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U.S. Army Corps of Engineers
New York District

TARGET INVESTIGATIONS IN CONNECTION WITH THE NEW YORK AND NEW JERSEY HARBOR NAVIGATION PROJECT UPPER AND LOWER BAY PORT OF NEW YORK AND NEW JERSEY KINGS, QUEENS, NEW YORK AND RICHMOND COUNTIES, NEW YORK ESSEX, HUDSON, MONMOUTH AND UNION COUNTIES, NEW JERSEY

FINAL REPORT

May 2004

Panamerican Consultants, Inc.
15 South Idlewild Street
Memphis, Tennessee 38104

PREPARED FOR:

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

UNDER SUBCONTRACT TO:

Matrix Environmental and
Geotechnical Services, Inc.
215 Ridgedale Avenue
Florham Park, New Jersey 07932

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Andrew D.W. Lydecker
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MANAGEMENT SUMMARY

From July 31–September 18, 2002, Panamerican Consultants, Inc. (Panamerican) of Memphis, Tennessee, conducted an underwater archaeological investigation for Matrix Environmental and Geotechnical Services, Inc., of Florham Park, New Jersey. This investigation is part of the New York and New Jersey Harbor Navigation Project. Its purpose was to examine the sources of eleven acoustic targets and 28 magnetic anomalies in the project area. Also included was a remote-sensing survey and target investigation of five areas skipped during the original survey due to safety concerns.

The current project includes the deepening and widening of numerous channels in the Port of New York and New Jersey. The survey consisted of an area extending 100 feet past the edges of each channel, including Ambrose, Anchorage (west side only), Kill Van Kull, Arthur Kill to Howland Hook Berth, Newark Bay and South Elizabeth Channels. Areas of Newark Bay Channel surveyed included the east side to the northern edge of the Port Newark Channel, west side between Kill Van Kull and South Elizabeth Channel, and the east side between Port Elizabeth and Port Newark Channels (to 250 feet). Also included were a dredged pit in the area of Robbins Reef, and the intersection of Newark Bay and Kill Van Kull Channels. Water depths ranged from zero to 55 feet.

During the investigation remote-sensing targets were refined and dived. Of the 28 magnetic anomalies, six were pipelines, 10 were miscellaneous non-historic modern debris, six were non-significant modern structures, two were non-significant submerged marine resources, one had a refined location outside the project area, one was not relocated on refinement, and two were not dived or refined due to safety concerns. Of the 11 acoustic targets, three were non-significant modern structures, six were non-significant submerged marine resources, one was determined to be outside the project area on refinement, and elements of one are recommended for Phase III investigation. In addition, the remote-sensing survey located two acoustic targets that were investigated by Panamerican divers. Of these, one was determined to consist of two modern steel vessels, and one was determined to be a cluster of five historic vessels, four of which are recommended for Phase III investigation. Several targets were added to the diving investigation, including three wrecks located on the navigation charts in areas that were not surveyed during the original survey due to extremely low water, and one acoustic target located during the original survey but not recommended for further work because it was initially determined to be outside the project area. Examination of the site determined that it is in fact inside the project area. A total of six vessels are recommended for further investigation ranging from partial recordation to full recordation to partial recovery.

Copies of the final report will be on file at the U.S. Army Corps of Engineers, New York District, and the New York State Historic Preservation Office.

ACKNOWLEDGMENTS

The successful completion of this project is the direct result of the input and hard work of numerous individuals. The authors would first like to thank the U.S. Army Corps of Engineers, New York District, and specifically Ms. Lynn Rakos for allowing Panamerican the opportunity to conduct this investigation. We would also like to extend our gratitude to Matrix Environmental and Geotechnical Services, Inc., under whose contract this project was conducted, and to Mr. Dennis Petrocelli, who administered the contract for the firm.

The authors would also like to thank the archaeological survey crew who partook in this investigation. Many thanks to Captain Paul Hepler and Ruth Hepler of the *Venture III* who assisted the Panamerican crew during the project. The Heplers' knowledge of area waters and boat handling experience was truly impressive, making our job that much easier.

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

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1. INTRODUCTION

From July 31–September 18, 2002, Panamerican Consultants, Inc. (Panamerican) of Memphis, Tennessee, conducted an underwater archaeological investigation for Matrix Environmental and Geotechnical Services, Inc., of Florham Park, New Jersey. This investigation is part of the New York and New Jersey Harbor Navigation Project. Its purpose was to examine the sources of eleven acoustic targets and 28 magnetic anomalies in the project area. Also included was a remote-sensing survey and target investigation of five areas skipped during the original survey due to safety concerns.

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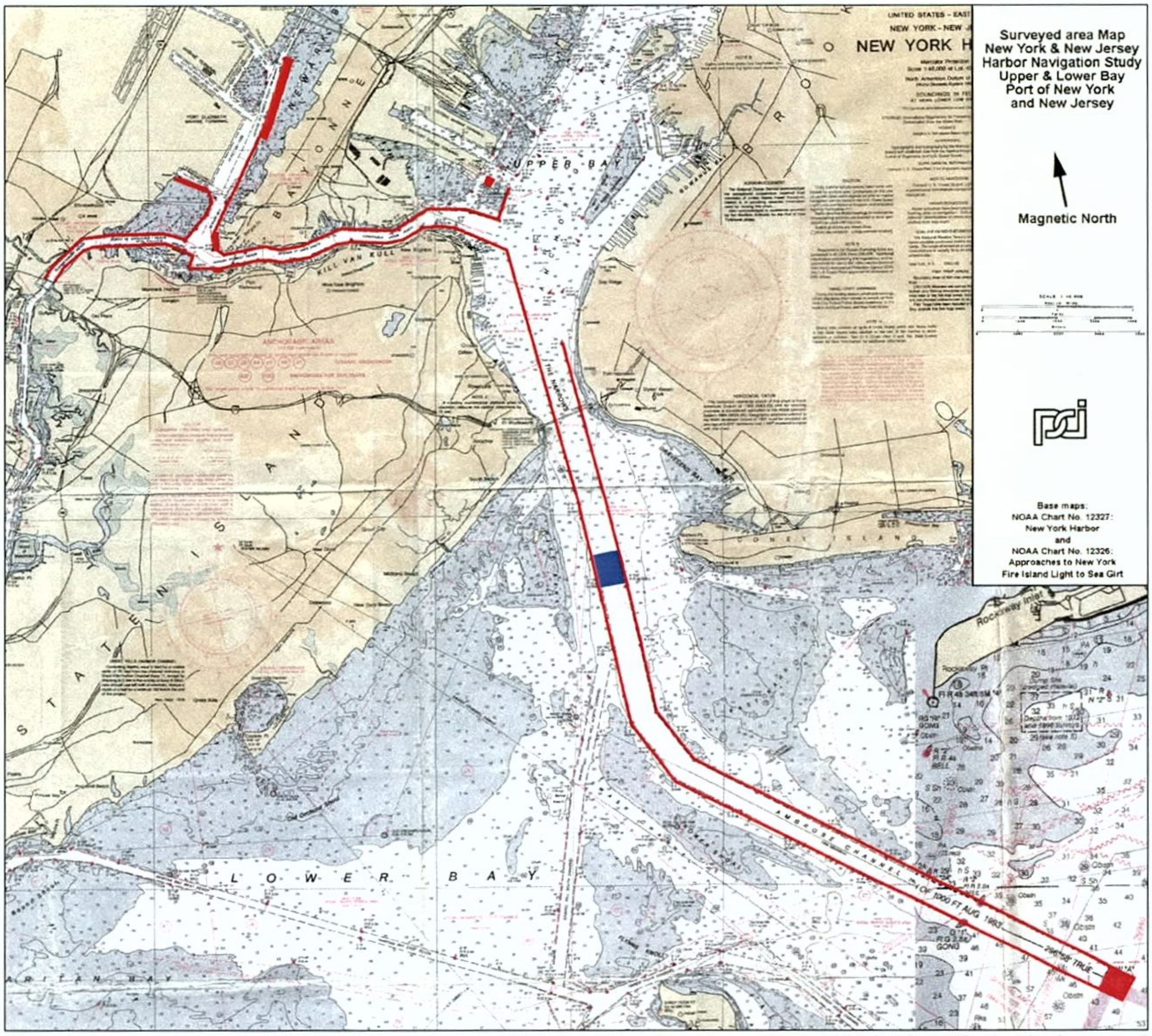

Figure 1. Area surveyed in 2001 (base map: NOAA navigation chart Nos. 12327: New York Harbor, and 12326: Approaches to New York Fire Island Light to Sea Girt).

2. RESEARCH DESIGN

PURPOSE OF INVESTIGATION

The purpose of this investigation was twofold: to identify the submerged targets located during the Phase I survey, and to evaluate those submerged targets as to their eligibility for inclusion on the National Register of Historic Places (NRHP).

RESEARCH OBJECTIVES

The main objective of the investigation was to collect enough information regarding the targets identified during the Phase I survey to determine NRHP eligibility. This information included, but was not limited to, condition, construction techniques, and place in local history.

THEORETICAL CONTEXT

Any attempt to understand the archaeological record requires a means and method to assess the age of artifactual material. The term "style" relates to artifacts contained in known archaeological deposits in which the artifacts display a regular and distinctive distribution. Generalizations about the temporal and spatial distribution of style led to the establishment of a standard procedure for the definition of type.

"Type" is the basic conceptual tool for cultural research. Archaeologists debate, however, on what constitutes a type. A great deal of attention is paid to the means by which taxonomic classifications (types) are ordered. Typology then finds expression through a seemingly endless series of classifications.

Regardless of the means by which materials (and cultures) are classified, a cultural-historical paradigm attempts to descriptively acknowledge particular artifactual patterns that occur chronologically and regionally in the archaeological record. Attributes or characteristics are arbitrarily determined (despite claims to the contrary) by investigators in order to facilitate the chosen method of seriation. The types are then arranged into some sort of spatial/temporal or functional sequence.

Raber et al. (1995a, 1995b) previously constructed typologies for individual vessels within the project area. The typologies incorporate various definitions, i.e., construction (wood, iron, steel), design (barge, tug), function (ferry, freighter), rigging (barkentine, schooner), or environment (harbor, canal, coast). These typologies serve the purpose of NRHP evaluation and are applicable here.

NATIONAL REGISTER OF HISTORIC PLACES ELIGIBILITY ASSESSMENT

The research presented in this report provides baseline data for NRHP eligibility evaluation for each vessel. Based on field observations, previous investigations, and research associated with similar property types, the present data offer documentation and analysis of any historic resources that may be located in the project area. The evaluation identifies sites that meet specific eligibility criteria and then presents recommendations for further investigation of these sites relative to the mitigation of adverse project effects.

As stated in National Register Bulletin 15, *How to Apply the National Register Criteria for Evaluation* (National Park Service n.d.), and Bulletin 20, *Nominating Historic Vessels and*

Shipwrecks to the National Register of Historic Places (National Park Service 1985), "the quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association." To be considered significant and therefore eligible for nomination to the NRHP, the property must meet one or more of the four National Register criteria:

> A. Be associated with events that have made a significant contribution to the broad patterns of our history; or
>
> B. Be associated with the lives of persons significant in our past; or
>
> C. Embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> D. Yield, or likely to yield, information important in prehistory or history [National Park Service 1985:5-6].

Properties found potentially eligible, eligible, or listed on the NRHP must be considered within the framework of the proposed action. If adverse impact to such a property is possible, alternatives to the proposed action, i.e., avoidance, must be evaluated. If avoidance is not practical, additional activities relative to the evaluation of the resource may be required.

A property's significance, as stated in Bulletin 15, is based on its association with significant themes in American history and "must be important for historical, architectural, archaeological, engineering, or cultural values." Cultural resources located in the project area are likely to be shipwrecks or sunken vessels. A vessel's significance, as stated in Bulletin 20, is based on a "representation of vessel type and (its) association with significant themes in American history and comparison with similar vessels" (National Park Service 1985:4). Of the five basic types of historic vessels that may be eligible for NRHP nomination, as stated in National Register Bulletin 20, the vessels within our project area fall into one of the defined categories: "hulks" and "shipwrecks." Bulletin 20 defines hulks as "substantially intact vessels that are not afloat, such as abandoned or laid up craft that are on a mudflat, beach or other shoreline." "Shipwreck" is defined as "a submerged or buried vessel that has foundered, stranded, or wrecked. This includes vessels that exist as intact or scattered components on or in the sea bed, lake bed, river bed, mud flats, beaches, or other shorelines, excepting hulks" (National Park Service 1985:3). The significance of shipwrecks, as opposed to intact vessels (i.e., hulks), "requires that the wreck display sufficient integrity to address architectural, technological, and other research concerns" (Pearson and Simmons 1995:129).

The photographs and archival data presented here show selected features of site details and serve as the basis for NRHP evaluation. Specific recommendations are made in the *Conclusions and Recommendations* chapter of this report.

3. HISTORIC OVERVIEW

GENERAL NAVIGATION HISTORY OF THE PROJECT AREA

Europe's first exposure to the New York Bay was during the voyages of Verrazano. An Italian from Florence sailing for Francois I, the king of France, he left European waters in January 1524 to find a route to China. His vessel, *La Dauphine*, named after the French heir to the throne, measured 100 tons and was manned by a crew of 50. In early March, after a tempest-tossed crossing, he came close to Cape Fear, North Carolina. By mid-April Verrazano had coasted far enough north and east to enter New York Bay, passing Sandy Hook en route. After some brief reconnaissance he continued on his voyage and returned to France in July. Being a competent seaman and navigator, Verrazano was able to conclude that he did not reach China, but rather a new world (Morison 1971:314). However, the French did not follow up on Verrazano's discovery of 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. 1999). Hudson was the next European to enter New York Harbor; he then sailed 150 miles up the river that was to bear his name. The Dutch were a bit more industrious and inaugurated European control of the region. Headquartered at Manhattan, private trading operations were established on the Hudson in 1613. Numerous exploratory ventures occurred after the founding of the trading post, and by the mid-1610s much of the area was well known. 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, and the town of New Amsterdam was founded in 1625 (Roberts et al. 1979:A-12, A-13).

The Dutch expansion caused conflict with the English by extending east toward New England. To the south, the Dutch absorbed the Swedish settlement at present-day Wilmington, Delaware. Trade connections were established with the Chesapeake Bay colonists, South America, and Europe. New Amsterdam was growing, and rivaled Boston as a center for maritime trade, with furs, fish, beef, and flour being exported, tobacco, slaves, and sugar being trans-shipped, and European goods imported. 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 took the colony in 1664 (Labaree et al. 1999).

Soon after the beginning of English rule, New Amsterdam was renamed New York and flour replaced furs as the port's main export, shipped mainly to the West Indies. In the eighteenth century exports included whale oil, beaver pelts, and some tobacco to England, and flour, pork, bread, peas, and horses to the West Indies. Imports from England and the West Indies included manufactured goods and rum, molasses, and sugar respectively (Watts 1986:11-12). Shipping increased considerably by the mid-1700s. Imports included "fish oil, blubber, whale fins, turpentine, seal skins, hops, cider, bricks, coal, lamp black, wrought iron, tin, brasury [*sic*], joinery, carriages and chairs. Exports included chocolate, lumber," and import goods from both the West Indies and Europe (Roberts et al. 1979:B-9).

New York did not confine her shipping activities to trade; her vessels were also heavily involved in privateering. Preying on enemy commerce led to the inevitability that some would turn 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, her merchants supported trade and reaped a profit by supplying pirates inhabiting such far-off places as Madagascar in the Indian Ocean (Cordingly 1995). Frederick Philipse, a merchant of New York, loaded ships with clothing, liquor, naval stores, guns, and ammunition, and had his local agent, Adam Baldridge, sell them to the pirates in return for their ill-gotten gain (Ritchie 1986). 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 were 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 (Watts 1986:11-12). Port records indicate that prior to 1720, few vessels entering the port registered over 100 tons. Larger vessels became more common within the next few years (Watts 1986:11-12). In 1770, New York stood fourth after Philadelphia, Boston, and Charleston among the American ports in total tonnage arriving and clearing (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 Roberts et al. 1979:B-13)

With intercolonial trade well established and foreign imports and exports on the increase, the port of New York continued to grow. 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. Two-thirds of all the nation's imports and one-third of its exports went through the port by 1860, with only London and Liverpool exceeding the port in the volume of shipping and value of imports and exports (Albion 1984:336; Ferguson 1986:17). Population growth mirrored the increase in shipping activities, declining only through war and epidemics. Associated reductions in maritime commerce occurred while the British occupied the port during 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).

During the nineteenth century, sailing vessels of varying sizes and shapes entered and exited the port of New York. These vessels included sloops, coastal schooners, 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"). These 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 *North River Steam Boat* completed its successful voyage from New York to Albany in 1807, steam power became 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 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).

With the port of New York immediately to the north, some of the many vessels transiting the waters were wrecked by storm, accident, or poor seamanship. It is known that numerous vessels wrecked while approaching or leaving New York. Long Island to the east and the shores of New Jersey to the south act as a funnel through which vessels enter New York Harbor. During the age of sail, vessels were dependent on the capricious winds for motive force–many were reported lost due to contrary winds. However, early steam vessels, without modern navigation aids such as radar, loran, or GPS, have had accidents in the ever-confining waters that mark the approaches to New York. In the modern era, technology has yet to abolish accidents caused by human error.

To ameliorate the affects of maritime disasters, numerous organizations were incorporated around the coasts. Local organizations took the responsibility of aiding the victims of shipwrecks. In an era of a small Federal government, each locality took responsibility for situations occurring within its immediate jurisdiction. However, during the mid-nineteenth century the port of New York rose to such prominence in commercial and emigration activities that the local resources could not sustain a full service for wrecked mariners and passengers. A Congressman from New Jersey, William Newell, once witnessed a shipwreck where no effective rescue was possible. In 1847 he persuaded Congress to appropriate money to provide lighthouses with lifeboats. However, the money was not spent for that purpose. The next year he obtained more funds for life saving equipment to be used between Sandy Hook and Little Egg Inlet, New Jersey, under the direction of the Revenue Marine (Bennett 1998). The following year Congress extended the network of stations to include the rest of the New Jersey shore and to the coast of Long Island, New York. Thus, the Federal government took its first tentative steps toward a remedy for mariners in distress.

Maritime History of the New York Harbor Area

Unlike early colonial enterprises founded on political or religious principles, New York's development was prompted by trade. Early maritime commerce in the New York Harbor area began in the early 1600s, centering around the limited trade and barter of fur, probably beaver (Bank of Manhattan Company 1915). After the area was discovered by the Italian explorer Verrazano in 1524, the Dutch began initial colonization of Manhattan Island, with the Dutch West India Company establishing a trading post of eight men in 1625 to help develop the fur trade (Shumway 1975). By 1650, New Amsterdam featured peoples speaking some 18 languages:

> This broad-minded tolerance, which was the universal Hollandish custom, attracted from Europe bold adventurers bent upon making their fortune. In spite of the interruption of the change from Dutch to English rule, in spite of the constant warfare of the eighteenth century and the British occupation during the Revolution, New York's commerce grew steadily. By 1800, eleven years after the adoption of the Constitution...New York had outstripped its rivals...and had taken the foremost place as the seat of American commerce...[Bank of Manhattan Company 1915:5].

The fledgling colony was replaced by British rule when a naval squadron appeared in 1664 off New Amsterdam and demanded its surrender. Renamed "New York," the colony was taken back in 1673 but was returned to the British as terms of a treaty in 1674.

In 1683 there were three ships, three barks, 23 sloops, and 41 small boats noted as being at New York. In 1696 there were 62 sloops, 40 square-rigged vessels, and 60 small boats. The single-masted sloop was the most extensively employed vessel type during the early years of the colony. Thought to have developed from the old Dutch yacht, the sloops had the broad beams and round, full bottoms that characterized seventeenth-century Dutch vessels. The universal boat for traveling and freighting on the river, the sloop's light draught was well suited to floating over the shallows of the Hudson River. By 1771, the Hudson River Sloop was a large and powerful boat (Hall 1884:115).

The rise of New York commercial activity was slow, and while merchants traded to the West Indies, they neglected the trade of Europe until after the Revolutionary War. Prior to the war, privateering and the slave trade were practiced. The port was especially known for its privateering, and during the French War and prior to 1758, 48 privateers, 695 guns, and 5,660 men were sent out from the port until the advent of the Revolutionary War. Fast-sailing brigs and schooners had sharp floors and sat low in the water; these vessels were seldom captured. A few of this same class of vessel also participated in the slave trade (Hall 1884:115).

Part of the British strategy during the Revolution was taking control of New York Harbor, with their first landing on Staten Island. Although the major battles of the war were fought outside the state, the British continued to hold New York as a main naval base. The end of the war brought restrictions against trade with the West Indies; however, the trade was revived in 1793 when France and England went to war. Becoming the leading seaport in 1797, the port was idled for over a year with the passage of the Embargo Act of 1807. Just four months prior to the Embargo, Robert Fulton successfully tested the steam-propelled *North River Steam Boat*, an event that signaled a revolution in marine transportation and waterborne commerce. Built in an East River yard and powered by an imported British steam engine, the vessel ran between New York and Albany in 1807. Although earlier steamboats had operated both in the United States and abroad, it was Fulton and his partner Robert Livingston whose success with the *North River Steam Boat* "marked the beginning of the unbroken development of steam navigation in America" (Ringwald 1965:1). In 1812, Fulton built the first "double-ended" ferryboat, *Jersey*, which operated between Jersey City and Manhattan. In 1814, he established the first steam ferry between Brooklyn and Manhattan (Brouwer 1990:20-26).

The development of the steamboat was impeded by the monopoly awarded to Fulton (actually awarded to Livingston, a state political power) for steamboat operation in the state of New York. Struck down in 1824 by the Supreme Court of the United States, the removal of the monopoly brought significant changes to the local waters, both in vessel types employing steam propulsion and the engines themselves, as well as waterborne commerce affected by the introduction of these vessel types. A general type evolved that would come to typify the larger Hudson River steamboats (Ringwald 1965:2), as well as the Long Island Sound and Chesapeake Bay steamboats.

After the War of 1812, the Port of New York increased its role in the sailing packet industry, both in the construction and in the commercial aspects of the vessels. Like the *North River Steam Boat*, the packets were built in East River yards. Packets bound for Liverpool, London, and Harve would make their eastbound crossing with cotton or grain and return with immigrants and European luxury goods. By 1850, New York was a center of clipper ship construction with between 50 and 100 vessels being built yearly. Mostly built for New York owners, the packets and clippers were launched for the packet, China tea, or California trades (Hall 1884:116).

After the Civil War, the American shipbuilding industry saw not only the final development of the American square-rigged ship, but in New York, where builders specialized in expensive packets and clippers, a dramatic decrease in production. Production of New York-built boats dropped from 40 in 1855 to zero in 1862, averaging only four per year over the next decade (Hutchins 1948). The completion of the trans-continental railroad and the opening of the Suez Canal spelled doom for the fast sailing vessels by the 1870s (Brouwer 1990:46).

The industry also witnessed a change in the way it conducted business. Before the Civil War, shipbuilding usually consisted of a small group of shipwrights headed by a master shipwright. Shippers, on the other hand, had little to do with shipbuilding. After the war, however, capitalists sought out the industry on a large scale. The master shipwright became an employee as the result of declining activity in the ship market and the increased cost of ship construction (decreased timber supply) (Hutchins 1948). By 1880, the economies associated with the free market system dramatically modified, if not replaced, the old apprenticeship system.

The opening of the Erie Canal in the fall of 1825 was perhaps the greatest stimulus to the growth and success of the Port in the early nineteenth century. Extending from Buffalo on Lake Erie to Albany on the Hudson River, the canal runs a distance of 365 miles. Reducing shipping times and costs of inland produce and commodities to the Port, the Erie Canal caused interior towns to thrive due to increased commerce, and ensured New York's leadership among eastern ports because of its access to markets and goods of the interior of the continent (Brouwer 1990:29-34; Hall 1884:224; Morrison 1958:539).

Soon other canals were being constructed throughout New York, with canals also constructed in Pennsylvania, Maryland, and Delaware. Navigation improvements in connecting inland waterways by canals in the 1820s and 1830s resulted in new commerce opportunities and increased maritime traffic. The Delaware & Raritan Canal, the company by the same name receiving its charter in 1830, was the conduit for Pennsylvania coal to New Brunswick, New Jersey on the Raritan River, and the Morris Canal carried coal across New Jersey to Newark from the mouth of the Lehigh River (Albion 1939:134-137; Morrison 1958:172; Raber et al. 1995b:25). A crucial corridor around Staten Island for waterborne commerce in the early nineteenth century traveling between Upper New York Bay to Raritan Bay, the importance of the Kill Van Kull and the Arthur Kill increased throughout the nineteenth century with the construction of the Delaware and Raritan Canal and the attendant expansion of the coal trade. With later direct railroad connections from Elizabethport to Phillipsburg, New Jersey on the Delaware River, and a new coal terminal at Port Johnson, Bayonne on the Kill (constructed in 1865), shipments of coal on the kills increased dramatically in the 1850s and 1860s (Albion 1939:134-137; Morrison 1958:167-189; Raber et al. 1995b:25).

The construction of canals brought about an attendant boom in the construction and use of canal boats or barges, as well as a reduction in the number of schooners involved in the same trade. The importance of the canal use in the waters of New York Harbor is indicated by the frequency with which they appear in historic photographs of the area (see Johnson and Lightfoot 1980). Either decked or open, the canal barges were towed through the Erie and Champlain Canals by horses and mules walking along towpaths. Arriving at the Hudson River, they would require other means of propulsion. Coinciding with the construction of the canals and the canal barge, the advent of steam power produced the towing vessel, the predecessor of the modern-day tugboat. The first vessel built for this general service appears to have been the *Hercules*, constructed in 1832 in New York by a company that ran a line of coastal packets (Morrison 1958:540).

At the same time steam propulsion was making inroads into maritime construction and commerce, it was also having a profound effect on land in the form of railroads. By the 1870s, the railroads would shape the way the Port area handled goods by effectively creating the lighterage system. Of the dozen major lines that serviced the port, only two directly serviced Manhattan Island. With the exception of the Baltimore & Ohio, which entered Staten Island, most railroads ended at the New Jersey shore of the Hudson River. These lines were forced to transport their cargoes of passengers and products over the last remaining leg of the journey by water. However, there remained a far greater tonnage of waterborne freight requiring discharge along piers and waterfront slips than land-conveyed freight (Harding 1912). Some freight cars crossed the waterways on long barges called car floats, while the contents of other cars were offloaded or transferred onto lighter barges in the form of sailing craft, deck scows, and hold and covered barges; steam lighters carried priority cargo such as mail.

Servicing the geographic and commercial needs of the harbor required a "railroad navy." Some 1,500 tugboats, car floats, covered lighters, express lighters, floating grain elevators, and other craft loaded and unloaded freight at specially designed rail-to-water transfer piers (Table 2). This transportation network offered (1) access to the water (slip) side of steamships, and (2) access to parts of the harbor not accessible by rail.

Table 2. Craft in New York by Class & Percent in Each Class, 1916*.

Vessel Class	Vessels		Tonnage		Value of	
	No.	%	Gross	%	$	%
tugs/towboats	559	9.1	57,687	3.2	13,153,417	21.7
ferryboats	125	2.0	115,363	6.4	11,406,584	18.9
municipal	16	0.3	15,471	0.9	2,107,199	3.5
railroad	59	1.0	68,881	3.8	6,779,130	11.2
other	50	0.8	31,011	1.7	2,520,255	4.2
unrigged craft	5,433	88.8	1,641,694	90.4	35,938,792	59.4
Total	6,117	100.0	1,814,754	100.0	60,498,793	100.0

**adapted from Squires 1918*

Historically, New York's leadership position in general cargo portage depended on its ability to move or "lighter" goods from ship to pier or ship to ship. The term "lighter" describes a small boat utilized as an intraport cargo carrier. These lighters, sail or steam propelled, handled all types of agricultural and commercial goods, including mail. The usual lighter transported between 500 and 800 tons of freight (Harding 1912).

In New York Harbor, the term also applies to cargo ferrying via scow, barge, derrick, carfloat, or grain elevator, vis-à-vis waterfront terminals or anchored ocean vessels. The breadth of New York's lighterage activity "reflected America's full scale entry into the industrial age, with its ever increasing demand for imports of raw materials and foreign markets..." (Brouwer 1987:30).

The harbor's vast waterways and dense population initially hindered centralized railroad service. "In response to these challenges, many major railroads established inter-modal networks designed to meet and beat their competitors" (Dibner 1994:6). Of the dozen or so railroad lines built during the mid-1800s, only one line, the New York Central, provided direct rail freight service to Manhattan (Brouwer 1987). From 1835 to 1865, tracks progressively penetrated the harbor, terminating at the nearest navigable waterway. Most came no closer to Manhattan than Jersey City.

In the 1870s, railroads adopted the carfloat interchange system. Cars from southern areas reached New England-bound railroads by flotation barge. In Manhattan, around 1900, and later in Brooklyn and the Bronx, float bridge stations (inland freight stations) provided mechanisms for freight marine/terrestrial interchange. Beginning around 1860, railroads delivered (at no charge) a carload or more of incoming freight to waterfront locations within a designated harbor boundary (free lighterage limits).

Waterfront destinations received the same rate "as though it were physically on the line of the railroad" (Flagg 1994:7). Railroad owners had no choice but to provide free lighterage since the free service directly competed with canal boat carriers who delivered goods directly to ships or terminals, and charging for the service would drive shippers to other East Coast ports. When later investments included port facilities, railroad owners "did not want New York to be placed at economic disadvantage in competition with East Coast ports where goods did not have to be lightered" (Brouwer 1987:31). By the 1920s, railroads owned outright large lighterage fleets.

By 1885, New York Central Railroad maintained 92 lightering boats, and the Pennsylvania Railroad maintained 104 vessels. In 1908, the Lehigh Valley Railroad had 250 craft, while the Baltimore and Ohio had 142 (Harding 1912). Three other railroads had fleets numbering more than 200 (Brouwer 1987). In 1907, the New York Central fleet moved 304,372 cars on float, or about 1,000 per day, in addition to 1,402,358 lightered tons of bulk freight, or some 5,000 tons per day (Harding 1912). In 1917, all railroad freight shipped to or from Manhattan Island (apart from New York Central's track) arrived by lighter or carfloat (French 1917).

Table 3. Railroad Tonnage in 1914 by Commodity, Percentage, & Local Movement*.

Commodity	Carfloat		Lighter		Total	
	Tons	%	Tons	%	Tons	%
Grain and mill products	593,000	14.0	3,232,000	76.1	4,244,000	100
Foodstuffs	2, 714,000	42.1	1,195,000	18.6	6,442,000	100
Fuel and ores	568,000	1.6	31,903,000	90.9	35,101,000	100
Building material	829,000	17.0	2,323,000	47.8	4,865,000	100
Miscellaneous	6,100,000	49.0	2,607,000	20.9	12,463,000	100

*adapted from New York, New Jersey Port and Harbor Development Commission 1920

Expansion of the free lighterage system allowed waterfront industries to develop floating sidings. Terminal companies took advantage of the situation by developing ports within ports, providing steamship piers, loft buildings, and freight stations, all served by private rail networks connected by carfloat. Companies set up special terminals for bananas, coal, grain, and perishables. A Merchant's Association of New York representative described the waters of Manhattan as "an interior belt line employed in switching cars between the terminals on the New Jersey shore and the industries...in various parts of the harbor" (Squires 1918:3).

The water belt line or lighterage and carfloat system came under attack around 1910. Independent cost analysis suggested that the system suffered from cost overruns, particularly delay and damage to freight. These allegations, however, often originated from rival ports. Objections also came from urban planners, who complained about the disproportionate amount of waterfront occupied by railroad marine operations. Supporters recognized that if operations moved elsewhere in Manhattan, companies would occupy space even more valuable.

The New York Port Authority (est. 1923) tried to carry out a comprehensive plan of replacing marine operations with land-based belt lines. Railroad executives refused to cooperate with one another; despite studies showing increased revenue by unifying terminals and belt lines, rail companies preferred the traditional lighterage/carfloat system (Flagg n.d.). The Port Authority modernized pier and vehicular crossings, eventually substituting motor trucks for lighterage.

Modern containerization and trucking diminished the importance of the lighterage system by 1960. The demise of the lighterage system came about with the advent of the modern standardized freight container that is adapted for quick transference from and onto train, truck and specially adapted ships (Brouwer 1990:54). By 1976 railroads no longer provided lighterage service. Hundreds of abandoned wooden vessels associated with this industry now litter the port's shoreline. Flagg et al. (1992) accurately noted that steel barges contain valuable scrap and are less likely abandoned. Some derelicts served as storage units for a time, but eventually lost any useful function.

The lack of railroad initiative aided Manhattan's port decline. Marine business slowed to the point that railroads found it cheaper to transfer freight in New Jersey by truck rather than by lighter. By the early 1970s, most free railroad lighterage in New York's port ended. The last carfloat operation in Manhattan ended in 1976.

Staten Island

Relative to the New York-New Jersey metropolitan area, Staten Island is both water-bound and isolated. Historically, the island's western border, the Arthur Kill channel, and its northwestern border, the Kill Van Kull, played vital roles connecting New York with New Jersey, Philadelphia, and Long Island Sound. Staten Island rests between New York Bay and New Jersey's northwestern shoreline, the Arthur Kill channel separating the Island from the latter. The Island's geographical center is situated 11 miles southwest of New York City. The Kill Van Kull extends from Newark Bay to New York Bay and separates Staten Island's northwestern shoreline from New Jersey at Bergen Point. Bayles (1887) states that the Island's name is an English rendering of the Dutch form *Staaten Eylandt*, meaning "Islands of the States."

The name "Kill Van Kull" (channel), historically known as the Kills, is apparently Dutch for the "Kill of the Cul" (*Het Kill van het Cul*) (Bayles 1887). *Kill* is a Dutch word for "creek," while *Cul* is possibly French for "bay," thus "the creek of the bay." *Achther Cul*, the Dutch rendering for Newark Bay, meant "Back Bay," the Dutch word *achter* meaning "after" or "behind" (Clute 1877).

De Vries (1655), as cited in Wacker (1975), comments on the immense numbers of water fowl on the Achter Cul, stating:

> There are great numbers...of geese, which stay here through the winter, by the thousands, and which afford fine sport with a gun...Land birds are also very numerous, such as wild turkeys...taken by the savages with their hands, who also shoot them with bows and arrows...There are different kinds of fine fish...haddock, plaice, flounders, herring, sole, and many more kinds...There are fine oysters, large and small, in great abundance. In the summer time crabs come on the flat shores, of very good taste [Wacker 1975:23-24].

The description offered by De Vries is a far cry from the fouled and polluted waters of the modern Arthur Kill and Kill Van Kull channels.

Initially, Native American conflict hampered European development of Staten Island. As part of the Province of New Netherland, the Island fell under the jurisdiction of the Dutch West India Company (1621 to 1664) (Black 1982). In 1661, French Waldenses and Huguenots established a modest village near South Beach, apparently the Island's first permanent European settlement (Steinmeyer 1950).

The Dutch surrendered its Island claim to England in 1664. Native American conflict culminated in the "Peach War" of 1655, which depopulated the Island where "settlement had to be recommenced" (Bayles 1887; Black 1982). Staten Island became part of the shire of Yorkshire. Francis Lovelace, who purchased Native American land rights to the island in 1670, laid out lots on the Island's north, south, and west sides. In 1675, the Island obtained separate jurisdiction, and in 1683, a separate county, Richmond.

Demographically, seventeenth-century Staten Island mirrored early Dutch and subsequent English settlements. Under English domain, the Island witnessed the arrival of fugitive French Huguenots in significant numbers. By the mid-1700s, Staten Island included Dutch, French, Belgian, and English populations (Bayles 1887).

Between 1790 and 1810, the Island featured a rural population subsisting on farming, fishing, and maritime commerce. The population (5,347) increased more than 39 percent by 1810 (Sachs and Waters 1988). Agriculture (beef, pork, wheat, rye, apples) and seafood (fish, clams, oysters) sustained the Island's population (Cotz et al. 1985). The community also harvested salt hay from the extensive salt meadows in Northfield, Southfield, and Westfield townships (Akerly 1843).

Commercial oystering dates from the earliest Dutch settlements. The industry even advertised in early Dutch journals (Powell 1976). Considered a staple in the eighteenth century, oysters were shipped locally and abroad. Beds thrived in the Arthur Kill's deeper waters, Prince's Bay, the mouth of the Raritan River, and the Kill Van Kull (Hine and Davis 1925; Sachs and Waters 1988).

Extensive marshes north of later Rossville, coupled with the Island's remoteness (relative to the New York City and Philadelphia markets), slowed coastal development. There was little settlement east of Palmer's Run (later called Bodine Creek)—this area was part of a large area owned by John Palmer and Thomas Donegan, who built several mills in Palmer's Run in the 1680s. These mills, particularly a grist mill built by Donegan where Richmond Terrace crosses Bodine Creek, served a wide area, including farmers as far away as Bergen Point, until 1795. This mill was replaced by a new flour mill just west of Broadway, built by John McVickar, who had recently purchased the Donegan estate. This mill was powered by a diversion of Palmer's Run to a pond which fed the mill's race. This system of waterpower powered the island's first large industry after 1819.

Furthermore, large land grants encompassing the Island's southern end restricted settlement. Mark Dusachoy, described in a seventeenth-century deed transaction as a "planter," held some 823 acres in the Smoking Point area (Schneider 1977). Christopher Billopp received about 1,600 acres on the Island's southwest corner. Begun circa 1709-1716 and running between Perth Amboy and the end of Amboy Road, the earliest ferry across the Arthur Kill was included in Billop's grant. Besides local ferry service, given opportunity, the Billopp ferry probably served as a link between New York City and Philadelphia. The ferry operated intermittently from the Amboy Road site until the beginning of the Civil War, when the landing moved a half mile north (Raber et al. 1995a:24).

By the end of the colonial period, subdivided Billopp grants, together with other smaller grants, led to increased farming near the Arthur Kill south of Fresh Kills. Eventually smaller communities emerged north of the Billopp grant boundaries as New York/Philadelphia markets expanded. The initial franchise, Old Blazing Star (now Rossville), is located in an area north along the south side of what is now Arthur Kill Road (prehistoric Smoking Point). The name

"Blazing Star" apparently originated from taverns at each ferry site. Old Blazing Star remained the project area's principal settlement until after the American Revolution. The New Blazing Star Ferry at Tompkinsville (Linoleumville) opened around 1757 and by 1764 featured a stagecoach connection.

One of the earliest ferries to cross the Kill Van Kull, the Port Richmond-Bergen Point ferry, dates to the 1690s. Jacob Corsen petitioned the New York Governor's Council in 1750 for a patent stating that he had operated a ferry between Staten Island and Bergen Point for some 60 years. His request, to "erect" his vessel into a public ferry, grew out of fear of competition as a result of increased population. Corsen received the patent, operating the ferry until 1764. New owners took over the operation the same year (Reed 1959). Isaac Decker took over the ferry in 1774, and operated it until 1780. During this time he added a direct freight and passenger ferry to New York City. Another early ferry operating in the area was the Howland Hook ferry, which was built on the edge of a large marsh, and was accessed via a causeway. It was operated by one Adoniah Schuyler from 1736 until the Revolution.

The New Blazing Star route began in New York City, crossed the North River by ferry to Powle's Hook (Jersey City), to Bergen Neck (Jersey City and Bayonne), to Bergen Point, where the ferry carried passengers and freight across the Kill Van Kull (Reed 1961). The New Blazing Star differed from the Blazing Star Ferry, which ran from modern Rossville, Staten Island to the opposing New Jersey shoreline. The New Blazing Star did not operate during the Revolutionary War.

British forces occupied the island during the Revolutionary War. Up to 40,000 garrisoned British and Hessian troops occupied the island, many stationed near the western shore (Sachs and Waters 1988). This was perhaps due to the location of the Old Blazing Star ferry and its subsequent access to Philadelphia and New Jersey (Schneider 1977). After the war, local officials confiscated and subdivided the grant's remaining acres. Development of the island's hamlets, villages, and industry depended, in part, on transportation networks, i.e., ferries, landings, and roads.

Ferry service provided early links with the mainland. By 1816 Daniel Tompkins' Richmond Turnpike Company opened a road connecting the northeast shore (Tompkinsville) with the New Blazing Star Ferry west in Linoleumville. Tompkins then offered steamboat service between Tompkinsville and Manhattan, establishing a direct route between New York and Philadelphia (Cotz et al. 1985). The ferry at Tottenville linked Staten Island with Perth Amboy, and the one at Holland or Howland Hook with Elizabeth, New Jersey. Another ferry ran across the narrows to Brooklyn. Kill Van Kull service ran between Bergen Point and Port Richmond (Leng and Davis 1930). In the 1830s, a horse ferry operated across the Kill Van Kull. The vessel, known as Coyles' horseboat, ran during the late 1830s and early 1840s. The project lasted only a few years, with the service replaced by rowboats or scows (Reed 1959).

Despite New York Harbor expansion, the Arthur Kill's marshy shoreline continued to hamper large-scale commercial development. In 1810, the Island's primary industries included two textile carding machines, two tanneries, three distilleries, and 59 looms producing some 23,100 yards of flaxen fabric, 12,000 yards of woolen fabric, and 7,000 yards of blended cloth (Sachs and Waters 1988). Even as the channel itself became an increasingly important commercial route, communities along the Arthur Kill remained largely agrarian.

Early industrial development began on the north shore at Factoryville, now West New Brighton. In 1819 Barrett, Tileston, and Company established a dyeing and printing house there (Leng and Delavan 1924). Port Richmond served as the location for the Staten Island Whaling Company and later the Jewett White Lead Works (1842).

The Island's rich clay and kaolin deposits on the southwest shore along the Fresh Kills and lesser deposits on the north shore led to an emerging brick-manufacturing industry (Sachs and Waters 1988). German immigrant Balthazar Kreischer, knowledgeable in the construction trades, built a Manhattan brickworks in 1845, and in 1852 built the International Ultramarine Works on the Arthur Kill south of Smoking Point.

In 1854, Kreischer established a clay and firebrick works on the Island that operated in several locations, the earliest and largest located along the Arthur Kill south of Rossville (Sachs and Waters 1988). In 1873-1874, he moved the entire manufacturing operation to a 3-acre site just north of the Outerbridge Crossing. In the 1880s, the family-owned plant produced an estimated 3.5 million bricks annually. Kreischerville became an industrial community. The plant shipped all products by water, building a steam lighter in 1880 (Raber et al. 1995a).

Transportation improvements during the last half of the nineteenth century accelerated Staten Island's industrial growth. The first railroad linked Clifton with Tottenville in 1869 (Leng and Delavan 1924). Small communities developed around the rail stations. Immediately after the Civil War, heavy industry expanded, especially after the 1880s. The emerging transportation industries and the subsequent communities built near their local hubs brought new occupations and services, providing opportunities for blacksmiths, coopers, wheelwrights, grocers, bakers, and printers (Sachs and Waters 1988).

The Staten Island Rapid Transit Railway Company opened a train bridge over the Arthur Kill in 1889. Coaches and horse cars linked north and east shores with Richmond and Linoleumville to the west (Leng and Delavan 1924). By 1880 Staten Island's population totaled approximately 40,000, 90% clustering in villages along the northern and eastern shorelines. The rest of the island remained rural farmland, swamp, saltmeadow, or beach. The Island featured 100 manufacturing plants employing some 1,550 people, mostly young men, though the plants employed 88 females over 15, and 30 children (Sachs and Waters 1988).

By the mid-1900s, agricultural chemical production facilities, metallurgic industry plants, clay and brick production facilities, building material factories, copper refineries, shipyards, and emerging petroleum industries lined the Arthur Kill's western shoreline. At Staten Island only a few small industries appeared: the American Linoleum Manufacturing Company, Atlantic Terra Cotta Company, Kreisher Brick Works, and Tottenville Copper.

During the early part of the twentieth century, New York's port handled 40% of all U.S. foreign trade. The average annual value of imports and exports for the port during 1911-1913 totaled $1,809,358,239, or 46.2 percent of that for the United States (Squires 1918). In 1920, nearly half of all foreign commerce for the United States entered through the Port of New York. Some eight million people lived within a 25-mile radius of the Statue of Liberty (New York, New Jersey Port and Harbor Development Commission [PHDC] 1920). Yet Staten Island's Arthur Kill waterfront remained underdeveloped.

Local economic fallout following World War I, limited access, and pollution governed the Island's future. When the Department of Health traced typhoid fever to Staten Island oysters, the department condemned the industry (Bureau of Curriculum Research ca. 1980s). Water pollution destroyed oyster beds, and by the early twentieth century, the local fishing business little resembled its admirable past.

Chemical and copper refineries along the Jersey shoreline released gaseous contaminants into the atmosphere. Prevailing westerly winds, in turn, pushed contaminants across the island, ruining agricultural production. Industrial waste eventually made Staten Island's real estate less than desirable. New York City started dumping garbage on the Island in 1916. Initial operations failed in 1918, but in 1946 dumping resumed. Following a series of land transfers, the present Fresh Kills Landfill on Staten Island is considered the largest landfill in the world.

The disposal of garbage, particularly during the nineteenth century, created special problems for local residents. Until 1934, ocean dumping was commonplace. Shoreline residents from Long Island to New Jersey complained of nasty beaches and shorelines. Dead cats, dogs, and chickens, and putrid fruits and vegetables lined the area shoreline. The problem, recognized by local officials, proved difficult to correct (Corey 1991).

The garbage scow, a barge filled with garbage, became commonplace on the rivers and channels. An article in the *New York Times* (*NYT* 1880) noted that the amount of garbage dumped in the harbor actually filled certain channels (as presented in Corey 1991). In 1871, the New York legislature enacted laws prohibiting the dumping of garbage into the waters of the North (Hudson) and East Rivers, Upper New York Bay, and parts of Raritan Bay (Corey 1991). As a result, legal dumping moved to southeastern Staten Island.

Staten Island Shipyards

The scarcity of timber following the American Revolution somewhat diminished the Staten Island shipbuilding trade. After the war, the U.S. shipbuilding industry thrived because of low-cost construction made possible by cheap timber (Hutchins 1948). The growth of the fishing and oystering industries following the War of 1812, and later the expansion of recreational boating industries, brought a revival in wooden boat/ship construction and repair.

By 1855, shipwrights in Tottenville (particularly in an area called Unionville), many of Scandinavian descent, produced sloops, schooners, propeller yachts, and coal barges. At one time stores stocked Norwegian newspapers because Staten Island had so many Scandinavian ship carpenters (John Noble Collection 1973). The William H. and James M. Rutan Shipyard built nearly 100 sloops and schooners (manuscript on file, Staten Island Institute of Arts and Sciences). Jacob Ellis operated a shipyard near the foot of Tottenville's Main Street. At the south side of the Ellis yard stood a blacksmith shop (A.E. Rolles) where Ellis's vessel fittings were probably wrought. Before mid-century, sailing lofts, which later manufactured building awnings, established services on the north shore. Rope walks appeared in Rossville and Richmond in the late 1850s (Sachs and Waters 1988).

One of Ellis's shipwrights, Chris Brown, eventually opened a business at the foot of Amboy Road, later building the oceangoing tug *Cyclops*, renowned for towing huge rafts of lumber from Nova Scotia to New York (*Staten Island Advance* March 24, 1968). By 1880, Staten Island had seventeen shipbuilding firms, eight in Tottenville. These latter eight yards included eight marine railways. Described by Henry Hall in 1880, "this is a fishing locality, with coal depots in New Jersey, and the work is largely for smacks (fishing), tugs, and coal barges" (Hall 1884:119).

From the middle to late nineteenth century, shipbuilding industries played a major role in Staten Island's maritime economy. Staten Island shipbuilding dramatically increased during WWI. Stephen Cossey operated a 20-acre plant that during its 22-year history constructed 1,149 boats. The $30,000,000 industry produced lighters, tugs, dredges, coastwise vessels, and dry docks. More than anything else Tottenville celebrated its shipyards and the quality and quantity of work done in them. The yards planned and built tugs, schooners, oyster boats, sloops, yachts, and all conceivable craft of ordinary tonnage, besides the work of overhauling, rebuilding, refitting, altering, etc. that is always ongoing. Competent mechanical work gave Tottenville shipyards an excellent reputation all along the coast.

Staten Island's shipbuilding tradition continued into the twentieth century. The Staten Island Shipbuilding Company (est. 1895) is historically known for its steel hulls and diverse designs. The early hulls built by the yard included tugs, carfloats, scows, barges (oil and coal), yachts, schooners, ferryboats, steam and derrick lighters, dredges, drill boats, and in recent years, mine sweepers, cargo freighters, and tankers (Allen 1922). There is a distinct probability that some of the derelict sites associated with the project area are vessels built by the Staten Island Shipbuilding Company.

BAYONNE

The Bayonne peninsula, to the north of Staten Island at the junction of Newark Bay, Kill Van Kull, and Arthur Kill, experienced a restricted amount of large scale waterfront development due to shallow water surrounding the area. Development was concentrated on the Kill Van Kull until navigation improvements in the early twentieth century opened Newark Bay to larger vessels. Due to its central location, the Bayonne peninsula benefited from increasing maritime traffic and was eventually transformed from a rural destination of wealthy New Yorkers in the nineteenth century to an urban industrial center in the twentieth century.

Inland navigation improvements in 1825-1835, along with rail connections, including the Elizabeth-Somerville (later the Central Railroad of New Jersey), were responsible for an increase in vessel traffic in the early nineteenth century. Such traffic carried coal from Pennsylvania, clay products from New Jersey, and manufactured goods from the surrounding area, and soon made cities like Jersey City and Elizabethtown into new industrial centers. In 1864, the Central Railroad of New Jersey opened the railroad bridge across Newark Bay and enabled coal to reach Jersey City via Bayonne.

Rail links through Bayonne resulted in its incorporation as a town in 1861 and as a city in 1864. The Port Johnson terminal, at which was transshipped large amounts of coal, was the first sizeable industrial development and set the stage for Bayonne's rapid growth as a center of industry. By 1875, the population growth of New York had increased the demand for kerosene used for lighting. Petroleum companies, seeking more inexpensive and larger areas than could be had in Brooklyn and Queens, soon relocated to the peninsula. Standard Oil completed the first long distance pipeline to Bayonne from oil fields in Texas, and Bayonne became a national center of petroleum refining. By the end of the nineteenth century, industrial activity had filled most of the Bayonne peninsula to somewhere east of Port Johnson.

Concurrent with the rise in demand for gasoline to power automobiles and generate electricity, production switched from kerosene to gasoline. This increasing demand resulted in the construction of new and bigger plants. This second wave of industrial expansion extended to 1917. By this time, most of the marsh lands had been filled in.

Maritime traffic began to diminish after WWI, and many waterfront industries disappeared during the Great Depression. Today, petroleum refining continues to form a large sector of the local economy, but not to the extent of the early twentieth century.

SHOOTER'S ISLAND

The known history of Shooter's Island, so called because the Dutch supposedly went there to shoot wild geese (Leng and Davis 1930:120), begins in the mid-nineteenth century and continues to the present. Its industrial use resulted in filling and expansion of the area of the island from its original six acres to upwards of 42 acres today. The first firm use of the island was by the Shooter's Island Petroleum Refining and Storage Company. This company erected several buildings on the island including a refinery, storage building, a cooper and barrel house, engine rooms, still, and other smaller buildings. The island's use as a refinery continued through the second half of the nineteenth century, when, in 1898 or 1900, Townsend and Downey opened their shipyard. The primary product of this shipyard was cruising and racing yachts, including the *Atlantic*, which set a transatlantic record in 1905, and the *Meteor*, which was built for Kaiser Wilhelm of Prussia. Morten and Downey operated this shipyard until 1906. At the start of WWI, Standard Shipbuilding Corporation began building steel cargo ships. Before suspending operations in 1920, this shipyard constructed some 29 vessels.

Since the Standard Shipbuilding corporation closed, there has been no formal use of the island, although it continued to be occupied and used in a casual manner. Most notably, Shooter's Island has been used as a dumping ground for abandoned, disused, and obsolete vessels. Today it has been reserved as a bird sanctuary.

4. VESSEL TYPES

This chapter presents the types of vessels potentially located within the project area. Sections to follow include information on scows, barges, lighters, pile drivers, tugboats, dredges, double-ended ferries, floating dry docks, water boats, menhaden trawlers, and floating grain elevators.

Scows

The wooden scow was the most ubiquitous barge type in the waters of the New York port, and played a crucial role in various industries within the project area. A non-self-propelled vessel, the scow was rectangular in shape. It was generally decked, with a flat bottom and vertical sides, and its ends were raked or angled upward in the common scow end. A small cabin with its door to the stern was often set on one end to provide living accommodations for the barge captain. To support the weight of the cargo, the hull contained an elaborate system of bulkheads, pillars, trusses, or braces, some possibly designed or adapted for a particular type of cargo.

Flat, flatboat, coal float, coal barge, *chalan* (Spanish) and *chaland* (French) are all historical terms for the type of watercraft employed in inland waters (e.g., bays, harbors, rivers) that have flat-bottomed hulls and square or raked ends. Vessels with these hull characteristics are called scows, a word derived from the Dutch word for this vessel type, *schouw*. A word that did not enter use in English until the late eighteenth century, it refers to a freight-carrying vessel. "Attributes of the scow hull include a flat bottom, a right-angle chine (The chine is the line of intersection between the side and bottom of a boat), straight sides (both horizontally and vertically), and squared ends that may be vertical or raked (i.e., slanted out)" (Saltus et al. 1995:2-45).

The wooden scow hull, with its many sizes, was adapted for numerous uses in the waters of New York. But while differing in use, the hulls were often identical from the deck down. The basic open-deck scow was generally used for non-bulk, non-perishable commodities requiring little or no protection (i.e., brick, stone), the main open deck providing storage. Based on cargo type, the scow might feature bulkheads forward and aft to avoid cargo spillage. Other scow barges employed to carry perishable products were covered with protective structures. Many hulls were also employed as various types of floating work plants, such as crane barges or derrick lighters.

Figure 2 presents a labeled plan of a scow constructed for the New York City Department of Street Cleaning in 1921. The plan shows a standard scow hull with raked bow and stern. The dimensions for the barge were 134 feet length, 37 feet breadth, with a depth of hull of 13 feet 8 inches. The cabin crew, 7 by 12 feet, is on deck, aft. From illustrations such as that presented in Figure 3, we know that the scow hull shape was present in New York waters as early as 1717. And while the evolution of this vessel type is little understood, by the late nineteenth century there was very little design variation in the hull shape. From a study of ferries, flats, and barges of the South Carolina lowlands (Newell 1996), we do know that the basic vessel form, a rectangular body and raked ends, was present throughout the eastern seaboard by the early 1800s, and it may have been introduced earlier. Thought to be a vessel reflecting the ethnic origins of its colonists, like its New York area counterpart, the scow type vessel found in South Carolina also appears to have become uniform in design by the mid-to late 1800s (Newell 1996).

Further clouding the question of origin and vessel evolution, the early use of the scow was not confined to the coast; it was also a vessel type employed extensively on inland rivers. Flatboats employed to carry coal down the Ohio River from Pittsburgh area mines as early as 1829 became known as coal boats. Illustrated in Figure 4, these early flatboats had scow characteristics and, by the mid-nineteenth century, varied in length from 160 to 175 feet, and were 24 feet wide and 8 feet deep (Saltus et al. 1995:2-53).

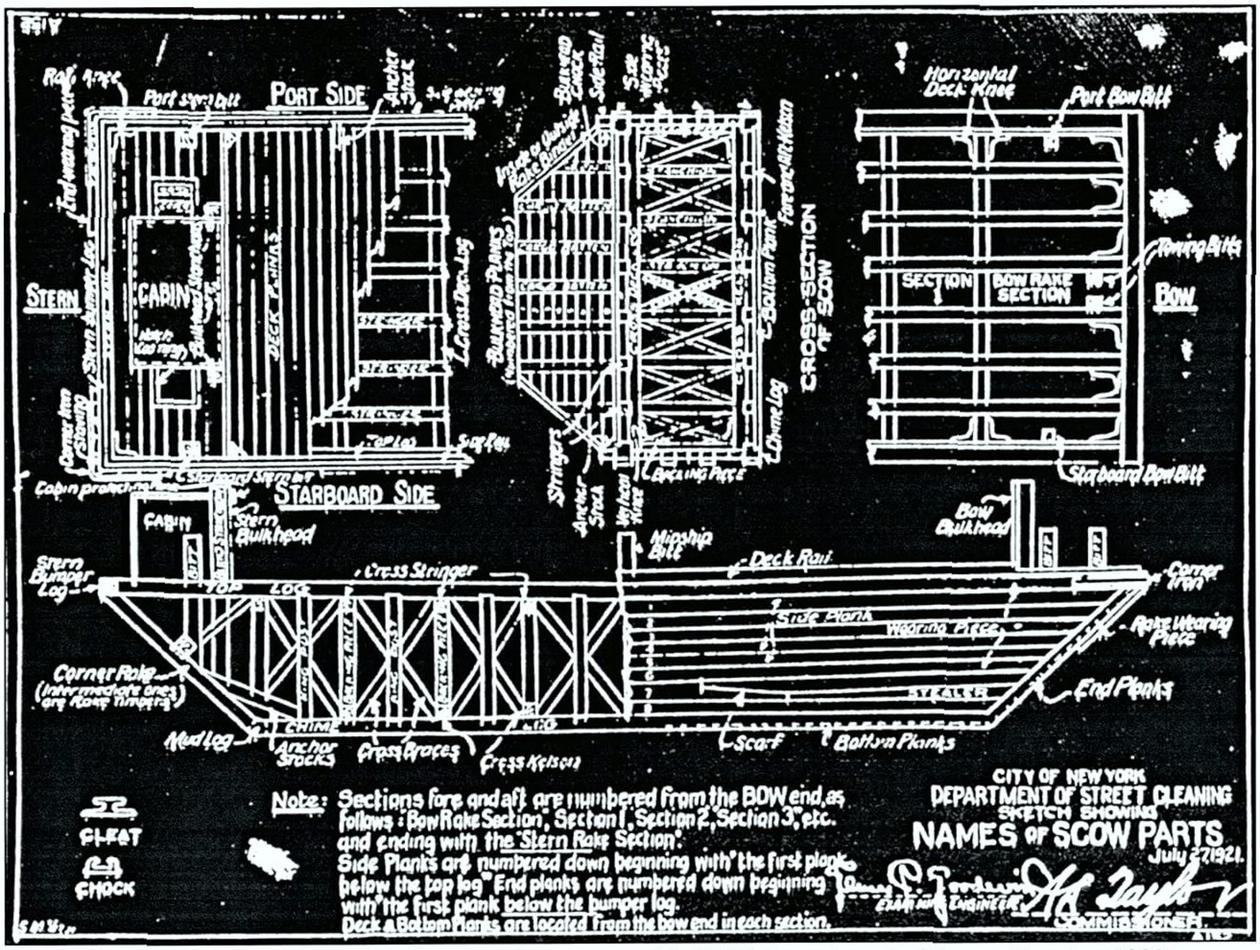

Figure 2. Plan of a 1921 street-cleaning scow (as presented in NYC Department of Street Cleaning 1921).

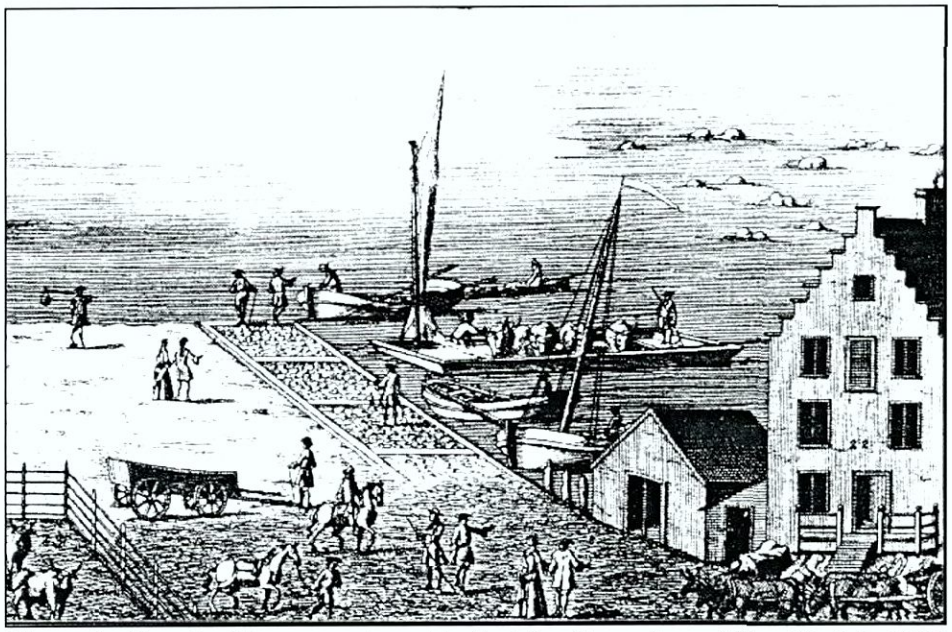

Figure 3. Vessel with a scow-shaped hull plying the waters of New York in 1717 (as presented in Brouwer 1981a).

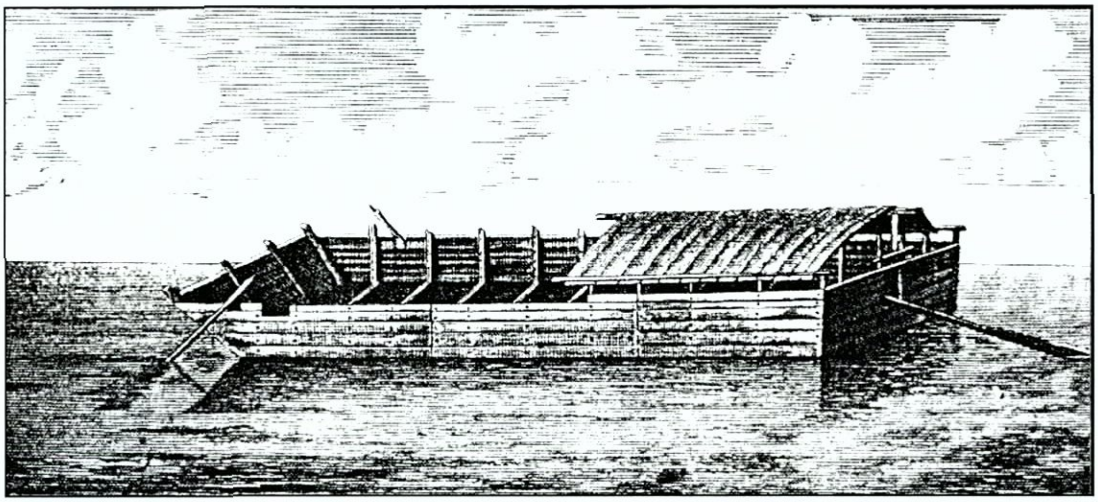

Figure 4. Drawing of a typical nineteenth-century inland rivers flatboat illustrating the early dissemination of this vessel type throughout the country (as presented in Bragg 1977:60).

Open-Deck Scow

As a vessel type, the wooden-hulled, open-deck scow or flat scow is not well documented. We do know from plans that the deck scow had three or more longitudinal bulkheads, effectively dividing the hull into evenly spaced sections; access to the holds was provided by small manholes, most likely as access for pumping and repair. However, scows were built with both bulkhead and stanchion type internal construction. A small cabin with its door to the stern was often set on one end to provide living accommodations for the barge captain. The open-deck scow was employed to transfer all manner of nonperishable goods.

Rock Scow (Bulkhead Scow)

These vessels were named for their specific cargo in the late nineteenth century, when quarries along the lower Hudson produced large quantities of crushed stone and sand for construction use at locations within the port area. Employed to ship other cargoes as well, companies delivered the building material on scows with the same hull configuration as the deck scow (e.g., triple bulkheads), but the rock scow included the addition of timber bulkheads for the retention of cargo, one located on deck at either end.

Termed the "Hudson River Rock Scow," the "bulkhead" scow type was an adaptation of the deck scow. Added high deck-end bulkheads were the distinctive features of this vessel. The bulkheads situated at the bow and forward of the deckhouse at the stern measured some 10 feet high in the center but angled downward 45 degrees at either side (Figure 5). Since the cargo peaked in a mound, the retaining bulkheads could measure as low as two feet. Vertical timbers supported the bulkheads, horizontally planked and smooth on the side facing the cargo (Brouwer 1996). Companies still transport crushed stone on the Hudson River. The scows are generally of the same configuration as earlier scows, but are steel built. The loading deck is usually sunk into the hull and not part of the main deck. Newer scows do not have steel cabins (Brouwer 1996).

It should be mentioned that the South Street Seaport Museum also has a complete set of plans for a New York Trap Rock Corporation scow, dated 1951; the 1950s were the last decade in which companies built wooden barges and scows (Brouwer 1996).

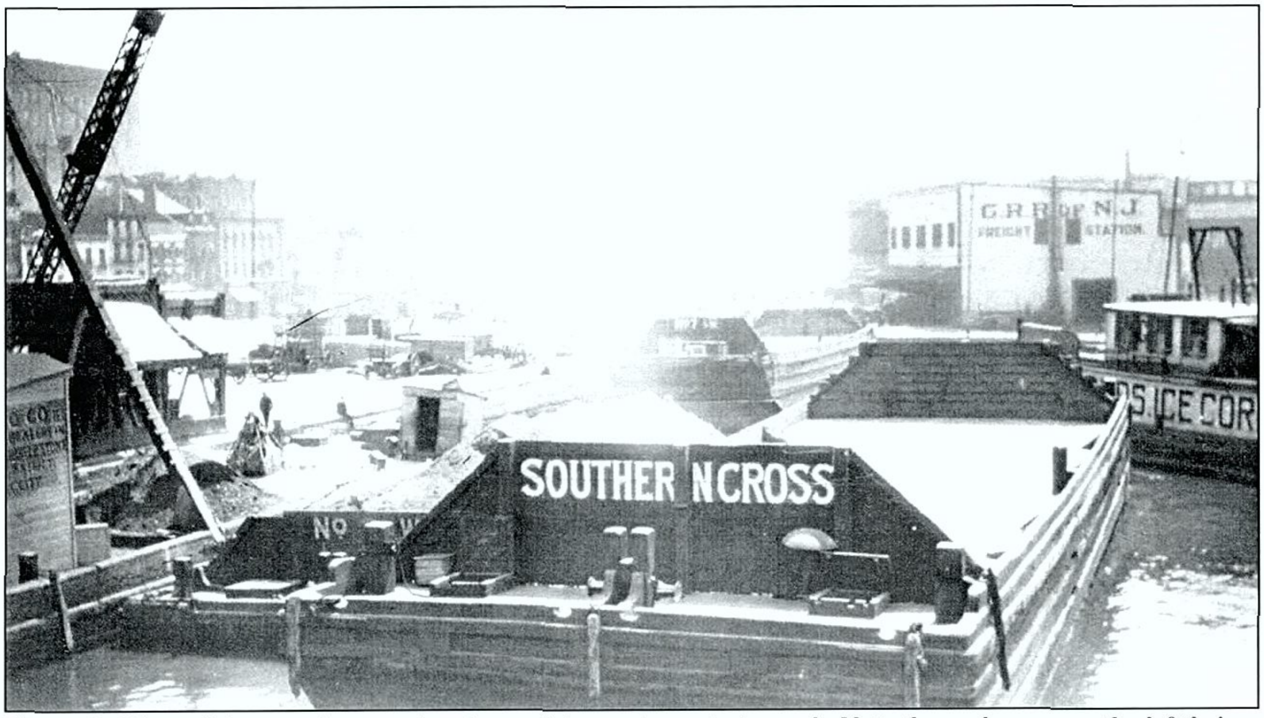

Figure 5. View of three rock scows in a turn-of-the-century photograph. Note the rock scow on the left being loaded with sand and rock by the crane barge. Also note how low in the water it sits compared to the two unloaded rock scows (courtesy of the South Street Seaport Museum).

WOODEN COVERED AND CONVERTED COVERED BARGES

Covered barges were employed in the port area to lighter (i.e., load, transport, and offload) various non-bulk, perishable cargoes from and to ship or shore. By the mid-nineteenth century, covered barges with boat-shaped hulls were present in the port area. There is uncertainty regarding the evolution of this craft, but similar to other barge types within the port, by the late nineteenth century the covered lighter barge was predominantly scow hulled (Brouwer 1996:128-129). As was the case with so many of the later barge types, the employment of the scow hull may have been associated with the economic practicality in building this type of hull (i.e., less boatbuilding craftsmanship, fewer curved timbers), as well as its proven functional aspects. Replaced in time by steel covered barges, the last wooden-hulled covered barges were built in the 1950s (Brouwer 1985:3-4).

Basically scow built with either a stanchion or bulkhead hull system, the barge featured a one-story structure or shed covering most of the deck, with all cargo carried on deck. Often barn sided, two large sliding doors opened port and starboard when cargo was handled over the gangway. A hatch at the margin of the roof allowed for vertical hoisting of goods when the barges were moored to the high side of an oceangoing vessel. Vents positioned at each end of the shed (attached to large ice bins) provided refrigeration for perishable items. Filled with ice through hatches in the roof, the vents circulated cool air top and bottom. When necessary, a stove, installed in the center of the shed, circulated warm, dry air (Brouwer 1996:132).

Some companies preferred centered penthouse cabins over the usual stern counterpart. The higher elevation permitted a 360-degree view of surroundings and, perhaps more importantly, wasted no cargo space. Some covered barges featured hoisting gear. A single mast with booms rose above the center of the deck house. Part of the rooftop cabin accommodated a steam-, or later, oil- or gasoline-powered winch (Brouwer 1996).

The presence of small cabins used as living quarters on this and other types of barges is illuminated by a 1918 document that stated for insurance reasons all non-self-propelled harbor boats must feature cabins (Squire 1918). The standard insurance policy of the Atlantic Inland Association, which many companies used, required a man on board. Many captains lived on board with their families; the size of the cabin varied from a shed to a family's permanent residence. Besides providing extra security, night-time operations (towing, moving, loading, etc.) required the captain's presence.

Of 208 unrigged boats owned by one company, 89 housed families with children ages one through 10, 71 had captains and their wives, and 48 had captains living alone on the boat (Squire 1918). Living conditions on board no doubt varied, but general descriptions mention crowded, damp, foul-smelling rooms. "The general impression given is that of dirt and disorder" (Squire 1918:16). Some companies tried to accommodate their employees if possible, providing stoves, furniture, etc., while others provided nothing at all. One company (200 unrigged boats) provided nothing for its employees (Squire 1918).

As a vessel type, the wooden-hulled, covered barge is well documented; numerous plans exist, several examples along waterfronts have been extensively recorded, and a restored example serves as a traveling museum. Two detailed covered barge plans are shown in Figures 6 and 7.

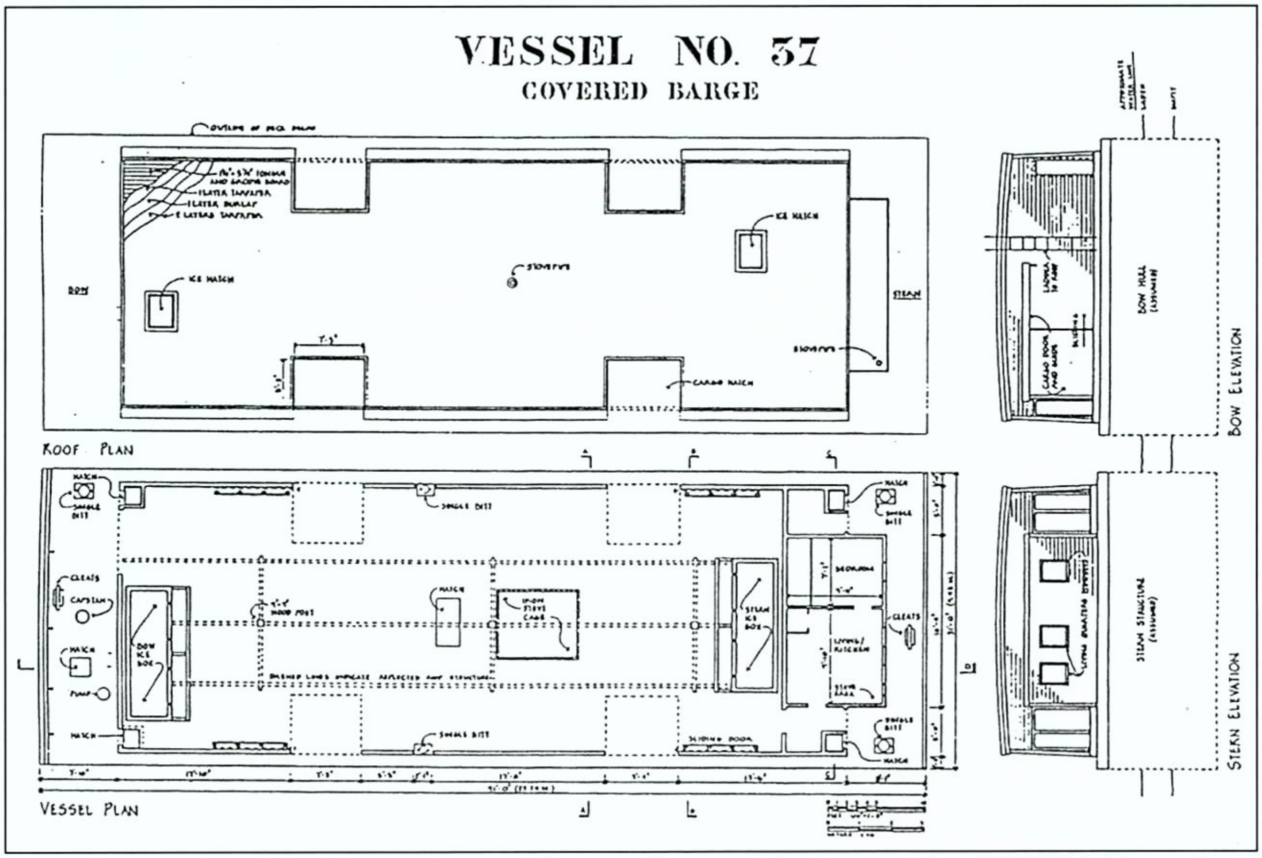

Figure 6. Plan view of deck house of covered barge at Shooters Island recorded to HABS/HAER standards (as presented in Kardas and Larrabee 1985a:109).

The Hudson River Waterfront Museum, located at various New York Harbor slips, is a restored wooden covered harbor barge. The barge's physical condition is in stark contrast to the physical remains of the covered barges in the project area, which are all deteriorated. The project area also includes three converted covered barges.

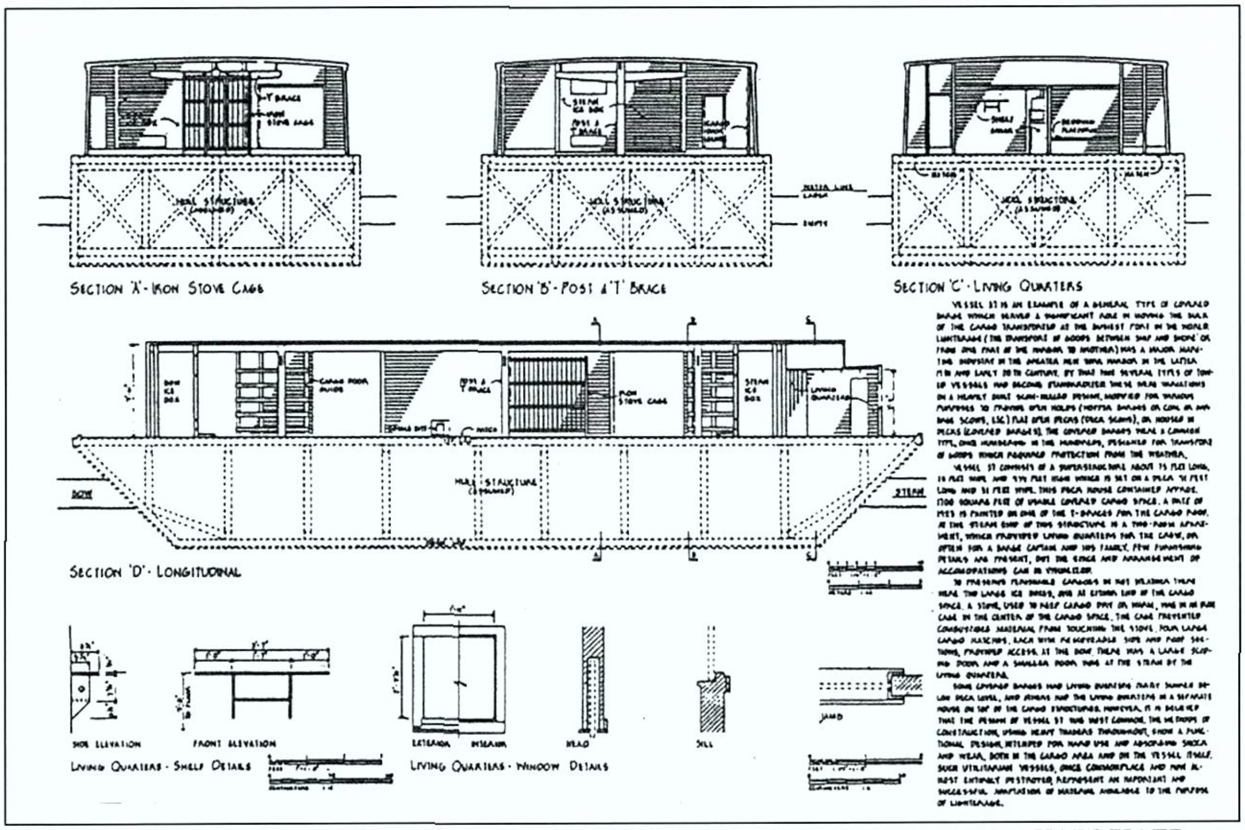

Figure 7. Side and end views of deck house of covered barge at Shooters Island recorded to HABS/HAER standards. Note absence of hull recordation (as presented in Kardas and Larrabee 1985a:110).

A-Frame Crane Barges

Most likely adapted from mid- to late nineteenth-century shore-based lifting equipment such as the stiff leg, these towed cranes would have been employed in ship salvage, dock and pier construction, and cargo transfers. The cranes and hoisting machinery are situated atop scow hulls that appear to represent the variety seen in scow construction.

Two A-frame crane barges in an apparent salvage operation are illustrated in Figure 8. The photograph reveals numerous aspects of these scow-hulled work barges, including the characteristic A-frame stays and chain plates found on this vessel type.

Hopper Barges

Builders developed several types of scows capable of dumping garbage and dredge spoil at sea, or depositing breakwater/shoreline extension fill. Of the types that were developed, including the hopper barge, the side-dumping scow, and the hinged scow, the hopper barge was the most common, possibly due to its functional design. Although the most common, its origins are not understood, and the type remains undocumented.

Plans of a 1927 six-pocket (hopper) dump scow (hopper barge) indicate that instead of a raked bow and stern seen on the scow, the hopper barge has:

> curved ends forming one-quarter of a circle from the keel to deck. The pockets measure 28 feet from side to side at the top and 16 feet 5 inches fore and aft. There is a 3 foot 4 inch coaming

rising above the deck. At deck level, the sides of the pockets begin sloping inward. The sides ending at the hatch in the bottom measure 9 feet 6 inches wide. The hatch is closed by a pair of timber doors. The doors are closed by chain bridles attached to single chains passing over sheaves on forward and aft bulkheads. These chains are in turn attached to cables on moving sheaves. The cables are taken in or released by turning a continuous shaft running along the top of the hatch coaming on one side. The shaft, probably operated by hand, closed the doors once the contents of the hopper had been dumped. In the middle of the barge is a seventh bay only eight feet 10 inches in the fore and aft dimension [Brouwer 1996:140-141].

Figure 8. Undated photograph of two A-frame crane barges involved in what appears to be a salvage operation. Note scow hulls, the machinery cabin, as well as the numerous crane stays on the barge to the left. These stays and their corresponding chain plates where they attach to the hull are a distinguishing characteristic of this vessel type (courtesy of the South Street Seaport Museum).

Although not represented in the investigated vessels, another dump scow type was the side-dump scow. Similar in hull configuration to the basic scow, it had bulkheads similar to the rock scow. It differed from both in that its deck was not level, but rather sloped downward 45 degrees on either side of the longitudinal centerline between the end bulkheads. This sloped deck was divided into sections by additional transverse bulkheads, with the "cargo" held in place and later released by bay doors at the base of the sloped deck (Brouwer 1996:141). A plan view of this type, found in the Feeney Collection but not pictured, shows the general interior layout of the vessel and illustrates its similarity with the deck and rock scows, but does not illustrate the slanted deck or additional deck pockets.

DERRICK OR STICK LIGHTER

Open-decked derrick lighters were employed in the port area to lighter (i.e., load, transport, and offload) various cargoes from and to ship or shore. Early stick lighters, as they became popularly known, likely because of prominent timber masts and cargo booms, had boat-shaped hulls, pointed bows, and elliptical sterns (Brouwer 1996:133). There is uncertainty regarding an association between this configuration and lighters or sailing craft, but by the late nineteenth century the derrick lighters were predominantly scow hulled. We do know that the advent of the steam tow was a significant impetus in the use, acceptance, and profusion of this vessel type, the combination of the steam tow and barges making the sailing lighter uneconomical and thus contributing to its demise. The employment of the scow hull for this vessel type, as seen on so many of the later barges and work platforms, may have been associated with the economic practicality in building this type of hull (i.e., less boatbuilding craftsmanship, fewer curved timbers), as well as its proven functional aspects.

As illustrated in Figure 9, the derrick lighter had a single sturdy timber mast stepped in one of two locations, either in the center of the deck or at the stern just in front of a small crew cabin. If the mast rested aft, only one cargo boom pointed forward. In the former case, there would be two cargo booms, one pointing forward and one pointing aft. The cargo booms were usually rigged like a sailing ship's fixed gaff in the central mast configuration. Fitted with wooden jaws to allow lateral swinging, and held at a constant angle by fixed wire topping lifts, they would be positioned about three-quarters of the way up the mast. The masts measured around 50 feet in height. In the central mast arrangement, the boat had two lighter masts at the bow and stern just forward of the cabin. Three masts around 20 feet high had sheaves mounted near their tops for lines used in hoisting the ends of a tarpaulin used in the protection of cargo (Brouwer 1990:134-135).

In 1985, Norman Brouwer recorded the intact derrick lighter L.V.R.R. No. 462, grounded at Edgewater, New Jersey. The boat, built at Mariner's Harbor, Staten Island in 1926, measured 104.5 feet in length, 32 feet in breadth, 7.8 feet depth of hull. A large winch house stood on deck aft, with mast and boom positioned directly in front of the house. The largest openings in the deck, small rectangular hatches, provided access and ventilation. A system of longitudinal bulkheads and timber pillars linked by crossed diagonal timber braces supported the deck. The derrick barge had more diagonal braces at the side rather than natural knees. A continuous row of windows spanned the front of the deck house. The cabin measured 6 feet 2 inches across the windows, 14 feet 9 inches at the side of the deckhouse. Interior cabin construction featured tongue-and-groove details (Brouwer 1985:8-12, 1990:135-137).

Later derrick lighters were fitted with steel A-frames and steel booms in place of their wooden counterparts. The wooden scow hull was eventually replaced with a steel barge hull, retaining its steel A-frame (Brouwer 1990:137).

As a vessel type, the wooden-hulled derrick lighter is somewhat documented. But as seen above there are differences, some unrecorded.

PILE DRIVERS

As stated in Raber et al., "the first steam-powered pile driver in the United States was a direct-acting type patented in 1841 and used in construction of Drydock No. 1 at the Brooklyn Navy Yard" (1995b:106). Virtually unchanged since the latter half of the nineteenth century, the steam pile drivers played a crucial role in the construction of area piers, bulkheads, bridges, and numerous other in-water construction projects such as lighthouses (i.e., the U.S. Dike).

The hulls are basically rectangular scows. The guides for the weight employed to drive the piles are supported on a tall timber framework, the distinct and defining characteristic of this vessel type. The steam winch, for hoisting the weight, and the steam boiler are located in a wooden deck house or cabin. The boiler is the vertical type, using oil for fuel, the stack projecting through the deck house roof. In the nineteenth century, coal probably fueled the boiler.

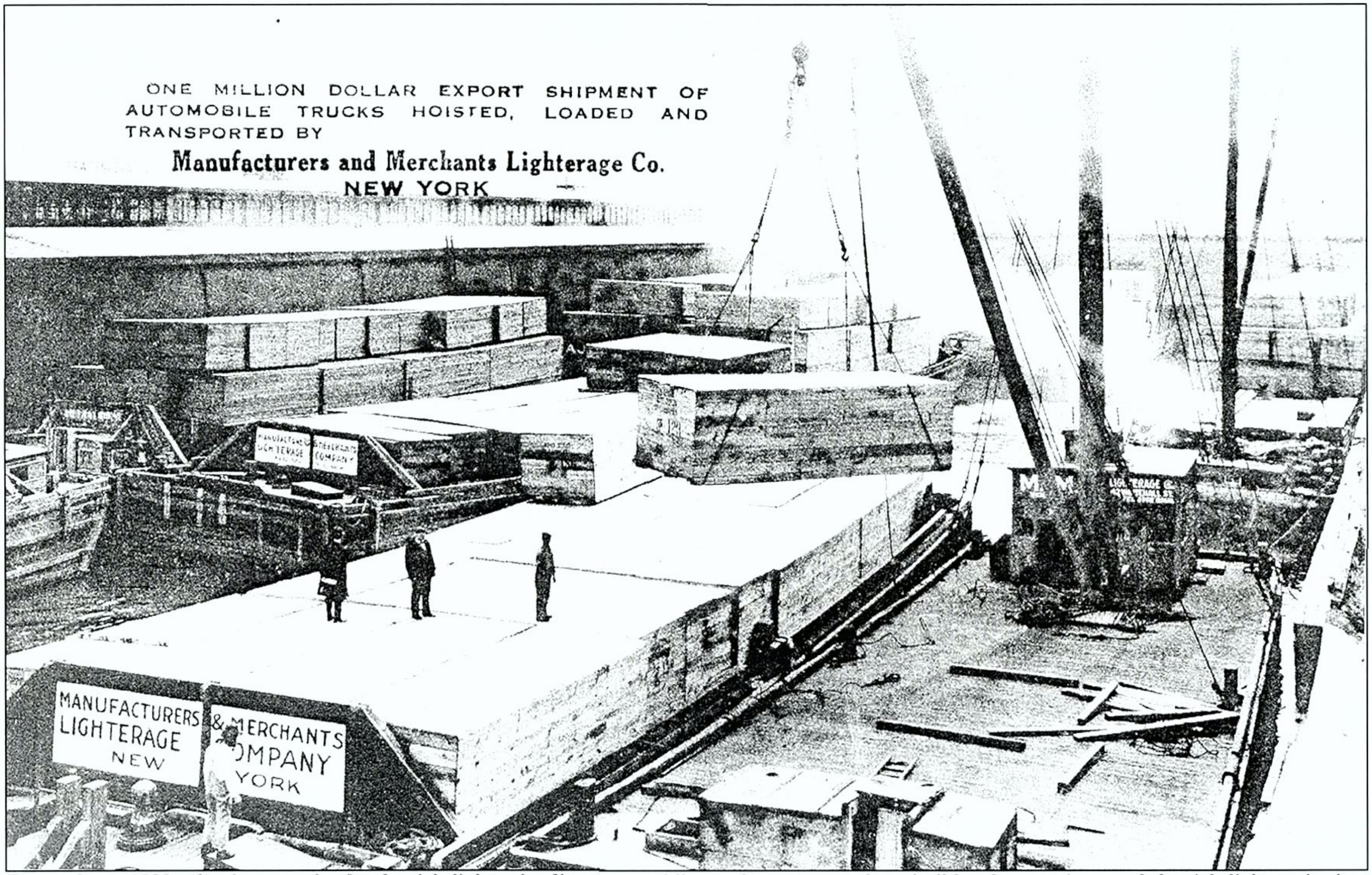

Figure 9. A 1930s (?) photograph of a derrick lighter loading automobile trucks onto a rock or bulkhead scow. A second derrick lighter sits just behind the first (courtesy of the South Street Seaport Museum).

There is little wasted space on the vessel. The open decks around the house are wide enough only for the walkways and for handling mooring lines. There are winch heads on the outside of the house used by the pile driver to winch itself into position.

Although today the majority of extant pile drivers are steel-hulled and diesel-powered, steam is still employed for driving piles in the maintenance of the slips for the Staten Island and Governors Island ferries. And while an important floating work plant vessel type, the wooden-hulled, steam-driven pile driver remains undocumented with the exception of the Feeney Collection plans and historic photographs. These, however, do not indicate if specific hull construction features were a requirement of the scow hull employed as a pile driver.

DREDGES

One of the earliest accounts of dredging in the present-day United States refers to attempts by the French in the eighteenth century to deepen the mouth of the Mississippi River. In 1718, the Company of the Indies, the French enterprise then in control of the Colony of Louisiana, sent several iron harrows from France. These were dragged across river bars to help remove them. These harrows were unloaded and lost in Mobile and the plan was never implemented. Several years later, in 1729, a scraper or harrow-like implement was finally built and dragged across the bar at Belize Pass, successfully deepening the channel by loosening the sediment and allowing it to be carried away by the current. In Philadelphia in the 1770s, a grab dredge, consisting of two moveable jaws or shovels, was used to clear slips, and in 1784 a man-powered treadmill machine fitted with dippers was used to remove sediment. By the end of the eighteenth century other similar types of crude dredging devices were in use in North America (Bastian 1980:1-3).

In the early nineteenth century, improvements began to appear in dredging technology, and several patents were issued for mechanical dredging machines. Among the earliest was one issued in 1804 to Oliver Evans of Philadelphia for his machine called the *Orukter Amphibulos*. Apparently the first self-propelled, wheeled vehicle in America, the *Amphibulos* was described as a "large flat, or scow, with a steam engine of the power of five horses on board to work machinery to raise the mud into flats" (Bastian 1980:3). Little is know about Evan's machine, but Oliver Evans himself became one of the most important figures in the development of steam engine technology and steam navigation in the United States. With the continued development of steam power, a variety of technological improvements in dredging machines appeared. However, Bastian (1980:5) suggests that the real impetus to dredging and the corresponding advancements in dredging machines in the United States resulted from the passage of the General Survey Act of 1824 and the fact that the Army Engineers were given the responsibility for its implementation. Under the authority of the Act, the Engineers began to acquire, develop and build dredges for use on a variety of harbor and inland river projects. John Grant of Baltimore built a steam-powered ladder bucket dredge for the Army Engineers in 1827 for use at Sacketts Harbor, New York (Bastian 1980:1-3). Illustrated in Figure 10, an 1830s ladder bucket dredge, although employed at Ocracoke Inlet, North Carolina, is thought to be similar to the one employed in New York.

By the early 1900s, the bucket and hydraulic cutter head dredges were the most common and extensively employed types in the dredging of harbors and navigation channels, and these are the two types represented within our project area. The bucket dredge, historically related to the spoon dredge, a simple scoop design, typically had a boom extending from its bow (Figure 11). The boom was supported by an A-frame or an H or gallows-type frame. Another boom, equipped with a large bucket at its pivot end, rested near the midpoint of the first boom. The first boom had a cable running through a sheaf at the head of the first boom. At the head of this boom was a bucket used as a scoop. In 1990, the Great Lakes Dredging Corporation used a bucket dredge in the channel at Newark Bay, off Staten Island, New York (Brouwer 1990; Mavor 1937:43).

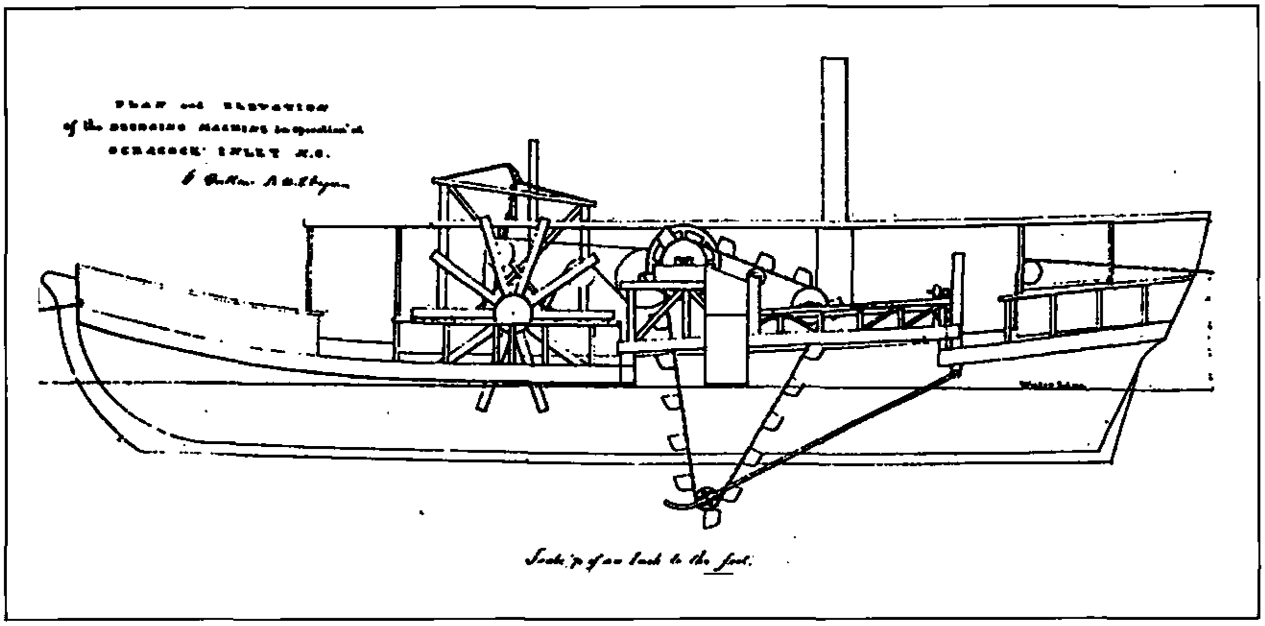

Figure 10. An 1830s ladder bucket dredge (as presented in Bastian 1980:Figure 2).

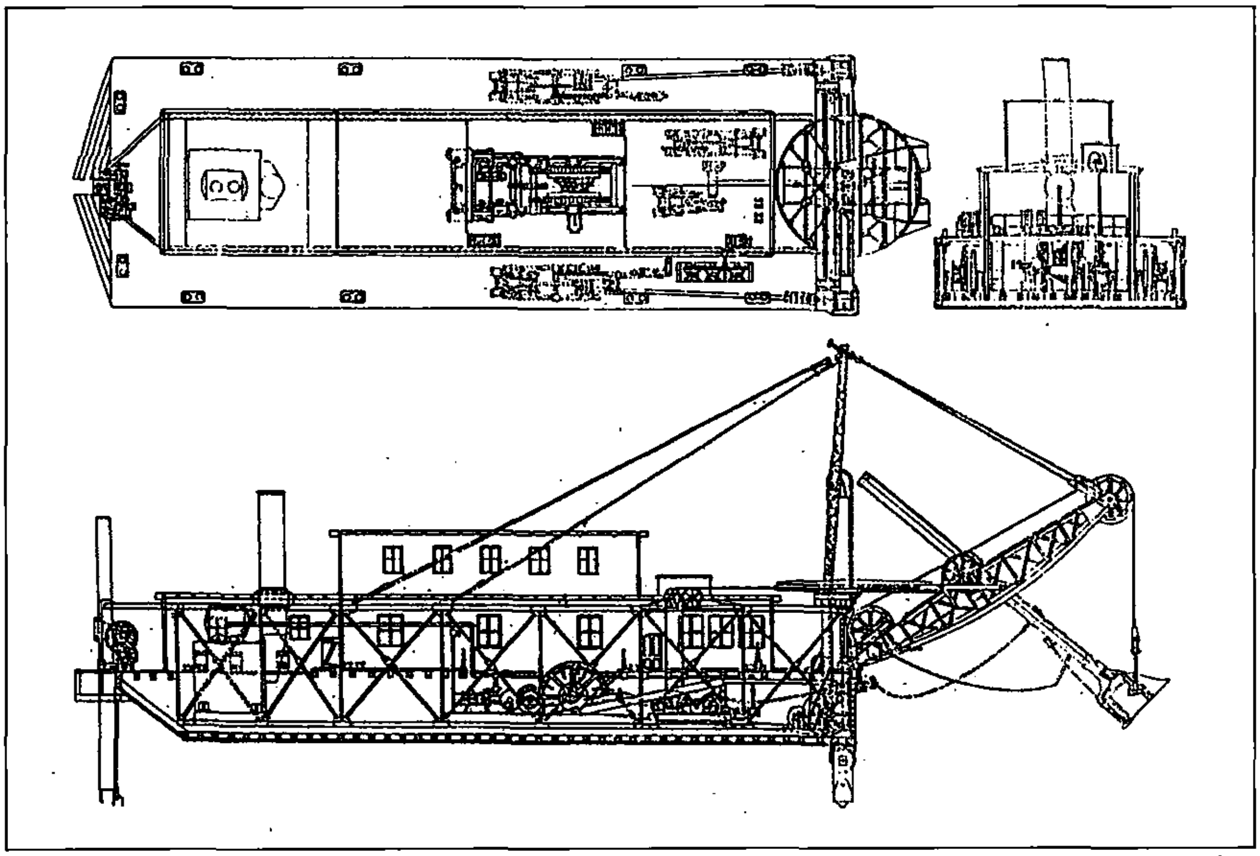

Figure 11. Inboard profile, deck plan, and cross section of the *Toledo*, a wooden-hulled bucket dredge. Note the spuds, the large legs that raise and lower and anchor the dredge in place (as presented in International Marine Engineering 1910).

The cutter head dredge differed from the bucket dredge in that it suctioned sediments through a pipe, the sediments having been loosened or cut by the cutter head. The boom was usually lowered by a lift rig supported by an A-frame. The hollow boom contained a pipe leading to a large hydraulic suction pump. A rotating cutter head, complete with a series of blades, was attached to the end of the boom. The bottom sediment was then discharged into a barge or floating pipeline (Brouwer 1990:150). Dredge material was either pumped into a waiting scow or was pumped to shore by a series of connected pipes.

International Marine Engineering (May 1912) published data on a 20-inch Morris hydraulic suction cutter head dredge owned by the American Pipe and Construction Company used on the New York State Canal Barge system. The hull was wooden, with two heavy steel girders running fore and aft. Powered by a triple-expansion Morris engine (750 hp @ 225 revolutions/minute), the main hydraulic dredge pump, steel constructed, had a 20-inch diameter suction/discharge. The power plants utilized a surface condenser, with vertical air pumps and centrifugal circulating pumps, boiler feed pumps, and service pumps. The cutter shaft measured 8.5 inches in diameter. The cutter-drive engine (12-by-12-inch double-cylinder horizontal engine) sat on deck.

Hydraulic dredges used early this century worked extensively during construction of the New York State Barge Canal System. Stationary vessels, these dredges had no propulsion systems; they reached their destinations by tug (Brouwer 1990). As depicted in the above figure, many dredges used vertical timbers termed "spuds" to anchor themselves in place. Raised and lowered by winches, the spud legs traveled through vertical guides called spud boxes that were built through or on the exterior of the hull.

DOUBLE-ENDED FERRIES

Indigenous to the port area of New York, the double-ended ferry was a quick adaptation of steam power, which itself was the result of several developments associated with the Industrial Revolution. The invention of malleable iron by Cort in 1784 certainly provided the means of shaping iron for power-plant production, as did the work of machinist Samuel Wilkinson and others. In the late eighteenth century, Boulton Watts (Soho) established an engine manufacturing plant that eventually provided an opportunity for European and American engineers to experiment with steam-power propulsion (Hutchins 1948).

In the U.S., John Fitch experimented with marine steam power on the Delaware River near Philadelphia, while John Stevens and Robert Fulton worked between New York and Hoboken, New Jersey. Colonel Stevens operated a steam launch at Hoboken in 1804 (Whittier 1987). When Robert Fulton built the world's first commercially successful steamboat, *North River Steam Boat,* in 1807 (Figure 12), he had little idea what the appropriate hull form should be. The vessel seems to have had a shape similar to a large canal boat (Brouwer 1996), though Dayton (1939) suggests lines similar to a sailing ship. In describing the boat, enrollment records state "she is a square-sterned boat, has a square tuck: no quarter galleries and no figurehead" (Morrison 1958:21). The vessel, built at the Charles Brown Shipyard on the East River near Manhattan, originally measured 140 feet in length by 16 feet in breadth, a ratio of almost 1 to 10 (Morrison 1958). The copper boiler (low-pressure) measured 20 feet long by 8 feet wide (Dayton 1939).

Rebuilt after its first season, the steamboat measured 149 feet. Peter A. Schenck, Surveyor of the Port, certified that the boat had one deck and two masts, a breadth of 17 feet 11 inches, and a 7-foot depth (Morrison 1958:21). A contemporary drawing of the boat, later named *North River,* shows a stern similar to those on sailing ships of the period, though with a proportionately wider transom. The paddlebox extended out from the hull with no additional structure forward or aft. There are two masts, one forward and one aft, with yards for square sails, which are furled.

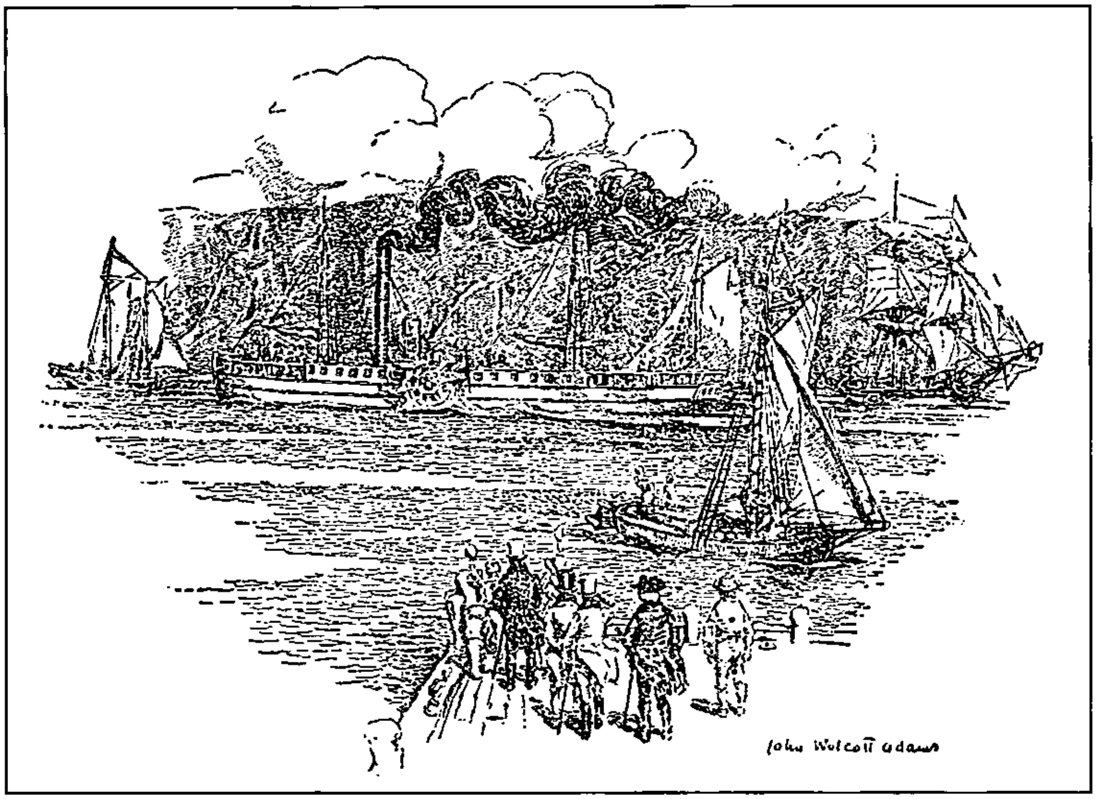

Figure 12. John Wolcott Adams's lithograph of *North River Steam Boat* (as presented in Dayton 1939).

Jean Marestier's study of American steamboats *Memoir on Steamboats of the United States of America,* published in Paris in 1824, includes an outboard profile of Fulton's steamboat *Paragon,* built for the Hudson River in 1811 (Figure 13). It is very similar to the print described above. The sails are shown set with a very deep square sail on the foremast, a small square topsail above, and a fore-and-aft sail from a gaff and boom on the second mast set. It has a plain bow with a convex curve to the stem, and a bowsprit house on deck from which is set a single jib. The main difference from the first steamboat is the apparent addition of "guards," protective mouldings faired out around the paddlebox.

Ship paddlewheels, called waterwheels at the time, had the same basic design as waterwheels used in powder mills. These wheels, easily modified for marine use, "ideally suited...the conditions which existed on American waterways in Fulton's time" (Whittier 1987:7). To generate enough thrust from a relatively slow-turning steam engine, screw propellers had appreciable draft, creating problems for a shallow-draft vessel. On a shallow-draft hull, a pair of paddlewheels generated ample thrust without projecting below the keel line.

The 1820s witnessed two major changes in steamboat design. Sails disappeared within a few years, and length-to-breadth ratios declined (7 to 1 or less). Aside from these developments, boats of the early 1820s had most of the same features as the *Paragon*. The *Constitution*, built in New York, had a similar bow and a transom stern with six or seven windows. The guards around the paddleboxes did not extend very far forward or aft, but did create some additional space for storing boiler wood. The vessel included a second deck aft of the engine, sheltered by an awning (Brouwer 1996).

The *DeWitt Clinton,* built at Albany in 1828, measured 233 feet in length, 28 feet in beam, 64 feet over the guards, 10 feet depth of hold, and 4.6 feet draft (Dayton 1939). Freeboard reduction brought the main deck much closer to the water. Little transom remained at the stern. The guards extended outboard around the paddleboxes in a continuous curve from bow to stern, supported at intervals by diagonal struts braced against the hull. In addition to providing more space, the guards afforded a practical place to put the boilers (Ringwald 1965). West Point Foundry built the engine, the largest at the time, with cylinders measuring 66 inches in diameter with a 10-foot stroke (Dayton 1939).

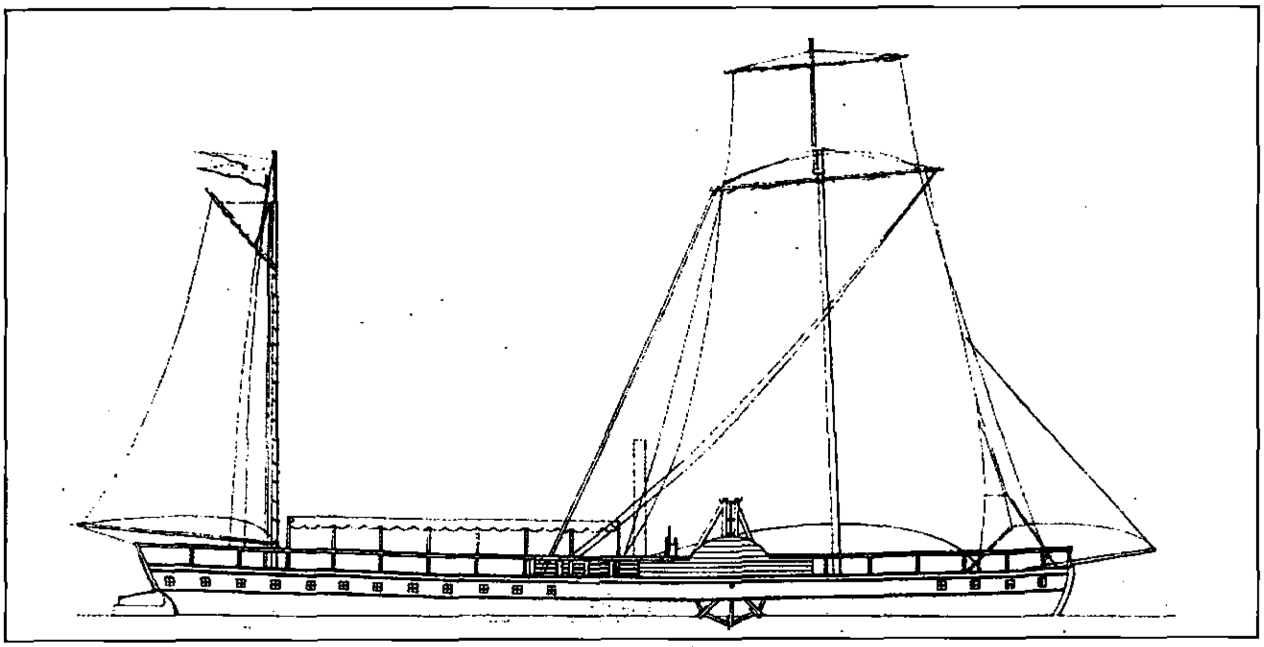

Figure 13. Side view of *Paragon* (as presented in Marestier 1824).

Marestier (1824) expressed concern over the stress engines and boilers placed on wooden hulls of this type once they exceeded a certain length. Several methods provided additional support. A heavy-timbered truss ran fore and aft on either side, with the highest point sometimes arching over the paddlewheels (Ringwald 1965). These trusses, called hogframes, were a distinctive feature on early wooden-hulled steamboats. The *DeWitt Clinton* also had three masts on the centerline supporting "hogging chains," iron rods extending to either side, offering additional support for the guards. These rods distributed the stress and provided support for the guards. Additionally, the wooden hulls were equipped with massive engine bed timbers because of the engine's great weight.

Crosshead engines powered early steamboats. Developed from Fulton's basic vertical-cylinder layout, this type of engine is named after the crosshead frame shown in Figure 14 (the small cylinder below the steam cylinder is the condenser). A long piston rod extended above the cylinder to form a T with the horizontal crosshead. The crosshead, a device forming a connection between the piston rod and connecting rod, is similar to the joints in the human body (Hawkins 1987[1904]). The engine, positioned athwartships, moved and up and down on vertical guides. The first guides were mounted on simple upright timbers. Later a pair of A-frames (linked together at the top) replaced these timbers. Some steamboaters called it the "gallows frame" because of its shape (Whittier 1987). Near the outer ends of the crosshead, two connecting rods attached together. These came down on either side of the cylinder to crank throws on the paddlewheel shafts. As the crosshead rose and fell, the connecting rods rotated the cranks, turning the wheels.

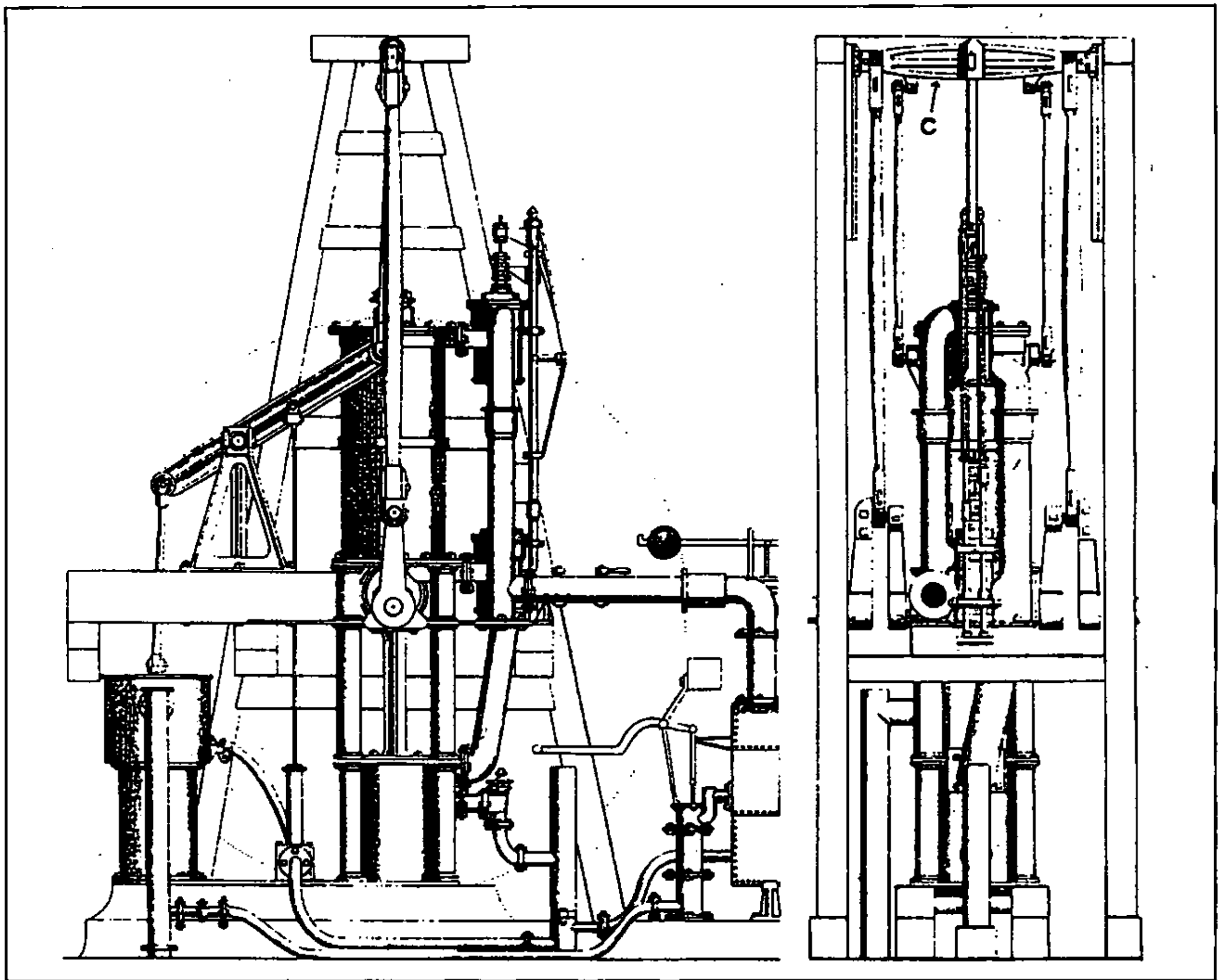

Figure 14. Vertical cylinder layout of a crosshead engine around 1850. The name comes from the sliding member marked "C" (as presented in Whittier 1987).

The vertical beam engine, known as the "walking beam," is a uniquely American technology. Developed around 1820, the engine's design was used as late as the 1950s. Its popularity revolved around its simplicity. Despite the popularity of the walking beam engine, crosshead engine production continued sporadically through the 1830s. Introduced as a solution for space and balance problems associated with bigger engines, the walking beam engine also had a vertical cylinder (Whittier 1987). A piston rod attached to a crosshead above; above the crosshead, a second rod connected to one end of a diamond-shaped beam. The beam rotated at its center on a bearing mounted at the top of an A-frame, similar to the A-frame of earlier engines. A connecting rod to the single crank throw was attached to the other end of the diamond-shaped beam. In this way the beam, rocking back and forth, transferred the up-and-down motion of the piston to the crank, turning the paddlewheels.

Figure 15 shows a walking beam engine built by T.F. Secor and Company, New York. A typical 1850 design, the long stroke piston and double poppet valves minimized the force needed to open them against steam pressure. Cold water passed through the injector pipe, then flowed through openings in a perforated plate into the condenser chamber. From there it mixed and condensed exhaust steam. The water/vapor mixture was withdrawn by air (Whittier 1987).

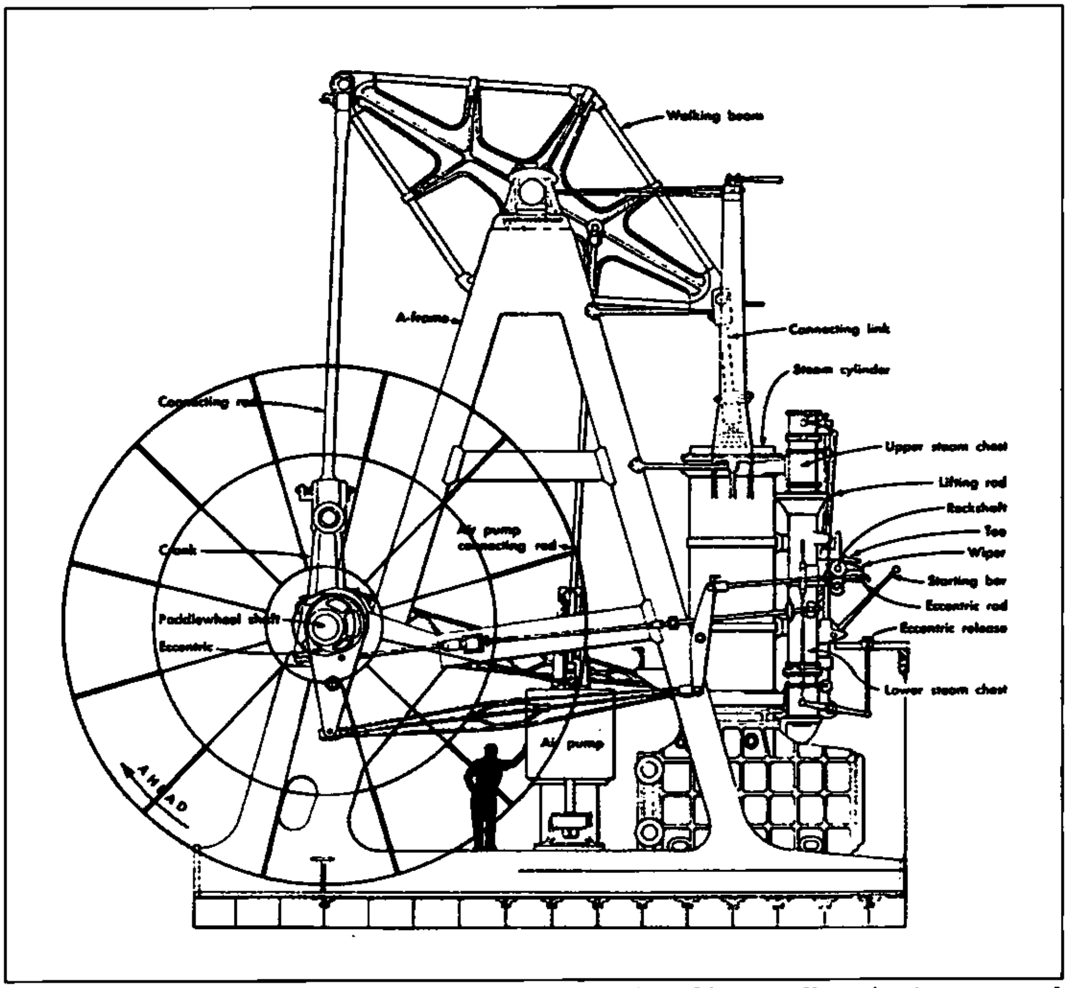

Figure 15. Labeled illustration of a walking beam engine of intermediate size (as presented in Whittier 1987:50).

The walking beam apparently got its name from the rate at which it moved, usually in full view above the roof of the steamboat's uppermost deck. In a few later steamboats, it was enclosed in a small uppermost deck. Later still, it was enclosed in a small, greenhouse-like structure (Brouwer 1996). By the mid-1800s, wrought-iron straps over a cast-iron framework replaced heavy wooden timbers, though wooden frames appeared right up to the end of the walking beam era (Whittier 1987). In the 1880s, A-frames consisted of iron and then steel angular plating. Three known examples of the walking beam engines survive, two in the United States: the ferry *Eureka*, preserved at San Francisco, and the lake steamer *Ticonderoga*, preserved at Shelburne, Vermont.

Development of New York City Double-Ended Ferryboats: 1812-1860s

Until the advent of the steam ferryboat, regularly scheduled connections to and from New York City (via the harbor) occurred by sloops, periaugers, and rowboats (Cudahy 1990). After Robert Fulton's successful use of steam power with *Clermont*, innovators realized the potential steam power had for ferrying passengers, and steam service soon became a routine and expected feature of New York City life. Original designs and characteristics took place under the guidance of Fulton and John Stevens, who, along with other builders, designed the double-ended ferry.

Robert Fulton launched the first double-ended ferry in July 1812, with the construction of the twin-hulled *Jersey*. Built by New York City's Charles Brown Shipyard, the 80-foot-long ferryboat transported passengers over the Hudson River. Fulton's design featured a twin-hulled vessel equipped with a 5-foot draft and a 30-foot beam. The draft allowed easy maneuvering over water (Marestier 1957[1824]). A platform between hulls held machinery, passengers, and cargo. Fulton placed the paddlewheel between hulls, mainly to avoid direct contact with floating ice. He situated the rudders in the same space, one forward, one aft of the paddlewheel. Equipped with fore and aft rudders and a double-ended hull, the ferryboat could travel to and fro across the river without turning. This characteristic gave the vessel type its name, "double-ender," and differentiated the class from other sidewheel vessel types such as the Hudson River and Long Island Sound vessels. These sidewheelers, also ferrying people and freight, and powered by the same engine types, had different hull and deck configurations, and had only the single stern rudder.

The *Nassau*, also built by the Charles Brown Yard (1814), retained the twin-hull configuration begun by Fulton, but featured a passenger cabin on the main deck (Cudahy 1990). *Jersey* and *Nassau* remained the only two ferryboats operated by Fulton. After Fulton's death, former associates added another twin-hulled ferryboat, *William Cutting*, to the fleet in 1827.

Following visits to the United States in the 1820s, Frenchman Jean Baptiste Marestier wrote an eyewitness account of the Fulton-type ferryboat. The boats, according to Marestier, had platforms between 72 and 79 feet long. The engines rested on the platform center. The paddlewheel rested in front of the engine. The paddlewheel contained eight buckets eight feet in length, two feet in height. Boiler dimensions averaged 18 feet long, 7 feet wide, and 7 feet high. At the end of each platform sat a cabin (Marestier 1957[1824]).

Because ice had a tendency to disrupt the twin-hulled paddlewheel's motion, the Union Ferry Company, "an outgrowth of the original Fulton ferry line interest, finally dispensed with its twin-hulled ferryboats" in 1833 (Spirek 1993:29). The company opted for a single-hulled configuration, which effortlessly sliced through ice. Latter-day New York City ferryboats retained two Fulton designs: a sloping main deck amidships to each end (caused by the paddlewheel shaft's placement above the sheerstrake of the hull) and the characteristic double end (Hall 1884).

John Stevens is credited for the prototype of the single-hulled New York City ferryboat. He launched *Hoboken*, a 98-foot steam-powered double-ender, on May 1, 1822. The ferryboat ran between Hoboken and Manhattan on the Hudson River. Keeping two characteristics of Fulton's early design, the characteristic double-end, and a sloping main deck from amidships to each end, the boat featured a single hull and a sidewheel port and starboard. To protect the sidewheels, Stevens extended the main deck. The addition, including paddlewheel sponsons, provided additional room and loading capacity to the boat. Not intended for oceanic passage, the vessel's design was adapted to the interior waters of New York Harbor (Cudahy 1990).

The demand for ferryboats increased as the boat proved its reliability. The corresponding economic growth in Manhattan and surrounding areas (New Jersey, Brooklyn, and Staten Island) further increased ferryboat demand. New York City's population in the 1800s numbered around 100,000. By 1824, six ferryboats serviced the city's population of 200,000. By 1860, 70 ferryboats serviced nearly 1,176,000 New Yorkers. Some ferryboat companies carried up to 5,000 passengers a day (Spirek 1993).

Into the 1830s, overall ferryboat size increased. Stevens' ferryboat line built *Fairy Queen* in 1826. One hundred forty-nine feet long, the boat measured 26 feet wide with a 6-foot draft. The boat featured a vertical walking beam engine with two paddlewheels. *Fairy Queen* had cabins in the hull, accommodating up to 100 passengers. The boat had a bar on board, and during the summer crewmen stretched an awning over the boat from end to end. A helmsman operated a rudder tiller, steering with the help of a pilot who stood at the forward end of the vessel (Stevens 1893).

In 1836 the Union Ferry Company operated three new ferryboats. On heavily traveled routes, the company added the 304-ton, 155-foot-long *Brooklyn*, the 155-foot-long *New York* (23-foot beam, 9-foot draft), and the diminutive *Olive Branch* (89 feet long, 23-foot beam, and 8-foot draft). Besides these three boats, Union Ferry operated three other ferryboats ranging in size from 100 to 125 feet in length, 145 to 184 in tonnage (Cudahy 1990).

By the 1840s, shipbuilders all across New York City built double-enders. William H. Webb, noted builder of sailing ships, built three double-enders for the city. *Wallabout* and *New York*, sister ships, measured 94 feet long, 23 feet in beam, and 9 feet draft. The third ferry, *Williamsburg*, built in 1846, measured 115 feet long, 26 feet in beam, and 10 feet in depth. Each of the boats featured a vertical beam engine with a walking beam. These boats operated on the East River (Dunbaugh and Thomas 1989).

The Staten Island ferryboat *Hunchback*, built by Jeremiah Simonson (New York City) in 1852, featured an upper cabin, making it the first double-decked ferryboat in New York Harbor (Cotterell 1978). The wooden housing built to enclose the walking beam gave the boat a lumpish appearance, hence the name. Another Staten Island ferry was the *Southfield*, built in 1857 for the New York and Staten Island Ferry Company's route from Staten Island to Manhattan by way of New York Harbor. The wooden double-ender was 200 by 34 feet, with an overall deck length over guards of 210 by 50 feet. The first 30 feet of hull at each end consisted of solid timber for navigating through ice floes in winter. She was converted to a gunboat by the U.S. Navy during the Civil War (Spirek 1993).

The 700-ton *Atlantic*, 177 feet long with a overall deck length of 190 feet, had a beam of 32.5 feet. Built in 1857, the New York Times called *Atlantic* the "largest and most perfect ferry-boat ever constructed" (*NYT*, January 21, 1858). The *Atlantic* featured a hull designed to plow through ice (*NYT*, August 12, 1857).

Another boat, *John S. Darcy*, also built in 1857, measured 191 feet in length, 33 feet in beam, and 11 feet in depth, and "became the largest ferryboat in the New York City area during this time" (Spirek 1993:33). Because some ferries serviced less-traveled locations, many were small. The ferryboats *Ethan Allen* and *Commodore Perry* (527 tons) measured 144 feet in length and 33 feet in beam (Franklin Institute 1859).

The New Jersey Railroad and Transportation Company operated *John P. Jackson* for ferry service between Jersey City and New York City. The 860-ton vessel, built by the Devine M. Burtiss Shipyard, measured 192 feet end to end, with its deck measuring 210 feet stem to stern. The ferry had a 36-foot beam, a 12-foot depth, and a draft of 5 feet 5 inches. The frame was of white oak, chestnut, and other hardwoods fastened together by copper spikes/bolts and treenails. Its single-cylinder, vertical-beam engine measured 46 inches with an 11-foot stroke. The paddlewheel had a 21-foot diameter and featured 18 buckets (Cudahy 1990; Franklin Institute 1860).

The archetypal ferryboat design established by Fulton and Stevens changed little over the years. Most builder concerns centered around keeping foot passengers separated from wagons and other cargo. Early configurations accommodated wagons near the center of the boat; enclosed cabins provided passenger room and space. Later ferryboat construction kept this configuration, but added a cabin above the main cabin (Grava 1986). An 1880 description of a double-ender states:

> The ferry-boats of New York are double-enders, sharp and swift, with side wheels, the deck highest amidships and dropping about 2 feet at the ends in a gradual curve. They are all of one general type,

varying only in size. The machinery is stowed away in the hull as much as possible. The engine is low-pressure condensing, is often built with horizontal cylinder and piston, has a long stroke, and acts quickly. A narrow house rises in the center of the deck to shelter the machinery and cover the stairways to the hold, and on each side of this the deck is open for 10 feet, in order to allow horses and wagons to pass from end to end of the boat. The cabins for passengers are outside of the two gangways, one on each side of the boat, and extend two-thirds of the length, each cabin being in turn divided nearly in two by the wheel-house, which rises through it and leaves only a hallway 3 feet wide between the forward and after halves of each cabin. A roof covers the whole of the cabin, engine-house, and spaces between for teams, and the pilot-houses are on this roof, one at each end of the boat. A portion of the deck at each end is clear of structures of any kind, except the posts and chains needed to prevent the passengers and teams from crowding each other overboard while in the stream. These boats are an important feature of the business life of New York city. They run across the North and East rivers at numerous points, and from the city to Staten Island, day and night, at intervals of from 5 to 30 minutes, according to the magnitude of the travel on each particular route. A large boat will carry 400 passengers and about 50 teams with wagons on a single trip. In construction of this class of boats the New York builders have attained special excellence. The hulls are strongly but lightly framed with oak and chestnut and planked with oak, yellow pine being used for the rest of the vessel except the houses and the decking, which are of white pine and spruce, with cherry, black walnut, etc., in the joiner work of the cabins. They cost from $50,000 to $90,000 each, according to the size of the hull and the luxury of the cabins. The Jersey ferry-boat *Princeton*, of 888 tons, built in the census year, was one of the large class. She was 192 feet long, 36.5 feet beam, and 12.5 feet deep in the hold, and to build her it required 52,000 feet of oak, and 10,000 fee of chestnut, 103,000 feet of white pine and spruce, and about 10,000 feet of yellow pine. Her machinery weighed 130 tons. Complete the boat cost $85,000 [Hall 1884:162].

Iron straps provided longitudinal support for most wooden-hulled, shallow-drafted ferries. Copper fasteners, commonplace by the 1860s, held strakes below the waterline together, while iron fasteners served the same purpose above. At either end of the hull was a rudder, and depending on the direction traveled, one rudder acted as a bow, locked in place with a lock-pin, while the other acted as the steering rudder and provided direction (Spirek 1993).

Winter ice created hazards for the pilot and his boat. Fulton and Stevens had some success with ice, each approaching the hazard differently. Fulton placed the paddlewheel in the center of the two hulls, but ice between the hulls created handling problems. Stevens' single-hull configuration pushed the ice out of the boat's path, and if caught between ice floes, compressed the ice downward, away from the hull. As a safety feature, Stevens placed cork inside the hull for buoyancy (*NYT*, December 12, 1857).

Boats operating in the harbor faced another hazard: marine borers. Coppering, or sheathing, protected the hull from borer infestation. The combination of sheathing, pitch, horse hair, cloth, or other materials extended the life of the vessel's hull. Ferryboat coppering usually occurred several months after construction was completed, allowing for exterior strake expansion. "It is customary not to copper them [ferryboats] until they have been in service for six months" (Franklin Institute 1860:291). Sheathing could then occur without strain or tear by further expansion.

Vertical-beam engines powered most early double-ender ferries. But because space in the hold of a double-ender was of little value and deck room was critical, the inclined marine engine, which occupied the hold and left more deck room, was accepted by many ferry companies for later vessels. However, in the late nineteenth century the walking beam engine still remained the more usual type.

The inclined engine was designed in 1839 by Charles Copeland, its patent issued in 1841. The placement of the inclined engine in the hold affected the beam-to-width ratio of inclined versus walking beam engine vessels, with the former being much beamier (Hall 1888:64). The engine and frame of an inclined engine are presented in Figure 16. Describing this figure, Copeland's patent of one engine states:

The cylinders in this arrangement of the engine are inclined at an angle dependent upon the depth of the hold and the length of stroke, and they are fastened to inclined beams extending from the paddle-wheel shaft to the keelsons, said beams being connected with the keelsons along their whole length by other beams and by bolts, the whole constituting truss-frames, which may be of wood or iron, which sustain and divide the weight and jar of the engines [Hall 1888:38].

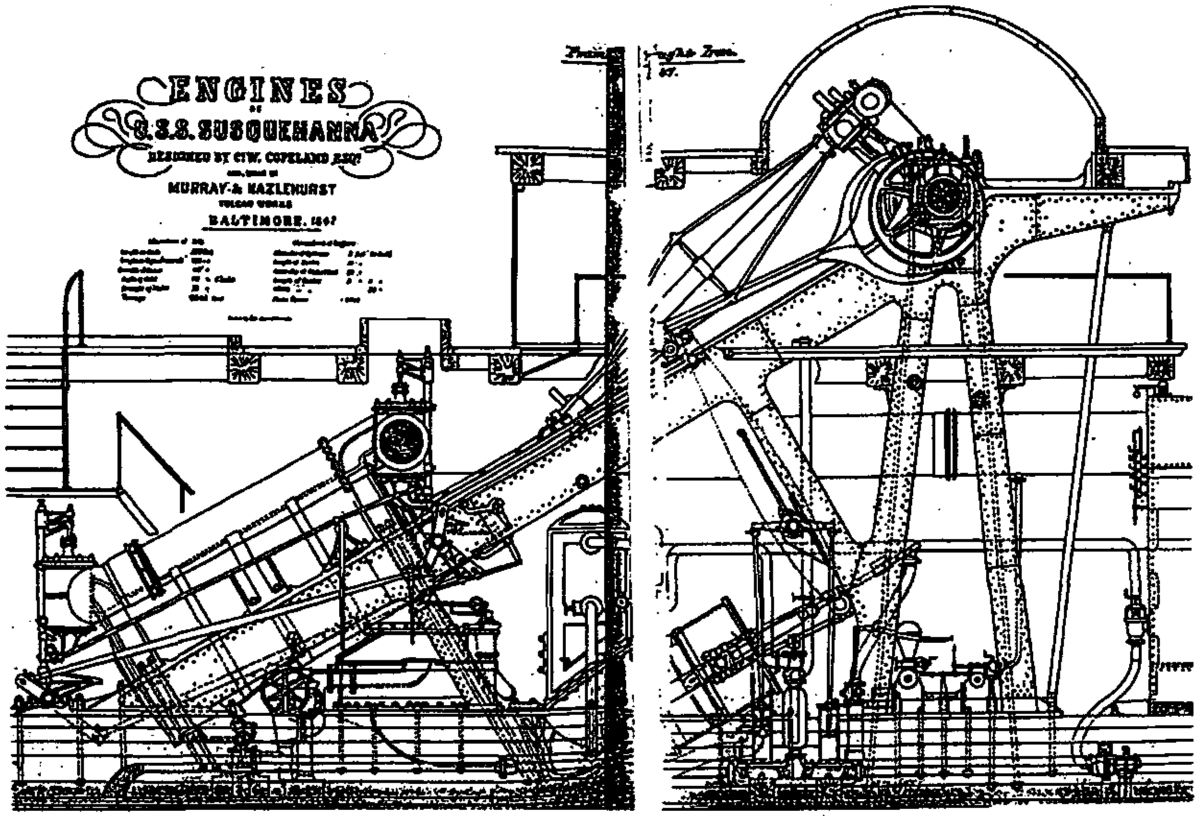

Figure 16. Inclined marine engine developed by Charles Copeland in 1839. The majority of the engine rests below the level of the main deck (as presented in Hall 1888:Figure 13).

Boiler locations varied from boat to boat, some positioned deep in the hold, others located near the paddlewheels. Wood originally provided heat for steam, though coal replaced it as a primary heating source in the early 1830s (Cotterell 1978). As one would suspect with wooden vessels, fire proved an immediate danger during operation. The *Williamsburg* ferry, operating between Manhattan and Williamsburg, Brooklyn, "adopted...every precaution...to guard against fire, the boilers being quickly felted, and the decks and wood-work around the boilers and chimneys protected by facings of zinc" (*NYT*, January 21, 1858). Fire protection for most ferries probably mimicked the *Williamsburg* vessel.

As passenger traffic increased, builders in the 1850s included a second cabin above the main cabin. This addition commonly appeared on long-distance service, i.e., Staten Island ferryboats. The promenade, or upper deck, supported the upper cabin and the fore and aft pilot house, and provided additional passenger space. The hurricane deck sat atop the promenade deck cabin. Generally, three pilot house patterns appeared in New York City. A freestanding circular house and a freestanding square house usually appeared on single-decked ferries. A rectangle backed by an upper cabin is normally associated with double-decked boats (Spirek 1993).

The general configuration of New York City ferryboats remained the same for decades. Until the late nineteenth century, most were sidewheelers, the propeller models appearing in the 1880s (Delgado and Clifford 1991:37). Design evolution focused on increased size and space. Never as ornate as Hudson River or Long Island Sound steamers, these boats provided ferry service to thousands of commuters. The design is still visible in modern-day ferries.

TUGBOATS

The tugboat, as a distinct vessel type, dates back to Scotland with the construction of the *Charlotte Dundas* (1801) for towing barges on the Forth and Clyde Canal (Moran and Reid 1956:9). The Staten Island ferry *Nautilus* inaugurated the modern towing and tugboat industries in the United States on January 26, 1818, when she towed the sailing ship *Corsair* through the ice-choked lower harbor of New York from one mile below the Narrows to the quarantine dock. Other vessels quickly followed. In 1825, the woodburning sidewheeler *Henry Eckford* towed Hudson River barges from New York to Waterfront, the eastern terminus of the Erie Canal (Cleary 1956:44). In port, *Henry Eckford*'s crew docked and undocked sailing vessels. From that time on, towing became a part-time concern for many steamers operating in and around the harbors of the United States until it grew to be its own industry. By 1880, there were more than 1,800 tugboats operating in different parts of the country, chiefly in the seacoast harbors and northern lakes (Albion 1939:147).

Sidewheelers mobilized the towage service almost exclusively in the first half of the nineteenth century, guiding windbound whaling vessels, produce barges, and rafts of canal boats through or into the harbor. The forerunner to today's tug, the workhorse sidewheeler marked an evolution in steamboat design that significantly contributed to New York's lighterage system. Many of the first vessels employed in towing were converted passenger ferries. Illustrated in Figure 17, the *Norwich* was built in 1836 as a passenger vessel, and later was employed on the Chesapeake as a packet and between New York City and Rondout as a nightboat (passenger service). She ran as a towboat on the Hudson until 1917, and in 1923 was sold for scrap.

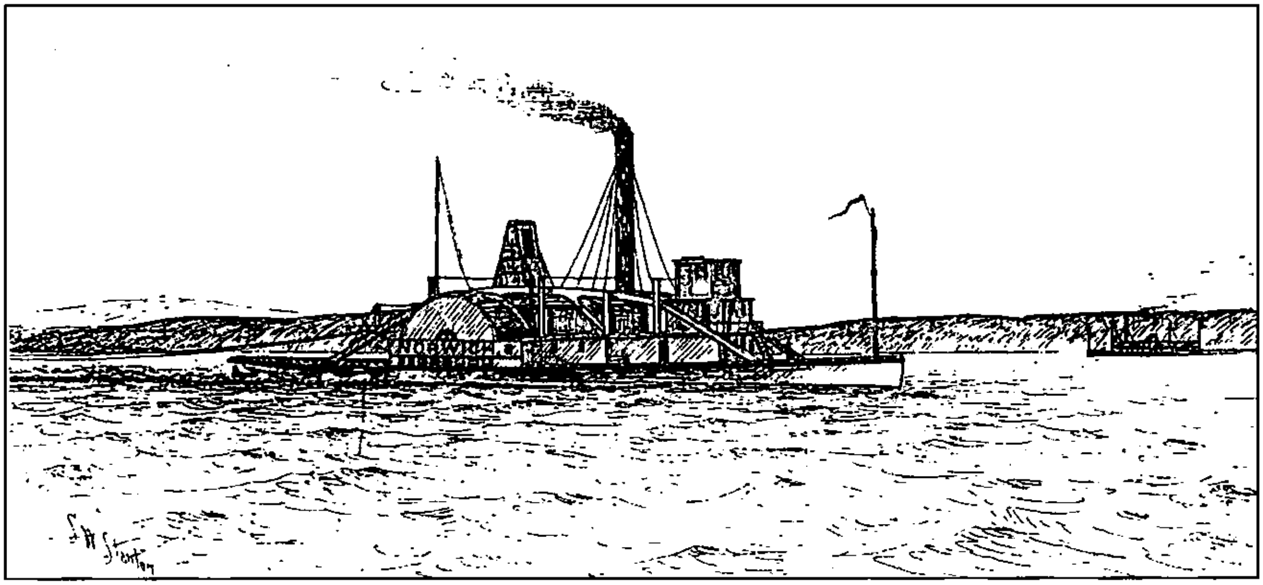

Figure 17. Representation of the *Norwich*, a 160-foot former passenger steamer employed for towing (as presented in Swanton n.d.). Note the vessel's crosshead engine.

In 1828, the New York Harbor Dry Dock Company built the first boat designed solely for towing in the Port of New York, the sidewheeler *Rufus B. King* (Cleary 1956). The hulls of these first towing vessels kept the lines of the passenger steamer, with its fine entrance and low freeboard. They also employed the same engine types, with the walking beam becoming the predominant later type.

With the first appearance of the propeller-driven vessel, the evolution of the towboat began. The unwieldy paddleboxes disappeared, and the hulls became shorter and narrower. A standard tugboat profile developed, featuring a long, narrow, one-story deckhouse. The wheelhouse appeared at the forward end, raised a few steps above the deck, or stacked on top of the deckhouse on smaller boats. Main decks developed a noticeable sheer, rising higher at the bow than the stern. Heavy moulding ran along the sides at deck level to withstand the constant buffeting by barges or car floats (Brouwer 1990:182-183).

Records suggest that the iron tug *R.B. Forbes*, of Ericsson design, appeared as early as 1845 (Hall 1884). The tug, twin-screwed, registered about 300 tons, its size apparently adapted for rough water work. Screw-type tugs later appeared in Philadelphia in 1849 (Hall 1884). Apparently an owner of two old paddlewheel towboats in the city saw the advantage of propeller tugs in the harbor. William Cramp of Philadelphia built the first propeller-type tug, *Samson*, on the Delaware River. The wooden-hulled vessel measured 80 feet in length, 17 feet in breadth, with a draft of 8 feet.

The success of the *Samson* drew a great deal of attention. Cramp departed from the idea of an entirely submerged screw, instead outfitting *Samson* with a 6-foot wheel, half of which remained below the hull, a 3-foot keel protecting the screw (Hall 1884). A number of boats featured this configuration. The need for a light-draft vessel led to the removal of the broad keel, the wheel placed entirely above the bottom of the vessel. "This boat proving to be as efficient as its predecessors and much more handy, a revolution was effected in the form of tugs" (Hall 1884:149).

By the late 1800s, propeller boats replaced the big sidewheel towboats. The construction of these new vessels called for heavier scantlings, with bigger frames, closer frame spacing, heavier fasteners, and thicker planking. Hall describes an average steam screw propeller tug of the late nineteenth century:

> The tug of our American harbors is a little propeller varying from 30 to 120 tons register. A few of large size range from 130 to 170 tons register, but the average tug is of about 80 tons, and is about 90 feet long, 18 feet wide on the beam, and 9 1/2 feet deep in the hold. One of 170 tons would be 120 feet long, 22 feet beam, and 12 feet deep in the hold. The hulls of the tugs are sharp and deep, but not long, and float at about 8 feet draught, drawing a foot or two more aft than forward. Those that go out into rough water are given a good deal sheer forward. The stems are perpendicular; the sterns are round and overhang from 6 to 10 feet. Although these little vessels sit low in the water, the deck being not more than 2 or 3 feet higher than the load-line, the bulwarks are always low. A house covers the machinery, which is placed amidships, and the pilot-house is either at the front of this cabin or on top of it at the forward end. Strong towing bitts are placed forward and aft of the house [Hall 1882:149].

By the 1920s and 1930s, most of the old steam wooden tugs and towboats had been converted to diesel. In addition to technological improvements, diesel propulsion offered economic benefits. In 1923, for example, the Moran Company converted their steam-driven 107-ton tug *Eugenia M. Moran* to diesel. With her new self-contained 2-cycle, 4-cylinder diesel engine, the *Eugenia*'s fuel bill was reduced approximately 50 percent in just one month. Over the course of a few months the *Eugenia*'s monthly savings in operational expenses ranged from $490 to $825 per month (Moran and Reid 1956:1965).

The final technological development signaling the end of steam-driven wooden tugs was the introduction of the welded steel hull. Although riveted iron or steel tugs developed in the late 1800s, the welded steel hull did not achieve prominence until the 1930s.

Tugs are generally divided into two categories, harbor or short-haul tugs and oceangoing or long-haul tugs. These in turn have their own varieties.

Carfloat Tugs

Among the larger propeller-driven harbor tugs are those specifically designed for moving car floats across the Hudson River and the Upper Bay. The upper deck wheelhouse, elevated 3 or 4 feet by an additional crawl space underneath, gave pilots greater visibility over a car float loaded with standard freight cars. The *New York Central No. 27*, built in 1910, was a typical example, measuring 97.5 feet in length and 25.6 feet in breadth, with a depth of hold measuring 12.2 feet (Brouwer 1996).

The *Newark*, built at Elizabethport, New Jersey in ca. 1916, served as a carfloat tug for the Central Railroad of New Jersey. The steel-hulled vessel measured 110 feet overall, with a molded beam of 26 feet and a depth of hold measuring 14 feet, 6.5 inches. The lower and narrower after part of the deck house provided an unobstructed view of the stern from the pilot house (Figures 18 and 19).

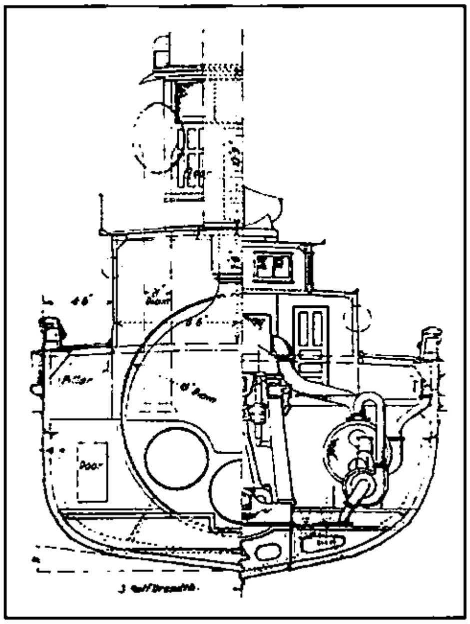

Figure 18. Midship section of the tug *Newark* (as presented in Norton 1916).

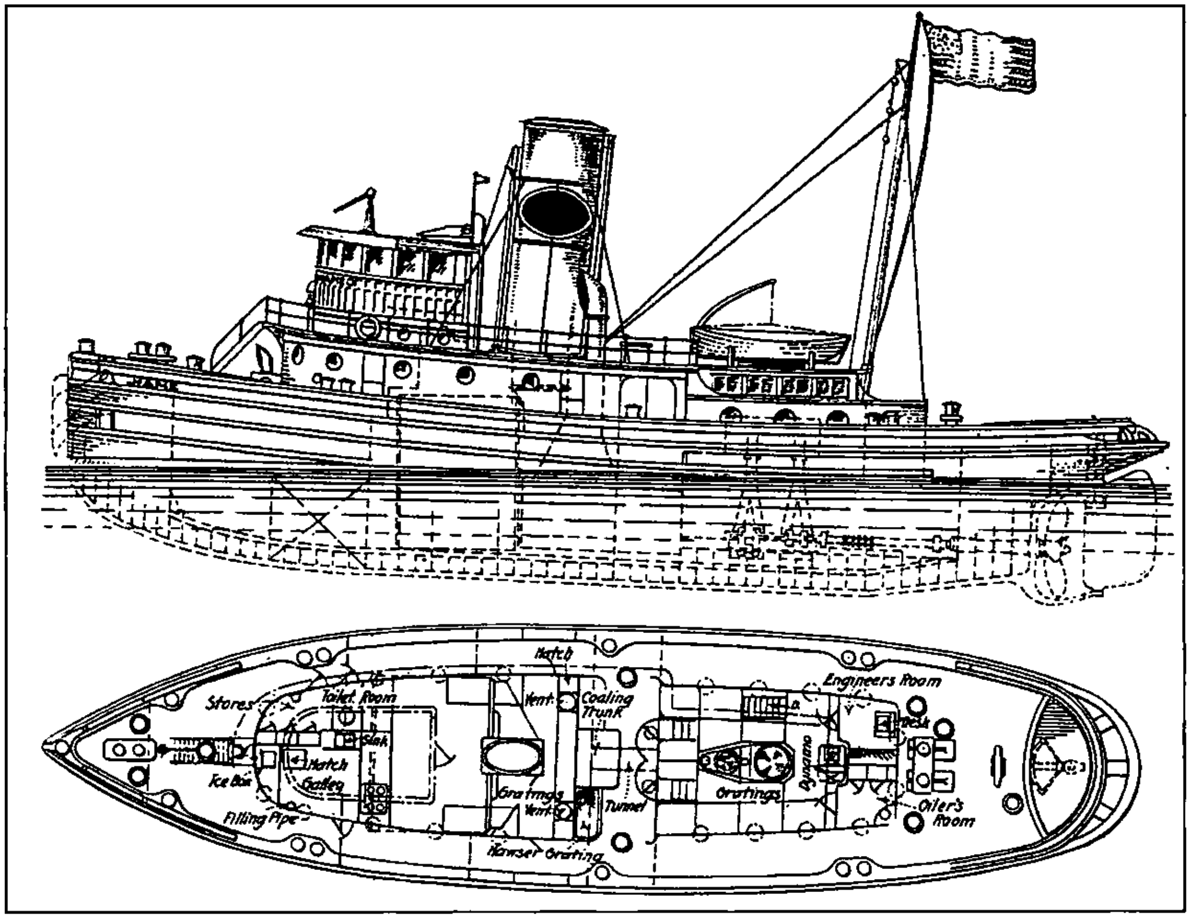

Figure 19. General arrangement of the iron-hulled *Newark* (as presented in Norton 1916).

Canal Tugs

After the completion of the New York State Barge Canal in 1921, goods were brought to the Port of New York from as far away as Buffalo in barges towed behind tugs. Because of height restrictions, the tugs used were long enough to accommodate the powerful engines required, but they also had a very low profile. Wheelhouses were again lowered to the main deck at the forward end of the deckhouse. Many canal tugs featured hydraulic systems for raising their pilothouse where heights were not restricted.

Offshore Tugs

The largest class of tugs moved coastwise barges, particularly the long strings of schooner barges that transported coal from New York and points south to ports in New England. Both wooden and steel-hulled, characteristics of this "seagoing" type are a series of steel-hulled boats built for the Reading Railroad around the turn of the century. One of these, *Catawissa* (1896), survives as a steam-cleaning plant based in Mariner's Harbor, Staten Island. The steel-hulled boat measures 158 feet by 29 feet breadth, with a depth of holding measuring 18 feet. Engines rated at 1,000 hp powered the boat. The seagoing tug featured a profile typical of tugs, but with two masts forward and aft (Brouwer 1996).

Often employed in the offshore towing of schooner barges, the size of the offshore tug and its horsepower determined the number of barges the pilot could tow. Bigger tugs, with a pulling capacity in excess of 400 hp, could tow three or more loaded schooner barges. Increased pulling power, larger loads, and stress on the bitts required a greater towing distance between barges. The greater the distance, the greater the probability for problems, especially during bad weather.

Wooden Harbor Tugs

The Emergency Fleet Corporation and the Consolidated Shipbuilding Corporation, formerly the Gas Engine & Power Company, built four 100-foot wooden harbor tugs for the USSB at Morris Heights, New York. J. Murray Watts, naval architect, Philadelphia, Pennsylvania, designed the boats. With lines similar to usual harbor tugs (100 feet), the American Bureau of Shipping rules for wooden tugs presented the following specifications (International Marine Engineering 1919):

Keel:	white oak, sided 12 in. and molded 13 in.
Stem:	white oak, sided 11 in. and molded 14 in.
Stern post:	white oak, sided 11 in. and molded 14 in.
Frames:	white oak, sided 6 in. double
Keelson:	12-by-12-in. yellow pine in long lengths with scarfs not less than 6 ft. long
Shaft log:	white oak in halves, 10 by 24 in.
Deadwoods:	white oak, sided 18 in. and molded back to receive the frames
Bottom ceiling:	yellow pine 3 in. thick
Side ceiling:	ceiling between the bilge strakes and the clamps $3\frac{1}{4}$-in. yellow pine
Clamps:	yellow pine 6 by 10 in., three strakes on each side in long lengths, scarfed
Shelf:	yellow pine, two strakes 5 by 9 in., lock strake 5 by 10 in., in beam 1 in.
Deck beams:	main beams yellow pine sided 11 in. and regular beams sided $8\frac{1}{2}$ in.
Knees:	white oak or hackmatack
Outside planking:	side and bilge planking $3\frac{1}{4}$-by-8-in. yellow pine
Sheer strakes:	three sheer strakes 4-by-10-in. yellow pine, fastened with $\frac{7}{16}$-by 8-in.galvanized spikes
Deck planking:	3-by-3-in. Douglas fir or yellow pine
Plank sheer:	white oak 4 by 14 in., let down over the stanchions and fastened with $\frac{7}{16}$-by 8-in. galvanized spikes
Rudder:	the rudder stock and main piece to be of the best steel casting; blade and balance made of oak
Shoe:	cast steel shoe for rudder
Water tanks:	either stock steel tanks or independent wooden tanks
Steel bunker bulkheads:	non-watertight steel bunker bulkheads; steel bulkhead forward of the boiler
Outboard joiner work:	the entire hull, decks, and rails well planed off smooth and fair
Wood deck house:	yellow pine; the top of the deck house made of Oregon pine, felted and covered with No. 6 canvas
Pilot house:	yellow pine

By 1920, 42 of these tugs were built according to Murray's design. Figures 20 and 21 show midship section and general arrangement plans of a typical 100-foot tug (International Marine Engineering 1920). The boats were wooden built with oak frames (8 by 12 inches) and hard pine planking. The keels were oak, measuring 12 by 15 inches. The overall length of the tug was 100 feet 8 inches. The keelsons were built of 11-by-12-inch hard pine.

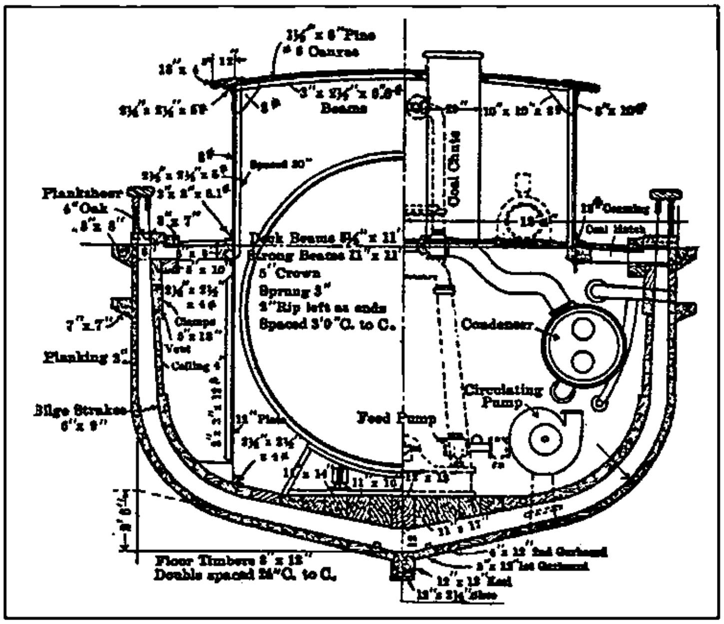

Figure 20. Midship section of a 100-foot wooden tug, circa 1920 (as presented in International Marine Engineering 1920).

Steel-Hulled Tugs

The Central Railroad of New Jersey had two tugs built "which embody new features and improvements which have been brought about through experience with former tugs..." (Norton 1916:56). Norton (1916:56) provides the following principal dimensions for the tug *Bethlehem*, built by Staten Island Shipbuilding Company for lighterage service:

Length of deck	98 ft. 0 in.
Beam, molded	24 ft. 0 in.
Depth, molded	12 ft. 7 in.
Draft, loaded	11 ft. 0 in.
Displacement	about 320 tons

Except for size, the general arrangement of the other tug, the steel-hulled *Newark*, remained the same. Used for the carfloat service, *Newark*'s dimensions measured as follows:

Length overall	110 ft. 0 in.
Length between perpendiculars	97 ft. 9 in.
Beam, molded	26 ft. 0 in.
Depth, molded	14 ft. 6.5 in.

In designing the tug, builders made sure of interior accessibility, primarily for painting and scraping. As witnessed in the profile, the forefoot and deadwood aft is cut away, enabling the tug to turn full circle within a short radius. The tug is fitted with a side-plate balanced rudder. Reverse frames, continuous athwartship, follow the top of the floor plates only. They are doubled in the engine room (Norton 1916).

The fitted keelson extends from the collision bulkhead to the after-end of the engine room. Longitudinal strength is provided by side keelsons and stringers, "the side stringer being deep and formed of intercoastal plates and clips, between frames, with a continuous angle along the outside of the frames" (Norton 1916:57).

The bulwark section aft is set in, cast steel protecting three fitted chocks. This sequence minimized the breaking of bulwarks. The space between the first and second fender guards is filled with solid wood from the stem to amidships, reducing damage to the hanging fenders. The deck is steel, covered with "litosilo" (Norton 1916:57). The after part of the deck house is narrowed and lowered to allow an unobstructed view of the stern from the pilot house.

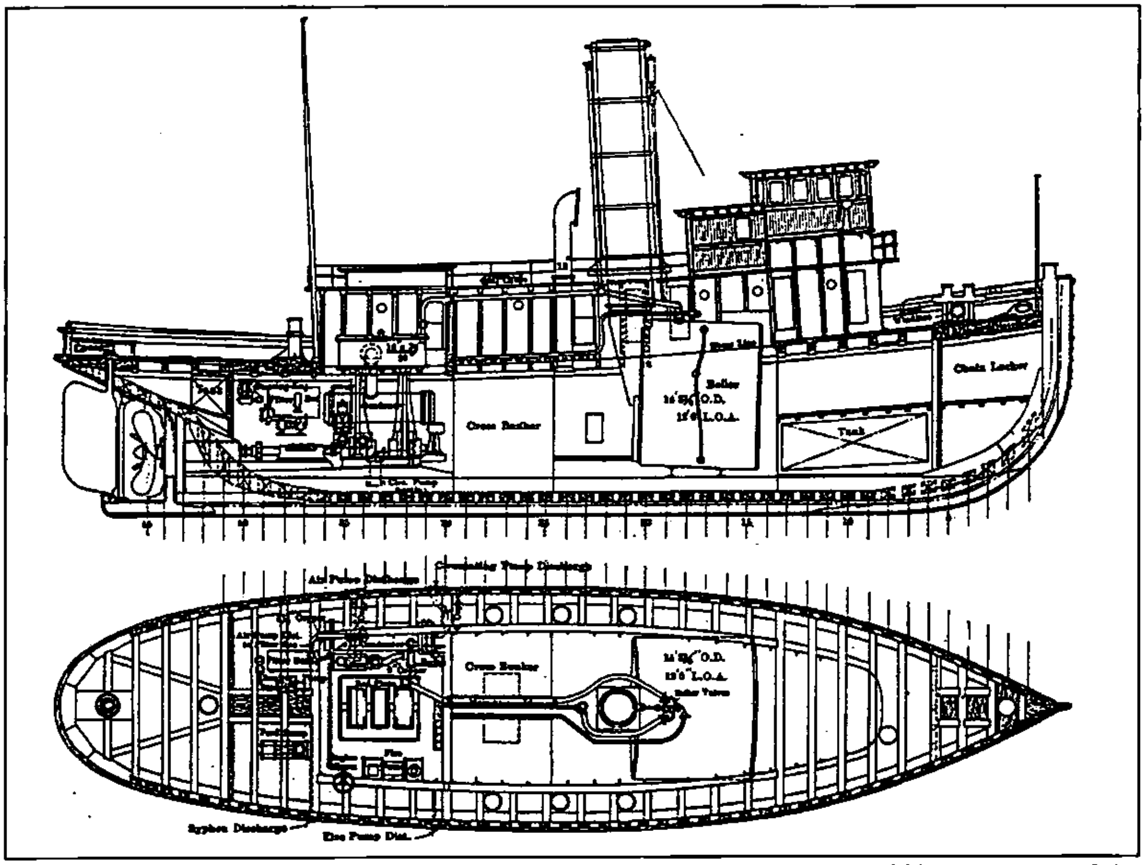

Figure 21. General plan and profile of a 100-foot wooden tug, circa 1920 (as presented in International Marine Engineering 1920).

World War II Tugs

The Army operated several thousand tugs during WWII. The tugs fit into four broad categories: (1) seagoing or large tugs designated as LTs (usually 92 feet or longer); (2) harbor or small tugs, designated STs (about 52 to 92 feet in length); (3) motor towing launches, known as MTLs (40 to 54 foot length); and (4) motor towboats or marine tractors, designated MTs (less than 40 feet) (Grover 1987). The measurements presented here are general. Several older vessels designated STs by the Army measured longer than 100 feet, while the MTL size often received ST designation.

Oceanic military operation and transportation during and after the Spanish-American War increased the need for tugs and towboats. By the turn of the century, Army tugs fell under the jurisdiction of the Quartermaster Corps. In 1909, the Army built four ship-class 98-foot tugs. Towboat construction preceded this class (Grover 1987). Early tugs featured War Department designations "Passenger, Auxiliary or Artillery, and Freight" vessels. These boats served in various capacities.

The Army operated a number of tugs in WWI (Grover 1987). These boats, built to various size specifications, included the oceangoing tug, which towed barges to Europe. During peacetime, the Army's tug fleet remained stagnant. However, WWII in Europe expedited U.S. naval construction. The pre-WWII buildup included tugboat construction, particularly harbor tugs. These workhorses assisted in the movement of ships and lighters at embarkation ports. The Army tried several designs, building one or two tugs in each class, finally deciding on the previously mentioned basic types in 1943 (Grover 1987).

As plans for European invasion and amphibious Pacific landings materialized, the Army ordered hundreds of tugs in each size. By the end of the war the Transportation Corps determined that 746 tugs operated under the designation LT or ST, 1,065 tow launches were designated MTL, and 1,113 were designated marine tractors or MTs. One hundred sixty-seven LTs or STs, 287 MTLs, and 295 MTs served in the European Theater. In the Southwest Pacific, 171 STs and LTs, 260 MTLs, and 180 MTs served (Grover 1987).

The Harbor Boat Branch of the Transportation Corps usually operated the tugs, though late in the war some fell under jurisdiction of other departments, particularly oceangoing tugs. The Coast Guard provided crews for most of the live-aboard LTs. Civilians generally operated the STs. Both civilian and military personnel crewed smaller harbor boats, usually day boats (Grover 1987).

FLOATING DRY DOCKS

The floating dry dock is generally considered an American invention. It is basically a large floating structure, "so large that it can not only float itself, but the largest vessel for which it is designed" (Donnelly 1905:312). Donnelly (1905:316) suggests that the design (Figure 22) originated from "the wreck of an old hull laying on some slope beach, which was used by cutting out the stern and making gates to close the opening...similar to...a canal lock." The United States issued a floating dry dock patent to J. Adamson in 1816. In 1849, Abraham Lincoln invented a hollow structure designed to provide extra buoyancy for vessels in shallow water (Figure 23). The United States government issued a patent for the design, but apparently nothing ever came from it.

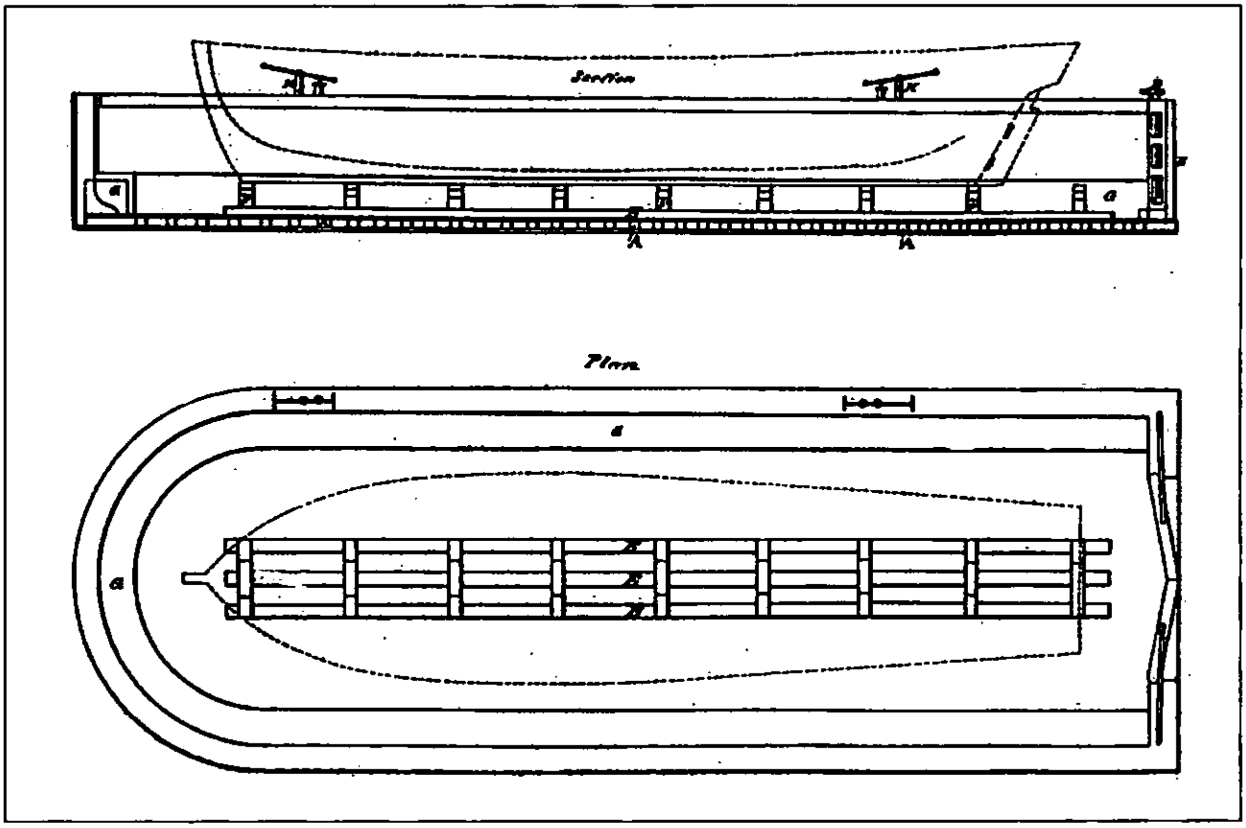

Figure 22. First U.S. floating dry dock patent issued to J. Adamson in 1816 (as presented in Donnelly 1905).

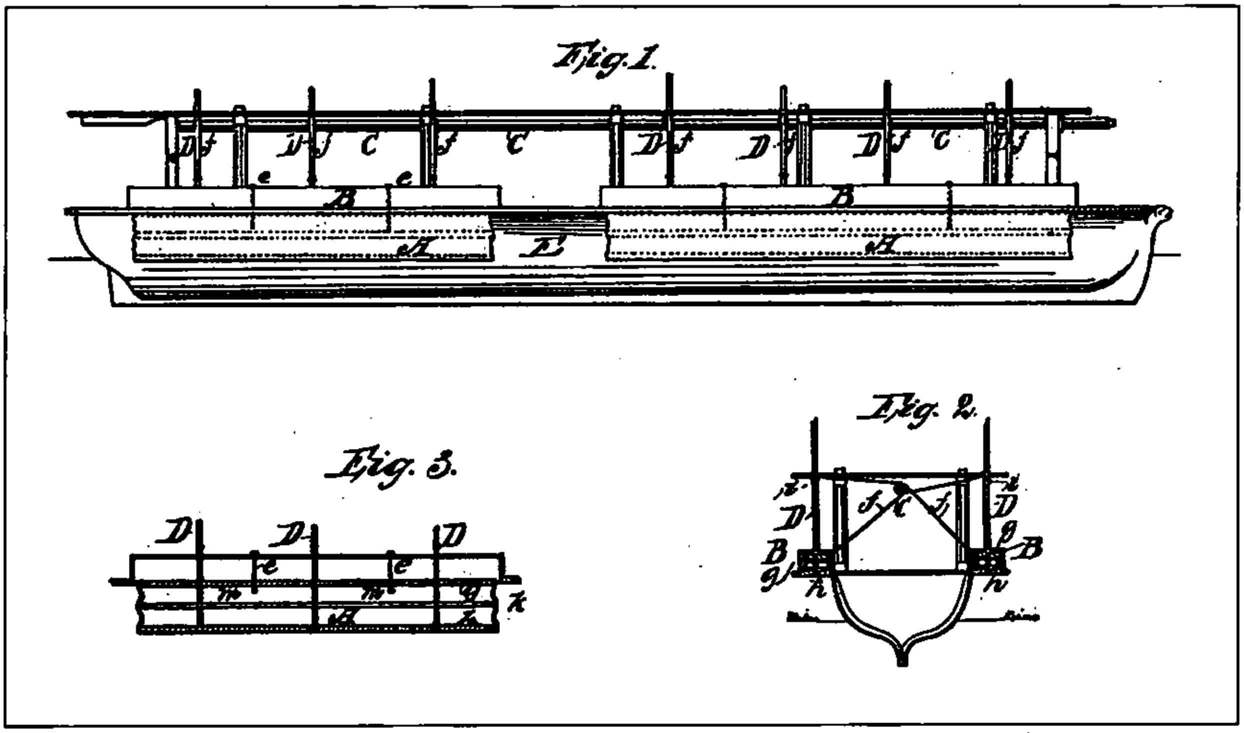

Figure 23. Floating dry dock patent issued to Abraham Lincoln (as presented in Donnelly 1905).

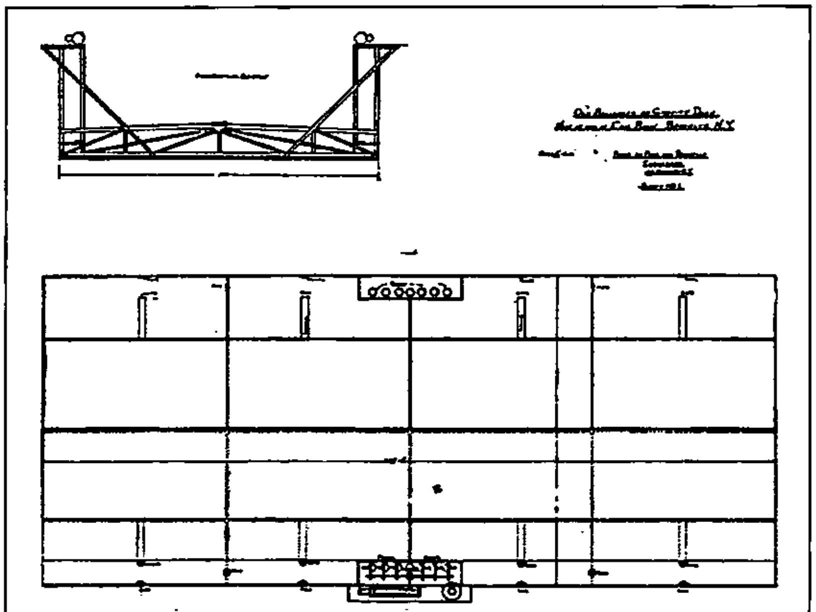

Fig. 4.—Old Balanced or Gravity Floating Drydock.

Figure 24. Old balanced or gravity floating dry dock (as presented in Donnelly 1905).

The Brooklyn Erie Basin dry dock, built 1845-1850, was in 1905 the oldest and largest known wooden dry dock (Donnelly 1905). Known as the old balanced or box dock, the structure (Figure 24) measured 330 feet long by 100 feet wide. Managing the combined weight of dock and vessel proved difficult. To compensate, builders connected smaller sectional docks together with locking logs.

The next development of dry dock construction, the early sectional dry dock (Figure 25), provided alignment stability while restricting the amount of motion between sections. The sway between sections required some means of flexible power from one section to another. For this purpose, designers invented a double universal joint, with a slip or extension joint between. The design, wrought with complications, proved popular. Built with three to seven 25-foot sections, the structure measured 200 feet in length.

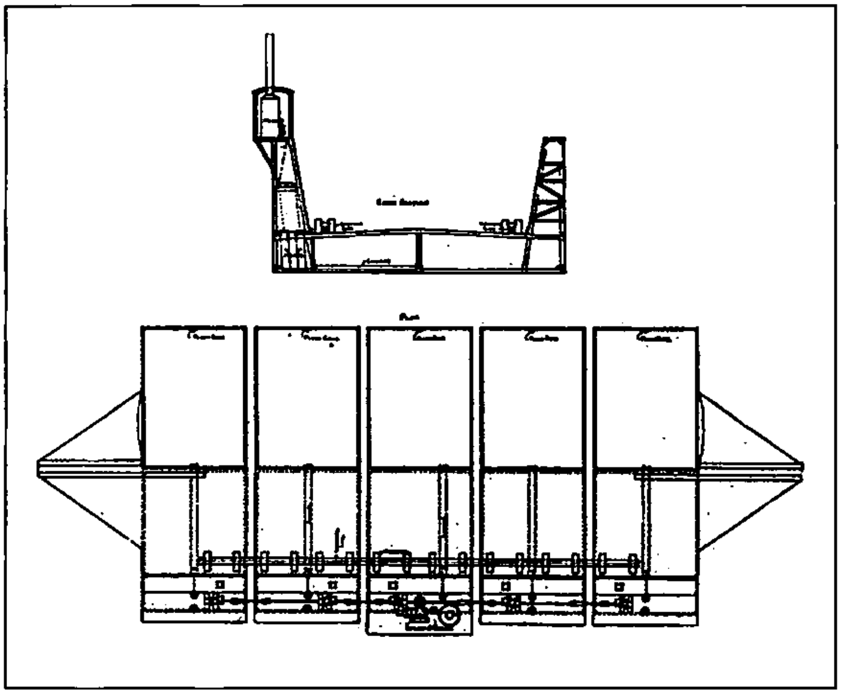

Figure 25. Old sectional dry dock style (as presented in Donnelly 1905).

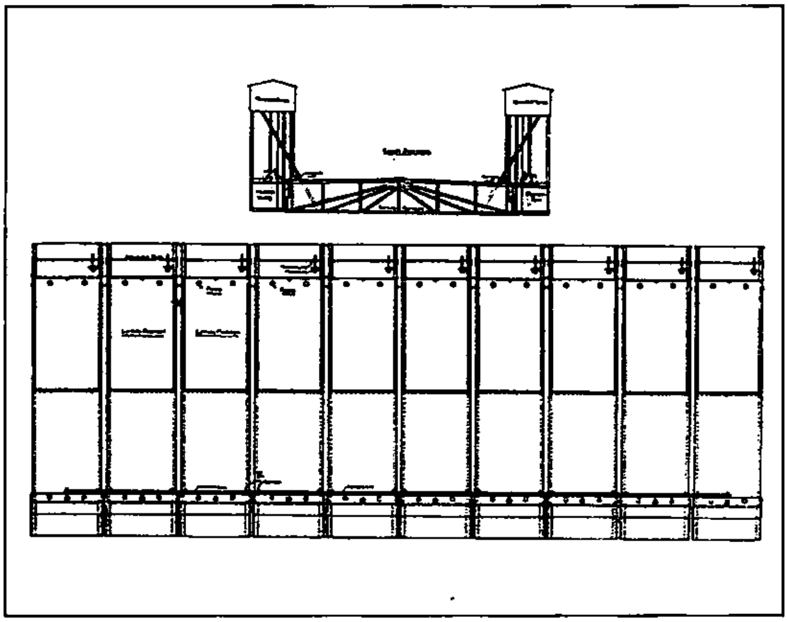

Figure 26. Dodge-Burgess sectional floating dry dock (as presented in Donnelly 1905).

The Dodge-Burgess sectional floating dock (Figure 26), patented in 1841, generally featured 10 pontoons. Connected by a locking log, the dock lost the wings typical of the earlier (and later) sectional dry docks. The framework's roof housed pumping machinery. The framework fastened to the central pontoon, lifting or lowering. Power was distributed along the top by a shaft with flexible couplings, in the same manner described for the sectional dock. Two of these docks were located for years near the Catherine Street Ferry (Donnelly 1905:320-321).

Built in one piece, the box or balanced dry dock (Figure 27) represents the next phase in floating dry dock construction evolution. The dock was built as a single rigid structure, and to limit the flow of water from one end of the interior to another, builders added watertight bulkheads, a feature not seen until this point. These cross-bulkheads, "together with the center longitudinal bulkhead, divide the dock into...independent watertight compartments" (Donnelly 1905:322). The pumping machinery was located on one side only. Gates controlled the flow of water from compartments to the pumps, balancing the dock and vessel. The balanced dry dock design appeared near the end of the Civil War and was built through the turn of the century. The smaller sizes, with lifting capacities of 500 to 3,000 tons, were more prevalent.

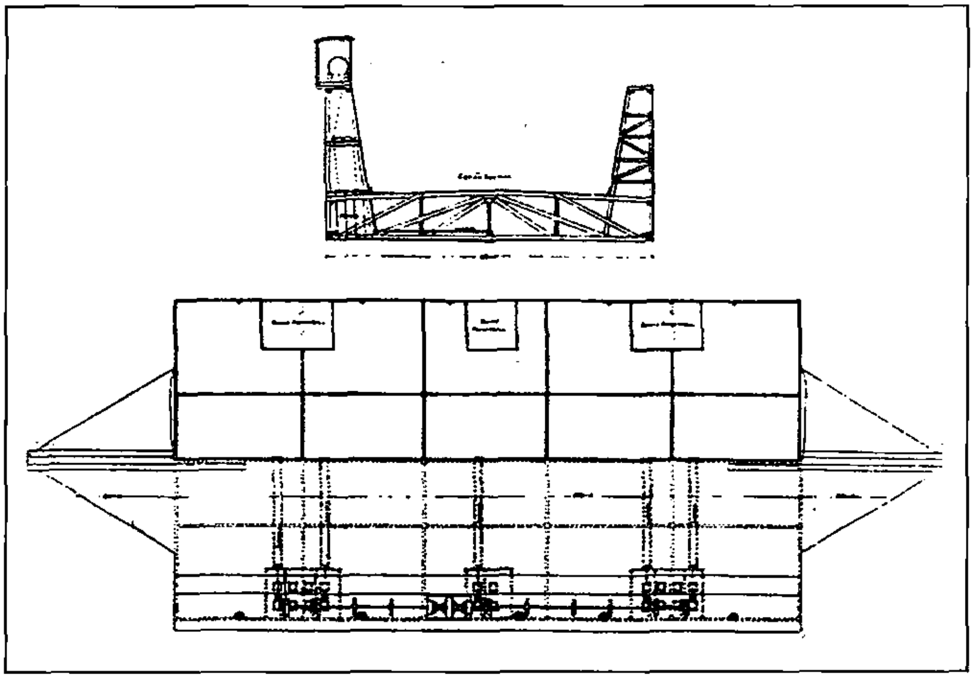

Figure 27. Cross section of the box or balanced dry dock, and a plan view of its pump layout (as presented in Donnelly 1905).

At the turn of the century, the balanced sectional floating dry dock represented the largest development in commercial dry docks. Illustrated in Figure 28, the five-section dock had an overall length of 468 feet, a width of 110 feet, and a lifting capacity of 10,000 tons; the height of the wings could allow vessels with draughts of up to 21 feet. Combining the best characteristics of the two dry dock types in use at the time, the balanced sectional floating dry dock possessed all the advantages of a balanced dry dock, with its cross and longitudinal bulkheads, separate gates, and independent means of admitting and removing water, and the sectional dock, with its freedom from both internal longitudinal strains and self docking. Differing from the balanced dry dock, machinery, in the form of a boiler and an engine, was placed on each side of the pontoon in the wings. Each of the five sections was divided into six compartments, and there were 60 pumps, 12 to a section (Donnelly 1905:322-323). This dock, patented to Frederic Lang in 1900, was significant in its lifting power, and it replaced the Dodge-Burgess Sectional Docks as the dry dock with the largest lifting capacity up to that time. However, the section dry dock would be contemporaneous with the newer balanced sectional type.

There was discussion as to constructing this dock with wood, steel, or a composite. Wood was chosen because it was half the cost. In order to protect the below-water portions from the *Teredo navalis* (a wood-eating bivalve often called the Teredo worm), the bottom was coated with coal tar, sheathed with creosote-saturated hair felt, then covered with one-inch-thick boards (hemlock or spruce) treated with creosote and arsenic (Donnelly 1905).

The complete cross section presented in this illustration shows the identifiable features of the dry dock. It has two wings on either side of and rising above the main float or pontoon. The side wings, wider at the base than at the top, house the pumping machinery, with the pump wells at their base, and the engines and boilers on top. Also water- and air-tight in construction, the height of the wings gives an indication of the maximum ship draughts it could accommodate. The main float platform or water-tight pontoon hull, as stated, was divided into numerous watertight compartments on both the balanced and the balanced sectional dry docks.

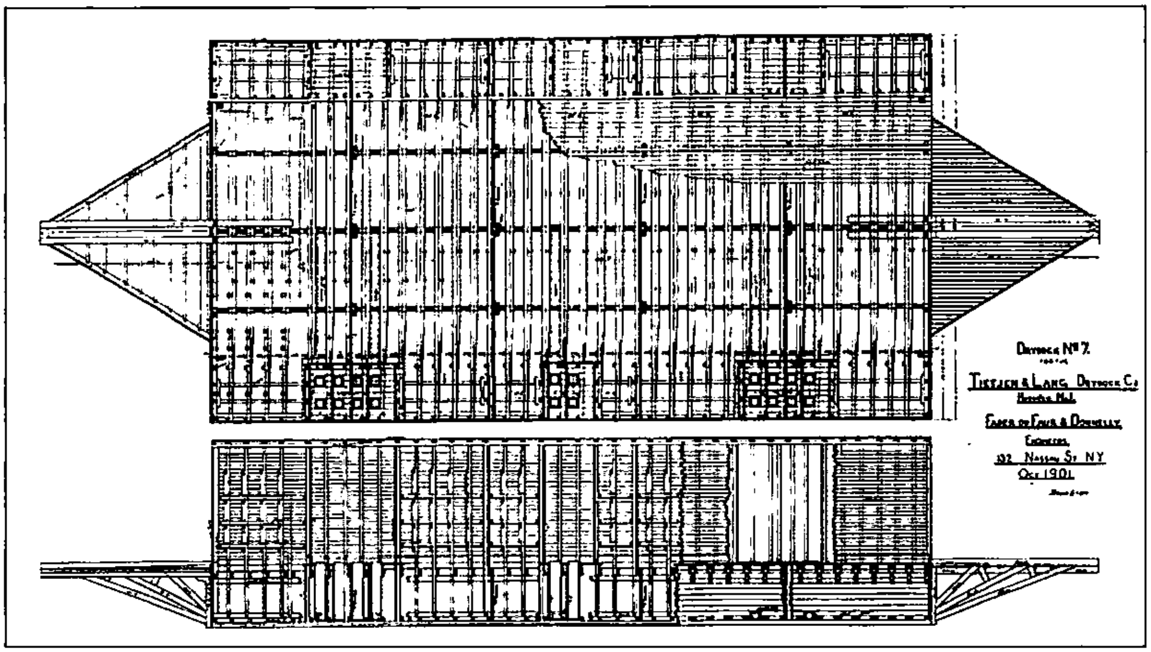

Figure 28. Plan and structural view of a box or balanced floating dry dock designed for the Tietjen and Lang Drydock Company in Hoboken, New Jersey, 1901 (as presented in Donnelly 1905).

In operation, keel and bilge blocks were prepared for the vessel to be docked, and water was let into the pontoon and eventually the wings through flood gates. The dry dock then slowly settled evenly down into the water, the deck of the pontoon (with its keel blocks) submerging to a depth that would allow the vessel to float freely atop the blocks (either motored or towed). At this point, only the wing tops with the machinery protruded from the water. Pumping machinery then slowly removed the water from the pontoon hull, floating both the dry dock and the vessel to be repaired.

WATER BOAT

The water boat supplied fresh and potable water to steamships and other facilities in the harbor. Very little is known about its history, though water boats, converted from steam lighters, served the port into the 1980s (Raber et al. 1996b). Some limited data are available on the water boat *Aqua I* at the South Street Seaport Museum in New York. Initial investigation collaborates Raber et al.'s findings (1996b) in that the vessel exhibits similar design features of a converted steam lighter. There are no known construction details or historic documentation on wooden/steel water boats.

MENHADEN TRAWLER

At the turn of the century, menhaden fish, or "pogie" as they are nicknamed, swam in large schools all along the Atlantic seaboard. Menhaden fishing in the Port of New York, as a profitable industry, began in the 1860s (Erismann 1912). However, initial efforts to develop menhaden as food failed because of its oiliness. Instead, processors derived profits from the fish for use in tanning, paint production, or fertilizer. The first steam-operated oil extraction plants occurred on Shelter Island around 1850 (Brouwer 1996).

A type of herring, the fish traveled at the surface in large schools. Lookouts posted on the mast of the fishing vessel sighted the schools. In describing trawling methods, Martin C. Erismann stated, "a purse seine is shot overboard from a seine boat, two usually carried, one on each quarter; the seine is brought along-side...the fish dipped out and transferred to the fish hold" (Erismann 1912:71). When full, the trawler made speed to the processing factory, where laborers extracted the oil. Once extracted, the remains of the fish became fertilizer. It became a substitute for German potash and bone phosphate.

Erismann (1912) described three boats, *Martin J. Marran*, *Rollan E. Mason*, and *Herbert N. Edwards*, built specifically as menhaden steamers under the direction of Capt. N.B. Church, who was manager of the fishing department, Atlantic Fertilizer & Oil Company. The Boston firm B.B. Crowninshield designed the boats, which were "of the usual type of vessel for this trade, except that they are larger and better equipped..." (Erismann 1912:71). The dimensions measured as follows:

Length overall	165 ft.
Breadth	23 ft.
Draft (loaded)	12 ft. 9 in.
Depth	13 ft.
Indicated horsepower	600
Speed	13 knots
Capacity of fish hold	4,000 barrels

The hulls were wooden; the keel, stern, stern post, and deadwood were made of oak. The framing was white oak; the planking and ceiling were made of hard pine some four inches thick. Bilge strakes are made of hard pine. A steel beam (with large gusset plates) tied the boat together near the boiler. The builders intended to strengthen the top member of the structure with a steel stringer, but "these were omitted owing to possible delay in the date of delivery" (Erismann 1912:71).

A two-story deck house sits forward, and a house is located aft on a raised poop (Figure 29). Part of the after house rests over the engine and boilers (Figure 30). A winch room is located in the forward end. Two large hatches "in the waist" provided access to the fish holds (Erismann 1912:71). Twenty-eight crewmen bunked in the forecastle below the main deck.

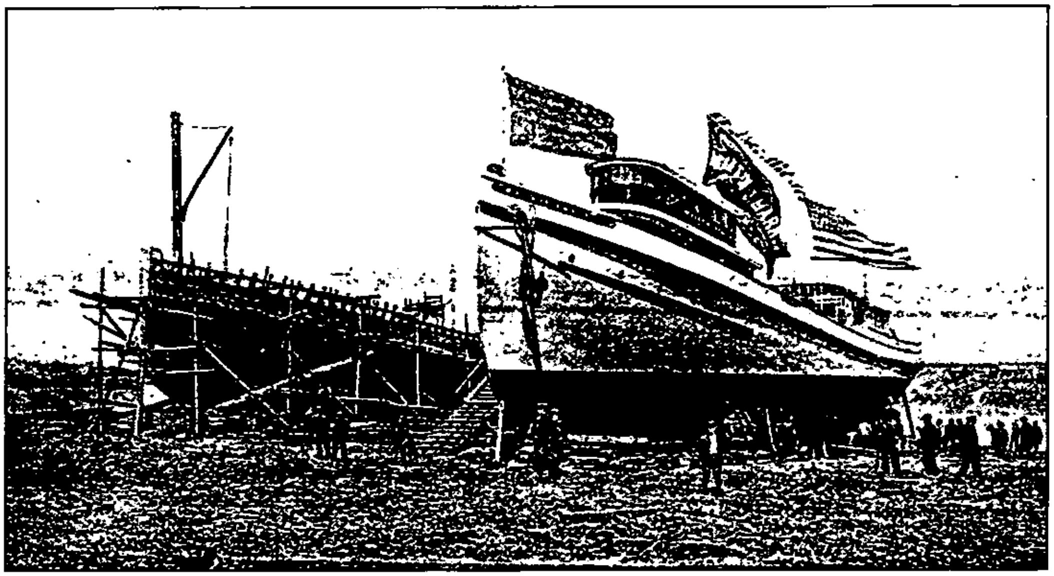

Figure 29. Menhaden steamer on the stocks (as presented in International Marine Engineering 1912:71).

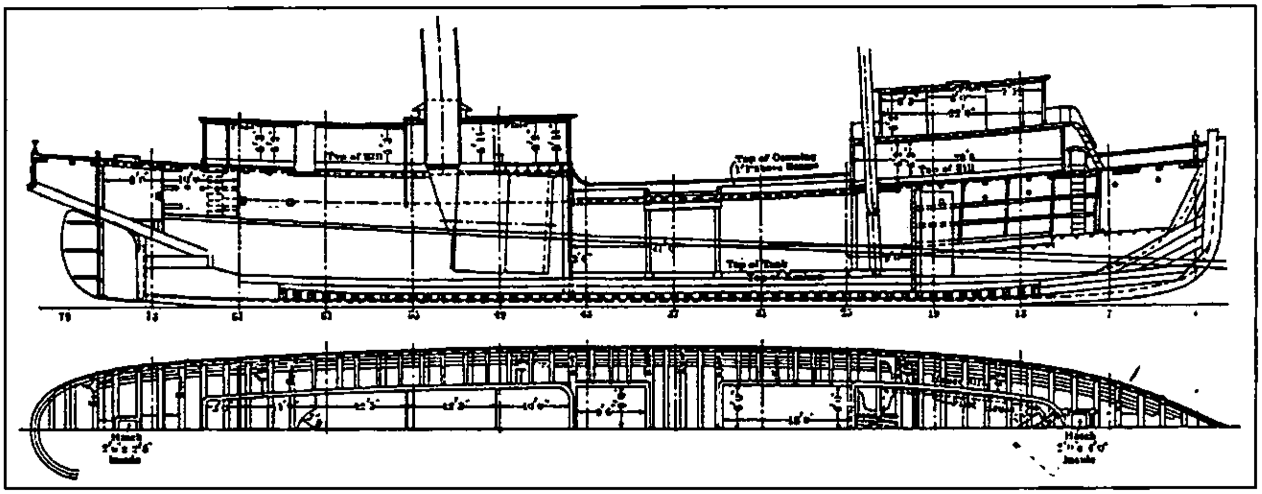

Figure 30. Inboard profile and deck plan of a 1912 menhaden steamer (as presented in International Marine Engineering 1912:72).

The early steamers had a wheelhouse on the main deck forward, with a tall mast for the lookout fitted high up with a boom for net handling. Crewman kept the central area of the deck open for loading fish. The forward end of the afterhouse housed dipping scoops, used to get fish from the seine to the fish hold (Erismann 1912). These boats usually had a sheer line rising to a fairly high bow (Brouwer 1996).

The menhaden steamer's basic design survived until quite recently. A plant handling menhaden was active on the New Jersey shore of Lower New York Bay and operated through the 1970s. Boats in the latter part of this century used diesel engines and had two-storied deckhouses forward. Menhaden fishing is still practiced today.

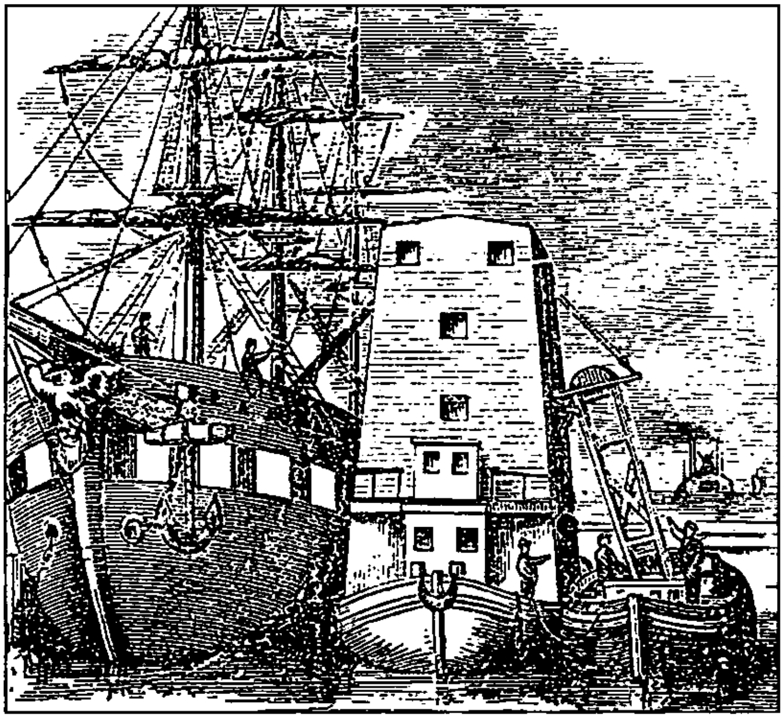

Figure 31. Illustration on a trade card of the International Board of Grain Measurers and Elevating Association, circa 1856 (as presented in Fuerst 1978).

FLOATING GRAIN ELEVATOR

Floating grain elevators are original to New York (Figures 31 and 32). Without the influence of naval architects, elevator construction slowly evolved over the last century. Called "skyscrapers on tugboats," or a "naval architect's nightmare," these vessels proved quite stable in the protected waters of New York Harbor (Fuerst 1978:131).

In the 1840s, gangs of men unloaded hundreds of bushel grain baskets by hand. Backbreaking, the labor process proved time consuming and inefficient. Then in 1848, the nation's first grain elevator, known as "Pagan's Patent," appeared on the waterfront. The elevator resembled its

Kansas cousin (Baab 1953). The elevator, basically a converted sailing ship equipped with a grain elevator, had an extendible leg and a conveyor belt with buckets. A loaded canal boat floated alongside the elevator, the extendible leg lowered into the hold, then the conveyor belt, set in motion, scooped up the grain, which was gravity-fed into the hold of a waiting vessel. The process could load up to 2,500 bushels per hour. Stevedores, keen to the situation, apparently destroyed the machine in 1852 (Fuerst 1978).

Early elevators, so-called single leggers, sat on the gutted hulls of old scows, brigs, barks, or schooners. Eventually, builders constructed vessels from the keel up. In the 1880s, Phillip H. Gill and Edward G. Burgess received a patent on "two elevators adapted to elevate grain simultaneously from two boats, suitable devices for weighing the grain elevated from each boat separately..." (Fuerst 1978:133-134). As larger steamers replaced sailing vessels in the grain trade in the 1880s, the length or height of the elevator increased proportionally (Baab 1953). In the twentieth century, grain elevators featured two marine legs (Figure 33).

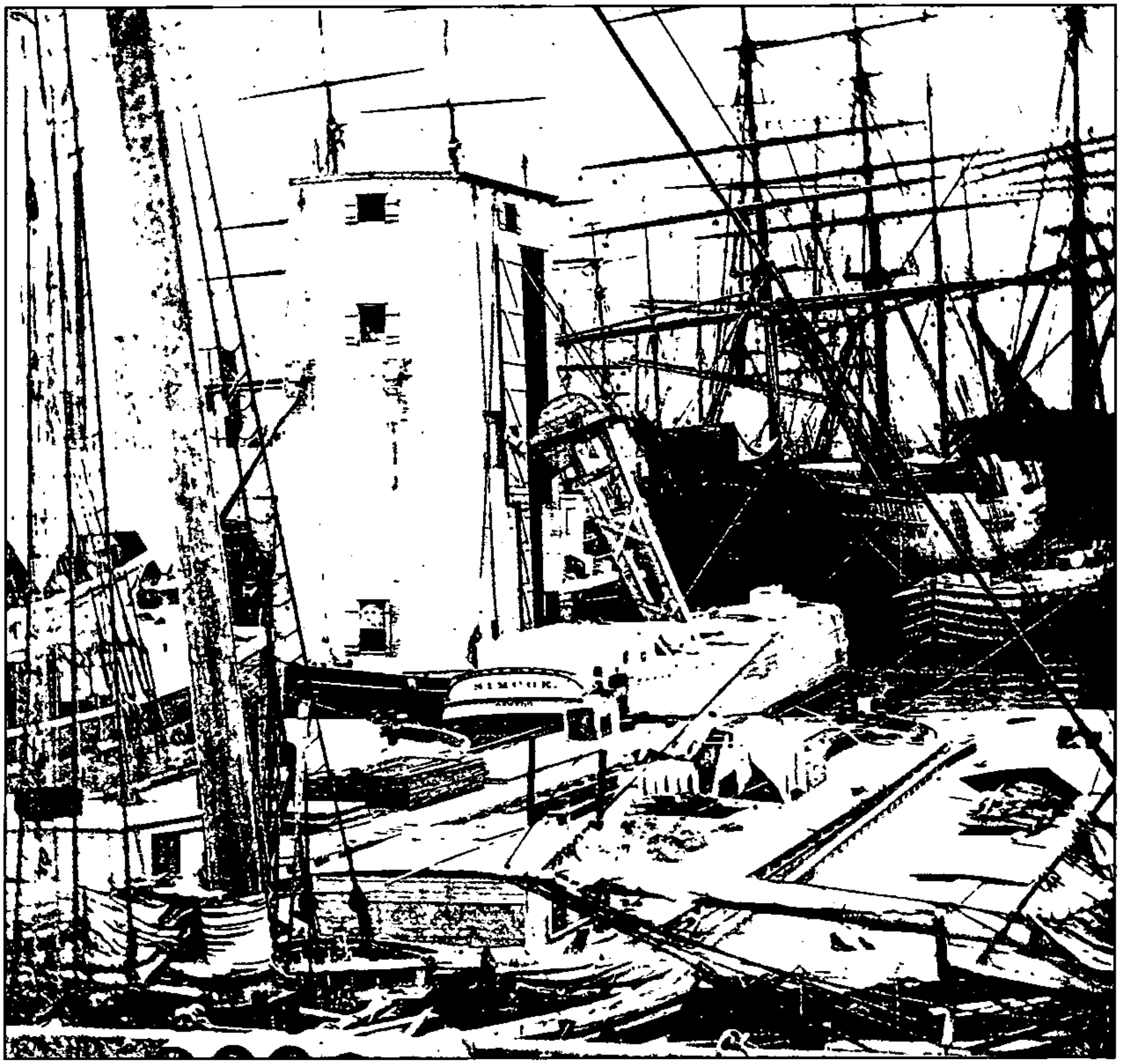

Figure 32. Nineteenth-century Anthony photograph of a floating grain elevator offloading grain from the *Simcoe*, a canal boat from Oswego, New York (courtesy of the South Street Seaport Museum).

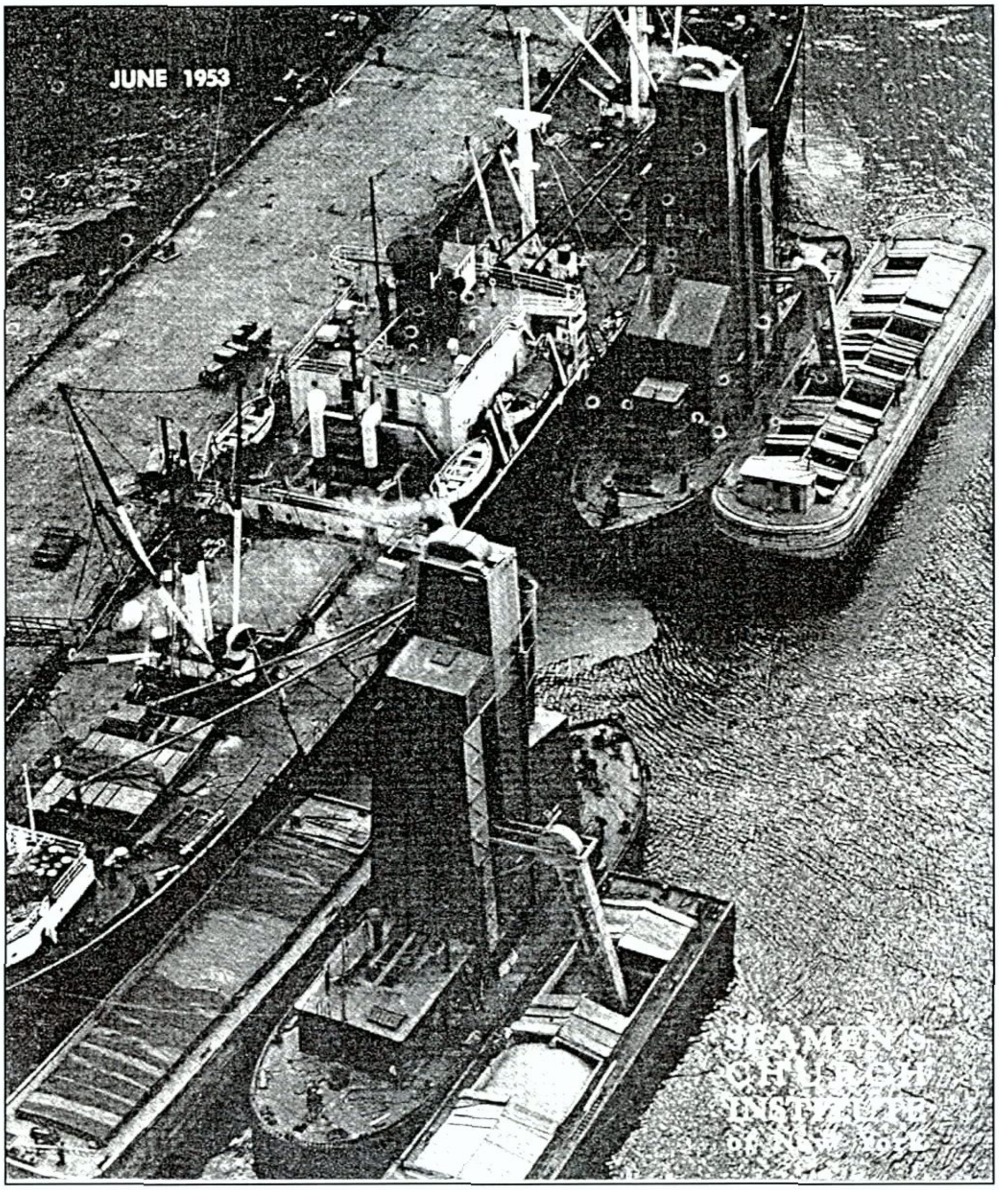

Figure 33. Early 1950s photograph showing two-legged elevators. Note the "skyscraper on a tugboat" look of these vessels, as well as the canal boats and hold barges offloading their cargos of grain (as presented in Baab 1953).

Initially, New York Harbor's free lighterage system provided companies with an incentive to use New York as their primary export port. However, under sanctions issued from the Interstate Commerce Commission in 1905, railroads serving the Atlantic seaboard planned to use other seaboard cities. By establishing "a freight rate differential for inland goods coming to the East Coast for export," goods shipped to Philadelphia or Baltimore cost less (Baab 1953:2). Grain transported to Buffalo east from the Great Lakes also featured a rate differential. Granaries on the Lakes also competed with iron ore suppliers for cargo space. Grain rates eventually increased. Finally, Canada stopped shipping grain to New York in 1932 when it issued a 6-cent-per-bushel tax on all exported grain (Baab 1953). New York Harbor's subsequent decline as a primary grain port in turn precipitated the decline of the grain elevator. By 1953 there were only seven remaining, and their unofficial demise occurred in the early 1960s (Baab 1953:2; Fuerst 1978).

Barge Types of the Arthur Kill/Kill Van Kull Reach

A barge is best described as a non-self-propelled watercraft used for hauling commodities. The modern use of simple boxlike vessels, similar in design to barges of the project area, can be traced historically to sixteenth- and seventeenth-century Europe. There the lines of the Thames sailing barge are remarkably similar to barge designs associated with the project area.

The lines of an English chalk barge, published in Chapman's *Architectura Navalis* (1768, as presented in Carr 1989), indicate a boxlike hull 56 feet in length, 15 feet in beam, with a depth of hold 5 feet amidships. The boat had lines very similar to the Thames punt, a small pleasure craft. The barge described by Chapman had a flat bottom and no external keel, and was steered by a large rudder and wooden tiller. In that regard, the barge design is similar to the river flatboat.

A forerunner of the modern American barge, the gondola was used during the American Revolution for harbor defense. This boat measured 40 to 60 feet and featured a flat bottom, double ends, and long, cutter, sloop, or hoy rigging. As a rule, gondolas had no deadrise or rocker in the bottom and "sometimes had flat sides in sections; at other times the sides had a little curvature" (Chapelle 1935:54). The Revolutionary War-era "radeau," basically a square-ended scow, represented another box-shaped vessel similar in design to the barges in the study area.

Most barges employed on the Hudson River, or within New York's harbor area, can be categorized into five major types: (1) canal barges (boats), (2) hold barges, (3) deck scows, (4) covered barges, and (5) schooner barges, with numerous variations of each type designed for every conceivable use. The canal barge or boat is a case in point with at least four subtypes: the laker, the bullhead, the deck scow, and the steam canal boat. The next three types are described in literature as "lighter barges" or "lighters," though the term "lighter" also refers to various types of smaller self-propelled craft. However, there is no agreed-upon definition of a lighter or barge, and no accepted authority to rely upon (Harding 1912). The last type, the schooner barge, is discussed separately because of its closer ties to a sailing vessel.

Canal Boats/Barges

The opening of the Erie Canal in the fall of 1825 was perhaps the greatest stimulus to the growth and success of the Port in the early nineteenth century. Reducing time and cost of shipping inland produce and commodities to the Port, the Erie Canal caused interior towns to thrive due to increased commerce. It also ensured New York's leadership among eastern ports because of its access to markets and goods from the country's interior (Brouwer 1990:29-34; Hall 1884:224; Morrison 1958:539). Soon other canals were being constructed throughout New York, and also in Pennsylvania, Maryland, and Delaware. Navigation improvements in connecting inland waterways by canals in the 1820s and 1830s resulted in new commerce opportunities and increased maritime traffic. The construction of canals brought about an attendant boom in the construction and use of canal boats or barges, a vessel type that apparently originated in Europe, as well as a reduction in the number of schooners involved in the same trade. As illustrated in Figure 34, the importance of the canal barge/boat in the waters of New York Harbor is indicated by the frequency with which they appear in historic photographs of the area (also see Johnson and Lightfoot 1980).

The Erie Canal as originally constructed was 4 feet deep and 40 feet wide, with locks measuring 15 feet wide and 90 feet long. Between 1836 and 1862, the state enlarged the canal to 7 feet deep by 70 feet wide and the locks to 18 feet wide and 110 feet long (Shaw 1966:87, 96, 241). "This permitted boats of much greater size on the Erie, Champlain, Cayuga-Seneca, and Oswego canals, and further diminished the importance of the smaller lateral canals" (Canal Museum 1981:5). Dimensions given for New York's State Repair Scows in the 1880s are 98 feet long, 17⅔ feet wide, and 9 to 10 feet draft (Canal Museum 1981). The 1908 Barge Canal Bulletin for the State of New York gives the following dimensions: 18 feet wide, 98 feet long, and 6 feet draft. A contract giving the dimensions for a state scow for the Erie Canal (1875) states:

> The Scow to be seventy feet long; fourteen and one half feet wide on top, and thirteen and one half feet wide on bottom, eleven feet top breadth of ends, four and one half feet height of sides; six feet rake, flooring to be one foot below top of sides; Stern deck to be six feet in length, and raise of bow and stern to be six inches. The cabin is to be twelve feet long and four and one half feet running above running board. The sides are to be seasoned white Pine, four inches in thickness and well jointed and doweled with 5/8 inch bolts to be placed not exceeding ten inches apart in each course. Floor timbers are to be well seasoned white oak three inches thick and eight inches deep. The long bow and stern timbers also the bow and stern Ricks are to be well seasoned white oak. The latter two inches in thickness. The Scow to be thoroughly caulked with the best quality oakum and the bottom to be well pitched. The Cabins to be made of thoroughly seasoned matched white pine, and to be painted with two coats of best Brooklyn lead and boiled linseed oil. All the bolts, fastenings and necessary iron to be of the best American iron [New York State Archives, Comptroller's Records. Canals. Collection 13. Package 2777].

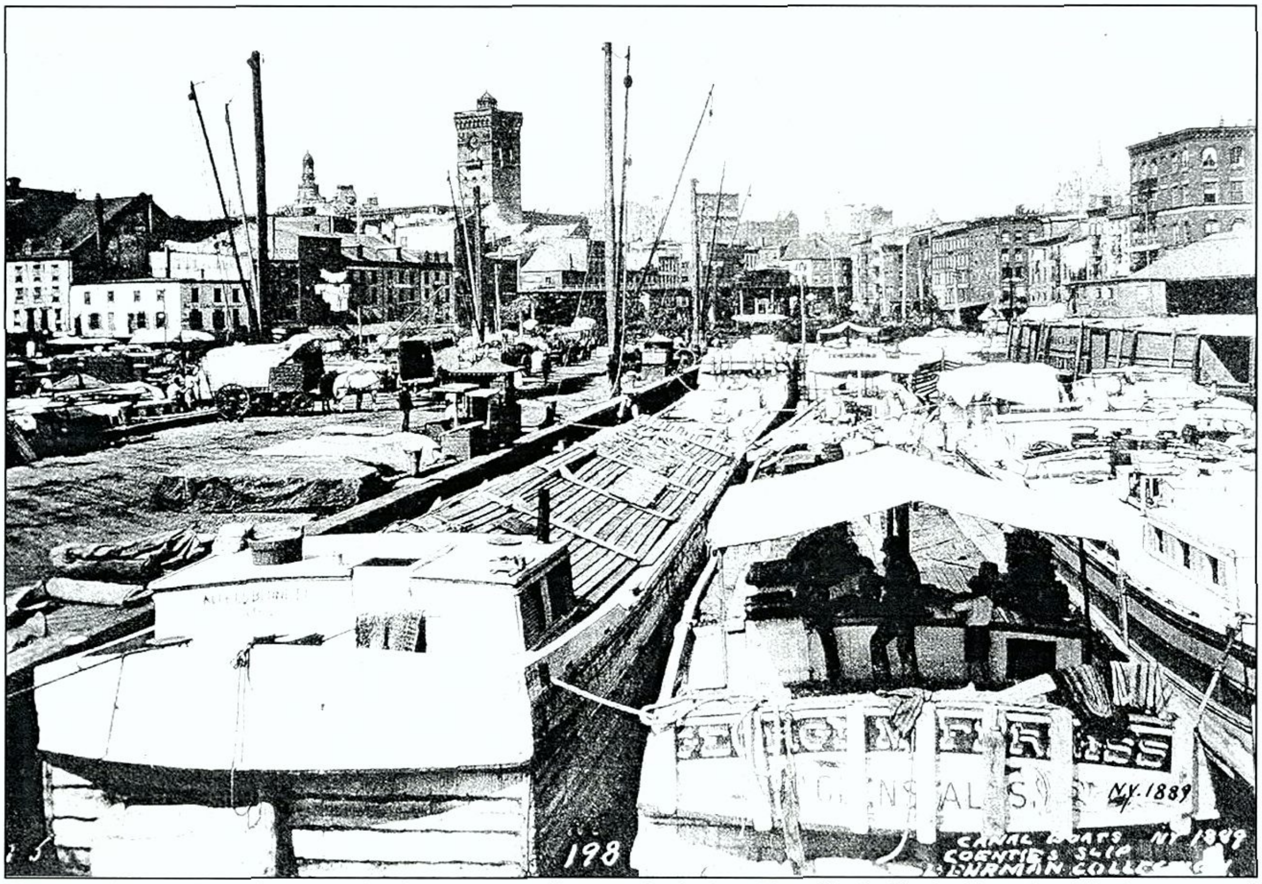

Figure 34. An 1889 photograph of canal boats/barges docked at New York City's Coenties Slip (courtesy of the South Street Seaport Museum).

Two major changes in New York canal boat-building occurred in the 1860s. Bigger boats and increased traffic provoked the state in 1862 to mandate rounded bows on the vessels employed in the canal system; the law prohibited square-bow boats. In a collision, a square-ended barge could shear off an entire section of boat "dumping a whole cargo and making a major blockage in the canal" (Canal Museum 1981:13). The mandate required better boat-building skills, but exploitation depleted local timber supplies, which was the second change. The boat-building industry developed along timber supply routes in Buffalo, Tonawanda, and Lockport. Canadian and northern New York timberlands supplied yards in Rochester, along the Oswego Canal to Phoenix and Fulton. Boatyards in Ithaca, supplied by southern timbermen, developed the slab side scow in the 1860s. The design made use of pine and hemlock 6-by-12-inch side timbers. The timbers were mounted edge to edge by steel drift pins. The use of cheap softwoods minimized framing and planking, reducing production cost and labor (Canal Museum 1981).

Growth in steam power and steel boat production led to the State Barge Canal System, a state-funded project featuring cast concrete construction and electronic locks. The System opened in 1918 and utilized canalized waterways and sections of the Old Erie Canal. The enlarged canal system had locks 45 feet wide, 310 feet long, and 12 feet deep. The ability of the canals to accommodate larger boats precipitated different towing methods, vessel types, and construction. "Whereas on the old system, mule-towed boats traveled separately, the steam-towed barges are propelled in fleets consisting of the 'steamer' and several, usually five or six, barges called consorts" (Springer and Hahn 1977:27). Figure 35 illustrates a tug towing both "transitional" barges and bulkheaded deck scows (rock scows discussed below). While at first boat builders were uncertain of what shapes and sizes could be accommodated, the new canal boats/barges were much larger and were pulled by steam or diesel.

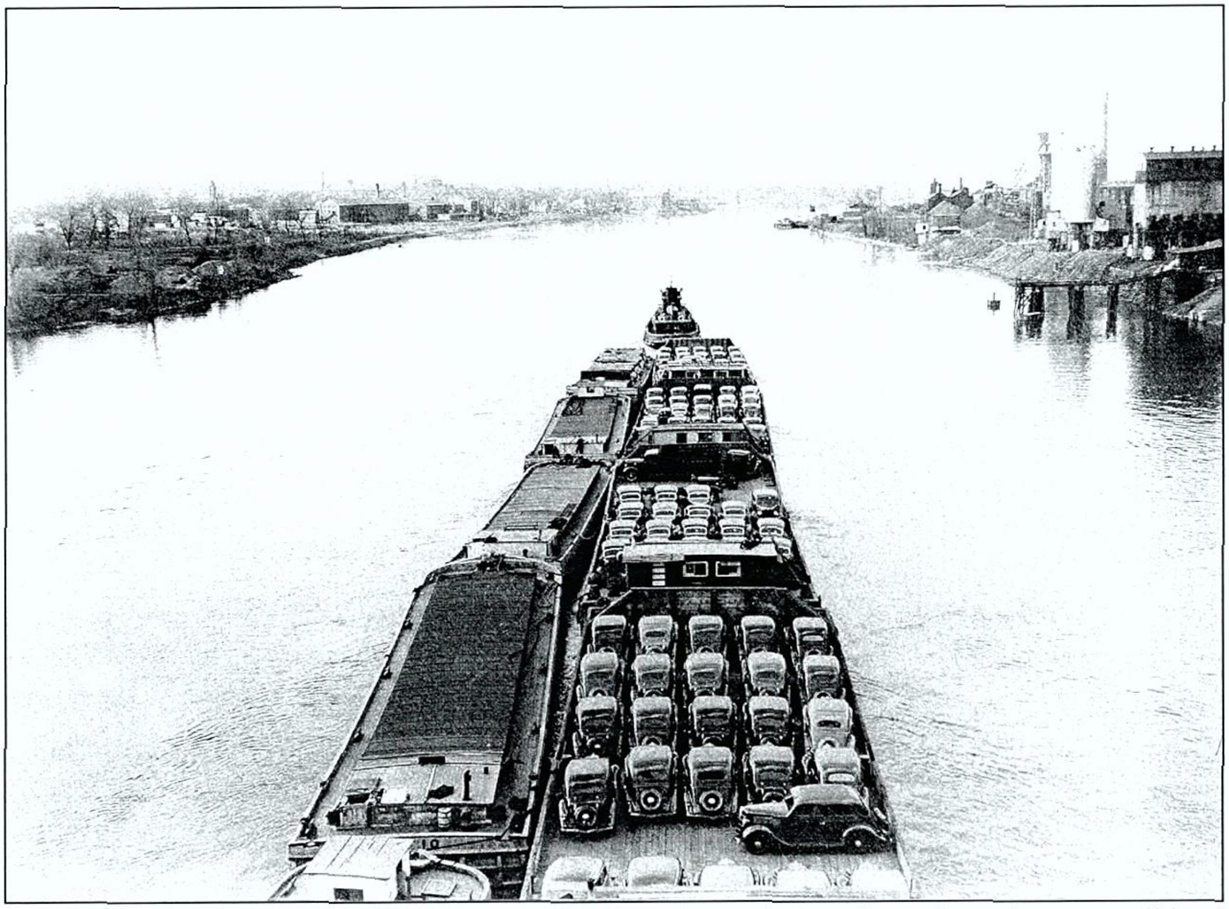

Figure 35. Late 1930s photograph showing changes in towing methods and towed vessel types; traditional shapes are at left, bulkhead scows are at right (courtesy of the South Street Seaport Museum).

Typological Issues. As stated in Raber et al. (1995a:98), "boats used on regional canals or contiguous waterways pose several identification problems." Boats used for canal service sometimes worked in a non-canal capacity, as in service on the Arthur Kill channel. Other times, these boat types served strictly in a non-canal capacity. These non-canal services included harbor freight traffic via creek and stream systems (including the Hudson River), and the movement of Woodbridge/Perth Amboy clay products.

The criteria adopted by Raber et al. (1995a) for canal boat typology is based on width and form. They state that boats identified in the project area are long enough for offshore/coastal service, but are narrower (20 to 25 feet), with pointed or rounded bows, occasionally featuring rounded sterns. Raber et al. state that these boats are "transitional" types "between traditional moulded hulls with curved floors and frames requiring bent or curved fabricated members, and barge forms with few if any members" (1995a:98). However, our investigation suggests that half of the group appear to represent traditional forms. Furthermore, the statement that traditional forms had moulded hulls with curved floors and frames appears to be at odds with some mid-nineteenth century plans for these vessels (presented below).

The use of the term "transitional" is based in part on the fact that all boats identified as canal boats supposedly featured measurements applicable only for the New York State Barge Canal. The boat measurements (20 to 25 feet wide) presented by Raber et al. (1995a:98) are not precise, but the authors state that the examples previously investigated exceed maximum 17.5-foot widths necessary for use on late nineteenth-century New York State Canals and the 10.5- to 14-foot boat widths witnessed on the Delaware and Hudson, Morris, and Delaware and Raritan canals (Raber et al 1995:58, 1995a:98-99). Our investigation indicates, however, that at least one and possibly two of the vessels represent pre-State Barge Canal measurements. Additionally, the similarity of these vessels to those with larger measurements suggests that the use of traditional hull shapes postdates at least the beginning years of the State Canal. Furthermore, by the mid-1850s, the locks on the Lehigh Canal were 22 feet wide, and a number of the locks on the Delaware Canal were rebuilt to correspond to those on the Lehigh. By 1847 similar locks were introduced to give access to the Delaware and Raritan Canal (Yoder 1972:85-87). This suggests the possibility that even some of the larger vessels in our group may be early or traditional vessels.

Raber et al. (1995) also categorized project-area canal boats into two types: (1) probable transitional/smaller barge canal boats, and (2) large wooden barge canal or harbor hold barges. The probable transitional/smaller barge canal boats are stated as apparently slightly larger versions of nineteenth-century forms, built circa 1905-1915 (Raber et al. 1995:58, 1995a:98-99). The second type, large harbor hold barges, according to Raber et al. (1995, 1995a), apparently corresponds to twentieth-century drawings of vessels generally 22-34 feet wide and 108 feet long labeled barge, barge canal boats, canal box, lake work barge, Box O'Donnell type, big grain boat/box, and deep barge. Plans of several of these vessels from the Feeney Collection (1920-1922) housed at the Hudson River Maritime Museum, Kingston, New York, are presented below in the discussion on hold barges. Raber et al. (1995:58) state that these boats are wider, though they retain pre-barge canal boat features (i.e., low set cabins), and may represent a thorough redesign of earlier forms for use on the Barge Canal after 1915-1920.

Adding to the problem of type distinction and transition/evolution is the Raber et al. (1995:63) vessel type, the "wooden coastwise hold barge". Noted as probably of early twentieth-century origin, the vessels were employed in the shipment of coal and grain. Defined as larger versions of the harbor hold barge, some with heavier internal framing, the report states that full distinctions between these two barge types remain undefined. We know through historic photographs that hold barges with low set cabins were employed on the New York Barge Canal, towed in fleets by steam and diesel tugs (see Garrity 1977 or Springer and Hahn 1977). However, barges that reflect both the "large wooden barge canal or harbor hold barge" and the "wooden coastwise hold barge" types predate the State Barge Canal. Barges with the same above characteristics had been built at Perth Amboy since 1860 for sending coal up to the city and points accessible from the harbor. A description of one barge being constructed in 1880 states that "this barge was perfectly flat on the floor amidships and square on the bilge, the floor being carried well forward and aft. The bow and stern were sharp, the stem perpendicular. This boat was 125 feet long, 28 feet broad and 11 deep amidships, with 2¾ feet sheer…and a house for the boatman and his family" (Hall 1884:121).

Although Raber et al. (1995) identify the two hold barge types, it may be that they represent variations of a single type or category, or that the two are not related at all and are typed incorrectly. While the large "coastwise" hold barges, either for canal or coastwise use (as illustrated in Figure 36), do appear to reflect a type, the canal/harbor hold barges identified in the previous studies either appear to be grouped incorrectly or do not represent a type. It is also possible that this scow-shaped type, contemporaneous with canal boats at least from 1860 onward, does not represent a reworking of the canal boat/barge for use on the State Barge Canal as previously theorized. Rather, their employment on the State Barge Canal may not be a function of a vessel redesign, but rather the employment of an extant vessel type on an enlarged canal. These vessels appear to have more in common with scow barges (discussed below) than canal boats. However, similarities between some hold barges and some types of canal boat/barge components, such as the curved stern construction (from the bottom to the top as opposed from the sides to the stem), suggest a common tie or relationship between these vessels. Whether this tie represents a common building method or builder, or a transition or evolution, can be answered only by archaeological data from these vessels and further archival research. Because of this understanding, the "large wooden barge canal or harbor hold barge" and the "wooden coastwise hold barge" will be discussed separately after the transitional barge canal boat type.

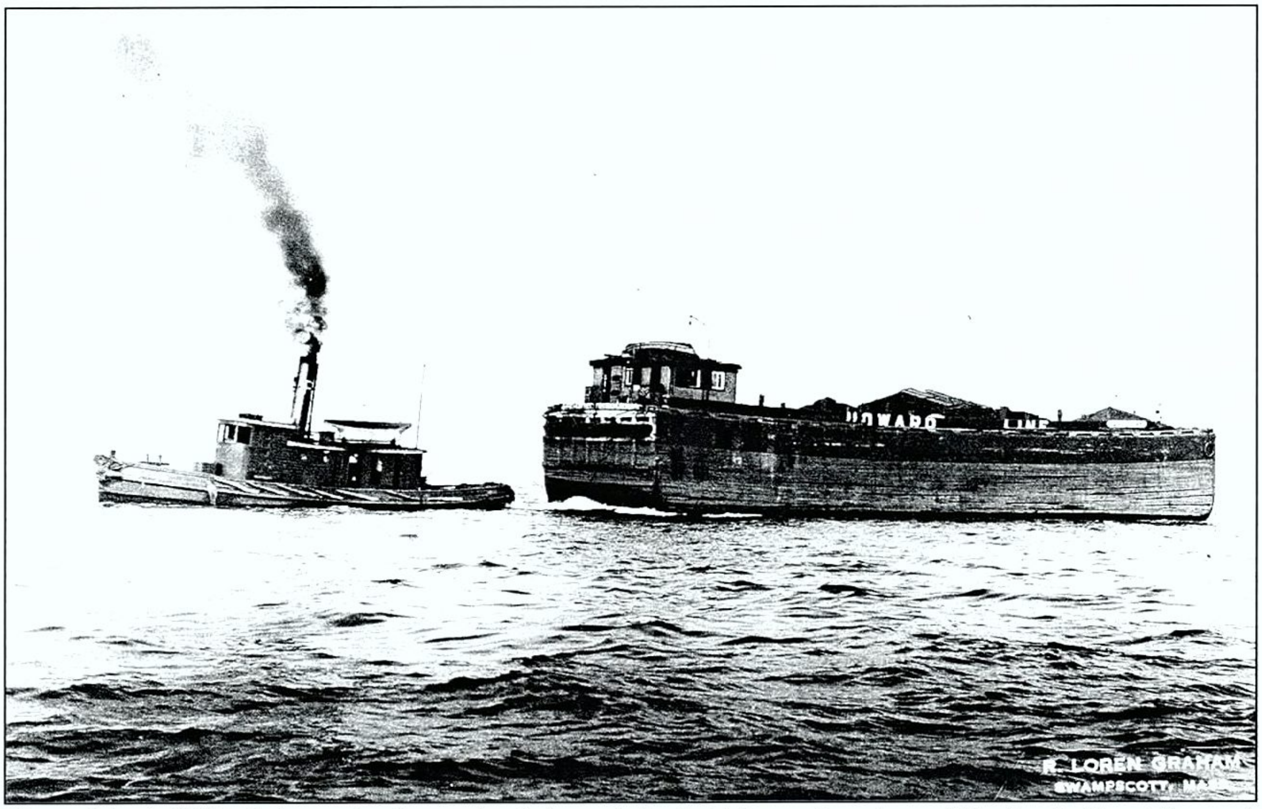

Figure 36. A 1937 photograph of an unloaded coastwise hold barge (courtesy of the South Street Seaport Museum).

Hold Barges

Hold barges moved bulk commodities, especially grain and coal. These boats had construction designs similar to canal boats, i.e., large, accessible deck hatches with deep holds. Not restricted by canal or lock dimensions, these boats measured between 25 and 35 feet in breadth, 90 to over 100 feet in length. Box designs (except for a short upturn of the bottom) led to the vernacular box barge (Figure 37). Sometimes known as a coal or grain box, the boat usually had a cabin, hatch boards, or a canvas tarpaulin covering cargo, particularly grain (Brouwer 1996).

Figure 37. Typical scow-built box design (origin unknown).

Dimensions for the hold barge *Quincy Adams*, built in 1917 at South Rondout, New York, provide data typical for project-area hold barges. The vessel measured 122.7 feet long, 28.4 feet in breadth, with a depth of hold measuring 13.4 feet (Government Printing Office [GPO] 1937). A photograph of the vessel from the Steamship Historical Society of America is pictured in an article on the Port of New York by Norman Brouwer (Brouwer 1987). The depth is almost double that of a scow hull. As with scows, there is usually a crew cabin at the stern, either built on deck or sunk into it about 4 feet. A large, open hatch (with low coamings) took up most open main deck space. For transverse strength, the hatch opening usually featured three or more permanent beams.

To protect cargo from the elements, fitted longitudinal strongbacks were installed on the centerline to form a peaked roof. The side planking consisted of single timbers laid over vertical frames. The frames were joined to the underside of the deck on either side of the hatch and to the floors with natural hanging or standard knees. The frame and knees were exposed at the sides of the hold, but the floors running across the bottom of the hold were protected by planked decking (Brouwer 1996).

Large Wooden Barge Canal/Harbor Hold Barges

As stated above, this vessel type was possibly employed both on and off the canals. Predating the State Barge Canal, and contemporaneous with earlier canals, it is believed that this vessel type does not represent a reworking of the canal boat/barge as previously theorized. Rather, their use on the State Barge Canal was not a function of a vessel redesign, but the employment of an extant vessel type on an enlarged canal, albeit a vessel type with some similarities to the traditional canal boat.

Wooden Coastwise Hold Barge

Figures 38 and 39 display plans of a 1903 coastwise hold barge. According to the *Nautical Gazette* (*NG*, October 8, 1903), the barge is of average size, about 100 feet long by 26 feet in beam. Longitudinal logs form the bottom framing. The planked sides serve as heavy girders. Heavy beams are connected by wooden knees. The transverse connections on the bottom are comparatively light, consisting of the outside transverse planks 3 by 12 inches. The center keel/keelson is a single log 12 by 12 inches. The corner keelsons are the same dimensions; the intermediate sister keelsons are 8 by 12 inches. The side planks are 6 by 12 inches, while the *garboards* are 8 by 12 inches. The wales are composed of two pieces, each 8 by 12 inches.

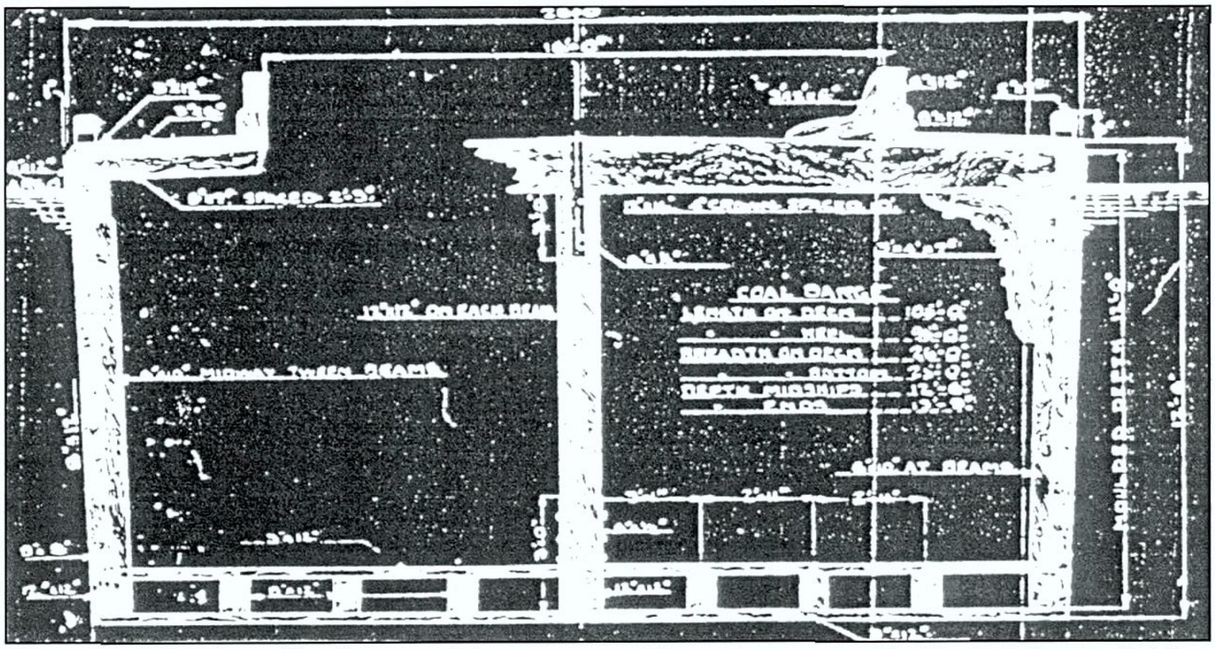

Figure 38. Midship profile of a turn-of-the-century coal barge (as presented in *Nautical Gazette*, October 8, 1903).

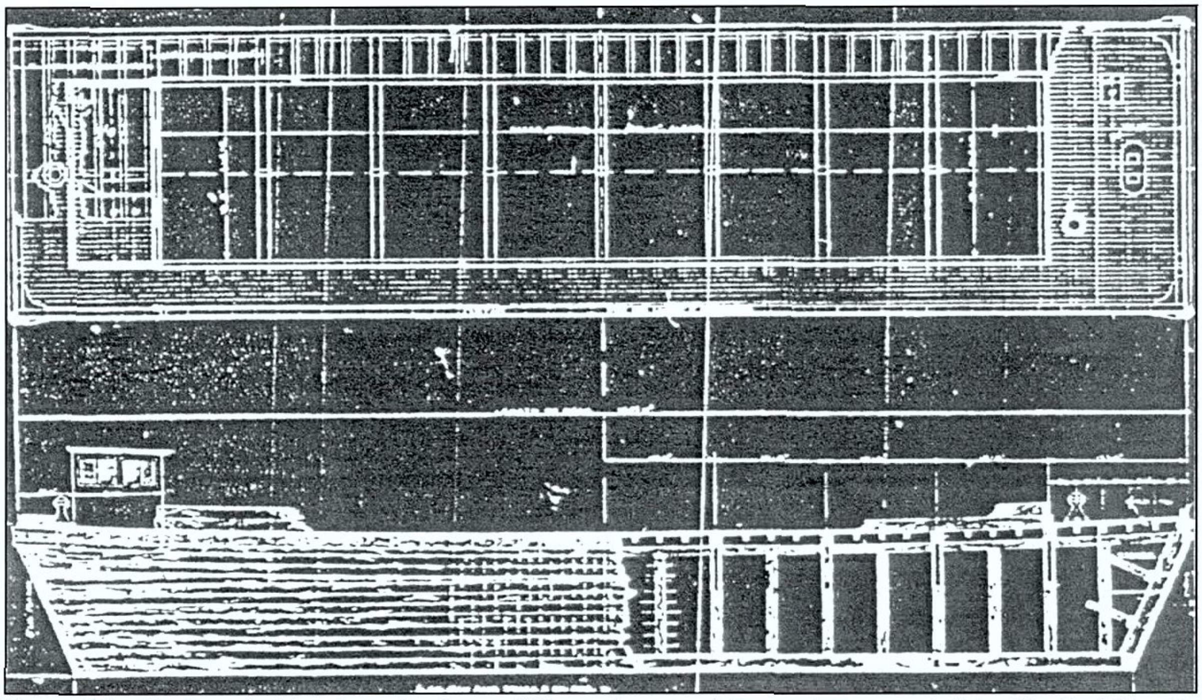

Figure 39. Deck and side plan of a turn-of-the-century coal barge (as presented in *Nautical Gazette*, October 8, 1903).

The deck planking measures 6 by 3 inches. The plank sheer is 3 by 12 inches with a rail 5 by 7 inches along the sides of the barge, lifted off the deck by distance pieces. The heavy hatch coaming is made of a lower strake 8 by 12 inches and an upper strake 6 by 12 inches, all around the hatch. The deck beams are 12 by 6 inches with a crown of 4 inches in their length and 10-foot spacing. At the center of each beam is a strong stanchion, 12 by 12 inches, connected by an iron strap ½ by 6 inches. The knees connecting the deck beams to the sides are 7 inches thick by 3 feet long on the beam and 4 feet long on the side vertical stanchion. These side stanchions are 6 by 10 feet with 5-foot spacing. Additional 5-by-7 inch half beams are between the main beam spaced at 2 feet 3 inches for more efficient support of the deck planking (*NG,* October 8, 1903).

The fastenings are particularly strong in the side planking, where heavy bolting unites the members into one rigid girder. Galvanized iron rods ⅞ inch in diameter are driven edgewise through the planks at a spacing of 2 inches. The knees also show the demand of strong fastenings at this junction. The center stanchions are connected with strong bolts to the iron straps that form the tie to the beams on top and for the main keelson on the bottom (*NG*, October 8, 1903).

Defined as larger versions of the harbor hold barge, some with heavier internal framing, full distinctions between these two hold barge types remain undefined. However, as stated above in *Typological Issues*, barges of this size were extant by 1860.

STEAM LIGHTERS

Operated by both major railroads and private lighterage firms, there were two types of wooden-hulled steam lighters, open-decked or covered (Figures 40). Brouwer states that the open-deck lighters "were either single-ended or double-ended, meaning they either had one mast and a single open deck forward, or two masts and open decks forward and aft" (1990:178). The open-decked lighters stored most of their cargo on deck, while the deck on the covered lighters was fully enclosed. With beamier hulls than tugs, the wooden-hulled, propeller-driven models may have appeared by the turn of the century, to be replaced by steel versions prior to WWII (Raber et al. 1995:65).

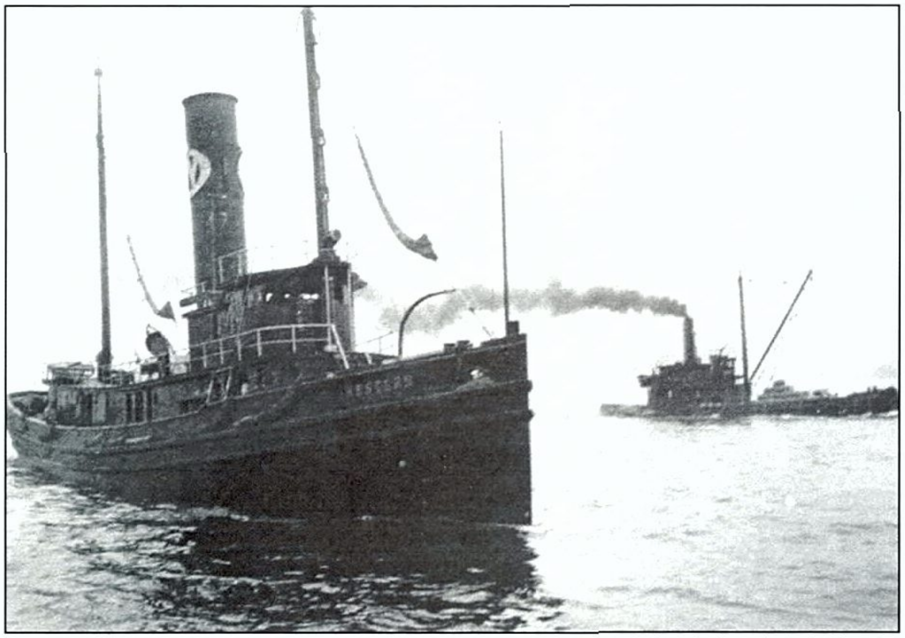

Figure 40. The open-decked steam lighter *Shooters Island* (at right), in the company of the harbor tug *Western*, also employed in the lighterage industry within the New York port area (as presented in Morris 1984:74).

5. INVESTIGATIVE PROCEDURES

Panamerican conducted archaeological fieldwork under the direction of Principal Investigator Andrew D.W. Lydecker, commencing on July 31, 2002. The archaeological field crew consisted of Andrew Lydecker, Matt Elliott, Gregory Cook, Jim Duff, and John Rawls. The project entailed the use of equipment and procedures chosen specifically to meet the project requirements (see Dive Safety Plan, Appendix B). The dive vessel *Venture III* was used for the work. Underwater investigations utilized surface-supplied air (SSA). Underwater equipment included video, hand- and hydro-probes, and a metal detector.

REMOTE SENSING SURVEY EQUIPMENT

The remote-sensing refinement 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.

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. Those positioning functions were accomplished with a Motorola LGT-1000 global-based positioning system (Figure 41).

Figure 41. Motorola LGT-1000 global based navigation system.

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. 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, which processed both satellite data and differential data transmitted from a shore-based GPS station utilizing Radio Technical Commission for Maritime Services (RTCM) 104 corrections. The shore-based differential station monitored the difference between the position that the shore-based receiver derived from satellite transmissions and that station's known position. Transmitting the differential that corrected the difference between received and known positions, the DGPS aboard the survey vessel constantly monitored the navigation beacon radio transmissions in order to provide a real-time correction to any variation between the satellite-derived and actual positions of the survey vessel. New Jersey State Plane coordinates, based on the 1983 North American Datum (NAD 83) coordinate system (provided by the Corps), were used for this project.

Both the satellite transmissions and the differential transmissions received from the shore-based navigation beacon were entered directly into an IBM Thinkpad 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. It was used to provide real-time trackline data for the vessel operator during remote-sensing survey operations. Positioning information was printed on hard copy and stored on magnetic disk aboard the survey vessel.

All positioning coordinates are based upon the position of the antenna of the DGPS. Each of the remote-sensing devices was oriented to the antenna, and their orientation relative to the antenna (known as a lay back), was noted. This information is critical in the accurate positioning of targets during the data analysis phase of the project. The lay back of the magnetometer sensor 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 (Figure 42). 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. Any physical contact with the sensor, such as bumping a river bottom or submerged object, will affect the readings as well. 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.

Figure 42. Geometrics 866 magnetometer.

For this project the magnetometer was interfaced with an IBM Thinkpad 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.

Side-scan Sonar

The remote-sensing instrument used to search for physical features on or above the bottom of the harbor bed was a Marine Sonic Technology (MST) Sea Scan PC Side-scan Sonar System (Figure 43). The side-scan sonar is an instrument that, through the transmission of dual fan-shaped pulses of sound and reception of reflected sound pulses, produces an acoustic image of the bottom. Under ideal circumstances, a side-scan sonar is capable of providing a near-photographic representation of the bottom on either side of the trackline of a survey vessel. The Sea Scan PC has internal capability for removal of the water column from the instrument's video printout, as well as correction for slant range distortion. This side-scan sonar was used with the navigation system to provide manual marking of positioning fix points on the digital printout. Side-scan sonar data are useful in searching for the physical features indicative of submerged cultural resources. Specifically, the record is examined for features showing characteristics such as height above bottom, linearity, and structural form.

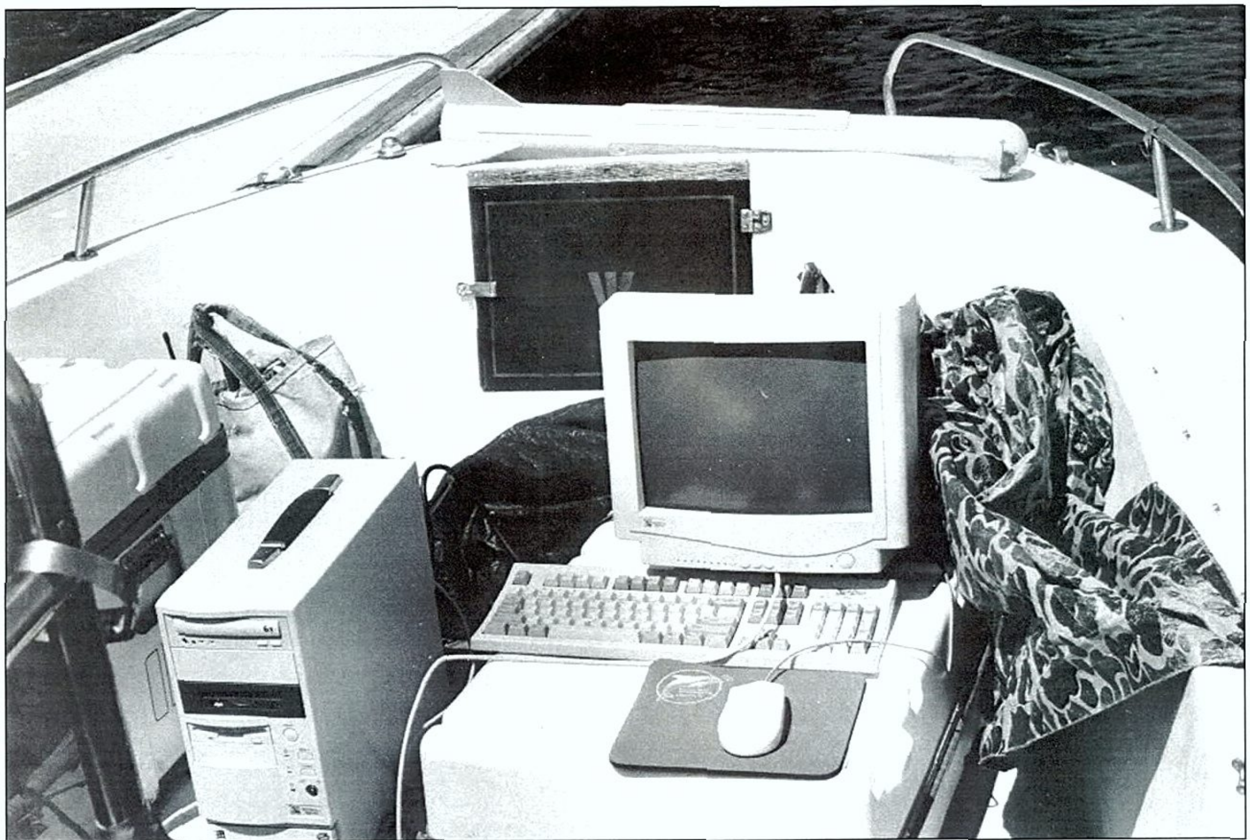

Figure 43. Side-scan sonar unit used during the project.

The MST Sea Scan PC side-scan sonar was linked to a towfish using a 600-kHz power setting and a variable side range of up to 100 meters per channel (200-meter coverage per line) on each of the side-scan sonar lines run. The range setting was selected to provide maximum possible detail on the record generated. The 20-meters-per-channel selection made it possible to collect acoustic data over a 40-meter (130-foot) wide area on each line the side-scan sonar was employed, creating a general image of the harbor bed. The side-scan sonar was operated on the same tracklines as the magnetometer.

Survey/Dive Vessel

The vessel used for the diving portion of the investigation was the *Venture III* (Figure 44), a 46-foot Breaux-built crew boat, powered by two 8-cylinder diesel engines. The survey vessel has a generator as an onboard power supply for the electronic equipment. It has an enclosed cabin for the onboard electronics and ample deck space for the handling of overboard sensors. The *Venture III* conformed to all U.S. Coast Guard specifications according to class, and had onboard all required safety equipment. It carried its own spare-parts kit, tool kit, first-aid materials, and potable water. Captain Paul Hepler piloted the survey vessel and was assisted by his mate Ruth Hepler. The vessel was berthed in Jersey City, New Jersey.

Figure 44. Project dive vessel, the *Venture III*.

Refinement and Survey Procedures

Coordinates for each of the five target areas were entered into the navigation computer. The survey vessel would transit to the coordinates as indicated by the navigation system and a marker buoy would be deployed over the target as identified during the Phase I survey (Lydecker 2001). The magnetometer or side-scan sonar and DGPS were mobilized and tested, and the running of tracklines began. A series of 500-foot long tracklines, spaced approximately 50 feet apart, was run over the target area to determine the exact location of the target around the buoyed location. At least three tracklines were run on a north/south or east/west heading when possible. Normally, at least six total lines are run, three in each direction in a cruciform pattern. However, due to the limited area of navigable water in the project area, lines were run in one direction only. For some target areas additional refinement passes with the magnetometer or sonar and a series of additional buoy drops were conducted in order to position over the loci of the anomaly.

The helmsman viewed a video monitor, linked to the DGPS and navigational computer, to aid in directing the course of the vessel relative to the target area. The monitor displayed the real time position of 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 every two seconds, each of which was recorded by the computer. Event marks were either hand annotated on the magnetometer stripchart, or noted on the scrolling computer file of the side-scan sonar readout, delineating the start and end of each of the tracklines. The exact time of both the start and end of a line was also recorded to aid in producing magnetic contour maps.

Following the completion of the refinement of each target, a review of the data was conducted to determine the presence or absence of each target within its refinement area. In general if no magnetic target was located within the refinement area it was speculated that the target has been displaced or removed by previous dredging, fishing vessels or natural processes. If the data indicated that a magnetic target was present within the refinement area, a series of additional tracklines was run with the magnetometer to refine the source of the anomaly. The *Venture III* then anchored close to the source of each located anomaly or target and was readied for dive operations. A diver then suited up and prepared to identify the source of the anomaly or target.

Dive Equipment

Throughout the diving phase of the investigation, operations utilized surface-supplied air (SSA) due to its inherent safety and efficient operations. SSA provides direct diver-to-surface air and communication. The system contains two complete diving sets, each with a dive helmet and 200-foot surface-to-diver air supply umbilical, polypropylene rope safety line, communications cable, and pneumatic hose. The Kirby-Morgan Superlite 17 helmets (Figure 45) are equipped with speakers, microphones, regulators and, at the air intake, a non-return safety valve. The communications components, regulators, and non-return safety valves of the dive masks are checked for proper functioning prior to each dive. In addition, divers using SSA wore safety equipment including a harness, quick-release attachments connecting the diver to the surface umbilical, a 50-cubic foot auxiliary air tank, quick-release weight belts, and protective gear including wet suits, boots, and gloves, which were worn during all diving operations.

A cascade air system for SSA diving provided no less than two 240-cubic foot 2100 PSI commercial K-bottles of certified breathing air. The system included a 72-cubic foot 3000 PSI backup cylinder worn by the diver and connected to the dive helmet as an emergency air source in the event of primary air failure. The diving supervisor monitored the air supply system during each dive to ensure correct air pressure.

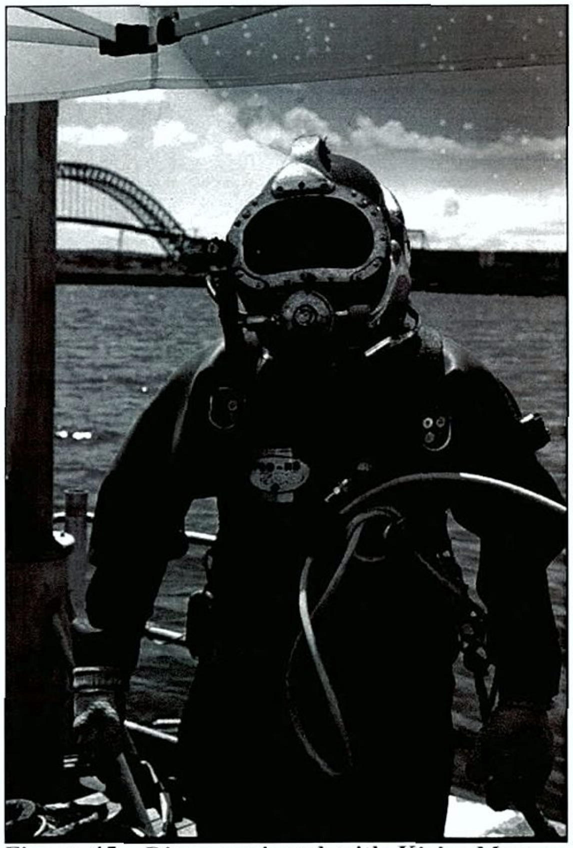

Figure 45. Diver equipped with Kirby Morgan Superlite 17 dive helmet and the type of diving equipment used during the investigations.

Air supply hoses consisted of Gates 33HB commercial dive hoses with a rated bursting pressure of at least 1000 PSI. A 3/8-inch polypropylene rope safety line secured the air supply hoses. The communications cable integrated into the diver umbilical included a 16-gauge four-conductor cable with oil resistant jacket. The diver umbilicals consisted of Synflex 3630-4 x 1/4-inch 300 PSI working pneumo hoses.

Dive length corresponded to that prescribed by the standard Professional Association of Diving Instructors (PADI) SCUBA table.

Video Equipment

Video plays an important role in underwater investigations of this type. An accurate record of the entire site, recorded on video, is invaluable during data analysis. It enables the researcher to revisit the site without having to actually return there, and lets him or her obtain details that would have been difficult or impossible to add during the dive itself. The video equipment used during this project was a Sony DCR-PC100 1-megapixel-per-frame digital video camera, using a MiniDV format and housed in a Light and Motion Mako aluminum submersible housing. A pair of 50-watt lights provided lighting for close-up shots. In addition to video capture, the PC100 camera is capable of 1-megapixel digital still photography, with the photos being stored on a small memory chip for later retrieval. Digital video allows playback using a Firewire-equipped Macintosh computer, running MacOS X and iMovie. Clips can be imported and saved in a number of formats, and reviewed frame by frame. Still frames can be exported in a number of digital formats. The versatility of digital video and the ability of the camera to save still photos as well as video eliminates the need to use a still camera.

Video photography played an important aspect in recording each site. In all instances the camera provided enhanced visibility and revealed structural aspects the diver could not see underwater. The video camera was equipped with a wide angle lens, which had a much wider field of view than the human eye and enabled the visualization of larger areas.

DIVING PROCEDURES

Diving began on August 1, 2002. Remote-sensing survey targets were dived first. After refinement of the targets, diving was initiated. This phase of the project was to attempt to locate the source of an 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 used by the diver on the sea floor. Anchors were then placed to hold the dive vessel over the target area and allow the diver safe entry and exit. If inadequate or unsafe conditions were evident at the primary dive site, operations were moved to one of several secondary dive sites.

Surface Supplied Air (SSA) was chosen as the most efficient and safe method of conducting underwater investigations. 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. A 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.

The initial objective for the diver was to visually inspect the sea bed for the source of the anomaly. The diver was first directed to the buoy located over the anomaly. If the source of the anomaly was not observable on the surface of the sea floor, a series of arcs was conducted by the diver to adequately cover the target area. If no materials were apparent to the diver on the surface of the sea bed other methods of examination were attempted, including probing and use of a metal detector.

Underwater Probing

Probing of anomalies is an effective means of determining the spatial extent and burial depth of a given target located beneath the seabed. Another function of the probe is to aid in determining the type of cultural material (i.e., wood, iron) and amount of overburden. Either a seven-foot steel probe or a ten-foot hydro-probe, depending on bottom type, was determined to be the most efficient tool for this project. Probes were spaced at ten-foot intervals along 100 foot arcs placed at ten-foot intervals across the area of the anomaly. The probes were forced into the sea bed to a desired depth. If a positive return was encountered, probing distances were refined in an effort to outline the size of the return.

If a target area could not be located through diver examination, it was generally considered that the source of the anomaly was either too deeply buried to be impacted by future activities, or more likely consisted of material difficult to pinpoint via probing, such as steel cable. In general articulated sections of wreck sites provide a good target for probing.

Use of Metal Detector
Another effective means of locating buried iron objects is through use of an underwater metal detector. This instrument is used in much the same manner as a regular metal detector. While the diver is making sweeps, as directed by the dive supervisor, he or she will sweep the metal detector across his or her path. This method is particularly useful for determining whether the anomaly is the result of a single large object or a collection of smaller localized objects.

Environmental Conditions

Water depths in the project area ranged from zero to 55 feet. Water temperature was in the low-60° range. There was no thermocline. Air temperatures ranged from 75° to 100°. Surge and surf were minimal, although tidal currents could exceed three knots. Rain was encountered on several days but did not hamper the diving operations. Marine life was minimal.

Photography and Video Conditions

Visibility ranged from zero to five feet, and conditions were generally poor for both still photography and video. Visibility was generally poorer after rain, falling to zero in most cases. In spite of the difficult conditions, some useable video was obtained.

6. RESULTS

The investigation took place during July 31–September 18, 2002. Twenty-eight anomalies and 11 acoustic targets were refined and dived (Figure 46a-e). Of the 28 magnetic anomalies, six were pipelines, 10 were miscellaneous non-historic modern debris, six were non-significant modern structures, two were non-significant submerged marine resources, one had a refined location outside the project area, one was not relocated on refinement, and two were not dived or refined due to safety concerns. Of the 11 acoustic targets, three were non-significant modern structures, six were non-significant submerged marine resources, one was determined to be outside the project area on refinement, and elements of one were determined eligible for listing on the NRHP and are recommended for Phase III investigation. In addition, the remote-sensing survey located two acoustic targets that were investigated by Panamerican divers. Of these, one was determined to consist of two modern steel vessels, and one was determined to be a cluster of five historic vessels, four of which were determined eligible for listing on the NRHP and are recommended for Phase III investigation.

Several targets in the original survey area were added to the diving investigation, including two wrecks located on the navigation charts in areas that were not surveyed during the original survey due to extremely low water; one wreck noted above water at low tide; and one acoustic target located during the original survey but not recommended for further work because it was initially determined to be outside the project area. Examination of the site determined that elements of it are in fact inside the project area. This target, SS22, consists of 17 vessels, but only one vessel is recommended for additional work. A summary of targets investigated is included in Table 4. Sites determined eligible for NRHP status and recommended for additional work are listed in Table 5 and on Figure 47. Vessel numbers are those used in Raber (et al. 1995b) and James (1999). A total of 6 vessels are recommended for further investigation.

Table 4. Targets Investigated.

Target	Type	Easting	Northing	Description	Further Work Recommended
A8	anomaly	593971	670141	modern debris	no
A9	anomaly	594123	670650	large 7' X 15' block of reinforced concrete, function unknown	no
A12	anomaly	595299	673793	not relocated on refinement	no
A15	anomaly	595451	674065	relocated on one line only; modern debris	no
A27	anomaly	590746	663270	combination of pipeline and remains of Conrail railroad trestle	no
A33	anomaly	590574	662744	modern debris	no
A39	anomaly	576833	658171	located in channel; not significant	no
A43	anomaly	581591	660921	remains of pier	no
A46	anomaly	582338	660900	pipeline	no
A49	anomaly	589176	662578	refined location outside project area	no
A50	anomaly	588844	662168	large pile of broken concrete	no
A51	anomaly	588710	662020	scattered debris on channel slope	no
A52	anomaly	589250	662729	modern debris	no
A53	anomaly	588931	662335	giant tire	no
A54	anomaly	588762	662151	modern debris	no
A55	anomaly	587691	660908	remains of dock, pier or tower	no
A61	anomaly	589315	662875	2 large metal objects under silt, attached to modern rope	no
A62	anomaly	589479	663219	pipeline	no
A63	anomaly	589695	663650	remains of Conrail railroad trestle	no
A64	anomaly	593455	659908	engine block	no
A73	anomaly	595314	659757	pipeline	no
A81	anomaly	656762	601225	unrecognizable large mass of metal	no
A85	anomaly	618275	651117	pipeline	no

Target	Type	Easting	Northing	Description	Further Work Recommended
A86	anomaly	618166	651567	pipeline	no
A99	anomaly	611407	660845	not refined or dived due to safety reasons	see discussion
A100	anomaly	612240	660479	not refined or dived due to safety reasons	see discussion
A101	anomaly	580587	660159	two piers, remains of pilings, trash	no
A110	anomaly	616361	650135	pipeline	no
SS3	side scan	657412	600934	part of unrecognizable large mass of metal (see A81 and SS4)	no
SS4	side scan	656762	601225	part of unrecognizable large mass of metal (see A81 and SS3)	no
SS11	side scan	600924	660453	barge remains - heavily deteriorated	no
SS13	side scan	597090	659063	refinement indicated target lies outside project area	no
SS16	side scan	587579	659553	3 derelict vessels	see discussion
SS19	side scan	582151	660191	several derelict vessels including 2 tugs, and a pier	no
SS24	side scan	581668	660989	old pilings or pier-similar to nearby structures visible at low water	no
SS26	side scan	593559	659955	barge or cargo vessel with hard chine. Wood and iron composite construction	no
SS27	side scan	590881	663231	remains of Conrail railroad trestle	no
SS28	side scan	590309	662041	large amount of steel cable off bottom, & remains of pier	no
SS29	side scan	590743	663018	steel jacketed piling	no
SSa	side scan	591320	658186	Cluster 3 (Raber et al. 1996) two iron wrecks – barge and possible tug	no
SSb	side scan	589729	657941	Cluster 4 (Raber et al. 1996). See discussion	yes
Additional targets					
T1	wreck	587490	660975	heavily deteriorated unrecognizable remains of wooden structure or vessel	no
T2	wreck	587385	660801	modern debris	no
T3	visible remains	579487	659864	heavily deteriorated remains of scow with bulkhead construction	no
SS22	side scan	585155	660137	northwest side of Shooters Island. 13 derelict vessels	yes

Table 5. Targets Recommended for Further Investigation.

Target	Vessel #	Description	Eligibility Criteria	Recommendation
SSb	V33	Menhaden trawler *Fish Hawk*	C, D	complete recordation and archival research
SSb	V36	Wood hydraulic dredge	D	recordation of main structural elements and basic dimensions
SSb	V37	4 masted schooner *Paul E. Thurlow*	C, D	complete recordation and archival research
SSb	V38	Balanced floating drydock	D	complete recordation and archival research
SS22	V2	Balanced floating drydock	C, D	complete recordation and archival research
SS16b	NA	Iron/wood composite vessel	C, D	complete recordation and archival research including recovery and conservation of diagnostic artifacts

DIVING RESULTS-ANOMALIES

Anomaly 8

Anomaly 8 is located in Newark Bay (see Figure 46a and 48), and appeared across three tracklines. Its coordinates as located during the survey were 593971 East/670141 North. Refined coordinates were 594000 East/670120 North. Its strength was +141/-4417 and duration was 51 feet. This anomaly was dived and determined to be modern debris; it is not recommended for further investigation.

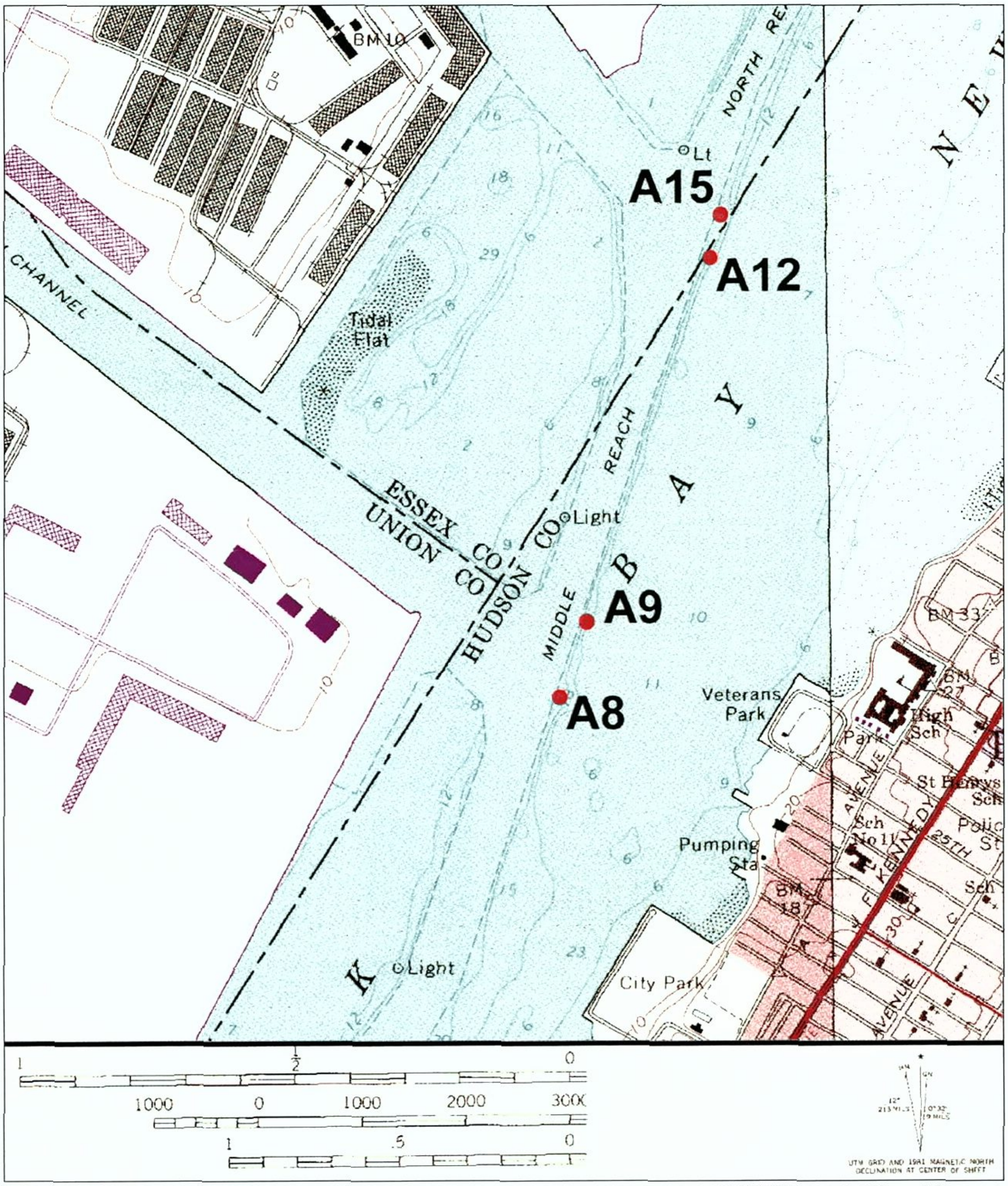

Figure 46a. Map of anomalies and side-scan sonar targets dived (base map: USGS Elizabeth NJ and Newark NJ 15' quadrangles).

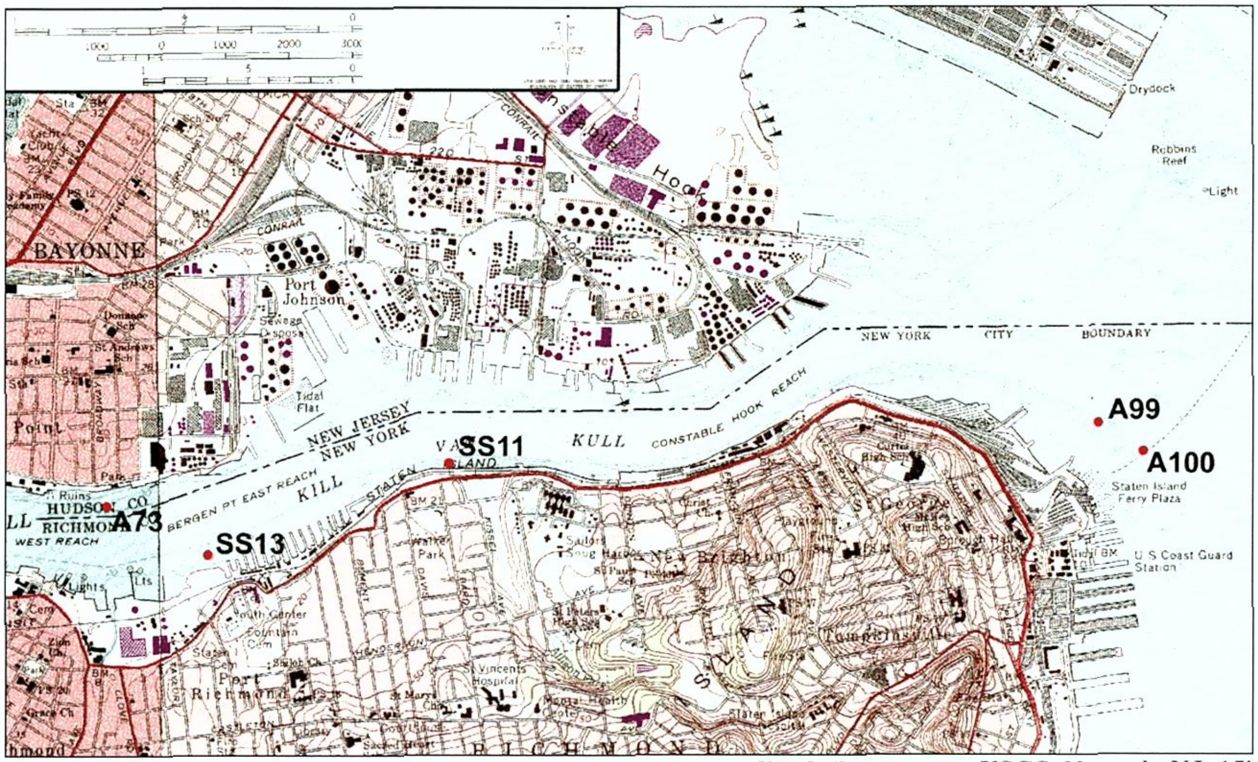

Figure 46b. Map of anomalies and side-scan sonar targets dived (base map: USGS Newark NJ 15' quadrangles).

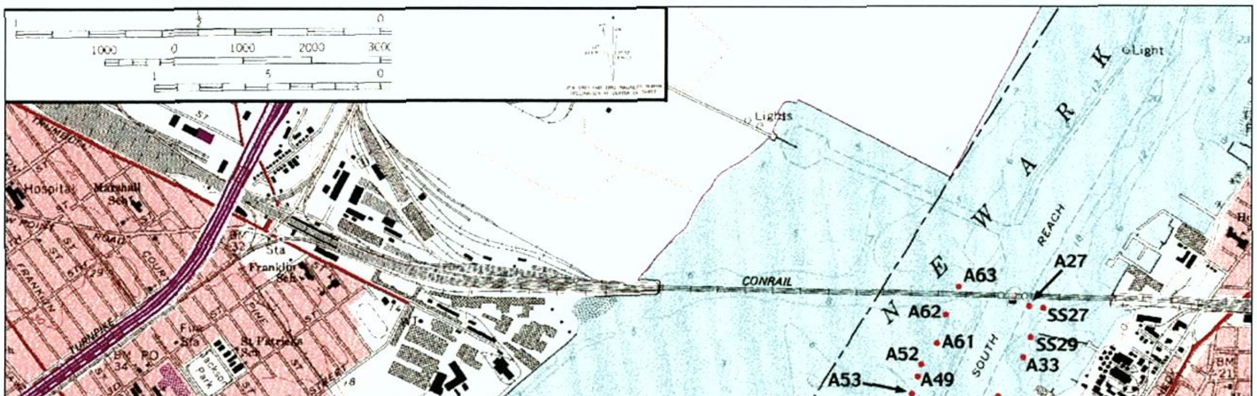

Figure 46c. Map of anomalies and side-scan sonar targets dived (base map: USGS Elizabeth NJ 15' quadrangles).

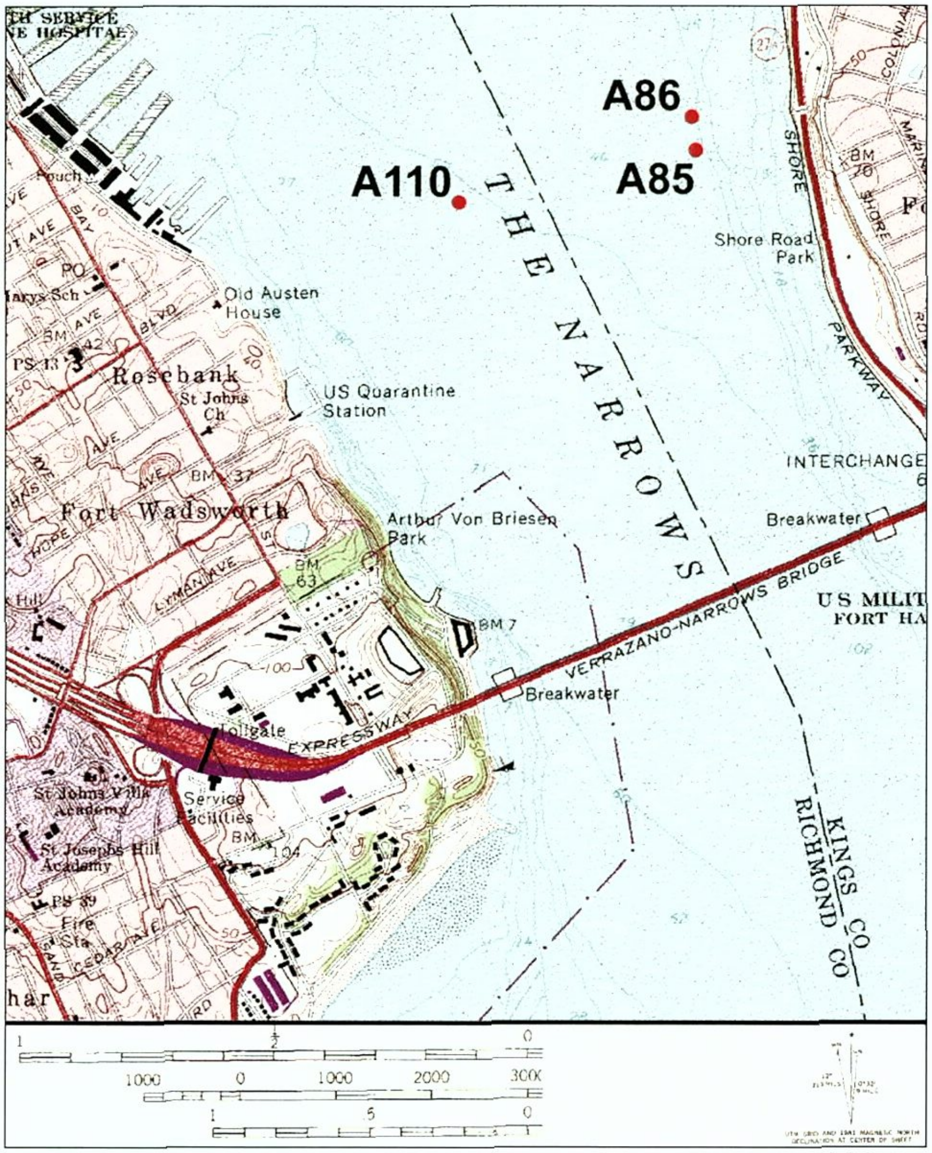

Figure 46d. Map of anomalies and side-scan sonar targets dived (base map: USGS Narrows NY 15' quadrangle).

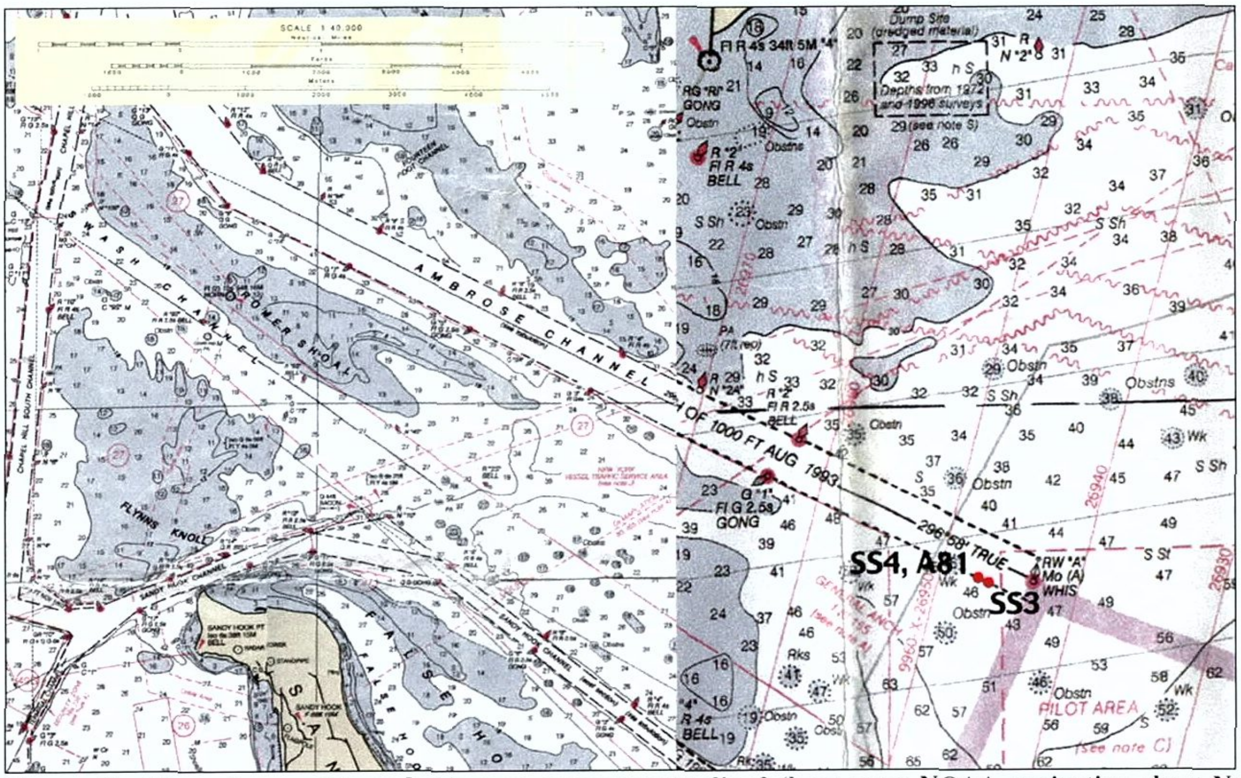

Figure 46e. Map of anomalies and side-scan sonar targets dived (base map: NOAA navigation chart No. 12326: Approaches to New York - Fire Island to Sea Girt).

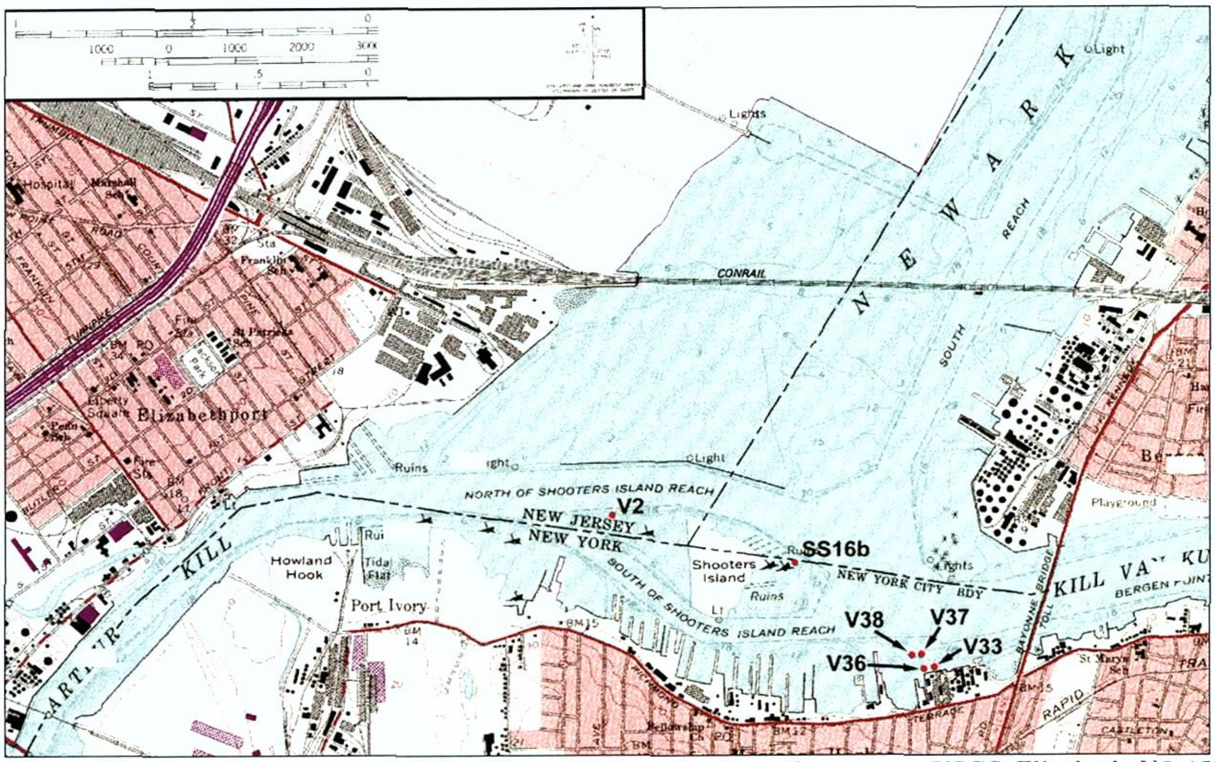

Figure 47. Targets recommended for Phase III investigations (base map: USGS Elizabeth NJ 15' quadrangle).

Anomaly 9
Anomaly 9 is located in Newark Bay (see Figure 46a and 48), and appeared across five tracklines. Its coordinates as located during the survey were 594123 East/670650 North. Refined coordinates were 594120 East/670640 North. Its strength was +281/-6890 and duration was 336 feet. Diving investigation revealed the source of the anomaly to be a large block of reinforced concrete with approximated dimensions of 7' x 15' x 10'. It is not considered significant and is not recommended for further investigation.

Anomaly 12
Anomaly 12 is located in Newark Bay (see Figure 46a, 49), and appeared across three tracklines. Its coordinates as located during the survey were 595299 East/673793 North. Its original strength was +192/-26 and original duration was 73 feet. This anomaly was not relocated on refinement and is not recommended for further investigation.

Anomaly 15
Anomaly 15 is located in Newark Bay (see Figure 46a, 49), and appeared across two tracklines. Its coordinates as located during the survey were 595451 East/674065 North. Refined coordinates were 595460 East/674080 North. Its strength was +104/-87 and duration was 175 feet. On refinement, it only appeared across one trackline. This anomaly was dived and determined to be modern debris; it is not recommended for further investigation.

Anomaly 27
Anomaly 27 is located in Newark Bay (see Figure 46c, 50), and appeared across three tracklines. It was located at 590746 East/663270 North. Refined coordinates were 590720 East/663340 N. Its strength was +274/-176 and duration was 153 feet. On refinement, it appeared across three tracklines. It is associated with acoustic target SS27.

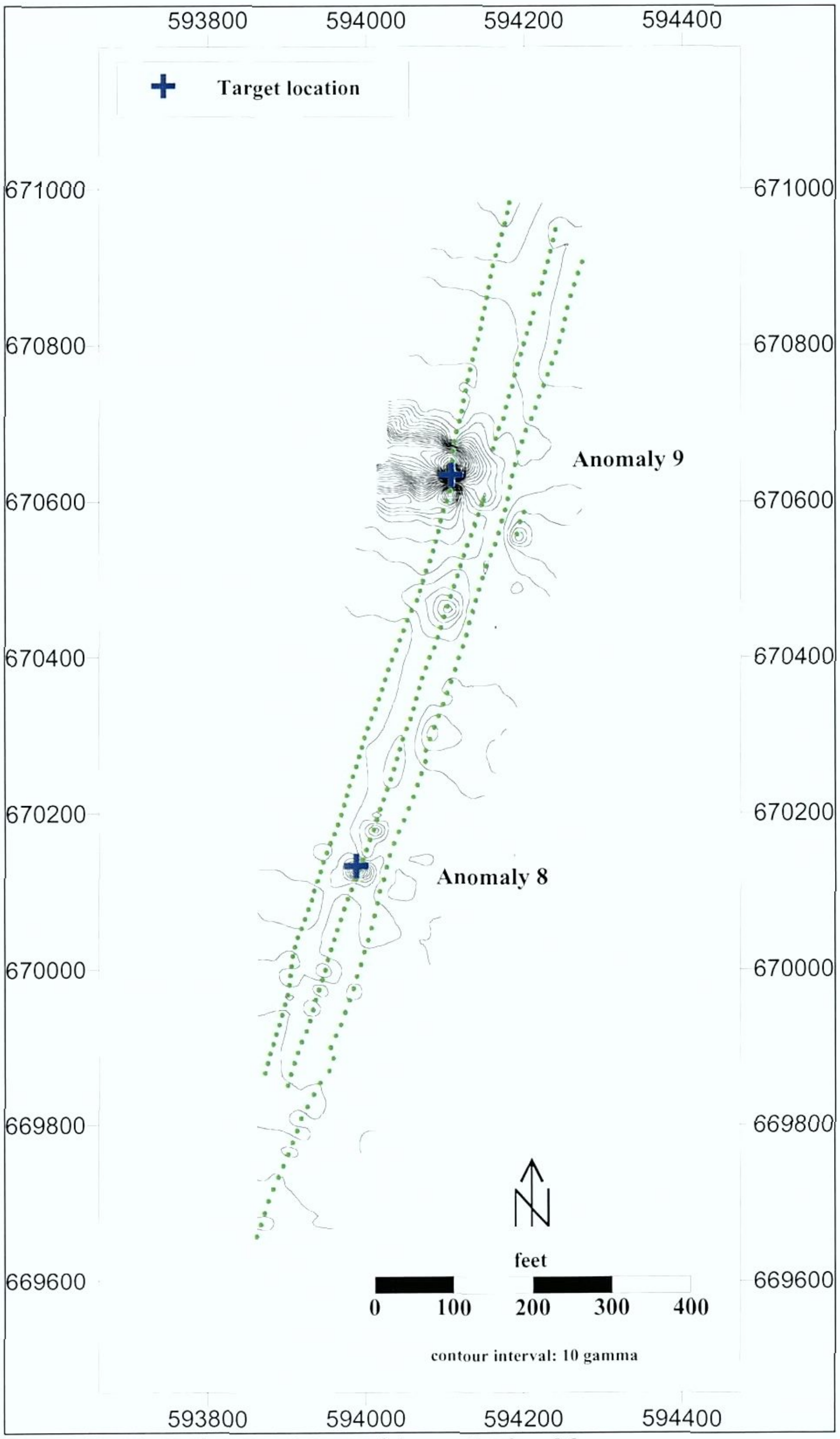

Figure 48. Magnetic anomaly map of Anomalies 8 and 9.

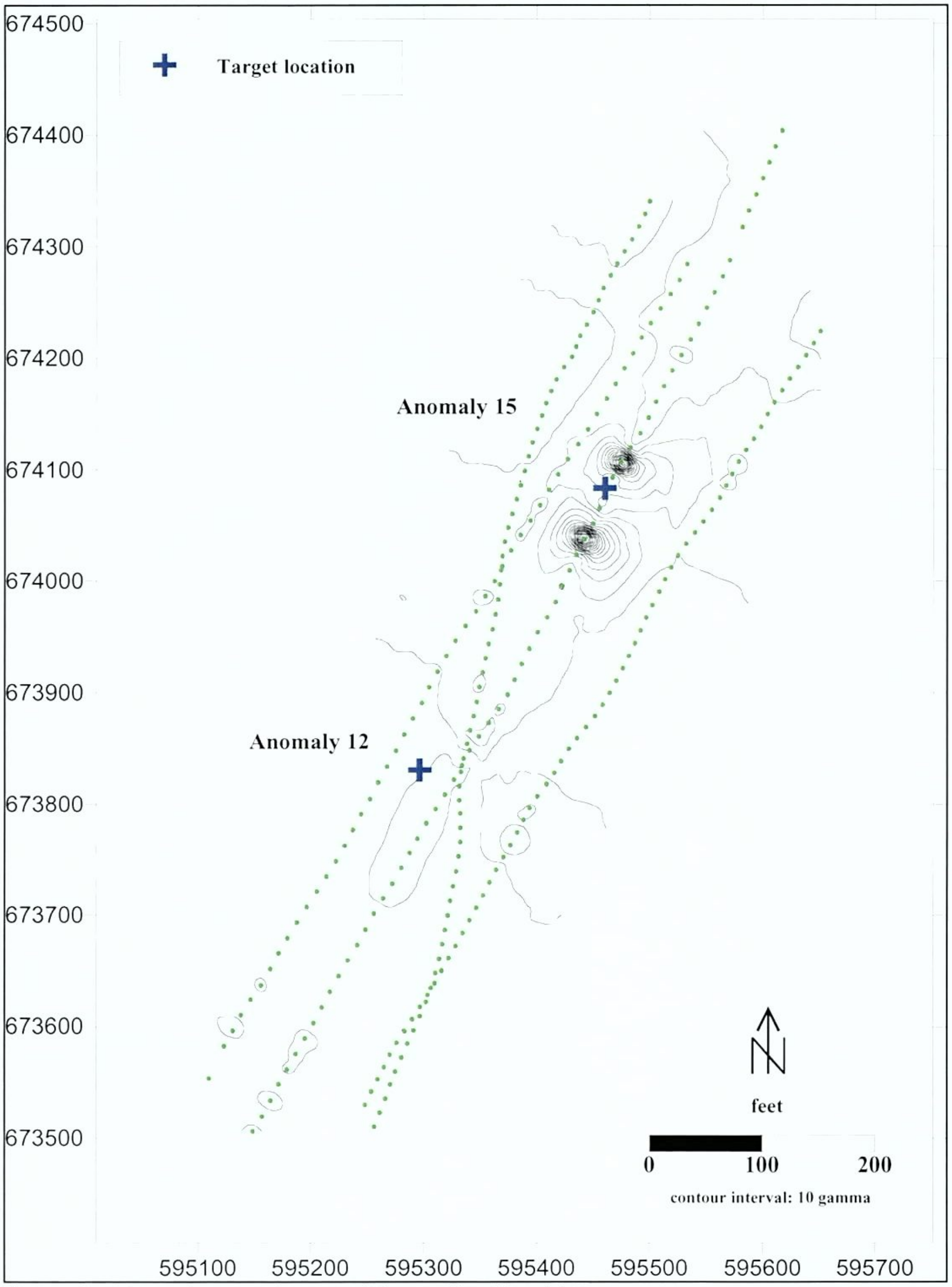

Figure 49. Magnetic anomaly map of Anomalies 12 and 15.

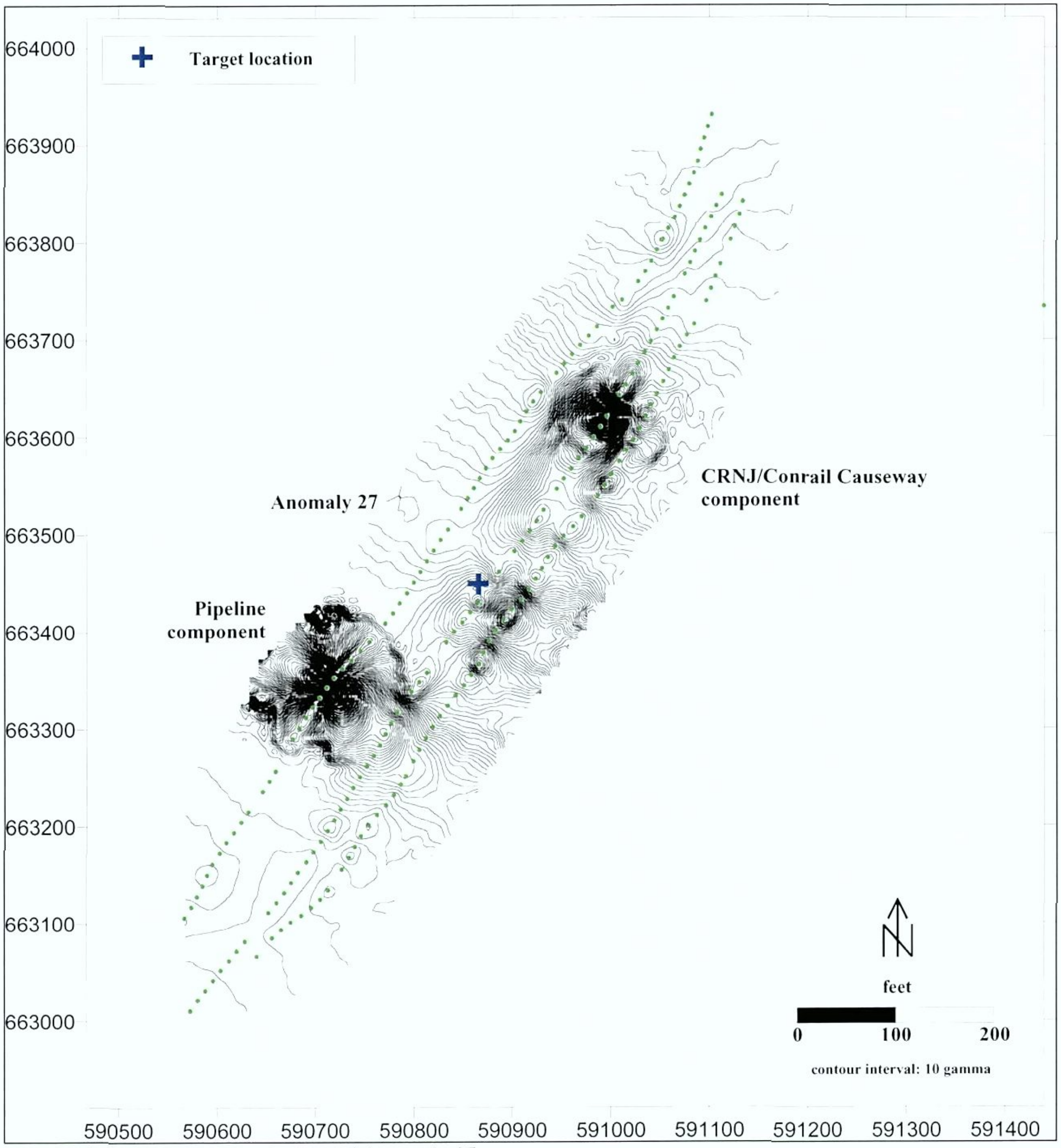

Figure 50. Magnetic anomaly map of Anomaly 27.

This anomaly was dived and its source was determined to be a combination of a pipeline (Figure 51) and the remains of the Central Railroad causeway that used to exist across Newark Bay in this vicinity (Figure 52). This causeway was constructed in 1864 when the Central Railroad of New Jersey (later Conrail) extended service to Jersey City. It was removed in the early 1970s. The remains of this structure, due to their extremely fragmentary condition, are not considered historically significant and are not recommended for further investigation.

Figure 51. Photograph of pipeline sign indicating the source of part of Anomaly 27.

Figure 52. Remains of Central Railroad of New Jersey/Conrail causeway, the source of part of Anomaly 27.

Anomaly 33

Anomaly 33 is located in Newark Bay (see Figure 46c, 53), and appeared across two tracklines. It was located at 590574 East/662744 North. Refined coordinates were 590560 East/662790 North. Its strength was +63/-23 with a duration of 234 feet. This anomaly was dived and probed with both hand- and hydro-probes. Various pieces of modern debris were found, along with a hard clay layer at two to three feet below the bottom. Although the located debris alone does not account for the anomaly, it is likely that other pieces of debris, including wire rope, exist in the three-foot layer between the bottom and the clay, and simply fell between probes. Also, any historic vessel present in the area of the anomaly would not sink below the clay layer, and would likely project above the river bottom and thus would have been seen with the side-scan sonar. This anomaly is not considered significant and is not recommended for further investigation.

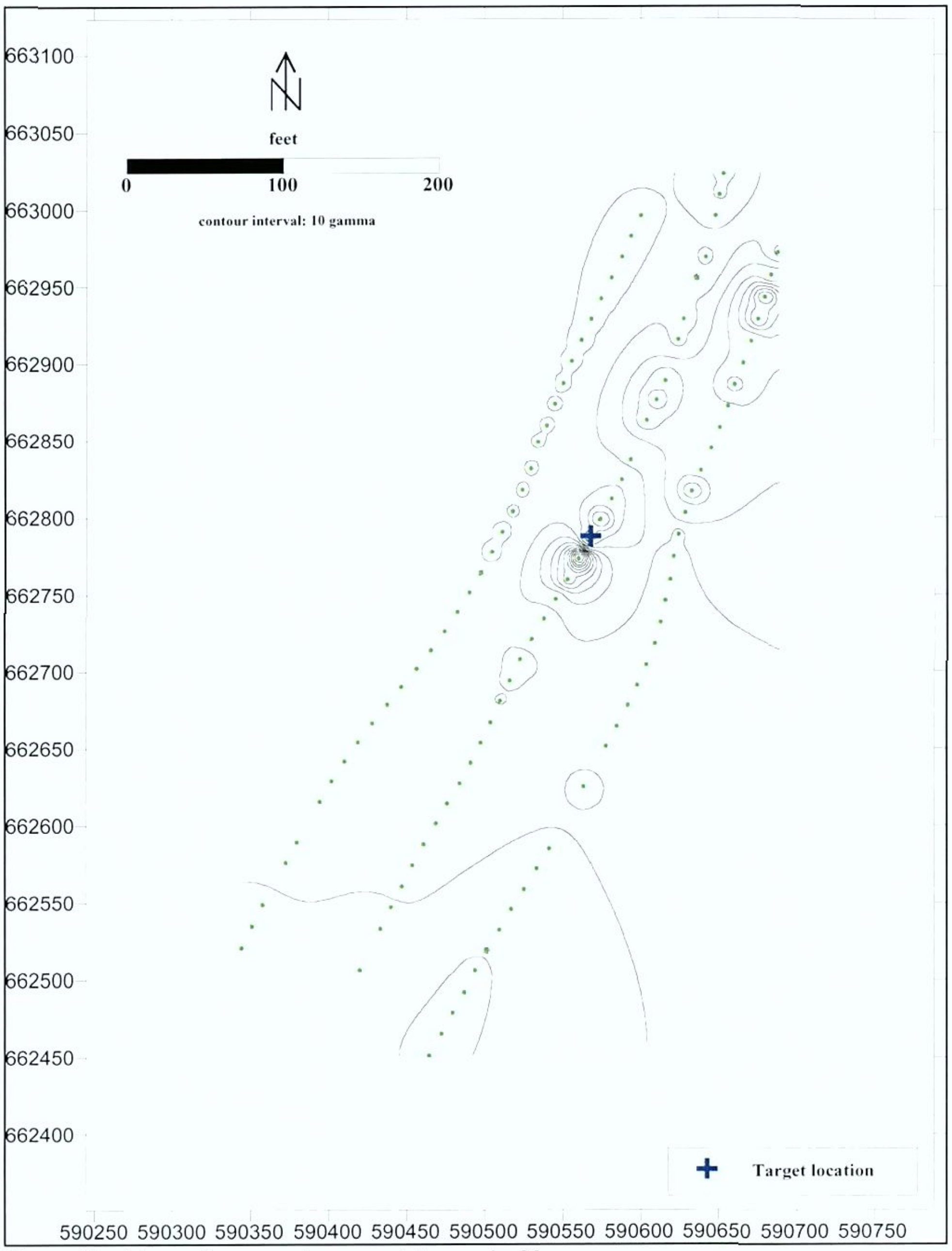

Figure 53. Magnetic anomaly map of Anomaly 33.

Anomaly 39
Anomaly 39 is located in Arthur Kill (see Figure 46c), and appeared across one trackline. It was located at 576833 East/658171 North. Its original strength was +25/-0 with a duration of 102 feet. This location was chosen for investigation not because of its magnetic characteristics, but because it appeared as a wreck on the navigation chart. This location was not dived, as it was determined that it was located in the navigation channel, and hence would have been removed during previous dredging operations. This target is not considered significant and is not recommended for further investigation.

Anomaly 43
Anomaly 43 is located in Arthur Kill (see Figure 46, 54), and appeared across two tracklines. It was located at 581591 East/660921 North. Its refined coordinates are 581680 East/660945 North. Its strength was +304/-0 with a duration of 146 feet. It was associated with acoustic target SS24. This target was dived and determined to be the remains of an old pier, characterized by a series of wooden pilings and disarticulated timbers, coupled with an assortment of trash and debris. This target is not considered significant and is not recommended for further investigation.

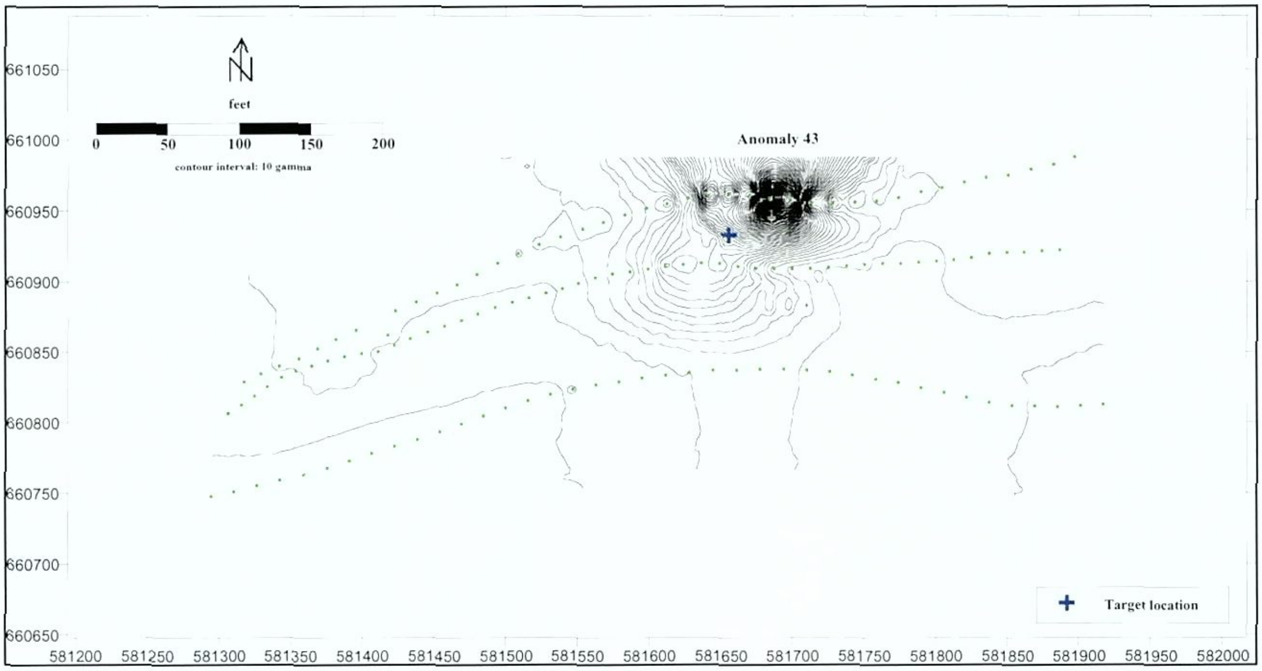

Figure 54. Magnetic anomaly map of Anomaly 43.

Anomaly 46
Anomaly 46 is located in Arthur Kill (see Figure 46c, 55), and appeared across one trackline. It was located at 582338 East/660900 North. Refined coordinates are 582380 East/660900 North. Its strength was +35/-1606 with a duration of 569 feet. On refinement, it appeared across five tracklines. This anomaly was not dived as it was determined to be a pipeline, as evidenced by a sign detailing such (Figure 56). This anomaly is not considered significant and is not recommended for further investigation.

Anomaly 49
Anomaly 49 is located in Newark Bay (see Figure 46c, 57), and appeared across two tracklines. It was located at 589176 East/662578 North. Refined coordinates are 589260 East/662760 North. Its strength was +111/-0 with a duration of 423 feet. On refinement, the anomaly appeared across two tracklines. The source of this anomaly was determined to be located outside the project area, and is not recommended for further investigation.

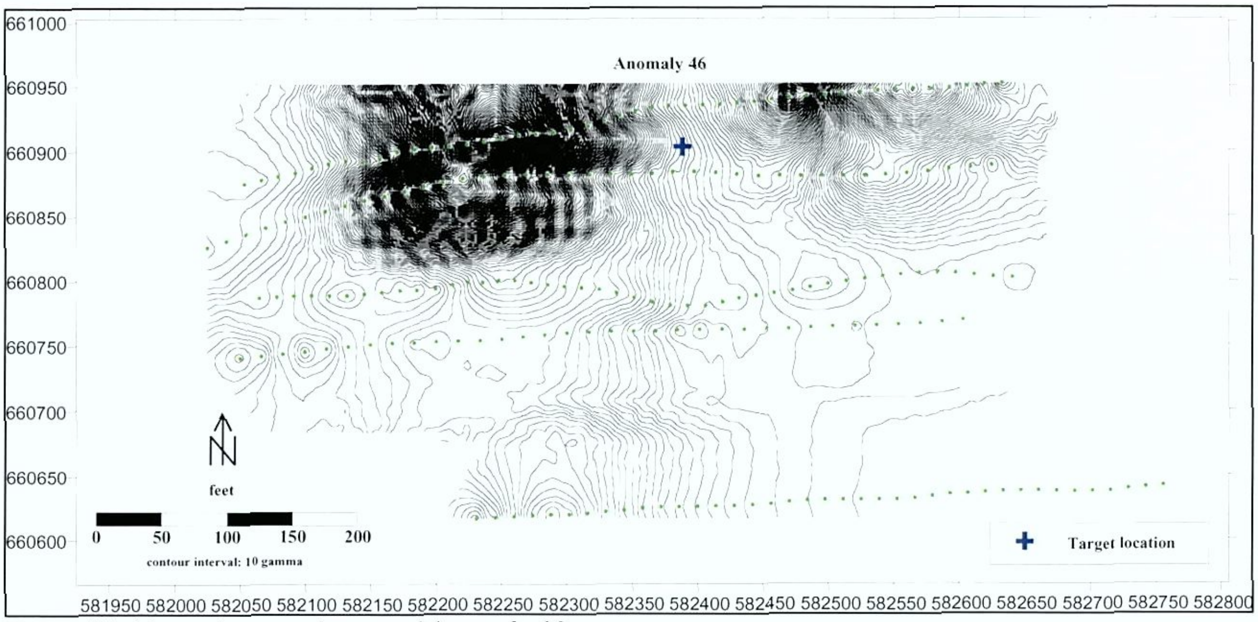

Figure 55. Magnetic anomaly map of Anomaly 46.

Figure 56. Photograph of pipeline sign indicating the source of Anomaly 46.

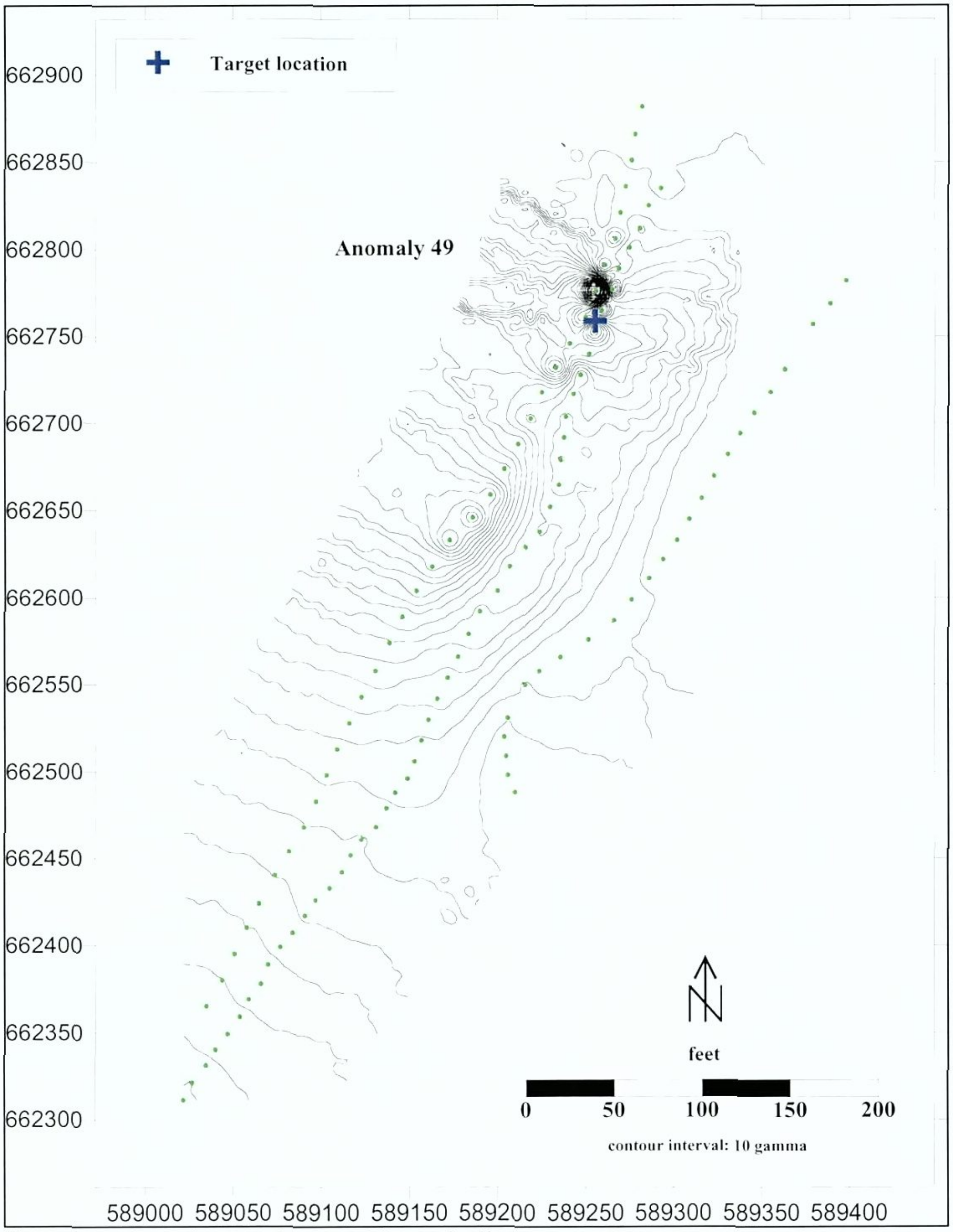

Figure 57. Magnetic anomaly map of Anomaly 49.

Anomaly 50

Anomaly 50 is located in Newark Bay (see Figure 46c, 58), and appeared across one trackline. It was located at 588844 East/662168 North. Refined coordinates are 588880 East/662280 North. Its strength was +0/-121 with a duration of 219 feet. This anomaly was dived and determined to be a large scatter of broken concrete, including at least one reinforced concrete mooring block. This anomaly is not considered significant and is not recommended for further investigation.

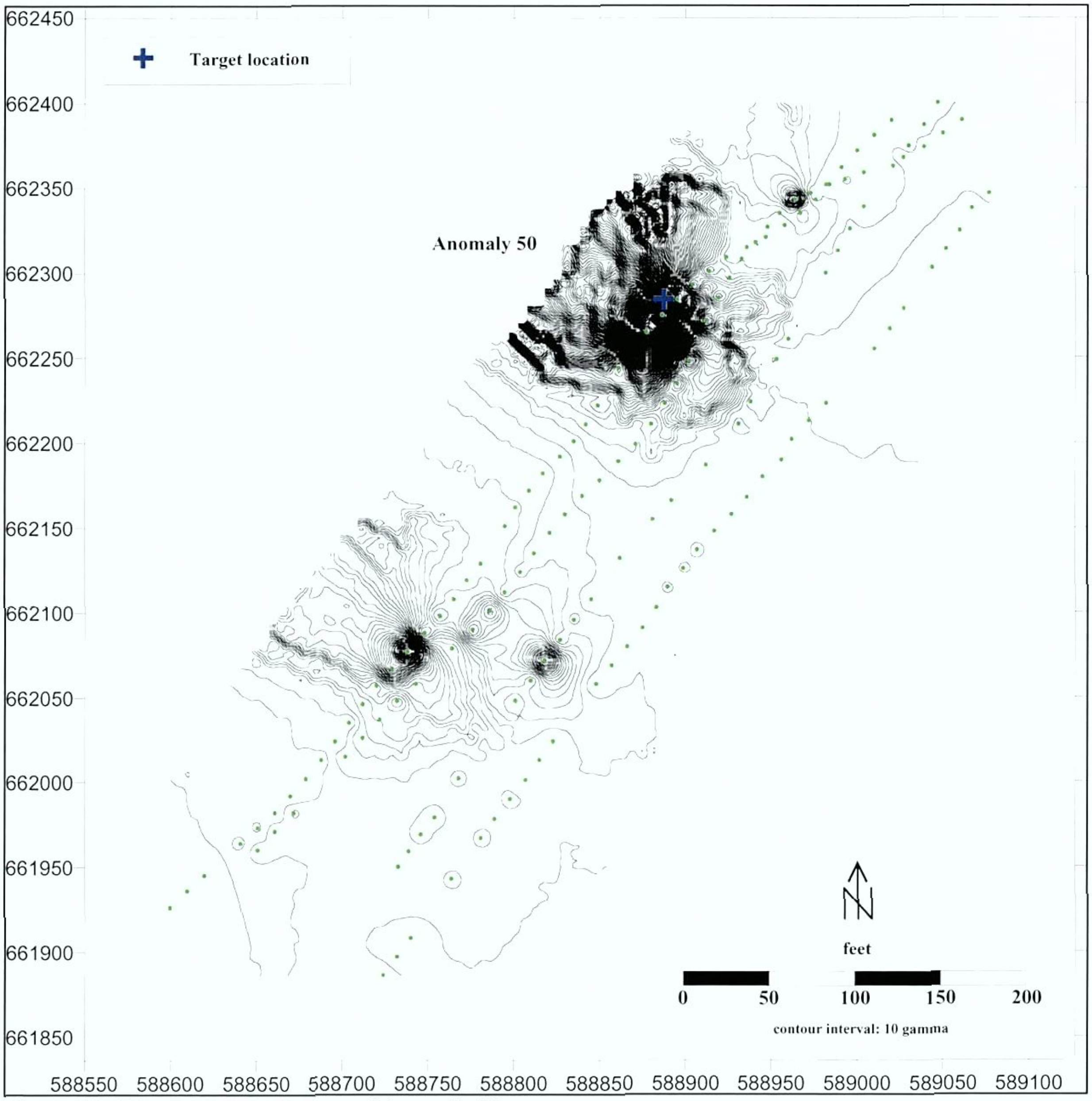

Figure 58. Magnetic anomaly map of Anomaly 50.

Anomaly 51

Anomaly 51 is located in Newark Bay (see Figure 46c, 59), and appeared across three tracklines. It was located at 588710 East/662020 North. Refined coordinates are 588720 East/662070 North. Its strength was +52/-113 with a duration of 204 feet. This anomaly was dived and determined to be scattered debris located on the channel slope. It is not considered significant and is not recommended for further investigation.

Anomaly 52

Anomaly 52 is located in Newark Bay (see Figure 46c, 60), and appeared across one trackline. It was located at 589250 East/662729 North. Refined coordinates are 589280 East/662760 North. Its strength was +180/-99 with a duration of 175 feet. This anomaly was dived and determined to be modern debris. It is not considered significant and is not recommended for further investigation.

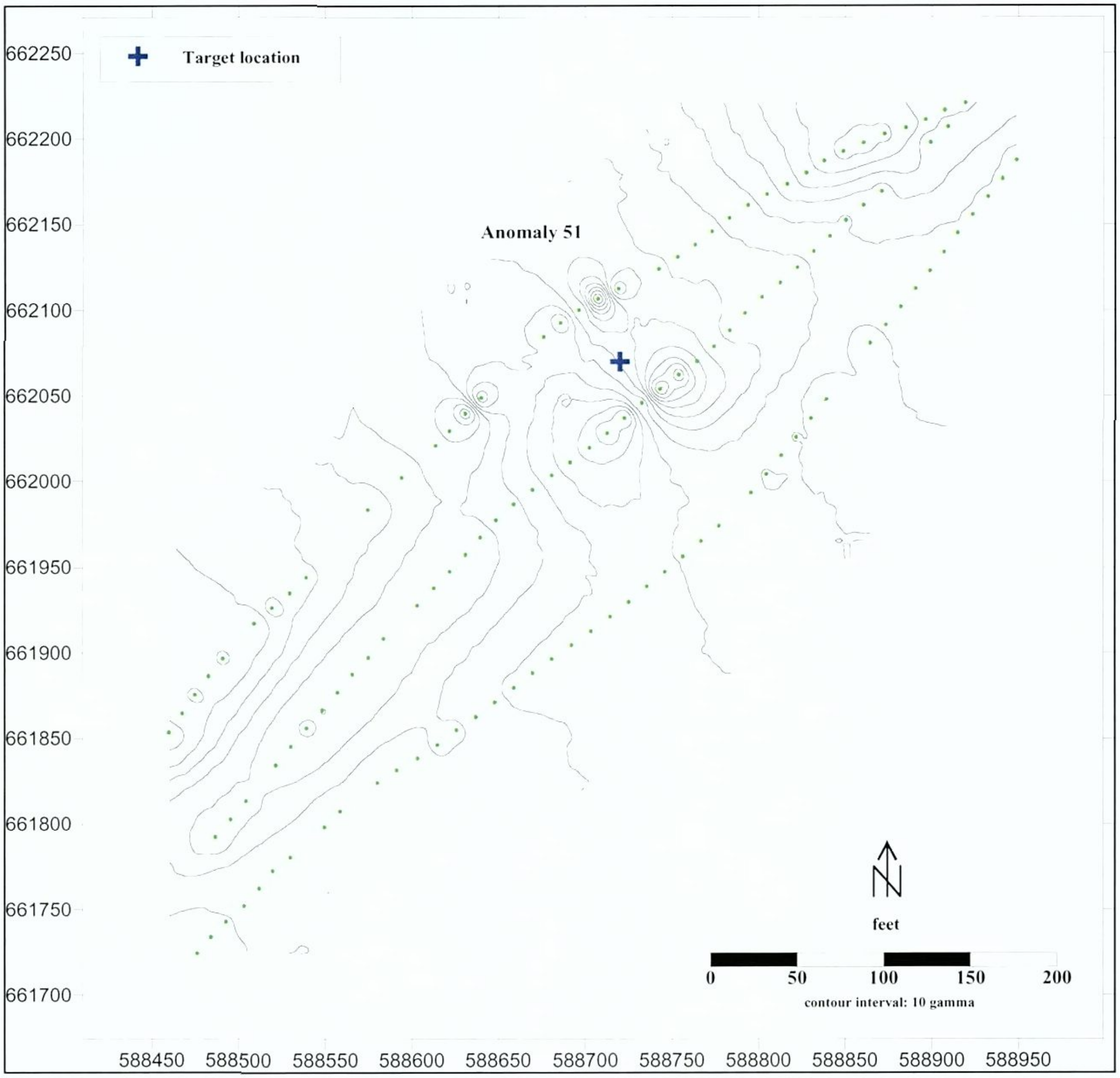

Figure 59. Magnetic anomaly map of Anomaly 51.

Anomaly 53

Anomaly 53 is located in Newark Bay (see Figure 46c, 61), and appeared across two tracklines. It was located at 588931 East/662335 North. Refined coordinates are 588860 East/662275 North. Its strength was +180/-99 with a duration of 175 feet. This anomaly was dived and determined to be a steel belted tire approximately eight feet in diameter. It is not considered significant and is not recommended for further investigation.

Anomaly 54

Anomaly 54 is located in Newark Bay (see Figure 46c, 62), and appeared across two tracklines. It was located at 588762 East/662151 North. Refined coordinates are 588730 East/662100 North. Its strength was +14/-212 with a duration of 117 feet. This anomaly was dived and determined to be modern debris. It is not considered significant and is not recommended for further investigation.

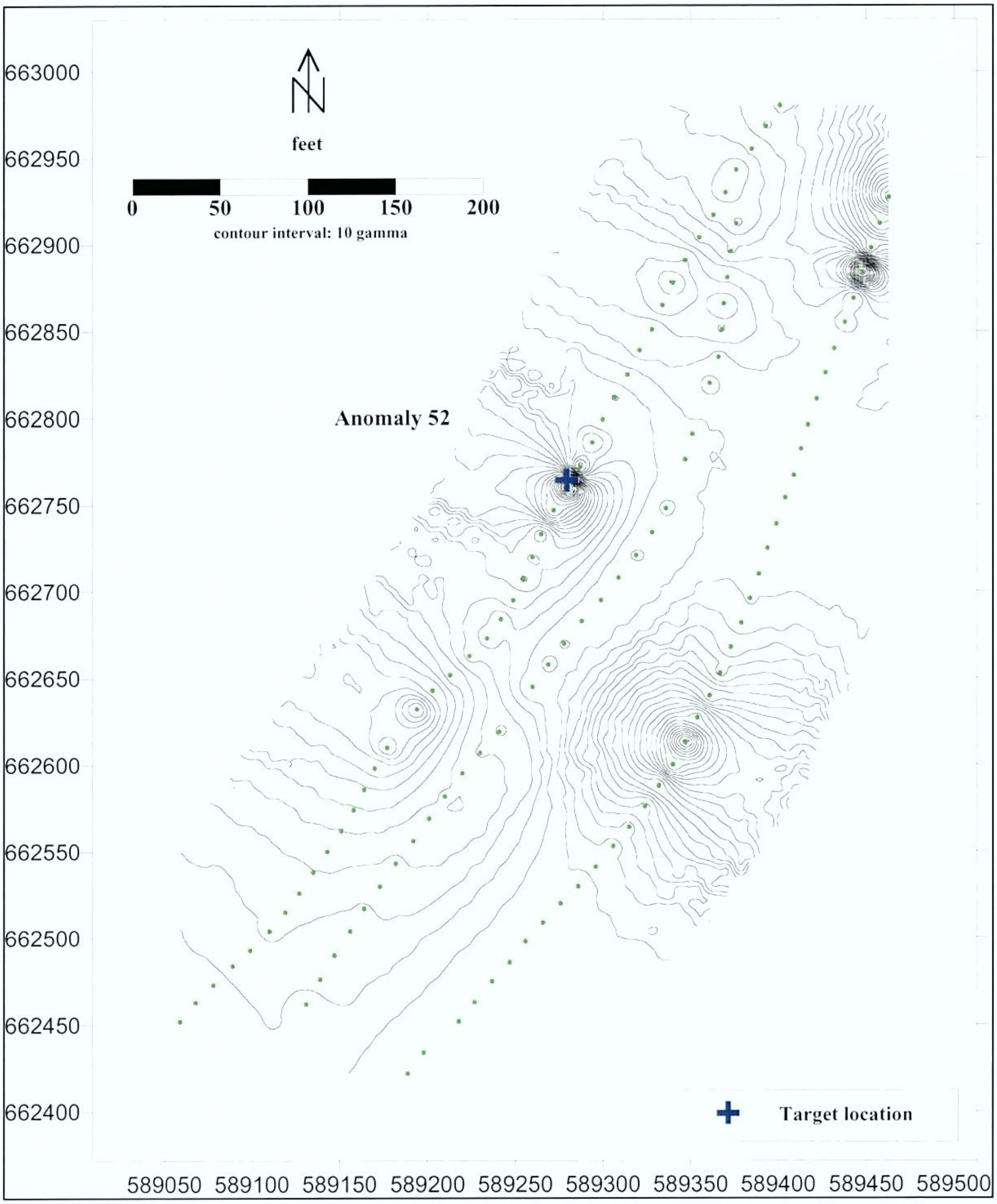

Figure 60. Magnetic anomaly map of Anomaly 52.

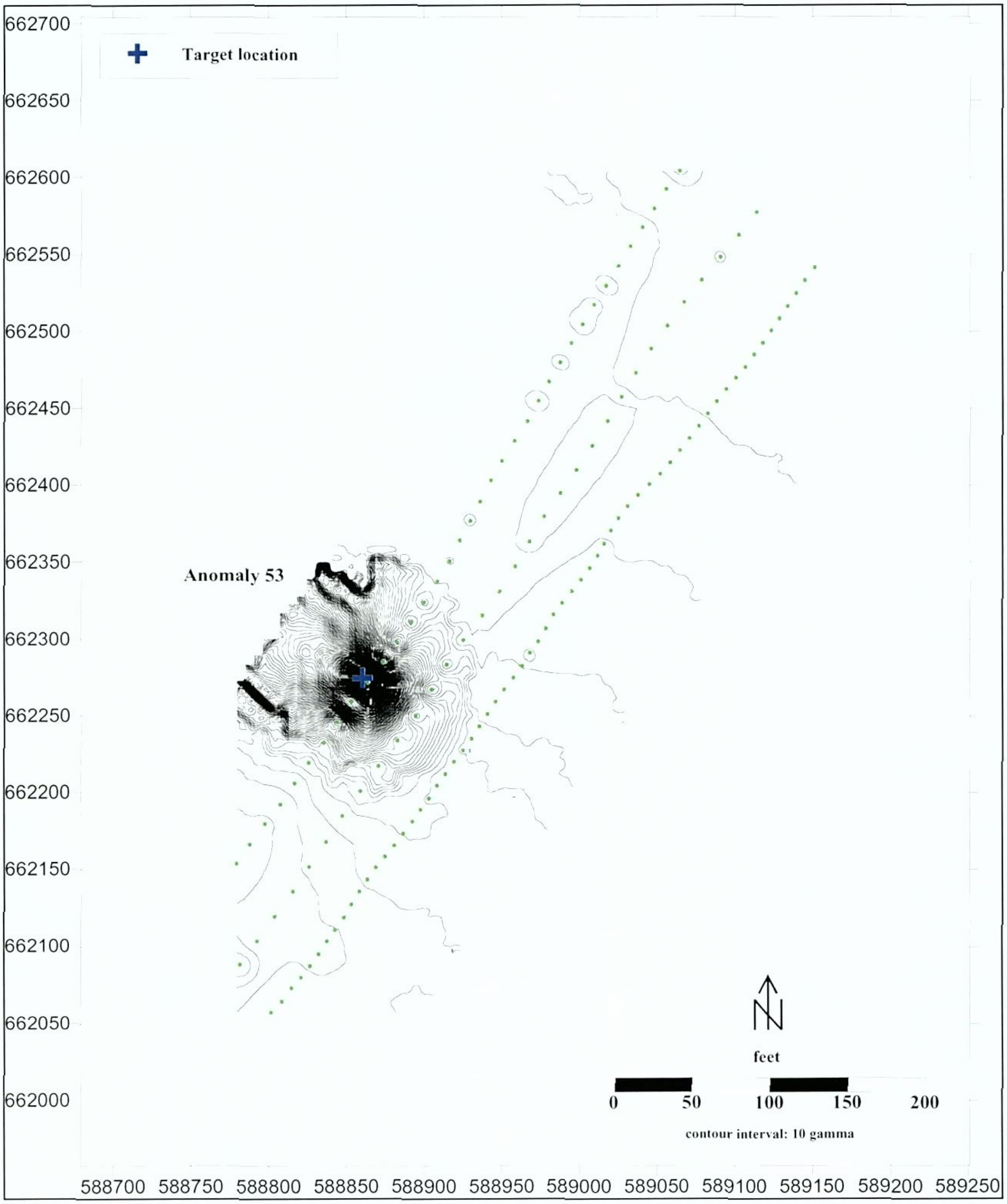

Figure 61. Magnetic anomaly map of Anomaly 53.

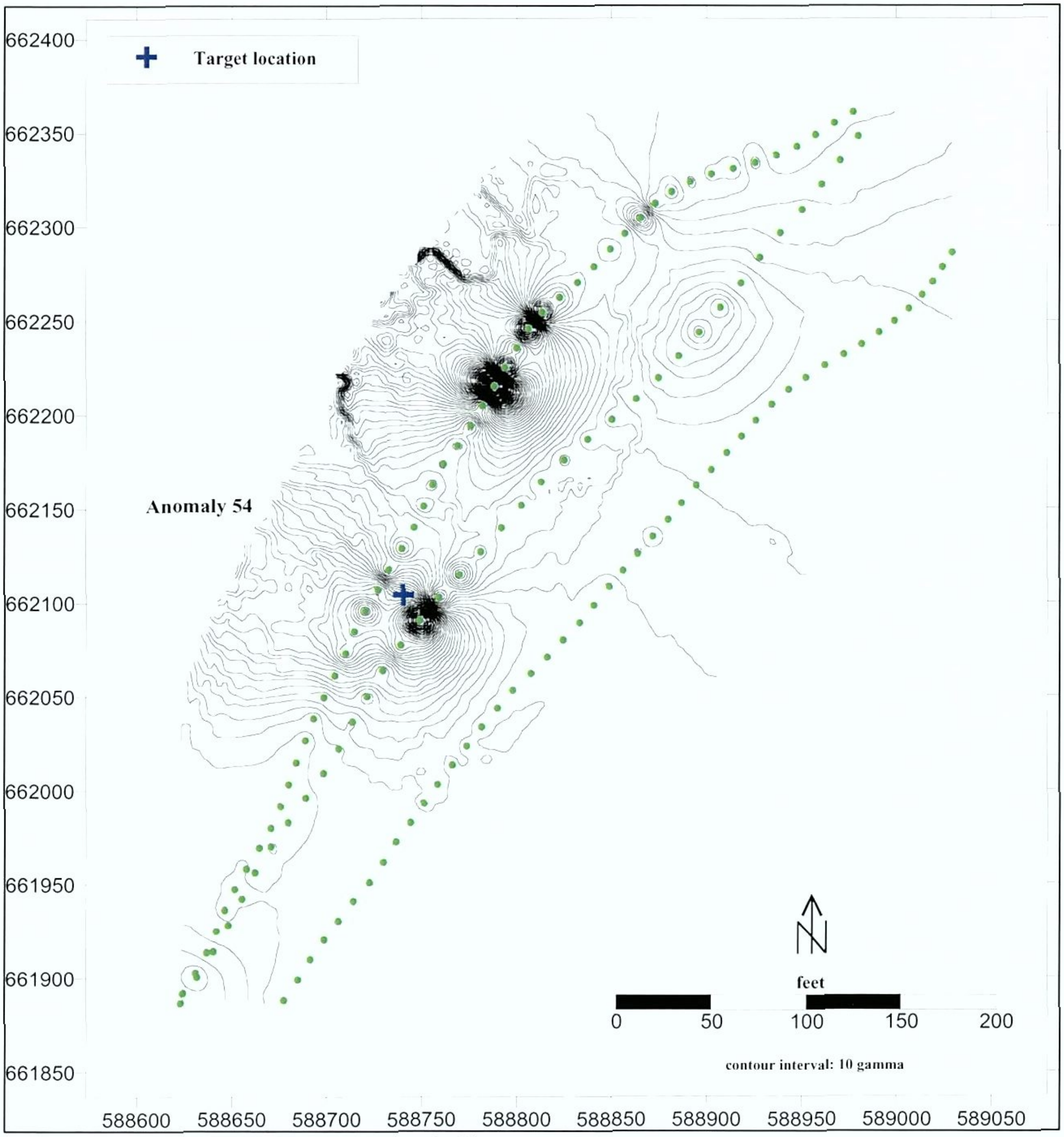

Figure 62. Magnetic anomaly map of Anomaly 54.

Anomaly 55

Anomaly 55 is located in Newark Bay (see Figure 46c, 63), and appeared across one trackline. It was located at 587691 East/660908 North. Refined coordinates are 587630 East/660820 North. Its strength was +709/-25 with a duration of 321 feet. This anomaly was dived and determined to consist of a series of wooden posts and pilings and assorted modern debris. This anomaly is not considered significant and is not recommended for further investigation.

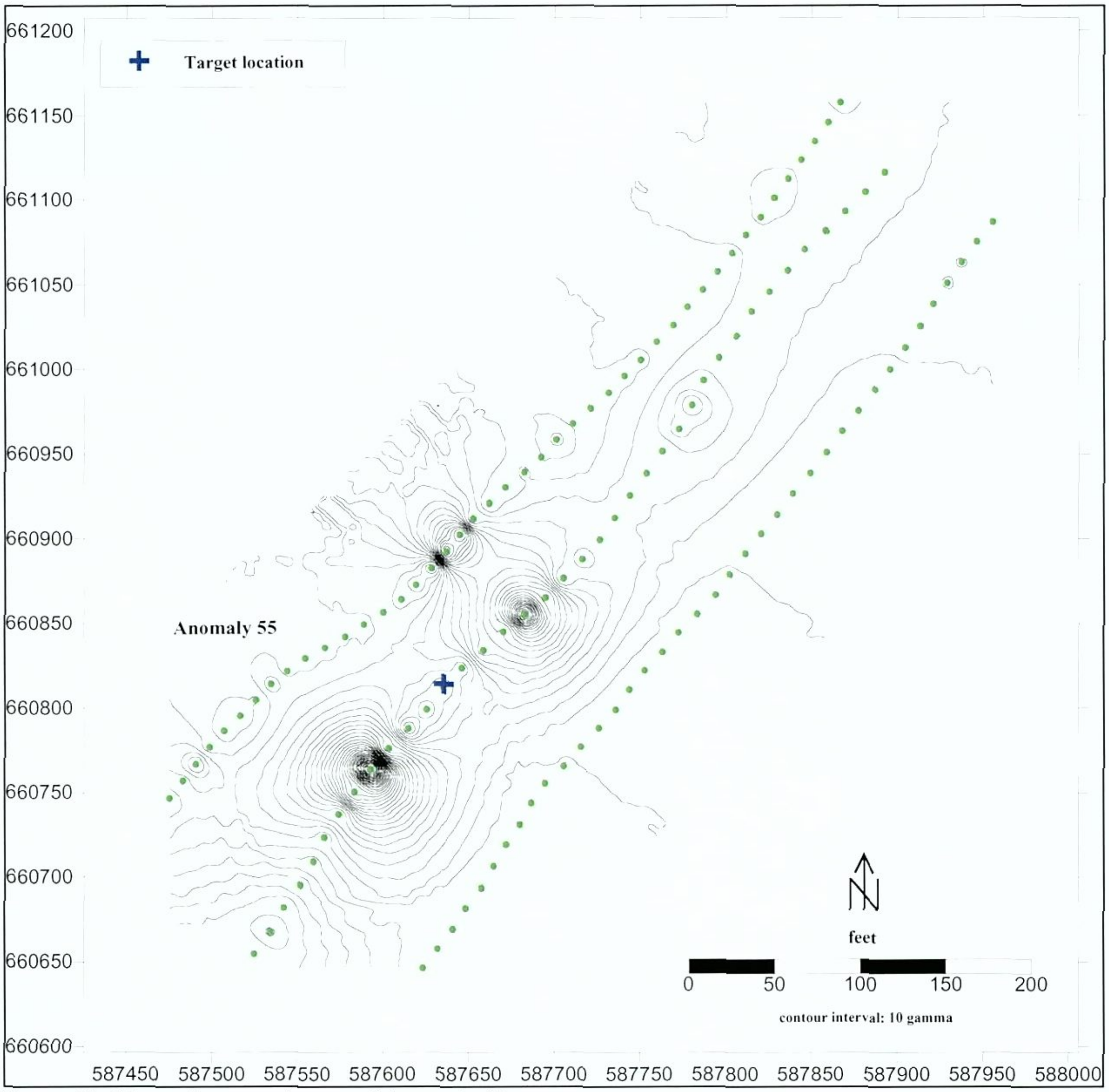

Figure 63. Magnetic anomaly map of Anomaly 55.

Anomaly 61

Anomaly 61 is located in Newark Bay (see Figure 46c, 64), and appeared across two tracklines. It was located at 589315 East/662875 North. Refined coordinates are 589330 East/663100 North. Its strength was +120/-60 with a duration of 146 feet. This anomaly was dived and determined to be two metal objects, possibly anchors, buried under three feet of mud. This anomaly is not considered significant and is not recommended for further investigation.

Anomaly 62

Anomaly 62 is located in Newark Bay (see Figure 46c, 65), and appeared across three tracklines. It was located at 589479 East/663219 North. Refined coordinates are 589300 East/663010 North. Its strength was +81/-493 with a duration of 365 feet. This anomaly was not dived but was determined to be a pipeline after the anomaly appeared across five lines on refinement and a sign was noted on the shore. This anomaly is not considered significant and is not recommended for further investigation.

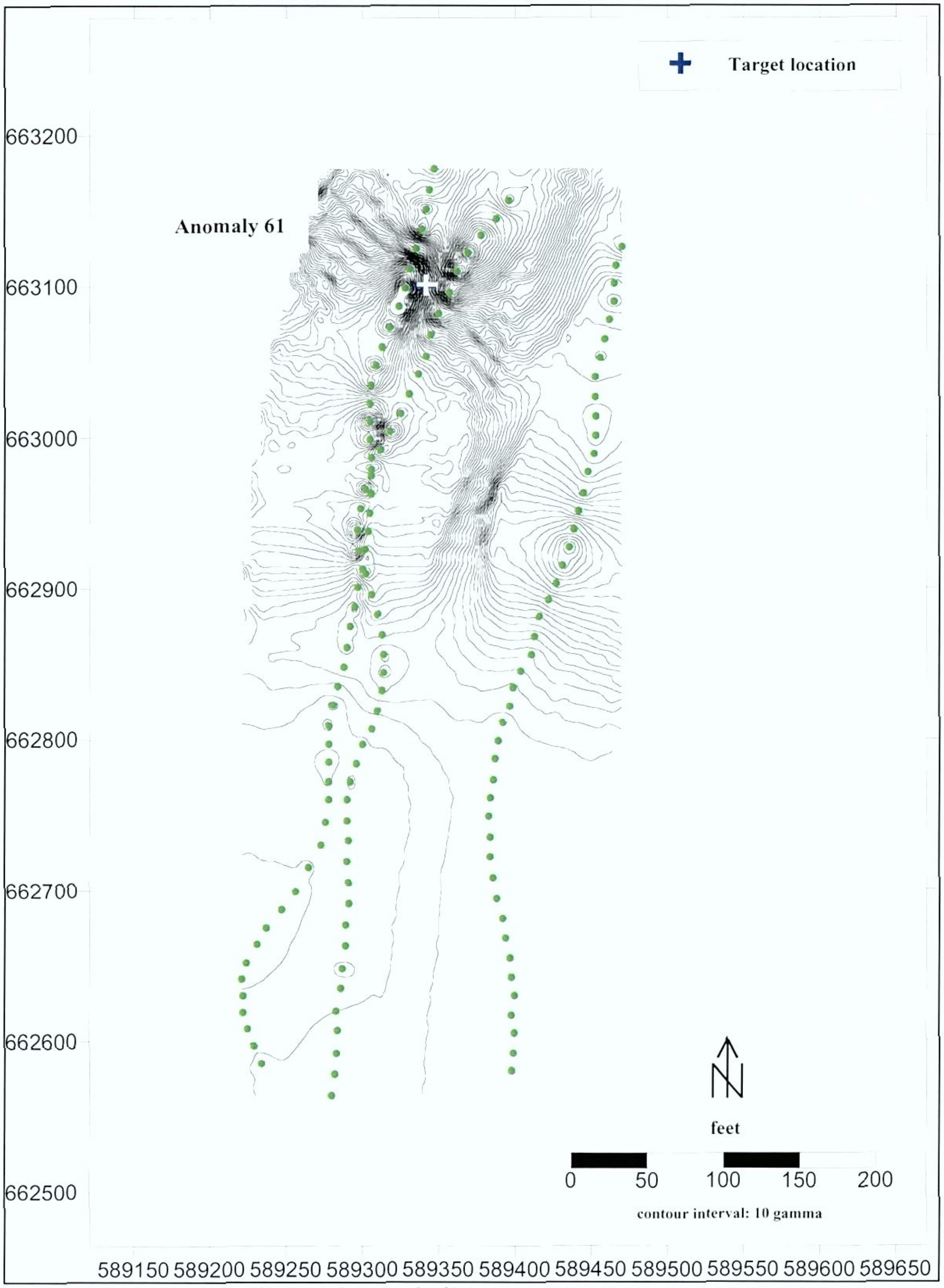

Figure 64. Magnetic anomaly map of Anomaly 61.

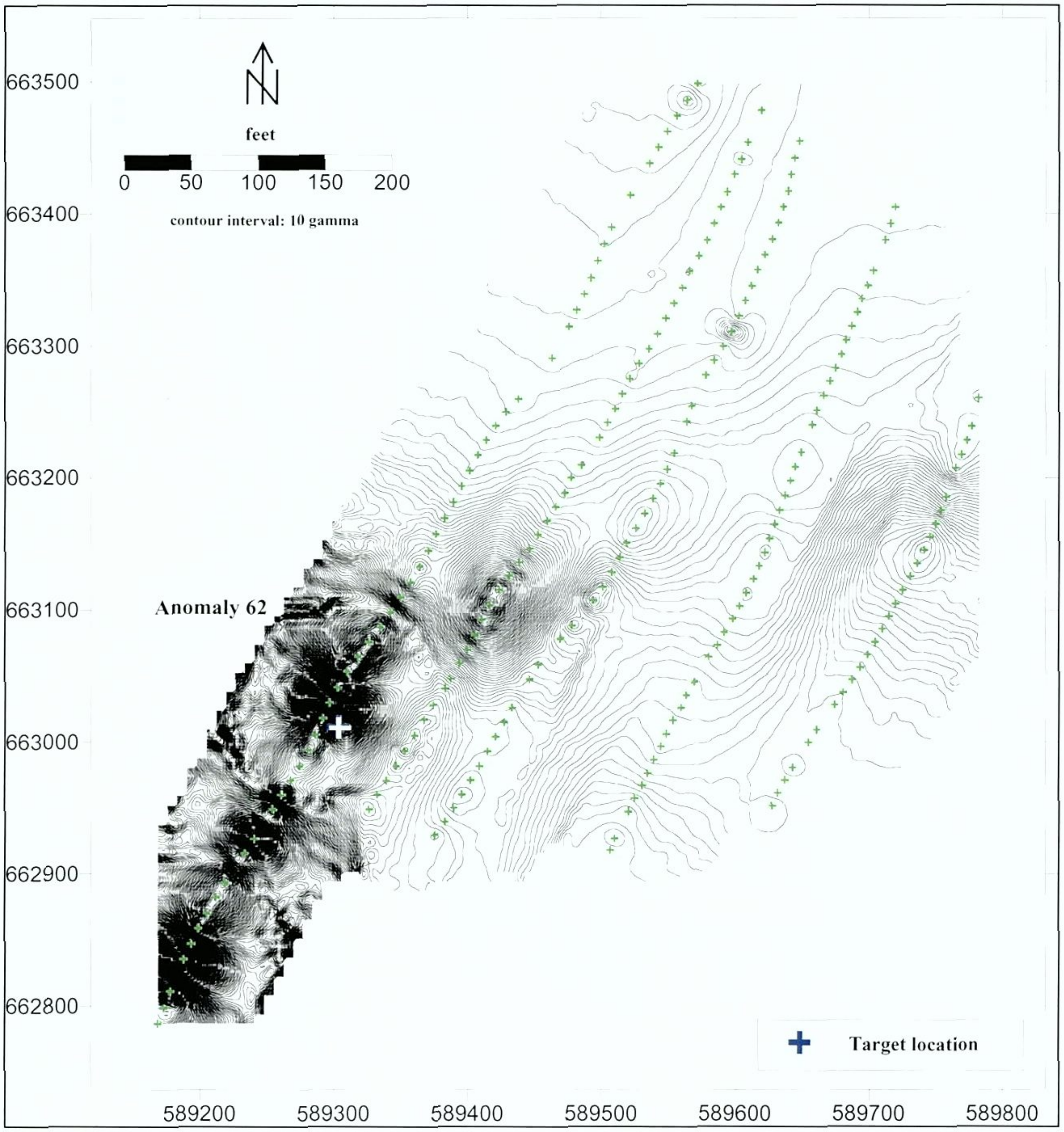

Figure 65. Magnetic anomaly map of Anomaly 62.

Anomaly 63

Anomaly 63 is located in Newark Bay (see Figure 46c, 66), and appeared across two tracklines. It was located at 589695 East/663650 North. Refined coordinates are 589640 East and 663600 North Strength was +550/-45 with a duration of 234 feet. This anomaly was dived and determined to be the remains of the same Central Railroad bridge, represented in the discussion on Anomaly 27, that used to extend across Newark Bay (Figure 52). It is not considered significant and is not recommended for further investigation.

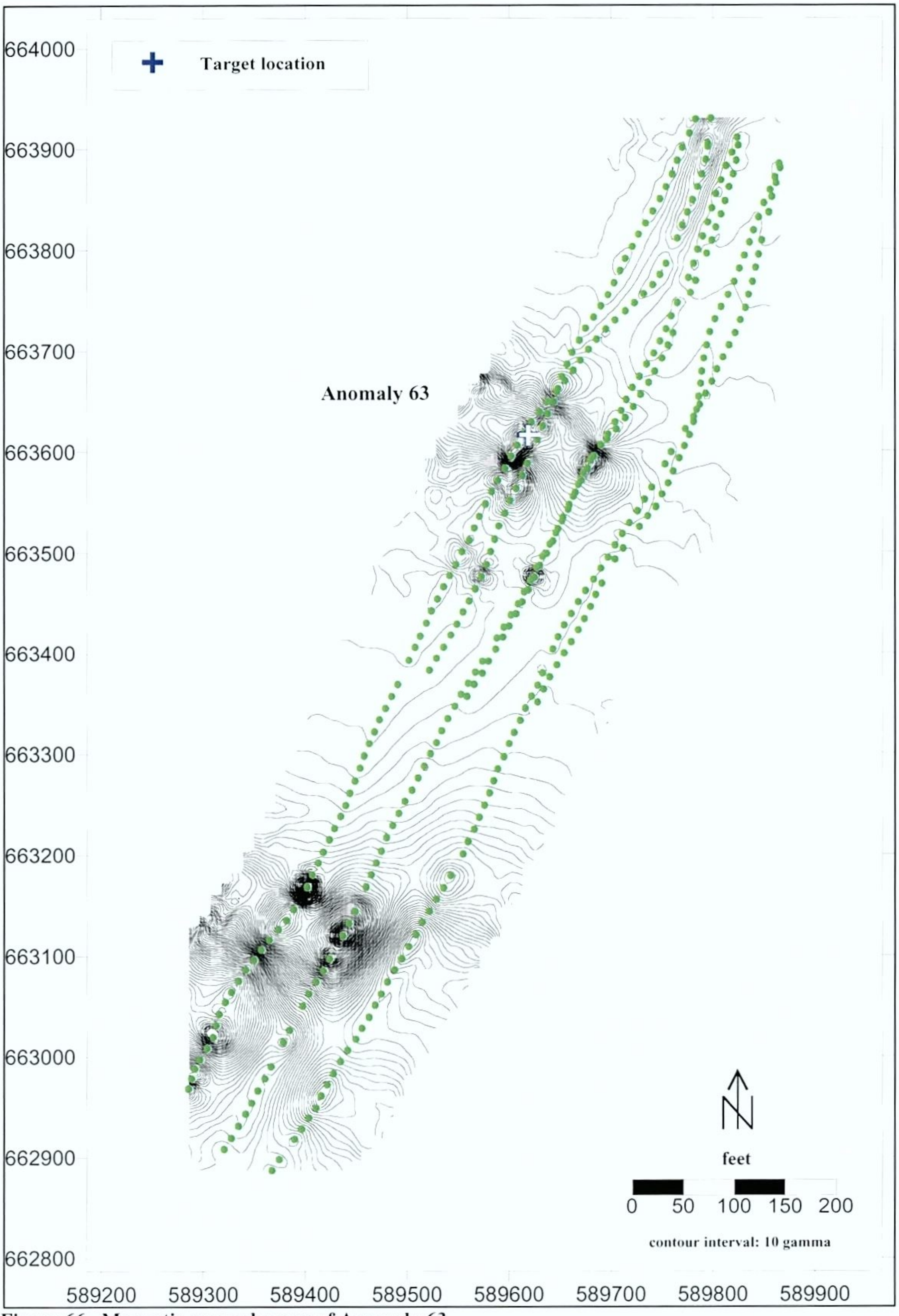

Figure 66. Magnetic anomaly map of Anomaly 63.

Anomaly 64

Anomaly 64 is located in Kill Van Kull (see Figure 46c, 67), and appeared across one trackline. It was located at 593455 East/659908 North. Refined coordinates are 593400 East/659935 North. Its strength was +70/-16 with a duration of 394 feet. It was originally thought to be associated with side-scan target SS26, but refinement indicated a different location. Diving investigation indicated that the anomaly can be accounted for by a marine engine block, along with a large pile of concrete and rock. This anomaly is not considered significant and is not recommended for further investigation.

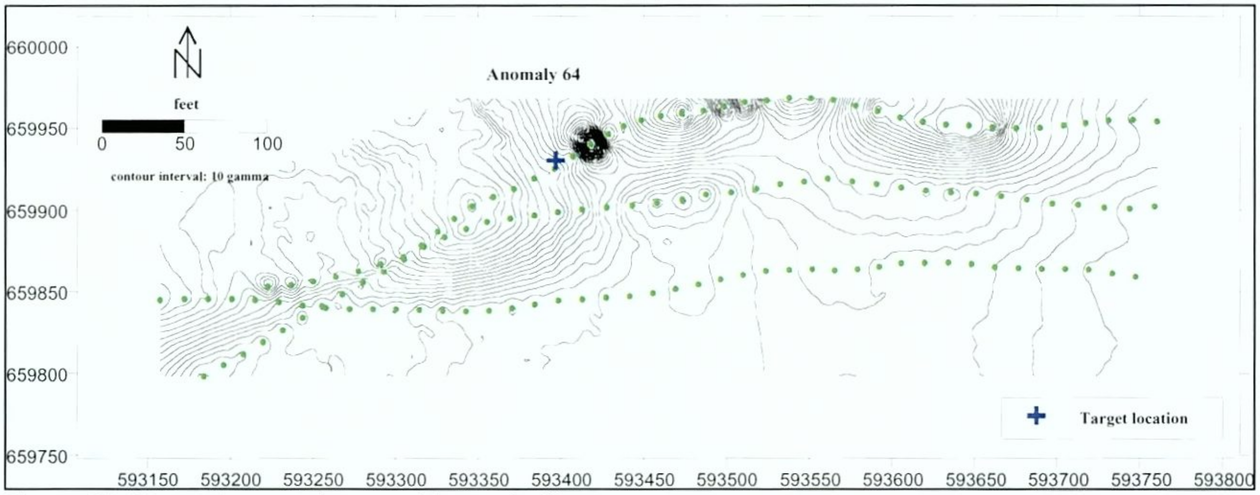

Figure 67. Magnetic anomaly map of Anomaly 64.

Anomaly 73

Anomaly 73 is located in Kill Van Kull (see Figure 46b, 68), and appeared across two tracklines. It was located at 595314 East/659757 North. Refined coordinates are 595250 East/659730 North. Its strength was +0/-167 with a duration of 102 feet. This anomaly was not dived but was determined to be a pipeline after the anomaly appeared across five tracklines on refinement and a sign was noted on the shore. This anomaly is not considered significant and is not recommended for further investigation.

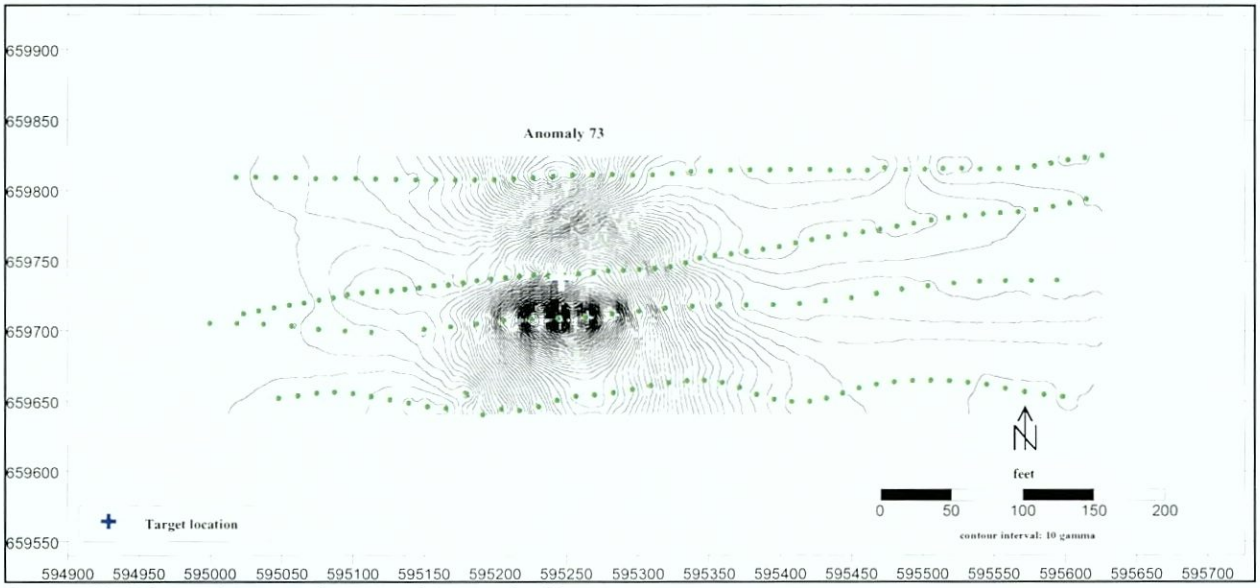

Figure 68. Magnetic anomaly map of Anomaly 73.

Anomaly 81

Anomaly 81 is located in Ambrose Channel (see Figure 46e, 69), and appeared across three tracklines. It was located at 656762 East/601225 North. Refined coordinates are 657240 East/601040 North. Its strength was +2043/-25 with a duration of 599 feet. On refinement it appeared across three tracklines. This anomaly was located in the vicinity of a wreck marked on the navigation chart. This anomaly was dived and determined to be an extensive unrecognizable debris field consisting of both large and small pieces of heavily concreted riveted iron. Nothing recognizable as a vessel component was found. Although separated from the main wreckage by 100 or so feet, acoustic targets SS3 and SS4 are also considered to represent the same debris field. This target is not considered significant and is not recommended for further investigation.

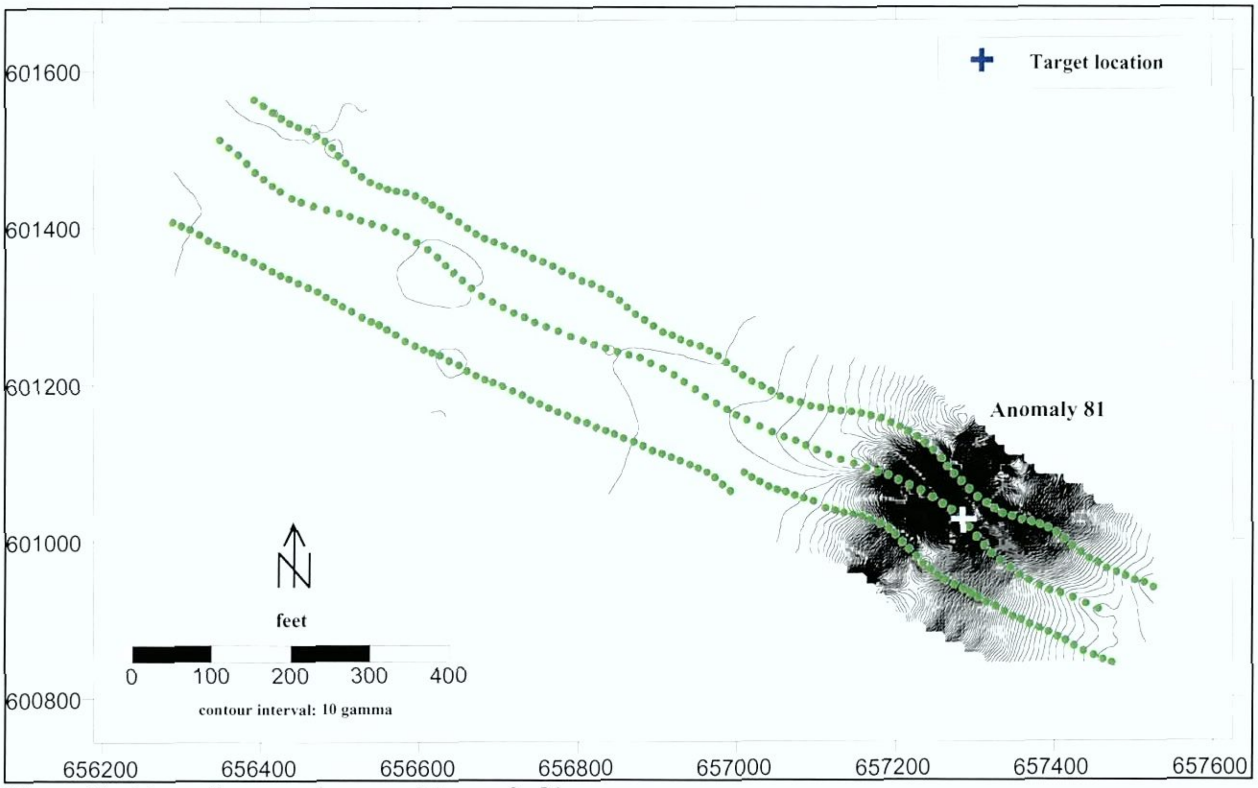

Figure 69. Magnetic anomaly map of Anomaly 81.

Anomaly 85

Anomaly 85 is located in Anchorage Channel (see Figure 46d, 70), and appeared across three tracklines. It was located at 618275 East/651117 North. Refined coordinates are 618240 East/651150 North. Its strength was +323/-137 with a duration of 511 feet. This anomaly was not dived but was determined to be a pipeline after the anomaly appeared across six tracklines on refinement and a sign was noted on the shore. This anomaly is not considered significant and is not recommended for further investigation.

Anomaly 86

Anomaly 86 is located in Anchorage Channel (see Figure 46d, 71), and appeared across three tracklines. It was located at 618166 East/651567 North. Refined coordinates are 618240 East/651570 North. Its strength was +112/-108 with a duration of 292 feet. This anomaly was not dived but was determined to be a pipeline after the anomaly appeared across six tracklines on refinement and a sign was noted on the shore. This anomaly is not considered significant and is not recommended for further investigation.

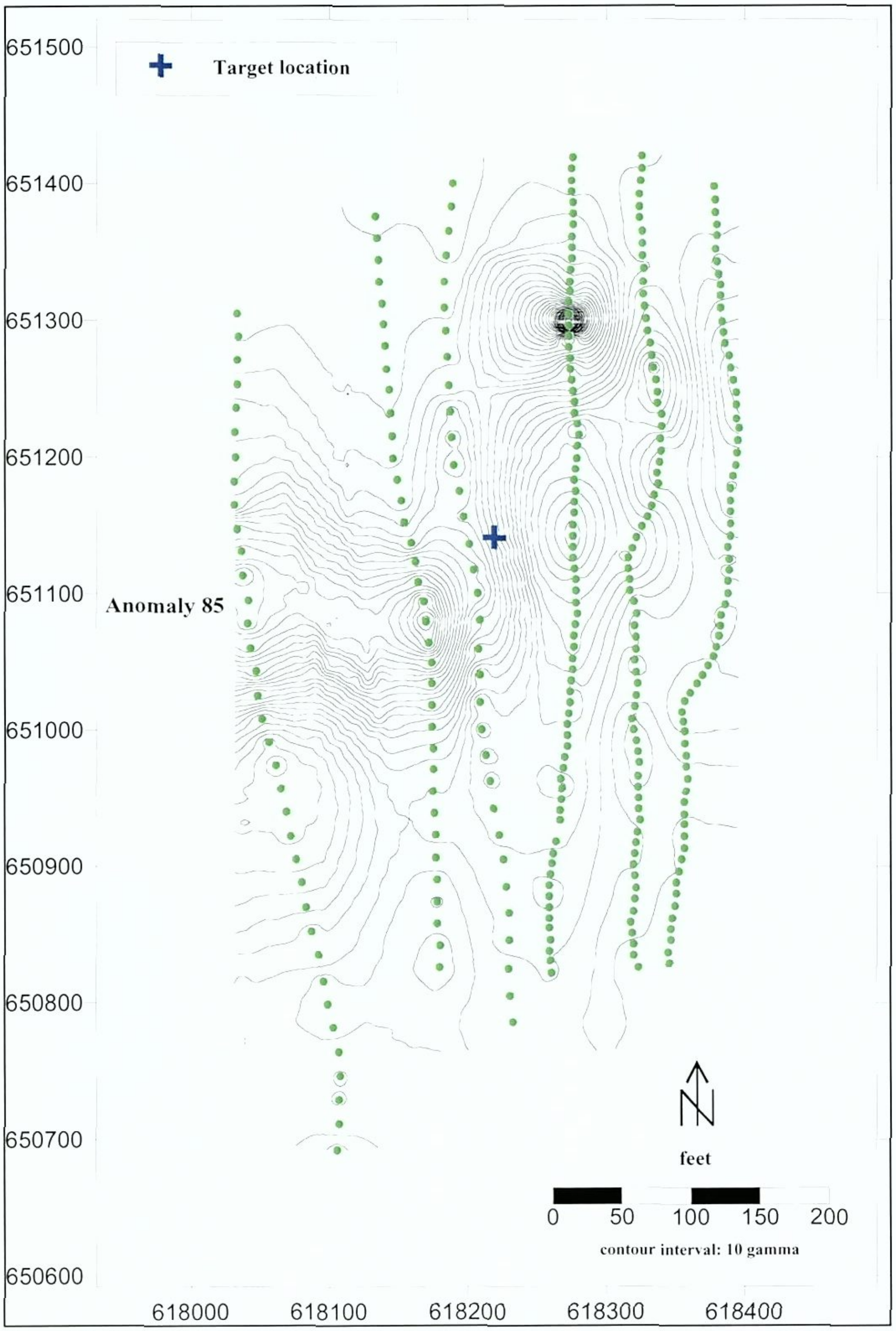

Figure 70. Magnetic anomaly map of Anomaly 85.

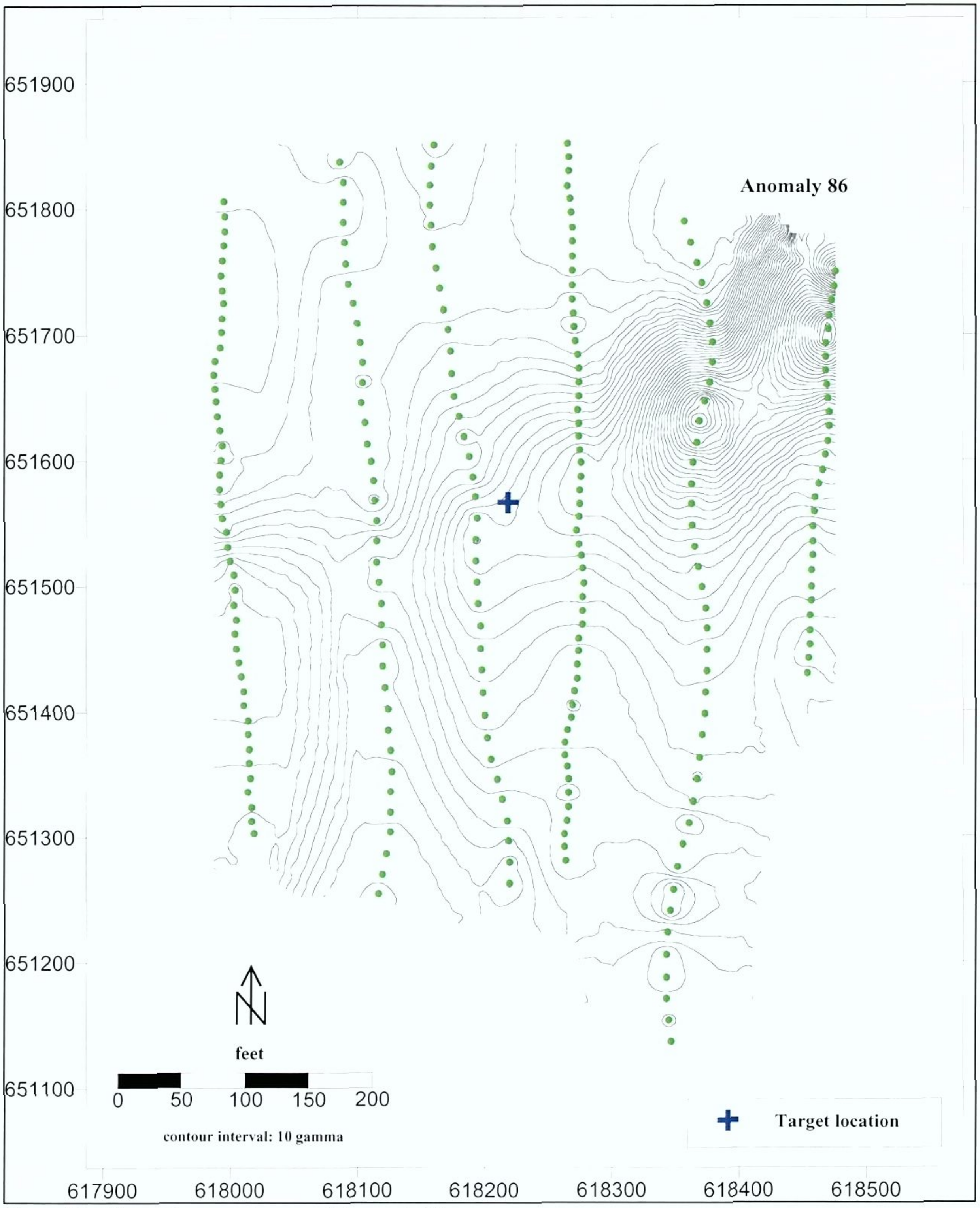

Figure 71. Magnetic anomaly map of Anomaly 86.

Anomaly 99

Anomaly 99 is located in Kill Van Kull (see Figure 46b), and appeared across three tracklines. It was located at 611407 East/660845 North. Its original strength was +640/-0 with a duration of 350 feet. The source of this anomaly remains unknown. Since it lies directly in the path of the

Staten Island Ferry, it was not dived or refined due to safety concerns. It is recommended that investigation be undertaken immediately prior to dredging operations, as the ferry will need to be diverted at that time.

Anomaly 100

Anomaly 100 is located in Kill Van Kull (see Figure 46b), and appeared across three tracklines. It was located at 612240 East/660479 North. Its original strength was +158/-0 with a duration of 828 feet. The source of this anomaly remains unknown. Since it lies directly in the path of the Staten Island Ferry, it was not dived or refined due to safety concerns. It is recommended that investigation be undertaken immediately prior to dredging operations, as the ferry will need to be diverted at that time.

Anomaly 101

Anomaly 101 is located in Arthur Kill (see Figure 46c), and appeared across two tracklines. It was located at 580587 East/660159 North. Refined coordinates are 580460 East/660150 North. Its strength was +109/-55 with a duration of 234 feet. The anomaly was located in the vicinity of several known wrecks, including V233, V234, and V235 from Raber and Associates (1996c) (Figure 72). Raber and Associates (1996) do not discuss the vessels thought to be represented by this anomaly, and make no recommendation. Upon refinement, it was determined that the anomaly represented those three wrecks. All three wrecks were dived and evaluated.

Both V234 and V235 were determined to be the remains of two separate piers, and consisted of a series of pilings along with a pile of trash, consisting of disarticulated timbers, iron fasteners, and various scraps of iron, at what would have been the end of the pier (Figures 74 and 75). Several interesting objects were noted in the trash pile, including several bottles (Figures 76 and 77). The other component of the anomaly, V233, was determined to be a series of pilings filled with stone, possibly representing a small breakwater or pier footing, along with a pile of modern trash (Figure 73). Of the three sites investigated at this location, none are considered significant, and none are recommended for further investigation.

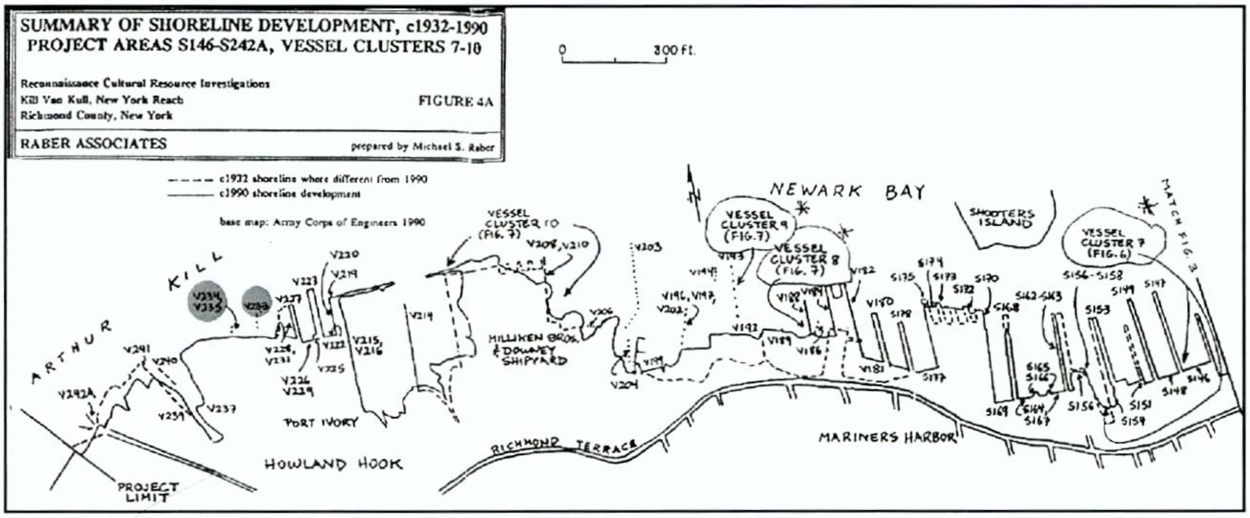

Figure 72. Map showing location of vessels V233, V234, and V235 as presented in Raber and Associates (1996c).


Figure 73. Photograph of Anomaly 101, Vessel 233.


Figure 74. Photograph of Anomaly 101, Vessel 234.

Figure 75. Photograph of Anomaly 101, Vessel 235.

Figure 76. Photograph of bottle recovered from V234. Item was redeposited on the site.

Figure 77. Photograph of bottle recovered from V235. Item was redeposited on the site.

Anomaly 110

Anomaly 110 is located in Anchorage Channel (see Figure 46d, 79), and appeared across three tracklines. It was located at 616361 East/650135 North. Refined coordinates were 616375 East/650120 North. Its strength was +206/-0 with a duration of 511 feet. This anomaly was originally thought to be in the vicinity of an obstruction on the navigation chart, but upon refinement it was determined that the anomaly was a separate entity from the obstruction and the obstruction lies outside the project area. The anomaly was not dived because it was determined to be a pipeline after refinement indicated it appeared across five tracklines and a sign indicating a pipeline was noted on shore (Figure 78). It is not considered significant and is not recommended for further investigation.

Figure 78. Photograph of pipeline sign indicating source of Anomaly 110.

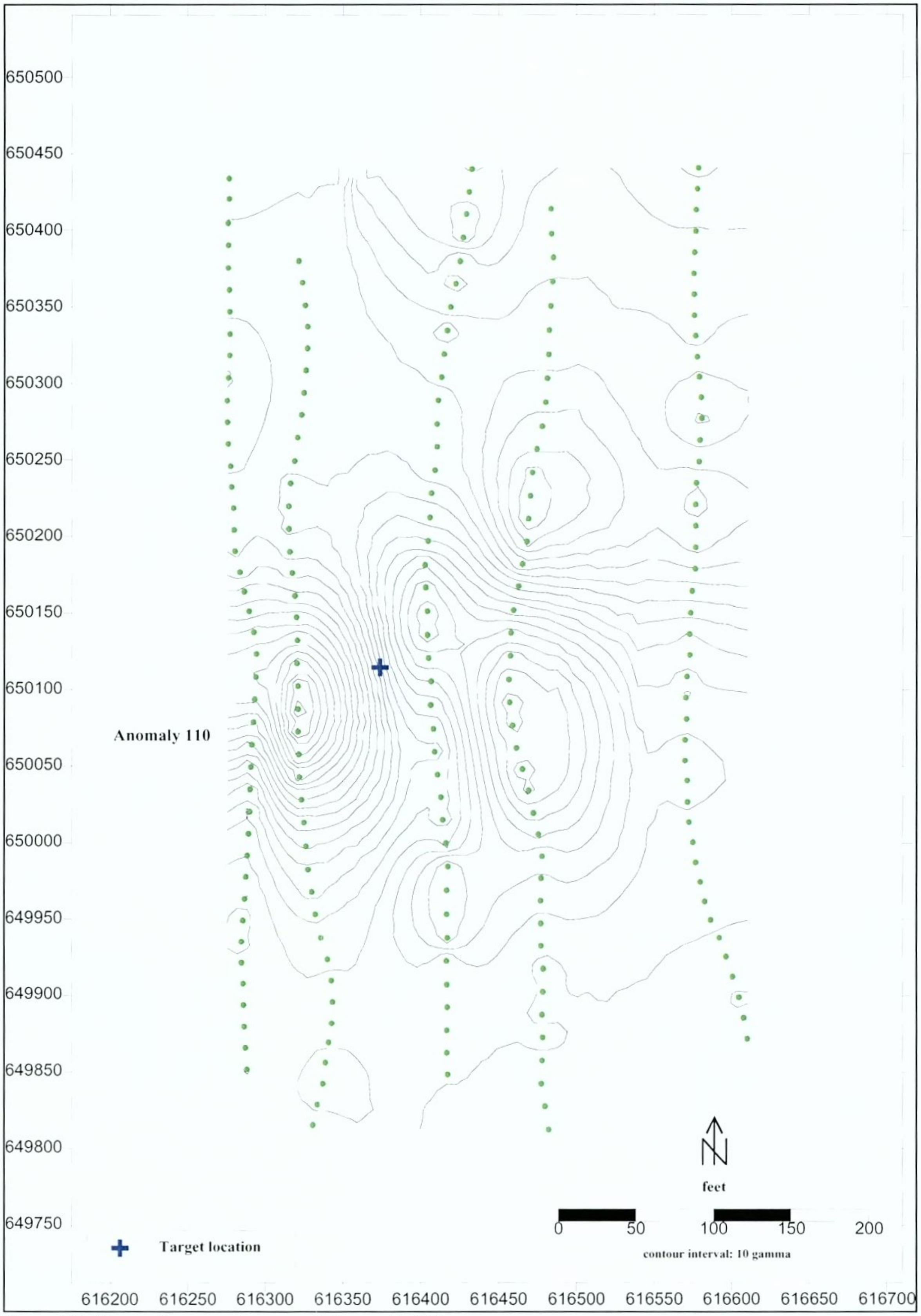

Figure 79. Magnetic anomaly map of Anomaly 110.

Target 3
Figure 80 shows the acoustic image captured during the survey. It is located in Ambrose Channel at 657412 East/600934 North (Figure 46e). This target was dived and was determined to be part of the same large ferrous debris field as Anomaly A81 and acoustic target SS4. For detailed discussion, see Anomaly 81 above. This target is not considered significant and is not recommended for further investigation.

Target 4
Figure 81 shows the acoustic image captured during the original survey. It is located in Ambrose Channel at 656762 East/601225 North (Figure 46e). This target was dived and was determined to be part of the same large ferrous debris field as Anomaly A81 and acoustic target SS4. For detailed discussion, see Anomaly 81 above. This target is not considered significant and is not recommended for further investigation.

Figure 80. Acoustic image of Target 3.

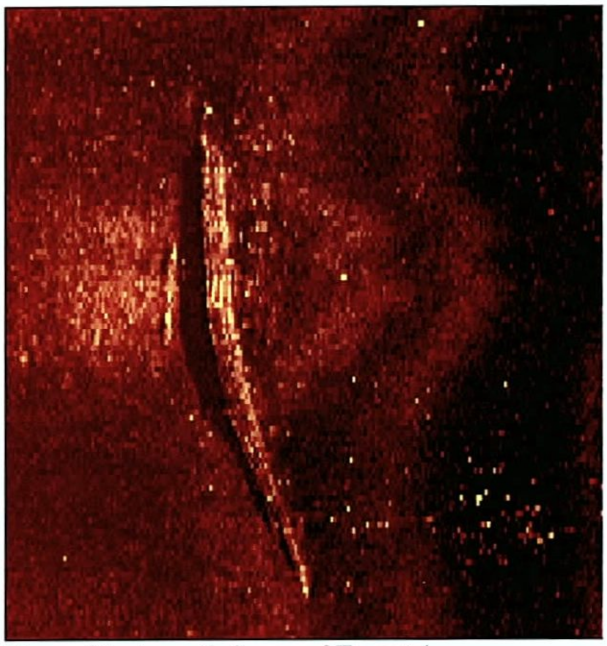

Figure 81. Acoustic image of Target 4.

Target 11
Figure 82 shows the acoustic image captured during the survey. It is located in Kill Van Kull at 600924 East/660453 North (Figure 46b). The original acoustic image showed a large section of rectangular wreckage with exposed frames. The target was dived and determined to be the heavily deteriorated remains of a scow-type barge. Approximate dimensions of the scow were 60 feet in length and 26 feet beam. Bow or stern could not be determined, but the eastern end was the best preserved, and some data regarding the construction of the vessel was obtained. Major framing was longitudinal, and frames measures nine inches square and were spaced 3' 4" on center with a four-inch room and three-foot space. Ceiling plank was noted and measured nine inches sided and 2 1/2 inches molded. Outer hull planks were buried in silt and clay and could not be measured. The vessel had a hard chine, with a one foot square chine log that was notched for six-inch vertical frames every foot. The western end of the vessel was nothing more than a heavily deteriorated pile of disarticulated timbers which possibly included debris from a deteriorated pier on shore. This vessel is not considered significant and is not recommended for further investigation.

Figure 82. Acoustic image of Target 11.

Target 13

Figure 83 shows the acoustic image captured during the survey. It is located in Kill Van Kull at 597090 East/659063 North (Figure 46b). Refined coordinates were 596549 East/658967 North. It is not associated with a magnetic anomaly. The source of the acoustic return, a diamond-shaped piece of wreckage, is thought to coincide with the location of the iron-hulled steam lighter *Blairstown* (referred to as vessel V28 in James [1999]) (Figure 84). This vessel was supposedly removed between 1995 and 1997. This target was not dived as it was determined on refinement to be located outside the project area.

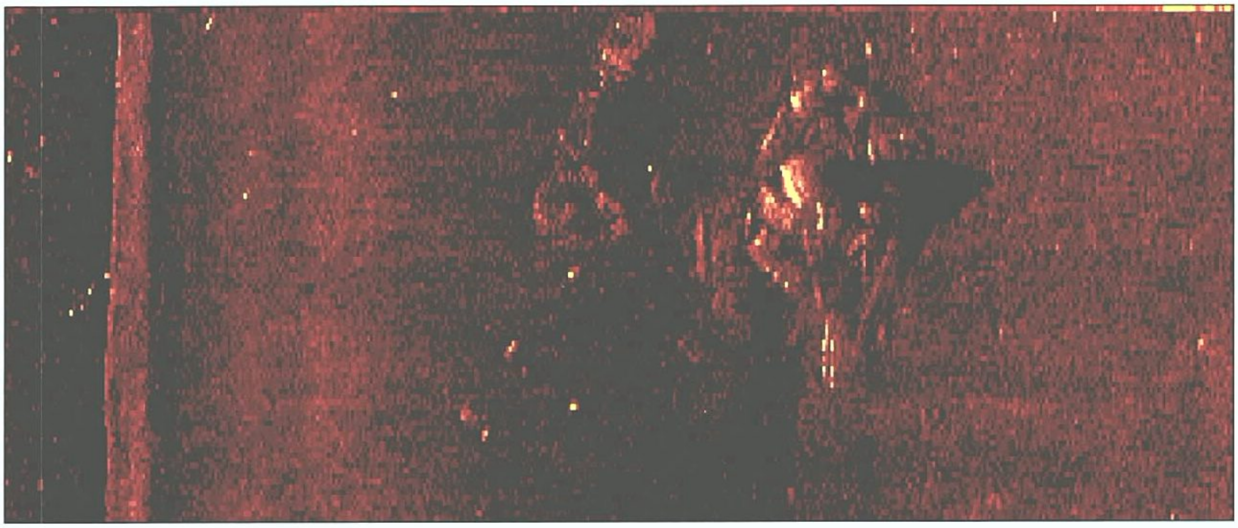

Figure 83. Acoustic image of Target 13.

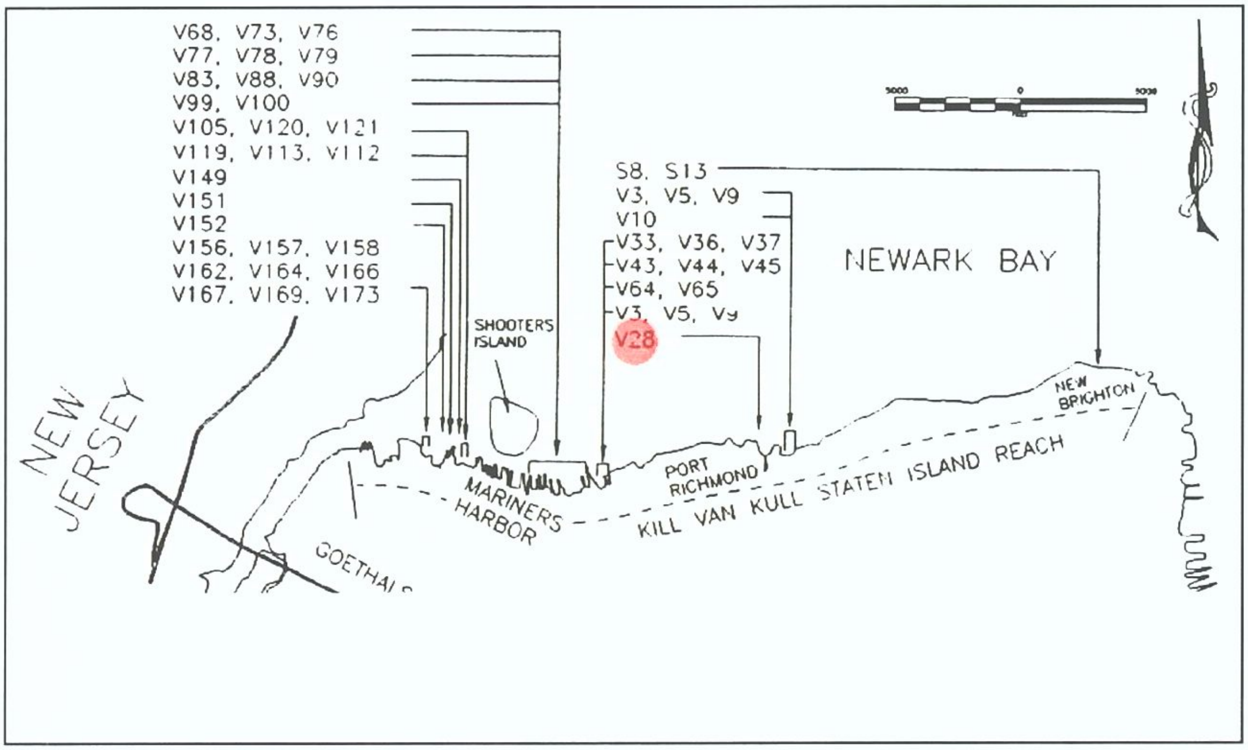

Figure 84. Map showing location of vessel V28 as presented in James (1999)

Target 16

Figure 85 shows the acoustic image captured during the survey. It is located at the east end of Shooter's Island, at 587579 East/659553 North (see Figure 46c). The source of the original acoustic return was thought to be at least three, possibly five, vessels and a pier. Two of the vessels were thought to be 89 and 90 from both Kardas and Larrabee (1985) and Brouwer (1981, 1983) (SS16d and SS16c respectively). This target was dived, and determined to be the remains of three vessels and a pier. Nothing was located in the area that was thought to be the fourth vessel.

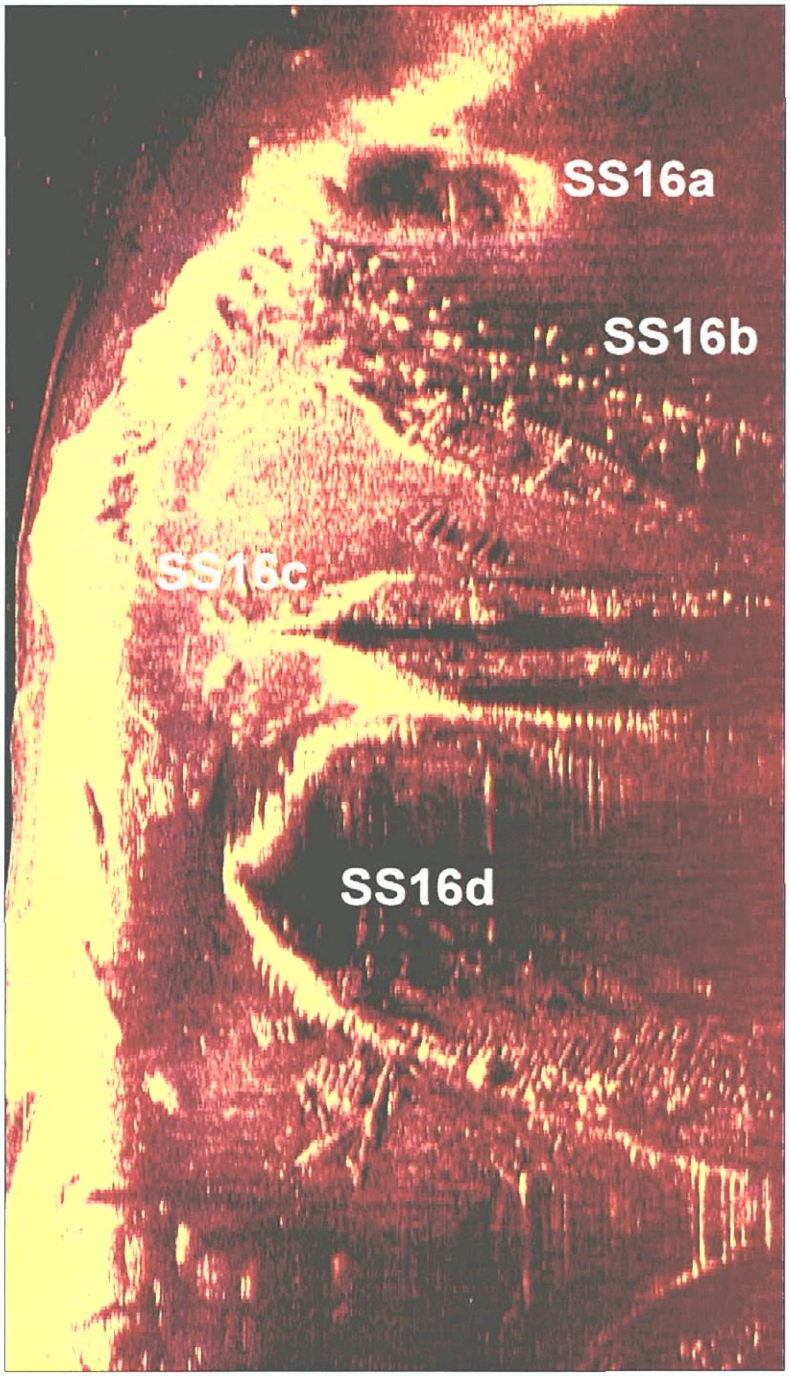

Figure 85. Acoustic image of Target 16.

Of the remaining three, one remains unidentified, and two are identified as probable tugs. SS16b was not identified by either Kardas and Larrabee (1985) or Brouwer (1981). Vessel SS16b is a composite vessel with iron frames and wood hull planking. It is approximately 65 feet in length and is lightly built and heavily deteriorated. The stern is facing the channel (east) and is characterized by the existence of a three-foot diameter five-bladed iron propeller and shaft. An interior iron bulkhead was also noted just forward of the stern section.

According to Mark Peckham of the New York SHPO, 16b represents a type of vessel that is unusual to the New York Harbor area for two reasons: the composite construction, and the five bladed propeller. Composite construction was introduced in Europe in the 1860s as a partial solution to the fouling of iron hulled vessels by marine organisms (Gardiner 1993:23-24). The reasoning behind this is that the traditional remedy - copper or yellow metal sheathing - was unworkable on iron hulls because the combination of iron and copper or a yellow metal created a galvanic response that greatly accelerated the corrosion of the iron. In the United States, composite vessels represented a transitional vessel type between wooden and iron hulled, and numerous examples of this have been found (James 1999:50). The propeller also marks this as an unusual vessel, as it is considerably different than propeller designs of the late 19th/early 20th centuries. *Its form is more* indicative of propellers found during the early experimental years of propeller technology, namely the mid to late 19th century (Peckham 2004).

For these two reasons,16b is recommended for further investigation in the form of complete recordation, including the recovery of key diagnostic artifacts such as the propeller and a small section of frame and planking including attachment points. The recovered artifacts should be conserved and sent to a suitable repository, preferably a regional maritime museum such as South Street Seaport Museum or the Hudson River Maritime Museum. Full archival research is also recommended.

Target SS16c coincides with vessel V90 from Brouwer (1981) and Kardas and Larabee (1985). Diving inspection determined it to be a heavily framed wooden vessel. Frames consisted of double futtocks, with three to four-inch thick hull and ceiling plank. The stern was facing the channel (east), and consisted mostly of a section of deadwood extending six feet above the surface. The deadwood had a 10-inch diameter shaft hole, but shaft, prop, and other machinery were absent. Also noted were a stout keelson and two equally stout rider keelsons. Construction of the vessel represented by SS16c is consistent with that of an early twentieth century wooden hulled tug.

Target SS16d coincides with vessel V89 from Brouwer (1981) and Kardas and Larrabee (1985). Diving inspection revealed that V89 is a heavily framed wooden vessel similar in construction to V90. The stern is facing the channel (east) and is characterized by a four-foot tall deadwood. The vessel itself is characterized by double futtock frames and thick hull planking. The interior of the vessel just forward of the stern is lined with bricks with a "Shultz" maker's mark. It is not known if they are firebricks; they appear to be too close to the stern to have been located under the boiler. However, the steam engine would have been in this location.

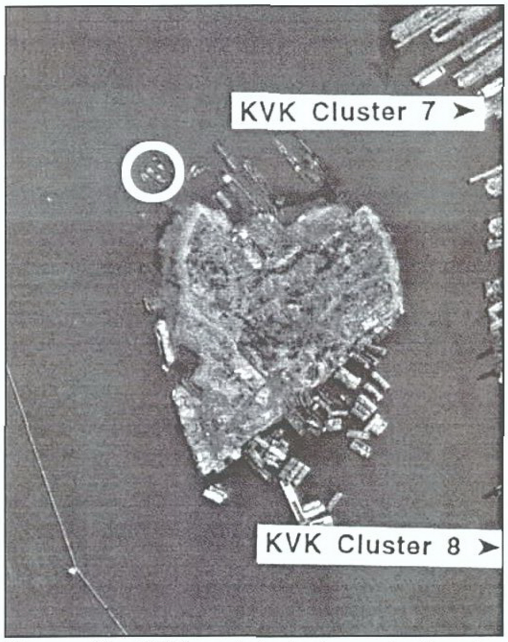

Figure 86. 1960 aerial photograph showing two sunken vessels.

According to analysis of aerial photographs, two of the three vessels represented by SS-16 were apparently abandoned some time between 1940 and 1951 and appear to have been sunken by 1960 (Figure 86). The third vessel (16b) does not appear on the aerial photographs and it is unclear when it was abandoned, although it seems likely it was abandoned either after the last aerial photograph was taken in the 1970s or long before the first aerial photograph from 1951, such that it had already sunk and disappeared from view by the time that photograph was taken.

Figure 87. Stern post of vessel SS16d (V89 from Brouwer (1981) and Kardas and Larrabee (1985).

Target 19

Figure 88 shows the acoustic image captured during the survey. It is located in Arthur Kill at 582151 East/660191 North (see Figure 46c). The initial acoustic image revealed one boat-shaped object, but refinement indicated the presence of four additional vessels or structures that needed to be evaluated. The refinement image is shown in Figures 89 and 90. This expanded target coincides with Vessel Cluster 10 from Raber and Associates (1996c:46), and includes vessels V143-V144, V144a, V145-V176, and V10 and V11 (Figure 89). This cluster is also near the site of the Milliken Brothers and Downey Shipyard, although it is doubtful that all vessels in this cluster are related to that site. The original target (SS19a) coincides with the location of vessel V154 from Raber and Associates (1996c), who identify it as a screw harbor tug.

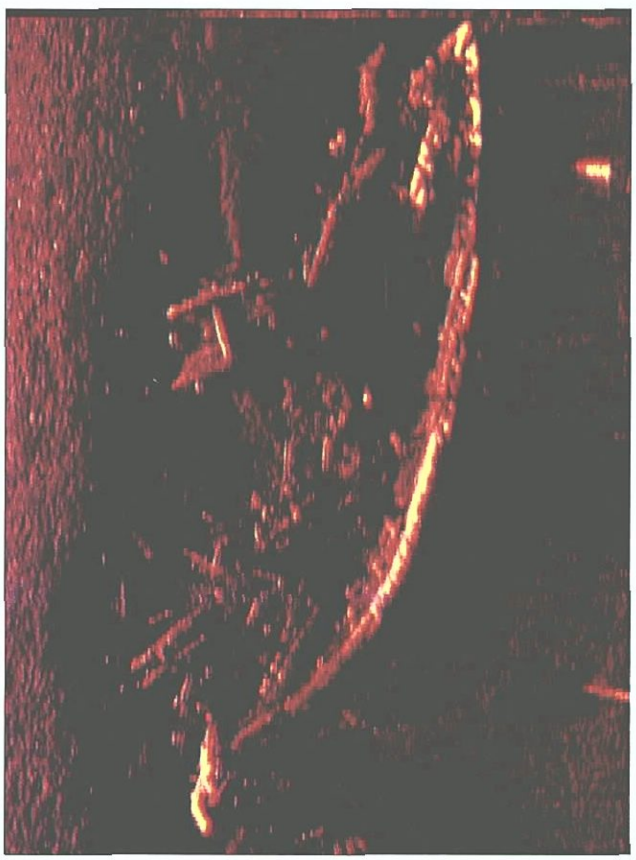

Figure 88. Acoustic image of Target 19.

The refined target contains five vessels or structures which were addressed as part of this study. Of the five vessels or structures, three were dived, and two were not for various reasons including that they were out of the project area (SS19d, SS19e), or had previously been determined ineligible (SS19a).

SS19a, which coincides with Raber and Associates' (1996c) V154, was dived and determined to be the remains of a heavily framed wooden vessel (Figure 91). Raber et al. (1996c) list it as a wooden tug and recommend no further work. The current study concurs with this identification and recommendation.

SS19b was not examined by any previous study. It was examined and appears to be the remains of a heavily framed wooden vessel 111 feet in length (Figure 92). Double framed on two foot centers, this vessel is consistent with SS19a (V154) in its construction, and appears to also be a wooden tug. It is in significantly poorer condition than SS19a (V154) and as such is not recommended for further investigation.

A third item examined as part of SS19 was SS19c. This target coincides with the location of Structure S211 from Raber and Associates 1996. The exposed timbers made this appear to be a vessel (Figure 93), but diving investigation revealed it to be either a short bulkhead or the end of a pier. It is not considered significant and is not recommended for further investigation.

The remaining two components of SS19, SS19d and SS19e, were not evaluated as part of this study as they were located outside of the project area.

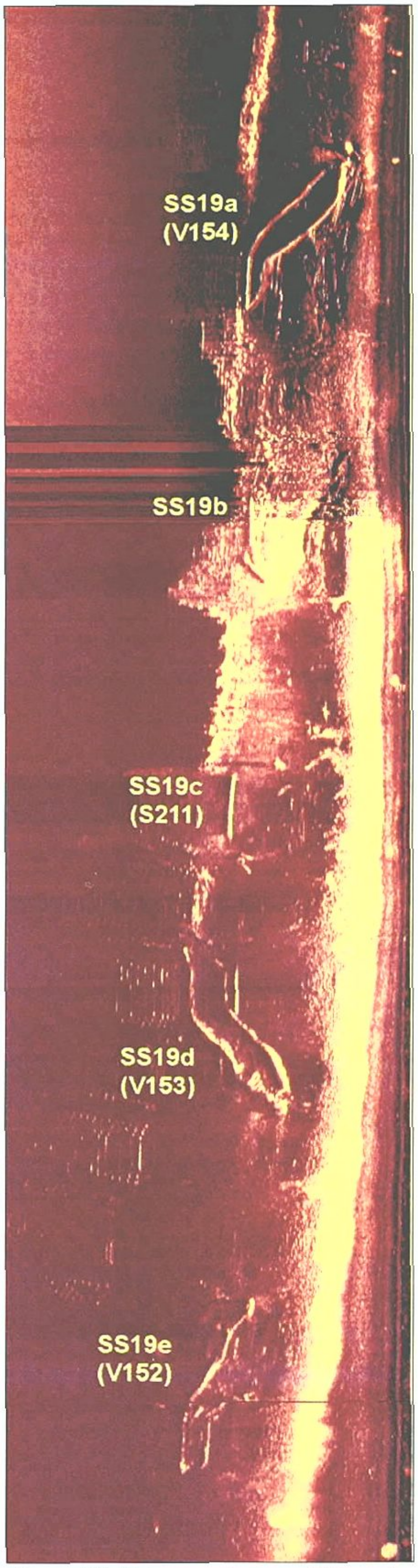

Figure 89. Side-scan image of Target 19 showing individual vessels.

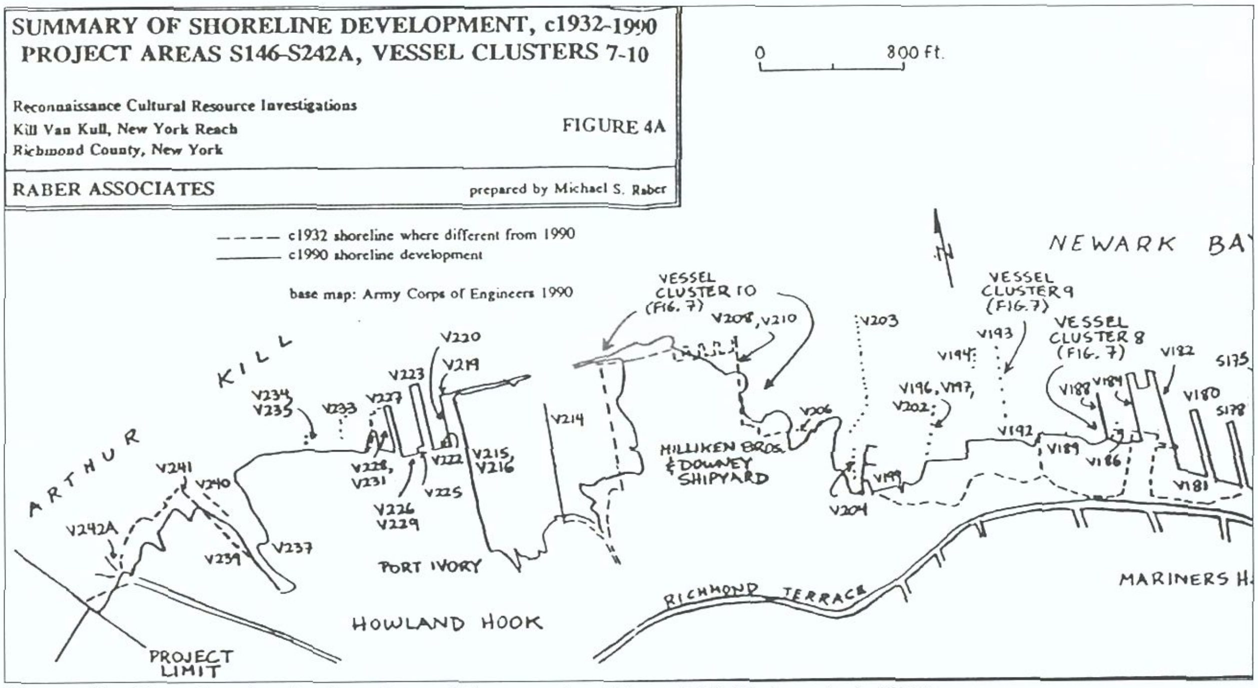

Figure 90. Map showing the locations of the vessels of Target 19 (Raber et al. 1996).

Figure 91. Photograph of SS19a (V154)

Figure 92. Photograph of SS19b.

Figure 93. Photograph of SS19c (S211).

Target 22

Figure 95 shows the acoustic image captured during the survey. It is located in Arthur Kill at 585155 East/660137 North. The source of the acoustic return is a number of vessels that are part of the group of derelict vessels at the west end of Shooter's Island. A map of the area is shown in Figure 94. This area was examined in the late 1970s and early 1980s by Brouwer (1983) and Kardas and Larabee (1985). Investigations then determined that none of the vessels in this area were old enough to be considered significant. However, twenty years have passed since those investigations, and several of the vessel types present in the area can now be considered significant. Seventeen vessels in this area potentially could be impacted by the current proposed project. A list of those vessels is presented in Table 6. The vessels comprising this area are made up primarily of scows, along with a couple of tugs. These vessel types either have been documented, or examples exist elsewhere in better condition.

Table 6. Recommendations for Vessels in Area West of Shooter's Island.

Vessel	Vessel Type	NRHP Significant	Further Work Recommended
SS22a	unknown scow	no	none
SS22b	unknown scow	no	none
SS22c	covered barge	no	none
V2	floating drydock	yes	complete recordation and archival research
V5	unknown scow	no	none
V12	rock scow	no	none
V13	unknown scow	no	none
V14	unknown scow	no	none
V15	unknown scow	no	none
V28	unknown scow	no	none
V29	rock scow	no	none
V30	hopper barge	no	none
V57	hopper barge	no	none
V58	unknown scow	no	none
V69	rock scow	no	none
V70	unknown scow	no	none
V72	unknown	no	none

One type of vessel present in this area, the floating drydock, has played a significant role in the history of New York. Despite the existence of numerous examples, this type has received relatively little documentation when the large variability within the type is taken into account (James 1999a:320-335). The vessel representing this type, V2 (Figure 96), is an excellent example of a sectional floating drydock, and embodies the distinctive characteristics of this type of vessel. For this reason, it is eligible under Criteria C. Vessel V2 is also in exceptionally well preserved condition when compared to other examples of its type (James 1999a: 327-335). Significant portions of both wings are intact, including pump gearing and machinery, and two-thirds of the vessel is exposed at low tide, including the upper portion of the pontoon. The side planking of the pontoons has been removed in various locations, either by salvage or natural processes, exposing the inner structural components to observation. Significant information regarding construction methods and design variability can be obtained by examination of this vessel. For this reason, it is eligible under Criteria D. This vessel is recommended for further investigation in the form of complete recordation. Full archival research is also recommended, including but not limited to consultation of vessel registries and former owners (if available).

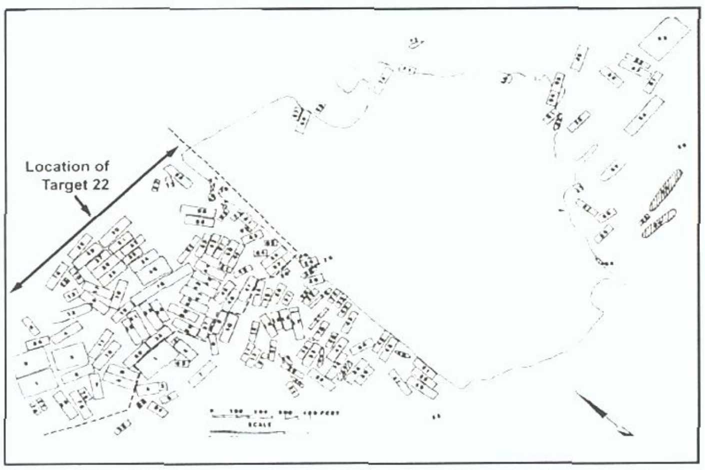

Figure 94. Map of vessels at west end of Shooter's Island (as presented in Kardas and Larrabee 1985).

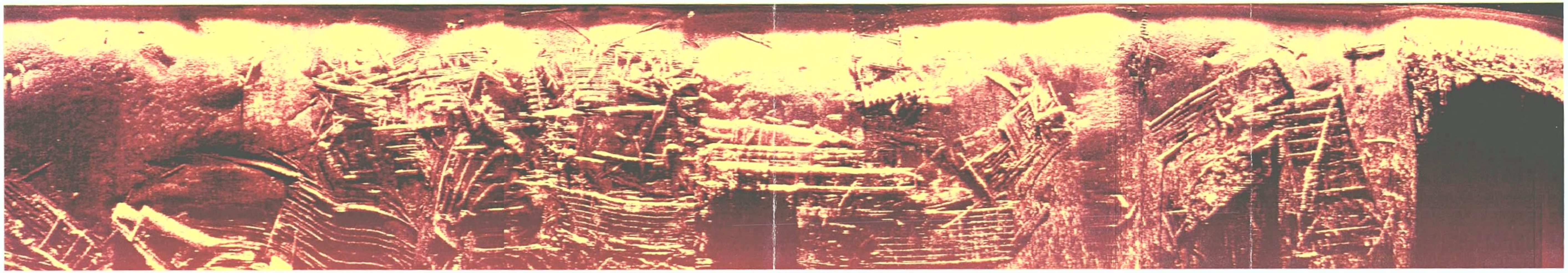

Figure 95. Acoustic image of Target 22.

Figure 96. Photograph of Vessel V2 (foreground).

Target 24

Figure 97 shows the acoustic image captured during the survey. It is located in Arthur Kill at 581668 East/660989 North (see Figure 46c). It is associated with Anomaly 43. This target was not dived, as it was determined that it was an old piling, identical to four nearby structures that can be seen at low tide (Figure 98). This target is not considered significant and is not recommended for further investigation.

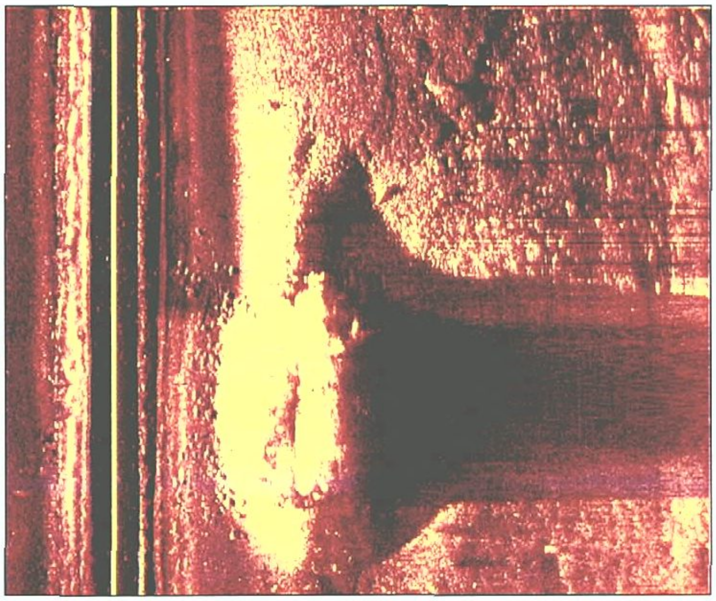

Figure 97. Acoustic image of Target 24.

Figure 98. Photograph of pilings similar to Target 24.

Target 26

Figure 99 shows the acoustic image captured during the survey. It is located in Kill Van Kull at 593559 East/659955 North (see Figure 46c). The source of the acoustic return was originally thought to be either vessel V27B, or V28, from Kardas and Larrabee (1985) (Figure 100), also identified as vessels V36 and V37 in Raber and Associates (1996d). Diving investigation determined it to be the remains of V28/V37. This target was dived and was determined to be the remains of a barge or cargo vessel, possibly with a hard chine, and of composite wood and iron construction. The framing of the vessel is constructed of wood, and includes diagonal iron bracing (Figure 101). These braces are fastened diagonally between the frames and the outer hull planking of a vessel to strengthen it against hogging, or the tendency of a vessel to sag at both the bow and the stern (Desmond 1919:56). This construction detail appears on vessels beginning around the end of the nineteenth century. The vessel is heavily deteriorated, with most of the exposed hull structure eroded. It is unknown how much of the vessel remains below the sediment level. Only frames and the diagonal iron bracing are visible above the bottom. This study concurs with the recommendation of Raber and Associates (1996d), who state that the vessel is non-significant. No further investigation is recommended.

Figure 99. Acoustic image of Target 26.

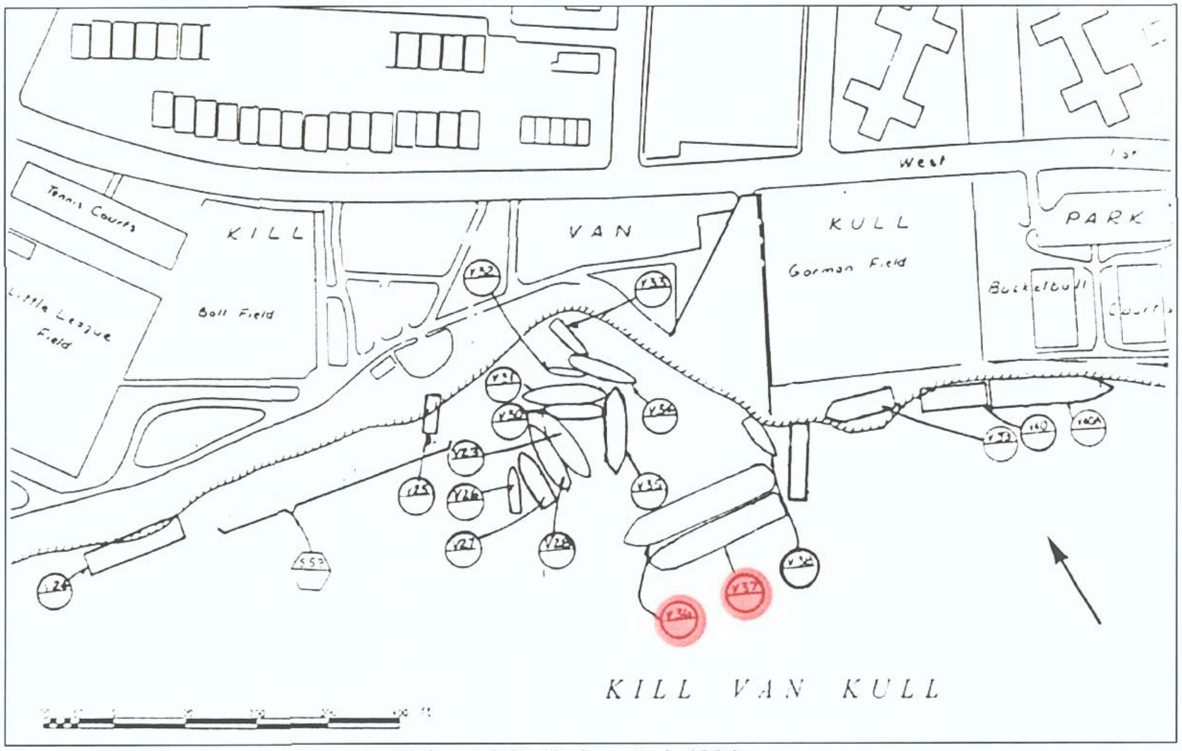

Figure 100. Map showing Vessels V36 and V37 (Raber et al. 1996).

Figure 101. Underwater photograph of frames and iron cross bracing on V37.

Target 27

Figure 102 shows the acoustic image captured during the survey. It is located in Newark Bay at 590881 East/663231 North (see Figure 46c). This target was associated with Anomaly A27. This anomaly was investigated and determined to be the remains of the causeway belonging to the Central Railroad of New Jersey (Figure 103). This causeway was built in 1864 and removed sometime in the 1970s. It is not considered significant and is not recommended for further investigation.

Figure 102. Acoustic image of Target 27.

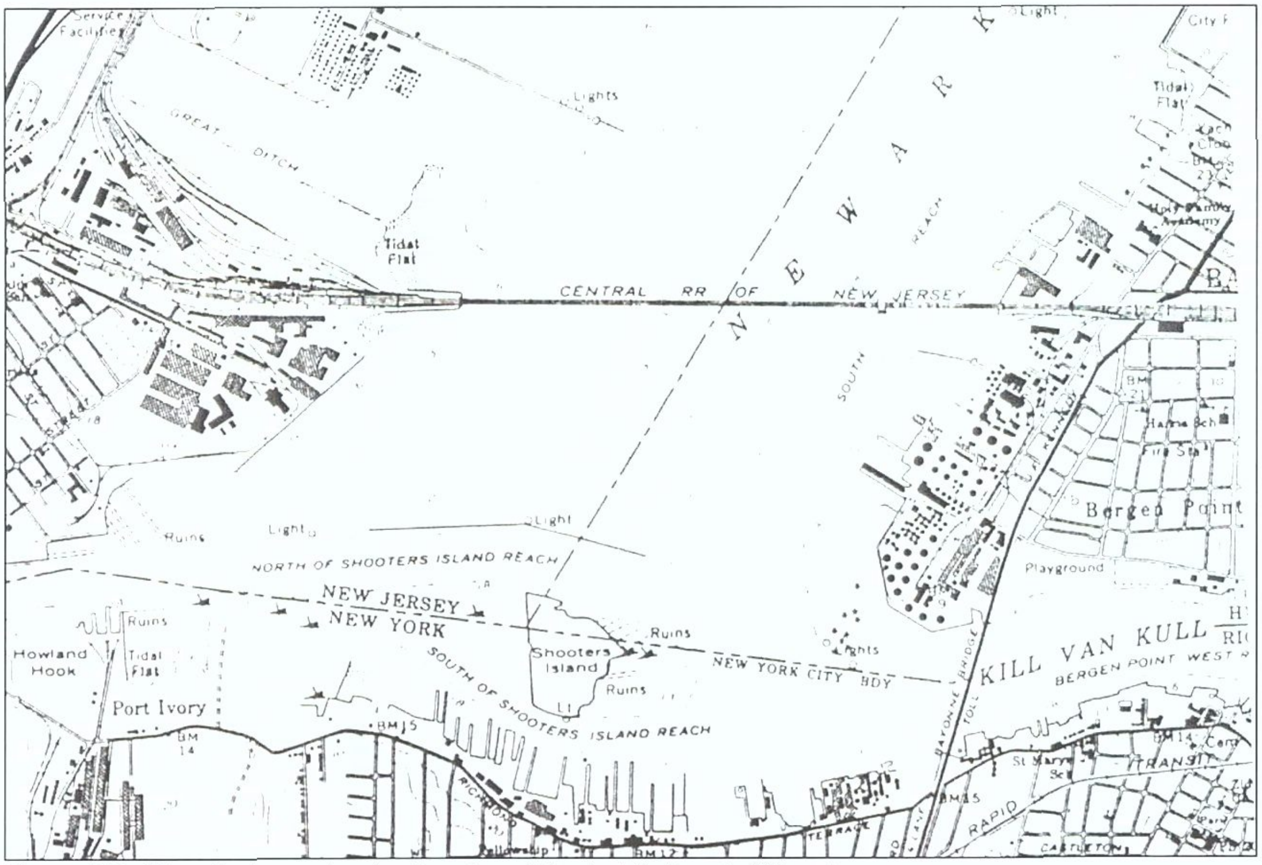

Figure 103. Historical map showing location of Central Railroad of New Jersey causeway.

Target 28

Figure 104 shows the acoustic image captured during the survey. It is located in Newark Bay at 590309 East/662041 North (see Figure 46c). The source of the acoustic return was originally thought to be a round object similar in form to a gun turret. The target was dived and was determined to be the remains of a steel- or iron-jacketed concrete piling. Most likely it is the remains of a pier. It is not considered significant and is not recommended for further investigation.

Target 29

Figure 105 shows the acoustic image captured during the survey. It is located in Newark Bay at 590743 East/663018 North (see Figure 46c). The source of the acoustic return was originally thought to be an uneven bottom, with possible exposed frames. Diving investigation revealed the presence of a large amount of wire rope and several pilings. This target is not considered significant and is not recommended for further investigation.

Target SSa

Figure 106 shows the acoustic image captured during the survey. It is located in Kill Van Kull at 591320 East/658186 North (see Figure 46c). The source of the acoustic return is the vessels of Cluster 3 as described in Raber and Associates (1996c) (Figure 107). This cluster is comprised of vessels V30 and V31 and structure S107. Raber and Associates (1996c) describe V30 and V31 as an unidentified metal vessel and an unidentified vessel, respectively. They did not discuss S107. Diving investigations of these vessels determined that V30 is a heavily deteriorated iron hulled vessel approximately 70 feet in length (Figure 108).

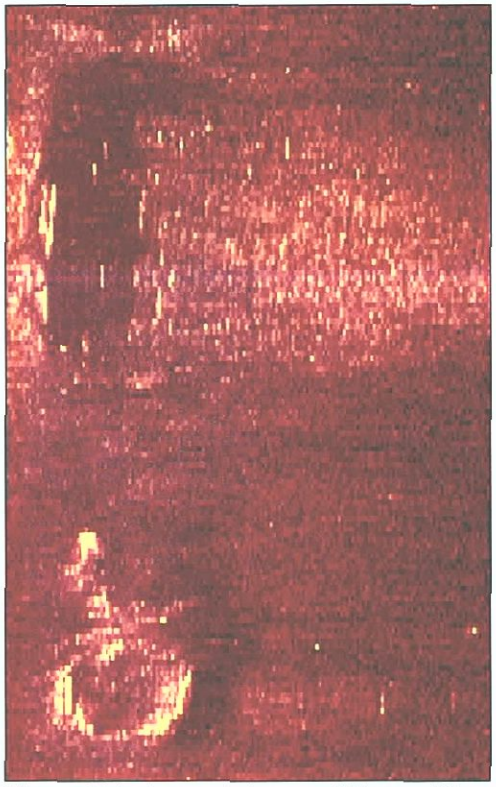
Figure 104. Acoustic image of Target 28.


Figure 105. Acoustic image of Target 29.

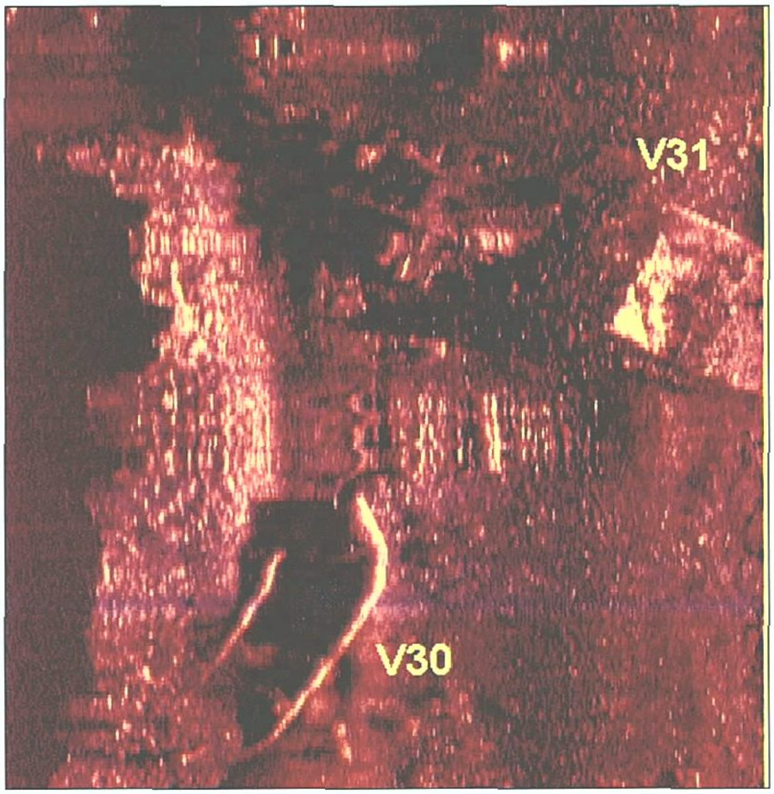

Figure 106. Acoustic image of Target Ssa.

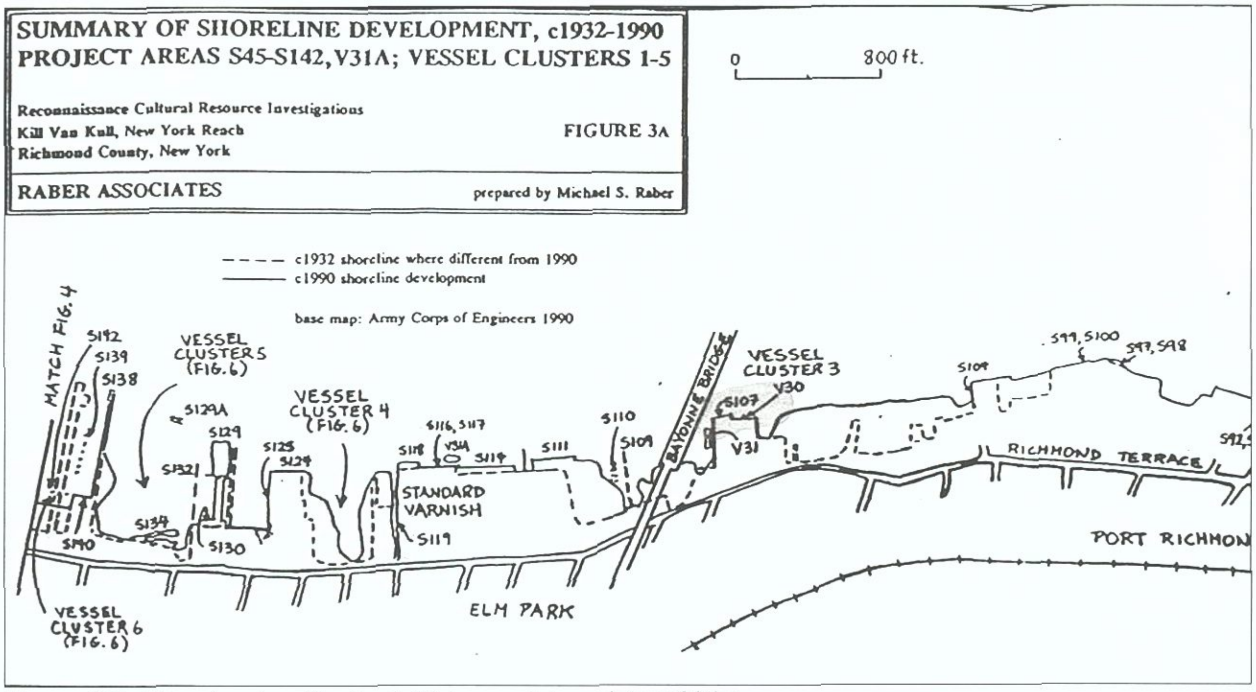

Figure 107. Map showing Cluster 3 (Raber and Associates 1996c).

Figure 108. Photograph of the bow of Vessel V30.

The iron plating of the vessel is riveted, indicating a construction date of sometime before the mid-twentieth century, when welding generally replaced riveting for fastening iron (Corlett

1990:28-29). While the vessel is heavily deteriorated, with the hull plate largely corroded away above the bottom and the stern section largely gone, a few basic measurements were obtained. Frames are spaced on two foot centers, and rivets are spaced every six inches. Also, fragments of heavily deteriorated machinery were noted inside the hull, including a possible winch drum. Although this vessel is of sufficient age to be considered historically significant, its state of heavy deterioration precludes obtaining enough useful information via further examination. Therefore, it is not considered significant and is not recommended for further investigation.

V31 was also examined. It was determined to be an iron-hulled scow with welded seams. V31 is not considered significant and is not recommended for further investigation. Likewise, S107 was determined to be the remains of a pier or dock structure (Figure 109); it is not considered significant and is not recommended for further investigation.

Figure 109. Photograph of Structure S107.

Target SSb

Figure 110 shows the acoustic image captured during the survey. It is located in Kill Van Kull at 589729 East/657941 North. The source of the acoustic return is the vessels of Cluster 4 as described in Raber and Associates (1996c) (Figure 111). This cluster is comprised of six vessels: V32, V33, V36, V37, V38 and V39.

The vessels are described by Raber and Associates (1996c) as follows: V32–flush-deck motor tanker (Figure 112); V33–a Menhaden fishing trawler called the *Fish Hawk* (Figure 113); V36–a wooden hydraulic dredge; V37–4-masted schooner *Paul E. Thurlow* (Figure 114); V38–not discussed or typed; and V39–not discussed or typed. As far as NRHP significance is concerned, Raber and Associates (1996c) describe V33, V36 and V37 as significant, but make no recommendation as to further work; James (1999) examined the same vessels and recommended mitigation in the form of full recordation for V33 and V37, and partial recordation for V36. Neither Raber and Associates (1996c) nor James (1999) discuss V38.

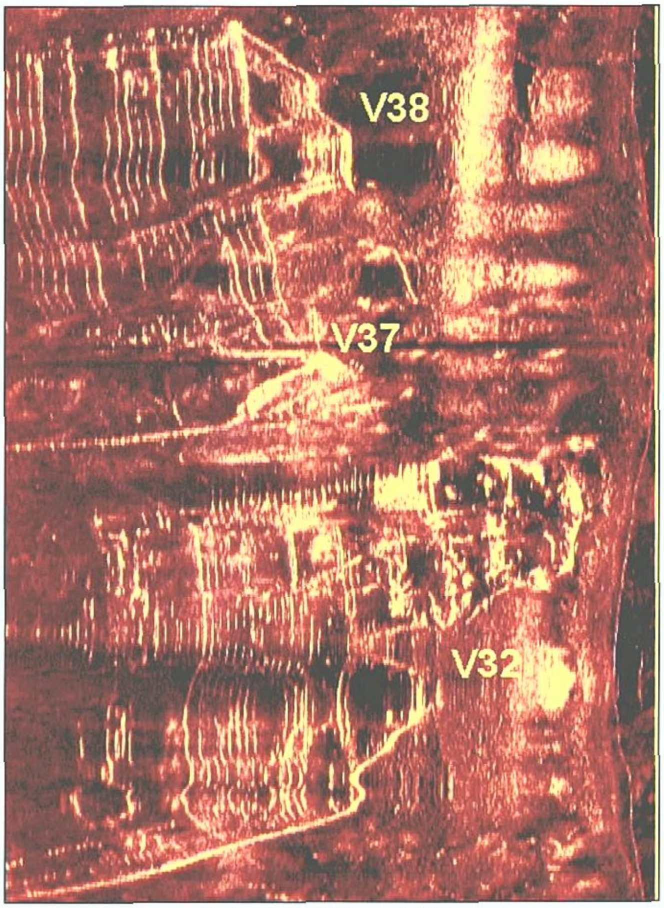

Figure 110. Acoustic image of Target SSb.

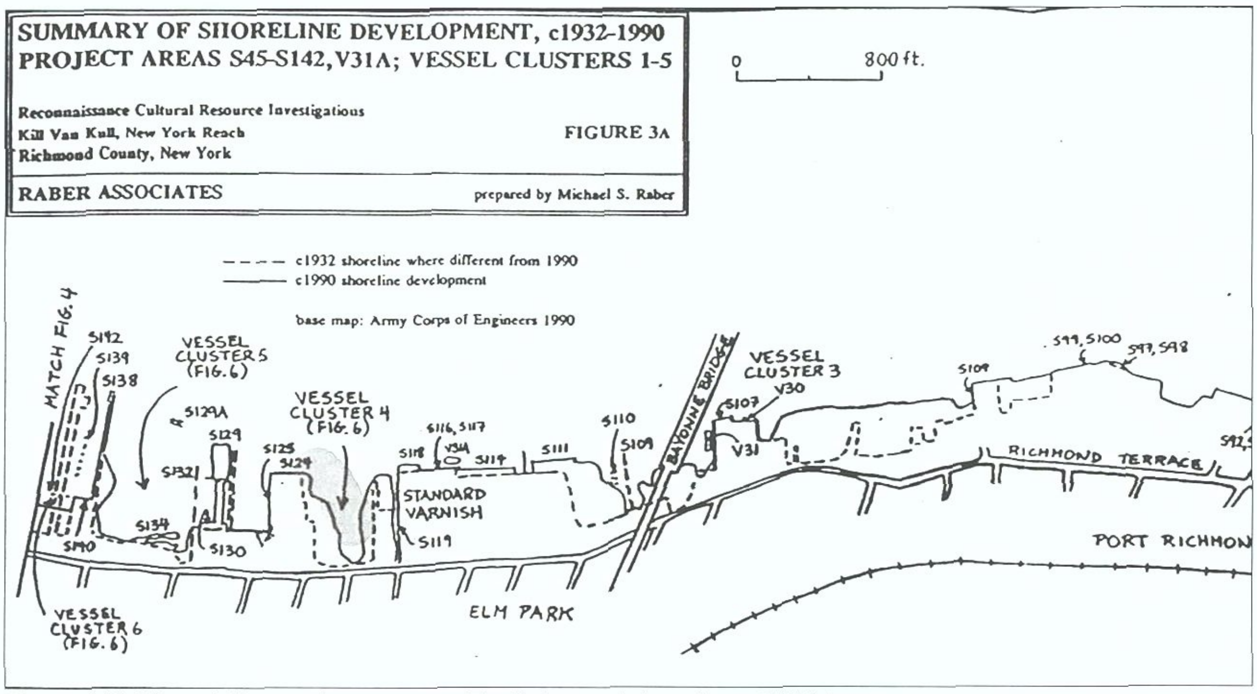

Figure 111. Map of Cluster 4 as presented in Raber and Associates (1996c).

Figure 112. Photograph of V32 – flush-deck motor tanker (foreground, mostly submerged).

Figure 113. Photograph of V33 – steam-powered Menhaden trawler (left background, partially submerged).

Figure 114. Photograph of V37 – 4-masted schooner *Paul E. Thurlow*.

Figure 115. Photograph of V38 – floating drydock (mostly submerged).

All six vessels were examined during the current project. Findings concur with previous studies of V32, V33, V36 and V37. In addition, V38 was determined to be a wooden hulled floating drydock (Figure 115), and as such represents a little-documented vessel type. For this reason, and despite its deteriorated condition, it is recommended for mitigation in the form of complete recordation. V39 remains unidentified, although it is most likely a scow, and is not recommended for further investigation. To summarize: V33, V36, V37 and V38 are considered significant vessels and are recommended for mitigation in the form of full or partial recordation. Full archival research is also recommended, including but not limited to consultation of vessel registries and former owners (if available). The remaining vessels in the cluster (V39 and V32) are not considered significant and are not recommended for further investigation. Recommendations are summarized in Table 7.

Table 7. Significance and Recommendations for Vessels in Cluster 4 .

Vessel No. (Raber and Associates 1996c)	Type	Vessel Name	NRHP Significance	Further work recommended
V32	Flush-deck motor tanker	N/A	no	none
V33	Menhaden fishing trawler	*Fish Hawk*	yes	complete recordation and archival research
V36	wooden hydraulic dredge	N/A	yes	partial recordation
V37	4-masted schooner	*Paul E. Thurlow*	yes	complete recordation and archival research
V38	floating drydock	N/A	yes	complete recordation and archival research
V39	unidentified	N/A	no	none

Diving Results-Additional Targets

Several additional targets were identified in areas not surveyed during the previous investigation due to extreme low water or other obstructions. These targets were either wrecks on the navigation chart or structures or vessels visible at low water. A list of these three additional targets can be seen in Table 4.

T1

This target is located at 587490 East/660975 North and is marked on the navigation chart as a wreck (Figure 116). It was dived and determined to be a field containing various pieces of vessel-related debris, including disarticulated timbers, iron plate, worked timbers with notches and scarphs, and brick (Figure 117). Most notable was a large section of articulated timbers, 38 feet in length, five feet in height, and comprised of five-inch square timbers. The timbers in the articulated section were jointed with six-foot planking scarphs. This section is likely part of a barge or scow, but the vessel itself has been broken up to the point where it has become unidentifiable. It is not considered significant and is not recommended for further investigation.

T2

This target is located at 587414 East/660986 North and is also a wreck marked on the navigation chart, less than 300 feet away from T1 (see Figure 116). This target was dived and determined to be a scatter of disarticulated pilings, timbers, and concreted pieces of iron. It is not considered significant and is not recommended for further investigation.

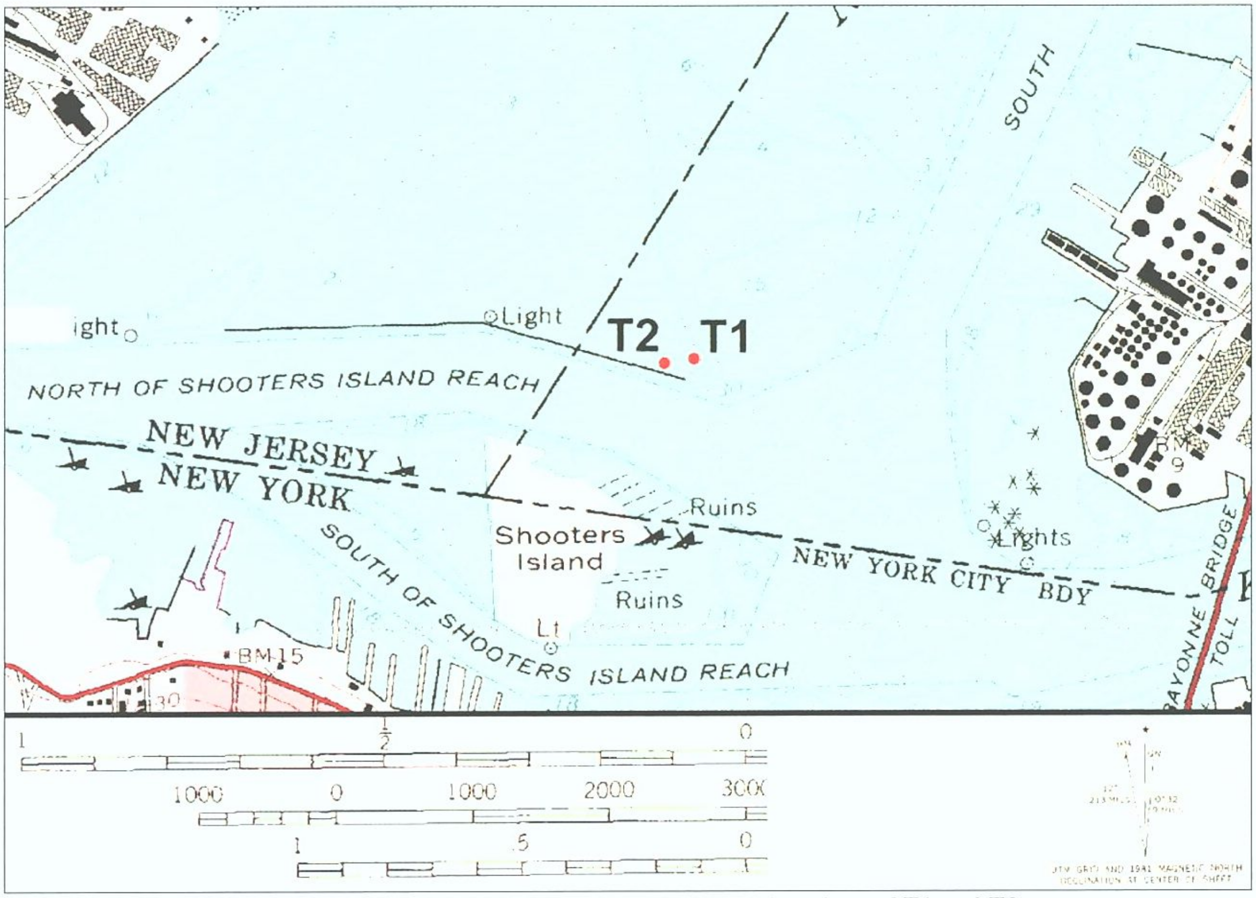

Figure 116. Portion of USGS Elizabeth NJ 15' Quadrangle showing locations of T1 and T2.

Figure 117. Photograph of timber from Target T1.

T3

This target is located at 580855 East/660051 North, and is listed by Raber et al. (1996) as V241. They did not discuss the vessel nor did they make any recommendations. This vessel was dived as part of the current project. It was determined to be the remains of a scow with bulkhead construction (Figure 118). This vessel is heavily deteriorated, and better examples, including ones that will receive documentation, exist elsewhere (Lydecker and James 2002). This vessel is not considered significant and is not recommended for further investigation.

Figure 118. Photograph of V241/T3.

7. CONCLUSIONS AND RECOMMENDATIONS

From July 31–September 18, 2002, Panamerican Consultants, Inc. (Panamerican) of Memphis, Tennessee, conducted an underwater archaeological investigation for Matrix Environmental and Geotechnical Services, Inc., of Florham Park, New Jersey. This investigation is part of the New York and New Jersey Harbor Navigation Study. Its purpose was to examine the sources of eleven acoustic targets and 28 magnetic anomalies in the project area. Also included was a remote-sensing survey and target investigation of five areas skipped during the original survey due to safety concerns.

The current project includes the deepening and widening of numerous channels in the Port of New York and New Jersey. The survey area consisted of an area extending 100 feet past each edge of the channels, which include Ambrose, Anchorage (west side only), Kill Van Kull, Arthur Kill to Howland Hook Berth, Newark Bay and South Elizabeth Channels. Areas of Newark Bay Channel surveyed included the east side to the northern edge of the Port Newark Channel, west side between Kill Van Kull and South Elizabeth Channel, and the east side between Port Elizabeth and Port Newark Channels (to 250 feet). Also included were a dredged pit in the area of Robbins Reef, and the intersection of Newark Bay and Kill Van Kull Channels. Water depths ranged from zero to 55 feet.

During the investigation, remote-sensing targets were refined and dived. Magnetic anomaly locations were probed to a depth of seven feet and diver sweeps were used to locate acoustic targets. Of the 28 magnetic anomalies, six were pipelines, 10 were miscellaneous non-historic modern debris, six were non-significant modern structures, two were non-significant submerged marine resources, one had a refined location outside the project area, one was not relocated on refinement, and two were not dived or refined due to safety concerns. Of the 11 acoustic targets, three were non-significant modern structures, five were non-significant submerged marine resources, one was determined to be outside the project area on refinement, and elements of two are recommended for Phase III investigation.

In addition, the remote-sensing survey located two acoustic targets that were investigated by Panamerican divers. Of these, one was determined to consist of two modern steel vessels, and one was determined to be a cluster of five historic vessels, four of which are recommended for Phase III investigation. Several targets were added to the diving investigation, including three wrecks located on the navigation charts in areas that were not surveyed during the original survey due to extremely low water, and one acoustic target located during the original survey but not recommended for further work because it was initially determined to be outside the project area. Examination of the site determined that it is in fact inside the project area. This target, SS22, consists of 17 vessels, but only one vessel is recommended for additional work. A complete locational map of investigated targets can be seen in the original survey report. In all, a total of six vessels are recommended for further investigation. These targets are shown on Figure 119 and in Table 8.

Target SSb/Vessel V33

Vessel V33 is generally accessible only by water, although large portions are exposed at both low and high tides, and is readily accessible by boat. Recommendations for V33 are that it receive complete recordation, including deck plan and hull lines, photo documentation with video, 35 mm, and digital photography, and archival research including consultation of vessel registries, local, regional and national repositories, and previous owners.

Target SSb/Vessel V36

Vessel V33 is generally accessible only by water, is mostly submerged at low tide, and is readily accessible by boat. Recommendations for V36 are that is receive partial recordation, including recording of main structural elements and basic dimensions.

Target SSb/Vessel V37
Vessel V33 is generally accessible only by water, although large portions are exposed at both low and high tides, and is readily accessible by boat. Recommendations for V37 are that it receive complete recordation, including deck plan and hull lines, photo documentation with video, 35 mm, and digital photography, and archival research including consultation of vessel registries, local, regional and national repositories, and previous owners.

Target SSb/Vessel V38
Vessel V38 is generally accessible only by water, is mostly submerged at low tide, and is readily accessible by boat. Recommendations for V38 are that is receive complete recordation, including deck plan and hull lines, photo documentation with video, 35 mm, and digital photography, and archival research including consultation of vessel registries, local, regional and national repositories, and previous owners.

Target SS22/Vessel V2
Vessel V33 is generally accessible only by water, although large portions are exposed at both low and high tides, and is readily accessible by boat. Recommendations for V2 are that it receive complete recordation, including deck plan, hull lines, and machinery, photo documentation with video, 35 mm, and digital photography, and archival research including consultation of vessel registries, local, regional and national repositories, and previous owners.

Target SS16b
Target SS16b is accessible only by water. Recommendations for SS16b are that it receive complete recordation, including deck plan and hull lines, photo documentation with video, 35 mm, and digital photography, and archival research including consultation of vessel registries, local, regional and national repositories, and previous owners. Key diagnostic artifacts, such as the propeller and one or more sections of iron frame with attached wooden hull planking be recovered, conserved and offered to a regional maritime museum.

Table 8. Vessels Recommended for Further Investigation.

Target	Vessel	Description	Eligibility Criteria	Recommendation
SSb	V33	Menhaden trawler *Fish Hawk*	C, D	complete recordation and archival research
SSb	V36	Wood hydraulic dredge	D	recordation of main structural elements and basic dimensions
SSb	V37	4 masted schooner *Paul E. Thurlow*	C, D	complete recordation and archival research
SSb	V38	Balanced floating drydock	D	complete recordation and archival research
SS22	V2	Balanced floating drydock	C, D	complete recordation and archival research
SS16b	NA	Iron/wood composite vessel	C, D	complete recordation and archival research including recovery and conservation of diagnostic artifacts

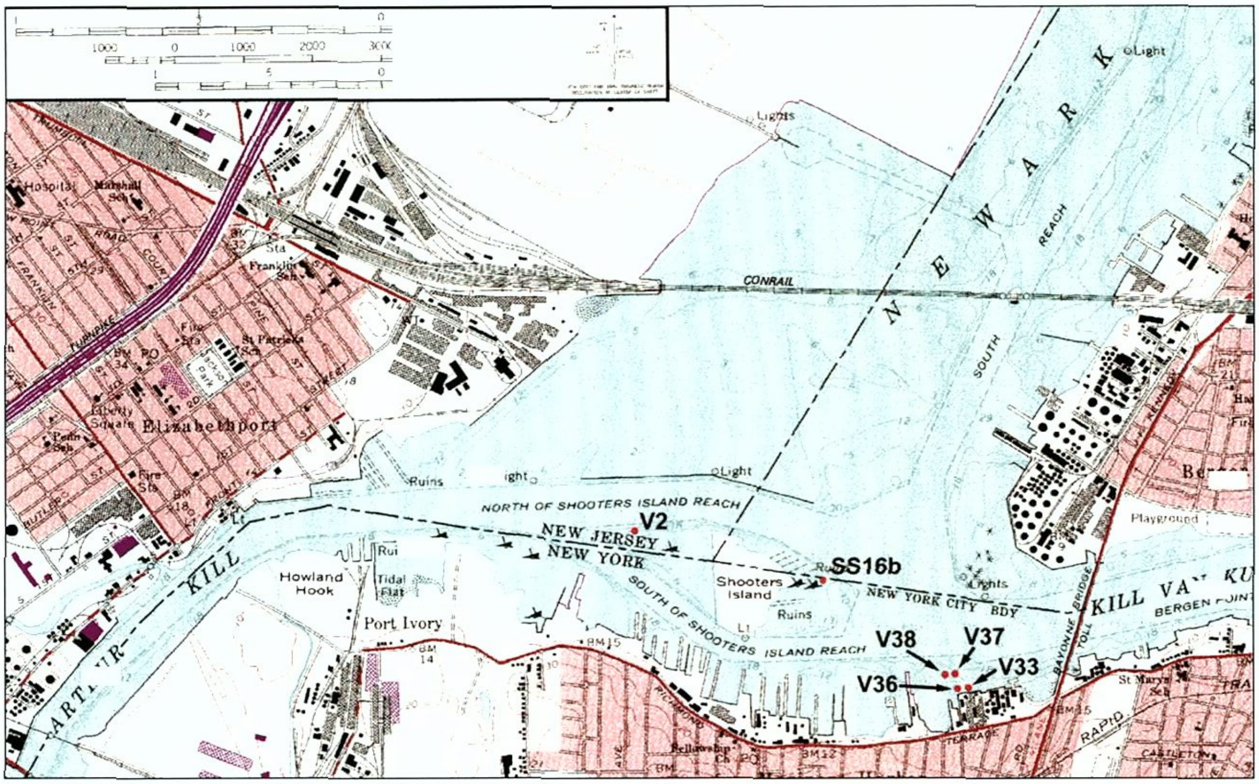

Figure 119. Map showing locations of targets recommended for further investigation (base map: USGS Elizabeth NJ 15' quadrangle).

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APPENDIX A: INTERIM REPORT

October 4, 2002

Ms. Lynn Rakos
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. DACW51-01-D-0015-8a
Delivery Order Number 0002
Target Investigations in Connection with the New York and New Jersey Harbor Navigation Study Upper and Lower Bay, Port of New York and New Jersey, Kings, Queens, New York, and Richmond Counties, New York, and Essex, Hudson, Monmouth and Union Counties, New Jersey

Dear Ms. Rakos:

The following management summary discusses the 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 the U.S. Army Corps of Engineers, New York District's obligations under the National Historic Preservation Act of 1966.

INTRODUCTION

From July 31–September 18, 2002, Panamerican Consultants, Inc. (PCI) of Memphis, Tennessee, conducted an underwater archaeological investigation for Matrix Environmental and Geotechnical Services, Inc., of Florham Park, New Jersey. This investigation is part of the New York and New Jersey Harbor Navigation Study. Its purpose was to examine the sources of eleven acoustic targets and 28 magnetic anomalies in the project area. Also included was a remote-sensing survey and target investigation of five areas skipped during the original survey due to safety concerns.

The current project includes the deepening and widening of numerous channels in the Port of New York and New Jersey. (Figure 1). The survey area consists of an area extending 100 feet past each edge of the channels, which include Ambrose, Anchorage (west side only), Kill Van Kull, Arthur Kill to Howland Hook Berth, Newark Bay and South Elizabeth Channels. Areas of Newark Bay Channel surveyed included the east side to the northern edge of the Port Newark Channel, west side between Kill Van Kull and South Elizabeth Channel, and the east side between Port Elizabeth and Port Newark Channels (to 250 feet). Also included were a dredged pit in the area of Robbins Reef, and the intersection of Newark Bay and Kill Van Kull Channels. Water depths ranged from zero to 40 feet.

Table 1. Assessment Results of Targets Investigated.

Target	Type	Description	Further Work
A8	anomaly	modern debris	no
A9	anomaly	large 7' X 15' block of reinforced concrete, function unknown	no
A12	anomaly	not relocated on refinement	no
A15	anomaly	relocated on one line only. Modern debris	no
A27	anomaly	combination of pipeline and remains of Conrail railroad trestle	no
A33	anomaly	modern debris	no
A39	anomaly	Located in channel. Not significant	no
A43	anomaly	Remains of pier	no
A46	anomaly	Pipeline	no
A49	anomaly	Refined location outside project area	no
A50	anomaly	Large pile of broken concrete	no
A51	anomaly	Scattered debris on channel slope	no
A52	anomaly	Modern debris	no
A53	anomaly	Giant tire	no
A54	anomaly	Modern debris	no
A55	anomaly	remains of dock, pier or tower	no
A61	anomaly	2 large metal objects under silt, attached to modern rope	no
A62	anomaly	pipeline	no
A63	anomaly	remains of Conrail railroad trestle	no
A64	anomaly	engine block	no
A73	anomaly	pipeline	no
A81	anomaly	unrecognizable large mass of metal	no
A85	anomaly	pipeline	no
A86	anomaly	pipeline	no
A99	anomaly	not refined or dived due to safety reasons	no
A100	anomaly	not refined or dived due to safety reasons	no
A101	anomaly	two piers, remains of pilings, trash	no
A110	anomaly	pipeline	no
SS3	side scan	part of unrecognizable large mass of metal (see A81 and SS4)	no
SS4	side scan	part of unrecognizable large mass of metal (see A81 and SS3)	no
SS11	side scan	barge remains - heavily deteriorated	no
SS13	side scan	refinement indicated target lies outside project area	no
SS16	side scan	3 derelict vessels (see discussion)	no
SS19	side scan	several derelict vessels including 2 tugs, and a pier	no
SS24	side scan	old pilings or pier - similar to nearby structures visible at low water	no
SS26	side scan	barge or cargo vessel with hard chine. Wood and iron composite construction	no
SS27	side scan	remains of Conrail railroad trestle	no
SS28	side scan	large amount of steel cable off bottom, and remains of pier	no
SS29	side scan	steel jacketed piling	no
SSa	side scan	Cluster 3 (Raber 1996) two iron wrecks - barge and possible tug	no
SSb	side scan	Cluster 4 (Raber 1996). 5 vessels.	yes

Target	Type	Description	Further Work
		Additional targets	
T1	Wreck on chart	heavily deteriorated unrecognizable remains of wooden structure or vessel	no
T2	Wreck on chart	modern debris	no
T3	visible remains	heavily deteriorated remains of scow with bulkhead construction	no
SS22	side scan	northwest side of Shooters Island. 13 derelict vessels	yes

The investigation took place during July 31–September 18, 2002. Remote-sensing targets were refined and dived. Of the 28 magnetic anomalies, six were pipelines, 10 were miscellaneous non-historic modern debris, six were non-significant modern structures, two were non-significant submerged marine resources, one had a refined location outside the project area, one was not relocated on refinement, and two were not dived or refined due to safety concerns. Of the 11 acoustic targets, three were non-significant modern structures, five were non-significant submerged marine resources, one was determined to be outside the project area on refinement, and elements of two are recommended for Phase III investigation. In addition, the remote-sensing survey located two acoustic targets that were investigated by Panamerican divers. Of these, one was determined to consist of two modern steel vessels, and one was determined to be a cluster of five historic vessels, four of which are recommended for Phase III investigation. Several targets were added to the diving investigation, including three wrecks located on the navigation charts in areas that were not surveyed during the original survey due to extremely low water, and one acoustic target located during the original survey but not recommended for further work because it was initially determined to be outside the project area. Examination of the site determined that it is in fact inside the project area. This target, SS22, consists of 13 vessels, but only one vessel is recommended for additional work. A summary of targets investigated is included in Table 1. Sites recommended for additional work are listed in Table 2 and on Figure 2. Vessel numbers are those used in Raber (1995b) and James (1999). A complete locational map of investigated targets can be seen in the original survey report.

Copies of the final report will be on file at the U.S. Army Corps of Engineers, New York District, and the New York State Historic Preservation Office.

Table 2. Sites Recommended for Further Investigation.

Target	Vessel #	Description	Eligibility Criteria	Recommendation
SSb	V33	Menhaden fishing trawler	C, D	complete recordation
SSb	V36	Wood hydraulic dredge	D	recordation of main structural elements and basic dimensions
SSb	V37	4 masted schooner *Paul E. Thurlow*	C, D	complete recordation
SSb	V38	Floating drydock	D	complete recordation
SS22	V2	Floating drydock	C, D	complete recordation

CURRENT PROJECT STATUS

Fieldwork was completed by September 18, 2002. Panamerican divers logged 45 hours of bottom time. The locations of all anomalies and acoustic targets were examined, relevant data was collected, and sites were assessed as to their eligibility for placement on the National Register of Historic Places. Work on the draft report began on Monday, September 23rd. Other sources of information, such as video and drawings, are in the process of being reviewed and finalized. The draft report is expected to be completed by the end of November.

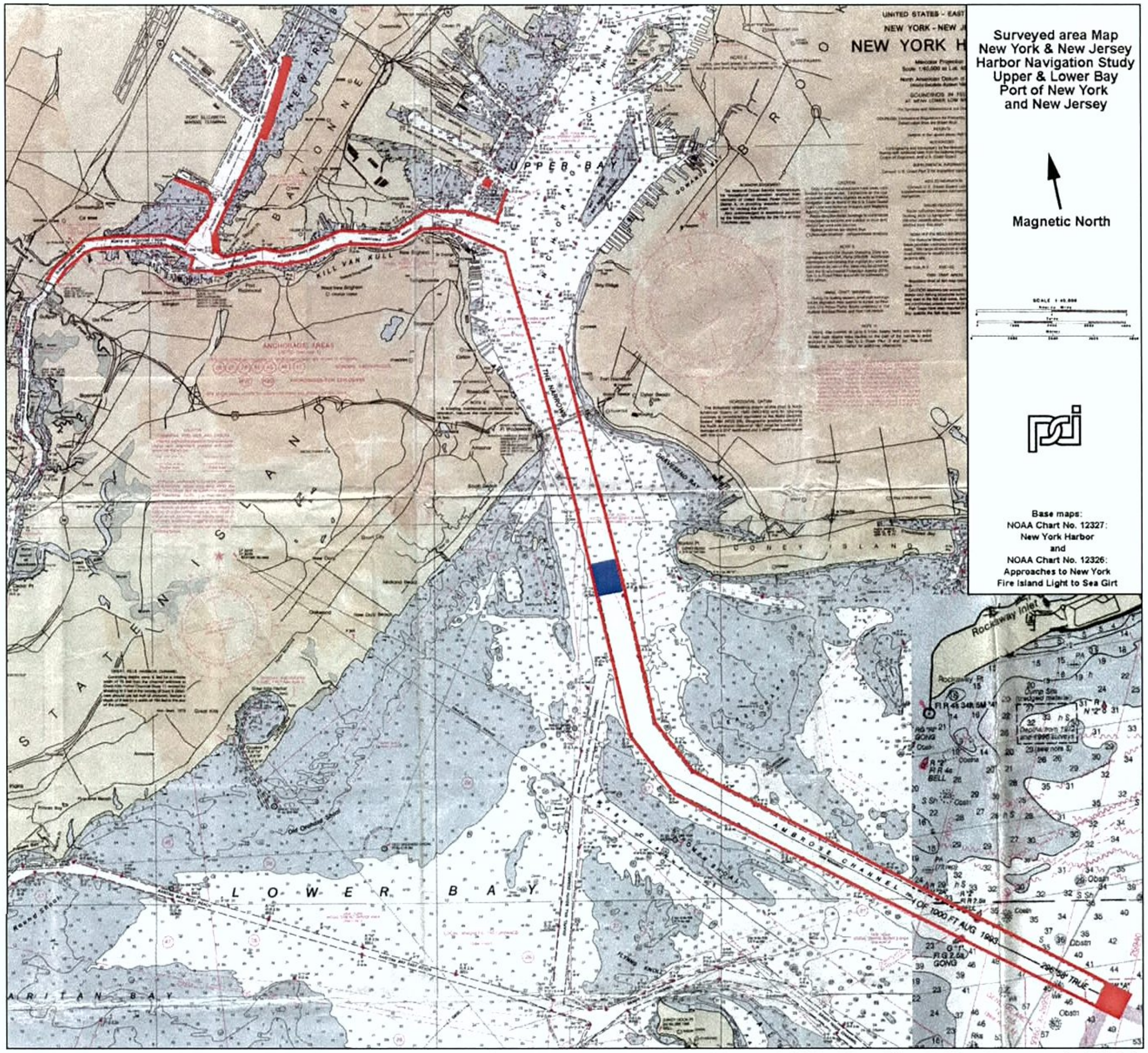

Figure 1. Area surveyed in 2001 (base map: NOAA navigation chart Nos. 12327: New York Harbor, and 12326: Approaches to New York Fire Island Light to Sea Girt.

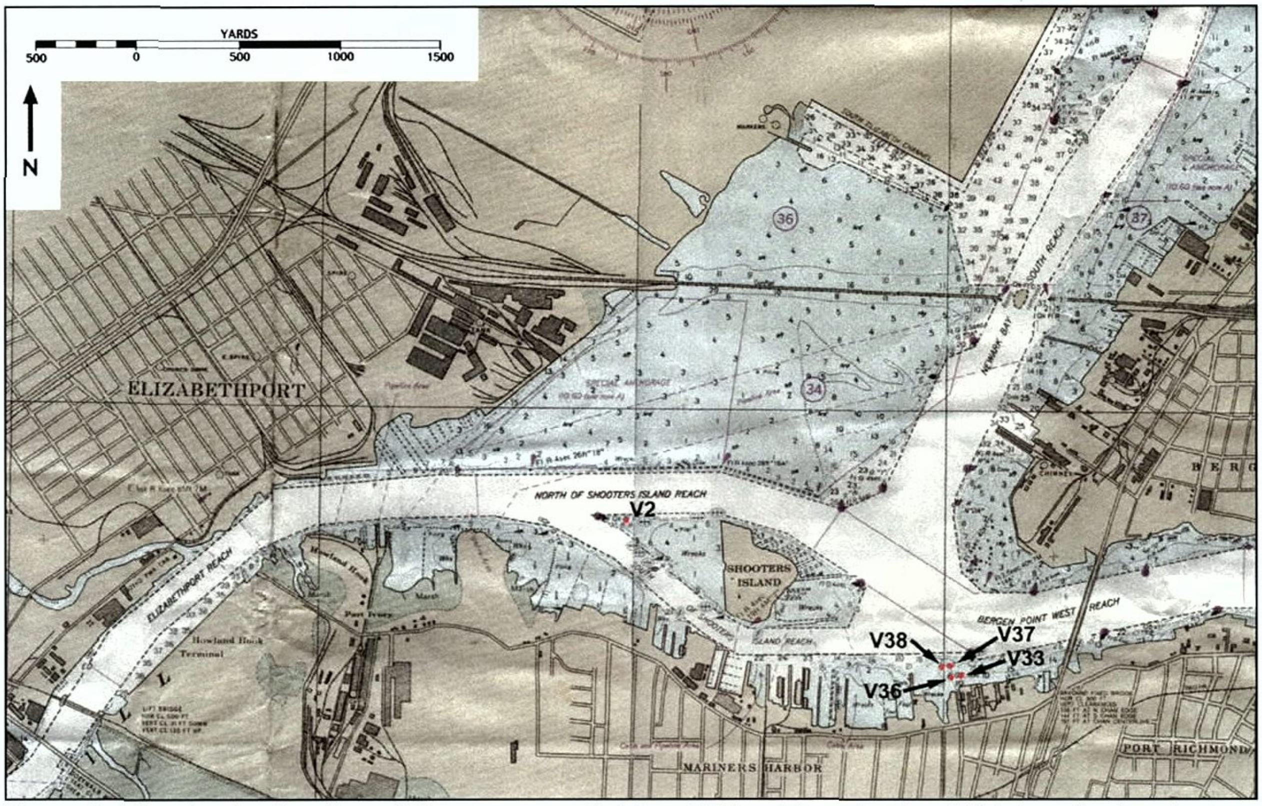

Figure 2. Map showing locations of sites recommended for additional investigation (NOAA navigation chart Nos. 12333: Kill Van Kull and Northern Part of Arthur Kill).

If there are any questions regarding this summary specifically or the project in general, please feel free to contact Stephen James or me at our Memphis office.

Sincerely,

Andrew D. W. Lydecker, Maritime Archaeologist

CC: Stephen R. James, Jr., Underwater Project Manager
Dennis Petrocelli, Matrix Environmental and Geotechnical Services, Inc.

REFERENCES CITED

James, Stephen R.
1999 *Cultural Resources Survey, New York Harbor Collection and Removal of Drift Project, Arthur Kill, Richmond County, New York Reach; Arthur Kill, Union and Middlesex Counties, New Jersey Reach; and Kill Van Kull, Richmond County, New York Reach.* Panamerican Consultants, Inc. Memphis, Tennessee. On file, U.S. Army Corps of Engineers, New York District.

Raber, Michael S., Thomas R. Flagg, Ernest A. Wiegand, Gerald Weinstein, and Norman Brouwer
1995b *Cultural Resources Reconnaissance of the Kill Van Kull Reach: New York Harbor Collection and Removal of Drift Project.* Draft report submitted to Frederic R. Harris, Inc. On file, U.S. Army Corps of Engineers, New York District.

APPENDIX B: DIVE SAFETY PLAN

DIVE SAFETY PLAN

Target Investigations in Connection with the New York And New Jersey Harbor Navigation Study Upper and Lower Bay, Port of New York and New Jersey, Kings, Queens, New York, and Richmond Counties, New York, and Essex, Hudson, Monmouth and Union Counties, New Jersey

Contract No. DACW51-01-D-0015 8a Delivery Order No. 0002

Introduction

This document is the Dive Safety Plan to be employed by Panamerican Consultants, Inc., (Panamerican) of Memphis, Tennessee during diving operations for the New York District, U.S. Army Corps of Engineers (COE), to examine 28 anomalies, and 11 side scan targets identified during a Phase I survey of Ambrose, Anchorage, Kill Van Kull, Arthur Kill, and Newark Bay Channels. This investigation will be conducted under subcontract to Matrix Environmental and Geotechnical Services, of Florham Park, New Jersey, for the New York District in response to their Scope of Work entitled *Target Investigations in Connection with the New York and New Jersey Harbor Navigation Study Upper and Lower Bay, Port of New York and New Jersey, Kings, Queens, New York, and Richmond Counties, New York, and Essex, Hudson, Monmouth and Union Counties, New Jersey,* under Contract No. DACW51-01-D-0015 8a, Delivery Order No. 0002.

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.

If for any reason the dive plan is altered in mission, depth, personnel, or equipment, the USACE Command Diving Coordinator (UDC) at the district level shall be contacted and shall review any revision prior to actual operation.

Research Design

The purpose of diving operations is to investigate and evaluate 28 magnetic anomalies and 11 side scan targets identified during a previous remote-sensing survey adjacent to the Federal Channels of Ambrose, Anchorage, Kill Van Kull, Arthur Kill, and Newark Bay. As specified in the SOW and the Memorandum of Agreement (MOA), field project aspects will include:

- Background Research/Remote-sensing Plan Development
- Development of Dive Safety Plan

- Remote sensing survey of areas not surveyed during initial project due to Corps blasting activities

- Conduct underwater inspections of all targets. Inspection is intended to locate each target and determine what, if any, further action should be taken. Sufficient information will be gathered through photography, video, and mapping to support the recommendation for or against further study. No artifacts will be recovered.

The underwater examination of each target will begin with a reconnaissance dive. The diver will attempt to identify the target. In the case of the magnetic anomalies, if the source is below the bottom of the river, additional methods including use of a metal detector and probing with a 7-foot hand probe or a 15-foot hydro-probe will be used. If the target cannot be located, is determined to exist below the depth of the proposed dredging, or is deemed non-significant, no further work will be recommended. In the case of derelict and wrecked vessels, access will be attempted from shore or water, whichever is most feasible. If a given vessel is submerged, diving will be attempted.

Schedule and Duration of Diving

The diving project is tentatively scheduled for August 1 through September 30, 2002. The diving will take place on each day that weather and safe water levels 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 depths recorded for the area range from five 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 five positions: a diving supervisor, a diver, a stand-by diver, one tender, and a time-keeper/communications operator. Each dive team member will meet the training and qualification requirements established in COE Safety and Health Requirements Manual (EM 385-1-1). Mr. Stephen James will serve as Project Manager. Mr. Andrew Lydecker will serve as the Diving Supervisor and Principal Investigator. Other members of the dive team are Michael Tuttle, underwater archaeologist; Jim Duff, underwater archaeologist; Matt Muldorf, archaeological diver; Greg Cook, archaeological diver, and Matt Elliott, archaeological diver. 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. 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.

Mr. Stephen R. James, Jr. acts as Project Manager for this project. Mr. James holds a degree in anthropology from Memphis State University and a master's degree in nautical archaeology from the Institute of Nautical Archaeology, Texas A&M University. SOPA (Society of Professional Archaeologists) certified since 1985, and with 20 years of experience in maritime archaeology, he has extensive project experience and has directed and conducted all phases of work on submerged sites including archival research, remote-sensing surveys, anomaly assessment, site testing, and full-scale shipwreck mitigation. Mr. James has an extensive diving background with various U.S. Army Corps of Engineer Districts: New York, Wilmington, Savannah, Vicksburg, Memphis, Mobile, New Orleans, and Galveston. He served as Project Manager for the investigation of the *Manuela* in San Juan Harbor in 2001.

Mr. Andrew Lydecker, who will act as Principal Investigator and Dive Supervisor for the investigation, holds an M.S. in Cartography and G.I.S. and an M.A. in Anthropology, both from the University of Wisconsin. He also holds a B.S. in Anthropology from Mankato State University. He has extensive archaeological and computer drafting experience. His previous archaeological experience was gained in the Great Lakes, Florida, Southern rivers, Caribbean, and South Pacific. Since joining Panamerican in 2000, he has directed and authored several projects for the New York District COE, including both diving and remote-sensing projects. He has been employed by Panamerican previously for New York, Wilmington, Jacksonville, Mobile, and Vicksburg District COE operations on various underwater diving projects. Recently he has acted as Principal Investigator and Diving Supervisor for a Phase II assessment of remote-sensing targets and hulks in the Hudson River at Athens, New York.

Mr. James Duff, who will act as Underwater Archaeologist for the investigation, joined Panamerican in August of 1991 and is A.B.T. in the master's program at Texas A&M University. He will act as Remote-sensing Specialist and Underwater Archaeologist. Prior to employment with Panamerican, he accumulated extensive professional experience working for the North Carolina State Underwater Archaeology Unit and participated in remote-sensing surveys and anomaly investigations on projects with various universities and consulting firms. Since joining Panamerican, Mr. Duff has successfully directed and completed a variety of underwater cultural resource projects. Among these, he co-authored a shipwreck compilation and historic background report recently completed as part of a remote-sensing survey for a submerged pipeline corridor from New Jersey to Staten Island, New York. That survey collected over 2,000 line miles of remote-sensing survey records, including magnetometer, side scan sonar, and sub-bottom profiler, which were analyzed and interpreted by Mr. Duff for potentially significant cultural resources. He has directed or participated in several remote-sensing surveys and diver investigations for the New York, Wilmington, Savannah, Mobile, and Vicksburg Districts. At present Mr. Duff is acting as an Archaeological Diver for the testing of six anomalies on the Yazoo River for the Vicksburg District Army Corps of Engineers. He also served as Underwater Archaeologist for the investigation of the *Manuela* in San Juan Harbor in 2001.

Mr. Gregory Cook, who will act as an Archaeological Diver, is A.B.D. from the program in anthropology at Syracuse University, and holds a B.A. in anthropology from Indiana University, and an M.A. in anthropology from the Institute of Nautical Archaeology at Texas A&M University. Mr. Cook has a wealth of experience in the field of maritime archaeology beginning in 1991. He has participated in various archaeological projects in the Caribbean, East Coast, Gulf Coast and Western Rivers. He has been employed by Panamerican for diving operations in the Gulf and Western Rivers. His dissertation focuses on cultural interaction through trade in West Africa, and is currently working on final submittal. He also served as Underwater Archaeologist for a Phase II assessment of remote-sensing targets and hulks in the Hudson River at Athens, New York.

Mr. John Rawls, who will act as Archaeological diver, holds a B.A. in Anthropology from Northwestern State University in Natchitoches, Louisiana, and is currently enrolled in the Graduate Historical Archaeology Program and the University of West Florida. Mr. Rawls has previous terrestrial and maritime experience in the south and the southeast. He has been employed by Panamerican for diving operations in the Gulf of Mexico and terrestrial archaeology in Kentucky, Tennessee, and Missouri. He participated in a Phase II diving job for the New York District in December of 1999. Most recently, he has participated as a Graduate Research Assistant in the underwater excavations of site 8GU108, in St. Joseph's Bay, Florida.

Mr. Matt Elliott, who will act as Archaeological Diver, holds a B.A. in Anthropology from the University of South Alabama, as well as a Commercial Diving Certificate from the International Commercial Diving Institute. Mr. Elliott has previous terrestrial and maritime archaeological experience in the South Pacific, southern rivers, and East Coast, and brings his extensive commercial diving experience to the team. Recently he participated as an archaeological diver on a Phase II assessment of remote-sensing targets and hulks in the Hudson River at Athens, New York for the New York District.

Dive Platform

The dive platform utilized will be of a size and type appropriate for the area environment and specific diving operations. At present a particular vessel has not been contracted for this project. A vessel will be chartered locally and be operated by an experienced and U.S.C.G. licensed local captain. The vessel will conform 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

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' Agency Diving Coordinator (ADC) 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.

Environmental Suits

Environmental suits will be required during excavation of suspected contaminated sediments and recordation in areas where diver/sediment contact might occur. The watertight suits will be used in conjunction with the SSA helmets to effectively seal off the diver from potential contamination in the suspended sediments. Hot water suits and dry suits are unacceptable since they do not protect the hands and feet. Divers and equipment used in excavating contaminated sediments will be hosed off after each dive and at the end of the day to reduce possible contamination.

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 below. 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 downtime.

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 airflow 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 fewer than two 240-cubic-foot 'K' bottles. Pressure gauges and check valves are included in the air supply system as appropriate. Two levels of redundant backup air supply will be used, including an aluminum 80cf SCUBA cylinder linked to the SSA cascade system, and a 50cf aluminum SCUBA cylinder worn by the diver and connected to the dive helmet. The cascade system will be stored in an environment 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 to 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 hoses 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, 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 site will begin with orientation dives to determine the visible spatial extent, integrity, and present components of the site. Appropriate techniques and equipment such as metal and hydraulic probes will be employed to locate buried remains if none are apparent above the bottom. If necessary, portions of the site and its components will be uncovered through the use of hydraulic venturi-style dredges powered by small, low-pressure water pumps. It is emphasized that a minimum necessary amount of sediments will be disturbed in order to locate, examine, and evaluate the site. Archaeological divers will record sufficient information to assess NRHP eligibility. Relative to existing water and overburden conditions, video will be produced of the site.

Environmental Considerations

A number of consistent environmental conditions are expected to be encountered in the project area. Water temperatures are expected to be in the 60-80 degree range. The project will have equipment on hand to deal with a wide range of temperature conditions. Visibility is not expected to exceed 2 feet, with most diving occurring in zero-visibility water. All divers are trained in and have extensive experience diving in zero visibility environments. Currents are not expected to exceed 1 knot. In the event current exceeds 1 knot, diving will not take place. When possible, diving will be coordinated with periods of slack tide.

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, Volumes I and II; and with Panamerican's "Diving Safety Program for Submerged Cultural Resource Investigation" as appropriate.

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.

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. Maximum depth and dive time will be determined before the completion of each dive. Approximate depth will be 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. All diving personnel will carry accurate timepieces and sharp knives. 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. Any accidents or injuries will be reported to the diving supervisor immediately, and a report of injury form will be completed.

Relative to Lock Out/Tag Out (LOTO) considerations, all project personnel will be familiarized with any potential sources of unexpected energy (i.e. boat motor) and/or any potential sources of kinetic or stored energy which could cause injury or damage. As stated in the Dive Safety Plan the dive platform will be anchored/moored (with at least two anchors) during all dive operations; therefore no "live-boating" will be conducted during this project. The dive platform's engine will not be started until all dive operations have ceased and each person is safely onboard the vessel. The boat captain and/or Principal Investigator will address any additional LOTO precautions prior to any dive operations. No differential water pressures (due to unequal water elevations) are anticipated during any phase of this project.

Safety Procedures and Checklists

Safety will be the paramount concern during the project. 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. A copy of EM385-1-1 will be reviewed prior to the fieldwork phase of the project. Special attention will be paid to Chapter 19, "Floating Plant and Marine Activities," and Chapter 30, "Contract Diving Operations," and a copy will made available for inspection to all persons on the crew.

All Panamerican personnel scheduled to participate in this research have been qualified in First Aid and CPR by the Red Cross or comparable agency. Certificates to this effect are presented as part of the Dive Safety Plan package. Prior to initiating any field work, the Diving Supervisor will locate the nearest hospitals, hyperbaric chamber, notify the U.S. Coast Guard, and take care of any other logistical safety considerations. During the investigation there will be available communication with shore in the event of an accident. If applicable, the United States Coast Guard will be contacted prior to the commencement of activities so a "Notice to Mariners" broadcast of our diving activities can be arranged. They will also be contacted at the completion of diving activities.

The diving environment will be the main consideration. Tides, weather and vessel traffic will all be monitored.

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. The ambulance service nearest to and/or which 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 will be ascertained prior to diving operations. The nearest hyperbaric chamber is located at the Memorial Medical Center (1-800-225-7654). The United States Coast Guard (U.S.C.G.) in the area is under the direction of 1st District Operations, New York Group. The 1st District U.S.C.G. maintains a 24-hour Search and Rescue Hotline (212-668-7913). Search and Rescue helicopters capable of providing emergency evacuation operate out of the Coast Guard Air Station (718-765-2409). The Coast Guard will be notified of our working dates and location prior to initiation of fieldwork and will be updated periodically of our standing.

EMERGENCY SERVICES

EMERGENCY	911	EMERGENCY
HOSPITAL	201-858-5000	Bayonne Hospital 29th St. and Ave., E. Bayonne, NJ 07002
HOSPITAL	718-226-9000	Staten Island University Hospital 475 Seaview Ave., Staten Island, NY 10305
HOSPITAL	718-226-2000	Staten Island University Hospital 375 Seguine Ave., Staten Island, NY 10309
HYPERBARIC CHAMBER	1-800-255-7654 908-892-1100	Memorial Medical Center 24-Hour, Point Pleasant Hospital

DIVERS ALERT NETWORK (D.A.N.)

DIVING EMERGENCY	919-684-8111	24-Hour Hotline

UNITED STATES COAST GUARD, 1ST DISTRICT

GROUP NEW YORK	212-668-7913	
SEARCH AND RESCUE	212-668-7913/7937	24-HOUR HOTLINE
Operations Office	212-668-7913	USCG, 1st District, Governor's Island
Air Station	718-765-2409	USCG Air Station Brooklyn
Waterways Office	212-668-7906	Waterways, Governor's Island

NEW JERSEY STATE MARINE POLICE, PORT NEWARK

State Marine Police	201-578-8173	Port Newark Office

APPENDIX C: INSTRUMENT LOGS

Panamerican Consultants
P.O. Box 050623 Tuscaloosa, Al. 35405

Project NY Harbor Diving
Location A27
Vessel Ventrue

Dive # 1
Date 8/2/02

DIVE LOG

DIVER J Duff
\# Dives in 12 Hr. Period
STANDBY DIVER M Elliott
PURPOSE find source of anomaly

ENVIRONMENTAL CONDITIONS:
Current 1kt
Visibility 0
Temperature
Bottom Type mud/gravel
Other

MODE AND EQUIPMENT:
K bottle
SSA
Tank type

TENDER J. Rawls
LEAVE SURFACE 11:53
RISE SURFACE 1:12
TOTAL TIME 1:19
MAXIMUM DEPTH 21'

OTHER DIVERS DOWN:

MAXIMUM PLANNED TIME AND DEPTH 25 ft 1 hr
TANK PRESSURE START 2600
TANK PRESSURE RETURN 400
TOTAL AIR USED 2200

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK Chord hwy

WORK ACCOMPLISHED AND REMARKS:

Depth 21'
lots of rebar!
square block - concrete
rebar, wire rope
10 metal probe, caught monofilament line - need to watch for it.
probed at area of rebar + wire rope - hit something 2.5 ft down.
cardinal directions hits → object roughly 2 ft square.
Swinging left from 2x2 object, 10 ft interval probes
2. 3 ft down wood item
3. neg; 4. neg; 5 neg; 6 neg, 7 pos 5.5; 8 rock 2 ft; 9 neg (gravel) stick
10 pos (rock) 11, gravel wood, 12 4 ft hard rock; 13 wood 3 ft; 14 neg; 15 rock 3 ft; 16 rock 3 ft
17 neg; 18 neg; 19 neg; 20 pos (rock) 4½ wood; 21 wood; 22 wood 3 ft;
exposed pieces of rebar 23 3 ft firm; 24 ... 1½ ft; 25 neg; 26 neg
gravel & boulders, 27 switch to 20 ft interval, neg
nice boulders - 4 ft tall 28 rock 3 ft; 29 3 ft hard
30 pos at 3 ft; 31 wood 3 ft
32 gravel/rock 3 ft; 33 wood 3 ft
34 wood 3 ft 35

boulders & wood; Hassle
mud; changes from rock to mud
pos; neg

35, 34, 33, 32, 31, 30, 29, 28, 27, 26, 23, 24, 25, 30 ft

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Project NY Harbor Diving
Location A50
Vessel Venture 3

Dive # 2
Date 8/5/02

DIVE LOG

DIVER M. Elliott
Dives in 12 Hr. Period 0

STANDBY DIVER G. Cook
PURPOSE identify source of Anomaly 50

ENVIRONMENTAL CONDITIONS:
Current 0
Visibility ~~ft~~ zero
Temperature 70°
Bottom Type ~~sand~~ mud
Other

MODE AND EQUIPMENT:
SSA

Tank type 240 cf k

TENDER J. Duff
LEAVE SURFACE 1:02
RISE SURFACE 1:35
TOTAL TIME :33
MAXIMUM DEPTH 31 ft

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 30 ft / hr
TANK PRESSURE START 2300
TANK PRESSURE RETURN 1450
TOTAL AIR USED 850

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

11 fathoms
large pile of oyster shells at buoy
concrete chunks at buoy
rip rap,
shells + silt, often pieces of concrete
large pieces of concrete
6x5 piece
7x8 piece
huge rock 3 ft off bottom
approx 100 ft long
3x4 piece is a block - mooring, buoy weight

Anomalies 12 + 15: water too shallow. Alternate dive site selec in same area.

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Project NM Harbour
Location Anomaly 51
Vessel Venture 3

Dive # 3
Date 8/6/02

DIVE LOG

DIVER G. Cook
Dives in 12 Hr. Period 0
STANDBY DIVER J. Rawls
PURPOSE Identify source of Anomaly 51

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility 0
Temperature 75°
Bottom Type mud
Other

MODE AND EQUIPMENT: SSA

Tank type 240 K

TENDER Elliott
LEAVE SURFACE 11:08
RISE SURFACE 12:06
TOTAL TIME :58
MAXIMUM DEPTH 46'

OTHER DIVERS DOWN: N/A

MAXIMUM PLANNED TIME AND DEPTH 90 min 25 ft
TANK PRESSURE START 1350
TANK PRESSURE RETURN 400
TOTAL AIR USED 950

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

24 ft at start of dive
8) float bangs
found other localized metal detector hits
* Anomaly location is on slope of channel. Therefore, there would be deposited after dredging and would not be historic
found a rock 2x2 ft

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Project NY Harbor Dmg
Location Anomaly 33
Vessel Venture 30

Dive # 4
Date 8/6/02

DIVE LOG

DIVER J. Rawls
Dives in 12 Hr. Period 0

STANDBY DIVER J. Duff
PURPOSE Identify source of Anomaly 33

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility 0
Temperature 70°
Bottom Type Soft mud
Other

MODE AND EQUIPMENT: SSA

Tank type 240 K

TENDER Elliott
LEAVE SURFACE 1:06
RISE SURFACE
TOTAL TIME
MAXIMUM DEPTH 15'

OTHER DIVERS DOWN: N/A

MAXIMUM PLANNED TIME AND DEPTH 90 min 20 ft
TANK PRESSURE START 2600
TANK PRESSURE RETURN
TOTAL AIR USED

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

suit squeeze diver up to fix back in at 1:28
no debris or anything on bottom
probe at buoy weight
1:35
probed in cardinals 5ft intervals out from center - all positive
positives most likely clay lens
there was difference between clay probes & wood probes - might be an object here
need to come back tomorrow w/ hydroprobe

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Project NY Harbour
Location Anomaly 63
Vessel Venture 3

Dive # 8
Date 8/7/02

DIVE LOG

DIVER J. Duff
STANDBY DIVER M. Elliott
Dives in 12 Hr. Period 0
PURPOSE Identify source of Anomaly 63

ENVIRONMENTAL CONDITIONS:
Current >1K
Visibility
Temperature 70°
Bottom Type mud
Other

MODE AND EQUIPMENT:
SSA

Tank type 240 K

TENDER C Cook
LEAVE SURFACE 10:35
RISE SURFACE 11:04
TOTAL TIME 29
MAXIMUM DEPTH 22'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 90 min 20 ft
TANK PRESSURE START 2600
TANK PRESSURE RETURN 1800
TOTAL AIR USED 800

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

20 ft at drop point
photo 19 - 20 - rr trestle remains
find RR tie
3/8 inch rod iron
~~iron bar~~
2 iron bars 3/4 - 1 inch diameter 1.5 ft off bottom - hook end
looks ~~[illegible]~~ like lots of debris, rr ties, rebar, pieces of iron rod,
boulders/rip rap
stones - broken up natural stone rather than blocks or cut stone
most likely represents remains of railroad trestle
~~heavy piece of angle iron [illegible] bottom - stick~~
vertical piece of rail
~~thick piece of iron - bigger than~~ rail possibly 4x6 angle iron
~~wooden piling lying down~~ > on edge of channel
vertical piling
continuous pile of boulders on edge of channel
large structural stone block.

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Project NY harbor
Location Anomaly 33
Vessel Venture 3

Dive # 6
Date 8/7/02

DIVE LOG

DIVER G. Cook
Dives in 12 Hr. Period 2
STANDBY DIVER M. Elliott
PURPOSE probe around anomaly 33 (hydroprobe)

ENVIRONMENTAL CONDITIONS:
Current >1kt
Visibility 0
Temperature 70°
Bottom Type mud
Other

MODE AND EQUIPMENT:
SSA

Tank type 240 K

TENDER Lewis
LEAVE SURFACE 12:06
RISE SURFACE 1:21
TOTAL TIME 1:15
MAXIMUM DEPTH 28'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 20ft 90 min
TANK PRESSURE START 1800/2300
TANK PRESSURE RETURN 400
TOTAL AIR USED

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:
probe at buoy 3ft down hard return
Shore

1. 3ft
2. 6ft
3 6ft
4 clay layer 3ft - could go down.
5. 2ft

retrieved probe - end full of stiff red clay
iron oxide? would account for anomaly.
5 4 3 2 1 buoy

Sent down jet nozzle to blast down to clay level to double check.
jetted at #5 - found stiff clay at 3ft down
Sent down
back to buoy to do same - 3ft down shell, 1ft thick mucky clay layer
5ft down definite wood.
actually probably not wood but shell + rock.
Sweeps left - small pieces of wood, 2x4

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Project NY Harbors
Location Anomaly 15
Vessel Venture 3

Dive # 7
Date 8/6/02

DIVE LOG

DIVER M Elliott
Dives in 12 Hr. Period 0
STANDBY DIVER J. Rawls
PURPOSE Identify source of A15

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility 2 ft
Temperature 70°
Bottom Type mud
Other

MODE AND EQUIPMENT:
SSA

Tank type 240K

TENDER G Cook
LEAVE SURFACE 10:22
RISE SURFACE 10:51
TOTAL TIME '29
MAXIMUM DEPTH 15 feet

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 90 min 20 ft
TANK PRESSURE START 1500
TANK PRESSURE RETURN 600
TOTAL AIR USED 900 psi

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:
[illegible] sweeping with metal detector @ 10 ft intervals of S of buoy. Anomaly located approx 60-80 ft S of buoy

diver getting hot and tired at 22 min - strong current

made 6 sweeps w/metal detector - nothing [illegible]

taking probes
- soft silt all the way to hit (6 ft)
= several probes taken, all negative into soft silt to hit

?

likely
anomaly is a localized piece of debris/wire rope/cable

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Project NY Harbor Diving
Location Anomaly 9
Vessel Vessel 3

Dive # 8
Date 8/9/02

DIVE LOG

DIVER J. Rawls
STANDBY DIVER J. Duff
Dives in 12 Hr. Period 1
PURPOSE identify source of Anomaly 9

ENVIRONMENTAL CONDITIONS:
Current >1
Visibility 2 ft
Temperature 70°
Bottom Type muddy
Other

MODE AND EQUIPMENT:
SSA

Tank type 240 K

TENDER G. Cook
LEAVE SURFACE 11:22
RISE SURFACE
TOTAL TIME
MAXIMUM DEPTH 36'

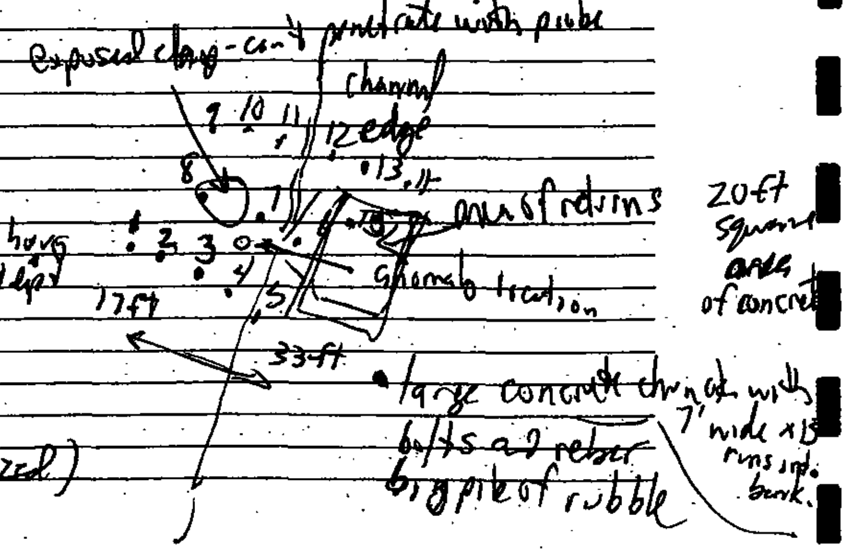
OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 20 ft 90 min
TANK PRESSURE START 2600
TANK PRESSURE RETURN
TOTAL AIR USED

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:
diver in

1. hard return 4.5 ft
2. 3 ft
3. ~~2ft~~ 3 ft 14. silt
4. 6 ft 15. 6 ft
5. 7 ft 16.
6. 1.5 ft
7. 2 ft
8. 2 ft rock or metal at about 3 ft. 33 ft deep
9. 3.5 ft several pieces 3 ft x 3 ft
10. 1 ft 6 ft down 10-15 ft in length
11. 1 ft could be concrete or iron
12. silt
13. silt
gravel, rocks, rip rap (not natural) (palm sized)



depth ~~was 35 80 up slope~~
depth of hard return ~~[illegible]~~ gets less as he goes up slope - coincides w/depth of silt

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Project NY Harbor Diving
Location Anomaly 8
Vessel Venture 3

Dive # 9
Date 8/13/02

DIVE LOG

DIVER J. Duff
STANDBY DIVER M. Elliott
Dives in 12 Hr. Period 1
PURPOSE Identify source of anomaly 8

ENVIRONMENTAL CONDITIONS:
Current 7/1/2
Visibility 2 ft
Temperature 76°
Bottom Type mud/& clay
Other

MODE AND EQUIPMENT: SSA

Tank type 240/K

TENDER G. Cook
LEAVE SURFACE 9:19
RISE SURFACE 10:10
TOTAL TIME :51
MAXIMUM DEPTH 7'

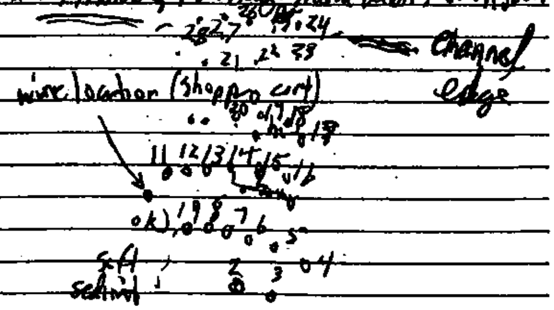
OTHER DIVERS DOWN: N/A

MAXIMUM PLANNED TIME AND DEPTH 20 ft/90 min
TANK PRESSURE START 2300
TANK PRESSURE RETURN 1600
TOTAL AIR USED 700

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK —

WORK ACCOMPLISHED AND REMARKS:
Soft bottom at barge - weight sink into clay

• pos
○ neg
1. neg - Found remains of shopping cart found. Anomaly is likely metal debris of modern nature
2. neg
3 neg
4 neg
5 neg
6 neg
7 neg
8 neg
9 neg
10 neg
11 neg
12 neg
13 neg
14 neg
15 neg
16 neg
17 neg
18 neg
19 neg
21. neg
22 neg
23 neg
24 neg
25 neg
26 neg
27 neg
28 neg
29 neg



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Project NY Harbor Diving
Location Anomaly 52
Vessel [illegible]

Dive # 10
Date 9/13/02

DIVE LOG

DIVER G. Cook
Dives in 12 Hr. Period 1

STANDBY DIVER M. Elliott
PURPOSE ident. source of Anomaly 52

ENVIRONMENTAL CONDITIONS:
Current >1 Kt
Visibility 0
Temperature 70°
Bottom Type mud silt/shell
Other

MODE AND EQUIPMENT:
SSA

Tank type 240K

TENDER V. Rawls
LEAVE SURFACE 11:09
RISE SURFACE 12:05
TOTAL TIME :56
MAXIMUM DEPTH 12'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 100 10fx/90 min
TANK PRESSURE START 1500/2600
TANK PRESSURE RETURN 300/
TOTAL AIR USED 1200+

TIMEKEEPER A. Updecker
ONE-HOUR CHECKBACK

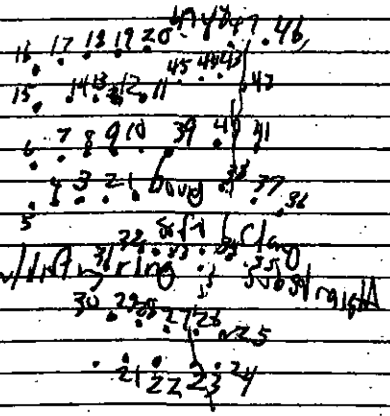
WORK ACCOMPLISHED AND REMARKS:

found a bucket w/metal top and ring. Anomaly is likely made ... also has direction w/ probe

Max 12'
V12 = 3ft
found buoy weight

37 neg
38 Posit. [illegible] wood [illegible] 1ft cardinals 38
at buoy

1. neg   16 neg   31 neg   39 neg
2. neg   17 neg   32 neg   40 - neg
3 neg   18 neg   33 neg   41. neg
4 neg   19 neg   34 neg   42. neg
5 neg   20 neg   35 neg   43. neg
6 neg   21 neg   36 neg   44. neg
7 neg   22 found a steel drum/five gallon bucket w/ lifting ring
8 neg   2ft diameter   45 neg
9 neg   23 neg.   46 neg
10 neg   24 neg   47 neg
11 neg   26 [illegible] layer shells (neg)   48 neg
12 neg   26 neg
13 neg   27 neg
14 neg   28 neg
15 neg   29 neg
30 neg



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Project NY Harbor
Location Anomaly 5-1
Vessel Venture 3

Dive # 11
Date 8/17/02

DIVE LOG

DIVER M. Elliott
Dives in 12 Hr. Period 1

STANDBY DIVER J. Rawls
PURPOSE Identify source of A54

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility 2 ft
Temperature 70°
Bottom Type mud/g/clay
Other

MODE AND EQUIPMENT:
SSA

Tank type 240K

TENDER J. Duff
LEAVE SURFACE 1:05
RISE SURFACE
TOTAL TIME
MAXIMUM DEPTH 49'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 90 min/12 ft
TANK PRESSURE START 2500
TANK PRESSURE RETURN
TOTAL AIR USED

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

big chunks of concrete
shell, rocks

short dive on tide change - boat swing on tow far away from buoy.

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Project NY Harbor
Location Anomaly 54
Vessel Vessel 3

Dive # 12
Date 8/14/02

DIVE LOG

DIVER J. Rawls
Dives in 12 Hr. Period 1
STANDBY DIVER J. Duff
PURPOSE identify source of Anomaly 54

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility 2 ft
Temperature 70°
Bottom Type shell clay mix
Other

MODE AND EQUIPMENT: SSA
Tank type 240K

TENDER M. Elliott
LEAVE SURFACE 9:05
RISE SURFACE 9:57
TOTAL TIME :52
MAXIMUM DEPTH 9'

OTHER DIVERS DOWN: N/A

MAXIMUM PLANNED TIME AND DEPTH 90 min/10 ft
TANK PRESSURE START 2500
TANK PRESSURE RETURN 1400
TOTAL AIR USED 1100

TIMEKEEPER A. Lydicker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

shell + clay mix bottom

1. neg
2. neg
3. neg
4. clay at 4 ft
5. clay @ 5 ft
6. neg
7. neg (noted tire in vicinity)
8. neg
9. neg clay at 3 ft
10. neg clay at 4 ft
11. neg clay at surface
12. neg
13. neg
14. clay surface - 3 ft neg.
15. neg clay at 4.5 ft.
16. neg clay at 4 ft
17. neg clay at 3 ft
18. neg clay at 3.5 ft
19. neg
20. neg
21. neg - clay at 4.5 ft
22. neg clay at 4.5'

23. Neg
24. 3.5 clay
25. neg
26. neg.
27. neg. clay @ 3'
28. neg
29. neg
30. neg
31. neg clay at 5 ft
32. neg
33. neg
34. neg
35. neg
36. neg.

tire

1 2 3 4 5 6 7 8
14 13 12 11 10 9
15 16 17 18
24 23 22 21 20 19 buoy
25 26 27 28
33 32 31 30 29
34 35 36

- nothing located on probing. Clay layers at 3-5 ft. Source of anomaly likely modern debris

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Project NMHarbour Diving
Location Anomaly 53
Vessel Venture 23

Dive # 13
Date 8/14/02

DIVE LOG

DIVER J. Duff
Dives in 12 Hr. Period 1

STANDBY DIVER M. Elliott
PURPOSE Ident. of source of Anomaly 53

ENVIRONMENTAL CONDITIONS:
Current 1/kt
Visibility 2ft
Temperature 70°
Bottom Type mud/shell/clay
Other

MODE AND EQUIPMENT:
SSA

Tank type 240K

TENDER G. Cook
LEAVE SURFACE 11:27
RISE SURFACE 11:49
TOTAL TIME :22
MAXIMUM DEPTH ~~20~~ 9'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 20'/90min
TANK PRESSURE START ~~[illegible]~~ 1400
TANK PRESSURE RETURN 900
TOTAL AIR USED

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:
giant ~~[illegible]~~ chunck of iron
steel reinforced tire
hole/rim 3ft diameter, 7-8 ft total diameter, chest high
GIANT tire, like the monster/dump truck tires
swinging right
iron plate 10"x18" near tire
oyster shells
rocks
buoy located 90ft North of hoag

source of anomaly is giant tire

hoag
@ plate @ tire

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Project NY Harbour Diving
Location Anomaly 55
Vessel Venture 30

Dive # 15
Date 8/15/02

DIVE LOG

DIVER M. Elliott
Dives in 12 Hr. Period 1
STANDBY DIVER G. Cook
PURPOSE Identify source of Anomaly 55

ENVIRONMENTAL CONDITIONS:
Current >1 Kt
Visibility 2ft
Temperature 70°
Bottom Type Silt & shell
Other

MODE AND EQUIPMENT: SSA
Tank type 240k

TENDER J. Rawls
LEAVE SURFACE 11:06
RISE SURFACE 11:28
TOTAL TIME :22
MAXIMUM DEPTH 24'

OTHER DIVERS DOWN: N/A

MAXIMUM PLANNED TIME AND DEPTH 25' / 90 min
TANK PRESSURE START 750/2100
TANK PRESSURE RETURN 400/1900
TOTAL AIR USED 550

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

1 6"x6" concrete post - square 20' long pile layed over
battered pile
actually wood buried @ one end 3ft off bottom at other end.
another piling - fasteners - uniform holes - ½ inch diameter 2 fasteners
- rr spike like fasteners - 3" x 1.5" head
- line
6x6 post (timber) - 2 holes in end - no fasteners present in post.
cable - 2 part ½" + ¼" insulated - rope, tackle
concrete weight
piling broken off
assorted trash
another timber, with planks + nails
2 big pieces of iron - angle iron 2"x2" 4ft long
bringing one in for photograph
ran over timbers + planks on way back in

no probing done on this anomaly

modern trash + debris

timbers found (111)

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Project NY Harbour Diving
Location Anomaly 101
Vessel Venture 3

Dive # 16
Date 8/16/02

DIVE LOG

DIVER G. Cook
Dives in 12 Hr. Period 1

STANDBY DIVER J. Rawls
PURPOSE identify source of Anomaly 101

ENVIRONMENTAL CONDITIONS:
Current >1Kt
Visibility
Temperature 76°
Bottom Type
Other

MODE AND EQUIPMENT: SSA
Tank type 240K

TENDER J. Duff
LEAVE SURFACE 10:09
RISE SURFACE 10:57
TOTAL TIME :48
MAXIMUM DEPTH ~~37~~ 39'

OTHER DIVERS DOWN: N/A

MAXIMUM PLANNED TIME AND DEPTH
TANK PRESSURE START 2,100
TANK PRESSURE RETURN
TOTAL AIR USED

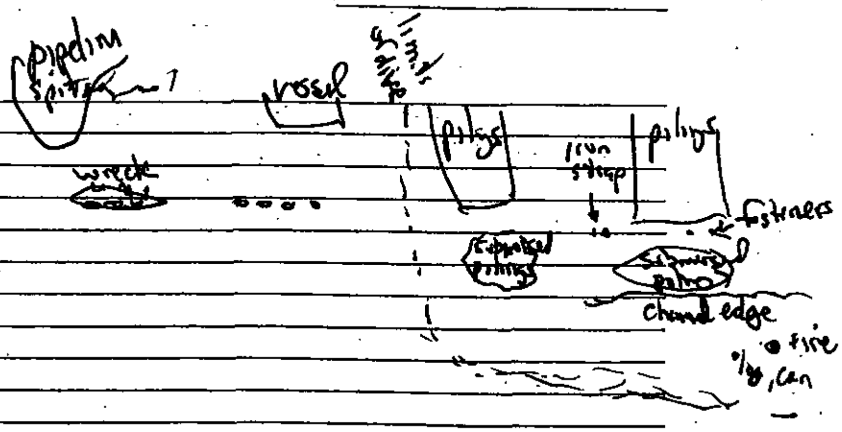
TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

rock, bottles, rope

anomaly is on slope into channel
Concreted iron fastener, bottle
iron fastener (round)
piece of piling
fastener, ~~pl~~ iron strap
Concreted iron pieces
pilings w/fasteners
iron slag

log, canvas strap, buckle
15 ft long, sinks into sediment
riverside



this site likely to be impacted by project but is remains of old pier and not historic

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Project NY Harbour
Location Anomaly 101 - Sandy Hook
Vessel Venture 3

Dive # 17
Date 8/16/02

DIVE LOG

DIVER J. Rawls
Dives in 12 Hr. Period 1
STANDBY DIVER J. Duff
PURPOSE Identify source of Anomaly 101

ENVIRONMENTAL CONDITIONS:
Current >1kt
Visibility 1ft
Temperature 70°
Bottom Type mud
Other

MODE AND EQUIPMENT:
SSA

Tank type 240K

TENDER Elliott
LEAVE SURFACE 1:16
RISE SURFACE 1:55
TOTAL TIME :39
MAXIMUM DEPTH 42

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH
TANK PRESSURE START 1650
TANK PRESSURE RETURN 700
TOTAL AIR USED 950

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

pilings, concrete blocks
fastener - round 12-14" long
round piling's 8-9' apart - evenly spaced
small metal fragments
looks to be remains of piling/crib with stone fill or a pier with stones/concrete deposited on top
planks 12" x 1.5" w/fastener holes
4"x4" square timber

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Project N Harbor Dive	Dive # 18
Location wrecks on chart near A35	Date 8/19/2002
Vessel Venture 3	

DIVE LOG

DIVER J. Duff	STANDBY DIVER G. Cook
# Dives in 12 Hr. Period 1	PURPOSE identify wreckage on bottom

ENVIRONMENTAL CONDITIONS:
Current ≥1 Kt
Visibility
Temperature 70°
Bottom Type silty w/oyster
Other

MODE AND EQUIPMENT:
SSA
Tank type 240 K

TENDER J. Rawls	OTHER DIVERS DOWN:
LEAVE SURFACE 11:24	N/A
RISE SURFACE 12:59	
TOTAL TIME ~~90~~ 1:35	
MAXIMUM DEPTH 17'	

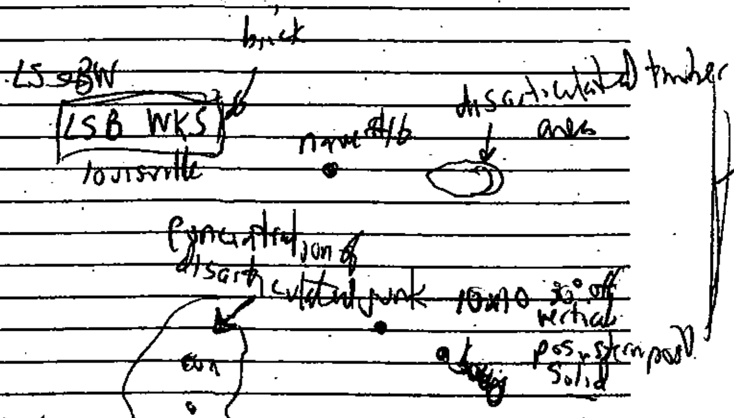
MAXIMUM PLANNED TIME AND DEPTH 20 ft/90 min
TANK PRESSURE START 1800/2250 TANK PRESSURE RETURN 500/2000
TOTAL AIR USED 1800

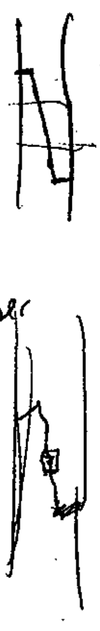
TIMEKEEPER D. Lydecker ONE-HOUR CHECKBACK A-OK

WORK ACCOMPLISHED AND REMARKS:
sheet metal, rock, 4x6, junk, iron plate, pipe, small pcs wood, iron concretion
disarticulated wood, deteriorated wood

timber: 6"x10", notched end.

? parallel timbers (3)
4-5" thick, 36' long, broken end
edge fasteners no thru fastener
parallel pieces has ship scarph
metal plate w/ flange (hull plate?) 1/4" - very fragile beneath the white
side of a barge? - 4-5" thick " 38' long, 5' wide • 4x4s edgebolted





- timber w/ iron fastener cut through on either side
5 ft wide
stacked up 4 x 4s bolted together
long timbers
looks like broken up wreckage - heavily impacted
80 ft wide

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Project NY Harbors Div
Location V36 + V37 KVK
Vessel Vindine 3

Dive # 19
Date 8/21/02

DIVE LOG

DIVER G. Cook
Dives in 12 Hr. Period 1
STANDBY DIVER J. Duff
PURPOSE assess V36 + V37

ENVIRONMENTAL CONDITIONS:
Current >1 Kt
Visibility
Temperature 70°
Bottom Type
Other

MODE AND EQUIPMENT: SSA

Tank type 240K

TENDER J. Rawls
LEAVE SURFACE 9:57
RISE SURFACE 11:29
TOTAL TIME 1:30
MAXIMUM DEPTH

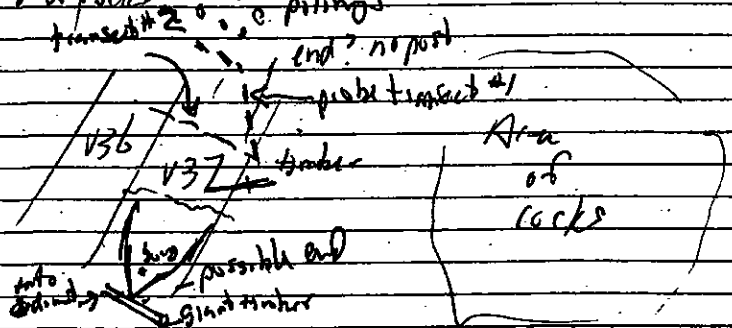
OTHER DIVERS DOWN: N/A

MAXIMUM PLANNED TIME AND DEPTH 20'/90 min
TANK PRESSURE START 1800
TANK PRESSURE RETURN 500
TOTAL AIR USED 1300

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK A-OK

WORK ACCOMPLISHED AND REMARKS:

bottom littered w/ rocks & pilings



XIXI

V37
wooden frames & cross strapping of iron - 4" wide, ½" thick, bolted to hull planking
intact to East of timber
broken up to west

iron strap

giant timber - thru bolt fasteners
possible hard chine
western end is vertical posts
frames single
approx 65' long

profile = 1 ft interval probes → S N S

#1 hull 4' 3' 5' 5' 5' 3' 3' 3' 5' 4' 5' 5' 5ft 3ft 3ft frames

#2 hull 5' 5' 3' 2' 5' 5' 5' 3' frames

Randive

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Project NM Harbor
Location V37
Vessel Venture 3

Dive # 20
Date 8/21/02

DIVE LOG

DIVER J. Duff
Dives in 12 Hr. Period 1

STANDBY DIVER M. Elliott
PURPOSE

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility 2.5'
Temperature 70°
Bottom Type silt/rock
Other

MODE AND EQUIPMENT:
SSA

Tank type 240K

TENDER J Rawls
LEAVE SURFACE 12:34
RISE SURFACE 1:29
TOTAL TIME :55
MAXIMUM DEPTH 15'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 20 ft/90 min
TANK PRESSURE START 2000
TANK PRESSURE RETURN 1000
TOTAL AIR USED 1000

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK N/A

WORK ACCOMPLISHED AND REMARKS:
video
#1 and timber could be stem
2 ft centers
wreck length approx 110 ft
ndivel sensor

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Project NY Harbour Diving
Location Anomaly 43
Vessel Vendor 3

Dive # 21
Date 8/22/02

DIVE LOG

DIVER M. Elliott
Dives in 12 Hr. Period 1

STANDBY DIVER J. Rawls
PURPOSE identify source of A43

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility 2 ft
Temperature 70°
Bottom Type silt/shell
Other

MODE AND EQUIPMENT:
SSA

Tank type 240 k

TENDER G. Cook
LEAVE SURFACE 10:11
RISE SURFACE 10:49
TOTAL TIME :38
MAXIMUM DEPTH 20"

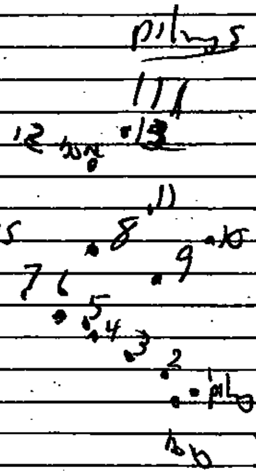
OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 20'/90 min
TANK PRESSURE START 1000
TANK PRESSURE RETURN 300
TOTAL AIR USED 700

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK N/A

WORK ACCOMPLISHED AND REMARKS:

1. 15 ft long piling at least 12" diameter
iron fastener - bolt + nut
probe in like butter
2 - another piling found
3. upright piling
4. beam - 4 x 8 - uniform holes - no fasteners 1/2 - 3/4" holes
5 piling
6 diesel. w/old timbers, piling, big beam 12x6
7. piling on silt
8. tire - steel belted w/rim
9. 12" piling
10 piling (2 pilings)
11 4x10 plank



13 piles (jumbled)
9 signif. pile of articulated timbers - anomaly 43 appears to be remnants of pier - nav chart (PANs) shows a pier

15

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Project NY Harbor Dredging
Location Anomaly 64
Vessel Venture 3

Dive # 23
Date 8/23/02

DIVE LOG

DIVER J. Rawls
STANDBY DIVER G. Cook / J. Duff
Dives in 12 Hr. Period 1
PURPOSE Identify source of Anomaly 64

ENVIRONMENTAL CONDITIONS:
Current 1 Kt
Visibility
Temperature 70°
Bottom Type mud/shell
Other

MODE AND EQUIPMENT:
SSA
Tank type 240k

TENDER G. Cook
LEAVE SURFACE 10:24
RISE SURFACE 1:19
TOTAL TIME 155
MAXIMUM DEPTH ~~30'~~ 46'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 20 ft / 90 min
TANK PRESSURE START 2600
TANK PRESSURE RETURN 1330
TOTAL AIR USED 1230

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:
17'
big rocks - natural
rock 6" below surface all around anomaly
looks like big gravel bar
concrete bar 4" diameter 19" long, elbow w flange
wood fragments
more iron
tire
keg bottom
plank w/ fastener holes - wire nail 20 ft long
concreted iron rod
big iron pipe w flange engine block! - heavy marine growth
5½' long, 3½' wide, cylindrical
heavily concreted
electrical wires - plastic coated

rocks
gravel rock
concrete pill. hose
concretions
lots of iron
wood fragments
tire

brought up starter to look & photo
also small diameter copper tube
and stranded copper wire w plastic
insulation

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Project NY Harbor Diving
Location Nof Howland Hook Terminal
Vessel Venture 3

Dive # 24
Date 8/26/02

DIVE LOG

DIVER J. Duff
Dives in 12 Hr. Period 1

STANDBY DIVER G. Cook
PURPOSE identify wreckage

ENVIRONMENTAL CONDITIONS:
Current ?/Kt
Visibility
Temperature 70°
Bottom Type
Other

MODE AND EQUIPMENT:
SSA
Tank type 240 K

TENDER J. Rawls
LEAVE SURFACE 12:21
RISE SURFACE 1:21
TOTAL TIME 1:00
MAXIMUM DEPTH 34'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 20 ft/90 min
TANK PRESSURE START 1250
TANK PRESSURE RETURN 300
TOTAL AIR USED 950

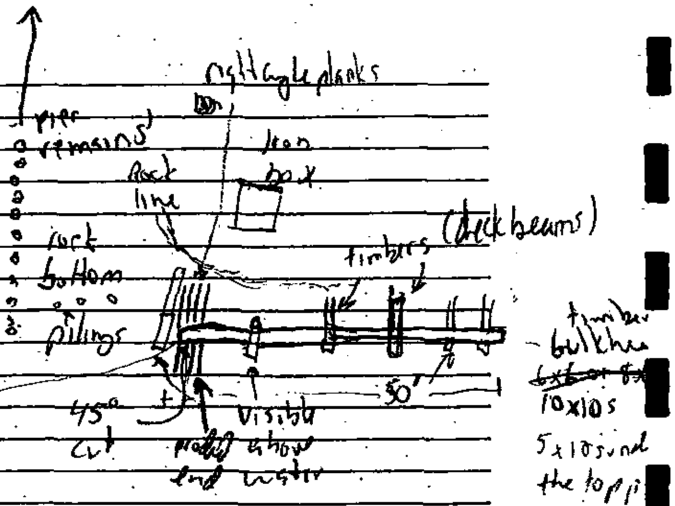
TIMEKEEPER A. Cyplecki
ONE-HOUR CHECKBACK —

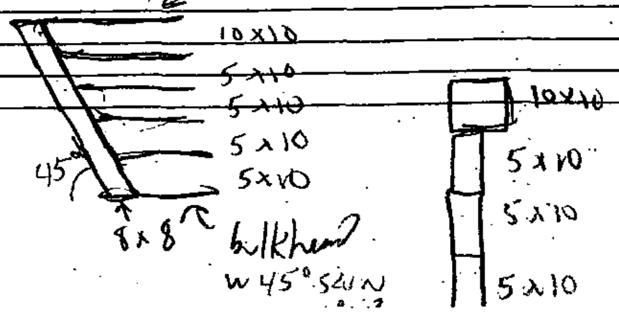
WORK ACCOMPLISHED AND REMARKS:
brick + rock - bits of broken up
broken glass

timber bulkheads 10 x 10 timbers -
cross timbers stick out

iron box sitting on top of "barge"

video taken





this target is remains of barge. Bulkhead is likely interior bulkhead, showing signs being is very eroded and

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Project NY Harbor Dredg
Location Anomaly 81
Vessel Venture 3

Dive # 26
Date 8/27/02

DIVE LOG

DIVER G Cook
Dives in 12 Hr. Period 1

STANDBY DIVER M Elliott
PURPOSE identify surveyed A 81

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility 1.5 ft
Temperature 70°
Bottom Type Sand
Other

MODE AND EQUIPMENT: SSA

Tank type 2(?) K

TENDER J. Rands
LEAVE SURFACE 1:11
RISE SURFACE 1:58
TOTAL TIME :47
MAXIMUM DEPTH 55'

OTHER DIVERS DOWN: N/A

MAXIMUM PLANNED TIME AND DEPTH 55 ft / 50 min
TANK PRESSURE START 2700
TANK PRESSURE RETURN 1300
TOTAL AIR USED 1400

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

iron wreckage - over/under plating? round, like a boiler

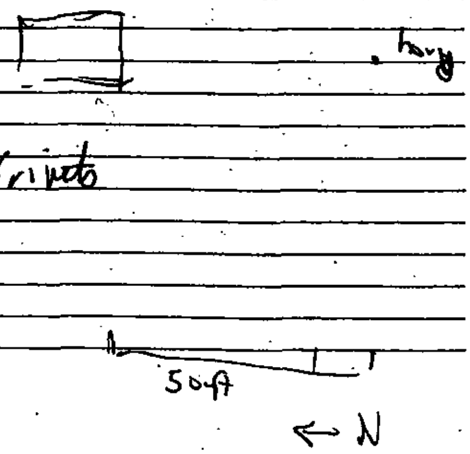
rubber strap heavily concreted

I-beams, angle iron - big piece

rivets - very degraded

likely a wreck

hull plating is smooth - like there are no areas of rivets



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Project NY Harbor Diving
Location Sidescan target 5519
Vessel Venture 3

Dive # 27
Date 8/28/02

DIVE LOG

DIVER M. Elliott
Dives in 12 Hr. Period 1

STANDBY DIVER J. Rawls
PURPOSE Examine 5519

ENVIRONMENTAL CONDITIONS:
Current ? 1 Kt
Visibility 3.5 ft
Temperature 73°
Bottom Type Silty
Other

MODE AND EQUIPMENT:
SSA

Tank type 240 K

TENDER J. Duff
LEAVE SURFACE 9:55
RISE SURFACE 10:49
TOTAL TIME 0:54
MAXIMUM DEPTH 23'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 20 ft / 90 min
TANK PRESSURE START 1200 / 2700
TANK PRESSURE RETURN 400 / 2600
TOTAL AIR USED 900

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK —

WORK ACCOMPLISHED AND REMARKS:

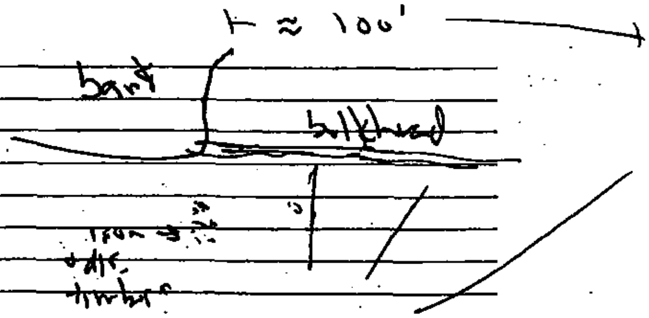
rubber bumpers
2x8 disarticulated timbers w fastener holes

1 inch angle iron
tires

pilings 2.5' centers

18" centers out of mud - deteriorated 6x6 timbers
some barely above mud, some 4' off bottom
planks w/ fastener holes - hull plank or wall plank

2x4 planks, 2x6 plank w/ fastener holes
— 2x6 plank - ½ inch apart, 2 ft apart lengthwise



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Project NY Harbor Diving
Location 5519
Vessel [illegible] 3

Dive # 28
Date 8/30/02

DIVE LOG

DIVER Rawls
STANDBY DIVER Duff
Dives in 12 Hr. Period 1
PURPOSE assess 5519

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility
Temperature
Bottom Type silt
Other

MODE AND EQUIPMENT:
SSA

Tank type 24K

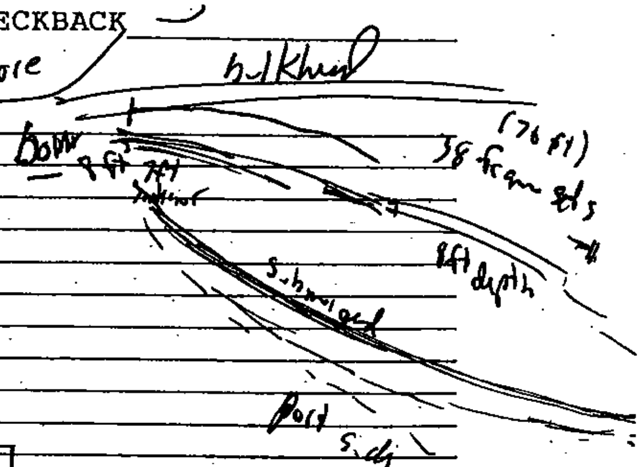
TENDER Cook
LEAVE SURFACE 9:49
RISE SURFACE 10:41
TOTAL TIME :52
MAXIMUM DEPTH 25

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 20 ft / 90 min
TANK PRESSURE START 2500
TANK PRESSURE RETURN 1600
TOTAL AIR USED 900

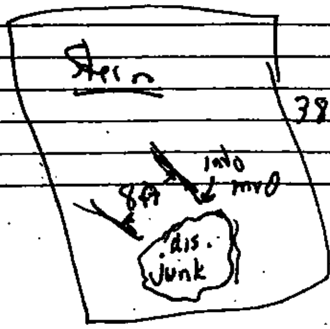
TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK ✓

WORK ACCOMPLISHED AND REMARKS:
bow toward shore, stern into channel
western section 8.5 ft



ceiling plank
7" wide, 9" wide, 11" wide
3" thick, 2", 2½"

frames:
room 10"
space 14"
molded 5"
sided 5"



38 frame sets for where wreck goes under water. Probably represents 2/3 of boat
making length 38x3 = 114'

outer hull plank
2.5" thick
[illegible] wide

need to check literature for wooden tugs to see how much

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Project NY Harbour Dive
Location Wreck in chart near 16 buoy AKC
Vessel [illegible] 3

Dive # 29
Date 9/3/02

DIVE LOG

DIVER Cook
Dives in 12 Hr. Period 1

STANDBY DIVER Elliott
PURPOSE identifying wreckage

ENVIRONMENTAL CONDITIONS:
Current >1 Kt
Visibility
Temperature 70°
Bottom Type silt
Other

MODE AND EQUIPMENT:
SSA

Tank type 240 K

TENDER Rawls
LEAVE SURFACE 11:31
RISE SURFACE 12:04
TOTAL TIME :33
MAXIMUM DEPTH 15'

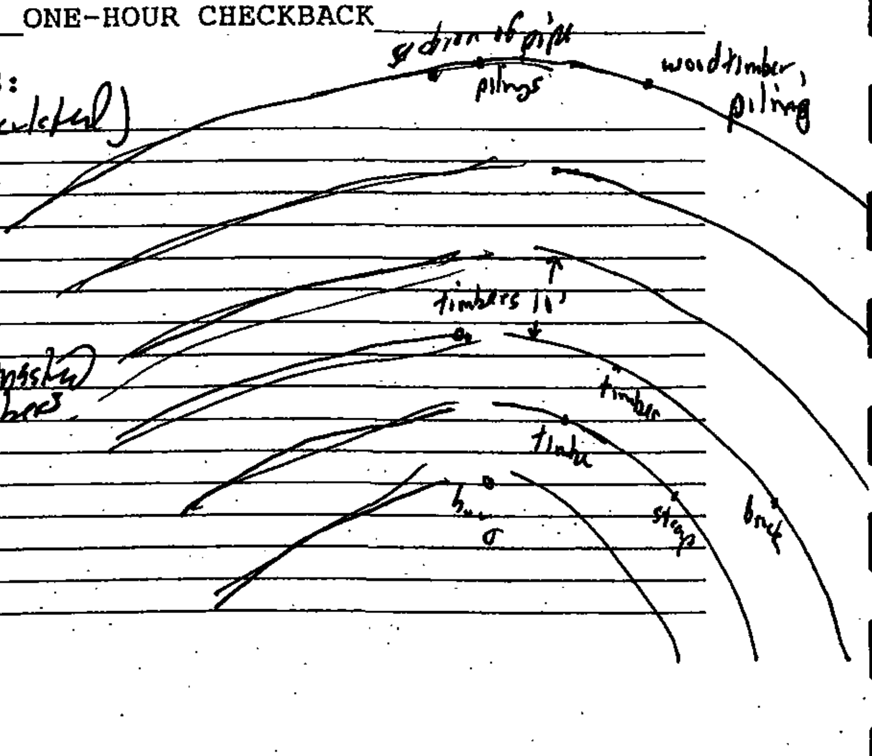
OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 20 ft / 90 min
TANK PRESSURE START 2650
TANK PRESSURE RETURN 1900
TOTAL AIR USED 750

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:
Cross strapping, planks (disarticulated)
from concretion around brick.
Sites pieces of concretion
pipe - 1.5 ft diameter
broken pilings
- could be remains of dike

- large #s of broken / bent over / smashed pilings. no articulated timbers.



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Project NY Harbor Diving
Location SS-19 Arthur Kill
Vessel Venture 3

Dive # 30
Date 9/03/02

DIVE LOG

DIVER Elliott
STANDBY DIVER Rawls
Dives in 12 Hr. Period 1
PURPOSE Examine vessel at SS19

ENVIRONMENTAL CONDITIONS:
Current >1 Kt
Visibility 0
Temperature 70°
Bottom Type silty
Other

MODE AND EQUIPMENT:
SSA
Tank type 2400 K

TENDER Carroll
LEAVE SURFACE 1:27
RISE SURFACE 1:56
TOTAL TIME :29
MAXIMUM DEPTH 33'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 20 ft / 90 min
TANK PRESSURE START 1900
TANK PRESSURE RETURN 1100
TOTAL AIR USED 800

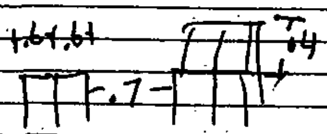
TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

inner plank .3 ~~inches~~ feet thick
width .5 ft

Futtocks .6 ft

room 1.2 ft   irregular, prob. 2 ft centers.
space .7 ft



bottom covered by river pebbles

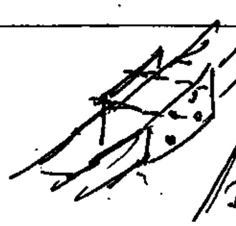
no hard chine

Keelson? 12x12

vessel is heavy framed wooden vessel ~~[illegible]~~ - most likely a tug.
not as good as V152/4 that we looked at Friday

43 frame sets exposed
= 86 feet
+ ≈ 25 ft
= 111 ft long

1/2 inch iron plate w/carriage bolts
10x4
stern is to East



wind shifted
an needed to
bring diver in
I think we have enough

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Project NM Harbour Diving
Location 5519
Vessel Venture 3

Dive # 31
Date 9/04/02

DIVE LOG

DIVER J. Duff
Dives in 12 Hr. Period 1

STANDBY DIVER G Cook
PURPOSE examine 3rd wreck at 5519

ENVIRONMENTAL CONDITIONS:
Current >1kt
Visibility
Temperature 70°
Bottom Type sand, gravel, silt, trash
Other

MODE AND EQUIPMENT:
SSA

Tank type 240K

TENDER M Elliott
LEAVE SURFACE 9:43
RISE SURFACE 10:31
TOTAL TIME :48
MAXIMUM DEPTH 22

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 22'/200 min
TANK PRESSURE START 900/2600
TANK PRESSURE RETURN 350/2200
TOTAL AIR USED 950

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:
clinker, disarticulated timbers, iron
single framed vessel, iron fasteners
planks .6' wide, .25' thick (probably outer hull planking)
11 planks to mud (top to bottom)
vertical timbers (stanchions/frames)
3ft above planks
.7ft wide, .5' thick (molded)
space = 1.4', 1.6', 1.45', 1.3' (uneven) distances b/n 1.4'-1.7' b/n
keelson 1.5' wide 0.45' thick
notches for stanchions: 1.45' apart - can't tell if extend all the way down keelson as it's
buried.
double frames on end
no discernible bow or stern

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Project NY Harbor Diving
Location SS29
Vessel Venture 3

Dive # 32
Date 9/4/02

DIVE LOG

DIVER Cook
Dives in 12 Hr. Period 1

STANDBY DIVER Elliott
PURPOSE examine SS29

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility
Temperature 70°
Bottom Type silt/sand
Other

MODE AND EQUIPMENT: SSA

Tank type 240k

TENDER Carroll
LEAVE SURFACE 12:50
RISE SURFACE 1:08
TOTAL TIME 0:18
MAXIMUM DEPTH 22'

OTHER DIVERS DOWN: N/A

MAXIMUM PLANNED TIME AND DEPTH 40' / 200 min
TANK PRESSURE START 1900
TANK PRESSURE RETURN 1700
TOTAL AIR USED 200

TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

Clay in this area is 2-3, so any wreck would be above this

large amount of cable sticking up - might account for arch shaped object - is in about right place

~~[illegible]~~.

no wreck appears to be present. Likely is remains of pier at bow: pilings broken at 2 ft above bottom - 7 total 1 ft diameter, one knocked over

cable ↑ 30 ft ↘ along

8th one kicked over and is flat on bottom

- cable and pilings account for image.

probably remains of pier on chart

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Project NY Harbor
Location SS29
Vessel Vendovi 3

Dive # 33
Date 9/4/02

DIVE LOG

DIVER Elliott
Dives in 12 Hr. Period 1

STANDBY DIVER Rawls
PURPOSE identify source of SS29

ENVIRONMENTAL CONDITIONS:
Current >1kt
Visibility Ø
Temperature 70°
Bottom Type sand
Other /

MODE AND EQUIPMENT:
SSA

Tank type 240K

TENDER Carroll
LEAVE SURFACE 10:57
RISE SURFACE 11:23
TOTAL TIME 126
MAXIMUM DEPTH 41'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 20ft/60 min 5
TANK PRESSURE START 1600
TANK PRESSURE RETURN 1000
TOTAL AIR USED 600

TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK —

WORK ACCOMPLISHED AND REMARKS:

diver found wire rope in a coil. may account for return if nothing else found.
iron piece of something
1/2" plate
sheet piling?
filled with concrete
steel jacket piling - demolished to bottom level. 1 - 1.5 feet above bottom

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Project NY Harbor Diving
Location SS11
Vessel Venture 3

Dive # RD 34
Date 9/6/02

DIVE LOG

DIVER Rawls
Dives in 12 Hr. Period 1

STANDBY DIVER Cook
PURPOSE Identify wreckage at SS11

ENVIRONMENTAL CONDITIONS:
Current 1Kt
Visibility
Temperature
Bottom Type
Other

MODE AND EQUIPMENT:
SSA

Tank type 240K

TENDER Cook
LEAVE SURFACE 10:17
RISE SURFACE 10:30
TOTAL TIME
MAXIMUM DEPTH 48'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 58' / 50 min
TANK PRESSURE START 800
TOTAL AIR USED
TANK PRESSURE RETURN

TIMEKEEPER A. Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

abort - current too strong.

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Project NY Harbor Dredg
Location 5511
Vessel ~~Vessel~~ Venture ?

Dive # 35
Date 9/6/02

DIVE LOG

DIVER Cook
STANDBY DIVER Elliott
Dives in 12 Hr. Period 1
PURPOSE examine 5511

ENVIRONMENTAL CONDITIONS:
Current 1kt
Visibility 3ft
Temperature 70°
Bottom Type rock, silt
Other

MODE AND EQUIPMENT:
SSA
Tank type 240K

TENDER Carroll
LEAVE SURFACE 12:45
12:35 RISE SURFACE 1:32
TOTAL TIME :47
MAXIMUM DEPTH 44'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 50' 50min
TANK PRESSURE START 1600
TANK PRESSURE RETURN 700
TOTAL AIR USED 900

TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK —

WORK ACCOMPLISHED AND REMARKS:
mostly jumbled timbers, loose on bottom

hard chine - notches every 1 foot

* railroad ties on shore - timbers in water too long to be ties

two vessels? not sure

barge wreck

longitudinal frames
- width .8' frame (sided) (9")

Ceiling plank
- 0.85ft wide
- .3ft thick

Chine:
.5' width notch
set in .3 ft
notches 1ft centers
sided: 1ft

* distance b/n frames
3ft edge to edge =
center to center 3ft 4inches

8 frames across
= 26ft

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Project NY Harbour
Location SS16
Vessel Venture 3

Dive # 37
Date 9/9/02

DIVE LOG

DIVER Duff
STANDBY DIVER Elliott
Dives in 12 Hr. Period 1
PURPOSE Identify wrecks at SS16

ENVIRONMENTAL CONDITIONS:
Current 3KT
Visibility <1ft
Temperature 71°
Bottom Type silt
Other

MODE AND EQUIPMENT: SSA

Tank type 2U6R

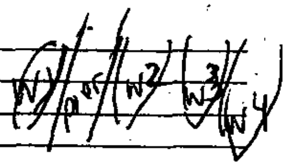
TENDER Rawls
LEAVE SURFACE 12:41
RISE SURFACE 1:29
TOTAL TIME :48
MAXIMUM DEPTH 44'

OTHER DIVERS DOWN: N/A

MAXIMUM PLANNED TIME AND DEPTH 40 ft / 30 min
TANK PRESSURE START 2500
TANK PRESSURE RETURN 1400
TOTAL AIR USED 1100

TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:



W1
3 ft blade propellor 5 blade iron
iron frame - thin iron
wood hull plank ~~[illegible]~~ very deteriorated 1.5 inch thick
~~[illegible]~~
prop shaft - no engine
interior bulkhead
≈65-70 ft long

W3
heavy wood timbers - wooden futtocks - double
ceiling 3-4" thick
hard chine ? don't know - looks like a rounded hull)
~~skin~~
- rider keelsons, keel
- prop shaft hole through 10 inch hole
- 6 ft of deadwood 2-3" hull planks
- bowtie shaped fastener

W4
wooden futtocks, hull planks, wood trunnel
double frames - not as substantial as W3
- massive stringers 6-8 inches square
- brass pipe - steam machinery?
not articulated
~~[illegible]~~
- deadwood - massive shaft log.
- 3-4 ft tall pt to shaft, 7-8 ft
- interior lined with bricks - deliberately laid "Shultz" bricks

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Project NM Arbor Drug
Location 5516
Vessel Venture 3

Dive # 38
Date 9/9/02

DIVE LOG

DIVER Elliott
STANDBY DIVER Rawls
Dives in 12 Hr. Period 1
PURPOSE Video 5516

ENVIRONMENTAL CONDITIONS:
Current 1 kt
Visibility 4ft
Temperature
Bottom Type
Other

MODE AND EQUIPMENT: SSA

Tank type 240 R

TENDER Cook
LEAVE SURFACE 1:58
RISE SURFACE 2:08
TOTAL TIME
MAXIMUM DEPTH 40'

OTHER DIVERS DOWN: N/A

MAXIMUM PLANNED TIME AND DEPTH 44 ft 50 min
TANK PRESSURE START 1400
TANK PRESSURE RETURN
TOTAL AIR USED

TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

dog off dive due to tide change

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Project NY Harbor
Location 554/553/A81
Vessel Kind 4 3

Dive # 40
Date 8/10/02

DIVE LOG

DIVER Rawls
Dives in 12 Hr. Period 1
STANDBY DIVER ~~[illegible]~~ Cook
PURPOSE Identify 553/4/A81

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility 0
Temperature 70°
Bottom Type Sand/Silt
Other

MODE AND EQUIPMENT:
SSA

Tank type 240k

TENDER Elliott
LEAVE SURFACE 11:29 (12:19)
RISE SURFACE 12:15
TOTAL TIME :46
MAXIMUM DEPTH 36'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 70' /50 min
TANK PRESSURE START 1000/2500
TANK PRESSURE RETURN 500/1500
TOTAL AIR USED 1500

TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK —

WORK ACCOMPLISHED AND REMARKS:

wire rope (lots) all over "wreck"
big chunks of iron
iron plate ~~[illegible]~~ "thick 3/4" no rivets
buried in the bottom, large amount under surface - disarticulated heavily
heavily concreted
8 inch wide iron "belt" appox 20 ft long
wood timber w/ fastener hole

round iron object
4½ ft diameter
2 ports on bottom & top
Could be boiler

weird iron sections & pipe things

Coordinates of this section of wreck
N 601082
E 657315

wreck dimensions
58 ft L to 38 ft top
~~38 ft bottom~~

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Project NY Harbor
Location Anomaly 61
Vessel Venture 3

Dive # 41
Date 9/12/02

DIVE LOG

DIVER Duff
Dives in 12 Hr. Period 1

STANDBY DIVER Elliott
PURPOSE identify source of Anomaly 61

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility Ø
Temperature 70°
Bottom Type
Other

MODE AND EQUIPMENT:
SSA

Tank type 240k

TENDER Cook
LEAVE SURFACE 10:03
RISE SURFACE 11:12
TOTAL TIME 1:09
MAXIMUM DEPTH 30'

OTHER DIVERS DOWN:
N/A

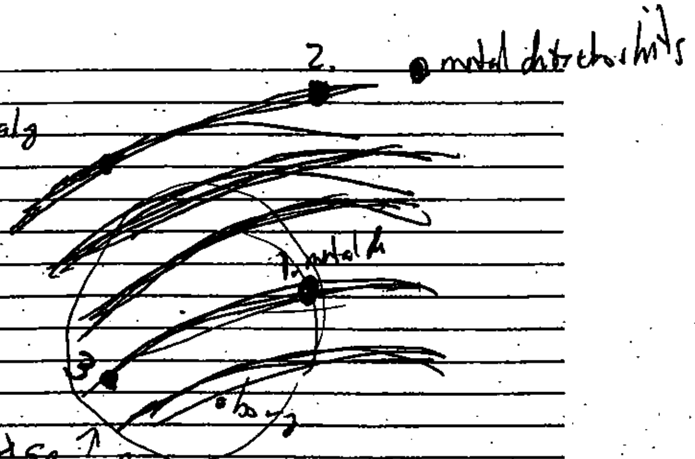
MAXIMUM PLANNED TIME AND DEPTH 25'/90 min
TANK PRESSURE START 1300/2500
TANK PRESSURE RETURN 500/1800
TOTAL AIR USED 1500

TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK AOK

WORK ACCOMPLISHED AND REMARKS:
sent divers

1. small hit at 1 (1 sq ft) - probably not anomaly
2. slightly larger hit ~2 x 3' area
 - 10" piece of 3/4 square tubing
 might be responsible for anomaly if sensor
 passed directly next to it?

3 location of rope. Rope attached to something
 solid under silt - wire bucket handle?
 Large reading on metal detector where rope
 enters bottom 3-4 ft square
 - other end of rope also has something on it
 sticks down probe to delineate site
 rope tangling diver
 - probes all the way to bottle
 anomaly is likely an anchor or mooring
 that was lost



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Project NY Harbor Diving
Location SSa
Vessel Venture 3

Dive # 42
Date 9/13/02

DIVE LOG

DIVER Elliott
Dives in 12 Hr. Period 1

STANDBY DIVER Cook
PURPOSE identify two wrecks at SSa

ENVIRONMENTAL CONDITIONS:
Current >1kt
Visibility
Temperature 70°
Bottom Type
Other

MODE AND EQUIPMENT:
SSA

Tank type 240K

TENDER Rowls
LEAVE SURFACE 9:39
RISE SURFACE 9:53
TOTAL TIME :14
MAXIMUM DEPTH 29

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 25'
TANK PRESSURE START 2400
TANK PRESSURE RETURN 2000
TOTAL AIR USED 400

TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

Abort dive - current too strong.

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Project NY Harbor Dvg
Location 55a
Vessel Venture 3

Dive # 43
Date 9/13/02

DIVE LOG

DIVER Cook
Dives in 12 Hr. Period 1

STANDBY DIVER Rawls
PURPOSE identify two wrecks at 55a

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility 0
Temperature 70°
Bottom Type rock
Other

MODE AND EQUIPMENT:
SSA

Tank type 2400K

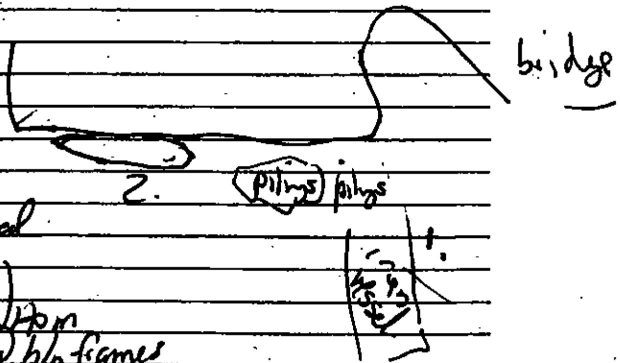
TENDER Rawls
LEAVE SURFACE 12:16 1:06
RISE SURFACE 12:58
TOTAL TIME :42
MAXIMUM DEPTH 47

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 70/50
TANK PRESSURE START 2000
TANK PRESSURE RETURN 1000
TOTAL AIR USED 1000

TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK —

WORK ACCOMPLISHED AND REMARKS:



Run wreckage at 1
- single iron
- boat like
- iron hulled
- on side or upside down.
- 30 ft + length
- welded seams
- barge-like
  - flat rectangl sides
  - scow end.
- 60-80 ft long
- filled w/stone
- modern welded steel barge.
- bollard

2. 60-70 ft long
- iron hulled
- heavily deteriorated
- iron frames
- iron plate (hull)
- 8-10 ft above bottom
- Collapsed riveted h/n frames
- riveted
  - every 6 inches on angle iron frame
-
- possible tug
- 2 ft frame spacing - 4" athwartships, 2" side/side
- possible machinery in hull
- no shaft or stern section
- round piece of machinery - winch drum.

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Project NY Harbor Diving
Location 556
Vessel Venture 3

Dive # 44
Date 9/13/02

DIVE LOG

DIVER Rants
Dives in 12 Hr. Period 1

STANDBY DIVER Orff
PURPOSE assess vessel at 556

ENVIRONMENTAL CONDITIONS:
Current 2 Kt
Visibility
Temperature 70°
Bottom Type silty, sandy
Other

MODE AND EQUIPMENT:
SSA

Tank type 240K

TENDER Elliott
LEAVE SURFACE 3:05
RISE SURFACE 3:40
TOTAL TIME :35
MAXIMUM DEPTH 41'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 40'/60 min
TANK PRESSURE START 1900
TANK PRESSURE RETURN 1200
TOTAL AIR USED 700

TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:
15' in work area
end of Schooner is fairly intact
Iron wreck [illegible] (FMT)
heavily concreted
riveted
- appears to be heavily deteriorated
- angle iron frames
- frames crumbled on touch.
- stern is heavily disarticulated

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Project NY Harbor Diving
Location Chesterfield? East Wreck
Vessel Venture 3

Dive # 45
Date 1 ? [illegible]

DIVE LOG

DIVER Duff
Dives in 12 Hr. Period 1

STANDBY DIVER Elliott
PURPOSE Identify wreck

ENVIRONMENTAL CONDITIONS:
Current > 1 kt
Visibility
Temperature 70°
Bottom Type Silt
Other

MODE AND EQUIPMENT:
SSA
Tank type 240K

TENDER Cook
LEAVE SURFACE 9:10
RISE SURFACE 9:34
TOTAL TIME :24
MAXIMUM DEPTH 15'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH
TANK PRESSURE START 1000
TANK PRESSURE RETURN 700
TOTAL AIR USED 300

TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:

Sweep back + forth. No wreck apparent above bottom

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Project NY Harbor diving
Location Cluster 4 west wreck
Vessel Venture 3

Dive # 46
Date 9/17/02

DIVE LOG

DIVER Elliott
Dives in 12 Hr. Period 1

STANDBY DIVER Cook
PURPOSE identify wreckage

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility 3 ft → 0
Temperature 70°
Bottom Type silt
Other

MODE AND EQUIPMENT:
SSA

Tank type 2 L/6 K

TENDER Rawls
LEAVE SURFACE 10:26
RISE SURFACE 10:46
TOTAL TIME :20
MAXIMUM DEPTH 17'

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 15'/90 min
TANK PRESSURE START 2500
TANK PRESSURE RETURN 2000
TOTAL AIR USED 500

TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK ——

WORK ACCOMPLISHED AND REMARKS:
frames – 2 ft centers
– lincoln log type construction on towers on sides
– planks on other side of frames
– 4" planks
– floors 2 ft centers
2 sets of frames a la drydock
vessel is a floating drydock
recommended for Phase III

1

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Project NM Harbor Dredging
Location 55/6
Vessel Venture 3

Dive # 47 40
Date 9/17/02

DIVE LOG

DIVER Cook
STANDBY DIVER Rawls
Dives in 12 Hr. Period 1
PURPOSE identify wreck at 55/6

ENVIRONMENTAL CONDITIONS:
Current Hi
Visibility
Temperature 70°
Bottom Type
Other
N/A

MODE AND EQUIPMENT:
SSA
Tank type 240K

TENDER Duff
LEAVE SURFACE ~~11:40~~ 12:40
RISE SURFACE ~~12:08~~ 1:08
TOTAL TIME :38
MAXIMUM DEPTH 43

OTHER DIVERS DOWN:
N/A

MAXIMUM PLANNED TIME AND DEPTH 60' 60min
TANK PRESSURE START 2000
TANK PRESSURE RETURN 1500
TOTAL AIR USED 500

TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK

WORK ACCOMPLISHED AND REMARKS:
- nothing up top of slope but pilings and a single [illegible] timber
- checking down in channel to see if it slid in after dredging

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Project Mt Harbor
Location SS17 Shooters Island
Vessel Venture 3

Dive # 48
Date 9/17/02

DIVE LOG

DIVER Rawls
STANDBY DIVER Duff
Dives in 12 Hr. Period 1
PURPOSE identify wreck

ENVIRONMENTAL CONDITIONS:
Current >1 kt
Visibility 0
Temperature 70°
Bottom Type silt
Other

MODE AND EQUIPMENT: SSA
Tank type 240K

TENDER Cook
LEAVE SURFACE 10:06
RISE SURFACE 10:55
TOTAL TIME 49
MAXIMUM DEPTH 24'

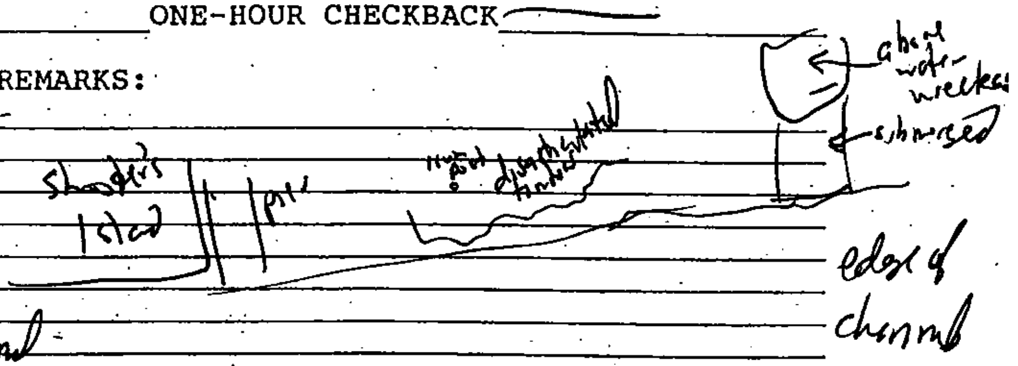
OTHER DIVERS DOWN: N/A

MAXIMUM PLANNED TIME AND DEPTH 60' 60min
TANK PRESSURE START 1000/2500
TANK PRESSURE RETURN 600/2100
TOTAL AIR USED 800

TIMEKEEPER Lydecker
ONE-HOUR CHECKBACK —

WORK ACCOMPLISHED AND REMARKS:

saved dive to fix comm -



wreckage up to edge of channel

observ:

bed of barge at 24'

timber dimensions
- 1'x1' longitudinal
- bottom planks .2' x .6'

2.4' b/n longitudinal timbers
longitudinal bulkhead

stanchions ~ .11' x .11'
definitely part of scow that can be seen above water

APPENDIX D: FIELD RECORDS

NY Harbor Diving

remote sensing notes

A101

pos time +1 sec

	time	heading	depth	line	comments
SOL	95541	W	40	50S	2nd anomaly btw pier & pipeline
EOL	95744		28		
SOL	10:00:28		40	∅	anomaly at pier to west of pipeline
EOL	10:02:20		40		
SOL	~~10:05:27~~	? got fix slip chart	40	50N	
EOL	10:05:50				

	E	N
A50	588844	662168
A51	588710	662020
A54	588762	662151
A53	588931	662335
~~A59~~		
A52	589250	662729

mag time + 1:06 1 hr 6 min

A52

	time	heading	depth
SOL	13:42:29	N	19
EOL	13:44:11		
SOL			
EOL			

Dogged off bad mag pointer

position on

Line		time	heading	depth	notes
1	SOL	61019	S	32	
	EOL	61148			
2	SOL	61355	N	39	
	EOL	61501		32	
3	SOL	61613	S	45	
	EOL	61728			

Anomaly probably nav bug. Although had big anomaly SOL on line 3. Also small anomaly on line 1

A 50

		time	heading	Depth	comments
E 1	SOL	Ø63948	N	48	20g anomaly
	EOL	64107		35	
C 2	SOL	64234	S	48	channel side
	EOL	64357		48	
W 3	SOL	64623	N	23	pointers messing up
	EOL	64752		48	
W 3	SOL	64934	S	25	return South
	EOL	65115		19	anomaly 200+ gamma anomaly ~~neighbor~~, even with bouy

A51

		time	heading	depth	Comments
1 W	SOL	70206	S	38	inshore line
	EOL	70340		12	hard bottom towards end [illegible] sensor bouncing?
2 C	SOL	70828	S	38	slight anomaly
	EOL	70957		22	bow to bow
					90g anomaly at 825
3 E	SOL	71355	S	~~48~~ 38	flat at 625
	EOL	71533		38	

next anomalies N E

A27 663270 590740

A63 663650 589695

~~A59~~ ~~663~~

A62 663219 589479

Resurrection Bay Pipeline?

6

A27

			time	heading	depth	pos time On comments
1	C	SOL	74607	S	18	a number from wreck on chart to buoy
		EOL	74845		44	
2	E	SOL	75319	S	14	Sig swim
		EOL	75552		40	extending to buoy
3	W	SOL	80036	S	23	a num, same
		EOL	80315		43	as 1, 2

26 39/4/01

~~ADS~~ time On

A63

		time	heading	depth	notes
1 C	SOL	82321	S	35	Gnomdy slightly south of buoy ~~(8sec)~~ (14sec south)
	EOL	82450			
2 W	SOL	82815	S	37	Gnomdy S of buoy
	EOL	82945		10	
3 E	SOL	83332	S	41	
	EOL	83502		40	

~~A~~63/A59

		time	~~heading~~	depth	notes
1 ~~W~~ C	SOL	84012	S	37	
	~~A~~EOL	84259		28	at 28 sec S south of buoy
2 W	SOL	84859	S	35	A63 buoy probably A62 check A62 strange 14sec S
	EOL	85151		8	
3 E	SOL	85706	S	42	
	EOL	85956		36	

A62

			time	hdg	depth	Comments
1	C -50	SOL	91814	S	20	Source is
		EOL	91949		25	24 sec South
2	W 0	SOL	92722	S	13	24 sec south
		EOL	92923		7	
3	E 50	SOL	93337	S	35	24 sec South
		EOL	93512		38	
4	E +100	SOL	94019	S	49	24 sec South
		EOL	94152		48	
5	+150	SOL	94628	S	48	
		EOL	94729		48	

-27
-30
-51
-52
59
63
62

A33

		time	heading	depth	comments
1 C	SOL	101425	S	21	Small anomaly on this heading
	EOL	101547		21	
2 W	SOL	101947	S	18	
	EOL	102102		19	
3 E	SOL	102440	S	40	
	EOL	102552			

HHHHHH

Lot # for 1st 6 bottles

K91722030I

310SCF

Lynn Rakos

212-264-[illegible] 0229

Coast Guard needs to know what we're doing

call on hardline or radio

Siu

P.T. Siu

fax all to him

212 264 7147 fax

0171 phone

Pun Tung Siu

→ hazard analysis

→ dive safety plan

→ up to date CPR 1st aid physicals, C1 r cert.

→

Tim Lafontaine - Mister Tug Siem

-212-

201-333-1170

A63

pos time – 43 sec

	time	line	heading	depth
SOL	6:43:09	Ø	N	39
EOL	6 45 01			37
SOL	6 52 38	-50W	N	11
EOL	6 54 30			
SOL	65857	50E	N	45
EOL	70051			38

A15 A12 sametime

+5 sec
pos time ~~30~~

	time	heading	depth	line	comments
SOL	6:40:10	N	10	Ø	
EOL	6:42:29		11		
SOL	6:44:30	S	11	Ø rerun	300+ anom. just S of buoy at A15
EOL	6:46:41	S	10		
SOL	6:48:45	N	10	50E	
EOL	6 50 54		10		
SOL	6:52:00	S	10	50W	
EOL	6 53 47		10		

Paul's settings

upper		lower	
1	off	1	off
2	off	2	on
3	on	3	off
4	off	4	off
5	off	5	off
6	off	6	off
7	off	7	on
8	off	8	on

A52 refine

post tm +2

	time	Line	depth	heading	comments
SOL	83510	Ø (actually 20 W)	31	N	buoy to stern
EOL	83709	(a little to the west)	22		50 ft n of buoy roughly 70 ft when take extra line into account
SOL	8:38:48	Ø 50 E	35	S	
EOL	8:38:00				
SOL	84154	50 E	46	N	
EOL	84337		46		

A52bm

A52bpb

A54 pos tm +4 sec

	time	heading	depth	line	comments
SOL	90643	N	27	Ø	big anomaly at b25 or slightly S
EOL	90825				
SOL	90958	S	25	50 ~~W~~ E	anomaly at B25
EOL	91111				
SOL	91323	N	45	100 E	nothing but static bump
EOL	91444				

A8 & A9 110 ft lay back DOS time + 2sec

	time	heading	depth	Line	comments
SOL	92233	N	11	Ø	
EOL	72519		16		
SOL	72719	S	13	50E	
EOL	73009				
SOL	73143	N	17	50W	turn made at A9 on 50 line
EOL	73440		33		

A55

line		time	[illegible]	depth	Comments
	S-L	93337	N	14	stuff at [illegible]
50W	EOL	93503		15	
Ø	SOL	93737	S	23	[illegible] 525 (5)
	EOL	93851		33	approx 30 ft 378 [illegible]
50E	SOL	94036	N	42	nothing
	EOL	94150		45	

A57 postime on

	time	hed	depth	comments
Ø SOL	73995	N	28	100 gm/ft sec S of buoy
EOL	74017		6	
SE SOL	74233	S	25	nothing
EOL	74437		45	
OW ~~SOL~~	74636	N	11	100+ gm 14 sec S of buoy
EOL	74748		7	

5 mph

5280 × 5 = 26405 ft/hr

26405 / 60 = 440 ft/min

440 / 60 = 8 ft/sec

14 × 8 = 112

A43

	time	heading	depth	line	comments
SOL	10:23:40	E	38	Ø	
EOL	10:25:01		16		
SOL	10:27:07	W	25	50S	
EOL	10:28:45		40		
SOL	10:30:53	E	40	100S	
EOL	10:32:13		40		

A4b refinement

	time	heading	depth	comments	pos from +1 sec line
SOL	62940	E	30		~~0~~ -50N
EOL	63110		12'		
SOL	63346	W	32'		Ø
EOL	63502		35'		
SOL	63650	E	35'		50S
EOL	63815		35'		
SOL	64039	W	35'		100S
EOL	64145		38'		
SOL	64517	E	39'		150S
EOL	64633		39'		
SOL					
EOL					

A73

pos +1 sec

	time	heading	line	depth	comments
SOL	11:30:17	E	Ø	48'	in the channel
EOL	11:32:16			35'	[illegible]
SOL	11:33:56	W	50S	44'	~~[illegible]~~ 800 at [illegible]
EOL	11:35:04			48'	
SOL	11:38:35	E	100S	48'	800 at [illegible]
EOL	11:40:41			51	
SOL	11:42:41	W	150S	53'	
EOL	11:43:37			53'	
SOL	11:45:09	E	50N	48'	
EOL	11:47:06			35'	

Reds

	time	heading	line	depth
SOL	11:51:27	E	Ø	49'
EOL	11:53:15			43'
SOL	11:54:49	W	50S	51'
EOL	11:55:53			48'
SOL	11:57:36	E	100S	49'
EOL	11:59:04			53'
SOL	12:00:09	W	50N	39'
EOL	12:01:35			

A85

pos time +1 sec

	time	heading	depth	line	
SOL	10:17:46	N	44	Ø	anomaly at buoy
EOL	102015		42		
SOL	10 26 37	S	43	50W	
EOL	102241		44		
SOL	102450	N	43	50E ~~100W~~	
EOL	10 27 10		41		
SOL	10:28:59	S	43	100W	big anomaly at B2S
EOL	10:30:09		46		
SOL	10:31:48	N	43	100E	
EOL	10 34 05		38		
SOL	10 41 45	S	49	150W	
EOL	104256				

A86

	time	heading	depth	line	comments
SOL	11:02:48	S	40'	Ø	anomaly @ bay
EOL	11:03:59		43'		
SOL	11:05 47	N	34'	50E	neg at buoys
EOL	11 07 33				
SOL	11 09 30	S	33'	100E	
EOL	11:10:49		43		
SOL	11:13:04	N	34	150E	
EOL	11:14:01				
SOL	11 17 50	S	44'	50W	
EOL	11:19:03		38		
SOL	11 25 48	N	47'	100W	
EOL	11 27 18		45'		

A110

time		hole	depth	filter	comments
SOL	11:55:20	N	67	∅	at bouy
EOL	11:56:39		60'		
SOL	11:58:15	S	61'	50E	snow at bouy
EOL	11:59:33		66'		
SOL	12:01:23	N	64'	100E	snow at bouy
EOL	120248		61'		
SOL	12:04:28	S	63'	30W	snow at bouy
EOL	1205:45		67'		
SOL	120748	N	68'	100W	
EOL	120909		62'		

pos tm ON

A64

	time	heading	depth	line	comments
SOL	61703	E	25'	Ø	lots o' anomalies
EOL	61828		49'		
SOL	61957	W	48'	50S	
EOL	62121		25'		
SOL	6 23 39	E	50'	50N	
EOL	6 25 11		40'		

A81

pos time On

	time	heading	line	depth	comments
SOL	71522	E	~~Ø~~ 50S	52	600 ft SE
EOL	71853			53	over wreck symbol on chart
SOL	702027	W	Ø	53	large anomaly same
EOL	72315			56	place
SOL	72721	E	50N	58	600 ft SE
EOL	73043	E		57	

New wreck location A81 REFIN

pos time ON

	time	heading	line	depth	comments
SOL	74635	S	Ø	60	Logging off
EOL	74819			49	
SOL	75103	N	Ø	49	at buoy
EOL	75341			63'	
SOL	75503	S	100E	64	at buoy
EOL	75711			47'	
SOL	75853	N	200E	48'	at buoy a little after
EOL	80126			64	buoy.
SOL	80307	S	100W	64'	at buoy
EOL	80519			48'	a little smaller
SOL	81213	W	Ø	54'	[illegible]
EOL	81411			63	at buoy

N 601049 new numbers
E 657176 . A81 refined

	time	heading	line	depth	comments
SOL	81543	E		57'	
EOL	81827		100N	57'	
SOL	81946	W	100S	52'	
EOL	82200			51'	
SOL					
EOL					

A61 refinement

		time	heading	depth	speed	Comments
Ø	SOL	82021	S	28'	2.8	anomaly at B25
	EOL	82153		50'		
50W	SOL	82350	N	38'	4.3	anomaly at B25
	EOL	82525		11'		
100E	SOL	82706	S	40'	3.6	anomaly just B4 B25
	EOL	82836				

A49 refinement

		time	heading	depth	speed	comments
50E	SOL	83939	N	55'	4.5	nothing
	EOL	84053		51'		
Ø	SOL	84239	S	20'	3.9	nothing significant
	EOL	84416		54'		
50W	SOL	84512	N	42'	4.8	big anomaly, source is likely outside survey area too shallow to determine exact location - likely is located in shallows to west
	EOL	84623		13'		

KVK 10 — pos tim on

	time (pos)	heading	depth	speed
Ø SOL	61627	W	53'	
EOL	61836		45'	
-50 SOL	62145	E	30'	
EOL	62436		38'	
-100 SOL / EOL	dogged too close to shore			

KVK 11

	time	heading	depth	
Ø SOL	63049	W	50'	3.0 kt
EOL	63235			
50 SOL	63513	E	36'	
EOL	63825		29'	
100 SOL / EOL	dogged too close to shore			

KVK12

		time	head	depth	speed	comments
ϕ	SOL	64245	W	53'	5.3	big anomaly off old ferry.
	EOL	65037		48'		
-50	SOL	65430	E	18'	3.8	
	EOL	70330		28'		
-100	SOL	70503	W	19'	5.1	
	EOL	71348		15'		

KVK13

		time	head	depth	speed	comments
ϕ	SOL	72214	W	53	3.5	no logging
	EOL	72435		24'		
50	SOL	72607	E	23'	4.8	
	EOL	72747		25		
100	SOL	73044	W	14'	3.1	huge anomaly off dereldson shore (40, wugan
	EOL	73339		22'		
~~ϕ~~ -50	SOL	73507	E	22'	4.8	
	EOL	73649		23'		
~~500~~ ϕ	SOL	73910	W	39'	2.8	
	EOL	74129		39'		

KVKIL

	time	winds	speed	depth	comments
~~Ø~~ Sol	74421	W	3.3	29'	
-50 tow	74937				
~~50~~ Sol	75233	E	4.4	9	mostly in South of Shooters Is. channel
~~Ø~~ tow	75534			21'	
-100					
~~70~~ Sol	75643	W	3.3	38'	
Ø end	80144				

SS Analysis for sum of Areas KVK10 - KVK14

SSA

211 ft 65 m ~~W~~ of 1700 ft mark of KVK12 1911 ft mark E of EOL

30 m S of ∅ line 98 ft

30 m S of Bayonne Bridge on [illegible] side of KVK
E

.3048

11SEP018.MST coords: N 658665
E 591722

1700 - 211 ft
= 1489

SSB

11SEP025.MST

82 ft E of 300 ft mark KVK13

382 ft E of EOL

50 ft S of ∅ line

- 0

.4224 ~~.582~~

1489 ~~1911~~

- 3500

3500 / ~~7441~~
1489

N 659021
658247
774

E 593304
589865
3439
× .54
~~1857~~ 1452

658247
327
658574

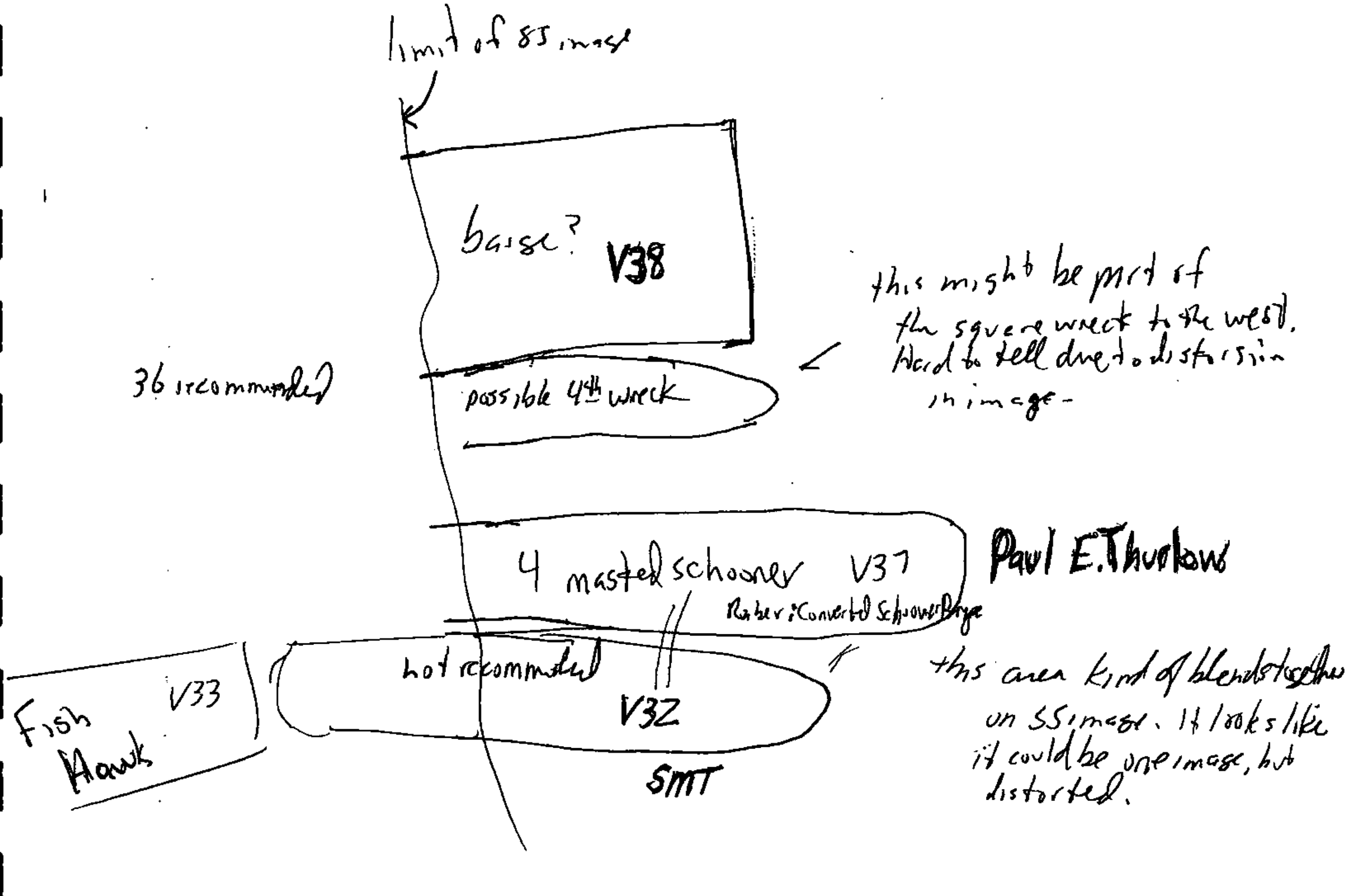
658247
~~659021~~
~~418~~
658665

589865
1857
591722

589865
1453
591318

Sidescan notes Cluster 4 (Fish Hawk Cluster)

V38 - not typed - unidentified
- possible dry dock?
- looks like it has floats on it in Arthur Kill report



V32 - not recommended
Steel Hull flush deck motor tanker (SMT)
- not significant
- 1960 (approx abandon date)

NY Harbor Diving

misc. notes

Targets remaining

- Cluster 4 wrecks (SSB) 2 days 4 dives
- Shooters Is. Wrecks 1 day 2 dives
- A61 1 dive
- ~~A49~~ not in project area
- SSA 1 dive
- ~~SSB~~
- SSB need to determine if its in project area.

A49 refined on 9/11/02. Anomaly not present at original location 400 + anomaly on 50W. This is edge of magnetic field and source likely is located to the west and is outside project area.
- could not refine further west as water too shallow

A61 Refined location N 662962 E 589375 820 gamma

7

Masterlist of targets

A62 - pipeline
A27 - pipeline

50 ft layback + 15 ft

65 ft layback
6 ft/sec

9½ sec layback

letter new address request removal of hold - medallion sign. guarantee

Munder
810 438 5789
1921835078

901-748-5800 Treadwell & Harry
call VP Bank
to —

Haywood

Tuesday Aug 6th 6:30
4508 Rt 32 9[illegible] 23
[illegible] 3[illegible]
[illegible]

Haywood [illegible]

Nanny Kim phone #
732-610-1100 C
732 291-8983 H

Vessel Traffic System
no longer in service → 212-668-7429 or
→ -7382

13,[illegible] 73

Port Control (Coast Guard)
718-556-4407

718 354 4088

A52

- anomaly probably nav. bouy
- big anomaly at 50L on line 3
- small anomaly on line 1

~~A50~~

~~200+ anomaly even w/ bouy~~

A5N

A51

- centerline (0) 90 gamma anomaly at B25

A33

-Small anomaly on Center line:

no disc?

General Notes

NY Harbor diving

Huntingdon Roofing
374-0700

H

T

136.50

Sent

Steve Fillmer
7944 St Hwy 149
West Frankfort
IL 62896

to do 8/7
- call welco
- find UPS office
-

1950.00

~~Refined Coordinates~~

Dive targets for 8/2/02

Location
Primary: A27/5527 Newark Bay Channel
Secondary: A51 "

welco welcocai

UPS locations 8007425877 - 877-935-2624
x 216
Counters 07093
601 W. 43rd St - NY
493 County Ave Secaucus 8-6
Bergen ~~1319 madison, NY~~
60 ~~&~~ Staples 347 River Rd Edgewater
201 945 0755
~~Madison Park~~

Commercial Bank
201-272-7300

731-642 3341

Hasseto
8009224050

NY Harbour Diving

Daily Notes

7/31/02 WEDNESDAY

- both plates today since paul not at dock until ca. 11 AM
- today
  - find a place for trailer
  - call Dave Salton
  - fax materials if possible

Equipment briefing
- Start time 8:00 AM
- End time - not done until truck unloaded
- sidescan cable
- proper deployment of sidescan towfish
- mag console
- mag sensor cable - proper wrapping of connector
- dive ~~[illegible]~~ gear
  - proper treatment of cam
  - proper treatment of reg - not leave hands except to put on

A27

- buoy actually ca 200 ft South of wreck on chart. Big anomaly extends from wreck to buoy. Buoy at A27 probably pipeline (see photo/video)
- will dive wreck on chart, as anomaly appeared there
- across 3 lines

A27 & 62 are pipeline

14×6

14
6
84

21120

A63

anomaly 14 sec 84 ft S out buoy.

Remains

4kts 4 mph
5280 ft/hr

352
60 | 21120
312
120

352 ft/min.

5.9 ft/sec
60 | 352
52

A62

- source is 24 sec 152 ft South of buoy
- probably a pipeline

3
24
6
152

8/2/02

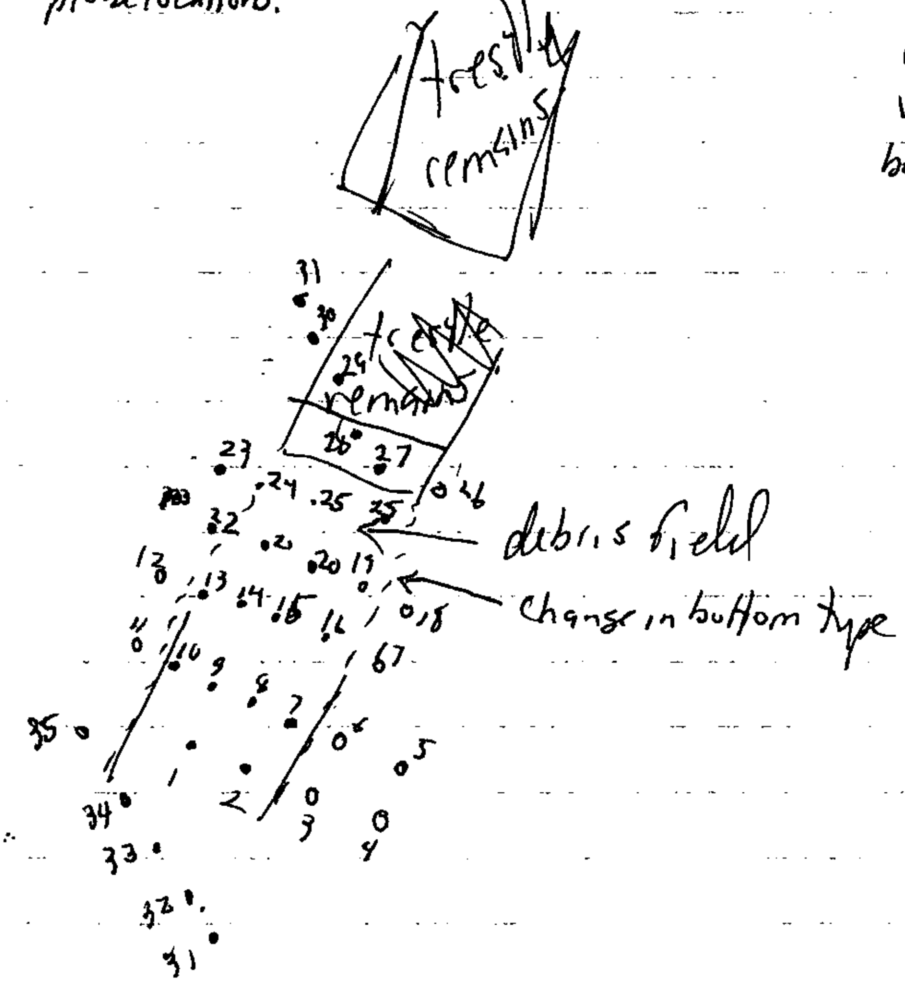
8:20 leave dock

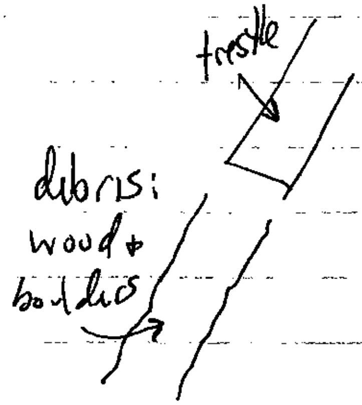
9:25 Arrive at site

Dive on A27, which is actually pipeline & wreck. We will dive the wreck as marked. Anomaly was over marked site

Dive #1 A27

probe locations.





See dive log for detail on each probe

8/5/02

A15

need to get!
= slates
= mylar

dogged off A13/72, A15, A8 & A9 as too shallow. Went on to A50

Pit meeting at 1PM

~~A50~~
found a field of concrete blocks (large). Size corresponds to anomaly.

2 pm dogged off dive due to bad nav monitor. Will pick up a new one at Target this evening.

8/8/02

7:00 leave ranch
7:30 arrive boat
7:45 GPS shit bed, return for back up
8:30 GPS working
8:35 leave dock
9:35 arrive dive site (A51)
Diver in water by 11:00 AM
Dived A51, found small amounts of debris. Anomaly located on [illegible] slope on side of channel in already dredged area.

12:30 heading over to A33

12:57 on station Diver setting up

~~1[illegible]~~

8/7

9 AM leave dock
9:15 arrive at site
9:30 begin mag
10:30 diver in
11:15 diver out, move to new area

A63 - Jim in, found lots of debris - rr ties, rebar, boulders, blocks, rocks, angle iron. Site is in line w/ an old rr trestle.

A33 - hydroprobe

today
- mail mag
- call for more air
-

8/8/02

4:00 Am leave dock

6:05 Am arrive at site

10:00 finish refinement

- 350 gamma on ø line at A15
- nothing at A12
- will dive A15, A12 will be blown off

11:00 Diver up, moving to next target (A52)

No more diving today - will refine mag for rest of day.

Mag A52 anomaly slightly South and west of buoy

Mag A53 - too shallow need to come back at high tide

Mag A55 - a whole mess of stuff just S of buoy area

8/9/02

~~8:17~~ 7:00 leave apt
8:15 leave dock
8:30 stop at fuel dock
10:00 arrive at site
10:44 finish mag refine
A8 - 200 gamma on line Ø at buoy
A2 - 70 gamma on Ø; 700 gamma on W50 at buoy.

8/12/02
8:00 leave Apt
8:45 arrive marina
9:00 set up gear
10:00 go dog of day – bad throttle cable

8/13/02
7:00 leave apt
7:45 arrive marina
8:00 leave dock
8:47 arrive at A8
9:00 ready to dive
9:20 diver in
10:10 diver up - found shipping cart - anomaly is modern debris
10:40 on station at Anomaly 52
11:00 Diver In
12:00 diver out Anomaly is modern debris
12:15 anchors pulled
12:30 move to next target (54)

8/15 Thurs.
7:00 leave apt
~~8~~7:45 arrive dock
8:00 leave dock
8:45 arrive at dive site
9:15 determined 5524 is old piling - is above water at low tide
~~8~~9:30 ~~onto A46~~ need to come back at high tide to mag

9:35 move to A46
~~8~~10:00 finish ~~magging~~ A46 - probably a pipeline but there appears to be other stuff going on in a complex anomaly. Too dangerous with current tide, ~~[illegible]~~ wind, and passing boats to dive - will come back during favorable conditions.
10:00 heading off to Anomaly 39 to mag and dive if possible

10:15 heading to A39
Lorco Petroleum Services
Federal Terminal, Elizabeth, NJ.

10:30 not going to dive A39 - need to consult w/Steve
call traffic control; also ~~need~~ probably need permission from Petrol Co.
Skipping to A55
11:00 on site at A55 - diver getting ready to go in
12:00 diver out - site consists of various timbers, planks, pilings & angle iron
all are disarticulated. Recovered piece of angle iron w/rivets. Site is likely remains of new hull - need to check to see if there was one nearby.
12:30 moving to wrecks on chart - cannot anchor due to unfavorable conditions
must come back when tide is going out

~~A101~~ ~~com~~

12:40 onto A~~[illegible]~~101. Anomaly is likely a pipeline, but there are 3 wrecks nearby. Probably should come back at low tide to look.

1:00 magged A101 - large anomaly at pipeline, but also an anomaly at pier to west. Come back at low tide to check, also need to dive refined anomaly location

1:15 magged A43. Anomaly on [illegible] 2 lines. Not a pipeline, as it did not appear on 3rd line (100 s)

1:30 Cannot dive A43 due to contrary current and wind causing unsafe anchoring conditions.
Same with A101

A101 - come back at low tide - 9 AM Friday
Wrecks near A55 - come back on ebb tide
A39 - ask permission to talk to [illegible] re: sheet piling - do we need to even dive it?
A43 come back to mag at high tide

Daily Summary 8/15/02

SS 24 is old piling or pile of rock. Right in line with others and SS image looks identical. See photos taken w/film & video

A46 magged but not dived due to unfavorable current/wind condi[tions]
A39 not magged or dived. Need to consult w/ Steve.
A55 Dived, determined to be pilings, timbers, planks, angle iron. Disarticulated, Probably remains of nav tower?
Wrecks on chart - not dived due to unfavorable conditions
A101 - magged. Anomaly at pipeline but also at pilings to the west. Not dived due to unfavorable conditions
A43 magged - not dived due to unfavorable conditions

8/16/02 Friday

7:00 leave apt

7:45 arrive dock

8:00 leave dock

9:00 arrive site A101

9:30 anchored - need to put out 3 anchors to avoid swinging
into channel

10:00 anchors in, vessel holding well.

Monday 8/19/02
8:00 Am leave apt
8:35 arrive dock
9:00 begin mobe
11:18 on site divers ready

things to get

- Duct tape (4 rolls)
- ratchet straps
- new tool box (bigger)
- water
- more gloves
- crc
- soap
-

8/20/02 Tuesday
11 Am leave apt

1:07 mag A85
possibly pipeline, need to make map

2:00 mag A86 - probable pipeline - appeared across multiple lines and is near pipeline sign

2:45 mag A110 - probable pipeline - appeared across all six lines, and is ~~near~~ in lid line with other anomaly that is pipeline; Also ~~cross~~ ~~with~~ it is in middle of pipeline area on chart

3:30 Arrive at A99 & A110 300 feet apart, they are both right in front of the Staten Island Ferry terminal - Not mapped. Called Lynn to inform her of problem - perhaps she knows some method can help.

4:00 heading in - no more targets to map and all available dive targets have current problems.

Target/Anomaly List - Results of investigations

8/2 A27 - Combo of pipeline + remains of rr trestle. dived by J. Duff. Probed to seven feet.

2 8/2 SS27 - Coincides with A27

3 8/2 A62 - pipeline - in center of pipeline area, across 6 lines (can 6 lines on refine), directly across from pipeline component of A27

4 8/5 A50 - large pile of broken concrete

5 8/6 A51 - various pieces of debris, scattered hits on metal detector anomaly located on middle of slope on channel edge. anything there would be historic

6 8/6 A33 - Wood return. 3 ft down. Need to return.
- probed out on 8/7 - hard return is clay lens 3 ft down. Any wreck would be above this layer and be visible above bottom

7 8/7 A63 - remains of railroad trestle + rebar, rails, [illegible]

8 8/8 A12 - not relocated on refinement

9 8/8 A15 - relocated on one line only. Nothing found with metal detector sweeps or probing. Most likely isolated debris or wire rope.

10 8/9 A9 large 7x15' block of reinforced concrete - no video taken as no viz

11 8/13 A8 shopping cart - anomaly likely modern debris

12 8/13 A52 found bucket with iron top and rings. also wood return at probe location anomaly likely modern debris

201 886 9080 T

13 8/14 A54 - various debris, probed to 7ft. Clay layer at 0.2-5.5 around; likely modern debris as a historic wreck would not be below clay layer

~~14 8/15 A55~~ —
A53

15 8/15 A55 pilings, planks, angle iron, disarticulated junk. Over sweeps performed. Likely remains of dock, pier or navy tower

16 8/18 SS24 old piling or pier - in line with 4 or 5 similar structures visible at LOW tide.

17 8/16 A101 - two piers, remains of pilings, ~~trash~~, piled riprap with [illegible] pilings & timber

18 8/19 A73 pipeline - not dived

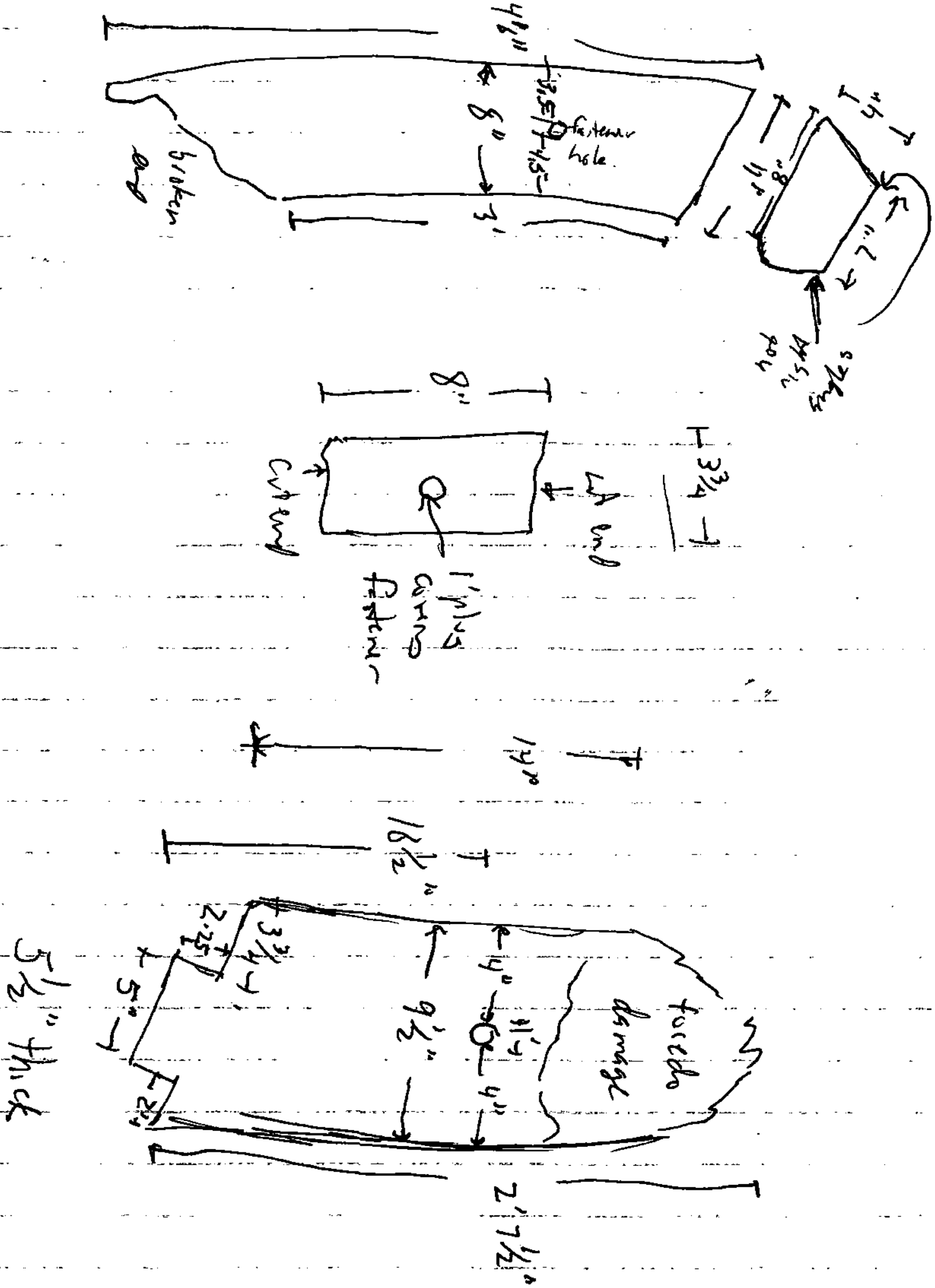
19 8/20 A85 probably pipeline - appeared across ~~[illegible]~~ all lines

20 8/20 A86 pipeline - appeared across multiple lines, is near pipeline S.S.A.

21 8/20 A100 pipeline - not dived

22 8/21 V36 & V37 ~~not anomalies~~ SS26 SS Target - barge or cargo vessel - hard chine, wood & iron composite

Timbers recovered from wrecks near A55



23 8/22 A43 - remains of pier - pilings, trash, disarticulated timbers.

24 8/22 A46 - pipeline - not dived.

8/23 A64 - engine block + misc. iron concretions

8/23 A99 off Staten Island ferry dock on Staten Is. not dived

8/23 A100 " " " "

8/26 T3 Just N of Harland Hook terminal - Remains of bulkhead seawall no further work

8/27 A-81 ????

8/28 SS/9 - remains appear consistent w/ wooden tug. Not recommended.

Extra targets

T1 wreck on chart (E wreck)

T2 wreck on chart next to T1 (W wreck)

T3

Targets/Anomalies left as of 8/20/02

~~A39 Wreck on Nav chart - by modern pilings - in channel~~

~~A43 magged - need to dive - need strong tide~~
~~A46 magged - need to dive - need strong tide~~
A49 mag + dive
~~A53 magged not dived may need to mag~~

A61 not magged or dived.
~~A64/SS26 Schooner image - need to dive + refine~~

A81 mag + dive
~~A85 mag + dive~~
~~A86 mag + dive~~
~~A99 mag + dive~~
~~A100 mag + dive~~
~~A110 mag + dive~~

SS3	refine + dive		3 parallel linear objects.
SS4	"	"	16 m linear
SS11	"	"	rectangular wreckage
SS13	"	"	diamond shaped wreckage
SS16	"	"	3 derelicts
~~SS26~~	~~"~~	~~"~~	~~boat shaped object Anomaly 64~~
SS28	"	"	turret looking object
~~SS29~~	~~"~~	~~"~~	~~uneven bottom poss. ble~~
~~SS49~~	~~"~~	~~"~~	~~Boat shaped object~~

8/21/02 Wed.

7:00 leave apt

7:30 arrive dock

7:45 leave dock

8:45 arrived primary site – not going to dive as Great Lakes is dredging in area – will be there for a week. [illegible] Saw chunks of wood floating – looks like they chopped into a site. Probably one we already looked at.

9:00 moving to A-65 SS-26 area. Numbers actually are East of two wrecks. We will dive the two wrecks today, and refine on a later date. We need to get this area done this week as they are going to blast soon.

9:30 on site and anchored. Greg Getting ready.

8/22/02 Thurs

7:00 leave apt
7:30 arrive marina
8:30 no air - leaving marina
9:30 arrival at Anomaly 43
10:00 anchored, call made to Coast Guard - need to call when done
10:15 diver in
11:00 diver out - anomaly is old pier - series of pilings flush and disarticulated timbers
11:15 moving to A46
11:30 anomaly is pipeline. There is no sign on north side of channel as pipeline turns East before reaching shore. Took photos of sign and Paul's chart showing location of pipeline area.
11:45 on to casually redeposit timbers on wreck site at confluence of NBC & AKC & KVK.

* Note: There is a wreck close to channel edge at West end of South of Shooters Island Channel, Need to look at Arthur Kill report to see if it was examined.

8/22/02

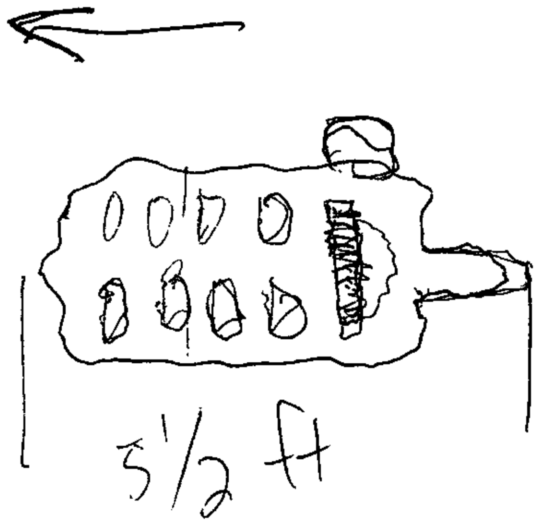
7:00 leave gob

7:45 leave dock

air bastards charged 25^00 for each bottle for air cert

9:00 arrive at AB4

9:10 buoy in - ready to mag.



Sketch of anomaly 64
by John Rawls
8/23/02

possible targets for 4/26/02

- ~~Obstruction on chart near A110~~
- A81 - wreck on chart
- ~~back to wreck E of Bayonne Bridge~~
- Anomalies + wrecks at NBC + AKC ~~49, 61~~ A49, A61, [illegible]
~~A95~~
~~A49~~
~~A39~~
* - ~~Wreckage off Howland Hook~~, ~~west of A107~~
~~-SS19 wreck visible at Low tide by dikes at Howland Hook.~~
- Shooters Island Wrecks A104, A102, A103, SS18, SS22, SS17
- SS 3
- SS 4
- SS11
- SS13
- SS16
- SS28
~~[illegible]~~
~~A49~~
~~A61~~
~~- wrecks by SS19 (2 or 3 more)~~

2625
875 875
3500

1200 1050

175 700
175
875 175
175

25 days
- 2 travel
- 1 mobe
- 1 weather
21 days

550
375

4/26/02 Monday

8:00 Am leave apt
8:45 Am arrive marina
10:00 leave marina
11:15 arrive site - need to wait for tide to change to anchor
12:20 dive in
1:20 dive out
2:00 heading back to marina - going to stop along the way to get some numbers

numbers

Barge at Howland Hook N 659864
E 579487

V37 N 659923
E 593062

8/27/02

7:00 Am leave apt
8:15 leave dock
10:00 arrive A81, drop buoy
10:15 mag A81

8/28/02

7:00 leave apt
7:45 arrive docks
8:00 leave dock
9:00 arrive site (55-19)
9:45 anchored / ready to dive
Traffic called
10:10 diver in
11:00 diver out
definitely shoot there, but also lots of [illegible] trash and [illegible]
need to come back for another dive and some video
~~12:00~~
- Dry suit has hole - need to drop off to fix
1200 anchors in, heading into dock

8/30/02

700 leave apt

745 arrive boat

8:15 leave dock

9:30 arrive at SS19

9:45 anchored

10:00 diver in

11:00 diver out

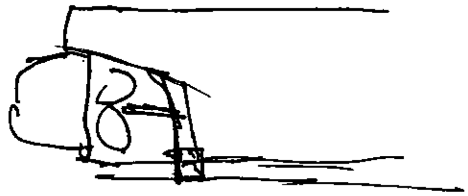
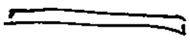
wreck consistent with tug. Well preserved below deck level. Bow is to shore. Stern heavily deteriorated - no keelson found. Basic measurements taken. Recommendation depends on what has been done regarding tug recordation.

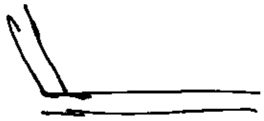
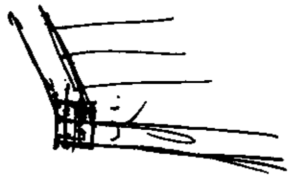
9/3/02
8:00 leave apt
8:45 arrive dock
9:45 leave dock
11:00 arrive site, anchored
11:30 diver in
12:00 diver out
12:10 pulling anchors
12:20 on to SS19
to dive middle wreck.
12:30 arrived at SS19
12:45 anchored
1:30 diver in
2:00 diver out - wind shifted
vessel is wooden tug, similar to
Rahr V-~~[illegible]~~/152 or 154
not much new info can be obtained.
I am concerned about the
iron at the bow - could be
composite iron-wooden hull.
2:15 anchors in, heading back
3:15 at dock
4:00 end day

To do
- reg
- fax timesheets
- mail timesheets
- get money.

T2 coords.
N 660801
E 587385

west wreck of 2 wrecks
on chart at 16 hours
AKC.

9/4/02

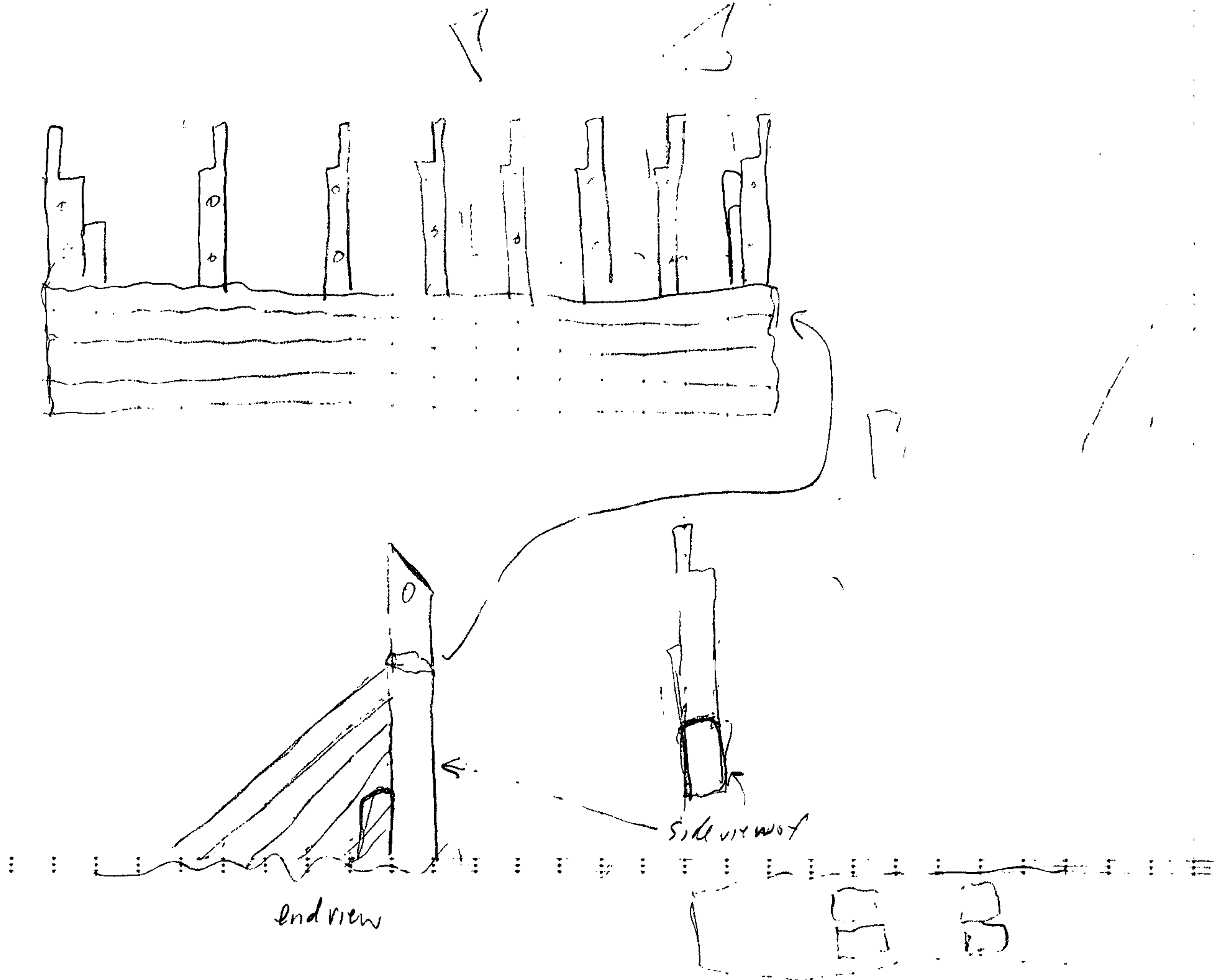
7:00 leave apt

7:45 arrive dock

8:00 leave dock

9:00 arrive SS19

9:30 anchored up


side view of
end view

9/5/02

7:00 leave got

7:45 arrive marina

8:15 leave marina

9:15 arrive 5528

10:30 Anchored at 5528

refined #5 for
5513

N 658967
E 596549

9/6/02

7:00 leave apt
7:45 arrive dock
8:00 leave dock
8:20 arrive coast guard dock
~~8:30~~ 9:15 arrive 5511
10:00 anchored up, ready to drop

9/9/02

8:00 leave apt
8:45 arrive dock + smoke
9:30 leave dock
10:30 arrive site
10:15 buoy drop, begin SS refine
10:45 done with refine
10:00 begin anchoring
10:45 anchored onsite
11:00

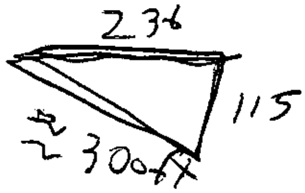
9/10/02

7:00 leave apt
7:30 arrive dock
7:45 leave dock
9:30 arrive SS3
- SS3 appears to be over refined coordinates for A81
  comparison of coords

	SS3	A81 refined	dif.
N	600934	601049	115
E	657412	657176	236

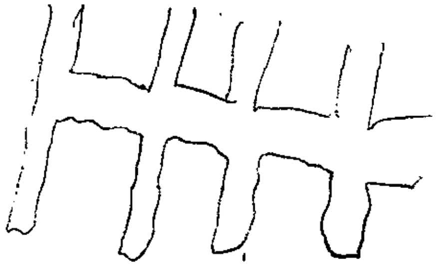
657412
−176
236

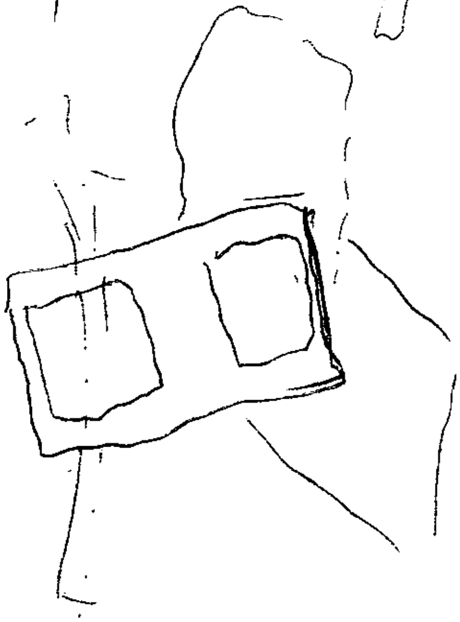
1000 Refine targets

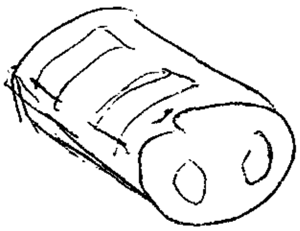


11:00 anchored, ready to dive

Sketches of A81/SS4 wreck
by J. [illegible]
9/10/02

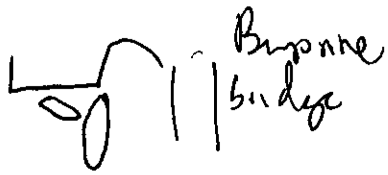






9/12/02

7:00 leave apt
7:45 arrive boat
8:00 leave dock
9:00 buoy dropped on AB1
9:15 anchored, preparing to dive
10:00 diver in
10:15 diver out
12:00 arrive at 55a (next target)
12:15 target refined
12:30 anchoring beginning
refinement indicates it is close to wreck on chart.



9/13/02

700 AM leave apt
7:45 arrive marina
800 leave marina
900 arrive SSa
930 anchored on site, diver getting ready
Coast Guard called

9/12/02

9:00 leave apt

9:45 arrive marina

10:15 leave marina

11:15 arrive site

11:45 anchored

-need to wait for tide/wind conditions

2:30 sick of waiting - reanchoring

3:00 diver going in

9/17/02

700 leave gpt

745 arrive marina

8:00 leave marina

9:00 arrive on site - anchored

(1) — 9:30 diver in

— 1000 diver out

10:30 anchored on SS/B drydock

— 1100 diver in

(2) — 1130 diver out

1200 anchored on SS/B

(3) — 1230 diver in

— 100 diver out

130 heading in

230 arrive gpt

9/17/02

* Observation:
corner of western most floating drydock west of showers
appears to be in project area.