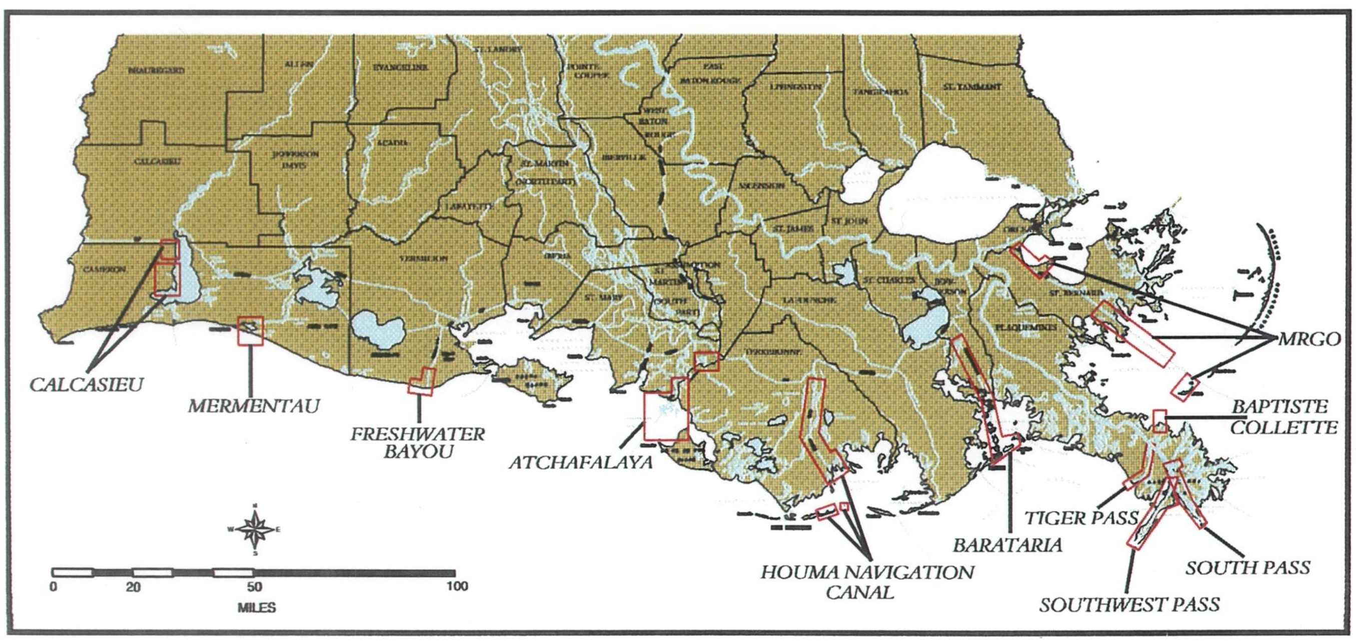
U.S. Army Corps of Engineers - New Orleans District
Louisiana State University - Coastal Studies Institute

BENEFICIAL USE OF DREDGED MATERIAL MONITORING PROGRAM 1996 ANNUAL REPORT
(Base year through FY1996)

Part 1: Introduction and Methodology



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1997

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INTRODUCTION

Beneficial Use of Dredged Material Monitoring Program Description

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

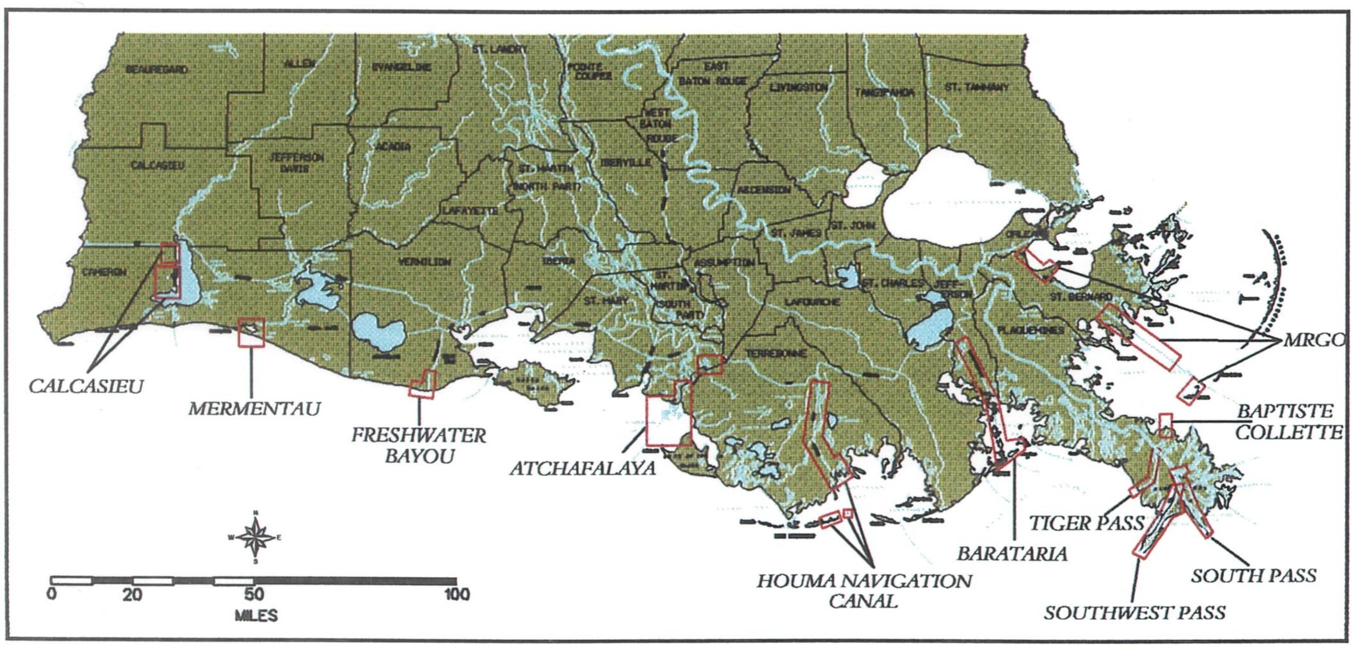


Figure 1. Locations of the beneficial use of dredged material monitoring areas.

TABLE 1
Beneficial Use of Dredged Materials Monitoring Program Research Staff

U.S. Army Corps of Engineers

- Dr. Linda Mathies - Environmental Resources Specialist
- Beth Nord - Environmental Resources Specialist
- Chris Accardo/Bill Caver - Project Engineer
- John Flanagan - Project Engineer
- Bob Gunn - Project Engineer
- Fred Schilling/Tim Roth - Project Engineer

Louisiana State University

- Dr. Shea Penland - Coastal Geologist
- Karen A. Westphal - Coastal Ecologist/Project Manager
- Lynda Wayne - GIS Specialist
- Qiang Tao - GIS Specialist
- Chris Zganjar - GIS Specialist
- Paul Connor - Geologist
- Jamie Phillippe - Geographer/photo-interpretation
- Robert Seal - Logistics Manager
- Elaine Evers - Coastal Ecologist/photo-interpretation
- Ashley Stokes - Coastal Ecologist/photo-interpretation
- Jenneke Vissar - Coastal Ecologist/field support
- Gary Peterson - Coastal Ecologist/Field support

LUMCON

- Dr. Denise Reed - Wetland Specialist

The Monitoring Program

The monitoring program uses remote sensing and field data acquisition strategies developed by the Baptiste Collette pilot study (Wayne et al., 1995) and refined in 1995. Table 2 lists the implementation schedule for the USACE-NOD beneficial use of dredged material monitoring program. This includes USACE-NOD and natural resources agency coordination, aerial photographic analysis, geographical information system (GIS) analysis, ground truthing, field monitoring, and the production of work products. Table 3 lists the data collection and analysis elements of the USACE-NOD monitoring program. The base year in Table 3 is the year chosen to begin GIS monitoring using aerial photography which ranges in date from 1976 for Baptiste Collette to 1992 for Calcasieu. Other dates are estimated for planning purposes and actual dates may vary due to weather or other unforeseen events. In 1997, the implementation of the large-scale monitoring program will be completed and will move from the implementation phase to the operation and maintenance phase.

TABLE 2
USACE-NOD Large-Scale Wetland Creation Monitoring Program Implementation Schedule

NAVIGATION CHANNEL	IMPLEMENTATION DATE	
	site specific aerial photography	field monitoring
1. Baptiste Collette Bayou	1993	1993
2. Lower Atchafalaya River		
Bay and Bar	fall 94	spring 95
Horseshoe Channel	fall 95	fall 96
Avoca Lake	fall 95	—
3. Mississippi River Gulf Outlet		
Mile 50-60	spring 95	fall 96
Jetties & Breton Island	spring 95	spring 95
4. Houma Navigation Canal		
Bay Chaland	spring 95	fall 96
Wine Island, East Island	spring 95	--
5. Southwest Pass	spring 95	summer 97
6. South Pass	spring 95	summer 95
7. Tiger Pass	spring 95	summer 97
8. Freshwater Bayou	spring 95	summer 97
9. Barataria Bay Waterway	spring 95	summer 97
10. Mermentau River - Mud Lake & Mermentau Beach	fall 95	summer 97
11. Calcasieu River - Brown Lake & Sabine	fall 95	summer 97

TABLE 3

Schedule for USACE-NOD Beneficial Use of Dredged Materials Monitoring Program

December 20, 1996

Navigation Channel	Engineer	Base Year	Disposal Since Base Year	Air Photo Acquisition	Air Photo Mosaic[3]	AP[4] Analysis[3]	Ground Truthing[3]	GIS Analysis[3,5]	Field Monitoring[3]	Dredging Conference [2]	Report
1. MRGO - Inside (Mi 50-60)	Bob Gunn	1990	1988 5Feb-26Jun 93 5Dec95-3Feb96	8Feb95 9Nov95 8Nov96	May 96 Feb 97	Jun 96 Feb 97	Nov 96	Jun 96 Mar 97	Nov 96	May 97	May 97
1. MRGO - Jetties (Mi 0-30)	Bob Gunn	1985	1993 1Jul-21Dec93 12Jul-29Aug94 18Jun-31Jul95 19Dec95-29Jan96 9May-17Jun96	8Feb95 9Nov95 8Nov96	Mar 95 May 96 Feb 97	Aug 95 Mar 96 Feb 97	May 95 Apr 96 Jun/Nov 96	Sep 95 Jun 96 Mar 97	May 95 Jun/Nov 96	May 96 May 97	May 96 May 97
1. MRGO - Breton Island (Mi -3 to -9)	Bob Gunn	1990	1984 4Oct91-9Mar92 Sep-Nov93 Sep-Nov94 22Aug-25Sep96	28Apr95 9Nov95 8Nov96 Pre/post 97	Mar 95 May 96 Feb 97	Feb 96 Feb 97	Feb 96	April 96 April 97	May 95 Aug 96	May 96 May 97	May 96 May 97
2. Baptiste Collette Bayou	Bob Gunn	1976	Jun-Oct 1994 2May-17May95 17May-21Sep95 31Aug-21Sep95 31Jul-16Sep96	11Nov94 9Nov95 8Nov96	Mar 95 May 96 Jan 97	May 95 May 96 Feb 97	Aug 95 Feb 96	Jun 95 May 96 Feb 97	Aug 95 Aug 96	June 95 May 96 May 97	Sept 94 June 95 May 96 May 97
3. South Pass	Fred Schilling	1985	Sep-Oct 1994	31Jan+28Apr95 9Nov95 9Nov96	May 95 May 96 Mar 97	Sep 95 Jun 96 Jun 97	Sep 95 Jun 96 Aug 97	Sep 95 Jun 96 Jun 97	Aug 95	May 96 May 98	May 96 May 98
4. Southwest Pass	Fred Schilling	1985	Mar-Oct 1994 4Sep95 Mar-Oct95 5Jun-4Sep95 24May-9Aug96	31Jan+28Apr95 12Nov 95 8Nov 96	May 95 May 96 Feb 97	Sep 95 Jun 96 Mar 97	Jun 95 Mar 97	Sep 95 Mar 97		May 97	May 96 May 97
5. Tiger Pass (Mi 6.2-9.5)	Bob Gunn	1985	7Dec93-26Jan94	8Feb 95 9Nov95 8Nov 96	Mar 95 May 96 Mar 97	Jun 96[5] Aug 97	Jul 96 Aug 97	July 96 Aug 97	Aug 97	May 98	May 98
6. Barataria Waterway - Queen Bess (Mi 2.6-12.1)	Bob Gunn	1985	1991 1Oct-3Dec96	8Feb 95 12Nov 95 9Nov 96	Mar 95 May 96 Mar 97	Aug 97	Aug 97	Aug 97	Aug 97	May 98	May 98
6. Barataria Waterway - Grand Terre Island	Bob Gunn	1985	19Aug-5Sep96	8Feb 95 12Nov 95 9Nov 96	Mar 95 May 96 Mar 97	Aug 97	Aug 97	Aug 97	Aug 97	May 98	May 98

(Table 4 continued on the next page)

TABLE 4 (cont'd)
Schedule for USACE-NOD Beneficial Use of Dredged Materials Monitoring Program

December 20, 1996

Navigation Channel	Engineer	Base Year	Disposal Since Base Year	Air Photo Acquisition[3]	Air Photo Mosaic[3]	AP[4] Analysis[3]	Ground Truthing[3]	GIS Analysis[3,5]	Field Monitoring[3]	Dredging Conference [2]	Annual Report
6. Barataria Waterway - Dupre Cut (Mi 32-27)	Bob Gunn	1985	none	8Feb 95 12Nov95 9Nov 96	Mar 95 May 96 Mar 97						
6. Barataria Waterway - Beauregard Is. to Bayou St. Denis	Bob Gunn	1985		8Feb 95 12Nov95 9Nov 96	Mar 95 May 96 Mar 97	Aug 97	Aug 97	Aug 97	Aug 97	May 98	May 98
7. Houma Nav. Canal Chaland Bay	Bob Gunn	1990	17Sep-7Nov93 29Sep-21Nov95 18Sep-19Nov95	8Feb+2Apr95 28Oct95 10Nov 96	Mar 95 May 96 Mar 97	Apr 96 Feb 97	19, 26Sep96	Jun 96 Feb 97	Sep 96	May 97	May 97
7. Houma Nav. Canal Cat Island Pass	Bob Gunn	1990	28Aug93-11Oct94 6May-10Jun95	8Feb+28Apr95 28Oct95 10Nov 96	Mar 95 May 96 Mar 97	Apr 96 Feb 97	Apr 97	Feb 97		May 98	May 98
8. Lower Atchafalaya River Bay and Bar	John Flanagan	1985	Jun-Oct 1994 28Aug-25Oct95 14Apr-11May95 24Jun-26Oct95 26Jul-28Aug95 16Apr-14Jul96 28Jul-16Dec96	11Nov 94 28Oct 95 10Nov 96	Jan 95 Mar 96 Feb 97	Apr 95 Jun 96 Feb 97	May 95 Sept 96	Jun 95 Jun 96 Mar 97	May 95 Aug/Oct 96 Aug 97	June 95 May 96 May 97	May 96 May 97
8. Lower Atchafalaya Channel (Horseshoe)	John Flanagan	1985	27May-16Oct94 12May-21Jun95 18Apr-16May96 17Aug-25Oct96 28Jul-16Dec96	28Oct 95 10Nov96+16Feb97	Mar 96 Feb 97	Jun 96 Feb 97	Oct 96	Jun 96 Mar 97	Oct 96	May 97	May 97
8. Atchafalaya Avoca Lake	John Flanagan	1985		28Oct 95 10Nov 96	Mar 96 Feb 97	Aug 97	Aug 97	Aug 97	Aug 97	May 98	May 98
9. Freshwater Bayou/Beach	Chris Accardo	1993 1990	30Jan-4Mar83 14Sep-17Oct90 27Mar-29Apr94	8Feb95 28Oct95 10Nov 96	Mar 95 May 96 Apr 97	Aug 97[S]	Sep 97	Sep 97[S]	Sep 97[S]	May 98	May 98
10. Mermentau River - Lake and Beach	Chris Accardo	1990	22Jun-16Jul 87 29Apr-10Jun 91 21Apr-22May96	28Oct 95 10Nov 96	May 96 Mar 97	Sep 97[S]	Sep 97	Sep 97[S]	Sep 97	May 98	May 98
11. Calcasieu River and Pass	Chris Accardo	1992	12Jun-20Oct 93 15Sep-10Oct93 1Jul96-17Jan97	28Oct 95 10Nov 96	May 96 Mar 97	Aug 97[S]	Aug 97	Aug 97	Aug 97	May 98	May 98

[S]Shoreline only, no habitats interpreted.

AD* To be done after dredging is completed, instead of or in addition to October. Check with project engineer.

[3]LSU is responsible for notification and performance.

[4]Aerial Photographic

[5]Geographic Information System Analysis

1996 Report and Products

Vertical aerial photography was acquired in October/November 1995, and color mosaics were produced for all sites listed in table 2; monitoring and analysis was continued and updated for Baptiste Collette Bayou, the Lower Atchafalaya River Bay and Bar, and Mississippi River Gulf Outlet (MRGO) jetties and Breton Island; full field effort including ground-truthing, establishing profile benchmarks, and profile data acquisition was implemented for MRGO - Mile 50-60, Houma Navigation Canal - Bay Chaland and Lower Atchafalaya River - Horseshoe.

Vertical photography was acquired in November 1996, and digital color mosaics were produced for all sites listed in table 2. GIS habitat analysis was completed for MRGO - Mile 50-60, MRGO - Jetties, Baptiste Collette Bayou, Southwest Pass, Houma Navigation Canal - Bay Chaland, Atchafalaya River Bay and Bar, Lower Atchafalaya River - Horseshoe, with shoreline data for MRGO-Breton Island. Since the most recent aerial photography was flown in November 1996, most data and results of the 1996 Final Report reflected maintenance events that occurred through FY96.

The work products include habitat maps for the benchmark year and habitat maps for the selected monitoring years. Habitat change maps were produced for each time interval of comparison. From this analysis, coastal change data quantified the creation of new coastal lands and other habitats at selected navigation channel locations. The field program included ground truthing operations to verify and update the habitat maps and field surveys to collect information about vegetation, disposal elevations, and placement practices which maximize beneficial use.

The results of the 1996 Beneficial Use of dredged material Monitoring Program (BUMP) is presented in a nine part report:

- Part 1: Introduction and Methodology
- Part 2: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Gulf Outlet, Louisiana - Mile 47-59
- Part 3: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Gulf Outlet, Louisiana - Jetties
- 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 - Bay Chaland
- 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

In addition, the BUMP has generated a map series in support of the 1996 Final Report and these are listed below.

Map Series #1:	Habitat and Shoreline Changes of the Mississippi River Gulf Outlet, Louisiana - Mile 47-59: 1990 to 1996
Map Series #2:	Habitat and Shoreline Changes of the Mississippi River Gulf Outlet, Louisiana - Jetties: 1985 to 1996
Map Series #3:	Shoreline Changes of the Mississippi River Gulf Outlet, Louisiana - Breton Island: 1985 to 1996
Map Series #4:	Habitat and Shoreline Changes of the Mississippi River Outlet, Venice, Louisiana - Baptiste Collette Bayou: 1975 to 1996
Map Series #5:	Habitat Inventory of the Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana - Southwest Pass: 1985
Map Series #6:	Habitat Inventory of the Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana - Southwest Pass: February 1995
Map Series #7:	Habitat Inventory of the Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana - Southwest Pass: November 1995
Map Series #8:	Habitat Inventory of the Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana - Southwest Pass: 1996
Map Series #9:	Habitat and Shoreline Changes of the Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana - Southwest Pass: 1985 to 1996
Map Series #10:	Shoreline Changes of the Houma Navigation Canal, Louisiana - Bay Chaland: 1985 to 1996
Map Series #11:	Habitat and Shoreline Changes of the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Lower Atchafalaya River Horseshoe: 1985 to 1996
Map Series #12:	Habitat Inventory of the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Atchafalaya Bay/Delta and Bar Channel: 1995
Map Series #13:	Habitat Inventory of the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Atchafalaya Bay/Delta and Bar Channel: 1996
Map Series #14:	Habitat and Shoreline Changes of the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Atchafalaya Bay/Delta and Bar Channel: 1985 to 1996

WORK PLAN

Aerial Photographic Analysis

The aerial photographic analysis involved five major steps, 1) photo acquisition, 2) photo mosaicing, 3) photo interpretation and digitization, 4) habitat classification, and 5) ground truthing.

1) Photo Acquisition

LSU's air photo contractor acquired photography of each BUMP site at the end of the USACOE-NOD maintenance year which corresponds to the end of the growing season to capture the maximum vegetation extent for that year. Color infrared photography was acquired at a scale of 1:24,000. There was a 60 percent forward overlap of the photography which allowed the use of stereo plotting techniques for better accuracy. Color infrared photography was used for mapping and photo-interpretation because it provided a better definition of vegetation types, habitats, and the land/water interface. LSU archived a copy of the color infrared photography at the Coastal Studies Institute in the Center for Coastal, Energy, and Environmental Resources (CCEER). A second set of color infrared photography was provided to the USACE-NOD.

2) Photo Mosaicing

The aerial photography acquired for each dredge disposal site was mosaiced for use by the USACE-NOD and LSU. The air photo mosaic was produced by scanning the photography into a digital database, rectifying to scale, and edge matching the photography to provide a complete image of the beneficial use disposal site. A color computer plot was made of the mosaiced image at a scale of 1:24:0006. The digital file can be used to overlay other USACE-NOD information as needed. The mosaics were delivered to the USACE-NOD as a hard copy plot and as a digital file on a CD ROM in Intergraph MGE format.

3) Photo Interpretation and Digitization

The study areas were interpreted and mapped from the base year photography and the color infrared aerial photography using a Bausch and Lomb Zoom Transfer Scope. USGS quadrangle maps were used for the initial ground control to set the interpretations in the state plane coordinate system. The absolute accuracy is ±50' and the relative accuracy is ±10'. The shoreline was interpreted according to the location of the wet/dry beach contact visible on aerial photographs, the outer edge of well-established marsh, or the outer edge of organic beaches. The work product is a map showing the location of the habitat types in each area.

4) Habitat Classification

The habitats are interpreted from the photography by discernible and recognizable differences in infrared color and texture, and specific areas were then ground truthed in the field for positive habitat identification and vegetative community composition.

The habitats will be broken into simple classes and sub-classes: water, wetlands (marsh and swamp), and land (beach, bare, dune, upland, shrub/scrub, and forest). These very general characterizations necessarily incorporate many other habitats and transition areas.

There are many areas that cannot easily be separated into one of these categories. The establishment of vegetation is a succession of gradual transitions as plant communities colonize, compete, adapt or die, and eventually dominate each habitat. Difficulties arise as an interpreter attempts to classify areas that are in transition from one class to another, either temporally, such as marsh newly colonizing a submerged area, or spatially, marsh grading to upland. At some point along the gradual and subtle changes in elevation, vegetative density, or vegetative composition, an interpreter must make a decision and draw a line, attempting to be consistent each time.

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

Water (not included in statistics)

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

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

Wetlands

Marsh for our purpose, is any unforested, vegetated area normally subject to inundation or tidal action at any time, sufficient to support wetland-dependant, emergent vegetation. The type of marsh is further broken into classifications based on the salinity regime of the area which is indicated by the dominant vegetation in Louisiana. *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 uplands.

Saltmarsh, high salinity (20-40 parts per thousand), is dominated by Spartina alterniflora, Juncus roemerianus, and Distichlis spicata.

Brackish marsh, moderate salinity (0.5-16 parts per thousand), is dominated by Spartina patens and Distichlis spicata.

Intermediate marsh, low salinity (0.5-8 parts per thousand), is dominated by Spartina patens, Phragmites australis, Echinochloa walterii, or Scirpus sp.).

Freshmarsh, no salinity (less than 0.5 parts per thousand), is dominated by Sagittaria spp. and Panicum hemitomon.

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. Dominant tree species indicate more specific habitats; in the study area usually:

Cypress swamp, dominated by Taxodium distichum.

Willow swamp or *batture community*, dominated by Salix nigra. A batture community colonizes open areas along waterways, or on newly deposited or newly exposed areas near water.

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 fresh, 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, or some types of agricultural land. Natural succession may lead to shrub/scrub in some areas.

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

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

5) Groundtruthing

The interpretations of habitat type are verified by taking the photography or interpreted map into the field to check against the actual landscape. Corrections are made where necessary to the map, and the revised map is then submitted for GIS digitization and final analysis. For each monitoring site, a base year was selected upon which the assessment of changes are based. The dates of the base years are listed in Table 2. The base year photography is acquired from sources such as National Aeronautics and Space Administration, U.S. Department of Agriculture, U.S. Geological Survey, USACE,and the U.S. Fish and Wildlife Service.

Field Program

The field program supported the air photo-interpretation and GIS analysis tasks. The field program was comprised of two work efforts. The first field effort, groundtruthing, verified the interpretation of habitat type, vegetative cover, and surface morphology from the aerial photographic analysis. The second field effort, field monitoring, recorded changes in elevation, vegetative cover, geomorphic character, and surface texture at selected beneficial use sites in order to assess the best disposal practices.

1) Ground Truthing

The interpretation of habitat type and vegetative cover within each beneficial use site were made from the color infrared aerial photography. These interpretations were made remotely by trained photo-interpreters. The work product is a map showing the location of the habitat types in each area. These interpretations were confirmed by site visits to each beneficial use disposal area. The photo-interpreted map was taken into the field and checked against the disposal area landscape. Corrections were made where necessary to the habitat map, and the revised map was then submitted for GIS data development and final analyses.

2) Field Monitoring

The objective of the field monitoring is to clarify the habitat types by identifying dominant vegetative communities, and to determine the best disposal elevation and placement configuration in order to produce the maximum habitat benefits. Monitoring changes in elevation, habitat type and surface morphology at a disposal site will identify the important processes that control change. Understanding the relationships between change and process and habitat and elevation will facilitate better predictions of the potential habitat benefits associated with different placement elevations and configurations.

Permanent benchmarks placed by the USACE-NOD or USACE-NOD contractors and temporary benchmarks placed on site by LSU to mark study profiles were established within each beneficial use dredged material disposal site to provide monitoring baseline. The elevation of these benchmarks was determined using either an existing datum, tide gage data combined with shoreline morphology, or a global positioning system (GPS). Where existing datums occur within range to the disposal site, a laser driven Total Station survey instrument will be used to level between the known datum and the new benchmark. This will allow the direct establishment of the elevation at the new benchmark.

Where there is no existing datum to use, an elevation can be inferred from tide gage data or measured directly by a GPS system. The inferred method uses a tide gage in close proximity to the site as a calibration for elevation. During the establishment of the benchmark, a measurement between the water level and the benchmark elevation was made. The tide gage record is then reviewed to determine the water level elevation at that moment in time. The elevational difference between the measured water level and benchmark height was then correlated back to the known datum for the tide gage to determine the actual benchmark elevation. This position was then referenced to the morphology of the high tide position on the shoreline. A direct measurement of the elevation of the new benchmark was also made using a global positioning system (GPS) survey system. Depending on the number of satellites available, two or three benchmarks was established per day. The new benchmarks were then used to survey other ones in close proximity.

Once the benchmark was established, a transect was surveyed to record elevation, habitat types, and vegetative cover for that beneficial use site. This data was compared to original dredge material stacking height information where available for initial performance evaluation of the newly created areas. Seasonal monitoring of this transect will record changes in elevation, habitat type, vegetative cover, and surface morphology. With repeated surveys, changes along the transect can be determined and interpreted. This information leads to an understanding of the relationship between disposal elevation and placement configuration in producing the maximum habitat benefits.

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, LSU proposes to develop a World Wide Web site for the dissemination of the beneficial use of dredged material monitoring data. A home page will be developed that will allow the user to click (hyperlink) through data on the beneficial use of dredged material. The user will be able to view scanned aerial photographic mosaics, habitat maps, habitat change maps, habitat data spread sheets, and the results of field investigations. The web site will be updated periodically and for the annual dredging conference.

WORK PRODUCTS

The work products for 1996 are 1) vertical, color, aerial photography, 2) color photo mosaics for October/November 1995 and color digital mosaics for November 1996, 3) habitat inventory maps, 4) shoreline change maps, 5) habitat change maps 6) change data matrices, 7) dredged material disposal history map 8) habitat creation and configuration monitoring results, 9) Coordination, 10) annual report, 11) BUMP archive, and 12) World Wide Web site.

1) Aerial Photography
   Color infrared aerial photography was acquired for areas selected by the USACE-NOD along each navigation channel (Appendix A). The scale of the photography was 1:24,000 in a 9" X 9" format.

2) Photo Mosaics
   For all of the beneficial use of dredged material areas delineated in Appendix A, a color infrared, aerial photographic mosaic was produced: photographically for the October/November 1995 photography and digitally for the November 1996 photography. The scale was approximately 1:24,000 within a 36" width.

3) Habitat Inventory Maps
   Habitat inventory maps were produced from the aerial photographic analysis for selected beneficial use areas on each navigation channel, for the base year and the selected monitoring years. Areas that could be determined to be created by BUMP were delineated. Habitat maps were produced at a scale to show appropriate resolution.

4) Shoreline Change Maps
   Shoreline change maps were produced where appropriate to show general trends in erosion and accretion of the study area.

5) Habitat Change Maps
   Habitat change maps were produced from the GIS analysis comparing the base year photography with subsequent monitoring year photography. These maps depict how the habitat evolved and changed through time to highlight areas created by BUMP. These maps were produced at the same scale and format as the habitat maps.

6) Change Data Matrices
   The data generated by the aerial photographic and GIS analyses was organized into data matrices for easy review and interpretation. Starting with the base year, information was generated to quantify, in acres, the amount of new wetlands and other habitats created. From the change analysis, data on how the habitats changed between each time period is provided. Sites previously monitored were updated.

7) Dredged Material Disposal History Map
From "As-Builts" provided by the USACE-NOD, historical photography and maps and any other information available, LSU compiled data into a map to illustrate the dredged materials placement history within the study area. This is only as accurate as the information that was located. This map is provided as a figure within the monitoring report.

8) Habitat Creation and Configuration Monitoring Results
For the beneficial use sites chosen, the results of the aerial photographic and GIS analysis combined with the field monitoring results document the performance of different disposal elevations and configurations to create wetlands and other valuable habitats. Using this new information, the USACE-NOD in cooperation with natural resource agencies can formulate new plans to improve disposal methods for the beneficial use of dredged material.

9) Coordination
LSU coordinated with USACE-NOD on a regular basis, participated in meetings with project engineers and natural resource agencies, and will present monitoring data at technical meeting and workshops. Semi-annual reports or memos were provided to document project milestones. Monthly work plans were developed with the USACE-NOD to coordinate changes in the LSU monitoring program in response to changes in USACE-NOD dredging activities, and to track monitoring program performances.

10) Annual Report
This is the annual report for the USACE-NOD Annual Dredging Conferences that has been prepared for distribution to the attendees. The annual report summarizes the status of sites being monitored for habitat inventories, wetland change statistics, recommendations concerning stacking elevations and placement configurations, and the total wetland and other habitat acreage created to date in the USACE-NOD.

11) BUMP Archive and LSU Facilities
LSU has established a data archive within the Howe-Russell Geoscience Complex for the USACE-NOD beneficial use of dredged materials monitoring program. Aerial photography, project mosaics, habitat maps, habitat change maps, and all digital data is being stored and maintained on the LSU campus. The archive contains two dedicated GIS workstations for viewing and analyzing wetland creation data. The archive also contains the data and results of the field monitoring program.

12) World Wide Web Site
LSU has established a World Wide Web Site for the distribution of BUMP data sets to natural resource trustees and other interested parties. The web site will be updated periodically as information is available. The BUMP Homepage may be accessed at http://beach.csi.lsu.edu/bump/

SUMMARY

The U.S. Army Corps of Engineers - New Orleans District in cooperation with Louisiana State University - Coastal Studies Institute established the Beneficial Use Monitoring Program (BUMP) to document the creation of new land through the placement of dredge material. The methodology used to quantify the creation or enhancement of new coastal lands through the beneficial use of dredge material is listed below.

1. Annual acquisition of color infrared photography of the eleven monitoring sites.

2. Creation of air photo mosaics of each monitoring site.

3. Photo-interpret the shoreline and habitat environments for each site and convert to digital data.

4. Import the digital shoreline and habitat data into Intergraph MGE for analysis.

5. Use Intergraph MGE to inventory each monitoring site for each time period and perform change detection analysis for each time period pairs.

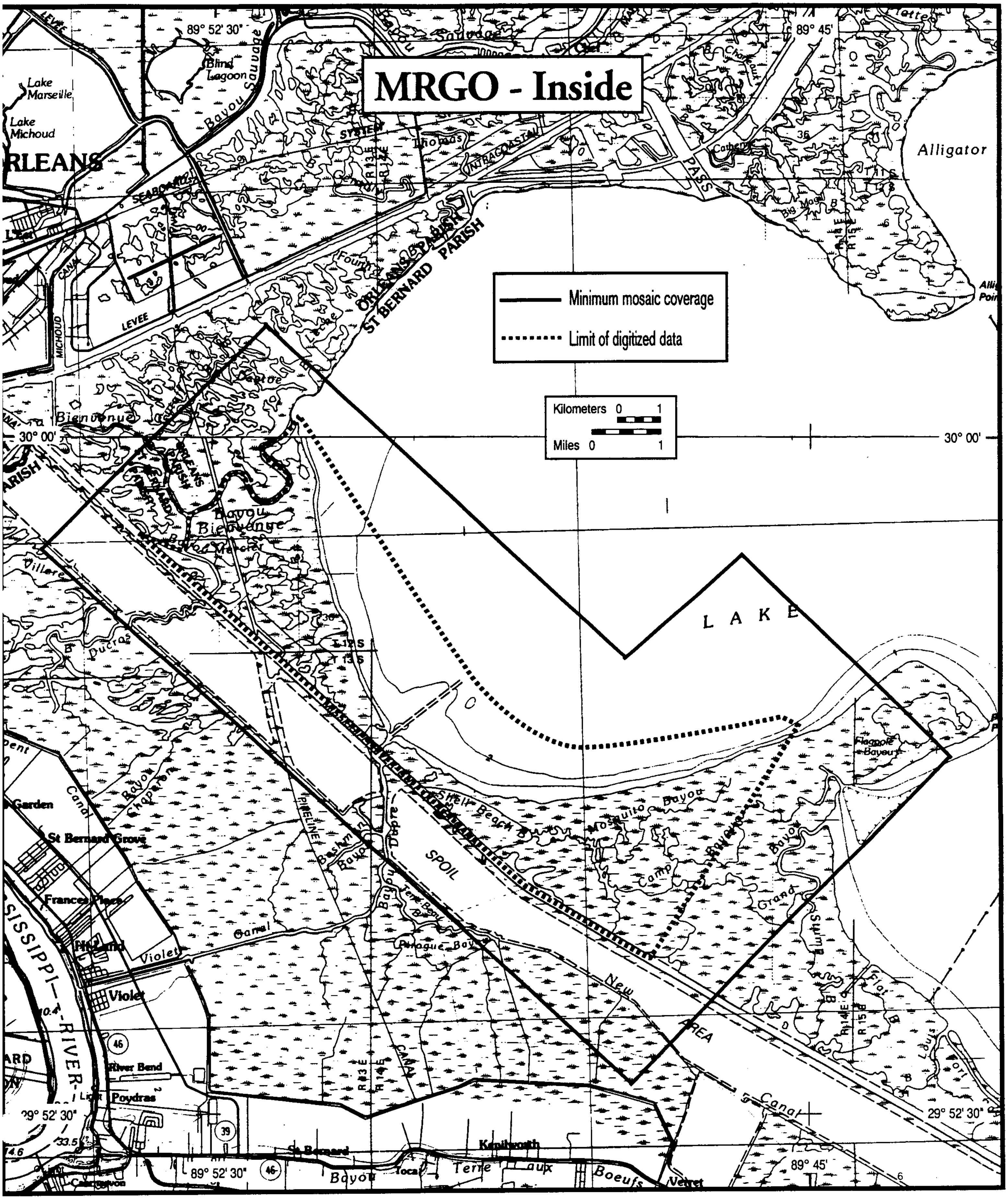
6. Ground truth the Intergraph MGE results.

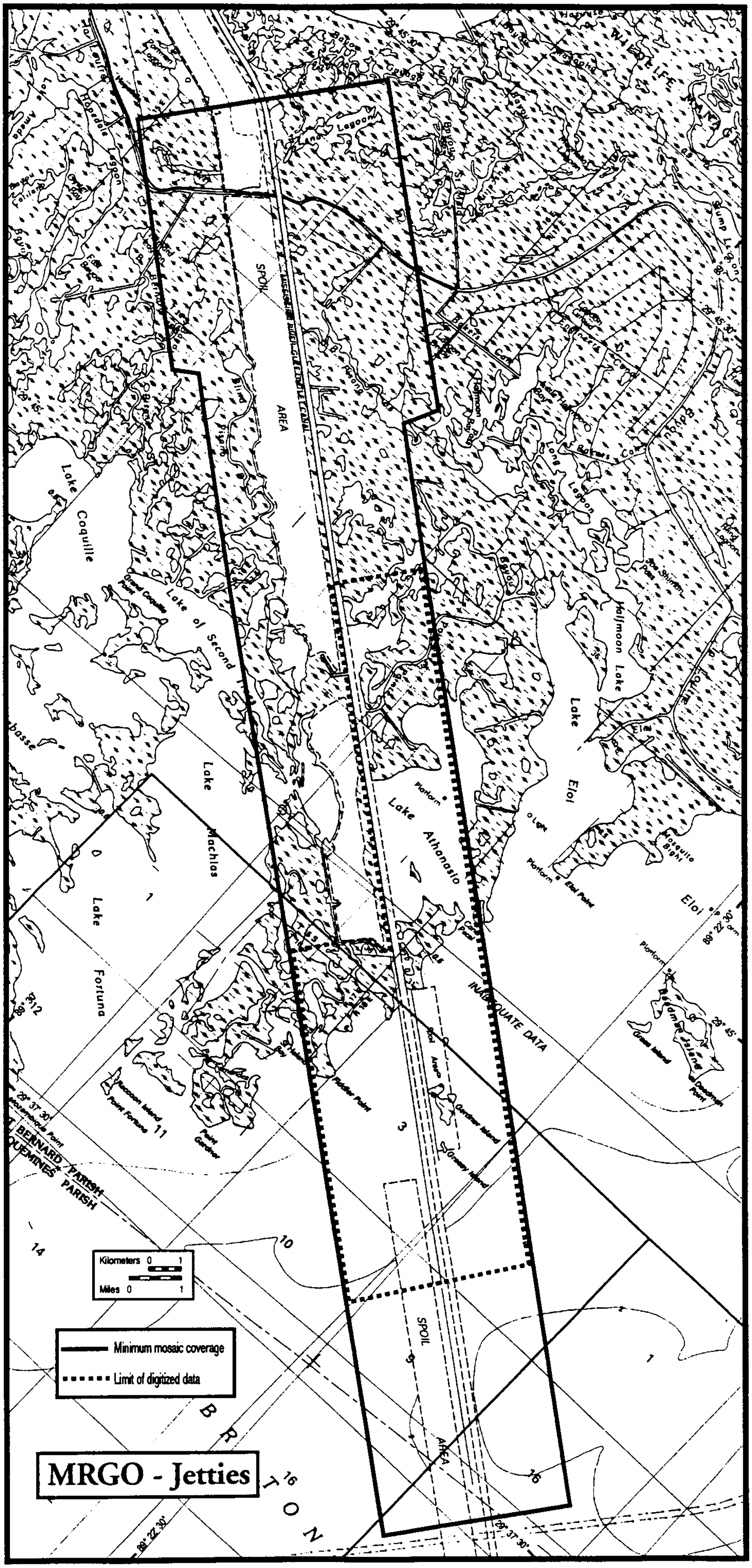
7. Conduct field monitoring to determine the best stacking height and placement configuration strategies for each site.

REFERENCES

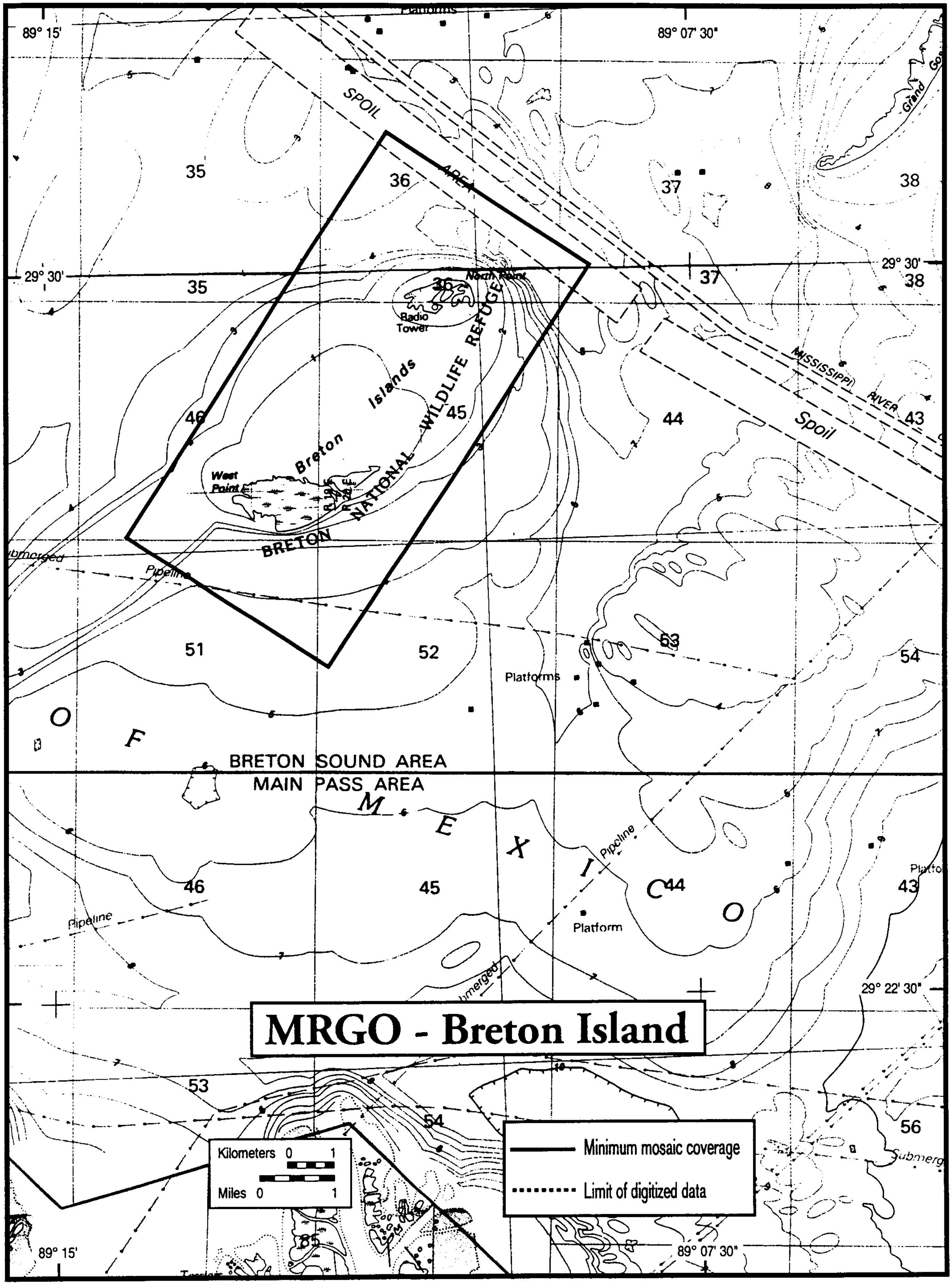
Wayne, L.D., Penland, S., Westphal, K.A., Hiland, M.W., Connor, P., and Zganjar, C.E., 1995. Development of a coastal monitoring program to document the beneficial use of navigation dredge materials in the U.S. Army Corps of Engineers - New Orleans District: Baptiste Collette Bayou Pilot Study. U.S Army Corps of Engineers, 34 pp.

APPENDIX 1A: BASE MAPS

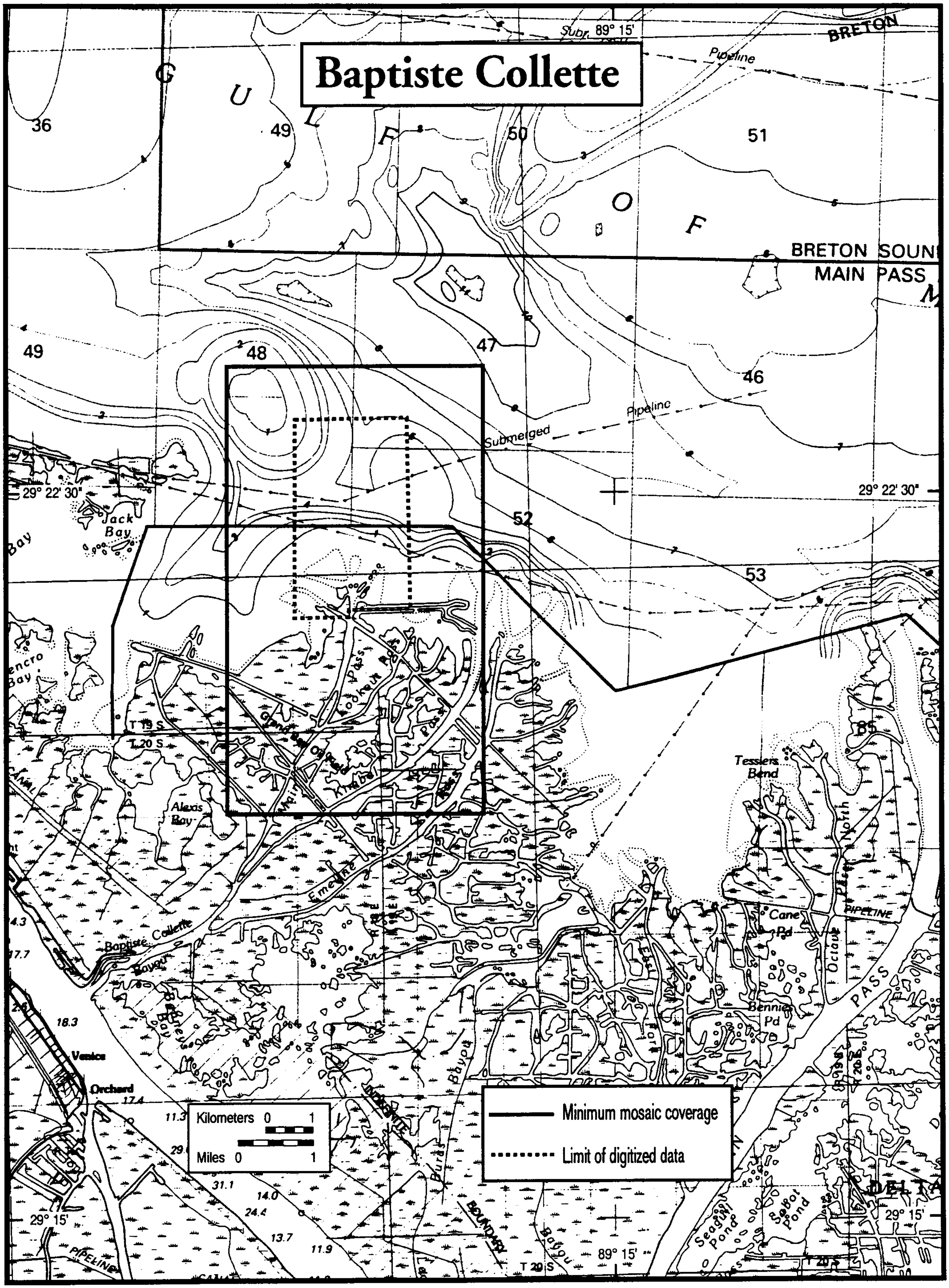

MRGO - Inside
Minimum mosaic coverage
Limit of digitized data
Kilometers 0 1
Miles 0 1
89° 52' 30"
89° 45'
30° 00'
29° 52' 30"
Lake Marseille
Lake Michoud
Blind Lagoon
Bayou Sauvage
ORLEANS
SEABOARD
LEVEE
MICHOUD
CANAL
INTRACOASTAL
SYSTEM
PASS
Alligator
ORLEANS PARISH
ST BERNARD PARISH
Bayou Bienvenue
Bayou Mercier
L A K E
T 12 S
T 13 S
SPOIL
PIPELINE
Shell Beach
Mosquito Bayou
Flagpole Bayou
Bayou Chaperon
Garden
St Bernard Grove
Frances Place
Violet
River Bend
Poydras
St Bernard
Kenilworth
Bayou Terre aux Boeufs
Verret
New
AREA
Canal
46
39

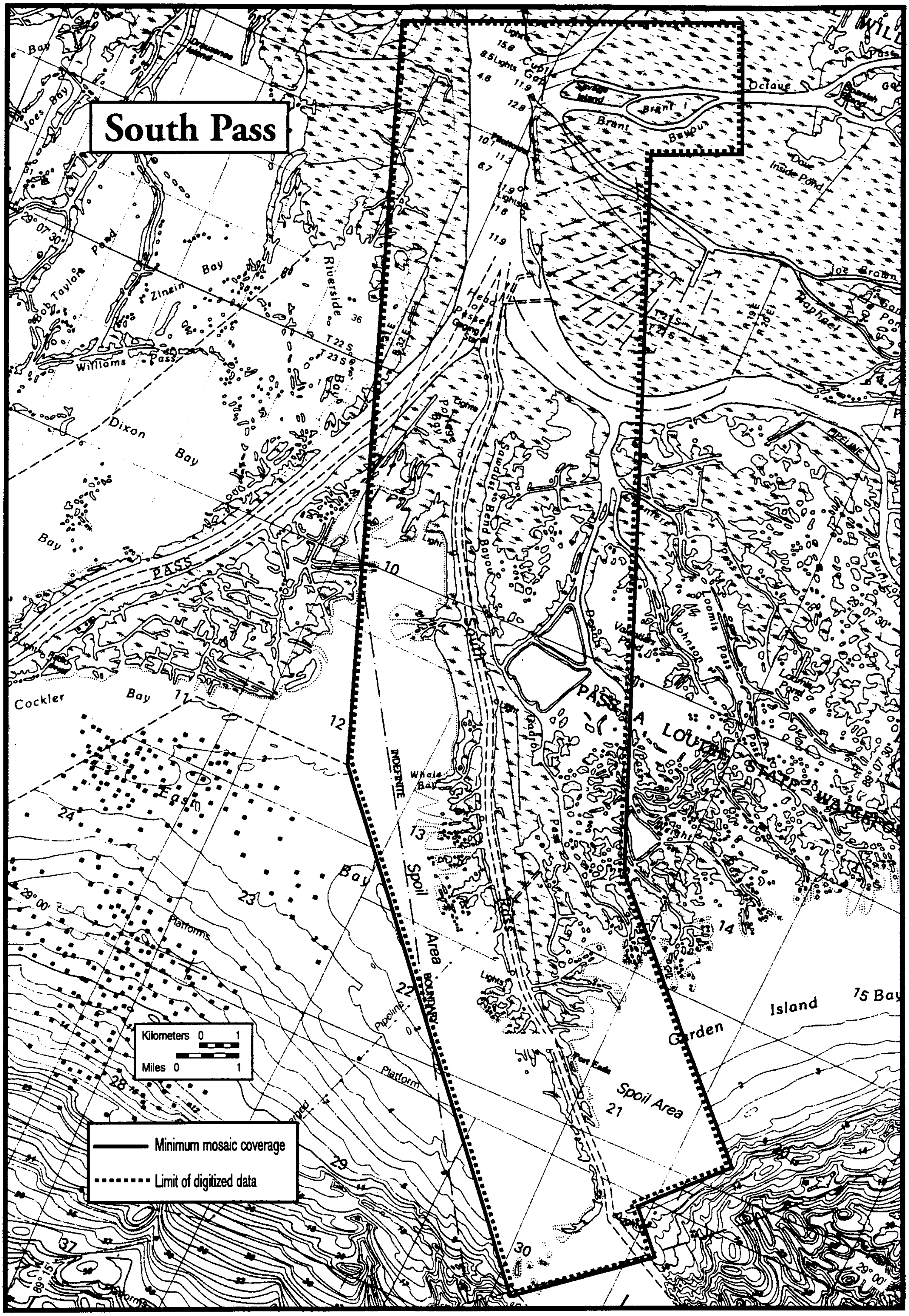


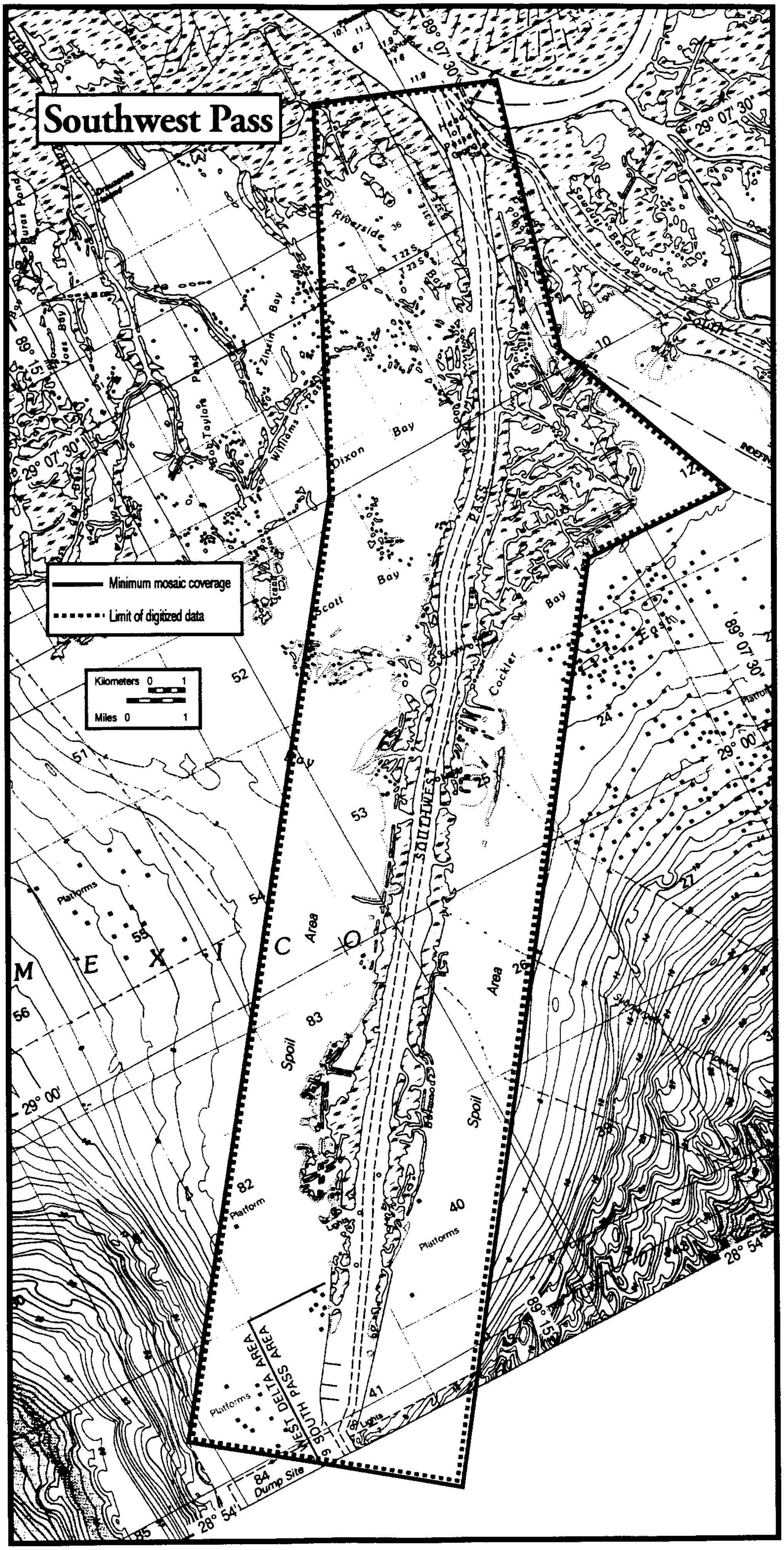
MRGO - Jetties
Minimum mosaic coverage
Limit of digitized data
Kilometers 0 1
Miles 0 1
SPOIL
AREA
INADEQUATE DATA
Lake Coquille
Lake of Second
Lake Machias
Lake Fortuna
Lake Athanasio
Lake Eloi
Long Lagoon
Halfmoon Lake
ST. BERNARD PARISH
PLAQUEMINES PARISH
BRETON

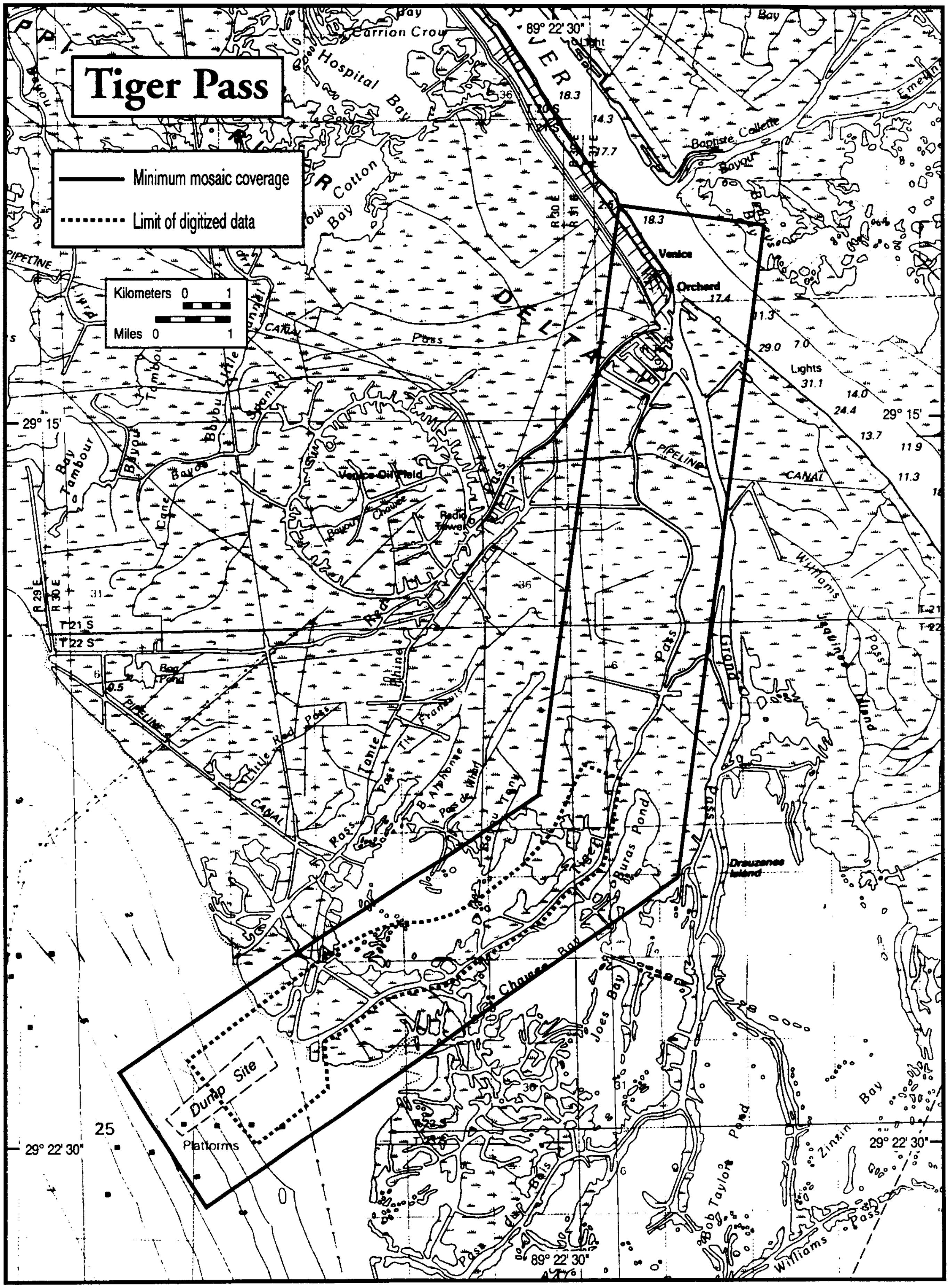

MRGO - Breton Island
Minimum mosaic coverage
Limit of digitized data
Kilometers 0 1
Miles 0 1
89° 15'
89° 07' 30"
29° 30'
29° 22' 30"
SPOIL AREA
MISSISSIPPI RIVER
Spoil
Breton Islands
BRETON NATIONAL WILDLIFE REFUGE
North Point
Radio Tower
West Point
Pipeline
Platforms
Platform
BRETON SOUND AREA
MAIN PASS AREA
O F M E X I C O
Submerged
35
36
37
38
43
44
45
46
51
52
53
54
56
85

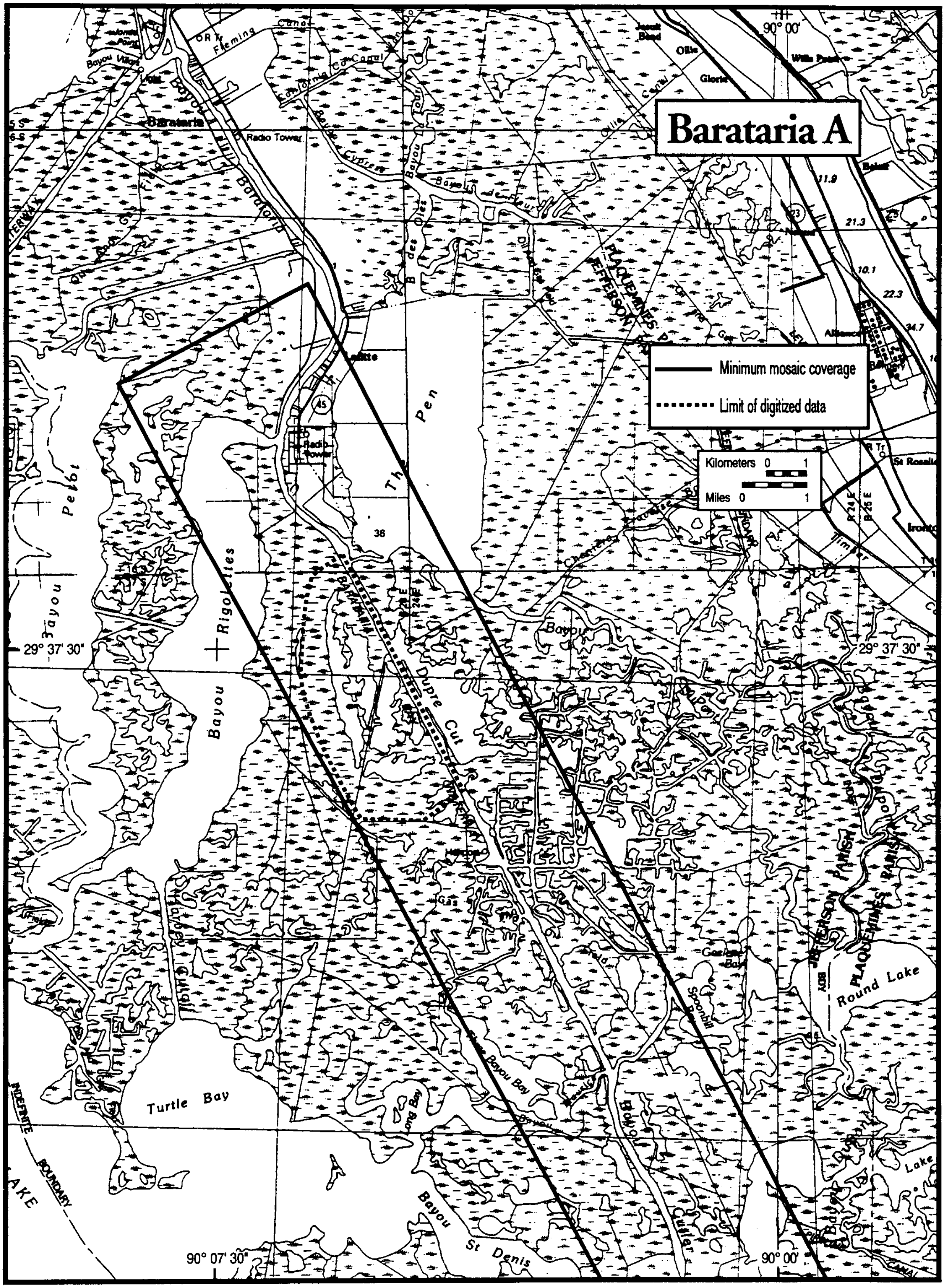
Baptiste Collette

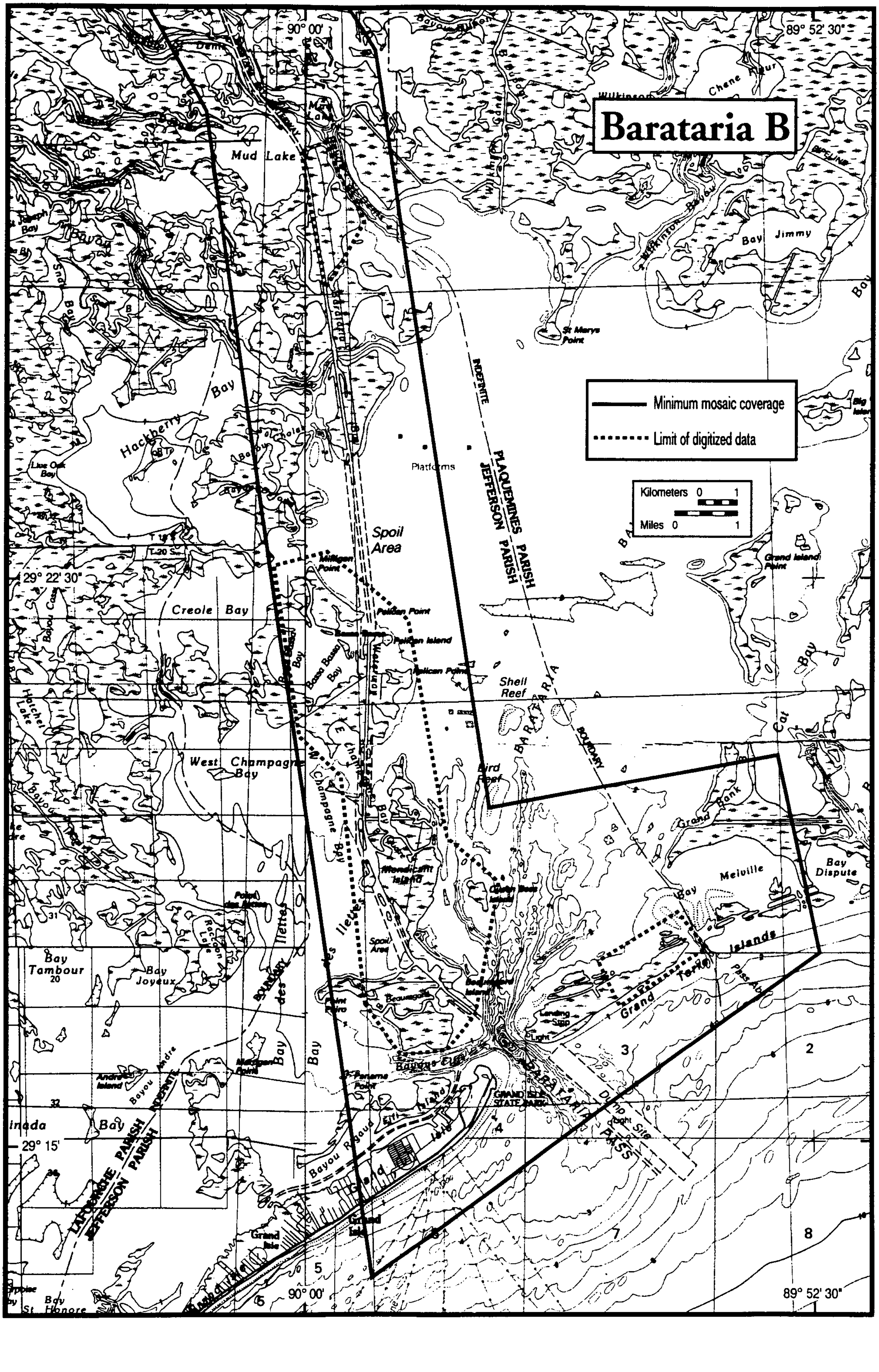


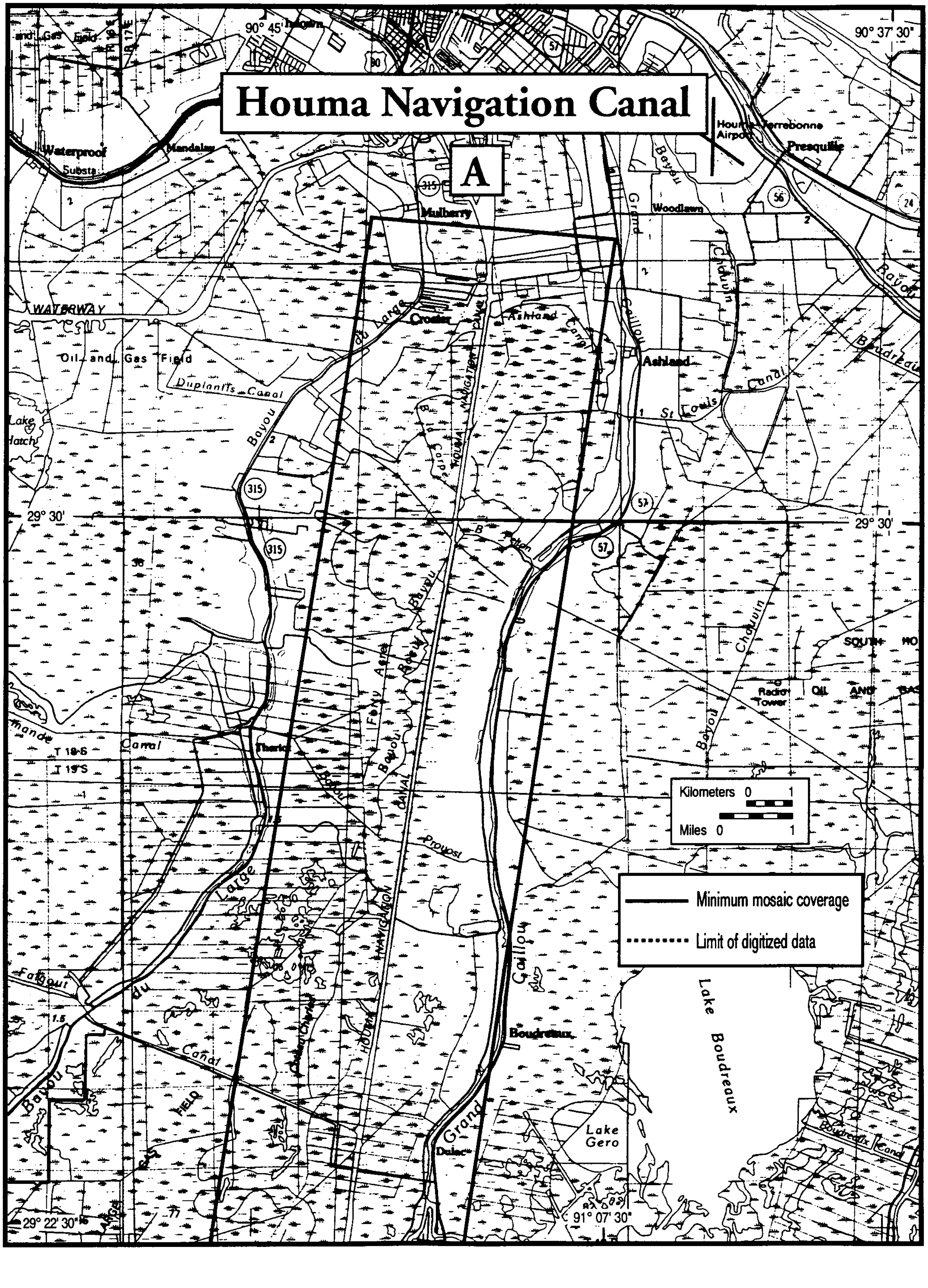

South Pass
Kilometers 0 1
Miles 0 1
Minimum mosaic coverage
Limit of digitized data
Joes Bay
Bob Taylors Pond
Zinzin Bay
Riverside Bay
Williams Pass
Dixon Bay
Bay
PASS
Cockler Bay
East Bay
Platforms
Pipeline
Platform
Spoil Area
INDEFINITE BOUNDARY
Whale Bay
South Pass
Garden Island Bay
Spoil Area
Port Eads
Octave
Brant
Brant Bayous
Cubits Gap
Inside Pond
Joe Brown
Raphael
PIPELINE
Johnson Pass
Loomis Pass
Pedro
PASS A LOUTRE STATE WATERFOWL
Dennis Pass
Valentine Pond
29° 07' 30"
29° 00'
89° 07' 30"
T 22 S
T 23 S

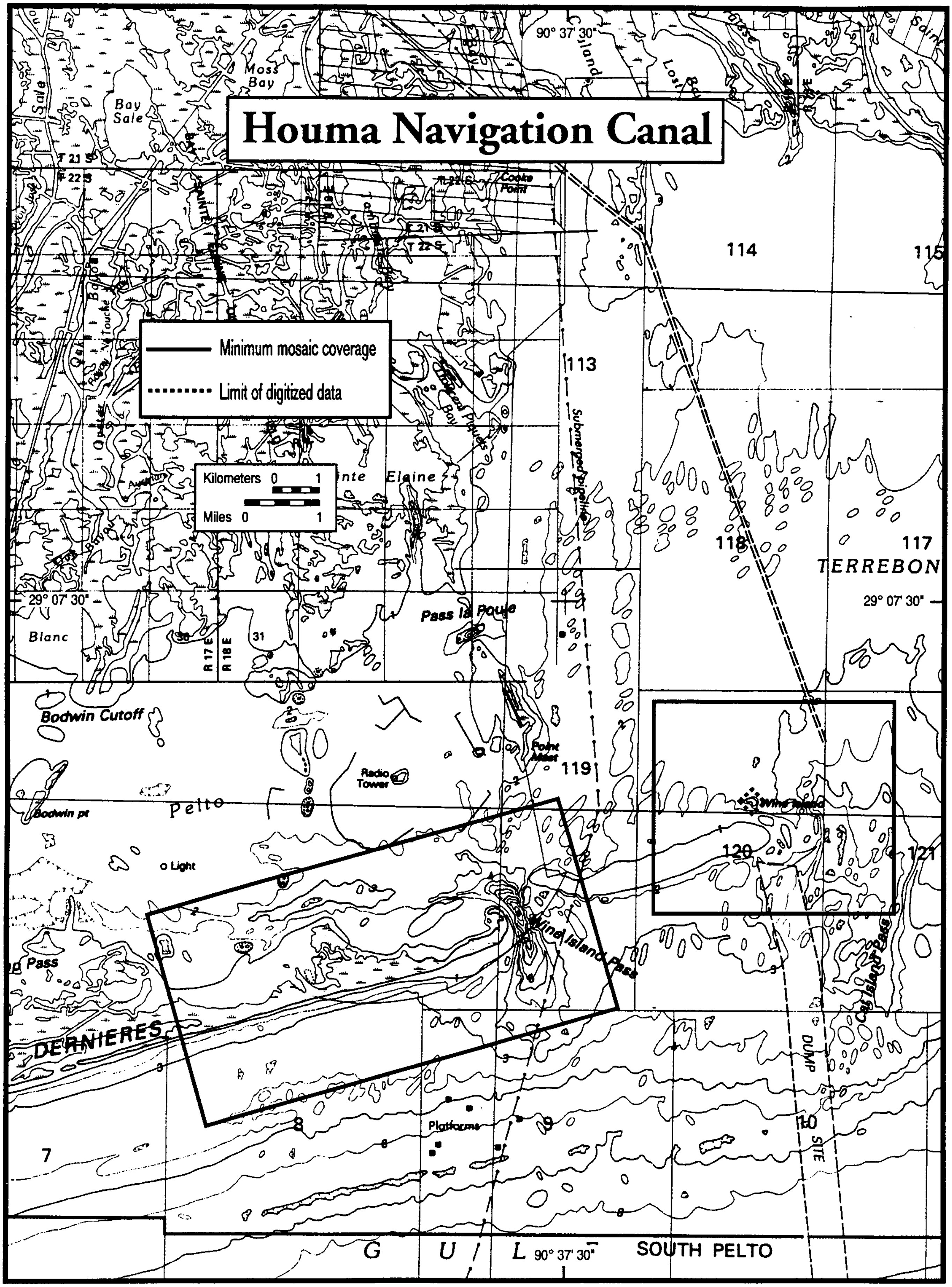

Southwest Pass
Minimum mosaic coverage
Limit of digitized data
Kilometers 0 1
Miles 0 1
Riverside
Bay
Dixon Bay
Scott Bay
Cockler Bay
SOUTHWEST PASS
Spoil Area
MEXICO
Platforms
Platform
WEST DELTA AREA
SOUTH PASS AREA
Dump Site
Southeast Bend Bayou
29° 07' 30"
29° 00'
28° 54'
89° 15'
89° 07' 30"


Tiger Pass
Minimum mosaic coverage
Limit of digitized data
Kilometers 0 1
Miles 0 1
Carrion Crow
Hospital Bay
Cotton Bay
Baptiste Collette Bayou
Venice
Orchard
Lights
PIPELINE
CANAL
Pass
Venice Oil Field
Radio Tower
Bayou Tambour
Bay Tambour
Cane Bayou
T 21 S
T 22 S
R 29 E
R 30 E
29° 15'
89° 22' 30"
29° 22' 30"
Williams
Jacquine Pass
Drouzenes Island
Buras Pond
Joes Bay
Zinzin Bay
Bob Taylor Pond
Williams Pass
Dump Site
Platforms
25

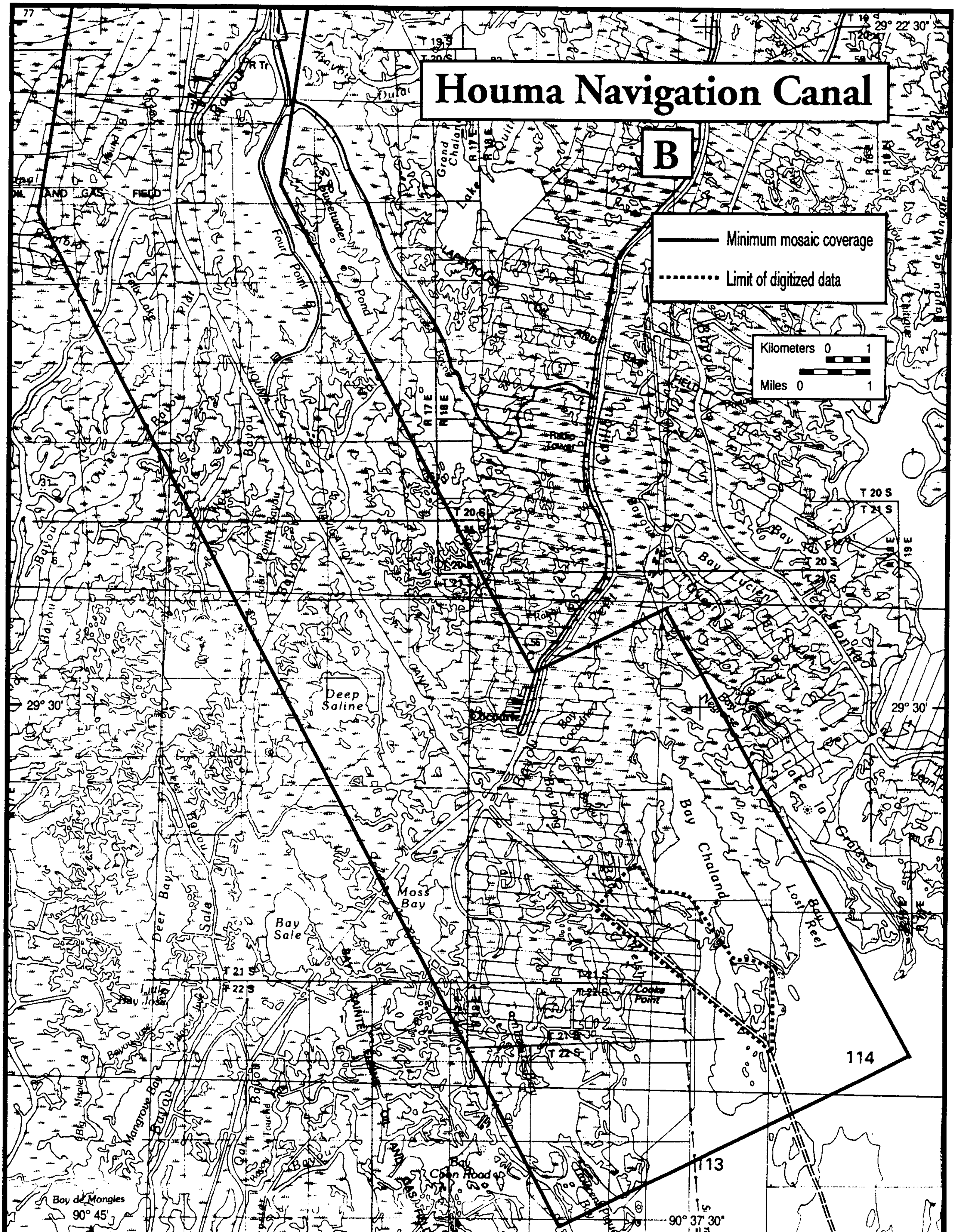

Barataria A
Minimum mosaic coverage
Limit of digitized data
Kilometers 0 1
Miles 0 1
90° 00'
29° 37' 30"
29° 37' 30"
90° 07' 30"
90° 00'
Barataria
Radio Tower
Lafitte
The Pen
Bayou Rigolettes
Bayou Perot
Dupre Cut
Turtle Bay
Bayou St Denis
Round Lake
Spoonbill Bay
Long Bay
JEFFERSON PARISH
PLAQUEMINES PARISH
Cutler
Alliance
Bay

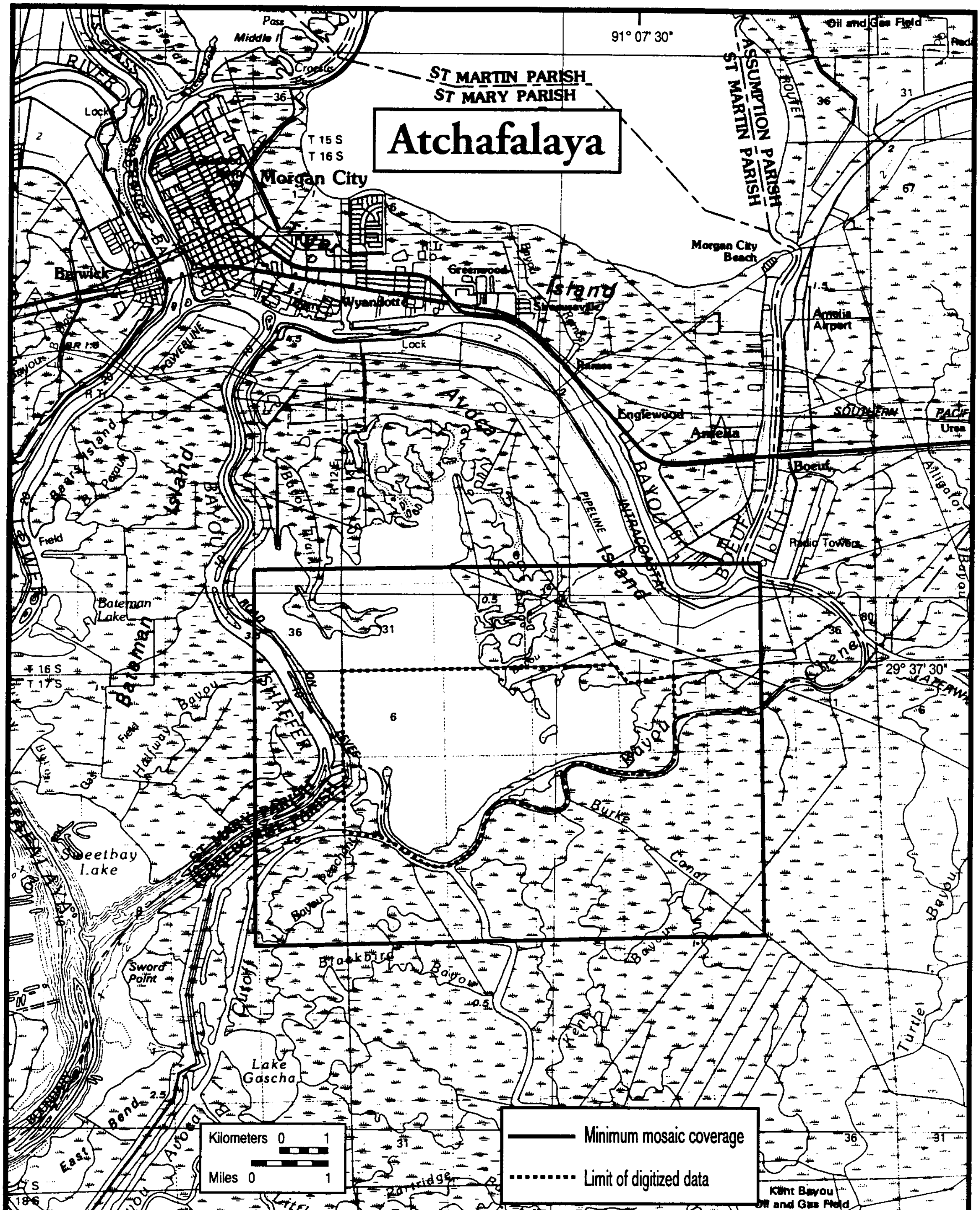

Barataria B
Minimum mosaic coverage
Limit of digitized data
Kilometers 0 1
Miles 0 1
90° 00'
89° 52' 30"
29° 22' 30"
29° 15'
Mud Lake
Hackberry Bay
Creole Bay
West Champagne Bay
Bay Tambour
Bay Joyeux
Bay Jimmy
Bay Melville
Bay Dispute
Spoil Area
Platforms
Shell Reef
Bird Reef
Grand Terre Islands
Grand Isle
GRAND ISLE STATE PARK
PLAQUEMINES PARISH
JEFFERSON PARISH
LAFOURCHE PARISH
BARATARIA PASS
Grand Bank
Cat Bay
St Marys Point
Pelican Point
Pelican Island
Milligen Point
Bay St Honore

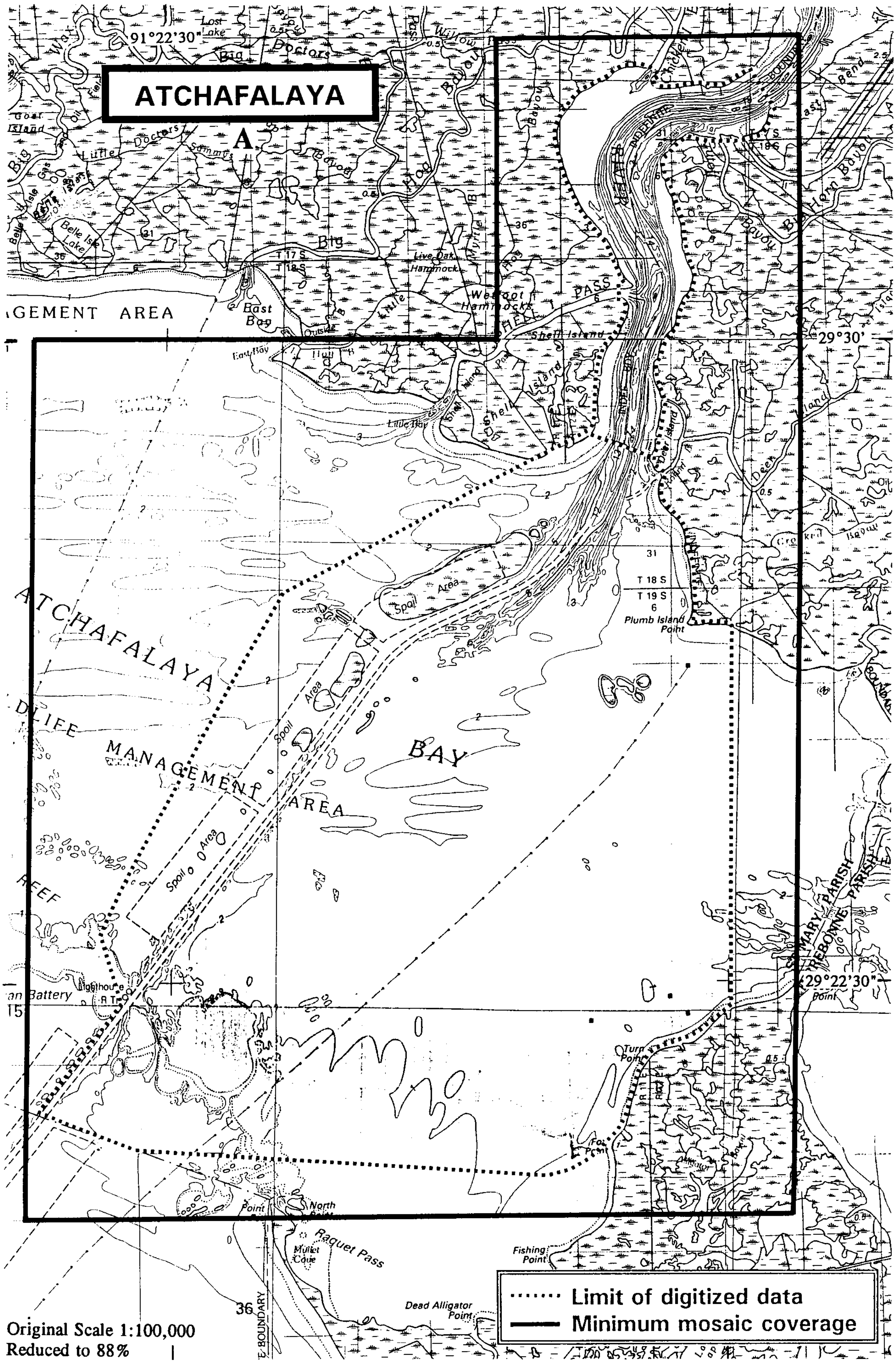

Houma Navigation Canal
A
Kilometers 0 1
Miles 0 1
Minimum mosaic coverage
Limit of digitized data
Mulberry
Crozier
Ashland
Woodlawn
Presquille
Waterproof
Mandalay
Theriot
Boudreaux
Dulac
Lake Boudreaux
Lake Gero
Radio Tower
90° 45'
90° 37' 30"
29° 30'
29° 22' 30"
91° 07' 30"



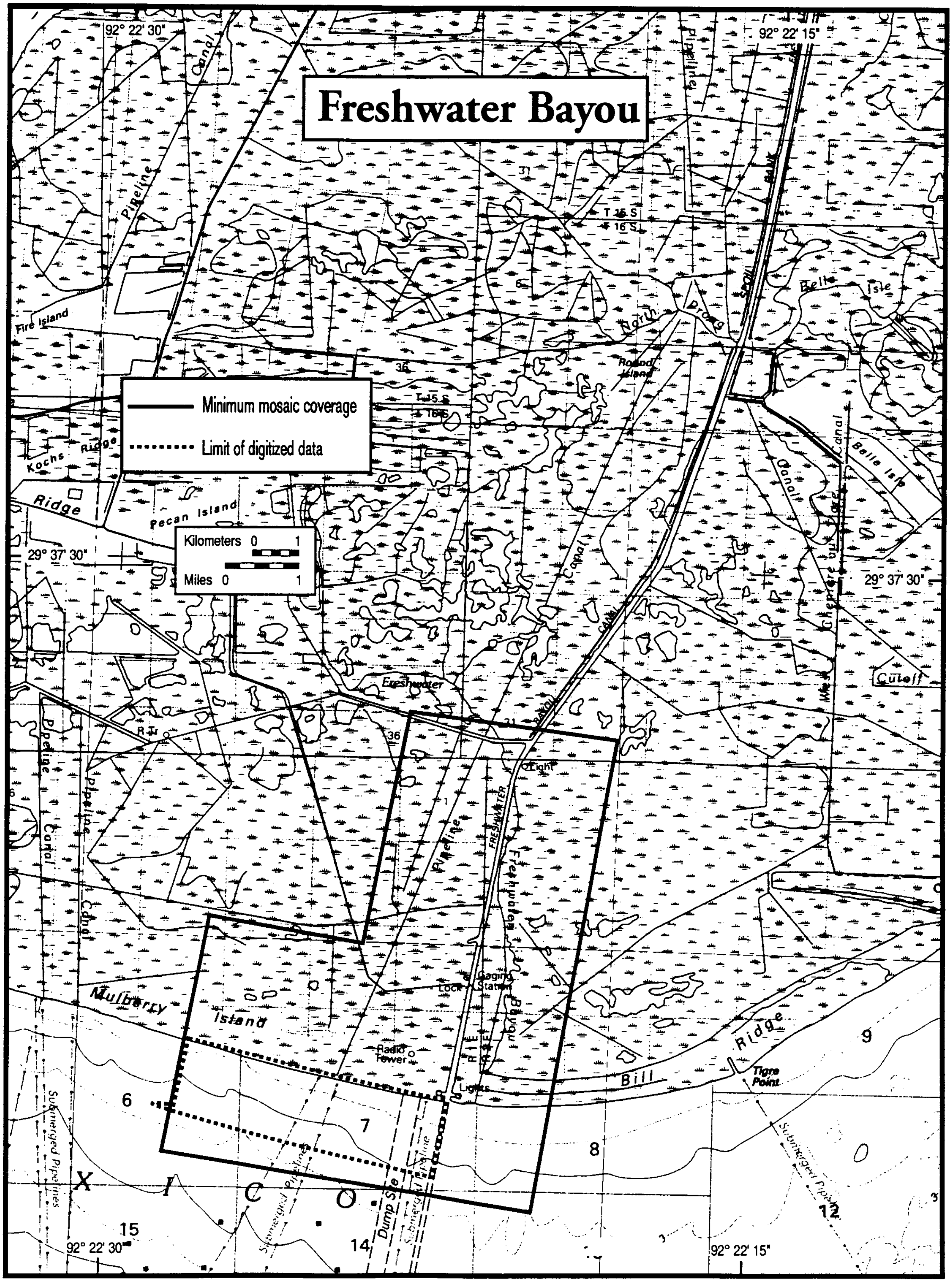
Houma Navigation Canal
Minimum mosaic coverage
Limit of digitized data
Kilometers 0 1
Miles 0 1
90° 37' 30"
Moss Bay
Bay Sale
Cooke Point
113
114
115
117
118
119
120
121
TERREBON
29° 07' 30"
Pass la Poule
Blanc
Bodwin Cutoff
Bodwin pt
Pelto
Radio Tower
Light
Point Mast
Wine Island
Wine Island Pass
Cat Island Pass
DERNIERES
Platforms
DUMP SITE
7
8
9
10
G U L
SOUTH PELTO


Houma Navigation Canal
B
Minimum mosaic coverage
Limit of digitized data
Kilometers 0 1
Miles 0 1
29° 22' 30"
29° 30'
90° 45'
90° 37' 30"
114
113
Four Point
Deep Saline
Moss Bay
Bay Sale
Deer Bay
Bay Chaland
Lost Reel
Lake la Grasse
Bay de Mongles
Mangrove Bay
Cocodrie
Bay Cocodrie
T 20 S
T 21 S
T 22 S
R 17 E
R 18 E
R 19 E

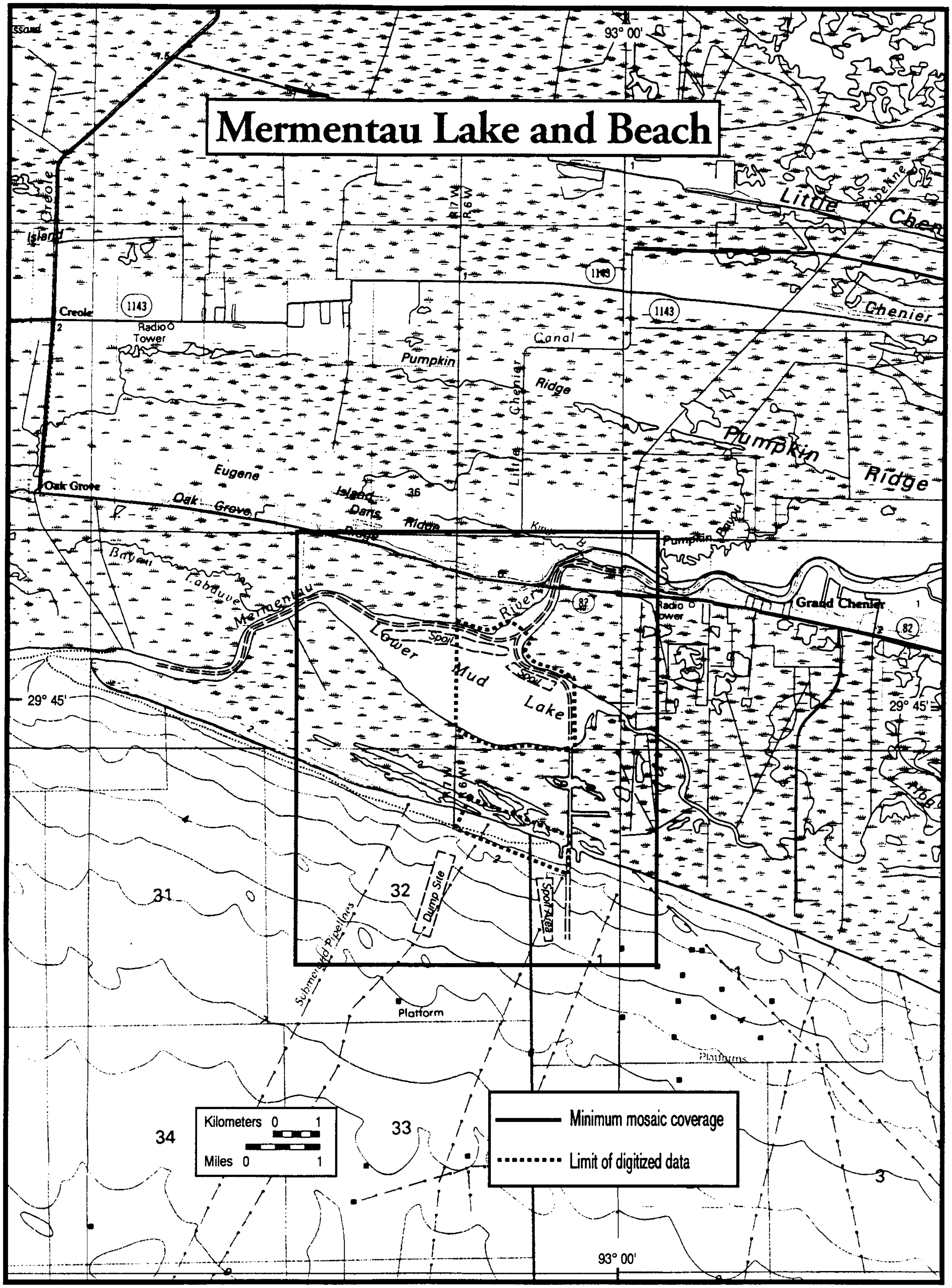

Atchafalaya
ST MARTIN PARISH
ST MARY PARISH
ASSUMPTION PARISH
ST MARTIN PARISH
91° 07' 30"
29° 37' 30"
Morgan City
Berwick
Wyandotte
Greenwood
Morgan City Beach
Amelia Airport
Amelia
Englewood
Boeuf
Radio Towers
Oil and Gas Field
T 15 S
T 16 S
T 17 S
Lock
Avoca
Island
Bateman Lake
Halfway Bayou
Sweetbay Lake
Sword Point
Lake Gascha
Blackbird Bayou
Burke Canal
Turtle Bayou
East Bend
Big Horn Bayou
Kent Bayou Oil and Gas Field
Kilometers 0 1
Miles 0 1
Minimum mosaic coverage
Limit of digitized data

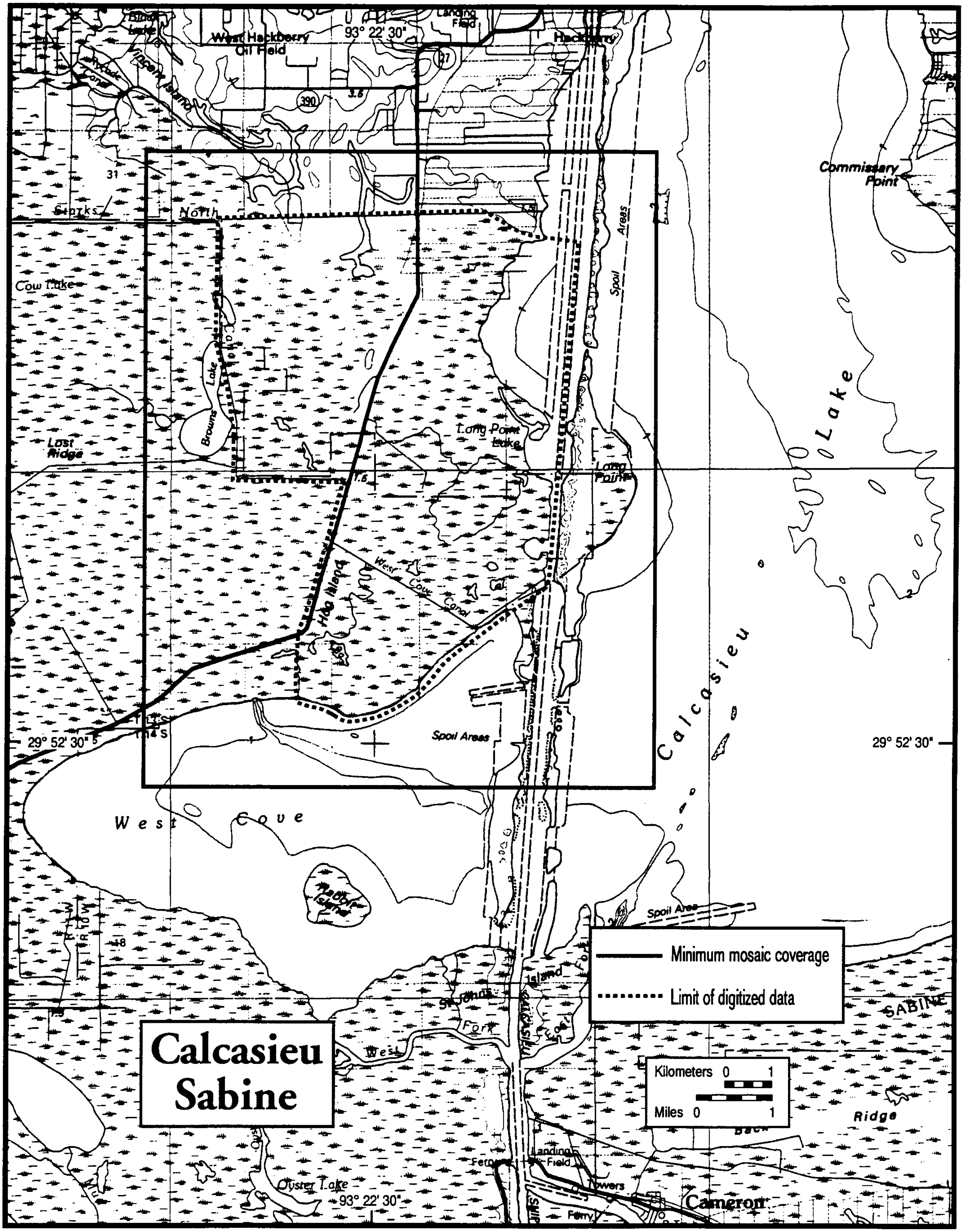


Original Scale 1:100,000
Reduced to 88%


Freshwater Bayou
Minimum mosaic coverage
Limit of digitized data
Kilometers 0 1
Miles 0 1
92° 22' 30"
92° 22' 15"
29° 37' 30"
Pipeline
Canal
Fire Island
Kochs Ridge
Ridge
Pecan Island
North Prong
Round Island
Belle Isle
Canal
Cheniere au Tigre
Cutoff
Freshwater
Freshwater Bayou
Light
Gaging Station
Lock
Radio Tower
Lights
Mulberry Island
Bill Ridge
Tigre Point
Submerged Pipelines
Submerged Pipeline
Dump Site
T 15 S
T 16 S
6
7
8
9
12
14
15

Mermentau Lake and Beach




Calcasieu
Sabine
Minimum mosaic coverage
Limit of digitized data
Kilometers 0 1
Miles 0 1
West Hackberry
Oil Field
Hackberry
93° 22' 30"
29° 52' 30"
Commissary
Point
Cow Lake
Lost
Ridge
Browns Lake
Long Point
Lake
Long
Point
Hog Island
West Cove Canal
Spoil Areas
Calcasieu Lake
West Cove
Rabbit
Island
Spoil Area
St. Johns
Island
West
Fork
Oyster Lake
Ridge
Back
SABINE
Landing
Field
Ferry
Towers
Cameron