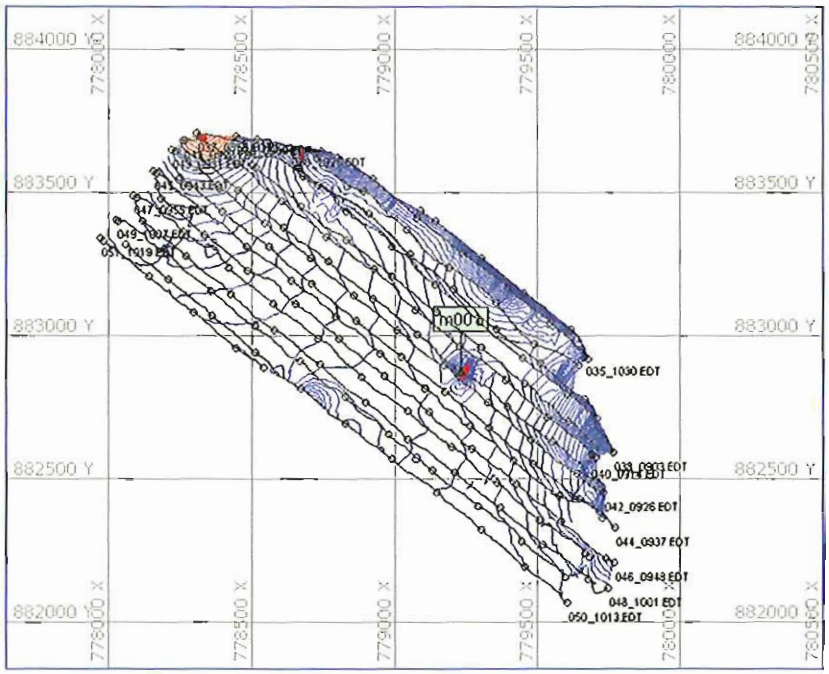
# APPENDIX M

Phase 1A & 1B Marine Archaeological Survey of the Proposed Dredge Material Placement Area, Laguna del Condado, for the San Juan Waterfront Project

# PHASE 1A & 1B MARINE ARCHAEOLOGICAL SURVEY OF THE PROPOSED DREDGE MATERIAL PLACEMENT AREA, LAGUNA DEL CONDADO, FOR THE SAN JUAN WATERFRONT PROJECT, SAN JUAN, PUERTO RICO




**Conducted for:**

**CSA Group, Inc.**
**Environmental Department**
**Merantil Plaza – Mezzanine Suite**
**San Juan, Puerto Rico 00918**

**CSA Project No. 06PR082C03**

**Prepared by:**

**Panamerican Consultants, Inc.**
**91 Tillman Street**
**Memphis, Tennessee 38111**

**Report Of Findings ♦ February 2008**

REPORT OF FINDINGS

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**Stephen R. James, Jr., MA, RPA**
**Principal Investigator and Author**

**FEBRUARY 2008**

# ABSTRACT

In February 2008, maritime archaeologists from Panamerican Consultants, Inc. of Memphis, Tennessee conducted Phase 1A & 1B marine archaeological investigations of the proposed dredge material placement area in Laguna del Condado, San Juan, Puerto Rico. Associated with the San Juan Waterfront Project, the project proposes to deposit dredge fill material into the Condado Lagoon. The fill material, to be obtained during dredging of the San Antonio Canal, will be deposited into the deeper areas in order to have a maximum depth of between 15 and 20 ft. throughout the Lagoon. The project area to be filled and subsequently to be investigated comprises approximately the eastern half of the Lagoon and is approximately 2,000 ft. by 1,000 ft.

Conducted under contract to CSA Group (CSA) of San Juan, Puerto Rico, the current investigation was implemented in order to determine if any properties eligible for the National Register of Historic Places (NRHP) were located within the current project area, specifically in the form of historic shipwrecks. Comprised of limited archival research and an intensive remote sensing survey utilizing a marine magnetometer, a sidescan sonar, and DGPS positioning, the remote sensing investigation identified one magnetic anomaly and no sidescan sonar targets which had the potential to represent historically significant cultural resources within the project area. Subsequent diver investigation of the single anomaly revealed that it is modern debris and is not significant. It is the opinion of the principal investigator that the project area does not contain historically significant cultural resources and there will be no adverse effects by project activities. No further archaeological investigations are required.

# ACKNOWLEDGMENTS

The successful completion of this project is the direct result of the input and hard work of numerous individuals. The authors would first like to thank the CSA Group, and specifically Ms. Raquel del C. Camacho-Hernández for allowing Panamerican the opportunity to conduct this investigation.

This work would not have been possible without the support of Captain Miguel Martorel, who provided all of the logistical support for this investigation. He not only provided the project vessel, *Tridentita,* but also the dive equipment.

The author would also like to thank Mr. Andy Lydecker who comprised the other half of the archaeological crew, and who, as always, conducted the remote sensing survey. In-house Panamerican personnel who must be thanked for their assistance with this report production include Jessie Flanders, report editor, and Kate Gilow, office manager.

Finally, the good people of San Juan, Puerto Rico, are thanked for the hospitality shown to the field crew during our stay. We hope to return in the future to sample that hospitality once again.

# TABLE OF CONTENTS

# LIST OF FIGURES



# LIST OF TABLES

# 1. INTRODUCTION

From February 8 to February 10, 2008, maritime archaeologists from Panamerican Consultants, Inc. (Panamerican) of Memphis, Tennessee conducted Phase 1A & 1B marine archaeological investigations of the proposed dredge material placement area in Laguna del Condado, San Juan, Puerto Rico (Figure 1). Associated with the San Juan Waterfront Project, the project proposes to deposit dredge fill material into the Condado Lagoon. The fill material, to be obtained during dredging of the San Antonio Canal, will be deposited into the deeper areas (20-40 ft.) in order to have a maximum depth of between 15 and 20 ft. throughout the Lagoon. As is indicated by the provided figure scale, the project area to be filled and subsequently to be investigated comprises approximately the eastern half of the Lagoon and is approximately 2,000 ft. by 1,000 ft.

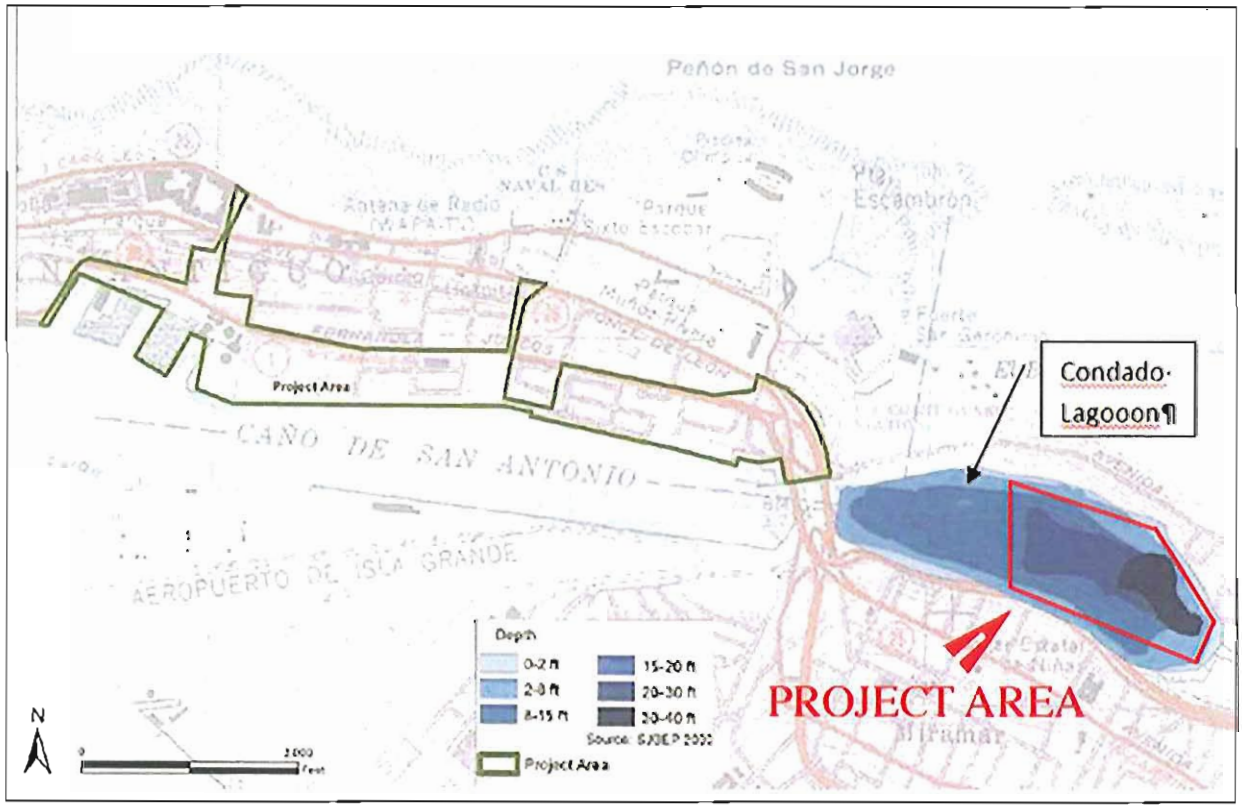


**Figure 1. Project location map.**

Map courtesy of CSA Group.

Conducted under contract to CSA Group (CSA) of San Juan, Puerto Rico, the current investigation was implemented in partial fulfillment of various federal and Commonwealth statutes and was composed of a review of previous cultural resources reports, an intensive remote sensing survey of the project area, and archaeological diver assessment of potentially significant targets. In order to protect and preserve any cultural resources that may be adversely affected by the project activities, the investigation was implemented to determine if any properties were located within the current project area, most likely historic shipwrecks, prior to the implementation of any projected activities, and if so, if the properties were eligible for listing on the National Register of Historic Places (NRHP). The federal statutes regarding these responsibilities include Section 106 of the National Historic Preservation Act of 1966, as amended; the National Environmental Policy Act of 1969; the Archaeological Resources

Protection Act of 1987; the Advisory Council on Historic Preservation Procedures for the Protection of Historic and Cultural Properties (36 CFR Part 800); and the Abandoned Shipwreck Act of 1987.

In fulfilling these responsibilities and as part of the proposed San Juan Waterfront Project, CSA initiated a comprehensive submerged cultural resources investigation to determine if any potentially significant submerged cultural resources eligible for listing on the NRHP were present within the project area, and which, subsequently, might require additional investigations or avoidance if threatened by project activities. Comprised of limited archival research and an intensive remote sensing survey using a marine magnetometer, a sidescan sonar, and DGPS positioning, the investigation recorded only one (n=1) magnetic anomaly and several sidescan sonar targets within the proposed dredge material placement site. Only the single anomaly had signal characteristics to represent a potentially significant submerged cultural resource (in the form of a shipwreck). Diving investigation of this target indicated that it was composed of non-significant modern debris. It is the opinion of the principal investigator that no additional archaeological work is recommended for the proposed dredge material placement area in Laguna del Condado.

Divided into chapters on Historical Background, Field Methods, Investigative Findings, and Conclusions, the following report presents the conduct and results of this investigation.

# 2. HISTORICAL BACKGROUND

## *GENERAL HISTORY*

The island of Puerto Rico was first "discovered" by Christopher Columbus during his second voyage to the New World in 1493. In 1508, Juan Ponce de Leon set out from Hispaniola (Dominican Republic) to conquer the island after gaining permission from the Spanish crown. The initial goals of colonization were to gain wealth through the acquisition of rare minerals (e.g., gold and silver) and spices, and to spread the Catholic faith. Ponce de Leon arrived along the southern coast of the island in search of a suitable harbor where he met with the Indian Chief Agueybana who recommended the north coast. After reaching San Juan Harbor, Ponce de Leon apparently exclaimed "Puerto Rico", meaning "rich port" (Brau 1966; Marín-Márquez and Cox 1993:4). Permanent settlement (by Europeans) of the island began at the first settlement of Caparra (along the southern portion of San Juan Harbor), south of San Juan. It lasted until 1521, when the capital city was moved to San Juan. During this time, there were about 300 inhabitants in the city.

During the sixteenth century, the mining of gold on the island took precedence over all other endeavors. This required enslaving the native population and the almost immediate importation of African slaves from Spain. In 1531, the population of the island consisted of at least 426 Spaniards and 2,264 slaves (Sued Badillo 1986:90; Morales Carrion 1983:32-33). San Juan was also recognized as a valuable trade center, serving as a stopping point for vessels traveling between Spain and Hispaniola. The island, situated in a geographically ideal location, also began to serve as a stopping point for vessels sailing between Spain and the Antilles islands (De Hostos 1983; Marín-Márquez and Cox 1993:5). Another valuable commodity available on the island included wood, which was needed to repair ships.

It was estimated that, during the early sixteenth century, the island of Puerto Rico contributed about one-fourth of all gold being exported from the Caribbean. However, by 1540, the mining of gold reserves on the island began to decline and, by 1570, was no longer profitable (Marín-Márquez and Cox 1993:6). It was then that the economy of Puerto Rico shifted to an agrarian-based market. Puerto Rico began to provide supplies and animals for the conquest of Nueva Espana (Mexico). The production of sugar also began to flourish with supplies being sent to Seville and Cadiz. Other products that helped to supplement the island's economy during the early seventeenth century included animal hides and ginger.

Proceeding into the seventeenth century, the island of Puerto Rico began to experience a period of slow economic growth. This was due in most part to changes in navigational routes, the implementation of "fleets", and the commercial monopoly of Andalucia (Marín-Márquez and Cox 1993:6). Although the raising of cattle continued, production of sugar declined. Moreover, while the commercial economy of the island was in dire straits, the fortification of San Juan Harbor increased.

The effect of the slow economy pushed the lawful commerce of the island towards the support of contraband. Economic and social needs forced settlers to engage in such clandestine trades as the slave trade (primarily with the Portuguese) and smuggling. It was this illicit trade that dominated the island's economy into the nineteenth century (Marín-Márquez and Cox 1993:6). In response to the heavy losses incurred by the contraband trade, the Spanish crown allowed free commerce between Spain, the Antilles, and other provinces (i.e., the United States) in 1775. Free trade was, however, permitted only through the port of San Juan (De Hostos 1983; Marín-Márquez and Cox 1993:6).

Noticeable changes did not occur until the eighteenth century. Due to the strategic location of Puerto Rico, the island was at the center of the western Europeans' armed struggle for trade and power in the Caribbean. The increased foreign attacks on the island encouraged the Spanish crown to sanction privateering against ships of their enemies. This struggle stimulated an obvious change because the Spanish crown's interest contributed to the development and growth of the island by increasing agricultural production through a larger slave population, better defenses, a more enlightened administration, and a profitable trade with Spain.

The population of the island went from 5,000 in 1700 to 103,051 in 1787, and to 153,232 in 1799. Although the island remained largely rural, by the turn of the eighteenth century over 30 towns had formed. Land reform occurred and trade was liberalized, stimulating economic growth. Military fortification of the island continued, especially around the San Juan area.

By the nineteenth century, Puerto Rico began to develop economically and socially. In 1824, free trade had been established with the United States and, by 1890, the U.S. imported 40 percent of the island's exports (Marín-Márquez and Cox 1993:7). Other notable trades developed (or were renewed) which directly affected the island's economy. These included the renewal of the slave trade, an increase in agriculture, and a strong demographic expansion. The demographic expansion included immigrants from Spain, France, Germany, and Venezuela. Census reports from 1832 to 1899 indicate that the population of Puerto Rico nearly tripled, from 330,000 to 953,000 inhabitants (Marín-Márquez and Cox 1993:7). During the nineteenth century, the island's agricultural resources once again flourished, mainly focusing on coffee and sugar.

By the last years of the nineteenth century, Puerto Rico embodied the classic aspects of a colony, including large plantations. While Spain continued to provide imports to Puerto Rico, both the United States and the United Kingdom were large contributors to the island's economy. Other countries contributing to the island's imports included Germany, Cuba, and France. With the introduction of the Spanish-American War (1898), Puerto Rico was just beginning its struggle for autonomy (Marín-Márquez and Cox 1993:7).

## *THE PORT OF SAN JUAN*

With the arrival of the Spanish during the sixteenth century until World War II, the Port of San Juan has played an important role in the development and security of Puerto Rico. During the sixteenth century, control of islands—such as Puerto Rico—enabled Spain to protect vessels en route to and from Central and South America, as well as Mexico. Additionally, these harbors, such as San Juan, provided protection from pirates and corsairs that were financed by other European powers (Marín-Márquez and Cox 1993:7).

Attacks from France during the middle and late sixteenth century prompted the Spanish to construct the first fort in San Juan Harbor in 1533. Work on the fort ended in 1540; the fort is located where the Puerto Rican Governor's Mansion sits today. The King of Spain ordered the construction of El Morro Castle at the entrance of San Juan Harbor in 1539.

It was later, during the second half of the sixteenth century, that France no longer posed a threat to Puerto Rico. Instead, it was England that pursued Spain's monopoly of the West Indies. One of the first attacks to San Juan came from the legendary Sir Frances Drake in 1595. In search of $2 million in gold and silver in transit to Spain, Drake obtained permission from Queen Elizabeth to attack San Juan. Armed with 23 sailing vessels and a caravel, Drake arrived off San Juan on November 22, 1595 (Marín-Márquez and Cox 1993:8). In response, military forces scuttled two vessels (the *Nuestra Senora de Begona* and the *La Pandorga*) in the entrance channel to aid in defending the harbor. Drake attempted to enter the harbor under darkness and soon faced a bitter battle, losing 9 or 10 of his vessels, including 400 men. Drake, defeated, set sail soon after, and San Juan's harbor defenses had stood the test.

The Earl of Cumberland successfully attacked the island with a fleet of 18 English ships in 1598. However, instead of attacking San Juan Harbor, the Earl of Cumberland landed east of San Juan and proceeded by land. Although he was successful in taking San Juan, an epidemic of dysentery caused major losses to his troops. Within two months, the English withdrew from the island, unsuccessful in their attempt to gain a stronghold within the West Indies.

Spain realized the importance of defending San Juan Harbor after these attacks by the English and began construction of additional fortifications. To protect the city, engineers began construction of the wall of San Juan in 1630. Additional construction began on Fort San Cristobal in 1631; this was not completed until 1772 (Marín-Márquez and Cox 1993:9). In order to protect the city from enemy vessels that might employ the shallow eastern entrance (the entrance to the current project area), two forts were constructed. In 1609, Fortín de San Gerónimo de Boquerón, a small, four-cannon defensive battery, was constructed to replace a smaller battery called El Boquerón. Improvements were made to this fort throughout the eighteenth century, and along with the San Antonio Bridge Fort, became the first line of defense from this direction (Figure 2).

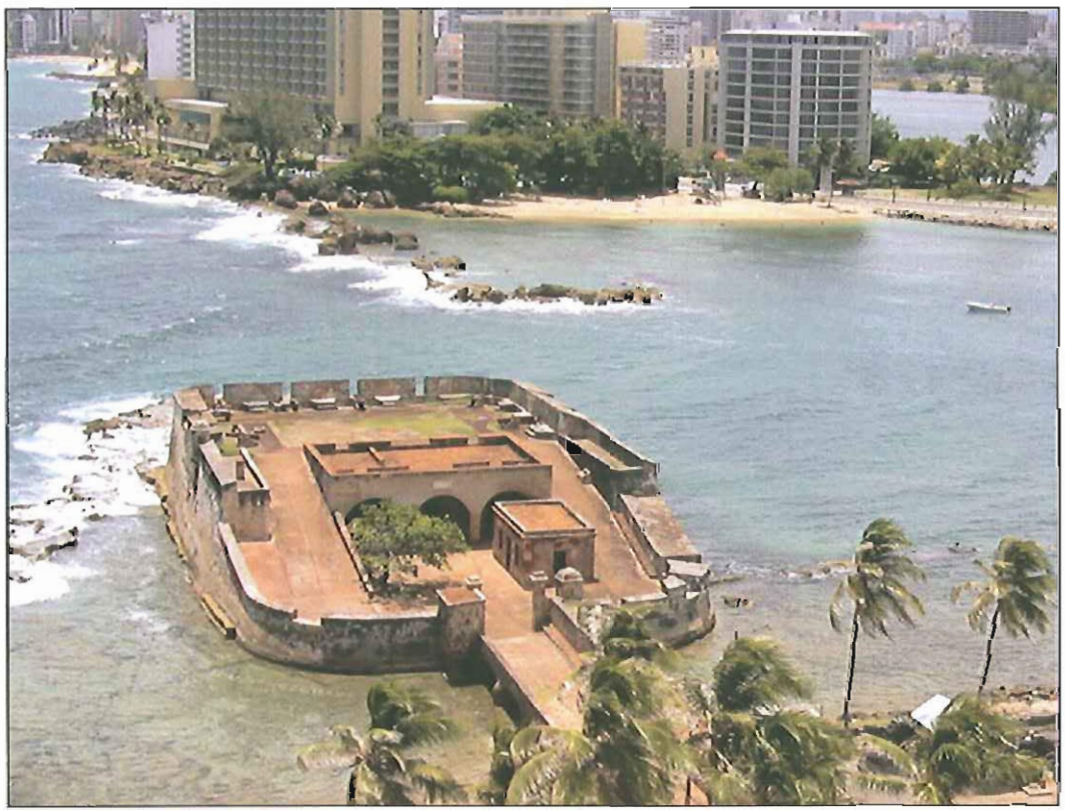

**Figure 2. Current photograph of Fortín de San Gerónimo de Boquerón, which guards the shallow eastern entrance to San Juan Harbor and the entrance to the project area (as presented in www.gearthhacks.com). The Laguna del Condado project area can be seen in the background.**

The Dutch developed the West India Company in 1621, which soon became a rouse to attack the Spanish dominance of the Caribbean. Interested in gaining a foothold, a Dutch fleet entered San Juan Harbor on September 26, 1625. The Dutch were successful in taking control of El Morro, as well as La Fortaleza, from where they proceeded to ransack and burn the city (Marín-Márquez and Cox 1993:9). Although successful in capturing many valuables, the Dutch vessel *Medenblick* ran aground trying to exit the harbor after being fired upon from El Morro. Overall, this was the worst and most devastating attack on San Juan in the history of the city.

Another attack on the port of San Juan occurred on April 18, 1797, by a fleet of English vessels under the command of Sir Ralph Abercromby (Gonzalez Vales 1983:48-50). After blockading the entrance, Abercromby began firing upon the city; firing lasted until April 30. Finding the city heavily fortified, the siege in San Juan was finally lifted on May 2, 1797, and the British withdrew. The victory over the British, the largest sea power of the time, was a huge success for Puerto Rico.

By the nineteenth century, San Juan Harbor remained important to the importation of goods, although the exportation of sugar and coffee had expanded to other developing ports around the island (such as Ponce, Aguadilla, and Arecibo). Although shipping had expanded around the island, the port remained important and improvements to the harbor began during the nineteenth century. In 1857, the government created the Office of Public Works, which set out to determine the condition of the harbor. Soon after, channel markers were placed at the entrance of the harbor as well as at corresponding channels within the harbor. Initially proposed in 1868 by the engineer Evaristo de Churruca, dredging of the harbor was approved in 1869, but was not undertaken until 1889. Dredge plans included widening the entrance channel, the formation of an anteport, and the removal of sediments to a depth of 7 to 9 meters, depending on the location (Marín-Márquez and Cox 1993:13). This work was contracted to an entrepreneur named Henri Satre of Lyon, France. By 1893, close to 14 million cubic feet of silt had been dredged and deposited along the eastside of the San Juan inlet.

In 1898, Puerto Rico was invaded by the American military during the Spanish and American War. Spain lost Puerto Rico to the American government, and it remains a Commonwealth of the U.S. today. In 1900, the Foraker Act formulated the government of Puerto Rico to consist of a governor and an executive council appointed by the President of the United States, and a civilian legislative assembly. The assembly consisted of 35 representatives and a town council for each municipality (municipio). In 1917, the Jones Act, passed by the U.S. Congress, created a legislative body, consisting of a Senate and House of Representatives elected every four years, and granted Puerto Ricans U.S. citizenship (Morales Carrion 1983:197-198, 152-155, 269-271).

With the outbreak of World War II, San Juan became the military headquarters in the Caribbean for the U.S. Numerous aircraft and ships based out of San Juan performed routine patrols, convoy protection, and anti-submarine missions during the war (Koski-Karrell 1995:11). After the war ended, the U.S. military, until very recently, continued a military presence on the island due to its' strategic location within the Caribbean.

## *THE LAGUNA DEL CONDADO PROJECT AREA*

A back bay to the main harbor of San Juan, and with only a small shallow entrance to the sea, Laguna del Condado appears to have had little in common with the maritime history of the historically significant San Juan Harbor. A review of historic maps and photographs was undertaken to determine the potential for cultural resources within the current project area. Various consulted sources include the Library of Congress online collection (http://memory.loc.gov), the National Oceanic and Atmospherics Administration (NOAA) Office of Coast Survey Historical Map and Chart Collection (http://nauticalcharts.noaa.gov/csdl/ctp/abstract.htm), and the National Archives at College Park, as well as previous investigations.

The earliest map located that illustrates the project area is a 1768 map from the Rucker Agee Map Collection (Figure 3). Review of the map identifies the shallow entrance, "Boca de Cangrejos", as well Fort St. Antonio. Showing soundings only for San Juan Harbor to the west, it is evident that the map-maker considered the eastern entrance unimportant from a maritime aspect and most likely not navigable. It should be pointed out as well that the bridge connecting the island to the mainland is in place, effectively precluding movement of vessels through what will eventually be known as San Antonio Canal.

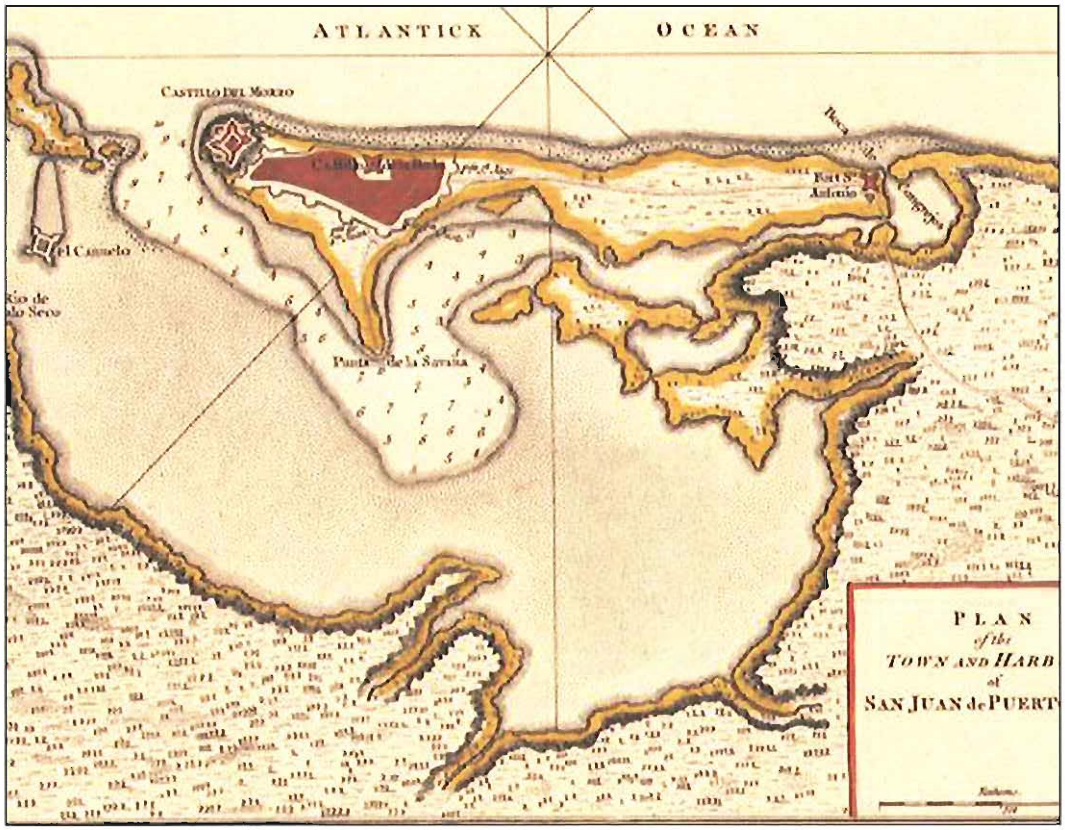


**Figure 3. A 1768 map identifies the shallow eastern entrance, "Boca de Cangrejos" as well as Fort St. Antonio (upper right) and San Antonio Bridge, which crosses to the island.**

Map courtesy of the Rucker Agee Map Collection.

Thought to date to 1780 and entitled "Plano del Puerto de Sn. Juan de Puerto Rico", the next map shows both the fort, "Cast. de St. Gerónimo" ("11"), and the San Antonio Bridge ("Puente Fortificado" – "10"). Similar to, although differing somewhat from the 1768 map, it shows soundings within the San Antonio Channel up to the bridge, but again not in the Condado Lagoon. Furthermore, this map shows very little in the way of an entrance channel, again minimizing its navigable properties. Interestingly, depicted on the southern shore of the Lagoon is "13-...donde se hace Aguada", or a watering station. Adjacent to the shoreline, it is unknown if it was accessed by small watercraft from the Lagoon or by wagon from land (Figure 4).

One of the most accurate early maps of San Juan Harbor is the 1794 map by Don Cosme de Churruca, a Captain in the Spanish Navy, which was published in 1805 (Figure 5). As the excerpt in Figure 6 illustrates, the Lagoon has been sounded but shows non-navigable mud and sand flats between the Lagoon entrance, "El Boquerón", or Little Mouth, and what would be the project area. Depicted in Spanish Brazas or Fathoms and equal to 5.5 ft., water depths in the western half of the Lagoon (containing the project area) are shown as being over 4 fathoms or approximately 25 ft. deep. San Antonio Bridge is boldly labeled as is the watering station on the Lagoon's south shore, and the shoreline of the west half is shown covered in mangroves.

Almost 100 years later, an 1899 U.S. Fish Commission map shows the western half of the Lagoon, now labeled Condado Bay, and the reef-choked entrance (Figure 6). Two additional bridges built for the railroad are present just west of San Antonio Bridge. Similar to earlier versions, the 1899 map shows soundings within San Antonio Channel up to the bridges but not in the Lagoon itself, arguing again that the Lagoon was unimportant from a maritime standpoint.

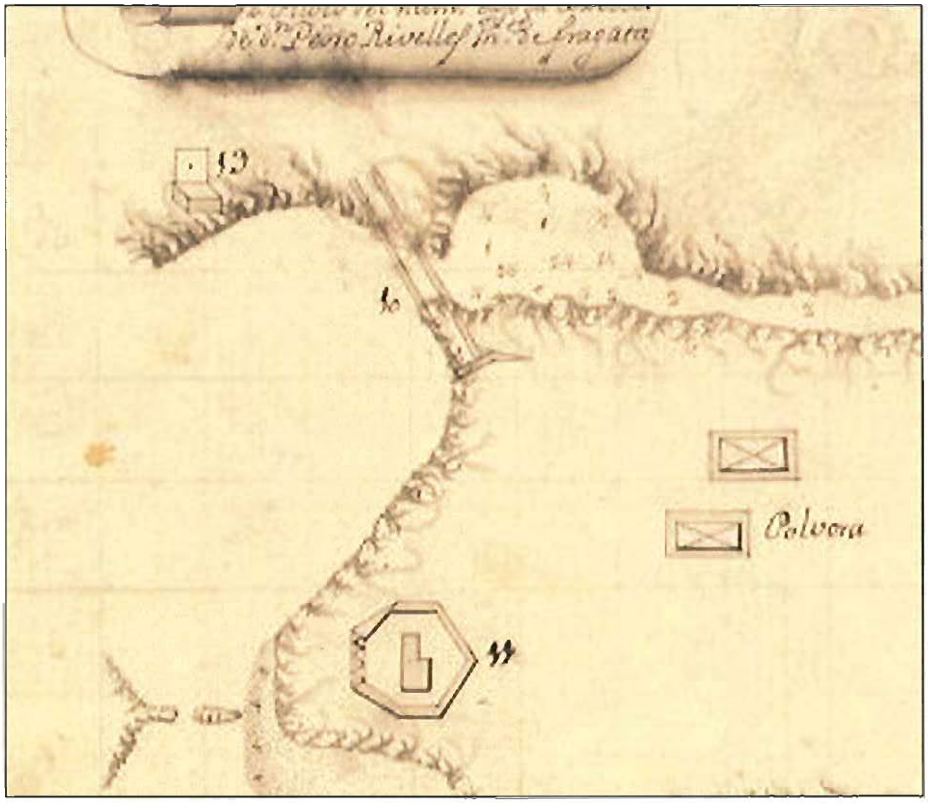


**Figure 4. The ca. 1780 "Plano de Pto. Rico" map.**

Courtesy of The Library of Congress.

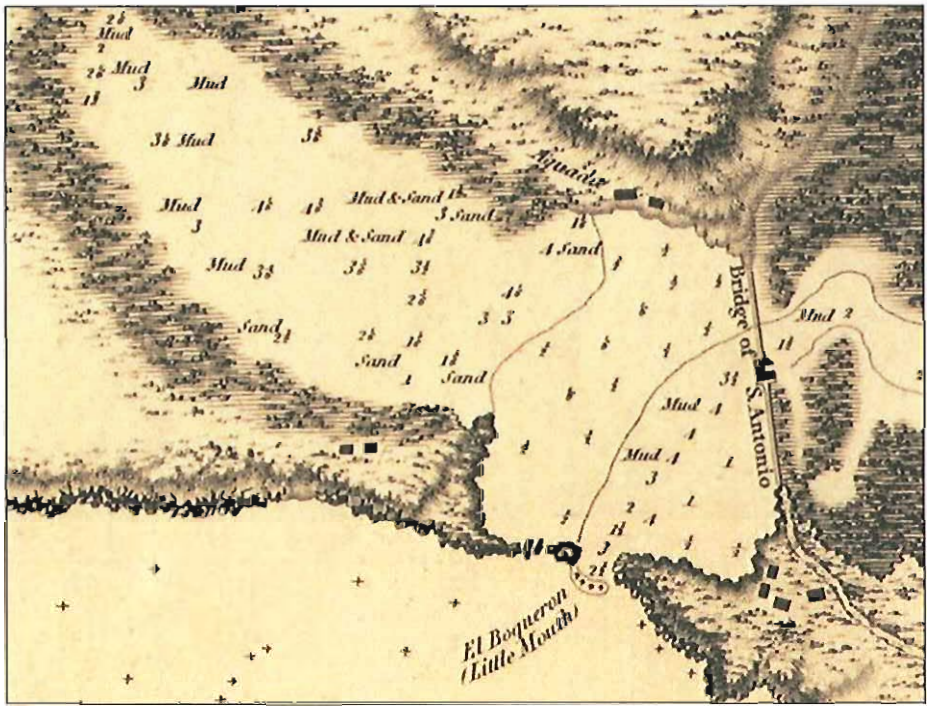


**Figure 5. Excerpt from the 1794 map "Geometrical Plan of the Principal Harbor in the Island of Porto Rico", by Don Cosme de Churruca showing Laguna del Condado.**

Courtesy of The Library of Congress.

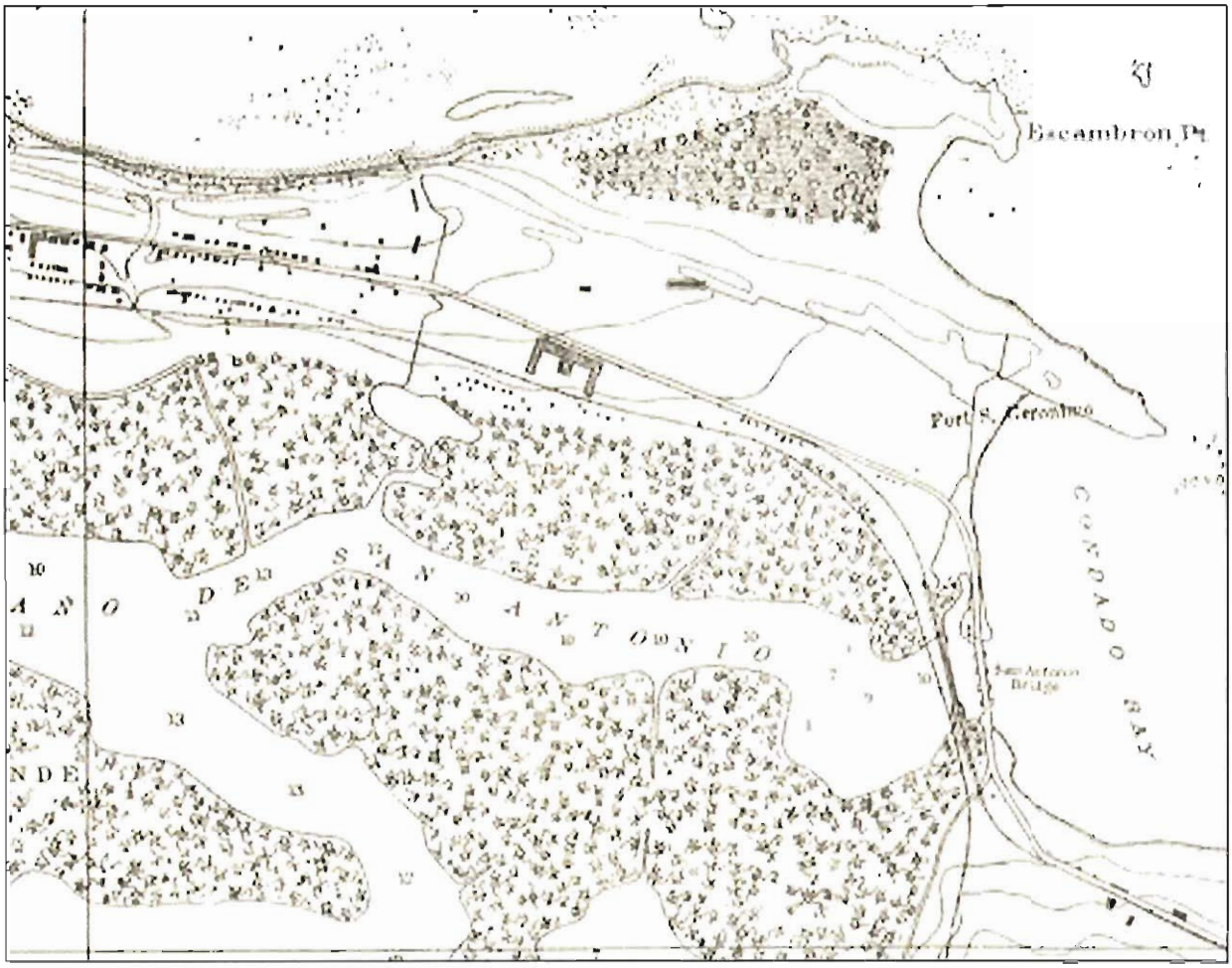


**Figure 6. The 1899 U.S. Fish Commission map showing the western portion of Laguna del Condado.**

The 1912 Coastal and Geodetic map of San Juan Harbor, while showing large piers and anchorages in the main harbor of San Juan, shows little change within "Condado Bay", with some exceptions (Figure 7). It appears that some modifications have been made along the southern shoreline. There appear to be a number of palm plantations along the harbor, intermixed amongst the mangroves. Several coconut groves have now taken the place of the mangroves, and several small piers are shown. The piers are of a size that seemingly could only accommodate small vernacular craft, and the extremely narrow and shallow El Boquerón entrance argues this assumption.

A map dating to 1933 offers few specifics with regards to "Condado Bay". One evident difference is the presence of the "Puente Dos Hermanos" bridge (Avenida Ashford Bridge), which now connects the Lagoon with the main island "La Isleta", effectively closing the El Boquerón entrance to all but the smallest of watercraft. Other than this, the Lagoon is shown as a shallow area (Figure 8).

Not much changed within the Lagoon until the 1940s. The 1943 map shows the presence of a large stack, which was not present at least as late as 1939. It is assumed that this stack is associated with the steam-generating power plant that was built at the end of Wilson Avenue. The remains of the intake culverts associated with this plant are visible along the eastern boarder of the Lagoon and project area (Figure 9). By 1957, there is little change (Figure 10). The "Stack" is prominent, however, little else is indicated for the Lagoon.

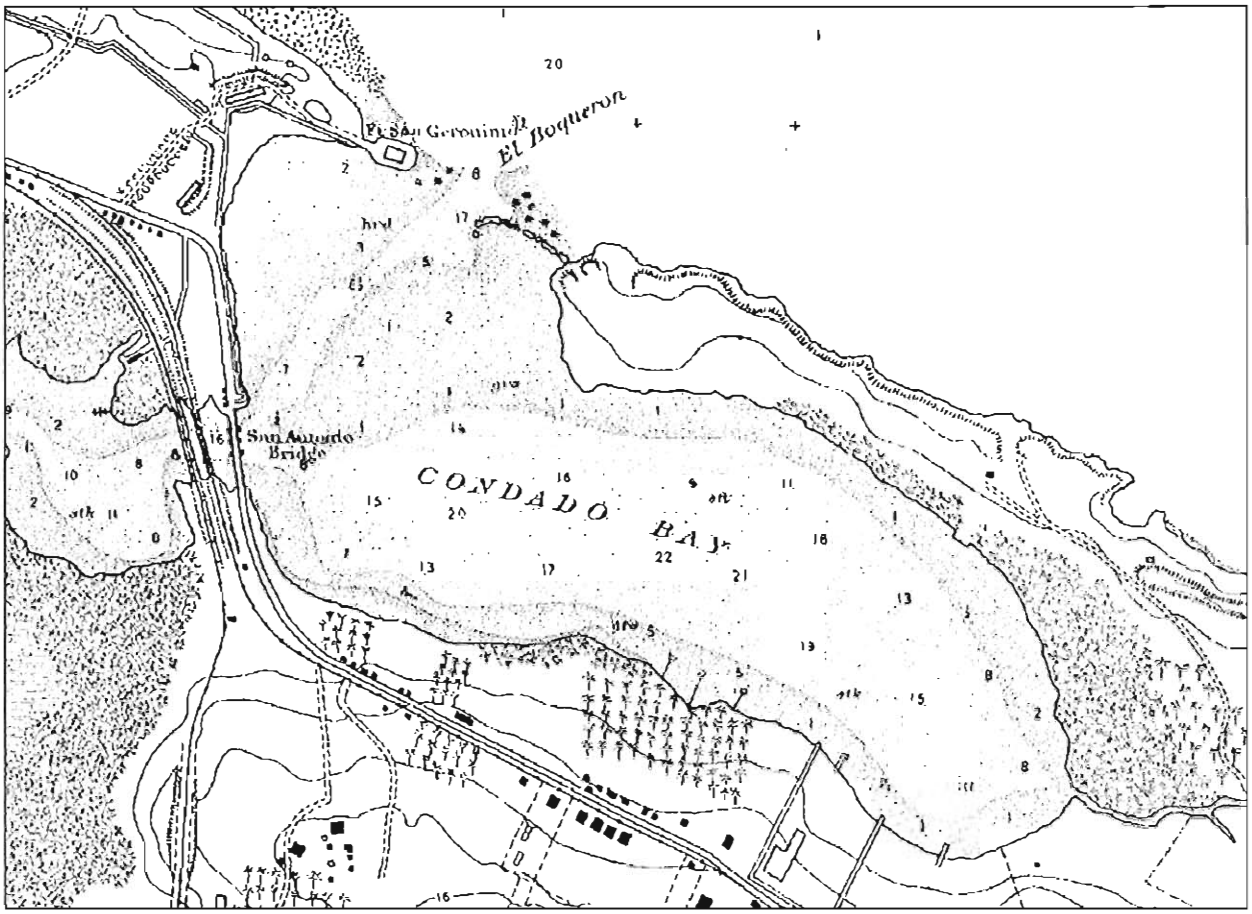


**Figure 7. Excerpt of 1912 "San Juan Harbor" map (Coast and Geodetic Survey).**

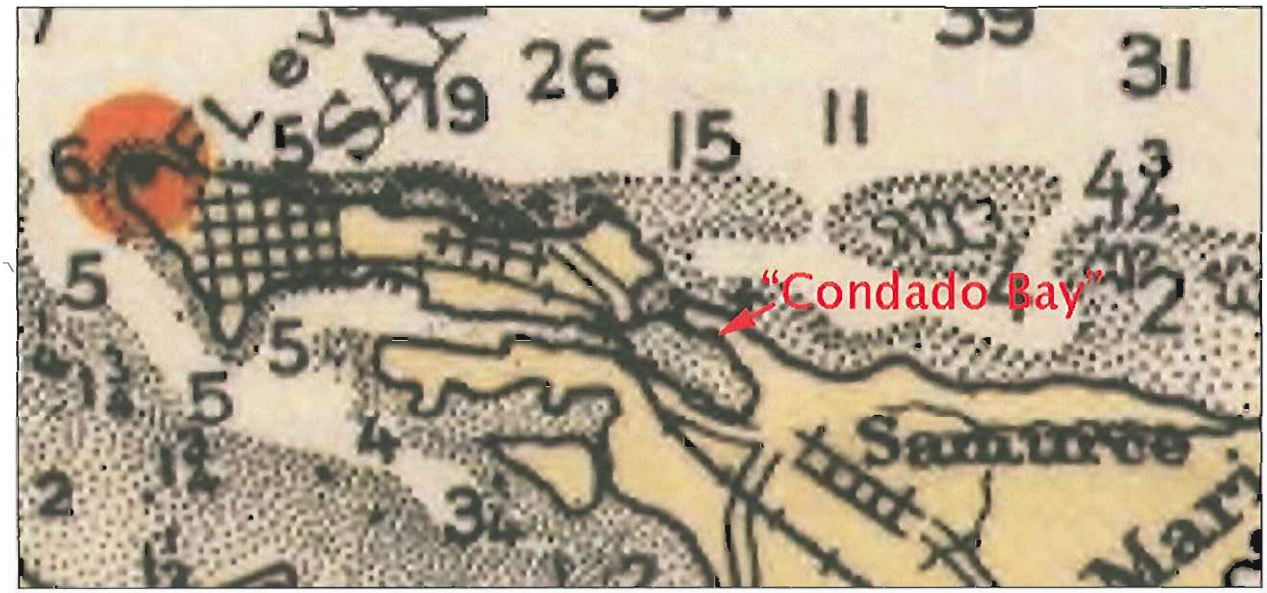


**Figure 8. 1933 map of San Juan Harbor showing the new bridge.**

Courtesy of NOAA Historical Map Collection.

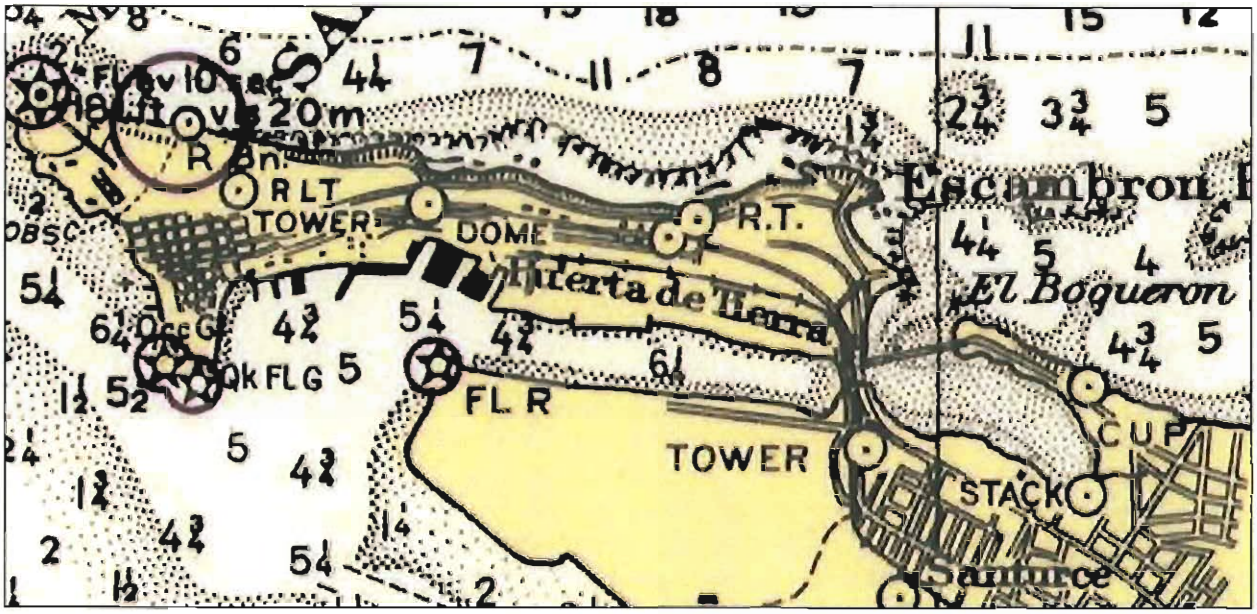


**Figure 9. 1943 map of San Juan Harbor. Note "Stack" at southeastern end of the Lagoon.**

Courtesy of NOAA Historical Map Collection.

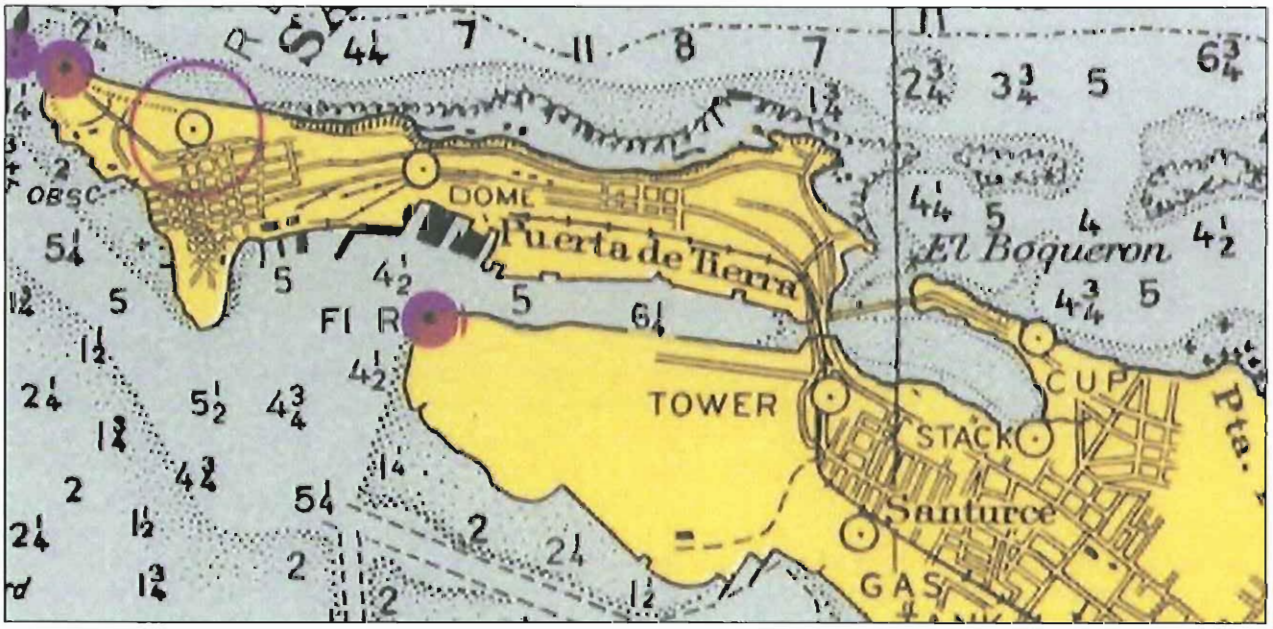


**Figure 10. 1957 map of San Juan Harbor showing little change.**

Courtesy of NOAA Historical Map Collection.

Although identifying no known wreck sites within proximity of the current project area, examination of these historic maps allows us to characterize the Lagoon as having shallow water levels and an entrance that prohibited all but the smallest vessels from entering. As early as 1794, the maps indicated that the Lagoon had mud and sand flats between the entrance and what would be the project area. Furthermore, all maps indicated very little in the way of an entrance channel and minimized its navigable properties. It is likely that vessel types traversing the project area were, therefore, small vessels employing a shallow draught. Moreover, while piers

appear in the Lagoon by 1912, they are of a size that seemingly could only accommodate small vernacular craft, and the extremely narrow and shallow El Boquerón entrance again argues this assumption.

In addition to the maps, a number of historic photographs were also reviewed. Figure 11 shows small vernacular craft most likely used for fishing, as well as finger piers located adjacent to the old railroad bridge. Most likely taken from the adjacent San Antonio Bridge, the 1964 photograph vividly illustrates the use of the Laguna del Condado area by this type of small vessel, a vessel type still seen today fishing in the Lagoon.

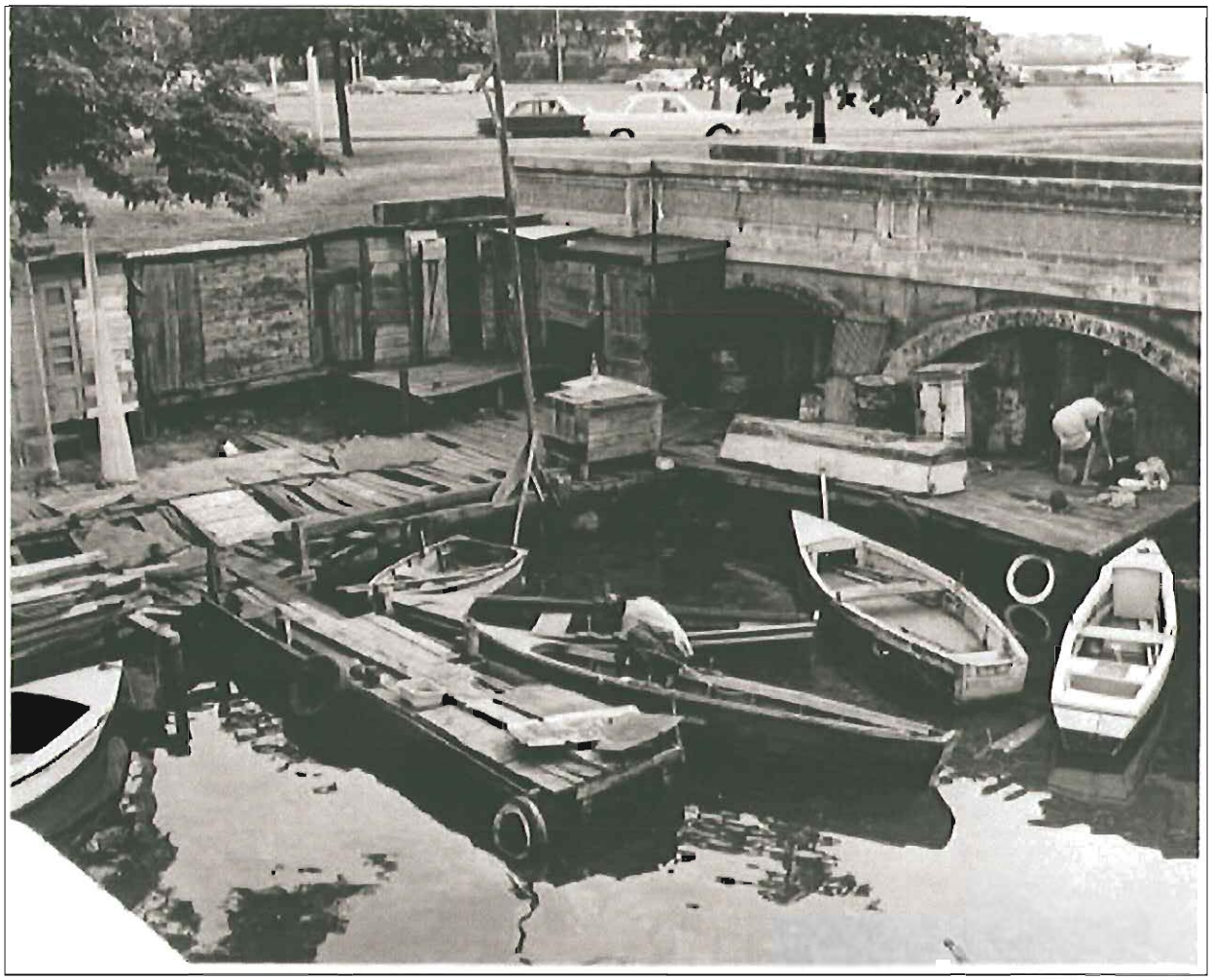

**Figure 11. 1964 photograph of small vernacular craft most likely used for fishing, as well as finger piers located adjacent to the old railroad bridge.**

Courtesy of Universidad de Puerto Rico, Biblioteca Digital Puertoriqueña.

Illustrated in Figure 12, a second photograph titled "Arrabal La Playita ubicado en la laguna del Condado" shows a slum that, according to the photograph's title, apparently lined the banks of the Lagoon at least during the 1950s. Not shown on any map, the location of the actual structures is not known. They are not readily identifiable on aerial photographs showing land changes for the Lagoon from the 1930s until recently. As presented in Seguinot-Barbosa (1996), land modifications and shoreline growth along the Laguna del Condado can be clearly seen. The 1936 image shows a shoreline that is beginning to be developed, with several collections of

houses and most likely businesses. By 1962 the southern shoreline has changed drastically with land reclamation for road construction. The culvert wall and possibly a small pier associated with the steam plant are present in the far eastern side of the Lagoon. By 1996, the Lagoon has taken on the characteristics that are present today.

**Figure 12. A 1955 photograph showing a slum that apparently lined the banks of the Lagoon.**

Courtesy of Universidad de Puerto Rico, Biblioteca Digital Puertoriqueña.

## *SHIPWRECK INVENTORY*

While numerous factors have contributed to a substantial number of vessel losses within San Juan Harbor, these do not apply to Laguna del Condado, as it apparently served only the smallest of vernacular craft. Although shipwreck inventories have been researched and developed (see Marín-Márquez and Cox 1993; Fontanez 2007), they do not apply to the current location, *per se*. Covering the current geographic location for the project area, a review of these inventories shows no wrecks listed for the lagoon. This holds true for NOAA's Automated Wreck and Obstruction System (AWOIS) list, which was also consulted. No wrecks or obstructions were listed.

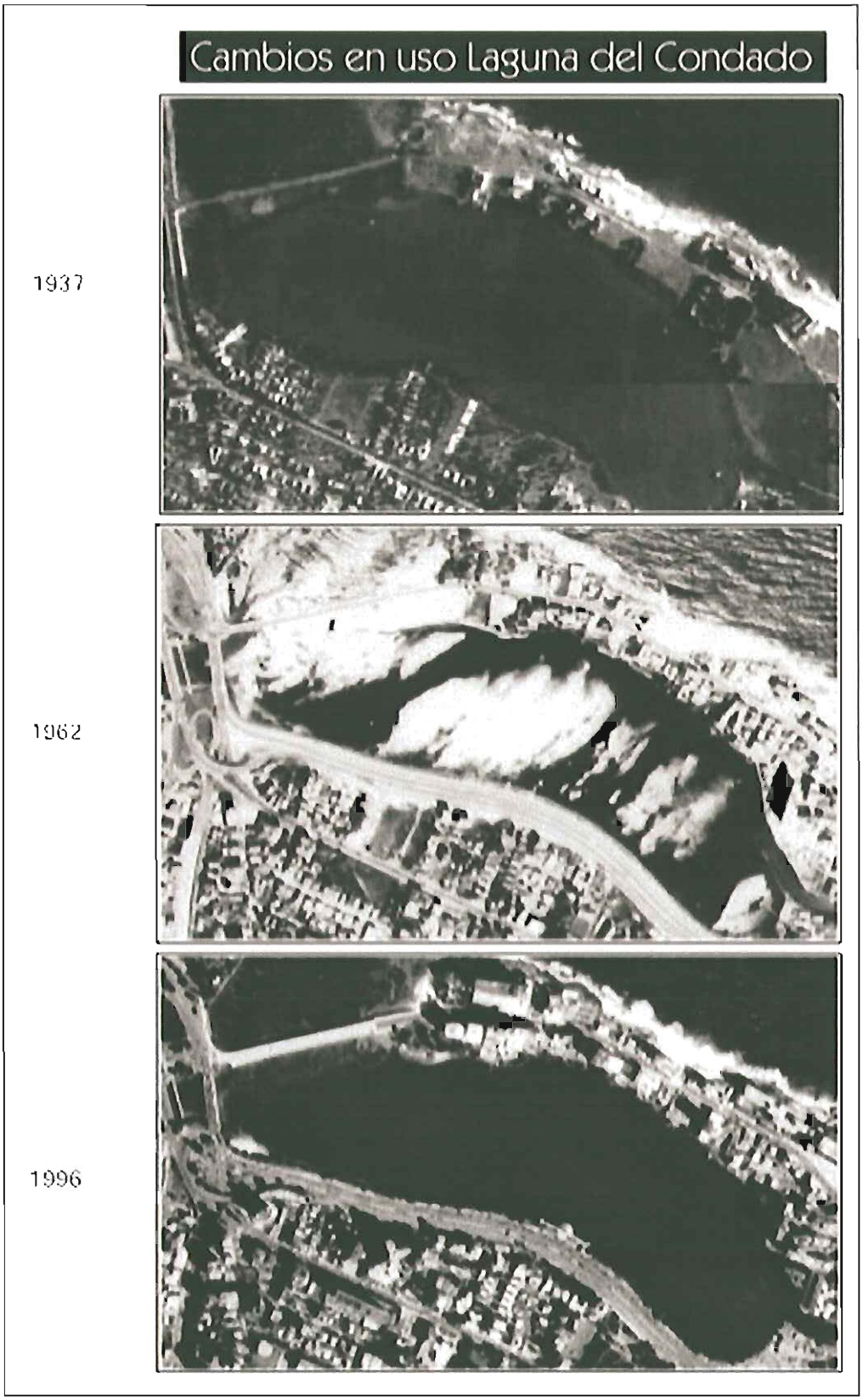


**Figure 13. Aerial photographs of land modifications and shoreline growth along Laguna del Condado (as presented in Seguinot-Barbosa 1996:33).**

## *PREVIOUS INVESTIGATIONS*

While numerous submerged cultural resources investigations have been conducted in the San Juan Harbor area, none have been conducted within Laguna del Condado. Presented in Table 1, only two of these investigations have any relevance to the current project, but they too, are not directly associated with the project area. In 1995, Jesus Vega conducted investigations in the San Antonio Channel associated with the replacement of Bridges 1 and 86. Located at the extreme western end of the lagoon, the investigation revealed the existence of remnants from the San Antonio Bridge Fort. The second study that has relevance is the recent Phase 1A/1B investigations of San Antonio Canal conducted by Fontánez (2007). Associated with the San Juan Waterfront Project, as is the current investigation, the Fontánez study area is well to the west of the current project area.

**Table 1. Previous submerged cultural resources investigations in the project area vicinity.**

| Date | Author(s) | Type | Findings |
|---|---|---|---|
| 1993 | Marín-Márquez and Cox | Phase I Remote Sensing Survey San Juan Harbor Entrance Channel | 13 targets recommended for Phase II investigations |
| 1995 | Koski-Karell | Phase II Diver Investigations of 13 Targets in San Juan Harbor Entrance Channel | Of 13 targets investigated, 1 NRHP shipwreck located |
| 1994 | Hall | Phase II Diver Investigations of NRHP Shipwreck San Juan Harbor Entrance Channel | Deemed shipwreck site, non-significant |
| 1995 | Fontánez | Phase II Investigations of Hall's 1994 Target Based on His Own Research That Vessel Might Be Associated with the Spanish American War | Tentatively identified Hall's wreck as *Manuela* and *Cristóbal Colón*, NRHP eligible |
| 1995 | Vega | Phase II Investigations in San Antonio Channel at Site of Bridges 1 and 36 | Identified San Antonio Fort remnants |
| 1997 | Fontánez | Three Phase 1A/1B Investigations in San Juan Bay | Negative findings |
| 2001 | James et al. | Phase II Investigations of Hall's 1994 Target recommended for further investigations by Fontánez | Identified site as remains of *Manuela* and *Cristóbal Colón*, both NRHP eligible |
| 2003 | James et al. | Phase III Data Recovery of Manuela and Cristobal Colon - Sunk to Block the Entrance Channel During the Spanish American War | Both vessels recovered, recorded and redeposited as an artificial reef |
| 2003 | Fontánez | Phase 1A/1B Investigations in San Juan Bay | Negative findings |
| 2005 | Fontánez | Phase 1A/1B Investigations in San Juan Bay | Negative findings |
| 2006 | Krivor | Phase I & II Investigations Southern San Juan Harbor by Panamerican Consultants, Inc. | Negative findings |
| 2007 | Fontánez | Phase 1A/1B Investigations in San Antonio Canal - Part of the Current San Juan Waterfront Project | Negative findings |

# 3. FIELD METHODS

## *PROJECT AREA ENVIRONMENT*

The survey area environment was protected from wind and swell, as depicted in Figure 14 below. Ringed by buildings or roads on all sides, the project area was extremely benign with little to no boat traffic, and relatively shallow depths with respect to survey instrument hazards (snags).

**Figure 14. General view of the survey area. View is to the east looking across the project area from its western boundary.**

## *PERSONNEL*

The personnel who were involved with the remote sensing survey and all dive operations retained the requisite experience to efficiently and safely complete the project. Stephen R. James, Jr., served as the principal investigator, with Andrew D.W. Lydecker serving as both remote sensing specialist and diver. Captain Miguel Martorel served as boat captain aboard the yola *Tridentita*.

## *REMOTE SENSING EQUIPMENT*

The remote sensing equipment used to locate the magnetic anomalies included a Trimble Navigation DSM212H Integrated 12-channel Global Positioning System (DGPS), a Marine Magnetics SeaSPY overhauser magnetometer, and a Marine Sonic Technology (MST) sidescan sonar.

### *DIFFERENTIAL GLOBAL POSITIONING SYSTEM*

A primary consideration in the relocation of magnetic anomalies is positioning. Accurate positioning is essential for returning to recorded locations for ground-truthing activities. These positioning functions were accomplished on this project through the use of a Trimble Navigation DSM212H global-based positioning system (Figure 15).


**Figure 15. Trimble Navigation DSM212H global-based positioning system.**

The 212H is a global positioning system (GPS) that attains differential capabilities by internal integration with a dual-channel MSK Beacon receiver. This electronic device interprets transmissions both from satellites in Earth's orbit and from a shore-based station to provide accurate coordinate positioning data for offshore surveys. This Trimble system has been specifically designed for survey positioning. This positioning was provided through continuous real-time tracking of the moving survey vessel by utilizing corrected position data provided by an on-board GPS, which processed both satellite data and differential data transmitted from a shore-based GPS station utilizing Radio Technical Commission for Maritime Services (RTCM) 104 corrections. The shore-based differential station monitored the difference between the position that the shore-based receiver derived from satellite transmissions and that station's known position. Transmitting the differential that corrected the difference between received and known positions, the DGPS aboard the survey vessel constantly monitored the navigation beacon radio transmissions in order to provide a real-time correction to any variation between the satellite-derived and actual positions of the survey vessel. Puerto Rico (5201 PR and Virgin Islands Zone 19) State Plane coordinates in feet, based on the 1927 North American Datum (NAD 27) coordinate system, were used for this project.

Both the satellite transmissions and the differential transmissions received from the shore-based navigation beacon were entered directly into a Sony Vaio laptop computer. The computer and associated hardware and software calculated and displayed the corrected positioning coordinates every second and stored the data. Computer software (Hypack Max®) used to control data acquisition was written and developed by Coastal Oceanographics, Inc. specifically for survey applications. Positioning information was stored on magnetic disk aboard the survey vessel.

### *MAGNETOMETER*

The remote sensing instrument used to relocate ferrous objects on or below the sea floor of the survey area was a Marine Magnetics SeaSPY overhauser magnetometer (Figure 16). The magnetometer is an instrument that measures the intensity of magnetic forces. The sensor measures and records both the Earth's ambient magnetic field and the presence of magnetic anomalies (deviations from the ambient background) generated by ferrous masses and various other sources. These measurements are recorded in gammas, the standard unit of magnetic intensity (equal to 0.00001 gauss). The SeaSPY is capable of sub-second repeatability, but data was collected at one-second intervals, both digitally and graphically, providing a record of both the ambient field and the character and amplitude of anomalies encountered. This data was stored electronically in the navigation computer.

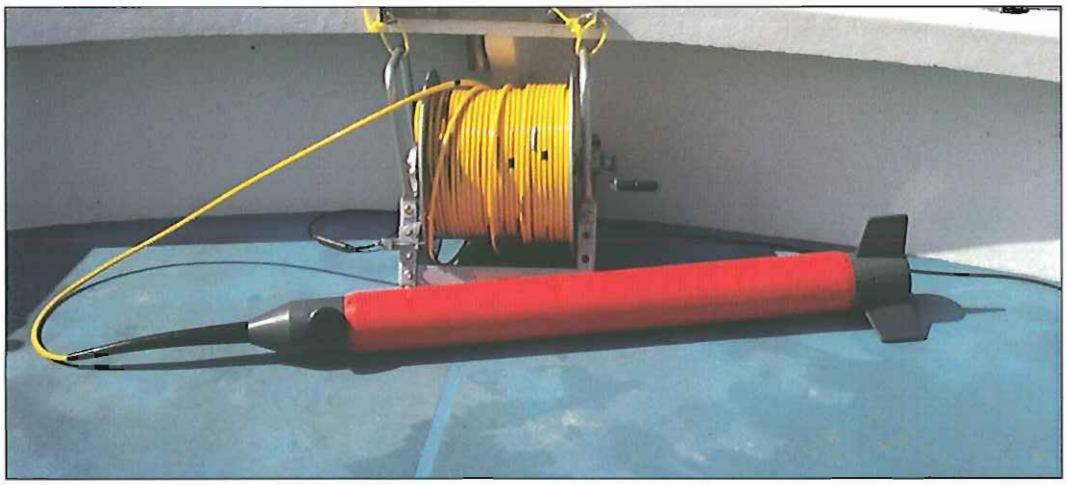

**Figure 16. Panamerican's Marine Magnetics SeaSPY magnetometer.**

The ability of the magnetometer to detect magnetic anomalies, the sources of which may be related to submerged cultural resources such as shipwrecks, has caused the instrument to become a principal remote sensing tool of marine archaeologists. While it is not possible to identify a specific ferrous source by its magnetic field, it is possible to predict shape, mass, and alignment characteristics of anomaly sources based on the magnetic field recorded. It should be noted that there are other sources, such as electrical magnetic fields, surrounding power transmission lines, underground pipelines, navigation buoys, or metal bridges and structures, that may significantly affect magnetometer readings. Interpretation of magnetic data can provide an indication of the likelihood of the presence or absence of submerged cultural resources. Specifically, the ferrous components of submerged historic vessels tend to produce magnetic signatures that differ from those that are characteristic of isolated pieces of debris. While it is impossible to specifically identify the source of any anomaly solely from the characteristics of its magnetic signature, this information, in conjunction with other data (historic accounts, use patterns of the area, diver inspection), other remote sensing technologies, and prior knowledge of similar targets, can lead to an accurate estimation.

### *SIDESCAN SONAR*

The remote sensing instrument used to search for physical features above the sea floor was a Marine Sonic Technology (MST) Sea Scan sidescan sonar system. The sidescan sonar is an instrument that, through the transmission of dual fan-shaped pulses of sound and reception of reflected sound pulses, produces an acoustic image of the bottom. Under ideal circumstances, the sidescan sonar is capable of providing a near-photographic representation of the bottom on

either side of the trackline of a survey vessel. The MST Sea Scan sidescan sonar unit utilized on this project was operated with an integrated single frequency 600 kHz towfish (Figure 17).

**Figure 17. Panamerican's Marine Sonic Technology Sea Scan PC sidescan sonar system.**

The Sea Scan PC has internal capability for removal of the water column from the instrument's video printout, as well as correction for slant range distortion. This sidescan sonar was utilized with the navigation system to provide manual marking of positioning fix points on the digital printout. Sidescan sonar data are useful in searching for the physical features indicative of submerged cultural resources. Specifically, the record is examined for features showing characteristics such as height above bottom, linearity, and structural form. Additionally, potential acoustic targets are checked for any locational match with the data derived from the simultaneous magnetometer survey.

The 20 meters-per-channel setting was chosen to provide detail and enough overlapping coverage with the 50 ft. line spacing to insure full coverage of the survey area. The power setting was selected in order to provide maximum possible detail on the record generated. The 20 meters-per-channel selection made it possible to collect acoustic data over a 40 m (132 ft.) wide area on each line that the sidescan sonar was employed.

## *Survey Vessel*

Prior to the survey, permission was obtained from the Departamento de Recursos Naturales y Ambinetales to operate a motor vessel in the Laguna Condado. The vessel employed during both the remote sensing survey of the dredge material placement site and subsequent diving investigations was the *Tridentita*, a "Yola", a 18 ft. local-built vessel powered by a 15-hp Johnson engines (Figure 18). The vessel had ample deck area for the placement and operation of the necessary remote sensing equipment. Conforming to all U.S. Coast Guard specifications according to class, the vessel carried appropriate emergency supplies including lifejackets, spare parts kit, tool kit, first-aid supplies, flare gun, air horns, and paddles. The vessel was conveniently located at the San Juan Bay Marina just west of the project area and was operated by Capt. Miguel Martorel.

**Figure 18. The *Tridentita*, an 18 ft. yola survey vessel being readied for the remote sensing survey.**

## *SURVEY PROCEDURES*

Coordinates for the project area were entered into the Hypack® software program, entering shoreline points around the boundary of the project area, and then creating pre-plotted tracklines with 50 ft. transect intervals extending over the entire project area. A total of 18 tracklines, approximately 2,100 ft. in length, were generated in order to adequately cover the entire project area.

The magnetometer, sidescan sonar, and DGPS were mobilized and tested, and the running of pre-plotted tracklines began (Figure 19). The helmsman viewed the DGPS and the navigational computer to aid in directing the course of the survey vessel relative to the individual survey tracklines. The computer displayed the real-time position of the path of the survey vessel along the trackline.

As the survey vessel maneuvered down each of the tracklines, the navigation system determined vessel position along the actual line of travel every second. One computer recorded positioning and magnetometer data every second while a separate computer recorded all sidescan sonar returns during the survey. Vessel speed was maintained between three and four feet per second, acquiring magnetic readings every second. The positioning points along the line traveled were recorded on the computer hard drive, and the magnetic data were also stored digitally (Figure 20).

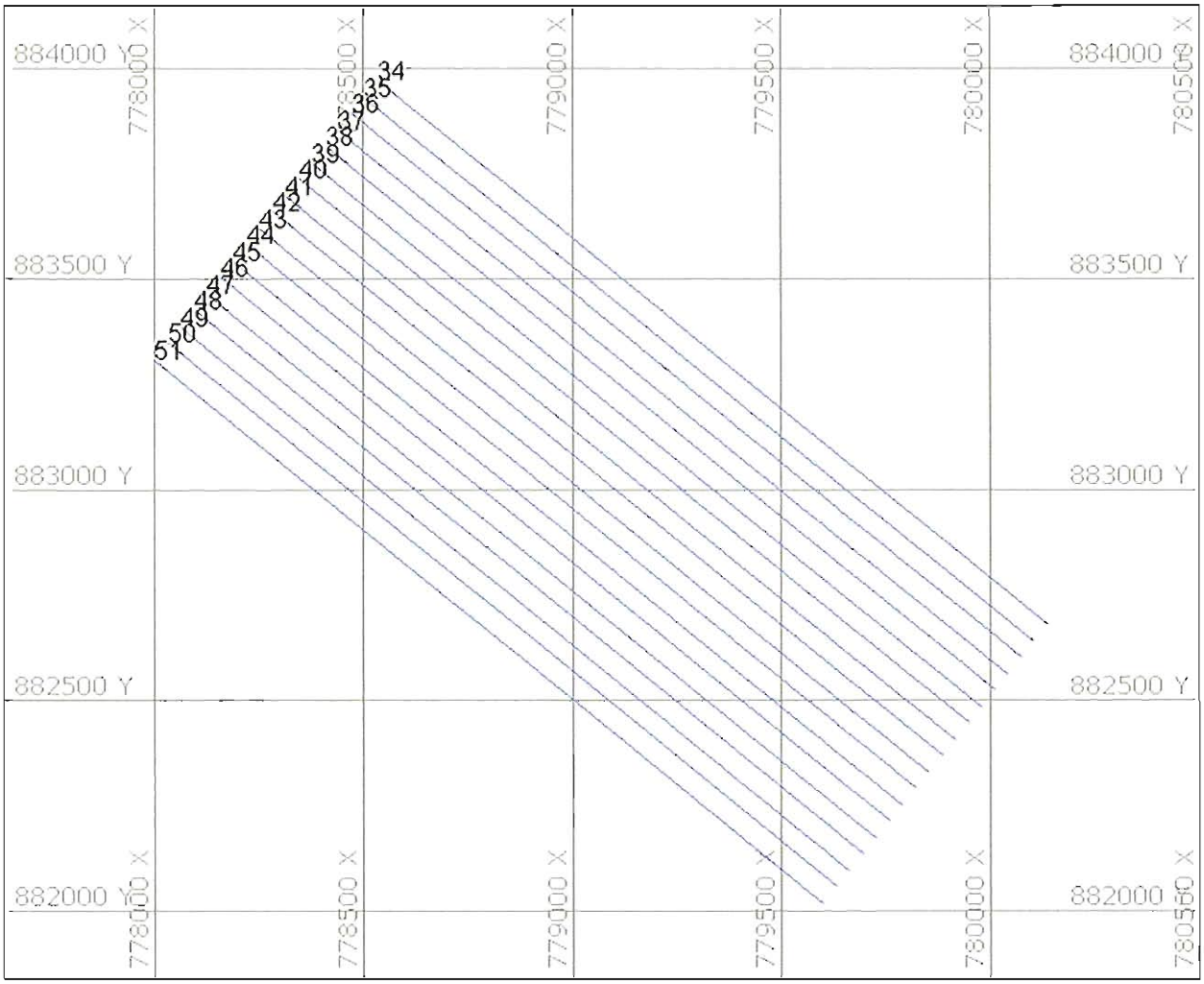


**Figure 19. Pre-plot tracklines of the survey area.**

Each of the tracklines was run until completed (Figure 20). Any navigation errors, problems with the remote sensing instruments, or problems with the positioning system during the running of a line resulted in the termination of that run. Significant off-line errors in navigation resulted in the immediate repetition of that line. Problems with the remote sensing instruments were resolved before repeating the run of an aborted line.

Upon completion of the magnetometer survey, the raw positioning and magnetometer data were edited within the Hypack® computer program. The edited file was input into the system's contouring program to produce magnetic contour maps. The maps, field notes, and magnetometer strip charts were then analyzed to create a list of magnetic anomalies that were indicative of potentially significant cultural resources. Afterwards, the sidescan sonar data was reviewed for any evidence of submerged cultural resources and correlated with magnetic targets. Relative to management considerations, all anomalies were analyzed for potential significance based on the magnetic deflection, duration (in seconds), type (e.g., monopole, dipole, multi-component), and association with other magnetic and sidescan sonar targets. Those anomalies/targets that retained signature characteristics of a potentially significant cultural resource were subsequently investigated by archaeological diver to determine identification and significance.

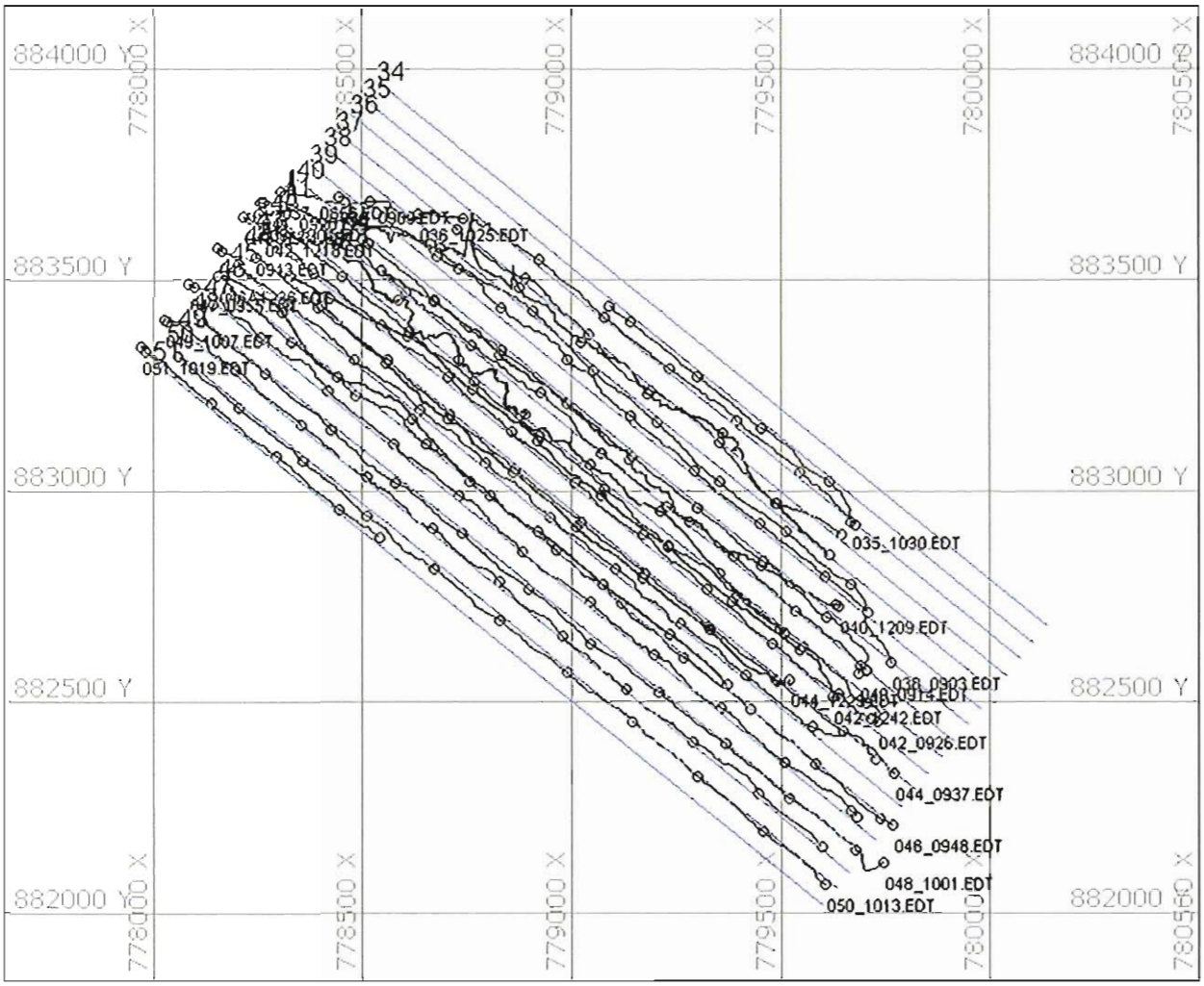


**Figure 20. Post-plot tracklines of the actual survey overlain atop pre-planned lines. As the figure indicates, some lines were not run completely. These lines actually projected onto the shore and therefore could not be run.**

## *DIVE OPERATIONS*

Any anomaly/target having signature characteristics of a potentially significant cultural resource was buoyed for investigation by an archaeological diver (Figure 21). Once a target location was buoyed, the next phase of the project was to attempt to locate the source of the anomaly through either visual or tactile methods. The Yola was anchored and a single diver entered the water, with a stand-by diver equipped to enter the water in an emergency.

The initial objective for the diver was to visually inspect the lagoon floor for the source of the anomaly. The diver was first directed to the buoy located over the anomaly. If the source of the anomaly was not observable on the surface of the sea floor, a series of arcs were conducted by the diver to adequately cover the target area. Once the target was located, a buoy was placed near the middle of the target area and a series of transects were run at cardinal points (north, south, east, and west) to determine the overall area of the target. If the target was above the lagoon floor, the diver conducted an assessment of identity and significance through either tactile or visual methods.

**Figure 21. Archaeological diver Andy Lydecker preparing to investigate anomaly M001.**

# 4. INVESTIGATIVE FINDINGS

Aspects of the current investigation consisted of a remote sensing survey of the proposed project area followed by diver investigations of those targets thought to represent potentially significant submerged cultural resources. The survey was completed in an effort to locate and identify any targets that may be significant cultural resources in the form of historical shipwreck sites.

Following completion of the remote sensing survey, a review of the data was conducted; the remote sensing specialist identified those magnetic anomalies with the greatest potential for representing submerged cultural resources. The evaluation of potential cultural significance of targets is dependent on a variety of factors. These selections were made by evaluating the characteristics of the magnetic and sidescan sonar anomalies recorded during the survey.

The interpretation of remote sensing data obtained from both the magnetometer and sidescan sonar is an imperfect process, at best, and, as stated by Pearson et al., "relies on a combination of sound scientific knowledge and practical experience" (1991). The evaluation of remote sensing anomalies, with regard to a determination that the anomaly does or does not represent shipwreck remains, depends on a variety of factors. These include the detected characteristics of the individual anomalies (e.g., magnetic anomaly strength and duration and sidescan image configuration), association with other sidescan or magnetic targets on the same or adjacent lines, and relationships to observable target sources, such as channel buoys.

Interpretation of data collected by the magnetometer, the tool of choice by the underwater archaeologist for locating shipwrecks, is perhaps the most problematic. Magnetic anomalies are evaluated and prioritized on the basis of magnetic amplitude or deflection of gamma intensity in concert with duration or spatial extent; they are also correlated with sidescan targets. Because the sonar record gives a visible indication of the target, identification or evaluation of potential significance is based upon visible target shape, size, and presence of structure, as well as association with magnetic anomalies. Targets, such as isolated sections of pipe, can normally be immediately discarded as non-significant, while large areas of above-sediment wreckage are generally easy to identify.

The problems of differentiating between modern debris and shipwrecks on the basis of remote sensing data have been discussed by a number of authors. This difficulty is particularly true in the case of magnetic data, and, therefore, it has received the most attention in the current body of literature dealing with the subject. Pearson and Saltus state, "even though a considerable body of magnetic signature data for shipwrecks is now available, it is impossible to positively associate any specific signature with a shipwreck or any other feature" (1990:32). There is no doubt that the only positive way to verify a magnetic source object is through physical examination. With that said, however, the size and complexity of a magnetic signature does provide a usable key for distinguishing between modern debris and shipwreck remains (see Garrison et al. 1989; Irion and Bond 1984; Pearson et al. 1993). Specifically, the magnetic signatures of most shipwrecks tend to be large in area and tend to display multiple magnetic peaks of differing amplitude.

With the above discussion the context for analysis of project area data, it can be stated that, with the exception of the anomalies that border the project area and that were produced by non-significant structures such as retaining walls, pier remains, and iron-reinforced concrete culvert walls, only a single anomaly, M001, was recorded in the project area (Figure 22, Table 2) The anomaly, which had no associated sidescan sonar image, is located in the approximate center of the project area. A large dipole with a total deviation of 658 gamma and a duration of 100 ft. (Figure 23), the target actually affects only a single line, suggesting it was a single-source object.

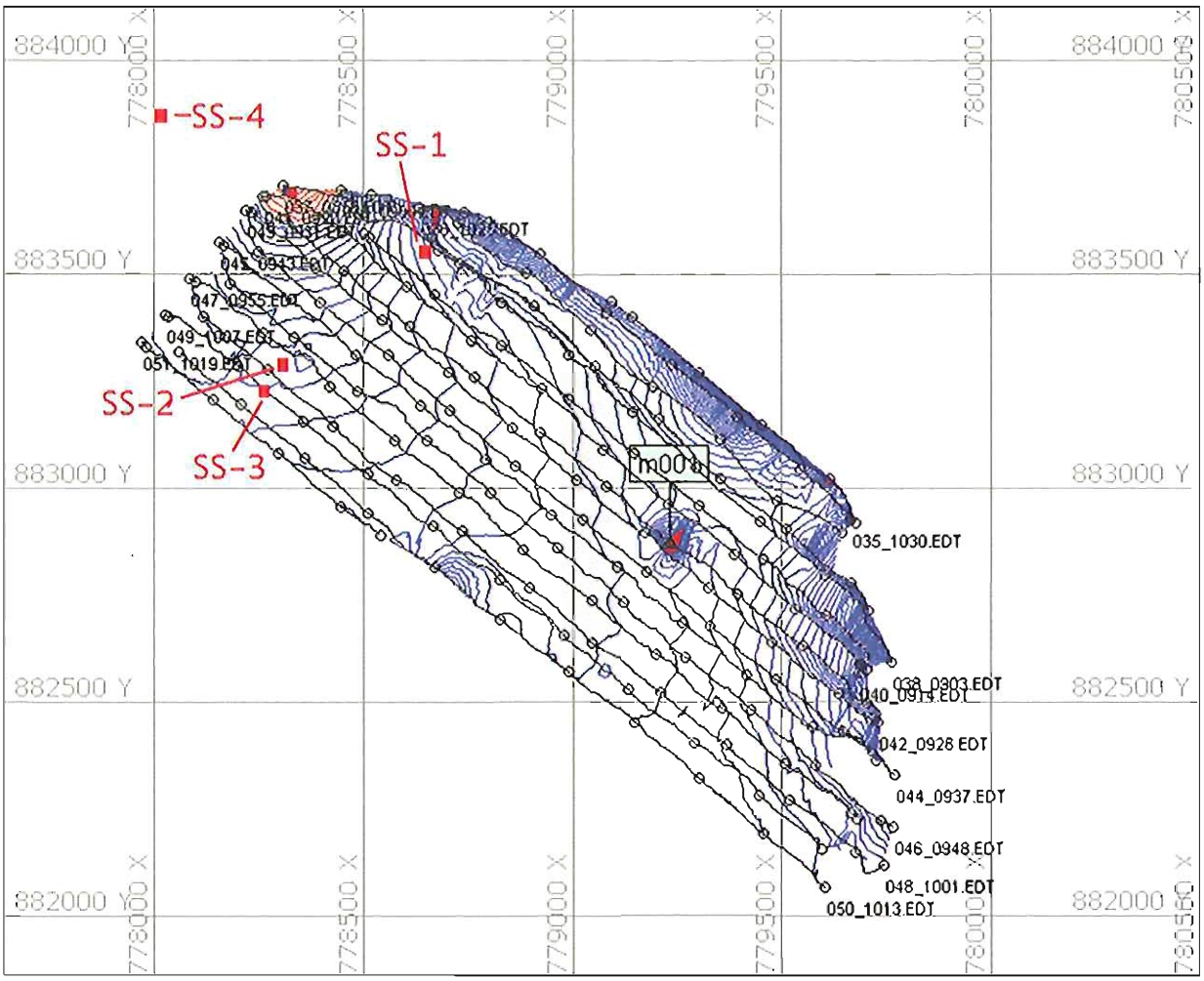


**Figure 22. Magnetic contour map of the project area (10 gamma contours).**

**Table 2. Magnetic anomalies and sidescan sonar targets.**

| Target | Easting | Northing | Type | Deviation | Duration | Significant |
|---|---|---|---|---|---|---|
| M001 | 779231 | 882871 | D | +554/-104 | 100' | No |
| SS-1 | 778649 | 883552 | N/A | N/A | NA | No |
| SS-2 | 778306 | 883291 | N/A | N/A | NA | No |
| SS-3 | 778269 | 882231 | N/A | N/A | NA | No |
| SS-4 | 778022 | 883709 | N/A | N/A | NA | No |

D = Dipole.

Anomaly M001 represented the only potentially significant target within the project area. However, as previously indicated, the target actually affects only a single line, suggesting a single-source object. Diver investigations were conducted to determine its source and significance, revealing the source was a 4 in. diameter iron pipe projecting perpendicular from the bottom for a distance of 4 ft. into the water column. Water depths at the target were 18 ft.

In addition to the magnetic target, review of sidescan data indicated several acoustic images within the project area (see Figure 22). All are extremely small and, lacking any magnetics, are from non-ferrous sources (Table 2 and Figures 24 through 27). All are considered non-significant based on signature characteristics and were not investigated. Note that target 4, well outside the project area, is the remains of a modern watercraft, either a sport or fishing craft.

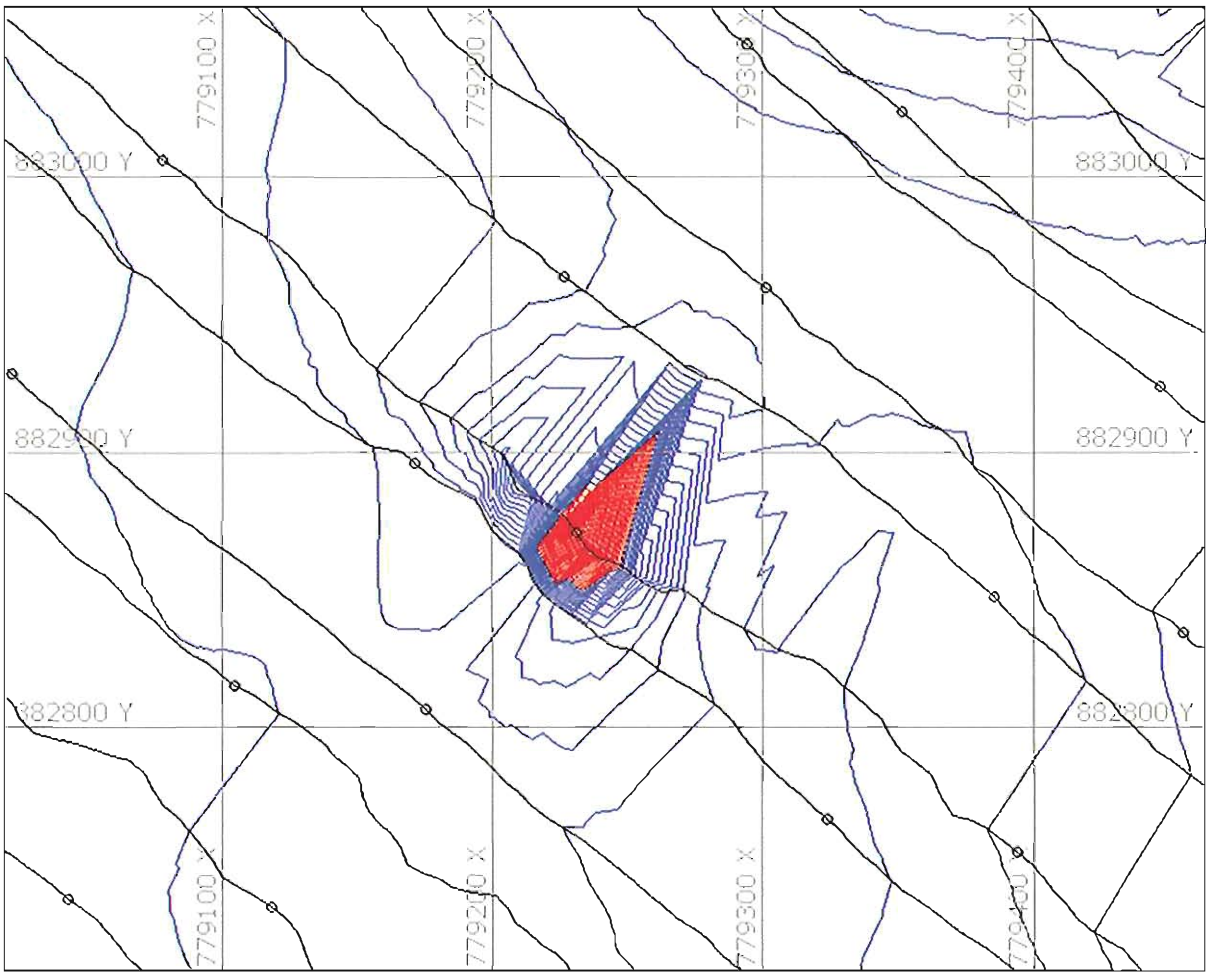


**Figure 23. Close-up of anomaly M001.**

In conclusion, results of the remote sensing survey identified one magnetic anomaly and no sidescan sonar targets that had the potential to represent historically significant cultural resources within the project area. However, diver investigation of the single anomaly revealed that it is modern debris and is not significant. It is the opinion of the principal investigator that the project area does not contain cultural resources and there will be no adverse effects by project activities. No further archaeological investigations are required.

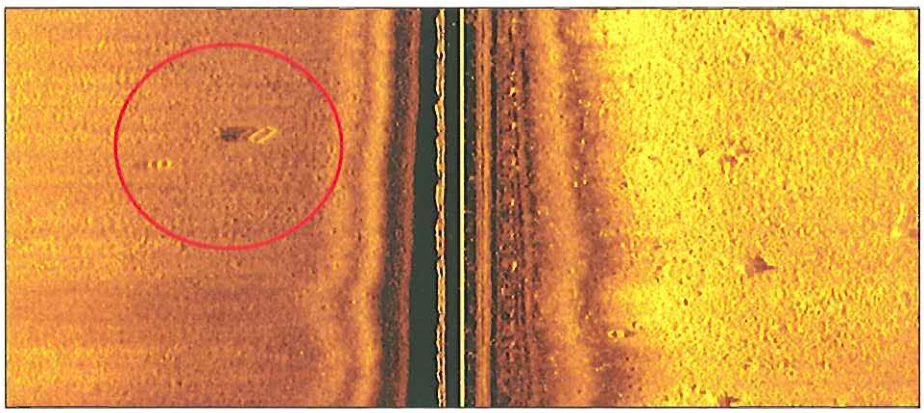

**Figure 24. Sidescan sonar target 1. A rectangular box-like object, it may represent a plastic "cooler".**

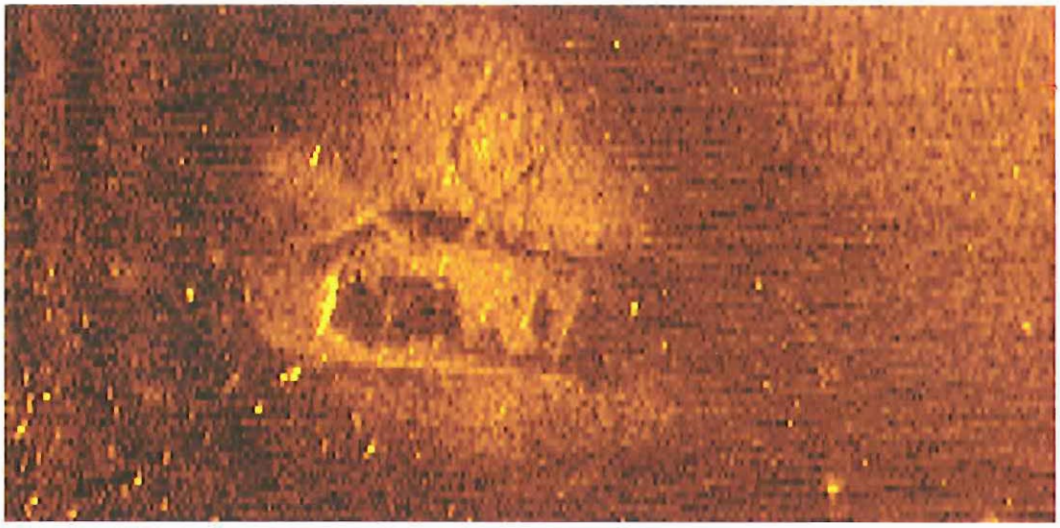

**Figure 25. Sidescan sonar target 2. Approximately 8 ft. in length, and lacking any magnetics, the object appears to be composed of modern lumber, and may represent storm-deposited debris.**

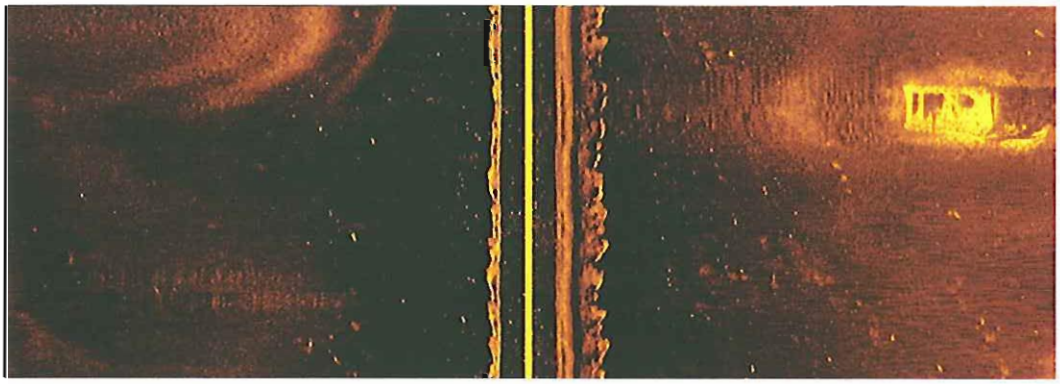

**Figure 26. Sidescan sonar target 3. Approximately 12 ft. in length, and lacking any magnetics, the object appears to be composed of modern lumber, and may represent storm-deposited debris.**

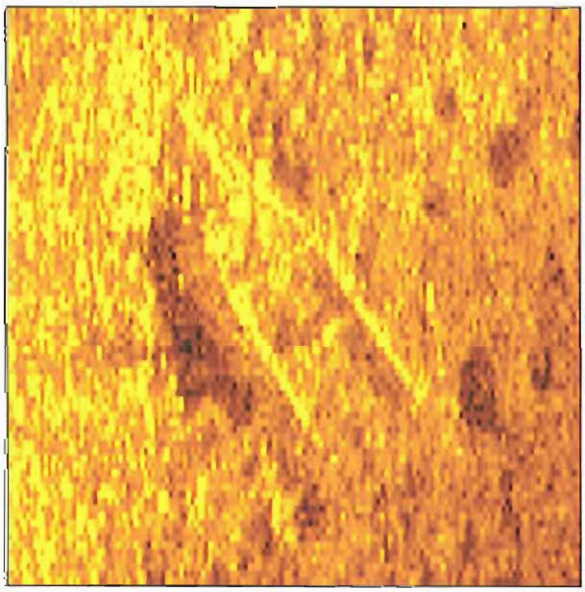

**Figure 27. Sidescan sonar target 4. Located well outside the project area boundaries, target 4 appears to be the remains of a modern watercraft, either a sport or local fishing craft.**

# 5. CONCLUSIONS

Conducted under contract to CSA Group (CSA) of San Juan, Puerto Rico, by Panamerican Consultants, Inc., of Memphis, Tennessee, the current investigation was implemented in order to determine if any properties eligible for the National Register of Historic Places were located within the Laguna del Condado project area, specifically in the form of historic shipwrecks. Comprised of limited archival research and an intensive remote sensing survey utilizing a marine magnetometer, a sidescan sonar, and DGPS positioning, the remote sensing investigation identified one magnetic anomaly and no sidescan sonar targets that had the potential to represent historically significant cultural resources within the project area. Subsequent diver investigation of the single magnetic anomaly revealed that it is modern debris and is not significant. It is the opinion of the principal investigator that the project area does not contain historically significant cultural resources and that there will be no adverse effects by project activities. No additional archaeological investigations are required.

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