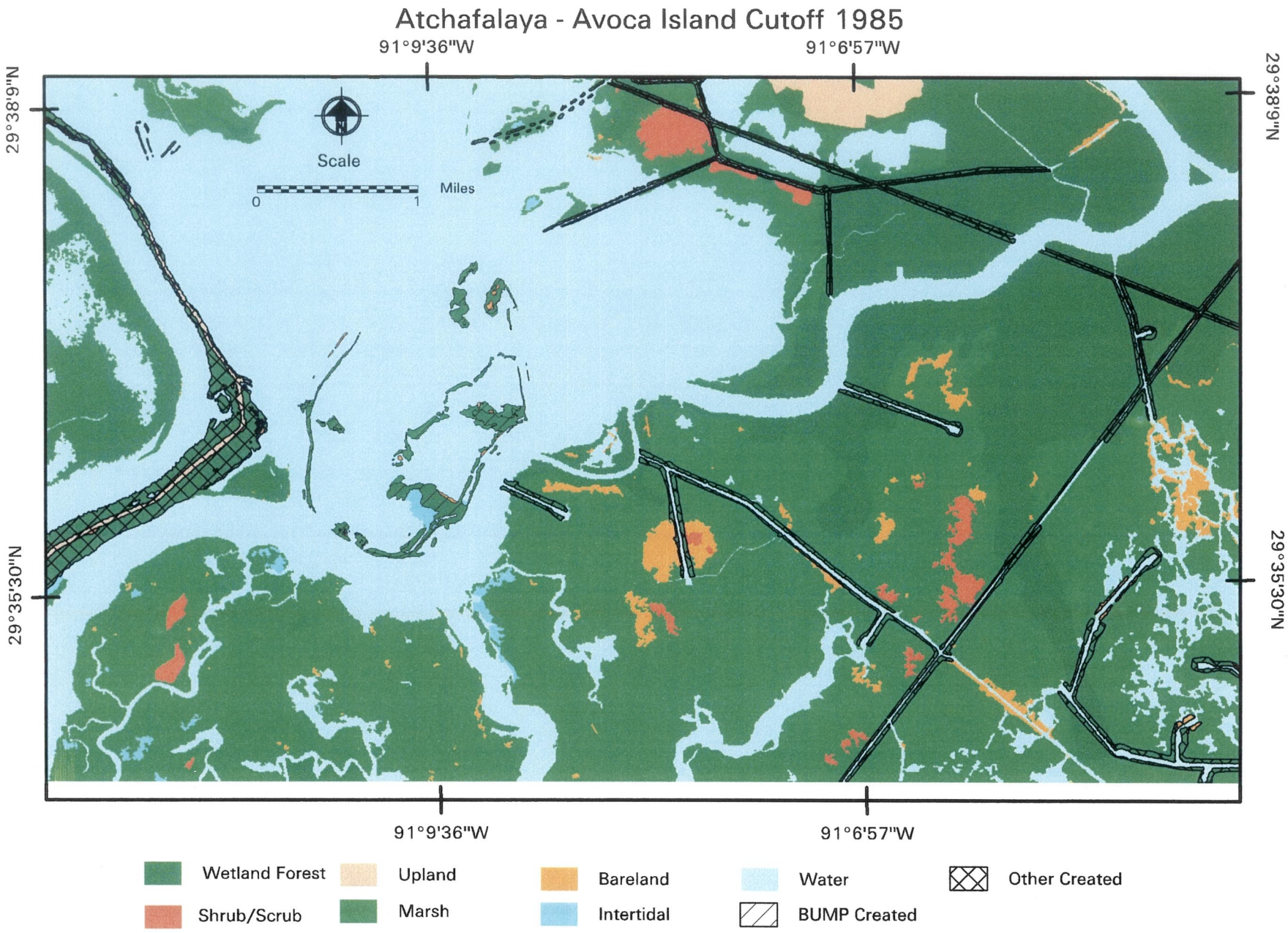

Figure 21 Habitat inventory map of the Atchafalya - Avoca Island Cutoff study area in December 1985.

Table 3 lists the areas of the five habitats found in the Atchafalaya - Avoca Island Cutoff BUMP study area in December 2000. The location and arrangement of these habitats is presented in figure 22. In 2000, the total area of the Atchafalaya - Avoca Island Cutoff BUMP study area was calculated at 13,986.3 acres. Of this total, 12,002.2 acres were natural and 1984.1 acres were man-made including 1,184.2 acres BUMP-made and 799.9 acres other-made. Habitats were 85.8 percent natural, 8.5 percent BUMP-made and 5.7 percent Other-made.

In order of decreasing size and importance, the largest habitats found were natural marsh (5,926.3 acres) followed by natural wetland forest (3,993.4 acres), natural bare land (1,289.2 acres), and BUMP-made wetland forest (812.4 acres). Between December 1985 and December 2000, natural bare land increased 1,095.7 acres. The increase in bare land may be explained by comparing total rainfall and the average stage of the Lower Atchafalaya River for December 1985 and 2001. In December 1985, there was 5.7 inches of rainfall and the Lower Atchafalaya River stage was 5.4 feet MLG (4.6 feet NGVD) at Morgan City, LA (Gage ID 03780). In December 2000, there was 3.1 inches of rainfall and the river stage was 2.2 feet MLG (1.4 feet NGVD).

In terms of total area, natural marsh (5,926.3 acres or 42.4 %) and natural wetland forest (3,993.4 acres or 28.6 %) dominated the landscape of the Atchafalaya - Avoca Island Cutoff BUMP study area.

Table 3. December 2000 Habitat Inventory of the Atchafalaya - Avoca Island Cutoff BUMP Study Area.

HABITAT	TOTAL	NATURAL	OTHER-MADE	BUMP-MADE
Bare Land	1,394.1	1,289.2	3.4	101.5
Marsh	6,206.4	5,926.3	9.8	270.3
Wetland Forest	5,545.1	3,993.4	739.3	812.4
Shrub/Scrub	686.0	685.7	0.3	-
Upland	154.7	107.6	47.1	-
Habitat Total	13,986.3	12,002.2	799.9	1,184.2

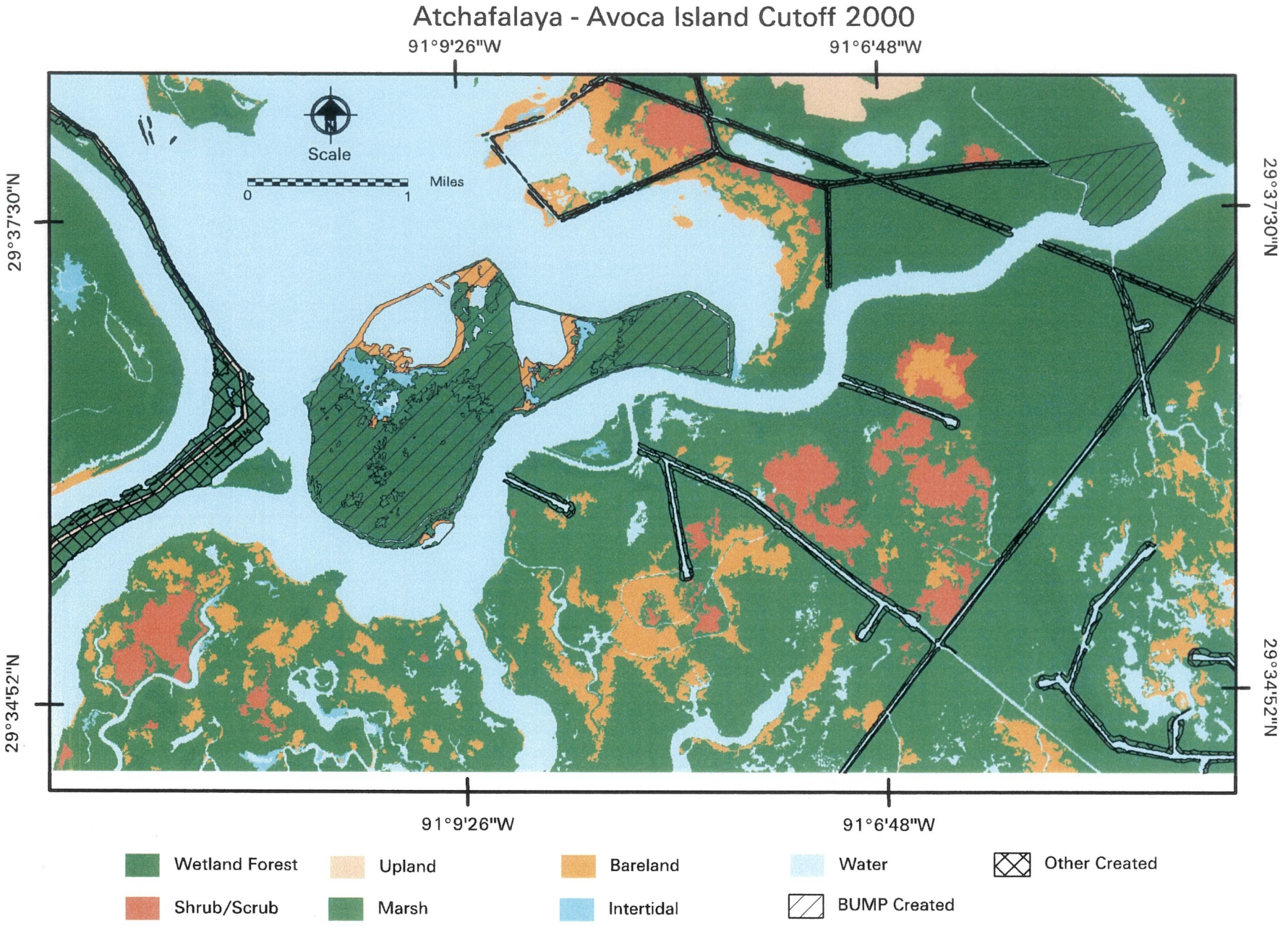

Figure 22 Habitat inventory of the Atchafalaya - Avoca Island Cutoff study area in December 2000

Habitat Change

Figure 23 shows changes over time of the major habitat categories: natural, other-made and BUMP- made. Figure 24 shows the creation of new habitat along the Atchafalaya - Avoca Island Cutoff BUMP study area by comparing December 1985 and December 2000. Land gain due to beneficial use of dredged materials dominates the processes of this area. The total area increased by +1,464.2 acres that represents a +12 percent increase in area between 1985 and 2000. There was an overall increase of +431.5 acres of the natural habitats, an increase of +16.1 acres in other-made habitats, and an increase of +1,016.6 acres of BUMP-made habitats. Table 4 lists the major habitat changes during the period between December 1985 and December 2000.

The greatest cumulative habitat changes between 1985 and 2000 were the increases of natural bare land (+1,018.0 acres) and BUMP-made wetland forest (+693.9 acres). Also, BUMP-made marsh gained 228.7 acres. The overall change in natural and man-made habitats was an increase of +1,016.6 acres.

Figure 25 shows a time series of habitat changes along the Atchafalaya - Avoca Island Cutoff BUMP study area. Figure 25a graphs the natural habitat changes over time. Natural land building and erosion dominates the processes affecting the natural habitat class. Figure 25b graphs the other-made habitat changes over time. Marsh and wetland forest creation by beneficial use of dredged material dominates the man-made class. Figure 25c graphs the BUMP-made changes over time.

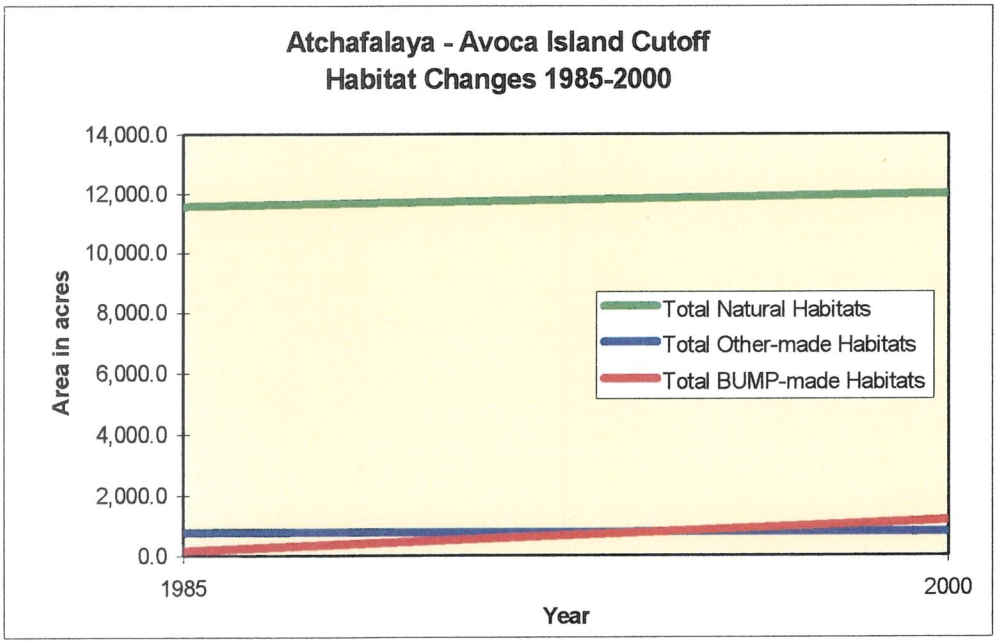

Figure 23. Graph showing the relative change in total area of the major habitat categories: natural, other-made, and BUMP-made, between 1985 and 2000.

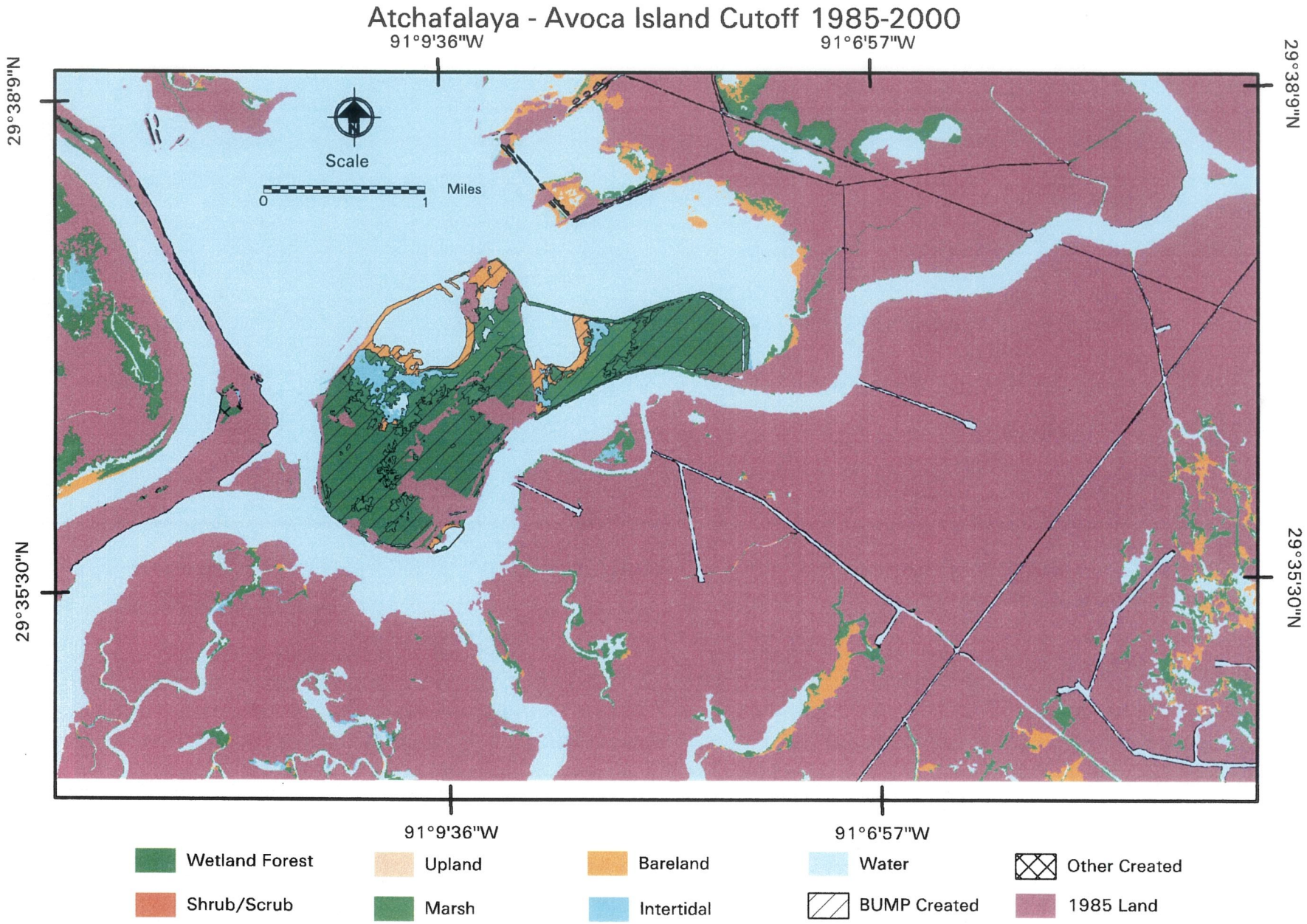

Figure24 Map of the Atchafalaya - Avoca Island Cutoff study area showing the new habitats that developed between December 1985 and December 2000

Table 4. Cumulative Change in Total Area of each habitat in Atchafalaya - Avoca Island Cutoff Study Area between 1985 and 2000[1].

HABITAT	Dec 1985	Dec 2000	AREA CHANGE
Natural Bare Land	271.2	1,289.2	1,018.0
Natural Marsh	7,220.5	5,926.3	-1,294.2
Natural Wetland Forest	3,740.7	3,993.4	252.7
Natural Shrub/Scrub	211.9	685.7	473.8
Natural Upland	126.4	107.6	-18.8
Total Natural Habitats	11,570.7	12,002.2	431.5
Other-made Bare Land	19.7	3.4	-16.3
Other-made Marsh	6.6	9.8	3.2
Other-made Wetland Forest	700.7	739.3	38.6
Other-made Shrub/Scrub	-	0.3	0.3
Other-made Upland	56.8	47.1	-9.7
Total Other-made Habitats	783.8	799.9	16.1
BUMP-made Bare Land	7.5	101.5	94.0
BUMP-made Marsh	41.6	270.3	228.7
BUMP-made Wetland Forest	118.5	812.4	693.9
BUMP-made Shrub/Scrub	-	-	-
BUMP-made Upland	-	-	-
Total BUMP-made Habitats	167.6	1,184.2	1,016.6
HABITAT TOTAL	12,522.1	13,986.3	1,464.2

[1] in acres

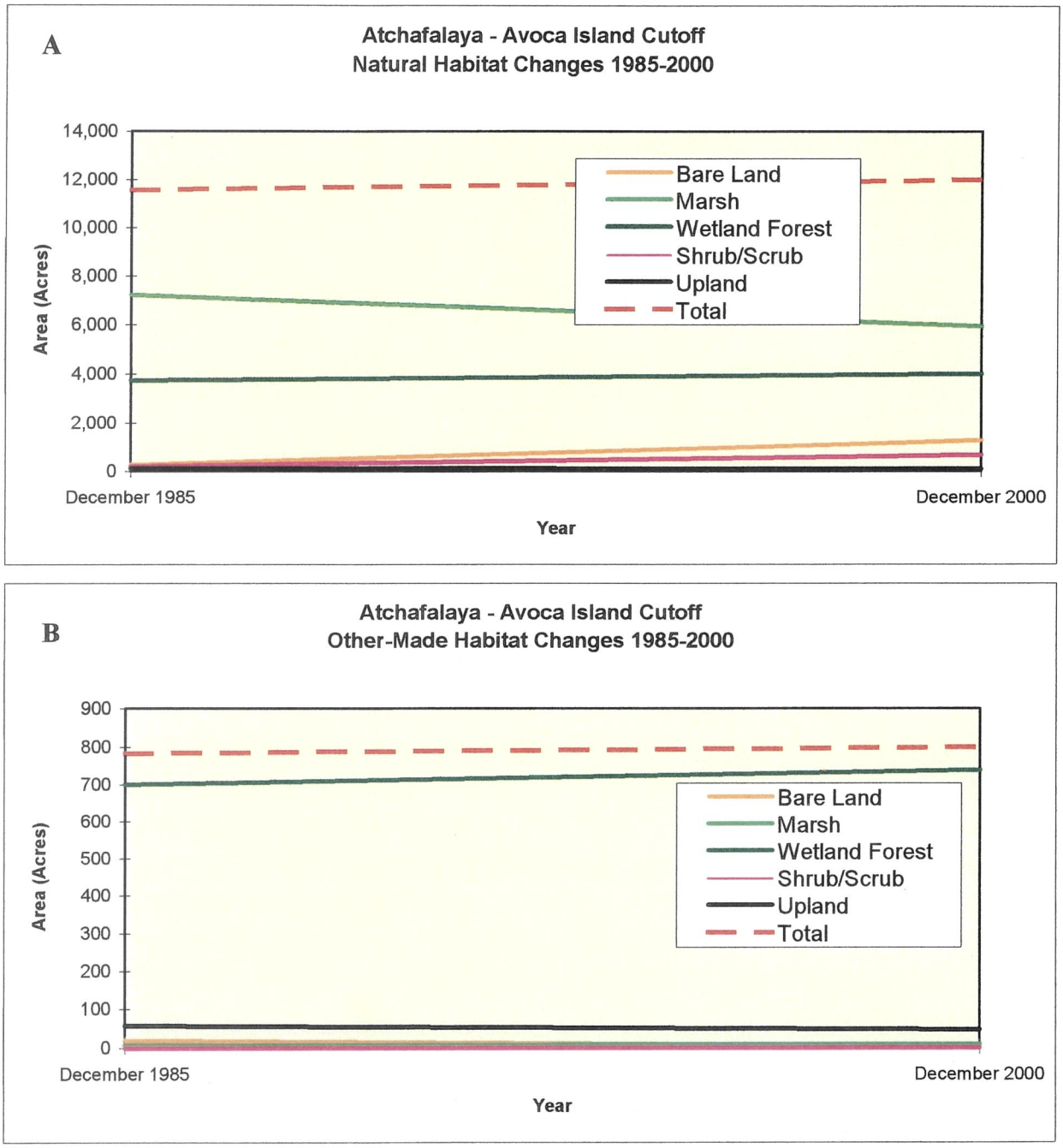

Figure 25. Time series showing the changes in total area of each habitat in the Atchafalaya - Avoca Island Cutoff BUMP study area between December 1985 and December 2000. A) Natural habitat changes. B) Other-made habitat changes.

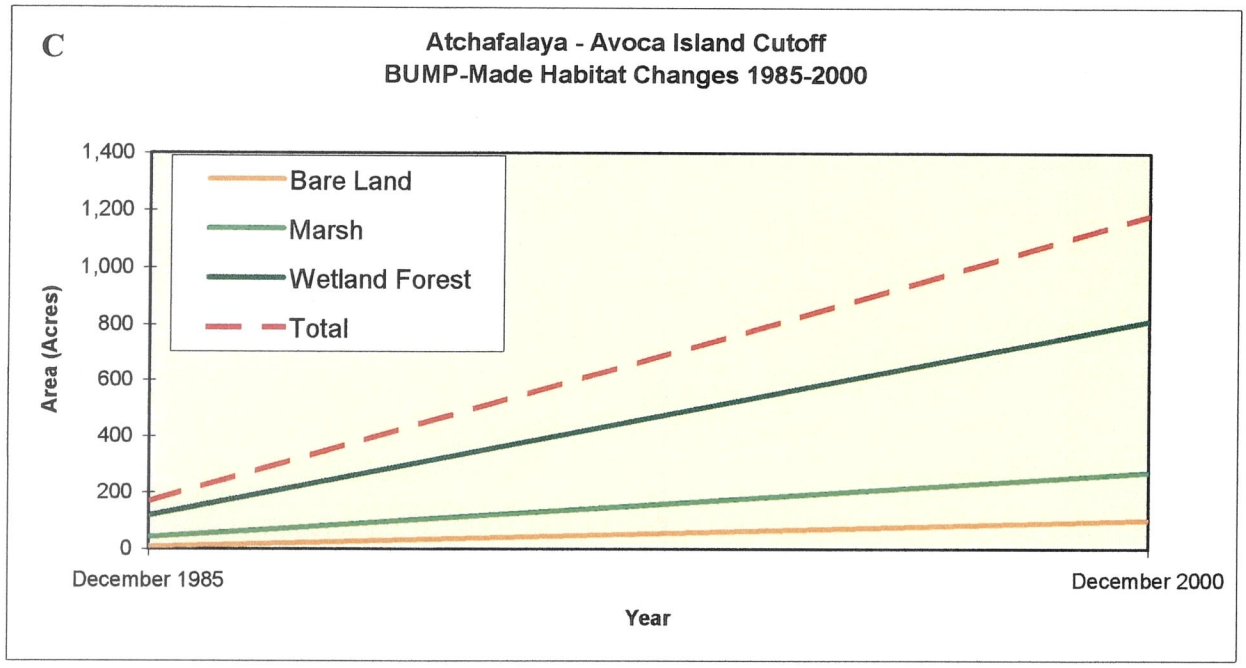

Figure 25. (continued) Time series showing the changes in total area of each habitat in the Atchafalaya-Avoca Island Cutoff BUMP study area between December 1985 and December 2000. C) BUMP-made habitat changes.

CONCLUSIONS

1. The Atchafalaya - Avoca Island Cutoff BUMP study area increased in area by +1,464.2 acres between 1985 and 2000 at a rate of +97.6 acres per year.

2. Between 1985 and 2000, natural processes accounted for 29.5 percent of the cumulative increase, beneficial use of dredged material processes accounted for 69.4 percent of the increase, and other human processes accounted for 1.1 percent of the increase.

3. For natural areas, the greatest contributions to area increase was from bare land (1,018.0 acres) followed by shrub/scrub (473.8 acres). Natural marsh decreased 7,220.5 acres in 1985 to 5,926.3 acres in 2000 for a loss of –1,294.2 acres over the 15 year period.

4. The Atchafalaya - Avoca Island Cutoff BUMP study area beneficial use is dominated by wetland forest, and freshwater marshes. For the beneficial use areas, the greatest contributions to area increase were from wetland forest (693.9 acres), followed by marsh (228.7 acres), and bare land (94.0 acres).

5. In the Avoca Island study area, 68.3 percent of the area created by beneficial use of dredged material was wetland forest and 22.5 percent was freshwater marsh.

APPENDIX

LIST OF VEGETATIVE SPECIES AT THE ATCHAFALAYA - AVOCA ISLAND CUTOFF BUMP STUDY SITE

LIST OF VEGETATIVE SPECIES IN THE ATCHAFALAYA - AVOCA ISLAND CUTOFF

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.

Acer rubrum ..... red maple
Tree; edge of marshes, swamps, stable dunes, uplands

Alternanthera philoxeroides ..... alligator weed
Perennial; fresh or intermediate aquatic or very wet habitats

Baccharus halimifolia ..... groundsel bush
Shrub or small tree; elevated sites in fresh to saline marshes

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

Eichhornia crassipes ..... water hyacinth
Floating aquatic; freshwater ponds and waterways

Hydrocotyle ranunculoides ..... pennywort
Aquatic or semi-aquatic perennial; seepage areas, pools, stream margins or swamps

Hydrocotyle umbellata ..... marsh pennywort
Creeping perennial; low or moist areas

Juncus effuses ..... soft rush
Perennial; moist soil, edges of soamps and ponds, low pastures

Lemna minor ..... duckweed
Floating aquatic; tidal fresh waters, freshwater lakes, ponds and slow-flowing streams

Panicum repens ..... dogtooth grass
Perennial grass; fresh and intermediate marsh, slightly elevated sites

Peltandra virginica ..... arrow arum
Perennial herb; tidal fresh to brackish marshes and swamps, nontidal swamps and marshes, ponds

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

Rubus trivialus ..... southern dewberry
Trailing or arching, thorny shrub; roadsides, old fields and along railroads

Sagittaria lancifolia ..... bulltongue
Perennial; ponds, ditches, sloughs, swamps, freshwater marshes

Salix nigra ..... black willow
Tree; streambeds and low moist areas

Sapium sebiferum ..... chinese tallow
Small tree; sandy soil, low swampy areas, waste places, stable dunes

Solanum americanum ..... black nightshade
Annual; woodland margins, fields, roadsides and waste places

Solidago sempervirens ..... goldenrod
Perennial; brackish marsh or saline sand

Typha domingensis ..... southern cattail
Aquatic or paludal, rhyzomatous perennial; alkaline brackish marshes and swamps

Vigna luteola ..... deer pea
Perennial herbaceous vine; waste places, borders of marshes and low fields

Woodwardia virginica ..... Virginia chain fern
Fern; tidal swamps, nontidal forested and shrub wetlands