FINAL REPORT

UNDERWATER INSPECTION OF TARGETS
BORROW AREA 2
ATLANTIC COAST OF LONG ISLAND
EAST ROCKAWAY INLET TO ROCKAWAY INLET
QUEENS COUNTY, NEW YORK
STORM DAMAGE REDUCTION PROJECT

Prepared for:
Environmental Analysis Section
U.S. Army Corps of Engineers, New York District
26 Federal Plaza • New York, New York 10278

Contract No. DACW51-97-D-0010
Delivery Order No. 0074

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September 2003

ABSTRACT

During the fall of 1999, archaeologists with Panamerican Consultants, Inc. (Panamerican) conducted a remote-sensing refinement survey and diver investigations of 34 targets within Borrow Area 2, off Rockaway Beach, Queens County, New York as part of the U.S. Army Corps of Engineers, New York District's (Corps) Storm Reduction Project. The Corps is currently evaluating new borrow sources for the renourishment project for Rockaway Beach from Beach 19th to Beach 149th Streets. The proposed borrow area, Borrow Area 2, is located approximately 7,000 feet south of Rockaway Beach and measures 6,000 feet by 3,000 feet. Implemented by the Corps in partial fulfillment of their obligation under the National Historic Preservation Act of 1966, the current project was designed to assess whether any of the 34 anomalies (identified in 1993) are potentially significant submerged cultural resources (i.e., shipwrecks) that may require additional investigations prior to renourishment activities. Performed under subcontract to Northern Ecological Associates, Inc. of Canton, New York, the investigation was conducted for the Corps in response to their Scope of Work, entitled *Underwater Inspection of Targets, Borrow Area 2, Atlantic Coast of Long Island, East Rockaway Inlet to Rockaway Inlet, Queens County, New York,* under Contract No. DACW51-97-D-0010, Delivery Order No. 74.

Results from the refinement survey successfully relocated and identified 18 of the 34 magnetic anomalies as specified by Riess (1994). The 18 targets are identified as modern debris (i.e., wire cable, concrete/rebar bridge spans) and are not considered potentially significant submerged cultural resources. The remaining 16 targets are no longer present and were likely redeposited to another location by trawling activities, surf clam dredging, physical processes (surge and/or current activity), or were simply erroneous anomalies due to a lack of contouring the original survey data. Therefore, any subsequent activities concerning the proposed dredging of Borrow Area 2 will not impact any historically significant watercraft.

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. Nancy Brighton, 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 Canton, New York under whose contract this was conducted, and to Ms. Beth Stuba who administered the contract for the firm.

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

It is rare to come across a boat captain and crew who worked harder than the Panamerican crew itself. This can be said for Captain Paul Hepler and Ruth Hepler of the *Venture III,* who brought their vessel up from Belmar, New Jersey expressly for this project. The Heplers' knowledge of area waters and boat handling experience was truly impressive, making our job that much easier.

The entire crew would also like to thank each of the Corp's Dive Safety Officers who accompanied the crew during the project. The Dive Safety Officers included Brian Aballo, Liz Finn, and Dan Florio.

In-house Panamerican personnel who must be thanked for their assistance with this report production include Kelly Blount, report editor, Kate Gilow, office manager, and Stephanie Gray and Andy Lydecker, computer graphic specialists.

Lastly, Panamerican would like to thank Mildred Goner and Alberta Libbey of M.A. Salazar, Inc. for finding us a place to stay, and the people of Long Island, New York for making us feel very welcome during our visit.

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INTRODUCTION

From October 7-31, 1999, archaeologists from Panamerican Consultants, Inc. (Panamerican) of Memphis, Tennessee conducted an intensive remote-sensing refinement survey and diver investigations of 34 magnetic anomalies and side-scan sonar targets located within Borrow Area 2, Queens County, New York. The purpose of the survey was to determine if any of the anomalies represented potentially significant submerged cultural resources eligible for listing on the National Register of Historic Places (NRHP) and which subsequently might require additional investigations. Performed under subcontract to Northern Ecological Associates, Inc., of Canton, New York, the project was conducted for the U.S. Army Corps of Engineers, New York District relative to their responsibilities under Section 106 of the National Historic Preservation Act.

As an agency of the Federal Government, the Corps has been entrusted with the protection and preservation of all cultural resources that may be adversely affected by their project activities. Therefore, they are responsible for determining if any properties within the current project area are eligible for listing on the National Register of Historic Places (NRHP) prior to the implementation of their project activities. 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 the Corps initiated a cultural resources survey of the project area in order to identify historically significant properties potentially eligible for NRHP listing.

The project area (Borrow Area 2) is located in Queens County, New York, approximately 7,000 feet south of Rockaway Beach and measures 6,000 feet by 3,000 feet (Figure 1). A magnetometer and side-scan sonar survey completed of the area in 1993 (Riess 1994b) identified 34 potentially significant targets within Borrow Area 2. These previously located anomalies were the focus of the current investigation.

The anomaly relocation and assessment investigation commenced with a remote-sensing refinement survey over each of the 34 targets located during the 1993 survey (Riess 1994b). The refinement survey included the implementation of those tools useful in determining the absence/presence of submerged cultural remains within the project area, and included a magnetometer, side-scan sonar, fathometer, and a Differential Global Positioning System (DGPS). A reference buoy was dropped at the coordinates of each of the targets identified by Riess (1994). The magnetometer was then deployed and a series of refinement tracklines were run over each target area. Magnetometer data for each of the 34 targets was collected for the production of magnetic contour maps presented within this report.

If a magnetic anomaly was located within the refinement area, a series of additional refinement buoys (if necessary) were placed on the actual position of the target for relocation purposes. A diver then suited up and prepared to locate and identify the source of each magnetic anomaly. If the target was not exposed on the ocean bottom, a hand-held underwater metal detector was used to localize the area of the target. A 10-foot hydro-probe and/or water jet were then used to delineate or expose any buried anomalies. Once relocated and identified, each target was videotaped (relative to adequate visibility) or sufficiently recorded for report and project purposes.

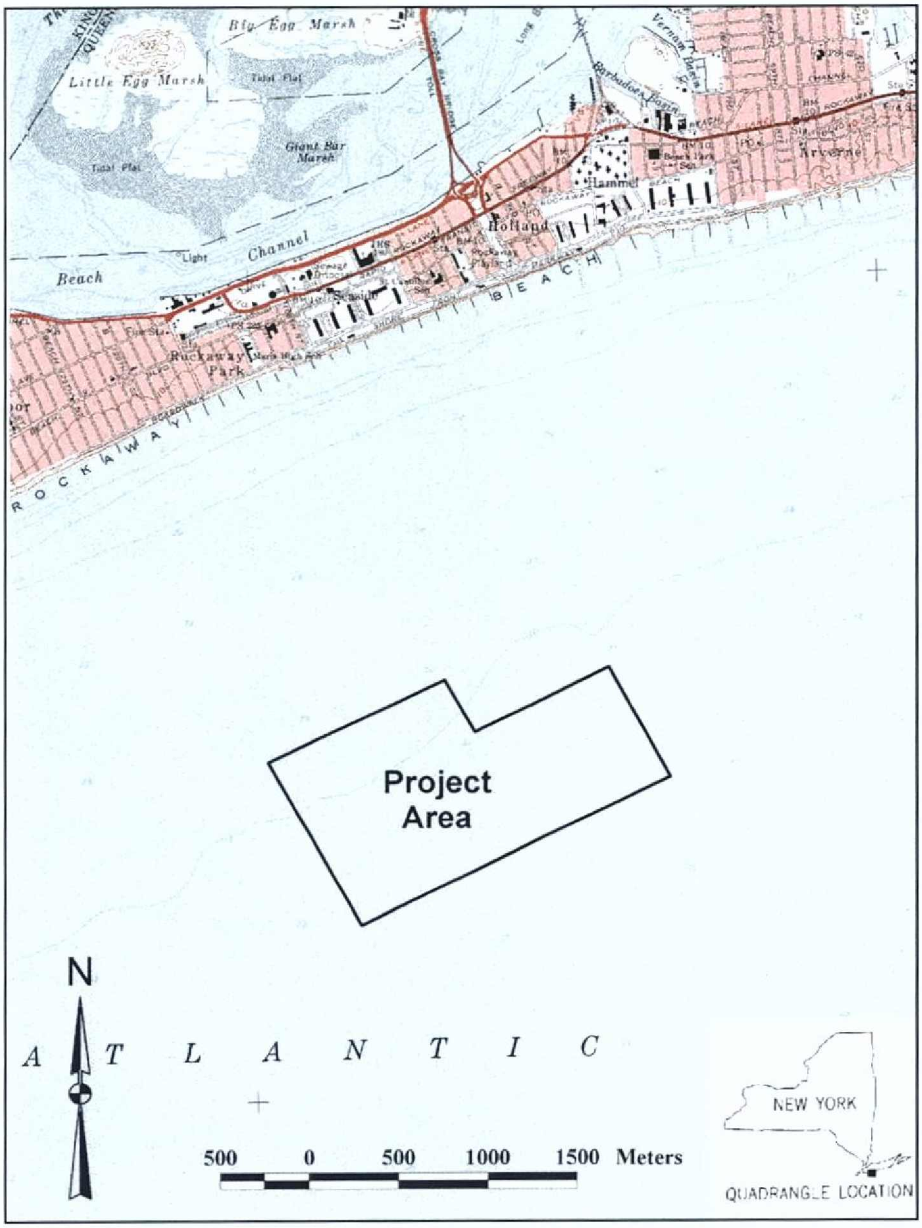

Figure 1. Project area location (base map: U.S.G.S. 1969 Far Rockaway, NY quadrangle).

Results from the refinement survey relocated only 18 of the 34 magnetic anomalies as specified by Riess (1994). The remaining 16 targets, no longer present within their respective refinement areas, were likely redeposited to another location by trawling activities, surf clam dredging, surge and/or current activity, or were simply erroneous anomalies due to a lack of contouring the original survey data. The lack of contouring results in a single anomaly being identified as multiple anomalies, all having incorrect coordinates. The remaining 18 targets still present were identified as modern debris (i.e., wire cable, concrete/rebar bridge spans) and are not considered potentially significant submerged cultural resources. Therefore, any subsequent activities concerning the proposed dredging of Borrow Area 2 will not impact any historically significant watercraft.

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 resources 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, as well as survey reports from adjacent areas along the south shore of Long Island. 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 which, 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 used 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, the investigation basing 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 then apply known parameters from above sea level sites to these landforms.

With this in mind, the potential for prehistoric resources within the project area is directly related to the geologic morphology of the area as a result of 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.) the sea level was more than 100 meters (325 feet) lower than at present. Depending on the source quoted, by 12,000 B.P. sea level had risen to between 60 m and 30 m below its 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. (albeit a conservative estimation), current speculation suggests that the entire project area would have been available for prehistoric occupation (Ferguson 1986:6).

Although 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 use, there is no actual evidence for prehistoric occupation or use during the Holocene for offshore areas (Institute for Conservation Archaeology 1979:Volume II, hereafter cited as ICA).

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 an 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 1.

Table 1. 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 steam 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).

More specific to Long Island, "Through the first half of the 19th century Long Beach Island remained uninhabited" (Pickman 1993:13). The same reasons prehistoric man did not settle the area may have kept Europeans and Americans away. It is noted, however, that the island was visited by hunters, fisherman, and wreck salvors. These individuals were short-term occupants with no lasting cultural impact. Habitation of the island took place after the development of the area as a summer resort in the latter half of the nineteenth century.

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).

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 2) were under consideration. Of the four potential pits, one (Ambrose

Channel Pit) located south of Rockaway Point, is west of 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 the Ambrose Pit Area concluded that "If this area is selected, it is recommended that it be subjected to remote sensing to determine the presence of shipwrecks (or other obstructions)" (1986:28).

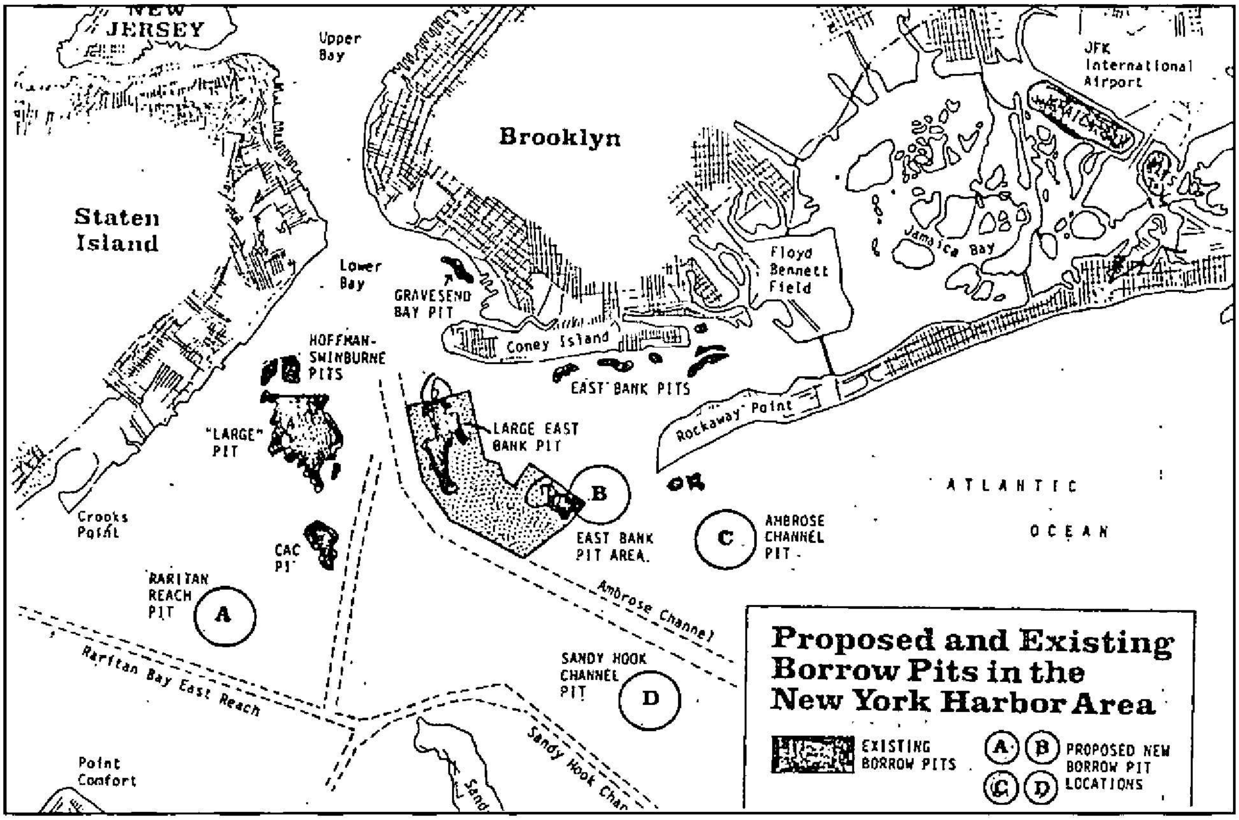

Figure 2. Proposed and existing borrow pits in the New York Harbor area (as presented in Ferguson 1986:3).

The remote-sensing survey of the Ambrose Pit Area was conducted by Ocean Services, Inc. (OSI) using a magnetometer, side-scan sonar, and bottom penetrating seismic reflection instruments. Field investigations, conducted between January 7 and March 5, 1988, located 86 magnetic targets along with 24 side-scan sonar targets. Correlating all the data together Nowak and Riess concluded that 12 of the sites had a high potential for shipwreck remains (1989:21).

Arnold Pickman (1990) conducted a cultural resources reconnaissance for a three-mile segment of beach zone along the Atlantic Coast of the Borough of Brooklyn in Kings County, New York. Consisting of both onshore and offshore study areas, Pickman used documentary data to determine the potential for prehistoric and historic sites within the project area. Relative to cultural resources within three proposed offshore borrow areas, Pickman documented two unidentified shipwrecks (on a marine chart) within Borrow Area C, located west of Rockaway Point (1990:55).

Another report compiled by Arnold Pickman, *Cultural Resources Reconnaissance, Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, City of Long Beach, Village of Atlantic Beach, Lido Beach and Point Lookout Areas, Town of Hempstead, Long Beach Island, Nassau*

County, New York (1993) is a comprehensive document on the growth, development, and maritime aspects of Long Island. The reconnaissance "was conducted in the areas to be affected by the proposed U.S. Army Corps of Engineers Beach Erosion Control Project along the Atlantic Coast of Long Island from East Rockaway Inlet to Jones Inlet, Nassau County, New York" (Pickman 1993:Abstract). More specifically the study included documentary data for both onshore and offshore portions of the project area. As a result of the study, Pickman's survey and documentary data provide a valuable source of the prehistory and history of Long Island. Regarding the potential for shipwrecks within the project area, Pickman concludes that "Although there are no reported wrecks on the ocean bottom within the study area, historical sources indicate that numerous wrecks occurred here" (Pickman 1993:52).

A number of other cultural resource investigations have taken place both the east and west of 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 off the south shore of Long Island.

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 3) 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 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).

Between November 8 and November 17, 1993 WCH Industries, Inc., in association with Boston Affiliates, conducted another remote-sensing survey of two additional borrow areas off Westhampton, New York. The report of this survey was titled *Atlantic Coast Of Long Island Fire Island To Montauk Point Westhampton Beach Interim Protection Plan Remote Sensing Survey Of Two Borrow Areas.* While located far to the east of the current project area, this area is located along the south shore of Long Island and is useful in determining the propensity for anomalous features within a similar environmental setting as that of the current project area. The east borrow area measured 3,600 feet in length with a width of 1,400 feet while the west borrow area measured 3,600 feet in length with a width of 2,100 feet (Riess 1994a:2). Remote-sensing techniques included the use of a positioning system, magnetometer, and side-scan sonar.

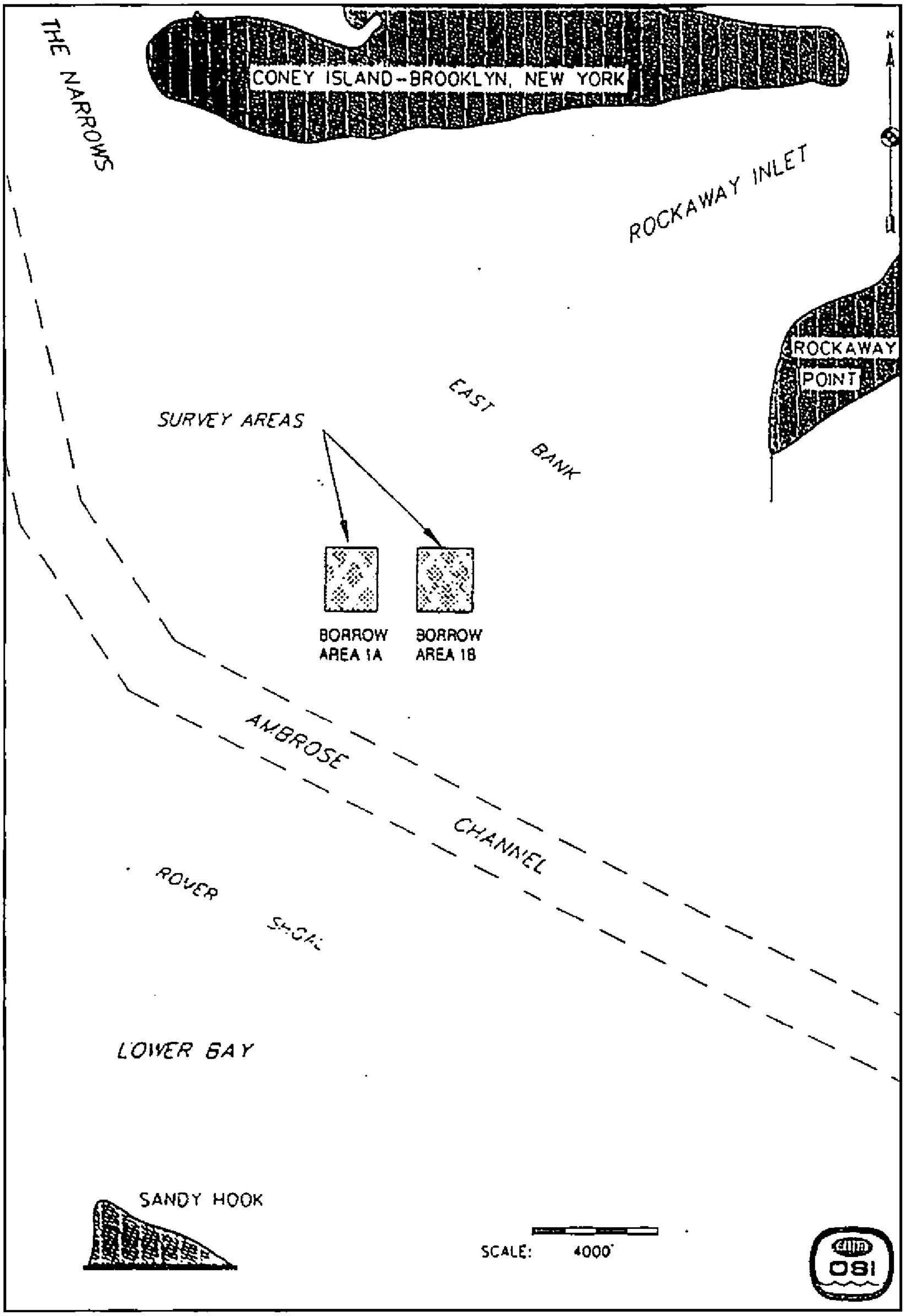

Figure 3. Proposed Borrow Areas 1A and 1B, Atlantic Coast of New York City, East Rockaway Inlet to Rockaway Inlet and Jamaica Bay, New York, Section 934 Study. Per OSI (as presented in Riess 1993:3).

Results of the survey indicated that no cultural resources were found in the East Borrow Area whereas six possible cultural resources were documented in the West Borrow Area (Riess 1994a:7). Recommendations for the six anomalies included avoidance or inspection of any anomalies if avoidance within a 100-ft. radius was not an option. Riess concluded by stating that "...upon inspection, most PCR's [Possible Cultural Resources] in such an area are found to be modern, insignificant debris such as steel cables, modern anchors, or steel drums" (1994a:9). This conclusive statement has been noted in all previous investigations by Riess in the areas surveyed off the south shore of Long Island.

The Corps again contracted with WCH Industries, of Waltham, Massachusetts (in association with Boston Affiliates, Inc., of Boston, Massachusetts) to conduct a remote sensing survey of Borrow Area 2 off of East Rockaway, New York. Titled *East Rockaway Inlet to Rockaway Inlet and Jamaica Bay, New York -- Section 934 Study Remote Sensing Survey of Borrow Area 2 1993*, the survey identified thirty-four remote sensing targets "which are possible cultural resources" (Riess 1994b:i). Recommendations regarding the 34 targets included avoidance of each target with at least a 100-ft. radius safety zone around each target. Target 17 required a larger safety zone (100 x 650 ft.) due to its elongated dimensions (Riess 1994b:10).

Riess acknowledged that, if future dredging activities within Borrow Area 2 were to be undertaken, all of the 34 targets should be subject to inspection and identification by underwater archaeologists prior to dredging (Riess 1994b:10). In an effort to evaluate new borrow sources as part of the renourishment project for Rockaway Beach from Beach 19th to Beach 149th Streets, Nassau County, New York, the Corps later tasked Panamerican (under subcontract to NEA) to conduct the current relocation and diver investigations of all 34 targets located during the survey by Riess (1994b).

Archaeologists with Panamerican Consultants, Inc., of Memphis, Tennessee conducted an archival and intensive remote-sensing survey of a borrow area (east of the current project area) located offshore from both Long Beach and Lido Beach (Figure 4) during September 1995. Titled *Remote Sensing Survey Atlantic Coast Of Long Island Jones Inlet To East Rockaway Inlet Long Beach Island, Nassau County, New York*, the project area lay approximately one mile from the existing shoreline and was approximately four miles long and one mile wide (Tuttle and James 1996:1).

This survey, using a magnetometer, side-scan sonar, sub-bottom profiler, and DGPS, covered over 120 linear miles. Although archival research did not indicate the presence of any historic shipwrecks within the proposed survey area, a total of 19 magnetic anomalies were recorded (Tuttle and James 1996:1). Of the 19 targets, four had associated linear returns indicative of modern sections of pipe, 13 appeared to represent modern debris or geologic features, and the remaining two indicated the potential for significant cultural resources. These two targets were recommended for avoidance; if avoidance was not an option, further investigation of the two sites by archaeologists was recommended (Tuttle and James 1996:2-3).

Running almost concurrently with the previously mentioned project, Panamerican conducted another underwater archaeological investigation for the Corps. Titled *Underwater Inspection Of Four Shipwrecks Atlantic Coast Of Long Island Jones Inlet To East Rockaway Inlet, Long Beach Island, Nassau County, New York Storm Damage Reduction Project*, the project was intended to assess if four wreck sites were eligible for nomination to the NRHP. The four wrecks included:

- The *Mexico* (1826), an American bark wrecked in 1837, killing most of the 111 passengers and crew.

- An unnamed tugboat in shallow water, located east of the *Mexico*, off Point Lookout.

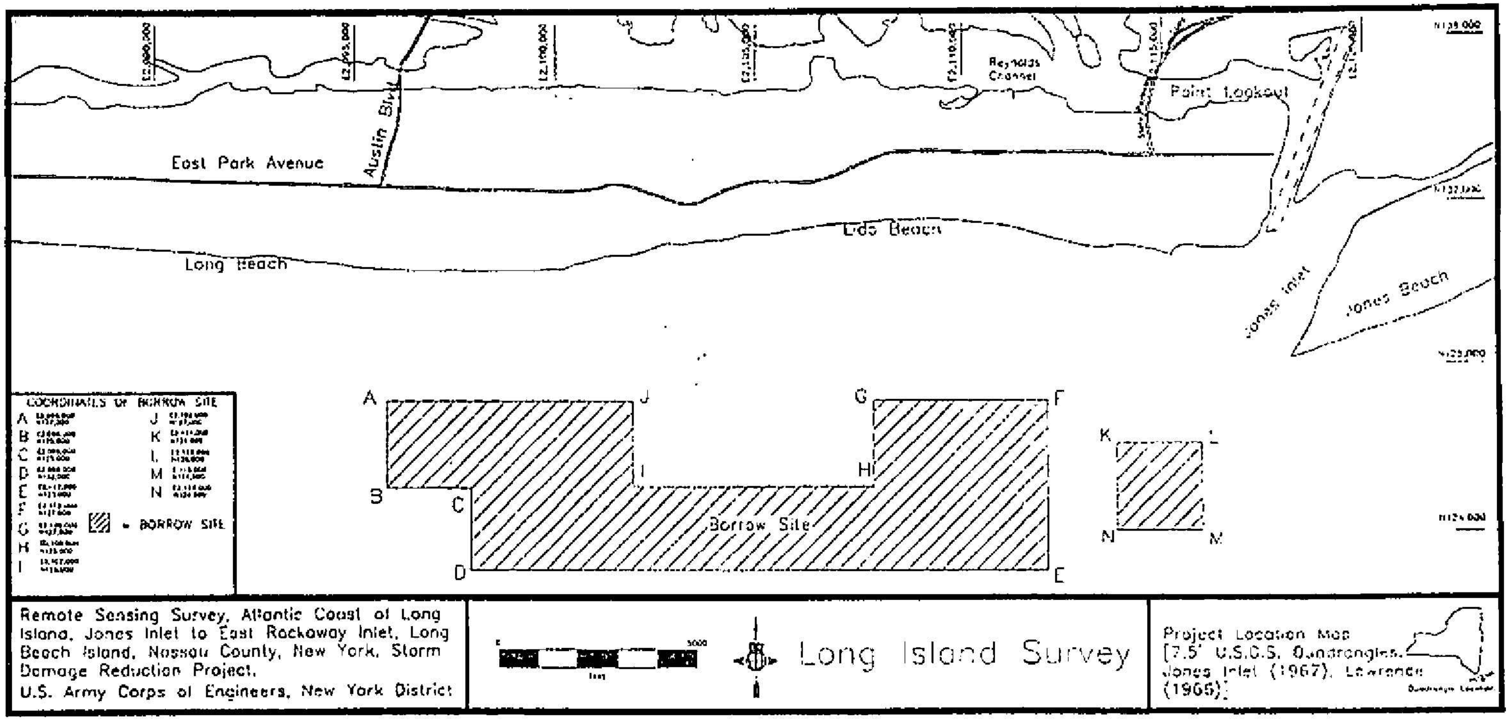

Figure 4.Borrow Area located offshore from both Long Beach and Lido Beach and east of the current project area (as presented in Tuttle and James 1996:2).

• An unnamed wreck, last reported completely buried.

• An unnamed barge, located off the western tip of Atlantic Beach.
(as presented in Mitchell et al. 1996:1)

Underwater archaeologists, provided only with LORAN coordinates, attempted to locate and assess each of the four wrecks. However, a lack of local informant information, sediment depth over the sites, and/or incorrect coordinates resulted in relocating and assessing only one of the four wrecks. Only the unnamed tugboat, located off Point Lookout, was successfully relocated and assessed for NRHP eligibility. The poor condition of the remaining hull structure, lack of integrity, and paucity of artifacts precluded this site from being considered for the NRHP. Recommendations for determining the location of the three additional wreck sites (not relocated during the assessment) included the use of a magnetometer, side-scan sonar system, DGPS, and a recording fathometer (Mitchell et al. 1996:25).

During June 1997, the Corps again contracted with Panamerican to conduct a remote-sensing survey of a proposed beachfill area on the Atlantic shore of Long Beach Island, New York. The project area ran parallel to the existing shoreline (Figure 5); it was approximately eight miles long and 1/4 mile wide (beginning from the easternmost end of Long Beach Island west to Yates Avenue in East Atlantic Village). In an effort to cover the entire project area, over 179 tracklines were run covering 126 linear miles (Tuttle and Mitchell 1998:1).

The project, titled *Remote Sensing Survey, Near Shore Project Area, Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, Nassau County, New York, Storm Damage Reduction Project*, recorded a total of 50 magnetic anomalies. Of the 50 anomalies 23 were determined likely to not represent historic wreck sites; while the remaining 27 were prioritized as to their potential to represent historic wreck sites (Tuttle and Mitchell 1998:1).

Of the 27 magnetic anomalies, four had associated side-scan sonar images while another grouping of three anomalies was determined to possibly represent the remains of the *Mexico*, one of the vessels not relocated during the survey by Mitchell et al. (1996). The remaining 20 anomalies retained characteristics of potentially significant submerged cultural resources. However, because none of the targets were exposed above the ocean bottom, it was determined that an additional covering of sand would not be detrimental to the anomalies (Tuttle and Mitchell 1998:3). Of the four side-scan sonar/magnetic anomalies, one was determined to be the unidentified tug investigated by Mitchell et al. (1996) while the other three remain unidentified. Recommendation for these three remaining targets by Panamerican was assessment by archaeologists to determine their identity and significance before burial by sand (Tuttle and Mitchell 1998:47).

During the fall of 1998 and spring of 1999, Panamerican (under subcontract to NEA) performed archaeological investigations at a proposed beachfill area along the Atlantic shore of Fire Island, New York. The proposed beachfill area was designed to reinforce portions of Fire Island (east of the current project area) between Fire Island and Moriches Inlet. This project, part of the Corps Interim Storm Damage Protection Project, provided additional erosion and storm protection along almost half the length of Fire Island (James and Tuttle 1999:1). More specifically, the project area consisted of four reaches extending along 12 miles of the island's 32-mile length. The survey employed a magnetometer, side-scan sonar, fathometer, and DGPS to record both magnetic and sonar targets in an effort to determine if beachfill activities would impact any anomalies potentially eligible for the NRHP.

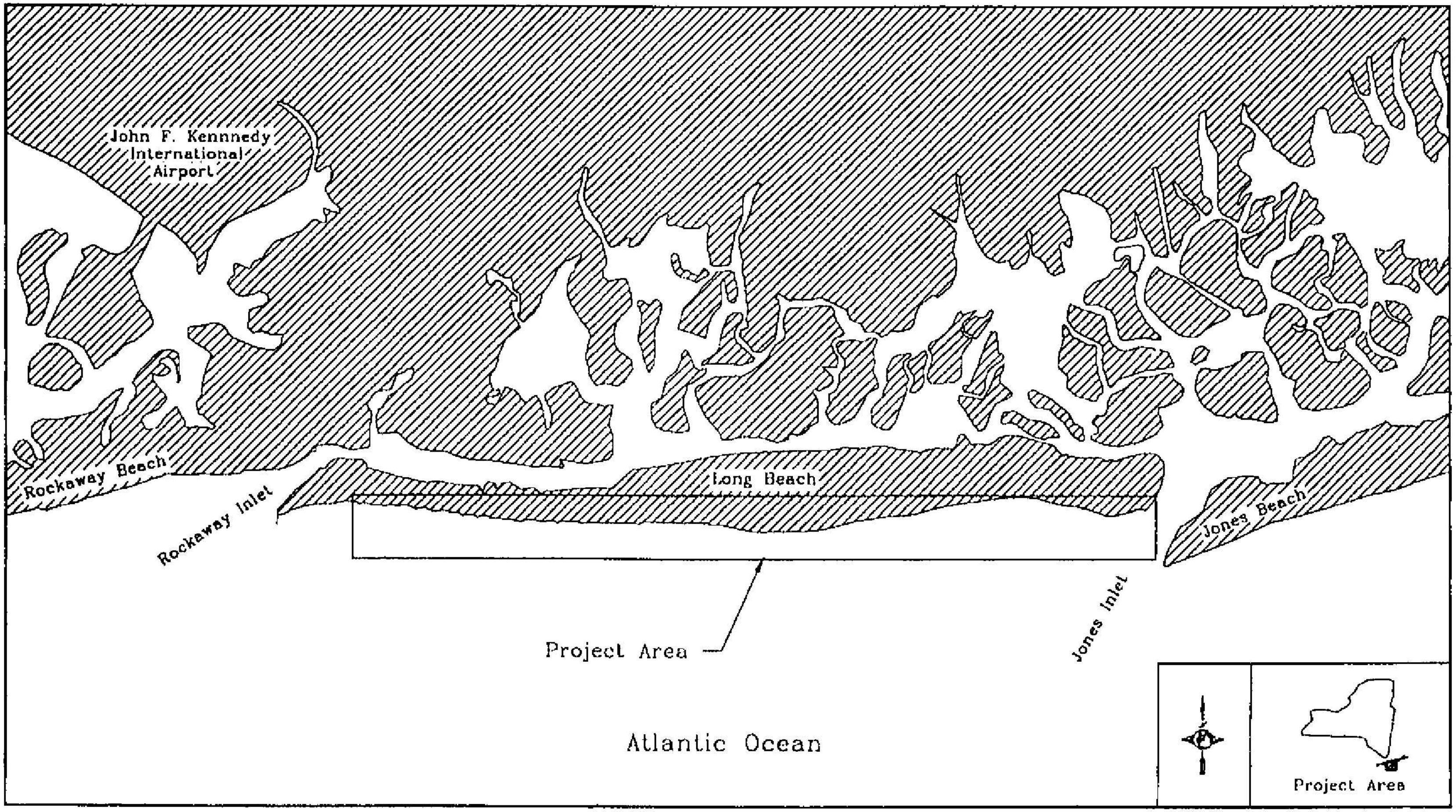

Figure 5. Near-shore project area, Jones Inlet to East Rockaway Inlet, Long Beach Island, Nassau County, New York (as presented in Tuttle and Mitchell 1998:2).

A total of seventy-eight anomalies were identified within the entire project area. Of those, 26 targets retained signal characteristics potentially representative of submerged cultural resources. Four of the 26 anomalies had associated side-scan sonar signatures. Since a majority of the targets remained buried, additional burial by beachfill activities was determined not to be detrimental to those targets. It was also ascertained that if beachfill activities (i.e., anchoring or dredging) would have no impact on the four exposed anomalies, that no further work be required. However, if impacts by Corps activities are possible, the targets were recommended for diver investigation and NRHP assessment prior to commencement of project activities (James and Tuttle 1999:9).

HISTORY AND MANAGEMENT OF THE ROCKAWAY/ATLANTIC BEACH ARTIFICIAL REEFS

For centuries artificial reefs have been constructed to attract marine organisms. More specifically these reefs stimulate the habitat for particular types of fish, crustaceans, and mollusks. The benefits of a properly constructed artificial reef are:

- enhanced fish habitat;
- more accessible fishing grounds;
- an advantage to anglers and the economics of shore communities;
- increased total fish biomass within a given area; and
- providing managers with another option for conserving and/or deploying fishery resources (New York State Department of Environmental Conservation 1993:1, hereafter cited as NYSDEC).

Apparently the first artificial reef on record (in New York waters) was built in the mid-1920s in the Great South Bay. The reef consisted of wooden butter tubs half filled with concrete which were sunk in several locations by the Boatmen's Association of Great South Bay (NYSDEC 1993:3). The next documented artificial reef was constructed by the Bay Shore Tuna Club during 1946 and 1947 and consisted of wooden boxes also half-filled with concrete. In the Atlantic Ocean, the McAllister Grounds were constructed in 1949, proceeded by the Schafer Grounds in 1953 (NYSDEC 1993:3).

Begun in 1962, New York's marine artificial reef program received twelve permits from the Corps and the Department of Environmental Conservation (DEC). While most of these permits have expired, material was deposited over ten areas, while eight of these are still currently managed as reef systems (NYSDEC 1993:3). During recent years an increase in the demand for fishery products, increased energy costs to the fishing industry, and a decline in fishery habitat quality and resources prompted the U.S. Congress to pass the National Fishing Enhancement Act (the Act) in 1984 (NYSDEC 1993:1). The Act states:

> ...artificial reefs should be constructed so as to provide: maximum enhancement of the fisheries; increased accessibility to US fisherman; minimum conflicts between user groups; minimum risks to the environment and to the health and safety of people; and no hazard to navigation or breach of international law (NYSDEC 1993:1).

One year later the National Marine Fisheries Service (NMFS) published the National Artificial Reef Plan (the Plan) "as a guide for siting, design, construction, materials, monitoring and maintenance of artificial reefs" (NYSDEC 1993:1). The Plan called for states as well as regional planners to develop their own plans relative to local environmental, economic and social conditions (NYSDEC 1993:1).

Under the Act, the State of New York developed a Marine Artificial Reef Development and Management Plan, through the DEC, Division of Marine Resources. The DEC was given the authority to develop and manage New York's marine artificial reefs under New York State's Environmental Conservation Law (ECL), Section 11-030 (NYSDEC 1993:1). All reefs were built with specific sport fishing groups in mind (with the exception of the Shinnecock Bay Artificial Reef which was established as a research project), and are located close to inlets to provide access to these various groups. The following table (Table 2) represents the major fishing centers within New York's Marine District and the associated artificial reefs.

Table 2. Major Fishing Centers in New York's Marine District & Nearby Artificial Reefs.

Fishing Center/Inlet	Artificial Reef
Great Kills Harbor	none
Rockaway Inlet	Rockaway Beach; Atlantic Beach
East Rockaway Inlet	Atlantic Beach
Jones Inlet	Hempstead Town
Fire Island Inlet	Fire Island; Great South Bay
Moriches Inlet	Moriches Anglers
Shinnecock Inlet	Shinnecock
Montauk	none
Greenport/Orient	none
Mattituck Inlet	none
Port Jefferson/Mt. Sinai	none
Stony Brook/Smithtown	Smithtown Bay
Huntington/Oyster Bay	none
Flushing/North Hempstead/City Island	none

(as presented in NYSDEC 1993:24)

More specific to the current project area is the Rockaway Beach Artificial Reef, developed in 1967. The reef site, identified as an obstruction/fish haven on the National Oceanographic and Atmospheric Association (NOAA) charts, is located approximately 3,000 feet to the southwest of Borrow Area 2 (Figure 6). The permit to construct an artificial reef in this area was initially issued to the DEC in 1965 "through the efforts of David H. Wallace (Chief of Conservation Department's Bureau of Marine Fisheries), Captain Laddie Martin and Howard Berlin of the Sheepshead Bay Boat Owners Association" (NYSDEC 1993:Appendix E). The wreck of the *Mistletoe* (to the southwest of the reef) permitted a controlling depth of 24 feet MLLW for the reef site, much shallower than other reef areas.

The area was surveyed by divers from the American Littoral Society in 1966 who reported that the bottom consisted of hard-packed sand and shell. While the 413-acre area (approximately 2,000 yds x 1,000 yds in dimension) used to be delineated with buoys, budgetary constraints on the DEC forced the cancellation of its buoying efforts (NYSDEC 1993:Appendix E). A brief description of the material placed within the designated reef area includes:

> Materials from several public works projects have been placed on the reef, including demolition debris from the Cross Bay Boulevard's South Channel Bridge. The deposition of large amounts of concrete and rock in the 1970's and 1980's has resulted in a jumble of materials concentrated in one area of the reef with scattered piles throughout the remainder. This configuration functions as a sort of sanctuary, as it is difficult for anglers to fish it effectively (NYSDEC 1993:Appendix E).

A description of the reef site proceeds to detail future plans for the site:

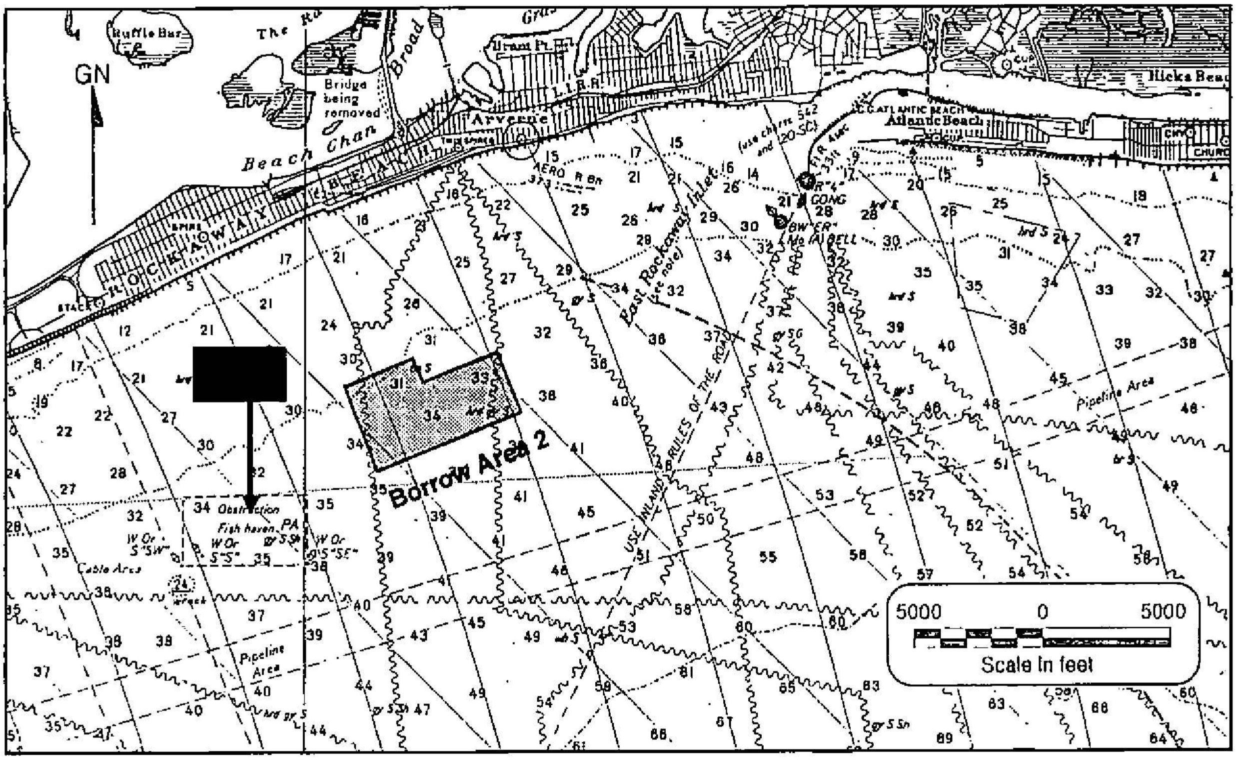

Figure 6. NOAA chart showing the close proximity of the Rockaway Beach Artificial Reef (identified as "Obstruction Fish haven) to Borrow Area 2 (as presented in Riess 1994b:3).

> This site may receive an additional 100,000 cubic yards of concrete rubble and rock from various public works projects. Pending an investigation of the effectiveness of the existing sanctuary, much of the material may be used to expand the sanctuary or construct an additional one (NYSDEC 1993:Appendix E).

Concrete materials (i.e., bridge support structures, culverts, building rubble) make an excellent artificial reef material due to their high density and durability (Figure 7). However, due to the high cost of transportation and deployment of concrete material, it is typically only placed on the artificial reefs closest to New York City (i.e., Rockaway Beach, Atlantic Beach). Due to a lack of concrete material being transported to the reefs further away the DEC explored the possibility of

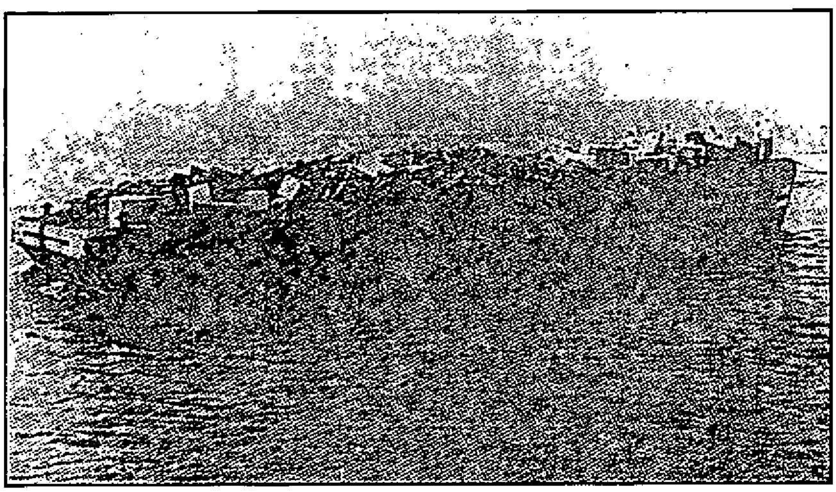

Figure 7. Material ready to be placed on an artificial reef off Long Island (as presented in Berg 1990:44).

establishing a fund to help with the additional costs of transporting such material to other outlying artificial reef areas (NYSDEC 1993:29). Any concrete material slated for an artificial reef must meet certain criteria established by the DEC:

> a.) Materials will be clean and free of any pollutants (adhering and compositional) and floatable debris.
>
> b.) No more than 10 percent of the total amount of any single bargeload or deployment unit should be comprised of pieces having overall dimension of less than one cubic foot. If materials are dredged from the sea bottom, it may be necessary to wash off the sediments with a high-pressure hose (NYSDEC 1993:29-30).

While the report by the DEC comments on the large amount of concrete rubble (approximately 83,500 cu yds) within the boundaries of the Rockaway Beach artificial reef, other material has also been deposited within the area. This additional material includes "6,000 tires in 3-tire units; 60 steel buoys; rock; and concrete slabs, piles, culvert, decking and rubble. One tire unit is configured into a 15-tire pyramid. Report of 16 auto bodies is unconfirmed" (NYSDEC 1993:29).

Located approximately 20,000 feet to the southeast of Borrow Area 2 is the Atlantic Beach Artificial Reef. Similar to the Rockaway Beach Artificial Reef, the Atlantic Beach reef covers 413 acres (2,000 yds x 1,000 yds). Artificial reef material for this area includes: "30,000 tires in 3-tire units; 404 auto bodies; 10 Good Humor trucks; 9 barges; the tug *Fran S*; a steel lifeboat; steel crane and boom; and concrete culvert, rubble, abutments and decking" (NYSDEC 1993:Appendix E). Future plans for the Atlantic Beach reef indicated that the "site may receive departments" (NYSDEC 1993:Appendix E).

Concerning the practice of illegally depositing reef material (outside maintained artificial reef areas or without the proper permits), the DEC vowed to "1) undertake an informational/educational campaign that exposes illegal reef building activity and destructive practices as violations of the law and harmful to the resource; and 2) prosecute any violators to the fullest extent of the law" (NYSDEC 1993:x).

To ensure that program goals and objectives are being met and to determine compliance (with federal and state permit requirements), the DEC was entrusted to monitor all artificial reefs within its jurisdiction. In order for the DEC to continue construction on its artificial reefs, compliance with permit requirements is necessary (OSI 1994:1). While subject to funding and staffing constraints, the monitoring is to include "sonar and videographic surveys, for purposes of permit compliance and reef status assessments; and harvest analyses, in accordance with coast-wide stock assessments" (NYSDEC 1993:viii).

In an effort to comply with the federal/state permit requirements and monitor the reef sites, the DEC contracted with OSI (of Old Saybrook, Connecticut) to conduct a hydrographic and side-scan sonar survey of seven artificial reefs off the south shore of Long Island (1994:1). The objectives of the project were to "address the physical component of the DEC's monitoring program" (OSI 1994:1). To complete the objectives of the monitoring program the DEC determined that a side-scan sonar survey of the artificial reefs would be the most reliable and cost-effective method available. The report titled *Side Scan Sonar Survey Of Marine Artificial Reefs Off South Shore Of Long Island Long Island, New York* reached the following conclusions regarding both the Rockaway Beach and Atlantic Beach Artificial Reefs:

> Rockaway Beach and Atlantic Beach Reefs contained by far the highest concentration of reef material per square foot on the seafloor. Both sites consist primarily of concrete rubble and associated bridge debris which blanket a majority of these sites. The primary difference between

these sites is the apparent absence of any sunken vessels at Rockaway Beach Reef, whereas there were numerous sunken vessels found at Atlantic Beach Reef. A total of 8 potential vessel sites were identified there including 5 barges and 3 apparent boat hulls. There are also a significant number of auto bodies documented at Atlantic Beach while reports of a limited number of auto bodies at Rockaway Beach could not be confirmed (OSI 1994:3).

OSI concludes by stating that due to the lack of original locational data it would be difficult to ascertain the "change in location, orientation, and condition of the existing reef material" (OSI 1994:17). OSI did confirm, however, that larger, heavier objects placed within these artificial reef areas tend to stay in their originally deposited location with little or no movement, whereas smaller pieces of debris (i.e., tires) have a tendency to be more affected by physical processes (i.e., storm surge). Concerning vertical relief of reef material, OSI concludes that "all the sites apparently exhibited a decrease in maximum relief associated with subsidence and deterioration of the materials" (OSI 1994:18). Additionally, OSI makes recommendations for types of optimum reef material (more resistant to chemical, biological, and physical processes), and their study has determined that reef material exists outside the reef boundaries established by the DEC (OSI 1994:20).

SHIPWRECK INVENTORY OF THE PROJECT AREA

A number of sources have been written concerning the history of the approach to New York Harbor and the subsequent loss of numerous vessels due to foul weather, lack of navigational aids, marine accidents, or simply grounding-out near the surf zone (followed by the subsequent degradation of the hull if the vessel could not be removed). Rattray mentions that the south shore of Long Island is well-known for shifting sandbars which parallel the whole length of the island (1973:50). Any and all of these factors helped to make both the shoreline of Long Island and New Jersey (the "approach" to New York Harbor) a haven for shipwreck disasters.

Considering the volume of shipping that moved in and out New York Harbor for the last three centuries the probability of shipwreck remains within the project area can be considered high. The report written by the Harvard University Institute for Conservation Archaeology (ICA) study of the Atlantic Coast titled *Summary and Analysis of Cultural Resource Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras* (1979) supplies some useful information regarding the final disposition, durability, historic shipping, data, and categories of shipwrecks:

A. Shipwreck locations

(1) References to shipwreck location are often vague, owing principally to the difficulty of locating things at sea. Even as late as World War II it was not customary or feasible for merchantships to maintain their position at sea with any great accuracy. Thus, a position reported at the time of the vessel's distress often refers to the last known position rather than the actual position at the time of the wreck.

(2) The change from sail to steam power during the mid-nineteenth century seems not to have affected shipwreck location.

B. Construction material and durability of shipwrecks

(1) Wooden shipwrecks tend to break up and disintegrate due to the effects of storms and/or attacks of marine organisms, with their remains scattered over an area much larger than the original dimension of the ship.

(2) Steel-vessel shipwrecks tend to retain a greater degree of structural integrity than wooden vessels.

(3) The early steel (actually iron) vessels of the 1860s were generally made of thin sheets of metal and tended to sink rapidly and scatter their remains over larger areas than the later, more-rigidly constructed steel vessels.

C.) Historic shipping

(1) The Harvard University study presents a brief history of shipping in the Greater New York Harbor area and makes predictions as to probable primary locations for shipwrecks for the various periods. New York Harbor has been an active port since the first Dutch settlements, and in fact since the early 1800s it has been a leading--often the leading--American port for commercial shipping. Because modern aids to navigation appeared only toward the latter part of the nineteenth century, it is probable that yearly vessel losses peaked during the period 1850-1880 (That the data contained in this shipwreck inventory does not show a peak towards the latter part of the nineteenth century is problematic, but perhaps is due only to the onset of record keeping in the twentieth century).

D.) Shipwreck data sources through time

(1) Pre-1800: there are not many records of any sort pertaining to shipwrecks during this period; what records do exist tend to be located now in European archives, since the ships involved, until 1776, were of European registry. Potential shipwreck locations are derived from analysis of shipping routes, trade, and settlement patterns.

(2) 1800-1880: coastal newspapers are the major source for information about ship arrivals and departures and about ship losses during this period.

(3) 1880-present: By 1880 the U.S. Life-Saving Service was publishing lists of casualties in its annual report. By 1910 a list of vessels lost was also included in Merchant Vessels of the United States, an annual record of registered vessels published by various government branches. By 1915 the U.S. Life-Saving Service was taken over by the U.S. Coast Guard, which also published annual reports of casualties and assistance.

4.) Categories of areas of expected shipwrecks

a. Primary: locations where popular shipping route pass through hazardous waters and/or close to shorelines.

b. Secondary: coastal and shoal areas less frequently utilized but known to contain submerged hazards and lee shores.

c. Tertiary: deep-water areas of major shipping channels, where shipwreck density relates directly to traffic density.
(as presented in Engebretsen 1982:2-3)

These factors (compiled by ICA) aided in establishing a shipwreck inventory for Lower New York Bay in a report titled *New York Harbor and Adjacent Channels Study Shipwreck Inventory* (Engebretsen 1982). In cooperation with the Corps and Port Authority of New York, this study established the potential for shipwrecks within navigation channels (and adjacent areas) in and near New York Harbor. Engebretsen created the inventory "of all known shipwrecks in the Greater New York Harbor area" (1982:3) using several shipwreck compendiums, lesser inventories, and government reports. The four major sources consulted include (but were not limited to) Londsdale and Kaplan (1964); Marx (1971); Berman (1972); and Rattray (1973).

Engebretsen's findings reported 15 wrecks documented near the Rockaway Point area (1982:Appendix 1). While Rockaway Point is west of the current project area, keep in mind the findings by Engebretsen in Section III 1(A) regarding the often vague references to shipwreck locations (see above). Table 3 lists the 15 wrecks as follows:

Table 3. Vessel Losses Documented off and Near Rockaway Point.

Name	Rig	Tons	Built	Date	Comments
Alexa	Brit. Schooner			1/23/1904	Total loss, Rockaway Point, LI.
Black Warrior	Sidewheel Steamer			2/20/1859	Sank in 30 ft. off Rockaway Beach, LI.
Boyle	Schooner			4/30/1900	Wrecked west of Rockaway Pt., LI
Copia	Schooner			9/18/1882	Total loss off Rockaway Pt. cargo coal
Cornelia Soule	3-Masted Schooner			4/26/1902	Sank off Rockaway Pt., LI.; cargo granite; called "Granite Wreck"
East Wreck-3	3-Coal Barges			1917	In triangle within 5 miles of shore, near Rockaway Pt.
Evelyn	Schooner			4/30/1900	Wrecked west of Rockaway Pt., LI.
Golden Nugget	?			Unknown	Wreck west of Rockaway Inlet
Governor	Tug			3/11-12/ 1888	Sunk between Rockaway Pt. and Swash Channel
Kenyon	Schooner			4/30/1900	Wrecked off (w) of Rockaway Pt., LI.
Mamie K.	Motor boat			11/25/1919	Total loss 4 miles west of Rockaway Beach
HMS Pentland Firth	British oil screw	500		9/22/1942	Torpedoed and sunk, Rockaway Inlet 40° 27' 45" N 73° 49' 30" W. Depth 80'
R.S. Lindsay	Schooner			4/10/1887	Sank s.w. of Rockaway Life Saving Station
Ruth Shaw	Barge	485	1916	11/11/1939	Foundered, 2 miles SE of Jones Inlet Buoy, LI. 40° 29' N 73°45'W.
Scow Franklin	Scow			8/15/1897	Total wreck; Rockaway Inlet

(Engebretsen 1982:Appendix I)

Engebretsen's principal purpose was to inventory shipwrecks "known or presumed to have occurred in the New York Harbor project area" (Engebretsen 1982:7). Additional purposes of the inventory were to:

- Assess the potential magnitude of the overall "shipwreck problem" with regard to deepening the navigation channels.
- Predict which areas have a high density of shipwrecks and which areas have a low density of wrecks.
- Predict the likelihood that a wreck encountered comes from a particular century and possibly predicting the parent material it is likely to be made from.
- Begin to track down and pinpoint the name and history of any shipwreck encountered (Engebretsen 1982:7).

As Table 3 above indicates, the approach off Rockaway Point (and Rockaway Beach) was an area of numerous historic vessel losses.

Included within the Background Analysis section of the report titled *Atlantic Coast of New York City East Rockaway Inlet to Rockaway Inlet and Jamaica Bay, New York, Section 934 Study, Borrow Areas 1A and B Remote Sensing Survey* (1993), Riess provides a table of documenting shipwrecks within the general area west of the current project area. A number of wrecks previously listed in Table 3 (Engebretson 1982) have been omitted from Riess' table to prevent duplication. The additional wrecks identified are presented below in Table 4.

Table 4. Additional Wrecks Identified by Riess.

Year	Name	Type	Disposition	Location
1744	No name	Sloop	Lost	Near East Bank
1747	*Shrewsbury*	Sloop	Wrecked	On Coney Island
1753	No name	Sloop	Lost	On East Bank
1776	*Generous Friends*	Troop Transport	Sunk	Near Coney Island
1789	*Sally*	Merchantman	Wrecked	On Coney Island
1818	*Albion*	Merchantman	Wrecked	On Coney Island
1831	*Spectacular*	Schooner	Sunk	Off Coney Island
1876	*Louis*	Steam Screw	Stranded	Coney Island
1897	*George L. Garlick*	Steam Tug	Wrecked	Coney Island
1923	*Halcyon*	Steam Screw	Foundered	Coney Island
1923	*Phillip J. Kenny*	Steam Screw	Burned	Off Ambrose Channel

(as presented in Riess 1993:5)

Pickman's cultural resources reconnaissance study (1993) provides an appendix of vessels wrecked in the general area of Long Beach, directly to the west of the current project area (Table 5). Considering the amount of vessels wrecked off of Coney Island/Ambrose Channel (west of the project area) and the number of vessels wrecked to the east of the project area, it can be inferred that the potential for wrecks off of Rockaway Beach remains high.

Table 5. Vessels Noted as Wrecked/Foundered near Long Beach & General Area.

Year	Name	Type	Disposition	Location
1884	*Alexander Harding*	Schooner	Sunk	Hog Island Inlet Shoals
1875	*Amelia*	Schooner	Ashore-Went to pieces	Hog Island
1909	*Arlington*	Schooner	Stranded-Went to pieces	Long Beach
1901	*Bay Queen*	Sloop	Total loss	Long Beach
1889	*Beechdale*	Bark	Ashore-Partly wrecked	East of Point Lookout Life Saving Station
1925	*Blue Haven*	Barge	Stranded	Long Beach
1893	*C. Henry Kirk*	Schooner	Total loss	Long Beach
1902	*Cavour*	Steamer	Foundered	Long Beach
1893	*David Carll*	Pilot Boat	Total loss	Off Point Lookout
1901	*Gwent*	Steamship	Went ashore- stranded	Long Beach
1901	*H.R. Keene*	Schooner	Went to pieces on bar	Long Beach
1929	*Henrietta*	Sloop	Capsized	Point Lookout-West of Jones Inlet
1888	*Iberia*	Steamer	Sunk	3-4 miles off Long Beach
1884	*Julia*	Schooner	Sunk	Long Beach
1902	*L. Schepp*	Merchant Ship	On shoals- damaged	Point Lookout
1887	*Lotus*	Bark	Total wreck on outer bar	Between Long Beach and Point Lookout
1893	*Martha P. Tucker*	Bark	Stranded	Point Lookout - 200 yards from shore
1894	*Massasoit*	Schooner	Wrecked ashore	Long Beach
1899	*May McFarland*	Schooner	n/a	Long Beach
1850	*Minerva*	Brig	Total wreck	7 miles west of Fire Island
1837	*Mexico*	Bark	Wrecked	Point Lookout area, ca. 600 ft. from shore
1900	*Mosquito*	Steamer	n/a	Point Lookout
1920	*Norma*	Gasoline screw	Stranded/Total loss	Near Point Lookout
1902	*Persia*	Barkentine	n/a	Long Beach

Table 5. continued

Year	Name	Type	Disposition	Location
1854	*Powhatan*	n/a	Grounded	Long Beach
1899	*Red Jacket*	Steamer	Ashore–Re-floated	Near Long Beach
1776-1780	*Revenue*	Privateer	Run ashore- bilged	Hempstead
After 1919	*Siesta*	Oil Screw	n/a	Off Long Beach
1880	*Thor*	Bark	Stranded	Hog Island Shoals
1889	*Vertumnus*	Steamer	Wrecked aground	Point Lookout
1880	*W.A. Holcomb*	Bark	Total wreck	Long Beach
1832	Unidentified	n/a	Wrecked	Hempstead

(as presented in Pickman 1993:172-177)

Pickman also includes a list of vessels erroneously recorded (in secondary sources) to have wrecked near Long Beach (Table 6). Sources consulted differ as to the location of wreckage, therefore making their final disposition somewhat ephemeral:

Table 6. Incorrectly Recorded Vessels Potentially Near Long Beach, Long Island.

Date	Name	Type	Comments
1847	*Auburn*	n/a	Rattray (1973) lists the wreck at Long Beach on 9/30/1847; New York *Evening Post* lists the vessel as wrecked at Barnegat Inlet, New Jersey 9/28/1847
1904	*Drumelzier*	Steamship (Freighter)	Fish (1989) gives location of wreck at Long Beach; Rattray and the New York *Times* list the wreck at Fire Island
1917	*Edna*	Sloop	Fish (1989) lists the wreck at Long Beach; Rattray lists it four miles west of Long Beach
1891	*Joseph Bannigan*	Brig	Rattray (1973) gives the wreck location at Long Beach; Berman (1972) and New York *Times* list it at Long Branch, New Jersey.
1877	*General Connor*	Schooner	Rattray (1973) lists the wreck at Long Beach; the New York *Times* states the vessel went ashore at Fire Island (opposite Amityville)

(as presented in Pickman 1993:179-180)

A number of other, more recent publications regarding historic vessel losses off the south shore of Long Island have been published as diver's guides (Berg 1990) and as narratives to some of the many vessels which met their demise in and near the approaches of New York Harbor (Sheard 1998). While these sources include a plethora of wreck information for the south shore of the Long Island area, only those wreck sites presented below have been identified by the authors as being near the current project area.

Daniel Berg's book *Wreck Valley Vol. II* "is designed as a diver's guide to shipwrecks located off the New Jersey and Long Island coasts" (1990:vi). Berg provides historical background, water depths, currents, visibility, and types of aquatic life on over 90 shipwrecks within the New York Bight or "Wreck Valley." Within the general area of Rockaway Beach, Berg lists seven wreck sites. These wrecks include the *Princess Anne*, *Robert A. Snow*, *Cornelia Soule*, *Rascal*, *Black Warrior*, *Mistletoe*, and the *Margaret* (Berg 1990:viii). While there are numerous other wreck sites further offshore from those listed above, these seven sites represent those closest to the current project area. Working from the west end of Rockaway Beach towards the east, the following represents the accounts of those seven vessels identified by Berg.

The *Princess Anne*, constructed for the Old Dominion Line, was built in Chester, Pennsylvania in 1897. The vessel (a single-screw steamship) was 350 feet in length with a 42-foot beam and a displacement of 3,629 gross tons (Berg 1990:107). Captain Frank Seay missed the entrance to New York Harbor at 2:00 am on February 6, 1930, stranding the vessel on the Rockaway Shoals east of Rockaway Point (Figure 8). The 74 crew members and 32 passengers remained safely onboard until 5:00 a.m. when a lifeboat from the Life Saving Service watchtower at Rockaway Point could safely reach the stranded vessel. While all the passengers were safely removed, the 74 crew members refused to leave the vessel without their belongings. Nine days later the vessel began to break apart, forcing the crew to raise a distress flag and be taken to safety. Later that day (February 15, 1930) the vessel broke in two. While many believe the wreck to be that of the *Princess Anne* (just east of Rockaway Point), the wreck remains in 20 feet of water and has never been positively identified (Berg 1990:107-109).

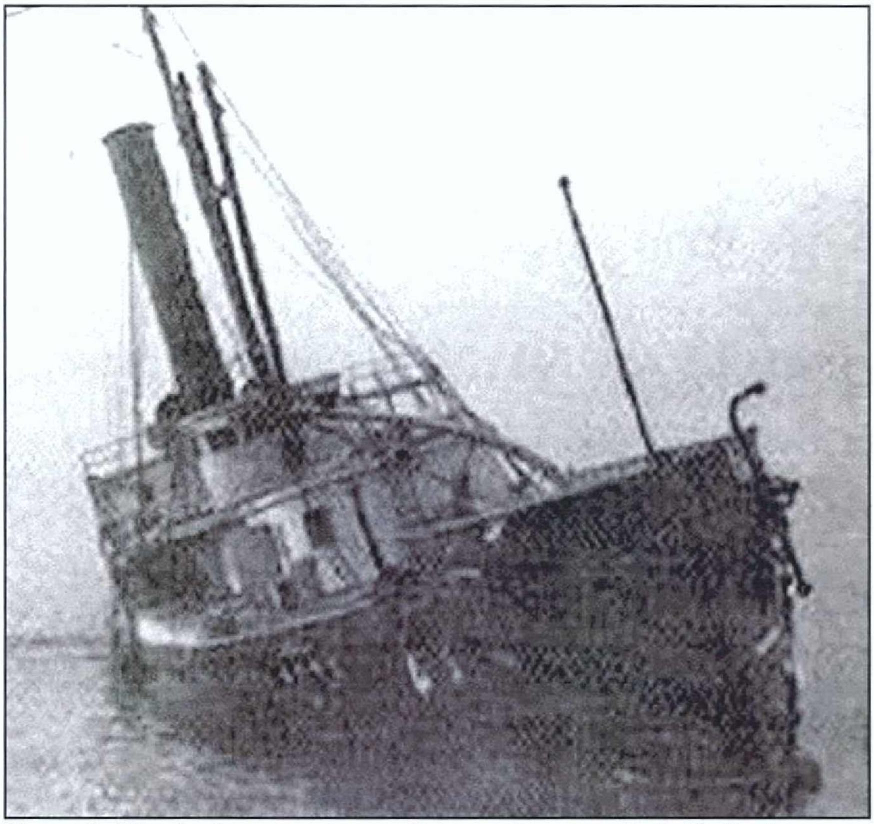

Figure 8. The single-screw steamer *Princess Anne* wrecked off Rockaway Shoals (Courtesy of the Dan Berg collection).

The *Robert A. Snow* sank with a cargo of fertilizer on February 8, 1899 en route from Barren Island to Rockaway Inlet. Built in Rockland, Maine in 1886, the schooner "now lies two miles northeast of Rockaway Point in 23 feet of water" (Berg 1990:121). Referred to many local divers as the *Derrick Barge*, the boiler, machinery, and some scantling are still visible on site (Berg 1990:121).

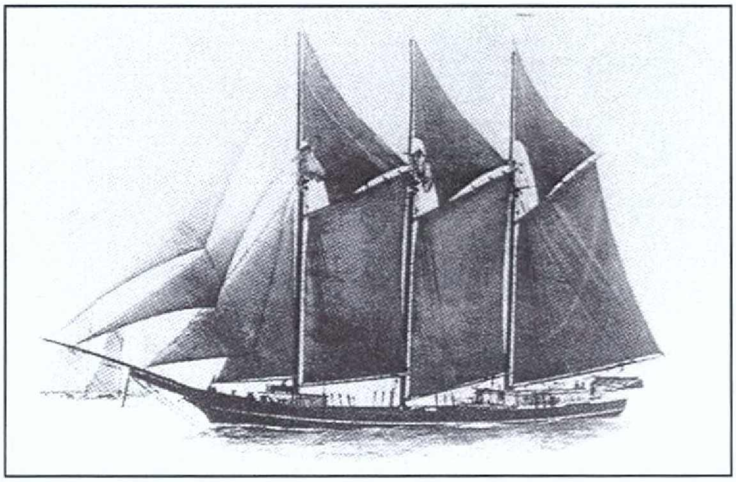

Figure 9. The *Cornelia Soule* ran aground on Rockaway Shoal (as presented in Berg 1990:33).

Further to the east is the wreck of the *Cornelia Soule*, a 306-ton, three-masted schooner, which ran aground on April 26, 1902 on Rockaway Shoals (Figure 9). Originally bound from Maine to Philadelphia loaded with a cargo of cut granite, the crew of six could not be rescued until the following morning. Today, most of the wood hull has deteriorated or is buried while some of the stern steering machinery is still exposed. More prominently exposed on site are the remains of a number of granite slabs (Berg 1990:32).

The *Rascal* (an ex-government boat), a 41-foot, single screw charter boat, was sunk on November 17, 1985, as a memorial to Captain Louis Schroeder. Schroeder, an avid diver since the 1960s and owner of the Wheel House dive shop, passed away in the fall of 1985 (Berg 1990:109). Because Schroeder's favorite wreck site was the *Black Warrior* (sunk in 1859), his vessel *Rascal* "was sunk just east of the *Black Warrior* in 40 feet of water" (Berg 1990:109). Berg's map (1990:vii), however, indicates the wreck to be just to the west of the *Black Warrior*.

Perhaps one of the more prolific vessels to have foundered in the general area of Rockaway Beach was the *Black Warrior*, a wooden-hulled, paddle-wheel steamship, built in 1852 in New York (Figure 10). Constructed for the New York and New Orleans Steamship Company for $135,000, the *Black Warrior* was 225 feet in length, had a 37-foot beam, and rated at 1,556 gross tons (Berg 1990:20). Used primarily to carry passengers, cargo, and mail between New York, New Orleans, and Havana, Cuba, the *Black Warrior* met its fate when the vessel ran aground on Rockaway Bar, February 20, 1859 on approach to New York Harbor (Berg 1990:20-22). All crew and passengers were removed safely by assisting vessels (*Screamer*, *Achilles*, and *Edwin Blount*); however, the hull sank deeper and deeper into the sand, making it impossible to remove. The hull was eventually smashed to pieces and today is spread over a large area. The *Black Warrior* now rests in 30-35 feet of water (Berg 1990:22).

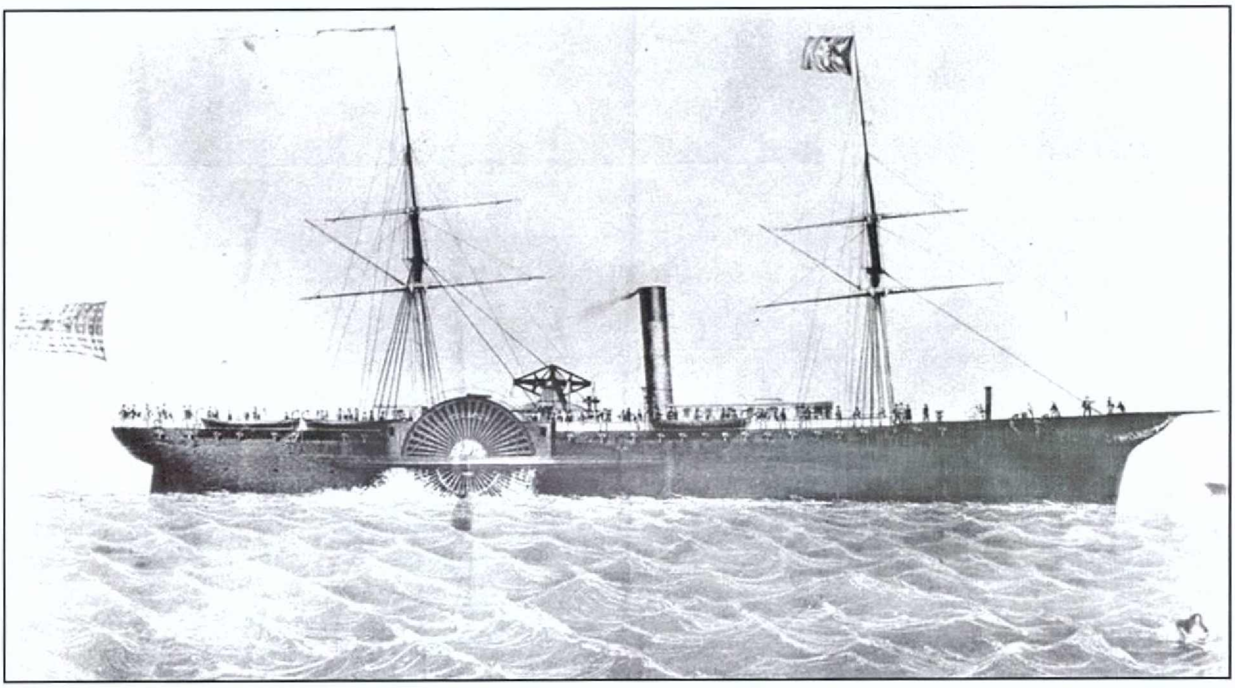

Figure 10. The *Black Warrior*, built in New York in 1852, ran aground off Rockaway Beach in 1859 (Courtesy of the Mariner's Museum, Newport News, Virginia).

Built in 1872, the *Mistletoe* was a wooden-hulled, sidewheel steamship built in Chester, Pennsylvania (Figure 11). The vessel was 152.6 feet in length, 26.7 feet in beam, and displaced 362 tons (Berg 1990:77). Captain Dan Gully, 74 passengers, and 10 crew members were on their way to an offshore-fishing ground when the vessel caught fire and sank "a few miles off

Rockaway" (Berg 1990:77-79). With the aid of small fishing boats in the area, no lives were lost during the incident. The *Mistletoe* currently lies in 42 feet of water, four miles to the southeast of Rockaway Inlet. Exposed remains consist of copper-hull sheathing, boilers, and paddle wheels (Berg 1990:79).

Another vessel to founder off Rockaway Beach was the *Ajace*, a 566-ton bark, which sank at 4:00 am on March 4, 1881. The vessel, loaded with scrap railroad iron, and 2,040 empty petroleum barrels, was bound from Belgium to New York. Caught in one of the worst storms of the year, the *Ajace* ran aground off Rockaway Beach; only one man, Peter Sala, survived the wreck (Berg 1990:3). The vessel remains now lie 300 yards west of the *Cornelia Soule* (Granite Wreck), inshore from the buoy which marks the *Black Warrior* (Berg 1990:3).

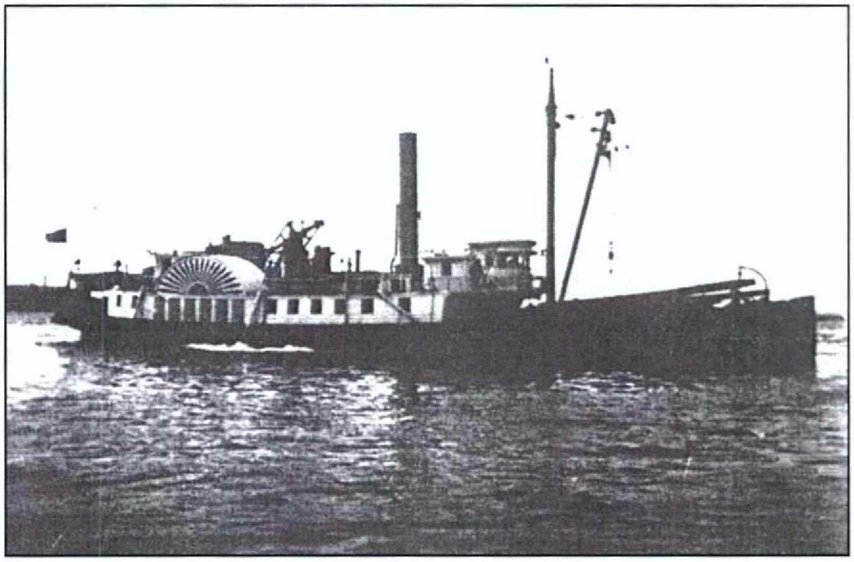

Figure 11. The wooden-hulled sidewheel steamship *Mistletoe* sank a few miles off Far Rockaway in 1924 (Courtesy Steamship Historical Society Collection, University of Baltimore Library).

The last wreck listed in Berg's book (near the project area) is the *Margaret*. Very little is known about the wreck, located approximately one mile south of Deb's Inlet. The wreck, apparently the remains of a tug, lies in approximately 40 feet of water (Berg 1990:76).

Another source of wreck accounts off Long Island is titled *Lost Voyages Two Centuries of Shipwrecks in the Approaches to New York* by Bradley Sheard (1998). Sheard's book covers the evolution of oceangoing vessels, the tragedy of shipwrecks, and documents a number of wrecks located near the approaches to New York Harbor. Specifically regarding the south shore of Long Island, Sheard lists numerous wrecks which were snared over the years on the sandy southern beaches. Sheard admits that his map is:

> ...only a partial listing; there were more documented wrecks, as well as undocumented ones. Note that the wreck locations are approximate. Early records are often incomplete and imprecise, and the sheer number of wrecks shown cannot be plotted with any accuracy due to space limitations alone (Sheard 1998:70).

Sheard's work provides a map of wreck sites along the south shore of Long Island with the name and dates of vessels lost (Sheard 1998:70). The vessels lost from Rockaway Point to Point Lookout are presented in Table 7 (from west to east):

Table 7. Vessels Lost from Rockaway Point to Point Lookout.

Date	Vessel Name	Location (approximate)
1898	*Governor*	Rockaway Point
1836	*Bristol*	Rockaway Beach
1859	*Black Warrior*	Rockaway Beach

Table 7. continued

Date	Vessel Name	Location (approximate)
1873	*Mic Mac*	Rockaway Beach
1877	*James Lawrence*	Rockaway Beach
1856	*John Stroud*	Rockaway Beach
1865	*Daniel C. Higgins*	Rockaway Beach
1866	*Flying Scud*	Rockaway Beach
1881	*Mary E. Turner*	Rockaway Beach
1867	*Hound*	Rockaway Beach
1895	*James W. Boyle*	Rockaway Beach
1884	*Alexander Harding*	Atlantic Beach
1872	*Breeze*	Atlantic Beach
1847	*Auburn*	Atlantic Beach
1893	*C. Henry Kirk*	Atlantic Beach
1891	*Joseph Bannigan*	Long Beach
1889	*Vertumnus*	Long Beach
1837	*Mexico*	Long Beach
1887	*Lotus*	Point Lookout
1884	*Curtis Tilton*	Point Lookout
1878	*Gazelle*	Point Lookout

While Sheard's book provides a useful glimpse into numerous wreck sites strewn throughout the approach to New York Harbor, no history or loss accounts (besides the date and general location) of any of the vessels listed above are provided in the book. Sheard does acknowledge that:

> Estimates of the number of shipwrecks in the region run from the hundreds into the thousands. The Long Island and New Jersey coastlines form the two sides of a "funnel" directing traffic into New York's great harbor, and have witnessed more shipwrecks than anywhere else along the East Coast of the United States, with the possible exception of Cape Hatteras, along the Carolina Outer Banks (Sheard 1998:8).

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.

INVESTIGATIVE METHODS

The investigation of thirty-four (34) magnetic anomalies off Rockaway Beach, Long Island by Panamerican included an intensive testing regime comprised of a magnetometer refinement survey integrated with a Differential Global Positioning System (DGPS), diver investigation, and identification of each target. Personnel conducting the fieldwork were all maritime archaeologists from Panamerican. Michael Krivor acted as Principal Investigator and report author. Michael Tuttle, James Duff, Dick Swete, and John Rawls acted as field technicians and archaeological divers during the investigation.

REMOTE-SENSING EQUIPMENT

The remote-sensing phase of the present investigation was conducted with equipment and procedures intended to facilitate the effective and efficient relocation of the sources of the thirty-four previously identified magnetic anomalies. For accurate positioning, a Motorola LGT-1000 Global Positioning System (GPS) linked to a Starlink MRB-2A MSK Radiobeacon receiver for differential (DGPS) capabilities was used. To relocate the magnetic anomalies and refine the target areas, an EG&G Model 866 marine magnetometer was employed. The equipment was placed aboard a vessel specifically chartered for the remote-sensing and diver investigation phases of the present project.

Differential Global Positioning System

A primary consideration in the search for magnetic anomalies is positioning. Accurate positioning is essential during the survey phase of an investigation and for returning to recorded locations for supplemental remote-sensing operations or diver investigation of anomalies. These positioning functions were accomplished on this project through the use of a Motorola LGT-1000 GPS used during both the remote-sensing survey and diver investigations of the 34 targets (Figure 12).

The Motorola LGT-1000 is a global positioning system that, when linked to the Starlink MRB-2A, MSK Radiobeacon receiver, attains differential capabilities. These electronic devices interpret transmissions from satellites in Earth's orbit and from a shore-based station to provide accurate coordinate positioning data for offshore surveys. The Motorola system processed both satellite data and differential data transmitted from a shore-based GPS station using RTCM 104 corrections. The shore-based differential station monitors the difference between the position that the shore-based receiver derives from satellite transmissions and that station's known position. The closest differential transmitting beacon to the survey area is in Sandy Hook, New Jersey. Transmitting the differential that corrected the difference between received and known positions, the DGPS constantly monitored the navigation beacon radio transmissions in order to provide a real-time correction to any variation between the satellite-derived and actual position.

Both the satellite transmissions and the differential transmissions received from the shore-based navigation beacon were displayed directly onto the screen of the LGT-1000 and were updated continuously every second. The level of accuracy for the system was considered at ±1 meter throughout the survey. The function of the Motorola GPS was to provide absolute positioning data during the remote-sensing survey, mapping of each site, and for the subsequent relocation of any cultural material encountered. For this survey, New York State Plane coordinates, based on the 1983 North American Datum (NAD 83), were used.

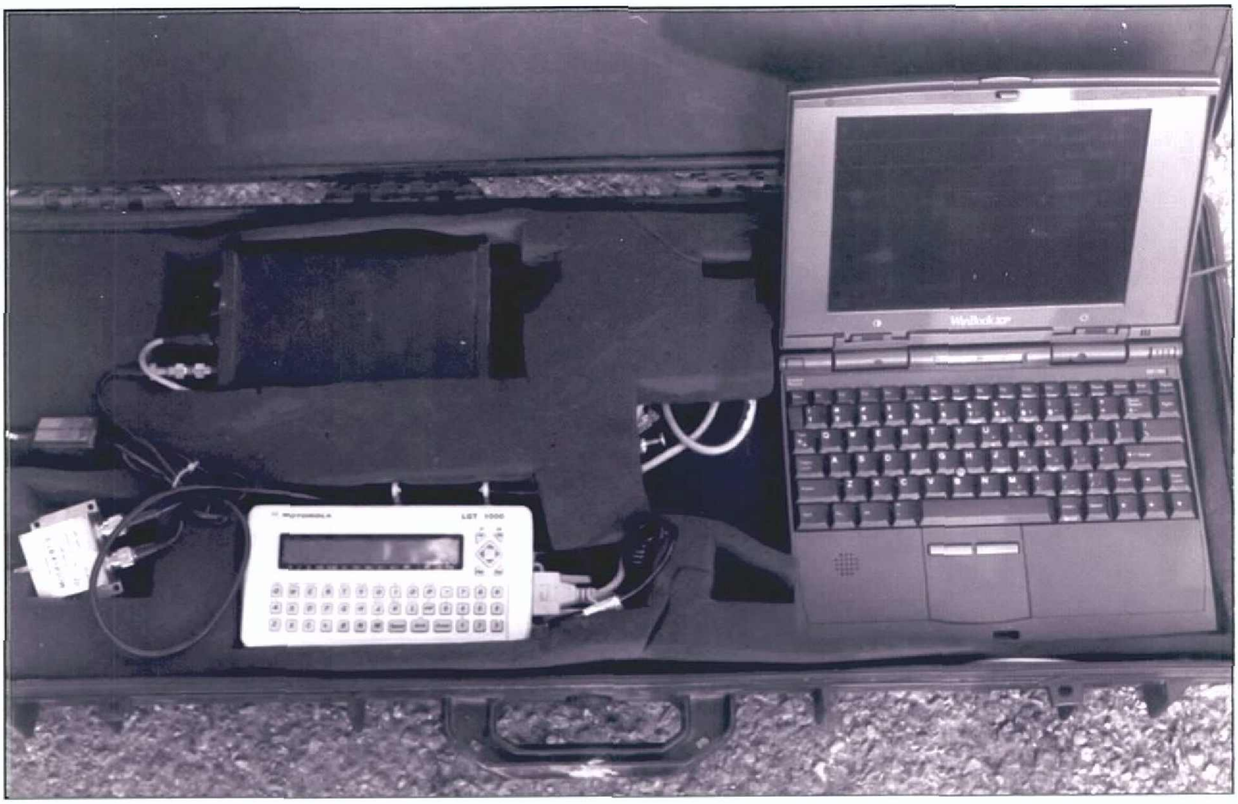

Figure 12. Differential Global Positioning System (DGPS) used for the project.

Magnetometer

The remote-sensing instrument used to search for ferrous objects contained within the submerged context of the present project area was an EG&G Model 866 marine magnetometer (Figure 13). Briefly, the magnetometer is an instrument that measures the intensity of magnetic forces. The magnetometer measures (at the location of the sensor) 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). As the sensor passes through the magnetic field surrounding a ferrous mass, the strength or intensity of that anomaly is 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.

It must be stated that interpretation of magnetic data is not an exact science. Numerous variables contribute to an anomalous feature that can be discerned from the Earth's ambient magnetic field by magnetometer investigation. The composition of the metallic object; size, mass, and area of the object; orientation to Earth's magnetic field; distance from sensor; and orientation of sensor to the object's magnetic field must be considered during interpretation of the data. The complexity of an anomaly is largely based upon the distance between the sensor and the center of mass of the source. Single-point sources are less likely than complexes of dipoles to be associated with significant cultural material. An object cannot be positively identified from its magnetic signature alone. However, in conjunction with other data, historic accounts, visual inspection, other remote-sensing technologies, and prior knowledge of similar targets, an estimation can be made on a signature with a high degree of confidence.

Figure 13. Geometrics Model G-866 marine magnetometer console and towfish.

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 specifically identify a 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. 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. It should be noted, however, that it is impossible to specifically identify the source of any anomaly solely from the characteristics of its magnetic signature.

Side-scan Sonar

The Marine Sonic Technology (MST) Sea Scan Side-scan Sonar is a self-contained sonar system (Figure 14). The software included with the Sea Scan Personal Computer (PC) system controls the collection of sonar imagery, as well as navigational input, and displays the information to the operator in the form of a digital display (via a 13-inch color monitor). The Sea Scan PC allows the operator to view wide tracts of the ocean bottom by isonifying along a predetermined swath width and recording the strength of the echoes from the sea/river bottom. This is performed by a towfish, which is towed just above the ocean bottom by a tow cable. The towfish emits a continuous, narrowly focused beam of sound perpendicular to the path of forward motion. The sound pulses pass through the water and are reflected by the ocean bottom and from various objects such as shipwrecks, debris, and geographic features (sand ripples, rocks, etc.). The strength of the signal returned to the towfish is recorded, and then the entire sonar record line is drawn onto the screen for viewing by the operator. An image of the ocean bottom is constructed line by line as the sonar record line from each pulse of the sonar is returned to the PC and then displayed onto the color monitor.

Figure 14. Marine Sonic Technology side-scan sonar ready for deployment.

The MST Sea Scan PC side-scan sonar was linked to the towfish that employed a 600-kHz power setting and a variable side range of 20 meters per channel on each of the side-scan lines run. The 20-meter-per-channel setting provided coverage of the target areas for those targets exhibiting relief off the ocean bottom. The power setting was selected in order to provide maximum possible detail on the record generated; 600 kHz was the preferred frequency. The 20-meters-per-channel selection made it possible to collect acoustic data over a 120-foot wide area on each line for which the side-scan sonar was employed while providing suitable resolution.

Survey Vessel

The vessel used for the remote-sensing survey and diver investigations was the *Venture III*, a 46-foot, all aluminum hulled Breaux-built Crew Boat (Figure 15). The vessel was powered by twin diesel engines and an on-board power source for the electronic equipment. The *Venture III* had an enclosed cabin to protect the electronic equipment from the elements and ample deck space for the handling of remote-sensing towfish(s) and for dive operations. The project vessel conformed to all U.S. Coast Guard specifications according to class, and had on board all required safety equipment. The vessel carried its own spare-parts kit, tool kit, first-aid materials, and potable water; these were supplemented by similar supplies provided by Panamerican. Captain Paul Hepler (U.S. Coast Guard Licensed) piloted the *Venture III*, which was berthed in the Lawrence Villa Marina, Lawrence, Long Island.

Figure 15. The 46-foot, all-aluminum hulled Breaux-built Crew Boat *Venture III* out of Lawrence Villa Marina, Lawrence, Long Island.

REMOTE-SENSING TARGET REFINEMENT

Each of the 34 targets had to be relocated before any remote-sensing survey refinement or diver investigations could commence. The coordinates of the anomalies were provided by the Corps (Riess 1993) prior to field investigations and entered into Panamerican's navigation system. The survey vessel then approached each target area and, when the proper coordinates were reached, a reference buoy deposited within close proximity of the target area.

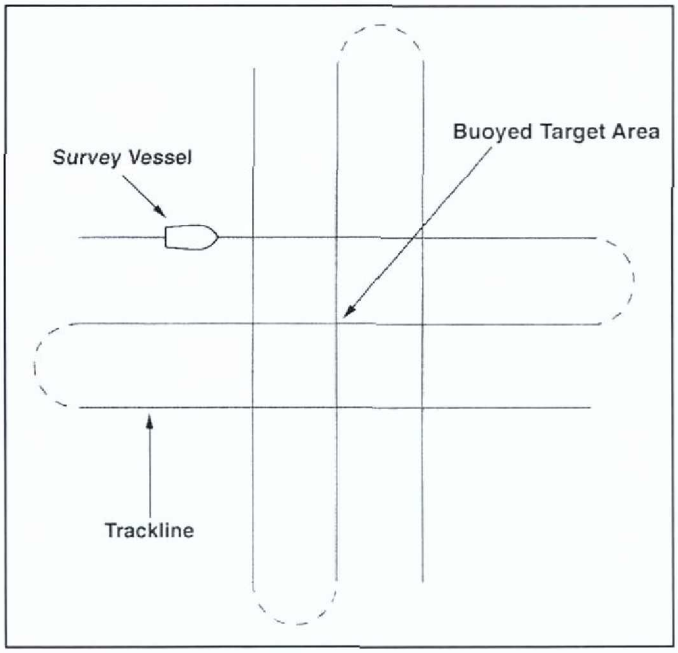

Figure 16. Refinement pattern run over each of the 34 targets during the current investigations.

The first step was to deploy a marker buoy at the coordinates reported by Riess (1993) beginning with Target 1 (proceeding sequentially through Target 34). For each of the targets the magnetometer sensor was deployed over the stern of the work vessel; the data integrated concurrently with the DGPS and navigation system. A minimum of six refinement tracklines were run past the buoyed location in a cruciform pattern in order to relocate and refine the target (Figure 16). Three tracklines were run on a north-south orientation followed by three tracklines on an east-west heading. This pattern allowed for complete coverage of the reported target location and helped to establish the exact location of the anomaly. Each refinement trackline was a minimum of 300 feet in length, extending at least 150 feet to either side of the buoyed location. The mid-line of each directional set (north-south, east-west) of tracklines passed directly over the buoyed location. Trackline spacing was approximately 50 to 60 feet apart depending on environmental factors including wind, waves, and currents.

During refinement runs additional buoys were continually deployed and recovered until little or no further refinement was necessary. Once the magnetic target was relocated and buoyed, remote-sensing operations ceased and the diving phase of the project began. If no reproducible magnetic targets were found within the general area, the target was written off as no longer present within its prescribed location and operations moved to the next sequential target.

DIVER INVESTIGATIONS

Once the target locations were refined the next phase of the project was to attempt to locate the source of the anomaly either through visual or tactile methods. Prior to diving, the direction of the tidal current relative to the target areas had to be ascertained. The ebb and flow of the tide determined the orientation of the survey vessel and effected the deployment of tools the diver would use on the sea floor. Anchors were then placed to hold the survey vessel over the target area and allow the diver safe entry and exiting from the stern of the vessel.

Figure 17. Surface Supplied Air (SSA) support system set up on the starboard side of the *Venture III*.

Surface Supplied Air (SSA) was chosen as the most efficient and safe method of conducting investigations in the tidal environment (Figure 17). Divers employed a Superlight 17-B helmet connected to a surface-supplied air source, radio communications cable, safety tether, and pneumo hose (Figure 18). On the surface, various individuals and pieces of equipment ensured safe diving operations. A dive tender was required to aid the diver in donning and doffing equipment and to tend the diver while submerged and moving about the sea bed. The radio operator kept in constant contact with the diver and relayed messages between the diver and the surface support team. A standby diver was required on site in the event of any emergency that would require aid to the primary diver. Finally, a dive supervisor was present on site at all times to coordinate the activity of the diver and surface support team to achieve the project goals.

The initial objective for the diver was to visually inspect the sea floor for the source of the anomaly prior to conducting any metal detecting and/or hydroprobing. The diver was first directed to the reference buoy located over the anomaly. If the source of the anomaly was not quickly observable on the surface of the sea floor near the buoyed location, the diver was then guided (by means of surface communications) to a pre-determined distance from the buoy. His location via the buoy was then recorded by the surface crew and a series of arcs to cover the area around the buoy was then undertaken. If no cultural materials were observed on the surface of the sea floor, the diver was given a underwater metal detector and/or hydro-probe to locate the source and burial depth of the anomaly.

Underwater Metal Detecting

If no targets were visually located after a series of arcs around the refinement buoy, the diver was given a J.B. Fishers MFG. Co. Pulse 8 underwater metal detector to more accurately refine the buried anomaly (see Figure 18). While somewhat limited in its ability to penetrate the sand bottom, this tool proved to be the most effective in localizing the source of many of the buried targets during the current investigation, as most were only lightly covered in sediment. Once the target was further refined, the diver moved a buoy over the source of the highest magnetics and prepared to either cut a trench across the area or hydro-probe the area in an effort to identify the source of the magnetics.

Figure 18. Diver, suited and wearing a Superlight 17-B helmet, prepared to investigate a target with the underwater metal detector.

Underwater Water Jet

The underwater water jet proved to be the most efficient means of removing sediment over a localized anomaly, resulting in the positive identification of each buried target. After the spatial extent of the anomaly was refined with the underwater metal detector and a buoy placed at the center of the highest magnetics, the underwater water jet was fed down to the diver by the support team on the surface. The water jet apparatus consists of a water pump, hoses, and a hand-held jet which effectively blows off overburden from over the source of the anomaly. This is accomplished by forcing water through a pipe which is attached to the water pump's effluent hose. For this project a 5-h.p. Honda water pump was connected to lengths of 1.5 inch fire hose, which was then connected by a camm lock to the water jet. If the use of the water jet failed to locate the source of the anomaly, the water jet was de-cammed and the diver was provided with a underwater probe which is more effective in locating deeply buried anomalies.

Underwater Probing

Probing of anomalies is an effective means of determining the spatial extent and burial depth of a given target located beneath the sea floor. The hydro-probe apparatus consists of a water pump, hoses, and various lengths of pipe. The hose was connected to the 1/2-inch diameter PVC pipe probe by a camm lock. The length of the hydro-probe used for this investigation was 10 feet. The basic function of the hydro-probe is to aid in determining the spatial extent of buried cultural material, the type of cultural material (i.e., wood, iron), and amount of overburden. This is accomplished by forcing water through the 10-foot pipe attached to the water pump's effluent hose. The force of the water ejected from the pipe end effectively allows the probe to be inserted through sediments of varying density (i.e., sands, silts) and depth.

Probes were spaced at 5 to 15-foot intervals during the investigation depending upon the amount of refinement necessary. If a positive return was encountered, probing distances were refined in an effort to outline the size of the return. Probes were placed at all cardinal points (north, south, east, west) to further delineate any positive returns. While typically a useful tool for underwater archaeologists, the hydro-probe was not as useful during the current investigation as the water jet. The buried anomalies located were typically strands of iron/steel cable which are difficult to delineate with the hydro-probe.

RESULTS

The refinement survey and diver investigations of 34 targets located within Borrow Area 2 was intended to relocate and identify any potentially significant submerged cultural resources which might require additional investigations prior to proposed future dredging operations. The survey was completed in an effort to identify those targets which might be eligible for inclusion into the NRHP. A magnetometer and side-scan sonar survey completed of the area in 1993 (Riess 1994b) identified 34 potentially significant targets within the Borrow Area 2. These previously located anomalies were the focus of the current investigation.

Table 8. Potentially Significant Targets Located within Borrow Area 2.

Target	Easting	Northing	Gammas	Description
1	2048665	118875	46	Side-scan: 2-3 small circular targets, 1-3 feet diameter, less than 2 ft. relief
2	2048645	119090	21	Side-scan: elongate target, 10-20 ft. long, 1-2 ft. wide, less than 1 ft. relief, partially buried
3	2048170	119215	61	Side-scan: one or more circular targets, 2-4 ft. diameter, 1-3 ft. relief.
4	2048385	120210	15	Side-scan: single elongate target, 10-15 ft. long, 1-3 ft. wide, 1-2 ft. relief
5	2047945	120515	51	Magnetic field anomalies evident on 2 lines
6	2047400	120470	69	Mag. anomalies on 3 lines
7	2047475	120905	51	Side-scan: single target, 4 x 8 ft. size, less than 2 ft. relief, partially buried?
8	2047640	120955	24	Single mag. anomaly
9	2047730	121025	49	Side-scan: oval-shaped target, 3 x 6 ft. size, possibly 8-15 ft. relief.
10	2048025	121160	74	Side-scan: 1-2 oval shaped targets, 3 x 5 ft. size, 1-2 ft. relief, mag anomalies on two lines.
11	2047930	121490	25	*Single mag. anomaly*
12	2048930	121555	16	Side-scan: elongate target, 8 x 20 ft. size, 2-4 ft. relief
13	2049210	121570	50	Mag. anomaly on 2 lines
14	2049460	121525	61	Side-scan: elongate target, 10-15 ft., 1-3 ft. wide, 2-4 ft. relief.
15	2048640	121150	17	Single mag. anomaly
16	2049420	121210	16	Side-scan: elongate target, 10-15 ft. long, 2-4 ft. wide, 1-2 ft. relief.
17	2049085	120455	147	Side-scan: series of point returns along same alignment, each 1-3 ft. dia., 1-2 ft. relief, possibly cable or pipe? Mag. anomalies on 8 lines
18	2049150	119630	23	Mag. anomalies on 2 lines
19	2049610	119535	40	Mag. anomalies on 2 lines
20	2049795	119580	64	Side-scan: elongate target, 50-70 ft. long, 1-4 ft. wide, 1-3 ft. relief
21	2050125	119445	19	Side-scan: one or more targets, 4-8 ft. long, 3-5 ft. wide, less than 2 ft. relief.
22	2051400	121360	22	Mag. anomalies on 2 lines
23	2051605	121485	53	Mag. anomalies on 3 lines
24	2051795	121965	12	*Single mag. anomaly*
25	2052445	120430	23	Mag. anomalies on 3 lines
26	2052790	120605	19	Side-scan: elongate target, 2-50 ft. long, 1-3 ft. wide, 1-3 ft. relief, possible cable?
27	2052595	120650	16	Single mag. anomaly
28	2052450	121045	18	Single mag. anomaly
29	2052700	121205	47	Mag. anomalies on 2 lines
30	2052460	121250	40	Mag. anomalies on 2 lines

Table 8. continued

Target	Easting	Northing	Gammas	Description
31	2052490	121505	48	Single mag. anomaly
32	2052500	121975	18	Mag. anomalies on 2 lines
33	2052710	122005	30	Mag. anomalies on 2 lines
34	2053145	121190	13	Single mag. anomaly

(as presented in Riess 1994b:7-8)

As stated, once a target was adequately refined, the dive boat was anchored near the site with the buoy located off the stern. After anchoring the vessel a diver suited up and prepared to enter the water. Upon reaching the bottom the diver took a pneumo depth gauge reading to determine the amount of bottom time allowable for the diver. The diver was then directed to the refinement buoy in an effort to locate the source of the anomaly. If the anomaly was not exposed above the ocean bottom near the buoy, the diver was then instructed to swing in a series of arcs to either side of the buoy. If the target was still not identified, the diver was given an underwater metal detector to determine the highest magnetic source of the buried object. Once the area was defined an additional refinement buoy was placed at the center of the magnetic source and the diver prepared to hydro-probe or water jet in an attempt to identify the buried target. The following represents the findings of each of the 34 targets refinement and subsequent identification.

TARGET 1

Previously identified as a single 46-gamma magnetic anomaly, Target 1 was reported to have 2-3 small circular associated side-scan sonar returns. A buoy was placed over coordinates provided by Riess, in approximately 39 feet of water. Refinement of the target (with the magnetometer) produced a 22-gamma dipole anomaly (Figure 20). Only three transects were run over the area before the target was adequately relocated and refined with an additional buoy.

Diver investigation of the target site identified the source of the anomaly as three exposed sections of 2.5 inch diameter armored cable protruding from the sea bed (Figure 19). Each exposed section of cable was approximately 2 to 7.5 feet in length. The cable appears to be heavily-armored, likely associated with a telephone/telegraph line. Exposure of the cable is likely due to active trawling in the area or snagging by anchors. The diver placed a refinement buoy for exact positioning which was shot in with the DGPS before leaving the

Figure 19. Exposed section of 2.5 inch-diameter armored cable identified as Target 1.

site. The cable was recorded with an underwater video camera. Side-scan sonar investigation of the area did not indicate any exposed sections of the cable. This site is not considered significant.

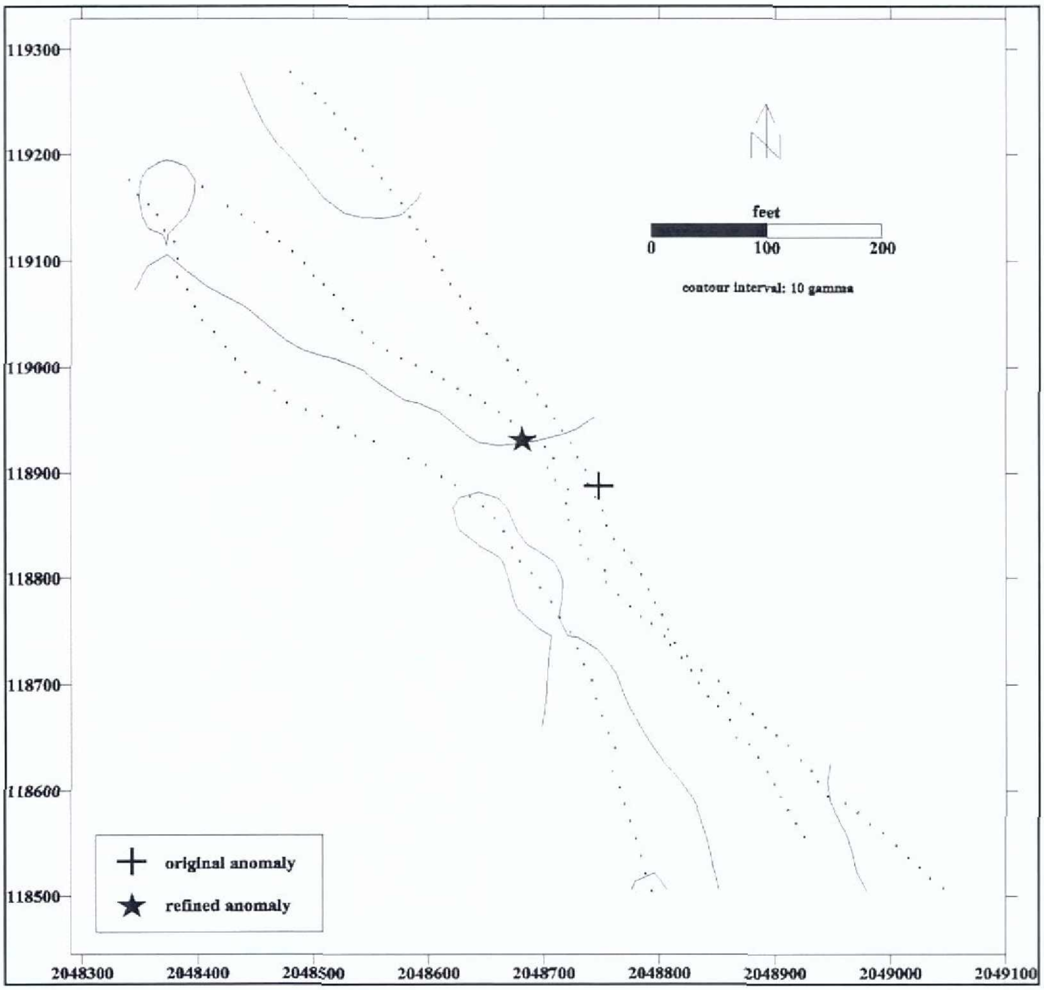

Figure 20. Magnetic refinement map of Target 1.

TARGET 2

Riess reported Target 2 to be a single source, 21-gamma magnetic anomaly with an associated side-scan sonar image (elongate target, 10-20 ft. long). Five refinement runs were made over the target location prescribed by Riess (1994:7). Magnetic refinement of the target area did not indicate the presence of any magnetic anomaly (Figure 21). This anomaly appears to have been mobilized from its original location and was not relocated during any of the refinement runs. From Riess' description of this object (Riess 1994b:7), it could have been an exposed piece of debris located on the ocean bottom which has since been moved from its original location either by trawling/surf clam dredging activities (Figure 22), anchoring, and/or environmental factors (currents, surge, tidal influences). No diver investigations were conducted at this site.

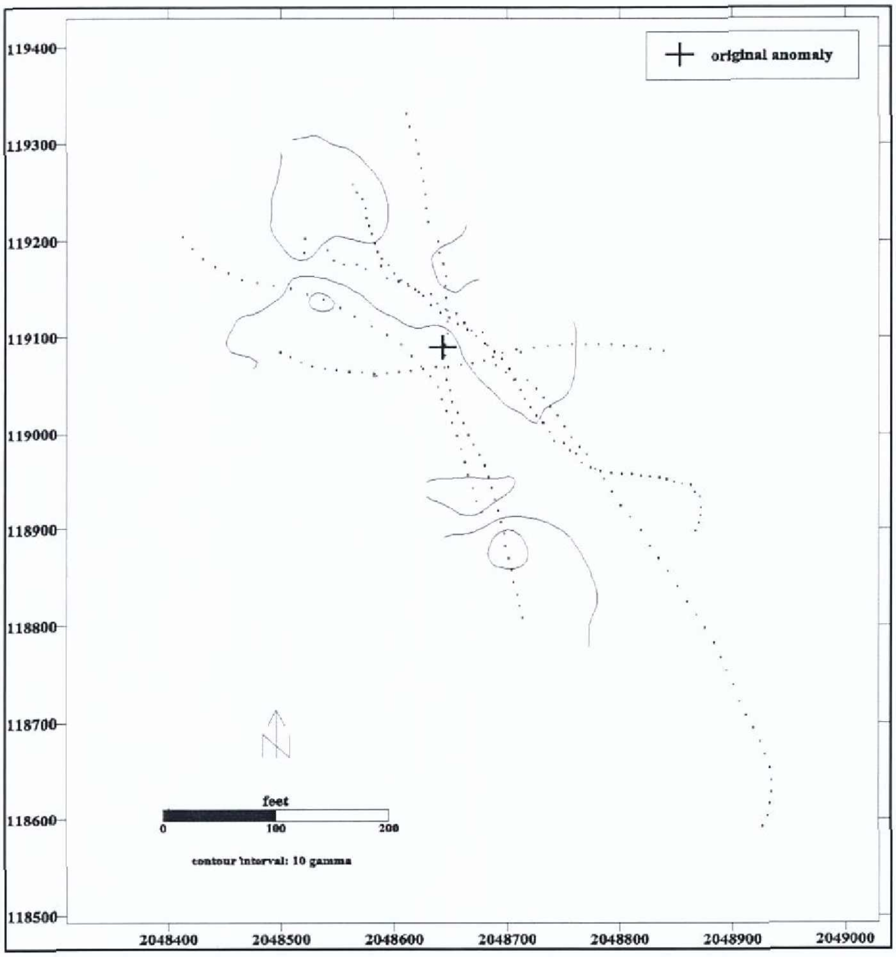

Figure 21. Magnetic refinement map of Target 2.

Figure 22. Surf clam dredging activities within the project area. Note the close proximity of the vessel to the refinement buoy in the foreground.

TARGET 3

Reported by Riess as a single 61-gamma magnetic anomaly, Target 3 also had an associated side-scan sonar return (one or more circular targets, 2-4 ft. diameter, 1-3 ft. relief). A buoy was placed over coordinates designated by Riess (1994:7). Seven refinement passes were made with the magnetometer. Magnetic refinement of the target area did not identify the presence of any anomaly source within the refinement square (Figure 23). Only a small, single point, 10-gamma anomaly was recorded approximately 180 feet east of the buoyed location. This anomaly was not considered significant enough (due to its single point signature) to warrant diver investigation. It appears that Target 3 has also been moved from its original location since located in 1993. No diver investigations were conducted at this site.

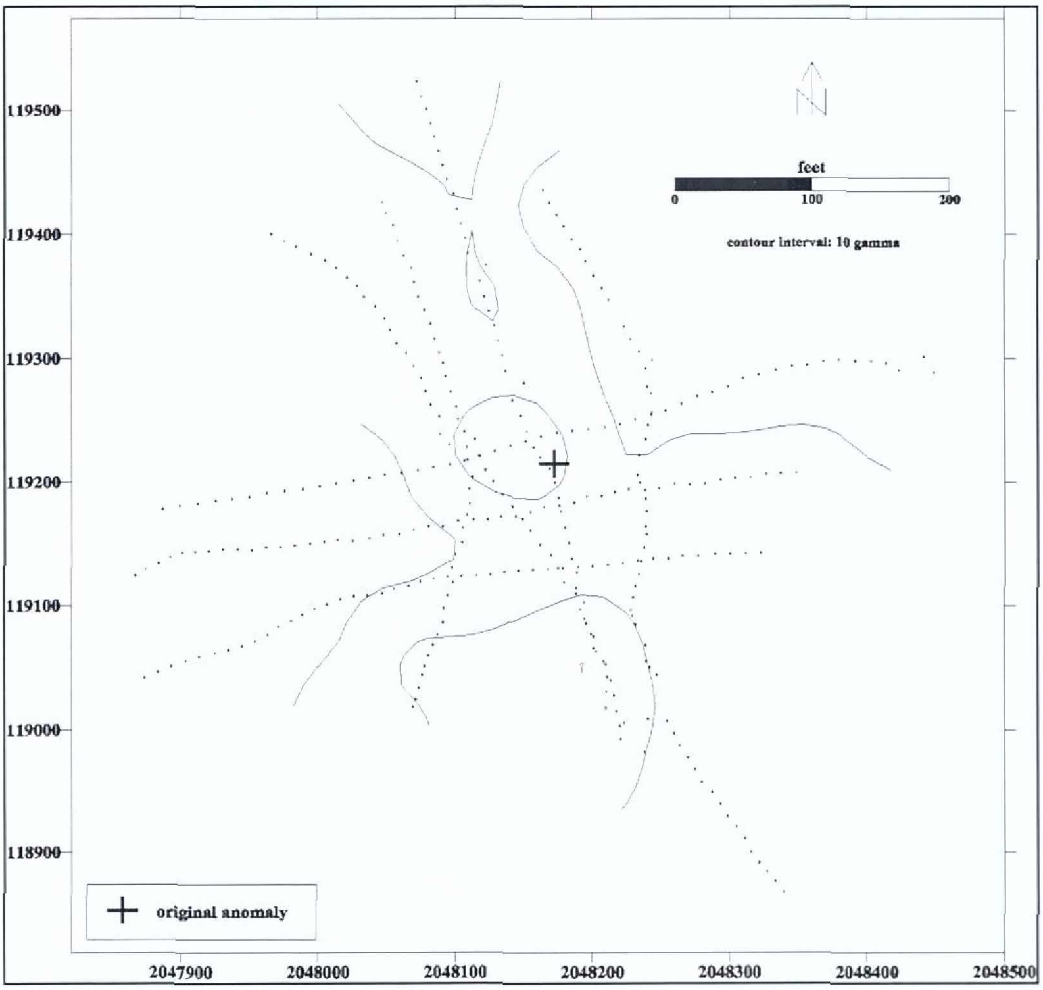

Figure 23. Magnetic refinement map of Target 3.

TARGET 4

Target 4 was reported as a single, 15-gamma magnetic anomaly with an associated elongate side-scan sonar return, approximately 10-15 feet in length, 1-3 feet in width with 1-3 feet of relief (1994:7). A reference buoy was dropped at the location designated by Riess in approximately 45 feet of water, and five passes were made over the location before the target was adequately refined. An additional refinement buoy was placed at the location of the anomaly. Magnetic refinement of the target area indicated the presence of a 34-gamma magnetic anomaly (Figure 24). During refinement runs an exposed feature, three to four feet in height, was noted on the *Venture III*'s fathometer, and depth on site was 46 feet. Target 4 was one of the deeper targets encountered during the project. This is believed to be due to the close proximity of the target to the inshore area previously dredged by the Corps (as noted by Riess 1994b:9).

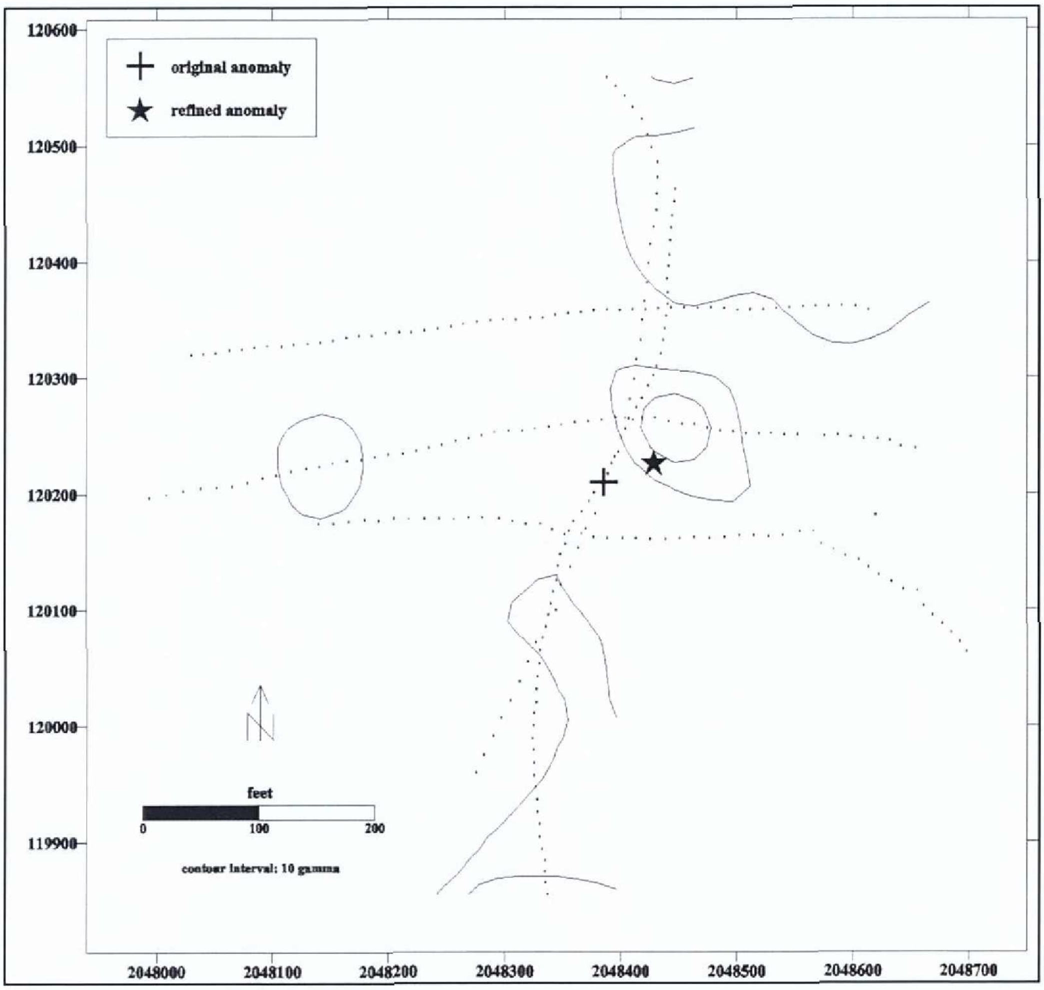

Figure 24. Magnetic refinement map of Target 4.

Diver investigation indicated the source of the anomaly as a large block of concrete and rebar. Three other smaller sections of broken concrete and rebar, associated with the larger block, were observed in close proximity. Observations by the diver indicate that these targets are associated with dismantled bridge span components from an unknown source. Measurements of the largest section indicated that the target was 28 feet in length with a maximum width of five feet. The large concrete span was roughly trapezoidal ("T") in shape, lying mostly flat on the ocean bottom (Figure 25). A large concave depression was recorded running along a majority of the centerline length of the span, approximately two feet in depth and two feet across. The raised sides of the depression were approximately one foot in width. One side of the span was exposed 1' 6" above the ocean bottom, while the opposite side was exposed 2' 6".

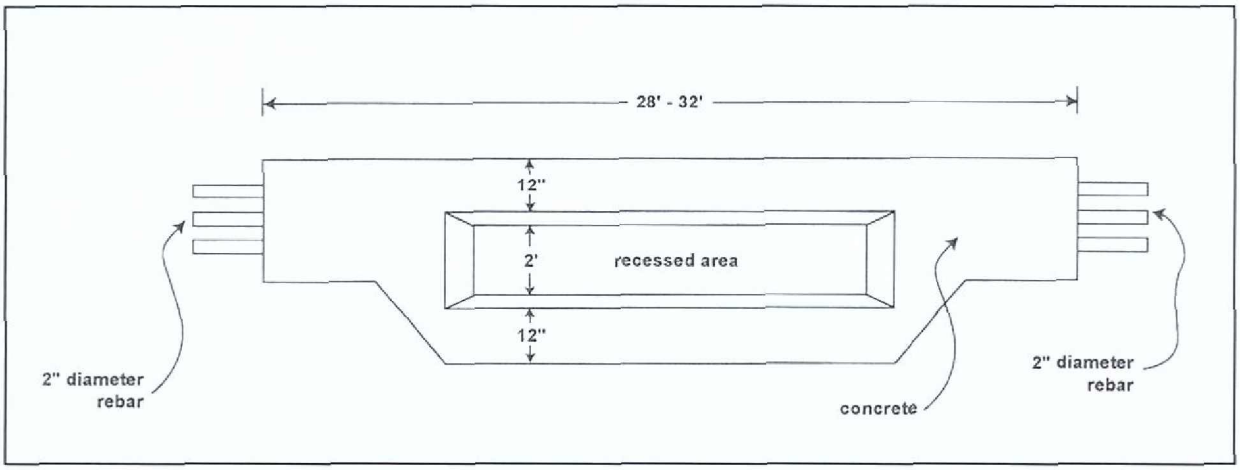

Figure 25. This drawing of Target 4 represents a close approximation (not to scale) of the concrete/rebar bridge spans identified throughout the project area during the current investigations.

Numerous industrial-strength rebar reinforcement rods extended out both longitudinal ends of the span. Each exposed section of rebar was two inches in diameter. The diver was given an underwater digital video camera to record the exposed portions of the target (Figure 26). Before returning to the surface the diver placed a refinement buoy at the center of the target to obtain an exact position.

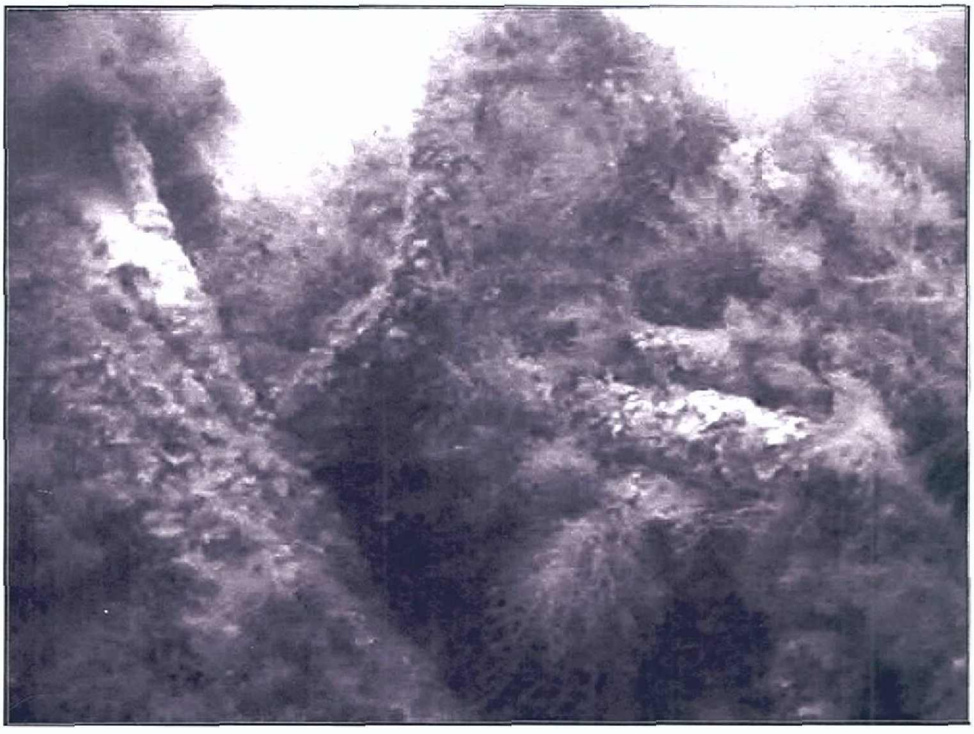

Figure 26. Close-up of exposed portion of Target 4 showing marine growth.

A side-scan sonar image of Target 4 clearly shows the shape of the concrete/rebar span exposed above the ocean bottom (Figure 27). In Dan Berg's book *Wreck Valley Vol. II* there is a section on Fish Havens (artificial). Berg describes in brief detail each of the six artificial reefs along the south shore of Long Island, including the one off Rockaway Beach (1990:44). Berg indicates that the artificial reef off Rockaway Beach is in 30 to 45 feet of water and consists of: "2,000 tire pyramids, each consisting of three tires; 420 tons of concrete culvert pipe, 12 inches to 72 inches in diameter; eight barges of concrete rubble; 60 steel buoys; and 25 barge loads of tunnel rock" (1990:44). It is likely that Target 4 is the remnants of some of the concrete rubble described by Berg and was unknowingly or illegally deposited out of the prescribed area as artificial reef material. Target 4 is considered modern and is not significant for the purposes of this investigation.

TARGET 5

Riess describes Target 5 as a magnetic anomaly with a 51-gamma deviation recorded on two survey transect lines. A marker buoy was placed within five feet of the coordinates provided and the magnetometer deployed in an effort to relocate the target. Seven transect lines were run over the target area before the magnetic target was adequately refined and buoyed. Panamerican recorded a dipole anomaly of roughly 53 gammas within 50 feet of Riess' original location (Figure 29). Once the diver reached bottom, a pneumo-gauge reading showed a depth of 40 feet.

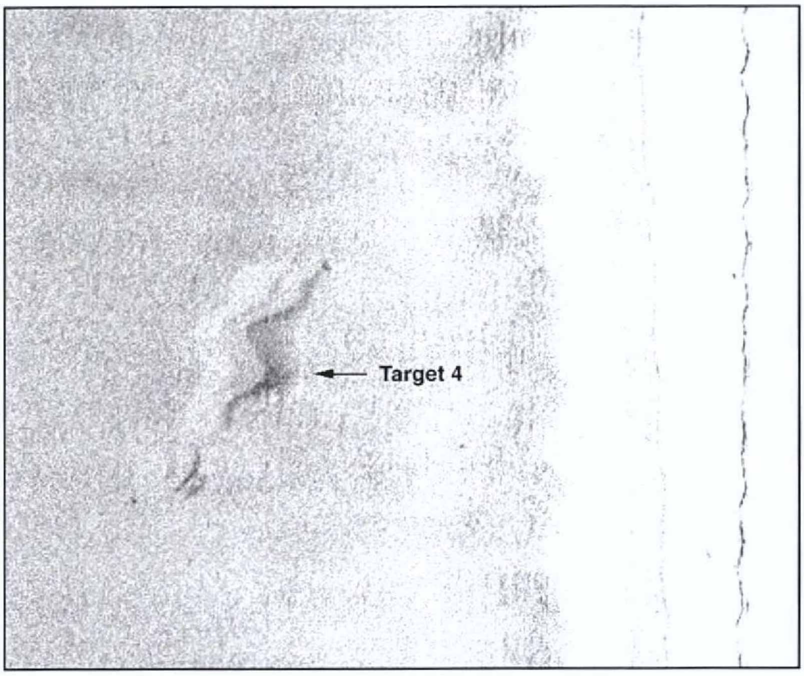

Figure 27. Side-scan sonar image of Target 4 exposed on the ocean floor.

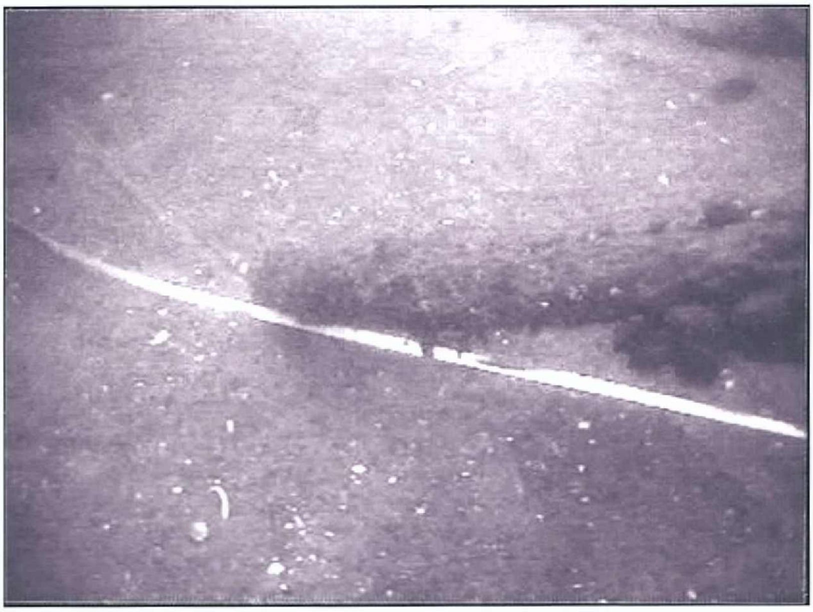

Figure 28. Underwater video image of Target 5.

The diver conducted a series of arcs (spaced 20 feet apart) around the location of the refinement buoy and quickly located the source of the anomaly. The diver reported at least two sections of exposed, heavily-armored wire cable. One section pulled off the bottom was shaped in an arc similar to the St. Louis Arch. This section of cable is arched off the bottom approximately six feet with an exposed length of seven feet. It appears that a dragged anchor is the cause of this portion of cable being exposed.

The next section of exposed cable is lying horizontal to the bottom and is exposed for four feet. Both sections of this large, heavily-armored cable are the same cable oriented roughly parallel to shore. The diver reported similarities between this cable and the one identified as Target 1. After videotaping the exposed sections of cable (Figure 28), the diver placed a refinement buoy at the center of the target for exact positioning This site is not considered significant for the purposes of this investigation.

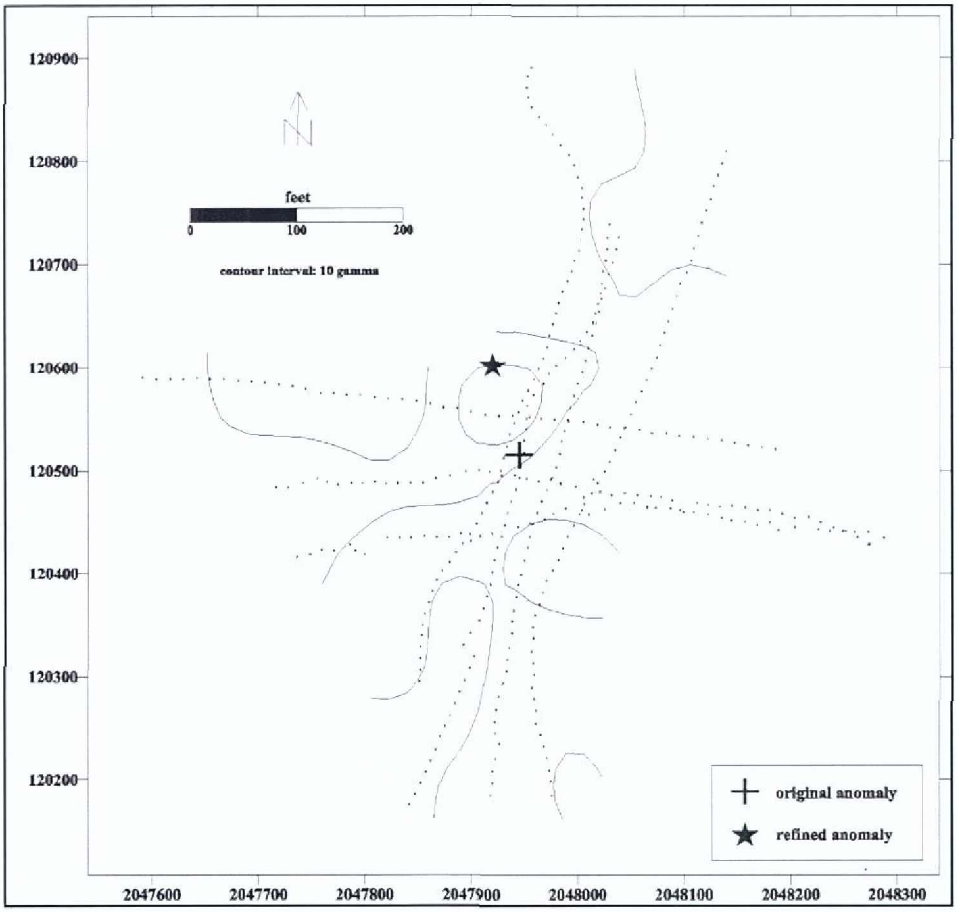

Figure 29. Magnetic refinement map of Target 5.

TARGET 6

Riess reported Target 6 as a magnetic anomaly with a maximum magnetic deviation of 69-gammas recorded on three survey transect lines. A reference buoy placed within approximately two feet of Riess' numbers allowed the refinement survey to begin. Seven transect lines were run over the target area until the anomaly was adequately refined and a buoy dropped. Magnetic data indicated the presence of an anomaly source with a total magnetic deviation of 90 gammas (Figure 30).

The pneumo-gauge reading at the target location was 39 feet. Initial diver sweeps (in arcs spaced at 20 feet) over the target area did not locate any exposed source of the anomaly. Since the anomaly was buried, a metal detector survey was conducted around the refinement buoy. The metal detector survey consisted of walking in cardinal directions (north, south, east, west) from the refinement buoy until the metal detector no longer registered a magnetic signature. The diver carried a measuring tape in each of the four directions to determine the distance from the refinement buoy and subsequent "area" of the anomaly. Target 6 covers an area approximately 44 feet by 60 feet.

The diver was then given a 3-foot long stainless-steel hand probe to determine if the anomaly was buried close to the surface. Proceeding in cardinal directions the diver encountered a hard, impenetrable lens on a number of the probes at roughly 2-3 feet below the surface. The diver was then sent down the 6-foot long stainless-steel probe for more leverage. Again proceeding in cardinal directions at 5-foot intervals, the diver encountered a number of impenetrable hits (i.e., clay lens, wood, metal, rock). It was decided to return the next day to hydro-probe the target area in an effort to either determine the material make-up of the lens or to determine if in fact the lens represented a cultural feature (i.e., wood, metal).

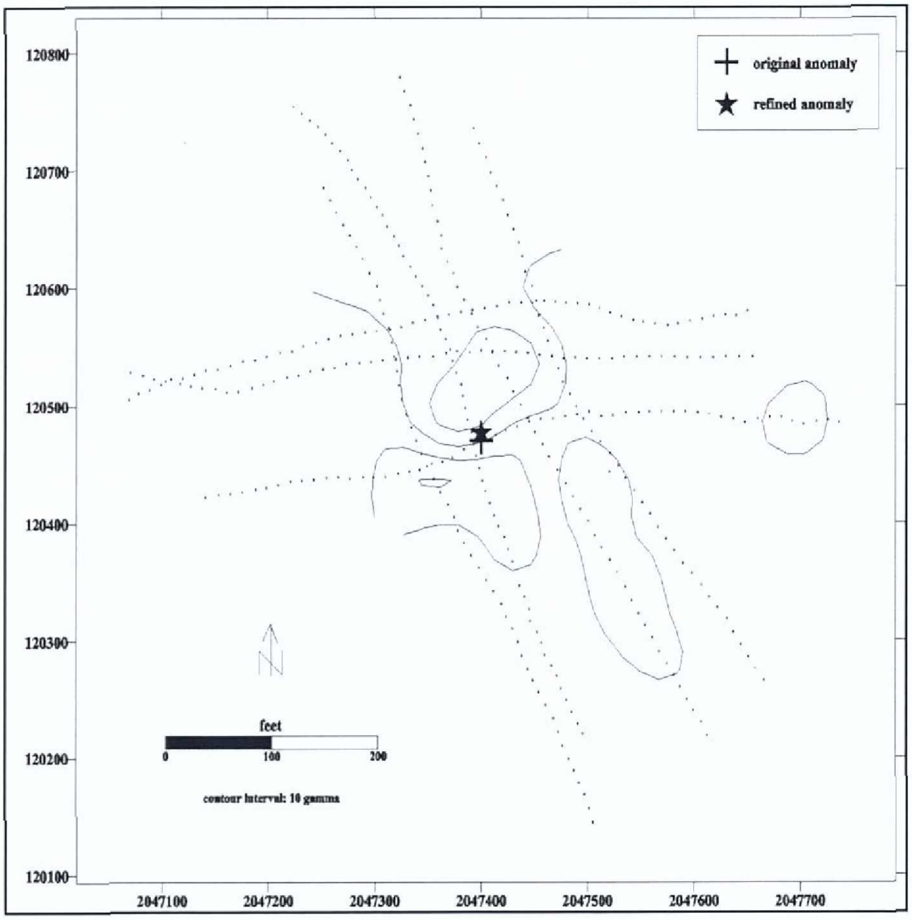

Figure 30. Magnetic refinement map of Target 6.

The next day hydro-probing was conducted at 10-foot intervals to a depth of 10 feet over the entire area (50 feet by 60 feet) of Target 6. No positive contacts were made on any of the hydro-probes. At one probe location near the refinement buoy the diver reported a black/rust coloration of sediment blowing out of the probe hole. It is assumed that the source of the anomaly is either deeply buried or more likely a buried wire cable.

This target, while not positively identified, is very likely a section of wire cable or is too deeply buried to be impacted by Corps dredging activities. One argument against the target not being deeply buried is that the Fisher underwater metal detector used to delineate the target area does not penetrate ocean bottom sediments for more than a maximum of a couple of feet. Target 6 is therefore not deeply buried, and is assumed to be a coil of wire cable that does not retain any structural qualities. This target is not considered significant for the purposes of this investigation.

TARGET 7

Riess reported Target 7 as a magnetic anomaly of 51 gammas with an associated side-scan sonar return of an object 4 x 8 feet in size, apparently partially buried (1994:7). A buoy placed on Riess' coordinates preceded a series of seven refinement runs made over the target area. Refinement of the target located a 59-gamma, monopole anomaly (Figure 31). A refinement buoy was deployed over the source of the anomaly and a diver prepared for investigation of the site. Water depth over the target area was 39 feet.

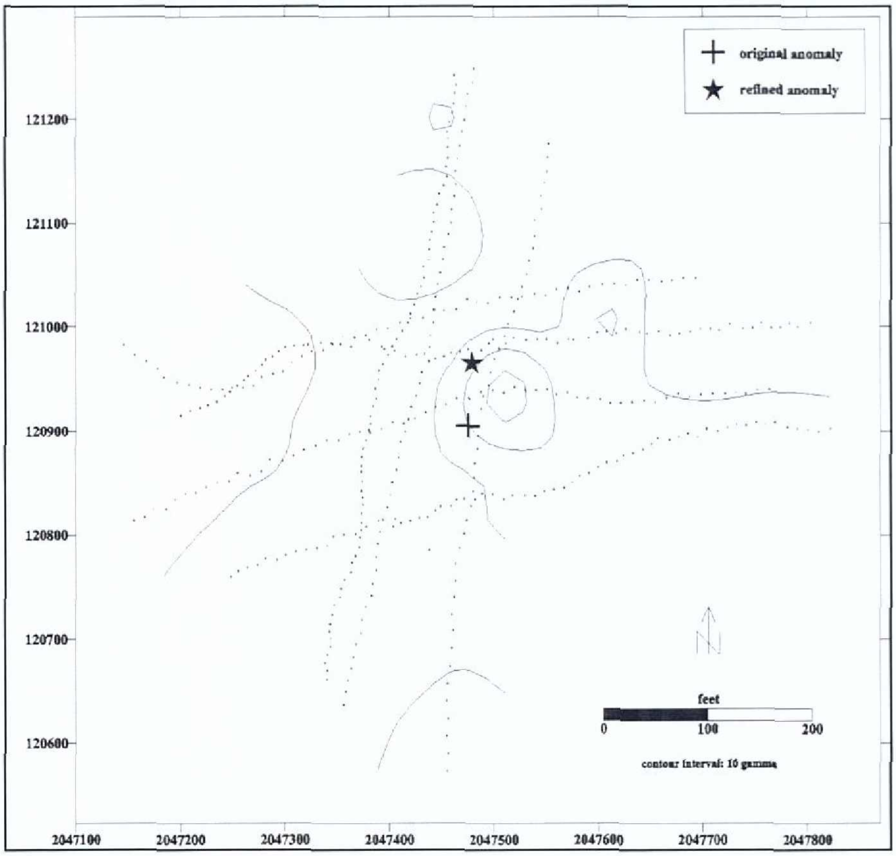

Figure 31. Magnetic refinement map of Target 7.

Initial diver investigation of the target area identified two granite blocks no larger than 2- by 3 feet on the sea bed. Two of the blocks (located about seven feet apart) had one foot of relief above the sand bottom. The metal detector and 3-foot hand probe were sent to the diver for additional testing of the target area. While the metal detector pegged out at "10" directly over the granite blocks, it was not considered the source of the magnetic anomaly. Some additional diver sweeps were made with the metal detector in the area at 20-foot intervals. An additional magnetic anomaly was identified approximately 40 feet from the blocks, covering a localized area, approximately 20 feet in diameter.

Hydro-probing was conducted at 10-foot intervals to a depth of 10 feet over the additional magnetic area with no positive returns. Similar to Target 6, this target was easily discernible with the hand-held metal detector over a rather localized area. However, probing of the area produced no positive returns to 10 feet below the sand bottom. Therefore, it is assumed that the source of the anomaly is likely a wire cable or other small ferrous metal object which is very difficult to locate with either a hand probe or hydro probe (as stated earlier, the metal detector does not penetrate to deeper than 2-3 feet). This site is not considered significant for the purposes of this investigation as it likely represents misplaced modern debris deposited during the construction or addition of artificial reef material (i.e., granite blocks) off Rockaway Beach.

TARGET 8

Riess reported Target 8 as a magnetic anomaly with a 24-gamma magnetic signature recorded on only one survey trackline. The target buoy was placed over the coordinates in approximately 38 feet of water, and six refinement runs were made over and near the buoyed location.

Magnetic refinement of the target area indicated a single point source of 25 gammas that was very localized (Figure 32). Repeated passes to drop a refinement buoy could not recreate the anomaly. Due to the close proximity of Target 8 between Targets 7 and 9 and lack of contouring of the original data, it is considered that the magnetics from this target are associated with either or both Targets 7 and 9. The site did not warrant diver investigations.

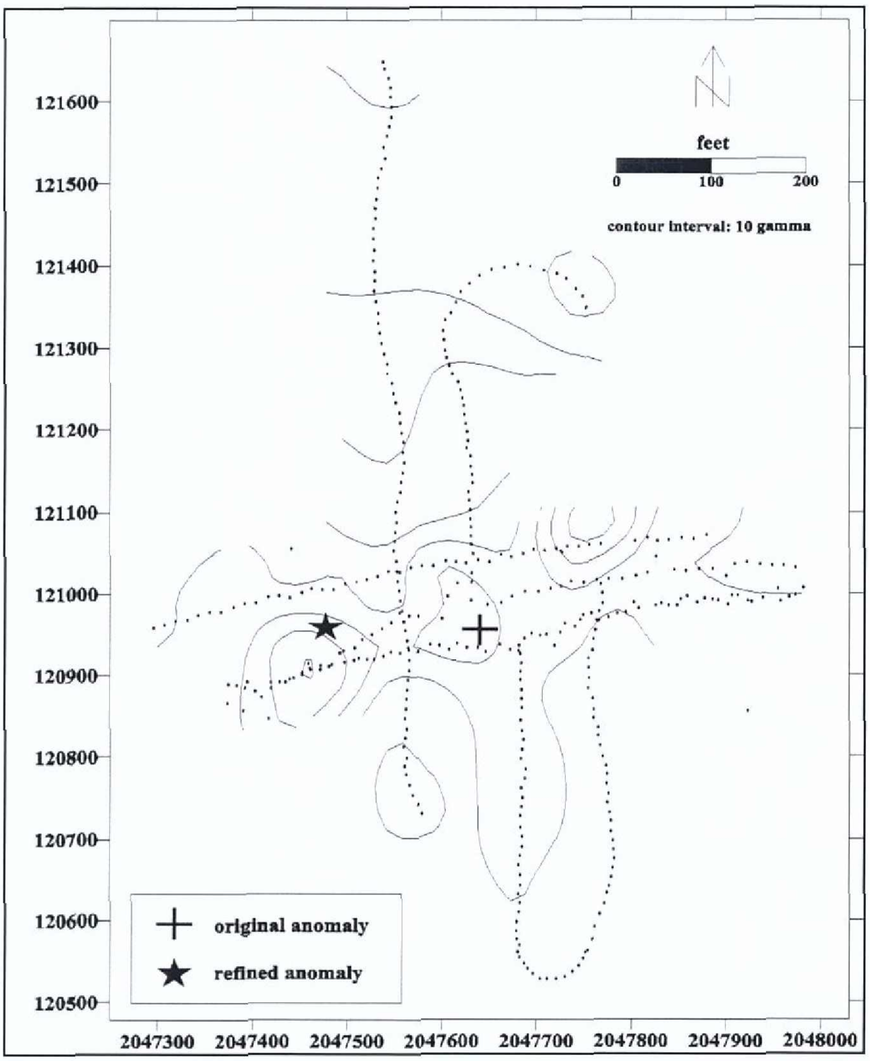

Figure 32. Magnetic refinement map of Target 8.

TARGET 9

Target 9 was identified as a single, 49-gamma magnetic anomaly with an associated side-scan image, oval shaped, 3 x 6 feet in size, with substantial relief (Riess 1994b:7). A buoy placed within seven feet of the coordinates provided by Riess was only 50 feet from the buoyed location of Target 8. Refinement of the target with the magnetometer relocated a 68-gamma magnetic anomaly (Figure 33). Seven passes were made over the targeted location to adequately refine the magnetic target. A refinement buoy was dropped close to the target and the dive vessel anchored for diving operations. Captain Hepler noted a sizable feature rising approximately four feet off the sea floor close to the refinement buoy. A grapple was successfully deployed to the unidentified feature in an effort to guide the diver to the target.

The diver first took a pneumo-gauge reading taken on the ocean bottom that registered 40 feet. Diver investigation quickly identified that the source of the anomaly was modern construction rubble consisting of concrete and rebar bridge spans identical to Target 4. Target 9, however, consists of two bridge spans oriented in an “L” shape. Each of the spans rest three feet above the sand bottom. While Target 4 was lying flat on the ocean bottom, both spans located at Target 9 are lying on their sides. Each of the spans, more intact than Target 4, were approximately 25 to 35 feet in length. The diver was given an underwater video camera to document the site (Figure 34) and a refinement buoy was placed between the two spans for exact target positioning. Subsequent side-scan sonar investigations of Target 9 clearly show the two spans resting on the ocean bottom (Figure 35). This site is considered modern and therefore not significant for the purposes of this investigation.

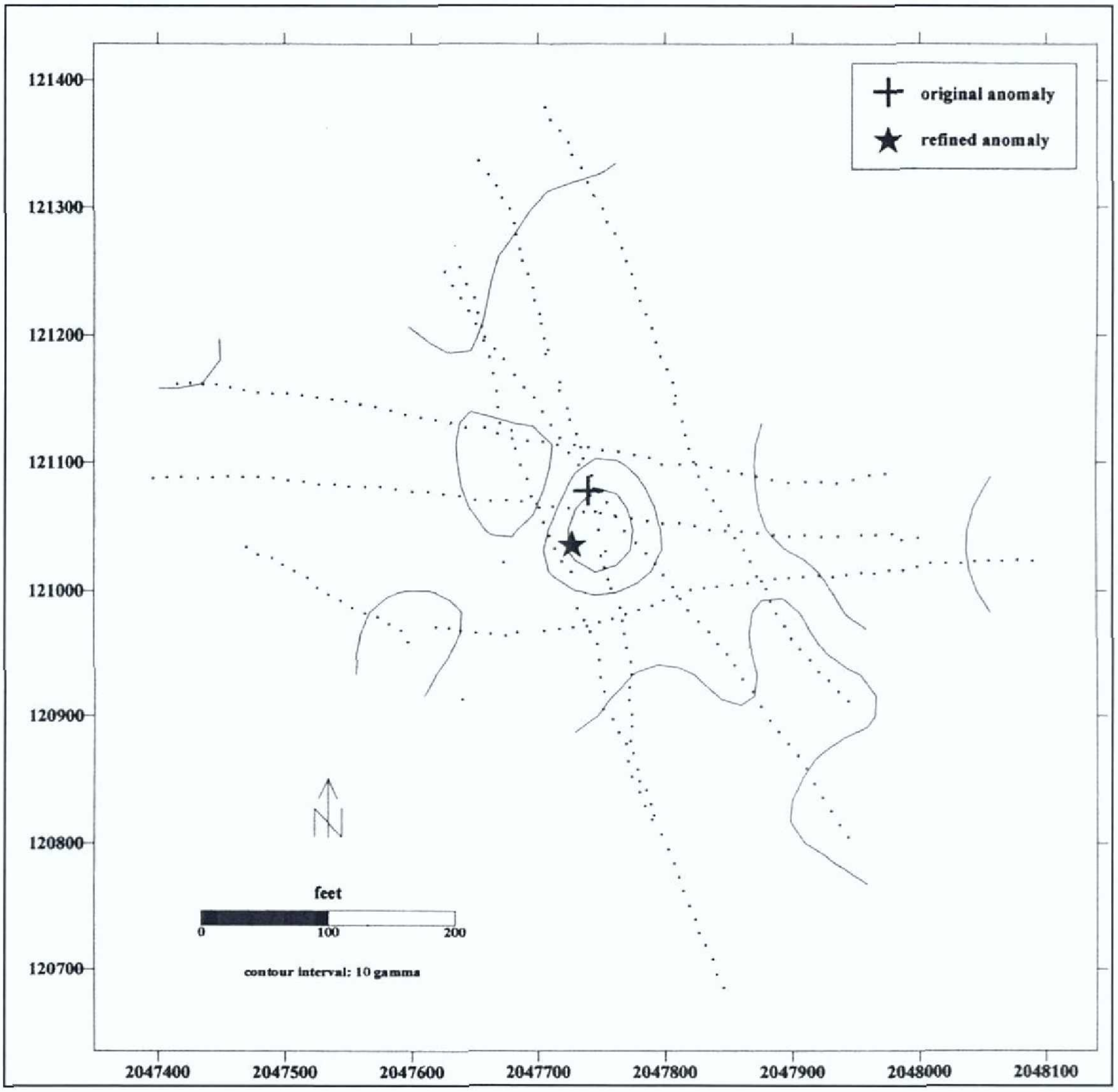

Figure 33. Magnetic refinement map of Target 9.

Figure 34. Underwater video image of Target 9.

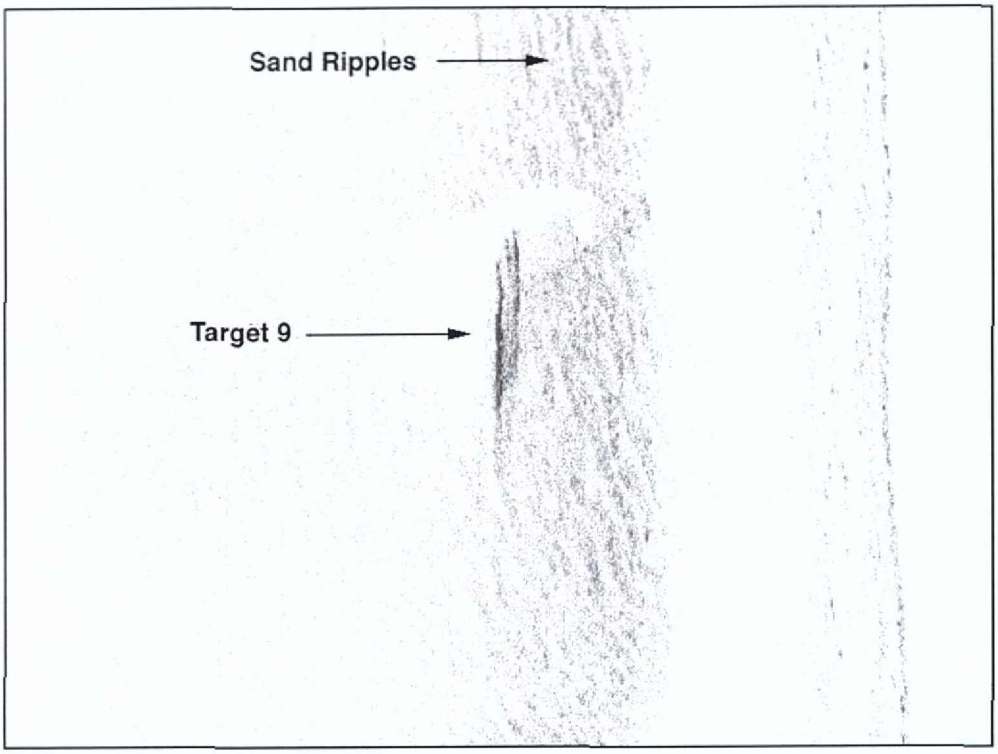

Figure 35. Side-scan sonar image of Target 9.

TARGET 10

Target 10 was initially identified as a 74-gamma magnetic anomaly recorded over two survey transects with an associated side-scan image. A buoy was deployed at the coordinates provided by Riess (1994:7) and six refinement runs were made with the magnetometer.

Refinement of Target 10 located a 76-gamma dipole anomaly (Figure 36) in approximately 45 feet of water. Captain Hepler again observed a feature on his fathometer rising off the ocean bottom at the location of the magnetic anomaly. After anchoring over the refined target, a grapple hook was placed on the feature to guide the diver quickly to the unidentified target.

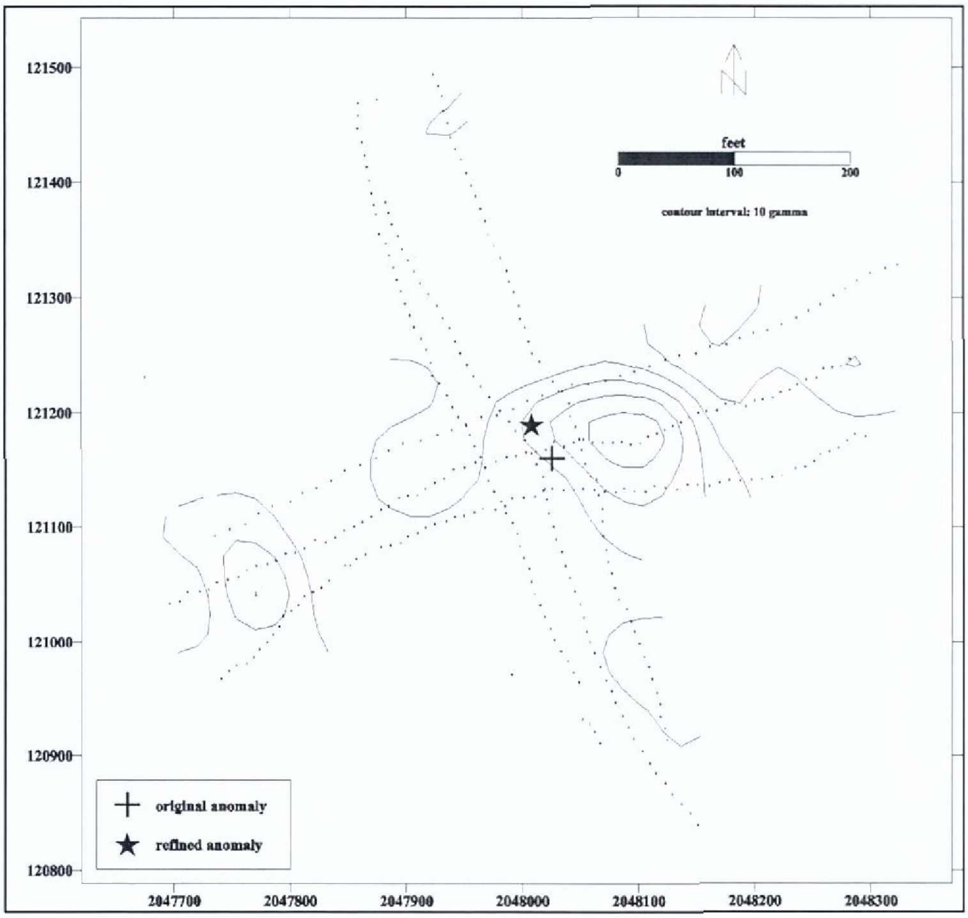

Figure 36. Magnetic refinement map of Target 10.

Upon reaching the bottom the diver took a pneumo reading (45 feet) and quickly identified a large piece of rock or concrete. There was no identifiable source of iron at this feature. The diver continued out the grapple line and quickly located two parallel concrete pillars reinforced with both iron rebar and angle iron. One exposed concrete pillar was 10 inches by 10 inches faced and had an exposed length of 16 feet. The other parallel pillar, located approximately one foot away, was much less exposed. The angle iron, attached to the larger concrete pillar, measured 3" by 3". Although mostly buried, the exposed features of this modern debris are similar to both Targets 4 and 9 and likely represent bridge span remains from the same source. While underwater video footage was shot at this location (even though visibility was only four feet), the footage proved unusable. Subsequent side-scan sonar investigations indicated the exposed features of the target (Figure 37). This site represents the remains of modern debris likely deposited as artificial reef material and is not considered significant for the purposes of this investigation.

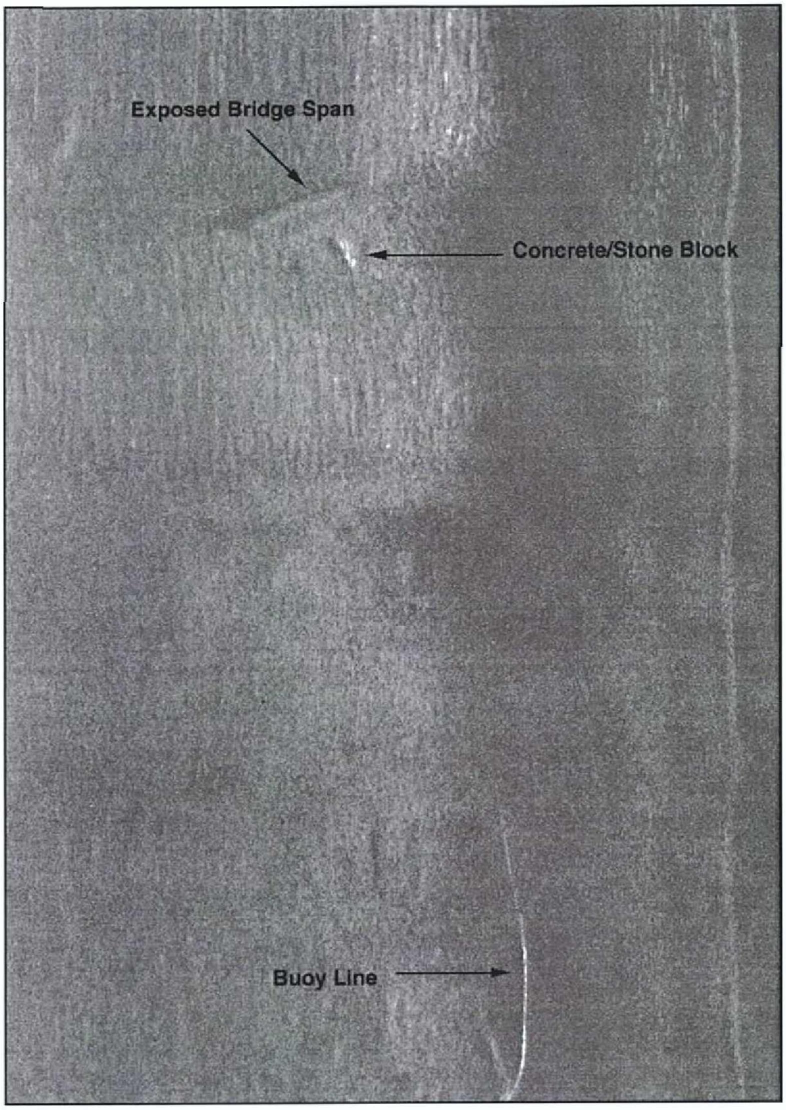

Figure 37. Side-scan sonar image of Target 10.

TARGET 11

Initially reported by Riess as a magnetic anomaly with a maximum 25-gamma deviation (recorded on only a single survey trackline), Target 11 had no associated side-scan image (1994:7). A buoy was placed over the coordinates and six tracklines were run over the location for refinement purposes. Refinement of the target identified a 27-gamma magnetic anomaly (Figure 38).

Once the dive vessel anchored over the site, the diver was suited and proceeded to the bottom. Water depth on site was 45 feet. Preliminary diver investigation (including a series of diver sweeps) around the refined target area indicated no exposed cultural remains. The Fisher underwater metal detector was next used to localize the source of the anomaly, an area covering approximately 18 feet by 21 feet. After localizing the source of magnetics and centering a refinement buoy, the diver requested the water jet to trench across the area. While waiting for the water jet the diver identified a ferrous-metal coupling barely visible above the sea bed. The target was further exposed with a water jet to determine the exact identity of the anomaly.

The object uncovered was a braided wire cable barely buried underneath the sediment. One end of the cable was frayed, consisting of 6-8 individually woven strands. The coupling was located at the center of the exposed cable. The other end of the cable was followed out for approximately six feet before it was determined that the cable was an isolated piece of modern debris and was not significant for the purposes of this investigation. Due to a lack of visibility no underwater video footage was taken at this site. Comparing coordinates from Riess' report (1994:7) with those refined by Panamerican, Target 11 was 33 feet (to the southwest) from its reported location.

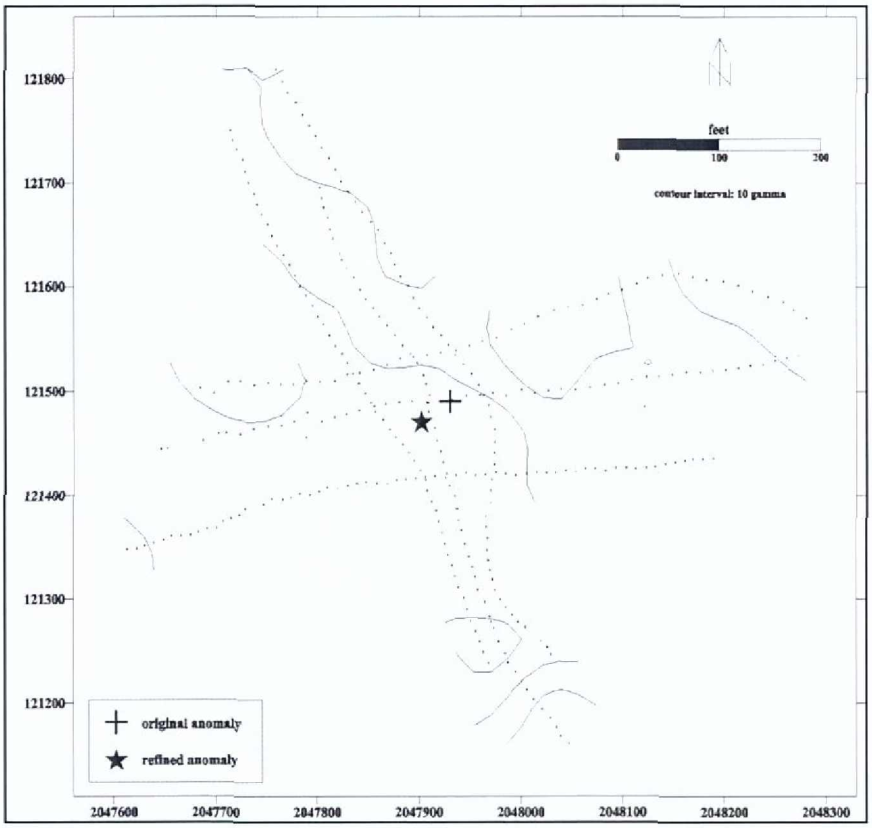

Figure 38. Magnetic refinement map of Target 11.

TARGET 12

Target 12, with a maximum magnetic strength of 16 gammas, had an associated side-scan sonar return identified as an "elongate target, 8 x 20 ft. size, 2-4 ft. relief" (Riess 1994b:7). After dropping a buoy at the location of Target 12, the magnetometer refinement of the target area began. Six refinement runs were made to adequately relocate the anomaly. Refinement of Target 12 indicated a maximum deviation of 38 gammas (Figure 39). Target 12 was visible above the seafloor on Captain Hepler's fathometer during the refinement runs.

After anchoring the dive vessel over the site the diver was deployed and a pneumo-gauge reading taken (43 feet). The diver began arched sweeps along the ocean bottom and within eight minutes located the source of the anomaly. Diver investigation identified the remains of a concrete and rebar bridge span exposed approximately five feet off the bottom. Overall length of the bridge span was 38 feet. Compared to Targets 4 and 9, this identical style of bridge span is more exposed and intact than those previously identified. Lying flat on the bottom, the span has a piece of angle iron, 3" by 3", attached to its top face (identical in dimensions to the angle iron recorded at Target 10).

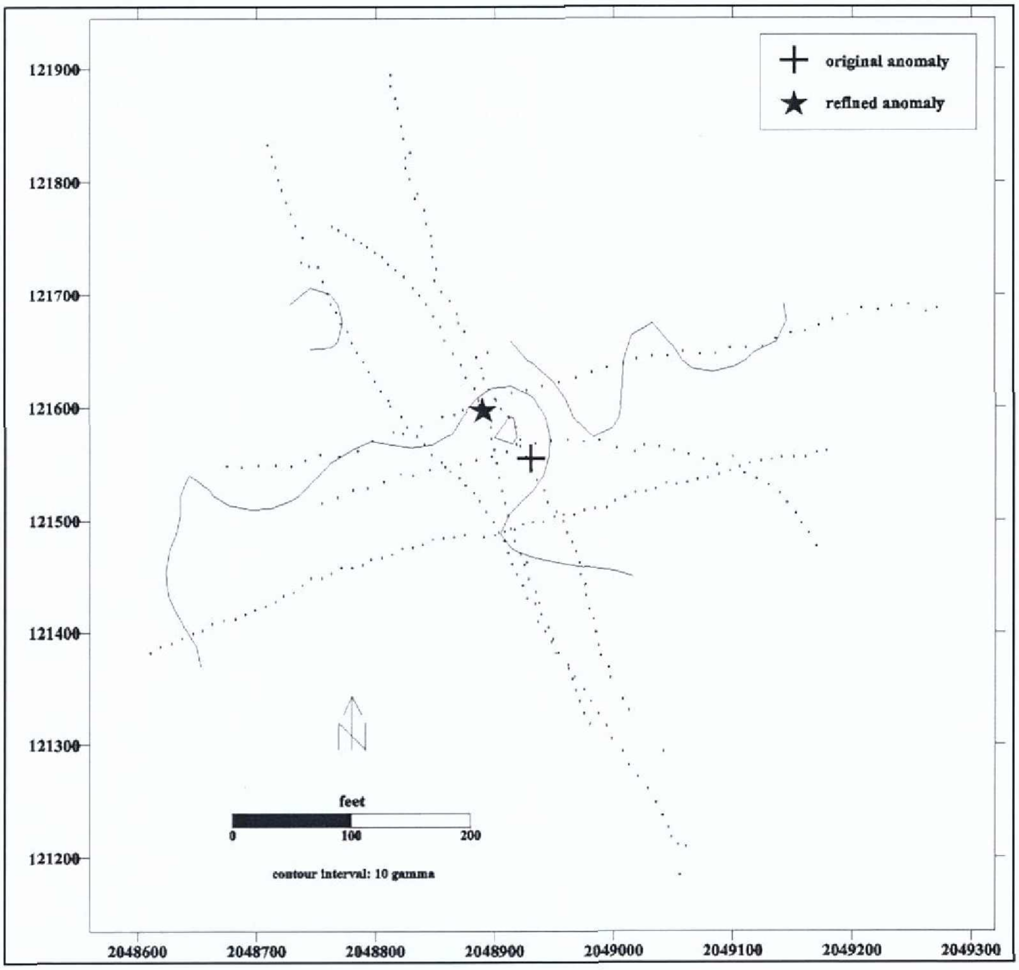

Figure 39. Magnetic refinement map of Target 12.

Industrial strength rebar, extending out both longitudinal ends of the span, is the primary cause of a substantial amount of fish net and fishing line snags (Figure 40). A small Danforth anchor was also observed hung up in the rebar during the dive. A smaller piece of disarticulated concrete was found in close proximity of Target 12. Side-scan sonar investigations indicate a distinct target exposed above the ocean sediment (Figure 41).

Identical in shape and size as the previously recorded bridge span debris, Target 12 is considered modern and therefore not significant for the purposes of this investigation.

Figure 40. Close-up underwater image of net snagged on Target 12.

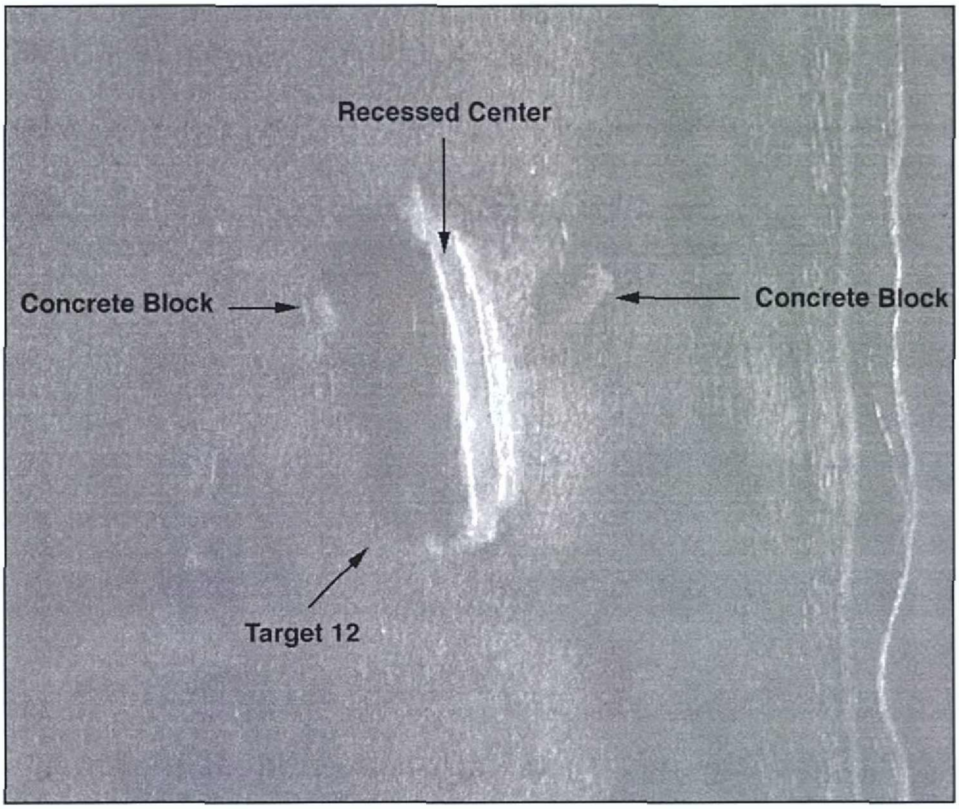

Figure 41. Side-scan sonar image of Target 12. Note the general shape of the bridge span as well as the recessed center and the smaller associated blocks of concrete.

TARGET 13

Reported as a magnetic anomaly with a maximum deviation of 50 gammas, Target 13 had no associated side-scan sonar return (Riess 1994b:7). A buoy was dropped on site and the magnetometer refinement began. Magnetic refinement of the target area indicated no anomaly within 250 feet of the reported location (Figure 42). An anomaly was recorded approximately 250 feet to the east of the original site, closer to the reported location of Target 14. Since Target 13 was not present near its reported location (after six magnetometer refinement passes), no further investigations were warranted at this site. The lack of a magnetic anomaly at this location precluded any diver investigations.

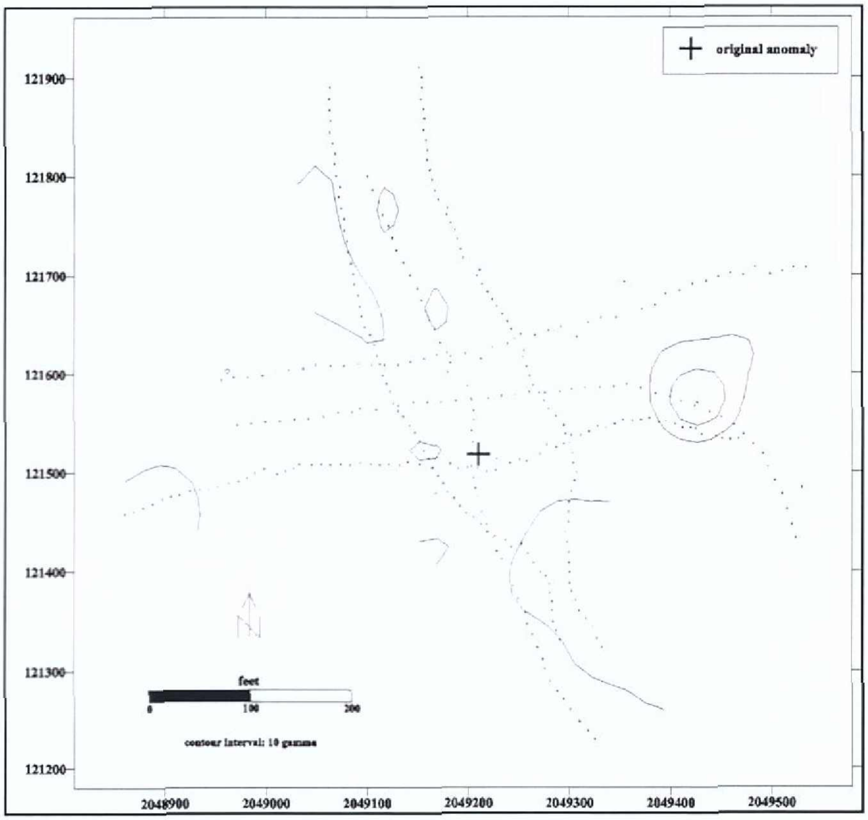

Figure 42. Magnetic refinement map of Target 13.

TARGET 14

Target 14 was originally described as a single 61-gamma magnetic anomaly with an associated side-scan sonar image (10-15 feet in length, 1-3 feet in width) with some relief above the ocean bottom (Riess 1994b:7). A buoy placed on site allowed for the magnetometer refinement runs to begin. After six refinement runs the highest magnetic reading obtained was 44 gammas (Figure 43). It was not necessary to drop a refinement buoy as the location of the anomaly was easily discernible approximately 40 feet to the northwest of the buoyed location. During the refinement runs, Captain Hepler noted a rise off the ocean bottom with his fathometer, in the location of the magnetic anomaly. Once anchored near the site a grapple hook was placed on the anomaly and a diver prepared for investigation of the target.

The diver, after descending the grapple line, quickly identified the source of the magnetic anomaly as another concrete and rebar bridge span likely deposited in the area as an artificial reef. Water depth at the target was 39 feet. Initially the target appeared to be two separate parallel sections of concrete and rebar. The first exposed section was 2 feet 6 inches in width, 5 feet 6 inches in length, and extended off the bottom at its highest point approximately 3 feet 6 inches. The second exposed section was approximately 14 feet in length. Closer examination by the diver determined the two parallel sections of concrete to be one section of bridge span instead of two individual pillars. While underwater footage of this target was taken, the relatively poor visibility made the footage unusable.

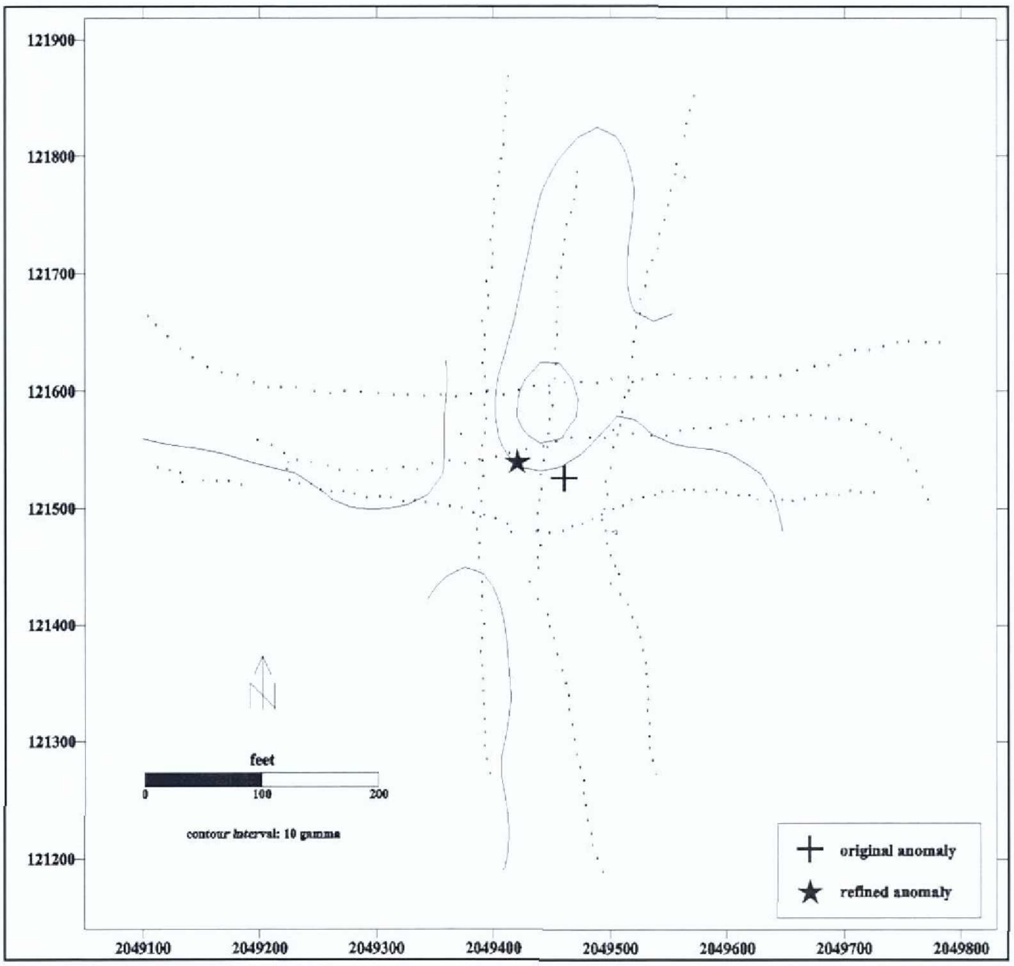

Figure 43. Magnetic refinement map of Target 14.

The diver then placed a refinement buoy on top of the concrete span and returned to the surface. Subsequent side-scan sonar investigations show the exposed sections of Target 14 (Figure 44). This target is not significant for the purposes of this investigation.

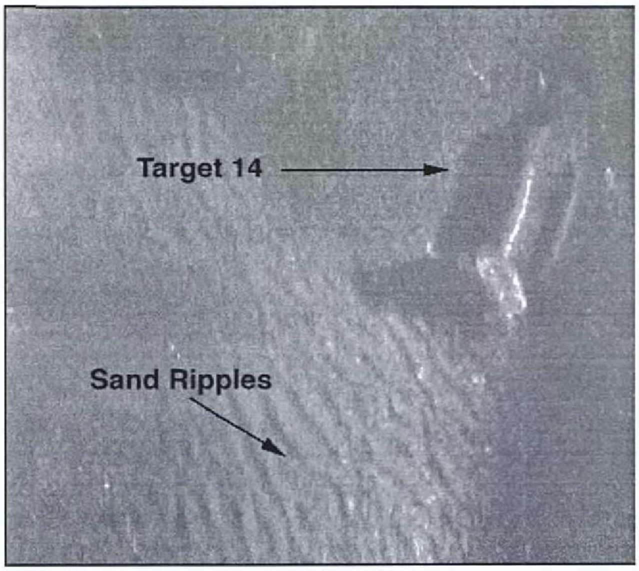

Figure 44. Side-scan sonar image of Target 14.

TARGET 15

Recorded on only one trackline, Target 15 was described as a magnetic anomaly with a maximum deviation of 17 gammas (Riess 1994b:7). After dropping the buoy on site, refinement with the magnetometer began. Six tracklines were run around the buoyed location (Figure 45). On one pass with the magnetometer, a very localized 6-gamma anomaly was noted. Additional refinement passes failed to locate any other magnetic anomalies within the general area. Since the anomaly appeared to be no longer present within the general area prescribed by Riess or was too minimal in gamma strength to warrant subsequent identification, no further investigations were conducted.

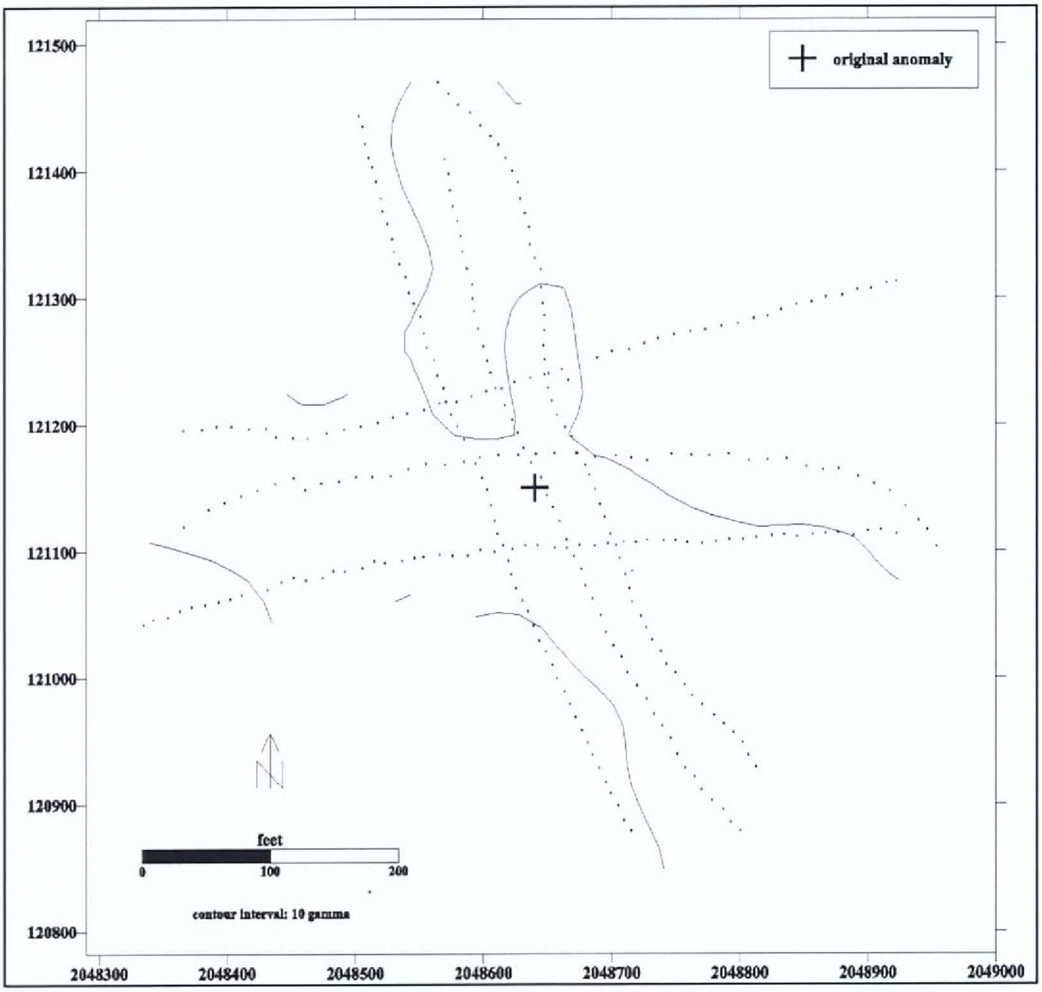

Figure 45. Magnetic refinement map of Target 15.

TARGET 16

Initially identified as a 16-gamma magnetic anomaly recorded on one trackline, Target 16 had an associated side-scan sonar return, 10-15 feet in length, 1-3 feet in width, with 2-4 feet of relief (Riess 1994b:7). A buoy was deployed within 12 feet of the coordinates provided by Riess (1994:7). Six refinement runs were made over the buoyed location with the magnetometer (Figure 46). Examination of the magnetometer data indicated a relatively small anomaly (10 gammas); however, it was discernible over a number of the tracklines. After dropping a refinement buoy, the dive vessel was anchored and a diver suited up for target identification.

After a series of diver sweeps, the diver reported no exposed target within the general area of the refinement buoy. The diver was given the underwater metal detector and delineated an area of magnetics approximately 18 feet (east to west) by 34 feet (north to south). After placing a refinement buoy in the center of the delineated area, the diver was given the 10-foot hydro-probe. Working in cardinal directions, the diver proceeded to probe the area at 10-foot intervals with no positive returns. Several steel probes, dropped at 5-foot intervals, resulted in negative returns as well.

Using the metal detector to re-acquire the highest magnetic area of the anomaly, the diver was then given the water jet to trench across the area in an effort to identify Target 16. After using the water jet for only six minutes the diver located the source of the anomaly; a woven, iron cable running in an east-west direction. The cable was nine inches below the sand bottom (41-foot depth). No underwater video of Target 16 was taken because of a lack of visibility. Before departing the target, a refinement buoy was placed on the cable and its exact position shot in with the DGPS. Target 16 is modern and not considered significant.

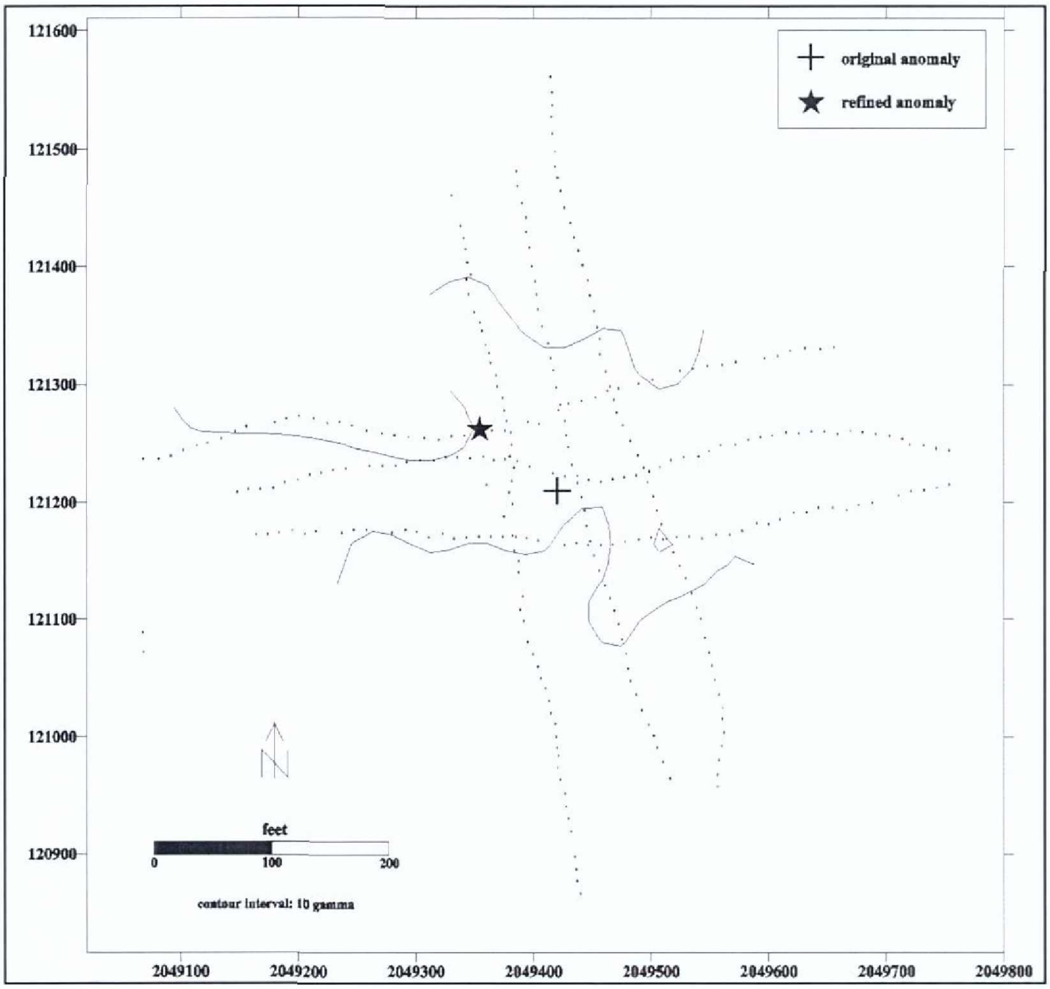

Figure 46. Magnetic refinement map of Target 16.

Target 17

Recorded on eight survey tracklines, Riess indicates Target 17 as the largest magnetic anomaly (approximately 147 gammas) located during the 1993 survey. Riess' side-scan sonar returns included a "series of point returns along same alignment, each 1-3 ft. dia., 1-2 ft. relief, possibly cable or pipe?" (1994:7) After six passes with the magnetometer, the anomaly was sufficiently refined and an additional buoy placed on site (Figure 47). The largest magnetic deviation recorded during the refinement survey over Target 17 was 46 gammas. During refinement runs Captain Hepler noted a rise off the ocean bottom in the location of the magnetic anomaly. After anchoring the dive vessel, Hepler successfully placed a grapple hook on the target as a diver suited up.

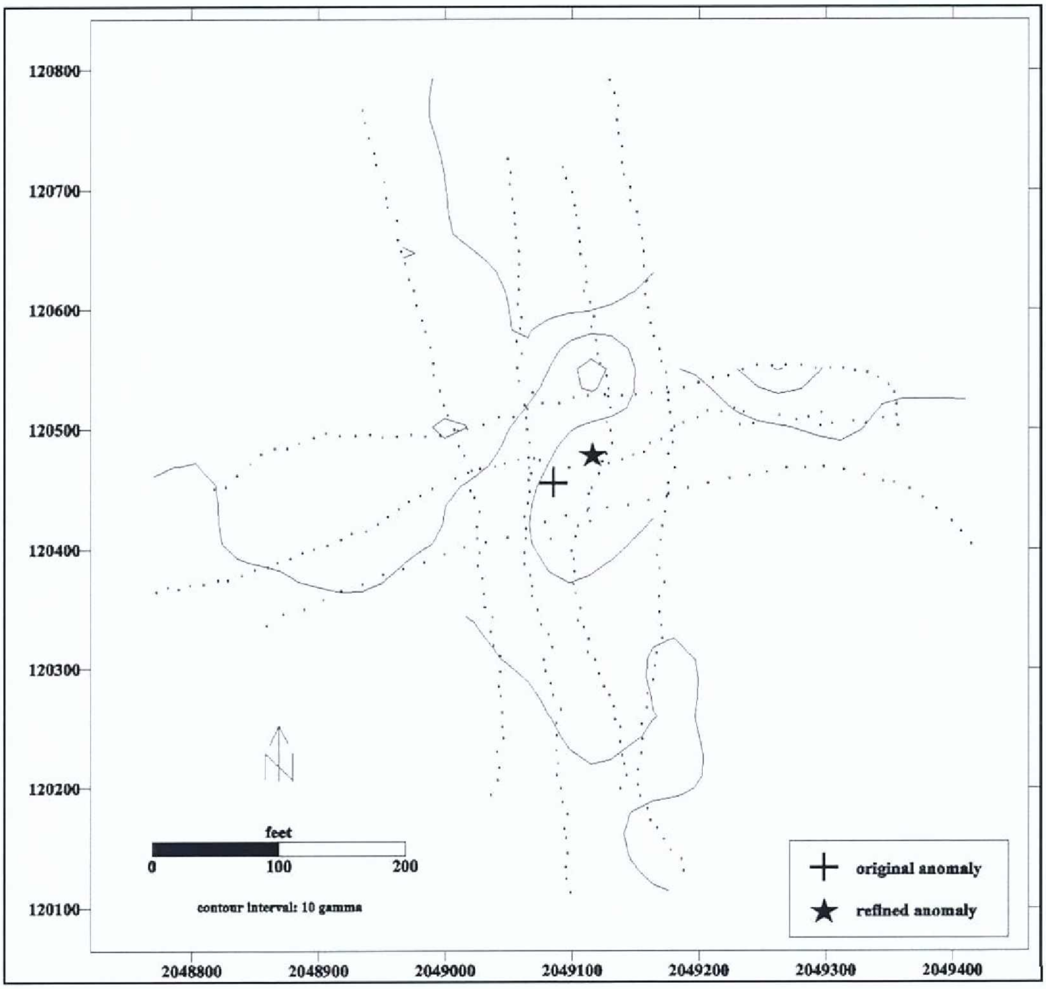

Figure 47. Magnetic refinement map of Target 17.

The diver took a pneumo-gauge reading after reaching the bottom at 41 feet. Afterwards the diver followed out the grapple hook line and quickly identified Target 17 as another section of concrete and rebar bridge span. The exposed span measured 26 feet in length with a maximum width of five feet. A pneumo-gauge reading taken at the most exposed end of the span was 39 feet 6 inches (for an exposed height of 1 foot 6 inches). The diver was given the underwater video camera and proceeded to record the target (Figure 48). The side-scan sonar image of Target 17 distinctly shows two parallel linear features distinguishing the exposed longitudinal features of the bridge span (Figure 49). Likely intended for the Rockaway Beach Artificial Reef or the Atlantic Beach Artificial Reef, Target 17 is considered modern and therefore not considered significant for the purposes of this investigation.

Figure 48. Underwater video image of Target 17. Note the refinement buoy line and concrete block in the foreground. Target is just behind concrete block.

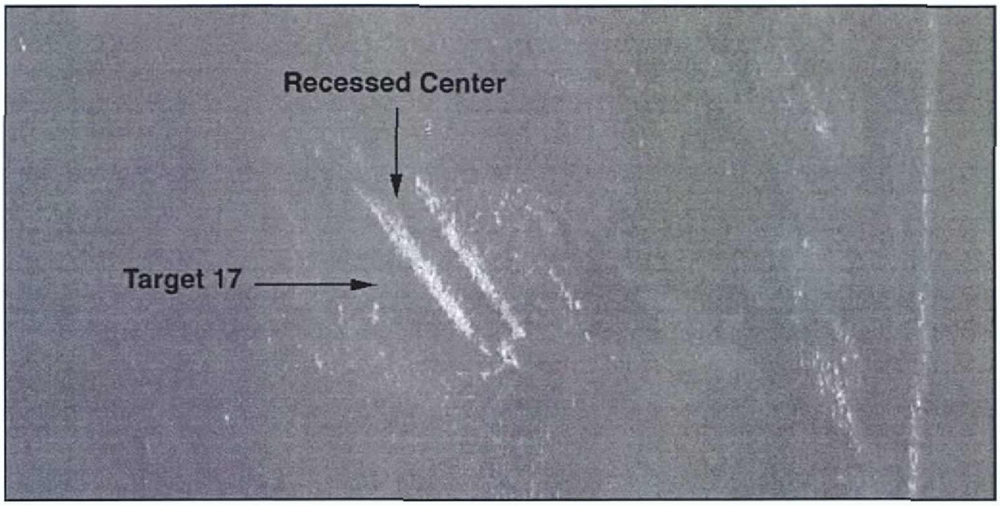

Figure 49. Side-scan sonar image of Target 17.

TARGET 18

Riess reported Target 18 as a magnetic anomaly with a maximum, 23-gamma deviation documented on two survey tracklines. A buoy was deployed within 14 feet of the coordinates provided by Riess (1994:7). Water depth over the target area was 36 feet. The magnetometer was deployed and six 500-foot long tracklines were run over the area (Figure 50). Magnetic refinement of the target area indicated only a 5-gamma anomaly on one of the tracklines. Additional refinement passes failed to recreate the anomaly. Since the anomaly appeared to be no longer present within the general area prescribed by Riess or was too minimal in gamma strength to warrant subsequent identification, no further investigations were conducted.

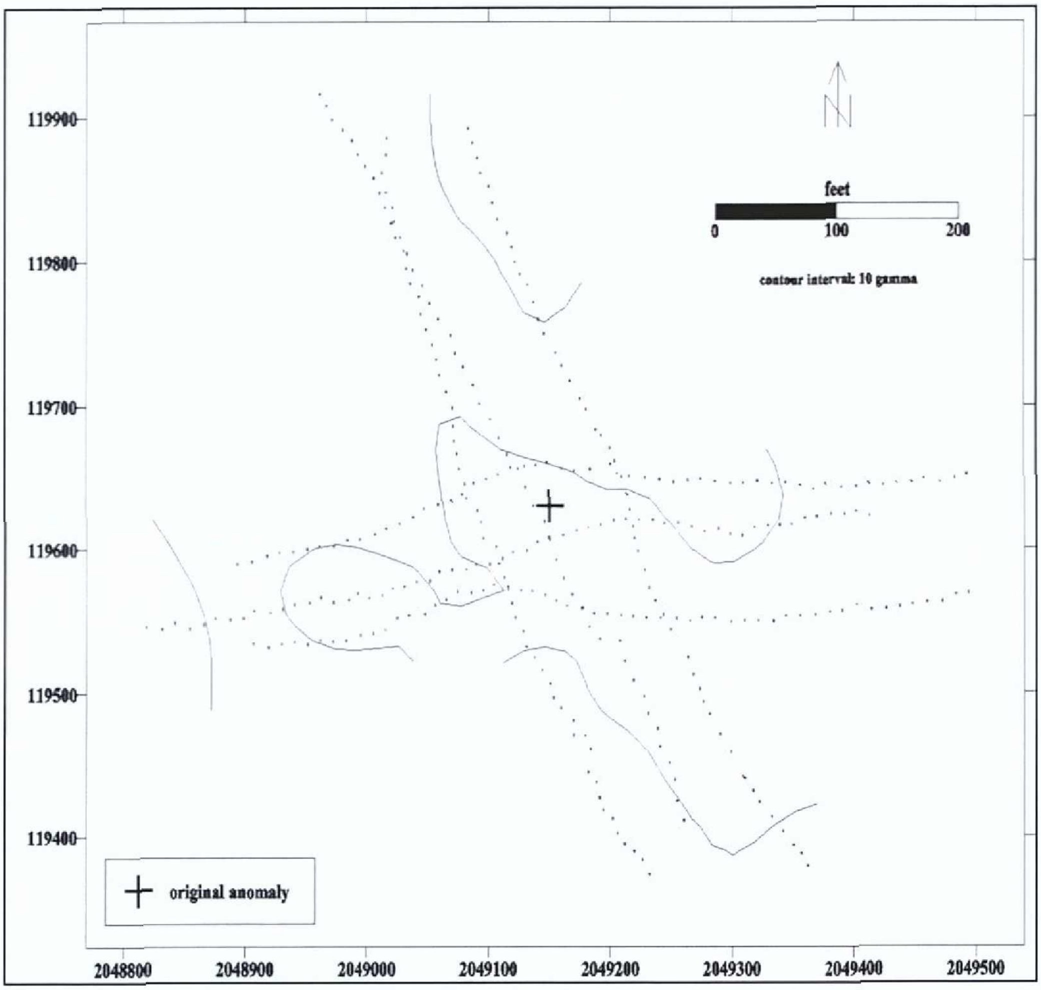

Figure 50. Magnetic refinement map of Target 18.

TARGET 19

Riess identified Target 19 as a magnetic anomaly with a maximum deviation of 40 gammas (recorded on 2 survey tracklines) with no associated side-scan sonar return. After deploying a buoy within 12 feet of the target area, a series of eight magnetometer refinement runs were made around the target area. Magnetic refinement of the target area indicated a dipole anomaly with a maximum deviation of 50 gammas (Figure 51).

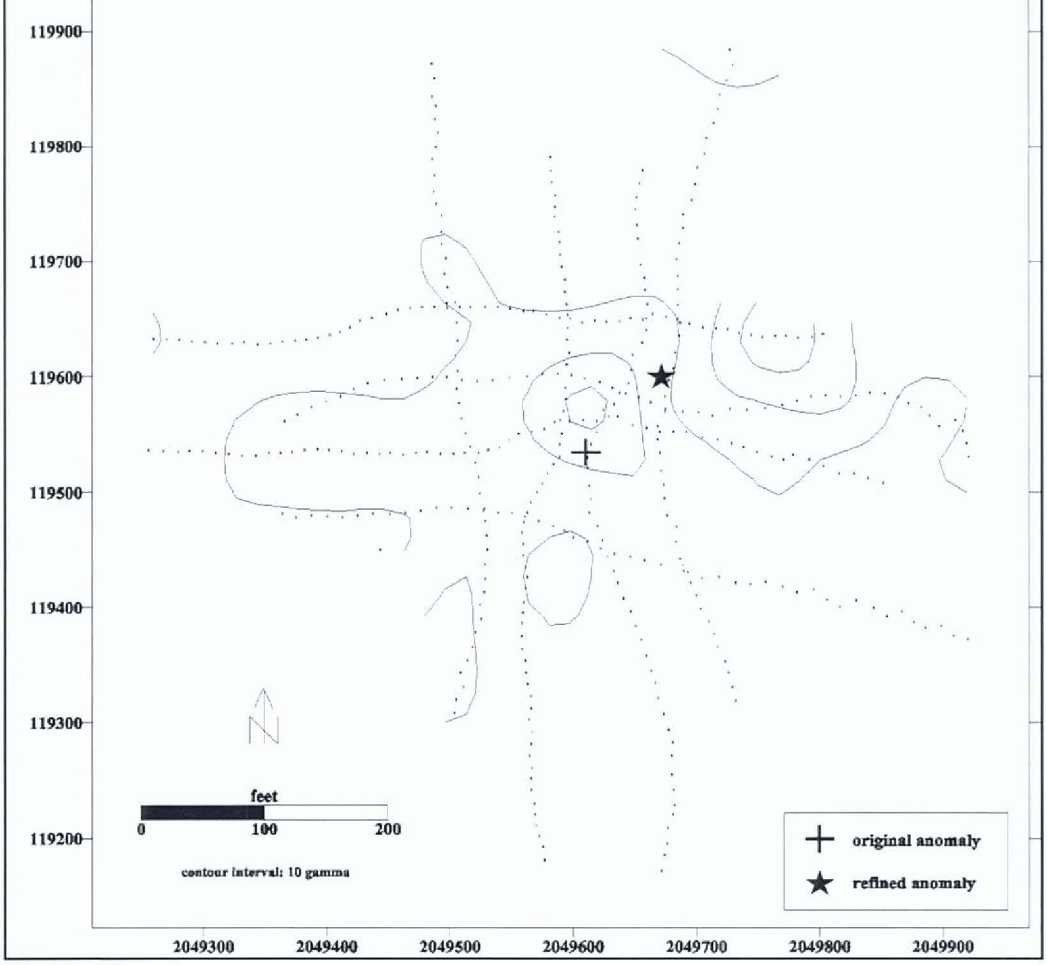

Figure 51. Magnetic refinement map of Target 19.

After placing a refinement buoy the dive vessel anchored over the refined target area and a diver suited up to investigate the target. Upon reaching the ocean bottom the diver's pneumo gauge registered a depth of 38 feet. After a series of arched sweeps around the refined area the diver reported no exposed target above the ocean bottom. In an effort to quickly locate the anomaly the diver was given the underwater metal detector to determine the spatial extent of the site. Proceeding in cardinal directions the diver's first transect extended from the refinement buoy to the west. The metal detector pegged out at "10" (the maximum magnetic reading) for approximately 100 feet. From the refinement buoy to the east the metal detector was still reading 8-9 for close to 95 feet. The diver then proceeded on two transects extending to the north and south of the refinement buoy. The metal detector remained pegged out at ten for 100 feet in either direction.

The water jet was then tied into the diver's rig and sent to the diver to clear a trench through the overburden to determine the source of the anomaly. Within five minutes the diver exposed a section of heavy, threaded hawser rope lying six inches below the surface. Jetting along the hawser rope, the diver then uncovered a 2-inch diameter wire cable. The hawser rope (made of modern synthetic material) is tied to the large wire cable. The diver followed the cable (buried 6-8 inches below the sand) for some distance before it was determined that the target consisted of no more than a lengthy, wire cable with some attached, synthetic hawser rope. The length of bottom time and poor visibility during the dive precluded obtaining any underwater video footage of Target 19 (see Target 20). Due to the extent of the readings taken by the underwater metal detector, it is assumed that this cable is relatively sizable in length and is buried relatively shallow below the sand bottom. The location of the centered refinement buoy was approximately 89 feet to the southeast of the coordinates provided by Riess.

In an effort to confirm that the cable and hawser rope had not hung on an obstruction (i.e., shipwreck) deeper under the sediment, a subsequent dive was made on site with the 10-foot hydro probe. After relocating the cable with the metal detector, the diver was given the hydro-probe. The diver reported negative findings after numerous probes at 10-15 foot intervals in the cardinal directions (out to 60 feet in all directions). It is assumed that Target 19 is a lengthy section of buried cable and not considered significant for the purpose of this investigation.

TARGET 20

Initially recorded on three tracklines, Target 20 had a magnetic signature with a maximum gamma strength of 64 gammas and an associated side-scan sonar return. The side-scan sonar return was an "elongate target, 50-70 ft. long, 1-4 ft. wide, 1-3 ft. relief" (Riess 1994b:8). After the successful deployment of the magnetometer, eight refinement runs were made around the buoyed target (Figure 52). The magnetometer registered a dipole anomaly with a maximum deflection of 87 gammas. During the passes with the magnetometer, Captain Hepler noted an object exposed above the ocean floor with his fathometer (within close proximity of the refinement buoy).

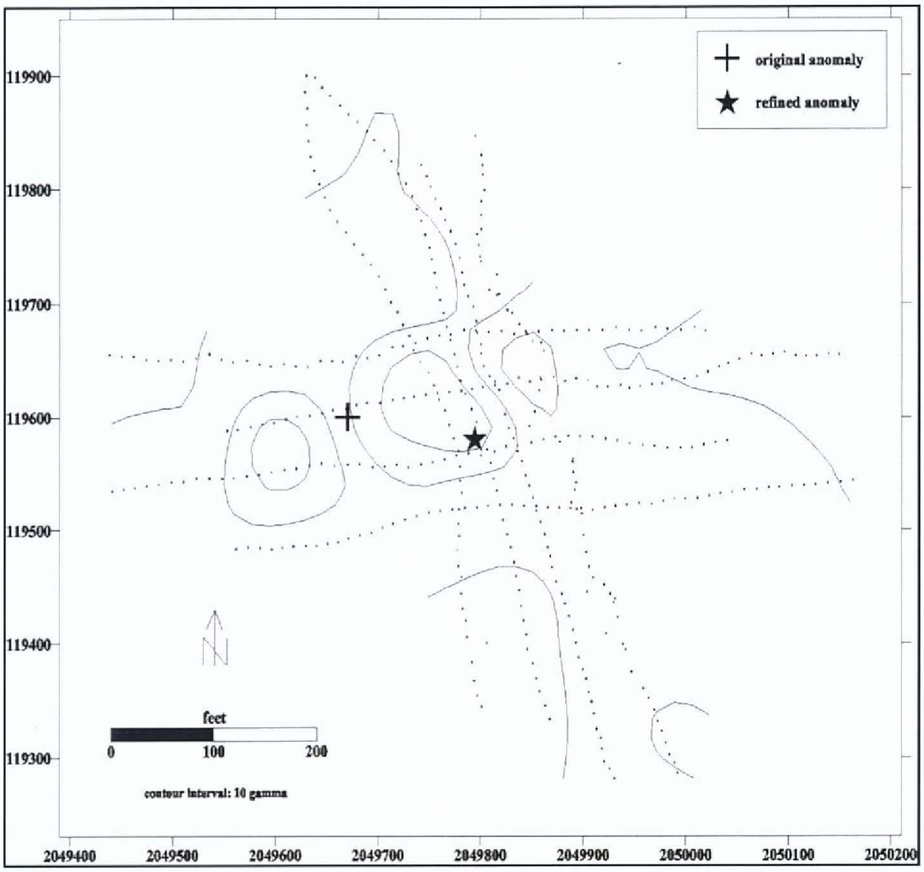

Figure 52. Magnetic refinement map of Target 20.

After anchoring the dive vessel, the captain and crew successfully placed the grapple hook on the anomaly. Once suited up the diver proceeded straight to the bottom and took a pneumo-gauge reading (36 feet). The diver then proceeded out the grapple hook line and quickly identified the source of the anomaly as a large, woven iron cable identical to Target 19. The exposed portion of the cable extended out of the sand in a large loop, roughly 4-5 feet in length. The underwater video camera was then sent down the diver's rig to document the target (Figure 53).

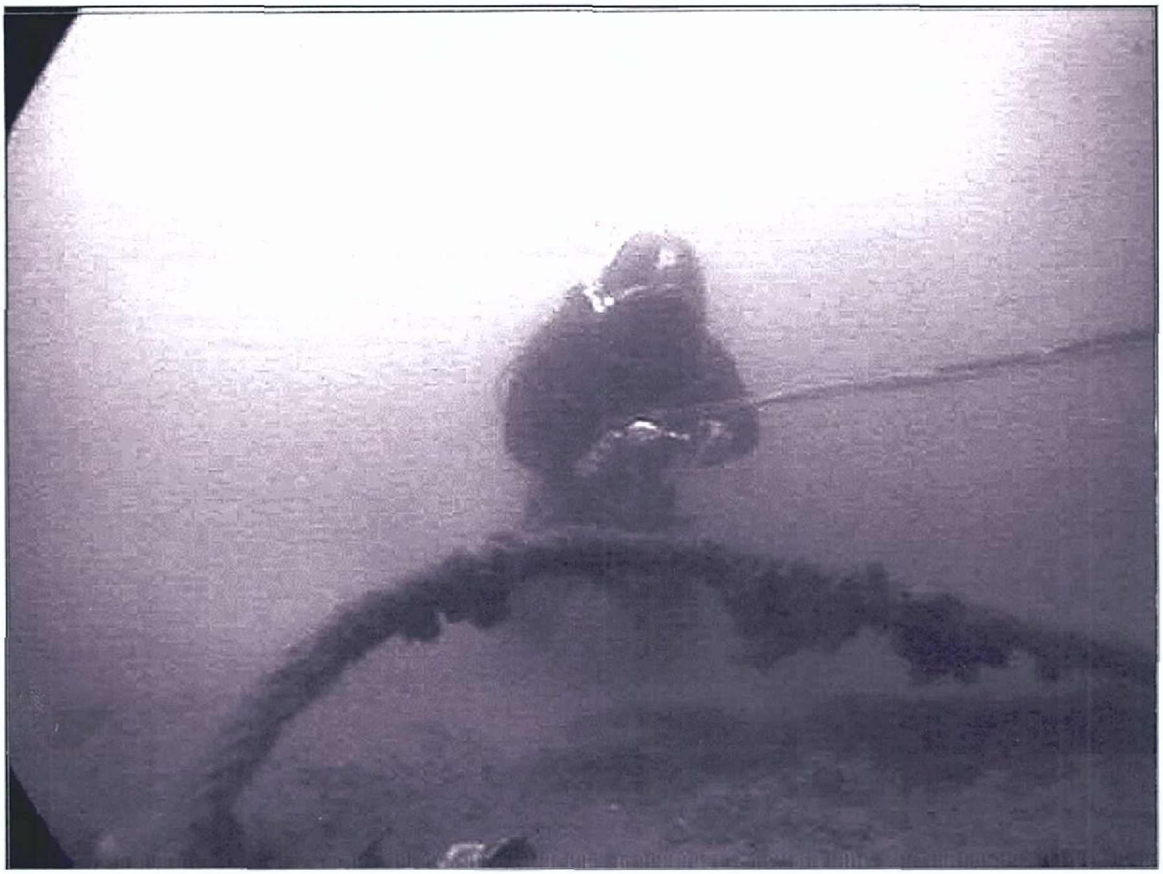

Figure 53. Diver preparing to take a measurement of Target 20.

Reviewing the refined coordinates for Targets 19 and 20, it is apparent that both targets are the same. In fact, the refined location of Target 19 is almost identical to the coordinates provided by Riess for Target 20. It is evident that the cable, exposed at both locations, is extremely lengthy. This is a clear example of the value of contouring magnetic data. If the data had been contoured during the initial remote-sensing survey, it would have been evident that Targets 19 and 20 are the same magnetic anomaly.

TARGET 21

Riess identified Target 21 as a 19-gamma magnetic anomaly recorded over two survey tracklines with an associated side-scan sonar return (1994:8). After dropping a buoy within eight feet of Riess' coordinates, the magnetometer towfish was deployed and the running of tracklines initiated. Depth of water over the target area was approximately 35 feet. After running six refinement runs over the general area (Figure 54), it is clear that Target 21 is no longer present at its prescribed location. After Captain Hepler noted a scour in the target area, an additional set of refinement runs were made in the area. However, the magnetometer recorded no associated anomalies within the area. Due to the relative paucity of magnetics within the general area, it was decided that Target 21 did not warrant diver investigations.

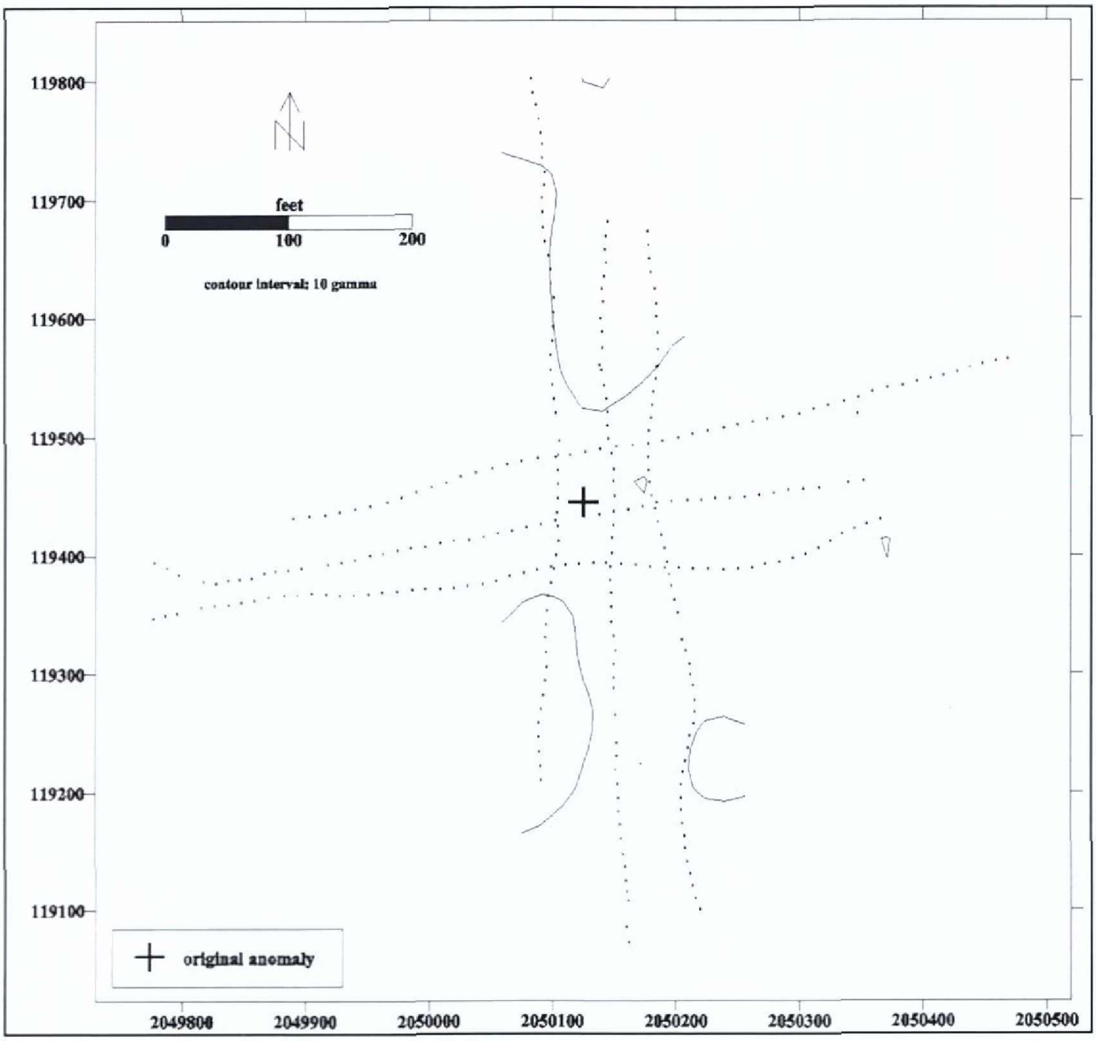

Figure 54. Magnetic refinement map of Target 21.

TARGET 22

Described as an anomaly with a maximum 22-gamma magnetic deviation, Target 22 was previously recorded on two tracklines. The magnetic refinement of the target area began after dropping a buoy on the coordinates provided by Riess (1994:8). Depth of water over the target area was 35 feet. Six refinement runs over the area with the magnetometer identified no definitive magnetic anomalies within the area (Figure 55). While the magnetometer recorded a couple of small magnetic "hits" (less than 10 gammas) within the area, these were small single-point sources and not definable anomalies. No additional investigations were undertaken at this location.

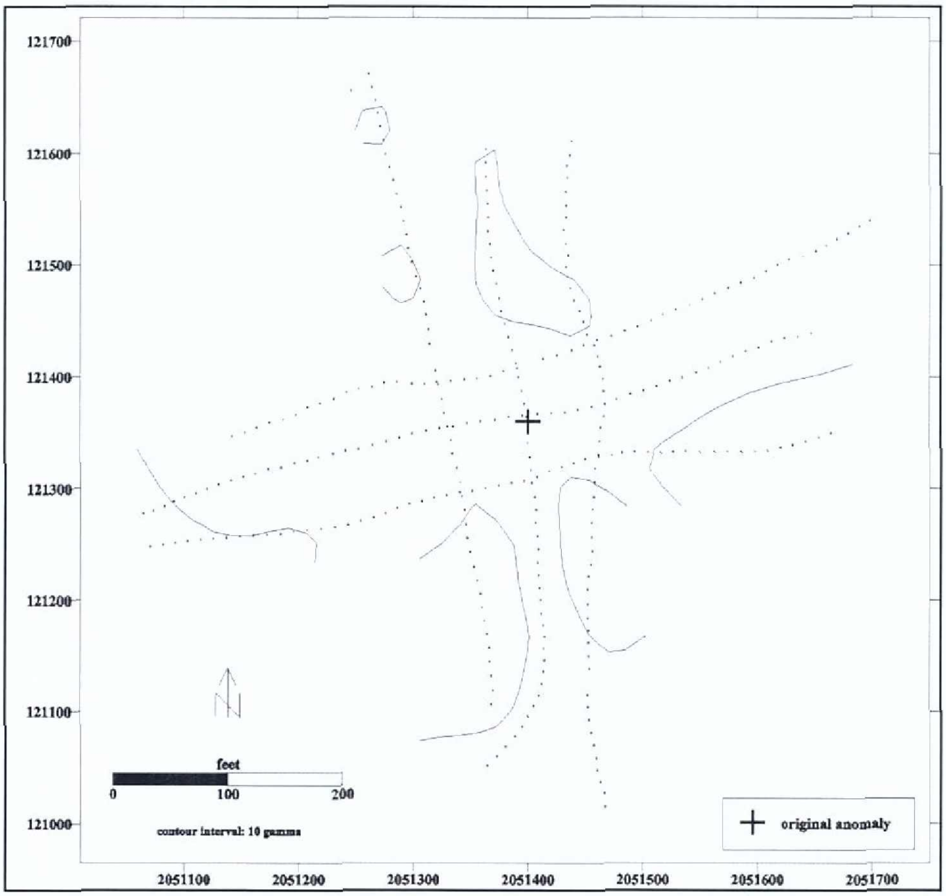

Figure 55. Magnetic refinement map of Target 22.

TARGET 23

Identified as a magnetic anomaly (with a maximum gamma deviation of 53 gammas) on three tracklines, Target 23 had no associated side-scan sonar return. After deploying a buoy within 14 feet of Riess' coordinates (1994:8), magnetic refinement runs with the magnetometer were undertaken. No discernible magnetic anomalies were identified within the area after eight successive passes with the magnetometer (Figure 56). It is apparent that Target 23 is no longer present within the general area prescribed by Riess and has likely been relocated from the area since the initial remote-sensing survey in 1993. Due to the lack of discernible magnetics within the general area, no diver investigations were undertaken at this location.

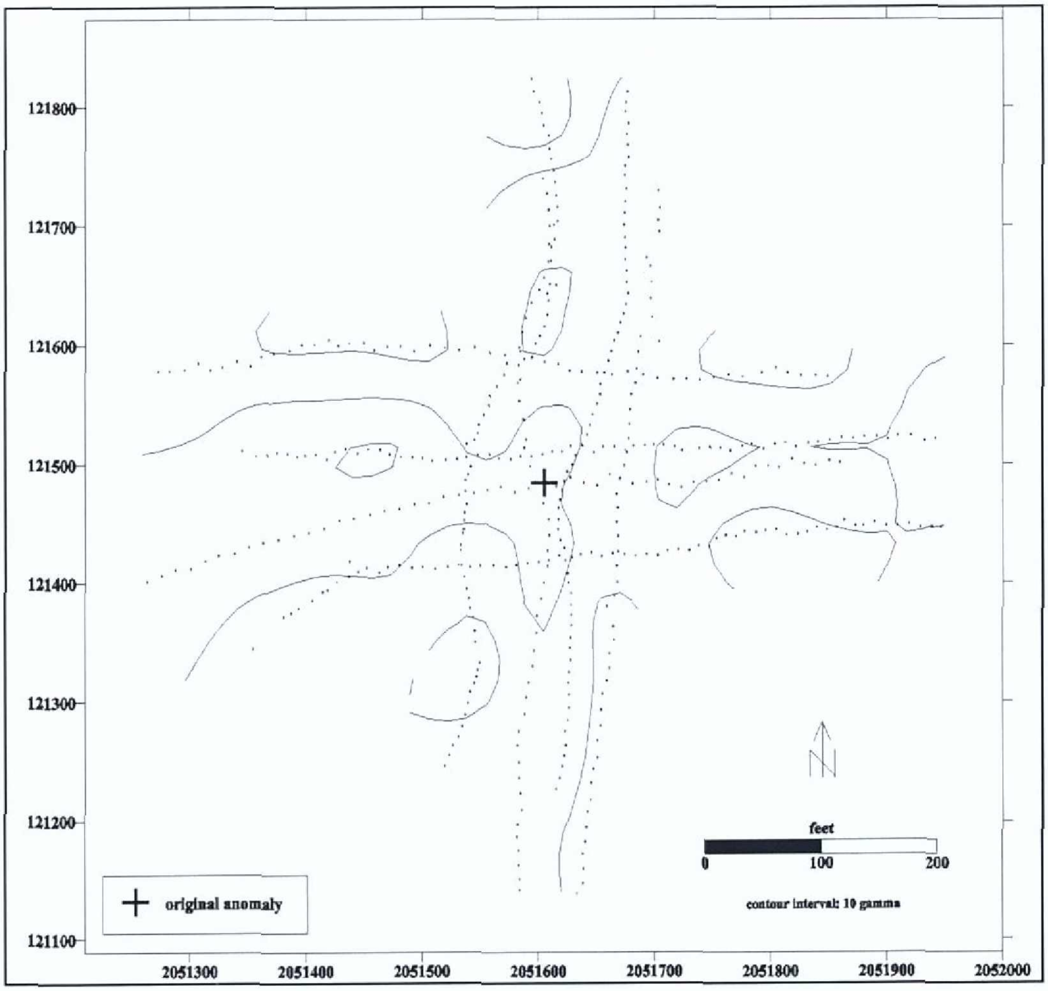

Figure 56. Magnetic refinement map of Target 23.

TARGET 24

Recorded on only one trackline during the previous investigation (Riess 1994b), Target 24 had a single magnetic signature of 12 gammas with no associated side-scan sonar return. Dropped within nine feet of the coordinates provided by Riess, a series of seven refinement runs were made with the magnetometer around the buoyed location (Figure 57). No definable magnetic anomalies were found within 150 feet of the buoyed location. No diver investigations were undertaken at this location due to a lack of magnetics within the area.

Although there were no discernible magnetic anomalies within 200 feet of the Target 24 coordinates, the magnetometer and Captain Hepler's fathometer recorded a large anomaly approximately 217 feet immediately to the north of Target 24 (see Figure 57). The anomaly had a much larger magnetic signature than Target 24, recorded during the previous remote-sensing survey (Riess 1994b). Therefore it was determined that the anomaly (not documented by Riess) was likely deposited in the area after Riess's survey in 1993. While this target was not slated for diver investigation, it was decided to conduct a diver investigation of the target for identification purposes.

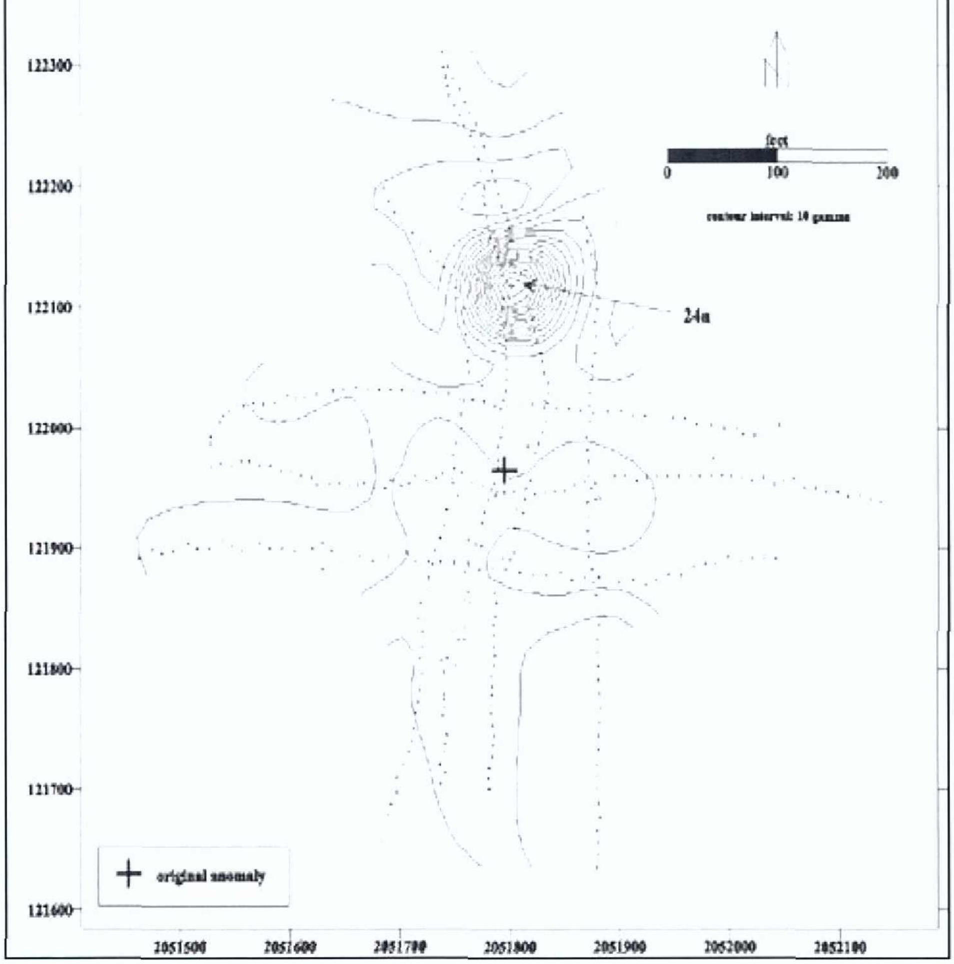

Figure 57. Magnetic refinement map of Target 24. Note Target 24a to the north.

After returning to the target area at a later date (after the refinement of Target 34), a buoy was quickly dropped on the target observed on Captain Hepler's fathometer. Due to its somewhat close proximity to Target 24 this target will be referred to as Target 24a. After anchoring the dive vessel, Captain Hepler placed the grapple hook/line on the large anomaly. The suited diver then proceeded to the bottom and took a pneumo-gauge reading (46 feet). The diver followed the line to the grapple hook which was firmly anchored amongst a large jumble of wire cable exposed on the sand bottom. Consisting of a large cable (2 1/2 inches in diameter) and a smaller, inter-twined wire cable, Target 24a was approximately 20-25 feet in diameter. The diver was then given the underwater video camera to record the anomaly. A subsequent pass with the side-scan sonar shows a large mass of cable above the ocean bottom (Figure 58). This target is not considered significant for the purpose of this investigation.

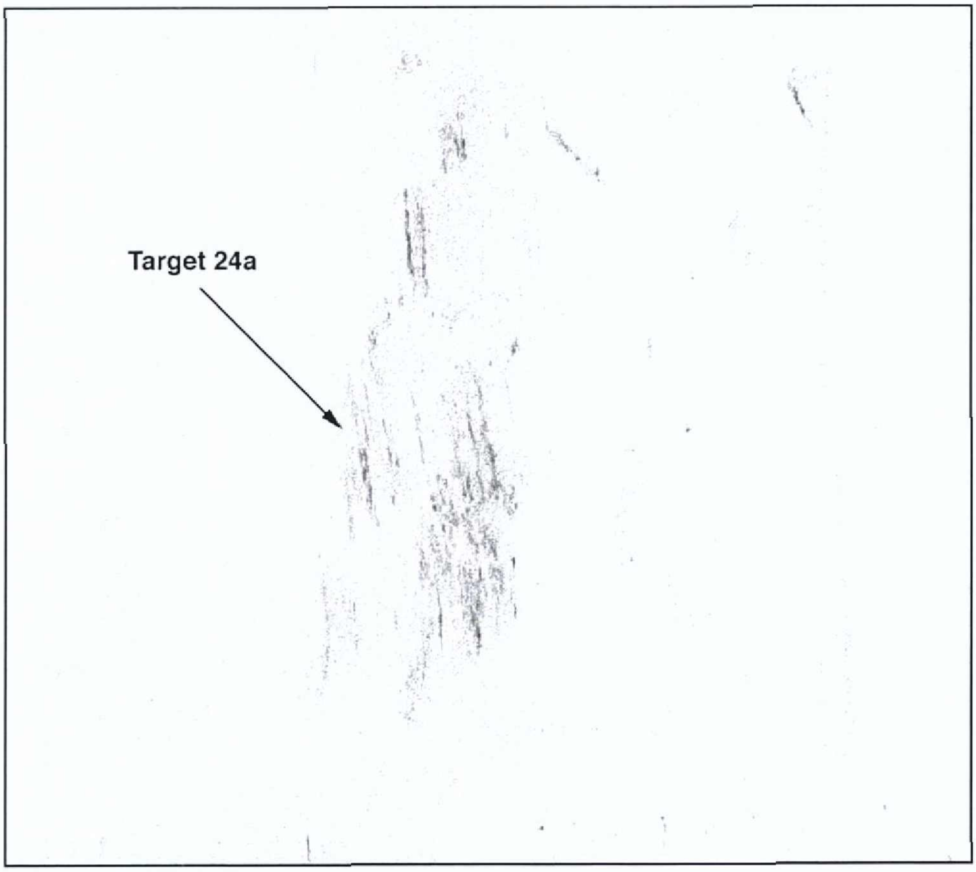

Figure 58. Side-scan sonar image of Target 24a.

TARGET 25

Riess reported Target 25 to be a magnetic anomaly with a maximum magnetic deviation of 23 gammas recorded on three tracklines (1994:8). Eight refinement runs were made over the target area with the magnetometer. Magnetic refinement of the area located the presence of an anomaly with a magnetic deviation of 14 gammas (Figure 59). After placing a refinement buoy over the source of the anomaly the dive vessel anchored near the site and the diver suited up.

A pneumo-gauge reading upon reaching the bottom registered 40 feet. Outfitted with the underwater metal detector, the diver proceeded to begin diver sweeps around the refinement area. The center of high magnetics was buoyed after localizing the target area. While waiting for the water jet the diver noted a small object protruding from the sand. Closer examination of the object identified the frayed end of a wire cable (approximately one inch in diameter). The diver exposed approximately three feet of the cable (buried 3-5 inches below the sand bottom) while the underwater video camera was being readied. The section of cable was documented and the diver returned to the surface (Figure 60). Target 25 is identified as a relatively isolated piece of small-diameter wire cable. This target is not considered significant for the purposes of this investigation.

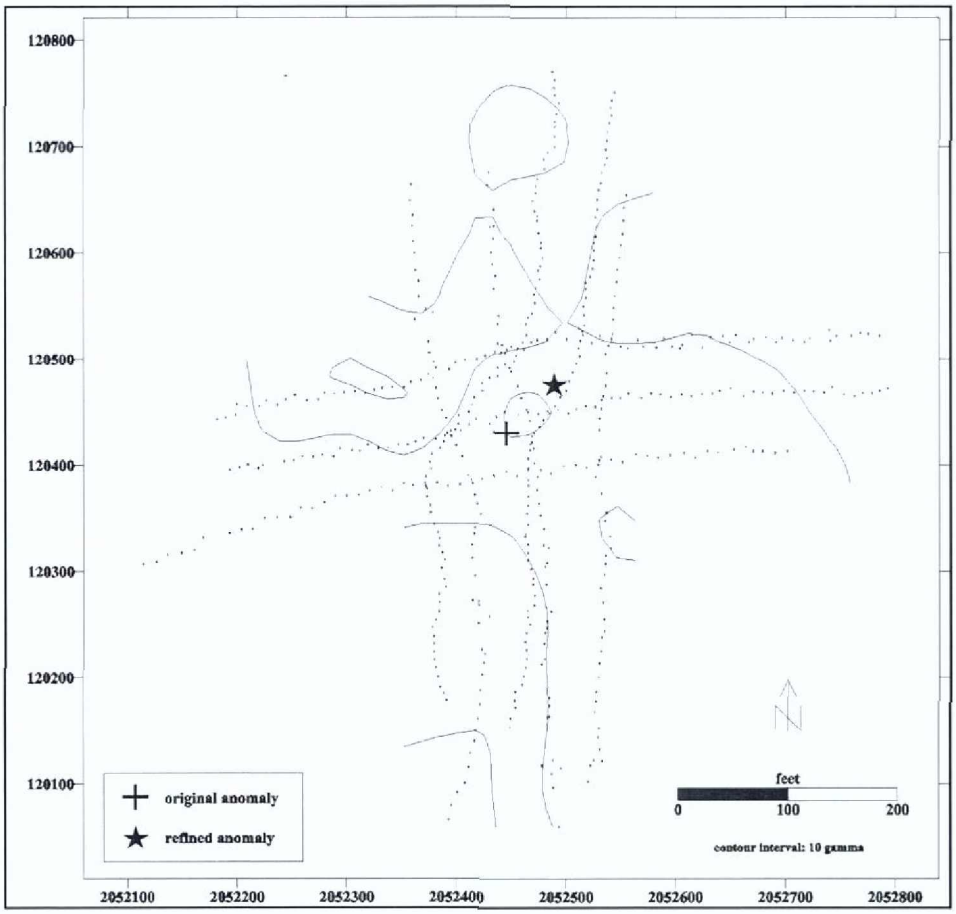

Figure 59. Magnetic refinement map of Target 25.

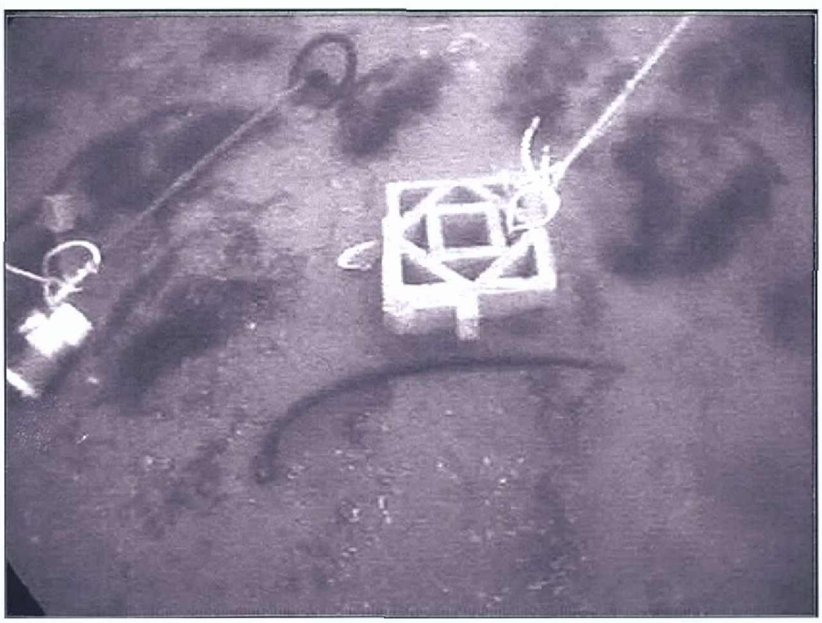

Figure 60. Underwater image of Target 25. Note the Fisher underwater metal detector and refinement buoy next to the exposed cable.

TARGET 26

The 1993 survey identified Target 26 as a magnetic anomaly (19 gammas) with an associated side-scan sonar return which was an "elongate target, 20-50 ft. long, 1-3 ft. wide, 1-3 ft. relief, possible cable?" (Riess 1994b:8) After placing a reference buoy (six feet from Riess' coordinates) on site, the dive vessel proceeded to make seven consecutive passes around the buoy (Figure 61). Water depth over the target area during the refinement survey was 38 feet. A review of the magnetometer data identified no magnetic anomalies within the general area. No diver investigations were undertaken at this location.

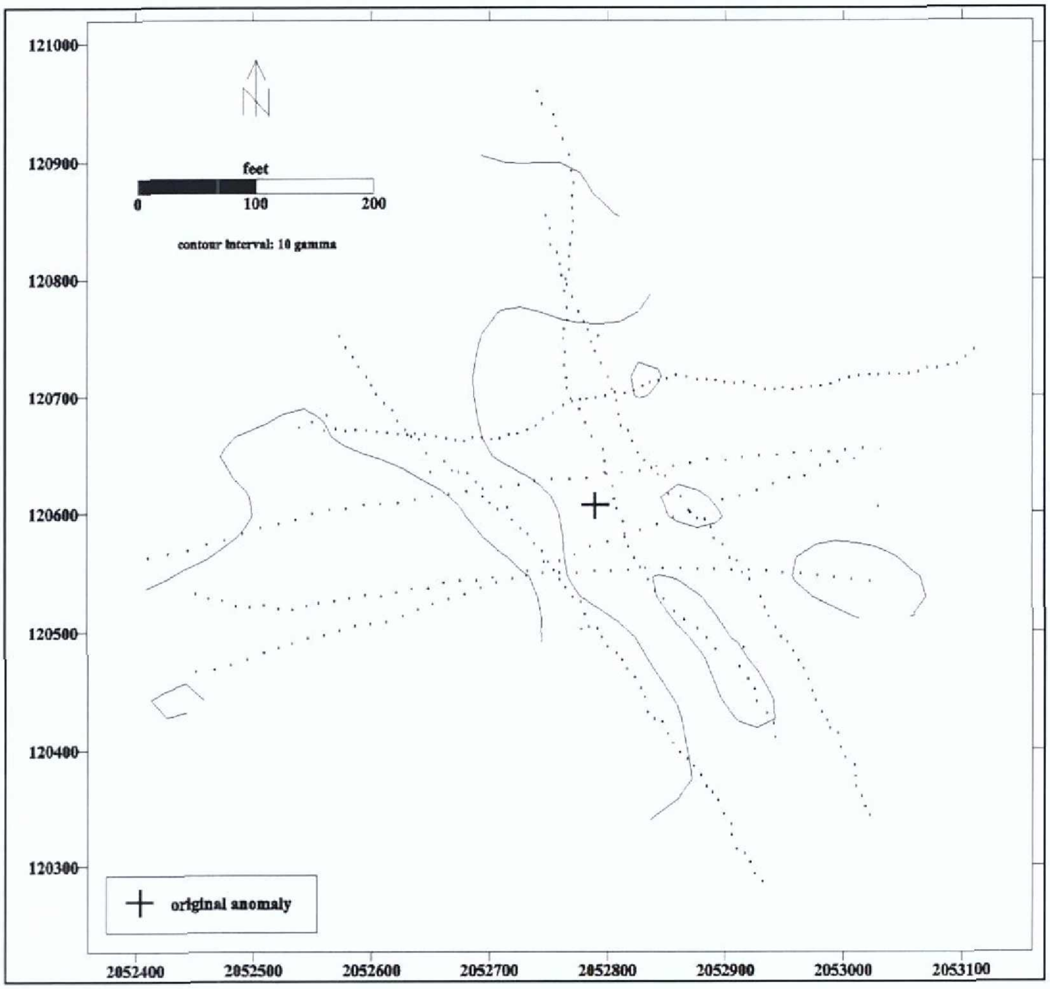

Figure 61. Magnetic refinement map of Target 26.

TARGET 27

Only recorded on one trackline during the previous remote-sensing survey (Riess 1994b:8), Target 27 had a magnetic deviation of 16 gammas. Upon locating the target area a reference buoy was deployed 12 feet due north of Riess' coordinates. Refinement runs commenced after successfully deploying the magnetometer. Six tracklines were run past the target area (Figure 62). Water depth over the target area was approximately 36 feet. A single-point, 5-gamma hit was the only magnetic anomaly within the entire area surveyed. This anomaly could not be reacquired on any other tracklines. Due to the relative dearth of magnetics within the refinement area, diver investigations were not undertaken at Target 27.

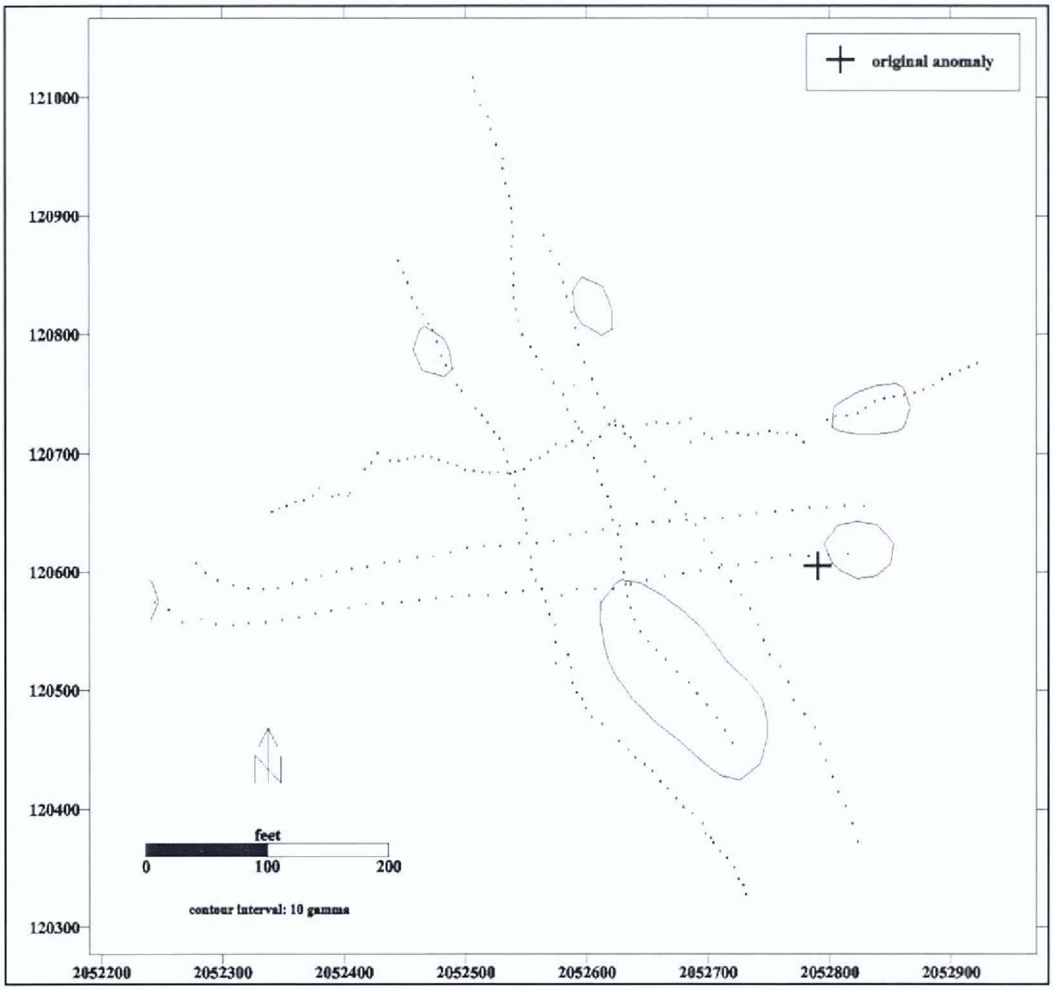

Figure 62. Magnetic refinement map of Target 27.

TARGET 28

Proceeding directly from Target 27 to Target 28, a reference buoy was dropped and refinement runs with the magnetometer begun. Riess describes Target 28 as a single magnetic anomaly with a deviation of 18 gammas and no associated side-scan sonar target (1994:8). Seven refinement runs were made to sufficiently relocate the anomaly (Figure 63). After anchoring the dive vessel, the diver proceeded to the bottom and took a pneumo-gauge reading. Water depth on site was 34 feet.

The diver quickly identified the source of the anomaly as an exposed section of 2-inch diameter cable/pipe. After scraping some of the growth from the anomaly it was identified as a section of woven steel cable. The cable was exposed above the sand bottom for approximately three feet. The underwater video camera was sent down to the diver in his rig and footage of the anomaly documented (Figure 64), after which the diver then returned to the surface. This target is not considered significant.

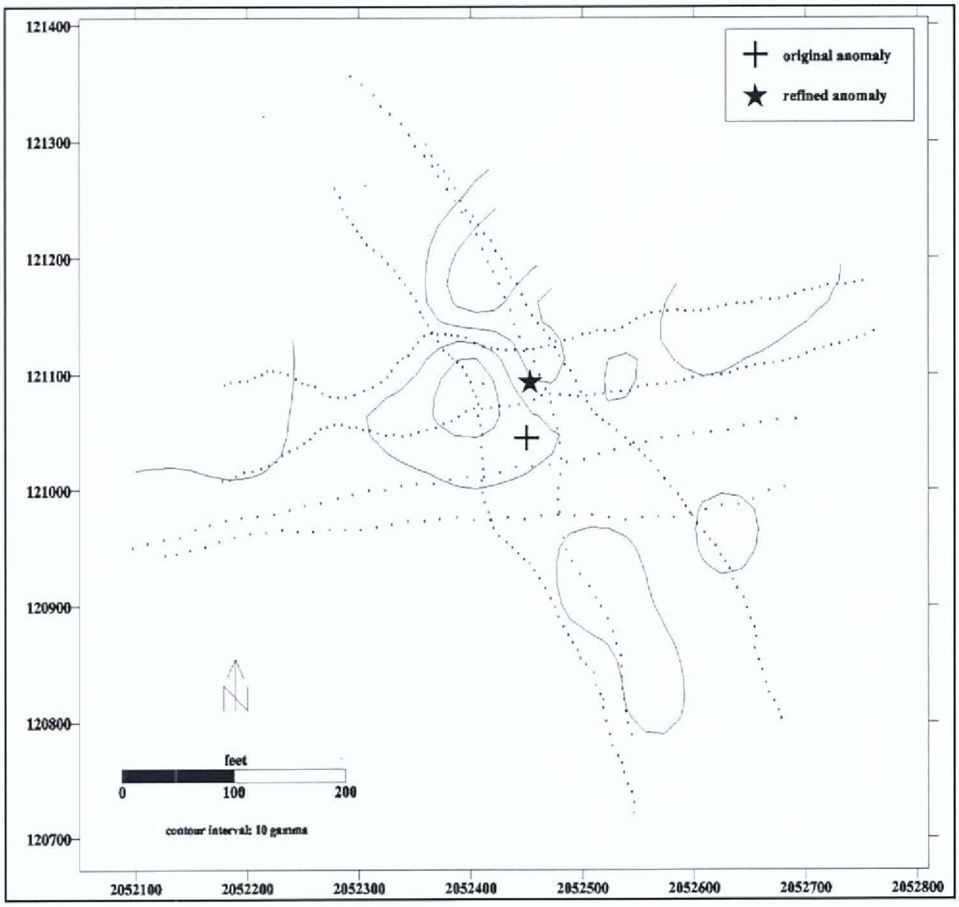

Figure 63. Magnetic refinement map of Target 28.

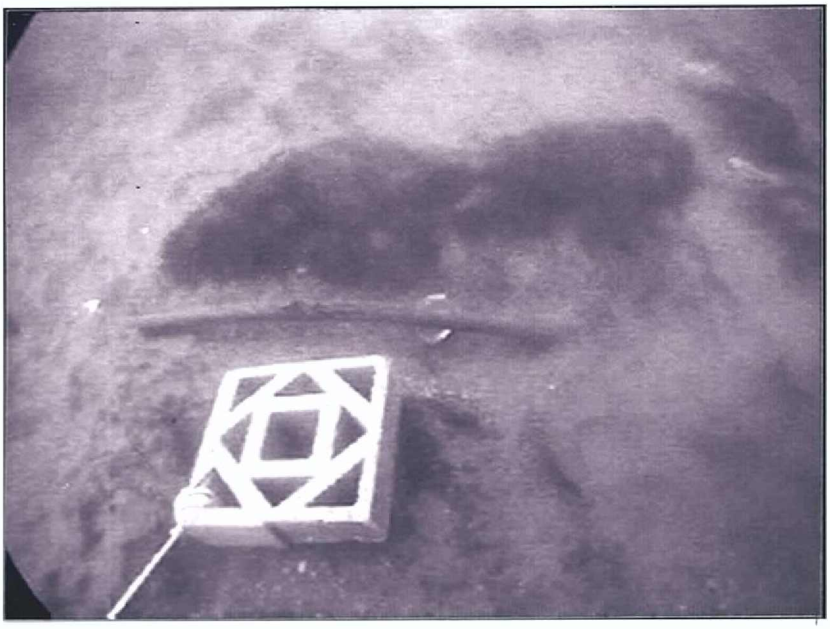

Figure 64. Underwater image of Target 28. The refinement block next to the exposed cable is 12 inches square for reference.

TARGET 29

The previous investigation identified Target 29 as a magnetic anomaly with a maximum deviation of 47 gammas and no associated side-scan sonar return (Riess 1994b:8). After dropping a reference buoy within 13 feet of the prescribed coordinates, the team deployed the magnetometer and the running of refinement tracklines was undertaken. Six tracklines were run to adequately refine the anomaly (Figure 65). Once refined, the dive vessel anchored with the refinement buoy off the stern as a diver prepared to investigate the target. Depth of water on site was 40 feet.

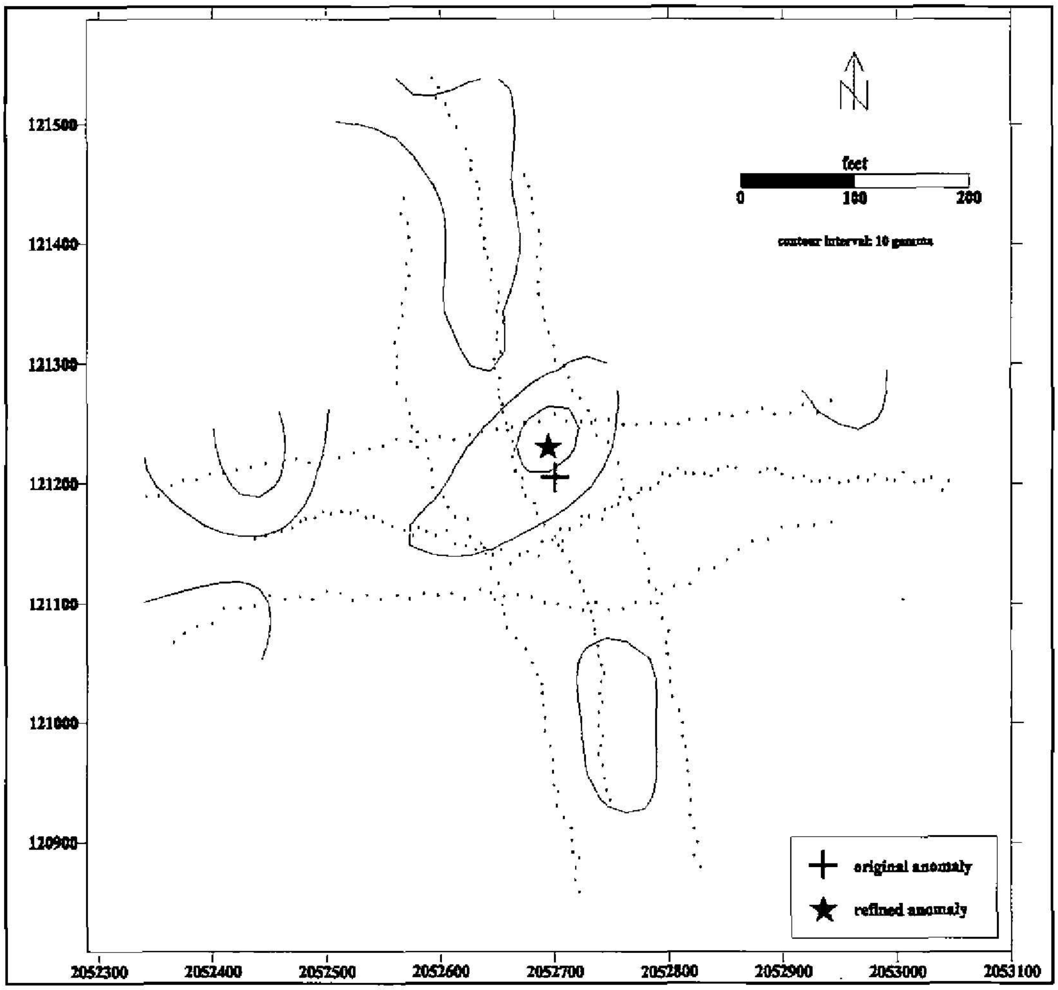

Figure 65. Magnetic refinement map of Target 29.

After a series of arched swings around the refinement buoy the target was not exposed above the sand bottom. The diver was given the underwater metal detector in an effort to localize the anomaly. The area of magnetics extended to the north/south for approximately 60 feet and east/west for 15 feet. The diver was then given the water jet to cut a trench from east to west. Within two minutes of trenching the diver identified the source of the anomaly as a wire cable oriented north/south, located approximately 9-12 inches under the sand. A lack of adequate visibility precluded any video documentation of Target 29. This target is modern and not significant for the purposes of this investigation.

TARGET 30

Investigations then moved on to Target 30, which was another magnetic anomaly recorded on two tracklines with no associated side-scan sonar return (Riess 1994b:8). A reference buoy was dropped on site and the magnetometer deployed in an effort to locate the anomaly. Six refinement passes over the target area were made before a refinement buoy could be placed closer to the source of the anomaly (Figure 66). Once in place, the dive vessel anchored near the refinement buoy and a diver readied for investigation.

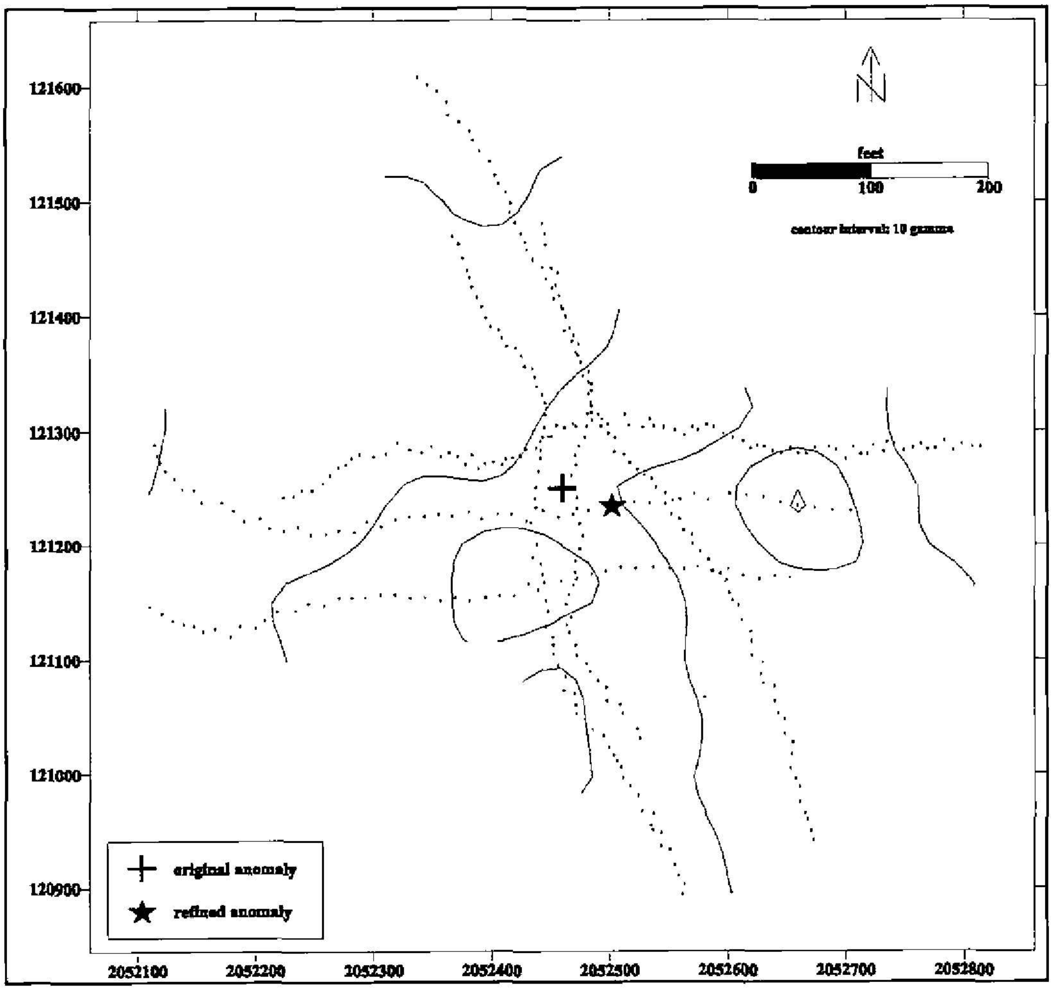

Figure 66. Magnetic refinement map of Target 30.

Once on the sand bottom the diver's pneumo-gauge reading registered 37 feet. The diver then began delineating the target area with the underwater metal detector. The target area extended north/south for approximately 116 feet and east/west for 18 feet. Similar in orientation to Target 29, the diver then proceeded to trench across the narrow (east/west) dimension of the target area with the water jet. Within one minute of trenching the diver uncovered a wire cable, 1 1/2 inches in diameter, approximately four inches below the sand bottom. Mimicking the findings from the metal detector, the cable was oriented north/south. The diver exposed 26 feet of the cable with no additional findings before aborting the dive. No video footage of the cable was taken due to a lack of visibility. Considered modern, Target 30 is not significant for the purposes of this survey.

TARGET 31

Riess identified Target 31 as a single magnetic anomaly with a deviation of 48 gammas (1994:8). There was no associated side-scan sonar image correlated with this target. After dropping a buoy four feet south of Riess' coordinates and deploying the magnetometer, a series of seven refinement runs were made over the target area (Figure 67). Water depth over the target area was approximately 39 feet. Review of the magnetometer data indicated no magnetic anomaly within the refinement area. The lack of any magnetics within the area negated the necessity for any diver investigations at this location.

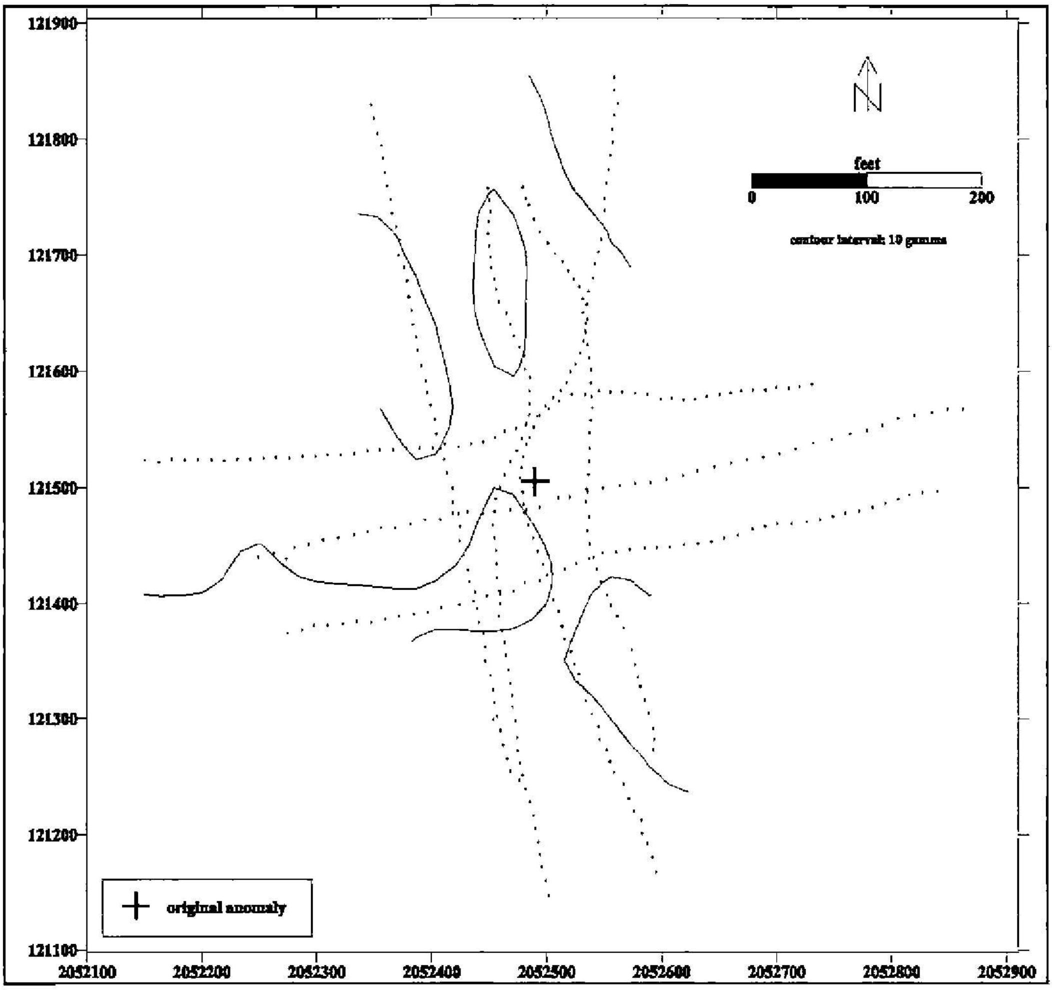

Figure 67. Magnetic refinement map of Target 31.

TARGET 32

Target 32 was identified during the previous investigation as an anomaly with a maximum magnetic deviation of 18 gammas recorded on two tracklines and no associated side-scan sonar return (Riess 1994b:8). After dropping a reference buoy two feet due east of Riess' coordinates, a series of six passes were made over the area with the magnetometer (Figure 68). Similar to Target 31, the water depth on site was approximately 39 feet. Examination of the magnetometer data identified no anomalies within the general area of Target 32. No diver investigations were necessary at this location.

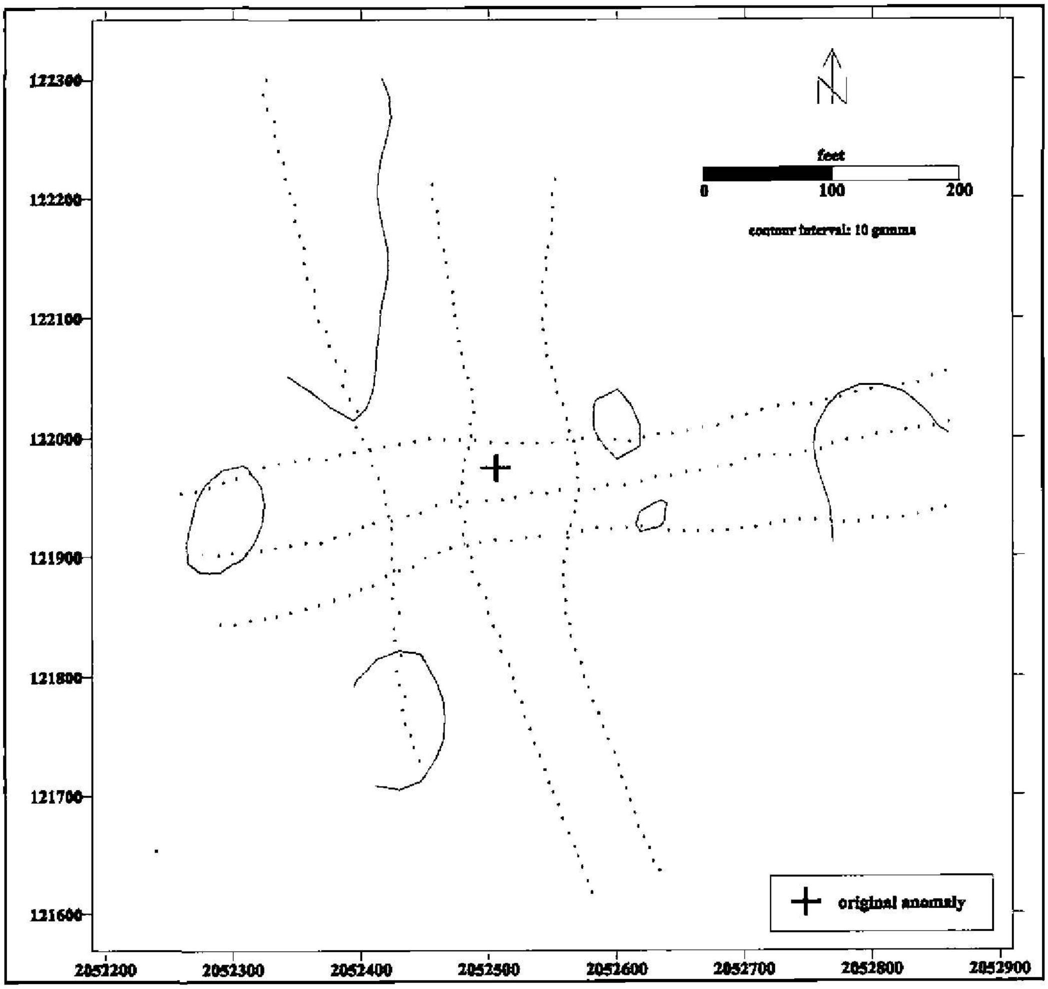

Figure 68. Magnetic refinement map of Target 32.

TARGET 33

The previous investigation identified Target 33 as a magnetic anomaly with a maximum deviation (over two tracklines) of 30 gammas (Riess 1994b:8). Once the reference buoy was in place (10 feet east of Riess' coordinates) and the magnetometer deployed off the stern, the running of tracklines began. Water depth over the target area was 40 feet. After a series of six tracklines were run and the data reviewed, it was apparent that Target 33 is no longer present at its original location (Figure 69). No diver investigations were undertaken at this location.

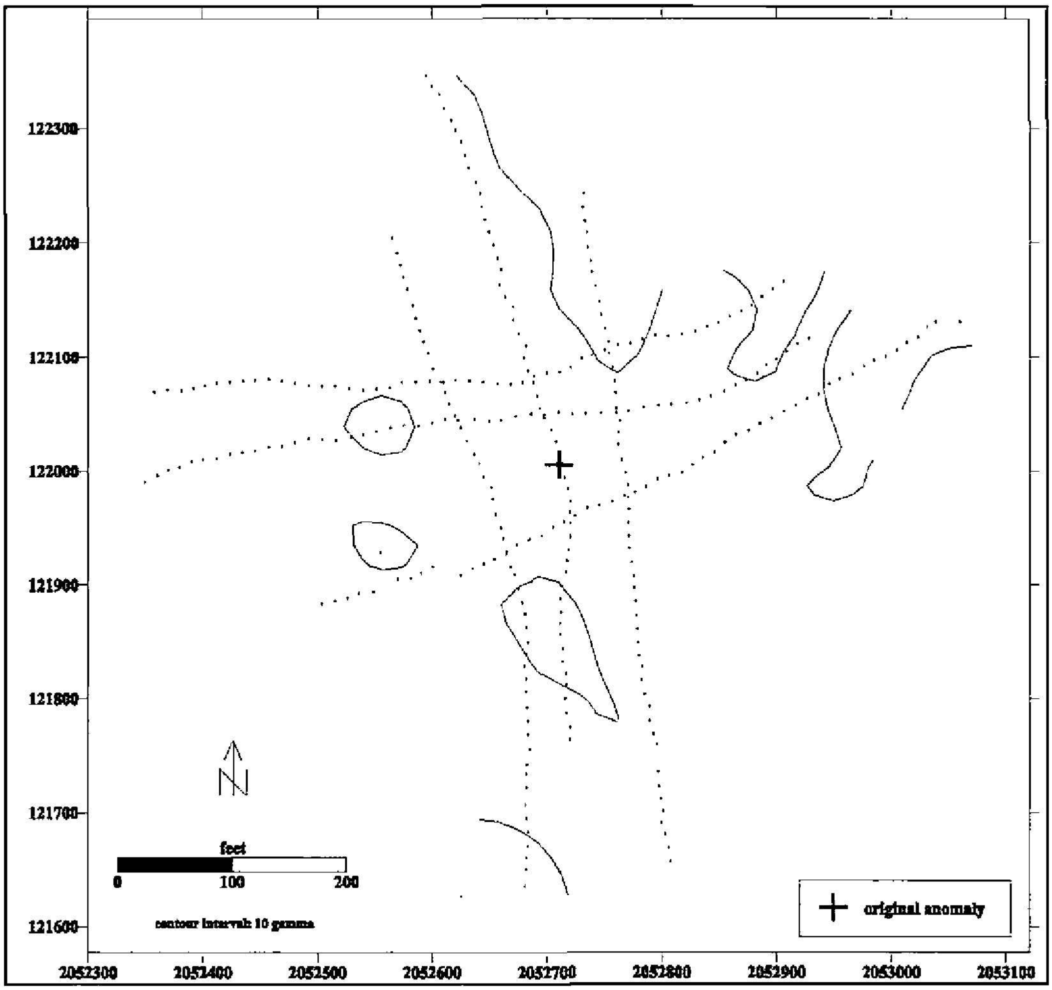

Figure 69. Magnetic refinement map of Target 33.

TARGET 34

Riess identified Target 34 as a single magnetic anomaly with a maximum deviation of 13 gammas (1994:8). Six tracklines were run after dropping a buoy 14 feet to the northeast of the coordinates provided by Riess. Water depth over the target area was 40 feet. Apparent in Figure 70, no magnetic anomalies were identifiable within the general area of Target 34. No diver investigations were made at this location.

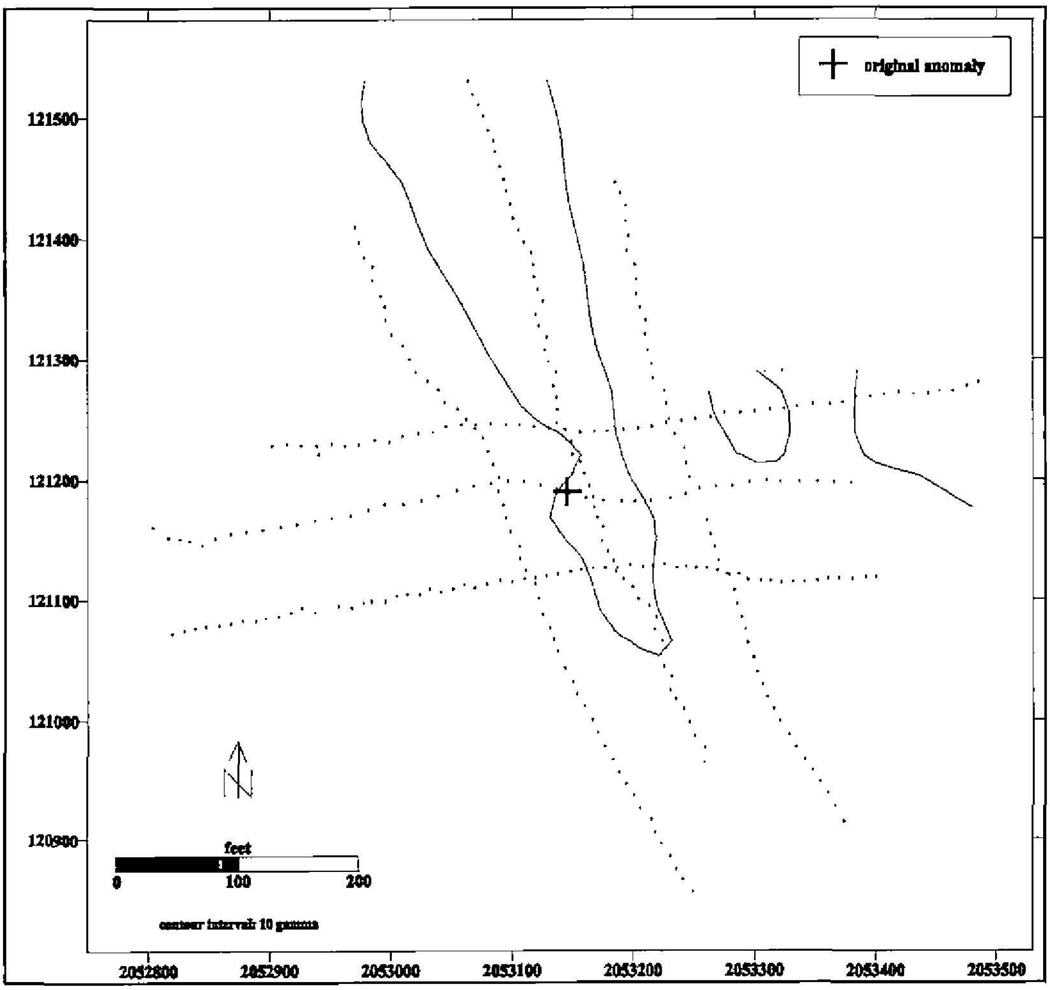

Figure 70. Magnetic refinement map of Target 34.

CONCLUSIONS

Panamerican conducted an intensive remote-sensing refinement survey and diver investigations of 34 magnetic anomalies and side-scan sonar targets located within Borrow Area 2, Queens County, New York. The purpose of the survey was to determine if any of the anomalies represented potentially significant submerged cultural resources eligible for listing on the National Register of Historic Places (NRHP) and which subsequently might require additional investigations. Table 9 represents the findings of the 34 targets investigated by Panamerican during the current investigation including refined coordinates, water depth, significance, and comments. Results from the refinement survey relocated only 18 of the 34 magnetic anomalies originally recorded by Riess (1994). All of the 18 relocated targets were identified during diver investigations as modern debris (i.e., wire cable, concrete/rebar bridge spans) and are not considered potentially significant submerged cultural resources.

Table 9. Refinement and Diver Investigation Results of Targets 1-34.

Target	Easting	Northing	Water Depth	Potentially Significant	Comments
1	2048681	118931	39'	No	2 1/2 inch diameter wire cable
2	2048645	119090	40'	No	Target not present
3	2048385	119215	40'	No	Target not present
4	2048428	121226	46'	No	Concrete/rebar bridge span
5	2047920	120601	39'	No	Exposed wire cable
6	2047382	120505	39'	No	Buried wire cable
7	2047477	120957	39'	No	Buried wire cable
8	2047640	120955	38'	No	Target not present
9	2047739	121078	40'	No	Concrete/rebar bridge span
10	2048007	121189	45'	No	Concrete/rebar bridge debris
11	2047902	121470	45'	No	Buried wire cable
12	2048890	121597	43'	No	Concrete/rebar bridge span
13	2049210	121570	37'	No	Target not present
14	2049420	121539	39'	No	Concrete/rebar bridge span
15	2048640	121150	44'	No	Target not present
16	2049354	121262	41'	No	Buried wire cable
17	2049116	120478	41'	No	Concrete/rebar bridge span
18	2049150	119630	36'	No	Target not present
19	2049671	119600	38'	No	Buried wire cable
20	2049773	119544	36'	No	Exposed wire cable
21	2050125	119445	35'	No	Target not present
22	2051400	121360	35'	No	Target not present
23	2051605	121485	37'	No	Target not present
24	2051605	121965	39'	No	Target not present
24a	2051795	121965	39'	No	Exposed wire cable
25	2052489	120475	40'	No	Buried wire cable
26	2052790	120605	38'	No	Target not present
27	2052595	120650	36'	No	Target not present
28	2052453	121093	34'	No	Exposed wire cable
29	2052694	121230	40'	No	Buried wire cable
30	2052502	121234	38'	No	Buried wire cable
31	2052490	121505	39'	No	Target not present
32	2052506	121975	39'	No	Target not present

Table 9. continued

Target	Easting	Northing	Water Depth	Potentially Significant	Comments
33	2052710	122005	40'	No	Target not present
34	2053145	121190	40'	No	Target not present

Six of the 18 identified targets were concrete/rebar bridge spans likely deposited imprecisely or illegally outside the designated Rockaway Beach Artificial Reef area and/or Atlantic Beach Artificial Reef. The presence of this material outside of its designated area is not surprising. OSI (1994), after completing a side-scan sonar survey of a number of artificial reefs off the south shore of Long Island, came to these conclusions:

> In addition, it is evident from the side scan sonar data that reef material extends beyond the designated limits of some sites surveyed for this project. In particular, moderate to dense concentrations of reef materials were identified on the seafloor south of the Rockaway Beach and Atlantic Beach Reefs, while a few isolated objects were observed south of the Shinnecock Reef. Chances are this material was originally deposited outside the reef limits as a result of inaccurate positioning. In order to document existing water depths, maximum relief, concentration, and condition of materials in these areas, further side scan sonar investigations would be necessary. These additional surveys are also recommended to ensure safe, navigable waters exist in these areas and to redefine the boundaries of the artificial reefs so that accurate and up-to-date reef locations may be published on the nautical charts (OSI 1994:20).

The remaining 12 identified targets were all identified as either buried or exposed wire/steel cables. Of varying lengths and thicknesses, each cable was deemed insignificant for the purposes of this investigation and no further archaeological investigations are warranted.

These findings are similar to other areas where modern usage of a water body is heavy. In a study conducted in the Lower Bay Area of New York Harbor, Nowak and Riess state that the area "has been exposed to a long development history and a high degree of commercial ship traffic. One must, therefore, expect a large quantity of culturally insignificant man-made material deposited, and thus a high number of sonar targets and magnetic anomalies" (1989:30).

Comparable to the present study, a summary survey of results from Mobile, Matagorda, and Galveston Bays, and approaches to New York Harbor, where modern commercial traffic is fairly high, follows (Irion 1986; Mistovich and Knight 1983; Pearson and Hudson 1990; Rogers et al. 1990; Tuttle and James 1996). In remote-sensing studies conducted in these areas, non-significant modern debris constituted the bulk of magnetic signatures located. Historic shipwrecks certainly exist in all these areas, but they can be extremely difficult to distinguish from modern debris, at least on the basis of magnetic data alone. In one survey of Mobile Bay, Irion (1986) reported that all the magnetic anomalies investigated were modern debris, much of it consisting of discarded steel cable. Mistovich and Knight (1983) also had similar findings in Mobile Bay. Pearson and Hudson (1990) reported similar findings in a remote-sensing survey of portions of the dredged navigation channel through Matagorda Bay, Texas, as did Rogers et al. (1990) for portions of the Gulf Intracoastal Waterway at the intersection of the Galveston-Freeport Cutoff and the Galveston Ship Channel. Off Rockaway and Jones Inlet, New York, Tuttle and James (1996) recorded numerous modern debris sources, such as dredge pipe.

The 16 targets that are no longer present at their original coordinate locations were likely redeposited to another location by trawling activities, surf clam dredging, surge and/or current activity, or were simply erroneous anomalies (due to a lack of contouring the original survey data). Therefore, any subsequent activities concerning the proposed dredging activities of Borrow Area 2 will not impact any historically significant watercraft.

It should be stated that the absence of magnetic and side-scan sonar anomalies within the project area is not unlike other previous investigations in similar marine environments. Pearson and Hudson state that:

> relocation of modern debris has been noted elsewhere. In a study in Mobile Bay, Irion (1986) reported that 24% of anomaly positions originally recorded could not be relocated. He attributed this factor to shrimpers catching and moving the objects from their originally surveyed positions. Garrison et al. (1989:222) reported a similar phenomenon in the Gulf of Mexico where 25% of anomalies selected for ground truthing could not be relocated. Again, the conclusion was that anomaly sources had been moved by trawling activity (1990:34).

While trawler/surf clam dredging activity and/or physical processes may explain the absence of many of the anomalies no longer present within the current project area, it is thought that the lack of contouring the original magnetic data resulted in the identification of erroneous anomalies, leaving the actual number and location of anomalies suspect. When running transect lines and contouring is not conducted, a single anomalous source, if present between the transects, will be represented as separate anomalies for each transect with differing coordinates. Contouring the data will identify the single anomaly and its coordinates correctly rather than presenting it as multiple targets. It is thought that the absence of some of the anomalies during the current investigation can be attributed to this lack of contoured data. It is therefore recommended that future remote sensing surveys be required to contour collected magnetic datat. A fairly quick and easy process, contouring is extremely cost effective when compared to the costs of resurvey and diver investigations of nonexistent targets.

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APPENDIX A

DIVE SAFETY PLAN

DIVE SAFETY PLAN

UNDERWATER INSPECTION OF TARGETS
BORROW AREA 2
ATLANTIC COAST OF LONG ISLAND
EAST ROCKAWAY INLET TO ROCKAWAY INLET
QUEENS COUNTY, NEW YORK
STORM DAMAGE REDUCTION PROJECT

INTRODUCTION

This document is the Dive Safety Plan to be employed by Panamerican Consultants, Inc., of Memphis, Tennessee (Panamerican) during diving operations for the New York District, U.S. Army Corps of Engineers (New York District), to relocate and inspect thirty four (34) targets located within Borrow Area 2 located offshore Rockaway Beach, Queens County, New York. To be performed under subcontract to Northern Ecological Associates, Inc. of Canton, New York, this investigation will be conducted for the New York District in response to their Scope of Work (SOW) entitled *Underwater Inspection of Targets Borrow Area 2, Atlantic Coast of Long Island, East Rockaway Inlet to Rockaway Inlet, Queens County, New York, Storm Damage Reduction Project* under Contract No. DACW51-97-D-0010, Delivery Order No. 00??.

The document provides an outline of procedures intended to (1) ensure the safety of project divers and (2) effectively and efficiently complete project goals and objectives. The diving operations for this project meet all federal requirements for safe diving. All diving activities are in accordance with the strictest provisions of U.S. Army Corps of Engineers, U.S. Navy, and Panamerican diving safety manuals and diving guidelines. The safety of project divers is given priority in all decisions and actions undertaken during diving operations. During all diving operations conducted as part of this project, all persons diving and working under the auspices of Panamerican shall abide by this Dive Safety Plan.

Research Design

The purpose of diving operations is to relocate the 34 targets identified by a previous remote sensing survey, determine if they represent significant submerged cultural resources (i.e., historic shipwrecks) which may be potentially eligible for nomination to the National Register of Historic Places (NRHP), and record sufficient information on each target to support recommendation for or against further study. Presented in Figure 1, the targets specifically lie in Borrow Area 2 which is approximately 7000 ft offshore of Rockaway Beach and approximately 3.5 miles to the southwest of East Rockaway Inlet.

Schedule and Duration of Diving

The diving will take place between October 1 and November 30 on each day that weather and conditions permit safe diving. Diving will not commence until the Dive Safety Plan is approved by the USACE Dive Safety Officer, and until the Dive Safety Officer visits the dive station and approves the operation.

The maximum depths recorded for the area range from 35 to 40 feet Mean Sea Level. Dives and divers will be restricted to no-decompression limits. In calculating no-decompression limits the next greater time and next greater depth will be used on standard U.S. Navy Diving tables.

Personnel

The dive team consists of six individuals: A diving supervisor, a diver, a stand-by diver, two tenders, and a time-keeper/communications operator. Each dive team member will meet the training and qualification requirements established in USACE Safety and Health Requirements Manual (EM 385-1-1). Mr. Mike Krivor, Principal investigator, Panamerican, will serve as the diving supervisor. Other members of the dive team are Michael Tuttle, field director; Jim Duff, nautical archaeologist; Dick Swete, nautical archaeologist; and Andrew Lydecker, nautical archaeologist. All of these dive team members are certified for diving; are current in Red Cross training for First Aid and Cardio-Pulmonary Resuscitation (CPR); and have recently passed a physical examination conducted for the purpose of ascertaining fitness for diving. Four members of the diving team are currently certified in oxygen administration. Prior to the start of diving operations all participants will receive a thorough briefing on the content and objectives of the Dive Safety Plan. Periodically during the conduct of diving operations, the dive team will review the Dive Safety Plan at briefings as deemed necessary by the Diving Supervisor.

Dive Platform

The dive platform utilized will be of a size and type appropriate for the area environment and specific diving operations. For the purposes of this investigation, the Venture III, a 45 foot aluminum crew boat equipped for diving will be employed. Captained by Paul Hepler, the vessel conforms to U.S. Coast Guard specifications according to class and requirements established in EM 385-1-1, and will have on board all required safety equipment. The vessel will be equipped with a safe and secure dive ladder at the stern to be used by divers, aided by their tender, when entering and leaving the water.

Diving Equipment

Although anticipated water depths are relatively shallow, for the purposes of this investigation Surface Supplied Air (SSA) will be the main diving system employed for the inherent safety and more efficient working operations provided by the direct diver to surface air line and communications. This is especially true when operating underwater dredges and jets. The dive helmets will be Superlite 17 A/B Helmets. The helmets are maintained according to manufacturer's specifications. No modifications will take place on air supply fixtures. The dive helmets and the dive hoses used are currently certified, and copies of these certifications will be provided to the New York District Corps Diving Safety Officer prior to the commencement of diving operations. All dive helmets will be fitted with radios to permit communication with the surface. It should be stated that in the event of a loss of radio communication, the dive will be terminated.

Diving Equipment Inspection

Inspection of all equipment will be performed as necessary or as required by the specific manufacturer. The inspection program will entail five different inspections:

- inspection and operational testing of equipment received from the factory or distributor

- inspection of equipment as it is issued to workers

- inspection after use

- periodic inspection of stored equipment

- periodic inspection when a question arises concerning the appropriateness of the selected equipment, or when problems with similar equipment arise

The inspection checklist is provided in Table 1. Records will be kept of all inspection procedures. Individual identification numbers will be assigned to all reusable pieces of equipment, and records should be maintained by that number. At a minimum, each inspection should record the ID number, date, inspector, and any unusual conditions or findings. Periodic review of these records may indicate an item with excessive maintenance costs or a particularly high level of down-time.

TABLE 1
EQUIPMENT INSPECTION CHECKLIST

HELMETS

Before use:

- Yearly inspection by certified inspector of all hoses, helmets, regulators, valves, etc. (These have been appended to this Plan).

During the work task:

- Daily inspection of helmets, including regulator (i.e., intake valves and exhaust ports), neck seal, one-way valve on air supply hose attachment, and free-flow operation. The helmets are checked for any leaks, malfunctions, and corrosion.

- Daily inspection of communication system. This involves a sound check at the surface when all gear is set up, and once again as soon as the diver is underwater. All wires at both the communication box and the helmet are checked for corrosion.

HOSES

Before use:

- Yearly pressure inspection.

During the work task:

- Daily, before connecting air hoses to helmets, they are blown free with air to make sure no debris or particulars are in the hose.

- Daily, all couplings are checked for leaks, corrosion, or malfunctions.

- Daily, all hoses are inspected for frays, cuts, corrosion, leaks, cracks, bulges, etc.

- Hoses, while in use, will be continually rinsed with a diluted bleach solution to keep contaminants to a minimum.

AIR SUPPLY

Before use:

- Certificate of air quality will be provided.

During the work task:

- K bottles will be properly secured in a well ventilated area out of the direct sun or other heat source.

Storage

Diving equipment will be stored properly to prevent damage or malfunction due to exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures, and impact. Storage procedures are as follows:

- All equipment will be stored in a well-ventilated area, with good air flow around each item, if possible.
- Dive suits, helmets, and hoses will be stored in a manner consistent with manufacturer's recommendations.

Air Supply

Air for SSA diving will be provided by cascade system of no less that two 240-cubic-foot 'K' bottles. Pressure gauges and check valves are included in the air supply system as appropriate. The cascade system will be stored in a protected from excessive heat and secure from falling. The timekeeper will monitor the air supply system during each dive to ensure that air pressure is correctly maintained and adequate reserve air is always available. A certificate of air quality will be obtained from the air supplier, and submitted to the New York District Dive Safety Officer for approval prior commencement of diving activities.

The air supply hoses are Gates 33 H/B commercial dive hoses that have a working pressure at least equal to the working pressure of the air supply system and will have a rated bursting pressure at least four times greater than operating pressure or at least 80 PSI over bottom (ambient) pressure. The hoses are kink resistant, marked in 10-foot increments from the diver, and will be equipped with corrosion-resistant fittings. When not in use hoses will be over-under coiled or figure-eight coiled to prevent twists and/or kinks. Hose ends will be capped or taped when not in use. The dive hose will be inspected prior to each dive.

Divers using SSA will wear a safety harness with a quick-release attachment connected to the air umbilical. A safety line of at least 3/8 inch synthetic material is included as an integral part of the umbilical. The divers will wear clothing or wet suits, boots, gloves, and other protective gear appropriate to the conditions. Divers will wear weight belts equipped with quick-release buckles. All the equipment used during the diving operations will be inspected prior to each dive.

During all periods of diving a suited stand-by diver will be fully prepared and equipped to dive SSA in the event of an emergency. There will be a separate individual timekeeper and communications operator during each dive. Voice communication between diver and surface will be maintained at all times. If voice communication is lost, the dive will be terminated.

Diving Operations

The dive platform will be securely anchored or moored during all diving operations; no "live-boating" will be conducted during this project. The diving will be provided by surface supply air only. Each diver will have a full-time dive tender handling the diver air supply hose. The tender will help the diver don and remove and adjust equipment. The tender will check and ensure that the diver is properly rigged and adjusted immediately before the diver enters the water. The diver will not enter the water until clearance from the tender has been given. The diver and the communications operator will conduct a communications check prior to the diver's entering the water. The diver will check all equipment for proper function immediately upon submerging, while descending, and upon reaching the bottom before conducting any work. The tender will hold the diver's hose with the proper tension at all times during the dive. The hose should be held with enough tension to permit the tender and diver to transmit and receive "pull-signals" as needed, particularly in the event of a loss of radio communication. Should the diver's hose become fouled, all work will cease, the hose will be cleared, and the hazard causing the fouling will be evaluated before work is resumed.

The underwater examination of each target location will begin with diver sweeps of each area in an attempt to locate any portion of the target that may either rise above the bottom or be felt immediately beneath the upper sediments. It should be noted that an unknown portion of each target may be buried beneath an uncertain depth of sediment. If the targets are not located on the initial diver sweeps, the search will continue utilizing appropriate techniques and equipment such as metal and hydraulic probes, a hand-held metal detector, or a magnetometer sensor. If necessary, buried targets will be uncovered through the use of hydraulic venturi-style dredges. It is emphasized that a minimum necessary amount of sediments will be disturbed in order to locate, examine, and evaluate the targets. Once a target is located, divers will record sufficient information to assess NRHP eligibility. Relative to existing water and overburden conditions, 35 mm black and white photographs, video, and measured drawings will be produced of each wreck site.

Safety Considerations

All diving will be performed in accordance with the U.S. Army Corps of Engineers "Safety and Health Requirements Manual" EM385-1-1 dated September 1996; with the U.S. Navy Diving Manual; and with Panamerican's "Diving Safety Program for Submerged Cultural Resource Investigation" as appropriate (submitted to the USACE Diving Safety Officer in 1998).

Colds, upper sinus infections, respiratory infections, and ear infections that are contra-indicated for diving will preclude an individual from diving. All divers will inform the diving supervisor of the ingestion of any medication. All diving will be voluntary, and any dive team member may decline to dive at any time. All dive team members will immediately bring to the attention of the diving supervisor any existing, arising, or potential threats to diver safety.

Safety and planning sessions will precede each day of diving. These sessions will include an assessment of safety aspects, potential hazards, tasks to be undertaken, emergency procedures, and any necessary modifications to operating procedures. All dives will be logged throughout the dive, and written comments for the dive log will be required of the returning diver immediately upon completion of each dive. Upon completion of a dive and prior to the commencement of the next dive the returning diver will inform the dive supervisor about diving conditions observed and specifically about any hazards or potential hazards encountered. Divers will remain awake for at least one hour after a dive. Divers will wait at least 12 hours before flying after any dive; this will be extended to 24 hours following multiple days of diving.

An international diving flag (Alpha flag) and a civilian "diver-down" flag (red with white diagonal stripe) will be raised on the diving platform prior to, and lowered following completion of, all diving operations. Accurate timepieces and sharp knives will be carried by all diving personnel. Fire extinguishers will be aboard the dive platform and in each vehicle used. The dive team will have a diver first aid kit, oxygen, and floating backboard on hand during all diving operations. All personnel will be familiar with safety procedures and with the locations of safety equipment. All accidents or injuries will be reported to the diving supervisor immediately, and a report of injury form will be completed.

Evacuation Routes and Emergency Facilities

Evacuation routes from project areas to emergency medical facilities will be established, and all project personnel will know these routes. There will be sufficient fuel kept in all vehicles for emergency use. There will always be a vehicle and/or boat available for emergency use during diving operations. In the event of an emergency the 911 emergency system is in operation in the project area, and a cellular telephone will be on-board the dive platform at all times. The ambulance service nearest to and/or that can most quickly reach the landing nearest the dive site will be ascertained prior to diving operations. The emergency medical facility closest to, and/or most quickly reached from, the dive site and project docking area is the Long Beach Medical Center. Emergencies will be directed to the Emergency Room at (516) 897-1100. As a fall back, Mercy Hospital Medical Center will be employed. The Emergency Room number is (516) 255-2223. The nearest Hyperbaric Chamber is located at the Nassau County Medical Center (516) 572-6213. Because a chamber may be in use and therefore we have listed on our emergency numbers sheet two additional nearby chambers.

The United States Coast Guard (U.S.C.G.) in the area is under the direction of 1st District Operations (monitoring marine radio channel 16). Search and rescue helicopters capable of providing emergency evacuation operate out of the Coast Guard Air Station (718) 765-2410 or 2409. Appropriate emergency facilities will be contacted and notified of the project prior to diving operations.

Dive Safety

Safety will be a primary goal of this project, and diver safety will be given priority in all decisions and actions undertaken during diving operations. If for any reason this safety plan is altered in mission, depth, personnel, or equipment before the start of the project, the New York District Diving Safety Officer shall be informed of the changes in a timely manner for New York District review prior to commencement of diving operations.

EMERGENCY SERVICES - ROCKAWAY BEACH, NEW YORK

EMERGENCY	911	EMERGENCY
AMBULANCE	911 or area hospital	
HOSPITAL	516-897-1000	Long Beach Medical Center
Emergency	516-897-1100	Emergency Room
HO09ital Medical Center		
Emergency	516-255-2223	Emergency Room

UNITED STATES COAST GUARD

SEARCH AND RESCUE	516-785-2988	24-Hour Hotline
Air Station	718-765-2410/09	USCG Air Station

DIVER ASSISTANCE NETWORK (D.A.N.)

DIVING EMERGENCY	919-684-8111	24-Hour Hotline

HYPERBARIC CHAMBERS

Nassau County Medical Center	24Hr #:	516-572-5299 or 516-572-3311 (Emergency)
J.T. Mather Memorial Hospital	24Hr #:	516-473-1320 or 516-476-2808 (Emergency)

APPENDIX B

MANAGEMENT SUMMARY

November 9. 1999

Mrs. Nancy Brighton
Environmental Analysis Section
U.S. Army Corps of Engineers
New York District
Jacob K. Javits Federal Building
26 Federal Plaza
New York, New York 10278-0090

RE: Contract No. DACW51-97-D-0010-3, Delivery Order No. 74.
Underwater Inspection of Targets
Borrow Area 2, Atlantic Coast of Long Island,
East Rockaway Inlet to Rockaway Inlet
Queens County, New York
Storm Damage Reduction Project
Management Summary

Dear Mrs. Brighton:

The following management summary discusses in detail the results of field investigations conducted pursuant to the above-referenced project. While analysis of field data is incomplete, this summary provides sufficient information on which to base management decisions relative to U.S. Army Corps of Engineers, New York District's obligations under the National Historic Preservation Act of 1966.

INTRODUCTION

From October 7-31, 1999, archaeologists from Panamerican Consultants, Inc. (Panamerican) of Memphis, Tennessee conducted an intensive remote-sensing refinement survey and diver investigations of 34 magnetic anomalies and sidescan targets located within Borrow Area 2, Queens County, New York. The purpose of the survey was to determine if any of the anomalies represented potentially significant submerged cultural resources eligible for listing on the National Register of Historic Places (NRHP) and which subsequently might require additional investigations. Performed under subcontract to Northern Ecological Associates, Inc., of Canton, New York, the project was conducted for the U.S. Army Corps of Engineers, New York District relative to their responsibilities under Section 106 of the National Historic Preservation Act.

The project area (Borrow Area 2) is located in Queens County, New York approximately 7,000 feet south of Rockaway Beach and measures 6,000 feet by 3,000 feet (Figure 1). A magnetometer and sidescan sonar survey completed of the area in 1993 (Riess 1994), identified

34 potentially significant targets within the Borrow Area. These previously located anomalies were the focus of the current investigation.

Figure 1. Project area location.

The current anomaly location and assessment investigation commenced with a remote-sensing refinement survey which included the implementation of those tools useful in determining the absence/presence of submerged cultural remains within the project area. The remote-sensing equipment used during this investigation included a magnetometer, sidescan sonar, fathometer, and a Differential Global Positioning System (DGPS). A buoy was dropped at the coordinates of each target located by Riess (1994). The magnetometer was then deployed and a series of refinement lines were run over each target area. Magnetometer data for each of the 34 targets was collected for the production of magnetic contour maps to be presented within the report.

If the target was still extant within the refinement area, an additional refinement buoy was placed close to the target for relocation purposes. A diver was then deployed to locate and identify the source of each magnetic anomaly. If the target was not exposed on the ocean bottom, a hand-held underwater metal detector was used to localize the area of the target. A 10-foot hydro-probe and/or water jet were then used to expose any buried anomalies. Once located and identified each target was videotaped (relative to adequate visibility) and sufficiently recorded for report and project purposes.

Results from the refinement survey located only 18 of the 34 magnetic anomalies as specified by Riess (1994), the remaining 16 targets were no longer present. Each of the 18 targets relocated were then identified during diver investigations. All of the 18 targets were identified as modern debris (i.e. wire cable, concrete/rebar bridge spans) and are not considered potentially significant submerged cultural resources. Therefore, any subsequent activities concerning the proposed dredging activities of Borrow Area 2 will not impact any historically significant watercraft. The 16 targets which were not reproducible, as discussed below, were absent at their respective coordinates owing to either trawler activity or a as a result of not contouring the original magnetic data. The lack of contouring results in a single anomaly being identified as multiple anomalies, all having incorrect coordinates.

PERSONNEL

The personnel involved with this remote-sensing survey had the requisite experience to effectively and safely complete the project as proposed. Stephen R. James, Jr. served as the project manager with Michael C. Krivor serving as principal investigator. Michael Tuttle, Richard Swete, Jim Duff, and John Rawls, rounded out the Panamerican team as both remote-sensing specialists and divers. Captain Paul Hepler and first mate Ruth Hepler served as boat captain and boat handler aboard the *Venture III*.

REMOTE-SENSING SURVEY EQUIPMENT

The remote-sensing survey was conducted with equipment and procedures intended to facilitate the effective and efficient search for magnetic anomalies and acoustic targets and to determine their exact location. The positioning system used was a Motorola LGT-1000 Global Positioning System (GPS) instrument linked to a Starlink MRB-2A, MSK Radiobeacon receiver for differential (DGPS) capabilities. Remote-sensing instruments included an EG&G Geometrics Model G-866 recording proton precession magnetometer, with an EG&G Geometrics Model G-801 marine sensor towed off the stern of the survey vessel. A Marine Sonic Technology Sea Scan PC Sidescan Sonar was used to create a near-photographic sonar image of the ocean floor.

DIFFERENTIAL GLOBAL POSITIONING SYSTEM. A primary consideration in the search for acoustic targets and 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. These positioning functions were accomplished on this project through the use of a Motorola LGT-1000 GPS-based system utilized

The Motorola LGT-1000 is a global positioning system that, when linked to the Starlink MRB-2A, MSK Radiobeacon receiver, attains differential capabilities. These electronic devices interpret transmissions both from satellites in Earth's orbit and from a shore-based station, to provide accurate coordinate positioning data for offshore surveys. The Motorola system used here has been specifically designed for survey positioning. New York State Plane coordinates, based on the 1927 North American Datum (NAD 27) coordinate system (used during the Riess survey), were used for this project. This positioning was provided through virtually continuous real-time tracking of the moving survey vessel by utilizing corrected position data provided by an on-board GPS system, 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 system 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.

Both the satellite transmissions and the differential transmissions received from the shore-based navigation beacon were entered directly into a Winbook XP 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 every two seconds. The level of accuracy for the system was considered at ±1 meter throughout the survey. Computer software (Navtrak®) used to control data acquisition was written and developed by Chris Ransome & Associates (CRA) specifically for survey applications. Positioning information was printed on hard copy and stored on magnetic disk aboard the survey vessel. It was used to provide real-time trackline data for the vessel operator during remote-sensing survey operations.

All positioning coordinates are based upon the position of the antenna of the DGPS system. 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. The lay back of the sidescan sonar was 2 feet starboard, 20 feet aft, and the magnetometer sensor lay back was 60 feet aft.

MAGNETOMETER. The remote-sensing instrument used to search for ferrous objects on or below the ocean floor of the survey area was an EG&G Geometrics Model G-866 proton precession magnetometer linked to an EG&G Model G-801 marine sensor. 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 stripchart printout of the G-866 recorded data at two-second intervals both digitally and graphically, providing a record of both the ambient background field and the character and amplitude of anomalies encountered. This information was also 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 surveyed, visual inspection), other remote-sensing technologies, and prior knowledge of similar targets, can lead to an accurate estimation.

For this project the magnetometer was interfaced with a Winbook XP laptop computer, utilizing Navtrak® software applications for data storage and management. It was also interfaced with the positioning system, allowing positioning fix points to be included on the stripchart printout.

SIDESCAN SONAR. The Marine Sonic Technology (MST) Sea Scan Sidescan Sonar is a self-contained sonar system. The software included with the Sea Scan Personal Computer (PC) system controls the collection of sonar imagery, as well as navigational input, and displays the information to the operator in the form of a digital display (utilizing a 13-inch color monitor). The Sea Scan PC allows the operator to view wide tracts of the ocean bottom by isonifying along a predetermined swath width and recording the strength of the echoes from the sea bottom. This is performed by a towfish, which is towed just above the river bottom by a tow cable. The towfish emits a continuous, narrowly focused beam of sound perpendicular to the path of forward motion. The sound pulses pass through the water and are reflected by the river bottom and from various objects such as shipwrecks, debris, and geographic features (sand ripples, rocks, etc.). The strength of the signal returned to the towfish is recorded, and then the entire sonar record line is drawn onto the screen for viewing by the operator. An image of the ocean floor is constructed line by line as the sonar record line from each pulse of the sonar is returned to the PC and then displayed onto the color monitor.

The MST Sea Scan PC sidescan sonar was linked to the towfish that employed a 600-kHz power setting and a variable side range of 50 meters per channel on each of the sidescan lines run. The 50-meter-per-channel setting provided overlapping coverage with the line spacing selected for sidescan recording. The power setting was selected in order to provide maximum possible detail on the record generated; 600 kHz was the preferred frequency. The 50-meters-per-channel selection made it possible to collect acoustic data over a 150-foot wide area on each line for which the sidescan sonar was employed.

SURVEY VESSEL. The survey vessel used during the refinement survey and dive operations was a 46-foot, all-aluminum, Breaux-built Crew Boat. The *Venture III* was perfectly suited for remote-sensing refinement work and dive operations. Ample deck area was available for the placement and operation of the necessary remote-sensing equipment and all dive equipment. The *Venture III* 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, and air horns.

REFINEMENT AND SURVEY PROCEDURES

Coordinates for each of the 34 targets identified by Riess (1994) were entered into the navigation computer. Beginning with Target 1 and proceeding sequentially through Target 34, each was refined with the magnetometer after a buoy was dropped at each prescribed location. Once the magnetometer and DGPS systems were tested, the running of tracklines began. A series of 300-foot long tracklines, spaced approximately 50 feet apart, were run over the target area to determine the exact location of the target around the buoyed location. Three tracklines were run on a north/south heading followed by three tracklines running east/west for complete coverage of each target area.

The helmsman viewed a video monitor, linked to the DGPS and navigational computer, to aid in directing the course of the vessel down the pre-plotted tracklines. The monitor displayed the pre-plotted trackline, the real time position of the survey vessel relative to the pre-plotted trackline, and the path of the survey vessel. The speed of the survey vessel was maintained at approximately three to four knots for the uniform acquisition of data.

As the survey vessel maneuvered down each trackline, the navigation system monitored the position of the survey vessel relative to the pre-plotted tracklines every two seconds, each of which was recorded by the computer. Event marks were hand annotated on the magnetometer stripchart delineating the start and end of each of the tracklines. The exact time of both the start and end of line was also recorded to aid in producing magnetic contour maps.

Following the completion of each magnetometer refinement survey, a review of the data was conducted to determine the presence or absence of each target within the refinement area. If no magnetic target was located within the refinement area it was speculated that the target has been displaced or removed (likely by fishing vessels and/or clam dredges in the area) since the initial survey by Riess (1994) and no further investigations were undertaken. If the data indicated that a magnetic target was present within the refinement area, a series of additional tracklines with the magnetometer were undertaken to localize the anomaly and an additional buoy placed at the source of the target. The*Venture III* was then anchored close to the source of each located anomaly and readied for dive operations.

DIVE OPERATIONS

Once the target locations were refined the next phase of the project was to attempt to locate the source of the anomaly either through visual or tactile methods. Prior to diving, the direction of the tidal current and wind direction, relative to each target area, had to be ascertained. The ebb and flow of the tide and wind direction determined the orientation of the survey vessel and affected the deployment of tools the diver would utilize on the sea floor. Anchors were then placed to hold the survey vessel over the target area and allow the diver safe entry and exiting from the stern of the vessel.

Surface Supplied Air (SSA) was chosen as the most efficient and safe method of conducting investigations within the project area. Divers employed a Kirby-Morgan Superlite-17 dive helmet connected to a surface-supplied air source, radio communications cable, safety tether, and pneumo hose. On the surface various individuals and pieces of equipment ensured safe diving operations. A dive tender was required to aid the diver in donning and doffing equipment and to tend the diver while submerged and moving about the sea bed. The radio communications operator kept in constant contact with the diver and relayed messages between the diver and the surface support team. A standby diver was required on site in the advent of any emergency situation that would require aid to the primary diver. Finally, a dive supervisor was present on site at all times to coordinate the activity of the diver and surface support team to achieve the project goals.

The initial objective for the diver was to visually inspect the sea floor for the source of the anomaly prior to conducting any hydro-probing. 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. If the target was not observed on the ocean bottom, the diver was given a underwater metal detector to locate the buried anomaly. 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, west) to determine the overall area of the target. Once delineated with the metal detector the diver was given either a 10-foot hydro-probe or water jet to identify the source of the target.

***UNDERWATER PROBING*:** Probing of anomalies is an effective means of determining the spatial extent and burial depth of a given target located beneath the sea floor. The hydro-probe and water jet were determined to be the most efficient tools for this project. The hydro-probe apparatus consists of a water pump, hoses, and various lengths of PVC pipe. For this project a 5-h.p. Honda water pump was connected to lengths of 1.5 inch fire hose. The hose was connected to the 1-inch diameter PVC pipe probe by a camm lock. The length of the hydro-probe used for this investigation was 10 feet. The basic function of the hydro-probe is to aid in determining the spatial extent of buried cultural material, the type of cultural material (i.e., wood, iron), and amount of overburden. This is accomplished by forcing water through a pipe which is attached to the water pump's effluent hose. The force of the water ejected from the pipe end effectively allows the probe to be easily inserted through sediments of varying density (i.e., sands, silts) to a desired depth. The utility of this tool in investigating buried objects cannot be overstated. Without the use of a probe, many cubic yards of overburden would have to be removed to obtain the same information.

Probes were typically spaced at 15-foot intervals during the investigation. If a positive return was encountered, probing distances were refined in an effort to outline the size of the return. Probes were placed at all cardinal points to further delineate any positive returns.

If hydro-probing failed to locate the target beneath the sediment, a water jet was used to trench across a section of the target area. When water is forced through the water jet it removes sediments quickly and efficiently to a depth of approximately 2-3 feet. Many of the targets located throughout the survey were simply buried lengths of wire cable which were easily missed by the hydro-probe. Use of the water jet proved to be the most effective means of identifying many of the target as most were buried sections of wire cable.

RESULTS

The refinement survey of Borrow Area 2 was intended to relocate and identify any potentially significant submerged cultural resources which may require additional investigations prior to proposed future dredging operations. The survey was completed in an effort to locate those targets which might be eligible for inclusion into the NRHP.

Presented in Table 1 are the results of the refinement survey and diver investigations of Targets 1-34. Of the 34 targets identified by Riess (1994), 18 were relocated and identified by Panamerican. The remaining 16 targets were not relocated during remote-sensing refinement. work. Each of the six, 300-foot survey tracklines adequately covered each target area and the absence of the 16 targets is likely due to current fishing and/or clam dredging activities within the project area.

The absence of magnetic and sidescan sonar anomalies within the project area is not unlike other previous investigations within a similar marine environment. Pearson and Hudson state that this:

> relocation of modern debris has been noted elsewhere. In a study in Mobile Bay, Irion (1986) reported that 24% of anomaly positions originally recorded could not be relocated. He attributed this factor to shrimpers catching and moving the objects from their originally surveyed positions. Garrison et al. (1989:222) reported a similar phenomenon in the Gulf of Mexico where 25% of anomalies selected for ground truthing could not be relocated. Again, the conclusion was that anomaly sources had been moved by trawling activity (1990:34).

While trawler activity explains the absence of many of the anomalies within the current project area, it is thought that the absence of contouring the original Riess magnetic data resulted in the identification of erroneous anomalies, the actual number and location of anomalies suspect. When running transect lines and contouring is not conducted, a single anomalous source, if present between the transects, will be represented as separate anomalies for each transect with differing coordinates. Contouring the data will identify the single anomaly and its coordinates correctly rather than presenting it as multiple targets. It is thought that the absence of some of the anomalies is attributed to this lack of contoured data.

Table 1. Refinement and diver investigation results of Targets 1-34

Target	Northing	Easting	Water Depth	Potentially Significant	Comments
1	118931	2048681	39'	No	2 1/2 inch diameter wire cable
2	119090	2048645	40'	No	Target not relocated
3	119215	2048385	40'	No	Target not relocated
4	120226	2048428	46'	No	Concrete/rebar bridge span
5	120601	2047920	39'	No	Exposed wire cable
6	120505	2047382	39'	No	Buried wire cable
7	120957	2047477	39'	No	Buried wire cable
8	120955	2047640	38'	No	Target not relocated
9	121078	2047739	40'	No	Concrete/rebar bridge span
10	121189	2048007	45'	No	Concrete/rebar bridge debris
11	121470	2047902	45'	No	Buried wire cable
12	121597	2048890	43'	No	Concrete/rebar bridge span
13	121570	2049210	37'	No	Target not relocated
14	121539	2049420	39'	No	Concrete/rebar bridge span
15	121150	2048640	44'	No	Target not relocated
16	121262	2049354	41'	No	Buried wire cable
17	120478	2049116	41'	No	Concrete/rebar bridge span
18	119630	2049150	36'	No	Target not relocated
19	119600	2049671	38'	No	Buried wire cable

20	119544	2049773	36'	No	Exposed wire cable
21	119445	2050125	35'	No	Target not relocated
22	121360	2051400	35'	No	Target not relocated
23	121485	2051605	37'	No	Target not relocated
24	121965	2051605	39'	No	Target not relocated
24a	121965	2051795	39'	No	Exposed wire cable
25	120475	2052489	40'	No	Buried wire cable
26	120605	2052790	38'	No	Target not relocated
27	120650	2052595	36'	No	Target not relocated
28	121093	2052453	34'	No	Exposed wire cable
29	121230	2052694	40'	No	Buried wire cable
30	121234	2052502	38'	No	Buried wire cable
31	121505	2052490	39'	No	Target not relocated
32	121975	2052506	39'	No	Target not relocated
33	122005	2052710	40'	No	Target not relocated
34	121190	2053145	40'	No	Target not relocated

Of the 18 identified targets, all were modern debris and are not considered significant for the purposes of this investigation. The present findings are similar to other areas where modern usage of a water body is heavy. In a study conducted in the Lower Bay Area of New York Harbor, Nowak and Riess state that the area "has been exposed to a long development history and a high degree of commercial ship traffic. On must, therefore, expect a large quantity of culturally insignificant man-made material deposited, and thus a high number of sonar targets and magnetic anomalies" (1989:30).

Comparable to the present study, a summary survey of results from Mobile, Matagorda, and Galveston Bays, and approaches to New York Harbor, where modern commercial traffic is fairly high, follows (Irion 1986; Mistovich and Knight 1983; Pearson and Hudson 1990; Rogers, Hoyt, Bond, Voellinger, and James 1990; Tuttle and James 1996). In remote-sensing studies conducted in these areas, non-significant modern debris constituted the bulk of magnetic signatures located. Historic shipwrecks certainly exist in all these areas, but they can be extremely difficult to distinguish from modern debris, at least on the basis of magnetic data alone. In one survey of Mobile Bay, Irion (1986) reported that all the magnetic anomalies investigated were modern debris, much of it consisting of discarded steel cable. Mistovich and Knight (1983) also had similar findings in Mobile Bay. Pearson and Hudson (1990) reported similar findings in a remote-sensing survey of portions of the dredged navigation channel through Matagorda Bay, Texas, as did Rogers et al. (1990) for portions of the Gulf Intracoastal Waterway at the intersection of the Galveston-Freeport Cutoff and the Galveston Ship Channel. Off Rockaway and Jones Inlet, New York Tuttle and James (1996) recorded numerous debris sources which were modern debris, such as dredge pipe.

CONCLUSIONS

Because the above 34 anomalies do not represent the remains of potentially significant submerged cultural resources, it is the opinion of the principal investigator that the proposed dredging activities of Borrow Area 2 will not impact any historically significant watercraft. Further archaeological work is not recommended for the project area.

If there are any questions regarding the findings of the remote-sensing survey or this summary please feel free to contact me or Stephen James at our Memphis office.

Sincerely

Michael Krivor
Principal Investigator

cc: Steven R. James, Jr., Underwater Project Manager
Beth Stuba, Northern Ecological Associates, Inc.