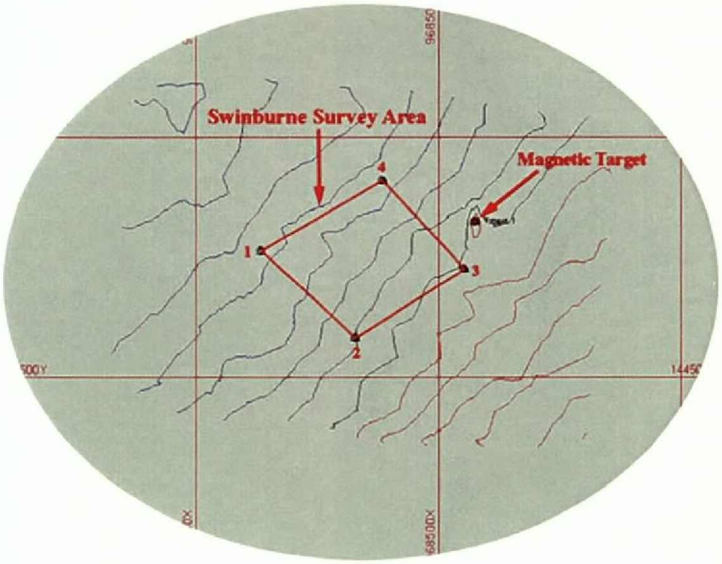
Contract No. DACW51-01-D-0018
Delivery Order No. 0061

U.S. Army
Corps of Engineers
New York District

REMOTE SENSING SURVEY OF THE SWINBURNE BENEFICIAL USE SITE IN CONNECTION WITH THE NEW YORK AND NEW JERSEY HARBOR NAVIGATION STUDY OF THE UPPER AND LOWER BAY PORT OF NEW YORK AND NEW JERSEY, RICHMOND COUNTY, NEW YORK



PREPARED FOR:

U.S. Army Corps of Engineers
New York District
New York, New York

UNDER SUBCONTRACT TO:

Northern Ecological Associates, Inc
NEA
Portland , Maine

PREPARED BY

Panamerican Consultants, Inc.
Memphis, Tennessee

DRAFT REPORT ♦ MAY 2006

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REMOTE SENSING SURVEY OF THE SWINBURNE BENEFICIAL USE SITE IN CONNECTION WITH THE NEW YORK AND NEW JERSEY HARBOR NAVIGATION STUDY OF THE UPPER AND LOWER BAY PORT OF NEW YORK AND NEW JERSEY, RICHMOND COUNTY, NEW YORK

Prepared for:
Environmental Analysis Section
U.S. Army Corps of Engineers, New York District
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Contract No. DACW51-01-D-0018-3
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May ♦ 2006

ABSTRACT

From February 20 to February 23, 2006, marine archaeologists with Panamerican Consultants, Inc. (Panamerican) of Memphis, Tennessee, conducted an intensive remote-sensing survey of the U.S. Army Corps of Engineers, New York District's proposed Swinburne Beneficial Use Site (in connection with the New York and New Jersey Harbor Navigation Study), located within the Upper and Lower Bay, Port of New York and New Jersey, Richmond County, New York. The project area is located due east of the northeastern shoreline of Staten Island, specifically off Midland Beach, Richmond County, New York. The New York District is proceeding with construction of the New York and New Jersey Harbor Navigation Project by constructing several miles of navigation channels to accommodate larger vessels. This work will permanently impact mudflats, beach, and slat marsh habitats by converting these areas into deepwater habitats. To mitigate for these impacts, several mitigation sites have been proposed. One site selected for mitigation efforts is the Swinburne Beneficial Use Site. The survey area is diamond shaped and is approximately 2 to 3 acres in size. Its east-to-west axis is roughly 420 feet in length, while its north-to-south axis is 330 feet in length.

Performed under subcontract to Northern Ecological Associates, Inc. (NEA) of Presumpscott, Maine, this investigation was conducted for the District in response to their Scope of Work (SOW) entitled *Remote Sensing Survey of the Swinburne Beneficial Use Site In Connection with the New York and New Jersey Harbor Navigation Study, Upper and Lower Bay, Port of New York and New Jersey, Richmond County, New York*, under Contract No. DACW51-01-D-0018-3, Delivery Order No. 0061.

The remote sensing survey recorded a total of only one magnetic anomaly near the project area. Located 90 feet from the Project Area's northwest boundary, the positive monopole anomaly has a magnetic deviation of +45 gamma over a duration of 47 feet. A review of side scan records indicate that the target has no associated acoustic image. Based on the magnetic signal characteristics, the anomaly appears to be generated by a small, single-point source, and is not characteristic of a shipwreck site (i.e., a complex magnetic signature). The absence of an acoustic image lends credence to this statement. Therefore, it is the opinion of the Principal Investigator that the proposed Swinburne Project Area, and its immediate surrounding area, contains no significant cultural resources.

ACKNOWLEDGMENTS

The successful completion of this project is the direct result of the input and hard work of numerous individuals. The author would first like to thank the U.S. Army Corps of Engineers, New York District, and specifically Ms. Lynn Rakos, Project Archaeologist, for allowing Panamerican the opportunity to conduct this investigation. We would also like to extend our gratitude to Northern Ecological Associates, Inc. of Presumpscott, Maine, under whose contract this was conducted, and to Ms. Beth Cole, who administered the contract for the firm.

The author would also like to sincerely thank the archaeological survey crew who participated in this investigation. This hard-working group of individuals, in no particular order, included Michael Faught and Jim Duff. All worked hard to keep the remote-sensing and diving activities at an absolutely safe level.

In-house Panamerican personnel who must be thanked for their assistance with this report production include Leslie Isaacman, report editor, and Kate Gilow, office manager.

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1. INTRODUCTION

From February 20 to February 23, 2006, marine archaeologists with Panamerican Consultants, Inc. (Panamerican) of Memphis, Tennessee, conducted an intensive remote-sensing survey of the U.S. Army Corps of Engineers, New York District's proposed Swinburne Beneficial Use Site (in connection with the New York and New Jersey Harbor Navigation Study), located within the Upper and Lower Bay, Port of New York and New Jersey Richmond County, New York. The project area is located due east of the northeastern shoreline of Staten Island, specifically off Midland Beach, Richmond County, New York (Figure 1). The New York District is proceeding with construction of the New York and New Jersey Harbor Navigation Project by constructing several miles of navigation channels to accommodate larger vessels. This work will permanently impact mudflats, beach, and slat marsh habitats by converting these areas into deepwater habitat. To mitigate for these impacts, several mitigation sites have been proposed. One site selected for mitigation efforts is the Swinburne Beneficial Use Site.

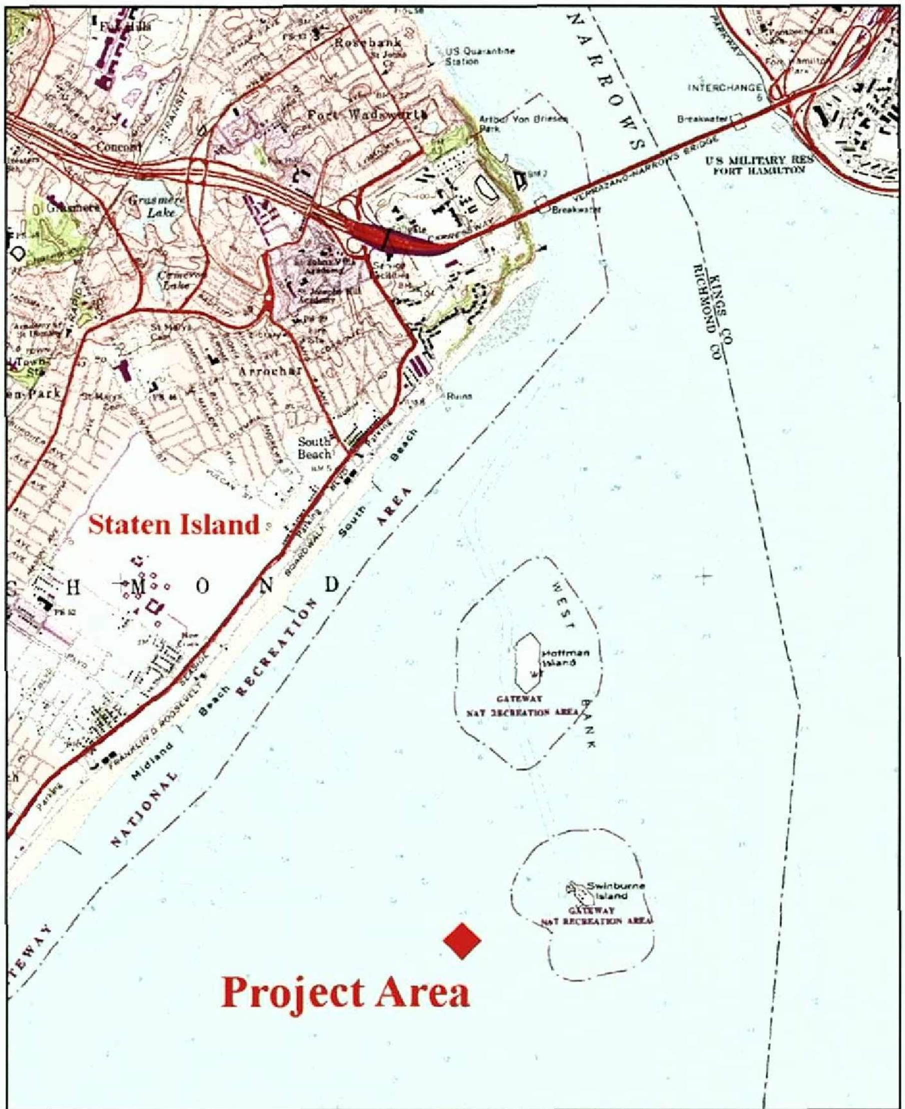

Figure 1. Project area location map (base map: U.S.G.S. The Narrows, N.Y.-N.J. Topographic Quadrangle 1981 photorevised).

Comprised of a review of previous cultural resources reports and an intensive remote-sensing survey of the offshore project area, the current investigation was implemented by the New York District in partial fulfillment of their obligations under various federal statutes. As an agency of the Federal government, the District is entrusted with the protection and preservation of all cultural resources that may be adversely affected by their project activities. The Federal statutes regarding these responsibilities include: Section 106 of the National Historic Preservation Act of 1966, as amended; Executive Order 11593; 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, the District initiated a remote-sensing survey to determine if any potentially significant submerged cultural resources were present in the project area that might subsequently be affected by the proposed borrow activities. Performed under subcontract to Northern Ecological Associates, Inc. (NEA) of Presumpscott, Maine, this investigation was conducted for the District in response to their Scope of Work (SOW) entitled *Remote Sensing Survey of the Swinburne Beneficial use Site In Connection with the New York and New Jersey Harbor Navigation Study, Upper and Lower Bay, Port of New York and New Jersey, Richmond County, New York*, under Contract No. DACW51-01-D-0018-3, Delivery Order No. 0061.

The remote-sensing survey project area is located offshore of Staten Island, Richmond County, New York, in Lower New York Bay, and it is the primary means of marine access to New York Harbor, historically one of America's busiest ports. Numerous historic vessels have wrecked within the Lower Bay during their approach to, or departure from, the harbor, and a limited number may be contained in the project area. As illustrated in Figure 1, above, and Figure 2, below, the proposed project area is situated southeast of Midland Beach on Staten Island's northeastern shore – about two miles from shore and just to the southwest of Swinburne Island. With coordinates for the Project Area presented in Table 1, the survey area is diamond shaped and is approximately 2 to 3 acres in size. Its east-to-west axis is roughly 420 feet in length, while its north-to-south axis is 330 feet in length. (Figure 3). Depths in the Project Area range from 12 to 18 feet at high tide.

Figure 2. Looking north from the Project Area. The Verrazano-Narrows Bridge is visible as is Staten Island to the left. The small island is Hoffman's Island, which is just north of Swinburne Island (see Figure 1).

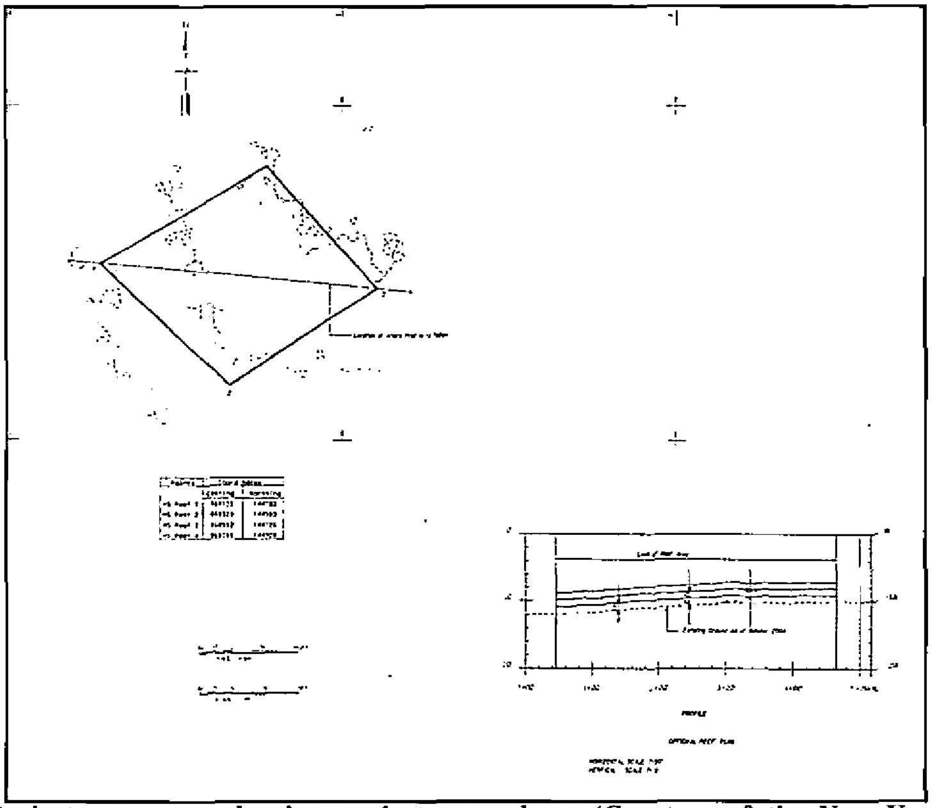

Figure 3. Project area map showing project area shape (Courtesy of the New York District).

Table 1. Project Area Corner Coordinates.

Corner	Easting	Northing
1	968,135	144,762
2	968,329	144,580
3	968,552	144,726
4	968,385	144,908

As detailed in the Remote Sensing Survey Plan, which was developed and accepted for the project prior to the implementation of fieldwork, remote-sensing equipment employed in the near-shore survey areas included a magnetometer, a side scan sonar, a fathometer, and a Differential Global Positioning System (DGPS). Recorded magnetic anomalies were prioritized as to the probability of representing historic shipwreck remains, based on characteristics such as anomaly strength, duration, and relative association with other remotely-sensing data. Side scan sonar records were reviewed for features, such as linearity, structure, height off ocean bed, and association with other remote-sensing data.

One magnetic anomaly was recorded during the remote sensing survey. Located 90 feet from the Project Area's northwest boundary, the positive monopole anomaly has a magnetic deviation of +45 gamma over a duration of 47 feet. Review of side scan records indicates that the target has no associated acoustic image. Based on the magnetic signal characteristics, the anomaly appears to be generated by a small single-point source and is not characteristic of a shipwreck site (i.e., a complex magnetic signature). The absence of an acoustic image lends credence to this statement. Therefore, it is the opinion of the Principal Investigator that the proposed Swinburne Project Area and its immediate surrounding area contain no significant cultural resources.

2. HISTORICAL OVERVIEW

BACKGROUND ARCHIVAL RESEARCH

Pursuant to guidelines established by the National Historic Preservation Act of 1966 and the National Environmental Policy Act of 1969, potential impacts to any significant cultural resources in a proposed borrow area must be addressed. In conjunction with the remote sensing survey, archival research was conducted in order to identify the location of, and/or the possibility of, the existence of cultural resources within the area. Significant cultural resource types potentially found within the project area include both prehistoric and historic resources, the latter represented by shipwrecks. To identify these resources or their potential presence, numerous agencies, archives, and references were contacted or researched.

The archival investigation employed both primary and secondary archival sources or literature (i.e., Lifesaving Service Reports, maps). Besides well-known published maritime histories of the area, references included numerous cultural resources remote-sensing survey reports for the general area. Published shipwreck compilations, in the form of references and reports which identified wreck locations in, adjacent to, or near the project area, were reviewed.

The information gleaned from these sources has been synthesized into a prehistoric and historic overview that, when employed during the assessment of actual remote-sensing data, enables the researcher to determine the potential for resources within the project area, and thus allows an accurate interpretation of the data. Presented below, the archival information has been divided into discussions of prehistoric resources, navigational history, previous studies, and a shipwreck inventory.

POTENTIAL FOR SUBMERGED PREHISTORIC SITES

Consideration of the potential for cultural resources within the project area focuses on two distinct types: prehistoric sites and historic shipwrecks. Although the location of shipwreck sites can be realized through the employment of an array of remote-sensing equipment, like that currently being utilized within the project area, the location of submerged prehistoric sites with current technology is highly unlikely. Rather, the emphasis during a study of this nature is more hypothesis than reality as the investigation bases potential submerged site locations on known above current sea level site locational parameters (i.e., land forms such as river terraces), as well as data on Pleistocene environments, and resources for the area (i.e., estuaries, food types). However, it is possible to identify relic submerged landforms, to some extent, with the side scan sonar and sub-bottom profilers, and then apply known parameters from above-sea-level sites to these landforms.

With this in mind, the potential for prehistoric resources within our project area is directly related to the geological morphology of the area resulting from post-Pleistocene sea-level changes. The last of the Pleistocene glacial stages was the Wisconsin glaciation; the project area lies just south of the maximum southerly limit of this glaciation (Ferguson 1986). Between 18,000 and 14,000 years before present (B.P.), sea level was more than 100 meters (325 feet) lower than it is now. Depending on the source quoted, by 12,000 B.P., sea levels had risen to between 60 m and 30 m below their current level. Hunter et al. (1985:3-28) illustrate that all the project area was above sea level during the Holocene period, or termination of the Pleistocene. With human occupation believed to have begun in this area circa 12,000 B.P. (a conservative estimation), current speculation suggests that the entire project area would have been available for prehistoric occupation (Ferguson 1986:6).

During an early investigation, Roberts et al. (1979:Volume II) indicated that evidence for Pleistocene megafauna and relic shell-fish beds has been reported from offshore areas, both representing Pleistocene resources and environments favorable or conducive to prehistoric population utilization, but there was no actual evidence for prehistoric occupation or utilization during the Holocene for offshore areas. Megafauna certainly could have been a resource exploited by prehistoric peoples. In the area, there are three regions where megafauna remains appear to be clustered offshore. Mammoth teeth have been found at the depth of approximately 80 meters. Mastodon teeth have been found in two separate belts, from 20-25 meters and 40-50 meters, below present sea level. These clusters of terrestrial remains may corroborate with past sea levels, indicating possible areas for human occupation (Miller et al. 1990:7).

The potential for submerged prehistoric sites on the continental shelf has been treated by several authors since Roberts et al.'s research (Stright 1990, 1995; Pickman 1994; Thieme 2000). Stright (1990) listed numerous sites found in a shallow water context, and then went on to create some predictive modeling as to where sites could be located. Later, Stright (1995) focused her studies on the effect of sea-level change on potential archaeological site location and expected levels of preservation. Pickman (1994) also focused on the potential location of prehistoric sites relative to sea-level change in the Long Island, New York area. In his study of the New York harbor region, Thieme (2000) indicates that there are known Late Paleoindian or Early Archic sites on Staten Island. He believes that the sites represent only a small portion of actual settlement in the region, and settlement extended across the inundated surfaces of the harbor region (Thieme 2000:3).

Many submerged prehistoric sites have been located in various regions of the continental shelf. Stright's (1990) compilation of 34 submerged prehistoric sites indicated the potential for the resource to be found on the continental shelf. Although the definition of site is "... used to designate any locality of archaeological material, not necessarily an in situ archaeological deposit," and the sample is admittedly biased–from shallow water areas–the data support the thesis that there are early prehistoric sites located in a submerged context (Stright 1990:439). Supporting this hypothesis, artifactual materials in the New England/Long Island Sound area were located due to dredging activity and were assigned to the Archaic period (Stright 1990: 441-442). Thus, there is a body of evidence to support the contention that there may be submerged prehistoric resources in the present project area.

It is believed that past dredging activity off of Sandy Hook may have exposed and redeposited portions of a prehistoric site. Known as the Corcione Collection, an assemblage of over 200 prehistoric artifacts was collected by a shell seeker on the beaches of Monmouth, New Jersey. The area where artifacts were located had recently been renourished by sands dredged from offshore in an area approximately one mile east off the southern portion of Sandy Hook, in depths of 35 to 40 feet below mean low water. It is believed that the artifacts came from a layer within the first five feet of the sea bed from the "Weeks 1 Borrow area" (COE Memo, 9/21/95). The lithics, including numerous projectile points, have been tentatively identified as ranging from the Early Archaic to the Late Woodland periods, with a large portion from the Archaic. It is tentatively considered that the concentration of the artifacts, most from the Archaic period, can be considered to consist of a site that had been dredged from the borrow area and deposited with sands onto the beach at Monmouth (Merwin, personal communication 2001).

Comparable submerged sites have been found and investigated in Florida. Most artifacts have not been found by archaeologists, but by divers/collectors. Some of the extinct faunal remains found in a submerged context show evidence of butcher cuts and other evidence of human shaping (Faught 2001). However, in general, the Florida environment is much more benign than the conditions found off Staten Island. Lower sedimentation, clearer and warmer waters, milder or no tides, and less dynamic conditions have allowed the Florida sites to be more easily found and investigated (Merwin, personal communications 2001). Although the environment is presently quite different between Lower New York Bay and Florida, the evidence of Holocene occupation existing in now-submerged portions of the continental shelf may be applicable to the Holocene environment of the present Project Area.

With the knowledge that there are other submerged prehistoric sites located on previously terrestrial Holocene environments, there is the potential for sites to be located in the present project area. This is evidenced by the assemblage of prehistoric cultural artifacts recovered from a renourished beach context, the original in situ location of the artifacts being considered an offshore borrow area south of the current project area. This would indicate that there are indeed submerged prehistoric sites in proximity to the Project Area. The question, then, is how to identify prehistoric sites that cannot be recorded during a typical marine remote-sensing investigation.

The equipment utilized for this project, i.e., magnetometer and side scan sonar, cannot positively identify prehistoric sites which are non-magnetic, nor protruding from the sea bed. Alternate methods and techniques may have better results. The application of a subbottom profiler survey, with parameters to identify relict landforms, in conjunction with coring, could possibly identify likely locations for submerged prehistoric sites. Rather than using these instruments in a broad survey to look for specific sites, which would be difficult, their application should be to indicate past submerged Holocene landforms with potential to contain cultural material. Subsequent testing for prehistoric sites (i.e., coring) could concentrate on the areas of higher potential, increasing the chance to contact these materials. In fact, a coring regimen was conducted in various locations throughout the harbor in 1999. An area cored just south of the current project area, Zone 2, suggested that "there appears to very little preservation of intact Holocene sediments within these cores" (LaPorta et al. 1999).

GENERAL NAVIGATION HISTORY OF THE PROJECT AREA

Europeans' first exposure to the New York Bay came during the voyages of Verrazzano. Originally from Florence, Italy, (sailing for Francois I, the King of France) Verrazzano left on a voyage to find a route to China in January of 1524. His vessel, *La Dauphine* (named after the French heir to the throne), was manned by a crew of 50. After a tempest-tossed crossing, he fetched up close to Cape Fear, North Carolina, in early March. By mid-April, Verrazzano had coasted far enough north and east to enter New York Bay. After some brief reconnaissance, he continued on his voyage and returned to France in July. Being a competent seaman and navigator, Verrazzano was able to conclude that he did not reach China, but a new world (Morison 1971:299-302). However, the French did not follow up on Verrazzano's discovery of what would later become the best harbor in the Americas.

Henry Hudson, an Englishman in the employ of the Dutch East India Company, investigated portions of the American east coast in 1609 (Labaree et al. 1998:38). Hudson was the next European to enter New York Harbor, sailing 150 miles up the river that still bears his name. The Dutch were a bit more industrious and inaugurated in expanding European control of the region. Headquartered at "Manhattan" (Native American term for the current-day island of Manhattan), private trading operations were established on the Hudson in 1613. Numerous exploratory ventures occurred after the founding of the trading post, and, by 1615, much of the area was well-traveled. The Dutch named this region the New Netherlands in 1614, with private fur-trading operations expanding into the surrounding country. In 1623, the Dutch West India Company took over trading operations of the region with the town of New Amsterdam being founded in 1625 (ICA 1979:A-12, A-13).

The Dutch expansion east toward New England caused conflict with the English. To the south, the Dutch took over the Swedish settlement at present-day Wilmington, Delaware. They established various trade connections between Chesapeake Bay colonists, South America, and Europe. New Amsterdam grew quickly and rivaled Boston as a center for maritime trade, with furs, fish, beef, and flour being exported and tobacco, slaves, and sugar being trans-shipped. European goods continued to account for most imports. New Amsterdam appeared to be the rising star of American colonial ports. However, with the restoration of Charles II in England and a more aggressive colonial policy, the English overtook the colony in 1664 (Labaree et al. 1998:46).

Soon after the beginning of British rule (at which time New Amsterdam was renamed New York), flour replaced furs as the port's main export, being shipped mainly to the West Indies. During the eighteenth century, other exports included whale oil, beaver pelts, and some tobacco to England; pork, bread, peas, and horses were shipped to the West Indies. Imports from England and the West Indies included manufactured goods, rum, molasses, and sugar (Watts 1986:11-12). Shipping continued to increase considerably during the mid-1700s. Additional imported goods included "fish oil, blubber, whale fins, turpentine, seal skins, hops, cider, bricks, coal, lamp black, wrought iron, tin, brasury [*sic*], joinery, carriages and chairs" (ICA 1979:B-9).

New York did not confine shipping activities to trade; sailing vessels were also heavily involved in privateering. Preying on enemy commerce inevitably led to the often-glamorized activity of pirating. The infamous Captain Kidd and various lesser-known pirates made New York a rendezvous around 1700 (Albion 1984:2-5). Not only was New York a rendezvous, merchants also supported the trade and reaped a profit by supplying pirates inhabiting such far-off places as Madagascar in the Indian Ocean (Cordingly 1995:182). Frederick Philipse, a merchant of New York, loaded ships with clothing, liquor, naval stores, guns, and ammunition, then had his local agent, Adam Baldridge, sell them to the pirates in return for their ill-gotten gain (Ritchie 1986:113). Commerce, with varying levels of ethics, was driving the growth of the port.

By the second decade of the eighteenth century, the interior settlements surrounding New York had become sufficiently established to allow for the production of significant amounts of export goods. As a result of the increased trade, the port expanded accordingly, as did its need for larger, more economical vessels with which to ship goods. Port records indicate that, prior to 1720, few vessels entering port registered over 100 tons; while, within the next few years, larger vessels were common (Watts 1986:11-12). In 1770, New York stood fourth among the American ports in total tonnage arriving and clearing, after Philadelphia, Boston, and Charleston (Albion 1984:2-5). Data relative to the increase in number and nationalities of vessels entering New York throughout the eighteenth century are presented in Table 2.

Table 2. Eighteenth-Century Shipping Data for the Port of New York.

Destination/Origin	**Year**				
Outward bound (Clearances)	**1726**	**1739**	**1754**	**1768**	**1772**
Great Britain	12	9	31	56	39
Ireland	--	15	23	30	19
Europe	8	21	19	45	48
Africa	--	4	2	--	9
Bahama Islands	--	1	3	4	5
Bermuda	3	3	3	7	3
Caribbean	95	113	180	156	199
Thirteen Colonies	90	97	51	125	324
Other American Colonies	5	10	12	55	54
	213	**273**	**324**	**478**	**700**
Inward bound (Entries)					
Great Britain	31	27	28	79	61
Ireland	1	4	10	15	11
Europe	10	22	25	31	38

Africa	--	--	5	2	--
Bahama Islands	--	1	6	9	11
Bermuda	9	14	3	3	5
Caribbean	85	105	177	158	208
Thirteen Colonies	69	93	23	139	352
Other American Colonies	5	11	7	26	24
	210	**277**	**284**	**462**	**710**

(as presented in ICA 1979:B-13)

By the last decade of the eighteenth century, the port of New York had surpassed Boston in importance; by the first decade of the nineteenth century, the port was larger than Philadelphia. With inter colonial trade well-established and foreign imports and exports on the increase, the port of New York continued to grow. Population growth mirrored the increase in shipping activities; it was held in check and/or declined only through war and epidemics. Associated reductions in maritime commerce occurred during the British occupation of the port, including the Revolutionary War, the yellow fever epidemics of 1795 and 1798, the Embargo Act of 1807, and the British closure of the port during the War of 1812 (Ferguson 1986:17).

"Of North America's many coastal towns, New York was most favored by nature to become a major seaport, as the nineteenth century would make abundantly clear" (Labaree et al. 1998:74). Two-thirds of all the nation's imports and one-third of its exports went through the port by 1860. Only London and Liverpool exceeded the port in the volume of shipping which entered and cleared, as well as the value of its imports and exports (Albion 1984:336; Ferguson 1986:17).

During the nineteenth century, sailing vessels of all types carrying cargoes and people entered and exited the port of New York. These vessels included sloops, coastal schooners, and merchantmen and packet ships, which increased in size as time and technology progressed. The late 1840s and 1850s saw the famous clipper ships entering the port, to be followed in the 1890s by the last of the American square-rigged, deep-water sailing ships, the "down easter," which, in turn, were followed by large, multi-masted schooners, the largest sailing vessels ever constructed. In addition to these major vessel categories, other vessel types present in the area included schooner barges, pilot boats, lighters, fishing boats, and other types of small craft (Morris and Quinn 1989:87-88).

The invention of the steam engine in the late eighteenth century and its application on vessels at the turn of the century played a profound role in the history of the port, and cut into the trades previously controlled by sailing vessels. After Fulton's steamer *Clermont* completed its successful voyage from New York to Albany in 1807, steam power was to become the dominant method of vessel propulsion, and would form the catalyst for the evolution of not only vessel shape and type, but trade and economics as well (Brouwer 1987).

The advent of the steam engine heralded the creation of the famous river and coastal sidewheel steamers, several of which are listed as having wrecked near the approaches to New York. Huge transatlantic liners followed in the wake of the sidewheel steamers, making New York the center for passenger travel to and from foreign ports. Steam also allowed the ever-important "tug boat" to evolve; after 1860 and by the 1870s, the tug boat industry expanded rapidly, with steam being employed on the tugs until just after World War I (Morris and Quinn 1989:87-88).

SPECIFIC PROJECT AREA HISTORY

Apart from the area being directly adjacent one of the busiest maritime trafficked harbor and channel in the United States, the Project Area is also located adjacent to two artificial islands built in the mid 1800s as quarantine stations, stations that saw constant maritime activity. In

1801, Tompkinsville, Staten Island was appointed as the location for New York's quarantine station against contagious diseases brought in by passengers on ships arriving from infected ports. Existing for over sixty years, resentment of the "pest house" by the growing local population and its eventual destruction by arsonists forced New York's Governor to seek a new location. The solution was the creation of two artificial islands in the Lower Bay (Figure 4). Begun around 1866 and completed in 1872, Swinburne Island was originally named Dix Island after New York Senator Dix, but was later renamed in honor of the noted Civil War military surgeon Dr. John Swinburne. Hoffman Island, was named for the former City Mayor and current State Governor, John Hoffman. Three miles below Swinburne Island was the hospital or boarding ship, *Illinois* (Figure 5). Vessels arriving from South America, the West Indies, and Africa had anchored near the ship for inspection. If the medical officers found any evidence of disease, a steamer took them to Swinburne Island. People not sick but exposed to any communicable disease were taken to Hoffman Island. Swinburne Island, the smaller of the two, consisted of several one-story buildings (Figure 6). Originally, an immigration detention center, Hoffman's facilities were later converted to a hospital (Figure 7).

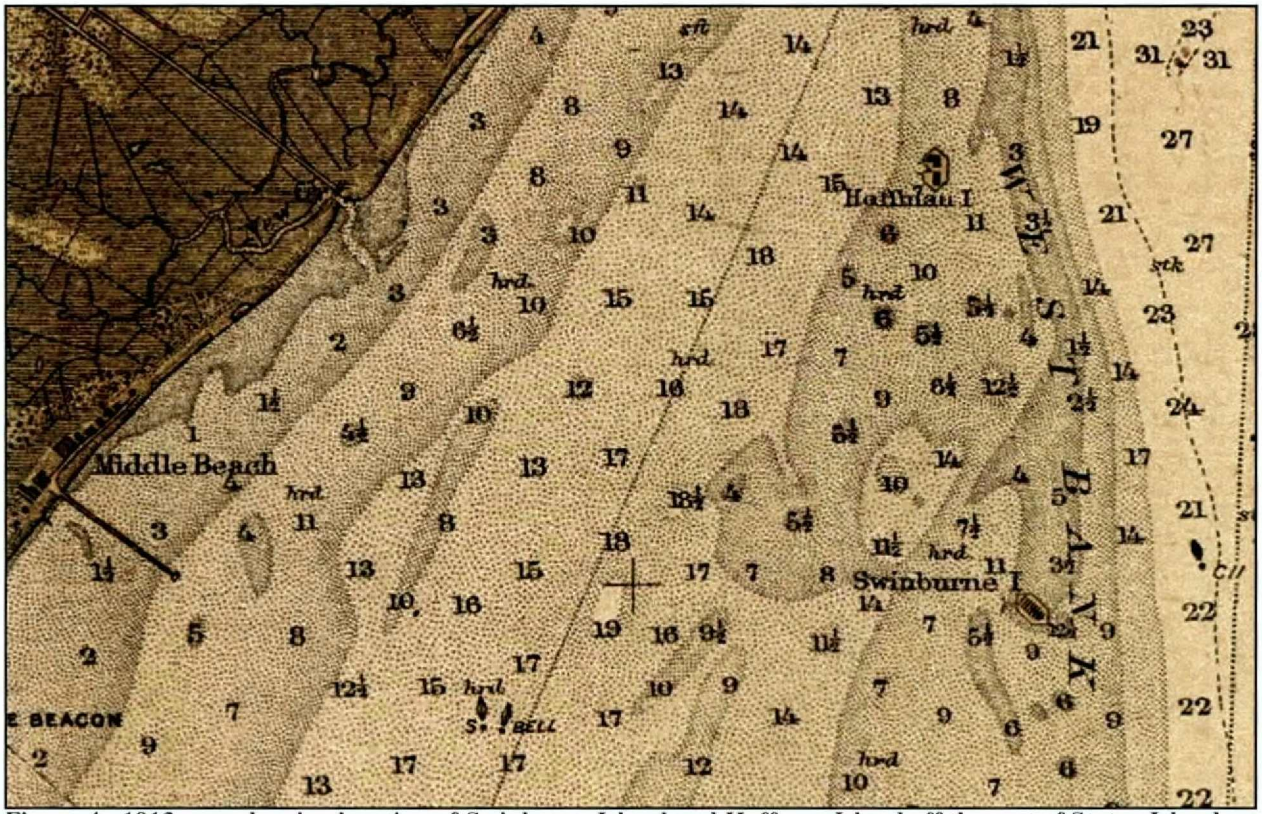

Figure 4. 1913 map showing location of Swinburne Island and Hoffman Island off the cost of Staten Island.

With immigration waning, the islands were sold in 1920, and, during World War II, the U.S. Navy and Coast Guard took over Swinburne Island while merchant seaman were trained by the marines at Hoffman Island. Abandoned in 1947, the islands are currently owned by the National Park Service and managed as part of the Gateway National Recreation Area.

PREVIOUS INVESTIGATIONS

Prior to field investigations, a number of previous investigations were reviewed in an effort to gain a better understanding of the potential for submerged cultural resources within or near the project area. A preliminary study by the Harvard University Institute for Conservation

Archaeology, titled *Summary and Analysis of Cultural Resource Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras* (1979), implies that the potential for shipwreck remains exists within the vicinity of the Project Area (see Shipwreck Inventory below).

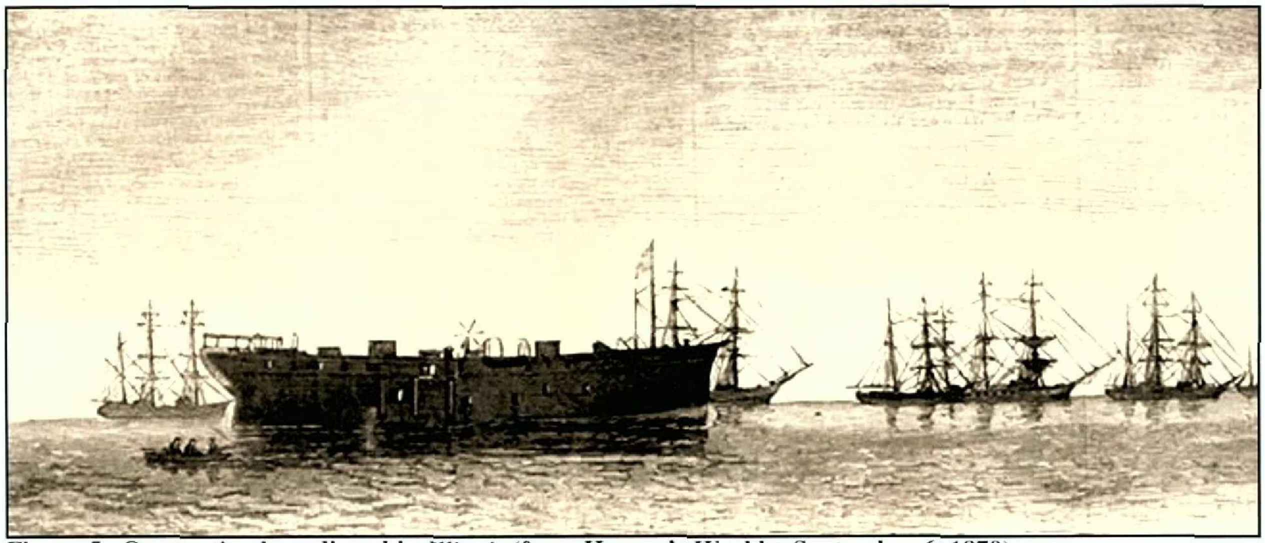

Figure 5. Quarantine boarding ship *Illinois* (from Harper's Weekly, September 6, 1879).

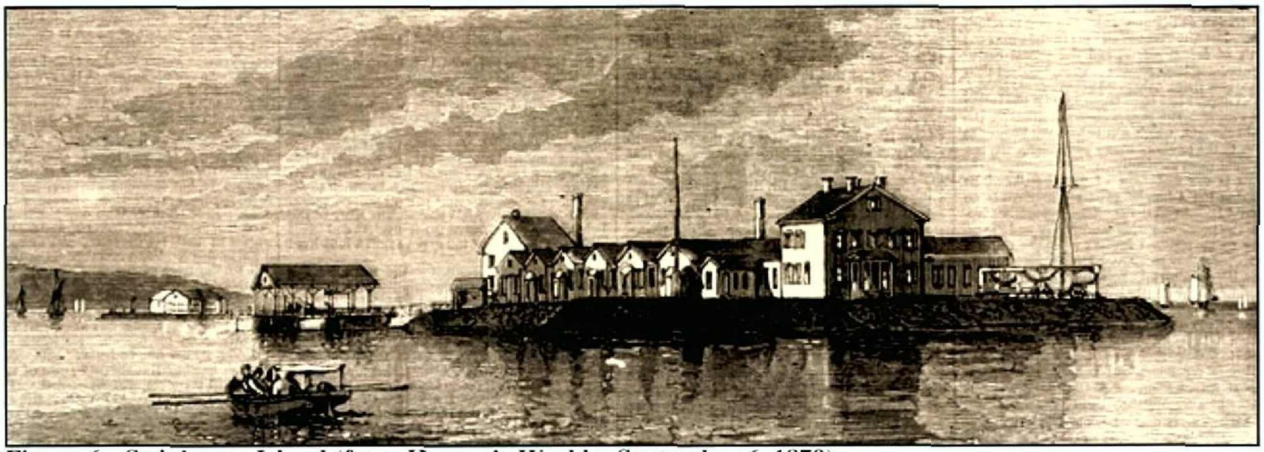

Figure 6. Swinburne Island (from Harper's Weekly, September 6, 1879).

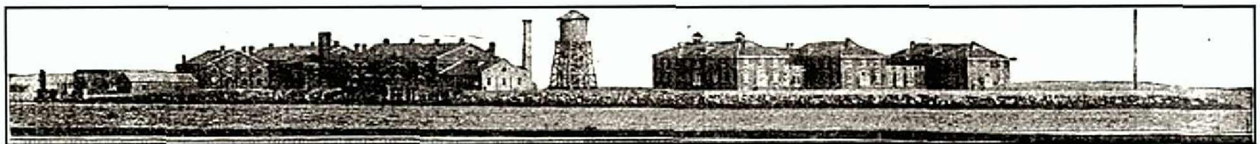

Figure 7. Hoffman Island in 1910 (As presented at http://en.wikipedia.org/wiki/Hoffman_Island).

During 1986, the Corps instituted a Dredged Material Disposal Management Plan that outlined the potential areas for the disposal of material dredged from the Port of New York and New Jersey (Ferguson 1986:1). While the Corps had seven existing borrow pits, an additional four new borrow pits (Figure 8) were under consideration. Of the existing pits, the Hoffman-Swinburne Pits are near the current project area. The report, titled *A Preliminary Assessment Of Cultural Resources Sensitivity For The Lower New York Bay New York And New Jersey* (Ferguson 1986), basically used Engebretsen's shipwreck inventory on the Greater New York

Harbor (1982) to determine the potential for cultural resources within the proposed borrow pit areas. Ferguson's recommendations regarding new pit areas concluded, "it is recommended that it be subjected to remote sensing to determine the presence of shipwrecks (or other obstructions)" (1986:28).

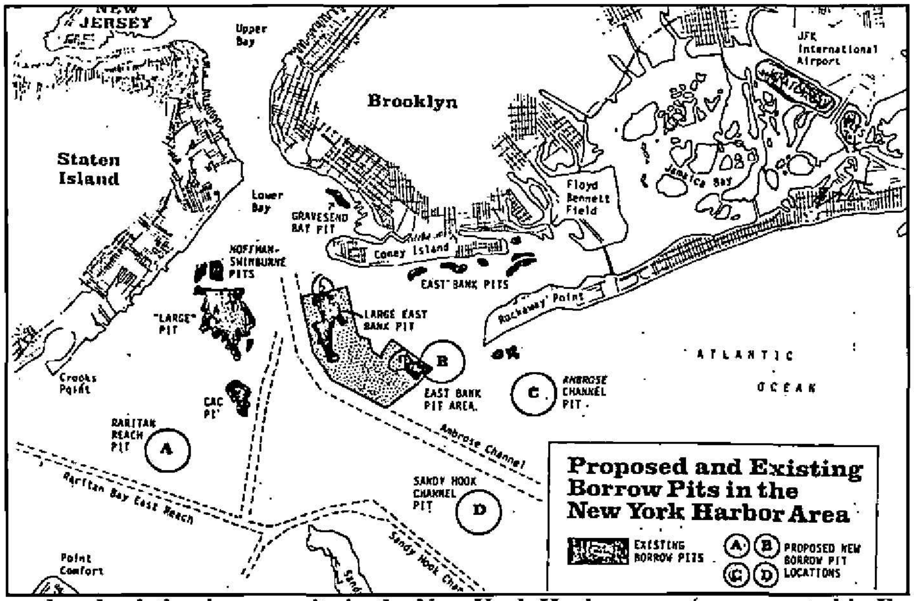

Figure 8. Proposed and existing borrow pits in the New York Harbor area (as presented in Ferguson 1986:3).

A number of other cultural resource investigations have taken place near the current project area. While not all of these studies are directly applicable to the current project area, the results typify the propensity for both anomalies and shipwreck remains in the area. In Lower New York Bay, there are comparable studies that may be considered pertinent to the present project area research. As the opposite arm of the funnel, directing shipping into the confined waters of the Lower Bay, similar atmospheric and oceanic environments and processes have contributed to the loss of numerous vessels. The following is a summary of various historical and archaeological investigations for vessels lost on the northern approaches to New York.

A remote-sensing examination was undertaken in two sections of the bay by Nowak and Riess (1989). The East Bank area encompassed approximately 1.6 square miles, while the Lower Bay area was approximately 0.9 square miles. Eighty-six magnetic anomalies and 24 side scan sonar targets were identified in the East Bank area, while the Lower Bay area contained 61 magnetic and 33 side scan targets. It was suspected that, of the remote-sensing targets in the East Bank area, 12 had the possibility of being shipwrecks, while, in the Lower Bay area, 15 sites were thought to have the possibility to represent shipwrecks.

A remote-sensing survey investigation of two borrow areas in the approaches to the New York Harbor area was conducted by Miller and Watts (1990). One of the borrow areas lies to the east of Ambrose Channel, and the other lies to the west. A total of 52 magnetic and acoustic targets were identified during the survey: eight acoustic only, eight magnetic and acoustic, and 36 magnetic only. Of this number, 28 were considered to have signatures that could be interpreted as characteristic of submerged cultural resources. It was also noted during the historical analysis that there have been historically documented shipwreck sites near the project area.

In 1993, the Corps contracted with WCH Industries., of Waltham, Massachusetts, (in association with Boston Affiliates, Inc., of Boston, Massachusetts) to conduct a remote sensing survey of Borrow Areas 1A and 1B (Figure 9) located approximately:

> 3 nautical miles to the southwest of Rockaway Point, adjacent to the borrow areas used in the original 1977 project...The east borrow area 1B measures 2,000 feet long by 1,800 feet wide. The west borrow area (1A) is smaller measuring 2,000 feet long by 1,600 feet wide (Riess 1993:2).

The Corps project plans called for the removal of sand from these two borrow areas to be placed along the same section of Rockaway Beach as the current project area (from Beach 19th Street to Beach 149th Street). Previous research (Ferguson 1986; Nowak and Riess 1989; Gardner and Riess 1990; Pickman 1990) concluded that the "probable previous destruction of any prehistoric aboriginal sites and the possibility of historic shipwreck remains in Borrow Areas 1A and B..." (Riess 1993:4). Both areas were also determined to have a high probability for historic shipwreck sites due to the intense shipping through the general area.

After compiling the remote-sensing survey data, all magnetic anomalies over five gammas were considered as potentially significant cultural remains (Riess 1993:7). Results of the survey produced one probable significant cultural resource (magnetic anomaly with associated side-scan image) and six possible cultural resources (magnetic anomaly with no side-scan return) in Area 1A (West), and four probable significant cultural resources within Area 1B (Riess 1993:7). Recommendations for the ten targets were either avoidance by the Corps or inspection of targets if "the Corps plans are such that the target safety zones are a major impediment to the borrow project" (Riess 1993:13).

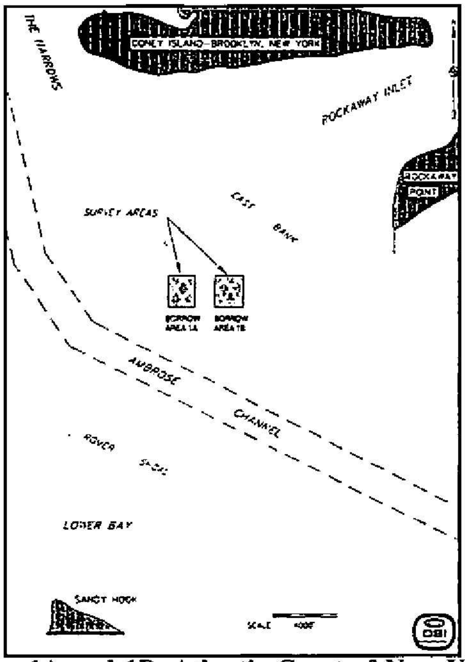

Figure 9. Proposed Borrow Areas 1A and 1B, Atlantic Coast of New York City, East Rockaway Inlet to Rockaway Inlet and Jamaica Bay, New York, Section 934 Study. Per OSI (as presented in Riess 1993:3).

Several cultural resources studies, including remote-sensing surveys and diver investigations, have been conducted in New York Bay, both upper and lower. These should be mentioned not only because they are in proximity to the project area, and reflect the same or similar environmental conditions, but also because their findings might reflect what could be located within the project area. Also, the historical shipwreck information contained in these reports may be applicable to our study.

A remote sensing study conducted in 2001 by Panamerican Consultants, Inc., and associated with the Harbor Navigation Study, discovered 28 magnetic anomalies and 11 acoustic targets that could potentially represent significant submerged cultural resources (Lydecker and James 2001). The study was undertaken in Newark Bay, Arthur Kill, Kill Van Kull, and the Lower Bay, a portion of this latter survey area close to the current project area. Phase II assessment of identified potentially significant targets (Lydecker and James 2004) resulted in five vessels in Kill Van Kull being recommended for mitigation.

To the east of the Lower Bay, numerous studies have been conducted relative to submerged cultural resources. Coney Island, the northeastward projection of land into New York Bay, was examined in 1999 (Tuttle 1999). At the northern and western side of the island, the southward facing beaches are experiencing lateral accretion. The sand mobilizing into these areas will be removed by the Corps of Engineers. Prior to any activity, the Corps initiated a near shore survey. Although no shipwreck sites were located, five magnetic anomalies were identified and correlated with dock structures or derelict piers.

SHIPWRECK INVENTORY OF THE PROJECT AREA

A review of shipwreck losses and a compilation of shipwrecks which might be located within the project area is presented to help determine the potential for shipwrecks within the area, as well as the types of vessels these wrecks may represent. Analysis of primary data, such as Life Saving Service Reports and National Oceanic and Atmospheric Administration (NOAA) AWOIS lists, as well as the studies of ship losses that have been conducted for the New York Harbor area, demonstrate that numerous vessels have been lost since the early seventeenth century. However, the analysis does not indicate which vessels, if any, lie within or near the proposed Project Area.

A review of the *Merchant Steam Vessels of the United States 1790-1868*, also known as The Lytle-Holdcamper List, originally compiled in 1952 and reprinted in 1975, indicates the potential for steam powered vessels lost in the port of New York. While not concerned with the project area directly, the volume is concerned with all steam vessels for the period noted. The *List* is a comprehensive register of most steam vessels in the United States, and indicates the name, rig, tonnage, year and place built, first home port, and its final disposition. Also included is a list of losses. It was this portion of the work that was examined, with respect to losses recorded as lost off New York, New York or Staten Island. Approximately 3,800 steam powered vessels are noted as being lost. Of this number, 42 are reported as lost off New York, New York, and only two are reported as lost off Staten Island, specifically where is not noted (Table 3).

Table 3. Steam Powered Vessels Reported as Lost off New York and Jersey City.

Vessel	Year Lost	Location
A.C. Nickerson	1894	Lost off New York, New York
Adelaide	1880	Lost off New York, New York
Andrew Fletcher	1872	Staten Island, New York
Buffalo	1854	Lost off New York, New York
Charter Oak	1850	Lost off New York, New York
City of Albany	1892	Lost off New York, New York
Dutchess	1902	Lost off New York, New York
Elizabeth	1901	Lost off New York, New York
Enterprise	1867	Lost off New York, New York
General A.E. Burnside	1895	Lost off New York, New York
George T. Olyphant	1880	Lost off New York, New York
Harry Bumm	1872	Lost off New York, New York
Henry Eckford	1841	Lost off New York, New York
Hunter	1857	Lost off New York, New York
James B. Schuyler	1897	Lost off New York, New York

James H. Elmore	1860	Lost off New York, New York
James Rumsey	1853	Lost off New York, New York
James Rumsey	1891	Lost off New York, New York
John A. Hadgman	1890	Lost off New York, New York
Knoxville	1856	Lost off New York, New York
Marigold	1875	Lost off New York, New York
Mary	1875	Lost off New York, New York
May Queen	1854	Staten Island, New York
N.B. Starbuck	1928	Lost off New York, New York
New Era	1860	Lost off New York, New York
Northfield	1901	Lost off New York, New York
Oceanus	1868	Lost off New York, New York
Oliver A. Arnold	1894	Lost off New York, New York
Oregon	1863	Lost off New York, New York
P.W. Sprague	1880	Lost off New York, New York
Palmella	1870	Lost off New York, New York
R.F. Loper	1893	Lost off New York, New York
S.S. Wyckoff	1913	Lost off New York, New York
Saint John	1885	Lost off New York, New York
Sea Bird	1932	Lost off New York, New York
Seneca	1870	Lost off New York, New York
Shepherd Knapp	1856	Lost off New York, New York
Spitfire	1849	Lost off New York, New York
T.A. Knickerbocker	1866	Lost off New York, New York
Tempest	1866	Lost off New York, New York
Thomas E. Hulse	1875	Lost off New York, New York
Trojan	1851	Lost off New York, New York
Union	1875	Lost off New York, New York
Warren	1850	Lost off New York, New York

(compiled from Lytle and Holdcamper 1975)

Although this listing is rather vague as to where a vessel went down relative to the locational information, and it represents only American steam vessels through the Civil War (foreign and sailing vessels are not considered), it gives a sample of the potential for historic wreck sites in the area. The vessels on the *List* do have the advantage of being powered by iron steam engines, which create a magnetic anomaly easily observed in the remote-sensing data.

One of the earliest studies of shipwrecks in the New York Harbor area was conducted in the early 1980s and was entitled *New York Harbor and Adjacent Channels Study Shipwreck Inventory* (Engebretsen 1982). Exclusively a shipwreck inventory, the report does not concern itself with other submerged cultural resources. It was designed to provide locational information to the U.S. Army Corps of Engineers, New York District, "to track down information on any shipwrecks that might be expected to be encountered in the channels, either during channel deepening or during channel use" (Engebretsen 1982:1). The report deals briefly with historical contexts and focuses on the reported loss of vessels. It is also noted that there are limitations in the data and that "...there is good reason to believe that the data contained in this shipwreck inventory underestimates the number of shipwrecks in the seventeenth and eighteenth century" (Engebretsen 1982:6). With these limitations noted, there are still 23 wrecks located in New York, New York, 13 wrecks in the Upper Bay, 13 in the Lower Bay, 36 unspecified wrecks in the New York area, and 23 listed for the Ambrose Channel.

From the maritime history and shipwreck information above, it is clear that the potential for shipwrecks within the approaches to New York Harbor remain extremely high. Vessel types spanning every era in American history have traversed the waters off New York, making it a haven for a variety of shipwreck sites, many still undocumented and unidentified.

3. INVESTIGATIVE PROCEDURES

PERSONNEL

The personnel involved with this remote-sensing survey and subsequent diver investigation had the requisite experience to effectively and safely complete the project as proposed. Stephen R. James, Jr. served as the Principal Investigator, Dr. Michael K. Faught served as Remote Sensing Specialist, and Jim Duff acted as remote-sensing technician.

REMOTE SENSING EQUIPMENT

The remote-sensing survey was conducted with equipment and procedures intended to facilitate the effective and efficient search for magnetic and/or side scan sonar anomalies, and to determine their exact location. The positioning system used was a Trimble Navigation DSM212H, Integrated 12-channel Differential Global Positioning System (DGPS). Remote-sensing instruments included a Marine Magnetics SeaSPY Overhauser Magnetometer, a Marine Sonic Technology side scan sonar (600 kHz towfish), and an Eagle Magna III fathometer.

Differential Global Positioning System

A primary consideration in the search for magnetic anomalies is positioning. Accurate positioning is essential during the running of survey tracklines, and for returning to recorded locations for supplemental remote-sensing operations or ground-truthing activities. These positioning functions were accomplished on this project through the use of a Trimble Navigation DSM212H global-based positioning system (Figure 10).

Figure 10. Trimble Navigation DSM212H global-based positioning system used during the current investigation.

The 212H is a global positioning system 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. New York (NY-3104 New York-Long Island) State Plane coordinates, based on the 1983 North American Datum (NAD 83) 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 with an auxiliary display screen aboard the survey vessel. 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.

All positioning coordinates are based upon the position of the antenna of the DGPS. Each of the remote-sensing devices was oriented to the antenna, and their orientation, relative to the antenna, (known as a lay back) was noted. This information is critical in the accurate positioning of targets during the data analysis phase of the project, and repositioning for any subsequent archaeological activities. The lay back of the magnetometer sensor was 65-ft. aft, and the layback for the side scan sonar was 10-ft. aft.

Magnetometer

The remote-sensing instrument used to search for ferrous objects on or below the Sound floor of the survey area was a Marine Magnetics Sea Spy Overhauser Magnetometer (Figure 11). 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 Sea Spy 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.

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 characteristic of isolated pieces of debris. While it is impossible to identify specifically 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.

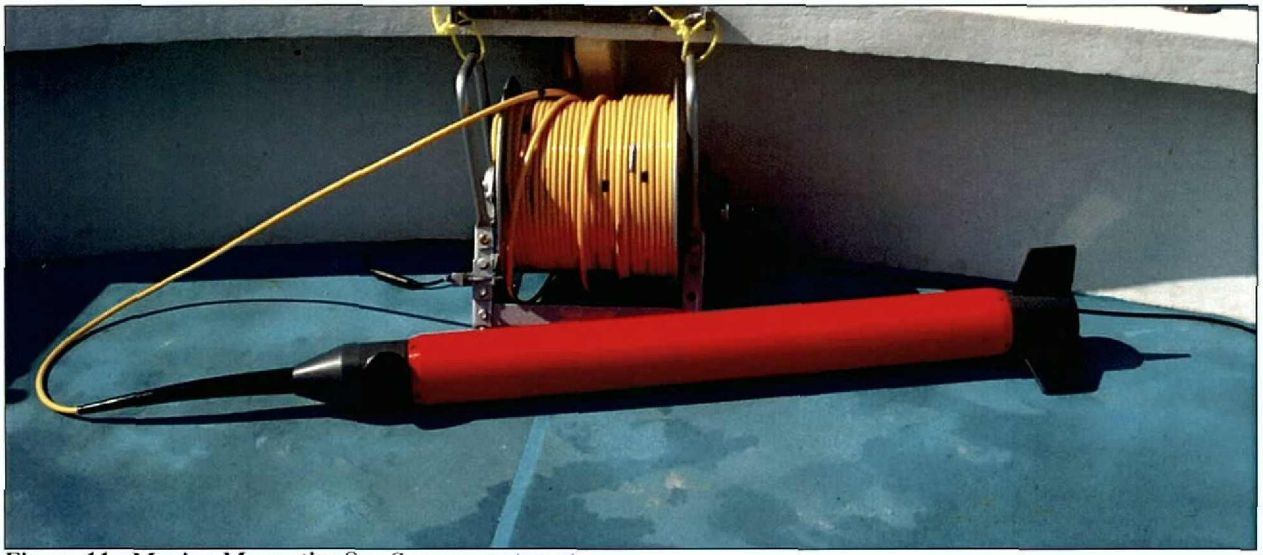

Figure 11. Marine Magnetics Sea Spy magnetometer.

For this project, the magnetometer was interfaced with a Sony Vaio laptop computer, utilizing Hypack® software applications for data storage and management. It was also interfaced with the positioning system, allowing positioning fix points to be integrated with each magnetometer data point.

Side Scan Sonar

The remote-sensing instrument used to search for physical features on or above the bottom of Pamlico Sound was a Marine Sonic Technology (MST) Sea Scan side scan sonar system (Figure 12). The side scan sonar is an instrument which, 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 side scan 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 side scan sonar unit utilized on this project was operated with an integrated single frequency 600 kHz towfish.

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 side scan sonar was utilized with the navigation system to provide manual marking of positioning fix points on the digital printout. Side scan 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.

Fathometer

The instrument used to obtain the bathymetric data off Rockaway Beach was an acoustic fathometer. For this project, an Eagle Magna III fathometer with a transom mounted transducer was used. By the continual transmittal and reception of timed sound pulses, an accurate measurement of harbor depths was obtained. Data was viewed instantaneously on an LED display screen.

Figure 12. Marine Sonic Technology (MST) Sea Scan side scan sonar system.

Survey Vessel

The vessel used during the remote-sensing survey was a 25-foot Parker. The vessel is powered by a 225-hp Yamaha Offshore-Series II engine. The Parker has an enclosed cabin and ample deck area for the placement and operation of the necessary remote-sensing equipment. The Parker conforms to all U.S. Coast Guard specifications according to class, and had a full compliment of safety equipment. The vessel carried appropriate emergency supplies, including lifejackets, spare parts kit, tool kit, first-aid supplies, flare gun, air horns, and paddles (Figure 13).

SURVEY PROCEDURES

Coordinates for the proposed groins, as indicated by the New York District, were entered into the navigation program Hypack® and pre-plotted tracklines were produced with a 50-foot (15 meter) transect interval (Figure 14). Additionally, a buffer zone of 150 feet to each side of the survey area was also surveyed. The magnetometer, side scan sonar, and DGPS were mobilized and tested, and the running of pre-plotted tracklines began. The helmsman viewed a video monitor, linked to the DGPS and navigational computer, to aid in directing the course of the vessel relative to the individual survey tracklines. The monitor displayed the real-time position of the path of the survey vessel along the trackline (Figure 15). The speed of the survey vessel was maintained at approximately four knots for the uniform acquisition of data.

As the survey vessel maneuvered down each trackline, 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 side scan sonar returns during the survey. Vessel speed was between six and eight 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 was also stored digitally.

Figure 13. Panamerican's 25-foot Parker was the primary survey vessel employed during the current investigation.

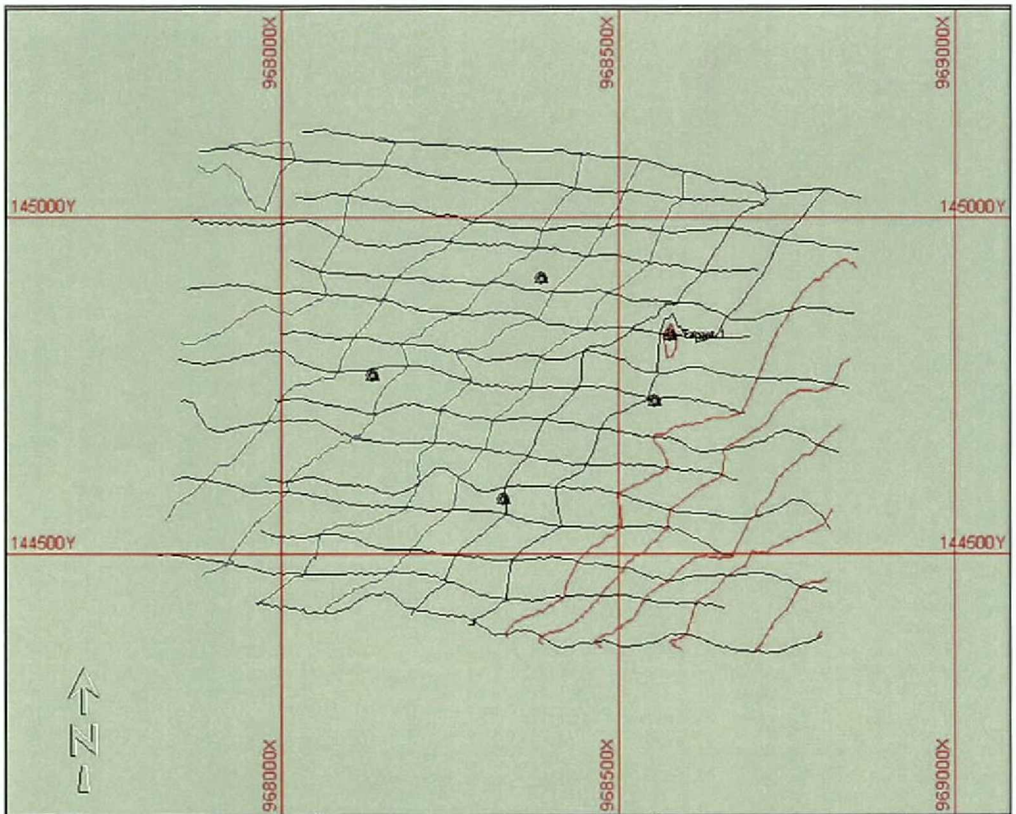

Figure 14. Post-plotted trackline data for the survey area in Hypack® software. Trackline interval is 50 feet.

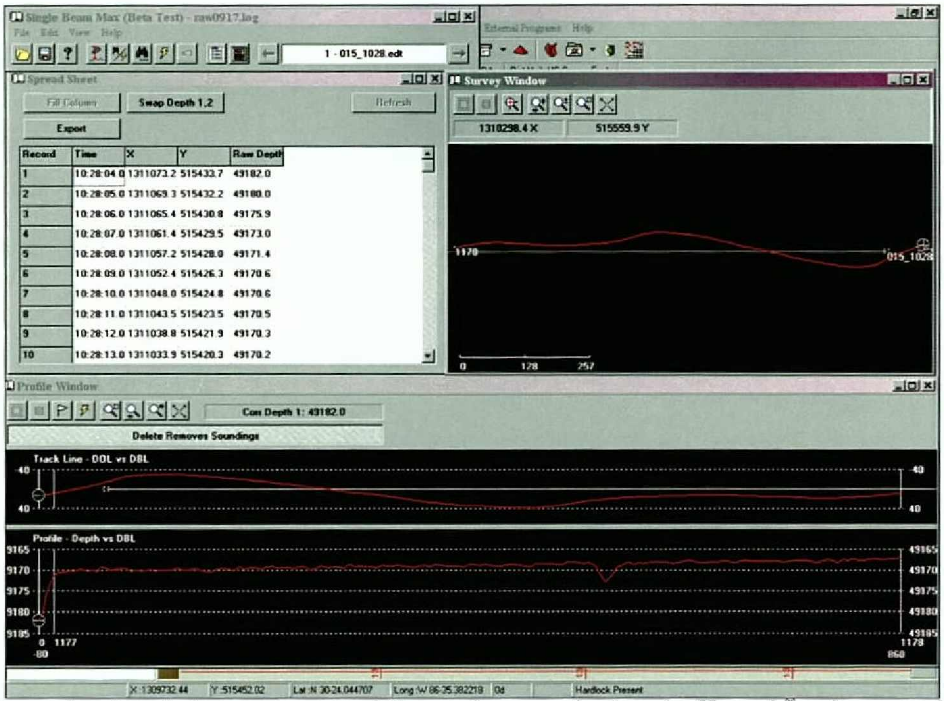

Figure 15. Example of real-time survey trackline and magnetic data in Hypack® software collected during the survey. Top left window shows magnetic values and positioning; top right window as well as window immediately below, shows overhead view for the trackline; bottom window shows magnetic deviation of the trackline.

Each of the tracklines were run until completed. Any navigation errors, problems with the remote-sensing instruments, or 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 remote-sensing instruments were resolved before repeating the run of an aborted line.

Upon completion of the remote sensing 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 side scan sonar data was reviewed for any evidence of submerged cultural resources and correlated with magnetic targets.

DATA ANALYSIS PROCEDURES

Upon completion of the remote sensing survey, the data was reviewed. This task essentially entailed the archaeologist and remote sensing specialist analyzing the previously acquired and processed data. Side scan features and magnetic anomalies were tabulated and prioritized as to possible significance by employing signal characteristics, e.g., spatial extent, structural features, etc. Magnetic data was presented in a magnetic contour map(s) with track line format. Specific side scan targets are also located on the map and are illustrated and discussed individually. The magnetic anomalies and/or side scan targets shown on the map(s) are sequentially numbered and tabulated as to location (northing and easting), as well as magnetic deviation. The contoured/labeled targets are then compared with strip chart records and attendant side scan data. Each magnetic anomaly or side scan target, described with the proper terminology and locational and positional information, is included. If any of the remote sensing targets correlated with any documentary evidence, it was noted.

The evaluation of the potential cultural significance of targets was then conducted; it was dependent on a variety of factors. These include the detected characteristics of the individual targets (e.g., magnetic anomaly strength and duration, and side scan image configuration), association with other side scan or magnetic targets on the same or adjacent lines, relationships to observable target sources, such as channel buoys or pipeline crossings, and correlation to the historic record. Magnetic anomalies were evaluated and prioritized on the basis of amplitude or deflection intensity, in concert with duration or spatial extent. Targets such as isolated sections of pipe can normally be immediately discarded as nonsignificant. Targets that were likely to represent potential historical shipwrecks or other potentially historic submerged resources were identified, and recommendations were made for subsequent avoidance or assessment by archaeological divers.

Magnetometer Analysis

Interpretation of data collected by the magnetometer is perhaps the most problematic to analyze. 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 side scan targets. 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 that "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 et al. 1995; 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.

The state of technology of iron-hulled or steam vessels may also be considered a factor in their potential for being detected by modern remote-sensing techniques. The magnetometer detects ferrous objects that create deviations in the Earth's natural magnetic field. The greater the weight of iron in the remains of a shipwreck, the greater the likelihood the remains will be observed, at least theoretically. The mass of metal on iron-hulled or steam vessels is made up of the hull and/or boilers, pipes, valves, steam engines, hogging trusses and straps, deck gear, auxiliary engines, pumps, hoists, winches, and other pieces of equipment. As the state of steam technology advanced, boilers and engines got larger, and/or more were used for larger vessels. Larger locomotion systems contained more iron and, therefore, are more likely to have a detectable magnetic signature.

In a study of magnetic anomalies in the northern Gulf of Mexico, Garrison et al. (1989) indicate that a shipwreck signature will cover an area between 10,000 and 50,000 m^2. Applicable to the Gulf Coast and based on large vessel types, the study's findings are not totally relevant to wooden sailing vessels in the pre-steam era. However, criteria from the Garrison et al. (1989) study and others developed to identify the signatures of larger vessel types are applicable. Using the Garrison et al. (1989) study, as well as years of "practical experience," in an effort to assess potential significance of remote-sensing targets, Pearson et al. (1991) developed general characteristics of magnetometer signatures most likely to represent shipwrecks. The report states that "the amplitude of magnetic anomalies associated with shipwrecks vary [*sic*] considerably, but, in general, the signature of large watercraft, or portions of watercraft, range from moderate to high intensity (>50 gamma) when the sensor is at distances of 20 ft. or so" (1991:70). Using a table of magnetic data from various sources as a base, the report goes on to state that "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 ft. across the smallest dimension. . . " (Pearson et al. 1991:70).

While establishing baseline amounts of amplitude and duration reflective of the magnetic characteristics for a shipwreck site, the authors recognize "that a considerable amount of variability does occur" (1991:70). Generated in an effort to test the 50-gamma/80-foot criteria and determine amount of variability, Table 4 lists numerous shipwrecks as well as single- and multiple-source objects located by magnetic survey and verified by divers. All shipwrecks meet and surpass the 50-gamma/80-foot criteria, while all single-object readings, with the exception of the pipeline, fall below the criteria. However, the signature of the pipeline should show up as a linear feature on a magnetic contour map and not be confused with a single-source object. While the shipwrecks and single source objects adhere to the 50-gamma/80-foot criteria, the multiple source objects do not. If all targets listed on the table had to be prioritized as to potential significance based on the 50-gamma/80-foot criteria, the two multiple-object targets would have to be classified as potentially significant.

Table 4. Magnetic Data from Shipwrecks and Nonsignificant Sources.

Vessel (object)	Type & Size	Magnetic Deviation	Duration (feet)	Reference
Shipwrecks				
Tug	Wooden tug with machinery	-30257	176	Tuttle and Mitchell 1998
Mexico	288 ton wooden bark	1260	454	Tuttle and Mitchell 1998
J.D. Hinde	129-ft. wooden sternwheeler	573	110	Gearhart and Hoyt 1990
Utina	267-ft. wooden freighter of 238 tons	690	150	James and Pearson 1991; Pearson and Simmons 1995
King Phillip	182-ft clipper of 1,194 tons	300	200	Gearhart 1991
Reporter	141-ft. schooner of 350 tons	165	160	Gearhart 1991
Mary Somers	iron-hulled sidewheeler of 967 tons	5000	400	Pearson et al. 1993
Gen. C.B. Comstock	177-ft. wooden hopper dredge	200	200	James et al. 1991
Mary	234-ft. iron sidewheeler	1180	200	Hoyt 1990
Columbus	138-ftwooden-hulled 416 ton Chesapeake Sidewheeler	366	300+	Morrison et al. 1992
El Nuevo Constante	126-ft. wooden collier	65	250	Pearson et al. 1991
James Stockton	55-ft. wooden schooner	80	130	Pearson et al. 1991
Homer	148-ft. wooden sidewheeler	810	200	Pearson and Saltus 1993
Modern shrimp boat	segment 27 x 5 ft.	350	90	Pearson et al. 1991
Confederate obstructions	numerous wooden vessels with machinery removed and filled with construction rubble	110	long duration	Irion and Bond 1984
Single Objects				
pipeline	18-in. diameter	1570	200	Duff 1996
anchor	6-ft. shaft	30	270	Pearson et al. 1991
iron anvil	150 lbs.	598	26	Pearson et al. 1991
engine block	modern gasoline	357	60	Rogers et al. 1990
steel drum	55 gallon	191	35	Rogers et al. 1990
pipe	8 ft. long x 3 in. diameter	121	40	Rogers et al. 1990
railroad rail segment	4-ft. section	216	40	Rogers et al. 1990

Multiple Objects				
anchor/wire rope	8-ft. modern stockless/large coil	910	140	Rogers et al. 1990
cable and chain	5 ft.	30	50	Pearson et al. 1991
scattered ferrous metal	14 x ft	100	110	Pearson et al. 1991

(After Pearson et al. 1991)

Although data indicate the validity of employing the 50-gamma/80-foot criteria when assessing magnetic anomalies, other factors must be taken into account. Pearson and Hudson (1990) have argued that the past and recent use of a water body must be an important consideration in the interpretation of remote-sensing data; in many cases, it is the most important criterion. Unless the remote-sensing data, the historical record, or the specific environment (e.g., harbor entrance channel) provide compelling and overriding evidence to the contrary, it is believed that the history of use should be a primary consideration in interpretation. What constitutes "compelling evidence" is, to some extent, left to the discretion of the researcher; however, in settings where modern commercial traffic and historic use have been intensive, the presence of a large quantity of modern debris must be anticipated. In harbor, bay, or riverine situations with heavy traffic, this debris will be scattered along the channel right-of-way, although it may be concentrated at areas where traffic would slow or halt; it will appear on remote-sensing surveys as discrete, small objects.

Side Scan Analysis

By contrast, side scan analysis is less problematic. The chief factors considered in analyzing side scan data included linearity, height off bottom, size, associated magnetics, and environmental context. Since historic resources in the form of shipwrecks usually contain large amounts of ferrous compounds, side scan targets with associated magnetic anomalies are of top importance. Targets with no associated magnetics usually turn out to be items such as rocks, trees, and other non-historic debris of no interest to the archaeologist. Also, since historic shipwrecks tend to be larger in size, smaller targets tend to be of less importance during data evaluation. In addition, the area in which the target is located can have a strong bearing on whether or not the target is selected for further work. If a target is found in an area with other known wreck sites, or an area determined to be high probability for the location of historic resources, it may be given more consideration than it would have otherwise. However, every situation, and every target located, is different, and all side scan targets are evaluated on a case-by-case basis.

4. INVESTIGATIVE FINDINGS

The remote-sensing survey of this project successfully collected data for the entire project area. DGPS positioning data, side scan sonar data, and magnetometer data were collected and digitally recorded on computer disk. The footprint of the project area (approximately 2 to 3 acres in size) was surveyed for a distance of 150 feet on either side of its boundaries, employing survey transects spaced at 50 foot intervals. Water depths for the project ranged between 12 and 18 feet at high tide. All survey work was performed in accordance with specifications determined in advance in the Scope of Work

Upon completion of the survey, the data were analyzed for errors and prepared for the production of maps and data tables. As illustrated in Figure 16 and presented in Table 5, a total of one magnetic anomaly was recorded during the survey. Located 90 feet from the Project Area's northwest boundary, the positive monopole anomaly has a magnetic deviation of +45 gamma over a duration of 47 feet. A review of side scan records indicates the target has no associated acoustic image. Based on the magnetic signal characteristics, the anomaly appears to be generated by a small, single-point source, and is not characteristic of a shipwreck site (i.e., a complex magnetic signature). The absence of an acoustic image lends credence to this statement. Therefore, it is the opinion of the Principal Investigator that the proposed Swinburne Project Area, and its immediate surrounding area, contains no significant cultural resources.

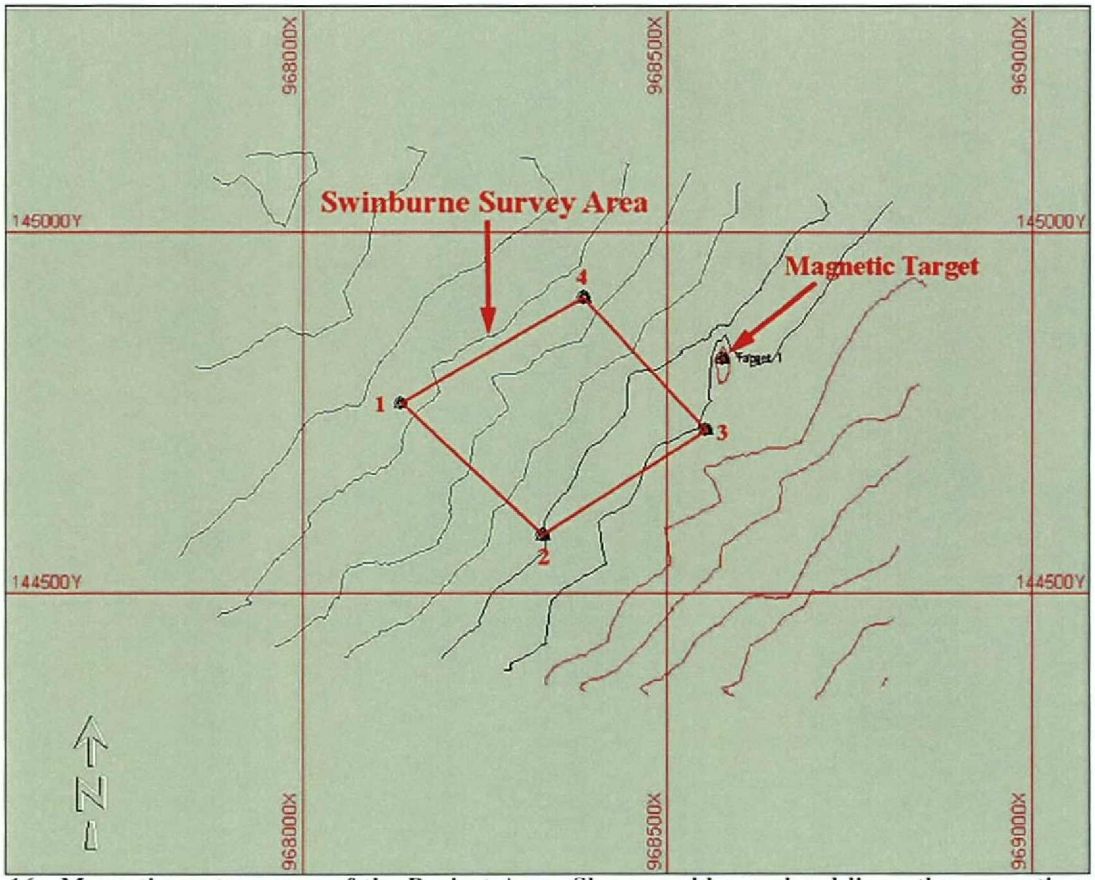

Figure 16. Magnetic contour map of the Project Area. Shown as blue and red lines, the magnetic contours indicate the area of survey coverage. The single magnetic anomaly is located 90 feet from the Project Area's northwest boundary. As indicated, the coordinate squares are 500 feet by 500 feet.

Table 5. Magnetic Anomalies in the Swinburne Beneficial Use Project Area.

Target No.	Easting	Northing	Gamma Strength	Duration (feet)	Type	Potentially Significant
1	968574.9	144824.5	+45	47	M	No

5. CONCLUSIONS

Panamerican Consultants, Inc. of Memphis, Tennessee, conducted an intensive remote-sensing survey of the U.S. Army Corps of Engineers, New York District's proposed Swinburne Beneficial Use Site (in connection with the New York and New Jersey Harbor Navigation Study), located within the Upper and Lower Bay, Port of New York and New Jersey, Richmond County, New York. Performed under subcontract to Northern Ecological Associates, Inc. (NEA) of Presumpscott, Maine, this investigation was conducted for the District in response to their Scope of Work (SOW) entitled *Remote Sensing Survey of the Swinburne Beneficial use Site In Connection with the New York and New Jersey Harbor Navigation Study, Upper and Lower Bay, Port of New York and New Jersey, Richmond County, New York*, under Contract No. DACW51-01-D-0018-3, Delivery Order No. 0061. The Project Area is located offshore of Staten Island, Richmond County, New York, in Lower New York Bay, historically one of America's busiest ports. Numerous historic vessels have wrecked within the Lower Bay during their approach to, or departure from, the harbor, and a limited number may be contained in the project area. Specifically, the proposed project area is situated southeast of South Beach on Staten Island's northeastern shore – about two miles from shore and just to the southwest of Swinburne Island. The survey area is diamond shaped, and is approximately 2 to 3 acres in size. Its east-to-west axis is roughly 420 feet in length, while its north-to-south axis is 330 feet in length.

The remote sensing survey recorded a total of only one magnetic anomaly in or near the project area. Located 90 feet from the Project Area's northwest boundary, the positive monopole anomaly has a magnetic deviation of +45 gamma over a duration of 47 feet. A review of side scan records indicates that the target has no associated acoustic image. Based on the magnetic signal characteristics, the anomaly appears to be generated by a small, single-point source, and is not characteristic of a shipwreck site (i.e., a complex magnetic signature). The absence of an acoustic image lends credence to this statement. Therefore, it is the opinion of the Principal Investigator that the proposed Swinburne Project Area and its immediate surrounding area contains no significant cultural resources.

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