Wooten addressed the problem again in 1907 and reported favorably on a dam-only alternative ($100,000). The object of the proposed dam was to save the navigability of the route between Caddo T. Lake ant Jefferson. Although the dam would destroy navigation between Jefferson and Shreveport, a lock court be placed through the dam at a later point and a channel dredged below.

The citizens of Jefferson, through their congressional representative, immediately moved to modify the proposal, ant the Rivers ant Harbors Act of March 1909 included provisions for a resurvey to include a lock with the dam. The resulting report by Capt. A F. Waldron favored the modification ant recommended that the dam not be built if the modification were not included.

The Rivers and Harbors Act of June 1910 appropriated $100,000 for the dam-only alternative and stipulated that the tam would be built in such a manner as to admit a lock when deemed necessary. The Rivers and Harbors Act of February 1911 initiated another survey to include the lock and downstream dredging. The report by Capt. T. H. Jackson was unfavorable. The dam was completed in December 1914 in the manner directed by Congress, bringing the history of navigation to Jefferson to a close, but with a provision that enabled hope for the resurrection of the waterway to continue.

CHAPTER 3

REMOTE-SENSING SURVEY AND DIVER EVALUATION

Remote-Sensing Survey

Introduction

The use of remote-sensing technology in the search for shipwrecks teas become an increasingly common aspect of underwater archaeology in recent years. As a result, there teas developed a relatively comprehensive archaeological literature on the application and utility of the remote-sensing instruments used in this study the magnetometer, the side-scan sonar, and the fathometer. The magnetometer probably has been the most commonly used of the three. The principles of how magnetometers work and their early application to marine archaeology were reported by Breiner and MacNaughton (1965). Pioneering work to plot the distribution of segments of a specific marine wreck as an interpretive aid was done by Clausen off the Florida east coast (Clausen 1966). Since that time, many researchers have contributed to the growing body of data involving the use of magnetics to locate and study shipwrecks (e.g., Arnold and Clausen 1975; Garrison et al. 1989).

Side-scan sonar has been used for many years in cultural resources and hazard surveys conducted relative to mineral leases on the Gulf of Mexico Outer Continental Shelf (see Garrison et al. 1989 for a discussion of the application of side-scan sonar on the Outer Continental Shelf). While most commonly used in coastal waters, the side-scan sonar is increasingly being applied to riverine cultural resources survey. It has been employed in a number of riverine cultural resources surveys in Texas and Louisiana

Several remote-sensing surveys intended to locate shipwrecks have been conducted along rivers in north Louisiana and east Texas. One of the early riverine studies in this region was conducted by J. Barto Arnold (1974) and consisted of a magnetometer survey of the wreck of the nineteenth century river steamer Black Cloud on the Trinity River about 5 km above the town of Liberty. In 1965 the boat was discovered during the construction of a pipeline across the Trinity. Although partially masked by the magnetics produced by the pipeline, Arnold (1974:Fig. 2) was able to distinguish an 80-by-30 ft anomaly associated with the wreck- Subsequent to Arnold's work, additional magnetometer survey and diving investigations confirmed the presence and identity of the wreck (Adams 1980, 1981; Hoyt 1991; Hundley n.d.). In 1987 a remote-sensing survey using magnetometer, fathometer and side-scan sonar of a portion of the Trinity River below Liberty was undertaken by Coastal Environments, Inc. (Weinstein et al. 1988). That study located several targets believed to be possible steamboat wrecks. Examination of these targets by Espey, Huston & Associates, Inc. (Gearhart and Hoyt 1990) revealed that one target did indeed represent the remains of a steamboat, possibly the sternwheeler J. D. Hinde, which sank in 1869.

Several remote-sensing surveys have been undertaken along the Red River of Louisiana. These studies have included terrestrial and riverine surveys, intended primarily to locate historic steamboat wrecks. These include two studies by Gulf South Research Institute (GSRI 1975, 1980), which together located over 900 magnetic anomalies, some of which are presumed to be related to shipwreck remains. Neither of these studies, however, included physical examination and identification of the sources of anomalies. In 1980 Rone Engineers, Inc. conducted a study involving the relocation and identification of several of the precariously recorded magnetic anomalies on the Red River (Rone Engineers, Inc. 1982). That study employed divers in an effort to identify sources of anomalies. The divers failed to find any obvious remains of shipwrecks. In 1980 and 1981 coastal Environments, Inc., conducted a terrestrial magnetometer survey at 17 proposed construction areas along and adjacent to the Red River channel (Pearson et al. 1982). These areas were selected. primarily, because most represented former locations of the Red River channel This survey identified 98 magnetic anomalies, several of which were subsequently located and identified. None of these proved to be shipwreck remains (Saltus 1983; Whelan and Pearson 1983).

The several surveys conducted along the main channel of the Red River have located numerous anomalies which may represent the remains of sunken vessels, however, none have yet been verified as the remains of historic vessels. The presumed wreck of the Civil War ironclad gunboat U.S.S. *Eastport* was located by an aerial-borne magnetometer survey just below the town of Montgomery. The wreck, which lies just outside of the river channel buried beneath SO ft of sediments, has been verified by coring, but its exact condition remains unknown (Tommy Birchett, personal communication 1992). A magnetometer survey of Ninock Lake, a Red River oxbow in Red River Parish, located a large magnetic anomaly believed to be the remains of the steamboat *Nat Dortch,* which sunk in 1889 (Hunter et at 1992).

Particularly pertinent to the present study is the archaeological research which has been conducted relative to trying to find the wreck of the nineteenth-century steamboat *Mittie Stephens* on Caddo Lake. This previous research has been synthesized by Ruby Lang in her MN Thesis on the history and archaeology of the *Mittie Stephens* (Lang 1986). Historical research indicated that the *Mittie Stephens* had gone down near the Texas-Louisiana border near the shore of the lane, in the vicinity of Swanson's Landing or Jeter's ! anding and previous searches have been concentrated in this area In October 1982, J. Barto Arnold m of the Texas Antiquities Committee, conducted a brief magnetometer survey near the south shore of the lake just off of Swanson's Landing. Two magnetic anomalies were located, but one was identified as oil field material and the other was unidentified. In 1983, Ervan Garrison (1983) conducted a magnetometer and remote-sensing survey along the south shore of Caddo Lake in the vicinity of Jeter's and Swanson's landings in a search for the remains of the vessel. Garrison's survey located a number of magnetic anomalies, presumably caused by the considerable amount of oil-field related material scattered throughout the lake in this area. No evidence of the *Mittie Stephens* was found, but this survey did find the remains of a partially preserved wooden skiff buried in the shoreline near the south shore of the lake (Garrison 1983). The skiff proves to be fairly modern, unlikely to be associated with the *Mittie Stephens*. Lang (1986:119-120) conducted additional magnetometer survey near the south shore off of a location known as Sproul's Farm, located east of Jeter's Landing. This survey recorded a magnetic anomaly which proved to be several 1.5-in diameter iron rods projecting from the lake bottom. These rods projected some 6 ft out of the lake bottom, however, efforts to verify their identity were unsuccessfulL Lang postulated that they may represent hog chains from a steamboat, but it was later found that these rods were associated with oil production facilities (Lang 1986:119-123). Lang conducted another brief magnetometer survey in the Spring of 1984, again in the vicinity of Sproul's Farm, but with no positive results.

In the summer and fall of 1984, the Environmental Engineering Department Texas A&M University conducted another remote-sensing survey for the *Mittie Stephens*. This work was again directed by Ervan Garrison. This survey work located *two* significant anomalies considered worthy of additional investigation. One of these anomaly locations was examined by divers in the summer of 1985 and proved to be the remains of an oil well platform The other target has never been examined (Lang 1986:117-131). Although these studies failed to locate the wreck of the *Mittie Stephens,* they did serve *to* collect a considerable amount of historical information on the vessel and the events of her loss.

Recently, two individuals have been involved in the search for the remains of the *Mime Stephens*, Jacques Bagur and Steve Nance. Relying on historical information about she wreck and, particularly, on lake conditions since the loss of the vessel, these two individuals, independently, arrived at conclusions as *to* where the wreck may lie. Searching the lake share, Nance found a large concentration of burnt ceramics and glass in the vicinity of Jeter's Landing. These materials appear to date *to* the period of the loss of the boat (1869), and there is every reason to believe that they represent material salvaged from the boat The remains of the vessel, however, have not yet been located. Presumably, it lies offshore not far from this location.

Remote-Sensing Survey and Data Interpretation

Interpretation of data collected by remote-sensing instruments is not always straightforward, and, generally, relies on a combination of sound scientific knowledge and practical experience. This is particularly true of the magnetometer, which produces data that can be processed manipulated, and displayed in a variety of ways to arrive at an assortment of interpretations and conclusions. In light of this, a brief discussion of remote-sensing survey and target interpretation as conducted is presented.

Magnetometer

Magnetic surveying involves the measurement of the earth's magnetic field intensity (measured in "gammas") using an instrument known as a magnetometer. The present study is concerned with the application of magnetometers in the search for shipwrecks. Details on the physics and mechanics of magnetometers are not discussed here and can be found elsewhere (e.g. Aitken 1958 and Breiner 1973). An assortment of objects and materiels, including buried archaeological features, cause localized disturbances, or "anomalies," in the earth's magnetic field that can be detected with a magnetometer. In terms of physical structure, archaeological objects typically found by magnetic search can be divided into three groups: (1) iron and other ferrous materials; (2) burned features such as fire hearths, kilns, daub, brick, etc.; and (3) unfired features such as wall trenches, ditches, walls, storage *pits*, etc. The first category of items is most easily identified since ferrous objects cause significant magnetic disturbances. The other two classes of items tend to be less easily detected. The objects of concern in this study, sunken boats, are variable in detectability because of differences in size, mode of construction, amount of iron, etc. We must assume that larger vessels that contain large amounts of ferrous metal, such as steamboats, will be much easier to detect than small boats, such as wooden skiffs flats, etc. Therefore, these latter types of boats might easily go undetected in a magnetometer survey.

Magnetic signatures (anomalies) can be characterized by two nonexclusive factors: strength (intensity) and shape, both of which are dependent upon a variety of factors related *to* anomaly source characteristics. Such factors include the size, shape, and mass of the source object; its magnetic susceptibility its distance from the point of measurement; and the magnetic properties of the surrounding soil. Magnetic anomalies caused by a single-source ferrous object typically produce a positive-negative

anomaly pair known as a dipole. The dipole is usually oriented along the axis of magnetization, with the negative anomaly falling nearest the north pole of the source object. The positive anomaly reading is commonly of greater intensity than is the negative. Historic shipwreck remains, because they generally contain numerous ferrous objects, most commonly will produce a magnetic signature composed of a cluster or group of dipoles and monopoles. This class of signature is particularly apparent when the wreck remains are scattered and dispersed

Anomalies of archaeological interest can vary from several hundred gammas or more, to less than one gamma depending upon the characteristics of the source and its distance from the point of measurement. As a rule, the strength of the anomaly is proportional to the inverse cube of the distance between the source and the point of measurement. Because of this rapid drop-off in anomaly strength, objects near the sensor are more likely to produce marked variations in magnetic intensity than are more distant objects. A variety of techniques have been developed to estimate anomaly depth (distance from sensor), all of which e xpress varying degrees of error (Breiner 1973). -

Even though a considerable body of magnetic signature data for shipwrecks is now available, it is impossible to positively associate a specific signature with a shipwreck or any other feature. The variations in the content (particularly iron), condition, and distribution of a shipwreck all influence the intensity and configuration of the magnetic signature produced. Also, the manner in which the magnetic data are collected influences the characteristics of the signature. This includes, among other factors, the spacing of survey lanes, direction of survey lines, and distance of sensor from the source object. Despite these problems, shipwreck remains to tend to exhibit a class of magnetic signatures, with broad similarities in characteristics, that aid in differntiating them from other types of anomalies. Larger shipwrecks, because they generally contain numerous ferrous objects, commonly will produce a magnetic signature composed of a cluster of multiple anomalies (both dipoles and monopoles) which cover a fairly large area. What constitutes a "fairly large area" can be difficult to define, but Garrison et al. (1989:222-223) suggest that a typical shipwreck signature will cover an area between about 10,000 and 50,000 m2. Their estimates are applicable primarily to larger vessels lost in the Gulf of Mexico. Smaller types of vessels, such as many of those that plied the waterways between Shreveport and Jefferson, would produce signatures of a smaller size. Even these smaller vessels should produce the characteristic multiple anomaly (sometimes termed "complex") signature that often can be distinguished from the isolated, individual anomaly signature that is more characteristic of single pieces of debris (barrels, pipes, pieces of cable, etc.). But, complexity partially depends on distance from the source. A magnetic anomaly recorded when the sensor is close to a shipwreck may exhibit a complex configuration because individual ferrous objects are detected; at a greater distance the signature may resemble a single dipole because the entire wreck is being recorded as a single-source object.

The multiple anomalies of shipwrecks tend to exhibit differential amplitude, reflecting the variability in size, composition, and mass of the elements of the shipwreck. Some nonshipwredked objects, such as a long length of cable, may produce a multiple anomaly signature covering a fairly large area, but the anomalies will customarily show a uniformity of amplitude (assuming constant distance from the sensor) distinct from the variability seen in shipwreck signatures (Garrison et al. 1989:122).

The amplitudes of magnetic anomalies associated with shipwrecks vary considerably, but, generally, the signature of larger watercraft, or portions of watercraft, range from moderate to high intensity (>50 gammas) when the sensor is at distances of 20 ft or so. Table 8 provides information on magnetic signatures produced by a variety of identified sources. These data suggest that at a distance of 20 ft or less watercraft of moderate size are

likely to produce a magnetic anomaly (this would be a complex signature. i.e., a cluster of dipoles and/or monopoles) greater than 80 or 90 It across the smallest dimension and have an intensity of greater than about 50 gammas. While recognizing that a considerable amount of variability does occur, this information establishes a starting point for the identification of the sources of magnetic anomalies in the project area.

Table 8. Magnetic Data From Various Sources.

Object	Size of Objects	Magnetic Intensity in Gammas	Area in ft (at 10 gamma contour level)	Sensor Distance (ft)
Single Objects				
Engine camshaft	20 ft x 2 in	45	45 x 50 feet	15
Cast iron soil pipe	10 ft long, 100 lbs	1407	45 x 65	4
Iron anvil	150 lbs.	598	26 x 26	4
Iron kettle	22 in diameter	200	23 x 23	4
Iron anchor	6-ft-long shaft	30	80 x 270	16
Multiple Objects				
Pipe and bucket	8 ft x 1 in	250	60 x 50	5
Cable and chain	5 ft	30	50 x 40	15
Scattered ferrous metal	14 ft x 3 ft x 0.8 ft	100	110 x 90	15
Shipwrecks				
Wooden, sailing trader	90 x 20 ft	35	250 x 150	16
Wooden steamer *Lotawanna*	180 x 47 ft	310	350 x 300	12
Wooden steamer *Spray*	140 x 90 ft	520	160 x 210	10
55-ft long, wooden schooner *James Stockton*	55 x 19 ft	80	90 x 130	8
126-ft long, wooden ship *El Nuevo Constante*	126 x 26 ft	65	150 x 250	20
150-ft-long, Civil War ironclad *CSS Tuscaloosa*	150 x 40 ft	4000	200 x 300	20
Segment of modern shrimp boat	27 x 5 ft	350	90 x 50	3
Gasoline stern-wheeler	50 x 10 ft	450	140 x 200	8
1840s tow boat	65 x 13 ft	110	110 x 60	12

Side-Scan Sonar

Side-scan sonar produces a visual image derived from sound waves sent through the water and reflected back to a sensor. Interpretation of side-scan records is fairly straightforward, because, generally, dense objects are good reflectors and produce a darker image on the record. The difficulties in interpretation arise from the fact that the visual portrayal of an object, such as a shipwreck, depends on a number of variables such as the target's condition and configuration, the site-specific environment, and the angle and distance from which the record is obtained. Side-scan sonar teas minimal penetrating power, so buried objects, particularly in a hard reflecting medium, such as sand, cannot be detected. The sidescan sonar records obtained in this study were generally very good, although the constantly changing water depth and bottom configuration required almost constant timing and adjustment of the instrument.

Fathometer

The fathometer, using acoustic energy, records water depth and can, as in this study, provide a hard copy track of the river bottom. Water depth information is particularly important in interpreting magnetometer data because of the sensitivity of the magnetometer to distance from the source object. In addition, by providing information on the configuration of the river bottom, the fathometer can often reveal bottom features that may be indicative of the presence of buried watercraft remains (e.g., bottom scours) or it may record waterc raft remains themselves if they protrude above the bottom.

While the generalizations discussed above are of use in establishing a basis for interpretation of remote-sensing data, a final evaluation must also take into account the specific natural conditions and history of use of the area under study. It is critical that magnetic data collection and signature interpretation be conducted within the context of the natural, settlement, and navigation histories of the region and the specific study locale. This historical framework should include an understanding of the navigation history of an area over time, encompassing the types of vessels used; the relative intensity of use; the cargoes carried; the locations of navigation *routes,* landings, docks, wharfs, etc.; and the shipwrecks which have occurred. This context should also include an understanding of the natural history of the areas of interest, particularly their geological and geomorphological histories, so that factors such as channel migration, water depth changes, etc., can be used in the evaluation and interpretation of specific magnetic signatures.

For example, several remote-sensing studies conducted in I Louisiana (e.g., Pearson and Saltus 1991; Pearson et al. 1991; Saltus 1985, 1988) have conclusively demonstrated that historic vessel remains are concentrated at locations such as landings, wharfs, and communities where the possibilities of loss and or abandonment have been greatest. This finding, which is not Surprising, emphasizes that a knowledge of the locations of these types of historic settlements is critical in implementing riverine survey and in interpreting the results. Recent remote-sensing surveys in the lower Atchafalaya River area (Pearson and Saltus 1991) and along the lower Pearl River in Louisiana (Pearson et al. 1991) by Coastal Environments, inc., clearly demonstrate the utility of this type of background information in the search for shipwrecks in settings generally similar *to* those found along the project area In these *two* studies, the remains of several, well-preserved historic folk craft (e.g., cypress skiffs and bateaux) and wooden barges were found submerged and buried adjacent to former settlements and landings. Most of these craft had been undetected during a magnetometer and side-scan sonar survey; however, careful physical examination of the bankline and shallow-water area near the former landings located the vessels. The reasons these boats were not found during the remote-sensing survey is because they contain little ferrous material or they are buried,

making them invisible or difficult to detect by both the magnetometer and the s scan sonar Further, the study demonstrated that the recent uses of several of the waterways examined have resulted in the accumulation of a large quantity of modern debris and *trash* , much of which was recorded during the remote-sensing survey (Pearson and Saltus 1991). Knowledge of the history of use of the individual waterways aided the development of informed decisions as to the identity and potential significance of various targets.

Within the project area are found a variety of settings and situations which can make the search for shipwrecks and the interpretation of remote-sensing data difficult. Water depth vary throughout the survey area, most particularly along Cypress Bayou, so the distance, between the magnetometer sensor and any source which rests on or under the bottom change constantly during survey. This variability can be a serious problem for the magnetometer because of the rapid fall-off in magnetic intensity with increased distance. An object the creates a large anomaly in the shallow water of a point bar may be barely detectable in the 15 ft of water found at some locations in the project area. A fathometer was used to record water depths, but knowing the water depth does not eliminate the possibility of not detecting some objects which may be in deep water. Fortunately, although water depths did vary, they were not extreme in most of the area surveyed.

Sedimentation and river migration also are factors that must be considered in the search for shipwrecks in the environments found within the project area. The presence of abondoned channels along portions of Cypress Bayou attests to meandering in the past. A comparison of modern channel morphology with available historic maps reveals that shifts in-channel positions have occurred, but, generally have been localized and minimal In light of these small changes in river positions, vessels lost in the channel or abandoned along its banks during the nineteenth-century probably will still be within the present channel boundaries. As noted in earlier sections, however, several cutoffs to improve navigation were mate in the nineteenth century along Cypress Bayou, leaving abandoned segments of the ever.

The impacts that natural riverine and lake processes have on boat wrecks are variable. The condition of a wreck today depends upon post-wreck natural and cultural impacts and upon the specifics of the wreck event itself (see Pearson et al. 1989 for more complete discussions of these types of impacts). In a sinking, many moveable and buoyant objects, including some cargo, could float away and therefore be absent from the archaeological record Additionally, efforts were almost always made to salvage the valuable parts of a boat and her cargo or, where possible, to raise the entire vessel. If large vessels were lost in the project area, we can assume that salvage would have been attempted. At least for steamboats, major efforts normally were made to remove the valuable engines and boilers, which could be reinstalled in other boats. If the hull could not be raised or salvaged, there is a reasonable chance that it could be preserved at least in part.

Post-Wreck impacts are normally difficult to identify and assess. The natural impacts will vary depending on many factors relating to stream or lake hydrology. Some (e.g., exposure to swift current) may act over time to destroy or disperse a wreck, others (e.g., increased sedimentation) may tend to enhance preservation of the remains. The variable velocities along Cypress Bayou could easily damage and scatter wreck materials. Additionally, the fairly low sediment load carried by the stream generally would decrease the potential for deep burial of wreck remains. One exception may be in the active deltaic area of lower Cypress Bayou and upper Caddo lake, where chances for complete burial of sunken vessels are much higher.

Man-induced impacts will also affect a wreck site long after the loss of the vessel. Channel dredging can be destructive to a wreck, both from direct impact and from any number of indirect impacts that may result from removal of sediment or alterations in river flow

characteristics. The project area has been subject *to* dredging, snagging and channel cutoffs, although the impacts these activities may have had on wrecks is unknown.

Additionally, if a wreck site is exposed as a result of channel migration, low water, or sediment removal (natural or man-induced), it becomes a prime target for salvage or looting. As is discussed elsewhere in this report, this is likely what happened to the wreck of the *Mittie Stephens,* over the many years that her remains were exposed.

Survey Methodology

The remote-sensing survey for this study used a side-scan sonar, magnetometer and fathometer. The survey vessel used was a 19-ft fiberglass, center console boat powered by a 125-horsepower outboard engine. The magnetometer used was a Geometries Model G-866 recording proton precession magnetometer. A chart-recording fathometer was used to gather bathymetric data The sonar used was a EG&G Model 260 side-scan with slant range correction and a 500 1& sensor (fish). The survey was conducted by a 4-person crew between December 27, 1992, and January 2, 1993.

The magnetometer sensor was mounted on an aluminum pole extended 2 m (6 *ft)* forward of the survey vessel and 0.6 m (2 ft) above the water. Prior to each day's survey, tests were nun to insure that the sensor was beyond the magnetic influence of the survey boat. The magnetometer was operated on a 100/1000 scale and readings were taken every 1 second. A boat speed of about 4 ml/hour was maintained during the survey, resulting in a magnetic eading approximately every 2 m. The magnetic data collected during the study generally were of good quality, with background noises less than +/- 3 gammas. The fathometer was hull mounted at the stern of the vessel The side-scan sonar sensor was lowered over the bow of -the vessel to a depth of about 1 m below the water's surface. The side scan sonar was operated on a 50 m scale, such that a total swath 100 m wide as covered. Several times the sensor had to be pulled out of the water because of logs and fallen trees.

Positioning during the survey was obtained with a Trimble Global Positioning System (GPS). The system was set to record a position every 45 seconds as the survey was being conducted. This resulted in a positioning point (or "shot point") being recorded approximately every 265 ft along the survey lines (Figures 34a and b). The survey coverage attempted to follow the nineteenth century steamboat route as derived from historic sources. As discussed earlier, this route followed Big Cypress Bayou from Jefferson to the upper positions of Caddo Lake. There were, apparently, several routes used in the very upper parts of Caddo Lake during the historic period. For most of the survey in Big Cypress Bayou, a single survey line was run down the visually-determined center of the channel The bayou is quite narrow along much of its length above Caddo Lake, generally less than 50 m wide, such that the single line achieved total coverage of the channel. In the lower parts of Big Cypress Bayou, in the vicinity of Caddo Lake State Park, the bayou is quite wide, and two survey lines were run in this area to achieve adequate coverage. Once Caddo Lake was reached, a single wurvey line was again used. This survey line followed what is thought to be the nineteenth century navigation route and generally follows the southern shore of the lake. Near the western end of Caddo Lake, the old channel of Cypress Bayou, which was the navigation channel, can clearly be seen with the side-scan sonar and fathometer and could be easily followed in the survey boat Farther east, near the Louisiana-Texas state line, as the lake becomes slightly deeper, this channel becomes obscure and impossible *to* follow. Along this portion of the survey, the survey line followed two of the numerous "boat lines" which are marked in the lake (see 34b). In Texas this was Boat Line 5, and in Louisiana, this was Boat line G. A review of available maps of the nineteenth century boat route through the lake suggests that these *two* boat lines correspond very closely to the route used by steamers.

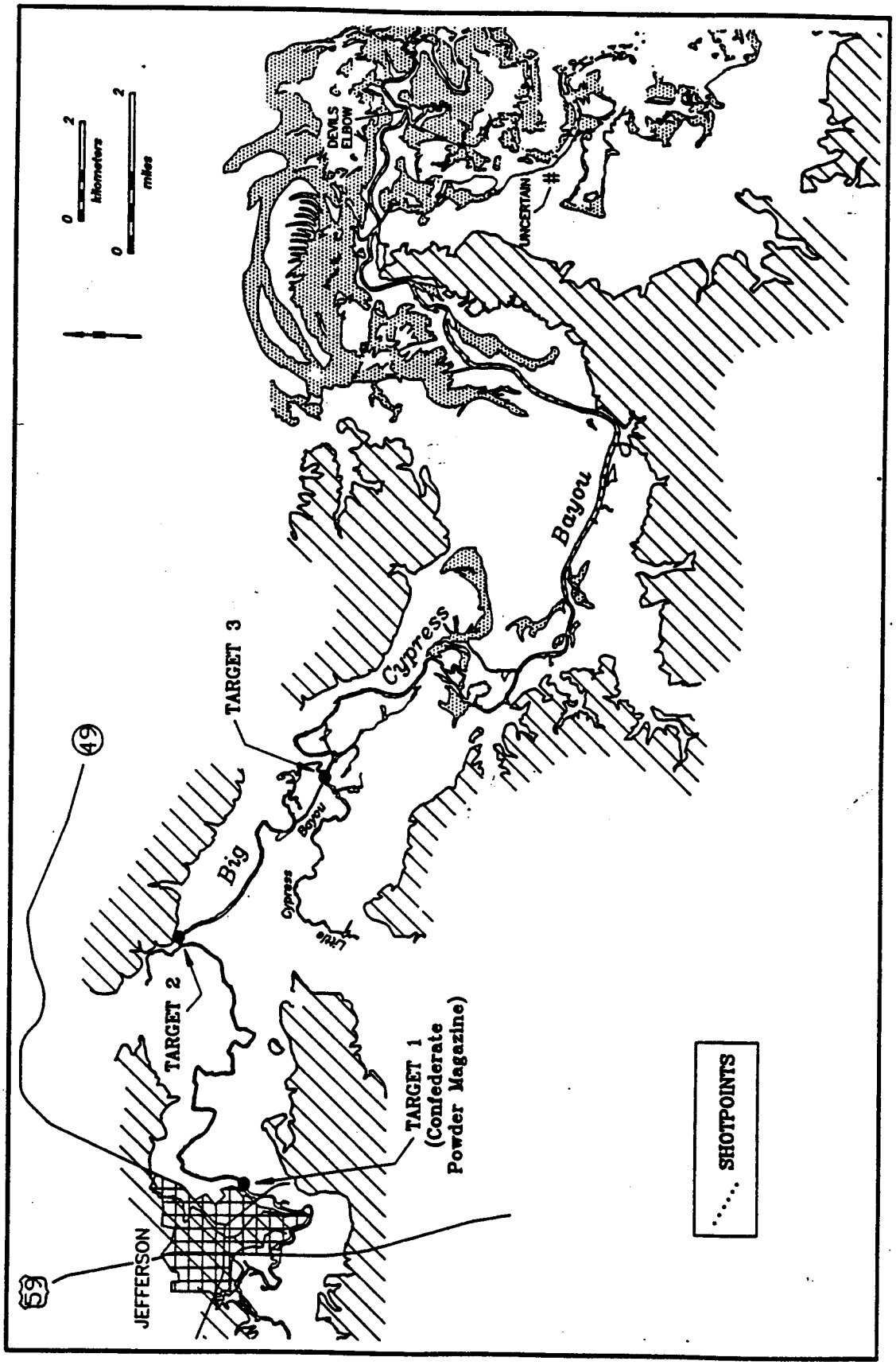

Figure 34a. The Upper (western) protions of the project area showing the survey control points and Target locations.

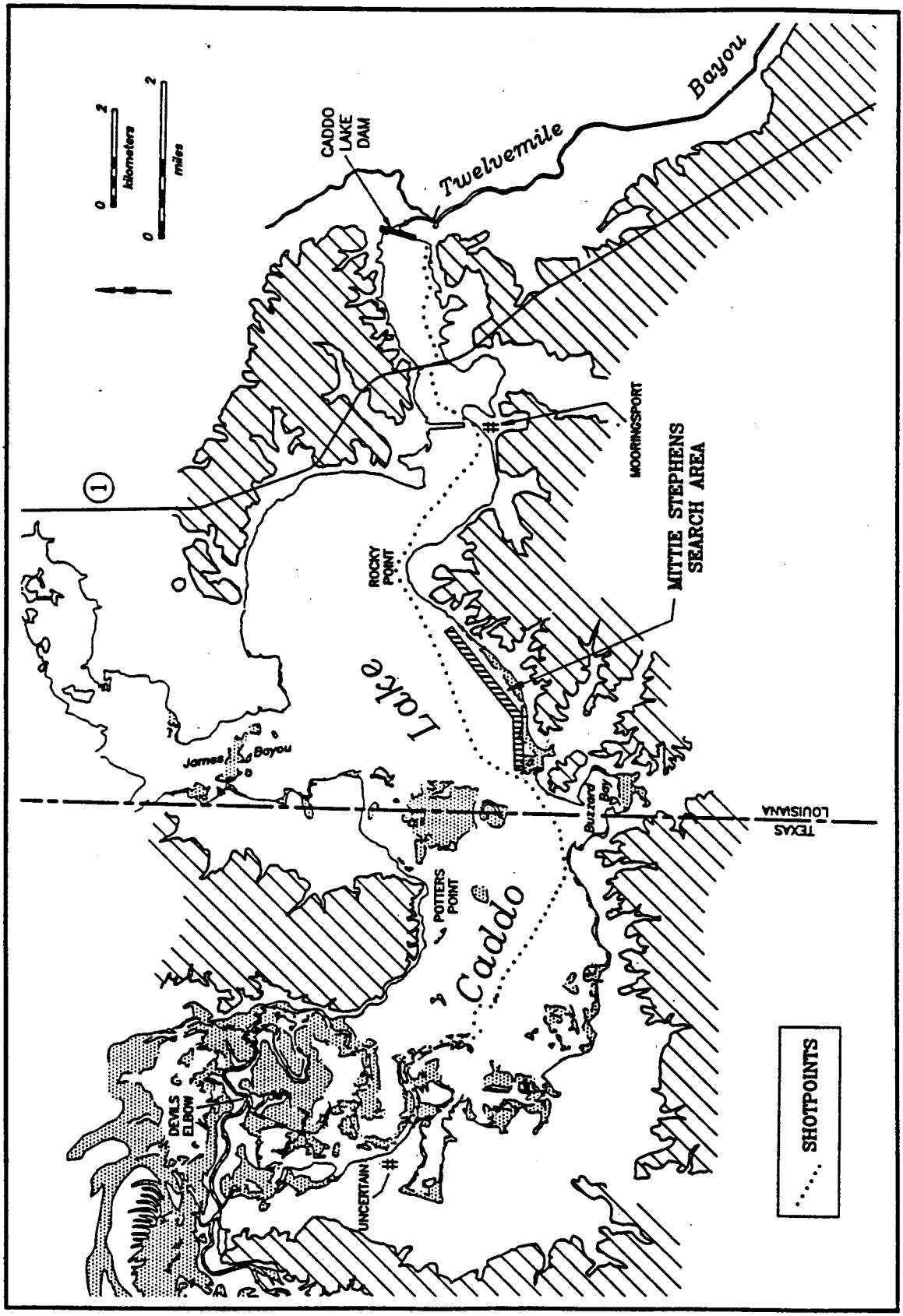

Figure 34b. The central portion of the project (Cado Lake) showing survey control points and the Mittie Stephens survey area.

In Twelvemile Bayou, a single survey line was run town the center of the channel from the foot of Caddo Lake Dam all the way to Red River. The survey positioning points in Twelvemile Bayou were spaced farther apart than those on the rest of the survey (Figure 34c).

Additional survey was conducted near the south shore of the lake in the area between Rocky Point and the Louisiana-Texas state line in an effort to locate the remains of the *Mittie Stephens.* The location of this survey is shown in Figure 34b. This survey was meant only as a brief exploratory examination of this area Portions of this area bad been covered by earlier investigators (e g., Garrison 1983; Lang 1986) using magnetometers, but, apparently, none hat used site-scan sonar. The search for the Mittie Stephens employed 4 parallel survey lines spaced approximately 50m apart and running generally parallel to the shore line. The intent was *to* extend the survey as close inshore as possible, but with the site-scan sonar sensor lowered in the water, it was not possible to operate in water less than about 5 ft deep. This meant that the survey could not come closer than about 150 m of the shore and just beyond the cypress trees lining much of the lakeshore in this area

During the survey, no correcting differential was applies to the GPS signal received from the satellites This was not considered necessary because no precise navigation was required. However, it was critical to know where the boat hat been in order to precisely locate any targets recorded. Therefore, coincident with the survey, a base station near Lafayette, Louisiana, collected data from the same satellites used by the survey in order to establish the built-in error in the satellite signals. The collected positioning data were stored ant after the survey was computer corrected using the data collected at the base station. This correction resulted in accuracies on the order of +/- 2 m for each positioning point obtained in the survey.

Survey Results

The remote-sensing survey locates only three targets of interest. All of these were in Cypress Bayou, and are designated Targets 1, 2 and 3 in Figure 34a Target 1 was selected only because it was adjacent to the remains of a brick powder magazine constructed during the Civil War. While no distinctive features were seen in this area on the remote-sensing "cords, *it* was decided that the area should be examined in the event that material related to the powder magazine may have fallen or been dumped into the bayou.

Target 2 appeared as a distinctive boat-shaped object on side-scan sonar records. This object measured approximately 10 m long (Figure 35) and was situated on the north side of Big Cypress Bayou at the former location of Smithland, a nineteenth centu ry landing located at the confluence of Big Cypress and Black Cypress bayous (Figure 36). It was thought that the object could be a vessel or portion of a vessel lost or abandoned at the landing.

41HS562 (Target 3) appeared as a distinctive side-scan sonar image (Figure 37) and magnetic anomaly (Figure 38) m Big Cypress Bayou. The object was located in the center of the channel at the mouth of Little Cypress Bayou and just below one of the navigation cuts made in the nineteenth century. The side-scan image of this target was a very boat-looking object, measuring approximately 15 to 20 m long and 7 to 8 m wide (Figure 37). The sonogram, also, seemed to show several logs or branches on the bottom on the downstream side of the target.

In addition to these targets of interest, the remote-sensing survey recorded many other objects, including large numbers of logs, branches, and cypress stumps. In Caddo Lake, in addition to these objects, the survey also recorded a number of derelict oil well facilities and features. To some extent, the large quantity of metal found in these objects could have masked magnetic signatures of sunken vessels. This was particularly true in the area searched for the

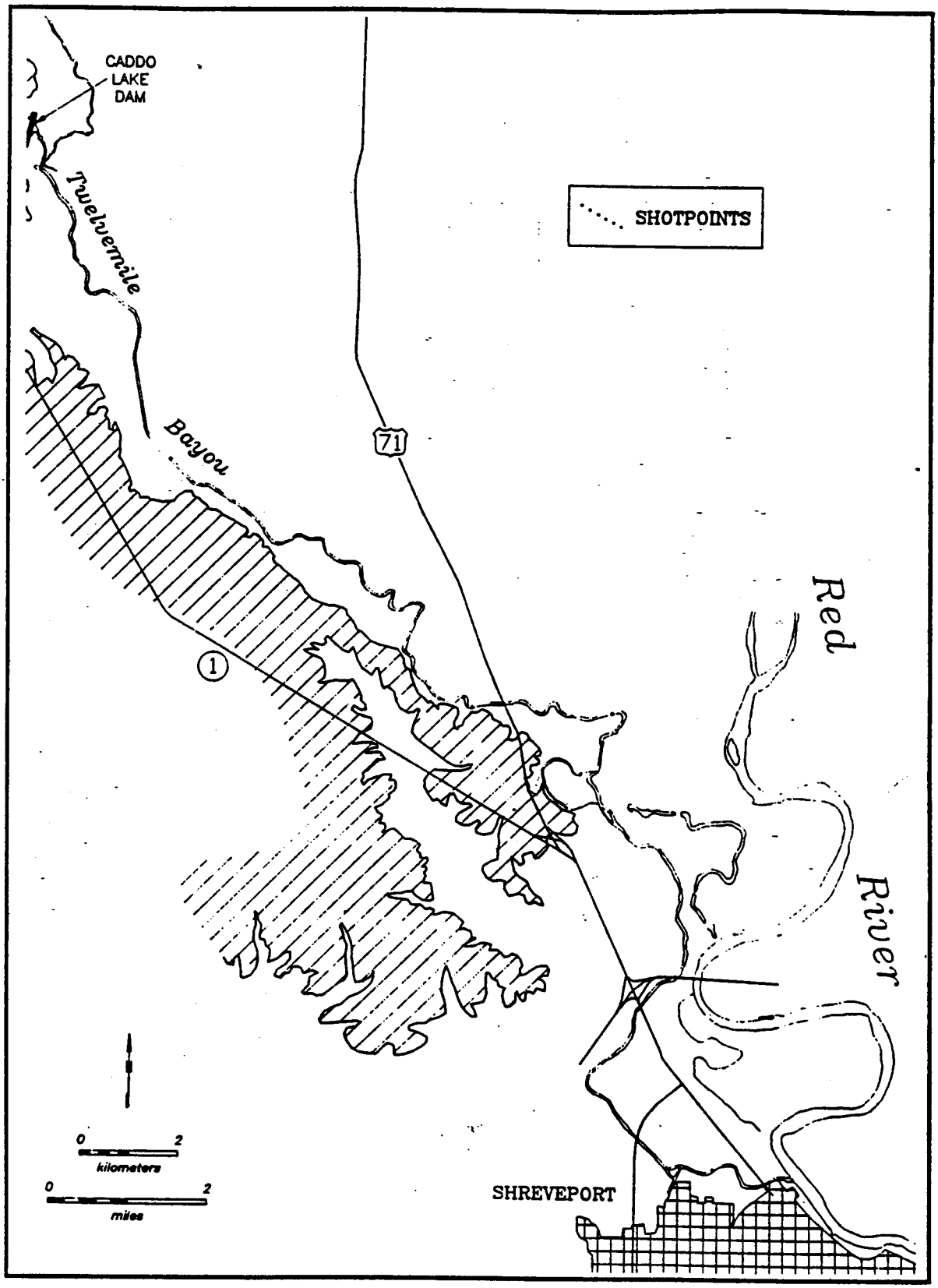

Figure 34c. The lower (eastern) portion of the project area showing survey control points along Twelvemile Bayou.

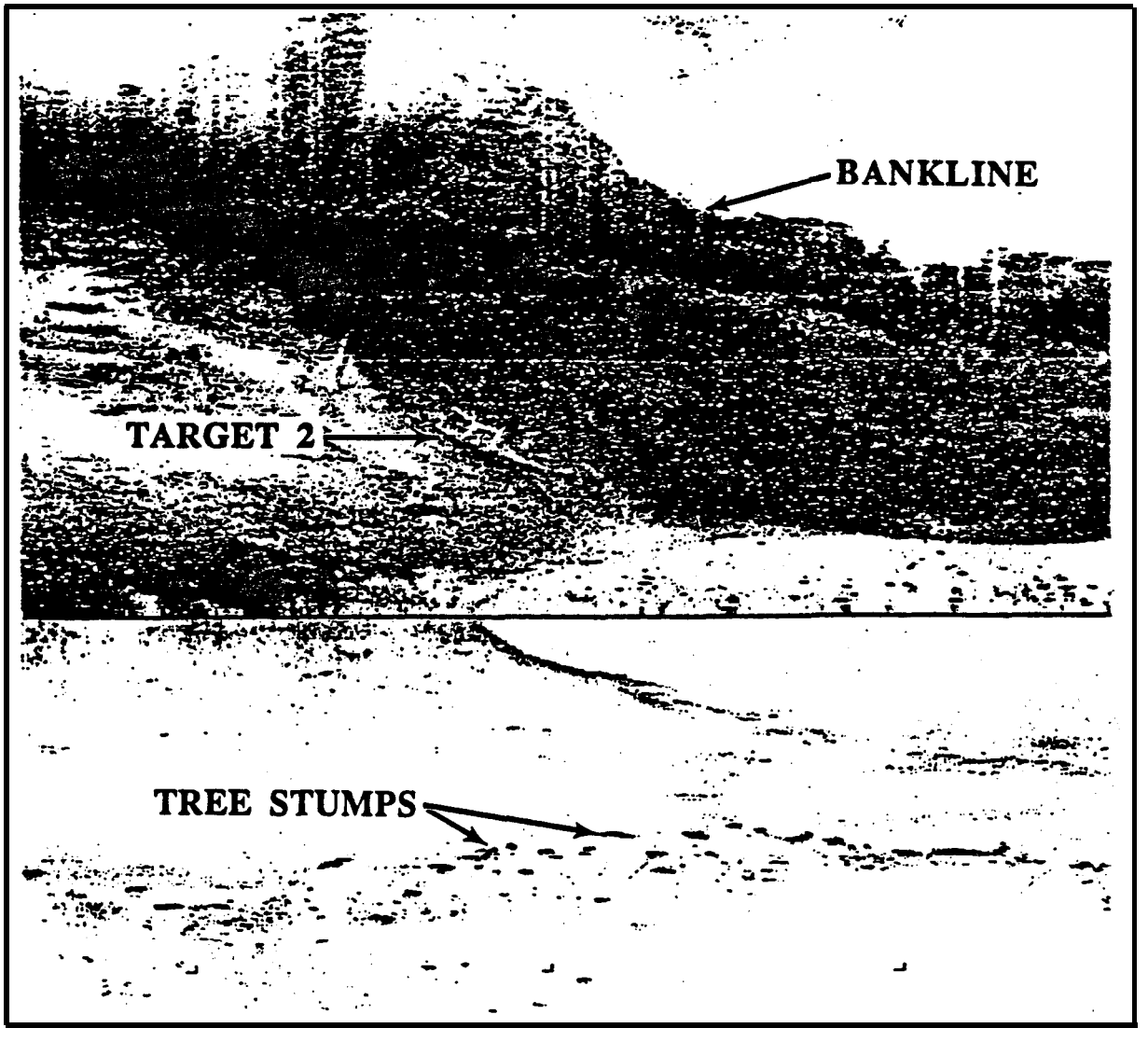

Figure 35. Side-scan sonar record of Target 2.

Diver Evaluation of Targets

Coastal Environments, Inc. of Baton Rouge, Louisiana, and Panamerica n Consultants, Inc. of Tuscaloosa, Alabama, undertook underwater archaeological investigation and assessment of three remote sensing target locations discussed above . The objective of this investigation was to relocate, identify and assess the sources of the two remote sensing targets, designated Target 2 and Target 3, and to report on the findings of an underwater investigation of the river bottom adjacent to the Civil War-era powder magazine located near Jefferson.

These underwater examination s took place over the five-day period between January 18 and January 22, 1993. The diving operations for this project were conducted to meet all federal for safe diving. All diving activities were accomplished in accordance

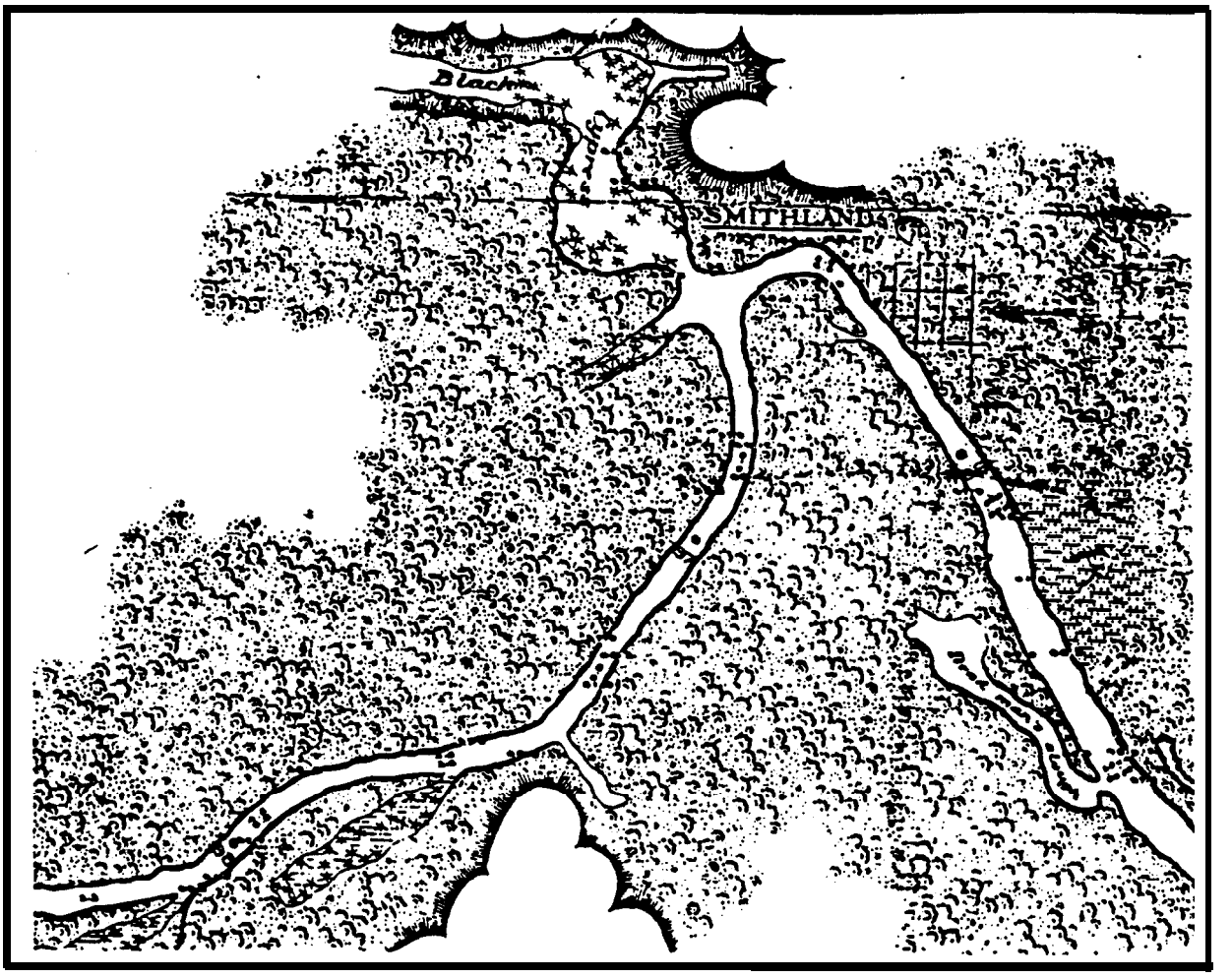

Figure 36. Nineteenth century map of Smithland Landing.

with the strictest provisions of U.S. Army Corps of Engineers and U.S. Navy diving safety manuals and diving guidelines.

The underwater archaeological dive team consisted of four individuals: a diving supervisor, a diver, a stand-by diver and a tender, with individual project participants specializing in one role or changing roles as necessary. Each dive team member met the training and qualification requirements established in ER 385-l-86. Mr. Stephen R James served as the Diving Supervisor and Field Director throughout the diving operations. James A. Duff, Steve Hack and Jeff Motz served variously as Archaeological divers, tenders and stand-by divers.

The vessel utilized during this project was a 23-foot center-console Wellcraft runabout Although normally considered small for an archaeological survey vessel, the Wellcraft was well suited for this project and was considered by locals to be large for the areas investigated. Sufficient deck space was available for the equipment and personnel necessary for surface supply diving operations. The vessel was launched from the boat ramp in Jefferson, Texas, and run downriver to the areas investigated by boat. Vehicle access to the river bank immediately adjacent to Targe t 2, the first target investigated, proved to be simpler, more

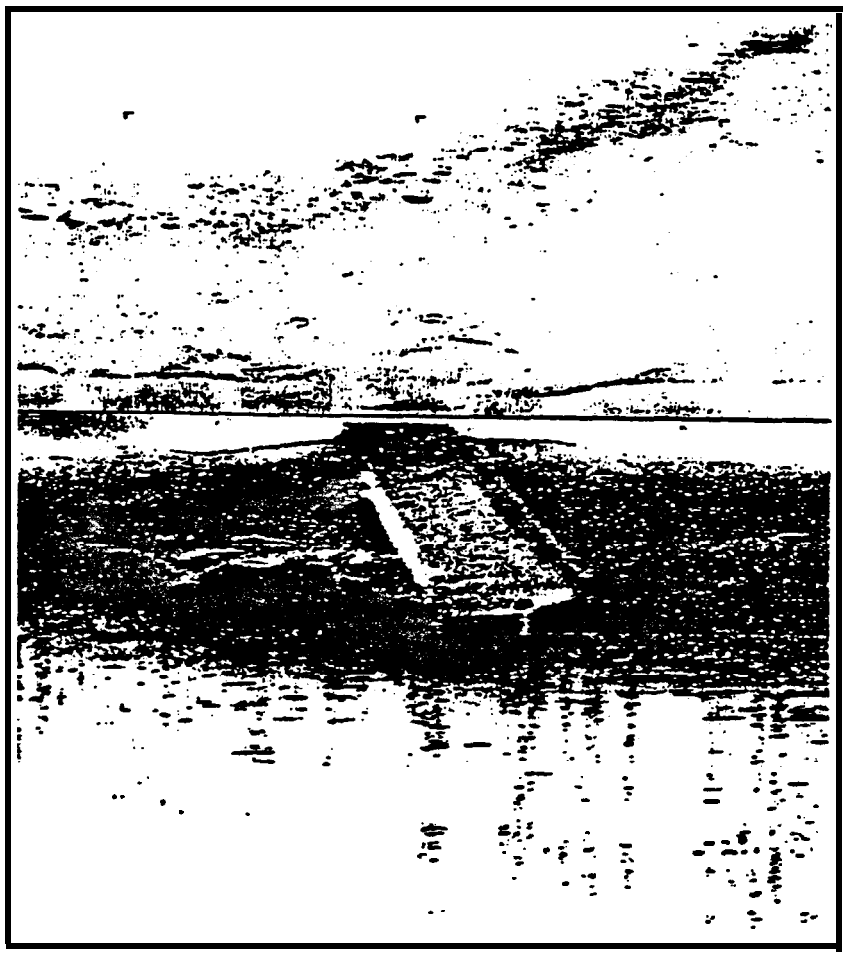

Figure 37. Side-scan sonar record of Target 3 (41HS562).

effective and efficient form of access at that one location. The other two locations required access by boat.

Far this investigation Surface Supplied Air (SSA) was used for the inherent safety and more efficient working operations provided by the direct diver to surface air line and communications link. The safety factorprovided by SSA was particularly important due to the minimal underwater visibility and strong currents encountered in Big Cypress Bayou. The dive helmets utilized were Heliox-18 band masks equipped with non-return valves. The helmets are maintained according to manufacturers specifications and only approved spare parts are used for replacements.

Air for diving was provided from a cascade system of 'K' bottles,with a backup bottle' connected to the main manifold. Pressure gauges and check valves were included in the air supply system as appropriate and as required. Air cylinders were stored aboard the vessel lying on their sides on the deck and secured against movement. The diving supervisor monitored the air supply system during each dive to insure that air pressure was correctly maintained and adequate reserve air always available.

Divers using SSA wore a safety harness with a quick release attachment connected to the air umbilical. A safety line was included as an integral part of the umbilical. The divers

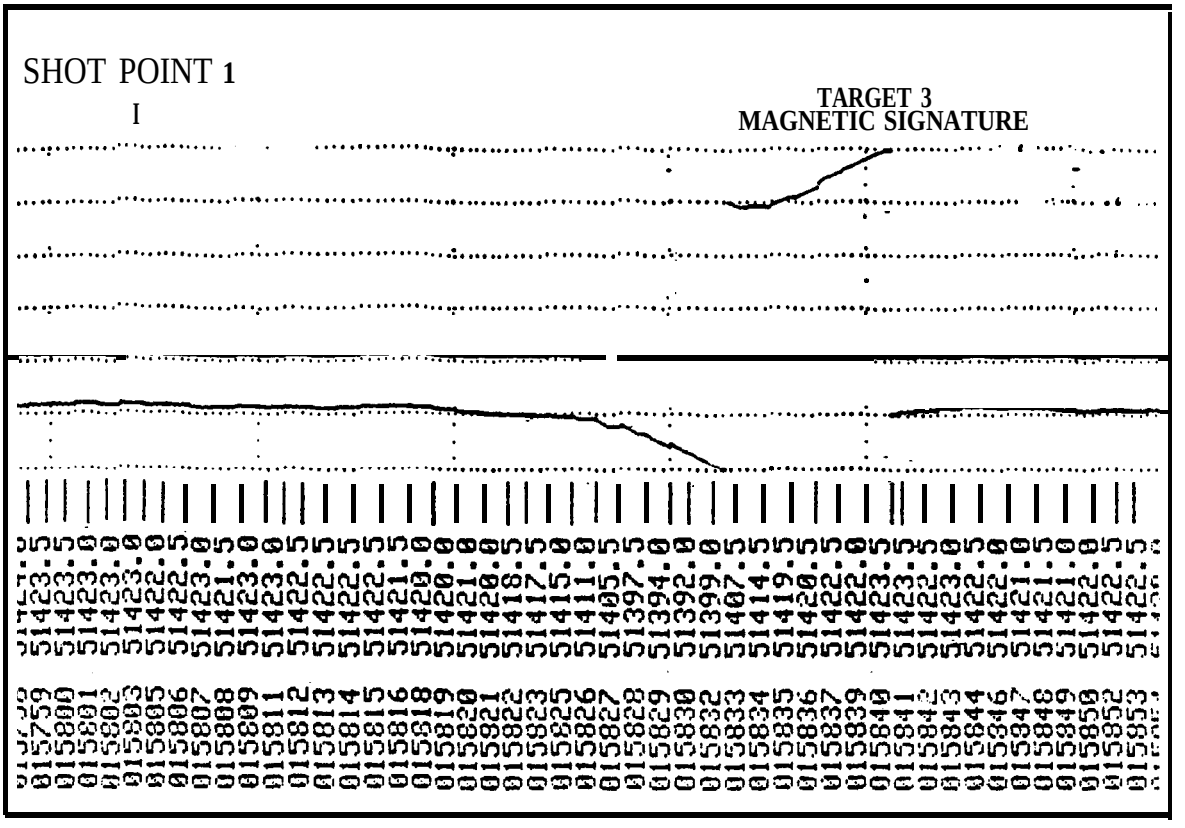

Figure 38. Magnetic strip chart record of 41HS562 (Target 3).

wore dry suits, boots, and gloves appropriate to the cold water diving conditions. All of the equipment used during the diving operations was inspected prior to each dive.

All diving was performed in accordance with the U.S. Army Corps of Engineers "Safety and Health Requirements Manual" EM385-l-l dated October 1992; with the U.S. Navy Diving Manual, and, with Panamerican Consultants, Inc. "Diving Safety Program for Submerged Cultural Resource Investigation" as appropriate. An international diving flag (Alpha flag) and a civilian 'diverdown' flag (red with white diagonal stripe) were raised prior to, and lowered following completion of, all diving operations. Safety was a primary goal of this project and diver safety was given priority in all decisions and actions undertaken during diving operations.

Results of Diver Investigations

The objective at Target 2 and 41HS562 (Target 3) was, initially, to relocate the targets that had been recorded during the preceding remote-sensing survey. Once the source, or potential source, was located the objective was to examine and assess that source. At the Civil War powder magazine (Target 1) the objective was to conduct a thorough examination of the river bottom adjacent to the site and record the findings.

Target 1, Civil War Powder Magazine

The Civil War-era powder magazine is a brick structure located on the south side of Cypress Bayou just east of the town of Jefferson. The structure is located about 20 m from the bank of the bayou, a bank which is now actively eroding. Unless the bankline is stabilized at

this location it is probable that continued aosion will eventually result in the destruction of the powder magazine. Only one dive was conducted at that location. The diver reached a maximum depth of 24-foot in the strong current that prevailed at this bend in the river . While the strong current made diving difficult, visibility on the bottom was on the order of 1 to 2 ft. It should be noted that current was actively causing erosion of the steep, freshly cut, river bank immediately in front of the powder magazine; undercut lumps of soil were observed falling into the river during the investigation . The diver covered the river bottom in ares off the stern of the dive vessel, progressing from upriver of the magazine to downriver of the magazine. The area covered by the diver was centered on the extant brick structure and extended approximately 40 m along, and 20 m out from, the riverbank. Artifactsrecovered included a square glass bottle base fragment with an embosse d crown; a round glass rim or bottle mouth fragment ; a broken red clay brick; a pair of scissors; and, two unidentified pieces of iron. The artifacts will be conserved and turned over to the Jefferson Historical Museum for final disposition.

No effort was made to examine the powder magazine structure itself, thus no information on its construction or condition was collected , This lack of information prohibited the completion of a State of Texas Site Form for the magazine, however it is recommended that an effort be made to collect the information necessary to develop a site form far this historic structure.

Target 2, Smithland Landing

Target 2 was the first of the three areas investigated. This target was located near the north bank of the river in a sharp bend approximately 3 miles east of Jefferson, at what was formerly the small community and steamboat landing known as Smithland. The target was recorded on side-scan sonar and appeared as a 10-m-long acoustic image with possibly two, 2-m-long projections extending toward shore and connecting with a parallel, S-m-long image (see Figure 35). This object was situated approximately 20 m off the north bank and 40 m downstream from a small, dirt boat ramp.

The diving at Target 2 was undertaken from the shore and involved the diver conducting a bottom search of the identified target location via a series of arcs. This technique provided systematic and complete coverage of the area where th e target was thought to be. As at the powder magazine, a strong current made diving difficult and arduous, plus visibility at the bottom was practically nil. Despite these difficult conditions, the target was quickly located and proved to be an exposed rock outcrop measuring approximately 15 to 20 cm thick A careful examination of this feature revealed that about 10 m of the undercut rock strata were exposed, and that in size and shape it closely resembled the feature identified on side-scan sonarrecords.

Following examinationof the rock strata, the surrounding area was carefully explored by divers. No additional feature s were discovered, however, a light scatter of bricks was found near mistream in this area. These are very likely related to former activities at Smithland landing.

Target 3, Wooden Barge (41HS562)

Target 3 was investigated during two dives on January 21, 1993. Site number 41HS562 has been asigned to this target. This target is situated approximately 5 mi east of Jefferson, immediatel y below (downstream) the entrance to an old navigation cut, apparently one of the Benton Cuts, dug by the Corps of Engineers in the 1870s. The side-scan sonar image of the target showed it to be located near the center of the channel of Cypress Bayou. The sonar image had a rectangular shape that appeared to measure approximately 7 m by 20 m (see Figure 37). As at the other locales examined the at Target 3 was swift, making

diving difficult; however, visibility was on the order of 2 or 3 ft, much better than at the other two targets. The target was quickly relocated on the first dive and immediately identified as a man-made, wooden structure. Examination of the object revealed it was an iron fastened, decked wooden barge or work platform measuring approximately 60 ft in length and 20 ft across with square comers and blunt ends (Figure 39).Several dives were made in order to gather basic information on the vessel 's physical characteristics and mode of construction.

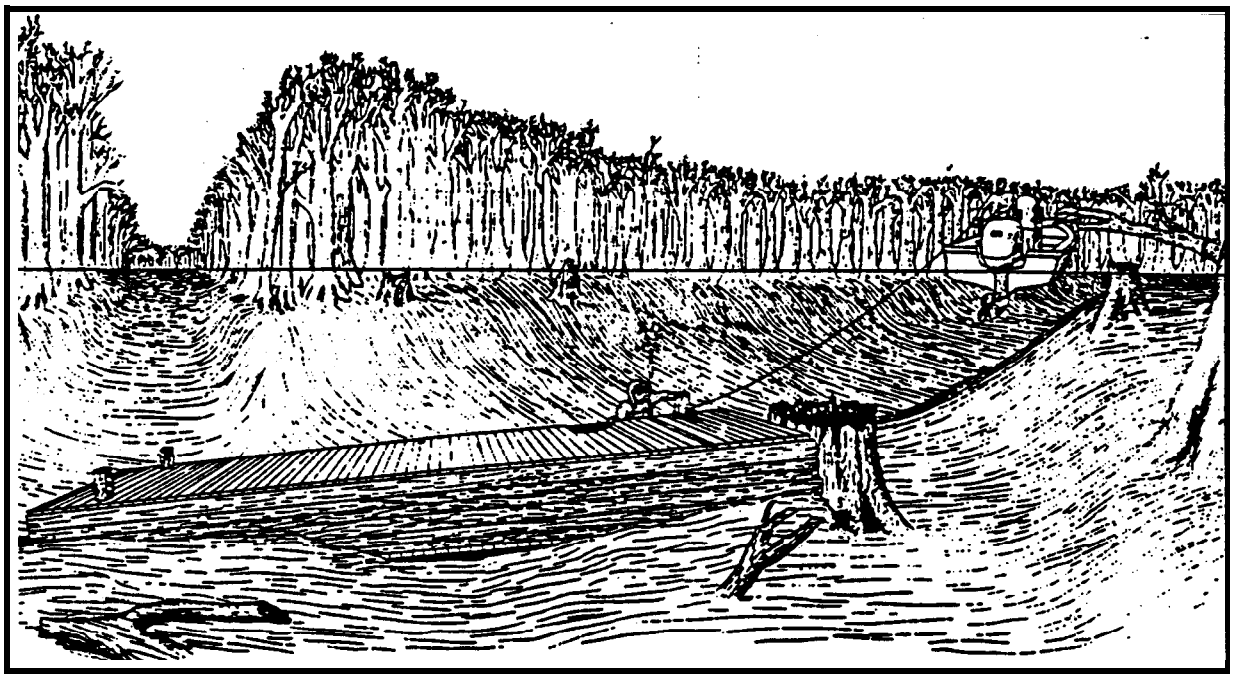

Figure 39. The search for 41HS562 (Target 3), the wooden barge.

The wooden barge had transverse deck and bottom planking and three remaining wooden bits or bollards projected above the deck near comers (Figure 40). These bits measured 11 in by 12 in in section and rose 1 ft, 11 in above the deck. Examination of several deck planks revealed they measured approximately 3.5 in thick and 9 in wide. The bottom planking appears to be the same size. A length of 2-in-diameter iron chain was wrapped around the single bit remaining at the high, or upstream, end that abutted a large tree stump. This end was found to have several broken and missing planks.

Examination of openings at the ends of the vessel revealed the presence of a series of four, evenly spaced, longitudinal deck beams spaced on about 3-ft centers. These beams measure 6 in by 7 in in section. It was initially thought that the barge sides were built of planks attached to upright frames, however, examination of the sides revealed the presence of several scarph joints, indicating that fairly large timbers were used in their construction. Additional examination of one of the sides of the barge suggests it is made of 6 large timbers or "sills" stacked one on top of the other. The sills appear to be about 6 in wide, but vary in height (Figure 40). Starting with the uppermost sill, the following height measurements were obtained: 12 in, 9 in, 7 in, 13 in, 8 in, and 6 in. It is presumed that the sides are what arc commonly known as "sill-on-sill" construction and normally arc built of 3 to 4 large sills or timbers joined togethe r by iron drift pins or bolts.This use of 3 or 4 sills apparently was common for towing barges such as those used on the Ohio and Mississippi rivers (Allen Saltus, personal communication 1993). These river barges were on the order of 100 to 125 ft long, much larger than the Cypress Bayou barge, and the sills used on these river barges

tended to be larger than those found on the Cypress Bayou vessel . The smaller sills used on the Cypress Bayou vessel may simply reflect its small size, or, possibly, indicate a non-barge use, such as a floating platform or dock The blunt, non-raked ends tend to support this latter assumption about use.

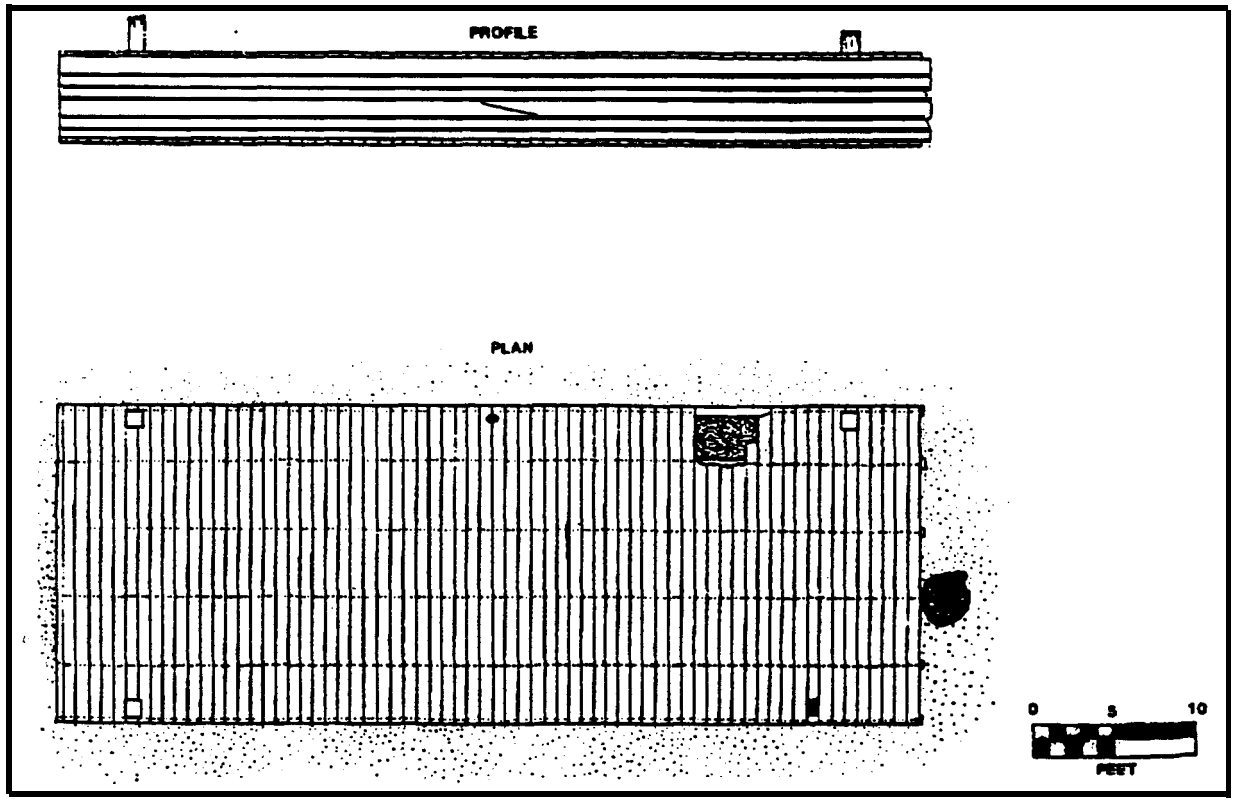

Figure 40. Plan and of wooden barge at 41HS562 (Taget 3).

No fastenings could be obtaine d from the vessel, although it was determined that each deck plank was attached to each side sill and longitudinal deck beam by a pair of spikes. Divers estimated that as much as 90 to 95 percent of the structure remains intact and well preserved. The specific age of the cypress bayou barge remains unknown. It probably post dates the construction of the adjacent navigation cut, or, possibly, is contemporaneous with the construction of the cut. Sill-on-sill construction was very common in the nineteenth century, apparently becoming less so toward the end of the century as it was replaced b y plank-on-frame construction. While none of the information collected provides specifics on the age of the barge, the indications are that it could date anytime from the 1870s to the early twentieth century. Additionally, the fact that the ends are blunt and not raked would seem to indicate that vessel was not commonly used for towing or pushing. It may have served as a floating dock or work platform?

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

This report has presented the results of historical research and archaeological field investigations intended to assess the potential for sunken watercraft along the historic navigation route between Jefferson, Texas, and Shreveport, Louisiana The historical information, in particular, provides vivid documentation of the importance of this route for steamboat commerce during the period from about 1845 to the 1880s. This documentation also records a number of wrecks of steamboats occurring along and or adjacent to the navigation route. The documents, however, to not always provide information on the specific place of loss or on post-wreck events, such that it is commonly impossible to determine the condition a boat may have been in when lost nor if, or to what extent, they were subjected to salvage As a result, reliable information on the number and nature of steamboat wrecks along the historic navigation route cannot be-obtained from the historical record alone. The remote-sensing survey conducted for this study was meant to augment the historical information.

To a large extent, the results of the remote-sensing survey were disappointing. In light of the known steamboat traffic along the Shreveport to Jefferson route, it was considered possible that the partial remains of steamboats, as well as other water raft, would be found. As noted, however, a careful examination of the historical documents suggests that steamer losses were not all that common on the Caddo Lake-Cypress Bayou stretch of the route; they appear to have been most common along Twelvemile Bayou. However, of the several wrecks reported to have occurred along Twelvemile Bayou, all but two were either removed or destroyed with explosives. These activities, while reducing the amount of wreckage, would not necessarily remove all physical remains of the wreck Additionally, the current course of Twelvemile Bayou is artificial; it does not follow completely the historic course of the waterway. Thus, the remote-sensing survey did not encompass the exact locations of all of the known wrecks along Twelvemile Bayou. The two reported steamboat wrecks which may not have been salvaged or removed are the *Jim Gilmer* and the *L. Dillard.* If remains of these vessels exist, they will be found outside of the present channel of Twelvemile Bayou because of the modern alterations in its course.

The *Mittie Stephens* remains the most widely known of the steamboat wrecks that occurred in the Caddo Lake area A considerable amount of effort has been expended in trying to locate her remains. Until recently these efforts have been futile. The recent discovery of artifacts likely to represent salvage from the *Mittie Stephens* provides a reasonabler indication of the location of her loss. This location is along the south shore of Caddo Lake just east of Buzzard Bay, the general area where previous searches for the wreck have been made.

Only one target of historical interest was discovered during this study. This is the wooden barge, Target 3, now designated as 41HS562, and located in Cypress Bayou. The construction characteristics of the barge, particularly its apparent sill on sill construction, indicates that it may date to the nineteenth century.

Recommendations

The current status of the Shreveport to Daingerfield Navigation Project suggests that it may not be built. If this is true, then no impacts will occur to Target 3, or to any unidentified cultural resources along the proposed route. However, if the project is revived, adverse impacts are likely to occur. The Vicksburg District needs to be cognizant of the existence of 41HS562 and it is recommended that this site be accorded protection at least until a detailed investigation and recording of the remains has been conducted if adverse impacts are likely to occur in the future.

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