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OCTOBER 2000

PHASE I MARINE ARCHEOLOGICAL REMOTE SENSING SURVEY OF SEGMENTS ALONG THE SOUTHWEST PASS OF THE MISSISSIPPI RIVER, PLAQUEMINES PARISH, LOUISIANA

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Final Report

R. Christopher Goodwin, Ph.D.
Principal Investigator

with

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Ralph Draughon, Jr., Ph.D., and Martha R. Willliams, M.A., M.Ed.

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This report presents the results of a Phase I Marine Archeological Remote Sensing Survey of segments along the Southwest Pass of the Mississippi River, in Plaquemines Parish, Louisiana. These investigations were conducted in June 1999, by R. Christopher Goodwin & Associates, Inc. on behalf of the U.S. Army Corps of Engineers, New Orleans District (USACE-NOD). The study was undertaken to assist the USACE-NOD to satisfy its responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended, prior to undertaking proposed repair and maintenance activities along segments of the Southwest Pass. All aspects of the investigations were completed in accordance with the Scope-of-Work, and the Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation* (Federal Register 48, No 190, 1983). The study area for this project consisted of three alternating blocks on the right and left descending banks of the river. Block One was located at river mile (RM) 14.4 – 15.2; Block Two encompassed the stretch between RM 11.3 and RM 12.5; and Block Three was located between RM 4.4 and RM 5.0.

The objectives of this study were to identify specific targets that might represent significant submerged cultural resources within the project area, and provide the USACE-NOD with management recommendations for such resources. These objectives were met with a research design that combined background archival investigations and a marine archeological remote sensing survey.

Background research and archival investigations indicated a moderate potential for encountering submerged historic cultural resources within the project reported within the area. A review of Louisiana archeological site files and relevant research reports documented only three historical building sites within a mile (1.6 km) radius of the project area; however, no sites are within the boundaries of the project area. A review of Louisiana's shipwreck database, the National Oceanic and Atmospheric Administration's (NOAA) Automated Wreck and Obstruction Information System (AWOIS) and several secondary sources yielded 17 wrecking incidents throughout Plaquemines Parish. During the course of the survey, none of these wrecks were found to be located in the Southwest Pass study area.

Archeological investigations consisted of a controlled marine remote sensing survey of approximately 44 linear miles (70.81 km) of river bank and bottom. This survey utilized a differential global positioning system (DGPS); a digital recording side scan sonar; a recording proton precession magnetometer; and, hydrographic navigational computer software. The survey was conducted with a lane spacing of 50 ft (15.24 m) to ensure the greatest detail in coverage. The survey techniques ensured that any abandoned or destroyed historic vessels in the survey area would be detected.

The marine remote sensing survey registered a total of 128 individual magnetic anomalies. Of these anomalies, thirty-five (35) disturbances comprise eleven (11) clusters or targets, none of which had corresponding acoustic anomalies. Analysis of the archeological data collected during the study yielded no evidence to suggest that potentially significant cultural resources were present within the project area. All targets could be interpreted as concentrations of modern ferrous debris, as anomalies related to extant structures such as wing dikes, or as pipeline and cable crossings.

Because no significant historic resources were identified in the project area, no additional investigations are warranted or recommended for the proposed construction areas along the Southwest Pass of the Mississippi River.

ABSTRACT

This report presents the results of a Phase I Marine Archeological Remote Sensing Survey of segments along the Southwest Pass of the Mississippi River, in Plaquemines Parish, Louisiana. These investigations were conducted in June 1999, by R. Christopher Goodwin & Associates, Inc. on behalf of the U.S. Army Corps of Engineers, New Orleans District (USACE-NOD). The study was undertaken to assist the USACE-NOD to satisfy its responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended, prior to undertaking proposed repair and maintenance activities along segments of the Southwest Pass. All aspects of the investigations were completed in accordance with the Scope-of-Work, and the Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation* (Federal Register 48, No 190, 1983). The study area for this project consisted of three alternating blocks on the right and left descending banks of the river. Block One was located at river mile (RM) 14.4 – 15.2; Block Two encompassed the stretch between RM 11.3 and RM 12.5; and Block Three was located between RM 4.4 and RM 5.0.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

This report presents the results of the Phase I Marine Archeological Remote Sensing Survey of segments along the Southwest Pass of the Mississippi River, in Plaquemines Parish, Louisiana (Figure 1). The investigations were conducted from June 20 – 27, 1999, by R. Christopher Goodwin & Associates, Inc. on behalf of the U.S. Army Corps of Engineers, New Orleans District (USACE-NOD) in support of the proposed repair and maintenance activities along segments of the Southwest Pass. The proposed project will require the temporary stockpiling of material dredged from the navigation channel on three sites between the channel and adjacent foreshore dikes, and additional excavation to provide barge access.

In keeping with the New Orleans District's mission to preserve, document, and protect significant cultural resources, a magnetic and acoustic remote sensing survey was undertaken to locate potential archeological remains and in so doing, to assist the USACE-NOD in satisfying its responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended. All aspects of the investigations were completed in full compliance with the Scope-of-Work; with 36 CFR 800, "Protection of Historic Properties;" with the Abandoned Shipwreck Act of 1987 (43 U.S. C. 2101 – 2106); with Abandoned Shipwreck Guidelines, National Park Service; with National Register Bulletins 14, 16, and 20; with 36CFR 66; and with the Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation* (Federal Register 48, No 190, 1983).

The survey area for this project consisted of three blocks representing a total of approximately 509 acres (1562 ft [476.1 m] x 14,194 ft [4326.38 m], located alternately on the right and left descending banks of the river (Figure 2). Block One is located between river miles (RM) 14.4 – 15.2, Block Two is located from RM 11.3 – RM 12.5, and Block Three extends from RM 4.4 to RM 5.0. In total, approximately 44 linear miles of riverbank and bottom were surveyed.

Research Objectives and Design

The objectives of this study were to identify all submerged and visible watercraft and other maritime related cultural resources in the Southwest Pass project area; whenever possible, to assess the National Register of Historic Places (NRHP) eligibility of identified resources, applying the Criteria for Evaluation (36 CFR 60.4 [a-d]; and, to provide the USACE-NOD with management recommendations for such resources. These objectives were addressed through a combination of archival research and field survey. The background study and history of the project area were researched through examination of archeological site files for the State of Louisiana, local historical literature files, previous cultural resources investigations conducted in the vicinity of the project area, historic maps, relevant primary map and microfilm records, and secondary literature.

Field survey of the project area was conducted from the 24-ft research vessel *Coli,* leased from the Louisiana Universities Marine Consortium (LUMCON). The project area was divided into three survey blocks, and data were collected within each block along parallel track lines spaced at 50-ft intervals. The equipment array used for the Southwest Pass survey included a DGPS, a proton precession marine magnetometer, side scan sonar, and a fathometer. Data were collected and correlated by a laptop computer using hydrographic survey software. Data were inventoried, post-processed, and analyzed to identify specific targets within the project area that might represent significant submerged cultural resources.

R. Christopher Goodwin, Ph.D., served as Principal Investigator for this project. Jean B. Pelletier, M.A., who served as Project Manager, directed all aspects of data collection and its subsequent analysis, with the assistance of Nautical Archeologist David W. Trubey, B.A. Anthony Randolph, B.A., served as Remote Sensing Specialist, and Captain Samuel LeBoeuf operated the survey vessel.

Organization of the Report

This report develops the natural and historical contexts of the project area as the basis for analysis and interpretation. The geological and prehistoric settings of the project area are discussed in Chapter II. Chapter III places the project area within its historic context, and develops a historic-chronological framework for retrodiction and subsequent evaluation of classes of submerged historic resources, particularly shipwrecks. Chapter IV reviews research methods and sources used during archival and background investigations as well as instrumentation and methods employed during field survey and analysis. Chapter V examines the results of the survey, and presents analyses of the remote sensing data. A summary of the study and management recommendations is provided in Chapter VI.

Appendix I contains the original Scope-of-Work for this project. Appendix II contains the curriculum vitae for key project personnel.

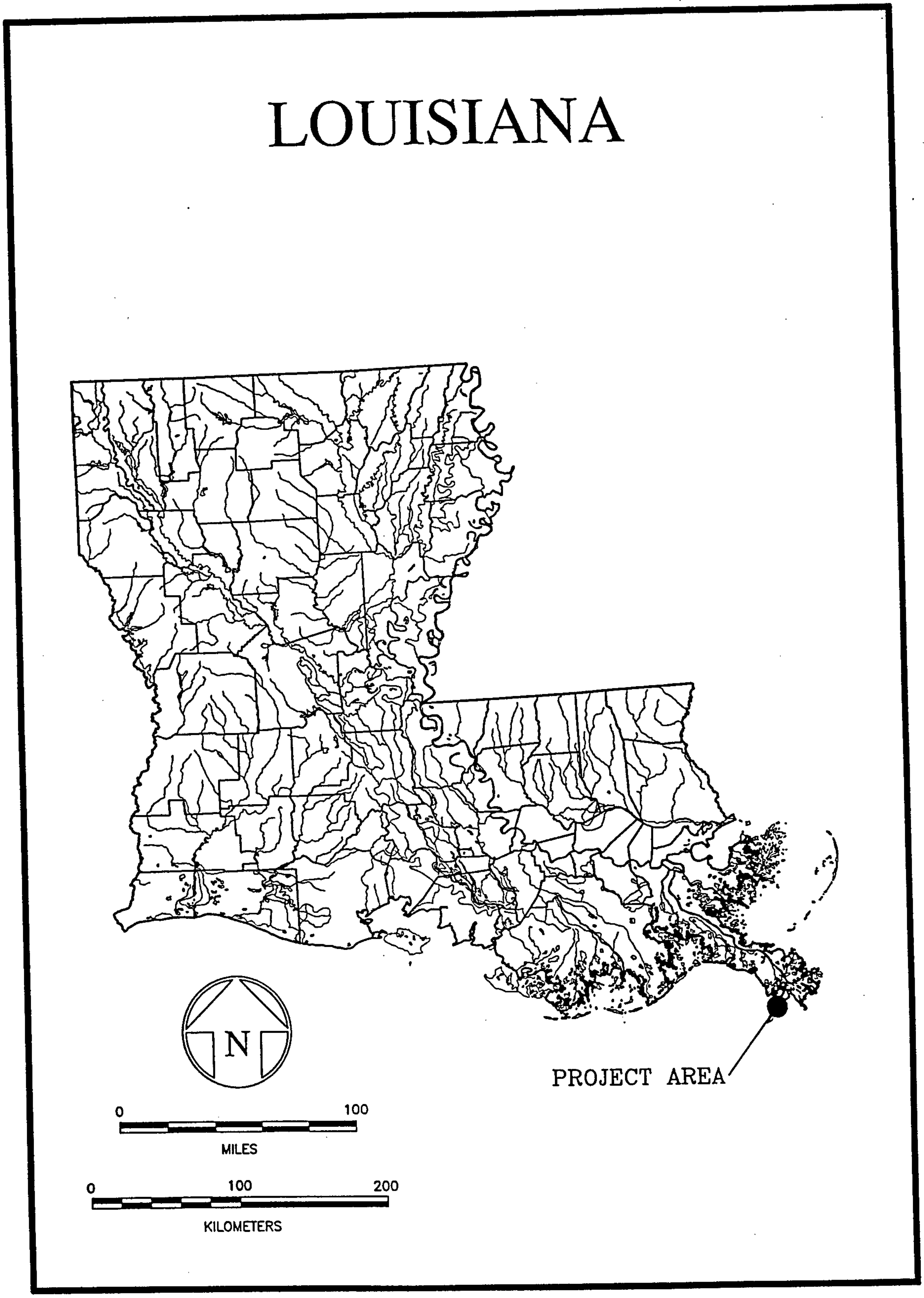


Figure 1. Southwest Pass Project Area, Mississippi River, Plaquemines Parish, Louisiana

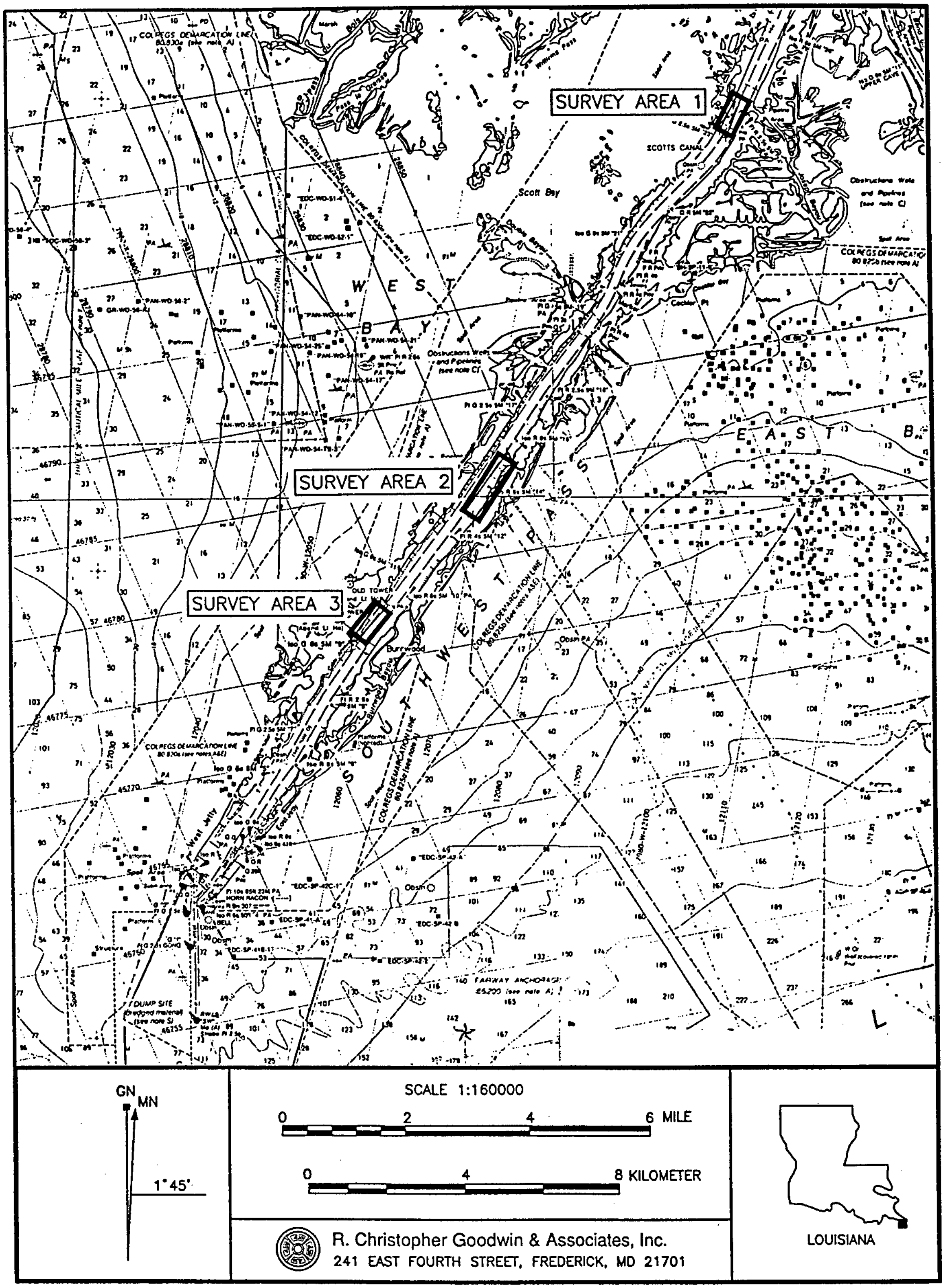


Figure 2. Location map of Southwest Pass showing Survey Areas 1-3

CHAPTER II

NATURAL SETTING

Purpose and Scope

This portion of the report focuses on the geologic setting and geomorphic processes of the modern, active (Balize) delta of the Mississippi River as they relate to the development of Southwest Pass, one of the principal distributaries of the river. It provides insights into aspects of the river's physiography, sedimentation, and stratigraphy that should be helpful in understanding the natural history context of potential cultural resources.

The unique economic and social importance of the Mississippi River delta has prompted a considerable number of detailed investigations related to its origin and physical processes. These studies have produced an appreciable body of published literature that forms the basis of this chapter. No geomorphological field investigations were conducted as part of this effort, and no new data were produced. However, the chapter summarizes the most current theories about the geomorphology and geoarchaeology of the region.

Geographic and Physiographic Settings

The active Mississippi River delta, where the stream discharges into the Gulf of Mexico, lies at the extreme southeastern tip of the Mississippi River delta plain of southeastern Louisiana. It is defined by the extent of those delta distributaries that have been active in historic times. These lie southeast of the town of Venice in Plaquemines Parish, and include six channels (passes) (Figure 3). The three farthest upstream passes--Baptiste Collette, Grand-Tiger, and Main--are minor and are largely inactive as far as delta growth is concerned. The larger and active ones are farthest downstream; they include the Southwest and South Passes and the Pass a Loutre, with several of its branches. These three major passes bifurcate at a point known as Head of Passes (HOP) just downstream from the community of Pilottown, LA. The pattern of bifurcation is the origin of the term "birdfoot delta" that often is used to describe the modern delta and to differentiate it from other types of delta plains (Fisk 1961). Navigation into and out of the mouth of the Mississippi River has been impeded seriously by bars at the mouths of the major passes. This problem has required constant attention, study, and expensive engineering works and activities for many decades.

Up to and including most of the nineteenth century, the Grand-Tiger and Main Pass complexes were the favored navigation channels, but in the twentieth century, Southwest Pass has assumed that role as a result of jetty construction and frequent dredging. Prior to jetty construction between 1902 and 1908 (Russell 1936), Southwest Pass was about 28.9 km (18 mi) long (below HOP). At the present time, it measures about 32.5 km (20.2 mi) long. The jetties consist of inner bulkheads and outer stone jetties on both sides of the pass that generally extend from below Mile 15 (below HOP) to its mouth (Mississippi River Commission 1976). In addition, short lateral spur dikes are located at several-hundred-meter intervals within the pass for most of the distance below the HOP. These navigation improvements help to maintain a

12.2 x 243.8-m (40 x 800-ft) shipping channel between miles 0 and 18, and a 12.2 x 182.9-m (40 x 600-ft) channel from mile 18 to the entrance channel outside the jetties. The overall width of the pass between its banks actually averages between 341 and 402 m (1,120 and 1,320 ft), and there are some reaches where the natural depth approximates 18.3 m (60 ft). In contrast to shallow-water lobe distributaries, the channel has shown no tendency toward meandering or lateral migration. Point bar deposits, indicative of lateral accretion, are completely absent along the pass.

Although the literature generally states that the three major passes handle about 80 per cent of the total river discharge, division of the river's flow between passes has been variously estimated. Welder (1959) stated that Southwest Pass carries 29 per cent of the total discharge, but Benson and Boland (1986) held that it carries 31.5 per cent of the discharge. These differences are not considered significant or indicative of a trend; rather, they probably reflect differences in measurement techniques. To place these values in context, Coleman and Roberts (1991) measured the average discharge of the river at 12,063 cu m/sec (142,000 cu ft/sec), and its maximum discharge has been recorded at 56,637 cu m/sec (2,000,000 cu ft/sec). Coleman and Roberts (1991) also estimated the average annual sediment load of the river at approximately 31,752,000 kg (700,000,000 tons).

Physiographically, the Southwest Pass is a narrow neck of land generally less than 4.8 km (3.0 mi) wide that projects seaward from the main delta plain landmass (Figure 4). In its natural state, the pass originally was bordered by very narrow natural levee ridges only a few hundred meters wide and less than 1 m (3.0 ft) above sea level. The natural levees decreased slightly in width and height in a downstream direction and were bordered by areas of fresh to intermediate intratidal marsh. According to O'Neil (1949), the marshes were vegetated with alligator grass (*Alternanthera philoxeroides*) and water hyacinth (*Eichornia crassipes*) with lesser amounts of cattail (*Typha spp*.), roseau cane (*Phragmites communis*), fresh marsh three-cornered grass (*Scirpus americanus*), dog-tooth grass (*Panicum repens*), yellow cutgrass (*Zizaniopsis miliacea*), oyster grass (*Spartina alterniflora*), and duck potato (*Sagittaria latifolia*). Most of the natural levee ridges also supported marsh grasses, with stands of willow (*Salix nigra*), hackberry (*Celtis laevigata*), and cottonwood (*Populus deltoides*) only on the higher elevations. More recently, Chabreck and Linscombe (1978) characterized the marsh vegetation as including wiregrass (*Spartina patens*), deer pea (*Vigna repens*), bulltongue (*Sagittaria sp*.), wild millet (*Echinochioa walteri*), bullwhip (*Scirpus californicus*), and sawgrass (*Cladium jamaicense*). The more recent assemblage reflects an overall trend toward higher salinity, which may be indicative of the deterioration of the wetlands due to subsidence.

Most of the marshes along Southwest Pass are associated with two small crevasses that formed small lobes or splays. The larger of the two formed on the left descending bank near river mile 5 below HOP and is marked by Joseph Bayou (Russell 1936). The smaller of the two formed on the right descending bank near river mile 9 below HOP and is marked by Double Bayou. Joseph Bayou was described as 3.4-m (11 ft) deep, 30.5-m (100 ft) wide, and about 3.2 km (2 mi) long in 1897. It was closed by a dam (stone jetty) in 1906, and by 1936 it was only 3.0 m (10 ft) deep and 15.2 m (50 ft) wide.

At the present time, a large proportion of the "land" along Southwest Pass consists of areas where dredge spoil has been placed during hydraulic maintenance dredging operations. The pass area landscape is dominated by artificial structures such as a Coast Guard Station, a pilots' station, numerous navigation lights, and production platforms, tank farms, and piers and docks related to petroleum production. While the normal tidal range along Southwest Pass is only 39.6 cm (1.3 ft), the entire area is submerged during storm tides that accompany tropical storms and hurricanes. All structures must be able to withstand occasional inundation to a depth of several meters since there are no flood-control levees or floodwalls in

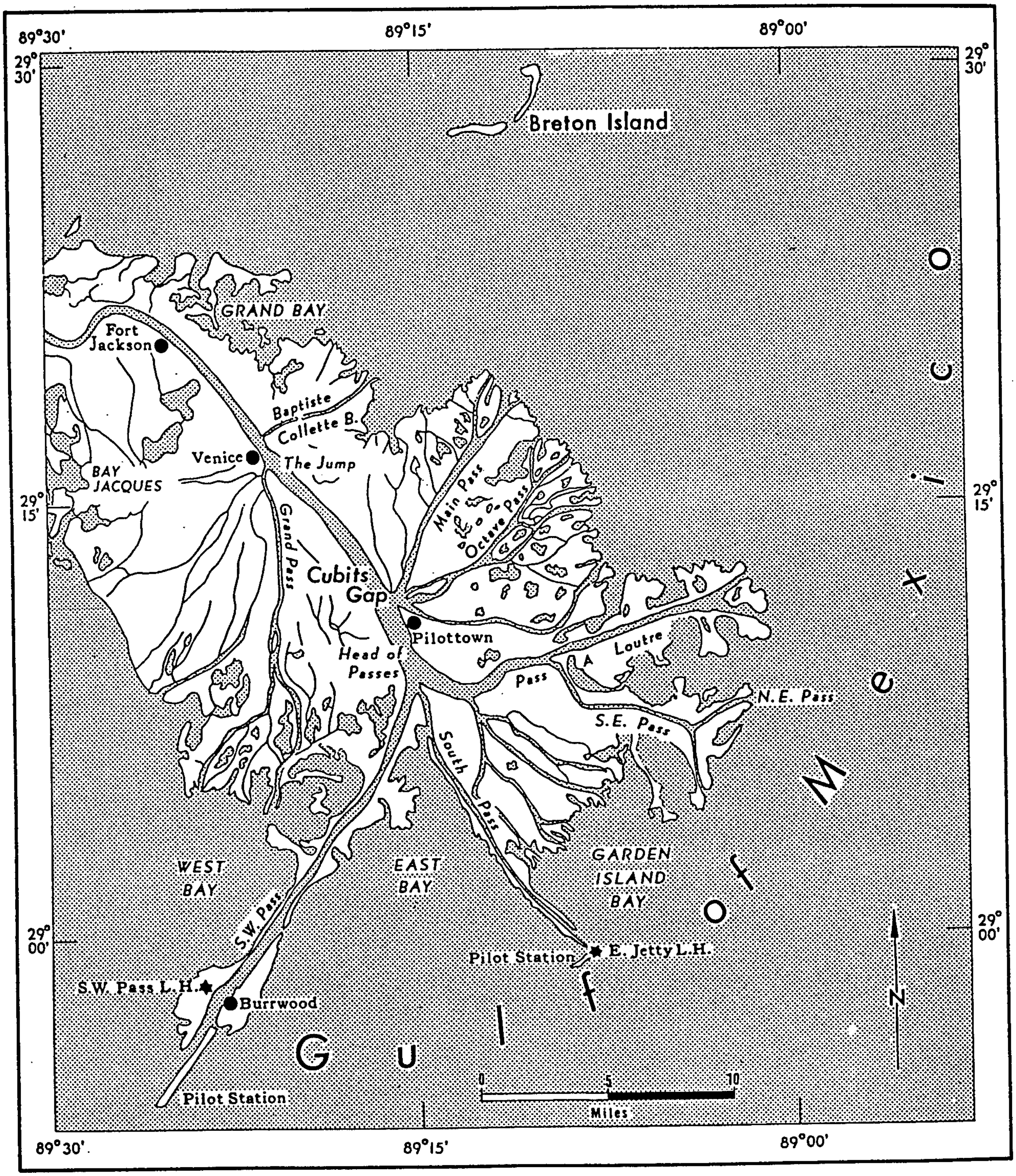


Figure 3. Lower (modern) delta of the Mississippi River. From Welder (1959)

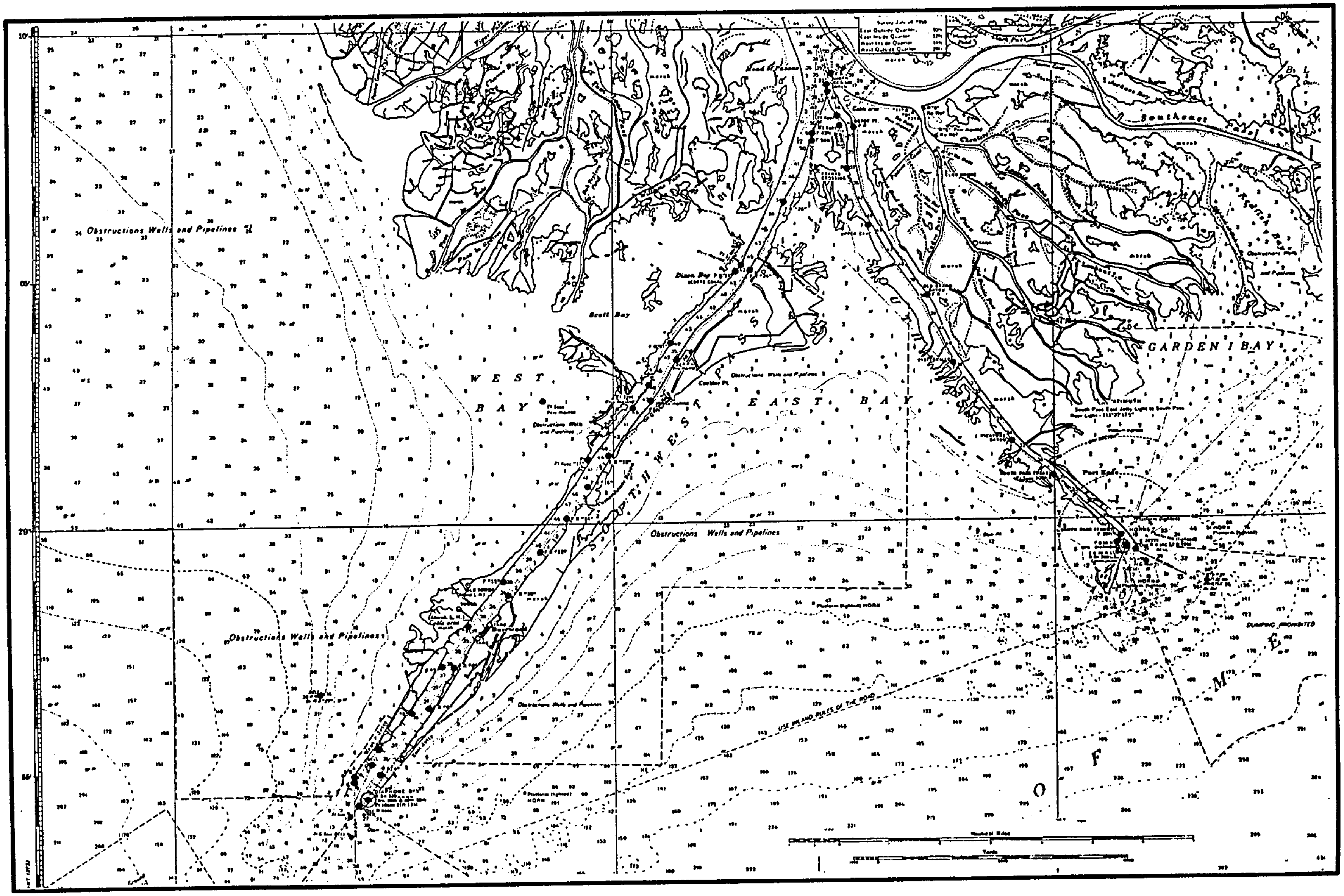


Figure 4. Extent of Southwest Pass as surveyed in 1959

this part of the delta. During severe hurricanes, wave heights of over 20 m (65 ft) have been recorded on offshore platforms in deep water off around the delta's perimeter, but these heights decreased to 3 to 5 m (10 to 15 ft) in water depths of 18 m (60 ft) or less (Bea and Audibert 1980). Storm surges of this magnitude could affect the immediate Southwest Pass area.

During times of high water due to upstream flooding on the river, the stage at HOP has reached an elevation of 1.58 m (5.2 ft) (NGVD) before the water surface slopes to Gulf level at the mouth of the pass. At such times, the entire delta is flooded much as it is during storm surges. At low water, all of Southwest Pass is affected by tides, and a salt wedge crosses the bar and moves upstream to a distance of 241 km (150 mi) or more.

In relation to subsequent discussions of the bar at the mouth of the pass, it is important to note that the end of the pass is essentially at the edge of the continental shelf. In fact, sediments discharged through the pass have created an extensive platform that has extended the shelf edge across the 240-ft (73-m) contour. Water depths of 250 ft (76 m) in the Gulf presently occur as close as 11.4 km (7.0 mi) to the tip of the jetties, and the 100 fathom (183 m) contour lies only 34.8 km (21.6 mi) offshore.

General Geologic Setting

Southwest Pass and the modern (Balize) delta are situated in the Gulf segment of the Coastal Plain Province of North America. The overall Mississippi delta plain is a broad, low-lying tract of alluvial land that is entirely of Holocene age and nowhere more than a few thousand years old. Geologically, it overlies the northern portion of the east-west trending Gulf Basin, a deep structural trough where the continental crust of Paleozoic basement rocks has been depressed and where mostly unconsolidated sediments of fluvial, estuarine, and marine origin have accumulated to a thickness of tens of thousands of meters. The northern flank of the Gulf Basin is characterized by prevailing subsidence, east-west trending zones of active faults, and the diapiric intrusion of salt to form piercement-type salt domes (Murray 1961).

More specifically, the Mississippi River delta plain is the surface manifestation of a relatively thin, seaward thickening prism of Holocene delta and shallow marine deposits that overlies Pleistocene deposits of similar origin and still older ones with depth (Kolb and VanLopik 1958). The Southwest Pass area lies where the prism begins to thicken sharply near the edge of the continental shelf. Fisk and McFarlan (1955) indicate that the top of Pleistocene-age deposits occurs at a depth of about 198 m (650 ft) near HOP but may be deeper (about 305 m [1,000 ft]) at the tip of the pass.

The prism of Holocene delta deposits represents a series of distinctive onlapping sedimentary cycles initiated by upstream diversions of river flow, each cycle being the correlate of a discrete delta complex. Each cycle involves sediments laid down in multiple environments ranging from fresh to saline water in a dynamic zone of interaction where the river emptied into the Gulf. The cumulative result of these multiple cycles has been a net buildup and seaward buildout of the delta plain. The Balize complex or birdfoot delta (also referred to as the Plaquemines-Modern complex) is the most recent of these complexes (Frazier 1967), and is the only one to have formed in relatively deep water; all the others are truly shallow-water complexes with distributaries that form a "horsetail" pattern.

Each delta complex in turn involves a series of delta lobes, a lobe being defined as that portion of a complex that formed during a relatively short period of time (decades to centuries) and that can be attributed to a single or discrete set of delta distributaries. Each lobe involves a characteristic pattern of sedimentary facies representing discrete environments of deposition such as natural levee, intratidal wetland, and bay-sound. In terms of its depositional environments and sedimentary architecture and because of its youthful state of development and brief history, the Balize complex (birdfoot delta) basically can be considered as a single lobe. Forming the flesh on the skeletal framework of major distributaries (passes) of the lobe is a series of lenticular sedimentary masses (Figure 5) (Coleman and Gagliano 1964). These masses, analogous in surficial landforms and environments to mini lobes of short duration, are crevasse systems dating to the historic period. The crevasse systems formed in shallow bays (bay fills) between or adjacent to major distributaries and extended seaward through a system of radial, bifurcating channels similar in planform to the veins of a leaf. Along Southwest Pass, the Joseph and Double Bayou systems are historic period crevasses.

Because of the prevailing influence of subsidence and sea level rise during the late Holocene (including the historic period), each delta lobe and crevasse system has experienced a constructional or progradational phase in which fluvial processes dominated, and a subsequent destructional or transgressive phase in which marine processes become progressively more dominant (Figure 6). Crevasse systems form initially as breaks in major distributary natural levees during flood stages, gradually increase in flow through successive floods, reach a peak of maximum discharge and deposition, wane, and become inactive. Eventually, the dead systems are inundated and revert to bay environments, thus completing the sedimentary cycle.

Basic Geologic Controls

Two processes--subsidence and sea level rise--are the paramount controls to be considered in virtually all aspects of the geomorphology and geoarchaeology of the Mississippi River delta plain. For more than a century, it has been known that delta plain landforms, and the structures and facilities located on them, are sinking at a rapid rate not only in geological time frames but human time frames as well. Geologically, subsidence can be defined simply as the relative lowering of the land surface with respect to sea level. Subsidence may involve five basic factors or natural processes (Kolb and VanLopik 1958): (a) true or actual sea level rise; (b) sinking of the basement (Paleozoic) rocks due to crustal processes; (c) tectonic activity such as faulting; (d) consolidation of the thousands of meters of sediments in the Gulf Basin; and (e) local consolidation of nearsurface deposits due to desiccation and compaction. All of these factors are present in the Balize complex area.

The rate of the true sea level rise component of subsidence has declined during the Holocene period as the effects of the waning of the last continental glaciation have declined (Saucier 1994). Sea level reached its last glacial maximum lowstand about 18,000 years ago and began rising rather rapidly thereafter. About 10,000 years ago, for example, the rate of sea level rise might have been as high as 20 mm/yr (0.79 in./yr), but between 5,000 and 3,500 years ago, it is believed to have declined to 6 mm/yr (0.24 in./yr). Within the last several centuries, it has probably averaged less than 1 mm/yr (0.04 in./yr). However, when other components are included, the total subsidence rate for the delta plain over the last several thousand years has been estimated from geological evidence at about 2.38 mm/yr (0.09 in./yr) (Kolb and VanLopik 1958).

There can be no doubt that the highest rates of subsidence currently occur in the Balize complex. Although the rate of sea level rise during historic times has been relatively low in a geological context, basement sinking, faulting, and especially local consolidation of sediments have been quite active. Based on tidal records and observations of structures (Kolb and VanLopik 1958), estimates of late historic-period

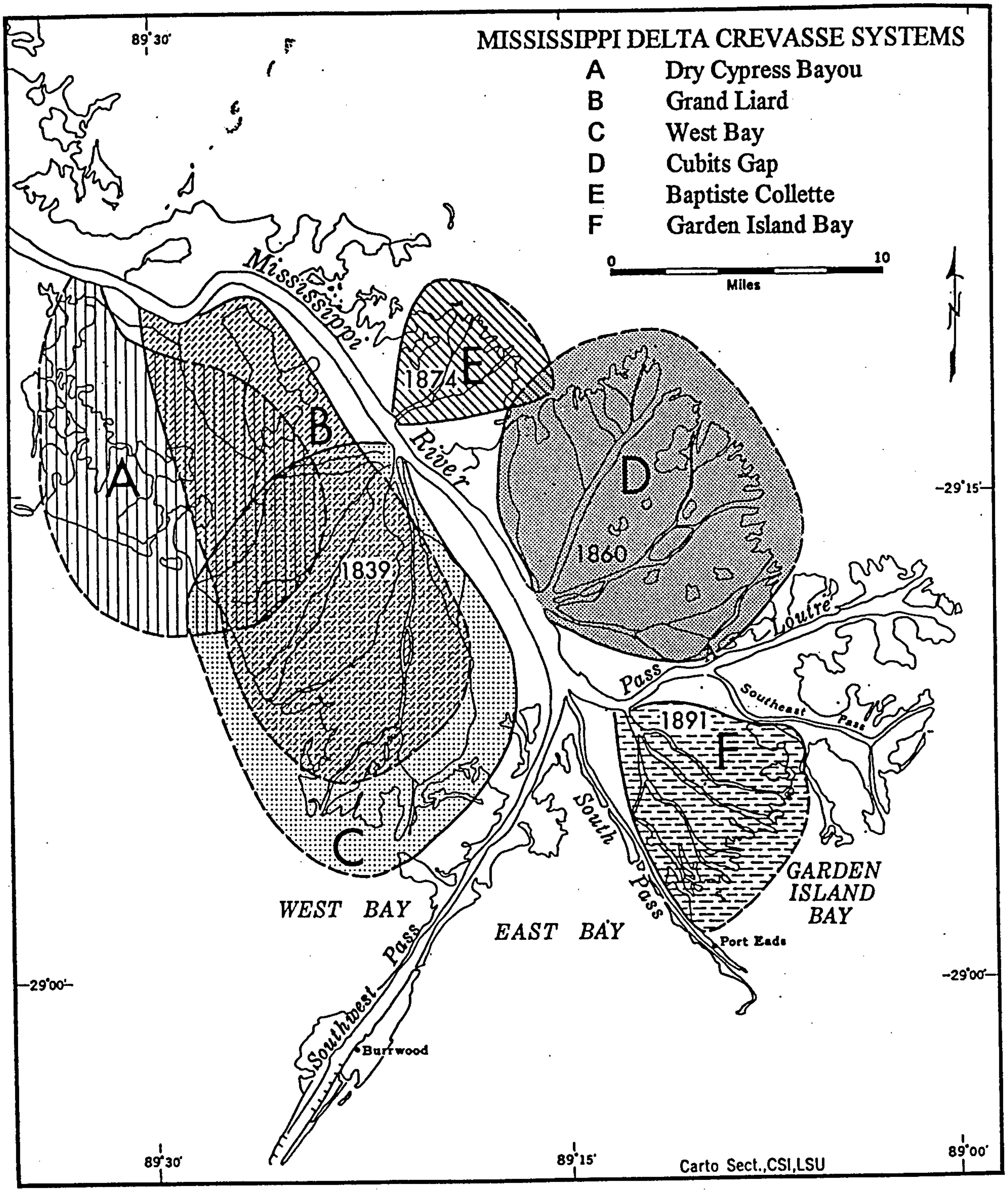


Figure 5. Crevasse systems of the modern (birdfoot or Balize) delta. Modified from Coleman and Gagliano (1964)

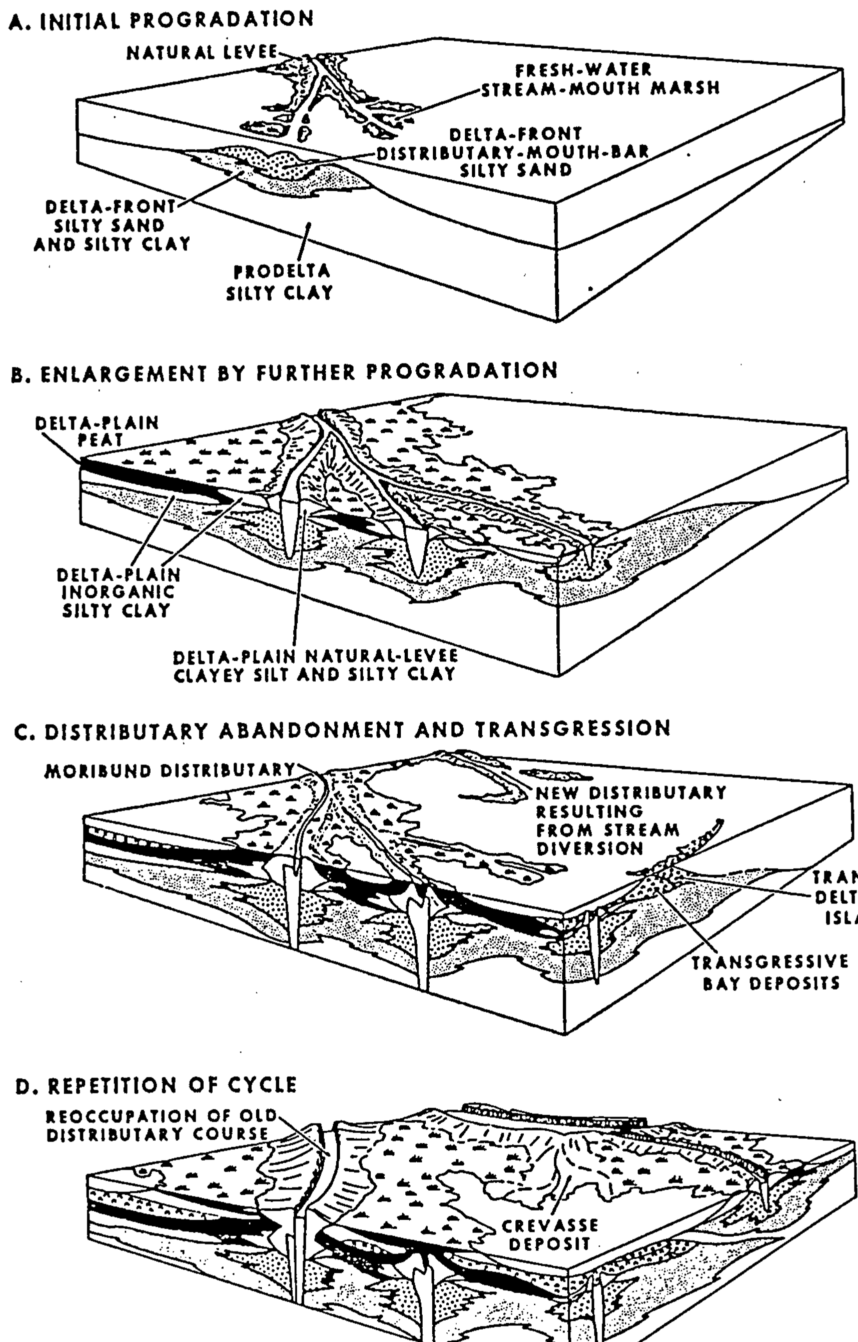


Figure 6. Idealized surface and subsurface distribution of environments of deposition at several stages in a typical delta cycle. From Frazier and Osanik (1965)

subsidence at locations such as HOP, Burrwood, Balize, and Port Eads vary from about 5.0 to 48.0 mm/yr (0.19 to 1.9 in./yr), with the mean value being 23.0 mm/yr (0.9 in./yr). Considered in a different perspective, it has been estimated that the shallowest Pleistocene formation underlying the complex, deposited at least 30,000 years ago, has been downwarped by about 152 m (500 ft) by the combined processes of subsidence.

The effects of subsidence are strongly manifested in the Balize complex in ways other than the sinking (and sometimes burial) of artificial structures. In the cases of the now largely inactive Joseph and Double Bayou crevasse systems, there has been a dramatic loss of vegetated wetlands and a corresponding increase in the extent of shallow open water in the last several decades (May and Britsch 1987). In addition, perhaps two-thirds of the wetlands along Southwest Pass below River Mile (RM) 12 below HOP were destroyed by erosion between 1932 and 1983. On the other hand, perhaps aided by the deposition of dredged material, the wetlands, which occur in narrow bands along the pass between RM 0 and RM 12 below HOP, have nearly doubled. While much of the wetland loss probably is attributable to canal dredging by the petroleum industry, overall wetland loss is probably due to salt water intrusion and plant community changes as well as the decline in Mississippi River discharge and sediment load caused by the growth of the Atchafalaya River distributary in south-central Louisiana.

Geomorphic Processes and Depositional Environments

Discussion of the sedimentary facies and depositional environments of the Southwest Pass area is complicated by the fact that the region contains elements typical of both shallow-water deltas and those unique to the Balize deep-water delta. Initially, seven environments--four subaerial and three subaqueous—will be described; these are listed under the heading *Balize Delta,* since they pertain to both the complex (single lobe) as a whole as well as to individual crevasses. Subsequent discussions will deal with three geomorphic elements--not environments *per se*--that are unique to the major passes of the Balize delta.

The typical distribution of depositional environments in a delta lobe or crevasse is shown in plan in Figure 7. The actual occurrence in the subsurface in a sedimentary sequence of several environments as shown in a boring near Fort Jackson (about river mile 20 above HOP) is depicted in Figure 8.

Balize Delta

Subaerial Environments. The *natural levee* environment includes those small, linear ridges that flank both sides of a channel (e.g., a distributary) that carries a heavy suspended sediment load and that periodically overtops its banks. The ridges are composed of firm to stiff, oxidized silts and silty clays. They are highest, thickest, and coarsest adjacent to the channel and they become thin and decrease in elevation in a distal direction. They also become thinner and narrower in a downstream direction and the deposits extend a few meters into the subsurface as a result of local and regional subsidence. Soils associated with natural levees have not been delineated in detail, but are described by Garofalo and Burk and Associates, Inc. (1982) as the Sharkey-Commerce, frequently flooded association. These soils are level, poorly drained, and frequently flooded.

The vegetation of *interdistributary wetlands* already has been described. The deposits consist of several meters of dark gray to black, watery, organic ooze or muck underlain by very soft, gray, organic clays. They occur laterally adjacent to natural levees and extend outward as flat, intratidal tracts, eventually giving way to shallow ponds, lakes, and bays. Drainage is sluggish and water exits these wetlands by way of narrow, sinuous tidal channels. Soils are described only as Medisaprists, Fresh Association. In the

Balize complex, all vegetated wetlands begin as accreting mudflats that are colonized when they become emergent.

Abandoned distributaries are channels whose basic role has changed from carrying river discharge during high stages to accommodating local drainage as tidal channels. In relatively more inland settings, such as near the parent channel, distributaries will become shallow and may even become narrower upon abandonment due to sediment filling (mostly loose silts and clays) and eventual plant colonization. In relatively more distal locations where the wetlands are deteriorating, the channels will become shallow but actually will become wider due to accelerated bank erosion. Upon abandonment, because the natural levees that flank the distributaries will no longer accrete and keep pace with subsidence, they eventually will disappear beneath sea level.

Beaches, and related longshore bars and spits, may form around the flank of an abandoned, subsiding lobe if it is exposed to sufficient wave action and currents. Such landforms develop as thin, narrow ribbons of silt with some shells, materials that are winnowed and redistributed from eroding mudflats, vegetated wetlands, and natural levees. These beaches and spits are usually very ephemeral features that often are destroyed in major storms. In the Balize complex, beaches are present only on the south and east sides of crevasses or lobes that are exposed to prevailing winds.

Subaqueous Environments. The shallow-water *bay-sound* environment is dominated by fluvial-marine processes in which mostly silts and silty clays accumulate as a result of the erosion and winnowing of delta deposits by waves and currents (Kolb and VanLopik 1958). Bays of the Balize complex are bordered by interdistributary wetlands on the landward side and open out into deeper water environments on the seaward side. The deposits contain small amounts of shell and shell fragments and can be anywhere from a few centimeters to a few meters thick. The thickest and coarsest deposits occur in the deeper, less-protected waters. Bays may either fill or enlarge within a matter of decades depending on cycles of crevasse growth and decay.

The *delta front* environment occurs in moderate water depths (generally 15 m [50 ft] and more) seaward from bays and sounds. It is characterized by alternating silts, fine sands, and clays that are deposited in Gulf waters ahead of advancing distributaries of lobes or crevasses (Coleman and Gagliano 1964). The deposits are highly lenticular in plan with the nature of deposits dependent upon the pattern and rate of advancing distributaries and the amount of marine action. This environment also includes the bars that form at the mouths of major distributaries like Southwest Pass. However, because of their considerable importance to the purposes of this report, these bars are discussed separately (see below).

Still deeper waters flanking the Balize complex are characterized by the prodelta environment. Deposits of this environment consist mostly of soft plastic clays with some silt in the form of thin lenses or lamina. These fine-grained materials accumulate to appreciable thicknesses in relatively deep water as the first manifestation of an advancing delta, and they overlie shelf deposits that represent an open marine environment. As determined from numerous borings, prodelta deposits are the most homogeneous of all the soils associated with a delta complex or major lobe (Kolb and Kaufman 1967). According to Fisk and McFarlan (1955), they have attained thicknesses of between 61 and 122 m (200 and 400 ft) beneath Southwest Pass.

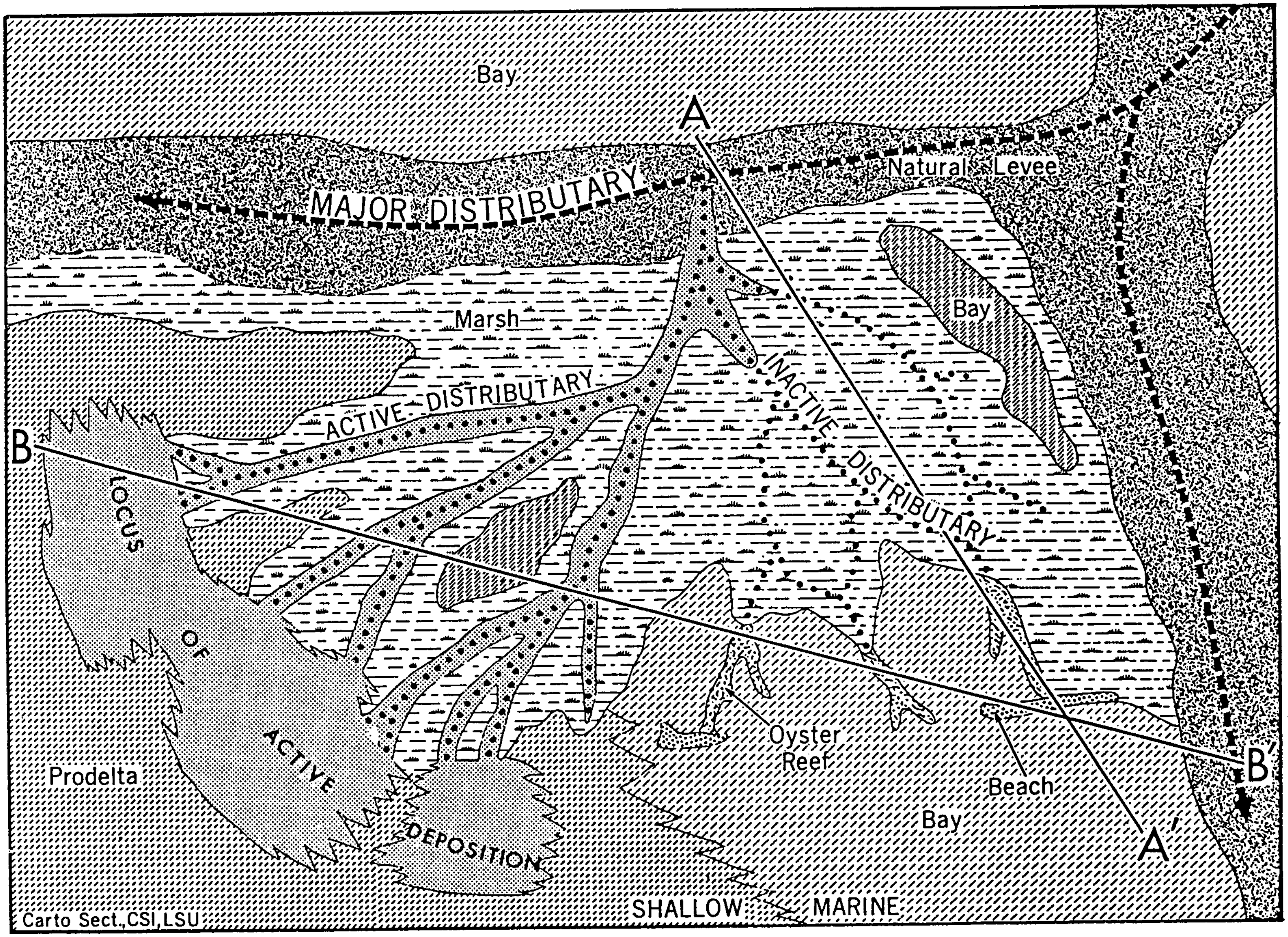


Figure 7. Sedimentary model of a crevasse system showing depositional facies. From Coleman and Gagliano (1964)

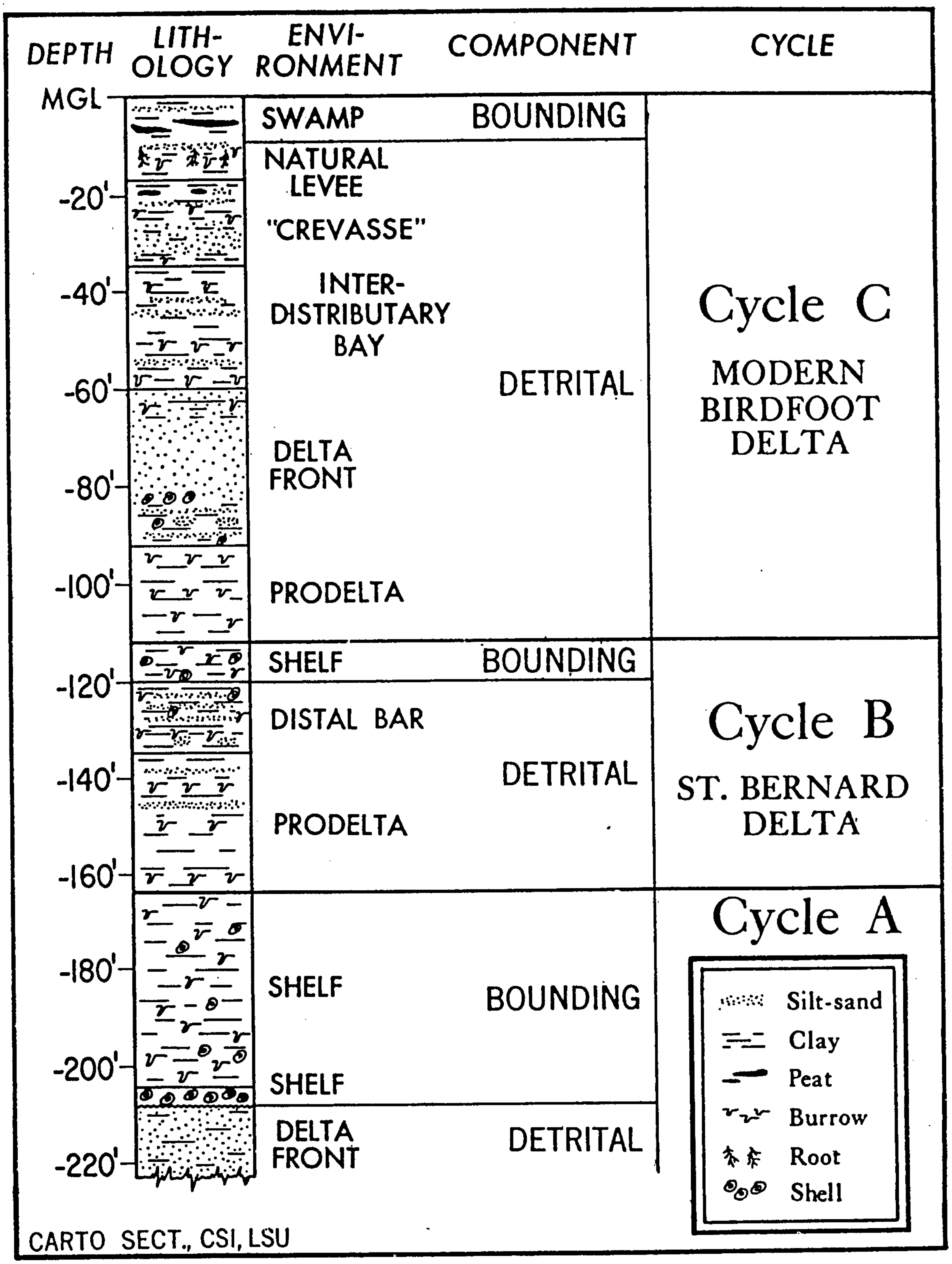


Figure 8. Generalized stratigraphy, cycles, and components of Mississippi Delta deposits as revealed in a deep boring near Fort Jackson. From Coleman and Gagliano (1964)

Major Passes

Bars and Bar Fingers. Distributary-mouth bars and bar fingers, which are the cumulative products of progressive seaward extension of the passes and bar migration, are phenomena unique to the major passes of the Balize complex and have been investigated extensively by Fisk (1961).

Bar formation is caused by shoaling that results primarily from reduction in the current velocities of river flow at the mouths of the passes. The shape and extent of these bars are influenced by such factors as littoral currents, tidal action, wind and waves, river discharge volume, and location of the salt water wedge (Benson and Boland 1986). Before jetty construction, the mouth of Southwest Pass was bell-shaped and the bar was located 1.6 km (1 mi) and more offshore. It maintained a general lunate shape and measured about 8 km (5 mi) wide. The bar crest was located directly out from the mouth of the pass or was offset slightly to the west, and relatively deeper water occurred at both ends. Although the bar itself did not emerge, water depths as shallow as 1 to 2 m (3 to 6 ft) did occur. After jetty construction, the bar developed as a narrow Gulf-floor bulge and constricted in width to about 1.6 km (1 mi). The front (offshore edge) of the bar has a slope of about 0.5° that, although it is quite shallow in an absolute sense, nevertheless is relatively steep as far as the delta flank is concerned.

Sediments of the current bar consist predominantly of "clean" fine sands up to about 46 m (150 ft) thick. These sands, being deposited nearer the mouth of the pass, accumulate rather rapidly, but the finer-grained sediments, being carried in an ever expanding effluent plume, become more widespread and depositional rates are significantly lower (Coleman and Roberts 1991). Bar deposits become mixed with increasing amounts of silts and clays with depth and at about 46 m, the finer-grained materials constitute about 95 per cent of their total volume. This is due to a winnowing process. During a flood, the river lays down stratified sands, silts, and clays. However, following the flood when depositional rates slow, the finer materials in the shallower waters are reworked and winnowed, leaving mostly the sand fraction.

As Southwest Pass has advanced gulfward, the cumulative bar sands have formed a finger-shaped sedimentary unit that is lens shaped in cross section, about 8 km (5 mi) wide, about 24 km (15 mi) long, and about 76 m (250 ft) thick (Figure 9). The latter dimension, about 30 m (100 ft) deeper than the present bar, reflects the effects of settlement and displacement of underlying deposits. Bar deposits have a unit weight of 2.0, whereas the underlying prodelta clays have a unit weight of only 1.7 (Morgan, Coleman, and Gagliano 1963). Hence, natural levees of the major distributaries of the Balize complex are underlain by thick sands in contrast to much thinner delta front sheet sands of smaller distributaries in shallow water. Bar formation and bar-finger growth have been major factors in the ability of the pass to resist increasing marine processes and to advance steadily into deep water.

Mudlumps. Whereas distributary-mouth bars have been a nemesis to navigators, associated mudlumps have been subjects of extensive notoriety and speculation as to their origin since the first Europeans first visited the delta area. Physiographically, mudlumps have been present within a thousand meters or so of the mouth of Southwest Pass (and other major passes as well) as scattered islands ranging in size from a few pinnacles to over 80,000 sq m (20 acres), and in elevation from 1.5 to 3.0 m (5 to 10 ft) (Morgan 1951). They are mostly elongate or sigmoidal in shape and typically exhibit fissures, vents, and springs of fluid mud. Mudlumps occur as subaqueous features as well as subaerial ones; they can emerge from bottom sediments within days or weeks (usually immediately after a major river flood); and they continually change in size and shape.

Basically, mudlumps are nearsurface expressions of diapiric (intrusive) folds of clay into and through bar deposits (Morgan, Coleman, and Gagliano 1963). They represent the plastic deformation of clays due to the load of bar deposits. Figure 10 is a schematic diagram showing stages in mudlump formation. Surficial bar deposits are the first to be extruded, but these are eroded away after several years, exposing a core of prodelta clays. Subsurface investigations have revealed that the prodelta clays are displaced upward from depths of between 107 and 122 m (350 to 400 ft).

As of 1951, Morgan reported that most mudlumps associated with the Southwest Pass were located west of its mouth along the relatively steep bar front in water depths of 6 to 18 m (20 to 60 ft). Most of these were formed before 1900 and before jetty construction. Because of the progressive buildout of the pass, other mudlumps have been incorporated into marsh deposits (interdistributary wetlands) as far north as about Burrwood. No mudlumps are known to have formed between 1900 and 1950, but there was renewed activity after that date. The present status of mudlump formation is not known.

Gullies and Mudflows. With the advent of detailed bathymetric surveys and an improved understanding of subaqueous processes, it has become apparent that mudlumps are by no means the only form of disturbance to the flank of the Balize complex. Despite slopes ranging only from about 0.2° to 1.0°, slope failures occur as bar silts and sands displace underlying plastic clays. As shown in a schematic diagram prepared by Coleman and Roberts (1991), elongate retrogressive slits (mudflow gullies and depositional lobes) form immediately seaward of the bar in water depths of 9 m (30 ft) or less. In water depths of 18 to 183 m (60 to 600 ft), the delta front is characterized by a maze of small-scale gullies and lobes (Bea and Audibert 1980). These evolve downslope into larger elongate slide gullies and fan-like mudnoses. Figure 11 provides an indication of the extent to which the seafloor off Southwest Pass has been disturbed.

Some failures occur due to seasonal bar growth (rapid deposition and loading) as slopes are oversteepened. However, based on damage assessments of offshore petroleum drilling platforms and pipelines, it is known that pressure fluctuations accompanying large swells during hurricanes also are a major cause of mudslide activity.

Delta Chronology

Geologic events older than the last glacial maximum about 18,000 years ago are not directly relevant to the purposes of this report. The chapter in the geologic history of the area that is of initial concern is the beginning of delta plain formation. The first hypothesized delta complex is thought to have begun forming offshore from central Louisiana about 9,000 years ago when sea level was perhaps 16 m (52 ft) lower than at present (see discussion in Saucier 1994). The first complex with preserved delta deposits, the Maringouin, dates to about 7,200 years ago, when sea level was about 6 m (20 ft) below present. Since that time, the plain has built up and built out by the coalescing of 14 lobes of three additional separate complexes (Frazier 1967). However, during all of that time and through multiple sedimentary cycles, the Balize complex area remained as shallow, open Gulf waters.

Virtually all workers accept the concept that the modern delta of the Mississippi River began when the river diverted near New Orleans into an interdistributary lowland between the La Loutre lobe of the St. Bernard complex to the east and the Bayou des Familles lobe of the same complex to the west (Frazier 1967). The new lobe, called the Plaquemines or Plaquemines-Modern complex, is generally believed to have begun forming about 1,000 to 1,200 years ago (Coleman and Roberts 1991; Frazier 1967; Kolb and VanLopik 1958). Since that time, it has progressively expanded southeastward past the towns of Pointe a la Hache and Buras.

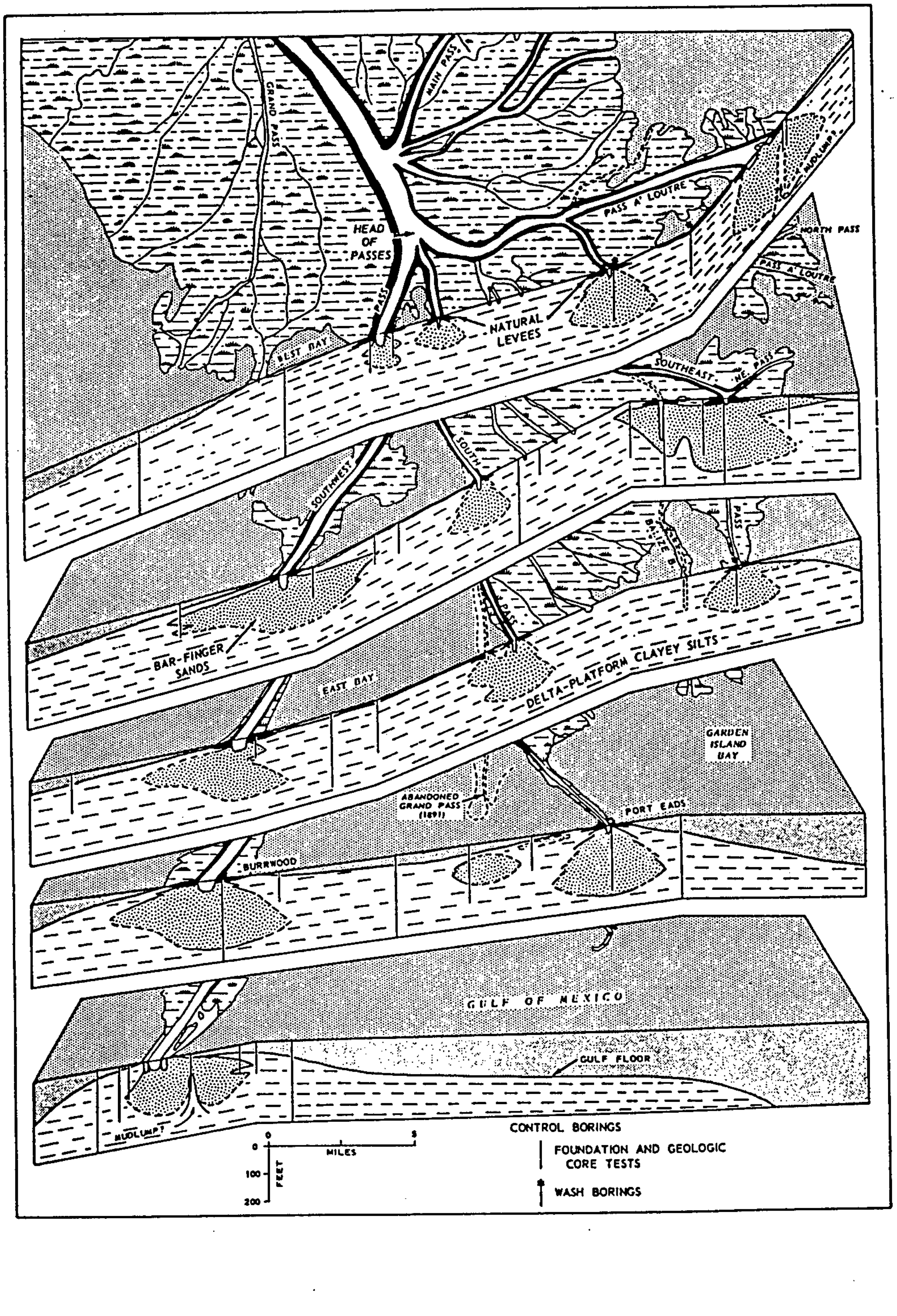


Figure 9. Occurrence of bar finger sands in the Balize delta complex. From Fisk (1961)

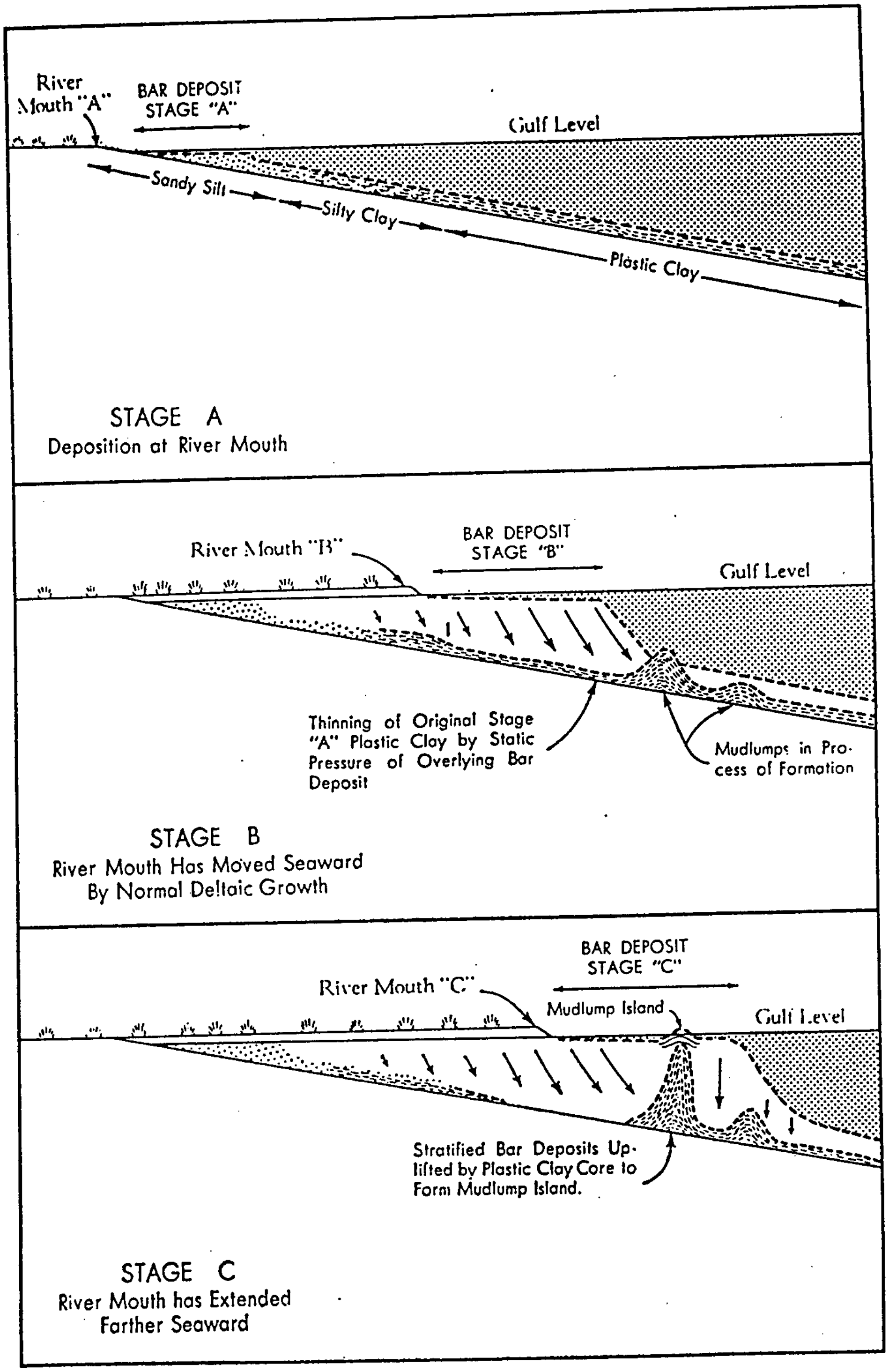


Figure 10. Schematic diagram showing relationship between bar growth and mudlump development. From Morgan (1951)

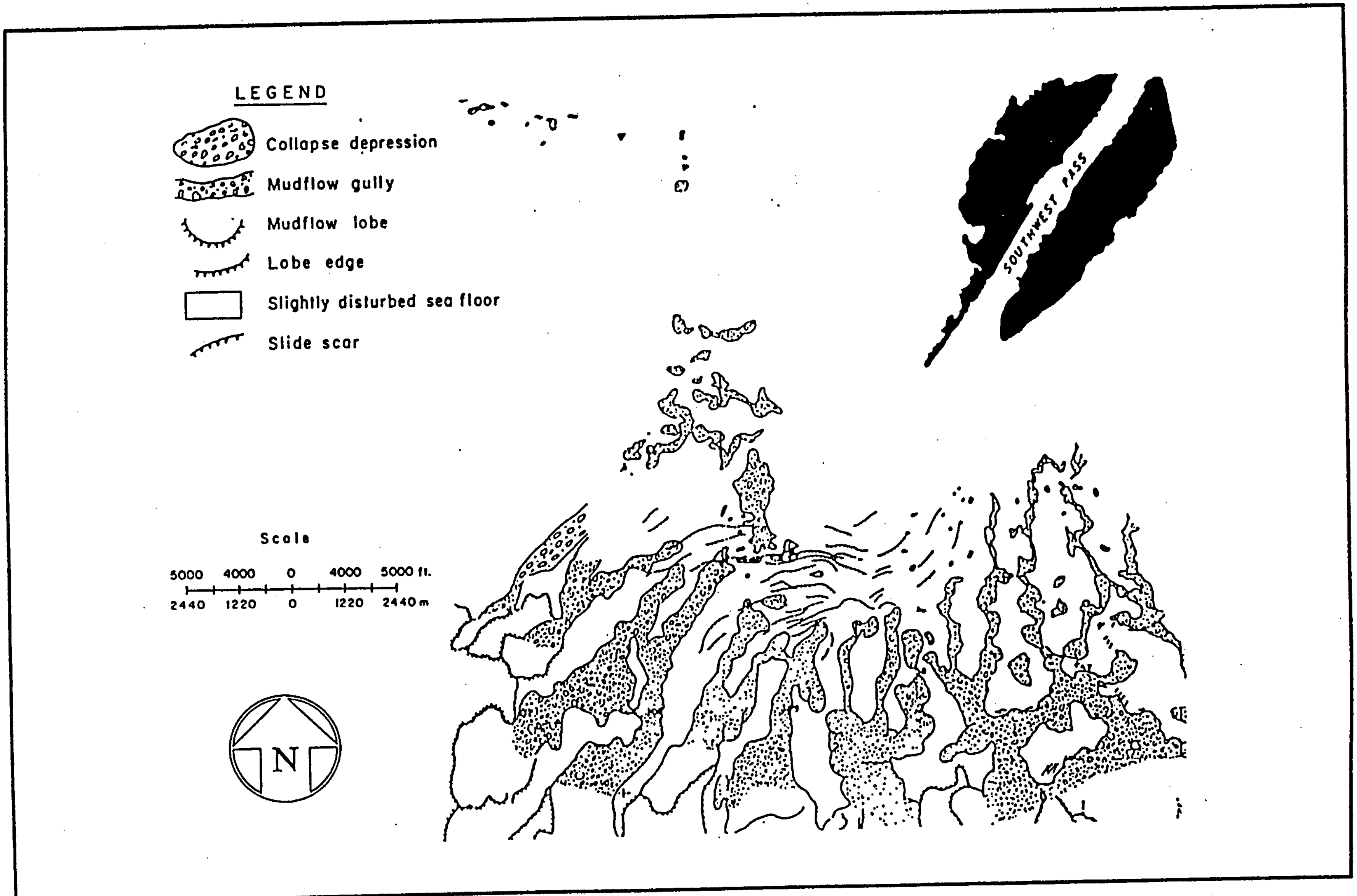


Figure 11. Seafloor features in the vicinity of Southwest Pass. From Bea and Audibert (1980)

Just when the Balize or birdfoot delta *per se* began to form south of Venice or the HOP is subject to debate and considerable uncertainty, despite its young age. Estimates range from as little as 200 to 250 years (Frazier 1967) to the more generally accepted value of about 500 years (Kolb and Van Lopik 1958; Russell 1936). All estimates are based largely on inference and extrapolations from the historical period rather than discrete evidence.

Part of the uncertainty stems from not knowing exactly when the delta was discovered by European explorers and what its shape and extent were at the time. The most succinct discussion of this topic can be found in Russell (1936). He reported that Vespucci may have been the first to see the delta in 1487 or 1498, and that Columbus supposedly prepared a map showing the delta in 1507. It is uncertain as to whether multiple major passes existed at the time. Most historians credit Pineda with the actual discovery of the delta in 1519; however, the event actually may have occurred as late as 1528.

At the other extreme, Thomas (cited in Russell 1936) maintained that the Southwest Pass may have started to form only in 1730. This date is consistent with estimates by Giardino (1984), who based his interpretation on interpretations of historical narratives that located the mouth of the Mississippi at Venice during the late seventeenth century and about 9.6 km (6 mi) farther southeast ca. 1712.

However, these dates seem much too recent, based on geological considerations and twentieth century data. They also do not conform to elements presented in a detailed map of the delta prepared by Talcott in 1838 (published in 1839) (Figure 12). At that time, Southwest Pass was about 24.5 km (15.2 mi) long, its mouth already was flared and shallow, and there were significant areas of interdistributary wetlands. Talcott (1839) depicted both Double Bayou (designated as Bayou B) and Joseph Bayou (designated as English Bayou) as well developed, and he pictured another lobe (undesignated and now destroyed) near R.M. 2.5 below HOP on the right descending bank opposite

Fishermans Bayou. Finally, his depiction of tree growth along the distributaries of the lobe suggests that well-developed natural levee ridges already had formed.

Estimates of the rate of growth (buildout) of Southwest Pass are reasonably consistent. Russell (1936) cites several sources that suggest an average rate of growth of 87 m (285 ft) per year during the eighteenth century. Giardino (1984) cites others that yield an average value of 78 m (256 ft) per year for the nineteenth century. More recent data compiled by Coleman and Roberts (1991:Figure 13) show the progradation of the mouth of the pass by means of the plotting of the -10 m (-33 ft) contour from surveys dating from 1764 to 1979. This contour represents the front of the bar. The results indicate a rate of growth of about 69 m (226 ft) per year over the 215-yr period. This rate is appreciable, but it still is less than the rate of growth of many distributaries in shallow-water lobes.

Archeological Implications

Aside from cultural considerations, three factors are involved in the possibility that prehistoric and historic cultural resources may be located and preserved in the Southwest Pass area. These include the nature of the depositional environment or landform, the geomorphic processes at work, and the age of the deposits. As explained below, all three factors indicate that significant resources of any type are exceedingly unlikely to occur.

During prehistoric times, the only suitable land for habitation, even on a temporary basis, would have been the natural levee ridges of distributaries. These are quite limited in areal extent and in a general environment that is subject to periodic inundations by both river floods and hurricanes; during such events, aboriginals would have had to vacate the Balize delta complex completely Otherwise, use of the area would have been limited to brief hunting, gathering, and fishing forays. Use of the area during historic times would have been subject to the same constraints; facilities related to petroleum extraction, commerce, and other activities would have had to be "hardened" to withstand adverse weather events.

Any remains of human use and occupation of any age would have been subjected to the high (approximately 15 mm/year) subsidence rates prevalent in this environment; even those a few decades old likely would be buried by alluvium. By way of example, a Spanish magazine was constructed in 1734 near the settlement of Balize on Balize Bayou off Southeast Pass (Russell 1936). It was destroyed by a hurricane in 1778. Only the tops of the magazine were visible in the late 1800s, and no traces remained above marsh level in 1936.

Concerning historic-period vessels that might have sunk in or at the mouth of the pass, these certainly will be buried by channel or bar deposits and possibly even natural levee deposits. Accretion has occurred both as narrowing of the pass and seaward buildout, especially construction of jetties. Off the flank of the bar, subaqueous failures could cause wrecks to migrate downslope into deeper water. Bea and Audibert (1980) documented the fact that mudslides triggered by hurricane waves and swells were quite capable of rupturing pipelines and overturning offshore drilling rigs.

It should also be remembered that Southwest Pass was not the favored entrance to the river before this century. Because of their smaller bars, the Grand-Tiger and Main Passes were favored in earlier times. Southwest Pass did not achieve its prominence as a navigation channel until after the jetties were constructed.

Despite the nature of the landscape and the geomorphic processes at work, it can be stated with certainty that no prehistoric archaeological sites will be found in the Balize complex. The deposits simply are too young. Under the most liberal interpretation of delta growth rates, it is possible that proto-historic sites could be present as far south as the HOP, but none have been found because surely they would be buried. Russell (1936) estimated that the southern limit of Indian mounds was near Buras (river mile 25 above HOP) and subsequent work by McIntire (1958) has affirmed this. The nearest known site is a Mississippian (Plaquemines Culture) shell midden located along the Gulf shoreline about 32 km (20 mi) northwest of Southwest Pass.

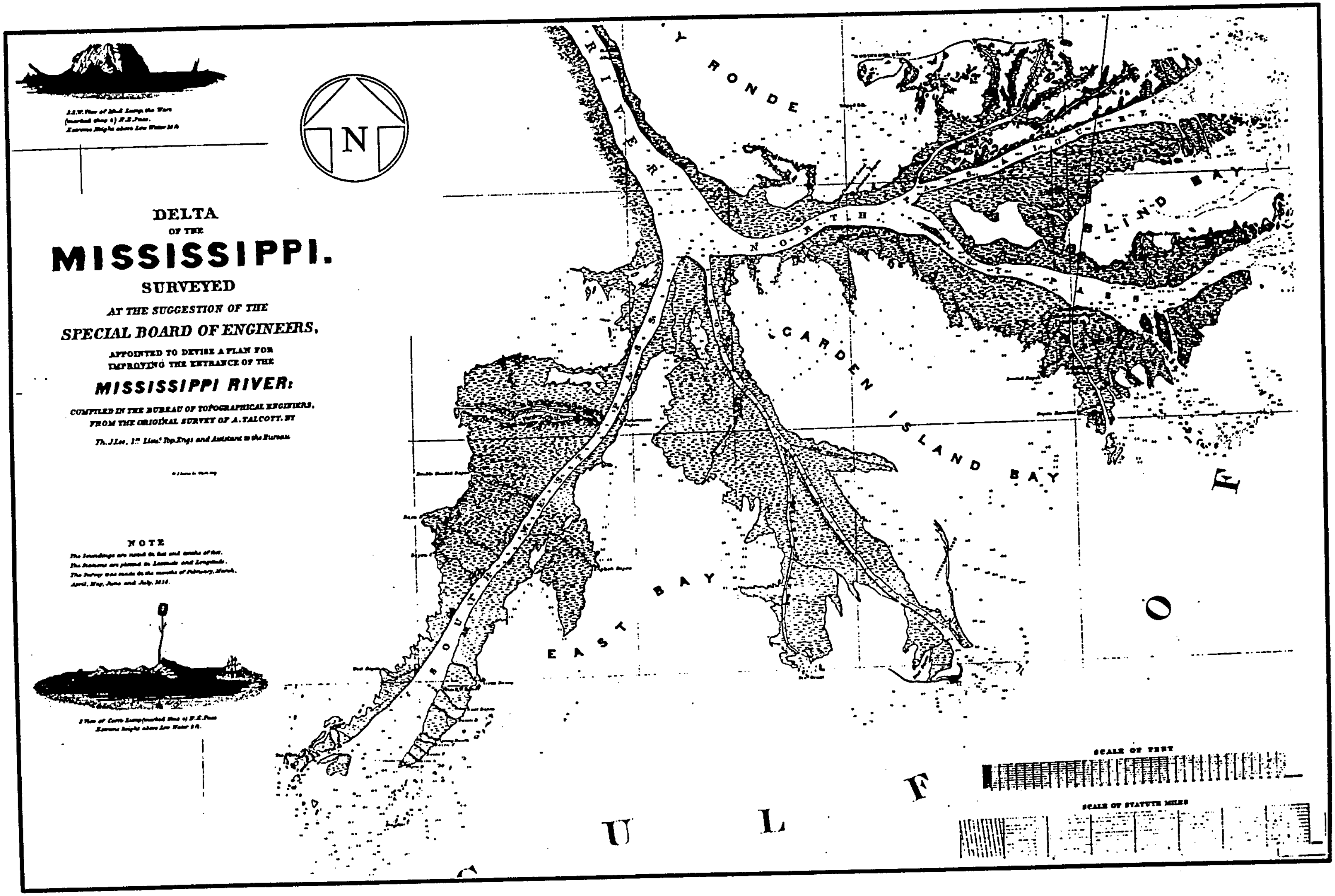


Figure 12. Excerpt from Talcott's 1838 map of the delta of the Mississippi River

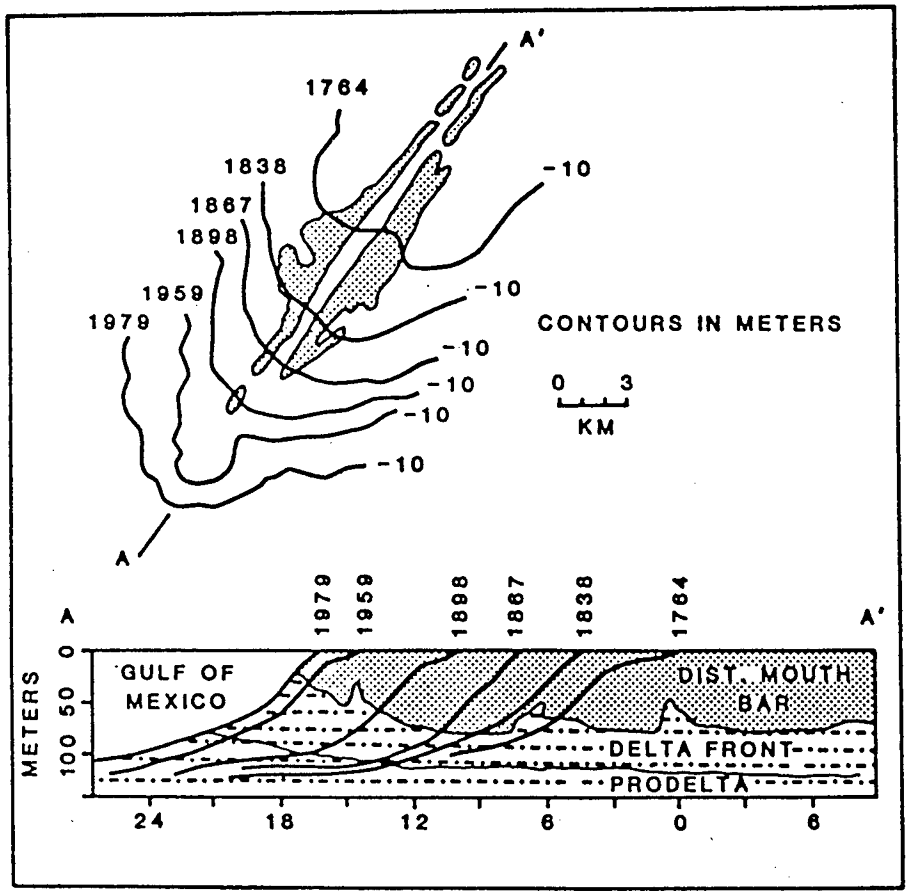


Figure 13. Progradation of the mouth of Southwest Pass during the period 1764 to 1979. From Coleman and Roberts (1991)

CHAPTER III

THE SOUTHWEST PASS: THE PROJECT CORRIDOR IN HISTORICAL PERSPECTIVE

Introduction

The Southwest Pass today serves as the Mississippi River's principal outlet to the Gulf of Mexico, but this vitally important channel dates only from the early twentieth century (Secretary of the Army 1996:11-2; Bragg 1977:268). Prior to its development, navigators of large vessels struggled, often unsuccessfully, to utilize the numerous other passes that extend like muddy fingers into the Gulf of Mexico. This chapter briefly summarizes the complex early history of the passes, the modern engineering effort at the Southwest Pass, and the historic sites situated near the project items.

Historical Setting

French Explorers and Colonists, 1682-1766

During an expedition from Canada down the Mississippi, René Robert Cavalier, Sieur de La Salle, discovered the mouth of the river in 1682. He noted that it flowed into the Gulf of Mexico through three channels. After claiming the entire Mississippi Valley for France, La Salle returned by river to Canada. Although he recorded the navigational position of the river's mouth, some historians believe that he calculated inaccurately. Whatever the case, when he attempted to return to the site, this time through the Gulf of Mexico, he could not locate the river. After numerous misadventures on the Texas coast, he was murdered by his own crew (Wilds et al. 1996:2-4).

Pierre Lemoyne, Sieur d'Iberville, rediscovered the mouth of the river for France in 1699. When he first entered the passes, he observed what appeared to be black rocks and petrified trees in the waterway, but he discovered, on closer inspection, that these objects were in fact mud lumps (McWilliams 1981:137-138). Although the French intended to fortify and colonize the mouth of the river, the marshy inhospitable land on the lower reaches of the Mississippi initially discouraged them. Until the founding of New Orleans in 1718, the French concentrated their efforts at settlement in the vicinity of Mobile rather than along the lower reaches of the Mississippi (Wilds et al. 1996:8-11).

From the first attempt by the French to navigate the passes, shoals and sand bars presented daunting problems. The river grew sluggish at the passes, and as it decreased its velocity it deposited an immense amount of sediment at the river's mouth, thus "creating a shoal which reduces the depth of navigable water at the most crucial point of the whole river system" (Clay 1983:22).

Preferred over the Southwest Pass and the project corridor, the Southeast Pass served as the principal point of entry into Louisiana during the entire colonial period. In an attempt to guard the mouth of the pass, the Chief Engineer of the French colony of Louisiana, Pierre Blond de la Tour, established on a small island a fort that served both as a military installation and as a lighthouse. The installation was known as the "Balise," meaning "beacon" or "buoy" in French. The anglicized corruption of this word, "Balise," has been in general usage at least since the Civil War (Lincoln 1983).

The French contended with but never solved the problem of the shoals. Initially, they found the average depth of the passes to be about six to eight feet, which provided sufficient depth only for small craft to cross the bar. To deepen the passes, the French in 1726 initiated a process known as harrowing, by which ships would drag iron harrows along the bottom of the outlets in order to break up sand bars. This method provided temporary deepening of the channel but proved ineffective in supplying a permanent solution, because the sand bars and shoals soon re-formed (Clay 1983:22).

In the meantime, the fortifications at Balise slowly sank into the mud. By the 1760s, the French had reduced the stronghold to a small battery with several cannon (Lincoln 1983:338). Balise nevertheless served as the site where France officially transferred the colony of Louisiana to Spain in 1766 at the conclusion of the Seven Years' War (known in America as the French and Indian War).

The Passes Under the Rule of Spain, 1766-1803

Like the French, the Spanish continued to use the Southeast Pass as the chief gateway to the colony of Louisiana. Furthermore, Spain granted to a chief pilot who resided at Balise the exclusive privilege of controlling the entry and exit of ships that attempted to trade with New Orleans and points along the river. The monopoly enjoyed by the pilot annoyed commercial interests that resided in the Crescent City. In the meantime, the passes remained as perilous to navigate under the Spanish as they had been under the French (Goodwin et al. 1985:47-50).

The Passes Under American Rule, 1803-1852

Spain actually ceded Louisiana to France in a secret treaty of 1800, but the Spanish provided a *de facto* government for the colony until 1803, when the territory was purchased from France by the United States. Under American rule, trade on the Mississippi River increased rapidly, particularly after the development of the steamboat, which could move upstream against a strong current.

However, although steamboats transformed New Orleans into a major American port, the outlet through the passes to the Gulf of Mexico remained a vexing problem. The Southeast Pass had provided the preferred gateway to the river during the colonial period, but it was replaced by the Northeast Pass early in the nineteenth century. All the passes presented problems to navigation, and harrowing continued to be the only method used to break up the sand and shoals at the mouth of the river. In 1835, however, Congress approved an appropriation of $250,000 to conduct dredging at all the passes, including the Southwest Pass, where the project corridor is located. This appropriation represented the first use of federal funds at the mouth of the Mississippi. Almost the entire appropriation was expended on surveys and on the construction of a dredging apparatus, a vessel called the *Belize*, that experienced numerous mechanical difficulties and never functioned properly.

During the 1840s, a lively debate developed on how to deal with the problem of the shoals and sand bars at the passes. Various dredging techniques were advocated, the use of drydocks to carry ships over the sand bars was suggested, and the sealing of all but one of the river passes was proposed (Clay 1983:23). While the debate was proceeding, the Northeast Pass (then the favored route) filled with shoals. As a result, the Southwest Pass, site of the project corridor, assumed a new importance, as did a community on the pass known as Pilot Town (16PL55), where the pilots had their headquarters (Gould 1889:314).

Developments Related to the Southwest Pass, 1852-1898

Although the Southwest Pass had become the favored gateway to the Mississippi, more than 40 vessels were grounded in 1852 for periods ranging from two days to eight weeks on the bar just outside the pass. To get off the mud lumps, the vessels had to lighten their loads, sometimes by throwing cargo overboard (Gould 1889:315).

In that year, Congress responded to the problems at the pass by appropriating $75,000 for improvements at the mouth of the river. The legislation also created a board of Army officers to study the situation at the passes and to make recommendations about increasing the depth of the water at the bar. Unsure that any one method would prove effective, the board recommended several alternatives: dredging a channel; constructing parallel jetties at Southwest Pass; and, finally, building a ship canal at Fort St. Philip that would extend from the river into the deep waters of the Gulf of Mexico (Gould 1889:315). At first, dredging was attempted, and by 1853, the Southwest Pass had been deepened to 18 feet. However, by 1856, no trace of the deepened channel remained (Gould 1889:315).

With the failure of dredging, the Federal government appropriated $330,000 for jetties. A commercial firm built a jetty on the east side of the Southwest Pass. Combined with a program of harrowing and dredging, the effort maintained a depth of 18 feet in the channel through 1859 and 1860. In spite of these promising initial results, the program actually seems to have increased and accelerated the shoaling of the pass, rather than decreasing it. On the eve of the Civil War, 35 ships were waiting outside the bar to enter the Southwest Pass, three vessels were grounded on the bar, and inside the river merchandise waiting for export lay rotting in warehouses (Morgan 1951:130).

During the Civil War, the passes assumed critical strategic importance; controlling the entire course of the river was established as a major military objective of the Union. Very early in the war, the Federal forces initiated a naval blockade of the Confederacy at the mouth of the river. The Confederates placed obstructions in the channel to defend the entrance to the river. A vessel in the blockading fleet, the U.S.S. *Richmond*, struck a submerged wreck on the inner bar of Southwest Pass in late September, 1861 (Stewart 1903:690). A few days later, the U.S.S. *Vincennes* collided with a sunken vessel that blocked the channel (Stewart 1903:696). However, more than a century of erosion and dredging seem to have eliminated these obstacles; present day shipwreck databases record no such obstructions from the Civil War era.

In October 1861, a Federal blockading fleet actually entered the Mississippi in order to establish a battery at the Head of Passes, but Confederate vessels succeeded in driving the Federals from the river. In retreat, several Federal vessels became stuck on the bars at the passes (Bragg 1977:268-269).

The blockading fleet nevertheless tightened its control of the mouth of the Mississippi. The Louisiana Division of Archeology shipwreck database records the mishap of the *Julia*, a Confederate blockade-runner, that was forced aground by a Federal vessel at the mouth of the river on January 24, 1862 (Table 1).

According to Raphael Semmes, the celebrated Confederate naval commander, the pilots along the coast of the Confederacy "were, with few exceptions, Northern men, and as a rule they went over to the enemy, though pretending, in the beginning of our troubles, to be good secessionists" (Semmes 1869:110). These pilots guided Commodore David C. Farragut through the passes in April 1862 when he led a fleet of 40 Federal vessels into the Mississippi River. Steaming by the Confederate defenses at Forts Jackson and St. Philip (above the Head of Passes), Farragut's fleet ultimately captured New Orleans in one of the most significant Federal victories of the Civil War.

Following the war, efforts to clear the Southwest Pass resumed. In 1868, the Corps of Engineers put into operation a dredging ship that initially appeared to break up the sand bars; however, the Corps eventually learned that sand bars could be cleared only if the dredging were undertaken continuously, a process that involved sizable difficulties and expense (Clay 1983:23).

By the 1870s, dredging had come into disfavor, and the construction of a canal was promoted by the Corps of Engineers. An alternative, and less popular, solution was advocated by James B. Eads, who proposed to jetty the mouth of the Southwest Pass in order to maintain and deepen the channels. A debate of considerable historic importance ensued on the question of whether jetties or a canal should be utilized (Pearson et al. 1989:184-185).

Congress resolved this historic debate with a compromise. Like many compromises, it included some unwise provisions. Eads was permitted to experiment with his jetties, but he was forced to do so at the much smaller South Pass rather than the Southwest Pass, which he considered the logical choice. He was required to deepen the South Pass to 30 feet and maintain it for 20 years. If his experiment failed, he would have to shoulder a heavy financial burden by himself; if he succeeded, he would receive eight million dollars (Dorsey 1947:167-178; How 1900:77-104).

Eads took the gamble. Already in his career he had invented a diving bell with which he made a fortune retrieving cargo from sunken steamboats; he had helped the Union gain control of the Mississippi River during the Civil War by building a fleet of armor-plated steel gunboats; and, in 1874, he had completed a bridge (that still stands today) across the Mississippi River at St. Louis. The jetties at the South Pass proved to be his most difficult task, but he achieved his goal.

Eads' experiment at the South Pass proved to be such a success that exports from New Orleans increased 2,600 per cent between the beginning and the completion date of the construction of the jetties (Dorsey 1947:216). Furthermore, New Orleans moved up from eleventh to second place among American ports within five years of the jetties' completion (Morgan 1971:167). As a result of Eads' experiment, the South Pass became the major navigational gateway to New Orleans between 1879 and ca. 1914 (Pearson et al. 1989:185).

The increased commerce through the small South Pass created a demand for a larger channel. As Eads had argued with no success in the 1870s, jetties could be much more effective at the Southwest than at the South Pass (Bragg 1977:268-269). In 1898, the government at last recognized the need to open a new channel in the Southwest Pass.

TABLE 1. REPORTED SHIPWRECKS IN PLAQUEMINES PARISH

NAME	TYPE	PROPULSION	YEAR BUILT	WHERE BUILT	DATE LOST	CAUSE	WATER BODY	PARISH	REMARKS
UNKNOWN	PLEASURE CRAFT	UNKNOWN	UNKNOWN	UNKNOWN	5/24/1976	UNKNOWN	MISSISSIPPI RVR.	PLAQUEMINES	USCG FILE #071-76
UNKNOWN	PILOT BOAT	UNKNOWN	UNKNOWN	UNKNOWN	8/17/1969	SANK IN STORM	MISSISSIPPI RVR.	PLAQUEMINES	WITHIN 10 MILES OF MILE 0 AHP; VESSEL WAS 15-20 YEARS OLD AT TIME OF LOSS; USCG
UNKNOWN	PILOT BOAT	DIESEL SCREW	UNKNOWN	UNKNOWN	8/17/1969	SANK IN STORM	MISSISSIPPI RVR.	PLAQUEMINES	WITHIN 10 MILES OF MILE 0 AHP; VESSEL WAS 20-30 YEARS OLD AT TIME OF LOSS; USCG
UNKNOWN	BARGE	UNKNOWN	UNKNOWN	UNKNOWN	0/0/1986	UNKNOWN	PASS A LOUTRE (MISS.R.)	PLAQUEMINES	FLATDECK BARGE; USCG FILE #064-86
UNKNOWN	TOW BOAT	DIESEL SCREW	UNKNOWN	UNKNOWN	1/20/1970	EQUIPMENT FAILURE	MISSISSIPPI RVR.	PLAQUEMINES	WITHIN 10 MILES OF MILE 0 AHP; TONNAGE REPORTED AS 15-100; USCG CASE #02231
UNKNOWN	UNKNOWN	DIESEL SCREW	UNKNOWN	UNKNOWN	1/30/1971	COLLISION	MISSISSIPPI RVR.	PLAQUEMINES	WITHIN 10 MILES OF MILE 0 AHP; VESSEL WAS 15-20 YEARS OLD AT TIME OF LOSS; USCG
UNKNOWN	TANKER	UNKNOWN	UNKNOWN	UNKNOWN	1/27/1972	COLLISION	MISSISSIPPI RVR.	PLAQUEMINES	WITHIN 10 MILES OF MILE 0 AHP; LENGTH REPORTED AS 100-200', TONNAGE AS 100-300;
UNKNOWN	BARGE	UNKNOWN	UNKNOWN	UNKNOWN	1/0/1975	COLLISION	MISSISSIPPI RVR.	PLAQUEMINES	LENGTH REPORTED AS 100-200'; USCG CASE #60275
UNKNOWN	TOW BOAT	DIESEL SCREW	UNKNOWN	UNKNOWN	10/0/1975	COLLISION	MISSISSIPPI RVR.	PLAQUEMINES	TONNAGE REPORTED AS 15-100; VESSEL WAS 20-30 YEARS OLD AT TIME OF LOSS; USCG CAS
UNKNOWN	CREW BOAT	DIESEL SCREW	UNKNOWN	UNKNOWN	1/7/1969	COLLISION	MISSISSIPPI RVR.	PLAQUEMINES	WITHIN 10 MILES OF MILE 0 AHP; TONNAGE REPORTED AS 15-100; USCG CASE #92187
JULIA	SCH00NER	SAIL	UNKNOWN	UNKNOWN	1/24/1862	BEACHED	MISSISSIPPI RVR.	PLAQUEMINES	BLOCKADE RUNNER; FORCED AGROUND BY THE 'USS MERCEDITA' AT THE MOUTH OF THE MISSI
UNKNOWN	BARGE	UNKNOWN	UNKNOWN	UNKNOWN	1/24/1862	BEACHED	MISSISSIPPI RVR.	PLAQUEMINES	UNIDENTIFIED BARQUE CHASED AGROUND AT THE MOUTH OF THE MISSISSIPPI RIVER
ELLEN H. MUNROE	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	10/19/1883	STRANDED & SWAMPED	MISSISSIPPI RVR.	PLAQUEMINES	AT JETTIES AT THE MOUTH OF THE MISSISSIPPI RIVER
GOVERNOR MORTON	CLIPPER SHIP	SAIL	1851	UNKNOWN	7/2/1877	BURNED	MISSISSIPPI RVR.	PLAQUEMINES	MOUTH OF THE MISSISSIPPI RIVER
GRAMPUS	PASSENGER STEAM BOAT	STEAM	1827	CINCINNATI	5/13/1840	EXPLOSION	MISSISSIPPI RVR.	PLAQUEMINES	2 KILLED; MOUTH OF THE MISSISSIPPI
HARRY OF THE WEST	CLIPPER SHIP	SAIL	1855	UNKNOWN	11/0/1865	BURNED	MISSISSIPPI RVR.	PLAQUEMINES	AT THE MOUTH OF THE MISSISSIPPI RIVER
STELLA	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	2/9/1904	COLLISION	MISSISSIPPI RVR.	PLAQUEMINES	COLLIDED WITH THE S.S. GEORGE DUMOIS AT THE MOUTH OF THE RIVER; E. MARSHALL, MAS

Engineering Efforts at the Southwest Pass, 1898 to Present

Efforts to create a modern channel for ocean-going ships through the Southwest Pass date from February 1898, when Congress authorized the Corps of Engineers to conduct a survey on the practicality of securing a 35 foot channel of adequate width through the pass. Completing the survey within a year, the Corps submitted a report favorable to such a channel on January 7, 1899 (Chief of Engineers 1899:1863).

Having set the wheels in motion, Congress insured that they turned very slowly. In the River and Harbor Act of 1899, Congress appointed a Board of Engineers to review the report that the Corps submitted. The especially appointed Board then submitted its review in a report of January 11, 1900 (Chief of Engineers 1900:2287-2302). The review recommended that a channel 1,000 feet wide and 35 feet deep be established at the Southwest Pass. The following recommendations also were included among its many provisions: 1) construction of two jetties at the mouth of the pass; 2) employment of additional dredges; and 3) the purchase of land adjoining the jetties for use as storage depots and a maintenance plant (Chief of Engineers 1901:383).

The River and Harbor Act of June 13, 1902, officially authorized the Southwest Pass project. Initial estimates indicated that the ship channel would be completed in three years after the funds were made available. The entire project was estimated to be completed in 5 years (Chief of Engineers 1902:315-316). These estimates proved to be optimistic and inaccurate.

To implement the act, the government began negotiations to acquire all the land below, or south of, Pilot Town on the east bank, as well as all the land below the United States lighthouse reservation on the west bank of Southwest Pass. When the owner, George Jurgens of New Orleans, insisted on a selling price of $250,000, the Secretary of War authorized the local United States district attorney to begin condemnation proceedings. The day after the proceedings were initiated, Jurgens agreed to accept only $5,000 for the property and to pay for certain court costs (Chief of Engineers 1903:1277).

The government initiated construction on the jetties in December 1903. The work was completed in 1908, but an extension of the jetties was begun in 1909 (Chief of Engineers 1909:440) . In the meantime, dredging operations commenced in April 1905. To serve the dredges operating in the pass, the United States established a coaling station and wharf on the east bank of the Southwest Pass at Mile 15 Below Head of Passes (BHP) in 1908. Known as Burrwood, the base subseqently expanded to included residences, administrative and industrial buildings, and numerous other structures (Goodwin et al. 1985:122).

While these various improvements were being made, the Southwest Pass remained closed to commercial shipping. According to a report to the Chief of Engineers in 1911:

> On the whole it may be said that the progress made in improving this channel is very satisfactory. Although the channel is not yet open to navigation, a large steamer drawing 30 1/3 feet went to sea through this channel April 18, 1911. This was the deepest draft vessel that ever sailed from the port of New Orleans (Chief of Engineers 1911:1736).

Emphasizing that commercial navigation would interfere with the continuing dredging operations, the report recommended that "Southwest Pass should not be used, except in special cases, until further channel development is secured" (Chief of Engineers 1911:1736). The recommendation was not adopted; however, the Southwest Pass channel officially opened to commercial navigation on December 26, 1911. When subsidence of the original jetties presented problems in 1913, capping stone was placed on the outer portions of the jetties and concrete on the inner portions. This effort prevented water from escaping over the jetties except at extraordinary high water (Chief of Engineers 1914:2566).

Many statistical indices demonstrated the importance of the Pass to the continued commercial success of the lower Mississippi River. In 1910, traffic through the passes amounted to not quite four million tons, but when the Southwest Pass opened the tonnage increased to five million by 1912, six million by 1913, seven million by 1916, eight million by 1917, nine million by 1918, 11 million by 1920, 12 million by 1921, 13 million by 1923, and 15 million by 1924 (Chief of Engineers 1925:675). A 1914 Report to the Chief of Engineers attributed the lower freight rates at the port of New Orleans to safer and improved conditions on the Southwest Pass (Chief of Engineers 1914:725).

Petroleum and petroleum-related products constituted the largest volume of both imports and exports. Other leading imports included bananas, sugar, molasses, syrup, and coffee. Wheat, raw cotton, and a significant amount of lumber also were shipped through the ports (Goodwin et al. 1985:106).

From 1920, the channel at Southwest Pass was maintained at a depth of thirty-five feet, which required frequent dredging and repair to the jetties. In 1921, in an innovative engineering design, the entrance channel at Southwest Pass was inclined eastward at an angle of 36 degrees from the jetty channels; after this re-design, the requirement for maintenance dredging was reduced. According to one authority, the maintenance of a dependable channel dates from this significant change of 1921 (Scheffaver 1954:329). Subsequent technological improvements increased the speed and efficiency of the dredgeboats that operated in the Southwest Pass.

During the interlude between the First and Second World Wars, the channel through the Southwest Pass was maintained at a 35 foot depth. Traffic through the passes peaked in 1926 at almost 19 million tons. The subsequent decline in tonnage had more to do with the severe and long-lasting economic depression that began in 1929 than to any defects in the Southwest Pass (Chief of Engineers 1936:1178).

In the summer of 1941, on the eve of American entry into the Second World War, construction began on a Navy Section Base in the lower portion of the Burrwood Reservation. The military installation was intended to engage in anti-submarine warfare. From the time that the war actually began until 1943, German submarines posed a significant threat to commercial shipping from the Mississippi River. A German submarine sank the oil tanker *Virginia* in the Southwest Pass early in 1942 (Morison 1961:140-141). On the same day, the Germans fired at a destroyer but missed their target; instead, the torpedo hit the jetties near the lighthouse on Southwest Pass (Goodwin *et al.* 1985:115).

At the conclusion of the war, the Burrwood facility declined in importance and eventually was closed. A fueling station and machine shop no longer were needed at the mouth of the river. The hopper dredge *Benyaurd,* which had devoted its entire operational life (1904 – 1946) to maintaining the Southwest Pass, also was retired. After the *Benyaurd*'s withdrawal, the *Langfitt* alone operated as a dredgeboat at the mouth of the river. In 1949, this vessel was equipped with radar, which enabled it to operate more easily in adverse weather conditions.

Louisiana began to develop its offshore oil and gas fields during the late 1940s. Since that time, numerous oil production facilities and pipelines have been established along the banks of the Southwest Pass. Oil and gas submarine pipelines run beside and across the pass.

In 1945, the United States Congress combined several navigational projects into the "Mississippi River, Baton Rouge to the Gulf of Mexico" project, which included the Southwest and South passes. This legislation deepened the Southwest Pass to 40 by 800 feet and the Southwest Pass Bar Channel to 40 by 600 feet. Further legislation concerning the project in 1962 deepened the channel between Baton Rouge and New Orleans to 40 feet (Secretary of the Army 1996:11-13). By 1963, the 40 foot channel was completed for a distance of 30 miles, from just below the town of Venice through the Southwest Pass to the Gulf of Mexico. From 1964 to 1980, annual maintenance dredging for this 30 mile stretch produced an average 20 million cubic yards of spoil per year. Unfortunately, subsidence and erosion within this reach led to loss of river banks and to river widening in several areas. While this loss of river water benefited the surrounding marshes, it caused increased shoaling within the navigational channel (Carney 1984:EIS44).

A 1984 environmental impact study conducted by the Corps of Engineers emphasized that "[T]he maintenance of Southwest Pass is becoming a more complex problem ... as a result of the rapid deterioration of the banks of the river and pass" (Carney 1984:EIS6). The deterioration resulted largely from subsidence, but wave erosion generated by storms and ship traffic also contributed to the problem.

The following year, Congress authorized the deepening of the channel through the Southwest Pass to a project depth of 55 feet. However, the legislation also contained a cost-sharing clause that required that "[F]or channels deeper than 45 feet, the cost sharing requirements are 50 percent Federal and 50 percent non-Federal for both construction and maintenance (Secretary of the Army 1996:11-14,15). The imposition of this cost-sharing requirement dampened state and local enthusiasm for deepening the channel considerably.

The process of subsidence, including sea level rise, continues to affect coastal Louisiana and to convert uplands and wetlands to open water. The subsidence of the banks of the pass and the loss of river water over its banks has resulted in increased shoaling within the Southwest Pass. As shoaling increases, it constrains river traffic and increases the costs of maintaining the channel. The Corps of Engineers therefore hopes to restore the subsided banks in order to increase river-water velocities, which decrease shoaling and thus improve navigation.

Navigation through the Southwest Pass remains a vital objective. The Mississippi River continues to serve as the mainstem of the world's most highly developed waterway system. As a result, the Corps of Engineers finds itself under considerable economic and political pressure to insure that the Southwest Pass remains open and usable. In the more than three centuries since La Salle discovered the mouth of the Mississippi, the passes have presented some daunting problems and called forth some dazzling engineering feats.

Shipwrecks in the Vicinity of the Project Area

Review of available documentation at several diverse repositories, including the Corps of Engineers' files for the New Orleans District and the Automated Wreck and Obstruction Information System (AWOIS) of the National Oceanographic and Atmospheric Administration (NOAA) indicated that a total of 17 vessels had been reported as lost near or within Plaquemines Parish (Table 1). Of these 17 vessels, six were lost during the nineteenth century, including two associated with the Union thrust up the Mississippi River during the Civil War. Collisions were the most frequently cited cause of loss. Seven of these vessels were lost before 1911, when the Southwest Passage was modified and became the primary entry for vessel traffic into the Mississippi River; it is therefore unlikely that any early vessel wrecks lie within the project area.

Of the remaining ten vessels on the list, the precise locations of the wrecks have not been established. Six were reported lost "within 10 miles of Mile 0 AHP," but more precise locational data were not available. No locational data were provided for four wrecks.

Historic Sites Near the Project Items

Four historic sites are located in the vicinity of the items included in this project area.

Site 16 Pl 53 : The Third Southwest Pass Lighthouse

The first Southwest Pass Lighthouse had a brief, inglorious existence. Built in 1831, supposedly on old flatboat planks, it collapsed in 1838. The second Southwest Pass Light was situated above Upper Lighthouse Bayou. Congress appropriated funds for it in 1838. Like its predecessor, the second lighthouse had structural problems, but plans to improve it were halted by the Civil War. By the end of the conflict, the tower had begun to tilt sideways as it sank into the muck. Abandoned in 1871, it still survived in dilapidated condition in 1909 (Beach 1909). As late as 1976, an authority on lighthouses reported, "The tower still stands, often incorrectly referred to as the Old Spanish Lighthouse" (Cipra 1976:35). According to the Louisiana site files, the site today lies under the waters of West Bay.

The third Southwest Pass Light was located below Lower Lighthouse Bayou. An elevated walkway connected it to a pier on the river (Beach 1909). Construction began in 1869, and this third structure entered service in 1871. The Southwest Pass Light continued to operate until 1953. Its iron superstructure, built in Ohio and shipped to the site, rose 128 feet above sea level (Cipra 1976:35).

Although a survey by the National Park Service suggested that the site has been destroyed, other information in the site form firmly contradicts this suggestion.

Site 16 Pl 54 : Building Site

Site 16 Pl 54 is located in Sections 16 and 17, T23S-R31E, on the west or right descending bank of Southwest Pass, near Mile 4.8 BHP. The site was recorded, but not visited, on evidence established by cartographic research. Although the site form mentions data obtained from an 1891 map, the form lists as its only reference the 1893 USGS West Delta, LA, 15' quadrangle. The 1893 quad indicates four buildings located at the site. The site first was recorded in 1981, when its condition was described as "Very disturbed" and "Reportedly destroyed" (Louisiana Site Record Form 16PL54 1981).

The Building Site is located where oil and gas submarine pipelines cross the pass. Because of this oil and gas activity, which included a Chevron facility on the bankline at Mile 4.8 BHP, a report to the Corps of Engineers in 1985 described the 1891 building site as "probably seriously disturbed" (Goodwin et al. 1985:32).

Site 16 Pl 55 : Pilot Lookout Site

Site 16PL55 is located on the east (left descending) bank of Southwest Pass near Mile 12.3 BHP. At least one pilot boat was stationed at Southwest Pass as early as 1837. As the Southwest Pass came into favor in the 1840s as the chief outlet for the river, a small community of pilots developed at 16 Pl 55. By 1847, about 70 persons lived in the locale (Carter 1942:431).

The site assumed particular importance during the Civil War. In 1861, "Pilot Town" was described as a community of "...about 30 private houses, inhabited principally by pilots and their families, a revenue station, and a telegraph station ... but no levees ... except a small one inclosing [sic] a private garden" (Stewart 1903:623). The telegraph station was located on the west bank opposite the community. The revenue station (Site 16 PL 56) was situated about a mile upstream from Pilot Town on the same side of the pass.

In March and April 1862, a Union fleet under Commodore David Farragut occupied Pilot Town prior to seizing New Orleans. Pilot Town served as the land base for Farragut's operations. The community was used as a depot area for military stores, and a guard force was stationed there (Stewart 1904:65,68,96). As previously mentioned, Confederate naval forces always believed that the pilots sympathized with the Union cause.

Maps reveal that Pilot Town or Pilotsville remained a community of sorts throughout the remainder of the nineteenth century. Nevertheless, it declined in size and importance when Eads began his work on the South Pass in 1879. When work began on the Southwest Pass, the old pilot community disappeared altogether. By 1905, it had been replaced by a new Pilottown above the head of passes.

The original Pilot Town on Southwest Pass was situated north of or above Pilot's Bayou. Nevertheless, the last map that records standing structures at the site, a Corps of Engineers "Chart of a Part of Southwest Pass" in June, 1909, depicts the following buildings: a triangle to denote Pilot Town Station above the bayou; another structure above the bayou; and, four structures below the bayou (Beach 1909).

Site 16 Pl 56 : The Customs House Site

The Customs House Site is located on the east (left descending) bank of the Southwest Pass near Mile 11.4 BPH. The revenue station near the old Pilot Town on Southwest Pass was established before the Civil War (Stewart 1903:523, 570). It was located on the upsteam side of Scott's Bayou near the river. The Eads experiments in the South and Southwest Passes obviously affected the revenue station or customs house site. The previously mentioned Corps of Engineers map of Southwest Pass in 1909 depicts Customhouse Bayou but no structure or structures are shown (Beach 1909).

CHAPTER IV

RESEARCH METHODS

Archival Investigations

Archival research concerning the history of the Southwest Pass Project area focused primarily on determining land use within the three survey blocks and its relationship to waterborne transportation on this section of the Mississippi River; and on identifying specific vessel losses reported near or within the project area. To accomplish this task, the archives at a number of institutions and collections were consulted: Tulane University's Howard Tilton Library; the New Orleans Public Library, Louisiana Division; the Williams Research Center, New Orleans; the U.S. Army Corps of Engineers Library, New Orleans District; and the State of Louisiana's Department of Culture, Recreation, and Tourism, Division of Archeology. Shipwreck data were obtained through a number of sources including the State of Louisiana Shipwreck Database (Department of Culture, Recreation, and Tourism, Division of Archeology), the U.S. Army Corps of Engineers shipwreck data base (USACE Planning Division, New Orleans District) and the Automated Wreck and Obstruction Information System (AWOIS) of the National Oceanic and Atmospheric Administration (NOAA). Additional shipwreck data were obtained from published secondary sources, specifically Berman's *Encyclopedia of American Shipwrecks*, *Way's Packet Directory*, and Lytle and Holdcamper's *Merchant Steam Vessels of the United States, 1790-1868.*

Archeological Investigations

The Southwest Pass marine remote sensing survey was conducted from the 26-ft research vessel *Coli.* R/V *Coli* was leased from the Louisiana Universities Marine Consortium (LUMCON), and was captained by LUMCON's Mr. Samuel LeBouef. The project area consisted of three survey blocks, which were divided into parallel track lines spaced at 50 ft intervals. Survey Block 1, which measured 539 x 3,279 ft (164.29 x 999.45 m) equaling 1,640,735 sq. ft. (.161 sq. km), contained seven transects. Survey Block 2, measuring 962 x 6,427 ft (293.22 x 1958.97 m) (6,046,755 sq. ft. [.5688 sq. km]), contained 11 transects. Survey Block 3, a 661 x 4,488 ft (201.48 x 1367.96 m) (3,220,794 sq. ft [.2862 sq. km]) area, contained nine transects.

The remote sensing survey was designed to identify specific magnetic or acoustic anomalies and/or clusters of anomalies that might represent potentially significant submerged cultural resources, such as shipwrecks. The natural and anthropogenic forces that form such sites typically scatter ferrous objects like fasteners, anchors, engine parts, ballast, weaponry, cargo, tools, and miscellaneous related debris across the river bottom. These objects normally can be detected with a marine magnetometer, side scan sonar system, and fathometer that record anomalous magnetic or acoustic underwater signatures that stand out against the ambient magnetic or visual field. Two critical elements in the interpretation of such anomalies, which may also result from natural or modern sources, are their patterns and, in the case of magnetic anomalies, their amplitude and duration. Because of the importance of anomaly patterning, accurate recording and positioning of anomaly locations is essential.

The equipment array used for the Southwest Pass survey included a DGPS, a proton precession marine magnetometer, a side scan sonar, and a fathometer (Figure 14). Data were collected and correlated via a laptop computer using hydrographic survey software.

Positioning

A Differential Global Positioning System (DGPS) was used to direct navigation and supply accurate positions of magnetic and acoustic anomalies. The DGPS system consisted of a Northstar 941XD with internal DGPS. The Northstar 941XD transmitted position information in NMEA 0183 code to the computer navigation system (version 7.0 of Coastal Oceanographics' *Hypack* software).

Hypack translates the NMEA message and displays the survey vessel's position on a computer screen relative to the pre-plotted track lines. During post-processing, *Hypack's* positioning files can be utilized to produce track plot maps and to derive the X, Y, and Z values used to produce magnetic and bathymetric contour plot maps. For the Southwest Pass marine remote sensing survey, positioning control points were obtained continuously by *Hypack* at one-second intervals. During the course of the survey, strong differential signals were acquired with a minimum noise to signal ratio.

Magnetometry

The recording proton precession marine magnetometer is an electronic instrument used to record the strength of the earth's magnetic field in increments of nanoTeslas or gammas. Magnetometers have proven useful in marine research as detectors of anomalous distortions in the earth's ambient magnetic field, particularly distortions that are caused by concentrations of naturally occurring and manmade, ferrous materials. Distortions or changes as small as 0.5 gammas are detectable when operating the magnetometer at a sampling rate of one second. Magnetic distortions caused by shipwrecks may range in intensity from several gammas to several thousand gammas, depending upon such factors as the mass of ferrous materials present, the distance of the ferrous mass from the sensor, and the orientation of the mass relative to the sensor (Figure 15). The uses of magnetometers in marine archeology and the theoretical aspects of the physical principals behind their operation are summarized and discussed in detail in Aitken (1961), Hall (1966, 1970), Tite (1972), Breiner (1973), Weymouth (1986), and Green (1990).

Individual anomalies produce distinctive magnetic "signatures." These individual signatures may be categorized as 1) positive monopole; 2) negative monopole; 3) dipolar or 4)-multi component (Figure 16). Positive and negative anomalies refer to monopolar deflections of the magnetic field and usually indicate a single source. They produce either a positive or negative deflection from the ambient magnetic field, depending on how the object is oriented relative to the magnetometer sensor and whether its positive or negative pole is positioned closest to the sensor. Dipolar signatures display both a rise and a fall above and below the ambient field; they also are commonly associated with single source anomalies, with the dipole usually aligned along the axis of the magnetic field and the negative peak of the anomaly falling nearest the North Pole.

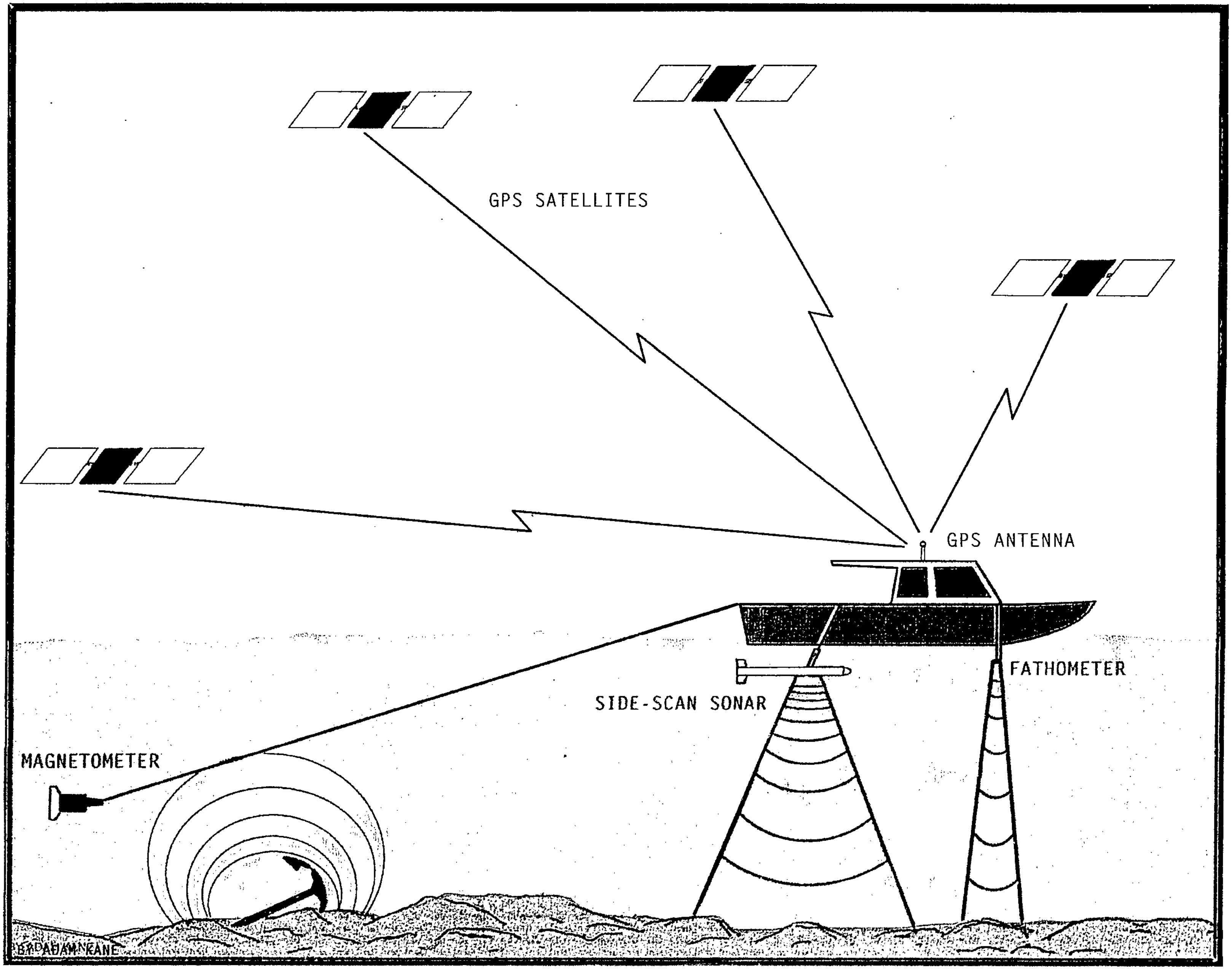
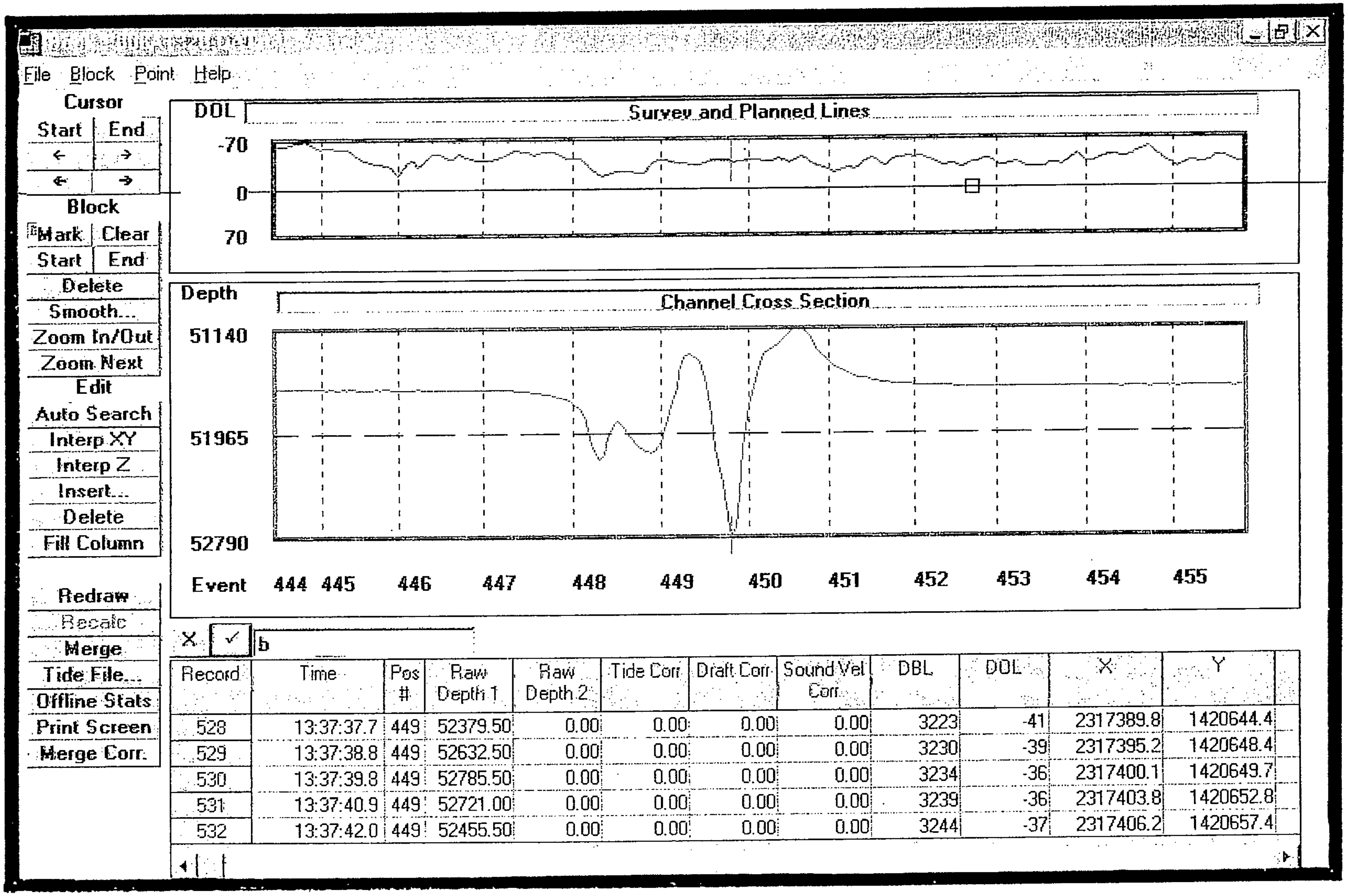


Figure 14. Array of instruments used during the Southwest Pass survey



Record	Time	Pos #	Raw Depth 1	Raw Depth 2	Tide Corr	Draft Corr	Sound Vel Corr	DBL	DOL	X	Y
528	13:37:37.7	449	52379.50	0.00	0.00	0.00	0.00	3223	-41	2317389.8	1420644.4
529	13:37:38.8	449	52632.50	0.00	0.00	0.00	0.00	3230	-39	2317395.2	1420648.4
530	13:37:39.8	449	52785.50	0.00	0.00	0.00	0.00	3234	-36	2317400.1	1420649.7
531	13:37:40.9	449	52721.00	0.00	0.00	0.00	0.00	3239	-36	2317403.8	1420652.8
532	13:37:42.0	449	52455.50	0.00	0.00	0.00	0.00	3244	-37	2317406.2	1420657.4

Figure 15. *Hypack* "Edit" screen image of a 1,650 gamma magnetic anomaly caused by the hull remains of a ca. 1860 steamboat wreck discovered by RCG&A during a recently completed remote sensing survey of the upper Yazoo River near Greenwood, Mississippi.

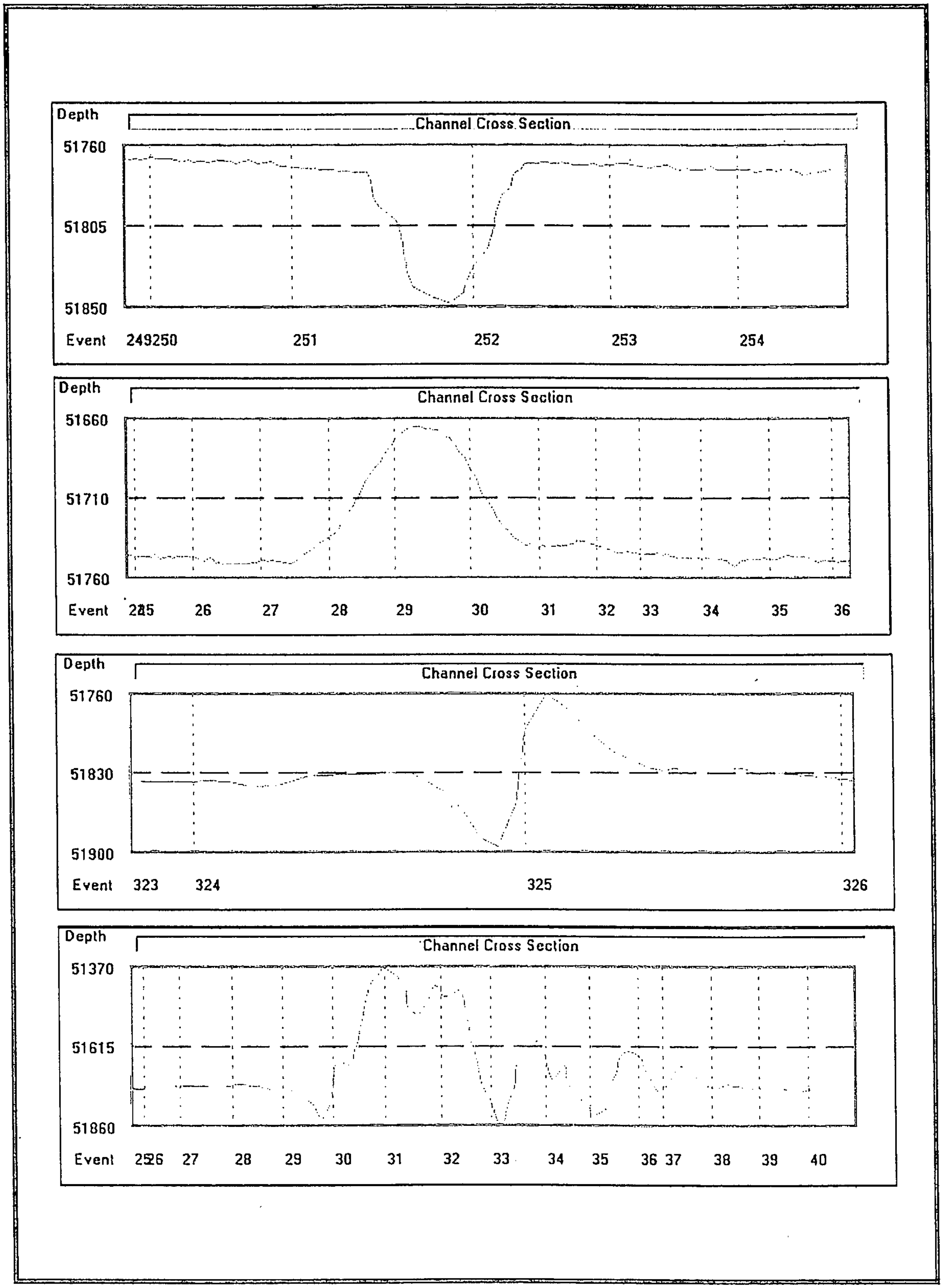


Figure 16. *Hypack* magnetic data screen showing the four types of magnetic signals commonly seen during a magnetic survey

Especially important for archeological surveys are multi-component anomalies. Multi-component or complex signature anomalies consist of both dipolar and monopolar magnetic perturbations associated with a large overall deflection that can be indicative of the multiple individual ferrous materials comprising the debris patterns typically associated with shipwrecks. The complexity of the signature is affected partially by the distance of the sensor from the debris and the quantity of debris. If the sensor is close to the wreck, the signature will be multi component; if far away, it may appear as a single source signature.

A Geometrics G866 proton precession marine magnetometer was used to complete the magnetic survey of the Southwest Pass project area. The G866 is a 0.1 gamma sensitivity magnetometer that downloads magnetic data in digital format as numeric data files in *Hypack*. As the magnetic data are being collected, *Hypack* attaches the precise real-time DGPS coordinates to each magnetic reading, thus ensuring precise positioning control. The magnetometer was towed far enough behind the survey vessel to minimize the associated noise, which generally measured less than two gammas. A float was attached to the magnetometer sensor, so that a consistent depth below the water's surface could be maintained.

Acoustic Imaging

Over the past 25 years, the combined use of acoustic (sonar) and magnetic remote sensing equipment has proven to be the most effective method of identifying submerged cultural resources and assessing their potential for further research (Hall 1970; Green 1990). When combined with magnetic data, the near photographic-quality acoustic records produced by side scan sonar systems have left little doubt regarding the identifications of some targets that are intact shipwrecks (Figure 17). For targets lacking structural integrity or those partially buried beneath bottom sediments, identification can be extremely difficult. Because intact and exposed wrecks are less common than broken and buried wrecks, remote sensing surveys generally produce acoustic targets that require ground-truthing by divers to determine their identification and historic significance.

An Imagenex color imaging digital side scan sonar system was utilized continuously during the Southwest Pass survey to produce sonograms of the river bottom on each transect within the project area. The Imagenex system consisted of a Model 858 processor coupled with a Model 855 dual transducer tow fish operating at a frequency of 330 KHz. The sonar was set at a range of 90 ft per channel, which yielded overlapping coverage of the study areas. Sonar data were recorded in a digital format on a 270 megabyte 3.5 in SyQuest cartridge. A stream of time-tags was attached continuously to the sonar data to assist in post-processing correlation of the acoustic and magnetic data sets. Acoustic images were displayed on a VGA monitor as they were recorded during the survey, and an observation log was maintained by the sonar technician to record descriptions of the anomalies and the times and locations associated with each target. Potential targets were inventoried both during the survey and in post-processing.

The methodology employed during the survey produced favorable results, with reliable DGPS signals, low noise levels on the magnetometer, and clear acoustic images. All positioning and remote sensing equipment performed reliably throughout the survey. Regular and evenly spaced coverage of the entire survey area was achieved.

Survey Control and Correlation of Data Sets

The *Hypack* survey software provided the primary method of control during the survey. Survey lanes were planned in *Hypack*, geodetic parameters were established, and instruments were interfaced and recorded through the computer software. During the survey, the planned survey lines were displayed on the computer screen, and the survey vessel's track was monitored. In addition to providing steering direction for the helmsman, *Hypack* allowed the surveyors to monitor instruments and incoming data through additional windows on the survey screen.

All remote sensing data were correlated with DGPS positioning data and time through *Hypack*. Positions for all data then were corrected through the software for instrument layback and offsets. Positioning was recorded using Louisiana South State Plane grid coordinates, referencing the North American Datum of 1983 (NAD-83). The GRS-1980 ellipsoid was used, along with a Lambert projection.

Remote Sensing Data Analysis

Magnetic and acoustic data were analyzed in the field while they were generated, and post-processed using *Hypack* and Autodesk's *AutoCAD* computer software applications. These computer programs were used to assess the signature, intensity, and duration of individual magnetic disturbances, and to plot their positions within the project area.

In the analysis of magnetometer data for this survey, individual anomalies were identified and carefully examined. First, the profile of each anomaly was characterized in terms of pattern, amplitude, and duration. Magnetic data were correlated with field notes, so that deflections from modern sources, such as channel markers, could be identified. Although all anomalies with an amplitude greater than ten gammas were given a magnetic anomaly number for reference purposes and tabulate; anomalies of larger amplitude (more than 50 gammas) and of longer duration (more than 20 seconds) generally are considered to have a higher likelihood of representing possible shipwreck remains, especially when such anomalies cluster together.

Side scan sonar data were examined for anomalous acoustic targets and shadows that might represent potentially significant submerged cultural resources, and to correlate with any magnetic or bathymetric anomalies.

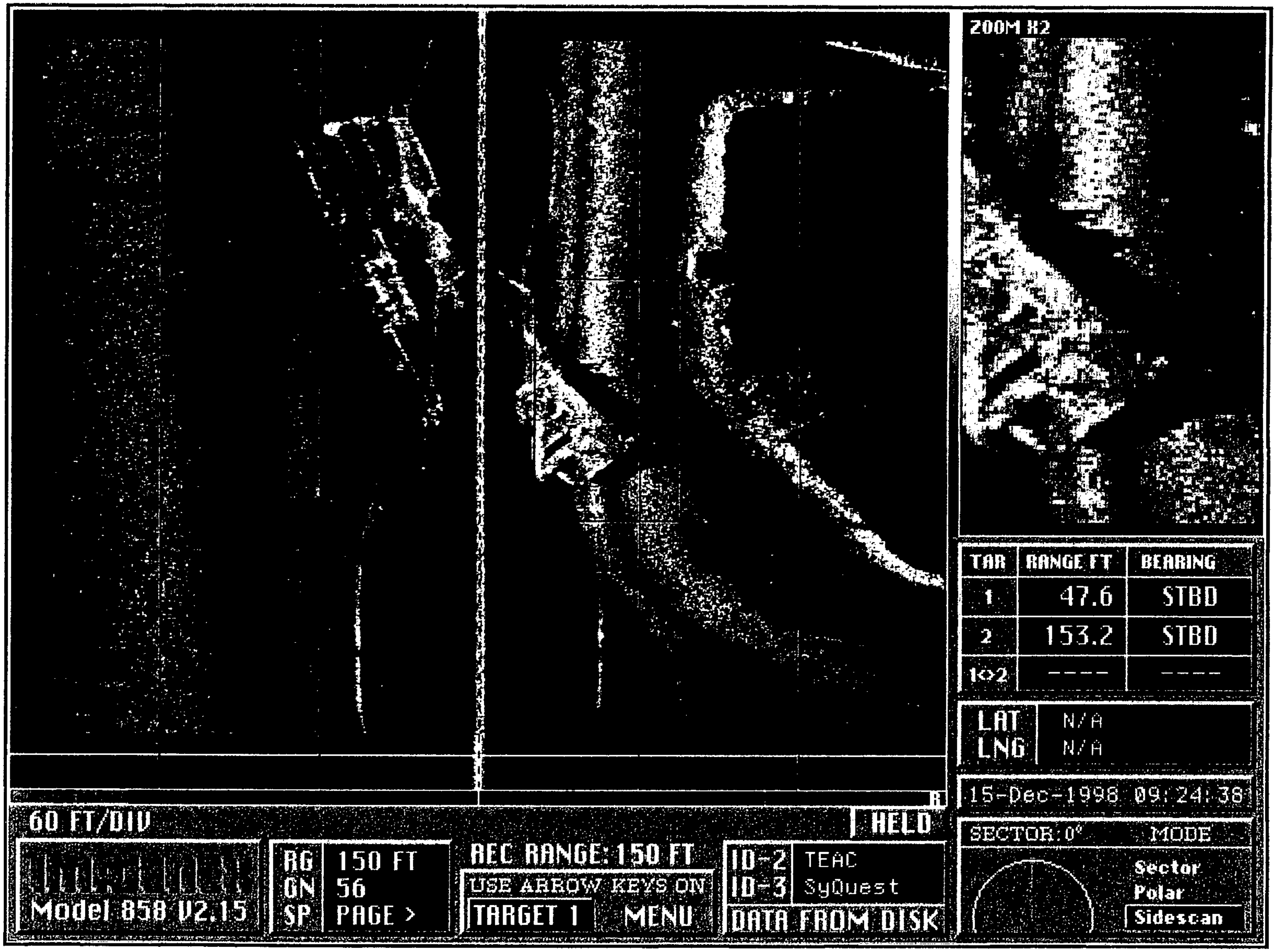


Figure 17. Imagenex 858 side scan sonar image of shipwreck located by RCG&A in 1998 on the Calcasieu River, Calcasieu Parish, Louisiana

CHAPTER V

SURVEY RESULTS

The following discussion reviews the results of the underwater cultural resources survey of segments along Southwest Pass of the Mississippi River, Baton Rouge to the Gulf of Mexico, Plaquemines Parish, Louisiana. A general overview is followed by a description of the anomalies located in the survey area. Figures 18-20 show the spatial distribution of the magnetic anomalies. As noted above, these anomalies were identified initially by reading individual trackline data sets, rather than by contouring; however, contours were produced and analyzed for those targets that will be impacted by the dike construction project.

Overview of the Survey Results

In the three survey blocks combined, approximately 44 linear miles of riverbank and bottom were surveyed. Water depths in the project area ranged from two to thirty feet and obstructions included numerous dikes, snags, mud bars and vessel traffic (Figure 21). A total of 128 individual magnetic anomalies were detected during the Southwest Pass survey (Table 2). More than half of these anomalies (58 per cent) were scattered throughout survey Block 2. Survey Block 1 contained 23 per cent of the total number, and Survey Block 3 encompassed the remaining 19 per cent of the anomalies.

Thirty-five (35) anomalies comprised single areas of high density, indicative of anomalies of unusually high amplitude or duration, or exhibiting complex magnetic signatures. These 35 anomalies were organized into eleven targets, none of which had corresponding acoustic anomalies. Each of these targets is discussed below. The remaining 93 anomalies constituted single, patternless point sources without correlations on adjacent tracklines. Analysis of these anomalies indicated that they represented very small areas of scattered, and presumably modern, isolated ferrous debris. Numerous sources of such ferromagnetic debris were observed along the riverbank (Figure 22).

Specific Target Analyses

Target #1

Four magnetic disturbances (M26, M10, M14 and M5) comprise Target #1. Three of these anomalies (M10, M14 and M26) were classified as high amplitude disturbances that measured 224.2, 1498.8, and 623 gammas, respectively. M5 was a medium amplitude disturbance registering 80.6 gammas of short duration (9.9 seconds). M10 (14.2 seconds) and M26 (10.2 seconds) were categorized as medium duration anomalies, while M14 (54.0 seconds) was categorized as long. Together, the four anomalies comprising this target exhibited a wide range of magnetic signatures, including two monopoles (M5 and M26), a dipole (M10) and a multicomponent disturbance (M14). No associated acoustical anomalies were noted in relation to this target.

Despite the high amplitude readings associated with this target, the predominately short to medium duration of its component anomalies, their close spatial distribution, and the absence of corresponding acoustical data suggest that Target #1 represents an area of scattered, presumably modern, ferrous debris (Figure 23). The magnetic attributes of the anomalies comprising this target are not typical of a shipwreck or other potentially significant cultural resource. Therefore, no further study of Target #1 is recommended or warranted.

<u>Target #2</u>

Target #2 consisted of a series of eight monopolar magnetic perturbations (M102, M97, M101, and M90, M78, M61, M73 and M41) (Figure 24). Four of these disturbances (M41, M61, M73 and M102) were considered high amplitude anomalies that measured 418, 208.2, 187, and 131.6 gammas, respectively. One disturbance, M78, was categorized as a medium amplitude anomaly at 65.6 gammas, while the remaining three anomalies (M90, M97 and M101) were categorized as low amplitude perturbations registering 43, 21.4 and 41.8 gamma. Three quarters of the anomalies comprising this target were of long duration, registering for 31.8 seconds (M41), 37.9 seconds (M73), 40.1 seconds (M78), 57.3 seconds (M90), 64.2 seconds (M101), and 43.9 seconds (M102). Anomalies M61 and M97 were of medium (19 and 24.2 seconds) duration.

The linear distribution of the anomalies comprising this target, their detection on several survey tracklines, their monopolar magnetic signatures, their occurrence in a charted pipeline crossing area, and the absence of correlating acoustic data indicated that Target #2 represents a buried pipeline that transects the survey block. These anomalies are not indicative of a potentially significant cultural resource. Therefore, no further study of Target #2 is recommended.

<u>Target #3</u>

Target #3 consisted of a pair of monopolar magnetic disturbances (M43 and M55) of high amplitude and medium duration (Figure 25). M43 measured 367 gammas for 12 seconds, while M55 measured 234.4 gammas for 12 seconds.

The amplitude and duration of these disturbances were characteristic of a small area of presumably modern, ferrous debris associated with the wing dikes along the riverbank, or debris trapped against the dikes during high water. Although the deflections of these disturbances were categorized as high, they were not of the amplitude typically associated with a shipwreck or other potentially significant cultural resource in such shallow water (approximately 2 – 3 ft). This conclusion was supported by the absence of correlative acoustic data. Therefore, no further study of Target #3 is recommended.

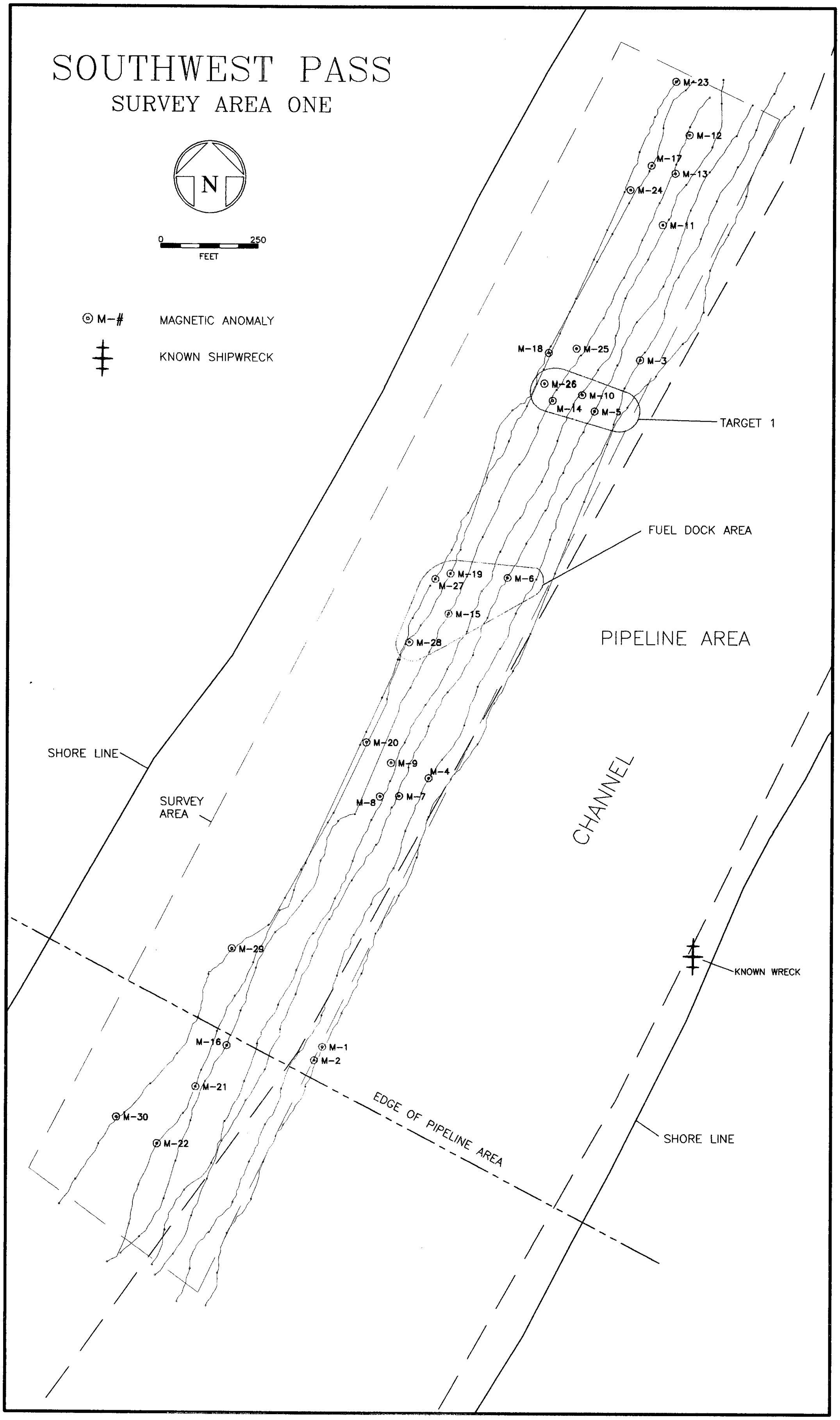


Figure 18. Map of Survey Area 1 depicting spatial distribution of magnetic anomalies and targets

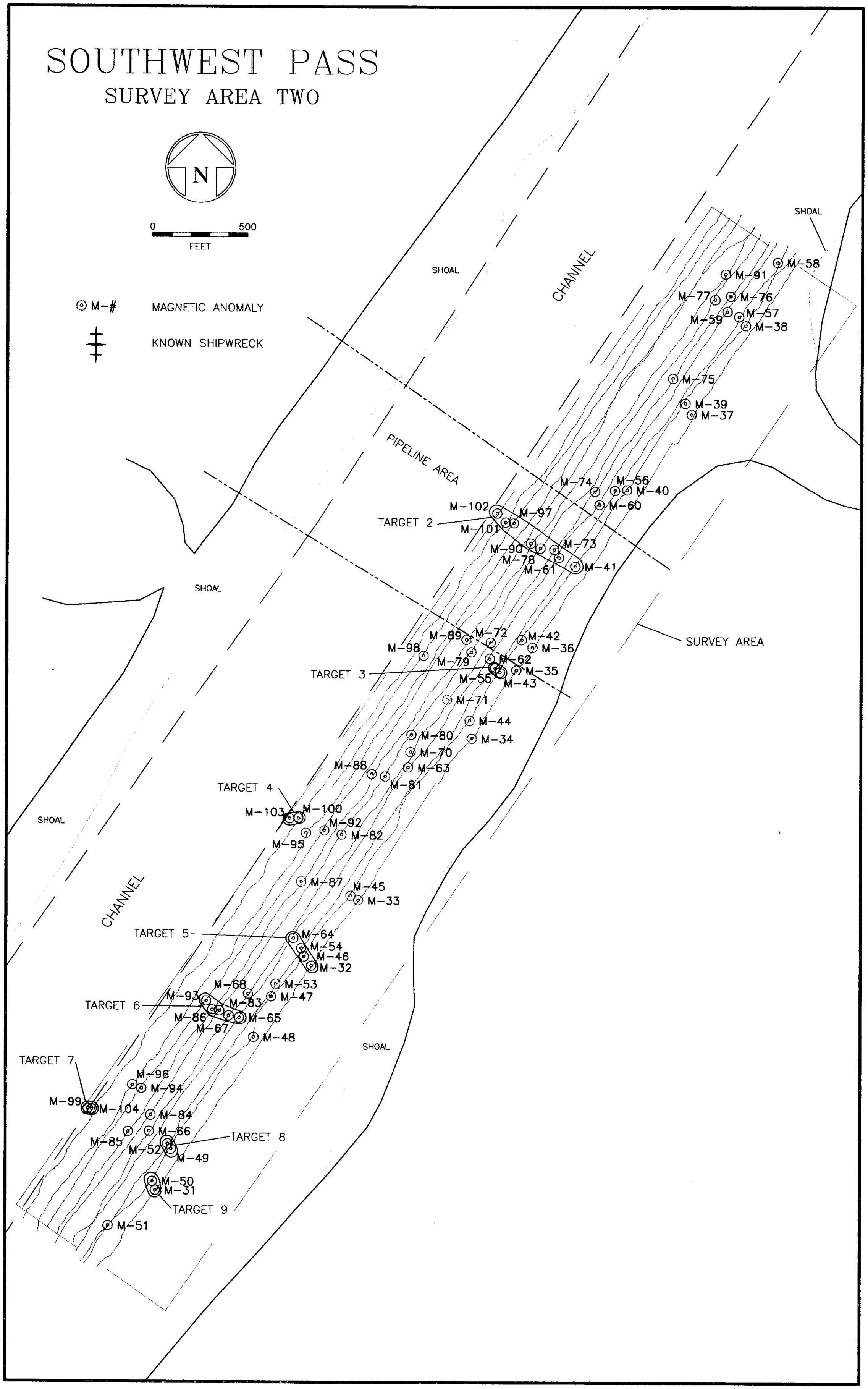


Figure 19. Map of Survey Area 2 depicting spatial distribution of magnetic anomalies and targets

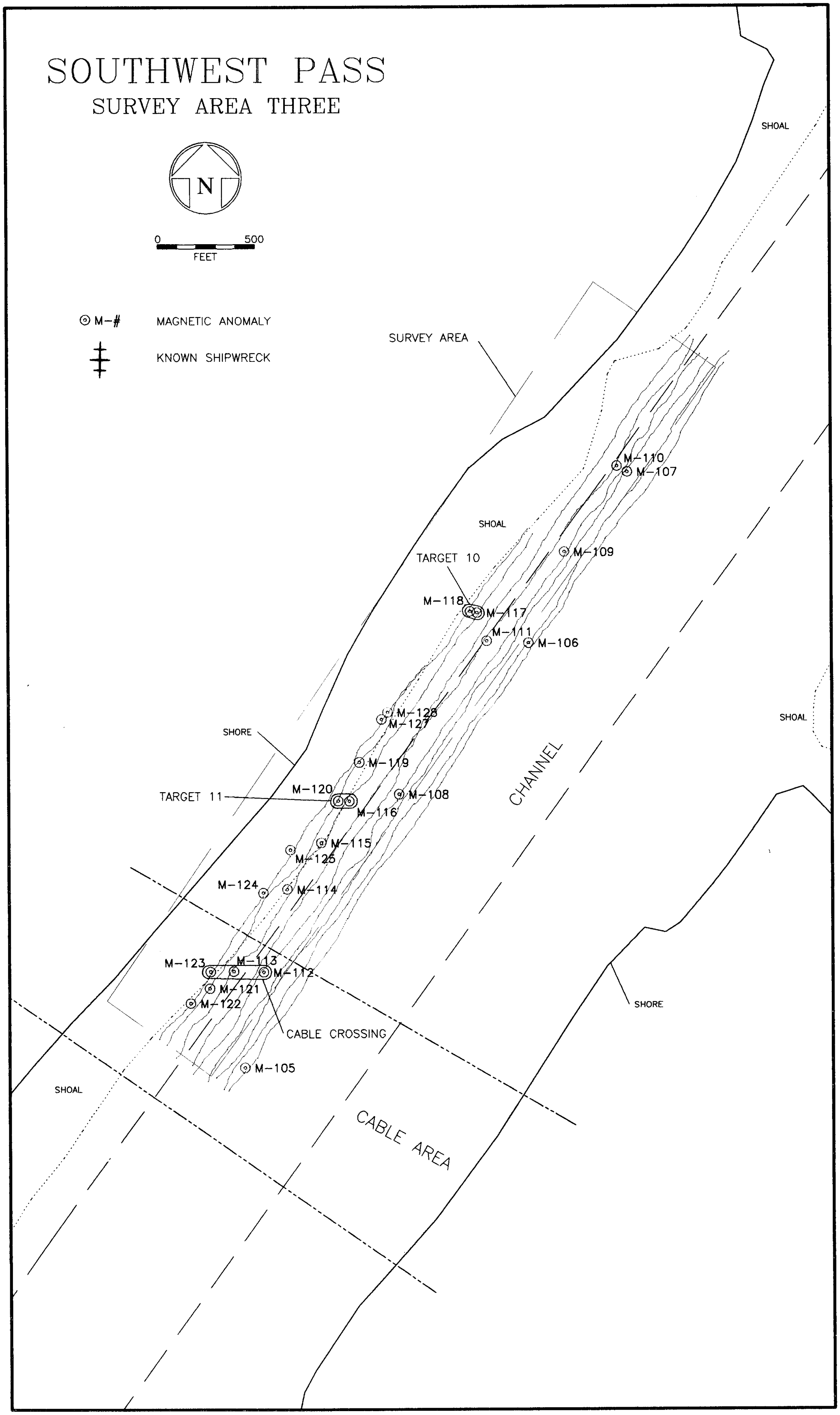


Figure 20. Map of Survey Area 3 depicting spatial distribution of magnetic anomalies and targets

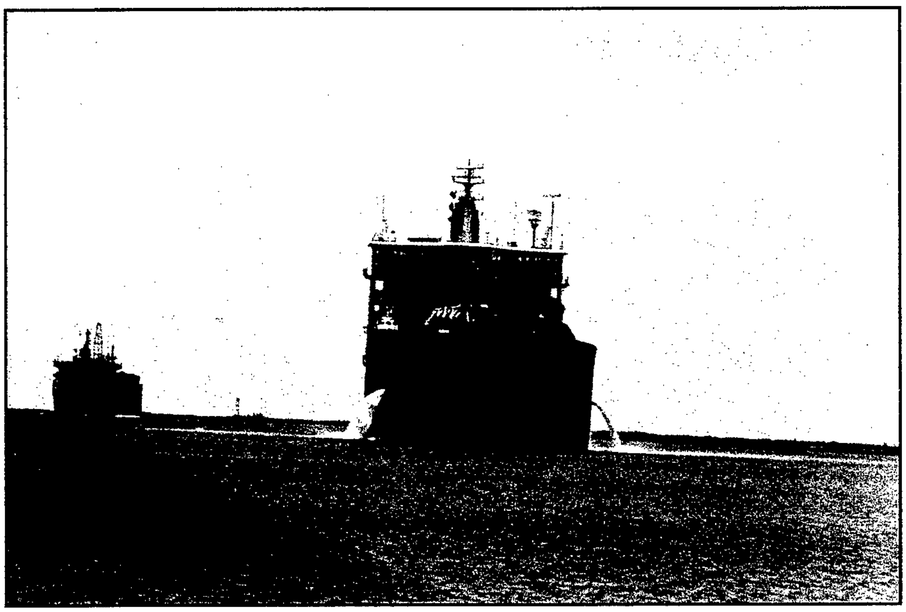


Figure 21. Photograph of typical vessel traffic in survey area

TABLE 2. MAGNETIC ANOMALIES RECORDED IN SURVEY BLOCKS

Anom #.	Block/ Line	Time	Duration	Gamma	Signatue	X	Y	Correlations
M1	B1L1	10:01:22	6	3775.2 M	Monopole	3935194.6	219013.4	
M2	B1L1	10:01:16	3.8	1606.8 M	Monopole	3935174	218978.4	
M3	B1L2	15:25:03	51.8	23 M	Monopole	3936006.4	220785	
M4	B1L2	15:22:27	19.8	74.4 M	Monopole	3935465.7	219706.2	
M5	B1L3	15:30:13	9.9	80.6 M	Monopole	3935889.4	220652.8	
M6	B1L3	15:31:13	7.6	112.2 D	Dipole	3935667.2	220222.9	
M7	B1L3	15:32:33	46.2	1051.4 D	Dipole	3935389.9	219659.7	
M8	B1L4	15:40:45	6	3842 M	Monopole	3935340.4	219658.5	
M9	B1L4	15:40:57	6.1	7143.8 M	Monopole	3935368.7	219745.3	
M10	B1L4	15:43:15	14.2	224.2 D	Dipole	3935857.7	220695.2	
M11	B1L4	15:44:23	12.1	78 M	Monopole	3936063.3	221134.5	
M12	B1L5	15:50:37	4.4	137.4 M	Monopole	3936131.4	221365.5	
M13	B1L5	15:50:51	3.9	225.6 M	Monopole	3936095.4	221266.6	
M14	B1L5	15:52:15	54	1498.8 MC	Multi-component	3935781.6	220680.2	
M15	B1L5	15:53:33	12	185.8 D	Dipole	3935515.2	220130.7	
M16	B1L5	15:56:29	8.2	39.6 D	Dipole	3934948.4	219016	
M17	B1L6	16:06:55	9.9	205.2 D	Dipole	3936034	221286.9	
M18	B1L6	16:05:19	42.1	1037.6 M	Monopole	3935771.3	220803.6	
M19	B1L6	16:04:07	6	224.8 M	Monopole	3935519.8	220233.8	
M20	B1L6	16:02:55	6.9	378.2 M	Monopole	3935304.9	219798.1	
M21	B1L6	16:00:37	3.8	115 M	Monopole	3934868.2	218908.8	
M22	B1L6	16:00:13	7.7	6288.2 D	Dipole	3934769.3	218760.7	
M23	B1L7	16:10:57	6	359.4 M	Monopole	3936096.2	221503.3	
M24	B1L7	16:11:41	12.1	197.8 D	Dipole	3935979.9	221224.5	
M25	B1L7	16:12:47	6	561.4 M	Monopole	3935842.7	220814.5	
M26	B1L7	16:13:07	10.2	623 +	Monopole	3935760.3	220724	
M27	B1L7	16:14:45	6	224.6 +	Monopole	3935480.8	220219.9	
M28	B1L7	16:15:15	9.9	174.2 -	Monopole	3935414.7	220057	
M29	B1L7	16:18:03	15.9	203.4 D	Dipole	3934960.5	219265.8	
M30	B1L7	16:19:25	6.1	74.8 D	Dipole	3934664.2	218828.9	
M31	B2L9	14:10:31	24.1	127.6 D	Dipole	3913076.6	186118.2	
M32	B2L9	14:14:44	5.5	290.6 D	Dipole	3913896	187306	
M33	B2L9	14:15:55	12.1	906 D	Dipole	3914142.1	187651.5	
M34	B2L9	14:19:08	12.1	684 D	Dipole	3914737.9	188501.9	
M35	B2L9	14:20:16	21.9	845 -	Monopole	3914971.8	188863.4	
M36	B2L9	14:20:39	8.2	1306 D	Dipole	3915056.3	188983.1	
M37	B2L9	14:25:10	12	279.4 +	Monopole	3915891.6	190213	
M38	B2L10	13:46:43	34	868.4 D	Dipole	3916175.3	190681.2	
M39	B2L10	13:47:58	37	176.2 +	Monopole	3915858.6	190270.3	
M40	B2L10	13:49:22	18	129 -	Monopole	3915552.2	189816.5	
M41	B2L10	13:50:32	31.8	418 +	Monopole	3915281.8	189410.9	
M42	B2L10	13:51:39	22	728.8	Monopole	3915000.1	189022.8	
M43	B2L10	13:52:07	12	367	Monopole	3914885	188852.2	
M44	B2L10	13:52:48	24.1	549.2 D	Dipole	3914726	188595.8	
M45	B2L10	55:23.0	9.8	197 +	Monopole	3914101.6	187675.1	
M46	B2L10	13:56:11	18.1	8076	Monopole	3913856.9	187354.2	

Anom #.	Block/ Line	Time	Duration	Gamma	Signatue	X	Y	Correlations
M47	B2L10	13:56:49	16.4	238.4 -	Monopole	3913685.2	187141.1	
M48	B2L10	13:57:17	9.8	371 +	Monopole	3913592.7	186926.4	
M49	B2L10	13:58:45	12.1	272.2 D	Dipole	3913159.2	186335	
M50	B2L10	13:59:07	13.8	433.4 D	Dipole	3913061.2	186164.9	
M51	B2L11	13:28:26	9.9	222.2 +	Monopole	3912828.8	185931.5	
M52	B2L11	13:29:43	12.1	180.4 -	Monopole	3913141.7	186361.9	
M53	B2L11	13:32:08	18	137.6 +	Monopole	3913707.1	187208	
M54	B2L11	13:32:42	16.6	294.8 -	Monopole	3913842.1	187397.1	
M55	B2L11	13:37:04	12	234.4 +	Monopole	3914860.1	188874.6	
M56	B2L11	13:39:40	27.9	484 D	Dipole	3915488.7	189813.1	
M57	B2L11	13:42:13	17.7	13415.6 D	Dipole	3916139.5	190728.9	
M58	B2L11	13:43:00	6	164 +	Monopole	3916341.7	191016	
M59	B2L12	13:15:05	18	290.8 +	Monopole	3916078.2	190756.2	
M60	B2L12	13:17:15	13.7	305 D	Dipole	3915407.6	189737.8	
M61	B2L12	13:17:52	18	208.2 -	Monopole	3915195.6	189458.3	
M62	B2L12	13:19:00	18.1	134.8 +	Monopole	3914831.8	188924.3	
M63	B2L12	13:20:15	25	283.8 +	Monopole	3914402.6	188349.4	
M64	B2L12	13:22:08	18.1	143.6 D	Dipole	3913800.8	187450.3	
M65	B2L12	13:23:02	24	93 +	Monopole	3913516.6	187028.9	
M66	B2L13	12:41:34	34	49.6 D	Dipole	3913044	186427.8	
M67	B2L13	12:43:34	15.9	44.2 -	Monopole	3913461.2	187039.5	
M68	B2L13	12:43:58	10	47.4 +	Monopole	3913563	187155.1	
M69	B2L13	12:46:02	16	84.6 D	Dipole	3913994.8	187812	
M70	B2L13	12:48:00	28	489.2	Monopole	3914415.2	188431.3	
M71	B2L13	12:48:52	26.3	106.2 D	Dipole	3914607.6	188707	
M72	B2L13	12:49:50	21.9	159 D	Dipole	3914837.2	189009.3	
M73	B2L13	12:51:16	37.9	187 -	Monopole	3915170.6	189501	
M74	B2L13	12:52:08	24.2	57.4 +	Monopole	3915383.3	189807.7	
M75	B2L13	12:53:52	13.7	73.6 -	Monopole	3915793.2	190401.1	
M76	B2L13	12:55:08	40	147.8 D	Dipole	3916095.2	190836.8	
M77	B2L14	12:26:40	27.3	59.4 D	Dipole	3916014.1	190817.7	
M78	B2L14	12:29:26	40.1	65.6 -	Monopole	3915097.1	189507.9	
M79	B2L14	12:30:32	23.5	750 +	Monopole	3914735.1	188959	
M80	B2L14	12:31:26	15.9	84.4 +	Monopole	3914419.9	188521.1	
M81	B2L14	12:31:52	17.5	121.4 +	Monopole	3914282.4	188301.5	
M82	B2L14	12:32:30	9.8	29.8 D	Dipole	3914053.6	187995	
M83	B2L14	12:34:22	18.1	31.4 +	Monopole	3913412.3	187065.4	
M84	B2L14	12:35:26	25.7	47.8 M	Monopole	3913052.2	186512.9	FUEL DOCK
M85	B2L15	12:09:48	6	31.0 +	Monopole	3912933.6	186425.9	
M86	B2L15	12:11:42	14.2	25 +	Monopole	3913374.1	187070.3	
M87	B2L15	12:13:40	26.2	37.6 -	Monopole	3913841.4	187748.7	
M88	B2L15	12:15:14	24.4	52.6 +	Monopole	3914211.4	188314.4	
M89	B2L15	12:17:16	41.6	29 D	Dipole	3914708.5	189024.1	
M90	B2L15	12:18:44	57.3	43 -	Monopole	3915046.9	189533.6	
M91	B2L15	12:22:38	47.2	96 D	Dipole	3916068.6	190953.9	DIKE/LIGHT
M92	B2L16	11:55:14	31.8	46.6 D	Dipole	3913962.8	188017.7	
M93	B2L16	11:57:20	15.8	30.8 D	Dipole	3913343	187117.3	
M94	B2L16	11:58:28	15.9	81.4 -	Monopole	3913003.6	186653.6	
M95	B2L17	11:34:42	102	121.8 D	Dipole	3913864.8	188003.8	FUEL DOCK
M96	B2L17	11:30:02	24	102.4 D	Dipole	3912956.2	186673.3	PIPE

Anom #.	Block/ Line	Time	Duration	Gamma	Signatue	X	Y	Correlations
M97	B2L18	11:09:38	24.2	21.4 -	Monopole	3914957.5	189640.4	FUEL DOCK
M98	B2L18	11:11:30	40.1	20.2 D	Dipole	3914482.3	188939.5	PIPE
M99	B2L19	10:47:07	52.1	51 D	Dipole	3912743	186542.6	
M100	B2L19	10:52:32	39.9	89.2 -	Monopole	3913825.5	188082.5	
M101	B2L19	10:57:56	64.2	41.8 +	Monopole	3914912.9	189644.3	
M102	B2L20	10:26:32	43.9	131.6 +	Monopole	3914869.1	189692	PIPE
M103	B2L20	10:30:10	20.2	34 -	Monopole	3913779.1	188080.2	FUEL DOCK
M104	B2L20	10:33:41	33.9	27.4 D	Dipole	3912721.7	186545.6	PIPE
M105	B3L1	14:05:34	6.9	11 D	Dipole	3903425.8	174633.3	
M106	B3L2	14:16:22	50	333 -	Monopole	3904896.6	176822.1	PASSING SHIP
M107	B3L3	14:30:12	19.6	21.8 D	Dipole	3905412	177706	
M108	B3L4	14:51:57	11.5	13 +	Monopole	3904223.2	176048.8	
M109	B3L4	14:55:45	20.4	24.4 D	Dipole	3905080.8	177295	
M110	B3L5	15:04:28	16.3	30.8 +	Monopole	3905352.4	177741.6	
M111	B3L5	15:07:26	24.1	65.6 +	Monopole	3904680.7	176833	
M112	B3L5	15:12:17	10.4	24.4 -	Monopole	3903519.6	175131.4	
M113	B3L8	15:18:47	12.1	115 -	Monopole	3903370.5	175134.4	
M114	B3L8	15:20:14	8.2	83 D	Dipole	3903643.2	175558.3	
M115	B3L8	15:21:03	16	184.2 D	Dipole	3903815.7	175793	
M116	B3L8	15:21:44	3.9	1131.4 +	Monopole	3903965.7	176011.5	
M117	B3L8	15:24:44	12.1	428.2 D	Dipole	3904632.1	176981.3	
M118	B3L9	15:29:06	11.4	247.6 D	Dipole	3904592.7	176989.5	
M119	B3L9	15:31:17	7.7	1795.2 D	Dipole	3904018.7	176208.9	
M120	B3L9	15:31:44	22.4	275.4 D	Dipole	3903911	176013.9	
M121	B3L9	15:34:05	9.8	82.2 +	Monopole	3903243.6	175043.2	
M122	B3L10	15:38:51	9.9	192.4 D	Dipole	3903141.7	174967.7	
M123	B3L10	15:39:19	7.6	83.6 -	Monopole	3903245.6	175127.7	
M124	B3L10	15:40:31	3.8	159.2	Monopole	3903522	175538.7	
M125	B3L10	15:41:21	18.3	172 D	Dipole	3903661.6	175758.7	
M126	B3L10	15:43:27	33.3	838.8 -	Monopole	3904022.5	176262.4	
M127	B3L10	15:44:07	11.8	259.8 D	Dipole	3904135.7	176428	
M128	B3L10	15:44:17	10.5	337.6 D	Dipole	3904166.9	176464.7	

Target #4

A pair of monopolar magnetic perturbations, M100 and M103, comprised Target #4. M100 was of medium amplitude (89.2 gamma) and long duration (39.9 seconds), while M103 had low amplitude (34 gammas) and medium duration (20.2 seconds).

The absence of complex magnetic signatures for these disturbances (Figure 26), their relatively low amplitudes, and the absence of correlative acoustic data suggested that Target #4 represents an isolated area of presumably modern, ferrous debris. Based on the location of this target on the boundary of the Southwest Pass shipping channel, these anomalies may be associated with the ground tackle for a current (5M "14") or former channel marker. The magnetic perturbations comprising Target #4 did not display the amplitude, duration, or complexity typically associated with a shipwreck or other potentially significant cultural resource. Therefore, no further study of Target #4 is recommended.

Target #5

Target #5 incorporated four magnetic anomalies (M64, M54, M46, and M32)(Figure 27). Although M32 and M64 both exhibited dipolar magnetic signatures and high amplitude (290.6 and 143.6 gammas), M32 was of short (5.5 seconds) duration, while M64 was of medium (18.1 seconds) duration. Anomalies M46 and M54 both exhibited monopolar magnetic signatures of high amplitude (8076 and 294.8 gammas) and medium duration (18.1 and 16.6 seconds).

The linear distribution of the anomalies comprising this target, their location on the left descending riverbank, and their relatively short duration indicate that Target #5 probably represents a deposit of presumably modern, ferrous debris associated with an extant wing dike structure, many of which were noted in the survey area. The magnetic anomalies forming this target lack the complexity generally expected with a shipwreck or other significant cultural resource. Based on these data and the absence of corresponding acoustic returns, no further study of Target #5 is recommended.

Target #6

Target #6 consisted of a series of five magnetic anomalies, including M93, M86, M83, M67 and M65 (Figure 28). Four of these disturbances (M67, M83, M86, and M93) were classified as low amplitude, measuring 44.2, 31.4, 25, and 30.8 gammas, respectively. Anomaly M65 was considered a medium amplitude disturbance at 93 gammas. All five anomalies within Target #6 were of medium duration (24 seconds [M65]; 15.9 seconds [M67]; 18.1 seconds [M83]; 14.2 seconds [M86]; and 15.8 seconds [M93]). With the exception of M93, which exhibited a dipolar magnetic signature, all of these anomalies were monopolar.

The linear distribution of these anomalies and their occurrence over several survey tracklines suggested that Target #6 likely represents a segment of linear, modern ferrous debris such as a segment of cable or pipe. This conclusion was supported by the absence of correlative acoustic data. The magnetic characteristics of the anomalies comprising this target, particularly those of low amplitude and medium duration, are not typically associated with a shipwreck site or other potentially significant cultural resource. Therefore, no further consideration of Target #6 is recommended.

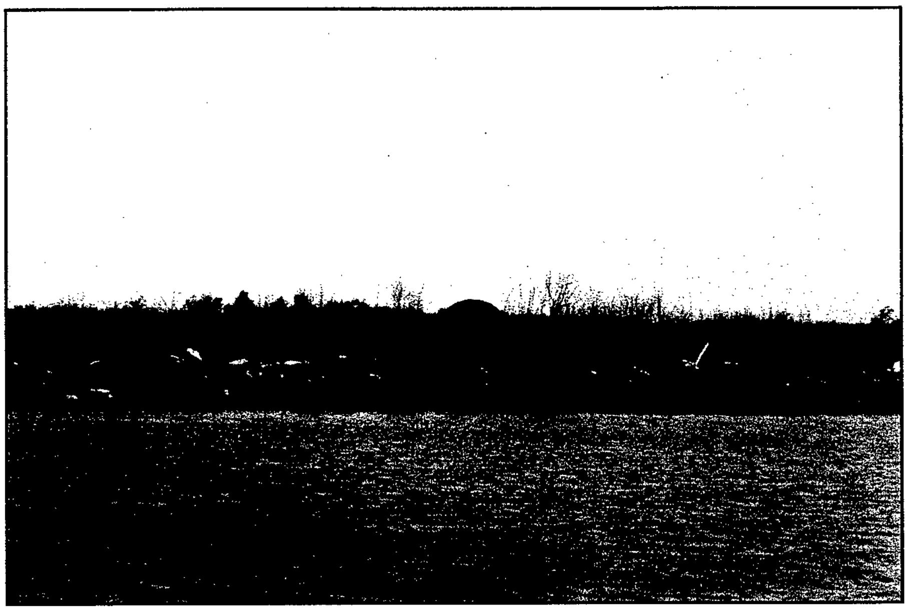


Figure 22. Photograph of typical source of spurious, modern, ferrous debris near survey area

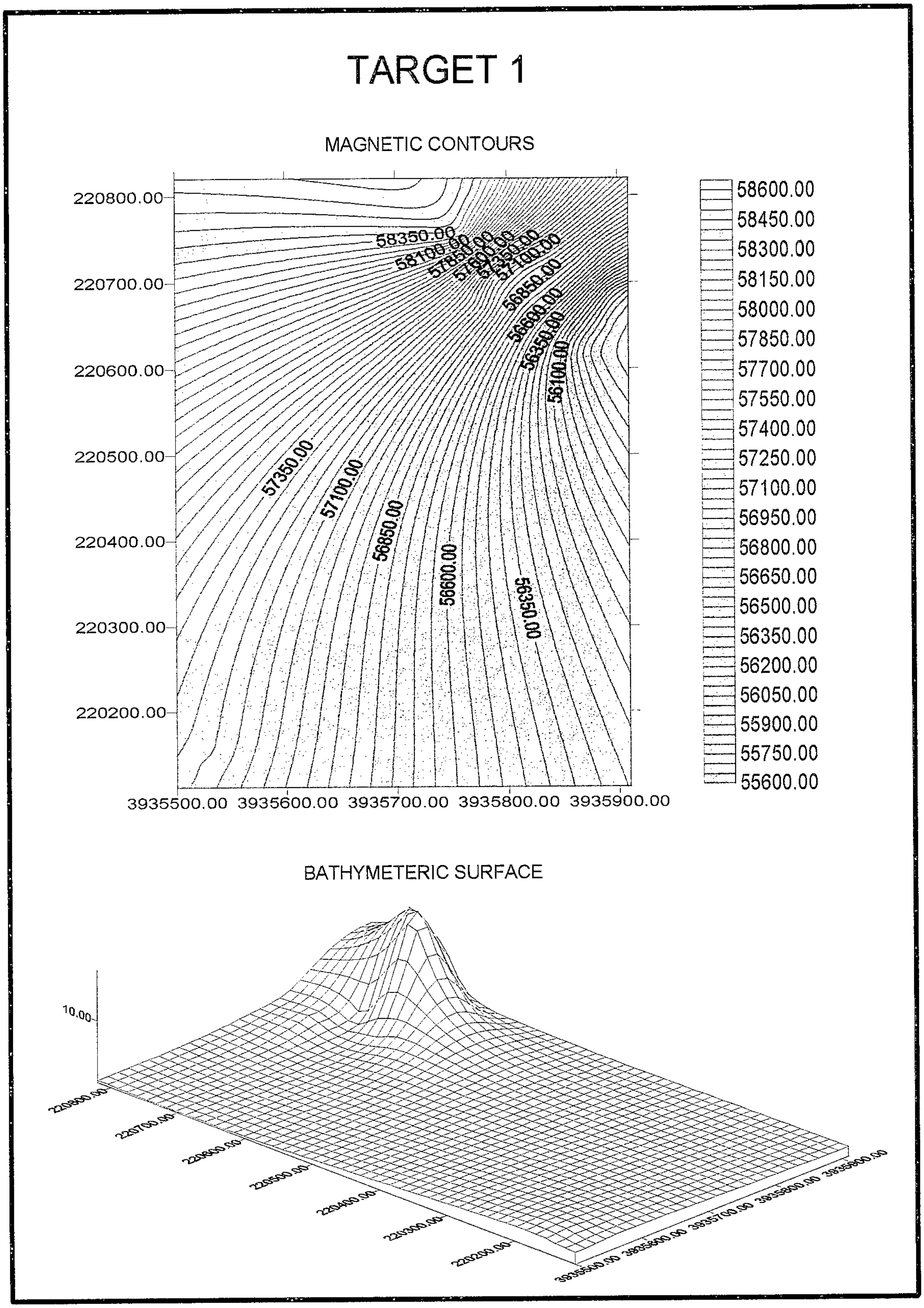


Figure 23. Magnetic contour and bathymetric surface plot of Target #1

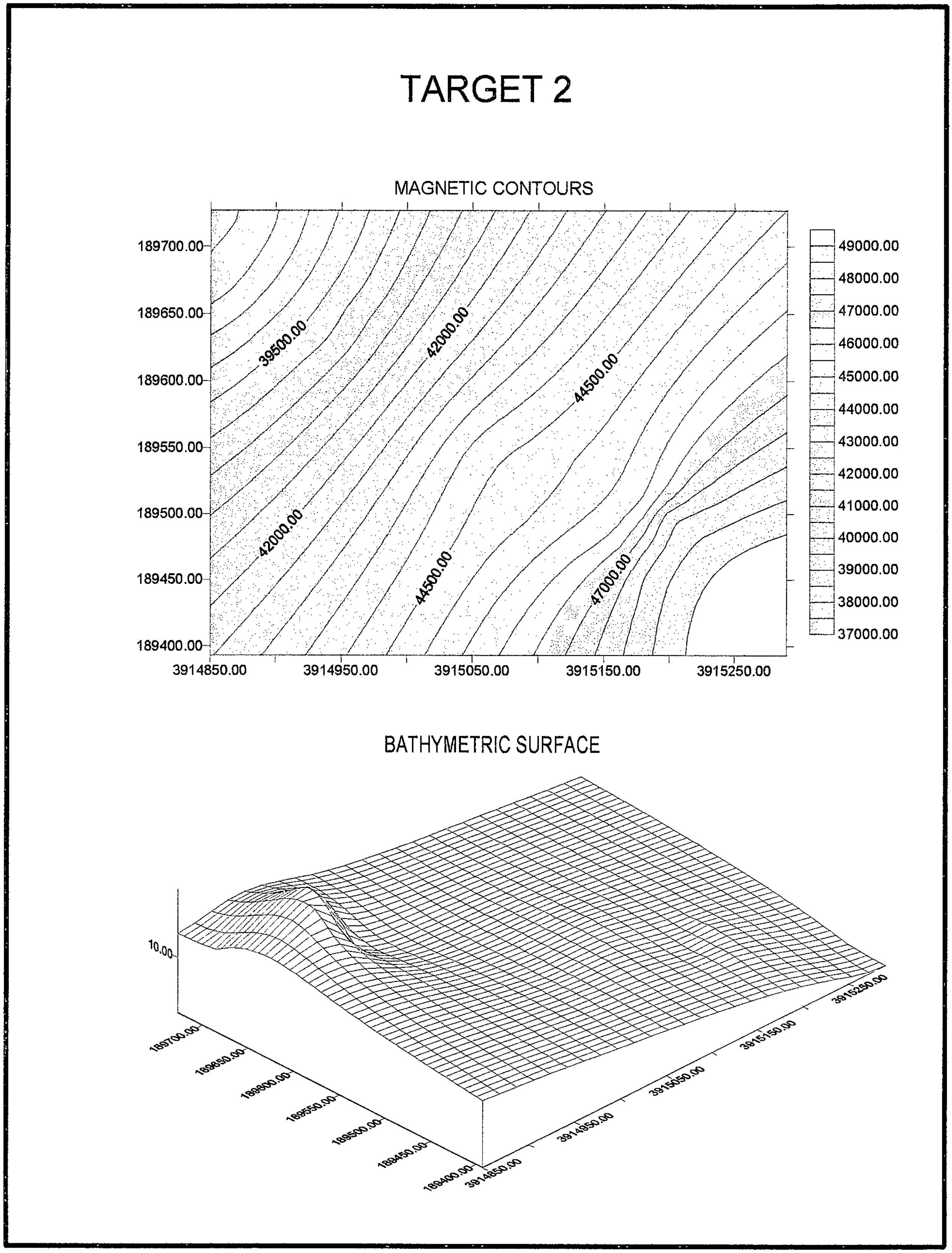


Figure 24. Magnetic contour and bathymetric surface plot of Target #2

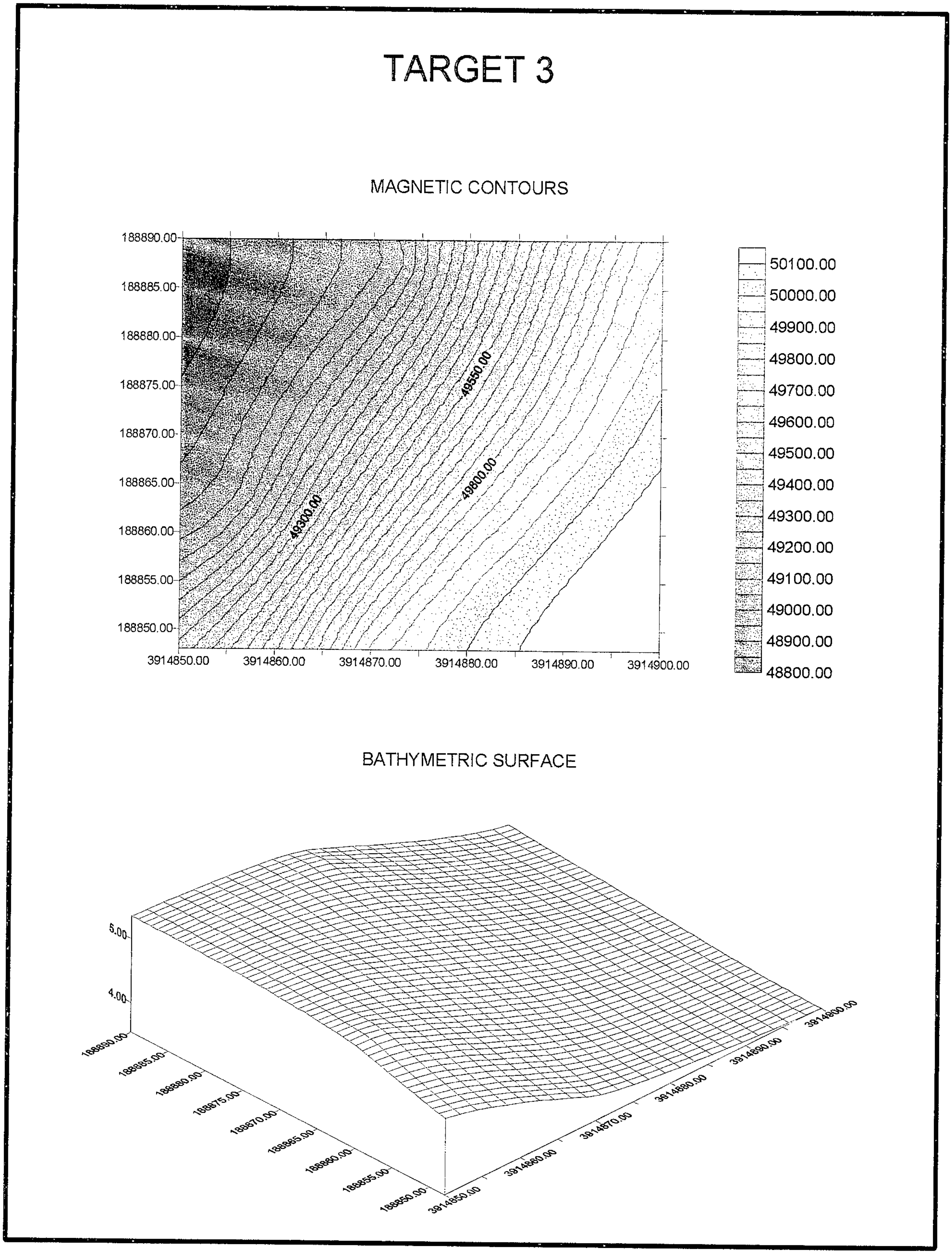


Figure 25. Magnetic contour and bathymetric surface plot of Target #3

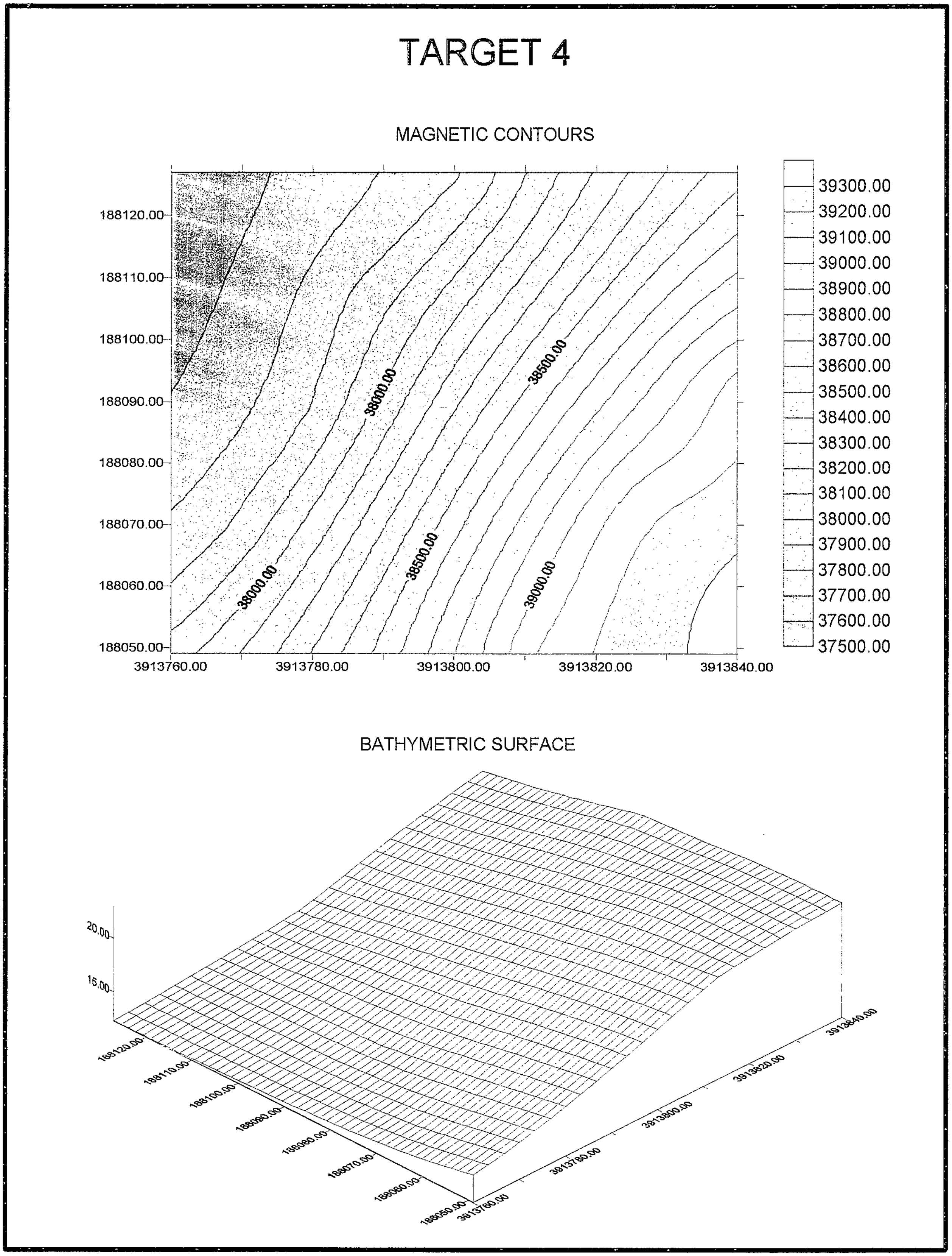


Figure 26. Magnetic contour and bathymetric surface plot of Target #4

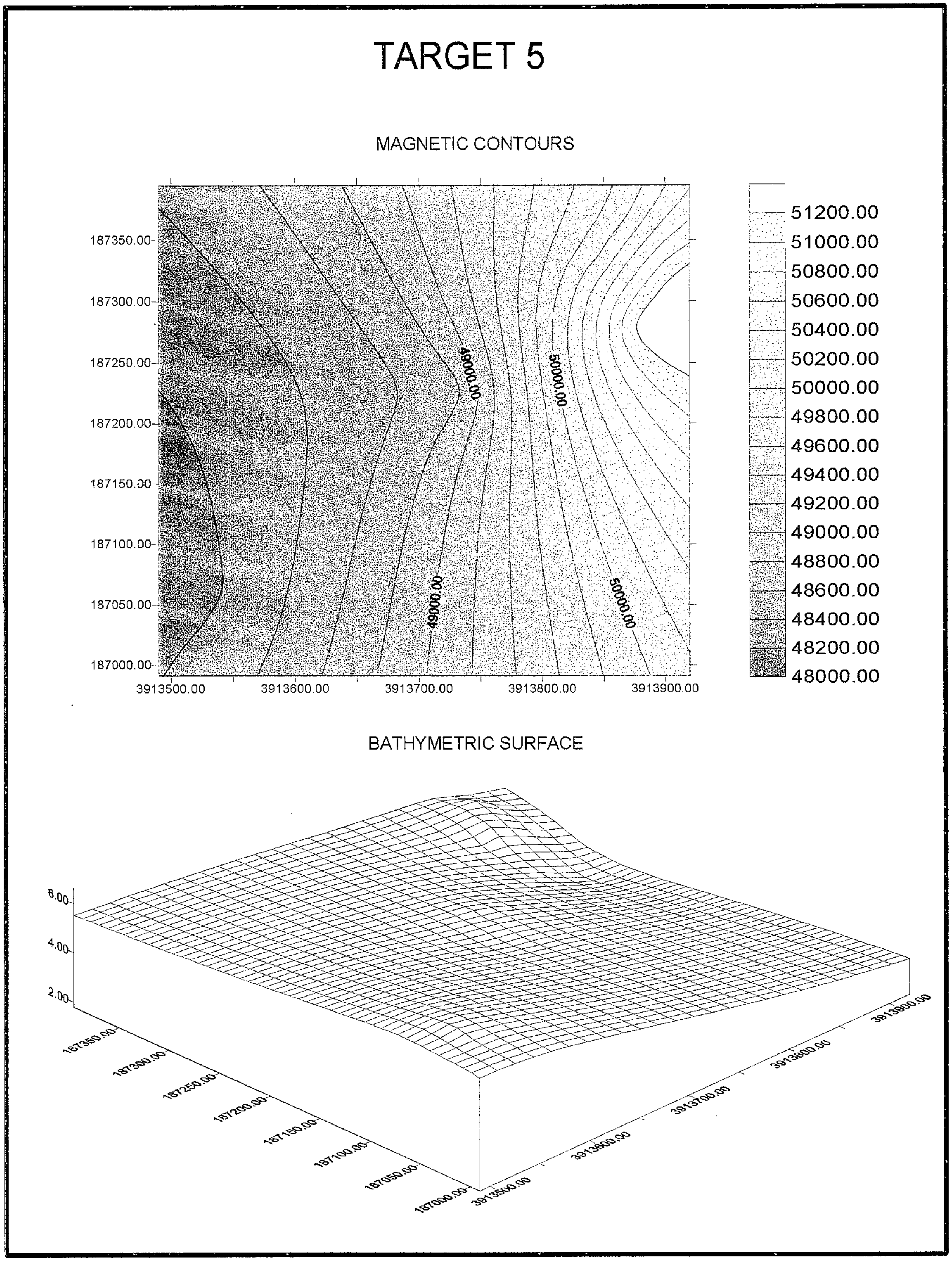


Figure 27. Magnetic contour and bathymetric surface plot of Target #5

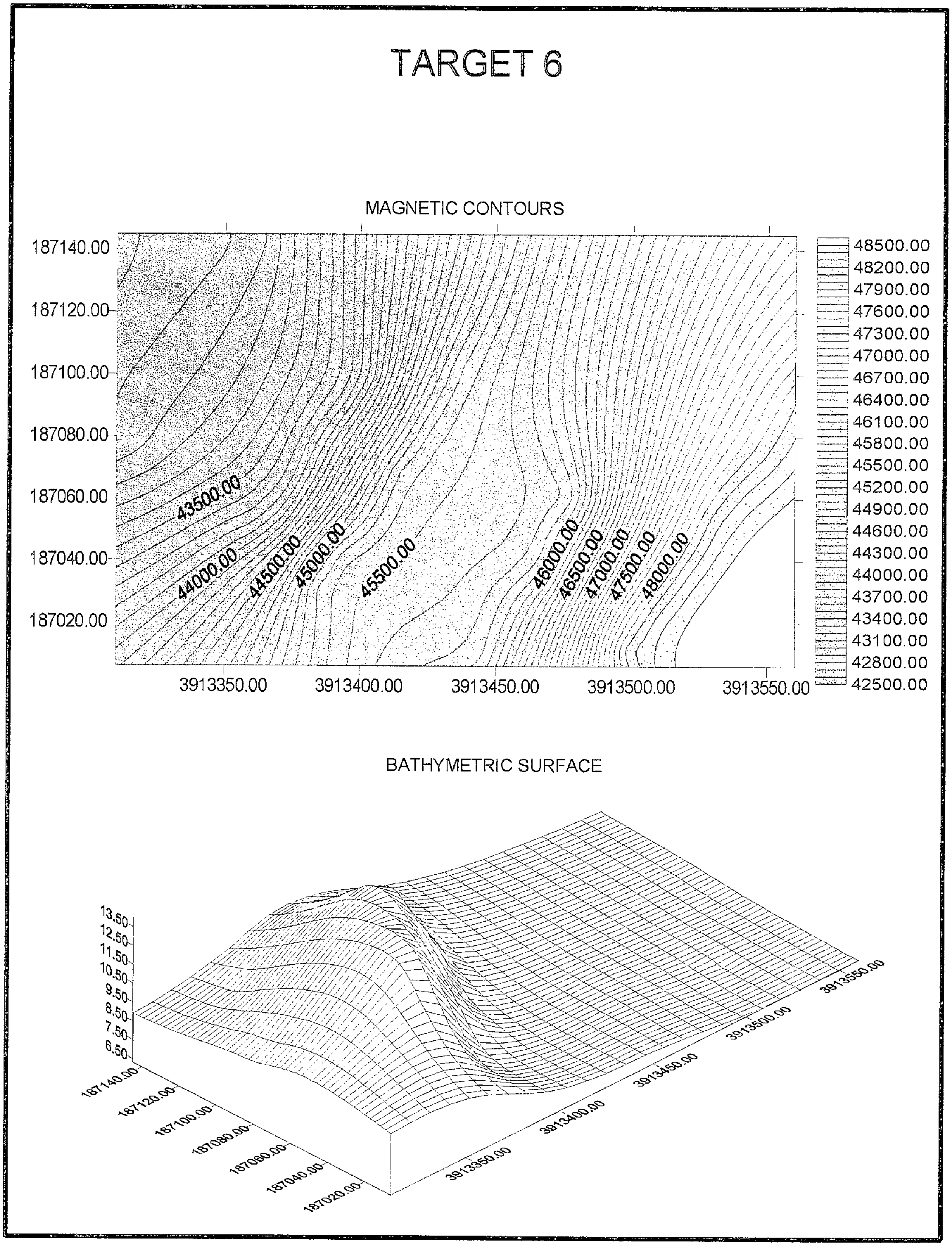


Figure 28. Magnetic contour and bathymetric surface plot of Target #6

Target #7

A pair of dipolar magnetic perturbations, M99 and M104, comprised Target #7 (Figure 29). While both anomalies were of long duration at 52.1 seconds (M99) and 33.9 seconds (M104), M99 was considered to be of medium (51 gammas) amplitude and M104 was of low (27.4 gammas) amplitude. The absence of complex magnetic signatures for these disturbances, coupled with their relatively low amplitudes, suggested that Target #7 represented an isolated area of presumably modern ferrous debris.

Based on the location of this target on the boundary of the Southwest Pass shipping channel, these anomalies, like those of Target #4, may be associated with the remnant ground tackle of a former channel marker. The magnetic perturbations comprising Target #7 were not of the amplitude, duration or complexity typically associated with a shipwreck or other potentially significant cultural resource.

Based on these data and on an absence of corresponding acoustic returns, no further study of Target #7 is recommended.

Target #8

Target #8 consisted of two high amplitude (272.2 and 180.4 gammas) magnetic anomalies, M49 and M52 (Figure 30). Both disturbances were of medium duration, measuring 12.1 seconds each. M49 exhibited a dipolar magnetic signature, while M52 was monopolar. The low number of anomalies comprising this target, together with the relatively low amplitudes of these anomalies for such shallow water, and the absence of correlative acoustic data, all suggested that Target #8 represents an isolated area of modern ferrous debris probably associated with the shipping and or petroleum industries.

The magnetic characteristics of this target do not indicate the presence of a potentially significant cultural resource. Therefore, no further study of this target is recommended.

Target #9

A pair of high amplitude, medium duration, magnetic disturbances (M31 and M50) comprised Target #9 (Figure 31). M31 measured 127.6 gammas for 24.1 seconds, and M50 registered 433.4 gammas for 13.8 seconds. Both M31 and M50 exhibited dipolar magnetic signatures. Although the amplitudes of these anomalies were classified as high, they were not unusually high, given the shallowness of the water. This fact, combined with the medium duration of these anomalies and an absence of correlative acoustic data, suggested that Target #9 represents an isolated area of presumably modern ferrous debris and not a potentially significant cultural resource. Based on these data, no further study of Target #9 is suggested.

Target #10

This target was composed of two high amplitude, medium duration disturbances (M118 and M117) with dipolar magnetic signatures (Figure 32). M118 and M117 measured 247.6 and 428.2 gamma for a duration of 11.4 and 12.1 seconds, respectively. Although these disturbances were classified as high amplitude, the medium duration and relatively simple magnetic signatures of anomalies M118 and M117, together with the absence of corresponding acoustic data, were consistent with the signature of an isolated deposit of presumably modern ferrous debris and not of a shipwreck site or other potentially significant cultural resource. The location of Target #10 along the right descending riverbank suggested that it could be associated with a remnant wing dike structure, many of which were noted in the survey area. No further study of Target #10 is recommended.

Target #11

Target #11 was composed of a pair of high amplitude (1131.4 and 275.4 gammas) magnetic anomalies, M116 and M120 (Figure 33). M116 displayed a monopolar magnetic signature for a short duration of 3.9 seconds. M120 displayed a dipolar magnetic signature for a medium duration of 22.4 seconds. Despite the high amplitude readings of these anomalies, their relatively short duration, lack of complex magnetic signatures, and absence of correlative acoustic data indicated that this target represents an isolated area of presumably modern ferrous debris.

Considering the location of this target along the right descending riverbank, it is likely that Target #11 is associated with a remnant wing dike structure. Based on these data, no further study of Target #11 is advised.

Acoustical Disturbances

In addition to the magnetic anomalies detected in the survey area, a total of four acoustic disturbances were recorded (Table 3). None of these anomalies could be correlated with magnetic data, and all can be attributed to modern structures or debris including a remnant dike, fuel dock, water tank and pipeline. No further investigations are warranted or recommended for these acoustic anomalies.

Table 3. Acoustic Anomalies Recorded in Survey Blocks

Anomaly #	Survey Block	Date	Line	Time	Description	Offset	Correlation
A1	3	6/21/99	7	13:52:53	Narrow linear anomaly approx. 2 x 60 (ft)	30 - 90 ft port	Bulkhead
A2	1	6/24/99	3	14:14:36	Linear anomaly approx. 15 x 30 (ft)	60 - 90 ft port	Remnant Fuel Dock Stuctures
A3	1	6/24/99	1	13:32:32	Rectangular anomaly approx. 3 x 6 (ft)	30 ft port	Discarded water tank
A4	2	6/22/99	13	12:47:51	Narrow linear anomaly approx. 3 ft in width	0 - 90 ft starboard	Pipeline

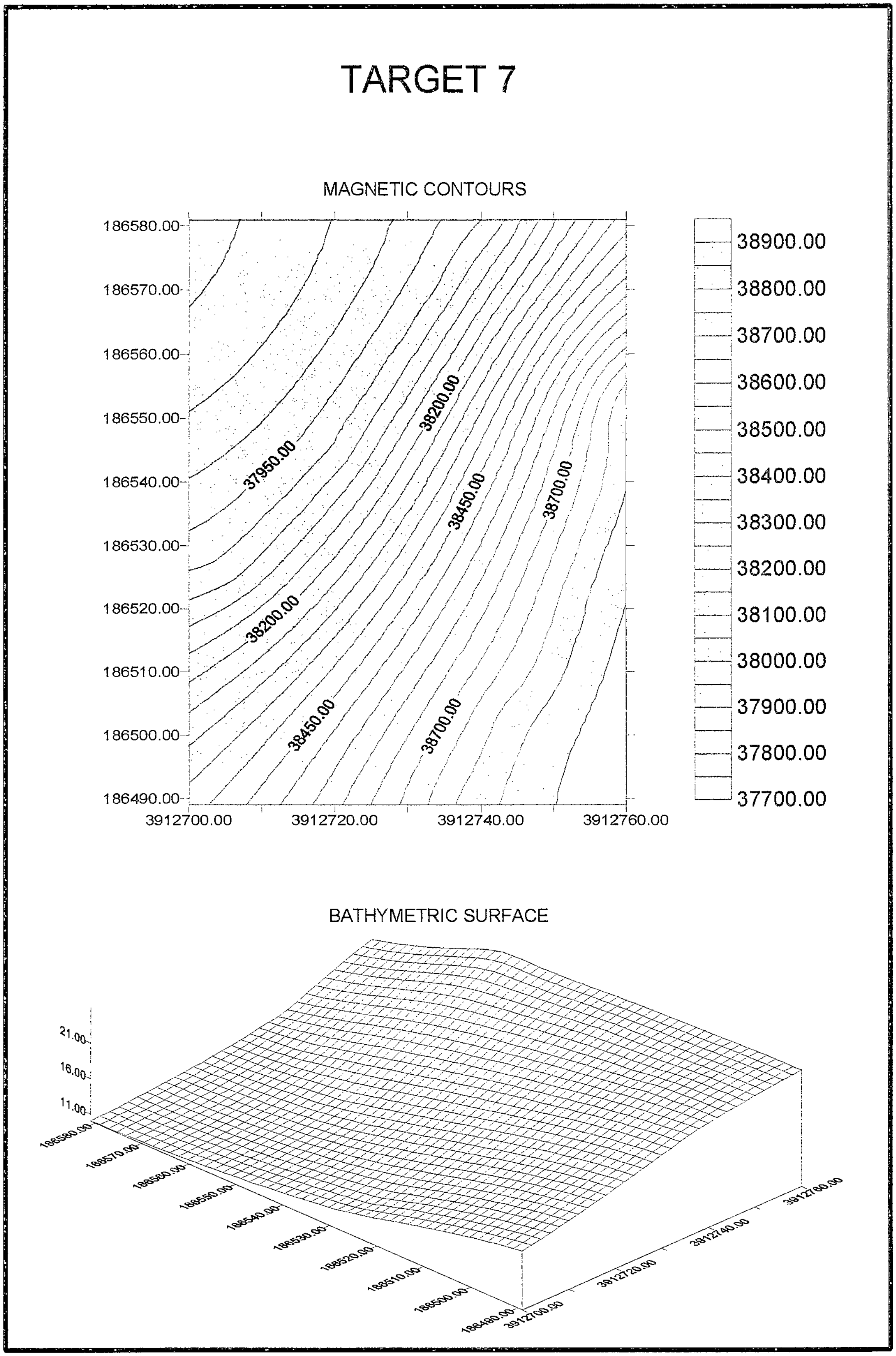


Figure 29. Magnetic contour and bathymetric surface plot of Target #7

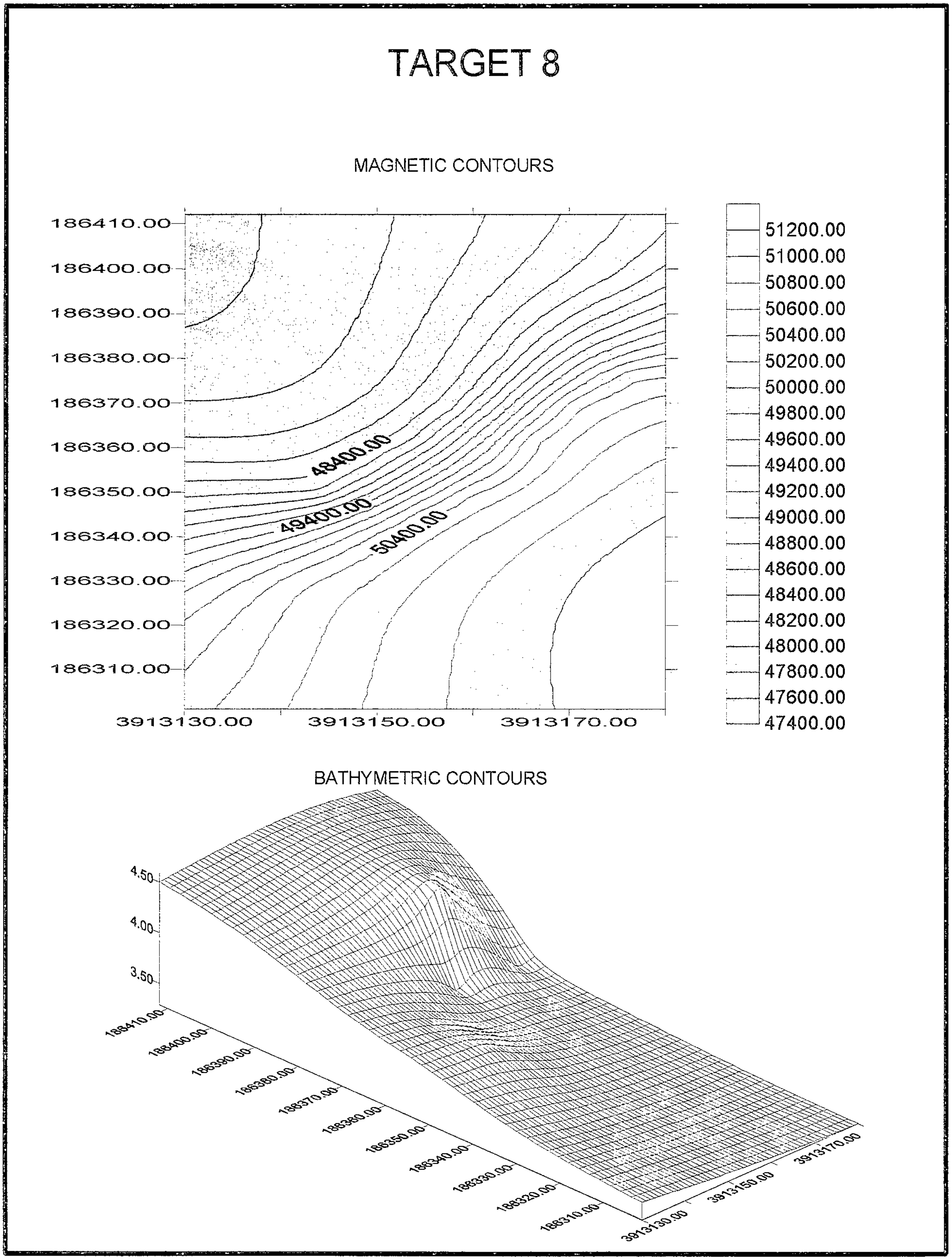


Figure 30. Magnetic contour and bathymetric surface plot of Target #8

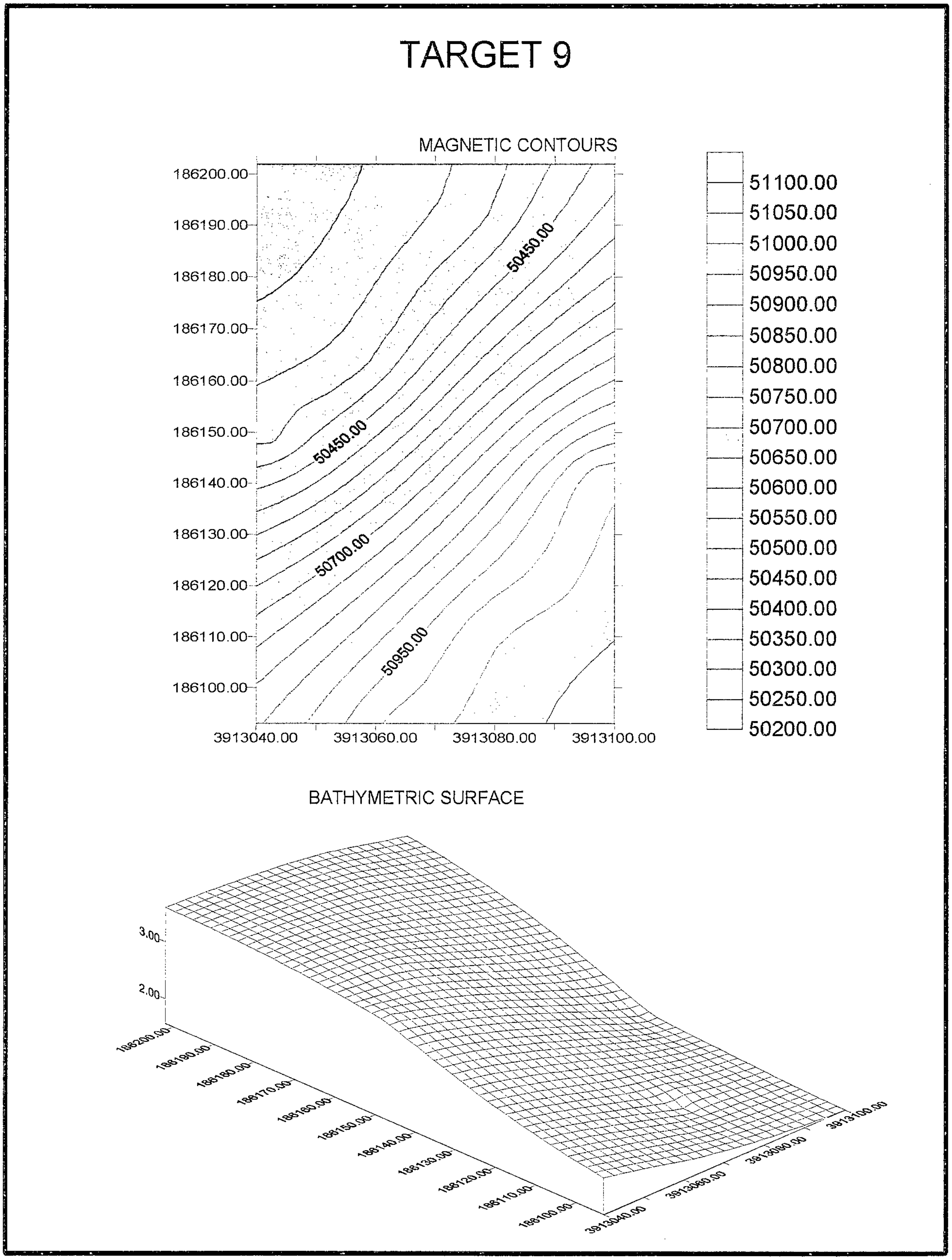


Figure 31. Magnetic contour and bathymetric surface plot of Target #9

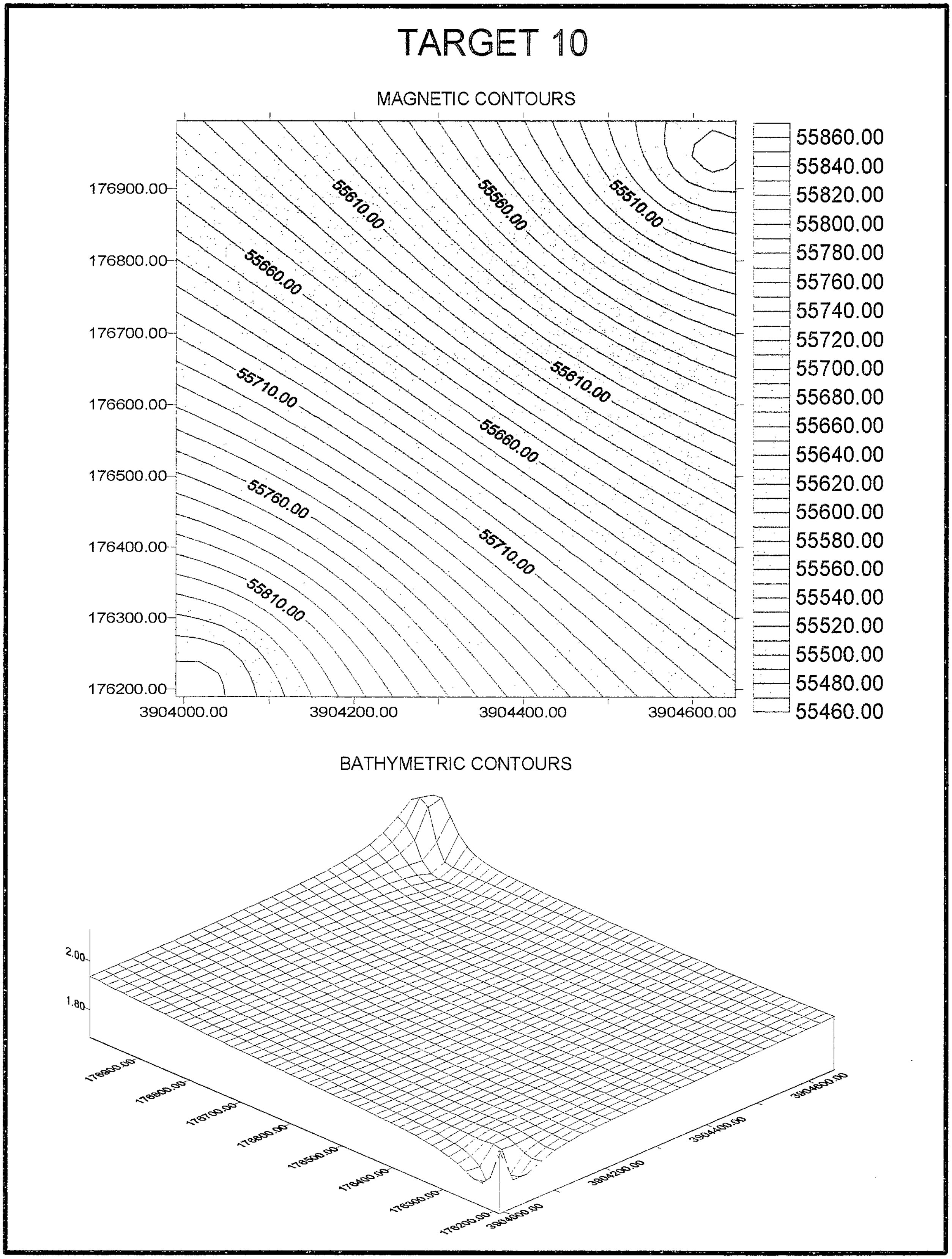


Figure 32. Magnetic contour and bathymetric surface plot of Target #10

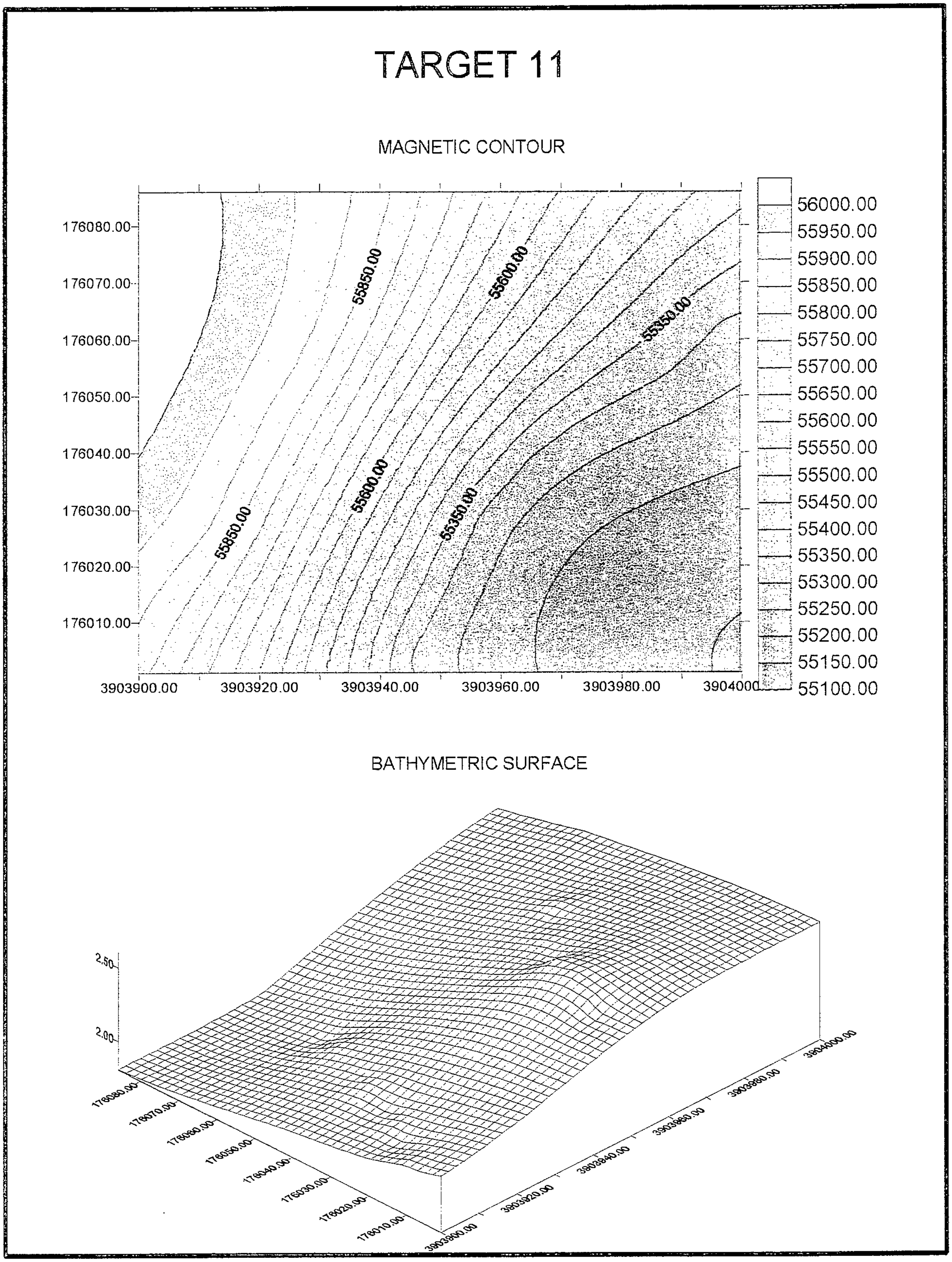


Figure 33. Magnetic contour and bathymetric surface plot of Target #11

CHAPTER VI

SUMMARY AND RECOMMENDATIONS

This report has presented the results of Phase I marine archeological remote sensing survey of segments along Southwest Pass of the Mississippi River, in Plaquemines Parish, Louisiana. These investigations were conducted from June 20 – 27, 1999, by R. Christopher Goodwin & Associates, Inc. on behalf of the U.S. Army Corps of Engineers, New Orleans District (USACE-NOD), in support of proposed repair and maintenance activities along segments of the Southwest Pass. The proposed repair and maintenance project will require the temporary stockpiling of dredge material from the navigation channel between the channel and adjacent foreshore dikes, and some additional excavation for barge access.

The survey area for this project consisted of three blocks representing a total of approximately 509 acres (1562 ft [476.1 m] x 14,194 ft [4326.38 m] located alternately on the right and left descending banks of the river. Block One was located at River Mile (RM) 14.4 – 15.2, Block Two encompassed RM 11.3 – 12.5, and Block Three extended from RM 4.4 – 5.0. Approximately 44 linear miles of riverbank and bottom were surveyed.

The potential for prehistoric resources was considered during the archival research phase of the study. Background research established that previous studies in this region (Russell 1936; McIntire 1958) had placed the southern limit of Indian mound-building approximately 25 river miles above the head of passage (HOP), well outside of the project area of impact. The nearest known prehistoric site is a Plaquemine Culture shell midden located on the Gulf shoreline about 20 mi from the Southwest Pass. Moreover, analysis of the geomorphology of the Southwest Pass project area suggested that it is unlikely that prehistoric archeological sites would be found in this region, primarily because the soil deposits are of such recent origin. These archivally based data suggest strongly that no further study of the project area is necessary to identify potential prehistoric resources.

A total of 128 individual magnetic anomalies were detected during the Southwest Pass survey (Table 2). More than half of these anomalies (58 per cent) were scattered throughout Survey Block 2. Survey Block 1 contained 23 per cent of the total number, and Survey Block 3 included the remaining 19 per cent. Thirty-five (35) of the magnetic anomalies detected in the survey area were grouped into 11 targets. None of these targets had corresponding acoustic data, and all exhibited magnetic characteristics associated with presumably modern ferrous debris scatters. Despite the archivally reported presence of 17 potential wrecks within the confines of Plaquemines Parish (Table 1), none of these targets displayed attributes typically associated with shipwrecks or other potentially significant submerged cultural resources. No further study of these targets is recommended.

In addition to the magnetic anomalies detected in the survey area, a total of four acoustic disturbances were recorded (Table 3). None of the acoustical anomalies could be correlated with magnetic data, and all could be attributed to modern structures or debris, including a remnant dike, a fuel dock, a water tank and a pipeline. None of these acoustical anomalies represent significant historic cultural resources, and no further study of these targets is warranted or recommended.

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APPENDIX I

SCOPE OF WORK

CEMVN-PM-RN

April 12, 1999

SCOPE OF SERVICES
Contract DACW29-97-D-0018
Delivery Order XX

UNDERWATER CULTURAL RESOURCES SURVEY OF SEGMENTS ALONG SOUTHWEST PASS OF THE MISSISSIPPI RIVER, BATON ROUGE TO THE GULF OF MEXICO, PLAQUEMINES PARISH, LOUISIANA.

1. Introduction

This delivery order calls for a remote sensing survey for underwater cultural resources along portions of Southwest Pass of the Mississippi River, Plaquemines Parish, Louisiana. The U.S. Army Corps of Engineers, New Orleans District (NOD) plans to temporarily stockpile material removed from the navigation channel and place the material between the navigation channel and adjacent foreshore dikes. The material is to be removed by dredging at a later date. NOD also plans to excavate flotation access to repair and maintain dikes located along Southwest Pass. Background research and underwater cultural resources investigations are required to identify the potential for project impacts to significant cultural resources. Additional details on the project are provided below. The contract period for this delivery order is 28 weeks.

2. Project Area

For the purposes of this study, the project will include the area between the top of banks from Head of Passes to the outer end of the Southwest Pass jetties. All temporary stockpile and dike repair areas are included in the project area. There are three segments of the project area to be included in the remote sensing survey. These segments are listed in Section 5.b below and are shown on Sheets 5,7,8, and 9, of the attached hydrographic survey charts (Attachment 1). The segments to be surveyed correspond to portions of the project adjacent to four previously recorded historic properties listed in Section 3 below.

3. Background Information

A remote sensing survey was conducted in the vicinity of the project area during 1982 and 1983. The results of these investigations were discussed in the report entitled Mississippi River, Baton Rouge to the Gulf, Louisiana Project, Final

Environmental Impact Statement, Supplement II, prepared by NOD (1984). Considerations for underwater cultural resources also were addressed in the report entitled A History of Waterborne Commerce and Transportation within the U.S. Army corps of Engineers New Orleans district and Inventory of Known Underwater Cultural Resources prepared by Coastal Environments, Inc. (1989).

Site records on file at Louisiana's Division of Archaeology demonstrate there are four potentially significant historic properties recorded along Southwest Pass. These properties include: the 1891 Building Group (16PL54) near Mile 4.8-R BHP, the Custom House Site (16PL56) near Mile 11.4-L BHP, the Pilot Lookout (16PL55) near Mile 12.3-L and the Third Southwest Pass Lighthouse (16PL53), near Mile 15.0-R. The limits, integrity, and associations for these four properties remain unknown.

4. Study Requirements

The study will be conducted utilizing current professional standards and guidelines including, but not limited to:

- the National Park Service's National Register Bulletin 15 entitled, "How to Apply the National Register Criteria for Evaluation";

- the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation as published in the Federal Register on September 29, 1983;

- Louisiana's Comprehensive Archaeological Plan, dated October 1, 1983;

- The Advisory Council on Historic Preservation's regulation 36 CFR Part 800 entitled, "Protection of Historic Properties";

- the Louisiana Submerged Cultural Resource Management Plan published by the Division of Archaeology in 1990.

The study will be conducted in three phases: Background Research and Review, Remote Sensing Survey, and Data Analyses and Report Preparation.

a. Phase 1: Background Research and Review. This phase is limited to a review of previous research and review of available literature and pertinent historical, archival, geomorphological and nautical maps and records. Information contained in the annual reports of the Chief of Engineers will be used to aid in the identification and interpretation of anomalies identified during the Phase 2 effort. Background research will be conducted to supplement information on each of the four previously recorded historic properties located in the project area. The research is to aid in the identification and interpretation historic and modern anomalies or features which might relate to significant underwater resources. The background research will provide a context for interpreting anomalies that may be discovered during the course of the survey.

b. Phase 2: Remote Sensing Survey. Upon completion of Phase 1, the contractor shall proceed with execution of the remote sensing fieldwork. The minimum equipment array required for this survey effort is:

(1) a marine magnetometer
(2) a positioning system
(3) a side-scan sonar system
(4) a fathometer.

The survey will include portions of Southwest Pass described above and depicted on the attached drawings. The x,y coordinates for the corners of each survey area are provided below. The survey area will include areas between the navigation channel and the adjacent foreshore dike for the respective bank.

Site No.	River Mile	x,y Coordinates (NAD 1983)
16PL54	M 4.4-5.0-R	x=3936363.00, y=221408.00
		x=3935954.00, y=221606.00
		x=3934877.00, y=218379.00
		x=3934441.00, y=218696.00
16PL55	M 11.3-12.5-L	x=3916756.00, y=190793.00
16PL56		x=3915995.00, y=191312.00
		x=3913135.00, y=185482.00
		x=3912349.00, y=186038.00
16PL53	M 14.4-15.2-R	x=3905871.00, y=178244.00
		x=3905240.00, y=178690.00
		x=3903248.00, y=174592.00
		x=3902713.00, y=174981.00

The following requirements apply to the survey:

(1) transect lane spacing will be no more than 75 feet;

(2) positioning control points will be obtained at least every 100 feet along transects;

(3) background noise will not exceed +/- 3 gammas;

(4) magnetic data will be recorded on 100 gamma scale;

(5) the magnetometer sensor will be towed a minimum of 2.5 times the length of the boat or projected in front of the survey vessel to avoid noise from the survey vessel; and

(6) the survey will utilize the Louisiana State Plane Coordinate System (NAD 1983).

c. Phase 3: Data Analyses and Report Preparation. All data will be analyzed using currently acceptable scientific methods. The post-survey data analyses and report presentation will include as a minimum:

(1) post-plots of survey transects and data points;
(2) same as above with magnetic data included;
(3) plan views of all potentially significant anomalies showing transects, data points and contours;
(4) correlation of magnetic, sonar, and fathometer data, where appropriate.

The interpretation of identified magnetic anomalies will rely on expectations of the character (i.e. signature) of shipwreck magnetics derived from the available literature. Interpretation of anomalies will also consider probable post-depositional impacts and the potential for natural and modern, i.e. insignificant, sources of anomalies. The Contractor will file state site forms with the Louisiana State Archeologist and cite the resulting state-assigned site numbers in all draft and final reports for any anomaly classified as a site.

The Contractor will classify each anomaly as either potentially eligible for inclusion in the National Register, or not eligible. The Contractor shall fully support his recommendations regarding site significance.

The draft and final reports will present an inventory of all magnetic anomalies recorded during the underwater survey, with recommendations for further identification and evaluation procedures when appropriate. These discussions must include justifications for the selection of specific targets for further evaluation. The potential for each target or submerged historic property to contribute to archeological or historical knowledge will be assessed. Recommendations for equipment and methodology to be employed in future evaluation studies must be discussed in detail.

The reports will include a summary table listing all anomalies. At a minimum, the tables will include the project name, survey segment/area, magnetic target number, gammas intensity, and target coordinates (Louisiana State Plane). Sonar images of potentially significant anomalies should be referenced and included in the report.

If determined necessary by the COR, the final report will not include detailed site location descriptions, state plane or UTM coordinates. The decision on whether to remove such data from the final report will be based upon the results of the survey. If removed from the final report, such data will be provided in a separate appendix. The analyses will be fully documented. Methodologies and assumptions employed will be explained and justified. Inferential statements and conclusions will be supported by statistics where possible. Additional requirements for the draft and final report are contained in Section 6 of this Scope of Services.

5. Reports

Five copies of a draft report integrating all phases of this investigation will be submitted to the COR for review and comment within 16 weeks after the date of the award. Completed state site forms will be submitted under separate cover at the same time as the draft report. The report will include a summary table listing all anomalies, a brief description of each anomaly located during the survey, and recommendations for further identification and evaluation procedures when appropriate. The final report shall follow the format set forth in MIL-STD-847A with the following exceptions: (1) separate, soft, durable, wrap-around covers will be used instead of self covers; (2) page size shall be 8-1/2 x 11 inches with 1-inch margins; (3) the reference format of American Antiquity will be used. Spelling shall be in accordance with the U.S. Government Printing Office Style Manual dated January 1973.

The COR will provide all review comments to the Contractor within 6 weeks after receipt of the draft reports (22 weeks after award). Upon receipt of the review comments on the draft report, the Contractor shall incorporate or resolve all comments and submit one preliminary copy of the final report to the COR within 4 weeks (26 weeks after award). Upon approval of the preliminary final report by the COR, the Contractor will submit one reproducible master copy, one copy on floppy diskette, 35 copies of the final report, and all separate appendices to the COR within 28 weeks after date of order. A copy of the Scope of Services shall be bound as an appendix with the Final Report. The Contractor shall also supply a complete listing of all computer files submitted. This listing will include file names, file types, disk number, and file description.

6. Attachments

Attachment 1. Sheets 5,7,8, and 9 of the Mississippi River hydrographic survey showing the study area

7. References

U.S. Army Corps of Engineers, New Orleans District Mississippi River, Baton Rouge to the Gulf, Louisiana Project, Final Environmental Impact Statement, Supplement II, (1984).

Coastal Environments, Incorporated A History of Waterborne Commerce and Transportation within the U.S. Army corps of Engineers New Orleans district and Inventory of Known Underwater Cultural Resources (1989).

APPENDIX II

RESUMES OF KEY PROJECT PERSONNEL

R. CHRISTOPHER GOODWIN, Ph.D.
PRESIDENT & CEO

Dr. R. Christopher Goodwin, is President and Director of Research of R. Christopher Goodwin & Associates, Inc., a preservation planning and research and compliance firm with offices in Frederick, Maryland, New Orleans, Louisiana, Tallahassee, Florida, and Seattle, Washington. A native of Maryland, he is a former Yale Peabody Museum Research Associate (1976), Arizona State University Fellow, and Smithsonian Institution (1979-1980) Research Fellow and Scholar-in-Residence. Dr. Goodwin holds degrees in Anthropology/Archeology from Tulane (B.A.), Florida State (M.S.), and Arizona State (Ph.D) Universities; the latter institution named him a "College of Liberal Arts Leader," in 1997.

Dr. Goodwin is recognized as one of the nation's leading experts in cultural resource management. He has been a contractor to the U.S. Army Corps of Engineers (Baltimore, Memphis, Nashville, New Orleans, Pittsburgh, Savannah, St. Louis, and Vicksburg Districts), to the Naval Facilities Engineering Command, and to the Department of Defense on numerous projects. During the past 18 years, he has served as Principal Investigator for major cultural resource investigations conducted by his firm in the Mid-Atlantic, Southeastern, Western, and Caribbean Regions. These projects have included such large-scale efforts as the architectural and archeological investigations at Baltimore's Oriole Park at Camden Yards stadium site; the new Baltimore Ravens Stadium; and the Washington Redskins' Jack Kent Cooke Stadium.

Dr. Goodwin's expertise also has been called upon for historic preservation planning projects, and for industrial and governmental agency compliance with federal and state laws and regulations governing archeological and historic sites. He has served as Principal Investigator on preservation and compliance projects for the National Capital, Southeast, and Southwest regions of the National Park Service (NPS); the Department of Energy (DOE); Her Majesty's Service, U.K.; the Louisiana Division of Archaeology; major utility companies, including Allegheny Power, ENRON, Texaco, Southern Natural Gas (SONAT), ANR/Coastal, Baltimore Gas and Electric Company, and Peabody Coal; the U.S. Fish and Wildlife Service, Northeast Region; the City of Annapolis; and, the Maryland Historical Trust. The geographic range of research and compliance projects completed under Goodwin's direction encompasses the Leeward Islands, Puerto Rico, the Bay Islands of Honduras, Maryland, Virginia, West Virginia, Pennsylvania, Ohio, Illinois, Arkansas, Florida, Georgia, Louisiana, Mississippi, California, and Texas.

Dr. Goodwin has published widely in the fields of prehistoric and historic archeology, and ethnohistory. His areas of particular expertise include preservation planning, cultural resource management, cultural ecology, prehistoric demography, field methods in archeology, human osteology, and historic archeology. He is a court-qualified expert in both historic archeology and in cultural resource management. In 1992, he was a recipient of the National Trust for Historic Preservation's National Preservation Honor Award for his work at Maryland's oldest surviving historic building, the Third Haven Meeting House, and of the Anne Arundel County Trust for Historic Preservation's Achievement in Archeology Award in 1992 and 1993. In 1997, he received the United States Small Business Administration's Administrators Award of Excellence, for "Outstanding Contribution and Service to the Nation," and the Maryland Historical Trust's Educational Excellence Award.

In addition to numerous technical reports and monographs, Dr. Goodwin has contributed to numerous scholarly journals, including *American Anthropologist, American Antiquity*, the *Florida Anthropologist*, and *American Scientist*. Dr. Goodwin is listed in *Who's Who in Leading American Executives* and *Who's Who Among Outstanding Americans*.

JEAN B. PELLETIER, M.A.

NAUTICAL ARCHAEOLOGIST/REMOTE SENSING SPECIALIST

Jean B. Pelletier, M.A., graduated from the University of Maine in 1991 with a Bachelors degree in Geological Sciences, and received a Master of Arts degree in History from the University of Maine in 1998. His research interests include maritime history and nautical archaeology, steamboat technology, industrial technology, remote sensing, geophysics, scientific diving technology, and underwater photography/videography. Mr. Pelletier has formal training in marine geophysics, remote sensing, remotely operated vehicles, and diving safety, and has conducted archaeological, archival, and geophysical investigations in Connecticut, Delaware, Louisiana, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Virginia. As a graduate student at the University of Maine, Mr. Pelletier worked with Dr. Warren C. Riess as a research assistant on the Penobscot Expedition Phase II, conducting remote sensing and underwater documentation of the ships of the Penobscot Expedition.

Before joining Goodwin and Associates Inc. in 1997, Mr. Pelletier served as an archeological and scientific diving consultant for several universities and public utility companies along the Atlantic seashore. In this capacity, Mr. Pelletier managed the recovery of nine cannons from the *Nottingham Galley*, an eighteenth century English merchant ship lost on the ledges of Boon Island, Maine.

Since joining Goodwin & Associates Inc., Mr. Pelletier has been involved in numerous Phase I, II, and III archaeological investigations of underwater sites. He has conducted remote sensing surveys in the Gulf of Mexico, Chesapeake Bay, and a Phase III recordation of the steamboat *Kentucky*, a confederate troop-transport lost on the Red River in 1865, near Shreveport, Louisiana. Mr. Pelletier's professional affiliations include: American Academy of Underwater Sciences, Marine Archaeology and Historical Research Institute (MAHRI), and the Society for Historical Archaeology.

DAVID W. TRUBEY
NAUTICAL ARCHEOLOGIST

David W. Trubey graduated from the University of Massachusetts at Lowell in 1989 where he received a B.A. in History and the History Department's Outstanding Academic Achievement Award. Mr. Trubey will be receiving a Master of Arts degree in Historical Archaeology from the University of Massachusetts-Boston in 1999.

Before joining R. Christopher Goodwin and Associates, Mr. Trubey served as a field archaeologist and research assistant for the Massachusetts Board of Underwater Archaeological Resources from 1995-1998. Among numerous projects with the Board, Mr. Trudey worked with the U.S. Naval Historical Center in compiling a comprehensive inventory of naval shipwrecks sites and resource management plan. During the field seasons of 1995-1997, he served as a Team Leader for the Institute for New Hampshire Studies-Plymouth State College excavation of an early eighteenth-century shipwreck at New Castle, NH. Mr. Trubey has also contributed historical and archaeological research for the cultural resource management of the Stellwagen Bank National Marine Sanctuary off the coast of Massachusetts. His research interests include remote sensing, maritime history and archaeology, and eighteenth and nineteenth-century canal construction.

Mr. Trubey is a PADI certified scuba diver and member of the Society for Historical Archaeology, Maritime Archaeology Research Institute, and the North American Society of Oceanic History.

RALPH DRAUGHON, JR., Ph.D.

SENIOR HISTORIAN

Dr. Ralph Draughon, Jr., holds a Masters Degree and a Doctorate in southern history from the University of North Carolina at Chapel Hill, where he also earned a Masters Degree in Library Science with a specialty in rare books and manuscripts. He holds a certificate from the Rare Book School at Columbia University in New York City and has recently completed a short course in Environmental Site Assessment. Dr. Draughon taught American History at the University of Georgia for twelve years. He came to New Orleans from Stratford Hall Plantation in Virginia, where he organized and directed a research center, the Jessie Ball duPont Memorial Library. At Stratford, he served as historian of the plantation, a complex of eighteenth century buildings and the birthplace of Gen. Robert E. Lee. Dr. Draughon also has taught at Auburn University in Alabama and in the Historic Preservation Program at Mary Washington College in Fredericksburg, Virginia. He served as associate director and lecturer of a summer seminar for teachers, the Monticello-Stratford Hall-University of Virginia graduate course in colonial and revolutionary America. This program, which Dr. Draughon helped to start, won a special award from the American Association of State and Local History. Dr. Draughon also has served as Curator of Manuscripts and Archivist at the Historic New Orleans Collection, a museum-research center in the Vieux Carre. He has published articles in state historical journals and anthologies. For the past several years, Dr. Draughon has been working on a biography of William Lowndes Yancey, the southern political leader.

Dr. Draughon has served as Senior Historian at R. Christopher Goodwin & Associates, Inc., since 1990. He has performed extensive research throughout the southeastern United States and has applied the findings to the historical significance of a project area. Dr. Draughon undertook historical research for cultural resources surveys conducted throughout the southeastern United States where he described the historical development of each project area and reported on the significant themes relevant to understanding the history of the region.

MARTHA R. WILLIAMS, M.A., M.ED.
PROJECT MANAGER/ARCHEOLOGIST/HISTORIAN

Martha R. Williams, M.A., M.Ed., Project Manager, holds a B.A. (1960) from Lebanon Valley College; a Master of Education, with emphasis in the Social Sciences, from the University of Pennsylvania (1965); and an M.A. in History, with emphasis in Applied History, from George Mason University (1987). She was a Coe Fellow in American Studies at SUNY Stony Brook in 1982 and 1989. While completing her internship with George Mason University, she co-authored the Heritage Resource Management Plan for Fairfax County, Virginia.

Ms. Williams has had extensive experience in cultural resource management and in historical archeology in Northern Virginia. As co-director of the Fairfax County Seminars in historical archeology for high school student (1973-1987), she directed or assisted in the investigation of fifteen archeological sites in Fairfax County, including investigations at Belvoir Manor (1973-1975). Her experience includes volunteer work on both prehistoric and historic sites with the Fairfax County Heritage Resources Branch, for the City of Alexandria, for the Virginia Division of Historic Resources, and for the National Park Service, including excavations at the Lost Colony site on Roanoke Island. Ms. Williams' archeological experience also includes a field school with Colonial Williamsburg (1972), and employment with the National Park Service as an archeological laboratory technician.

Since joining R. Christopher Goodwin & Associates, Inc., Ms. Williams has served as historian, project archeologist, project manager, and public interpretation specialist for numerous studies conducted by the firm. She has co-authored reports and/or managed projects in Maryland, Virginia, the District of Columbia, Pennsylvania, Maine, Massachusetts, Vermont, North Carolina, Mississippi, Louisiana, and Puerto Rico. As public interpretation specialist, she designed and executed successful public information activities for the company's Stadium Project in Baltimore; the Drane House project in Garrett County, Maryland; the Icehouse Square project in Gettysburg, Pennsylvania; at the Gott's Court and Main Street sites in Annapolis, Maryland; at Pemberton Plantation in Salisbury, Maryland; and for two public information and training projects under the Legacy Program of the Department of Defense. She has managed such diverse projects as Phase I/II survey and evaluation of private developments in Anne Arundel County, Maryland, archeological testing of urban sites in Baltimore, archeological and architectural survey of the Redskins new stadium site in Prince George's County, Maryland, and preparation of the Cultural Resources Management Plan (CRMP) for the U.S. Naval Academy.

Ms. Williams also is actively involved with professional preservation organizations. She has served as Vice-President of the Archeological Society of Virginia (ASV) , and on the ASV Board of Directors. She has written for numerous publications, including the *Yearbook* of the Historical Society of Fairfax County, *Museum News, Interpretation* (NPS), the *Quarterly Bulletin* of the Archeological Society of Virginia, *American Antiquity*, and the *Journal of Mid-Atlantic Archaeology*. In 1991, she received a Distinguished Service Award from the Fairfax County History Commission for her contributions to local history and preservation. She was recognized in 1992 by the Society for Historical Archaeology for her two-year service as Chair of that organization's Committee on Public Education. In 1996, the ASV recognized Ms. Williams as "Professional Archeologist of the Year."